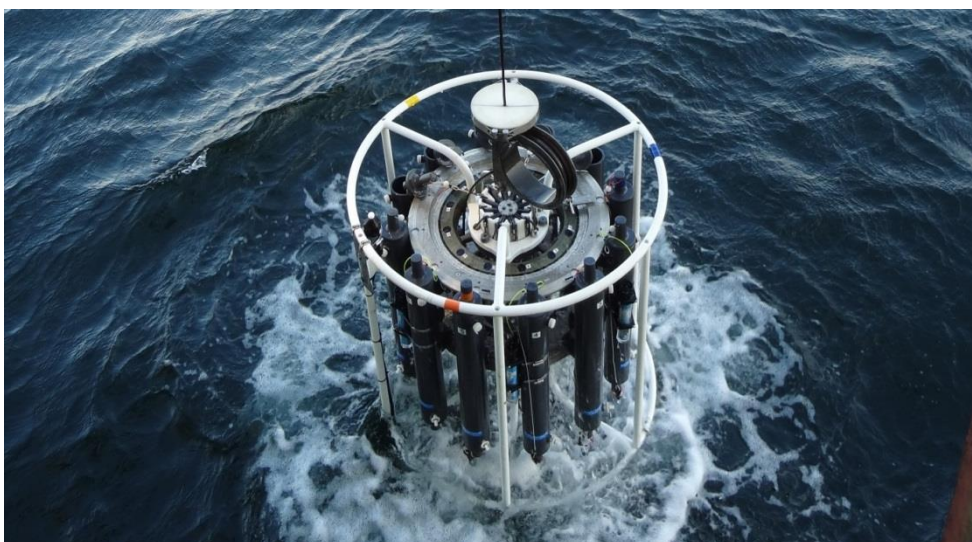


Summary of the Swedish National Marine Monitoring 2016

- Hydrography, nutrients and phytoplankton



Front: CTD with a rosette of bottles samplers on R/V Aranda during SMHI's monitoring cruises 2016. Photo: Karin Wesslander

REPORT OCEANOGRAPHY NO. 60, 2017

Summary of the Swedish National Marine Monitoring 2016

- Hydrography, nutrients and phytoplankton

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Summary

Results from the Swedish national marine monitoring in the pelagic during 2016 are presented. The institutes who conduct the national monitoring are SMHI (Swedish meteorological and hydrological institute), SU (Stockholm University) and UMF (Umeå marine sciences centre). The presented parameters in this report are; salinity, temperature, oxygen, dissolved inorganic phosphorous, total phosphorous, dissolved inorganic nitrogen, total nitrogen, dissolved silica, chlorophyll and phytoplankton. Secchi depth, zooplankton, humus, primary production, pH and alkalinity are also measured but not presented. Seasonal plots for surface waters are presented in Appendix I. Time series for surface waters (0-10 m) and bottom waters are presented in Appendix II. The amount of nutrients in the sub-basins of the Baltic Sea is presented per season and year in Appendix III.

Exceptional events 2016

- A warm September due to several high pressure systems, with temperatures more than one standard deviation above mean in almost all stations from Skagerrak, Kattegat and the Baltic Proper.
- Low oxygen in Kattegat bottom water during autumn as can be seen in the seasonal plots for both Anholt E and Fladen.
- Improved oxygen condition in the East Gotland Basin, due to an increased frequency of deep water inflows in comparison to the period 1983 until the large inflow in December 2014. The inflow of 30 km³ in the beginning of the year could be tracked in the deep water in the Eastern Gotland Basin in June.
- Elevated levels of silicate have been observed in the Baltic Sea since 2014 and the silicate levels were also elevated this year but mainly in the central and the northern parts of the Baltic Proper.
- In July there were high cell numbers of the dinoflagellate *Dinophysis acuminata*, which caused high levels of toxins in blue mussels. During this period it was forbidden to harvest blue mussels along the Bohus coast.
- Unusual long period of cyanobacteria bloom in the Baltic Sea.

Sammanfattning

Resultat från Sveriges nationella samlade nationella marina övervakning i den fria vattenmassan under året 2016 presenteras. De nationella utförarna är Sveriges meteorologiska och hydrologiska institut (SMHI), Stockholms Universitet (SU) och Umeå marina forskningscentrum (UMF). De parametrar som presenteras i rapporten är salthalt, temperatur, syre, löst oorganiskt fosfor, totalfosfor, löst oorganiskt kväve, totalkväve, löst kisel, klorofyll och växtplankton. Även siktdjup, djurplankton, humus, primär produktion, pH och alkalinitet provtas men de presenteras inte. Säsongsförändringar tillsammans med statistik presenteras för ytvatten i Bilaga I. Tidsserier för ytvatten (0-10 m) och bottenvatten presenteras i Bilaga II. Mängden närsalter i Östersjöns delbassänger under vintern presenteras i bilaga III.

Speciella händelser 2016

- Flertalet högtryckspassager orsakade en ovanligt varm septembermånad, vilket gav ytemperaturer mer än en standard avvikelse över det normala vid nästa alla stationer i Skagerrak, Kattegatt och Östersjön.
- I Kattegatts bottenvatten var det mycket låga syrgashalter under hösten men förhållandena återgick till det normala under vintern. Detta syns framförallt i säsongsförändringarna för Anholt E och Fladen.
- Syresituationen i Östra Gotlandsbassängen har förbättrats något och anledningen är att antalet inflöden har blivit fler sedan det senaste stora inflödet som skedde i

december 2014. Inflödet på 30 km³ i början av året kunde senare under juni spåras i bottenvattnet i Östra Gotlandsbassängen.

- Nivåerna av kisel i Östersjön har under de senaste åren varit över det normala och så även detta år men främst i de centrala och norra delarna av Egentliga Östersjön.
- I juli noterades förhållandevis stora mängder av dinoflagellaten *Dinophysis acuminata*. Detta orsakade förhöjda halter av Dinophysis-toxiner i blåmusslor vilket i sin tur ledde till att Livsmedelsverket förbjöd musselskörd i vissa områden längs Bohuskusten.
- Ovanligt lång blomning av cyanobakterier i Östersjön.

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Appendix I - Seasonal cycles of surface waters

Appendix II - Time series of surface and bottom waters

Appendix III - Nutrient content per basin in the Baltic Sea

1 Introduction

The purpose of marine monitoring is to document the status and changes in the marine environment through a selection of parameters. There are both national environmental goals, EU legislations and commitments to the sea conventions OSPAR and HELCOM to consider in the work. In Sweden, SwAM (Swedish agency for marine and water management) is responsible for the pelagic marine monitoring program and there are three institutes that implement the monitoring; SMHI (Swedish meteorological and hydrological institute), SU (Stockholm university) and UMF (Umeå marine sciences centre). The monitoring program is co-funded by SwAM, SMHI, SU and UMF.

The pelagic marine monitoring program in Sweden consists of 32 standard stations distributed in the seas surrounding Sweden, see figure 1. The visiting frequency is monthly at the standard stations and five of the standard stations (Släggö, Anholt E, Ref M1V1, B1 and BY31) are visited every other week. The pool of winter nutrients and oxygen during autumn is mapped once per year at 56 additional stations. The visiting frequency on the standard stations during 2016 is presented in figure 2.

Sweden has, since 2014, contracted the Finnish research vessel Aranda for SMHI's monitoring purpose in the open sea. As part of the agreement SMHI visits Finnish monitoring stations in the Gulf of Finland on the way out from Helsinki and Finland visits Swedish winter mapping stations in the Gulf of Bothnia on their winter cruise. SU uses the ships Fyrbyggaren, Limanda and Aurelia and UMF uses Lotty and KBV181. Starting in 2017, SU will also use their new ship Electra for monitoring as well as research. Monitoring is made according to the HELCOM COMBINE manual¹.

This report is written by SMHI as a part of the SMHI monitoring contract from SwAM for the year 2016 and it is focusing on data from the national marine monitoring performed during 2016 with the aim to summarize the main results. Quality controlled data available at the national data host (SMHI) is used in the report. Data from the monitoring made by SU has not yet gone through the quality control process and is therefore not presented. All data is open access and free for anyone to use. To download the data visit <https://www.smhi.se/klimatdata/oceanografi/havsmiljodata> or <http://sharkdata.se/about/>.

The presented parameters in this report are; salinity, temperature, oxygen, dissolved inorganic phosphorous, total phosphorous, dissolved inorganic nitrogen, total nitrogen, dissolved silicate, chlorophyll and phytoplankton. Time series are shown for surface waters (0-10 m) and bottom waters. Seasonal plots are presented for surface waters.

Other parameters also included in the marine monitoring program are Secchi depth, zooplankton, humus, primary production, pH and alkalinity but these are not presented here.

¹ Manual for marine monitoring in the COMBINE program of HELCOM: <http://www.helcom.fi/action-areas/monitoring-and-assessment/manuals-and-guidelines/combine-manual>

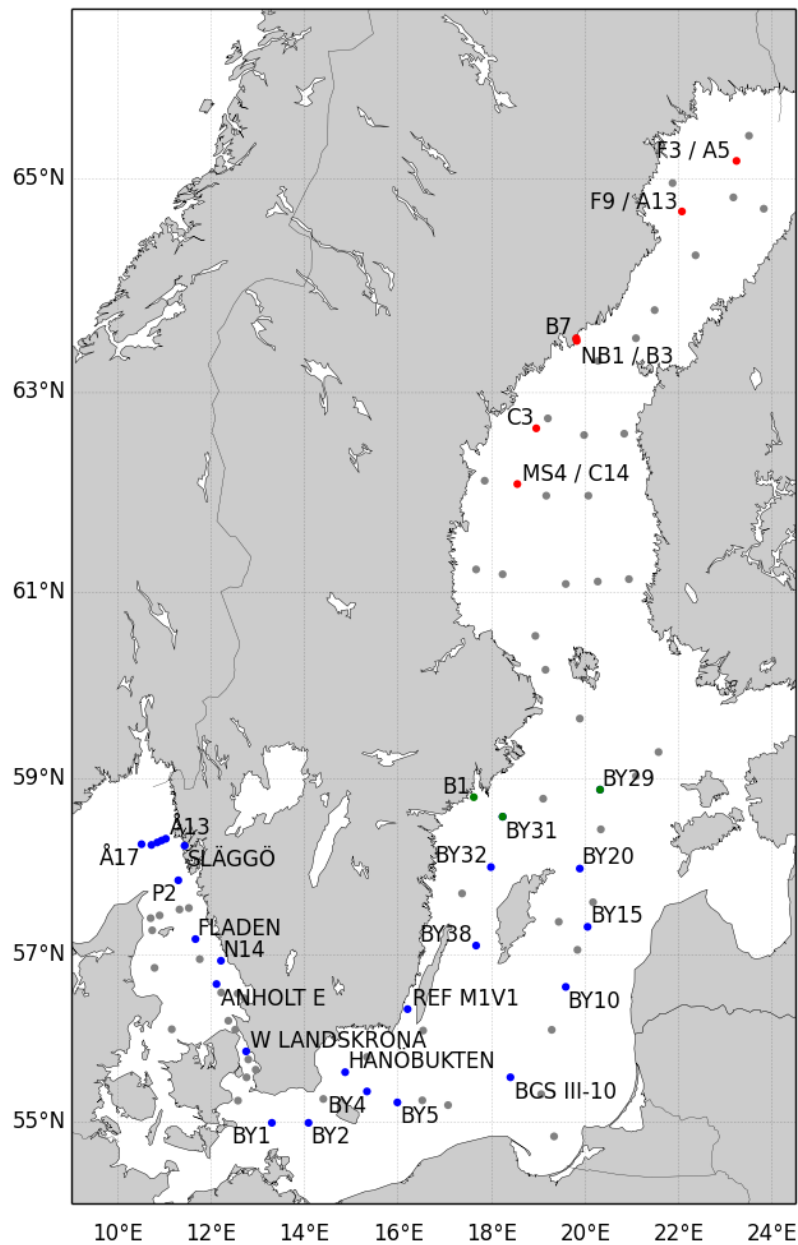


Figure 1. Monitoring stations in the Swedish national pelagic marine monitoring program. Blue: SMHI standard stations, red: UMF standard stations, green: SU (B1, BY31, BY29) and SMHI (BY31, BY29) standard stations, grey: mapping stations for the pool of winter nutrients.

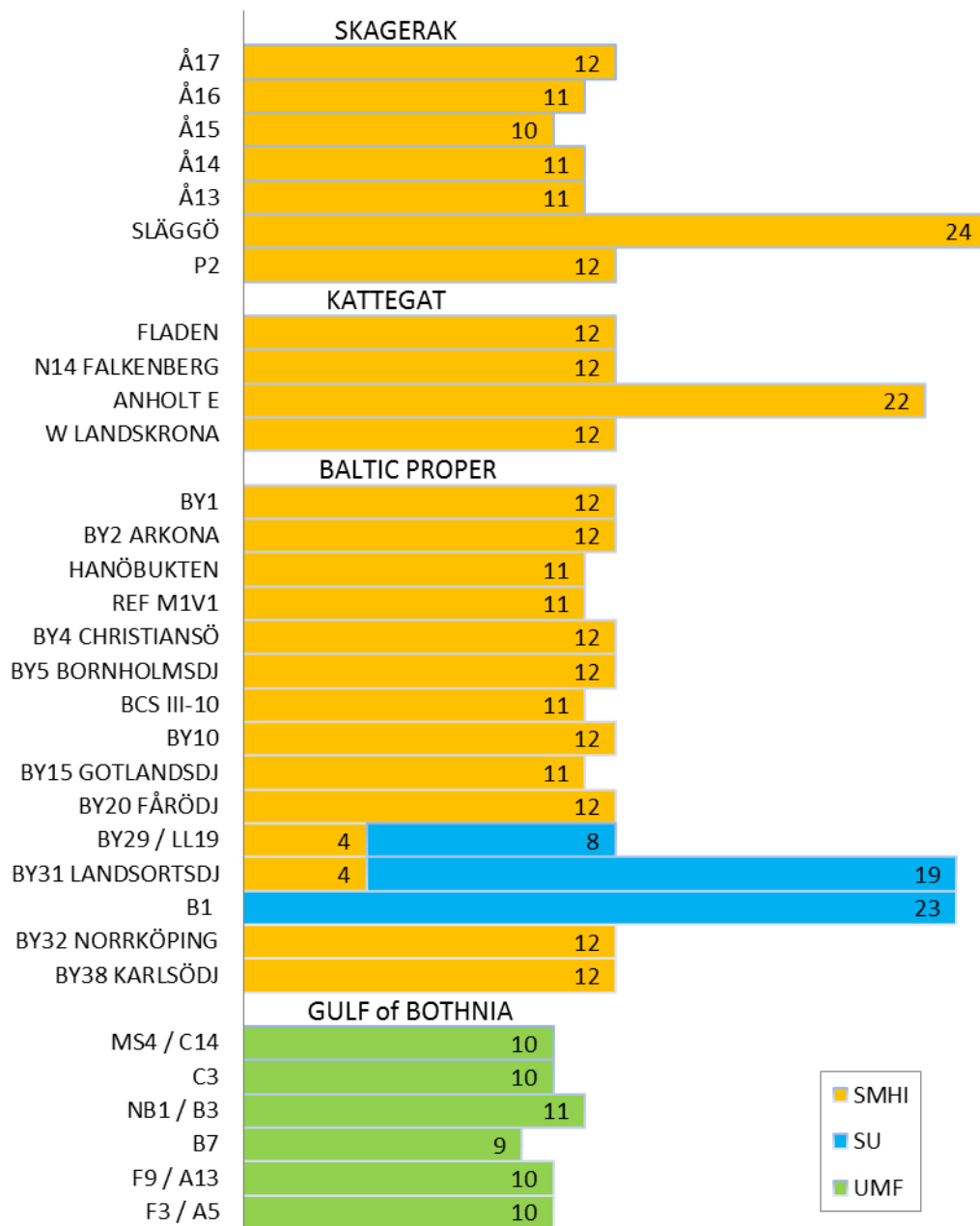


Figure 2. Number of visits at standard stations during 2016 per institute. Note that REF M1V1 is a high frequent station also visited by Kalmar, which is not shown here.

2 Ice, sea water levels and inflows during 2016

The ice season

The ice season 2015/2016 started later than normal but a temporary cold spell in January increased the ice growth and the maximum ice extent was reached on the 23th of January, one day earlier than the previous season. The ice season was considered to be mild but still quite close to normal with a maximum ice extent of 111 000 km². The daily survey of ice ended on the 12th of May, which is about two weeks earlier than usual.

Reference: <https://www.smhi.se/klimat/arssammanstallningar/vatten/havsis-vintern-2015-2016-1.108571>

Sea water levels

The year began with varying weather conditions and hence also varying sea water levels. In spring, the sea water levels dropped to lower than normal and the low levels persisted until summer when several storm passages increased the water levels. Northeasterly winds during autumn caused extremely low sea water levels, close to the lowest ever observed since 1886 when observations with mareographs started. Sea water levels increased again towards the end of the year and the storm Urd that passed at Christmas caused extreme high sea water levels along the Swedish west coast.

The highest value during 2016 was observed in Uddevalla, +161 cm, and the lowest was observed in Haparanda, -126 cm.

Reference: <https://www.smhi.se/klimat/arssammanstallningar/vatten/havsvattenstand-2016-1.114348>

Inflows to the Baltic Sea through the Sound

The inflows through the Sound to the Baltic Sea during 2016 summed up to 294 km³ and the summed outflows were 654 km³. Both the inflow and the outflow were near the long term means of inflows and outflows, which are 316 km³ and 624 km³ respectively for the time period 1977-2015. A small inflow with the size of 30 km³ entered the Sound in the beginning of the year. Even though it was considered small, it could be seen in the deep water of the southern Baltic Proper. Only minor inflows occurred during spring and summer and this is normal for the season. Three inflows of 20 km³ each entered the Sound during late October, mid-November and late December after the period with low sea water levels in the Baltic Sea (described above). An inflow needs to be about 100 km³ to be considered a strong Major Baltic Inflow (MBI).

Reference: <https://www.smhi.se/klimat/arssammanstallningar/vatten/ostersjons-in-och-utfloden-2015-1.116090>

3 Hydrography, nutrients and phytoplankton 2016

In this section, results of the national monitoring program are presented. SMHI Cruise reports and SMHI Algae reports are available at <https://www.smhi.se/en/publications/cruise-reports-from-the-marine-monitoring> and <http://www.smhi.se/publikationer/publikationer/algrapporter>

3.1 Skagerrak, Kattegat and the Sound

Hydrography and oxygen

The sea surface temperature on the west coast of Sweden was about normal for the year, except from some occasions. September was warmer than normal because of several high pressure systems. In off shore Skagerrak this warm water layer was about 50 meters thick and the thickness decreased towards the coast and Kattegat where it was about only 15 meters. November was colder than normal and winter arrived early.

The sea surface salinity was lower than normal in March and this can be connected with an earlier large outflow pulse of Baltic Sea water. Out flowing Baltic Sea water flows along the Swedish coastline and lowers the salinity in the surface water. In December, the salinity was much higher than normal in the surface in the whole area.

The levels of oxygen in the deep water of Kattegat and the Sound were lower than normal during the autumn. Acute hypoxia (<2 ml/l) was measured in the Sound already from 20 meters depth and lowest value (1.2 ml/l) was measured at 52 meters. Near the bottom at the coastal station N14 and at Anholt E lowest oxygen levels were close to acute hypoxia, 2.6 ml/l and 2.3 ml/l respectively. The low oxygen conditions did however not last for long and in December concentrations were again back to normal.

In the open Skagerrak there is normally no shortage of oxygen in the deep water.

Nutrients

All nutrients in the surface water had dropped significantly between the cruises in February and March, which implies that the spring bloom went on between these two cruises. The intensity of the spring bloom is also reflected in the increased oxygen saturation in March. There was also a late November bloom in the Kattegat, the Sound and coastal Skagerrak, which is seen in the lower levels of nutrients. The nutrient levels were lower than normal in December and they had not reached the normally higher winter values.

Phytoplankton

The yearly diatom spring bloom in March was intense. In July there were high cell numbers of the dinoflagellate *Dinophysis acuminata*, which caused high levels of toxins in blue mussels. During this period it was forbidden to harvest blue mussels along the west coast. Mussels filter the phytoplankton and the toxins are accumulated in the mussel meat. One of a few diatoms that produce toxins is *Pseudo-nitzschia* and this particular species was abundant in July and during the autumn. The produced toxin is called AST (Amnesic Shellfish Toxin) and levels exceeding the threshold levels were observed during spring. The dinoflagellate *Lingulodinium polyedrum* was common during late summer and in the beginning of autumn. It produces yessotoxins that probably has no effect on humans. A diatom bloom was observed in November.

Algae harmful for fish were observed but no consequent fish kills were reported during the year.

3.2 Baltic Proper

Hydrography and oxygen

The sea surface temperature in the Baltic Proper was normal except in September that was warmer than usual. The inflow of 30 km^3 in the beginning of the year could be seen as an increased salinity in the surface waters of the Arkona and Bornholm basins during spring and it could be tracked in the deep water in the Eastern Gotland Basin. This is evident from measurements during the cruise in April, water with higher concentration of oxygen than previous month was found at BCS III (90 meters) and at BY10 (120 meters) and in June it was spotted at BY15 (150 meters). In late summer, surface salinities were substantially lower down to 20 meters in parts of the East Gotland Basin (BY15 and BY20) and the Northern Baltic Proper (BY29, BY31 and BY32). The reason for this low surface salinity is not fully analyzed at the time of writing. Freshwater and low saline water from rivers and adjacent seas is usually trapped in the warmer surface layer of the Baltic Sea and the annual minimum salinity is often observed in summer. Hence, the very low salinity in the area during this summer could be due to processes enhancing this process.

The oxygen situation in the Eastern Gotland Basin has improved after the large salt water inflow in December 2014. This caused a decrease in the concentration of hydrogen sulphide and dissolved inorganic phosphorous in the deep water of the Eastern Gotland Basin. At the station BY15 Gotland Deep hydrogen sulphide has only been observed occasionally nearest the bottom but more often towards the end of the year. A bit further north, at the station BY 20 Fårö Deep, the deep water is usually anoxic below the halocline but during 2016 this anoxic layer has been thinner than before and the concentration of oxygen has been varying around zero ml/l. In the

Northern Baltic Proper, the deep water is still anoxic below the halocline but the inflow effect can be tracked as lower phosphate levels, higher salinities and higher temperatures. This pattern is also seen in the Western Gotland Basin. The reason that the deep water is still anoxic in these areas is probably because the inflow has lost its oxygen content when mixing with the water in the Eastern Gotland basin. Despite the more frequent inflows to the Baltic Sea since 2014 approximately 17% of the bottom area was affected by anoxia and 28% by hypoxia during 2016. Nevertheless, the amount of hydrogen sulphide has, due to the inflows, decreased in the Eastern and Northern Gotland Basin.

More details about the oxygen situation in the Baltic Sea:

http://www.smhi.se/polopoly_fs/1.114927!/RO_58.pdf²

Nutrients

In the whole Baltic Proper, the concentration of dissolved inorganic nitrogen (DIN = nitrate + nitrite + ammonium) was high in the surface waters in the beginning of the year and decreased to nearly zero during spring/summer, which is normal. In November/December levels of DIN had increased again but to higher levels than normal. The concentration of phosphate in the surface waters was normal almost in the whole area. In September, levels of phosphate in the surface had decreased more than usually after the bloom period in the Arkona and Bornholm Basins and Hanö Bight. At the end of the year, levels of phosphate had increased more than normal in the East Gotland Basin and parts of the Northern Baltic Proper and Western Gotland Basin. Elevated levels of silicate have been observed since 2014 in the Baltic Sea and the silicate levels were also elevated this year but mainly in the central and the northern parts of the Baltic Proper.

The nutrients, in particular dissolved inorganic phosphorous, ammonia and silicate, in the deep water of the central Baltic Proper were lower than normal. This is because the stagnant water has been mixed with the recent inflows of oxygenated deep water. In the Western Gotland Basin, concentrations of ammonia were on the other hand elevated and the cause might be old water transported from the Eastern Gotland Basin. The salinity is also elevated in the deep water of the Western Gotland basin, which supports the theory.

Phytoplankton

The spring bloom usually starts a bit later in the Baltic Sea compared to the Kattegat and Skagerrak areas. In the southern areas it started in late March this year and even later further north. When it was cloudless and the satellite monitoring worked, surface blooms of cyanobacteria were observed almost uninterruptedly for three months, from June 20 to September 21, which is an unusual long period. The sea areas most affected by intensive blooms were the Eastern and Western Gotland Basins. In all, the cyanobacteria bloom in 2016 was lower than average in comparison with previous years.

The toxic species *Nodularia spumigena* was observed in all samples from the June cruise. In July this species had increased its cell numbers in the southern areas while in north the non-toxic species *Aphanizomenon flos-aquae* dominated the samples. There were still high abundances of cyanobacteria in September. The potentially harmful dinoflagellate *Prorocentrum cordatum* was found in high cell numbers during autumn.

More details about the cyanobacteria bloom in 2016: <http://www.helcom.fi/baltic-sea-trends/environment-fact-sheets/eutrophication/cyanobacterial-blooms-in-the-baltic-sea>.

² Martin Hansson, Lars Andersson (2016). Oxygen Survey in the Baltic Sea 2016 - Extent of Anoxia and Hypoxia 1960-2016. Report of Oceanography nr 58.

3.3 Gulf of Bothnia

Salinity, temperature, oxygen and nutrient data is presented in the time series. No seasonal figures are made for these stations, because of too short time between data delivery and the delivery of this report. Also, not all of these stations have monthly resolution for all nutrient parameters and oxygen which makes a seasonal figure for those stations un-informative.

References

- Cyanobacteria bloom in 2016: <http://www.helcom.fi/baltic-sea-trends/environment-fact-sheets/eutrophication/cyanobacterial-blooms-in-the-baltic-sea/>
- Ice season 2015/2016: <https://www.smhi.se/klimat/arssammanstallningar/vatten/havsis-vintern-2015-2016-1.108571>
- Inflows to the Baltic Sea through the Sound 2016: <http://www.smhi.se/klimat/klimatet-da-och-nu/arets-vatten/ostersjons-in-och-utfloden-2016-1.116090>.
- Manual for marine monitoring in the COMBINE programme of HELCOM
<http://www.helcom.fi/action-areas/monitoring-and-assessment/manuals-and-guidelines/combine-manual>
- Martin Hansson, Lars Andersson (2016). Oxygen Survey in the Baltic Sea 2016 - Extent of Anoxia and Hypoxia 1960-2016. Report of Oceanography nr 58.
- Monitoring data from 2016 available at the national data host 2017-04-25
- Sea water levels 2016:
<https://www.smhi.se/klimat/arssammanstallningar/vatten/havsvattenstand-2016-1.114348>
- SMHI cruise reports: <https://www.smhi.se/en/publications/cruise-reports-from-the-marine-monitoring>
- SMHI algal reports: <http://www.smhi.se/publikationer/publikationer/algrapporter>

Appendix I

Seasonal plots for surface waters

STATION SLÄGGÖ SURFACE WATER (0-10 m)

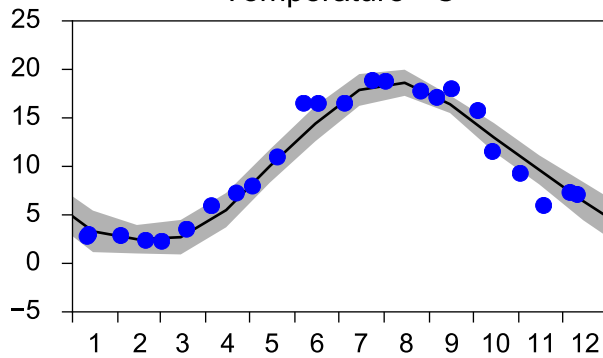
Annual Cycles

— Mean 2001-2015

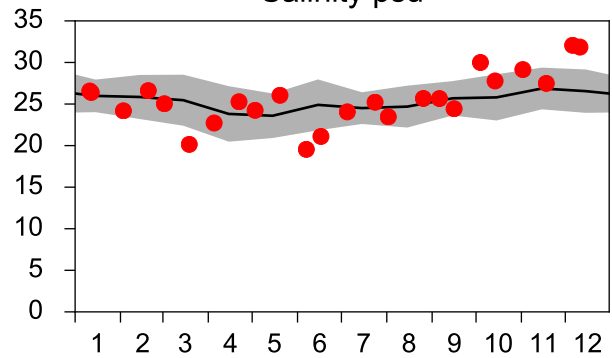
■ St.Dev.

● 2016

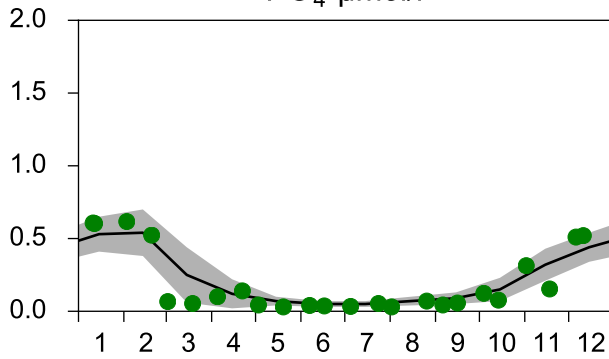
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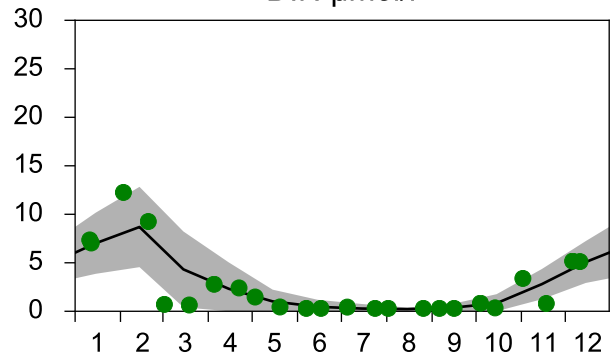
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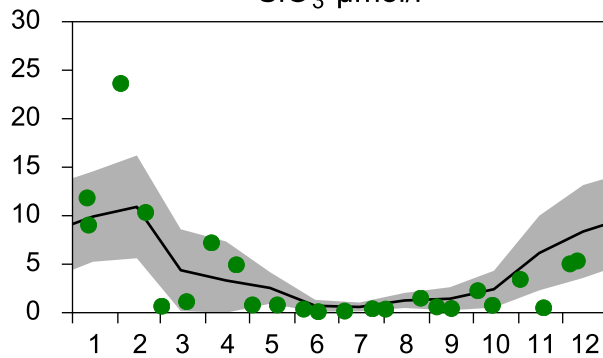
PO₄ µmol/l



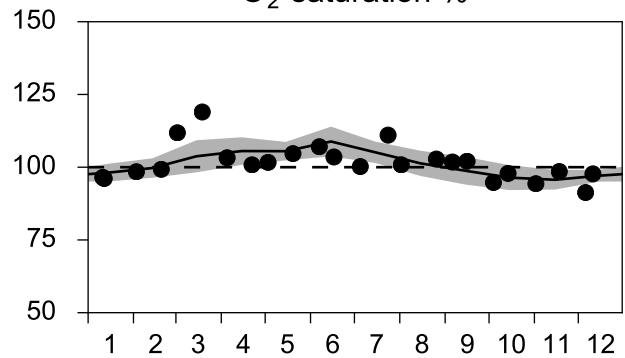
DIN µmol/l



SiO₃ µmol/l

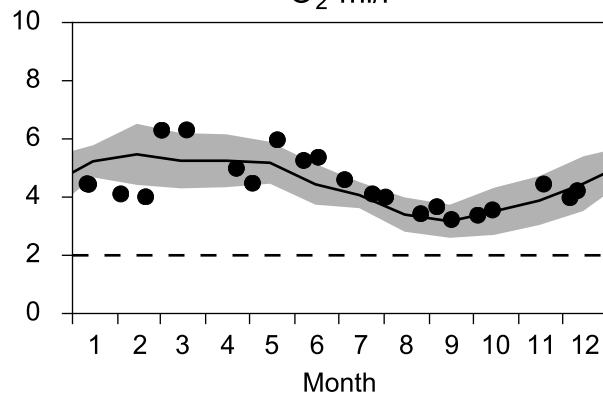


O₂ saturation %

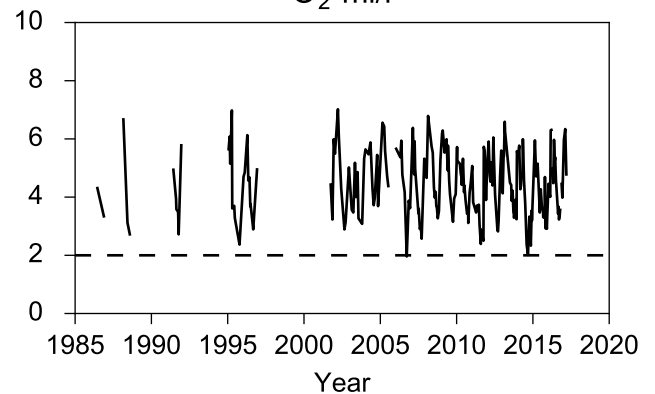


OXYGEN IN BOTTOM WATER (depth >= 64 m)

O₂ ml/l



O₂ ml/l



STATION Å13 SURFACE WATER (0-10 m)

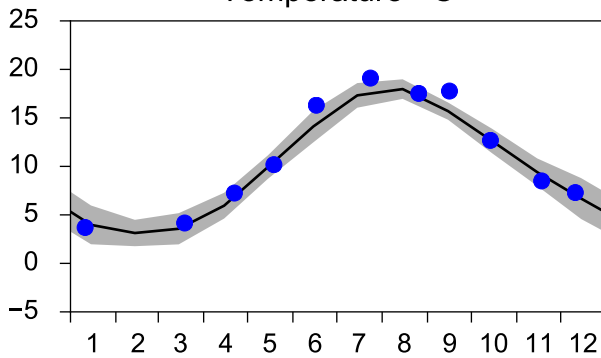
Annual Cycles

— Mean 2001-2015

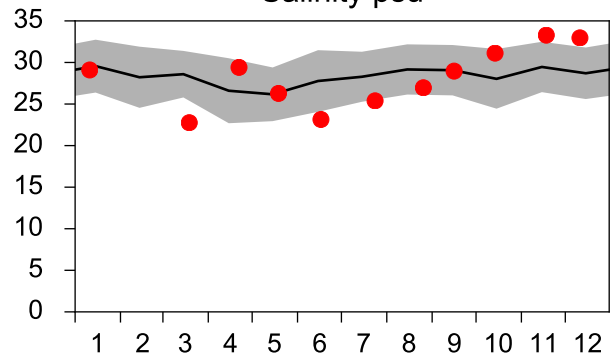
■ St.Dev.

● 2016

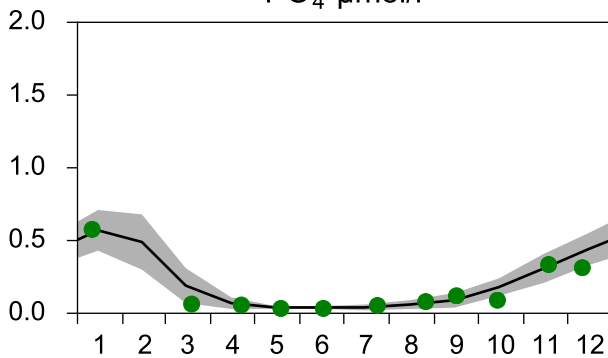
Temperature °C



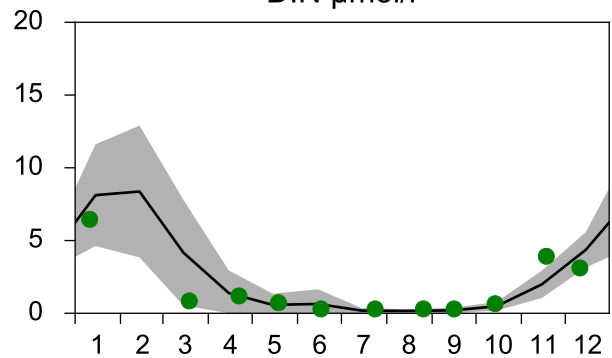
Salinity psu



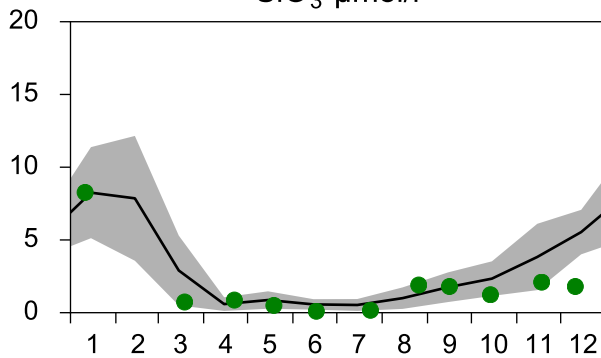
PO₄ µmol/l



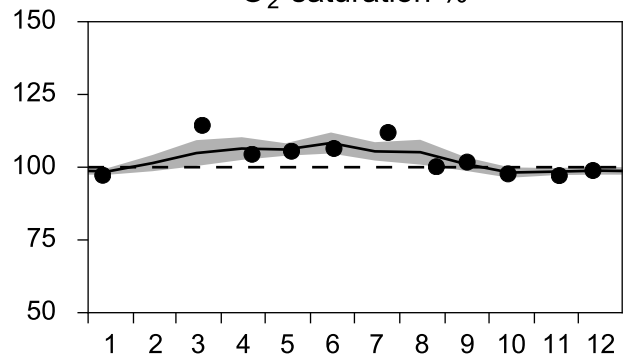
DIN µmol/l



SiO₃ µmol/l

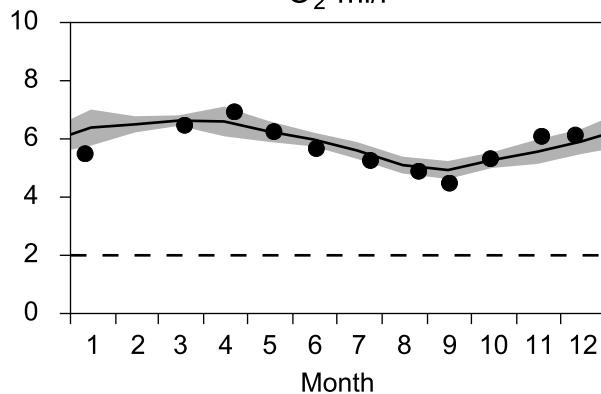


O₂ saturation %

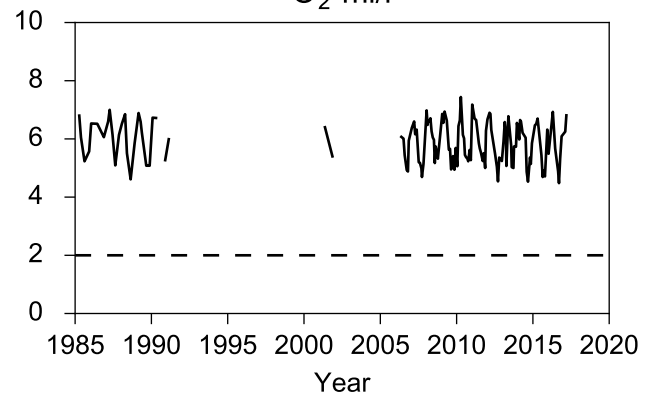


OXYGEN IN BOTTOM WATER (depth >= 80 m)

O₂ ml/l



O₂ ml/l



STATION Å15 SURFACE WATER (0-10 m)

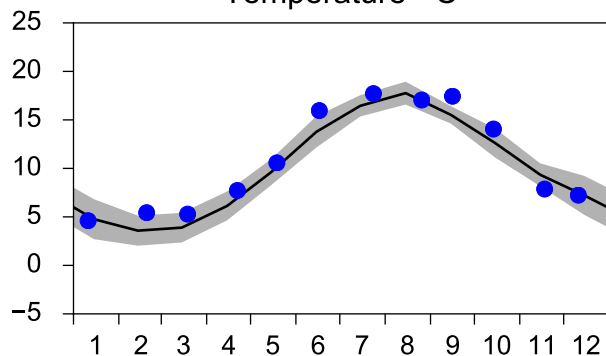
Annual Cycles

— Mean 2001-2015

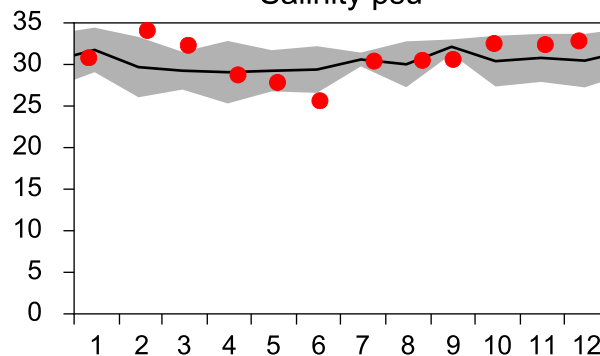
■ St.Dev.

● 2016

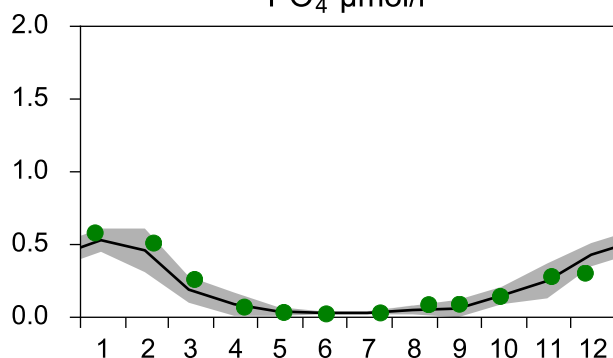
Temperature °C



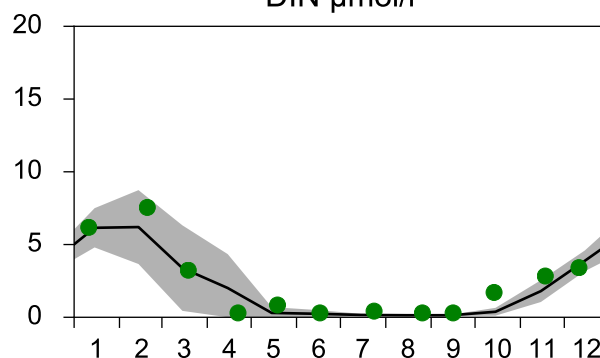
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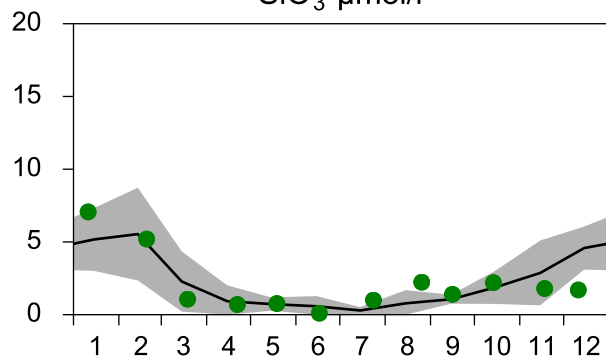
PO₄ µmol/l



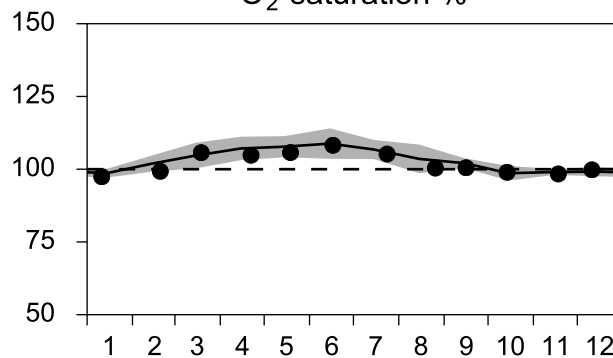
DIN µmol/l



SiO₃ µmol/l

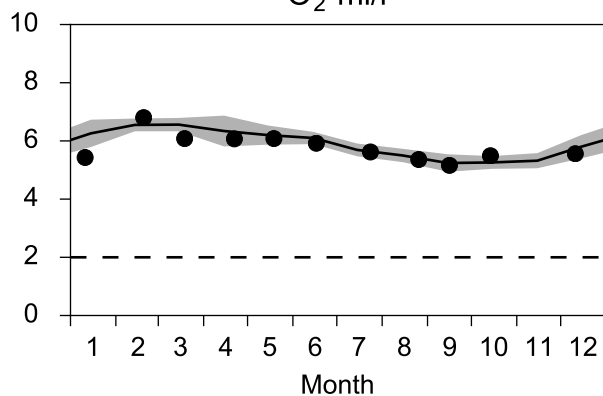


O₂ saturation %

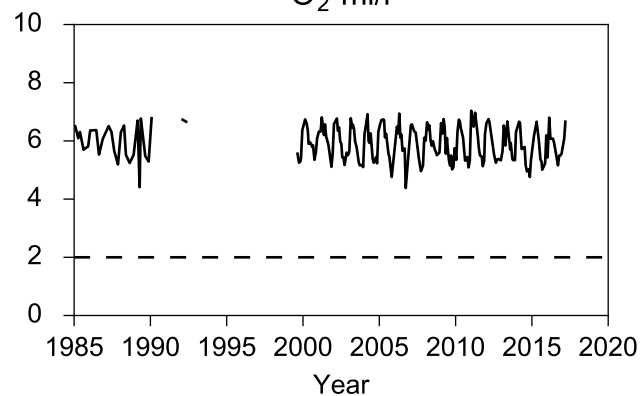


OXYGEN IN BOTTOM WATER (depth >= 125 m)

O₂ ml/l



O₂ ml/l



STATION Å17 SURFACE WATER (0-10 m)

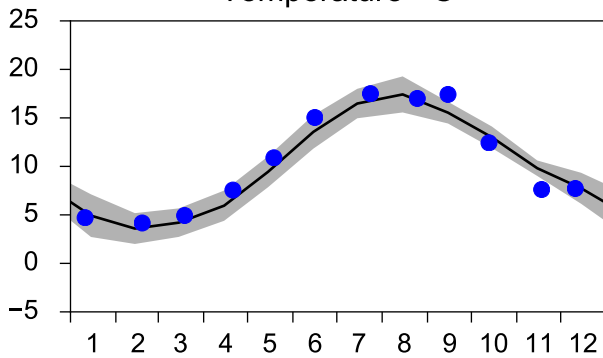
Annual Cycles

— Mean 2001-2015

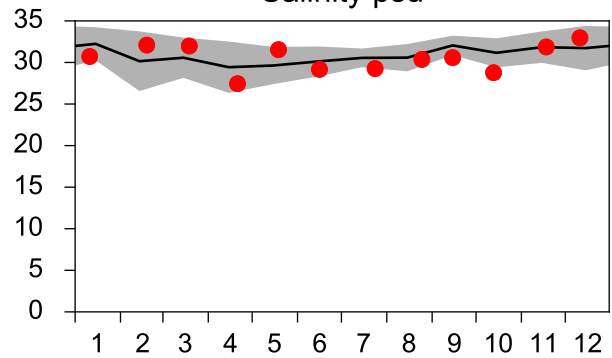
■ St.Dev.

● 2016

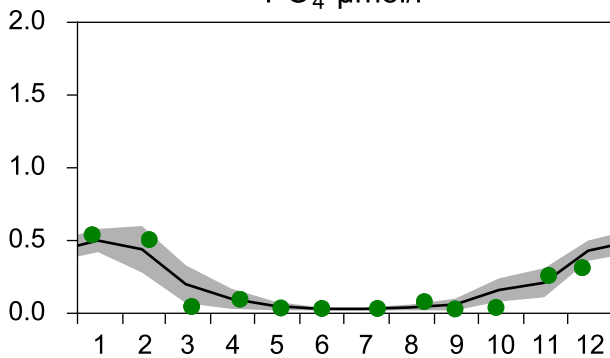
Temperature °C



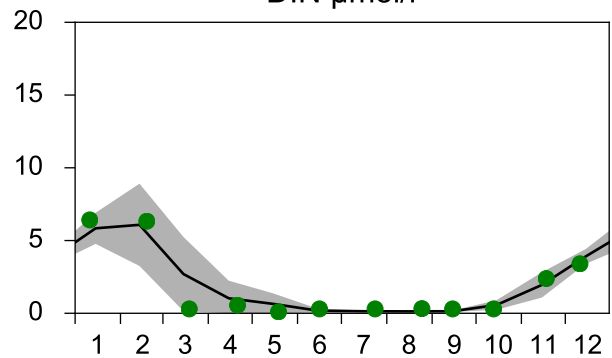
Salinity psu



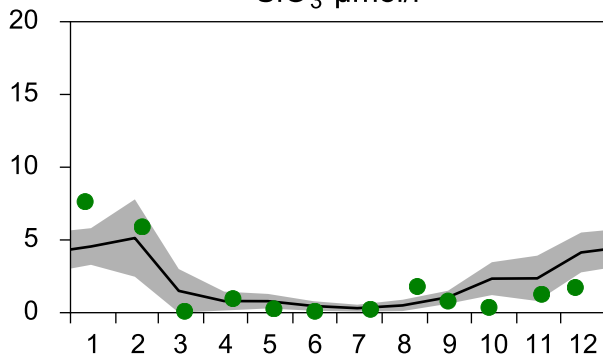
PO₄ µmol/l



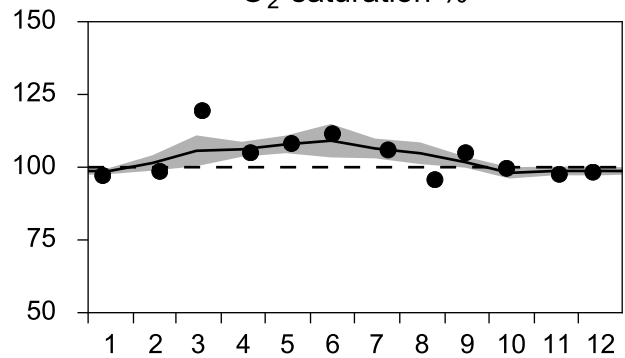
DIN µmol/l



SiO₃ µmol/l

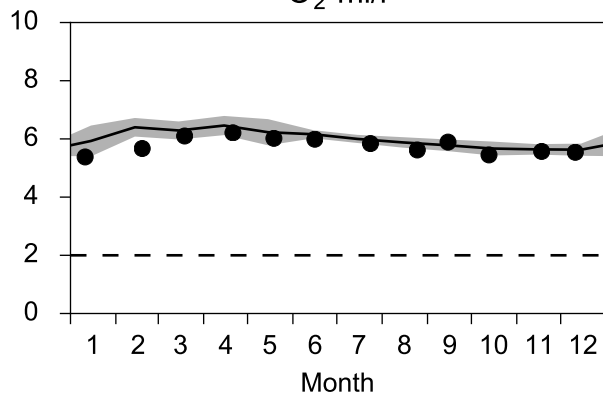


O₂ saturation %

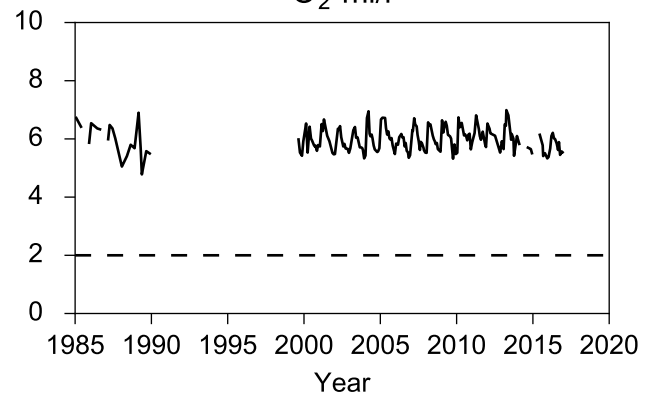


OXYGEN IN BOTTOM WATER (depth >= 300 m)

O₂ ml/l



O₂ ml/l



STATION P2 SURFACE WATER (0-10 m)

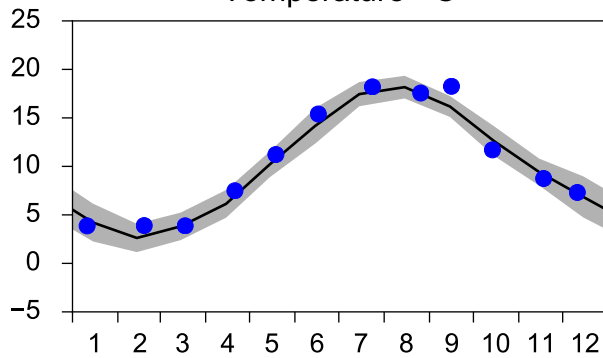
Annual Cycles

— Mean 2001-2015

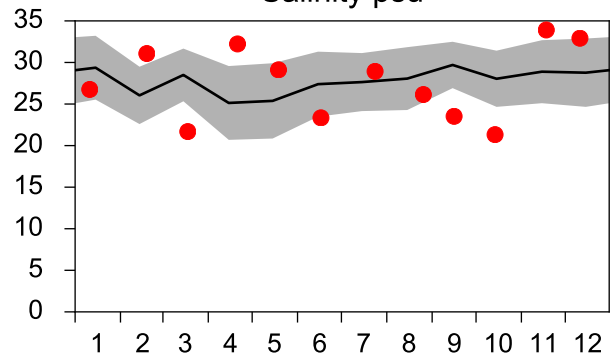
■ St.Dev.

● 2016

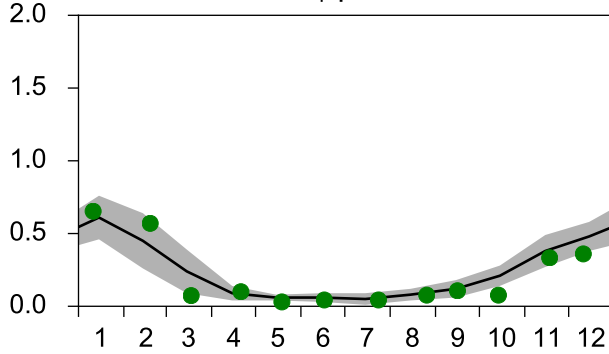
Temperature °C



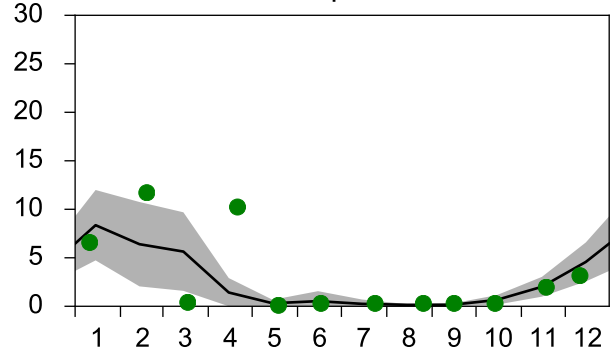
Salinity psu



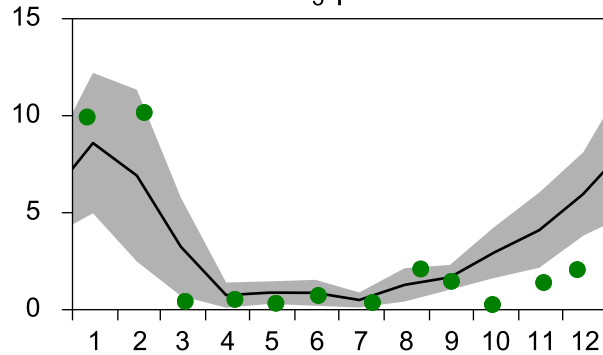
PO₄ µmol/l



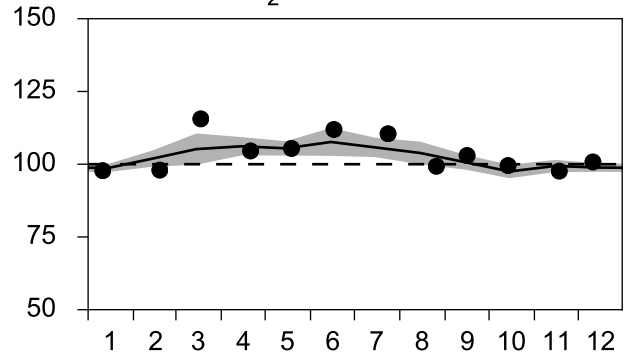
DIN µmol/l



SiO₃ µmol/l

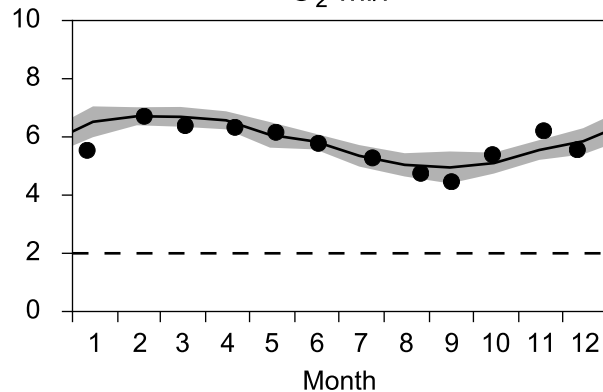


O₂ saturation %

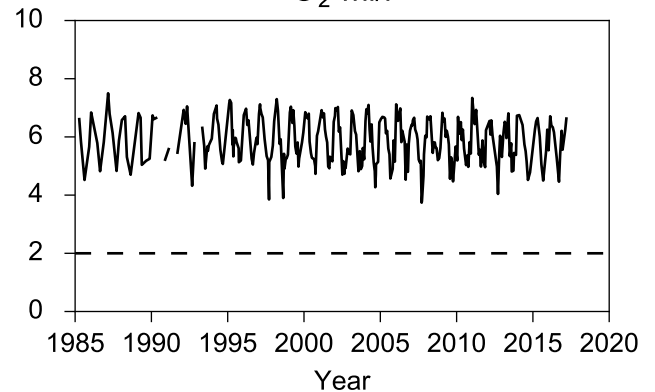


OXYGEN IN BOTTOM WATER (depth >= 75 m)

O₂ ml/l



O₂ ml/l



STATION FLADEN SURFACE WATER (0-10 m)

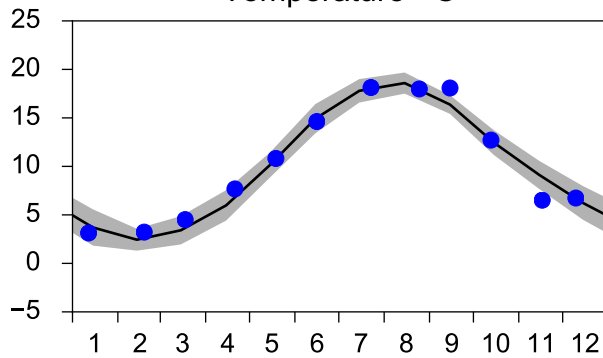
Annual Cycles

— Mean 2001-2015

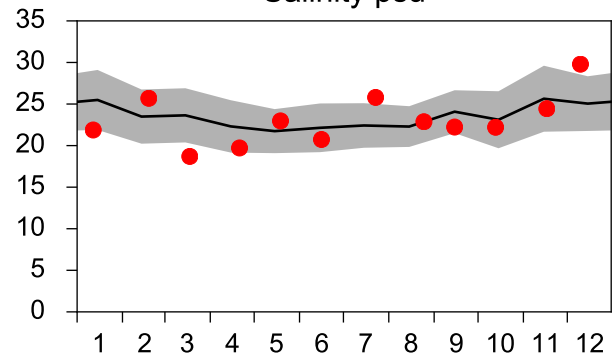
■ St.Dev.

● 2016

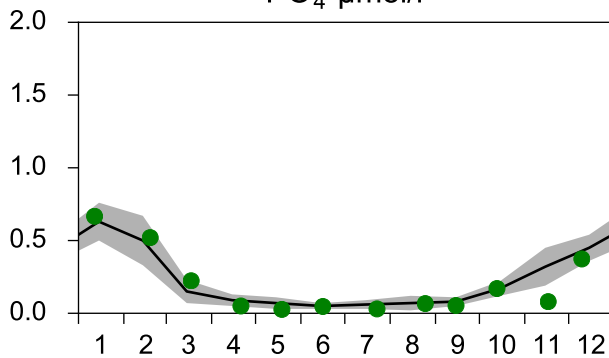
Temperature °C



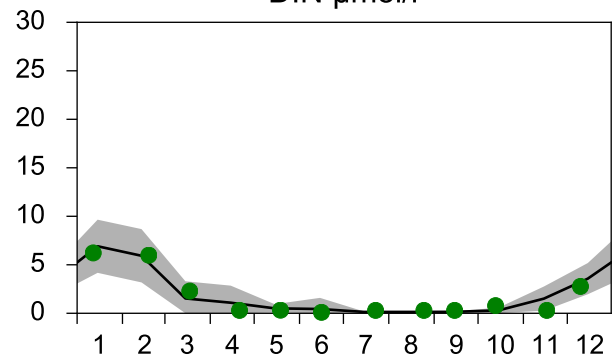
Salinity psu



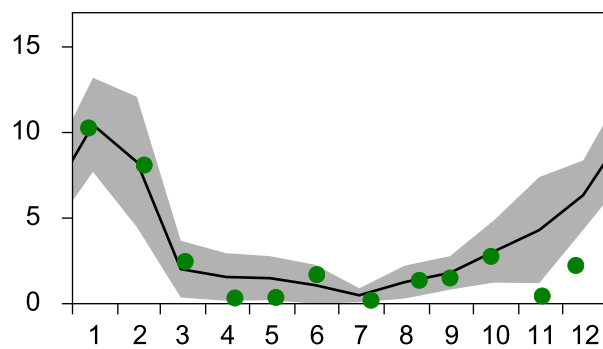
PO₄ µmol/l



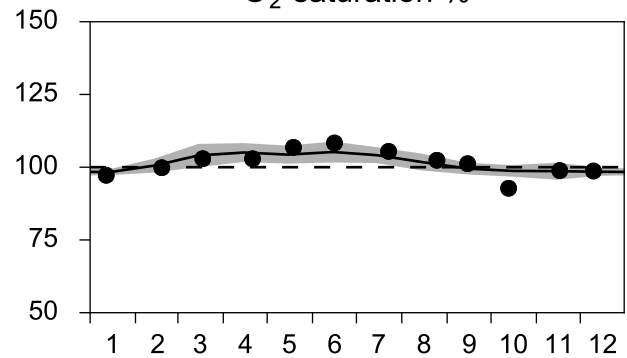
DIN µmol/l



SiO₃ µmol/l

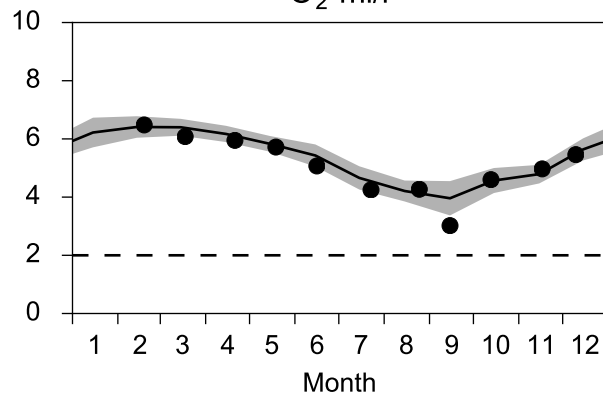


O₂ saturation %

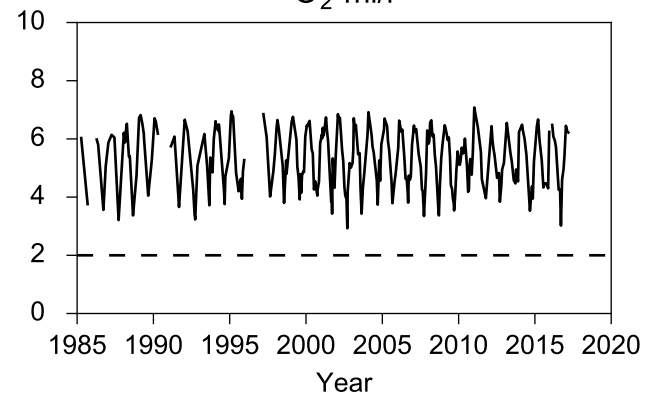


OXYGEN IN BOTTOM WATER (depth >= 74 m)

O₂ ml/l



O₂ ml/l



STATION ANHOLT E SURFACE WATER (0-10 m)

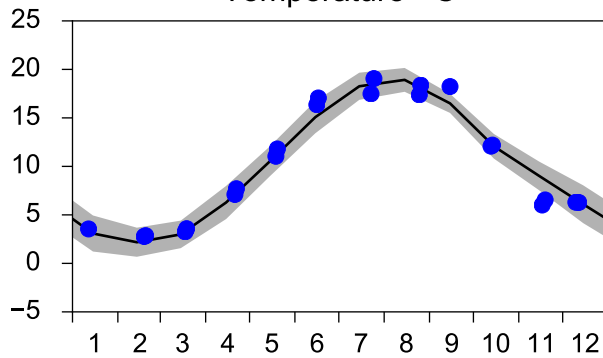
Annual Cycles

— Mean 2001-2015

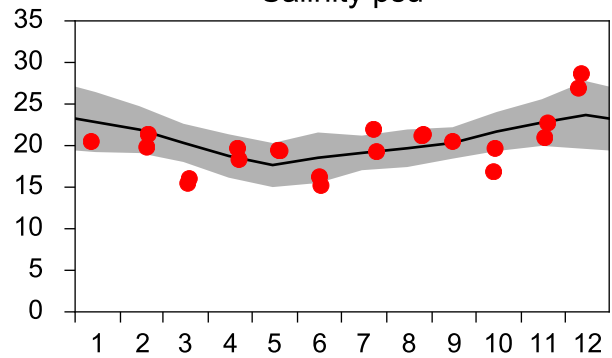
■ St.Dev.

● 2016

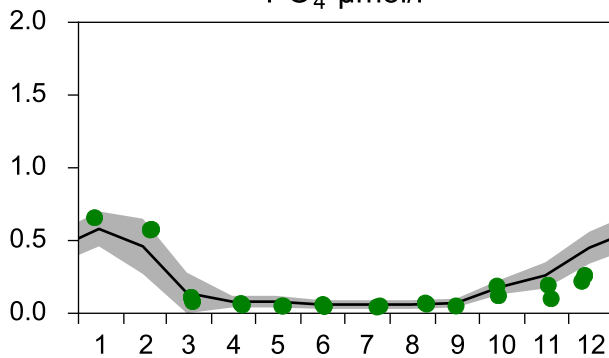
Temperature °C



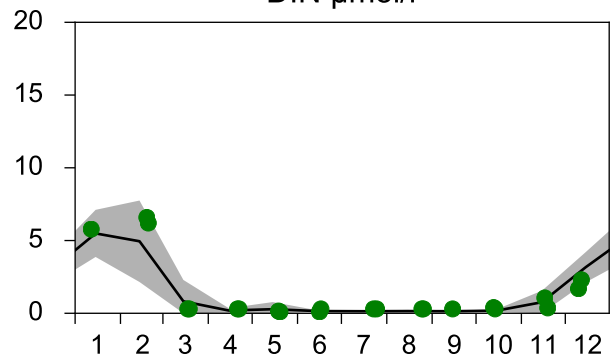
Salinity psu



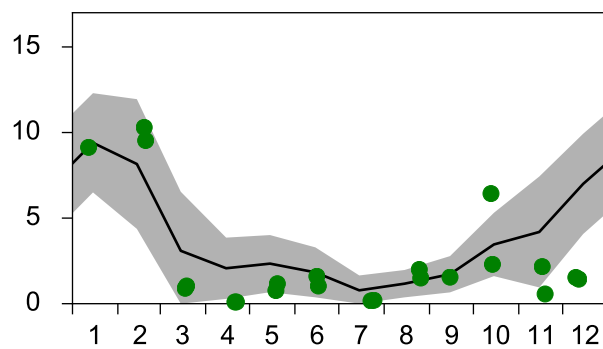
PO₄ µmol/l



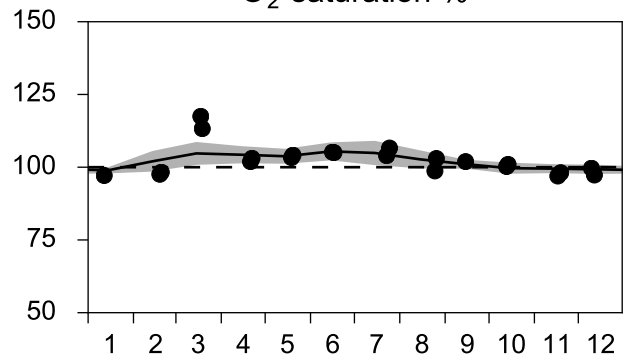
DIN µmol/l



SiO₃ µmol/l

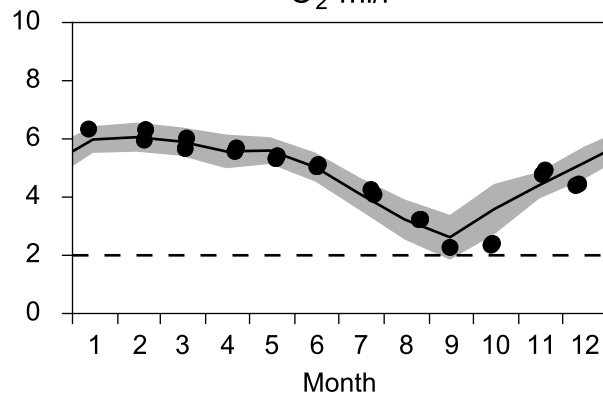


O₂ saturation %

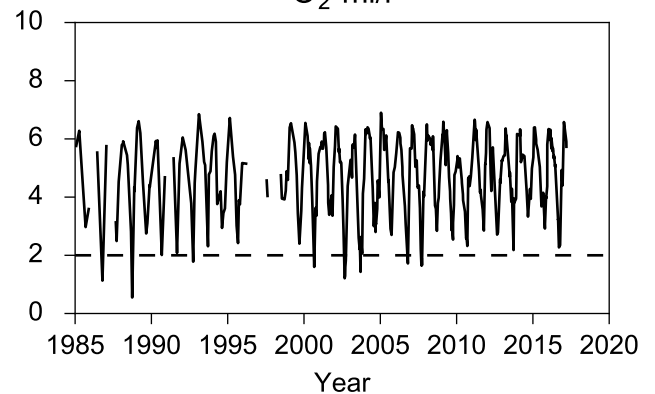


OXYGEN IN BOTTOM WATER (depth >= 52 m)

O₂ ml/l



O₂ ml/l



STATION W LANDSKRONA SURFACE WATER (0-10 m)

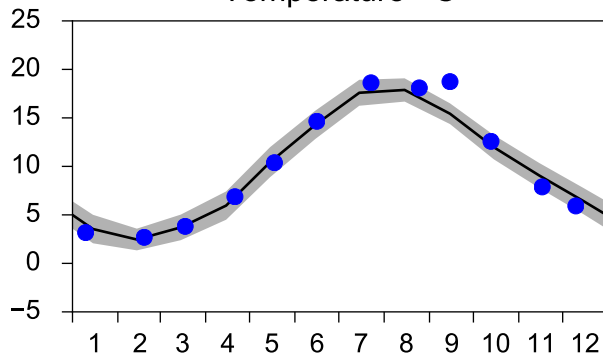
Annual Cycles

— Mean 2001-2015

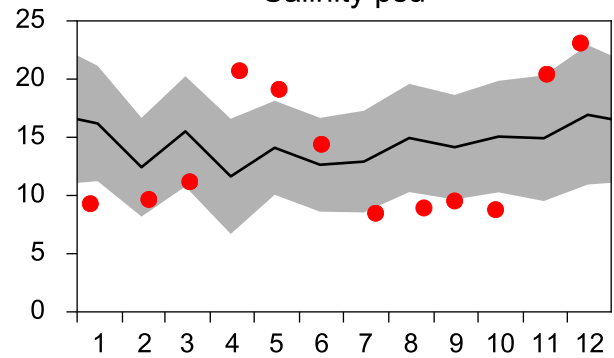
■ St.Dev.

● 2016

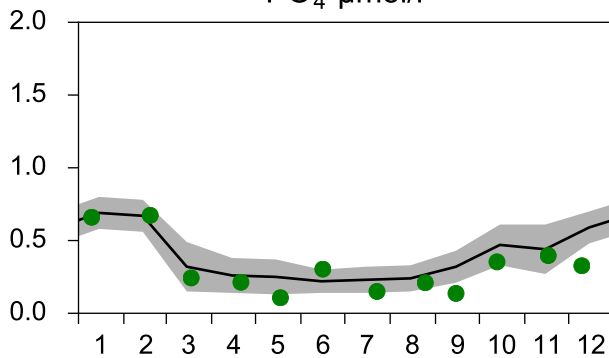
Temperature °C



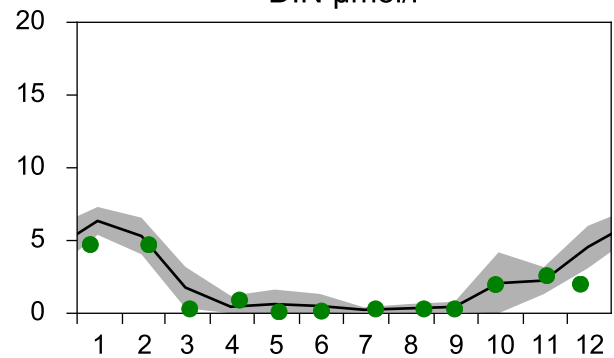
Salinity psu



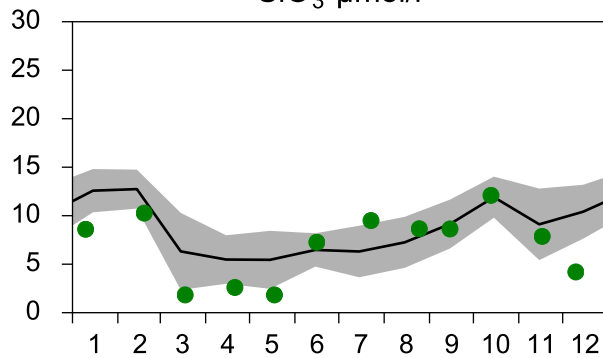
PO₄ µmol/l



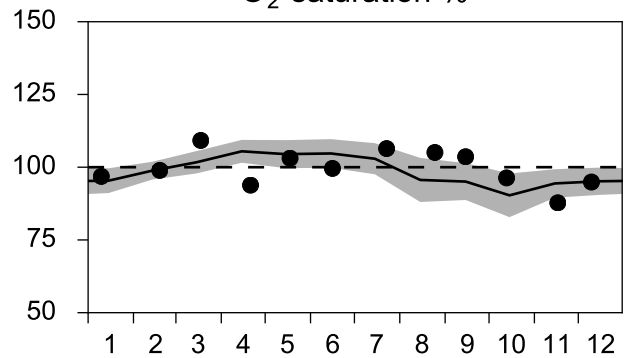
DIN µmol/l



SiO₃ µmol/l

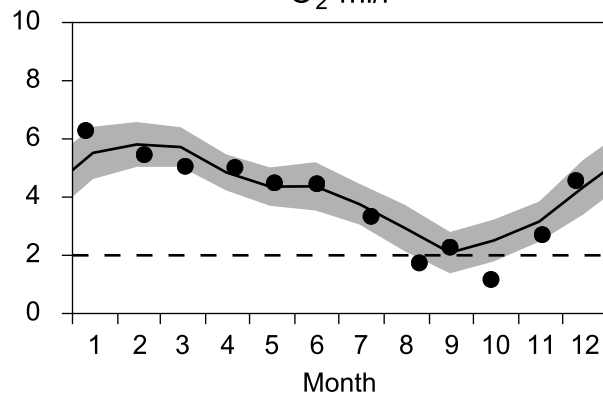


O₂ saturation %

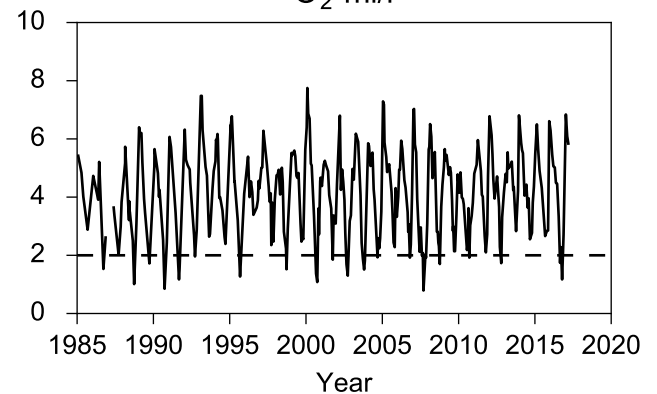


OXYGEN IN BOTTOM WATER (depth >= 40 m)

O₂ ml/l



O₂ ml/l



STATION BY1 SURFACE WATER (0-10 m)

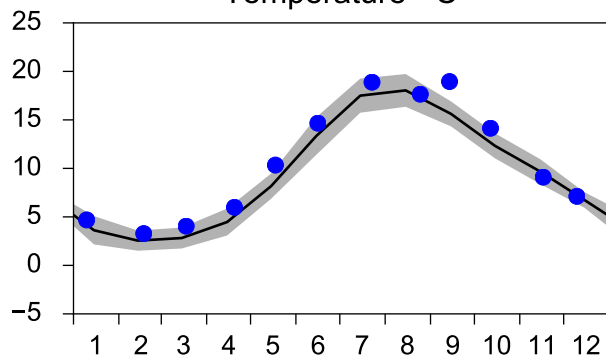
Annual Cycles

— Mean 2001-2015

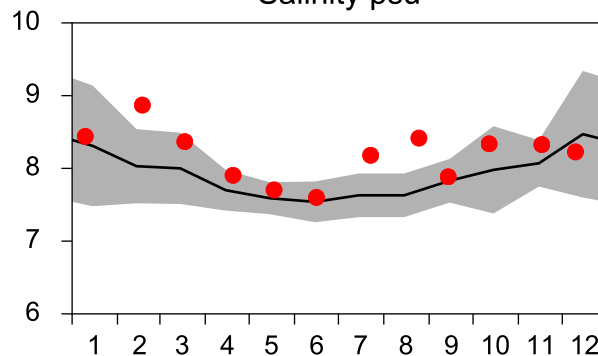
■ St.Dev.

● 2016

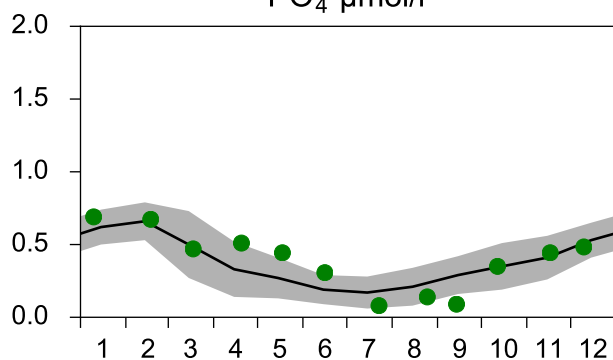
Temperature °C



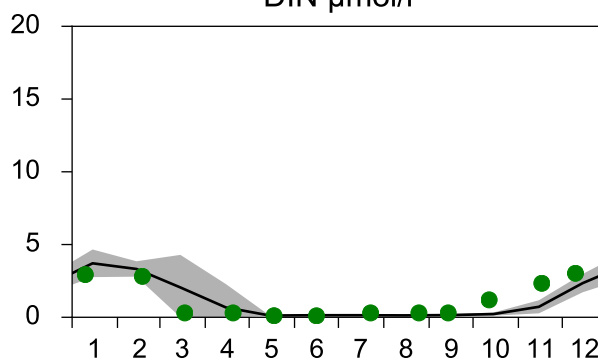
Salinity psu



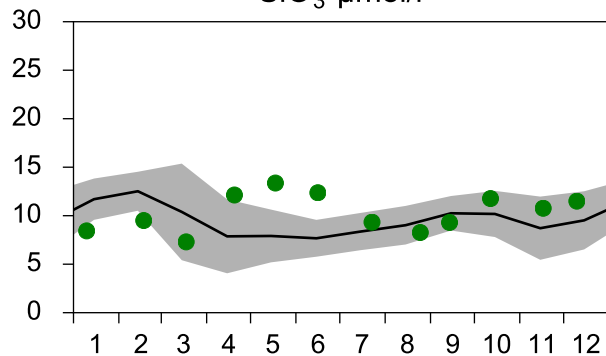
PO₄ μmol/l



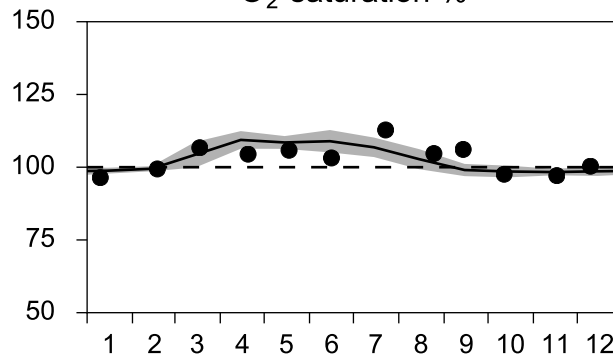
DIN μmol/l



SiO₃ μmol/l

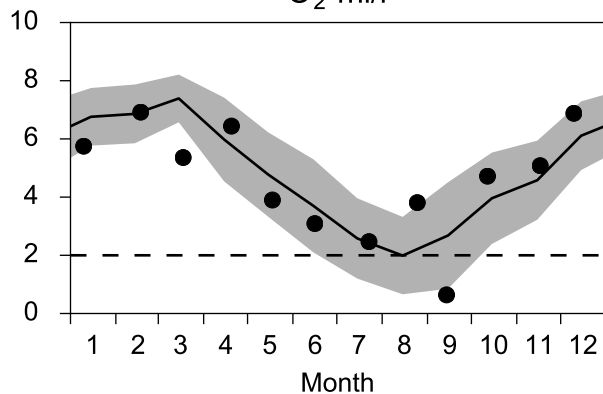


O₂ saturation %

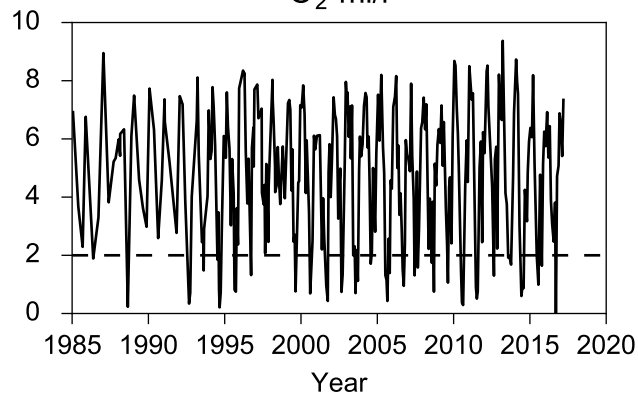


OXYGEN IN BOTTOM WATER (depth >= 40 m)

O₂ ml/l



O₂ ml/l



STATION BY2 ARKONA SURFACE WATER (0-10 m)

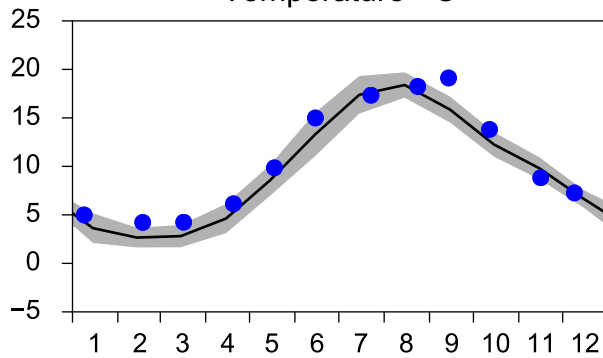
Annual Cycles

— Mean 2001-2015

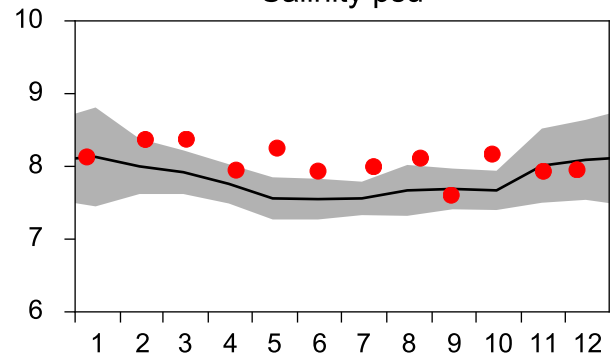
■ St.Dev.

● 2016

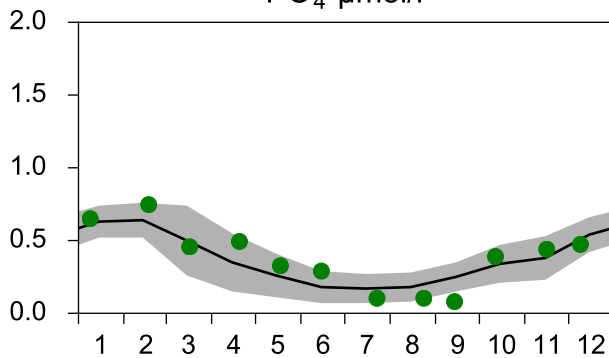
Temperature °C



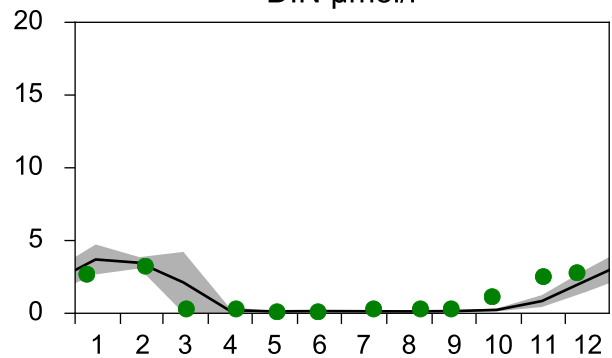
Salinity psu



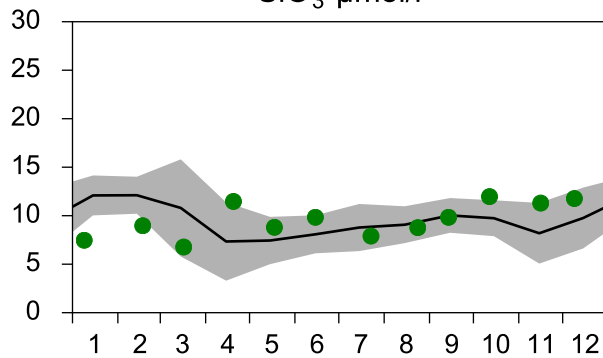
PO₄ µmol/l



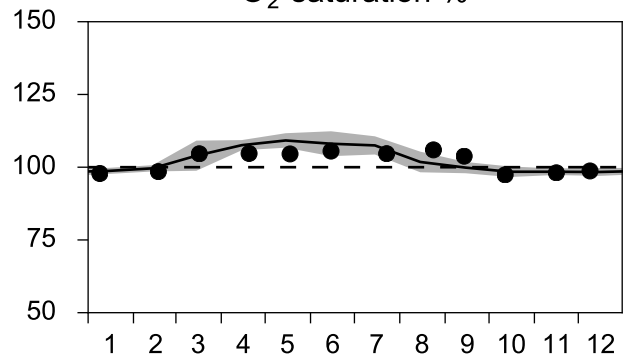
DIN µmol/l



SiO₃ µmol/l

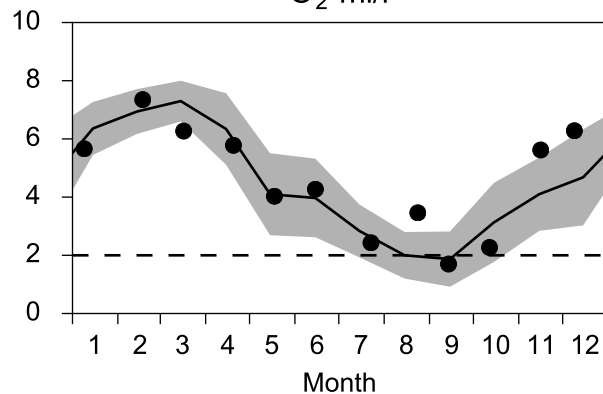


O₂ saturation %

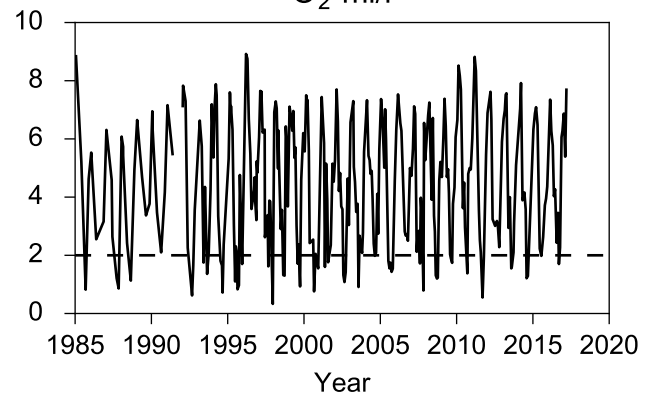


OXYGEN IN BOTTOM WATER (depth >= 40 m)

O₂ ml/l



O₂ ml/l



STATION HANÖBUKTEN SURFACE WATER (0-10 m)

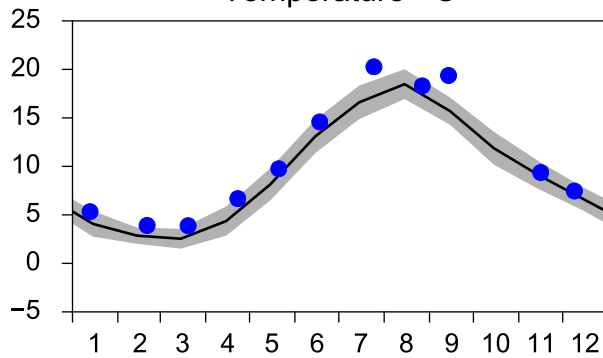
Annual Cycles

— Mean 2001-2015

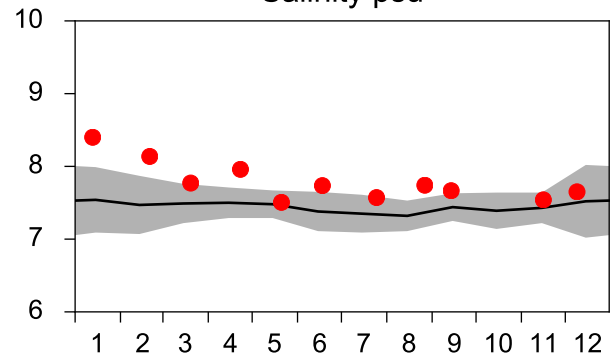
■ St.Dev.

● 2016

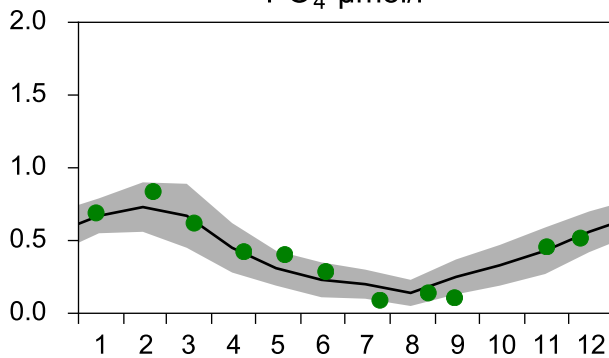
Temperature °C



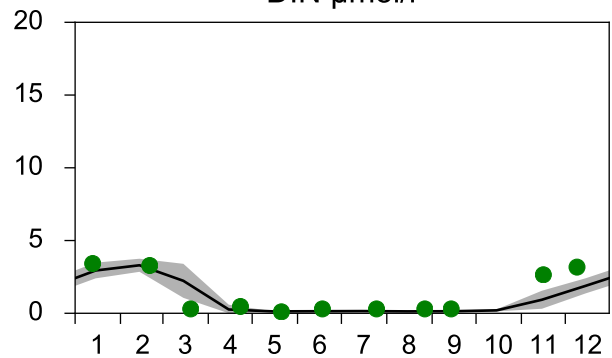
Salinity psu



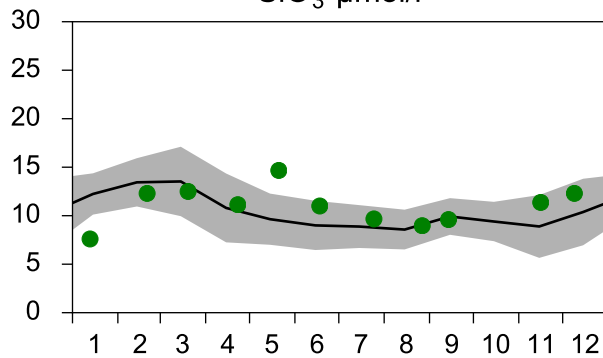
PO₄ µmol/l



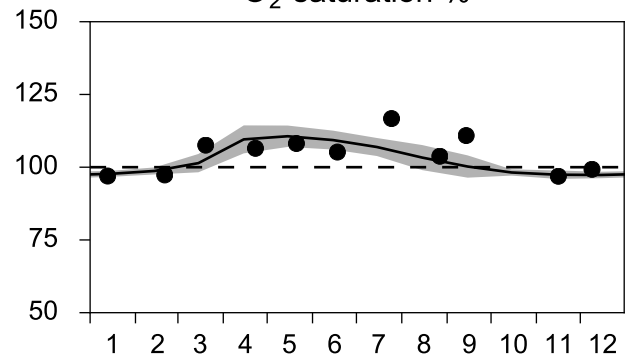
DIN µmol/l



SiO₃ µmol/l

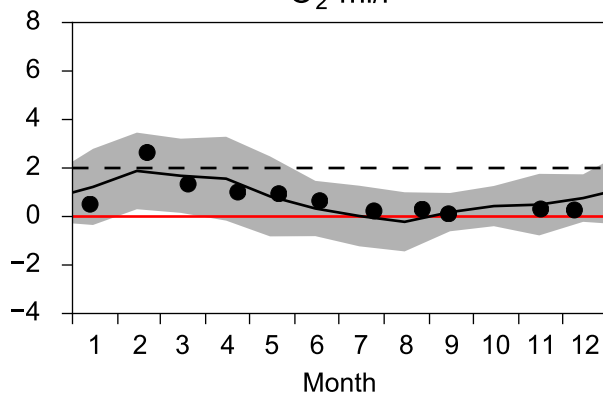


O₂ saturation %

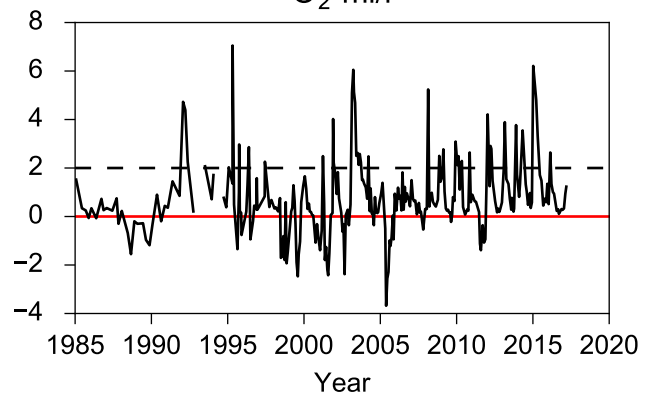


OXYGEN IN BOTTOM WATER (depth >= 70 m)

O₂ ml/l



O₂ ml/l



STATION BY4 CHRISTIANSÖ SURFACE WATER (0-10 m)

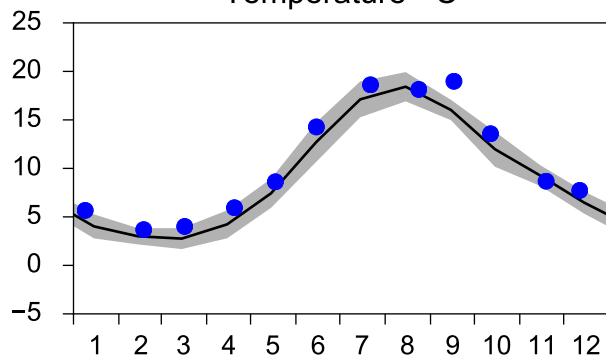
Annual Cycles

— Mean 2001-2015

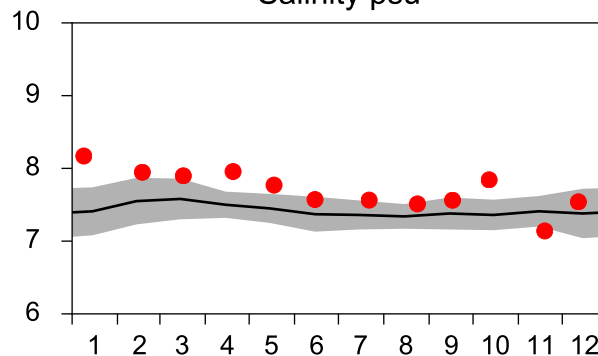
■ St.Dev.

● 2016

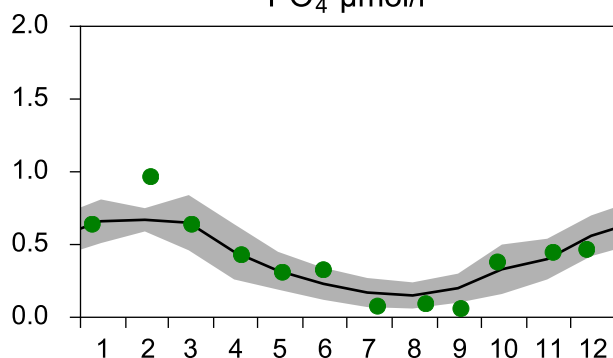
Temperature °C



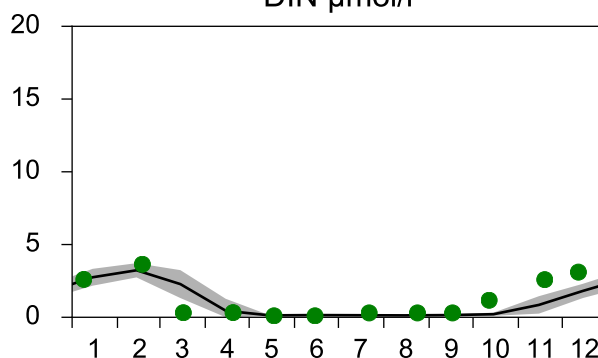
Salinity psu



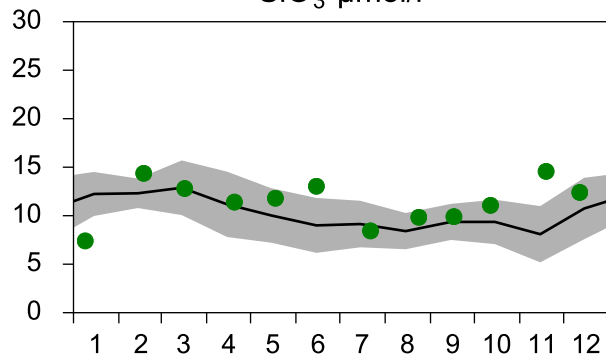
PO₄ µmol/l



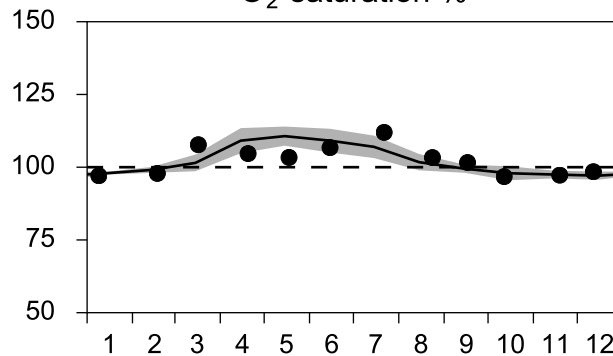
DIN µmol/l



SiO₃ µmol/l

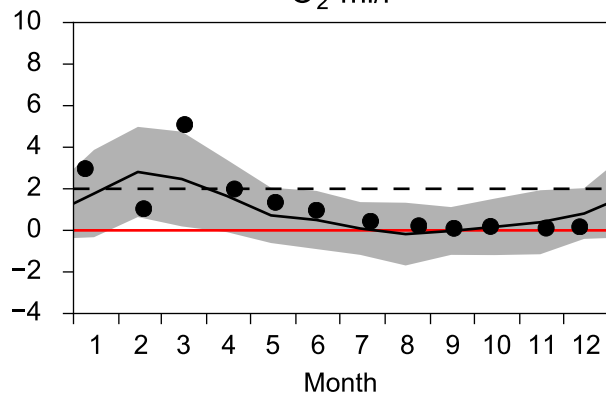


O₂ saturation %

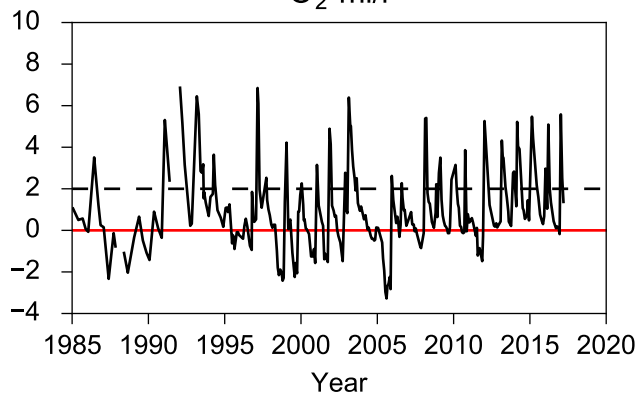


OXYGEN IN BOTTOM WATER (depth >= 80 m)

O₂ ml/l



O₂ ml/l



STATION BY5 BORNHOLMSDJ SURFACE WATER (0-10 m)

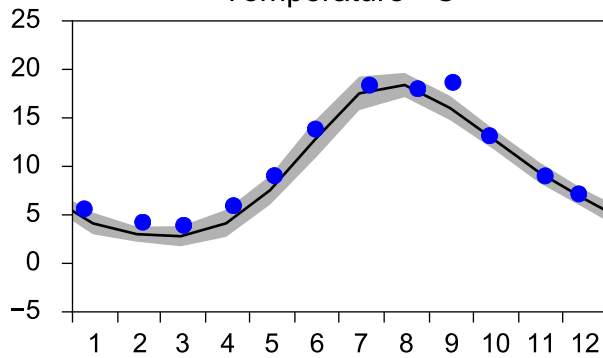
Annual Cycles

— Mean 2001-2015

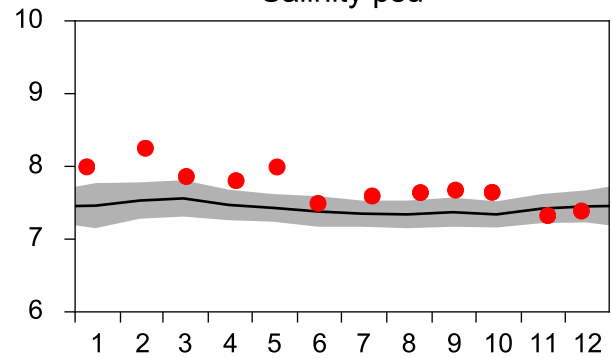
■ St.Dev.

● 2016

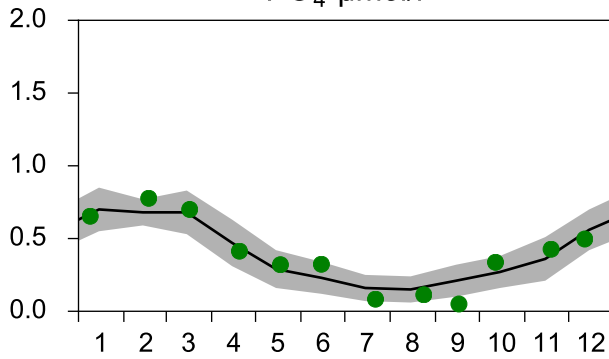
Temperature °C



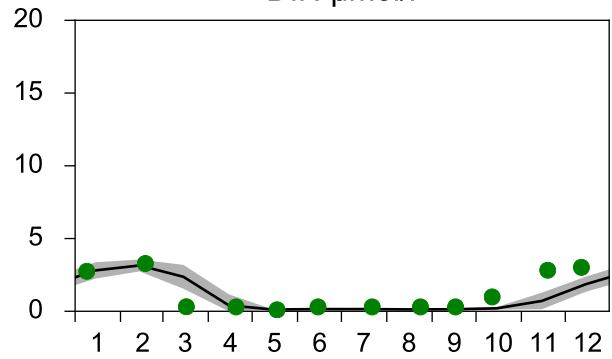
Salinity psu



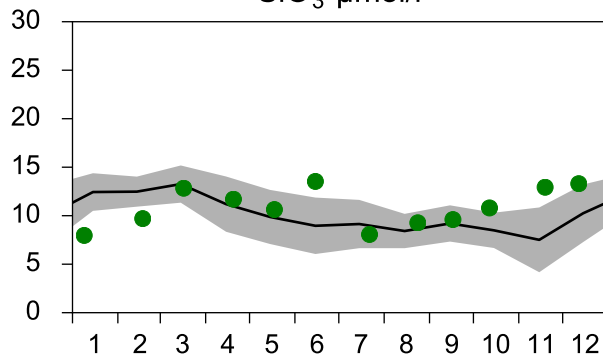
PO₄ μmol/l



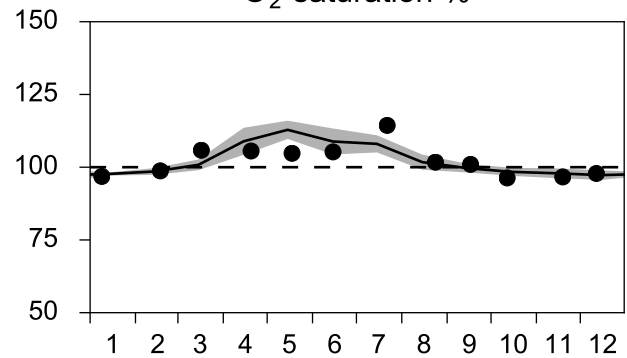
DIN μmol/l



SiO₃ μmol/l

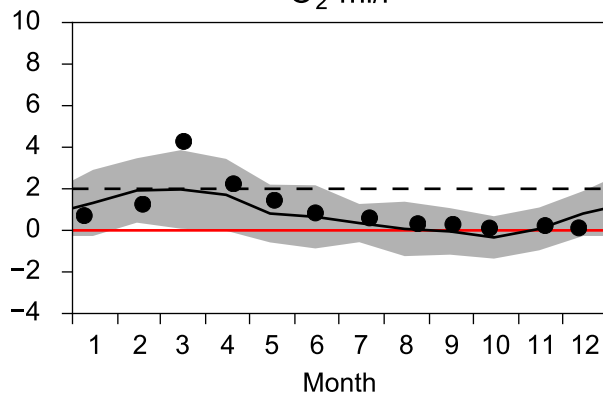


O₂ saturation %

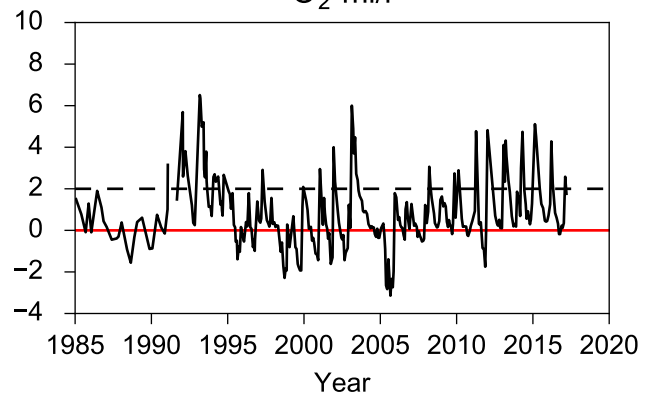


OXYGEN IN BOTTOM WATER (depth >= 80 m)

O₂ ml/l



O₂ ml/l



STATION BCS III-10 SURFACE WATER (0-10 m)

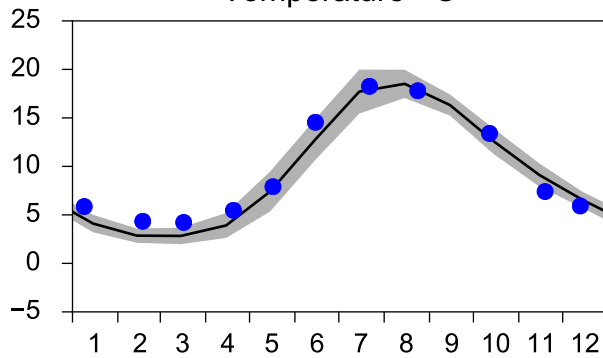
Annual Cycles

— Mean 2001-2015

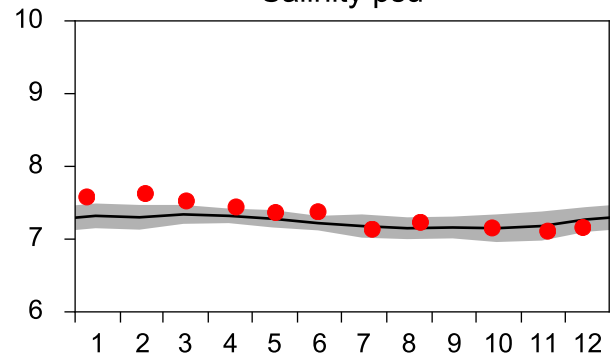
■ St.Dev.

● 2016

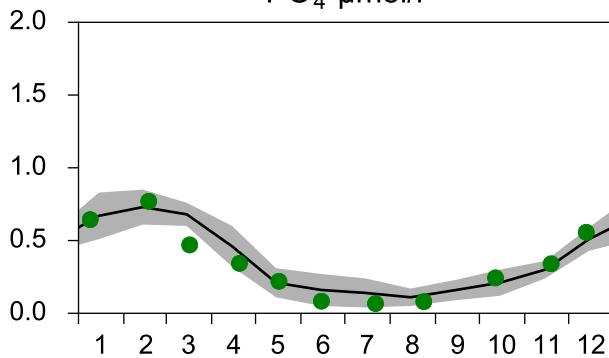
Temperature °C



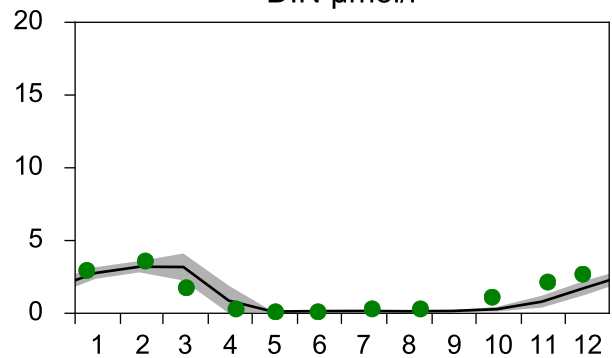
Salinity psu



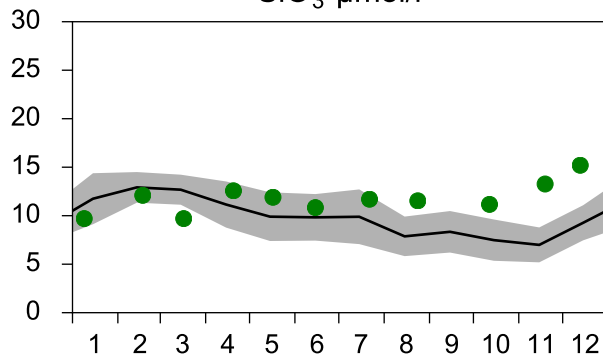
PO₄ µmol/l



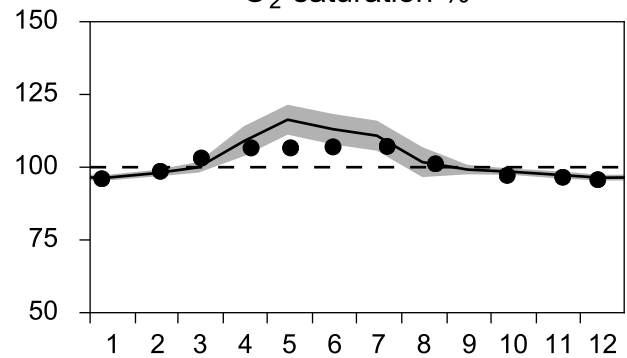
DIN µmol/l



SiO₃ µmol/l

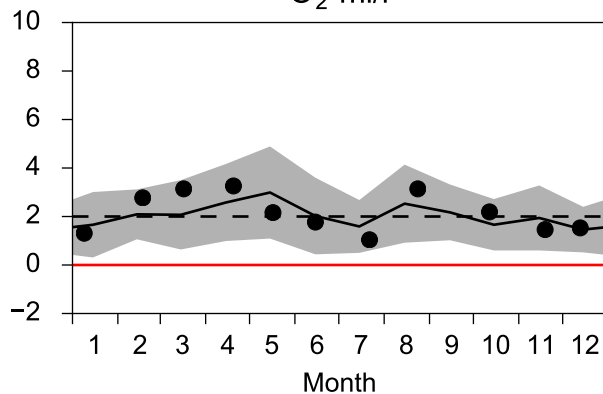


O₂ saturation %

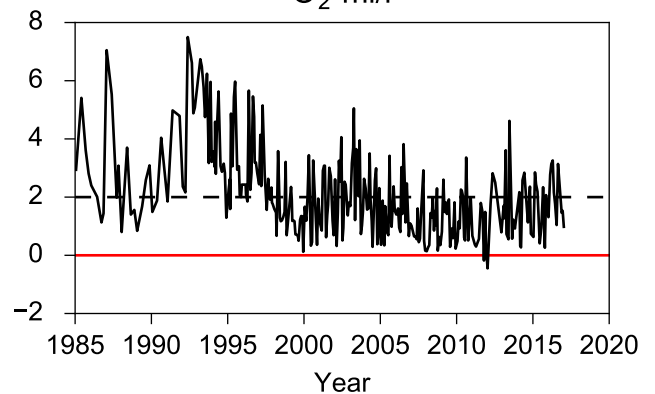


OXYGEN IN BOTTOM WATER (depth >= 80 m)

O₂ ml/l



O₂ ml/l



STATION BY10 SURFACE WATER (0-10 m)

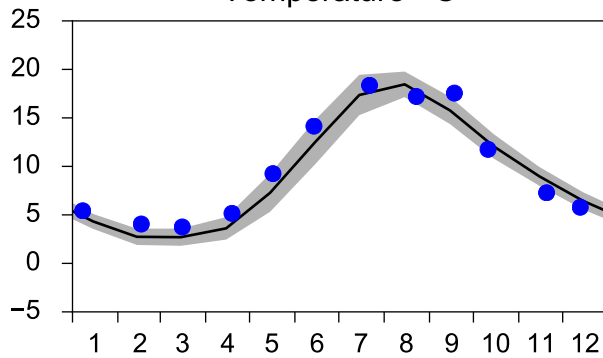
Annual Cycles

— Mean 2001-2015

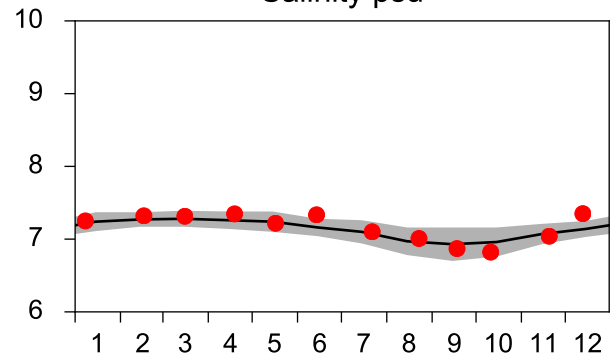
■ St.Dev.

● 2016

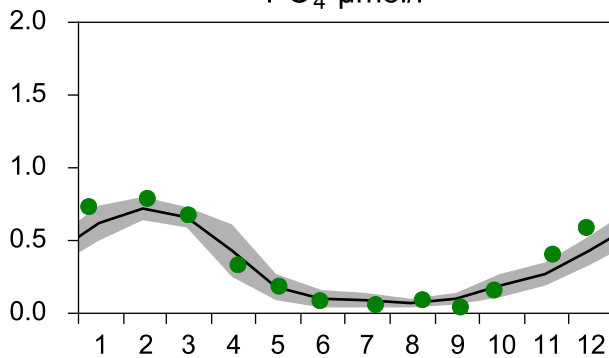
Temperature °C



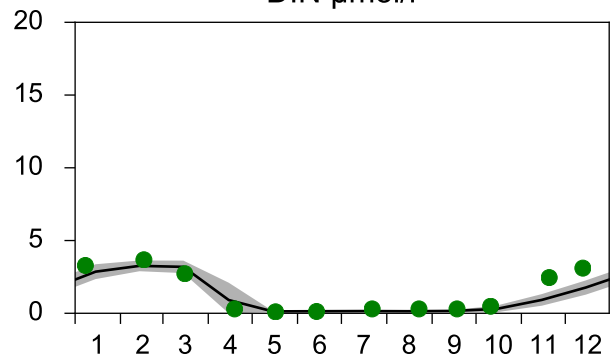
Salinity psu



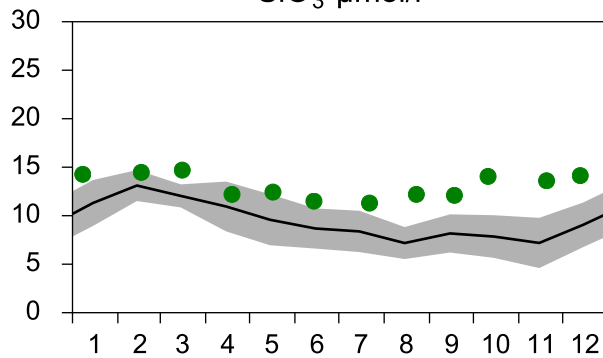
PO₄ µmol/l



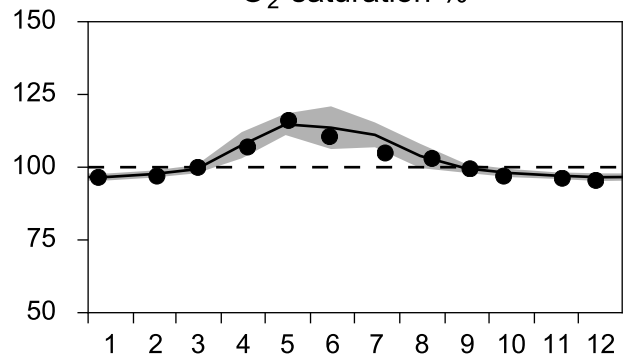
DIN µmol/l



SiO₃ µmol/l

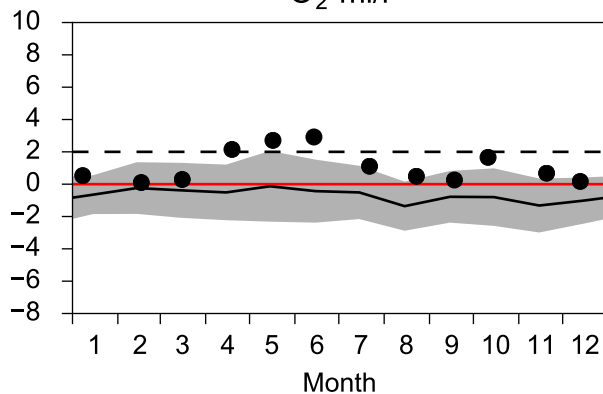


O₂ saturation %

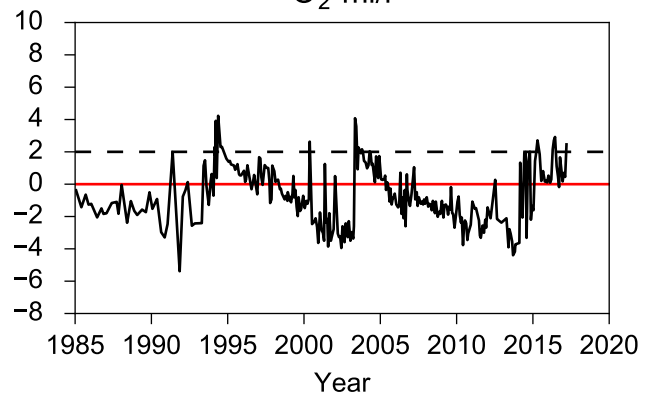


OXYGEN IN BOTTOM WATER (depth >= 125 m)

O₂ ml/l



O₂ ml/l



STATION BY15 GOTLANDSDJ SURFACE WATER (0-10 m)

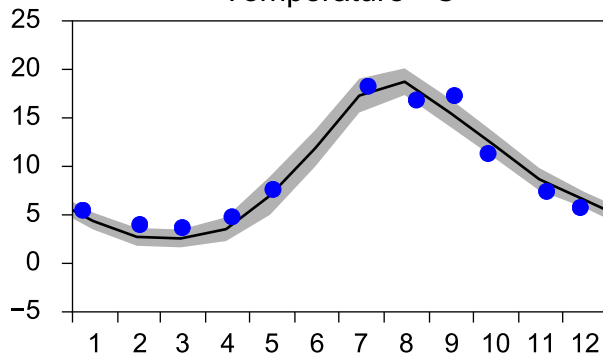
Annual Cycles

— Mean 2001-2015

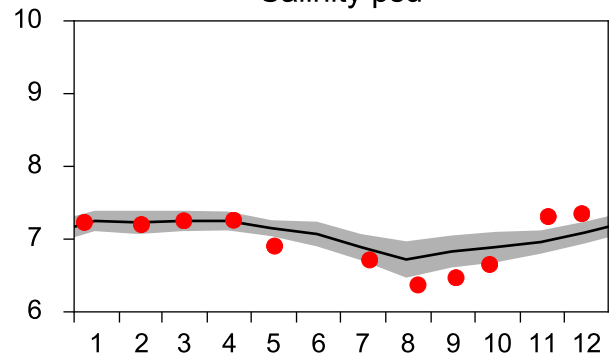
■ St.Dev.

● 2016

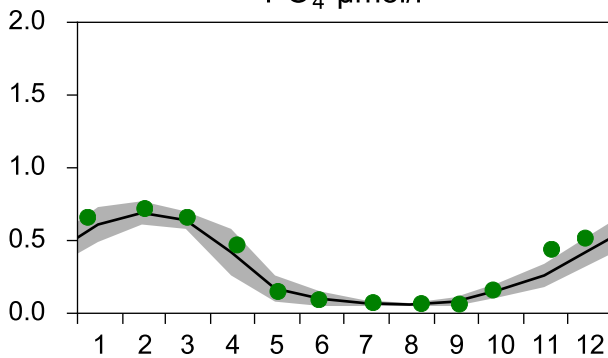
Temperature °C



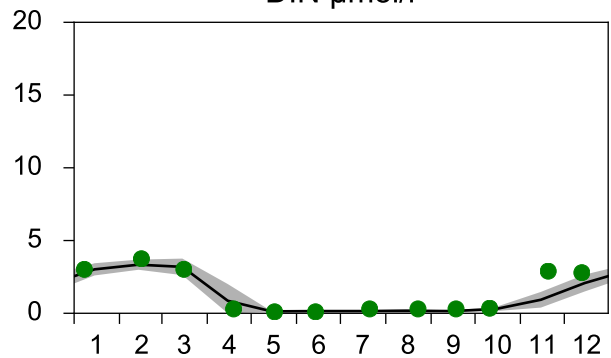
Salinity psu



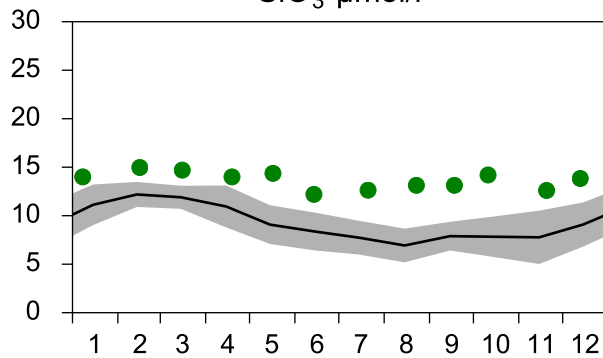
PO₄ μmol/l



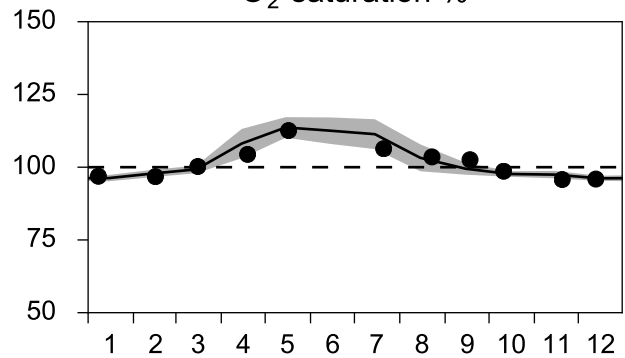
DIN μmol/l



SiO₃ μmol/l

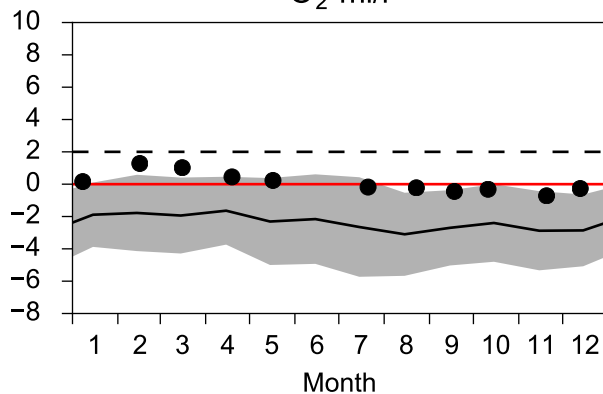


O₂ saturation %

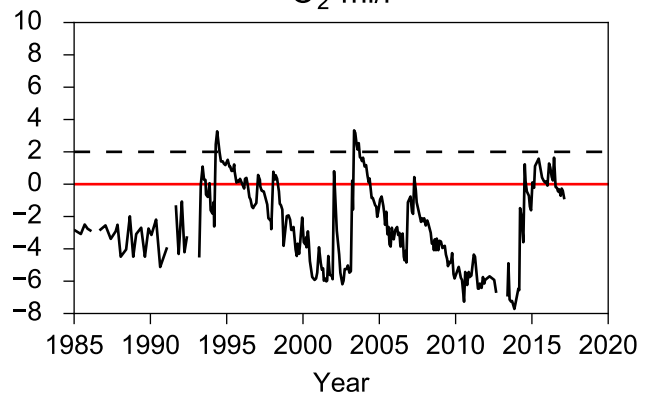


OXYGEN IN BOTTOM WATER (depth >= 225 m)

O₂ ml/l



O₂ ml/l



STATION BY20 FÅRÖDJ SURFACE WATER (0-10 m)

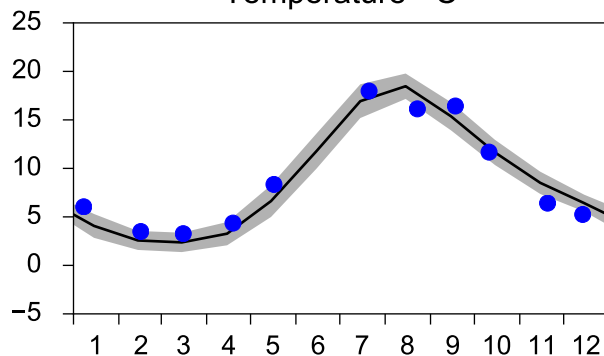
Annual Cycles

— Mean 2001-2015

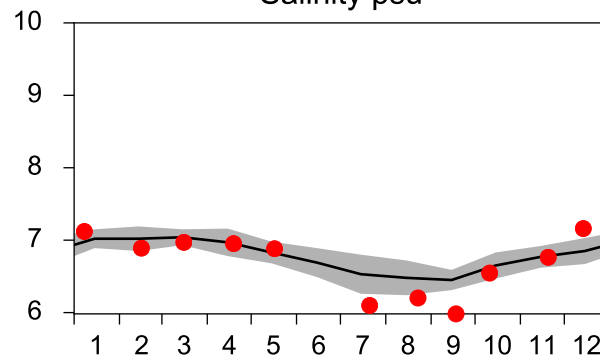
■ St.Dev.

● 2016

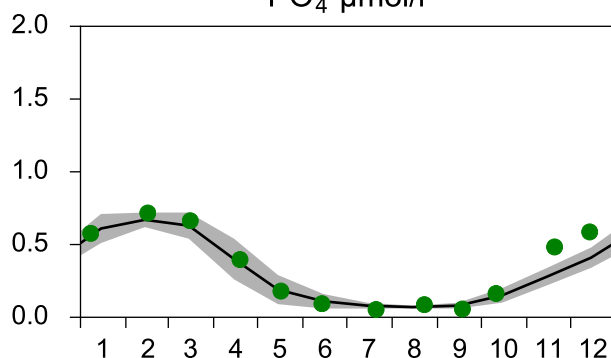
Temperature °C



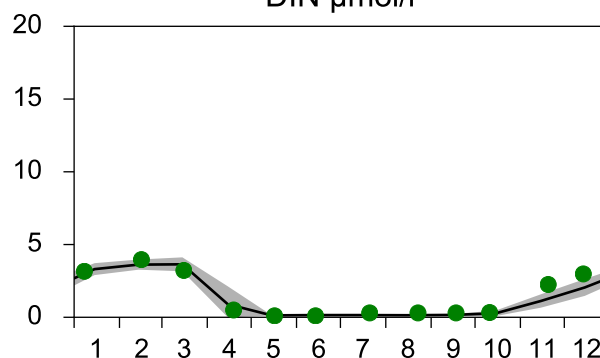
Salinity psu



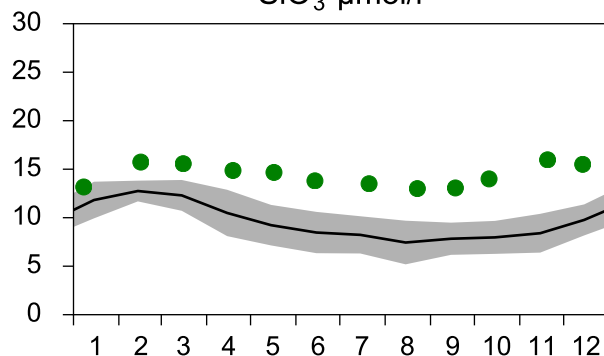
PO₄ μmol/l



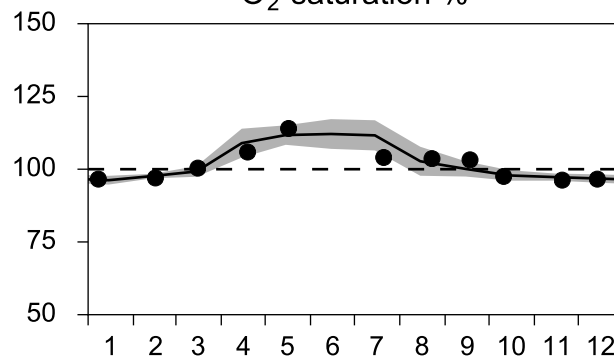
DIN μmol/l



SiO₃ μmol/l

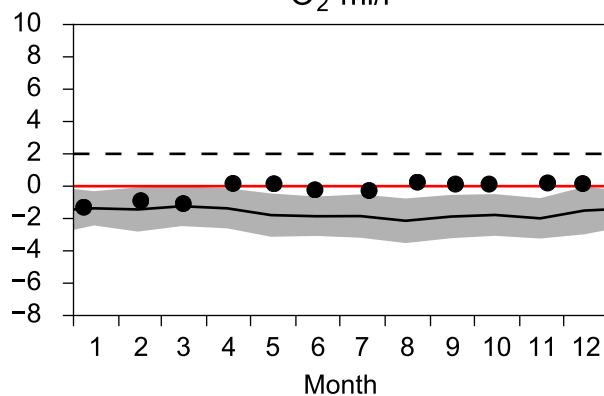


O₂ saturation %

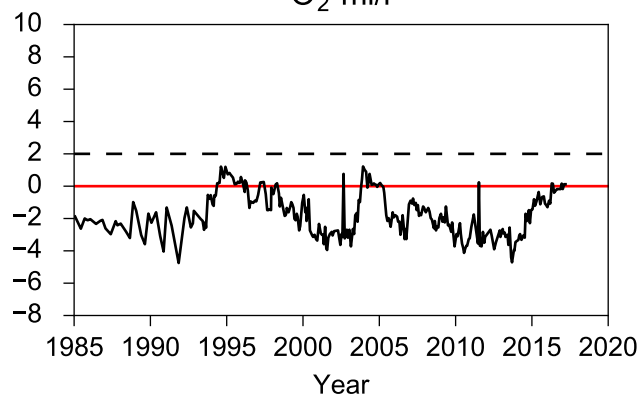


OXYGEN IN BOTTOM WATER (depth >= 175 m)

O₂ ml/l



O₂ ml/l



STATION BY29 / LL19 SURFACE WATER (0-10 m)

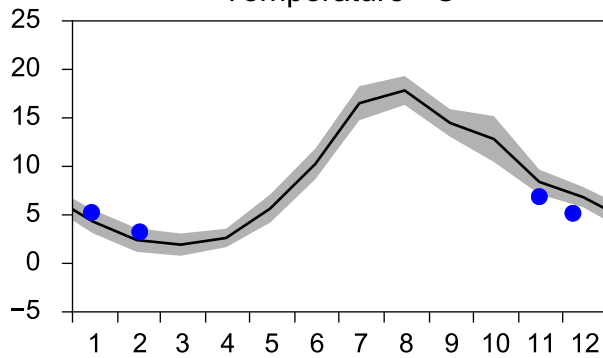
Annual Cycles

— Mean 2001-2015

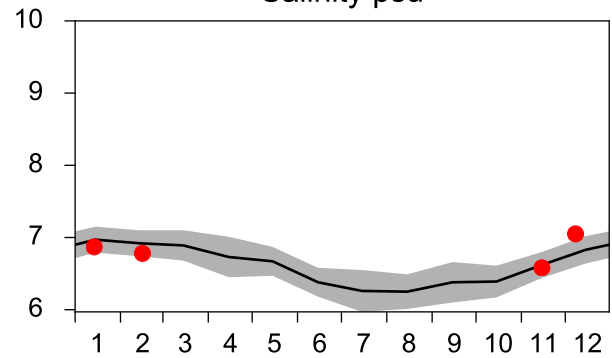
■ St.Dev.

● 2016

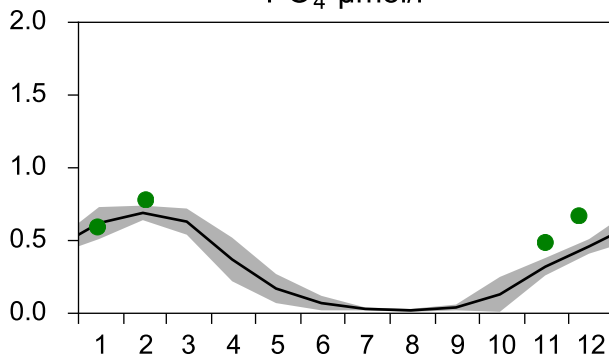
Temperature °C



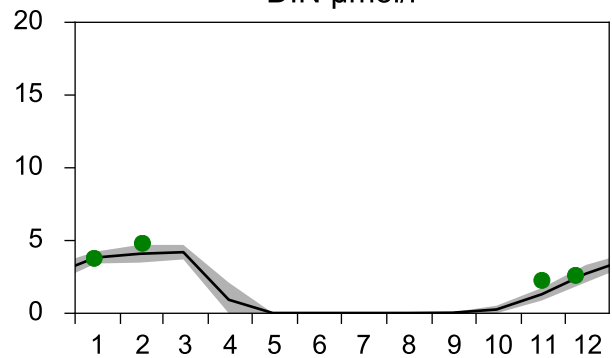
Salinity psu



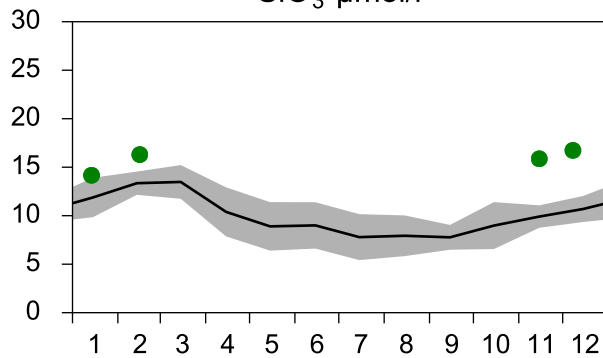
PO₄ μmol/l



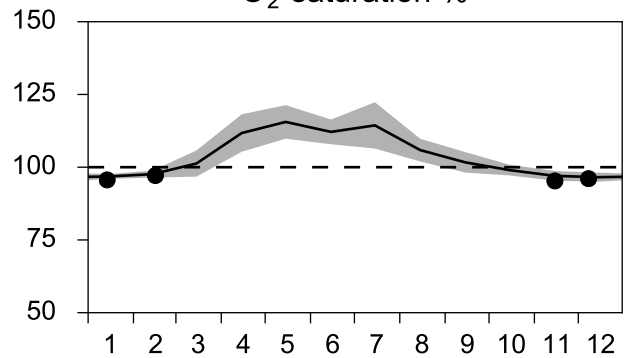
DIN μmol/l



SiO₃ μmol/l

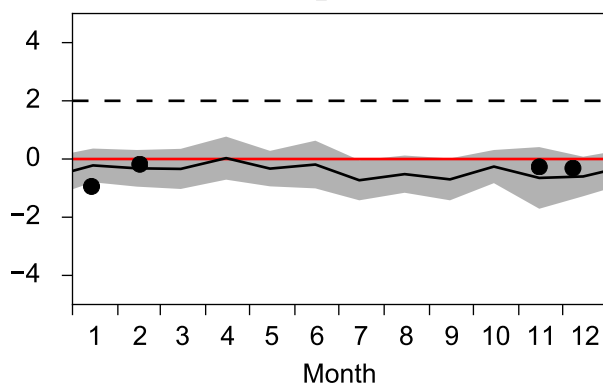


O₂ saturation %

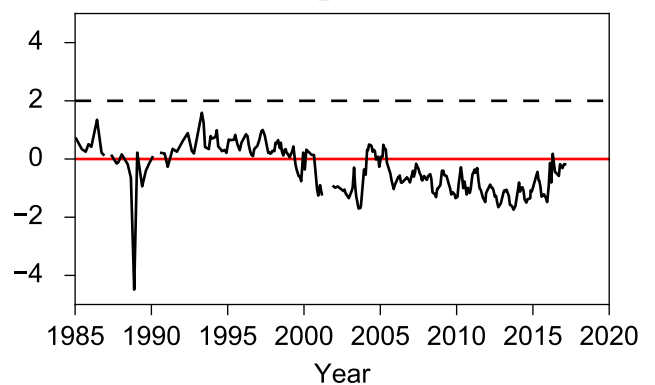


OXYGEN IN BOTTOM WATER (depth >= 150 m)

O₂ ml/l



O₂ ml/l



STATION BY31 LANDSORTSDJ SURFACE WATER (0-10 m)

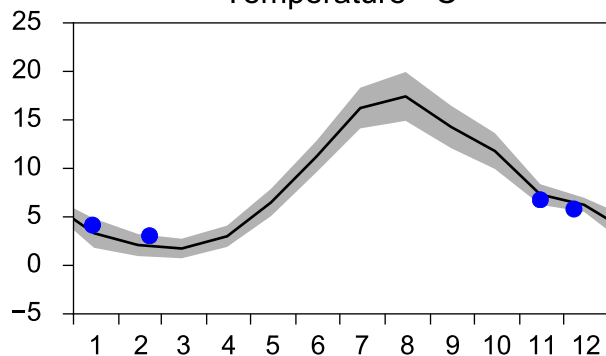
Annual Cycles

— Mean 2001-2015

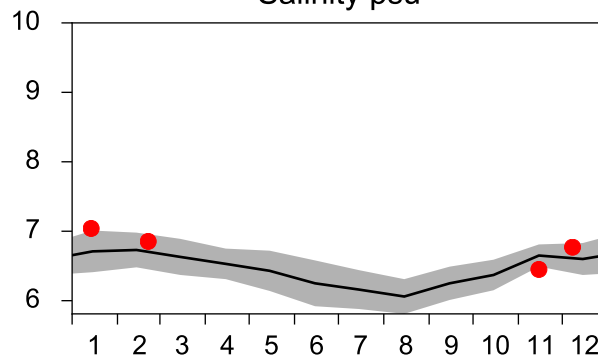
■ St.Dev.

● 2016

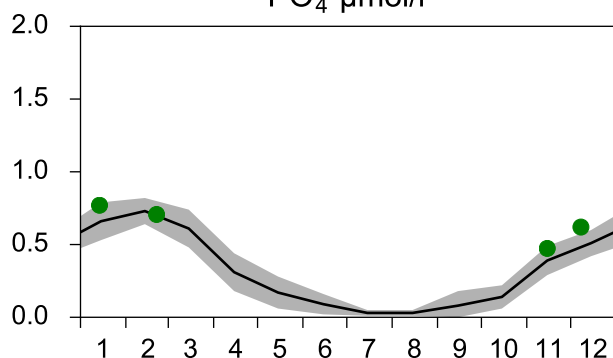
Temperature °C



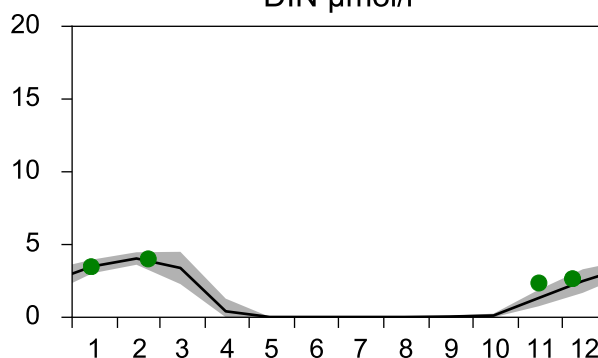
Salinity psu



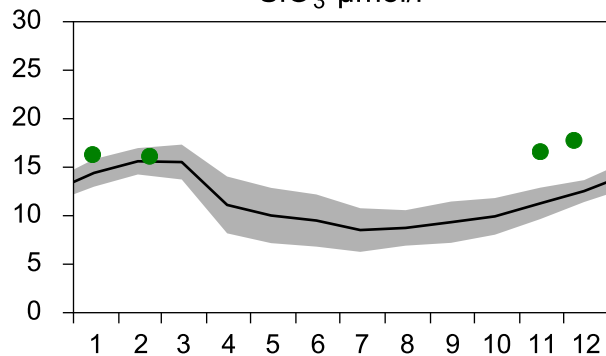
PO₄ μmol/l



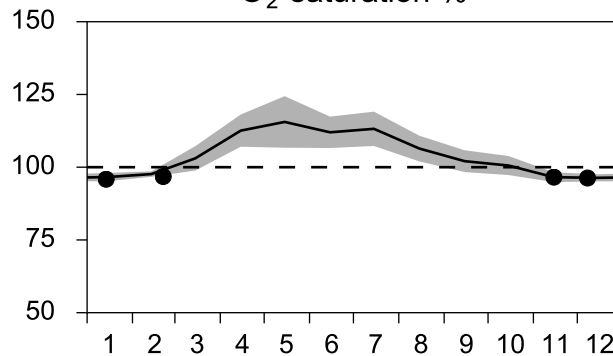
DIN μmol/l



SiO₃ μmol/l

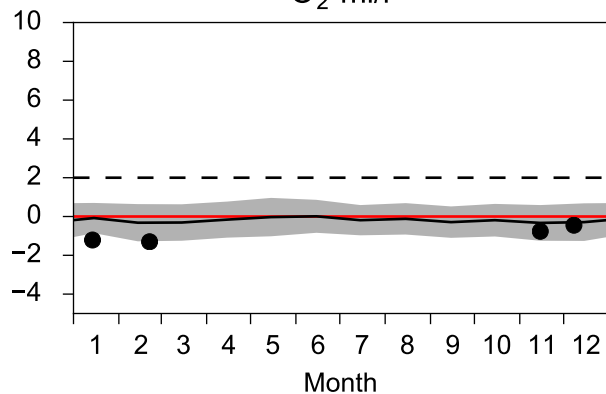


O₂ saturation %

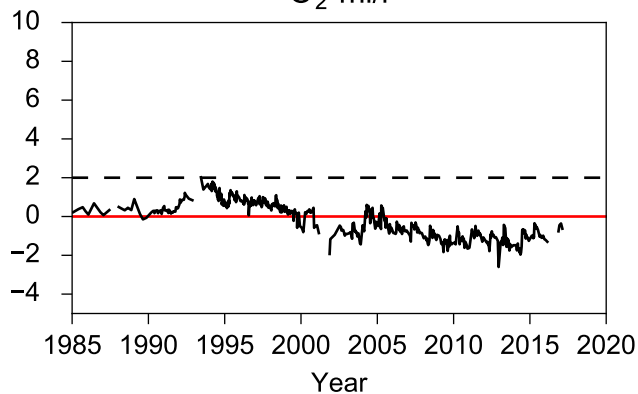


OXYGEN IN BOTTOM WATER (depth >= 425 m)

O₂ ml/l



O₂ ml/l



STATION BY32 NORRKÖPINGSDJ SURFACE WATER (0-10 m)

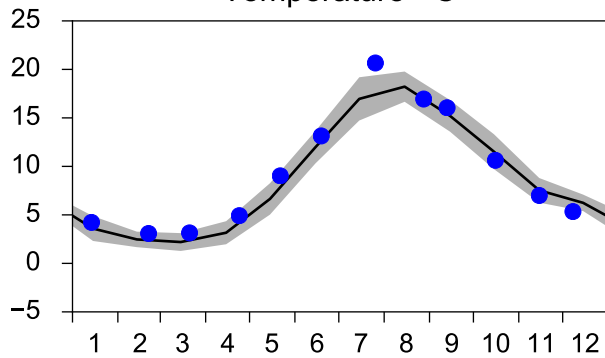
Annual Cycles

— Mean 2001-2015

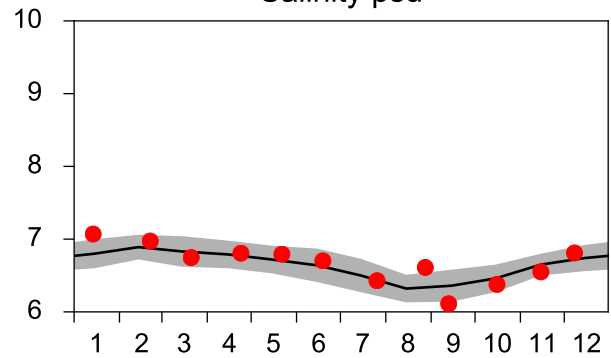
■ St.Dev.

● 2016

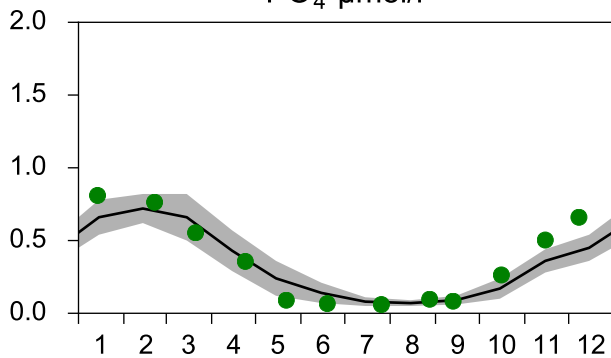
Temperature °C



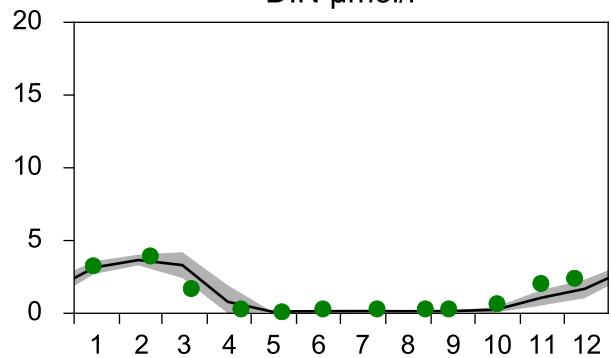
Salinity psu



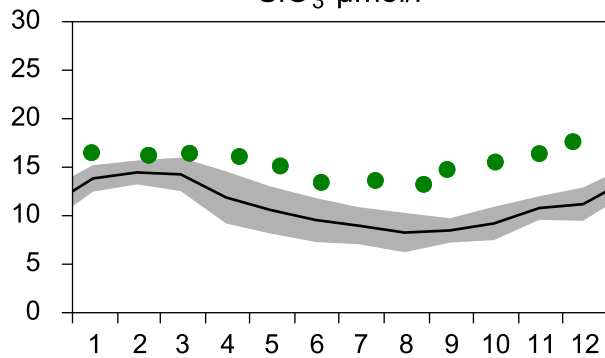
PO₄ µmol/l



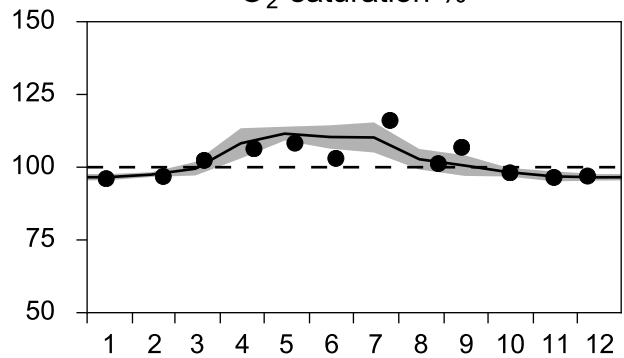
DIN µmol/l



SiO₃ µmol/l

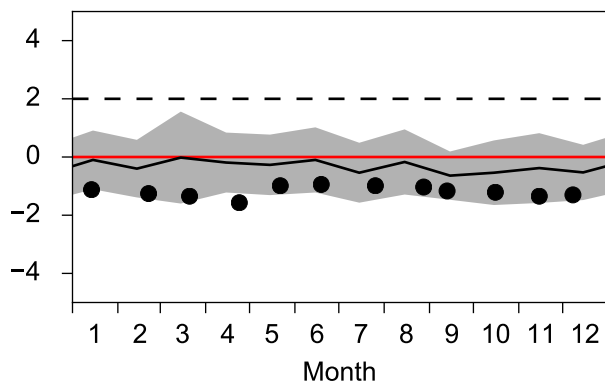


O₂ saturation %

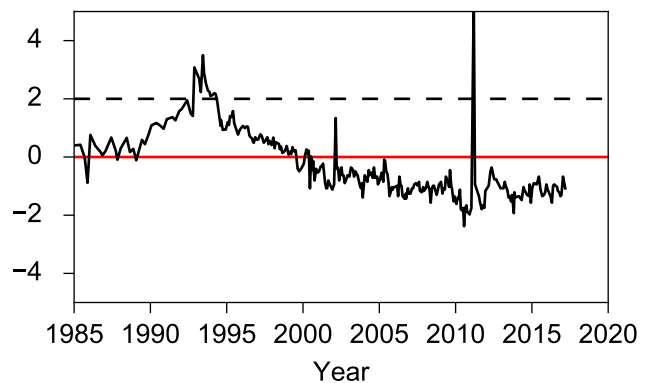


OXYGEN IN BOTTOM WATER (depth >= 175 m)

O₂ ml/l



O₂ ml/l



STATION BY38 KARLSÖDJ SURFACE WATER (0-10 m)

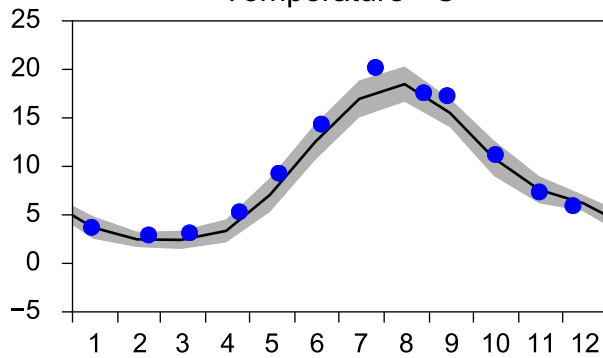
Annual Cycles

— Mean 2001-2015

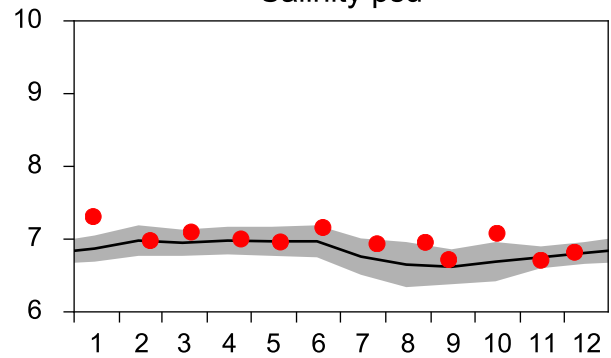
■ St.Dev.

● 2016

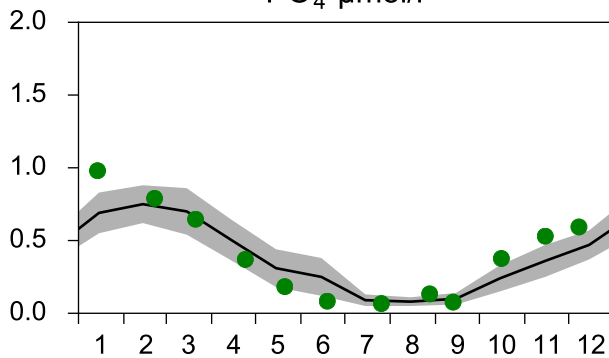
Temperature °C



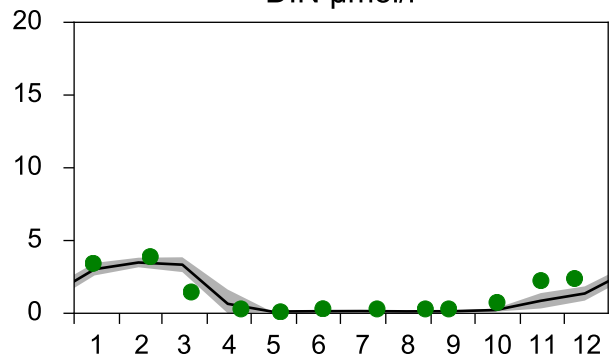
Salinity psu



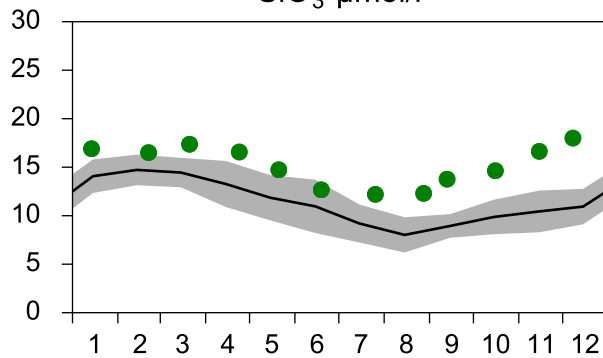
PO₄ µmol/l



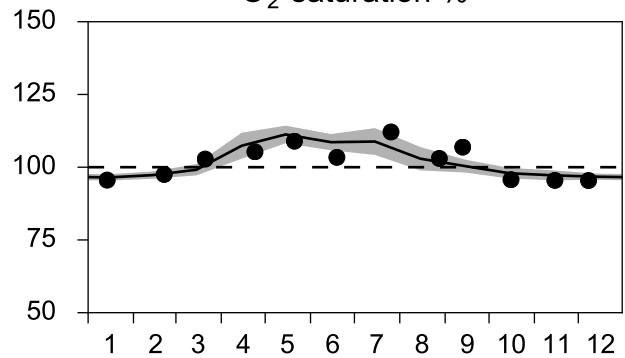
DIN µmol/l



SiO₃ µmol/l

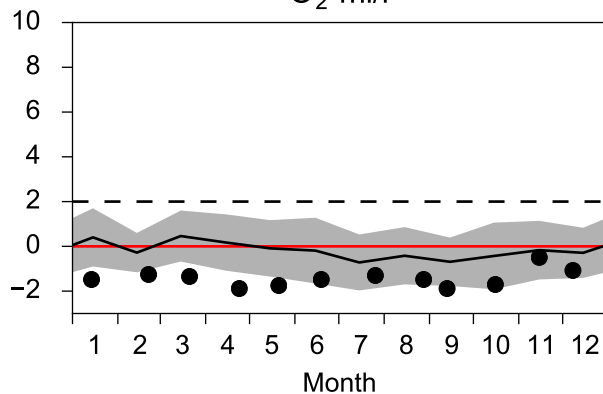


O₂ saturation %

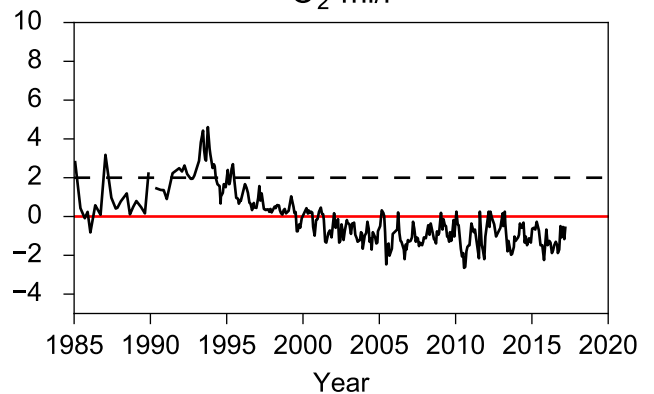


OXYGEN IN BOTTOM WATER (depth >= 100 m)

O₂ ml/l



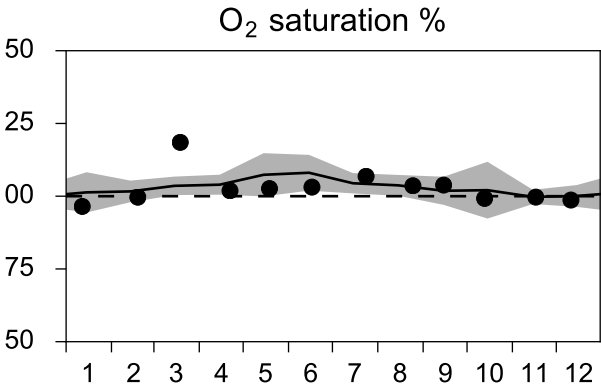
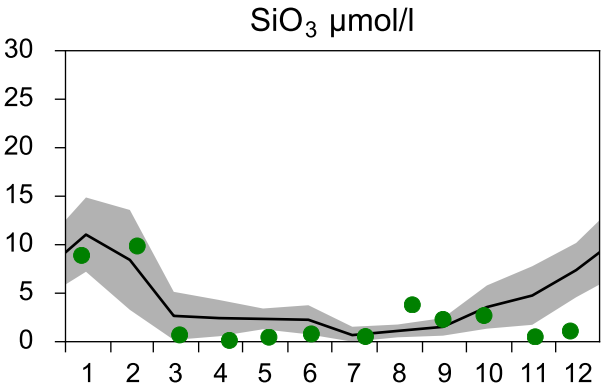
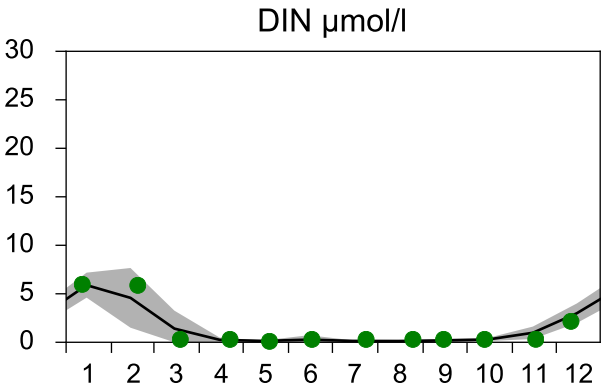
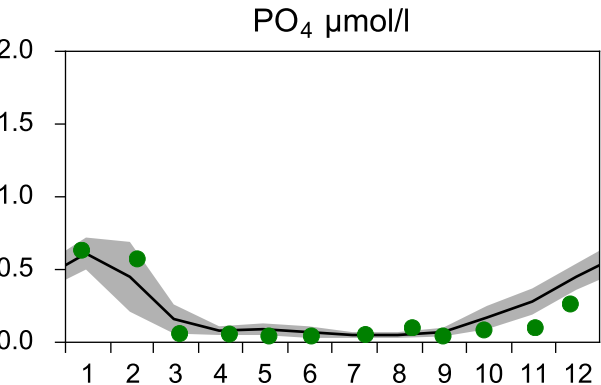
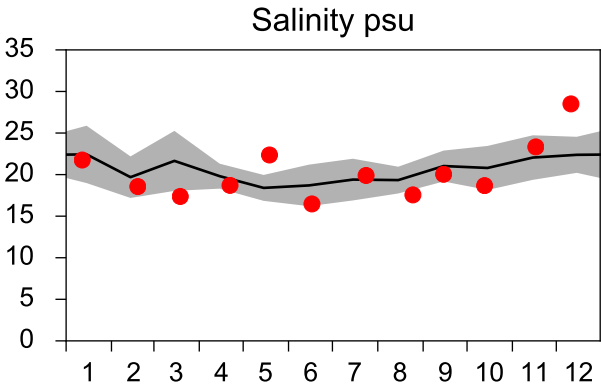
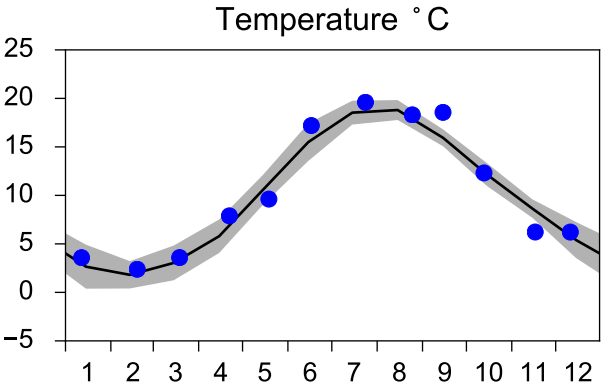
O₂ ml/l



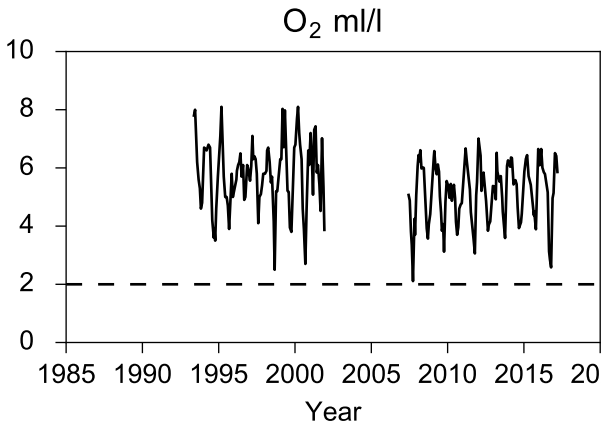
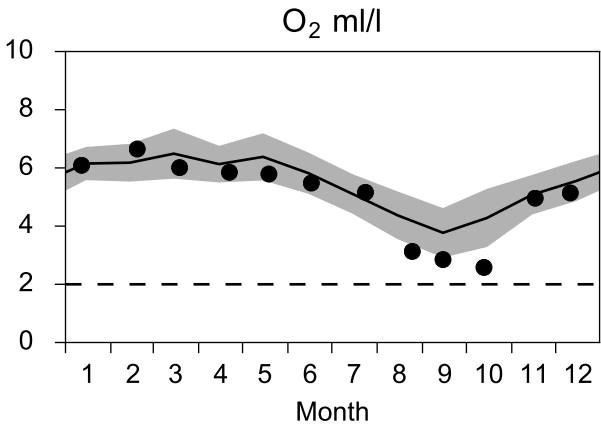
STATION N14 FALKENBERG SURFACE WATER (0-10 m)

Annual Cycles

— Mean 2001-2015 St.Dev. ● 2016



OXYGEN IN BOTTOM WATER (depth >= 25 m)



STATION REF M1V1 SURFACE WATER (0-10 m)

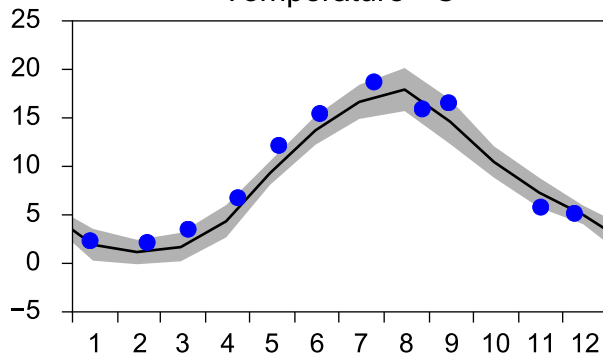
Annual Cycles

— Mean 2001-2015

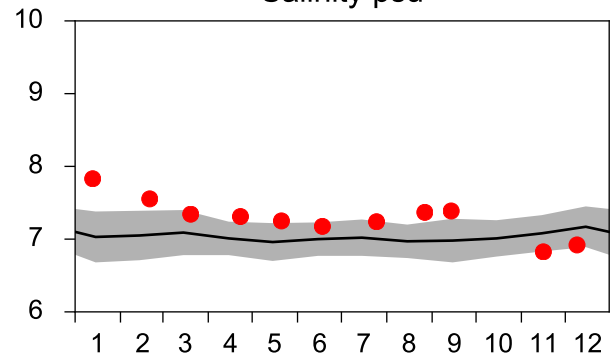
■ St.Dev.

● 2016

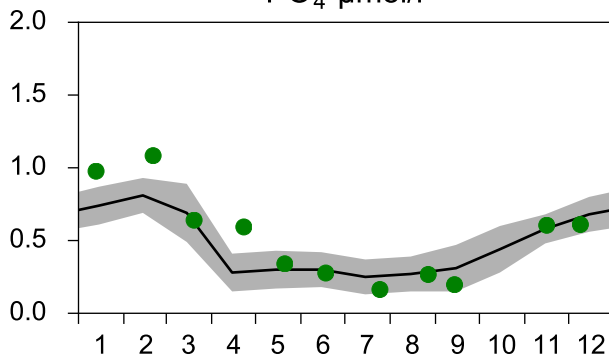
Temperature °C



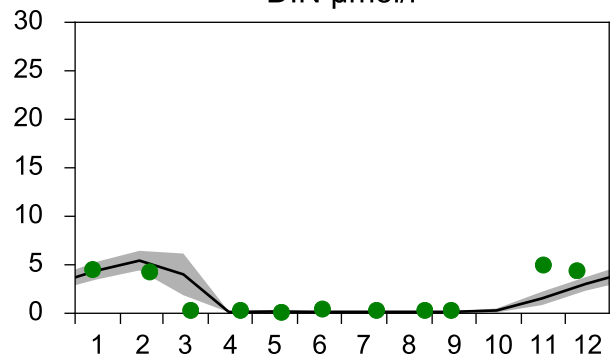
Salinity psu



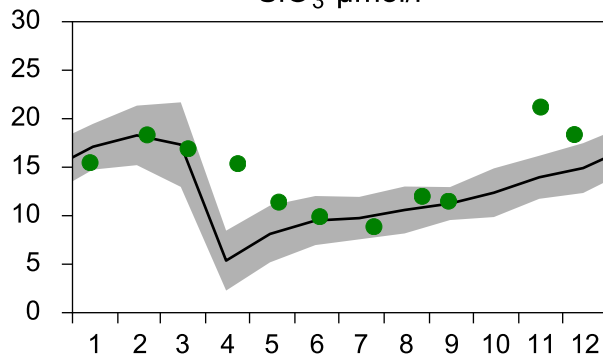
PO₄ µmol/l



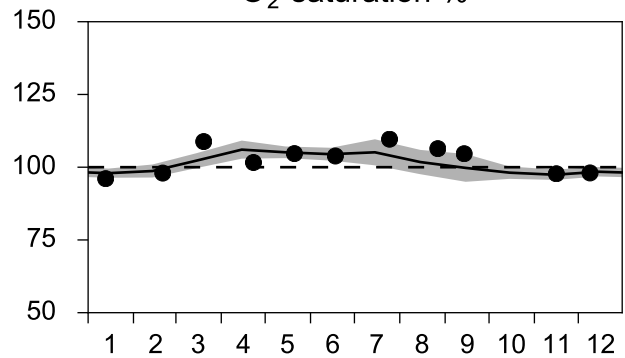
DIN µmol/l



SiO₃ µmol/l

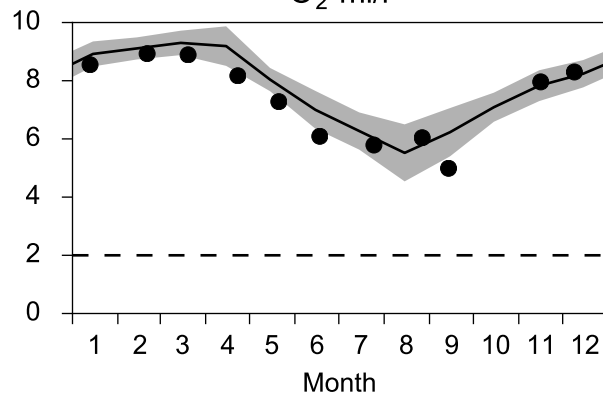


O₂ saturation %

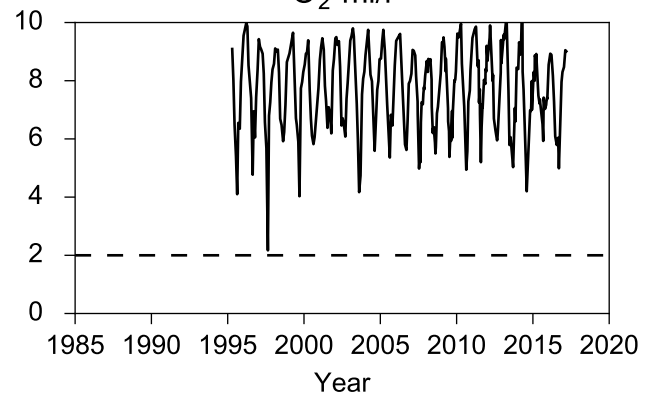


OXYGEN IN BOTTOM WATER (depth >= 17 m)

O₂ ml/l



O₂ ml/l

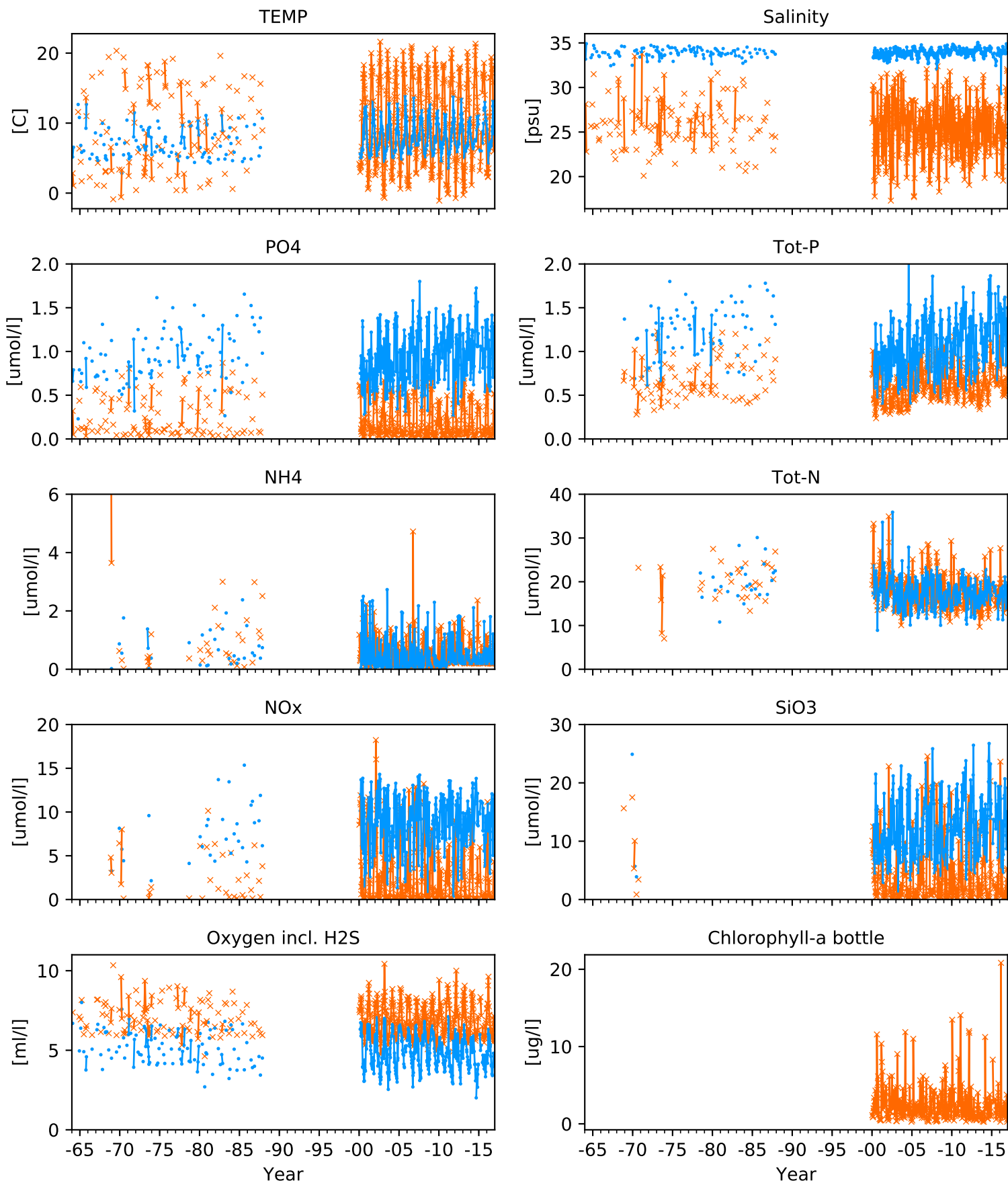


Appendix II

Time series of surface and bottom waters

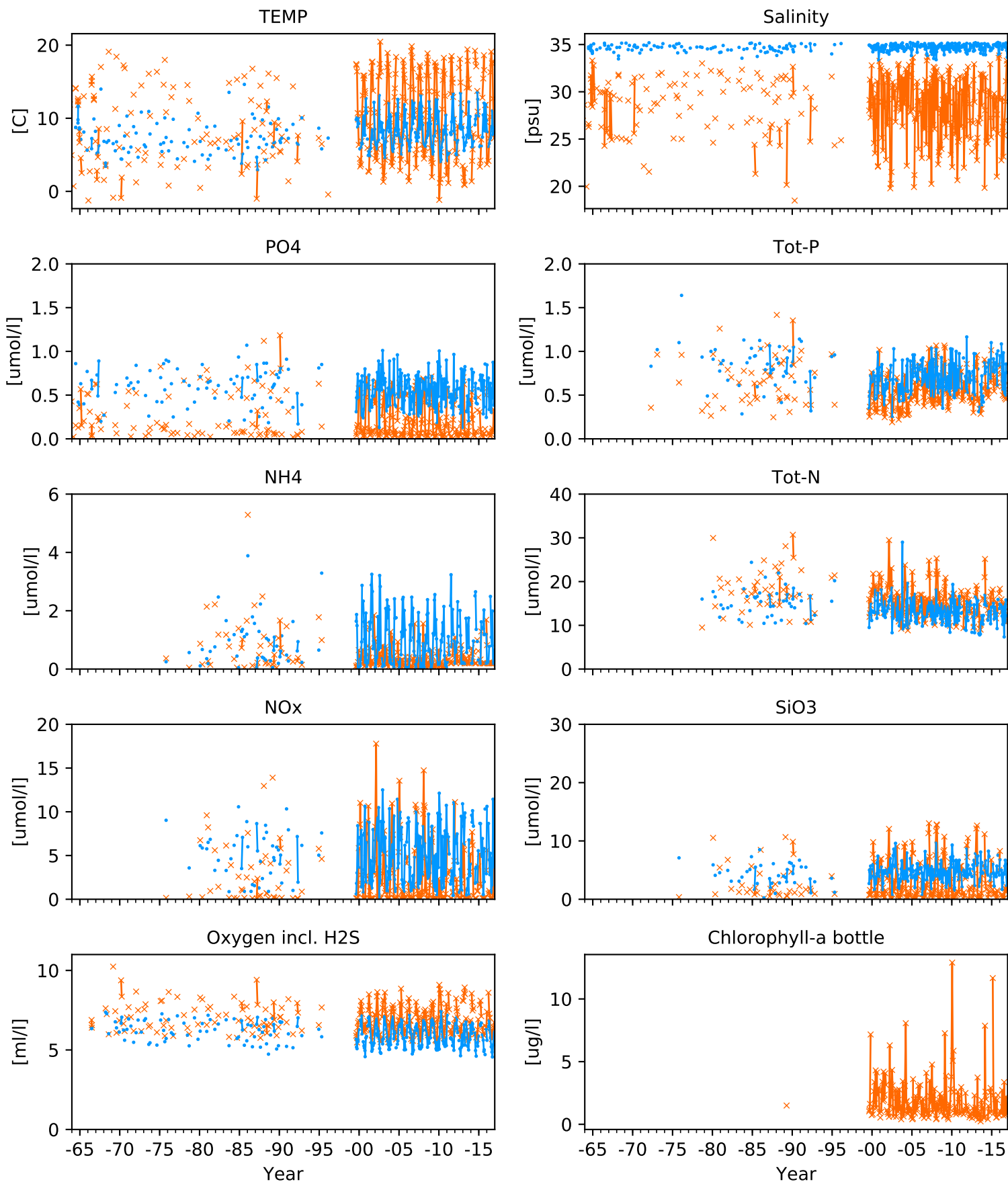
SKAGERAK: SLÄGGÖ

— 0-10 m — ≥ 50 m



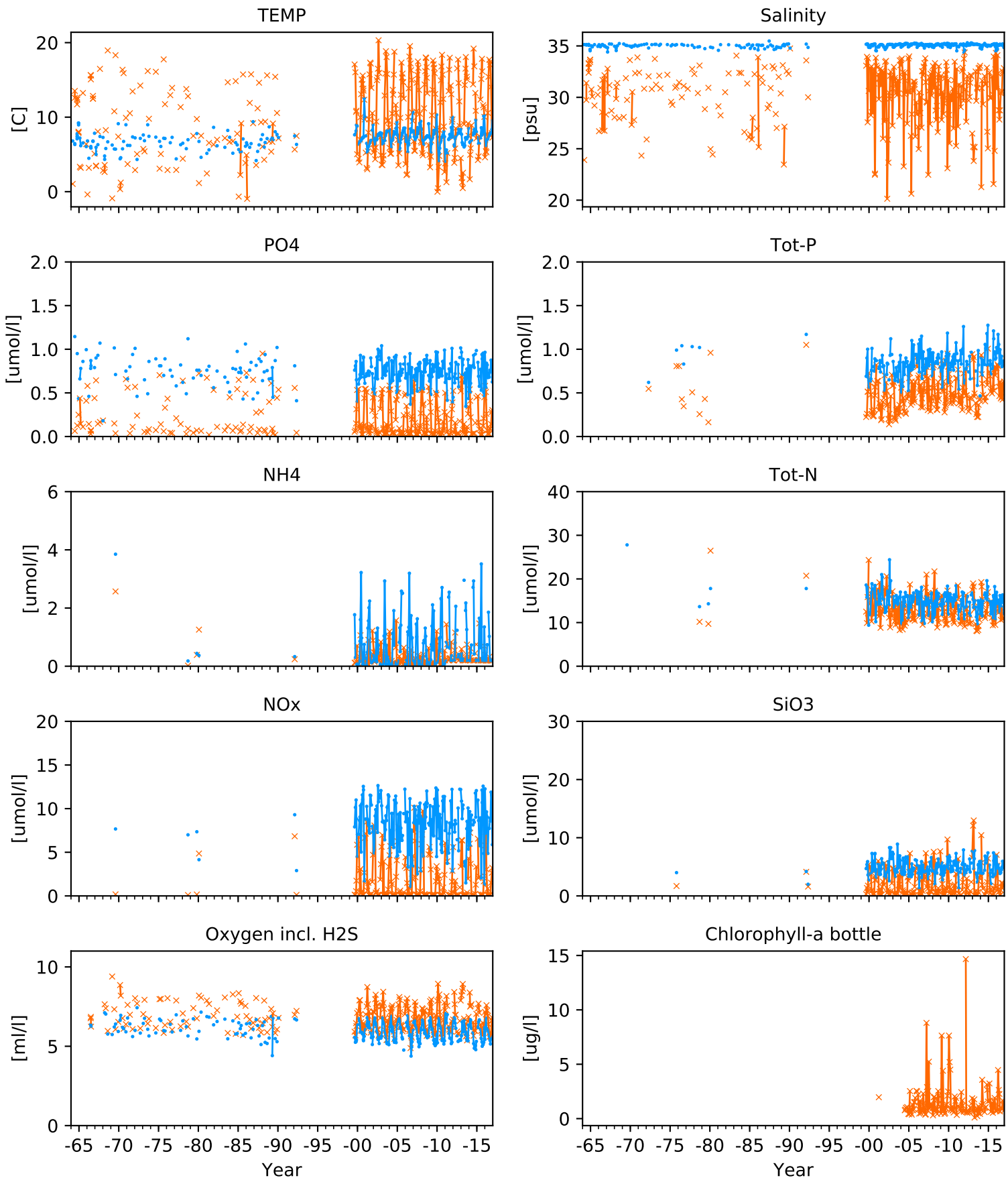
SKAGERAK: Å13

0-10 m ≥ 75 m



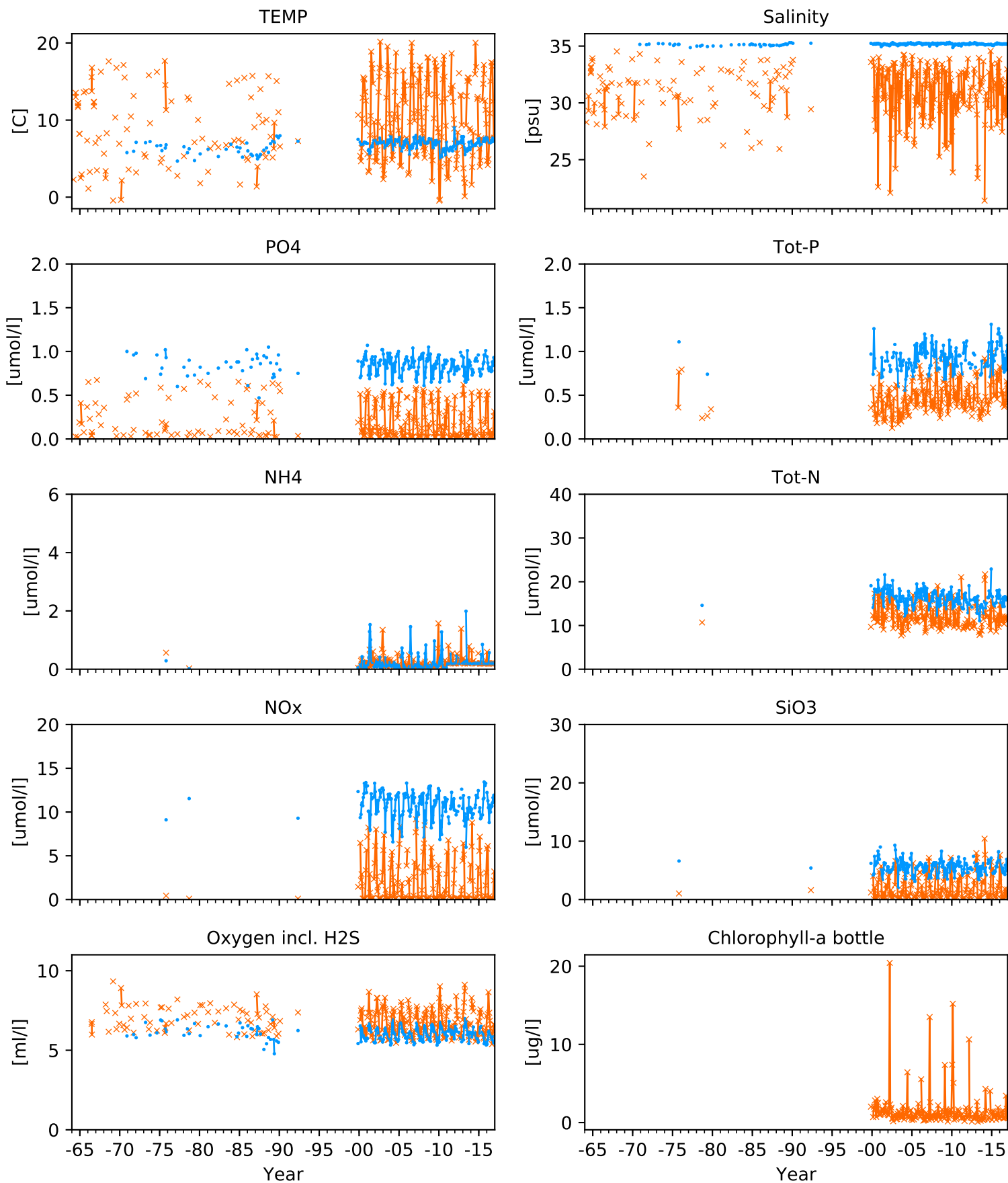
SKAGERAK: Å15

— 0-10 m — ≥ 125 m



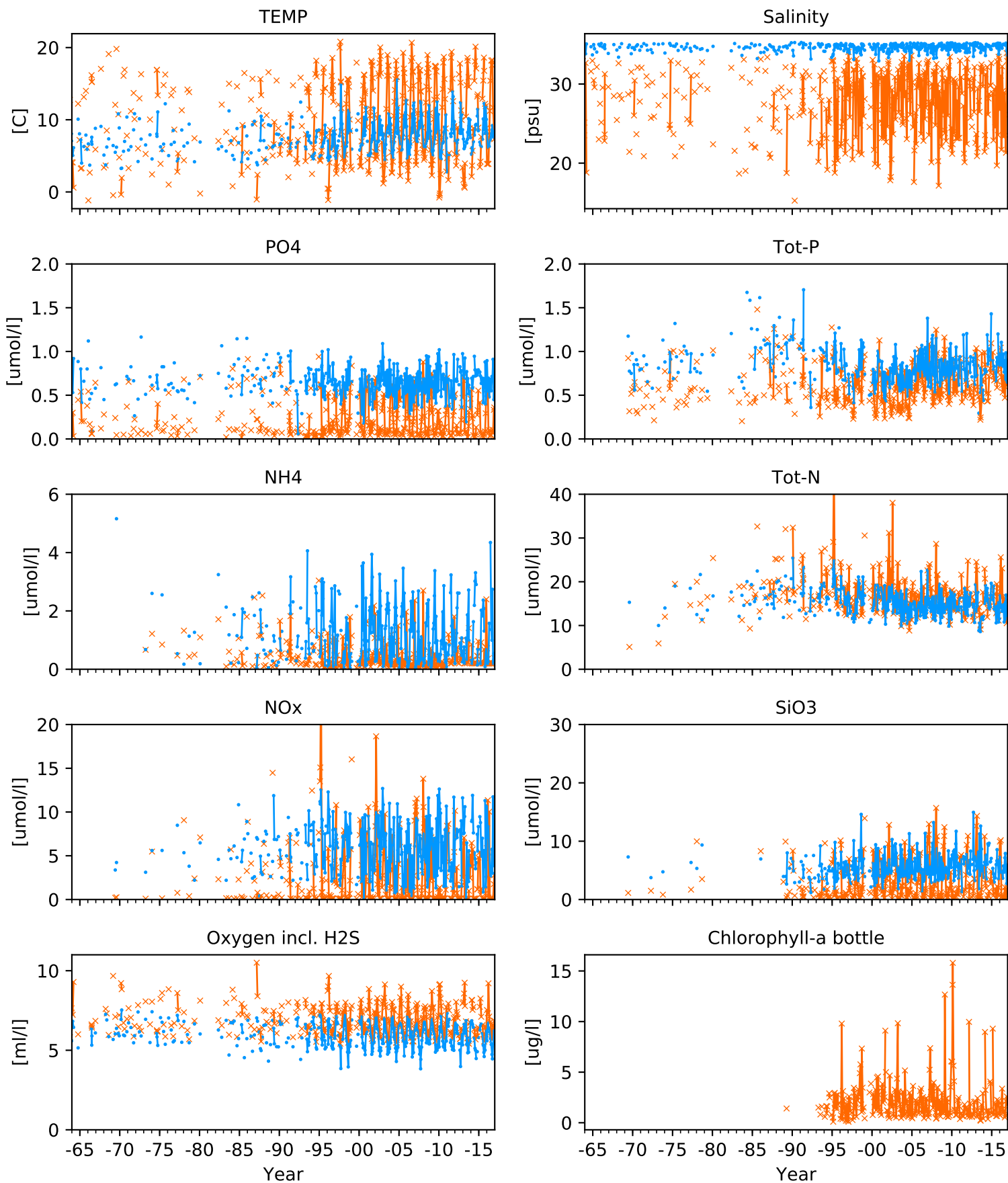
SKAGERAK: Å17

— 0-10 m — ≥ 300 m



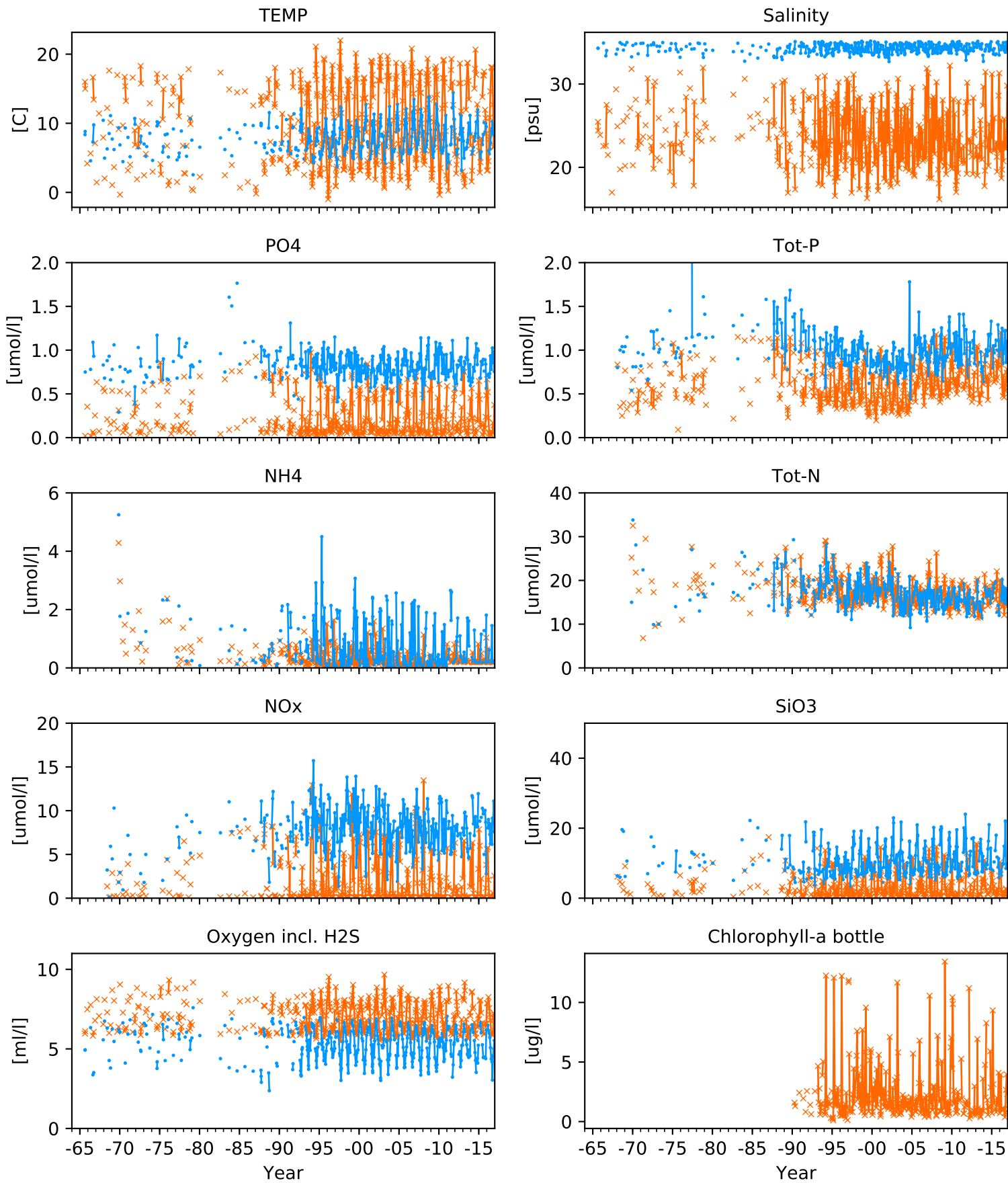
SKAGERAK: P2

0-10 m ≥ 75 m



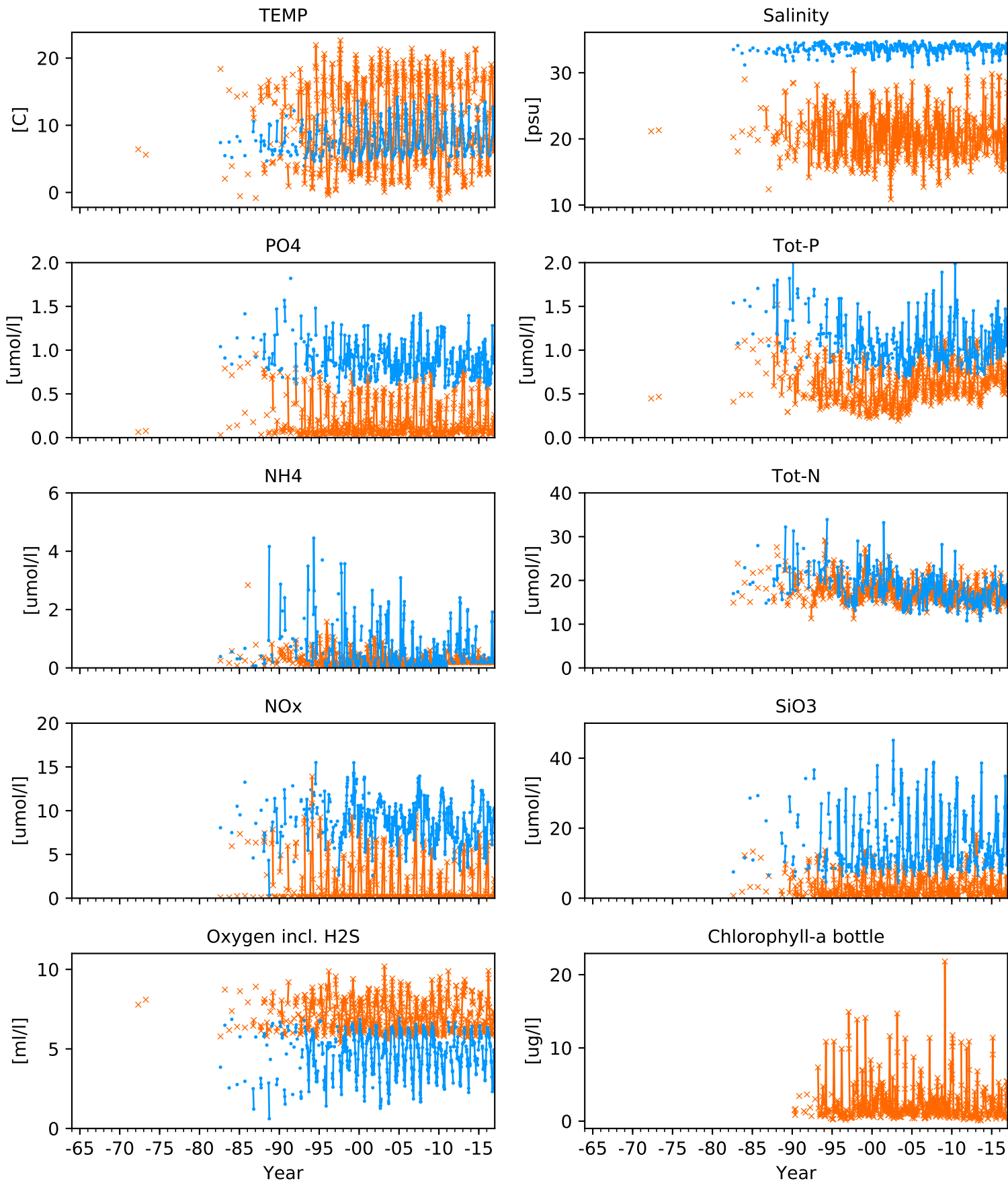
KATTEGAT: FLADEN

— 0-10 m — ≥ 70 m



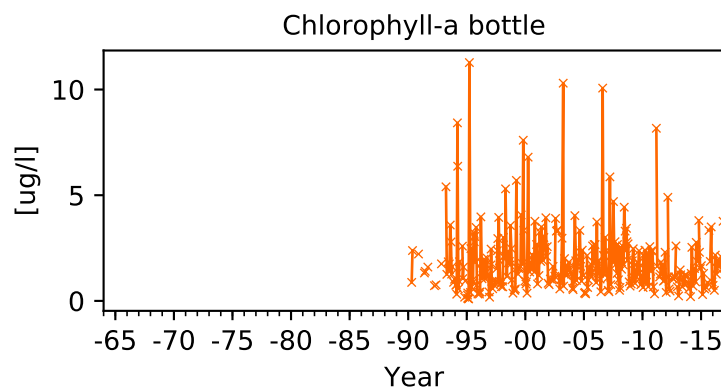
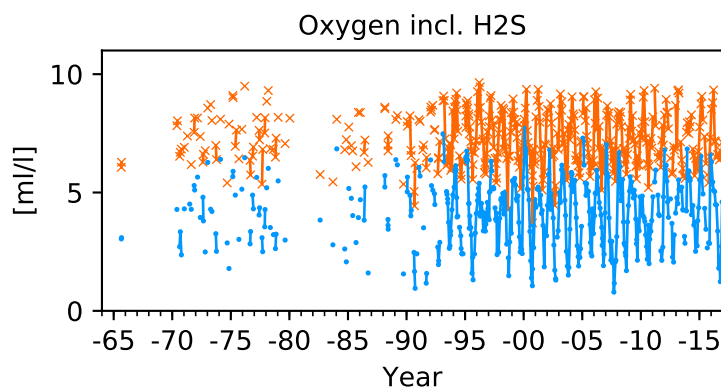
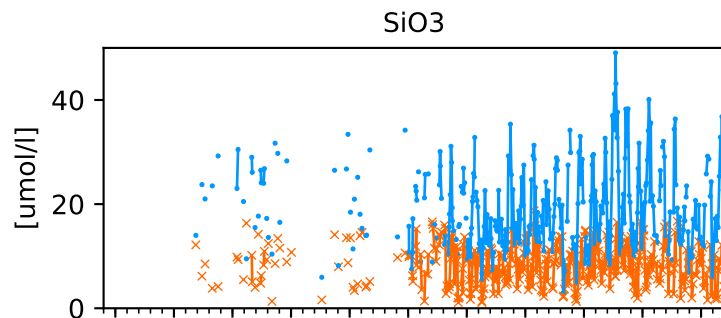
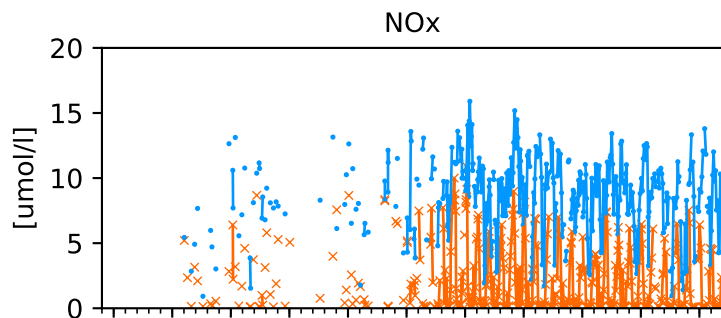
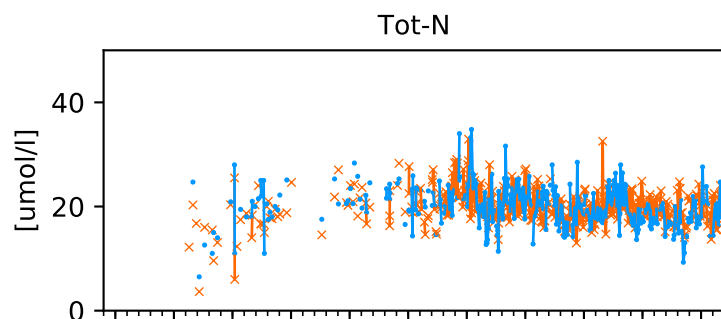
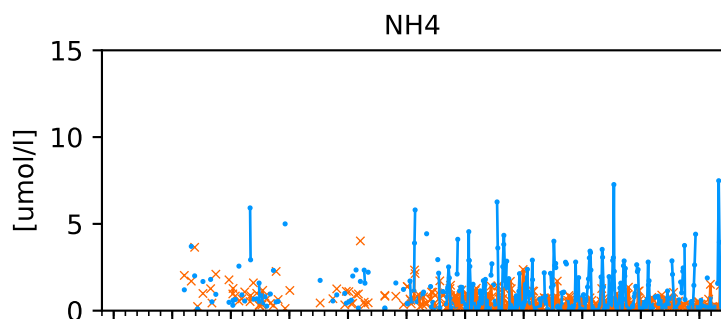
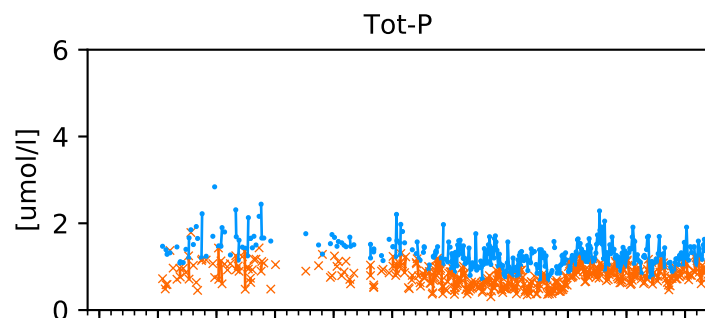
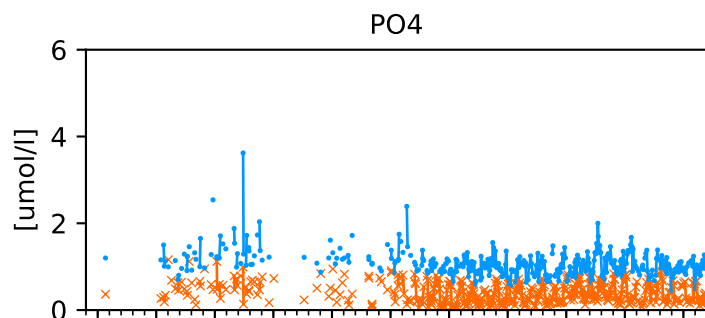
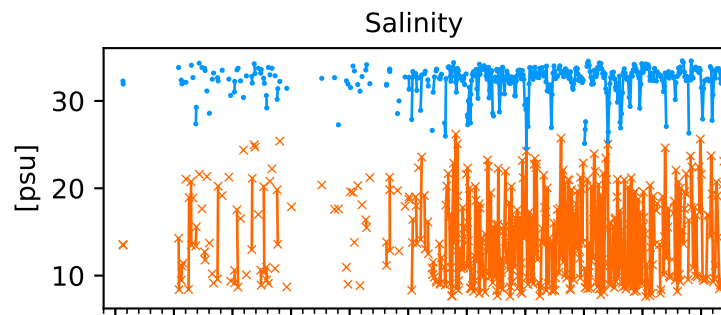
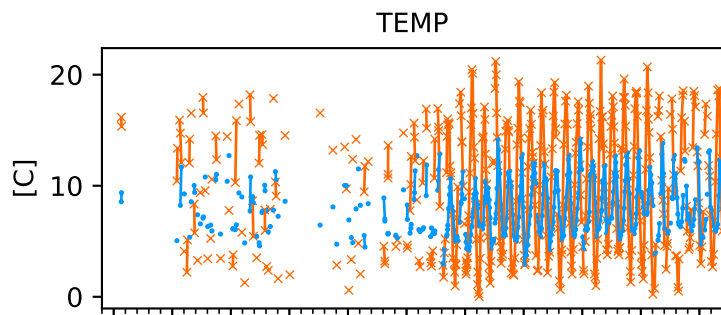
KATTEGAT: ANHOLT E

— 0-10 m — ≥ 50 m



THE SOUND: W LANDSKRONA

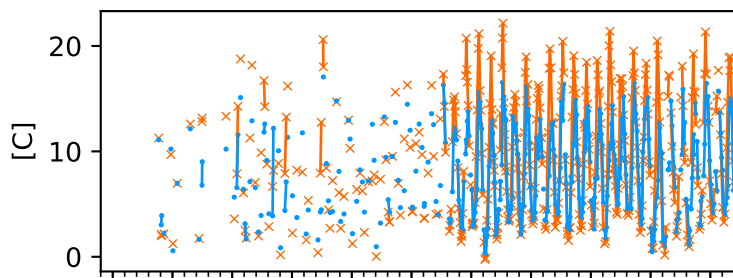
— 0-10 m — ≥ 40 m



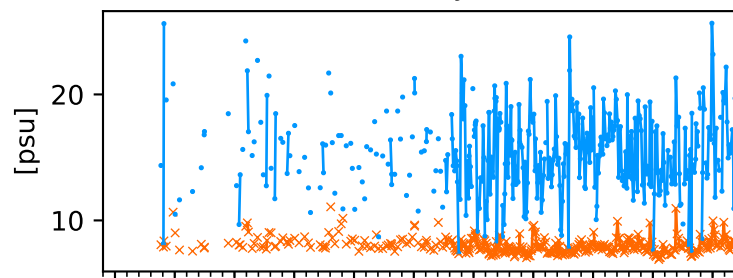
ARKONA: BY1

0-10 m ≥ 40 m

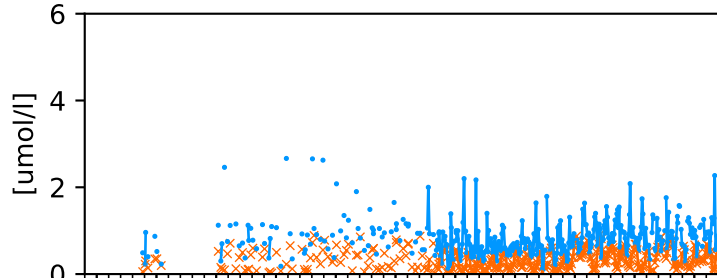
TEMP



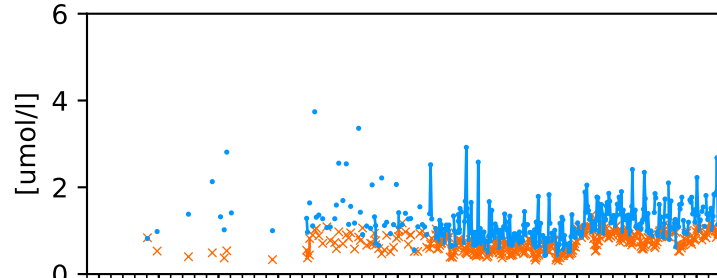
Salinity



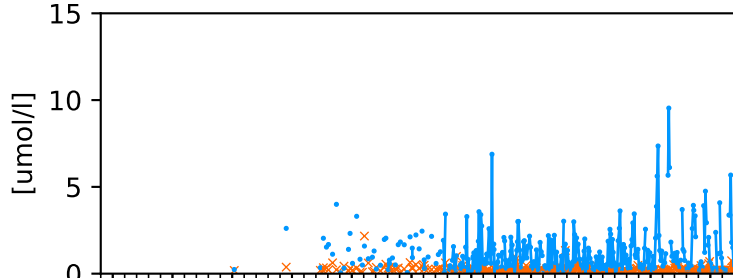
PO4



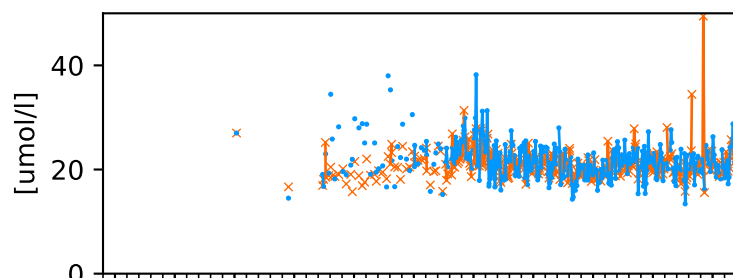
Tot-P



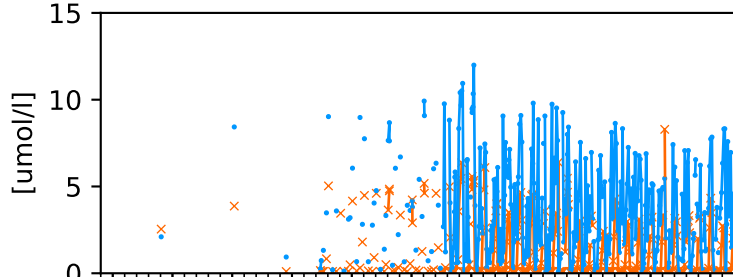
NH4



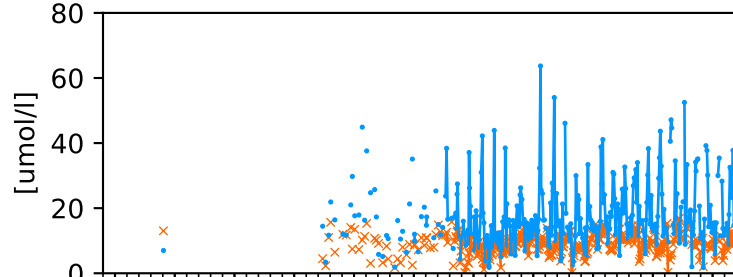
Tot-N



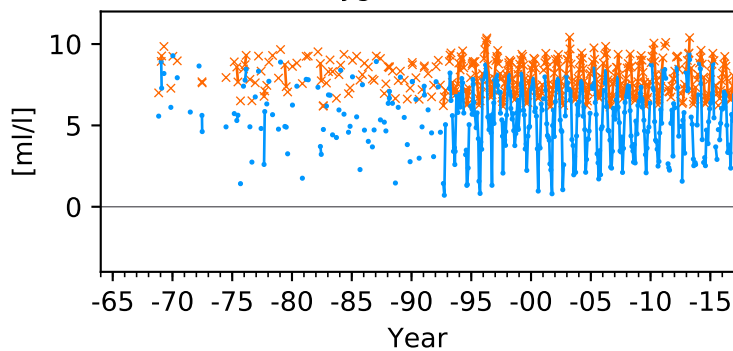
NOx



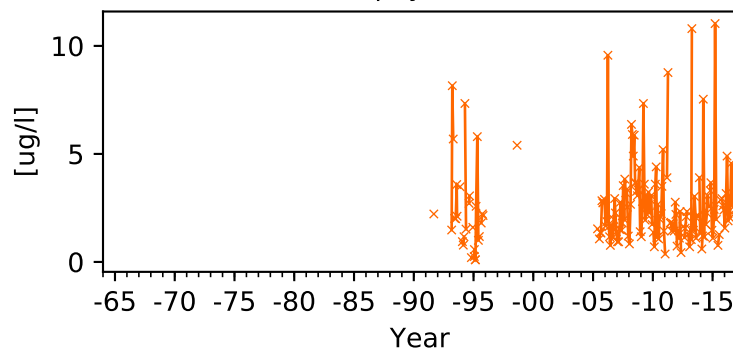
SiO3



Oxygen incl. H2S



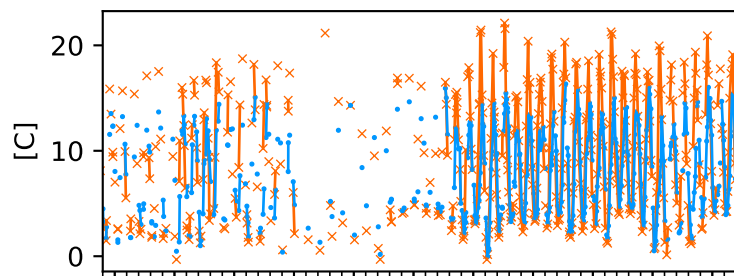
Chlorophyll-a bottle



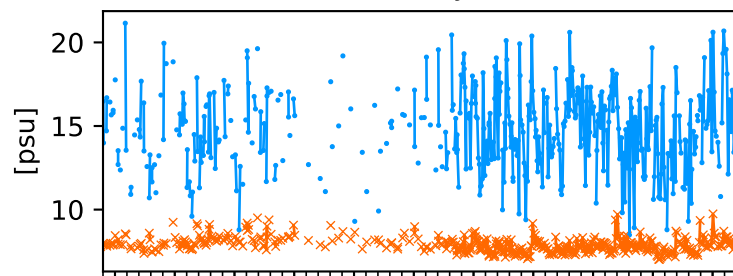
ARKONA: BY2 ARKONA

0-10 m ≥ 40 m

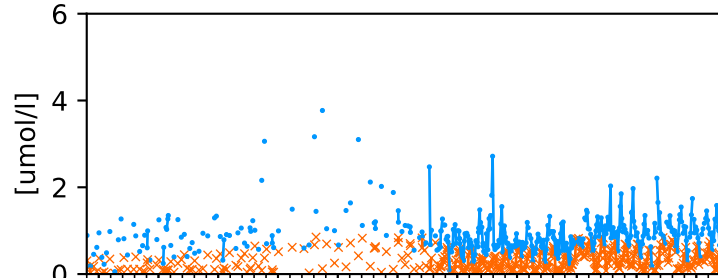
TEMP



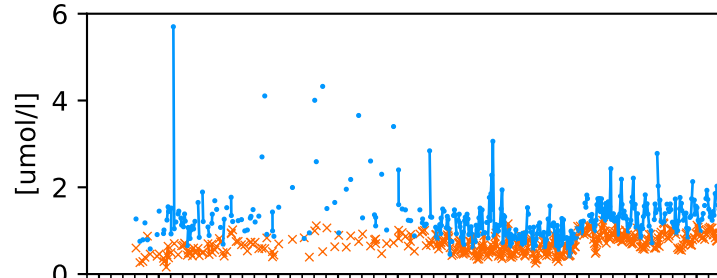
Salinity



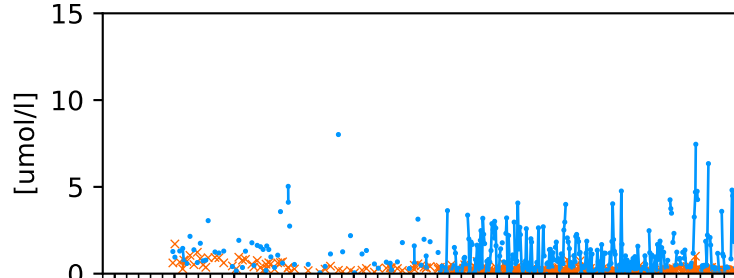
PO4



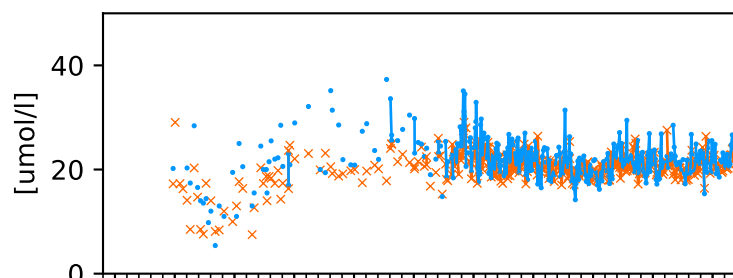
Tot-P



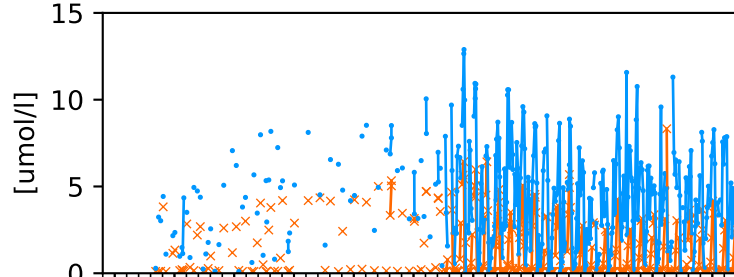
NH4



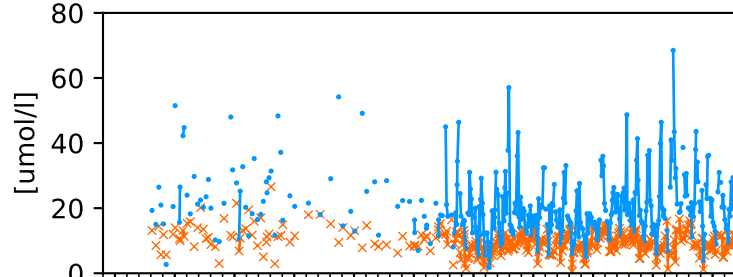
Tot-N



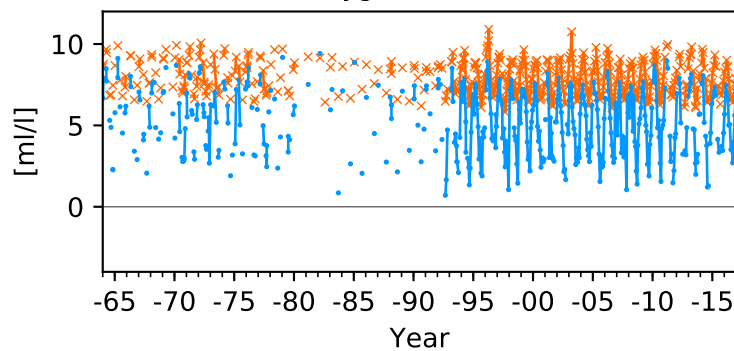
NOx



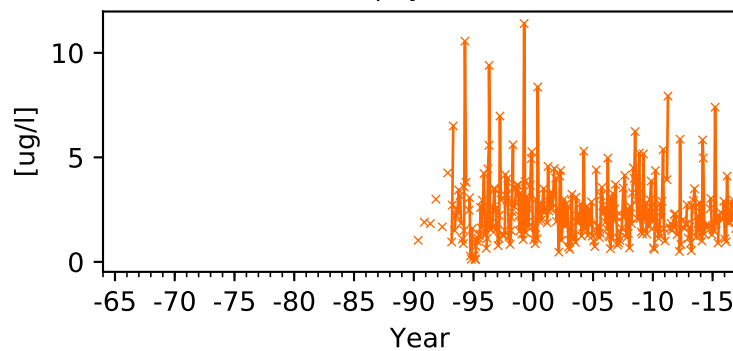
SiO3



Oxygen incl. H2S

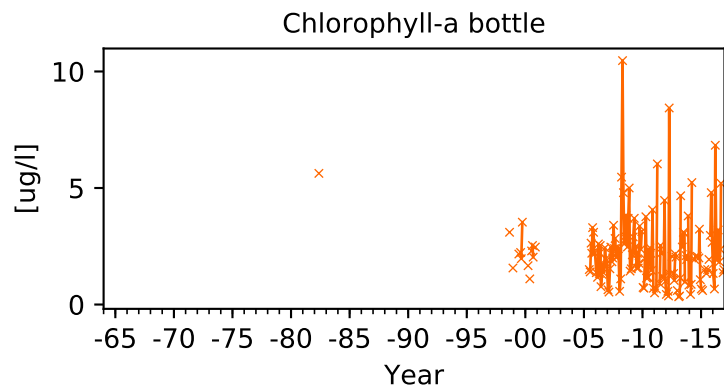
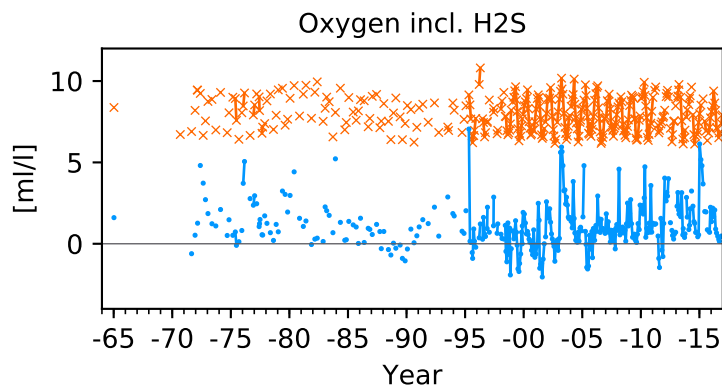
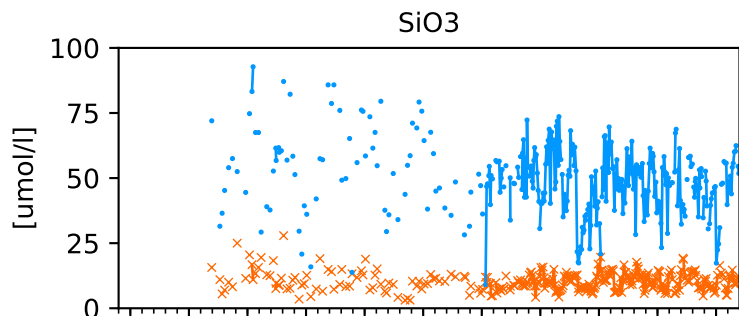
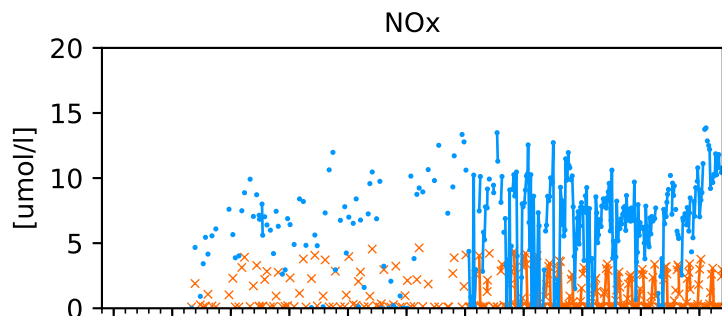
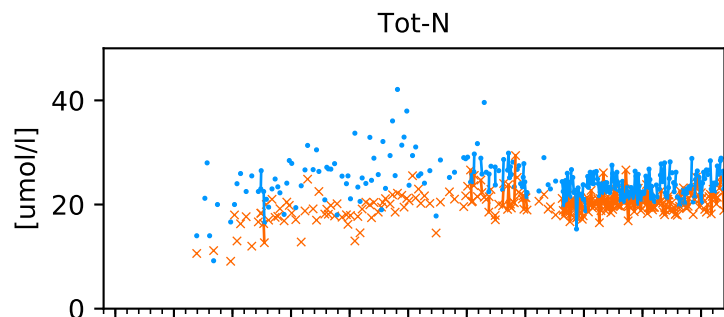
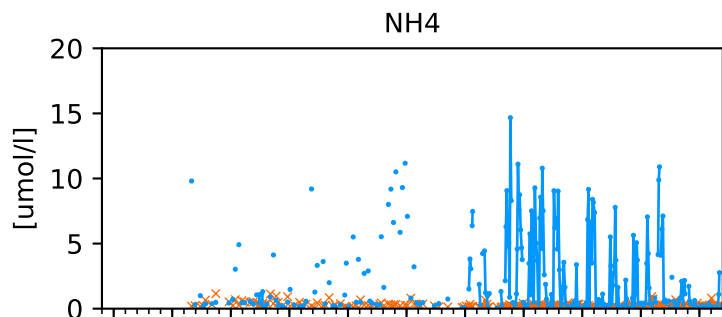
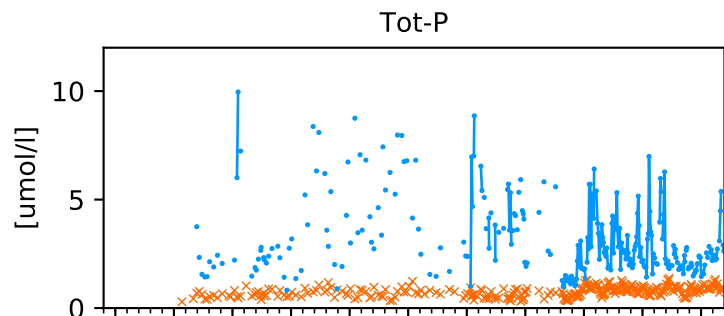
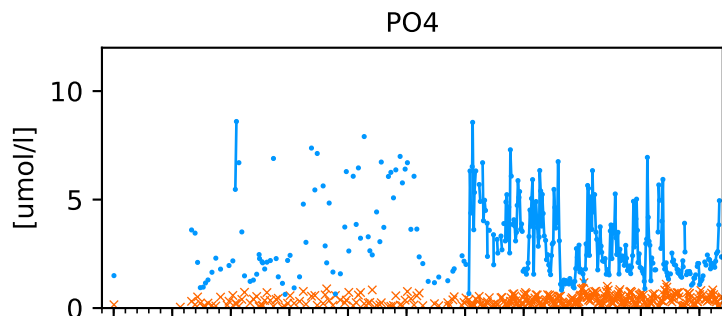
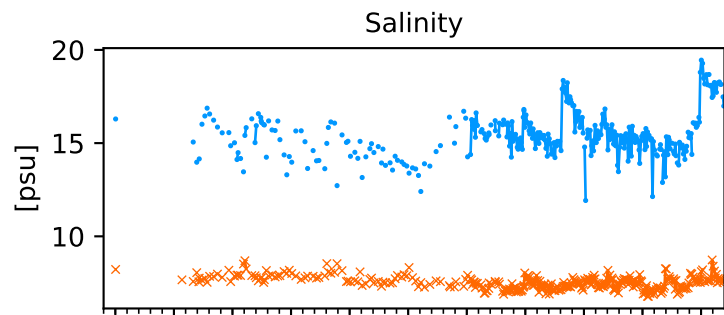
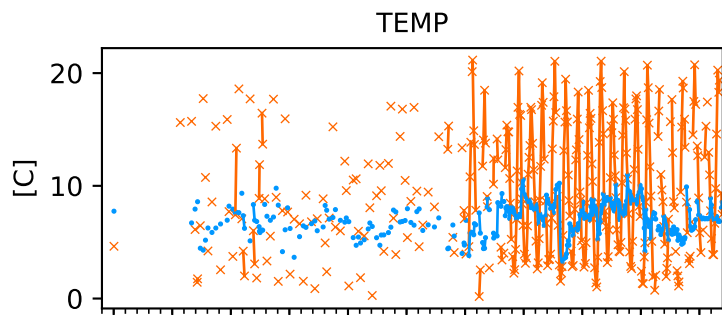


Chlorophyll-a bottle



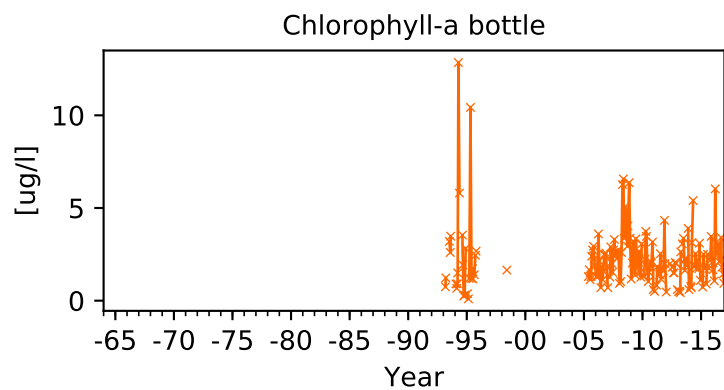
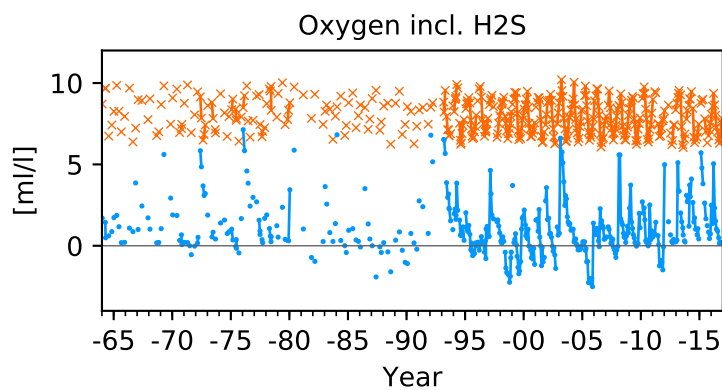
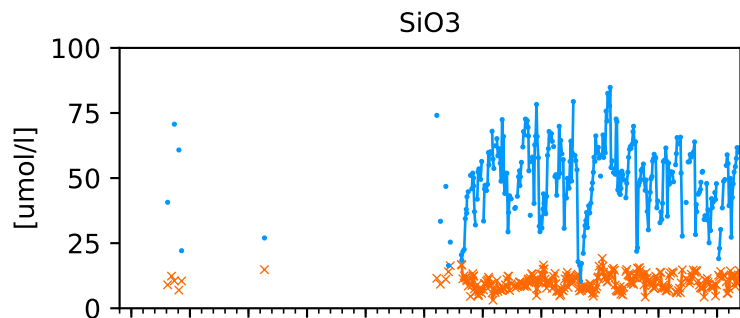
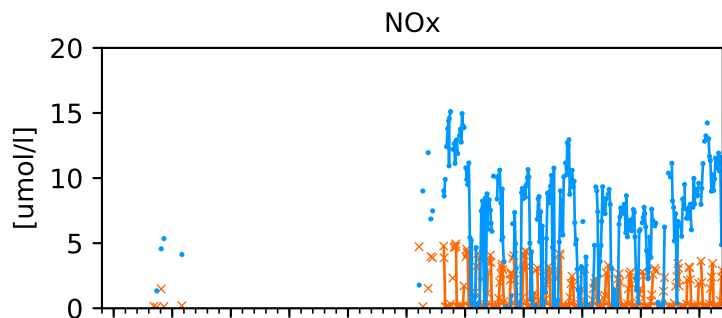
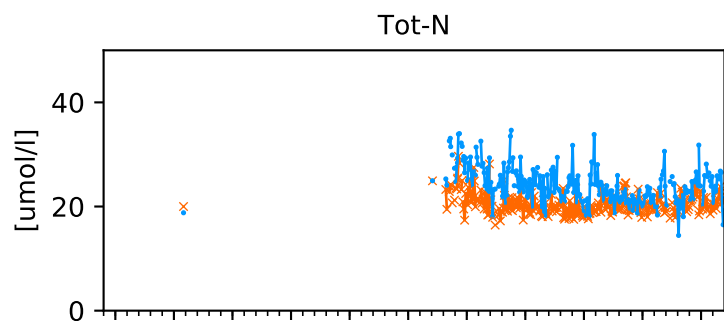
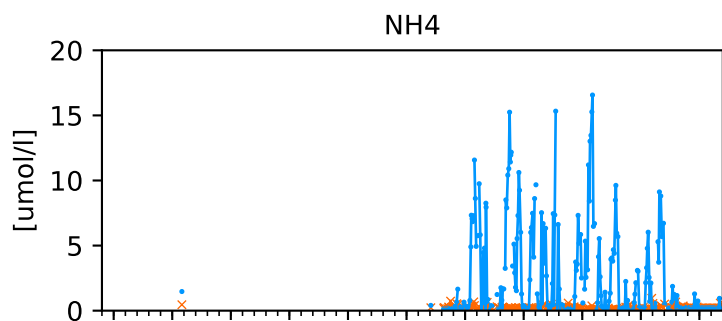
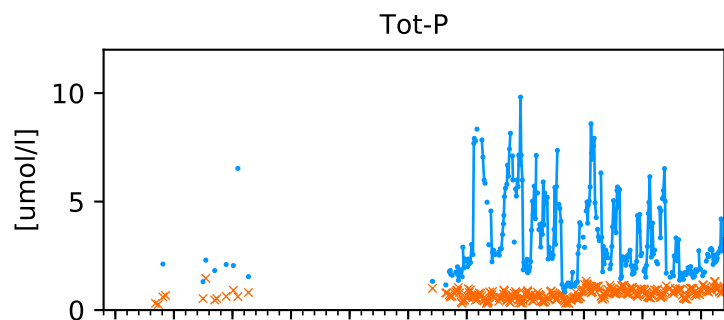
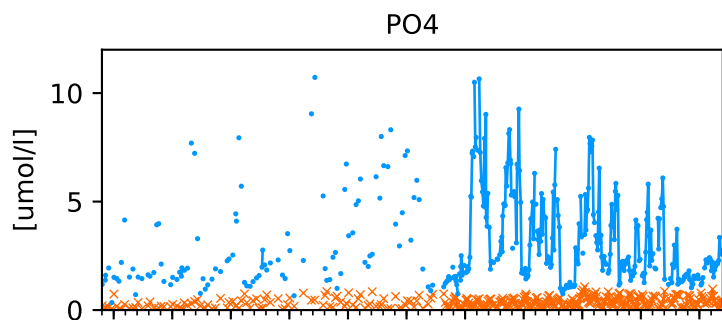
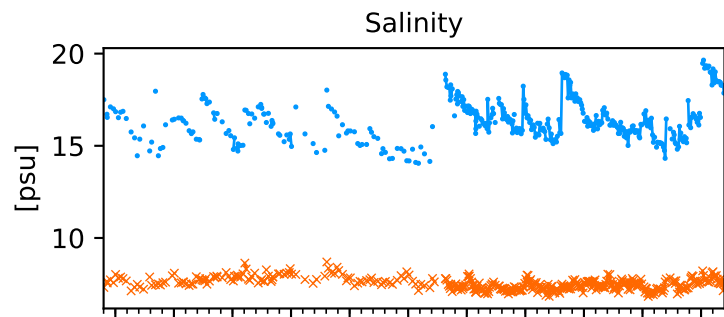
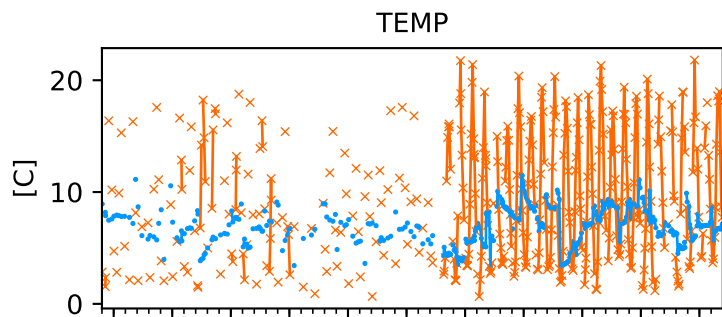
BORNHOLM: HANÖBUKTEN

— 0-10 m — ≥ 70 m



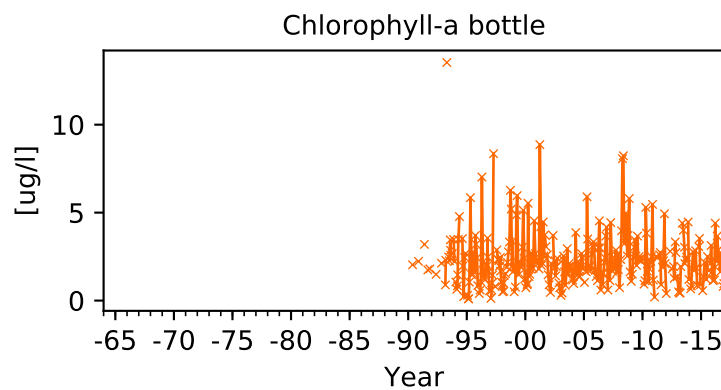
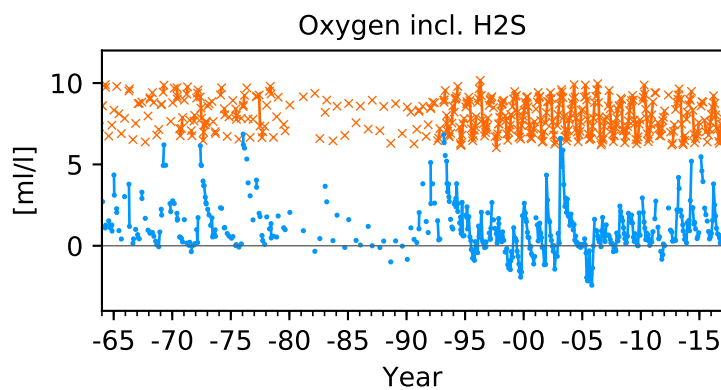
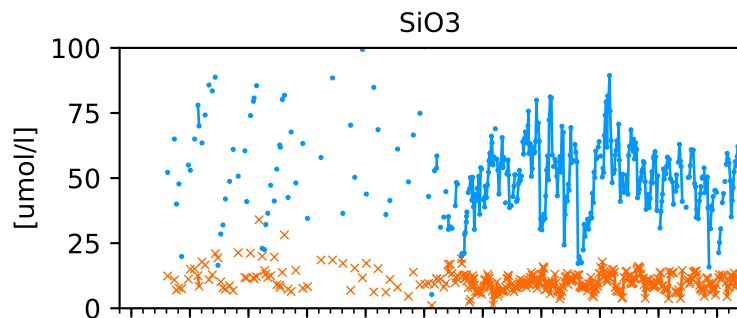
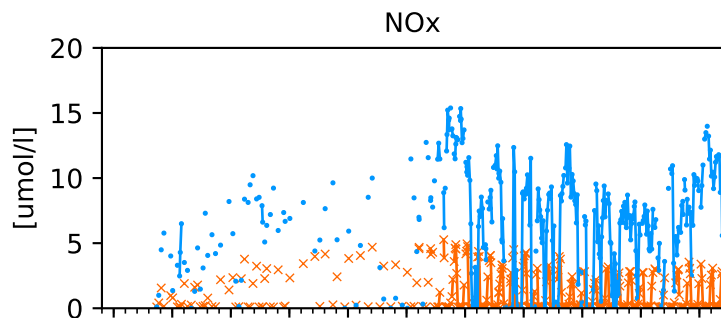
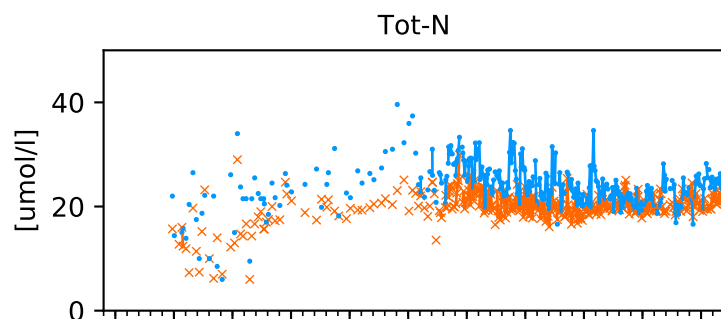
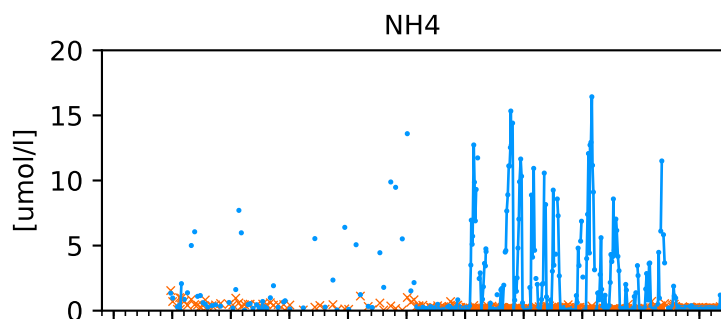
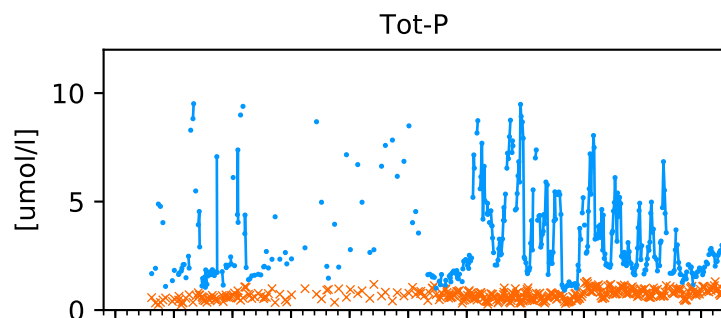
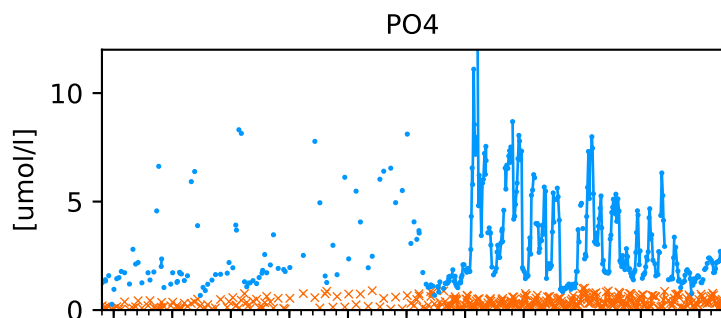
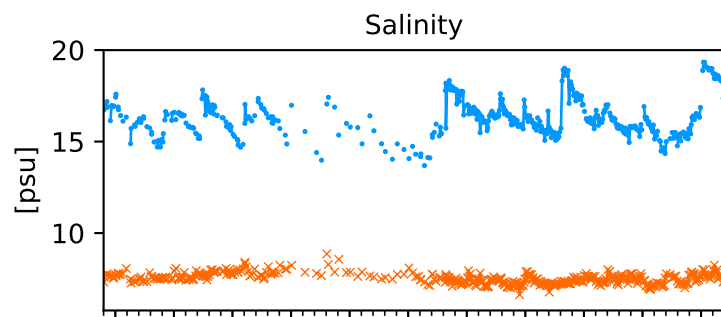
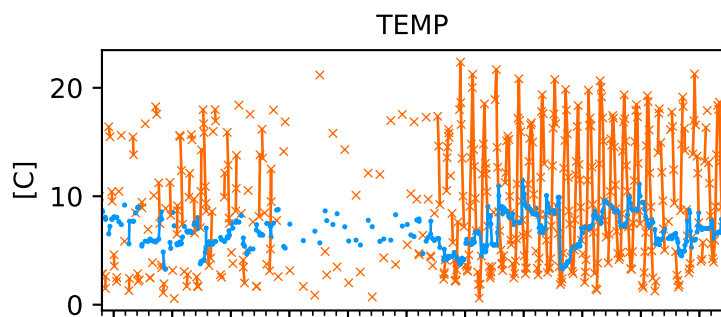
BORNHOLM: BY4 CHRISTIANSÖ

0-10 m ≥ 80 m



BORNHOLM: BY5 BORNHOLMSDJ

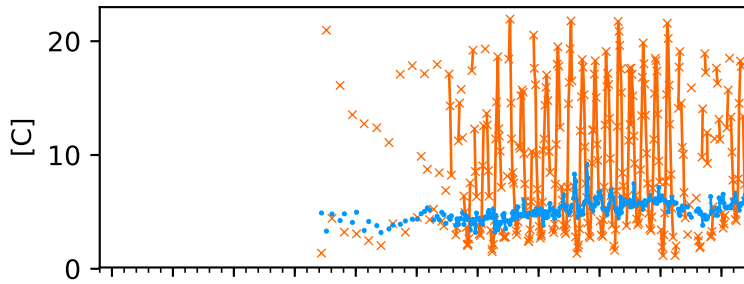
0-10 m ≥ 80 m



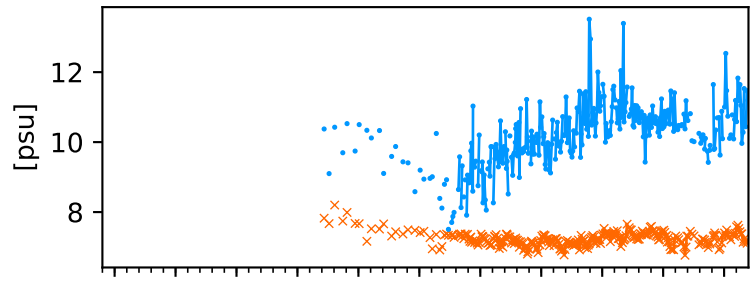
SE BALTIC PROPER: BCS III-10

0-10 m ≥ 80 m

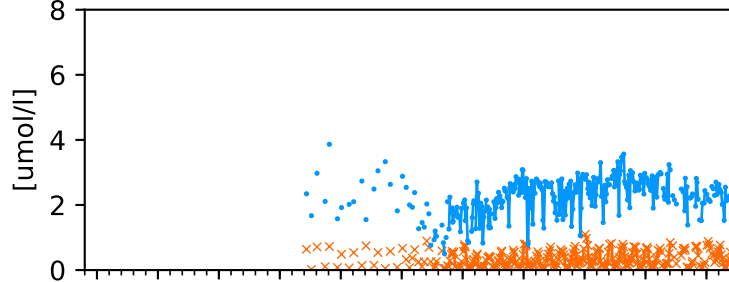
TEMP



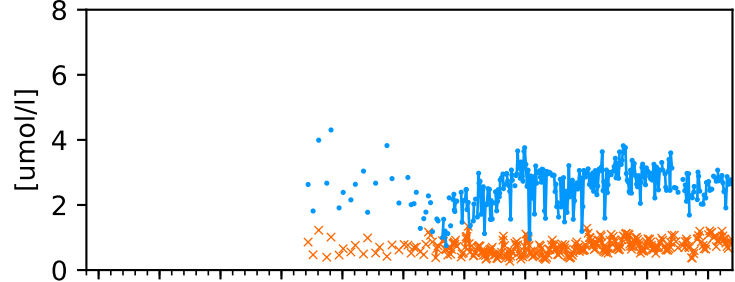
Salinity



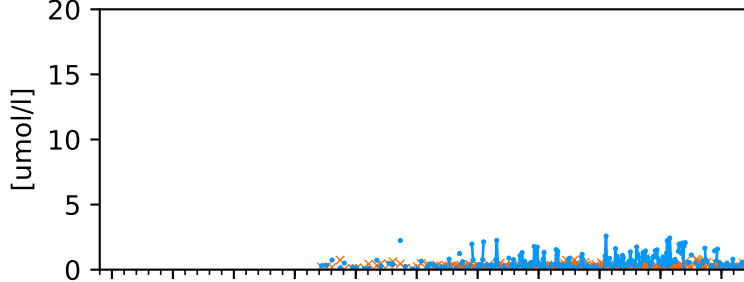
PO4



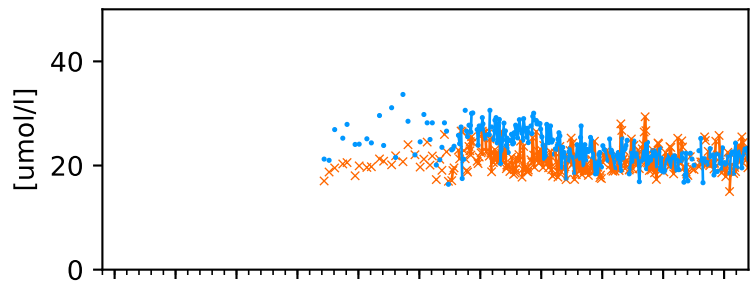
Tot-P



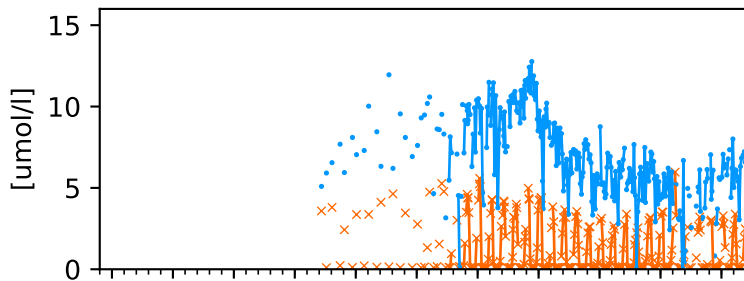
NH4



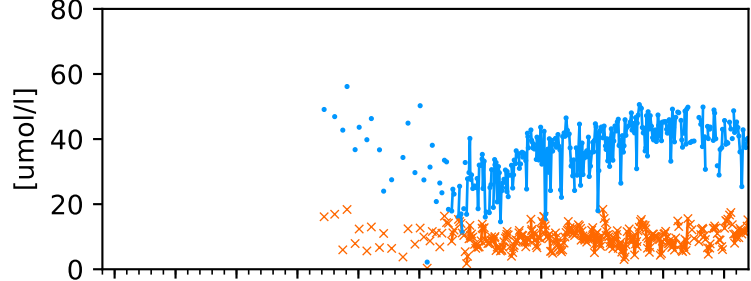
Tot-N



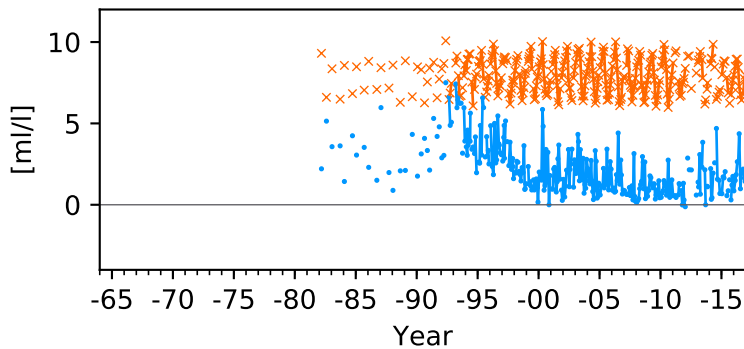
NOx



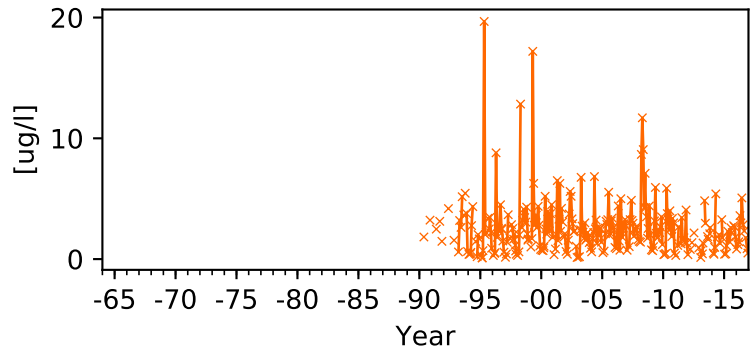
SiO3



Oxygen incl. H2S

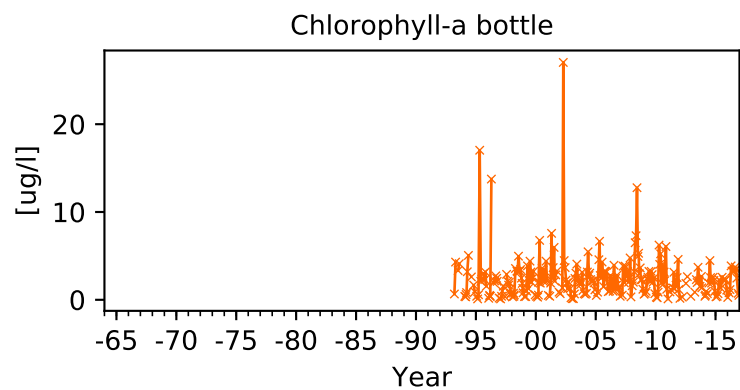
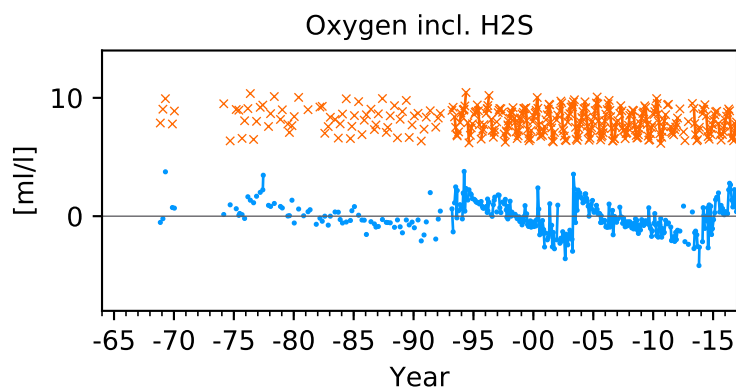
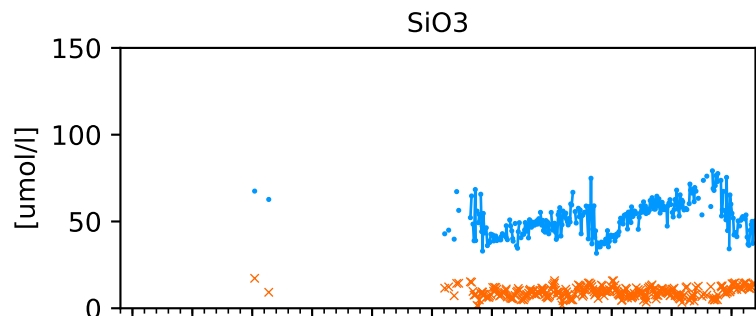
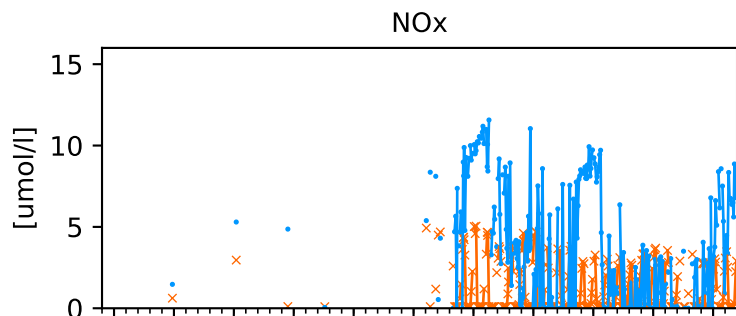
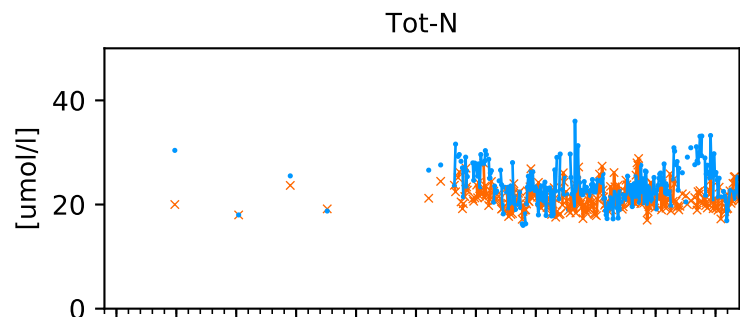
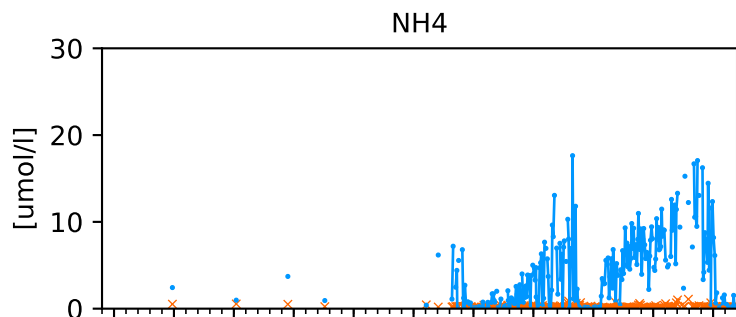
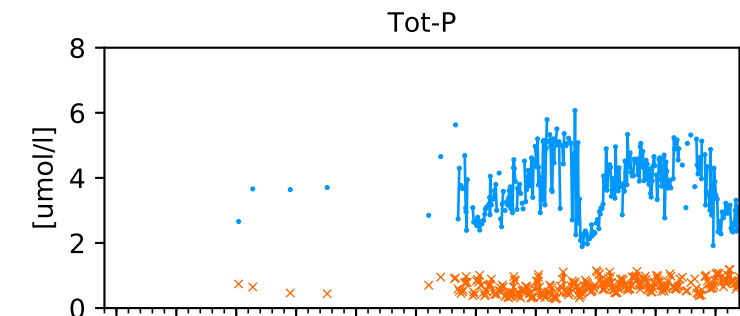
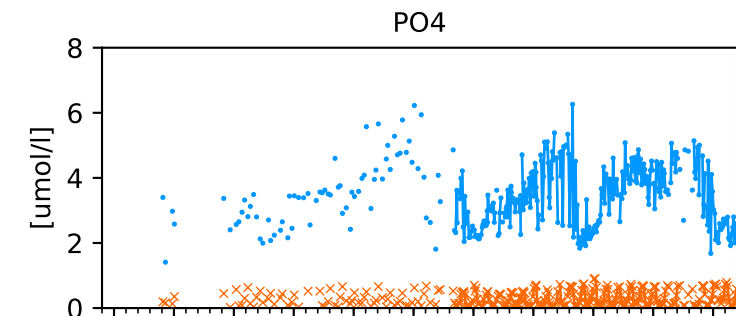
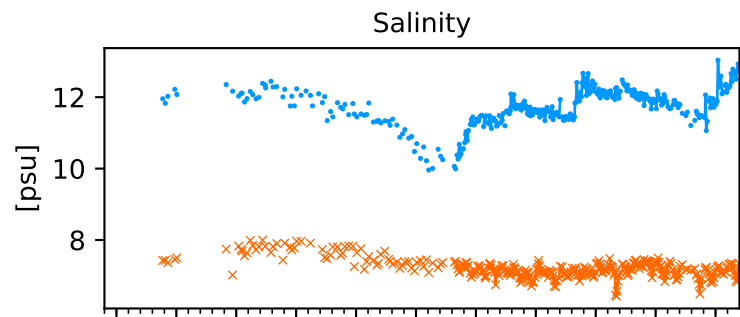
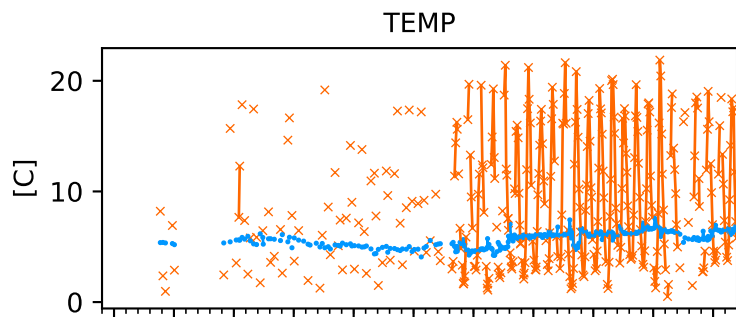


Chlorophyll-a bottle



EASTERN GOTLAND BASIN: BY10

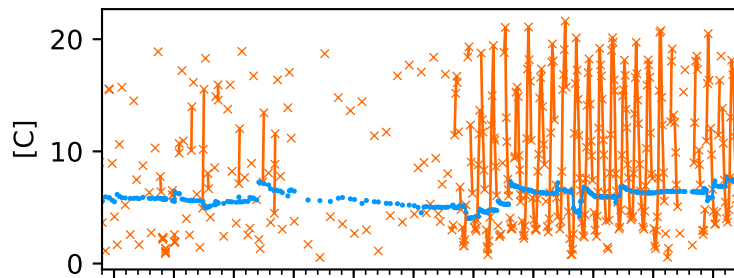
— 0-10 m — ≥ 125 m



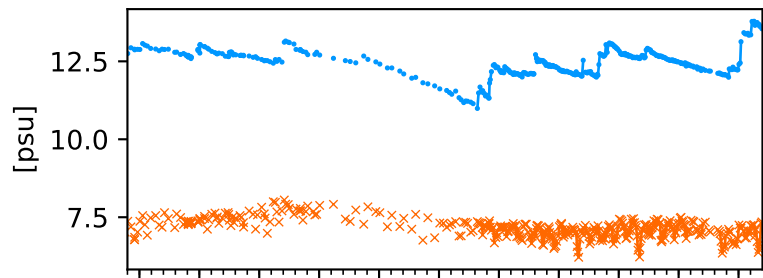
EASTERN GOTLAND BASIN: BY15 GOTLANDSDJ

0-10 m ≥ 225 m

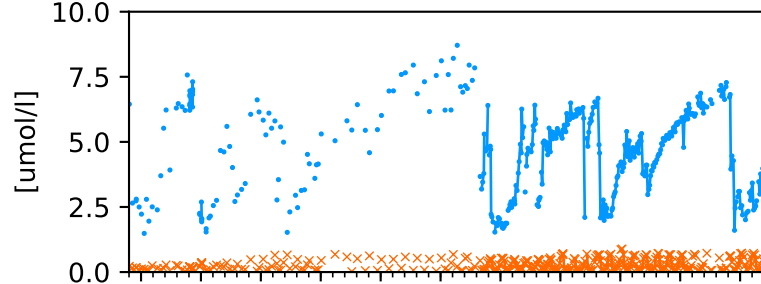
TEMP



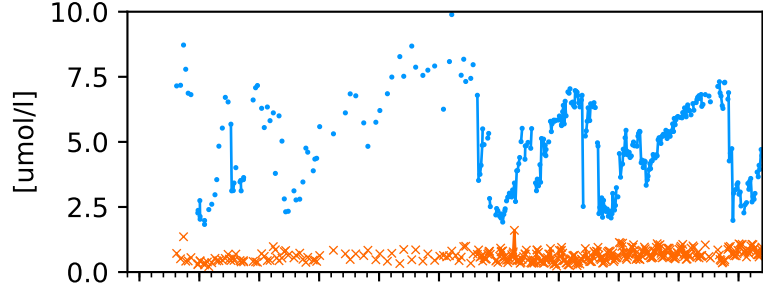
Salinity



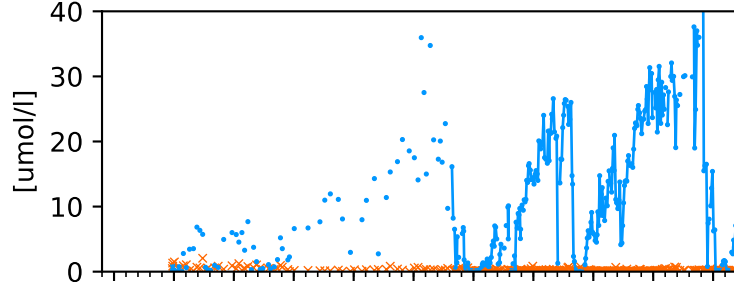
PO4



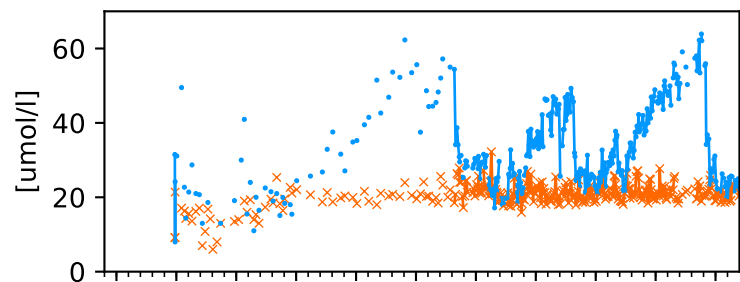
Tot-P



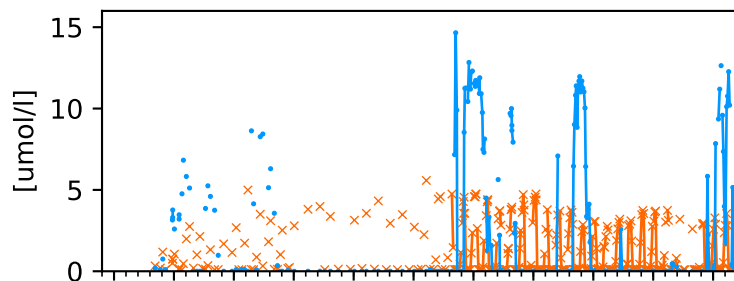
NH4



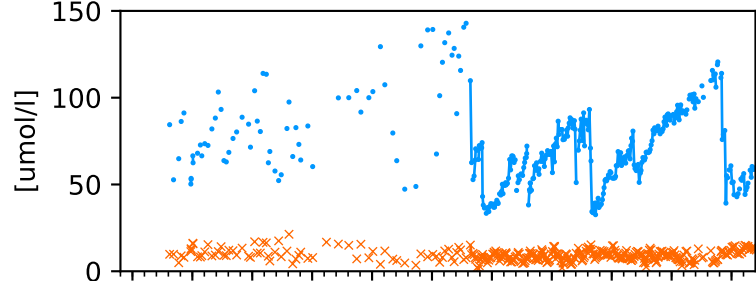
Tot-N



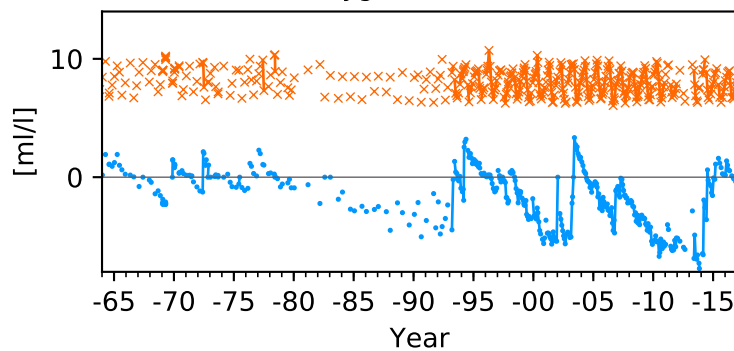
NOx



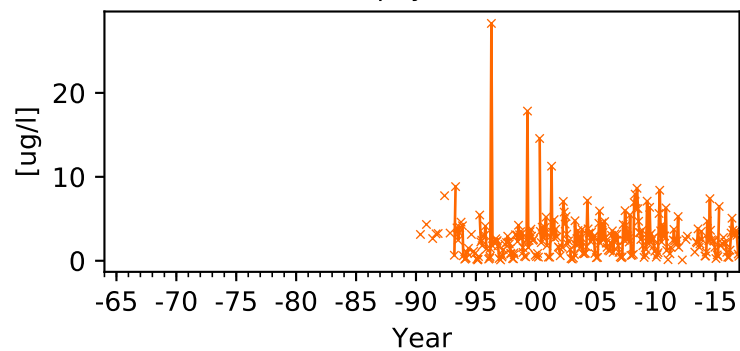
SiO3



Oxygen incl. H2S



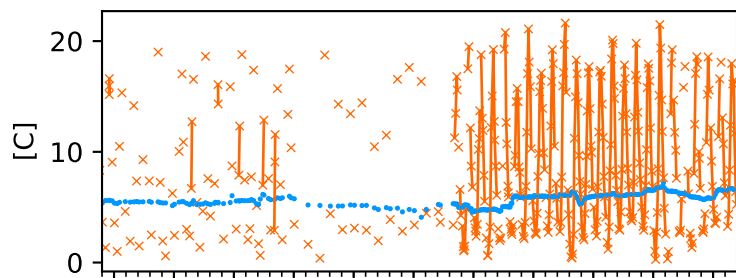
Chlorophyll-a bottle



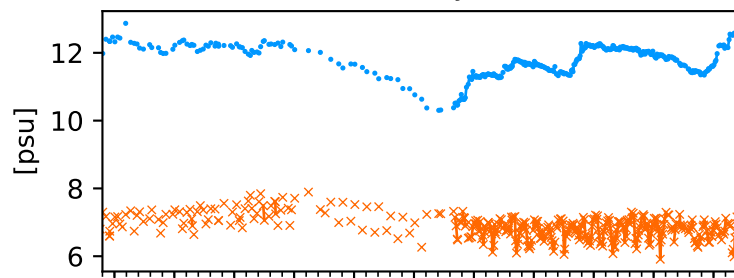
EASTERN GOTLAND BASIN: BY20 FÅRÖDJ

0-10 m ≥ 175 m

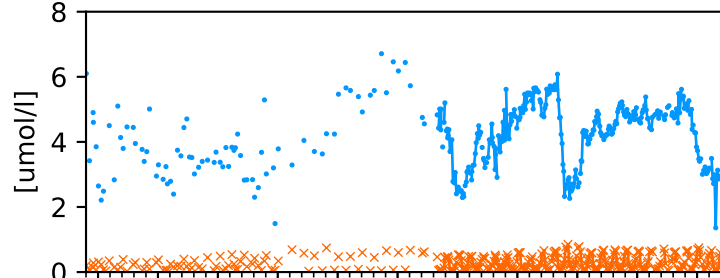
TEMP



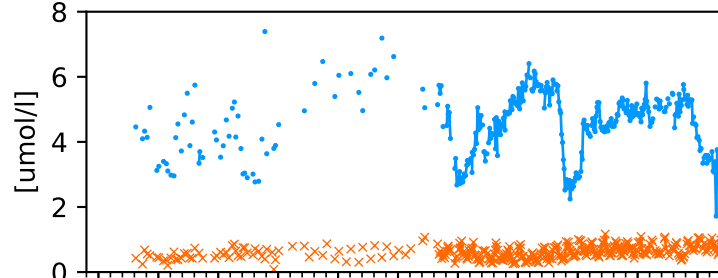
Salinity



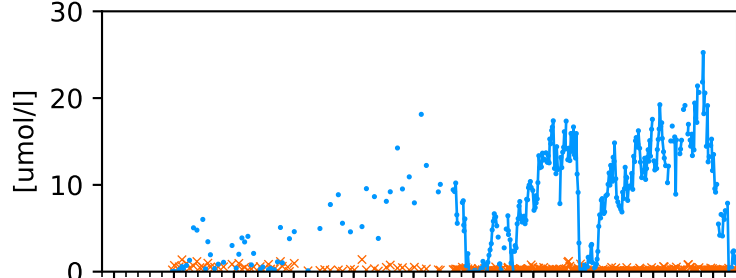
PO4



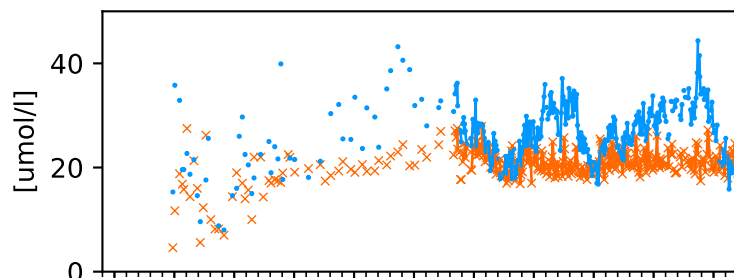
Tot-P



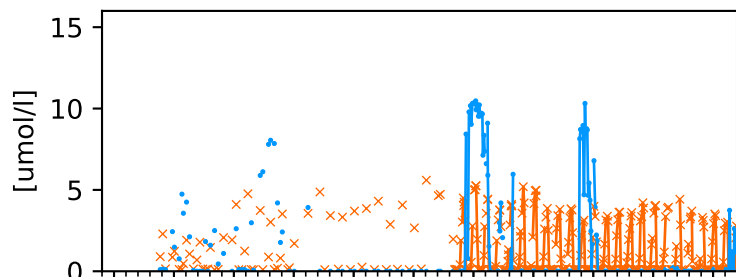
NH4



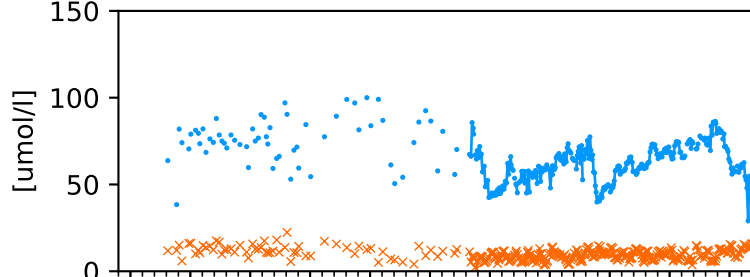
Tot-N



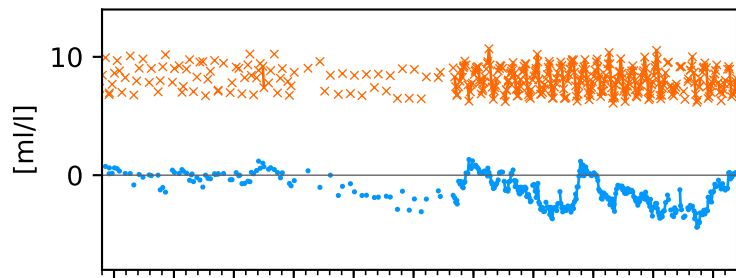
NOx



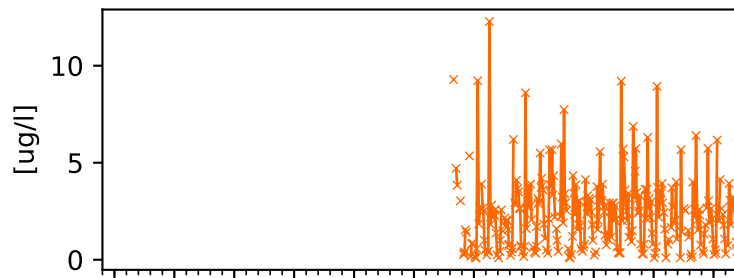
SiO3



Oxygen incl. H2S



Chlorophyll-a bottle

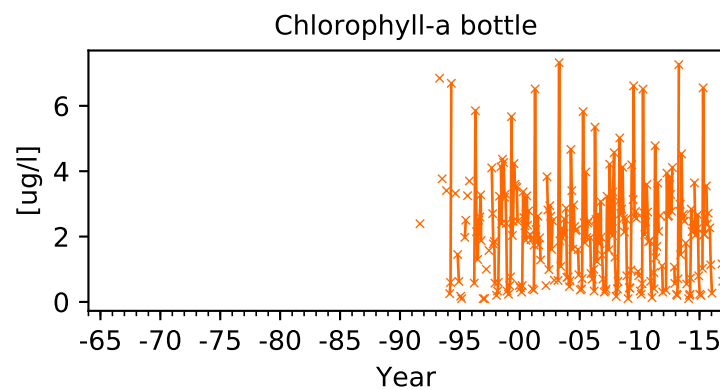
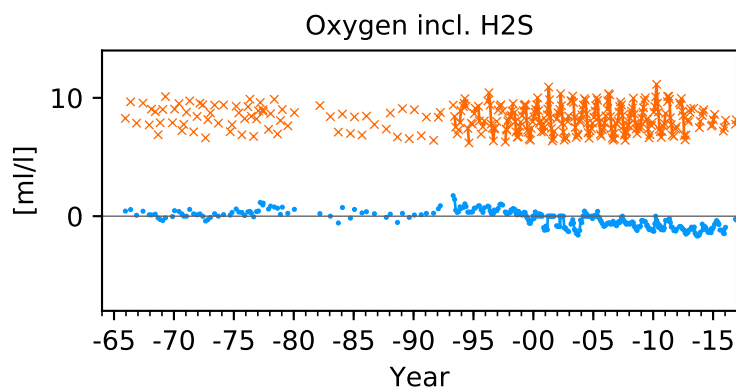
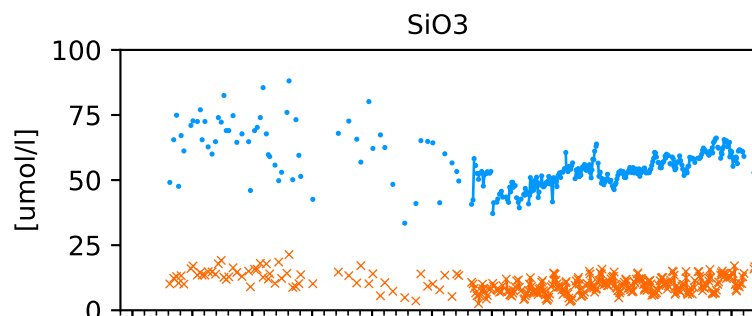
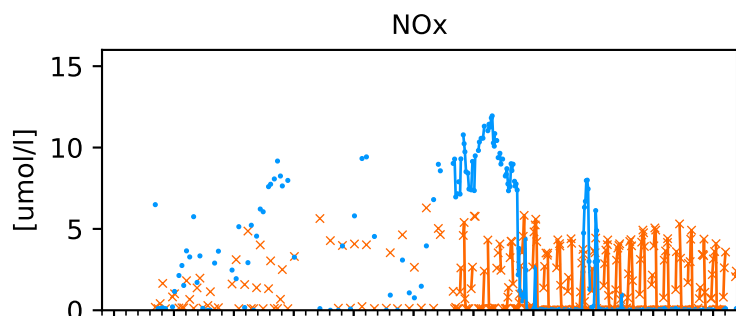
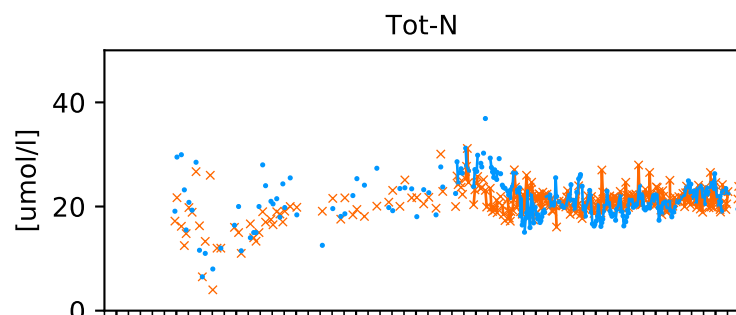
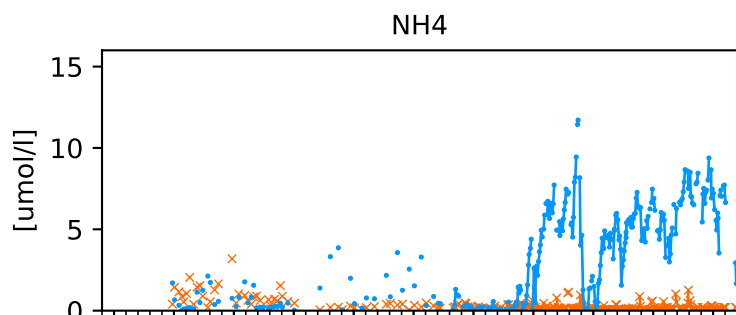
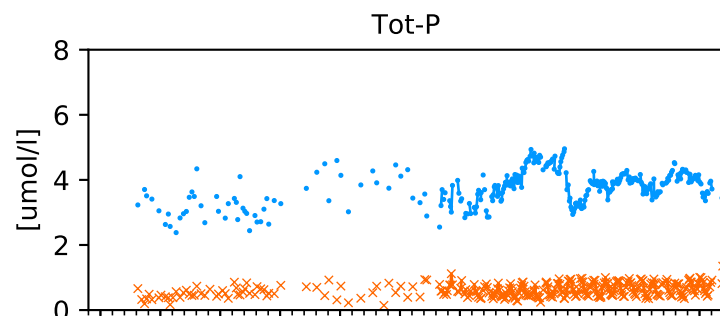
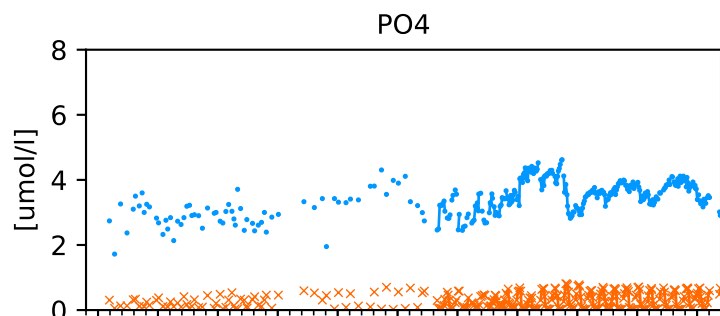
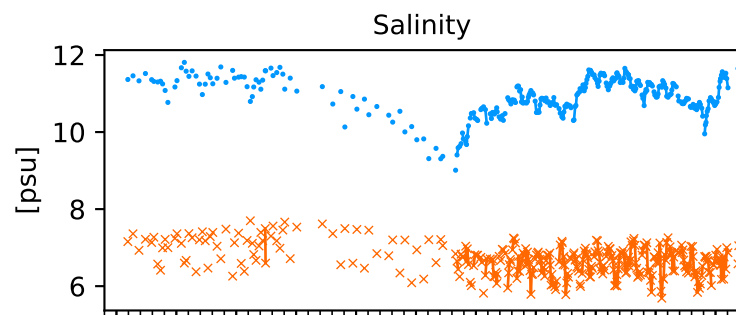
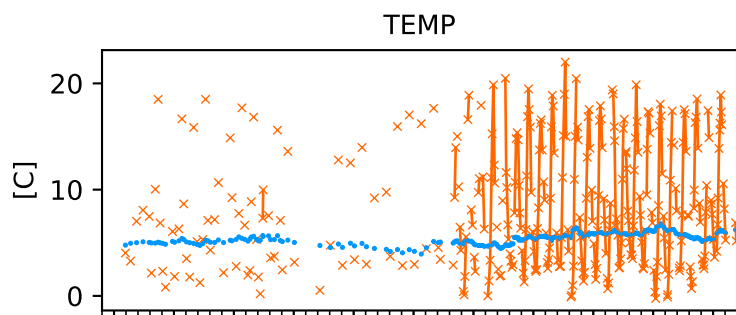


Year

Year

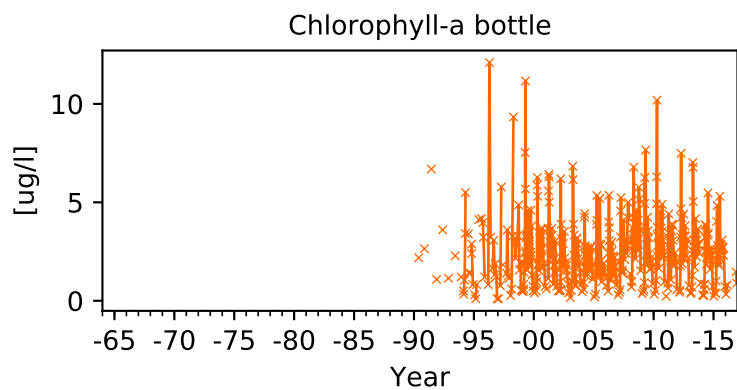
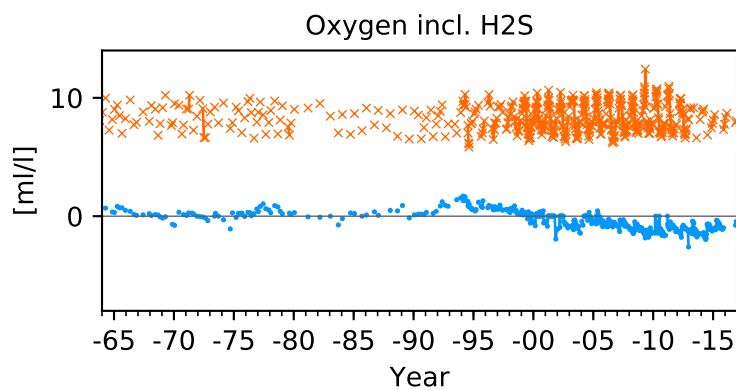
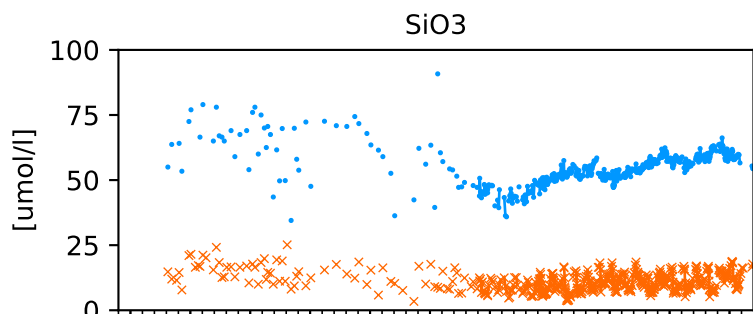
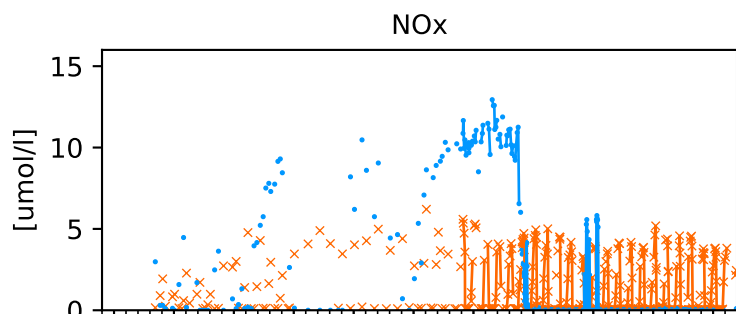
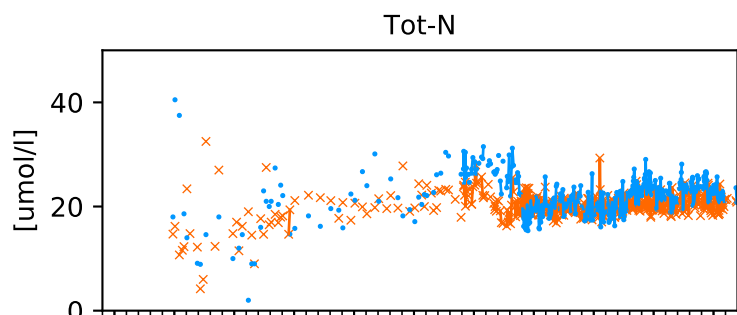
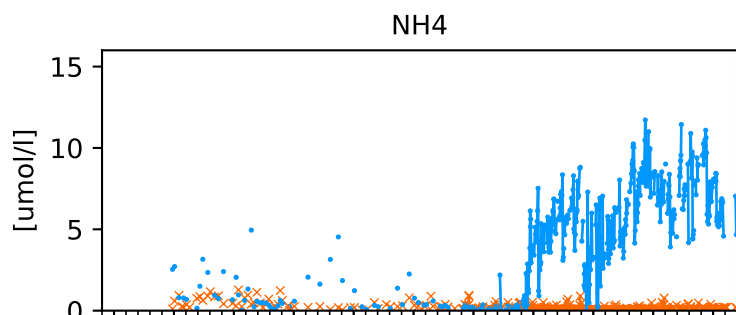
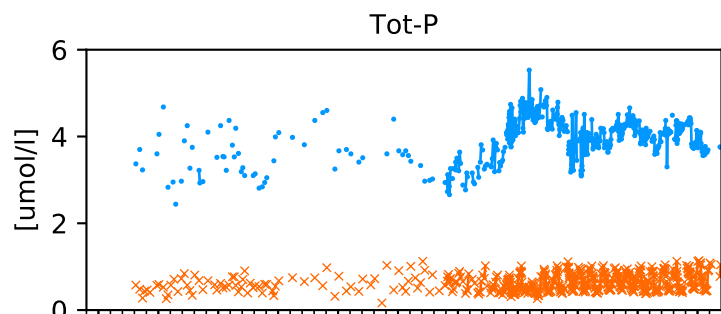
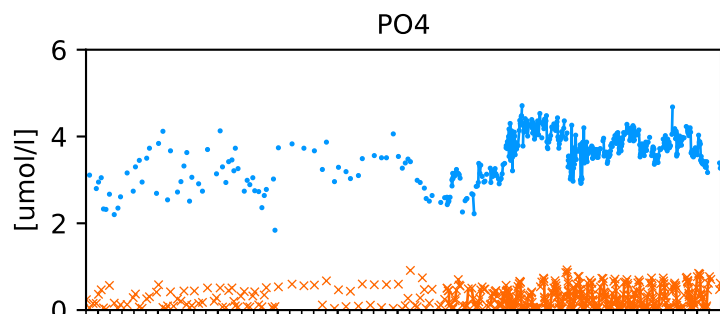
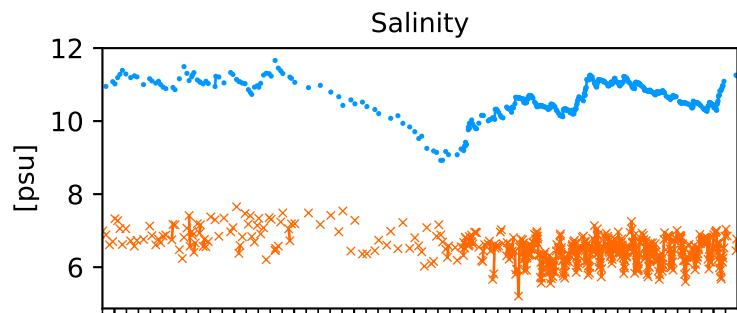
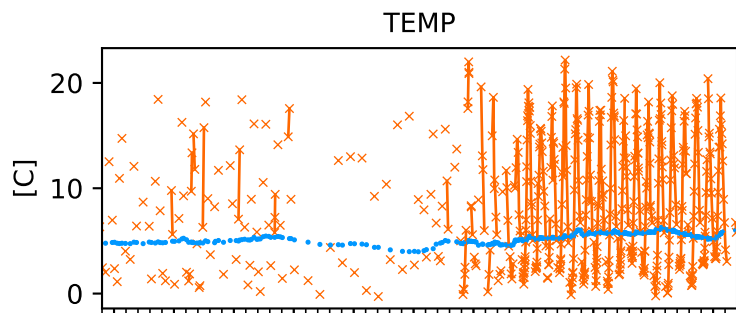
NORTHERN BALTIC PROPER: BY29 / LL19

0-10 m ≥ 150 m



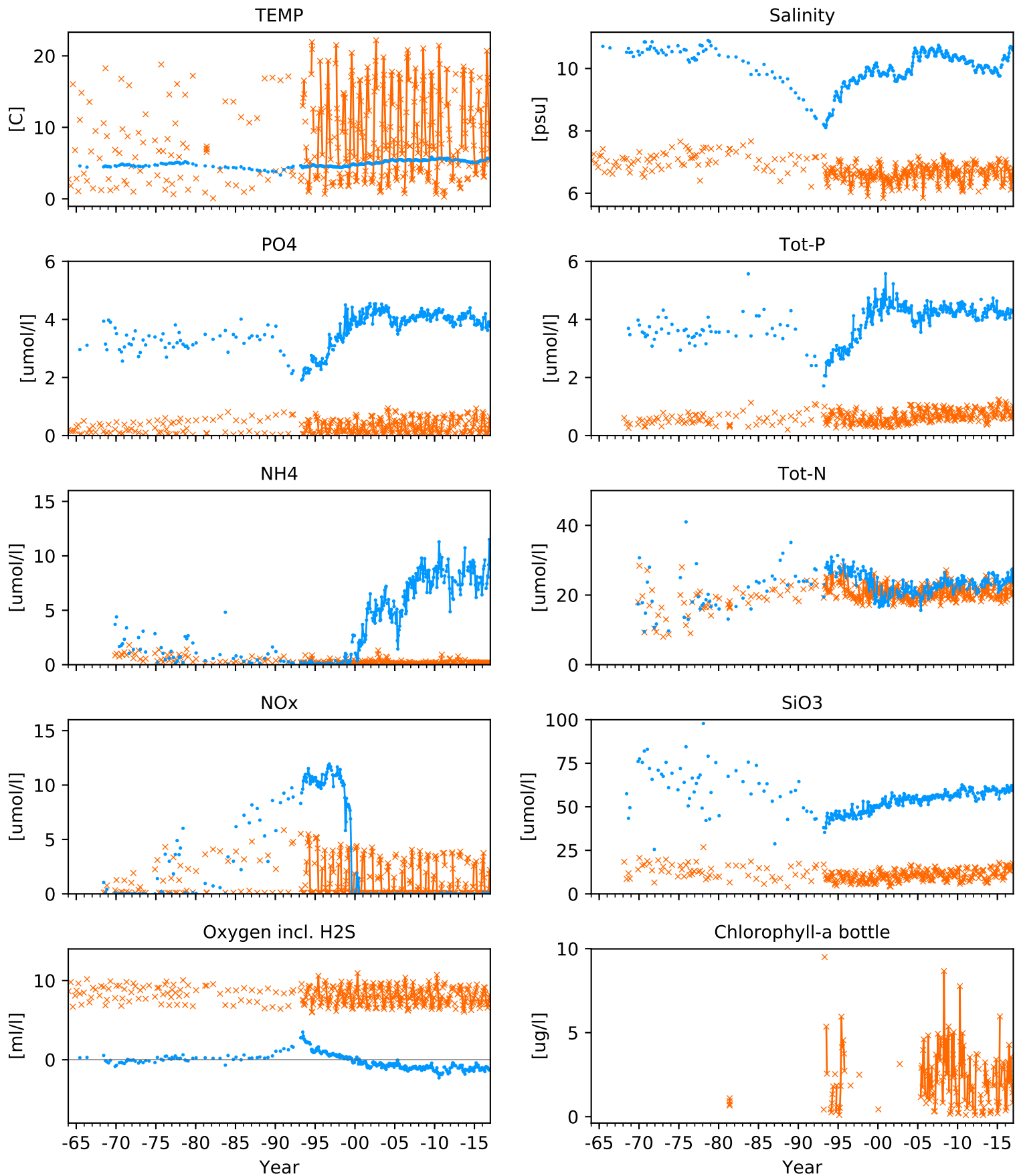
NORTHERN BALTIC PROPER: BY31 LANDSORTSDJ

0-10 m ≥ 440 m



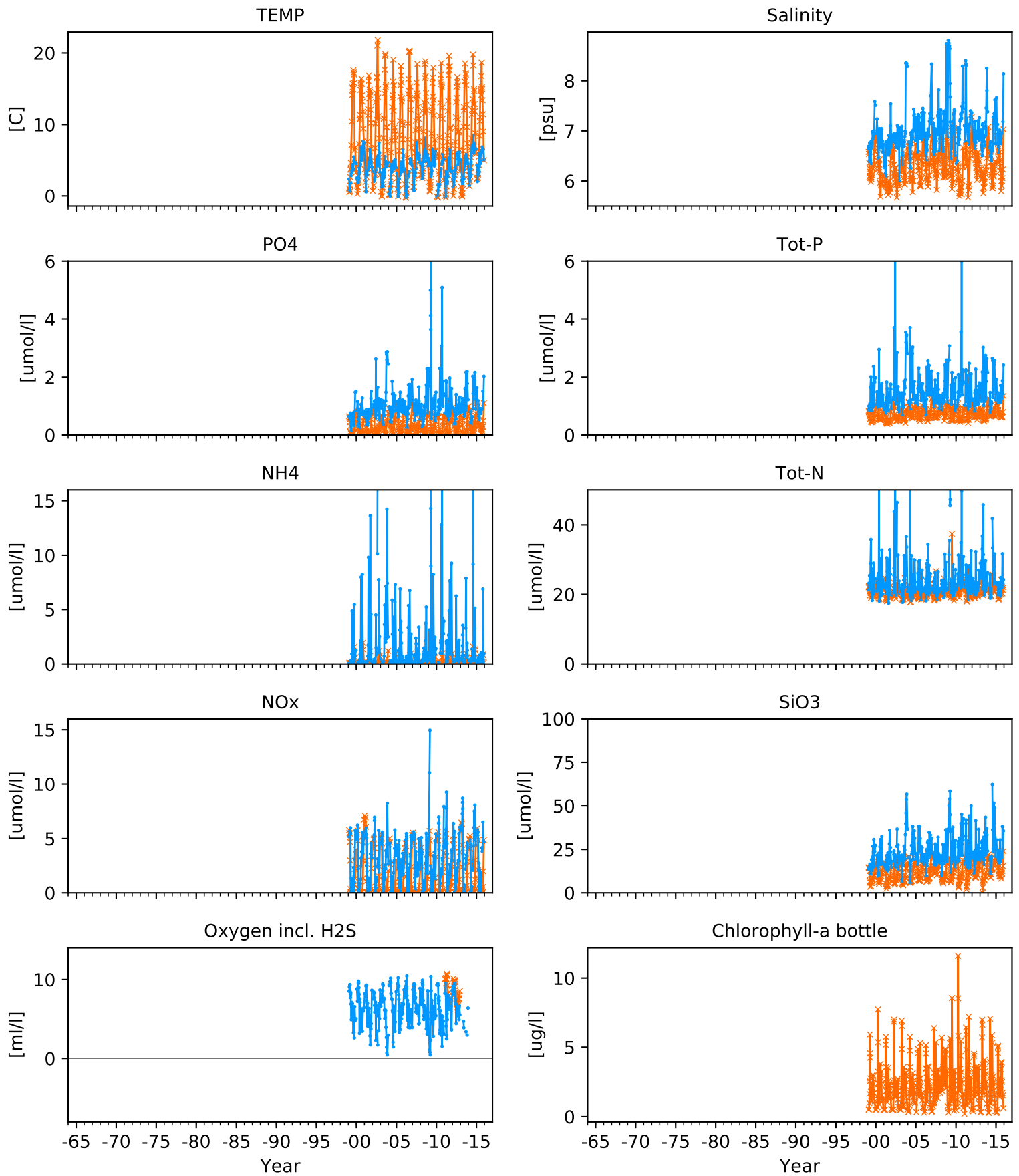
WESTERN GOTLAND BASIN: BY32 NORRKÖPINGSDJ

0-10 m ≥ 175 m



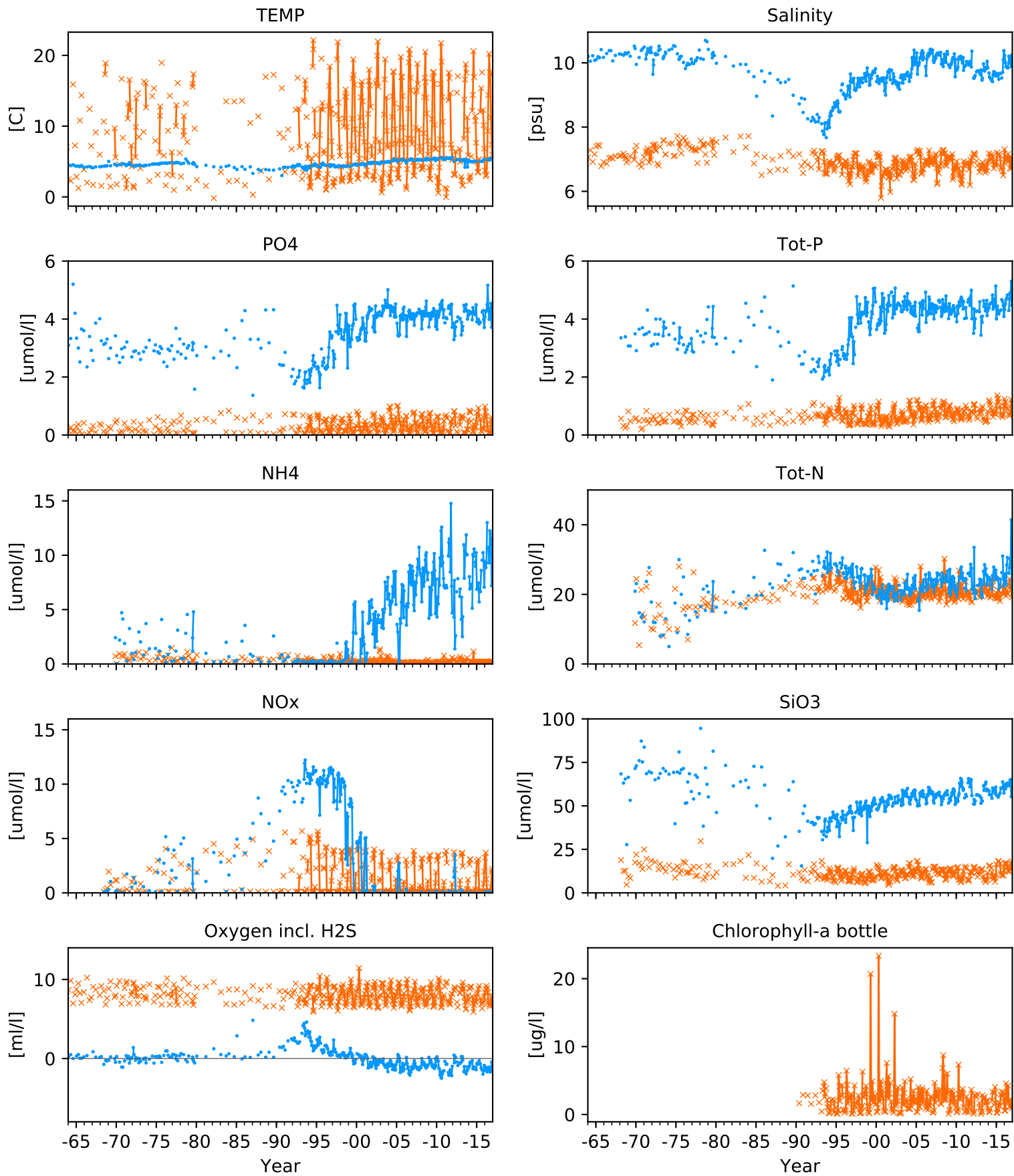
WESTERN GOTLAND BASIN: B1

0-10 m ≥ 40 m



WESTERN GOTLAND BASIN: BY38 KARLSÖD

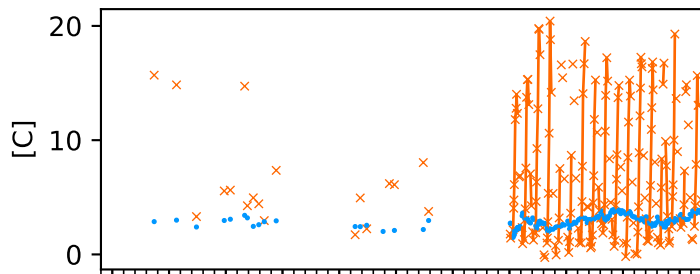
0-10 m ≥ 100 m



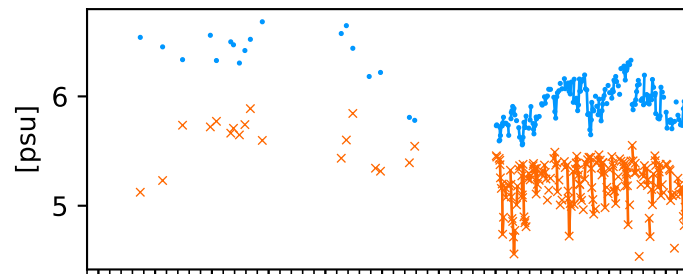
BOTHNIAN SEA: MS4 / C14

0-10 m ≥ 80 m

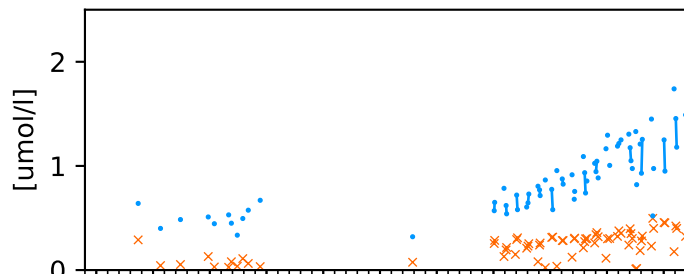
TEMP



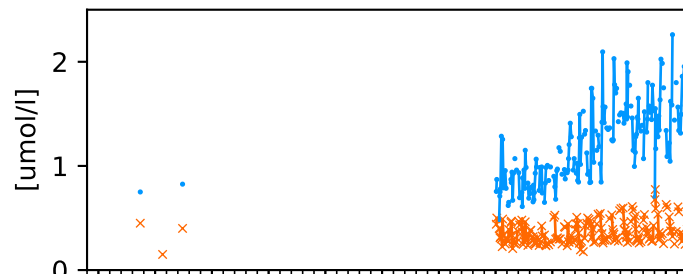
Salinity



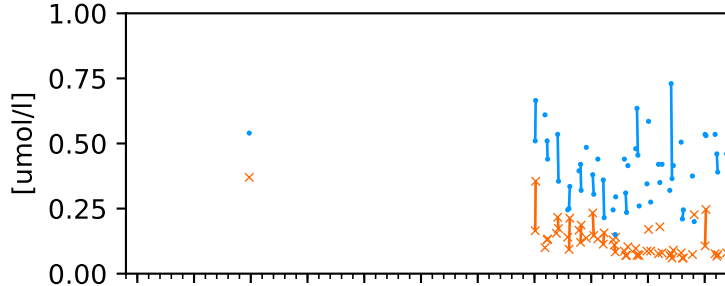
PO4



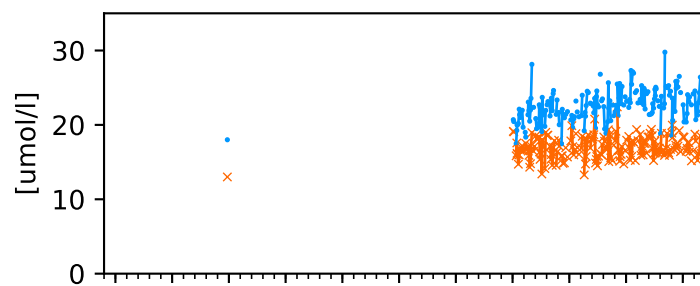
Tot-P



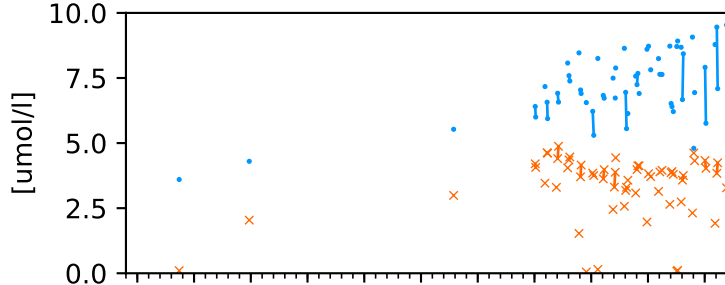
NH4



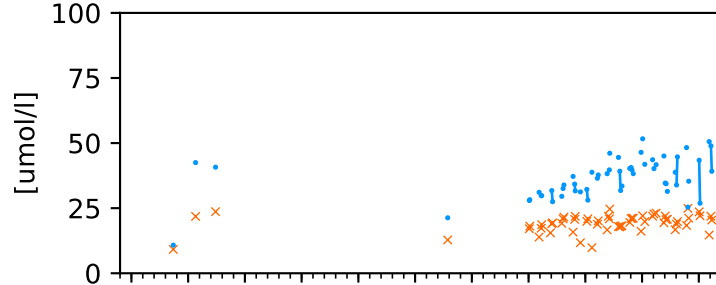
Tot-N



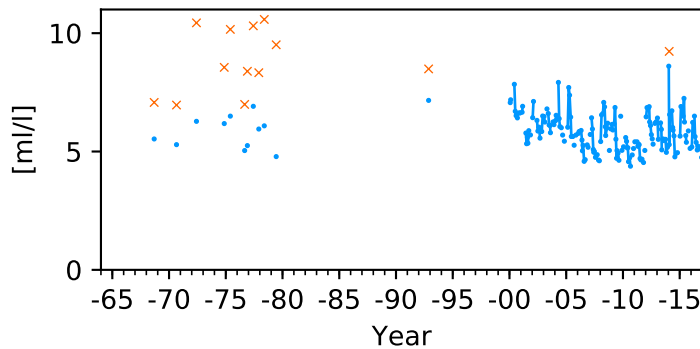
NOx



SiO3



Oxygen incl. H2S



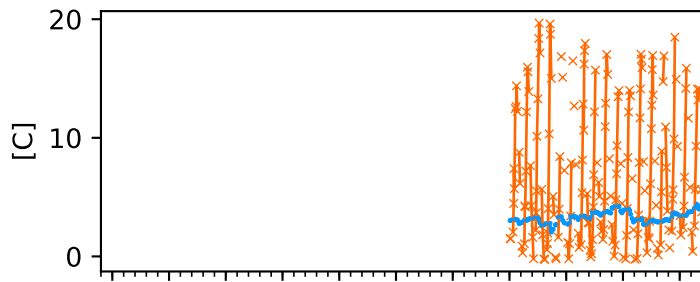
Chlorophyll-a bottle

No or very few Chlorophyll bottle data

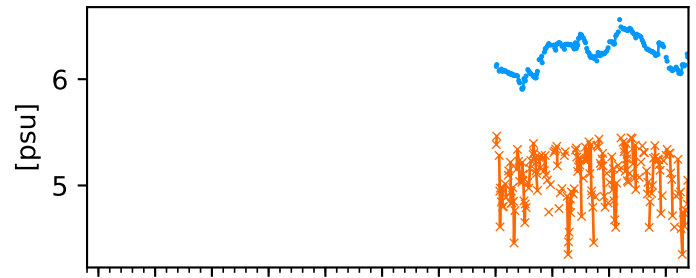
BOTHNIAN SEA: C3

0-10 m ≥ 180 m

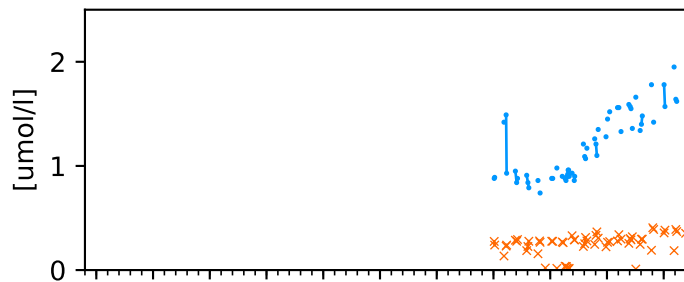
TEMP



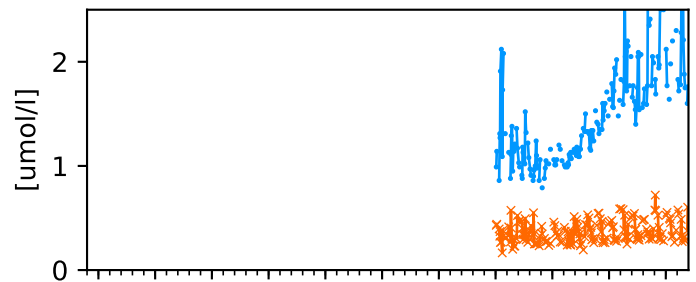
Salinity



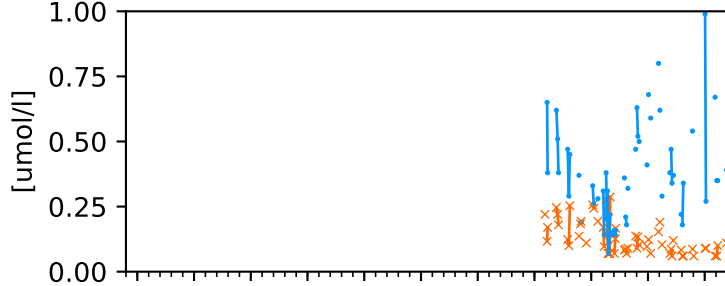
PO4



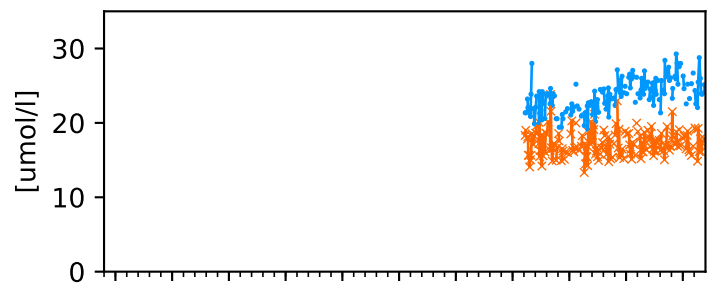
Tot-P



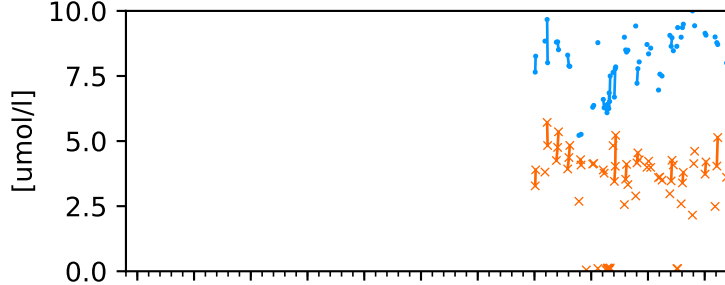
NH4



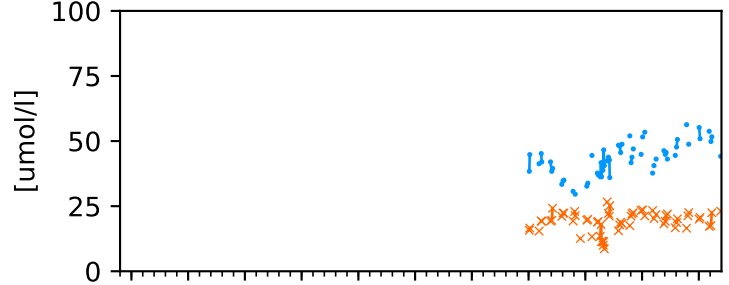
Tot-N



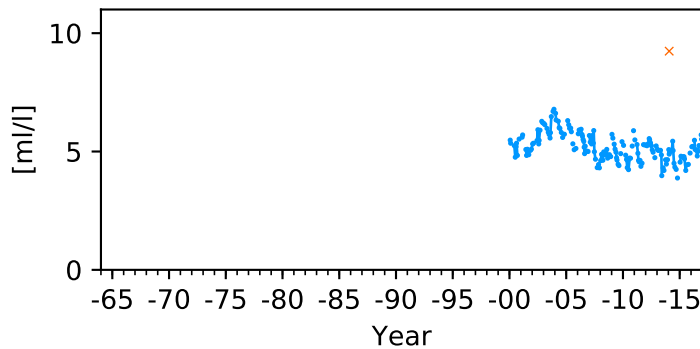
NOx



SiO3



Oxygen incl. H2S



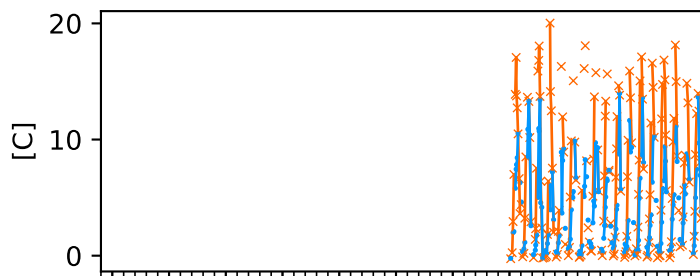
Chlorophyll-a bottle

No or very few Chlorophyll bottle data

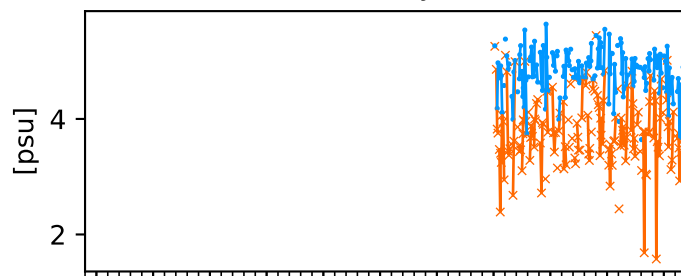
THE QUARK: B7

0-10 m ≥ 20 m

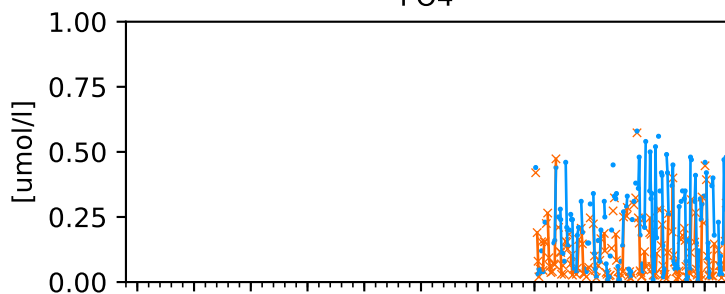
TEMP



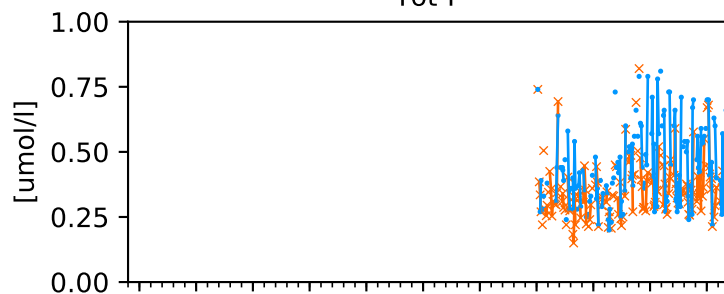
Salinity



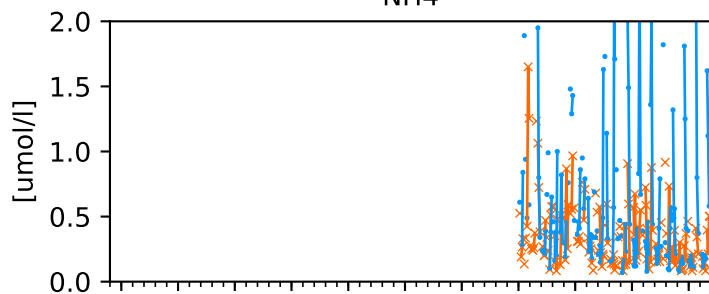
PO4



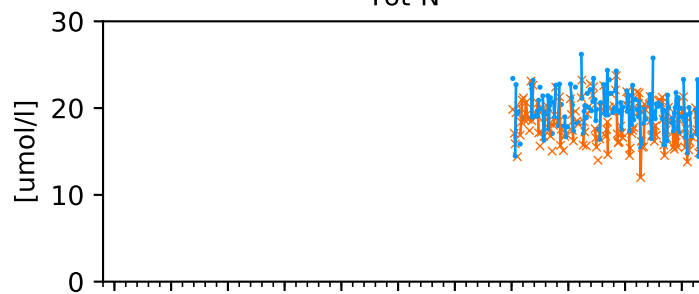
Tot-P



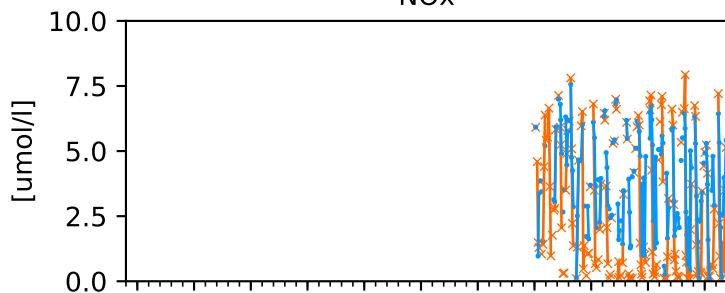
NH4



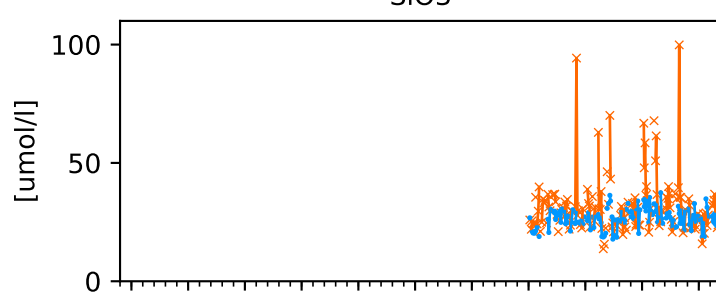
Tot-N



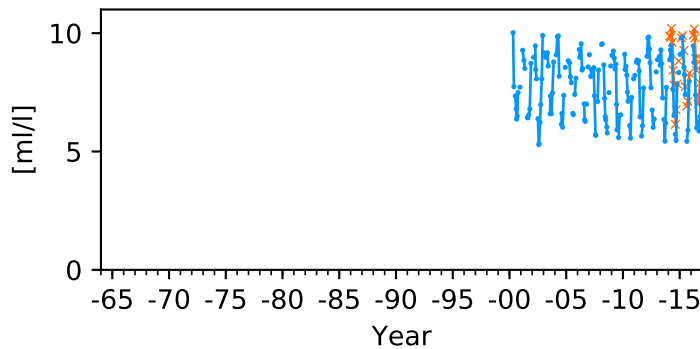
NOx



SiO3



Oxygen incl. H2S



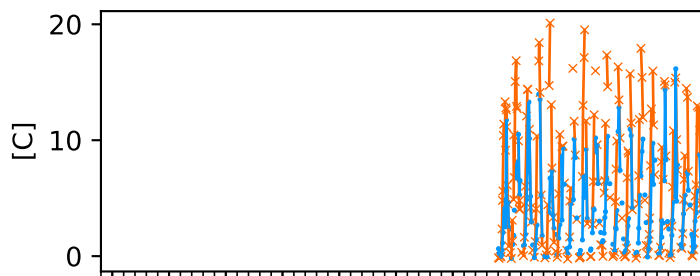
Chlorophyll-a bottle

No or very few Chlorophyll bottle data

THE QUARK: NB1 / B3

0-10 m ≥ 20 m

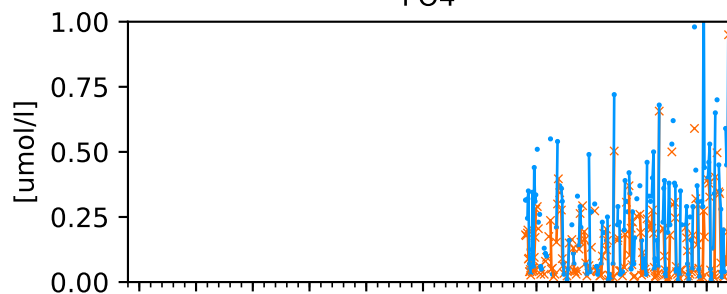
TEMP



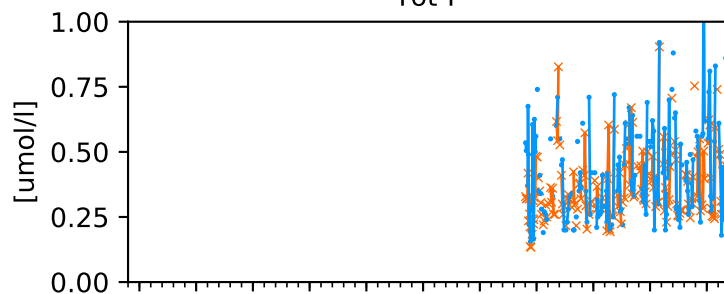
Salinity



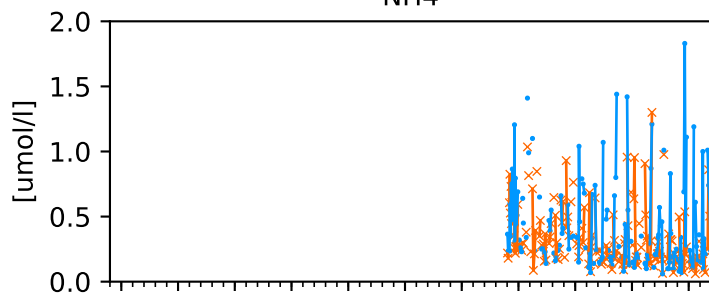
PO4



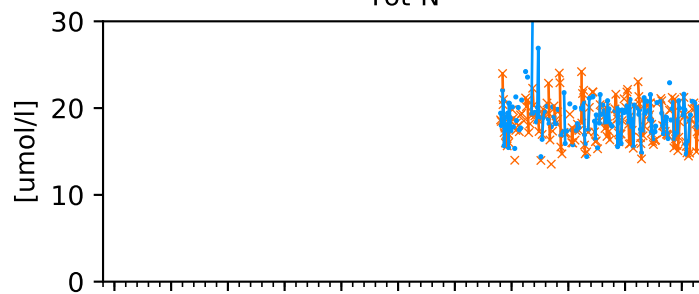
Tot-P



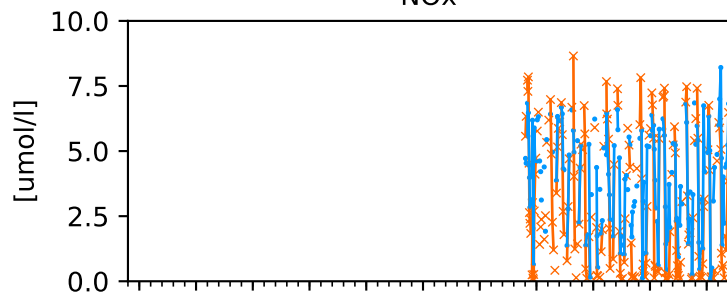
NH4



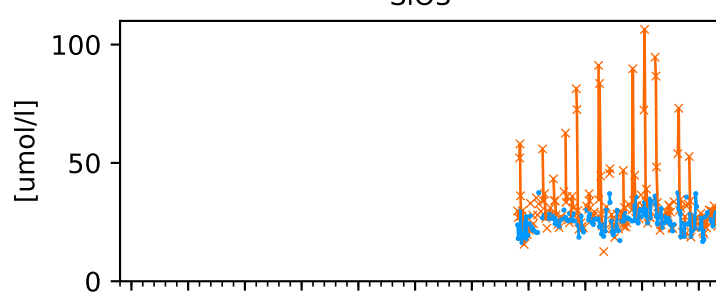
Tot-N



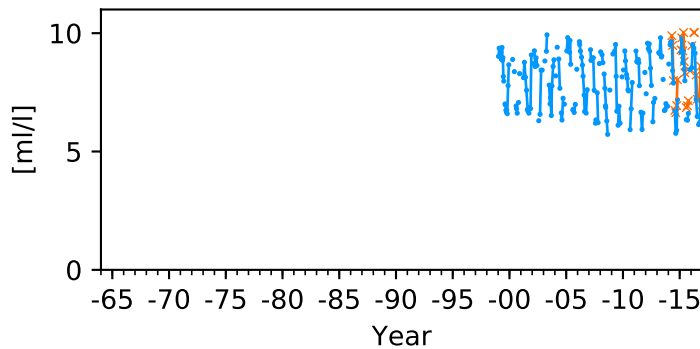
NOx



SiO3



Oxygen incl. H2S



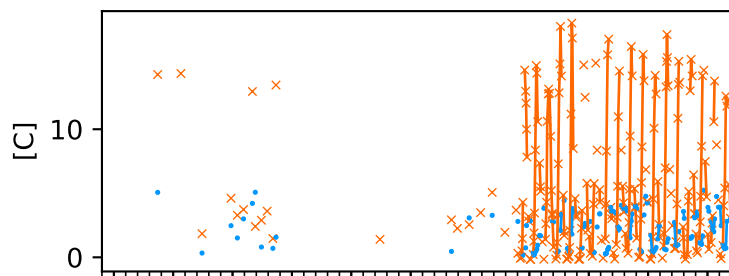
Chlorophyll-a bottle

No or very few Chlorophyll bottle data

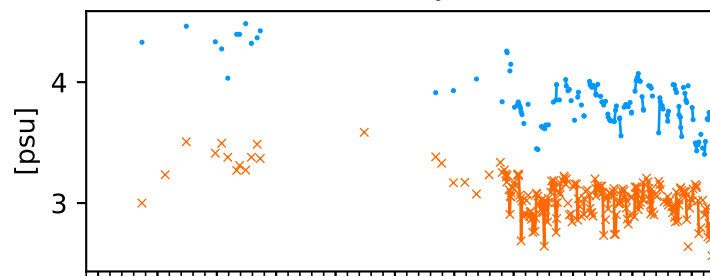
BOTHNIAN BAY: F9 / A13

0-10 m ≥ 120 m

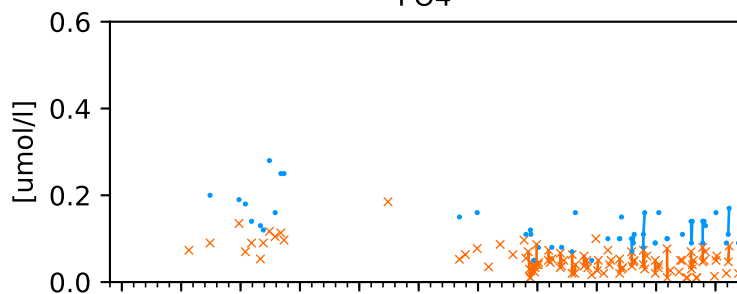
TEMP



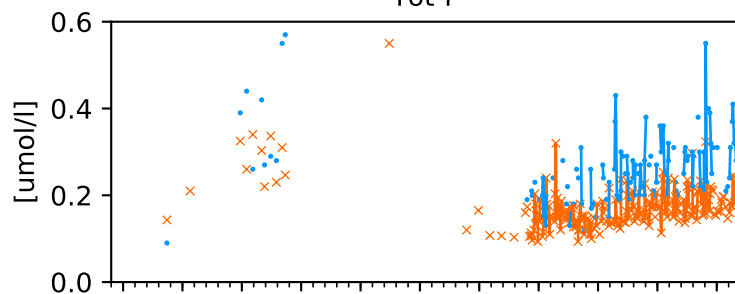
Salinity



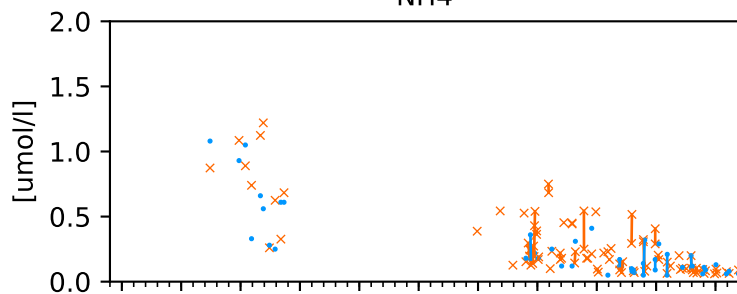
PO4



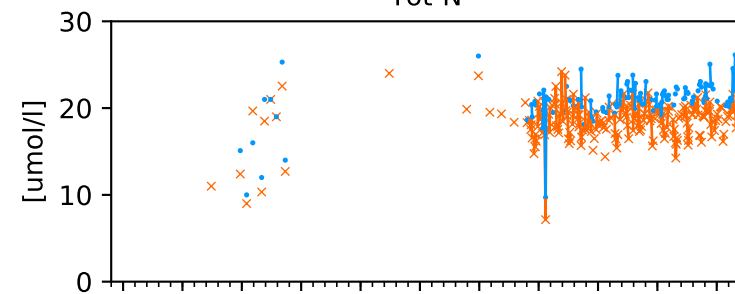
Tot-P



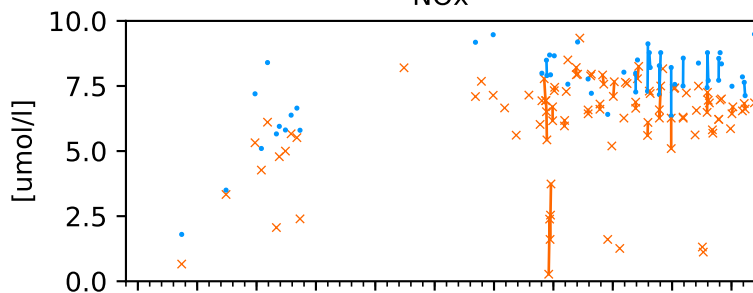
NH4



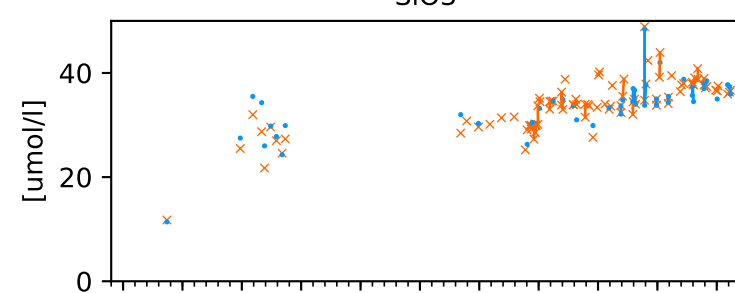
Tot-N



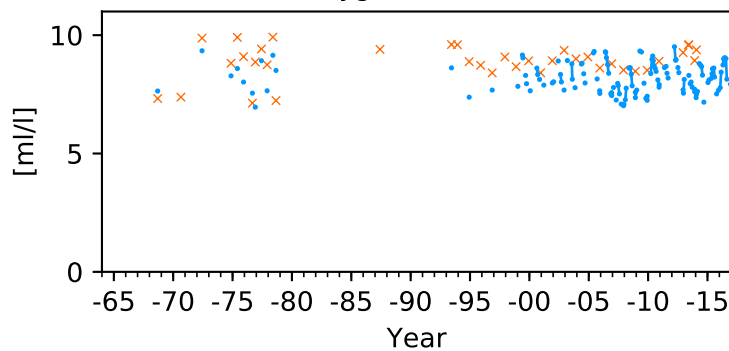
NOx



SiO3



Oxygen incl. H2S



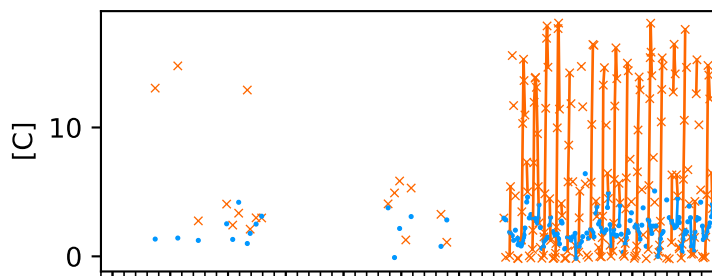
Chlorophyll-a bottle

No or very few Chlorophyll bottle data

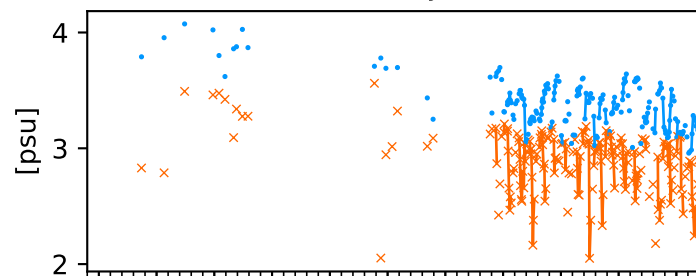
BOTHNIAN BAY: F3 / A5

0-10 m ≥ 80 m

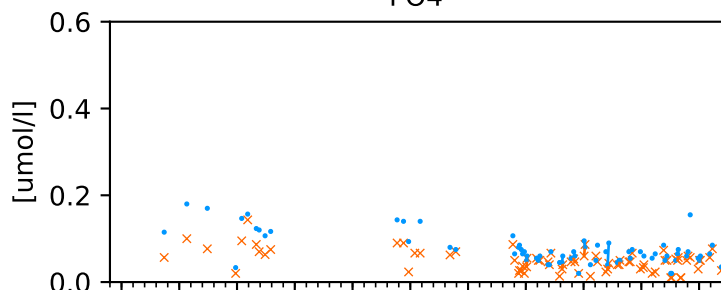
TEMP



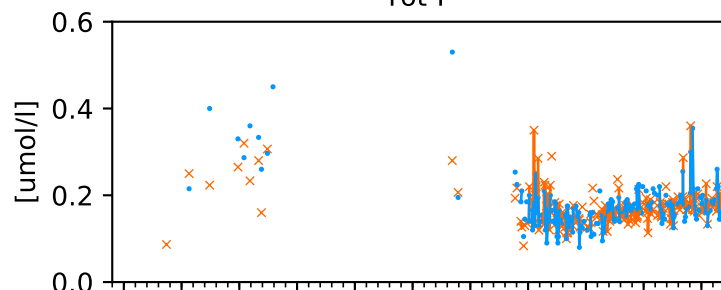
Salinity



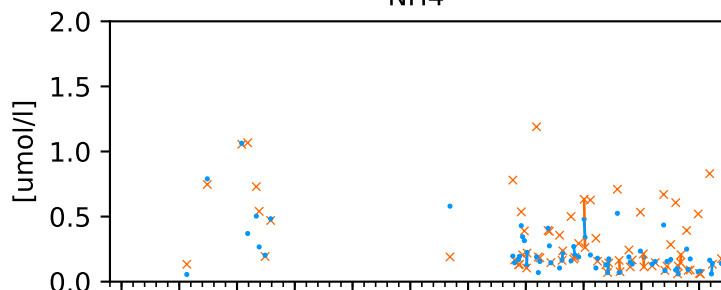
PO4



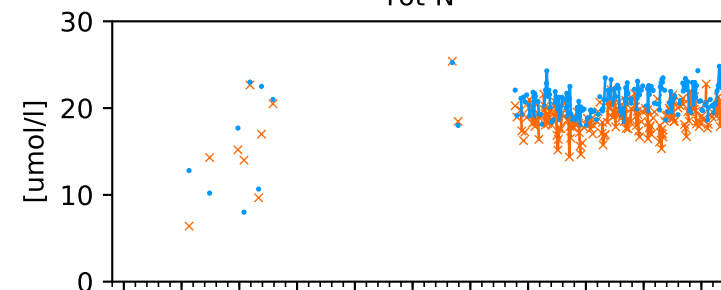
Tot-P



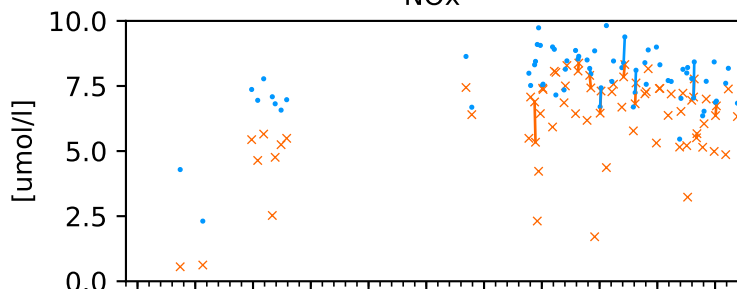
NH4



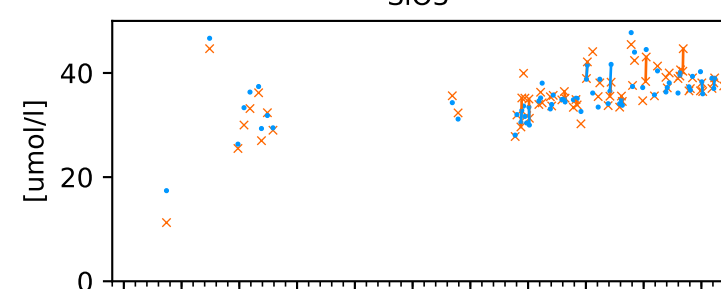
Tot-N



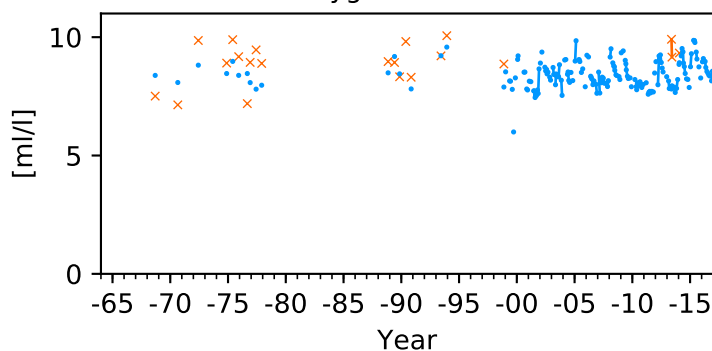
NOx



SiO3



Oxygen incl. H2S

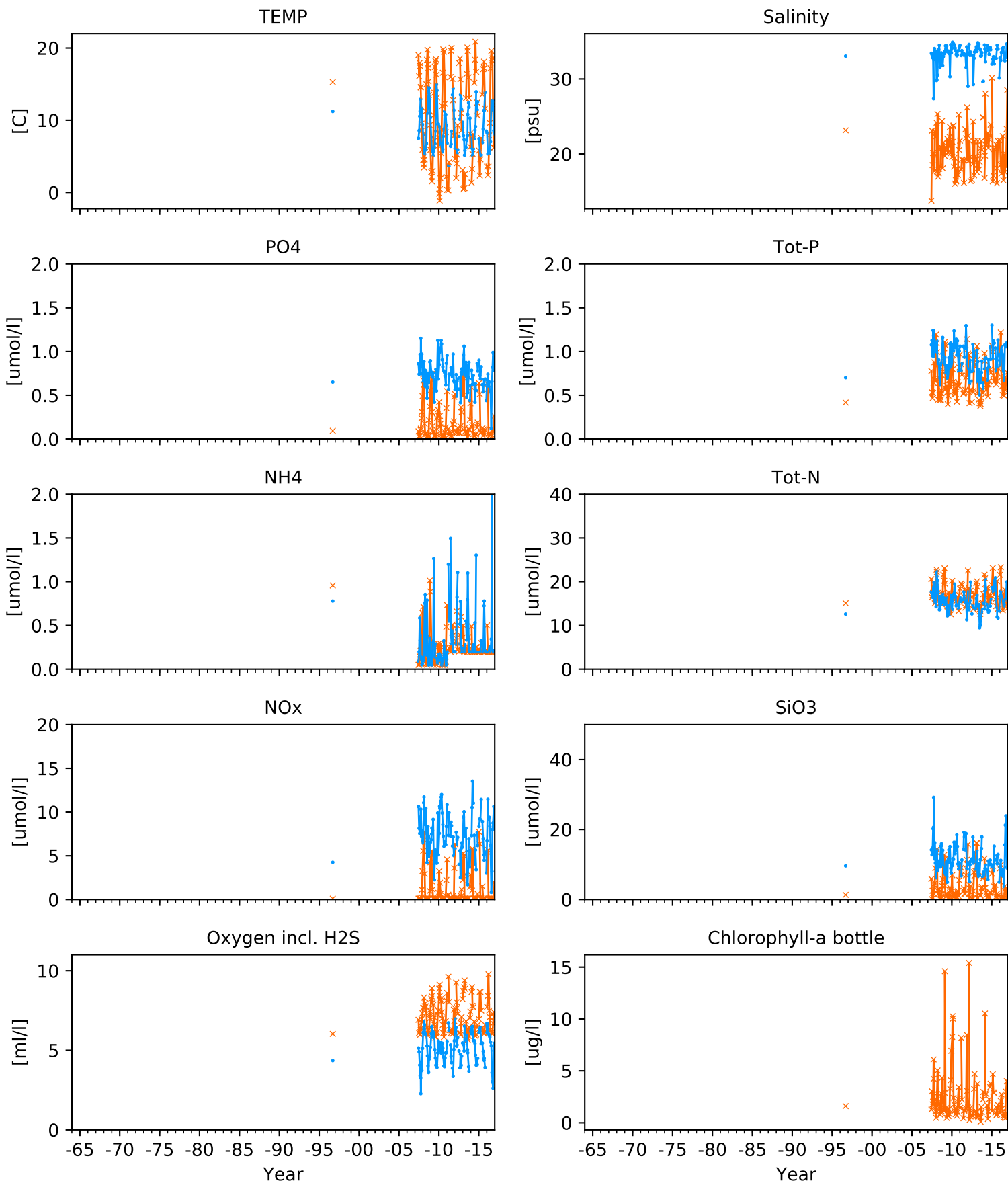


Chlorophyll-a bottle

No or very few Chlorophyll bottle data

KATTEGATT: N14 FALKENBERG

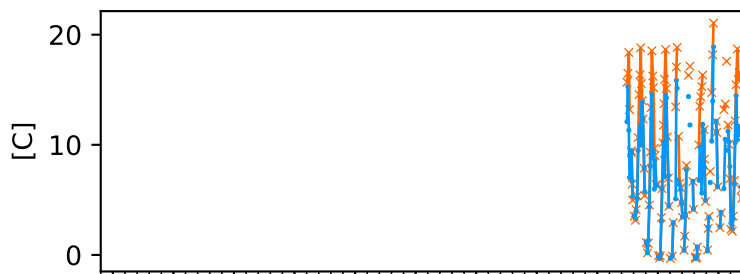
0-10 m ≥ 25 m



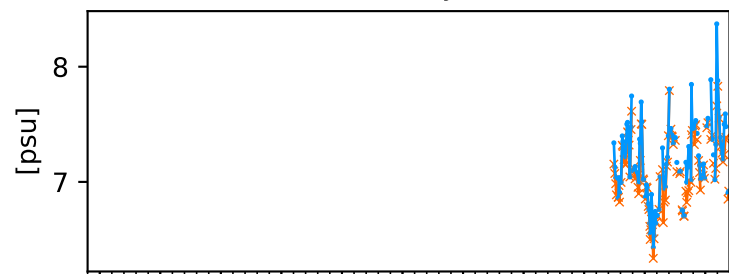
BORNHOLM: REF M1V1

0-10 m ≥ 15 m

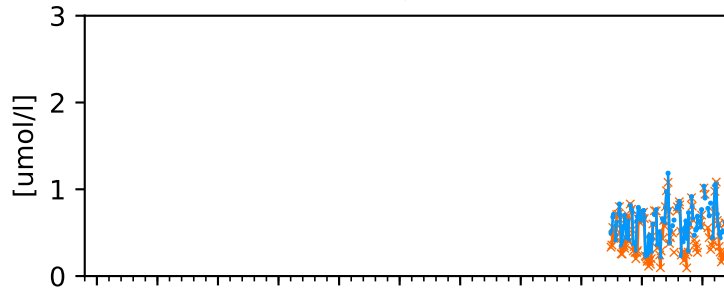
TEMP



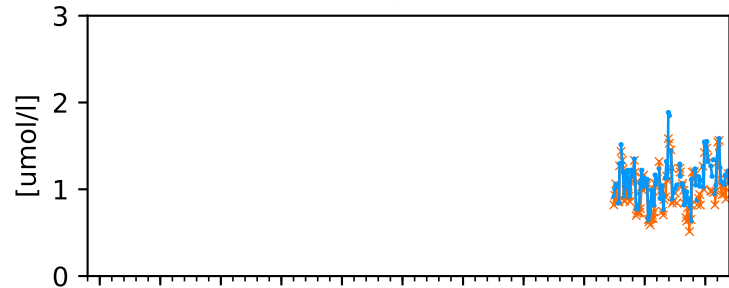
Salinity



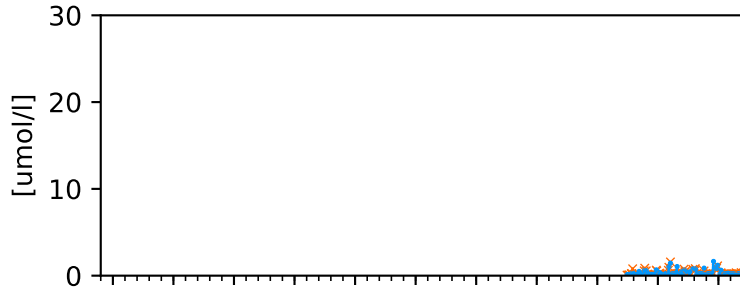
PO4



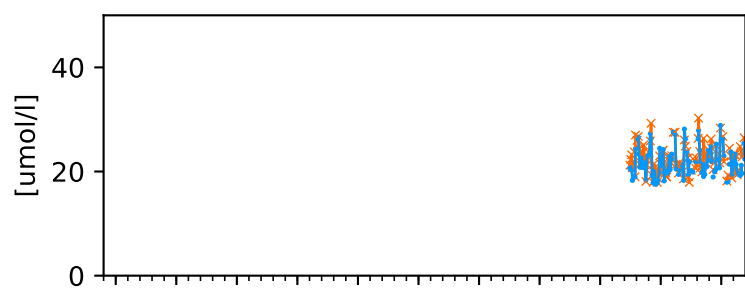
Tot-P



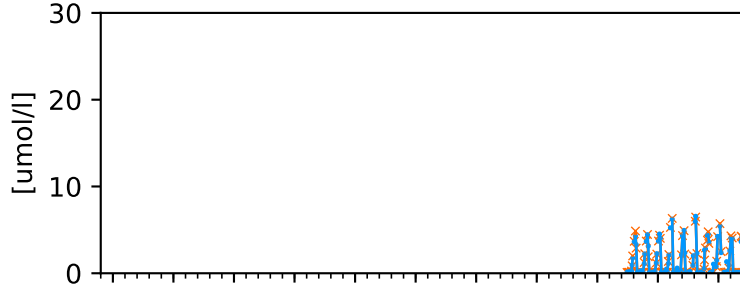
NH4



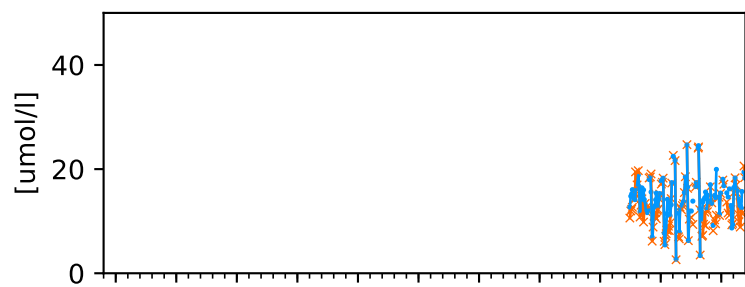
Tot-N



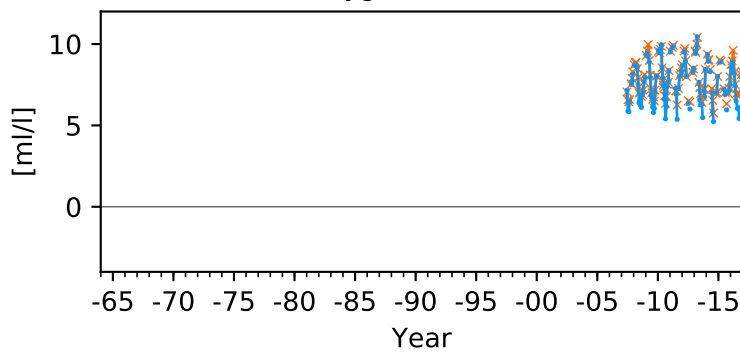
NOx



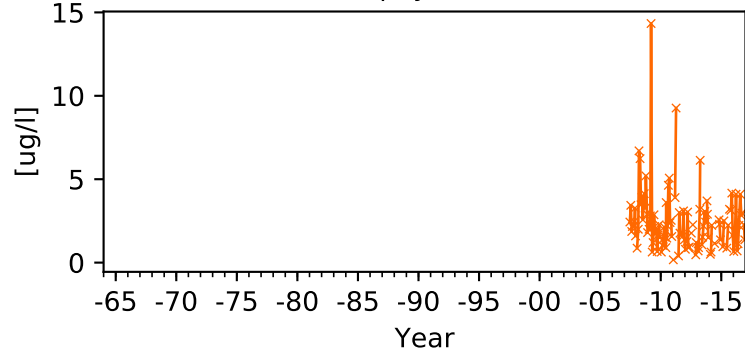
SiO3



Oxygen incl. H2S



Chlorophyll-a bottle



Appendix III

Nutrient content per basin in the Baltic Sea

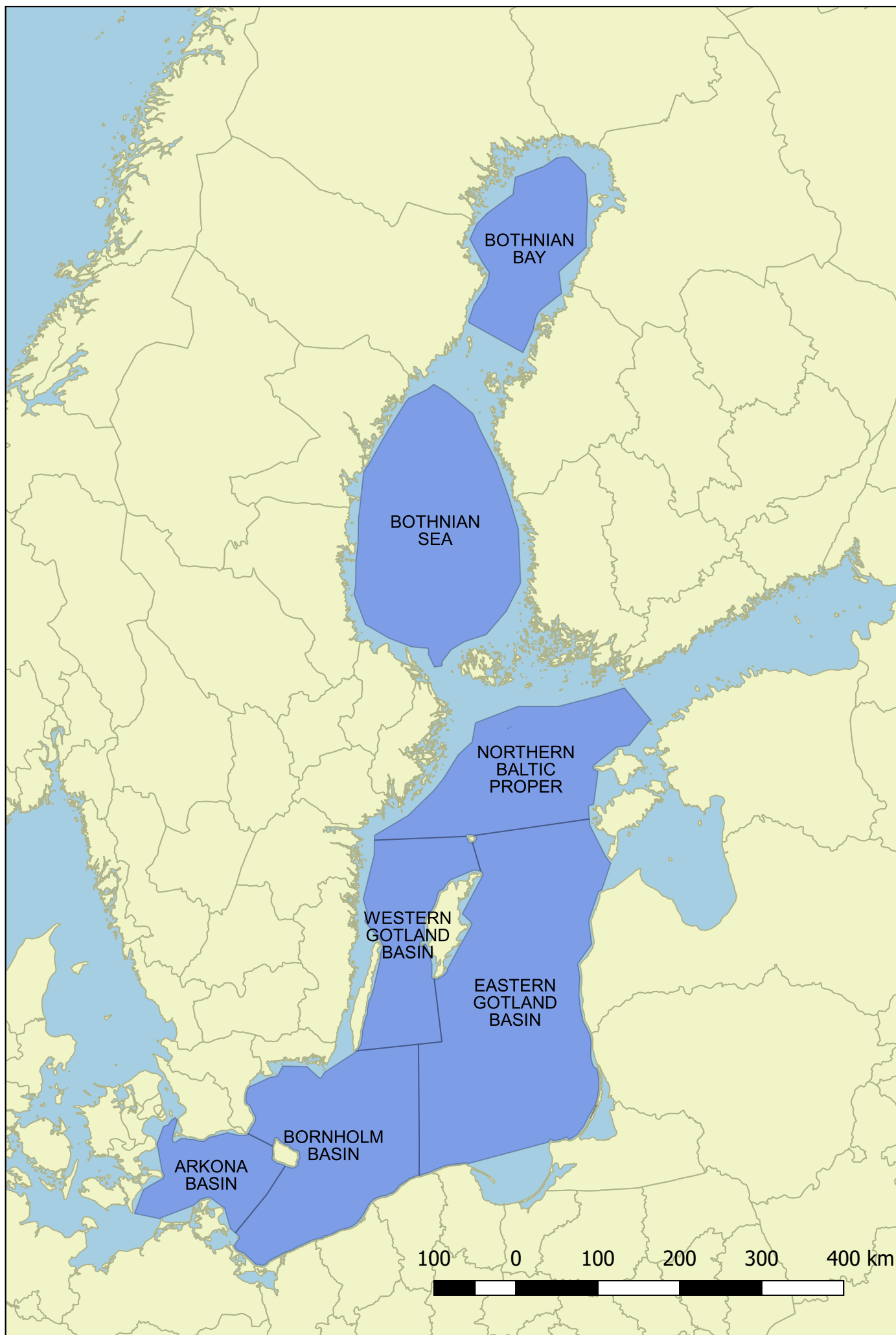
Method

The basin content of nutrients is calculated from the same data set that is used for the time series presented in Appendix II. Each profile is interpolated (linearly) to retrieve concentrations in 1 m depth intervals from each station. Only complete profiles with data in the surface, intermediary and deep waters are used.

The data is divided into winter, spring, summer and autumn seasons (winter: Dec-Feb, spring: Mar-May, summer: June-Aug, autumn: Sep-Nov). This means that 2016 winter is calculated from data collected in December 2015, January 2016 and February 2016.

The seasonal content in each basin is then calculated as follows: the concentration for each depth layer from all stations within one basin is averaged and multiplied with the volume of that depth layer, thereby getting the content of each nutrient in that depth layer. All depth layers are then summed to give the content for the whole basin. The yearly content is calculated by averaging the content over all seasons for each year allowing missing data from one season. For the Bothnian Bay and Bothnian Sea this means only Total Phosphorus and Total Nitrogen is shown for the content per year. Content for the Baltic Proper is calculated by summing the content in the basins; Arkona, Bornholm, Eastern Gotland Basin, Northern Baltic Proper and Western Gotland Basin.

The volume of each depth layer is calculated from the bathymetry dataset iowotopo2 available by IOW at <https://www.io-warnemuende.de/topography-of-the-baltic-sea.html> and by using the open sea basin subdivision set by HELCOM, (<http://maps.helcom.fi/website/mapservice/index.html>). The basin subdivisions used are shown in the first figure of Appendix III.

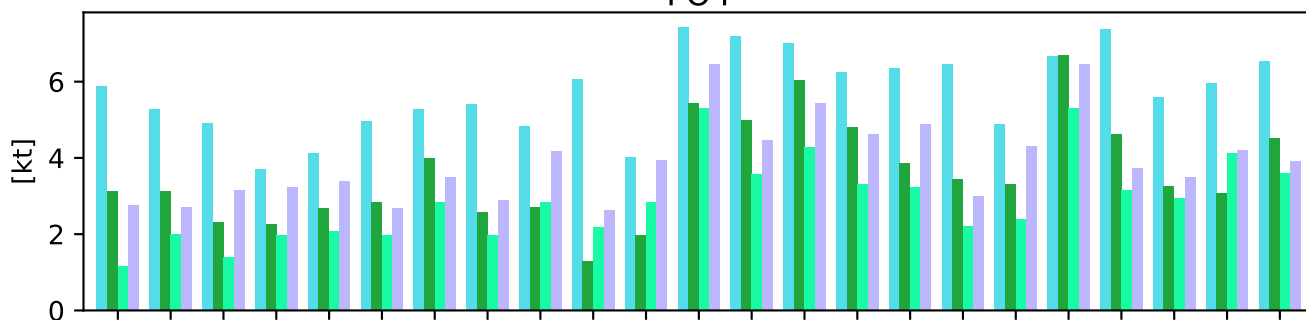


Arkona Basin

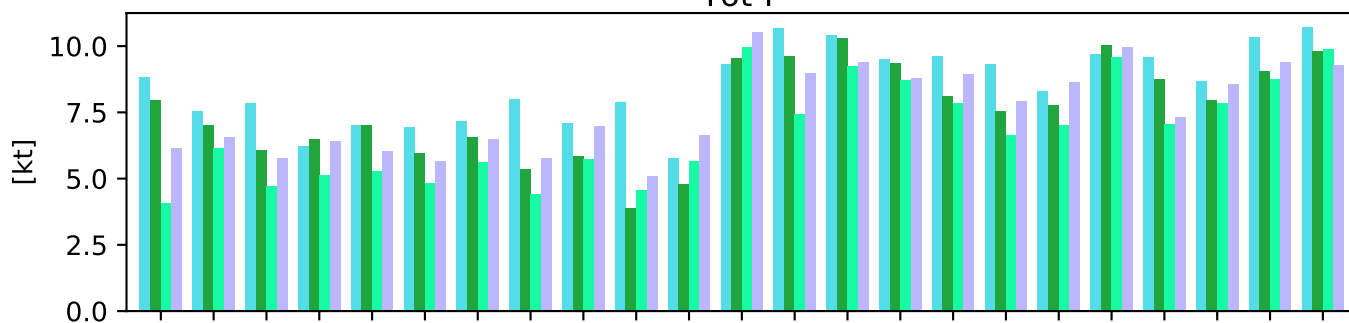
Offshore volume of basin: 344 km³

winter spring summer autumn

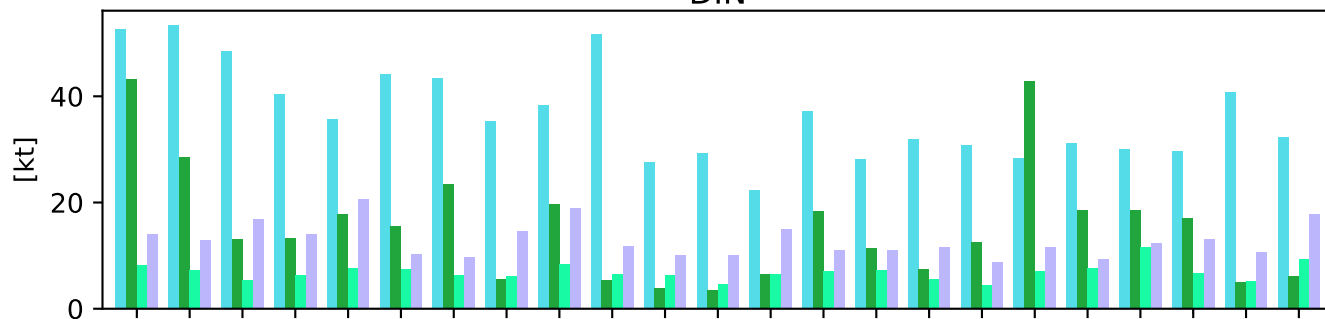
PO4



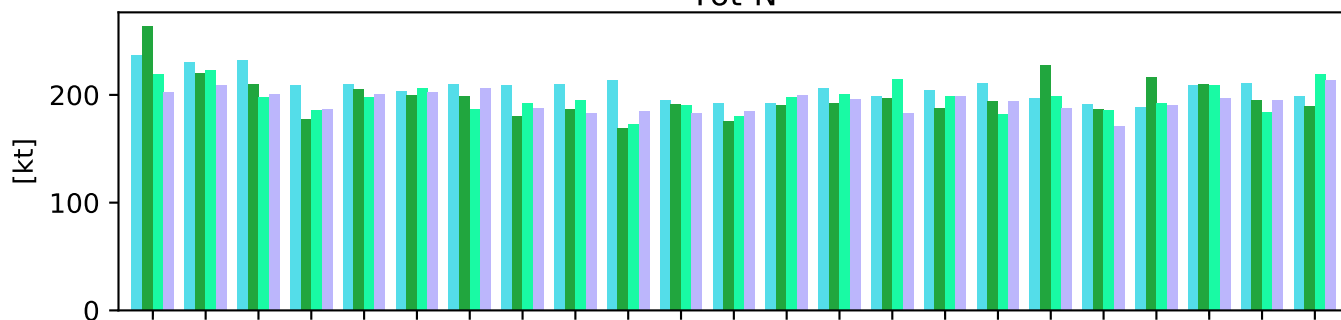
Tot-P



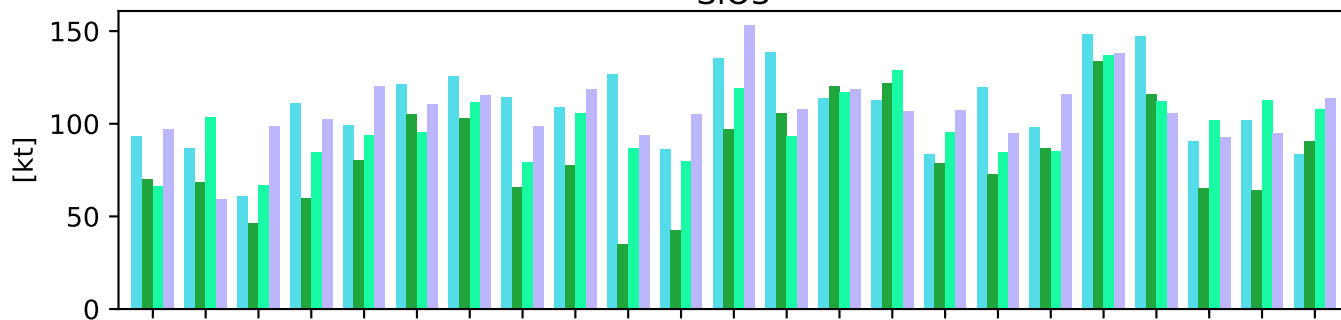
DIN



Tot-N



SiO3



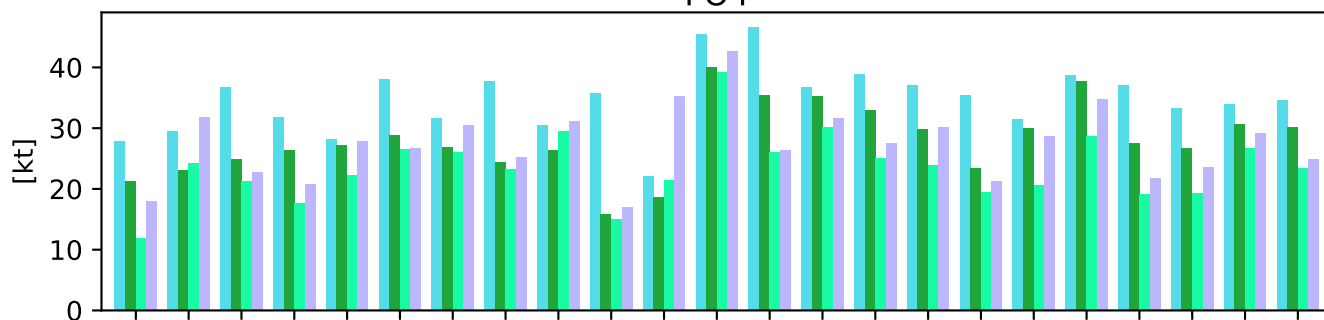
year

Bornholm Basin

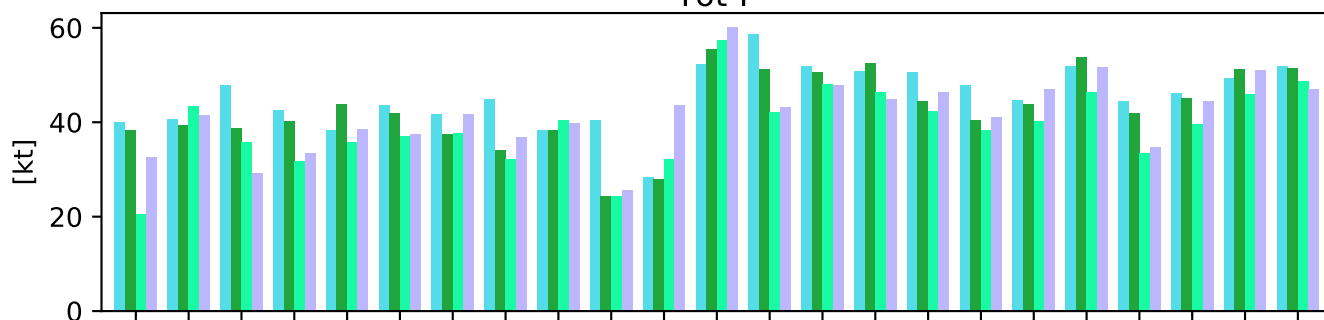
Offshore volume of basin: 1561 km³

winter spring summer autumn

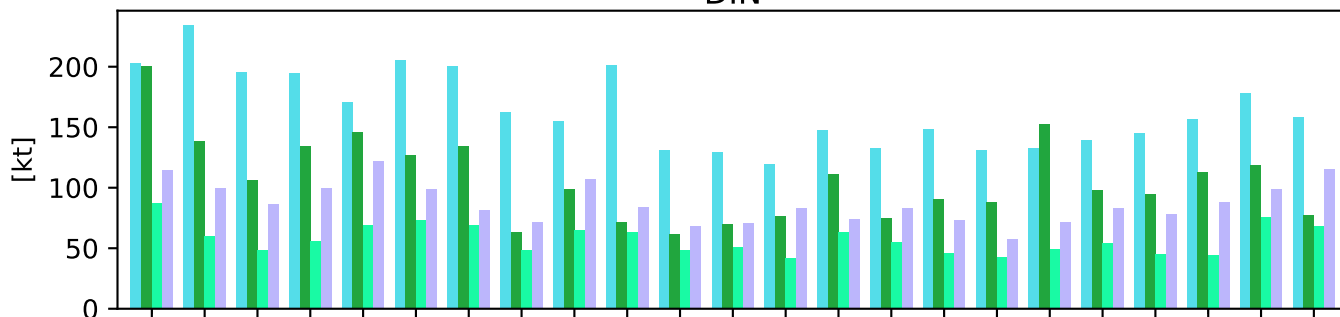
PO4



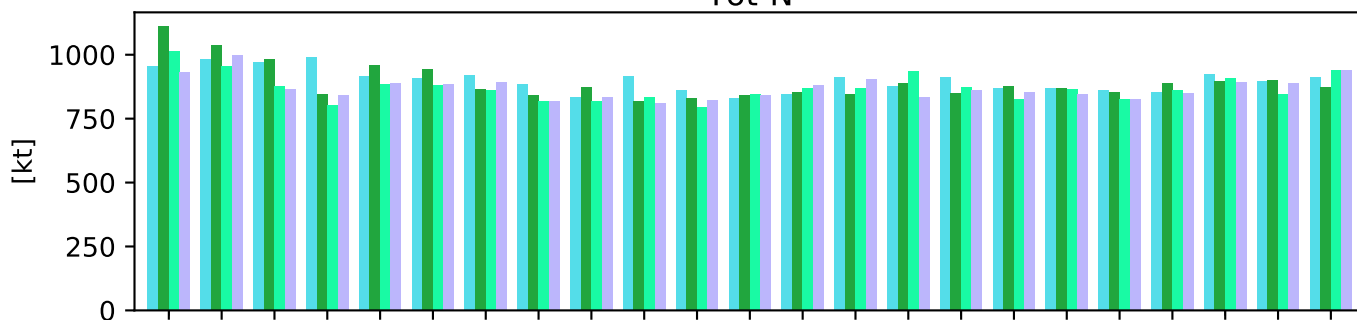
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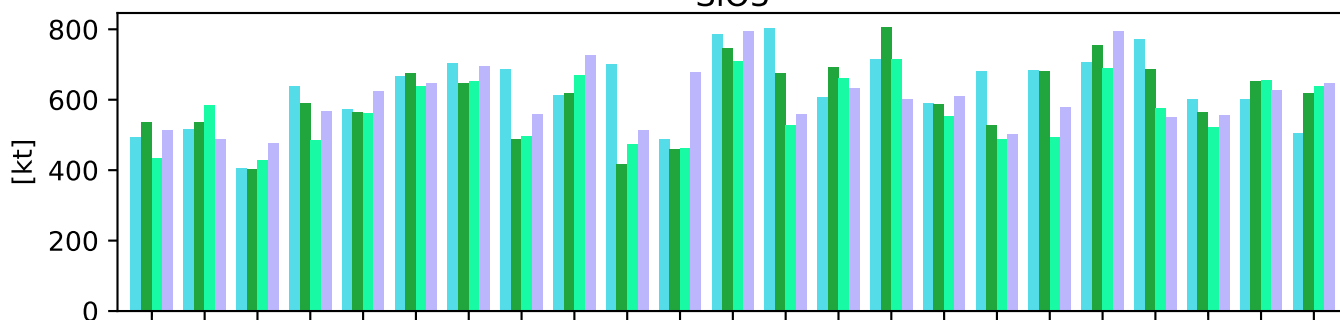
DIN



Tot-N



SiO3



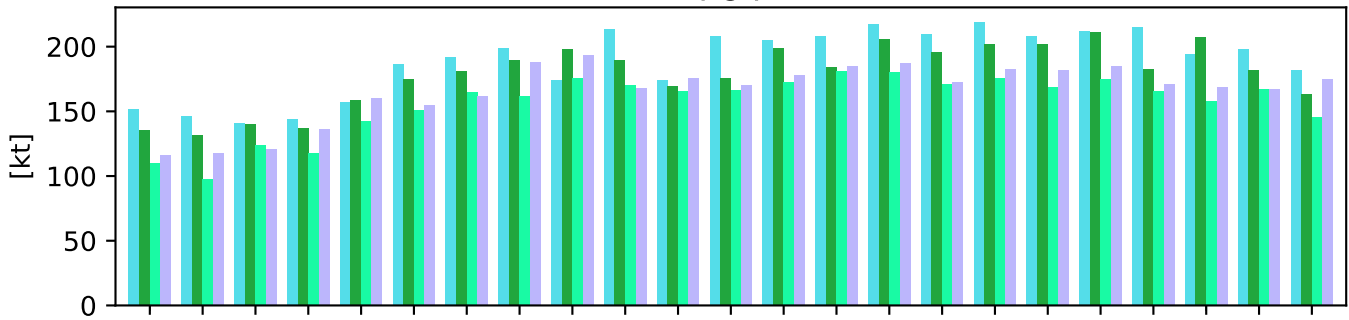
year

Eastern Gotland Basin

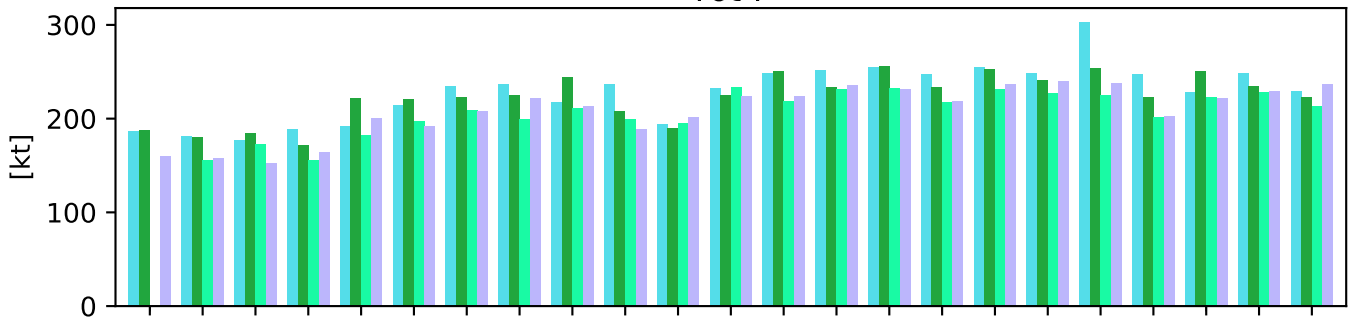
Offshore volume of basin: 5186 km³

winter spring summer autumn

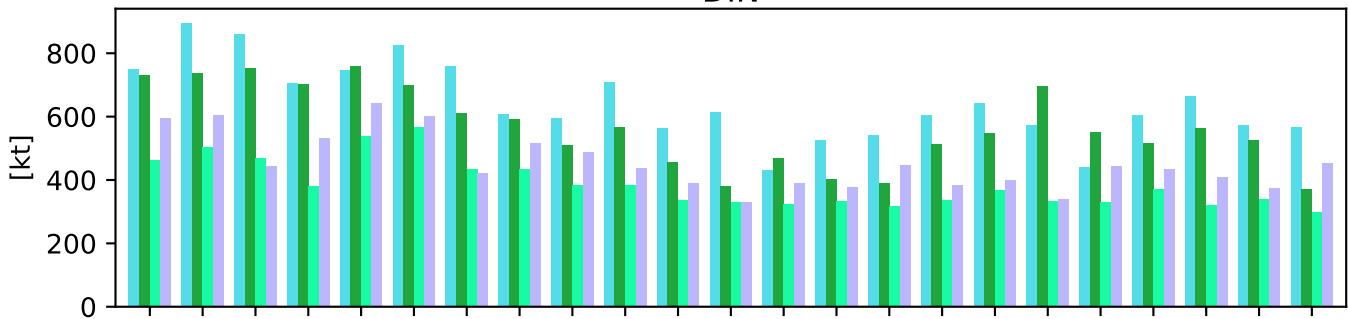
PO4



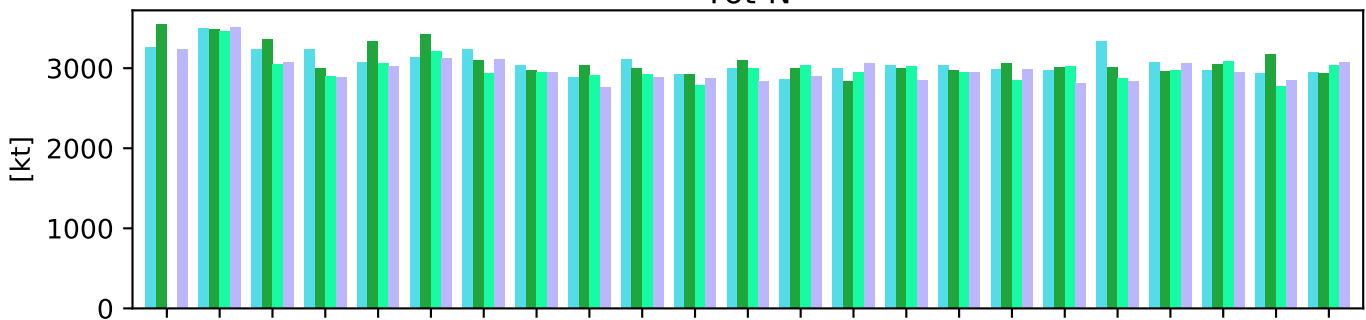
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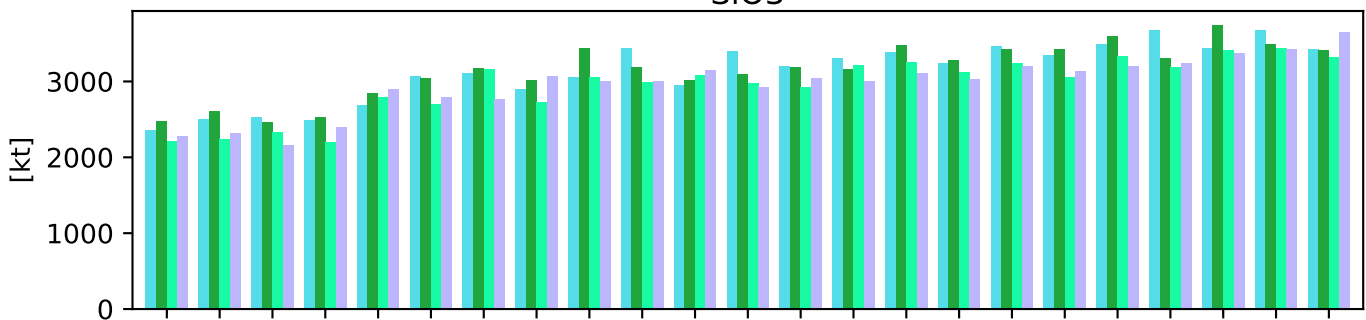
DIN



Tot-N



SiO3



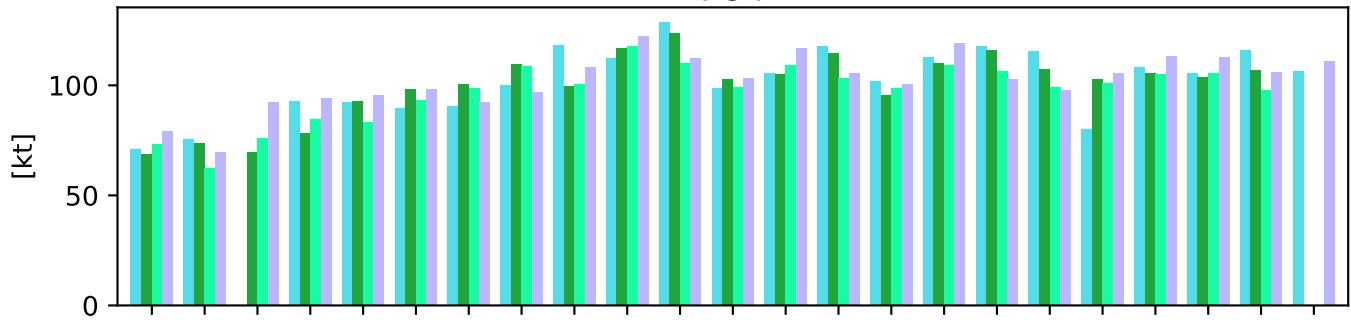
year

Northern Baltic Proper

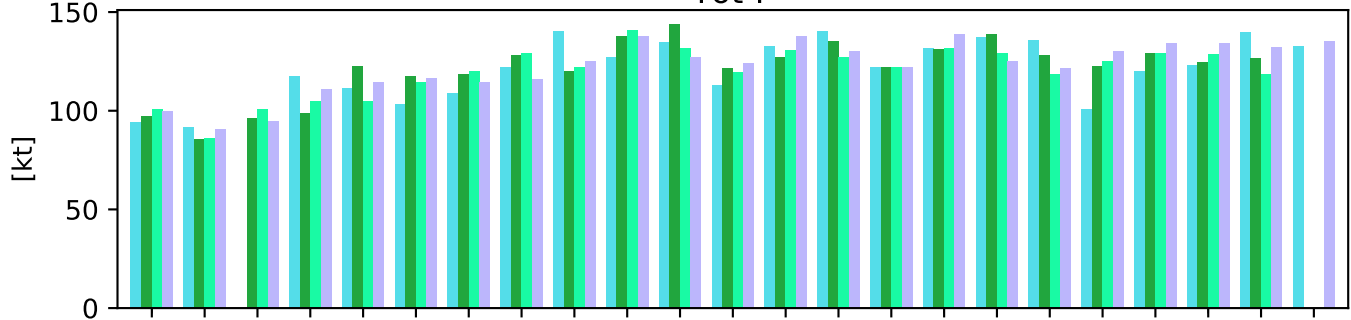
Offshore volume of basin: 2674 km³

winter spring summer autumn

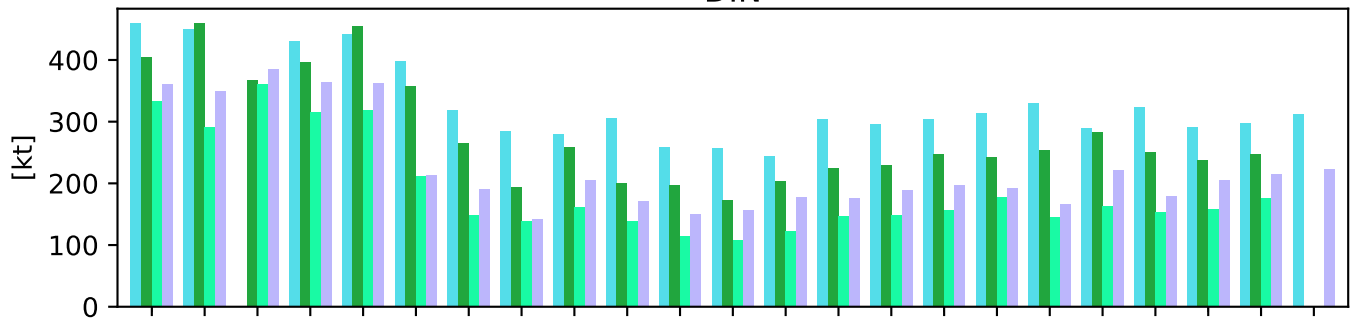
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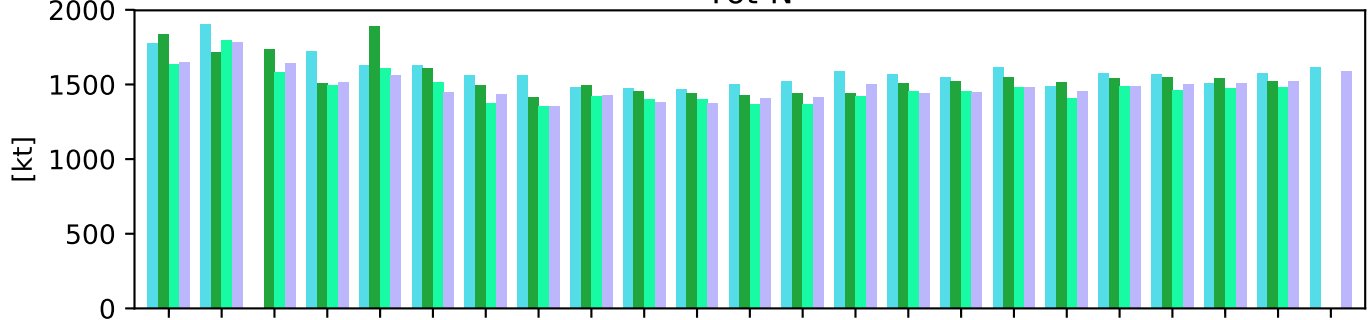
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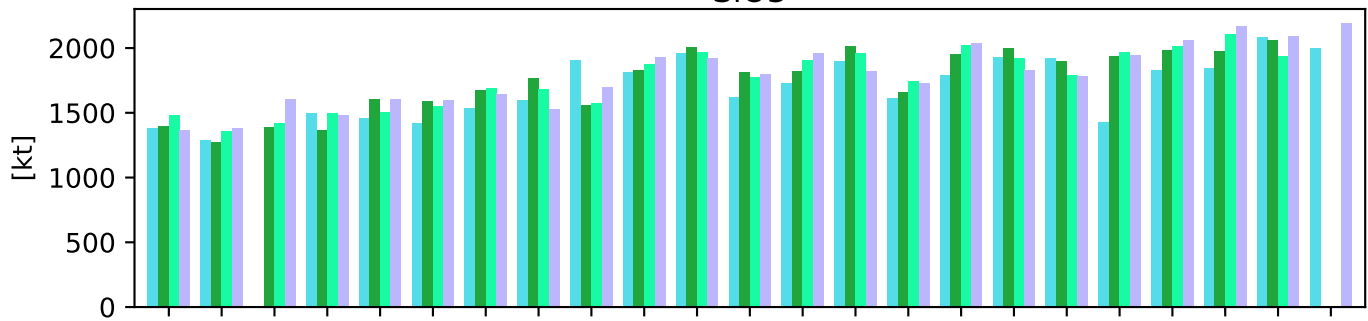
DIN



Tot-N



SiO3



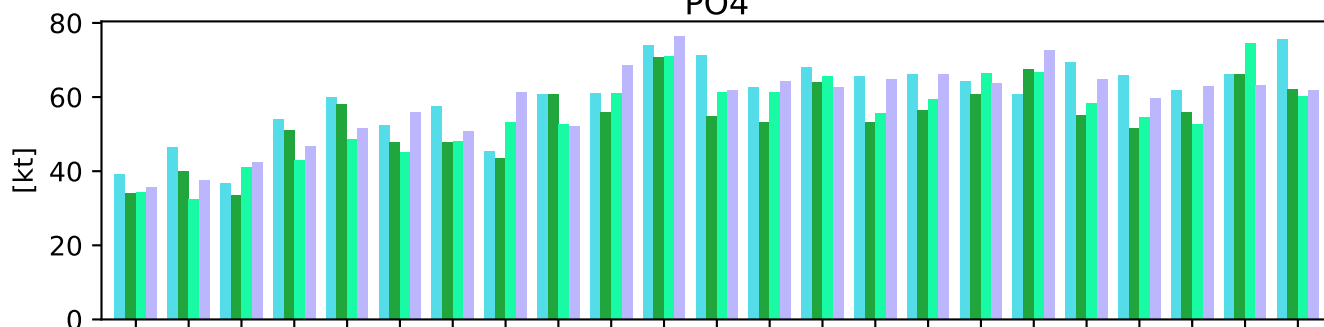
year

Western Gotland Basin

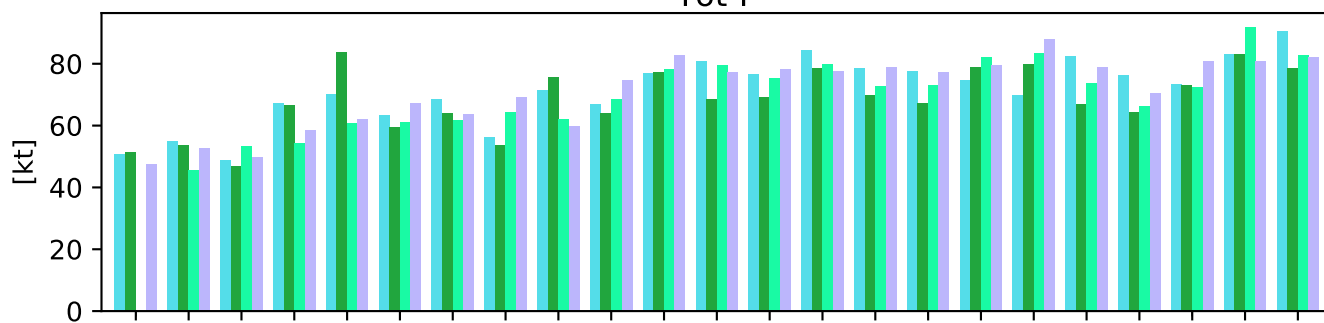
Offshore volume of basin: 1596 km³

winter spring summer autumn

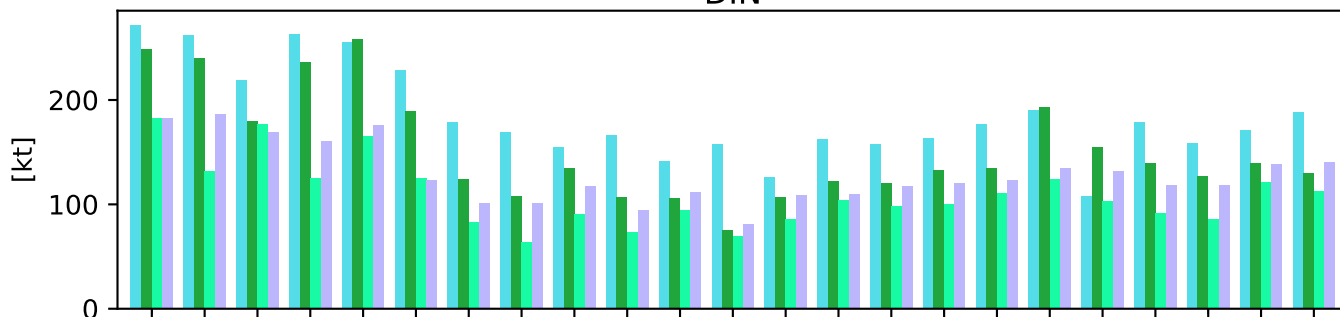
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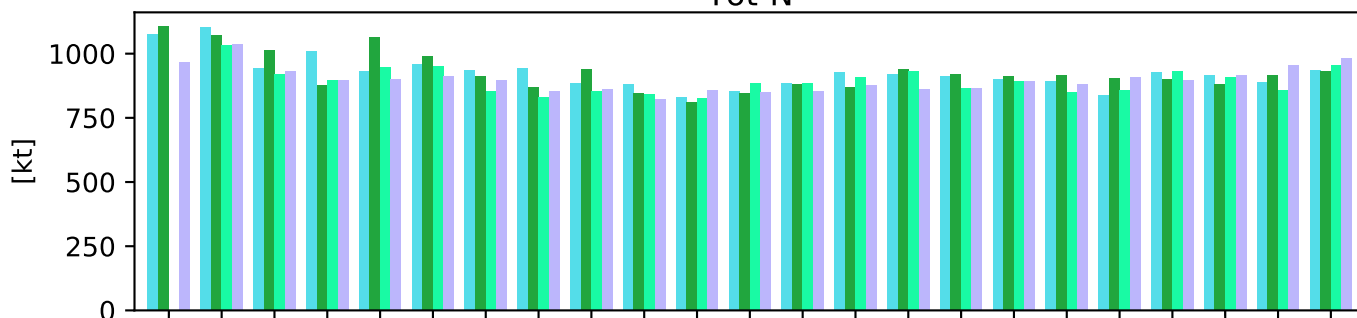
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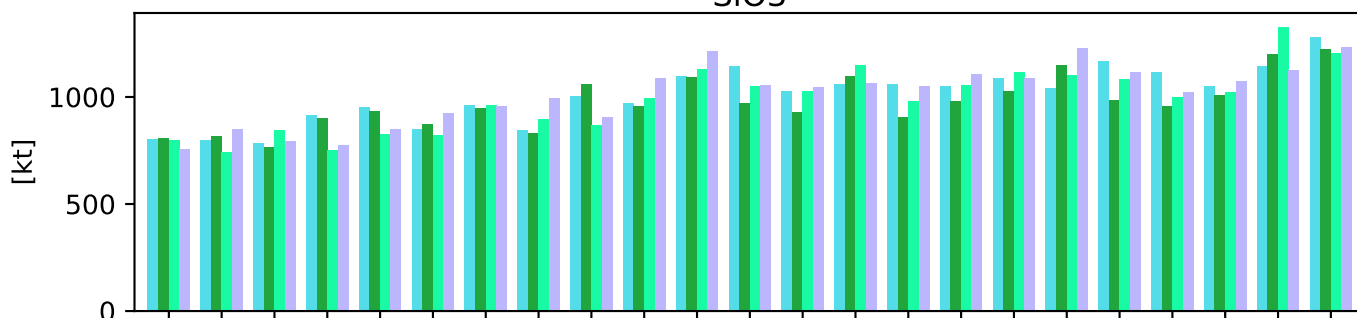
DIN



Tot-N



SiO3



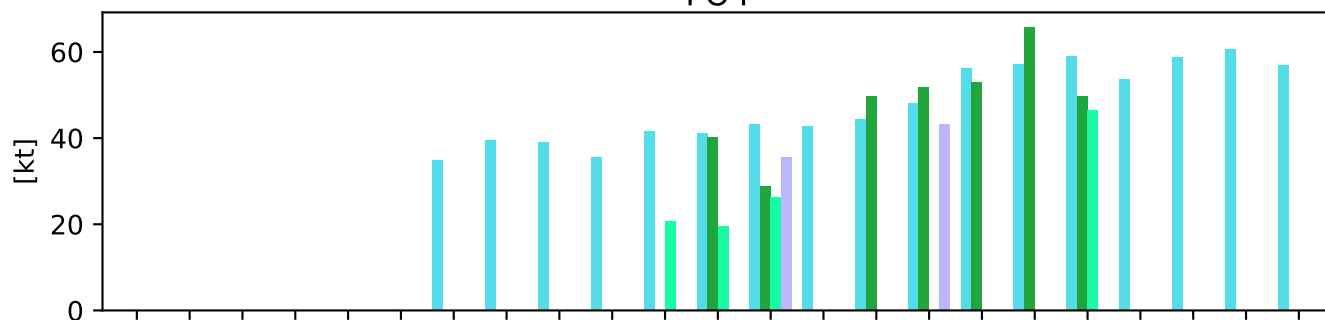
year

Bothnian Sea

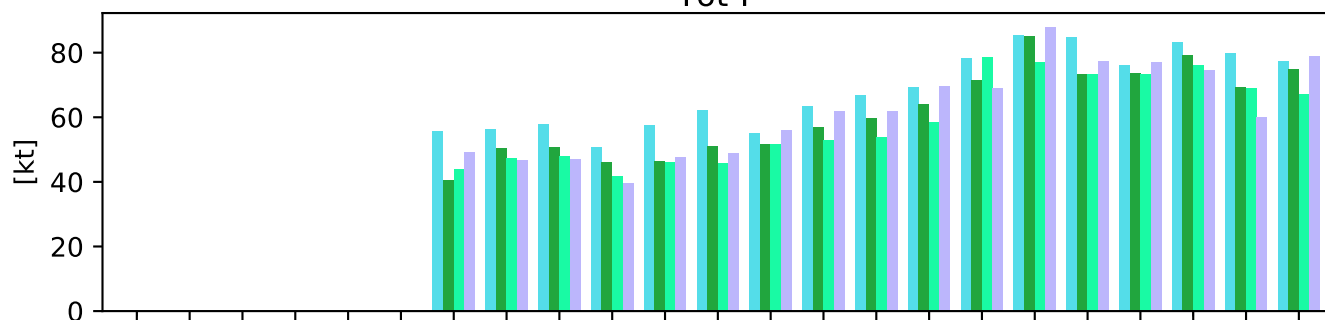
Offshore volume of basin: 4053 km³

winter spring summer autumn

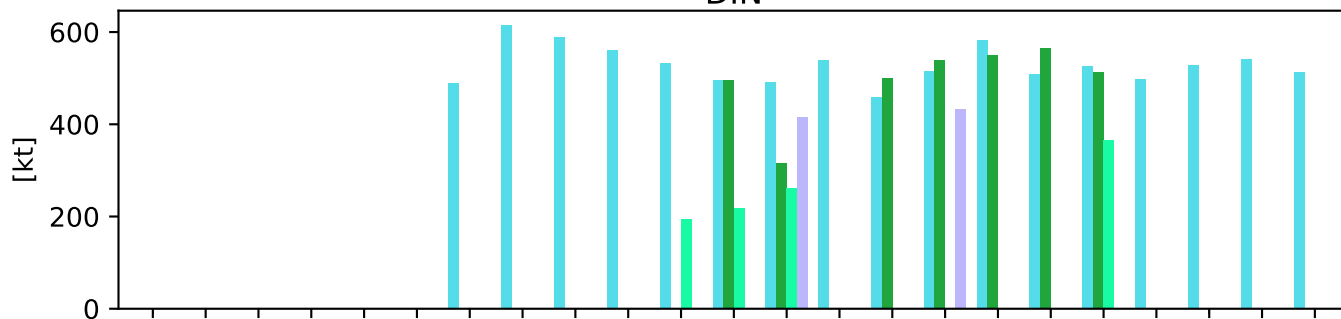
PO4



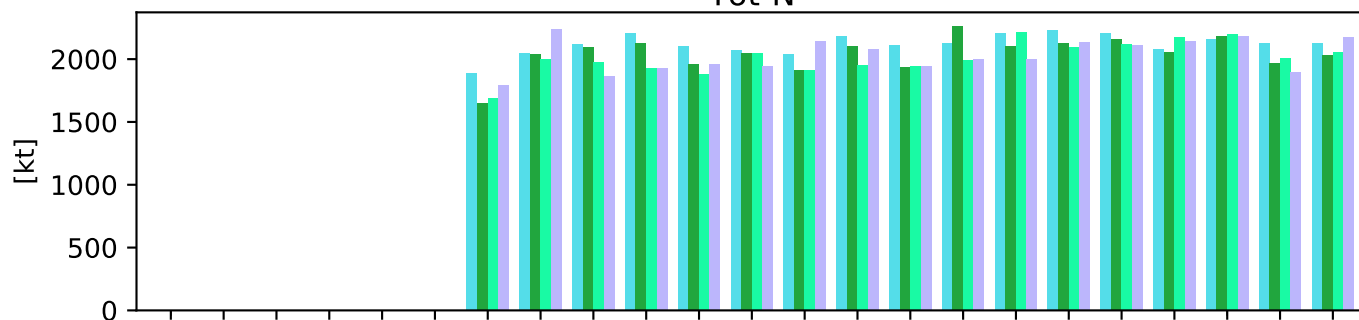
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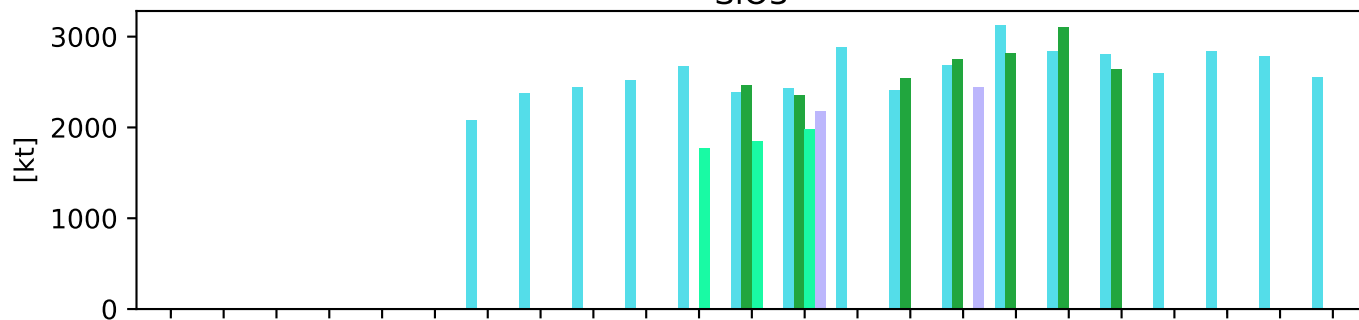
DIN



Tot-N



SiO3



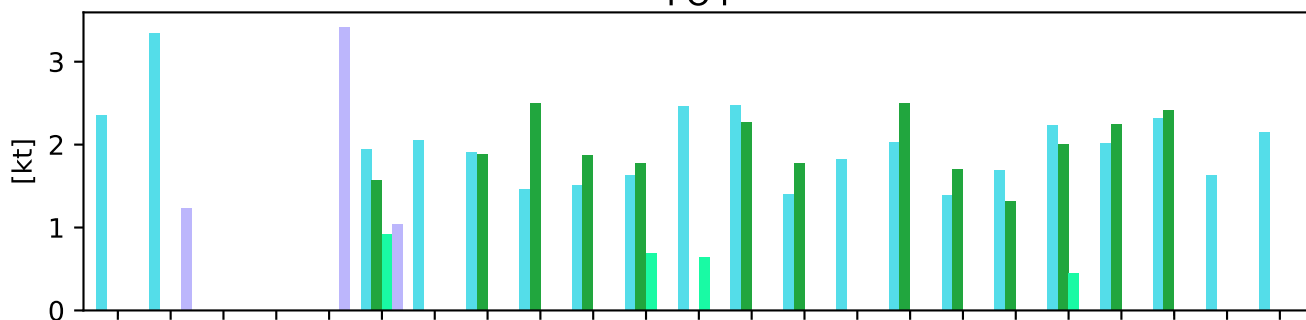
year

Bothnian Bay

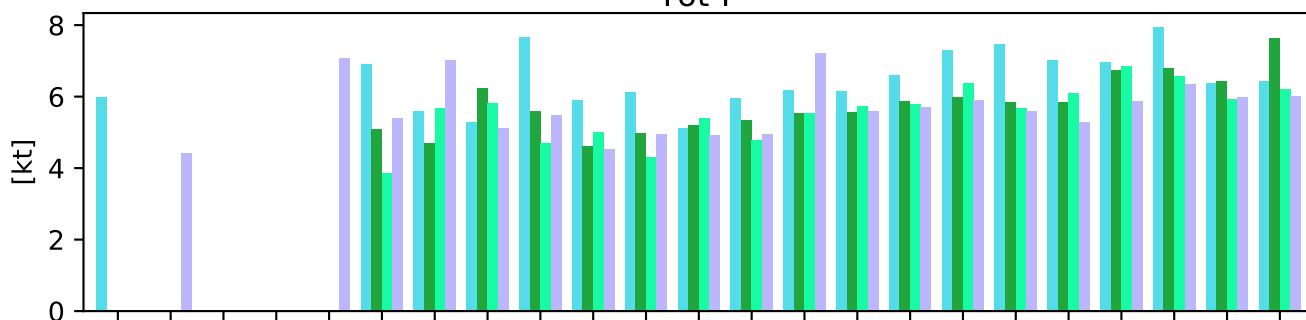
Offshore volume of basin: 1338 km³

winter spring summer autumn

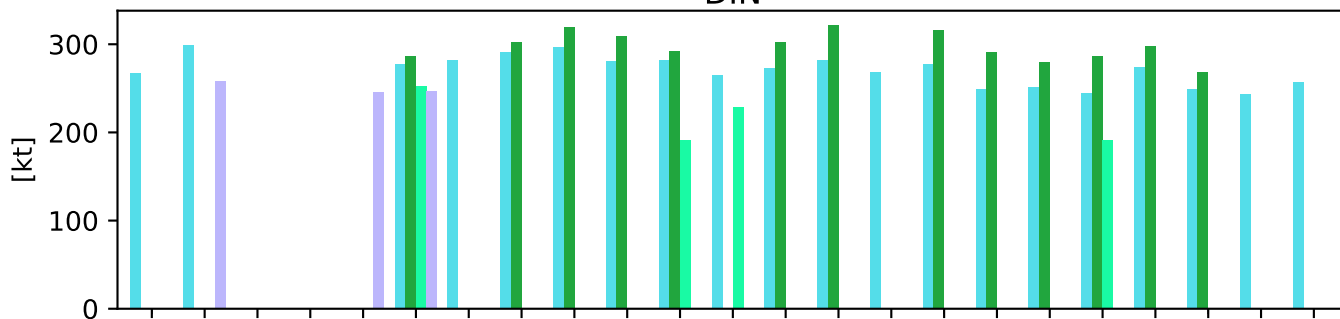
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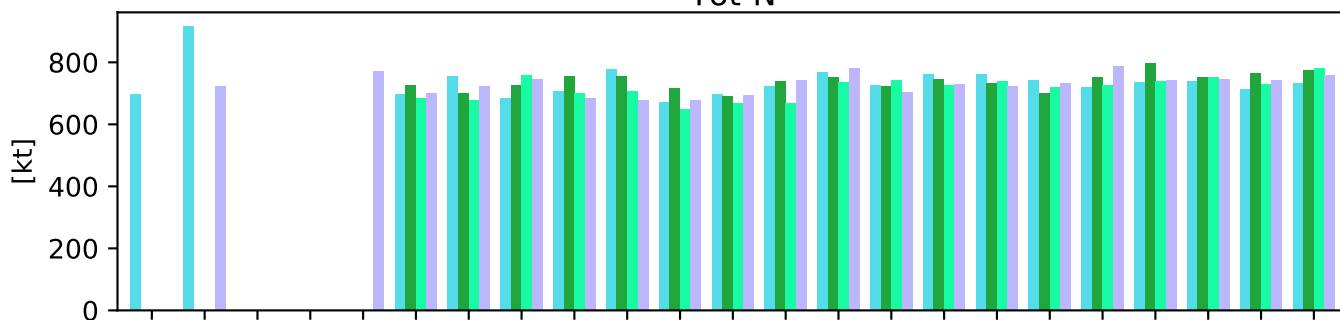
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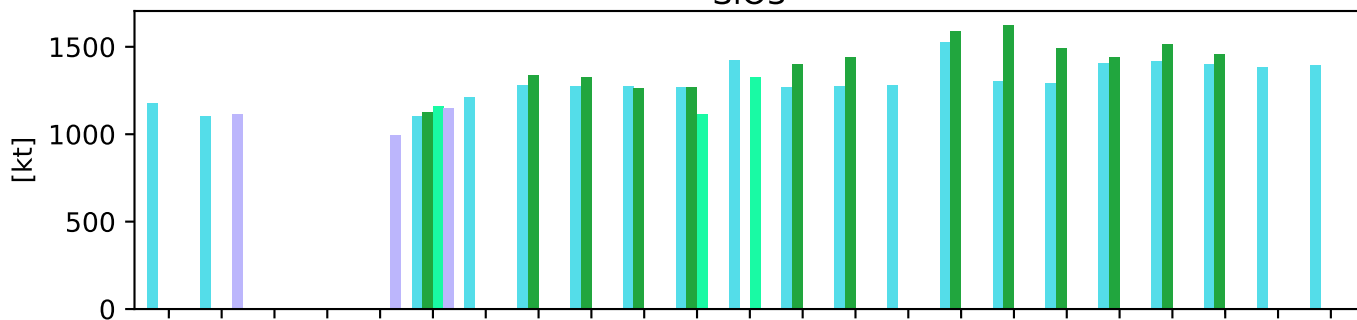
DIN



Tot-N



SiO3

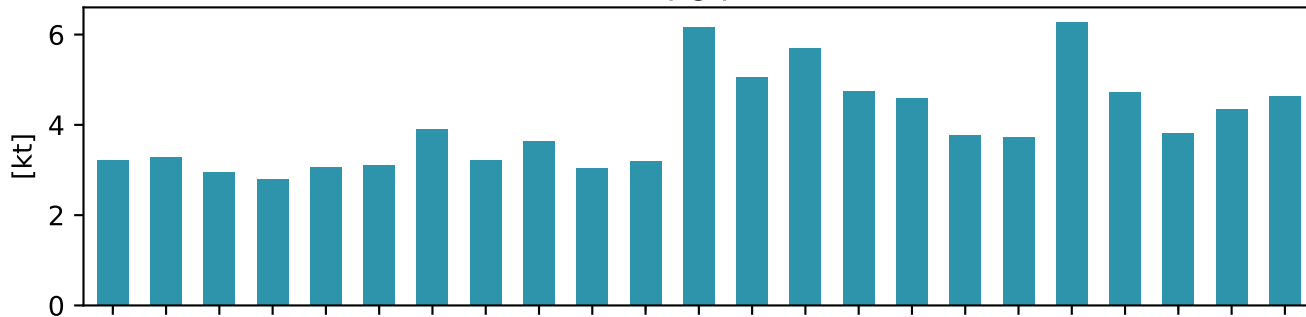


year

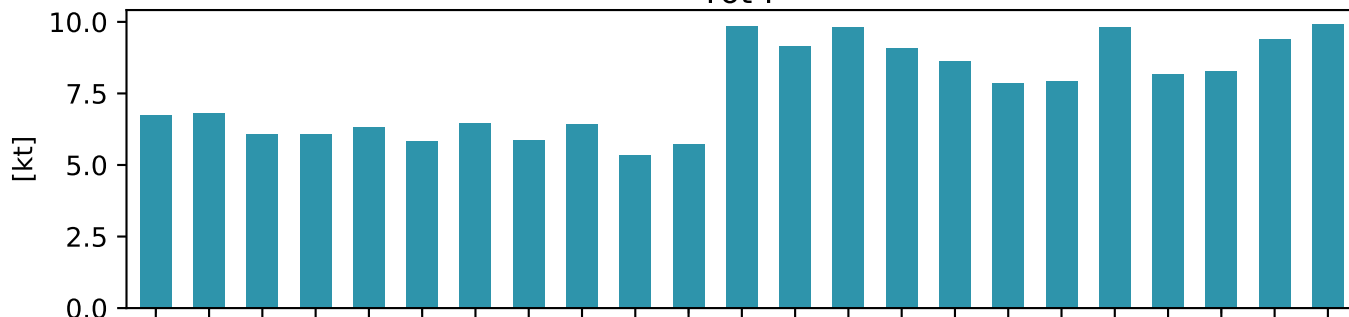
Arkona Basin

Offshore volume of basin: 344 km³

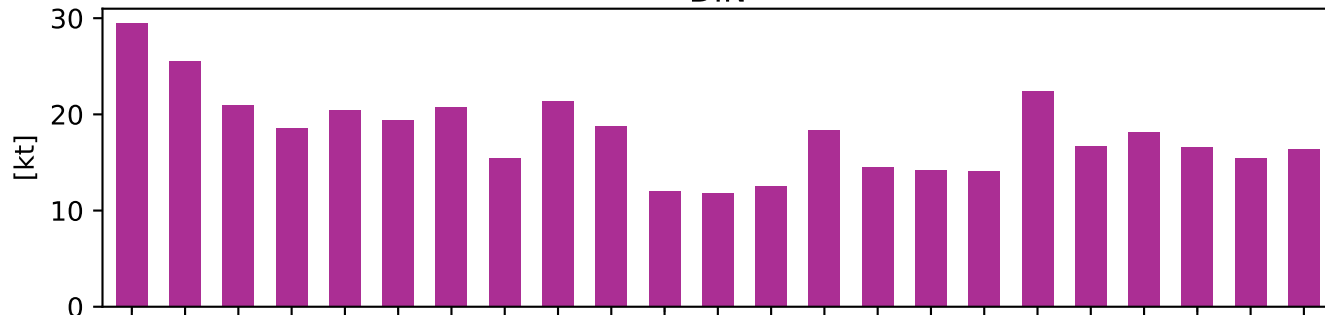
PO4



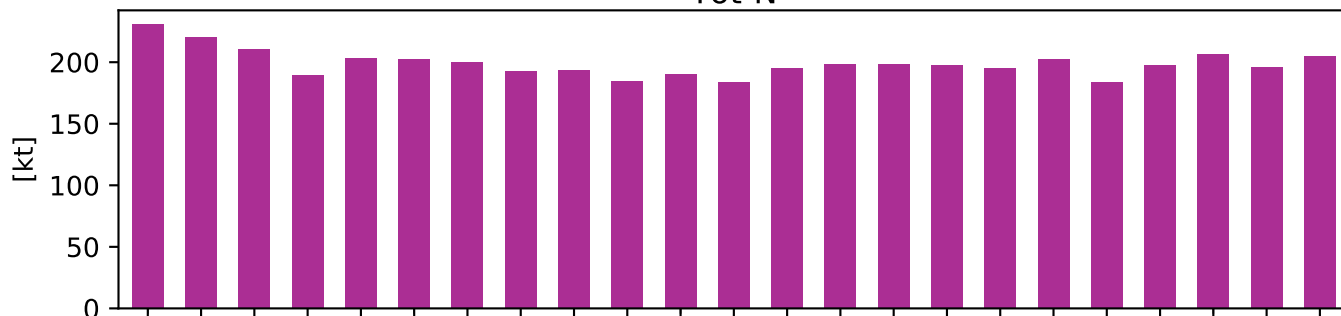
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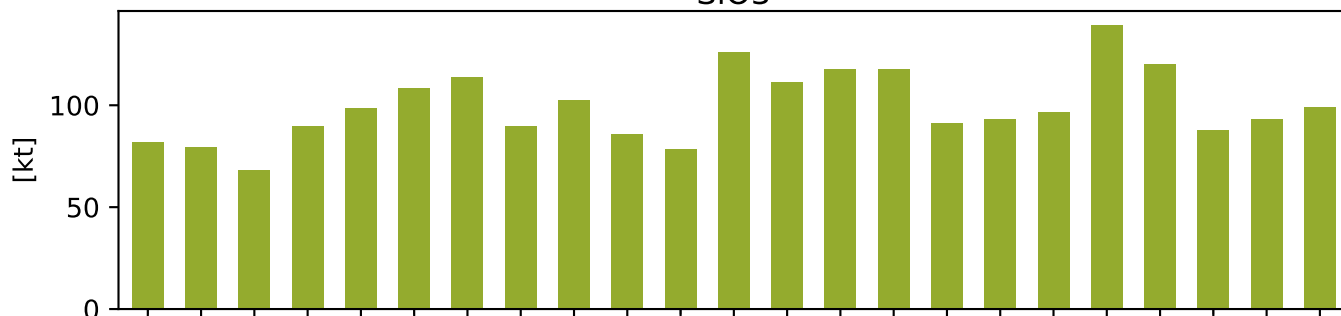
DIN



Tot-N



SiO3

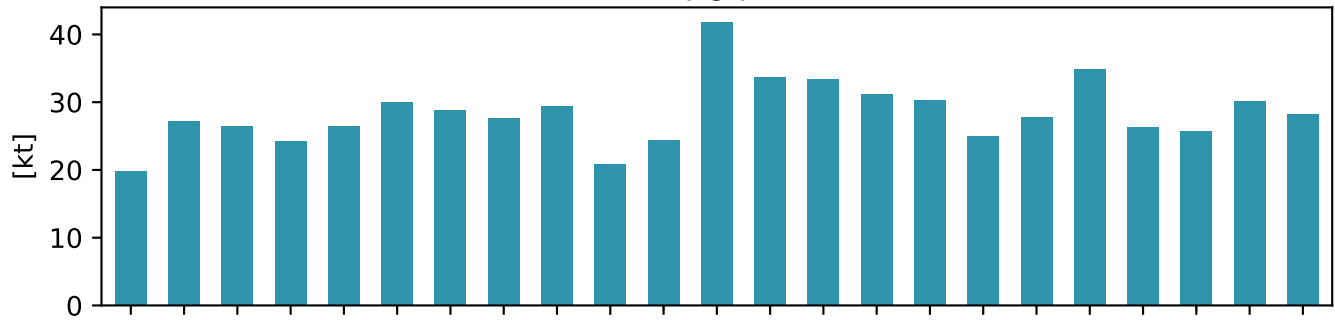


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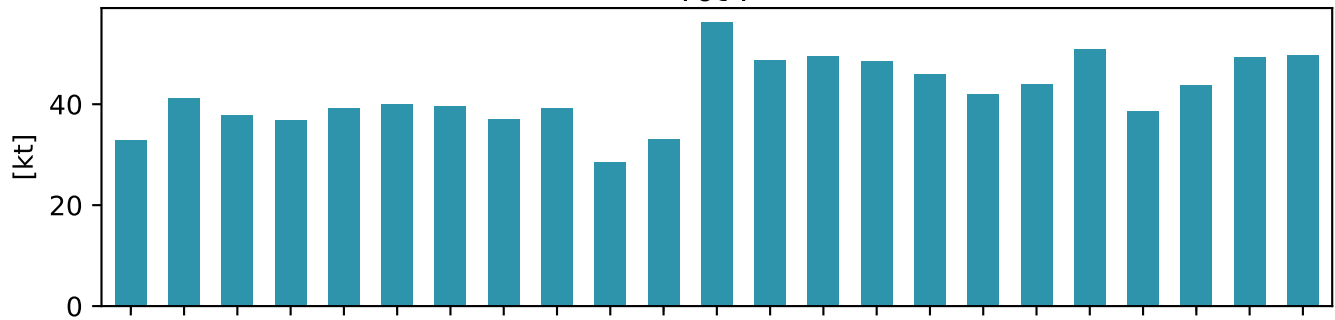
Bornholm Basin

Offshore volume of basin: 1561 km³

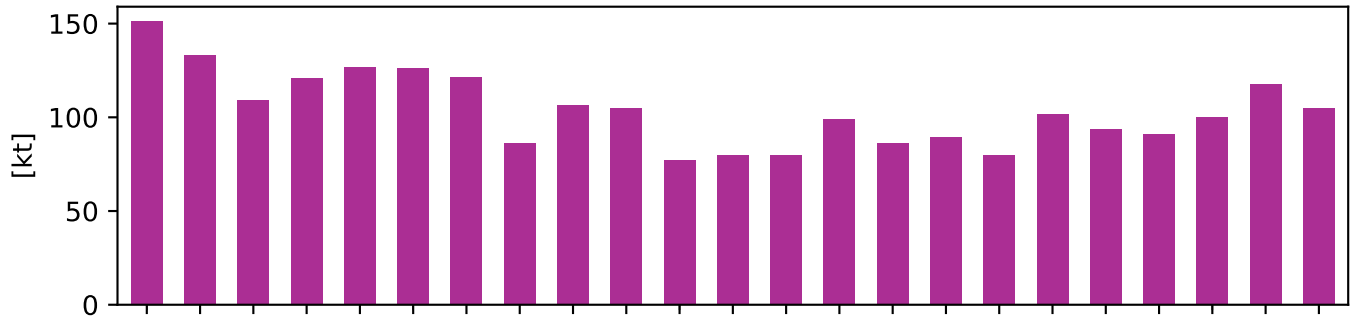
PO4



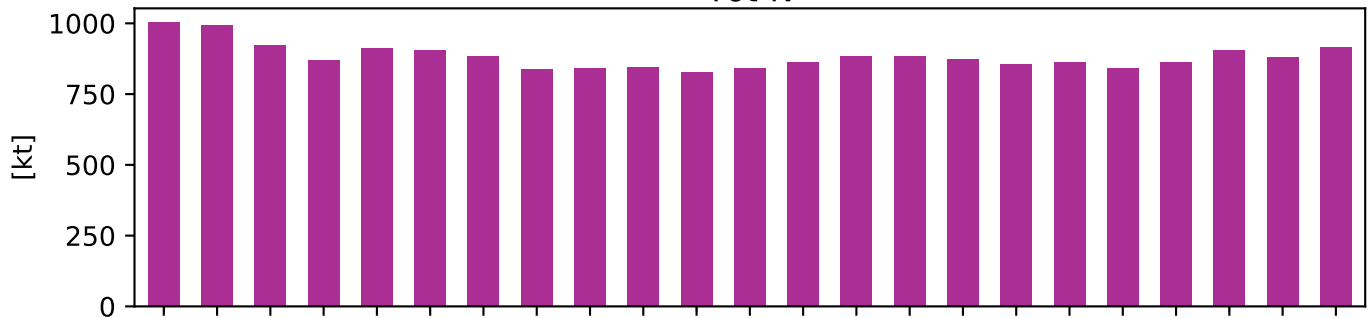
Tot-P



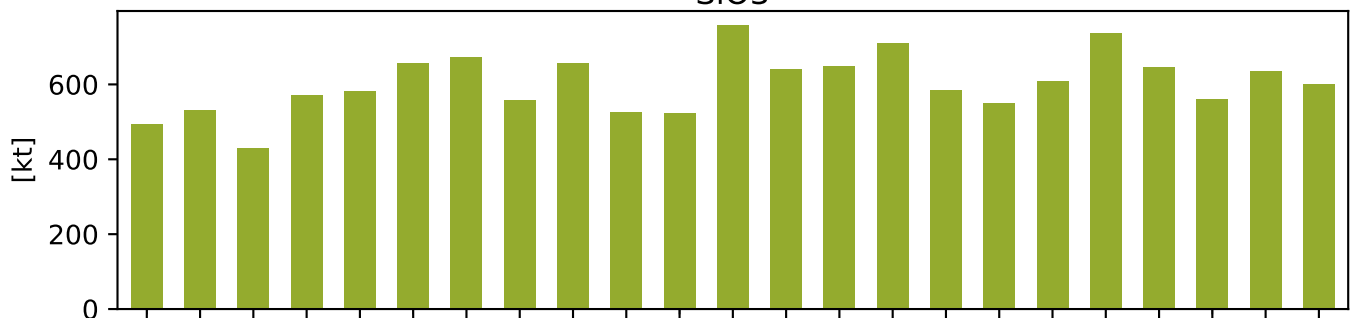
DIN



Tot-N



SiO3

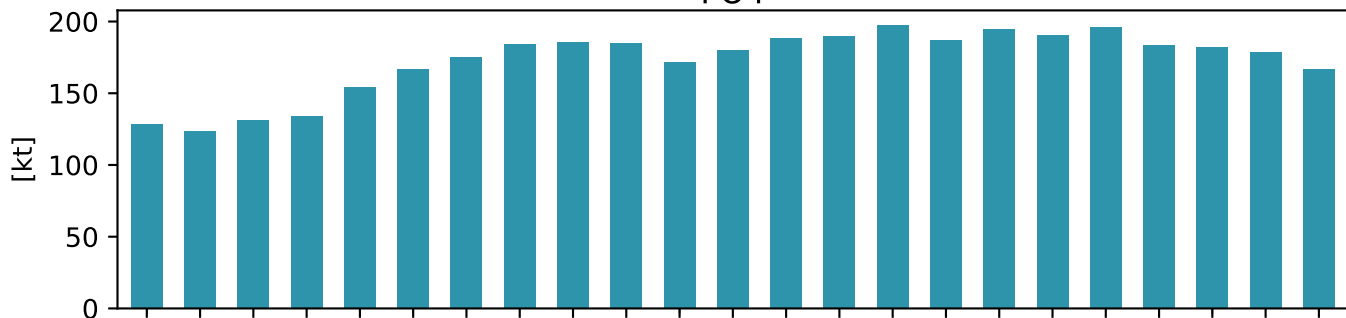


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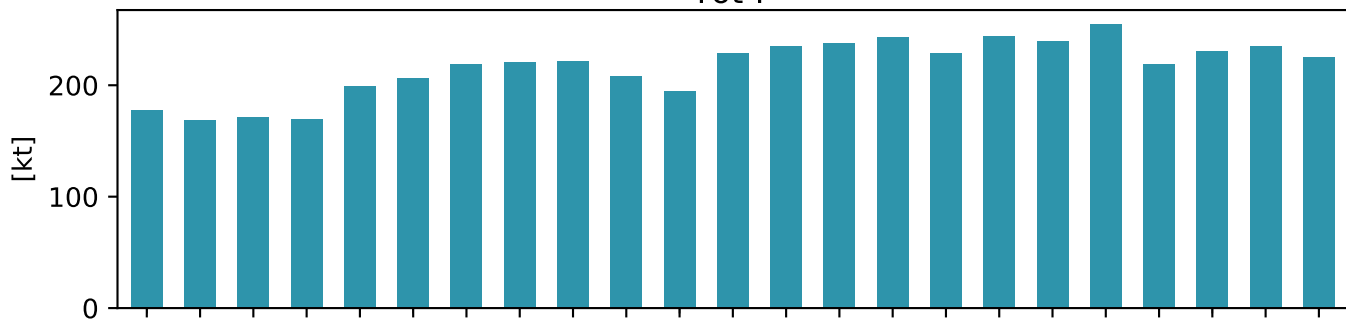
Eastern Gotland Basin

Offshore volume of basin: 5186 km³

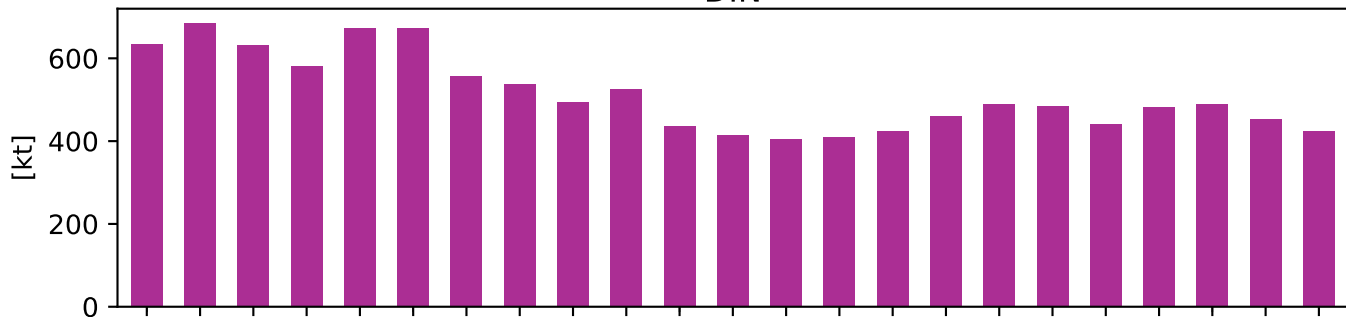
PO4



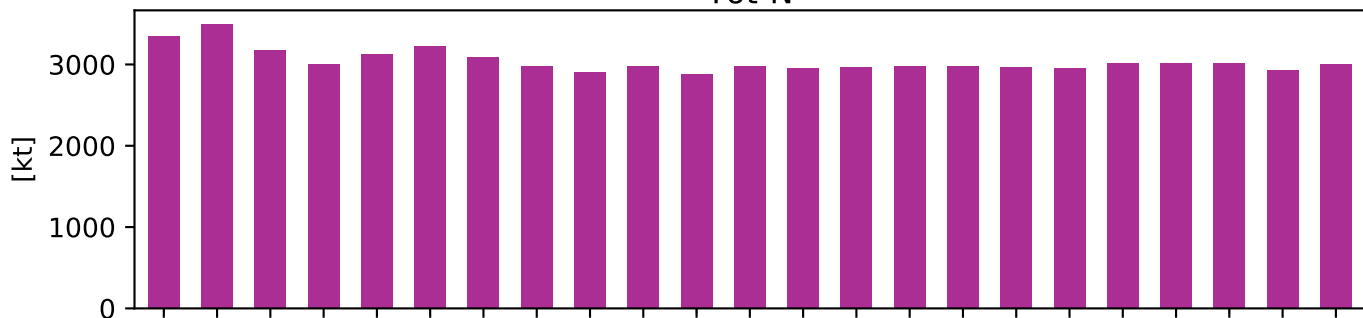
Tot-P



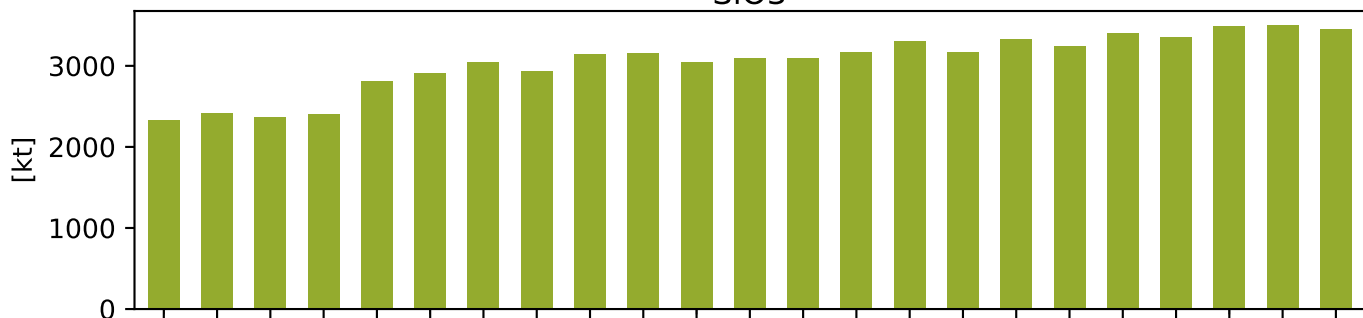
DIN



Tot-N



SiO3

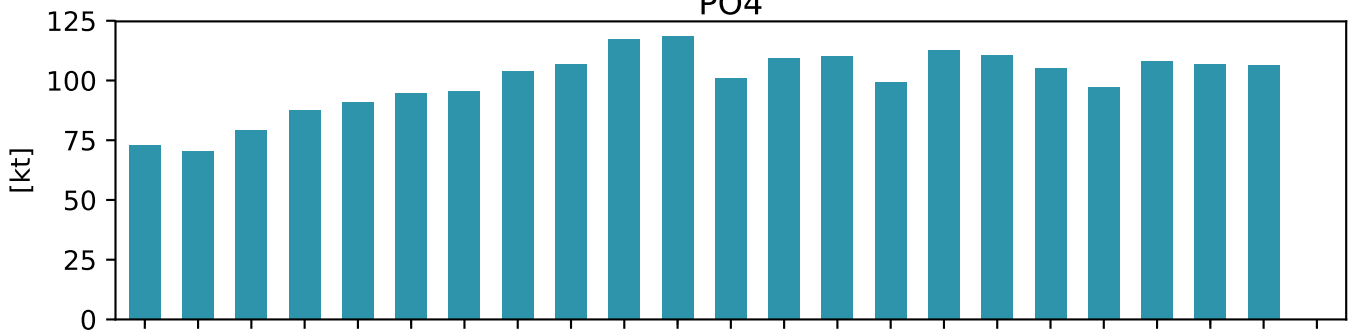


year

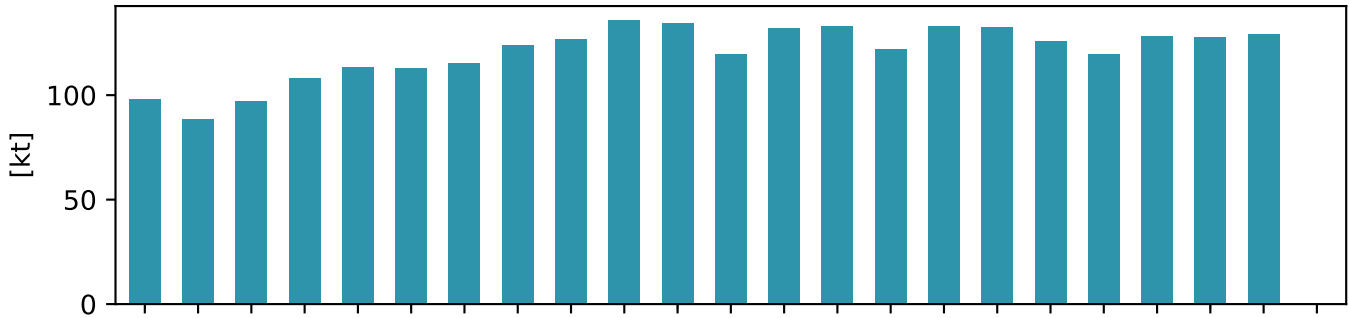
Northern Baltic Proper

Offshore volume of basin: 2674 km³

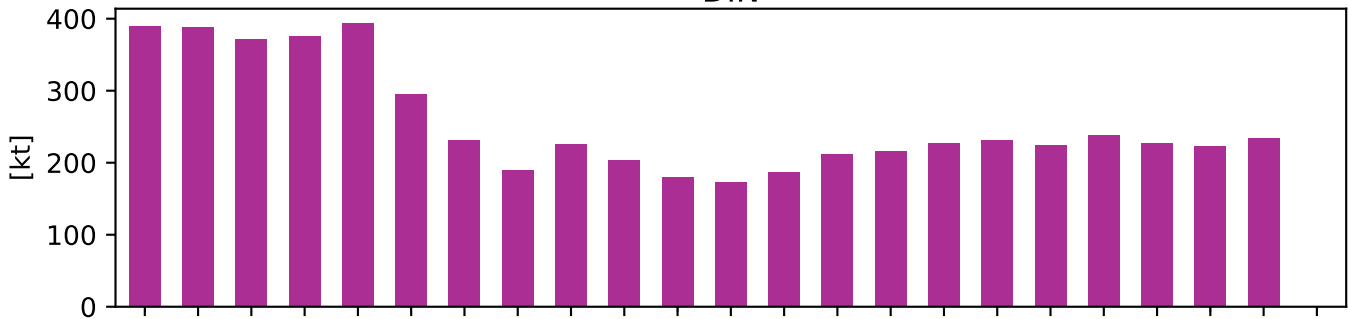
PO4



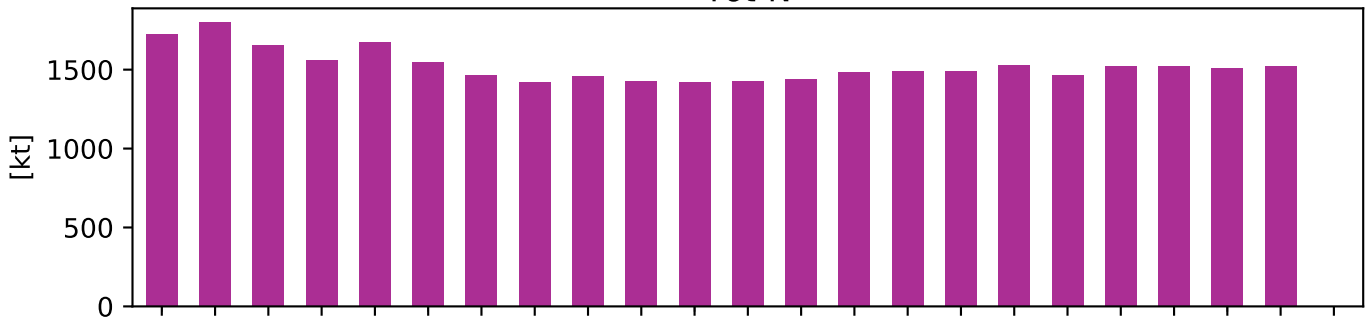
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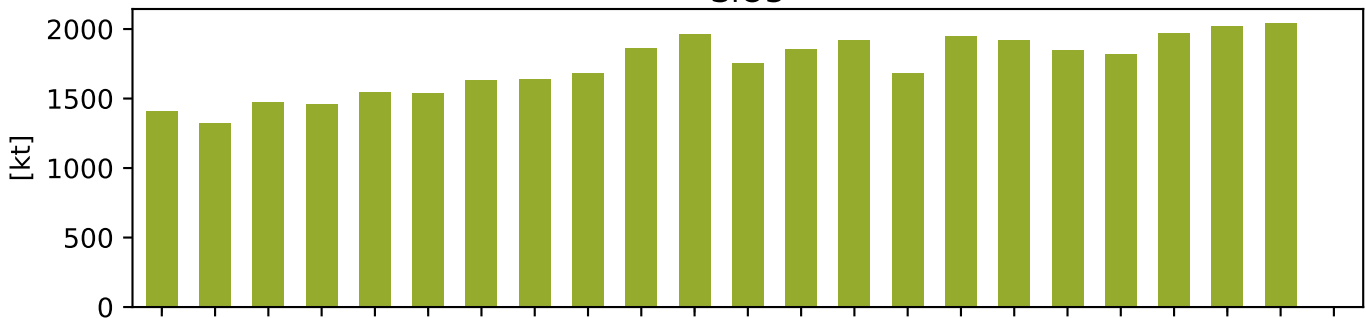
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Tot-N



SiO3

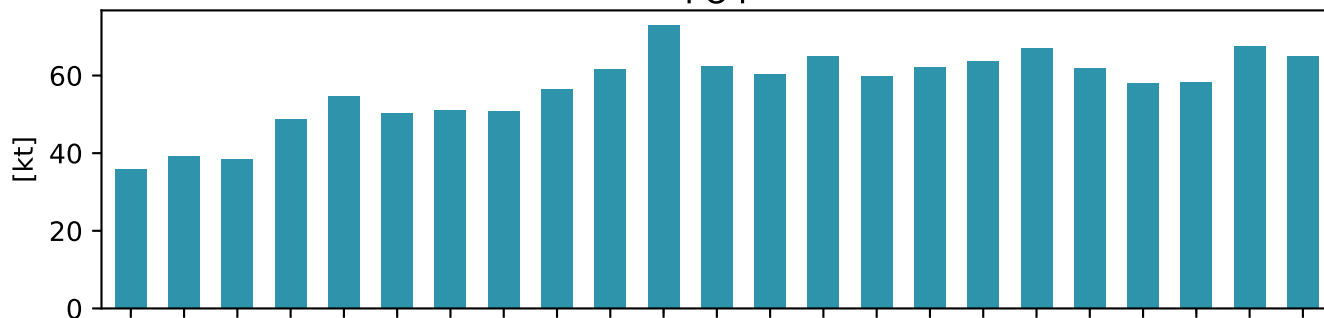


year

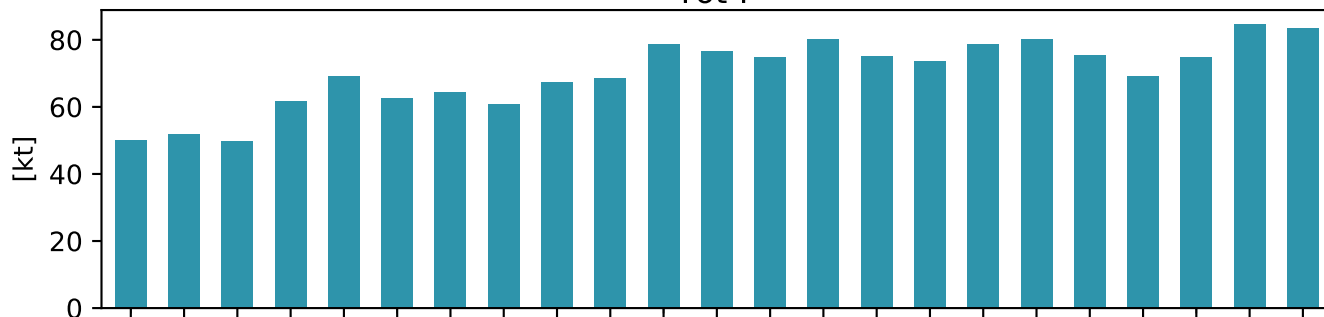
Western Gotland Basin

Offshore volume of basin: 1596 km³

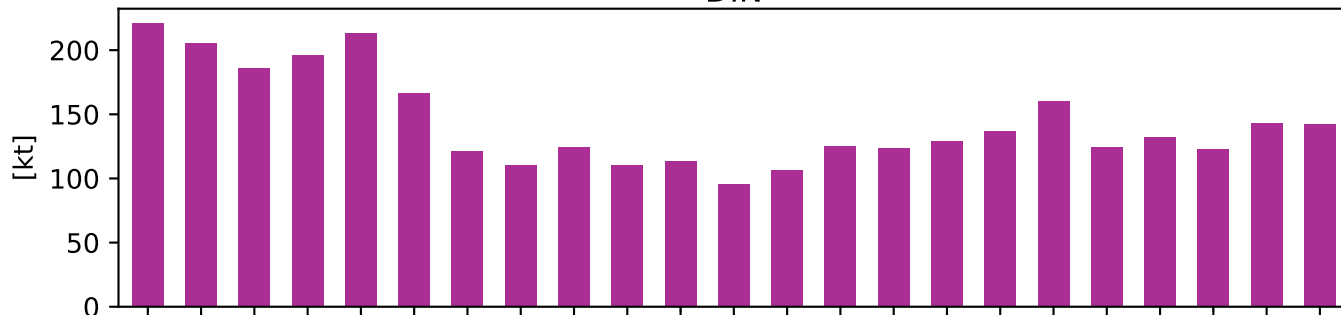
PO4



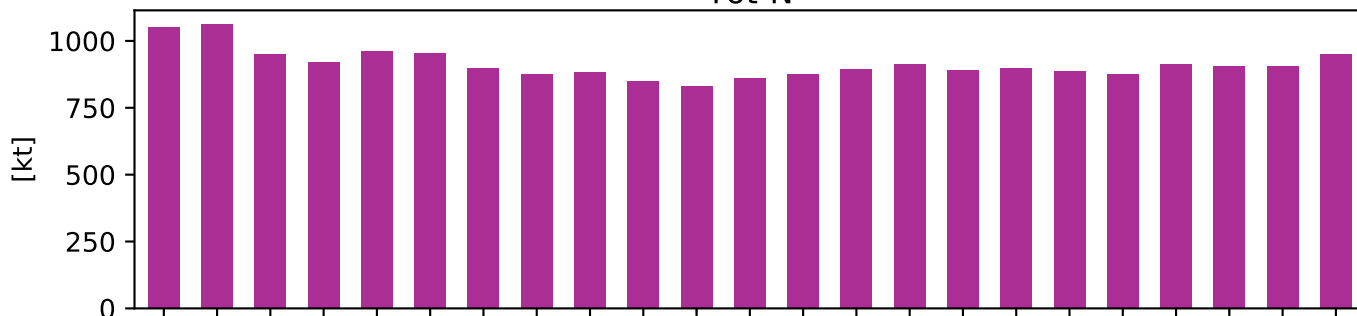
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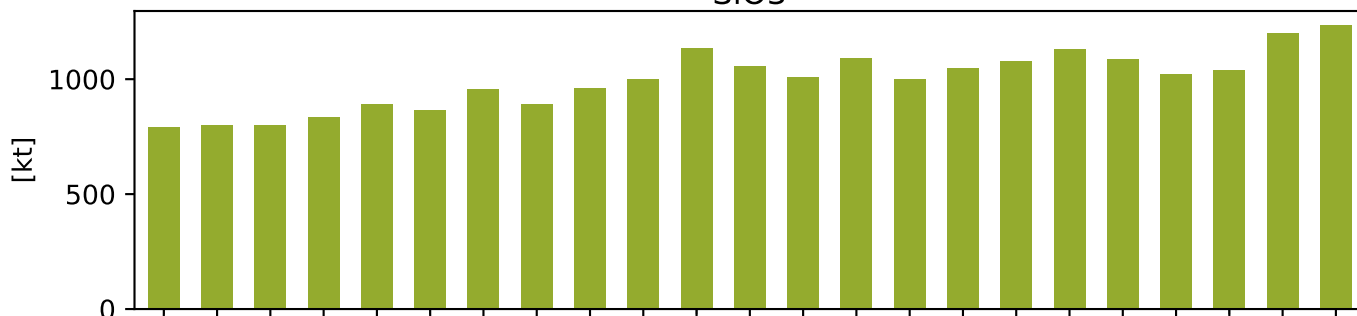
DIN



Tot-N



SiO3

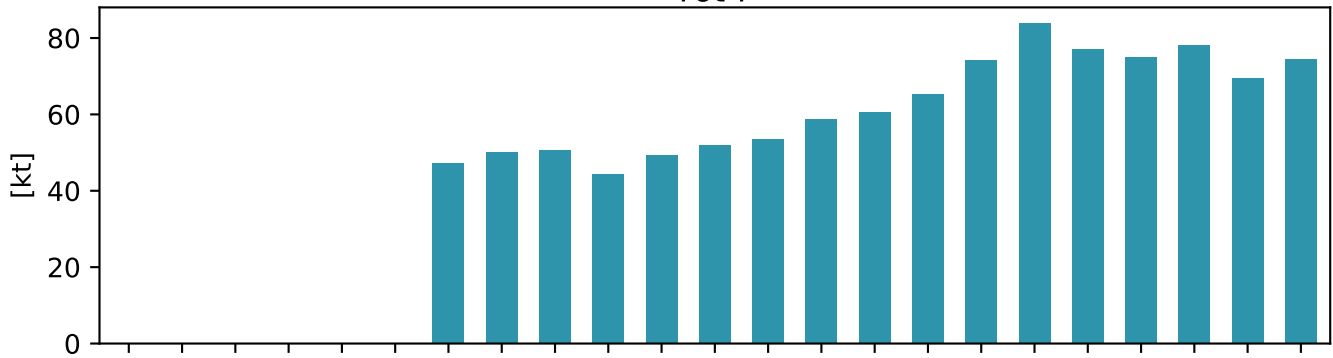


year

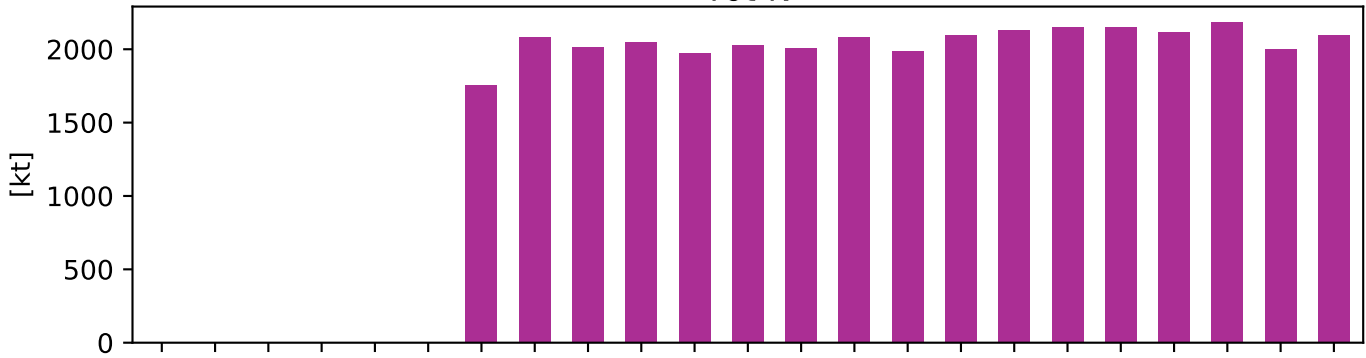
Bothnian Sea

Offshore volume of basin: 4053 km³

Tot-P



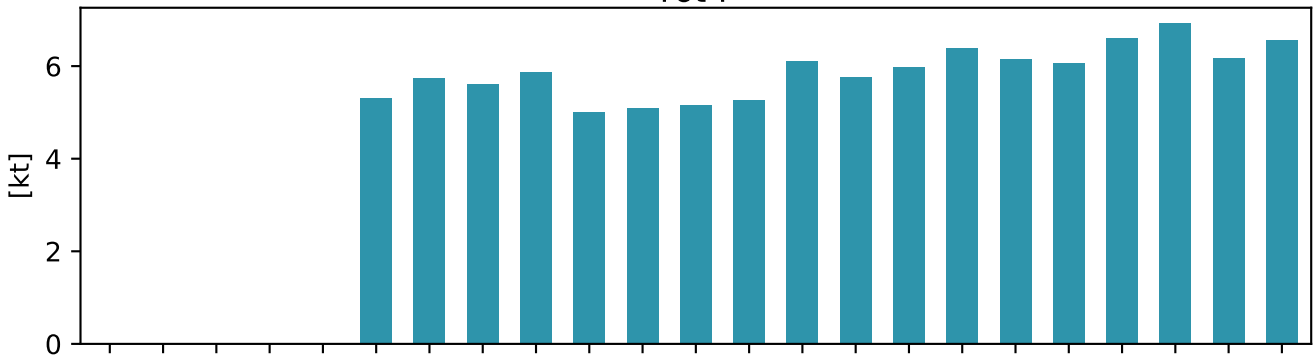
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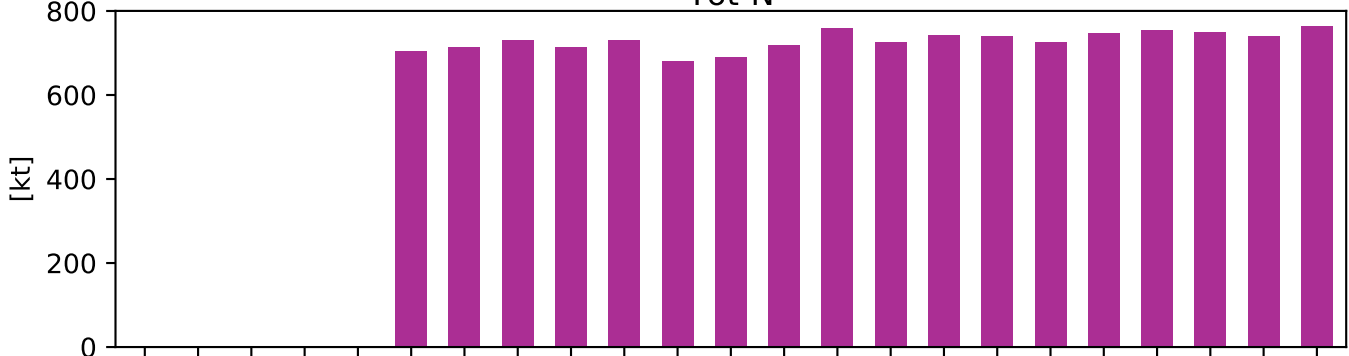
Bothnian Bay

Offshore volume of basin: 1338 km³

Tot-P



Tot-N



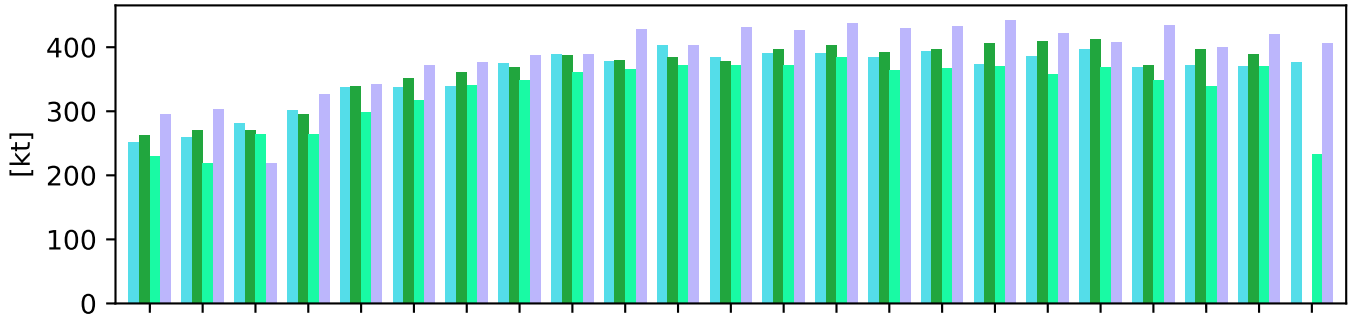
year

Baltic Proper

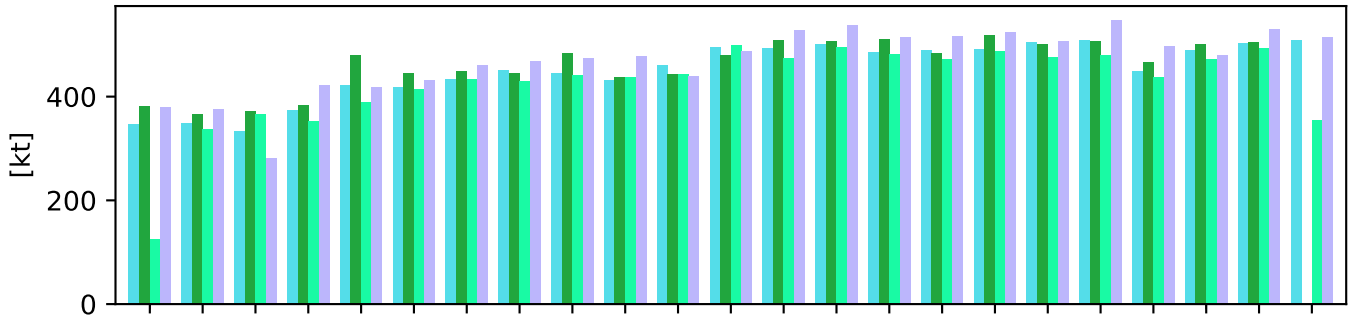
Offshore volume of Baltic Proper: 11362 km³

autumn spring summer winter

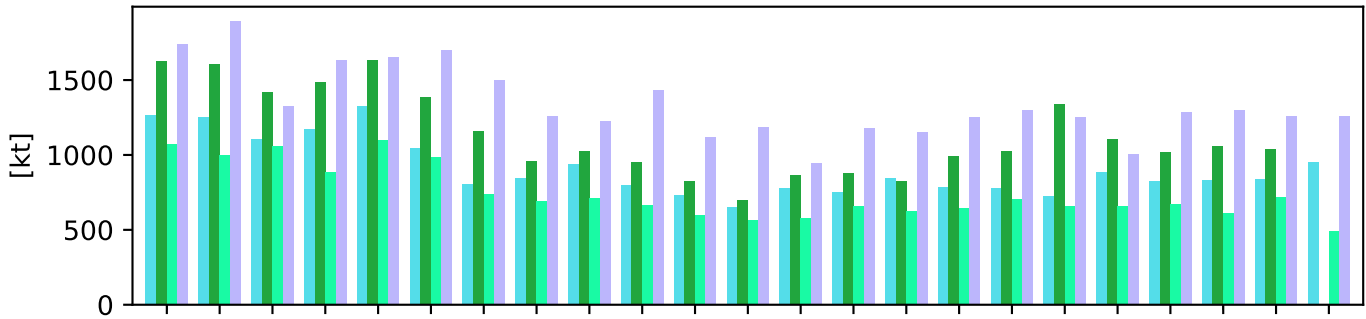
PO4



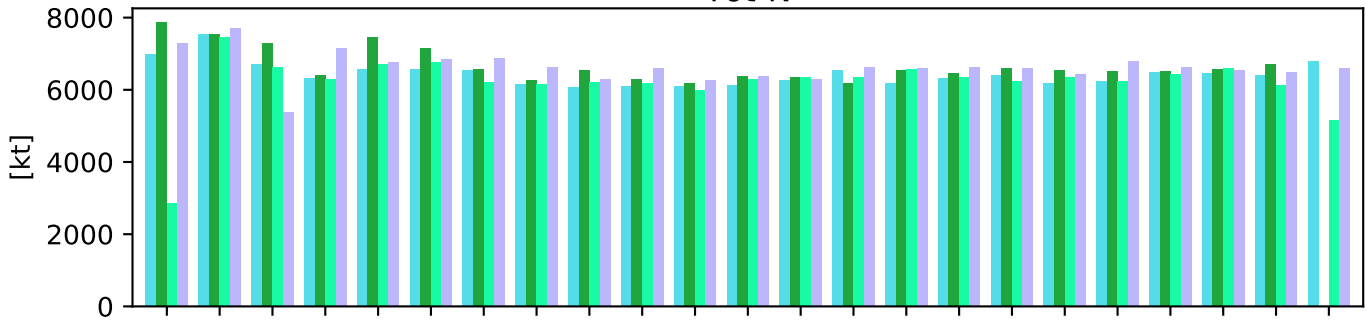
Tot-P



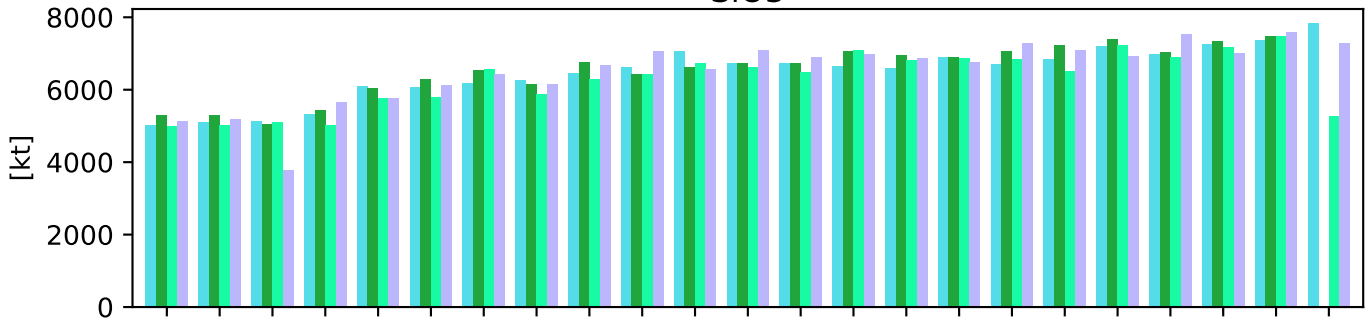
DIN



Tot-N



SiO3



year

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OCEANOGRAFI	1985
KLIMATOLOGI	2009

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Ice reconnaissance and forecasts in Storfjorden, Svalbard. |
| 2 | Thomas Thompson (1986)
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Program för miljö kvalitetsövervakning - PMK. Utsjöprogram under 1988. |
| 3 | Stig Carlberg et al (1986)
Program för miljö kvalitetsövervakning - PMK. | 10 | L. Fransson, B. Håkansson, A. Omstedt och L. Stehn (1989)
Sea ice properties studied from the ice-breaker Tor during BEPERS-88. |
| 4 | Jan-Erik Lundqvist och Anders Omstedt (1987)
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Program för miljö kvalitetsövervakning - PMK. Utsjöprogram under 1989 |
| 5 | Stig Carlberg, Sven Engström, Stig Fonselius, Håkan Palmén, Eva-Gun Thelén, Lotta Fyrberg och Bengt Yhlen (1987)
Program för miljö kvalitetsövervakning - PMK. Utsjöprogram under 1986 | 12 | Anders Omstedt (1990)
Real-time modelling and forecasting of temperatures in the Baltic Sea |
| 6 | Jorge C. Valderama (1987)
Results of a five year survey of the distribution of UREA in the Baltic Sea. | 13 | Lars Andersson, Stig Carlberg, Elisabet Fogelqvist, Stig Fonselius, Håkan Palmén, Eva-Gun Thelén, Lotta Fyrberg, Bengt Yhlén och Danuta Zagradkin (1991) Program för miljö kvalitetsövervakning – PMK. Utsjöprogram under 1989. |
| 7 | Stig Carlberg, Sven Engström, Stig Fonselius, Håkan Palmén, Eva-Gun Thelén, Lotta Fyrberg, Bengt Yhlén och Danuta Zagradkin (1988).
Program för miljö kvalitetsövervakning - PMK. Utsjöprogram under 1987 | 14 | Lars Andersson, Stig Carlberg, Lars Edler, Elisabet Fogelqvist, Stig Fonselius, Lotta Fyrberg, Marie |

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