

**Daily Loads of Nutrients, Total Alkalinity,
Dissolved Inorganic Carbon and
Dissolved Organic Carbon of the
European Continental Rivers for the
Years 1977 – 2014**

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Abstract

The daily nutrient loads of the European continental rivers entering the North Sea are estimated for the years 1977 to 2014. The parameter treated are total nitrogen, nitrate, ammonium, total phosphorus, orthophosphate and silicate. Additionally for the rivers Elbe, Ems, Nieuwe Waterweg, Haringvliet and Scheldt the loads of Total Alkalinity (TALK), dissolved inorganic carbon (DIC) and dissolved organic carbon (DOC) are presented.

The raw data, in most cases daily values of discharge and nutrient concentrations sampled weekly, biweekly or monthly, are illustrated and statistically discussed. The observations used are: total nitrogen, Kjeldahl nitrogen, nitrate, nitrite+nitrate, ammonium, total phosphorus, orthophosphate and silicate.

Based on the investigations of annual load estimates by De Vries & Klavers (1994) the "double interpolation method" to calculate daily loads is used. Adopting their arguments general problems of load estimates are flagged. These arguments help to understand the advantages and disadvantages of the method used in relation to the individual nutrients. A further description on the method used as well as a discussion on the time series of the resulting river loads is presented in the paper by Radach and Pätsch (2007)

The carbon related loadings of TALK, DIC and DOC result from different measurements by A. Borges (pers. comm) that resulted in one representative concentration for each river and each parameter.

The graphical and statistical tools already used for the discussion of the raw data are also applied to the resulting daily river loads.

Under the restrictions also flagged in this report, the calculated values build a good estimate for the daily nutrient loads for further use in ecosystem models.

This report and all data shown are available under

https://wiki.zmaw.de/ifm/ECOHAM/DATA_RIVER/

1 Introduction

Over the years a range of eutrophication problems have been well documented. The source of these problems is generally understood to be excessive nutrient concentrations (Ospar, 1998). Listing the pathways of nutrients into the North Sea a considerable portion is provided by river nutrient loads and diffusive inputs of nutrients along the coast (Nelissen & Stefels, 1988; Radach *et al.*, 1990; Radach, 1992; Radach & Pätsch, 2007; Lorkowski *et al.*, 2012.)

Even though the dynamical link between nutrient river input into the North Sea and coastal eutrophication problems has been realized, papers like the Quality Status Report 2000 (Ospar, 2000) deal with this topic only on the basis of estimates for annual river loads. In order to investigate the effects of these inputs with an ecosystem model, the information provided clearly lacks the resolution of the seasonal pattern.

The first attempt to provide adequate estimates of river loads was made by the NSTF guiding document (Anonymous, 1992), where monthly values of all major rivers around the North Sea were aggregated for the year 1985. Estimates of daily nutrient loads for the continental rivers were presented by Pätsch & Lenhart (2004) for the years up to 2002.

The present paper is an update of the former report, providing an extension of the time range to cover the years from 1977 to 2014 for continental rivers entering the North Sea, as presented in Fig. 1.

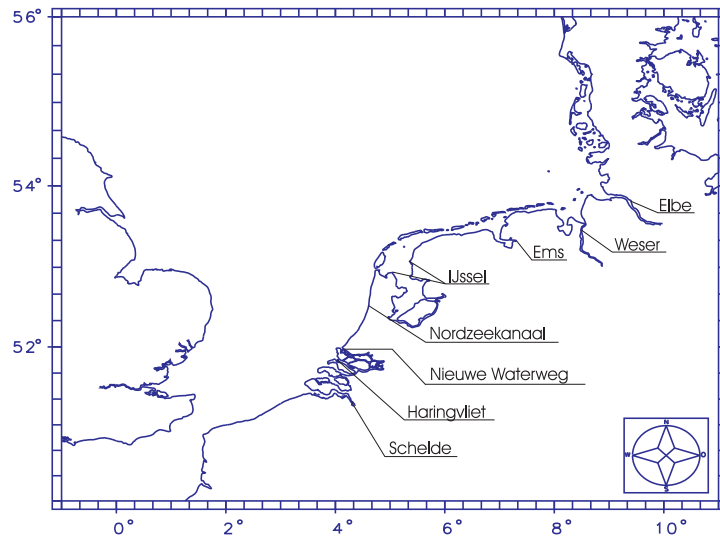


Fig. 1: *The main continental rivers entering the North Sea.*

The nutrient loads described here build an important piece of information on the nutrient loads for the North Sea as a whole. They were used in an OSPAR ecological modelling workshop, where the reduction scenarios for the ecosystem model simulation were related to the reduction effort achieved by the individual countries around the North Sea since 1985, the year where the 50 river loads of DIN and DIP was suppose to start. The related year, for which the reduction levels achieved were tested, was 2002, the year where OSPAR provided a first assessment on the eutrophication status of the North Sea, based on the Comprehensive Procedure. The result of the ecosystem modelling workshop and the discussion on the river loads in the context of the reduction scenarios is presented in Lenhart et al. (2010).

The following institutions kindly provided data for the river load calculations:

- Arbeitsgemeinschaft für die Reinhaltung der Elbe (ARGE), Hamburg, FRG
- Bundesanstalt für Gewässerkunde, Koblenz, FRG
- NLWKN, Hildesheim, FRG
- Rijkswaterstaat, Den Haag, NL
- University of Liege, Chemical Oceanography Unit, Institut de Physique (B5), B-4000 Liege, Belgium

2 The raw data: an overview

Table 1 gives an overview of the original data provided by the different river authorities. The numbers within the boxes give the years of the beginning and the end of the available time series for the specific parameter.

Tab. 1a: *List of parameters aggregated for each river*

River	DIS	TN	KjN	NO3	NO2	N23	NH4	TP	PO4	SiO4	Cl
Elbe	77-14	78-14		77-14	90-14		77-14	78-14	77-14	88-14	77-14
Weser	77-14	80-14		77-14	90-05 07-14		77-14	77-14	81-14	93-94	90-14
Ems	77-14	80-14		77-14	90-09 11-14		77-14	77-14	81-14	89-94	90-14
Kornwederzand	77-14										
Den Oever	77-14										
Vrouwenzand			77-14	10-14	99-03 10-14	77-14	77-94 98-14	77-14	77-14	77-94 99-14	77-14
NZ Kanaal	77-10 12-14		77-14	10-14	99-03 10-14	77-14	77-94 98-14	77-14	77-14	79-94 99-14	90-94 98-14
N. Waterweg	77-14		77-14	10-14	99-03 10-14	77-14	77-14	77-14	77-14	77-94 99-14	90-14
Haringvliet	77-14		77-14	10-14	99-03 10-14	77-14	77-94 98-14	77-14	77-14	77-94 99-14	90-94 98-14
Scheldt	77-14		77-14	10-14	99-03 10-14	77-14	77-94 98-14	77-14	77-14	77-94 99-14	90-94 98-14

The abbreviations and the units for the parameters are:

DIS	discharge	$[m^3/s]$
TN	Total nitrogen	$[mg/l]$
KjN	Kjeldahl nitrogen	$[mg/l]$
NO2	Nitrite	$[mg/l]$
NO3	Nitrate	$[mg/l]$
N23	Nitrite + Nitrate (NO_2 plus NO_3)	$[mg/l]$
NH4	Ammonium	$[mg/l]$
TP	Total phosphorus	$[mg/l]$
PO4	Orthophosphate	$[mg/l]$
SiO4	Silicate	$[mg/l]$
Cl	Chloride	$[mg/l]$

For some of the raw data, like chloride and NO2, generally no time series of daily loads are calculated. These data are only included as additional information to complete the overall picture of the data. The nitrate loads of the German rivers do not include NO2. As the Dutch and Belgium authorities delivered in most cases only Nitrogen-Oxids which include nitrate and nitrite the corresponding

loads also include both components. This is not the case for the German fivers. One should point out that the timeseries described in Tab. 1 may have gaps which can only be recognized by looking at the presentation of the individual parameter. The data presented here are only a subset of the data available at the authorities, here collected for specific aim of load calculations.

For Lake IJssel the load calculations were performed for the stations Kornwederzand and Den Oever. As no concentration data were available at these stations, these values were taken from Vrouwenzand.

For the Dutch and Belgium rivers total nitrogen is calculated as the sum of Kjeldahl nitrogen, nitrite and nitrate (N23). Kjeldahl nitrogen includes particulate organic nitrogen (PON), dissolved organic nitrogen (DON), and ammonium.

$$KjN = PON + DON + NH_4$$

For the German rivers the values for total nitrogen are not differentiated into Kjeldahl- and nitrite/nitrate-nitrogen. Here the originators delivered values for total nitrogen, nitrate and ammonium.

The abbreviations and the units (assuming density 1 kg/l) for the carbon related parameters are:

TALK	Total Alkalinity;	$[\mu mol/kg]$
DIC	Dissolved Inorganic Carbon	$[\mu mol/kg]$
DOC	Dissolved Organic Carbon	$[\mu mol/kg]$

Only for some of the rivers a constant concentration value for these parameters could be estimated:

Tab. 1b: *List of estimated concentrations ($[\mu mol/kg]$) for some rivers*

River	TALK	DIC	DOC
Elbe	2231	2195	456
Ems	2562	2738	1007
N. Waterweg	2580	2678	230
Haringvliet	2580	2678	230
Scheldt	3832	3971	512

Some problems regarding the interpretation of the data should be mentioned. Since the North Sea is a tidally influenced shelf sea the inflowing rivers show typical estuarine characteristics. McLellan (1977) classified these regions as: "The term estuary has been traditionally used by geographers to denote rather loosely the lower reaches of a river where tide and river flow interact". Therefore any measurement monitoring the outflowing river waters has to take into account the phenomena of mixing water masses. In order to get a pure sample of the river water, it should be taken at low tide so that mixing processes can be considered to have a minor influence. A valuable information about the state of mixing within the water mass is given by the chloride content of the sample.

The discharge is usually measured at the last tide-free gauge station. In order to account for the additional contribution of the downstream part of the river, certain factors are provided by the different authorities monitoring the rivers. These factors will be mentioned in the description of the raw data but they did not enter the load estimates within this paper. The idea of providing the load estimates based on the raw data was that someone who wants to use the data can decide himself in the frame of his own application if he wants to apply a drainage factor or other additional factors, like a retention factor.

In contrast to the position of the discharge measurements the position of the concentration measurements are oriented towards the river mouth. In this way the concentration measurement represents as good as possible the state of the river entering the North Sea. Of course this site must allow to identify the outflowing water. Practically the selection of the monitoring station for the load calculation is determined by the frequency of the measurements available and the state of tidal mixing at that station, which may be checked by the chloride contents of the samples. Therefore there is a spatial difference between the position where the discharge is measured and the sampling stations for the nutrient concentrations. This is definitely a drawback for the load estimates, but one has to consider the load calculations from discharge and concentration data as the best estimates possible, given the restrictions by the data as well as the assumptions that have to be applied.

3 Description of raw data : discharge and concentrations

3.1 German Rivers

3.1.1 River Elbe

All data for the river Elbe were provided by the Arbeitsgemeinschaft für die Reinhaltung der Elbe (ARGE). The data are published in form of the annual publication series "Wassergütedaten der Elbe" and in papers on special issues. All documents are available under **www.fgg-elbe.de** in the internet.

The discharge data represent daily measurements from the last tide-free gauge station at Neu Darchau (km 536). Until 1991 the concentration data were selected from weekly samples at the site Teufelsbrück (km 630) just downstream of the Hamburg harbour; afterwards they stem from weekly samples at the sampling site Seemannshöft (km 628). At these stations the outlets of the big water treatment plant Köhlbrandshöft are not completely mixed with the Elbe water. Both sampling sites are well beyond the starting of the tidal mixing zone near Glückstadt (about km 674), which is characterized by the low chloride content of about 150 *mg/l*.

Before 1993 the nutrient data were derived from individual samples, whereas from 1994 onward the data are taken from horizontal profile mixing probes (Querprofilmischproben). The data for total phosphorus and total nitrogen start with the year 1978. Furthermore the technique of measuring Kjeldahl nitrogen was changed towards the measurement of Koroleff nitrogen which should lead to higher nitrogen values than the previous technique. However, no inhomogeneity can be detected within the data presented here. Nitrite data were measured by ARGE also before 1990 but are not taken into account in this updated report. Silicate data were provided by ARGE for the sampling station Grauerort (km 660) starting in February 1988; since at least 2013 the silicate data stem from Seemannshöft (km 628).

To the river discharge given at the tide-free gauge station Neu Darchau an amount of 21 % (pers. comm. Bergemann; ARGE) has to be added in order to take into account the additional drainage from the area downstream of Neu Darchau. As mentioned before this factor has not yet been used for the presented data within this volume.

Discharge from River Elbe

TIME SERIES

number of data: 13878

mean: $717 \text{ m}^3/\text{s}$

relative standard deviation: 0.64

minimum: $173 \text{ m}^3/\text{s}$ August 18, 2003

maximum: $4070 \text{ m}^3/\text{s}$ June 11, 2013

LOW PASS

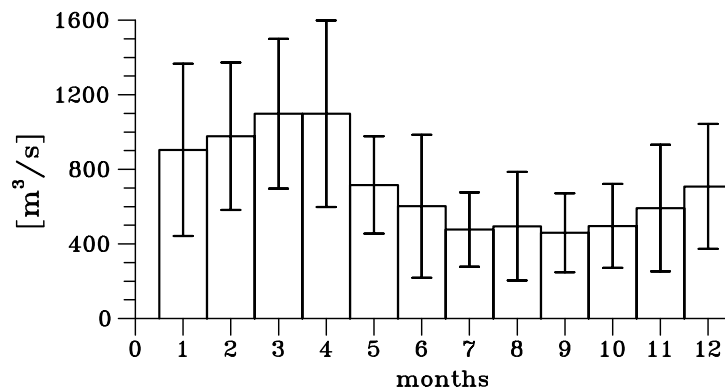
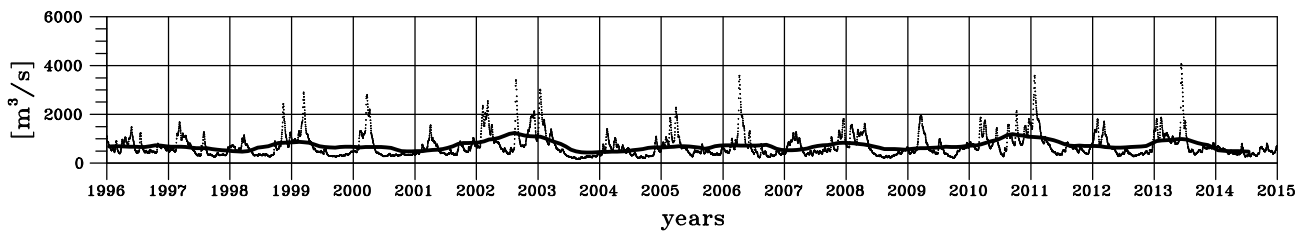
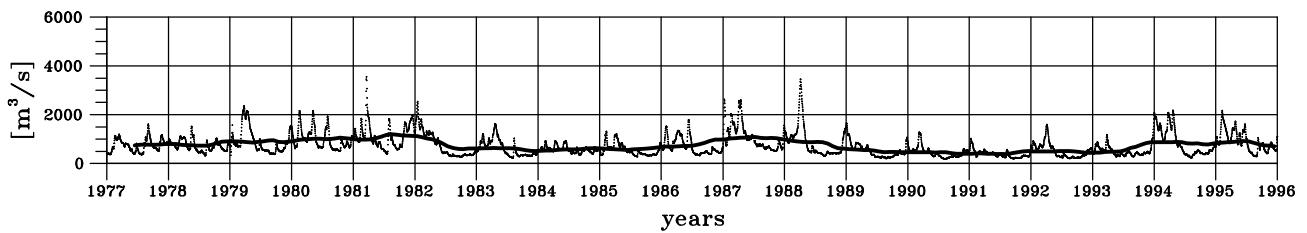
minimum: $381 \text{ m}^3/\text{s}$ July 1991

maximum: $1229 \text{ m}^3/\text{s}$ August 2002

ANNUAL CYCLE

minimum: $460 \text{ m}^3/\text{s}$ September, rel. stdev: 0.46

maximum: $1098 \text{ m}^3/\text{s}$ April, rel. stdev: 0.46



Total Nitrogen from River Elbe

TIME SERIES

number of data: 1303

mean: 5.78 mg/l

relative standard deviation: 0.32

minimum: 1.50 mg/l August 20, 2012

maximum: 11.80 mg/l December 21, 1982

LOW PASS

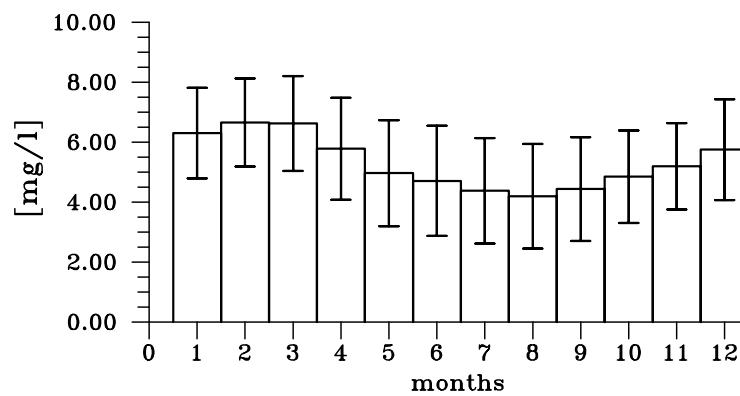
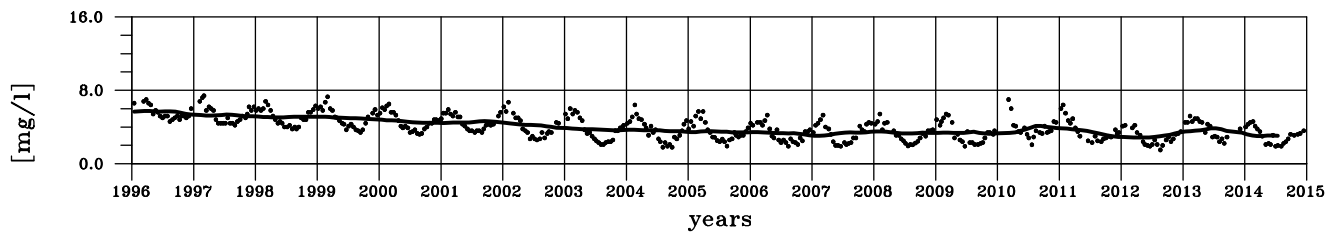
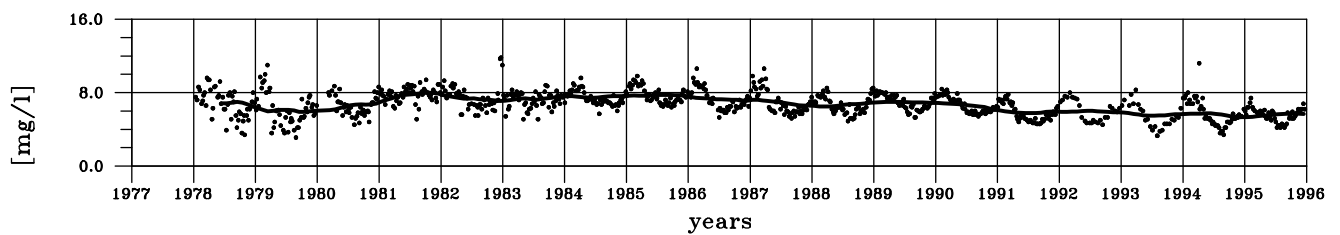
minimum: 2.85 mg/l April 2012

maximum: 7.99 mg/l October 1981

ANNUAL CYCLE

minimum: 4.19 mg/l August, rel. stdev: 0.42

maximum: 6.66 mg/l February, rel. stdev: 0.22



Nitrate from River Elbe

TIME SERIES

number of data: 1328

mean: 3.65 mg/l

relative standard deviation: 0.35

minimum: 0.48 mg/l January 18, 1983

maximum: 7.40 mg/l March 29, 1993

LOW PASS

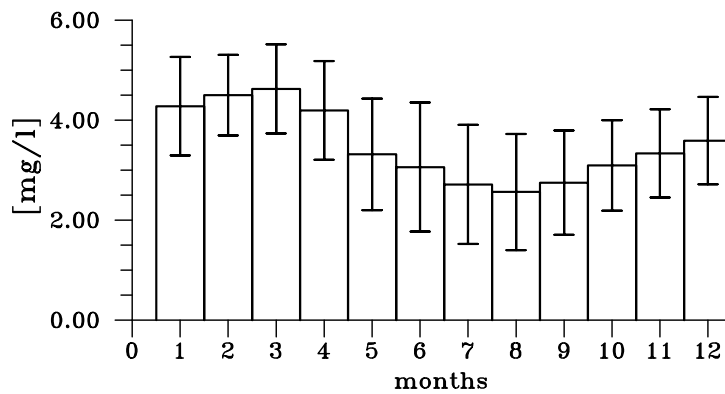
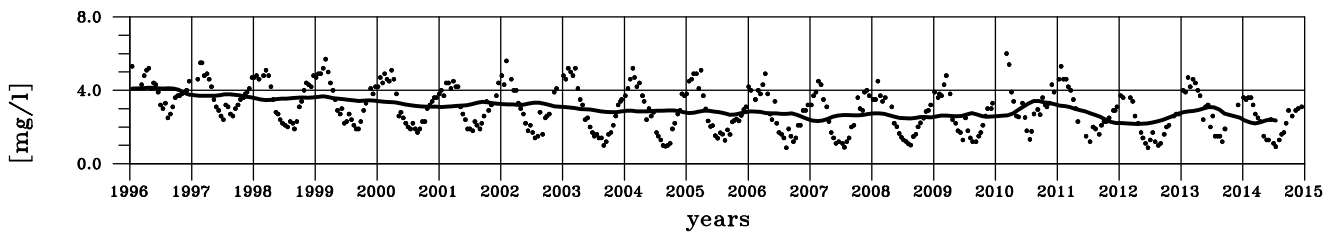
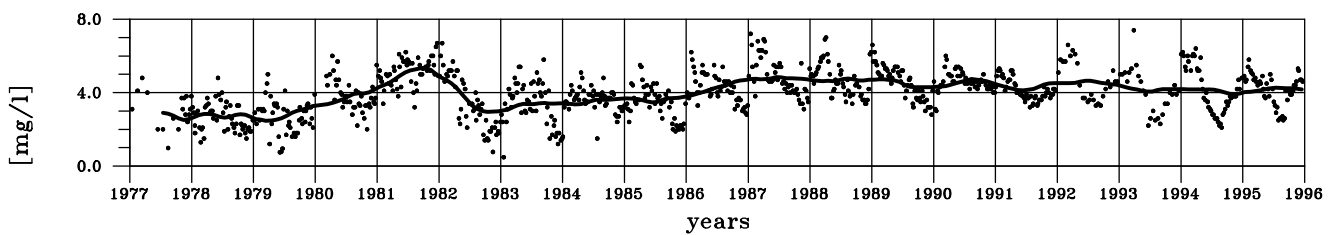
minimum: 2.17 mg/l April 2012

maximum: 5.34 mg/l October 1981

ANNUAL CYCLE

minimum: 2.56 mg/l August, rel. stdev: 0.45

maximum: 4.63 mg/l March, rel. stdev: 0.19



Nitrite from River Elbe

TIME SERIES

number of data: 705

mean: 0.06 mg/l

relative standard deviation: 0.90

minimum: 0.01 mg/l April 26, 2005

maximum: 0.46 mg/l May 15, 1990

LOW PASS

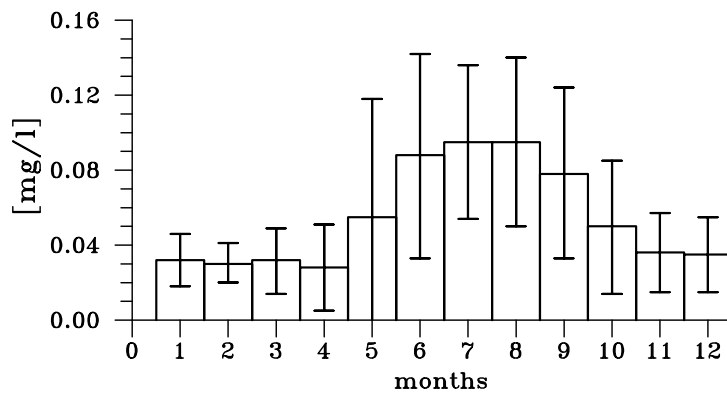
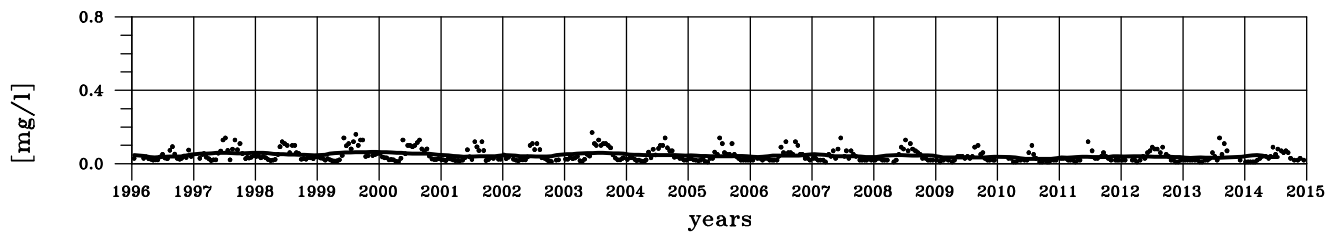
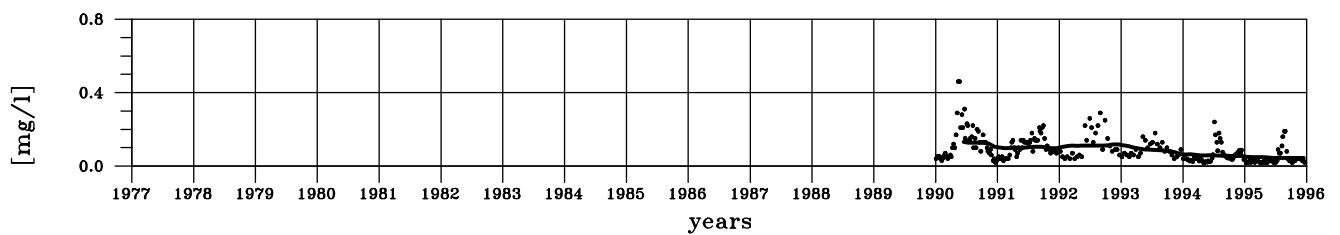
minimum: 0.03 mg/l July 2010

maximum: 0.13 mg/l June 1990

ANNUAL CYCLE

minimum: 0.03 mg/l April, rel. stdev: 0.81

maximum: 0.09 mg/l July, rel. stdev: 0.43



Ammonium from River Elbe

TIME SERIES

number of data: 1338

mean: 1.01 mg/l

relative standard deviation: 1.06

minimum: 0.02 mg/l May 9, 1994

maximum: 5.00 mg/l January 15, 1977

LOW PASS

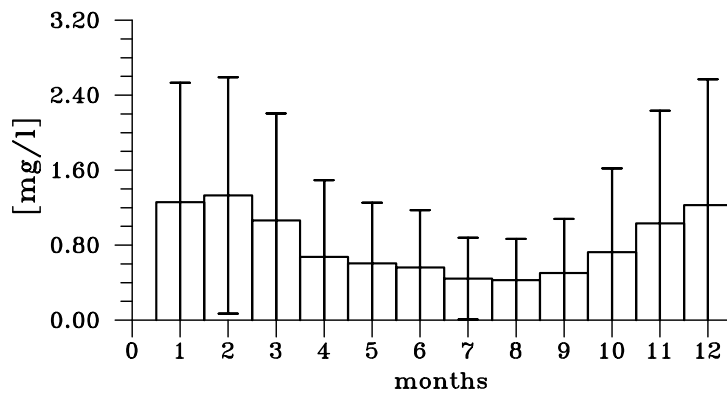
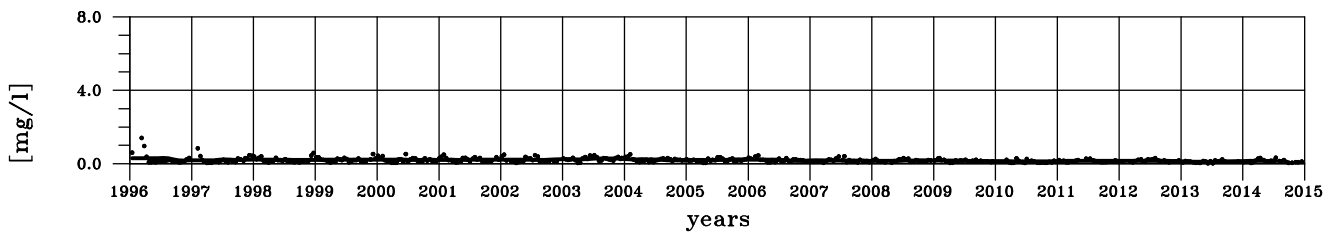
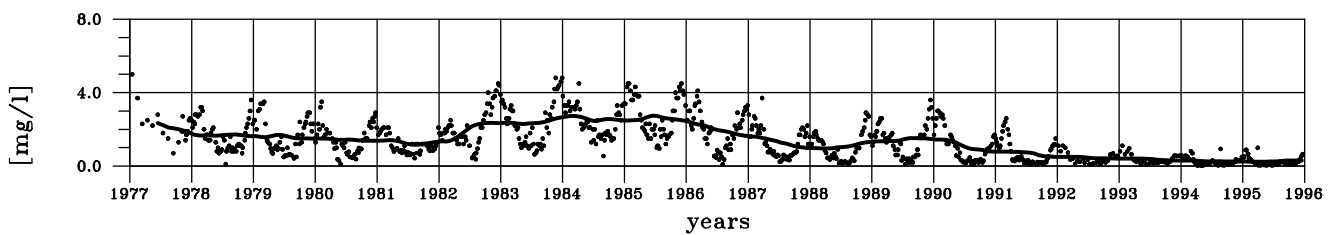
minimum: 0.11 mg/l July 2013

maximum: 2.75 mg/l June 1985

ANNUAL CYCLE

minimum: 0.43 mg/l August, rel. stdev: 1.03

maximum: 1.33 mg/l February, rel. stdev: 0.95



Total Phosphorus from River Elbe

TIME SERIES

number of data: 1304

mean: 0.31 mg/l

relative standard deviation: 0.45

minimum: 0.09 mg/l February 23, 2011

maximum: 1.10 mg/l September 28, 1982

LOW PASS

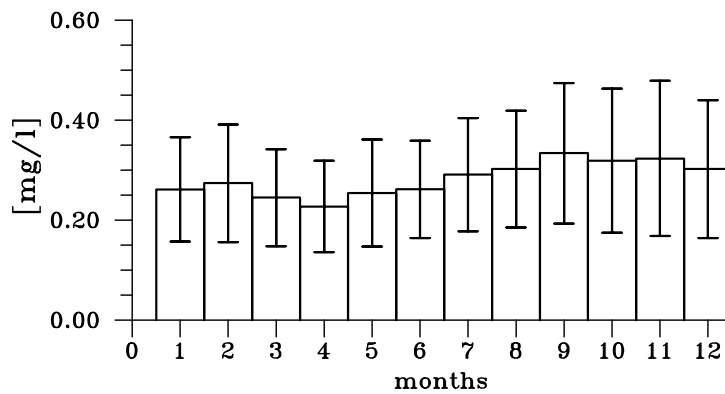
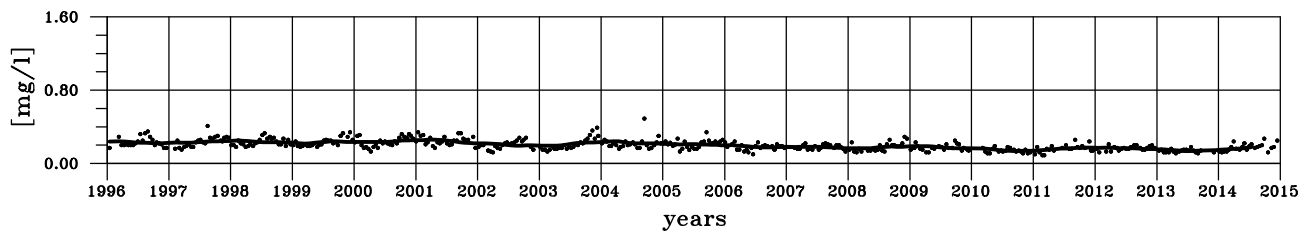
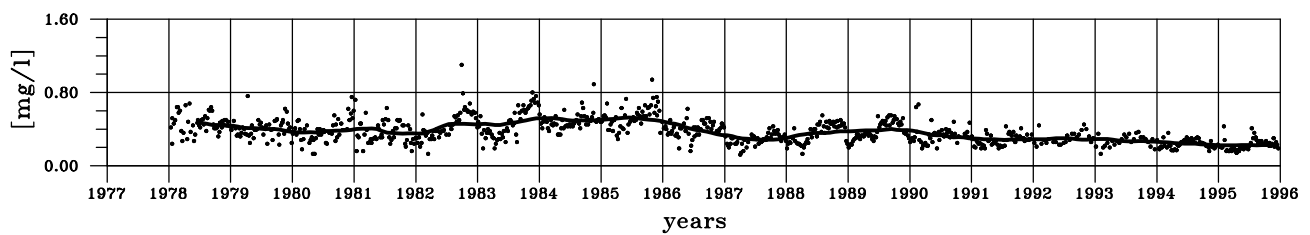
minimum: 0.14 mg/l July 2013

maximum: 0.53 mg/l June 1985

ANNUAL CYCLE

minimum: 0.23 mg/l April, rel. stdev: 0.40

maximum: 0.33 mg/l September, rel. stdev: 0.42



Phosphate from River Elbe

TIME SERIES

number of data: 1338

mean: 0.14 mg/l

relative standard deviation: 0.66

minimum: 0.00 mg/l April 10, 2013

maximum: 0.65 mg/l June 15, 1977

LOW PASS

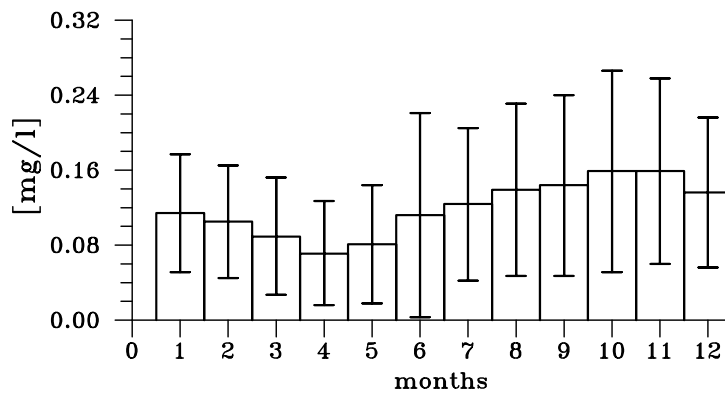
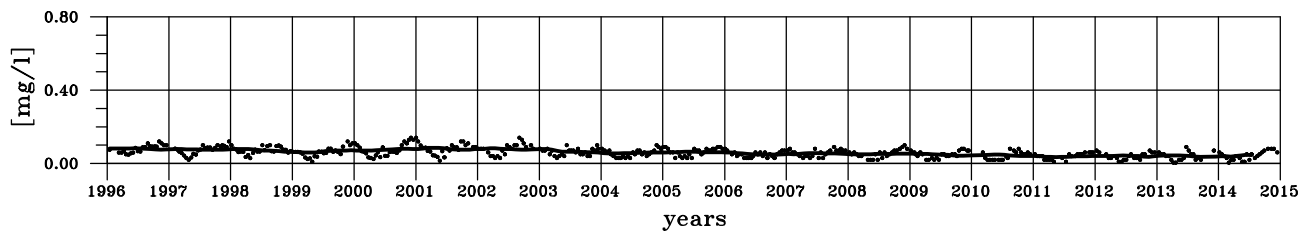
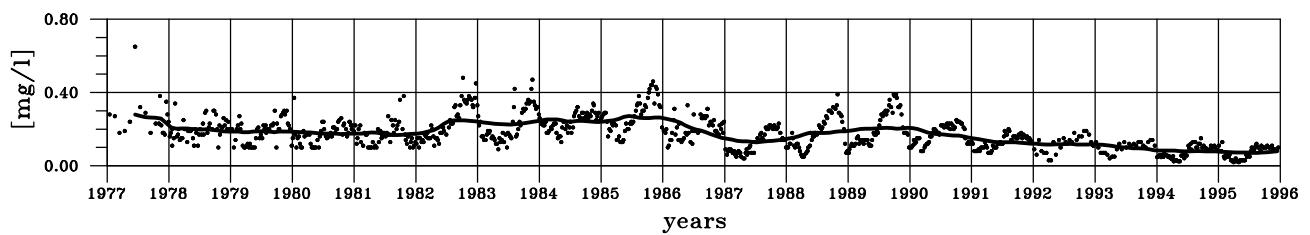
minimum: 0.04 mg/l May 2011

maximum: 0.28 mg/l June 1977

ANNUAL CYCLE

minimum: 0.07 mg/l April, rel. stdev: 0.78

maximum: 0.16 mg/l November, rel. stdev: 0.63



Silicate from River Elbe

TIME SERIES

number of data: 845

mean: 2.90 mg/l

relative standard deviation: 0.73

minimum: 0.02 mg/l July 13, 1988

maximum: 7.30 mg/l January 17, 2006

LOW PASS

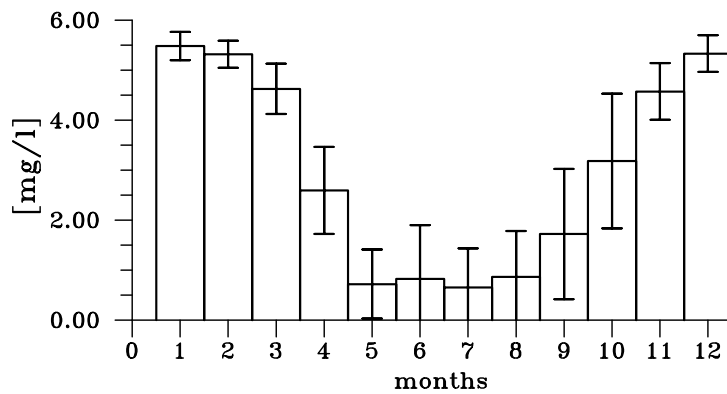
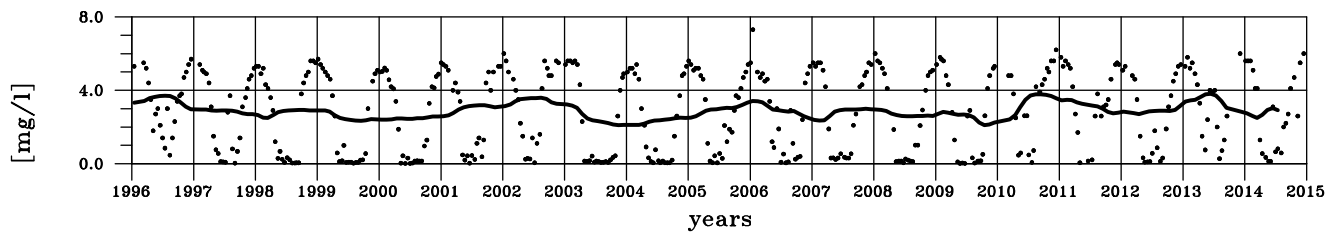
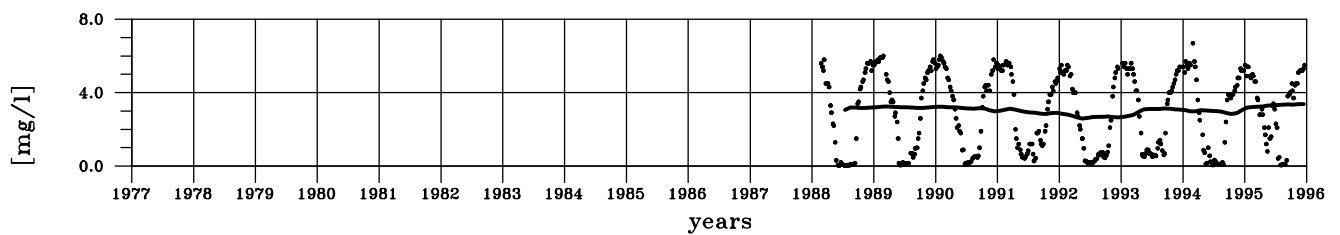
minimum: 2.10 mg/l October 2009

maximum: 3.82 mg/l June 2013

ANNUAL CYCLE

minimum: 0.65 mg/l July, rel. stdev: 1.20

maximum: 5.48 mg/l January, rel. stdev: 0.05



Chloride from River Elbe

TIME SERIES

number of data: 1334

mean: 157 *mg/l*

relative standard deviation: 0.35

minimum: 2 *mg/l* May 9, 2000

maximum: 336 *mg/l* September 28, 1989

LOW PASS

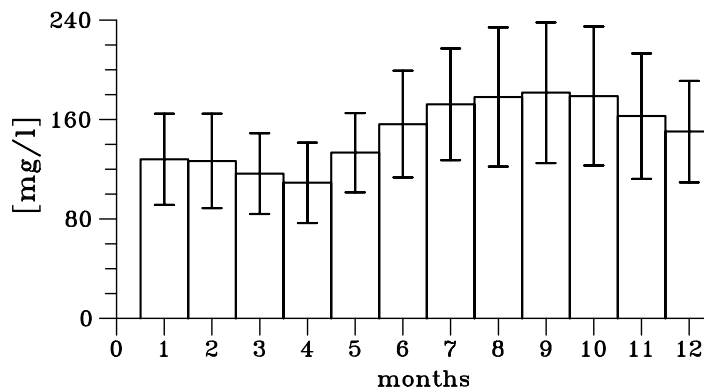
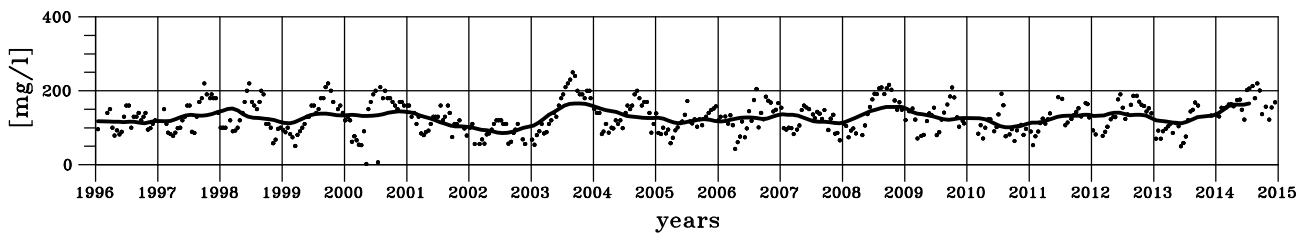
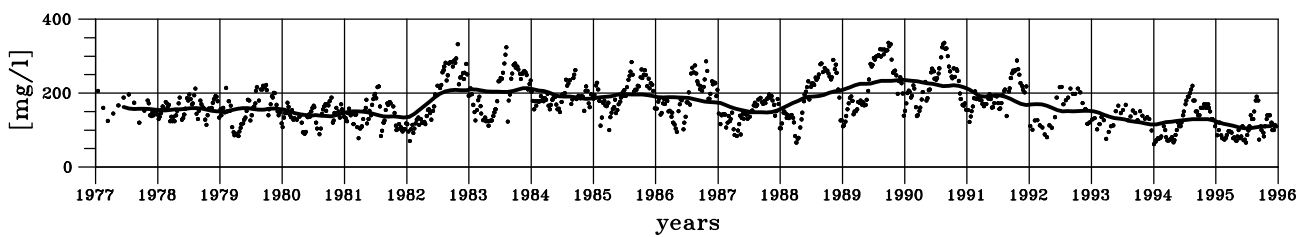
minimum: 85 *mg/l* July 2002

maximum: 236 *mg/l* December 1989

ANNUAL CYCLE

minimum: 109 *mg/l* April, rel. stdev: 0.30

maximum: 182 *mg/l* September, rel. stdev: 0.31



3.1.2 River Weser

The daily flow data at the last tide-free gauge station for the river Weser at Intschede were provided by the Bundesanstalt für Gewässerkunde in Koblenz. The data are published in the yearly series of the "Deutsche Gewässerkundliche Jahrbücher", further information is available in the internet under www.bafg.de. The concentration data for the station Intschede for 1977 - 2006 and the station Uesen for 2007 - 2014 at the Weser were provided by the NLWKN in Hildesheim. Information on the data is published in "Gewässerüberwachungssystem Niedersachsen (GÜN) - Gütemeßnetz Fließgewässer.- Niedersächsisches Umweltministerium und Niedersächsisches Landesamt für Ökologie, Meßstrategie und Meßnetzkonzeption, 1998". Additional information is available under www.nlwkn.de in the internet.

The concentration data cover the whole range from 1977 up to the end of 2014 for nitrate, ammonium and total phosphorus. Data on total nitrogen were available from 1980 and for orthophosphate from 1981 on. For this updated report nitrite and chloride were only taken into account from 1990 onward. For all these time series of nutrient concentrations there is only one value available for the year 1993. In contrast, silicate data were available at the measuring site Brake for the years 1993 and 1994 only. An amount of 19 % of discharge has to be added to the actual discharge data at the station Intschede (pers. comm. Berger, LfÖ) to get an improved estimate of the discharge entering the North Sea.

Discharge from River Weser

TIME SERIES

number of data: 13879

mean: $324 \text{ m}^3/\text{s}$

relative standard deviation: 0.76

minimum: $74 \text{ m}^3/\text{s}$ September 11, 1991

maximum: $2370 \text{ m}^3/\text{s}$ March 16, 1981

LOW PASS

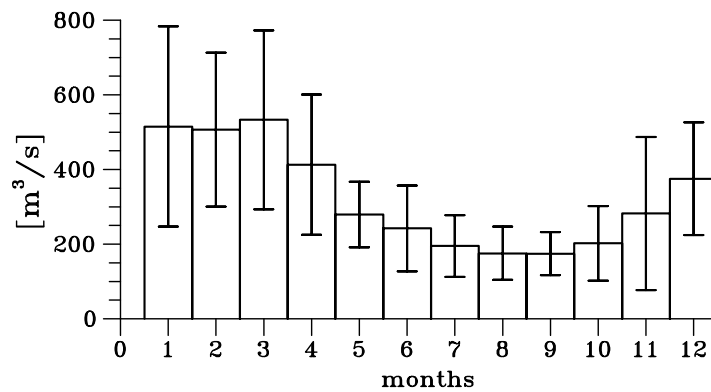
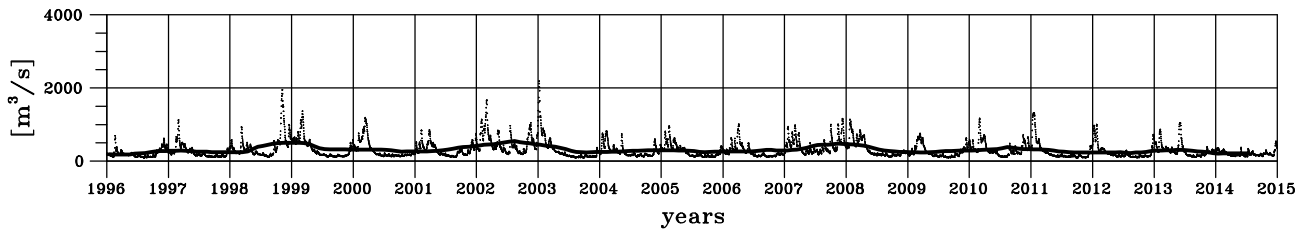
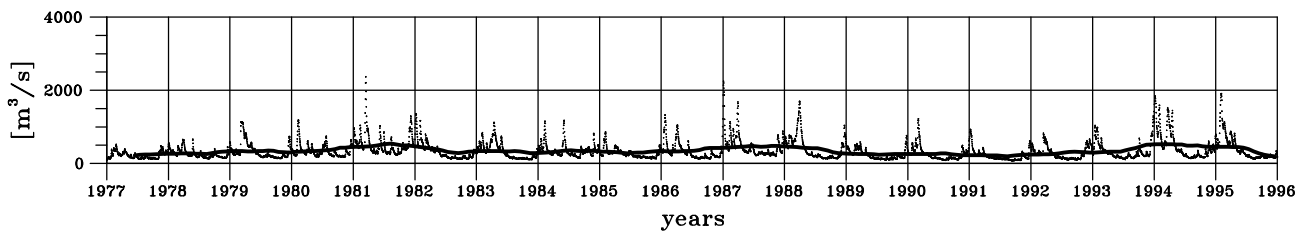
minimum: $179 \text{ m}^3/\text{s}$ April 1996

maximum: $552 \text{ m}^3/\text{s}$ August 2002

ANNUAL CYCLE

minimum: $174 \text{ m}^3/\text{s}$ September, rel. stdev: 0.33

maximum: $533 \text{ m}^3/\text{s}$ March, rel. stdev: 0.45



Total Nitrogen from River Weser

TIME SERIES

number of data: 452

mean: 5.21 mg/l

relative standard deviation: 0.31

minimum: 1.80 mg/l August 21, 1996

maximum: 12.60 mg/l November 10, 1980

LOW PASS

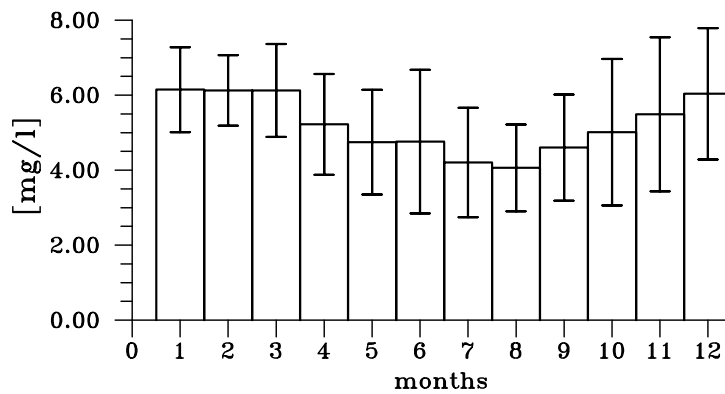
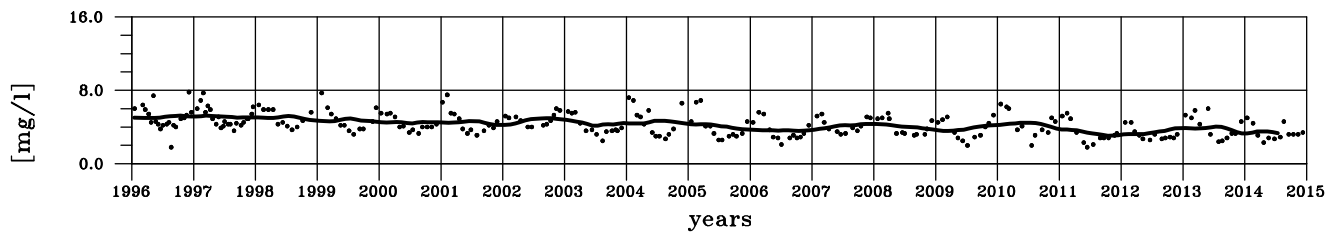
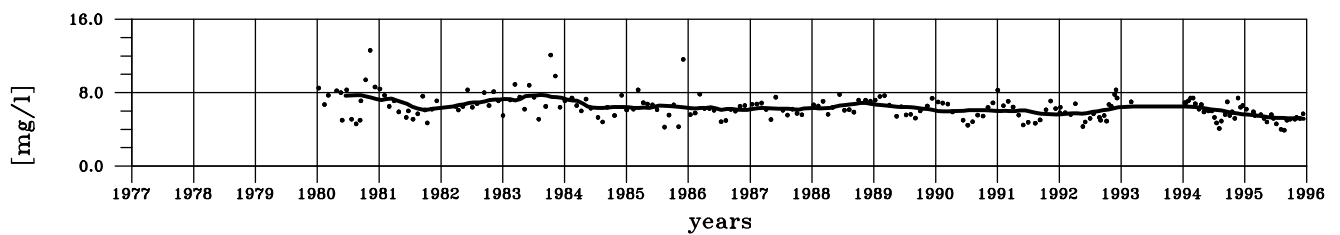
minimum: 3.06 mg/l October 2011

maximum: 7.77 mg/l August 1983

ANNUAL CYCLE

minimum: 4.06 mg/l August, rel. stdev: 0.29

maximum: 6.15 mg/l January, rel. stdev: 0.18



Nitrate from River Weser

TIME SERIES

number of data: 495

mean: 4.18 mg/l

relative standard deviation: 0.30

minimum: 0.35 mg/l October 23, 1997

maximum: 13.00 mg/l March 5, 1979

LOW PASS

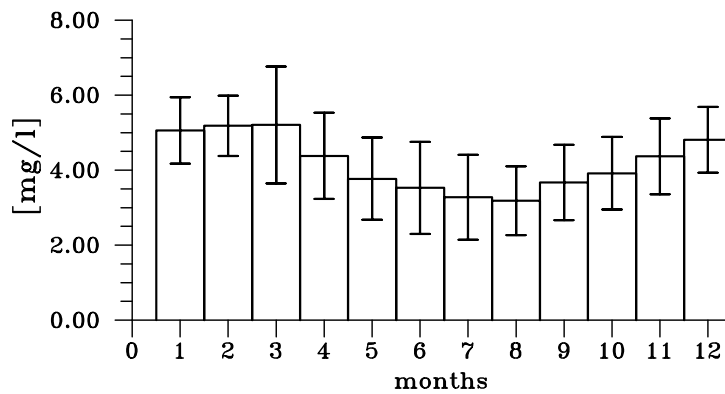
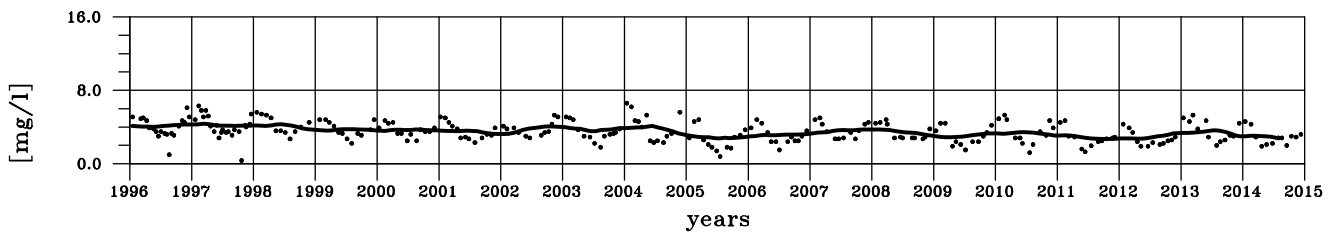
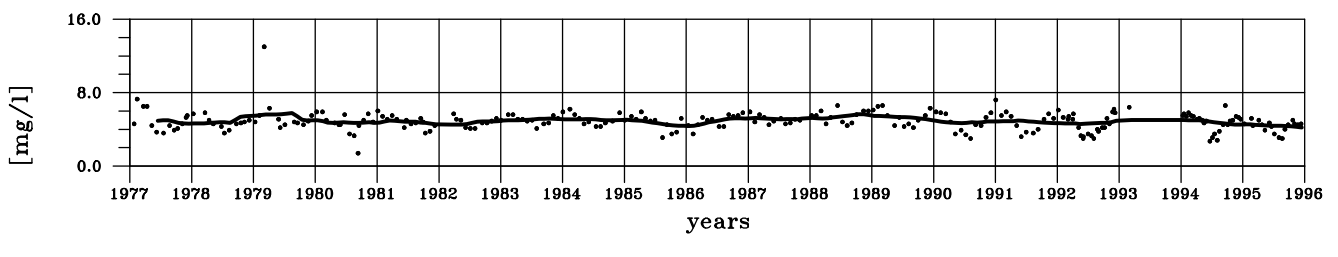
minimum: 2.69 mg/l November 2011

maximum: 5.76 mg/l August 1979

ANNUAL CYCLE

minimum: 3.19 mg/l August, rel. stdev: 0.29

maximum: 5.20 mg/l March, rel. stdev: 0.30



Nitrite from River Weser

TIME SERIES

number of data: 326

mean: 0.03 mg/l

relative standard deviation: 0.83

minimum: 0.00 mg/l March 19, 2014

maximum: 0.20 mg/l April 5, 1995

LOW PASS

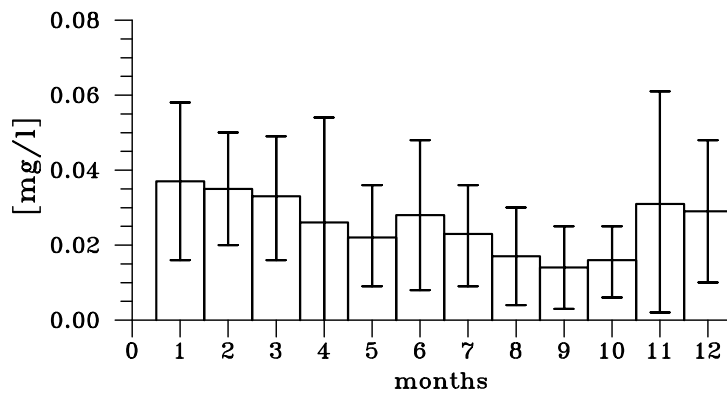
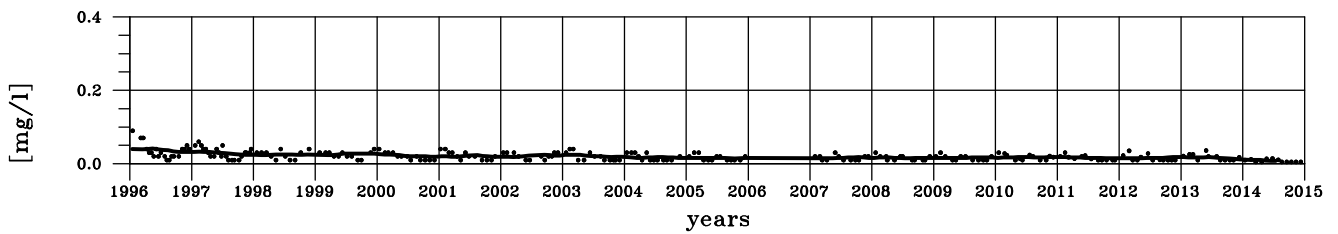
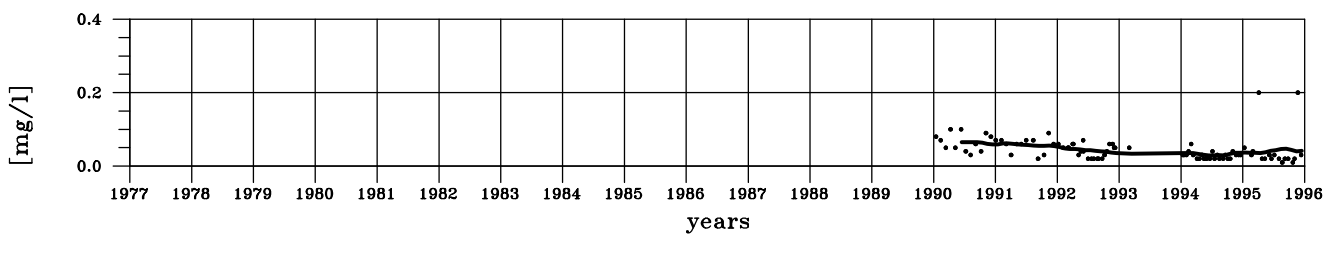
minimum: 0.01 mg/l July 2014

maximum: 0.07 mg/l September 1990

ANNUAL CYCLE

minimum: 0.01 mg/l September, rel. stdev: 0.77

maximum: 0.04 mg/l January, rel. stdev: 0.56



Ammonium from River Weser

TIME SERIES

number of data: 477

mean: 0.20 mg/l

relative standard deviation: 1.38

minimum: 0.02 mg/l July 1, 1992

maximum: 2.30 mg/l January 26, 1977

LOW PASS

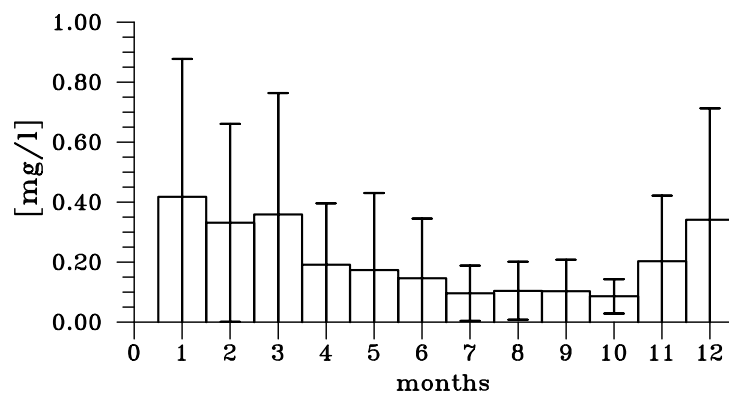
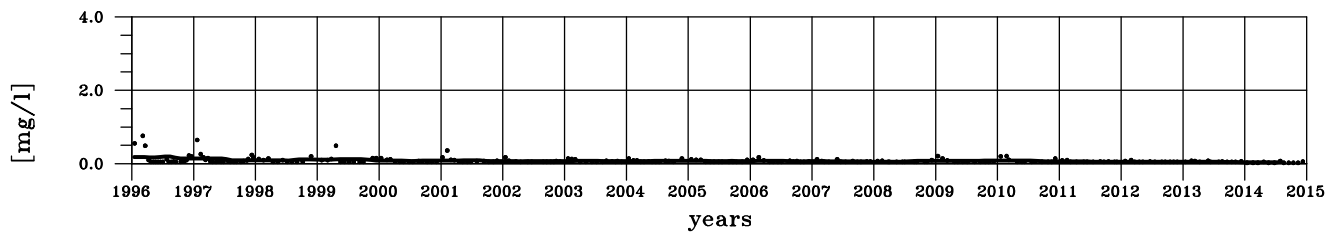
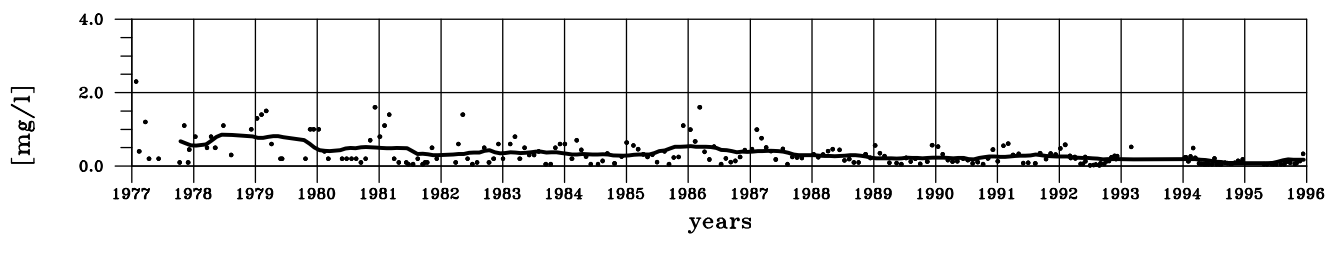
minimum: 0.03 mg/l June 2014

maximum: 0.85 mg/l June 1978

ANNUAL CYCLE

minimum: 0.09 mg/l October, rel. stdev: 0.67

maximum: 0.42 mg/l January, rel. stdev: 1.10



Total Phosphorus from River Weser

TIME SERIES

number of data: 493

mean: 0.30 mg/l

relative standard deviation: 0.68

minimum: 0.05 mg/l May 8, 1996

maximum: 1.80 mg/l March 5, 1979

LOW PASS

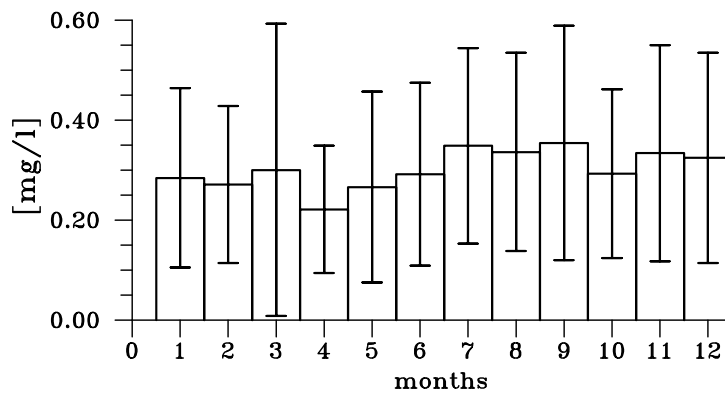
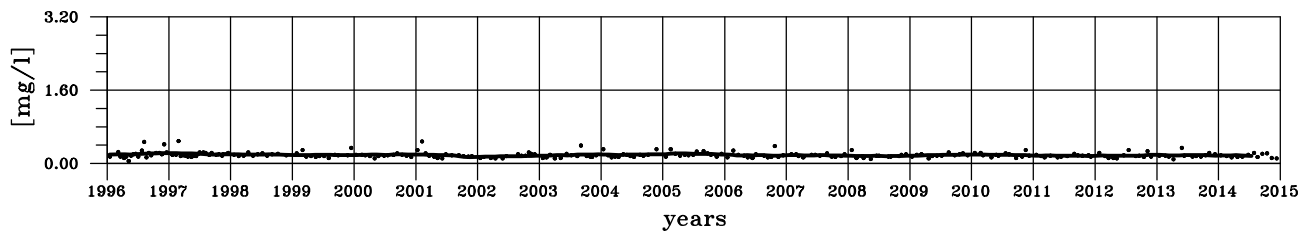
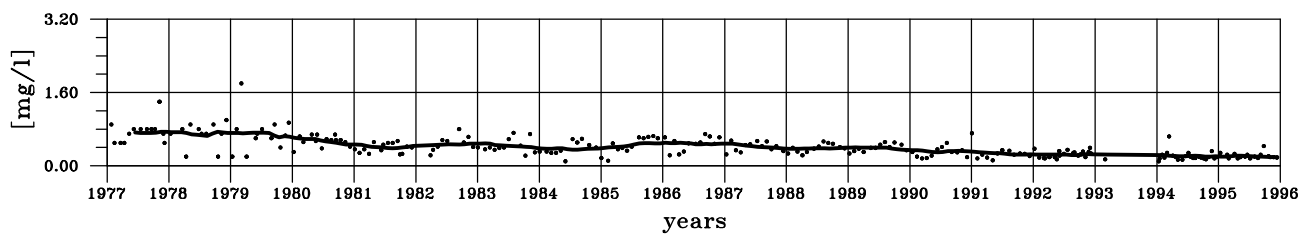
minimum: 0.14 mg/l November 2001

maximum: 0.74 mg/l October 1978

ANNUAL CYCLE

minimum: 0.22 mg/l April, rel. stdev: 0.58

maximum: 0.35 mg/l September, rel. stdev: 0.66



Phosphate from River Weser

TIME SERIES

number of data: 421

mean: 0.12 mg/l

relative standard deviation: 0.98

minimum: 0.01 mg/l March 19, 2014

maximum: 0.63 mg/l November 5, 1985

LOW PASS

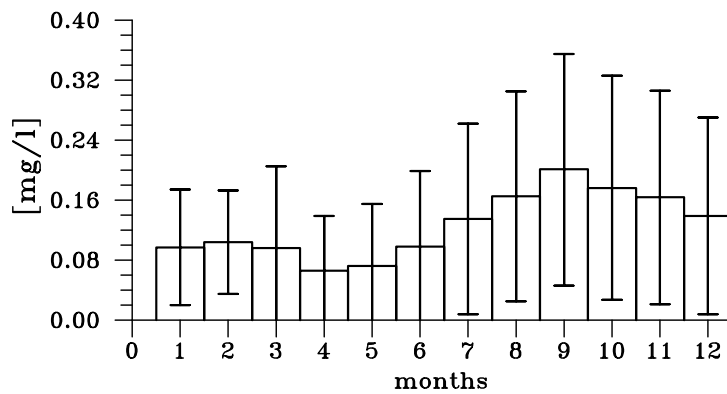
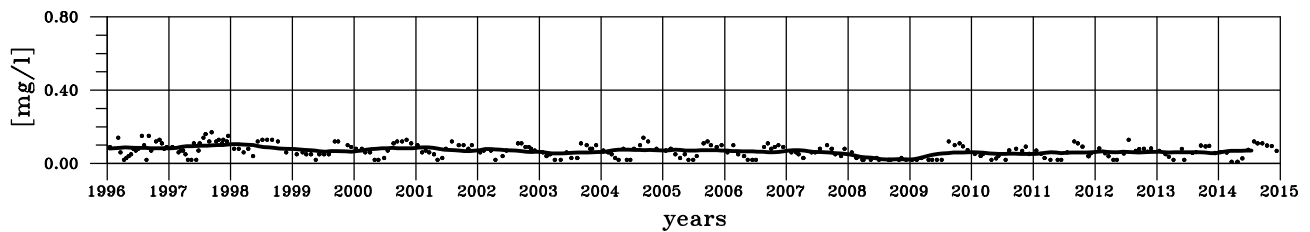
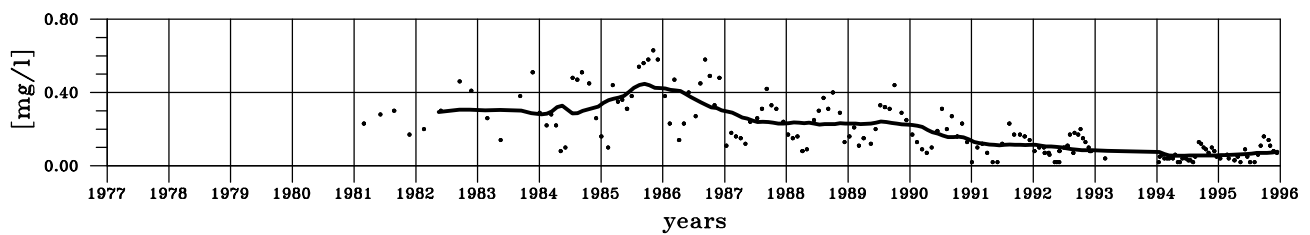
minimum: 0.02 mg/l January 2009

maximum: 0.45 mg/l September 1985

ANNUAL CYCLE

minimum: 0.07 mg/l April, rel. stdev: 1.11

maximum: 0.20 mg/l September, rel. stdev: 0.77



Silicate from River Weser

TIME SERIES

number of data: 47

mean: 7.41 mg/l

relative standard deviation: 0.50

minimum: 0.10 mg/l July 14, 1994

maximum: 14.00 mg/l December 7, 1993

LOW PASS

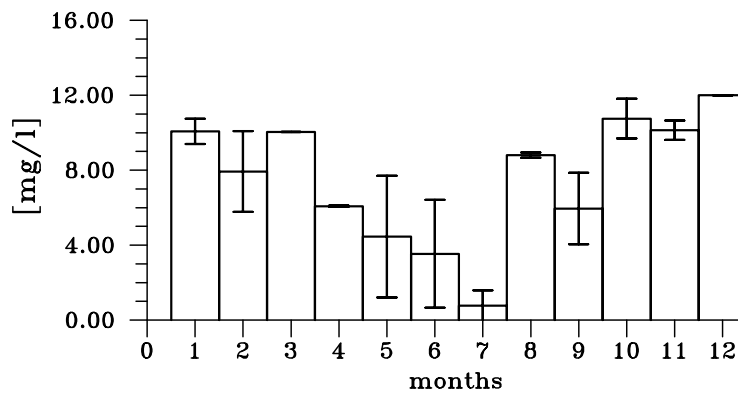
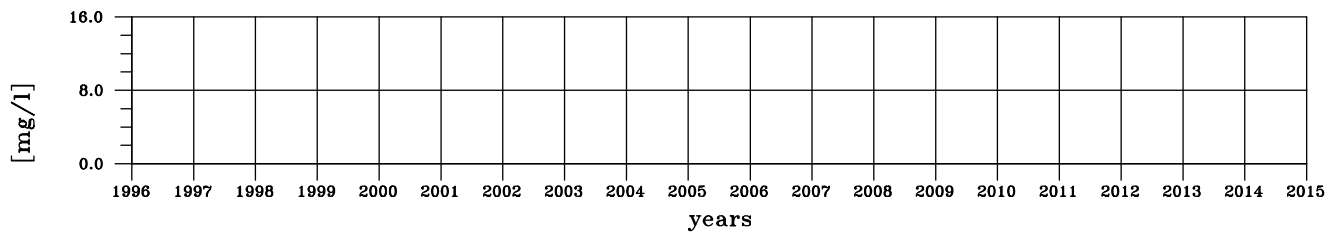
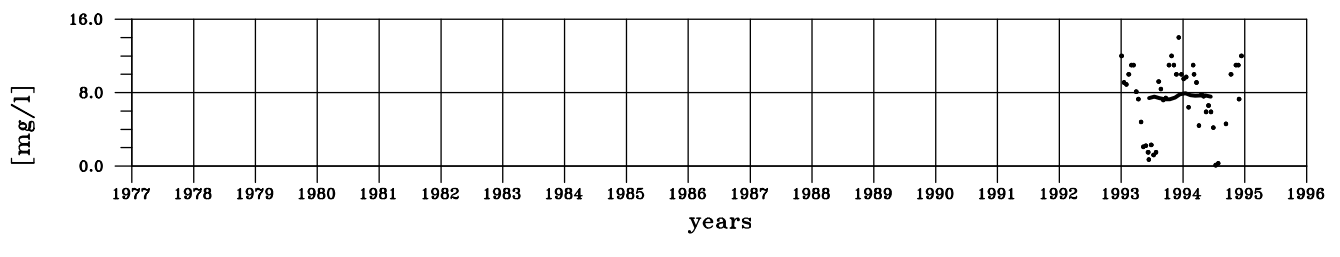
minimum: 7.27 mg/l September 1993

maximum: 7.94 mg/l January 1994

ANNUAL CYCLE

minimum: 0.78 mg/l July, rel. stdev: 1.05

maximum: 12.00 mg/l December, rel. stdev: 0.00



Chloride from River Weser

TIME SERIES

number of data: 338

mean: 303 *mg/l*

relative standard deviation: 0.62

minimum: 63 *mg/l* January 12, 1994

maximum: 1840 *mg/l* July 10, 1990

LOW PASS

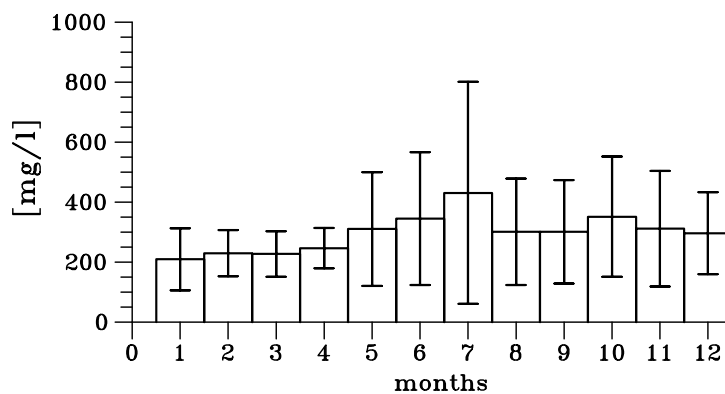
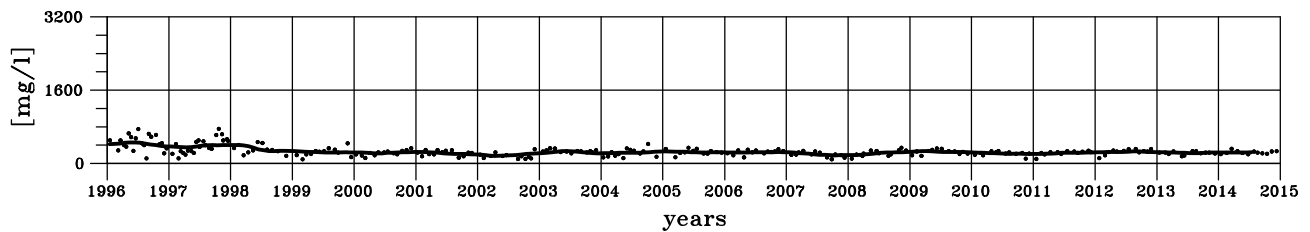
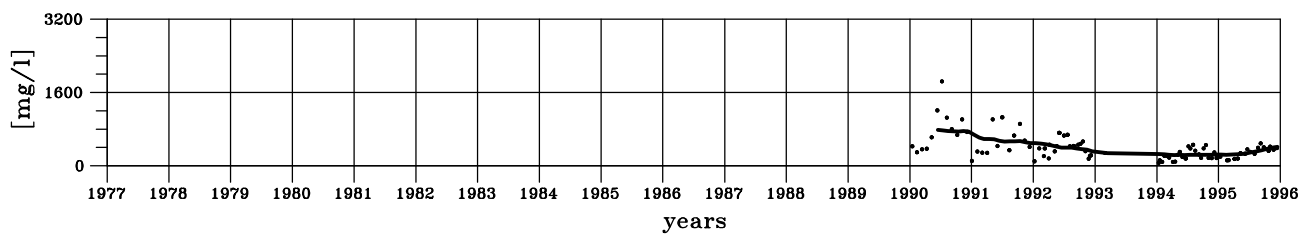
minimum: 162 *mg/l* April 2002

maximum: 785 *mg/l* June 1990

ANNUAL CYCLE

minimum: 210 *mg/l* January, rel. stdev: 0.49

maximum: 431 *mg/l* July, rel. stdev: 0.86



3.1.3 River Ems

The daily flow data at the last tide-free gauge station for the river Ems at Herbrum were provided by the Bundesanstalt für Gewässerkunde in Koblenz. The data are published in the yearly series of the "Deutsche Gewässerkundliche Jahrbücher", further information is available in the internet under www.bafg.de. The concentration data for the station Herbrum at the Ems were provided by the NLWKN in Hildesheim. Information on the data is published in "Gewässerüberwachungssystem Niedersachsen (GÜN) - Gütemeßnetz Fließgewässer.- Niedersächsisches Umweltministerium und Niedersächsisches Landesamt für Ökologie, Meßstrategie und Meßnetzkonzeption, 1998". Additional information is available under www.nlwkn.de in the internet.

The concentration data cover the whole range from 1977 up to the end of 2014 for nitrate, ammonium and total phosphorus. Data on total nitrogen were available from 1980 and for orthophosphate from 1981 on. For this updated report data on nitrite and chloride were only taken into account from 1990 onward. Silicate data were available for the years 1989 and 1994 at the measuring site Terborg. These data stem from a different measuring program. An amount of 30 % of discharge has to be added to the actual discharge data at the station Herbrum (pers. comm. Berger, LfÖ) to get an improved estimate of the discharge which also regards the contributions downstream of the gauge station.

Discharge from River Ems

TIME SERIES

number of data: 13879

mean: $82 \text{ m}^3/\text{s}$

relative standard deviation: 0.84

minimum: $11 \text{ m}^3/\text{s}$ July 30, 1999

maximum: $643 \text{ m}^3/\text{s}$ November 3, 1998

LOW PASS

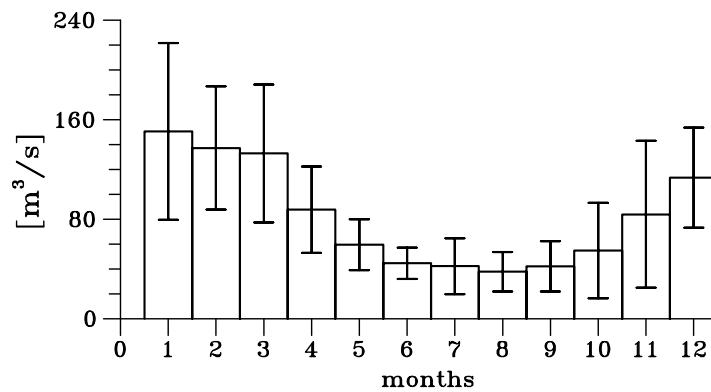
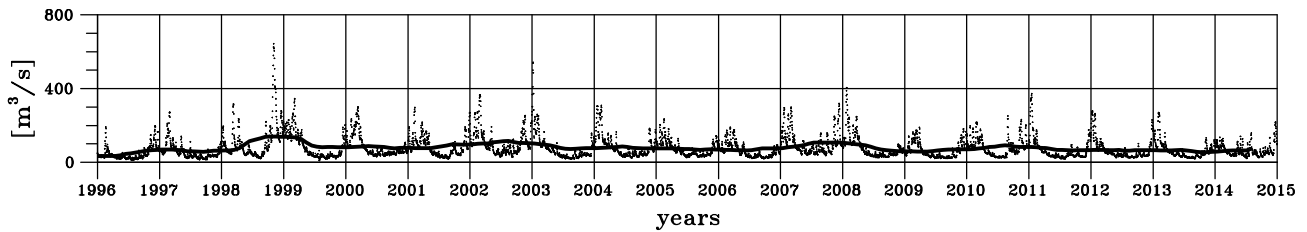
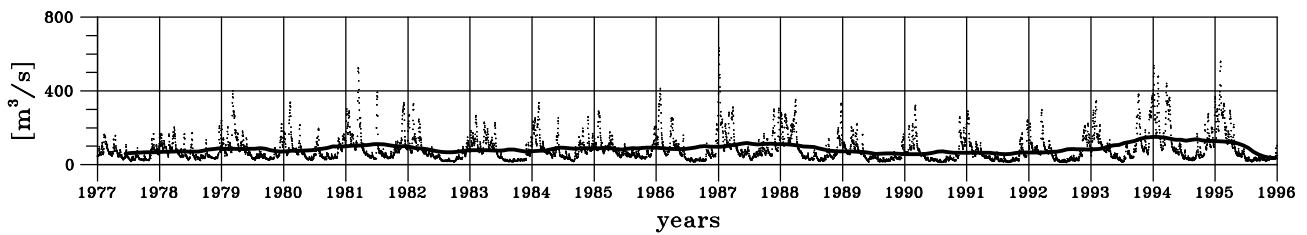
minimum: $34 \text{ m}^3/\text{s}$ March 1996

maximum: $150 \text{ m}^3/\text{s}$ January 1994

ANNUAL CYCLE

minimum: $38 \text{ m}^3/\text{s}$ August, rel. stdev: 0.42

maximum: $151 \text{ m}^3/\text{s}$ January, rel. stdev: 0.47



Total Nitrogen from River Ems

TIME SERIES

number of data: 686

mean: 5.89 mg/l

relative standard deviation: 0.37

minimum: 0.06 mg/l December 9, 2010

maximum: 13.00 mg/l January 22, 2004

LOW PASS

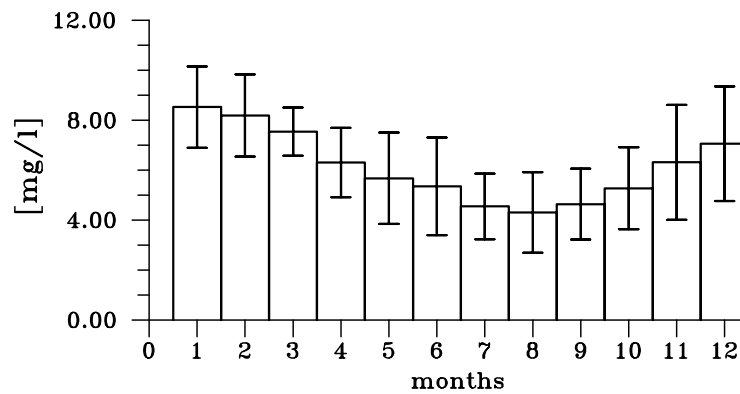
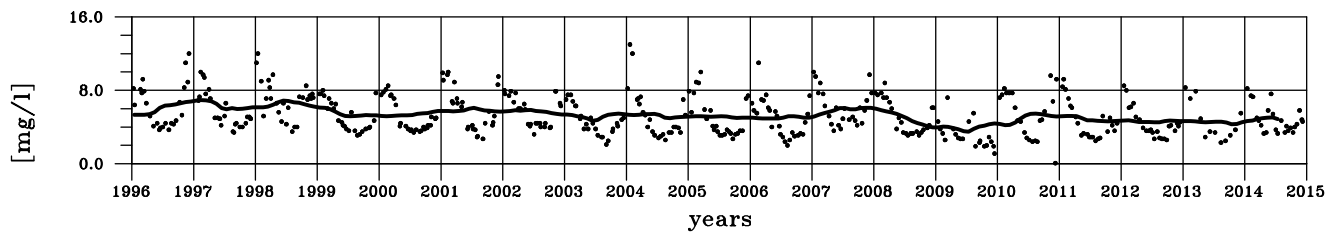
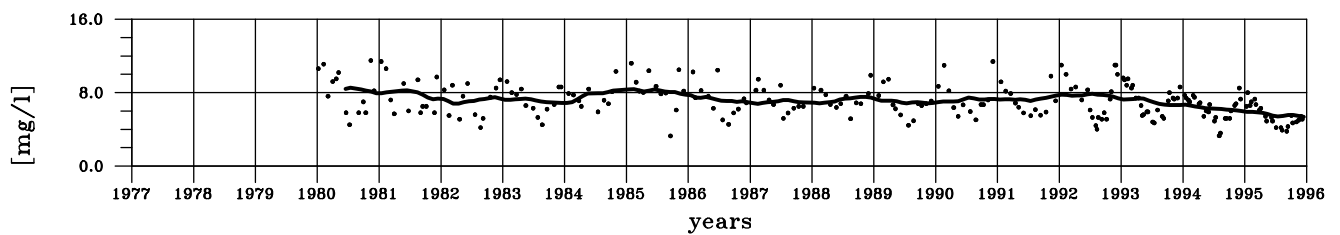
minimum: 3.47 mg/l July 2009

maximum: 8.54 mg/l July 1980

ANNUAL CYCLE

minimum: 4.30 mg/l August, rel. stdev: 0.37

maximum: 8.53 mg/l January, rel. stdev: 0.19



Nitrate from River Ems

TIME SERIES

number of data: 722

mean: 4.62 mg/l

relative standard deviation: 0.39

minimum: 0.04 mg/l September 9, 2010

maximum: 11.00 mg/l March 6, 1979

LOW PASS

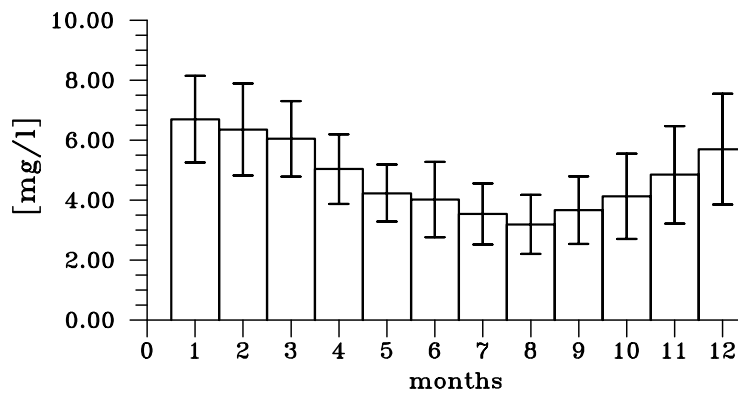
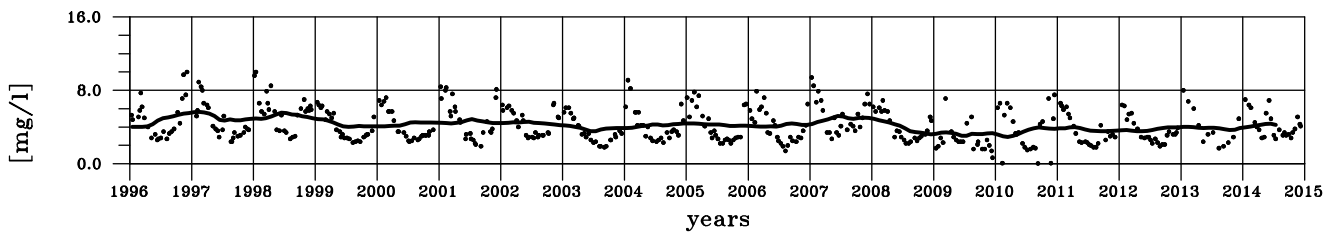
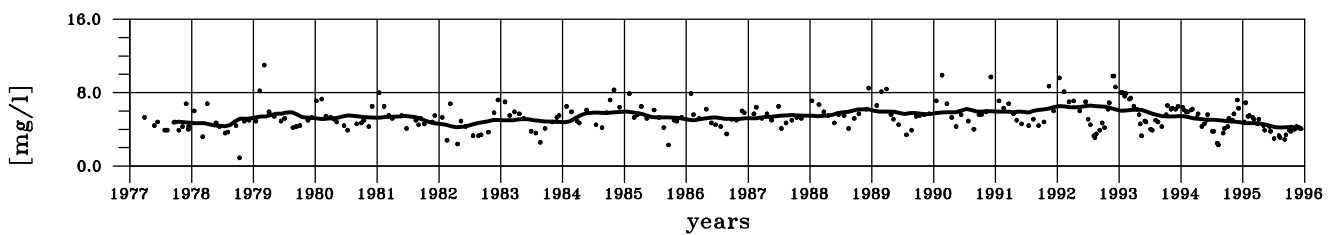
minimum: 2.92 mg/l March 2010

maximum: 6.60 mg/l July 1992

ANNUAL CYCLE

minimum: 3.19 mg/l August, rel. stdev: 0.31

maximum: 6.70 mg/l January, rel. stdev: 0.22



Nitrite from River Ems

TIME SERIES

number of data: 544

mean: 0.05 mg/l

relative standard deviation: 0.57

minimum: 0.01 mg/l August 9, 1995

maximum: 0.31 mg/l August 13, 2009

LOW PASS

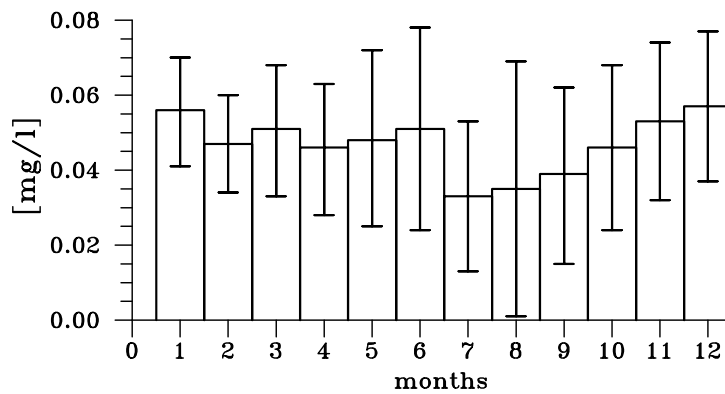
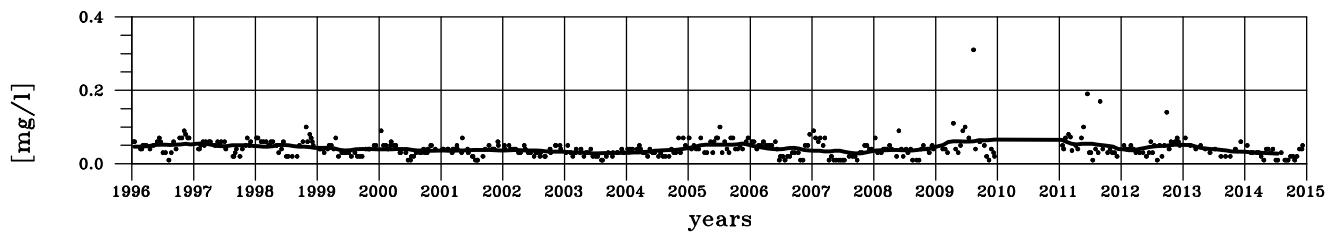
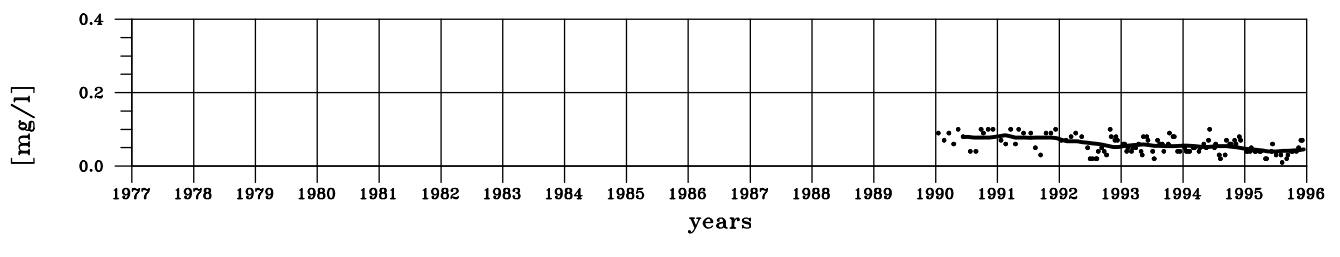
minimum: 0.03 mg/l July 2014

maximum: 0.08 mg/l February 1991

ANNUAL CYCLE

minimum: 0.03 mg/l July, rel. stdev: 0.60

maximum: 0.06 mg/l December, rel. stdev: 0.35



Ammonium from River Ems

TIME SERIES

number of data: 717

mean: 0.32 mg/l

relative standard deviation: 1.08

minimum: 0.05 mg/l September 30, 1980

maximum: 2.30 mg/l January 16, 1979

LOW PASS

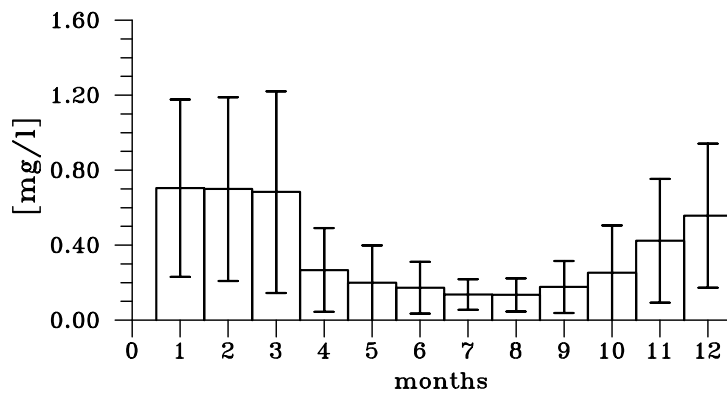
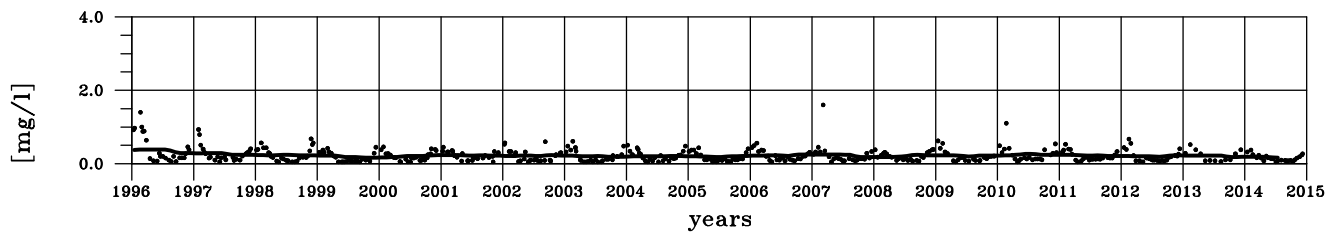
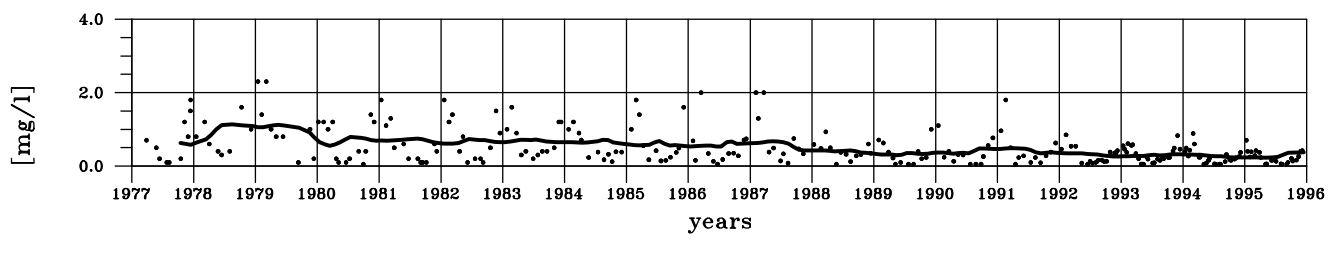
minimum: 0.16 mg/l July 2014

maximum: 1.14 mg/l August 1978

ANNUAL CYCLE

minimum: 0.13 mg/l August, rel. stdev: 0.66

maximum: 0.70 mg/l January, rel. stdev: 0.67



Total Phosphorus from River Ems

TIME SERIES

number of data: 725

mean: 0.20 mg/l

relative standard deviation: 0.83

minimum: 0.04 mg/l May 15, 2008

maximum: 1.30 mg/l January 15, 2009

LOW PASS

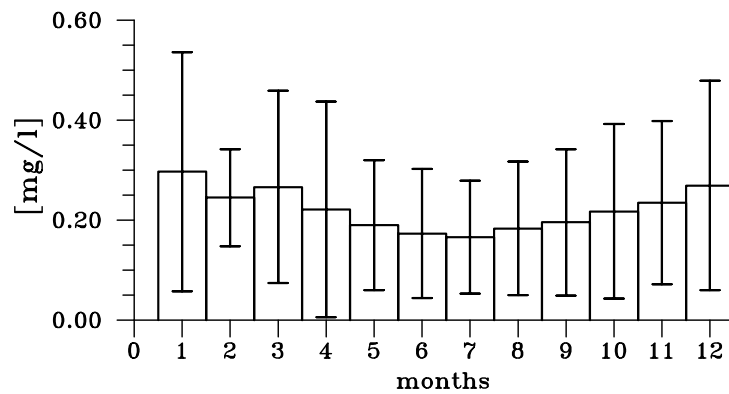
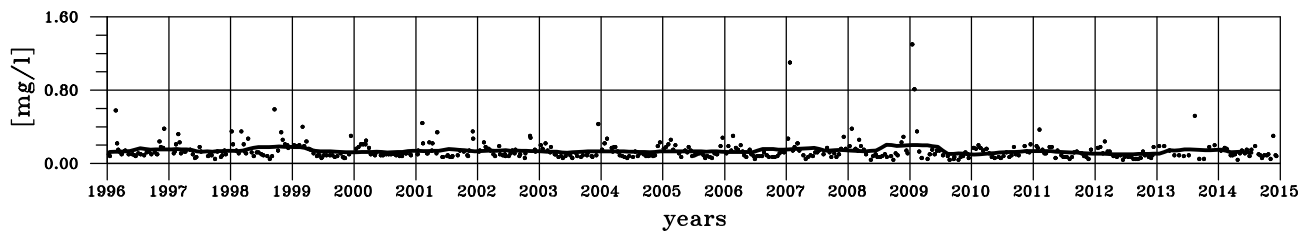
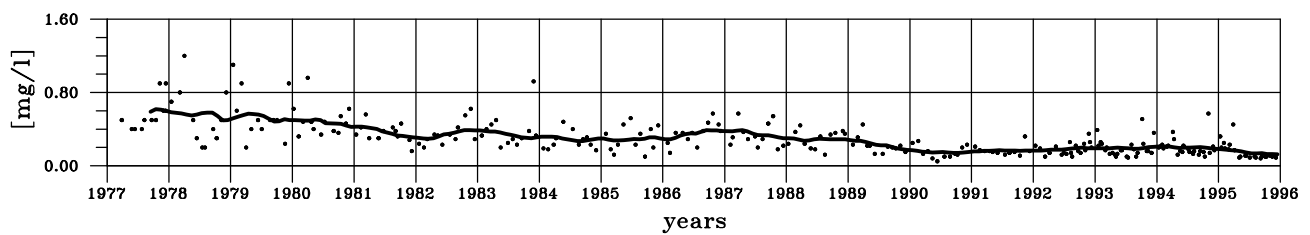
minimum: 0.10 mg/l January 2010

maximum: 0.62 mg/l October 1977

ANNUAL CYCLE

minimum: 0.17 mg/l July, rel. stdev: 0.68

maximum: 0.30 mg/l January, rel. stdev: 0.81



Phosphate from River Ems

TIME SERIES

number of data: 652

mean: 0.05 mg/l

relative standard deviation: 0.97

minimum: 0.02 mg/l February 4, 1987

maximum: 0.36 mg/l November 2, 1981

LOW PASS

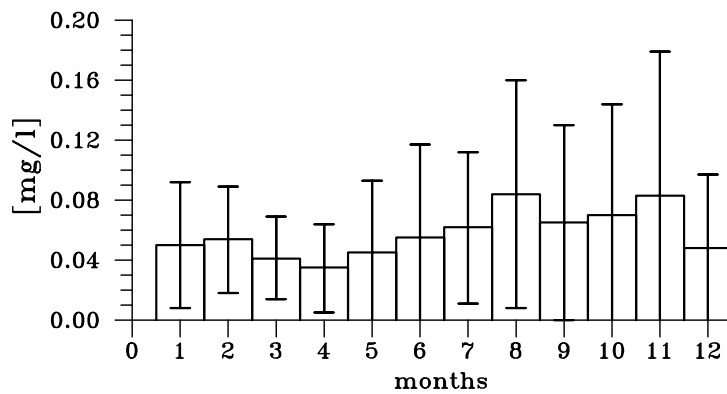
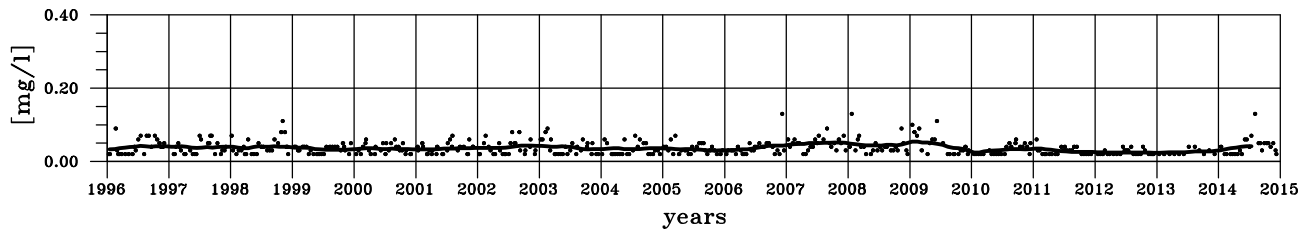
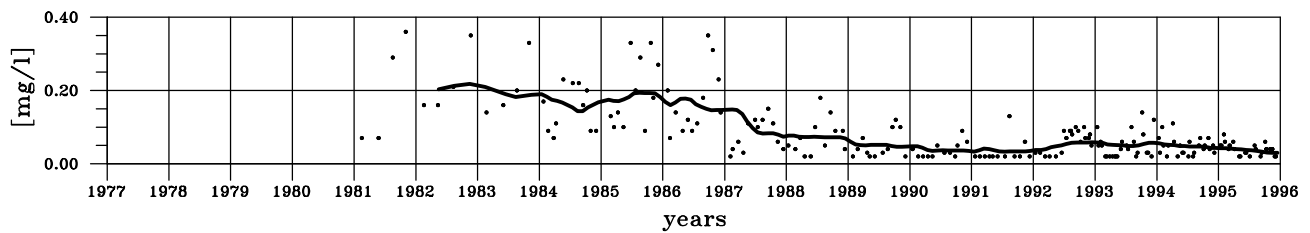
minimum: 0.02 mg/l January 2013

maximum: 0.22 mg/l November 1982

ANNUAL CYCLE

minimum: 0.03 mg/l April, rel. stdev: 0.86

maximum: 0.08 mg/l August, rel. stdev: 0.90



Silicate from River Ems

TIME SERIES

number of data: 31

mean: 9.55 mg/l

relative standard deviation: 0.26

minimum: 3.10 mg/l July 11, 1989

maximum: 12.00 mg/l March 26, 1990

LOW PASS

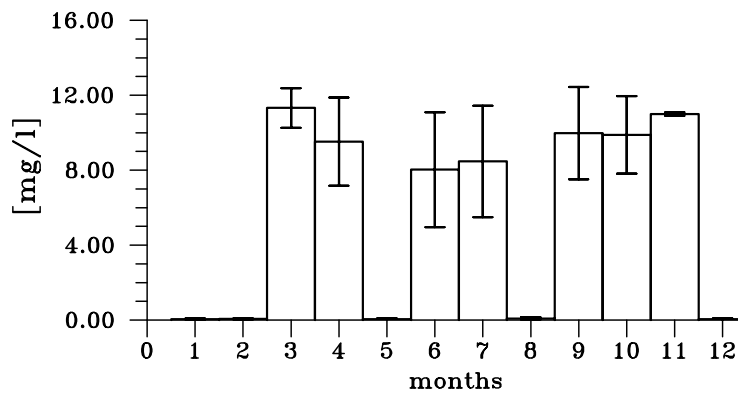
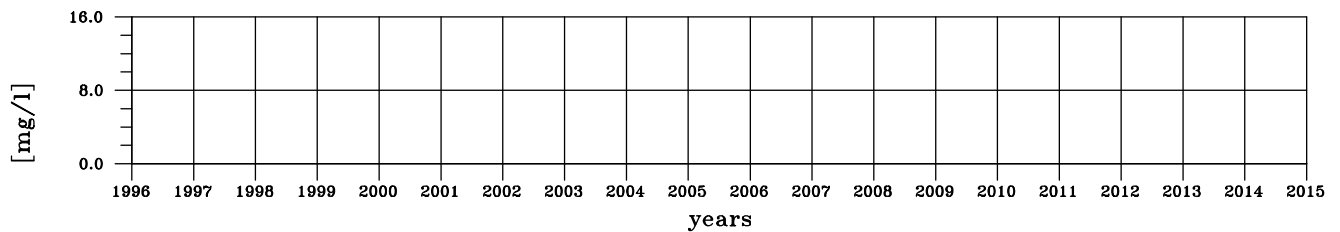
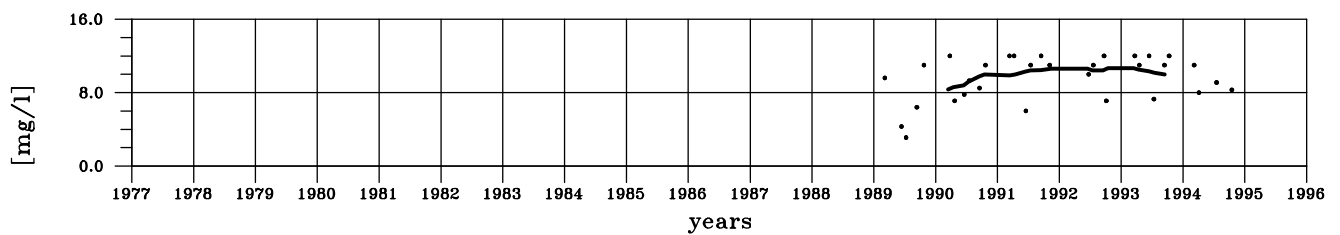
minimum: 8.36 mg/l March 1990

maximum: 10.66 mg/l March 1993

ANNUAL CYCLE

minimum: 0.05 mg/l May, rel. stdev: 1.05

maximum: 11.32 mg/l March, rel. stdev: 0.09



Chloride from River Ems

TIME SERIES

number of data: 569

mean: 168 *mg/l*

relative standard deviation: 0.42

minimum: 38 *mg/l* February 1, 1995

maximum: 413 *mg/l* August 19, 1992

LOW PASS

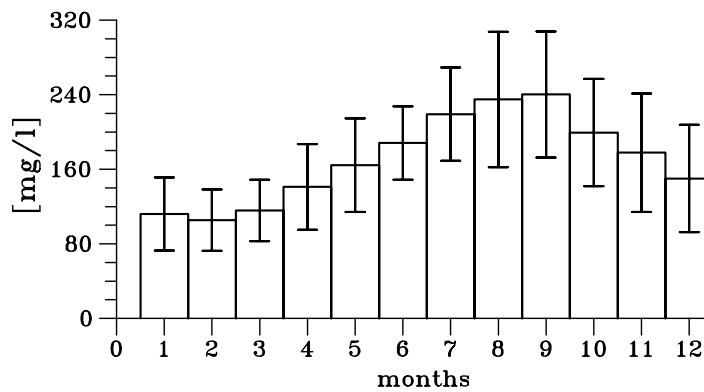
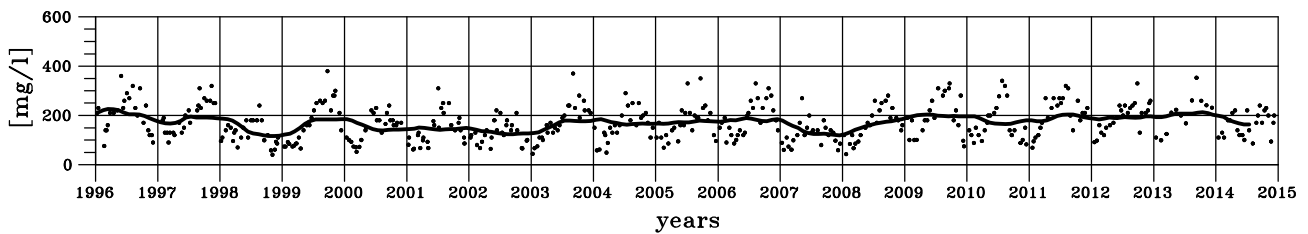
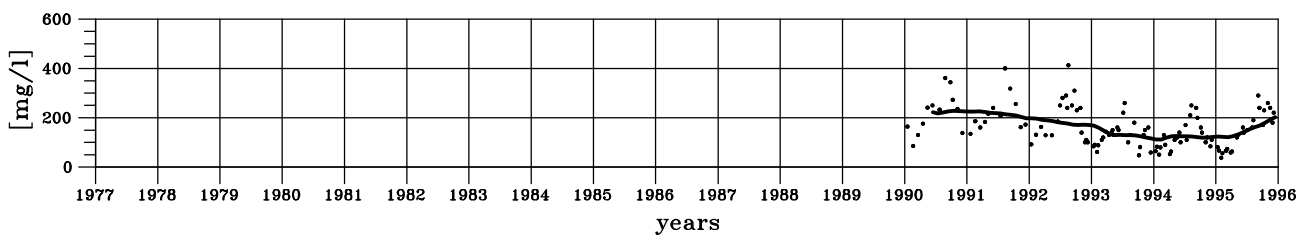
minimum: 112 *mg/l* January 1994

maximum: 228 *mg/l* October 1990

ANNUAL CYCLE

minimum: 105 *mg/l* February, rel. stdev: 0.31

maximum: 240 *mg/l* September, rel. stdev: 0.28



3.2 River inputs from the Dutch and Belgian coast

All data of the Netherlands riverine inlets into the North Sea including the Scheldt were supplied by Rijkswaterstaat, Netherlands. From 2003 - 2014 the data were extracted from www.waterbase.nl and from 2007 on the combined concentration of nitrate and nitrite are calculated using the corresponding two different timeseries. Information on the older data is provided by the series "Jaarboek Monitoring Rijkswateren", especially edition 1998, "part 2 Kengestallen" contains statistics of discharge, concentrations and loads over the years 1989 to 1998 (pers. comm. Doekes, former RIKZ). General information on the "Jaarboek Monitoring Rijkswateren" is available on the internet under www.waterland.net.

Since the Netherlands have established a dense net of channels for regulating the waterflow and especially the waterlevel throughout the country it is usually not possible to trace back the input of a certain river, e.g. the Rhine. So in view on calculating the overall input into the North Sea we loose the information on the contribution of a single river. However, within the short description on each inlet some comments on the sources of the river will be made. Furthermore it should be mentioned that the data of the Netherlands inlets contain concentration and discharge data right at the inlet. Therefore the additional multiplication factors to get the contribution for the area downstream the gauge station are not necessary.

A certain way of handling the Netherlands' sluice system allows to stop the flow of several inlets. This results in zero discharge values for short intervals. For these intervals the corresponding load of all substances is also zero, independent of the concentration measured during such a period. However, at the inlet Nieuwe Waterweg, the largest branch of the river Rhine, even single events of negative discharge values occur, indicating an inflow of North Sea water into the channel system. Together with the date of occurrence these values are listed in Tab. 2. For our load calculation these discharge values are set to zero.

Tab. 2:*Overview on negative discharge events at the inlet Nieuwe Waterweg*

Date	[m ³ /s]	Date	[m ³ /s]	Date	[m ³ /s]
1999.11.06	-1371	2005.11.15	-296	2010.11.12	-469
1999.11.27	-98	2005.11.24	-515	2011.05.24	-449
1999.12.01	-194	2005.12.16	-159	2011.07.14	-50
2000.01.29	-391	2006.01.17	-28	2011.10.04	-78
2000.03.03	-7	2006.02.08	-387	2011.10.06	-170
2003.04.01	-170	2006.10.31	-834	2011.11.25	-605
2003.04.02	-490	2006.11.11	-1259	2011.11.27	-760
2003.10.07	-480	2007.01.04	-49	2011.12.03	-453
2003.11.03	-2	2007.01.18	-955	2011.12.09	-595
2003.11.15	-116	2007.03.18	-152	2012.09.14	-14
2003.11.30	-202	2007.11.25	-595	2012.09.24	-213
2003.12.13	-439	2008.03.01	-1004	2012.12.09	-40
2003.12.14	-144	2008.10.05	-35	2013.09.10	-802
2003.12.21	-1128	2009.01.18	-174	2013.12.05	-1047
2004.01.09	-126	2009.01.23	-637	2014.12.10	-504
2004.02.08	-99	2009.09.09	-240		
2004.09.21	-408	2009.10.16	-198		
2004.12.17	-795	2009.11.23	-219		
2005.01.02	-473	2010.01.17	-28		

3.2.1 Lake IJssel

In comparison to the first report (Lenhart *et al.*, 1996), the data basis for the calculation of nutrient loads for the Lake IJssel has changed completely. While sampling at Kornwederzand and Den Oever, the two locations at the outlets of the Lake IJssel, was terminated in 1995, concentration data could be supplemented from the location Vrouwenzand. However, at this location no discharge data were available. Therefore, the outflows data from the locations Kornwederzand and Den Oever were used and combined with the concentration data at Vrouwenzand.

Discharge from Kornwerderzand

TIME SERIES

number of data: 13876

mean: $213 \text{ m}^3/\text{s}$

relative standard deviation: 0.98

minimum: $0 \text{ m}^3/\text{s}$ January 1, 1977

maximum: $1468 \text{ m}^3/\text{s}$ January 31, 1995

LOW PASS

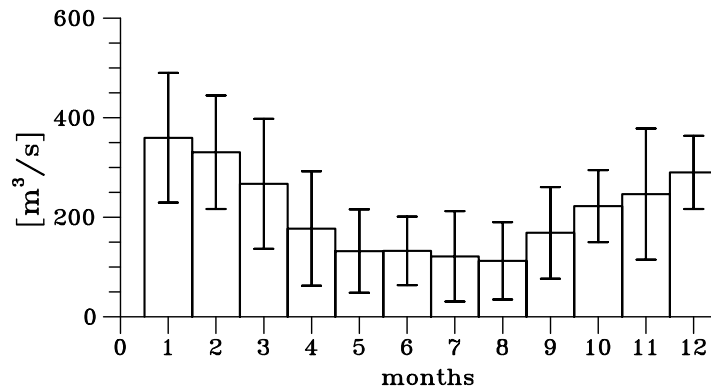
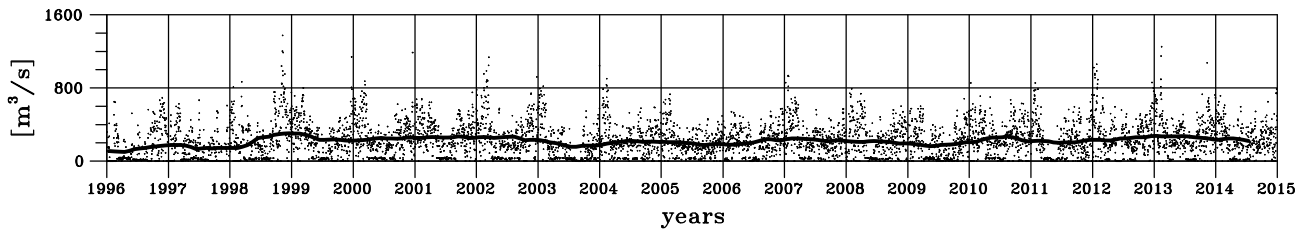
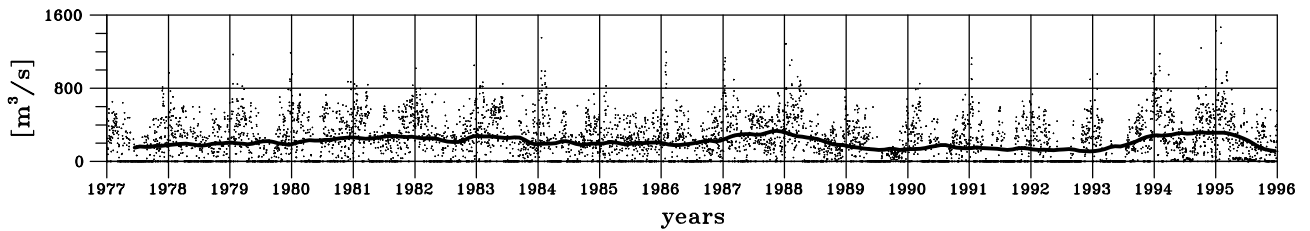
minimum: $100 \text{ m}^3/\text{s}$ April 1996

maximum: $336 \text{ m}^3/\text{s}$ November 1987

ANNUAL CYCLE

minimum: $112 \text{ m}^3/\text{s}$ August, rel. stdev: 0.69

maximum: $360 \text{ m}^3/\text{s}$ January, rel. stdev: 0.36



Discharge from Den Oever

TIME SERIES

number of data: 13879

mean: $297 \text{ m}^3/\text{s}$

relative standard deviation: 0.89

minimum: $0 \text{ m}^3/\text{s}$ January 1, 1977

maximum: $2602 \text{ m}^3/\text{s}$ November 26, 1977

LOW PASS

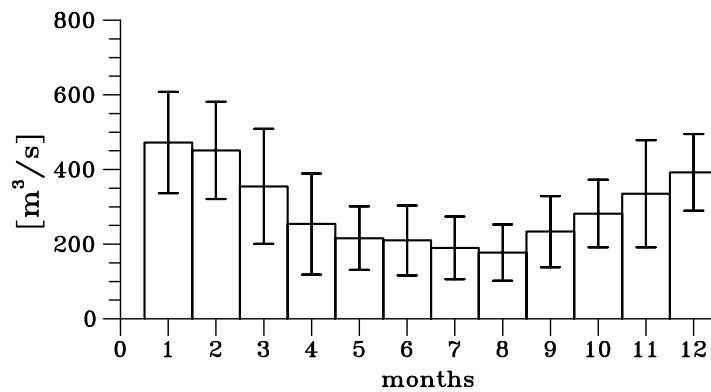
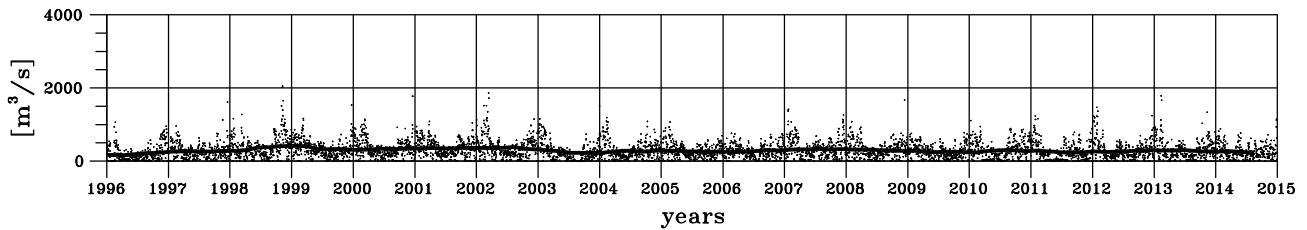
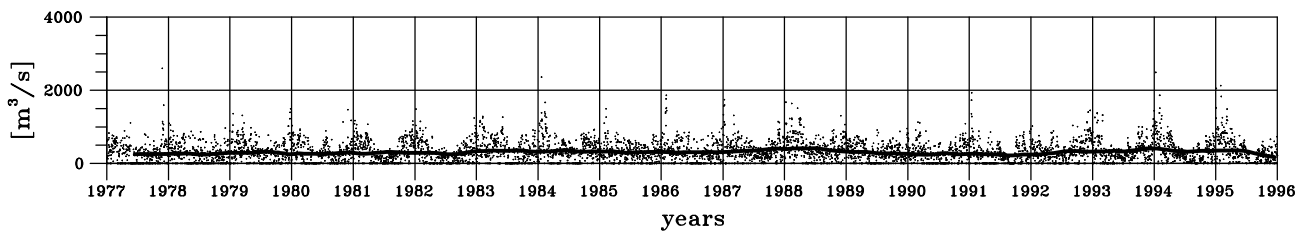
minimum: $165 \text{ m}^3/\text{s}$ January 1996

maximum: $414 \text{ m}^3/\text{s}$ February 1999

ANNUAL CYCLE

minimum: $177 \text{ m}^3/\text{s}$ August, rel. stdev: 0.42

maximum: $472 \text{ m}^3/\text{s}$ January, rel. stdev: 0.29



Total Nitrogen from Vrouwenzand

TIME SERIES

number of data: 556

mean: 3.49 mg/l

relative standard deviation: 0.45

minimum: 0.27 mg/l September 9, 2014

maximum: 8.14 mg/l January 28, 1986

LOW PASS

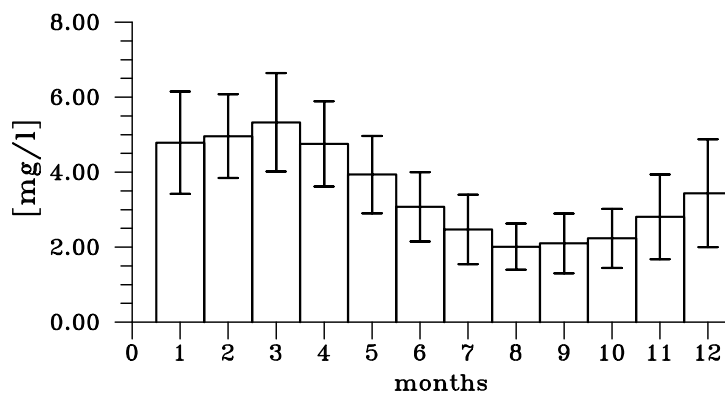
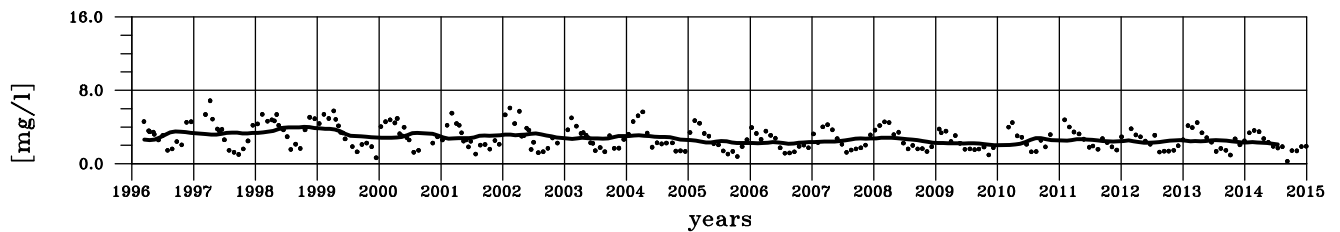
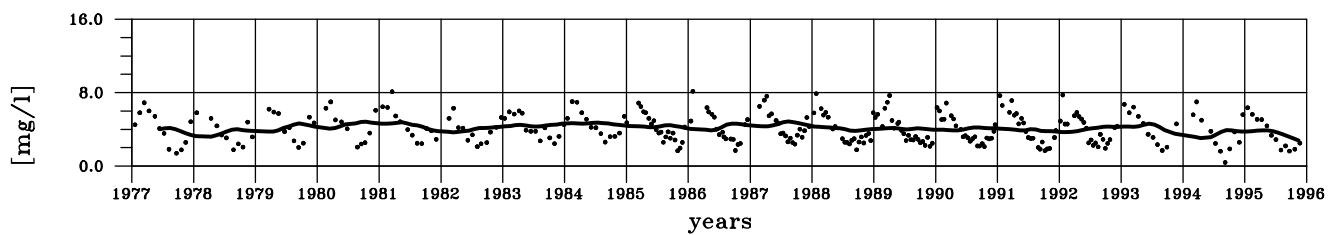
minimum: 2.02 mg/l December 2009

maximum: 4.85 mg/l August 1987

ANNUAL CYCLE

minimum: 2.01 mg/l August, rel. stdev: 0.31

maximum: 5.32 mg/l March, rel. stdev: 0.25



Kjeldahl Nitrogen from Vrouwenzand

TIME SERIES

number of data: 559

mean: 1.63 mg/l

relative standard deviation: 0.39

minimum: 0.20 mg/l January 9, 2001

maximum: 3.99 mg/l September 7, 1983

LOW PASS

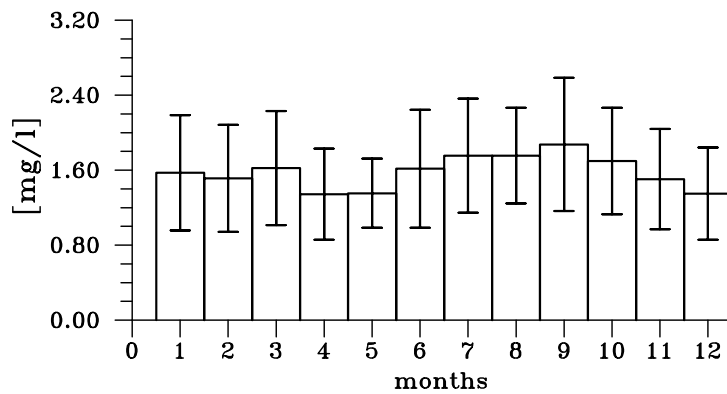
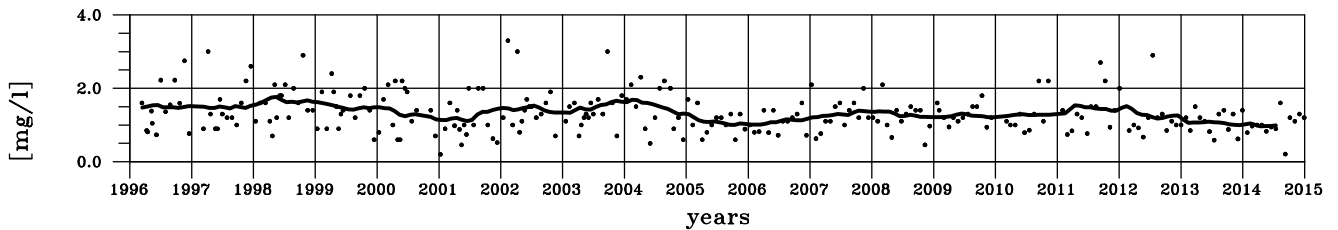
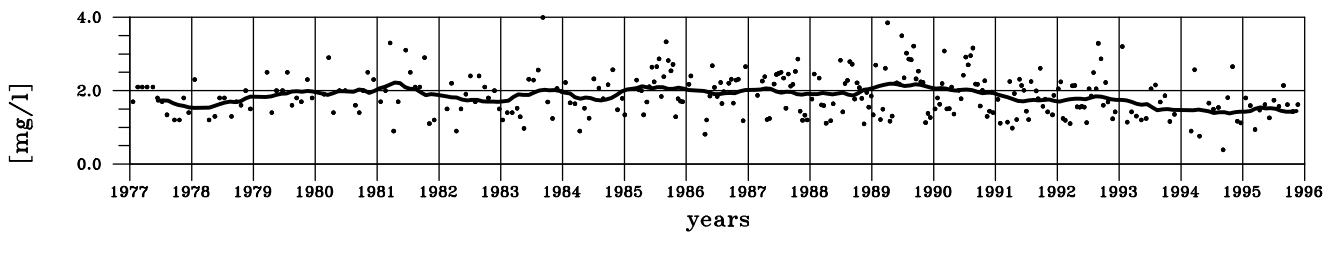
minimum: 0.97 mg/l April 2014

maximum: 2.22 mg/l April 1981

ANNUAL CYCLE

minimum: 1.34 mg/l April, rel. stdev: 0.36

maximum: 1.87 mg/l September, rel. stdev: 0.38



Nitrate + Nitrite from Vrouwenzand

TIME SERIES

number of data: 564

mean: 1.87 mg/l

relative standard deviation: 0.80

minimum: 0.00 mg/l September 22, 1988

maximum: 5.90 mg/l January 15, 1991

LOW PASS

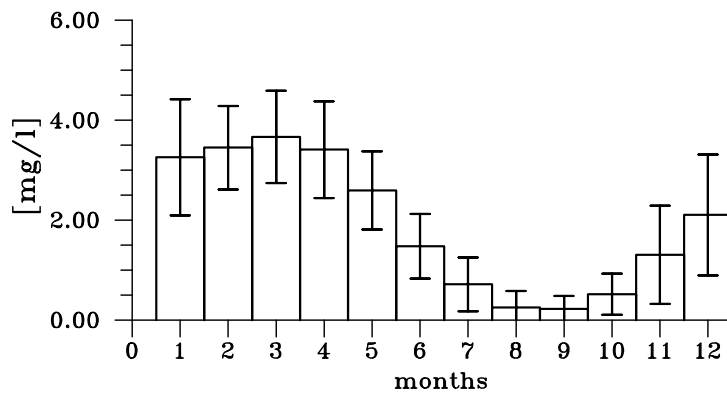
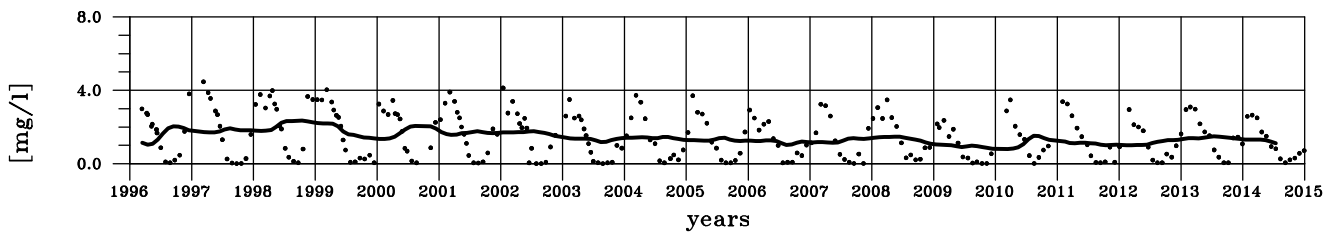
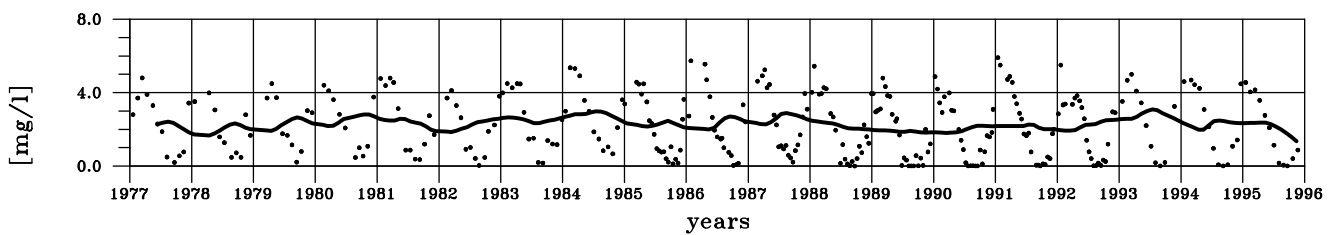
minimum: 0.80 mg/l March 2010

maximum: 3.09 mg/l July 1993

ANNUAL CYCLE

minimum: 0.23 mg/l September, rel. stdev: 1.14

maximum: 3.66 mg/l March, rel. stdev: 0.25



Ammonium from Vrouwenzand

TIME SERIES

number of data: 516

mean: 0.09 mg/l

relative standard deviation: 1.78

minimum: 0.00 mg/l April 13, 1977

maximum: 1.51 mg/l March 22, 1979

LOW PASS

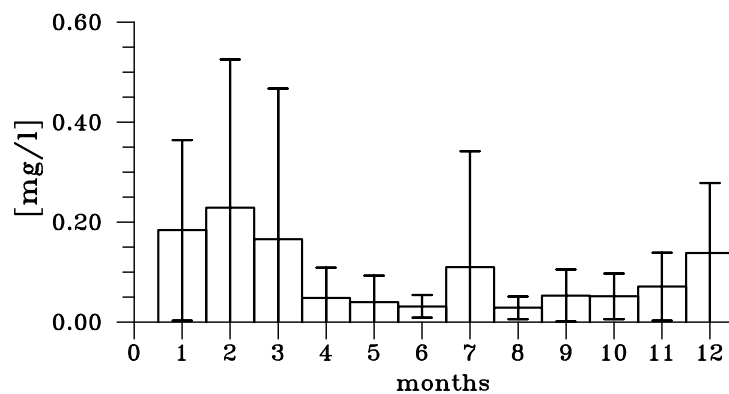
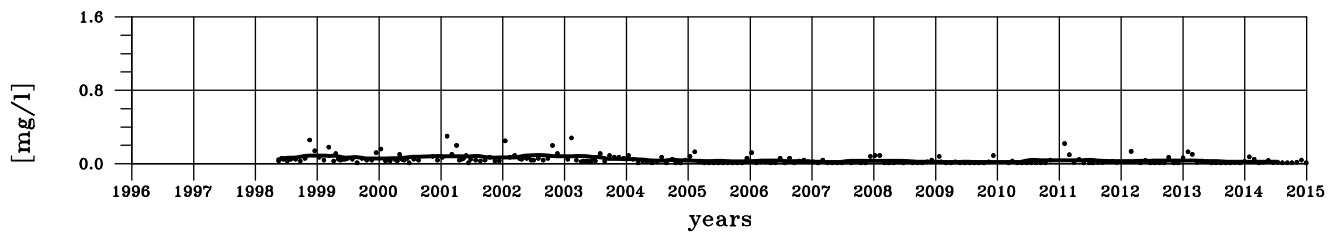
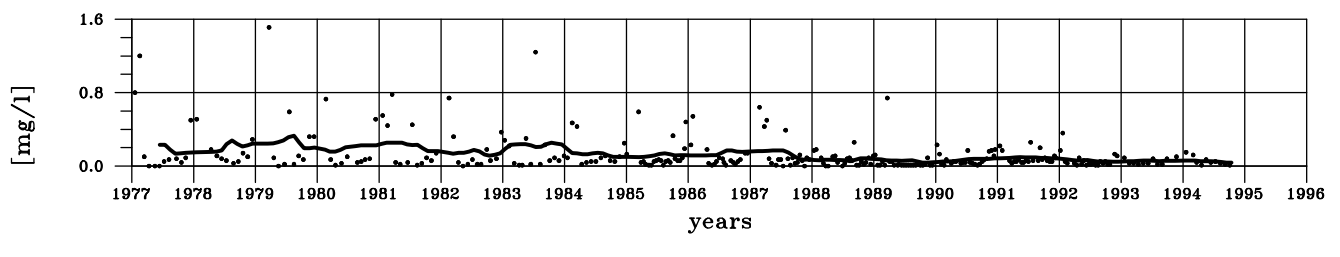
minimum: 0.02 mg/l May 2007

maximum: 0.33 mg/l August 1979

ANNUAL CYCLE

minimum: 0.03 mg/l August, rel. stdev: 0.78

maximum: 0.23 mg/l February, rel. stdev: 1.29



Total Phosphorus from Vrouwenzand

TIME SERIES

number of data: 561

mean: 0.17 mg/l

relative standard deviation: 0.73

minimum: 0.02 mg/l May 16, 2000

maximum: 1.23 mg/l January 27, 1988

LOW PASS

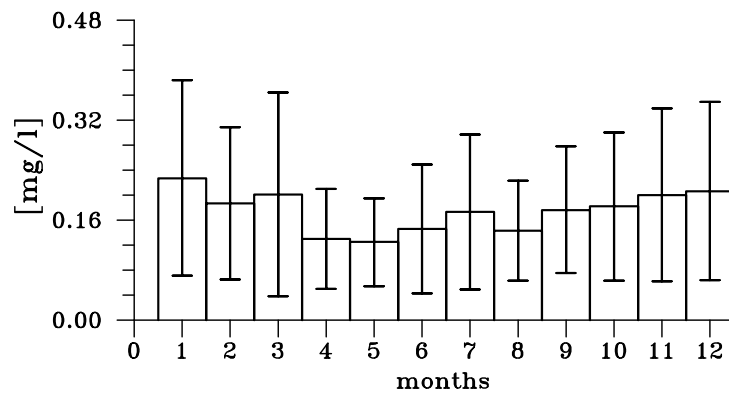
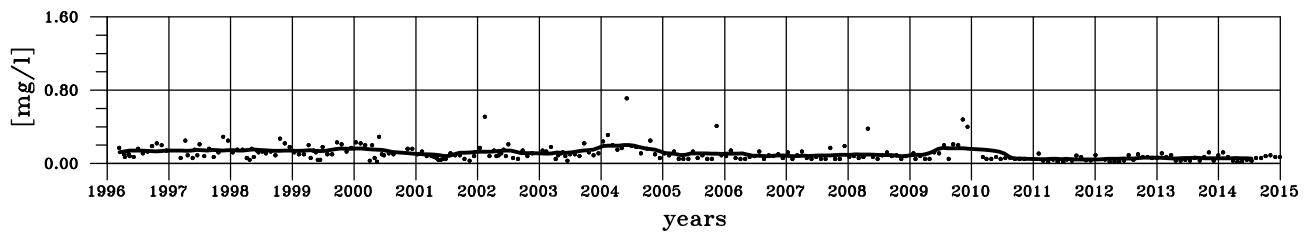
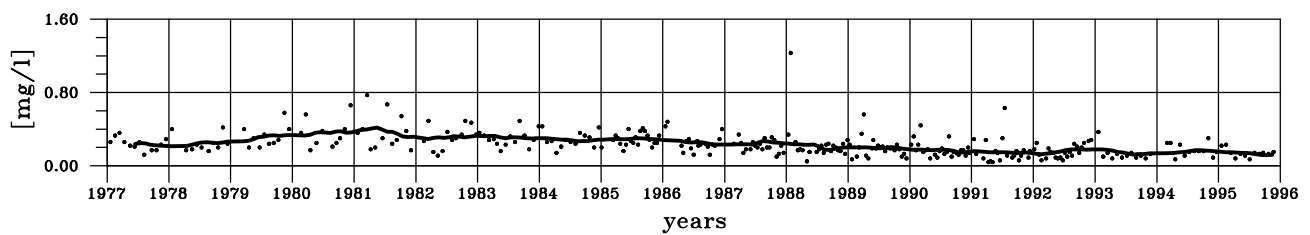
minimum: 0.04 mg/l November 2011

maximum: 0.42 mg/l May 1981

ANNUAL CYCLE

minimum: 0.12 mg/l May, rel. stdev: 0.56

maximum: 0.23 mg/l January, rel. stdev: 0.69



Phosphate from Vrouwenzand

TIME SERIES

number of data: 562

mean: 0.04 mg/l

relative standard deviation: 1.32

minimum: 0.00 mg/l June 8, 1982

maximum: 0.32 mg/l November 15, 1979

LOW PASS

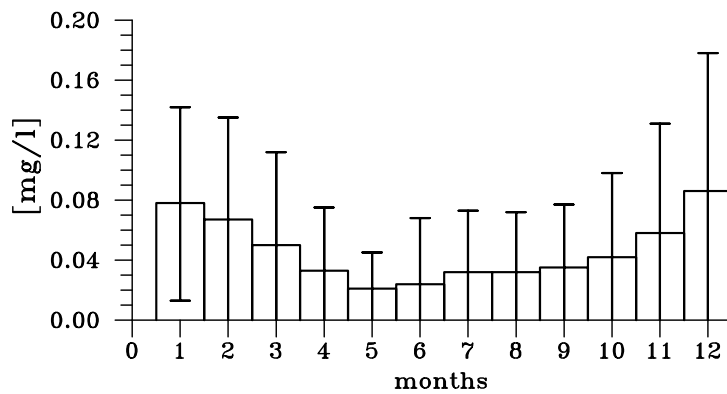
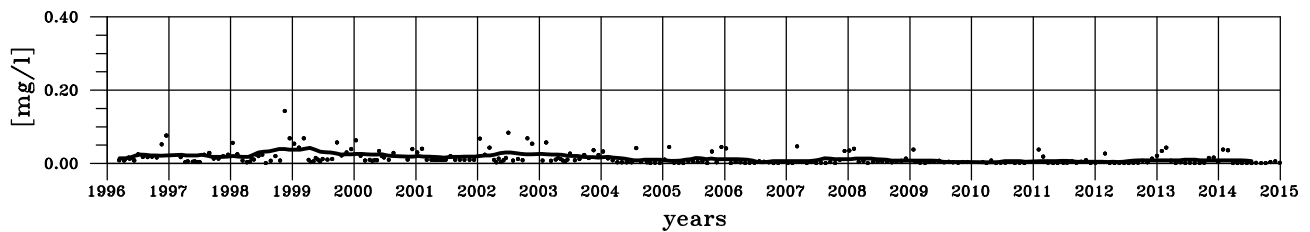
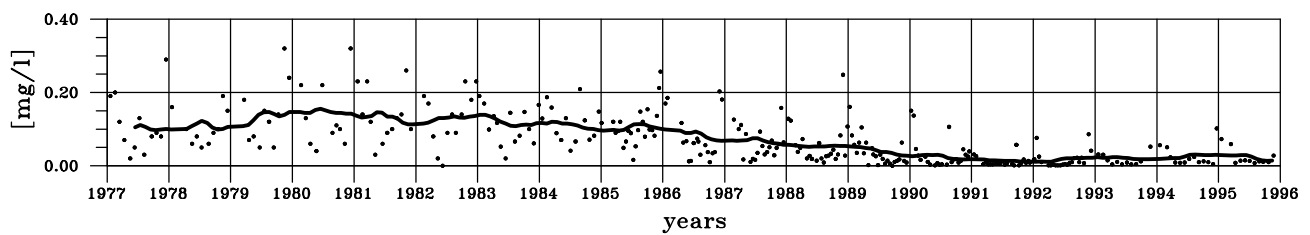
minimum: 0.00 mg/l August 2006

maximum: 0.16 mg/l June 1980

ANNUAL CYCLE

minimum: 0.02 mg/l May, rel. stdev: 1.19

maximum: 0.09 mg/l December, rel. stdev: 1.08



Silicate from Vrouwenzand

TIME SERIES

number of data: 506

mean: 0.92 mg/l

relative standard deviation: 1.15

minimum: 0.00 mg/l April 13, 1978

maximum: 4.48 mg/l February 10, 2003

LOW PASS

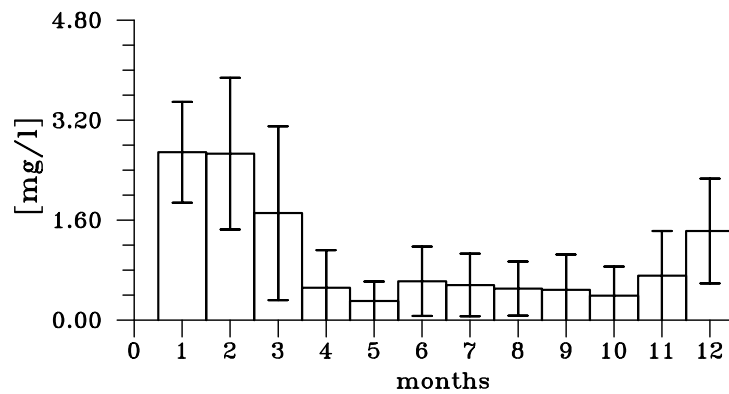
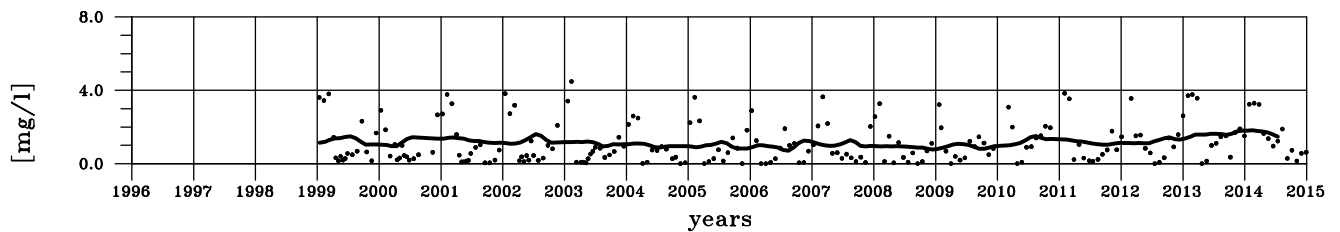
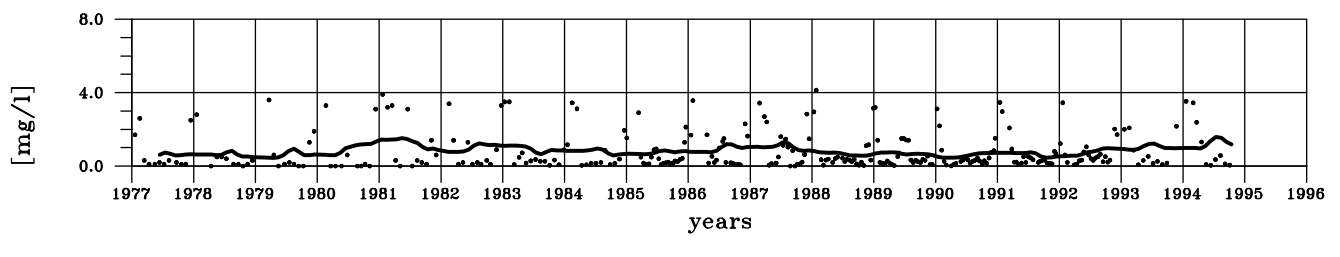
minimum: 0.43 mg/l April 1979

maximum: 1.83 mg/l February 2014

ANNUAL CYCLE

minimum: 0.30 mg/l May, rel. stdev: 1.02

maximum: 2.69 mg/l January, rel. stdev: 0.30



Chloride from Lake Vrouwenzand

TIME SERIES

number of data: 563

mean: 142 *mg/l*

relative standard deviation: 0.36

minimum: 39 *mg/l* November 17, 1998

maximum: 393 *mg/l* June 29, 1999

LOW PASS

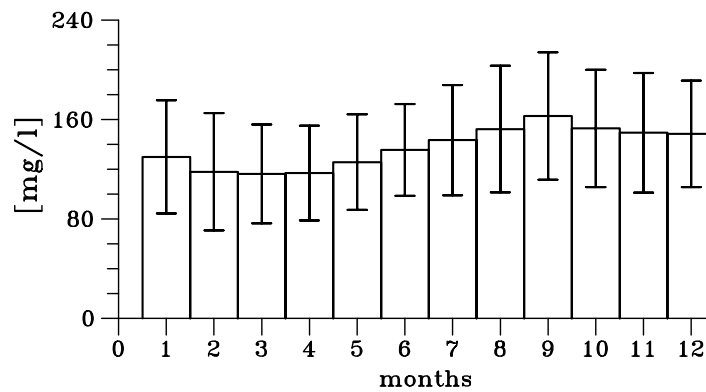
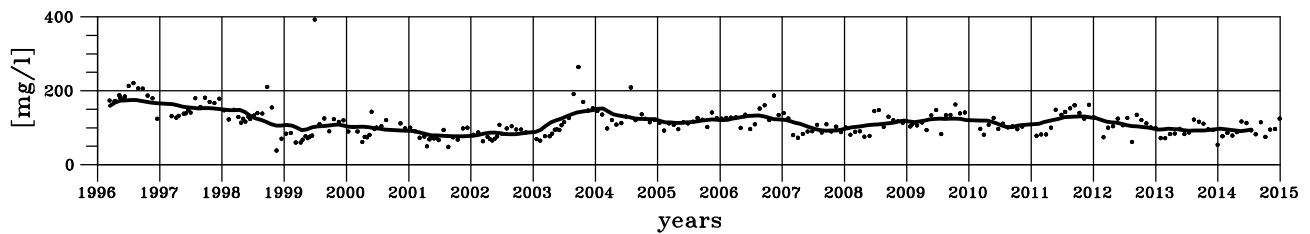
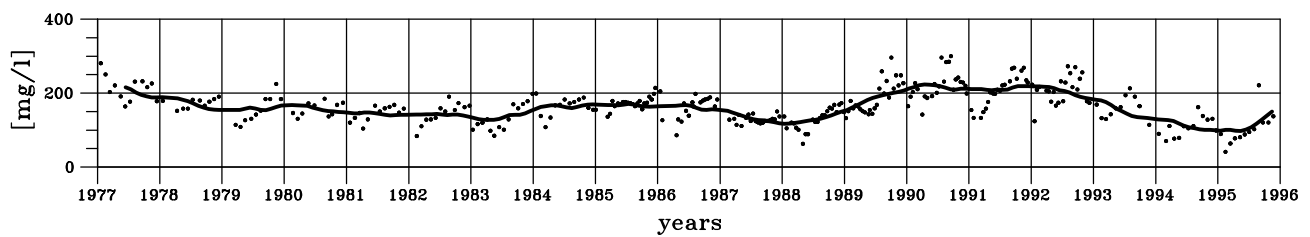
minimum: 77 *mg/l* October 2001

maximum: 223 *mg/l* April 1990

ANNUAL CYCLE

minimum: 116 *mg/l* March, rel. stdev: 0.34

maximum: 163 *mg/l* September, rel. stdev: 0.32



3.2.2 Nordzeekanaal

This channel represents the direct connection from Amsterdam to the North Sea. Additional water masses enter from the Markermeer which is separated from the Lake IJssel by a dam. Daily discharge data and biweekly samples for all the concentration values were available. The sampling took place about 2 km before the sluice system (Ijmuiden). The elevated chloride content of about 2000 mg/l was caused by opening the locks for in- and outgoing ships, thereby permitting seawater to enter the sluice system.

Discharge from Nordzeekanaal

TIME SERIES

number of data: 13856

mean: $92 \text{ m}^3/\text{s}$

relative standard deviation: 0.46

minimum: $0 \text{ m}^3/\text{s}$ March 24, 1990

maximum: $365 \text{ m}^3/\text{s}$ May 29, 2011

LOW PASS

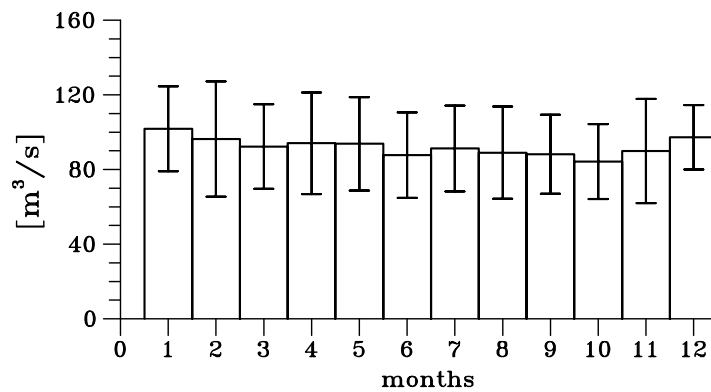
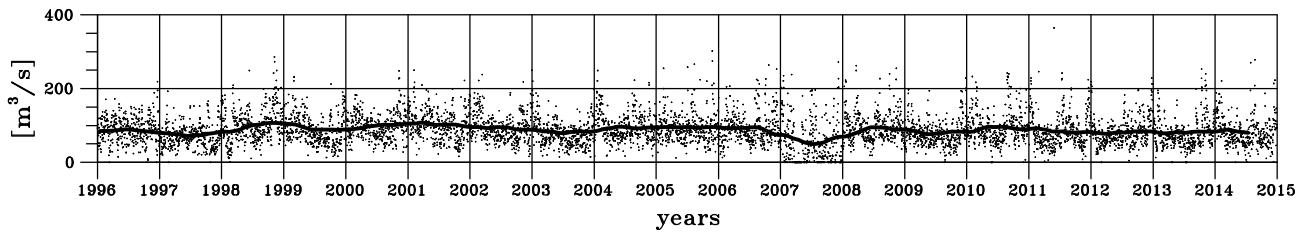
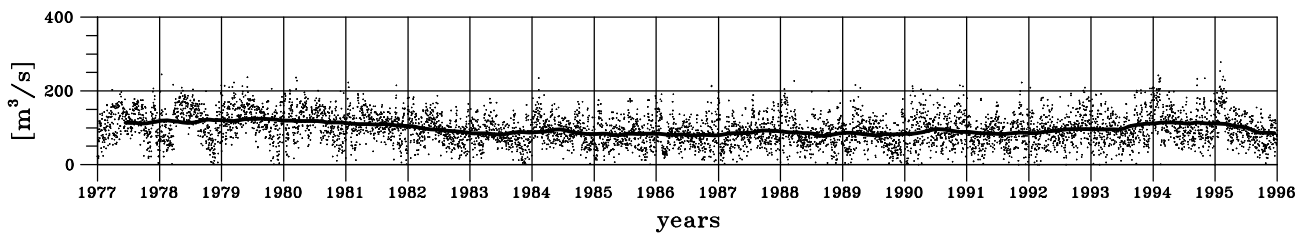
minimum: $50 \text{ m}^3/\text{s}$ July 2007

maximum: $124 \text{ m}^3/\text{s}$ August 1979

ANNUAL CYCLE

minimum: $84 \text{ m}^3/\text{s}$ October, rel. stdev: 0.24

maximum: $102 \text{ m}^3/\text{s}$ January, rel. stdev: 0.22



Total Nitrogen from Nordzeekanaal

TIME SERIES

number of data: 697

mean: 4.34 mg/l

relative standard deviation: 0.42

minimum: 1.09 mg/l July 28, 2014

maximum: 11.40 mg/l January 2, 1984

LOW PASS

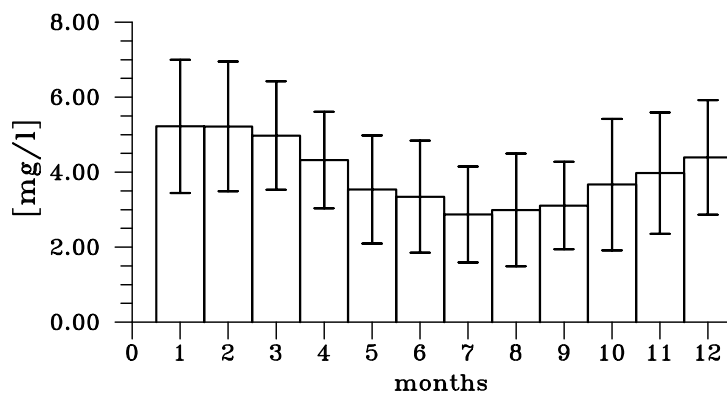
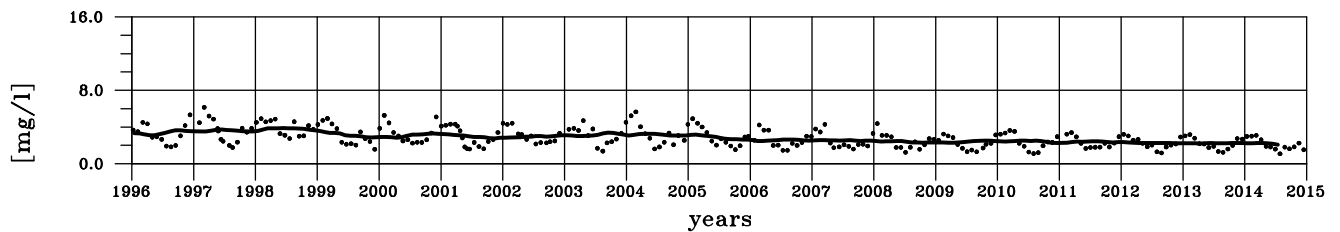
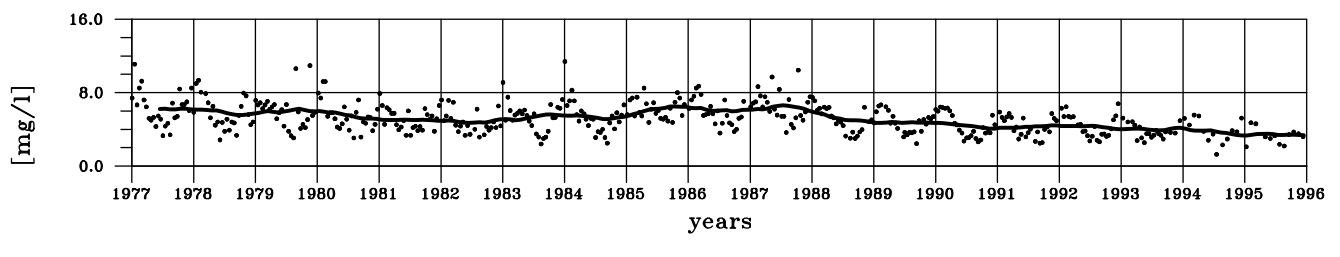
minimum: 2.08 mg/l July 2014

maximum: 6.61 mg/l July 1987

ANNUAL CYCLE

minimum: 2.87 mg/l July, rel. stdev: 0.45

maximum: 5.22 mg/l January, rel. stdev: 0.34



Kjeldahl Nitrogen from Nordzeekanaal

TIME SERIES

number of data: 701

mean: 1.89 mg/l

relative standard deviation: 0.63

minimum: 0.10 mg/l June 16, 2004

maximum: 9.10 mg/l August 27, 1979

LOW PASS

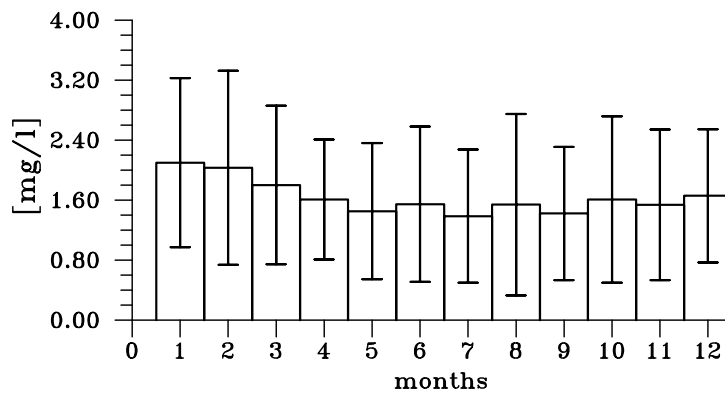
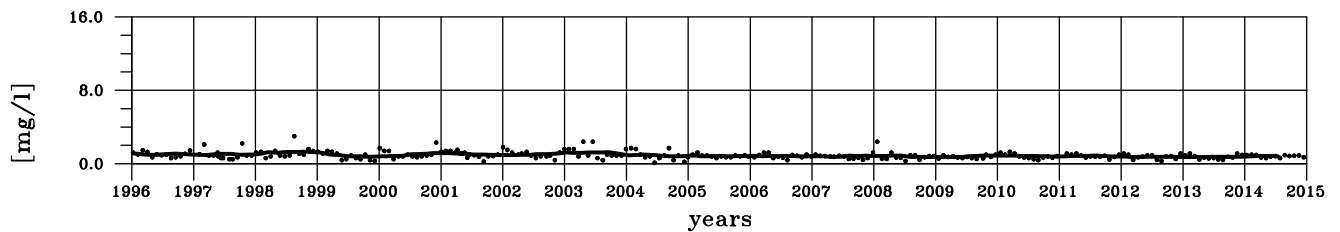
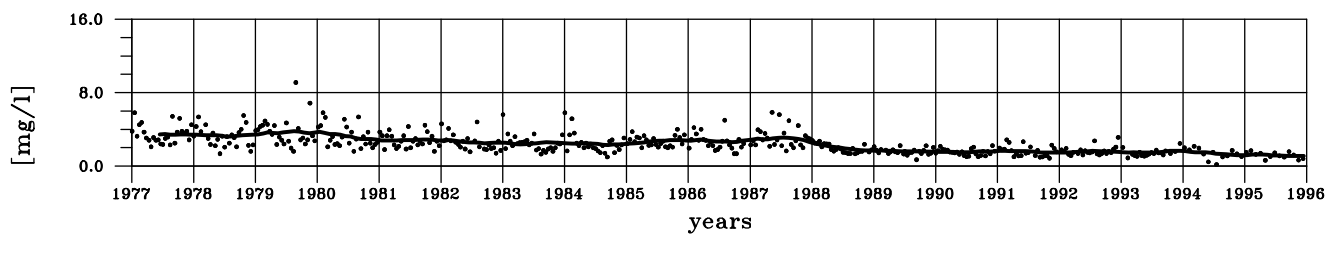
minimum: 0.72 mg/l April 2013

maximum: 3.79 mg/l August 1979

ANNUAL CYCLE

minimum: 1.39 mg/l July, rel. stdev: 0.64

maximum: 2.10 mg/l January, rel. stdev: 0.54



Nitrate + Nitrite from Nordzeekanaal

TIME SERIES

number of data: 702

mean: 2.46 mg/l

relative standard deviation: 0.42

minimum: 0.46 mg/l July 28, 2014

maximum: 6.05 mg/l October 12, 1987

LOW PASS

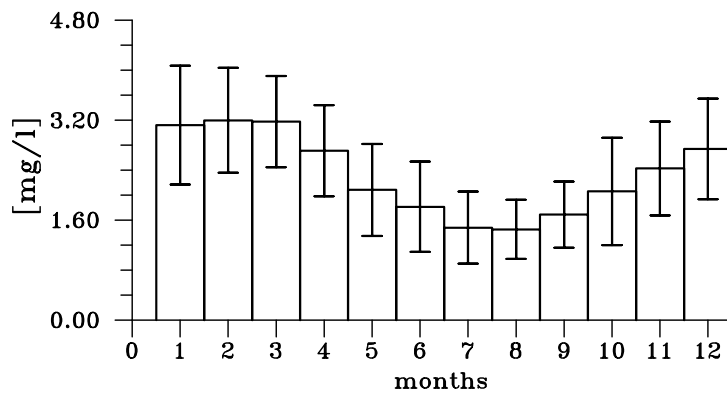
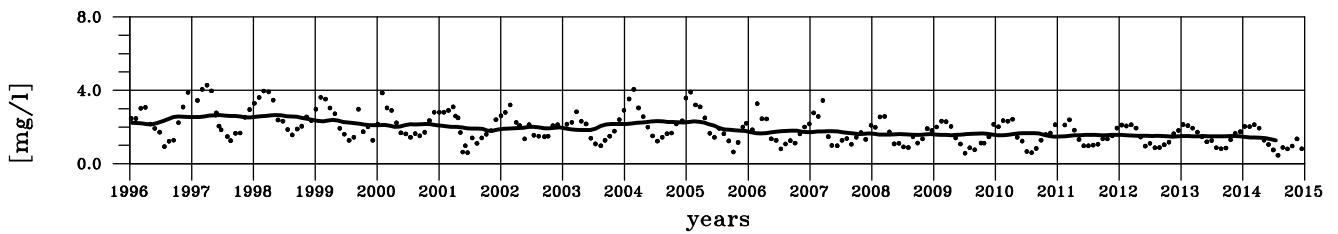
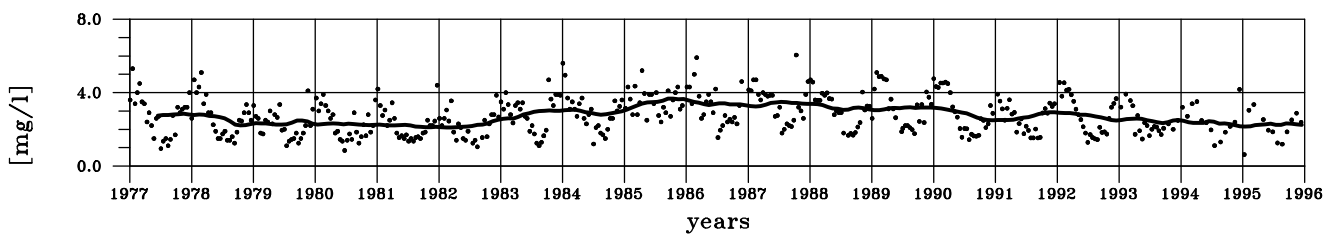
minimum: 1.27 mg/l July 2014

maximum: 3.67 mg/l October 1985

ANNUAL CYCLE

minimum: 1.45 mg/l August, rel. stdev: 0.33

maximum: 3.20 mg/l February, rel. stdev: 0.26



Ammonium from Nordzeekanaal

TIME SERIES

number of data: 655

mean: 0.72 mg/l

relative standard deviation: 1.02

minimum: 0.01 mg/l June 30, 1992

maximum: 4.70 mg/l January 17, 1977

LOW PASS

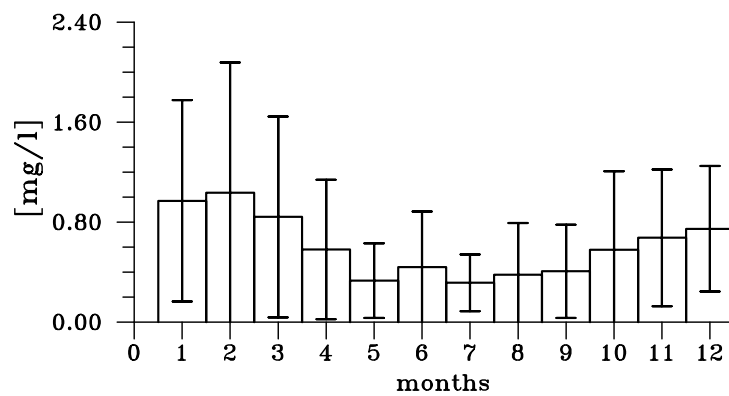
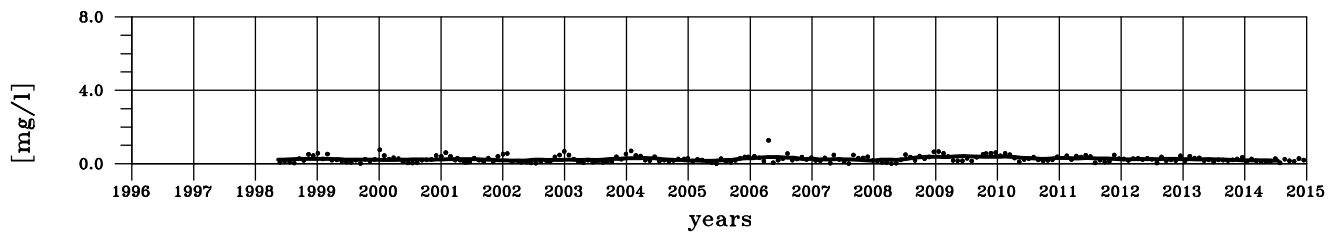
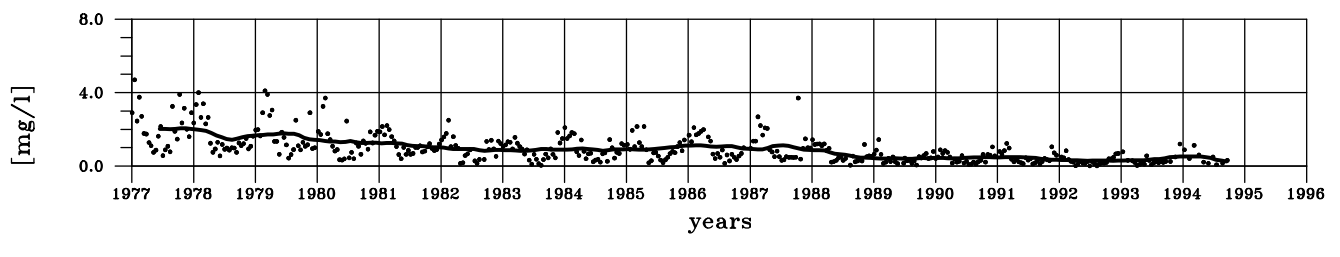
minimum: 0.16 mg/l April 2005

maximum: 2.05 mg/l November 1977

ANNUAL CYCLE

minimum: 0.31 mg/l July, rel. stdev: 0.72

maximum: 1.04 mg/l February, rel. stdev: 1.01



Total Phosphorus from Nordzeekanaal

TIME SERIES

number of data: 698

mean: 0.46 mg/l

relative standard deviation: 0.60

minimum: 0.05 mg/l April 19, 2007

maximum: 3.30 mg/l December 4, 1978

LOW PASS

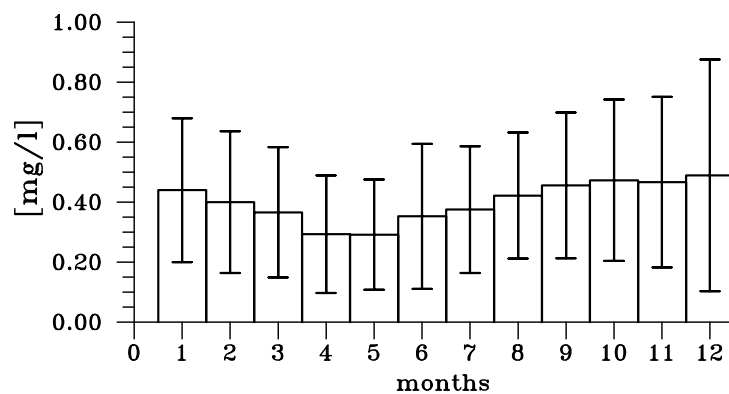
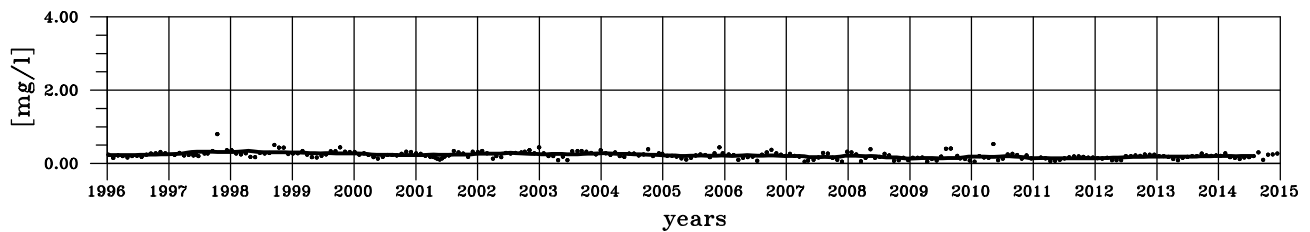
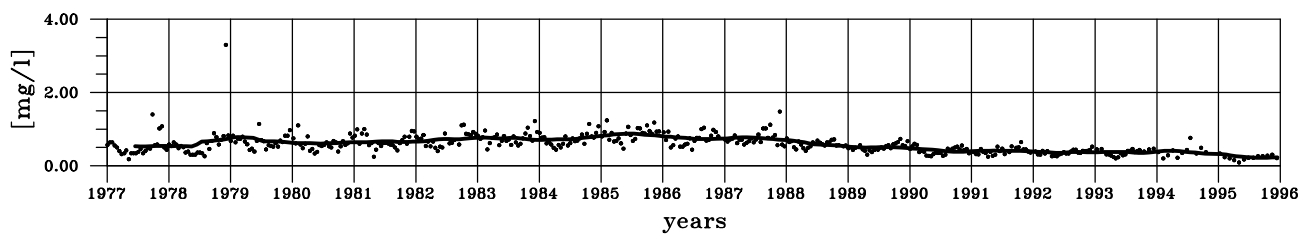
minimum: 0.14 mg/l January 2009

maximum: 0.88 mg/l June 1985

ANNUAL CYCLE

minimum: 0.29 mg/l May, rel. stdev: 0.63

maximum: 0.49 mg/l December, rel. stdev: 0.79



Phosphate from Nordzeekanaal

TIME SERIES

number of data: 692

mean: 0.35 mg/l

relative standard deviation: 0.61

minimum: 0.00 mg/l June 19, 2000

maximum: 1.40 mg/l November 23, 1987

LOW PASS

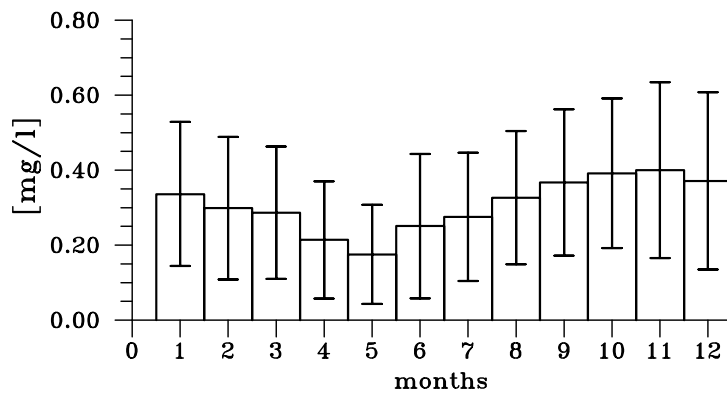
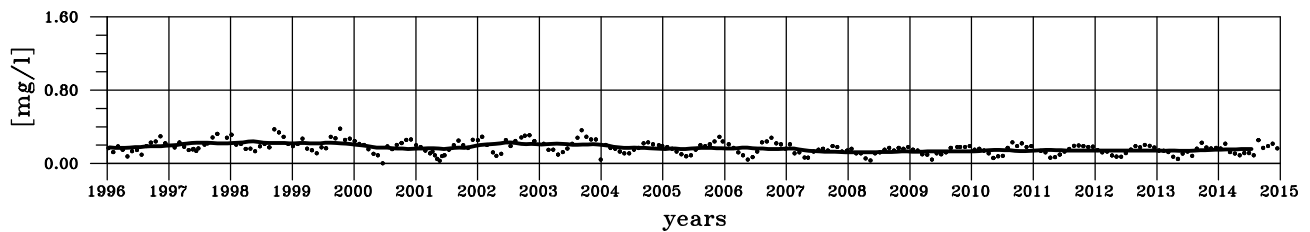
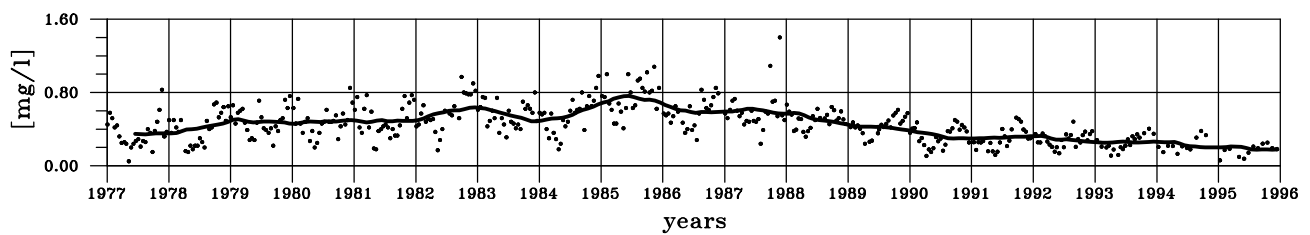
minimum: 0.12 mg/l February 2008

maximum: 0.76 mg/l June 1985

ANNUAL CYCLE

minimum: 0.18 mg/l May, rel. stdev: 0.76

maximum: 0.40 mg/l November, rel. stdev: 0.59



Silicate from Nordzeekanaal

TIME SERIES

number of data: 594

mean: 2.27 mg/l

relative standard deviation: 0.63

minimum: 0.10 mg/l July 30, 1979

maximum: 5.70 mg/l January 7, 1980

LOW PASS

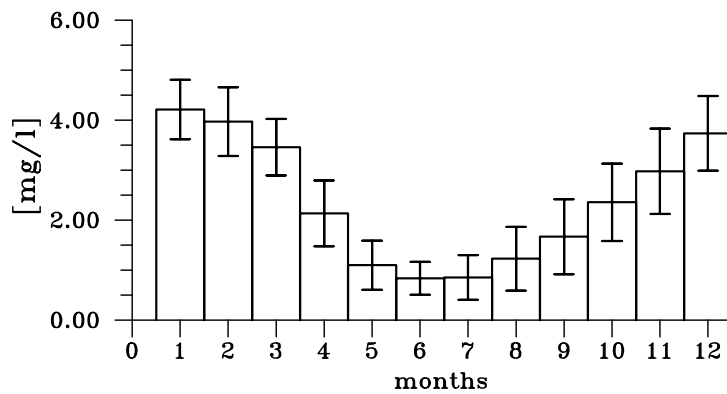
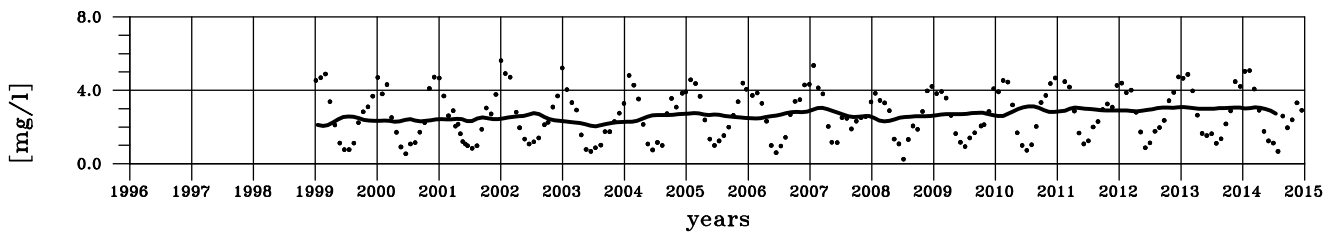
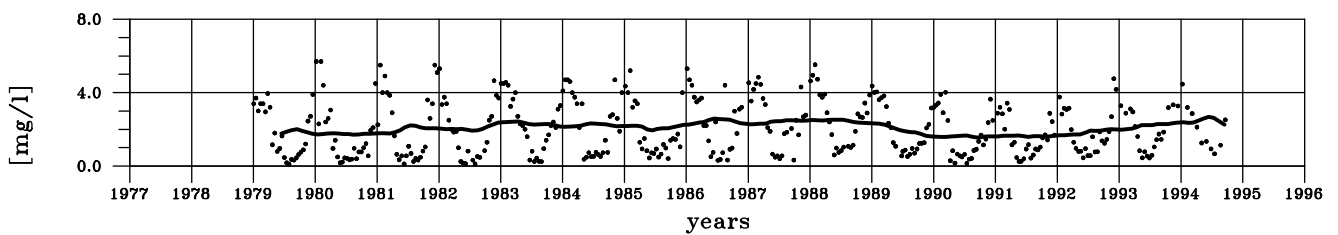
minimum: 1.56 mg/l September 1990

maximum: 3.13 mg/l August 2010

ANNUAL CYCLE

minimum: 0.84 mg/l June, rel. stdev: 0.39

maximum: 4.21 mg/l January, rel. stdev: 0.14



Chloride from Nordzeekanaal

TIME SERIES

number of data: 321

mean: 3600 *mg/l*

relative standard deviation: 0.29

minimum: 663 *mg/l* February 8, 1994

maximum: 6870 *mg/l* October 8, 1990

LOW PASS

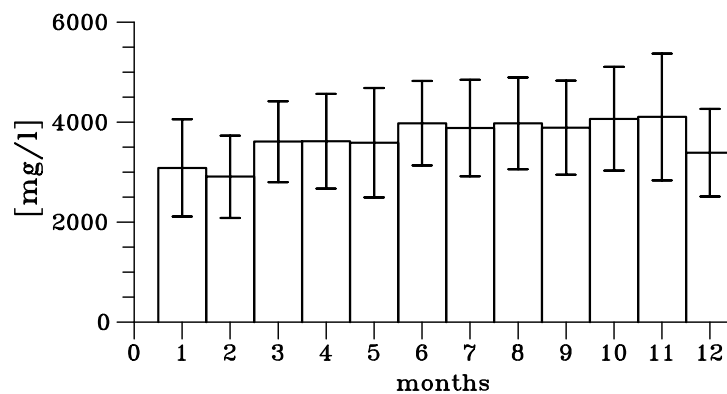
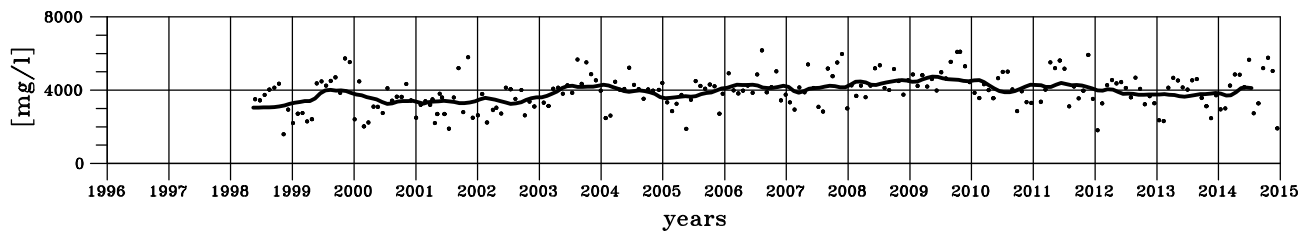
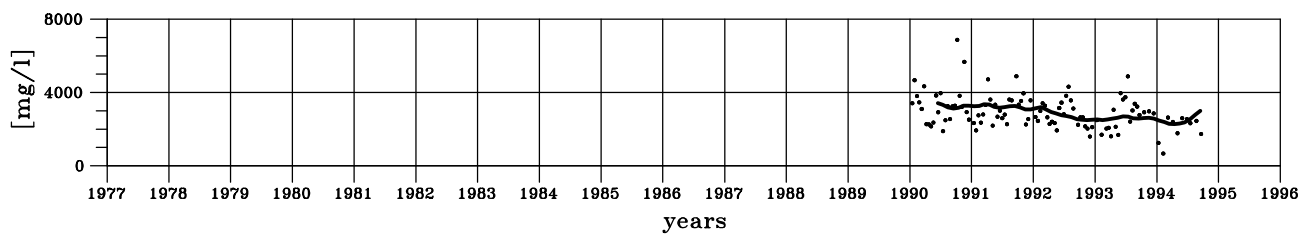
minimum: 2269 *mg/l* April 1994

maximum: 4733 *mg/l* May 2009

ANNUAL CYCLE

minimum: 2909 *mg/l* February, rel. stdev: 0.28

maximum: 4106 *mg/l* November, rel. stdev: 0.31



3.2.3 Nieuwe Waterweg

The sampling station lies just beyond the combined outflow from Nieuwe Maas and Oude Maas (Maassluis). Both waterways have different connections to the Waal, the largest branche of the river Rhine. For the calculation of discharge weekly measured data until 1980 and daily data since 1980 are available. Since 1987 these data were modelled instead of measured. The model simulates the discharge using the information of the phase of the tide, water surface elevation as well as the movement of the sluices. The change from measured discharge towards modelled discharge can clearly be seen in the figure of the time series. All concentrations were measured every two weeks. The sampling location was situated in the mixing zone, near the city of Maassluis which results, on a tidal average basis, in 10 to 15 % seawater. The 24-hour, and therefore tidal-averaged, mean chloride content is about 1200 *mg/l*.

Discharge from Nieuwe Waterweg

TIME SERIES

number of data: 12928

mean: $1434 \text{ m}^3/\text{s}$

relative standard deviation: 0.38

minimum: $-1371 \text{ m}^3/\text{s}$ November 6, 1999

maximum: $4649 \text{ m}^3/\text{s}$ January 31, 1995

LOW PASS

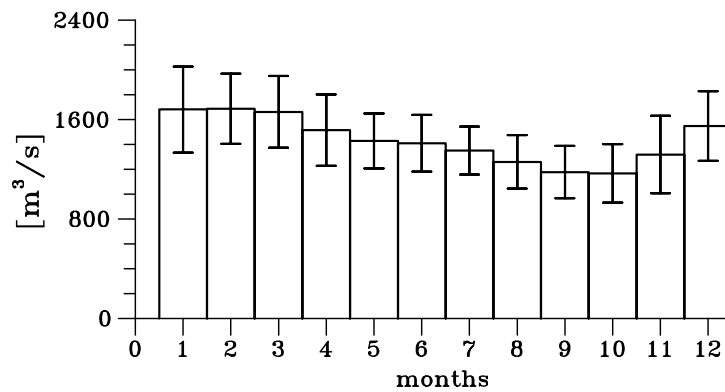
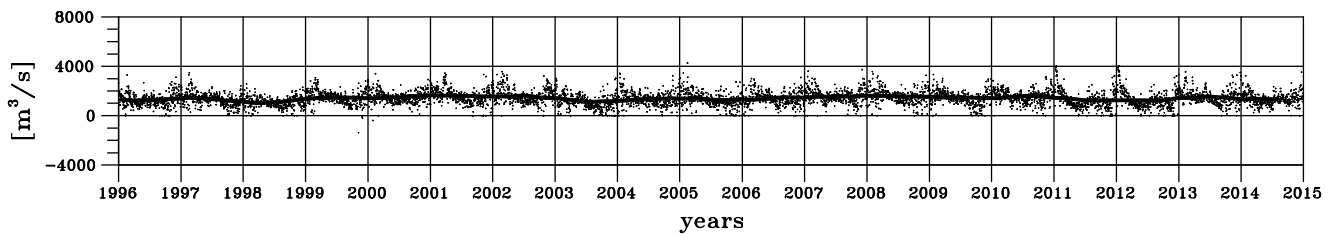
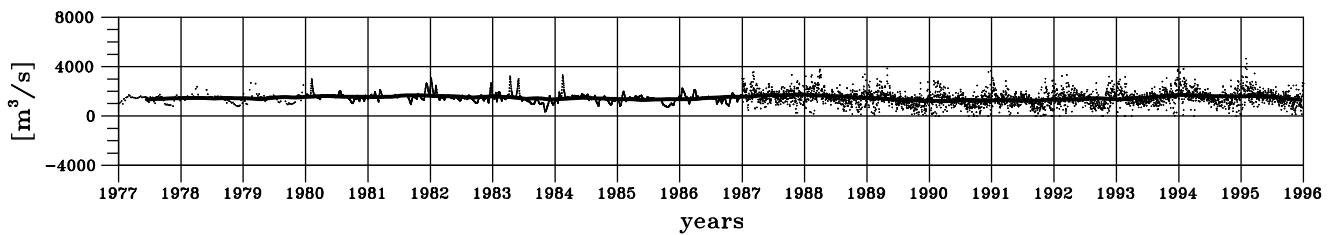
minimum: $1037 \text{ m}^3/\text{s}$ April 1998

maximum: $1740 \text{ m}^3/\text{s}$ November 1987

ANNUAL CYCLE

minimum: $1167 \text{ m}^3/\text{s}$ October, rel. stdev: 0.20

maximum: $1687 \text{ m}^3/\text{s}$ February, rel. stdev: 0.17



Total Nitrogen from Nieuwe Waterweg

TIME SERIES

number of data: 957

mean: 4.12 mg/l

relative standard deviation: 0.34

minimum: 0.65 mg/l June 15, 2005

maximum: 8.20 mg/l February 1, 1977

LOW PASS

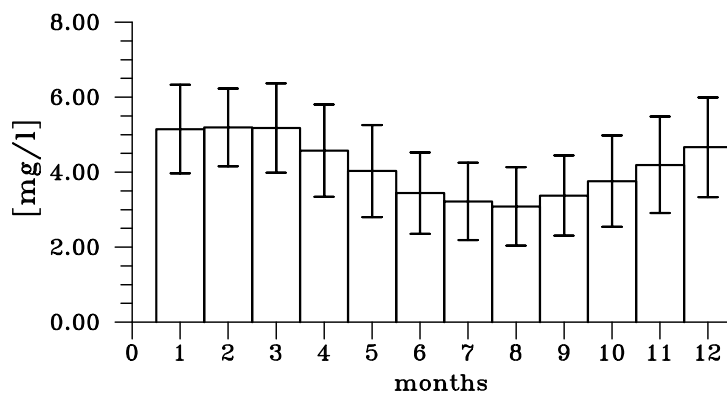
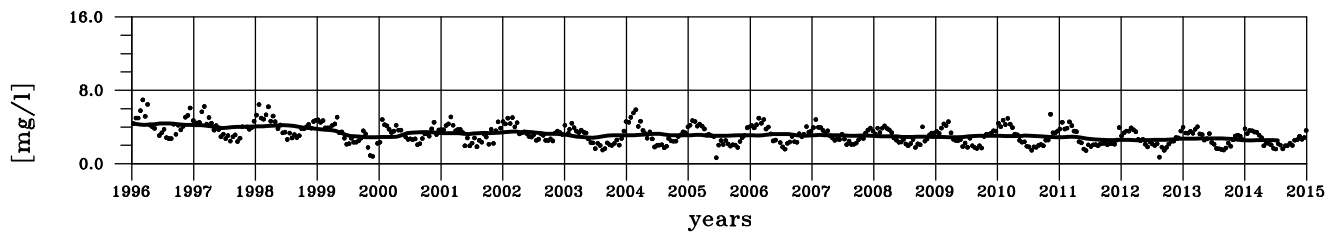
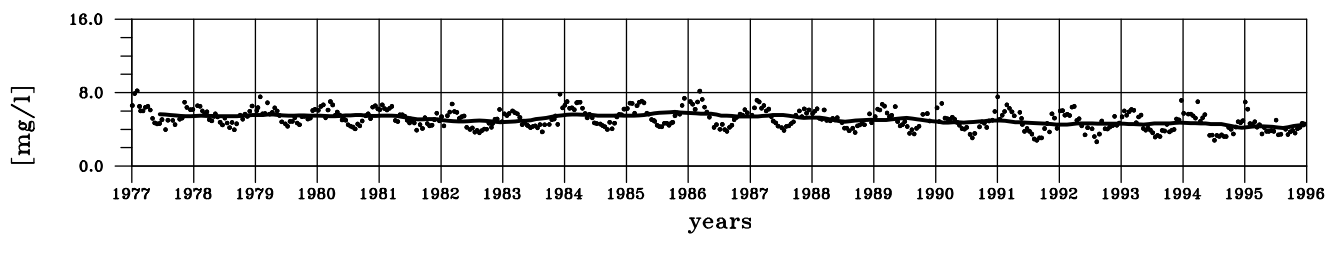
minimum: 2.52 mg/l July 2014

maximum: 5.88 mg/l October 1985

ANNUAL CYCLE

minimum: 3.08 mg/l August, rel. stdev: 0.34

maximum: 5.19 mg/l February, rel. stdev: 0.20



Kjeldahl Nitrogen from Nieuwe Waterweg

TIME SERIES

number of data: 960

mean: 0.95 mg/l

relative standard deviation: 0.58

minimum: 0.04 mg/l September 14, 1994

maximum: 3.60 mg/l January 30, 1979

LOW PASS

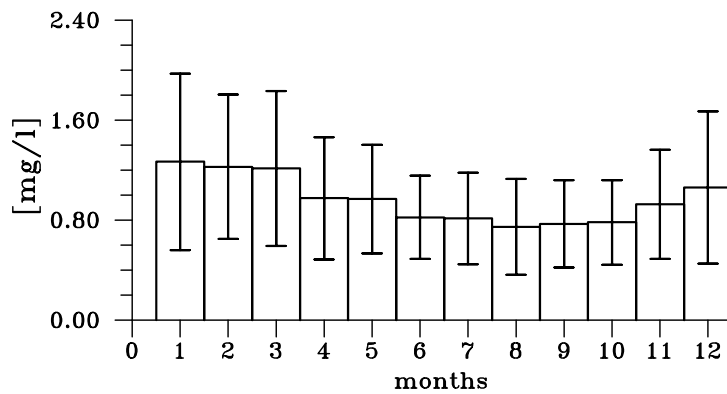
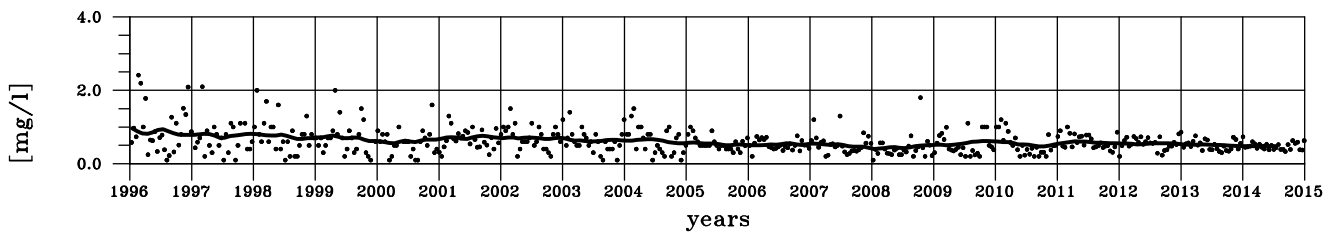
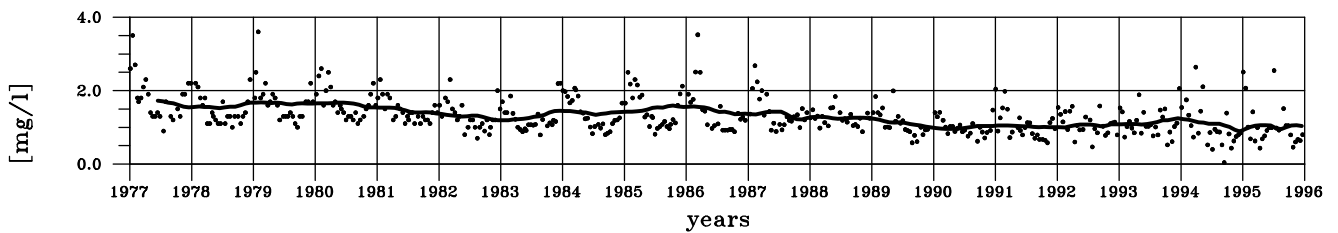
minimum: 0.40 mg/l January 2008

maximum: 1.73 mg/l June 1977

ANNUAL CYCLE

minimum: 0.74 mg/l August, rel. stdev: 0.52

maximum: 1.27 mg/l January, rel. stdev: 0.56



Nitrate + Nitrite from Nieuwe Waterweg

TIME SERIES

number of data: 963

mean: 3.17 mg/l

relative standard deviation: 0.32

minimum: 0.05 mg/l June 15, 2005

maximum: 5.63 mg/l December 5, 1983

LOW PASS

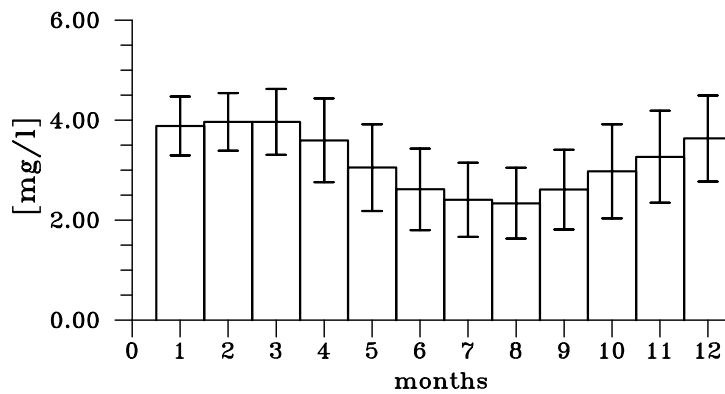
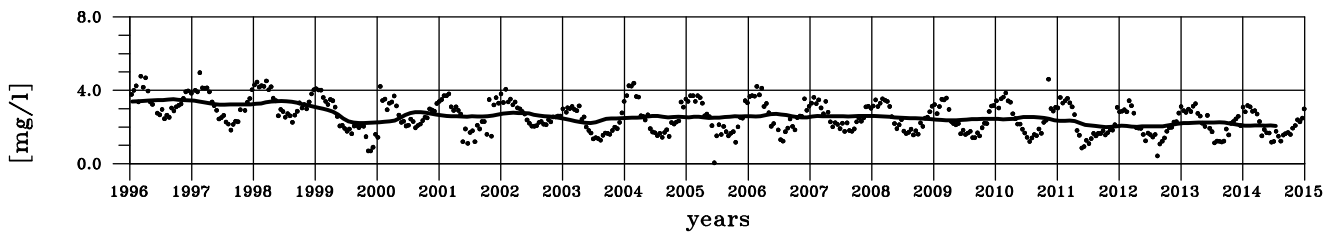
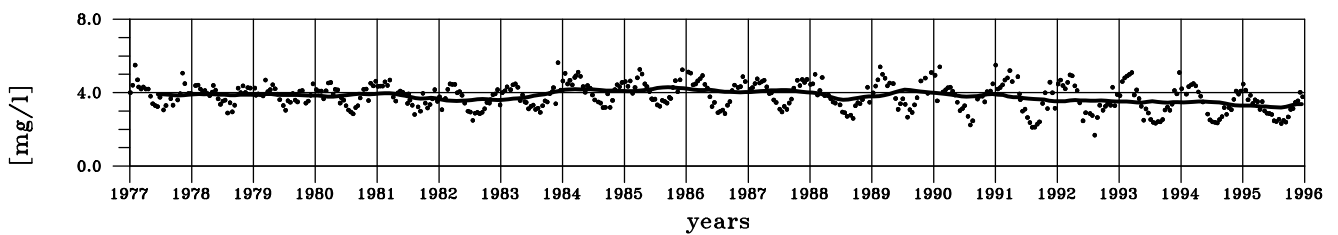
minimum: 1.99 mg/l October 2011

maximum: 4.30 mg/l September 1985

ANNUAL CYCLE

minimum: 2.34 mg/l August, rel. stdev: 0.30

maximum: 3.97 mg/l March, rel. stdev: 0.17



Ammonium from Nieuwe Waterweg

TIME SERIES

number of data: 968

mean: 0.28 mg/l

relative standard deviation: 1.14

minimum: 0.01 mg/l June 21, 2000

maximum: 2.60 mg/l January 18, 1977

LOW PASS

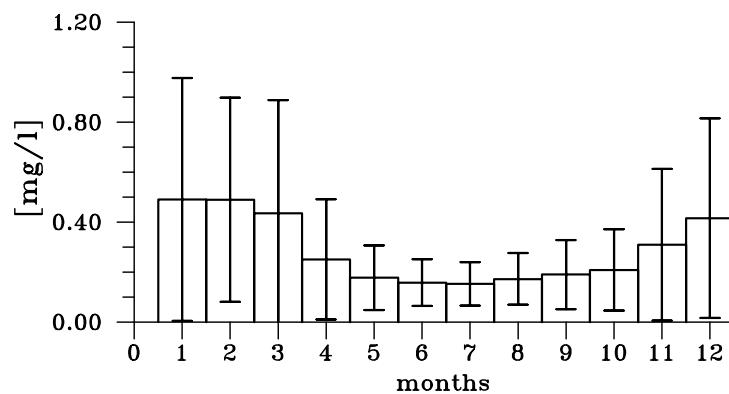
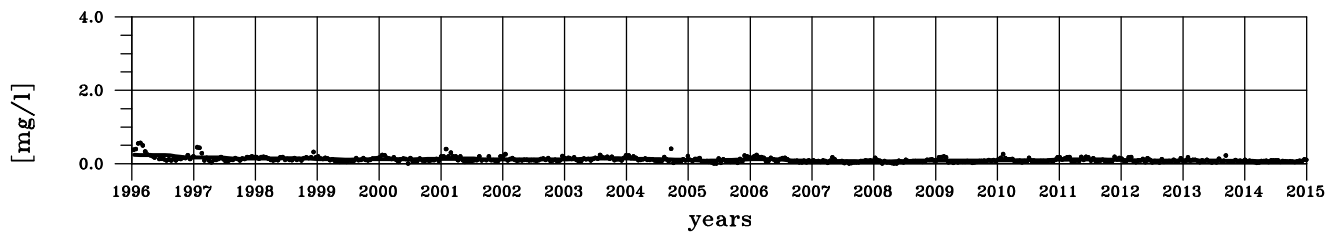
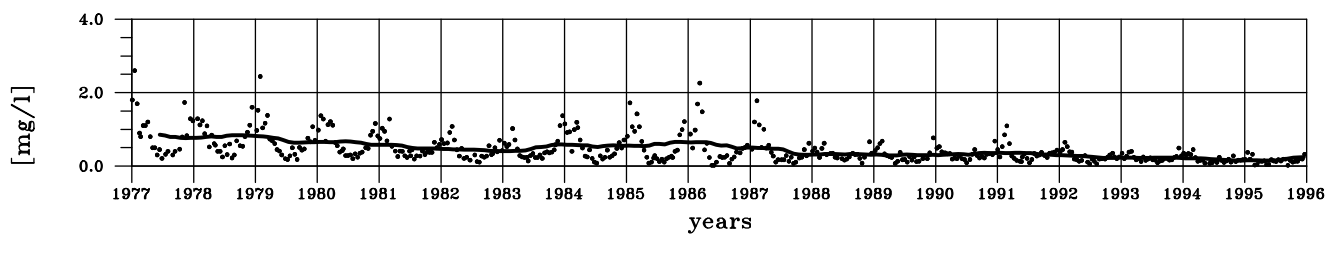
minimum: 0.06 mg/l December 2007

maximum: 0.85 mg/l June 1977

ANNUAL CYCLE

minimum: 0.15 mg/l July, rel. stdev: 0.57

maximum: 0.49 mg/l January, rel. stdev: 0.99



Total Phosphorus from Nieuwe Waterweg

TIME SERIES

number of data: 956

mean: 0.31 mg/l

relative standard deviation: 0.67

minimum: 0.01 mg/l November 5, 2003

maximum: 1.26 mg/l November 21, 1983

LOW PASS

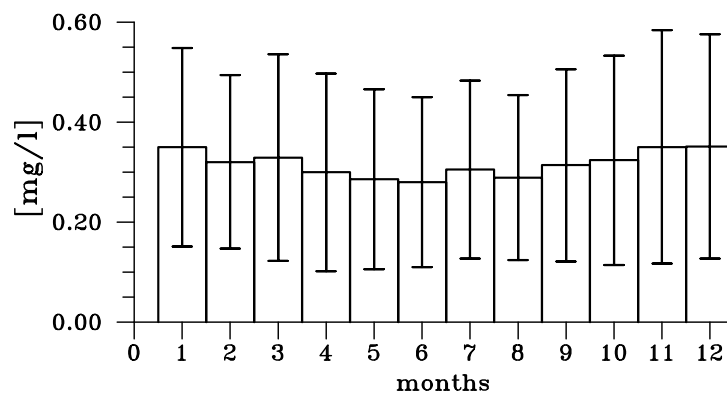
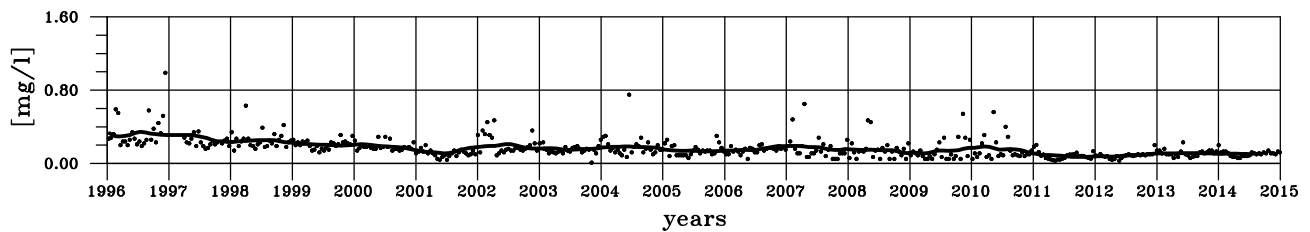
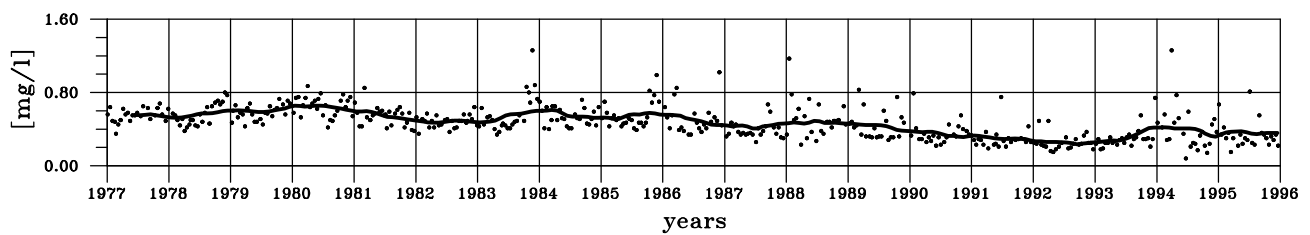
minimum: 0.07 mg/l September 2011

maximum: 0.65 mg/l January 1980

ANNUAL CYCLE

minimum: 0.28 mg/l June, rel. stdev: 0.61

maximum: 0.35 mg/l December, rel. stdev: 0.64



Phosphate from Nieuwe Waterweg

TIME SERIES

number of data: 964

mean: 0.19 mg/l

relative standard deviation: 0.78

minimum: 0.00 mg/l July 18, 2013

maximum: 1.12 mg/l November 21, 1983

LOW PASS

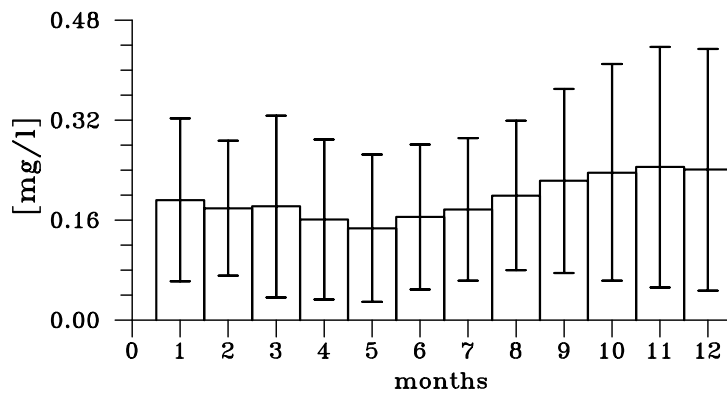
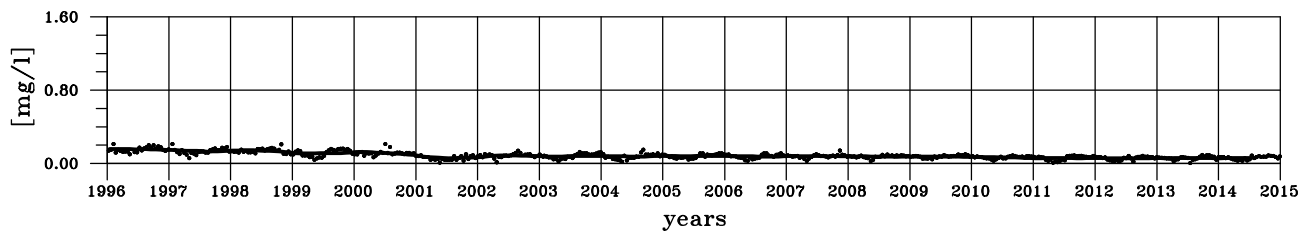
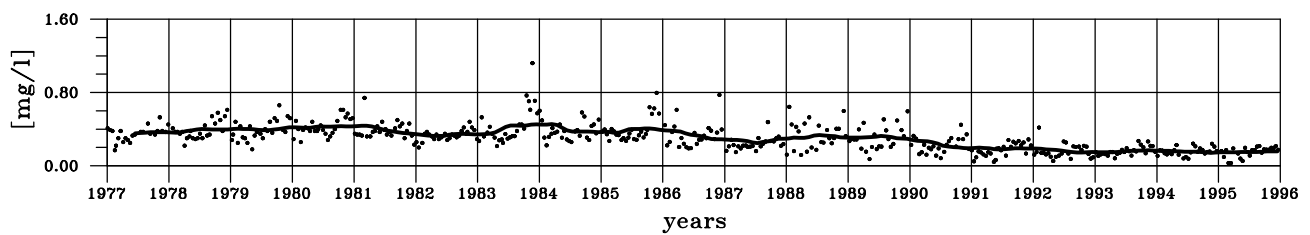
minimum: 0.06 mg/l August 2012

maximum: 0.45 mg/l March 1984

ANNUAL CYCLE

minimum: 0.15 mg/l May, rel. stdev: 0.80

maximum: 0.24 mg/l November, rel. stdev: 0.79



Silicate from Nieuwe Waterweg

TIME SERIES

number of data: 859

mean: 2.13 mg/l

relative standard deviation: 0.52

minimum: 0.03 mg/l May 13, 1991

maximum: 3.96 mg/l December 18, 1984

LOW PASS

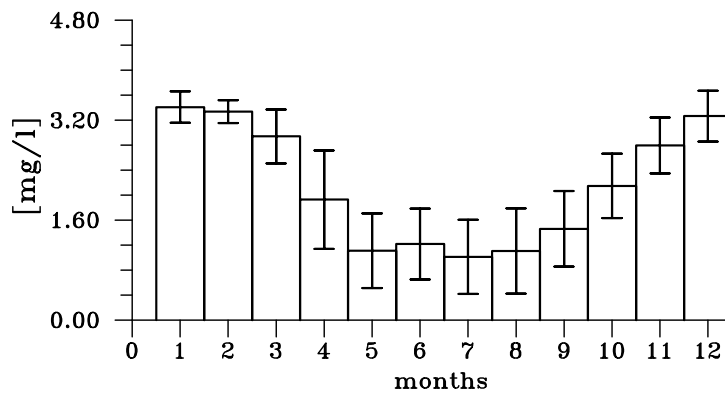
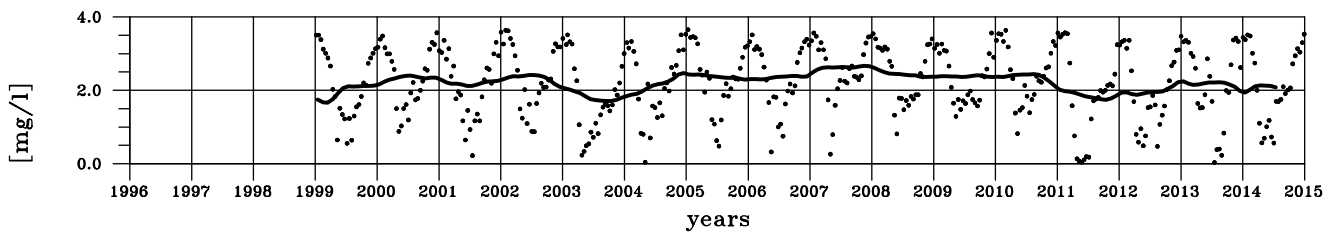
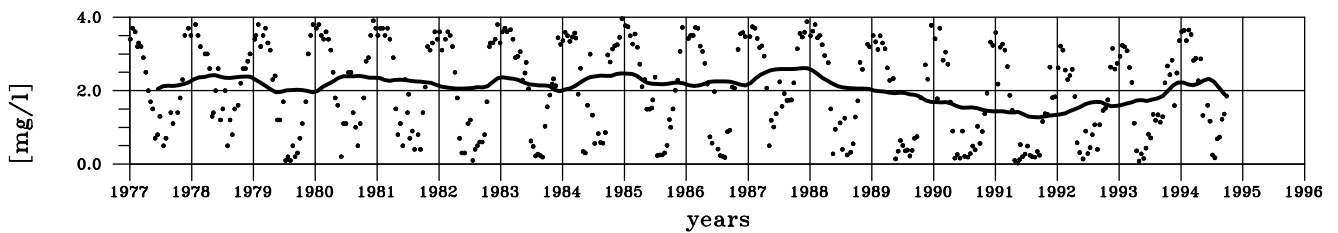
minimum: 1.27 mg/l September 1991

maximum: 2.67 mg/l November 2007

ANNUAL CYCLE

minimum: 1.01 mg/l July, rel. stdev: 0.59

maximum: 3.41 mg/l January, rel. stdev: 0.07



Chloride from Nieuwe Waterweg

TIME SERIES

number of data: 637

mean: 1236 *mg/l*

relative standard deviation: 0.78

minimum: 63 *mg/l* January 19, 2011

maximum: 6740 *mg/l* December 18, 1991

LOW PASS

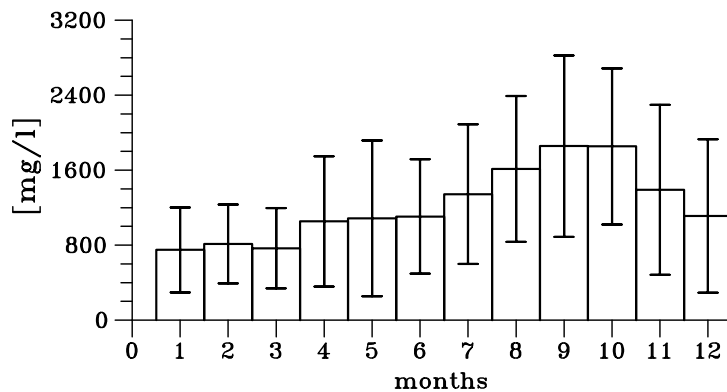
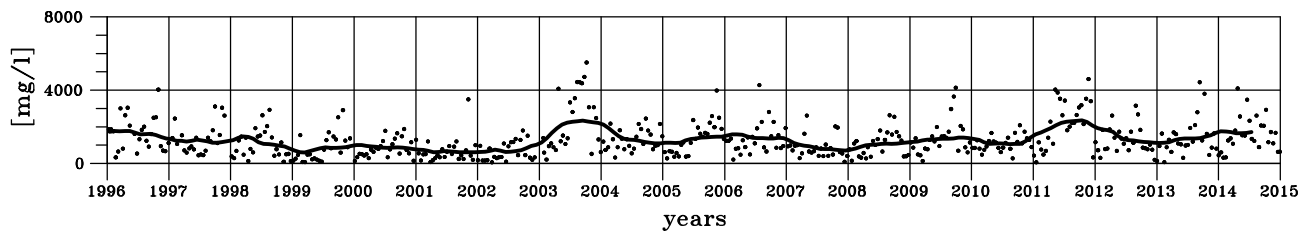
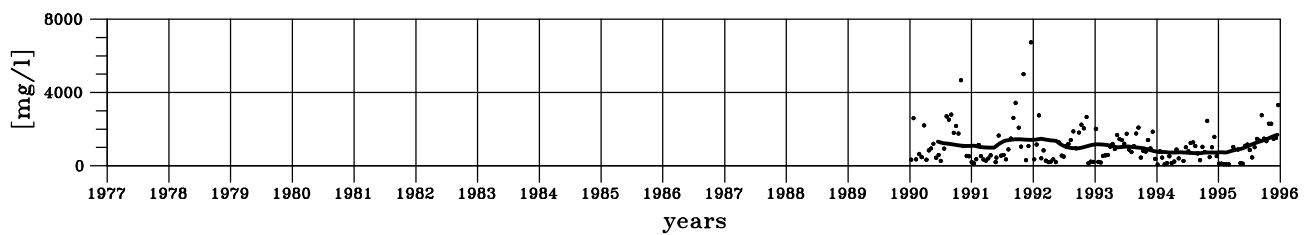
minimum: 601 *mg/l* March 1999

maximum: 2361 *mg/l* October 2011

ANNUAL CYCLE

minimum: 749 *mg/l* January, rel. stdev: 0.61

maximum: 1855 *mg/l* September, rel. stdev: 0.52



3.2.4 Haringvliet

Sampling took place close to the big weir (Haringvlietsluis), before the water masses combined from Rhine and Maas enter the North Sea. From 1980 on there were daily data available for the discharge and samples for all the concentrations every two weeks. Even though the samples are taken very near to the North Sea the mean chloride content of about 100 *mg/l* indicates that there is no mixing of outgoing freshwater with seawater. This results from the fact that the big weir is regulated only for outlet of freshwater which therefore yields no elevated chloride contents.

Discharge from Haringvliet

TIME SERIES

number of data: 12909

mean: $732 \text{ m}^3/\text{s}$

relative standard deviation: 1.37

minimum: $0 \text{ m}^3/\text{s}$ August 28, 1990

maximum: $9015 \text{ m}^3/\text{s}$ February 2, 1995

LOW PASS

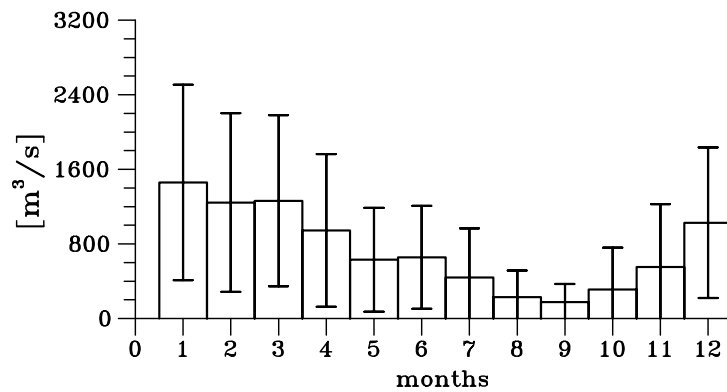
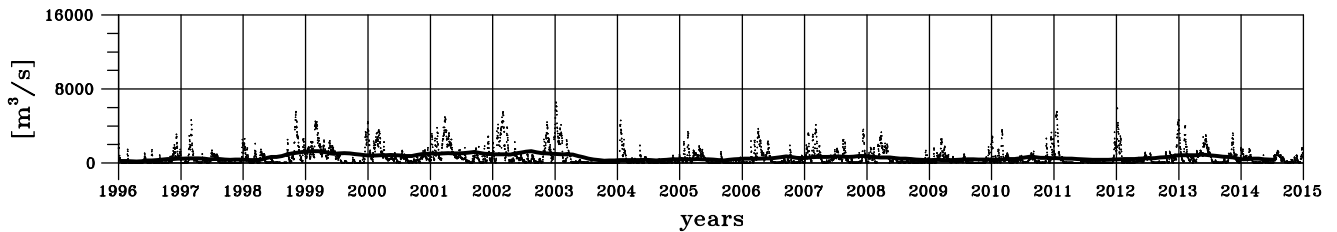
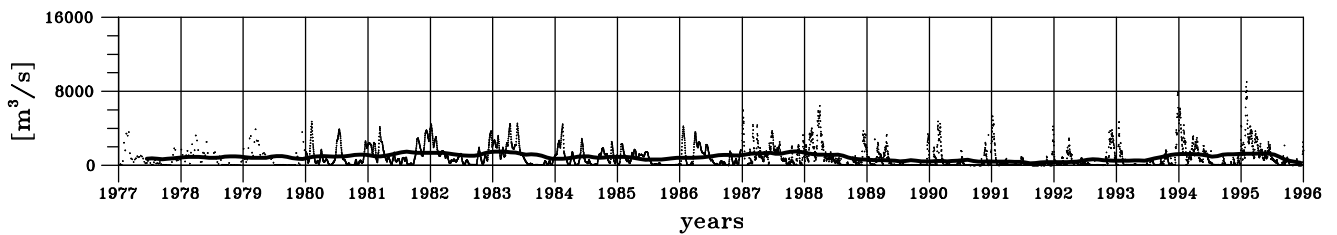
minimum: $168 \text{ m}^3/\text{s}$ April 1996

maximum: $1520 \text{ m}^3/\text{s}$ November 1987

ANNUAL CYCLE

minimum: $174 \text{ m}^3/\text{s}$ September, rel. stdev: 1.13

maximum: $1459 \text{ m}^3/\text{s}$ January, rel. stdev: 0.72



Total Nitrogen from Haringvliet

TIME SERIES

number of data: 646

mean: 4.08 mg/l

relative standard deviation: 0.31

minimum: 0.92 mg/l March 28, 1990

maximum: 7.70 mg/l February 1, 1977

LOW PASS

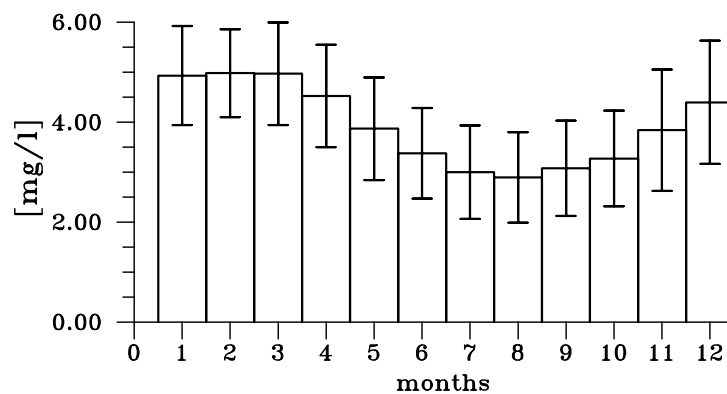
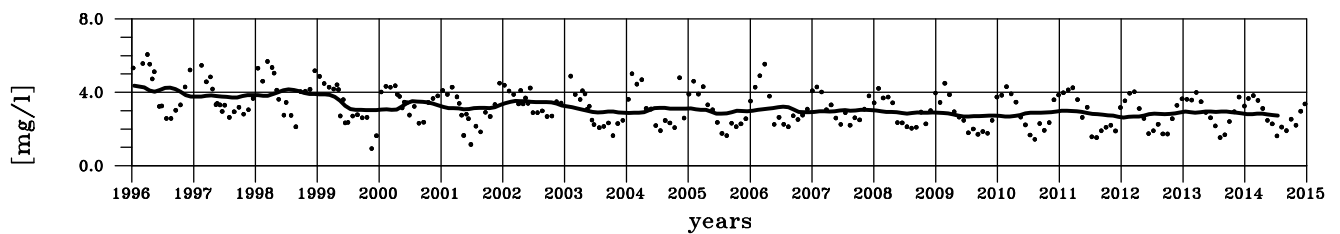
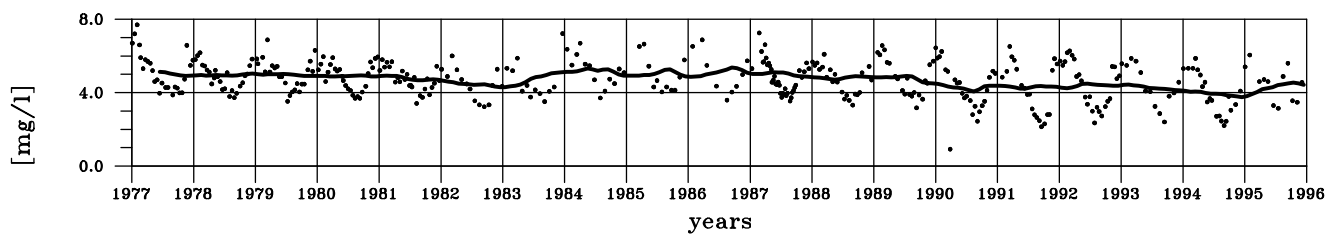
minimum: 2.62 mg/l January 2012

maximum: 5.36 mg/l September 1986

ANNUAL CYCLE

minimum: 2.89 mg/l August, rel. stdev: 0.31

maximum: 4.98 mg/l February, rel. stdev: 0.18



Kjeldahl Nitrogen from Haringvliet

TIME SERIES

number of data: 648

mean: 0.88 mg/l

relative standard deviation: 0.52

minimum: 0.08 mg/l November 4, 1991

maximum: 3.28 mg/l September 12, 1995

LOW PASS

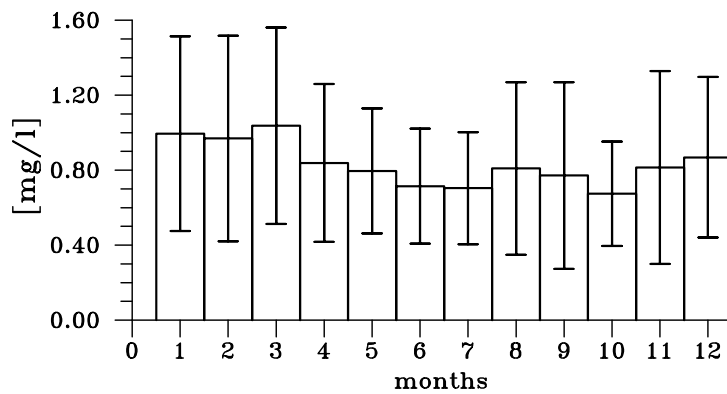
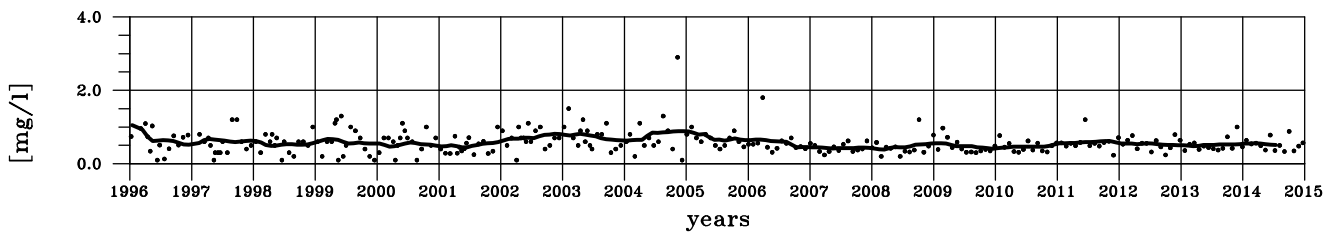
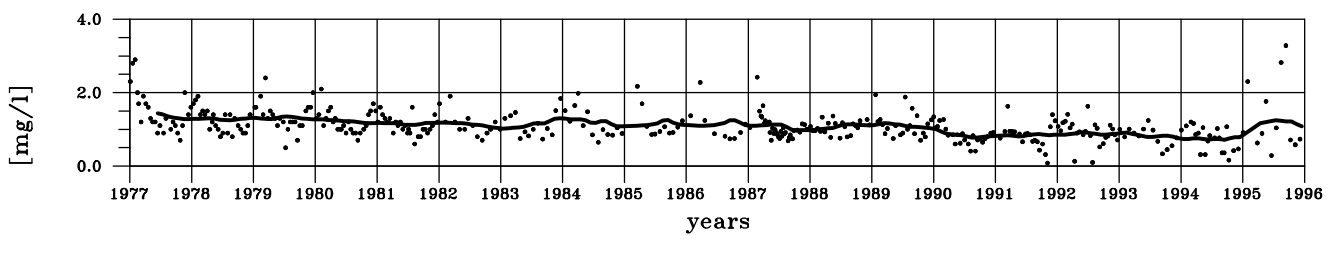
minimum: 0.39 mg/l March 2008

maximum: 1.43 mg/l June 1977

ANNUAL CYCLE

minimum: 0.67 mg/l October, rel. stdev: 0.41

maximum: 1.04 mg/l March, rel. stdev: 0.51



Nitrate + Nitrite from Haringvliet

TIME SERIES

number of data: 651

mean: 3.20 mg/l

relative standard deviation: 0.30

minimum: 0.08 mg/l March 28, 1990

maximum: 5.38 mg/l December 20, 1983

LOW PASS

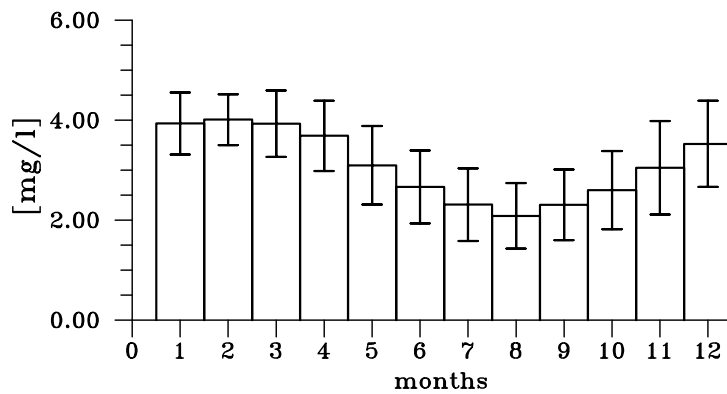
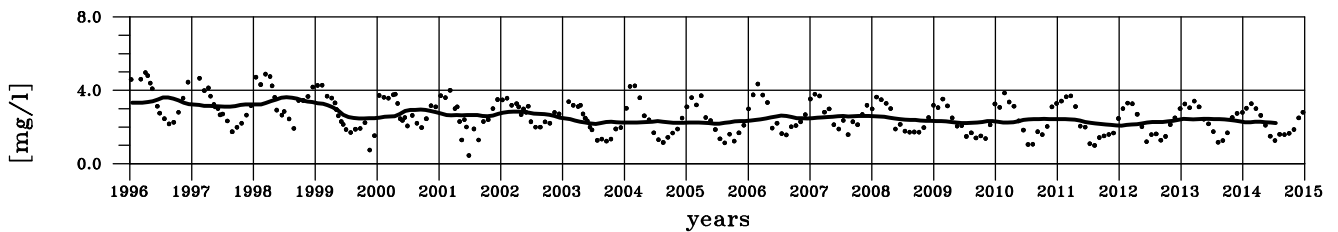
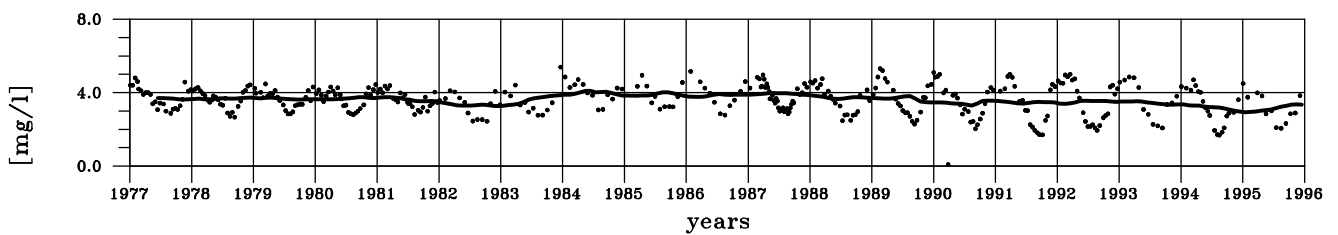
minimum: 2.07 mg/l January 2012

maximum: 4.10 mg/l May 1984

ANNUAL CYCLE

minimum: 2.09 mg/l August, rel. stdev: 0.31

maximum: 4.01 mg/l February, rel. stdev: 0.13



Ammonium from Haringvliet

TIME SERIES

number of data: 599

mean: 0.25 mg/l

relative standard deviation: 1.12

minimum: 0.00 mg/l September 11, 1989

maximum: 2.04 mg/l March 28, 1990

LOW PASS

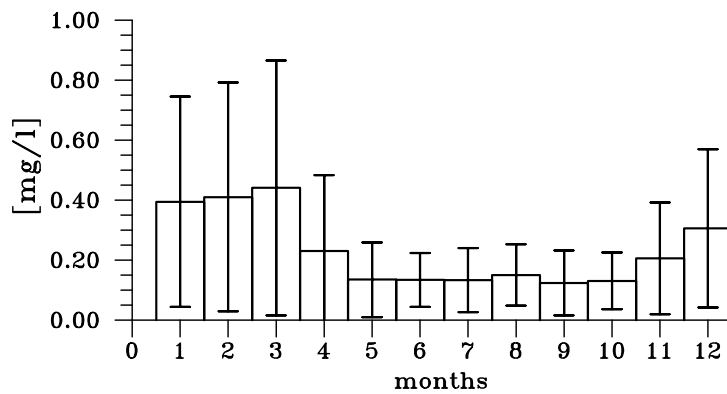
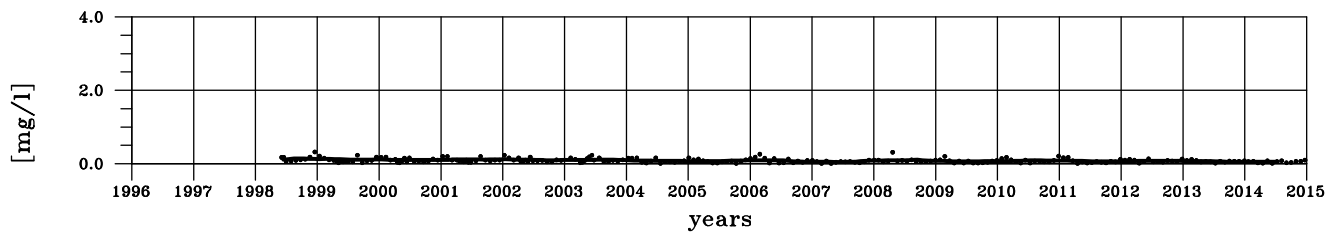
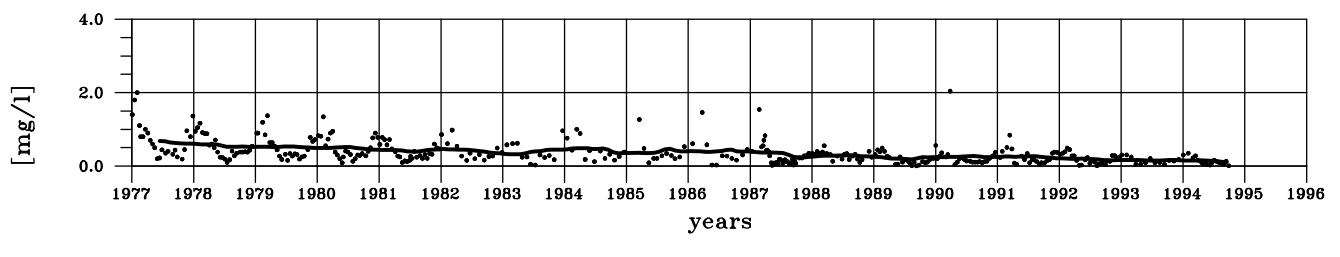
minimum: 0.05 mg/l May 2007

maximum: 0.68 mg/l June 1977

ANNUAL CYCLE

minimum: 0.12 mg/l September, rel. stdev: 0.87

maximum: 0.44 mg/l March, rel. stdev: 0.96



Total Phosphorus from Haringvliet

TIME SERIES

number of data: 648

mean: 0.22 mg/l

relative standard deviation: 0.57

minimum: 0.03 mg/l May 17, 2011

maximum: 1.55 mg/l April 14, 1994

LOW PASS

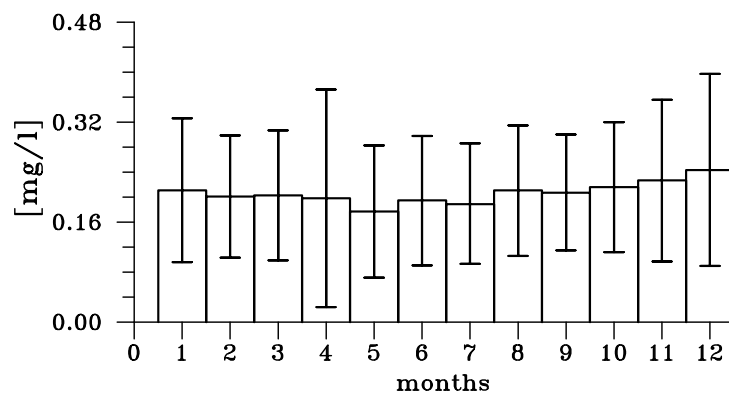
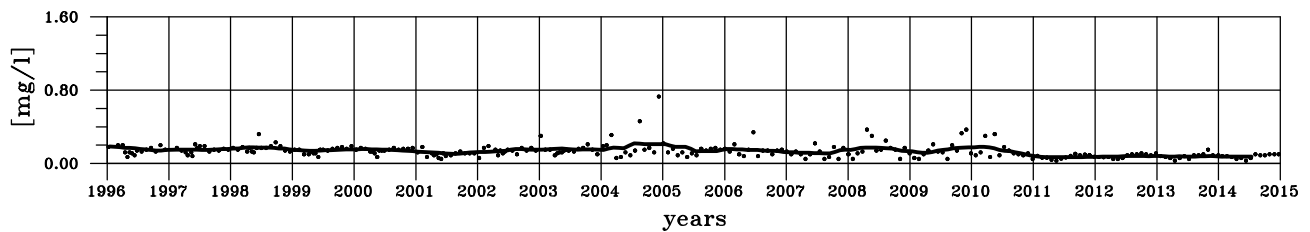
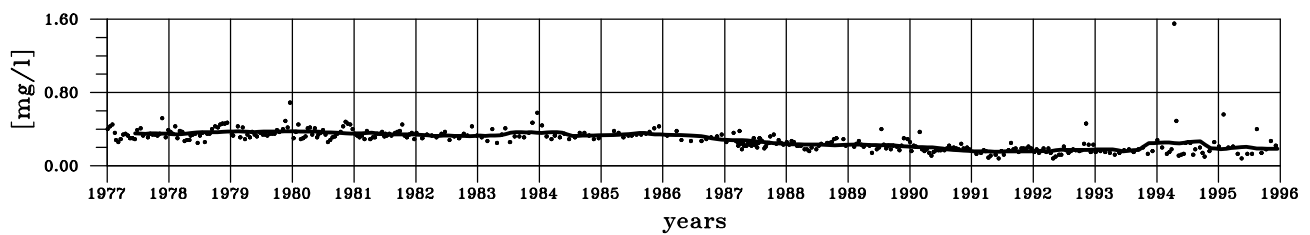
minimum: 0.07 mg/l May 2011

maximum: 0.38 mg/l January 1980

ANNUAL CYCLE

minimum: 0.18 mg/l May, rel. stdev: 0.60

maximum: 0.24 mg/l December, rel. stdev: 0.63



Phosphate from Haringvliet

TIME SERIES

number of data: 647

mean: 0.15 mg/l

relative standard deviation: 0.64

minimum: 0.00 mg/l April 24, 2007

maximum: 0.51 mg/l December 20, 1983

LOW PASS

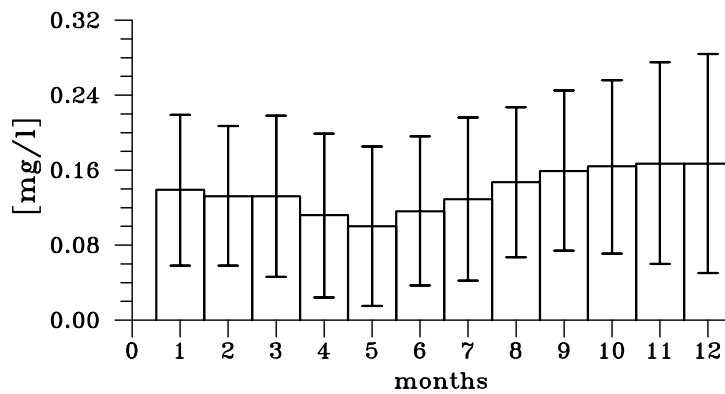
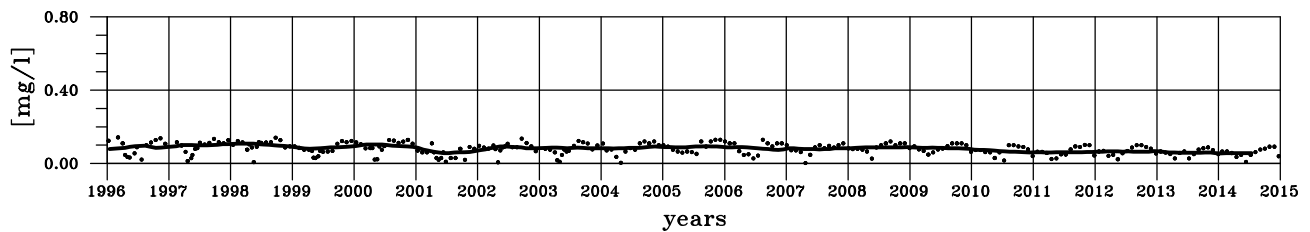
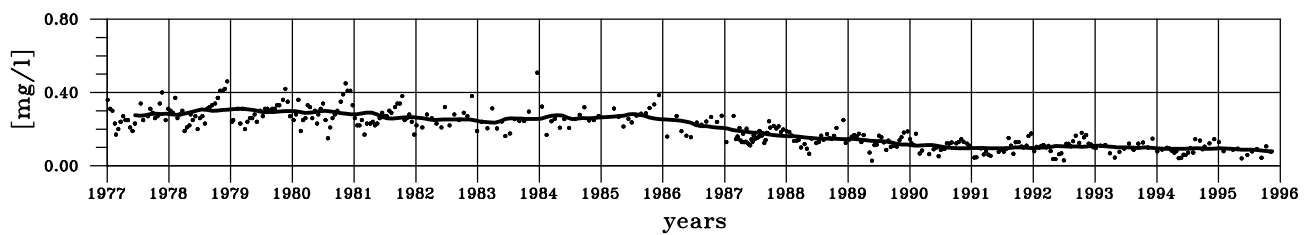
minimum: 0.05 mg/l January 2014

maximum: 0.31 mg/l February 1979

ANNUAL CYCLE

minimum: 0.10 mg/l May, rel. stdev: 0.85

maximum: 0.17 mg/l November, rel. stdev: 0.64



Silicate from Haringvliet

TIME SERIES

number of data: 586

mean: 1.99 mg/l

relative standard deviation: 0.64

minimum: 0.01 mg/l May 16, 1988

maximum: 7.46 mg/l March 28, 1990

LOW PASS

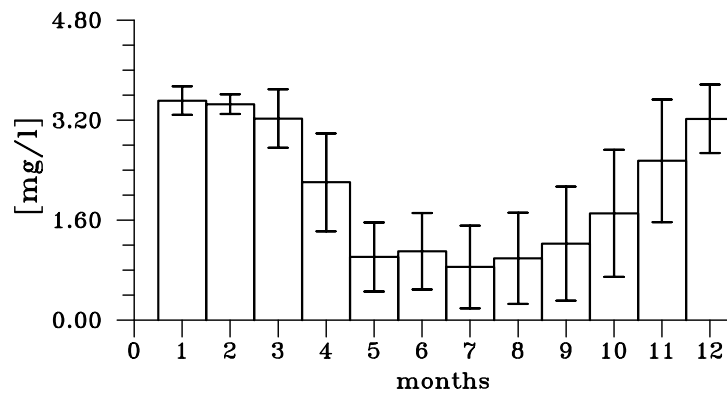
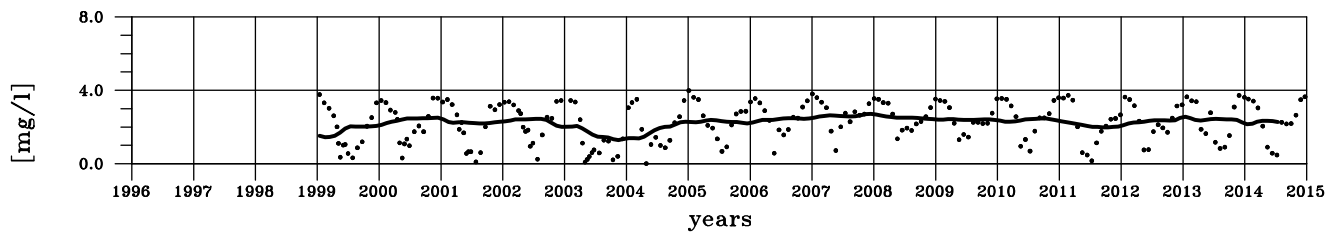
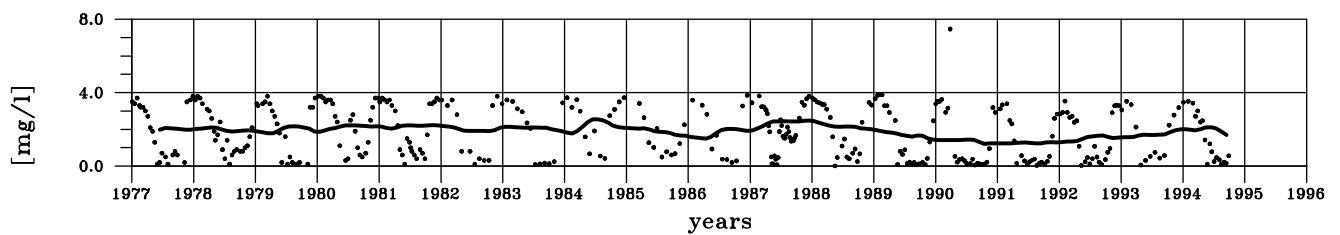
minimum: 1.21 mg/l October 1990

maximum: 2.72 mg/l December 2007

ANNUAL CYCLE

minimum: 0.85 mg/l July, rel. stdev: 0.78

maximum: 3.51 mg/l January, rel. stdev: 0.07



Chloride from Haringvliet

TIME SERIES

number of data: 334

mean: 108 *mg/l*

relative standard deviation: 0.55

minimum: 23 *mg/l* May 15, 2001

maximum: 340 *mg/l* November 4, 1991

LOW PASS

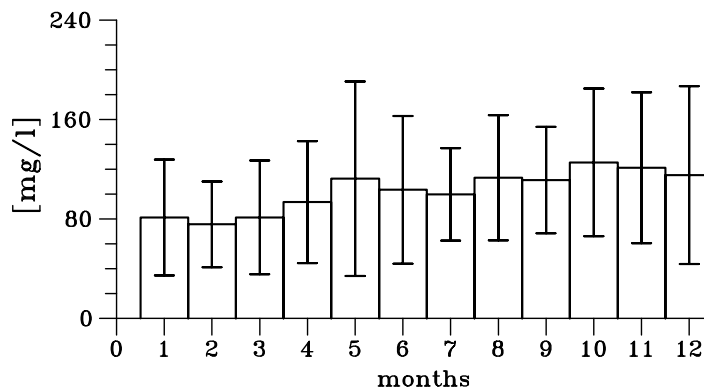
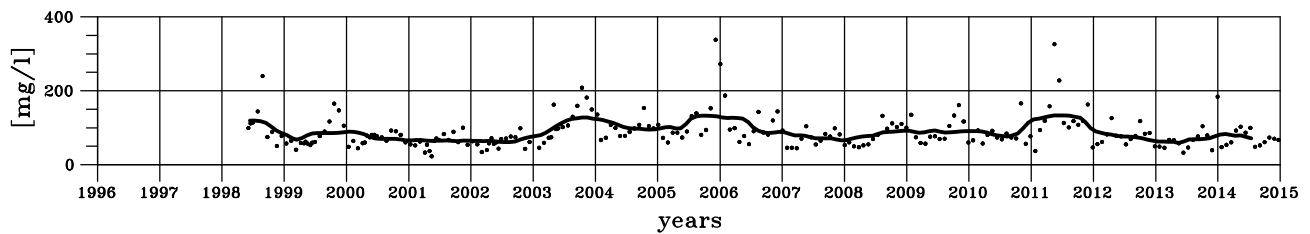
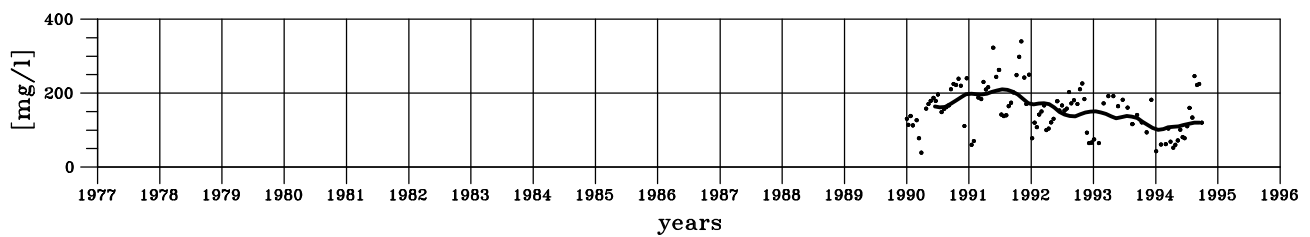
minimum: 59 *mg/l* May 2013

maximum: 210 *mg/l* July 1991

ANNUAL CYCLE

minimum: 76 *mg/l* February, rel. stdev: 0.45

maximum: 126 *mg/l* October, rel. stdev: 0.47



3.2.5 River Scheldt

The river Scheldt actually originates from Belgium. RIKZ in the Netherlands could therefore only provide data for the Belgium/Dutch border at location Schaar van Ouden Doel. The discharge data were available every 10 days whereas all concentrations were measured every two weeks.

Discharge from River Scheldt

TIME SERIES

number of data: 9594

mean: $136 \text{ m}^3/\text{s}$

relative standard deviation: 0.72

minimum: $17 \text{ m}^3/\text{s}$ July 21, 2002

maximum: $753 \text{ m}^3/\text{s}$ December 21, 1993

LOW PASS

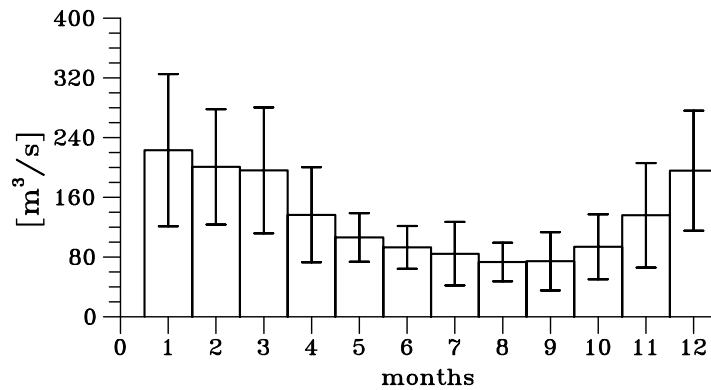
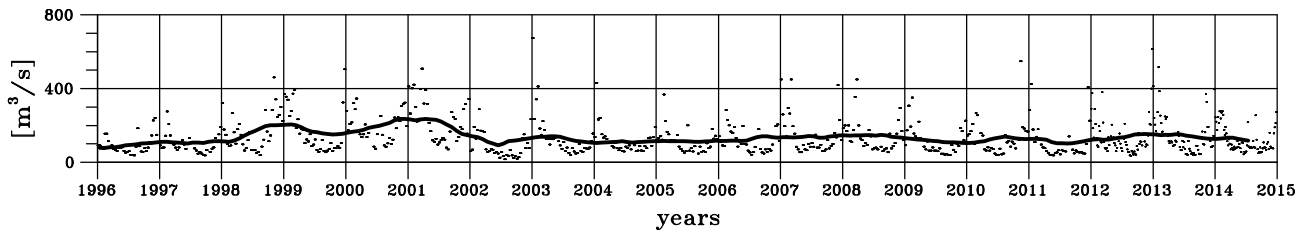
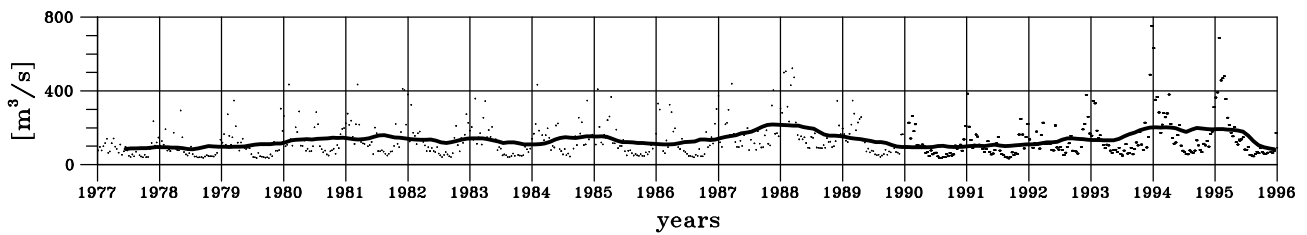
minimum: $79 \text{ m}^3/\text{s}$ January 1996

maximum: $236 \text{ m}^3/\text{s}$ April 2001

ANNUAL CYCLE

minimum: $73 \text{ m}^3/\text{s}$ August, rel. stdev: 0.35

maximum: $223 \text{ m}^3/\text{s}$ January, rel. stdev: 0.46



Total Nitrogen from River Scheldt

TIME SERIES

number of data: 964

mean: 6.21 mg/l

relative standard deviation: 0.35

minimum: 1.66 mg/l October 6, 2005

maximum: 14.58 mg/l March 2, 1987

LOW PASS

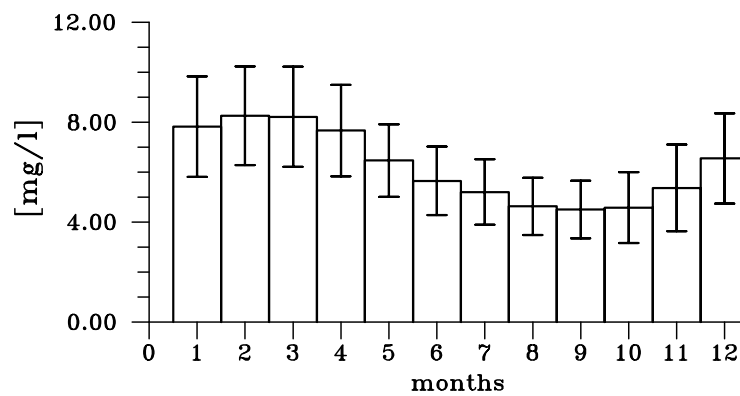
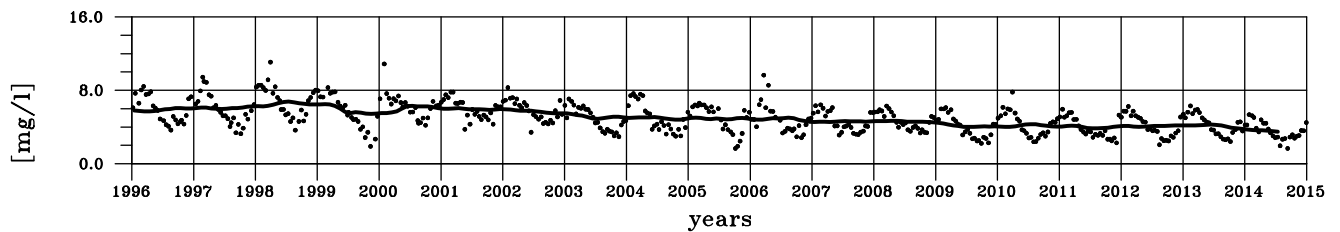
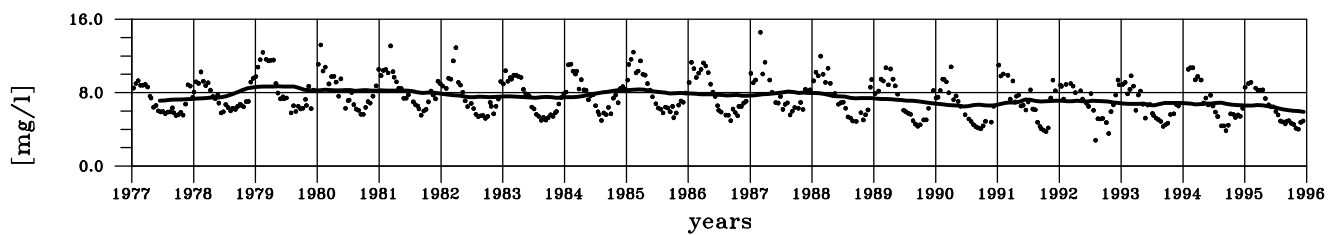
minimum: 3.49 mg/l July 2014

maximum: 8.69 mg/l May 1979

ANNUAL CYCLE

minimum: 4.50 mg/l September, rel. stdev: 0.26

maximum: 8.26 mg/l February, rel. stdev: 0.24



Kjeldahl Nitrogen from River Scheldt

TIME SERIES

number of data: 969

mean: 2.10 mg/l

relative standard deviation: 0.85

minimum: 0.10 mg/l October 11, 1999

maximum: 9.96 mg/l March 2, 1987

LOW PASS

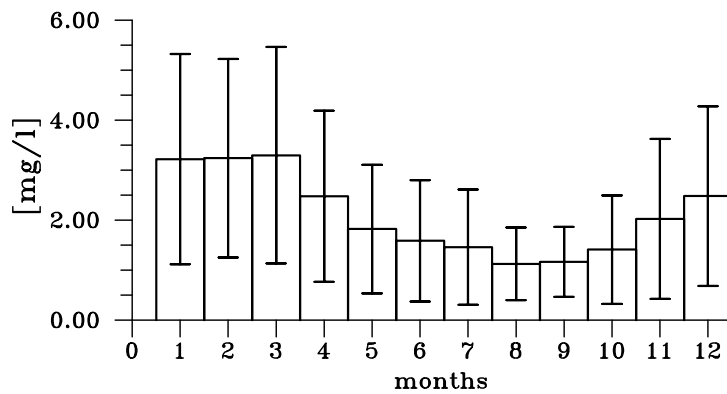
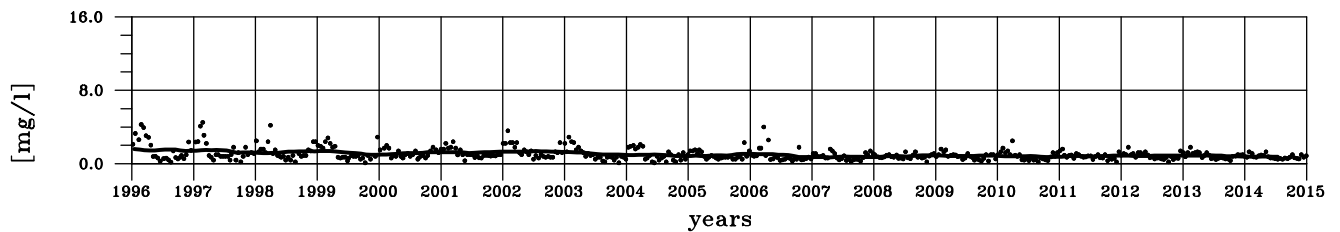
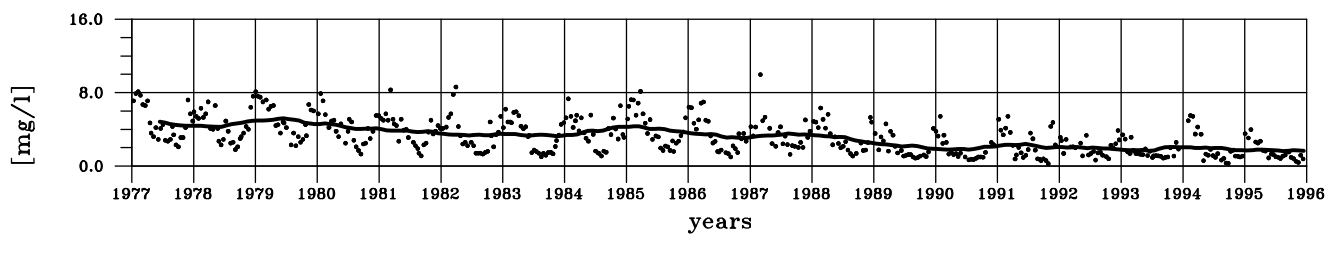
minimum: 0.71 mg/l April 2007

maximum: 5.20 mg/l June 1979

ANNUAL CYCLE

minimum: 1.13 mg/l August, rel. stdev: 0.65

maximum: 3.30 mg/l March, rel. stdev: 0.66



Nitrate + Nitrite from River Scheldt

TIME SERIES

number of data: 974

mean: 4.11 mg/l

relative standard deviation: 0.29

minimum: 0.16 mg/l November 26, 1979

maximum: 9.30 mg/l April 2, 1990

LOW PASS

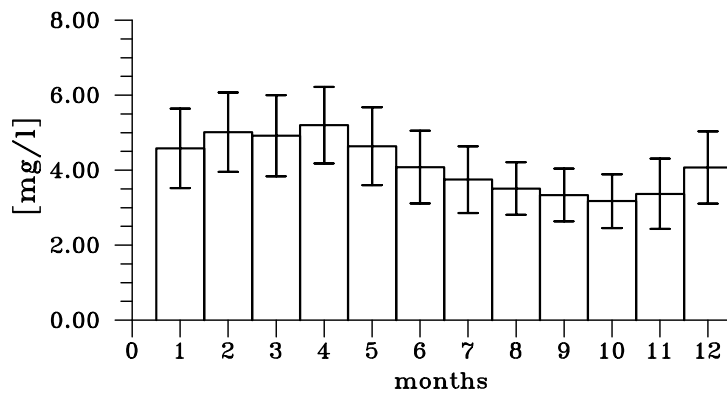
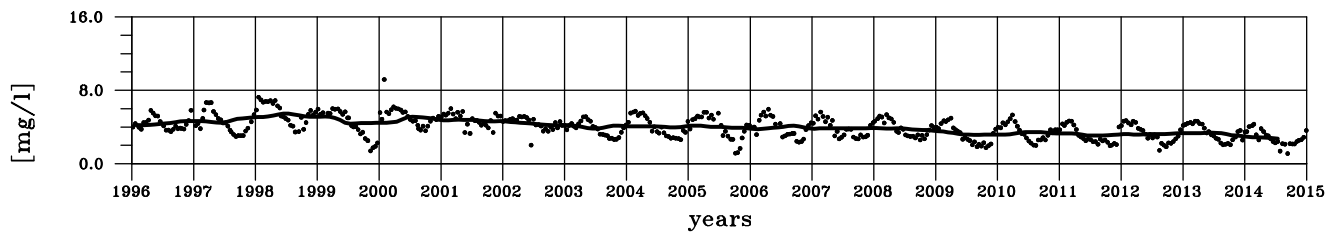
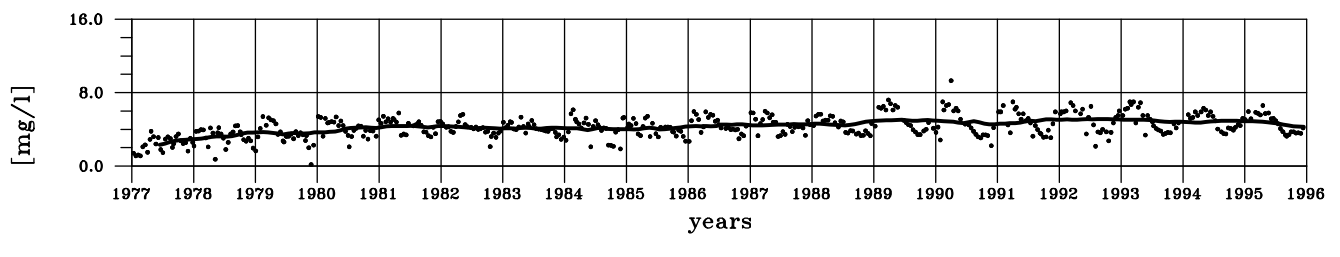
minimum: 2.32 mg/l June 1977

maximum: 5.47 mg/l June 1998

ANNUAL CYCLE

minimum: 3.17 mg/l October, rel. stdev: 0.23

maximum: 5.20 mg/l April, rel. stdev: 0.20



Ammonium from River Scheldt

TIME SERIES

number of data: 889

mean: 1.15 mg/l

relative standard deviation: 1.20

minimum: 0.01 mg/l September 13, 1999

maximum: 7.40 mg/l April 4, 1977

LOW PASS

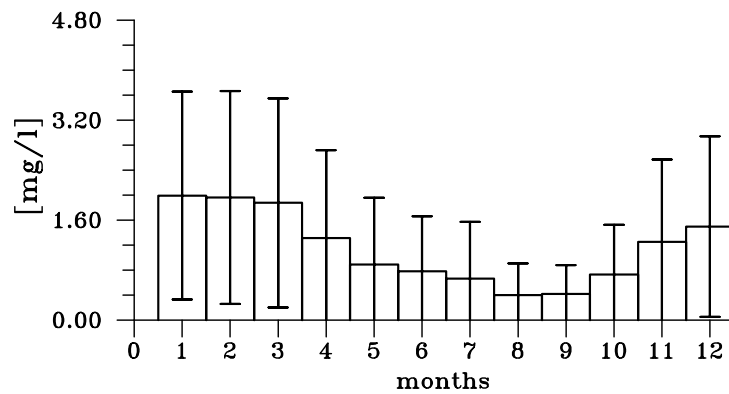
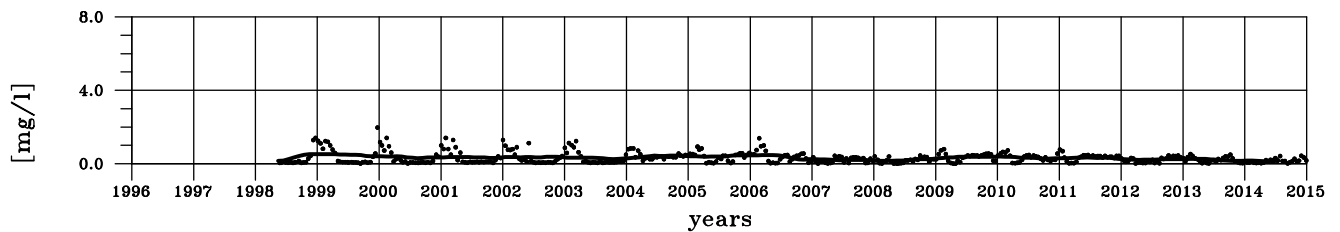
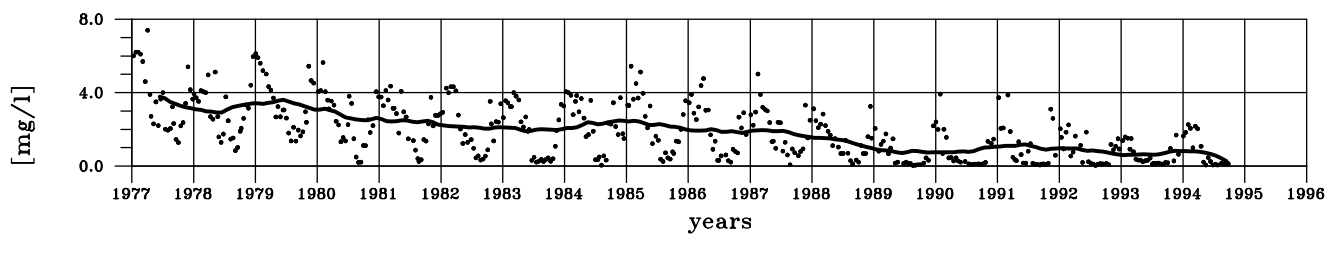
minimum: 0.13 mg/l May 2014

maximum: 3.78 mg/l June 1977

ANNUAL CYCLE

minimum: 0.40 mg/l August, rel. stdev: 1.28

maximum: 1.99 mg/l January, rel. stdev: 0.84



Total Phosphorus from River Scheldt

TIME SERIES

number of data: 969

mean: 0.62 mg/l

relative standard deviation: 0.75

minimum: 0.05 mg/l April 4, 2007

maximum: 7.70 mg/l February 21, 1977

LOW PASS

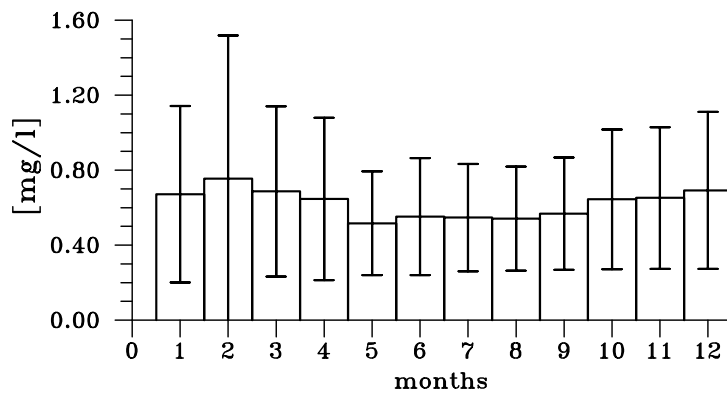
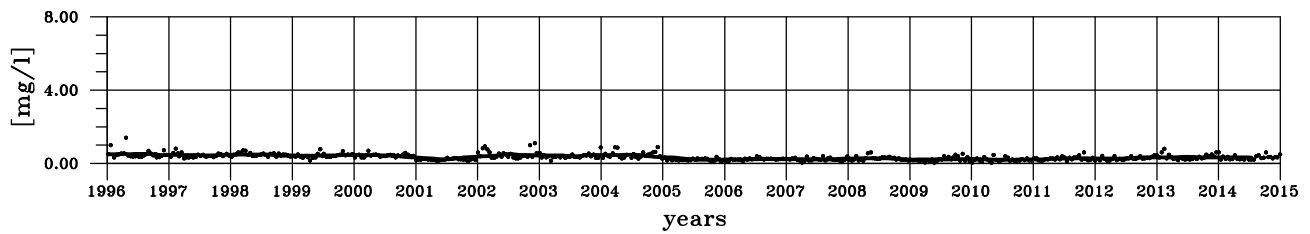
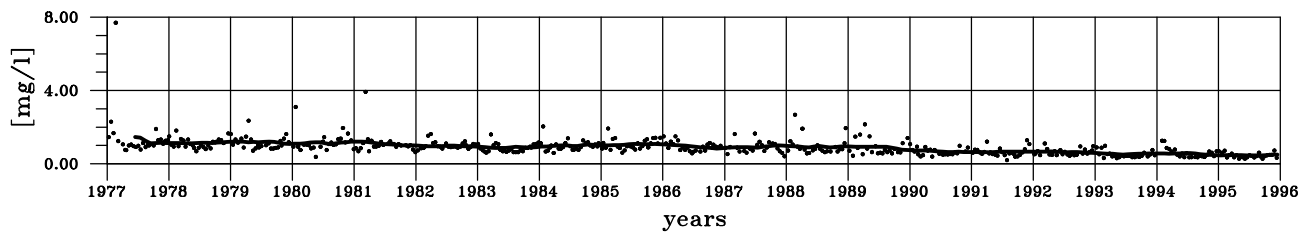
minimum: 0.20 mg/l June 2010

maximum: 1.46 mg/l June 1977

ANNUAL CYCLE

minimum: 0.52 mg/l May, rel. stdev: 0.54

maximum: 0.75 mg/l February, rel. stdev: 1.02



Phosphate from River Scheldt

TIME SERIES

number of data: 975

mean: 0.29 mg/l

relative standard deviation: 0.67

minimum: 0.02 mg/l January 31, 2002

maximum: 1.02 mg/l July 7, 1980

LOW PASS

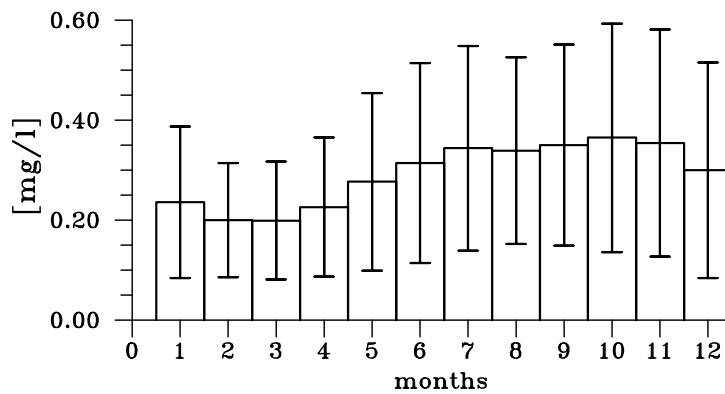
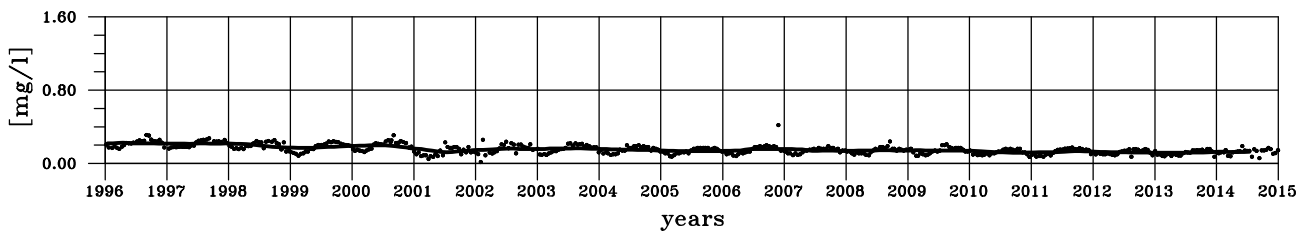
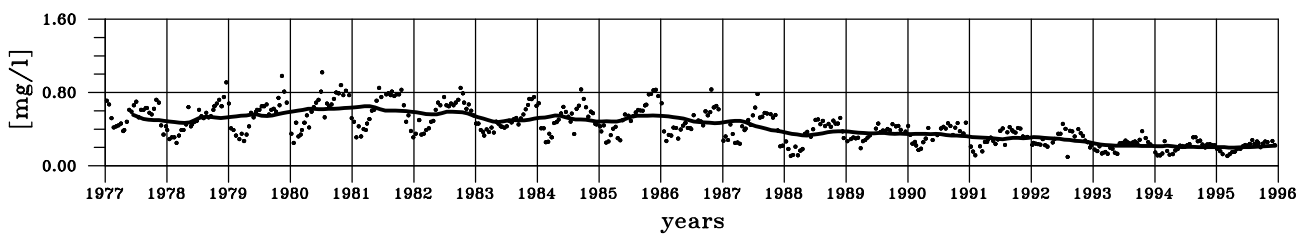
minimum: 0.12 mg/l April 2013

maximum: 0.65 mg/l April 1981

ANNUAL CYCLE

minimum: 0.20 mg/l March, rel. stdev: 0.59

maximum: 0.36 mg/l October, rel. stdev: 0.63



Silicate from River Scheldt

TIME SERIES

number of data: 872

mean: 3.52 mg/l

relative standard deviation: 0.47

minimum: 0.04 mg/l May 15, 2008

maximum: 7.40 mg/l February 4, 1980

LOW PASS

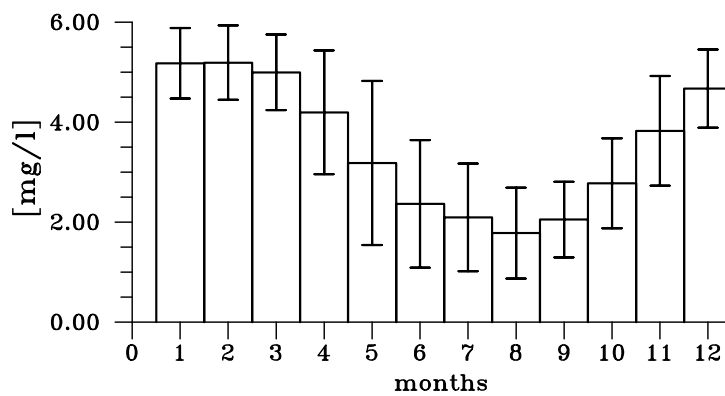
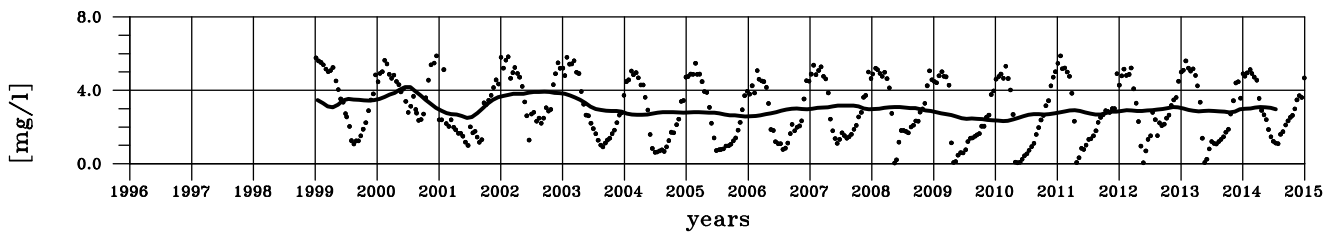
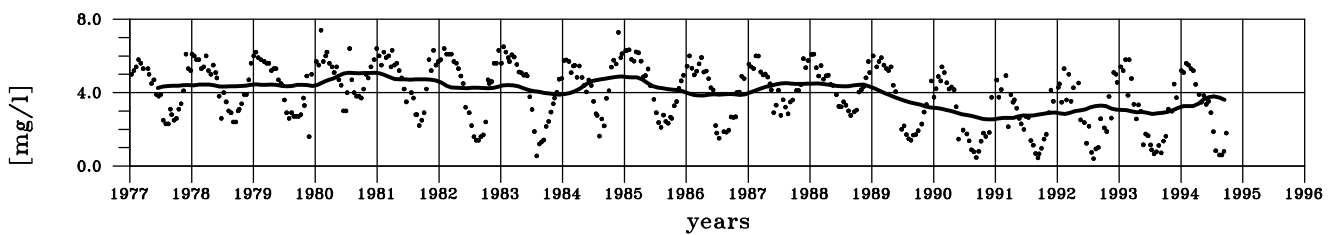
minimum: 2.33 mg/l February 2010

maximum: 5.09 mg/l July 1980

ANNUAL CYCLE

minimum: 1.78 mg/l August, rel. stdev: 0.51

maximum: 5.19 mg/l February, rel. stdev: 0.14



Chloride from River Scheldt

TIME SERIES

number of data: 543

mean: 4094 *mg/l*

relative standard deviation: 0.50

minimum: 61 *mg/l* June 3, 2002

maximum: 8880 *mg/l* August 13, 1990

LOW PASS

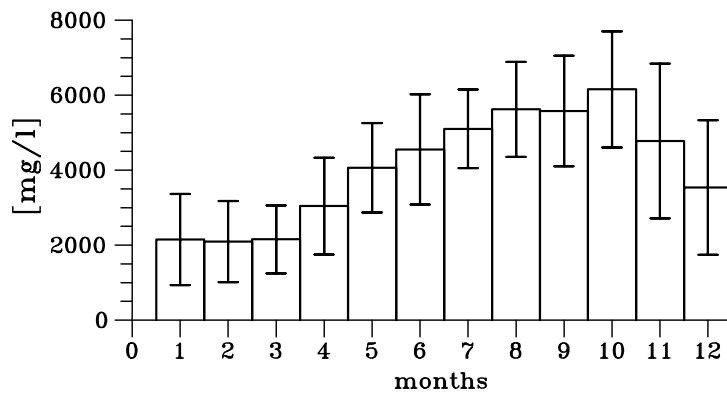
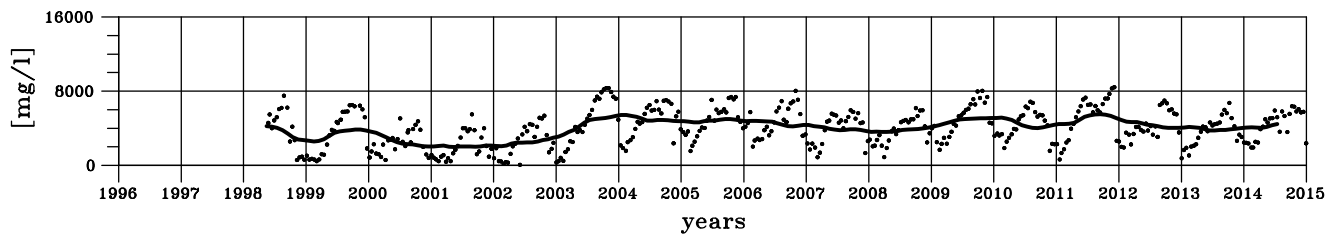
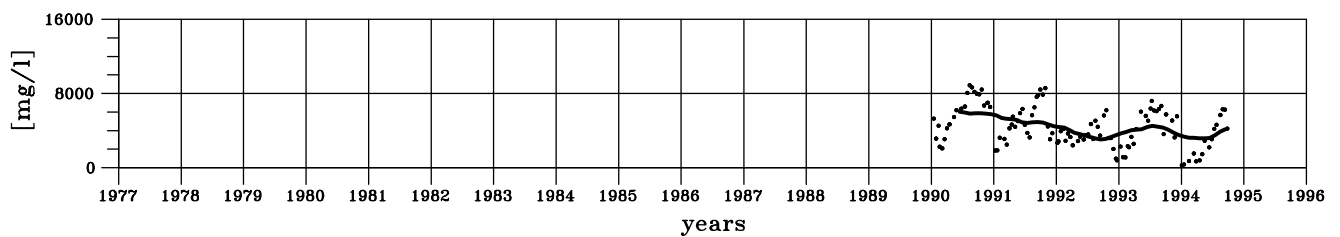
minimum: 1968 *mg/l* May 2001

maximum: 6026 *mg/l* June 1990

ANNUAL CYCLE

minimum: 2094 *mg/l* February, rel. stdev: 0.52

maximum: 6154 *mg/l* October, rel. stdev: 0.25



4 Methods for river load estimation

In this chapter a method for calculating daily nutrient loads will be presented. Based on a comparison of different methods for the calculation of yearly load estimates by De Vries & Klavers (1994), an appropriate method for calculating daily river loads of nutrients was deduced (de Vries, pers. com.) and the adopted method will be demonstrated.

There are several problems when calculating load estimates for substances transported by a river. Firstly there exists a spatially inhomogeneous distribution of the concentration across the river. A single inlet of kali salt, e.g. from an incoming river at the bank of the river Elbe, can be identified by a cross section tenth of kilometers downstream of the inlet (Bergemann, pers. comm.). Since in most cases only point measurements are available, we have to ignore this problem by simply assuming a spatially homogeneous distribution across the river. We therefore take the available discrete point measurements as representative for the whole cross-section of the river.

Secondly, one cannot expect to represent the inhomogenities of concentration values in time by one, two or four measurements per month. The question of temporal interpolation of concentration measurements in order to calculate yearly load estimates is dealt with in the paper by De Vries & Klavers (1994). For these yearly load estimates 7 interpolation methods were tested by De Vries & Klavers (1994), of which 3 will be discussed here. Finally a modified method for the use of calculating daily load estimates and the resulting formulae will be presented, using the following abbreviations:

C_i :	mean concentration at day i
Q_i :	mean discharge at day i
C_i^{LI} :	C_i if a concentration value is available for day i, otherwise linearly temporal interpolated concentration value
Q_i^{LI} :	Q_i if a discharge value is available for day i, otherwise linearly temporal interpolated discharge value
n :	number of days per year with concentration values
m :	number of days per year with discharge values
k :	number of days per year
L :	yearly load

(1) **Simple method**, using mean annual values for concentration and discharge

$$L = k \left(\frac{1}{n} \sum_{i=1}^n C_i \right) \left(\frac{1}{m} \sum_{i=1}^m Q_i \right)$$

(2) **Direct method**, using daily discharge and concentration values when available

$$L = \frac{k}{n} \sum_{i=1}^n C_i \cdot Q_i$$

For method (2) the discharge values have to be available for the same day as the concentration measurements. Only when both data are available for the same day the product for that day can be calculated.

(3) **Linear interpolation method**, using interpolated concentrations

$$L = \sum_{i=1}^k C_i^{LI} Q_i$$

For method (3) it has to be assumed that daily discharge values are available. Since the discharge data as presented in chapter 3 are not always available on a daily basis for all rivers an extended method of the linear interpolation method is presented:

(4) **Double linear interpolation method**, using daily interpolated values for discharge and concentration

$$L = \sum_{i=1}^k C_i^{LI} Q_i^{LI}$$

De Vries & Klavers (1994) investigated the quality of their load estimates using the terms accuracy and precision. Accuracy determines the distance from the yearly load as it would be measured. Precision is determined by the scattering of repeated calculations with randomly chosen days of measurement.

For the calculation of daily loads a maximum of temporal resolution and a maximum of accuracy and precision have to be combined. Because of this the **Double linear interpolation method** (4) has been chosen. The i-th term of the sum is identified with the daily load L_i

$$L_i = C_i^{LI} Q_i^{LI}$$

The **Simple method** (1) would not be appropriate as it smears out all temporal variability while the **Direct method** (2) has the disadvantage that a lot of discharge as well as concentration measurements have to be ignored. When daily values of discharge are available the discussion by De Vries & Klavers (1994) concerning the **Linear interpolation method** (3) can be adopted: In case of positive correlation between concentration and discharge the load will be underestimated. In case of negative correlation the load will be overestimated. If the concentration does not vary with varying discharge this method results in load estimates which would be similar to those resulting from calculations with daily concentration measurements. The reason for the systematical under- or overestimation results from the frequency distribution of the discharge values of almost all rivers: it is not symmetric and exhibits rare large events.

In the first report (Lenhart *et al.*, 1996) the correlation between discharge and nutrient concentration had been plotted for all the parameters. From these figures one can see that the correlation between nitrogen compounds and discharge is weakly positive in most cases. Phosphorus compounds show in most cases a negative correlation. Silicate exhibits in most cases strongly positive correlation. Following the discussion above we can conclude that the load estimates of nitrogen compounds will not result in a systematic error. The load estimates of phosphorus compounds may be overestimated. Silicate loads may be underestimated.

In the following chapter the resulting time series of daily load estimates together with the low-pass filtered curve will be presented in combination with their statistical properties, as it was done for the presentation of the raw data. In a separate figure, the climatological monthly means are added. In order to allow comparisons with literature values, e.g. the Quality Status Report 2000 (OSPAR, 2000), the results of the daily load calculations are given as yearly integrals for all available years.

Two final comments should be made. First, in the calculation of the mass, the units refer to the relevant elements N, P or Si, e.g. tons $NO_3 - N$ per day. Second, there are differences between the presented data and those from Lenhart *et al.* (1996), which are related to zero values for the load minimum. Since these values stem from zero discharge values which enter the load calculation, the related zero loads in this report should be taken as the realistic ones. Additionally negative discharge values for the Nieuwe Waterweg exist. They represent short events of North Sea outflow into the river system. These events could be found in the time series of discharge illustrated. The corresponding loads however were defined as zero.

5 Resulting river load estimates

5.1 Loads of River Elbe

Total Nitrogen load for River Elbe

ANNUAL LOADS

year	kt/y	year	kt/y	year	kt/y	year	kt/y	year	kt/y	year	kt/y
		1984	138.3	1991	72.0	1998	110.0	2005	84.2	2012	66.8
1978	160.6	1985	140.3	1992	106.0	1999	116.7	2006	84.0	2013	121.8
1979	182.6	1986	168.5	1993	94.3	2000	103.7	2007	82.1	2014	47.9
1980	217.4	1987	255.2	1994	175.1	2001	89.6	2008	76.8		
1981	273.7	1988	195.9	1995	165.3	2002	157.8	2009	74.6		
1982	185.1	1989	119.6	1996	121.8	2003	91.3	2010	138.8		
1983	140.4	1990	97.7	1997	109.3	2004	66.0	2011	111.3		

TIME SERIES

mean: 341.7 t/d

relative standard deviation: 0.86

minimum: 31.4 t/d August 18, 2003

maximum: 2419.3 t/d April 5, 1988

LOW PASS

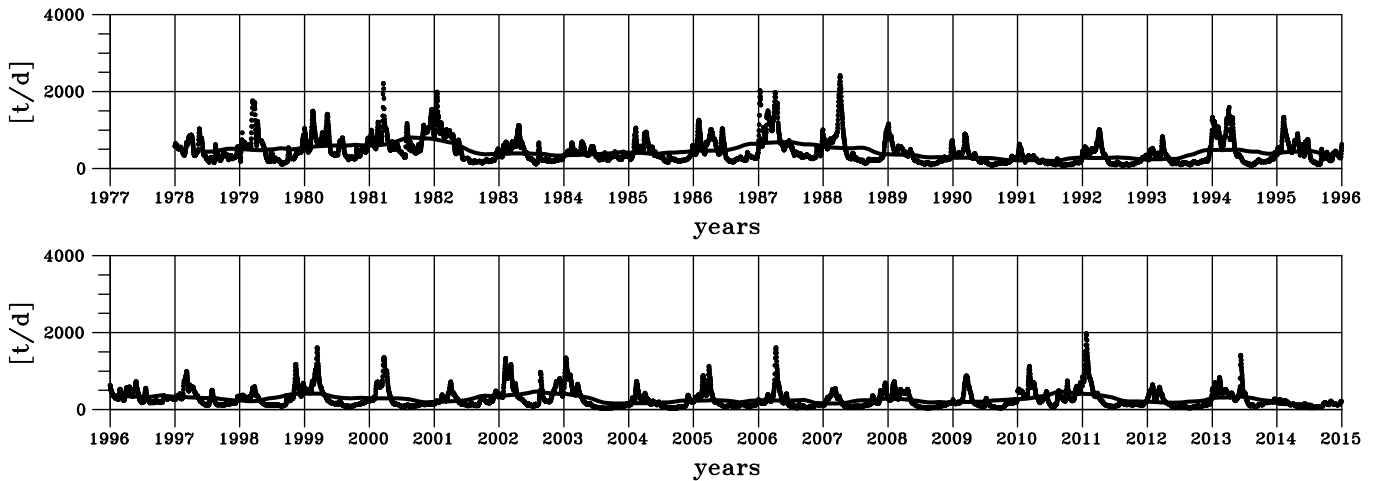
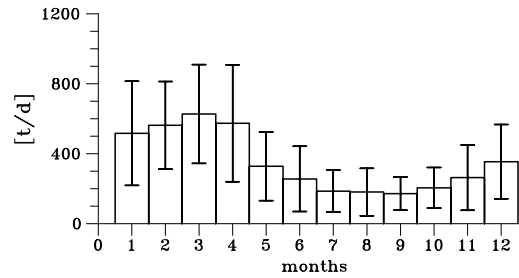
minimum: 127.2 t/d July 2014

maximum: 805.6 t/d August 1981

ANNUAL CYCLE

minimum: 172.3 t/d September, rel. stdev: 0.55

maximum: 626.8 t/d March, rel. stdev: 0.45



Nitrate load for River Elbe

ANNUAL LOADS

year	kt/y	year	kt/y	year	kt/y	year	kt/y	year	kt/y	year	kt/y
1977	71.0	1984	67.5	1991	51.5	1998	81.0	2005	70.8	2012	53.8
1978	62.1	1985	63.9	1992	83.8	1999	87.0	2006	73.5	2013	99.4
1979	83.1	1986	101.5	1993	69.7	2000	79.6	2007	67.6	2014	38.0
1980	131.8	1987	179.4	1994	132.6	2001	65.2	2008	61.1		
1981	180.6	1988	145.0	1995	127.8	2002	127.3	2009	60.9		
1982	102.0	1989	79.3	1996	87.9	2003	77.4	2010	118.5		
1983	70.3	1990	65.9	1997	78.5	2004	54.0	2011	91.1		

TIME SERIES

mean: 240.8 t/d

relative standard deviation: 0.91

minimum: 15.6 t/d September 1, 2003

maximum: 2090.8 t/d April 5, 1988

LOW PASS

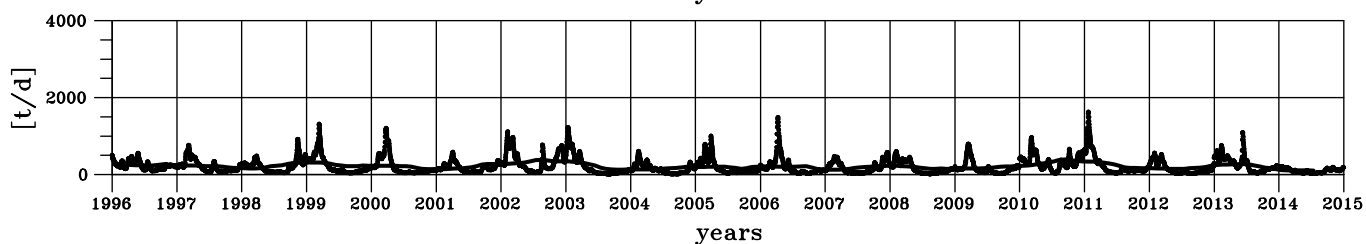
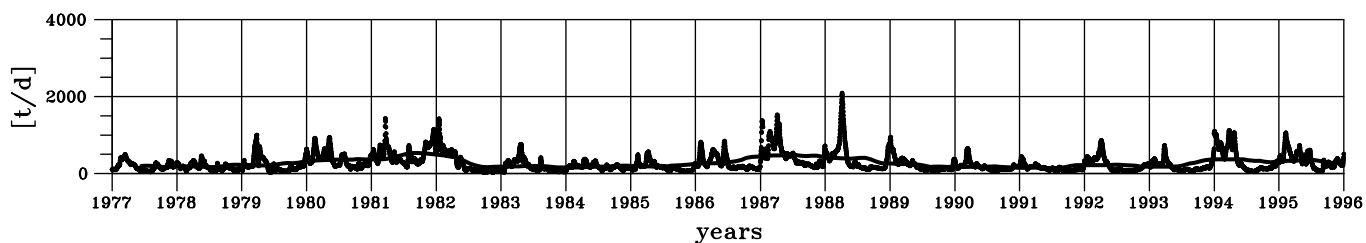
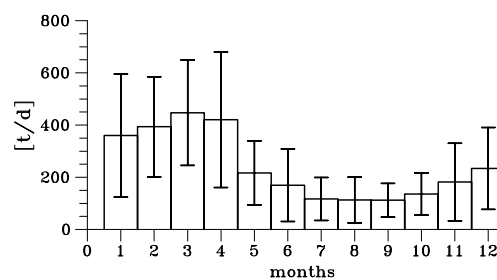
minimum: 100.5 t/d July 2014

maximum: 537.7 t/d August 1981

ANNUAL CYCLE

minimum: 111.8 t/d September, rel. stdev: 0.58

maximum: 447.4 t/d March, rel. stdev: 0.45



Ammonium load for River Elbe

ANNUAL LOADS

year	kt/y	year	kt/y	year	kt/y	year	kt/y	year	kt/y	year	kt/y
1977	51.3	1984	45.0	1991	10.2	1998	4.5	2005	3.8	2012	2.9
1978	39.3	1985	49.7	1992	7.9	1999	4.2	2006	4.4	2013	3.0
1979	46.3	1986	43.7	1993	7.1	2000	3.4	2007	3.2	2014	2.0
1980	43.7	1987	49.2	1994	7.7	2001	4.0	2008	2.9		
1981	43.3	1988	28.8	1995	7.0	2002	5.9	2009	2.8		
1982	45.4	1989	26.0	1996	7.2	2003	4.9	2010	3.8		
1983	43.0	1990	18.6	1997	4.7	2004	3.5	2011	3.9		

TIME SERIES

mean: 49.6 t/d

relative standard deviation: 1.38

minimum: 0.8 t/d August 8, 1994

maximum: 515.1 t/d January 10, 1987

LOW PASS

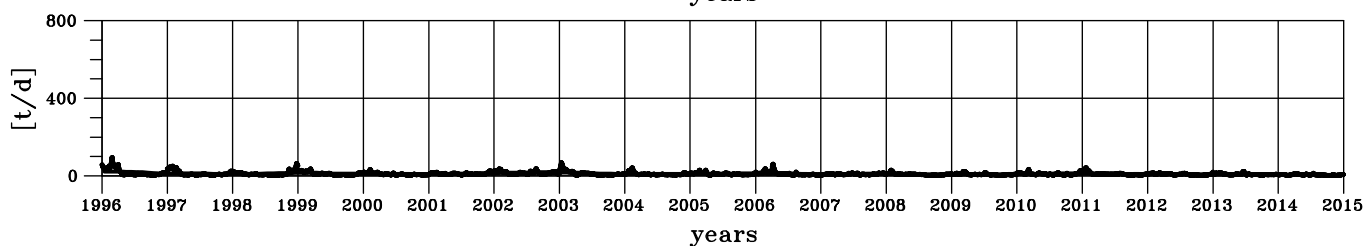
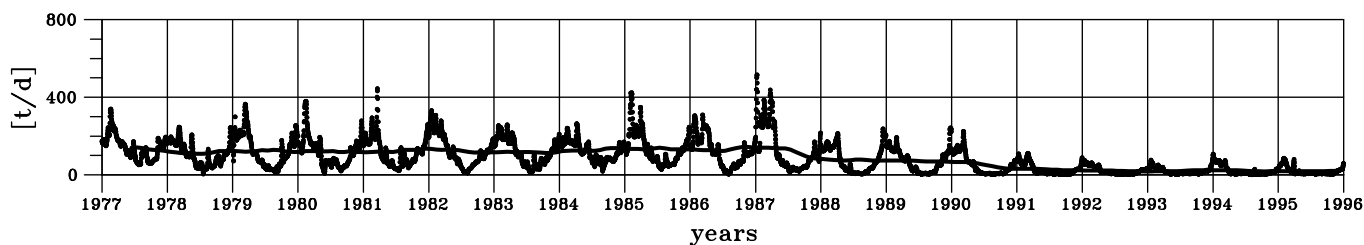
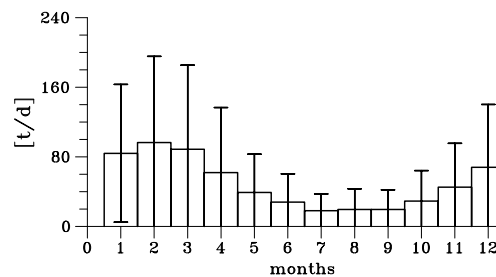
minimum: 5.4 t/d July 2014

maximum: 143.8 t/d November 1986

ANNUAL CYCLE

minimum: 18.2 t/d July, rel. stdev: 1.05

maximum: 96.4 t/d February, rel. stdev: 1.03



Total Phosphorus load for River Elbe

ANNUAL LOADS

year	kt/y	year	kt/y	year	kt/y	year	kt/y	year	kt/y	year	kt/y
		1984	8.8	1991	3.3	1998	4.6	2005	4.5	2012	3.2
1978	10.5	1985	8.9	1992	4.7	1999	4.6	2006	3.9	2013	4.2
1979	11.6	1986	8.6	1993	4.1	2000	4.3	2007	3.8	2014	2.7
1980	11.3	1987	9.2	1994	6.1	2001	4.7	2008	3.4		
1981	12.2	1988	8.2	1995	6.2	2002	6.8	2009	3.2		
1982	8.9	1989	5.7	1996	4.8	2003	3.6	2010	4.4		
1983	7.9	1990	4.5	1997	4.2	2004	3.5	2011	4.0		

TIME SERIES

mean: 17.1 t/d

relative standard deviation: 4.06

minimum: 2.8 t/d August 3, 2008

maximum: 141.0 t/d April 12, 1979

LOW PASS

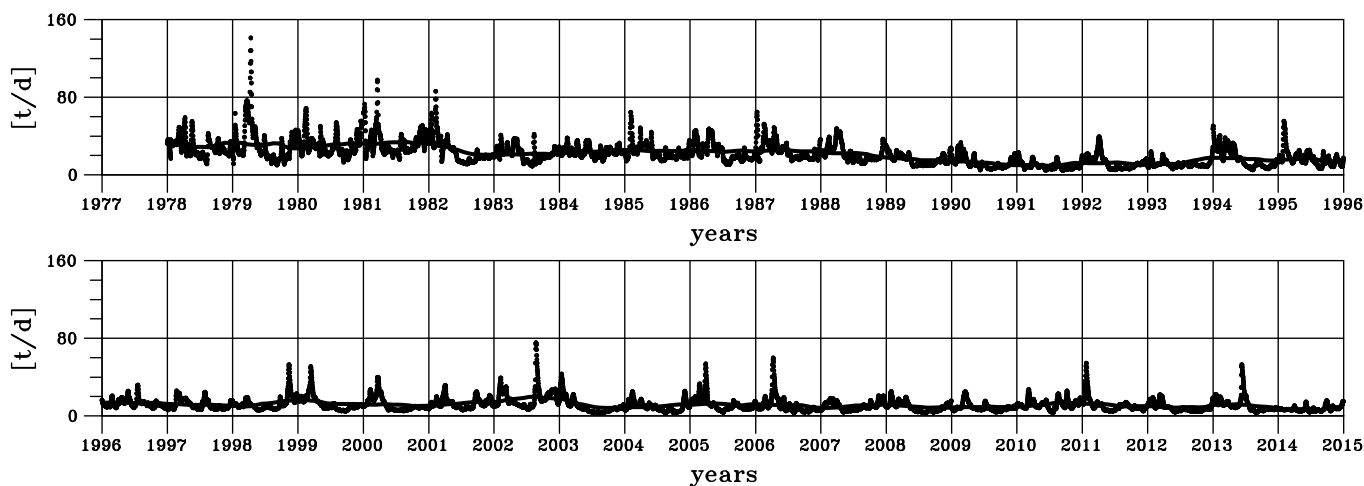
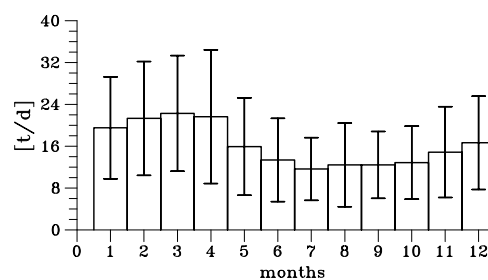
minimum: 6.4 t/d February 2014

maximum: 34.0 t/d August 1981

ANNUAL CYCLE

minimum: 11.7 t/d July, rel. stdev: 0.52

maximum: 22.3 t/d March, rel. stdev: 0.50



Phosphate load for River Elbe

ANNUAL LOADS

year	t/y	year	t/y	year	t/y	year	t/y	year	t/y	year	t/y
1977	6046	1984	4283	1991	1457	1998	1450	2005	1280	2012	927
1978	4456	1985	4306	1992	1598	1999	1155	2006	1044	2013	1383
1979	4651	1986	4147	1993	1537	2000	1267	2007	1322	2014	704
1980	5152	1987	3609	1994	1642	2001	1503	2008	967		
1981	5649	1988	3624	1995	1786	2002	2828	2009	949		
1982	4501	1989	2767	1996	1624	2003	1277	2010	1502		
1983	3775	1990	2120	1997	1318	2004	894	2011	1007		

TIME SERIES

mean: 6.6 t/d

relative standard deviation: 0.78

minimum: 0.2 t/d March 3, 2014

maximum: 41.4 t/d March 20, 1981

LOW PASS

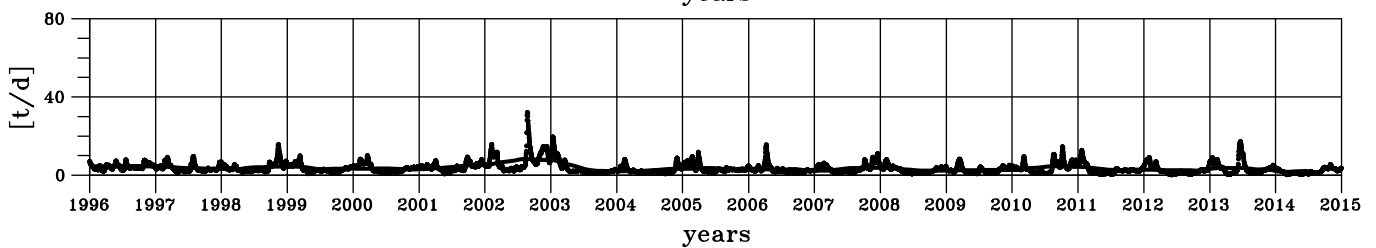
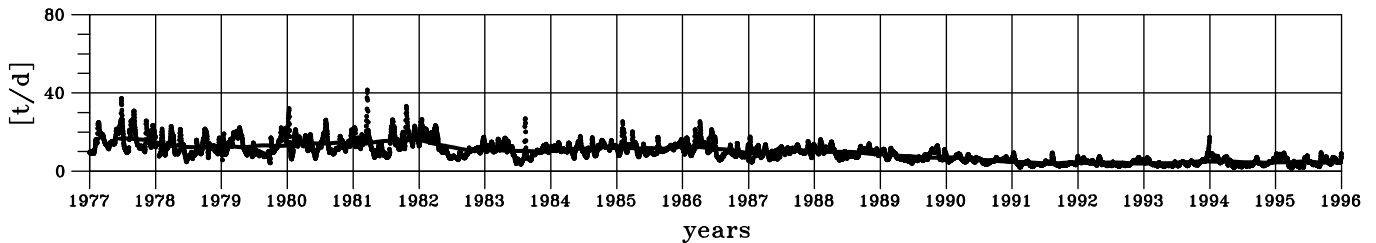
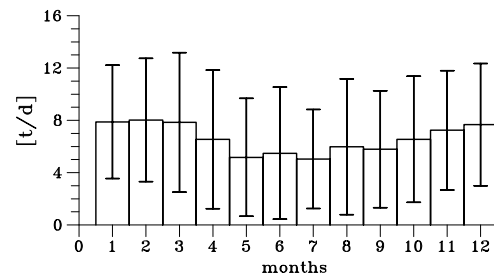
minimum: 1.7 t/d February 2014

maximum: 16.7 t/d July 1977

ANNUAL CYCLE

minimum: 5.0 t/d July, rel. stdev: 0.75

maximum: 8.0 t/d February, rel. stdev: 0.59



Silicate load for River Elbe

ANNUAL LOADS

year	kt/y	year	kt/y	year	kt/y	year	kt/y	year	kt/y	year	kt/y
				1991	38.9	1998	76.3	2005	72.1	2012	71.8
				1992	54.7	1999	68.1	2006	74.4	2013	123.4
				1993	57.5	2000	64.3	2007	80.7	2014	49.7
				1994	95.8	2001	65.7	2008	68.5		
		1988	106.9	1995	100.4	2002	150.2	2009	62.1		
		1989	66.9	1996	78.0	2003	75.2	2010	127.0		
		1990	53.0	1997	63.8	2004	46.8	2011	105.3		

TIME SERIES

mean: 153.0 t/d

relative standard deviation: 1.40

minimum: 0.5 t/d July 3, 2000

maximum: 1655.9 t/d January 23, 2011

LOW PASS

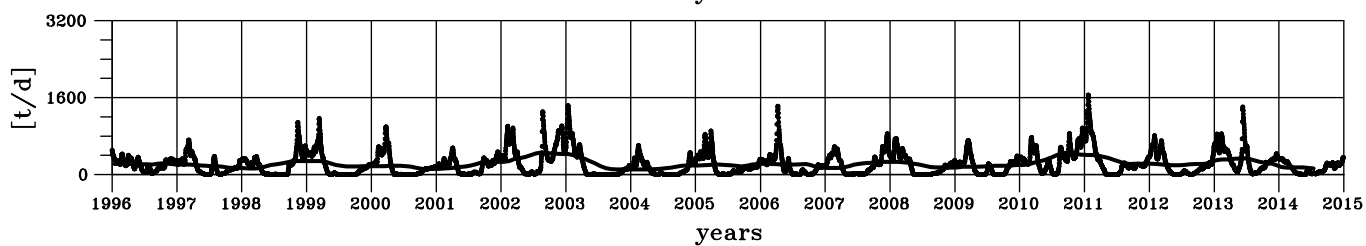
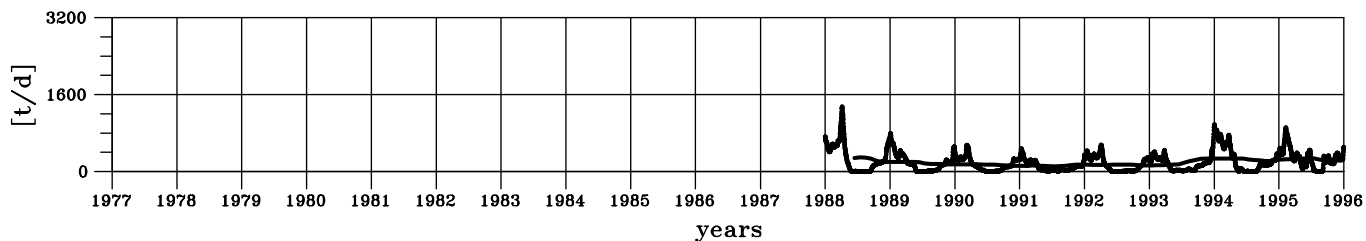
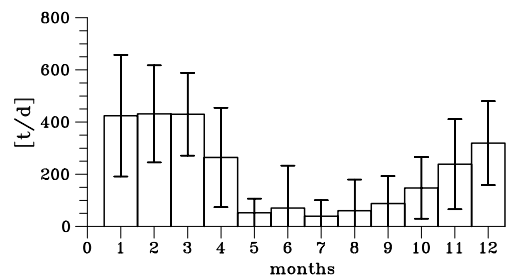
minimum: 104.1 t/d November 2003

maximum: 459.9 t/d August 2002

ANNUAL CYCLE

minimum: 39.3 t/d July, rel. stdev: 1.55

maximum: 431.6 t/d February, rel. stdev: 0.43



Total Alkalinity load for River Elbe

ANNUAL LOADS

year	Gmol/y	year	Gmol/y	year	Gmol/y	year	Gmol/y	year	Gmol/y	year	Gmol/y
1977	52.2	1984	41.1	1991	26.9	1998	45.7	2005	47.1	2012	44.9
1978	51.3	1985	39.2	1992	36.4	1999	47.4	2006	49.7	2013	69.2
1979	63.9	1986	50.4	1993	35.9	2000	45.8	2007	49.1	2014	33.4
1980	70.1	1987	77.1	1994	60.5	2001	42.5	2008	45.4		
1981	79.7	1988	61.8	1995	63.9	2002	80.0	2009	44.8		
1982	52.8	1989	36.6	1996	47.2	2003	44.2	2010	69.4		
1983	43.8	1990	31.4	1997	42.8	2004	36.1	2011	58.6		

TIME SERIES

mean: 138.2 Mmol/d

relative standard deviation: 0.64

minimum: 33.3 Mmol/d August 18, 2003

maximum: 784.5 Mmol/d June 11, 2013

LOW PASS

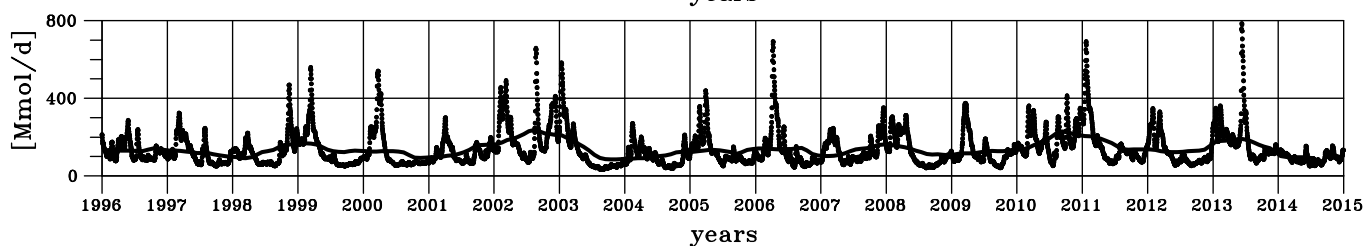
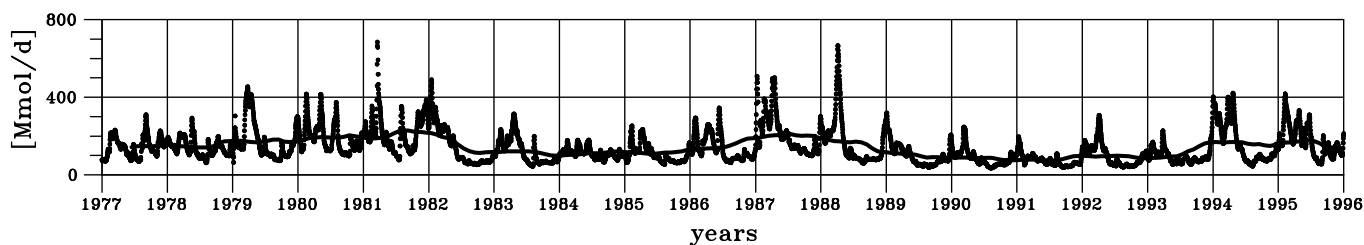
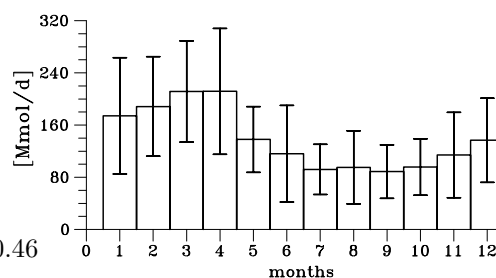
minimum: 73.5 Mmol/d July 1991

maximum: 237.0 Mmol/d August 2002

ANNUAL CYCLE

minimum: 88.6 Mmol/d September, rel. stdev: 0.46

maximum: 211.6 Mmol/d April, rel. stdev: 0.46



Dissolved Inorganic Carbon load for River Elbe

ANNUAL LOADS

year	Gmol/y	year	Gmol/y	year	Gmol/y	year	Gmol/y	year	Gmol/y	year	Gmol/y
1977	51.4	1984	40.4	1991	26.4	1998	44.9	2005	46.4	2012	44.2
1978	50.4	1985	38.6	1992	35.8	1999	46.6	2006	48.9	2013	68.1
1979	62.9	1986	49.5	1993	35.3	2000	45.1	2007	48.3	2014	32.9
1980	68.9	1987	75.8	1994	59.6	2001	41.8	2008	44.7		
1981	78.4	1988	60.8	1995	62.9	2002	78.7	2009	44.0		
1982	52.0	1989	36.0	1996	46.5	2003	43.5	2010	68.2		
1983	43.1	1990	30.9	1997	42.1	2004	35.5	2011	57.7		

TIME SERIES

mean: 136.0 Mmol/d

relative standard deviation: 0.64

minimum: 32.8 Mmol/d August 18, 2003

maximum: 771.9 Mmol/d June 11, 2013

LOW PASS

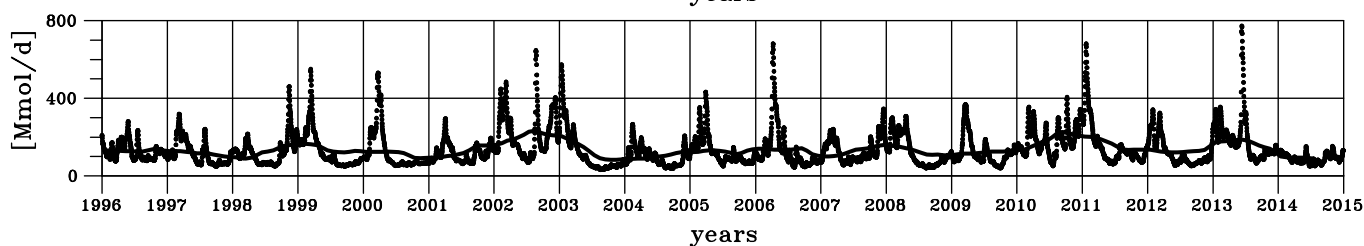
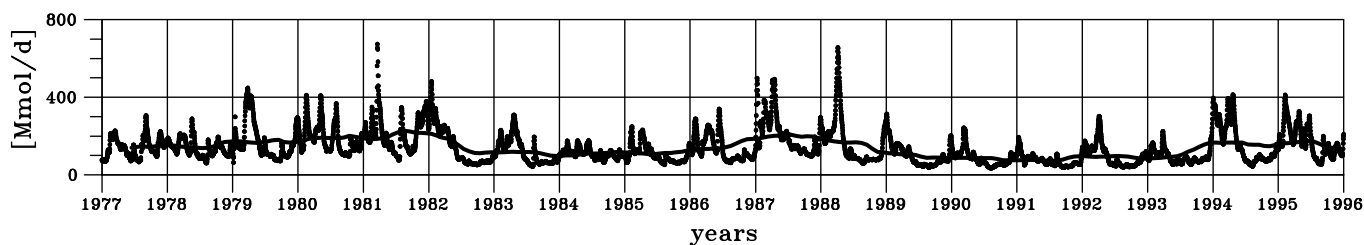
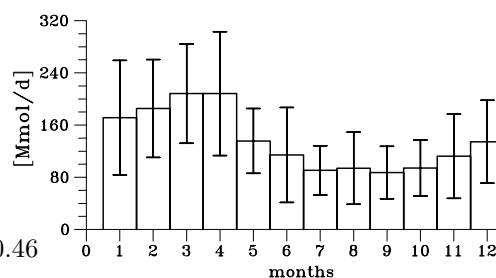
minimum: 72.3 Mmol/d July 1991

maximum: 233.1 Mmol/d August 2002

ANNUAL CYCLE

minimum: 87.2 Mmol/d September, rel. stdev: 0.46

maximum: 208.2 Mmol/d April, rel. stdev: 0.46



Dissolved Organic Carbon load for River Elbe

ANNUAL LOADS

year	Gmol/y	year	Gmol/y	year	Gmol/y	year	Gmol/y	year	Gmol/y	year	Gmol/y
1977	10.7	1984	8.4	1991	5.5	1998	9.3	2005	9.6	2012	9.2
1978	10.5	1985	8.0	1992	7.4	1999	9.7	2006	10.2	2013	14.1
1979	13.1	1986	10.3	1993	7.3	2000	9.4	2007	10.0	2014	6.8
1980	14.3	1987	15.7	1994	12.4	2001	8.7	2008	9.3		
1981	16.3	1988	12.6	1995	13.1	2002	16.3	2009	9.2		
1982	10.8	1989	7.5	1996	9.7	2003	9.0	2010	14.2		
1983	9.0	1990	6.4	1997	8.8	2004	7.4	2011	12.0		

TIME SERIES

mean: 28.2 Mmol/d

relative standard deviation: 0.64

minimum: 6.8 Mmol/d August 18, 2003

maximum: 160.4 Mmol/d June 11, 2013

LOW PASS

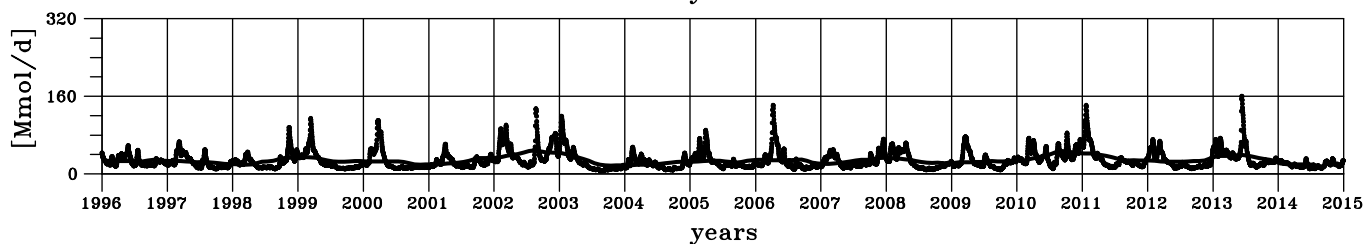
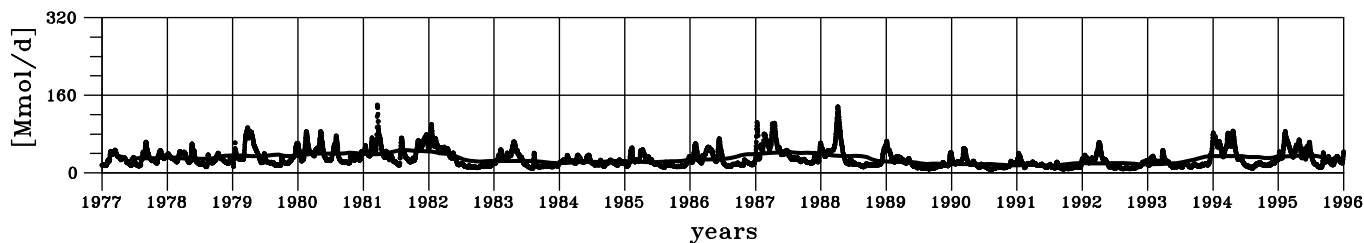
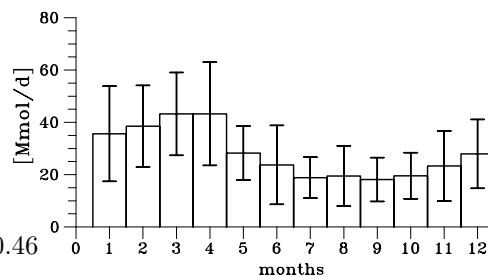
minimum: 15.0 Mmol/d July 1991

maximum: 48.4 Mmol/d August 2002

ANNUAL CYCLE

minimum: 18.1 Mmol/d September, rel. stdev: 0.46

maximum: 43.3 Mmol/d April, rel. stdev: 0.46



5.2 Loads of River Weser

Total Nitrogen load for River Weser

ANNUAL LOADS

year	kt/y	year	kt/y	year	kt/y	year	kt/y	year	kt/y	year	kt/y
		1984	75.2	1991	43.3	1998	67.8	2005	40.9	2012	27.7
		1985	59.4	1992	55.6	1999	60.2	2006	32.4	2013	42.1
		1986	64.7	1993	73.5	2000	45.9	2007	60.4	2014	23.2
1980	81.5	1987	96.8	1994	103.4	2001	47.1	2008	46.5		
1981	109.2	1988	87.1	1995	71.8	2002	78.4	2009	33.6		
1982	70.1	1989	50.8	1996	35.9	2003	47.4	2010	50.0		
1983	76.2	1990	50.9	1997	44.1	2004	47.7	2011	33.7		

TIME SERIES

mean: 148.8 t/d

relative standard deviation: 0.96

minimum: 17.1 t/d August 21, 1996

maximum: 1392.4 t/d March 16, 1981

LOW PASS

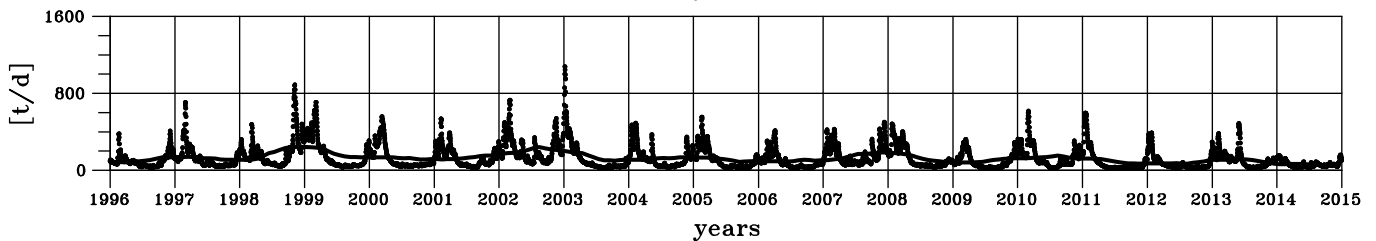
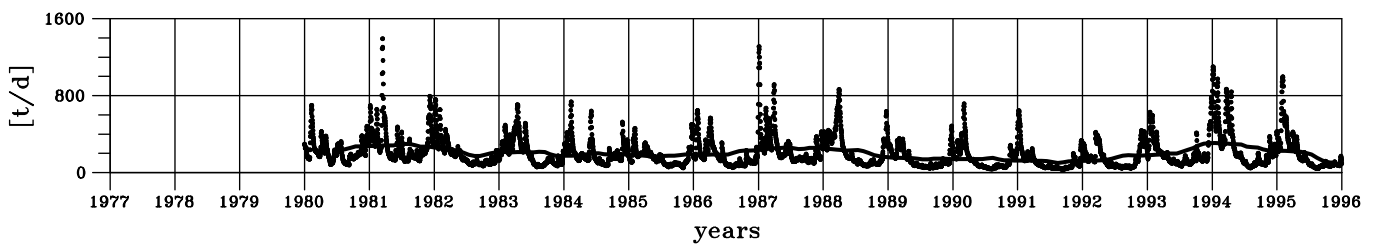
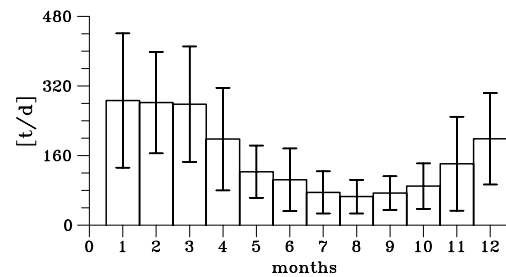
minimum: 61.0 t/d July 2014

maximum: 308.0 t/d January 1994

ANNUAL CYCLE

minimum: 65.8 t/d August, rel. stdev: 0.59

maximum: 286.6 t/d January, rel. stdev: 0.54



Nitrate load for River Weser

ANNUAL LOADS

year	kt/y	year	kt/y	year	kt/y	year	kt/y	year	kt/y	year	kt/y
1977	36.7	1984	60.1	1991	35.8	1998	57.0	2005	27.1	2012	24.4
1978	41.6	1985	42.2	1992	44.9	1999	45.1	2006	27.7	2013	37.7
1979	70.9	1986	51.1	1993	67.2	2000	38.1	2007	53.4	2014	20.3
1980	52.0	1987	79.8	1994	81.3	2001	36.1	2008	40.6		
1981	80.9	1988	72.1	1995	59.7	2002	61.4	2009	27.0		
1982	54.2	1989	42.6	1996	29.3	2003	41.6	2010	40.5		
1983	53.1	1990	41.5	1997	36.3	2004	42.1	2011	28.1		

TIME SERIES

mean: 128.4 t/d

relative standard deviation: 0.93

minimum: 3.7 t/d October 23, 1997

maximum: 1227.0 t/d March 7, 1979

LOW PASS

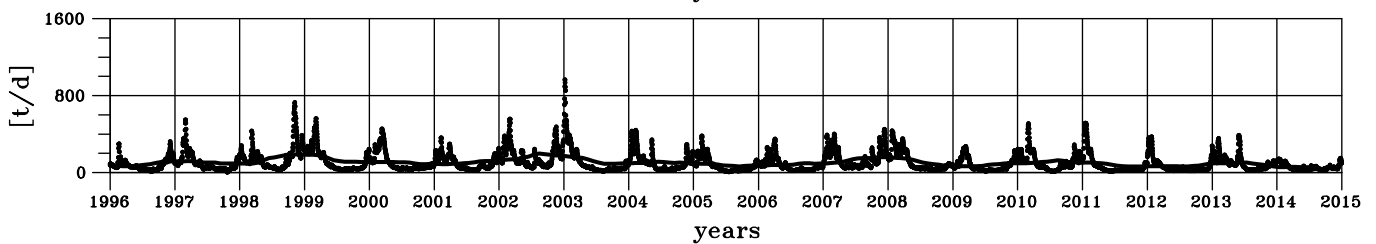
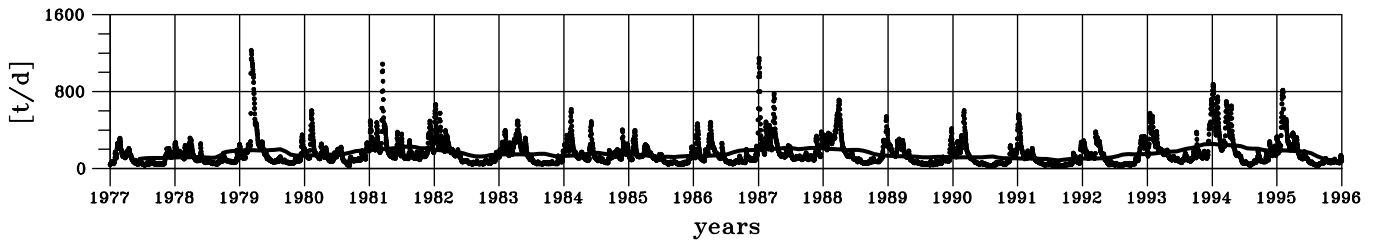
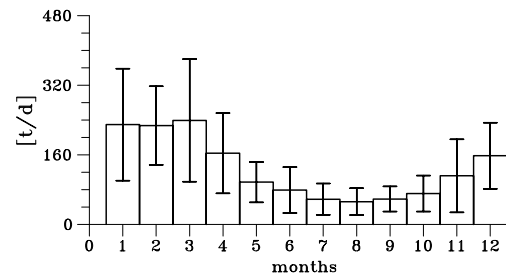
minimum: 53.0 t/d July 2014

maximum: 253.3 t/d December 1993

ANNUAL CYCLE

minimum: 52.4 t/d August, rel. stdev: 0.59

maximum: 239.1 t/d March, rel. stdev: 0.59



Ammonium load for River Weser

ANNUAL LOADS

year	t/y	year	t/y	year	t/y	year	t/y	year	t/y	year	t/y
1977	3882	1984	2882	1991	2036	1998	1556	2005	722	2012	476
1978	5909	1985	3781	1992	2145	1999	1448	2006	656	2013	572
1979	8198	1986	5796	1993	5457	2000	824	2007	950	2014	228
1980	5117	1987	6997	1994	2378	2001	1048	2008	654		
1981	7208	1988	4097	1995	868	2002	1065	2009	634		
1982	3104	1989	1980	1996	1599	2003	974	2010	1088		
1983	4198	1990	2028	1997	1251	2004	778	2011	582		

TIME SERIES

mean: 6.9 t/d

relative standard deviation: 1.68

minimum: 0.2 t/d July 2, 1992

maximum: 163.8 t/d March 16, 1981

LOW PASS

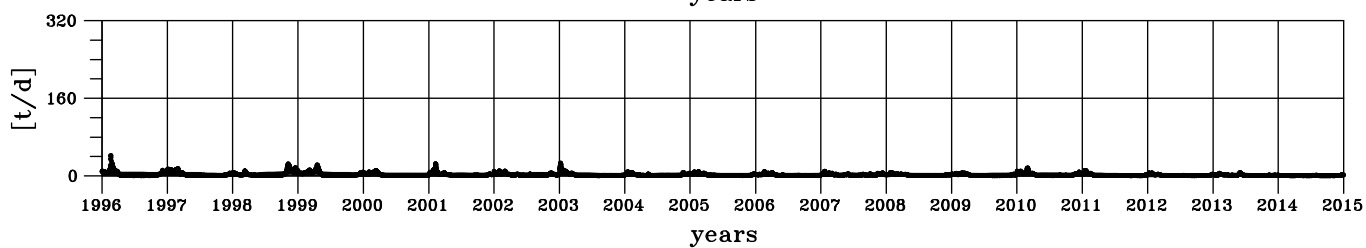
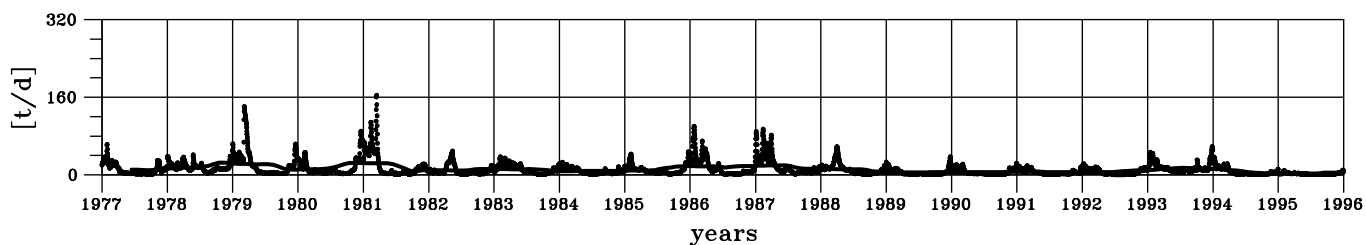
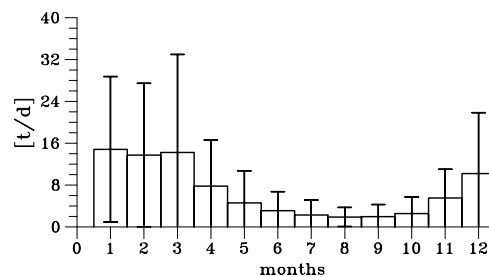
minimum: 0.6 t/d July 2014

maximum: 24.9 t/d November 1978

ANNUAL CYCLE

minimum: 1.9 t/d August, rel. stdev: 0.95

maximum: 14.8 t/d January, rel. stdev: 0.94



Total Phosphorus load for River Weser

ANNUAL LOADS

year	kt/y	year	kt/y	year	kt/y	year	kt/y	year	kt/y	year	kt/y
1977	5.0	1984	4.0	1991	2.1	1998	2.4	2005	1.8	2012	1.4
1978	6.0	1985	3.5	1992	2.2	1999	2.3	2006	1.5	2013	1.8
1979	8.1	1986	4.8	1993	1.5	2000	1.7	2007	2.4	2014	1.1
1980	5.8	1987	6.0	1994	3.6	2001	2.0	2008	1.8		
1981	6.3	1988	4.5	1995	3.0	2002	2.5	2009	1.4		
1982	3.8	1989	2.8	1996	1.4	2003	1.5	2010	2.0		
1983	4.2	1990	2.0	1997	1.8	2004	1.9	2011	1.4		

TIME SERIES

mean: 8.1 t/d

relative standard deviation: 1.04

minimum: 0.7 t/d May 8, 1996

maximum: 165.7 t/d March 7, 1979

LOW PASS

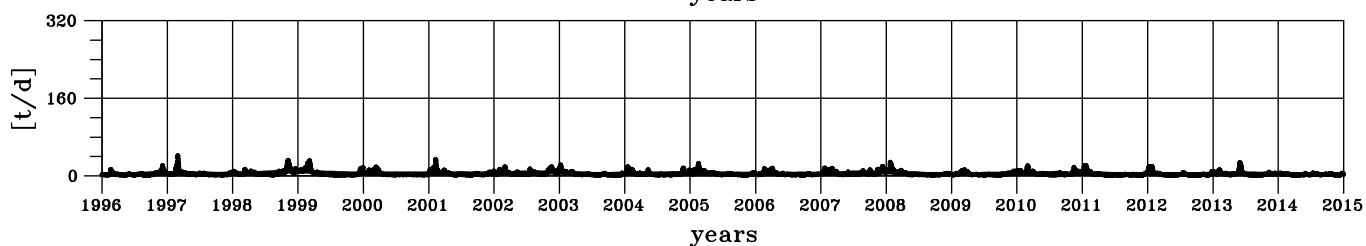
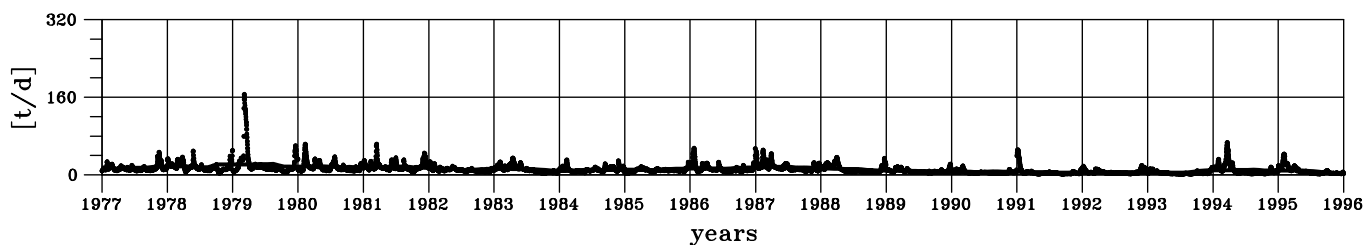
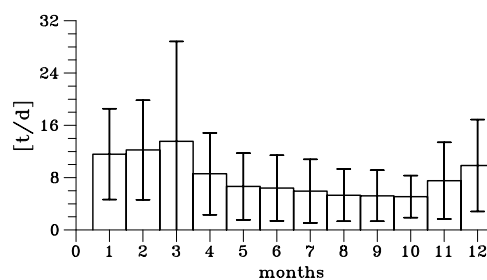
minimum: 2.9 t/d July 2014

maximum: 22.4 t/d August 1979

ANNUAL CYCLE

minimum: 5.1 t/d October, rel. stdev: 0.63

maximum: 13.6 t/d March, rel. stdev: 1.13



Phosphate load for River Weser

ANNUAL LOADS

year	t/y	year	t/y	year	t/y	year	t/y	year	t/y	year	t/y
		1984	3259	1991	670	1998	1069	2005	569	2012	533
		1985	3260	1992	774	1999	656	2006	494	2013	539
		1986	3541	1993	420	2000	694	2007	848	2014	457
		1987	3165	1994	774	2001	715	2008	317		
1981	3953	1988	2240	1995	711	2002	1112	2009	383		
1982	2914	1989	1597	1996	595	2003	539	2010	547		
1983	2691	1990	1176	1997	682	2004	596	2011	472		

TIME SERIES

mean: 4.0 t/d

relative standard deviation: 2.36

minimum: 0.1 t/d April 16, 2014

maximum: 48.9 t/d March 16, 1981

LOW PASS

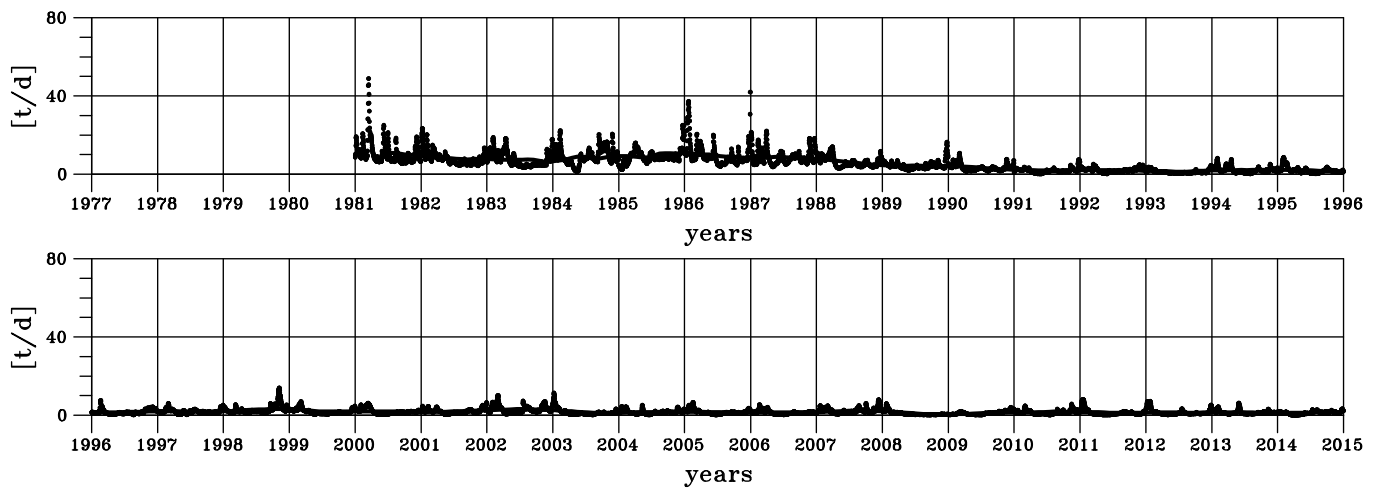
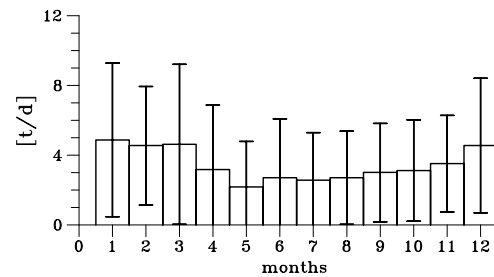
minimum: 0.5 t/d December 2008

maximum: 10.9 t/d July 1981

ANNUAL CYCLE

minimum: 2.2 t/d May, rel. stdev: 1.20

maximum: 4.9 t/d January, rel. stdev: 0.90



Silicate load for River Weser

ANNUAL LOADS

year	kt/y	year	kt/y	year	kt/y	year	kt/y	year	kt/y	year	kt/y
				1993	91.6						
				1994	125.0						

TIME SERIES

mean: 36.5 t/d

relative standard deviation: 3.64

minimum: 1.7 t/d July 14, 1994

maximum: 1514.5 t/d January 7, 1994

LOW PASS

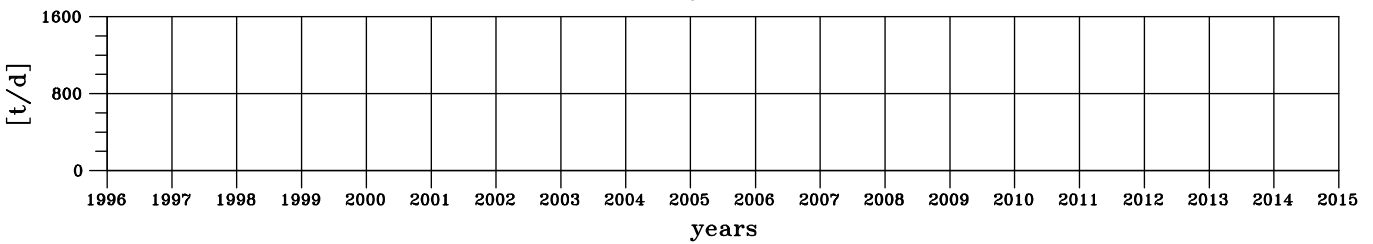
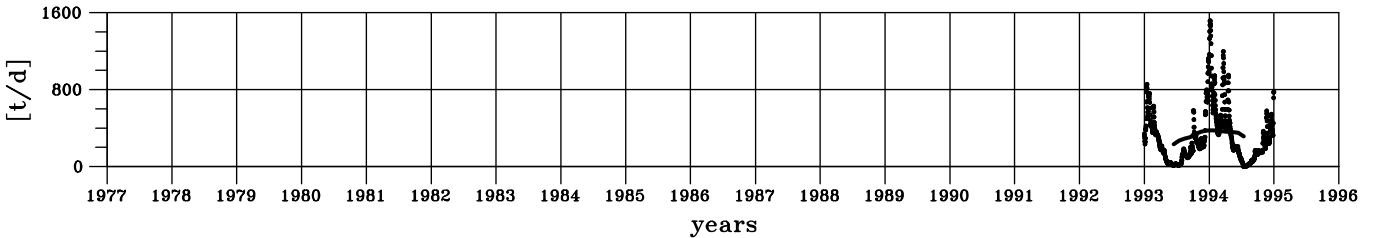
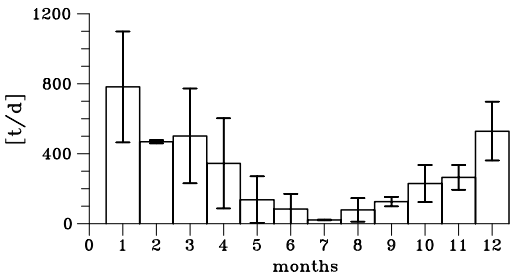
minimum: 234.3 t/d June 1993

maximum: 378.1 t/d January 1994

ANNUAL CYCLE

minimum: 21.1 t/d July, rel. stdev: 0.12

maximum: 782.1 t/d January, rel. stdev: 0.41



5.3 Loads of River Ems

Total Nitrogen load for River Ems

ANNUAL LOADS

year	kt/y	year	kt/y	year	kt/y	year	kt/y	year	kt/y	year	kt/y
		1984	24.0	1991	14.9	1998	28.3	2005	14.2	2012	11.9
		1985	22.9	1992	20.5	1999	17.1	2006	11.6	2013	11.7
		1986	21.4	1993	27.5	2000	16.2	2007	22.9	2014	11.0
1980	20.8	1987	28.2	1994	28.5	2001	19.5	2008	15.5		
1981	29.3	1988	24.9	1995	19.6	2002	22.1	2009	6.9		
1982	16.5	1989	13.8	1996	11.8	2003	13.7	2010	16.9		
1983	18.5	1990	18.8	1997	12.0	2004	18.9	2011	12.6		

TIME SERIES

mean: 49.3 t/d

relative standard deviation: 2.13

minimum: 0.4 t/d December 9, 2010

maximum: 451.0 t/d January 4, 1987

LOW PASS

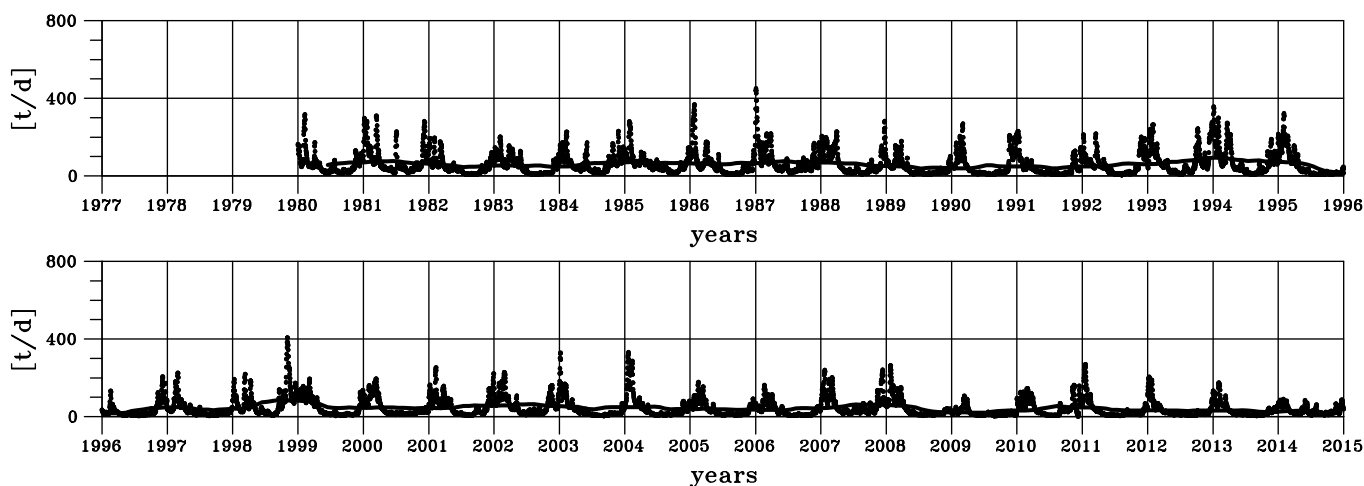
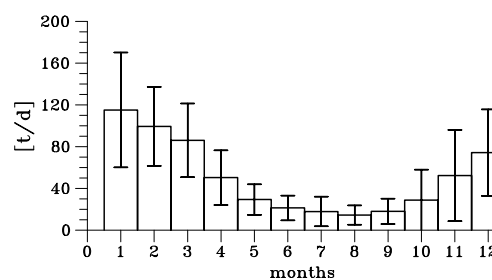
minimum: 17.1 t/d February 1996

maximum: 93.2 t/d January 1994

ANNUAL CYCLE

minimum: 14.5 t/d August, rel. stdev: 0.64

maximum: 115.1 t/d January, rel. stdev: 0.48



Nitrate load for River Ems

ANNUAL LOADS

year	kt/y	year	kt/y	year	kt/y	year	kt/y	year	kt/y	year	kt/y
1977	9.4	1984	18.0	1991	12.1	1998	23.1	2005	11.8	2012	9.4
1978	10.7	1985	15.0	1992	17.4	1999	13.5	2006	9.6	2013	10.4
1979	17.6	1986	16.0	1993	22.5	2000	12.9	2007	19.8	2014	9.5
1980	13.9	1987	20.5	1994	23.3	2001	15.9	2008	12.3		
1981	20.2	1988	20.1	1995	15.4	2002	17.5	2009	5.9		
1982	10.6	1989	11.7	1996	9.4	2003	10.6	2010	11.6		
1983	13.2	1990	16.0	1997	9.8	2004	14.5	2011	9.6		

TIME SERIES

mean: 39.0 t/d

relative standard deviation: 1.08

minimum: 0.2 t/d September 9, 2010

maximum: 368.5 t/d March 8, 1979

LOW PASS

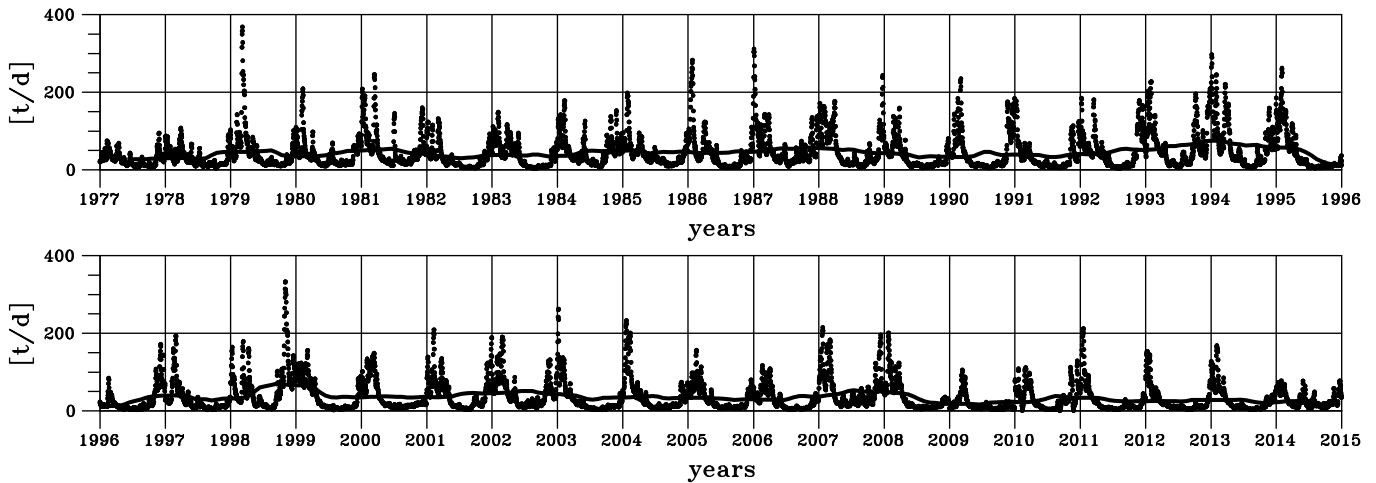
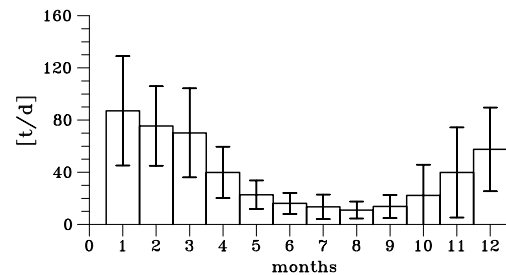
minimum: 12.6 t/d February 1996

maximum: 75.4 t/d January 1994

ANNUAL CYCLE

minimum: 11.0 t/d August, rel. stdev: 0.59

maximum: 87.1 t/d January, rel. stdev: 0.48



Ammonium load for River Ems

ANNUAL LOADS

year	t/y	year	t/y	year	t/y	year	t/y	year	t/y	year	t/y
1977	1294	1984	1814	1991	1267	1998	1098	2005	516	2012	632
1978	1886	1985	2175	1992	935	1999	722	2006	519	2013	611
1979	3122	1986	1824	1993	1340	2000	619	2007	1088	2014	397
1980	2057	1987	4090	1994	1326	2001	659	2008	565		
1981	2714	1988	1624	1995	996	2002	870	2009	473		
1982	2308	1989	866	1996	695	2003	694	2010	863		
1983	1868	1990	1034	1997	607	2004	718	2011	583		

TIME SERIES

mean: 3.4 t/d

relative standard deviation: 1.73

minimum: 0.1 t/d August 5, 1990

maximum: 109.2 t/d January 4, 1987

LOW PASS

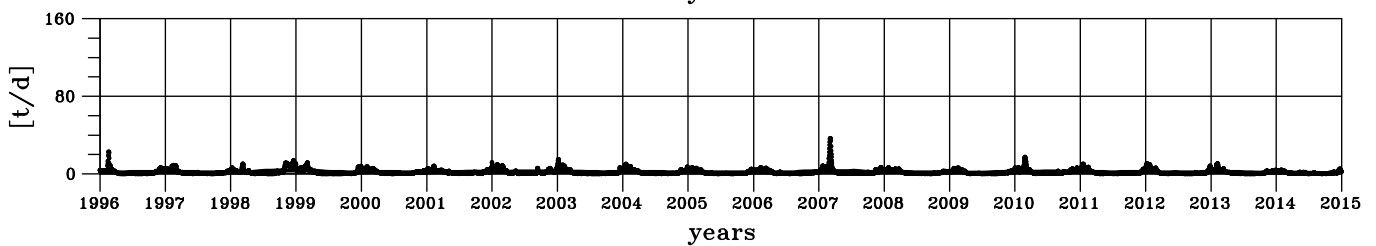
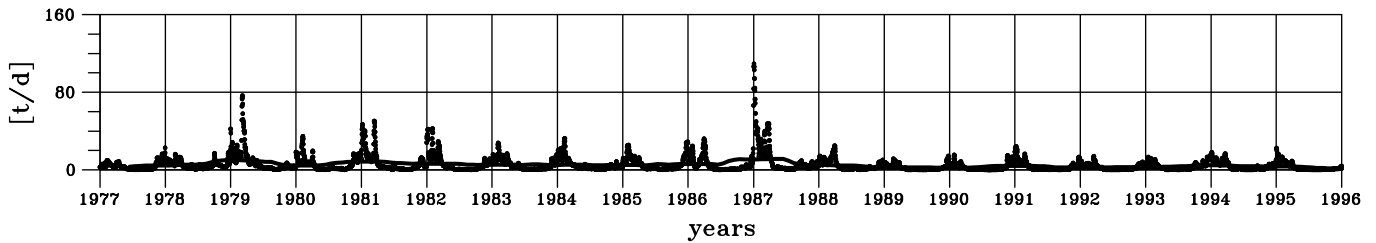
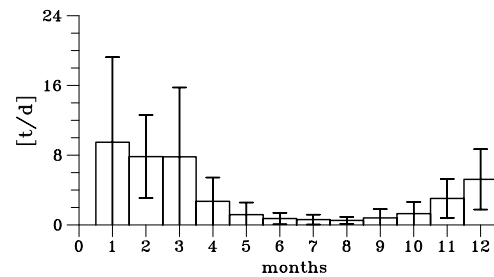
minimum: 1.0 t/d July 2014

maximum: 11.4 t/d May 1987

ANNUAL CYCLE

minimum: 0.5 t/d August, rel. stdev: 0.77

maximum: 9.5 t/d January, rel. stdev: 1.03



Total Phosphorus load for River Ems

ANNUAL LOADS

year	t/y	year	t/y	year	t/y	year	t/y	year	t/y	year	t/y
1977	1028	1984	762	1991	353	1998	851	2005	365	2012	279
1978	1495	1985	827	1992	439	1999	539	2006	276	2013	335
1979	1653	1986	870	1993	895	2000	397	2007	738	2014	259
1980	1257	1987	1214	1994	929	2001	520	2008	457		
1981	1285	1988	1019	1995	637	2002	546	2009	385		
1982	675	1989	459	1996	336	2003	389	2010	375		
1983	880	1990	410	1997	268	2004	434	2011	337		

TIME SERIES

mean: 1.8 t/d

relative standard deviation: 1.28

minimum: 0.1 t/d September 29, 1997

maximum: 29.4 t/d March 8, 1979

LOW PASS

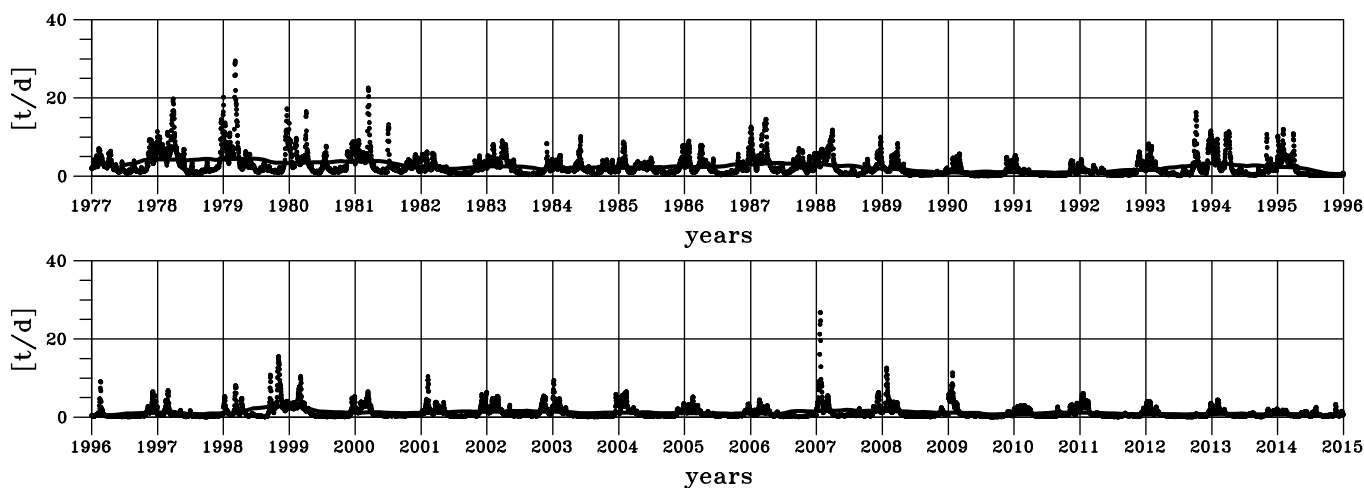
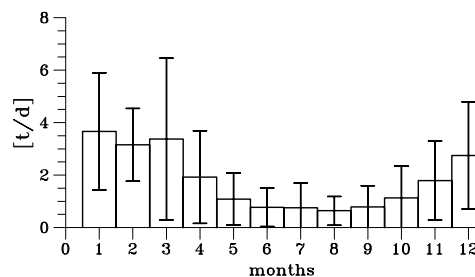
minimum: 0.5 t/d January 1996

maximum: 4.4 t/d June 1979

ANNUAL CYCLE

minimum: 0.6 t/d August, rel. stdev: 0.86

maximum: 3.7 t/d January, rel. stdev: 0.61



Phosphate load for River Ems

ANNUAL LOADS

year	t/y	year	t/y	year	t/y	year	t/y	year	t/y	year	t/y
		1984	430	1991	52	1998	200	2005	83	2012	49
		1985	466	1992	101	1999	96	2006	68	2013	47
		1986	421	1993	238	2000	90	2007	168	2014	86
		1987	225	1994	237	2001	95	2008	134		
1981	642	1988	190	1995	149	2002	136	2009	93		
1982	446	1989	78	1996	69	2003	115	2010	84		
1983	428	1990	84	1997	65	2004	93	2011	71		

TIME SERIES

mean: 0.6 t/d

relative standard deviation: 3.94

minimum: 0.0 t/d September 15, 1991

maximum: 10.5 t/d December 8, 1981

LOW PASS

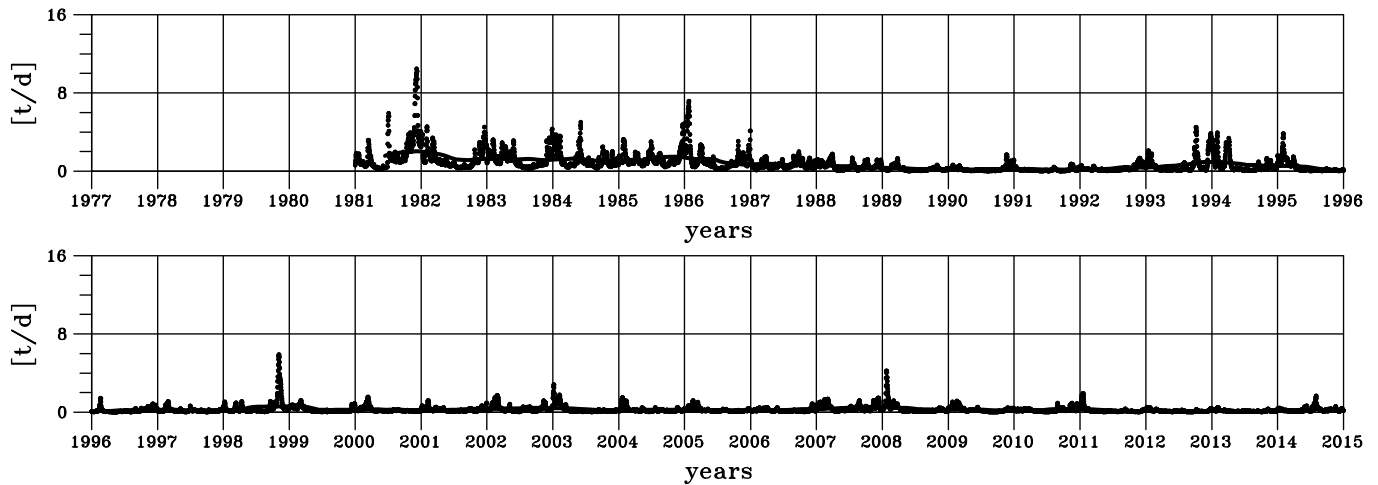
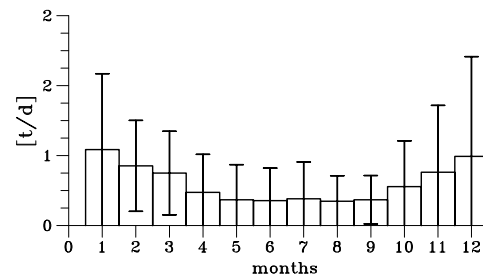
minimum: 0.1 t/d January 1996

maximum: 2.0 t/d December 1981

ANNUAL CYCLE

minimum: 0.3 t/d August, rel. stdev: 1.06

maximum: 0.9 t/d January, rel. stdev: 1.00



Silicate load for River Ems

ANNUAL LOADS

year	kt/y	year	kt/y	year	kt/y	year	kt/y	year	kt/y	year	kt/y
				1991	21.4						
				1992	21.0						
				1993	40.9						
				1994	38.8						
		1989	15.6								
		1990	22.8								

TIME SERIES

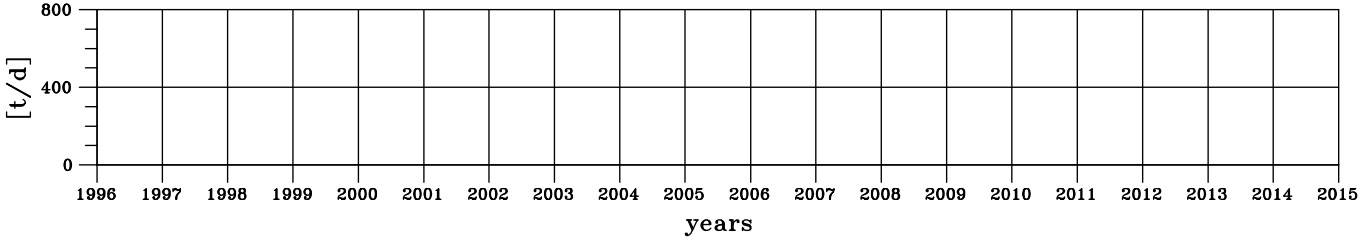
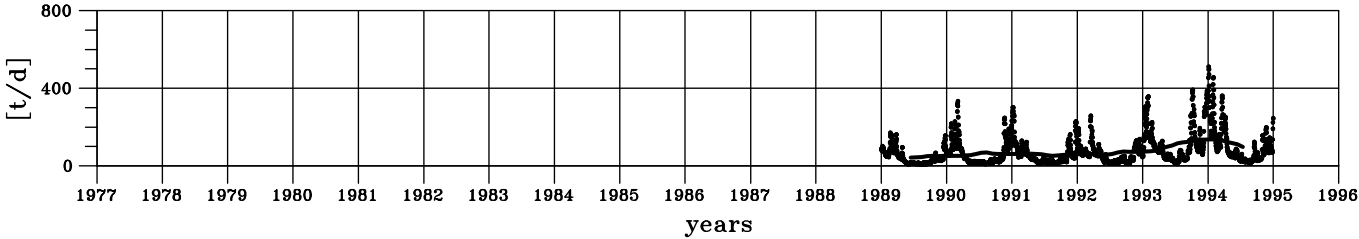
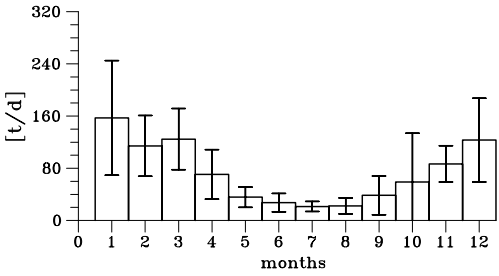
mean: 24.8 t/d
relative standard deviation: 2.22
minimum: 6.0 t/d June 4, 1989
maximum: 510.2 t/d January 5, 1994

LOW PASS

minimum: 41.7 t/d June 1989
maximum: 136.5 t/d January 1994

ANNUAL CYCLE

minimum: 21.5 t/d July, rel. stdev: 0.35
maximum: 157.1 t/d January, rel. stdev: 0.56



Total Alkalinity load for River Ems

ANNUAL LOADS

year	Gmol/y	year	Gmol/y	year	Gmol/y	year	Gmol/y	year	Gmol/y	year	Gmol/y
1977	4.9	1984	7.5	1991	4.9	1998	9.6	2005	5.9	2012	5.4
1978	5.8	1985	6.6	1992	5.9	1999	7.0	2006	5.0	2013	5.3
1979	7.0	1986	6.8	1993	9.0	2000	6.8	2007	8.5	2014	5.3
1980	6.3	1987	9.6	1994	10.6	2001	6.8	2008	6.5		
1981	9.3	1988	8.0	1995	8.0	2002	8.8	2009	5.1		
1982	5.6	1989	4.7	1996	3.9	2003	6.2	2010	6.7		
1983	6.1	1990	5.4	1997	4.6	2004	6.9	2011	5.5		

TIME SERIES

mean: 18.2 Mmol/d

relative standard deviation: 0.84

minimum: 2.4 Mmol/d July 30, 1999

maximum: 142.3 Mmol/d November 3, 1998

LOW PASS

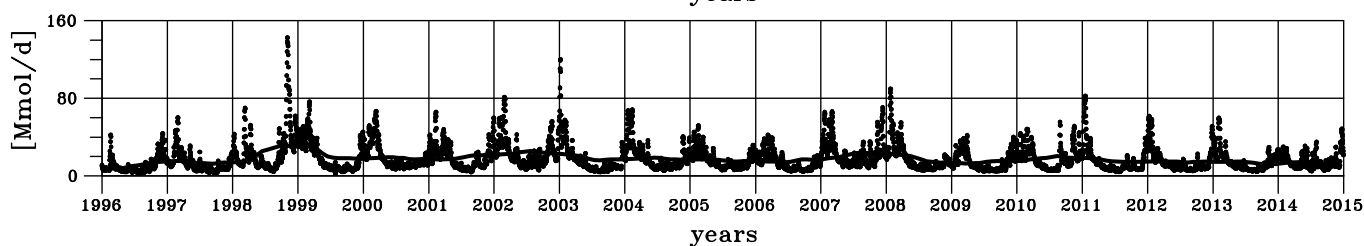
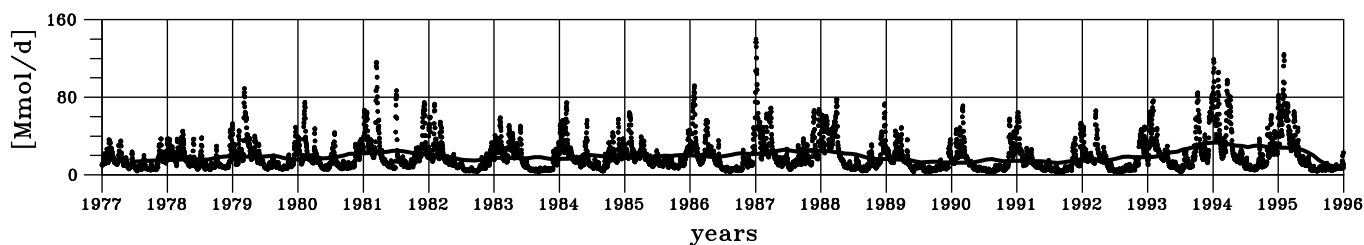
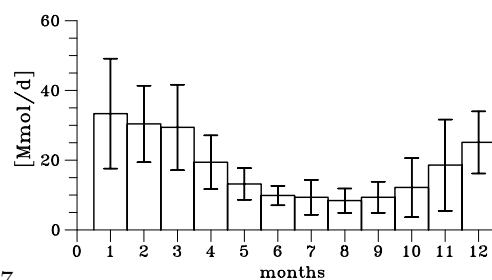
minimum: 7.5 Mmol/d March 1996

maximum: 33.3 Mmol/d January 1994

ANNUAL CYCLE

minimum: 8.4 Mmol/d August, rel. stdev: 0.42

maximum: 33.3 Mmol/d January, rel. stdev: 0.47



Dissolved Inorganic Carbon load for River Ems

ANNUAL LOADS

year	Gmol/y	year	Gmol/y	year	Gmol/y	year	Gmol/y	year	Gmol/y	year	Gmol/y
1977	5.2	1984	8.0	1991	5.2	1998	10.3	2005	6.3	2012	5.8
1978	6.2	1985	7.1	1992	6.3	1999	7.5	2006	5.3	2013	5.6
1979	7.5	1986	7.3	1993	9.6	2000	7.3	2007	9.1	2014	5.7
1980	6.7	1987	10.3	1994	11.3	2001	7.3	2008	7.0		
1981	9.9	1988	8.6	1995	8.6	2002	9.4	2009	5.4		
1982	6.0	1989	5.1	1996	4.1	2003	6.6	2010	7.2		
1983	6.5	1990	5.8	1997	5.0	2004	7.4	2011	5.9		

TIME SERIES

mean: 19.4 Mmol/d

relative standard deviation: 0.84

minimum: 2.5 Mmol/d July 30, 1999

maximum: 152.1 Mmol/d November 3, 1998

LOW PASS

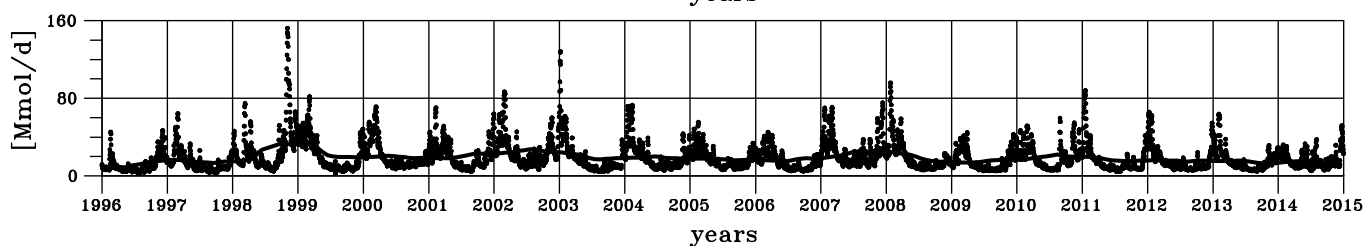
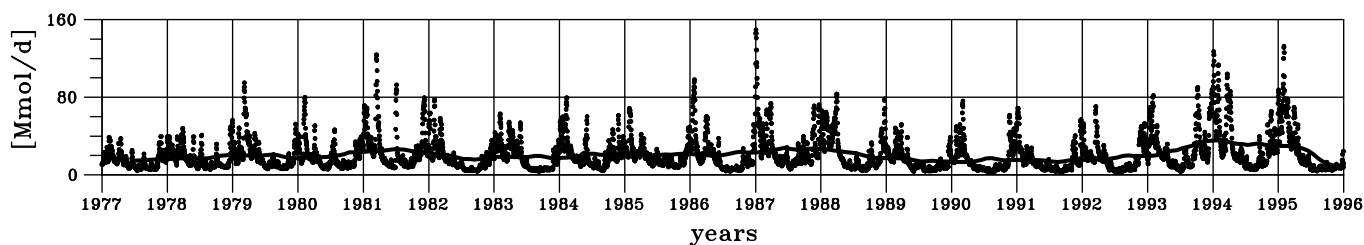
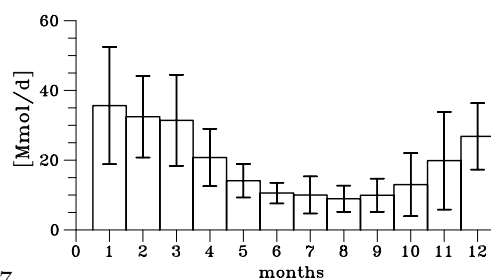
minimum: 8.1 Mmol/d March 1996

maximum: 35.6 Mmol/d January 1994

ANNUAL CYCLE

minimum: 9.0 Mmol/d August, rel. stdev: 0.42

maximum: 35.6 Mmol/d January, rel. stdev: 0.47



Dissolved Organic Carbon load for River Ems

ANNUAL LOADS

year	Gmol/y	year	Gmol/y	year	Gmol/y	year	Gmol/y	year	Gmol/y	year	Gmol/y
1977	1.9	1984	2.9	1991	1.9	1998	3.8	2005	2.3	2012	2.1
1978	2.3	1985	2.6	1992	2.3	1999	2.8	2006	2.0	2013	2.1
1979	2.7	1986	2.7	1993	3.5	2000	2.7	2007	3.3	2014	2.1
1980	2.5	1987	3.8	1994	4.2	2001	2.7	2008	2.6		
1981	3.6	1988	3.2	1995	3.2	2002	3.5	2009	2.0		
1982	2.2	1989	1.9	1996	1.5	2003	2.4	2010	2.6		
1983	2.4	1990	2.1	1997	1.8	2004	2.7	2011	2.2		

TIME SERIES

mean: 7.1 Mmol/d

relative standard deviation: 0.84

minimum: 0.9 Mmol/d July 30, 1999

maximum: 55.9 Mmol/d November 3, 1998

LOW PASS

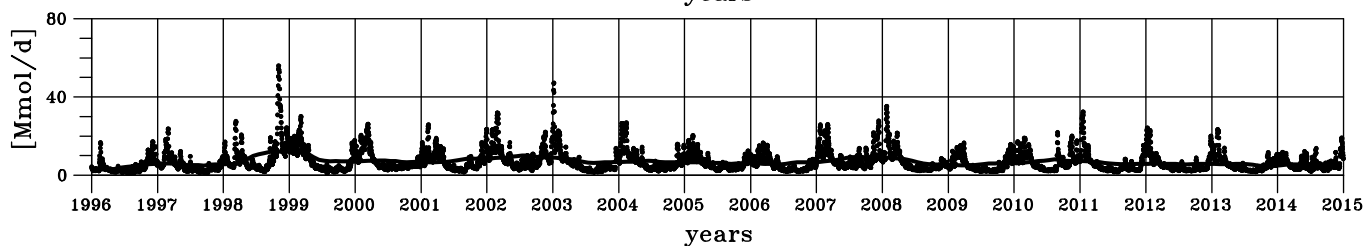
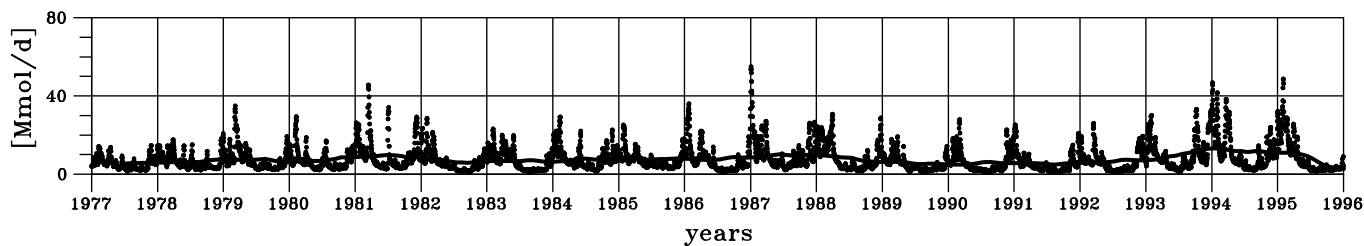
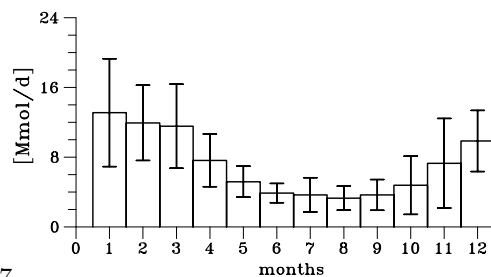
minimum: 3.0 Mmol/d March 1996

maximum: 13.1 Mmol/d January 1994

ANNUAL CYCLE

minimum: 3.3 Mmol/d August, rel. stdev: 0.42

maximum: 13.1 Mmol/d January, rel. stdev: 0.47



5.4 Loads of Kornwederzand

Total Nitrogen load for Kornwederzand

ANNUAL LOADS

year	kt/y	year	kt/y	year	kt/y	year	kt/y	year	kt/y	year	kt/y
1977	21.3	1984	34.0	1991	20.4	1998	33.4	2005	17.1	2012	19.5
1978	24.2	1985	25.5	1992	20.2	1999	25.5	2006	15.0	2013	23.2
1979	36.1	1986	31.0	1993	20.8	2000	26.1	2007	20.1	2014	16.5
1980	34.6	1987	46.5	1994	40.5	2001	24.5	2008	20.0		
1981	41.8	1988	39.3	1995	33.6	2002	29.1	2009	12.7		
1982	31.2	1989	18.6	1996	15.7	2003	16.8	2010	24.2		
1983	37.7	1990	23.8	1997	15.5	2004	21.0	2011	19.0		

TIME SERIES

mean: 70.3 t/d

relative standard deviation: 1.28

minimum: 0.0 t/d January 1, 1977

maximum: 839.7 t/d January 29, 1986

LOW PASS

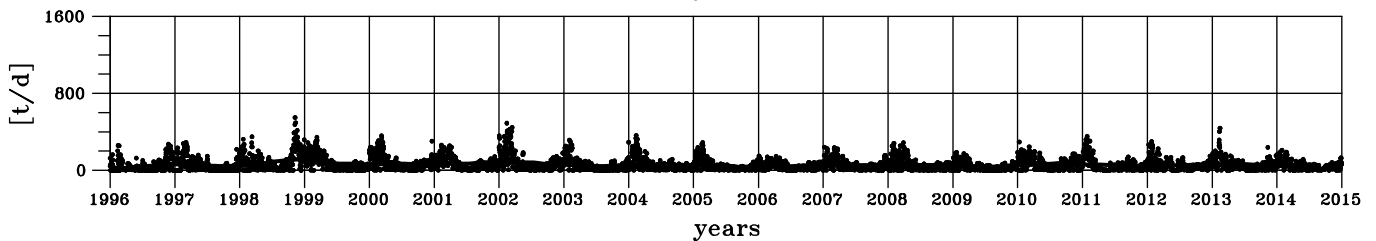
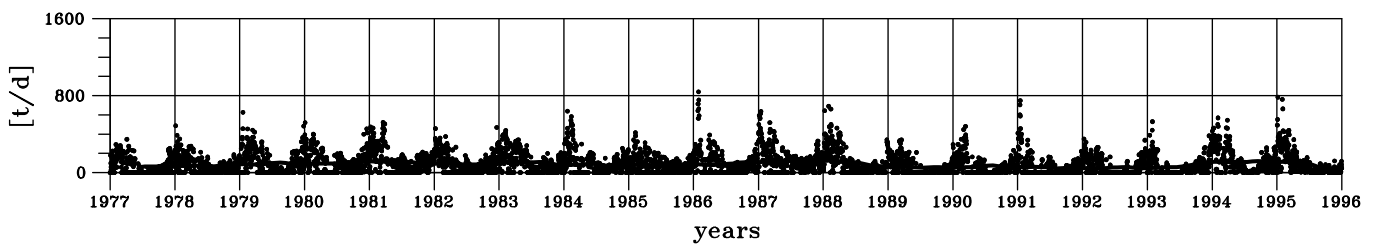
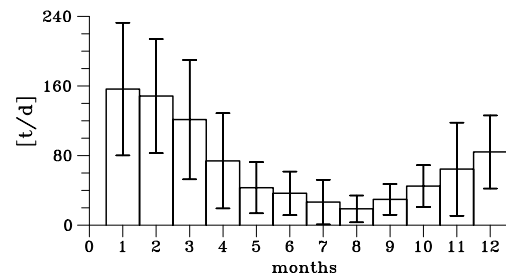
minimum: 25.7 t/d March 1996

maximum: 139.2 t/d November 1987

ANNUAL CYCLE

minimum: 18.7 t/d August, rel. stdev: 0.83

maximum: 156.5 t/d January, rel. stdev: 0.49



Nitrate + Nitrite load for Kornwederzand

ANNUAL LOADS

year	kt/y	year	kt/y	year	kt/y	year	kt/y	year	kt/y	year	kt/y
1977	12.8	1984	20.8	1991	13.2	1998	20.2	2005	10.1	2012	9.2
1978	14.5	1985	13.7	1992	12.9	1999	15.6	2006	8.2	2013	14.2
1979	21.4	1986	19.5	1993	11.6	2000	15.2	2007	10.8	2014	9.4
1980	20.1	1987	27.8	1994	27.2	2001	16.1	2008	12.0		
1981	24.8	1988	24.6	1995	21.9	2002	16.7	2009	5.9		
1982	19.1	1989	11.5	1996	8.3	2003	9.6	2010	13.0		
1983	25.1	1990	13.3	1997	10.3	2004	10.4	2011	9.6		

TIME SERIES

mean: 41.8 t/d

relative standard deviation: 1.53

minimum: 0.0 t/d January 1, 1977

maximum: 593.4 t/d January 29, 1986

LOW PASS

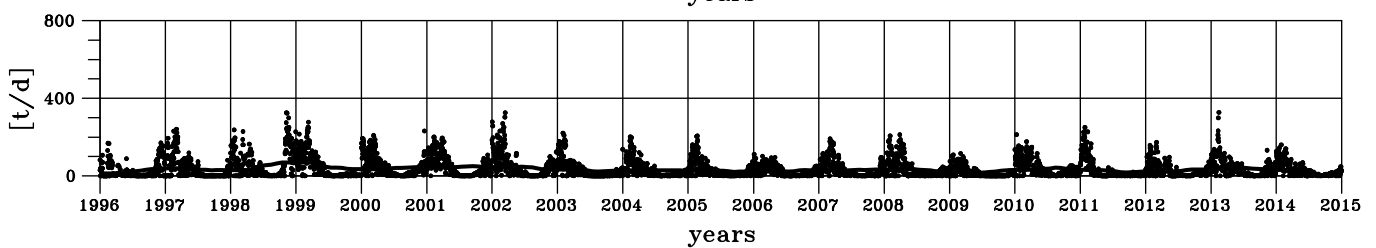
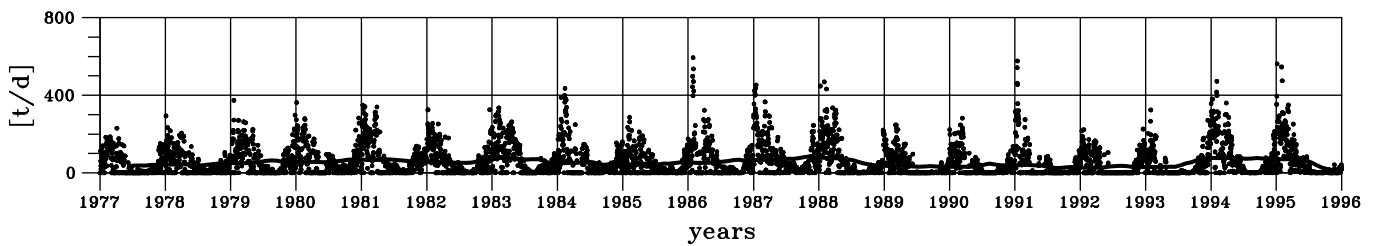
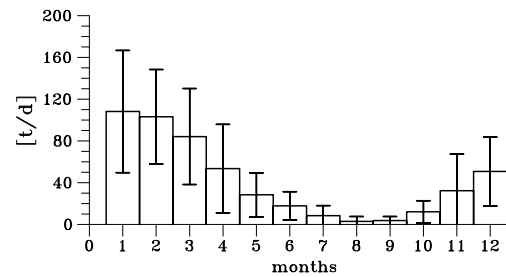
minimum: 11.8 t/d February 1996

maximum: 84.1 t/d November 1987

ANNUAL CYCLE

minimum: 2.9 t/d August, rel. stdev: 1.69

maximum: 108.2 t/d January, rel. stdev: 0.54



Ammonium load for Kornwederzand

ANNUAL LOADS

year	t/y	year	t/y	year	t/y	year	t/y	year	t/y	year	t/y
1977	2112	1984	1202	1991	505	1998	768	2005	243	2012	295
1978	1391	1985	1020	1992	417	1999	584	2006	184	2013	350
1979	5277	1986	1152	1993	367	2000	481	2007	180	2014	229
1980	2403	1987	2584	1994	548	2001	759	2008	200		
1981	2521	1988	587			2002	868	2009	185		
1982	2415	1989	333			2003	440	2010	140		
1983	1174	1990	458			2004	243	2011	505		

TIME SERIES

mean: 2.7 t/d

relative standard deviation: 2.57

minimum: 0.0 t/d January 1, 1977

maximum: 152.5 t/d January 19, 1979

LOW PASS

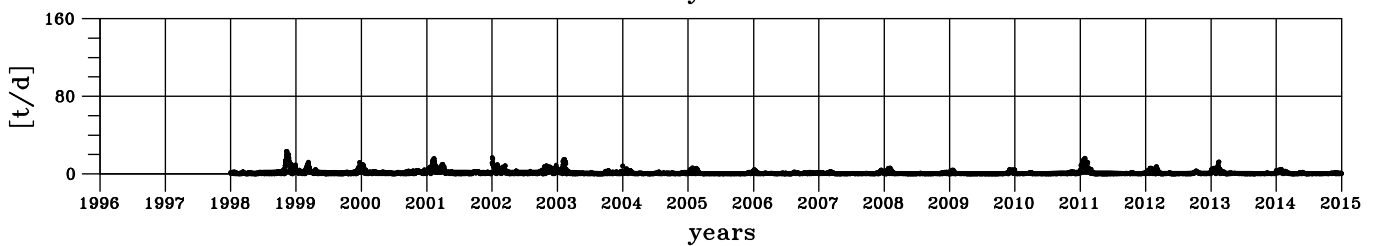
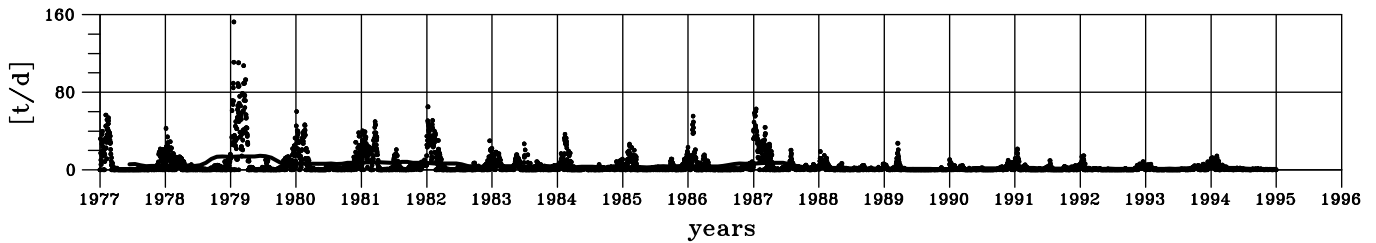
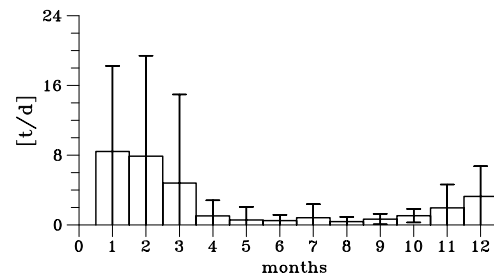
minimum: 0.3 t/d May 2009

maximum: 14.4 t/d June 1979

ANNUAL CYCLE

minimum: 0.4 t/d August, rel. stdev: 1.40

maximum: 8.4 t/d January, rel. stdev: 1.16



Total Phosphorus load for Kornwederzand

ANNUAL LOADS

year	t/y	year	t/y	year	t/y	year	t/y	year	t/y	year	t/y
1977	1270	1984	2190	1991	828	1998	1313	2005	654	2012	482
1978	1512	1985	1659	1992	865	1999	965	2006	468	2013	550
1979	2555	1986	1847	1993	756	2000	1274	2007	691	2014	507
1980	2801	1987	2161	1994	1876	2001	637	2008	684		
1981	3356	1988	2497	1995	1227	2002	1348	2009	1053		
1982	2271	1989	675	1996	726	2003	646	2010	456		
1983	2288	1990	1053	1997	452	2004	1472	2011	389		

TIME SERIES

mean: 3.5 t/d

relative standard deviation: 1.51

minimum: 0.0 t/d January 1, 1977

maximum: 96.0 t/d February 1, 1988

LOW PASS

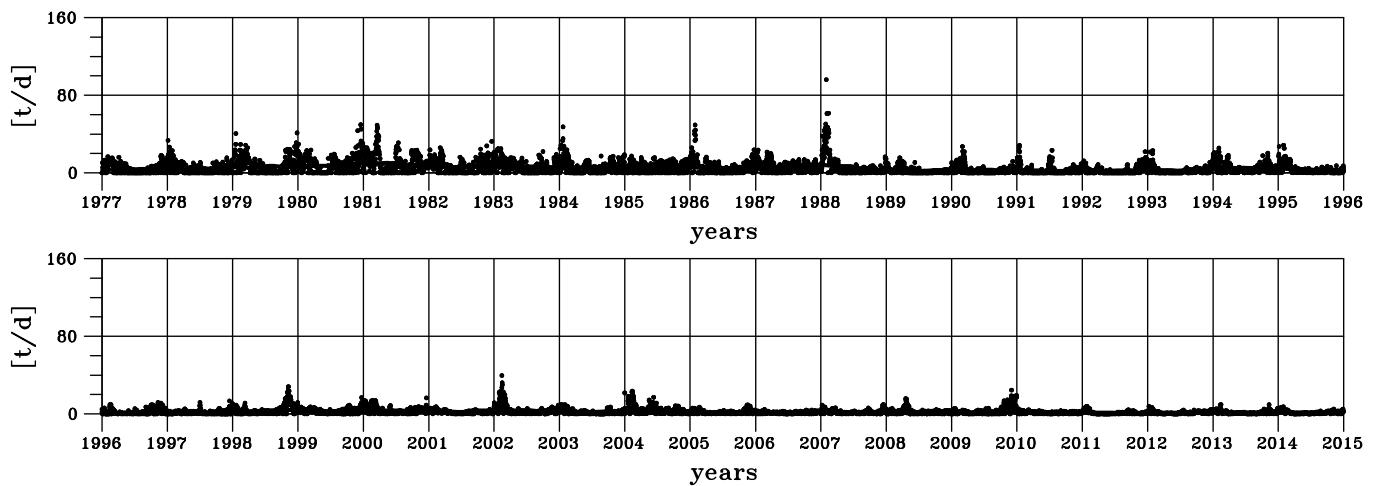
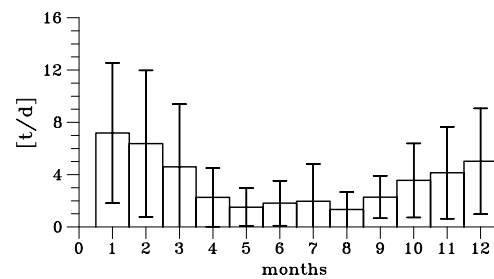
minimum: 0.9 t/d September 2011

maximum: 10.2 t/d May 1981

ANNUAL CYCLE

minimum: 1.3 t/d August, rel. stdev: 1.00

maximum: 7.2 t/d January, rel. stdev: 0.75



Phosphate load for Kornwederzand

ANNUAL LOADS

year	t/y	year	t/y	year	t/y	year	t/y	year	t/y	year	t/y
1977	715	1984	887	1991	66	1998	407	2005	98	2012	62
1978	666	1985	678	1992	128	1999	264	2006	31	2013	122
1979	1213	1986	710	1993	144	2000	186	2007	89	2014	92
1980	1312	1987	759	1994	282	2001	125	2008	81		
1981	1350	1988	532	1995	309	2002	318	2009	37		
1982	1128	1989	234	1996	140	2003	107	2010	21		
1983	915	1990	193	1997	56	2004	68	2011	91		

TIME SERIES

mean: 1.1 t/d

relative standard deviation: 2.07

minimum: 0.0 t/d January 1, 1977

maximum: 24.7 t/d December 27, 1979

LOW PASS

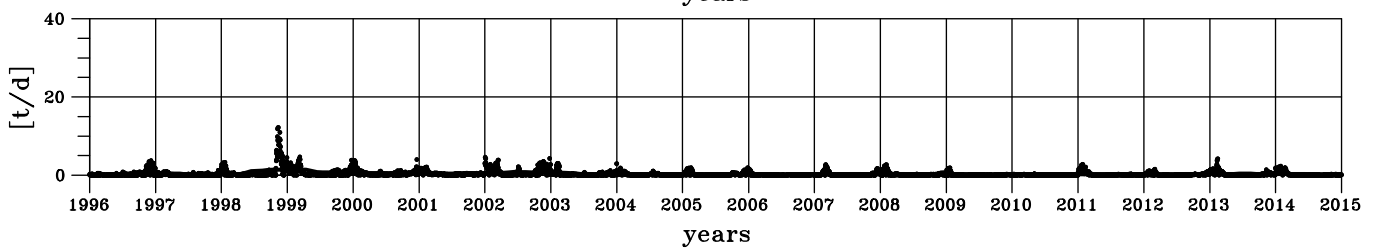
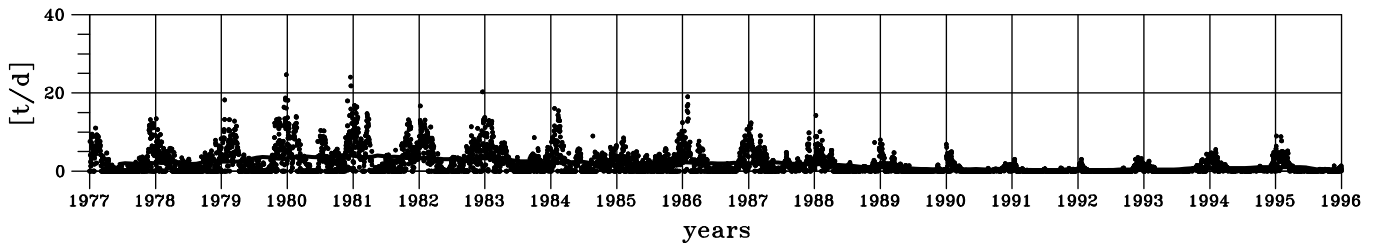
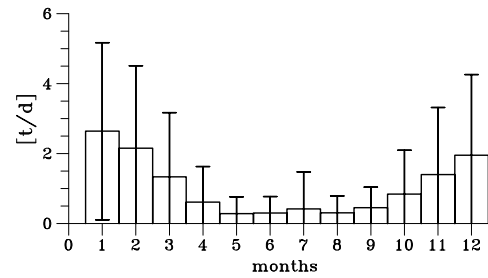
minimum: 0.1 t/d August 2009

maximum: 4.0 t/d November 1980

ANNUAL CYCLE

minimum: 0.3 t/d May, rel. stdev: 1.70

maximum: 2.6 t/d January, rel. stdev: 0.96



Silicate load for Kornwederzand

ANNUAL LOADS

year	kt/y	year	kt/y	year	kt/y	year	kt/y	year	kt/y	year	kt/y
1977	5.7	1984	8.5	1991	6.3			2005	8.7	2012	11.7
1978	5.2	1985	5.6	1992	4.8	1999	14.5	2006	3.8	2013	16.2
1979	14.1	1986	9.2	1993	6.6	2000	9.4	2007	10.4	2014	12.3
1980	11.3	1987	16.8	1994	13.5	2001	10.8	2008	7.0		
1981	15.2	1988	9.1			2002	15.9	2009	5.4		
1982	12.5	1989	2.8			2003	9.7	2010	14.8		
1983	8.8	1990	3.6			2004	7.7	2011	11.2		

TIME SERIES

mean: 26.2 t/d

relative standard deviation: 1.69

minimum: 0.0 t/d January 1, 1977

maximum: 404.8 t/d February 14, 2013

LOW PASS

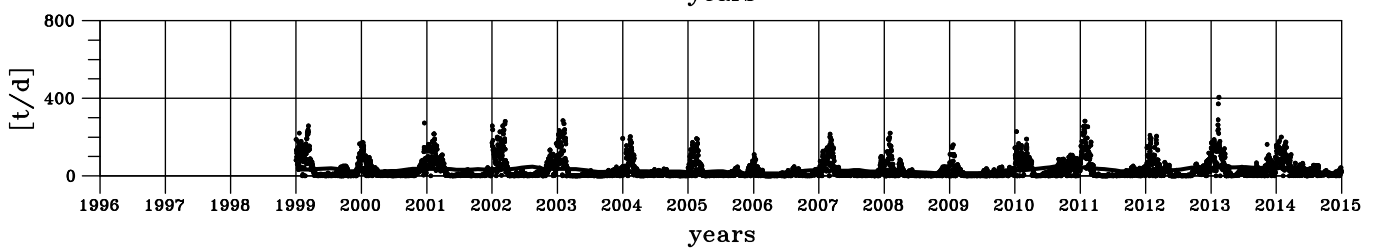
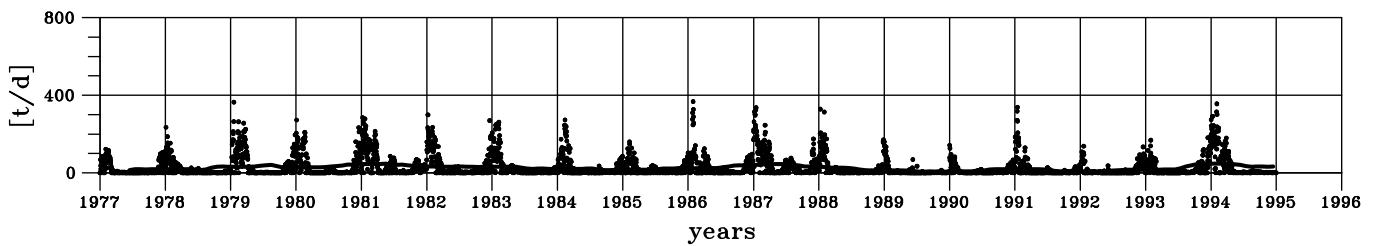
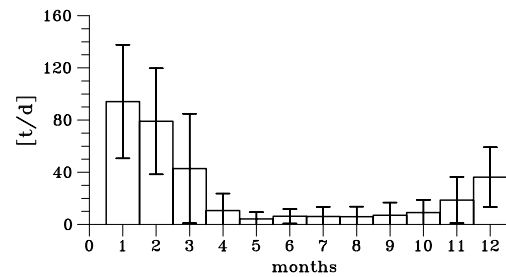
minimum: 6.5 t/d August 1989

maximum: 48.9 t/d August 2010

ANNUAL CYCLE

minimum: 4.2 t/d May, rel. stdev: 1.21

maximum: 94.2 t/d January, rel. stdev: 0.46



5.5 Loads of Den Oever

Total Nitrogen load for Den Oever

ANNUAL LOADS

year	kt/y	year	kt/y	year	kt/y	year	kt/y	year	kt/y	year	kt/y
1977	34.2	1984	56.7	1991	34.2	1998	48.5	2005	23.1	2012	21.4
1978	32.7	1985	40.3	1992	42.7	1999	34.8	2006	19.8	2013	25.8
1979	49.7	1986	50.6	1993	42.4	2000	34.8	2007	28.1	2014	17.6
1980	40.5	1987	57.7	1994	48.4	2001	33.1	2008	27.1		
1981	48.9	1988	59.9	1995	46.7	2002	41.3	2009	18.4		
1982	36.8	1989	36.7	1996	23.4	2003	24.2	2010	27.8		
1983	49.3	1990	34.7	1997	29.0	2004	26.4	2011	22.9		

TIME SERIES

mean: 98.8 t/d

relative standard deviation: 1.20

minimum: 0.0 t/d January 1, 1977

maximum: 1301.4 t/d January 31, 1986

LOW PASS

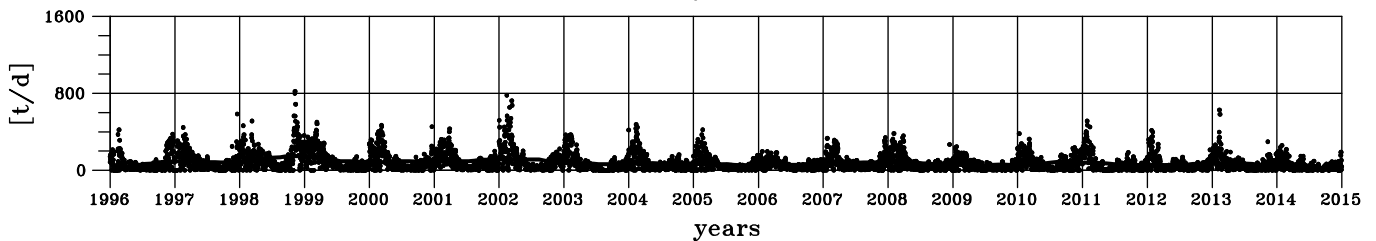
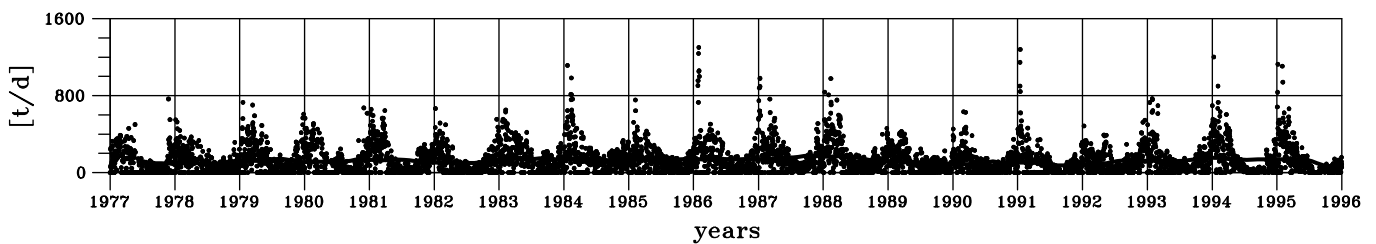
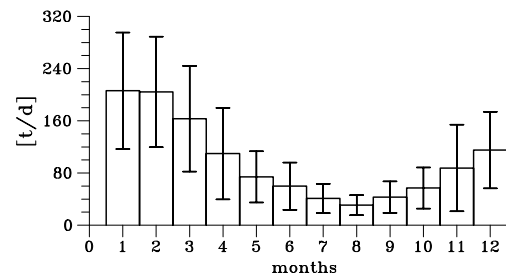
minimum: 44.3 t/d January 1996

maximum: 175.3 t/d October 1987

ANNUAL CYCLE

minimum: 30.8 t/d August, rel. stdev: 0.50

maximum: 206.0 t/d January, rel. stdev: 0.43



Nitrate + Nitrite load for Den Oever

ANNUAL LOADS

year	kt/y	year	kt/y	year	kt/y	year	kt/y	year	kt/y	year	kt/y
1977	20.5	1984	35.1	1991	21.9	1998	29.4	2005	13.8	2012	10.2
1978	19.5	1985	22.6	1992	24.6	1999	20.7	2006	11.0	2013	15.9
1979	29.2	1986	32.4	1993	24.7	2000	20.2	2007	14.8	2014	10.0
1980	24.1	1987	36.0	1994	34.8	2001	21.5	2008	15.7		
1981	30.4	1988	35.2	1995	30.6	2002	23.8	2009	8.5		
1982	22.7	1989	18.4	1996	13.3	2003	13.7	2010	14.1		
1983	31.0	1990	18.7	1997	17.6	2004	12.4	2011	11.9		

TIME SERIES

mean: 58.4 t/d

relative standard deviation: 1.47

minimum: 0.0 t/d January 1, 1977

maximum: 990.6 t/d January 11, 1994

LOW PASS

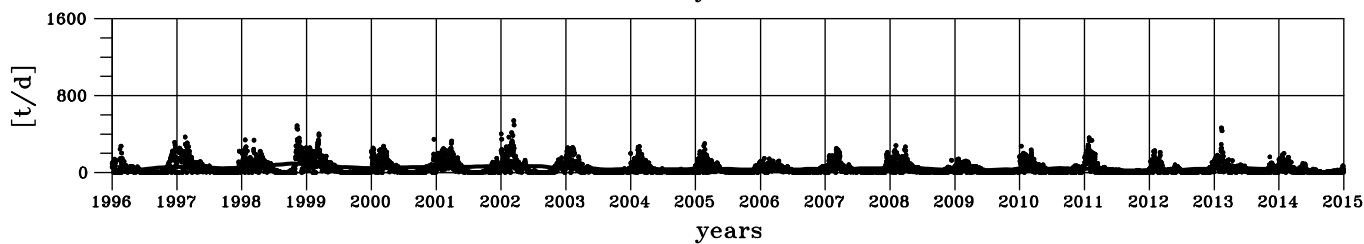
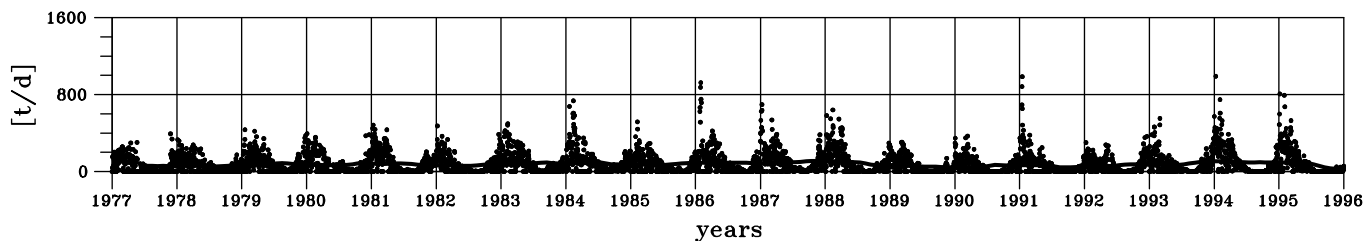
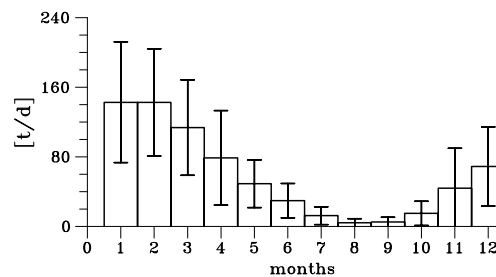
minimum: 20.8 t/d September 2011

maximum: 110.0 t/d November 1987

ANNUAL CYCLE

minimum: 4.2 t/d August, rel. stdev: 1.15

maximum: 142.7 t/d January, rel. stdev: 0.49



Ammonium load for Den Oever

ANNUAL LOADS

year	t/y	year	t/y	year	t/y	year	t/y	year	t/y	year	t/y
1977	2928	1984	1916	1991	800	1998	1042	2005	304	2012	340
1978	1820	1985	1544	1992	783	1999	790	2006	254	2013	405
1979	6461	1986	1884	1993	641	2000	628	2007	279	2014	249
1980	2816	1987	2987	1994	721	2001	1032	2008	296		
1981	2820	1988	944			2002	1192	2009	247		
1982	2917	1989	568			2003	654	2010	166		
1983	1600	1990	718			2004	333	2011	630		

TIME SERIES

mean: 3.6 t/d

relative standard deviation: 2.48

minimum: 0.0 t/d January 1, 1977

maximum: 177.6 t/d January 19, 1979

LOW PASS

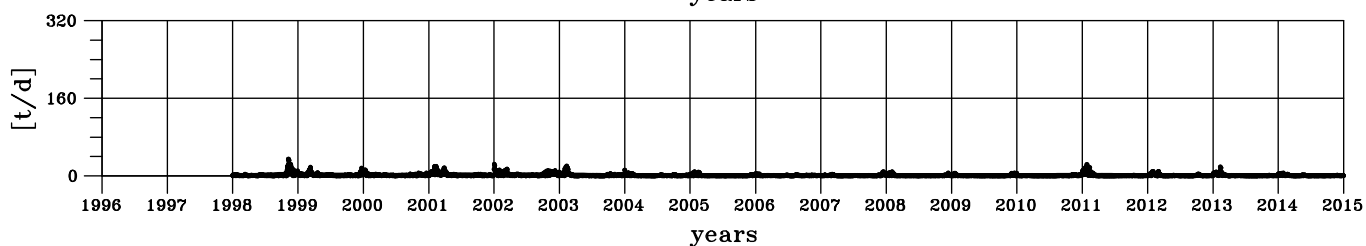
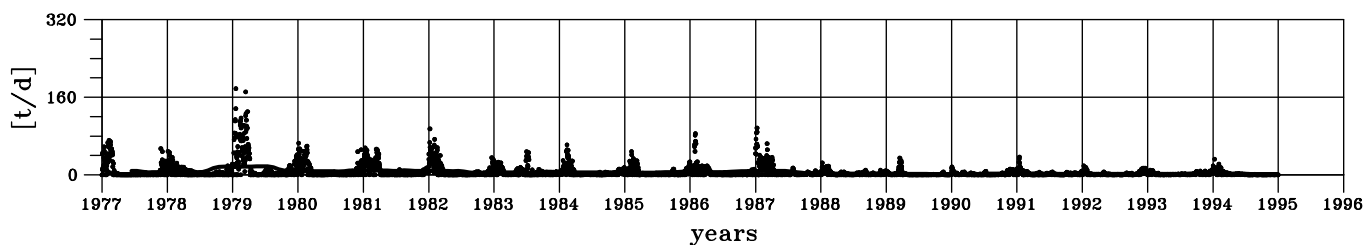
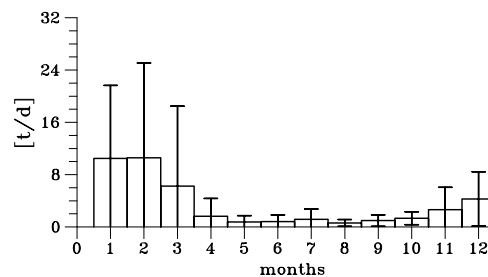
minimum: 0.5 t/d May 2009

maximum: 17.7 t/d June 1979

ANNUAL CYCLE

minimum: 0.6 t/d August, rel. stdev: 0.88

maximum: 10.6 t/d February, rel. stdev: 1.37



Total Phosphorus load for Den Oever

ANNUAL LOADS

year	t/y	year	t/y	year	t/y	year	t/y	year	t/y	year	t/y
1977	2005	1984	3491	1991	1220	1998	1845	2005	871	2012	526
1978	2029	1985	2474	1992	1929	1999	1337	2006	623	2013	622
1979	3421	1986	2894	1993	1463	2000	1644	2007	1010	2014	536
1980	3169	1987	2517	1994	2041	2001	876	2008	911		
1981	3617	1988	3714	1995	1666	2002	1812	2009	1393		
1982	2687	1989	1589	1996	998	2003	941	2010	532		
1983	3152	1990	1538	1997	1047	2004	1821	2011	468		

TIME SERIES

mean: 4.8 t/d

relative standard deviation: 1.40

minimum: 0.0 t/d January 1, 1977

maximum: 112.3 t/d February 1, 1988

LOW PASS

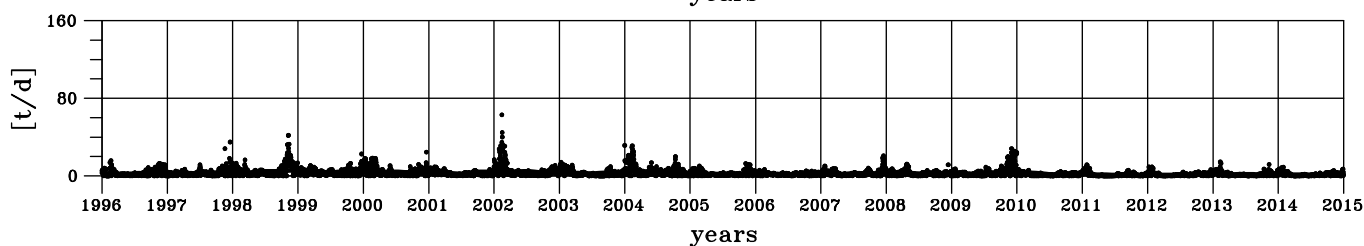
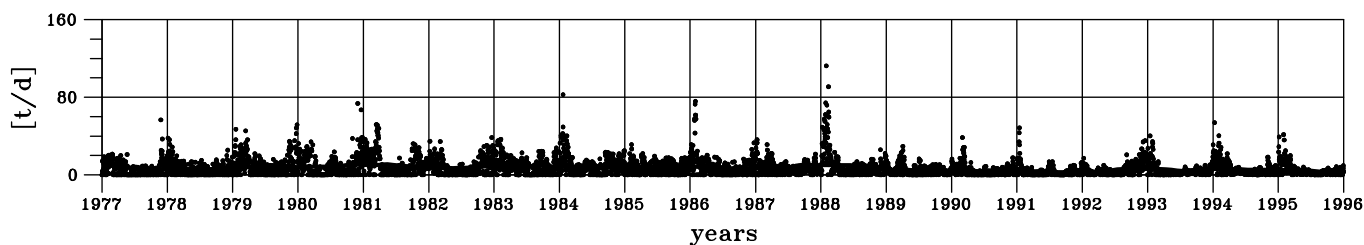
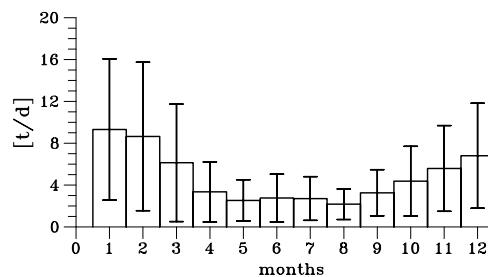
minimum: 1.1 t/d September 2011

maximum: 10.9 t/d May 1981

ANNUAL CYCLE

minimum: 2.2 t/d August, rel. stdev: 0.67

maximum: 9.3 t/d January, rel. stdev: 0.72



Phosphate load for Den Oever

ANNUAL LOADS

year	t/y	year	t/y	year	t/y	year	t/y	year	t/y	year	t/y
1977	1071	1984	1414	1991	104	1998	543	2005	127	2012	70
1978	886	1985	1015	1992	259	1999	344	2006	43	2013	142
1979	1544	1986	1069	1993	245	2000	240	2007	136	2014	96
1980	1481	1987	918	1994	344	2001	173	2008	117		
1981	1572	1988	845	1995	418	2002	434	2009	52		
1982	1354	1989	394	1996	194	2003	158	2010	23		
1983	1223	1990	280	1997	124	2004	97	2011	112		

TIME SERIES

mean: 1.4 t/d

relative standard deviation: 2.00

minimum: 0.0 t/d January 1, 1977

maximum: 35.3 t/d November 26, 1977

LOW PASS

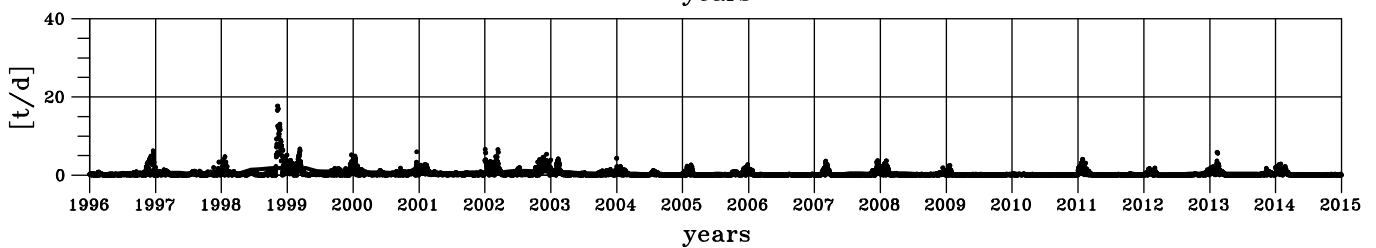
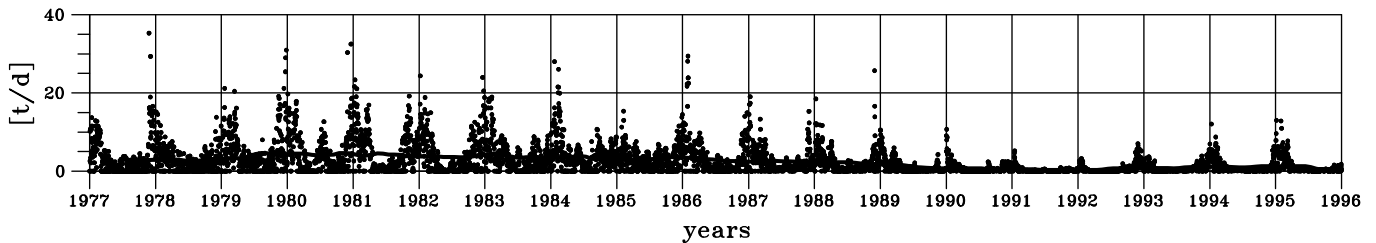
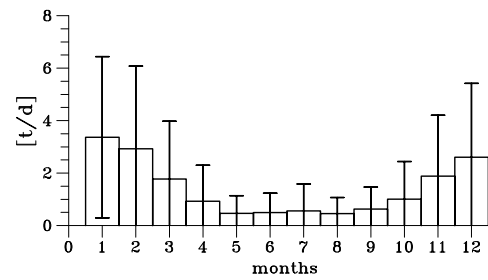
minimum: 0.1 t/d June 2010

maximum: 4.6 t/d November 1980

ANNUAL CYCLE

minimum: 0.5 t/d August, rel. stdev: 1.33

maximum: 3.4 t/d January, rel. stdev: 0.91



Silicate load for Den Oever

ANNUAL LOADS

year	kt/y	year	kt/y	year	kt/y	year	kt/y	year	kt/y	year	kt/y
1977	8.1	1984	13.3	1991	9.8			2005	11.1	2012	12.8
1978	6.8	1985	8.8	1992	9.7	1999	18.8	2006	5.5	2013	18.5
1979	17.0	1986	14.8	1993	11.6	2000	11.9	2007	14.5	2014	12.9
1980	13.2	1987	19.4	1994	17.9	2001	14.7	2008	10.1		
1981	17.9	1988	12.8			2002	21.1	2009	7.9		
1982	15.2	1989	5.6			2003	13.7	2010	18.8		
1983	11.4	1990	5.2			2004	10.0	2011	13.7		

TIME SERIES

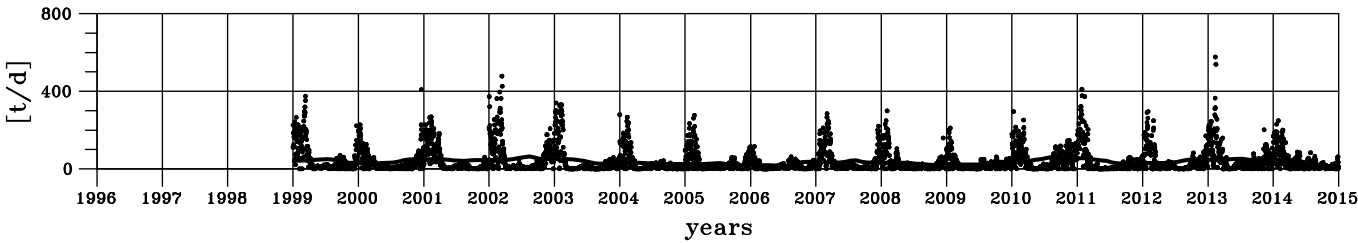
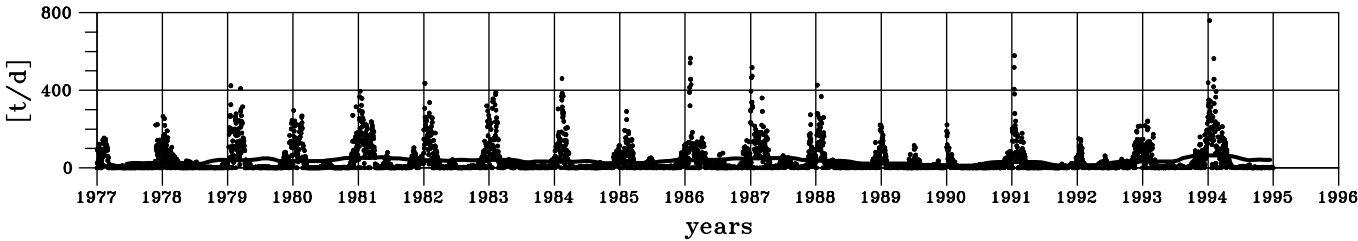
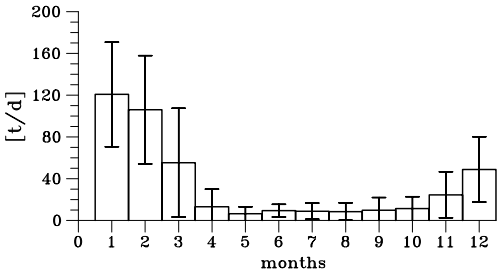
mean: 34.8 t/d
relative standard deviation: 1.68
minimum: 0.0 t/d January 1, 1977
maximum: 758.5 t/d January 11, 1994

LOW PASS

minimum: 10.5 t/d April 1990
maximum: 64.8 t/d November 1993

ANNUAL CYCLE

minimum: 6.5 t/d May, rel. stdev: 1.02
maximum: 120.7 t/d January, rel. stdev: 0.41



5.6 Loads of Nordzeekanaal

Total Nitrogen load for Nordzeekanaal

ANNUAL LOADS

year	kt/y	year	kt/y	year	kt/y	year	kt/y	year	kt/y	year	kt/y
1977	21.7	1984	16.4	1991	11.2	1998	12.5	2005	9.1	2012	5.8
1978	19.6	1985	16.0	1992	13.4	1999	9.0	2006	7.7	2013	5.6
1979	23.3	1986	15.4	1993	11.9	2000	10.7	2007	4.1	2014	5.5
1980	20.7	1987	17.4	1994	14.0	2001	9.6	2008	7.7		
1981	17.4	1988	13.8	1995	10.9	2002	9.4	2009	5.6		
1982	13.9	1989	11.9	1996	9.5	2003	8.1	2010	7.2		
1983	13.5	1990	13.2	1997	8.3	2004	10.3	2011	6.5		

TIME SERIES

mean: 32.3 t/d

relative standard deviation: 0.68

minimum: 0.0 t/d March 24, 1990

maximum: 176.2 t/d January 13, 1978

LOW PASS

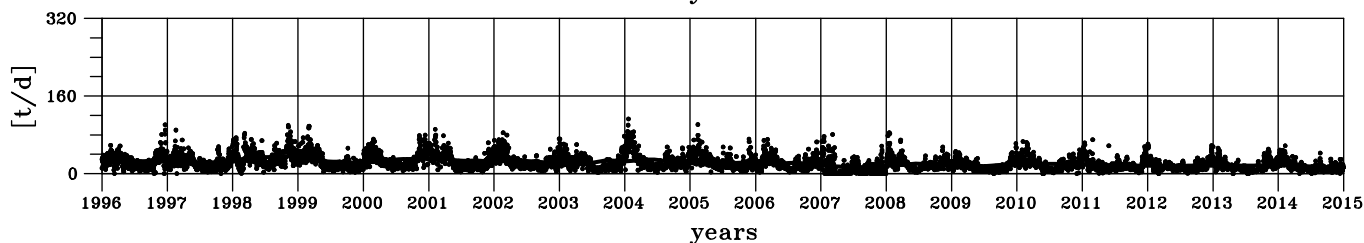
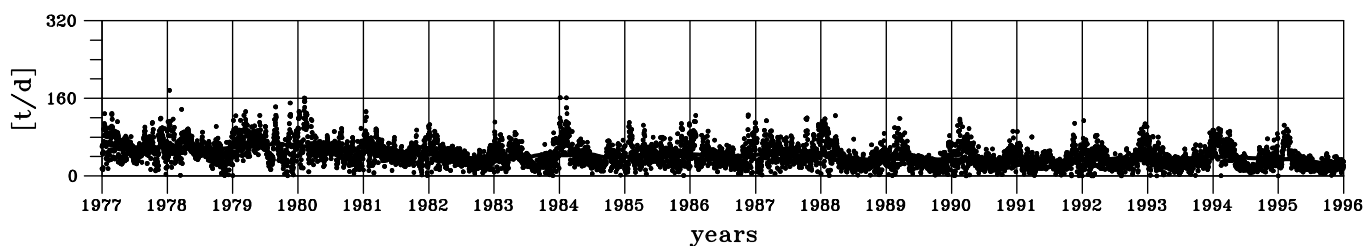
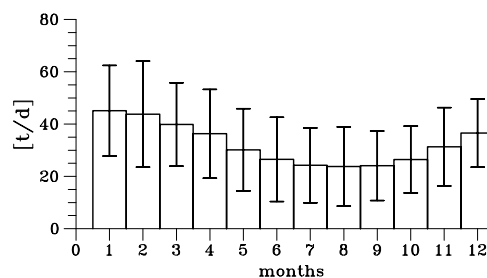
minimum: 11.7 t/d July 2007

maximum: 66.5 t/d September 1979

ANNUAL CYCLE

minimum: 23.8 t/d August, rel. stdev: 0.64

maximum: 45.1 t/d January, rel. stdev: 0.38



Nitrate + Nitrite load for Nordzeekanaal

ANNUAL LOADS

year	kt/y	year	kt/y	year	kt/y	year	kt/y	year	kt/y	year	kt/y
1977	9.5	1984	8.8	1991	7.0	1998	8.5	2005	6.5	2012	3.8
1978	8.8	1985	9.0	1992	8.4	1999	6.6	2006	5.3	2013	3.7
1979	8.8	1986	8.7	1993	7.4	2000	7.2	2007	2.9	2014	3.4
1980	8.5	1987	9.0	1994	9.1	2001	6.4	2008	4.9		
1981	7.7	1988	8.4	1995	7.2	2002	6.3	2009	3.8		
1982	6.3	1989	8.0	1996	6.6	2003	4.9	2010	4.8		
1983	7.2	1990	8.6	1997	6.0	2004	7.4	2011	4.2		

TIME SERIES

mean: 18.7 t/d

relative standard deviation: 0.65

minimum: 0.0 t/d March 24, 1990

maximum: 90.0 t/d January 13, 1978

LOW PASS

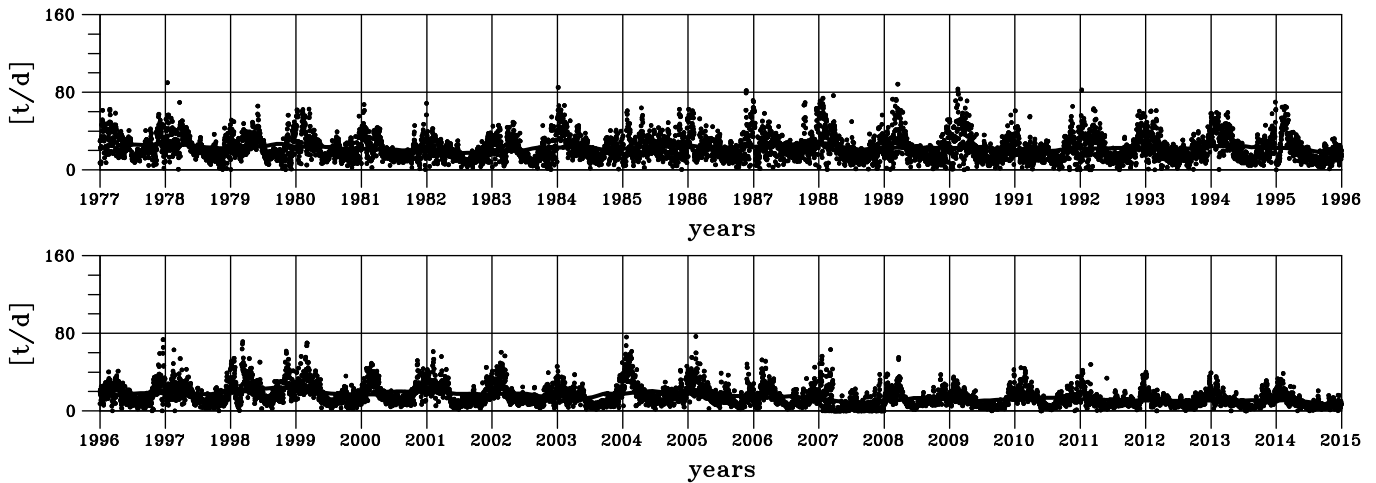
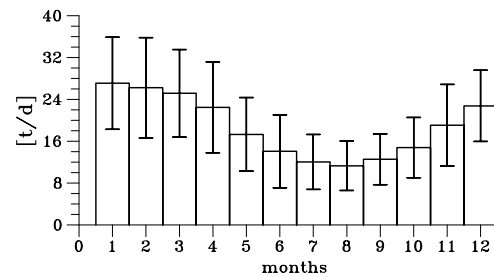
minimum: 7.7 t/d August 2007

maximum: 27.1 t/d February 1978

ANNUAL CYCLE

minimum: 11.3 t/d August, rel. stdev: 0.42

maximum: 27.1 t/d January, rel. stdev: 0.33



Ammonium load for Nordzeekanaal

ANNUAL LOADS

year	t/y	year	t/y	year	t/y	year	t/y	year	t/y	year	t/y
1977	6883	1984	2853	1991	1245	1998	650	2005	560	2012	643
1978	5150	1985	2407	1992	922	1999	669	2006	1075	2013	599
1979	6802	1986	2720	1993	1196	2000	819	2007	367	2014	447
1980	4990	1987	2971	1994	1510	2001	883	2008	750		
1981	3920	1988	1803			2002	718	2009	1020		
1982	2782	1989	995			2003	586	2010	912		
1983	2125	1990	1307			2004	992	2011	798		

TIME SERIES

mean: 5.3 t/d

relative standard deviation: 1.22

minimum: 0.0 t/d March 24, 1990

maximum: 72.9 t/d March 5, 1979

LOW PASS

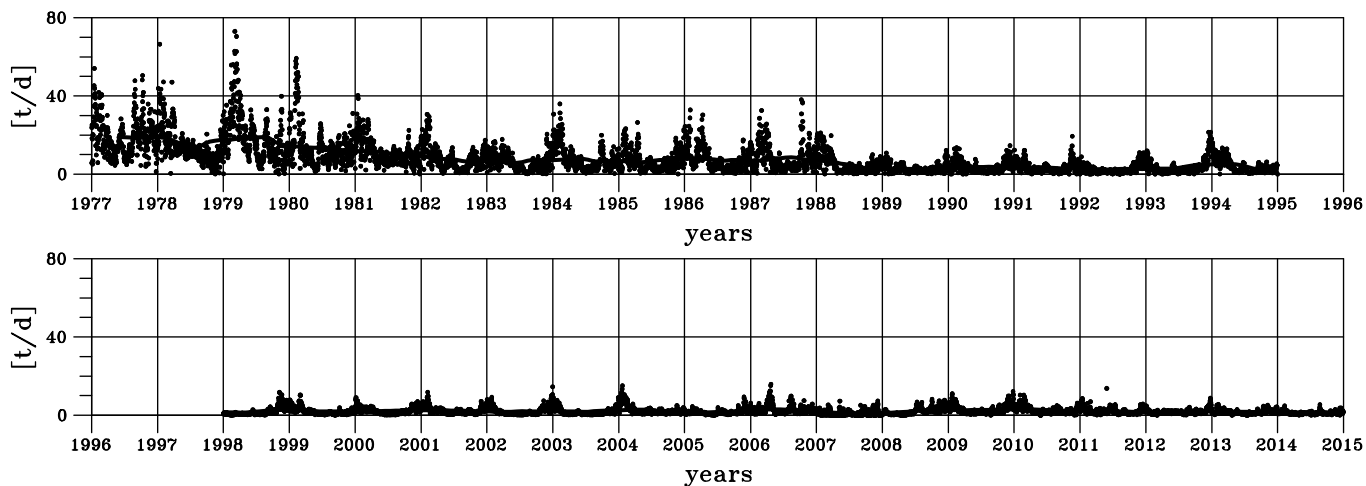
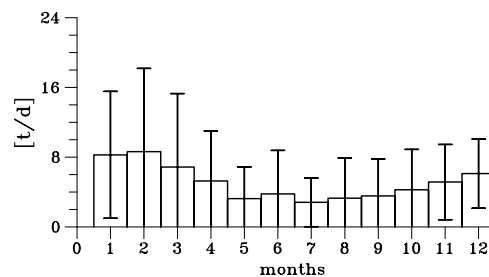
minimum: 0.9 t/d December 2007

maximum: 19.1 t/d November 1977

ANNUAL CYCLE

minimum: 2.8 t/d July, rel. stdev: 0.99

maximum: 8.6 t/d February, rel. stdev: 1.10



Total Phosphorus load for Nordzeekanaal

ANNUAL LOADS

year	t/y	year	t/y	year	t/y	year	t/y	year	t/y	year	t/y
1977	1824	1984	2153	1991	1071	1998	1008	2005	676	2012	469
1978	2109	1985	2283	1992	1113	1999	789	2006	647	2013	476
1979	2612	1986	1947	1993	1148	2000	761	2007	282	2014	545
1980	2220	1987	2093	1994	1322	2001	754	2008	551		
1981	2307	1988	1623	1995	703	2002	841	2009	411		
1982	2117	1989	1256	1996	643	2003	619	2010	589		
1983	1917	1990	1212	1997	744	2004	788	2011	406		

TIME SERIES

mean: 3.2 t/d

relative standard deviation: 0.84

minimum: 0.0 t/d March 24, 1990

maximum: 40.8 t/d December 4, 1978

LOW PASS

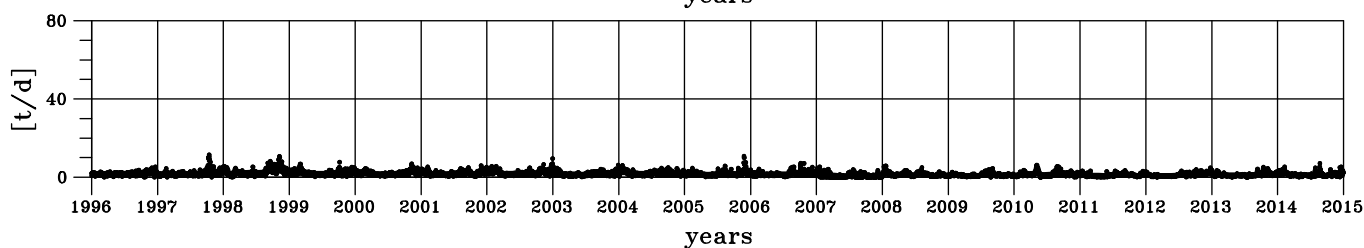
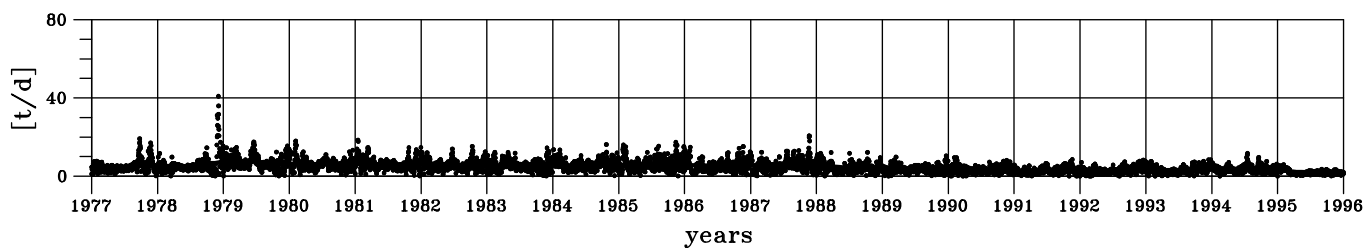
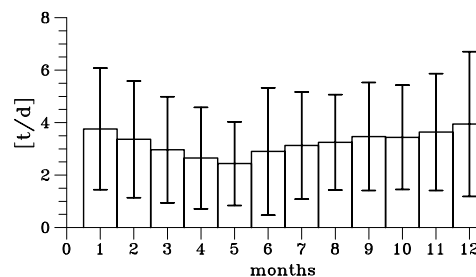
minimum: 0.8 t/d July 2007

maximum: 7.8 t/d February 1979

ANNUAL CYCLE

minimum: 2.4 t/d May, rel. stdev: 0.66

maximum: 3.9 t/d December, rel. stdev: 0.70



Phosphate load for Nordzeekanaal

ANNUAL LOADS

year	t/y	year	t/y	year	t/y	year	t/y	year	t/y	year	t/y
1977	1200	1984	1634	1991	794	1998	746	2005	527	2012	378
1978	1313	1985	1987	1992	868	1999	632	2006	504	2013	348
1979	1893	1986	1556	1993	804	2000	571	2007	234	2014	414
1980	1766	1987	1633	1994	854	2001	521	2008	396		
1981	1707	1988	1387	1995	507	2002	665	2009	335		
1982	1684	1989	1034	1996	495	2003	496	2010	476		
1983	1405	1990	945	1997	492	2004	543	2011	399		

TIME SERIES

mean: 2.5 t/d

relative standard deviation: 0.83

minimum: 0.0 t/d March 24, 1990

maximum: 19.4 t/d November 22, 1987

LOW PASS

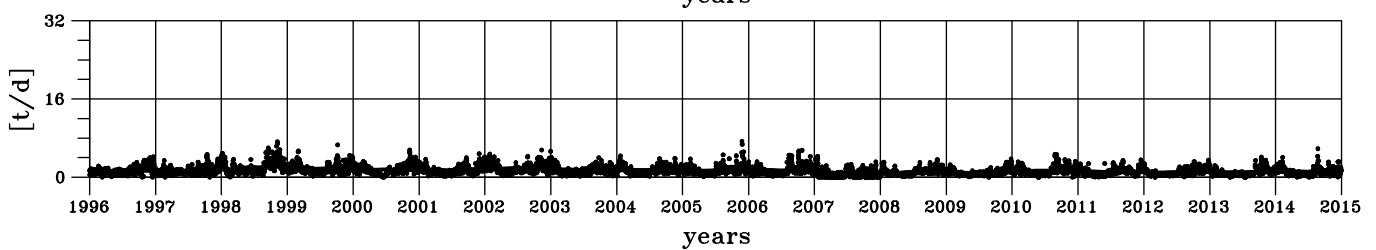
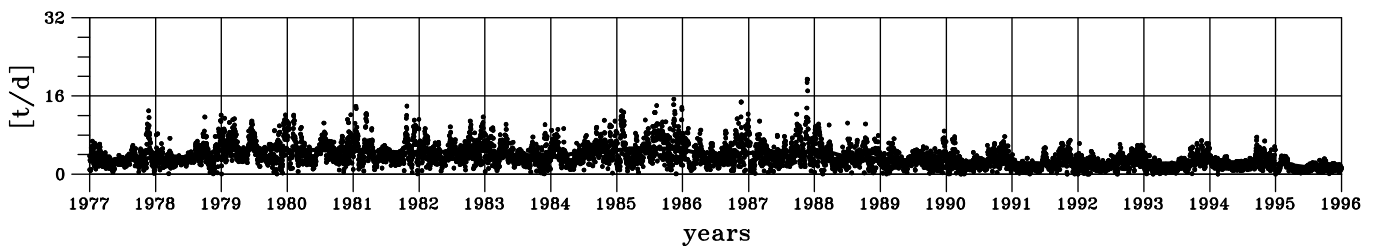
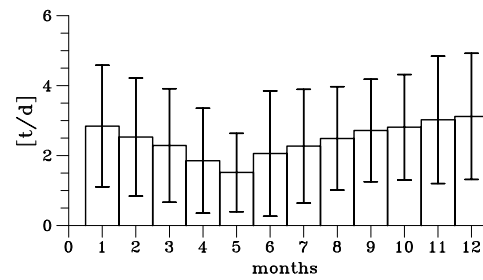
minimum: 0.6 t/d August 2007

maximum: 5.5 t/d July 1985

ANNUAL CYCLE

minimum: 1.5 t/d May, rel. stdev: 0.74

maximum: 3.1 t/d December, rel. stdev: 0.58



Silicate load for Nordzeekanaal

ANNUAL LOADS

year	kt/y	year	kt/y	year	kt/y	year	kt/y	year	kt/y	year	kt/y
		1984	7.4	1991	4.1			2005	8.7	2012	7.7
		1985	4.9	1992	6.1	1999	8.2	2006	8.2	2013	7.6
1979	7.1	1986	6.5	1993	6.7	2000	8.6	2007	4.9	2014	7.5
1980	6.6	1987	6.5	1994	8.1	2001	7.8	2008	7.9		
1981	7.4	1988	7.7			2002	9.0	2009	6.4		
1982	5.5	1989	5.0			2003	5.6	2010	9.3		
1983	5.9	1990	4.9			2004	8.9	2011	8.1		

TIME SERIES

mean: 17.9 t/d

relative standard deviation: 0.87

minimum: 0.0 t/d March 24, 1990

maximum: 112.8 t/d December 31, 2002

LOW PASS

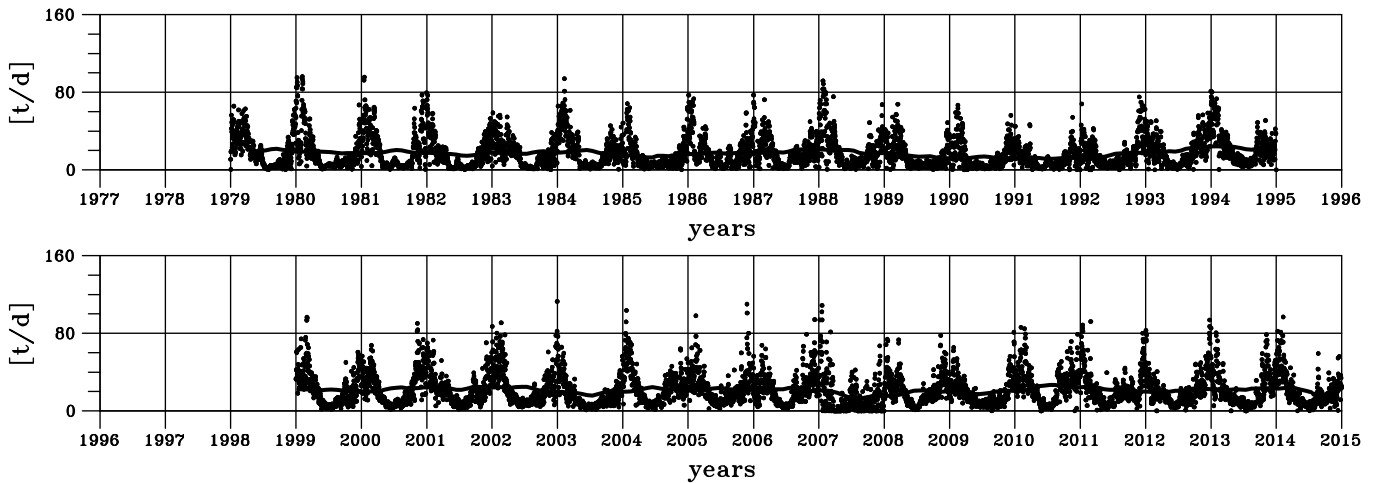
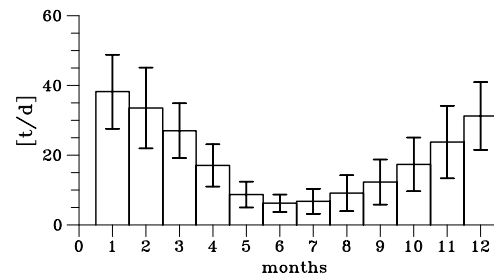
minimum: 11.4 t/d July 1991

maximum: 26.8 t/d August 2010

ANNUAL CYCLE

minimum: 6.2 t/d June, rel. stdev: 0.40

maximum: 38.2 t/d January, rel. stdev: 0.28



5.7 Loads of Nieuwe Waterweg

Total Nitrogen load for Nieuwe Waterweg

ANNUAL LOADS

year	kt/y	year	kt/y	year	kt/y	year	kt/y	year	kt/y	year	kt/y
1977	241.4	1984	258.1	1991	192.9	1998	144.5	2005	131.5	2012	110.2
1978	239.3	1985	236.4	1992	212.1	1999	148.9	2006	146.1	2013	137.8
1979	260.0	1986	259.7	1993	226.5	2000	159.3	2007	158.0	2014	112.7
1980	275.0	1987	294.8	1994	234.3	2001	169.2	2008	149.1		
1981	267.8	1988	251.5	1995	214.2	2002	181.8	2009	135.1		
1982	239.4	1989	218.0	1996	180.3	2003	103.8	2010	157.0		
1983	223.6	1990	193.5	1997	168.9	2004	145.3	2011	120.9		

TIME SERIES

mean: 525.9 t/d

relative standard deviation: 0.54

minimum: 0.0 t/d February 8, 1990

maximum: 2327.9 t/d December 27, 1993

LOW PASS

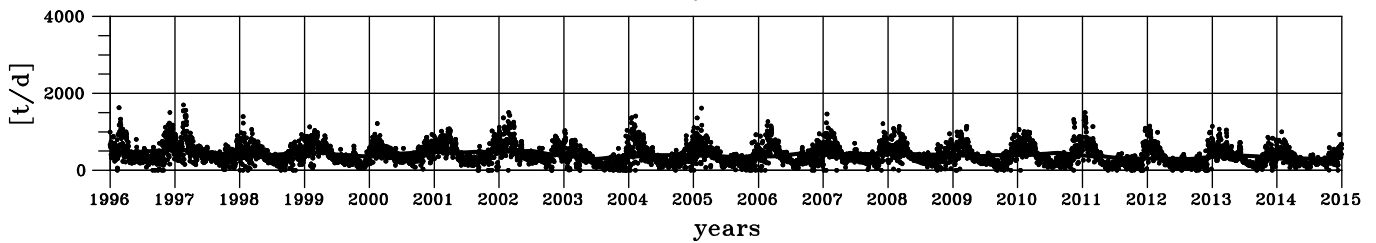
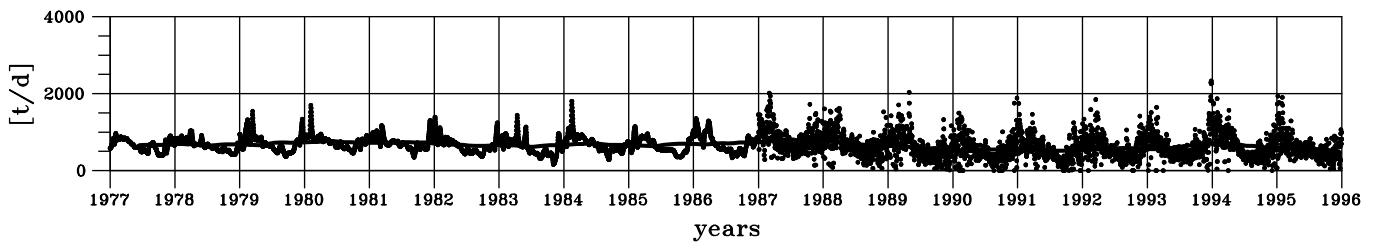
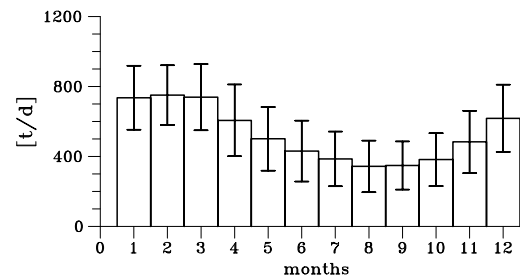
minimum: 288.9 t/d August 2012

maximum: 805.7 t/d June 1987

ANNUAL CYCLE

minimum: 343.2 t/d August, rel. stdev: 0.43

maximum: 750.5 t/d February, rel. stdev: 0.23



Nitrate + Nitrite load for Nieuwe Waterweg

ANNUAL LOADS

year	kt/y	year	kt/y	year	kt/y	year	kt/y	year	kt/y	year	kt/y
1977	167.2	1984	195.0	1991	150.9	1998	117.0	2005	107.2	2012	88.2
1978	173.5	1985	173.5	1992	162.9	1999	116.2	2006	122.9	2013	112.4
1979	181.3	1986	192.6	1993	172.2	2000	131.2	2007	130.6	2014	92.3
1980	191.7	1987	218.7	1994	179.1	2001	135.2	2008	128.7		
1981	194.1	1988	187.4	1995	161.0	2002	143.0	2009	111.2		
1982	174.7	1989	172.7	1996	140.1	2003	80.7	2010	129.6		
1983	168.5	1990	152.6	1997	139.2	2004	117.3	2011	95.5		

TIME SERIES

mean: 404.1 t/d

relative standard deviation: 0.52

minimum: 0.0 t/d February 8, 1990

maximum: 1658.1 t/d December 27, 1993

LOW PASS

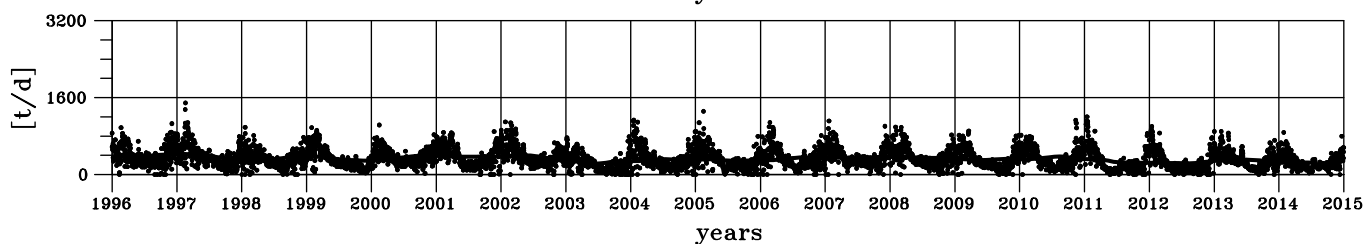
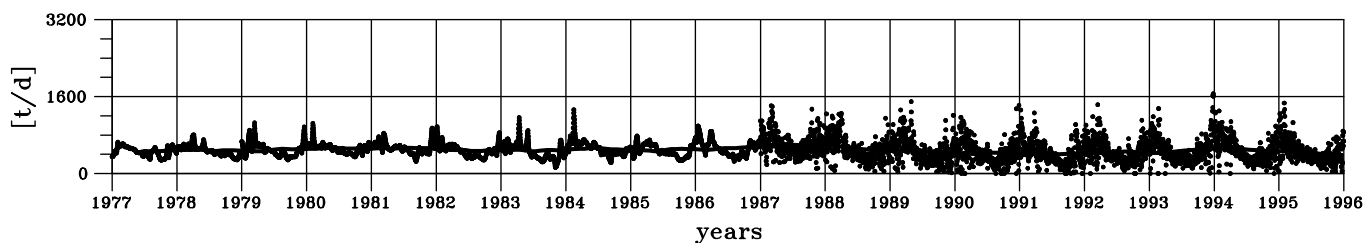
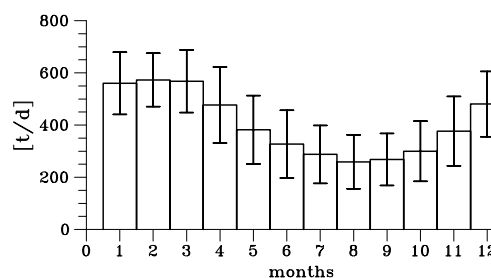
minimum: 226.2 t/d June 2003

maximum: 602.0 t/d November 1987

ANNUAL CYCLE

minimum: 259.0 t/d August, rel. stdev: 0.40

maximum: 572.7 t/d February, rel. stdev: 0.18



Ammonium load for Nieuwe Waterweg

ANNUAL LOADS

year	kt/y	year	kt/y	year	kt/y	year	kt/y	year	kt/y	year	kt/y
1977	35.1	1984	22.9	1991	14.0	1998	5.0	2005	3.7	2012	3.8
1978	33.2	1985	24.1	1992	11.5	1999	5.2	2006	4.8	2013	4.2
1979	33.5	1986	25.9	1993	10.9	2000	5.7	2007	3.2	2014	3.0
1980	33.7	1987	24.6	1994	9.7	2001	7.8	2008	3.4		
1981	25.1	1988	16.6	1995	7.8	2002	6.1	2009	3.8		
1982	21.9	1989	12.5	1996	9.3	2003	4.8	2010	5.1		
1983	21.0	1990	12.7	1997	7.3	2004	5.5	2011	4.8		

TIME SERIES

mean: 35.5 t/d

relative standard deviation: 1.16

minimum: 0.0 t/d February 8, 1990

maximum: 319.5 t/d February 6, 1980

LOW PASS

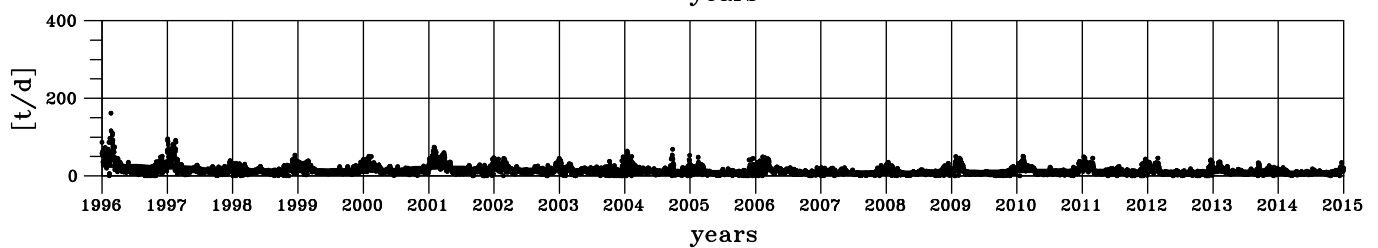
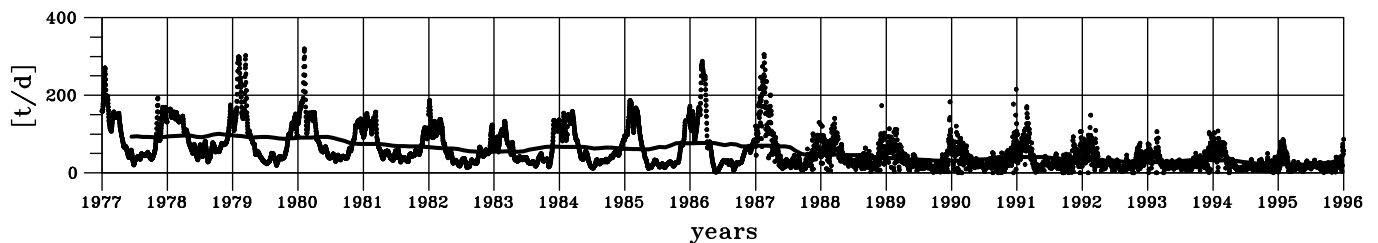
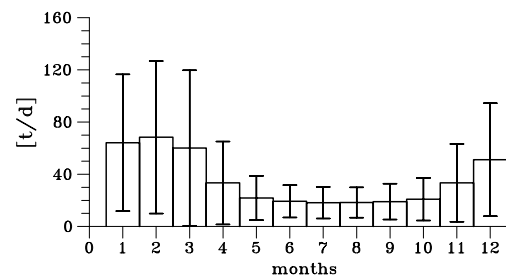
minimum: 7.9 t/d December 2007

maximum: 100.3 t/d October 1978

ANNUAL CYCLE

minimum: 18.2 t/d July, rel. stdev: 0.66

maximum: 68.3 t/d February, rel. stdev: 0.86



Total Phosphorus load for Nieuwe Waterweg

ANNUAL LOADS

year	kt/y	year	kt/y	year	kt/y	year	kt/y	year	kt/y	year	kt/y
1977	23.6	1984	24.7	1991	11.7	1998	8.8	2005	6.0	2012	3.7
1978	24.5	1985	22.3	1992	11.4	1999	9.9	2006	6.4	2013	5.7
1979	27.0	1986	23.8	1993	15.0	2000	8.8	2007	8.6	2014	4.6
1980	32.5	1987	20.6	1994	21.2	2001	5.6	2008	7.7		
1981	27.3	1988	25.4	1995	16.8	2002	11.7	2009	6.0		
1982	23.7	1989	18.2	1996	14.8	2003	5.2	2010	7.1		
1983	23.2	1990	13.9	1997	10.5	2004	8.3	2011	3.9		

TIME SERIES

mean: 39.6 t/d

relative standard deviation: 0.74

minimum: 0.0 t/d February 8, 1990

maximum: 240.6 t/d December 27, 1993

LOW PASS

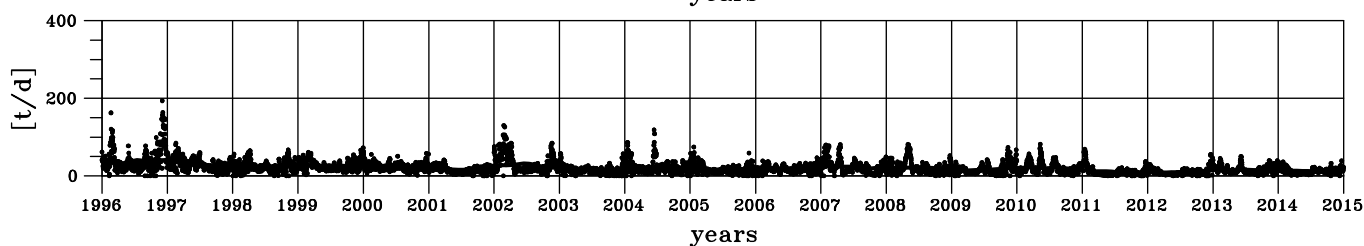
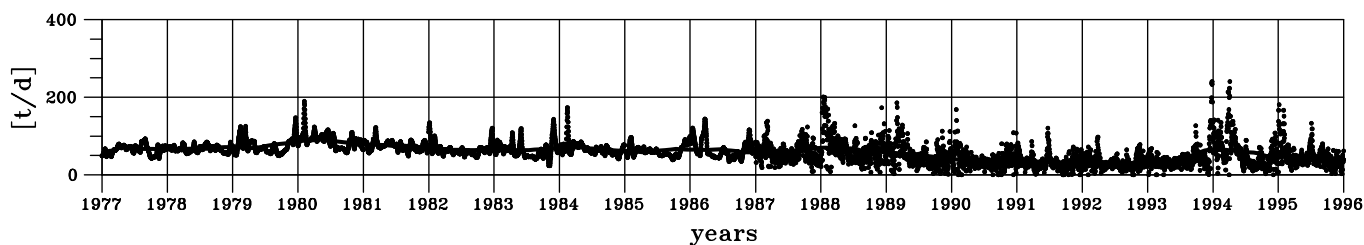
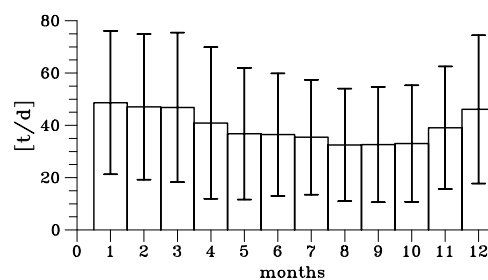
minimum: 8.7 t/d September 2011

maximum: 91.0 t/d May 1980

ANNUAL CYCLE

minimum: 32.5 t/d August, rel. stdev: 0.66

maximum: 48.6 t/d January, rel. stdev: 0.56



Phosphate load for Nieuwe Waterweg

ANNUAL LOADS

year	kt/y	year	kt/y	year	kt/y	year	kt/y	year	kt/y	year	kt/y
1977	14.9	1984	17.1	1991	6.6	1998	4.6	2005	3.2	2012	2.3
1978	17.1	1985	15.9	1992	6.8	1999	5.2	2006	3.3	2013	2.9
1979	17.9	1986	15.7	1993	7.7	2000	5.4	2007	4.0	2014	2.7
1980	21.0	1987	12.5	1994	7.7	2001	3.0	2008	3.7		
1981	19.5	1988	16.8	1995	7.2	2002	4.4	2009	3.3		
1982	16.0	1989	12.6	1996	6.0	2003	2.7	2010	3.3		
1983	17.6	1990	8.7	1997	5.7	2004	3.3	2011	2.5		

TIME SERIES

mean: 23.8 t/d

relative standard deviation: 0.79

minimum: 0.0 t/d February 8, 1990

maximum: 156.4 t/d December 7, 1988

LOW PASS

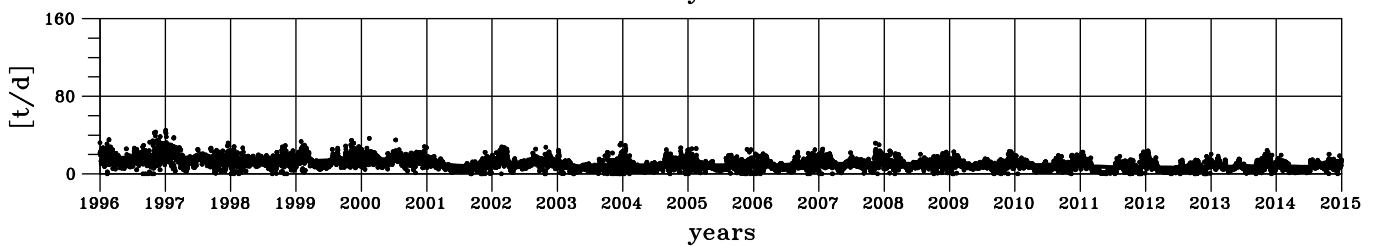
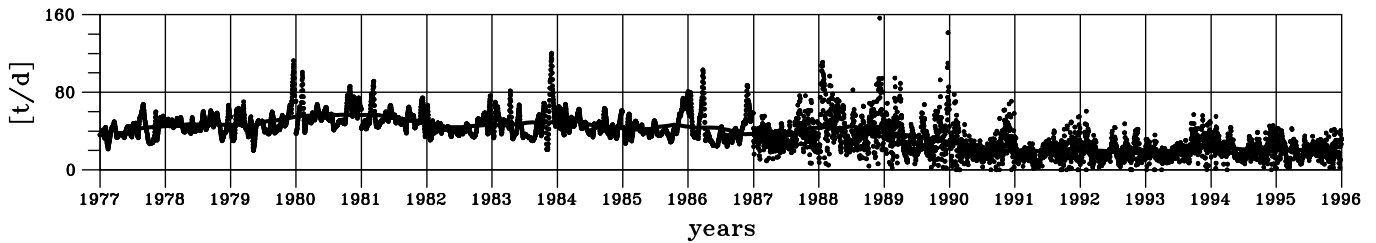
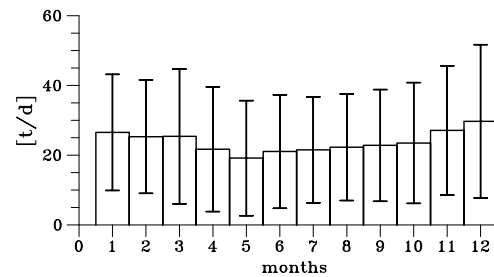
minimum: 5.9 t/d August 2012

maximum: 58.3 t/d May 1980

ANNUAL CYCLE

minimum: 19.2 t/d May, rel. stdev: 0.86

maximum: 29.7 t/d December, rel. stdev: 0.74



Silicate load for Nieuwe Waterweg

ANNUAL LOADS

year	kt/y	year	kt/y	year	kt/y	year	kt/y	year	kt/y	year	kt/y
1977	90.2	1984	108.7	1991	57.3			2005	100.5	2012	89.2
1978	102.6	1985	88.0	1992	77.2	1999	104.8	2006	106.0	2013	113.9
1979	103.3	1986	108.8	1993	90.1	2000	118.2	2007	132.2	2014	98.6
1980	120.1	1987	139.9	1994	107.2	2001	111.1	2008	125.3		
1981	116.7	1988	112.2			2002	130.8	2009	107.7		
1982	103.8	1989	84.2			2003	63.9	2010	125.3		
1983	103.5	1990	67.3			2004	95.8	2011	88.6		

TIME SERIES

mean: 280.2 t/d

relative standard deviation: 0.68

minimum: 0.0 t/d February 8, 1990

maximum: 1268.8 t/d February 15, 2005

LOW PASS

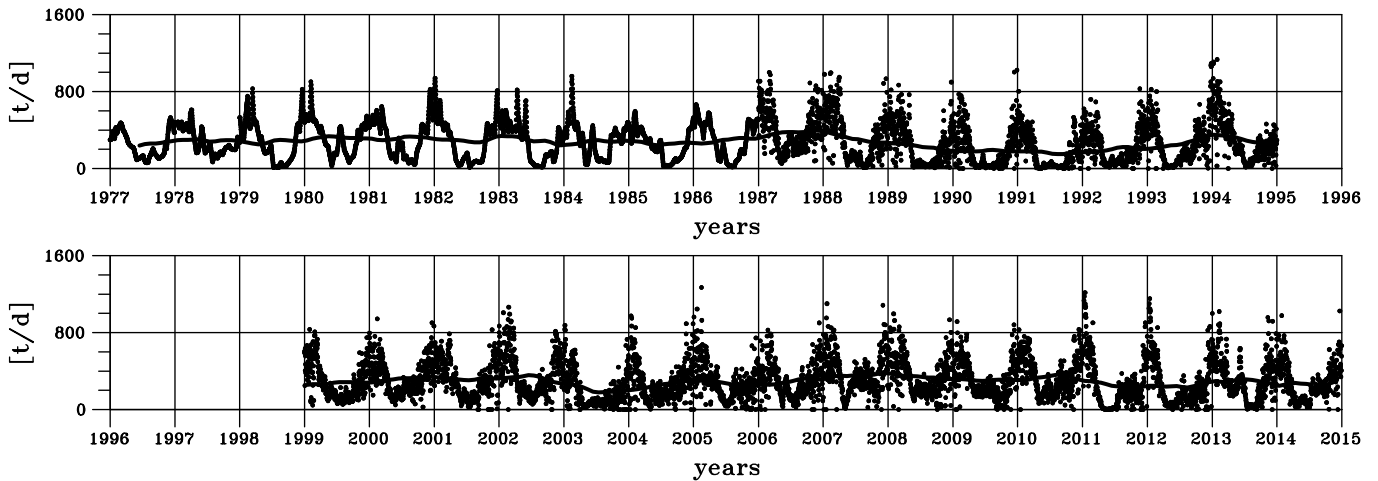
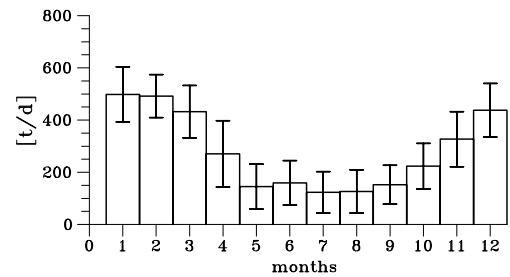
minimum: 151.9 t/d August 1991

maximum: 395.5 t/d November 1987

ANNUAL CYCLE

minimum: 122.7 t/d July, rel. stdev: 0.65

maximum: 498.3 t/d January, rel. stdev: 0.21



Total Alkalinity load for Nieuwe Waterweg

ANNUAL LOADS

year	Gmol/y	year	Gmol/y	year	Gmol/y	year	Gmol/y	year	Gmol/y	year	Gmol/y
1977	110.3	1984	120.1	1991	102.6	1998	86.9	2005	107.3	2012	102.9
1978	115.1	1985	105.8	1992	115.0	1999	121.9	2006	114.1	2013	124.7
1979	120.1	1986	119.8	1993	121.7	2000	122.1	2007	127.9	2014	110.0
1980	128.7	1987	137.6	1994	129.9	2001	129.9	2008	128.4		
1981	131.8	1988	131.0	1995	128.3	2002	132.4	2009	115.3		
1982	126.9	1989	107.1	1996	103.9	2003	89.6	2010	126.4		
1983	113.3	1990	102.7	1997	109.5	2004	110.7	2011	102.6		

TIME SERIES

mean: 319.5 Mmol/d

relative standard deviation: 0.37

minimum: 0.0 Mmol/d February 8, 1990

maximum: 1036.3 Mmol/d January 31, 1995

LOW PASS

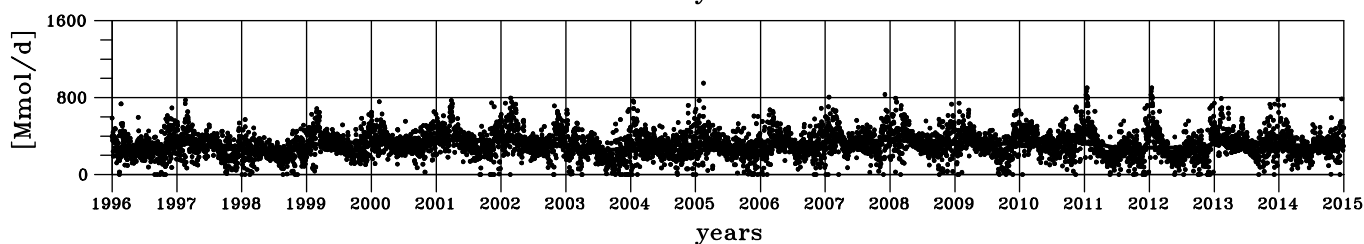
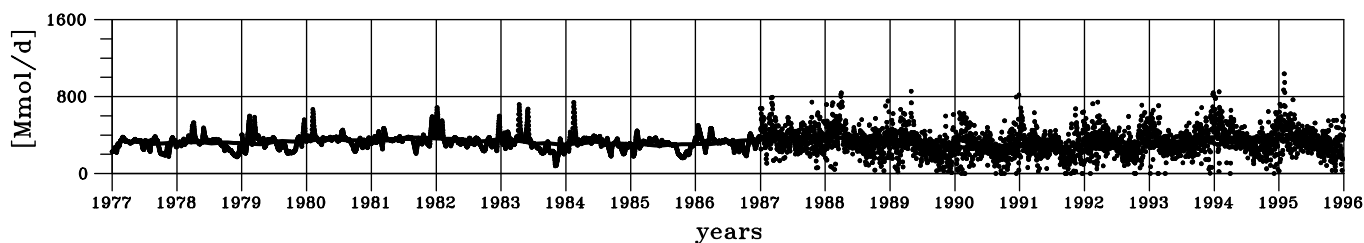
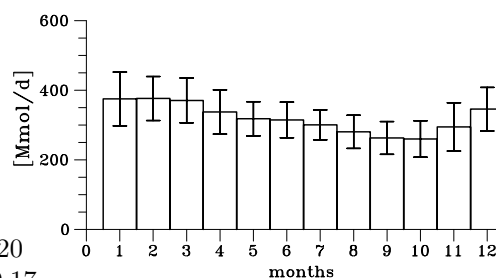
minimum: 231.2 Mmol/d April 1998

maximum: 387.5 Mmol/d November 1987

ANNUAL CYCLE

minimum: 259.9 Mmol/d October, rel. stdev: 0.20

maximum: 376.2 Mmol/d February, rel. stdev: 0.17



Dissolved Inorganic Carbon load for Nieuwe Waterweg

ANNUAL LOADS

year	Gmol/y	year	Gmol/y	year	Gmol/y	year	Gmol/y	year	Gmol/y	year	Gmol/y
1977	114.5	1984	124.6	1991	106.5	1998	90.2	2005	111.4	2012	106.8
1978	119.4	1985	109.8	1992	119.3	1999	126.6	2006	118.4	2013	129.4
1979	124.6	1986	124.3	1993	126.3	2000	126.8	2007	132.8	2014	114.2
1980	133.6	1987	142.8	1994	134.8	2001	134.9	2008	133.2		
1981	136.8	1988	136.0	1995	133.2	2002	137.5	2009	119.7		
1982	131.7	1989	111.2	1996	107.8	2003	93.0	2010	131.2		
1983	117.6	1990	106.6	1997	113.7	2004	114.9	2011	106.4		

TIME SERIES

mean: 331.6 Mmol/d

relative standard deviation: 0.37

minimum: 0.0 Mmol/d February 8, 1990

maximum: 1075.7 Mmol/d January 31, 1995

LOW PASS

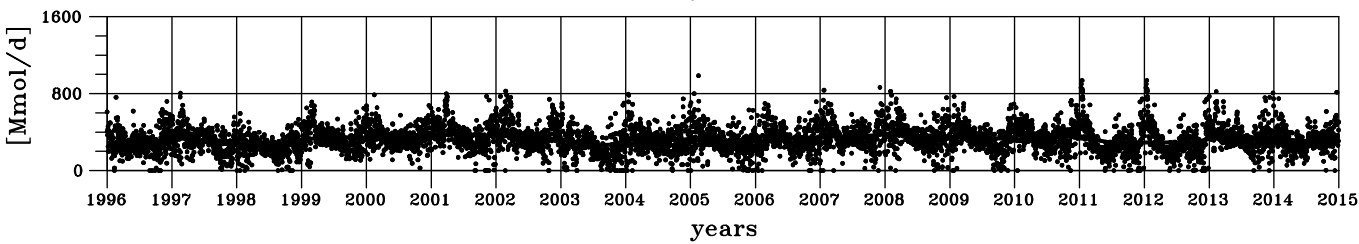
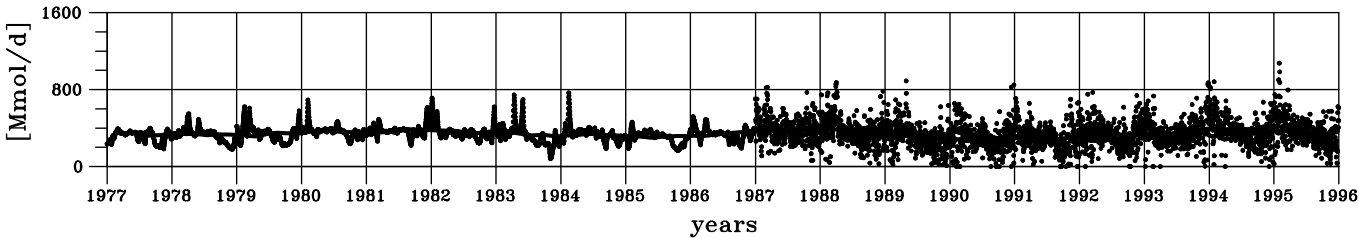
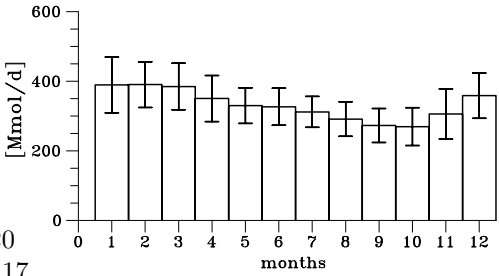
minimum: 240.0 Mmol/d April 1998

maximum: 402.2 Mmol/d November 1987

ANNUAL CYCLE

minimum: 269.8 Mmol/d October, rel. stdev: 0.20

maximum: 390.5 Mmol/d February, rel. stdev: 0.17



Dissolved Organic Carbon load for Nieuwe Waterweg

ANNUAL LOADS

year	Gmol/y	year	Gmol/y	year	Gmol/y	year	Gmol/y	year	Gmol/y	year	Gmol/y
1977	9.8	1984	10.7	1991	9.1	1998	7.7	2005	9.6	2012	9.2
1978	10.3	1985	9.4	1992	10.2	1999	10.9	2006	10.2	2013	11.1
1979	10.7	1986	10.7	1993	10.8	2000	10.9	2007	11.4	2014	9.8
1980	11.5	1987	12.3	1994	11.6	2001	11.6	2008	11.4		
1981	11.8	1988	11.7	1995	11.4	2002	11.8	2009	10.3		
1982	11.3	1989	9.5	1996	9.3	2003	8.0	2010	11.3		
1983	10.1	1990	9.2	1997	9.8	2004	9.9	2011	9.1		

TIME SERIES

mean: 28.5 Mmol/d

relative standard deviation: 0.37

minimum: 0.0 Mmol/d February 8, 1990

maximum: 92.4 Mmol/d January 31, 1995

LOW PASS

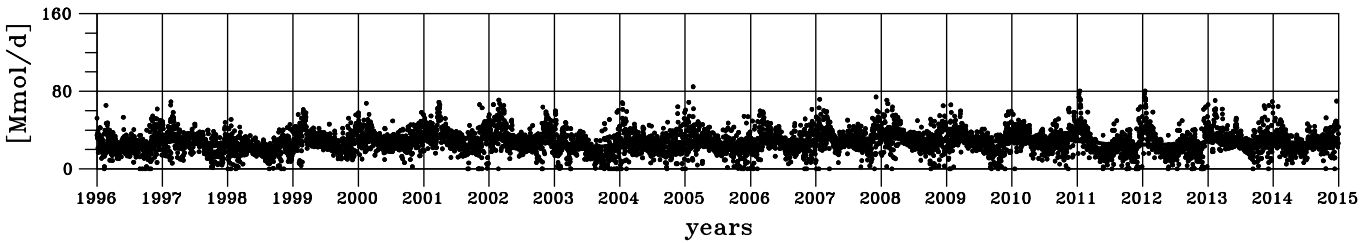
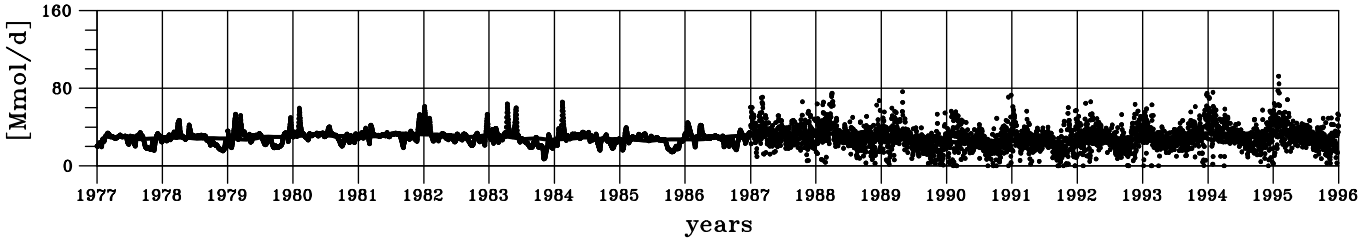
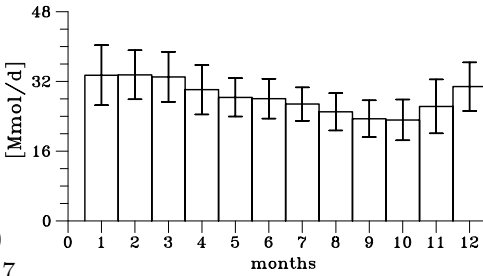
minimum: 20.6 Mmol/d April 1998

maximum: 34.5 Mmol/d November 1987

ANNUAL CYCLE

minimum: 23.2 Mmol/d October, rel. stdev: 0.20

maximum: 33.5 Mmol/d February, rel. stdev: 0.17



5.8 Loads of Haringvliet

Total Nitrogen load for Haringvliet

ANNUAL LOADS

year	kt/y	year	kt/y	year	kt/y	year	kt/y	year	kt/y	year	kt/y
1977	129.5	1984	168.8	1991	62.8	1998	97.8	2005	44.7	2012	54.1
1978	128.1	1985	103.9	1992	89.9	1999	114.1	2006	60.9	2013	81.8
1979	173.3	1986	169.1	1993	77.9	2000	99.9	2007	81.0	2014	34.2
1980	146.8	1987	191.9	1994	146.7	2001	113.1	2008	53.6		
1981	213.6	1988	192.6	1995	197.4	2002	128.5	2009	37.2		
1982	164.5	1989	78.9	1996	44.6	2003	81.2	2010	56.2		
1983	181.9	1990	74.8	1997	49.4	2004	42.3	2011	44.7		

TIME SERIES

mean: 289.1 t/d

relative standard deviation: 1.48

minimum: 0.0 t/d August 28, 1990

maximum: 4672.3 t/d February 2, 1995

LOW PASS

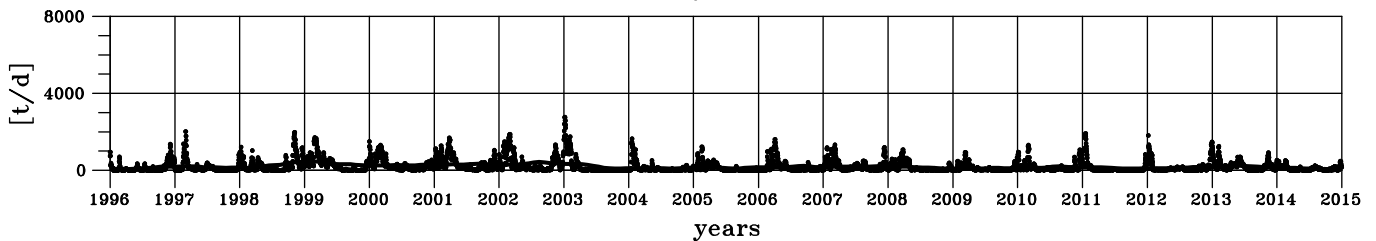
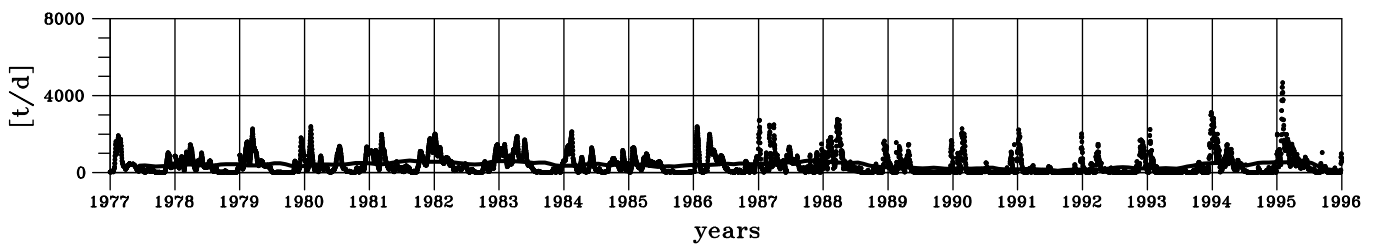
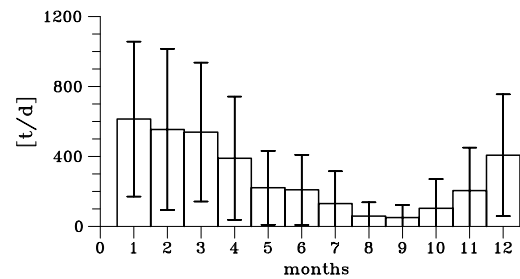
minimum: 61.4 t/d April 1996

maximum: 641.4 t/d November 1987

ANNUAL CYCLE

minimum: 51.2 t/d September, rel. stdev: 1.38

maximum: 613.8 t/d January, rel. stdev: 0.72



Nitrate + Nitrite load for Haringvliet

ANNUAL LOADS

year	kt/y	year	kt/y	year	kt/y	year	kt/y	year	kt/y	year	kt/y
1977	92.0	1984	131.6	1991	51.4	1998	84.3	2005	35.5	2012	44.6
1978	94.3	1985	75.9	1992	73.7	1999	97.8	2006	48.4	2013	69.0
1979	122.3	1986	130.5	1993	65.0	2000	84.6	2007	70.1	2014	28.1
1980	107.0	1987	150.0	1994	120.0	2001	97.0	2008	46.9		
1981	162.5	1988	152.4	1995	142.3	2002	106.0	2009	30.7		
1982	120.6	1989	62.6	1996	38.0	2003	58.3	2010	47.5		
1983	139.7	1990	59.3	1997	42.4	2004	34.3	2011	37.4		

TIME SERIES

mean: 227.2 t/d

relative standard deviation: 1.46

minimum: 0.0 t/d August 28, 1990

maximum: 2927.3 t/d February 2, 1995

LOW PASS

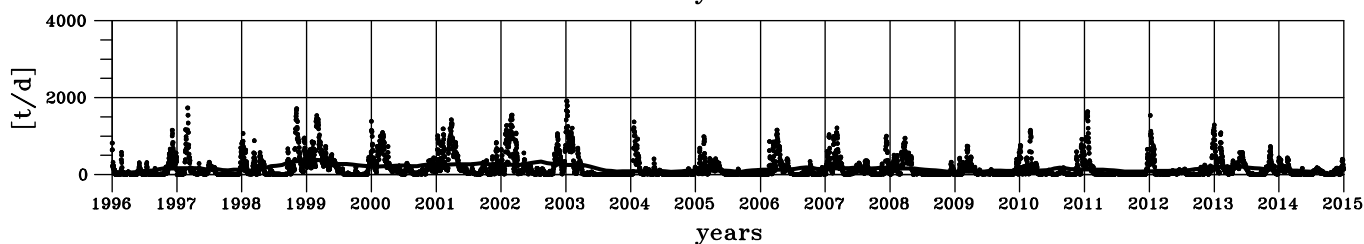
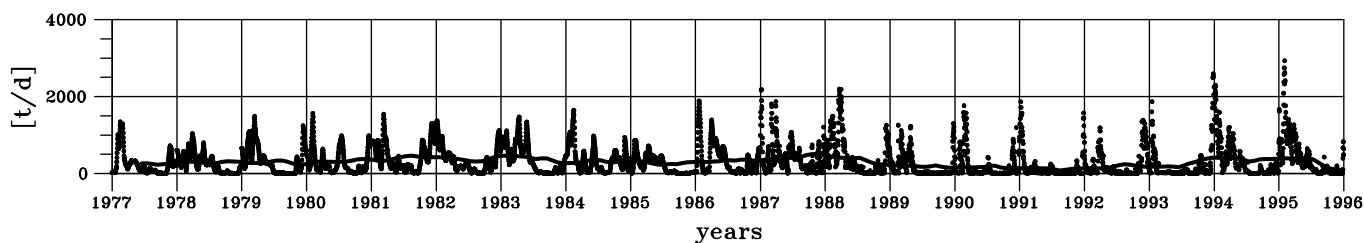
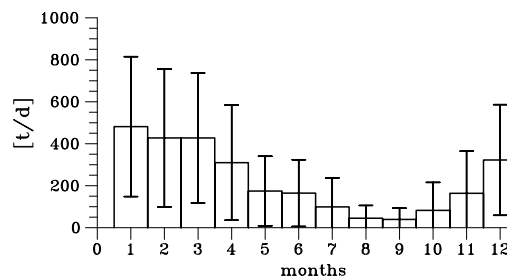
minimum: 52.3 t/d April 1996

maximum: 513.0 t/d November 1987

ANNUAL CYCLE

minimum: 38.8 t/d September, rel. stdev: 1.41

maximum: 481.7 t/d January, rel. stdev: 0.69



Ammonium load for Haringvliet

ANNUAL LOADS

year	t/y	year	t/y	year	t/y	year	t/y	year	t/y	year	t/y
1977	19944	1984	13617	1991	3693	1998	3824	2005	1045	2012	1656
1978	15312	1985	11813	1992	4311	1999	3669	2006	1674	2013	1825
1979	24225	1986	15603	1993	3332	2000	3072	2007	1358	2014	737
1980	18596	1987	12901	1994	6158	2001	3663	2008	1921		
1981	19828	1988	12466			2002	4207	2009	992		
1982	18746	1989	3256			2003	2575	2010	2013		
1983	15377	1990	4473			2004	1291	2011	1731		

TIME SERIES

mean: 21.5 t/d

relative standard deviation: 1.95

minimum: 0.0 t/d August 28, 1990

maximum: 523.7 t/d February 6, 1980

LOW PASS

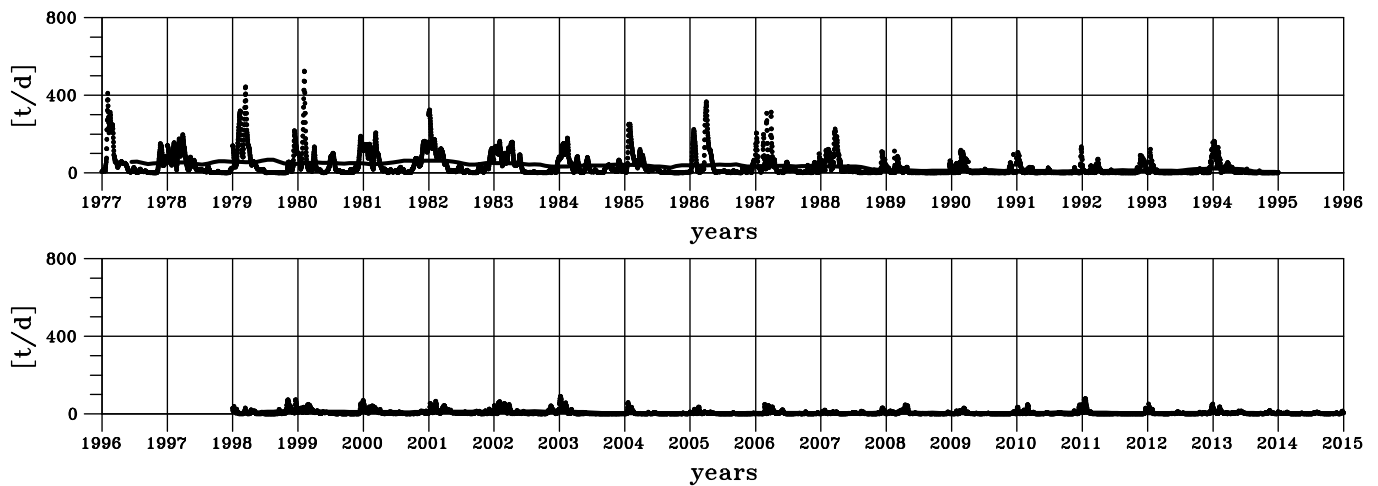
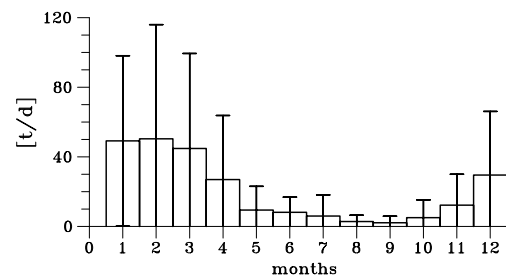
minimum: 1.9 t/d July 2014

maximum: 67.7 t/d August 1979

ANNUAL CYCLE

minimum: 2.1 t/d September, rel. stdev: 1.85

maximum: 50.4 t/d February, rel. stdev: 1.30



Total Phosphorus load for Haringvliet

ANNUAL LOADS

year	t/y	year	t/y	year	t/y	year	t/y	year	t/y	year	t/y
1977	7874	1984	10655	1991	1890	1998	3545	2005	1549	2012	1446
1978	8596	1985	6396	1992	3392	1999	4208	2006	2196	2013	2064
1979	12509	1986	9462	1993	2738	2000	3927	2007	2889	2014	1004
1980	10857	1987	9992	1994	10231	2001	3536	2008	2819		
1981	14626	1988	8618	1995	10741	2002	5455	2009	1365		
1982	11726	1989	3362	1996	1553	2003	3794	2010	2105		
1983	12388	1990	3635	1997	1910	2004	2307	2011	983		

TIME SERIES

mean: 15.0 t/d

relative standard deviation: 1.73

minimum: 0.0 t/d August 28, 1990

maximum: 416.2 t/d February 2, 1995

LOW PASS

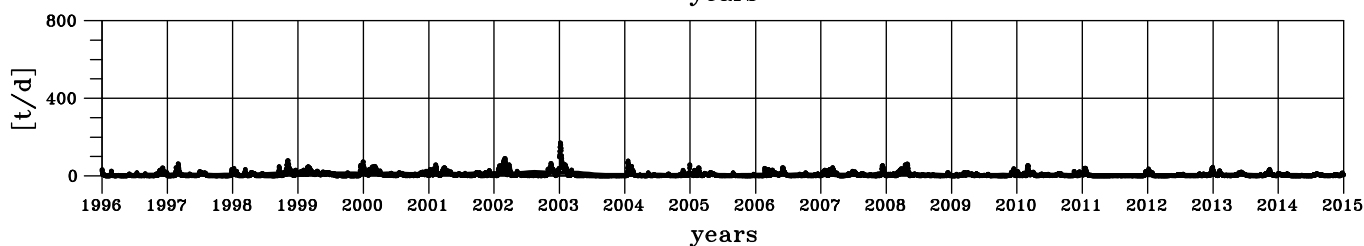
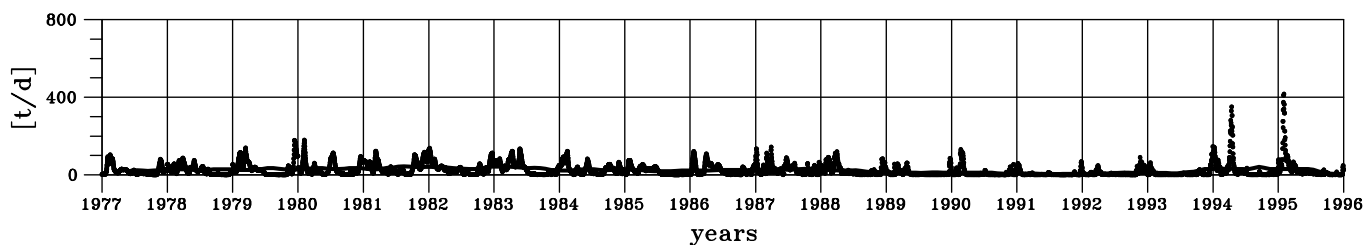
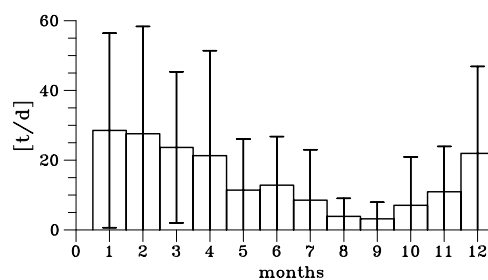
minimum: 2.1 t/d September 2011

maximum: 42.9 t/d August 1981

ANNUAL CYCLE

minimum: 3.2 t/d September, rel. stdev: 1.50

maximum: 28.5 t/d January, rel. stdev: 0.98



Phosphate load for Haringvliet

ANNUAL LOADS

year	t/y	year	t/y	year	t/y	year	t/y	year	t/y	year	t/y
1977	5734	1984	7824	1991	1052	1998	2252	2005	953	2012	1122
1978	6850	1985	4966	1992	1893	1999	2511	2006	1088	2013	1607
1979	8430	1986	6156	1993	2125	2000	2537	2007	1986	2014	736
1980	8631	1987	6252	1994	2519	2001	2137	2008	1193		
1981	10579	1988	5213	1995	3183	2002	3021	2009	816		
1982	8597	1989	2025	1996	1035	2003	1385	2010	1140		
1983	9077	1990	1487	1997	1241	2004	884	2011	765		

TIME SERIES

mean: 9.4 t/d

relative standard deviation: 1.58

minimum: 0.0 t/d August 28, 1990

maximum: 141.9 t/d February 6, 1980

LOW PASS

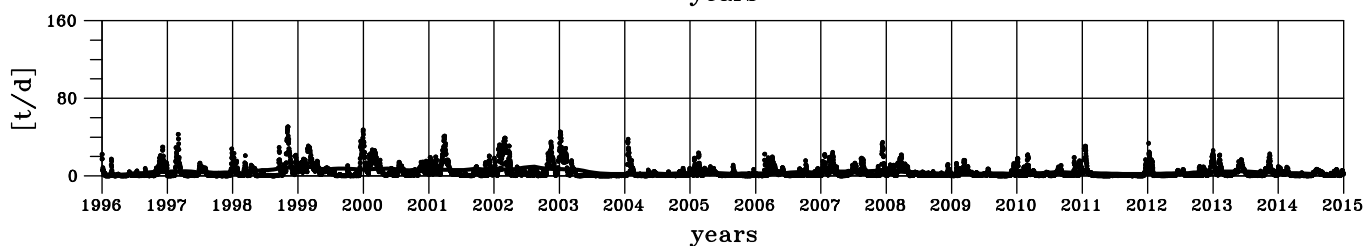
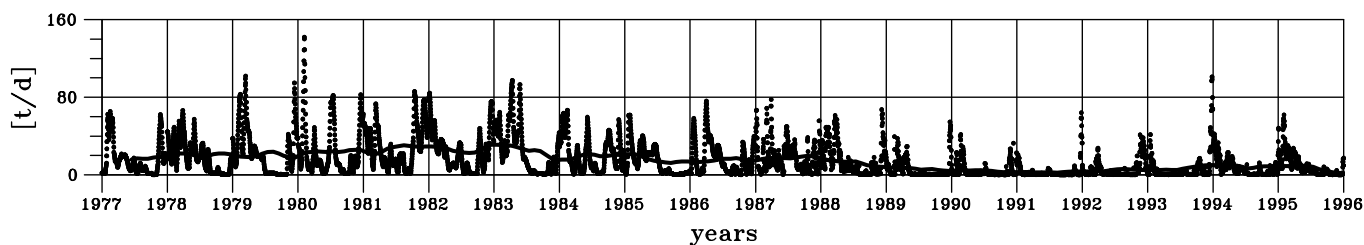
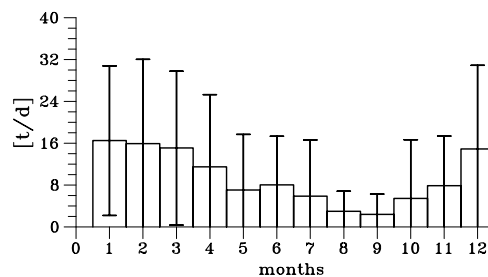
minimum: 1.3 t/d April 1996

maximum: 31.1 t/d December 1982

ANNUAL CYCLE

minimum: 2.4 t/d September, rel. stdev: 1.64

maximum: 16.5 t/d January, rel. stdev: 0.87



Silicate load for Haringvliet

ANNUAL LOADS

year	kt/y	year	kt/y	year	kt/y	year	kt/y	year	kt/y	year	kt/y
1977	59.1	1984	88.2	1991	32.4			2005	33.5	2012	49.7
1978	60.7	1985	42.2	1992	46.3	1999	78.5	2006	37.6	2013	73.4
1979	92.0	1986	77.1	1993	47.4	2000	72.1	2007	71.8	2014	32.5
1980	81.7	1987	94.0	1994	76.8	2001	82.2	2008	45.9		
1981	127.0	1988	107.7			2002	104.6	2009	30.7		
1982	94.4	1989	38.6			2003	56.9	2010	49.8		
1983	105.1	1990	39.2			2004	28.5	2011	38.8		

TIME SERIES

mean: 179.2 t/d

relative standard deviation: 1.48

minimum: 0.0 t/d August 28, 1990

maximum: 2168.6 t/d December 27, 1993

LOW PASS

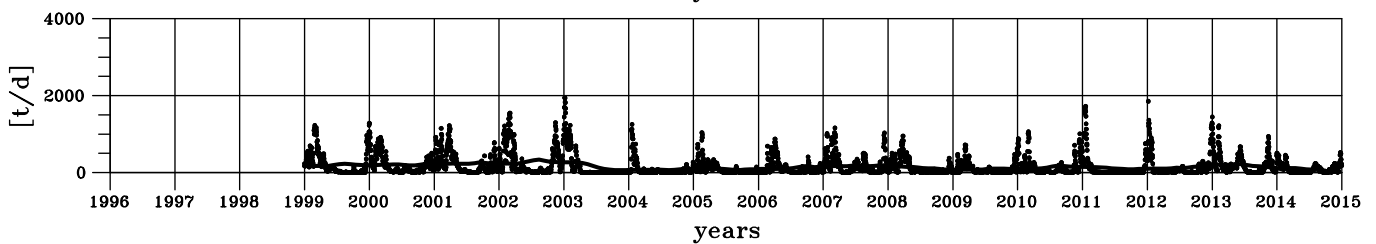
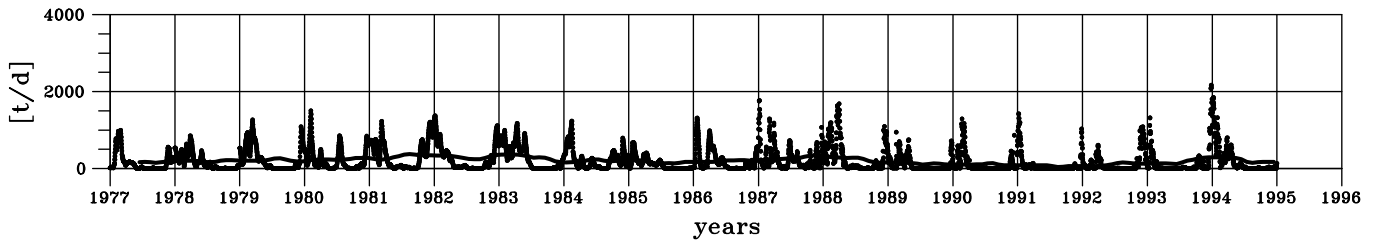
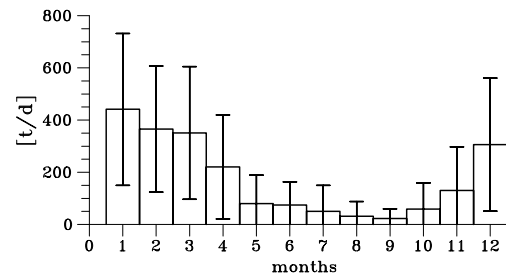
minimum: 38.6 t/d August 1991

maximum: 374.8 t/d August 1981

ANNUAL CYCLE

minimum: 22.7 t/d September, rel. stdev: 1.62

maximum: 441.0 t/d January, rel. stdev: 0.66



Total Alkalinity load for Haringvliet

ANNUAL LOADS

year	Gmol/y	year	Gmol/y	year	Gmol/y	year	Gmol/y	year	Gmol/y	year	Gmol/y
1977	58.2	1984	81.2	1991	32.9	1998	55.7	2005	31.9	2012	44.6
1978	65.2	1985	46.7	1992	45.7	1999	82.6	2006	41.3	2013	66.8
1979	79.1	1986	78.8	1993	43.6	2000	66.1	2007	61.9	2014	30.4
1980	75.8	1987	98.1	1994	78.5	2001	85.4	2008	40.5		
1981	111.6	1988	97.5	1995	101.3	2002	90.8	2009	28.5		
1982	88.3	1989	36.5	1996	25.0	2003	46.2	2010	43.2		
1983	96.2	1990	38.4	1997	30.8	2004	27.8	2011	32.1		

TIME SERIES

mean: 164.7 Mmol/d

relative standard deviation: 1.34

minimum: 0.0 Mmol/d August 28, 1990

maximum: 2009.6 Mmol/d February 2, 1995

LOW PASS

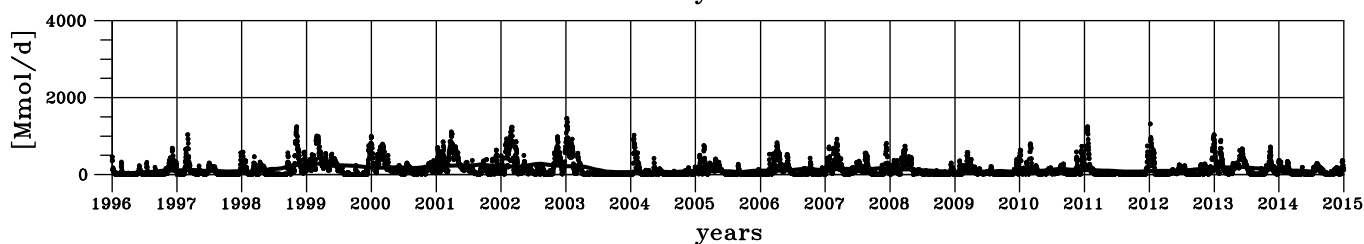
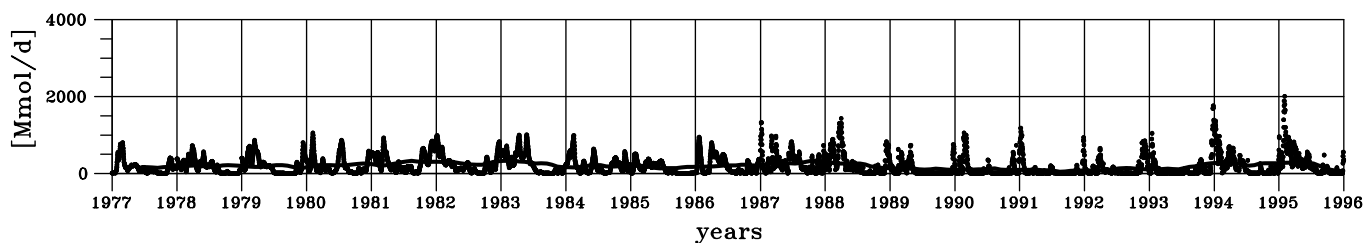
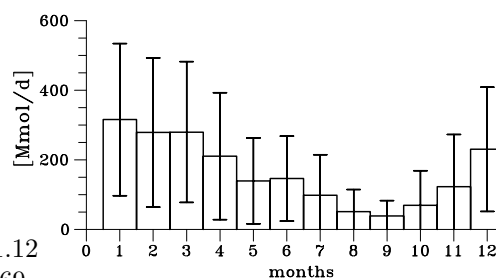
minimum: 37.3 Mmol/d April 1996

maximum: 336.5 Mmol/d November 1987

ANNUAL CYCLE

minimum: 39.0 Mmol/d September, rel. stdev: 1.12

maximum: 315.7 Mmol/d January, rel. stdev: 0.69



Dissolved Inorganic Carbon load for Haringvliet

ANNUAL LOADS

year	Gmol/y	year	Gmol/y	year	Gmol/y	year	Gmol/y	year	Gmol/y	year	Gmol/y
1977	60.4	1984	84.2	1991	34.2	1998	57.8	2005	33.1	2012	46.3
1978	67.7	1985	48.5	1992	47.4	1999	85.7	2006	42.9	2013	69.4
1979	82.1	1986	81.8	1993	45.3	2000	68.6	2007	64.3	2014	31.6
1980	78.6	1987	101.9	1994	81.5	2001	88.6	2008	42.0		
1981	115.8	1988	101.2	1995	105.2	2002	94.2	2009	29.6		
1982	91.7	1989	37.9	1996	26.0	2003	48.0	2010	44.8		
1983	99.9	1990	39.8	1997	32.0	2004	28.8	2011	33.3		

TIME SERIES

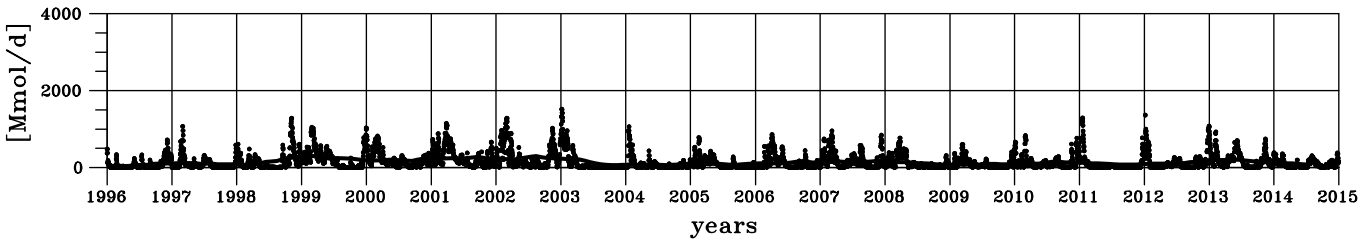
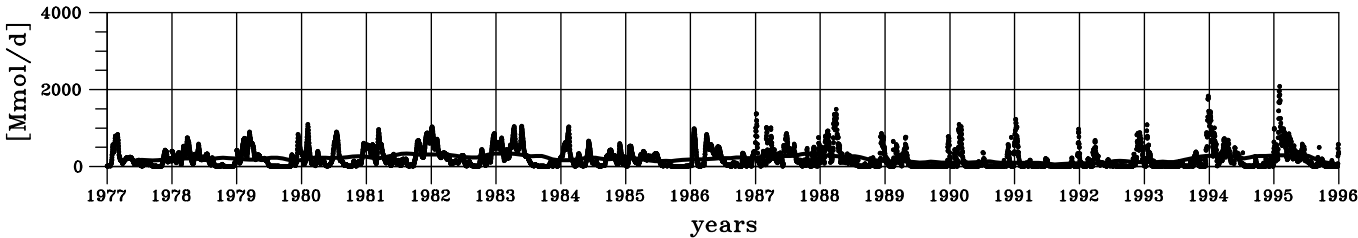
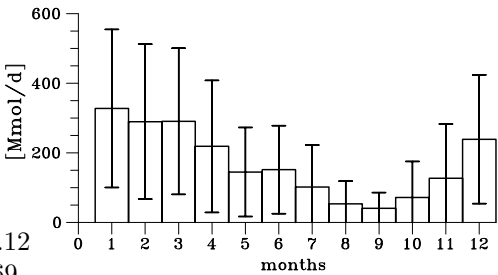
mean: 170.9 Mmol/d
relative standard deviation: 1.34
minimum: 0.0 Mmol/d August 28, 1990
maximum: 2085.9 Mmol/d February 2, 1995

LOW PASS

minimum: 38.8 Mmol/d April 1996
maximum: 349.3 Mmol/d November 1987

ANNUAL CYCLE

minimum: 40.5 Mmol/d September, rel. stdev: 1.12
maximum: 327.7 Mmol/d January, rel. stdev: 0.69



Dissolved Organic Carbon load for Haringvliet

ANNUAL LOADS

year	Gmol/y	year	Gmol/y	year	Gmol/y	year	Gmol/y	year	Gmol/y	year	Gmol/y
1977	5.2	1984	7.2	1991	2.9	1998	5.0	2005	2.8	2012	4.0
1978	5.8	1985	4.2	1992	4.1	1999	7.4	2006	3.7	2013	6.0
1979	7.0	1986	7.0	1993	3.9	2000	5.9	2007	5.5	2014	2.7
1980	6.8	1987	8.7	1994	7.0	2001	7.6	2008	3.6		
1981	9.9	1988	8.7	1995	9.0	2002	8.1	2009	2.5		
1982	7.9	1989	3.3	1996	2.2	2003	4.1	2010	3.8		
1983	8.6	1990	3.4	1997	2.7	2004	2.5	2011	2.9		

TIME SERIES

mean: 14.7 Mmol/d

relative standard deviation: 1.34

minimum: 0.0 Mmol/d August 28, 1990

maximum: 179.1 Mmol/d February 2, 1995

LOW PASS

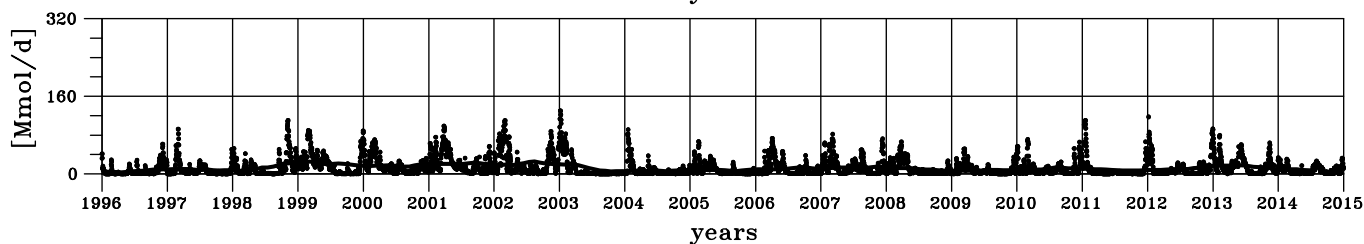
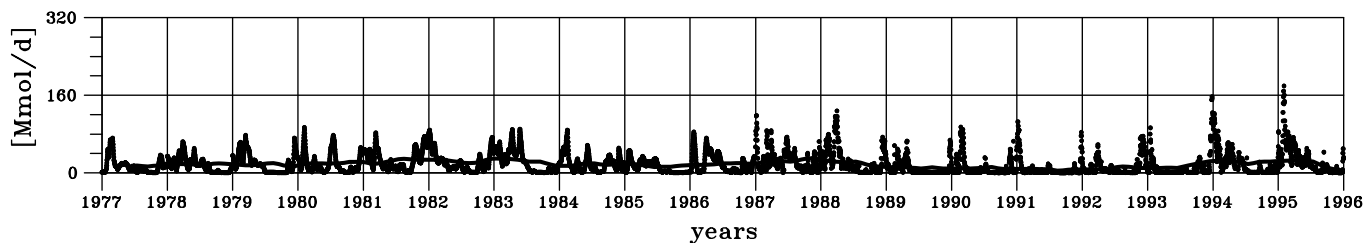
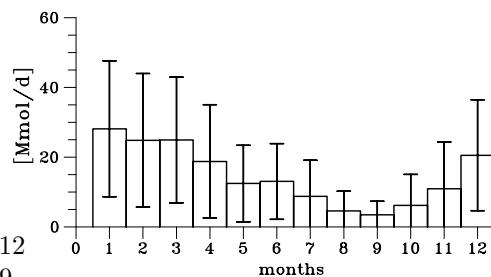
minimum: 3.3 Mmol/d April 1996

maximum: 30.0 Mmol/d November 1987

ANNUAL CYCLE

minimum: 3.5 Mmol/d September, rel. stdev: 1.12

maximum: 28.1 Mmol/d January, rel. stdev: 0.69



5.9 Loads of River Scheldt

Total Nitrogen load for River Scheldt

ANNUAL LOADS

year	kt/y	year	kt/y	year	kt/y	year	kt/y	year	kt/y	year	kt/y
1977	20.2	1984	38.7	1991	27.9	1998	36.4	2005	19.0	2012	19.5
1978	20.9	1985	34.5	1992	30.0	1999	33.3	2006	19.6	2013	21.1
1979	32.1	1986	35.1	1993	32.2	2000	39.9	2007	23.2	2014	14.8
1980	37.5	1987	45.5	1994	45.8	2001	45.8	2008	22.7		
1981	44.1	1988	53.6	1995	41.5	2002	17.1	2009	16.4		
1982	31.2	1989	31.1	1996	18.3	2003	23.5	2010	18.9		
1983	30.8	1990	21.4	1997	20.1	2004	20.0	2011	14.8		

TIME SERIES

mean: 79.2 t/d

relative standard deviation: 0.91

minimum: 7.0 t/d August 16, 2012

maximum: 576.1 t/d January 1, 1994

LOW PASS

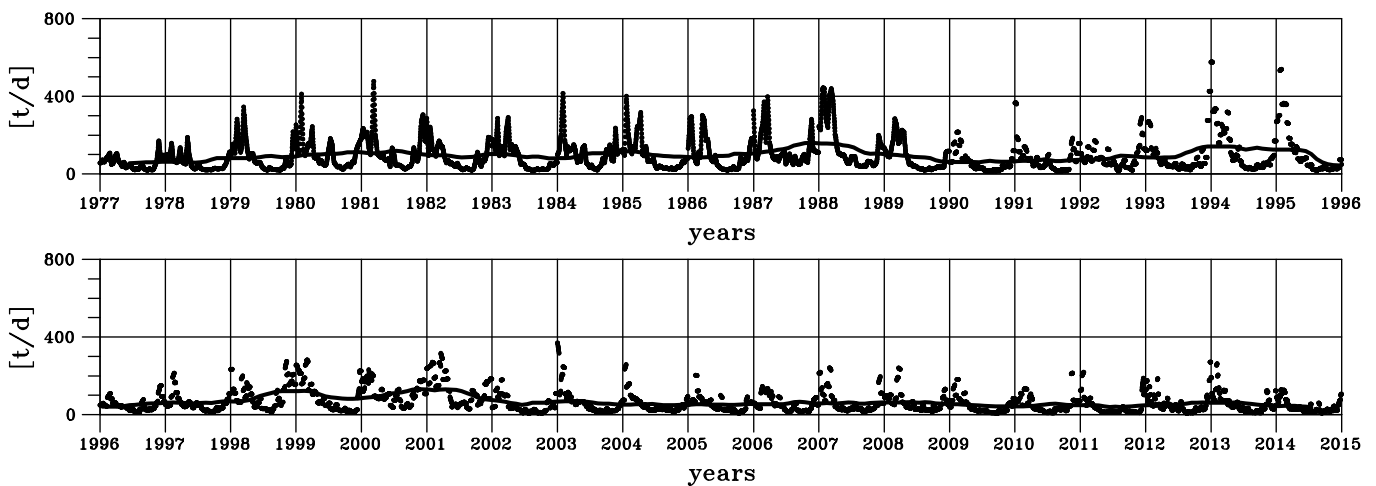
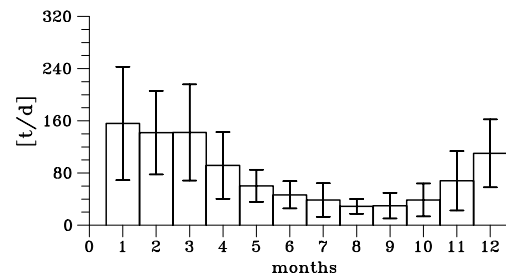
minimum: 38.8 t/d July 2014

maximum: 160.1 t/d November 1987

ANNUAL CYCLE

minimum: 28.8 t/d August, rel. stdev: 0.39

maximum: 156.0 t/d January, rel. stdev: 0.56



Nitrate + Nitrite load for River Scheldt

ANNUAL LOADS

year	kt/y	year	kt/y	year	kt/y	year	kt/y	year	kt/y	year	kt/y
1977	6.1	1984	18.5	1991	17.5	1998	28.6	2005	15.3	2012	15.3
1978	7.7	1985	15.5	1992	21.1	1999	24.5	2006	15.7	2013	16.5
1979	12.4	1986	18.1	1993	23.5	2000	31.9	2007	19.2	2014	11.7
1980	17.6	1987	23.8	1994	29.1	2001	36.3	2008	19.0		
1981	22.2	1988	29.4	1995	28.5	2002	12.4	2009	13.0		
1982	15.6	1989	21.2	1996	13.2	2003	17.3	2010	14.9		
1983	15.6	1990	14.7	1997	14.8	2004	15.7	2011	11.6		

TIME SERIES

mean: 50.8 t/d

relative standard deviation: 0.85

minimum: 1.0 t/d November 26, 1979

maximum: 353.1 t/d January 23, 1995

LOW PASS

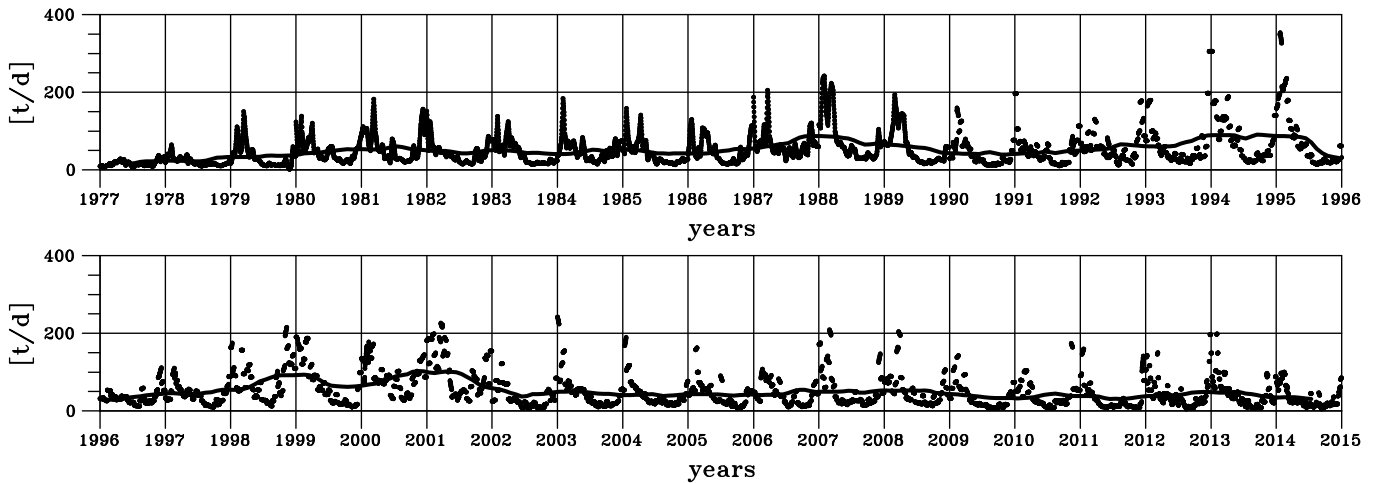
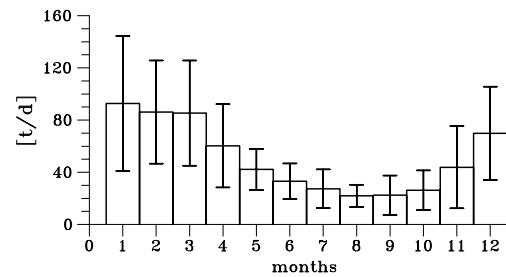
minimum: 16.2 t/d June 1977

maximum: 102.7 t/d November 2000

ANNUAL CYCLE

minimum: 21.9 t/d August, rel. stdev: 0.39

maximum: 92.7 t/d January, rel. stdev: 0.56



Ammonium load for River Scheldt

ANNUAL LOADS

year	t/y	year	t/y	year	t/y	year	t/y	year	t/y	year	t/y
1977	11211	1984	12481	1991	5735	1998	1477	2005	1577	2012	1012
1978	9258	1985	11601	1992	3945	1999	4335	2006	1742	2013	1023
1979	13925	1986	10358	1993	3581	2000	2480	2007	876	2014	569
1980	13142	1987	11590	1994	5783	2001	3693	2008	902		
1981	14071	1988	11634			2002	1330	2009	1408		
1982	10316	1989	3833			2003	2293	2010	1455		
1983	9397	1990	3462			2004	1860	2011	1346		

TIME SERIES

mean: 16.0 t/d

relative standard deviation: 1.41

minimum: 0.1 t/d September 13, 1999

maximum: 199.4 t/d February 1, 1980

LOW PASS

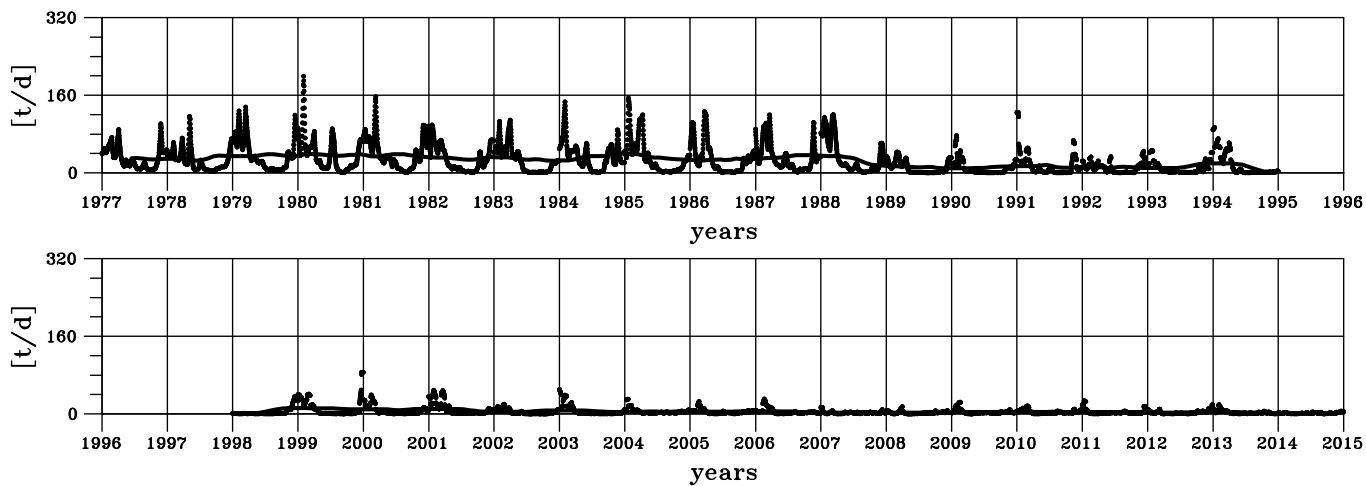
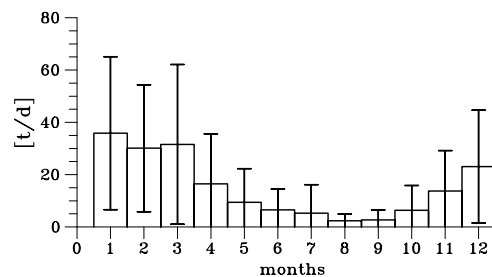
minimum: 0.9 t/d February 1998

maximum: 39.6 t/d November 1984

ANNUAL CYCLE

minimum: 2.3 t/d August, rel. stdev: 1.13

maximum: 35.8 t/d January, rel. stdev: 0.82



Total Phosphorus load for River Scheldt

ANNUAL LOADS

year	t/y	year	t/y	year	t/y	year	t/y	year	t/y	year	t/y
1977	4179	1984	4883	1991	2497	1998	2517	2005	771	2012	1246
1978	3082	1985	4070	1992	2670	1999	2212	2006	850	2013	1907
1979	4047	1986	4183	1993	2519	2000	2627	2007	1020	2014	1261
1980	4984	1987	4808	1994	4375	2001	1517	2008	1147		
1981	5952	1988	6699	1995	2650	2002	1626	2009	723		
1982	3911	1989	3953	1996	1570	2003	1715	2010	812		
1983	3387	1990	2094	1997	1471	2004	1706	2011	888		

TIME SERIES

mean: 7.4 t/d

relative standard deviation: 1.13

minimum: 0.3 t/d May 25, 2009

maximum: 133.3 t/d March 11, 1981

LOW PASS

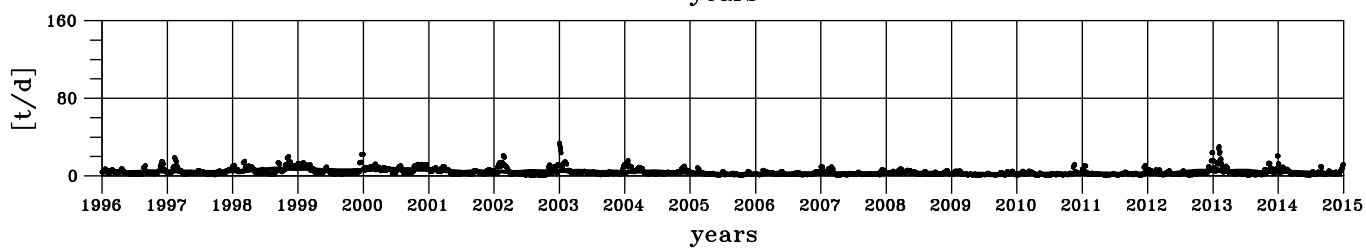
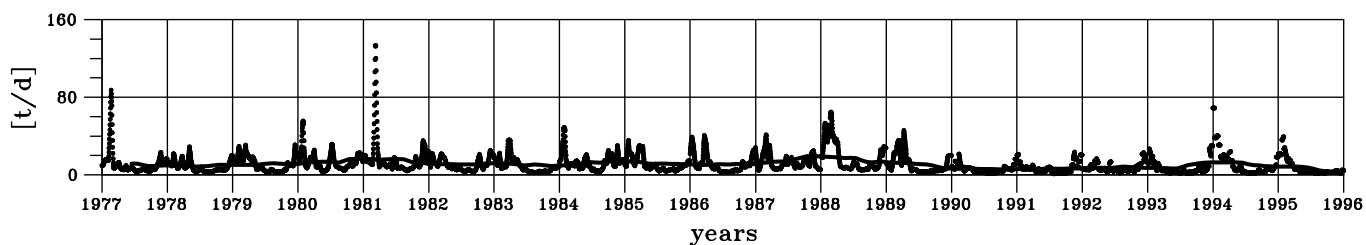
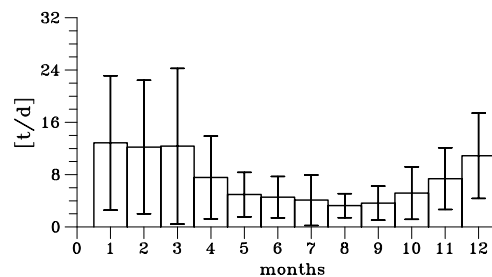
minimum: 1.9 t/d August 2009

maximum: 19.4 t/d November 1987

ANNUAL CYCLE

minimum: 3.2 t/d August, rel. stdev: 0.57

maximum: 12.8 t/d January, rel. stdev: 0.80



Phosphate load for River Scheldt

ANNUAL LOADS

year	t/y	year	t/y	year	t/y	year	t/y	year	t/y	year	t/y
1977	1438	1984	2426	1991	949	1998	980	2005	460	2012	497
1978	1320	1985	1808	1992	1132	1999	821	2006	553	2013	503
1979	1733	1986	2003	1993	1033	2000	1152	2007	605	2014	485
1980	2543	1987	2210	1994	1010	2001	835	2008	615		
1981	2674	1988	1825	1995	925	2002	395	2009	472		
1982	2131	1989	1249	1996	652	2003	613	2010	478		
1983	1696	1990	996	1997	670	2004	520	2011	394		

TIME SERIES

mean: 3.1 t/d

relative standard deviation: 0.87

minimum: 0.3 t/d September 11, 2014

maximum: 22.2 t/d July 7, 1980

LOW PASS

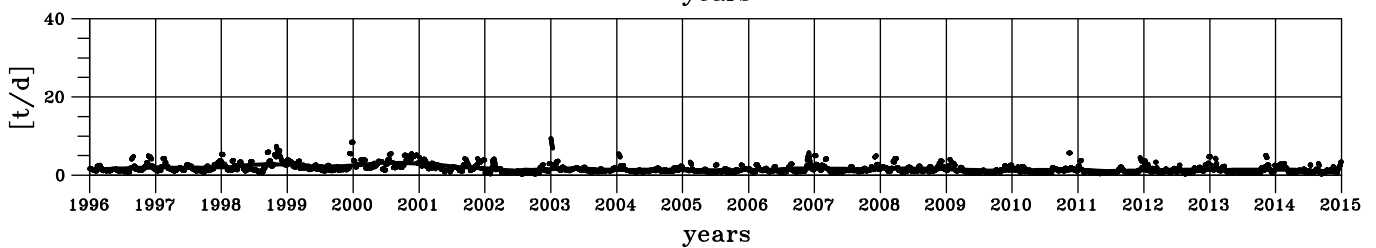
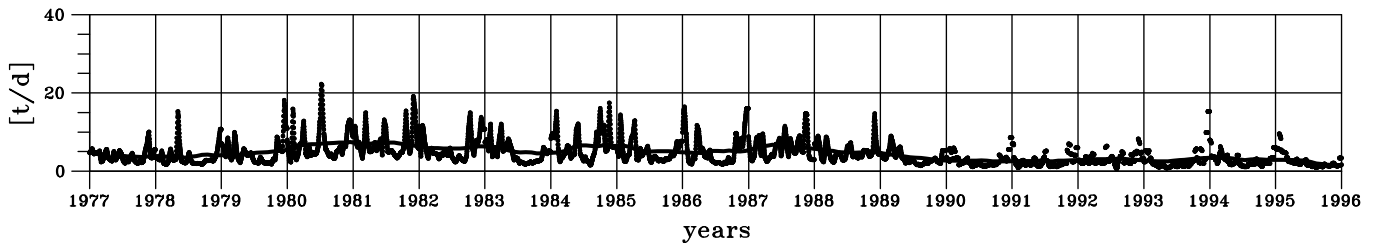
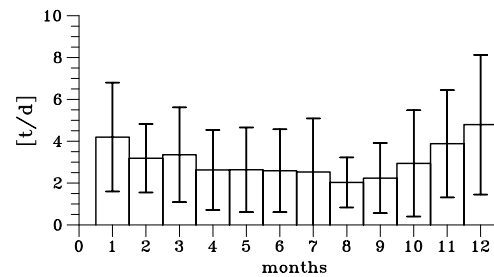
minimum: 1.0 t/d June 2011

maximum: 7.5 t/d December 1980

ANNUAL CYCLE

minimum: 2.0 t/d August, rel. stdev: 0.59

maximum: 4.8 t/d December, rel. stdev: 0.70



Silicate load for River Scheldt

ANNUAL LOADS

year	kt/y	year	kt/y	year	kt/y	year	kt/y	year	kt/y	year	kt/y
1977	12.4	1984	23.6	1991	11.2			2005	11.8	2012	14.9
1978	12.7	1985	18.9	1992	14.0	1999	23.2	2006	12.0	2013	16.4
1979	16.7	1986	18.9	1993	16.4	2000	27.2	2007	17.8	2014	13.5
1980	22.8	1987	24.7	1994	20.6	2001	19.5	2008	16.8		
1981	25.9	1988	30.3			2002	12.5	2009	11.5		
1982	19.2	1989	17.2			2003	17.0	2010	13.9		
1983	18.0	1990	10.3			2004	12.0	2011	12.7		

TIME SERIES

mean: 47.6 t/d

relative standard deviation: 0.91

minimum: 0.3 t/d April 26, 2011

maximum: 303.4 t/d January 1, 2003

LOW PASS

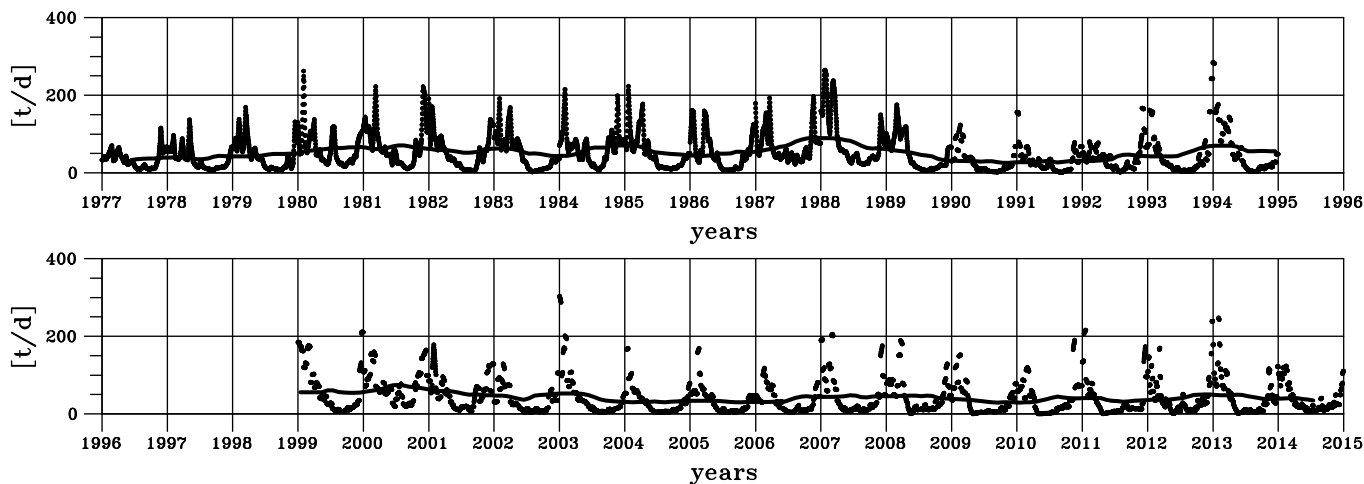
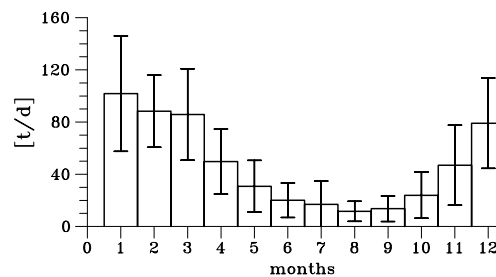
minimum: 25.8 t/d November 1990

maximum: 90.1 t/d November 1987

ANNUAL CYCLE

minimum: 11.6 t/d August, rel. stdev: 0.66

maximum: 101.8 t/d January, rel. stdev: 0.43



Total Alkalinity load for River Scheldt

ANNUAL LOADS

year	Gmol/y	year	Gmol/y	year	Gmol/y	year	Gmol/y	year	Gmol/y	year	Gmol/y
1977	10.4	1984	17.9	1991	13.2	1998	19.8	2005	13.8	2012	16.6
1978	10.0	1985	14.5	1992	15.6	1999	20.3	2006	14.3	2013	17.3
1979	13.0	1986	15.6	1993	17.9	2000	23.2	2007	17.7	2014	14.8
1980	16.4	1987	20.3	1994	21.3	2001	27.9	2008	17.5		
1981	19.0	1988	24.3	1995	20.9	2002	10.5	2009	13.9		
1982	14.8	1989	14.7	1996	11.4	2003	16.5	2010	15.6		
1983	14.2	1990	11.6	1997	12.2	2004	13.9	2011	12.9		

TIME SERIES

mean: 44.4 Mmol/d

relative standard deviation: 0.70

minimum: 5.6 Mmol/d July 21, 2002

maximum: 249.3 Mmol/d December 21, 1993

LOW PASS

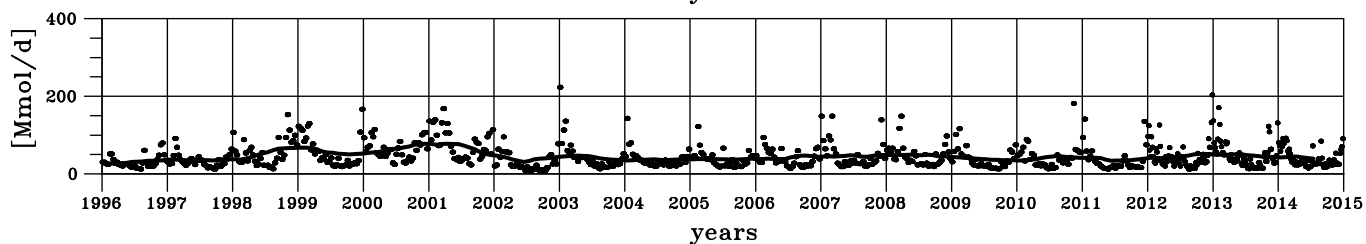
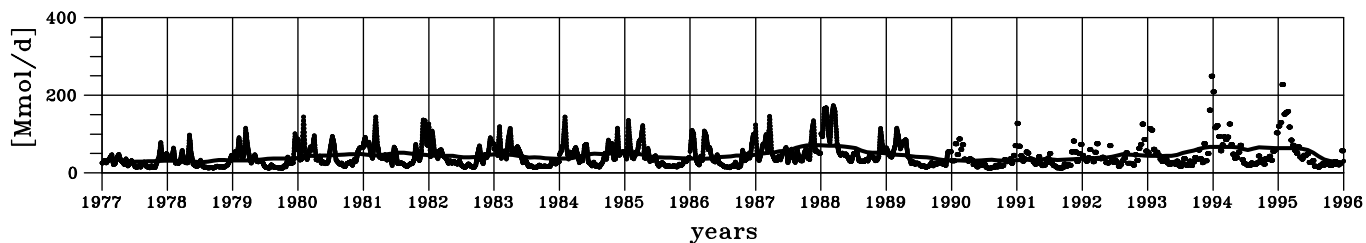
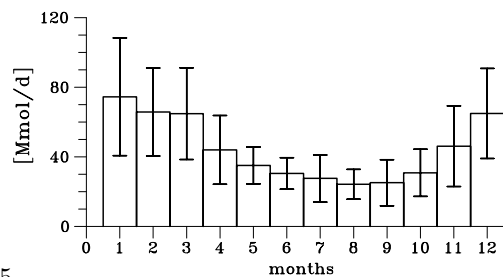
minimum: 26.0 Mmol/d January 1996

maximum: 78.0 Mmol/d April 2001

ANNUAL CYCLE

minimum: 24.2 Mmol/d August, rel. stdev: 0.35

maximum: 74.5 Mmol/d January, rel. stdev: 0.45



Dissolved Inorganic Carbon load for River Scheldt

ANNUAL LOADS

year	Gmol/y	year	Gmol/y	year	Gmol/y	year	Gmol/y	year	Gmol/y	year	Gmol/y
1977	10.7	1984	18.6	1991	13.7	1998	20.5	2005	14.3	2012	17.2
1978	10.4	1985	15.0	1992	16.1	1999	21.1	2006	14.9	2013	18.0
1979	13.5	1986	16.2	1993	18.6	2000	24.0	2007	18.4	2014	15.3
1980	17.0	1987	21.1	1994	22.0	2001	28.9	2008	18.2		
1981	19.7	1988	25.2	1995	21.6	2002	10.9	2009	14.4		
1982	15.4	1989	15.3	1996	11.8	2003	17.1	2010	16.2		
1983	14.7	1990	12.0	1997	12.6	2004	14.4	2011	13.3		

TIME SERIES

mean: 46.0 Mmol/d

relative standard deviation: 0.70

minimum: 5.8 Mmol/d July 21, 2002

maximum: 258.4 Mmol/d December 21, 1993

LOW PASS

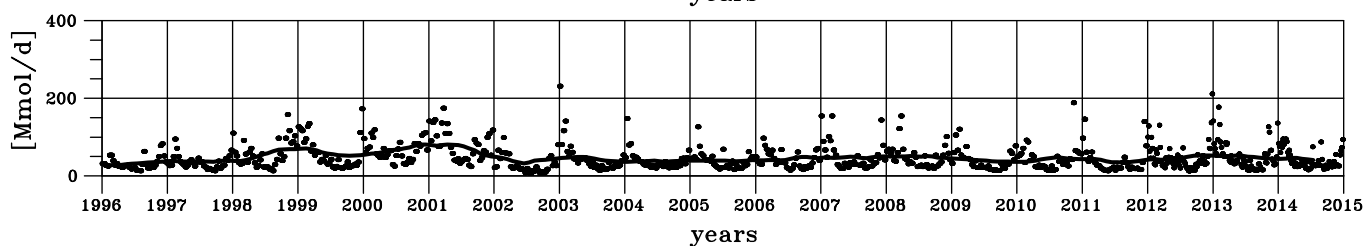
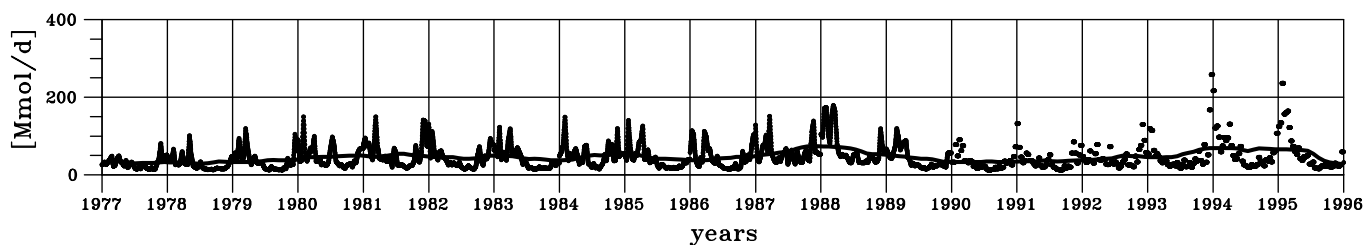
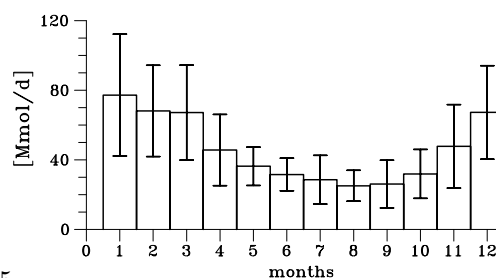
minimum: 26.9 Mmol/d January 1996

maximum: 80.9 Mmol/d April 2001

ANNUAL CYCLE

minimum: 25.1 Mmol/d August, rel. stdev: 0.35

maximum: 77.2 Mmol/d January, rel. stdev: 0.45



Dissolved Organic Carbon load for River Scheldt

ANNUAL LOADS

year	Gmol/y	year	Gmol/y	year	Gmol/y	year	Gmol/y	year	Gmol/y	year	Gmol/y
1977	1.4	1984	2.4	1991	1.8	1998	2.6	2005	1.8	2012	2.2
1978	1.3	1985	1.9	1992	2.1	1999	2.7	2006	1.9	2013	2.3
1979	1.7	1986	2.1	1993	2.4	2000	3.1	2007	2.4	2014	2.0
1980	2.2	1987	2.7	1994	2.8	2001	3.7	2008	2.3		
1981	2.5	1988	3.3	1995	2.8	2002	1.4	2009	1.9		
1982	2.0	1989	2.0	1996	1.5	2003	2.2	2010	2.1		
1983	1.9	1990	1.5	1997	1.6	2004	1.9	2011	1.7		

TIME SERIES

mean: 5.9 Mmol/d

relative standard deviation: 0.70

minimum: 0.8 Mmol/d July 21, 2002

maximum: 33.3 Mmol/d December 21, 1993

LOW PASS

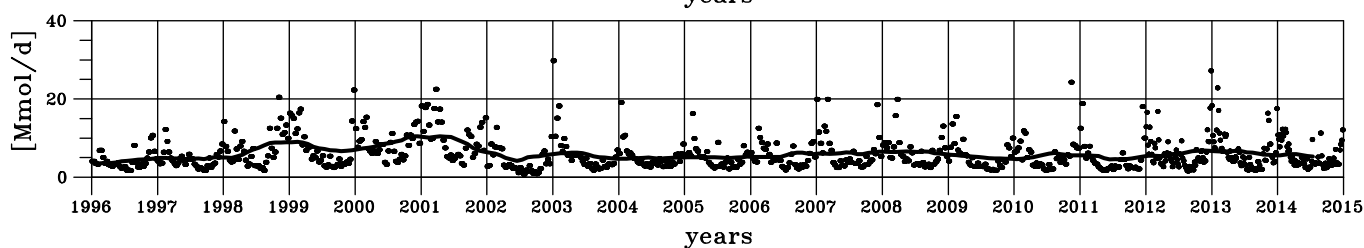
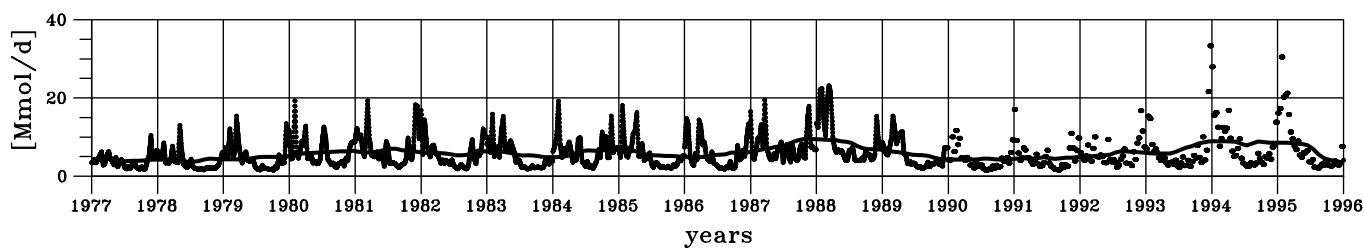
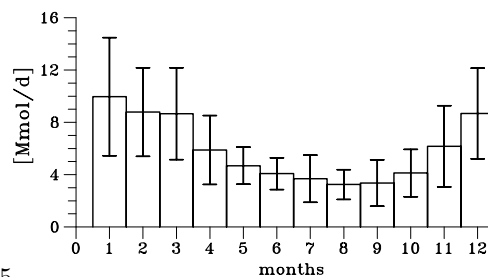
minimum: 3.5 Mmol/d January 1996

maximum: 10.4 Mmol/d April 2001

ANNUAL CYCLE

minimum: 3.2 Mmol/d August, rel. stdev: 0.35

maximum: 10.0 Mmol/d January, rel. stdev: 0.45



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