RIJKSINSTITUUT VOOR VOLKSGEZONDHEID EN MILIEU
NATIONAL INSTITUTE OF PUBLIC HEALTH AND THE ENVIRONMENT

Report no. 722108027

Deposition of acidifying components and base cations in Germany in the period 1987-1995

A. Bleeker[*], G.P.J. Draaijers[**], J.M. Klap[***]
and J.A.van Jaarsveld

June 2000

[*] Present address: TNO-MEP, P.O.Box 342, 7300 AH Apeldoorn, the Netherlands
[**] TNO-MEP, P.O.Box 342, 7300 AH Apeldoorn, the Netherlands
[***] Alterra, P.O.Box 47, 6700 AA Wageningen, the Netherlands

This study has been carried out on behalf of and for the account of Umwelt Bundes Amt (UBA, Berlin) within the framework of Project No. 108 03 081 (RIVM Project No. 722115)

National Institute of Public Health and the Environment, P.O. Box 1, 3720 BA Bilthoven, The Netherlands, telephone: +31-30-2749111, telefax +31-30-2742971

Abstract

This report describes the results of the project: 'Deposition of acidifying components and base cations in Germany in the period 1987-1995'. The project was carried out by RIVM on behalf and for account of the national environmental agency ‘Umweltbundesamt’ (UBA) in Germany in co-operation with TNO and Alterra in the Netherlands. For Germany, the research carried out has yielded, as main product, estimates of dry deposition with a high spatial resolution. These, in combination with wet deposition data, will be used for calculating critical load exceedances. The basic model used in this study is EDACS, which calculates dry deposition fluxes on the basis of meteorological data and atmospheric concentrations of relevant species. Atmospheric concentrations were taken from results of the EMEP model (SO_2 and NO_x), the EUTREND model (NH_x) and wet deposition measurements (base cations). SO_x dry deposition fluxes were largest in eastern Germany; NO_y fluxes in central-west Germany and NH_x fluxes in north-west Germany. The highest dry deposition of potential acid (up to 20,000 eq ha^{-1} y^{-1} as average for the period 1987-1989) was calculated for eastern Germany and the highest dry deposition load of nitrogen (up to 3500 eq ha^{-1} y^{-1} as average for the period 1987-89) for North Rhine-Westphalia. Dry deposition of SO_x, NO_y, NH_x and potential acid in the period 1993-95 decreased by 49%, 13%, 21% and 42%, respectively, compared to the 1987-89 period. Dry deposition of non-sea-salt Ca^{2+}, K^+, Mg^{2+} and base cations decreased in the 1993-95 period by 42%, 24%, 65% and.43%, respectively. On average, the modelled dry deposition of NH_x, Mg^{2+}, Ca^{2+} and K^+ can be concluded as not significantly different from dry deposition derived from throughfall measurements, although a considerable scatter can be observed. The comparison reveals an overestimation of the dry deposition of SO_x, NO_y and Na by factors of 1.67, 1.58 and 1.75, respectively.

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Samenvatting

Dit rapport beschrijft de resultaten van het het project 'Depositie van verzurende componenten en basische kationen in Duitsland in de periode 1987-1995', dat door het RIVM, TNO en SC-DLO werd uitgevoerd in opdracht en ten laste van het Duitse 'Umweltbundesamt' (UBA).

Het hoofdproduct van het onderzoek zijn ruimtelijk gedetailleerde schattingen (5x5 km) van droge depositie in Duitsland van verzurende stoffen. In combinatie met uit metingen afgeleide ruimtelijke verdelingen van natte depositie kunnen hiermee overschrijdingen van kritische depositiewaarden worden bepaald. De droge depositiewaarden zijn berekend met het EDACS model welk uitgaat van gemodelleerde concentraties in buitenlucht (vnl. uit het EMEP model) en deze combineert met lokale, meteo- en landgebruikafhankelijke, droge depositiesnelheden. De beschreven studie is een uitbreiding van een project dat in 1996 werd uitgevoerd. De volgende aspecten werden verbeterd of nader onderzocht:

a. De verdeling van NH_3 concentraties in Duitsland werd berekend met het EUTREND model met een 5x5 km resolutie. Dit geeft gemiddeld 56% hogere concentraties dan het EMEP model (150x150 km resolutie) maar vergelijking met metingen laat zien dat er nog steeds 25 % onderschatting is. Dit komt overeen met de afwijking welke voor Nederland is gevonden.
b. Een aantal concepten om wolkendepositie te introduceren in het bestaande modelconcept zijn onderzocht. In bergachtig terrein kan deze bijdrage 20-30% van de zure depositie bedragen. De wolkenbasishoogte blijkt hier bij een belangrijke parameter te zijn, evenals de wolkenwaterconcentratie.
c. De schattingen van 'canopy exchange' voor 67 boslocaties in Duitsland werden gerelateerd aan lokaal gemeten grootheden om betere inzichten in de procesparameters te krijgen. De gevonden verbanden suggereren dat ionenuitwisseling tussen water op bladeren en de apoplast van bladeren een belangrijk mechanisme is voor basische kationen, terwijl de opname van stikstof door bladeren vooral wordt bepaald door concentratieverschillen in lucht en apoplast.

Hoge basische kationendepositie komt voor in het oosten van Duitsland. De hoogste droge depositie van potentieel zuur werd berekend voor oostelijk Duitsland (tot 20000 eq ha^{-1} y^{-1}) terwijl de hoogste droge depositie van stikstof werd berekend voor het gebied Nordrhein-Westfalen (tot 3500 eq ha^{-1} y^{-1}). Droge depositie van SO_x, NO_y, NH_x en potentieel zuur verminderde in de periode 1993-1995 vergeleken met de periode 1987-1989 met respectievelijk 49%, 13%, 21% en 42%. De vermindering in potentieel zuur was het grootst in Berlijn: 57% en het kleinst in Schleswig-Holstein: 24%. Droge depositie van (zeezoutinvloed gecorrigeerde) Ca^{2+}, K^+, Mg^{2+} en basische kationen verminderde tussen deze twee perioden met respectievelijk 42%, 24%, 65% en 43%.

Uit vergelijkingen met doorval metingen volgt dat de gemodelleerde droge depositie van NH_x, Mg^{2+},Ca^{2+} and K^+ niet significant verschilt van gemeten droge depositie. De spreiding is echter

aanzienlijk. Het EDACS model, in de oorspronkelijke benadering, geeft een overschatting van de droge depositie van SO_x, NO_y en Na met factoren van respectievelijk 2.15, 1.58 and 1.75. Een belangrijke oorzaak hiervan voor SO_x is de te hoge SO_2 luchtconcentratie die het EMEP model berekent. Voor deze stof is daarom een correctie uitgevoerd op basis van gemeten lucht-concentraties in Duitsland, waarna de factor verlaagd is van 2.15 naar 1.67.

Summary

This report describes the results of the project ‘Critical Load exceedances für wald-, agrar- und naturnahe waldfreie Ökosysteme' (No. 10803081) under the title, 'Deposition of acidifying components and base cations in Germany in the period 1987-1995'. The project was carried out by RIVM on behalf and for account of the German national environmental agency ‘Umweltbundesamt’ (UBA) in close cooperation with sub-contractors TNO-MEP and Alterra (former SC-DLO). For Germany, the research carried out has yielded, as the main product, estimates of dry deposition with a high spatial resolution . These are needed to calculate critical load exceedances with great spatial detail. The basic model used in this study is EDACS, a model that calculates dry deposition fluxes on the basis of meteorological data and atmospheric concentrations of relevant species. As such, the project reported here further elaborates the work carried out in a previous project in 1996. Only the RIVM/TNO part of the project is described here; the work of Alterra on critical loads is reported separately.

The RIVM/TNO project took place in close co-operation with the University of Stuttgart, Institute for Navigation (INS) and the Research Company for Ecology, Nature and Environmental Protection (Öko-data). INS provided detailed land-use data and interpolated wet deposition fields from which atmospheric levels of base cations were estimated. Data for Level 1 and observational sites were provided by BFH.

Dry deposition of acidifying components and base cations in Germany was calculated for the period 1987-1995 using the inferential modelling technique. The results are given as country-wide maps with a 5 x 5 km resolution but also as estimates for individual Levels 1 and 2 sites. Compared to the previous study, which was limited to the years 1989 and 1993, a number of extensions and/or improvements have been worked out. These are indicated below.

- The distribution of NH_3 concentrations in Germany has now been calculated on a 5 x 5 km grid, using the EUTREND model, while in the previous study these data were taken from the standard EMEP model, which has a 150 x 150 km resolution. The new approach yields higher average NH_3 concentrations (56 %); however, a comparison of model-calculated wet deposition with the EMEP network measurements in Germany still indicates a 25% underestimation. The suggestion is that the latter is caused by a general underestimation of ammonia emissions in Germany, similar to the situation in the Netherlands.
- Possible concepts for introducing cloud deposition into the inferential approach have been investigated and (preliminary) results for a small study area in southern Germany shown. The contribution of cloud deposition to total deposition is highest in mountainous areas; for the selected area in Schwarzwald this deposition is, on average, 20-30%. An important parameter in estimating cloud deposition is the cloud base height, is at the moment not

available with great spatial detail. Another important parameter is the cloud water concentration estimated from empirical relations with local air concentrations.

- Canopy exchange estimates for forest sites in Germany were related to parameters, also measured at these sites to gain a better insight into the parameters controlling canopy uptake and leaching. The impact of deposition on canopy exchange estimates was investigated as well by relating these estimates to total deposition estimates for 67 forest sites. Canopy leaching of base cations was found to be negatively correlated with deposition of base cations, suggesting ion exchange between surface water and apoplast of canopy tissues as a main exchange mechanism. Canopy uptake of nitrogen species was found positively correlated to deposition of nitrogen species, suggesting that the concentration difference between atmosphere and apoplast determines the magnitude of the uptake.

The dry deposition fields clearly reflect the spatially detailed land-use information and the large-scale concentration and climate patterns Germany. SO_x dry deposition fluxes were largest in central-east Germany, NO_y fluxes in central-west Germany and NH_x fluxes in north-west Germany. Dry deposition of Na^+ is clearly related to the distance to the sea; this reflects its sea-salt origin. High $Ca^{2+} + K^+ + Mg^{2+}$ fluxes (when corrected for the influence of sea salt) can be found in eastern Germany, especially in the period 1987-89. This is most probably due to the intensive industrial activities in that area. The highest dry deposition of potential acid (up to 20,000 eq ha^{-1} y^{-1} as average for the period 1987-89) was calculated for eastern Germany and the highest dry deposition load of nitrogen (up to 3500 eq ha^{-1} y^{-1} as average for the period 1987-89) for North Rhine-Westphalia. Dry deposition of SO_x, NO_y, NH_x and potential acid in the period 1993-95 decreased compared to the period 1987-89 by 49%, 13%, 21% and 42%, respectively. The decrease in potential acid was largest in Berlin (57%) and lowest in Schleswig-Holstein (24%). Emissions for SO_2, NO_2 and NH_3 in Germany decreased by 63%, 33% and 22%, respectively, between the two periods (Tarrason and Schaug, 1999). Dry deposition of non-sea-salt Ca^{2+}, K^+, Mg^{2+} and base cations deceased by 42%,.24%, 65% and.43%, respectively. The influence of meteorological conditions on the dry deposition between the two periods is relatively small.

Modelled dry deposition estimates were compared with dry deposition derived from throughfall estimates. On average, the modelled dry deposition of NH_x, Mg^{2+},Ca^{2+} and K^+ was not significantly different from measured dry deposition, although a considerable scatter could be observed. The EDACS model tends to overestimate the dry deposition of SO_x, NO_y and Na by factors of 2.15, 1.58 and 1.75, respectively. For SO_x this could be partly explained by the EMEP modelled air concentrations, which for Germany have been found too high compared with measurements. A correction on the modelled dry deposition was therefore carried out on the basis of measured SO_2 concentrations in Germany, which reduced the overestimation for SO_x to a factor of 1.67.

1 Introduction

Both sulphur, and reduced and oxidised nitrogen compounds, have been found to acidify soils and surface waters. In addition, nitrogen compounds have been found to eutrophicate ecosytems. Effects of acidification and eutrophication have been described extensively in the literature. The chemical components considered in the processes are SO_2 and its secondary SO_4^{2-} aerosols, NO + NO_2 (sum indicated as NO_x) and the secondary products HNO_2, HNO_3 and NO_3^+ aerosol, and NH_3, along with its secondary NH_4^+aerosol. The sum of primary and secondary forms of sulphur, oxidised nitrogen and reduced nitrogen are indicated as SO_x, NO_y and NH_x, respectively. Base cations such as Ca^{2+}, Mg^{2+}, K^+ and Na^+ also play an integral role in the chemical processes of acid deposition. The depletion of exchangeable base cations in sensitive soils is thought to represent a major detrimental effect of acid deposition on terrestrial ecosystems (De Vries, 1994). The atmospheric input of base cations to vegetation in nutrient-poor conditions may be important when taken quantitatively.

Abatement strategies based on the critical load concept require relevant deposition data on both local and regional scales. On the local scale this means that the actual deposition has to be known for specific ecosystems, which will depend heavily on landscape features and the presence of local sources of SO_2 , NO_x and NH_3. For the larger regional scale, it means that the influence of long-range transported pollutants also has to be known. The two approaches should be linked so as to evaluate the complete chain from emission to deposition and to develop adequate abatement strategies.

Critical loads in Germany are currently mapped on a 0.015° x 0.015° lat/lon resolution. Deposition estimates from long-range transport models such as EMEP do not meet the critical load requirements for spatial resolution. Direct measurements of dry deposition are either not available or, if based on bulk deposition measurements, are not representative enough to serve as dry deposition estimates. This was the reasoning behind RIVM's development of the EDACS model (European Deposition of Acidifying Components on a Small scale), which can be regarded as an extension to the EMEP model for estimating land-use-specific small-scale deposition fluxes. The basic idea of this model is to combine modelled (or measured) atmospheric concentrations (with a limited spatial resolution) with locally determined, land-use-dependent dry deposition velocities.

The study described in this report may be considered as an extension of the UBA Project (No.10701033) , 'Mapping dry deposition of acidifying components and base cations on a small scale in Germany' (Van Leeuwen *et al.*, 1996). In the study presented in this report the EDACS model is applied to Germany for the estimation of dry deposition on a 5 x 5 km resolution, but also for the dry deposition for the so-called Level 1 and Level 2 monitoring sites. Calculations are extended to the period 1987-1995. The NH_3 concentrations required by EDACS are calculated using the EUTREND model, since it is more dedicated to low-level dispersion and deposition processes. Results are presented from a study on the possibility of parameterisation cloud deposition in a mountainous area. Canopy exchange estimates for forest sites in Germany are related to parameters measured at these sites to gain a better insight in the controlling of canopy uptake and leaching. For the Level 1 sites the calculated depositions and site-specific data (roughness lengths, tree height, etc.), are used for deriving site-specific critical loads. Model results are evaluated using throughfall measurements and uncertainties are discussed.

In an earlier stage of this study the modelled SO_x depositions found were systematically too high, especially in more recent years. This was based on comparisons with measurements carried out in Germany. On the basis of existing SO_2 measurements in Germany, concentration maps were constructed using Kriging techniques. Correction factors were then derived from the ratio of modelled to measured concentrations and applied to the calculated dry SO_x deposition data. The correction procedure is described in Annex A. All the results (except the cloud deposition calculations) are based on these corrected SO_x depositions.

2 Dry deposition calculations for the period 1987-1995

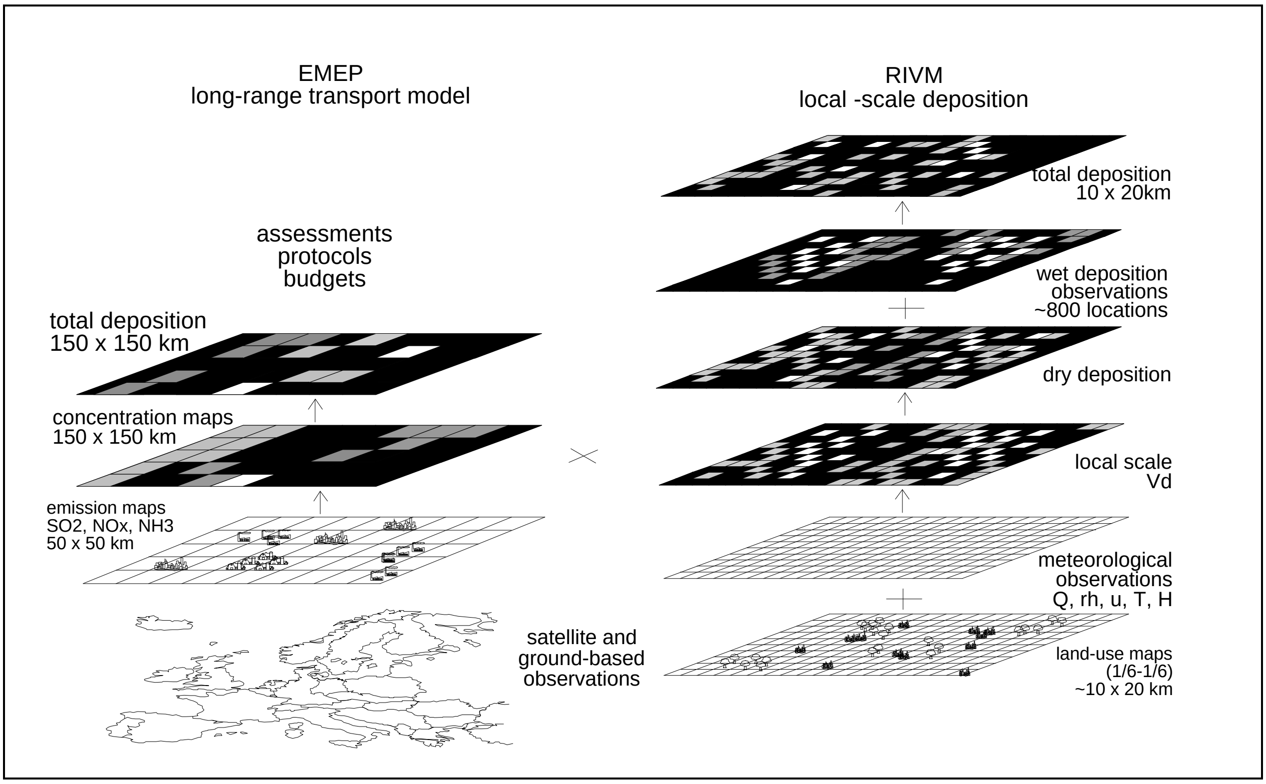
In this chapter the results are presented of the calculation of the dry deposition of acidifying components and base cations for the period 1987-1995. First the models used are described, after which the calculation results are presented. These models are: EDACS (European Deposition of Acidifying Components on a Small scale) for calculating dry deposition of acidifying components and base cations and EUTREND for calculating dry deposition of ammonia based on local scale ammonia emissions. The last part of this chapter gives an insight in the uncertainties in the dry deposition calculations.

2.1 General description of models used

2.1.1 The EDACS model

The components considered in EDACS are SO_2 and SO_4^{2-}-aerosol (SO_x); NO, NO_2 (NO_x); HNO_3 and NO_3^--aerosol, NH_3 and NH_4^+-aerosol (NH_x) and Na^+, Ca^{2+}, K^+ and Mg^{2+}-aerosol. The outline of the method to estimate local scale deposition fluxes is presented in *Figure 1*.

Figure 1: Outline of the EDACS model.



In the EDACS-model dry deposition is estimated with the inference method, i.e. deposition at the surface is inferred from the concentration and deposition velocity at the same height (Erisman, 1992; Erisman and Baldocchi, 1994; Van Pul *et al.*, 1992, 1995). In the inference method it is assumed that a constant flux layer between the reference height and the surface (i.e. the atmospheric surface layer) is present. This assumption implies that i) there is no significant advection in the layer, ii) the air flow is well-adapted to the surface properties, and iii) chemical reactions are not present. In that case the deposition flux at the reference height equals the deposition flux at the surface. The adaptation of the airflow to the surface strongly depends on the surface roughness and the stability of the air. The reference height must fulfil following criteria: i) it must be high enough so that the concentration is not severely affected by local deposition and ii) it must be below the surface layer height. In EDACS the reference height is taken at 50 m above ground level, which is considered as an optimum (Erisman, 1992).

The deposition velocity is calculated using a resistance model in which for each component transport to the surface and absorption or uptake by the surface are described. The parameterisations depend on surface characteristics and other environmental and meteorological conditions. Dry deposition velocity fields for every 6-hr period are constructed from a detailed land use map, using these parameterisations along with the meteorological information. In order to estimate atmospheric transport to the surface a roughness length is used. This roughness length (z_0) was derived from a land use map provided by Ökodata (Berlin) (*Figure 2*) and z_0 classifications according to Wieringa (1992). The roughness length is used to estimate atmospheric transport to the surface. A typical vegetation height, necessary in the surface resistance parameterisation, is also denoted (*Table 1*). For the land use classes deciduous, coniferous and mixed forest tree heights were averaged for each Bundesland as listed in *Table 2*. These data have been provided by the German Federal Ministry of Agriculture. More detailed forest height data (e.g. on a 1x1 km^2 scale) would have significantly improved the reliability of the modelling results.

Table 1: Land use types used in the EDACS and EUTREND calculations, assigned values for roughness length and vegetation height

land use type	roughness length (m)	height (m)
agricultural areas	0.1/0.05*	0.5
coniferous forest	0.085 x treeheight	see *Table 2*
deciduous forest	0.06 x treeheight/0.09 x treeheight*	see *Table 2*
mixed forest	0.085 x treeheight	see *Table 2*
water	0.0002	-
urban areas	1.0	not available

* summer/winter value

Figure 2: Landuse map of Germany on a 1x1 km and 5x5 km resolution

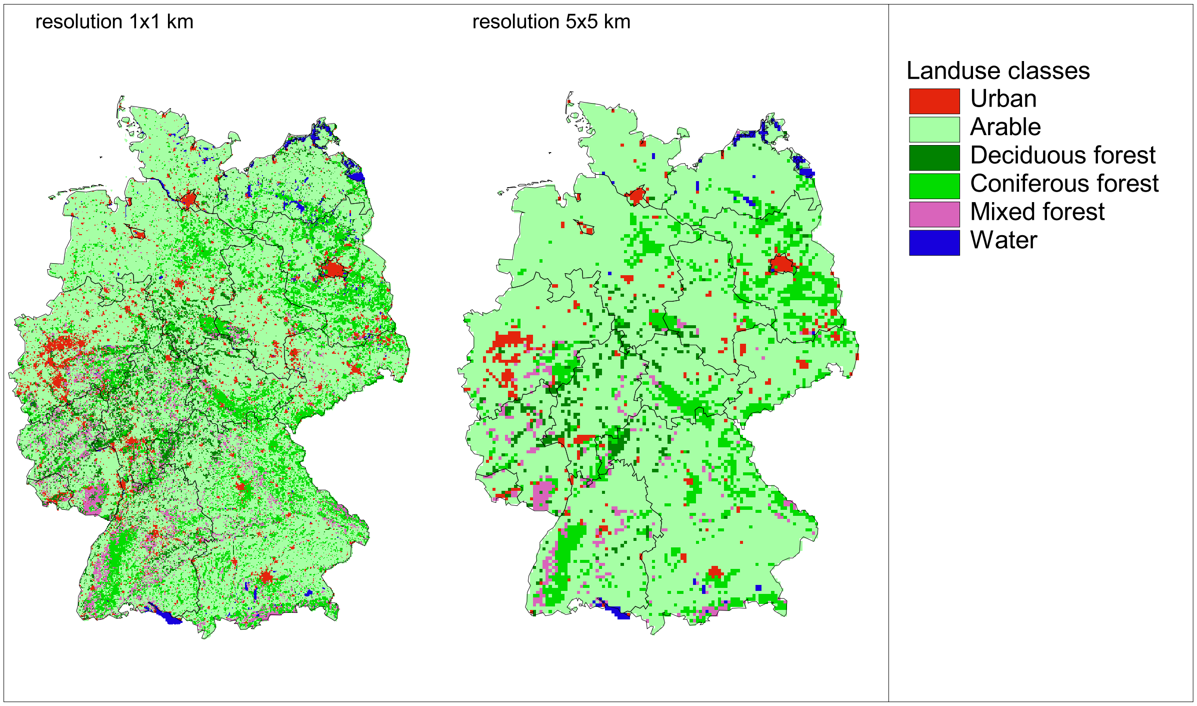


Table 1: Average treeheight (m) per tree type and per Bundesland

Bundesland	Deciduous	Coniferous	Mixed
Brandenburg	19.3	14.6	15.3
Mecklenburg-V	21.0	16.8	18.4
Sachsen	17.1	15.2	15.6
Sachsen-Anhalt	19.6	15.2	16.6
Thuringen	21.1	16.4	17.9
Schleswig-H	19.3	16.4	18.0
Niedersachsen	17.7	14.8	15.9
Saarland	17.8	17.8	17.7
Rheinland-Pfalz	18.6	18.4	18.5
Hessen	21.8	19.8	20.8
Badem-W	21.6	22.1	21.7
Bayern	18.2	21.0	20.2
Nordrhein-W	18.7	17.4	18.1
Germany	19.4	17.4	18.0

In EDACS meteorological data are used to describe, among others, the transport of the components to the surface and surface condition. For 1987-1989 and 1990-1995 two different databases were used, generally containing data from the same meteorological stations on the same time resolution. For the period 1987-1989, a database of the synoptic stations of the

WMO (World Meteorological Organisation) on a global scale archived by ECMWF (European Centre for Medium-range Weather Forecasts), Reading, UK was used. This so-called ODS (Observational Data Set) data set contains 6 hr averaged meteorological observations at 00, 06, 12, 18 GMT measured at 1306 stations over Europe (of which 4 are ship-observations). For 1990-1995, data were obtained from NCAR (National Centre for Atmospheric Research), Boulder, USA. Precipitation data for this period were obtained from the German Weather Service. Data used in this study are summarised in *Table 3*.

Table 3: Meteorological variables extracted from the ODS and NCAR databases.

variable	measurement height	Units
wind speed (U)	10 m.	m s^{-1}
total cloud cover (N)	-	Octa
air temperature (T)	1.5 m.	0.1 °C
dew point temperature (Td)	1.5 m.	0.1 °C
precipitation (RR)	-	0.1 mm

The data are interpolated to a 1.0°x0.5° (lat/lon) grid to obtain a coverage over Europe. More details about the data, data selection and interpolation procedure can be found in Potma (1993).

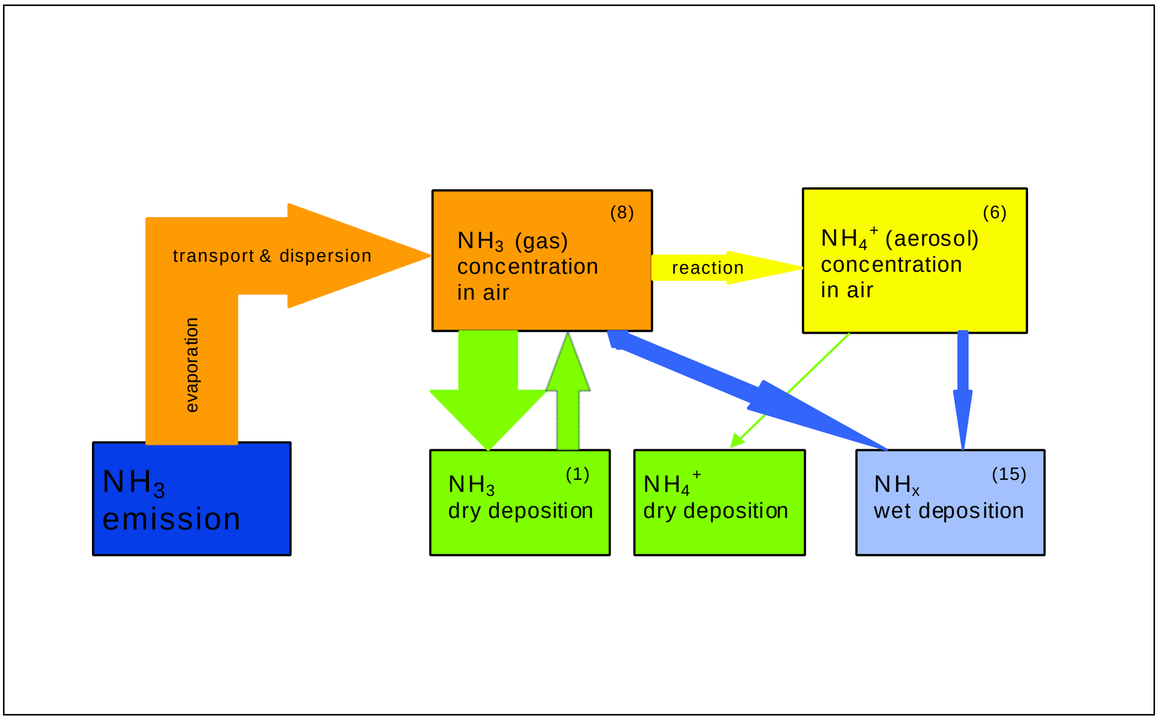
The meteorological parameters and surface conditions are used to calculate a component specific deposition velocity for each land-use type at 50 m above ground level. For all components this is carried out on a 6-hourly basis. Subsequently these 6-hourly deposition velocity fields are averaged to daily values. For the acidifying components these fields are combined with the daily concentration data calculated by the EMEP/LRT to obtain dry deposition fluxes. Using calculated concentration fields, the relation between emissions and deposition is maintained and assessments or scenario studies can be carried out (see *Figure 1*). Daily fluxes were subsequently summed to annual totals. For base cations 6-hourly dry deposition velocity fields were averaged to annual means before they were combined with annual mean air concentration fields (see section 2.2.2).

2.1.2 The EUTREND model

The model used for the calculation of the dry deposition of NH_x is the so-called EUTREND model, which is an European version of the Operational Priority Substances (OPS) model (Van Jaarsveld, 1995). The model concept has been used in studies of deposition to the North Sea (Van Jaarsveld *et al*. 1986, Warmenhoven *et al*., 1989), the Rhine catchment area (Baart and Diederen, 1991) and Europe, the so called ESQUAD study (Van den Hout, 1994). The model was originally developed for the calculation of transport and deposition of acidifying compounds such as ammonia (Asman and Van Jaarsveld, 1992). In these studies the more general model concept was also validated by comparing model results with measurements of concentrations in air and in precipitation (Van Jaarsveld, 1989).

The version used here (EUTREND v1.17) covers the entire European continent with its marginal seas and calculates concentrations and depositions as functions of surface characteristics. The model is able to describe both short and long-distance transport by combining a Lagrangian trajectory model with a Gaussian plume model. The advection in this model is based on meteorological data (6-hour time step, 1000 and 850 hPa pressure levels) obtained through the Netherlands Meteorological Institute (KNMI) from the European Centre for Medium range Weather Forecasts (ECMWF) in Reading, England. The basic resolution of this data is 1^{o} longitude x 0.5^{o} latitude. Small scale processes such as dispersion, dry and wet deposition are described on the basis of surface observations of wind speed, cloud cover, temperature, humidity and precipitation. These surface observation data are obtained (mainly as 6-hourly values) from databases kept by ECMWF, the American National Centre for Atmospheric Research (NCAR) and the Deutsche Wetter Dienst (DWD). The spatial resolution of these small scale processes is limited by the (local) density of the meteorological stations. For Europe as a whole, data of more than 1300 stations is available. For practical purposes the EUTREND model distinguishes 50 'climatological areas' in Europe, but the model can also be used on a sub-European scale with the same number of climatological areas.

Figure 3: *The atmospheric cycle of ammonia. The width of the arrows are representative for the relative importance of the processes.*



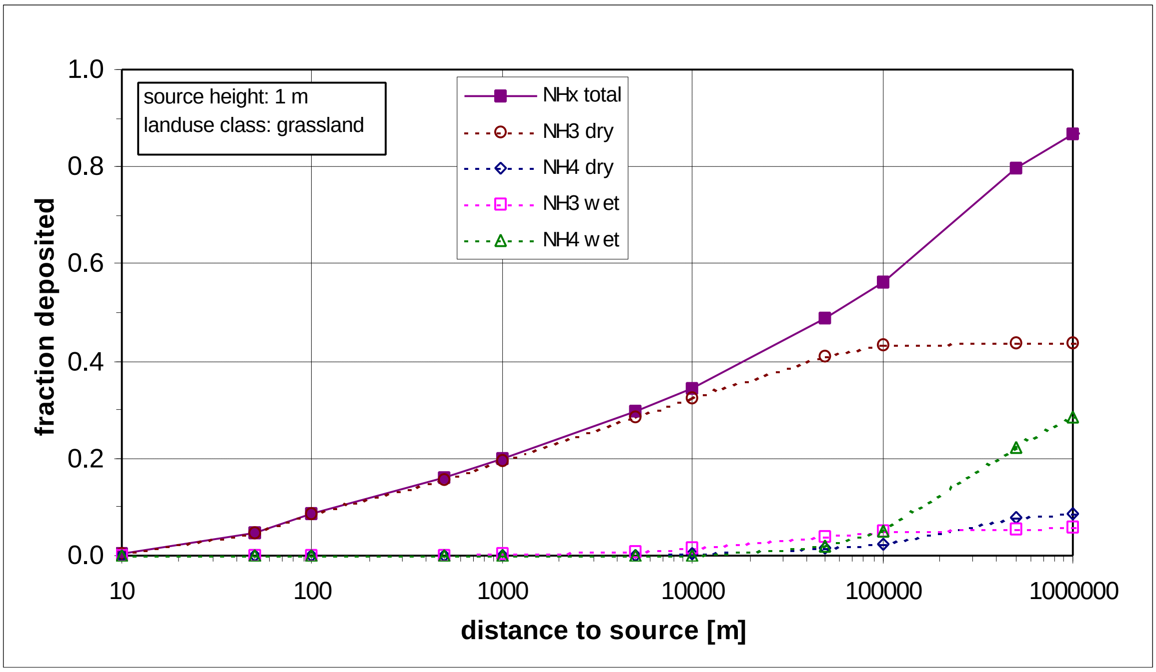
Atmospheric processes included in the model are: emission, dispersion, advection, chemical conversion and wet and dry deposition (see *Figure 3* where the atmospheric cycle of ammonia is given). An important aspect with regard to dispersion and advection is that the model describes long range transport using well mixed trajectories while local transport and dispersion is described using a Gaussian plume model. The latter model describes the air concentration as a function of source height and meteorology related dispersion parameters but - in case of high stacks - it also allows for (temporarily) transport of pollutants above the so called mixing layer. Dry deposition is modelled using the so-called resistance approach, in which the dry deposition velocity is constructed from resistances of both the atmosphere and the receiving surface in the same way as described in Paragraph 2.2.1. The EUTREND model uses the same resistance parameterisation module as the EDACS model.

Chemical reaction rates are used in the model independently of concentration levels, which means that only linear chemistry can be described. A general description of the modelled processes is given in Van Jaarsveld (1995). The model can be applied with a variable spatial resolution, using a fixed receptor grid or using a set of individual receptor points. In such a case is each receptor point characterised by its coordinates, landuse class and roughness length.

Ammonia in the EUTREND model

Modelling the dispersion and deposition of ammonia and ammonium is special in a way that ammonia is emitted as part of an evaporation process e.g. when manure is applied on the land. This means that there is a correlation between the meteorological condition and the emission rate in such a way that the dispersion (and also the dry deposition velocity) is high when the emission rate is high. In these terms one can speak of a feedback between atmospheric concentrations and emissions.

Figure 4: Cumulative deposition of ammonia and ammonium due to an ammonia point source as a function of downwind distance (Asman and Van Jaarsveld, 1992).



Another important aspect is the low height at which ammonia enters the atmosphere (zero level for emissions due to manure application and 2-6 m for emissions from stables). Due to the initial transport close to the surface a significant part of the ammonia will be dry deposited close to the source. The problem is illustrated in *Figure 4* where the (cumulative) deposited fraction of ammonia is given as a function of the downwind distance for a release height of 1 m. Under average meteorological conditions already 20% of the emitted ammonia will be dry deposited within the first 1000 m and 50% within 60 km. From *Figure 4* it can also be seen that the dominant deposition form in the first 100 km is dry deposition while for larger distances wet deposition of secondary formed ammonium will be the dominant form.

Differences between the EUTREND model and the EMEP Lagrangian model

The aspects of low emission heights are addressed in the EUTREND model through a local Gaussian plume model superimposed on a trajectory model. In single-layer trajectory models such as the EMEP model, the locally emitted NH_3 will be immediately mixed up over the entire boundary layer, causing an underestimation of atmospheric concentrations close to the surface and hence an underestimation of the dry deposition flux. On the basis of this difference in model approach one may expect that the EUTREND model will calculate significantly higher surface concentrations for substances like NH_3 and NO_x. One solution to address the effects of local and low level sources in the EMEP model is the introduction of a local deposition factor. This means that a certain fraction of the emission is directly attributed to deposition in the same grid cell. The local deposition factor depends on the grid size used in the model. In case of the EMEP Lagrangian model with its 150 x 150 km resolution the factor would be (according to *Figure 4*) in the order of 50%. It is clear that in such an approach the calculated deposition depends heavily on the local deposition factor. In the present study local scale emissions on a 5 x 5 km grid are used (see 2.1.2.1). Even then approximately 25% of a grid cell emission will be deposited within the same grid cell.

Recent improvements

For the present study a number of extensions have been made to the EUTREND model. The most important is the introduction of local landuse and surface roughness effects on dry deposition. These parameters now can be specified either in grid-form or as properties of receptors. Corresponding dry deposition resistance parametrisations are now based on the same module as used in the EDACS inference model.

Comparison with observations

In order to validate the outcome of the EUTREND model (including the emissions used) the results should be compared with measurements. Comparing on the basis of atmospheric ammonia concentrations would be the most direct action but such measurements where not available. A recent comparison of results of a similar model approach with measurements in the Netherlands for the period 1993-1998 revealed a relatively high spatial correlation (R^2 = 0.9; 7 stations) but an underestimation of NH_3 concentrations of almost 30%. Similar results were obtained for the modelled wet deposition ($R^2 = 0.9$; 14 stations). In the present case the measured wet deposition in the EMEP network is used for validation purposes. For the 8 stations, which were in operation in 1994, the concentrations are calculated on the basis of NH_3 emissions in Germany and other European countries. The results are given in *Figure 13*. The largest discrepancy is found for the EMEP station Westerland, which is a coastal station at the German Bight. It turns out that the model approach gives 25 % lower concentrations in precipitation. This result is consistent with the Netherlands situation. One of the suggestions is a general underestimation of ammonia emissions, especially those of manure application

2.1.2.1 Local scale ammonia emissions

The ammonia emissions from the CORINAIR database are specified as total animal emission per territorial unit (German Kreis) (source: allocation of animal numbers and emissions to kreis units based on CORINAIR, performed by UBA). These emissions have been allocated to areas with agricultural land use using a Geographic Information System (Arc/Info). As a basis a land use map on a resolution of 1x1 km provided by INS in 1994 was used. This map was first classified into two items, i.e. agricultural and non-agricultural land use. Then the fraction of agricultural land use per territorial unit was calculated, and subsequently the emission per agricultural land use cell within each territorial unit. Animal emissions account for 85.7% of the total ammonia emission. In order to accommodate for other emissions, i.e. emissions from fertiliser application (9.3%), industry (1.3%) and others (traffic, combustion plants and denox, together 3.7%) these emissions were equally spread over the agricultural land use cells. The emissions on a 1x1 km resolution were then aggregated to 5x5 km grid cells, the resolution used in the EUTREND model.

Using the methods described above, only the German contribution is accounted for. In border areas (especially near the Dutch border) this may give serious underestimates. Therefore, in order to account for the foreign contribution, the EUTREND model was also run using a European emission database excluding Germany. For the Netherlands and Belgium the resolution of these emissions is also 5x5 km. For other countries a 75x75 km resolution was used according to Asman (1992). Actual emission data for 1994 were taken from EMEP. The concentration and deposition thus derived were added to the results obtained using the German emission data.

Figure 5: Ammonia emission per Kreis and per 5x5 km for 1994.

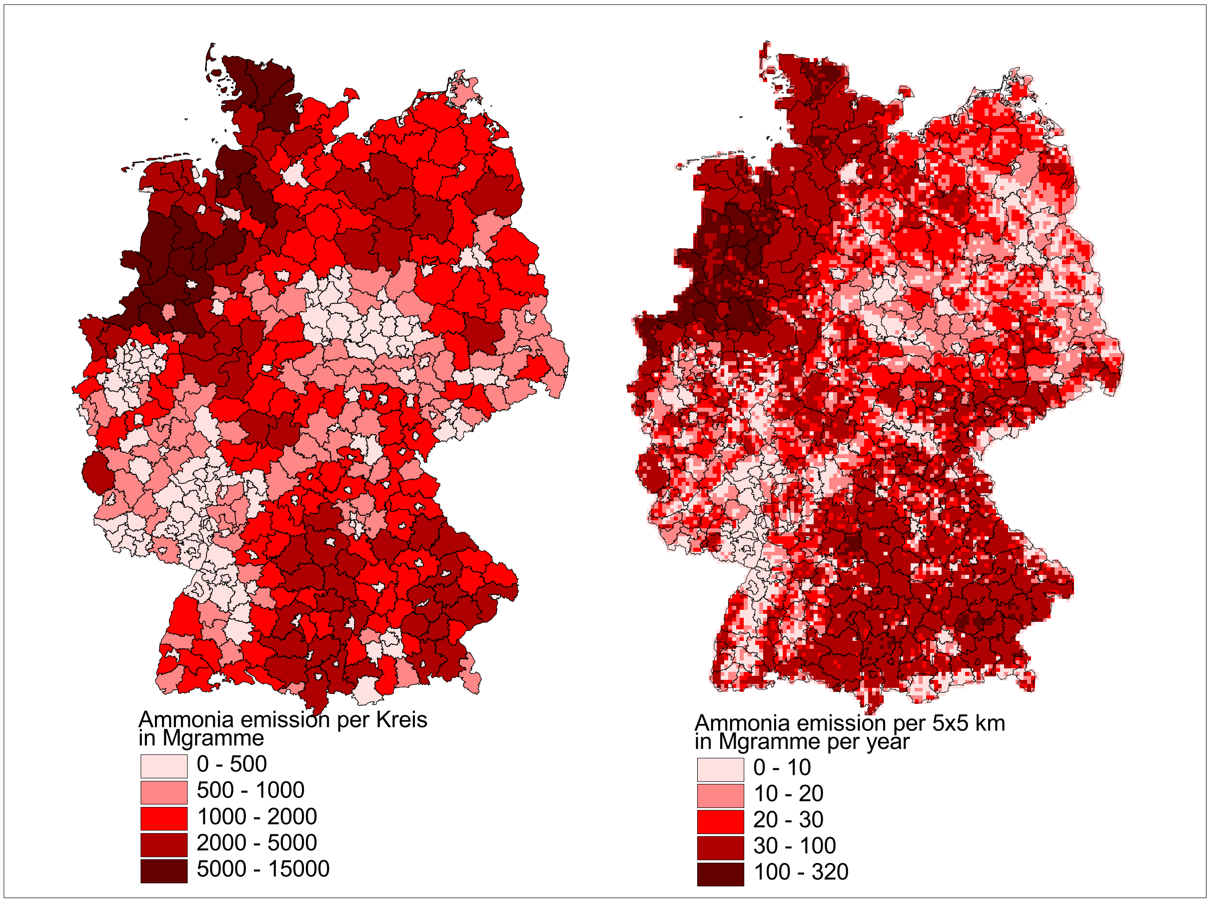


Table 4: Total agricultural ammonia emissions for the period 1985-1996 in ktonne

	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996
Berlin (East) 90 / Berlin ges 94	0.9	0.9	0.9	0.9	0.9	0.7	0.4	0.3	0.2	0.1	0.1	0.1
Brandenburg	59.2	59.0	58.0	57.8	57.2	46.1	28.2	24.3	23.0	22.1	22.5	22.8
Mecklenburg-Vorpommern	47.7	47.4	46.7	46.5	46.0	37.1	23.3	20.4	19.7	19.7	20.2	20.6
Sachsen	37.9	37.7	37.1	37.0	36.6	29.5	19.7	18.5	19.0	20.0	20.1	20.1
Sachsen-Anhalt	42.5	42.3	41.6	41.5	41.0	33.1	20.4	17.7	16.8	16.1	15.5	14.9
Thüringen	33.7	33.6	33.0	32.9	32.6	26.3	17.1	15.7	15.8	16.1	15.5	14.9
Schleswig-Holstein	47.9	47.2	46.1	45.1	44.7	44.7	42.8	41.9	41.2	40.9	43.3	46.2
Hamburg	0.1	0.04	0.04	0.04	0.04	0.04	0.1	0.2	0.2	0.3	0.4	0.5
Niedersachsen	134.5	132.6	129.4	126.6	125.6	125.6	121.8	121.0	120.0	119.5	113.2	108.9
Bremen	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.3	0.4	0.4
Nordrhein-Westfalen	88.0	86.7	84.6	82.8	82.2	82.1	78.9	78.5	77.5	76.3	66.9	59.0
Hessen	25.1	24.7	24.1	23.6	23.4	23.4	22.1	21.4	20.7	20.1	20.1	20.4
Rheinland-Pfalz	17.6	17.4	17.0	16.6	16.5	16.5	15.6	15.2	14.9	14.6	15.5	16.5
Baden-Württemberg	54.7	53.9	52.6	51.5	51.1	51.0	49.0	48.3	47.7	47.3	46.7	46.8
Bayern	145.4	143.3	139.9	136.8	135.8	135.7	129.8	126.8	124.5	123.6	130.6	139.1
Saarland	2.0	2.0	2.0	1.9	1.9	1.9	1.8	1.8	1.7	1.7	1.9	2.2
East	222.0	220.9	217.3	216.5	214.3	172.8	109.0	96.7	94.4	94.2	93.9	93.5
West	515.8	508.3	496.1	485.3	481.5	481.3	462.3	455.4	448.9	444.8	439.1	440.0

2.2 Methods to derive dry deposition fluxes

The dry deposition flux of gases and particles from the atmosphere to a receptor surface is governed by 1) the concentration in air, 2) turbulent transport processes in the boundary layer, 3) the chemical and physical nature of the depositing species and 4) the efficiency of the surface to capture or absorb gases and particles. The flux of a trace gas is given as:

$$F = V_d(z)c(z)$$

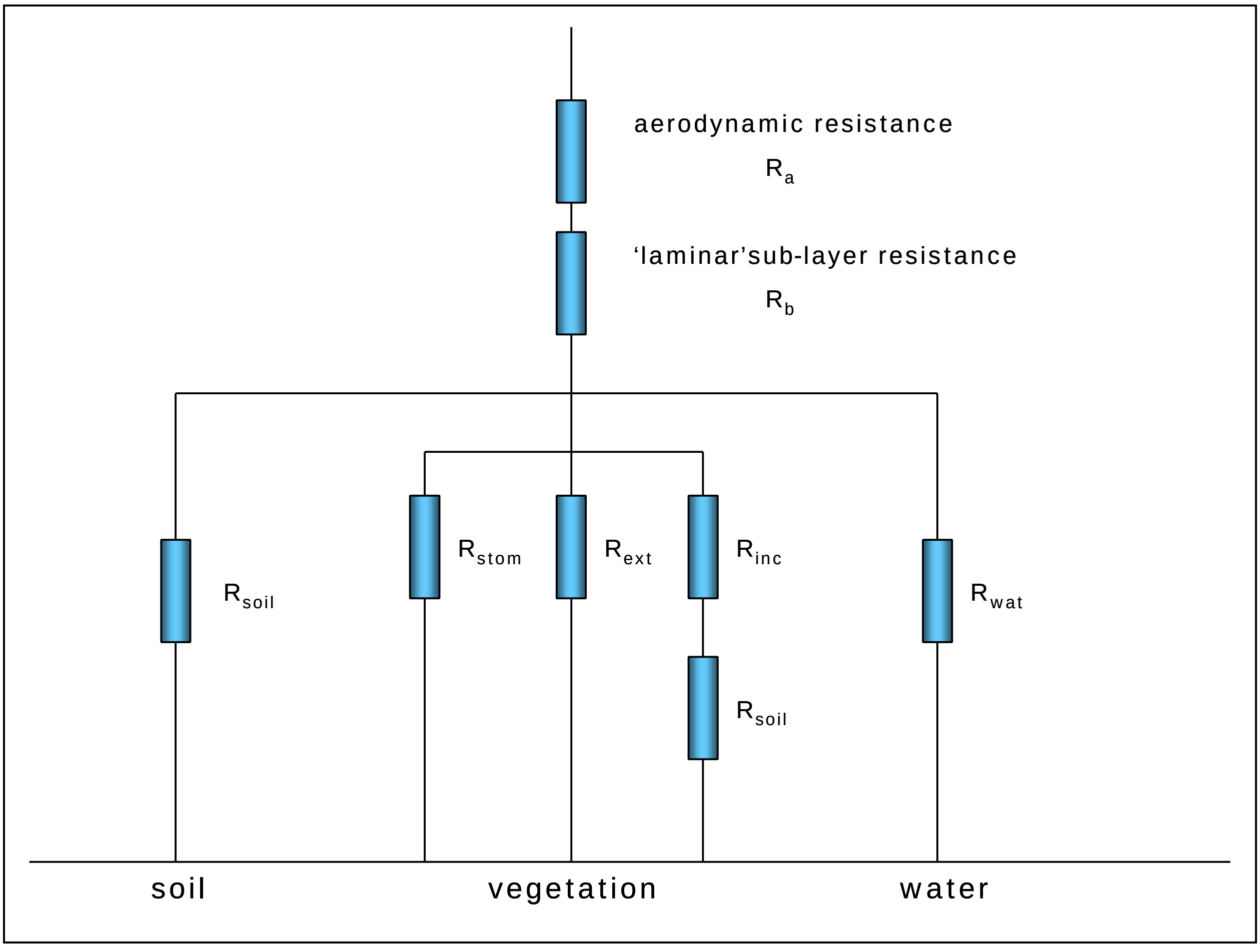
where:
c(z) is the concentration at height *z*;
$V_d(z)$ is the dry deposition velocity at height *z* (Chamberlain, 1966).

The reference height *z* in the above equation, is taken as 50 m. If the surface is covered with vegetation, a zero-plane displacement (*d*) is included: $z = z - d$. The absorbing surface is often assumed to have zero surface concentration. This only holds for depositing gases, but not for gases that might also be emitted (like NH_3 and NO). For these gases a non-zero surface concentration (compensation point c_p) might exist. If this concentration is higher than the ambient concentration, the gas is emitted. Because of insufficient knowledge on the compensation point, it is not included as a model parameter.

2.2.1 Dry deposition velocity

The parameterisation of the dry deposition velocity is based on a description with a resistance analogy or Big Leaf Model (see e.g. Thom, 1975; Hicks *et al.*, 1987; Fowler, 1978; Erisman *et al.*, 1994a). In this resistance model the most important deposition pathways by which the component is transported to and subsequently taken up at the surface are parameterised. The resistances used in the V_d parameterisation in EDACS are presented in *Figure 6* and described in Erisman *et al.* (1994a).

Figure 6: Resistances used in EDACS. For explanation of the symbols see text



V_d is represented by the inverse of three resistances:

$$V_d = (R_a + R_b + R_s)^{-1}$$

These three resistances represent the three stages of transport. The aerodynamic resistance (R_a) represents the resistance against turbulent transport of the component close to the surface, the quasi-laminar sublayer resistance (R_b) accounts for the transport of the component by molecular diffusion through a laminar layer adjacent to the surface, and the surface resistance (R_s) accounts for the uptake at the surface. The surface resistance is composed of the resistances of the various uptake processes at the surface. For a surface covered with vegetation this is:

- stomatal resistance (R_{stom}): the resistance to transport through stomata of leaves and needles;
- mesophyll resistance (R_m): the resistance of internal plant tissues against uptake (in a chemical way). For the components considered R_m is assumed 0;
- cuticle resistance (R_{cut}) or external surface resistance (R_{ext}): the resistance of the exterior plant parts against uptake of the component;
- in-canopy aerodynamic resistance (R_{inc}): the resistance accounting for transport of air above the vegetation towards the soil and lower plant parts;
- soil resistance (R_{soil}): the resistance against absorption at the soil surface.

These resistances, which act in parallel or in series, are summed to yield a (total) surface resistance (R_s):

$$R_s = \left[\left(R_{inc} + R_{soil} \right)^{-1} + R_{ext}{}^{-1} + \left(R_m + R_{stom} \right)^{-1} \right]^{-1}$$

For a water surface R_s=R_{wat} (where R_{wat} is the resistance against uptake of gases in water), for bare soil R_s=R_{soil}, for urban areas R_s=R_{urban} and for a surface covered with snow R_s=R_{snow}. In turn, these resistances are affected by meteorology, leaf area, stomatal physiology, soil and external leaf surface pH, and presence and chemistry of water drops and films. Especially the state of the leaf and soil surface (i.e. the presence of water films and snow) is an important variable governing the deposition of soluble gases like SO_2 and NH_3.

The scheme to derive the surface resistances for SO_2, NO_2, NO, HNO_3, NH_3 used in EDACS is described in Erisman et al. (1994). This scheme is based among others on Wesely (1989) and Lövblad et al. (1993) and recent dry deposition measurements (e.g. performed within the framework of the BIATEX project).

Deposition velocities of particles composed of SO_4, NO_3, NH_4 and Na, Ca, Mg and K are calculated using two different parameterisations. For acidifying compounds, the particle dry deposition velocity for low vegetation and other areas with a roughness length (z_0) less than 0.5 m. is calculated using a parameterisation by Wesely *et al.* (1985), and for forests and other areas with a z_0 above 0.5 m. using a parameterisation based on the model of Slinn (1982) which was recently tested with micro-meteorological measurements performed at the Speulder forest in the Netherlands (Ruijgrok *et al.*, 1994; Erisman *et al.*, 1994b). The dry deposition velocity for base cation particles is calculated using the latter parameterisation. It includes both turbulent exchange and sedimentation of coarse particles (Ruijgrok *et al.*, 1994).

Input to the deposition module of EDACS is information on component type, landuse type and meteorology. Also information on the 'pollution climate' of the surface is taken into account by expressing the ratio between the ammonia and sulphur concentration (denoted N/S) as low or high. With this ratio the interaction of ammonia and sulphur in the deposition process of ammonia and sulphur is modelled (Erisman and Wyers, 1993; Erisman *et al.*, 1994a). An extensive description of all databases used in the EDACS model is given in Van Pul *et al.* (1995).

For each 5x5 km grid cell, 6-hourly meteorological information was used to calculate the friction velocity, surface heat fluxes (sensible and latent heat) and short-wave incoming radiation. These meteorological parameters are calculated using the scheme described by Beljaars and Holtslag (1990). In this scheme the landuse specific z0 values were used. In EDACS the Leaf Area Index (LAI) of the vegetation is needed to calculate the effective stomatal resistance of the 'big leaf' layer. A simple seasonal variation of the LAI in agricultural areas was assumed. The LAI linearly increases from zero in April to 6 or 5 in July and August (for resp. grassland and forests/cultivated land), and linearly decreases from the August-value to zero in November.

Surface wetness, as a result of rainfall, was taken from the synoptic data. If rain was reported, the surface was assumed wet during the time period of 6 hours. Drying of the surface or information on surface wetness of the previous time period were not taken into account because only 6 hr average meteorological data are used.

2.2.2 Air concentrations

Concentration data calculated by the EMEP Langrangian long-range transport model (hence EMEP-LRT) on a 150x150 km scale (Sandnes, 1993) were used to obtain concentration fields of acidifying components over Germany. This model uses annual mean emission maps of SO_2, NO_x and NH_3 on a 50x50 km grid as input. The concentration at 50m is taken to be representative for an EMEP-LRT gridcell of 150x150 km, and is consequently used to estimate the deposition to surfaces within this area. Daily averaged values of the concentration of SO_2, NH_3, NO, NO_2, HNO_3 and SO_4-, NO_3- and NH_4-particles were calculated and used as input for EDACS.

Air concentrations of base cations were estimated from precipitation concentrations using scavenging ratios. The latter were derived from simultaneous measurements of base cation concentrations in precipitation and surface-level air, using a relatively simple scavenging process model (Draaijers *et al.*, 1996). This approach to estimate air concentrations is based on the premise that cloud droplets and precipitation efficiently scavenge particles and that the surface layer is well mixed and that washout is larger than rainout, resulting in a strong correlation between concentrations in precipitation and the surface-level air (Eder and Dennis, 1990). Factors that will influence the magnitude and variability of scavenging ratios include ambient concentration (Galloway *et al.*, 1993), particle size distribution (Kane *et al.*, 1994; Jaffrezo and Colin, 1988; Buat-Menard and Duce, 1986) and to a lesser extent particle solubility (e.g. Slinn *et al.*, 1978; Jaffrezo and Colin, 1988), precipitation amount (Barrie, 1985; Savoie *et al.*, 1987), precipitation rate (Slinn, 1977; Scott, 1981), droplet accretion process (Scott, 1981) and storm type (Barrie, 1992). Event scavenging ratios can differ several orders of magnitude even for single species at a single location but scavenging ratios have been found reasonably consistent when averaged over one year or longer (Galloway *et al.*, 1993). For this reason, annual mean precipitation concentrations were used to infer annual mean air concentrations of Na^{+}, Mg^{2+}, Ca^{2+} and K^{+}. Precipitation concentration data were obtained from the INS (Institut für Navigation in Stuttgart). They used data from measurement stations to estimate precipitation concentrations and wet deposition on a 5x5 km scale over Germany.

2.3 Results of dry deposition calculations

2.3.1 Dry deposition of acidifying components

In the next sections the calculated dry deposition fields over Germany are presented. The different maps show average dry deposition results for the period 1987-1989 and 1993-1995 for SO_x, NO_y, and NH_x, respectively.

2.3.1.1 Dry deposition calculations of SO_x and NO_y based on EMEP concentrations

Figure 7 and *Figure 8* show dry deposition maps of oxidised sulphur and oxidised over Germany estimated with the EDACS model (in eq ha^{-1} y^{-1}). Dry deposition values for most components vary over Germany to a large extent. This is partly the result of the variation in the deposition velocities (which are governed by differences in land use and meteorological conditions) but also of the concentration patterns over Germany associated with the distribution of emissions. However, as EMEP model results are used, concentrations vary only between 150x150 km grid cells. Areas with high concentrations can be detected in the maps, e.g. for SO_x in eastern Germany.

Figure 7: Average annual mean dry deposition of SO_x in 1987-1989 and 1993-1995 (eq ha^{-1} y^{-1})

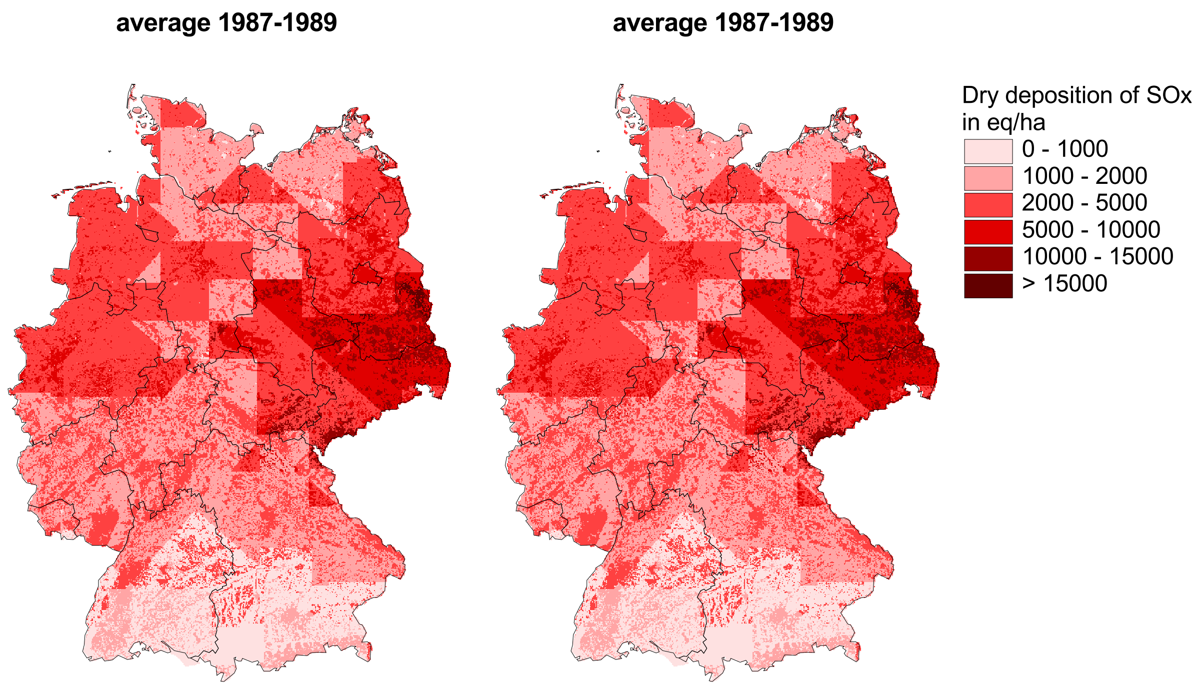
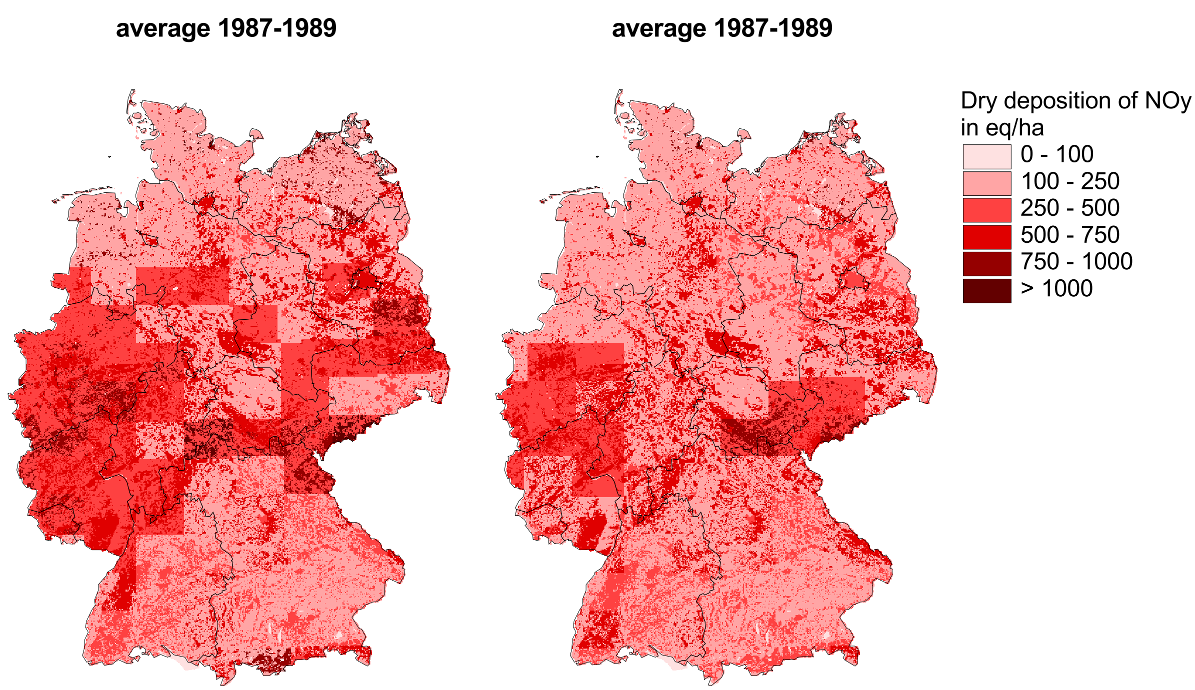


Figure 8: Average annual mean dry deposition of NO_y in 1987-1989 and 1993-1995 (eq ha^{-1} y^{-1})



2.3.1.2 Dry deposition of NHx based on local emissions

Figure 9 shows the dry deposition of NH_x based on local scale emissions of ammonia (see 2.1.2.1). As already stated in section 2.1.2 only meteorological data are available for 1990. Therefore, the change in deposition present in the maps of *Figure 9* is based only on changes in ammonia emissions. There is, however, also a meteorological component involved in the overall change of deposition over the years. A meteorological correction was applied on the EUTREND results, which was based on EDACS calculations. This was done by performing two calculations for each year under study (e.g. 1995), for which the concentrations for 1995 were used and respectively the meteorological data for 1990 (the EUTREND calculations are based on these meteorological data) and for 1995. Dividing the deposition field of 1995 with the deposition field of 1990 gives a field with correction factors that have to be multiplied with the EUTREND 1995 results, in order to get a deposition field that is corrected for the meteorological influences of that specific year. The result of this correction is shown in *Figure 10* and *Figure 11*.

Figure 9: Average annual mean dry deposition of NH_x in 1987-1989 and 1993-1995 (eq ha^{-1} y^{-1}) based on local scale emissions

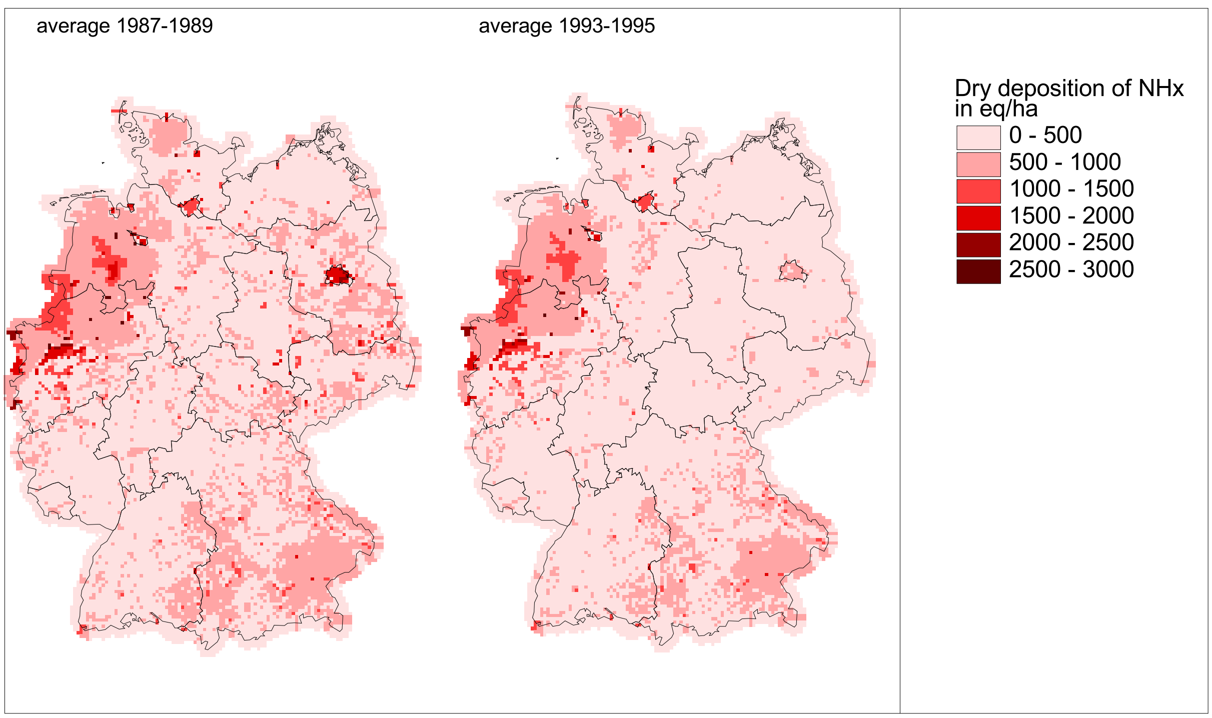


Figure 10: Average annual mean dry deposition of NH_x in 1987-1989 (eq ha^{-1} y^{-1}) based on local scale emissions, with; left, uncorrected and right, corrected for meteorological influences

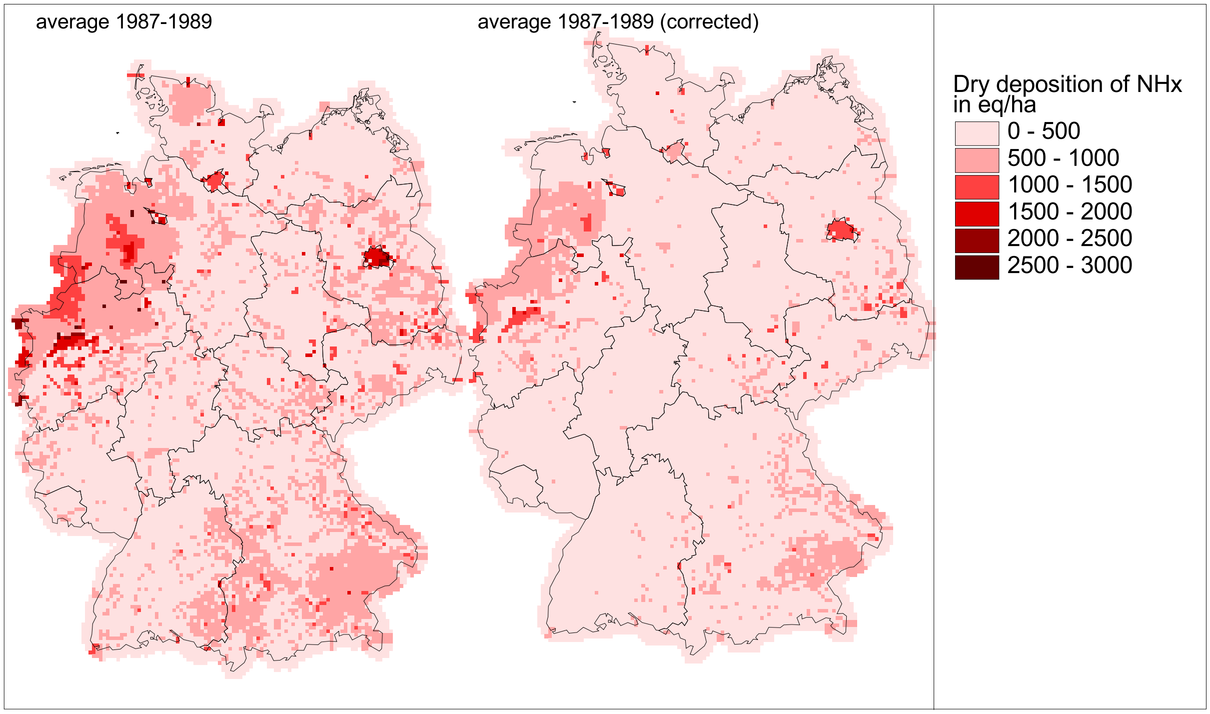
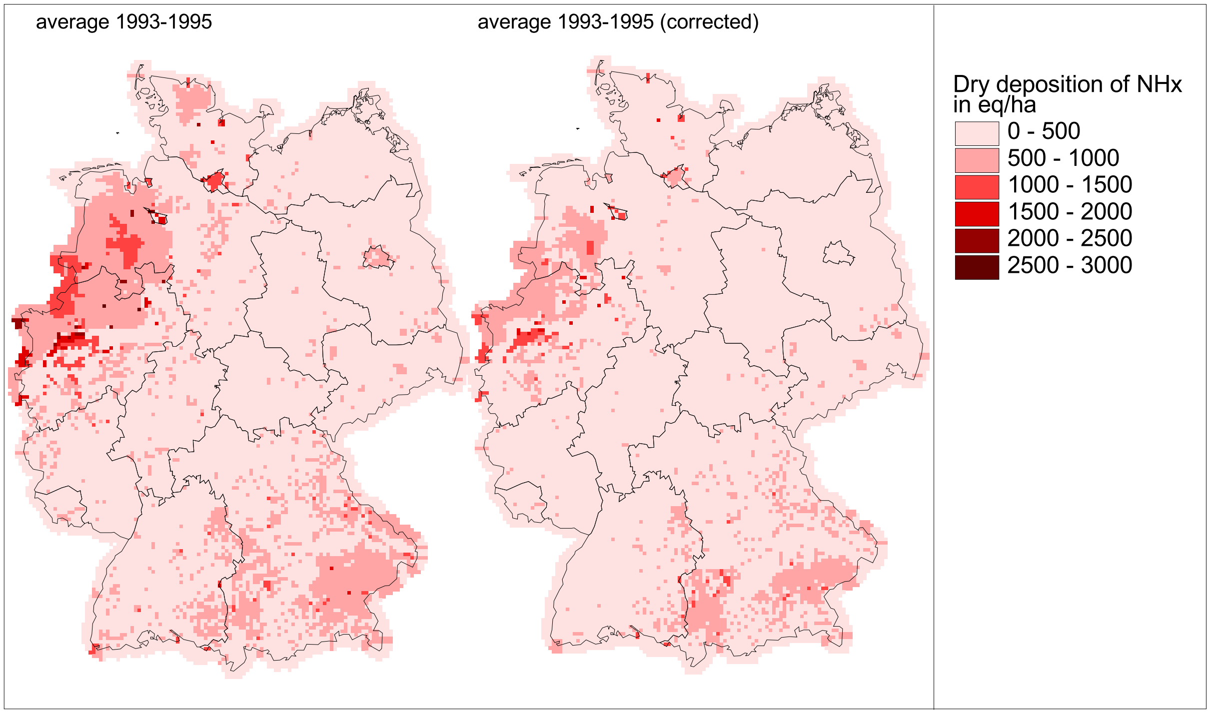


Figure 11: Average annual mean dry deposition of NH_x in 1993-1995(eq ha^{-1} y^{-1}) based on local scale emissions, with; left, uncorrected and right, corrected for meteorological influences

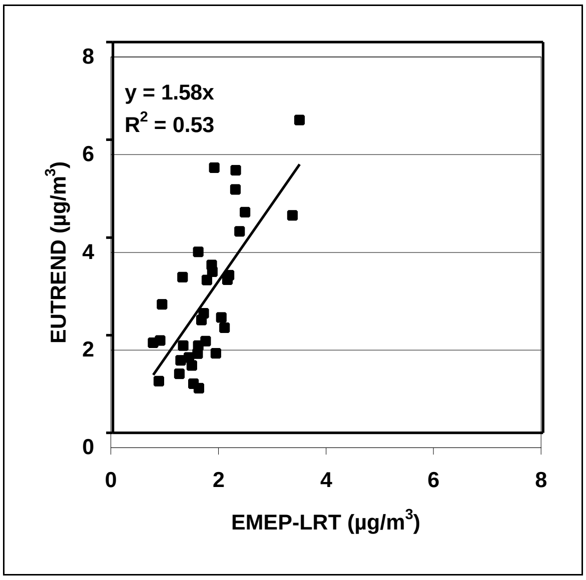


Comparison with modelled EMEP-LRT air concentrations and measured EMEP precipitation concentrations

In order to validate the outcome of the EUTREND model (including the emissions used) the results should be compared with measurements. Comparing on the basis of atmospheric ammonia concentrations would be the most direct action but such measurements where not available. A recent comparison of results of a similar model approach with measurements in the Netherlands for the period 1993-1998 revealed a relatively high spatial correlation (R^2 = 0.9; 7 stations) but an underestimation of NH_3 concentrations of almost 30%. Similar results were obtained for the modelled wet deposition (R^2 = 0.9; 14 stations).

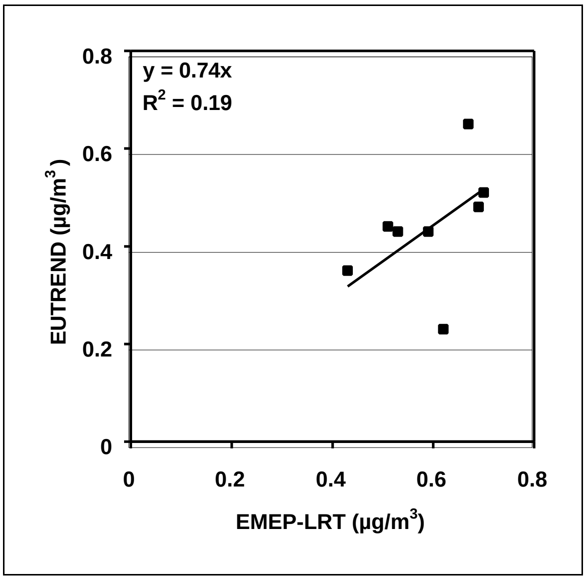
The ammonia concentrations calculated by means of the EUTREND model were compared to those calculated by the EMEP-LRT model. The comparison is made per EMEP grid cell. *Figure 12* shows the comparison of the averages per EMEP grid cell for both the EUTREND and EMEP-LRT model results. Van Leeuwen *et al*. (1996) based their dry deposition estimates for NH_x on the EMEP-LRT modelled air concentrations. *Figure 12* shows that, on average, the calculated EUTREND air concentrations are 56% higher than the EMEP-LRT values.

Figure 12: Comparison of EUTREND and EMEP-LRT modelling results for NH_3 concentration (µg m^{-3})



In the present case the measured wet deposition in the EMEP network is used for validation purposes. For the 8 stations, which were in operation in 1994, the concentrations are calculated using EUTREND on the basis of NH_3 emissions in Germany and other European countries. The results are given in *Figure 13*. The largest discrepancy is found for the EMEP station Westerland, which is a coastal station at the German Bight. It turns out that the model approach gives 25 % lower concentrations in precipitation. This result is consistent with the Netherlands situation. One of the suggestions is a general underestimation of ammonia emissions, especially those of manure application.

Figure 13: Comparison of modelled concentration in precipitation with observations of the EMEP network for the year 1994



Comparison of the German average dry deposition calculated in the preceding project (Van Leeuwen *et al.*, 1996) with the German average dry deposition obtained from the EUTREND model revealed the latter to be a factor two higher. This results from dry deposition velocities calculated by the EUTREND model being higher than those calculated by the EDACS model (Van Leeuwen *et al.*, 1996).

2.3.2 Dry deposition of base cations

Figure 14 to *Figure 18* show the calculated dry deposition of Ca^{2+}, Na^{+}, K^{+} and Mg^{2+} and non-sea salt Mg^{2+}+Ca^{2+}+K^{+}, averaged for the three year periods of 1987-1989 and 1993-1995. These depositions were calculated using the EDACS model in combination with air concentration data derived according to *Paragraph 2.2.2*. The difference between the depositions for the two periods under consideration is to a large extend caused by the difference in the measured precipitation concentrations (Gauger *et al.*, 1999).

Figure 14: Average annual mean dry deposition of Ca^{2+} in 1987-1989 and 1993-1995 (eq ha^{-1} y^{-1})

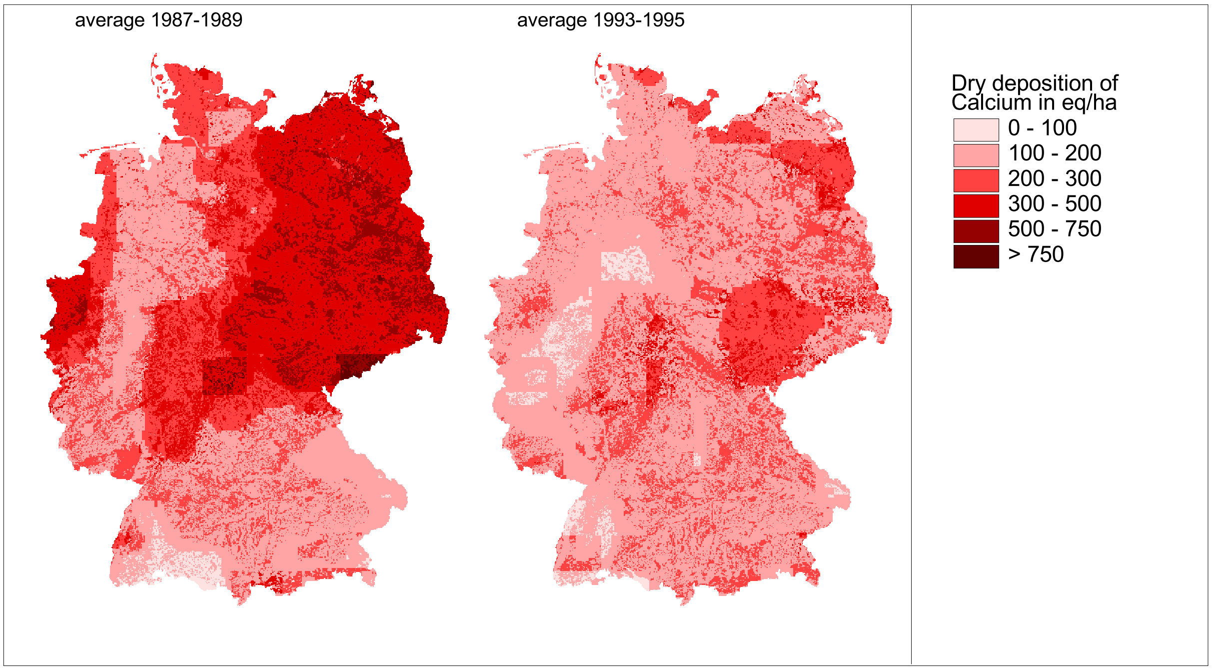


Figure 15: Average annual mean dry deposition of Na^{+} in 1987-1989 and 1993-1995 (eq ha^{-1} y^{-1})

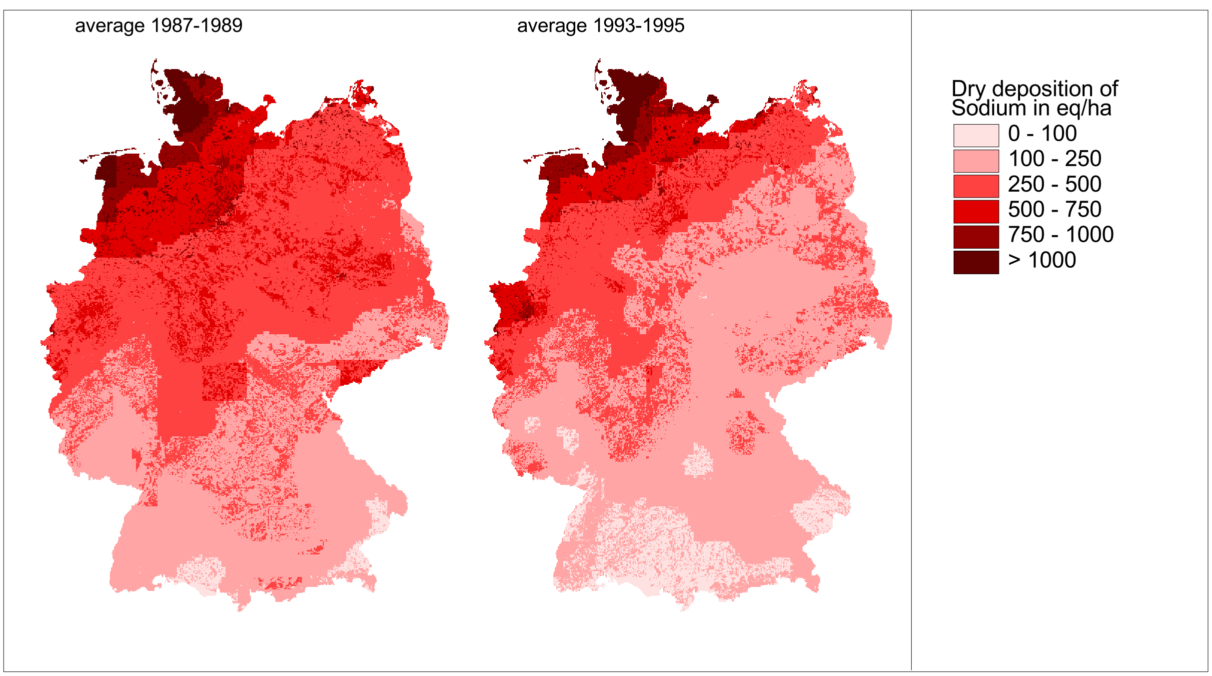


Figure 16: Average annual mean dry deposition of K^+ in 1987-1989 and 1993-1995 (eq ha^{-1} y^{-1})

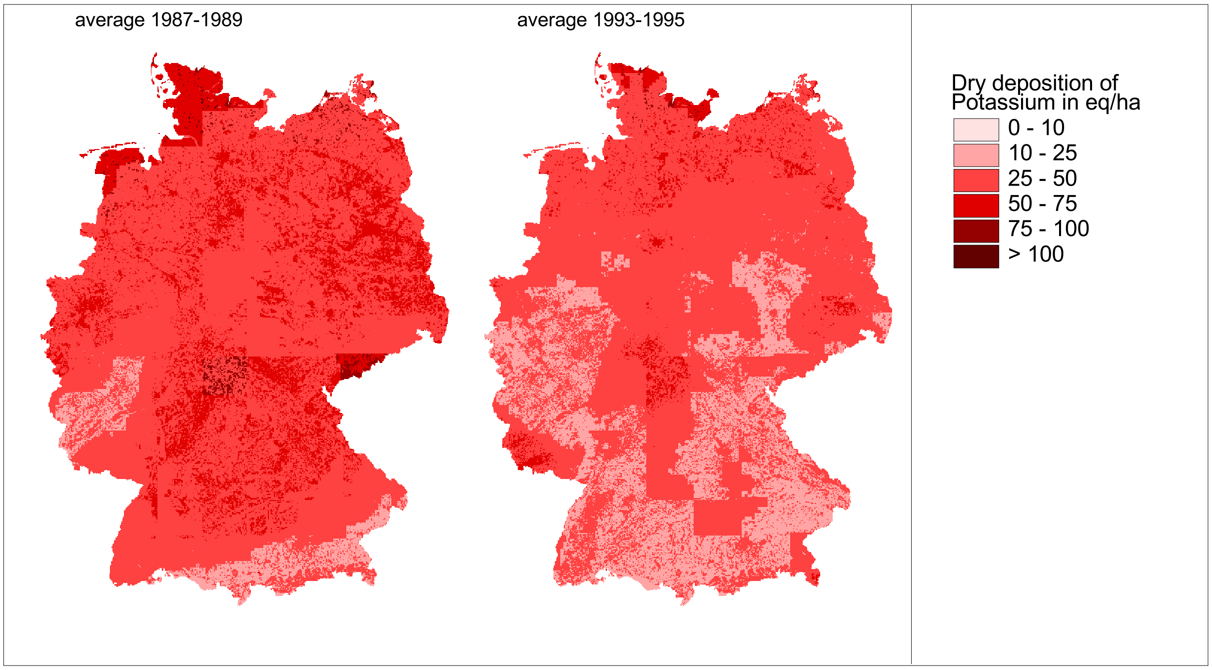


Figure 17: Average annual mean dry deposition of Mg^{2+} in 1987-1989 and 1993-1995 (eq ha^{-1} y^{-1})

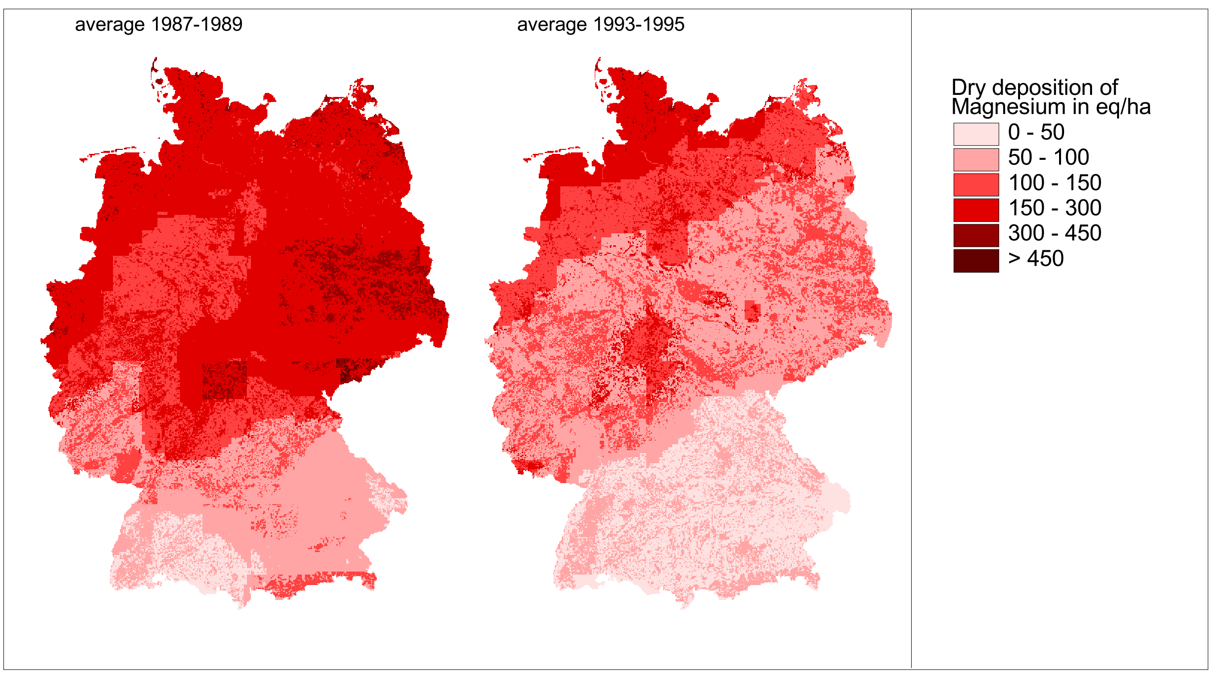
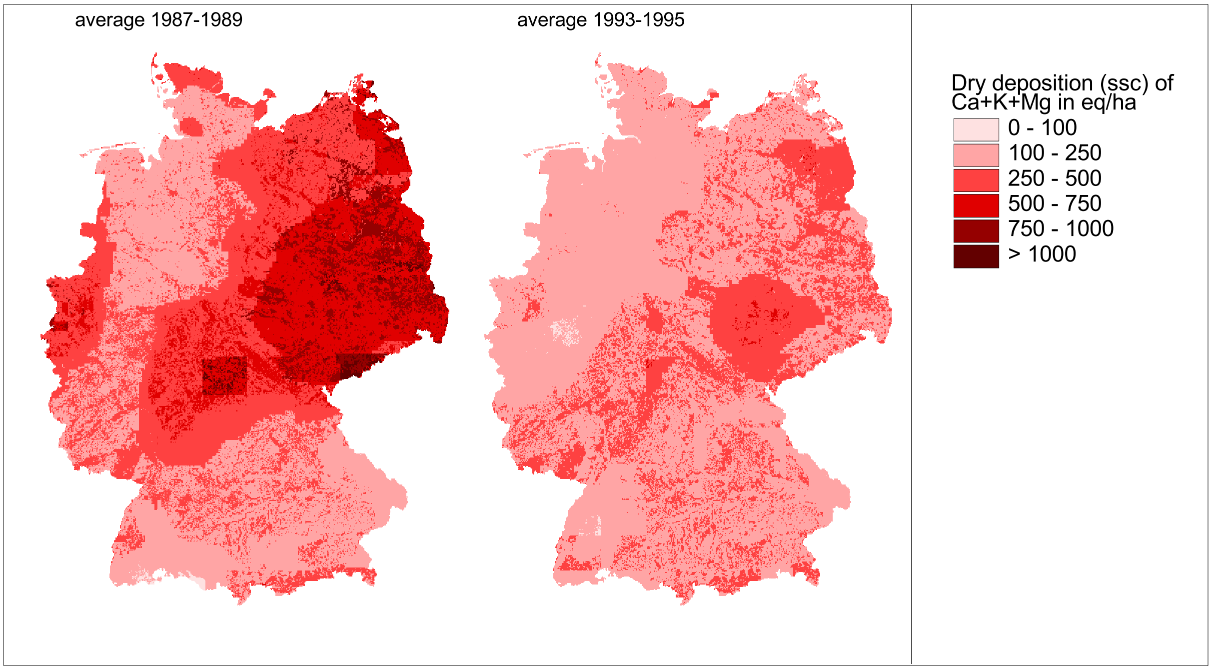


Figure 18: Average annual mean dry deposition of sea salt corrected $Ca^{2+}+K^{+}+Mg^{2+}$ in 1987-1989 and 1993-1995 (eq ha^{-1} y^{-1})



2.3.3 Total deposition of acidifying components and base cations

In *Table 4* the country averaged dry, wet and total deposition of the acidifying components is listed. *Table 5* contains the deposition for the sea-salt corrected base cations. For calculating these total depositions, the dry deposition, as presented in the previous paragraphs, is added to the wet deposition. The wet deposition of the different components was derived from measurements by INS (Gauger *et al.*, 1999). *Table 6* gives the deposition of potential acid, total nitrogen and sea-salt corrected base cations per Bundesland as an average for the period 1987-1989 and 1993-1995. Also included in this table are the differences for these periods (in percentages).

Table 4: Country averaged dry, wet and total deposition of acidifying components in eq ha^{-1} y^{-1}.

	SOx			NOy			NHx			Nitrogen			Pot. Acid		
	dry	Wet	tot.	dry	wet	tot.	dry	wet	tot.	dry	Wet	tot.	dry	wet	tot.
1987	3998	1013	5011	358	355	713	479	479	958	837	834	1671	4835	1847	6682
1988	2970	900	3870	319	344	663	472	466	938	791	810	1601	3761	1710	5471
1989	2306	751	3057	394	325	719	469	475	944	863	800	1663	3169	1551	4730
1993	2004	557	2561	320	309	629	376	422	798	696	731	1427	2700	1288	3988
1994	1546	526	2072	311	312	623	373	413	786	684	725	1409	2230	1251	3481
1995	1218	462	1680	303	295	598	370	401	771	673	696	1369	1891	1158	3049

Table 6: Country averaged dry,wet and total deposition of sea-salt corrected base cations in eq ha^{-1} y^{-1}.

	Ca (ssc)			K (ssc)			Mg (ssc)			BC (ssc)		
	dry	Wet	tot.	dry	wet	tot.	dry	wet	tot.	dry	wet	tot.
1987	284	316	600	40	43	83	64	46	110	388	405	793
1988	287	300	587	32	32	64	61	38	99	380	370	750
1989	296	263	559	37	32	69	54	29	83	387	324	711
1993	194	173	367	30	31	61	26	17	43	250	221	471
1994	179	160	339	25	26	51	22	15	37	226	201	427
1995	134	113	247	28	29	57	15	9	24	177	151	328

Table 7: Averages of the dry deposition of potential acid, total nitrogen and base cations per Bundesland (in eq ha^{-1} y^{-1}) for the periods 1987-1989 and 1993-1995, as well as the difference between the two periods (in %).

	Potential Acid			Total Nitrogen			Base Cations (ssc)		
Bundesland	87-89	93-95	diff	87-89	93-95	diff	87-89	93-95	diff
Schleswig-Holstein	2797	2131	-24	702	652	-7	263	159	-39
Mecklenburg-Vorpommern	3223	1879	-42	682	440	-36	518	250	-52
Niedersachsen	3832	2453	-36	837	763	-9	258	168	-35
Hamburg	4200	3051	-27	1220	1218	0	339	165	-51
Brandenburg	6815	3626	-47	901	559	-38	670	273	-59
Bremen	5481	3823	-30	1655	1537	-7	223	175	-21
Sachsen-Anhalt	5564	2761	-50	756	498	-34	616	272	-56
Berlin	9325	4021	-57	2119	899	-58	768	304	-60
Nordrhein-Westfalen	4272	2606	-39	1100	958	-13	316	157	-50
Sachsen	7741	4210	-46	877	639	-27	717	287	-60
Hessen	3591	1952	-46	772	647	-16	447	276	-38
Thüringen	4685	2672	-43	880	657	-25	601	293	-51
Rheinland-Pfalz	3228	1733	-46	760	658	-13	256	201	-22
Bayern	2636	1582	-40	819	730	-11	263	209	-21
Baden-Württemberg	2052	1290	-37	707	670	-5	225	188	-16
Saarland	2584	1515	-41	751	646	-14	240	283	18

2.4 Uncertainty in the dry deposition maps

Uncertainty in the dry deposition estimates originates from uncertainty in a) air concentrations, and b) dry deposition velocities. In the last paragraph of this section (2.4.3) the site-level deposition estimates based on EDACS/EUTREND (wet/dry) for 1989 are compared with throughfall measurements, in order to give an impression of the total uncertainty in the sum of calculated (dry) and measured (wet) depositions.

2.4.1 Air concentrations

Sulphur and nitrogen compounds

The concentration at 50m above ground level is taken to be representative for an EMEP LRT gridcell of 150x150 km, and is consequently used to estimate the deposition to surfaces within this area. Uncertainty in the air concentration derived from the EMEP-LRT model is not yet

quantified. However, comparison studies, performed by EMEP, show a significant difference between modelled and measured concentrations for a number of German EMEP measuring sites (Tarrason, 1998; EMEP,1998). This difference is most pronounced during the winter months with de modelled concentrations being higher than measured concentrations, while the difference seems to increase in the period 1990-1995 compared to 1980-1985. For the present study this means that there will be a systematical overestimation of dry SO_2 deposition in more recent years.
With regard to the spatial representativity of the air concentrations it is important to mention that the consequence of using model calculated concentrations is that the distribution within gridcells of 150x150 km is homogeneous. In reality this is not the case in a gridcell that contains industrialised areas or many scattered sources such as intensive animal husbandry farms and/or roads. For such conditions, sub-grid concentration variations will be present. The uncertainty in the deposition in a 1/6°x1/6° grid cell due to these concentration gradients is assumed to be 25% on the average (Van Pul *et al*., 1995). In addition, the EMEP model does not account for the effect of local deposition on air concentrations as only the long-range transported fraction of pollutants is accounted for.

Base cations
Uncertainty in the base cation air concentrations is introduced by uncertainties in the scavenging ratios and precipitation concentration maps used to estimate air concentrations. The overall uncertainty in average precipitation concentration per 5x5 km grid cell is caused by uncertainty in the measurements and the interpolation procedure (Gauger *et al*., 1999). Theoretical models (Slinn, 1982) and field measurements (Kane *et al*., 1994) suggest that the scavenging efficiency increases with particle diameter. Using the relationship between particle mass median diameter and scavenging efficiency presented by Kane *et al*. (1994), the uncertainty in estimated ambient air concentrations caused by variation in size distribution was estimated to amount (50-100% per 50x50 km), assuming an average mass median diameter (MMD) of 5 µm and taking a geometric standard deviation (σ_g) of 2-3. Large potential errors may arise in areas very close or far away from major sources, areas where sufficient mixing has not occurred and/or areas with a strongly deviating precipitation climatology. In the scavenging model the impact of particle solubility, precipitation amount, precipitation rate, droplet accretion process and storm type is not taken into account (Draaijers *et al*., 1998).

2.4.2 Dry deposition velocities

The uncertainty in the dry deposition velocities is mainly the result of using the simple resistance formulation for a highly complex process, and, more specifically, the surface resistance (R_c) parameterisations. Accurate R_c parameterisations are not always available for all vegetation species, surface types and conditions. The influence of surface wetness is up to now parameterised only very roughly. It is found to be one of the major factors influencing the deposition process of soluble gasses. The overall uncertainty in the surface resistance parameterisation due to above mentioned factors varies between 20% and 100%, and depends on component and surface type (Van Pul *et al.*, 1995). They report and quantify other sources of uncertainty as well. The accuracy of the presented results will also depend on the quality of the meteorological and the land use data. Uncertainties in these data are not yet accurately quantified.

Ruijgrok *et al.* (1994) assessed the uncertainty of the model on which the parameterisation of the deposition velocity of base cations was based. The overall uncertainty in modelled deposition velocities integrated over the size distribution representative for alkaline particle at the Speulder forest was found to equal 60%. For other sites additional uncertainty will arise due to limited availability and accuracy of relevant land use information and meteorological parameters. The uncertainty in deposition velocity caused by variation in size distribution of alkaline particles amounts 30-50% per 50x50 km grid cell, assuming a MMD of 5 µm and taking a σ_g of 2-3 to represent the variation (Ruijgrok *et al*., 1994). The MMD of particles at a particular site will depend on the distance to sources and on e.g. ambient relative humidity (Fitzgerald, 1975). Draaijers *et al*. (1996) give a more extensive description of the uncertainty associated with dry deposition of base cations.

2.4.3 Dry deposition flux

The uncertainty in regional scale deposition estimates strongly depends on the pollution climate and on landscape complexity of the area under study. Deposition estimates yield higher uncertainty in areas built up by complex terrain and with strong horizontal concentration gradients. Until further research has been done on the total uncertainty in the annual dry deposition estimates, only rough estimates of uncertainty can be given. It is thought that the uncertainty in deposition estimates per 1/6°x1/6° grid cell can be as large as 100%. Systematic errors in dry deposition estimates may arise from neglecting complex terrain effects in the parameterisation of the deposition velocity. For base cations, systematic errors may also arise from using scavenging ratios which are based on only a limited set of simultaneous ambient air and precipitation concentration measurements, and using annual mean air concentrations and deposition velocities for flux calculation, thereby neglecting temporal correlation. From previous research it was concluded that modelled dry deposition fluxes and throughfall estimates both compare reasonably well taking into account the relatively large uncertainty in both estimates. The outcome of that comparison suggests that the EDACS-model is suitable for mapping of acidifying components and base cations on a high resolution. However, recent comparisons (see also next paragraph) suggest that dry deposition of (especially) SO_x is overestimated by the EDACS-model. In *Chapter 6* this will be further discussed.

2.4.4 Comparison between modelled and measured dry depositions

A comparison was made between site-specific dry deposition modelled by EDACS/Eutrend and dry deposition derived from measured throughfall and precipitation measurements using the canopy budget model of Draaijers and Erisman (1995). NH_x and K^+ being the only exceptions, significant relationships ($p<0.05$) were found between modelled and measured dry deposition (*Figure 19* and *Figure 20*). Although generally a considerable scatter can be observed, on average for NH_x, Mg^{2+}, Ca^{2+} and K^+ modelled dry deposition was not significantly different from measured dry deposition (*Table 8*). Dry deposition of SO_x, NO_y and Na^+, however, was significantly overestimated by the EDACS model (on average by a factor of 1.67, 1.58 and 1.75, respectively). For SO_x and NO_y this can be explained by EDACS using EMEP modelled air concentrations, which in Germany have been found too high, compared to measured air concentrations. For Na^+ the explanation is less obvious. The EDACS model uses scavenging ratios for deriving annual air concentrations from annual average precipitation concentrations. Annual average Na^+ air concentrations will strongly depend on the occurrence of storm events. When it is not raining during these storm events annual average rain concentrations will not (or less) be influenced. This will result in wrongly estimated air concentrations derived from annual scavenging ratios and precipitation concentrations.

Differences between modelled and measured dry deposition can also be attributed to the uncertainty in the throughfall measurements and assumptions underlying the canopy budget model of Draaijers and Erisman (1995). For example, canopy uptake of oxidised nitrogen, not taken into account in the canopy budget model, may account for part of the difference observed between modelled and measured NO_y dry deposition.

Figure 19: Relationships between modelled dry deposition and dry deposition estimated from throughfall and bulk precipitation measurements.

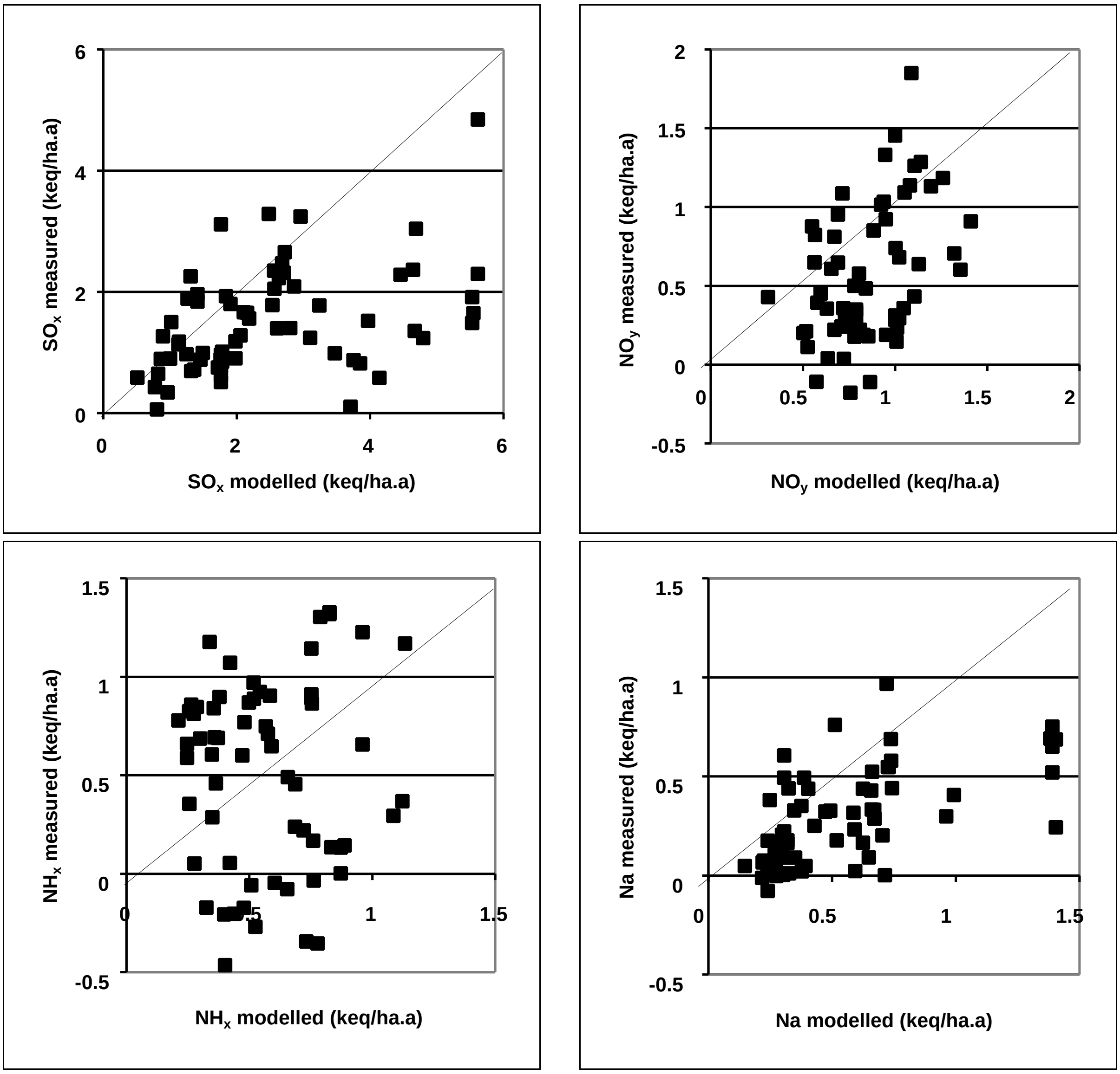


Figure 20 *Relationships between modelled dry deposition and dry deposition estimated from throughfall and bulk precipitation measurements.*

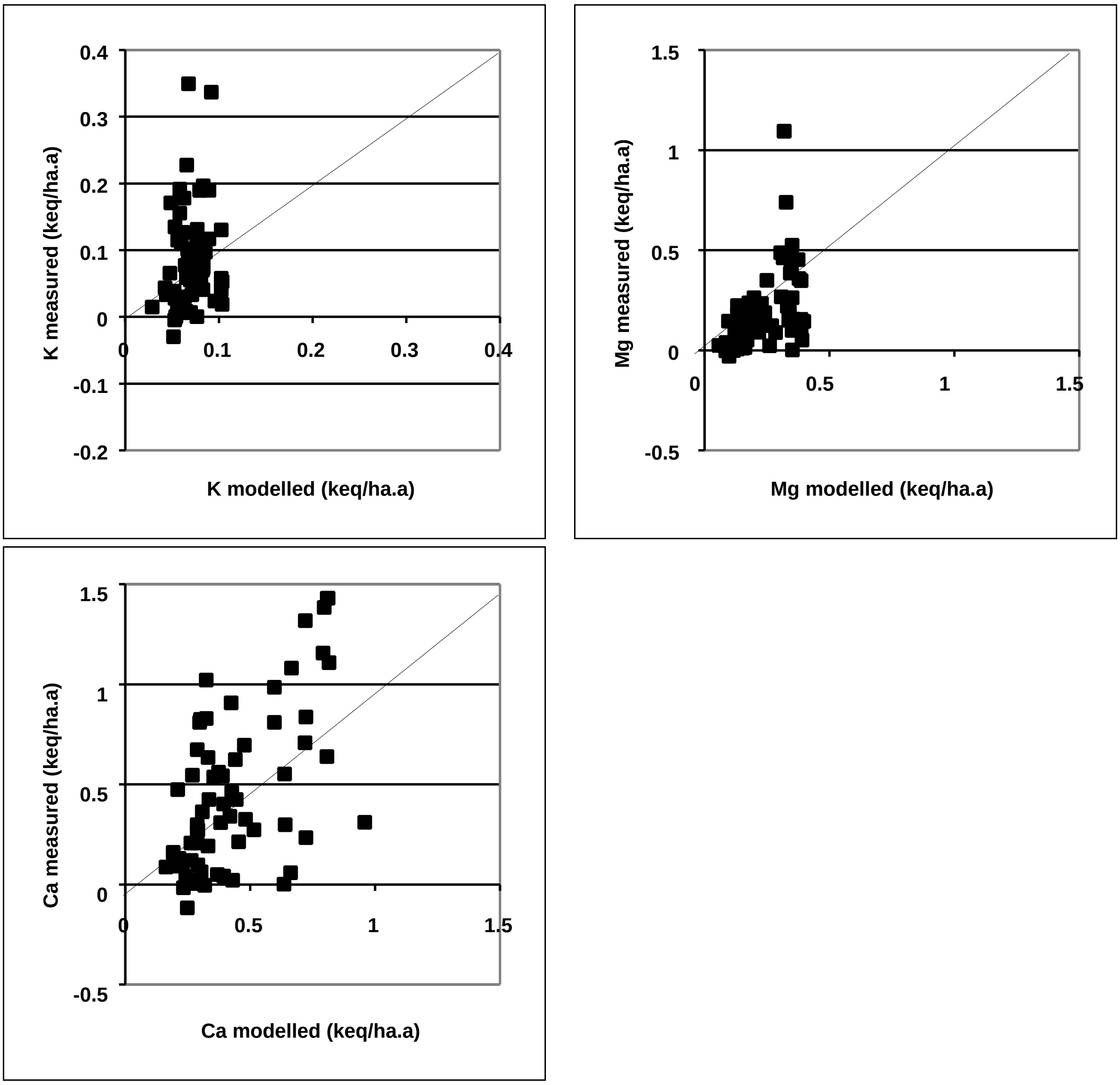


Table 8: *Pearson correlation coefficients of linear regression equations between modelled and measured dry deposition as well as the average ratio between modelled and measured dry deposition. Results of a 'paired two sample for means' t-test are also presented to see whether both estimates are equal on the average or not. * denotes both estimates differ not significantly (p<0.05; n=67).*

	SO_x	NO_y	NH_x	Na^+	Mg^{2+}	Ca^{2+}	K^+
r	0.42	0.41	0.30	0.69	0.50	0.59	0.18
ratio model/measured	1.67	1.58	1.13	1.75	1.22	0.90	0.85
t-test			*		*	*	*

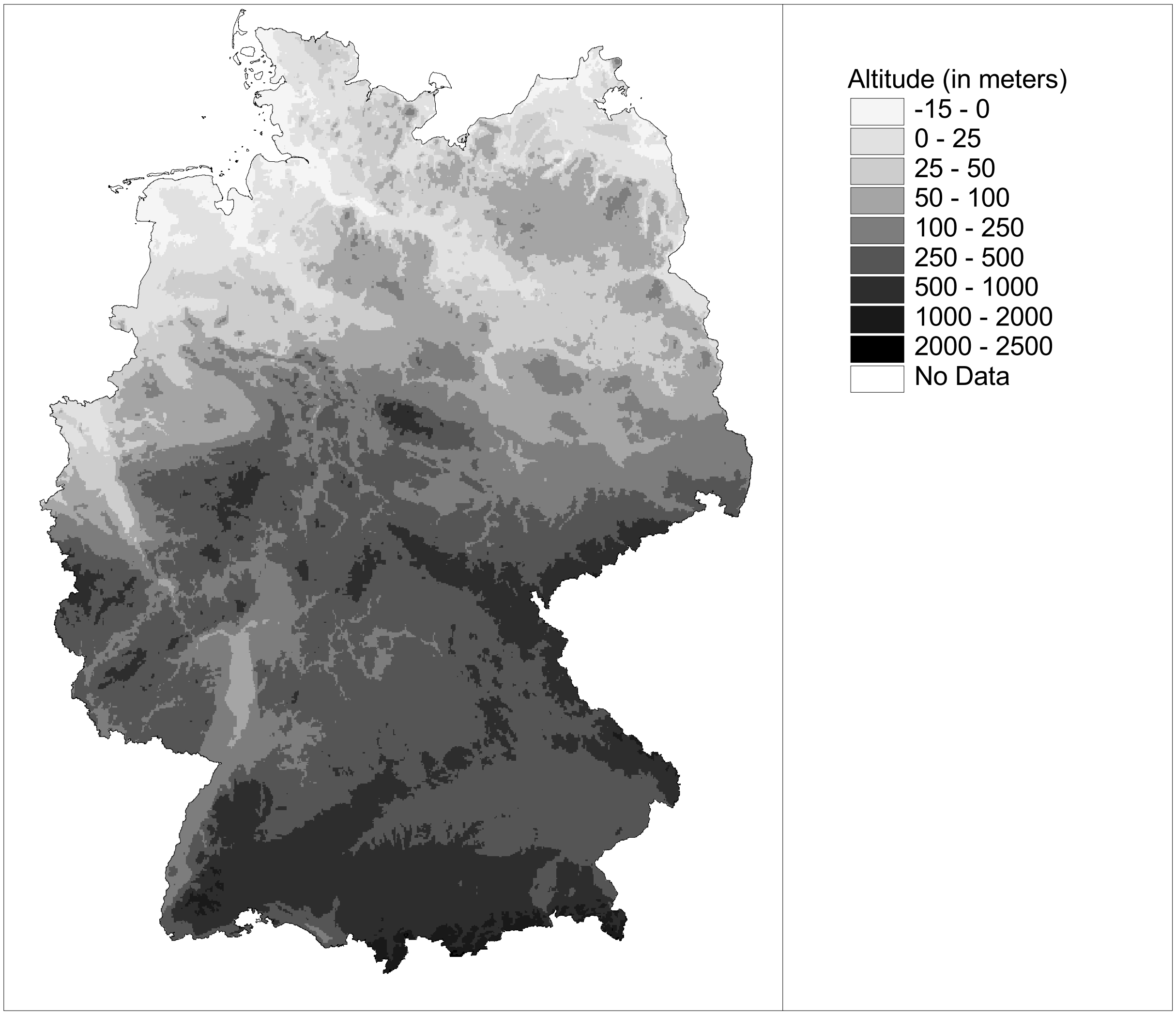
3 Calculating cloud deposition

3.1 Concept of cloud deposition modelling

Hill or mountain cloud occur either as a result of condensation processes in moist air lifted by mountains (hence the term orographic cloud), or by intrusion of mountaintops into a low level cloud deck. Hill cloud can be distinguished from radiation fog, which is formed very often on low ground as the ground surface temperature falls as a consequence of radiative cooling to a 'cold' clear sky and the air close to the ground is cooled below the dew point. Activation of aerosols in the air close to the ground then produces fog droplets, which grow as the cooling proceeds. The microphysical properties of hill cloud and radiation fog and their patterns and rates of growth are therefore driven by quite different processes. The chemical properties of radiation fog are also found quite different with mean concentrations of all species large relative to those for hill cloud and strongly coupled to local sources. Therefore, this section focuses on the chemistry of hill, (orographic) cloud water.

The presence of clouds at hillsides can be estimated from an interpolated cloud frequency map of Europe based on cloud height and cloud presence data from NCAR (time resolution 6 hrs.). This information should be used in conjunction with a Digital Terrain Model (DTM) to determine occurrence of cloud deposition (see *Figure 21*).

Figure 21: Elevation of Germany in meters above sea level



3.1.1 Estimation of cloud deposition

Cloud deposition is modelled by determination of the water flux of cloud droplets and the concentration of all relevant components in the droplets. In the next paragraphs this will be described.

3.1.1.1 Calculating the water flux

There are different ways of calculating the water flux. The first one being described makes a distinction between the turbulent water flux and the sedimentation water flux. The second one expresses the deposition rates as a deposition velocity very similar to those for momentum.

Turbulent water flux and sedimentation water flux

When making a distinction between the turbulent water flux and the sedimentation water flux, the cloud deposition can be estimated from:

$$F_{d,x} = (F_t C_x) + (F_s C_x)$$

in which:

$F_{d,x}$ = cloud deposition flux of component x

F_t = turbulent cloud water flux

F_s = sedimentation cloud water flux

C_x = mean concentration in the cloud droplets

Turbulent water flux

The turbulent water flux of cloud droplets can be estimated from:

$$F_t = v_t LWC$$

in which:

F_t = turbulent cloud water flux (mg/m2.s)

v_t = turbulent deposition velocity of cloud droplets (m/s)

LWC = liquid water content of clouds (mg/m^3)

v_t can be calculated from parameterisations made by Callagher *et al.* (1992) from data at Great Dunn Fell, UK:

$$v_t = (-0.011R^2 + 0.311R - 1.41)v_m$$ (derived for forest from correlation measurements)

$$v_t = (-0.0173R^2 + 0.315R - 1.30)v_m$$ (derived for moorland from gradient measurements)

$$v_m = \frac{ku_*}{\ln(z/z_0)}$$

in which:

u_* = friction velocity (m/s)

v_m = deposition velocity for momentum (m/s)

R = droplet radius (µm)

k = Von Karman constant

z = measurement height above the zero plane displacement (m)

z_0 = canopy roughness length (cm)

Using Gallagher's v_t parameterisations with the droplet radius and v_m, v_t should be integrated over the entire droplet size range.

The turbulent deposition velocity of cloud droplets was also parameterised by Vermeulen *et al.* (1994) from eddy correlation measurements at the Speulder forest:

$$v_t = 0.195 u_*^2$$

Water flux through sedimentation

The sedimentation flux of cloud droplets can be estimated from:

$$F_s = v_s LWC$$

in which:

v_s = sedimentation velocity of cloud droplets (m/s)

v_s can be calculated according to Stoke's law:

$$v_s = \frac{2 r_v g \rho_w}{9 \rho_a \eta}$$

in which:

r_v = mean volume weighted cloud droplet radius (µm)

g = gravity acceleration (m/s^2)

?$_w$ = density of water (kg/m^3)

?$_a$ = density of air (kg/m^3)

? = kinematic viscosity of air (m^2/s)

v_s must be integrated over the entire droplet size range.

Liquid water content (LWC) of clouds

The liquid water content can either be derived as an average of measurements made at different locations in Europe, or it can be obtained using information on horizontal visibility.
LWC's were found ranging from 84 to 164 mg m^{-3} (Gallagher *et al.*, 1992), from 200 to 400 mg m^{-3} (Saxena and Lin, 1990), from 10 to 400 mg m^{-3} (Lovett, 1984) and 160 mg m^{-3} (Dasch, 1988). From these measurements a mean LWC for cloud droplets of 150 mg m^{-3} can be derived.

The liquid water content can also be estimated according to Atlas and Bartnoff (1953) from:

$$LWC = \frac{K(n) \rho_w d_0}{V}$$

in which:

$K(n)$ = size dependent parameter (can be taken as a constant with value 1.2)

d_0 = mean diameter (µm)

V = horizontal visibility (m)

Deposition velocity similar to that for momentum

When using the equations above, capture of cloud droplets by vegetation varies with droplet radius. However, for typical hill cloud with droplets between 4 and 10 µm the rates of deposition expressed as a deposition velocity (V_d) are very similar to those for momentum (Reynolds *et al.*, 1997). They made the assumption that $V_d \approx r_a^{-1}$ for cloud droplets (where $r_a = u_z / u_*^2$, with u_z being the windspeed at reference height z and u_* the friction velocity obtained from the wind profile equation $u_z = u_* / k \cdot \ln(z - d / z_0)$ in which k is von Kármán's constant, d the zero-plane displacement and z_0 the roughness length). The only additional information required to calculate annual cloud droplet deposition is the mean concentration of the chemical species in cloud water and the cloud duration for the period under consideration.

3.1.1.2 Calculating the concentration of relevant components in cloud droplets

Measurements of the chemical composition of cloud water were initiated following observations of forest decline at high altitude sites in The United Stated of America, Canada and Europe. Concentrations in cloud droplets depend on air concentrations of aerosols and gases and their scavenging ratios and have been found highly variable in space and time. Usually concentrations have been found much larger in comparison to concentrations in precipitation measured at the same site. Weathers *et al*. (1988) reported for ten non-urban elevated sites in the USA average ratios between cloud water and precipitation concentrations of 3-7.

In Germany, forest decline has been found very severe at high elevation sites (e.g. Harz, Schwarzwald area) and it is hypothesised this may be the result of enhanced deposition due to the frequent coverage of these forests by hill clouds containing relatively large concentrations of acidifying compounds. To estimate cloud water deposition in Germany on a regional scale, among other parameters, the typical chemical composition of these hill clouds need to be determined. Here the results of a study are presented in which the chemical composition of hill cloud in Germany is estimated by combining well monitored precipitation composition fields with the average cloud water / rainwater ion concentration ratio derived from literature.

There is no formal network of cloud water samplers in Germany. For this reason, the cloud chemistry on a regional scale in Germany has been estimated using precipitation concentration fields along with the average ratio of cloud and rain concentrations derived from simultaneous cloud water and precipitation chemistry measurements. Data for 1993 were kindly provided by INS. They interpolated precipitation concentrations based on measurements at 182-271 sites (depending on component) in Germany for 1993. Concentration fields were derived using Kriging interpolation (Gauger *et al*., 1999).

3.2 Results

3.2.1 Ratios ion concentrations in cloud water and precipitation

Cloud water composition in relation to precipitation composition for a range of sites in Europe, the United States and Canada is presented in *Table 9* along with some site characteristics like the elevation above sea level. All sites are located in upland areas relatively remote from pollution sources. The ratios of ion concentrations in hill cloud to that in precipitation are variable and range between 0.7 to 13.8 with typical values between 3 and 7. Largest average ratios are found for the acidifying compounds SO_4^{2-}, NO_3^- and NH_4^+, i.e. 5.4-6.3. Smaller ratios are recorded for compounds mainly originating from sea spray (average ratios for Na^+ and Cl^- amount 4.6-5.0), for base cations (average ratios for Mg^{2+}, Ca^{2+} and K^+ equal 3.3-4.5) and for H^+ (average ratio of 3.2).

Figure 22 presents the relationship between ratio and elevation for the sites mentioned in *Table 9*. For almost all ions clear logarithmic relationships can be observed with ratios decreasing with increasing elevation. High elevation sites experience lower ratios due to dilution of more regional air masses by winds aloft and because high elevation sites receive comparatively high rates of wet deposition which may act to cleanse the atmosphere. Relatively high cloud water concentrations will be found near source areas and/or when the cloud is formed in the lower atmosphere where it will be particularly efficient at scavenging ambient materials which are concentrated near ground level. In *Table 10* best fitting regression models are presented for the relationships between ratio and elevation presented in *Figure 22*.

Table 9: Average ratio between cloud water and precipitation composition found for a range of sites in Europe, the United States and Canada along with some site characteristics.

site		**characteristics**	**elev. (in m)**	**period**	**Average ratio cloud water / rain concentration**								
					SO_4	**NO_3**	**NH_4**	**H**	**Na**	**Cl**	**Mg**	**Ca**	**K**
Dunclair Heights[1]	UK	upland forest	600	93-94	5.4	7	7.5						
Halladale[1]	UK	upland	337	93	8	12.8							
Great Dun Fell[1]	UK	upland	847	93	5	13.8	5.1						
Holme Moss[2]	UK	upland	600	94	4.6	6.6	4.2						
Castleaw[3]	UK	upland	450	86	12	7.6	10.5						
Llyn Brianne[4]	UK	hilltop with short grass	520	89-90	7.5	7.5	8.5	3.5	11	11	11	5	6.5
Mt Sonnblick[5]	A	on snow covered peak	3106	91	3	2	5	3					
Mt Rigi[6]	S	slope of 1800 m high mountain	1325	90-91	2.3	2.6	2.7						
Douglas Island[7]	USA	alpine vegetation in Alaska	800	84-85	5.6	7	3.5	3	4.8	6.3	5.5	5	5.3
Marys Peak[7]	USA	meadows and forest in Oregon	1245	84-85	2.7	3.4	4.6	2	0.9	0.7	0.9	1.4	1.2
Whiteface Mountain[8]	USA	above subalpine mixed spruce, fir and birch forest	1050	86-89	3.3	2.7	5.1	2.6	2.1	2.2	1.5	1.3	2.5
Cheeka Peak[9]	USA	on hill located 4 km from Pacific Ocean	460	93	6.5	5.6	3	5.7	6.9	7.7			3
Mont Tremblant e.o.[10]	CAN	average of 3 mountain sites	610	85-91	4	3.9	5.9	2.6	2.1	2.2	3.5	3.8	3.2

1 Fowler *et al*., 1995
2 Inglis *et al.*, 1995
3 Crossley *et al*., 1992
4 Reynolds *et al.*, 1996
5 Brantner *et al.*, 1994
6 Collett *et al.*, 1993
7 Bormann *et al.*, 1989
8 Miller *et al.*, 1993
9 Vong *et al.*, 1997
10 Schemenauer *et al.*, 1995

Figure 22: Relationship between cloudwater/rainwater concentration ratio and elevation for the sites mentioned in Table 9.

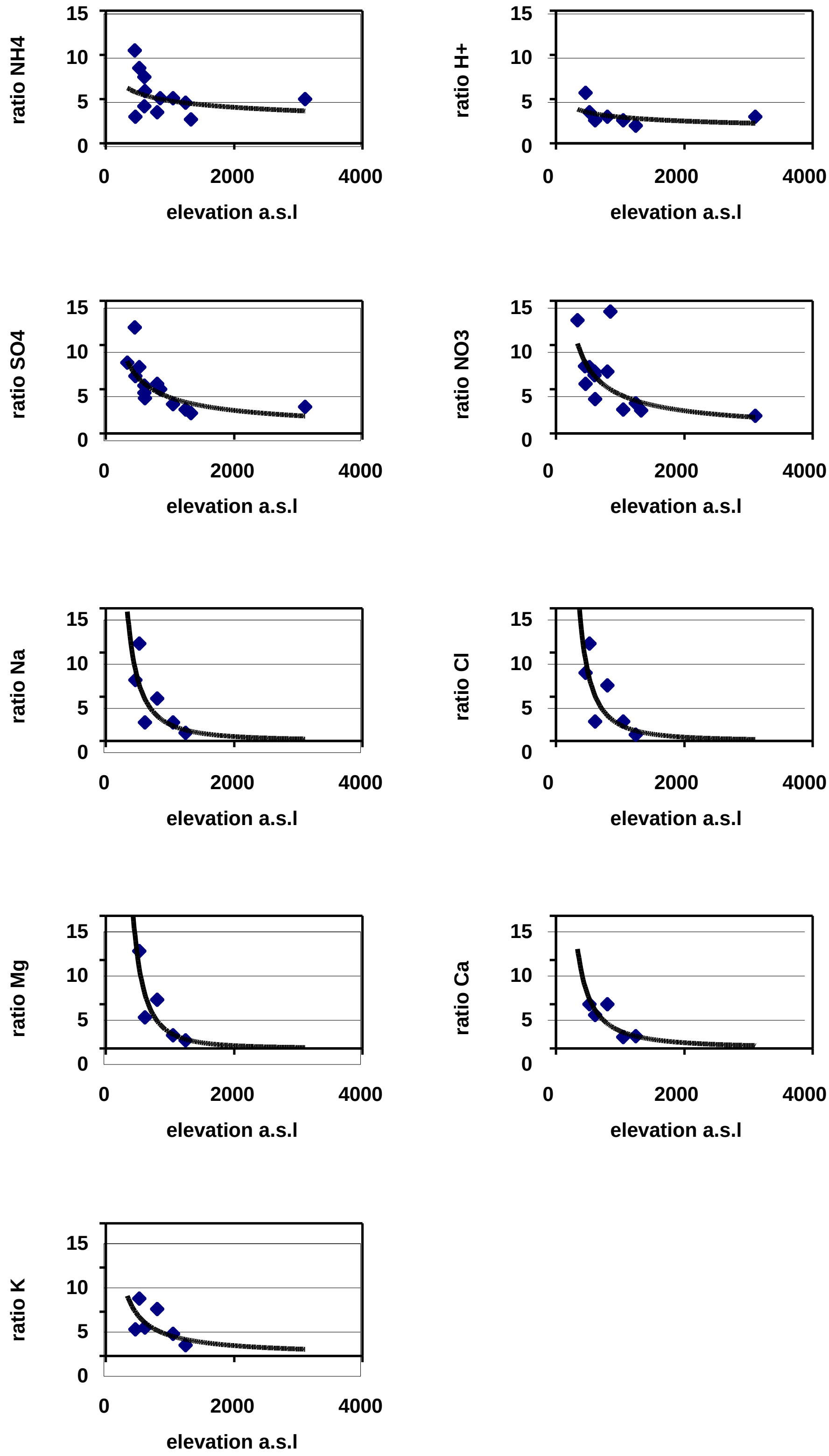


Table 10: Best fit models for the relationships between ratio(y) and elevation (x) as presented in Figure 22.

Component	Best fit model	R^2
SO_4^{2-}	$y = 341.19x^{-0.6413}$	0.6318
NO_3^-	$y = 911.66x^{-0.7727}$	0.5693
NH_4^+	$y = 25.584x^{-0.2418}$	0.1095
H^+	$y = 15.332x^{-0.2377}$	0.2279
Na^+	$y = 914276x^{-1.8975}$	0.6694
Mg^{2+}	$y = 6E+7x^{-2.5025}$	0.8268
Ca^{2+}	$y = 127404x^{-1.6038}$	0.7411
K^+	$y = 2150.2x^{-0.9892}$	0.4315
Cl^-	$y = 3E+6x^{-2.0905}$	0.6482

3.2.2 Regionalisation of cloud concentrations

Combining the elevation map and the rainwater concentration maps using the best fit models of *Table 10* gives the following maps (*Figure 23* - *Figure 26*). In these maps only the areas are shown that are above 50 meter above sea level. When including the areas below 50 meter high unrealistic values for the ratios occur. When calculating the cloud deposition only the areas above 350 meter above sea level are included in the calculation, because below this level the scavenging ratio equations are not valid (see also *Table 9*).

Figure 23: Cloudwater concentration for SO_4 (ssc) (left) and NO_3 (right) ($\mu g\ m^{-3}$)

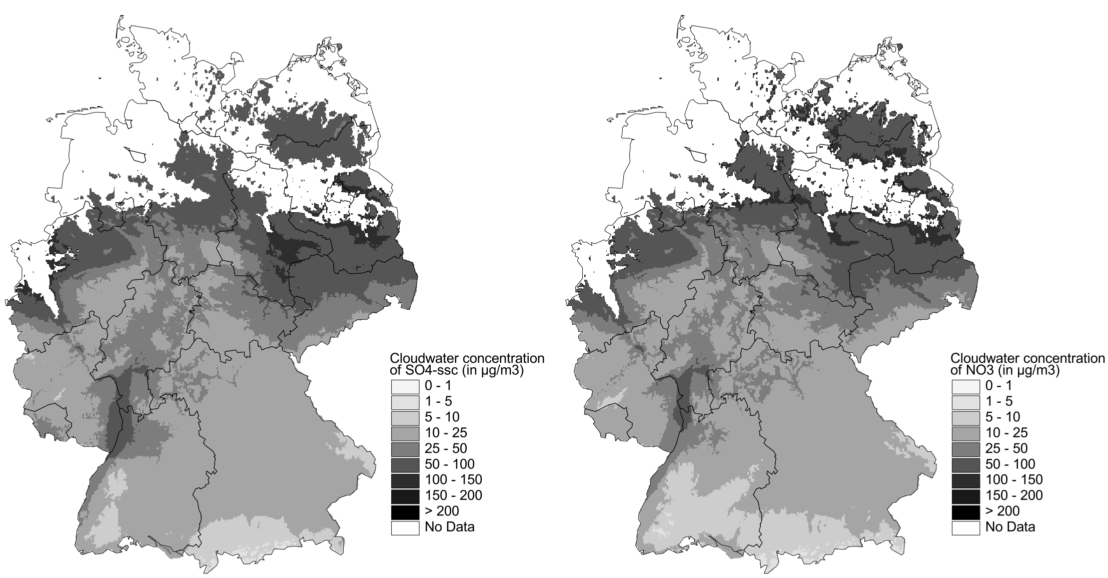


Figure 24: Cloudwater concentration for NH_4 (left) and Na (right) ($\mu g\ m^{-3}$)

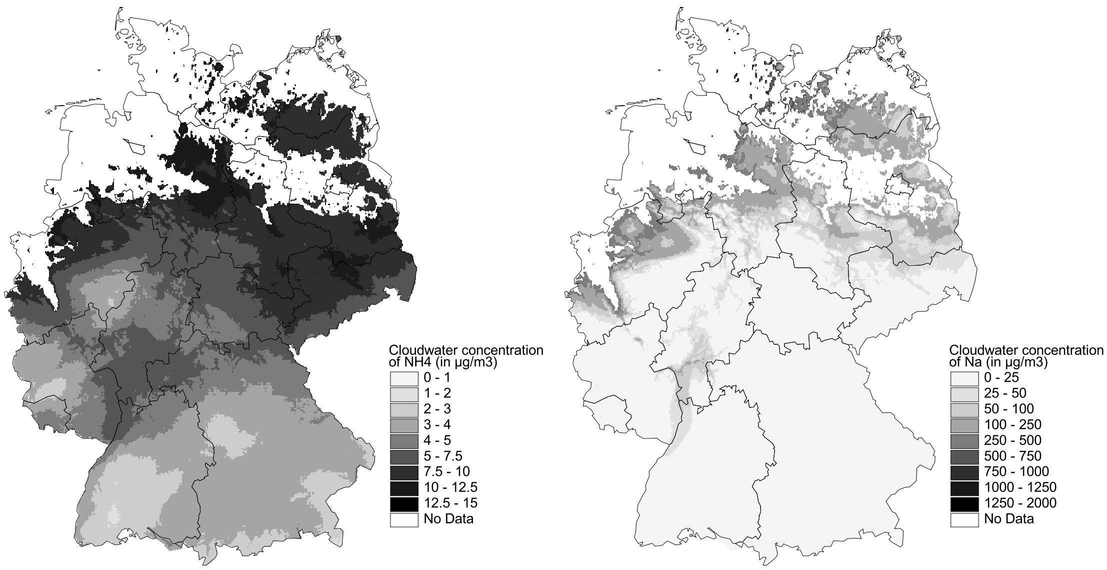


Figure 25: Cloudwater concentration for Ca (ssc) (left) and K (ssc) (right) ($\mu g\ m^{-3}$)

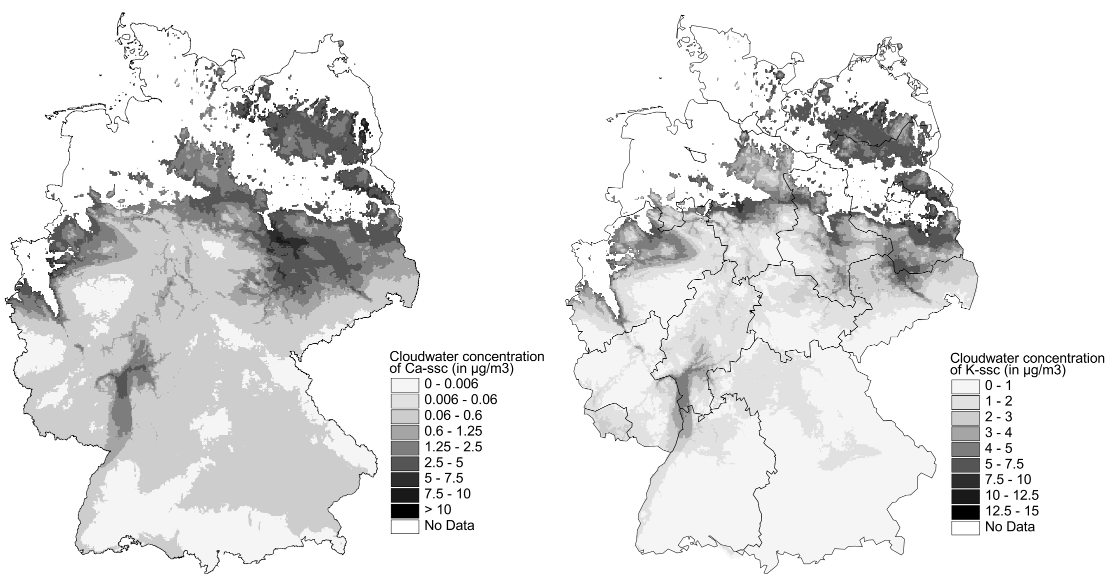
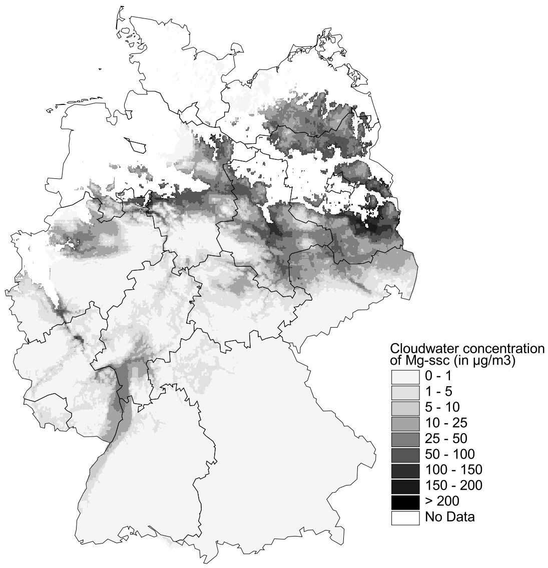


Figure 26: Cloudwater concentration for Mg (ssc) (µg m^{-3})



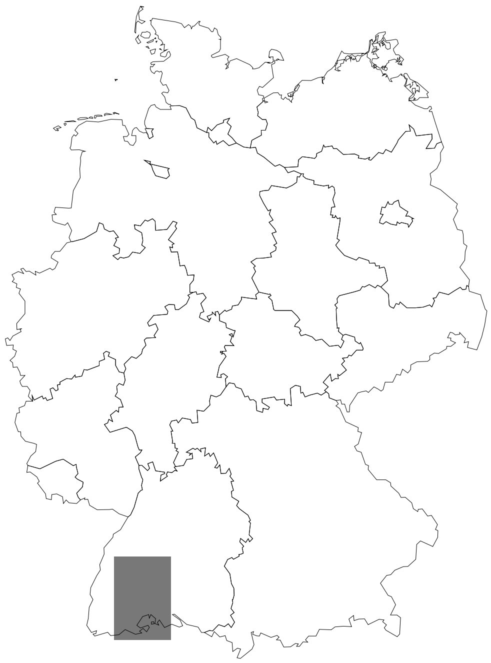
It is assumed that the aerosol mass in the boundary layer air will almost all be activated into cloud droplets in these hill clouds. Orographic clouds have been shown to provide important sites for the transformation of e.g. SO_2 into SO_4^{2-} but the in situ oxidation provides usually only a small addition to the existing ionic composition at most sites, and since the majority of the ionic content of hill cloud water is derived from upwind aerosol, a knowledge of the regional aerosol composition provides a good guide to cloud water composition.

3.2.3 Results of cloud deposition calculations

For calculating cloud deposition the method is used in which cloud deposition velocity is considered similar to that for momentum (see 3.1.1.1.; $V_d \approx r_a^{-1}$; r_a at 4 m). An important reason for using this method is the fact that the calculation of cloud deposition by means of determining the turbulent and the sedimentation water flux has the need for information about cloud water properties and other parameters, that is not available for these kind of studies. The method used in this study, using the inverse aerodynamic resistance, is easily applicable, because this parameter is already calculated for the dry deposition calculations performed by the EDACS model (see 2.2.1).

Cloud deposition has been calculated on a 1x1 km^2 grid for 1993. However, calculating the deposition for the entire area of Germany would need extensive calculation capacity when calculating on this resolution. Therefore, the cloud deposition has been calculated for a mountainous area in the southern part of Germany of about 6000 km^2. The area is shown in *Figure 27*.

Figure 27: Study area for cloud deposition



The roughness length needed for the calculation is according to *Table 1*. The tree height is taken from *Table 2* for the 'Bundesland' Baden-Württemberg. Besides roughness length, the duration of cloud occurrences is needed in order to calculate the total flux. This has been done by determining, for each time step, the cloud base height from the NCAR database. The cloud base height per grid cell is taken from the nearest valid measurement station in the NCAR database. The cloud base height is reported as a height above ground level. In order to compare this cloud base height with the altitude of the terrain under consideration the cloud base height is added to the mean height of the station. When this sum is lower than the altitude of the terrain, the assumption is made that cloud deposition is occurring. On average cloud deposition occurs for about 1400 hours in 1993 for this region. This is in good agreement with observations made by Reynolds *et al*. (1997). They reported a cloud frequency of appr. 1500 hours annualy (alt. 340-740 m). The average deposition velocity is combined with the cloud concentration described in 3.2.2. This results in cloud depositions for the different components which are shown in *Figure 28 – Figure 31*. The large difference between North and South in these figures is the result of using different grid cells from the meteorological data.

Table 11 gives the average deposition as well as the contribution of cloud deposition to the total deposition in that region. Also given in is the average contribution onto forests in that region.

Table 11: Average dry/wet/cloud deposition (eq ha^{-1} y^{-1}) and contribution of dry/wet/cloud deposition to total deposition in the southern Schwarzwald area.

	Entire area				Forest			
	Dry	Wet	Cloud	Total	Dry	Wet	Cloud	Total
Deposition (in eq ha^{-1} y^{-1})								
Ca	159	133	83	375	200	140	136	476
Ca(ssc)	154	129	80	363	194	135	131	461
K	28	28	18	73	35	30	29	95
K(ssc)	26	26	16	68	33	28	27	88
Mg	54	39	35	128	71	43	57	172
Mg(ssc)	18	12	10	39	23	13	17	53
Na	122	97	71	291	160	98	117	375
NHx	343	269	288	901	494	298	485	1278
NOy	369	251	285	905	545	278	477	1299
SOx(ssc)	745	528	538	1811	1058	527	888	2472
Contribution (in %)								
	Dry	Wet	Cloud		Dry	Wet	Cloud	
Ca	42	36	22		42	29	29	
Ca(ssc)	42	35	22		42	29	28	
K	38	38	24		38	32	31	
K(ssc)	38	38	24		38	32	31	
Mg	42	30	27		41	25	33	
Mg(ssc)	45	30	26		44	25	32	
Na	42	34	24		43	26	31	
NHx	38	30	32		39	23	38	
NOy	41	28	32		42	21	37	
SOx(ssc)	41	29	30		43	21	36	

Figure 28: Cloud deposition of seasalt corrected sulphate (mol ha^{-1} y^{-1}) for the study area depicted in Figure 27.

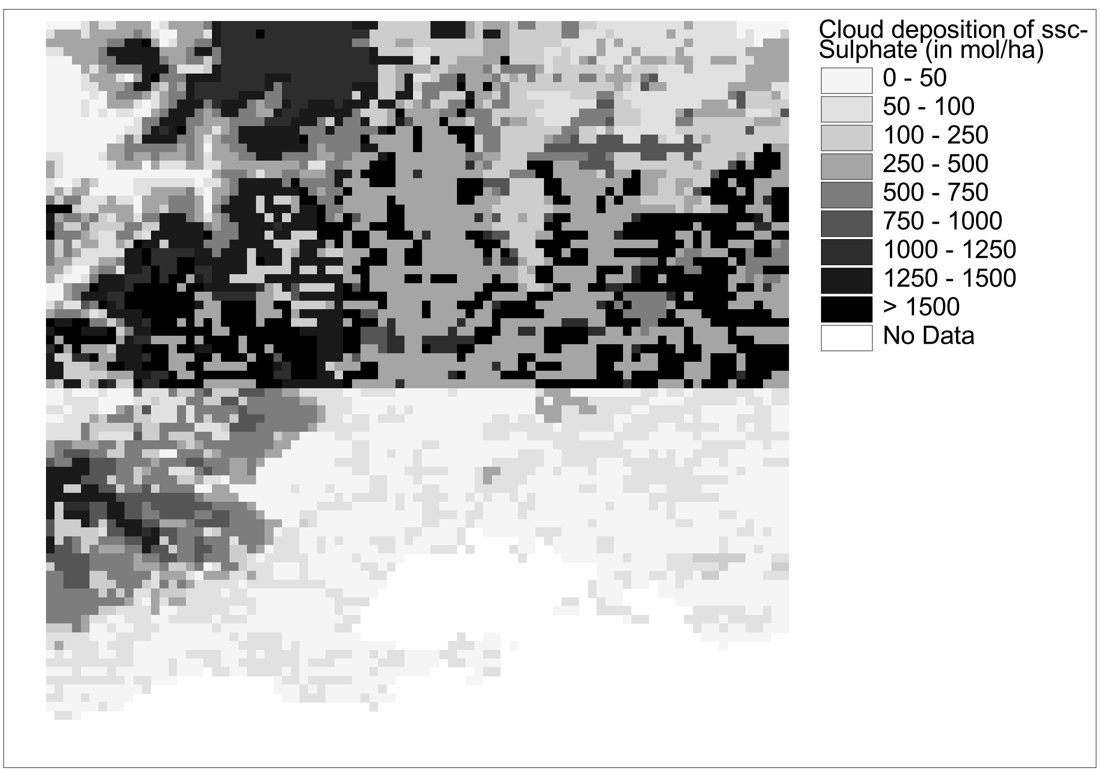


Figure 29: Cloud deposition of nitrate (mol ha^{-1} y^{-1}) for the study area depicted in Figure 27.

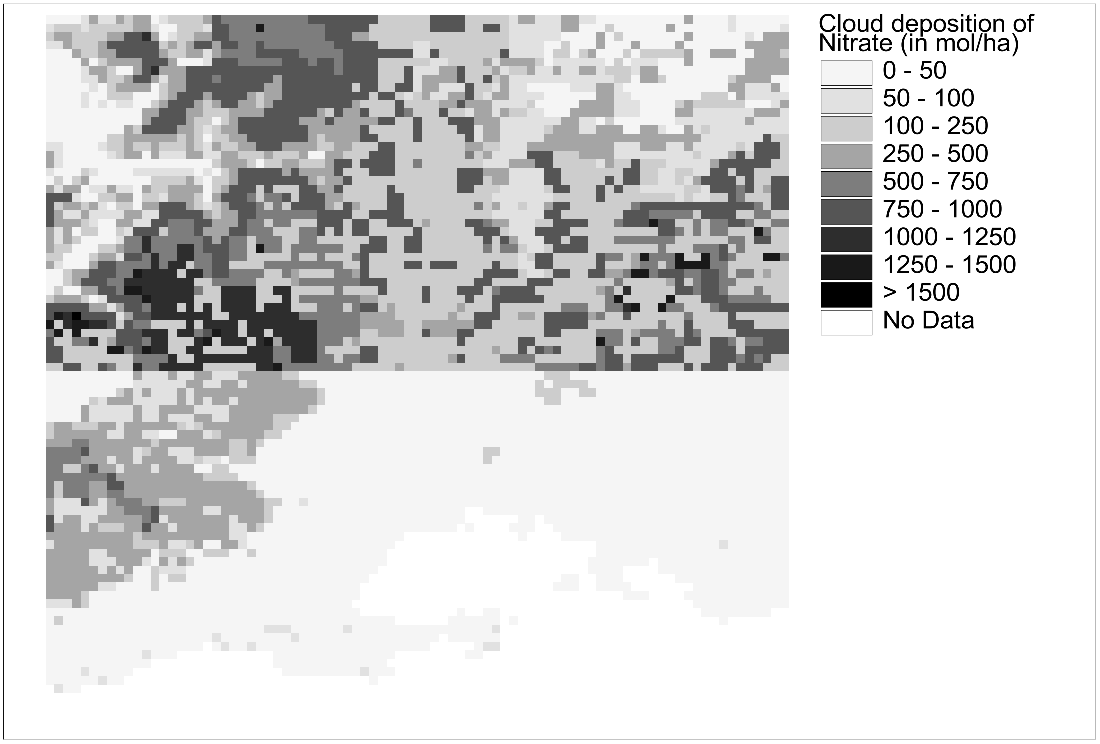


Figure 30: Cloud deposition of ammonium (mol ha^{-1} y^{-1}) for the study area depicted in Figure 27

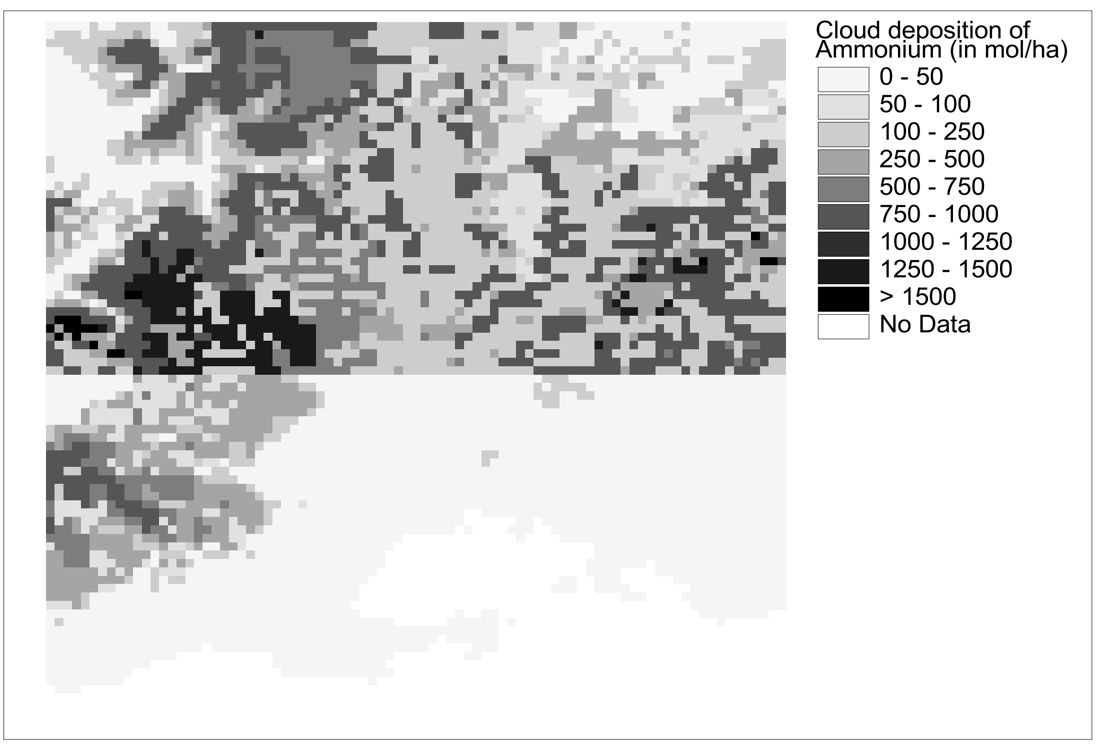
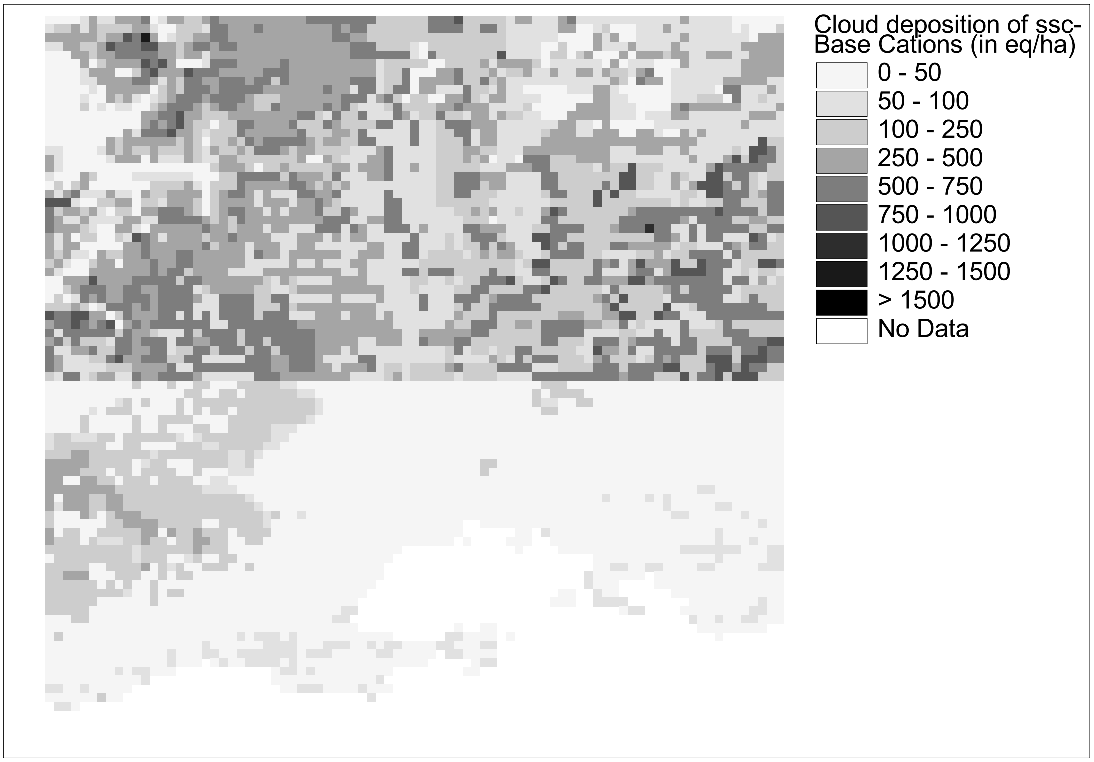


Figure 31: Cloud deposition of sea-salt corrected base cations (eq ha^{-1} y^{-1})



3.2.4 Uncertainty in cloud deposition calculations

3.2.4.1 Cloud concentrations

Uncertainty in the cloud concentrations is introduced by uncertainties in the scavenging ratios and precipitation concentration maps used to estimate the cloud concentrations. The overall uncertainty in average precipitation concentration per 5x5 km grid cell is caused by the uncertainty in the measurement results and the interpolation procedure used for deriving the concentrations per 5x5 km grid cell. Also the use of elevation depended scavenging ratios will introduce uncertainty in the scavenging ratios. Besides this, systematic errors may arise from using scavenging ratios, which are based on only a limited set of simultaneous cloud and precipitation concentration measurements.

3.2.4.2 Cloud deposition velocities

As with dry deposition, the uncertainty in the dry deposition velocities is mainly the result of using the simple resistance formulation for a highly complex process. In case of cloud deposition velocities only the aerodynamic resistance (R_a) is used.

Uncertainty in the cloud deposition velocities is also introduced by the way the occurrence of cloud deposition is determined. When calculating an average deposition velocity it is most important to know how often cloud deposition occurs, otherwise higher or lower velocities may be calculated. The accuracy of the determination of the occurrence of cloud deposition to a great extent depends on the quality of the meteorological data and of the suitability of these coarse (1° x 0.5° lat/lon) data for such ‘local’ phenomena. The effect of the latter is clearly visible in the *Figures 29-31*.

3.2.5 Discussion and conclusions on cloud deposition calculations

The contribution of cloud deposition to the total deposition in the Schwarzwald area is, on average, 20-30% (Paragraph 3.2.1). However, the contribution depends to a large extent on the occurance of clouds in these high altitude areas. In order to be able to calculate the cloud deposition on a high resolution, the cloud base height (when used for determining the occurance of cloud deposition) should be available in more detail than used in this study. This is also valid for the other meteorological parameters.

Another important input to the cloud deposition calculations is the specific cloud concentration. The concentration depends on the scavenging ratios for the different components, that are derived from measurements. The included number of measurements is limited and should be extended to get better altitude/ratio functions for the different components (*Table 10*).

Despite the uncertainties it seems that cloud deposition is too important to ignore in deposition calculations, especially in mountainous areas.

4 Calculation of site-specific depositions

4.1 Introduction

This chapter describes the calculation results of the deposition of the different components by means of EDACS and Eutrend on a site level. This has been done on the so-called Level I and Level II sites. The next paragraph describes the calculation results for the German Level I sites for the period 1987-1995. Paragraph 4.2 also describes the results of the calculation of site-specific critical loads and their exceedances. Paragraph 4.3 describes the calculations that were performed for the Level II sites. For these sites a distinction was made between calculations based on the EMEP concentrations (4.3.1) and calculations based on site-specific measurements of the different concentrations and meteorological data (4.3.2)

4.2 Level I

4.2.1 Deposition of acidifying components and base cations

For a total of 1811 German Level I sites deposition of the acidifying components and base cations have been calculated for the period 1987-1995. For the calculation of the deposition the 'standard' EDACS model was used. However, for the dry deposition of ammonia the Eutrend model was used, together with the small-scale ammonia emission map (see also 2.1.2). The sites that were included in these calculations are shown in *Figure 32*. Data on location, tree species and height were provided by BFH. These data have been used to derive a site-specific roughness length, in order to calculate the site-specific depositions.

The results of the deposition calculations are shown in *Figure 33* to *Figure 35*. These figures show the averages per Level I site for two periods under consideration (1987-1989 and 1993-1995) for respectively potential acid, total nitrogen and sea-salt corrected base cations. *Figure 36* to *Figure 38* show averaged depositions per 'Bundesland' for the same components for the period 1987-1995. The actual data per site for potential acid, total nitrogen and sea-salt corrected base cations for the periods 1987-1989 and 1993-1995 are listed in Annex B.

Figure 32: German Level1 sites for which EDACS/Eutrend calculations were done.

Figure 33: Dry deposition of potential acid (eq ha^{-1} y^{-1}) for the German Level 1 sites.

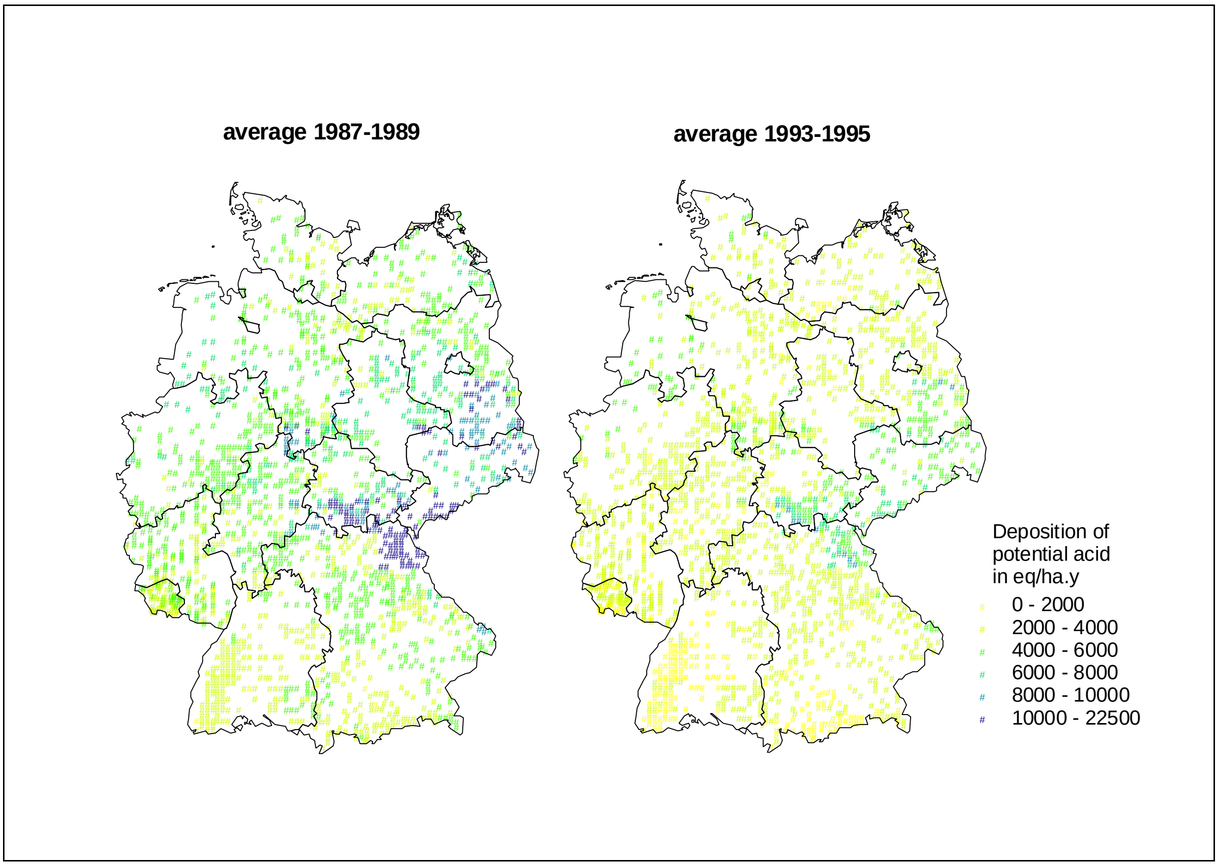


Figure 34: Dry deposition of total nitrogen (eq ha^{-1} y^{-1}) for the German Level 1 sites.

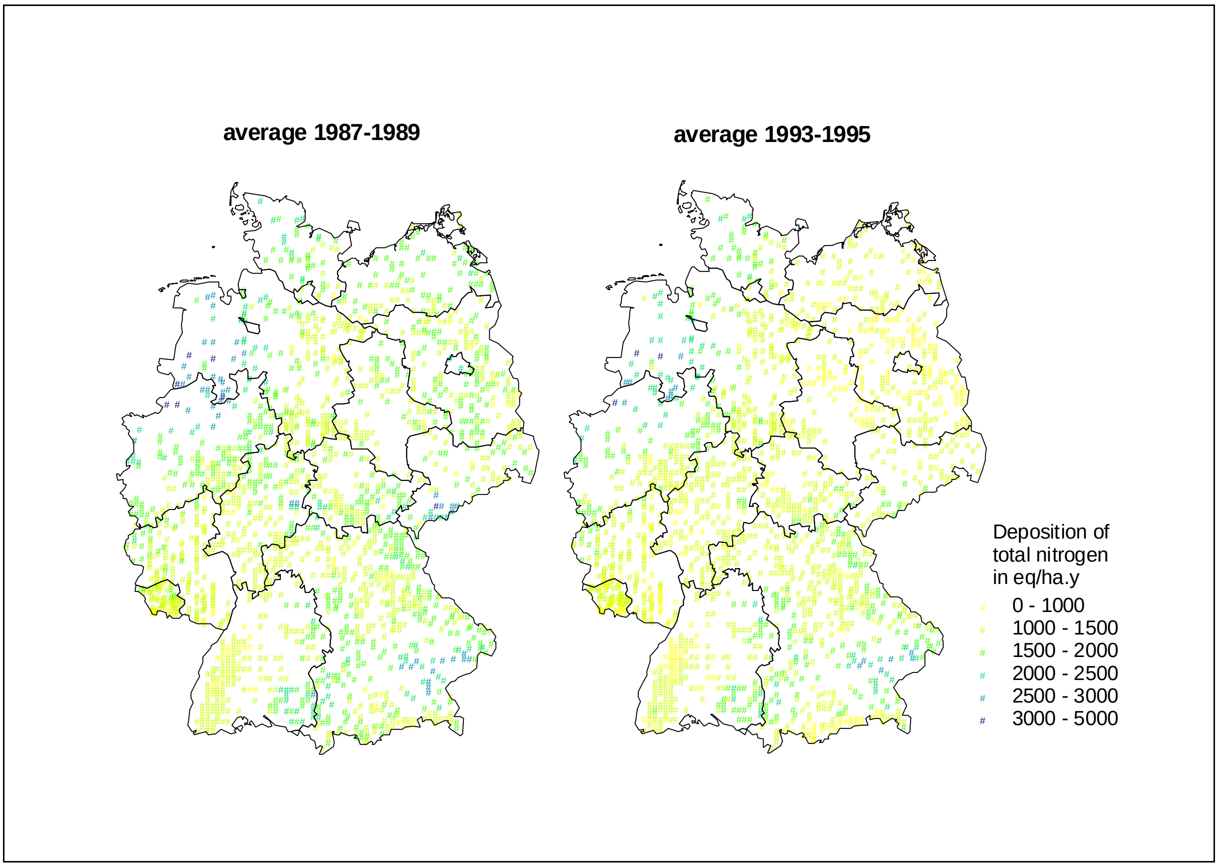


Figure 35: Dry deposition of seasalt corrected base cations (eq ha^{-1} y^{-1}) for the German Level 1 sites.

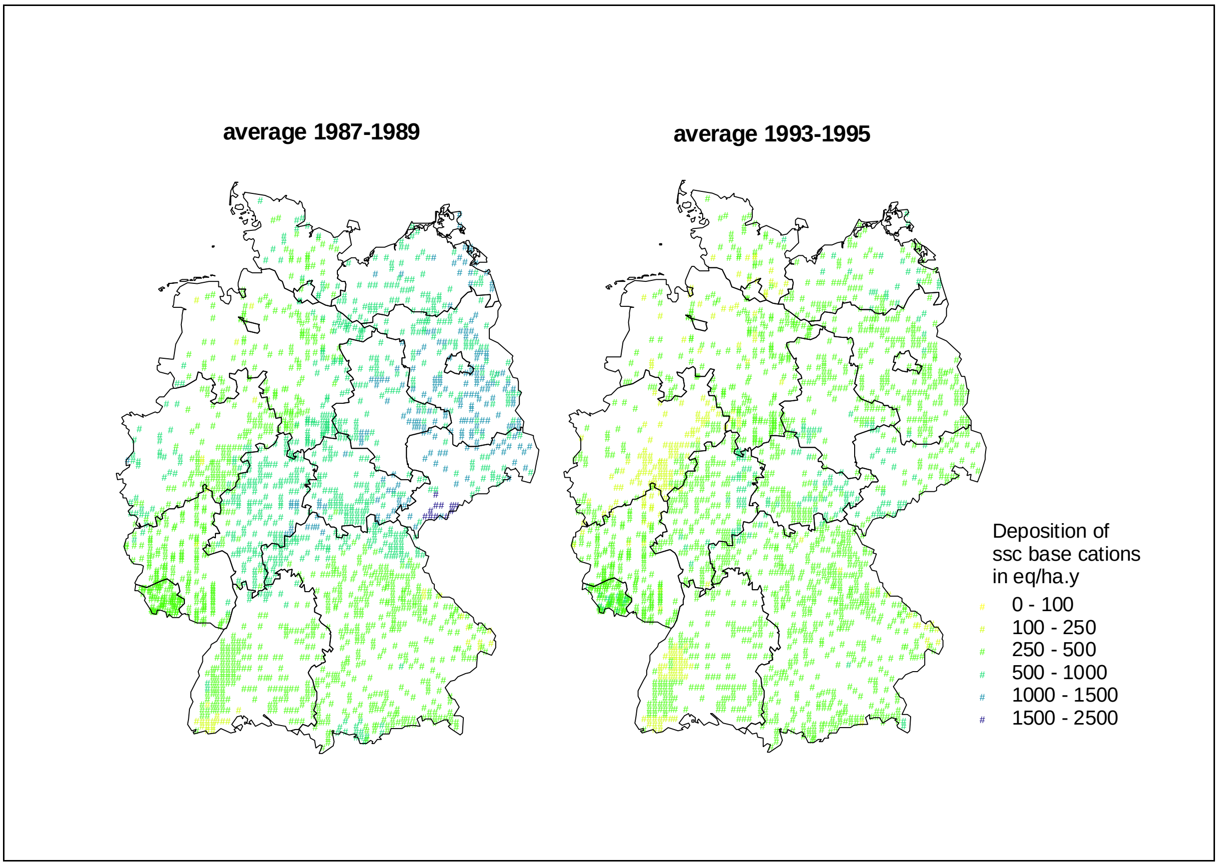


Figure 36: Average dry deposition of potential acid per 'Bundesland' for Level 1 sites (eq ha^{-1} y^{-1}).

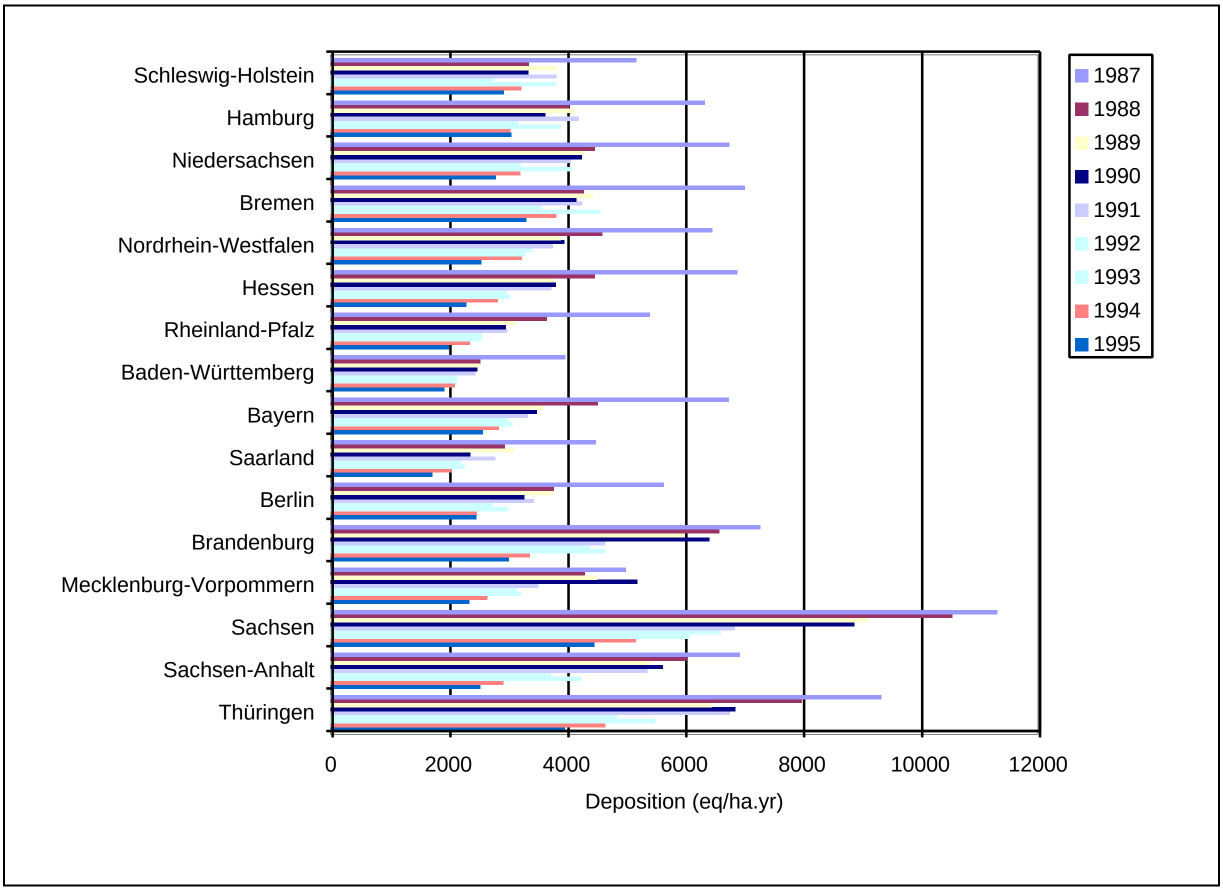


Figure 37: Average dry deposition of total nitrogen per 'Bundesland' for Level 1 sites (eq ha^{-1} y^{-1}).

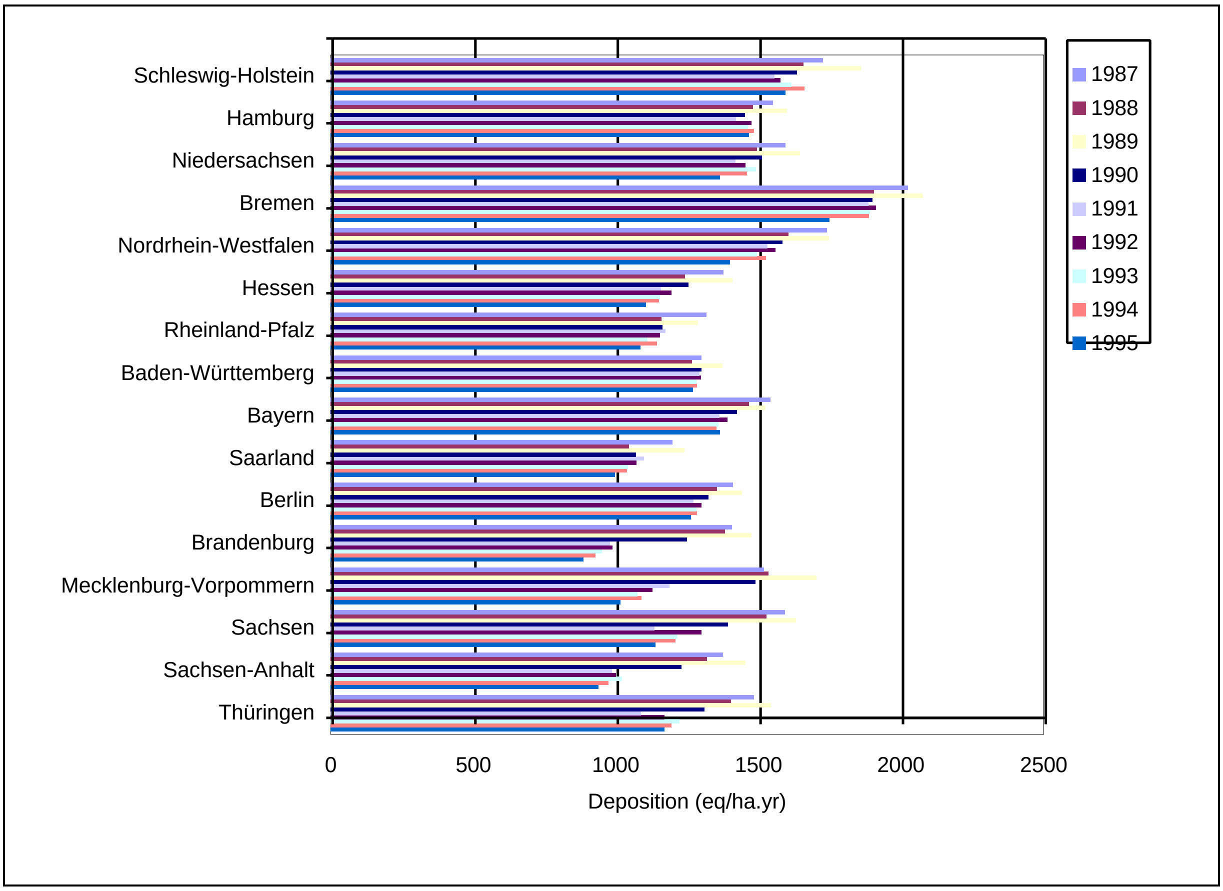
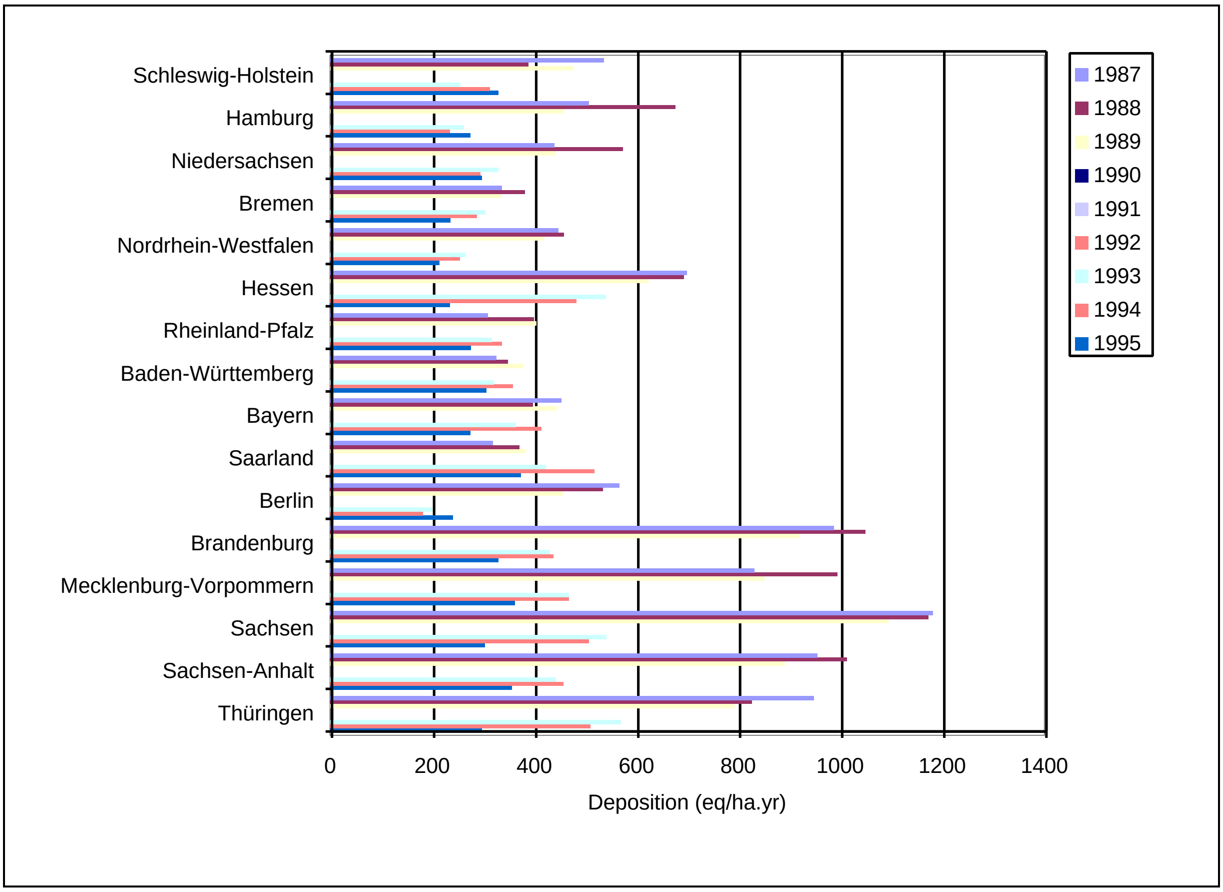


Figure 38: Average dry deposition of sea-salt corrected base cations per 'Bundesland' for Level 1 sites (eq ha^{-1} y^{-1}).



4.2.2 Site-specific critical loads and their exceedances

Within the framework of this project a study was performed by Alterra (former DLO Winand Staring Centre) (Wageningen, The Netherlands) in which site-specific (Level I) estimates for meteorological phenomena (natural stress) and atmospheric deposition (anthropogenic stress) were assessed (Klap *et al.*, 2000). The major aims of that study were: a) to provide site-specific estimates for relevant meteorological stress parameters related to drought and adverse temperature conditions for the years 1987-1995; b) to provide site-specific estimates for the threshold level of the forest ecosystem for the deposition of nitrogen and acidity, both at the short-term and long-term (resp. the critical deposition levels and the critical loads) and c) to provide an overview of the current exceedances of these threshold values for the years 1987-1995.

Below the (extended) summary of the study is listed. More detailed information on this study is given in Klap *et al*. (2000).

Summary of Klap *et al*.

Introduction

The lack of site-specific information on stress caused by meteorological phenomena and atmospheric deposition is a major limitation in the possibilities for a comprehensive evaluation of the results of crown condition monitoring since the mid 1980’s in Germany at a 4 x 4 km^2 gridnet. This study provides estimations for a set of relevant key factors, while accounting for different threshold values with respect to atmospheric deposition.

Methodological approach

Two key factors for temperature stress (Winter Index and Late Frost) and one key factor for drought stress (Relative Transpiration) were selected, along with few less important ones. These key factors were derived from interpolated 6-hourly and daily meteorological data. The Relative Transpiration was based on a water balance model, which also included physical, physiological and soil physical variables.

Two key factors for present loads (total N deposition and total acidity deposition) were selected. Deposition was estimated by combining estimates of the dry deposition from the EDACS model (using EMEP data) and interpolated wet deposition data. Threshold values for the short-term (critical deposition level) and long-term for both key factors were derived using a SMB model, which includes all relevant (chemical) processes and fluxes in the forest ecosystem, while accounting for certain critical values. Exceedances were calculated by subtracting the threshold values from the present load.

Results

The temperature indices (90% of the mean values over the period 1987-1995) varied between 70 and 230 degree days below 0 °C for the Winter Index and between 1.6 and 4.4 degrees below 0 °C for Late Frost. These factors characterized as important stress factors for forests in Germany. Drought stress, in terms of Relative Transpiration, generally varied between 0.7 and 1.00, with a median value of 0.85 but also with values down to 0.5 (mean values over the period 1987-1995) and can therefore be considered as an important stress factor in many German forests.

The meteorological stress indices showed considerable temporal variation between 1987 and 1995. The coldest winters occurred in 1991, 1993 and 1994, whereas the most harmful late frosts occurred in 1993 (and 1987 and 1995). The driest years occurred in 1989, 1992 and 1994.

The meteorological stress indices showed considerable spatial variation, with clear differences between the different years. The coldest winters -on average- were found in the hilly and mountainous areas, whereas the key year 1995 was specifically cold in the Bavarian Alps. Late Frost shows an increase from northwest to southeast and with increasing altitude, whereas in the key year 1995 relatively high values were found in a north to south belt over the country and along the southern border. The northern half of the country suffered -on average- from a moderate level of drought stress, whereas in the key 1995 large areas in the northwestern and northeastern part of the country had serious drought stress.

The calculated nitrogen deposition (averaged over the years 1987-1995) mostly ranged between 1500 and 3000 eq ha^{-1} a^{-1}, with a median value of 2000 eq ha^{-1} a^{-1}. The deposition of total acidity mostly varied between 3400 and 10000 eq ha^{-1} a^{-1} over the same period, with a median value of 5000 eq ha^{-1} a^{-1}. Both variables showed a decreasing tendency over the considered period with a limited number of plots (<5%) with extremely high deposition of acidity in the first couple of years, mostly related to extremely high SO_x deposition.

The average N deposition was highest (>2500 eq ha^{-1} a^{-1}) in large part of the northwestern part of the country and in some areas in the southeast. The average deposition of acidity was highest (>8000 eq ha^{-1} a^{-1}) in the southern half of the former GDR and adjacent areas with extreme peak values (>20000 eq ha^{-1} a^{-1} in the first couple of years) at a few plots in the Ertz Mountains and Fichtel Mountains.

The estimated critical deposition level for nitrogen mostly varied between 1550 and 4000 eq ha^{-1} a^{-1} (short-term) and between 1100 and 3600 eq ha^{-1} a^{-1} (long-term), both with median values of 2000 eq ha^{-1} a^{-1}. The estimated critical deposition level for acidity varied between 1600 eq ha^{-1} a^{-1} and indefinite (short-term for the plots with BS<25%) and between 2400 and 11000 eq ha^{-1} a^{-1} (long-term for all plots), with median values of 5400 and 4800 eq ha^{-1} a^{-1}, respectively. The results were generally higher than in comparable studies, especially for acidity, mainly due to an improved Al/BC criterion, a large share of plots with loamy/clayey or wet soils (with different denitrification and leaching characteristics) and large variation in other input variables.

Most of the plots in the large northeastern part of the country had low values (< 2000 eq ha^{-1} a^{-1}) for the critical deposition level and for the critical load of nitrogen, indicating a high vulnerability to N deposition. Most of the plots in an even larger area in the northern half of the country had low values (< 4000 eq ha^{-1} a^{-1}) for the critical deposition level and for the critical load of acidity, indicating a high vulnerability to acid deposition. Vulnerable plots occurred more scattered also in other parts of the country.

The exceedance of the critical loads and critical deposition levels reflected the results for the present loads and the critical loads and critical deposition levels. Exceedances for nitrogen, averaged over the years 1987-1995, were found at 50% (short-term) or 67% (long-term) of the plots, with extreme values above 400 and 1000 mol_c ha^{-1} a^{-1}, respectively. Exceedances for acidity, averaged over the years 1987-1995, were found at 54% (short-term) or 86% (long-term) of the plots, with extreme values above 4000 and 6000 eq ha^{-1} a^{-1}, respectively. All these variables showed a clear decrease over the considered period, but with a stabilization for the nitrogen in the latest years.

The exceedance of the critical N deposition and critical N load were concentrated in the northern half of the country, with some more serious exceedances (> 750 eq ha^{-1} a^{-1}) of the critical loads in the former GDR and in the northwestern part of the country. Moderate exceedances (< 2000 eq ha^{-1} a^{-1}) of the critical load for acidity occurred on a large scale throughout the country. More serious exceedances (> 4000 eq ha^{-1} a^{-1}) of both the critical load and critical deposition level were concentrated in the southern half of the former GDR but severe exceedances were concentrated in the Ertz Mountains and Fichtel Mountains.

Uncertainties
The calculated indices for temperature and drought stress contain uncertainties, which largely depend on the reliability of the site-specific meteorological data and the spatial resolution of the interpolation method. The estimations for drought stress are also affected by uncertainties in various model terms in the used water balance model. In general the site-specific meteorological estimates followed the geographical patterns as expected.

The uncertainties in the deposition estimates were mostly related to uncertainties in the model terms and parameters (e.g. the estimated deposition velocity), in uncertainties related to the grid-oriented basis of the air concentration and in simplifications of the model. The uncertainties in the critical deposition levels and critical loads were related to (i) the choice of criteria (e.g. the N leaching rate, assumptions about effects of Al and the use of annual mean values rather than peak values), (ii) model assumptions (e.g. the homogeneity of the rootzone and simplifications of several N transformations and other chemical equilibria) and (iii) the quality of the input data, which were mostly estimated rather that measured.

4.3 Level II

4.3.1 Level II using EMEP concentrations

For 48 German Level II sites, of which data were available, deposition of the acidifying components and base cations was calculated for the period 1990-1995. For the calculation of the deposition the ‘standard’ EDACS model was used. However, for the dry deposition of ammonia the Eutrend model was used, together with the small-scale ammonia emission map (see also 2.1.2). The sites that were included in these calculations are shown in *Figure 39*. Data on location, tree species and height were kindly provided by Ökodata. These data were used to derive a site-specific roughness length, in order to calculate the site-specific depositions.

The results of the calculations were grouped per 'Bundesland' and the averages are shown in *Figure 40* to *Figure 42* for respectively potential acid, total nitrogen and base cations. The calculation results per site are listed in Annex C.

Figure 39: German Level II sites for which deposition of acidifying components and base cations are calculated

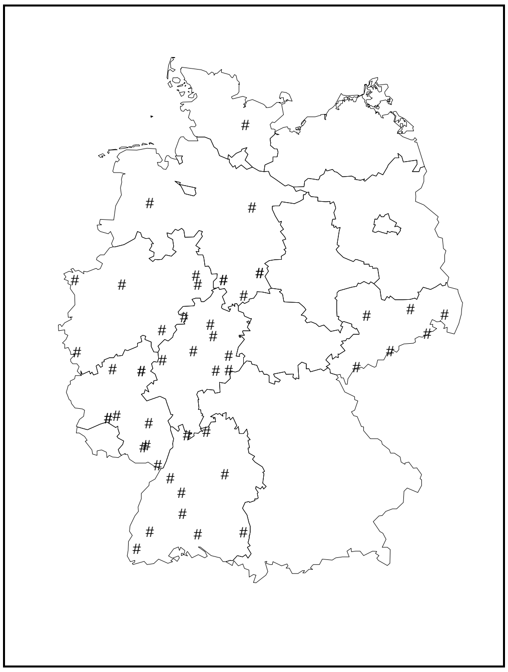


Figure 40: Average dry deposition per 'Bundesland' of potential acid (eq ha^{-1} y^{-1}) for 48 German Level II sites.

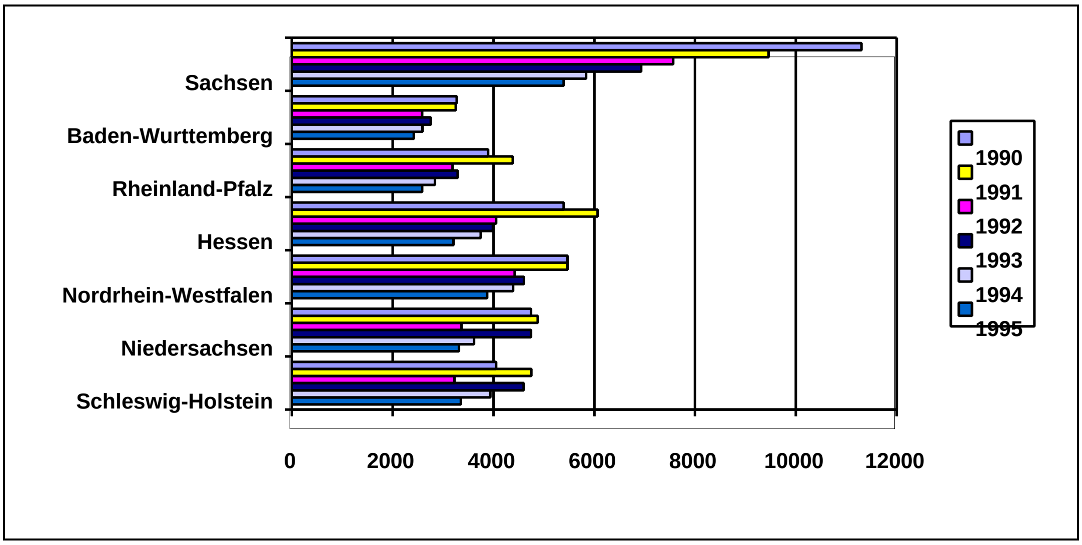


Figure 41: Average deposition per 'Bundesland' of nitrogen (eq ha^{-1} y^{-1}) for 48 German Level II sites.

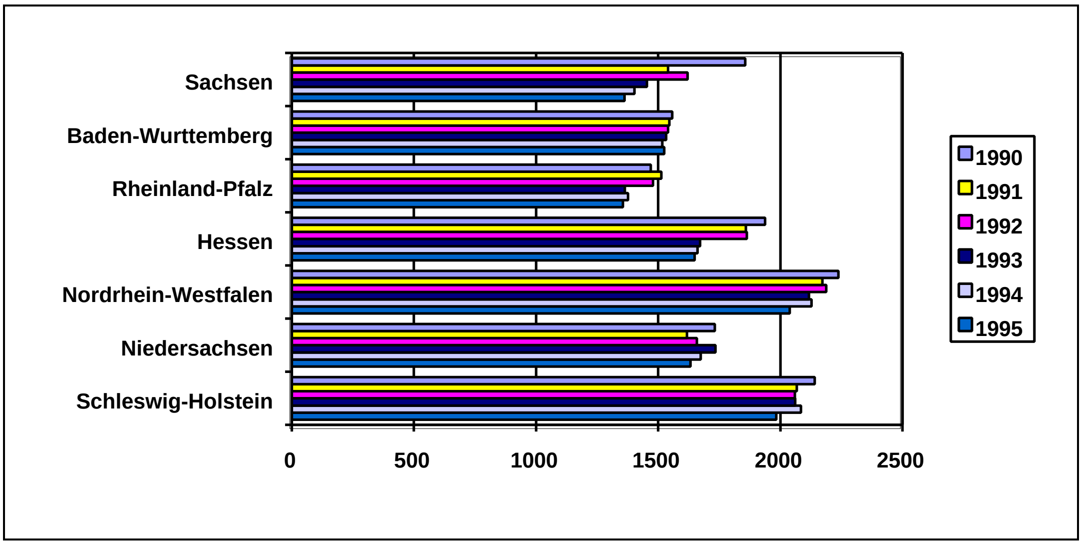
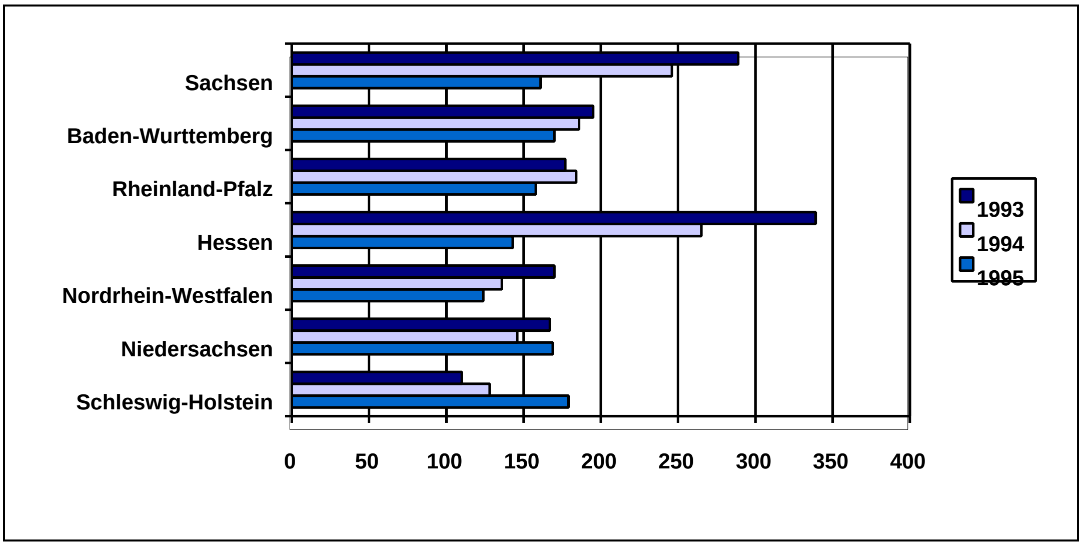


Figure 42: Average deposition per 'Bundesland' of base cations (eq ha^{-1} y^{-1}) for 48 German Level II sites.



4.3.2 Level II using site measurements

For 8 German Level II sites site-specific deposition were calculated using measured concentration and meteorological data instead of the data normally used for performing EDACS calculations. The location of these 8 sites is shown in *Figure 43*. For calculating the deposition of the acidifying components and base cations the data listed in *Table 12* is needed. From that same table, in which also the availability of these data is shown for the different sites, it is clear that calculating the total acid and base cation deposition is not possible. Based on the available data depositions of SO_2, NO_2 and NO were calculated. For all 8 sites the site-specific data were available for 1996. For the same 8 sites EDACS calculations were performed in order to compare these calculations with those based on measurements, and in order to find out what the contribution of SO_2, NO_2 and NO is to the total deposition of respectively SO_x and NO_y. Because concentration data, as used for the EDACS calculations, was not available for 1996, the EDACS calculations were performed for 1995.

Figure 43: German Level 2 sites for which site-specific calculations were performed.

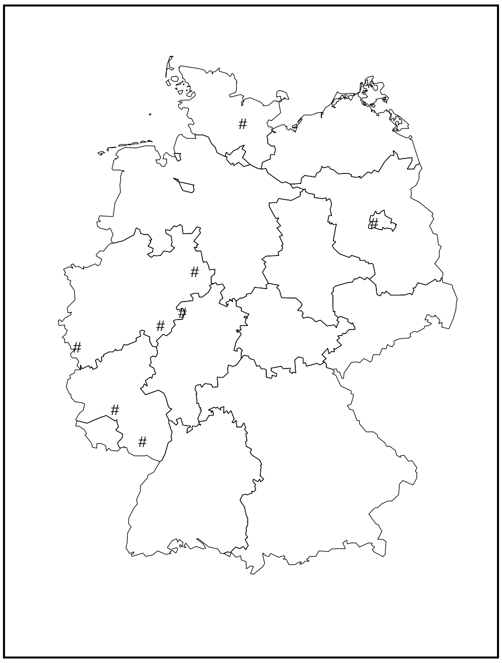


Table 12: Availability of data needed for calculating deposition of total potential acid and base cations. When available, the parameters in italics are improving the results,but are not strictly needed.

	Rheinland Pfalz		Nordrhein-Westfalen				Schleswig-Holstein	Berlin
Forest characteristics	Idar-Oberstein	Merzalben	no. 503	no. 504	no. 506	no. 507	no. 101	Berlin
tree height	+	+	+	+	+	+	+	+
canopy closure (or LAI)	-	-	+	+	+	+	+	-
tree species	+	+	+	+	+	+	+	+
distance to forest edges	-	-	+	+	+	+	+	+
Meteorological data								
precipitation amount	+	+	+	+	+	+	+	+
wind speed	+	+	+	+	+	+	+	+
air temperature	+	+	+	+	+	+	+	+
dew point temp. or rel. humidity	+	+	+	+	+	+	+	+
cloud cover	-	-	-	-	-	-	-	-
Air concentrations								
SO_2, SO_4-aerosol	+ , -	+ , -	+ , -	+ , -	+ , -	+ , -	+ , -	+ , -
NO_x (NO_2+NO), HNO_3, NO_3-aer.	+ , - , -	+ , - , -	+ , - , -	+ , - , -	+ , - , -	+ , - , -	+ , - , -	+ , - , -
NH_3, NH_4-aerosol	- , -	- , -	- , -	- , -	- , -	- , -	- , -	- , -
Base cations (Na, Mg, Ca, K-aer.)	-	-	-	-	-	-	-	-
HCl	-	-	-	-	-	-	-	-

\+ available

\- not available

The calculation of the deposition based on measurements was performed using a modified EDACS model. Normally EDACS uses gridded data (meteorological and concentration data), but by changing the input/output structure of EDACS it is possible to use site-specific data. In the next paragraphs respectively the meteorological and concentration data that have been used for the different calculations are discussed, after which the resulting depositions are presented.

4.3.2.1 Meteorological data

In *Table 13* the yearly averages are shown for three meteorological parameters (wind velocity, temperature and relative humidity) that have been used for the calculations based on measurements and on the EDACS model, respectively. Also included in *Table 13* is the 1996 meteorological data as used in EDACS. This is done to be able to compare the site-specific data (for 1996) with the EDACS data. As stated in paragraph 4.3.2 the EDACS calculations were performed for 1995, because of missing concentration data for 1996. In order to understand the differences in the resulting depositions (*Table 15*), the site-specific data should therefore be compared with the 1995 data used in EDACS.

The differences in the meteorological data are mainly the result of the fact that the EDACS data is interpolated data on a 0.5° x 1.0° resolution.

Table 13: Meteorological data used for calculating depositions. Also shown the 'EDACS' meteorological data for 1996.

	Site-data			EDACS					
	WV	T	rH	WV_95	T_95	rH_95	WV_96	T_96	rH_96
	$m\ s^{-1}$	°C	%	$m\ s^{-1}$	°C	%	$m\ s^{-1}$	°C	%
Rheinland-Pfalz									
Idar-Oberstein	1.8	6.5	78.1	3	9	78.9	2	7.2	78.3
Merzalben	3.2	6.8	74.8	3	10.1	78	3	8.4	76.4
Nordrhein-Westfalen									
503	1.5	7.8	66.4	3	10.4	77.8	3	8.4	77.5
504	4.8	6.0	85.0	3	11	79.5	2	9.2	78.7
506	3.7	5.6	84.2	3	9.4	78.4	2	7.5	78.9
507	4.1	6.4	83.2	3	9.9	78.3	3	7.9	79
Schleswig-Holstein									
101	3.6	7.1	81.9	5	9.1	80.7	5	7.4	81.9
Berlin									
Berlin	2.2	7.5	74.5	3	9	79.9	3	7	80.3

4.3.2.2 Concentration data

For 'standard' EDACS calculations concentration data is used that have been calculated with the EMEP model. The resolution of this data is 150x150 km^2. In *Table 14* these concentrations are presented for the eight Level II sites under study. This table also contains the site-specific concentrations. It is clear that differences occur for the different components, which is mainly caused by the fact that it is not possible to give an accurate estimate of site-specific concentration when using the 150x150 km^2 EMEP model results.

Table 14: Concentration data used for calculating depositions in Table 15.

	Site-data			EDACS		
	SO_2	NO_2	NO	SO_2	NO_2	NO
	$\mu g\ m^{-3}$	$\mu g\ m^{-3}$	$\mu g\ m^{-3}$	$\mu g\ m^{-3}$	$\mu g\ m^{-3}$	$\mu g\ m^{-3}$
Rheinland-Pfalz						
Idar-Oberstein	7.37	19.05	2.14	10.10	9.92	0.53
Merzalben	7.08	17.88	2.47	7.57	9.08	0.49
Nordrhein-Westfalen						
503	18.30	31.63	16.38	13.24	14.91	0.75
504	13.32	15.27	4.40	10.61	15.59	0.81
506	10.75	11.66	3.81	13.24	14.91	0.75
507	8.99	13.77	4.33	13.24	14.91	0.75
Schleswig-Holstein						
101	8.42	18.19	3.21	9.15	7.29	0.35
Berlin						
Berlin	12.07	17.99	7.05	25.77	10.08	0.51

4.3.2.3 Calculated depositions

Depositions, as presented in *Table 15*, are the result of multiplying a deposition velocity with a concentration (see also paragraph 2.2). The deposition velocity, to a large extent, depends on meteorological data (4.3.2.1). For the EDACS calculations the meteorological as well as the concentration data can be considerably different from those measured at the specific sites. This subsequently results in differences between the EDACS and the site-specific depositions. Beware: the results for EDACS are corrected according to the procedure described in Annex A). For instance: the EDACS SO_2 deposition for Berlin is 1326 mol ha^{-1} y^{-1} (corrected: 769 mol ha^{-1} y^{-1}) while based on site-specific data the deposition is 383 mol ha^{-1} y^{-1}. To a large extent this difference is caused by a higher concentration of SO_2 (25.8 vs. 12.1 µg m^{-3} for resp. EDACS and site-specific) and a higher wind velocity (3 vs. 2.2 m s^{-1} for resp. EDACS and site-specific).

Table 15: Deposition of SO_2, NO_2 and NO (mol ha^{-1} y^{-1}) as calculated by using site-specific data and by EDACS (SO_2-cor: depositions of SO_2 corrected according to Annex A). Also shown the percentage of the SO_2, NO_2 and NO deposition of the total SO_x and NO_y deposition as calculated by using EDACS

	Site-data[1]			EDACS[2]				Contribution		
	SO_2 mol ha^{-1}	NO_2 mol ha^{-1}	NO mol ha^{-1}	SO_2 Mol ha^{-1}	SO_2-cor mol ha^{-1}	NO_2 mol ha^{-1}	NO mol ha^{-1}	SO_2/SO_x %	NO_2/NO_y %	NO/NO_y %
Rheinland-Pfalz										
Idar-Oberstein	226	93	1.3	787	575	99	0.6	89.3	13.8	0.08
Merzalben	377	107	1.3	614	418	113	0.5	88.7	18.4	0.09
Nordrhein-Westfalen										
503	491	142	9.5	911	738	128	0.6	89.5	17.1	0.07
504	1241	98	2.6	836	568	129	0.8	91.7	20.5	0.13
506				865	701	93	0.6	90.3	14.4	0.09
507	893	97	2.4	913	621	129	0.5	88.8	16.1	0.07
Schleswig-Holstein										
101	683	160	1.9	1171	972	72	0.3	84.2	6.6	0.03
Berlin										
Berlin	383	70	4.5	1326	769	42	0.3	91.4	7.8	0.05

[1] site-specific data for 1996

[2] EDACS calculations for 1995

5 Parameters controlling canopy exchange processes

5.1 Introduction

Forest deposition can be estimated from results of throughfall, stemflow and precipitation measurements in combination with canopy budget models to estimate canopy exchange. Atmospheric deposition of sulphur, sodium and chloride can be estimated reasonably well in this way, because canopy exchange is negligible. Unfortunately, up to now relatively large uncertainties are involved with the estimation of atmospheric deposition of oxidised and reduced nitrogen, magnesium, calcium and potassium to forest stands. Most important reason for this are the large uncertainties involved with the estimation of the contribution of canopy exchange of these compounds to throughfall fluxes (Draaijers *et al.*, 1998).

Throughfall fluxes are found to be influenced by passive diffusion and ion exchange between the surface water and the underlying apoplast of canopy tissues. Passive diffusion is found to be the major cause of elevated anionic concentrations in throughfall while both diffusion and ion exchange contribute to cationic concentrations in throughfall (Schaefer & Reiners, 1990). The rate of canopy exchange has been found to depend on tree species and ecological setting (e.g. pollution climate, soil nutrient status, biotic and abiotic stresses). Process-oriented research on canopy exchange of nitrogen and base cations is necessary to derive quantitative relationships between canopy exchange on the one hand and tree species and ecological setting on the other hand. These relationships can be incorporated into canopy budget models and will therefore improve forest deposition estimates when using throughfall, stemflow and precipitation measurement results

Canopy exchange estimates for forest sites in Germany were related to parameters also measured at these sites to gain a better insight in the parameters controlling canopy uptake and leaching. Parameters for which relationships with canopy uptake and leaching were investigated include tree species, deposition amount and stand age. Results were set along information available in literature.

5.2 Methods for calculating canopy leaching

Results of throughfall, stemflow and bulk precipitation measurements in 1989 at 75 sites in Germany were mostly measured by Länder institutions and were obtained from the University of Stuttgart. Sites situated in Sachsen and Sachsen-Anhalt were not used because results deviated strongly from the other sites thereby seriously hampering accurate statistical analysis. The remaining 67 measurement sites are reasonably well distributed over the country. The majority of these sites (85%) is situated in coniferous forest stands and only 15% in deciduous forest stands. At most sites stemflow was not measured, as it generally constitutes only a small fraction of the total flux to the forest floor. In that case, the stemflow flux was computed as a percentage of the throughfall flux using a parameterisation on tree species and stand age described by Ivens (1990). A canopy budget model developed by Ulrich (1983) was used to estimate canopy leaching of Mg^{2+}, Ca^{2+} and K^{+}. In the model, Na^{+} in throughfall is assumed not to be influenced by canopy exchange. Furthermore, particles containing Mg^{2+}, Ca^{2+} and K^{+} are assumed to have the same mass median diameter as Na^{+} containing particles. Dry deposition of Mg^{2+}, Ca^{2+} and K^{+} is calculated according to (Ulrich, 1983):

$$DD = DDF * BP$$

where DD represents dry deposition, BP the bulk precipitation flux and DDF the dry deposition factor. The dry deposition factor equals:

$$DDF = (TF_{Na}+SF_{Na}-BP_{Na})/BP_{Na}$$

where TF and SF represent the throughfall and stemflow flux, respectively. Canopy leaching (CL) of Mg^{2+}, Ca^{2+} and K^{+} is subsequently calculated according to:

$$CL = TF+SF-BP-DD.$$

Another estimate of the canopy leaching of magnesium, calcium and potassium as well as an estimate of the canopy uptake of oxidised and reduced nitrogen was obtained by comparing net throughfall fluxes (TF+SF-BP) with dry deposition estimates for the German forest sites from the inferential deposition model EDACS (Erisman and Draaijers, 1995). This model, which is generally used to estimate atmospheric deposition on regional scales (see Chapter 2), also provides the possibility to estimate dry deposition to specific forest sites. Dry deposition is calculated by multiplying air concentrations with dry deposition velocities. Dry deposition velocities are calculated from land-use and meteorological information using detailed parameterisations of the dry deposition process. To estimate dry deposition to specific forest sites, information is necessary on *i)* site characteristics (location, main tree species and tree height, *ii)* air concentrations of particles and gasses (Na, Mg, Ca, K, NO_2, NO, HNO_3, HNO_2, NO_3, NH_3 and NH_4) and *iii)* meteorology (wind speed, temperature, dew point temperature or relative humidity, cloud cover and precipitation amount). Site characteristics were obtained through the University of Stuttgart, air concentrations derived from precipitation concentrations in combination with scavenging ratios (Na, Mg, Ca and K) or from EMEP (NO_2, NO, HNO_3, HNO_2, NO_3, NH_3 and NH_4), and meteorological data from ECMWF. The EDACS model was run using precipitation concentrations measured at the site and stand-specific roughness lengths (z_0). For NH_3, however, the EUTREND model (Van Jaarsveld,

1995) was used in order to account for the local influences of the ammonia emissions (see also Chapter 2.1.2). The roughness lengths have been found dependent on tree height (h) and canopy closure (Jarvis *et al*., 1976). The following relationship was derived taking the average tree height of mature forests in Europe equal to 20m and assuming their average z_0 approximates 1.2m:

$$z_0 = 0.06 * h$$

If site-information on tree height was not available, tree height was indirectly derived using species-specific relationships between tree height and tree age presented by Schober (1987). If tree age was unknown, tree height was taken equal to the average height of other forest stands situated in the region/country. The impact of canopy closure on the roughness length could not be taken into account due to lack of data.

5.3 Results and discussion

5.3.1 Canopy exchange estimates

Significant relationships (paired t-test, p=0.05 two-sided) are found between canopy leaching of base cations estimated from the canopy exchange model and canopy leaching of base cations estimated from TF+SF-BP minus dry deposition (DD) estimated from the EDACS model, Mg^{2+} being the only exception (*Figure 44*). The scatter in *Figure 44* is found relatively large for Mg^{2+}, Ca^{2+} and (Mg^{2+}+Ca^{2+}+K^+). Very good agreement is found for K^+ (r^2 = 0.86). A paired two sample for means' t-test revealed that both estimates are equal on the average for Ca^{2+}, K^+ and (Mg^{2+}+Ca^{2+}+K^+). For Ca^{2+} the estimates from the canopy exchange model are significantly smaller than the estimates from TF+SF-BP-DD.

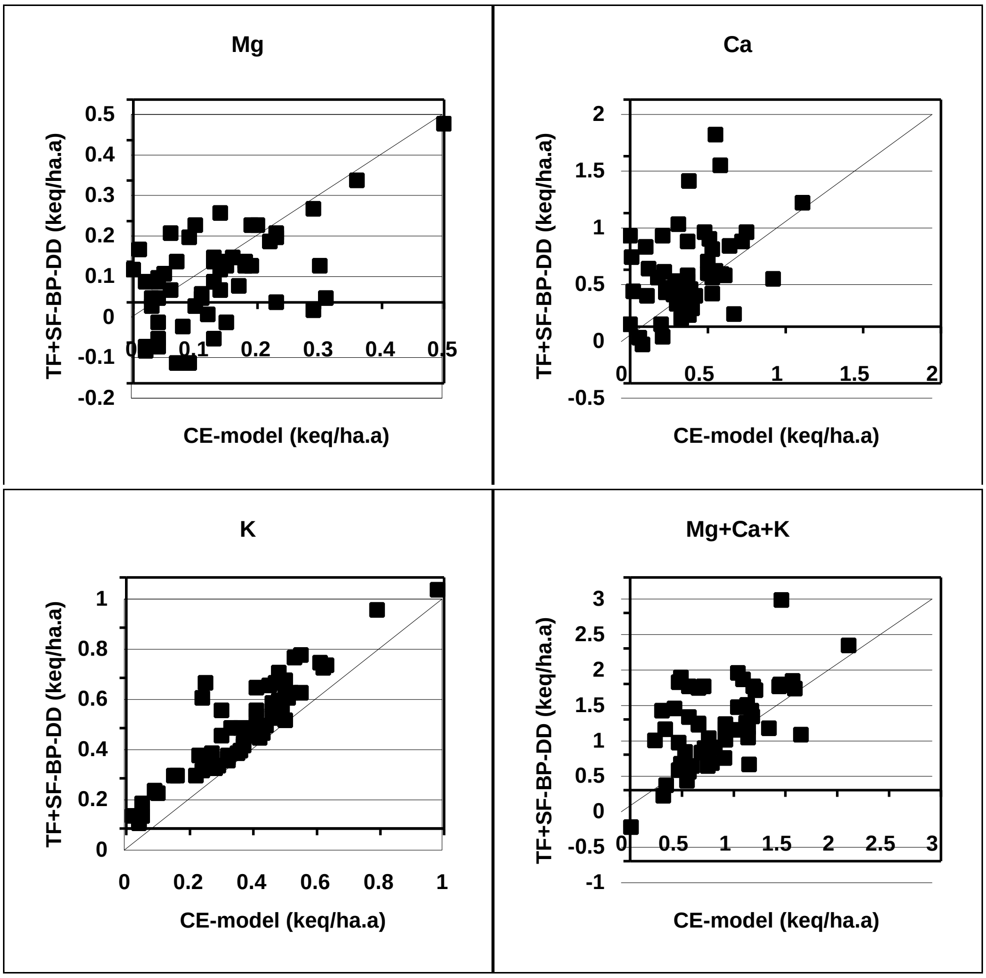
In *Table 16* a statistical summary is presented of canopy leaching amounts estimated from the canopy exchange model and from TF+SF-BP-DD as well as of TF+SF fluxes for the 67 forest sites in Germany. Canopy leaching of Mg^{2+}, Ca^{2+}, K^+ and Mg^{2+}+Ca^{2+}+K^+ amounted on average 70(±190), 190(±400), 360(±190) and 620(±680) eq ha^{-1} y^{-1}, respectively, when estimated from the canopy exchange model and 60(±120), 360(±410), 390(±200) and 820(±620) eq ha^{-1} y^{-1} when estimated from TF+SF-BP-DD. Canopy leaching of Mg^{2+}, Ca^{2+}, K^+ and (Mg^{2+}+Ca^{2+}+K^+) estimated from the canopy exchange model constituted on average 17%, 18%, 69% and 31% of the TF+SF flux of Mg^{2+}, Ca^{2+}, K^+ and (Mg^{2+}+Ca^{2+}+K^+), respectively. For canopy leaching estimated from TF+SF-BP-DD this was on average 15%, 34%, 76% and 41%, respectively.

In *Table 16* also canopy uptake of oxidised nitrogen, reduced nitrogen and total (oxidised + reduced) nitrogen as estimated from the EDACS and EUTREND model is presented. Average uptake amounts for the 67 forest sites in Germany equal 250(±400), 50(±440) and 290(±740) eq ha^{-1} y^{-1}, respectively. Canopy uptake of oxidised nitrogen, reduced nitrogen and total nitrogen equals on average 24%, 5% and 15% of the TF+SF flux of N-NO_3^-, N-NH_4^+ and N-total, respectively.

Table 16: Canopy exchange estimates (+ leaching; - uptake) for 67 forest stands in Germany (in keq ha^{-1} y^{-1})

According to canopy exchange model							
	Mg	Ca	K	Mg+Ca+K			
average	0.07	0.19	0.36	0.62			
standard deviation	0.19	0.40	0.19	0.68			
minimum	-0.74	-0.92	-0.10	-1.51			
maximum	0.50	1.11	0.98	2.11			
According to TF+SF-BP-DD							
	Mg	Ca	K	Mg+Ca+K	NO_3	NH_4	NO_3+NH_4
average	0.06	0.36	0.39	0.82	-0.25	-0.05	-0.29
standard deviation	0.12	0.41	0.20	0.62	0.40	0.44	0.74
minimum	-0.15	-0.47	0.02	-0.57	-0.91	-1.02	-1.61
maximum	0.44	1.69	0.95	2.68	0.80	1.04	1.24

Figure 44: Canopy exchange model result vs. TF+SF-BP-DD (EDACS) for Mg, Ca, K and Mg+Ca+K (in keq ha^{-1} y^{-1}).



5.3.2 The impact of tree species on canopy exchange estimates

Of the 67 forest sites under investigation for this study, 42 consisted of *Picea abies*, 14 of *Pinus sylvestris*, 6 of *Fagus sylvatica*, 3 of *Quercus robur* and 2 of *Alnus glutinosa*. In *Table 17* for each tree species a statistical summary is presented of canopy leaching and uptake amounts estimated from the canopy exchange model and from TF+SF-BP-DD.

For Mg^{2+} on average largest canopy leaching amounts are found in *Alnus glutinosa* and *Quercus robur* stands. According to results of the canopy exchange model, in *Pinus sylvestris* stands on average even canopy *uptake* of Mg^{2+} takes place. For Ca^{2+} largest leaching amounts occur in *Alnus glutinosa* (according to canopy exchange model) and *Picea abies* stands (according to TF+SF-BP-DD). Relatively large leaching amounts are also found in *Quercus robur* stands. On average, Ca^{2+} canopy *uptake* is calculated for *Pinus sylvestris* and *Fagus sylvatica* stands. For K^+, largest leaching amounts are found in *Quercus robur* stands. Relatively small K^+ leaching amounts are found in *Pinus sylvestris* stands.

For total base cations (Mg^{2+}+Ca^{2+}+K^+) average leaching amounts decrease following *Quercus robur* (ca. 1210 eq ha^{-1} y^{-1}), *Alnus glutinosa* (ca. 1070 eq ha^{-1} y^{-1}), *Picea abies* (ca. 960 eq ha^{-1} y^{-1}) and *Fagus sylvatica* (435 eq ha^{-1} y^{-1}). For *Pinus sylvestris* on average even uptake of base cations is found (110 eq ha^{-1} y^{-1}). Results suggest that in Germany broadleaved and coniferous forest stands are on average more vulnerable to canopy leaching than are pine stands. The uptake of base cations in *Pinus sylvestris* stands may result from the low nutrient content in the needles of this tree species.

Uptake of oxidised nitrogen is found largest in *Pinus sylvestris* stands followed by *Fagus sylvatica* and *Fagus sylvatica* stands. For *Picea abies* stands on average only very small canopy leaching of oxidised nitrogen is calculated. Uptake of reduced nitrogen is found largest in *Fagus sylvatica* stands followed by *Pinus sylvestris* and *Alnus glutinosa* stands. In *Quercus robur* and *Picea abies* stands on average canopy uptake of reduced nitrogen occurs.

For total nitrogen (NO_y+NH_x) average uptake amounts decrease following *Pinus sylvestris* (850 eq ha^{-1} y^{-1}), *Fagus sylvatica* (770 eq ha^{-1} y^{-1}), *Alnus glutinosa* (600 eq ha^{-1} y^{-1}), *Quercus robur* (10 eq ha^{-1} y^{-1}) and *Picea abies* (40 eq ha^{-1} y^{-1}). The low N uptake amounts in Picea abies and Quercus robur stands may result from the high N content in the needles of these tree species as a result of large N deposition amounts over the last few decades.

It must be noted that reported differences in canopy exchange amounts between tree species will partly be due to the fact that each tree species occurs in specific geographical regions with each its own pollution climate and ecological circumstances. The impact of pollution climate on canopy exchange amounts is extensively dealt with in *Chapter 3.3*.

In Table 17 for each tree species the average amount of canopy exchange relative to the TF+SF flux is presented. In *Quercus robur* and *Alnus glutinosa* stands, canopy leaching of base cations is found relatively large compared to the TF+SF flux. Relatively small leaching amounts compared to TF+SF fluxes are found in *Pinus sylvestris* and *Fagus sylvatica* stands. Canopy uptake of nitrogen is found large relative to TF+SF fluxes in *Pinus sylvestris* and *Fagus sylvatica* stands. Relatively small uptake amounts compared to TF+SF fluxes are found in Picea *abies* and *Quercus robur* stands.

Table 17: Canopy exchange estimates for different tree species in Germany (in keq ha^{-1} y^{-1}).

	According to canopy exchange model				*According to TF+SF-BP-DD*						
	Mg	Ca	K	Mg+Ca +K	Mg	Ca	K	Mg+Ca +K	NO_3	NH_4	NO_3+ NH_4
Alnus glutinosa (n=2)											
average	0.31	0.45	0.47	1.23	0.05	0.44	0.42	0.91	-0.45	-0.15	-0.60
standard deviation	0.01	0.11	0.04	0.16	0.06	0.02	0.02	0.06	0.06	0.09	0.14
minimum	0.30	0.37	0.44	1.12	0.01	0.43	0.41	0.87	-0.49	-0.22	-0.71
maximum	0.31	0.53	0.50	1.34	0.09	0.45	0.43	0.95	-0.41	-0.09	-0.50
Fagus (n=6)											
average	0.12	-0.07	0.41	0.46	-0.02	0.02	0.41	0.41	-0.50	-0.27	-0.77
standard deviation	0.05	0.13	0.06	0.10	0.12	0.09	0.10	0.27	0.03	0.16	0.18
minimum	0.04	-0.31	0.32	0.34	-0.15	-0.10	0.27	0.07	-0.55	-0.55	-1.06
maximum	0.19	0.06	0.48	0.60	0.19	0.17	0.51	0.86	-0.47	-0.07	-0.54
Picea abies (n=42)											
average	0.12	0.37	0.41	0.90	0.08	0.50	0.45	1.03	-0.06	0.03	-0.04
standard deviation	0.12	0.28	0.11	0.43	0.11	0.34	0.13	0.52	0.38	0.50	0.80
minimum	-0.32	-0.27	0.24	-0.27	-0.15	-0.09	0.23	0.13	-0.69	-1.02	-1.61
maximum	0.50	1.11	0.63	2.11	0.44	1.69	0.69	2.68	0.80	1.04	1.24
Pinus sylvestris (n=14)											
average	-0.17	-0.28	0.07	-0.37	0.03	0.12	0.11	0.26	-0.60	-0.25	-0.85
standard deviation	0.22	0.43	0.10	0.53	0.14	0.55	0.09	0.68	0.22	0.19	0.26
minimum	-0.74	-0.92	-0.10	-1.51	-0.14	-0.47	0.02	-0.57	-0.91	-0.66	-1.18
maximum	0.04	0.58	0.23	0.49	0.41	1.42	0.29	1.86	-0.23	0.13	-0.43
Quercus (n=3)											
average	0.19	0.30	0.75	1.24	0.12	0.29	0.77	1.18	-0.47	0.33	-0.15
standard deviation	0.04	0.08	0.25	0.34	0.09	0.08	0.25	0.41	0.10	0.35	0.45
minimum	0.14	0.23	0.49	0.92	0.03	0.20	0.48	0.71	-0.59	0.00	-0.59
maximum	0.22	0.39	0.98	1.59	0.19	0.34	0.95	1.43	-0.39	0.69	0.31

5.3.3 The impact of deposition on canopy exchange estimates

The impact of deposition on canopy exchange estimates was investigated by relating canopy exchange estimates with total deposition estimates for the 67 forest sites (*Table 19*). Total deposition was obtained by adding dry deposition from the EDACS model with wet deposition derived from bulk precipitation measurements at the sites corrected for dry deposition directly onto the funnels.

Mg^{2+}, Ca^{2+} and total base cation canopy leaching was found negatively correlated with deposition of base cations (*Figure 45*), suggesting diffusion (and ion exchange) between the surface water and the underlying apoplast of canopy tissues being the main exchange mechanism. At very high deposition rates (> 1300 eq $Mg^{2+}+Ca^{2+}+K^{+}$ ha^{-1} y^{-1}) both uptake and canopy leaching of base cations may occur. For K^{+} canopy leaching no relationship was found with K^{+} deposition suggesting ion exchange with H^{+} and/or NH_4^{+} is a more important exchange meachanism compared to K^{+} diffusion. Canopy leaching of total base cations is negatively correlated with deposition of potential acid (*Figure 46*). This can be explained by leaching of base cations from the soil as a result of large acid deposition loads through which these ions are not available anymore for transport to the needles/leaves and subsequent canopy leaching. At large potential acid deposition rates (> 6000 eq H^{+} ha^{-1} y^{-1}) in most forest stands canopy uptake of base cations occurs.

Table 18: The amount of canopy exchange relative to TF+SF flux for forest stands in Germany (average percentage).

According to canopy exchange model							
	Mg	Ca	K	Mg+Ca +K			
All stands	17	18	69	31			
Alnus glutinosa	55	48	83	59			
Fagus	28	12	73	30			
Picea abies	34	33	72	44			
Pinus sylvestris	30	21	31	18			
Quercus	59	38	87	63			
According to TF+SF-BP-DD							
	Mg	Ca	K	Mg+Ca +K	NO3	NH4	NO_3+NH_4
All stands	15	34	76	41	24	5	15
Alnus glutinosa	9	46	74	44	65	11	29
Fagus	4	4	73	27	77	25	45
Picea abies	23	45	79	51	5	3	2
Pinus sylvestris	5	9	47	13	5	34	66
Quercus	39	37	89	60	91	37	11

Canopy uptake of N-NH_4^{+} and N-total is found positively related to deposition of NH_x and N-total respectively (*Figure 48* and *Figure 47*) suggesting the concentration gradient between atmosphere or surface water layer and the underlying apoplast determines the amount of uptake. At low NH_x depositions (<1000 eq ha^{-1} y^{-1}) for some sites canopy leaching of NH_4^{+} is calculated. Canopy uptake of N-NO_3^{-} is found positively related to deposition of potential acid. At low potential acid depositions (< 500 eq ha^{-1} y^{-1}) even NO_3^{-} leaching was calculated. The following relationships could be derived:

$$[NH_4^{+}]_{le} = -0.598 * [NH_x]_{dep} + 0.602 \qquad r = 0.50$$

$$[NO_3^{-}]_{le} = -0.101 * [ACID]_{dep} + 0.265 \qquad r = 0.50$$

in which $[NH_4^+]_{le}$ and $[NO_3^-]_{le}$ denotes leaching of NH_4^+ and NO_3^-, respectively (negative values indicate canopy uptake) and $[NH_x]_{dep}$ and $[ACID]_{dep}$ denotes deposition of reduced nitrogen and potential acid respectively.It must be noted that presented relationships are relatively weak. Several other parameters are expected to influence canopy uptake of reduced and oxidized nitrogen as well (see *Chapter 5.3.4*)

Table 19: Pearson correlation coefficients between canopy exchange and deposition amounts for German forests. Only correlations coefficients are shown in case p<0.05 (one tailed). Correlation coefficients are presented in italic in case p<0.01 (n.s. = not significant, x = not determined).

	Deposition Mg	Ca	K	Mg+Ca+K	NO_3	NH_4	NO_3+NH_4	pot. Acid
Canopy exchange according to canopy exchange model								
Mg	n.s.	*-0.38*	n.s.	*-0.34*	x	x	n.s.	*-0.34*
Ca	-0.28	-0.21	n.s.	-0.26	x	x	n.s.	*-0.36*
K	*-0.29*	*-0.53*	n.s.	*-0.50*	x	x	n.s.	*-0.57*
Mg+Ca+K	*-0.30*	*-0.38*	n.s.	*-0.38*	x	x	n.s.	*-0.47*
Canopy exchange according to TF+SF-BP-DD								
Mg	-0.23	n.s.	n.s.	n.s.	x	x	n.s.	n.s.
Ca	n.s.	n.s.	n.s.	n.s.	x	x	n.s.	n.s.
K	-0.28	*-0.46*	n.s.	*-0.45*	x	x	n.s.	*-0.52*
Mg+Ca+K	n.s.	n.s.	n.s.	n.s.	x	x	n.s.	n.s.
NO_3	x	x	x	*-0.44*	n.s.	-0.18	n.s.	*-0.50*
NH_4	x	x	x	n.s.	n.s.	*-0.50*	-0.35	-0.25
NO_3+NH_4	x	x	x	*-0.29*	n.s.	*-0.40*	-0.28	*-0.42*

Figure 45: Relation between canopy leaching and deposition of base cations (in keq ha^{-1} y^{-1}).

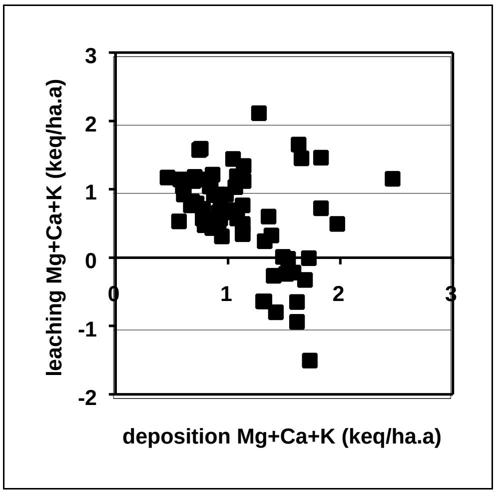


Figure 46: Relation between canopy leaching of base cations and deposition of potential acid (in keq ha^{-1} y^{-1}).

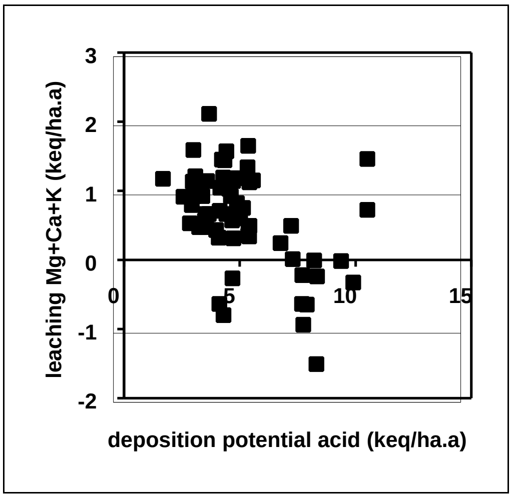


Figure 47: Relation between canopy leaching of NO_3^- and deposition of potential acid (in keq ha^{-1} y^{-1}).

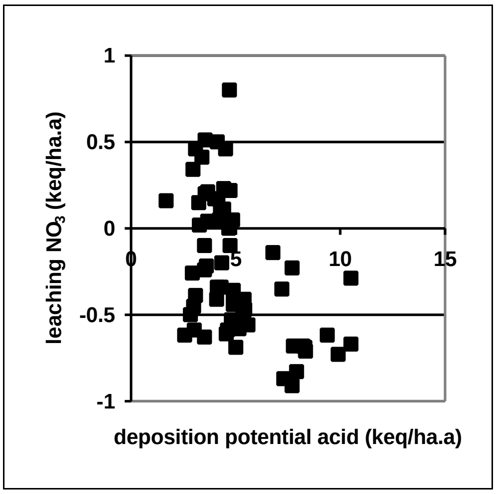
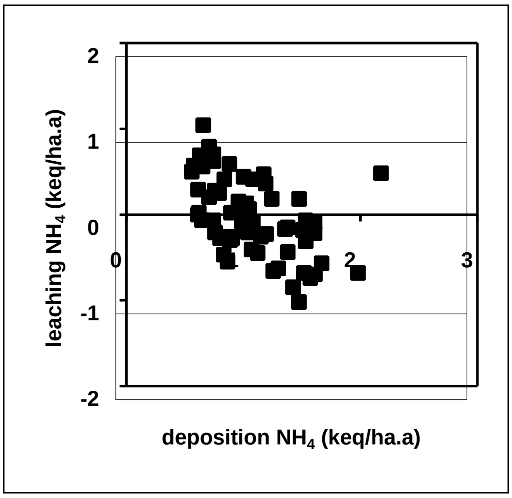


Figure 48: Relation between canopy leaching of NH_4^+ and deposition of NH_x (in keq ha^{-1} y^{-1}).



5.3.4 The impact of other parameters on canopy exchange estimates (literature overview)

The rate of canopy exchange depends on tree species and ecological setting. For example, during the growing season deciduous tree species tend to lose more nutrients from the crown foliage through leaching than coniferous tree species. Conifers, however, stay green all the year round and continue to lose nutrients throughout the dormant season (Smith, 1981). The age distribution of leaves and soil nutrient status also affects the magnitude of leaching to a large extent. Young immature leaves/needles tend to lose much more nutrients compared to older ones (except when they are hydrophobic; Parker, 1990), and fertilisation is found to enhance canopy leaching considerably (Matzner *et al.*, 1983). Biotic stresses like insect plagues may initiate large canopy leaching. Bobbink *et al*. (1990) monitored throughfall in a heather vegetation and observed a marked increase of canopy losses occurring simultaneously with an outbreak of a heather-beetle plague. Furthermore, abiotic stresses like drought and temperature extremes are found to enhance canopy leaching (Tukey and Morgan, 1963). The presence of certain pollutants may also be of importance. Large concentrations of ozone, for example, were found to enhance the permeability of cell membranes in canopy foliage, thereby increasing ion leakage (Evans and Ting, 1973). Moreover, the amount and timing of precipitation is found to be relevant with respect to canopy leaching. Relatively long residence times during drizzle account for relatively high leaching rates compared to short rain periods with large rainfall intensities. Large rain amounts may deplete leachable pools within the canopy, thereby inhibiting ion leaching (Lovett and Lindberg, 1984). Losses from leachable pools within the canopy are believed to be replenished within 3-4 days after a large storm by increased root uptake or translocation from other parts of the tree (Parker, 1983). From literature, it can be derived that, in general, stomatal uptake of SO_2 will be balanced by leaching of SO_4^{2-}. However, significant stomatal uptake of NO_2, HNO_2 and NH_3 has been found as well as uptake of H^+ and NH_4^+ from water layers covering the tree surface. Several experiments also indicate uptake of NO_3^- in solution. Canopy uptake of H^+ and NH_4^+ is generally assumed to be equal to leaching of K^+, Ca^{2+} and Mg^{2+} via ion exchange processes. Additional leaching of K^+, Ca^{2+} and Mg^{2+} takes place along with weak organic acids. Canopy exchange of Na^+ and Cl^- is usually considered insignificant.

6 Discussion and conclusions

6.1 Evaluation using site-specific measurements

EDACS uses meteorological data on the basis of measurements. This data is gridded with a resolution of 0.5^o x 1.0^o lat/lon. From the comparison of data measured at eight Level I sites and the data used by EDACS, there is no systematic difference in wind speed observed for the set of eight sights. For individual sites, however, differences up to a factor of 2 are possible. These differences reflect to some extent complex terrain effects and effects of forest edges. Apart from errors in R_s values, these local effects may lead to errors in local dry deposition velocities, again, up to a factor of 2. Similar discrepancies are also found for SO_2 and NO_x concentrations. The latter comparison is, however, hampered by the fact that the measured site-specific data refer to 1996 while the modelled concentrations are only available for 1995. Despite this, the comparison may well serve as an indication of the magnitude of local errors. It can be concluded that the total error for individual sites may be as large as a factor of 2 to 4, depending how meteo data and concentrations are correlated. This estimate for individual sites is not necessarily different from the 100% error estimated in the previous study for dry deposition in a $1/6^o$ x $1/6^o$ grid cell. Extending the comparison carried out for eight sites to many more sites and for equal time periods is recommended for future studies.

6.2 Evaluation using throughfall measurements.

Modelled dry deposition estimates were compared with dry deposition derived from throughfall estimates. On average, the modelled dry deposition of NH_x, Mg^{2+}, Ca^{2+} and K^+ was not significantly different from the measured dry deposition, although a considerable scatter can be observed. The EDACS model in the original approach tends to overestimate the dry deposition of SO_x, NO_y and Na by factors of 2.15, 1.58 and 1.75 respectively. The strong overestimation of SO_x could be explained to a large extent by the EMEP modelled air concentrations, which for Germany have been found to be too high when compared with the measurements (Tarrason, 1998; EMEP, 1998). A correction of the modelled dry deposition was therefore carried out on the basis of measured SO_2 concentrations in Germany (see Annex A); however, there is still an overestimation of a factor 1.67. A possible explanation for overestimation of dry deposition to forest sites is that air concentations above forests are systematically lower than regional averages (or 150 x 150 km grid averages) because of the systematically higher dry deposition velocities for forests. Another reason might be that forest sites are systematically found at a larger distance from emission sources than other sites, also resulting in lower air concentrations. Suggested is to base future estimates of dry deposition in Germany on concentration maps showing greater spatial detail. For SO_2 this can be achieved by interpolating available measurements as in 'Daten zur Umwelt' (UBA, 1997). For

NO_2 and NH_3 the way towards improvement probably lies in the application of high resolution regional models in combination with spatial representative measurements.

6.3 Conclusions

The dry deposition fields clearly reflect the spatial detailed land-use information and the large-scale concentration and climate patterns across Germany. SO_x dry deposition fluxes were largest in central-east Germany, NO_y fluxes in central-west Germany and NH_x fluxes in north-west Germany. Dry deposition of Na^+ is clearly related to the distance to the sea, which reflects its sea-salt origin. High Ca^{2+} + K^+ + Mg^{2+} fluxes (when corrected for the influence of sea salt) can be found in eastern Germany, especially for the period 1987-89. This is most probably due to the intensive industrial activities in that area.

The highest dry deposition of potential acid (up to 20,000 eq ha^{-1} y^{-1} as average for the period 1987-89) was calculated for eastern Germany and the highest dry deposition load of nitrogen (up to 3500 eq ha^{-1} y^{-1} as an average for the period 1987-89) for North rhine-Wesphalia. Dry deposition of SO_x, NO_y, NH_x and potential acid decreased by 49%, 13%, 21% and 42%, respectively, in the period 1993-95 compared to the period 1987-1989. The decrease in potential acid was highest in Berlin (57%) and lowest in Schleswig-Holstein (24%). Emissions for SO_2, NO_2 and NH_3 in Germany decreased by 63%, 33% and 22%, respectively, in the 1993-95 period (Tarrason and Schaug, 1999).

Dry deposition of non-sea-salt Ca^{2+}, K^+, Mg^{2+} and base cations decreased by 42%, 24%, 65% and 43%, respectively, between these two periods The influence of meteorological conditions on the dry deposition between the two periods is relatively small.

The distribution of NH_3 concentrations in Germany has now been calculated on a 5x5 km grid using the EUTREND model, while in the previous study these data were taken from the standard EMEP model with a 150 x 150 km resolution. The new approach yields 56 % higher NH_3 concentrations on average; however, a comparison of model-calculated wet deposition with measurements from the EMEP network in Germany still indicates a 25% underestimation, which is suggested as being due to a general underestimation of ammonia emissions in Germany, similar to the situation in the Netherlands.

Preliminary results for a small study area in southern Germany show that cloud deposition can be assessed by an inference method. The contribution of cloud deposition to total deposition is highest in mountainous areas; for the selected area in the Schwarzwald, deposition is, on average, 20-30%. An important parameter in estimating cloud deposition is the cloud base height, which is currently not available with great spatial detail. Another important parameter is the cloud water concentration, estimated from empirical relations with local air concentrations.

Canopy exchange estimates for forest sites in Germany were related to parameters that were also measured at these sites to gain better insight in the parameters controlling canopy uptake and leaching. The impact of deposition on canopy exchange estimates was investigated too by relating these estimates to total deposition estimates for 67 forest sites. The most important conclusions were that canopy leaching of base cations was found to be negatively correlated with deposition of base cations. This suggests that ion exchange between surface water and apoplast of canopy tissues is a major exchange mechanism. However, canopy uptake of nitrogen species was found positively correlated to deposition of nitrogen species, suggesting that the concentration difference between atmosphere and apoplast determines the amount of uptake.

Modelled dry deposition estimates were compared with dry deposition derived from throughfall estimates. On average, the modelled dry deposition of NH_x, Mg^{2+},Ca^{2+} and K^+ was not significantly different from measured dry deposition, although a considerable scatter could be observed. The EDACS model in its original approach tends to overestimate the dry deposition of SO_x, NO_y and Na by factors of 2.15, 1.58 and 1.75, respectively. For SO_x this could be partly explained by the EMEP modelled air concentrations, which for Germany have been found too high when compared with measurements. A correction of the modelled dry deposition was therefore carried out on the basis of measured SO_2 concentrations in Germany, which reduced the overestimation for SO_x to a factor 1.67. The present data and the conclusions are based on the corrected deposition data. A further explanation for overestimation of dry deposition to forest sites might be that air concentations above forests are systematically lower than regional averages (or 150 x 150 km grid averages) because of the systematically higher dry deposition velocities for forests. Another reason might be that forest sites are systematically at a larger distance from emission sources than other sites, also resulting in lower air concentrations. It is therefore suggested to base future estimates of dry deposition in Germany on more detailed concentration maps; for SO2 these can be obtained by interpolating available measurements.

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Annex A

SO_x deposition correction procedure

From an evaluation of EDACS results with throughfall measurements it turned out that the EDACS model tends to overestimate the dry deposition of SO_x with by a factor of 2.15. A large part of the difference can be explained by the EMEP modelled air concentrations, which for Germany have been found too high compared with measurements (Tarrason, 1998; EMEP, 1998). It was suggested to base future estimates of dry SO_2 deposition in Germany on concentration maps interpolated from available measurements.

As a first attempt to ‘correct’ these too high concentrations, Level II sites dry depositions for SOx were corrected using ‘local’measurements (‘Daten zur Umwelt’; UBA, 1997). In this case the outcome of the EDACS model was multiplied with the ratio of the annual mean SO_2 concentration form the EMEP model and the concentration interpolated from local observations. In Figure A1 the results are given for a model-measurement comparison for the situation before and after correction. It turns out that the regression between the throughfall results and model estimates increases from 0.36 to 0.64 for the 1989 situation. For 1995, the regression increases from 0.35 to 0.54. This excercise was carried out on the basis of existing maps of interpolated concentrations. There are possibly better ways to derive ‘measured concentration’ maps for the present purpose. For example, one can distinguish between rural and non-rural measuring stations. Furthermore, if one chooses to replace modelled concentrations with measured concentrations then seasonal and diurnal aspects have to be considered because concentration levels and dry deposition velocities may be time-correlated.

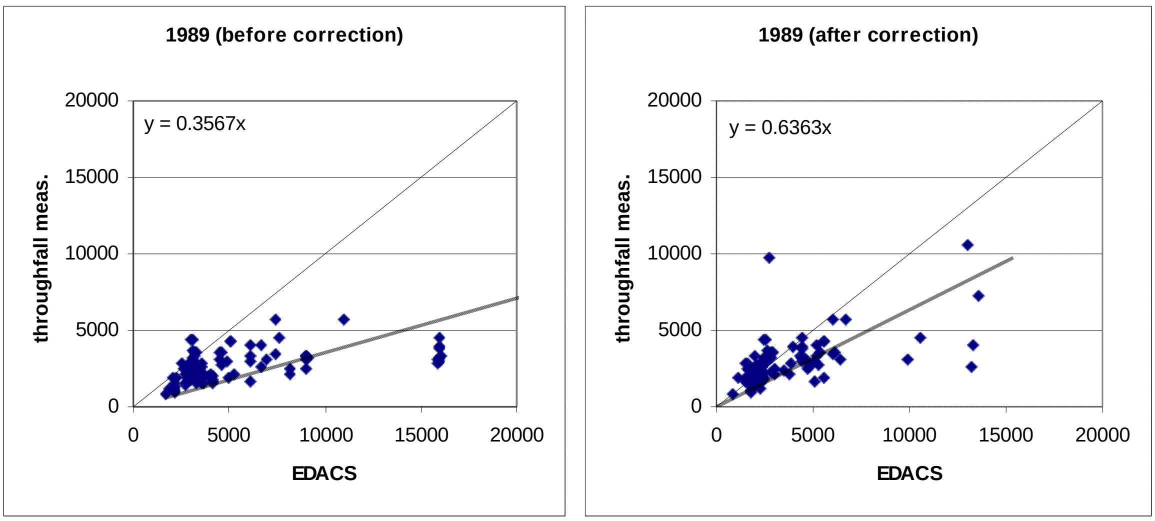

Figure A1: Calculated dry deposition of SO_2 compared with dry deposition derived from through fall measurements at Level II sites. Left: standard results of the EDACS model. Right: results after correction on the basis of local measurements.

For components such as NO_2 and especially NH_3 it is much more difficult to construct 'measured' concentration maps because these components are more locally influenced by sources (roads, farms) and therefore much more measuring sites would be needed.
The above mentioned procedure was only performed on the Level II sites in Germany and therefore not representative for the overall German situation. The actual procedure (developed by INS) for correcting the EDACS SO_x dry deposition is as follows:

1. Calculate the air concentration at 50m height (C50) by taking the measured concentration at 3.5 m height (C4) and assuming an average vertical concentration gradient:
   C50 = C4 x 1.2 [µg/m^3] (rural stations only)
2. Interpolate the C50 points to generate "INS_{rural}" C50 maps in 50x50 km grid resolution over Germany.
3. Resample the "INS_{rural}" C50 map with 1x1 km resolution and calculate averages for each of the 150x150 km EMEP grid cells in Germany.
4. Calculate correction factors between "INS_{rural}" C50 and EMEP C50 for each of the EMEP grid cells:
   $Factor_{150km}$ = "INS_{rural}"C50/EMEP C50 x 100 [%] (EMEP=100%)
5. Correct the EDACS SO_x dry deposition maps using the derived factors:
   $SO_{x\ dry\ corrected}$ [eq/ha] = $SO_{x\ dry}$ [eq/ha] x $Factor_{150km}$ [%] / 100

The average $Factor_{150km}$ for Germany for the individual years is as follows:

1987:	118%
1988:	106%
1989:	78%
1993:	86%
1994:	85%
1995:	65%

The spatial distribution of these factors is shown in Figure A2.

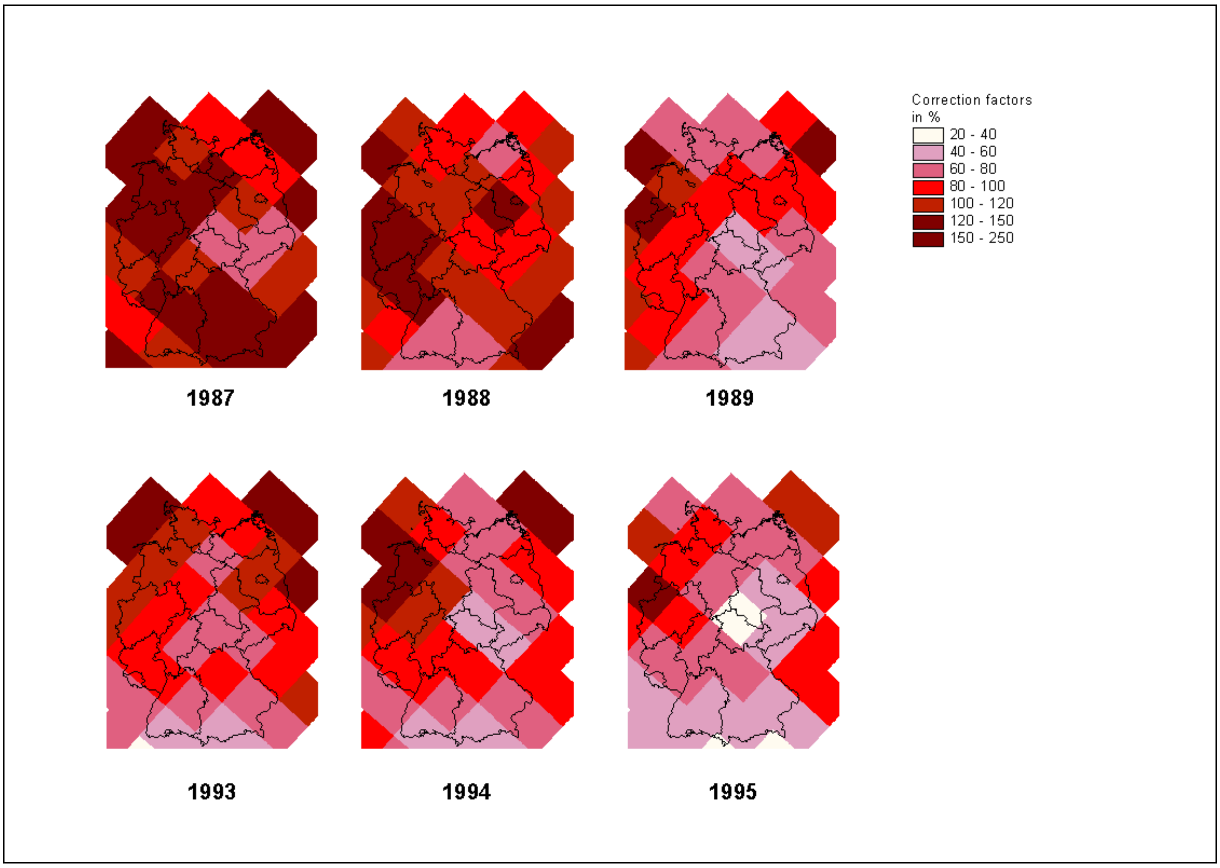

Figure A2: Correction factors for the individual years.

Annex B

Dry deposition for the Level I sites per 'Bundesland'

This annex contains the results of dry deposition calculations for the Level I sites per ‘Bundesland’. The tables contain depositions of total potential acid (Acid), total nitrogen (Nit.) and sea-salt corrected base cations (BC) in equivalents per hectare per year.

Schleswig-Holstein

	1987			1988			1989			1993			1994			1995		
ID	Acid	Nit.	BC	Acid	Nit.	BC	Acid	Nit.	BC	Acid	Nit.	BC	Acid	Nit.	BC	Acid	Nit.	BC
1002	3683	935	535	2510	909	494	2681	1026	350	2336	949	188	2026	955	175	1819	891	231
1003	7192	1708	761	4648	1623	599	4824	1769	530	3700	1526	223	3015	1530	224	3043	1504	313
1004	4186	1188	506	2904	1155	392	3059	1280	391	2699	1198	165	2376	1206	176	2150	1141	242
1005	4780	1315	633	3249	1274	590	3500	1419	470	2984	1299	232	2600	1307	228	2385	1240	278
1006	6440	1666	669	4298	1598	495	4306	1703	469	3415	1500	195	2834	1502	197	2835	1484	279
1007	5242	1570	402	3378	1506	346	3469	1604	345	3785	1425	154	2837	1425	188	2863	1415	232
1008	5991	2307	601	3918	2193	563	4572	2428	530	4765	2161	237	3928	2209	318	3460	2078	399
1009	4139	1670	388	2825	1615	316	3133	1739	392	3419	1586	224	2849	1616	236	2424	1519	243
1010	3949	1336	510	2734	1290	307	3011	1407	395	2508	1266	179	2256	1297	195	1892	1201	252
1011	5000	1613	556	3117	1525	397	3703	1737	440	3941	1531	201	3168	1579	287	2695	1433	357
1012	5439	1830	599	3409	1728	402	4052	1959	455	4277	1728	220	3458	1779	322	2982	1632	387
1013	4976	1802	545	3210	1714	347	3749	1908	400	3965	1694	221	3232	1735	277	2795	1618	338
1014	4425	1679	522	2940	1614	294	3320	1762	397	3597	1583	294	2958	1618	289	2521	1513	317
1015	5560	1857	617	3617	1759	448	4366	2013	574	4197	1735	197	3425	1766	246	3322	1752	257
1016	5605	1949	568	3687	1852	402	4417	2099	533	4247	1814	202	3483	1843	285	3385	1834	276
1017	5308	1964	547	3441	1872	382	4017	2075	455	4235	1853	191	3467	1898	357	3020	1775	339
1018	4378	1854	422	3026	1789	272	3344	1914	334	3619	1750	145	3028	1777	242	2615	1690	279
1019	3322	1246	362	2241	1205	227	2467	1308	266	2741	1186	132	2271	1213	191	1888	1130	235
1020	4669	1739	476	3062	1664	330	3532	1833	398	3760	1643	167	3075	1679	307	2662	1576	293
1021	4363	1585	450	2846	1516	296	3283	1675	313	3507	1494	169	2865	1531	251	2458	1431	300
1022	4824	1729	519	3135	1655	358	3614	1834	336	3898	1647	200	3203	1692	293	2716	1560	349
1023	5239	1997	526	3430	1907	337	3975	2101	424	4191	1875	172	3452	1923	368	3004	1803	328
1024	5694	1978	639	3758	1882	327	4481	2135	564	4337	1858	227	3589	1893	293	3453	1875	307
1025	4570	1752	469	3031	1682	276	3468	1839	391	3699	1651	167	3033	1684	326	2633	1592	278
1026	3856	1452	396	2583	1401	316	2881	1524	262	3166	1379	242	2616	1411	247	2198	1316	278
1027	3976	1119	401	2886	1141	347	2913	1266	459	3598	1187	436	2930	1192	394	2813	1132	357
1028	3955	1193	359	2908	1213	293	2922	1329	350	3592	1252	424	2939	1255	367	2824	1202	331
1029	3647	1325	390	2427	1279	311	2714	1398	320	2999	1262	356	2460	1293	304	2053	1200	284
1030	6642	2029	638	3840	1919	329	4768	2266	565	4655	1822	225	4107	1928	389	3748	1889	390
1031	4081	1640	565	3349	1669	545	3363	1828	697	3436	1581	594	3309	1684	543	3005	1572	487
1032	5252	1544	466	3074	1477	399	3711	1729	457	3696	1396	336	3281	1482	352	2942	1441	352
1033	6729	2016	646	3871	1906	306	4834	2268	590	4703	1811	241	4146	1922	380	3768	1874	413
1034	7031	2132	625	4048	2014	580	5077	2400	681	4906	1906	460	4331	2024	491	3945	1977	486
1035	5930	1902	516	3545	1821	365	4258	2102	499	4220	1723	290	3762	1816	346	3409	1780	419
1036	6295	1912	550	3652	1814	404	4502	2136	566	4431	1728	286	3908	1827	385	3562	1789	438
1037	6052	1735	538	3489	1656	506	4290	1966	653	4245	1581	349	3771	1690	423	3377	1629	423
1038	5692	2151	519	3788	2063	221	4537	2330	608	4341	1975	300	3668	2018	334	3532	2032	287
1039	7130	2390	617	4293	2287	524	5196	2635	705	5084	2167	302	4551	2285	468	4149	2239	469
1040	5346	1963	486	3545	1890	218	4247	2141	571	4082	1816	260	3441	1858	324	3293	1861	282
1041	6874	2216	598	4100	2118	536	4991	2462	685	4899	2016	310	4379	2135	458	3968	2081	469
1042	4520	2003	777	3236	1956	301	3923	2213	718	3728	1904	348	3250	1935	451	3189	1969	303
1043	6132	1485	606	4060	1424	581	4070	1526	481	3234	1352	230	2658	1357	200	2638	1326	261

Hamburg

	1987			1988			1989			1993			1994			1995		
ID	Acid	Nit.	BC	Acid	Nit.	BC	Acid	Nit.	BC	Acid	Nit.	BC	Acid	Nit.	BC	Acid	Nit.	BC
2001	5905	1497	514	3652	1430	356	3761	1545	441	4239	1447	247	3163	1480	248	3212	1483	274
2002	6210	1690	562	3894	1620	473	4007	1734	489	4394	1538	187	3270	1544	208	3283	1520	292
2003	6723	1551	500	4381	1482	1008	4431	1600	477	3551	1476	308	2935	1502	243	2938	1479	275
2004	6574	1466	453	4230	1391	869	4349	1523	425	3431	1388	306	2807	1410	242	2827	1387	258

Niedersachsen

	1987			1988			1989			1993			1994			1995		
ID	Acid	Nit.	BC	Acid	Nit.	BC	Acid	Nit.	BC	Acid	Nit.	BC	Acid	Nit.	BC	Acid	Nit.	BC
3001	12847	1419	643	7339	1283	696	8094	1474	526	5928	1302	587	5198	1230	386	4015	1190	276
3002	13521	1388	645	7545	1232	675	8404	1452	520	6084	1256	596	5277	1187	361	4127	1154	266
3003	7527	1427	738	5819	1289	710	5064	1485	566	4700	1292	488	3272	1221	349	2749	1184	278
3004	7410	1372	701	5718	1238	667	4970	1430	538	4622	1248	397	3211	1178	314	2687	1141	262
3005	7730	1402	692	5934	1258	705	5156	1463	531	4804	1276	389	3318	1201	311	2782	1165	262
3006	7092	1309	596	5489	1182	677	4767	1366	466	4447	1199	349	3089	1131	263	2572	1094	244
3007	14395	1467	598	8111	1303	782	8933	1536	481	6462	1322	358	5572	1248	262	4395	1217	270
3008	5863	1325	299	3664	1208	441	3374	1347	297	3876	1281	257	2934	1259	188	2655	1209	289
3009	14167	1559	455	8058	1405	623	8882	1622	406	6506	1432	335	5689	1353	227	4423	1308	286
3010	6624	1429	481	4106	1292	691	3755	1445	417	4286	1372	361	3208	1345	244	2937	1301	304
3011	3569	808	271	2158	752	295	2054	803	259	1727	717	218	1601	714	176	1220	658	181
3012	5338	1185	248	3377	1095	306	3068	1206	266	3585	1169	247	2748	1143	182	2420	1088	279
3013	11750	1288	445	6749	1166	525	7460	1340	400	5485	1192	373	4799	1125	238	3688	1084	240
3014	10736	1128	307	6186	1020	396	6839	1183	306	4996	1042	256	4323	985	177	3346	951	229
3015	13251	1378	378	7524	1239	436	8315	1441	376	6070	1272	348	5283	1194	252	4095	1155	280
3016	14552	1434	311	8157	1266	364	8919	1500	344	6485	1296	310	5586	1222	235	4415	1189	301
3017	5989	1315	279	3761	1208	333	3426	1338	294	3963	1290	286	3034	1263	212	2689	1205	309
3018	6199	1422	448	3906	1308	814	3570	1441	413	4098	1380	297	3160	1356	226	2811	1298	314
3019	6880	1542	432	4288	1398	870	3931	1557	428	4458	1472	301	3356	1445	237	3078	1399	350
3020	6449	1483	419	4070	1366	827	3707	1501	414	4257	1440	292	3282	1412	229	2918	1353	338
3021	7654	1730	549	4753	1560	1069	4374	1746	502	4924	1639	342	3725	1611	281	3423	1562	398
3022	6903	1599	453	4350	1468	1006	3965	1614	449	4526	1541	292	3492	1511	250	3117	1453	382
3023	14037	1684	717	8055	1531	625	8866	1741	594	6489	1518	643	5686	1432	510	4464	1404	321
3024	7980	1383	659	6059	1224	659	5269	1451	548	4846	1234	728	3298	1158	511	2810	1141	299
3025	8183	1465	733	6284	1313	689	5438	1532	599	5068	1336	814	3488	1253	553	2944	1224	334
3026	7642	1261	676	5770	1108	639	5017	1327	557	4622	1135	768	3147	1068	504	2661	1044	300
3027	9480	1831	912	7238	1632	925	6337	1909	691	5771	1588	552	3956	1503	412	3417	1474	337
3028	8050	1615	771	6217	1463	771	5419	1670	579	5034	1452	426	3520	1376	332	2976	1332	298
3029	4403	1404	518	3521	1252	1262	2776	1429	564	3630	1327	346	2337	1301	339	2243	1269	441
3030	3725	1175	454	2989	1055	961	2338	1196	436	3111	1126	255	1995	1103	241	1904	1071	333
3031	8209	1300	591	6214	1136	1053	5316	1370	542	4919	1150	328	3302	1077	297	2814	1058	349
3032	3914	1229	377	3133	1098	1079	2458	1250	437	3253	1173	261	2083	1148	259	1991	1117	375
3033	8652	1568	669	6979	1416	1138	5624	1580	666	5469	1388	415	3659	1292	380	3143	1239	427
3034	8397	1327	657	6348	1158	1107	5483	1404	596	5032	1168	369	3366	1092	334	2868	1075	371
3035	4392	1346	659	3494	1191	1326	2745	1374	627	3607	1270	405	2299	1244	379	2210	1216	441
3036	3520	1064	453	2819	952	1040	2197	1088	478	2937	1016	298	1859	994	288	1769	966	353
3037	4232	1310	441	3377	1164	1207	2650	1336	498	3495	1244	275	2230	1219	299	2132	1188	401
3038	8134	1278	804	6412	1144	1100	5026	1301	669	5588	1273	509	3951	1257	460	3516	1269	495
3039	8347	1332	766	6607	1195	1120	5162	1355	661	5707	1297	506	4038	1282	463	3595	1296	517
3040	8267	1323	788	6273	1159	1090	5432	1402	655	4969	1161	425	3334	1087	354	2834	1067	364
3041	7477	1190	657	5657	1044	993	4875	1249	569	4504	1051	359	3031	986	313	2563	965	332
3042	6453	1113	664	4973	996	851	4311	1167	535	3979	979	350	2703	922	279	2264	897	285
3043	7501	1255	682	5699	1110	956	4936	1315	566	4539	1108	363	3072	1041	299	2605	1018	316
3044	4910	826	533	3890	750	732	3349	876	447	3170	763	280	2165	716	232	1760	687	245
3045	6647	1142	745	5405	1046	941	4204	1157	609	4759	1125	449	3432	1104	399	3004	1108	417
3046	6697	1482	355	4201	1358	703	3799	1496	390	4385	1442	287	3358	1410	230	2994	1356	383
3047	6471	1874	326	4633	1790	306	3868	1887	276	4012	1726	272	3436	1729	279	2770	1601	358
3048	5785	1502	272	4089	1431	294	3378	1522	252	3537	1386	239	2997	1390	219	2374	1278	309
3049	5670	1543	248	4046	1474	311	3347	1557	258	3506	1426	242	2987	1431	248	2379	1322	317
3050	6926	1772	351	4873	1681	343	4008	1795	339	4142	1617	272	3517	1624	250	2799	1497	352
3051	7298	1803	348	5070	1681	335	4180	1831	343	4286	1622	294	3592	1628	258	2887	1508	340
3052	6046	1612	272	4283	1536	336	3544	1629	287	3699	1484	249	3145	1490	236	2508	1377	322
3053	5981	1561	264	4167	1470	349	3480	1576	283	3617	1422	247	3039	1427	240	2470	1332	315
3054	5755	1549	259	4094	1479	337	3385	1565	276	3545	1430	241	3018	1436	234	2403	1328	307
3055	6766	1740	318	4712	1649	383	3918	1761	327	4063	1587	276	3443	1594	234	2741	1471	337
3056	6044	1327	295	3757	1207	424	3437	1341	316	3947	1282	278	2968	1259	226	2703	1213	338
3057	5182	1195	245	3283	1102	348	3009	1217	274	3493	1169	226	2658	1148	172	2380	1097	277
3058	8320	2020	376	5209	1839	545	4821	2038	415	5382	1926	350	4107	1894	268	3783	1830	444
3059	5967	1499	275	3830	1392	402	3506	1512	305	4011	1458	261	3139	1435	205	2781	1367	334
3060	6456	1484	330	4065	1364	489	3719	1505	328	4271	1448	279	3291	1419	211	2926	1358	340
3061	6756	1541	339	4261	1416	514	3858	1554	345	4443	1500	284	3416	1468	226	3048	1409	370
3062	6034	1299	290	3742	1180	456	3425	1317	307	3939	1257	248	2958	1234	203	2687	1188	327
3063	6849	1459	357	4236	1316	662	3879	1479	381	4407	1398	289	3304	1374	227	3028	1331	357
3064	6777	1493	375	4251	1367	622	3857	1514	388	4432	1455	296	3398	1424	253	3027	1368	416
3065	6721	1503	377	4221	1378	588	3817	1516	384	4407	1464	337	3381	1433	292	3016	1377	449
3066	5514	1169	285	3443	1065	570	3139	1187	329	3627	1134	237	2712	1112	196	2463	1073	322

Niedersachsen (2)

	1987			1988			1989			1993			1994			1995		
ID	Acid	Nit.	BC	Acid	Nit.	BC	Acid	Nit.	BC	Acid	Nit.	BC	Acid	Nit.	BC	Acid	Nit.	BC
3067	4926	1099	266	3134	1020	495	2842	1122	299	3332	1088	260	2571	1068	223	2259	1019	343
3068	5479	1194	277	3452	1101	547	3136	1218	318	3656	1175	259	2798	1151	226	2466	1101	358
3069	6157	1334	335	3851	1223	750	3504	1356	390	4045	1301	275	3094	1277	230	2727	1222	384
3070	5182	1090	422	3252	1003	854	2947	1114	470	3447	1066	318	2628	1045	250	2315	1002	365
3071	7441	2559	287	5083	2438	496	4971	2585	389	4558	2308	325	4403	2367	374	3846	2182	285
3072	8220	2969	216	6102	2806	363	5012	2914	359	4226	2574	250	4414	2646	292	3555	2444	243
3073	7293	2736	282	5120	2626	430	4986	2756	362	4609	2482	292	4456	2535	345	3912	2346	276
3074	9650	3380	271	6408	3188	425	5783	3304	449	4943	2927	284	4783	3004	327	3849	2778	287
3075	8687	3020	245	5772	2859	384	5192	2958	407	4462	2625	258	4329	2698	298	3475	2499	262
3076	7307	2652	270	5130	2560	443	4947	2679	375	4606	2420	283	4476	2475	365	3844	2267	295
3077	9706	2985	289	6214	2788	495	5599	2930	398	4660	2521	281	4487	2616	326	3546	2424	307
3078	3037	485	411	2001	454	577	1816	503	476	1601	440	242	1438	441	244	1101	411	249
3079	6264	1301	669	4143	1207	910	4047	1366	774	3405	1146	377	2955	1141	423	2451	1084	411
3080	5394	1100	685	3432	1019	915	3419	1155	755	2627	951	341	2113	941	387	2121	896	365
3081	6854	1407	640	4247	1277	1108	3841	1429	679	4420	1357	484	3355	1326	381	2988	1281	515
3082	6572	1281	585	3963	1139	996	3630	1307	626	4183	1223	462	3096	1197	366	2824	1164	483
3083	12942	1163	649	7662	1034	918	7892	1183	697	6037	1075	352	5046	999	361	4054	959	377
3084	9189	1623	835	7359	1455	1123	5932	1628	875	5793	1486	442	3886	1384	463	3336	1325	470
3085	8524	2178	354	5485	2046	421	4988	2178	373	5030	2043	306	3889	1972	327	3156	1806	349
3086	6985	1668	361	4470	1537	534	4064	1684	385	4615	1622	338	3595	1591	272	3207	1526	411
3087	7224	1429	385	4471	1339	591	4016	1443	418	4627	1384	379	2873	1279	315	2295	1096	334
3088	7783	1477	395	4714	1366	600	4329	1499	429	4934	1426	393	2972	1311	353	2449	1129	347
3089	4862	1194	633	3237	1147	728	3484	1316	516	2803	1130	350	2386	1123	309	2173	1032	320
3090	5043	1396	683	3443	1344	794	3650	1510	567	2959	1303	369	2578	1302	327	2322	1198	353
3091	5028	1360	610	3398	1309	760	3645	1477	580	2924	1251	345	2505	1242	353	2284	1144	330
3092	4965	1300	634	3336	1250	801	3587	1419	607	2865	1192	350	2446	1183	343	2228	1087	338
3093	4938	1270	644	3312	1223	793	3558	1390	593	2854	1180	361	2436	1172	340	2218	1078	355
3094	4894	1224	662	3268	1177	796	3512	1345	583	2808	1135	371	2390	1127	334	2176	1036	354
3095	4872	1203	680	3248	1157	843	3492	1325	628	2773	1100	373	2357	1094	354	2145	1005	348
3096	6630	1641	530	4346	1565	515	4451	1690	459	3494	1494	341	2857	1493	224	2839	1432	264
3097	5308	1229	448	3543	1194	406	3625	1325	427	3318	1256	337	2462	1210	211	2300	1102	247
3098	5422	1177	412	3549	1136	386	3653	1279	486	3331	1208	283	2456	1160	285	2295	1050	257
3099	4930	1070	477	3282	1041	432	3351	1166	428	3087	1104	349	2272	1061	220	2097	959	242
3100	6527	1428	618	4153	1368	563	4425	1549	531	3927	1449	450	2909	1397	270	2748	1268	300
3101	5410	1183	478	3489	1102	624	3430	1234	570	2710	1053	309	2197	1041	365	2198	991	344
3102	4041	901	358	2642	845	451	2514	937	439	2022	807	238	1717	804	282	1642	756	262
3103	4935	1205	460	3269	1155	461	3535	1329	467	2863	1168	304	2442	1162	281	2227	1067	268
3104	5457	1230	484	3535	1148	623	3475	1280	567	2749	1091	302	2236	1080	354	2234	1028	334
3105	5310	1298	505	3491	1239	536	3815	1434	496	3070	1253	325	2623	1249	304	2391	1145	284
3106	4897	1167	525	3233	1119	549	3500	1293	469	2824	1129	326	2403	1123	271	2192	1032	285
3107	5415	1187	527	3494	1106	704	3432	1237	608	2695	1038	321	2182	1026	361	2183	977	345
3108	5449	1221	513	3528	1140	666	3464	1270	584	2721	1063	310	2208	1052	353	2208	1002	332
3109	4469	1060	422	2957	999	544	2822	1098	490	2246	927	267	1905	923	300	1837	870	285
3110	4737	1068	567	3115	1024	618	3360	1193	477	2703	1030	328	2288	1025	274	2079	939	290
3111	5128	1228	628	3373	1176	674	3672	1361	504	2936	1175	349	2503	1170	283	2289	1076	310
3112	4899	1231	644	3276	1186	679	3522	1354	474	2796	1123	337	2381	1118	258	2175	1034	296
3113	4937	1094	610	3221	1024	797	3093	1139	679	2443	940	321	2025	934	358	1972	881	343
3114	4693	1025	556	3070	981	634	3319	1152	484	2658	985	329	2242	979	296	2035	895	306
3115	4763	1082	591	3131	1038	653	3385	1209	490	2711	1034	336	2293	1027	287	2086	943	303
3116	4715	1047	554	3094	1004	661	3342	1174	498	2674	1001	334	2258	995	313	2051	910	302
3117	4814	1149	610	3189	1102	693	3440	1272	499	2767	1094	342	2351	1088	295	2139	998	315
3118	5417	1191	412	3497	1110	514	3437	1242	526	2723	1065	279	2210	1054	352	2210	1004	322
3119	3958	943	279	2832	920	360	2767	1010	338	2843	970	231	2241	937	199	1724	852	190
3120	6592	1542	417	4276	1466	561	4389	1595	365	3428	1407	317	2791	1409	218	2771	1348	253
3121	5949	1410	387	3919	1363	381	4066	1514	340	3680	1438	333	2756	1389	210	2587	1264	254
3122	6611	1560	433	4301	1485	549	4411	1613	381	3447	1422	314	2807	1424	217	2787	1362	256
3123	5860	1348	348	3850	1305	391	3994	1455	445	3612	1380	321	2693	1332	264	2525	1208	257
3124	5995	1456	382	3963	1407	378	4111	1559	425	3721	1479	322	2798	1431	247	2624	1301	262
3125	6027	1488	383	3995	1439	372	4142	1590	395	3751	1509	324	2828	1461	236	2653	1330	260
3126	5407	1247	353	3605	1211	334	3677	1345	320	3390	1283	310	2520	1236	202	2347	1123	239
3127	3672	863	264	2536	843	282	2536	929	356	2383	889	235	1785	858	202	1621	776	192
3128	4674	1076	316	3177	1050	324	3214	1165	399	2990	1114	275	2221	1072	231	2041	969	225
3129	5909	1300	395	3841	1254	374	3967	1409	442	3606	1335	332	2669	1286	253	2509	1166	268
3130	5941	1402	411	3912	1356	379	4059	1507	408	3670	1428	332	2747	1380	228	2579	1256	259
3131	5074	1241	387	3444	1209	424	3505	1333	383	3237	1269	293	2432	1227	195	2251	1117	230

Niedersachsen (3)

	1987			1988			1989			1993			1994			1995		
ID	Acid	Nit.	BC	Acid	Nit.	BC	Acid	Nit.	BC	Acid	Nit.	BC	Acid	Nit.	BC	Acid	Nit.	BC
3132	5860	1322	400	3831	1277	370	3984	1429	491	3594	1352	316	2671	1304	287	2503	1180	268
3133	6651	1339	383	3946	1244	445	3700	1352	461	3830	1284	336	2262	1187	323	2174	1028	239
3134	5841	1302	388	3813	1257	385	3960	1408	505	3573	1331	311	2650	1283	298	2483	1160	266
3135	5779	1227	401	3746	1185	371	3900	1337	490	3512	1264	317	2585	1215	287	2423	1096	269
3136	5059	1115	387	3366	1083	341	3433	1211	412	3167	1152	313	2335	1107	225	2164	1001	244
3137	6202	1385	480	4026	1337	419	4208	1496	494	3754	1407	367	2782	1357	274	2629	1233	286
3138	8141	1561	499	4711	1429	618	4495	1582	607	4586	1489	397	2665	1363	435	2603	1173	329
3139	7443	1378	448	4323	1269	540	4082	1403	544	4205	1325	351	2426	1212	382	2359	1039	289
3140	6169	1234	445	3928	1184	512	4132	1354	577	3672	1271	328	2682	1219	388	2524	1095	340
3141	5666	1127	410	3642	1086	435	3791	1238	538	3407	1165	289	2485	1118	340	2325	1003	303
3142	5633	1237	467	3772	1155	610	3602	1285	543	3127	1108	318	2679	1097	380	2249	1043	354
3143	6997	1504	356	4427	1418	417	3981	1517	407	4572	1458	317	2895	1359	261	2332	1180	201
3144	7905	1599	415	4834	1486	547	4448	1618	490	5049	1541	381	3088	1427	299	2560	1240	228
3145	7846	1543	377	4772	1429	503	4401	1565	505	4997	1489	381	3036	1375	330	2511	1189	251
3146	5649	1161	299	3567	1092	418	3126	1168	393	3661	1122	323	2288	1043	238	1847	908	179
3147	7794	1490	409	4725	1379	461	4345	1513	508	4945	1437	395	2984	1323	354	2464	1143	241
3148	6733	1282	353	4119	1190	413	3746	1296	460	4297	1232	341	2593	1137	299	2115	983	204
3149	7867	1561	456	4795	1448	556	4409	1580	537	5006	1499	419	3046	1385	460	2521	1200	341
3150	8562	1635	555	5133	1497	780	4768	1654	616	5369	1559	489	3231	1433	509	2675	1235	419
3151	5637	1620	253	3481	1531	304	3398	1629	291	3697	1537	259	3053	1522	206	2765	1420	194
3152	5173	1894	373	3438	1809	427	3821	1999	418	3966	1738	328	3194	1751	261	2658	1587	233
3153	4994	1798	371	3308	1716	426	3676	1903	435	3824	1648	321	3080	1665	253	2549	1505	226
3154	3952	1590	303	2755	1529	357	2932	1652	323	3113	1466	258	2569	1479	200	2117	1344	184
3155	5515	1708	334	3572	1640	437	3673	1741	326	4009	1575	280	3025	1573	202	2997	1498	210
3156	4646	1399	306	3018	1345	426	3072	1427	308	3372	1289	251	2546	1289	179	2497	1225	188
3157	7137	2822	227	5094	2719	300	4939	2827	299	4594	2568	284	4444	2616	316	3918	2433	250
3158	8187	2281	254	5318	2147	342	4920	2273	282	4937	2137	257	3815	2077	317	3187	1930	275
3159	8386	2582	330	5098	2426	373	5139	2588	380	5386	2428	335	4469	2402	396	4073	2237	315
3160	7852	2297	286	4715	2148	394	4742	2303	315	5025	2171	312	4143	2144	355	3768	1988	271
3161	8278	2375	295	5409	2240	365	5017	2368	326	5022	2222	266	3880	2142	287	3203	1945	285
3162	5242	1836	234	3613	1734	330	3470	1832	288	3542	1740	231	2959	1720	281	2562	1602	222
3163	8141	2233	301	5272	2099	363	4880	2234	299	4898	2098	269	3766	2028	313	3138	1881	272
3164	7943	2296	312	4756	2147	443	4782	2302	371	5055	2166	324	4159	2140	367	3799	1990	292
3165	6837	2295	389	4632	2167	428	4508	2301	363	4524	2177	310	3773	2150	330	3228	1987	285
3166	7917	2009	321	5058	1885	394	4656	2010	316	4689	1889	249	3562	1824	290	2948	1691	258
3167	7705	1797	347	4848	1675	419	4449	1803	360	4488	1688	271	3360	1622	282	2758	1501	262
3168	8351	1727	417	5084	1594	574	4721	1740	479	5317	1654	321	3264	1533	300	2722	1335	242
3169	6601	1779	380	4389	1701	508	4479	1821	338	3571	1633	304	2954	1632	211	2915	1555	239
3170	7850	3240	556	6627	3169	735	6302	3278	425	5267	2959	317	5309	2987	303	4594	2849	229
3171	7679	2920	538	6442	2849	738	6141	2966	439	5084	2647	331	5101	2676	311	4373	2550	247
3172	8090	2712	464	5523	2651	635	5188	2762	415	4803	2457	309	4494	2486	305	3774	2379	216
3173	7471	2680	398	6246	2629	571	5904	2731	415	4874	2426	319	4905	2465	337	4183	2349	257
3174	9675	3402	478	6606	3303	573	6275	3453	446	5764	3066	313	5431	3104	334	4584	2964	252
3175	4447	1622	205	3204	1576	318	3028	1644	273	2869	1495	229	2797	1530	234	2448	1420	183
3176	5112	1959	224	3706	1898	282	3514	1984	301	3339	1807	246	3239	1841	244	2854	1719	188
3177	8047	2687	348	5197	2543	404	5485	2761	383	5177	2483	301	4371	2399	297	3881	2223	231
3178	9076	3584	324	6358	3429	452	6280	3607	401	5749	3244	352	5576	3315	367	4929	3086	302
3179	7786	2554	294	5005	2413	289	5270	2621	376	4994	2365	342	4207	2282	287	3725	2109	233
3180	6626	2559	209	4524	2451	251	4631	2591	256	4454	2372	226	3805	2298	254	3382	2138	183
3181	8056	2473	303	4984	2340	411	4923	2477	331	5265	2351	326	4407	2324	371	3963	2158	286
3182	6086	1849	306	3981	1778	372	4294	1947	315	3905	1709	288	3619	1723	264	2706	1566	212
3183	6935	2131	346	4494	2033	423	4919	2235	353	4427	1957	323	4096	1969	299	3089	1794	239
3184	6644	2110	325	4356	2019	369	4736	2216	333	4288	1945	300	3984	1965	272	3011	1788	214
3185	3688	1072	216	2463	1045	240	2465	1096	229	2420	1021	201	2269	1026	174	1643	938	147
3186	5460	2181	316	3715	2086	372	4098	2276	365	4231	2003	310	3453	2010	247	2905	1834	206
3187	5342	2031	356	3589	1946	384	3981	2139	408	4111	1862	314	3343	1882	247	2793	1712	213
3188	5708	1535	313	3582	1454	193	3809	1633	244	3153	1324	172	2698	1309	227	2456	1212	141
3189	9233	2643	464	5708	2467	358	6252	2804	422	5136	2244	296	4416	2217	346	4114	2061	217
3190	6907	2312	278	4552	2206	261	4665	2363	284	4482	2143	240	3799	2074	250	3322	1914	174
3191	8667	2526	379	5370	2364	322	5881	2669	380	4851	2158	250	4173	2131	306	3880	1982	213
3192	9909	2848	495	6108	2652	405	6696	3022	461	5504	2403	322	4744	2384	365	4436	2222	236

Bremen

	1987			1988			1989			1993			1994			1995		
ID	Acid	Nit.	BC	Acid	Nit.	BC	Acid	Nit.	BC	Acid	Nit.	BC	Acid	Nit.	BC	Acid	Nit.	BC
4001	8170	2267	337	4839	2118	429	4885	2286	333	5171	2147	336	4233	2119	316	3870	1971	263
4002	8220	2217	347	4804	2052	443	4862	2231	343	5126	2079	342	4187	2061	322	3835	1922	272
4003	7618	2118	312	4524	1980	395	4548	2133	310	4837	2003	313	3969	1986	292	3608	1843	243
4004	6099	1710	330	3931	1642	329	4228	1816	332	3855	1573	267	3591	1593	253	2635	1460	194
4005	5053	1803	356	3379	1733	315	3728	1919	359	3887	1654	260	3155	1675	258	2626	1550	206

Nordrhein-Westfalen

	1987			1988			1989			1993			1994			1995		
ID	Acid	Nit.	BC	Acid	Nit.	BC	Acid	Nit.	BC	Acid	Nit.	BC	Acid	Nit.	BC	Acid	Nit.	BC
5001	6822	1432	216	4466	1289	259	4369	1442	358	3451	1184	148	3464	1227	208	2698	1099	195
5002	8235	2566	1337	6680	2384	1228	6084	2547	687	4958	2249	451	4318	2190	301	3529	2045	182
5003	6673	1912	447	5578	1783	645	4394	2024	765	3383	1655	339	3536	1808	334	3052	1710	307
5004	6329	1800	576	5297	1681	712	4174	1910	568	3216	1562	346	3373	1710	319	2901	1617	271
5005	7144	2341	1221	5942	2194	1087	5362	2330	606	4393	2057	424	3872	2004	267	3130	1849	159
5006	5084	2078	1030	4477	2019	930	4073	2072	522	3694	1900	370	3332	1939	252	2963	1828	171
5007	6379	2686	937	5335	2631	884	4930	2668	491	4262	2485	330	4347	2517	233	3788	2361	157
5008	2926	808	175	2435	773	274	1932	849	537	1553	750	179	1577	780	170	1325	728	178
5009	5957	1712	372	4986	1596	539	3936	1809	651	3038	1482	299	3179	1614	287	2715	1514	262
5010	5403	1566	467	4532	1462	573	3589	1652	443	2779	1362	286	2907	1480	262	2464	1380	224
5011	5247	1572	543	4424	1476	604	3542	1656	429	2760	1375	294	2862	1481	255	2452	1393	216
5012	6936	2014	1231	5700	1867	1056	5115	2009	596	4137	1743	436	3593	1688	270	2868	1560	167
5013	6969	2111	1263	5752	1967	1106	5150	2101	614	4194	1837	457	3666	1784	273	2942	1648	165
5014	6433	2350	976	5269	2285	953	4842	2332	514	4141	2152	354	4197	2185	255	3619	2045	176
5015	5947	1774	349	4995	1658	507	3962	1866	657	3072	1538	302	3207	1666	278	2732	1552	259
5016	5793	1731	421	4891	1626	540	3896	1823	565	3026	1503	306	3124	1615	273	2682	1519	247
5017	5152	1516	493	4350	1422	553	3464	1599	450	2686	1317	282	2793	1425	245	2386	1336	216
5018	7308	1979	342	5680	1802	551	4742	1998	909	3991	1752	365	3819	1843	352	3213	1751	341
5019	5602	1486	299	4386	1373	437	3584	1497	643	3112	1344	274	2936	1401	272	2418	1298	239
5020	6494	1808	366	5039	1657	508	4196	1813	677	3605	1623	300	3425	1691	300	2830	1561	265
5021	5513	1439	266	4274	1318	422	3495	1444	581	3023	1289	273	2858	1346	253	2355	1253	248
5022	6545	1792	485	5088	1640	568	4206	1795	574	3615	1606	321	3430	1674	302	2833	1544	258
5023	5140	1351	316	3997	1241	421	3249	1353	482	2847	1216	256	2681	1266	234	2192	1167	213
5024	8618	2043	1288	5991	1843	1030	5333	1998	605	4627	1737	590	4565	1775	374	3900	1683	219
5025	7338	1826	1119	5192	1681	927	4559	1777	535	4000	1582	531	4025	1614	304	3398	1519	187
5026	7187	1893	953	5122	1754	926	4508	1841	517	3974	1653	487	4006	1683	258	3384	1581	184
5027	7644	2062	945	5408	1898	935	4822	2012	525	4277	1800	478	4223	1828	271	3598	1717	191
5028	4947	1414	366	3903	1319	421	3191	1417	402	2813	1283	249	2662	1326	233	2185	1223	199
5029	4472	1278	684	3464	1158	553	3224	1365	387	2499	1055	252	1950	1040	206	1714	976	150
5030	8103	2147	1105	5747	1961	823	4429	2089	616	3989	1842	606	4029	1876	388	3235	1770	230
5031	8842	4023	739	7434	3938	875	7203	4042	474	6302	3746	382	6140	3717	329	5156	3369	216
5032	4871	1218	394	3795	1120	433	3046	1222	381	2674	1095	267	2508	1143	242	2049	1056	203
5033	4420	1262	511	3439	1147	444	3187	1342	341	2463	1042	211	1939	1024	188	1691	958	151
5034	6512	1895	856	4802	1722	658	4168	1987	495	3336	1577	315	3231	1555	294	2585	1458	194
5035	7550	2140	611	5437	1987	656	4830	2089	473	4284	1873	386	4235	1897	284	3595	1765	199
5036	5359	1510	564	4084	1346	496	3815	1611	388	2931	1222	232	2288	1204	223	2022	1134	176
5037	6078	1831	654	4515	1673	510	3912	1909	438	3160	1535	244	3041	1508	262	2437	1405	181
5038	7117	1935	652	5064	1780	509	3893	1882	508	3524	1666	458	3580	1699	317	2849	1587	203
5039	6059	1574	559	4293	1448	483	3259	1526	455	2965	1359	420	3034	1387	278	2394	1298	182
5040	7694	3178	522	6420	3119	693	6176	3211	441	5348	2967	354	5232	2941	311	4338	2656	218
5041	5482	1392	380	4245	1272	437	3461	1398	370	2994	1244	287	2821	1300	288	2306	1199	224
5042	5795	1624	588	4274	1472	461	3695	1713	466	2938	1338	265	2810	1318	256	2250	1238	180
5043	7412	1962	610	5192	1778	475	4020	1909	490	3628	1668	391	3634	1702	303	2893	1587	211
5044	6370	1743	486	4653	1562	450	4024	1843	396	3181	1414	193	3052	1396	244	2432	1310	196
5045	7210	2576	382	5801	2512	561	5675	2630	431	4851	2395	336	4674	2380	306	3836	2150	224
5046	5493	1530	359	4327	1422	404	3525	1533	358	3076	1368	265	2917	1420	305	2425	1338	228
5047	4638	1353	335	3477	1246	310	3001	1418	295	2396	1132	136	2323	1114	180	1824	1024	151
5048	6588	1550	355	4367	1400	353	3646	1556	321	3008	1284	164	3049	1328	232	2254	1191	190
5049	7529	1692	416	4928	1511	396	4102	1701	402	3345	1380	140	3395	1439	261	2508	1295	222
5050	6412	1550	363	4620	1428	349	3501	1515	402	3100	1320	168	3187	1359	241	2394	1232	217
5051	7306	2325	340	5473	2197	413	4294	2270	468	3851	2041	268	3964	2070	310	3078	1872	232
5052	6133	1410	286	4083	1280	336	3384	1411	295	2801	1172	191	2869	1206	226	2111	1095	199
5053	7477	1640	348	4877	1460	355	4051	1650	392	3295	1330	141	3345	1389	234	2464	1251	216
5054	7165	1655	338	4742	1495	337	3939	1657	387	3245	1373	139	3309	1413	228	2448	1276	218
5055	6543	1655	292	4409	1515	295	3695	1652	371	3077	1399	137	3146	1432	215	2333	1285	200
5056	6478	1664	301	4711	1552	317	3575	1625	390	3179	1432	166	3301	1466	235	2485	1325	218

Nordrhein-Westfalen (2)

	1987			1988			1989			1993			1994			1995		
ID	Acid	Nit.	BC	Acid	Nit.	BC	Acid	Nit.	BC	Acid	Nit.	BC	Acid	Nit.	BC	Acid	Nit.	BC
5057	6008	1807	260	4454	1707	285	3443	1761	363	3111	1585	173	3220	1609	218	2451	1443	192
5058	5890	2325	225	4548	2230	298	3683	2267	340	3382	2091	199	3468	2097	228	2725	1868	174
5059	6491	1716	291	4407	1577	324	3702	1707	309	3081	1436	161	3149	1468	201	2404	1378	191
5060	7306	1568	318	4753	1394	340	3941	1579	378	3201	1267	149	3251	1325	224	2388	1193	219
5061	3900	784	198	2561	737	208	2111	800	277	1798	709	112	1825	704	155	1327	636	148
5062	4134	1074	195	3016	1028	213	2261	1052	279	2073	978	123	2161	979	161	1621	883	153
5063	5719	1796	204	4263	1704	244	3316	1751	360	3010	1585	179	3110	1603	215	2377	1436	185
5064	8261	2619	260	6095	2481	472	5519	2571	362	4465	2275	297	4677	2334	309	3830	2120	256
5065	2935	539	192	1917	503	212	1582	561	204	1338	490	126	1373	486	127	990	443	128
5066	6358	1296	293	4126	1150	327	3405	1309	308	2773	1045	172	2819	1092	200	2051	987	193
5067	6009	1334	263	3977	1207	293	3291	1337	305	2721	1107	147	2788	1141	191	2038	1027	182
5068	5929	1382	230	3954	1257	261	3290	1384	327	2728	1157	138	2804	1191	194	2046	1066	186
5069	7112	2330	199	5301	2224	343	4794	2294	322	3914	2032	243	4105	2089	261	3366	1887	221
5070	8208	2603	228	5988	2455	403	5488	2552	340	4417	2242	269	4590	2310	295	3764	2090	247
5071	6579	1315	314	4245	1160	389	3498	1326	337	2832	1048	240	2886	1101	232	2092	991	219
5072	8329	1880	390	5443	1667	438	4551	1892	386	3672	1508	236	3725	1579	264	2749	1415	249
5073	5980	1150	261	3868	1016	299	3167	1163	300	2581	921	154	2628	967	191	1893	869	189
5074	6364	1597	229	4269	1455	275	3584	1598	317	2972	1334	146	3016	1374	191	2240	1228	188
5075	7320	1831	249	4880	1660	297	4088	1829	366	3363	1517	161	3417	1566	220	2550	1402	211
5076	6184	1417	214	4095	1281	258	3411	1425	356	2810	1172	147	2857	1215	206	2101	1089	194
5077	7167	2758	217	5514	2629	308	4449	2683	367	4053	2453	198	4149	2467	253	3265	2205	208
5078	7484	2709	196	5582	2573	342	4578	2658	347	3875	2353	232	4036	2408	255	3197	2171	214
5079	4254	882	294	2792	793	336	2364	878	276	1944	745	231	2086	800	211	1603	738	158
5080	7883	1562	455	5053	1361	443	4178	1581	366	3343	1225	248	3392	1294	269	2471	1164	226
5081	5785	1090	339	3739	962	315	3054	1103	274	2489	870	178	2541	915	194	1823	823	182
5082	7171	1461	311	4631	1287	365	3820	1470	334	3090	1165	193	3142	1223	219	2284	1095	216
5083	6288	1345	228	4112	1201	293	3400	1351	322	2789	1095	175	2834	1139	198	2058	1017	196
5084	7447	1554	252	4821	1372	320	3989	1566	397	3226	1244	198	3276	1304	239	2390	1167	228
5085	8032	1690	279	5189	1485	334	4309	1704	474	3465	1343	208	3521	1414	274	2575	1265	249
5086	6379	1724	250	4654	1610	294	3553	1677	423	3175	1487	189	3287	1516	247	2481	1363	220
5087	7902	2799	218	5906	2649	337	4782	2737	370	4032	2412	230	4230	2471	265	3336	2227	227
5088	6941	1355	485	4440	1185	448	3664	1368	355	2962	1074	254	3009	1128	265	2174	1011	209
5089	8498	1655	573	5373	1421	509	4477	1672	405	3548	1276	266	3598	1353	299	2603	1212	253
5090	5643	1069	311	3650	946	341	2993	1084	288	2434	856	200	2484	900	191	1780	806	186
5091	7086	1404	297	4561	1234	344	3757	1418	366	3033	1115	236	3083	1173	241	2233	1050	221
5092	6953	1765	337	5030	1623	366	3846	1719	471	3385	1490	234	3474	1531	269	2611	1371	234
5093	6826	1794	383	4971	1668	384	3784	1746	469	3359	1536	232	3485	1569	269	2621	1406	232
5094	6222	1546	360	4491	1426	358	3415	1508	436	3017	1311	213	3107	1347	249	2323	1206	217
5095	6964	1424	540	4525	1265	506	3725	1429	409	3019	1145	302	3094	1188	298	2245	1070	216
5096	7834	1503	565	4980	1298	527	4109	1517	423	3288	1169	297	3344	1239	305	2414	1108	241
5097	8094	1630	392	5160	1415	429	4278	1642	432	3433	1276	289	3491	1349	293	2523	1203	247
5098	8224	1774	381	5331	1563	393	4434	1786	523	3573	1412	279	3624	1484	310	2658	1325	250
5099	6668	1719	373	4847	1599	378	3677	1674	450	3267	1470	250	3387	1501	270	2539	1344	225
5100	3276	565	268	2263	525	256	1661	577	297	1497	510	161	1552	515	168	1118	463	145
5101	5740	1596	368	4205	1494	364	3226	1555	389	2899	1379	203	2963	1403	231	2236	1251	191
5102	9337	2959	320	6068	2784	424	5428	2902	443	4575	2528	256	4412	2598	308	3429	2348	284
5103	6048	1142	526	3873	1002	502	3192	1156	429	2578	904	312	2633	950	289	1893	856	196
5104	6047	1167	449	3871	1024	403	3195	1178	423	2597	930	280	2648	976	256	1889	870	191
5105	6984	1438	508	4542	1279	446	3742	1444	508	3046	1163	316	3115	1206	296	2261	1082	220
5106	6847	1483	516	4499	1329	456	3714	1485	531	3041	1212	291	3107	1251	287	2265	1120	215
5107	7614	1803	631	5480	1637	587	4190	1767	611	3605	1490	335	3723	1547	347	2790	1390	266
5108	5938	1508	466	4306	1405	432	3242	1466	432	2902	1294	246	3011	1321	257	2245	1180	206
5109	8214	2298	316	5125	2138	335	4586	2264	339	3813	1921	215	3659	2000	263	2799	1806	248
5110	8044	1369	590	5206	1234	507	4677	1477	537	3319	1146	341	3340	1138	305	2652	1092	234
5111	4915	1231	483	3416	1118	417	2961	1262	457	2315	1034	257	2420	1049	222	1899	980	172
5112	6068	1607	481	4168	1448	442	3679	1638	457	2850	1336	262	2945	1356	243	2354	1266	199
5113	5785	1965	365	4213	1835	338	3734	1979	344	3026	1707	213	3134	1718	214	2523	1576	187
5114	6525	1319	624	4464	1217	527	3986	1387	528	2924	1143	320	2978	1122	285	2330	1054	202
5115	6387	1818	548	4455	1657	496	3919	1843	489	3081	1530	302	3195	1545	264	2559	1437	214
5116	6011	1825	411	4267	1680	385	3760	1845	354	2995	1558	243	3101	1568	233	2473	1446	204
5117	5914	1862	366	4230	1722	342	3740	1882	329	2996	1602	228	3101	1613	223	2492	1492	199
5118	7722	2522	336	5629	2414	385	4756	2526	333	4876	2320	271	4223	2314	289	3432	2119	318
5119	6666	1842	661	4610	1671	587	4062	1873	560	3158	1535	358	3282	1550	298	2639	1454	224
5120	8093	2098	718	5509	1857	680	4890	2158	611	3732	1698	394	3827	1729	352	3096	1638	278
5121	5995	1850	464	4230	1698	443	3776	1874	397	2988	1573	271	3081	1588	239	2472	1461	195

Nordrhein-Westfalen (3)

	1987			1988			1989			1993			1994			1995		
ID	Acid	Nit.	BC	Acid	Nit.	BC	Acid	Nit.	BC	Acid	Nit.	BC	Acid	Nit.	BC	Acid	Nit.	BC
5122	7011	2248	405	4964	2069	401	4444	2274	363	3528	1917	266	3612	1929	252	2949	1786	223
5123	6124	1778	308	4378	1686	305	3653	1785	296	3783	1626	209	3208	1621	220	2583	1478	218
5124	5507	1549	278	3952	1474	272	3283	1562	270	3424	1424	182	2888	1421	200	2324	1299	203
5125	7696	2261	275	5066	2140	337	4694	2253	304	4721	2115	246	3677	2050	266	3003	1848	263
5126	6166	1843	306	3870	1699	293	3809	1859	286	3105	1577	233	2922	1588	216	2326	1471	198
5127	5147	1409	282	3690	1351	262	3049	1423	256	3213	1307	192	2732	1307	187	2156	1190	198
5128	4178	1184	220	3025	1135	221	2496	1195	230	2613	1096	158	2232	1096	161	1802	1002	205
5129	5375	1426	397	3742	1294	435	3287	1457	341	2554	1192	308	2647	1210	248	2103	1127	196
5130	7452	1967	375	4487	1778	367	4447	2001	348	3544	1641	315	3307	1660	277	2644	1565	258
5131	6601	1747	340	4659	1644	324	3839	1764	307	3961	1584	249	3334	1585	238	2693	1455	261
5132	6689	1900	336	4770	1813	314	3980	1917	310	4125	1745	229	3518	1743	232	2803	1589	265
5133	6475	1827	321	4618	1743	297	3846	1842	310	3994	1679	224	3408	1680	225	2715	1534	285
5134	4824	1476	466	3464	1368	451	3057	1496	395	2415	1245	328	2492	1253	268	2023	1184	185
5135	6414	1791	393	3923	1631	438	3901	1816	347	3123	1504	319	2908	1520	261	2313	1409	219
5136	7158	1980	364	4357	1800	347	4322	2009	337	3462	1662	302	3238	1678	259	2577	1561	245
5137	5375	1526	272	3869	1463	248	3208	1537	251	3366	1410	192	2872	1411	189	2274	1282	236
5138	7545	2096	505	4580	1903	531	4555	2124	435	3647	1753	383	3405	1768	318	2725	1652	273
5139	7168	1894	379	4312	1712	380	4286	1928	357	3412	1578	305	3185	1596	254	2532	1494	270
5140	5176	1331	265	3675	1272	247	3013	1348	256	3189	1232	215	2697	1234	191	2115	1125	239

Hessen

	1987			1988			1989			1993			1994			1995		
ID	Acid	Nit.	BC	Acid	Nit.	BC	Acid	Nit.	BC	Acid	Nit.	BC	Acid	Nit.	BC	Acid	Nit.	BC
6001	10459	1706	1105	6404	1491	1029	4623	1776	988	3197	1091	665	3197	1136	586	2555	1075	281
6002	12889	2232	1372	7892	1943	1293	5770	2322	1245	3980	1419	795	4058	1495	735	3300	1435	364
6003	7635	1409	719	5073	1288	631	4112	1381	633	3371	1258	527	2689	1203	497	2368	1143	206
6004	3550	677	468	2445	632	488	1835	663	443	1719	621	412	1544	597	425	1174	556	137
6005	5631	1157	652	3666	1057	676	2820	1126	581	2274	957	519	2298	976	541	1803	937	181
6006	4383	1077	379	3057	997	425	2701	1137	398	2197	996	400	2083	1011	457	1778	957	202
6007	5003	1099	588	3251	948	604	2937	1151	601	2543	1026	479	2451	1101	442	2128	1046	254
6008	2827	690	394	1891	619	380	1633	698	395	1489	642	298	1436	677	274	1214	632	158
6009	4960	1348	513	3321	1203	473	3022	1381	545	2637	1231	501	2540	1290	469	2237	1238	255
6010	5847	1156	807	3963	1069	777	3066	1138	704	2798	1058	554	2494	1007	492	1939	954	196
6011	7181	1433	833	4506	1291	859	3548	1416	740	2780	1161	618	2785	1191	552	2196	1140	229
6012	6647	1284	852	4346	1162	803	3441	1265	776	3050	1141	614	2689	1089	529	2084	1029	234
6013	6787	1232	891	4384	1103	757	3467	1214	762	3065	1097	601	2696	1045	531	2070	984	236
6014	6737	1316	837	4376	1187	833	3469	1293	786	3107	1174	625	2735	1118	548	2120	1054	232
6015	6511	1263	704	4084	1138	760	3196	1247	624	2513	1030	553	2518	1055	565	1980	1011	202
6016	4900	1104	578	3224	1020	622	2518	1080	520	2045	919	451	2053	936	423	1620	896	166
6017	4643	1029	479	3118	934	504	2803	1094	467	2221	941	480	2093	961	536	1757	902	210
6018	8829	1432	787	5691	1280	732	4657	1417	752	3737	1278	638	2946	1214	638	2580	1149	267
6019	7720	1251	714	5029	1127	662	4048	1230	667	3302	1119	572	2598	1066	560	2269	1004	222
6020	5598	1255	458	3726	1135	521	3400	1340	474	2639	1140	484	2501	1166	543	2110	1103	256
6021	5211	1183	498	3510	1078	535	3185	1263	494	2477	1075	503	2345	1099	570	1980	1038	236
6022	5916	1176	714	4005	1086	710	3106	1157	658	2833	1072	592	2519	1018	584	1958	960	206
6023	5276	1089	629	3388	993	644	2648	1068	569	2114	895	483	2120	914	458	1667	877	160
6024	7084	1325	643	4754	1217	589	3833	1300	605	3178	1188	477	2533	1136	453	2228	1076	213
6025	5196	1161	519	3717	1102	461	2915	1133	485	2500	1052	371	2072	1011	349	1836	961	160
6026	7460	1259	709	4922	1142	587	3961	1237	605	3242	1133	479	2565	1083	459	2255	1031	218
6027	5589	1013	525	3905	950	470	3015	990	535	2566	929	421	2074	888	408	1820	835	186
6028	5175	1147	648	3474	1042	685	3149	1227	600	2443	1041	623	2312	1066	682	1945	1003	225
6029	5737	1212	664	3493	1048	733	2820	1197	594	2571	985	560	2434	1058	602	1929	996	206
6030	4851	1295	489	3248	1154	477	2970	1332	527	2571	1187	478	2478	1246	445	2174	1192	248
6031	4692	1285	592	3201	1158	539	2863	1320	573	2507	1181	488	2433	1237	456	2140	1182	229
6032	5179	1248	633	3437	1096	649	3143	1305	635	2676	1150	519	2584	1222	483	2254	1167	266
6033	4679	1059	623	3060	922	514	2775	1106	548	2394	985	481	2307	1053	448	2003	1002	230
6034	4563	1030	358	3081	939	424	2761	1091	390	2196	943	385	2074	965	422	1747	909	234
6035	5433	1218	412	3611	1101	483	3288	1297	439	2563	1106	451	2423	1131	505	2052	1072	248
6036	5075	994	654	3243	903	619	2504	972	597	2011	816	455	2016	836	382	1564	797	175
6037	6664	1332	789	4203	1205	782	3295	1314	720	2590	1084	557	2594	1108	480	2047	1064	212
6038	6316	1267	793	4079	1152	784	3157	1240	719	2510	1042	564	2538	1062	496	1993	1019	211
6039	5412	1226	658	3517	1126	666	2772	1197	603	2224	1009	491	2222	1023	416	1780	989	183
6040	10643	1820	1094	6556	1602	1076	4772	1894	1010	3307	1183	664	3315	1229	593	2664	1167	290
6041	6251	1176	727	4087	1063	670	3200	1155	647	2880	1053	564	2536	1004	539	1953	944	208

Hessen (2)

	1987			1988			1989			1993			1994			1995		
ID	Acid	Nit.	BC	Acid	Nit.	BC	Acid	Nit.	BC	Acid	Nit.	BC	Acid	Nit.	BC	Acid	Nit.	BC
6042	7353	1502	845	4792	1360	772	3838	1481	732	3411	1338	637	3010	1275	603	2355	1213	239
6043	7082	1422	816	4612	1285	792	3675	1399	735	3279	1266	646	2889	1205	619	2250	1142	231
6044	7887	1693	920	5143	1534	906	4170	1670	813	3679	1500	707	3259	1430	699	2569	1364	242
6045	6523	1299	613	4091	1155	676	3347	1285	557	2806	1075	525	2445	1147	584	2175	1082	210
6046	4220	1033	453	2946	958	489	2602	1092	441	2112	954	451	2009	971	510	1707	915	193
6047	7630	1184	730	4947	1062	724	3960	1163	675	3235	1061	618	2536	1009	625	2207	947	220
6048	9125	1520	830	5894	1361	828	4864	1508	767	3878	1355	729	3075	1289	778	2696	1224	271
6049	5807	1118	672	3854	1017	663	3009	1099	622	2729	1006	557	2400	959	547	1849	901	195
6050	6973	1144	625	4617	1040	610	3681	1126	598	3042	1032	546	2390	981	559	2085	924	209
6051	4440	1037	531	3028	950	512	2719	1097	513	2159	946	505	2038	964	515	1721	908	194
6052	13174	2572	1361	8231	2284	1401	6099	2658	1247	4266	1708	903	4333	1771	810	3560	1697	392
6053	11367	2191	1182	7210	1964	1207	5319	2246	1099	3718	1477	771	3732	1512	676	3037	1446	331
6054	12022	2307	1220	7515	2051	1312	5527	2384	1156	3871	1533	772	3915	1586	694	3212	1518	340
6055	13481	2665	1384	8379	2359	1475	6237	2746	1286	4351	1760	884	4422	1827	808	3658	1756	412
6056	9683	1862	1003	6214	1687	1010	4558	1914	938	3197	1280	631	3175	1303	546	2556	1240	270
6057	4680	1043	603	3068	962	608	2400	1019	563	1940	861	452	1942	877	376	1541	843	167
6058	5468	732	693	3456	674	730	2354	766	657	1777	582	447	1707	567	381	1306	527	187
6059	7235	1542	757	4598	1407	705	3949	1634	661	3182	1286	559	2867	1268	487	2360	1238	239
6060	7317	1521	758	4395	1349	761	3909	1594	728	3732	1350	727	3082	1274	575	2606	1251	284
6061	7322	1526	759	4400	1353	727	3913	1598	716	3742	1360	748	3090	1282	583	2614	1259	280
6062	7189	1402	772	4272	1234	797	3795	1479	718	3610	1233	721	2967	1162	571	2490	1137	295
6063	6404	1423	700	3983	1283	703	3525	1478	642	3359	1278	674	2839	1204	526	2375	1176	265
6064	4317	892	532	2719	808	542	2357	939	481	2290	811	515	1928	768	403	1569	745	211
6065	7850	1646	871	4948	1495	800	4249	1748	763	3382	1351	652	3040	1333	569	2522	1312	272
6066	8338	1678	869	4959	1471	821	4467	1776	774	4204	1495	876	3476	1408	684	2948	1386	329
6067	7404	1465	809	4637	1325	775	3961	1564	717	3161	1203	626	2837	1188	547	2329	1165	275
6068	7054	1418	725	4192	1250	709	3744	1489	662	3591	1267	730	2964	1196	565	2485	1169	279
6069	6622	1537	737	4354	1419	671	3727	1605	644	3028	1293	572	2764	1267	484	2271	1235	241
6070	6493	1408	736	4228	1293	697	3601	1479	646	2916	1181	583	2656	1159	493	2162	1125	248
6071	8214	1696	815	4896	1493	812	4410	1788	718	4164	1507	855	3434	1420	676	2919	1398	337
6072	5835	1003	565	4536	902	606	3957	1062	477	3667	902	555	2483	844	391	2077	829	233
6073	5132	1547	763	3654	1375	812	3318	1626	661	3450	1377	758	2388	1300	600	2095	1271	328
6074	6251	1269	679	3832	1132	713	3375	1328	596	3229	1148	704	2713	1078	552	2247	1048	298
6075	4822	1410	789	3423	1252	809	3087	1481	684	3194	1242	682	2215	1177	533	1933	1147	312
6076	3788	802	536	2406	735	539	2087	847	494	1953	658	435	1656	628	354	1329	604	196
6077	9102	1629	768	6924	1443	807	6057	1717	641	5537	1448	823	3761	1358	560	3240	1343	332
6078	9241	1583	766	7014	1390	851	6129	1676	655	5591	1399	834	3773	1309	585	3239	1297	351
6079	7861	1556	713	5183	1423	596	4680	1647	599	3374	1309	390	3389	1293	346	2731	1251	228
6080	8604	1897	765	5723	1748	616	5193	1988	630	3769	1592	427	3776	1570	372	3097	1533	241
6081	8572	1568	739	5527	1417	623	4996	1676	616	3561	1306	435	3567	1289	377	2869	1255	243
6082	6660	1286	542	4516	1182	492	4031	1359	456	2923	1097	339	2978	1076	290	2351	1036	208
6083	6555	1181	521	4414	1080	450	3929	1257	457	2836	1010	321	2893	991	274	2263	948	204
6084	6751	1545	737	4424	1425	662	3781	1615	621	3075	1304	561	2798	1276	469	2302	1244	246
6085	7010	1476	648	4713	1362	574	4261	1553	552	3099	1248	420	3127	1230	360	2507	1191	206
6086	8644	1608	810	5580	1455	732	5042	1714	671	3596	1334	535	3611	1319	485	2893	1284	271
6087	8658	1623	774	5620	1472	703	5074	1730	648	3610	1344	496	3627	1330	418	2934	1303	247
6088	8553	1679	780	5578	1527	717	5054	1782	673	3623	1397	533	3636	1378	446	2941	1349	242
6089	13147	1372	697	7447	1233	625	8224	1430	569	5993	1248	602	5240	1171	471	4055	1144	297
6090	5758	1446	547	3461	1306	563	3438	1477	447	2701	1178	390	2500	1192	333	1999	1152	228
6091	13181	1418	592	7495	1279	656	8274	1477	508	6039	1294	505	5286	1217	356	4095	1184	277
6092	5713	1161	596	3488	1037	547	3064	1219	505	2980	1057	618	2479	1000	496	2043	966	261
6093	8311	1439	693	6320	1272	695	5474	1506	576	5040	1278	768	3409	1196	538	2935	1187	316
6094	13106	1348	646	7434	1212	705	8211	1410	536	5978	1233	552	5227	1158	399	4040	1127	284
6095	7241	1393	709	4848	1275	622	4345	1470	610	3140	1179	470	3190	1154	394	2536	1119	228
6096	7051	1552	699	4836	1439	628	4347	1619	594	3180	1315	510	3228	1288	415	2594	1253	229
6097	6200	1216	618	4216	1121	548	3786	1292	540	2729	1027	433	2768	1015	350	2184	979	191
6098	7984	1679	738	5302	1542	680	4799	1766	641	3467	1402	515	3478	1382	443	2834	1354	219
6099	7427	1617	721	5049	1495	646	4541	1686	597	3314	1366	541	3355	1337	487	2706	1302	261
6100	6123	1665	657	4246	1510	568	3729	1694	548	2887	1368	351	2990	1378	304	2431	1334	199
6101	7622	1845	854	5135	1621	783	4528	1905	688	3396	1450	564	3500	1479	496	2859	1451	287
6102	8324	1615	786	5447	1472	718	4917	1714	644	3518	1341	555	3531	1325	517	2858	1294	279
6103	7854	2078	746	5337	1846	721	4751	2133	618	3609	1665	460	3709	1690	403	3039	1643	273
6104	5940	1400	680	3970	1297	654	3386	1461	601	2768	1186	520	2532	1160	444	2068	1129	205
6105	7935	1612	770	5299	1479	705	4774	1691	664	3453	1356	540	3505	1329	440	2819	1298	238
6106	6923	1324	708	4314	1186	794	3389	1307	616	2656	1078	549	2662	1107	563	2091	1057	221

Hessen (3)

	1987			1988			1989			1993			1994			1995		
ID	Acid	Nit.	BC	Acid	Nit.	BC	Acid	Nit.	BC	Acid	Nit.	BC	Acid	Nit.	BC	Acid	Nit.	BC
6107	4355	932	440	2878	840	497	2434	925	397	2006	785	347	2167	839	337	1664	782	163
6108	4216	940	480	2804	852	534	2381	933	429	1964	793	376	2117	842	352	1636	788	158
6109	6102	1200	536	4146	1105	554	3726	1274	459	2695	1017	367	2740	1004	322	2159	972	189
6110	8334	1627	788	5459	1484	773	4929	1724	685	3527	1350	561	3539	1333	481	2872	1308	242
6111	6398	1350	753	4160	1234	772	3239	1321	639	2586	1118	556	2613	1137	473	2062	1089	218
6112	4963	1192	591	3341	1109	619	2603	1160	509	2140	1002	435	2159	1015	372	1714	972	171
6113	6542	1355	621	4269	1209	640	3514	1359	513	2864	1088	401	2928	1124	371	2141	1030	213
6114	6304	1243	544	3993	1080	605	3377	1228	464	2761	1013	389	2914	1087	368	2270	1024	211
6115	7146	1477	504	4507	1281	577	3848	1459	442	3155	1203	374	3319	1290	360	2592	1215	239
6116	6015	1220	456	3832	1068	536	3250	1206	418	2659	999	356	2810	1070	345	2189	1010	202
6117	7579	1405	680	4957	1277	638	4476	1498	584	3211	1176	458	3225	1160	379	2573	1127	221
6118	6227	1271	604	4292	1175	593	3836	1338	520	2805	1086	421	2864	1064	354	2256	1029	201
6119	7624	1452	653	5004	1322	615	4522	1543	558	3252	1217	436	3265	1200	369	2615	1167	220
6120	8097	1375	632	5193	1235	604	4682	1483	527	3327	1143	392	3341	1130	347	2656	1099	238
6121	7751	1615	838	4875	1457	913	3873	1597	708	3038	1317	624	3046	1347	562	2429	1295	247
6122	7686	1560	875	4819	1406	867	3799	1540	771	2978	1262	672	2989	1294	571	2366	1239	258
6123	6786	1446	770	4301	1314	782	3409	1424	695	2685	1178	588	2682	1200	499	2138	1152	225
6124	4512	960	580	2943	883	602	2289	937	512	1851	795	445	1855	811	380	1461	778	164
6125	6787	1336	775	4234	1202	821	3339	1317	685	2620	1085	586	2621	1111	526	2068	1064	219
6126	6241	1541	420	4219	1357	509	3917	1517	408	3142	1265	361	2671	1340	432	2366	1277	215
6127	7455	1417	585	4766	1230	584	3907	1431	459	3125	1098	339	3180	1161	342	2309	1055	230
6128	6889	1428	670	4351	1241	741	3710	1408	559	3034	1162	473	3202	1246	426	2498	1172	228
6129	8150	1820	886	5182	1654	912	4145	1796	746	3254	1486	657	3261	1517	564	2626	1459	255
6130	5823	1300	674	3755	1190	690	2965	1274	594	2373	1071	514	2372	1089	436	1888	1045	190
6131	4483	919	456	2923	826	452	2405	918	380	1986	751	292	2064	774	263	1487	704	161
6132	5694	1038	584	3854	948	641	3104	1009	496	2222	862	431	2537	884	395	1927	842	189
6133	7834	1410	710	5087	1270	786	4209	1395	589	2935	1152	496	3300	1183	439	2538	1130	229
6134	6574	1255	737	4112	1130	794	3218	1239	625	2513	1020	545	2515	1046	488	1987	1004	215
6135	6379	1331	757	4142	1215	799	3220	1302	669	2568	1100	574	2595	1119	525	2048	1074	218
6136	5892	1323	467	3892	1188	542	3296	1307	431	2701	1102	372	2891	1170	370	2261	1104	197
6137	4882	1082	629	3245	999	626	2505	1050	566	2043	899	485	2064	914	407	1622	874	183
6138	7286	1479	848	4577	1336	869	3618	1460	750	2806	1196	629	2822	1224	550	2251	1180	235
6139	4596	1102	486	2923	989	559	2361	1088	446	2162	912	402	2066	970	424	1657	918	165

Rheinland-Pfalz

	1987			1988			1989			1993			1994			1995		
ID	Acid	Nit.	BC	Acid	Nit.	BC	Acid	Nit.	BC	Acid	Nit.	BC	Acid	Nit.	BC	Acid	Nit.	BC
7001	5740	1234	264	3743	1104	298	3120	1243	283	2545	1007	154	2617	1050	183	1901	950	178
7002	8466	1785	388	5455	1562	449	4547	1801	391	3641	1408	228	3692	1484	270	2718	1343	261
7003	4568	924	234	2970	830	291	2455	930	252	2018	755	184	2085	787	189	1521	728	170
7004	6873	1804	308	4557	1632	373	3939	1778	314	3272	1519	212	3418	1588	246	2801	1548	213
7005	6098	1699	302	4228	1529	376	3935	1672	311	3173	1423	226	2750	1495	259	2493	1457	208
7006	6276	1530	310	4164	1288	456	3481	1385	395	2777	1216	373	2568	1255	356	2119	1162	272
7007	5598	1263	280	3692	1138	359	3131	1250	302	2584	1066	245	2764	1132	270	2167	1073	197
7008	5540	1395	272	3804	1245	350	3524	1378	282	2835	1165	221	2425	1235	259	2168	1188	198
7009	4741	1095	254	3165	997	324	2681	1084	274	2226	933	225	2397	992	259	1875	940	173
7010	6564	1891	390	5162	1752	493	4308	1905	432	3657	1672	339	3495	1742	376	2957	1675	275
7011	4545	1031	296	3008	933	361	2560	1021	301	2113	867	257	2253	921	284	1777	885	163
7012	6148	1528	289	4197	1352	388	3891	1508	318	3124	1266	247	2657	1342	312	2384	1297	222
7013	5609	1520	328	4408	1407	434	3606	1528	372	3117	1353	296	2945	1406	329	2465	1345	245
7014	5106	1317	319	3991	1217	427	3233	1325	413	2820	1182	270	2665	1234	245	2201	1164	216
7015	5973	1400	284	4010	1226	383	3719	1382	318	2984	1156	248	2530	1234	322	2236	1178	220
7016	4996	1338	265	3934	1239	380	3175	1337	323	2783	1194	284	2629	1241	306	2194	1188	229
7017	6624	1600	375	5059	1438	551	4173	1614	530	3518	1409	352	3343	1490	320	2754	1398	285
7018	6252	1569	357	4835	1426	511	3969	1580	563	3381	1394	319	3206	1465	288	2647	1373	270
7019	5048	1165	251	3434	1032	337	3171	1152	289	2538	967	229	2157	1034	297	1901	988	194
7020	6221	1538	332	4805	1396	504	3939	1550	568	3350	1363	323	3177	1436	293	2625	1351	275
7021	5518	1289	334	3791	1147	410	3479	1275	354	2785	1075	290	2393	1149	397	2100	1089	206
7022	3853	881	229	2653	788	288	2449	876	259	1968	741	208	1689	796	283	1468	751	157
7023	6130	1568	303	4711	1425	478	3879	1573	409	3305	1380	342	3127	1444	322	2599	1374	271
7024	5521	1355	280	4264	1233	449	3465	1362	435	2981	1202	301	2809	1261	265	2326	1195	249
7025	4776	1120	302	3311	1003	367	3035	1109	326	2433	940	277	2097	1004	370	1837	952	184
7026	5076	1397	247	3976	1294	387	3248	1398	338	2835	1244	289	2680	1290	281	2246	1241	224
7027	5219	1191	324	3541	1047	393	3271	1179	346	2620	983	304	2221	1055	392	1953	1004	196

Rheinland-Pfalz (2)

	1987			1988			1989			1993			1994			1995		
ID	Acid	Nit.	BC	Acid	Nit.	BC	Acid	Nit.	BC	Acid	Nit.	BC	Acid	Nit.	BC	Acid	Nit.	BC
7028	6003	1673	265	4685	1541	436	3866	1675	674	3329	1486	289	3151	1544	277	2660	1487	275
7029	5529	1414	258	4312	1299	442	3511	1424	499	3027	1259	296	2851	1316	269	2376	1256	258
7030	6257	1728	257	4881	1589	431	4044	1737	852	3460	1539	309	3282	1606	310	2775	1543	316
7031	3705	1067	248	2796	984	327	2807	1123	297	2137	982	281	2000	1001	336	1691	959	199
7032	3625	1120	233	2795	1046	318	2729	1169	290	2150	1039	268	2022	1053	315	1729	1012	195
7033	5055	1635	200	3988	1506	323	3324	1613	740	2694	1400	230	2531	1432	221	2202	1378	225
7034	6627	1715	277	4422	1458	462	3724	1560	605	3004	1389	305	2784	1427	283	2310	1325	277
7035	4391	1333	276	3299	1227	364	3325	1393	326	2533	1214	312	2374	1235	375	2022	1190	224
7036	6473	1588	279	4304	1338	461	3601	1439	434	2872	1268	326	2655	1309	300	2195	1210	273
7037	4593	1371	294	3431	1263	388	3471	1440	346	2609	1246	334	2444	1266	388	2088	1225	237
7038	5574	1375	280	3719	1173	402	3081	1252	349	2502	1105	323	2316	1137	317	1910	1056	233
7039	5633	1375	241	3720	1163	394	3086	1241	525	2516	1110	266	2321	1142	263	1906	1056	249
7040	6655	2172	266	5217	1988	427	4434	2156	904	3511	1848	297	3316	1893	304	2921	1828	291
7041	4680	1330	374	3439	1214	446	3480	1401	403	2614	1207	410	2451	1231	473	2070	1180	241
7042	2462	724	197	1903	676	260	1851	756	245	1472	676	232	1377	687	252	1153	654	153
7043	4259	1047	224	2825	896	318	2318	950	282	1922	846	261	1788	870	254	1455	808	192
7044	5693	1421	243	3788	1211	396	3161	1291	530	2559	1149	268	2369	1184	265	1962	1103	251
7045	5617	1360	257	3705	1147	391	3072	1225	372	2495	1089	298	2299	1120	280	1888	1037	245
7046	6611	1701	296	4433	1449	458	3726	1550	451	2977	1366	341	2765	1408	326	2305	1314	287
7047	6784	1956	266	4636	1705	425	3942	1804	718	3204	1616	311	2987	1652	316	2540	1567	295
7048	5238	1536	229	4104	1402	361	3395	1524	719	2699	1304	254	2536	1345	282	2184	1281	259
7049	5814	1692	272	4533	1540	413	3783	1688	803	2988	1445	289	2806	1491	311	2423	1416	284
7050	3580	1034	250	2743	962	342	2691	1091	318	2094	963	306	1966	979	332	1664	934	222
7051	5293	1407	219	3568	1217	347	2971	1282	486	2439	1148	266	2263	1177	265	1892	1110	240
7052	4169	1250	204	3268	1149	302	2687	1234	593	2186	1073	215	2043	1099	240	1744	1049	216
7053	5940	1405	272	3894	1174	404	3246	1265	389	2613	1119	332	2410	1155	317	1968	1061	267
7054	6689	1844	276	4530	1592	433	3835	1690	461	3088	1497	352	2872	1534	345	2426	1450	294
7055	5267	1159	380	3512	1049	467	3185	1239	424	2484	1057	415	2351	1083	460	1982	1025	277
7056	3900	1047	262	2901	959	366	2920	1112	335	2190	961	320	2046	983	345	1716	938	225
7057	5686	1394	281	3770	1180	412	3127	1258	357	2528	1111	335	2332	1144	319	1928	1067	250
7058	5858	1428	279	3884	1207	407	3234	1290	362	2600	1139	341	2402	1174	318	1983	1092	265
7059	5209	1353	227	3477	1162	327	2886	1227	390	2375	1098	284	2201	1125	284	1826	1056	242
7060	6493	1941	250	4440	1701	380	3778	1786	527	3094	1596	319	2884	1625	330	2465	1556	284
7062	5977	1345	333	4007	1219	475	3699	1450	427	2823	1226	410	2695	1261	441	2283	1202	303
7063	6166	1538	307	4104	1304	450	3434	1395	385	2747	1227	365	2545	1265	343	2113	1180	274
7064	5884	1519	286	3964	1309	405	3302	1390	359	2679	1230	346	2488	1263	317	1185	1185	271
7065	5337	1383	251	3589	1195	352	2974	1263	339	2441	1125	315	2268	1154	298	1890	1086	248
7066	5726	1501	232	3825	1289	355	3193	1362	457	2616	1220	301	2420	1250	305	2017	1174	262
7067	5405	1206	304	3610	1093	432	3287	1289	391	2555	1100	367	2421	1127	392	2051	1074	283
7068	6818	1767	345	4574	1502	504	3857	1610	423	3071	1414	407	2842	1452	377	2378	1359	308
7069	4952	1325	244	3340	1150	338	2761	1209	299	2291	1080	296	2133	1105	263	1781	1046	234
7070	5726	1516	230	3813	1301	336	3190	1376	466	2617	1232	299	2426	1261	316	2021	1186	267
7071	5201	1720	202	3633	1545	287	3086	1601	479	2611	1448	256	2456	1469	279	2124	1424	236
7072	6490	1889	290	5052	1710	413	4242	1884	747	3299	1591	354	3106	1644	423	2687	1564	351
7073	4917	1142	287	3313	1041	396	2984	1207	358	2371	1044	330	2240	1067	347	1907	1018	257
7074	6275	1498	304	4149	1256	414	3463	1354	371	2761	1193	383	2554	1234	368	2096	1136	307
7075	5966	1453	253	3938	1224	351	3277	1310	479	2654	1168	332	2452	1204	367	2017	1113	303
7076	6500	1549	332	4297	1294	443	3597	1399	383	2851	1228	386	2640	1271	334	2170	1172	316
7077	5616	1377	252	3713	1168	308	3096	1246	312	2507	1107	321	2317	1140	306	1906	1059	275
7078	5382	1304	244	3573	1111	294	2956	1186	330	2411	1055	310	2231	1086	323	1837	1008	273
7079	5697	1372	241	3757	1158	326	3132	1239	446	2537	1106	321	2344	1141	361	1918	1052	295
7080	4829	1141	304	3284	1044	406	2967	1206	351	2343	1042	322	2215	1064	336	1887	1019	264
7081	6659	1699	277	4460	1444	292	3749	1545	376	2987	1362	353	2774	1404	361	2311	1311	330
7082	5605	1475	244	3778	1277	301	3147	1352	378	2572	1205	308	2393	1236	355	2003	1164	289
7083	4946	1089	288	3132	960	382	2643	1086	332	2142	896	312	1981	934	306	1782	910	278
7084	4764	1166	275	3117	988	362	3188	1201	350	2417	990	307	2081	996	302	1751	930	288
7085	5859	1528	268	3829	1298	344	3936	1568	462	2981	1301	356	2573	1302	432	2203	1227	354
7086	4334	1041	342	2834	934	400	2329	1027	349	1942	867	311	1822	897	306	1623	873	245
7087	4867	1153	242	3156	968	280	3227	1188	352	2443	977	285	2100	985	327	1756	912	303
7088	5876	1452	277	3791	1216	353	3919	1496	464	2935	1229	364	2531	1234	456	2146	1152	369
7089	5681	1345	319	3592	1191	422	3069	1332	360	2497	1112	343	2306	1149	343	2093	1128	311
7090	5820	1246	311	3483	1057	425	3175	1276	381	2543	1054	344	2216	1058	348	1904	993	303
7091	4846	1241	257	3242	1065	310	3300	1283	362	2504	1065	303	2184	1071	355	1845	1000	311
7092	4963	1219	247	3238	1032	313	3310	1255	399	2515	1038	323	2166	1044	406	1825	974	325
7093	4357	1207	218	2961	1054	279	2989	1236	379	2311	1042	292	2031	1046	370	1725	986	289

Rheinland-Pfalz (3)

	1987			1988			1989			1993			1994			1995		
ID	Acid	Nit.	BC	Acid	Nit.	BC	Acid	Nit.	BC	Acid	Nit.	BC	Acid	Nit.	BC	Acid	Nit.	BC
7094	4448	1137	295	2934	1029	369	2432	1123	320	2032	954	291	1909	982	295	1716	963	257
7095	5682	1310	323	3571	1155	424	3055	1301	357	2475	1081	346	2284	1119	350	2069	1095	319
7096	4148	1072	247	2764	924	324	2800	1098	320	2154	915	287	1869	921	314	1575	868	273
7097	3905	934	214	2569	792	273	2603	960	334	1995	796	280	1723	805	353	1428	745	278
7098	5583	1260	434	3505	1107	485	2998	1254	435	2419	1035	390	2231	1073	385	2014	1046	290
7099	6565	1469	368	3914	1248	489	3611	1501	423	2866	1238	390	2509	1240	418	2175	1173	347
7100	4553	1219	241	3074	1057	313	3112	1253	374	2385	1051	324	2096	1058	419	1783	1002	318
7101	5843	1353	461	3754	1204	514	3177	1356	471	2573	1125	411	2384	1162	413	2172	1141	316
7102	6533	1484	366	3901	1265	485	3606	1516	418	2869	1254	391	2515	1256	430	2185	1191	346
7103	4484	925	363	2812	807	407	2327	915	372	1906	756	319	1770	793	320	1556	759	260
7104	6007	1353	400	3762	1186	480	3243	1350	407	2592	1113	373	2394	1155	391	2168	1128	342
7105	2584	445	274	1644	410	301	1325	471	283	1096	387	234	1020	407	232	859	377	191
7106	5299	1221	318	3279	1060	413	2972	1253	365	2395	1046	340	2123	1050	382	1827	990	310
7107	5636	1125	426	3455	969	484	2935	1123	433	2345	912	373	2155	956	379	1919	917	318
7108	4549	999	337	2880	880	390	2400	989	340	1975	826	297	1836	861	311	1632	833	272
7109	5020	1104	321	3166	972	398	2678	1100	334	2175	913	321	2012	950	349	1801	921	310
7110	5088	1063	398	3246	936	442	2690	1065	408	2185	878	340	2025	915	352	1808	882	301
7111	5214	1051	370	3220	908	429	2728	1049	371	2197	860	322	2017	900	345	1795	864	307
7112	6472	1404	399	4019	1222	499	3509	1418	410	2756	1150	405	2540	1200	455	2308	1173	405
7113	5141	1119	286	3098	955	379	2834	1148	344	2276	953	375	1999	958	443	1711	903	336
7114	5388	1060	397	3306	910	446	2798	1057	405	2243	859	337	2060	901	349	1830	863	311
7115	5673	1213	391	3608	1069	460	3041	1223	392	2451	1010	347	2261	1047	389	2044	1019	353
7116	6512	1407	365	3882	1193	468	3563	1449	415	2825	1192	461	2469	1197	555	2138	1129	411
7117	5987	1200	480	3682	1033	514	3174	1210	521	2497	973	417	2293	1019	394	2052	982	322
7118	4757	938	346	2956	812	392	2470	935	363	1999	767	293	1845	806	303	1628	769	283
7119	5413	1145	376	3435	1008	437	2876	1152	377	2328	951	311	2155	989	350	1932	956	330
7120	6213	1306	387	3828	1131	467	3322	1314	380	2626	1070	383	2417	1118	446	2177	1084	390
7121	5696	1139	397	3504	981	454	2992	1143	415	2355	926	339	2187	973	352	1955	936	329
7122	5764	1214	400	3651	1068	464	3076	1226	399	2477	1011	332	2288	1050	375	2062	1018	354
7123	6466	1301	431	3968	1118	503	3457	1322	424	2698	1060	359	2475	1111	407	2238	1078	387
7124	4264	1055	279	2784	950	330	2330	1046	270	1929	885	309	1809	917	362	1622	898	298
7125	3169	635	263	2062	559	302	1513	592	281	1405	545	214	1237	552	221	1049	518	195
7126	5463	1117	391	3559	976	466	2748	1060	378	2473	961	320	2129	964	344	1825	906	309
7127	5044	1075	369	3366	955	433	2550	1030	351	2298	932	307	2009	936	339	1743	886	300
7128	5081	1105	351	3338	978	418	2562	1047	327	2321	954	332	2021	958	371	1746	910	310
7129	6013	1281	459	3952	1123	538	3099	1224	529	2754	1097	395	2367	1096	359	2048	1038	319
7130	4443	969	331	2981	865	376	2216	917	345	2023	837	279	1789	846	284	1548	800	259
7131	5504	1232	400	3716	1101	454	2851	1185	361	2552	1073	377	2229	1073	423	1961	1025	351
7132	5606	1376	380	3748	1235	438	2946	1310	333	2655	1190	402	2323	1190	451	2044	1149	353
7133	5276	1183	394	3554	1058	447	2716	1137	467	2443	1028	339	2140	1031	315	1862	975	284
7134	6051	1406	432	4031	1250	469	3182	1348	366	2834	1216	408	2469	1217	447	2150	1163	369
7135	4926	992	349	3214	871	394	2451	940	338	2216	857	309	1915	862	325	1641	810	285
7136	5777	1382	424	3934	1246	450	3057	1336	361	2731	1205	395	2397	1205	439	2122	1161	361
7137	4256	953	312	2872	857	354	2134	904	384	1959	830	272	1739	839	256	1497	786	237
7138	5154	1098	351	3384	970	404	2604	1042	403	2345	944	315	2034	948	297	1755	898	285
7139	4791	966	365	3137	850	387	2388	915	318	2153	833	318	1867	840	337	1602	790	288
7140	5603	1174	424	3667	1030	447	2838	1116	342	2560	1016	393	2205	1017	424	1898	960	345
7141	5611	1209	389	3691	1065	422	2880	1152	412	2584	1044	345	2228	1043	325	1929	990	317
7142	5802	1238	431	3831	1092	450	3001	1187	380	2671	1071	376	2301	1071	384	1995	1017	336
7143	5424	1132	370	3554	995	396	2747	1077	392	2470	975	330	2129	977	312	1830	922	306

Baden-Württemberg

	1987			1988			1989			1993			1994			1995		
ID	Acid	Nit.	BC	Acid	Nit.	BC	Acid	Nit.	BC	Acid	Nit.	BC	Acid	Nit.	BC	Acid	Nit.	BC
8001	3073	1335	279	2023	1287	254	2343	1422	263	1739	1294	261	1752	1286	318	1590	1244	229
8002	2487	1006	272	1588	967	218	1854	1075	214	1360	976	212	1367	966	260	1213	924	195
8003	2495	1087	202	1637	1049	192	1887	1149	209	1418	1052	207	1422	1040	255	1274	1000	187
8004	2516	1040	214	1621	1003	197	1886	1112	209	1392	1010	202	1398	998	255	1246	958	193
8005	2717	969	262	1884	999	258	1961	1137	261	1923	1226	363	1913	1169	416	1703	1146	332
8006	2978	1045	309	2059	1079	291	2141	1233	279	2083	1326	384	2078	1267	443	1851	1243	381
8007	2980	1035	333	2058	1071	295	2141	1227	282	2081	1319	381	2074	1259	435	1845	1235	385
8008	2552	1031	192	1631	993	197	1905	1105	231	1399	1005	233	1408	996	279	1255	956	188
8009	2356	1006	176	1536	973	177	1775	1069	204	1327	975	201	1332	964	246	1191	927	182
8010	2589	1054	198	1658	1013	196	1937	1127	214	1419	1021	206	1426	1011	262	1272	969	201

Baden-Württemberg (2)

	1987			1988			1989			1993			1994			1995		
ID	Acid	Nit.	BC	Acid	Nit.	BC	Acid	Nit.	BC	Acid	Nit.	BC	Acid	Nit.	BC	Acid	Nit.	BC
8011	2829	992	244	1958	1025	260	2035	1171	272	1990	1262	378	1982	1204	436	1762	1180	353
8012	3381	1284	287	2372	1317	305	2485	1496	307	2382	1572	408	2369	1505	482	2136	1482	419
8013	2764	1014	245	1931	1043	244	2001	1175	250	1964	1264	327	1956	1207	380	1741	1182	343
8014	2808	995	471	1945	1027	348	2020	1169	262	1980	1260	342	1972	1204	370	1754	1179	359
8015	2579	1074	613	1877	1100	403	1955	1216	234	1911	1286	303	1910	1237	324	1700	1205	314
8016	2934	1097	789	2060	1127	529	2137	1273	273	2086	1358	362	2076	1298	380	1856	1274	373
8017	2672	1031	815	2421	1062	541	2558	1200	266	2346	1282	363	2268	1227	367	1947	1202	360
8018	3238	1328	652	2658	1309	426	2880	1417	259	2006	1239	251	1995	1223	270	1782	1202	256
8019	2690	1143	168	1750	1101	189	2029	1214	236	1504	1103	237	1510	1092	291	1354	1051	188
8020	2938	1320	175	1953	1274	191	2245	1394	233	1681	1265	229	1689	1254	290	1528	1210	195
8021	2658	1096	171	1708	1052	181	1990	1167	214	1457	1053	207	1463	1042	264	1306	1000	189
8022	2920	1053	237	2034	1085	267	2107	1228	267	2062	1323	346	2054	1263	419	1831	1239	342
8023	3020	1113	277	2110	1143	282	2187	1294	274	2129	1380	341	2122	1321	415	1891	1293	351
8024	2566	918	506	1782	946	359	1859	1078	245	1824	1159	294	1817	1107	327	1609	1082	303
8025	2938	1137	609	2078	1164	422	2154	1307	271	2101	1386	325	2092	1328	359	1872	1301	335
8026	2483	900	572	1731	926	387	1805	1050	243	1774	1130	293	1764	1078	312	1560	1052	317
8027	3100	1223	562	2532	1206	372	2747	1314	250	1891	1140	210	1884	1125	243	1675	1106	236
8028	2864	1132	457	2346	1120	308	2524	1216	239	1761	1061	208	1754	1047	226	1553	1026	222
8029	2736	1006	393	2220	996	281	2398	1092	249	1643	945	221	1635	931	231	1439	913	229
8030	2545	1032	150	1630	993	175	1902	1104	213	1383	990	206	1389	978	264	1236	937	188
8031	2917	1021	202	2020	1055	242	2093	1201	276	2050	1300	392	2040	1240	460	1817	1217	344
8032	2841	972	236	1954	1006	266	2031	1154	268	1985	1248	348	1978	1190	423	1755	1166	338
8033	2892	1007	269	2001	1042	282	2076	1191	275	2028	1284	336	2017	1223	416	1795	1200	342
8034	2943	1057	358	2050	1091	317	2124	1239	281	2074	1330	319	2062	1268	395	1840	1244	344
8035	3089	1066	492	2124	1101	385	2225	1270	312	2146	1358	339	2136	1295	410	1905	1271	374
8036	2558	951	417	1795	977	312	1866	1103	248	1831	1180	267	1823	1127	314	1617	1102	292
8037	2633	909	463	1815	940	340	1889	1076	272	1851	1162	289	1844	1108	328	1634	1084	323
8038	3417	1220	453	2159	1204	330	2291	1326	281	1670	1133	206	1708	1118	255	1569	1102	241
8039	2997	1048	273	2408	1033	231	2632	1146	284	1756	978	225	1748	965	241	1538	948	251
8040	2768	947	298	2222	936	265	2420	1039	292	1618	886	228	1608	872	244	1406	854	239
8041	2679	1154	146	1747	1108	183	2022	1219	219	1492	1097	210	1498	1086	267	1342	1043	190
8042	2792	955	227	1920	987	269	1997	1133	271	1952	1224	347	1944	1166	418	1725	1143	334
8043	2982	1005	275	2047	1042	303	2134	1204	298	2073	1298	357	2063	1236	445	1836	1214	364
8044	2753	916	323	1884	950	298	1961	1096	279	1916	1188	308	1908	1130	386	1690	1107	335
8045	2855	1004	396	1977	1038	325	2051	1182	287	2003	1272	302	1992	1211	372	1771	1186	341
8046	3049	1018	464	2080	1054	372	2178	1220	320	2106	1314	331	2094	1250	403	1864	1229	380
8047	3133	1124	470	2174	1158	374	2270	1323	326	2190	1406	324	2178	1343	386	1948	1318	380
8048	2885	933	343	1770	922	268	1878	1028	254	1353	871	172	1387	858	221	1256	840	209
8049	3056	975	295	1866	964	249	1987	1078	278	1419	908	192	1456	895	233	1321	878	230
8050	3244	1138	264	2619	1123	246	2880	1250	315	1889	1054	231	1881	1039	257	1664	1025	271
8051	3082	1037	273	2468	1023	255	2725	1148	314	1776	962	234	1768	949	254	1557	936	265
8052	2732	908	270	2192	900	258	2402	1007	299	1584	851	222	1575	838	236	1376	822	241
8053	2617	869	268	2100	862	261	2298	963	298	1519	815	218	1512	803	234	1318	787	234
8054	3600	976	309	2954	964	317	2418	1077	353	1839	909	249	1747	896	272	1598	880	269
8055	5220	1119	302	3448	992	318	2663	1066	348	2396	971	261	2077	975	265	1790	917	267
8056	2834	1260	145	1871	1211	214	2154	1325	244	1599	1193	227	1606	1181	278	1446	1136	201
8057	2971	1166	207	2109	1193	288	2182	1333	291	2125	1408	356	2115	1349	423	1896	1323	333
8058	2878	1046	279	2005	1075	290	2080	1216	293	2035	1307	318	2024	1247	397	1805	1223	341
8059	2794	1046	318	1956	1071	301	2034	1210	293	1983	1286	267	1972	1228	333	1760	1203	328
8060	3045	1040	279	1893	1026	264	2000	1132	272	1462	968	163	1499	955	228	1359	934	217
8061	3021	941	259	1832	930	262	1955	1045	291	1388	877	160	1425	864	226	1291	848	225
8062	3222	1058	252	1976	1040	264	2116	1166	314	1510	980	208	1549	967	237	1413	953	242
8063	2886	1030	232	2327	1016	246	2534	1123	295	1703	959	203	1697	946	223	1488	926	222
8064	3008	1033	266	2416	1019	292	2654	1137	341	1747	960	234	1739	946	252	1529	930	242
8065	3479	930	263	2853	919	290	2330	1031	339	1774	869	229	1689	857	246	1535	838	234
8066	3357	894	265	2755	885	302	2246	992	352	1715	837	226	1627	824	245	1482	807	248
8067	3022	1237	299	2167	1261	314	2243	1402	307	2174	1464	280	2163	1405	348	1945	1378	340
8068	3661	1401	298	2369	1383	314	2510	1509	318	1843	1291	189	1880	1274	264	1742	1259	251
8069	3353	1213	259	2121	1194	289	2245	1311	307	1648	1123	164	1684	1107	235	1544	1089	233
8070	3286	1167	249	2069	1151	285	2200	1268	319	1602	1081	206	1638	1067	235	1501	1049	234
8071	3419	1179	267	2134	1160	308	2273	1285	345	1637	1090	232	1674	1074	255	1533	1058	249
8072	3703	1067	262	3045	1051	308	2507	1163	348	1924	991	233	1832	977	248	1674	958	238
8073	3541	979	263	2911	968	306	2384	1078	353	1822	912	233	1734	900	248	1582	882	236
8074	4182	1157	335	3464	1144	398	2858	1282	454	2125	1067	281	2022	1052	308	1868	1040	291
8075	6419	1398	347	4274	1232	415	3394	1350	473	2977	1209	303	2571	1211	312	2224	1142	317

Baden-Württemberg (3)

	1987			1988			1989			1993			1994			1995		
ID	Acid	Nit.	BC	Acid	Nit.	BC	Acid	Nit.	BC	Acid	Nit.	BC	Acid	Nit.	BC	Acid	Nit.	BC
8076	5536	1177	312	3643	1036	365	2827	1120	419	2547	1021	270	2196	1021	275	1888	958	273
8077	2617	1140	148	1844	1144	243	2003	1234	249	1708	1201	245	1690	1161	302	1533	1120	240
8078	3597	1261	231	2091	1186	289	2112	1227	267	1740	1161	193	1776	1180	244	1600	1138	244
8079	3711	1381	235	2207	1304	309	2228	1343	295	1844	1267	215	1879	1285	237	1703	1243	244
8080	3982	1029	225	2044	965	294	1875	1003	287	1747	951	214	1685	968	226	1461	932	230
8081	4493	1211	277	2335	1132	343	2152	1176	353	2001	1116	260	1935	1136	262	1685	1096	260
8082	3524	865	257	2609	805	304	2005	838	332	1759	804	230	1634	820	236	1460	786	233
8083	3970	1106	311	3035	1025	363	2410	1097	414	2090	1052	277	2049	1081	290	1820	1039	295
8084	3163	1198	248	2137	1206	365	2395	1346	336	1942	1296	286	1921	1246	370	1751	1204	335
8085	4312	1231	246	2290	1159	367	2106	1194	311	1963	1133	242	1899	1149	259	1661	1109	246
8086	4397	1194	285	2293	1120	381	2112	1161	360	1961	1100	279	1896	1117	273	1654	1079	256
8087	3942	1007	297	2021	944	349	1841	977	371	1724	932	263	1663	948	265	1438	912	243
8088	4013	1089	358	3057	1006	412	2428	1082	456	2096	1036	309	2059	1070	315	1827	1026	294
8089	3411	945	352	2595	876	390	2049	933	424	1803	900	286	1760	925	282	1554	883	254
8090	5245	1312	581	3504	1159	560	3210	1369	619	2734	1207	526	2641	1280	488	2314	1226	279
8091	2469	831	205	1617	842	317	1812	948	291	1483	930	258	1465	888	318	1307	850	280
8092	4354	1318	250	2357	1245	390	2178	1281	316	2030	1212	253	1965	1226	269	1731	1187	250
8093	4725	1348	316	2511	1268	434	2320	1311	391	2145	1237	307	2078	1255	307	1827	1215	276
8094	3931	1007	313	2015	944	364	1837	977	383	1718	930	274	1656	945	274	1434	910	247
8095	3406	935	335	2584	865	370	2040	921	413	1795	890	277	1755	916	277	1546	874	248
8096	4875	1144	499	3209	1001	505	2910	1193	537	2529	1073	415	2440	1145	375	2124	1088	263
8097	4996	1085	550	3264	937	560	2964	1144	585	2531	1013	454	2441	1090	411	2115	1035	266
8098	2952	1034	199	1946	1040	351	2202	1177	343	1773	1140	339	1752	1091	406	1586	1052	349
8099	2524	853	201	1651	862	348	1857	972	308	1515	953	289	1497	910	340	1339	872	299
8100	3672	889	208	1845	829	363	1682	863	281	1574	821	253	1512	836	272	1301	803	240
8101	4527	1149	308	2318	1074	556	2134	1121	379	1962	1054	326	1897	1074	345	1651	1038	292
8102	4332	1135	336	2230	1060	470	2050	1103	394	1904	1042	329	1835	1060	339	1594	1020	277
8103	4063	1102	372	2121	1036	403	1950	1074	428	1810	1012	311	1745	1026	311	1523	991	259
8104	3512	1050	391	2699	981	414	2161	1036	466	1891	991	316	1846	1014	305	1639	972	246
8105	3855	1161	460	2970	1085	485	2385	1150	519	2072	1092	366	2022	1119	332	1810	1077	256
8106	5467	1285	620	3614	1120	607	3326	1352	626	2816	1197	488	2731	1282	454	2381	1221	276
8107	4353	1057	250	2190	982	444	2005	1025	343	1856	970	318	1796	993	337	1549	954	298
8108	4106	1071	336	2112	1002	462	1939	1041	392	1798	981	333	1734	998	345	1506	962	268
8109	3875	1190	491	2991	1111	477	2409	1176	523	2099	1119	372	2050	1143	338	1830	1099	258
8110	5399	1430	554	3643	1273	527	3342	1484	574	2868	1329	441	2777	1404	407	2442	1343	264
8111	5997	1503	672	3982	1319	623	3730	1579	661	3121	1396	521	3043	1488	494	2661	1421	312
8112	3107	1348	154	2177	1346	283	2399	1464	333	2006	1417	354	1980	1368	411	1818	1327	326
8113	3679	1634	191	2604	1634	353	2890	1785	387	2367	1699	400	2346	1647	478	2173	1603	393
8114	3666	1143	234	2271	1148	418	2326	1279	379	2139	1233	361	2018	1184	411	1779	1142	357
8115	4548	1252	256	2382	1174	438	2196	1216	357	2034	1148	332	1971	1168	343	1723	1128	303
8116	5432	1435	596	3663	1277	517	3360	1489	579	2888	1334	452	2796	1411	437	2458	1349	277
8117	3371	1523	164	2395	1521	296	2629	1645	353	2193	1580	376	2172	1532	439	2003	1488	347
8118	3785	1657	202	2673	1660	363	2980	1822	410	2427	1732	428	2403	1678	508	2230	1635	412
8119	3419	1515	201	2415	1513	359	2662	1645	367	2203	1573	372	2180	1523	430	2008	1478	360
8120	3684	1364	218	2396	1361	379	2430	1473	350	2262	1419	341	2143	1369	378	1914	1326	329
8121	4086	1473	210	2641	1472	353	2694	1607	379	2471	1538	389	2344	1487	442	2106	1444	373
8122	4765	1977	269	3226	1977	444	3304	2128	432	3002	2014	423	2865	1957	466	2615	1911	408
8123	4251	1142	249	2208	1070	382	2028	1108	357	1885	1048	330	1817	1063	326	1584	1026	285
8124	4168	1228	286	2234	1158	411	2059	1191	377	1916	1124	324	1852	1139	323	1627	1101	277
8125	4261	1125	348	2201	1052	449	2026	1095	434	1871	1028	350	1810	1048	347	1573	1010	290
8126	3923	1083	403	2074	1005	417	1926	1066	497	1805	1024	350	1814	1050	350	1548	1002	271
8127	5238	1352	573	3514	1199	449	3218	1404	555	2763	1255	411	2673	1329	424	2347	1272	278
8128	5062	2130	185	3366	2115	278	3702	2251	397	2758	1974	406	2667	1960	427	2595	1968	340
8129	6685	2309	239	4036	2285	377	4188	2455	444	3376	2124	447	3110	2112	450	2968	2125	384
8130	6371	2085	265	3783	2061	417	3908	2225	459	3158	1923	447	2893	1911	435	2753	1923	383
8131	6209	2179	262	3770	2154	412	3856	2296	441	3175	2012	421	2922	1998	403	2775	1997	356
8132	4448	1332	238	2451	1292	349	2494	1349	367	1933	1179	296	1947	1253	300	1864	1276	271
8133	4786	1455	387	2652	1391	426	2504	1418	511	2401	1403	380	2547	1501	439	2497	1579	408
8134	4473	1123	416	2342	1069	439	2210	1104	534	2108	1102	387	2255	1202	449	2206	1284	400
8135	4615	1263	432	2477	1205	447	2342	1238	540	2235	1229	388	2380	1327	452	2328	1407	396
8136	7252	1913	559	3568	1784	462	3700	1873	572	3488	1801	414	3489	1893	492	3371	1920	377
8137	4305	2075	206	3113	2035	305	3192	2188	501	2459	1867	435	2546	1861	528	2213	1768	366
8138	6295	1857	212	3622	1845	312	3785	2021	452	2989	1722	446	2722	1712	484	2582	1728	385
8139	6094	2064	266	3656	2039	407	3741	2181	448	3060	1896	423	2807	1882	402	2670	1891	358
8140	4243	1055	392	2216	1003	408	2082	1035	508	1995	1036	366	2130	1129	429	2085	1206	377

Baden-Württemberg (4)

	1987			1988			1989			1993			1994			1995		
ID	Acid	Nit.	BC	Acid	Nit.	BC	Acid	Nit.	BC	Acid	Nit.	BC	Acid	Nit.	BC	Acid	Nit.	BC
8141	4131	1901	230	2939	1861	305	3028	2024	527	2297	1705	423	2386	1701	534	2056	1611	369
8142	6225	2055	207	3707	2031	285	3816	2193	446	3105	1904	403	2846	1891	449	2707	1901	360
8143	5502	1817	254	3282	1801	355	3351	1927	429	2764	1689	389	2523	1672	364	2394	1678	332
8144	4644	1454	366	2605	1393	395	2467	1421	497	2356	1397	373	2489	1488	433	2438	1559	389
8145	3953	1041	368	2104	994	366	1965	1020	471	1903	1019	337	2020	1100	398	1966	1162	343
8146	6333	1646	478	3128	1542	374	3221	1616	517	3066	1559	340	3053	1636	450	2928	1653	336
8147	5518	1440	615	3802	1328	414	3352	1419	555	3194	1374	395	3402	1469	501	3079	1501	363
8148	4583	2060	231	3368	2021	304	3046	2171	532	2452	1844	409	2561	1839	528	2225	1757	363
8149	5981	1891	221	3514	1867	298	3615	2024	449	2927	1744	398	2672	1733	423	2539	1747	357
8150	4647	1614	187	2809	1594	248	2846	1691	343	2398	1501	312	2204	1488	298	2073	1485	273
8151	5244	1577	368	2905	1531	414	3017	1614	523	2275	1387	365	2277	1474	374	2206	1510	321
8152	5066	1902	363	3032	1831	386	2878	1850	495	2748	1801	369	2883	1887	435	2829	1956	376
8153	4741	1241	438	2507	1181	439	2375	1218	572	2255	1209	398	2414	1318	489	2368	1406	427
8154	5378	1683	233	3147	1664	309	3201	1786	439	2637	1559	382	2400	1545	361	2276	1556	343
8155	5896	2025	268	3556	2000	353	3631	2134	474	2984	1862	413	2749	1856	390	2616	1865	363
8156	5887	1600	309	3312	1590	411	3440	1757	539	2715	1481	469	2455	1472	444	2323	1493	409
8157	6289	1912	346	3649	1899	447	3802	2069	572	3016	1764	492	2754	1755	464	2617	1774	416
8158	4386	1346	319	2433	1306	335	2461	1358	453	1924	1191	317	1942	1262	318	1864	1288	271
8159	4252	1090	345	2234	1056	358	2288	1118	476	1721	955	314	1735	1031	335	1660	1061	277
8160	5135	1785	401	2993	1720	407	2855	1749	521	2709	1703	391	2849	1796	477	2792	1870	408
8161	4300	1133	409	2285	1082	391	2137	1107	505	2065	1110	352	2200	1202	451	2155	1279	391
8162	7716	2332	514	3990	2191	403	4129	2282	551	3868	2179	352	3877	2273	527	3768	2303	400
8163	5791	2229	232	3881	2205	335	3726	2357	552	2913	2058	414	2841	2045	520	2769	2065	386
8164	5942	2281	257	3979	2257	359	3831	2411	558	2969	2089	436	2895	2077	507	2843	2119	405
8165	5999	1969	250	3571	1954	339	3656	2096	516	2975	1811	416	2732	1807	457	2605	1826	378
8166	6959	2521	320	4263	2487	408	4425	2661	575	3581	2314	485	3312	2302	483	3168	2314	427
8167	5311	1788	265	3172	1759	330	3214	1872	459	2684	1654	389	2456	1638	379	2336	1651	333
8168	4687	1433	353	2603	1389	359	2668	1454	490	2051	1264	324	2061	1340	353	1985	1368	296
8169	5080	1957	370	3087	1897	371	2942	1920	484	2797	1856	362	2922	1939	454	2865	2004	398
8170	5144	1742	421	2958	1674	407	2815	1701	523	2677	1661	379	2823	1759	496	2774	1841	422
8171	5063	1711	430	2909	1636	406	2771	1665	523	2633	1627	367	2777	1725	492	2726	1804	419
8172	5812	2363	461	3590	2287	411	3432	2302	538	3261	2232	359	3412	2332	509	3349	2402	423
8173	4508	1468	330	2556	1426	325	2587	1478	463	2033	1299	325	2047	1369	333	1972	1397	284
8174	4647	1655	382	2708	1585	356	2574	1611	468	2484	1575	328	2602	1655	442	2552	1722	365
8175	5423	1804	385	3103	1748	375	3206	1826	535	2452	1575	371	2451	1658	413	2427	1741	339
8176	4880	1690	381	2833	1618	358	2703	1654	479	2565	1606	373	2697	1695	484	2651	1771	400
8177	4160	1160	336	2188	1091	448	2006	1125	405	1877	1066	333	1813	1082	334	1582	1043	279

Bayern

	1987			1988			1989			1993			1994			1995		
ID	Acid	Nit.	BC	Acid	Nit.	BC	Acid	Nit.	BC	Acid	Nit.	BC	Acid	Nit.	BC	Acid	Nit.	BC
9001	4599	1009	589	3008	876	515	2721	1058	545	2340	942	444	2254	1010	418	1952	959	235
9002	5221	1212	659	3434	1055	570	3130	1269	600	2679	1127	505	2588	1204	477	2263	1154	259
9003	7353	1334	707	4893	1219	564	3950	1310	591	3259	1201	479	2598	1152	458	2300	1106	211
9004	6571	1329	748	4325	1208	595	3417	1302	615	3073	1195	515	2715	1143	484	2132	1096	220
9005	7767	1481	971	5024	1326	922	4057	1470	831	3517	1320	703	3118	1260	675	2420	1201	252
9006	4603	1062	562	3012	928	452	2706	1098	514	2371	993	421	2286	1060	406	1987	1008	235
9007	4790	1121	602	3158	982	470	2873	1169	536	2474	1043	451	2384	1112	434	2082	1066	240
9008	5541	1015	699	3687	923	512	2856	999	545	2601	926	464	2285	884	416	1756	832	182
9009	6454	1269	726	4232	1150	511	3344	1245	570	2979	1143	474	2655	1096	448	2071	1045	214
9010	5089	1242	653	3366	1091	452	3076	1293	535	2651	1154	482	2557	1227	458	2243	1181	249
9011	6141	1104	734	4021	993	462	3147	1087	543	2814	995	461	2475	950	436	1905	898	210
9012	6812	1231	830	4382	1102	555	3456	1212	610	3090	1107	532	2713	1054	501	2086	994	218
9013	6106	1136	808	4013	1027	718	3149	1118	672	2819	1022	541	2483	977	490	1920	926	199
9014	6593	1210	763	4249	1086	387	3343	1189	517	3016	1091	456	2644	1040	439	2044	984	228
9015	7423	1326	915	4756	1179	463	3806	1314	602	3321	1185	555	2923	1128	533	2251	1067	251
9016	7107	1265	894	4525	1127	549	3636	1252	639	3191	1131	557	2814	1079	524	2161	1020	241
9017	6591	1159	850	4241	1034	677	3339	1142	697	2975	1039	560	2614	991	504	1995	929	218
9018	6999	1279	821	4135	1099	411	3715	1266	570	3719	1222	609	3159	1183	553	2602	1140	269
9019	6375	1122	792	3729	958	594	3316	1103	662	3396	1077	632	2862	1041	535	2333	991	245
9020	5878	1025	738	3444	879	635	3054	1009	674	3125	981	623	2624	949	514	2130	901	236
9021	6871	1279	849	4064	1103	766	3634	1264	782	3677	1219	738	3118	1179	600	2558	1128	276
9022	6021	1123	671	3556	972	340	3148	1101	488	3245	1076	473	2738	1043	440	2242	999	242
9023	5826	1161	690	3534	1024	429	3048	1126	551	3175	1111	499	2720	1072	464	2237	1032	224

Bayern (2)

	1987			1988			1989			1993			1994			1995		
ID	Acid	Nit.	BC	Acid	Nit.	BC	Acid	Nit.	BC	Acid	Nit.	BC	Acid	Nit.	BC	Acid	Nit.	BC
9024	6710	1190	808	3931	1022	692	3522	1180	739	3568	1145	669	3015	1106	563	2466	1057	269
9025	7112	1319	836	4181	1135	758	3743	1302	787	3776	1253	699	3207	1213	592	2643	1167	283
9027	7082	1370	806	4202	1188	717	3762	1352	763	3796	1301	649	3227	1260	569	2675	1219	275
9028	6031	1087	706	3533	937	645	3125	1067	682	3219	1038	572	2708	1004	499	2207	957	236
9029	4140	1071	533	2888	993	342	2450	1042	453	2391	1026	337	2601	1096	398	1109	1109	276
9030	4363	1200	512	3071	1119	336	2626	1170	468	2534	1143	319	2760	1214	406	2444	1233	287
9031	5766	1129	622	3423	987	428	3030	1104	527	3128	1076	425	2649	1044	433	2177	1005	226
9032	7010	1275	818	4137	1095	770	3713	1261	798	3710	1209	659	3151	1170	583	2591	1126	280
9033	5486	1165	594	3356	1034	458	2873	1121	541	3037	1110	392	2619	1075	410	2151	1038	226
9034	6829	1309	746	4045	1134	737	3616	1291	739	3661	1241	583	3107	1202	516	2565	1159	274
9035	10662	1687	1054	6507	1466	1130	4693	1767	1051	3219	1057	577	3240	1110	538	2587	1053	294
9036	5624	1301	496	3203	1220	360	2691	1268	449	2847	1231	303	3003	1299	399	2612	1326	280
9037	11958	2011	1178	7321	1752	1298	5337	2101	1196	3664	1272	598	3719	1339	606	3005	1281	344
9038	3441	1219	222	2381	1198	299	2096	1325	533	1621	1086	359	1716	1084	501	1442	1034	322
9039	3059	1109	211	2130	1089	286	1880	1196	474	1462	991	328	1540	984	432	1303	943	285
9040	5490	2010	235	3618	1984	343	3461	2129	553	2678	1841	421	2606	1827	518	2575	1895	376
9041	5055	1806	226	3312	1786	317	3154	1918	507	2449	1660	393	2383	1649	467	2352	1707	351
9042	4555	1700	213	3029	1684	289	2868	1791	445	2262	1564	353	2200	1551	392	2168	1603	317
9043	4493	1290	257	2562	1277	306	2605	1385	436	2140	1196	369	1936	1184	358	1836	1215	310
9044	4818	1567	278	2730	1520	309	2794	1585	442	2161	1376	329	2171	1450	349	2135	1520	308
9045	6123	1577	437	3552	1485	335	3033	1535	445	3175	1482	257	3327	1550	418	2934	1588	296
9046	5511	1303	545	3443	1179	450	2967	1260	520	3108	1234	340	2702	1200	395	2249	1172	231
9047	5296	1061	559	3164	936	504	2755	1033	552	2900	1010	336	2457	981	383	2008	944	225
9048	12259	2192	1170	7566	1925	1321	5541	2276	1194	3837	1420	551	3900	1488	602	3186	1433	346
9049	11790	2086	1150	7243	1835	1382	5316	2170	1184	3606	1279	570	3652	1344	602	2948	1279	338
9050	7112	1557	723	4323	1376	732	3902	1533	727	3890	1458	455	3330	1417	523	2805	1389	280
9051	3635	1452	282	2560	1429	414	2545	1566	637	1773	1294	427	1778	1289	596	1558	1251	341
9052	4240	1752	307	3059	1727	439	2742	1877	651	2163	1562	428	2272	1559	595	1983	1522	384
9053	5687	2144	294	3784	2119	382	3631	2269	569	2804	1953	470	2729	1938	510	2718	2019	404
9054	5644	1942	331	3264	1881	350	3389	1968	508	2593	1698	370	2592	1783	419	2581	1878	361
9055	4622	1529	310	2635	1484	311	2678	1542	451	2090	1342	324	2105	1414	355	2067	1483	298
9056	5877	1239	470	3244	1154	390	2758	1216	459	2926	1174	275	3029	1245	420	2650	1283	291
9057	5812	1261	603	3576	1125	553	3093	1219	592	3197	1193	345	2769	1156	432	2291	1120	236
9058	11697	2029	1076	7208	1779	1204	5250	2110	1098	3627	1305	468	3682	1370	582	2991	1317	326
9059	6107	1532	420	3515	1439	324	3008	1493	436	3146	1441	237	3307	1513	434	2913	1550	302
9060	4137	1692	313	2965	1663	481	2653	1807	682	2095	1507	446	2197	1503	625	1918	1468	360
9061	3371	1271	261	2363	1246	401	2096	1365	571	1637	1132	378	1721	1126	518	1478	1092	304
9062	3710	1236	320	2533	1216	484	2222	1366	683	1692	1096	424	1801	1096	621	1495	1038	372
9063	4015	1570	305	2846	1544	454	2532	1686	647	1982	1394	418	2085	1391	587	1799	1349	373
9064	4382	1632	219	2915	1607	320	2769	1715	498	2178	1503	357	2128	1487	455	2095	1540	313
9065	5324	2006	308	3540	1978	362	3382	2114	535	2635	1832	445	2561	1816	483	2540	1884	379
9066	6176	2183	351	3753	2158	383	3846	2299	560	3143	1986	464	2895	1974	495	2828	2053	402
9067	5459	2116	324	3298	2052	329	3370	2117	474	2667	1858	342	2670	1932	391	2672	2039	324
9068	3836	1329	332	2241	1282	295	2104	1299	404	2043	1266	284	2137	1333	396	2109	1408	311
9069	4141	1381	355	2749	1331	299	2227	1348	413	2323	1310	224	2507	1378	406	2309	1460	305
9070	6631	1726	396	3860	1629	306	3328	1687	450	3460	1627	241	3618	1701	470	3220	1751	349
9071	7188	1602	450	3993	1488	372	3460	1575	492	3602	1511	258	3726	1600	517	3329	1662	370
9072	7069	1763	446	4035	1657	363	3516	1732	475	3641	1649	264	3755	1731	485	3376	1799	341
9073	6078	1503	463	3488	1413	390	2980	1465	457	3120	1414	255	3279	1485	434	2887	1525	295
9074	7567	1199	512	3596	1065	439	3034	1162	470	3496	1142	307	2914	1107	419	2336	1070	243
9075	7982	1233	562	3701	1084	501	3211	1208	530	3674	1171	340	3008	1137	429	2419	1100	241
9076	5521	1271	556	3434	1145	495	2959	1229	533	3077	1198	314	2682	1166	400	2224	1135	225
9077	6949	1481	680	4191	1305	642	3768	1459	668	3802	1395	402	3238	1355	498	2721	1324	272
9078	6229	1289	635	3742	1134	657	3343	1264	662	3381	1203	367	2871	1169	458	2388	1135	252
9079	3194	998	293	2151	982	455	1870	1109	608	1415	887	398	1510	885	545	1234	831	321
9080	5893	2398	309	4006	2363	390	3849	2510	576	3020	2179	477	2945	2164	537	2946	2255	409
9081	5040	1505	430	3033	1353	715	2278	1458	788	1235	835	322	1300	831	475	1304	878	306
9082	5256	1933	413	3366	1784	618	2643	1873	706	1632	1259	308	1679	1249	436	1712	1320	294
9083	5313	1824	406	3200	1779	432	3045	1798	579	2469	1568	422	2322	1569	499	2255	1619	396
9084	4157	1522	321	2565	1492	334	2388	1495	455	2002	1331	330	1893	1326	383	1834	1371	300
9085	7504	1768	395	4332	1720	334	3428	1709	454	3556	1607	196	3183	1588	397	2902	1622	282
9086	6788	1767	390	4244	1687	331	3398	1725	430	3095	1564	181	2881	1541	366	2646	1622	234
9087	7072	1764	415	4384	1681	357	3501	1732	452	3170	1560	202	2949	1535	383	2701	1620	240
9088	6596	1550	410	4046	1479	386	3202	1521	440	2906	1369	218	2693	1349	360	2452	1423	225
9089	6923	1566	503	4218	1493	471	3326	1540	492	3005	1381	260	2784	1358	369	2526	1435	218

Bayern (3)

	1987			1988			1989			1993			1994			1995		
ID	Acid	Nit.	BC	Acid	Nit.	BC	Acid	Nit.	BC	Acid	Nit.	BC	Acid	Nit.	BC	Acid	Nit.	BC
9090	5805	1193	493	3406	1120	448	2713	1178	449	3034	1197	286	2766	1170	394	2432	1216	237
9091	4993	989	431	2917	927	411	2301	979	419	2644	1006	266	2391	981	349	2087	1013	207
9092	5289	1006	495	3069	941	466	2401	993	469	2755	1025	284	2499	999	368	2175	1032	223
9093	5994	1246	469	3547	1174	455	2822	1234	453	3162	1256	296	2882	1228	406	2532	1275	243
9094	5158	2024	386	3361	1873	543	2688	1962	637	1716	1372	284	1747	1356	403	1788	1431	274
9095	3965	1731	267	2649	1670	312	2402	1687	438	2197	1643	421	2322	1679	534	2205	1706	412
9096	4218	1893	330	2844	1822	311	2583	1839	430	2359	1786	435	2479	1814	512	2366	1851	430
9097	4144	1273	373	2411	1245	364	2239	1255	477	1835	1099	348	1711	1096	413	1641	1128	322
9098	4732	1556	422	2816	1524	410	2648	1537	524	2159	1342	379	2024	1341	453	1961	1385	352
9099	4883	1888	416	3061	1845	393	2890	1853	510	2409	1640	356	2277	1634	421	2230	1694	321
9100	7335	1852	370	3636	1789	341	3401	1772	427	3256	1688	340	2844	1658	407	2808	1702	315
9101	7394	1938	374	3710	1875	337	3484	1859	419	3324	1764	336	2915	1734	414	2877	1777	304
9102	7575	1903	418	4733	1830	404	3777	1874	479	3389	1679	236	3163	1656	423	2905	1752	259
9103	6958	1649	396	4280	1576	385	3389	1620	451	3068	1457	230	2850	1435	390	2597	1516	238
9104	6907	1694	399	4277	1622	388	3400	1663	376	3083	1498	231	2863	1474	388	2618	1557	231
9105	6475	1517	400	3975	1449	390	3143	1491	372	2853	1340	230	2633	1319	363	2403	1392	217
9106	6085	1289	407	3669	1227	415	2870	1269	396	2607	1138	241	2400	1119	338	2156	1179	197
9107	4757	1297	638	3558	1225	617	2895	1284	627	2906	1268	326	2743	1242	422	2468	1287	258
9108	3967	1790	256	2682	1724	324	2439	1739	442	2234	1692	406	2354	1726	534	2251	1763	394
9109	5815	1120	581	3385	1051	528	2676	1110	552	2996	1127	318	2723	1099	400	2379	1142	242
9110	3635	1489	287	2368	1423	289	2133	1443	406	1958	1422	400	2066	1448	504	1953	1472	403
9111	3680	1575	291	2437	1510	281	2200	1525	397	2022	1495	393	2134	1524	487	2030	1557	395
9112	4267	1560	406	2811	1525	395	2476	1541	517	1926	1346	387	1909	1342	457	1884	1386	358
9113	4844	1745	419	2971	1713	389	2803	1723	512	2318	1522	356	2182	1516	445	2125	1568	344
9114	5537	2331	447	3582	2279	412	3415	2291	523	2856	2031	386	2715	2026	460	2687	2108	352
9115	7340	1639	388	3507	1588	359	3281	1575	435	3114	1493	352	2697	1468	435	2658	1505	335
9116	7900	1644	388	4413	1591	355	3437	1579	425	3608	1498	352	3194	1472	447	2902	1507	324
9117	8011	1822	391	4561	1760	353	3597	1748	424	3740	1651	350	3326	1624	445	3052	1671	311
9118	7665	1723	384	4361	1663	325	3434	1660	427	3586	1569	315	3189	1541	431	2907	1581	291
9119	6579	1433	405	3990	1367	427	3128	1411	403	2830	1264	262	2619	1245	369	2366	1316	212
9120	6263	1307	412	3768	1243	423	2940	1287	400	2665	1152	254	2447	1132	350	2207	1196	203
9121	4928	1054	395	2919	991	373	2337	1042	386	2652	1061	256	2402	1035	348	2108	1069	198
9122	5309	1085	523	3119	1019	469	2478	1072	478	2795	1089	287	2542	1064	365	2227	1101	218
9123	5716	1312	604	3438	1243	537	2764	1296	571	3027	1251	309	2764	1225	376	2437	1265	239
9124	5309	1216	566	3177	1148	476	2559	1199	521	2853	1193	277	2599	1167	343	2301	1209	219
9125	5548	1674	592	3338	1497	670	2533	1625	849	1348	902	369	1434	901	545	1447	960	366
9126	5281	1551	520	3158	1388	618	2376	1503	788	1248	824	346	1325	824	510	1333	875	344
9127	5761	1858	545	3525	1672	654	2719	1803	833	1505	1054	362	1594	1054	545	1616	1123	378
9128	3284	1251	258	2098	1202	277	1873	1219	397	1722	1211	376	1827	1236	496	1710	1253	377
9129	5055	1973	457	3416	1941	454	3077	1966	576	2374	1709	419	2357	1707	535	2339	1763	415
9130	7582	1582	376	4260	1534	346	3323	1523	411	3468	1439	336	3073	1416	435	2792	1452	314
9131	6977	1621	371	4269	1545	352	3376	1592	408	3057	1433	288	2837	1410	420	2582	1491	251
9132	6757	1581	363	4147	1511	376	3274	1551	337	2969	1396	279	2756	1376	404	2506	1452	230
9133	5762	1337	557	3462	1266	463	2775	1317	508	3102	1316	306	2834	1288	378	2518	1340	226
9134	6252	1575	649	3823	1497	553	3109	1551	597	3370	1507	316	3095	1477	390	2771	1538	252
9135	6302	1236	381	3754	1174	403	2907	1218	376	2633	1089	295	2422	1070	371	2163	1130	209
9136	5929	1841	611	3594	1649	634	2764	1798	895	1472	996	373	1572	999	588	1599	1069	400
9137	5575	1687	532	3355	1511	579	2550	1637	811	1353	908	348	1441	909	538	1458	970	367
9138	5273	1658	488	3211	1496	535	2440	1603	695	1359	948	315	1426	943	483	1441	1000	340
9139	3091	1126	238	1944	1078	260	1722	1093	381	1597	1099	351	1699	1123	484	1583	1136	363
9140	3650	1440	286	2353	1381	285	2111	1401	400	1932	1383	392	2049	1413	528	1930	1436	409
9141	4533	1854	421	3086	1812	398	2745	1822	494	2184	1609	364	2165	1604	455	2158	1665	352
9142	4310	1761	416	2937	1728	374	2598	1733	468	2077	1532	348	2060	1526	433	2043	1577	323
9143	4655	1634	429	2818	1592	383	2644	1599	475	2188	1413	362	2055	1408	438	1996	1455	326
9144	8276	1832	416	4687	1777	366	3674	1763	446	3835	1664	360	3409	1638	463	3124	1687	347
9145	7852	1444	420	4291	1394	360	3306	1387	445	3475	1317	359	3057	1294	465	2753	1321	345
9146	6820	1262	373	3757	1220	323	2882	1215	387	3043	1156	320	2682	1134	416	2392	1154	292
9147	6651	1166	360	3629	1127	318	2748	1118	379	2940	1073	328	2579	1050	413	2286	1065	285
9148	7647	1644	389	4312	1591	343	3371	1581	417	3536	1500	353	3136	1473	455	2846	1508	286
9149	7392	1267	375	3995	1221	346	3038	1213	421	3236	1163	352	2832	1139	466	2521	1154	289
9150	6491	1346	350	3903	1280	335	3041	1324	385	2753	1187	317	2543	1169	417	2285	1235	235
9151	6938	1488	371	4200	1421	374	3285	1466	329	2965	1315	335	2742	1292	439	2479	1369	250
9152	7181	1519	455	4342	1449	465	3388	1497	432	3043	1333	320	2822	1313	406	2550	1396	231
9153	3756	856	493	2275	806	364	1827	845	427	2099	846	215	1891	826	280	1636	845	173
9154	5666	1746	445	3429	1567	439	2617	1697	773	1409	957	356	1500	957	547	1518	1020	378

Bayern (4)

	1987			1988			1989			1993			1994			1995		
ID	Acid	Nit.	BC	Acid	Nit.	BC	Acid	Nit.	BC	Acid	Nit.	BC	Acid	Nit.	BC	Acid	Nit.	BC
9155	4879	1419	361	2915	1272	374	2180	1374	631	1162	772	302	1219	766	458	1225	811	314
9156	3902	1086	311	2316	977	327	1705	1053	480	902	599	243	924	587	361	925	618	246
9157	2593	988	253	1668	953	237	1497	971	314	1381	963	305	1459	978	381	1361	990	307
9158	4218	1620	422	2822	1588	384	2488	1597	467	1962	1405	360	1946	1403	442	1927	1451	336
9159	8436	1737	440	4700	1678	386	3687	1672	447	3828	1577	391	3396	1551	484	3092	1595	363
9160	7159	1370	386	3949	1324	340	3028	1313	389	3214	1254	344	2832	1230	426	2540	1256	312
9161	6944	1531	340	3963	1485	309	3098	1477	371	3247	1399	340	2894	1376	421	2612	1408	263
9162	6599	1244	338	3655	1204	306	2803	1198	302	2974	1142	337	2622	1120	423	2333	1139	259
9163	6253	1233	339	3728	1172	344	2889	1216	306	2620	1089	333	2411	1072	414	2156	1132	232
9164	6317	1183	325	3730	1121	380	2881	1168	339	2607	1043	329	2388	1023	415	2131	1084	221
9165	4611	1028	447	2783	967	337	2236	1014	352	2522	1034	256	2300	1006	331	2015	1032	197
9166	5707	1264	524	3409	1194	384	2731	1248	408	3034	1252	290	2766	1225	377	2451	1274	224
9167	5472	1241	690	3277	1173	476	2635	1226	557	2919	1207	321	2661	1180	364	2349	1222	224
9168	6879	1428	366	4141	1361	402	3226	1407	358	2908	1257	356	2685	1235	437	2420	1310	231
9169	3231	1226	254	2056	1174	248	1840	1196	343	1695	1189	356	1799	1213	472	1680	1227	363
9170	3305	1236	272	2097	1185	266	1866	1202	350	1717	1198	368	1824	1224	478	1704	1239	379
9171	2955	1187	270	1939	1141	246	1733	1152	330	1608	1148	339	1691	1161	428	1589	1179	344
9172	4591	1739	445	3067	1708	438	2717	1722	489	2117	1504	391	2101	1503	485	2089	1561	371
9173	8272	1427	426	4450	1373	401	3419	1369	442	3595	1304	437	3154	1277	508	2827	1303	347
9174	7374	1300	365	4018	1259	365	3072	1251	384	3250	1192	396	2848	1169	460	2551	1192	302
9175	6425	1280	351	3840	1217	351	2978	1261	304	2695	1129	377	2485	1111	429	2225	1175	240
9176	6037	1128	335	3570	1070	337	2752	1115	295	2497	997	371	2289	979	415	2036	1034	228
9177	6465	1171	331	3802	1110	369	2928	1157	318	2632	1028	399	2422	1010	450	2153	1073	237
9178	6667	1313	350	3978	1249	390	3077	1294	339	2775	1155	380	2560	1135	443	2294	1204	230
9179	5677	1204	397	3455	1148	351	2708	1181	334	2433	1062	283	2259	1042	351	2030	1097	196
9180	4617	1061	396	2798	999	323	2256	1045	342	2554	1065	269	2325	1036	340	2041	1064	198
9181	5765	1335	580	3464	1262	395	2793	1318	457	3100	1315	295	2833	1287	361	2515	1339	231
9182	5324	1123	591	3146	1057	394	2508	1110	461	2817	1117	280	2563	1092	349	2249	1130	217
9183	4425	1258	334	2635	1129	344	1949	1216	507	1035	687	275	1076	678	404	1079	716	278
9184	5174	1716	398	3205	1563	411	2464	1662	567	1427	1037	305	1482	1029	451	1504	1090	315
9185	4975	1555	393	3031	1408	406	2299	1505	527	1282	900	300	1336	893	438	1350	945	303
9186	3374	1264	261	2141	1213	261	1909	1231	332	1754	1226	373	1865	1254	488	1744	1270	379
9187	2682	954	241	1680	914	234	1497	935	293	1382	936	318	1471	956	402	1358	962	318
9188	3320	1065	326	2008	1014	305	1759	1036	354	1610	1052	403	1731	1084	498	1589	1086	407
9189	4599	1544	436	3140	1511	421	2375	1526	461	2125	1329	408	2090	1329	468	2001	1373	341
9190	6846	1616	372	3901	1567	348	2825	1558	382	2995	1472	380	2764	1447	439	2688	1487	322
9191	7562	1348	381	4104	1301	379	3126	1290	390	3319	1232	404	2916	1209	464	2615	1234	301
9192	6320	1438	298	3856	1371	339	3042	1414	294	2764	1270	393	2554	1251	422	2317	1321	216
9193	6051	1262	339	3638	1200	347	2843	1244	308	2569	1110	335	2362	1092	392	2125	1155	203
9194	7055	1558	470	4305	1491	418	3376	1536	380	3028	1368	328	2809	1346	409	2554	1433	226
9195	5601	1183	456	3323	1115	337	2636	1169	344	2970	1186	304	2701	1159	392	2384	1207	227
9196	5716	1287	659	3419	1218	401	2748	1271	488	3053	1269	303	2788	1242	358	2466	1289	233
9197	5599	1271	689	3346	1200	414	2697	1255	509	2972	1240	313	2717	1214	354	2408	1262	228
9198	23899	1560	945	14411	1479	586	10689	1662	696	9747	1539	489	9727	1510	513	7773	1482	306
9199	5736	1746	491	3461	1563	526	2638	1699	612	1406	943	370	1503	946	545	1518	1008	381
9200	5583	1750	482	3397	1575	516	2595	1698	561	1426	985	352	1511	985	508	1525	1045	360
9201	3631	1521	261	2394	1466	262	2159	1481	320	1983	1455	373	2093	1482	482	1984	1510	378
9202	3022	976	303	1832	931	279	1609	951	321	1482	967	369	1588	993	445	1458	996	369
9203	4503	1575	439	3102	1538	406	2359	1550	430	2126	1361	387	2088	1359	442	2003	1405	326
9204	6679	1304	432	3985	1240	384	2986	1278	341	2771	1143	344	2559	1125	400	2294	1196	218
9205	6577	1269	493	3909	1206	374	3021	1252	346	2725	1114	305	2509	1094	377	2240	1159	211
9206	4970	1078	550	2936	1012	328	2360	1064	394	2651	1068	262	2402	1042	318	2115	1079	206
9207	5142	1162	654	3064	1097	379	2476	1148	476	2752	1137	286	2501	1111	328	2208	1150	212
9208	5641	1213	776	3339	1144	465	2670	1198	575	2960	1183	341	2697	1158	379	2373	1200	233
9209	9229	1184	859	9174	1128	518	8033	1282	631	6245	1202	447	5388	1174	456	4798	1139	274
9210	12008	1557	1139	11626	1468	723	10163	1674	844	7748	1549	627	6756	1519	626	6084	1480	352
9211	3761	1392	301	2572	1352	327	2122	1396	374	1483	1106	297	1541	1116	403	1390	1084	246
9212	4588	1698	353	2937	1636	352	2592	1661	388	1988	1433	336	2016	1455	413	1943	1478	306
9213	5385	1438	344	3636	1395	331	2733	1407	275	2373	1241	357	2375	1284	409	2147	1295	239
9214	6204	1221	363	3478	1128	328	2686	1140	313	2841	1120	404	2318	1061	382	2047	1069	210
9215	10661	1341	1054	10378	1265	655	9111	1447	784	6976	1338	574	6042	1311	557	5437	1273	316
9216	4216	1223	367	2702	1184	408	2166	1254	455	1391	911	386	1473	931	528	1246	854	312
9217	3668	1071	317	2368	1039	355	1874	1088	387	1222	809	332	1290	824	448	1100	763	268
9218	3927	1184	352	2368	1132	343	2047	1161	366	1509	980	325	1540	1005	388	1446	1003	289
9219	4415	1374	417	2690	1317	395	2341	1349	413	1724	1137	361	1758	1164	420	1664	1168	318

Bayern (5)

	1987			1988			1989			1993			1994			1995		
ID	Acid	Nit.	BC	Acid	Nit.	BC	Acid	Nit.	BC	Acid	Nit.	BC	Acid	Nit.	BC	Acid	Nit.	BC
9220	5795	1690	406	3780	1636	366	2772	1636	390	2836	1574	430	2675	1560	443	2611	1569	320
9221	4956	1473	365	3382	1434	326	2398	1446	338	2123	1270	358	2186	1313	398	2103	1325	267
9222	5173	1356	353	3486	1315	314	2613	1327	328	2273	1172	347	2270	1212	389	2039	1217	235
9223	6619	1440	319	3777	1339	343	2941	1346	301	3077	1312	451	2540	1252	405	2274	1272	240
9224	5222	1002	359	2870	920	272	2211	931	267	2394	921	328	1958	873	319	1709	876	180
9225	6438	1405	456	3673	1305	329	2874	1315	324	3011	1278	319	2483	1218	344	2218	1233	202
9226	26719	1536	588	15537	1439	412	11509	1607	401	8678	1297	342	7654	1222	416	6107	1189	229
9227	27639	1795	785	16105	1689	453	11993	1860	500	9054	1515	341	8005	1437	384	6448	1414	242
9228	12807	1542	1127	12256	1458	658	10741	1634	795	7666	1454	499	6296	1389	496	5745	1381	314
9229	4707	1772	331	3035	1712	370	2692	1737	361	2067	1503	344	2096	1526	423	2022	1548	305
9230	6291	1308	347	3564	1215	327	2771	1225	322	2920	1199	415	2397	1140	382	2130	1153	213
9231	3281	950	292	2121	921	340	1677	967	326	1092	721	301	1152	733	398	983	680	240
9232	3586	1164	321	2373	1129	370	1904	1170	345	1286	902	303	1347	913	400	1182	868	247
9233	4468	1409	389	2733	1351	389	2385	1384	382	1761	1169	355	1795	1198	419	1702	1202	317
9234	6223	1787	434	4036	1732	385	2979	1745	401	3008	1664	444	2836	1649	458	2793	1672	340
9235	5644	1518	349	3815	1473	344	2862	1481	273	2484	1306	369	2491	1353	418	2262	1366	242
9236	6921	1606	325	4006	1497	348	3172	1509	298	3286	1459	439	2719	1397	410	2462	1424	248
9237	6161	1260	307	3468	1167	296	2692	1177	283	2845	1155	425	2330	1096	381	2069	1109	227
9238	6248	1266	346	3522	1173	322	2729	1183	311	2881	1160	411	2358	1101	373	2089	1112	215
9239	6198	1301	374	3503	1205	301	2729	1216	325	2880	1190	376	2365	1131	356	2104	1145	207
9240	5408	1031	365	2982	949	281	2254	954	285	2465	946	335	2012	896	314	1759	901	184
9241	6533	1450	456	3741	1349	324	2939	1359	331	3069	1318	346	2535	1259	337	2272	1276	203
9242	26293	1702	574	15402	1603	397	11490	1769	405	8680	1448	338	7676	1372	393	6163	1351	224
9243	28458	1765	760	16519	1657	441	12293	1835	469	9245	1486	323	8171	1407	389	6552	1378	247
9244	14010	1908	1040	13132	1793	553	11598	1981	648	7346	1592	356	5699	1508	422	5213	1481	279
9245	13744	1883	1146	12892	1772	646	11379	1955	778	7208	1563	422	5592	1479	462	5114	1453	279
9246	4940	1902	346	3198	1829	398	2859	1867	363	2200	1613	355	2228	1635	433	2162	1668	313
9247	4676	1096	375	3060	1061	329	2044	1073	337	1808	932	358	1880	981	402	1778	974	260
9248	3531	999	329	2264	968	391	1783	1016	355	1149	748	313	1216	763	415	1030	702	256
9249	4080	1477	300	2602	1425	352	2291	1449	310	1759	1256	311	1783	1276	373	1708	1290	273
9250	5027	1940	368	3253	1865	421	2899	1893	364	2234	1638	357	2262	1660	427	2188	1691	317
9251	6146	1757	457	3988	1711	396	2932	1714	391	2984	1648	474	2809	1631	469	2755	1643	341
9252	4688	1098	394	3062	1062	330	2046	1075	331	1815	934	356	1885	984	398	1779	975	261
9253	5105	1488	367	3467	1446	336	2448	1458	331	2165	1279	360	2231	1325	404	2149	1338	247
9254	5169	1553	374	3531	1512	343	2519	1525	269	2231	1341	364	2300	1389	407	2211	1401	245
9255	5577	1422	303	3732	1378	344	2797	1391	270	2401	1218	367	2412	1267	412	2172	1272	244
9256	5234	1453	304	3568	1411	315	2683	1418	251	2337	1254	341	2341	1294	383	2122	1308	220
9257	6800	1464	328	3878	1358	341	3039	1371	296	3173	1336	419	2604	1272	394	2335	1291	245
9258	6402	1273	320	3588	1176	305	2761	1186	291	2914	1163	415	2384	1104	378	2111	1116	226
9259	6323	1236	324	3535	1140	306	2734	1152	293	2882	1131	416	2349	1073	375	2078	1082	223
9260	6228	1431	329	3579	1334	296	2820	1343	275	2962	1306	383	2459	1248	350	2209	1270	206
9261	6511	1434	375	3723	1334	301	2908	1343	316	3044	1305	373	2521	1247	348	2256	1266	213
9262	6222	1380	382	3556	1285	295	2785	1294	312	2925	1259	363	2423	1201	330	2168	1219	203
9263	5075	1010	383	2819	933	271	2157	940	295	2329	926	285	1926	881	278	1685	885	172
9264	27457	1875	722	16047	1769	422	11983	1939	458	9057	1592	296	8023	1514	369	6479	1496	241
9265	26846	1411	766	15511	1317	423	11461	1483	471	8576	1173	283	7547	1100	361	6015	1063	243
9266	11390	1426	818	10766	1338	413	9467	1489	498	5991	1192	272	4626	1122	338	4165	1091	235
9267	13866	1899	1164	12989	1785	636	11485	1973	790	7264	1571	426	5632	1489	467	5156	1462	277
9268	12623	1850	1186	12152	1764	686	10675	1928	856	7709	1722	540	6396	1659	524	5869	1669	310
9269	3243	980	292	2122	951	365	1685	995	330	1114	753	272	1170	763	368	1009	716	232
9270	3609	1151	334	2378	1116	408	1908	1161	353	1278	888	293	1340	900	386	1170	851	248
9271	4102	1416	423	2576	1363	345	2251	1385	347	1706	1189	336	1734	1211	342	1653	1222	280
9272	8102	2709	556	5425	2638	474	4233	2649	472	4123	2497	555	3875	2467	549	3871	2519	419
9273	6855	2054	519	4482	1987	434	3356	2004	420	3351	1898	503	3156	1881	497	3127	1913	370
9274	4248	1165	360	2870	1131	294	1981	1142	295	1771	1005	323	1817	1040	349	1730	1043	233
9275	5314	1488	403	3568	1443	353	2503	1457	342	2209	1275	376	2284	1328	417	2191	1335	260
9276	4932	1185	299	3282	1148	307	2421	1161	243	2099	1018	327	2095	1058	368	1865	1058	216
9277	5179	1115	334	2920	1034	259	2258	1041	278	2422	1019	306	2019	974	289	1786	985	178
9278	30533	2066	769	17741	1947	486	13257	2133	518	9976	1744	305	8803	1661	400	7187	1645	254
9279	13202	1553	797	12384	1448	470	10900	1633	519	6838	1289	295	5254	1210	388	4768	1172	265
9280	12548	1676	859	11815	1573	419	10435	1745	519	6613	1403	281	5140	1328	357	4661	1296	253
9281	13040	1703	962	12262	1599	428	10814	1776	579	6826	1415	300	5286	1337	379	4808	1306	263
9282	13840	1979	1154	12985	1865	599	11471	2047	801	7289	1644	423	5674	1561	483	5199	1538	276
9283	6278	1447	307	3613	1350	284	2842	1357	270	2989	1321	371	2481	1263	351	2229	1283	213
9284	3969	1148	383	2546	1111	492	2025	1169	424	1305	856	316	1380	873	430	1172	804	281

Bayern (6)

	1987			1988			1989			1993			1994			1995		
ID	Acid	Nit.	BC	Acid	Nit.	BC	Acid	Nit.	BC	Acid	Nit.	BC	Acid	Nit.	BC	Acid	Nit.	BC
9285	3491	1089	333	2292	1056	418	1833	1103	358	1221	838	276	1282	850	364	1114	802	242
9286	5098	2250	423	3457	2172	372	3116	2195	358	2475	1927	348	2500	1946	357	2459	1998	293
9287	6753	2346	479	4574	2282	396	3508	2283	379	3500	2163	470	3328	2148	448	3307	2192	334
9288	7277	2476	535	4903	2408	441	3758	2406	414	3733	2280	519	3528	2253	493	3519	2305	363
9289	4478	1222	332	3012	1185	302	2075	1195	298	1857	1052	331	1912	1091	356	1819	1094	224
9290	5363	1871	320	3777	1821	325	2796	1840	259	2484	1626	335	2540	1665	381	2479	1696	228
9291	5773	1182	294	3230	1093	292	2511	1103	253	2665	1082	352	2186	1028	334	1939	1041	213
9292	6443	1460	310	3713	1364	281	2921	1374	258	3057	1335	368	2532	1276	352	2275	1297	223
9293	5732	1248	293	3246	1159	247	2535	1168	231	2693	1142	344	2230	1089	322	1982	1104	203
9294	6737	1446	333	3842	1345	283	3011	1356	259	3136	1318	385	2572	1256	367	2307	1274	235
9295	5992	1107	351	3308	1018	290	2538	1030	298	2705	1019	321	2194	963	318	1922	965	204
9296	27961	1870	569	16319	1762	442	12156	1932	443	9187	1591	306	8125	1513	392	6588	1494	238
9297	28971	2030	610	16916	1917	473	12643	2093	473	9518	1725	304	8424	1645	399	6876	1633	242
9298	13592	1902	683	12785	1789	527	11291	1972	537	7185	1602	300	5592	1523	406	5115	1499	249
9299	13624	1683	787	12767	1573	506	11254	1762	551	7087	1402	304	5460	1321	405	4969	1285	256
9300	13121	1956	857	12320	1844	454	10921	2022	564	6999	1653	301	5478	1572	382	4999	1553	260
9301	11652	1632	921	11023	1540	452	9719	1693	640	6196	1369	327	4825	1299	396	4369	1276	237
9302	12789	1654	1081	11996	1549	575	10600	1724	781	6678	1363	410	5168	1287	475	4688	1254	262
9303	2894	920	272	1931	894	355	1539	933	312	1030	717	227	1077	724	308	940	687	207
9304	3071	1005	292	2055	978	372	1650	1017	321	1115	787	239	1163	793	315	1022	757	213
9305	4637	2096	370	3180	2033	331	2877	2054	323	2293	1804	330	2315	1820	323	2279	1872	262
9306	7293	2858	481	5086	2782	391	4010	2775	379	3958	2614	483	3776	2589	438	3783	2662	331
9307	5717	1985	440	3894	1934	339	2965	1934	336	2992	1838	421	2843	1821	395	2802	1858	278
9308	4596	1136	312	3028	1100	309	2053	1114	251	1825	972	318	1884	1016	360	1785	1011	225
9309	5749	1376	304	3297	1278	296	2382	1289	254	2552	1258	352	2191	1197	343	2101	1215	224
9310	6137	1522	285	3582	1427	244	2846	1433	245	2984	1387	329	2496	1330	319	2263	1358	207
9311	6676	1633	307	3907	1535	267	3113	1548	267	3235	1496	340	2701	1434	340	2450	1462	215
9312	6383	1411	327	3652	1316	284	2865	1326	292	3006	1292	326	2474	1232	331	2222	1248	209
9313	6050	1371	326	3457	1276	278	2723	1286	289	2871	1253	303	2382	1197	305	2125	1213	197
9314	31195	2409	575	18272	2289	499	13720	2474	490	10386	2065	332	9201	1974	429	7576	1978	259
9315	13830	1968	635	12973	1853	574	11460	2037	569	7308	1663	305	5691	1578	417	5218	1557	253
9316	13234	1678	1092	12439	1574	675	10982	1756	866	6903	1378	441	5325	1299	526	4834	1264	282
9317	11876	1482	1147	11390	1405	712	9971	1565	914	7168	1380	548	5894	1321	597	5363	1315	321
9318	11567	1629	460	10914	1537	446	9651	1692	447	6174	1387	295	4817	1317	358	4359	1294	217
9320	7637	2838	552	5254	2760	437	4119	2768	408	4056	2603	532	3861	2585	482	3861	2648	354
9321	6079	1971	491	4059	1917	378	3055	1917	360	3078	1822	457	2914	1805	421	2879	1839	300
9322	6471	2070	518	4297	2014	405	3237	2017	376	3260	1920	480	3081	1903	449	1936	1936	311
9323	5090	1601	314	3498	1548	315	2517	1566	251	2244	1382	328	2305	1425	359	2223	1442	227
9324	5608	1329	295	3195	1234	265	2311	1244	249	2487	1217	344	2141	1159	330	2043	1175	219
9325	5639	1270	300	3191	1174	269	2278	1186	253	2459	1164	349	2098	1105	335	2002	1117	223
9326	5881	1449	295	3400	1353	253	2473	1361	253	2639	1325	326	2280	1266	341	2184	1286	225
9327	6549	1484	307	3763	1385	295	2941	1392	302	3086	1356	298	2563	1297	325	2299	1316	209
9328	6034	1354	310	3442	1262	300	2706	1271	312	2856	1238	291	2369	1184	292	2109	1198	192
9329	12983	1993	444	12197	1881	457	10819	2053	458	6961	1701	353	5464	1621	389	5002	1608	237
9330	3874	1369	347	2613	1329	468	2134	1375	406	1477	1078	260	1541	1091	352	1376	1050	246
9331	4520	1772	356	2952	1707	387	2618	1728	356	2039	1507	347	2066	1529	340	2000	1556	275
9332	4959	2194	431	3544	2134	336	2872	2144	330	2548	1897	386	2551	1912	320	2459	1965	248
9333	6687	2406	483	4572	2343	379	3521	2333	363	3519	2216	495	3351	2200	417	3326	2243	309
9334	5690	1931	334	3963	1875	329	2914	1886	265	2583	1664	347	2654	1712	373	2589	1748	242
9335	5279	1708	307	3644	1654	310	2648	1673	255	2354	1479	327	2416	1521	353	2337	1539	229
9336	4485	1388	278	3089	1349	269	2201	1358	226	1976	1203	280	2017	1238	314	1937	1250	202
9337	5810	1234	294	3255	1136	254	2300	1148	253	2487	1133	324	2116	1072	340	2005	1079	232
9338	6028	1604	281	3541	1497	248	2610	1504	255	2765	1456	305	2408	1396	329	2316	1421	223
9339	6299	1733	280	3734	1620	261	2784	1636	272	2929	1578	324	2554	1513	332	2463	1539	226
9340	6801	1723	273	4001	1611	260	3190	1626	274	3306	1567	308	2779	1506	325	2526	1536	220
9341	12691	1884	409	11957	1781	447	10573	1946	460	6776	1606	346	5303	1529	381	4853	1516	234
9342	12886	1801	495	12103	1695	549	10709	1870	573	6836	1528	307	5328	1448	394	4845	1420	238
9343	12799	1822	626	12038	1714	588	10637	1887	653	6790	1540	314	5309	1463	408	4822	1435	244
9344	3853	988	319	2780	957	411	1755	1003	387	1052	747	265	1186	760	326	874	708	232
9345	3179	983	264	1936	943	313	1681	967	305	1249	827	280	1273	845	282	1188	842	229
9346	5838	2579	435	4151	2500	387	3365	2513	374	2984	2221	444	2982	2231	348	2891	2303	280
9347	5721	2827	418	4215	2744	345	3511	2754	338	3131	2452	422	3138	2468	317	3056	2540	251
9348	5818	2561	502	4132	2481	397	3346	2495	378	2966	2203	472	2974	2223	359	2872	2285	277
9349	4565	1485	404	3180	1441	326	2287	1450	281	2053	1289	326	2096	1321	329	2025	1341	218
9350	4177	1119	297	2815	1087	270	1926	1095	224	1726	965	301	1769	999	307	1679	1000	201

Bayern (7)

	1987			1988			1989			1993			1994			1995		
ID	Acid	Nit.	BC	Acid	Nit.	BC	Acid	Nit.	BC	Acid	Nit.	BC	Acid	Nit.	BC	Acid	Nit.	BC
9351	5300	1733	305	3672	1688	294	2666	1697	248	2383	1506	314	2445	1548	340	2372	1575	226
9352	5295	1779	298	3683	1725	283	2685	1733	244	2411	1545	290	2470	1585	334	2396	1612	225
9353	5643	1554	259	3332	1457	231	2477	1465	244	2635	1419	279	2303	1362	301	2217	1390	208
9354	4873	1295	231	2841	1213	217	2084	1218	238	2248	1184	270	1968	1136	270	1881	1154	187
9355	13293	1644	481	12473	1538	544	10990	1723	606	6926	1378	338	5343	1299	407	4859	1262	251
9356	5102	1097	357	3859	1006	428	1996	1065	473	1351	854	399	1832	1009	517	1194	844	351
9357	5352	1251	383	4084	1156	448	2168	1216	488	1499	988	427	1990	1146	530	1342	983	362
9358	4291	1320	260	3171	1311	314	2264	1356	343	2399	1313	448	2290	1301	410	2137	1305	332
9359	4742	1810	293	3609	1786	304	2720	1826	332	2810	1743	506	2701	1727	401	2575	1755	324
9360	6598	3027	424	5026	2967	347	4027	2958	338	3965	2822	542	3930	2842	416	3763	2864	297
9361	6077	2530	459	4520	2478	374	3529	2470	341	3515	2376	498	3484	2398	427	3294	2399	295
9362	5458	1941	455	3927	1901	382	2952	1901	330	2970	1844	439	2938	1865	436	2733	1847	275
9363	5484	1587	379	3663	1521	326	2583	1534	274	2532	1440	348	2657	1485	384	2650	1549	280
9364	10582	1983	273	7729	1967	253	4714	1978	273	3917	1802	252	4084	1754	339	4145	1847	258
9365	9718	1721	248	7120	1717	246	4244	1723	273	3557	1577	229	3722	1534	319	3747	1612	239
9366	5378	1761	325	3681	1692	282	2677	1702	260	2605	1590	306	2715	1627	345	2723	1700	261
9367	5879	1393	410	4521	1291	447	2383	1352	507	1884	1108	483	2378	1277	549	1858	1108	379
9368	5686	2366	274	4631	2333	292	3429	2363	336	3167	2241	518	3147	2225	397	2992	2274	324
9369	4752	1952	322	3668	1929	286	2806	1955	316	2891	1864	589	2782	1847	379	2672	1887	298
9370	5683	2429	363	4252	2378	304	3343	2378	307	3332	2281	550	3299	2298	362	3126	2306	263
9371	10360	1977	272	7597	1961	255	4631	1972	262	3874	1798	256	4038	1750	321	4076	1839	251
9372	10466	1783	265	7633	1779	255	4569	1794	283	3775	1636	235	3949	1592	331	3984	1672	260
9373	6076	1450	401	4686	1345	401	2473	1409	523	1954	1154	531	2473	1334	562	1932	1157	390
9374	4988	2183	354	3904	2151	296	3040	2186	316	3098	2075	649	2994	2058	382	2895	2108	289
9375	6317	2697	457	4725	2638	382	3726	2641	343	3699	2544	511	3659	2556	423	3477	2567	293
9376	4717	1445	350	3194	1389	239	2280	1402	237	2239	1315	279	2333	1348	308	2325	1401	239
9377	7177	950	207	5189	958	198	2857	963	233	2486	889	180	2627	860	254	2577	893	199
9378	5664	1324	321	4364	1229	316	2284	1289	486	1813	1062	476	2290	1223	521	1783	1057	364
9379	6004	1458	383	4634	1357	367	2467	1420	510	1962	1174	531	2465	1347	544	1932	1172	380
9380	4244	1173	221	3300	1167	232	2183	1202	314	2039	1176	476	2018	1165	363	1827	1163	299
9381	5131	1935	264	4128	1913	260	2973	1949	323	2752	1858	544	2729	1841	373	2571	1880	305
9382	4489	1280	289	3497	1271	270	2340	1311	322	2161	1269	580	2152	1259	375	1958	1263	303
9383	5764	1583	379	3810	1517	263	2660	1533	283	2597	1440	323	2745	1494	356	2735	1556	295
9384	5343	1502	276	3551	1441	259	2492	1458	286	2458	1380	243	2581	1425	323	2561	1477	271
9385	5481	1664	397	3698	1601	293	2640	1612	274	2574	1510	277	2698	1554	348	2698	1620	270
9386	7266	1946	407	5700	1823	395	3129	1897	627	2491	1565	625	3108	1787	678	2486	1585	480
9387	6411	1560	369	4973	1453	347	2636	1519	552	2091	1251	565	2642	1444	592	2069	1252	419
9388	6263	2538	418	4636	2487	358	3606	2490	337	3596	2406	506	3558	2428	410	3354	2417	294
9389	5914	1613	326	3915	1549	282	2731	1565	322	2663	1473	275	2819	1529	341	2803	1591	297
9390	5799	1618	295	3845	1552	265	2694	1567	304	2631	1474	256	2780	1529	330	2769	1590	287
9391	5143	1435	243	3422	1379	240	2395	1394	283	2359	1318	213	2480	1362	297	2462	1410	262
9392	4523	1748	314	3325	1719	258	2544	1721	257	2565	1668	302	2537	1680	309	2363	1668	216
9393	5446	1480	295	3594	1419	244	2501	1434	287	2455	1352	238	2589	1401	309	2577	1456	273
9394	5917	2400	353	4376	2350	294	3402	2351	300	3399	2274	353	3367	2295	366	3172	2287	266
9395	6090	1639	366	4018	1570	301	2798	1588	310	2722	1493	243	2889	1553	369	2875	1618	312
9396	5477	1296	254	3530	1237	239	2383	1256	300	2347	1190	229	2498	1247	319	2470	1291	284
9397	4283	1185	230	3500	1133	234	2724	1151	289	2475	1096	204	2530	1143	295	2743	1180	266
9398	5103	1184	258	3292	1132	227	2196	1147	277	2190	1094	212	2323	1144	293	2293	1184	269
9399	6709	2724	396	4959	2660	334	3882	2669	344	3861	2588	508	3825	2612	409	3607	2605	308
9400	6108	2686	338	4609	2637	282	3646	2625	294	3624	2528	388	3591	2547	349	3423	2562	260
9401	4938	1262	235	3241	1211	214	2210	1224	264	2202	1166	183	2321	1210	267	2294	1251	253
9402	6129	2612	325	4588	2562	265	3614	2563	298	3591	2466	410	3559	2487	340	3374	2489	265
9403	5456	2237	281	4050	2196	225	3155	2197	273	3160	2125	299	3127	2142	305	2940	2131	240
9404	4605	1634	254	3326	1605	203	2481	1607	251	2549	1581	254	2524	1600	282	2321	1571	223
9405	5390	1568	259	3617	1509	209	2545	1521	263	2512	1439	153	2634	1483	262	2624	1541	263
9406	5216	1555	270	4294	1491	265	3374	1509	315	3053	1432	180	3149	1497	293	3394	1551	309
9407	5877	1694	279	3937	1632	228	2774	1646	283	2720	1556	166	2868	1609	286	2858	1673	286
9408	5991	2005	342	4262	1970	272	3187	1979	328	3211	1946	448	3182	1971	368	2933	1934	301
9409	6280	1989	315	4283	1921	239	3094	1933	301	3001	1813	211	3160	1872	312	3161	1949	306
9410	6575	1801	269	5154	1784	195	3260	1795	282	3006	1669	264	3053	1645	250	2724	1630	223
9411	6882	1999	271	5422	1982	191	3495	1994	275	3200	1843	246	3254	1819	249	2933	1815	225
9412	9613	1546	298	9493	1582	213	5571	1598	301	5003	1533	205	4973	1405	262	4902	1369	242
9413	7252	2126	286	5709	2108	198	3679	2118	289	3366	1958	276	3424	1932	257	3089	1926	233
9414	6970	1774	299	5420	1764	203	3368	1779	304	3079	1649	314	3143	1628	265	2783	1600	239
9415	10015	1662	317	9885	1700	222	5786	1710	324	5212	1647	231	5188	1515	272	5150	1481	252

Bayern (8)

	1987			1988			1989			1993			1994			1995		
ID	Acid	Nit.	BC	Acid	Nit.	BC	Acid	Nit.	BC	Acid	Nit.	BC	Acid	Nit.	BC	Acid	Nit.	BC
9416	9480	1436	294	9370	1474	212	5426	1487	315	4882	1432	199	4857	1305	257	4798	1267	240
9417	5866	1702	239	4675	1696	159	2984	1703	260	2788	1589	229	2817	1564	212	2519	1550	204
9418	7967	1141	262	7936	1181	186	4630	1202	296	4148	1155	198	4094	1046	228	3998	1005	211
9420	4301	1299	338	2488	1270	364	2321	1283	500	1891	1120	369	1763	1118	419	1684	1147	336
9421	4783	1781	358	2966	1748	373	2794	1756	505	2323	1552	370	2191	1546	422	2133	1596	335
9422	4987	1527	455	3020	1378	735	2285	1479	777	1259	869	323	1316	863	466	913	913	306
9423	4876	1416	461	2913	1270	450	2178	1372	668	1162	772	301	1220	767	461	1225	811	308
9424	4853	1393	400	2890	1247	381	2156	1350	641	1142	752	303	1200	747	459	1203	789	309

Saarland

	1987			1988			1989			1993			1994			1995		
ID	Acid	Nit.	BC	Acid	Nit.	BC	Acid	Nit.	BC	Acid	Nit.	BC	Acid	Nit.	BC	Acid	Nit.	BC
10001	4444	1633	404	3663	1473	435	3987	1642	599	2835	1406	479	2542	1370	591	2267	1444	441
10002	4423	1382	342	3104	1179	371	3851	1418	474	2559	1184	420	2221	1189	547	1797	1130	394
10003	4690	1503	315	3286	1287	353	4076	1539	502	2709	1286	413	2360	1291	538	1932	1236	386
10004	4335	1393	294	3051	1196	328	3781	1426	468	2522	1194	384	2199	1200	499	1794	1148	358
10005	4613	1552	319	3340	1354	352	4079	1598	510	2735	1343	412	2409	1349	544	1987	1294	386
10006	4280	1328	293	2992	1131	331	3727	1363	451	2467	1135	384	2144	1142	499	1729	1082	360
10007	3958	1319	285	2874	1152	316	3499	1354	411	2359	1143	368	2078	1148	482	1700	1100	351
10008	3758	1280	271	2741	1124	299	3319	1309	390	2257	1111	349	1995	1116	455	1637	1073	333
10009	4705	1202	270	3097	1027	311	3162	1232	405	2417	1029	354	2096	1038	458	1779	981	336
10010	2511	838	356	1945	803	355	2220	918	374	1509	788	418	1487	762	500	1247	744	362
10011	4091	1255	325	2867	1066	359	3553	1285	404	2367	1074	411	2052	1080	530	1651	1024	392
10012	4475	1370	349	3118	1163	388	3880	1406	434	2565	1169	443	2222	1175	575	1797	1116	424
10013	2472	800	347	1908	767	353	2183	881	362	1476	755	431	1454	729	506	1210	707	361
10014	2670	855	369	2029	806	372	2388	942	387	1581	805	439	1546	774	521	1289	752	378
10015	4428	1379	415	3164	1185	417	3899	1428	454	2575	1187	509	2250	1193	635	1819	1128	454
10016	4690	1428	365	3253	1206	407	4075	1470	453	2669	1213	464	2312	1220	603	1870	1157	445
10017	2371	734	333	1796	691	342	2096	807	348	1396	691	418	1371	665	486	1131	643	349
10018	4186	1079	223	2786	929	293	2822	1105	347	2173	925	315	1891	934	407	1603	888	308
10019	4405	1100	234	2905	938	307	2950	1127	364	2262	940	317	1957	947	406	1649	891	311
10020	2634	827	370	2025	793	389	2350	922	377	1558	782	477	1533	753	550	1271	727	386
10021	4593	1384	344	3183	1168	374	3980	1423	436	2607	1176	455	2257	1182	594	1818	1118	440
10022	4290	1085	227	2823	925	296	2882	1111	352	2208	927	307	1919	935	392	1614	880	301
10023	2491	741	348	1867	694	368	2199	823	354	1443	698	454	1416	671	518	1158	642	366
10024	3149	1009	420	2394	947	438	2845	1118	435	1843	943	530	1799	904	614	1512	880	439
10025	4312	1299	354	2996	1098	382	3735	1334	417	2462	1105	453	2132	1112	576	1712	1051	424
10026	5978	1633	293	3953	1402	395	4056	1675	456	3085	1398	424	2680	1401	553	2336	1352	415
10027	5278	1451	275	3578	1262	356	3640	1497	408	2775	1252	363	2427	1255	467	2097	1201	359
10028	4665	1257	248	3161	1093	331	3205	1295	373	2455	1085	360	2154	1092	470	1841	1040	350
10029	3820	1006	210	2537	868	274	2577	1024	312	2005	863	289	1748	872	368	1472	829	282
10031	4294	1146	359	2577	981	376	3183	1188	385	2155	985	486	2013	993	576	1645	928	405
10032	5023	1356	358	2936	1145	406	3671	1391	418	2478	1152	464	2293	1157	600	1900	1098	440
10033	3504	963	200	2372	840	258	2380	980	297	1870	832	272	1641	836	346	797	797	265
10034	4210	1114	331	2492	948	361	3084	1144	371	2101	952	436	1947	961	536	1596	906	393
10035	4535	1242	246	3067	1082	320	3115	1276	352	2393	1071	332	2104	1078	421	1801	1028	323
10036	4097	1041	227	2748	897	281	2780	1074	327	2133	897	281	1863	904	343	1560	843	280
10037	4665	1204	353	2707	1011	396	3402	1241	391	2285	1023	463	2112	1030	594	1724	964	424
10038	4088	1089	328	2453	931	361	3024	1126	364	2055	936	422	1920	943	544	1562	879	387
10039	5302	1444	412	3180	1235	458	3932	1499	456	2646	1239	534	2465	1245	699	2045	1173	492
10040	6697	1444	380	3986	1221	432	3659	1486	440	2905	1226	487	2538	1232	653	2210	1172	478
10041	5375	1194	300	3263	1026	331	2971	1222	362	2397	1021	383	2103	1028	502	1823	984	374
10042	5733	1437	301	3740	1214	386	3844	1484	418	2896	1222	374	2494	1227	446	2137	1162	371
10043	2869	949	351	2179	891	399	2556	1036	371	1699	885	489	1661	851	575	1400	835	392
10044	4677	1216	350	2718	1022	402	3413	1252	385	2296	1034	463	2122	1040	605	1735	975	425
10045	4024	1093	306	2429	939	329	2985	1128	352	2037	941	389	1904	947	518	1556	888	373
10046	5342	1216	303	3298	1052	342	2990	1250	362	2409	1046	389	2137	1053	507	1847	1000	373
10047	3604	886	211	2383	758	262	2406	907	293	1863	758	254	1614	767	298	1338	718	251
10048	4150	1186	232	2834	1040	302	2857	1208	320	2223	1024	305	1959	1029	377	1686	993	294
10049	2584	930	341	2020	893	370	2292	1005	336	1580	867	518	1558	841	551	1331	835	353
10050	2238	765	298	1715	724	330	1976	827	302	1357	716	448	1331	691	496	1122	682	319
10051	3465	680	253	2147	622	287	1863	706	278	1539	602	341	1369	618	419	1147	583	293
10052	6581	1622	355	4101	1418	419	3760	1668	423	3015	1401	473	2677	1404	599	2372	1360	433
10053	7185	1683	330	4351	1444	451	3998	1723	446	3188	1435	460	2806	1439	570	2477	1390	441

Saarland (2)

	1987			1988			1989			1993			1994			1995		
ID	Acid	Nit.	BC	Acid	Nit.	BC	Acid	Nit.	BC	Acid	Nit.	BC	Acid	Nit.	BC	Acid	Nit.	BC
10054	5191	1402	291	3439	1207	390	3518	1433	378	2689	1196	354	2337	1201	405	2015	1155	335
10055	2947	1044	370	2263	986	407	2636	1128	362	1777	970	569	1738	935	601	1488	929	386
10056	6348	1359	365	3756	1147	440	3462	1395	399	2750	1152	519	2405	1158	633	2078	1097	431
10057	4209	957	261	2591	828	300	2336	977	299	1916	824	355	1697	829	426	1444	784	304
10058	5052	1143	252	3063	982	339	2798	1165	329	2260	974	320	1997	983	374	1720	938	299
10059	5979	1307	331	3567	1111	391	3285	1341	379	2624	1113	463	2299	1119	561	1987	1063	398
10060	2301	848	312	1795	812	334	2028	910	301	1423	790	457	1400	765	490	1200	763	318
10061	5355	1229	325	3312	1066	384	3003	1263	357	2420	1057	454	2148	1064	554	1860	1013	377
10062	3294	660	244	2047	605	282	1776	684	266	1471	583	331	1312	599	396	1102	569	276
10063	5446	1270	283	3315	1097	360	3038	1295	348	2451	1086	375	2164	1093	450	1887	1053	343
10064	3667	1064	342	2887	1006	413	2542	1153	365	1968	989	497	1842	954	578	1640	948	385
10065	5232	1190	320	3229	1031	377	2930	1224	350	2362	1025	446	2095	1031	544	1809	980	370
10066	5612	1312	322	3484	1141	388	3167	1349	370	2544	1128	436	2262	1137	528	1969	1086	376
10067	6019	1325	319	3596	1127	411	3309	1357	382	2645	1128	432	2319	1134	518	2008	1079	381
10068	7090	1622	357	4240	1380	480	3921	1659	439	3075	1369	475	2735	1382	570	2403	1327	430
10069	3518	1001	329	2754	946	404	2414	1085	351	1879	932	456	1757	898	535	1554	888	369
10070	2970	1067	364	2285	1008	412	2659	1151	352	1798	991	494	1758	955	563	1509	950	382
10071	1832	631	274	1453	635	302	1624	693	268	1126	595	365	1124	591	418	961	595	286
10072	6941	1564	391	4138	1328	483	3832	1604	426	3036	1328	545	2660	1331	663	2335	1277	458
10073	6496	1366	344	3830	1146	447	3528	1404	412	2793	1154	469	2438	1161	564	2103	1094	414
10074	3658	1089	350	2879	1030	412	2528	1171	355	1975	1009	484	1848	973	561	1649	968	382
10075	3659	1090	350	2880	1031	412	2529	1172	355	1976	1010	484	1849	974	561	1650	969	382
10076	6239	1437	368	3821	1238	445	3500	1481	401	2798	1235	483	2474	1238	590	2155	1176	416
10077	6791	1484	371	4026	1253	470	3720	1523	423	2947	1256	494	2578	1261	597	2244	1200	432
10078	6646	1439	368	3958	1217	467	3623	1476	421	2886	1220	491	2521	1225	592	2193	1165	429
10079	6102	1371	338	3666	1172	431	3367	1402	383	2701	1169	427	2367	1173	510	2056	1120	378
10080	5566	1243	326	3358	1065	404	3074	1271	353	2477	1060	407	2171	1065	490	1864	1004	359

Berlin

	1987			1988			1989			1993			1994			1995		
ID	Acid	Nit.	BC	Acid	Nit.	BC	Acid	Nit.	BC	Acid	Nit.	BC	Acid	Nit.	BC	Acid	Nit.	BC
11001	5654	1409	567	3785	1353	535	3767	1442	456	3014	1281	201	2483	1285	182	2468	1262	240

Brandenburg

	1987			1988			1989			1993			1994			1995		
ID	Acid	Nit.	BC	Acid	Nit.	BC	Acid	Nit.	BC	Acid	Nit.	BC	Acid	Nit.	BC	Acid	Nit.	BC
12001	9057	2145	922	8028	2083	1118	7594	2272	1017	5425	1207	430	3687	1123	462	3013	1058	403
12003	6557	1686	1112	6256	1661	1203	5118	1714	1010	3897	1003	592	2731	960	489	2323	903	396
12004	8166	2267	897	7446	2227	1042	6865	2362	937	4712	1131	436	3269	1024	433	2638	957	317
12005	4547	1147	717	4152	1149	975	4149	1289	836	3624	798	458	2278	728	421	2232	723	341
12006	5456	1427	844	4868	1419	1041	4905	1591	1013	4285	977	409	2705	893	445	2640	883	398
12007	3002	798	658	2788	798	648	2696	843	676	2256	444	264	1435	419	287	1385	417	265
12008	5459	1269	1015	4895	1244	1255	4609	1297	901	4147	938	518	2969	927	496	2691	867	427
12009	5491	1463	996	4896	1454	1077	4943	1626	1063	4302	993	342	2721	910	428	2654	897	393
12010	4368	1071	730	4463	1079	768	3773	1176	764	2804	689	258	1814	630	311	1616	624	285
12011	3650	1056	727	3162	1036	761	3026	1164	775	2699	794	294	1932	775	357	1549	719	334
12012	4459	1391	790	3825	1361	830	3733	1521	828	3219	1006	347	2314	983	400	1884	918	367
12013	5077	1300	965	4623	1281	1157	4273	1320	841	3809	901	520	2754	888	459	2483	834	375
12014	5247	1308	1000	4744	1285	1095	4423	1331	879	3948	922	502	2843	908	461	2569	851	404
12015	3588	1030	726	3329	1035	815	3256	1119	749	2747	657	326	1776	599	326	1697	590	287
12016	5376	1561	941	4854	1558	1101	4874	1716	1021	4147	1001	377	2638	917	423	2581	909	378
12017	5890	1792	1054	5117	1767	1239	4957	1835	932	4248	1117	575	2966	1100	506	2816	1057	357
12018	6110	1783	1197	5268	1748	1276	5073	1813	1049	4453	1156	616	3132	1140	536	2922	1084	424
12019	6335	1229	803	5951	1204	885	5254	1326	824	3466	796	243	2342	753	322	1910	707	285
12020	6542	1263	799	5821	1263	935	4866	1347	794	4542	838	475	3027	787	410	2871	722	241
12021	4999	1316	984	4362	1295	1112	4139	1351	881	3727	881	539	2571	868	461	2422	827	316
12022	6537	1292	873	5937	1266	945	5451	1392	854	4097	887	305	2859	873	358	2352	833	317
12024	7476	1500	1195	6051	1469	1311	4772	1546	1035	4977	1018	594	3146	1004	550	3403	959	343
12025	6472	1499	1132	6123	1471	1215	5057	1537	1005	3926	971	551	2724	952	490	2363	908	370
12026	6937	1666	1184	6513	1632	1283	5454	1710	1071	4170	1055	525	2896	1032	515	2526	985	372
12027	7237	1161	1002	6442	1155	1106	4879	1219	894	4513	801	431	3218	771	430	3087	718	252
12028	12486	1196	864	9519	1165	914	7612	1226	770	7155	800	384	4910	783	376	4462	712	233
12029	12469	1937	1227	11135	1865	1290	10868	1988	1060	7381	1280	543	5727	1251	526	4824	1150	339

Brandenburg (2)

	1987			1988			1989			1993			1994			1995		
ID	Acid	Nit.	BC	Acid	Nit.	BC	Acid	Nit.	BC	Acid	Nit.	BC	Acid	Nit.	BC	Acid	Nit.	BC
12030	15843	1688	1145	13885	1624	1170	12369	1733	1009	8064	1133	482	6049	1107	482	4437	1011	321
12031	17157	1978	1235	14924	1902	1249	13461	2029	1083	8684	1291	480	6526	1261	515	4839	1159	319
12032	7827	1445	1153	6952	1401	1059	6494	1569	1036	4929	1035	409	3400	1021	466	2785	969	351
12033	6056	1244	918	5737	1225	896	5044	1336	887	3292	779	311	2247	737	350	1833	694	282
12034	4417	621	778	4032	635	841	2996	667	723	2804	412	312	1949	399	325	1856	376	196
12035	6728	1118	981	6022	1115	1052	4575	1172	878	4210	753	379	2966	722	390	2860	675	265
12036	10051	1348	1078	9149	1300	1079	8703	1391	938	6086	945	428	4679	922	438	3872	836	288
12037	13770	1385	1082	12217	1337	1051	10734	1426	936	7114	955	409	5295	932	434	3844	847	279
12038	8279	1899	1166	7486	1867	949	7394	2011	1096	4818	1213	412	3409	1201	494	3136	1193	394
12040	6812	842	836	6339	832	861	5851	886	757	4122	534	321	3177	511	340	2529	485	234
12041	10026	1680	1071	9238	1636	1081	8784	1717	930	6051	1067	399	4676	1040	429	3895	961	297
12042	10228	1478	1116	9315	1429	1140	8888	1519	978	6176	1010	406	4741	985	448	3953	901	296
12043	10406	1656	1149	9491	1605	1138	9063	1694	988	6238	1072	434	4802	1047	452	4013	962	307
12044	10582	1429	1127	10029	1382	1181	9648	1498	1032	6342	1092	454	5125	1069	513	4070	971	294
12045	9563	1363	1074	9218	1340	1104	7776	1365	938	6227	1047	416	5053	1074	491	4835	1074	317
12046	10140	1795	1132	9718	1772	1141	8238	1793	959	6435	1216	477	5263	1237	484	5033	1239	333
12047	11521	1803	1261	10824	1762	1305	9263	1795	1079	7159	1323	656	5891	1361	518	5658	1362	337
12048	4830	1324	695	4568	1324	1102	4689	1451	777	3525	895	608	2748	907	534	1848	707	287
12049	5724	1639	862	5179	1613	1264	4840	1651	878	4221	1103	667	3105	1089	555	2791	1025	436
12050	4224	1118	659	3910	1124	840	3868	1245	794	3334	752	383	2111	687	377	2058	681	322
12051	4888	1421	897	4483	1422	877	4430	1553	936	3787	938	363	2453	864	390	2371	851	354
12052	6043	1607	1005	5427	1580	1381	5110	1626	966	4519	1131	627	3293	1118	568	2967	1047	460
12053	5307	1419	818	4820	1398	1070	4495	1441	823	3958	967	503	2865	953	472	2594	898	415
12054	2860	657	555	2646	656	678	2555	703	653	2196	383	300	1376	361	305	1326	358	269
12055	2759	553	523	2545	554	604	2451	601	668	2156	343	247	1337	321	289	1285	319	272
12056	4963	1428	963	4540	1427	956	4496	1562	974	3845	944	335	2479	868	391	2398	854	362
12057	5134	1429	956	4641	1426	955	4651	1578	966	4010	949	347	2543	870	396	2489	862	364
12058	6183	1730	919	6161	1733	916	5310	1875	925	3921	1066	355	2562	983	388	2316	978	359
12059	6100	1762	882	4128	1711	996	4529	1919	859	3305	1289	474	2780	1267	440	2553	1186	423
12060	4690	1335	736	4348	1322	1075	3982	1351	748	3515	899	488	2573	885	447	2322	838	341
12061	4513	1047	837	4153	1034	1060	3788	1068	773	3474	775	462	2504	764	435	2238	711	372
12062	5197	1539	931	4342	1492	979	4332	1693	978	3707	1143	388	2654	1120	469	2161	1043	433
12063	5753	1434	815	3792	1386	940	4129	1593	784	3183	1176	455	2659	1157	427	2433	1071	397
12064	6036	1465	945	5986	1463	982	5133	1613	971	3880	961	333	2495	883	394	2240	874	367
12065	5169	1266	973	4677	1245	1252	4367	1290	850	3903	902	514	2808	890	475	2542	835	395
12066	5575	1337	977	5002	1312	1186	4721	1365	918	4223	972	499	3023	959	495	2743	899	438
12067	5000	1469	845	4571	1469	954	4579	1613	946	3878	939	326	2471	862	387	2421	855	355
12068	6870	1596	1083	6699	1582	1156	5807	1775	1135	4420	1079	360	2843	990	451	2540	976	413
12069	4302	1005	728	4397	1013	766	3708	1111	759	2780	665	265	1792	607	314	1592	600	285
12070	5095	1397	737	3465	1362	851	3751	1532	771	2808	1050	399	2354	1029	403	2145	958	377
12071	6564	1584	1262	5818	1541	1628	5626	1627	1085	4956	1163	658	3545	1150	593	3266	1081	479
12072	5265	1313	1050	4764	1293	1185	4412	1329	904	3961	947	519	2898	937	485	2593	873	419
12073	5685	1522	858	5716	1523	967	4904	1656	927	3616	942	304	2346	865	371	2116	860	344
12074	4060	998	855	3801	991	961	3421	1016	734	3125	710	448	2254	695	395	2015	650	334
12075	3945	1103	745	3679	1110	862	3616	1216	806	3070	710	320	1952	648	343	1900	642	306
12076	6474	1665	963	6378	1658	1113	5510	1817	1052	4117	1054	359	2661	967	424	2392	959	387
12077	5218	1598	973	4633	1581	1152	4353	1625	866	3829	1022	537	2721	1007	469	2526	961	334
12078	4476	1138	888	3961	1124	1034	3699	1170	791	3381	777	481	2342	767	423	2189	728	311
12079	3021	708	726	2716	707	732	2462	732	647	2220	411	365	1535	403	323	1393	385	264
12080	4656	1302	925	4147	1288	942	3839	1325	830	3457	854	444	2450	844	411	2259	798	351
12081	7164	1669	930	5767	1616	1092	6360	1801	961	5486	1153	456	3746	1134	458	3371	1082	388
12082	7350	1446	811	6595	1412	953	6104	1559	873	4601	998	362	3192	982	398	2625	938	353
12083	6298	1602	1014	6222	1596	1107	5368	1753	1046	4019	1024	318	2595	939	408	2332	930	372
12084	5207	1404	1001	4537	1380	1133	4344	1440	890	3877	931	541	2670	916	469	2522	874	343
12085	7130	1469	846	6416	1436	960	5885	1569	890	4445	1012	337	3153	1000	394	2568	951	355
12086	8071	1583	976	7163	1537	1079	6701	1706	968	5059	1110	328	3513	1095	416	2884	1043	379
12087	5624	1635	1047	4891	1610	1194	4715	1674	931	4110	1041	572	2839	1024	495	2699	982	345
12088	5793	1563	1113	4980	1533	1220	4844	1609	994	4277	1034	590	2935	1016	506	2786	969	396
12089	6572	1277	838	6151	1249	924	5452	1374	854	3598	823	266	2422	776	335	1974	729	287
12090	4987	1268	1021	4333	1248	1112	4127	1304	913	3699	846	539	2553	836	460	2395	793	330
12091	4935	1302	995	4315	1282	1085	4091	1336	905	3650	856	532	2524	841	443	2371	799	341
12092	7695	1467	1000	7081	1426	1091	6446	1586	997	4229	955	320	2814	900	379	2310	845	325
12093	7017	1603	1078	5796	1578	1187	4547	1638	945	4652	1033	544	2989	1019	506	3201	977	310
12094	5184	1055	902	4391	1046	958	3240	1074	802	3491	708	455	2288	701	406	2355	659	262
12095	4378	1065	962	3877	1053	1025	3606	1096	862	3317	730	484	2287	720	424	2130	681	304

Brandenburg (3)

	1987			1988			1989			1993			1994			1995		
ID	Acid	Nit.	BC	Acid	Nit.	BC	Acid	Nit.	BC	Acid	Nit.	BC	Acid	Nit.	BC	Acid	Nit.	BC
12096	6507	1700	1093	6202	1675	1174	5137	1734	983	3835	968	525	2646	922	474	2285	873	364
12097	6981	1327	1016	6298	1297	1026	5709	1427	934	4376	948	365	3095	939	414	2503	888	339
12098	6988	1546	954	6524	1516	1031	5748	1637	943	3779	965	316	2603	911	368	2108	846	305
12099	6322	1212	875	5631	1213	985	4642	1285	841	4386	828	435	2941	781	401	2746	711	243
12100	4007	767	780	3416	766	826	2500	790	700	2635	441	390	1686	431	347	1755	414	228
12101	6097	1369	1100	5807	1347	1164	4745	1406	968	3701	903	529	2582	891	476	2237	849	339
12102	6762	1637	1185	6381	1607	1252	5314	1678	1046	4086	1046	551	2849	1028	507	2483	984	372
12103	7437	1457	1074	6672	1422	1029	6204	1575	969	4653	1004	382	3231	989	433	2655	943	329
12104	7539	1640	1098	6824	1605	1023	6243	1740	991	4677	1096	387	3328	1084	441	2712	1031	338
12105	6649	1261	971	6220	1233	978	5523	1364	942	3648	822	319	2447	775	369	1992	726	298
12106	18759	1974	1192	13817	1901	1257	11582	2020	1025	10456	1282	527	7162	1252	513	6839	1155	326
12107	8027	1640	1119	7242	1603	1042	7175	1752	1037	4723	1104	394	3320	1097	465	3041	1087	366
12108	8185	1622	1082	7278	1610	1184	5656	1678	965	5073	1019	442	3633	978	459	3484	925	279
12109	18472	1745	1199	13567	1674	1272	11346	1794	1041	10358	1204	484	7071	1179	509	6755	1081	341
12110	10470	1482	1074	9504	1428	1112	9073	1530	940	6305	1018	451	4865	994	447	4041	908	297
12111	11131	1563	1148	10014	1503	1174	9659	1608	1000	6658	1075	478	5156	1052	474	4290	957	314
12112	7965	1616	1132	7181	1582	1045	7098	1726	1043	4688	1090	403	3289	1082	474	3014	1074	352
12113	8053	1799	1129	7278	1760	966	7177	1898	1046	4697	1154	393	3319	1146	473	3044	1137	367
12114	7627	1395	1112	6932	1366	1033	7012	1609	1136	4366	1010	399	2650	897	436	2344	877	347
12115	4520	726	781	4133	740	840	3099	769	723	2842	450	312	1986	436	321	1897	413	201
12116	11123	1519	1178	9994	1458	1173	9654	1566	1013	6674	1059	458	5157	1037	475	4295	942	311
12117	5907	1150	897	5500	1138	884	5297	1231	847	3587	789	351	2490	782	384	2244	775	263
12118	6204	1340	938	5758	1325	863	5562	1420	867	3719	873	338	2596	862	395	2359	857	282
12119	5967	1485	921	5594	1473	769	5249	1545	852	3544	924	323	2554	914	384	2272	903	294
12120	8157	1438	1136	7231	1428	1216	5588	1503	1011	5129	960	430	3655	923	462	3500	865	297
12121	12841	1112	921	9716	1078	956	7795	1146	826	7392	789	354	5045	774	378	4600	698	260
12122	10133	1383	1081	9220	1334	1114	8795	1426	943	6137	971	417	4703	947	436	3913	861	303
12123	12275	1720	1309	10933	1645	1297	10672	1772	1114	7305	1191	486	5651	1167	524	4747	1062	353
12124	6183	1227	1005	5129	1209	1097	3912	1260	884	4162	830	507	2650	819	465	2834	780	290
12125	7544	1569	1075	6826	1537	1057	6723	1667	995	4447	1037	395	3121	1031	457	2851	1023	323
12127	6151	1183	956	5701	1168	910	5500	1267	889	3730	818	338	2588	812	406	2344	805	289
12128	7591	1530	1148	6848	1500	896	6748	1634	1050	4482	1040	387	3144	1032	493	2874	1023	372
12129	3879	584	801	3733	576	686	3608	655	785	2297	404	301	1420	363	324	1197	349	244
12130	6974	1149	1026	6228	1143	1092	4737	1205	920	4366	786	386	3100	755	414	2971	706	263
12131	6895	929	851	6421	919	858	5936	971	756	4147	558	326	3200	534	338	2561	510	236
12132	10064	1570	1127	9263	1524	1095	8631	1593	970	6090	1046	420	4728	1019	446	3853	927	303
12133	7508	1565	1092	6811	1535	1068	6681	1665	1010	4423	1033	401	3105	1028	459	2834	1019	337
12134	12371	1885	1343	11046	1812	1307	10698	1932	1136	7329	1255	484	5685	1229	527	4788	1128	365
12135	4394	885	820	4073	875	741	3786	927	751	2580	517	284	1787	502	341	1564	495	249
12136	7672	1613	1157	6924	1580	1042	6833	1714	1042	4510	1068	396	3172	1060	491	2903	1051	361
12137	11125	1485	1174	10516	1433	1240	10133	1556	1067	6622	1139	477	5354	1117	529	4264	1013	311
12138	7328	1006	883	7155	987	915	6656	1051	816	4593	753	351	3720	737	380	2899	667	232
12139	9496	1318	1088	9101	1293	1110	7656	1316	932	6135	1011	436	5004	1042	471	4764	1039	324
12140	10761	1532	1216	10233	1498	1236	8692	1530	1025	6796	1162	481	5583	1195	524	5343	1193	364
12141	7143	1043	911	6948	1028	898	5799	1042	785	4835	783	369	3953	806	389	3716	803	278
12142	10895	1690	1225	10291	1653	1226	8781	1683	1024	6835	1222	494	5602	1249	523	5354	1248	377
12143	9165	1610	1072	8877	1589	1033	7482	1602	902	5949	1098	433	4855	1119	456	4619	1118	338
12144	9452	1635	1112	9378	1659	1103	9370	1803	1037	6947	1266	489	5461	1240	501	5075	1205	383
12145	10081	1336	1094	9614	1294	1140	9226	1402	1002	6085	1018	439	4884	992	489	3880	900	284
12146	6554	972	831	6380	957	830	5345	970	743	4502	752	329	3709	783	380	3481	780	241
12147	10247	1534	1157	9751	1503	1176	8289	1532	985	6525	1134	471	5335	1162	497	5100	1161	317
12148	8715	1767	1025	8488	1751	1019	7093	1750	877	5709	1147	435	4716	1164	430	4433	1158	290
12149	9590	1555	1108	9235	1531	1123	7820	1552	944	6197	1107	499	5062	1132	466	4812	1132	308
12150	8991	1484	1092	9002	1510	1119	8963	1649	1020	6708	1191	568	5275	1168	478	4891	1134	353
12151	8381	1525	1065	8458	1547	1076	8431	1674	970	6309	1168	527	4983	1147	487	4608	1115	338
12153	6987	1035	884	6796	1020	892	5651	1031	779	4737	773	386	3885	799	374	3657	797	237
12154	8676	1346	1069	8452	1326	1072	7022	1334	915	5789	1009	498	4745	1034	441	4465	1027	285
12155	10664	1855	1234	10439	1881	1278	10456	2050	1152	7659	1439	667	6042	1415	537	5639	1378	391
12156	9614	1607	1088	9274	1584	1119	7833	1600	939	6199	1130	541	5076	1157	452	4833	1156	289

Mecklenburg-Vorpommern

	1987			1988			1989			1993			1994			1995		
ID	Acid	Nit.	BC	Acid	Nit.	BC	Acid	Nit.	BC	Acid	Nit.	BC	Acid	Nit.	BC	Acid	Nit.	BC
13001	5101	1368	1176	4461	1453	1438	4227	1639	1336	4724	1088	511	3125	1132	551	3147	1111	527
13002	4643	1198	1134	4069	1279	1412	3851	1445	1171	4342	965	521	2863	1006	523	2877	986	479
13003	4787	1789	772	4323	1887	1080	5014	2160	1071	3528	1311	348	3058	1369	444	2727	1270	413
13004	4791	1510	683	4077	1579	958	4580	1816	1024	3322	1186	478	2770	1213	480	2316	1071	365
13005	5971	1492	975	5221	1461	1264	5433	1619	883	2772	862	421	2127	797	414	2551	913	360
13006	4780	1581	668	4088	1648	932	4564	1873	967	3268	1188	502	2731	1214	500	2287	1077	356
13007	6035	1556	977	5284	1524	1278	5496	1682	876	2799	889	423	2153	824	422	2577	940	361
13008	3926	1074	699	3552	1068	894	3513	1142	632	1827	595	350	1422	556	302	1666	624	264
13009	4963	1868	861	4450	1930	1125	5210	2202	1009	2831	1147	460	2562	1199	524	2404	1155	394
13010	7239	1979	1145	6247	1927	1517	6626	2130	1017	3354	1112	513	2595	1033	482	3102	1177	418
13011	4029	1541	728	3664	1599	931	4200	1787	802	2223	908	416	2026	947	438	1868	913	310
13012	4638	1774	754	4177	1832	938	4852	2072	907	2615	1073	435	2372	1118	492	2216	1078	352
13013	5016	1809	877	4343	1886	1044	4759	2091	1045	3413	1333	615	2909	1366	540	2414	1218	393
13014	4708	1754	802	4079	1814	942	4492	2011	928	3154	1245	541	2665	1267	465	2243	1144	337
13015	6730	1569	1051	6124	1528	1411	6279	1704	912	3592	919	422	2325	848	480	2897	973	386
13016	6378	1579	968	5878	1547	1322	5989	1705	873	3381	896	430	2211	831	440	2741	948	363
13017	4789	1805	1014	4298	1863	1443	5014	2121	980	2694	1080	554	2437	1129	585	2279	1087	415
13018	4756	1695	798	4101	1759	936	4539	1966	955	3191	1205	557	2679	1228	543	2248	1099	367
13019	4667	1736	824	4051	1800	940	4456	1993	916	3103	1207	543	2619	1229	495	2195	1106	372
13020	5372	1615	677	4159	1639	684	4117	1780	726	3342	1373	462	3024	1385	429	2898	1305	393
13021	5660	1529	911	5059	1522	996	5112	1702	1054	4437	1044	409	2821	961	445	2751	952	403
13022	6227	1669	900	5724	1654	1302	6086	1847	825	4531	1185	481	3496	1208	633	2429	951	329
13023	5637	1467	812	5227	1461	1266	5487	1625	792	4107	1036	471	3187	1062	579	2178	827	308
13024	7072	2067	958	6481	2043	1525	6924	2262	974	5038	1389	581	3903	1418	683	2767	1135	367
13025	6685	1851	887	6133	1833	1354	6540	2041	937	4812	1279	578	3717	1306	631	2601	1030	353
13026	4651	1722	894	4171	1779	978	4874	2029	965	2635	1051	513	2383	1098	567	2224	1056	387
13027	4977	1784	969	4290	1849	1053	4769	2075	1050	3350	1268	620	2812	1293	603	2367	1157	409
13028	4848	1704	1099	4170	1768	1203	4636	1987	1038	3304	1259	639	2773	1283	530	2337	1150	391
13029	4628	1323	682	4420	1328	1054	4496	1441	677	3384	888	424	2657	905	493	1788	718	263
13030	4568	1779	895	3995	1798	947	4137	1970	961	2858	1187	525	2445	1187	531	2304	1160	394
13031	3723	1337	778	3263	1355	842	3357	1496	823	2385	941	446	2037	939	442	1889	911	347
13032	6841	1662	1022	6213	1639	1590	6701	1875	1033	5025	1255	705	3848	1286	754	2673	982	371
13033	5687	1597	792	5301	1591	1273	5537	1749	835	4123	1085	565	3200	1106	591	2204	876	309
13034	5317	1540	751	5023	1541	1233	5121	1671	830	3874	1046	539	3042	1064	556	2053	842	303
13035	6650	1909	874	6116	1897	1446	6497	2097	980	4758	1289	622	3682	1314	655	2580	1044	353
13036	3953	1515	843	3481	1533	915	3584	1677	843	2501	1027	464	2142	1024	449	1997	997	354
13037	4411	1704	967	3858	1723	1053	3994	1888	918	2776	1156	510	2385	1159	479	2236	1128	396
13038	3816	1430	874	3356	1448	941	3449	1588	812	2438	994	475	2090	992	417	1942	964	353
13039	4532	1335	846	3619	1352	886	3517	1475	736	2144	924	437	1862	920	362	1833	895	308
13040	4909	1448	972	3937	1476	1007	3760	1597	802	2347	1035	483	2066	1039	376	2007	1001	322
13041	5903	1532	998	3898	1484	1018	4316	1676	789	3326	1302	509	2863	1316	409	2632	1216	367
13042	5946	1474	870	5459	1464	1357	5809	1650	903	4369	1079	634	3349	1100	644	2293	848	319
13043	5772	1540	723	5335	1556	973	5443	1730	862	4620	1183	592	3640	1227	625	3162	1164	427
13044	4135	1417	940	3580	1438	972	3724	1609	967	2650	1019	509	2249	1018	506	2097	984	389
13045	5843	1562	752	5395	1576	812	5509	1754	913	4683	1203	568	3685	1246	607	3198	1181	438
13046	5821	1693	841	5104	1702	843	5339	1890	942	4048	1286	568	3750	1331	621	3160	1263	448
13047	6023	1707	912	5242	1714	906	5505	1917	991	4203	1326	584	3881	1373	642	3271	1303	472
13048	5758	1797	771	3949	1748	774	4297	1919	536	3264	1391	317	2840	1404	270	2600	1310	305
13049	2770	713	546	1960	698	600	2009	759	438	1444	481	290	1244	486	224	1117	468	243
13050	5620	1490	793	5235	1508	869	5273	1662	954	4545	1170	541	3610	1211	583	3067	1136	446
13051	4683	1225	746	4181	1243	753	4320	1390	842	3322	983	466	3114	1020	506	2592	961	390
13052	3720	1329	854	3259	1347	875	3361	1489	869	2368	922	433	2018	919	433	1870	889	350
13053	3758	1207	683	3083	1231	711	2921	1314	685	1748	778	350	1554	777	335	1479	749	276
13054	4755	1532	738	3373	1502	751	3537	1632	545	2776	1171	348	2428	1180	275	2180	1096	294
13055	4929	1464	715	3442	1433	691	3639	1577	483	2924	1211	315	2551	1223	254	2292	1130	290
13056	6281	1684	875	5794	1701	1133	5842	1878	1066	5034	1314	641	3978	1362	677	3418	1279	510
13057	4738	1214	676	4489	1238	793	4494	1366	833	3867	961	470	3096	995	504	2636	934	387
13058	4990	1303	766	4708	1327	787	4721	1462	876	4061	1027	466	3248	1063	505	2772	998	404
13059	4597	1434	821	3708	1453	880	3595	1572	704	2153	945	421	1878	942	355	1844	915	312
13060	4077	1185	766	3287	1206	821	3152	1310	647	1918	814	393	1673	811	322	1626	783	293
13061	4473	1414	799	3622	1434	859	3496	1546	641	2111	942	404	1845	938	316	1799	910	302
13062	5571	1556	861	3741	1510	901	4096	1683	658	3128	1236	451	2702	1249	367	2458	1152	354
13063	5125	1297	843	4796	1314	852	4870	1470	921	4167	1025	431	3290	1061	495	2837	1001	417
13064	4358	1259	787	3490	1279	865	3373	1395	728	2039	855	399	1768	851	361	1730	822	310
13065	5060	1482	885	4011	1500	969	3906	1638	753	2374	1018	445	2058	1016	363	2039	984	355
13066	5766	1751	764	3934	1703	828	4288	1875	584	3232	1339	406	2806	1353	323	2559	1254	339

Mecklenburg-Vorpommern (2)

	1987			1988			1989			1993			1994			1995		
ID	Acid	Nit.	BC	Acid	Nit.	BC	Acid	Nit.	BC	Acid	Nit.	BC	Acid	Nit.	BC	Acid	Nit.	BC
13067	4566	1228	642	3124	1192	709	3312	1342	501	2529	994	337	2152	989	276	1958	920	297
13068	5035	1417	747	3437	1374	855	3672	1536	616	2715	1070	403	2310	1064	340	2115	993	345
13069	3693	1145	611	3346	1236	831	3823	1436	900	2790	939	250	2434	992	348	2087	898	349
13070	4574	1696	725	4163	1802	1013	4753	2040	1021	3358	1254	371	2951	1318	438	2596	1215	384
13071	6119	1560	994	5327	1524	1280	5570	1688	895	2833	895	434	2178	830	413	2608	947	363
13072	4515	1646	588	3933	1715	810	4284	1891	871	3017	1172	459	2572	1198	443	2113	1069	321
13073	4923	1804	980	4413	1869	1291	5202	2151	1047	2825	1116	546	2548	1170	583	2398	1130	429
13074	4460	1658	821	3873	1715	920	4257	1899	878	2950	1143	518	2492	1164	479	2078	1047	370
13075	4013	1173	604	3648	1195	602	3686	1296	633	2823	895	415	2702	925	441	2219	872	300
13076	4293	1516	934	3734	1541	965	3889	1716	997	2729	1066	528	2316	1065	535	2176	1035	392
13077	2784	989	667	2488	1010	683	2517	1107	674	1779	687	363	1535	685	354	1382	660	282
13078	4009	1325	713	3297	1349	751	3149	1440	659	1855	832	360	1631	829	337	1591	809	281
13079	6036	1696	751	4032	1640	698	4432	1831	479	3434	1415	309	2977	1430	269	2729	1324	325
13080	5076	1274	812	4751	1290	843	4831	1446	919	4138	1011	431	3271	1049	495	2817	988	411
13081	6096	1673	984	5602	1683	974	5745	1871	1039	4867	1273	495	3825	1316	579	3323	1247	479
13082	3204	1190	770	2848	1209	763	2900	1322	821	2020	792	356	1730	786	371	1577	759	326
13083	4339	1398	765	3548	1424	826	3373	1521	632	2055	936	380	1820	935	302	1747	902	299
13084	4733	1205	699	4465	1224	719	4520	1365	821	3854	948	452	3069	983	487	2637	927	374

Sachsen

	1987			1988			1989			1993			1994			1995		
ID	Acid	Nit.	BC	Acid	Nit.	BC	Acid	Nit.	BC	Acid	Nit.	BC	Acid	Nit.	BC	Acid	Nit.	BC
14002	9783	1532	939	8654	1476	1015	6934	1588	935	4648	1058	360	3932	1029	409	4232	998	280
14003	9161	1735	1079	8545	1657	1186	8592	1811	1051	4705	1164	413	3937	1137	468	3554	1109	314
14004	9515	1694	1160	8826	1608	1291	8912	1775	1112	4844	1148	440	4042	1117	489	1089	1089	319
14005	10325	1677	1092	9850	1647	1141	8353	1670	973	6621	1271	455	5468	1326	507	5237	1327	304
14006	10895	1463	1147	10292	1414	1211	9920	1533	1069	6523	1149	458	5270	1139	540	4221	1039	292
14007	11948	1670	1227	11194	1606	1297	10850	1742	1149	7064	1294	495	5738	1290	605	4618	1178	314
14008	9915	1344	1071	9492	1304	1116	9079	1409	1004	6065	1079	437	4926	1070	526	3904	976	272
14009	10111	1425	1087	9664	1383	1135	9258	1490	1001	6122	1090	438	4975	1077	496	3945	982	281
14010	8026	1155	929	7800	1129	961	7325	1204	870	5046	893	370	4106	888	422	3219	810	235
14011	11773	1606	1229	11029	1544	1287	10659	1677	1125	6929	1238	494	5642	1231	569	4524	1121	314
14012	10455	1431	1138	9890	1397	1189	8366	1428	1002	6686	1164	451	5488	1210	536	5245	1207	322
14013	5938	665	810	5788	662	813	4857	700	731	4038	501	322	3259	502	374	3010	490	230
14014	9855	1655	1069	9509	1631	1111	8063	1652	945	6419	1239	438	5267	1288	491	5049	1288	297
14015	11271	1451	1239	10542	1409	1291	8955	1446	1074	7056	1186	541	5796	1230	547	5563	1230	339
14016	8970	1344	965	8441	1286	1026	7054	1285	945	6105	1236	449	5343	1315	481	5415	1289	321
14017	7493	1160	977	7081	1112	1005	5778	1099	884	5203	1009	537	4531	1075	416	4557	1051	284
14018	7345	1094	954	6948	1049	989	5641	1035	875	5127	974	469	4450	1036	425	4480	1013	280
14019	10312	1526	1156	9884	1496	1193	8274	1510	1025	6710	1218	533	5543	1263	514	5232	1253	316
14020	11711	1589	1260	10912	1541	1319	9313	1582	1098	7296	1282	529	6019	1335	576	5783	1334	349
14021	7908	1117	955	7464	1066	998	6168	1060	896	5482	1039	537	4778	1107	407	4818	1081	303
14022	6646	1074	837	6267	1028	859	5024	1010	806	4768	942	402	4139	998	362	4053	965	263
14023	7475	1223	957	7091	1174	976	5740	1153	889	5324	1078	644	4633	1140	354	4584	1106	303
14024	5993	835	840	5620	794	853	4474	781	772	4261	754	568	3677	804	305	3638	782	252
14025	8928	1531	1058	8662	1511	1073	7330	1531	907	5865	1091	586	4807	1124	418	4576	1125	276
14026	7335	1390	820	6938	1340	829	5634	1319	810	5206	1155	395	4552	1220	339	4496	1190	273
14027	7441	1289	816	7007	1240	846	5708	1223	808	5152	1087	378	4495	1154	365	4532	1134	268
14028	6894	991	794	6504	943	809	5205	925	807	4987	953	371	4302	1007	378	4262	977	267
14029	7875	1287	927	7414	1234	984	6122	1225	887	5400	1103	402	4718	1175	436	4765	1153	299
14030	6886	982	822	6494	934	856	5195	917	824	4965	932	365	4281	986	396	4235	954	277
14031	8898	1149	1006	8377	1091	1079	7000	1090	982	6039	1138	451	5281	1213	492	5395	1190	357
14032	7258	1327	857	6864	1277	886	5559	1257	835	5170	1114	398	4507	1179	372	4449	1147	267
14033	8728	1561	1018	8741	1563	1086	7375	1561	994	6898	1446	666	6100	1515	477	5757	1460	364
14034	6994	1342	771	6588	1296	786	5359	1279	757	4868	1073	395	4241	1138	328	4236	1117	258
14036	10150	1671	984	9611	1607	978	8150	1602	984	6766	1483	405	5976	1576	437	6133	1555	371
14037	6064	1124	709	6528	1123	703	5192	1122	759	3862	894	385	3402	900	303	3064	848	236
14038	22580	2587	1585	19847	2377	1768	16837	2711	1717	7443	1616	689	6590	1459	653	1239	1239	364
14039	23339	2941	1686	20494	2719	1873	17451	3059	1785	7729	1798	703	6877	1644	681	5522	1422	362
14040	23725	2749	1775	20788	2514	1803	17695	2878	1799	7812	1728	643	6982	1566	665	5576	1331	342
14041	24560	2872	1766	21545	2628	1900	18324	3006	1882	8076	1794	727	7240	1623	704	5794	1379	388
14042	22581	2864	1883	19910	2655	1905	16928	2980	1792	7501	1738	674	6643	1590	667	5309	1375	314
14043	24760	3086	2364	21733	2842	2261	18498	3212	2092	8160	1885	812	7320	1720	787	5886	1477	351
14044	19966	2130	1504	17620	1953	1467	14856	2239	1468	6605	1341	506	5724	1199	537	4512	1010	276

Sachsen (2)

	1987			1988			1989			1993			1994			1995		
ID	Acid	Nit.	BC	Acid	Nit.	BC	Acid	Nit.	BC	Acid	Nit.	BC	Acid	Nit.	BC	Acid	Nit.	BC
14045	22268	2460	1876	19574	2252	1718	16582	2582	1712	7328	1545	571	6469	1387	624	5126	1169	308
14046	21188	2383	1978	18668	2192	1703	15795	2497	1685	6992	1474	613	6127	1326	624	4848	1123	286
14047	23303	2623	2164	20450	2399	1857	17352	2750	1868	7652	1642	621	6790	1475	680	5416	1248	324
14048	22483	2490	2143	19750	2281	1767	16740	2615	1801	7383	1555	651	6526	1395	673	5182	1176	308
14049	5427	553	765	5259	527	546	4437	601	667	3385	464	330	2764	430	328	2352	403	182
14051	13674	1549	976	12746	1440	752	11272	1636	891	7033	1264	397	5379	1182	508	4878	1135	295
14052	12772	1744	1216	12248	1663	871	10758	1832	1033	7583	1490	573	6255	1439	581	5704	1424	322
14053	12607	1870	1437	12110	1793	994	10643	1954	1141	7472	1519	822	6180	1475	649	1458	1458	311
14054	4836	935	757	4792	937	761	3995	951	722	3965	678	478	3425	690	310	3150	662	217
14055	7844	1900	986	8235	1904	1054	6452	1904	964	5656	1593	611	5465	1669	498	4797	1619	319
14056	21175	2786	2041	18661	2592	1996	15930	2894	1788	7038	1657	733	6219	1527	670	4960	1329	285
14057	6444	1318	1006	6823	1319	968	5193	1316	902	4864	1201	543	4679	1258	492	4051	1212	255
14058	3866	785	780	4007	786	682	3071	801	684	2929	592	414	2764	599	354	2307	571	173
14059	7294	1356	1233	7703	1356	1192	5916	1360	1058	5425	1309	854	5204	1368	643	4509	1310	361
14060	7572	1597	1161	8082	1622	1068	7194	1735	1014	5322	1303	815	4660	1303	646	3951	1262	316
14061	8136	1229	1111	8205	1250	1067	8216	1384	978	6273	1089	778	4951	1083	604	4570	1046	324
14062	7897	1221	1071	8009	1244	1093	7981	1370	962	6120	1069	533	4825	1063	546	4447	1029	345
14063	12954	1417	1227	12474	1438	1267	11538	1592	1080	8238	1241	586	6281	1230	644	5132	1191	391
14064	12526	1424	1199	12177	1447	1234	11203	1592	1047	8034	1226	603	6121	1216	641	4990	1175	396
14065	6120	999	913	6247	1011	909	6052	1095	831	4921	866	552	3894	861	400	3522	827	272
14066	10189	1644	1282	9991	1666	1285	10002	1826	1148	7430	1388	868	5884	1386	604	5498	1350	376
14067	8977	1471	1148	8996	1494	1164	8999	1636	1044	6781	1245	759	5362	1244	474	4982	1209	338
14068	7714	1373	1100	7735	1375	1099	6475	1373	976	6236	1252	725	5490	1312	507	5172	1264	309

Sachsen-Anhalt

	1987			1988			1989			1993			1994			1995		
ID	Acid	Nit.	BC	Acid	Nit.	BC	Acid	Nit.	BC	Acid	Nit.	BC	Acid	Nit.	BC	Acid	Nit.	BC
15000	4483	1159	672	3026	1106	822	2905	1201	701	2099	793	285	1727	780	324	1682	738	297
15001	7886	1512	998	6397	1379	1064	5191	1529	903	4847	1158	487	3181	1075	502	2758	1035	396
15002	7605	1480	959	6199	1353	1064	5018	1496	847	4698	1132	475	3091	1051	471	2676	1011	391
15003	7626	1330	986	6070	1210	1078	4755	1343	865	5174	1175	536	3651	1153	564	3244	1166	501
15004	7709	1493	1080	6266	1383	1117	4898	1504	934	5299	1289	590	3805	1257	612	3359	1269	505
15005	7694	1384	1024	6137	1263	1083	4833	1399	885	5207	1197	560	3685	1177	586	3272	1188	487
15006	8338	1521	883	6697	1373	1143	5470	1536	773	5130	1217	486	3353	1130	439	2923	1092	428
15007	8028	1518	971	6482	1400	1126	5076	1530	827	5521	1351	582	3968	1320	529	3504	1332	521
15008	6315	1034	768	5099	943	927	3974	1055	643	4458	980	462	3158	963	414	2780	971	408
15009	6674	1372	1072	6120	1349	883	5982	1459	958	4002	925	361	2795	917	467	2535	901	343
15010	8016	1718	1230	7229	1680	927	7150	1824	1090	4701	1136	424	3314	1128	542	3029	1106	396
15011	6609	1477	1088	6138	1461	824	5863	1557	973	3971	984	405	2816	973	486	2518	950	358
15012	4962	913	937	4590	901	988	4305	971	821	3031	651	373	2120	648	431	1875	633	291
15013	5801	1123	1048	5404	1111	1102	5088	1194	914	3531	806	440	2502	801	486	2209	780	326
15014	13318	1580	1310	10089	1461	1379	9259	1577	1123	7421	1266	655	4359	1152	594	3973	1118	397
15015	8199	1700	1020	7526	1653	1172	6884	1821	1030	4491	1079	340	3011	1019	402	2482	952	330
15016	7304	1498	950	6781	1464	1085	6020	1604	959	4006	954	324	2693	899	376	2203	837	307
15017	5555	1097	886	5343	1088	907	5238	1254	914	3341	806	346	2090	718	361	1799	687	301
15018	4993	1336	965	4131	1256	1101	3682	1388	947	3082	933	366	2114	916	417	1881	873	366
15019	4469	1175	880	3761	1113	1015	3269	1225	870	2785	835	349	1924	821	392	1686	778	342
15020	4578	1237	782	3835	1170	967	3350	1283	797	2857	881	328	1977	865	380	1740	822	335
15021	7786	1645	849	6397	1519	1005	5194	1660	829	4780	1203	441	3167	1119	439	2747	1077	399
15022	6843	1488	1015	5663	1400	997	4480	1503	894	4758	1194	599	3452	1167	589	3029	1169	447
15023	7162	1375	1060	5850	1274	1053	4585	1389	923	4982	1192	612	3589	1167	612	3139	1172	477
15024	5571	1086	909	4651	1018	898	3648	1108	796	4060	954	530	2931	930	521	2551	933	389
15025	6683	1272	1083	6132	1250	847	5980	1363	980	4025	897	412	2801	891	484	2541	875	360
15026	7294	1351	1173	6597	1322	992	6469	1453	1044	4356	966	455	3039	962	531	2758	944	387
15027	6890	1225	1121	6353	1204	1053	6426	1425	1074	4033	910	461	2446	808	484	2148	783	337
15028	7139	1475	1164	6601	1453	1203	6672	1672	1072	4132	1010	519	2542	905	516	2241	876	333
15029	7390	1370	1206	6762	1342	1224	6854	1580	1120	4279	993	552	2601	885	542	2291	858	355
15030	4740	1212	392	3193	1172	545	3407	1331	453	2641	1026	306	2230	1014	338	2025	929	297
15031	6485	1890	858	4350	1793	1058	4385	1942	859	2994	1208	347	2429	1184	392	2453	1135	368
15032	6365	1150	913	5159	1059	954	4061	1170	792	4447	1002	494	3155	982	508	2786	991	409
15033	8240	1702	1180	6696	1584	1182	5272	1713	998	5587	1407	678	4028	1375	678	3561	1385	500
15034	8032	1633	1005	7384	1589	1138	6752	1753	1003	4420	1061	381	2961	1001	417	2426	932	340
15035	7573	1365	969	6950	1325	1100	6333	1486	970	4204	942	358	2798	888	399	2287	825	327
15036	8175	1562	1048	7483	1517	1185	6833	1688	1048	4515	1044	381	3006	985	422	2475	918	345

Sachsen-Anhalt (2)

	1987			1988			1989			1993			1994			1995		
ID	Acid	Nit.	BC	Acid	Nit.	BC	Acid	Nit.	BC	Acid	Nit.	BC	Acid	Nit.	BC	Acid	Nit.	BC
15037	7937	1606	1030	7301	1562	1150	6672	1726	1023	4364	1038	375	2921	979	406	2405	913	344
15038	7660	1452	929	7036	1410	1074	6418	1571	934	4240	978	337	2833	923	383	2320	858	316
15039	7763	1555	903	7137	1512	1053	6519	1672	913	4282	1020	327	2873	963	375	2360	897	316
15040	8677	1813	873	7913	1758	1066	7306	1944	888	4765	1171	351	3204	1109	385	2647	1036	317
15041	8730	1923	930	7992	1868	1097	7390	2049	949	4770	1200	326	3206	1135	389	2662	1063	320
15042	8276	1663	894	7580	1613	1077	6929	1785	904	4564	1093	333	3053	1032	380	2521	964	316
15043	9895	1792	735	7831	1606	1282	6571	1823	726	6037	1479	457	3951	1381	421	3469	1336	471
15044	5943	1004	658	4956	909	891	3855	1021	598	3779	851	365	2489	787	334	2118	754	316
15045	7594	1238	657	6106	1105	1034	4911	1255	585	4745	1072	392	3087	994	361	2675	957	372
15046	6362	1137	1028	5973	1121	931	5989	1324	1020	3781	847	396	2290	751	421	2004	727	320
15047	7810	1509	1081	7101	1477	1086	7170	1722	1090	4471	1077	461	2733	962	467	2409	931	360
15048	6450	1150	947	6025	1132	995	6004	1335	982	3825	864	371	2325	768	390	2032	743	326
15049	4036	735	712	3885	726	748	3748	801	730	2364	472	287	1485	428	299	1254	408	244
15050	6901	1346	1047	5848	1279	1000	4496	1350	891	4405	1087	638	2775	991	532	2417	949	314
15051	6917	1507	1062	5912	1444	971	4582	1509	875	4388	1140	688	2797	1045	534	2449	1002	267
15052	3524	700	725	3444	683	621	2475	714	603	2895	528	492	2165	487	388	1648	451	180
15053	5647	1211	953	5802	1196	796	4770	1238	802	4573	1059	717	3868	990	545	3239	934	219
15054	8589	1883	1156	8537	1871	978	6572	1943	940	6495	1529	914	4879	1444	690	3911	1364	270
15055	7582	1620	1189	6877	1589	1174	6758	1719	1050	4476	1073	411	3150	1067	534	2868	1046	366
15056	5105	1448	896	4244	1369	1050	3792	1498	898	3130	981	337	2161	963	390	1927	919	352
15057	5414	1608	979	4527	1562	1116	4444	1766	1032	3847	1196	382	2753	1172	467	2249	1088	417
15058	5647	1504	769	3771	1457	937	4145	1656	828	3088	1151	401	2581	1128	433	2351	1038	352
15059	5071	1372	534	3432	1329	704	3685	1498	556	2762	1076	344	2334	1063	351	2125	975	317
15060	7757	1598	933	7172	1557	1071	6534	1715	954	4269	1022	310	2867	965	371	2355	900	303
15061	4342	657	686	4123	648	772	3521	706	691	2371	431	250	1601	408	281	1271	380	235
15062	6938	1453	1006	6460	1421	1051	5696	1547	977	3779	934	353	2585	880	391	2088	815	316
15063	4552	1186	830	3826	1121	1002	3336	1235	835	2837	851	345	1956	837	392	1729	797	348
15064	5899	1173	899	5653	1161	915	5555	1338	922	3573	871	387	2217	775	388	1919	743	308
15065	5723	1232	960	5344	1220	723	5114	1304	871	3447	812	353	2425	805	424	2179	788	315
15066	6803	1500	1099	6297	1481	1024	6036	1582	992	4078	1001	386	2901	994	474	2592	971	340
15067	8073	1558	1254	7320	1521	1229	7398	1778	1178	4588	1100	568	2799	983	564	2475	954	378
15068	6935	1125	965	7108	1145	954	7062	1253	875	5439	928	401	4270	911	449	3919	877	313
15069	12756	1290	1229	12360	1315	1307	11389	1466	1074	8142	1156	591	6175	1135	637	5022	1091	417
15070	9816	1328	1063	7889	1266	1067	6938	1330	916	5770	1040	582	3534	949	495	3119	909	329
15071	3523	531	532	2904	495	673	2251	546	465	2567	432	311	1771	411	285	1480	393	290
15072	7279	1440	1049	5960	1340	1074	4687	1456	902	5053	1230	585	3647	1203	592	3203	1209	473
15073	7340	1397	985	5968	1294	1065	4674	1412	839	5096	1231	568	3673	1206	539	3220	1212	467

Thüringen

	1987			1988			1989			1993			1994			1995		
ID	Acid	Nit.	BC	Acid	Nit.	BC	Acid	Nit.	BC	Acid	Nit.	BC	Acid	Nit.	BC	Acid	Nit.	BC
16001	7494	1510	901	6128	1407	1040	4811	1522	732	5208	1317	522	3776	1297	472	3329	1302	468
16002	6651	1325	858	5454	1234	969	4305	1338	713	4700	1164	499	3413	1145	452	2993	1147	429
16003	6931	1414	760	5392	1293	864	4722	1472	593	4158	1073	400	2856	1019	309	2399	993	282
16004	7103	1435	874	5527	1312	911	4818	1488	667	4310	1121	450	2985	1061	365	2488	1033	286
16005	8036	1649	976	6536	1535	1031	5142	1661	756	5531	1427	575	4006	1404	494	3549	1413	430
16006	3799	1142	794	2830	1032	800	2511	1197	695	2535	938	521	1754	884	440	1491	849	278
16007	6788	1449	737	5307	1333	756	4634	1500	573	4072	1078	450	2809	1025	350	2365	999	249
16008	7233	1382	922	5896	1281	959	4620	1397	734	5062	1244	541	3661	1224	473	3218	1229	400
16009	7672	1393	946	6131	1275	1003	4823	1407	753	5220	1226	560	3704	1211	491	3304	1226	409
16010	8282	1640	1136	6714	1521	1171	5258	1648	921	5670	1428	647	4092	1405	617	3627	1418	471
16011	6940	1408	1002	5690	1315	1023	4496	1425	826	4871	1214	573	3539	1196	537	3109	1201	410
16012	8025	1695	968	6246	1558	980	5465	1760	758	4826	1291	544	3341	1221	442	2816	1194	308
16013	5742	1231	782	4789	1158	795	3787	1247	638	4150	1051	473	3029	1033	406	2646	1033	310
16014	7012	1532	1065	5793	1441	1039	4595	1545	884	4906	1263	632	3583	1247	596	3149	1250	367
16015	5797	1083	959	4747	1004	920	3711	1101	822	4122	940	596	2942	926	548	2593	933	318
16016	4693	1518	866	3433	1373	876	3123	1580	701	3079	1220	634	2159	1153	510	1875	1119	319
16017	4001	1333	770	2999	1220	777	2694	1386	658	2619	1035	529	1851	984	437	1587	948	276
16018	5988	1380	927	4906	1301	854	4122	1395	747	3869	1075	530	3052	1079	503	2848	1168	318
16019	6285	1686	1002	5196	1610	867	4412	1702	812	3993	1211	646	3184	1219	566	2976	1303	305
16020	6946	1534	768	4227	1382	787	3764	1602	681	3448	1212	655	2858	1153	531	2383	1118	293
16021	4035	1377	762	3065	1266	772	2742	1427	664	2650	1053	537	1871	1001	437	1606	963	274
16022	7949	1468	1150	7937	1450	964	5879	1513	906	6251	1397	859	4700	1318	667	3740	1243	268
16023	5936	1291	959	6098	1276	820	5037	1318	818	4788	1148	677	4079	1089	510	3420	1030	206

Thüringen (2)

	1987			1988			1989			1993			1994			1995		
ID	Acid	Nit.	BC	Acid	Nit.	BC	Acid	Nit.	BC	Acid	Nit.	BC	Acid	Nit.	BC	Acid	Nit.	BC
16024	6237	1296	1083	6587	1296	966	4987	1291	906	4753	1160	670	4555	1207	565	3905	1148	257
16025	4274	1019	574	2766	944	584	2421	1068	535	2180	768	432	1848	736	363	1494	706	203
16026	3935	1278	732	2965	1167	735	2645	1331	664	2601	1004	513	1821	951	428	1557	915	255
16027	4170	844	736	3382	789	633	2796	854	593	2772	679	419	2170	687	380	2010	751	233
16028	7026	1538	983	5517	1425	851	4749	1553	774	4319	1162	575	3356	1178	524	3168	1278	329
16029	7148	1518	1043	5602	1402	878	4827	1534	829	4407	1166	630	3419	1183	569	3222	1284	323
16030	7513	1336	1081	7485	1317	878	5466	1369	844	5903	1293	742	4447	1219	593	3531	1148	260
16031	7743	1566	1113	7716	1547	888	5693	1597	869	6012	1402	794	4558	1330	614	3639	1255	248
16032	8712	1679	1263	8784	1657	1018	7702	1743	1006	6467	1519	914	5401	1447	692	4571	1370	269
16033	6322	1571	687	4049	1444	707	3600	1627	669	3209	1200	588	2720	1142	484	2257	1105	252
16034	4215	1240	723	3022	1110	737	2717	1303	709	2709	975	496	1846	925	423	1582	893	249
16035	5649	990	636	4445	903	629	3742	1006	608	3604	857	410	2798	866	389	2611	955	279
16036	6853	1376	716	5353	1265	694	4599	1394	668	4256	1099	443	3289	1112	433	3106	1215	320
16037	7210	1682	1025	5683	1574	839	4936	1698	811	4405	1231	607	3434	1248	551	3250	1347	320
16038	7661	1729	1007	7622	1717	797	5742	1767	790	5887	1431	679	4476	1373	544	3608	1301	235
16039	8681	1948	1181	8752	1922	940	7709	2004	921	6404	1620	841	5388	1555	634	4575	1475	250
16040	9287	2066	1269	9354	2046	1005	8295	2131	985	6833	1741	912	5736	1669	689	4869	1581	271
16041	6692	1543	694	4117	1399	749	3674	1608	694	3302	1161	556	2744	1109	469	2277	1071	263
16042	7700	1368	768	5901	1231	749	5097	1392	722	4715	1157	479	3624	1174	478	3440	1301	365
16043	5418	1145	637	4349	1069	559	3646	1155	575	3470	901	358	2727	911	361	2527	988	264
16044	7783	1837	984	6114	1709	781	5316	1849	782	4730	1344	556	3700	1365	519	3490	1469	326
16045	7413	1675	1070	5812	1555	816	5047	1691	838	4543	1248	614	3543	1268	565	3346	1373	315
16046	5720	973	924	5842	958	696	4825	1008	721	4622	981	612	3899	926	471	3267	874	194
16047	5440	1215	904	5500	1196	664	4579	1238	708	4314	1029	599	3666	984	449	3101	933	186
16048	8294	1747	1178	8388	1721	889	7329	1802	924	6214	1518	813	5216	1449	607	4415	1372	244
16049	7659	1737	1107	7829	1725	837	6760	1783	876	5851	1466	757	4945	1405	568	4183	1330	230
16050	11428	2218	1129	7175	1989	1284	5290	2295	1097	3493	1274	578	3534	1338	584	2847	1260	353
16051	12474	1200	661	10457	1163	684	7973	1292	661	6568	1098	437	6731	1064	429	5331	1008	284
16052	15803	1319	754	12773	1261	751	9746	1427	733	7725	1228	491	7978	1202	494	6498	1149	329
16053	7492	950	636	7446	919	558	5628	1042	608	5335	910	368	4038	885	391	3315	840	254
16054	11255	1603	1061	10690	1532	843	8146	1709	851	7373	1404	635	5689	1378	593	4801	1321	338
16055	11052	1977	1070	10597	1918	821	8184	2073	842	7239	1546	634	5625	1524	587	4754	1461	315
16056	11348	1895	1167	10809	1826	888	8336	2002	901	7415	1531	712	5749	1509	630	4864	1448	326
16057	5718	716	874	5653	695	633	4279	782	674	4012	557	475	2965	519	429	2382	487	209
16058	11812	2008	1316	11407	1945	975	10014	2090	990	7047	1515	700	5840	1465	585	5267	1426	292
16059	12301	1988	1519	11830	1920	1114	10419	2074	1143	7269	1521	865	6019	1471	655	5453	1437	307
16060	10082	1560	1325	9813	1505	1014	8494	1628	1035	6118	1218	738	5048	1175	563	4516	1144	258
16061	11656	2185	1155	7277	1949	1330	5338	2266	1145	3547	1267	579	3596	1333	594	2896	1257	359
16062	10952	2076	1065	6853	1858	1224	5031	2141	1055	3337	1194	518	3361	1252	551	2697	1178	332
16063	19135	1688	840	15203	1605	909	11599	1806	846	9067	1532	588	9425	1507	597	7774	1451	389
16064	16298	1373	732	13102	1307	707	10007	1480	721	7921	1273	459	8191	1247	491	6680	1193	328
16065	14412	1149	684	11766	1099	607	8947	1251	657	7166	1099	402	7392	1073	441	5954	1024	293
16066	9616	1174	793	9306	1120	652	7019	1275	710	6510	1127	445	4967	1099	476	4152	1052	296
16067	12141	1731	984	11483	1653	798	8734	1842	847	7825	1512	586	6071	1489	590	5148	1432	354
16068	9102	1514	998	8941	1471	738	6880	1612	778	6252	1248	583	4804	1222	521	4002	1166	273
16069	5702	825	917	5531	797	630	4706	868	693	3503	582	471	2881	548	376	2463	513	185
16070	10627	1662	1346	10318	1603	954	8974	1735	1019	6428	1302	756	5314	1256	576	4767	1225	273
16071	12892	2121	1565	12427	2041	1131	10954	2203	1191	7604	1617	890	6305	1568	673	5736	1536	318
16072	9422	2001	935	6160	1844	1052	4568	2051	923	3004	1180	509	2987	1215	481	2383	1144	264
16073	5288	753	659	3384	704	771	2309	788	669	1629	483	306	1575	478	325	1184	436	192
16074	7784	626	497	6464	605	480	4916	685	497	4061	502	267	4103	465	289	3188	437	200
16075	18231	1563	807	14557	1483	767	11093	1675	777	8681	1430	480	9025	1405	530	7401	1351	335
16076	16266	1337	803	13067	1270	675	9965	1443	728	7900	1252	456	8170	1225	490	6661	1174	298
16077	10493	1325	851	10030	1262	680	7622	1434	743	6974	1243	478	5348	1217	501	4486	1166	296
16078	8423	1053	830	8301	1014	626	6276	1154	689	5871	1009	448	4466	983	448	3692	937	263
16079	9873	1303	984	9526	1247	719	7233	1406	780	6629	1193	564	5071	1166	523	4255	1119	285
16080	11185	1584	1146	10901	1508	822	9576	1694	884	7178	1415	674	6252	1391	610	5618	1339	324
16081	13014	2096	1481	12500	2013	1011	11028	2178	1111	7665	1616	807	6342	1564	649	5775	1532	321
16082	14716	1419	664	12092	1368	759	9219	1517	704	7306	1240	407	7541	1216	464	6136	1168	280
16083	16541	1613	798	13341	1545	672	10237	1715	722	8036	1389	450	8308	1364	486	6797	1310	293
16084	17258	1531	872	13859	1464	699	10599	1644	766	8295	1378	492	8608	1355	519	7055	1303	307
16085	10474	1279	920	9980	1212	691	7566	1387	763	6961	1227	507	5336	1200	516	4479	1151	301
16086	9811	1271	985	9676	1213	704	8491	1379	783	6485	1205	553	5595	1179	522	4992	1132	287
16087	12802	1884	1315	12293	1806	887	10823	1973	982	7575	1526	665	6248	1470	580	5685	1442	303
16088	13473	2082	1476	12892	1998	981	11397	2174	1106	7933	1654	780	6555	1596	649	5976	1567	325

Thüringen (3)

ID	1987			1988			1989			1993			1994			1995		
	Acid	Nit.	BC	Acid	Nit.	BC	Acid	Nit.	BC	Acid	Nit.	BC	Acid	Nit.	BC	Acid	Nit.	BC
16089	19007	1804	873	15152	1720	747	11593	1916	793	9019	1581	481	9385	1559	554	7732	1504	327
16090	17823	1833	846	14288	1755	687	11001	1939	749	8585	1551	455	8888	1526	509	7311	1469	312
16091	19784	1165	812	12203	1115	599	8974	1267	675	8248	1121	420	8201	1095	455	6427	1051	273
16092	10178	1383	945	9979	1315	652	8779	1488	741	6688	1287	495	5787	1261	514	5169	1212	296
16093	13167	1622	1292	12622	1540	833	11046	1719	955	7804	1457	622	6413	1395	570	5846	1378	313
16094	8479	1202	957	8265	1153	588	7088	1260	718	5269	1007	454	4350	968	406	3843	942	231
16095	16347	1418	693	13145	1348	678	10042	1520	686	8015	1367	403	8283	1338	483	6786	1299	301

Annex C

Dry deposition for Level II sites.

This annex contains the results of dry deposition calculations for 48 Level II sites. The table contains depositions of total potential acid (Acid), total nitrogen (Nit.) and sea-salt corrected base cations (BC) in equivalents per hectare per year.

Level II sites

	1990			1991			1992			1993			1994			1995		
ID	Acid	Nit.	BC	Acid	Nit.	BC	Acid	Nit.	BC	Acid	Nit.	BC	Acid	Nit.	BC	Acid	Nit.	BC
101	4050	2141		4751	2067		3225	2060		4602	2061	110	3937	2085	128	3351	1984	179
301	4745	1630		4579	1550		3133	1534		4218	1672	162	3412	1606	161	3070	1494	158
302	2751	1156		3224	1042		2090	1088		3090	1169	113	2098	1141	117	2005	1135	171
303	2823	1184		3312	1068		2142	1113		3171	1198	115	2149	1170	119	2058	1163	175
304	4597	1609		4554	1478		3252	1547		4957	1649	183	3994	1611	146	3575	1582	184
305	5205	1772		5297	1617		3657	1680		5698	1812	190	4470	1761	152	4112	1757	213
306	6788	1663		6939	1490		4352	1605		6070	1696	232	4239	1613	189	3705	1614	165
307	6330	3107		6226	3083		4937	3042		5996	2944	176	4932	2819	140	4691	2678	119
501	7237	2902		7308	2807		6184	2860		6431	2848	224	6285	2852	174	5869	2716	148
502	7092	3581		6415	3492		6291	3606		6376	3481	189	6236	3492	137	5842	3391	109
503	4382	1429		4543	1398		3518	1385		3408	1276	116	3260	1280	101	2607	1202	107
504	4541	1843		4663	1895		3661	1855		3611	1766	152	3651	1908	134	3272	1836	129
505	4722	2029		4228	1878		3431	1897		4012	1914	179	3623	1906	137	3054	1821	131
506	5537	1946		5540	1830		4138	1849		4275	1783	213	4138	1730	166	3485	1669	124
507	4760	1936		5602	1906		3708	1867		4139	1753	117	3545	1726	104	3005	1630	121
601	7201	2281		8734	2303		5312	2300		4641	1805	426	4437	1807	330	3751	1791	175
602	6353	1903		7772	1933		4699	1937		4042	1498	363	3850	1502	275	3226	1484	153
603	4503	1668		4817	1544		3297	1545		3472	1498	321	3316	1504	255	2842	1489	132
604	4594	1899		4841	1753		3408	1746		3550	1686	318	3400	1685	248	2950	1673	125
605	4510	1651		4812	1594		3681	1625		3632	1488	225	3731	1537	203	3139	1506	121
606	5357	2154		5814	2015		4048	2015		4359	1930	345	3806	1865	267	3341	1867	150
607	5224	2006		5684	1870		3911	1871		4227	1789	373	3676	1728	278	3214	1734	148
701	4408	1665		4740	1721		3471	1672		3778	1599	207	3126	1569	191	2764	1522	179
702	3638	1338		4283	1419		2884	1371		2831	1178	176	2574	1203	194	2403	1209	184
703	5120	1886		6060	2090		4320	1937		4381	1848	203	3913	1872	162	3496	1838	154
704	3143	1244		3268	1194		2432	1195		2713	1165	172	2415	1156	159	2175	1139	164
705	3251	1266		3825	1328		2618	1285		2537	1113	186	2322	1135	178	2164	1142	141
706	3648	1302		4308	1391		2877	1345		2843	1136	175	2572	1171	188	2386	1173	181
707	3903	1435		4218	1485		3075	1446		3360	1387	173	2782	1362	194	2450	1320	173
708	3903	1435		4218	1485		3075	1446		3360	1387	173	2782	1362	194	2450	1320	173
709	3961	1551		4446	1502		3562	1538		3536	1407	148	2941	1459	185	2769	1438	116
710	3979	1569		4462	1518		3578	1554		3552	1423	154	2956	1474	195	2785	1454	118
801	4178	1645		4392	1581		3264	1593		3649	1537	173	3227	1530	172	2885	1494	189
802	3123	1178		3245	1137		2507	1169		2946	1199	247	2758	1260	204	2532	1248	143
803	3355	1767		3344	1805		2619	1749		2657	1803	233	2450	1675	220	2290	1655	201
804	3031	1568		2890	1544		2295	1495		2124	1437	118	2103	1444	129	1988	1431	134
805	3149	1636		3105	1681		2572	1719		2527	1675	201	2435	1586	221	2252	1589	181
806	3030	1484		2990	1533		2443	1573		2397	1528	172	2303	1437	188	2118	1441	188
808	3456	2030		3315	1991		2717	1927		3231	2033	192	2935	1996	176	2820	2043	183
809	3141	1563		3049	1544		2392	1491		2493	1430	150	2327	1437	132	2146	1427	139
810	2885	1338		2735	1332		2339	1356		2397	1309	204	2421	1380	198	2438	1492	198
811	3357	1357		3472	1311		2717	1340		3165	1370	256	2964	1429	223	2730	1416	147
1401	9369	1827		5571	1371		5056	1321		5509	1399	219	4458	1353	227	4207	1371	158
1402	8631	1322		5003	1060		6174	1337		6975	1366	235	5954	1421	229	6234	1460	171
1403	17990	2665		18940	2391		11711	2333		8606	1769	297	7250	1576	278	5839	1420	152
1404	18489	3031		19333	2634		12015	2560		8905	1999	367	7546	1816	295	6123	1656	188
1405	8577	1357		4949	1049		6110	1316		6894	1342	321	5882	1396	240	6144	1431	173
1406	4762	935		2954	741		4328	853		4682	852	294	3948	860	204	3818	832	124

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