

Report from SMHI's marine monitoring cruise with R/V Svea



Survey period: 2023-04-12 – 2023-04-18
Principal: Swedish Meteorological and Hydrological Institute (SMHI),
Swedish Agency for Marine and Water Management (SwAM)
Cooperation partners: Swedish University of Agricultural Sciences (SLU), Swedish
Maritime Agency (SMA)

SUMMARY

The Skagerrak, the Kattegat, The Sounds and the Baltic Proper was visited during the cruise, as a part of the National Marine Monitoring Programme of Sweden.

Sea surface temperature was within normal range for the season at all visited stations.

Concentrations of phosphate and dissolved inorganic nitrogen were low across all sampling points, which is considered normal for this time of year. Silicate concentrations in the sea surface was slightly above normal range for the season in the Skagerrak and the Kattegat, and within normal range in the Baltic Proper.

In the Arkona basin, the oxygen levels in the bottom waters was observed to be in good condition. Oxygen levels in the Bornholm basin and the Bay of Hanö had decreased since sampling in the March expedition and hypoxi (oxygen concentration <2 ml/l) occurred in the bottom waters of the Bornholm basin, and below 70 m in the Hanö Bay. Despite the oxygen deficiency, no hydrogen sulphide was recorded at the sampling points.

At station BCSIII-10, the oxygen levels had improved since sampling in March, and no hydrogen sulphide was detected. Hypoxi could be observed below 80 m. In the Eastern and Western Gotland

Basins, oxygen deficiency started occurring around a depth of 70-80 m. Hydrogen sulphide could be observed at a depth of 80 m in the Eastern Gotland Basin, and around 90 m in the Western Gotland Basin.

The next cruise is planned to depart on May 8th from Lysekil.

RESULTS

The expedition was performed with the Swedish research vessel Svea and departed from Lysekil on the 12th of April and terminated in Gothenburg on the 18th. Winds during the expedition were light to moderate and shifted between south-easterly and north-easterly. Air temperature varied between 3,2 to 8,9°C.

The two ADCPs (current measurement) of R/V Svea ran throughout the whole cruise. The Ferrybox (continuous measurements at a depth of 4 m) only ran for the initiation of the cruise, due to a loss of the GPS signal to the instrument.

Additional phytoplankton samples were taken at stations Släggö, Å17 (the Skagerrak) and Anholt E (the Kattegat), for an external project run by the universities of Stockholm and Uppsala.

During the monthly cruise of April, two guest scientists from the university of Gothenburg carried out measurements and sampling of the marine carbonate system. To observe the carbonate system, three parameters were analysed onboard: pH, total alkalinity (TA) along with dissolved inorganic carbon (DIC). Additionally, water samples were brought back to the lab for analysis of organic alkalinity and to study the effect of storage on the total alkalinity in samples containing hydrogen sulphide.

The report is based on data that has undergone an initial quality control and has been compared with a monthly average over the period of 1991 – 2020. When further quality control has been carried out, certain values might change. Values presented in the report has been rounded to the nearest tenth, therefore some of the values could differ from published data.

Data from this cruise is published as soon as possible on the data host's website, this usually takes place within a week after the cruise has ended. Some analyses are made after the cruise and are published later.

Data can be accessed here:

<https://sharkweb.smhi.se/hamta-data/>

The Skagerrak

Sea surface temperatures varied between 6,0°C och 6,5°C, which is within normal range for the time of year.

Surface salinity varied between 21 and 31 psu, being normal to slightly below normal range for the area. A pycnocline around a depth of 15-25 m could be observed at most stations. Å17 furthermore had a termocline around 50 m.

Concentrations of phosphate and dissolved inorganic nitrogen in the sea surface of the Skagerrak were low or had been depleted, which is normal for the season. Concentrations of silicate were slightly above normal range in the area and varied between 2,1 and 4,0 µmol/l.

Phosphate levels were 0,05-0,07 µmol/l and concentrations of dissolved inorganic nitrogen were below detection levels (0,1 µmol/l).

Levels of oxygen were in good conditions at all sampling points in the Skagerrak, with values within normal range for the time of year. The lowest concentration measured in the bottom waters could be found at Släggö, at 5,3 ml/l.

Chlorophyll fluorescence, measured with CTD and used as a parameter to indicate plankton activity, displayed high activity at around 20 m in the area.

The Kattegat and the Sound

Sea surface temperatures in the Kattegat and the Sound were within normal range and varied between 6,2-6,4°C.

Surface salinity varied between 18-20 psu in the Kattegatt. Surface salinity in the Sound was observed around 9 psu. Both areas presenting values slightly below or within normal range. In the Kattegatt and in the Sound the thermo- and haloclines could be detected at around 10 to 20 m.

Concentration of phosphate and dissolved inorganic nitrogen in the surface waters were slightly below or within normal range in the area. Phosphate levels varied between 0,06-0,21 µmol/l and levels of dissolved inorganic nitrogen varied between <0,1-0,21 µmol/l.

Concentrations of silicate were normal to above normal range and was observed of a range of 4,5-6,4 µmol/l. The highest levels were detected in the Sound.

Oxygen levels were normal for the season and in the bottom waters of the Kattegat, the lowest values were detected at 5,8 ml/l, and 4,5 ml/l in the Sound.

The chlorophyll fluorescence indicated low activity in the area.

The Baltic Proper

The sea surface temperatures were within normal range for the season at the sampled points in the area. Temperatures varied between 3,3-5,6°C. Surface salinity varied between 7,0-8,5 psu and were within normal range to slightly above normal over the sampled area. A thermo- and halocline were mutually detected at depths around 60 to 85 m.

Nutrient concentrations in the sea surface were within normal range across all sampling points. Levels of phosphate varied between 0,19-0,59 µmol/l, dissolved inorganic nitrogen between <0,1-1,33 µmol/l and silicate levels between 7,2-15,3 µmol/l.

In the Arkona basin, oxygen levels were in good condition, with the lowest levels at 4,7 ml/l in the bottom waters.

In the Bornholm basin and the Bay of Hanö, oxygen levels had decreased since sampling in March and hypoxi (<2ml/l) could be detected in the bottom waters of the Bornholm basin, as well as in the Bay of Hanö below 70 m. Despite this, no hydrogen sulphide was recorded.

At station BCSIII-10, the oxygen levels had improved since sampling in March, and no hydrogen sulphide was measured. Hypoxi could be observed below 80 m. In the Eastern and Western Gotland Basins, oxygen deficiency started occurring around a depth of 70-80 m. Hydrogen sulphide could be observed at a depth of 80 m in the Eastern Gotland Basin, and around 90 m in the Western Gotland Basin.

Scattered plankton activity was observed with the CTD in the Eastern and Western Gotland Basin.

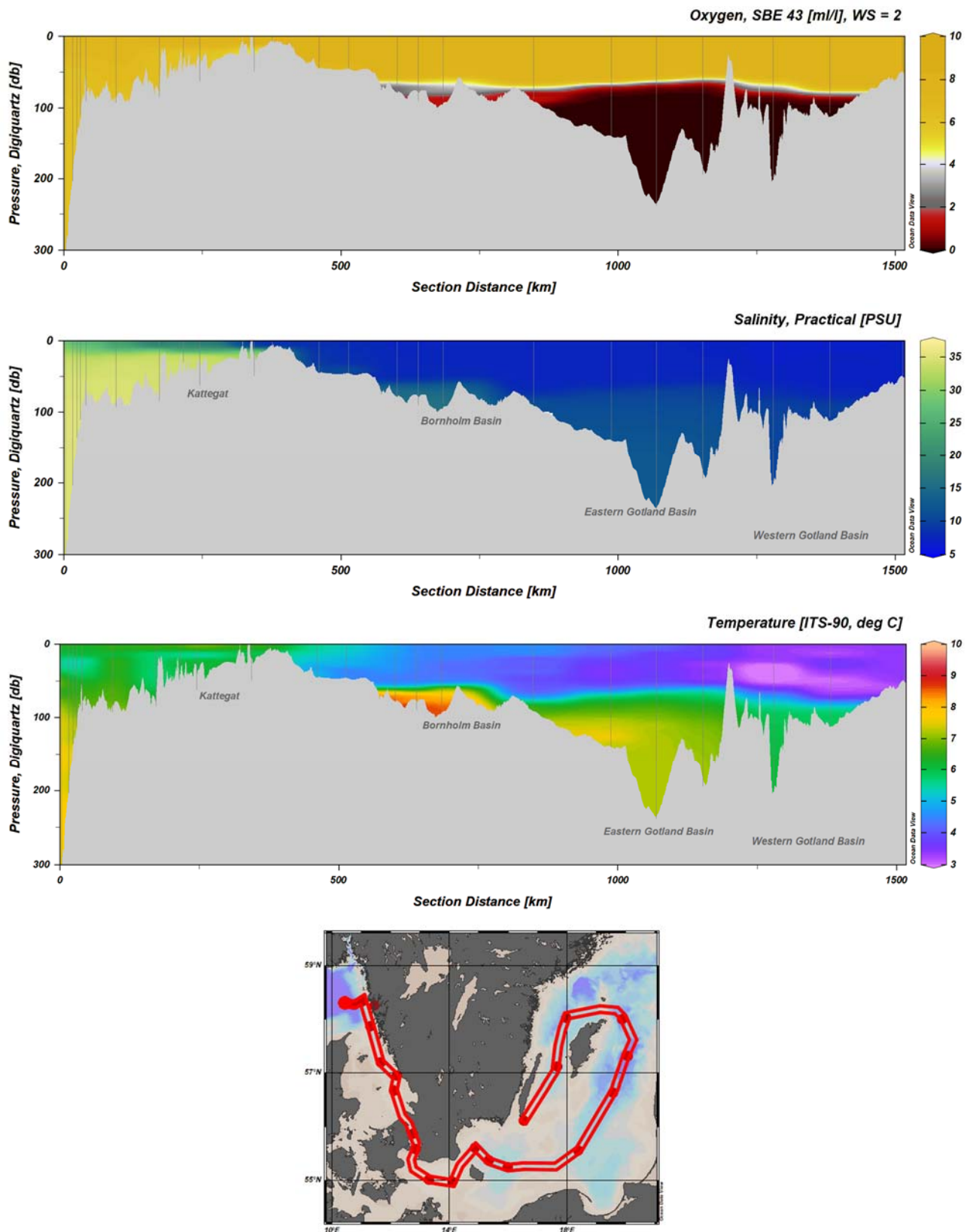


Figure 1. Section showing temperature, salinity and oxygen concentration from the Skagerrak, through the Sound and further up through the Baltic Sea proper according to the map (bottom). The figure is created in Ocean Data View with DIVA-interpolation.

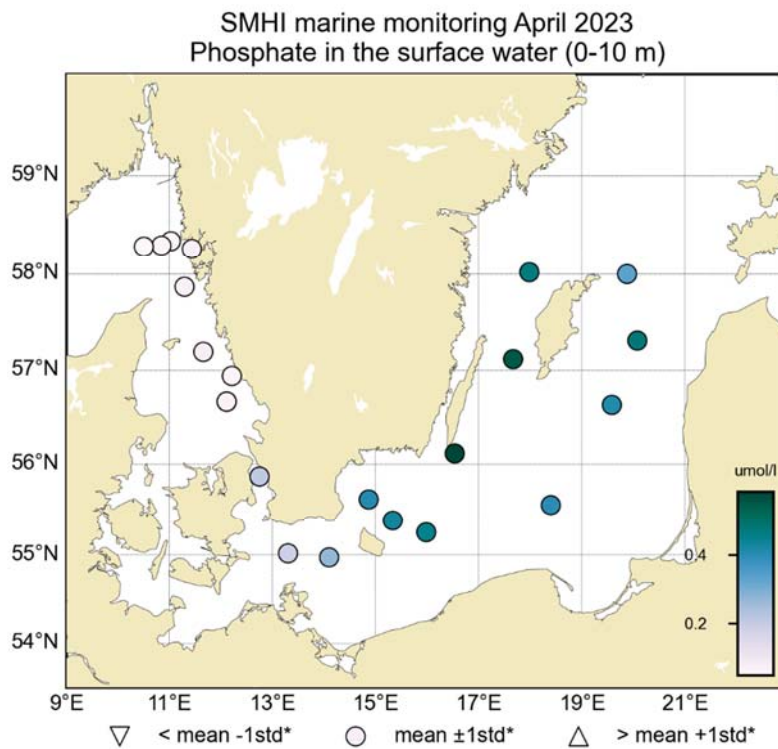


Figure 2. The concentration of phosphate in the surface water (0– 10 m). The mean value is based on monthly data within each basin from 1991–2020.

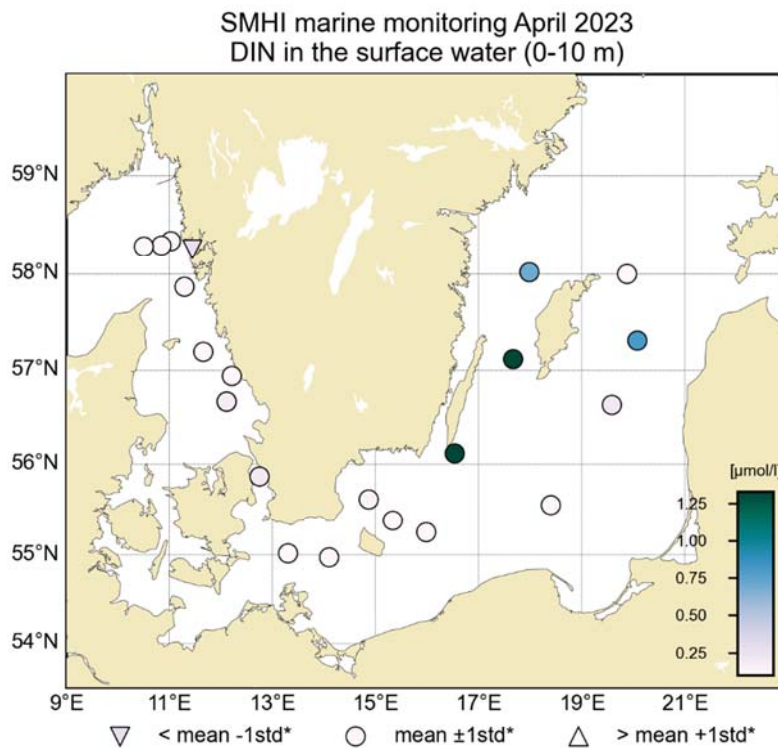


Figure 3. The concentration of dissolved inorganic nitrogen (DIN) in the surface water (0–10m). The mean value is based on monthly data within each basin from 1991–2020.

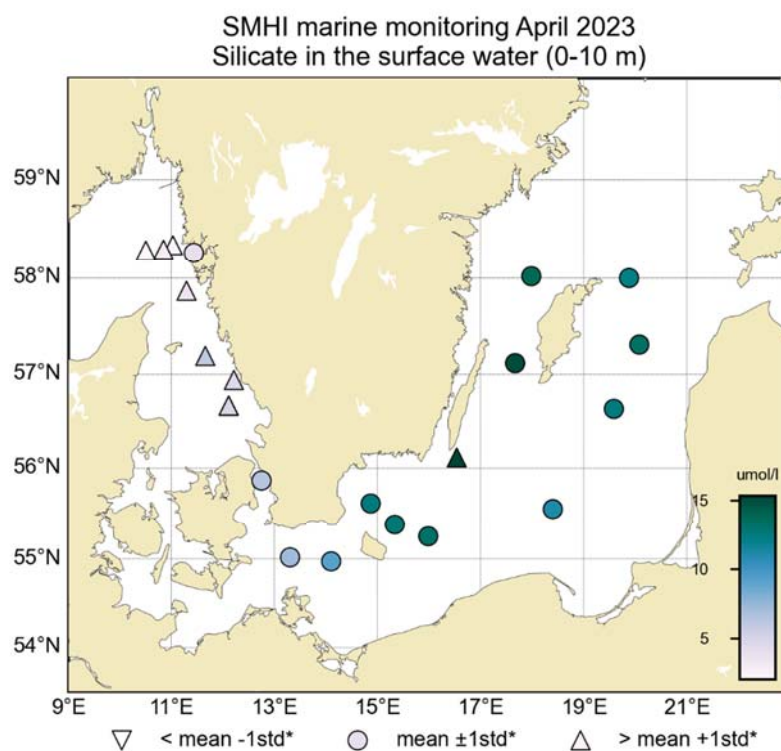


Figure 4. The concentration of silicate in the surface water (0–10 m). The mean value is based on monthly data within each basin from 1991–2020.

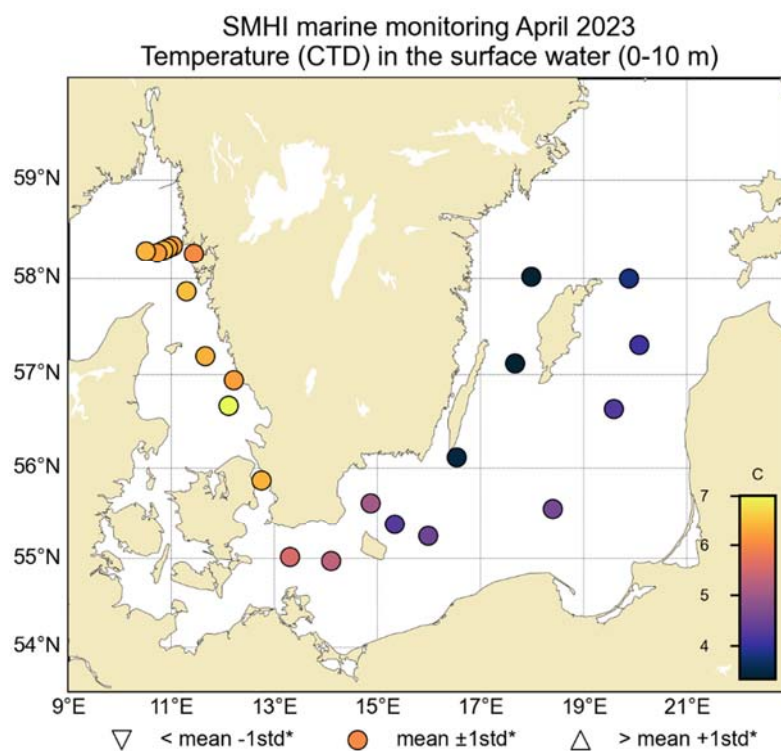


Figure 5. Temperature in the surface water (0–10 m). The mean value is based on monthly data within each basin from 1991–2020.

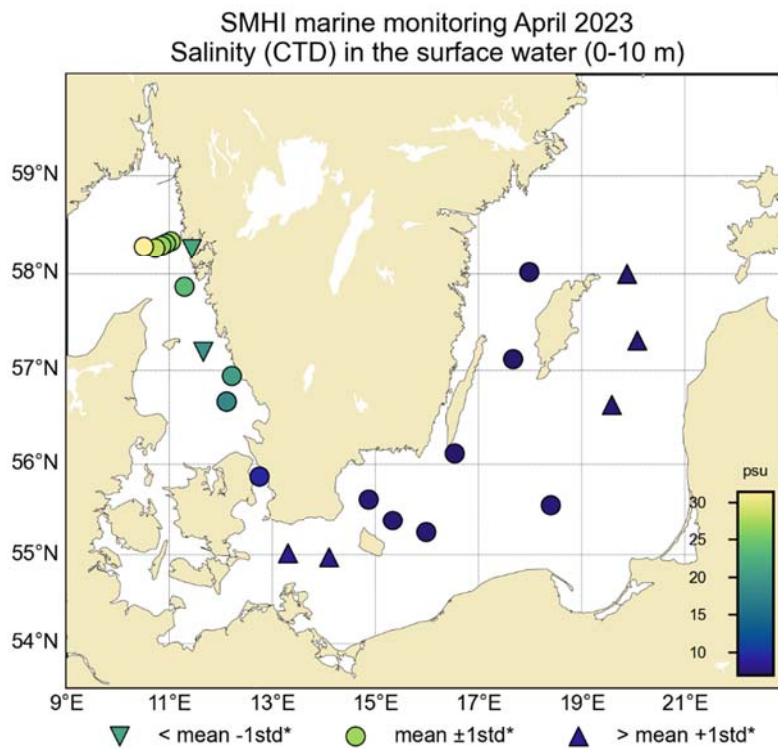


Figure 6. Salinity in the surface water (0–10 m). The mean value is based on monthly data within each basin from 1991–2020.

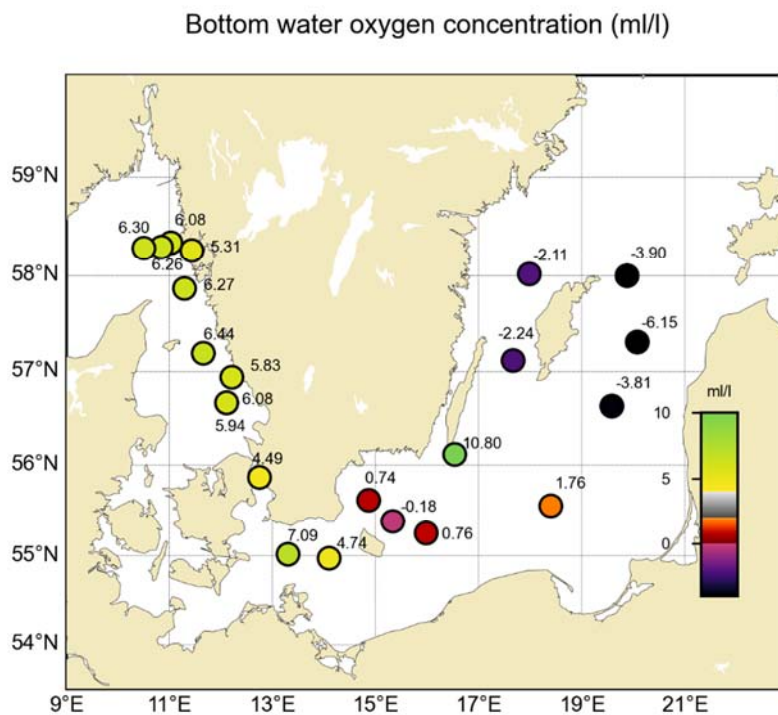


Figure 7. The concentration of oxygen (in ml/l) in the bottom water, about 1 m above the bottom. Note that the value is not compared against statistics in the same way as Figures 2–6 and therefore only circles are shown in the graph. Presence of hydrogen sulphide is illustrated as negative oxygen concentration.

DELTAGARE

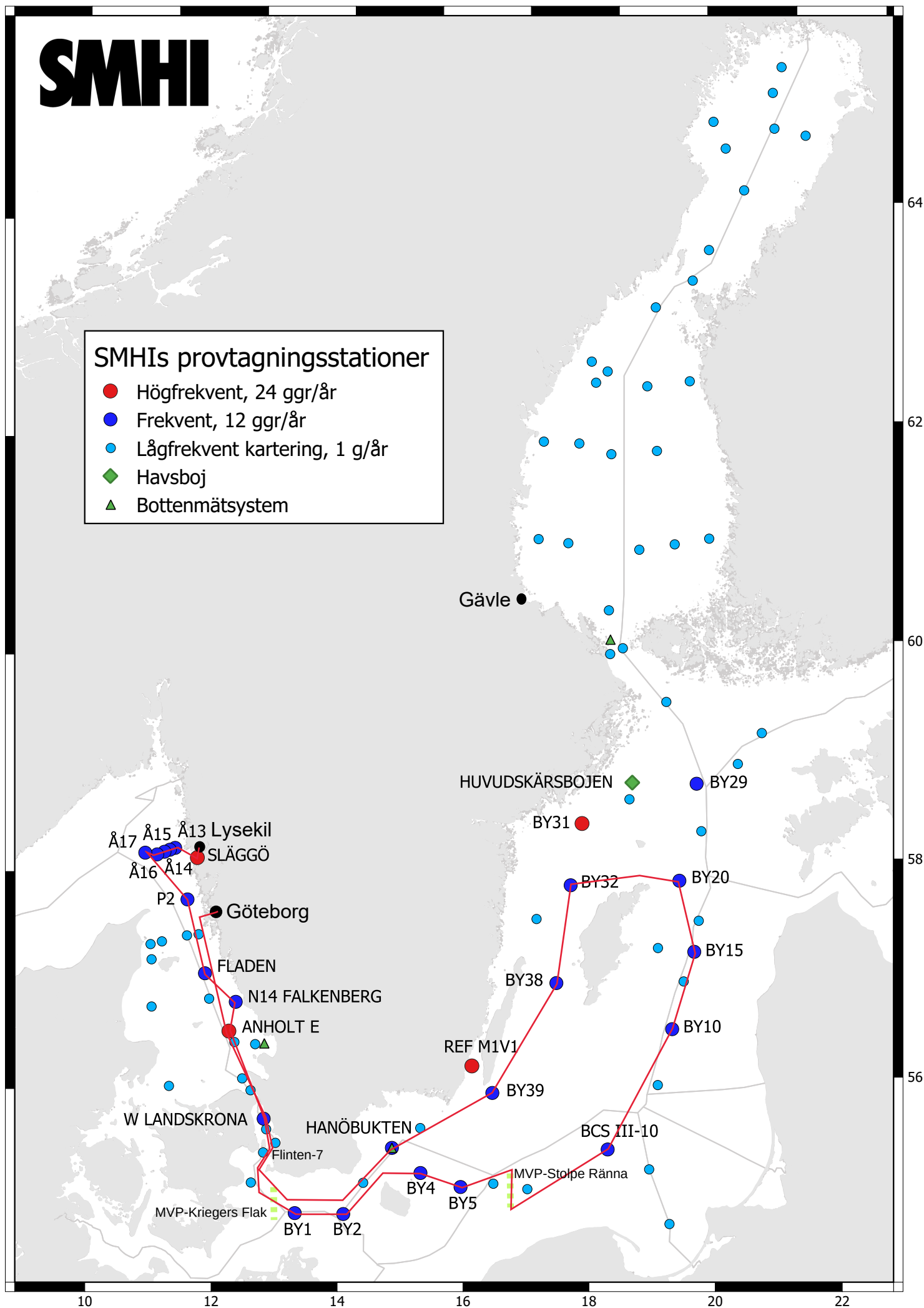
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Anna-Kerstin Thell	Chief scientist	SMHI
Helena Björnberg	Marine chemist	SMHI
Örjan Bäck	Oceanographer	SMHI
Johan Håkansson	Marine chemist	SMHI
Sari Sipilä	Marine chemist	SMHI
Maja Billman	Guest scientist	University of Gothenburg
Adam Ulfso	Guest scientist	University of Gothenburg

APPENDICES

- Track chart
- Table over stations, sampled parameters and number of sampling depths
- Map showing bottom oxygen concentrations
- Vertical profiles for regular monitoring stations
- Monthly average surface water plots for regular monitoring stations

SMHIs provtagningsstationer

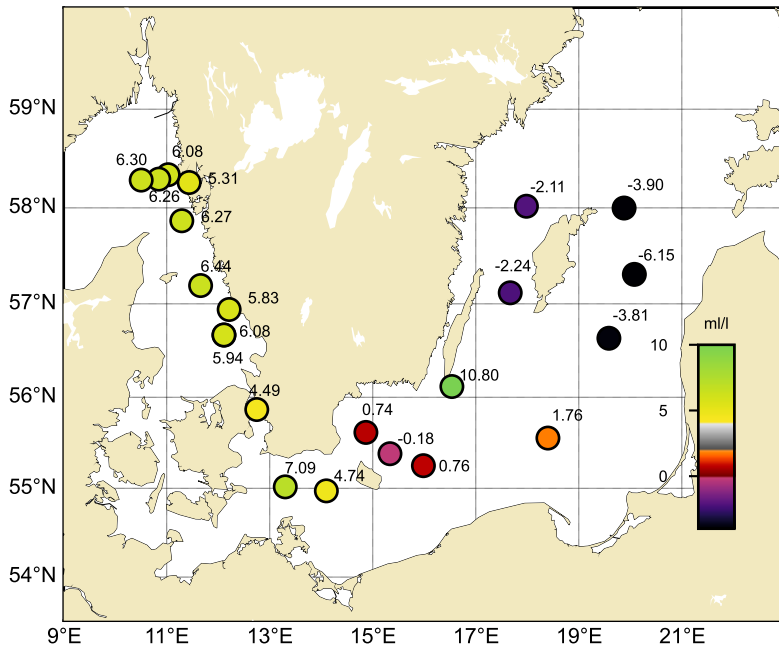
- Högfrekvent, 24 ggr/år
- Frekvent, 12 ggr/år
- Lågfrekvent kartering, 1 g/år
- ◆ Havsboj
- ▲ Bottenmätsystem



Time: 23:35

Ser no	Cru no	Stat code	Proj	Stat name	Lat	Lon	Start date yyyymmdd	Start time hhmm	Bottom depth m	Secchi depth m	Wind dir	Air vel	Air temp C	Air pres hPa	WCWI elac aove hdsb	CZPP hohp loy apt o	No de	No btl	T e m m p p t t l d	S e a l l d	P a h o x x s o o r r r o o k o m m m	D h o o s t i a z n t y 3 u n n	H 2 h t t t t m t l i u o o	P P N N N A N A S H C C	
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0267	06	SKEX15	BAS...	Å14	5818.96	01056.13	20230412	1425	111		16	5	6.9	1006	1130	----	11		- x - x - - x - - - - - - - - - - - -						
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Bottom water oxygen concentration (ml/l)



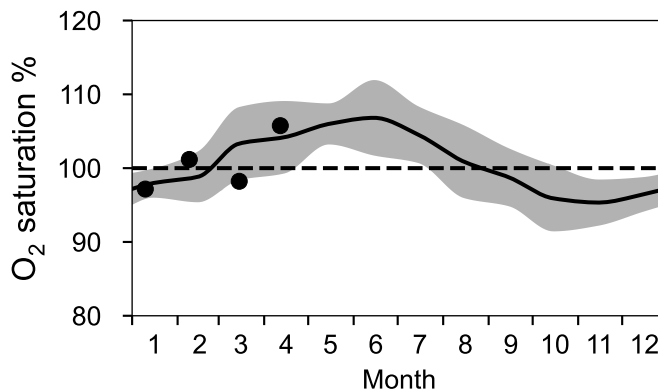
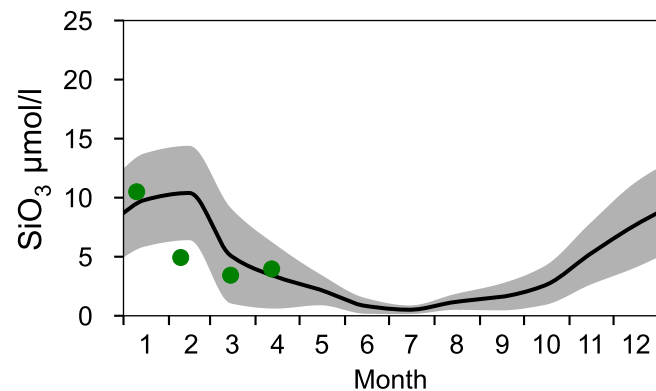
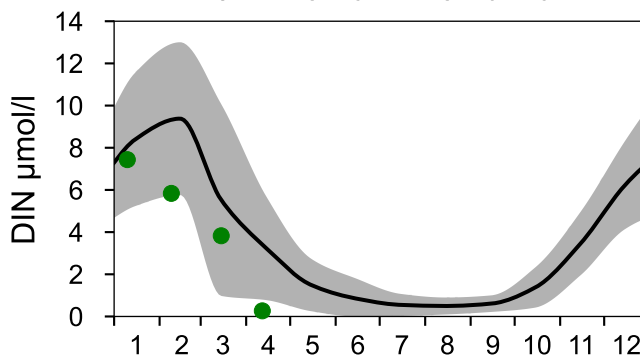
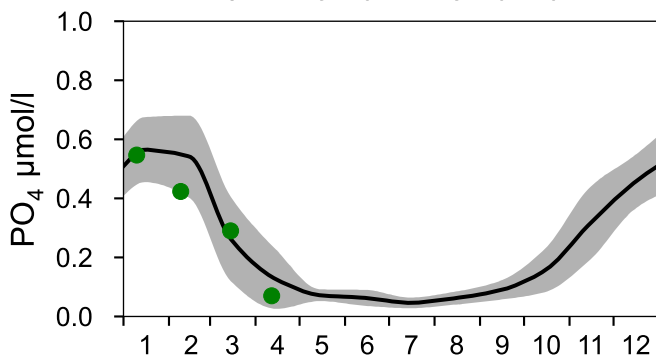
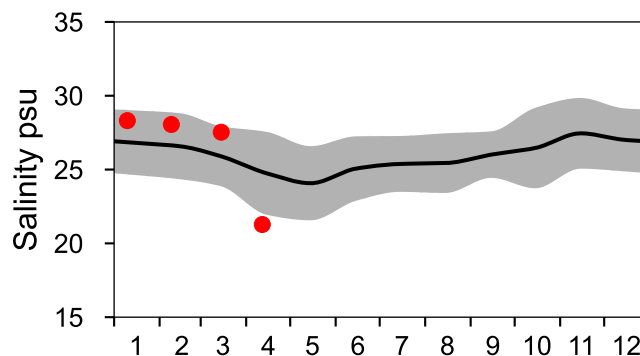
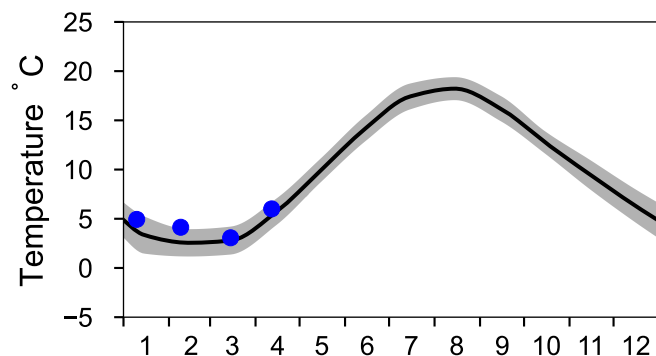
STATION SLÄGGÖ SURFACE WATER (0-10 m)

Annual Cycles

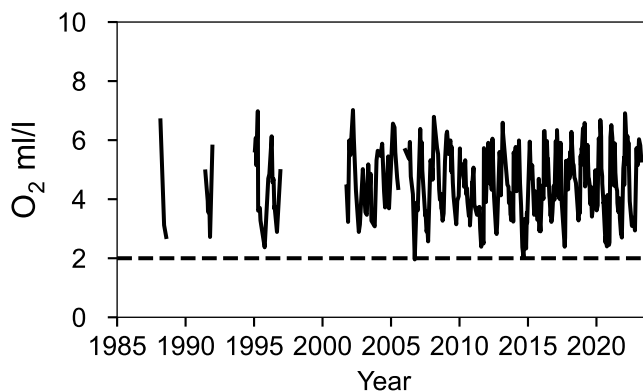
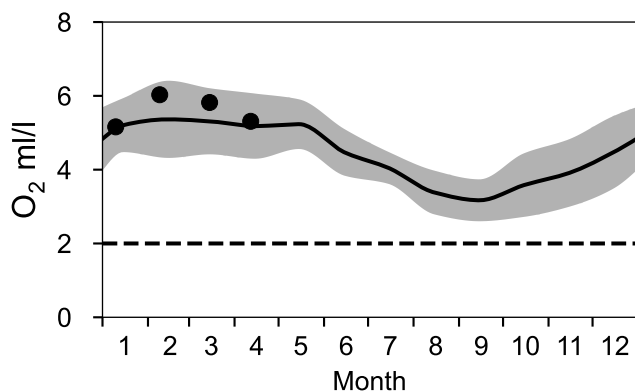
— Mean 1991-2020

■ St.Dev.

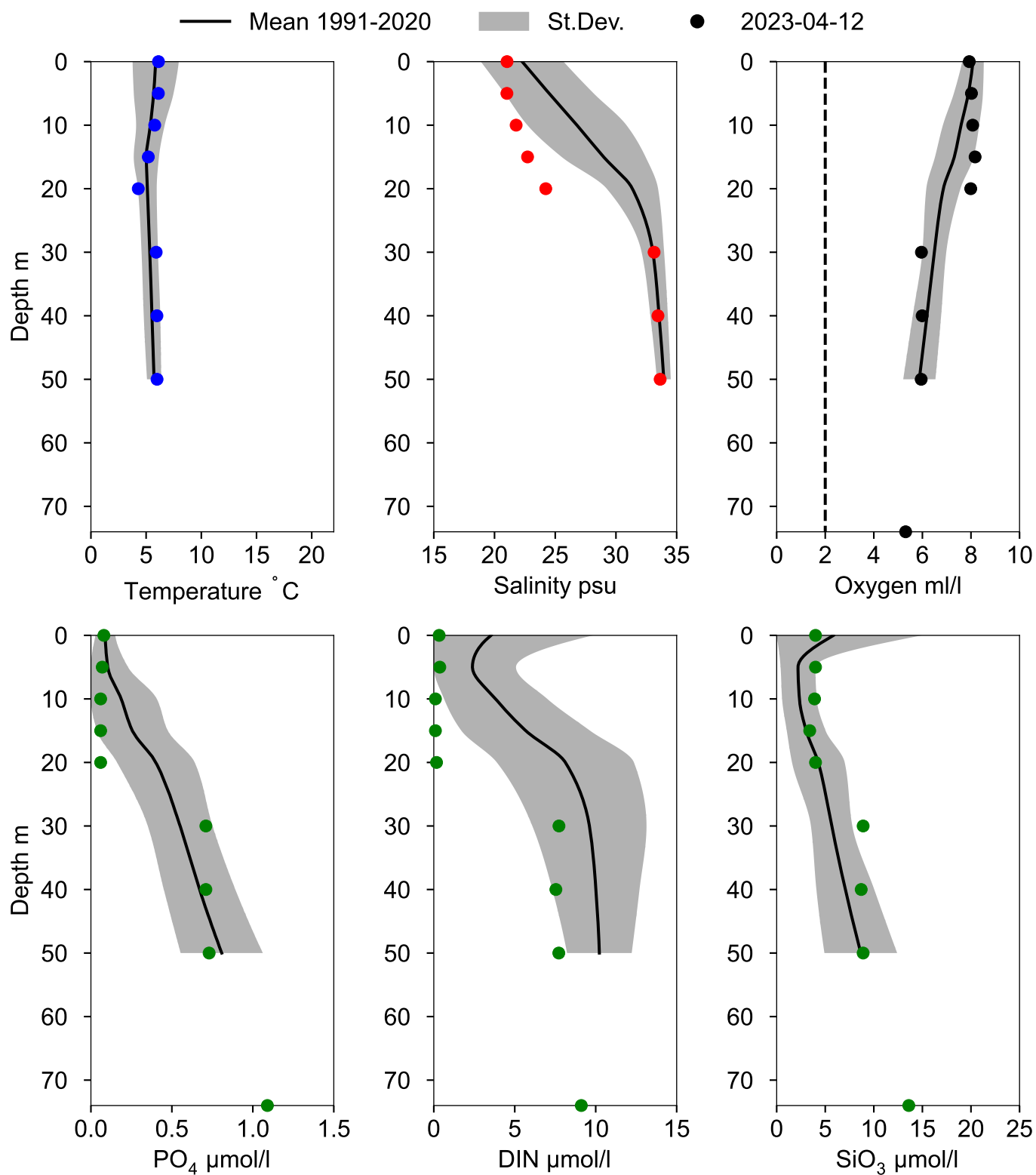
● 2023



OXYGEN IN BOTTOM WATER (depth >= 64 m)



Vertical profiles SLÄGGÖ April



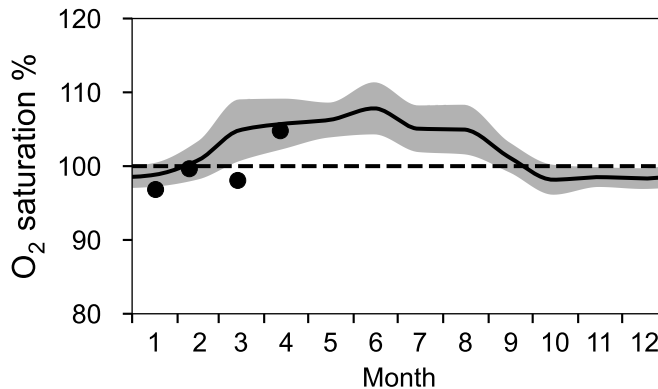
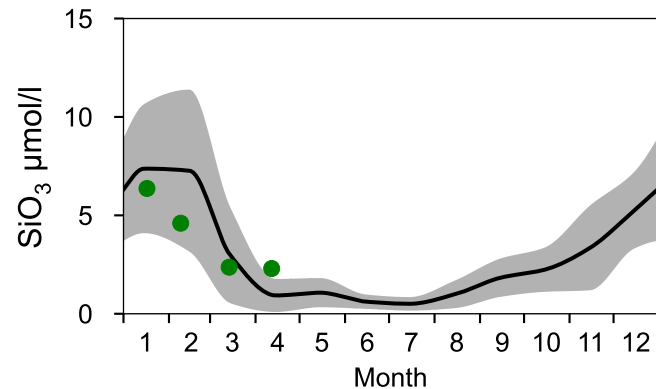
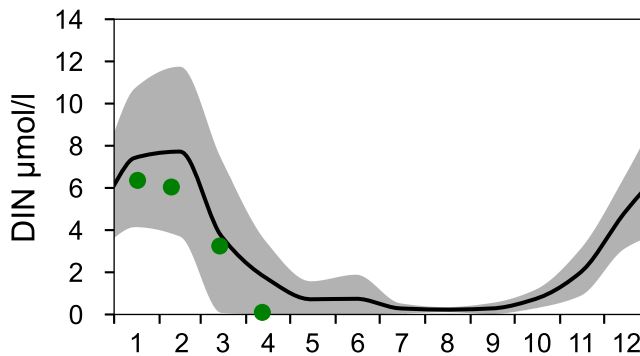
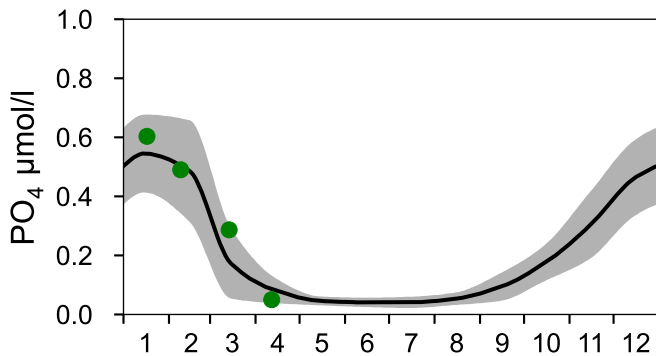
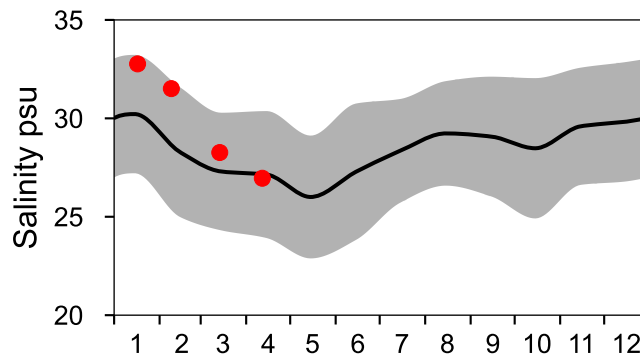
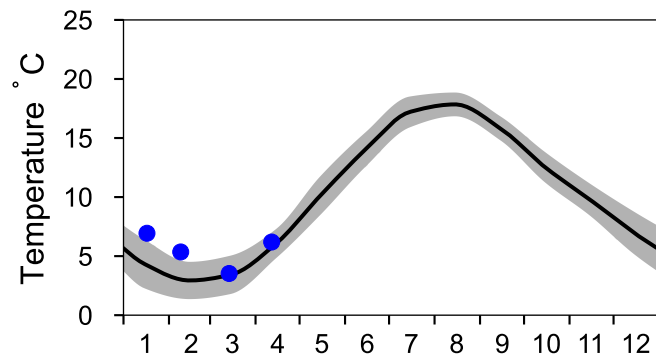
STATION Å13 SURFACE WATER (0-10 m)

Annual Cycles

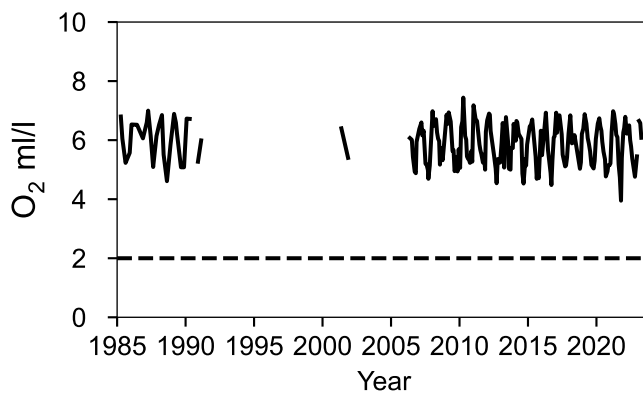
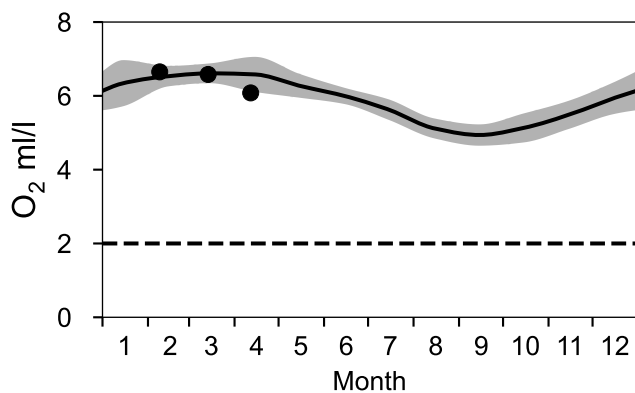
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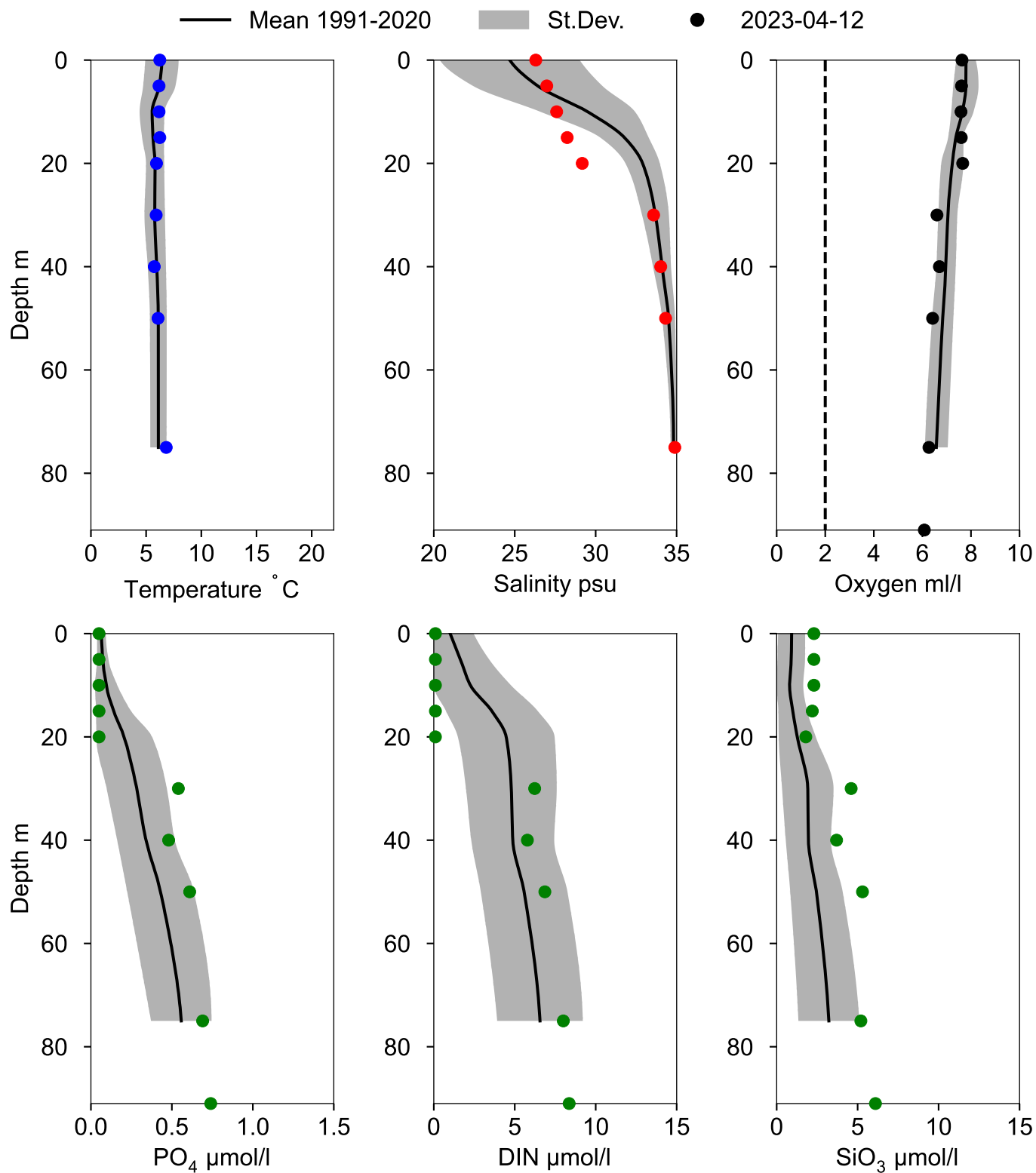
● 2023



OXYGEN IN BOTTOM WATER (depth >= 82 m)



Vertical profiles Å13 April



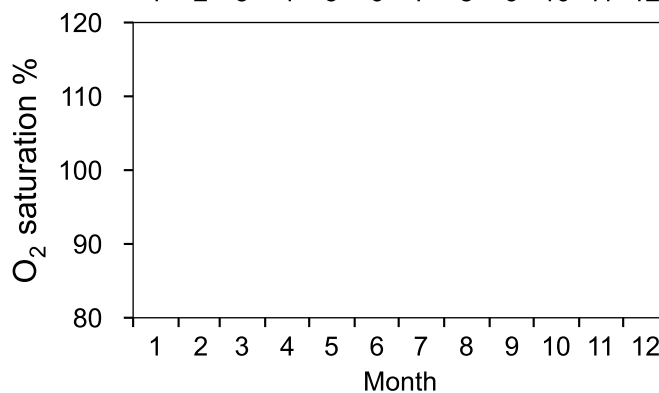
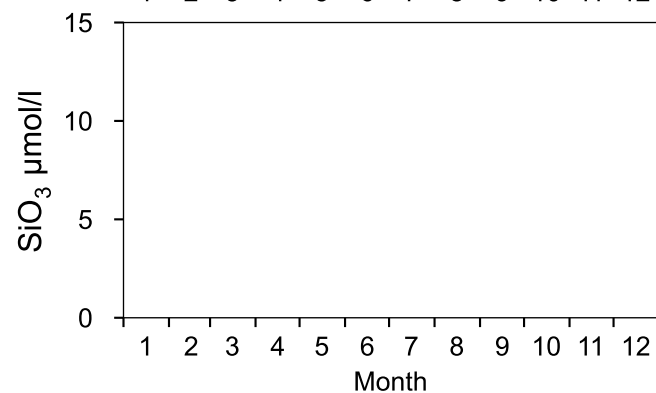
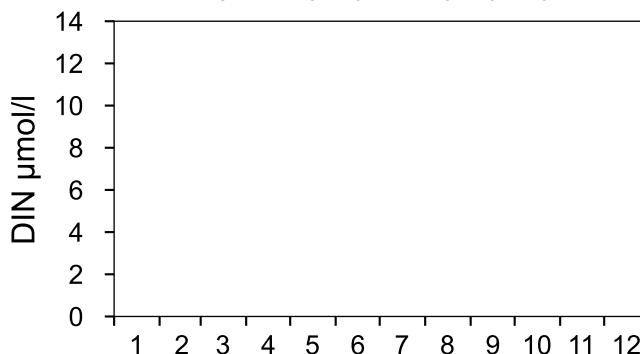
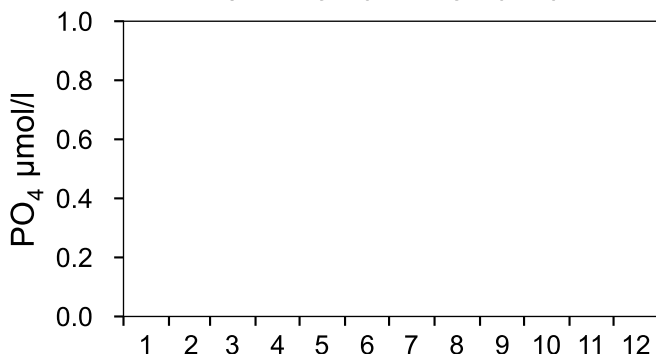
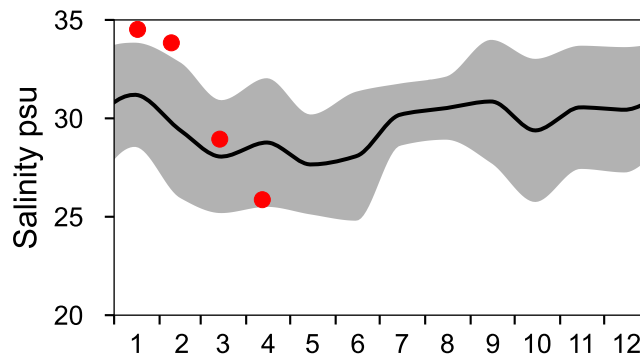
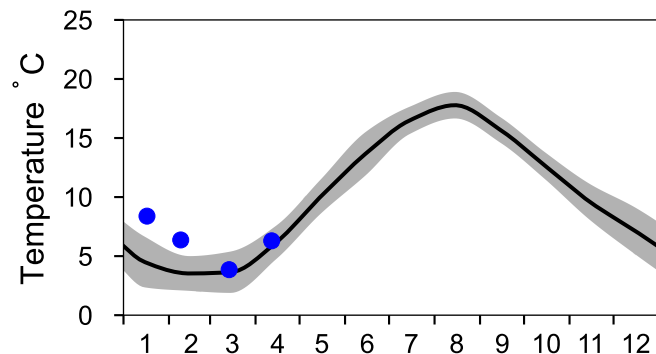
STATION Å14 SURFACE WATER (0-10 m)

Annual Cycles

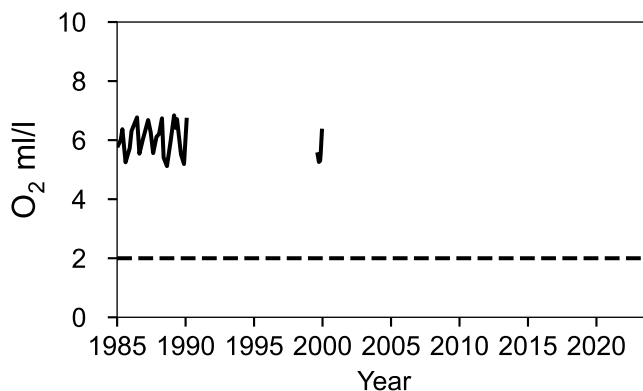
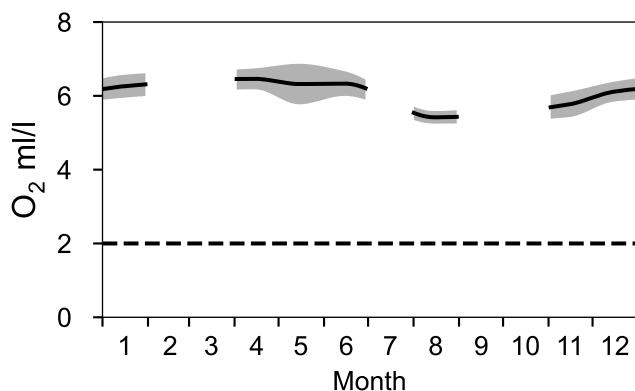
— Mean 1991-2020

■ St.Dev.

● 2023



OXYGEN IN BOTTOM WATER (depth >= 100 m)

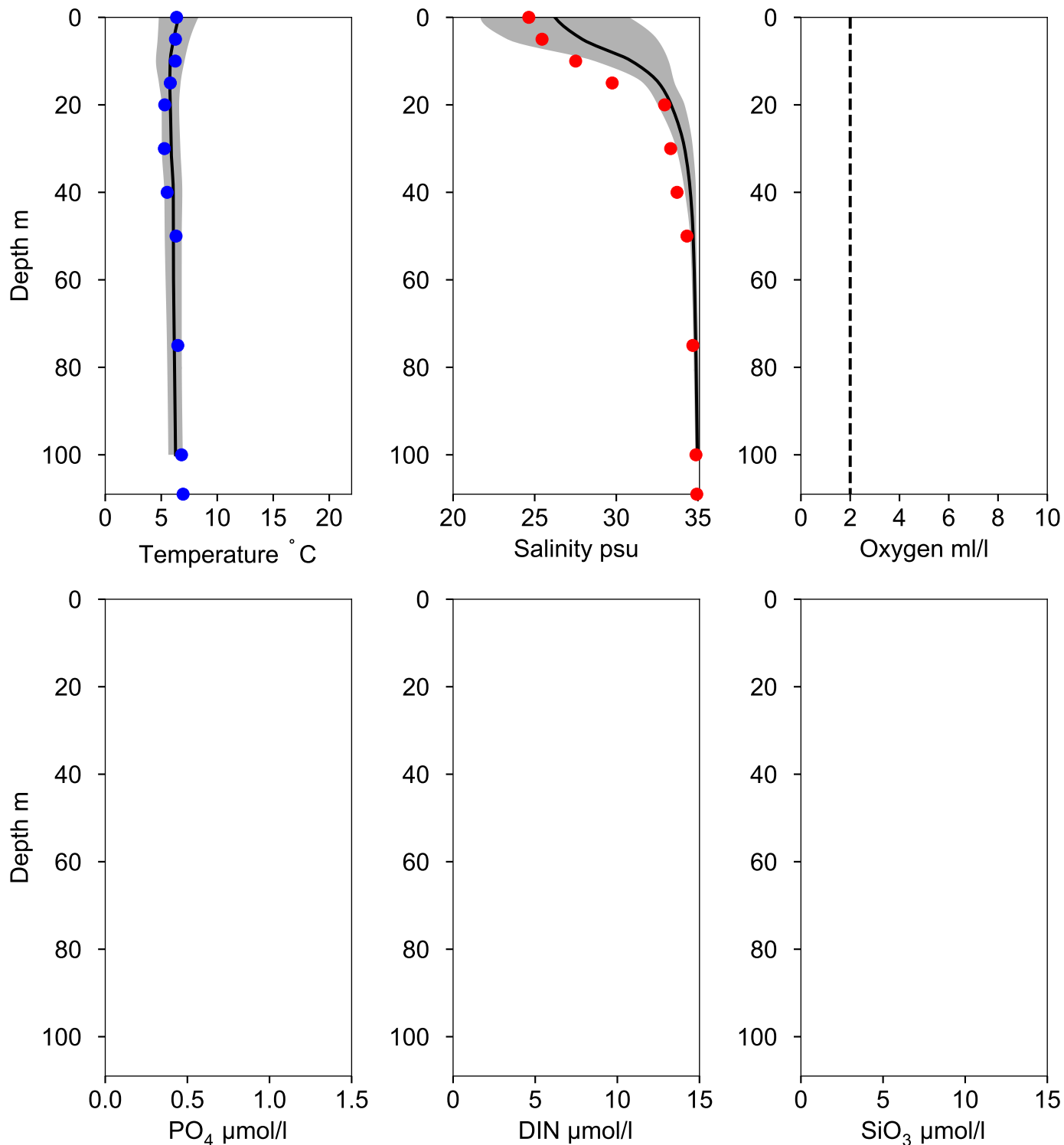


Vertical profiles A14 April

— Mean 1991-2020

■ St.Dev.

● 2023-04-12



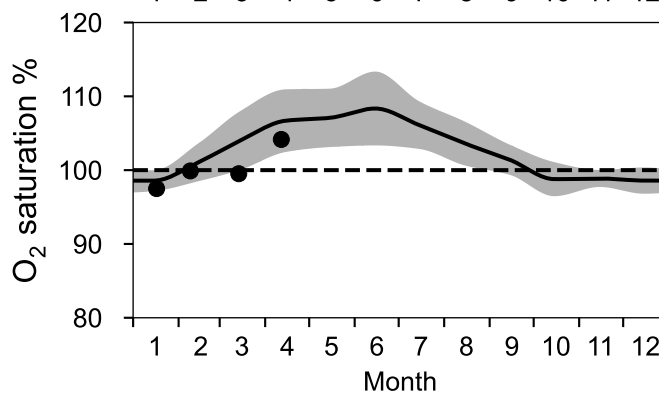
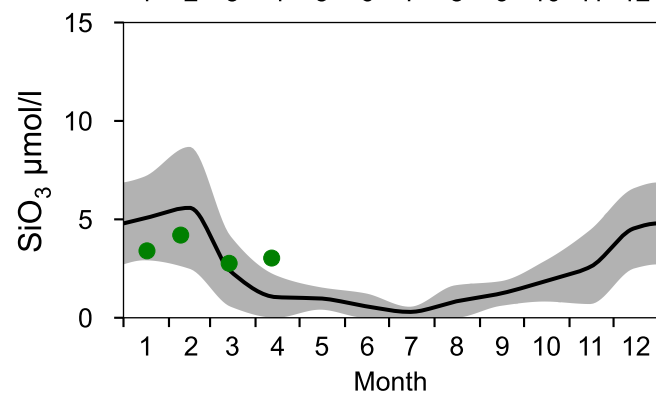
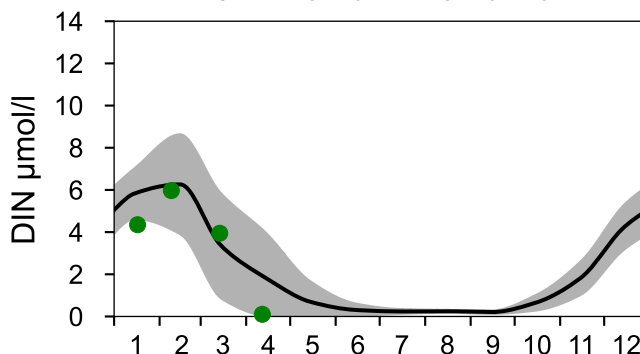
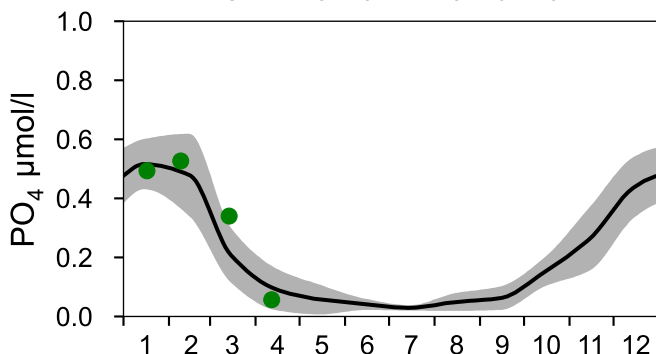
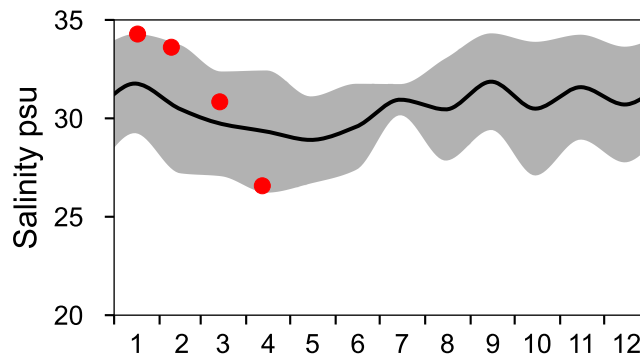
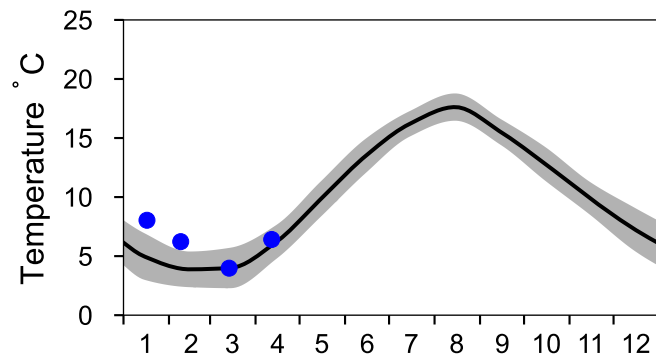
STATION Å15 SURFACE WATER (0-10 m)

Annual Cycles

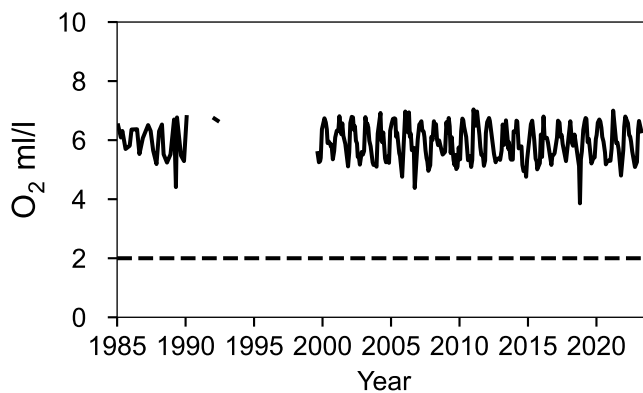
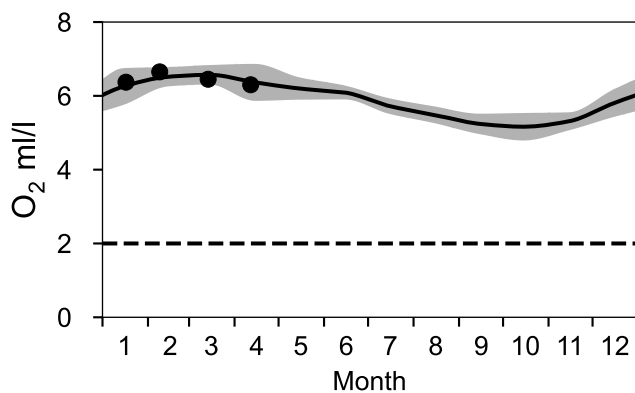
— Mean 1991-2020

■ St.Dev.

● 2023



OXYGEN IN BOTTOM WATER (depth >= 125 m)

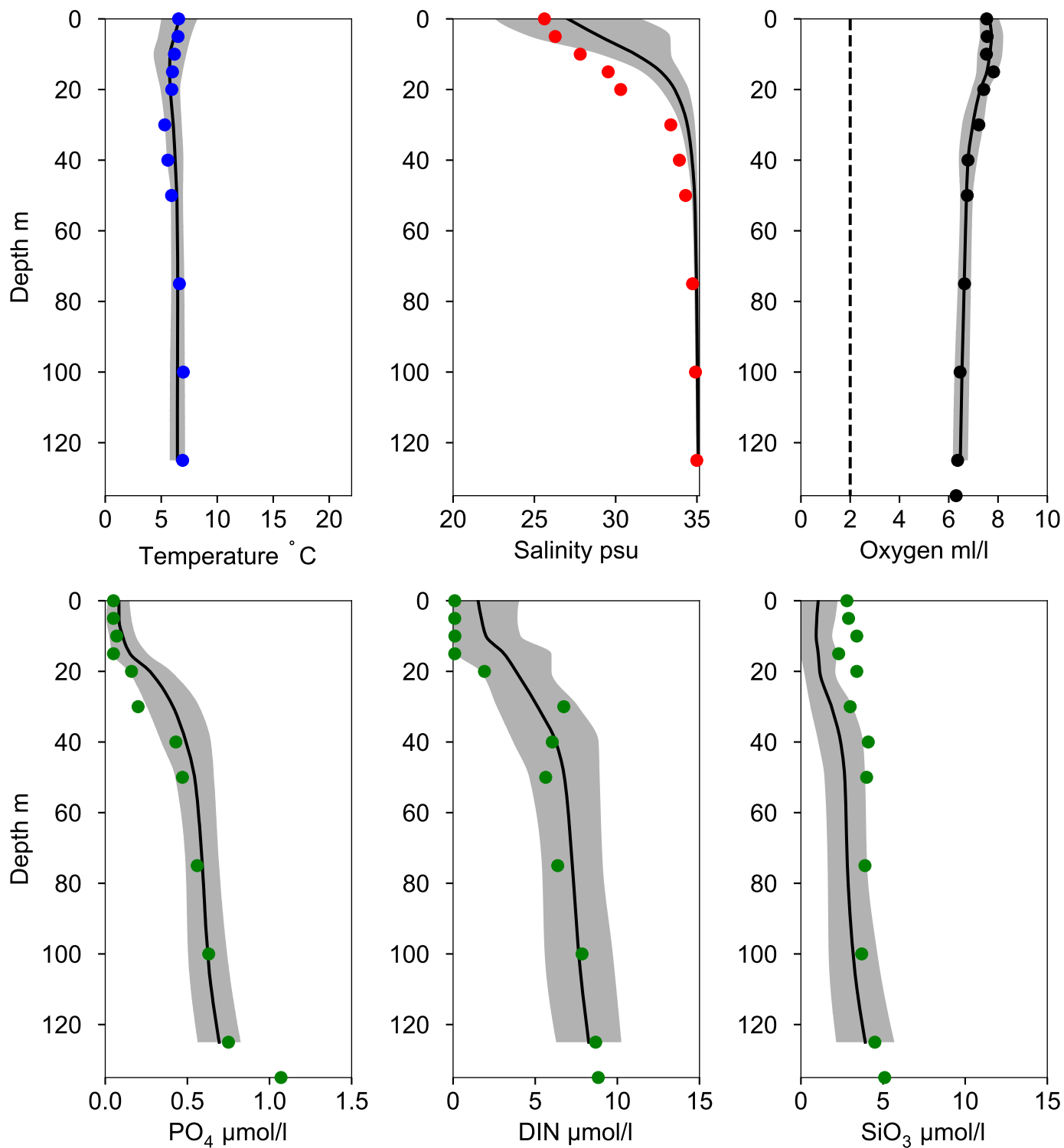


Vertical profiles Å15 April

— Mean 1991-2020

■ St.Dev.

● 2023-04-12



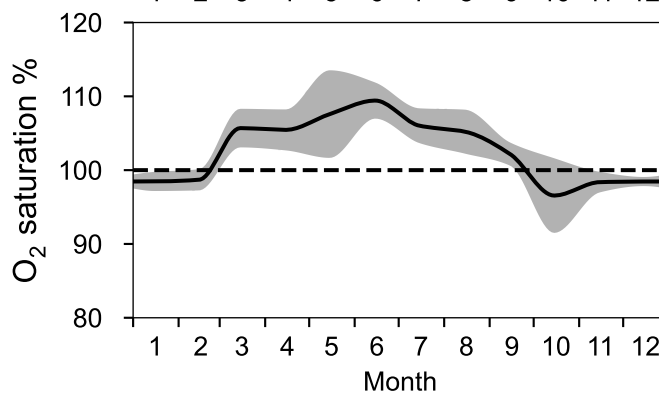
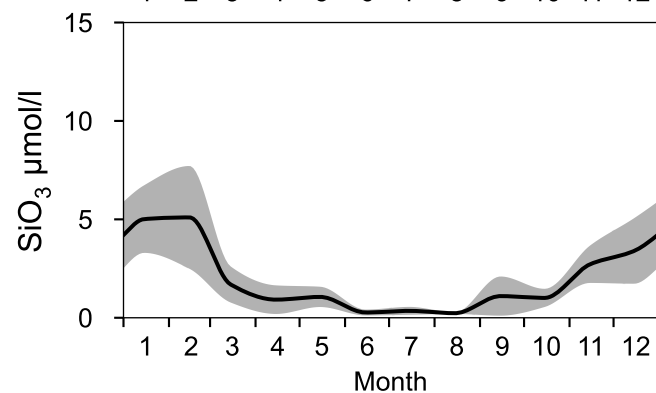
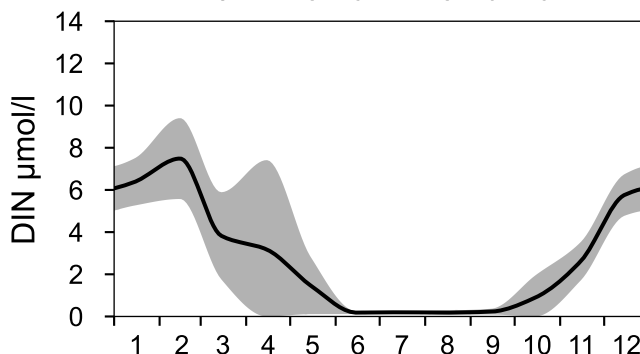
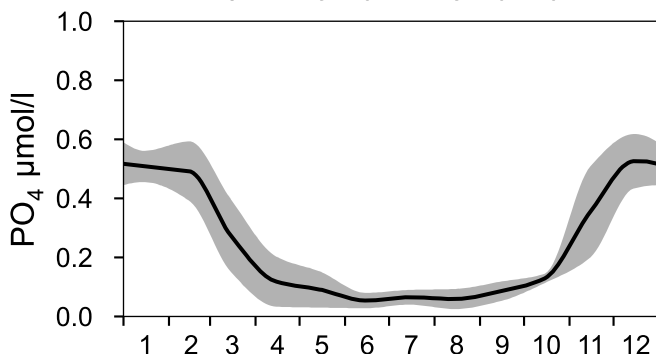
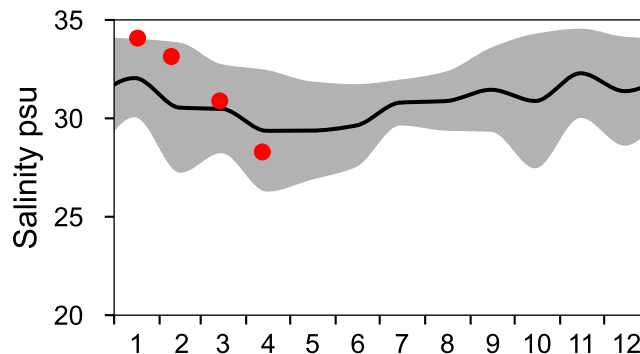
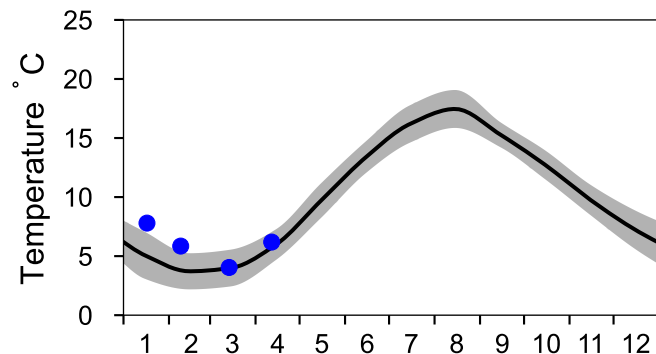
STATION Å16 SURFACE WATER (0-10 m)

Annual Cycles

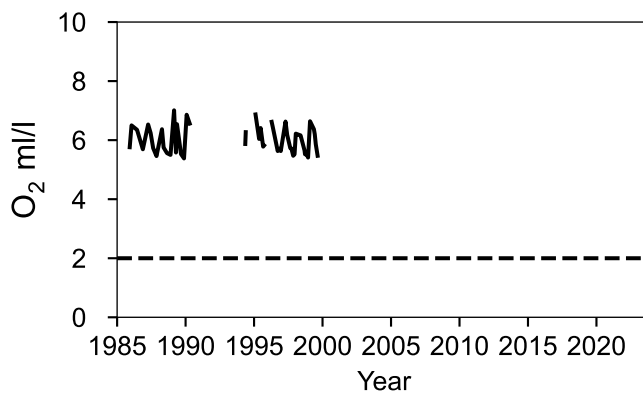
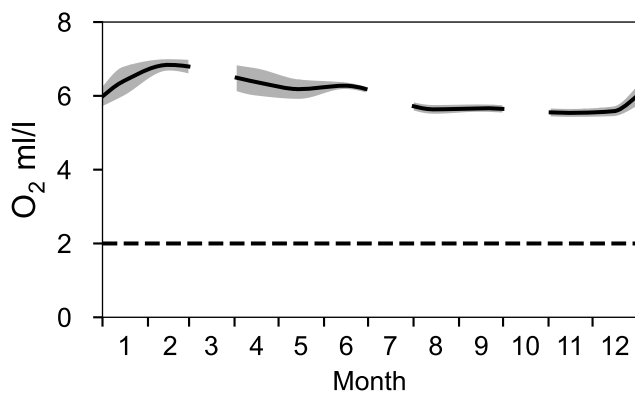
— Mean 1991-2020

■ St.Dev.

● 2023



OXYGEN IN BOTTOM WATER (depth >= 193 m)

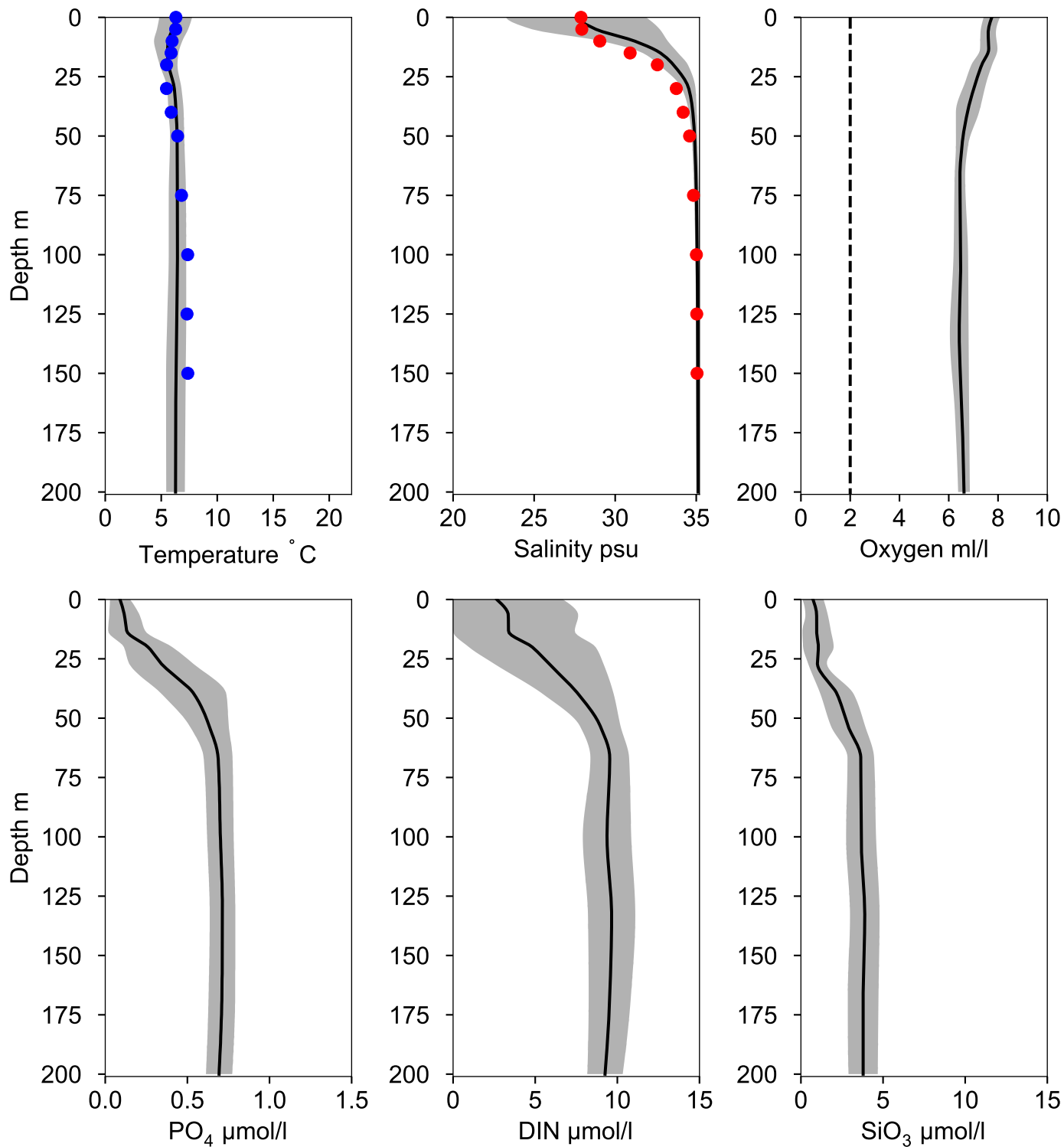


Vertical profiles A16 April

— Mean 1991-2020

■ St.Dev.

● 2023-04-12



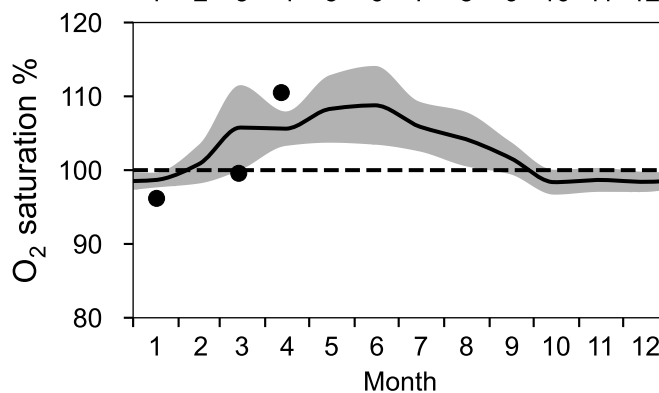
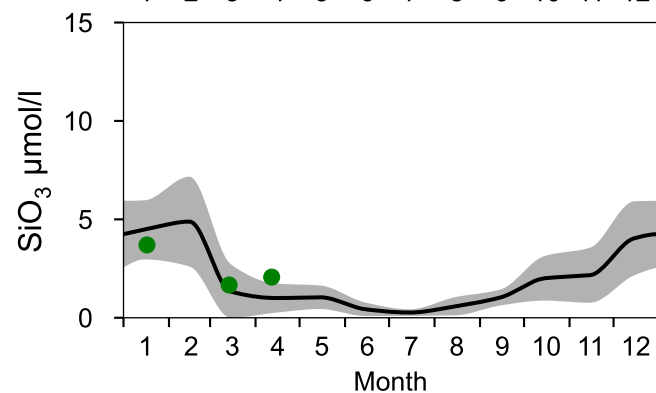
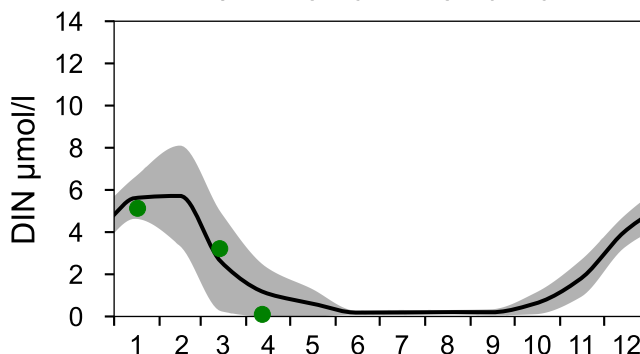
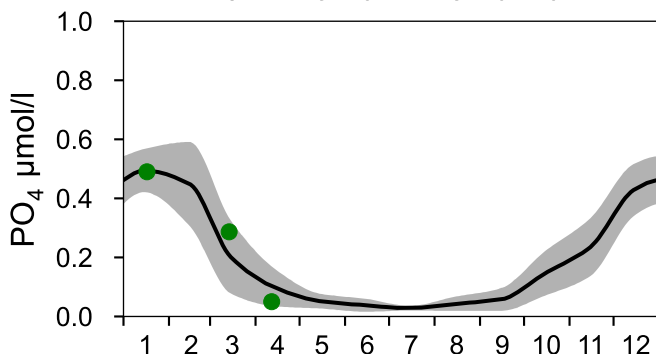
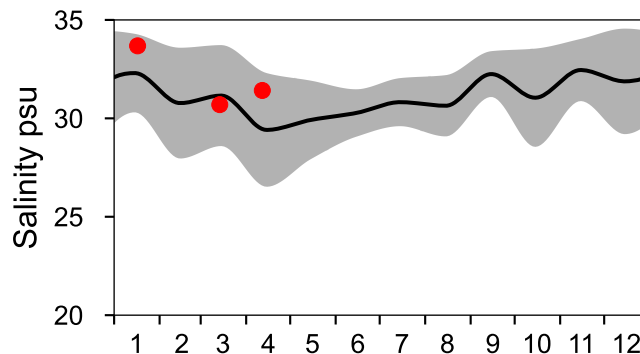
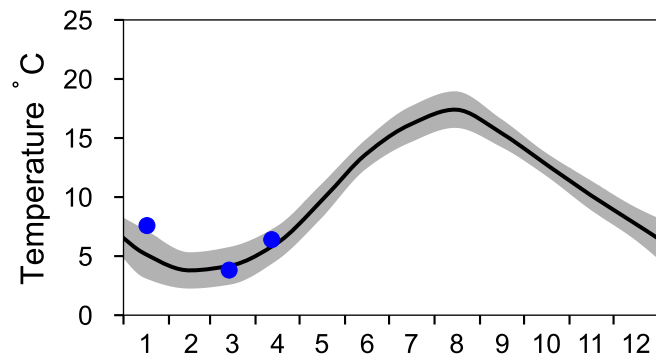
STATION Å17 SURFACE WATER (0-10 m)

Annual Cycles

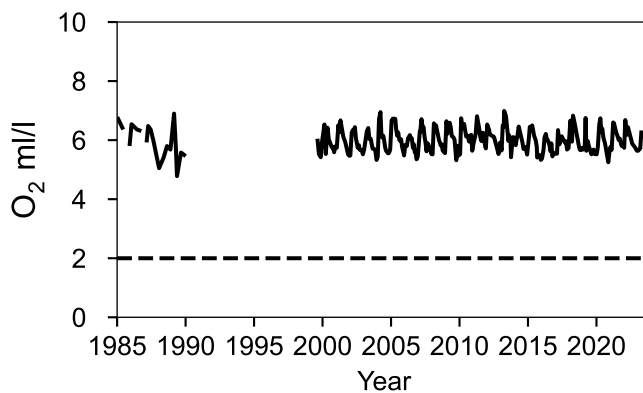
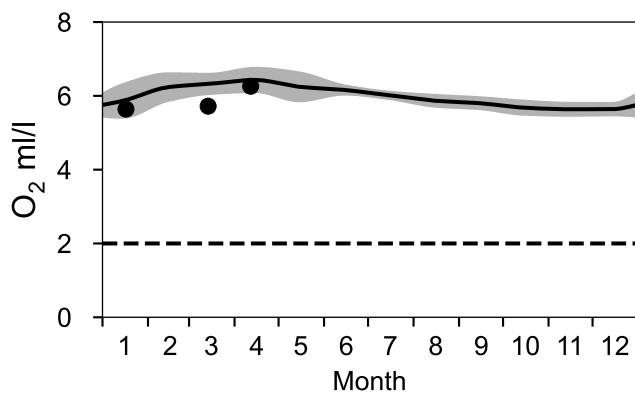
— Mean 1991-2020

■ St.Dev.

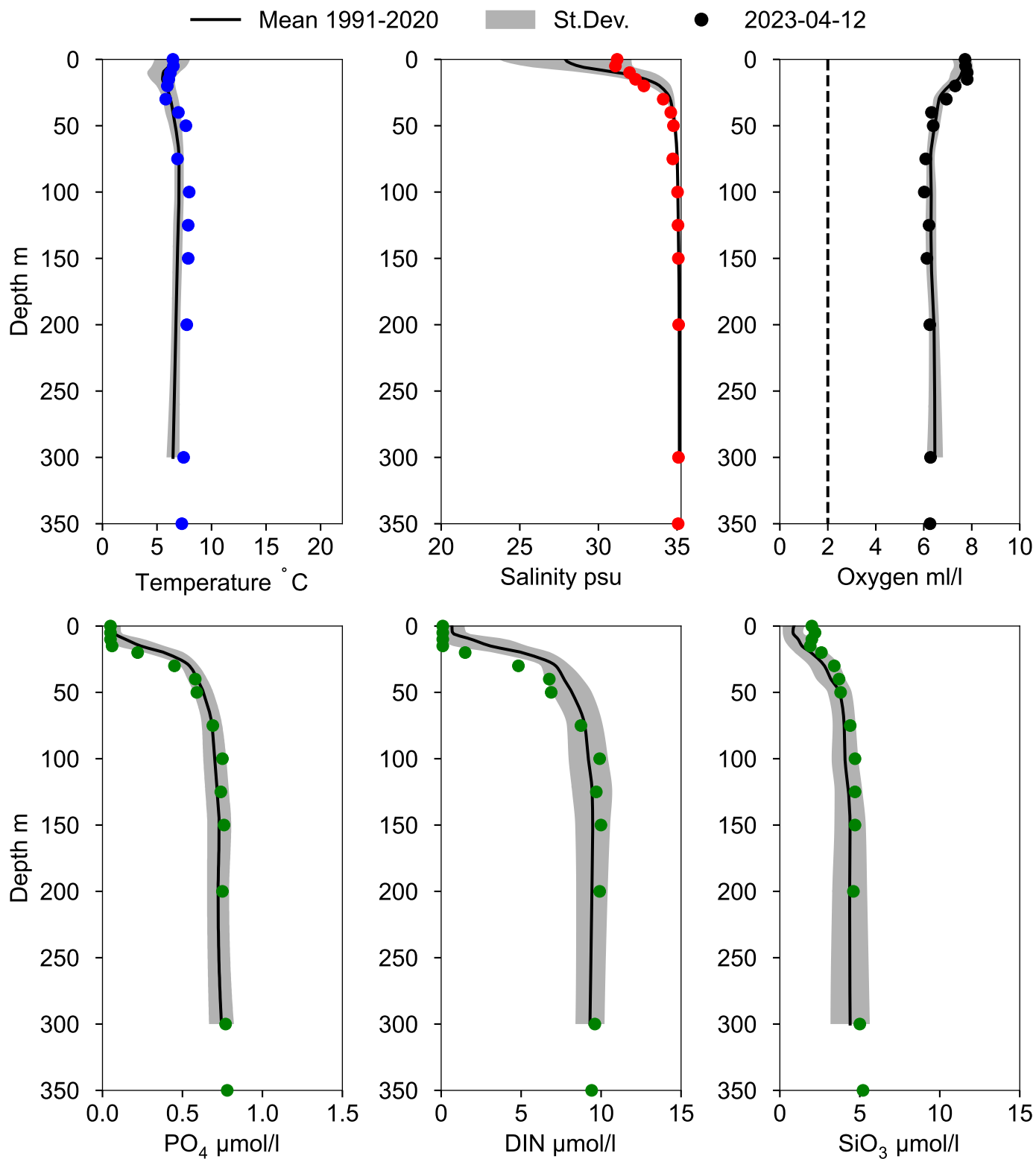
● 2023



OXYGEN IN BOTTOM WATER (depth >= 300 m)



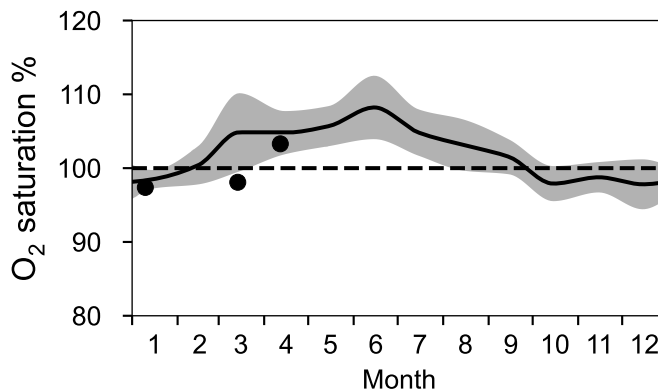
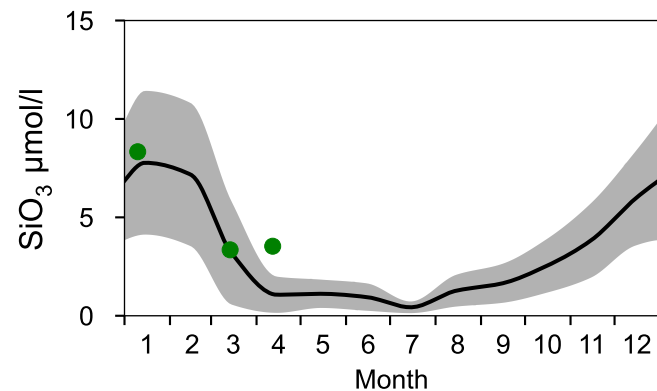
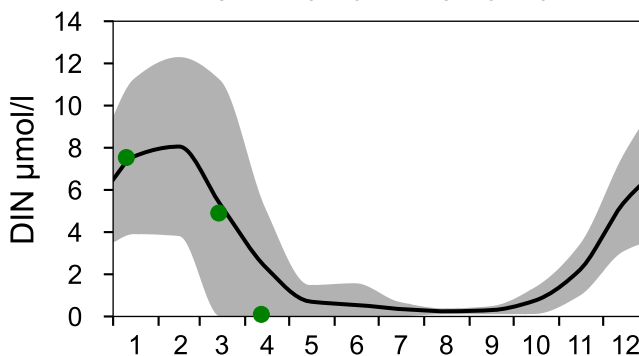
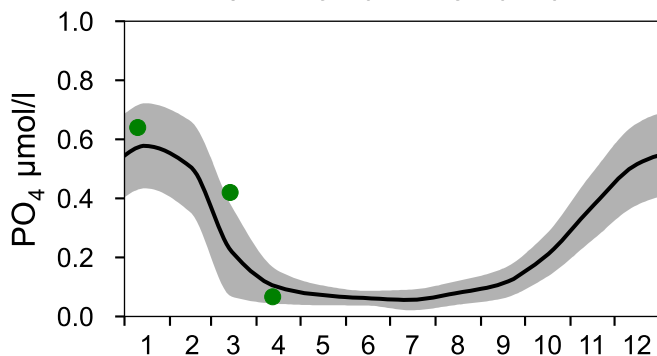
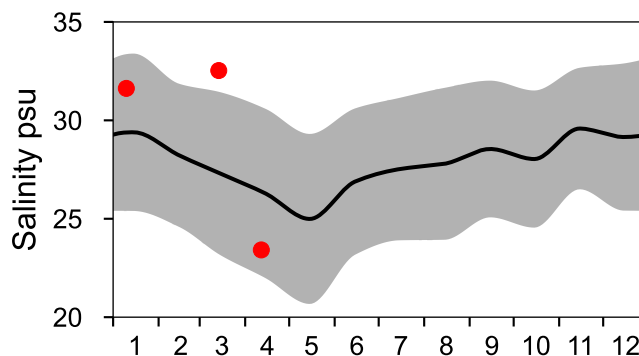
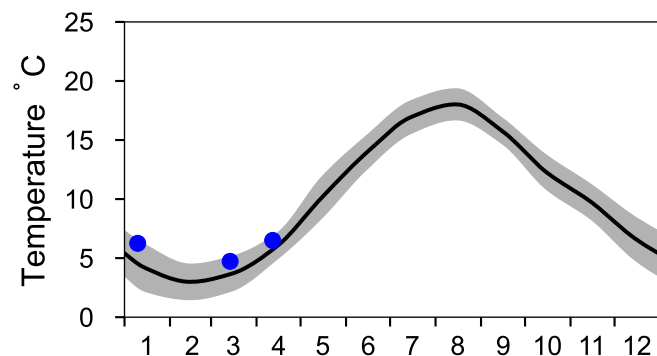
Vertical profiles Å17 April



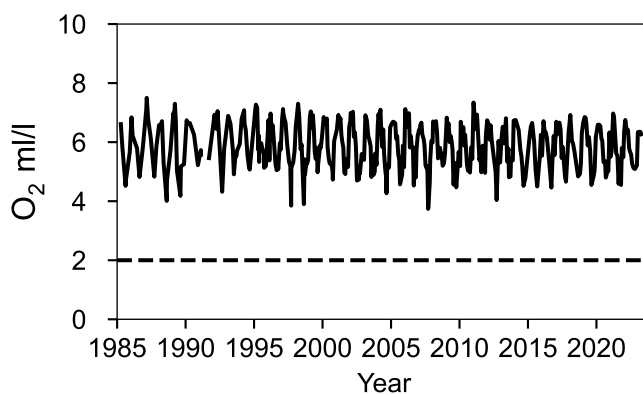
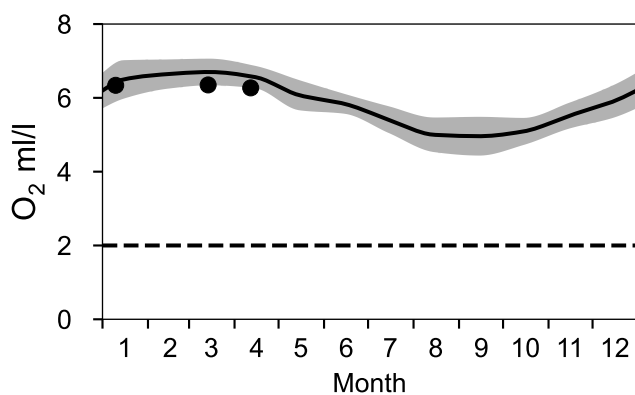
STATION P2 SURFACE WATER (0-10 m)

Annual Cycles

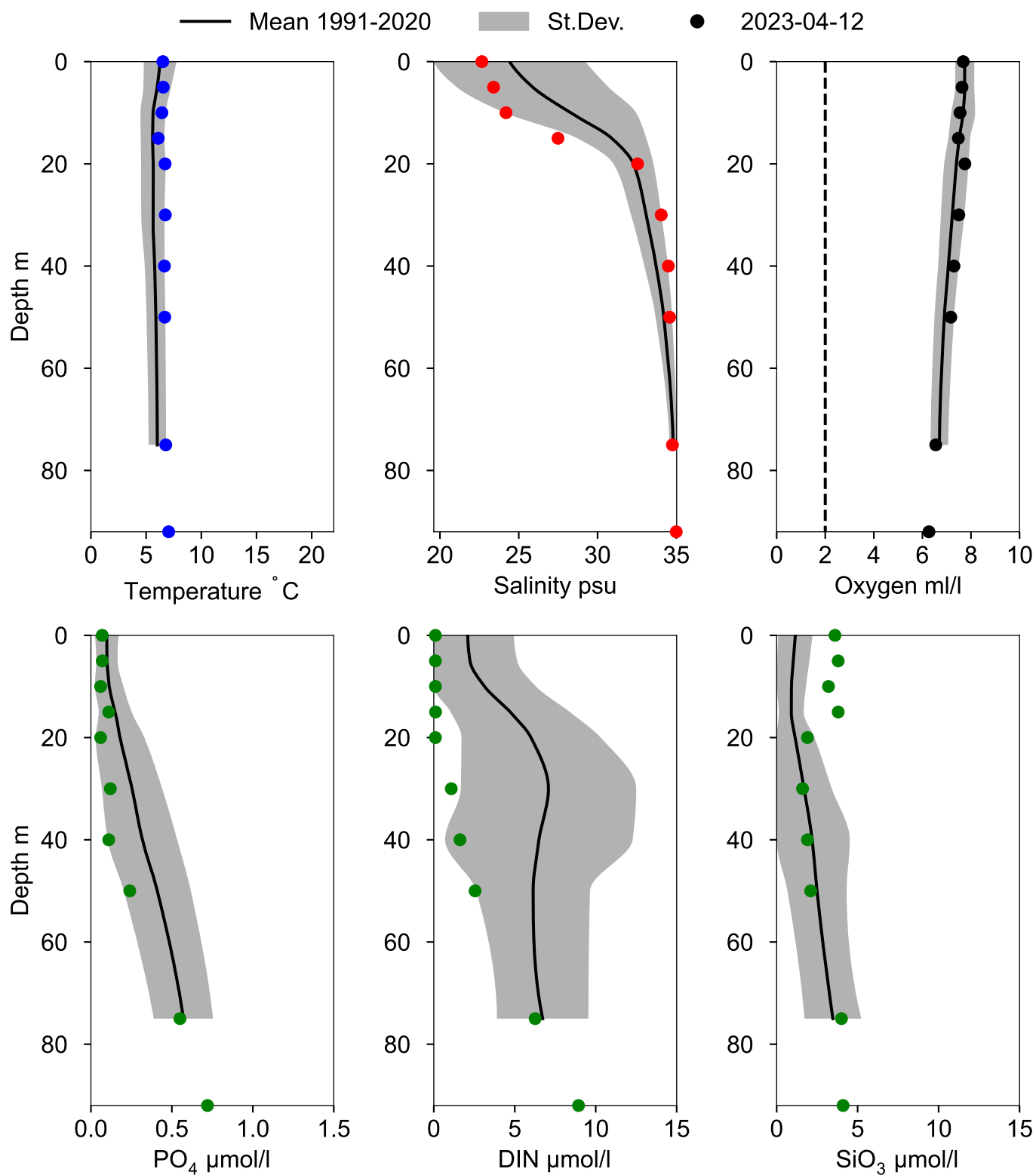
— Mean 1991-2020 St.Dev. ● 2023



OXYGEN IN BOTTOM WATER (depth >= 75 m)



Vertical profiles P2 April



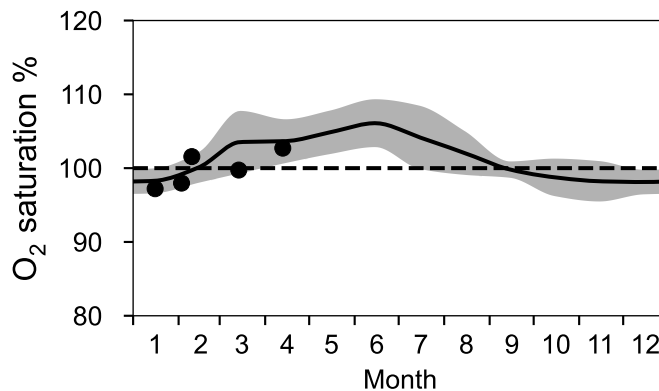
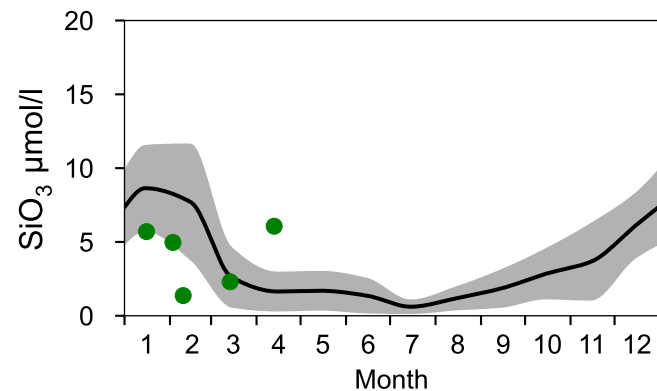
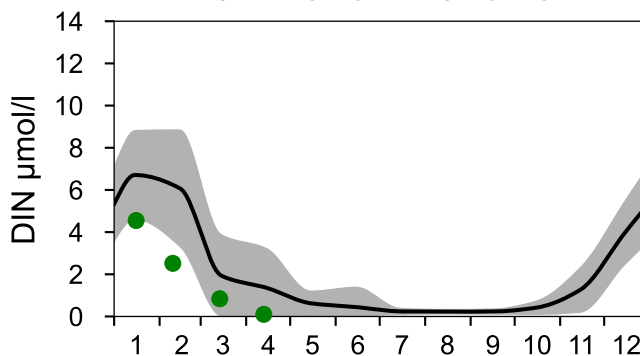
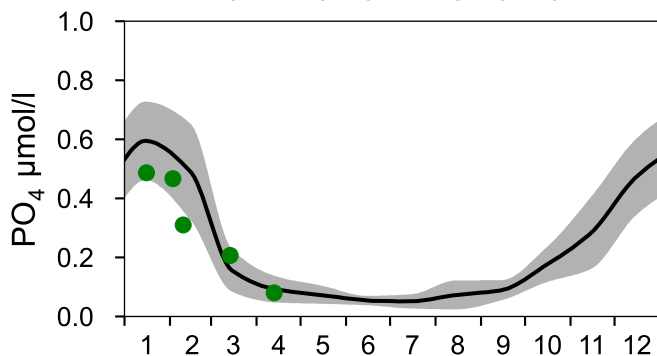
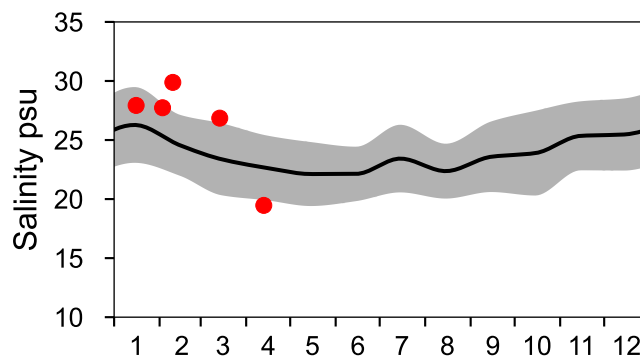
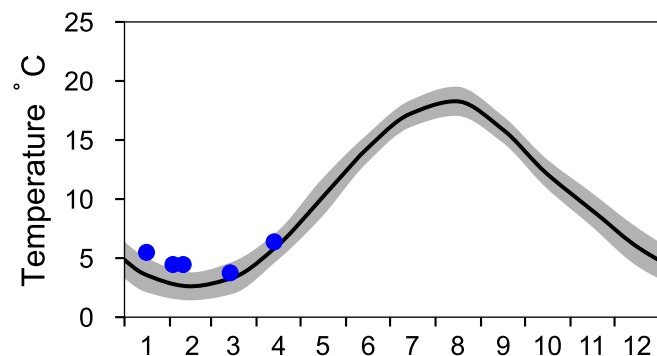
STATION FLADEN SURFACE WATER (0-10 m)

Annual Cycles

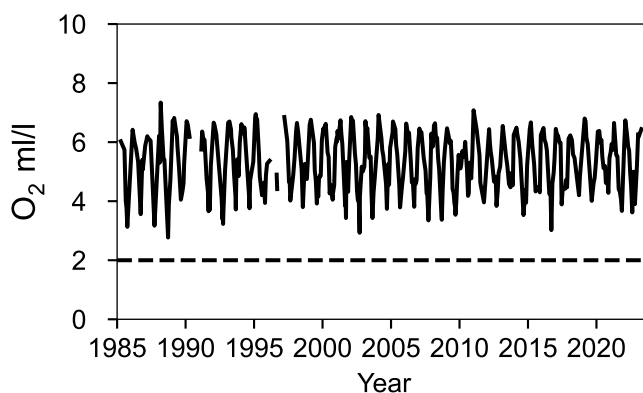
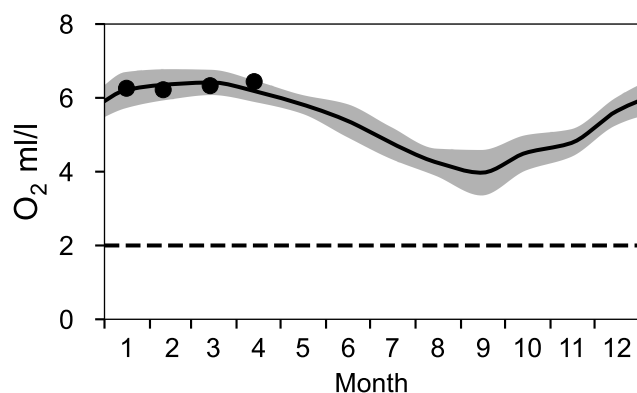
— Mean 1991-2020

■ St.Dev.

● 2023



OXYGEN IN BOTTOM WATER (depth >= 74 m)

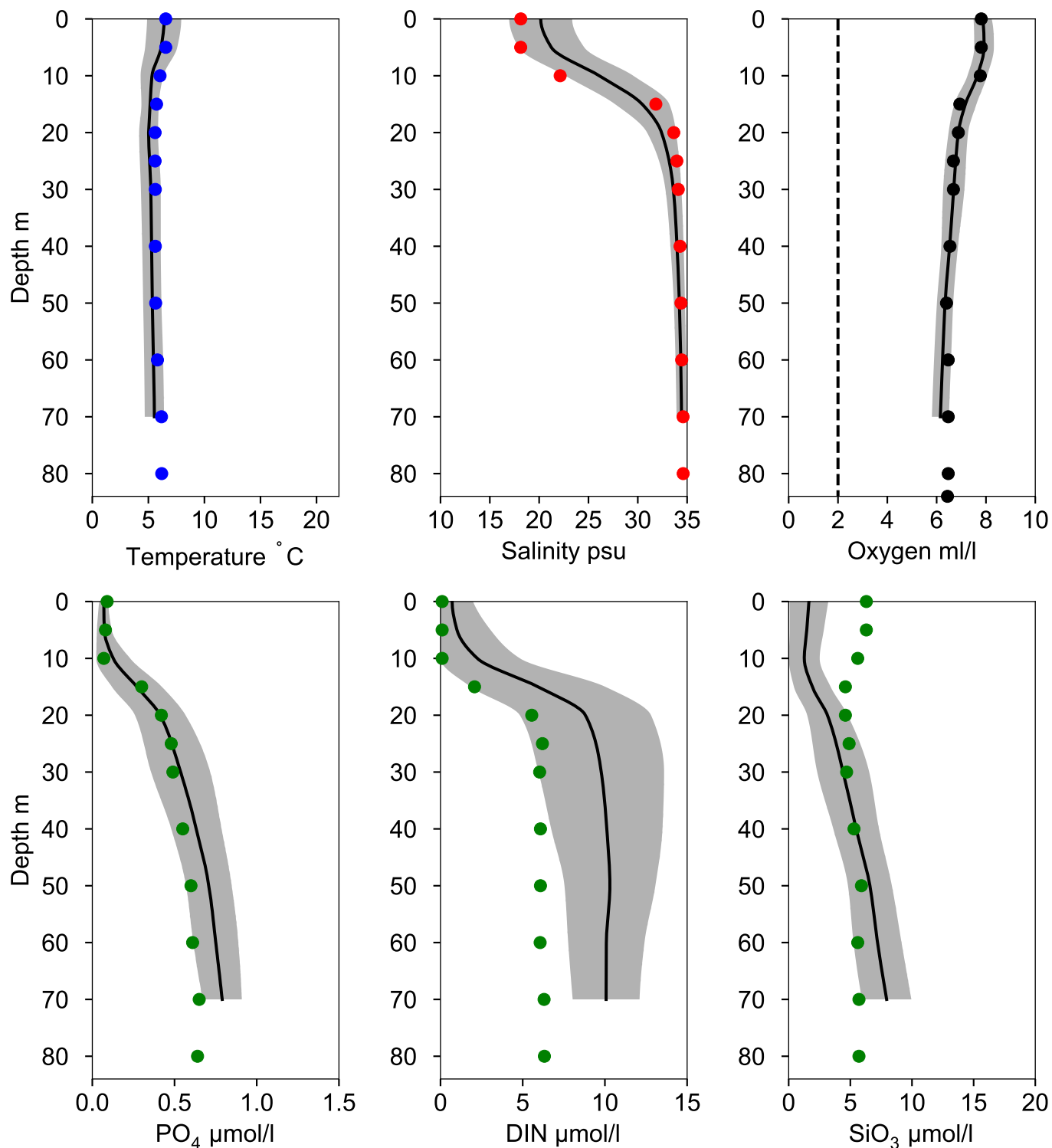


Vertical profiles FLADEN April

— Mean 1991-2020

■ St.Dev.

● 2023-04-13



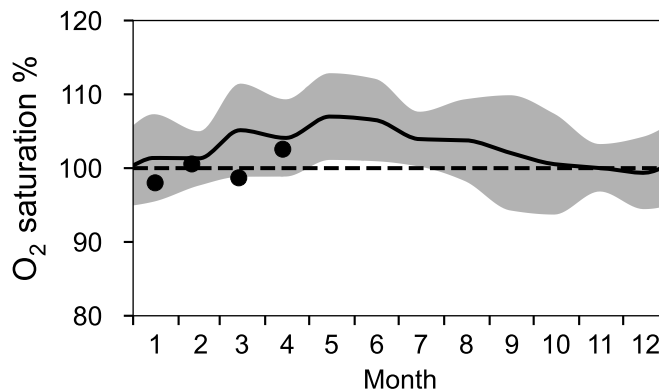
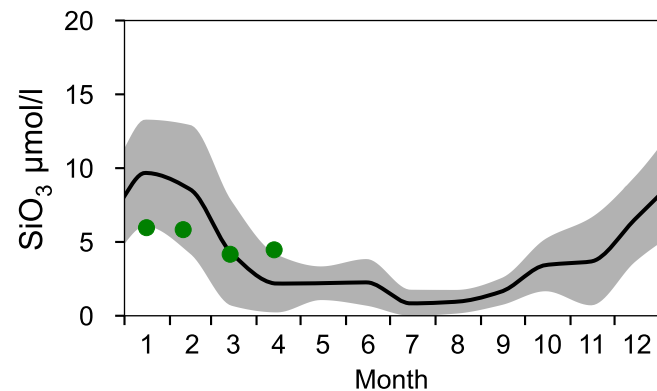
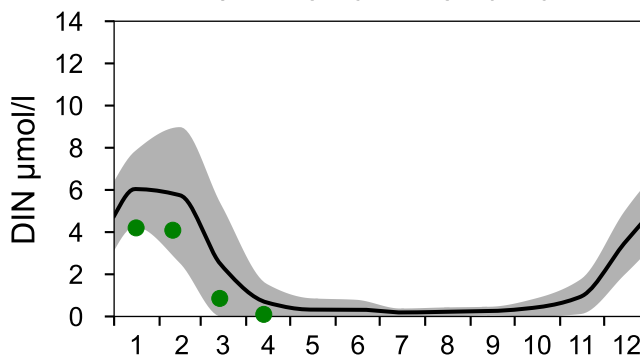
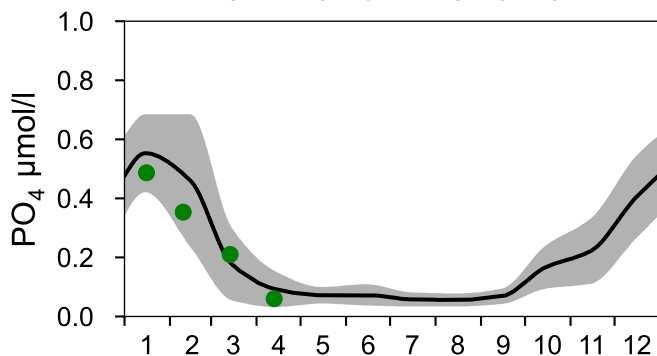
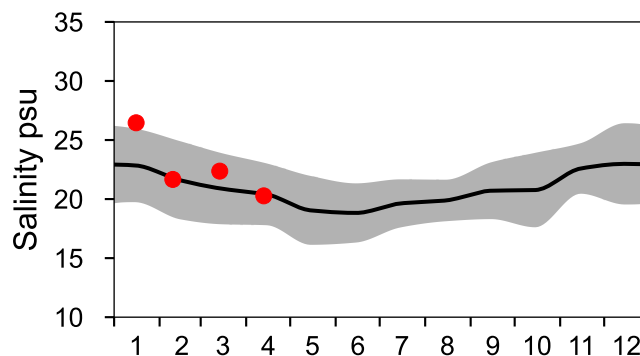
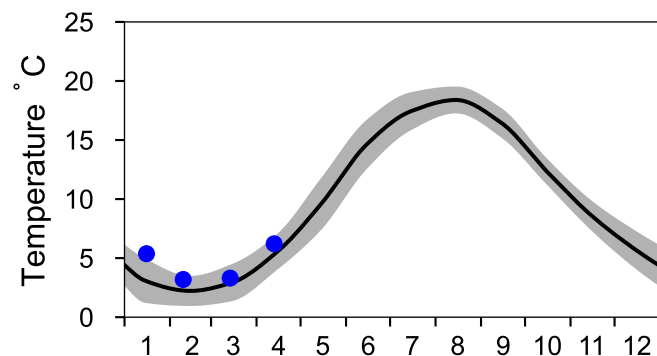
STATION N14 FALKENBERG SURFACE WATER (0-10 m)

Annual Cycles

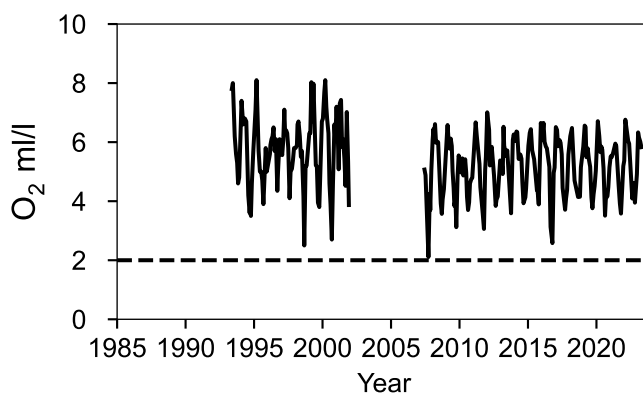
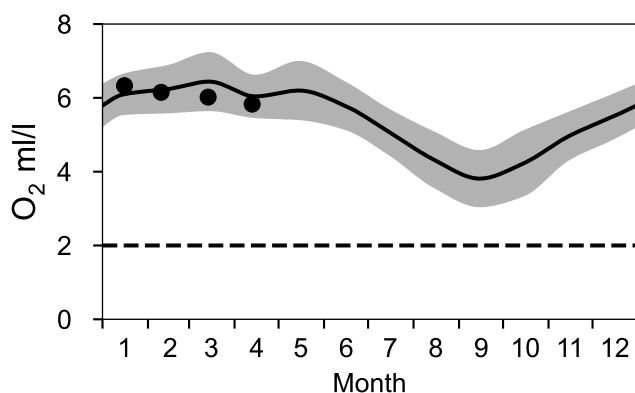
— Mean 1991-2020

■ St.Dev.

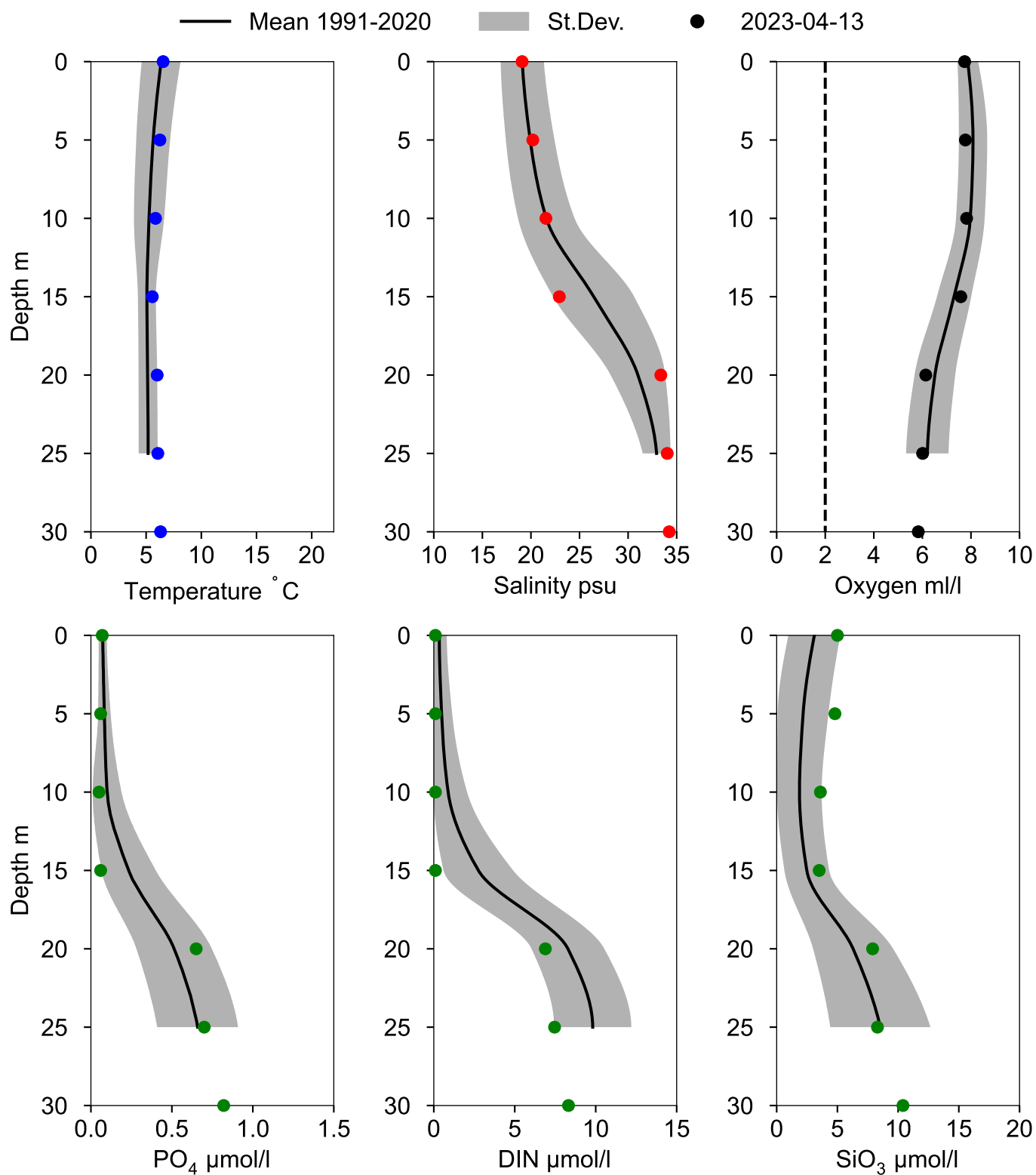
● 2023



OXYGEN IN BOTTOM WATER (depth >= 25 m)



Vertical profiles N14 FALKENBERG April



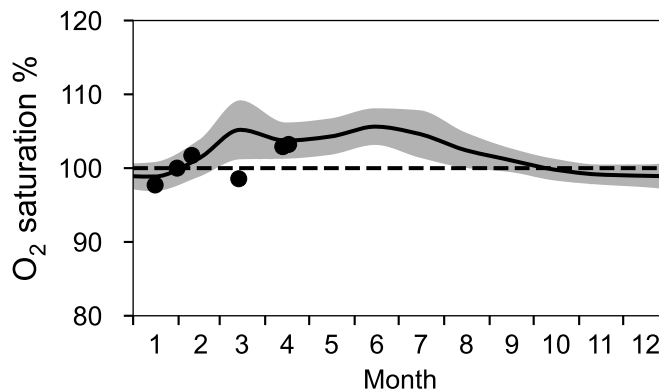
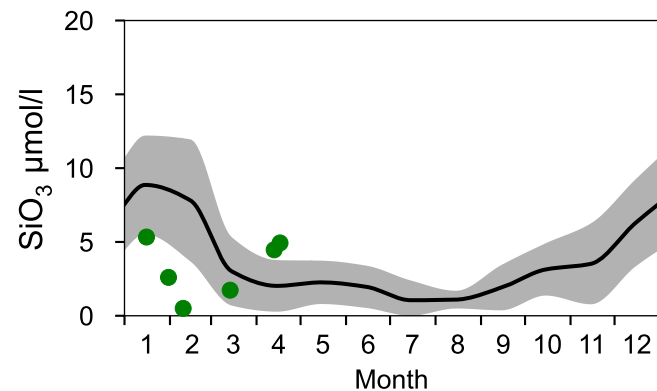
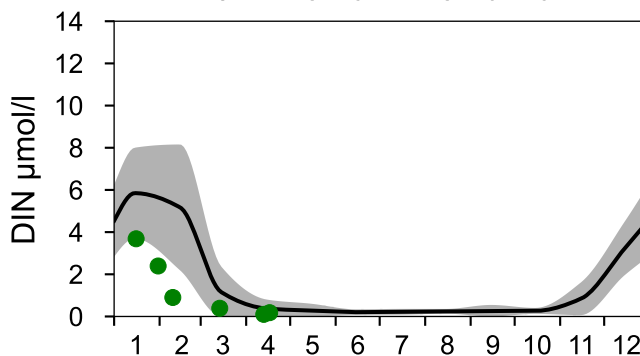
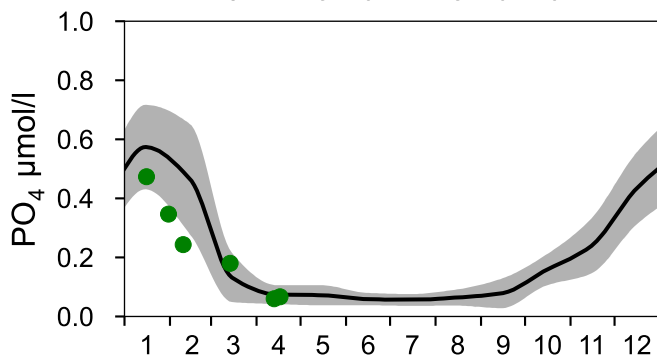
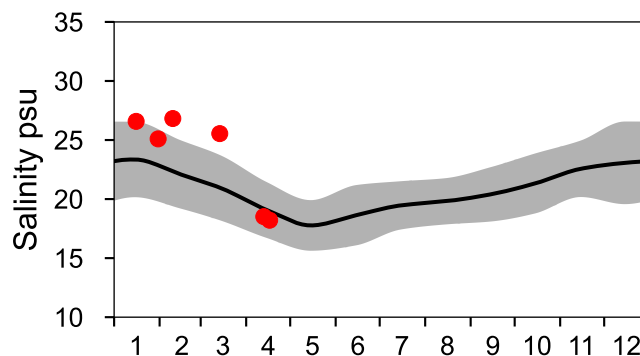
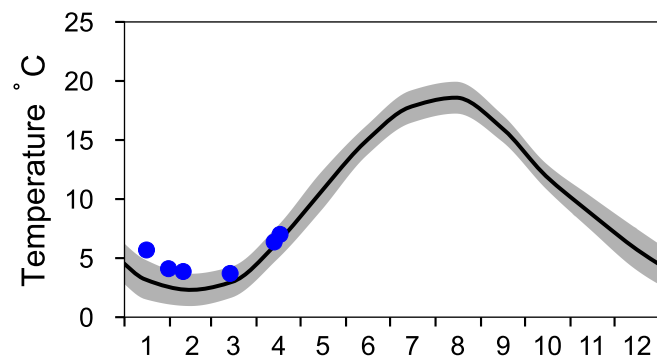
STATION ANHOLT E SURFACE WATER (0-10 m)

Annual Cycles

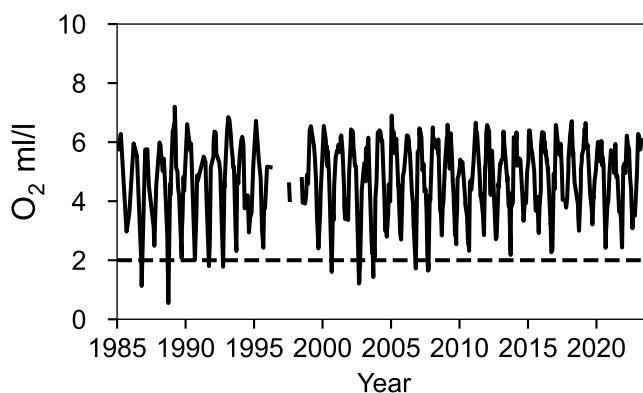
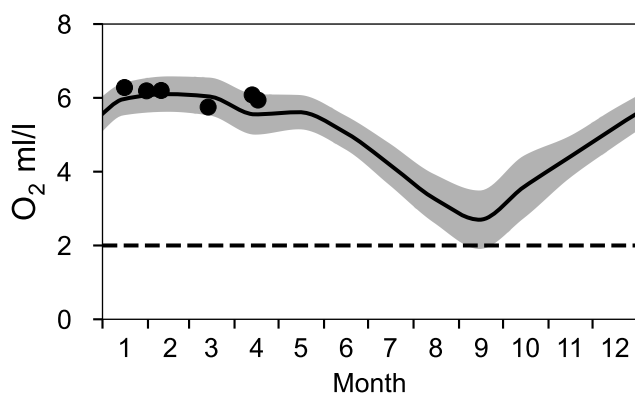
— Mean 1991-2020

■ St.Dev.

● 2023

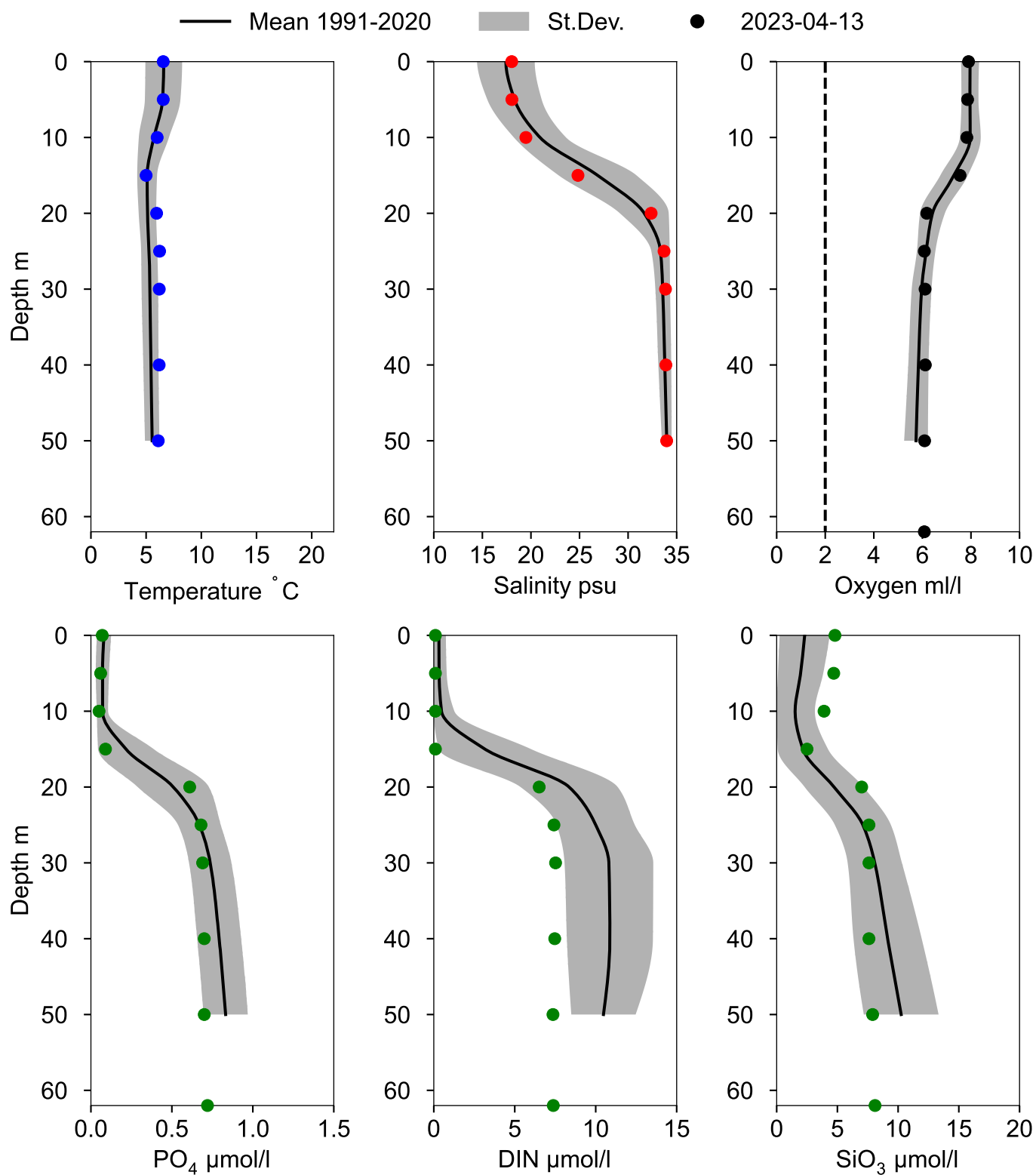


OXYGEN IN BOTTOM WATER (depth >= 52 m)



Vertical profiles ANHOLT E

April



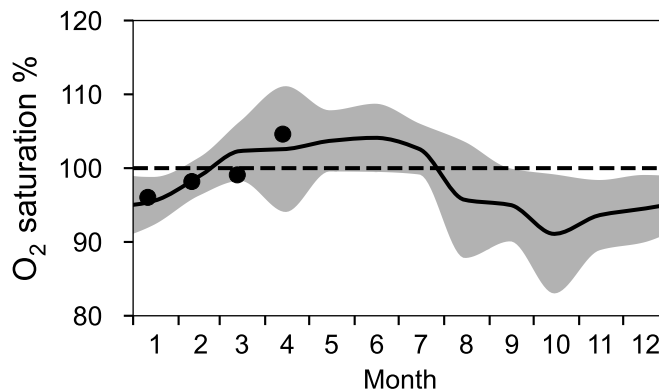
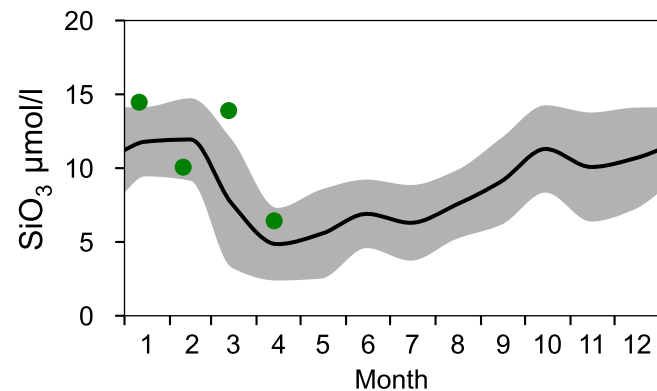
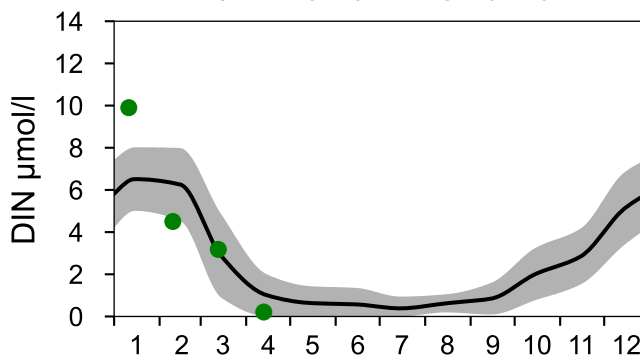
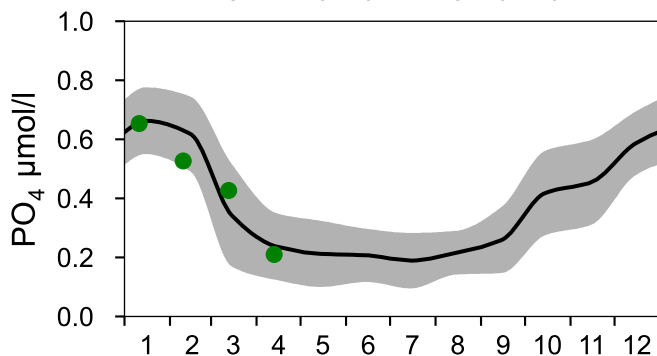
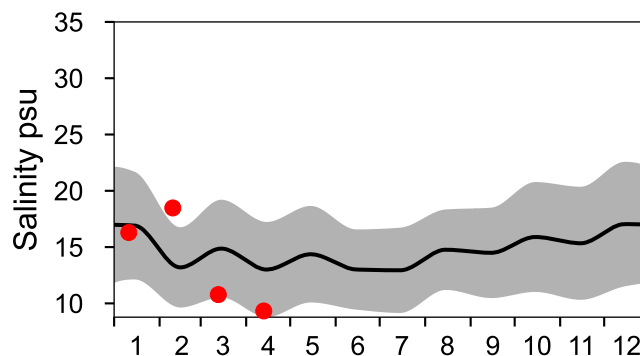
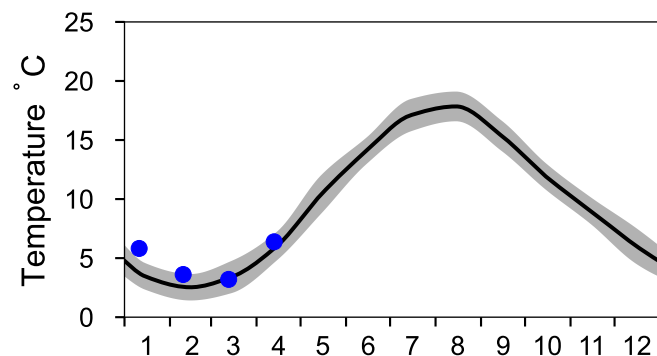
STATION W LANDSKRONA SURFACE WATER (0-10 m)

Annual Cycles

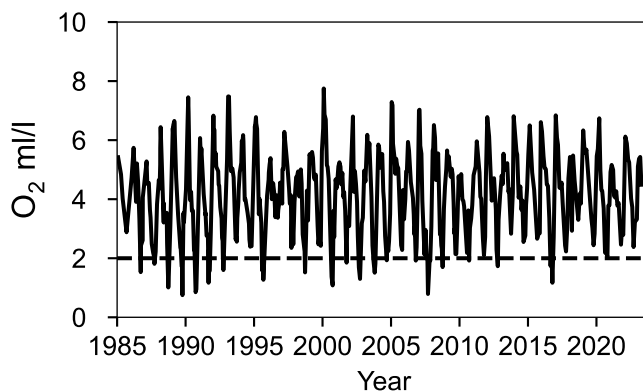
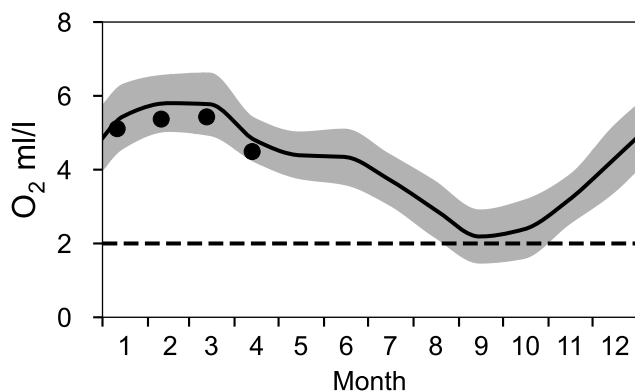
— Mean 1991-2020

■ St.Dev.

● 2023

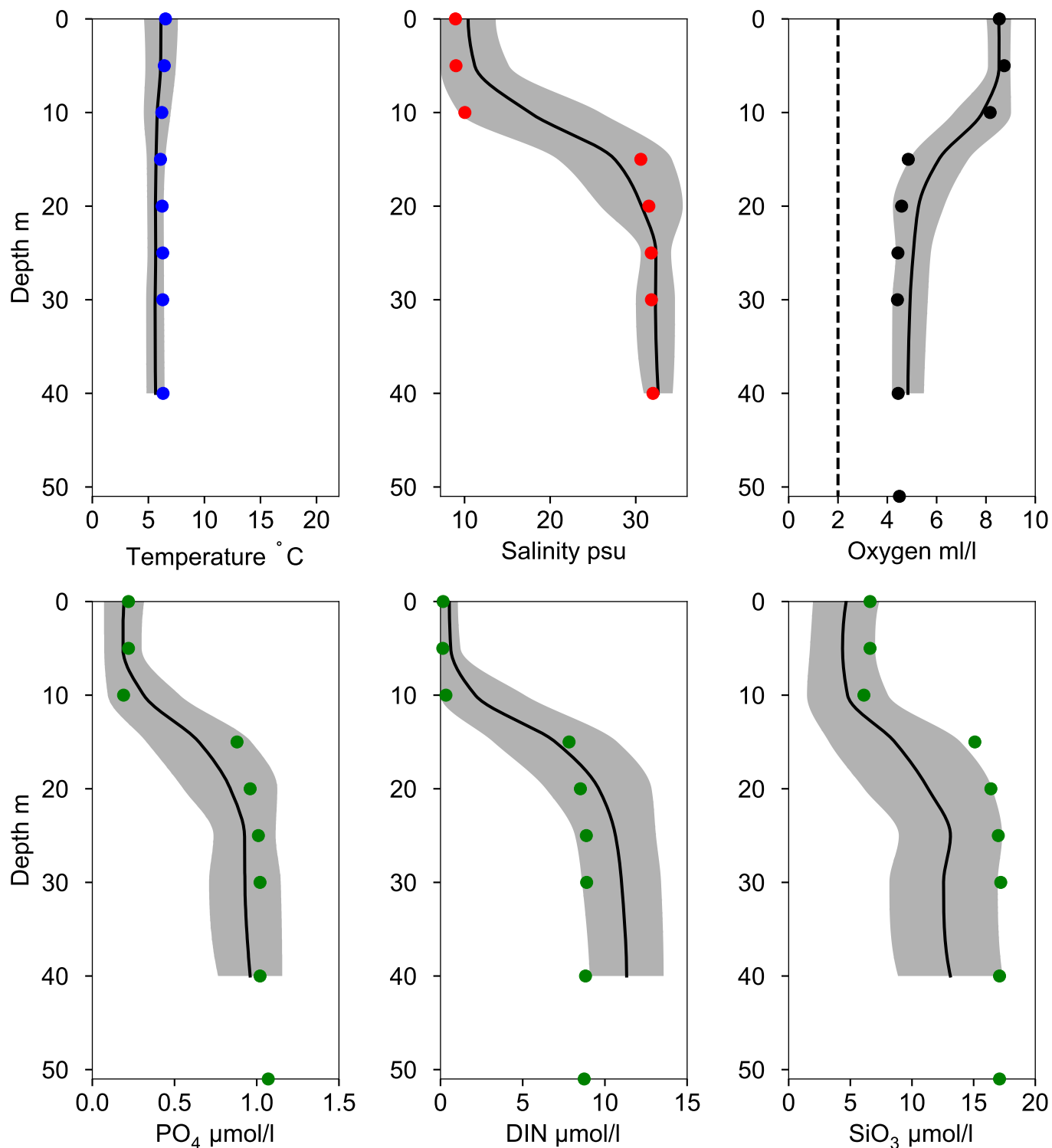


OXYGEN IN BOTTOM WATER (depth >= 40 m)



Vertical profiles W LANDSKRONA April

— Mean 1991-2020 St.Dev. ● 2023-04-13



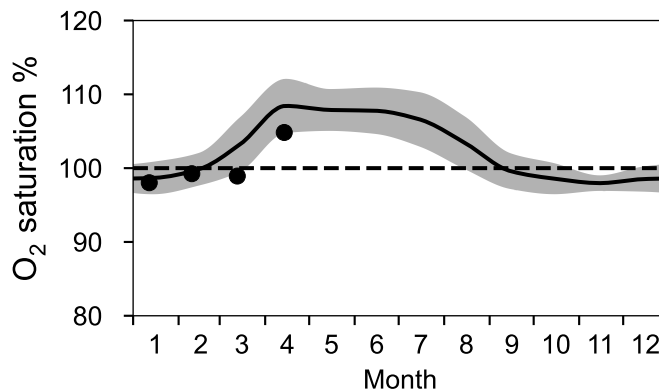
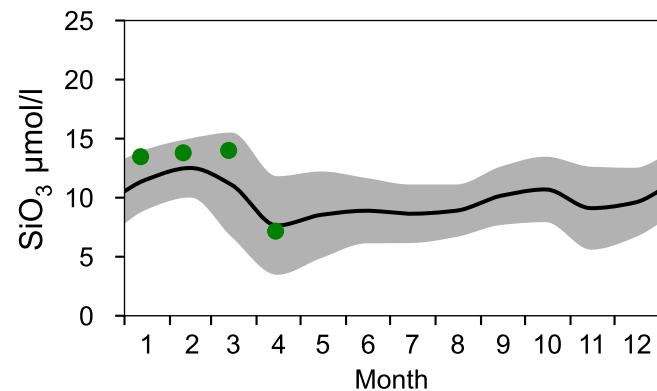
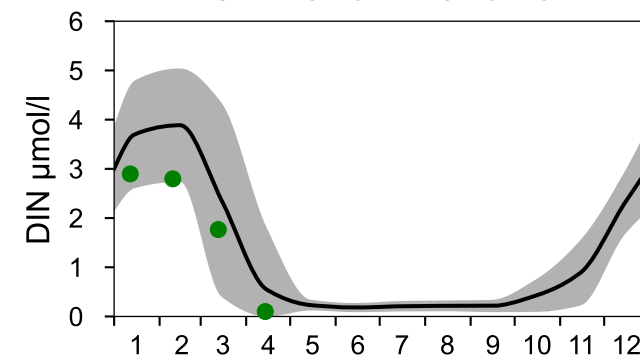
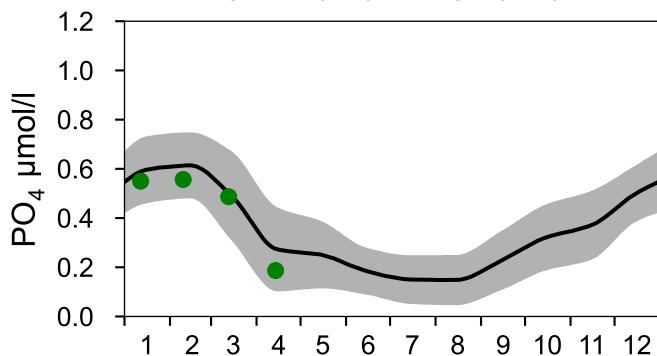
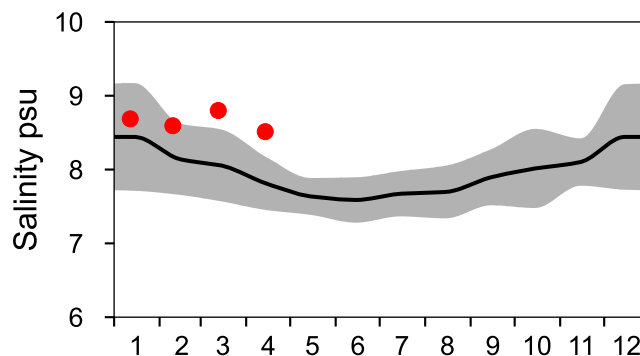
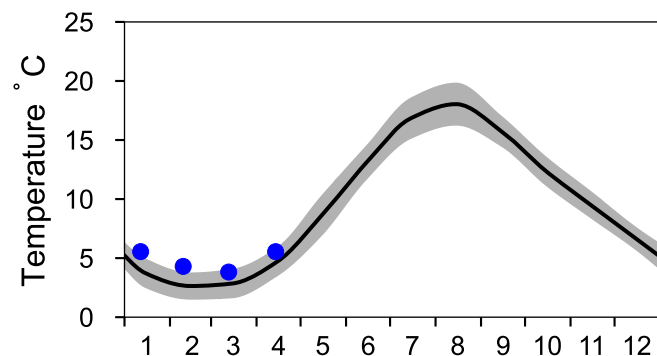
STATION BY1 SURFACE WATER (0-10 m)

Annual Cycles

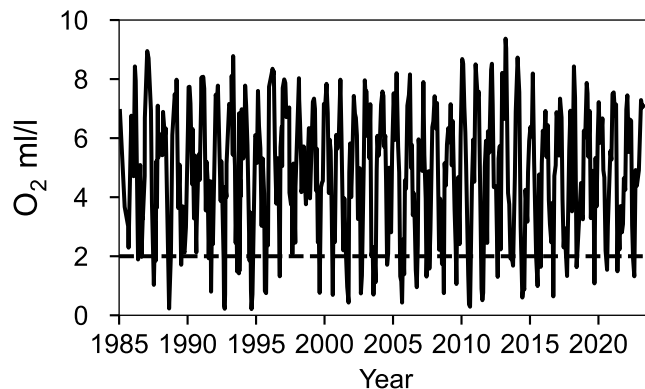
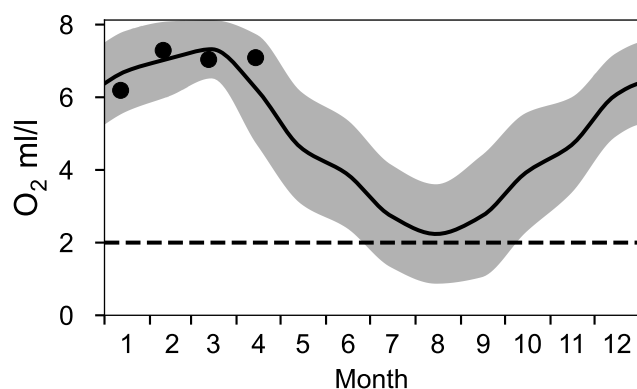
— Mean 1991-2020

■ St.Dev.

● 2023

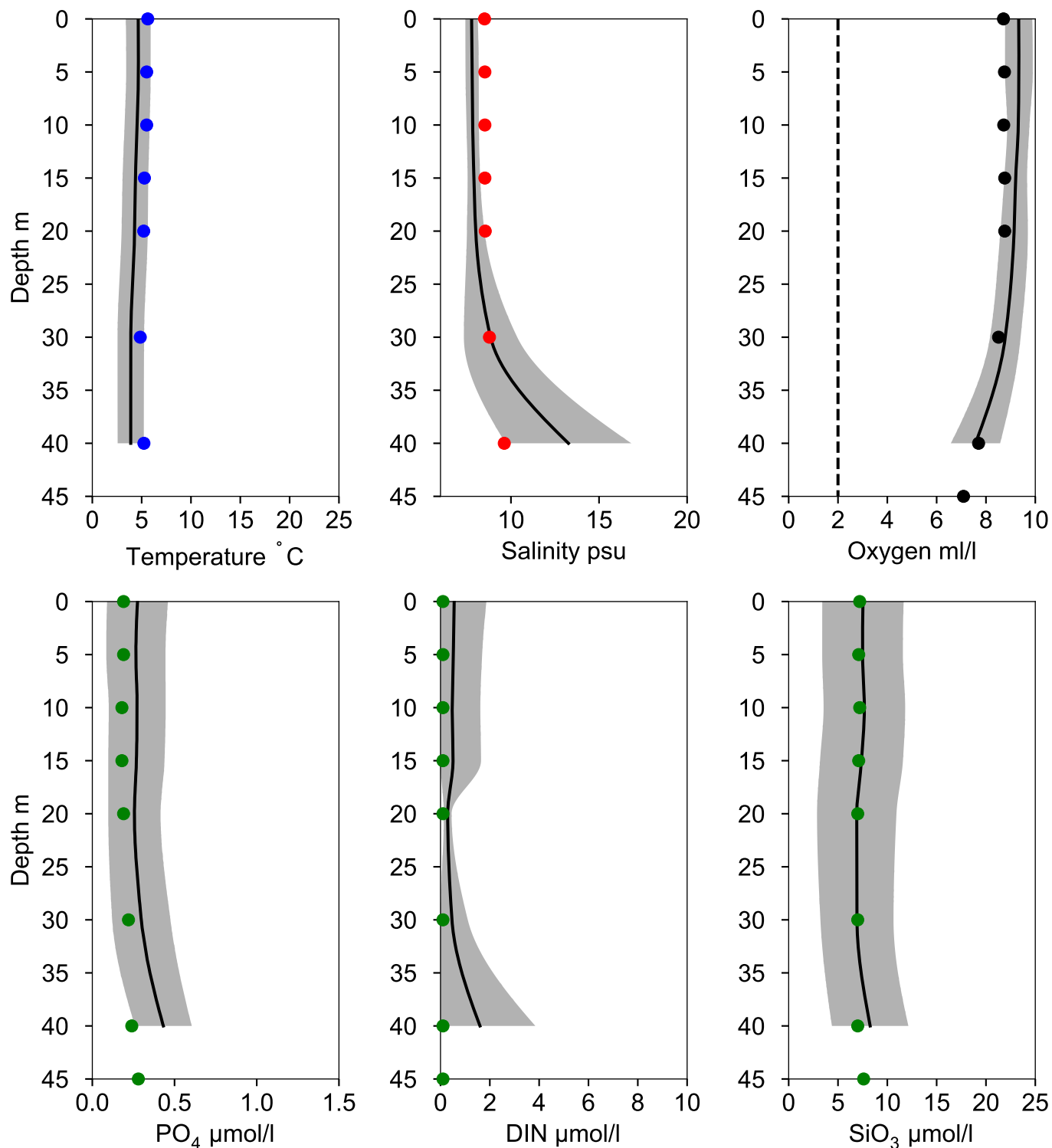


OXYGEN IN BOTTOM WATER (depth >= 39 m)



Vertical profiles BY1 April

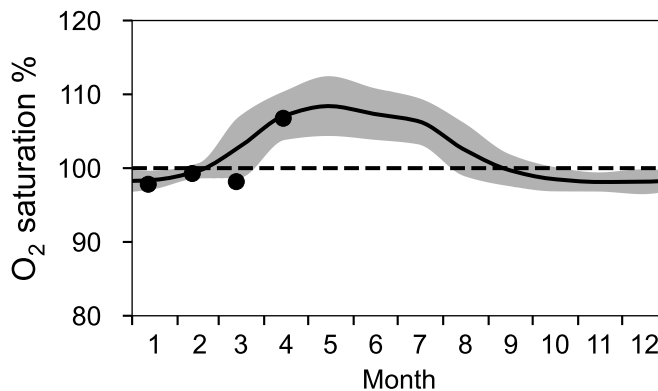
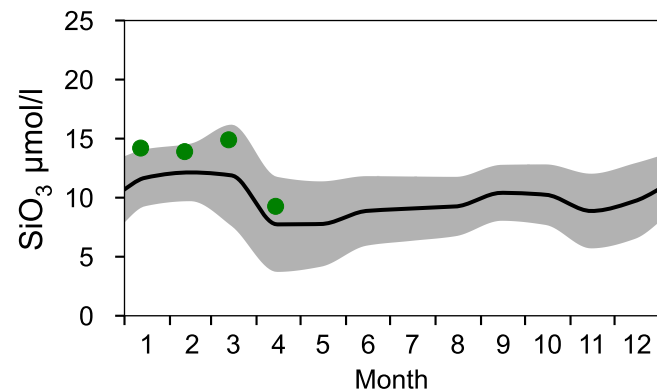
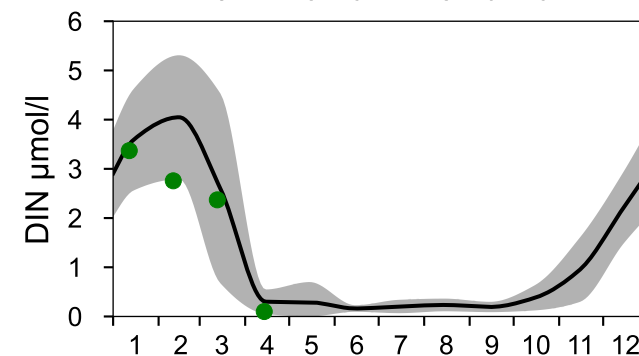
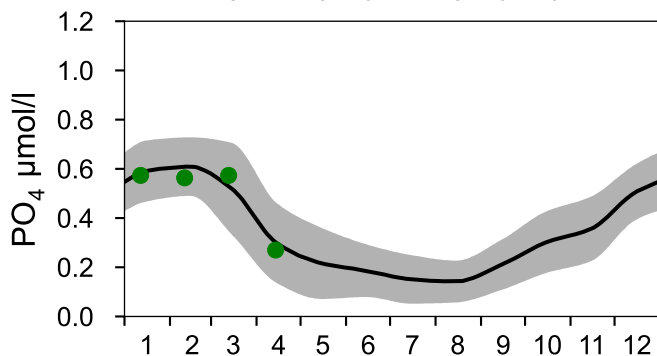
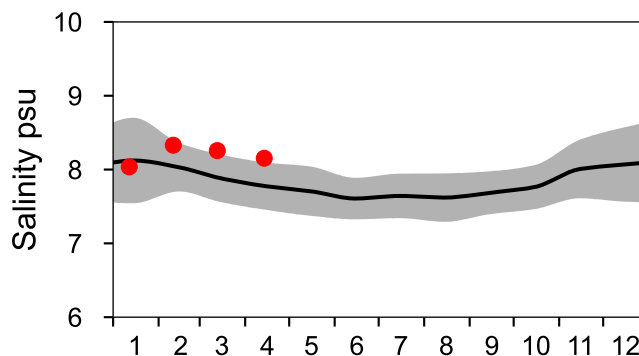
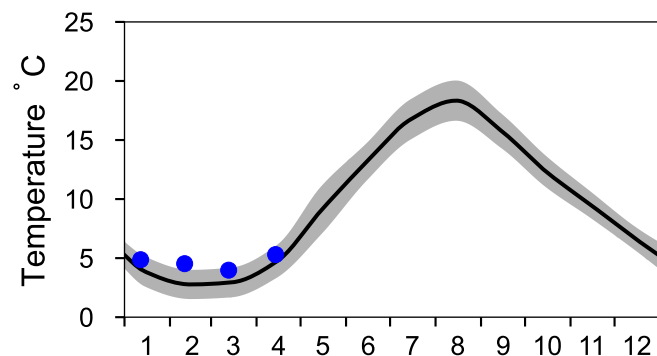
— Mean 1991-2020 St.Dev. ● 2023-04-14



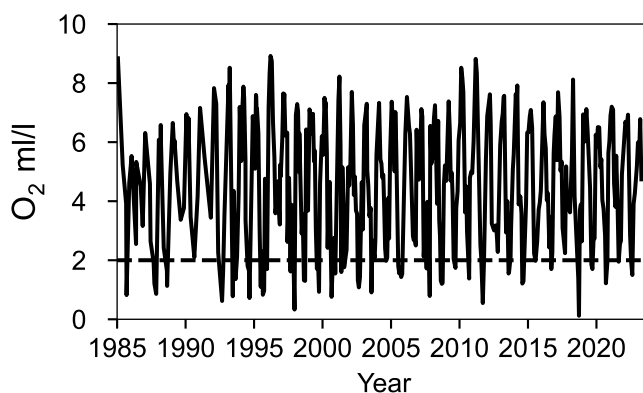
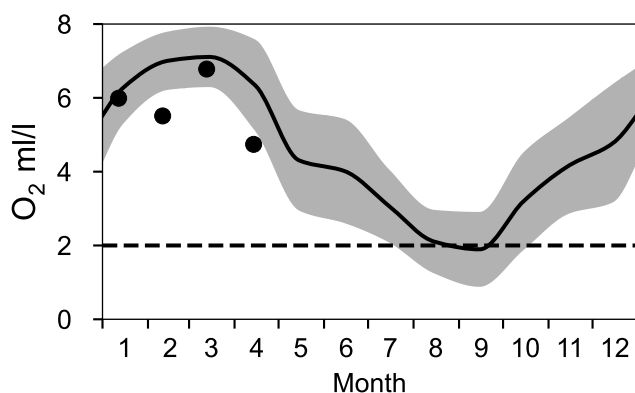
STATION BY2 ARKONA SURFACE WATER (0-10 m)

Annual Cycles

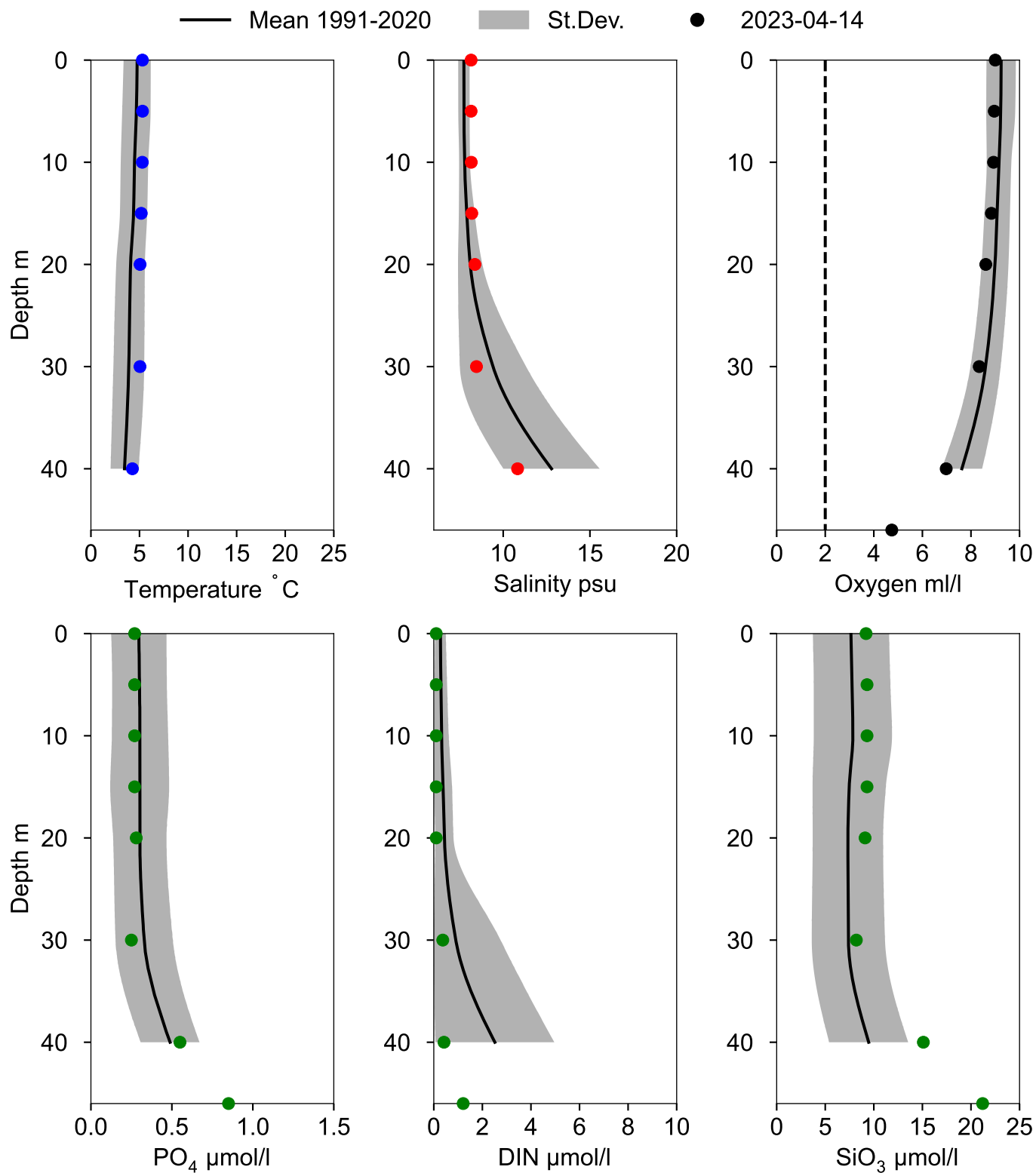
— Mean 1991-2020 St.Dev. ● 2023



OXYGEN IN BOTTOM WATER (depth >= 40 m)



Vertical profiles BY2 ARKONA April



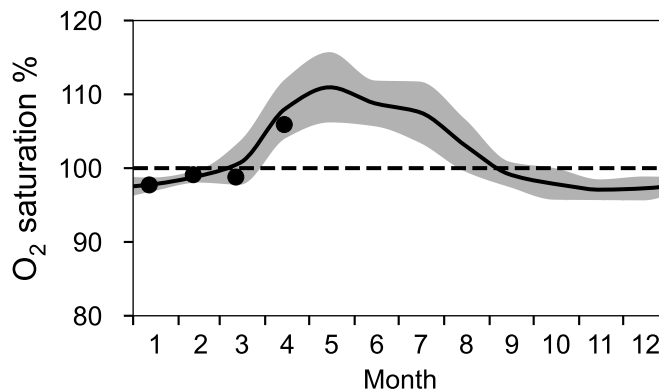
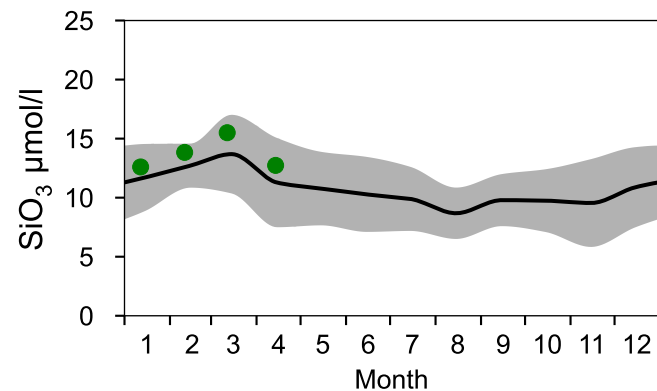
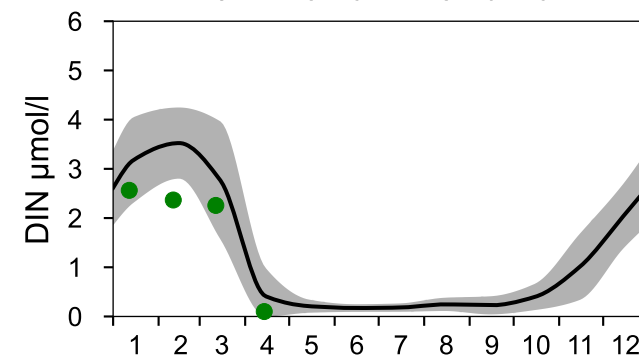
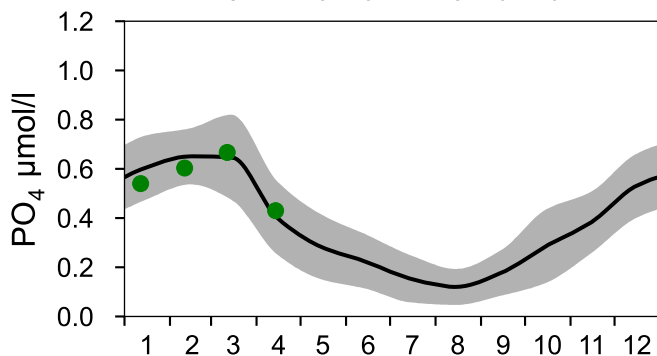
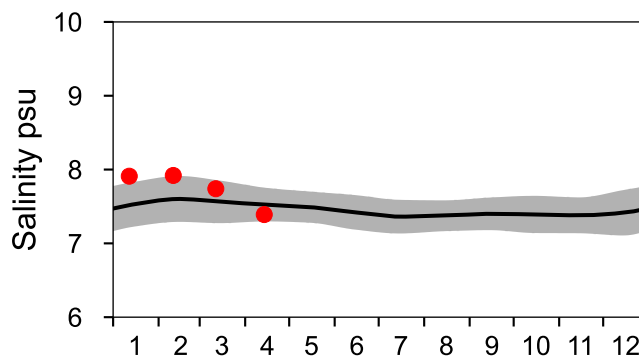
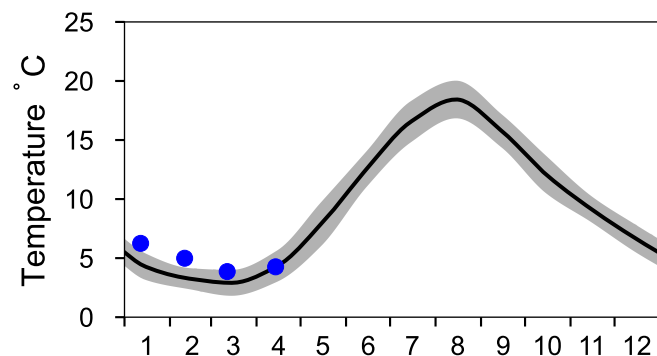
STATION BY4 CHRISTIANSÖ SURFACE WATER (0-10 m)

Annual Cycles

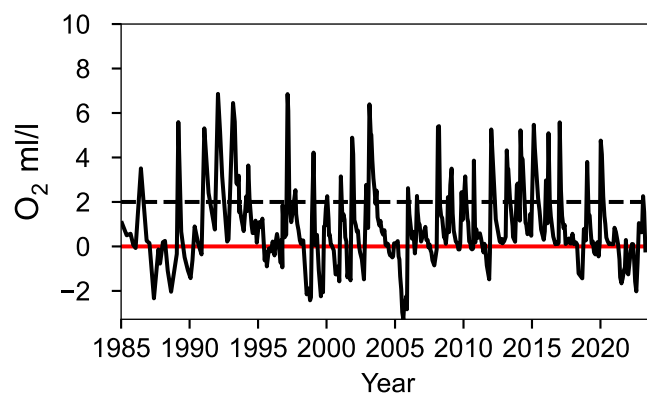
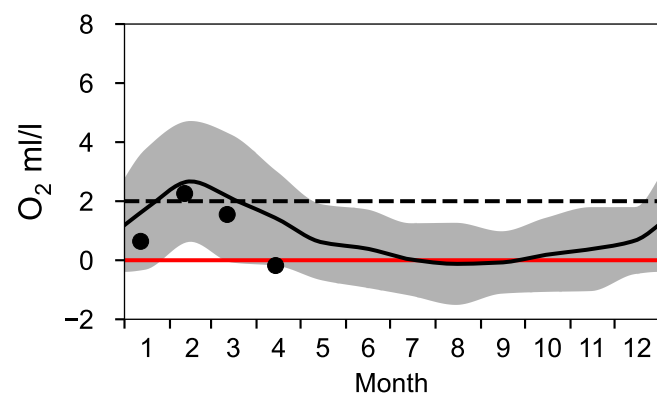
— Mean 1991-2020

■ St.Dev.

● 2023

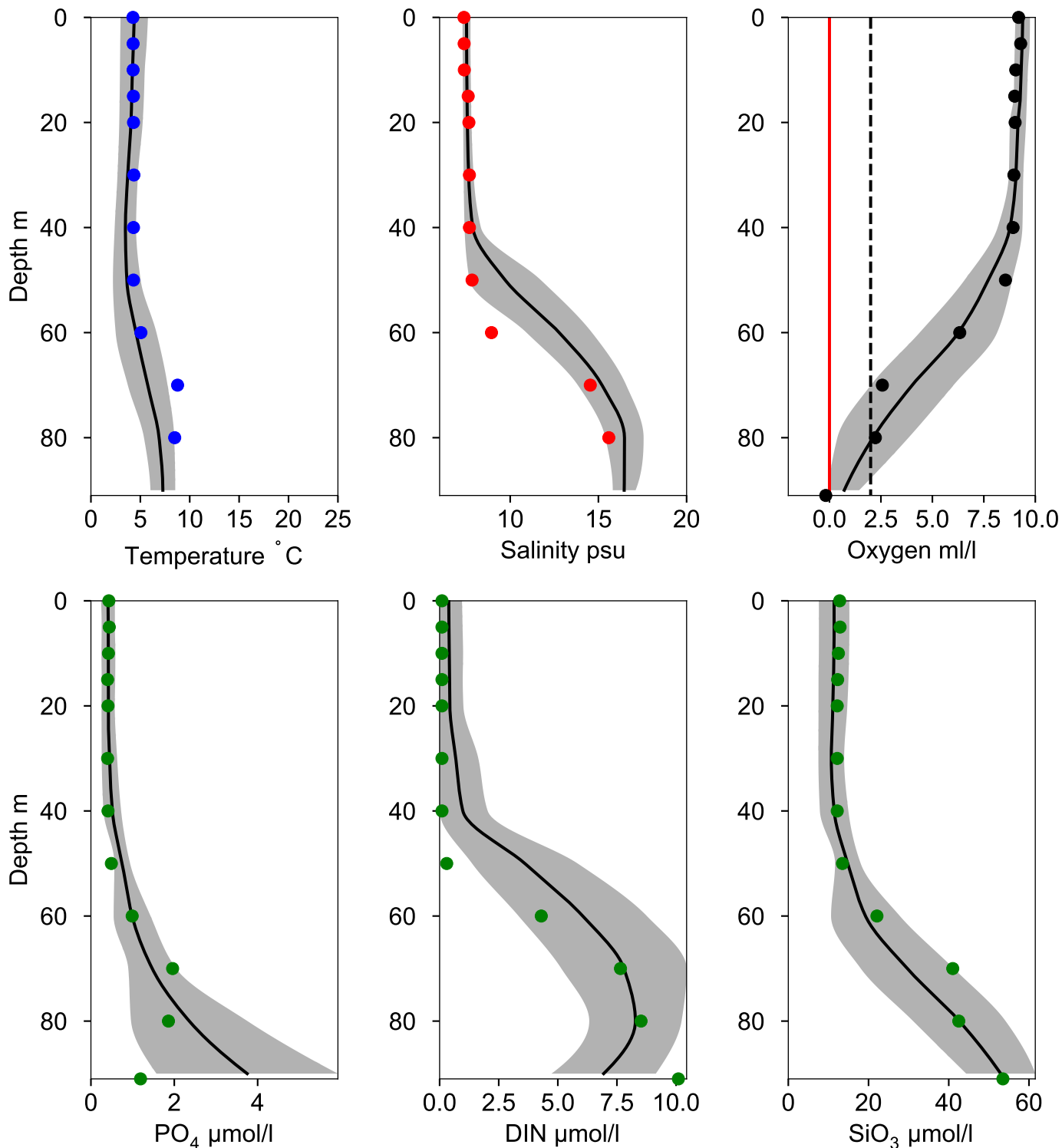


OXYGEN IN BOTTOM WATER (depth >= 80 m)



Vertical profiles BY4 CHRISTIANSÖ April

— Mean 1991-2020 St.Dev. ● 2023-04-14



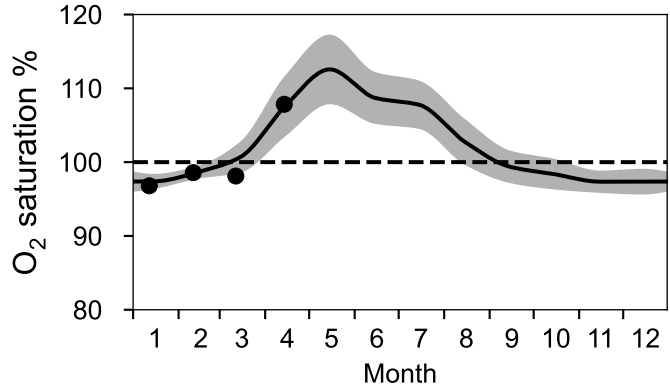
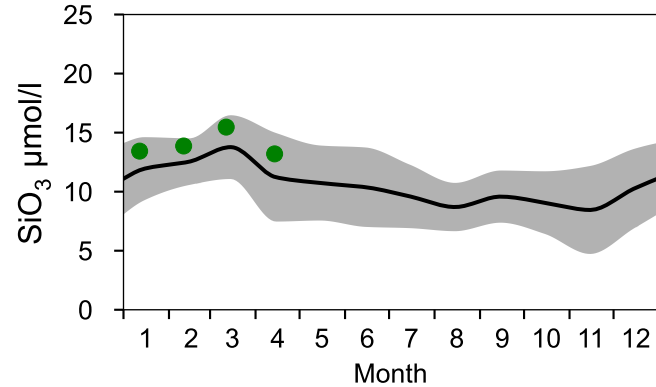
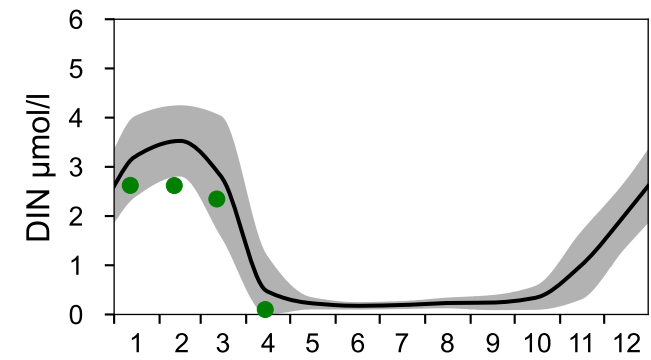
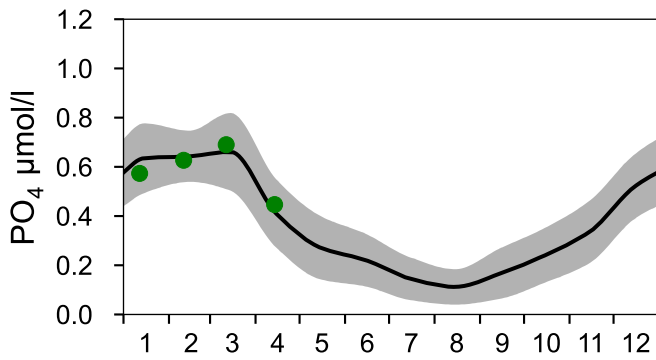
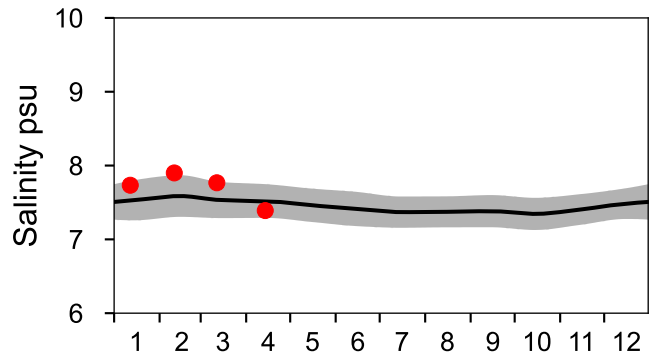
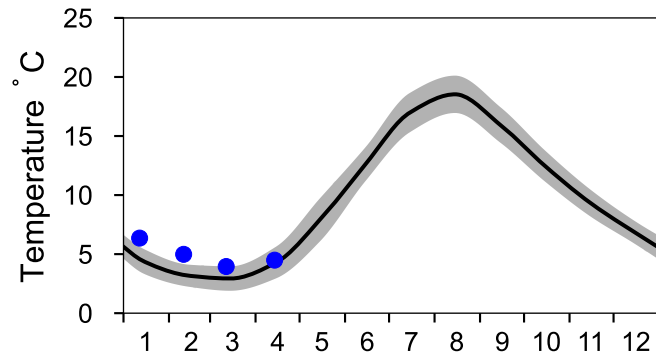
STATION BY5 BORNHOLMSDJ SURFACE WATER (0-10 m)

Annual Cycles

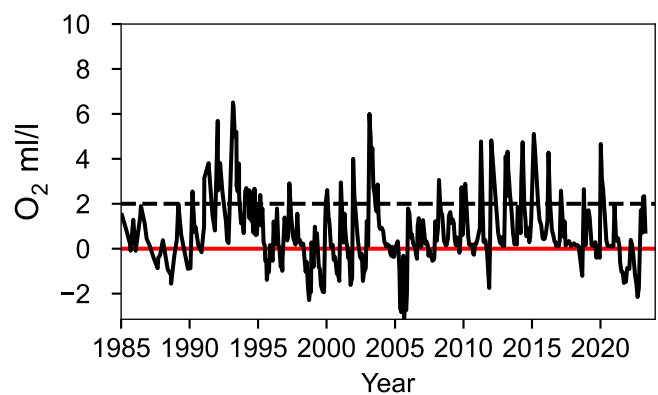
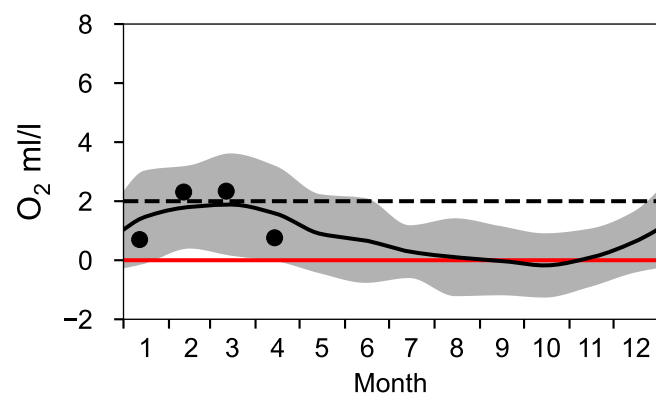
— Mean 1991-2020

■ St.Dev.

● 2023

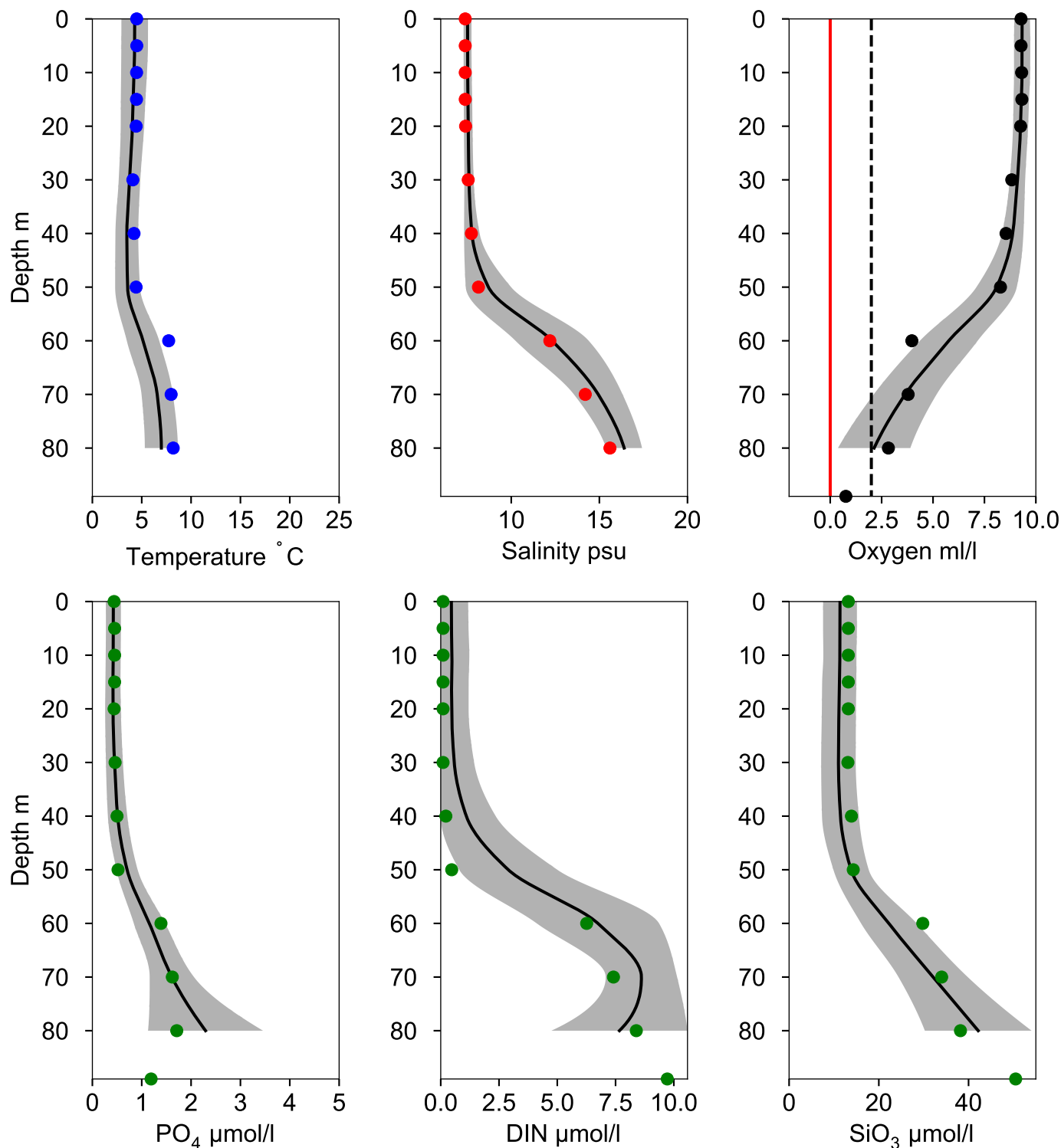


OXYGEN IN BOTTOM WATER (depth >= 80 m)



Vertical profiles BY5 BORNHOLMSDJ April

— Mean 1991-2020 St.Dev. ● 2023-04-14



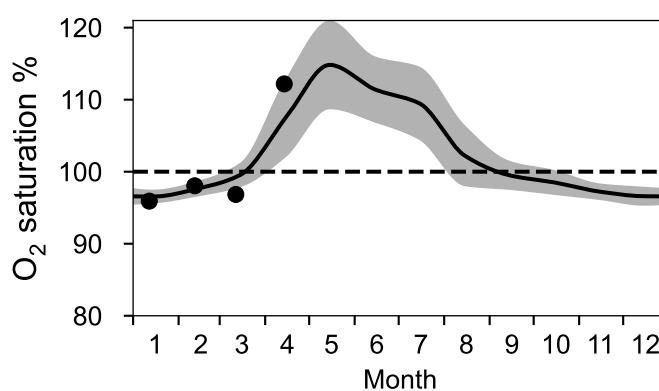
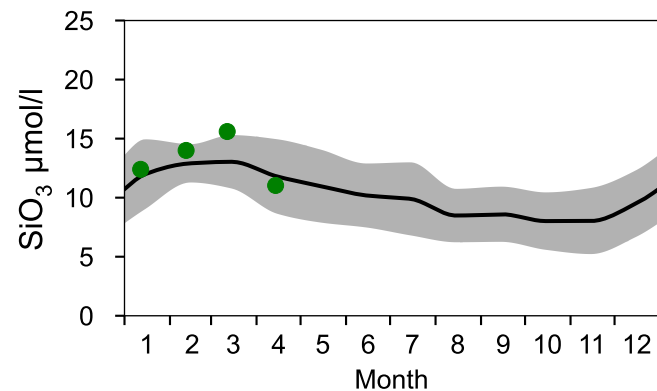
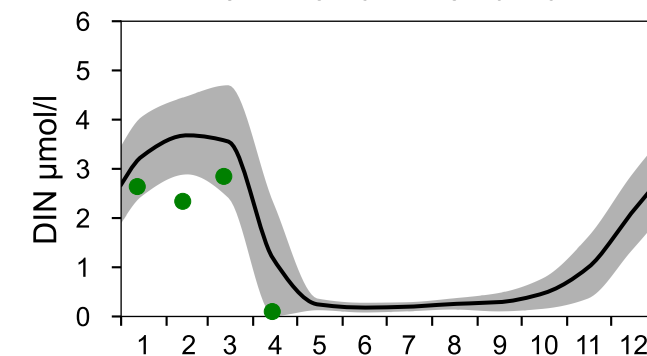
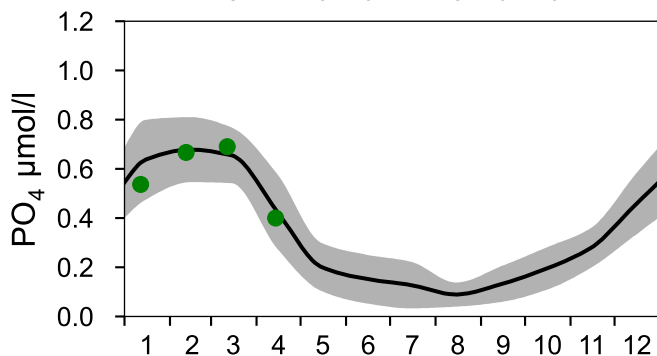
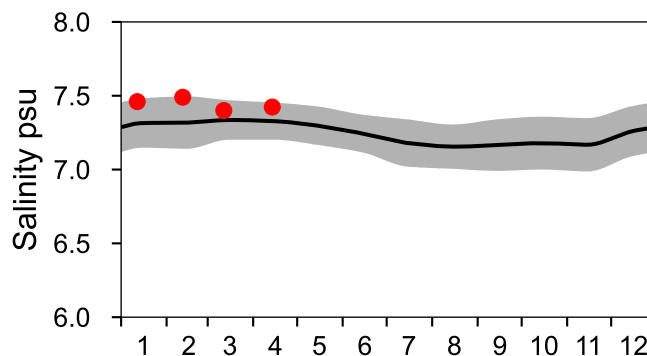
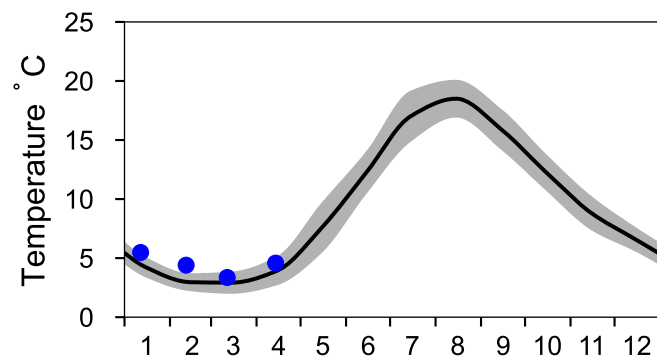
STATION BCS III-10 SURFACE WATER (0-10 m)

Annual Cycles

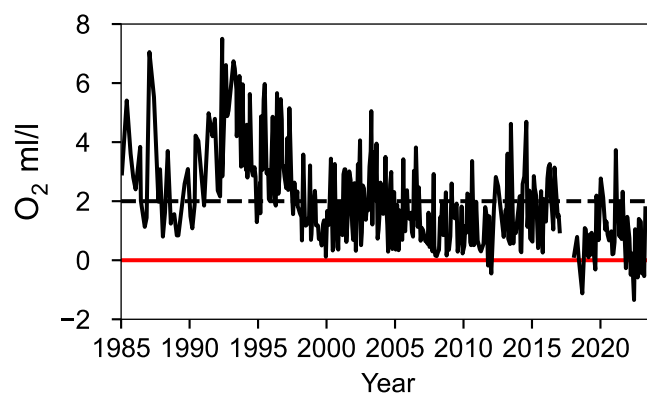
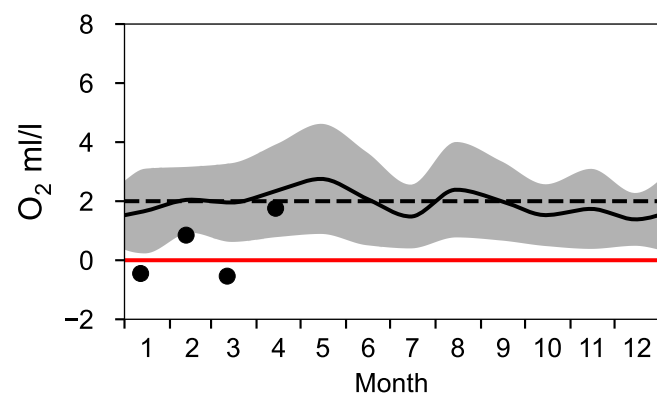
— Mean 1991-2020

■ St.Dev.

● 2023



OXYGEN IN BOTTOM WATER (depth >= 80 m)



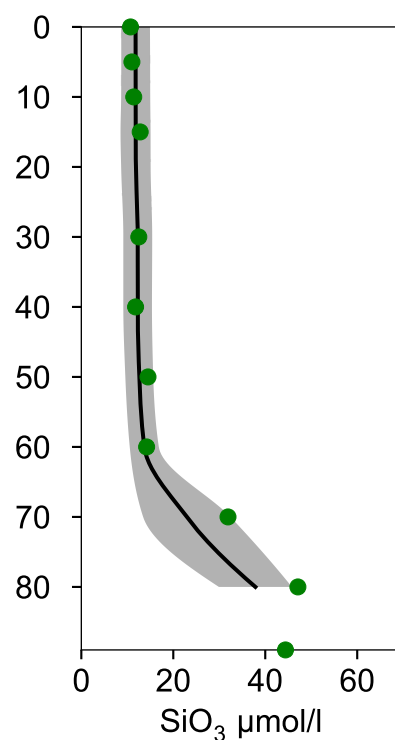
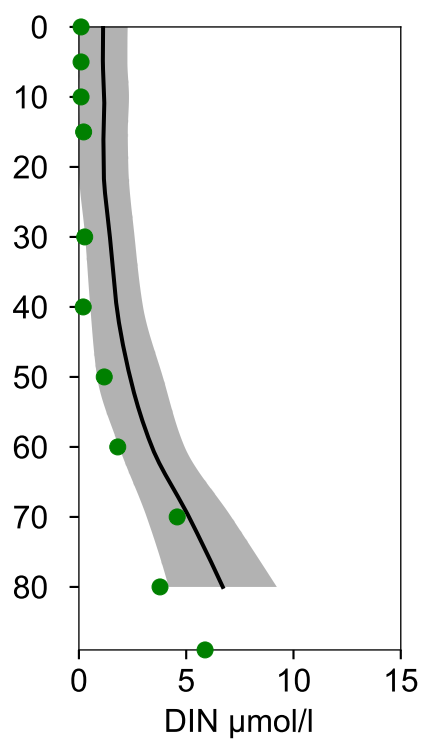
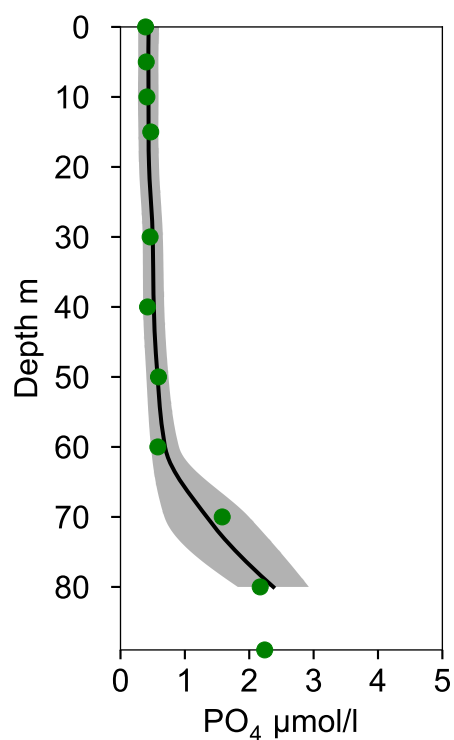
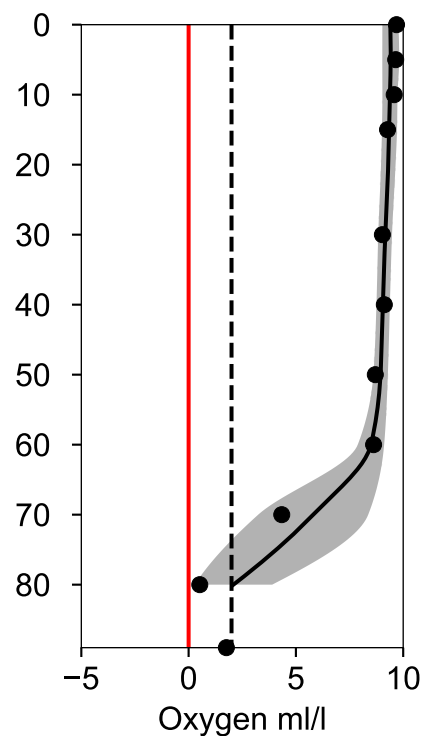
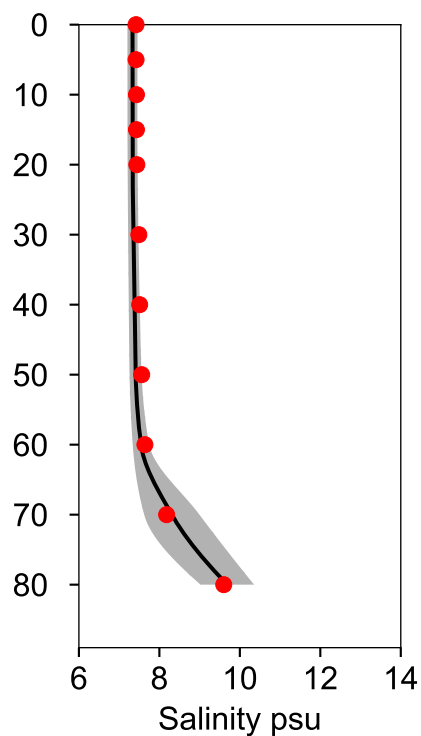
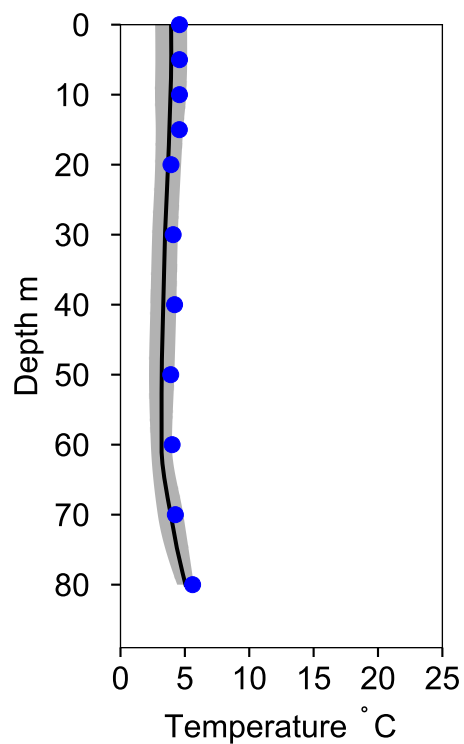
Vertical profiles BCS III-10

April

— Mean 1991-2020

■ St.Dev.

● 2023-04-14



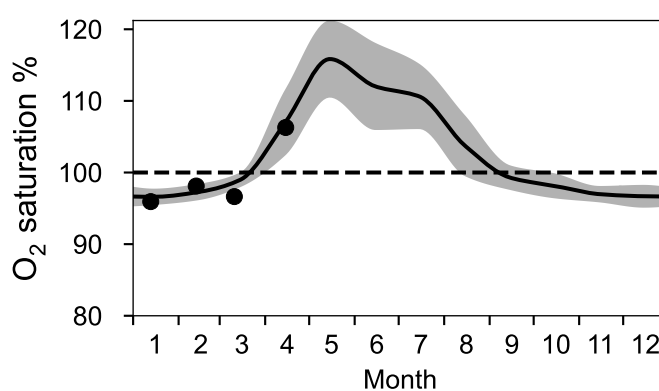
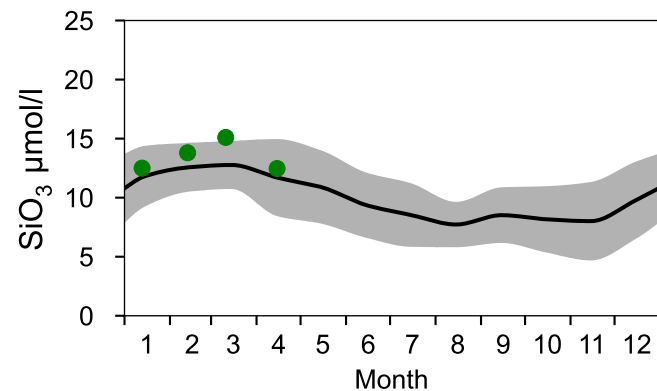
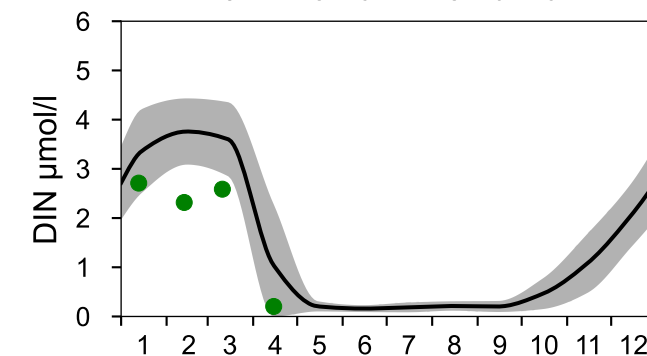
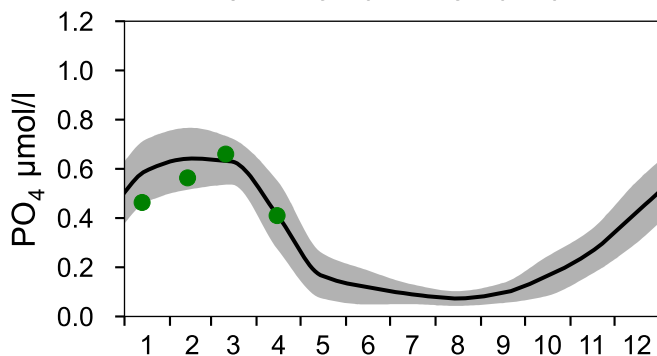
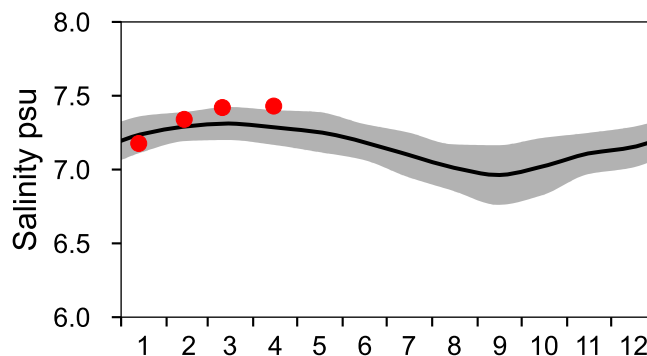
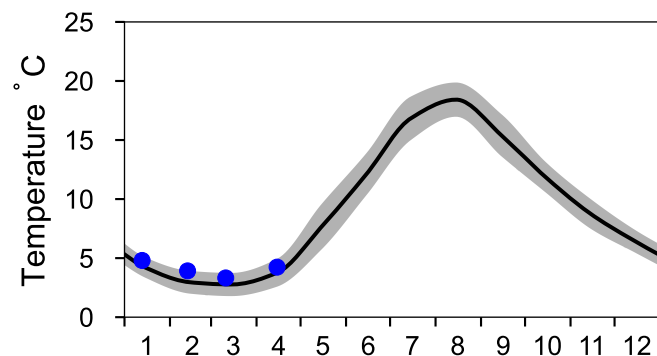
STATION BY10 SURFACE WATER (0-10 m)

Annual Cycles

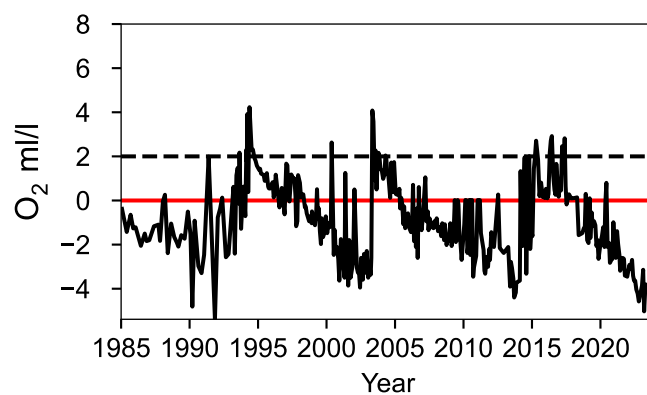
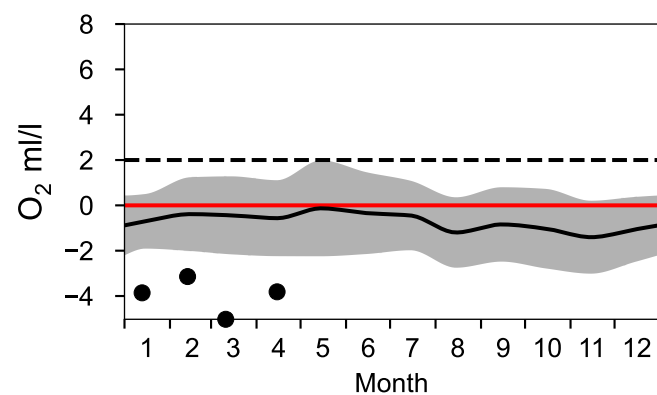
— Mean 1991-2020

■ St.Dev.

● 2023

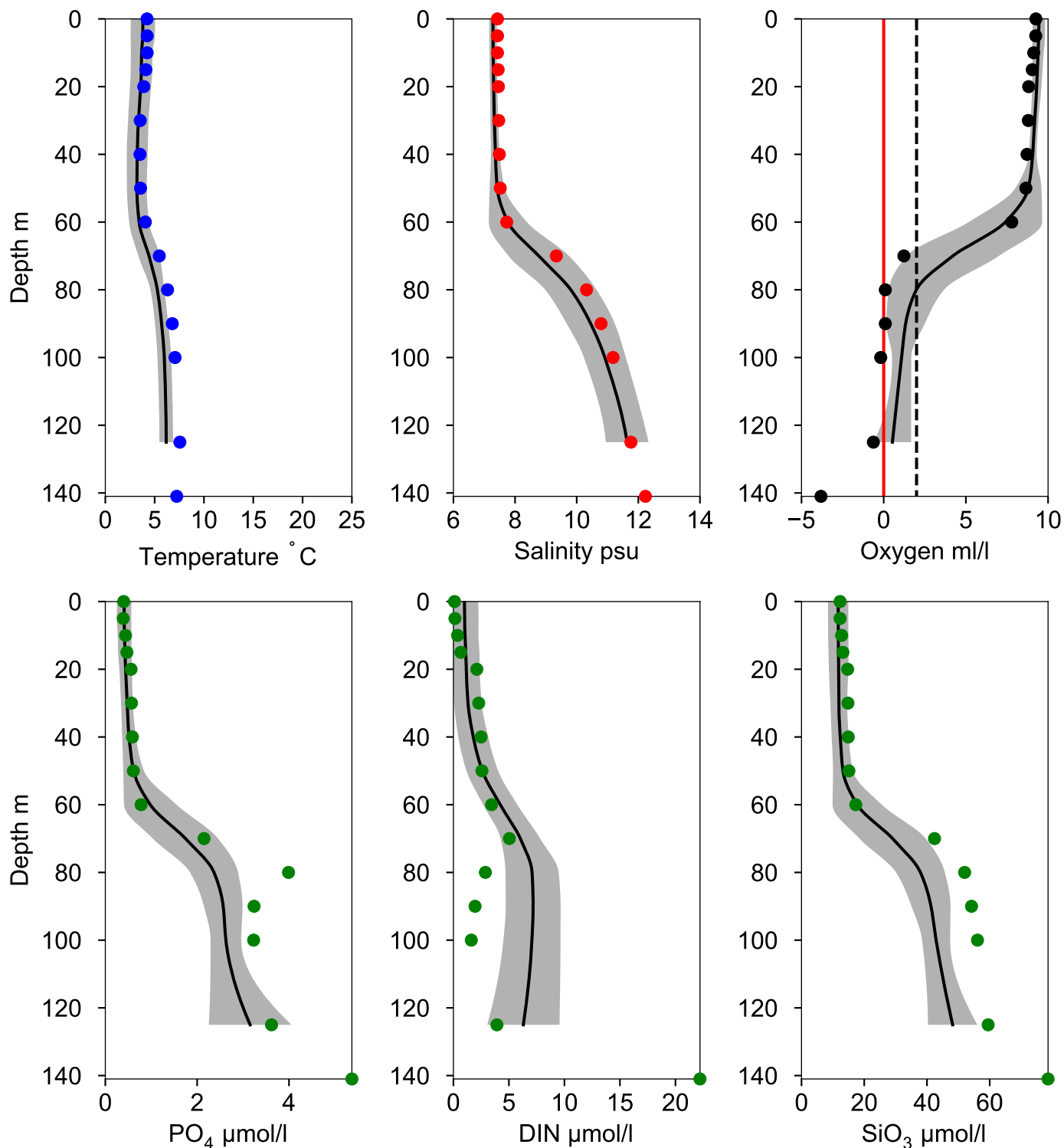


OXYGEN IN BOTTOM WATER (depth >= 125 m)



Vertical profiles BY10 April

— Mean 1991-2020 St.Dev. ● 2023-04-15



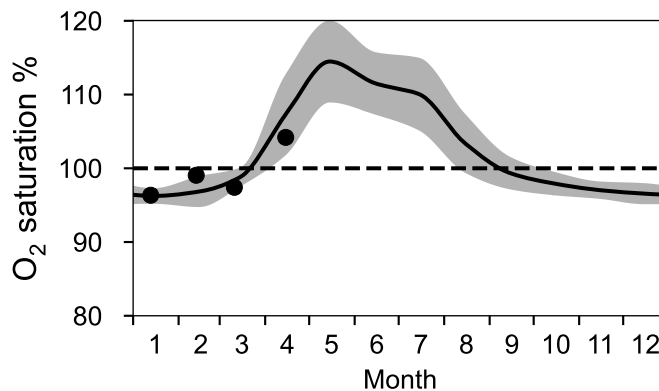
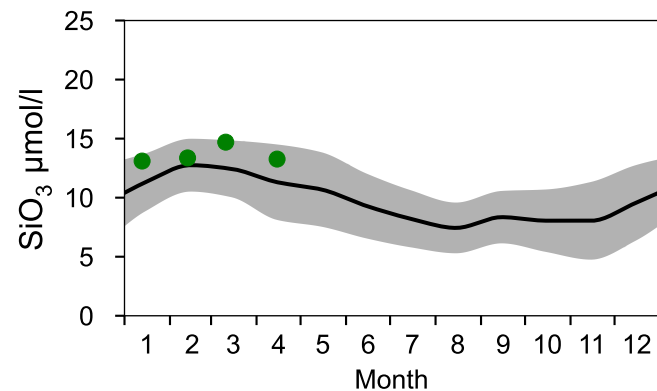
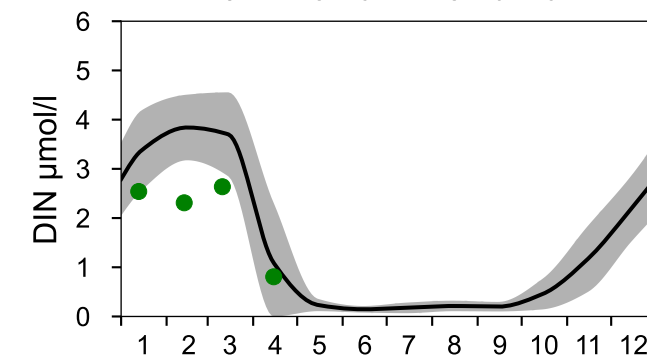
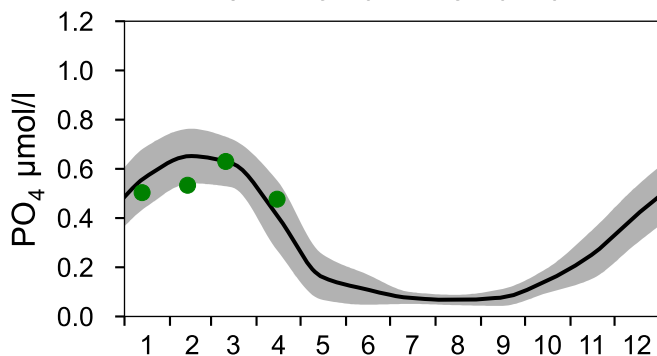
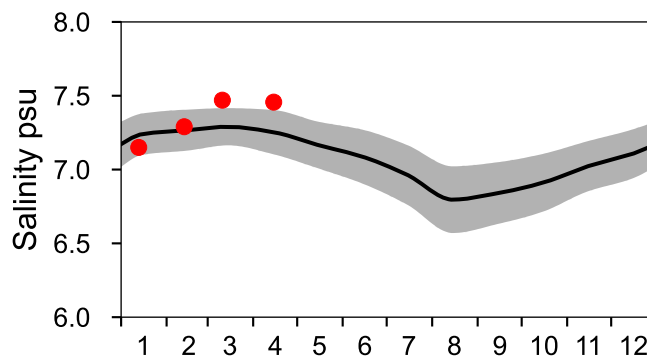
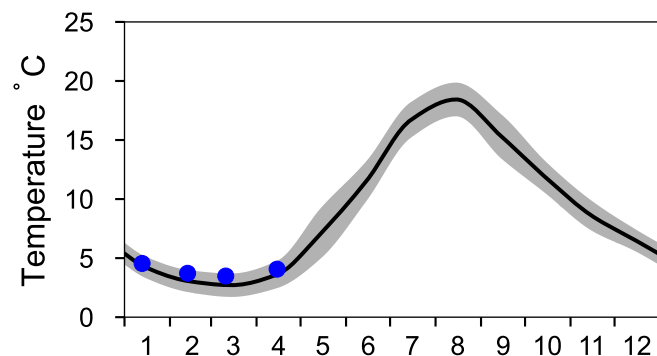
STATION BY15 GOTLANDSDJ SURFACE WATER (0-10 m)

Annual Cycles

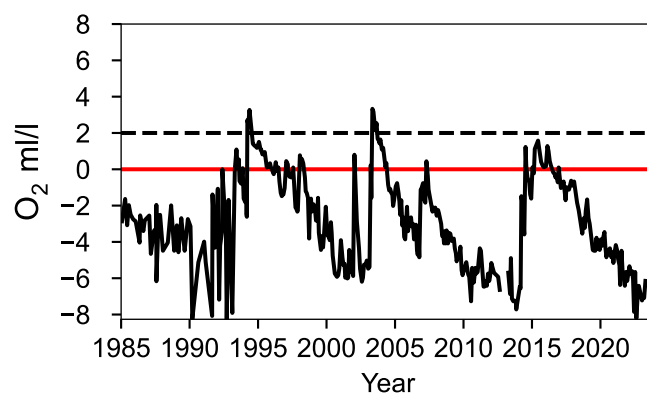
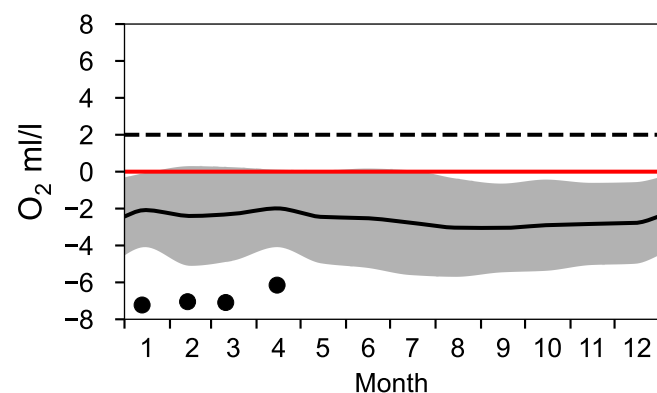
— Mean 1991-2020

■ St.Dev.

● 2023

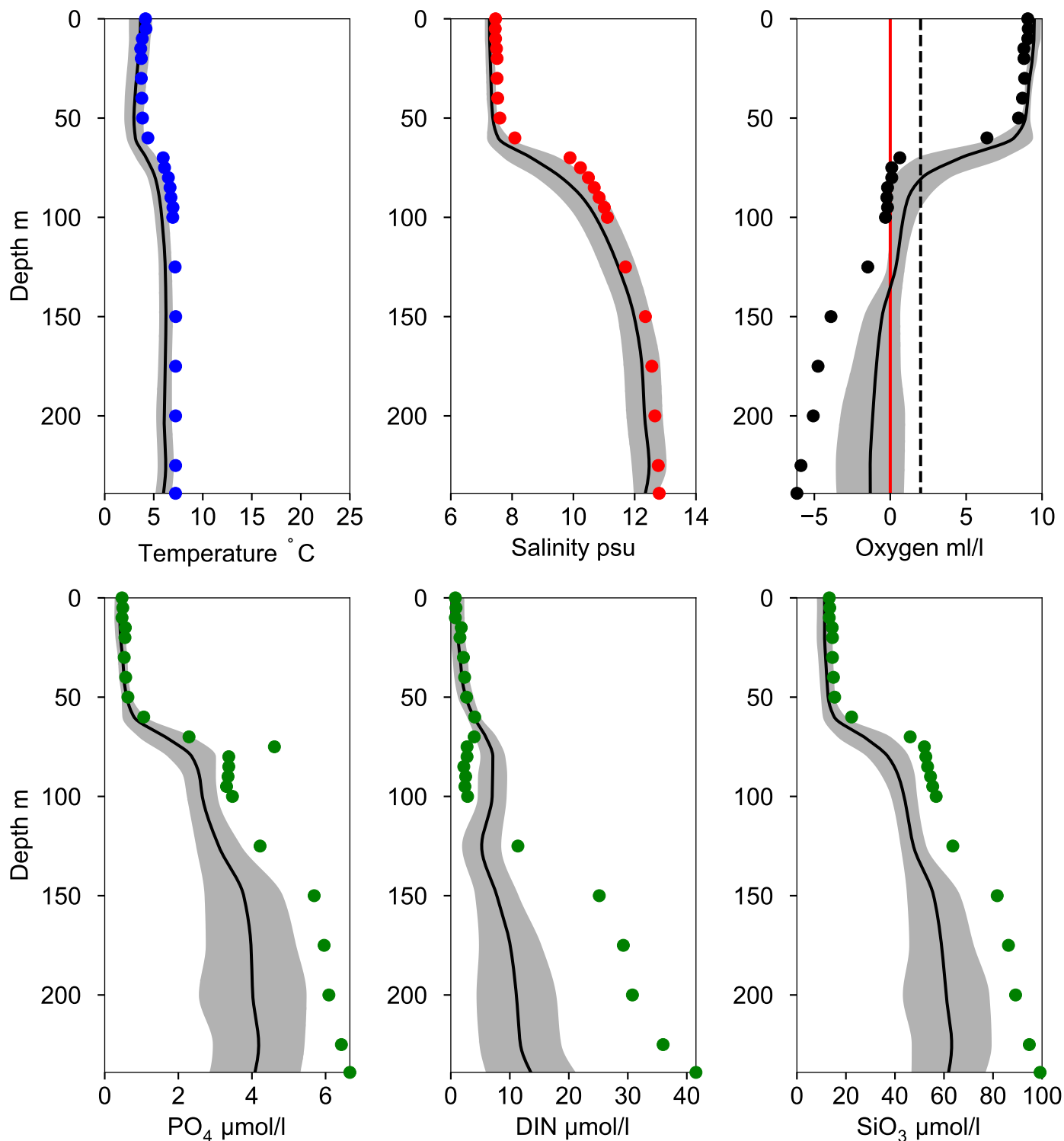


OXYGEN IN BOTTOM WATER (depth >= 225 m)



Vertical profiles BY15 GOTLANDSDJ April

— Mean 1991-2020 St.Dev. ● 2023-04-15



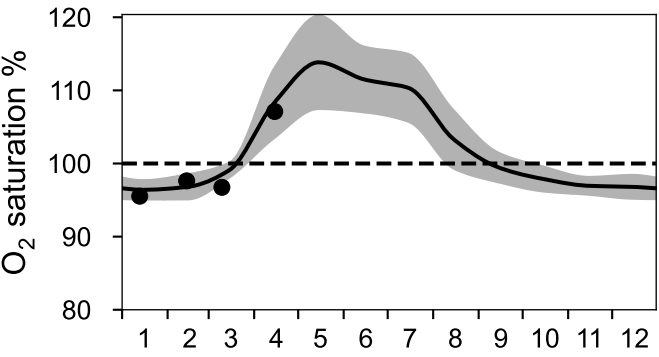
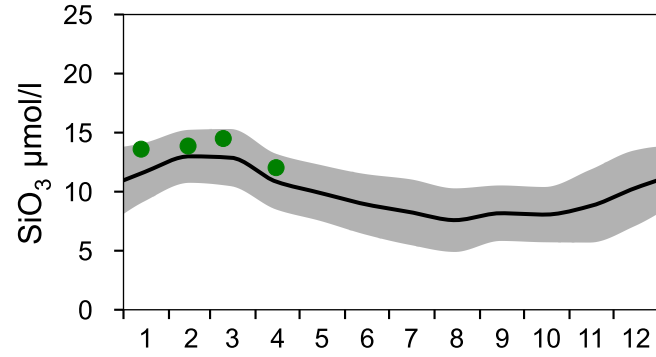
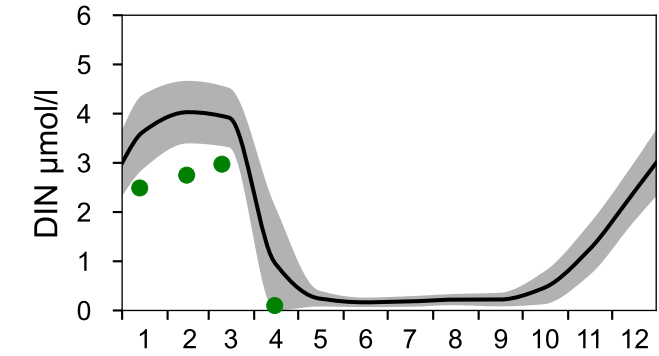
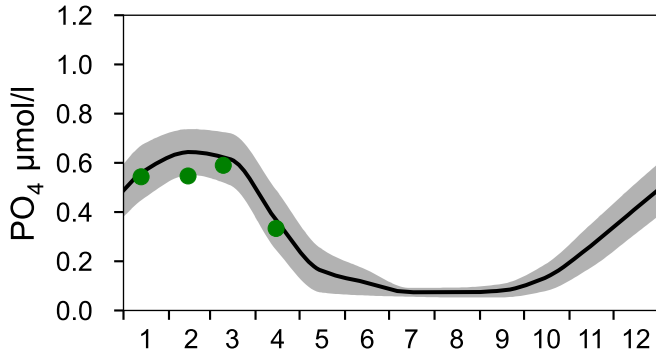
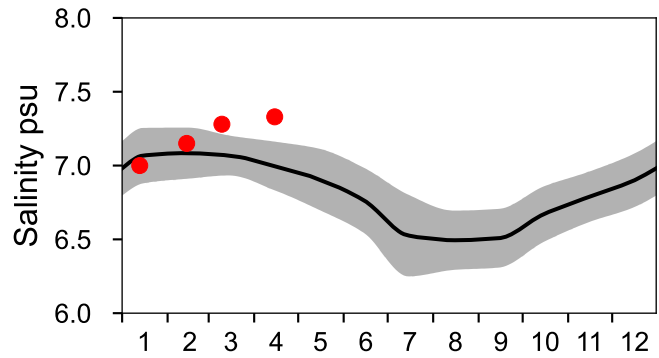
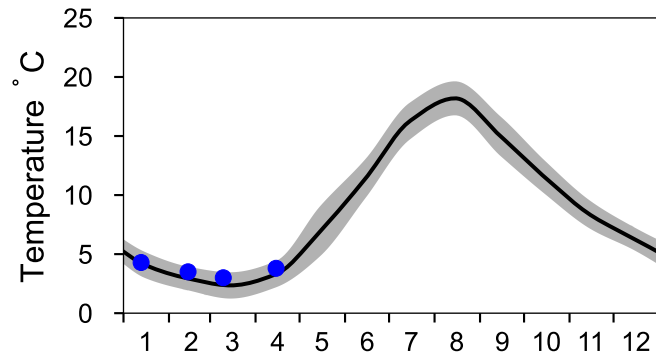
STATION BY20 FÄRÖDJ SURFACE WATER (0-10 m)

Annual Cycles

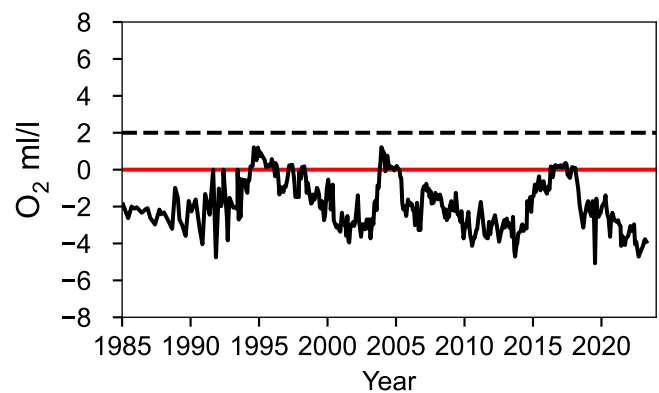
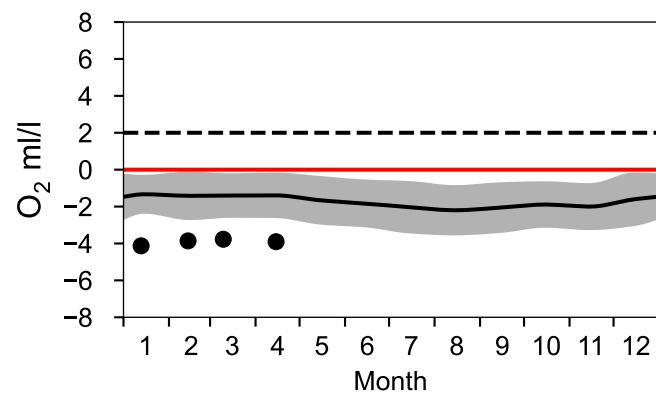
— Mean 1991-2020

■ St.Dev.

● 2023

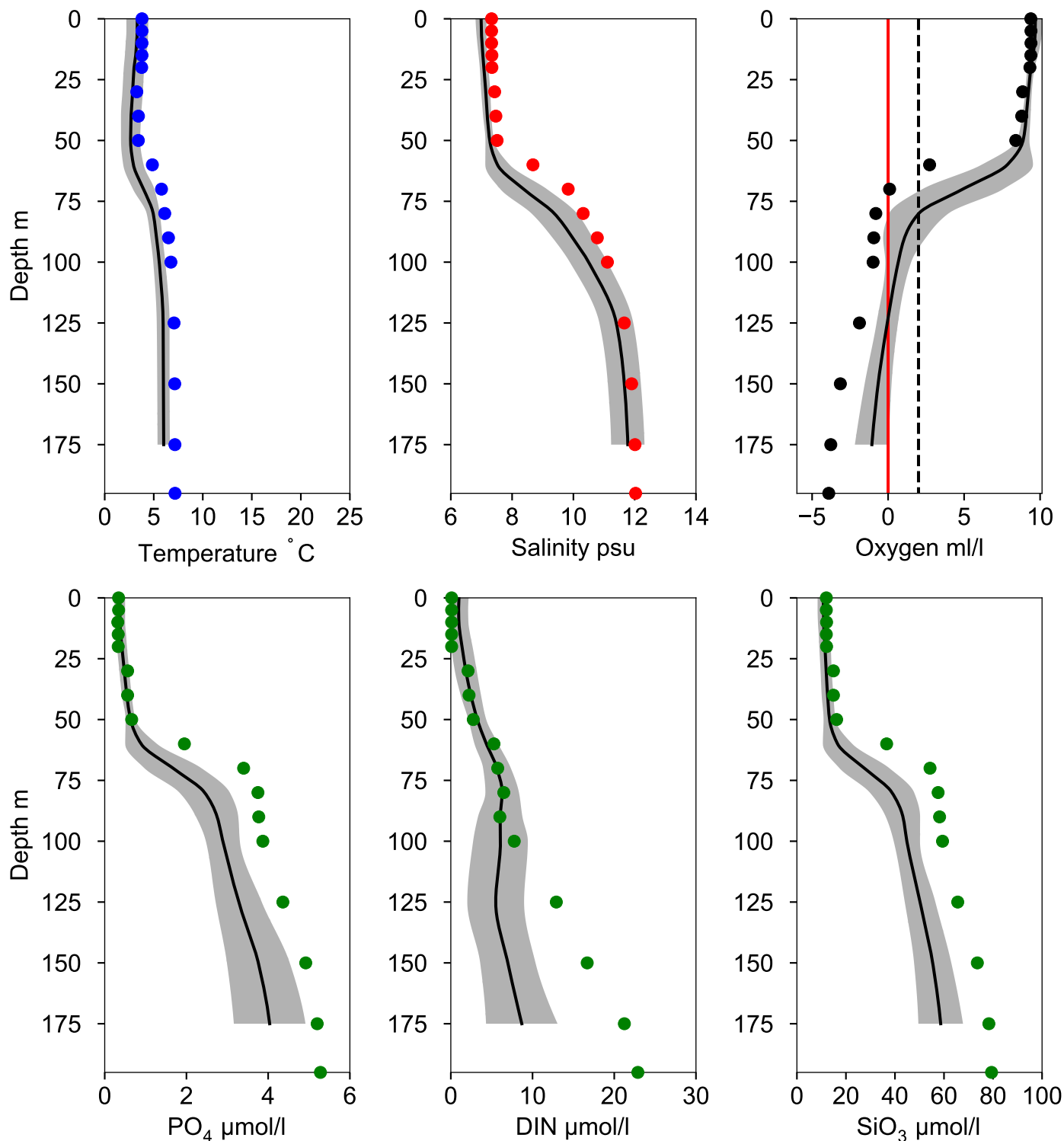


OXYGEN IN BOTTOM WATER (depth >= 175 m)



Vertical profiles BY20 FÅRÖDJ April

— Mean 1991-2020 St.Dev. ● 2023-04-15



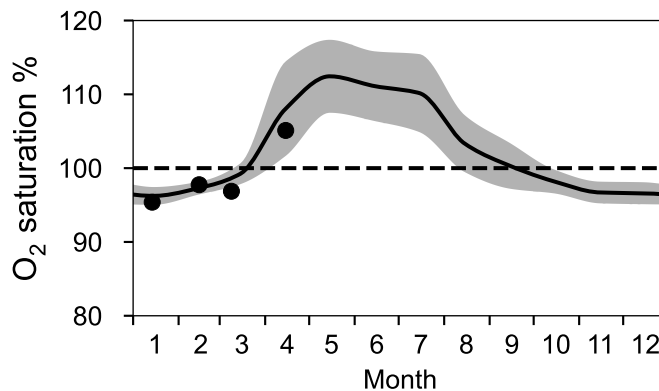
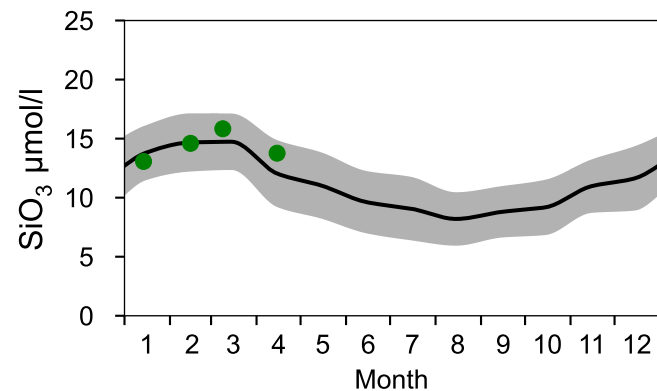
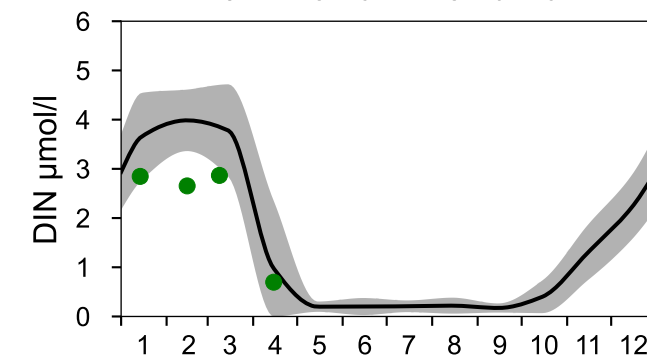
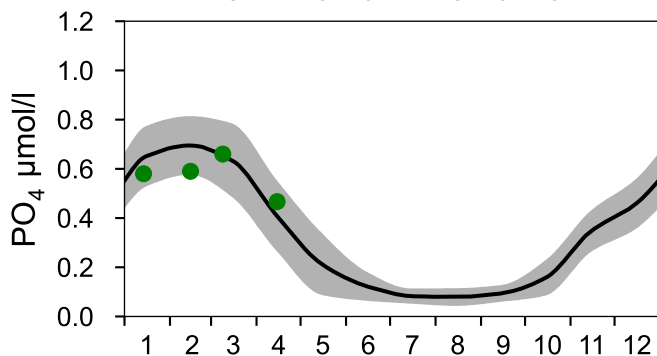
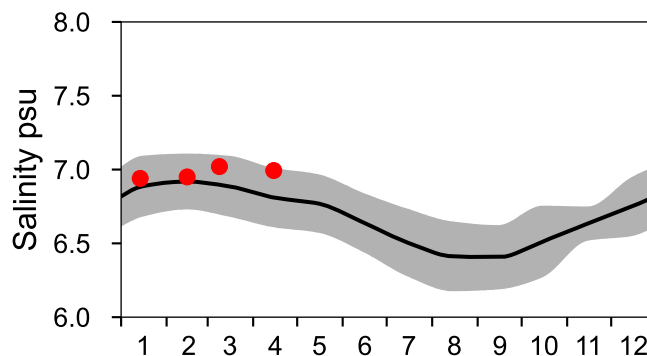
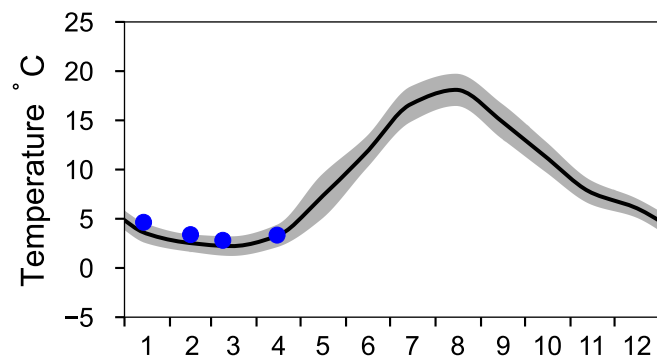
STATION BY32 NORRKÖPINGSDJ SURFACE WATER (0-10 m)

Annual Cycles

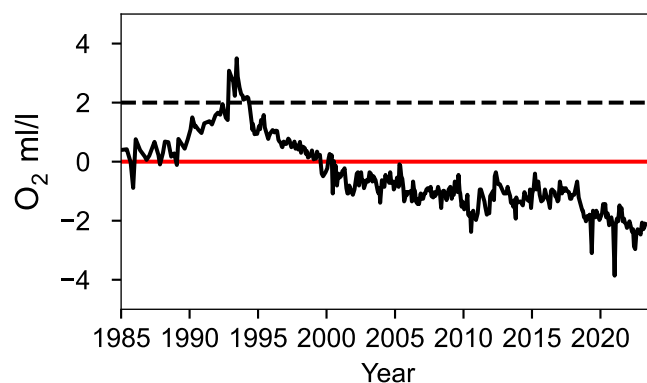
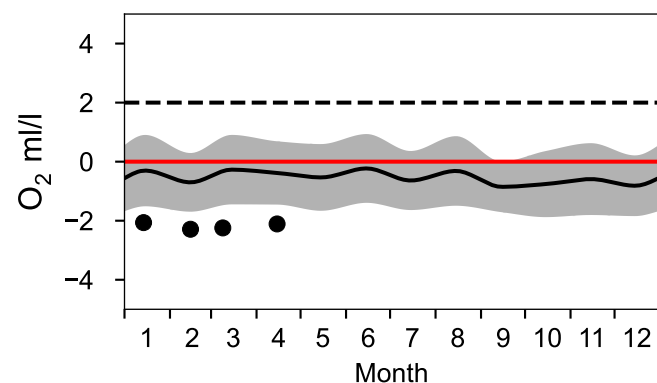
— Mean 1991-2020

■ St.Dev.

● 2023

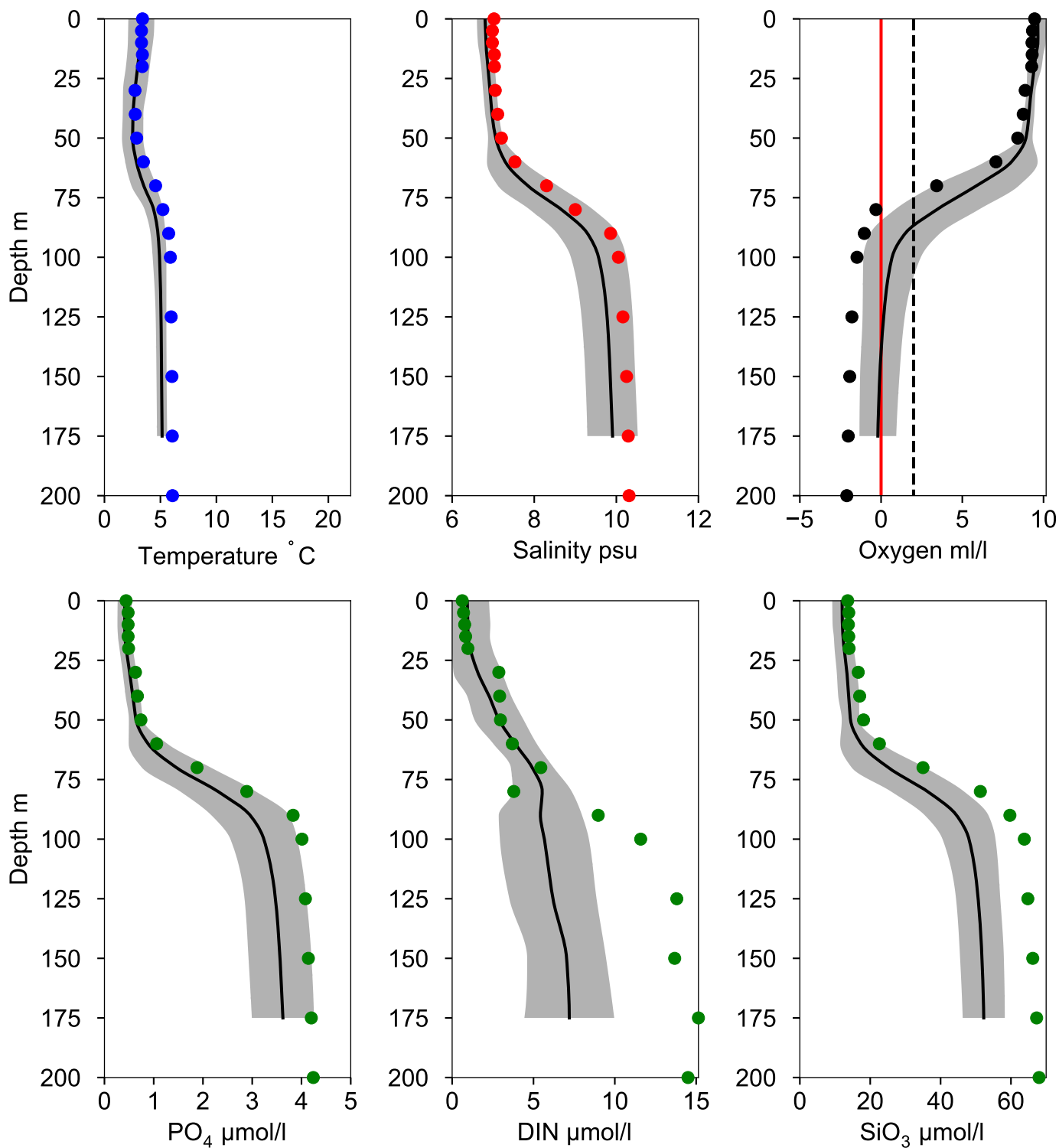


OXYGEN IN BOTTOM WATER (depth >= 175 m)



Vertical profiles BY32 NORRKÖPINGSDJ April

— Mean 1991-2020 St.Dev. ● 2023-04-15



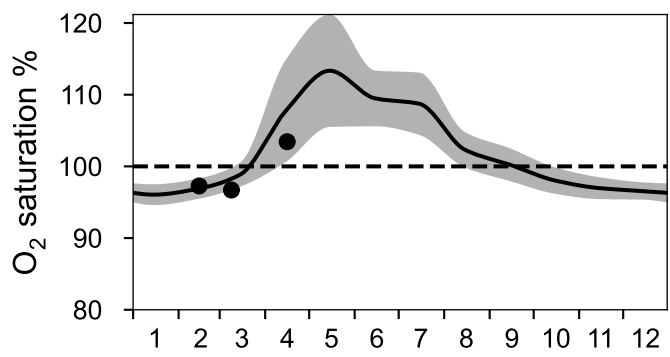
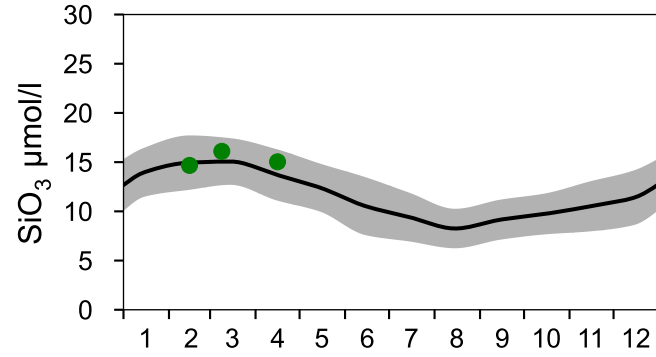
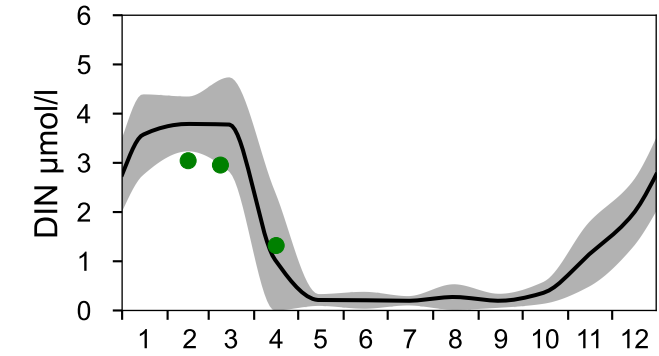
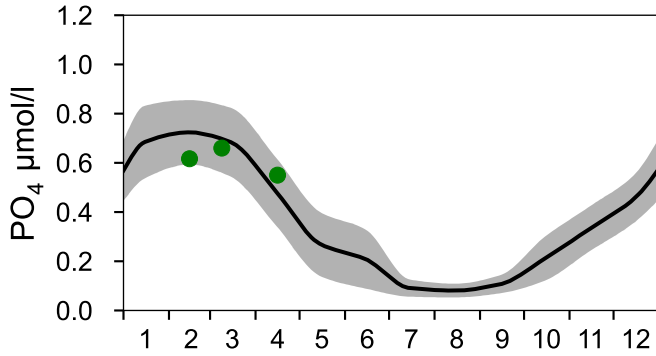
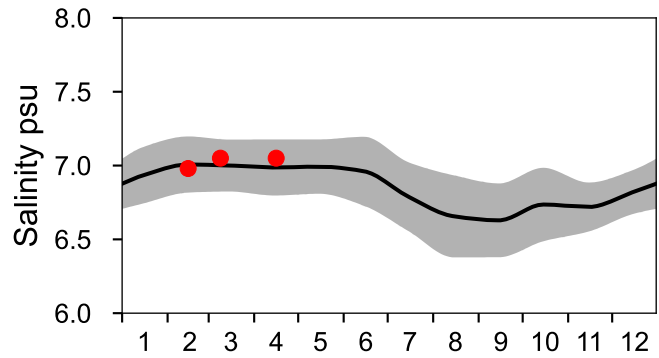
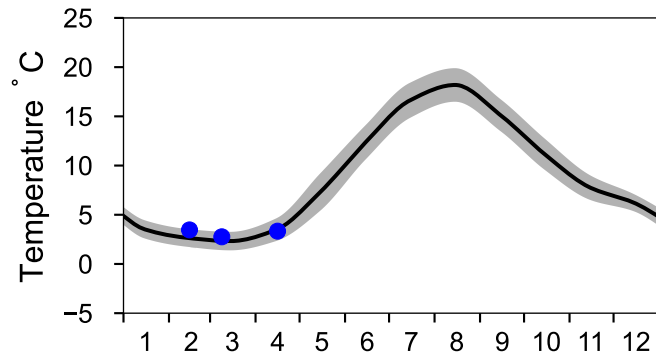
STATION BY38 KARLSÖDJ SURFACE WATER (0-10 m)

Annual Cycles

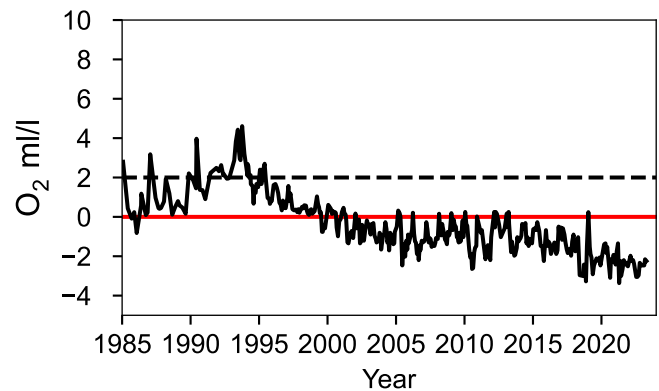
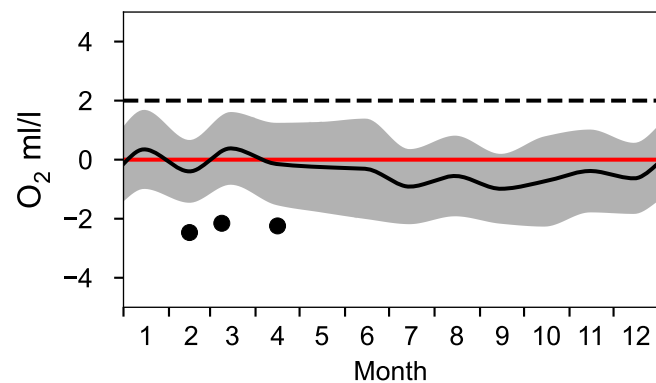
— Mean 1991-2020

■ St.Dev.

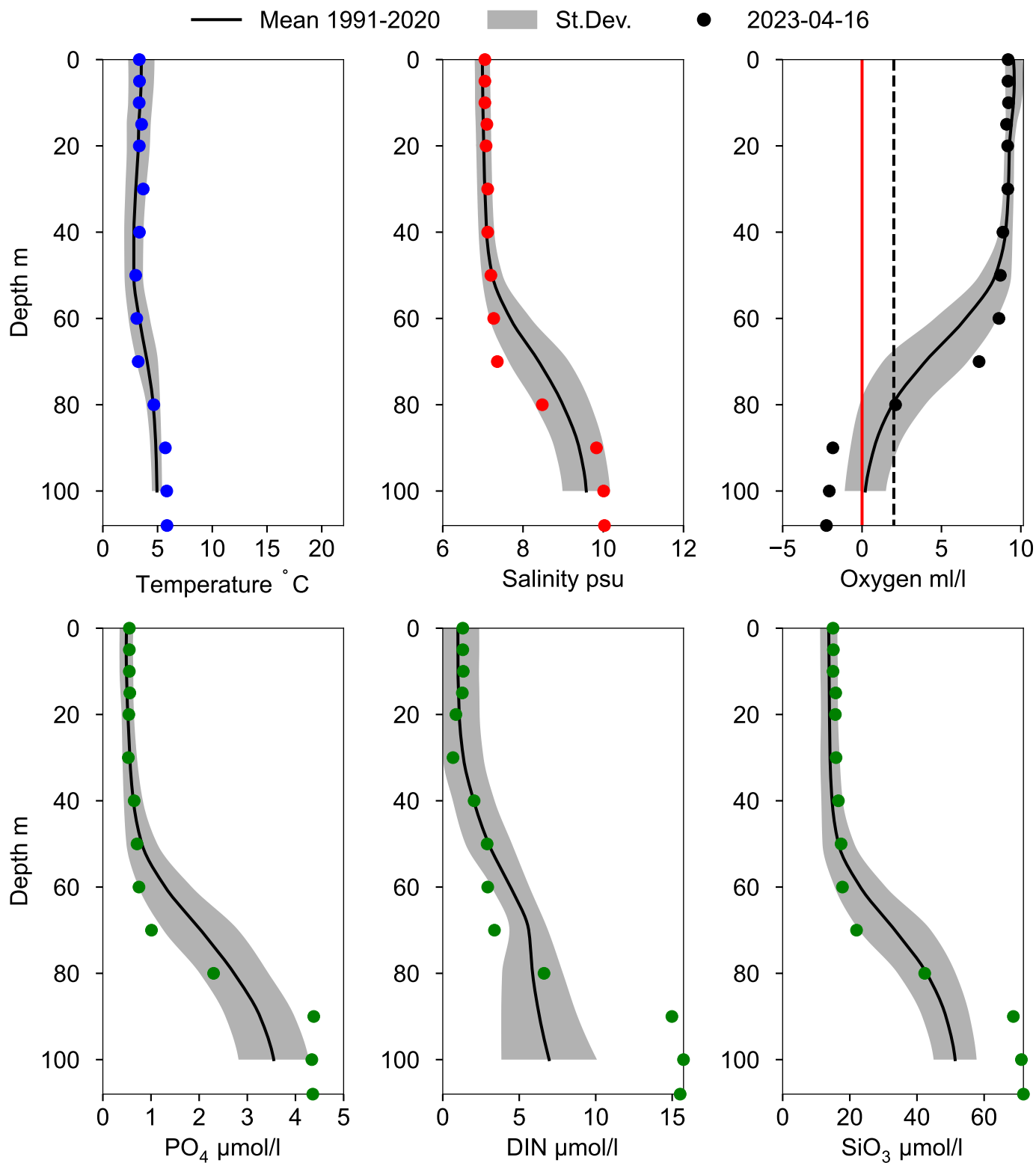
● 2023



OXYGEN IN BOTTOM WATER (depth >= 100 m)



Vertical profiles BY38 KARLSÖDJ April



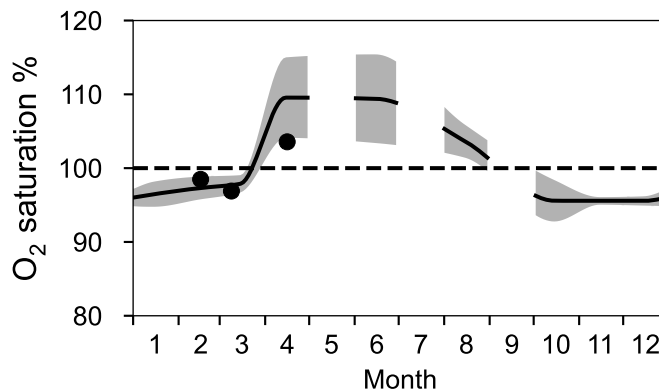
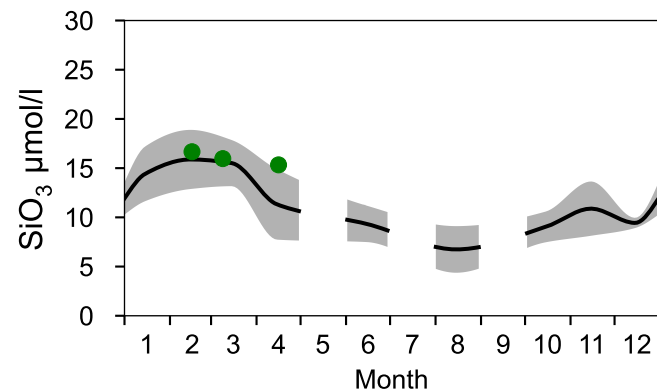
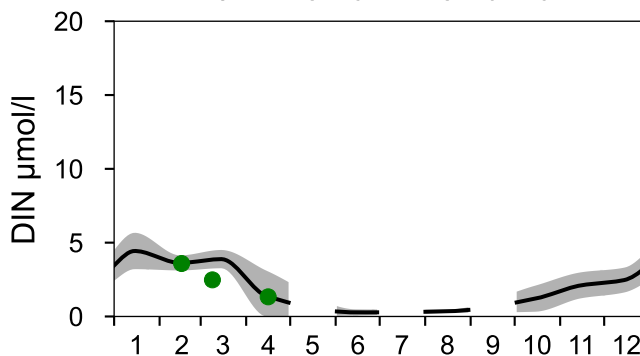
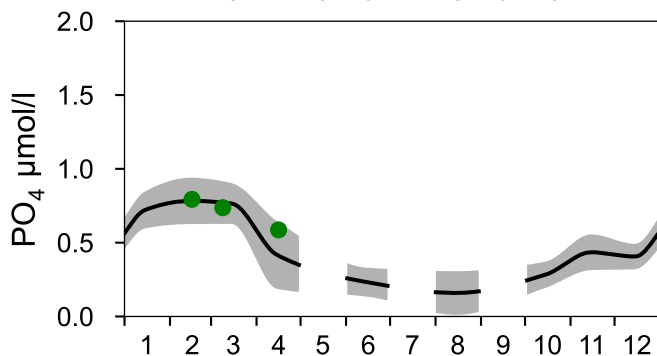
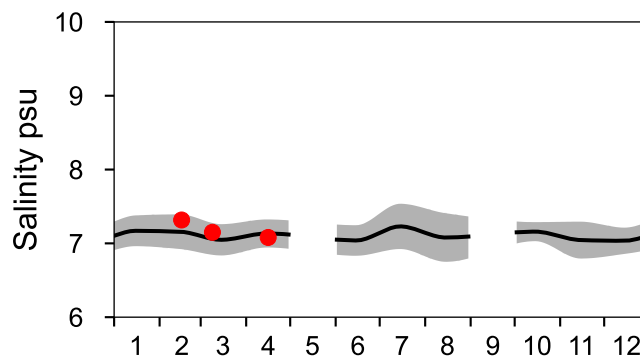
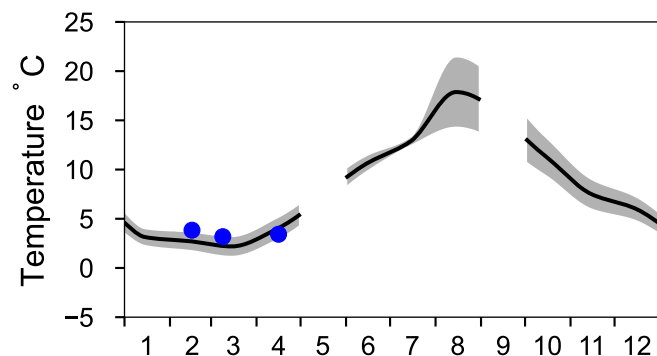
STATION BY39 ÖLANDS S UDDE SURFACE WATER (0-10 m)

Annual Cycles

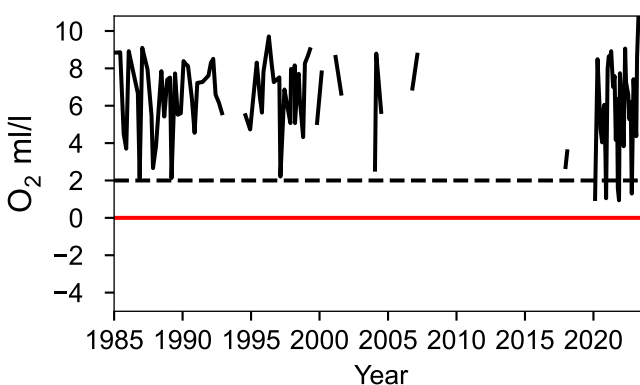
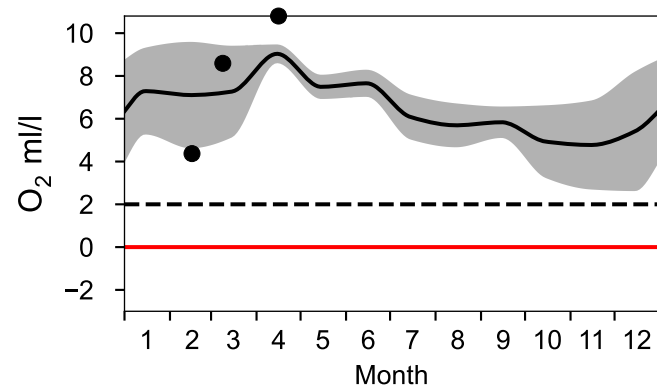
— Mean 1991-2020

■ St.Dev.

● 2023

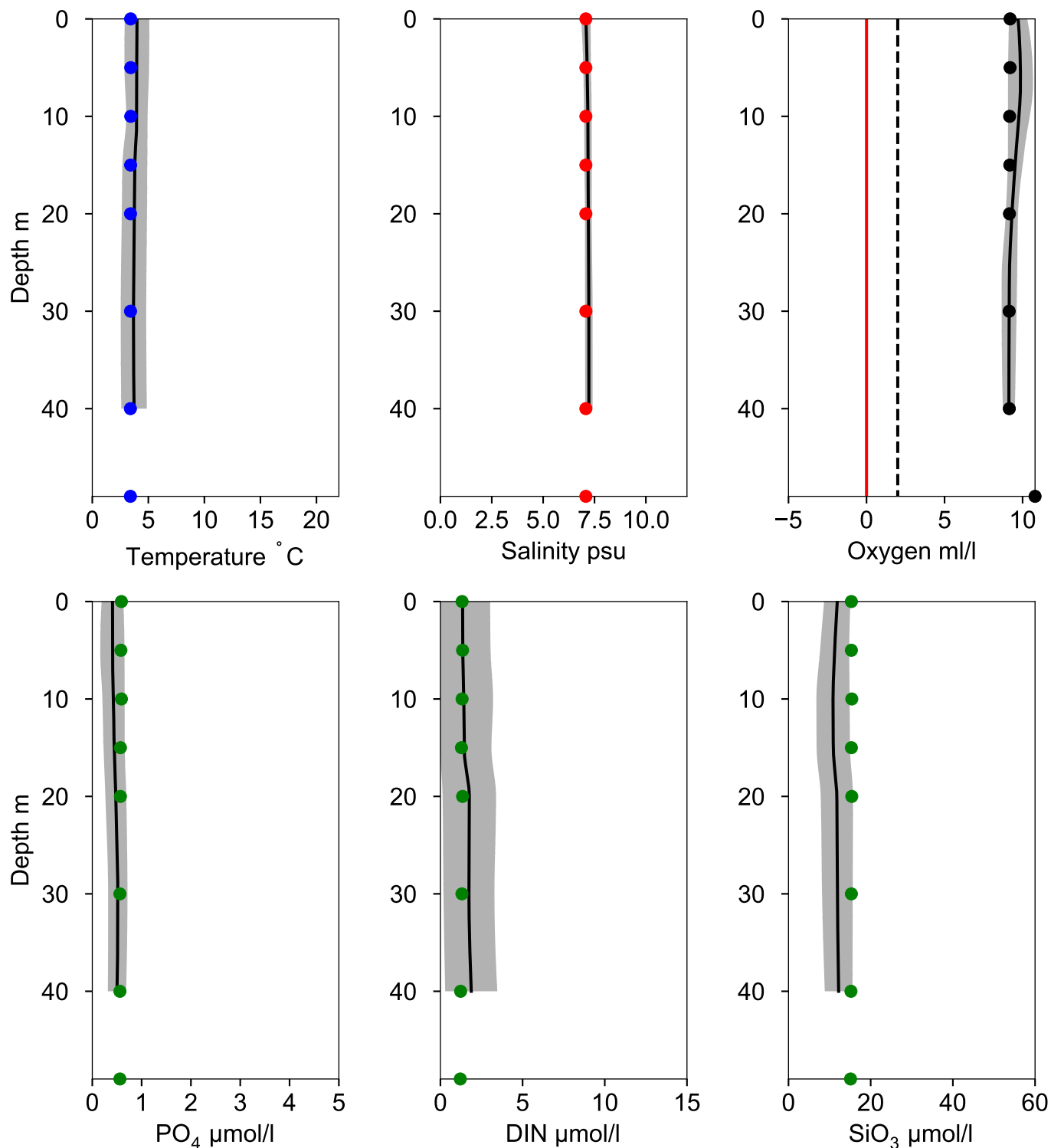


OXYGEN IN BOTTOM WATER (depth >= 40 m)



Vertical profiles BY39 ÖLANDS S UDDE April

— Mean 1991-2020 St.Dev. ● 2023-04-16



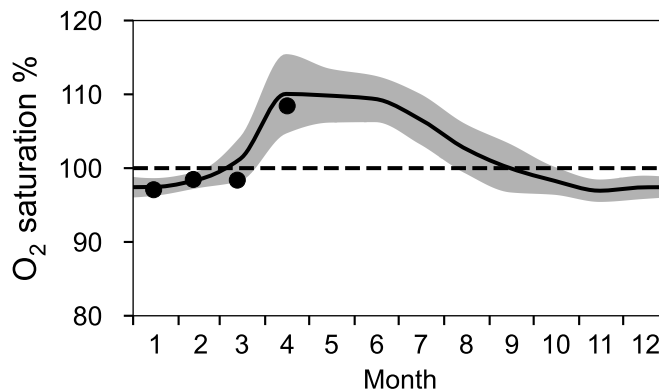
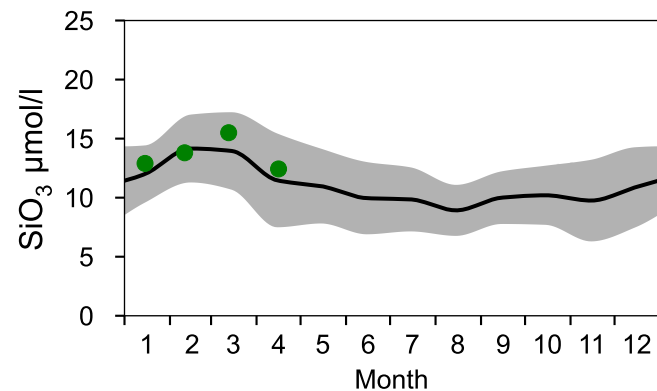
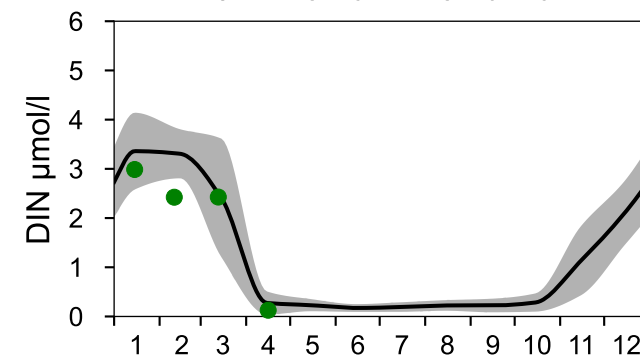
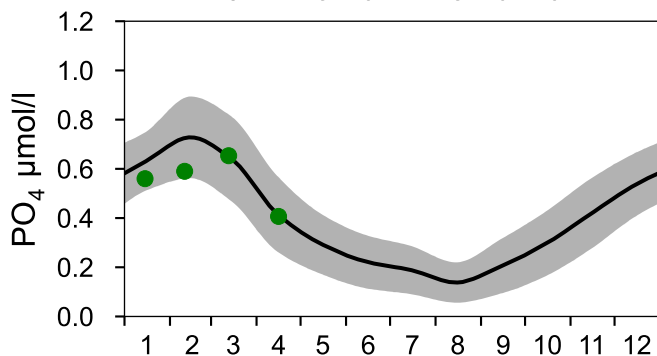
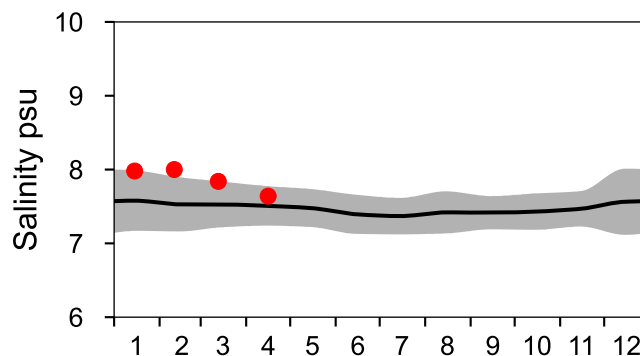
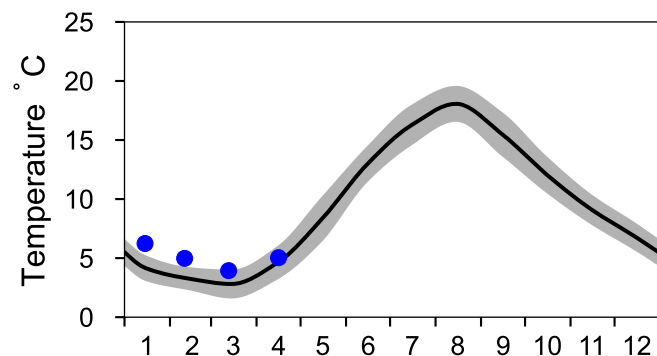
STATION HANÖBUKTEN SURFACE WATER (0-10 m)

Annual Cycles

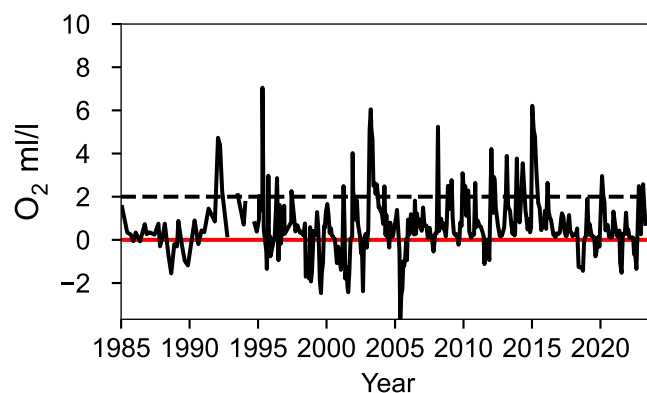
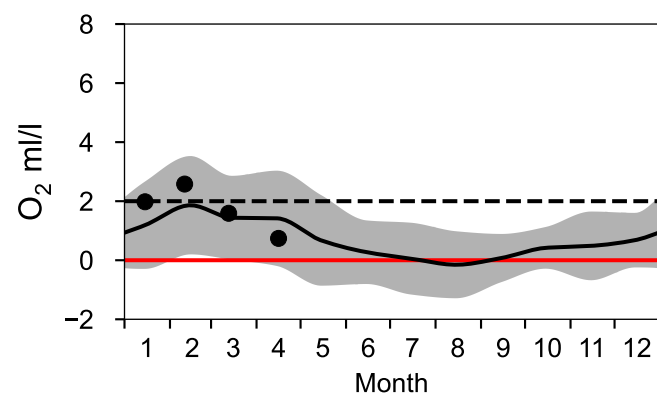
— Mean 1991-2020

■ St.Dev.

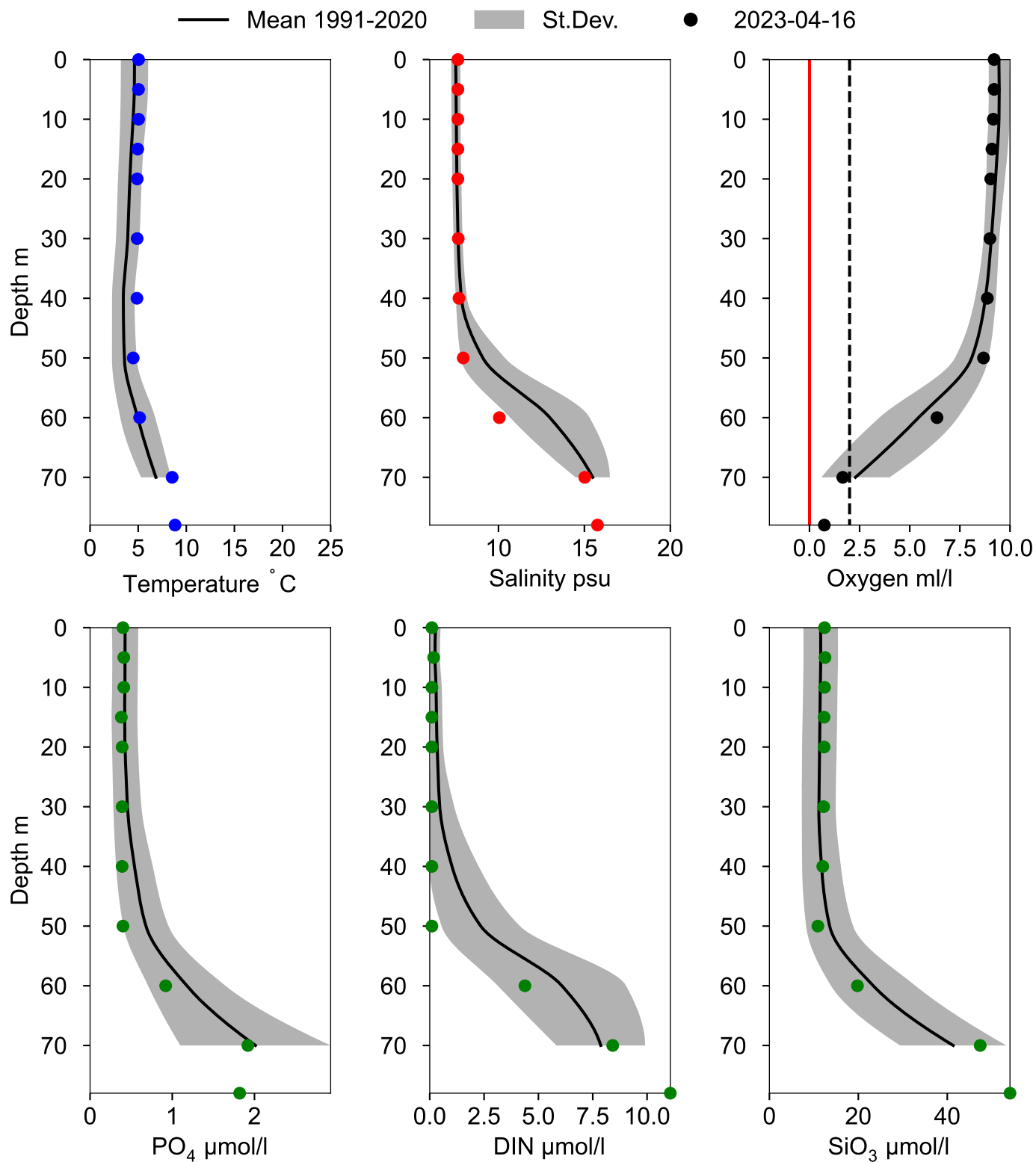
● 2023



OXYGEN IN BOTTOM WATER (depth >= 70 m)



Vertical profiles HANÖBUKTEN April



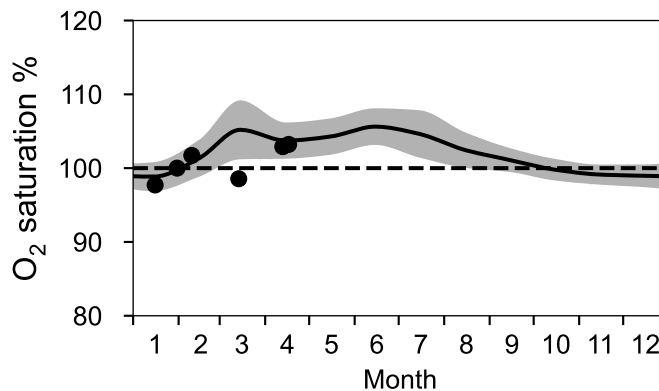
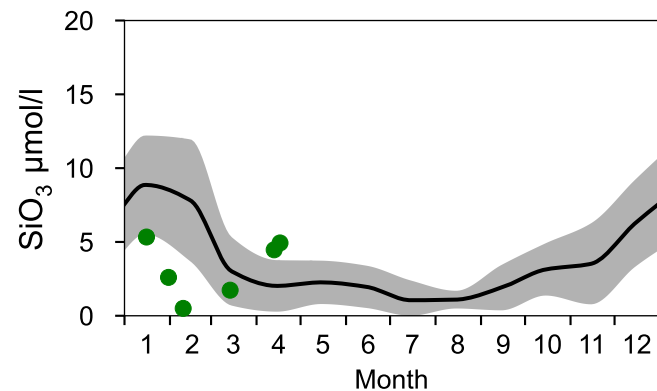
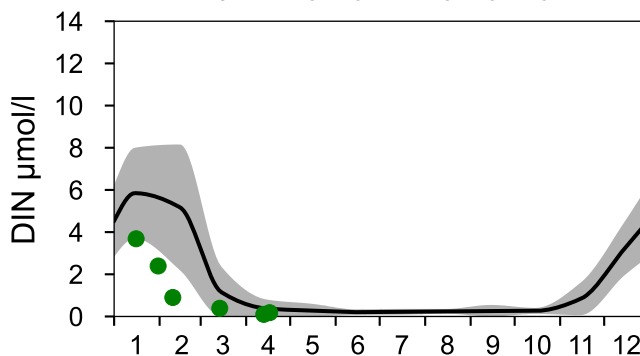
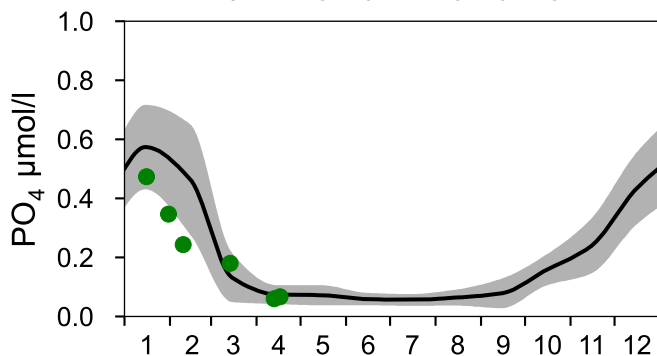
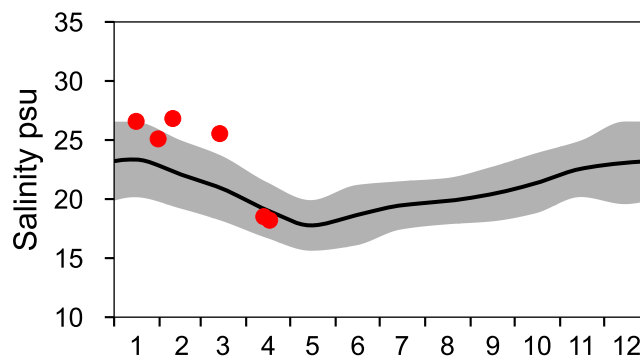
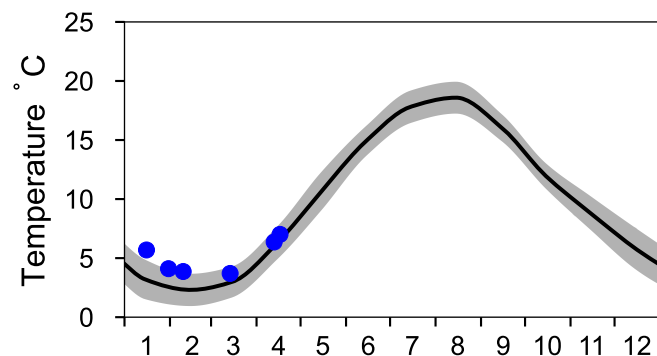
STATION ANHOLT E SURFACE WATER (0-10 m)

Annual Cycles

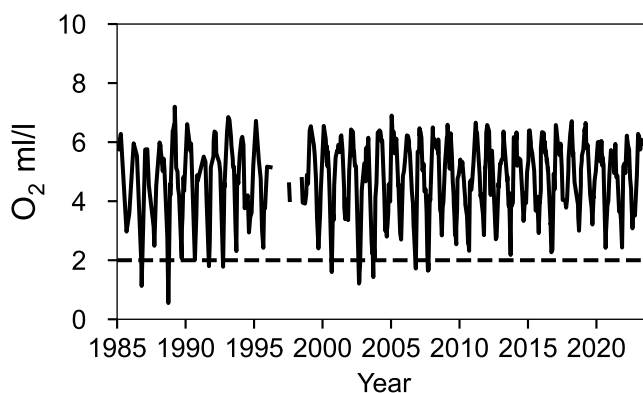
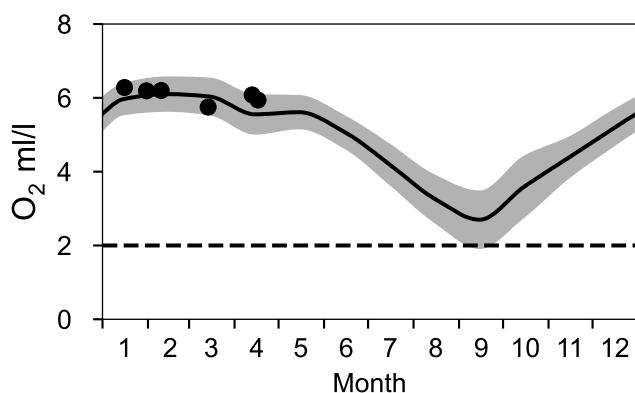
— Mean 1991-2020

■ St.Dev.

● 2023



OXYGEN IN BOTTOM WATER (depth >= 52 m)



Vertical profiles ANHOLT E

April

