

## Report from the SMHI monitoring cruise with M/V Meri



**Survey period:** 2018-03-14 - 2018-03-20  
**Principal:** Swedish Meteorological and Hydrological Institute (SMHI),  
Swedish Agency for Marine and Water Management (SwAM)  
**Cooperation partners:** Finnish Environment Institute (SYKE), VG-Shipping

### SUMMARY

Due to the rough and cold weather and the resulting icing situation, the central parts of the Baltic Proper could not be visited. During the cruise, which is part of the Swedish pelagic monitoring programme, the Skagerrak, the Kattegat, the Sound, the Arkona Basin, the Bornholm Basin, the Hanö Bight and the Kalmarsund was visited.

The spring bloom in the Skagerrak and the Kattegat was ongoing, which was noted with high fluorescence peaks noted from the CTD probe and low nutrient concentrations in the surface water. In the visited parts of the Baltic Proper there were still winter conditions. For more information on species composition see separate algae report "AlgAware". Nutrients in the form of dissolved inorganic nitrogen (DIN) and phosphorus (DIP) in the surface layer were generally at normal levels throughout the investigated area. The silicate concentrations in the southern Baltic Proper were still much higher than normal.

In the bottom water of the Hanö Bight and the Bornholm Basin, oxygen levels were found close to 0 ml/l. Acute oxygen deficiency (<2 ml/l) was found here from 65-70 meters deep. In the Skagerrak, oxygen concentrations were noted that were lower than normal. However, the concentrations in the deep water ranged between 5-6 ml/l which is above the limit of acute oxygen deficiency. In the Sound, low oxygen levels were also observed near the bottom, just under 3 ml/l.

The next cruise is scheduled for mid April.

## RESULTS

The March cruise was conducted on board the Finnish heavy load carrier M/S Meri and started in Gothenburg on March 14th and ended in the same port on March 20th.

The winds were weak the first day but then increased to fresh or tough wind from the northeast. The air temperature fell in the Baltic Sea from just over 0 to -4°C. The cruise was forced to make a day's stay in the Kalmarsund due to hard winds and minus degrees, which created ice formation on the ship. Icing warnings were issued for the central Baltic Proper and therefore it was not possible to visit the stations around Gotland.

This report is based on data that have passed a first quality control. When data are published at the National Oceanographic Data Centre some values might have changed after further quality controls have been performed. Data from this cruise will be published as soon as possible on the data center's webpage, normally within a week after the cruise.

Download data here: <http://www.smhi.se/klimatdata/oceanografi/havsmiljodata> (only available in Swedish).

### **The Skagerrak**

After recent cold weather, the surface water temperature was below normal and varied around 0°C. Below the cold surface water at the outer stations there was warmer water than usual for the season. The salinity in the surface was much lower than normal, about 25 in the offshore areas and about 20 at the coast and in the southern parts. The thermocline and halocline coincided at all stations, and was found at about 10 meters depth.

The nutrients were influenced by the current spring bloom and were partially or almost completely consumed. The levels of dissolved inorganic nitrogen (DIN, sum of nitrate + nitrite + ammonium) were at normal levels in surface water throughout the area and varied around 0.3 - 0.6 µmol/l except at Å15 and at Släggö close to the coast where higher concentrations were noted, 3.0 and 1.8 µmol/l respectively. Dissolved inorganic phosphorus (DIP) showed normal levels around 0.05 - 0.22 µmol/l. The silicate content was normal for the season in the surface water with concentrations of about 0.9 - 3.0 µmol/l.

The spring bloom were continuing at all stations in the Skagerrak and high fluorescence peaks were found at around 5-15 meters deep throughout the area. For more information on species composition and abundance see separate algae report:

"AlgAware" <https://www.smhi.se/publikationer/publikationer/algrapporter>

Oxygen levels were higher than normal in the surface water as a result of the current spring bloom, but lower than normal in the deep water. However, the oxygen concentrations in the deep water ranged between 5 - 6 ml/l, which is well above the limit of acute oxygen deficiency at 2 ml/l.

### **The Kattegat and the Sound**

The water temperature was lower than normal for the season and varied around 0 - 1°C in the surface layer. The temperature increased with depth and in the deeper water mass it was 5 - 7°C. Also, the salinity was lower than normal and varied in surface water between 17 and 18. In the Sound salinity ranged between 10 at the surface and up to 32 at the bottom. At all stations, the thermocline coincided with the halocline between 10 - 20 meters depth.

Due to the ongoing spring bloom, the concentrations of nutrients DIN, DIP and silicate had now dropped and showed low levels, which is normal for this time of the year. The levels of DIN in the surface water now varied around 0.3 - 0.9  $\mu\text{mol/l}$  and DIP around 0.1 - 0.3  $\mu\text{mol/l}$ . The levels of DIN and DIP both increased with depth. The silicate concentration had also decreased as a result of spring bloom, but at Fladen concentrations much higher than normal were found; 8.0  $\mu\text{mol/l}$ . In the Sound the nutrient levels were not affected by the spring bloom because the surface water here usually comes from the southern Baltic Sea where winter conditions still prevailed and spring bloom had not started. The levels of nutrients were here much higher than normal; DIN: 6.0  $\mu\text{mol/l}$ , DIP: 0.7  $\mu\text{mol/l}$ , silicate: 20  $\mu\text{mol/l}$ .

The spring bloom in the Kattegat continued as observed with fluorescence measurements with the CTD probe. High concentrations of phytoplankton were noted at 5 - 20 meters deep. Extra phytoplankton samples were taken in these fluorescence maxima which will be analyzed and reported in the separate algae report "AlgAware".

The deep water in the entire area was well oxygenated, which is normal for the season. The only exception was the bottom water in the Sound where very low oxygen levels were observed, just under 3 ml/l.

### **The Arkona Basin, the Bornholm Basin, the Hanö Bight and the Kalmarsund**

Due to rough and cold weather and the resulting icing situation, the central parts of the Baltic Proper could not be visited. The areas that could be investigated were the Arkona and Bornholm Basin, the Hanö Bight and the Kalmarsund.

The surface water temperature was normal throughout the surveyed area and varied around 2.0 - 2.5°C, and at the coastal stations in the Kalmarsund approximately 0.1°C. The salinity in the surface water varied between 7.4 - 8.0. In the Kalmarsund the salinity was somewhat lower; 6.8. The surface layer was cooled and well mixed and was divided from the deep water by a distinct thermocline and halocline that coincided throughout the area. The stratification was found in the Arkona Basin at 40 meters and in the other areas around 60 meters depth.

The level of dissolved inorganic nitrogen (DIN) was normal for the season in the surface water and varied between 2.2 - 2.9  $\mu\text{mol/l}$ . In the Kalmarsund the level was higher; 5.2  $\mu\text{mol/l}$ . The concentration of phosphate (DIP) in the surface layer was at normal levels or slightly higher than normal and varied around 0.7 - 0.8  $\mu\text{mol/l}$ . The silicate concentrations in the area were still much higher than normal. The levels had increased at most stations since the last visit in January/February. The concentrations varied just over 19  $\mu\text{mol/l}$ , slightly higher, 21  $\mu\text{mol/l}$ , at the coastal station in the Kalmarsund.

In the bottom water in the Hanö Bight and the Bornholm Basin, oxygen levels were found close to 0 ml/l. Acute oxygen deficiency (<2 ml/l) was found in the Bornholm Basin and in Hanö Bight from 65 - 70 meters deep. In the Arkona Basin at BY2, oxygen concentration dropped to about 5.5 ml/l at the bottom.

Fluorescence measurements from CTD probe did not show any phytoplankton activity, no strong fluorescence peaks were found.

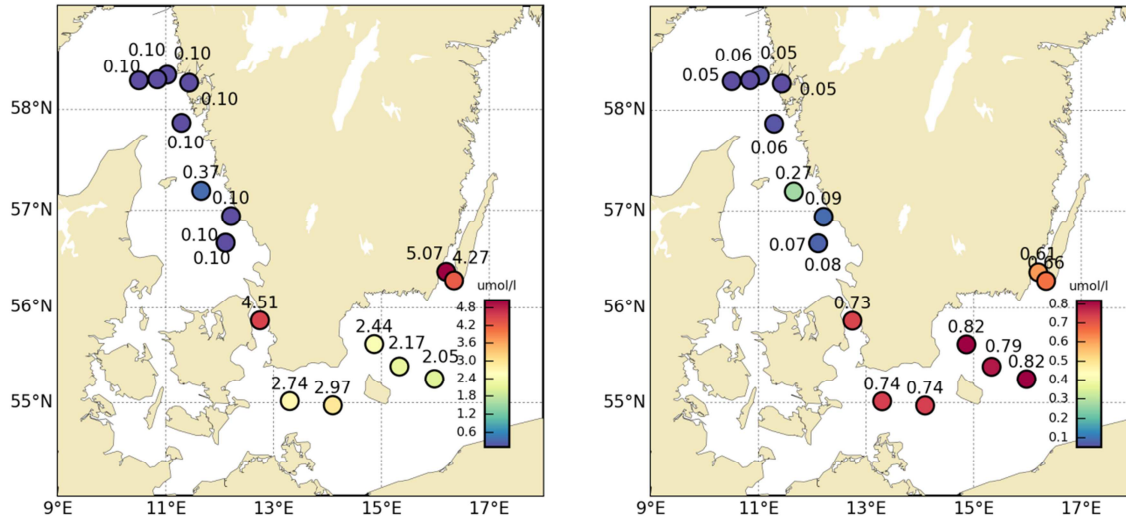


Figure 1. Map showing surface values of nitrate+nitrite (left) and phosphate (right) in  $\mu\text{mol/l}$ .

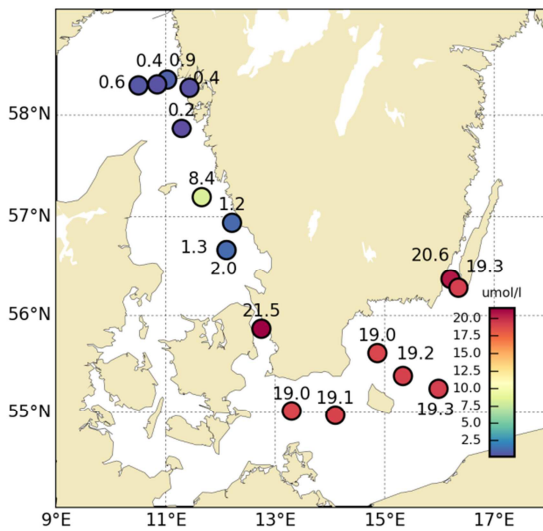


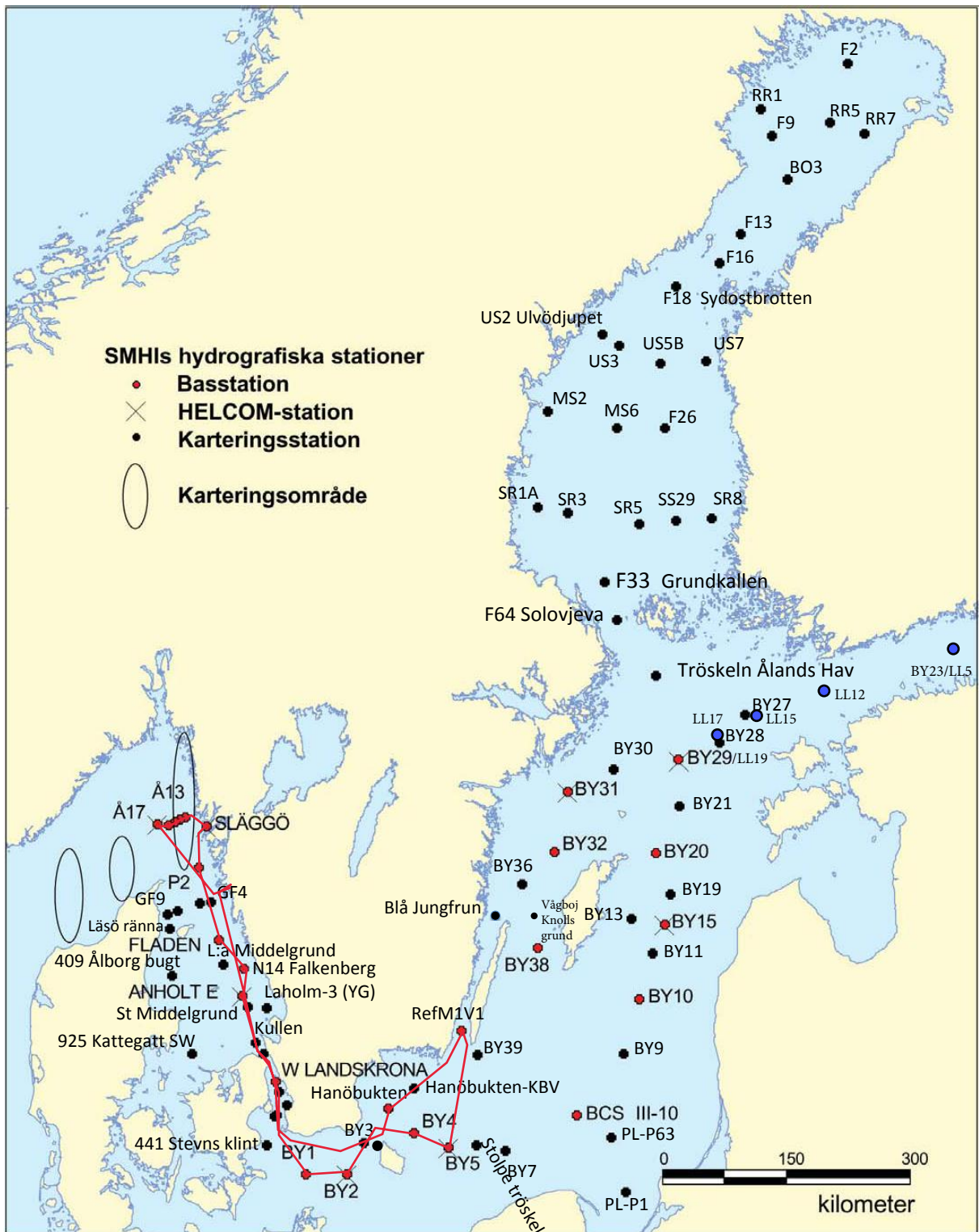
Figure 2. Map showing surface values of silicate in  $\mu\text{mol/l}$ .

## **PARTICIPANTS**

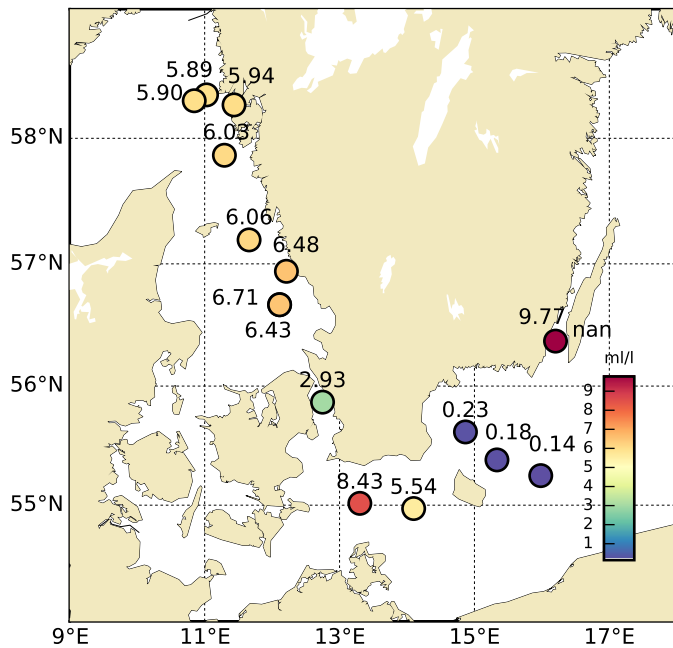
<b>Name</b>		<b>From</b>
Martin Hansson	Chief Scientist	SMHI
Örjan Bäck		SMHI
Sara Johansson		SMHI
Sari Sipilä		SMHI
Anna-Kerstin Thell		SMHI

## **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





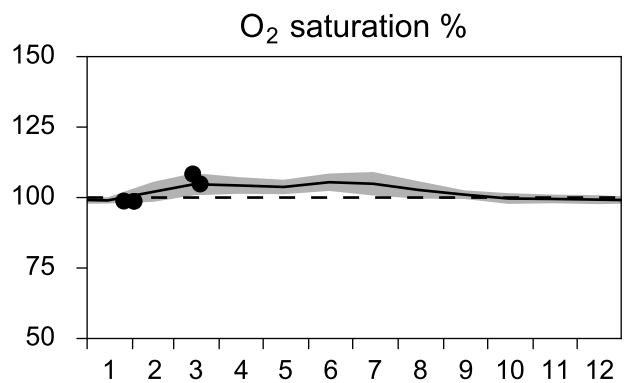
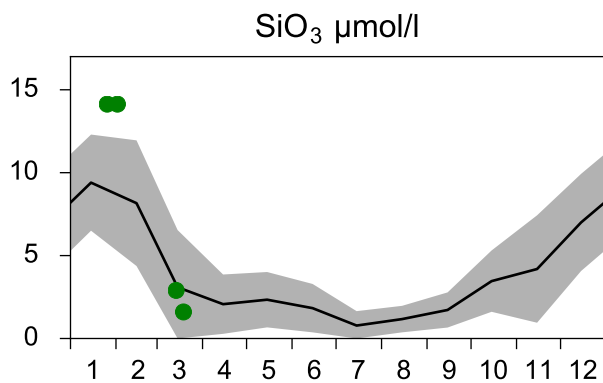
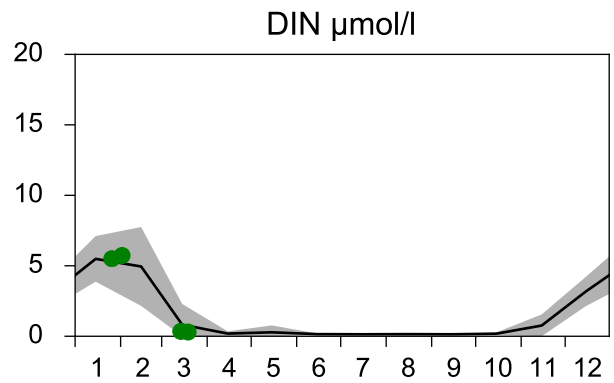
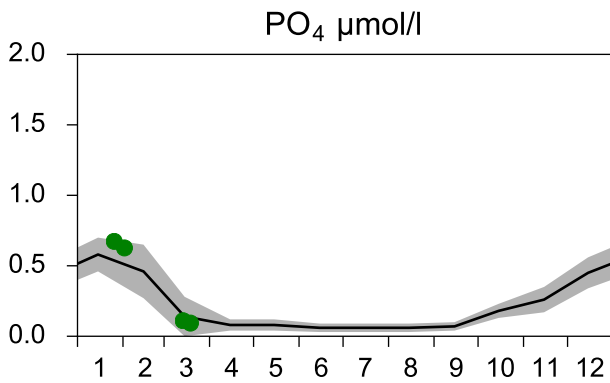
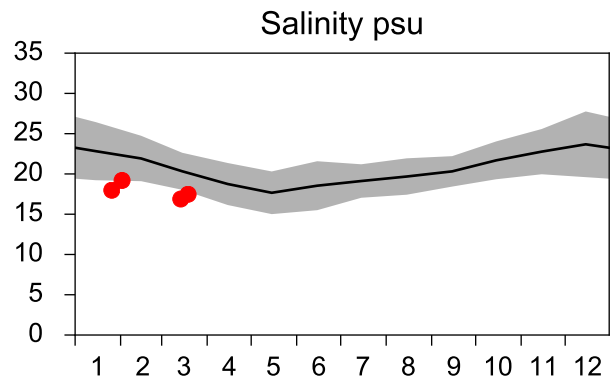
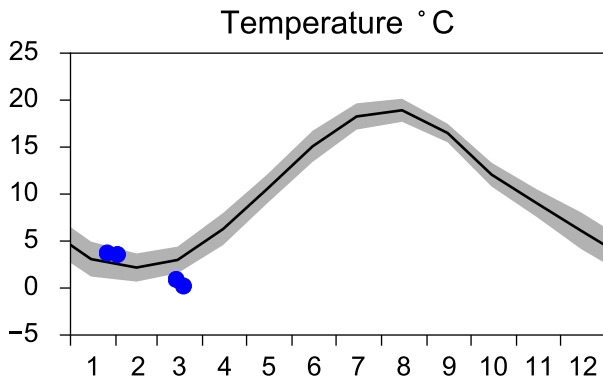




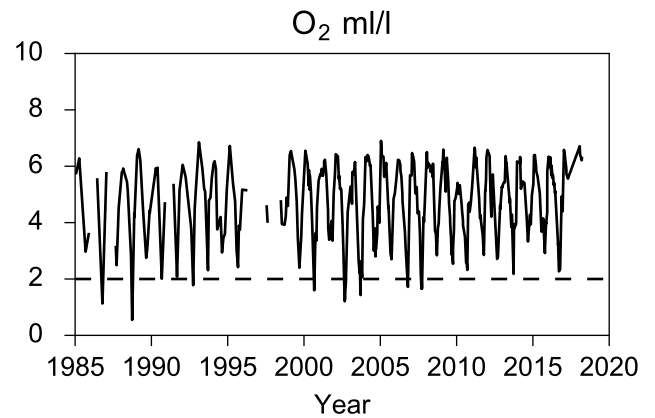
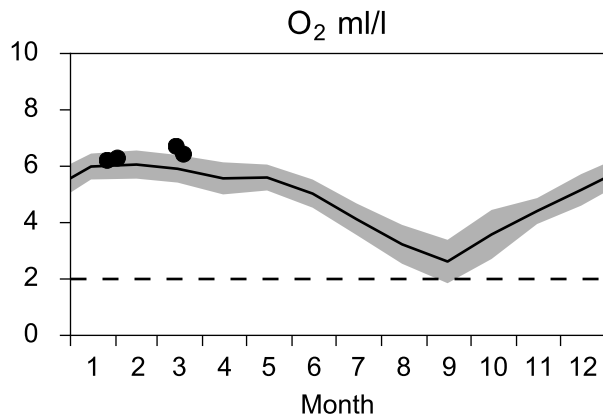
# STATION ANHOLT E SURFACE WATER (0-10 m)

## Annual Cycles

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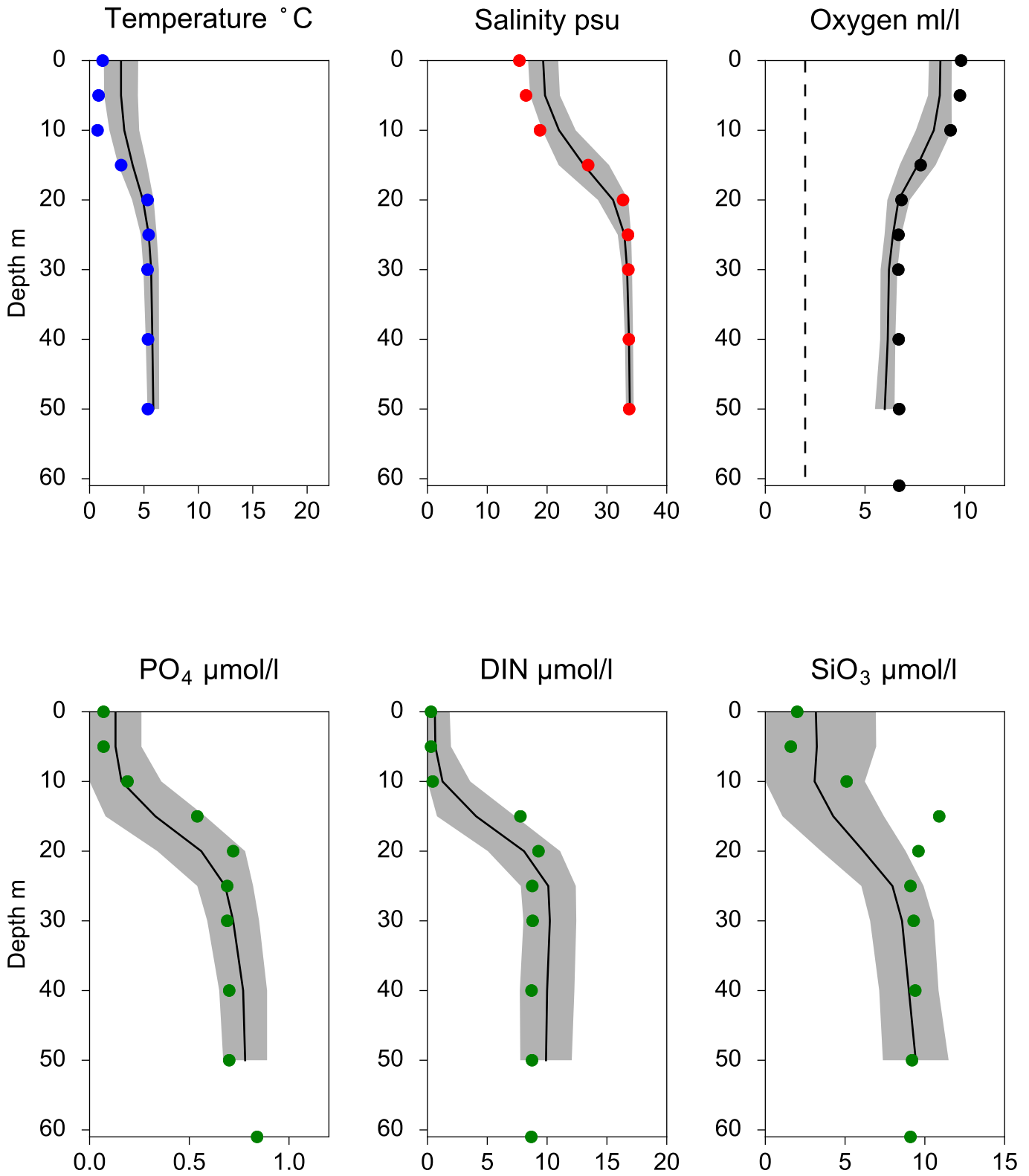


## OXYGEN IN BOTTOM WATER (depth >= 52 m)



# Vertical profiles ANHOLT E March

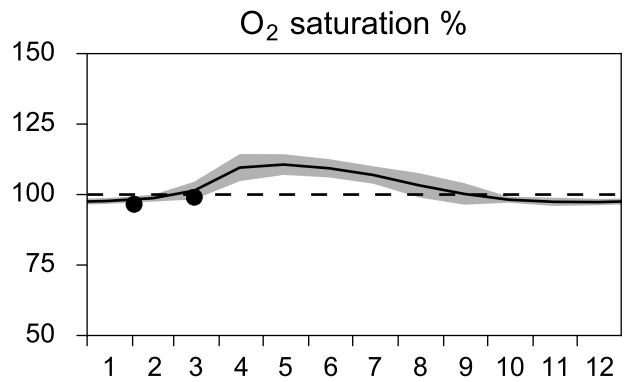
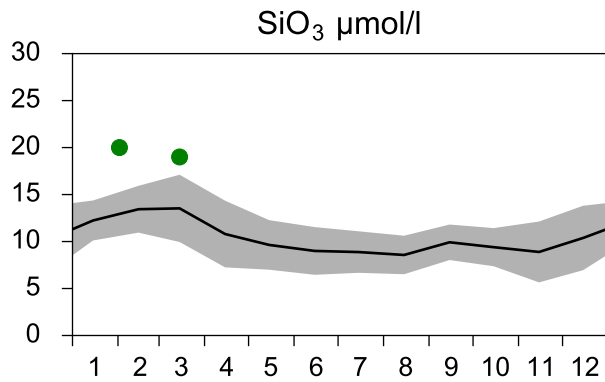
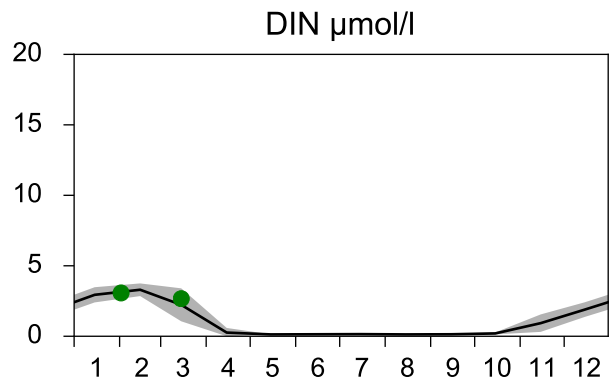
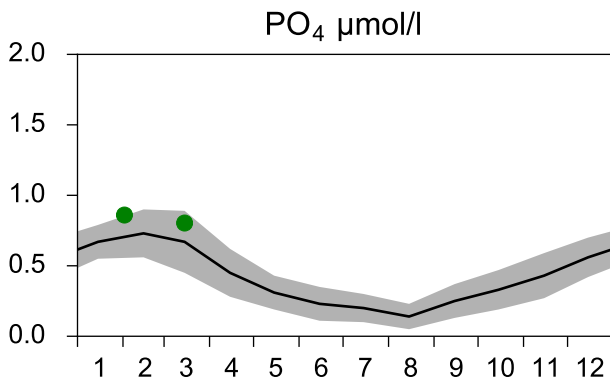
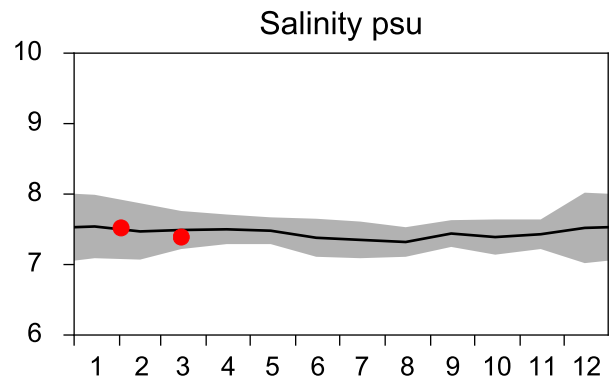
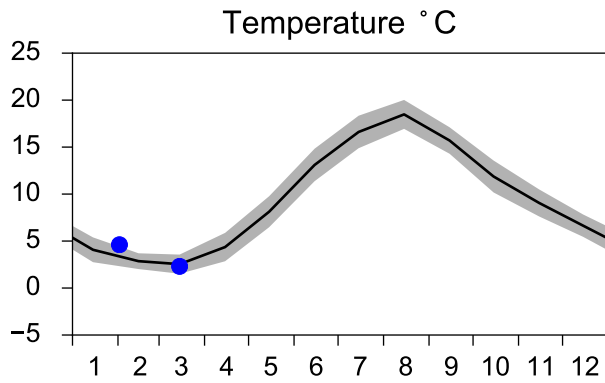
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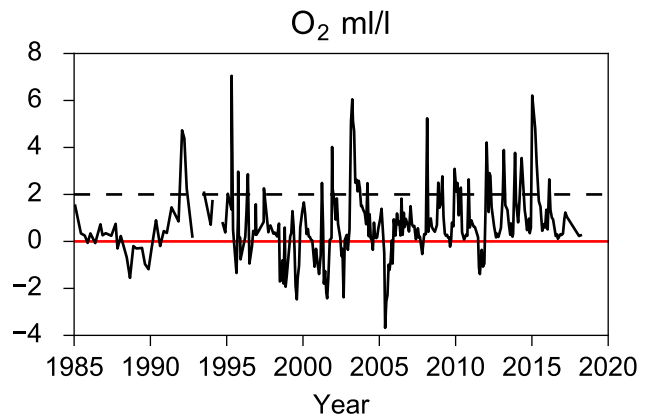
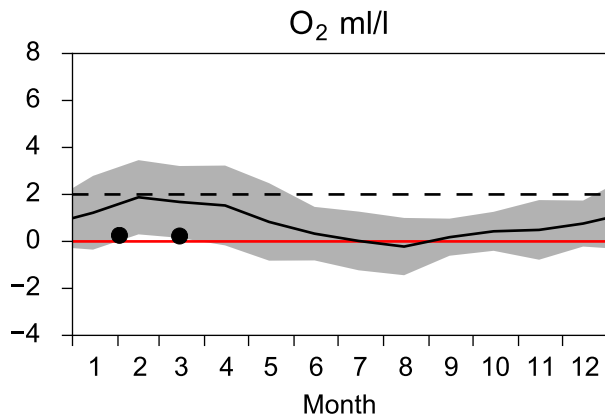
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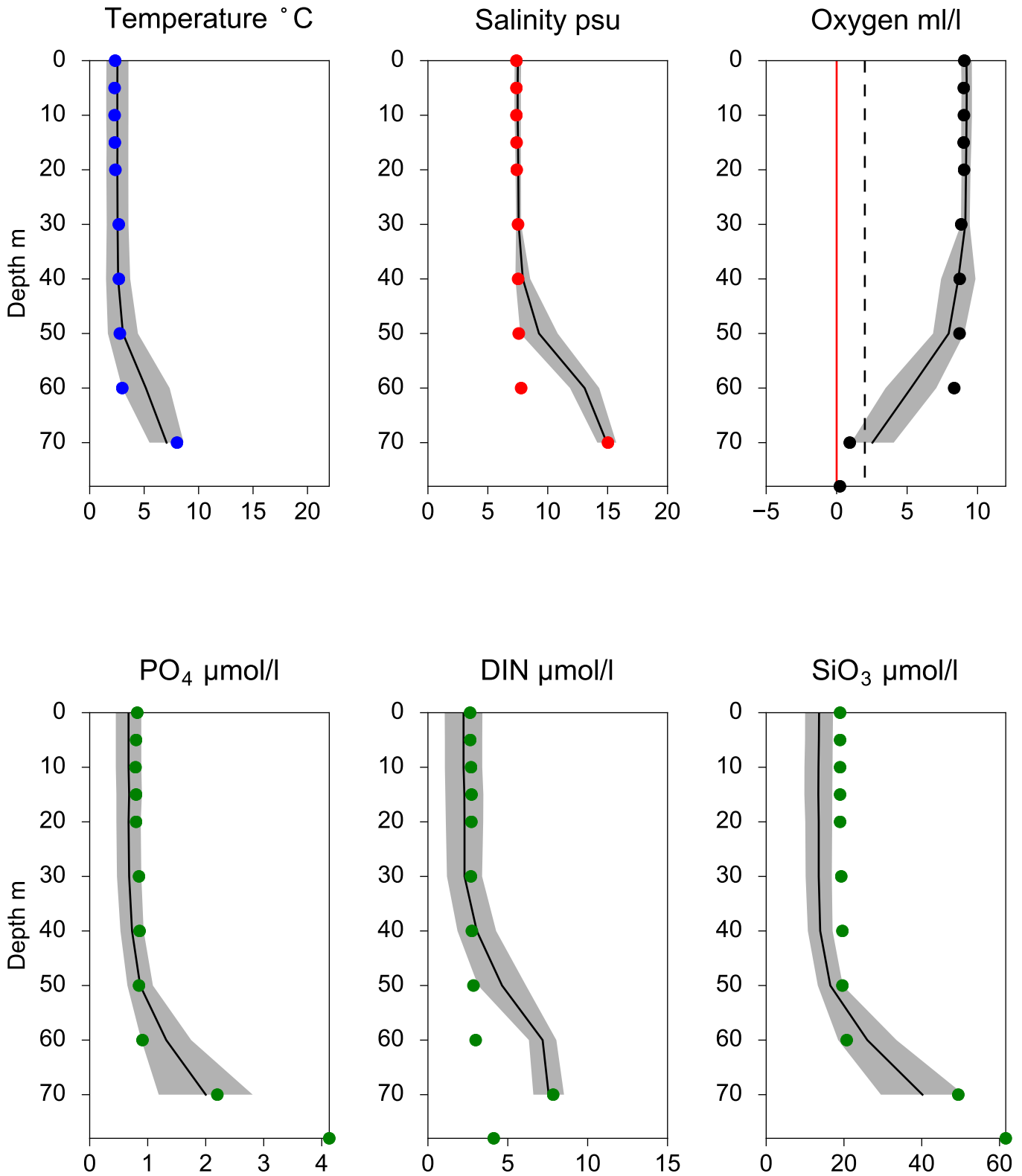


## OXYGEN IN BOTTOM WATER (depth >= 70 m)



# Vertical profiles HANÖBUKTEN March

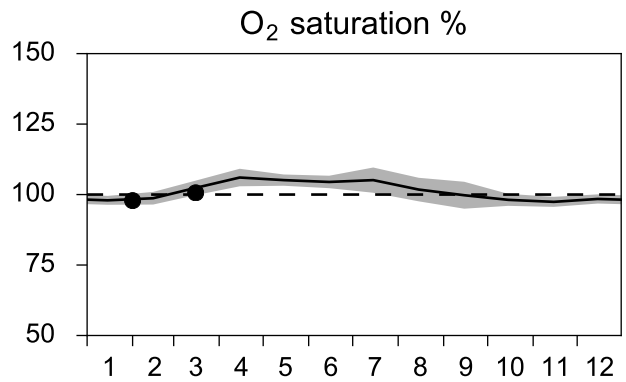
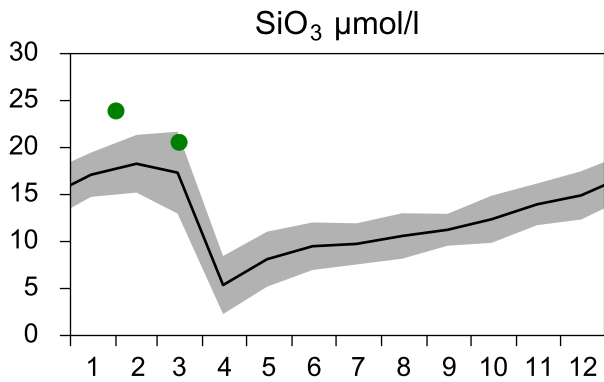
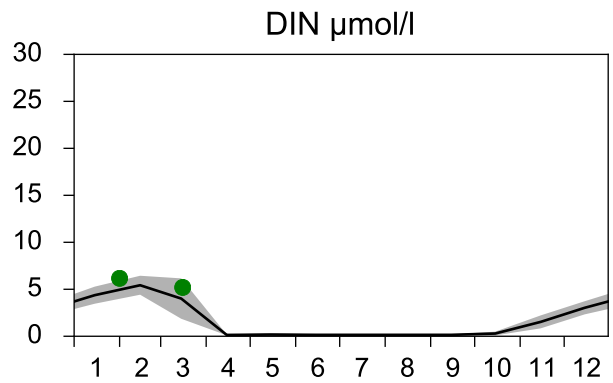
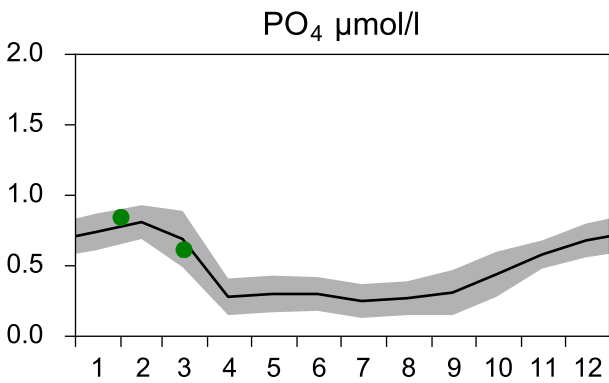
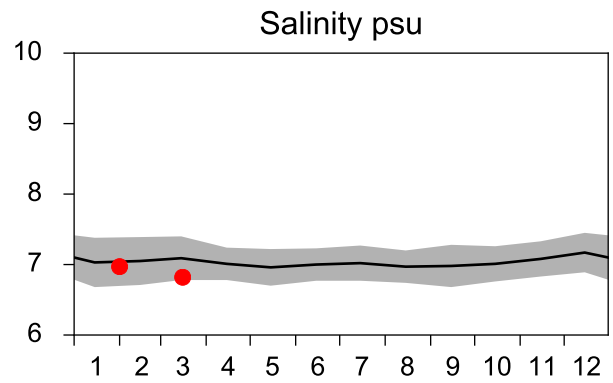
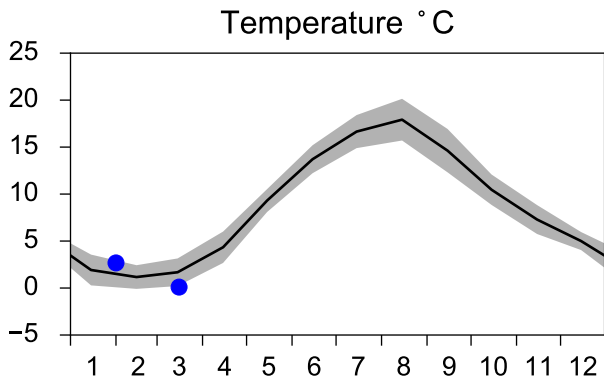
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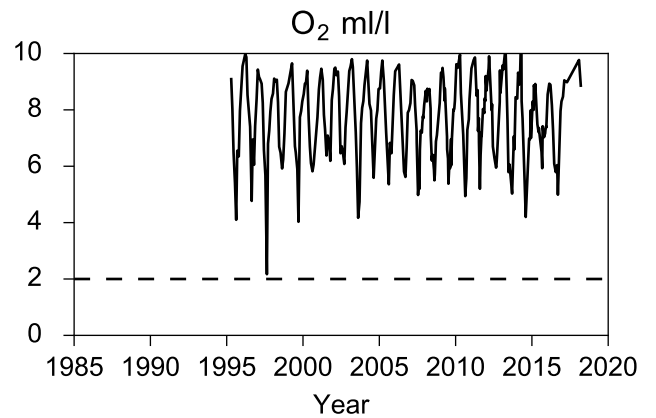
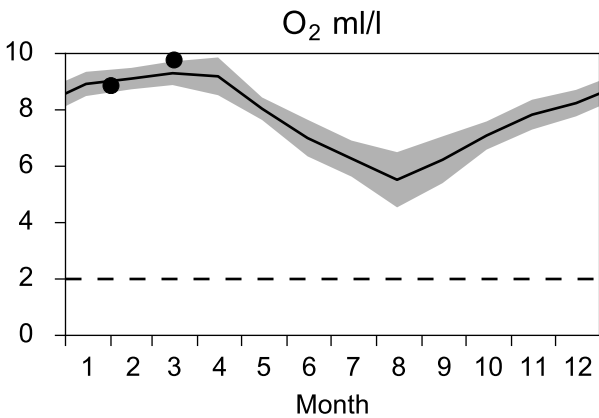
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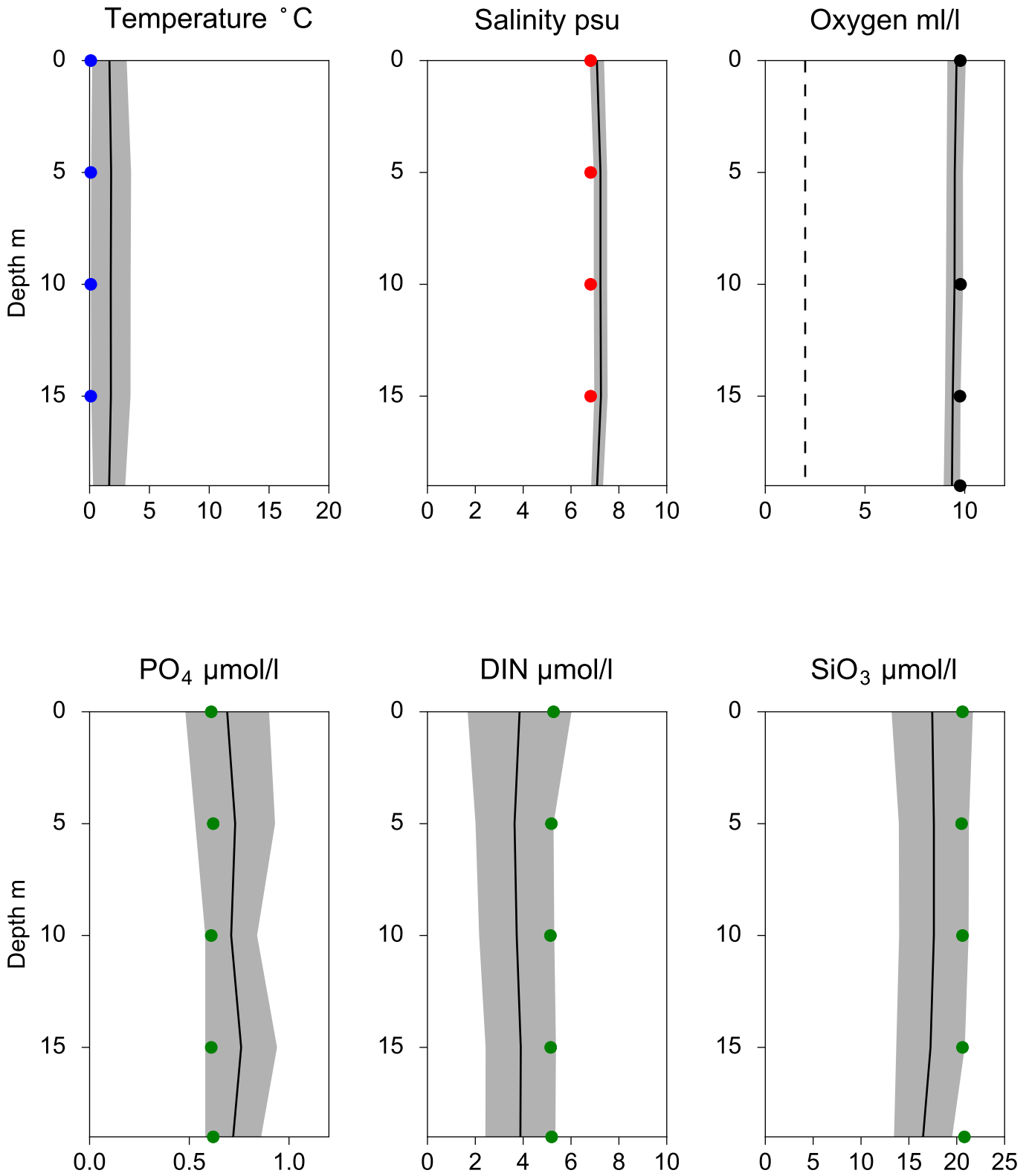


## OXYGEN IN BOTTOM WATER (depth >= 17 m)



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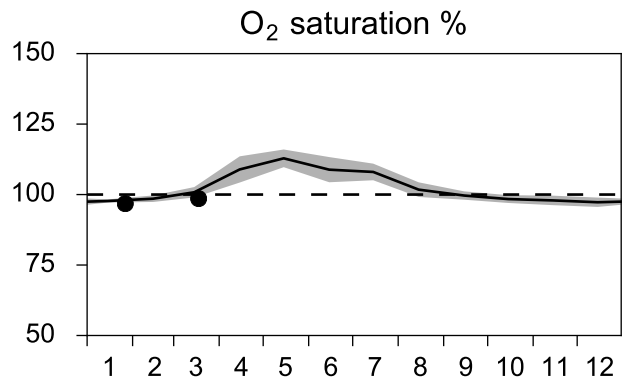
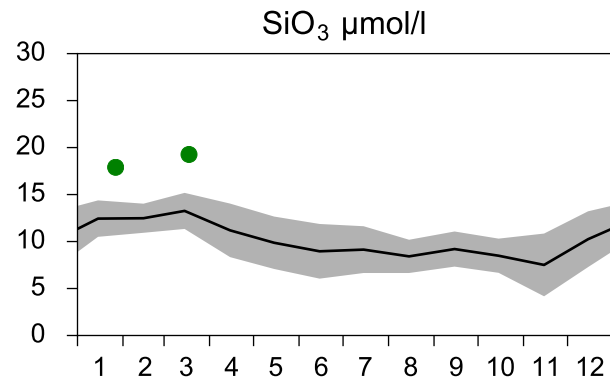
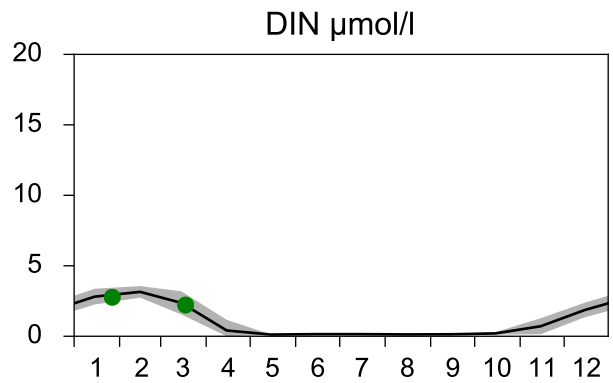
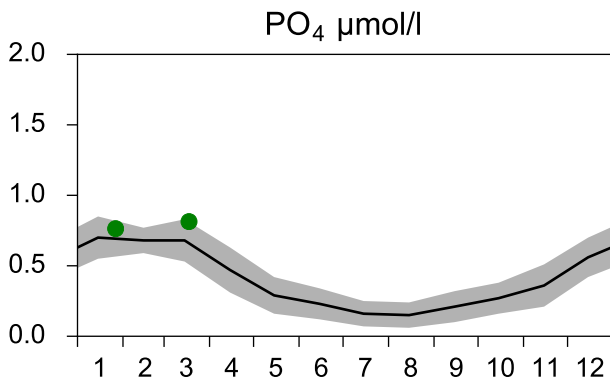
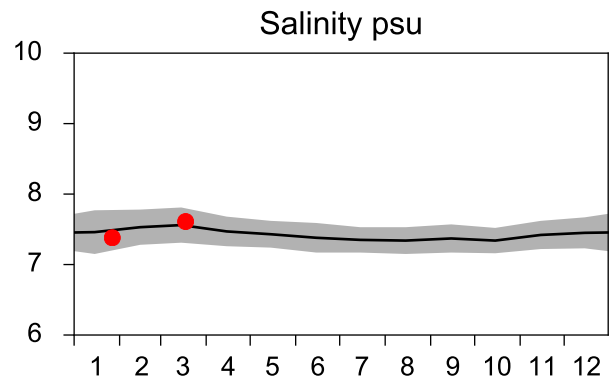
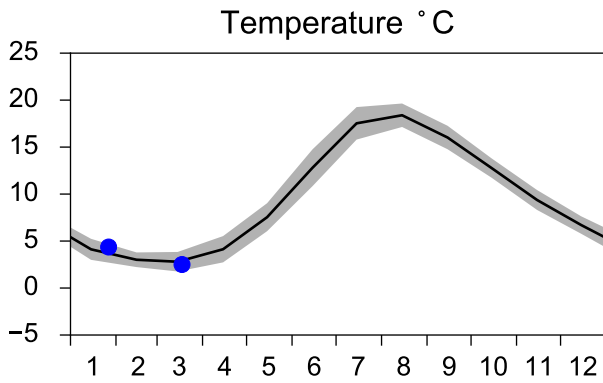
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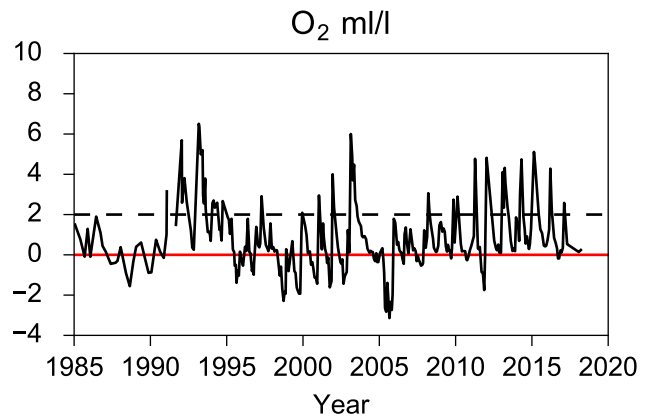
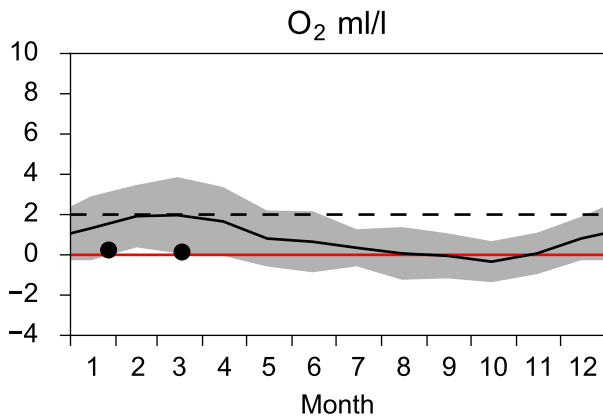
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Annual Cycles

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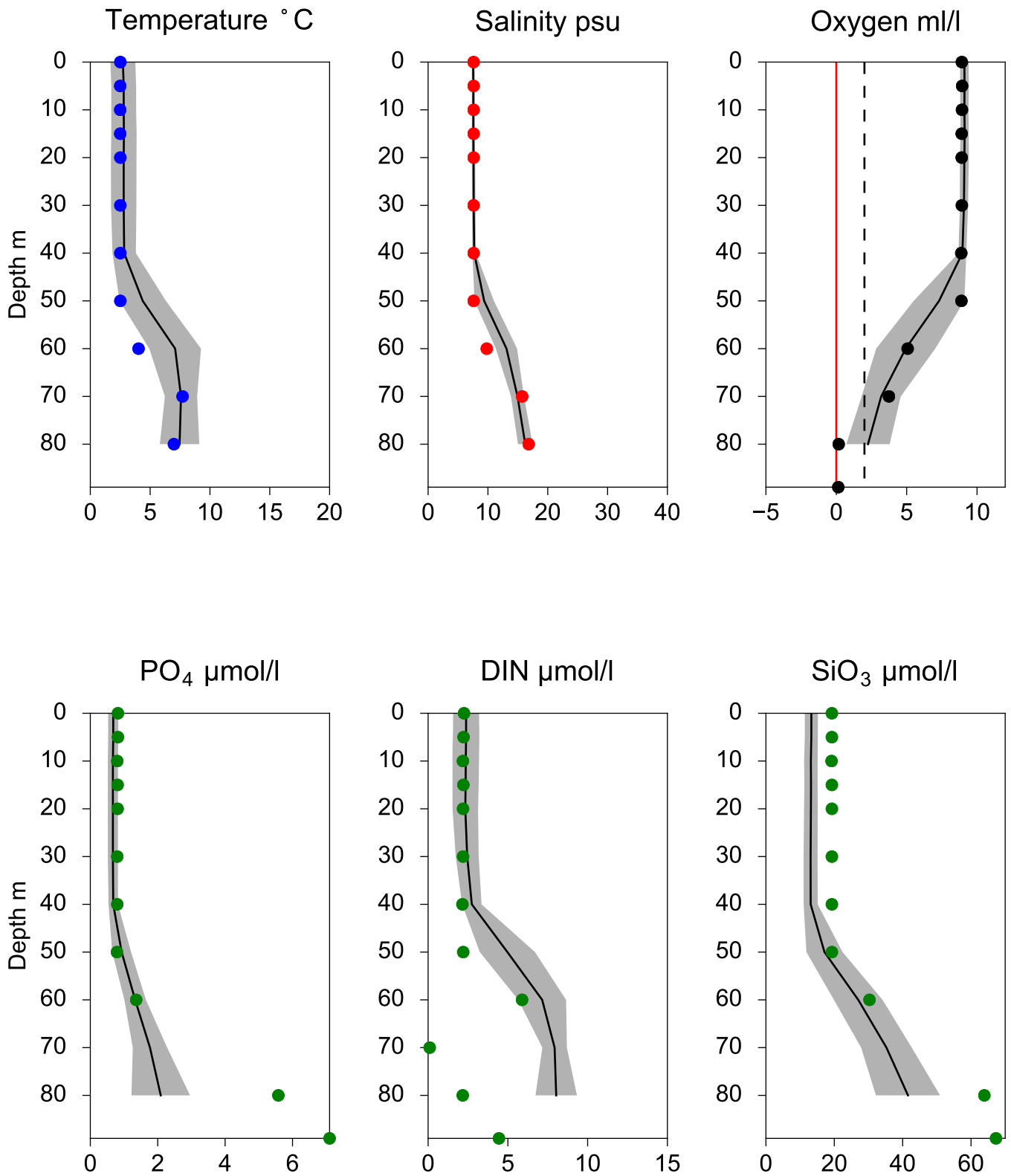


## OXYGEN IN BOTTOM WATER (depth >= 80 m)



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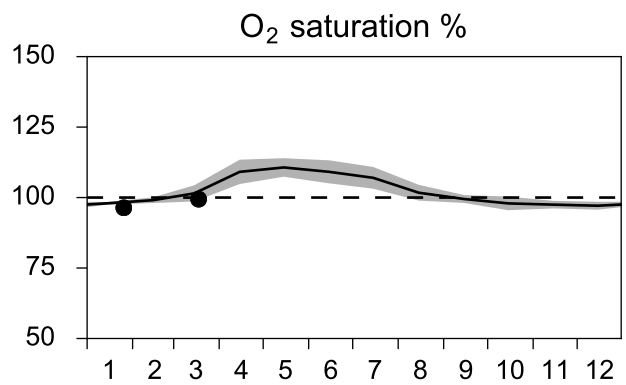
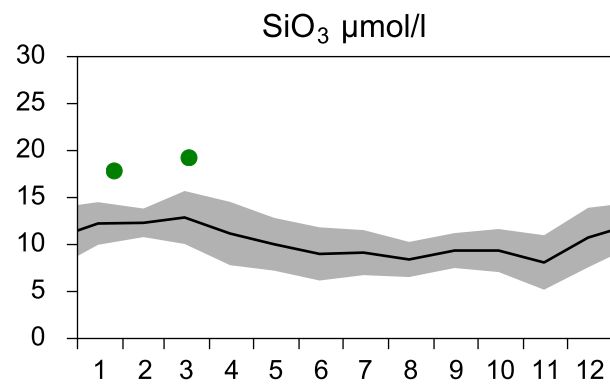
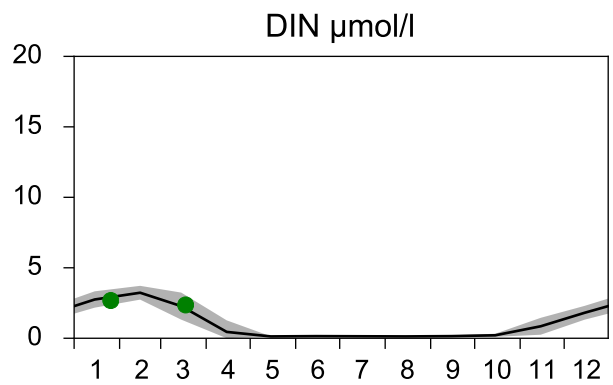
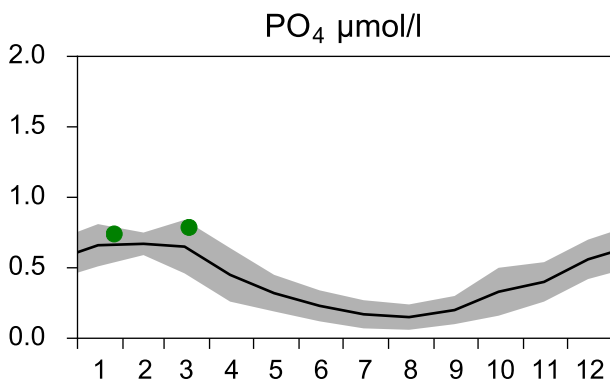
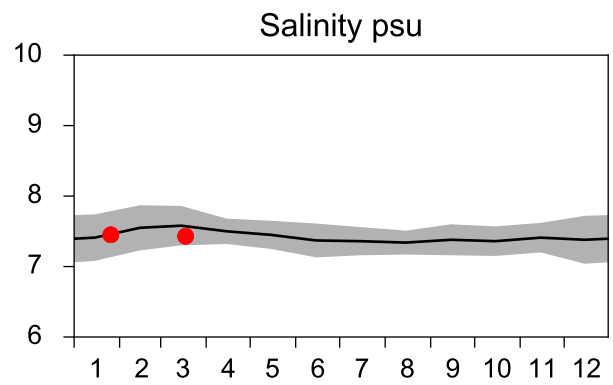
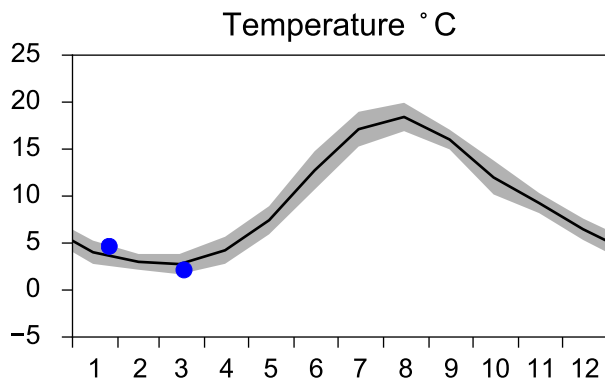




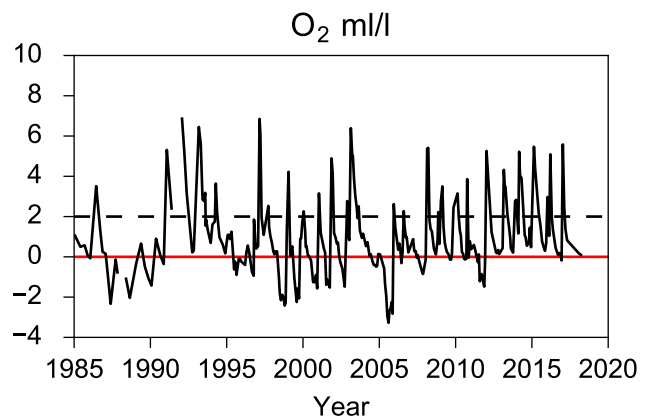
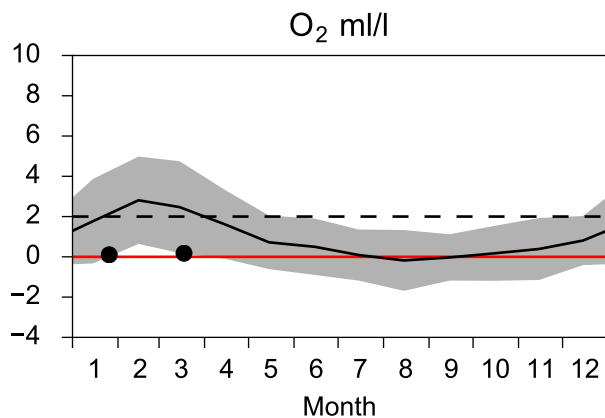
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Annual Cycles

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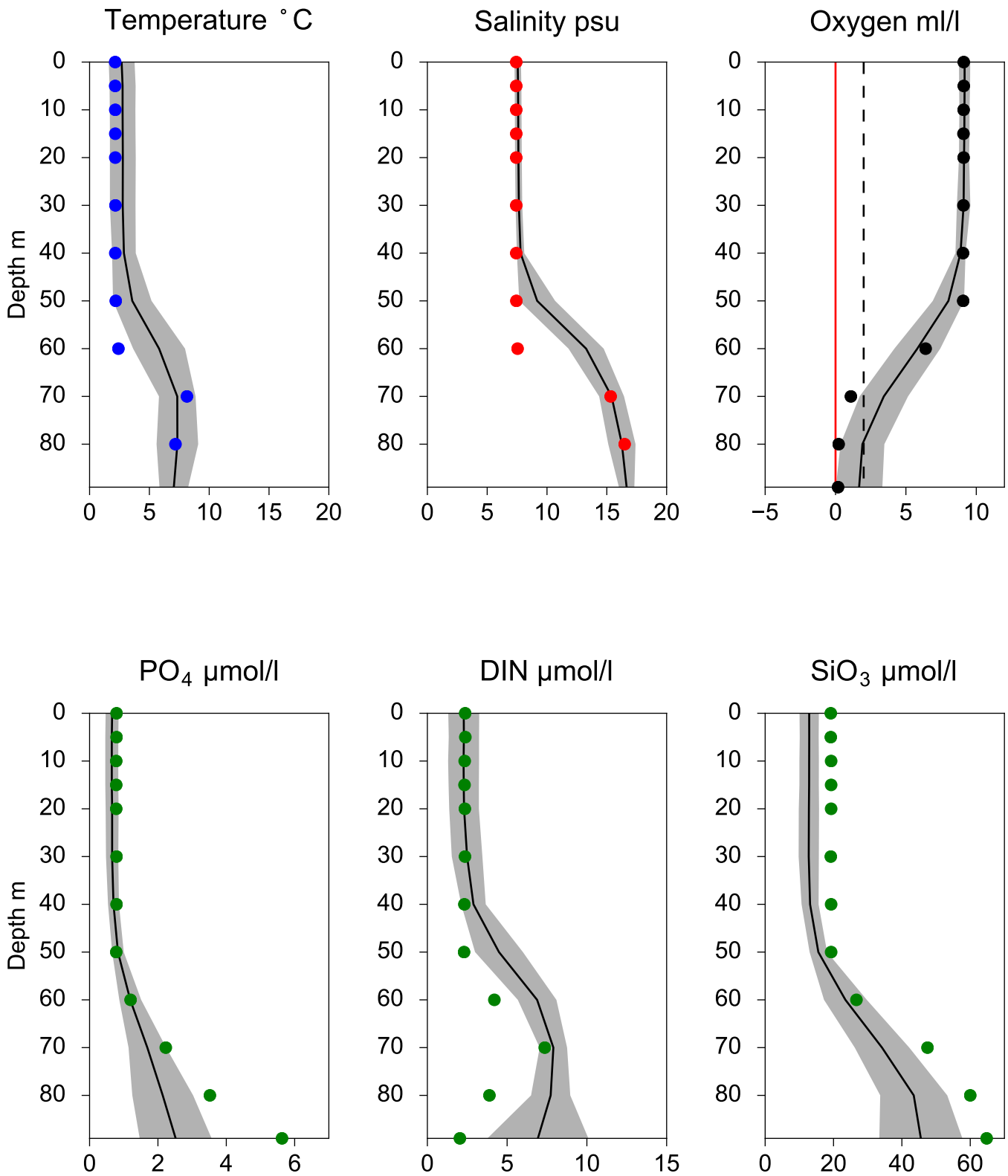


## OXYGEN IN BOTTOM WATER (depth >= 80 m)



# Vertical profiles BY4 CHRISTIANSÖ March

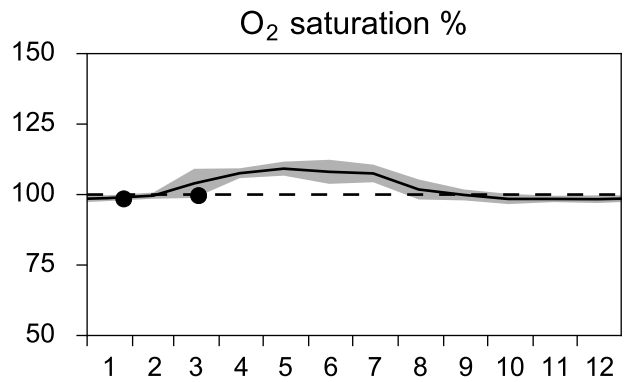
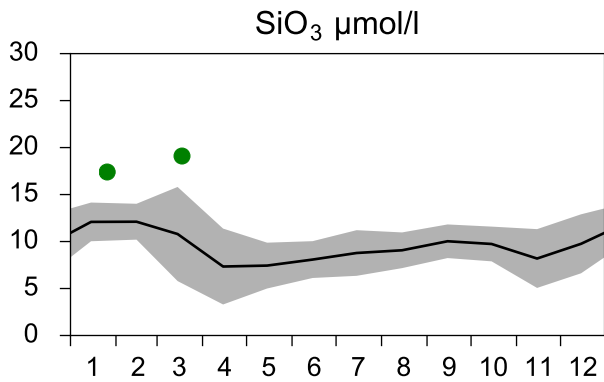
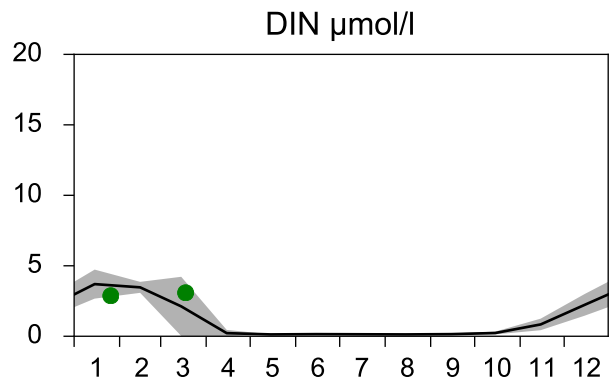
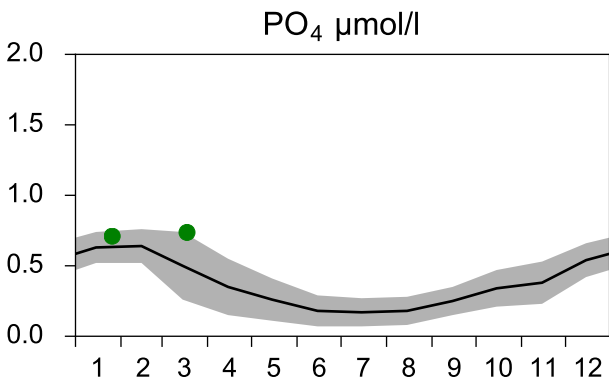
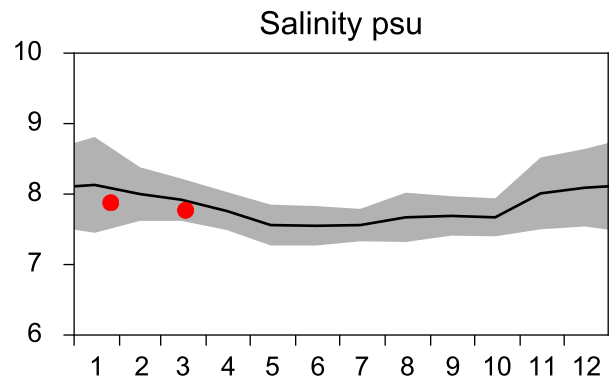
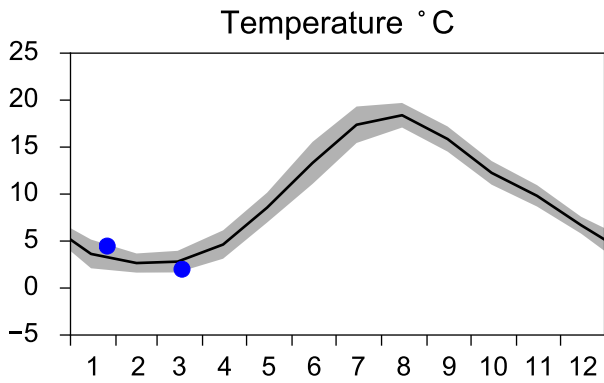
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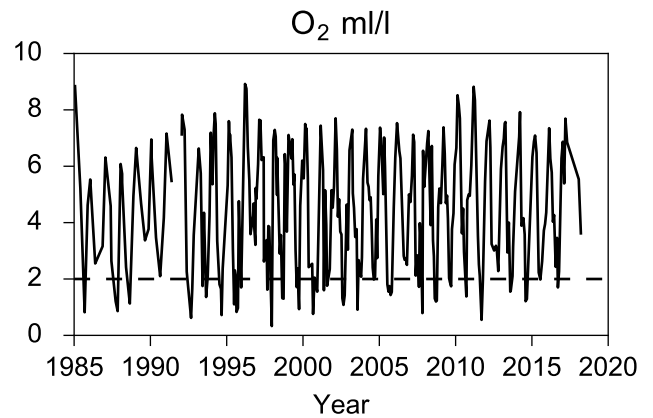
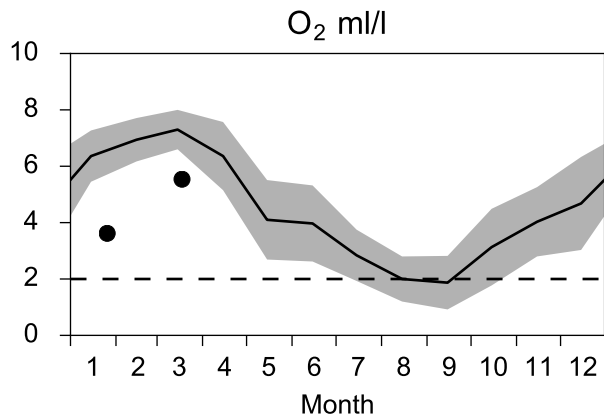
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Annual Cycles

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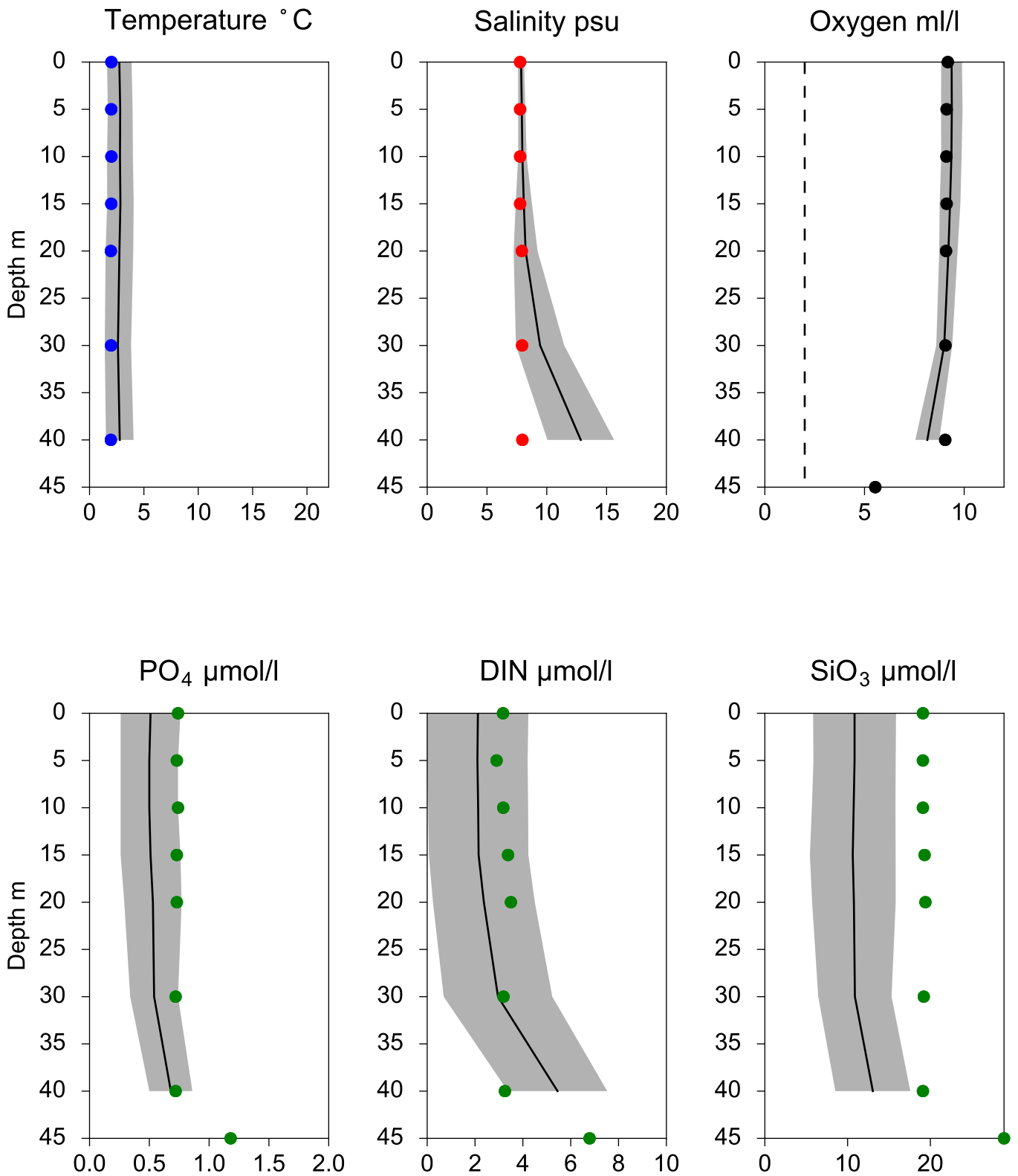


## OXYGEN IN BOTTOM WATER (depth >= 40 m)



# Vertical profiles BY2 ARKONA March

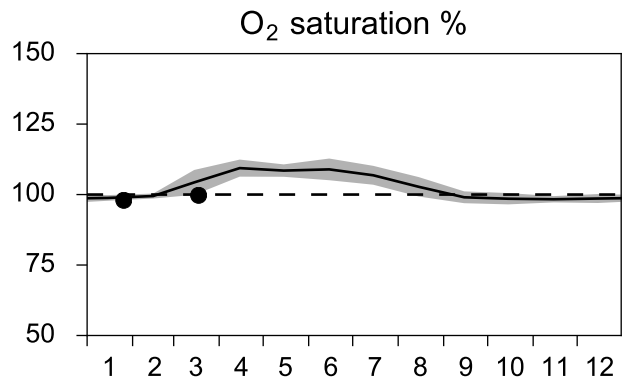
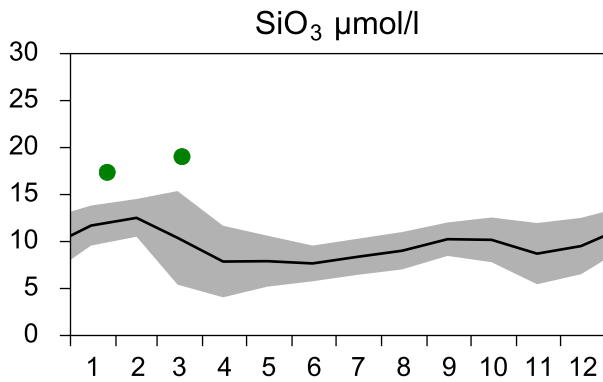
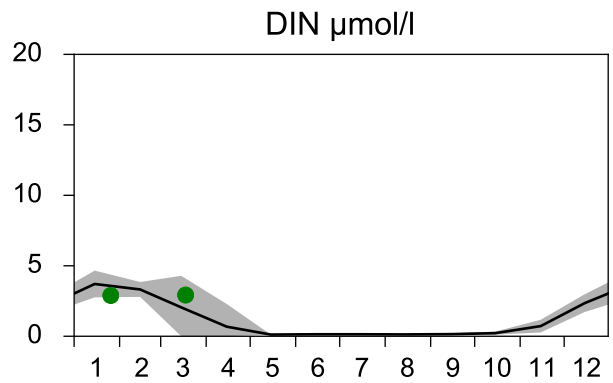
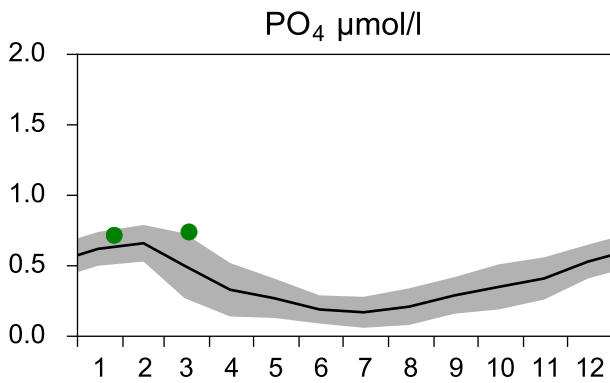
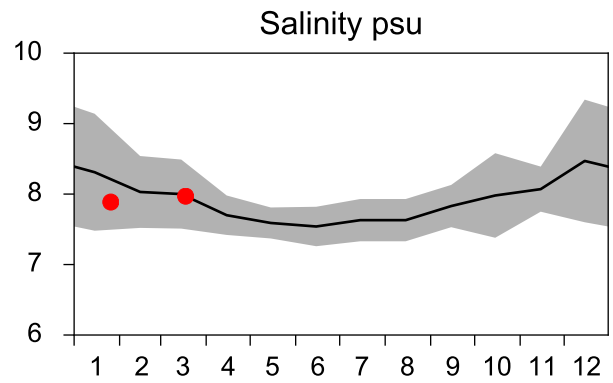
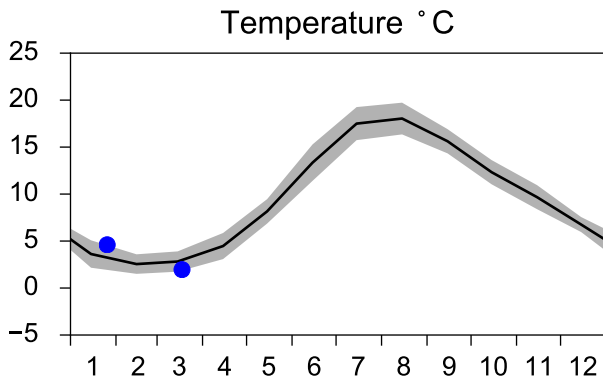
— Mean 2001-2015    ■ St.Dev.    ● 2018-03-18



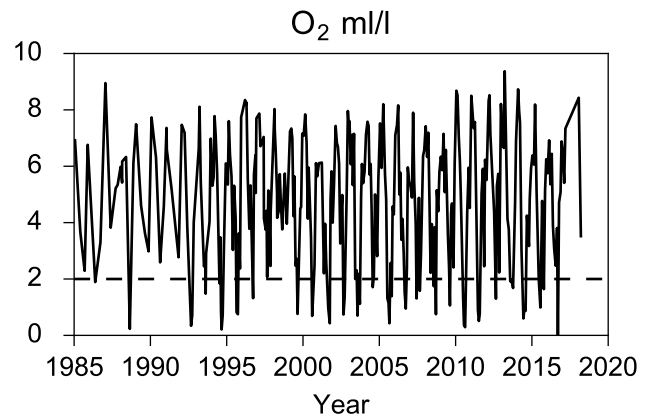
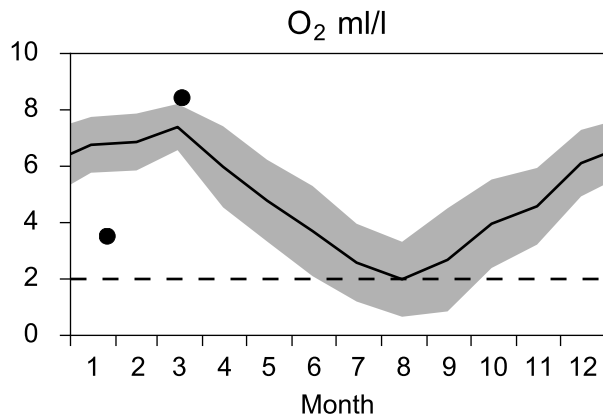
# STATION BY1 SURFACE WATER (0-10 m)

Annual Cycles

— Mean 2001-2015    ■ St.Dev.    ● 2018

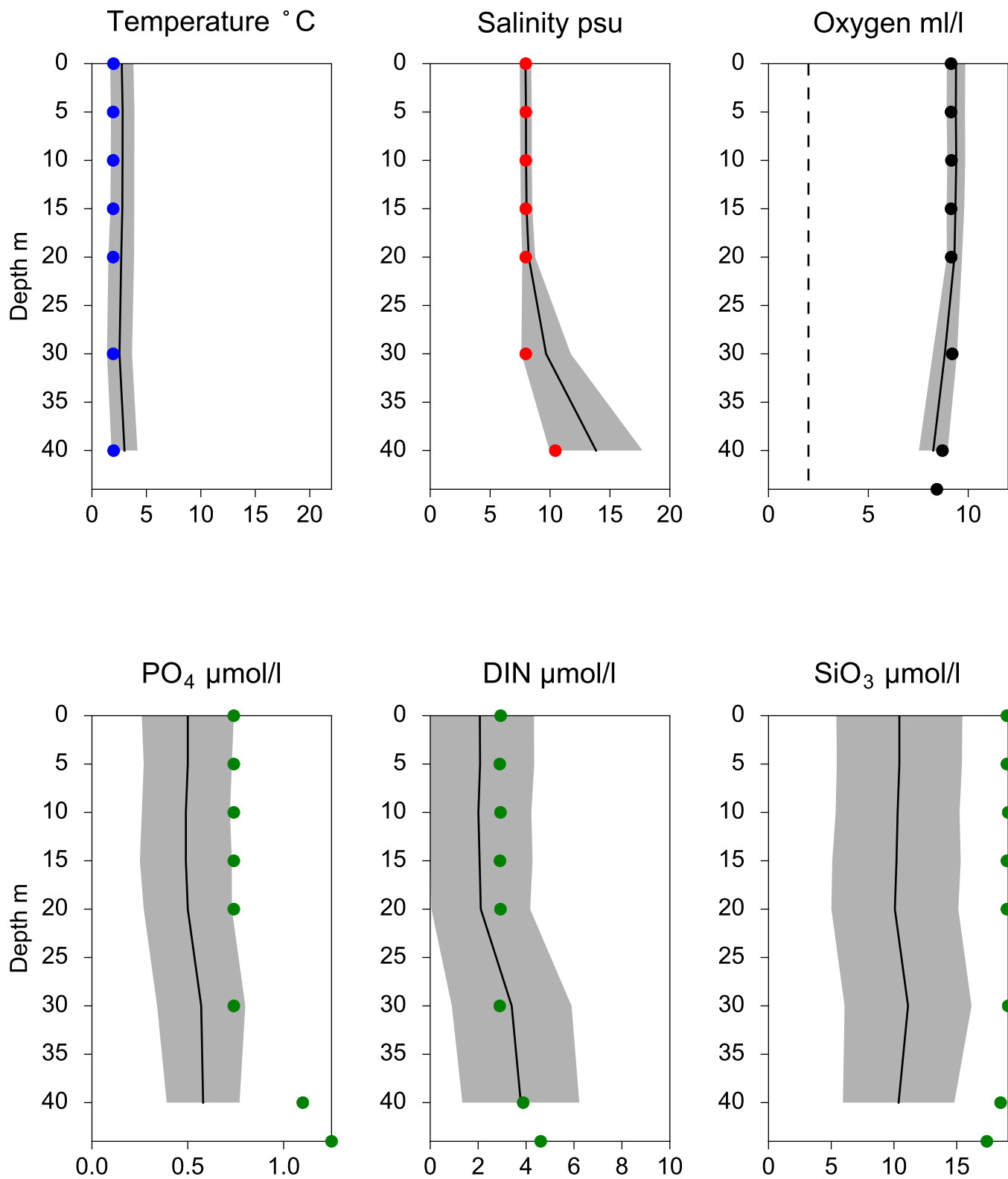


# OXYGEN IN BOTTOM WATER (depth >= 40 m)



# Vertical profiles BY1 March

— Mean 2001-2015    ■ St.Dev.    ● 2018-03-18



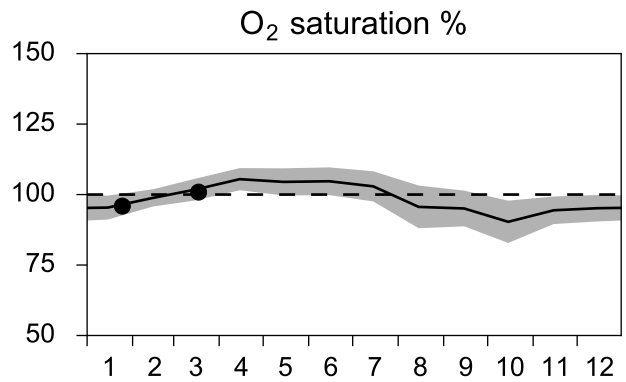
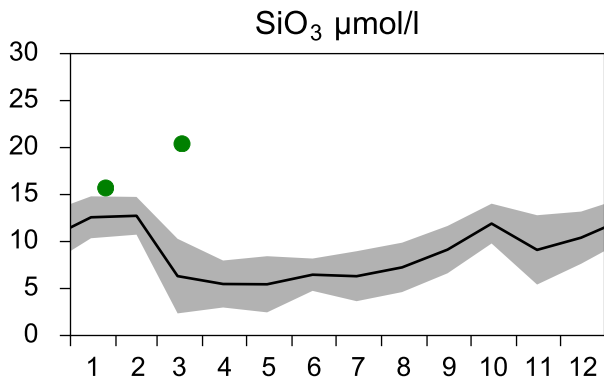
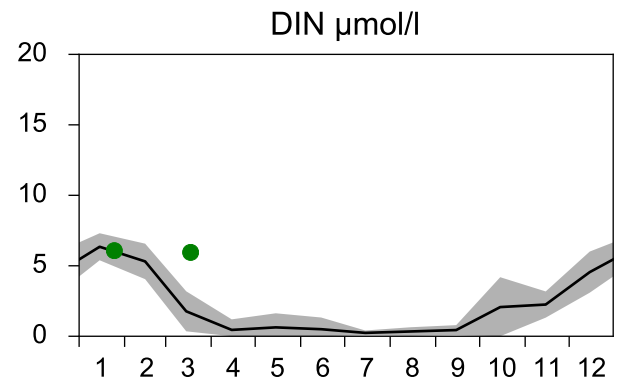
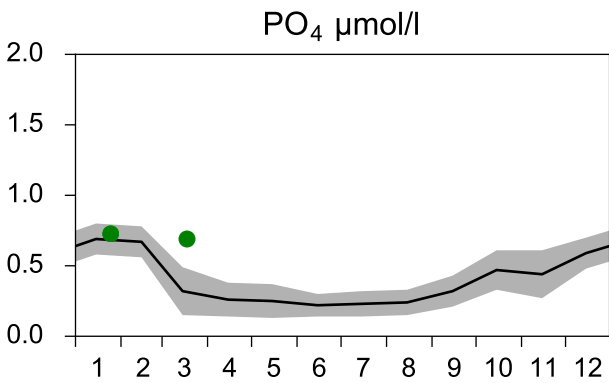
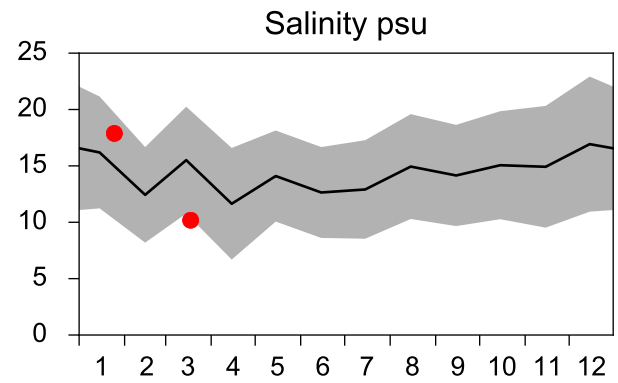
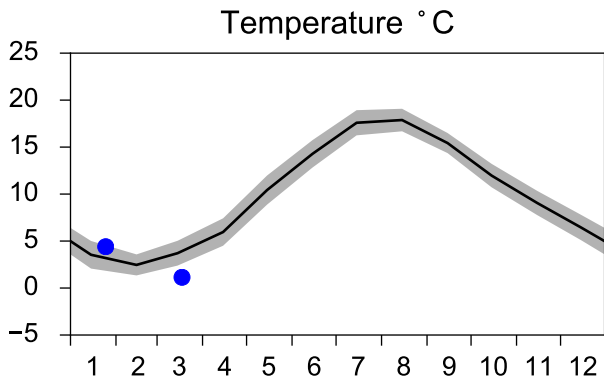
# STATION W LANDSKRONA SURFACE WATER (0-10 m)

Annual Cycles

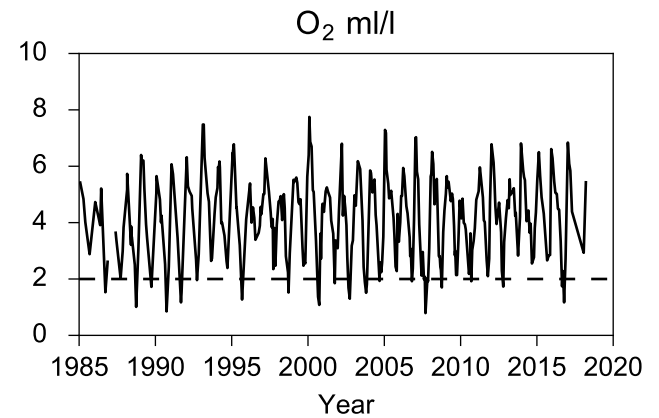
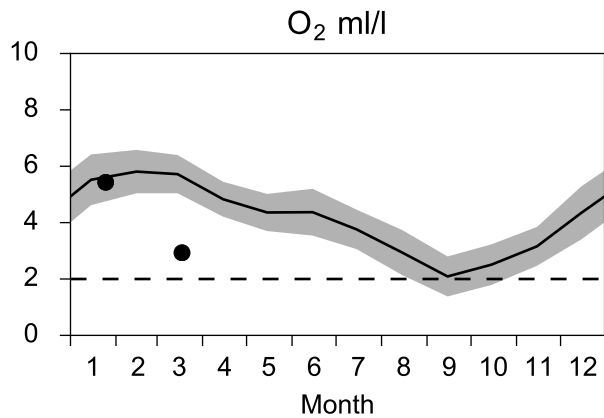
— Mean 2001-2015

■ St.Dev.

● 2018

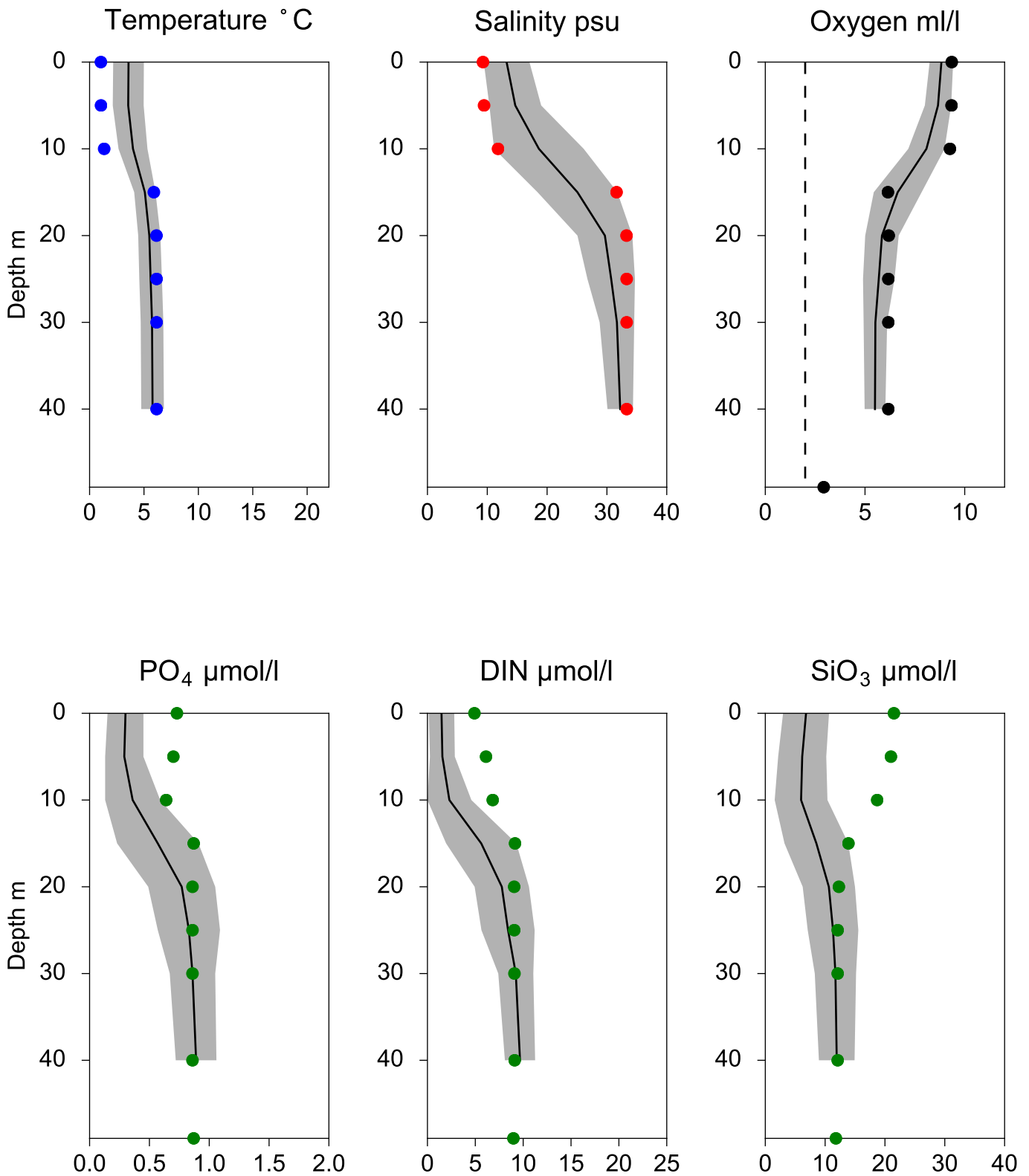


## OXYGEN IN BOTTOM WATER (depth >= 40 m)



# Vertical profiles W LANDSKRONA March

— Mean 2001-2015    ■ St.Dev.    ● 2018-03-18

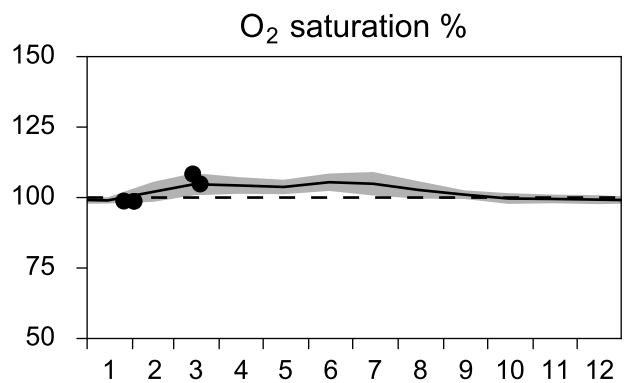
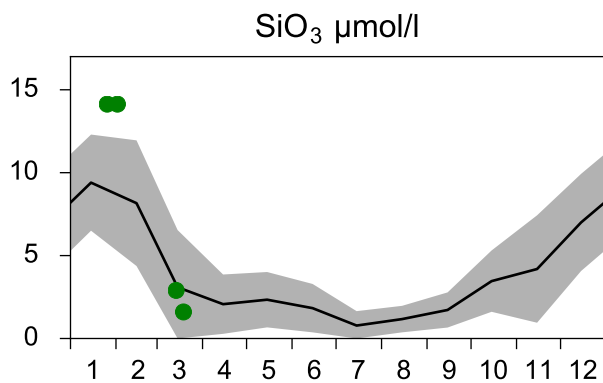
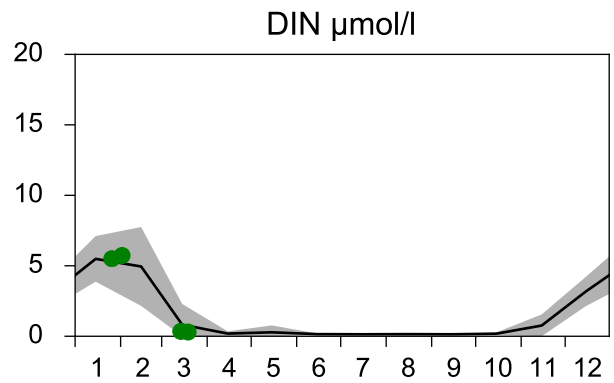
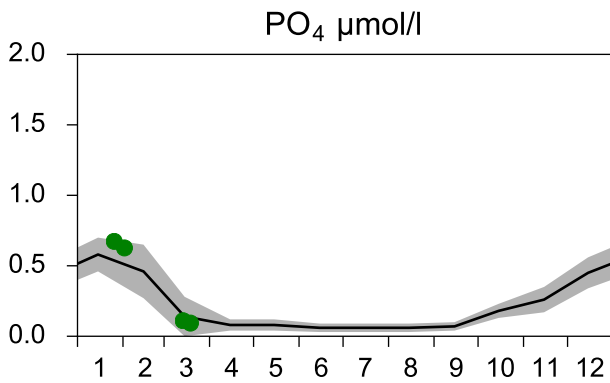
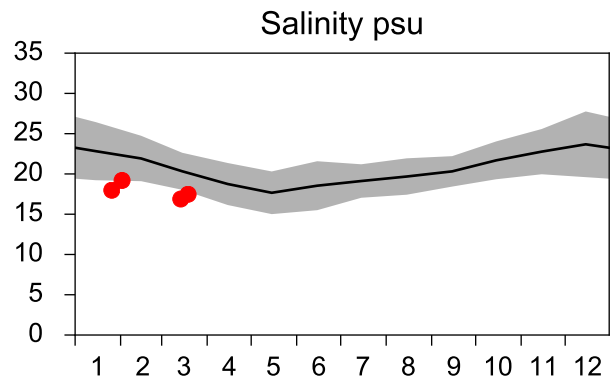
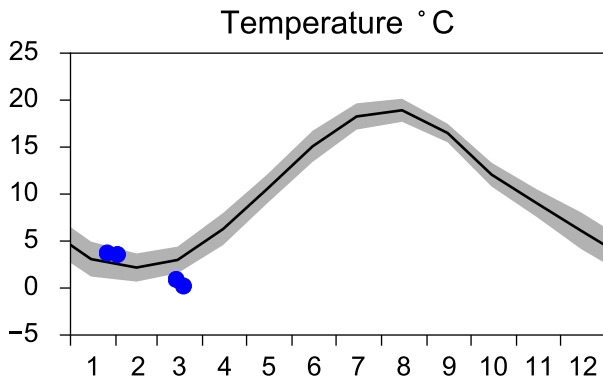




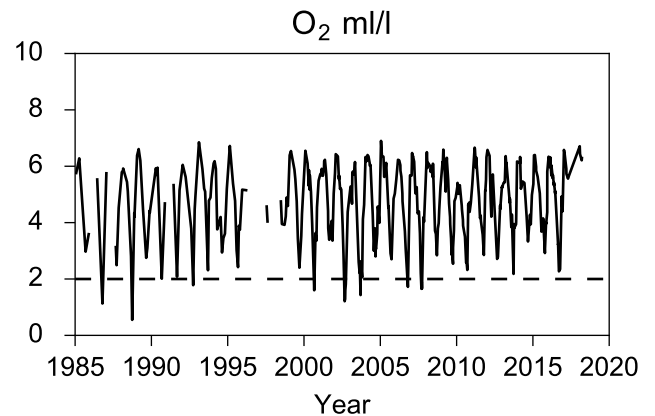
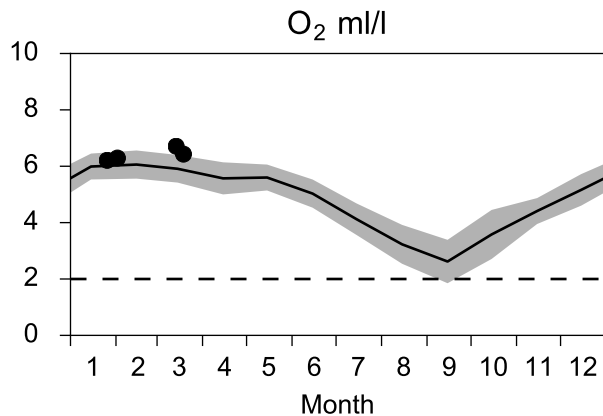
# STATION ANHOLT E SURFACE WATER (0-10 m)

## Annual Cycles

— Mean 2001-2015    St.Dev.    ● 2018

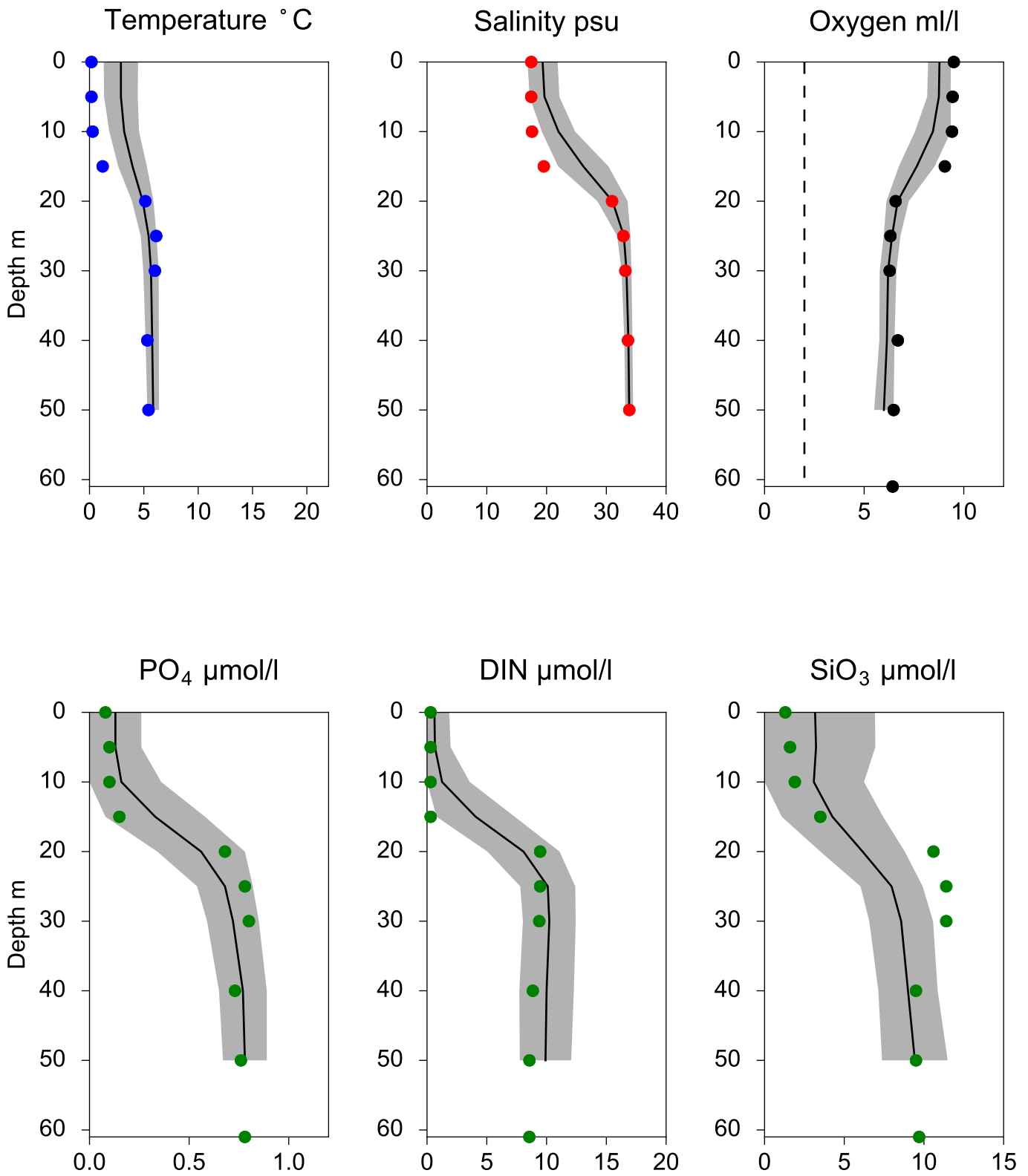


## OXYGEN IN BOTTOM WATER (depth >= 52 m)



# Vertical profiles ANHOLT E March

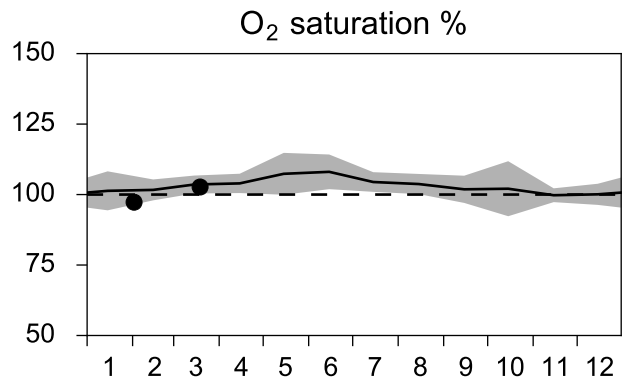
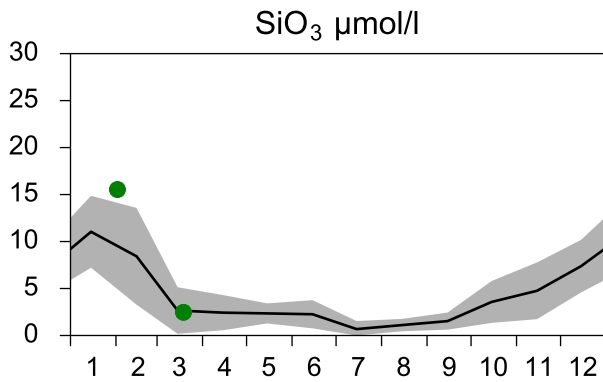
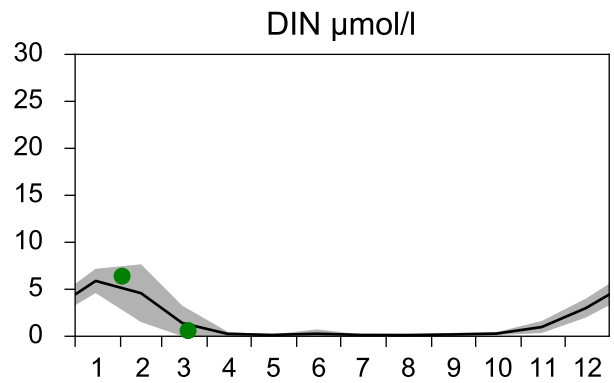
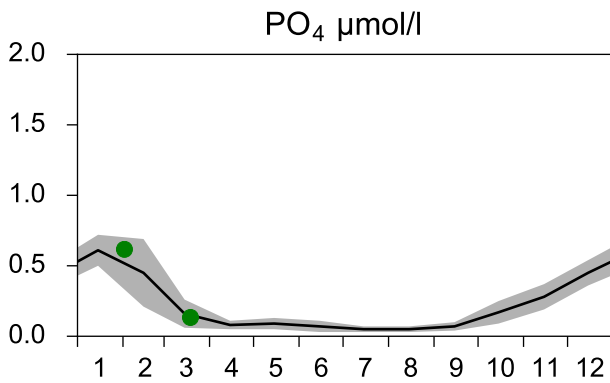
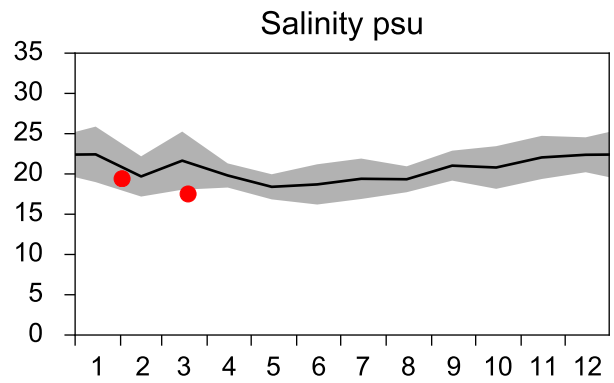
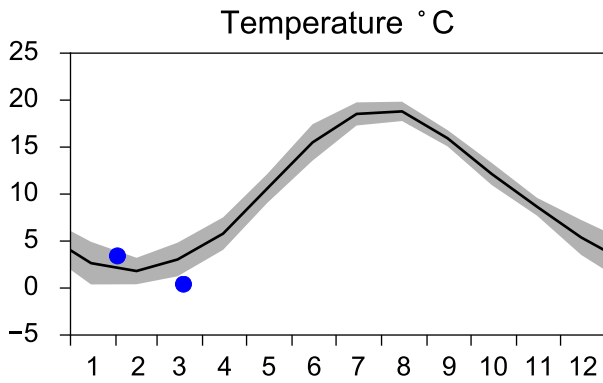
— Mean 2001-2015    ■ St.Dev.    ● 2018-03-19



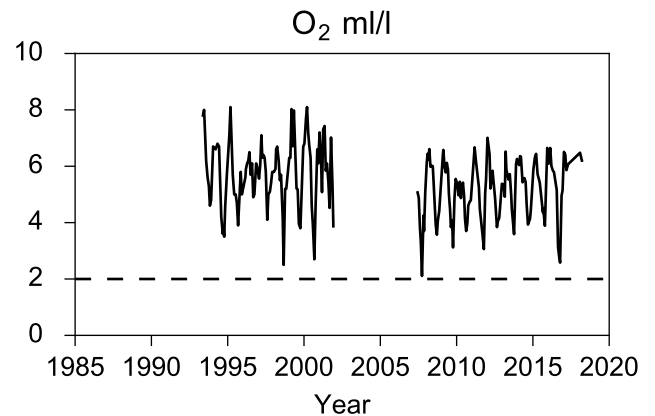
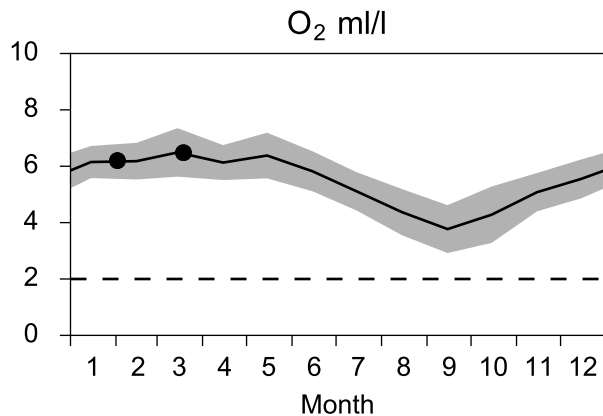
# STATION N14 FALKENBERG SURFACE WATER (0-10 m)

Annual Cycles

— Mean 2001-2015    ■ St.Dev.    ● 2018

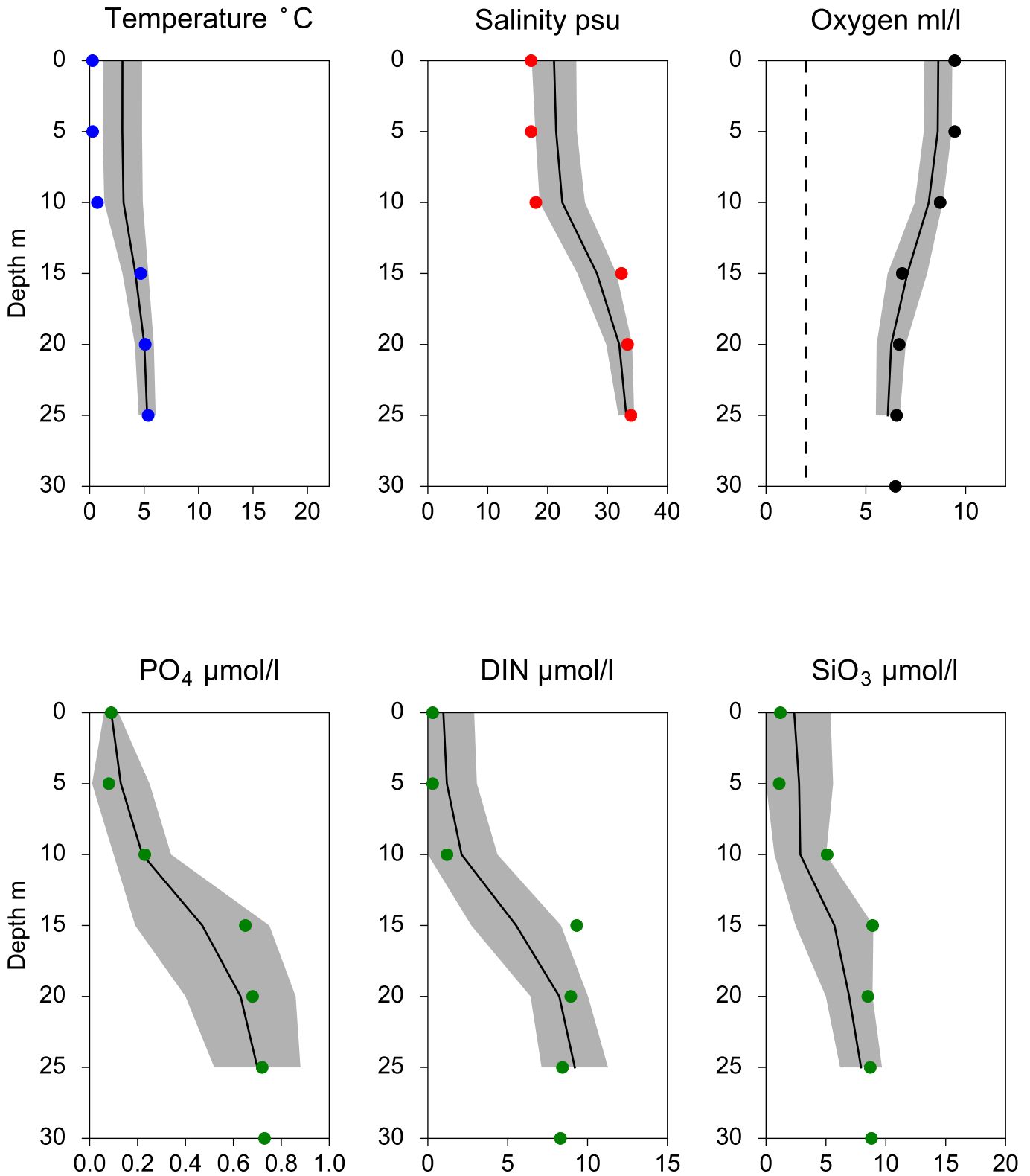


## OXYGEN IN BOTTOM WATER (depth >= 25 m)



# Vertical profiles N14 FALKENBERG March

— Mean 2001-2015    ■ St.Dev.    ● 2018-03-19



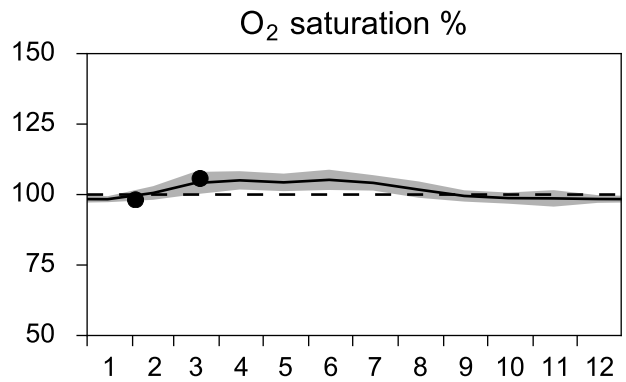
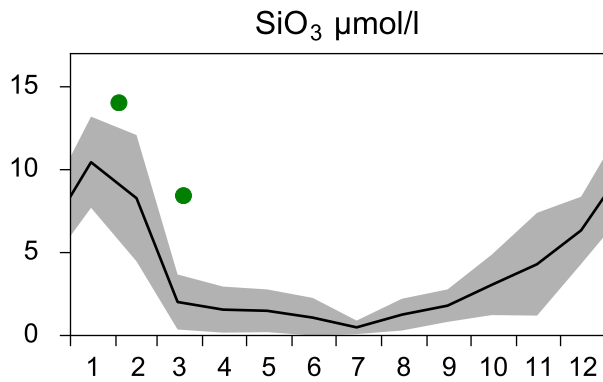
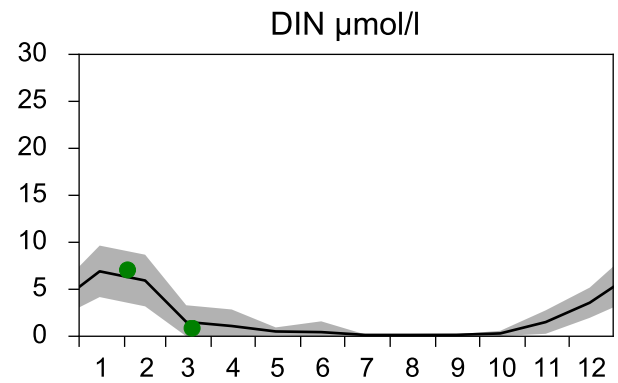
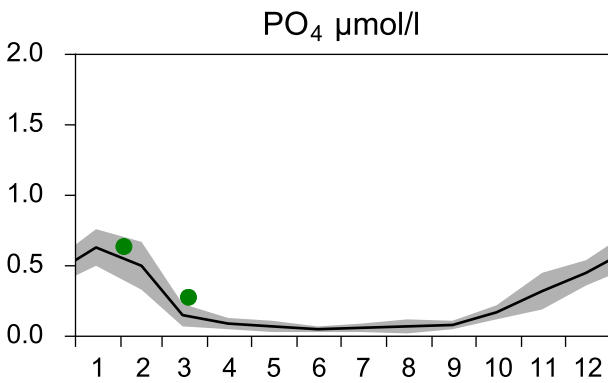
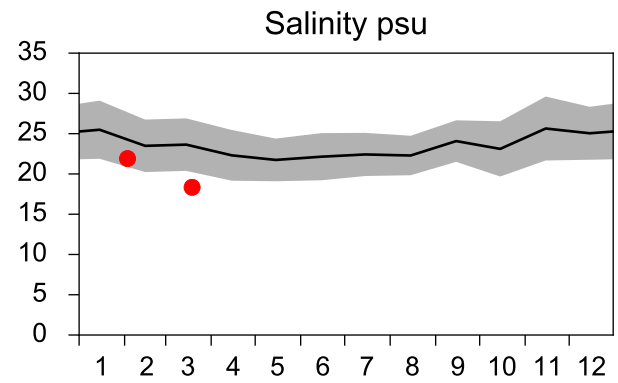
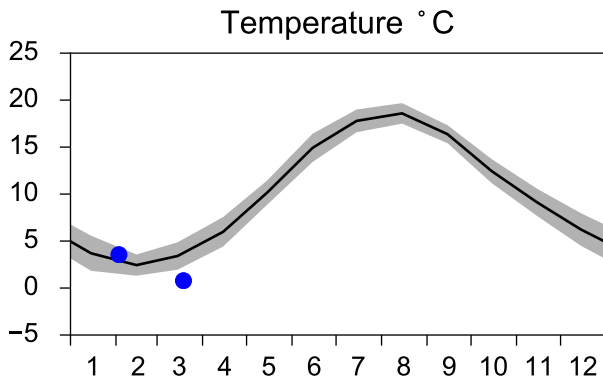
# STATION FLADEN SURFACE WATER (0-10 m)

Annual Cycles

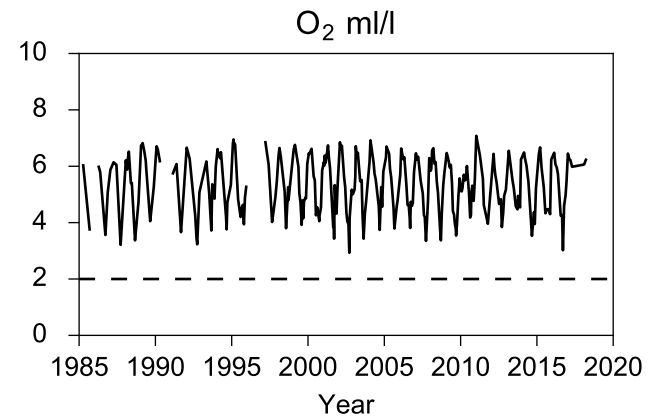
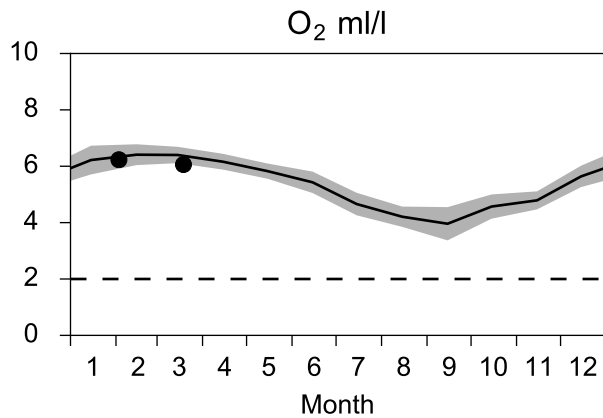
— Mean 2001-2015

■ St.Dev.

● 2018

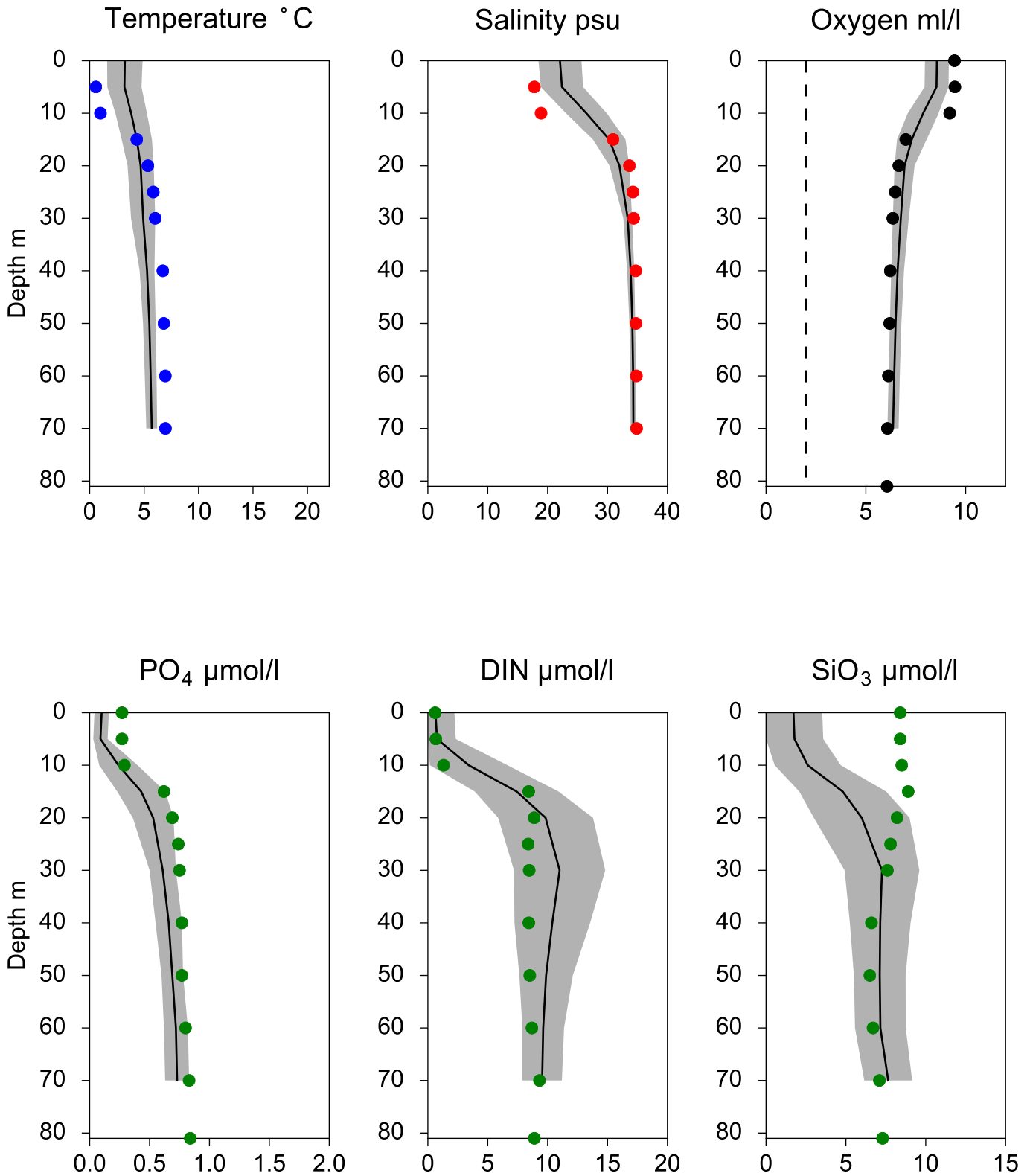


## OXYGEN IN BOTTOM WATER (depth >= 74 m)



# Vertical profiles FLADEN March

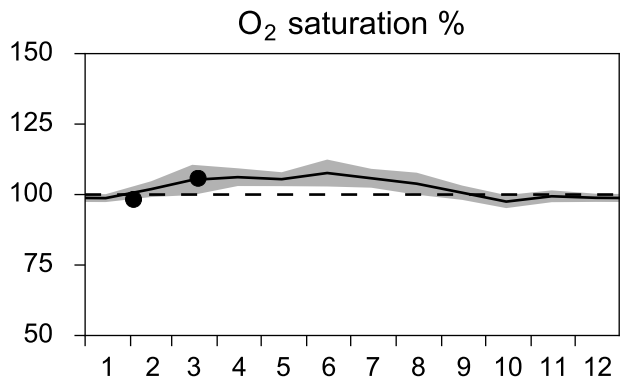
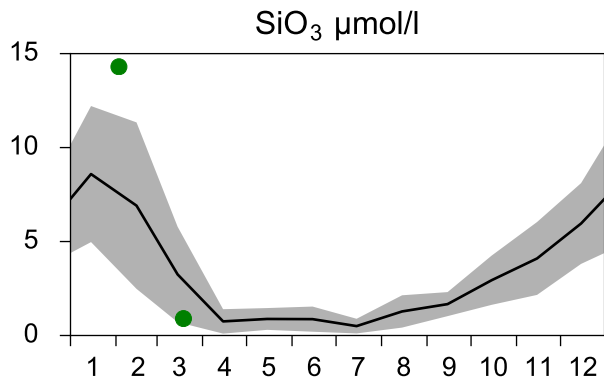
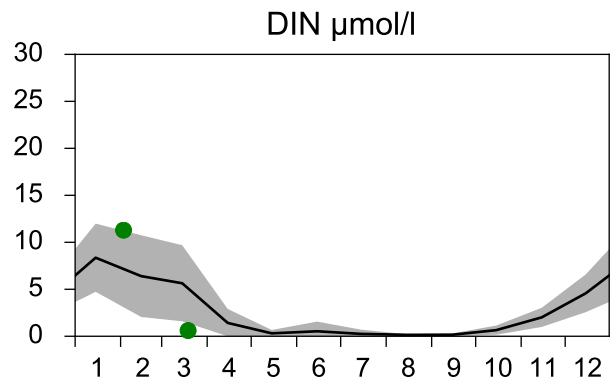
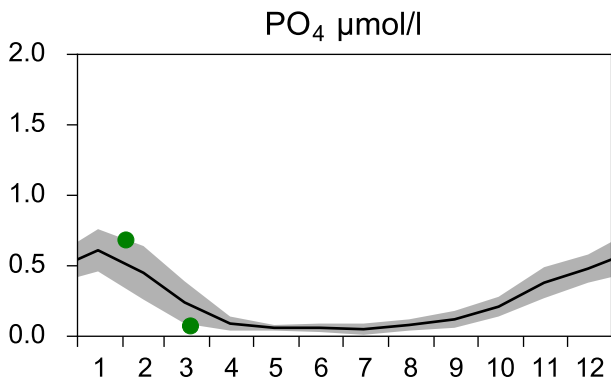
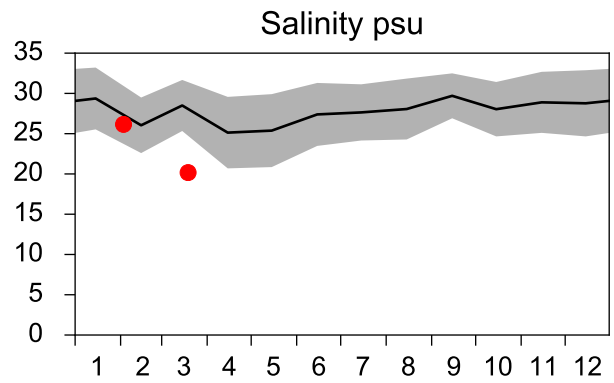
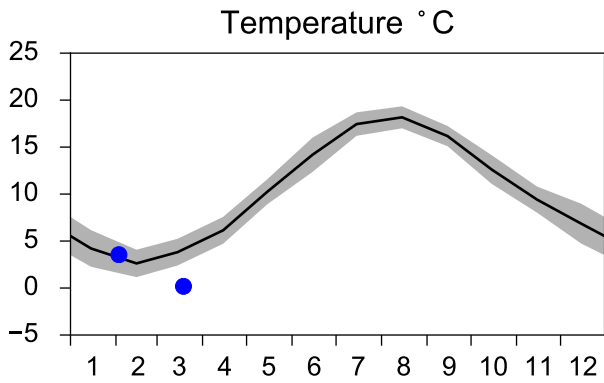
— Mean 2001-2015    St.Dev.    ● 2018-03-19



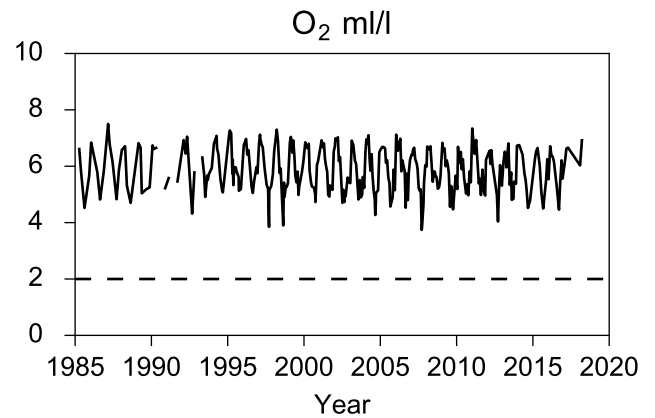
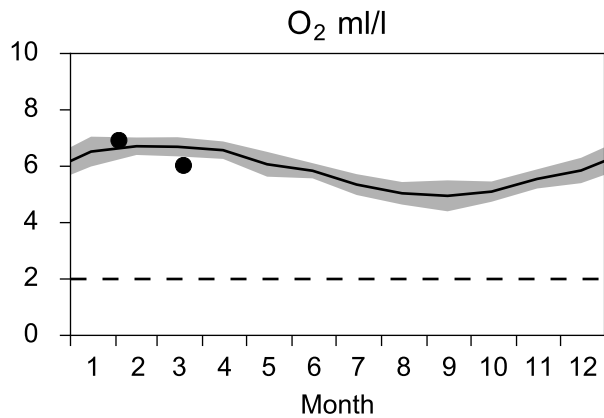
# STATION P2 SURFACE WATER (0-10 m)

Annual Cycles

— Mean 2001-2015    ■ St.Dev.    ● 2018

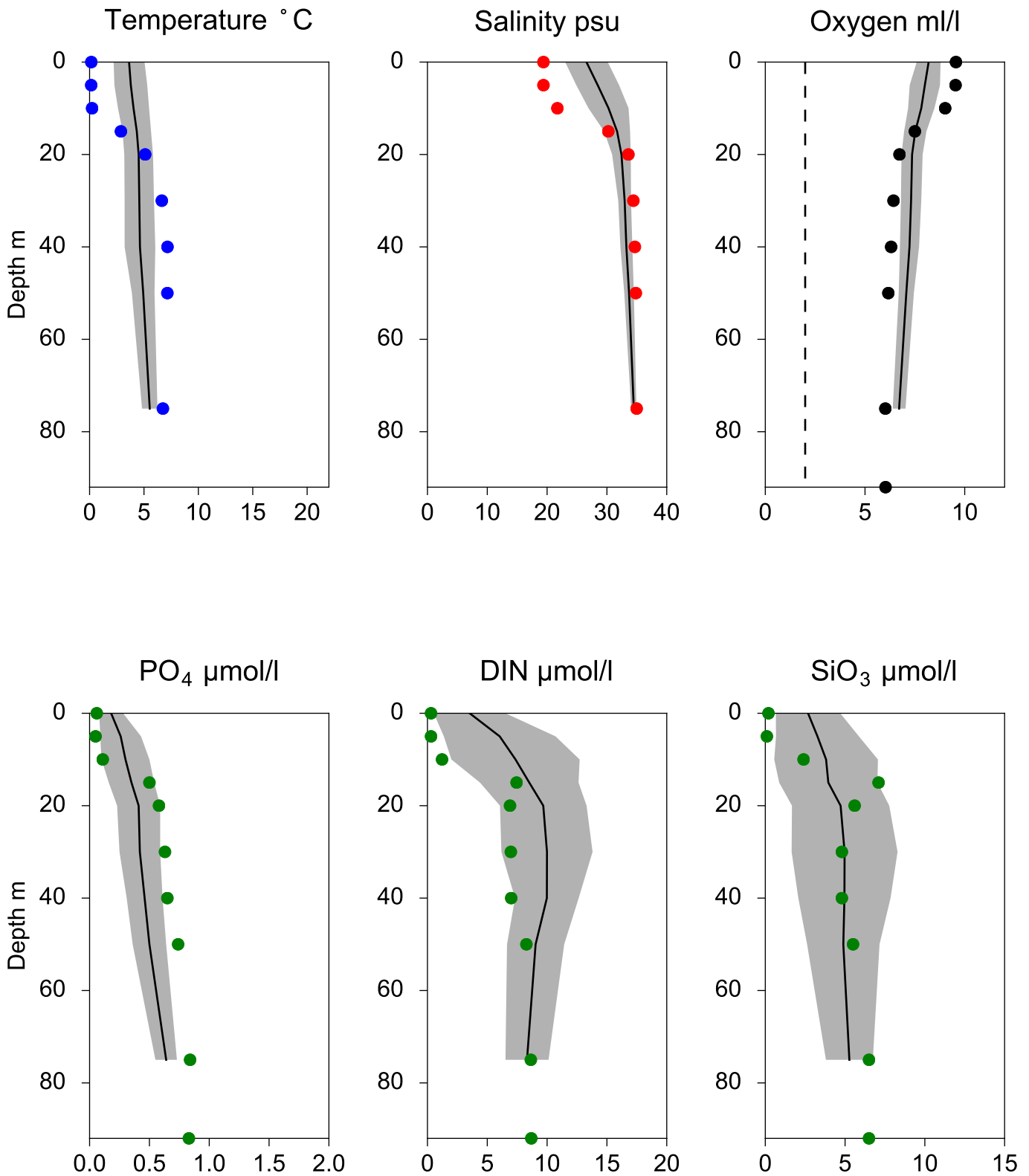


## OXYGEN IN BOTTOM WATER (depth >= 75 m)



# Vertical profiles P2 March

— Mean 2001-2015    ■ St.Dev.    ● 2018-03-19

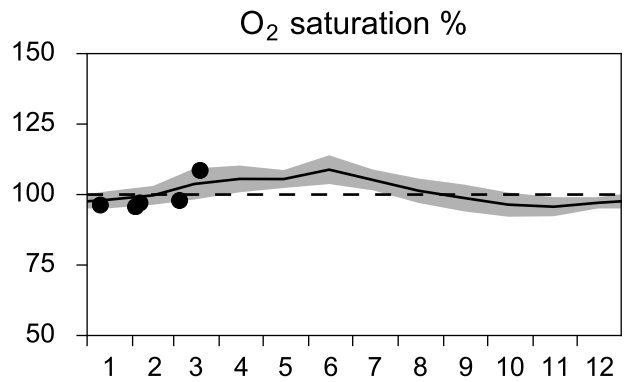
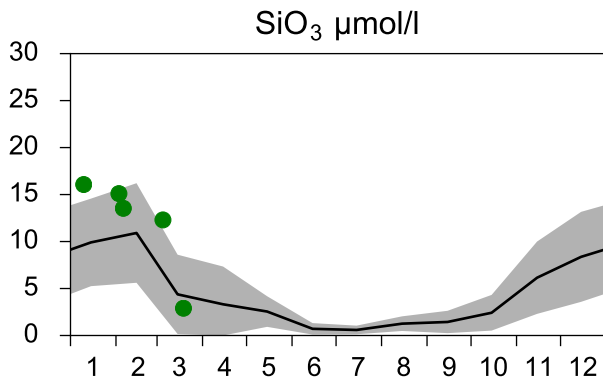
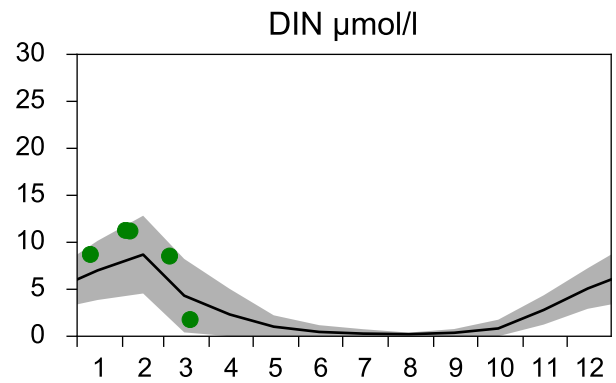
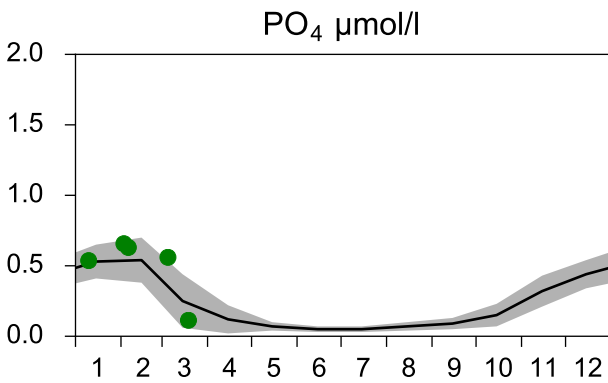
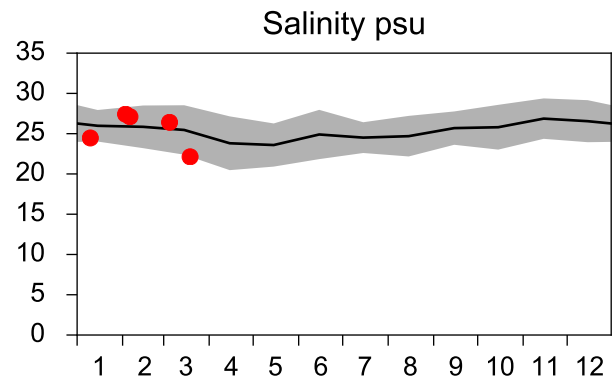
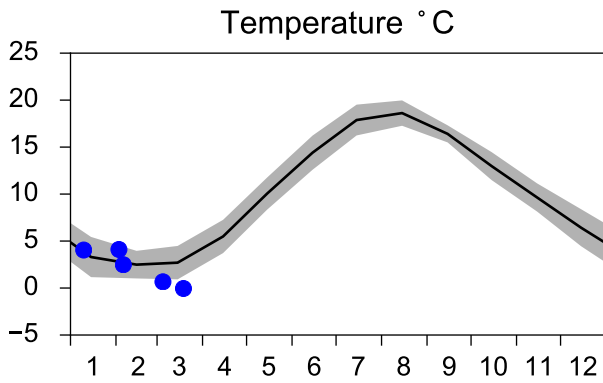




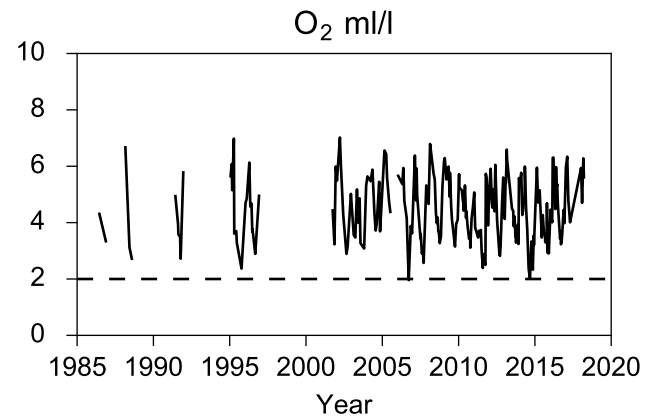
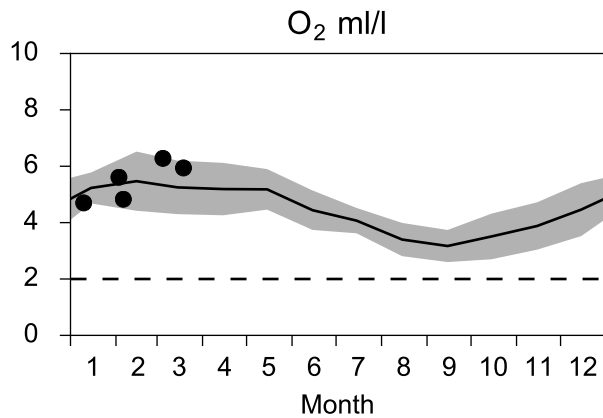
# STATION SLÄGGÖ SURFACE WATER (0-10 m)

## Annual Cycles

— Mean 2001-2015    ■ St.Dev.    ● 2018

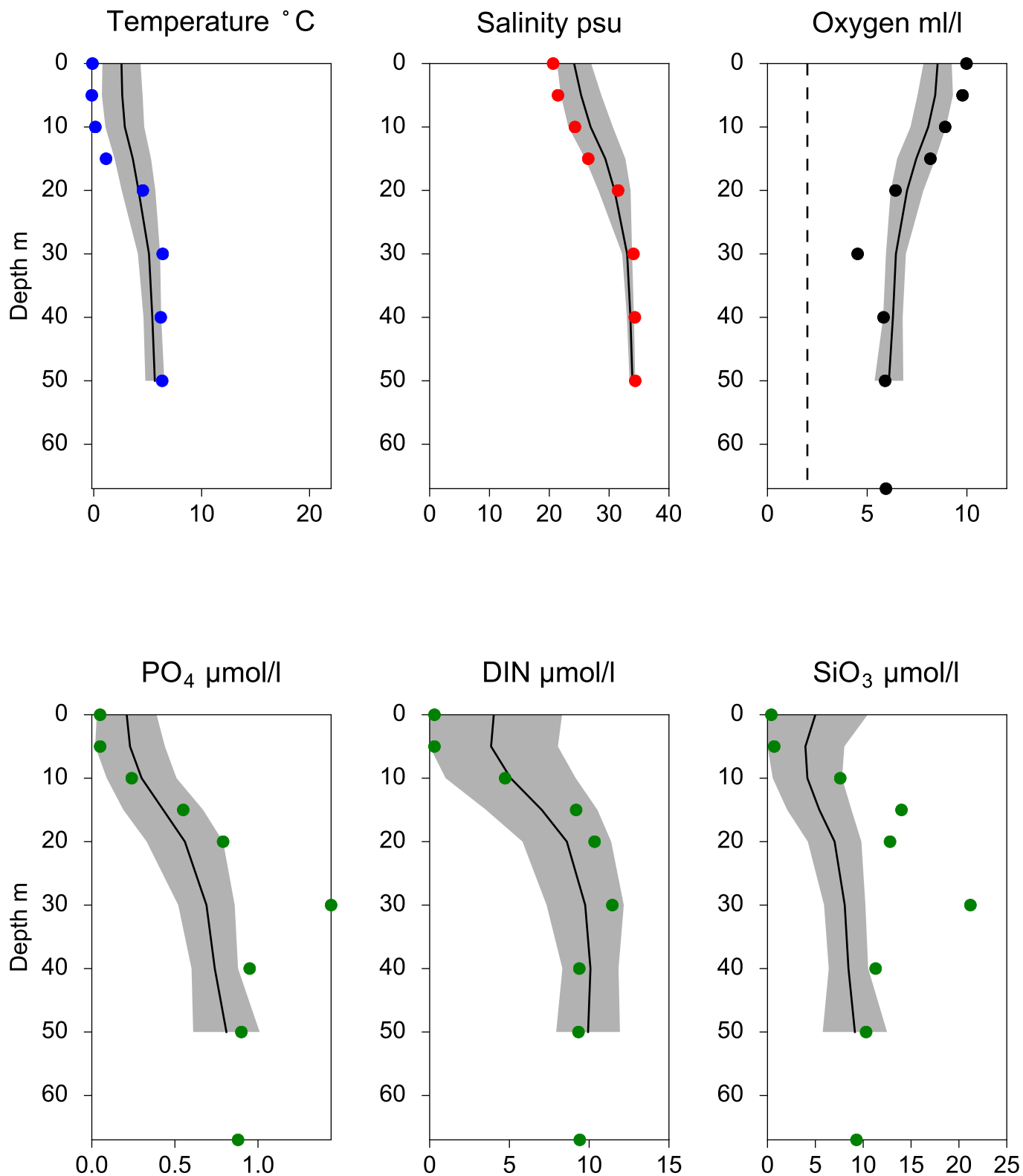


## OXYGEN IN BOTTOM WATER (depth >= 64 m)



# Vertical profiles SLÄGGÖ March

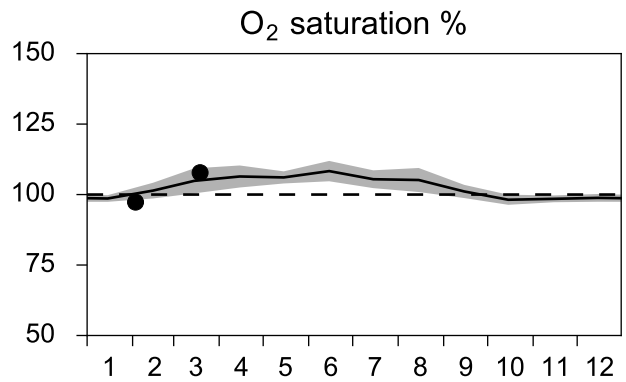
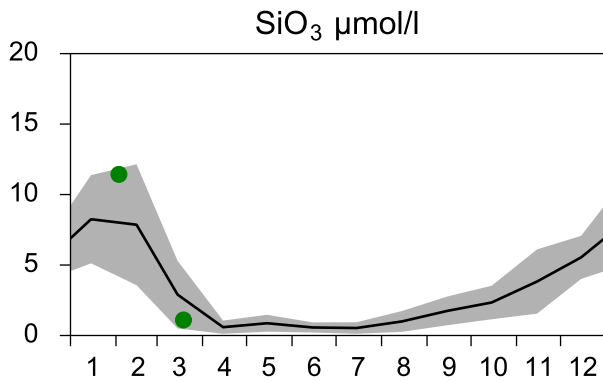
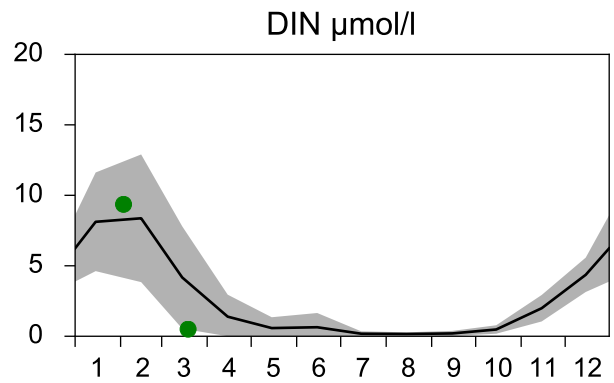
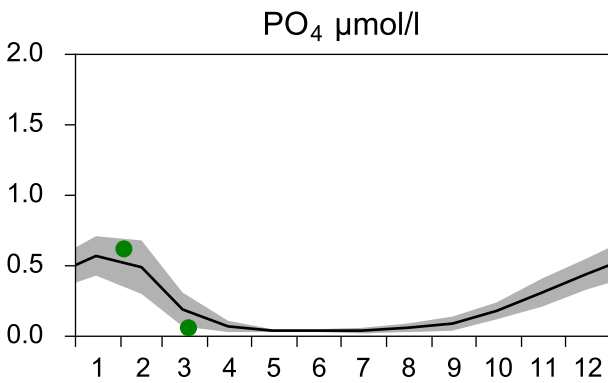
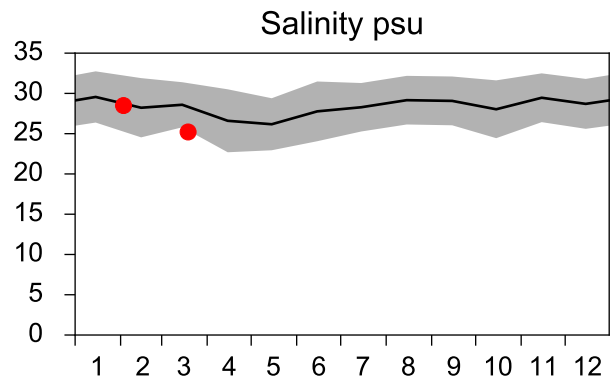
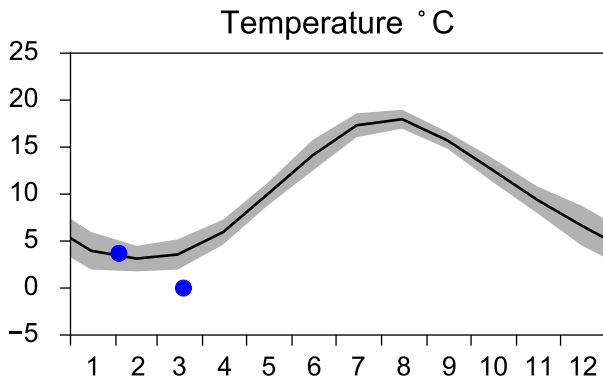
— Mean 2001-2015    ■ St.Dev.    ● 2018-03-19



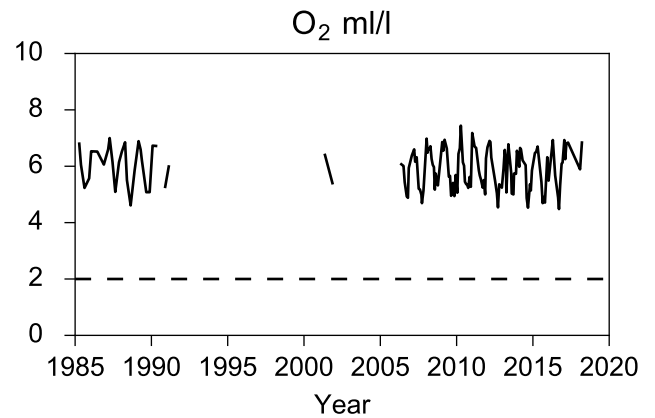
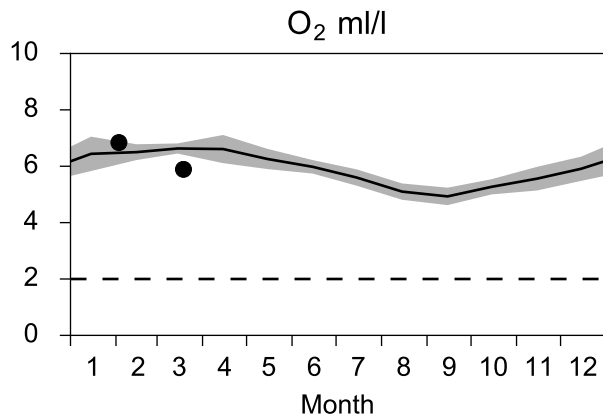
# STATION Å13 SURFACE WATER (0-10 m)

Annual Cycles

— Mean 2001-2015    ■ St.Dev.    ● 2018

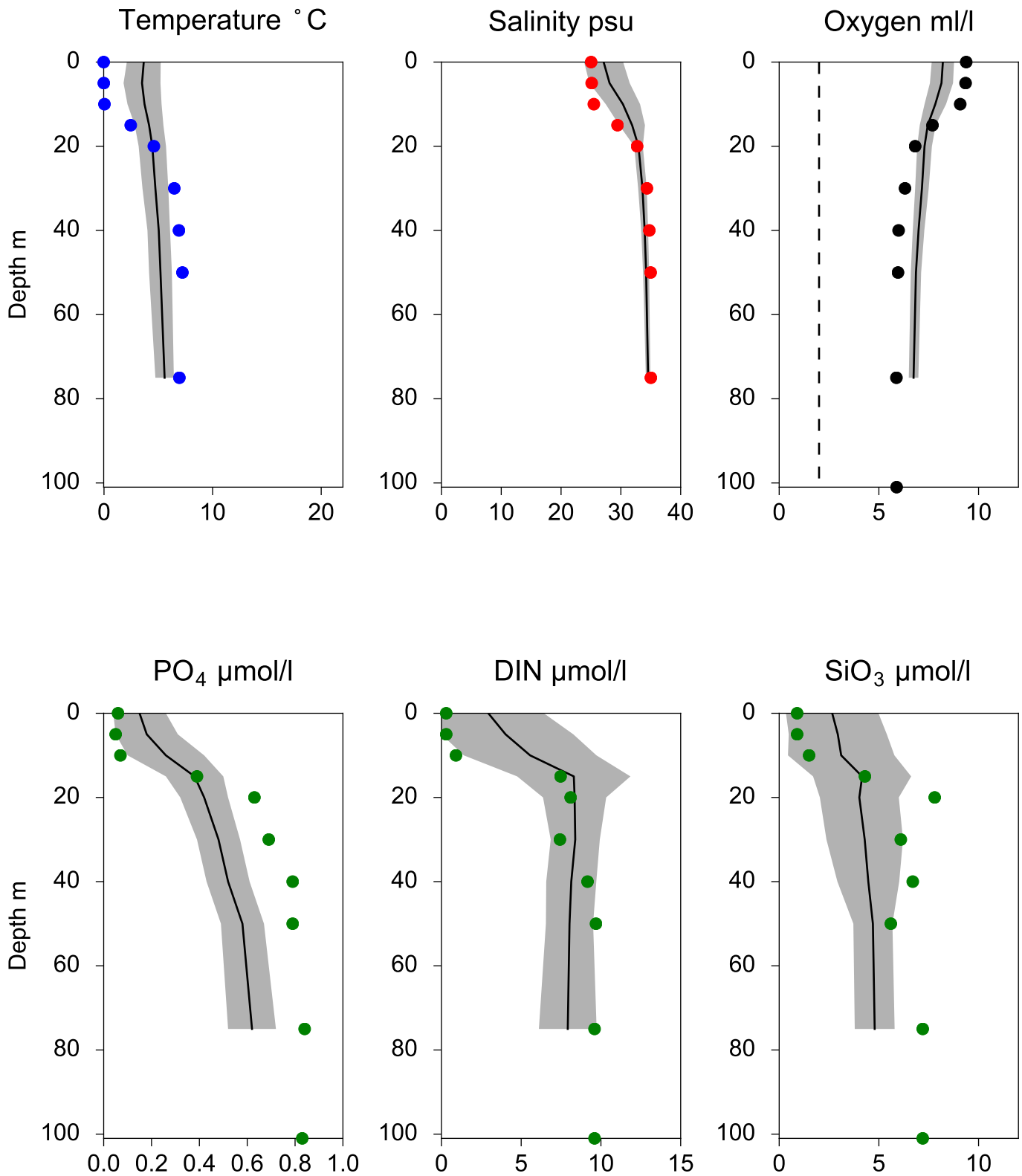


## OXYGEN IN BOTTOM WATER (depth >= 80 m)



# Vertical profiles Å13 March

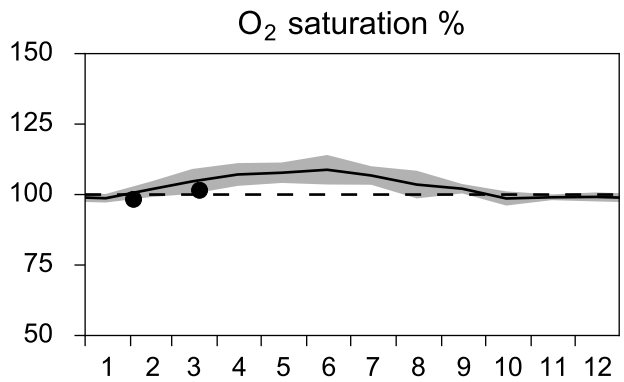
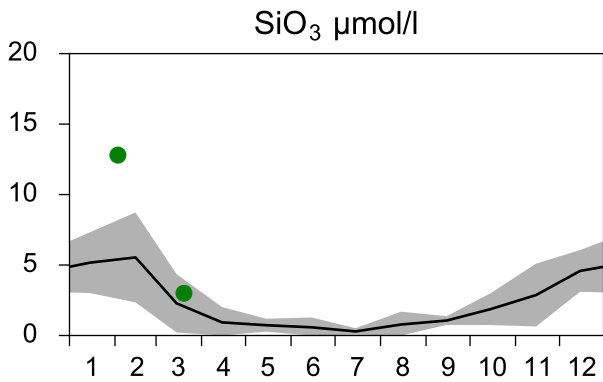
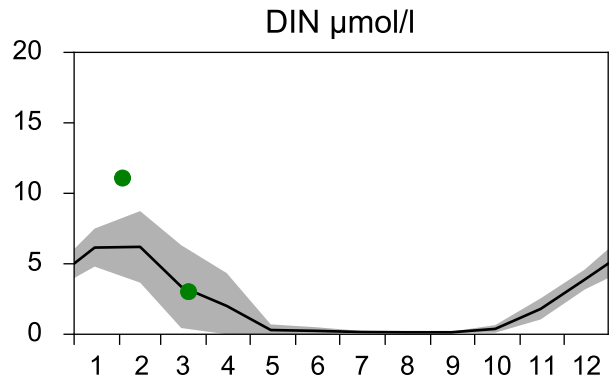
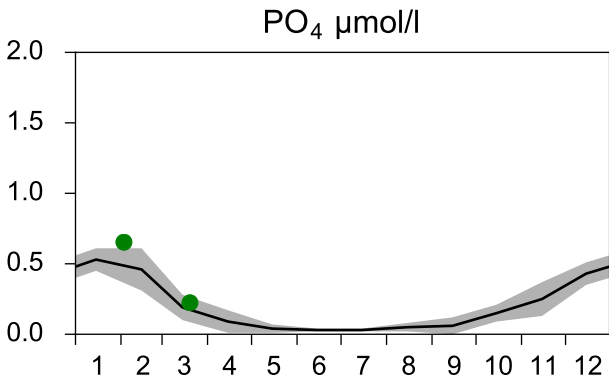
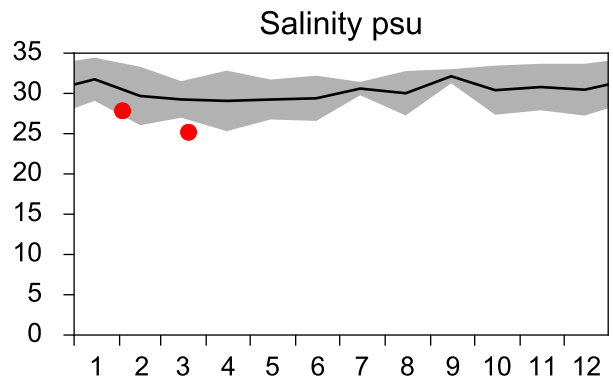
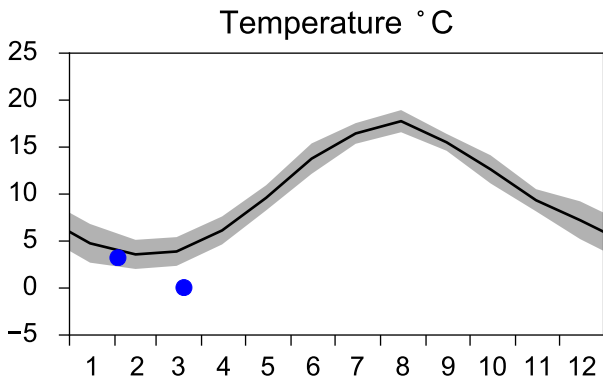
— Mean 2001-2015    ■ St.Dev.    ● 2018-03-19



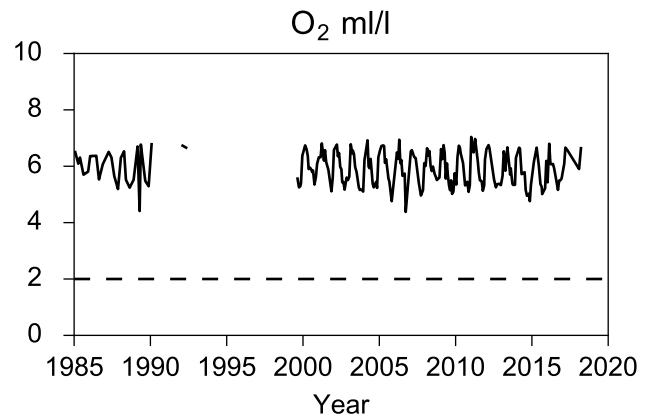
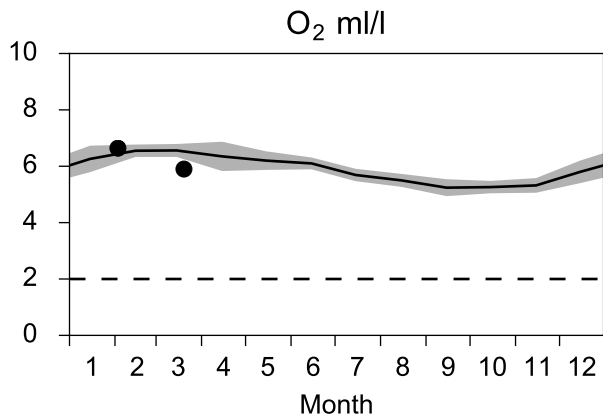
# STATION Å15 SURFACE WATER (0-10 m)

Annual Cycles

— Mean 2001-2015    St.Dev.    ● 2018

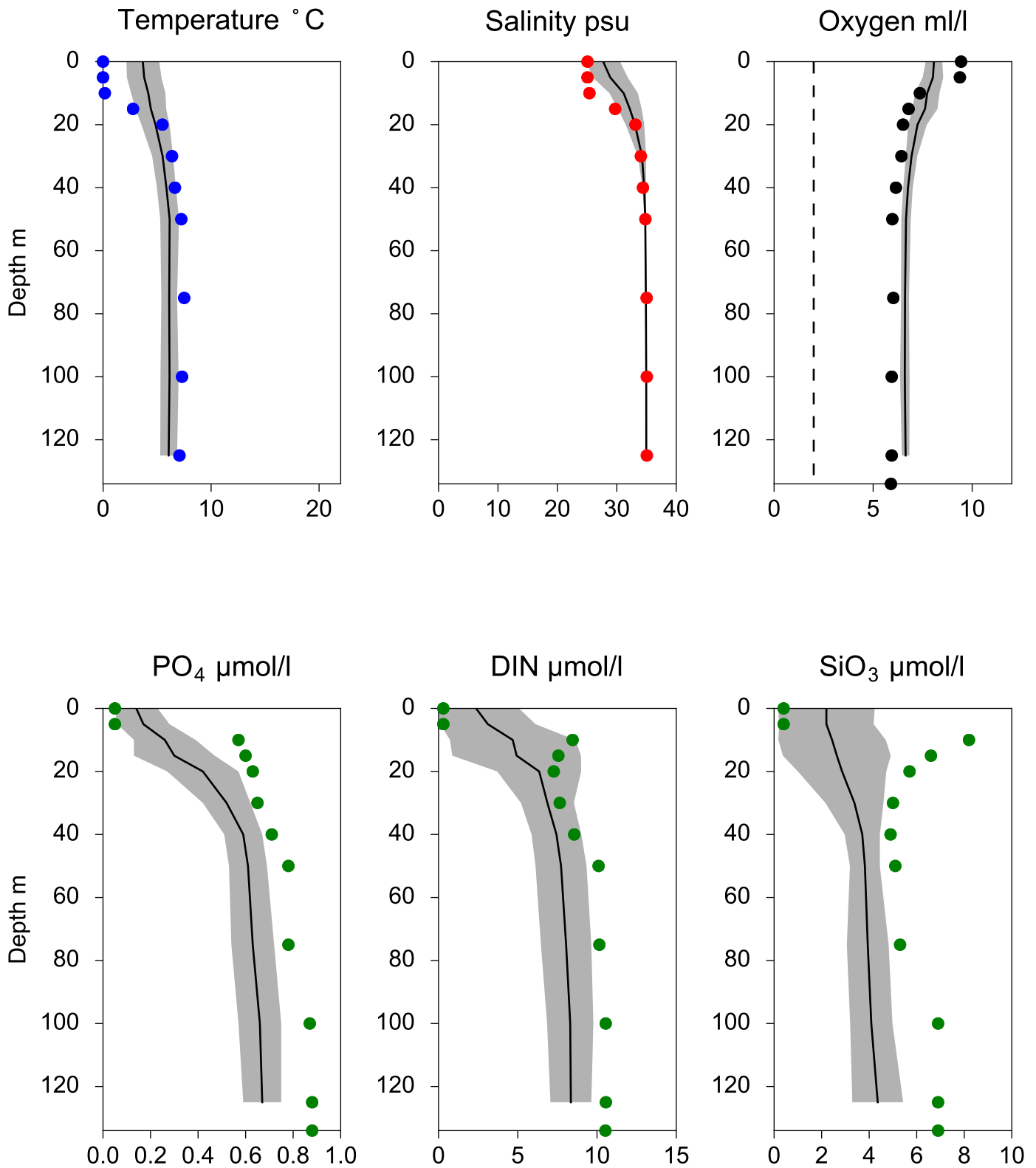


## OXYGEN IN BOTTOM WATER (depth >= 125 m)



# Vertical profiles Å15 March

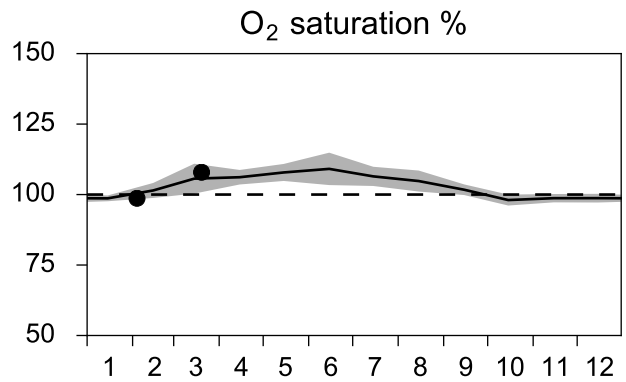
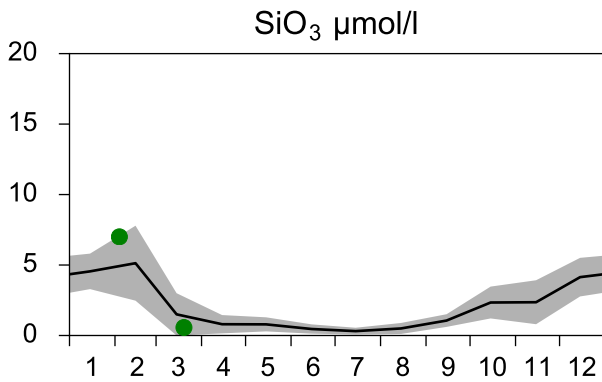
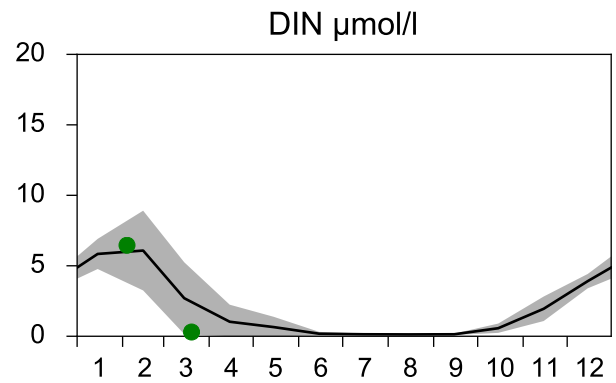
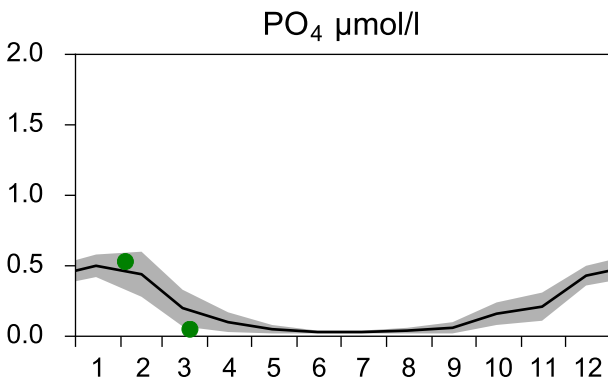
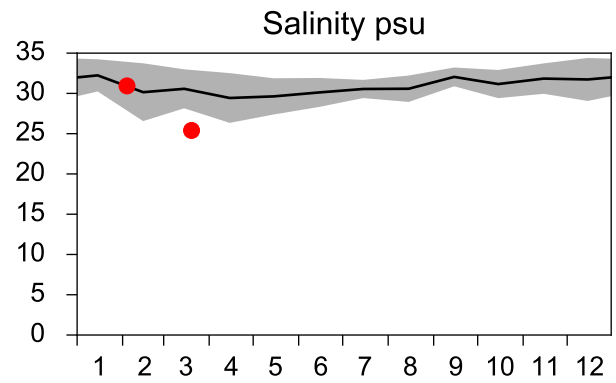
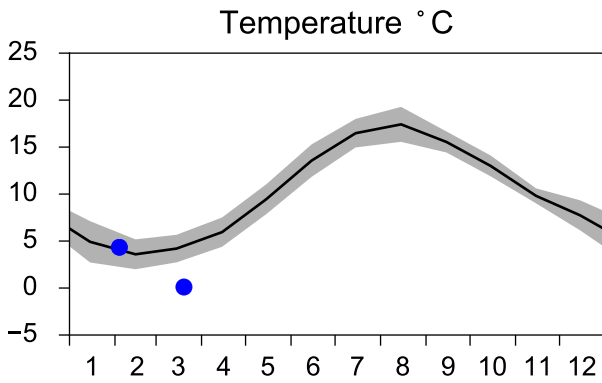
— Mean 2001-2015    ■ St.Dev.    ● 2018-03-20



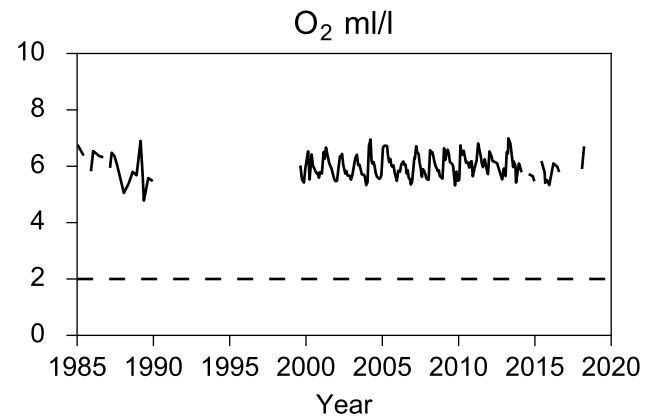
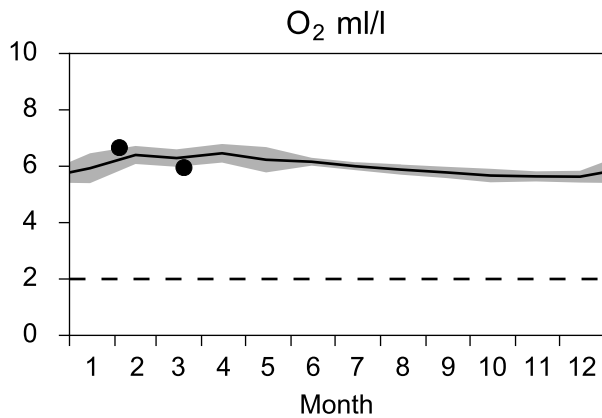
# STATION Å17 SURFACE WATER (0-10 m)

Annual Cycles

— Mean 2001-2015    ■ St.Dev.    ● 2018



## OXYGEN IN BOTTOM WATER (depth >= 300 m)



# Vertical profiles Å17 March

— Mean 2001-2015    ■ St.Dev.    ● 2018-03-20

