

## Report from the SMHI monitoring cruise with R/V Aranda



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**Survey period:** 2015-02-14 - 2015-02-22  
**Survey area:** Kattegat, the Sound and the Baltic Proper  
**Principal:** SMHI and the Swedish Agency for Marine and Water Management

### SUMMARY

The expedition was part of the Swedish regular marine monitoring programme and covered Kattegat, the Sound and the Baltic Proper. Mapping of winter nutrients were performed in the Baltic Proper.

Data presented in this report have been subject to preliminary quality control procedures only.

The water temperature in the surface layer was normal in the Skagerrak and Kattegat while it was slightly above normal in the Baltic Proper. Surface nutrients showed for the season almost normal values, except for silicate and phosphate which, in parts of the Baltic, were elevated.

The effects of the inflow during December 2014 were clearly visible during the expedition. The Bornholm Basin was now filled up to the sill depth with water having a salinity of about 18 psu and an oxygen content of 5.5 ml/l. In The Stolpe Furrow water with a salinity of 16 psu and an oxygen content of 4 ml/l was recorded at depths exceeding 60 meters. At the station BCSIII-10 in southeast a salinity of 12 psu, and an oxygen concentration of 2.8 ml/l was found at depths exceeding 82 m.

The next cruise is planned to start March 16, 2015.

## PRELIMINARY RESULTS

The cruise, performed on board the Finnish research vessel Aranda, began in Helsinki on February 14 and ended in the same port on the 22<sup>nd</sup>. The winds during the expedition were essentially fresh to hard, at the beginning of the expedition northeasterly then the wind turned over to southwest. Air temperature varied between 0 and 5°C.

Due to problems, with the nutrient analyzer, data of phosphate, nitrate and silicate from the Western Gotland Basin are missing.

### The Skagerrak

Surface water temperature was again normal for the season, after being elevated at the end of last year, and ranged between 3.2 and 4.2 °C. The salinity in the surface layer varied between 28.7 and 32.4 psu, which is normal. Thermocline and halocline were located at about 30 meters depth.

Nutrient levels in surface waters, down to the thermocline, were clearly below normal near the coast, while they showed normal levels further west. Phosphate concentrations in the surface water varied between 0.3 and 0.5 µmol/l, nitrite + nitrate were in the range 5.1 - 7.1 µmol/l, while the concentrations of silicate ranged from 1.5 to 5.4 µmol/l.

Fluorescence measurements along with nutrient concentrations showed that the spring bloom was in full progress in the coastal zone, and that it was starting out in the central parts.

### The Kattegat and the Sound

The temperature of the surface water was around 2.5°C, normal for the season. Also surface salinity was normal, in the Kattegat it varied between 22.5 and 25.5 psu, while in the Sound it was measured to 9.7 psu. In the northern Kattegat halocline and thermocline were located at 20 meters depth, both relatively sharp developed, while stratification in the southern regions was significantly weaker and found at depths between 20 and 30 meters. A very sharp halocline was recorded in the Sound at a depth of 15 meters.

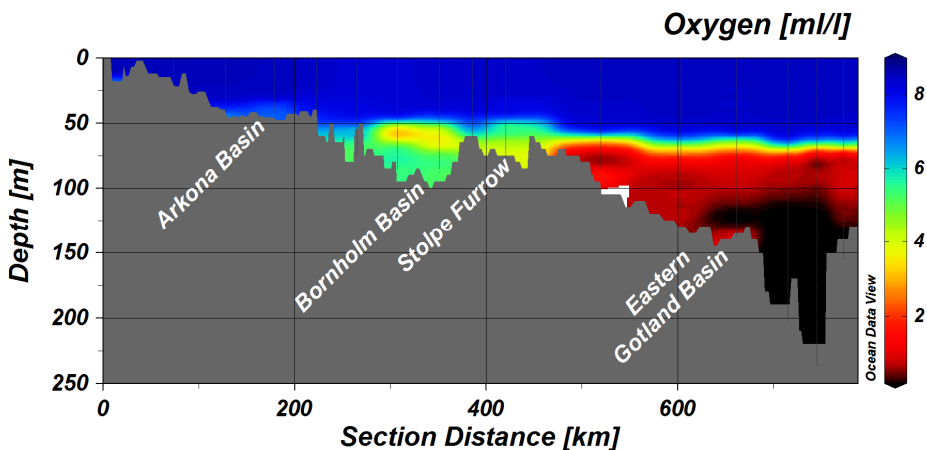
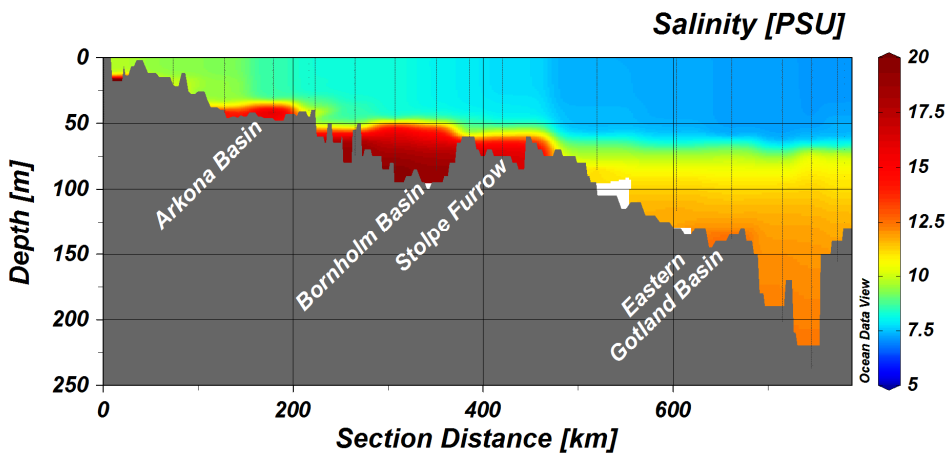
Nutrient concentrations had begun to fall from winter levels and the spring bloom was in full progress, which also was indicated by high fluorescence values. Phosphate concentrations were around 0.4 µmol/l, inorganic nitrogen in the range 6.0 - 6.5 µmol/l, while silicate levels varied between 5.6 and 6.2 µmol/l. At the station Anholt E, which was visited twice, inorganic nitrogen decreased from 6 to 4.8 µmol/l and silicate from 6.7 to 3.8 µmol/l in 30 hours.

The lowest oxygen concentrations in the bottom water were measured at Anholt E in the Kattegat, 6.4 ml/l, and at W Landskrona in the Sound, 6.5 ml/l.

### The Baltic Proper

The water temperature in the surface layer was slightly above normal and ranged from 3.4 to 4.1 °C. Surface salinity was normal, 6.7 - 8.0 psu, except in the Arkona Basin (8.5 to 9.5 psu), and in the Bornholm Basin and Hanö Bight (just over 8 psu) which is higher than normal. The high salinities can be explained by the strong mixing that occurred during the storm Egon in January. The halocline was found at about 60 to 80 meters in the Western and Eastern Gotland Basin and in the northern Baltic Proper, while it was located shallower in the south, at depths between 30 and 60 meters. The nutrients showed almost normal levels for the season in the surface layer, with slightly elevated levels of phosphate and silicate. Phosphate concentrations were in the range 0.60 - 0.85 µmol/l, with the highest concentrations in the north. The concentrations of inorganic nitrogen (nitrite + nitrate) ranged from 3.0 to 4.6 µmol/l, in the Gulf of Gdansk 5.5 µmol/l. Silicate showed slightly elevated concentrations in the northern and central parts, while concentrations were normal in other areas. Concentrations varied in the range 10 - 16 µmol/l.

In December 2014 there was an inflow into the Baltic through the Sound and Belts which was one of the largest in 60 years. A total of over 200 km<sup>3</sup> water entered into the Baltic at this time. In January there was an additional inflow to the Baltic Sea of about 18 km<sup>3</sup> entering through the Sound. These inflows were preceded by one of about 70 km<sup>3</sup>, which took place in October. The effects of these inflows were now clearly visible in the southern and southeastern parts. The Bornholm Basin was filled up to the sill depth with water with a salinity of about 18 psu and an oxygen content of 5.5 ml/l. In the Stolpe Furrow, water with a salinity of 16 psu and an oxygen content of 4 ml/l was recorded at depths exceeding 60 meters. At the station BCSIII-10, in southeast, high salinity of 12 psu, and an oxygen concentration of 2.8 ml/l at depths exceeding 82 m was measured. Also the Gulf of Gdansk was well oxygenated at depths exceeding 90 m. The effects here are probably due to the previous inflows during last autumn. Even in the southern parts of Eastern Gotland Basin water with oxygen content of 2 ml/l close to the bottom, was found, even if hydrogen sulfide was present in the water above.



In the central parts of Eastern Gotland Basin, BY15, acute hypoxia was noted from 70 meters depth and hydrogen sulfide at depths exceeding 125 meters. At the station BY29, in the north, hydrogen sulphide was present already at 90 meters depth. In the Western Gotland Basin oxygen situation was serious, when acute hypoxia occurred from depths exceeding 50-60 meters and hydrogen sulphide from about 85 meters depth.

## PARTICIPANTS

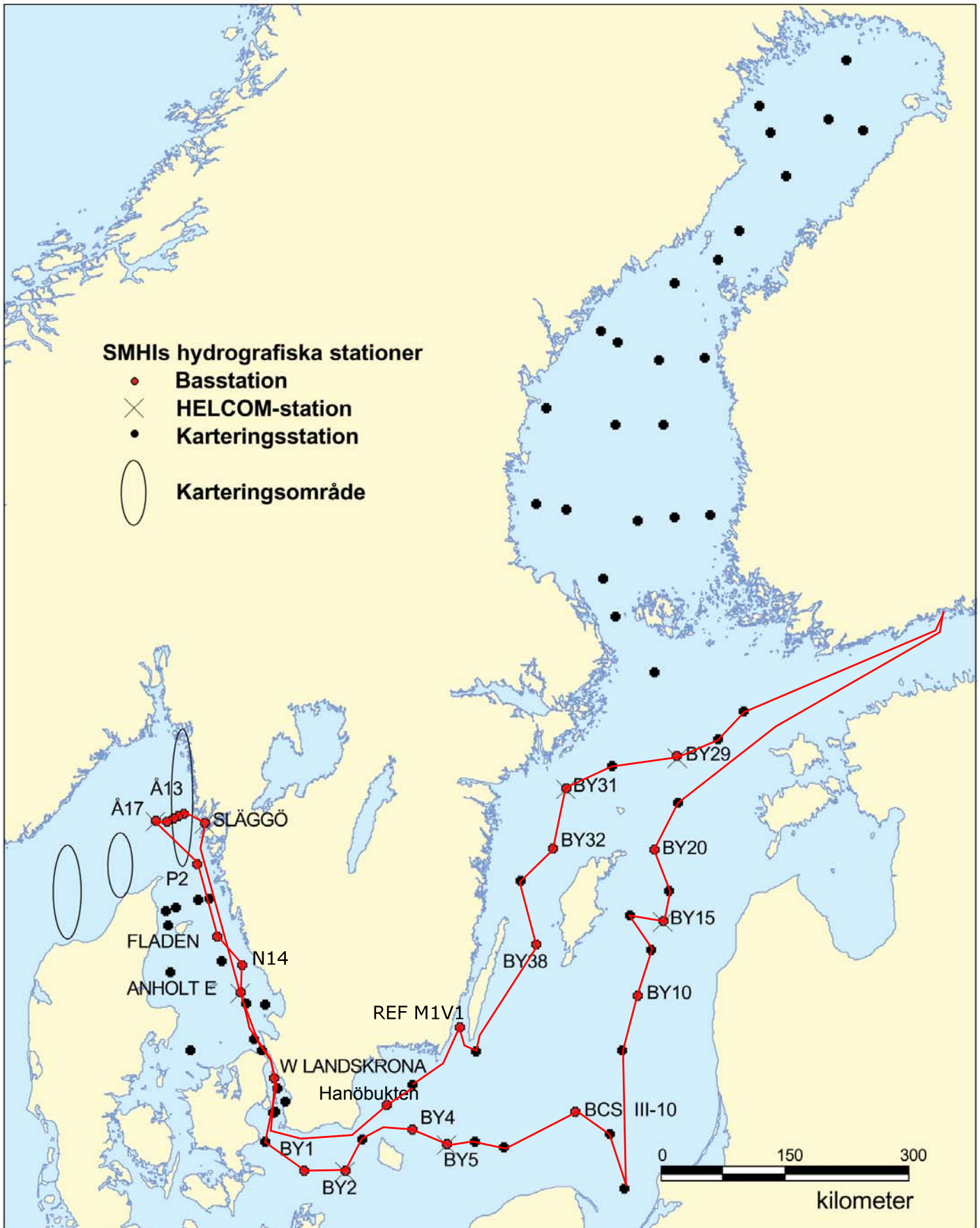
<b>Name</b>		<b>Institute</b>
Lars Andersson	Chief Scientist	SMHI
Kristin Andreasson		SMHI
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Sari Sipilä		SMHI
Anna-Kerstin Thell		SMHI

## APPENDICES

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

TRACKCHART

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Ship: R/V ARANDA  
Date: 20150214-20150222  
Series: 0100-0144

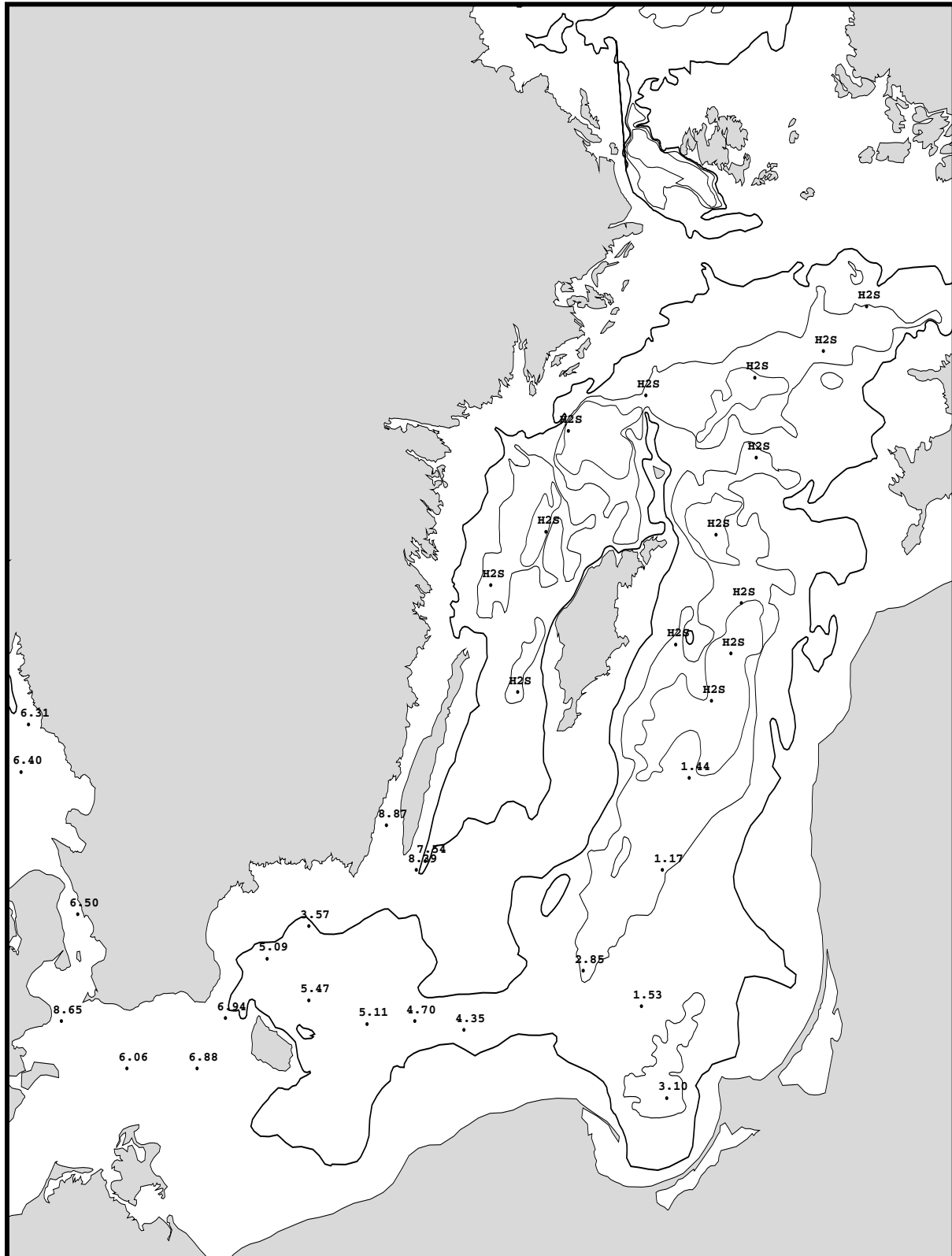






# Bottom water oxygen concentration (ml/l)

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Ship : Aranda  
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Series : 0100-0144

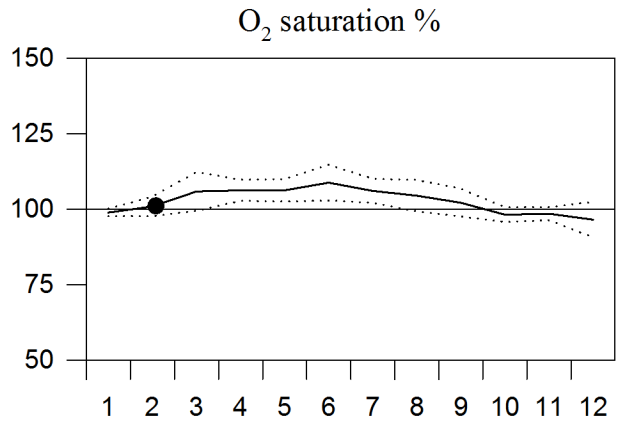
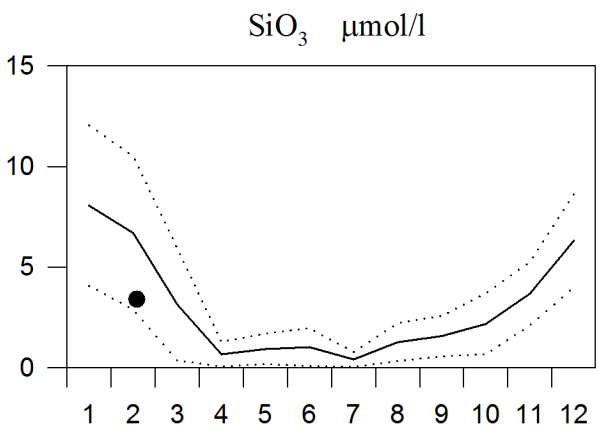
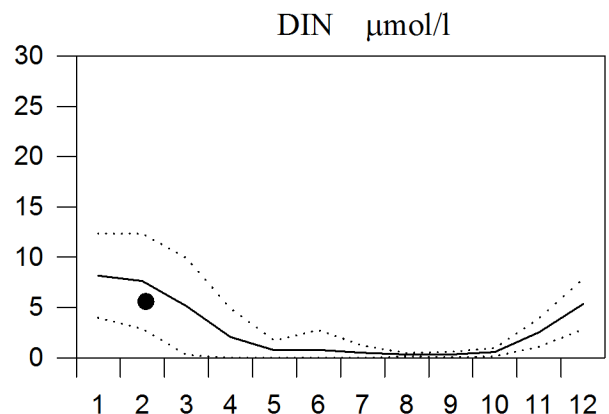
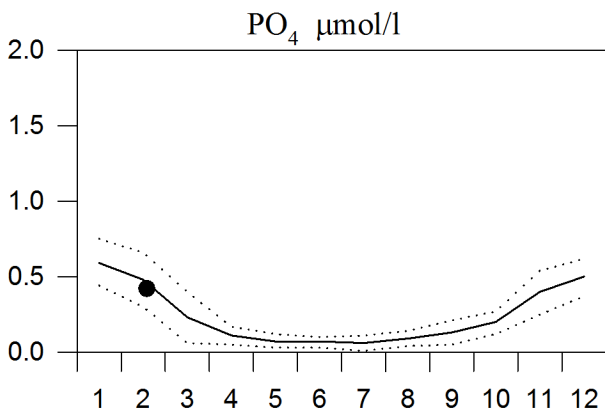
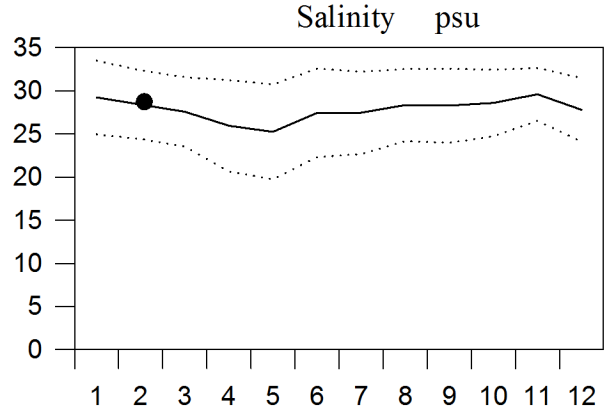
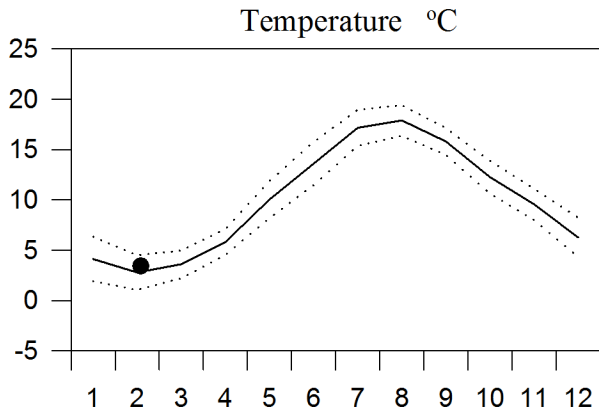




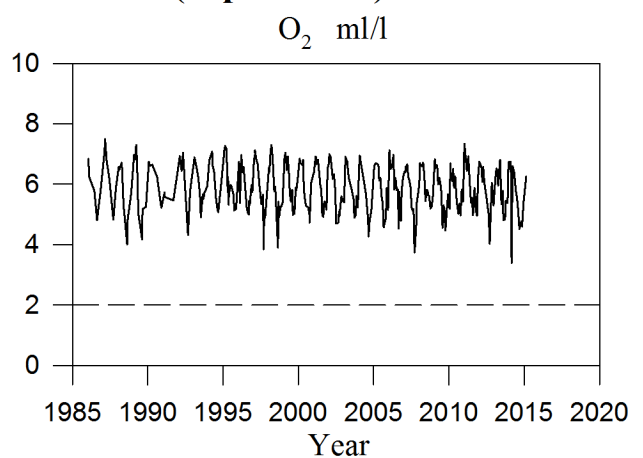
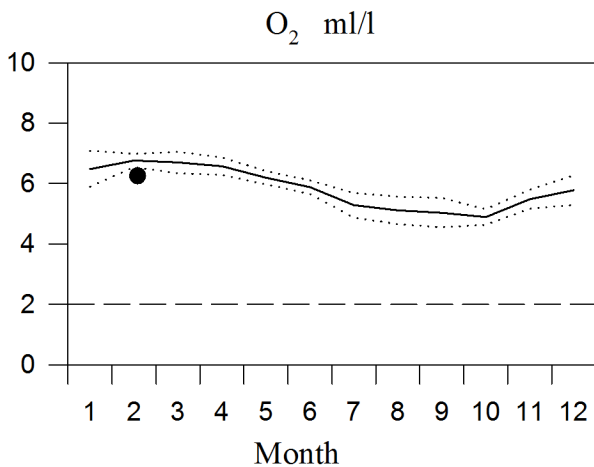
# STATION P2 SURFACE WATER

## Annual Cycles

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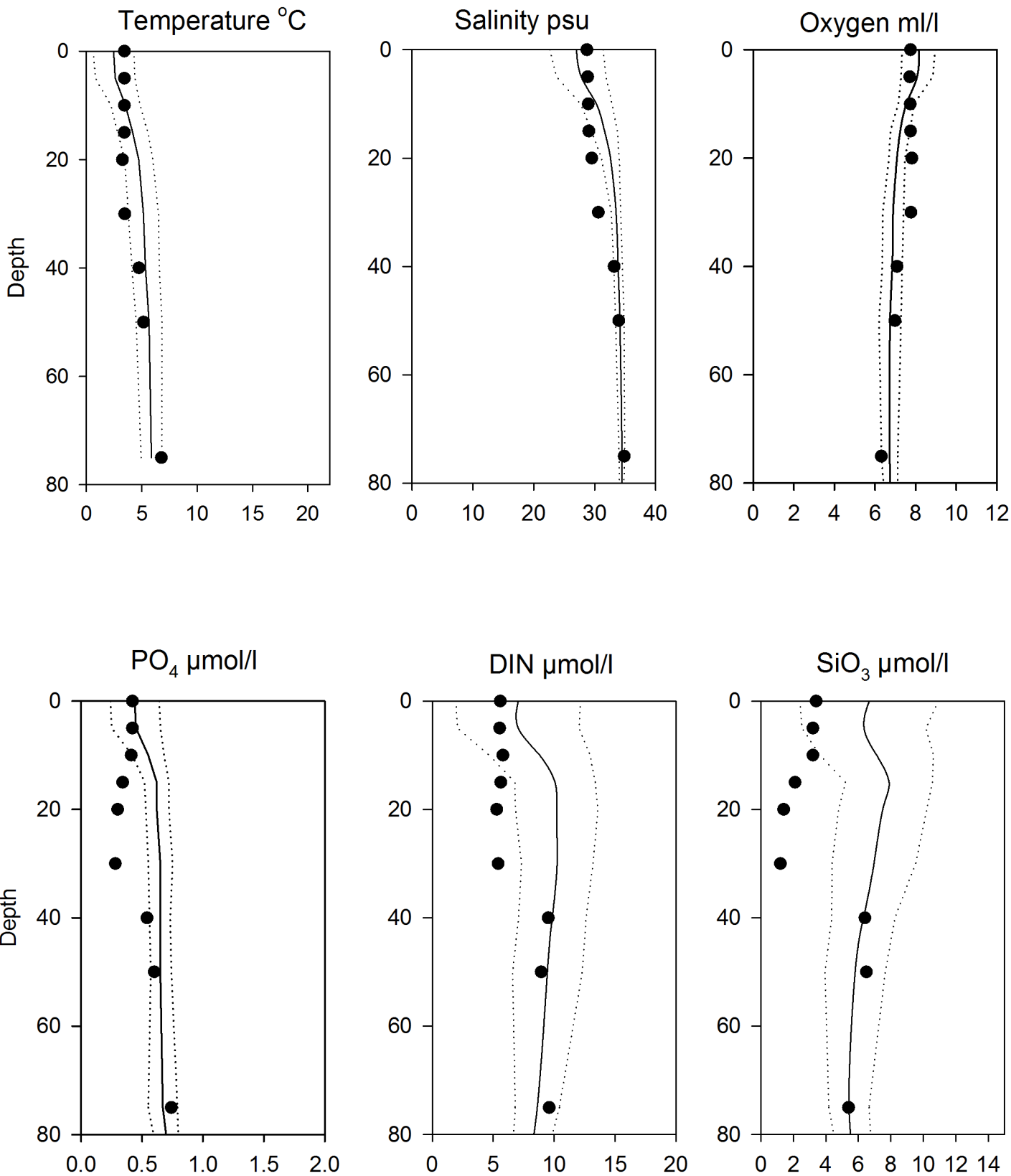


## OXYGEN IN BOTTOM WATER (depth >75m)



# Vertical profiles P2 February

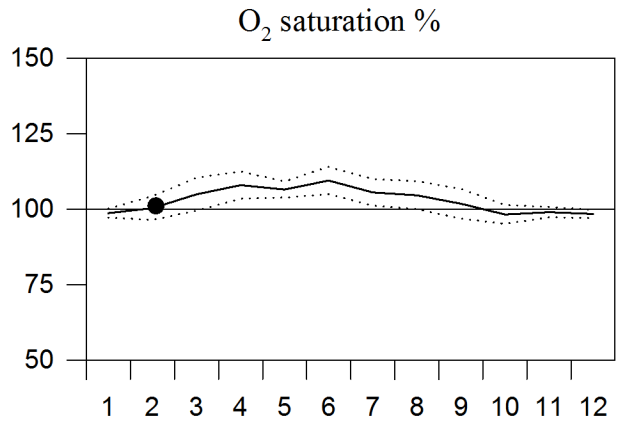
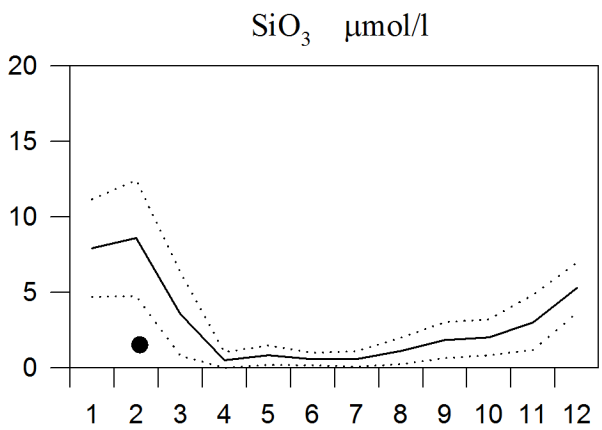
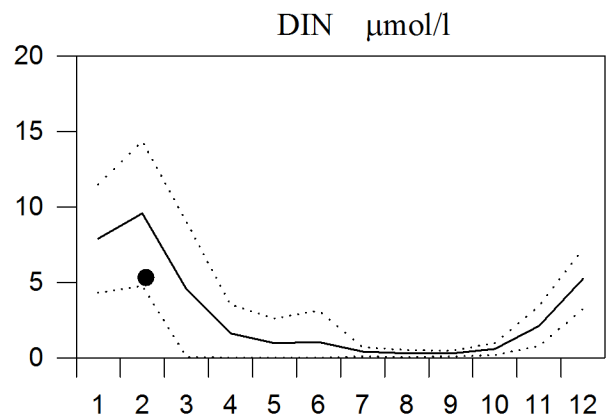
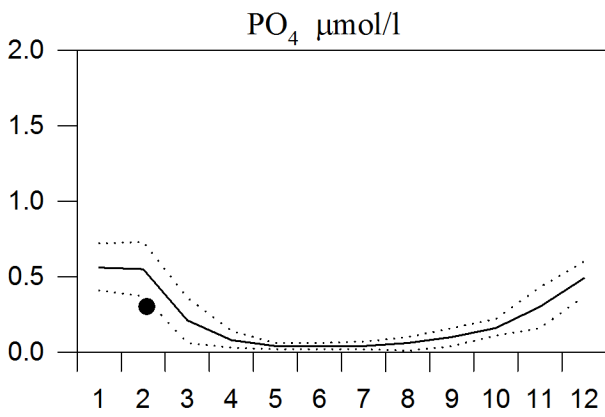
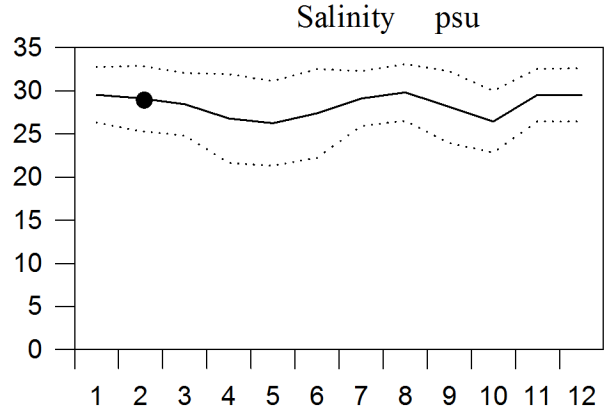
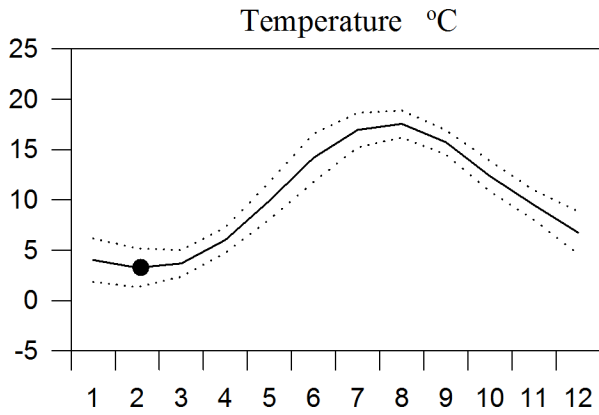
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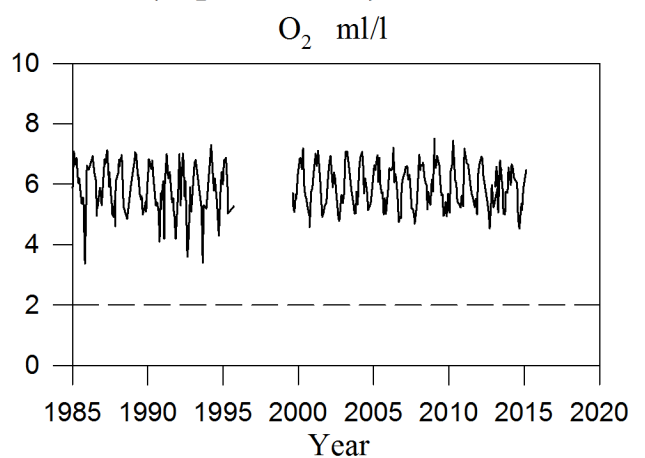
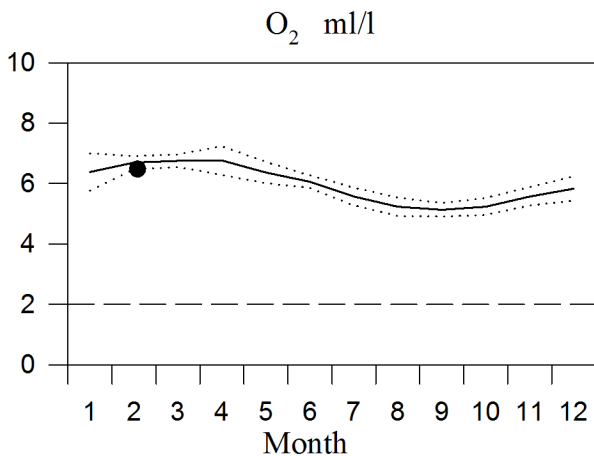
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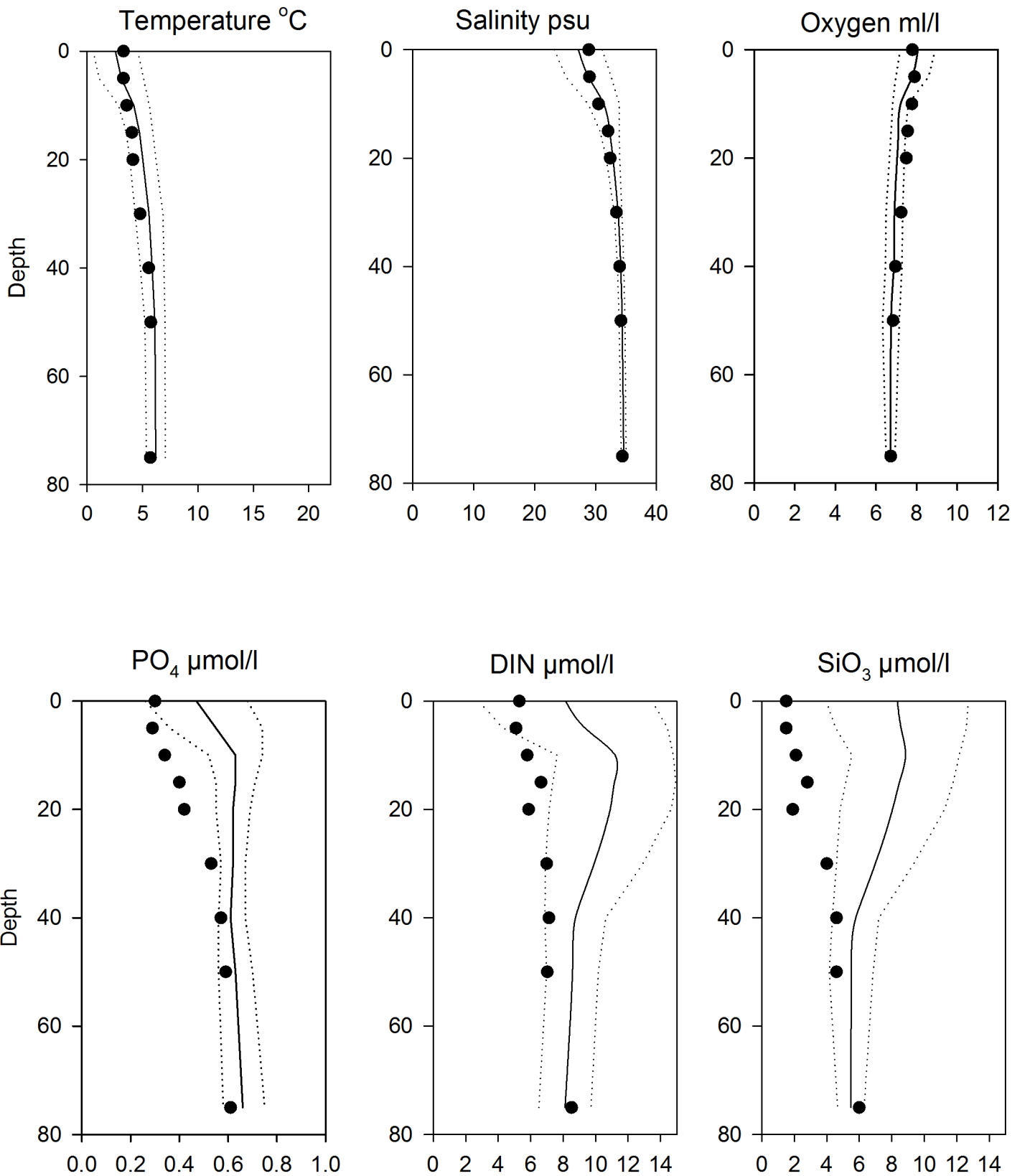


## OXYGEN IN BOTTOM WATER (depth >=75m)



# Vertical profiles Å13 February

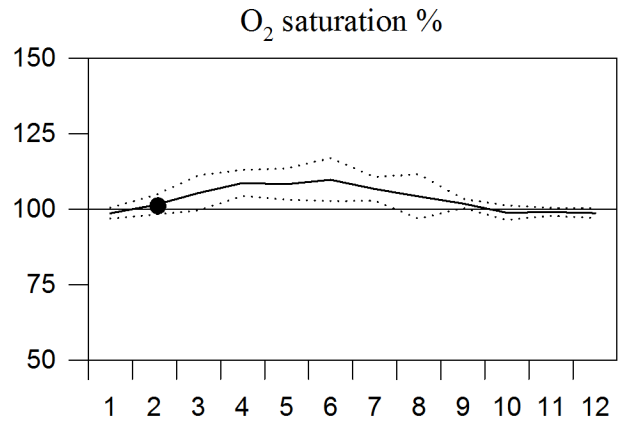
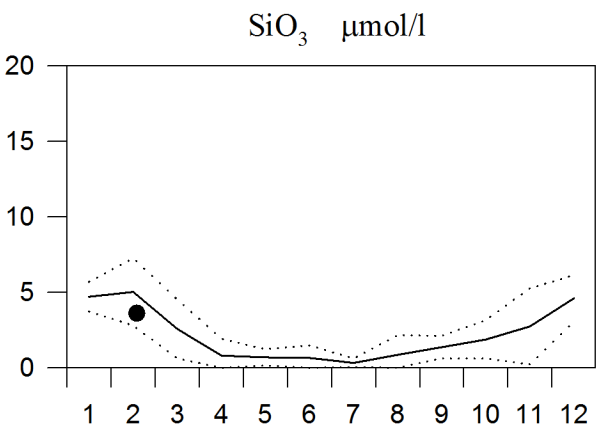
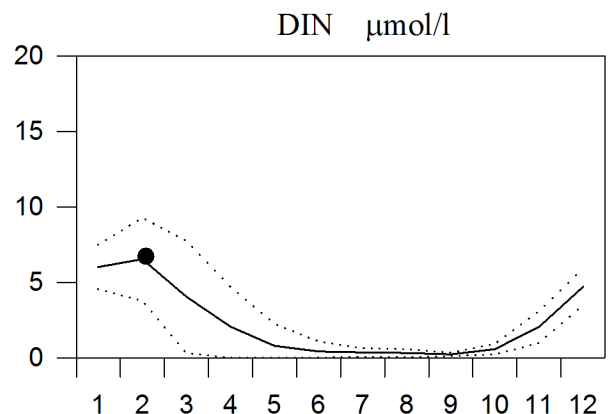
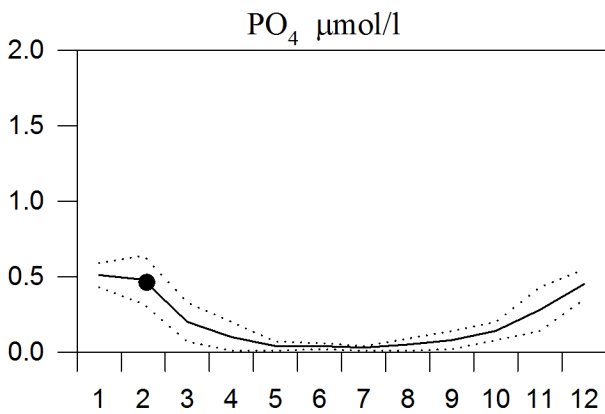
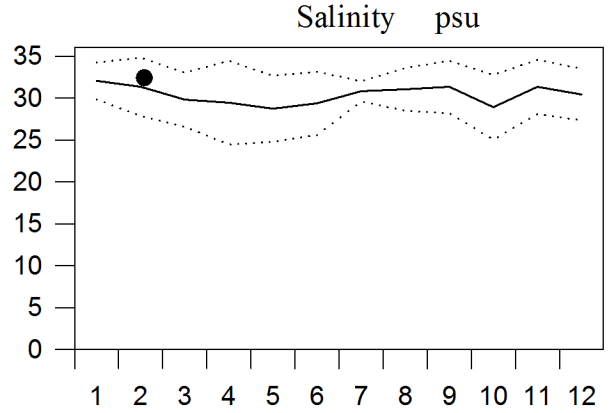
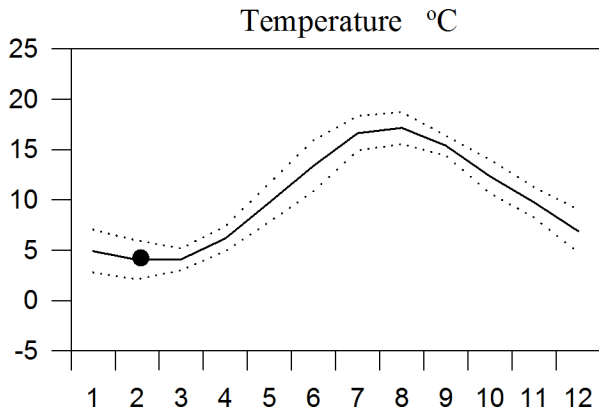
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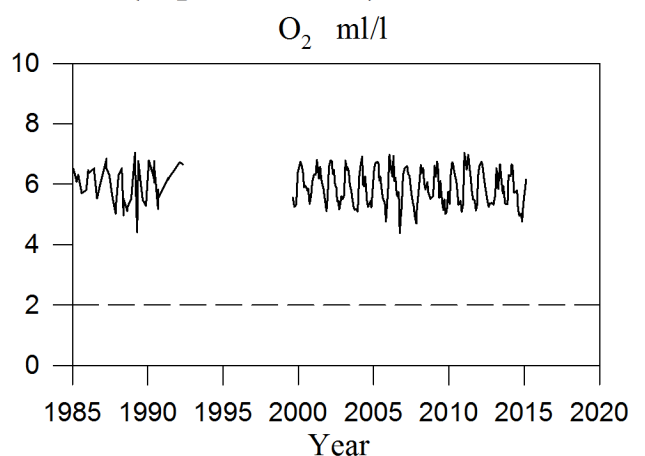
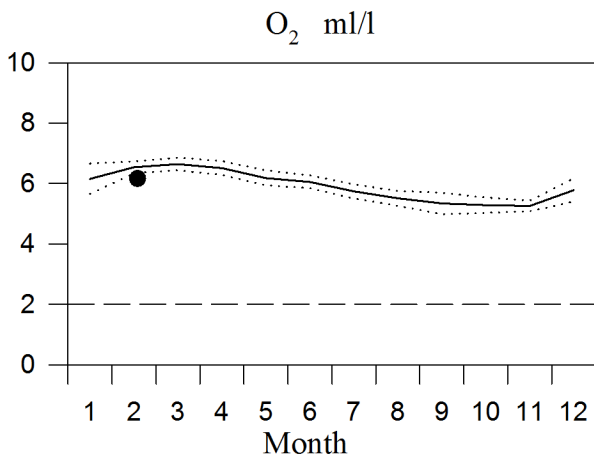
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## Annual Cycles

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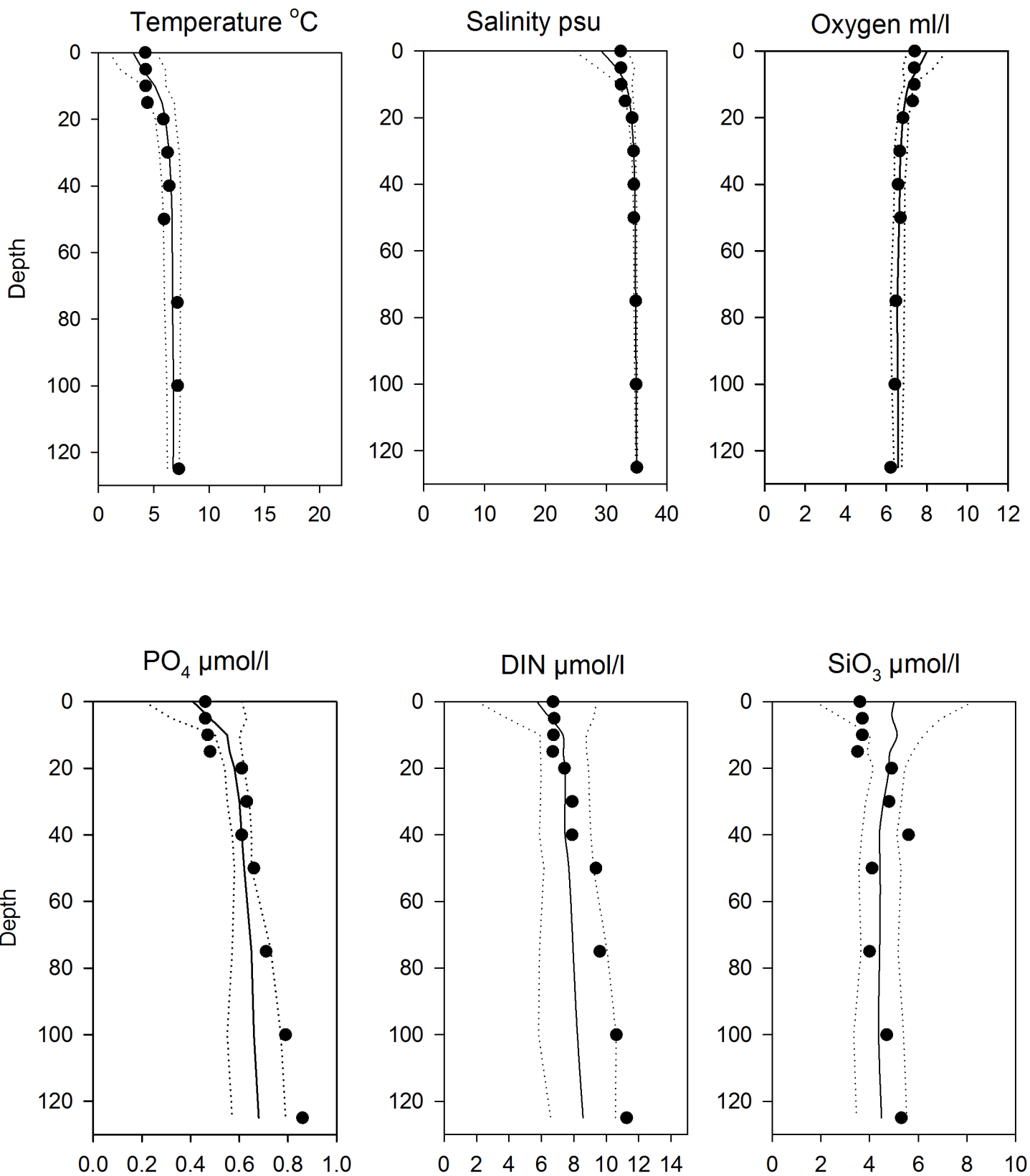


## OXYGEN IN BOTTOM WATER (depth >=125m)



# Vertical profiles Å15 February

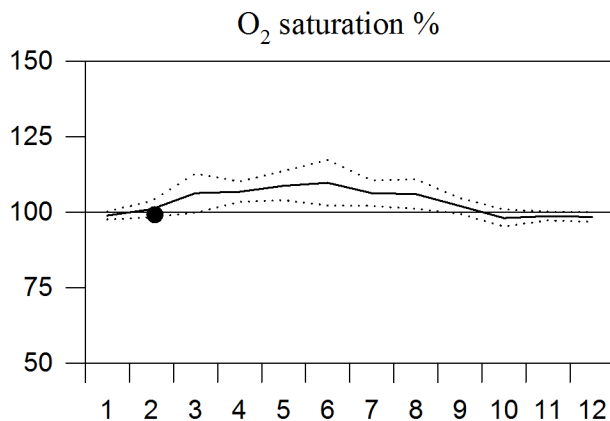
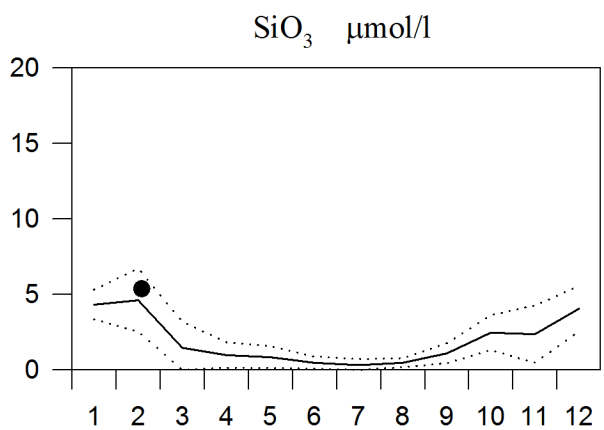
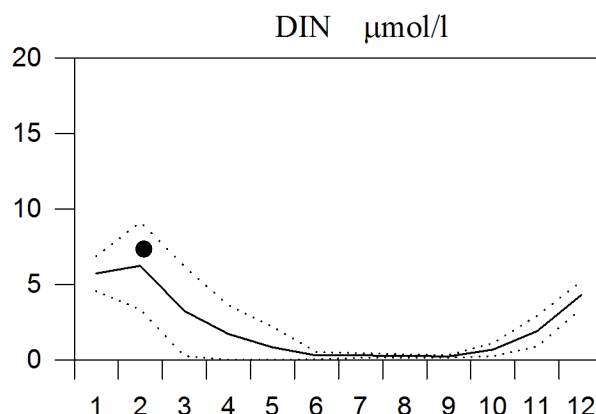
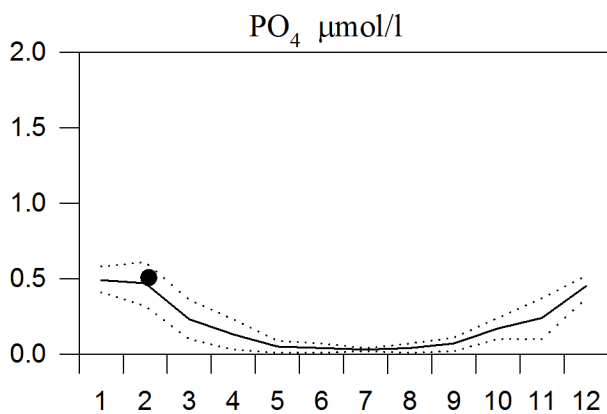
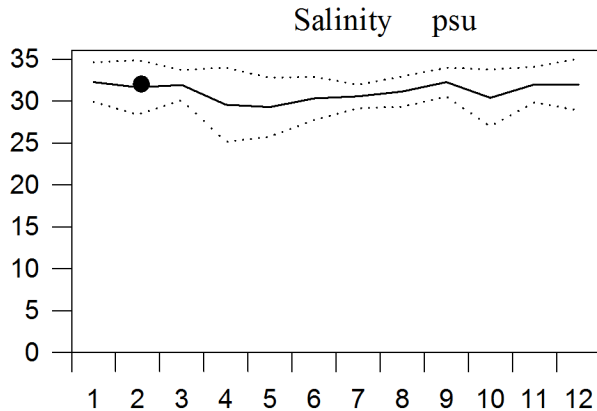
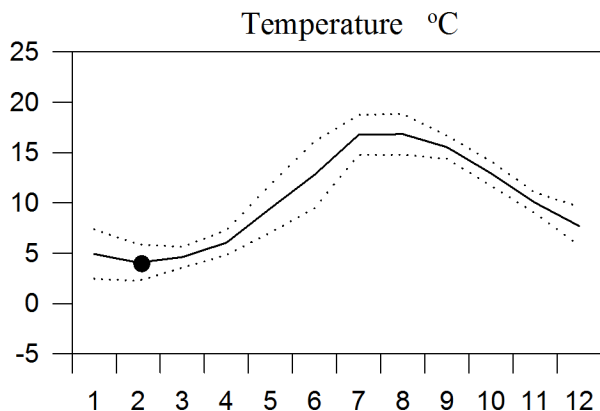
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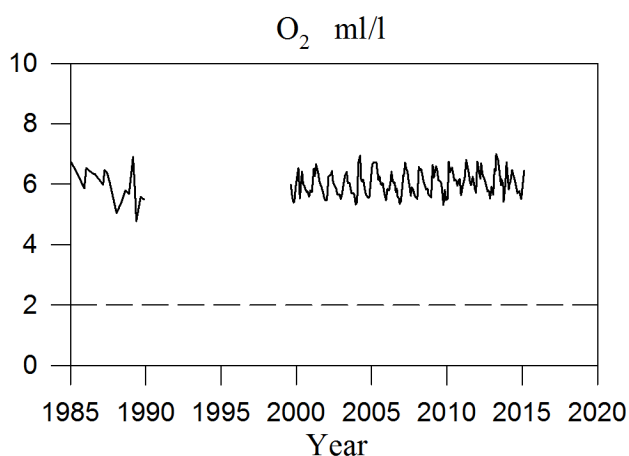
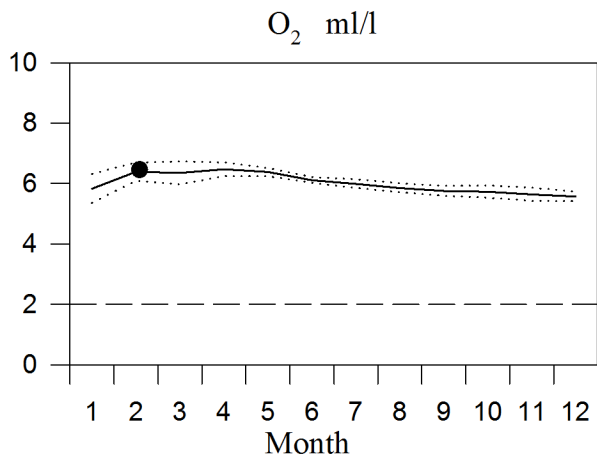
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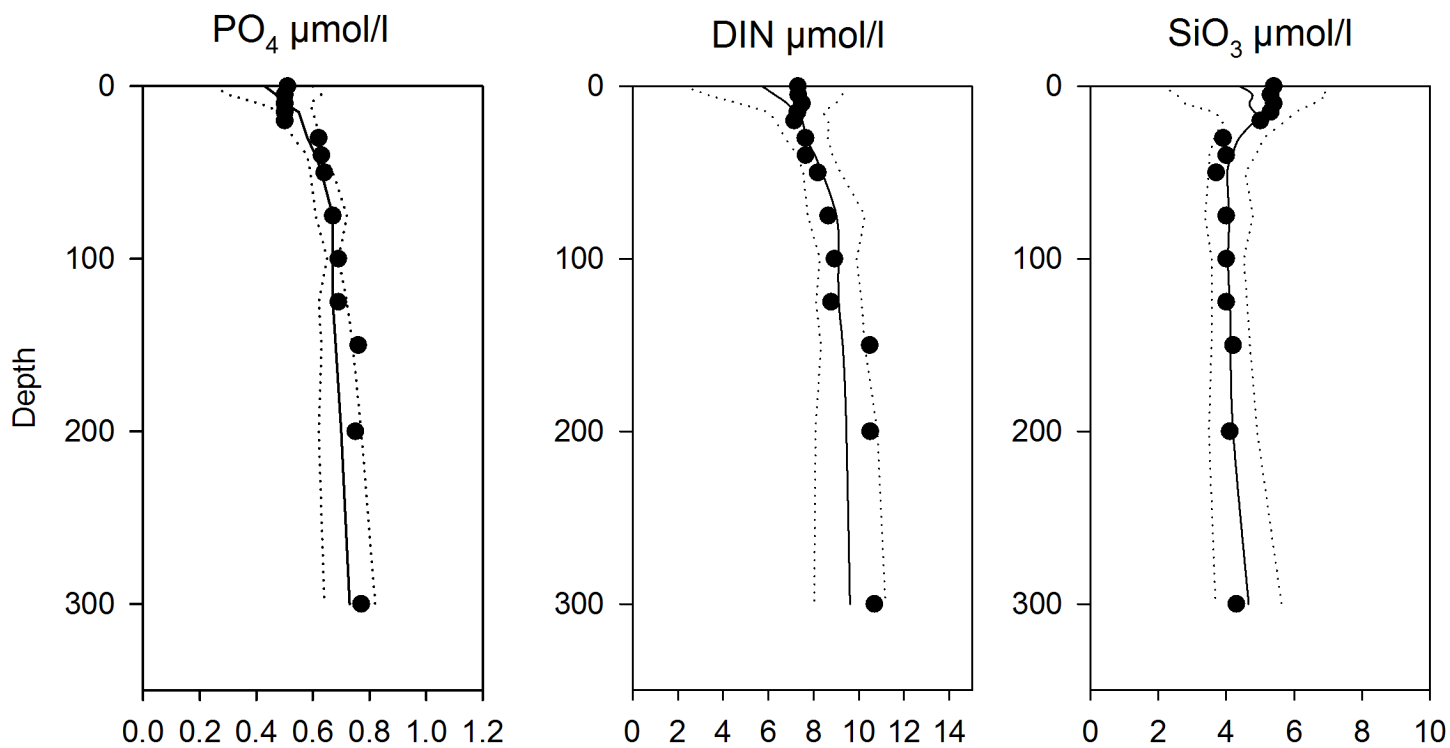
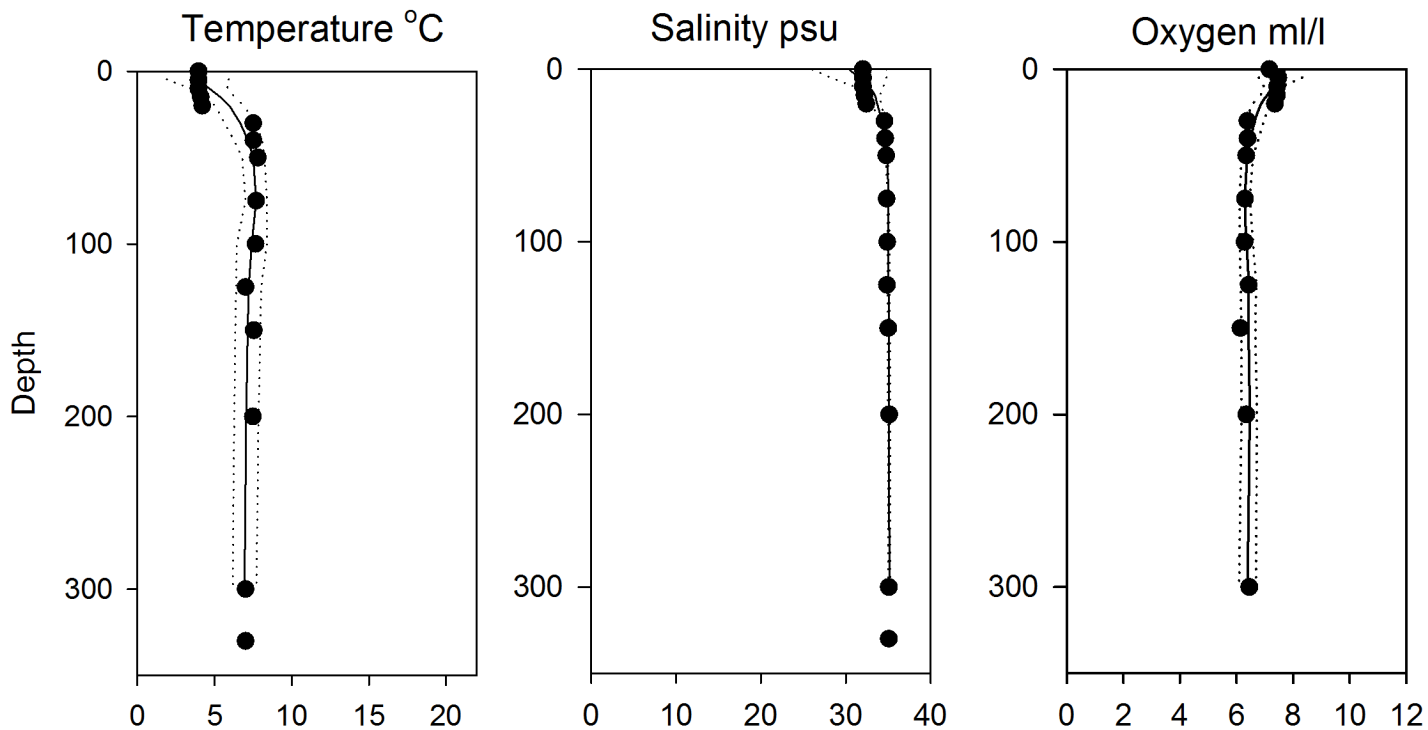


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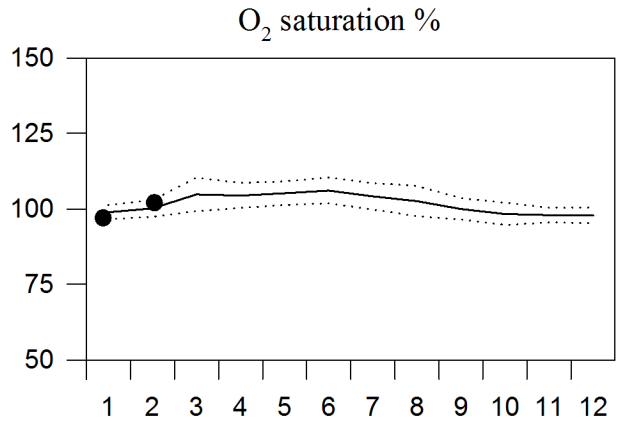
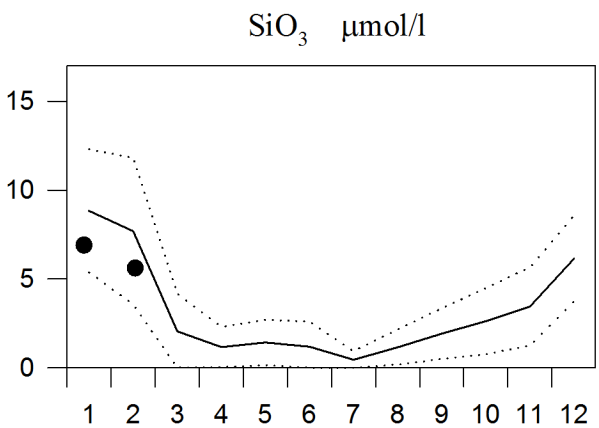
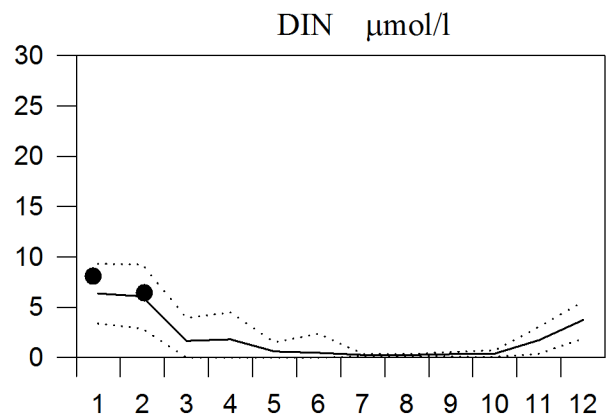
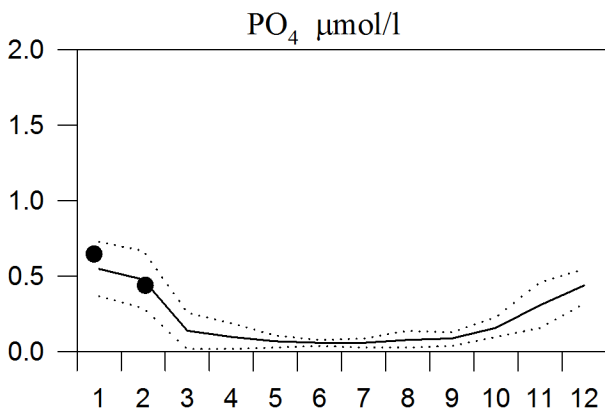
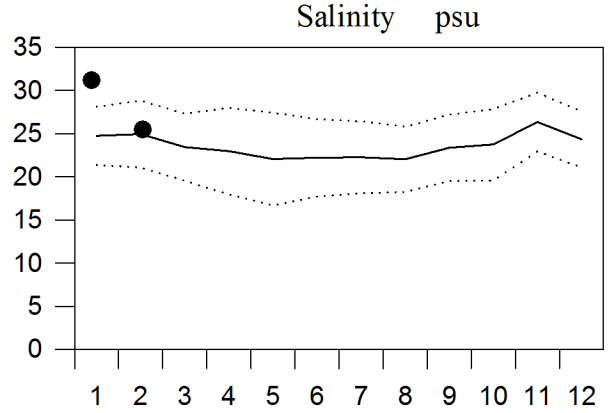
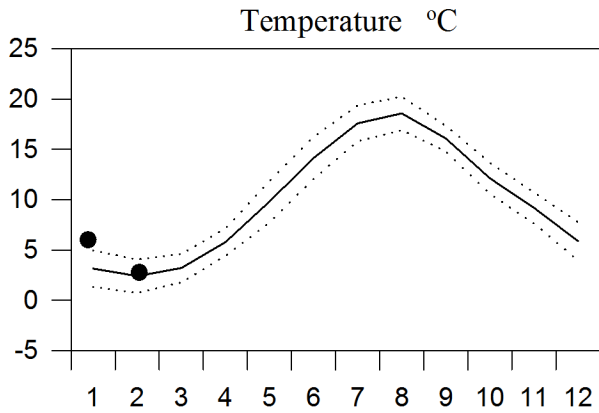




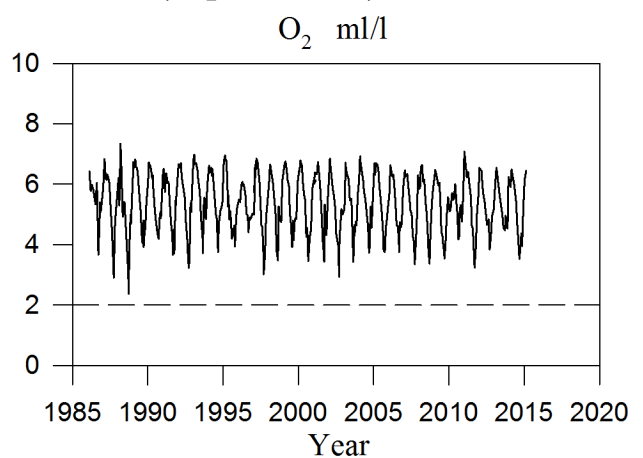
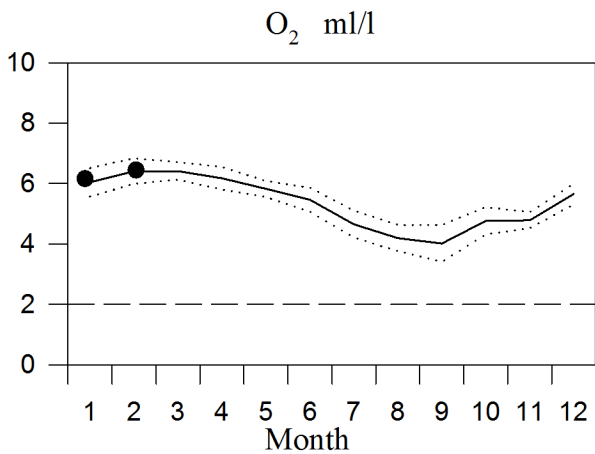
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## Annual Cycles

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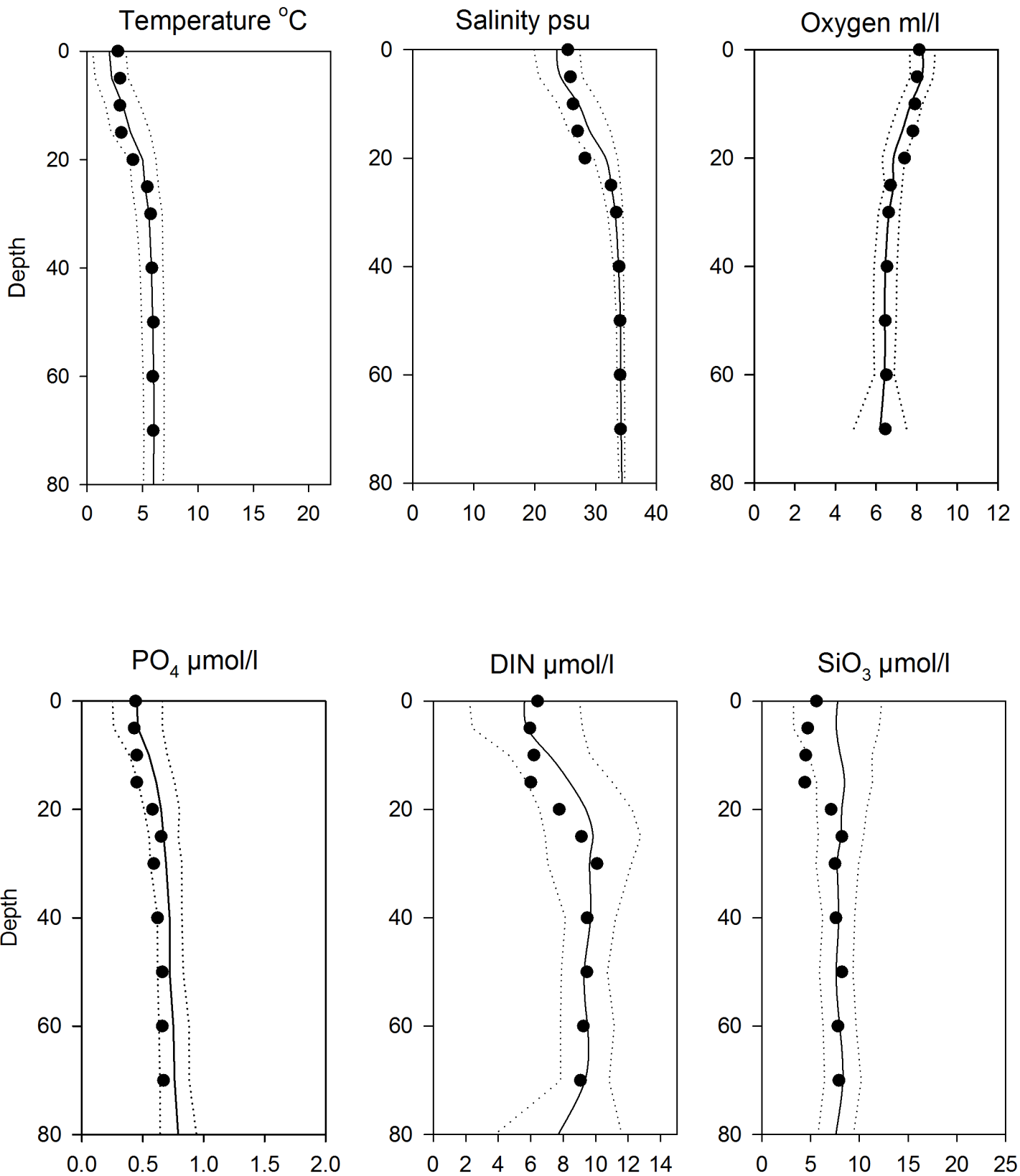


## OXYGEN IN BOTTOM WATER (depth > 70m)



# Vertical profiles Fladen February

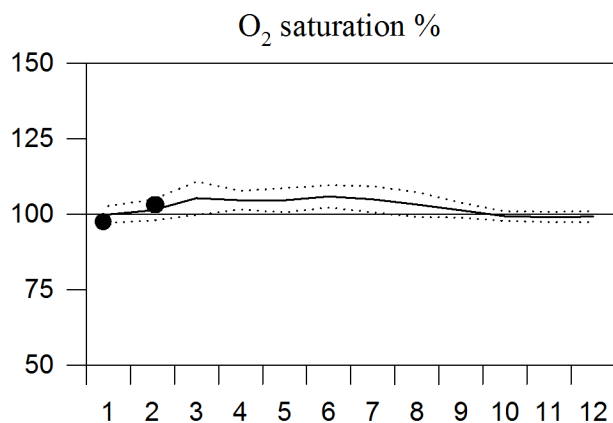
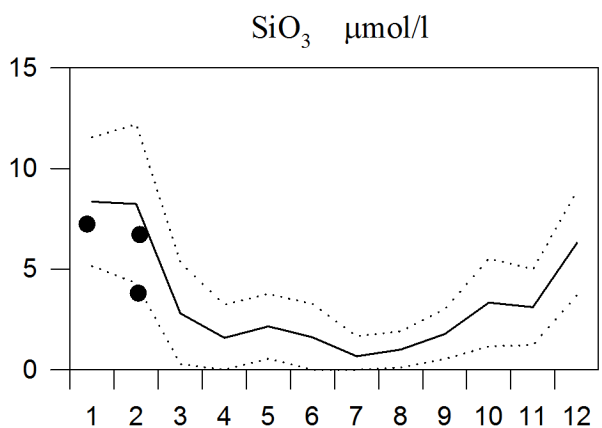
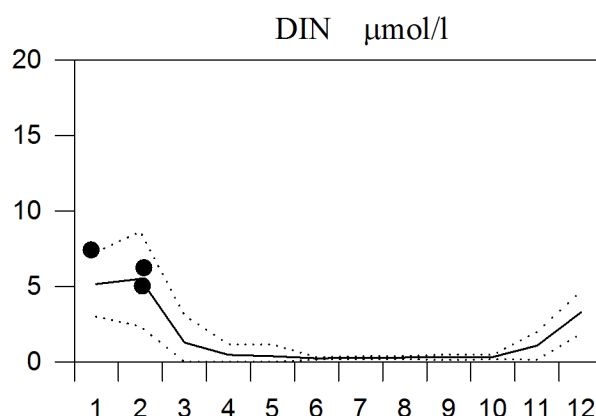
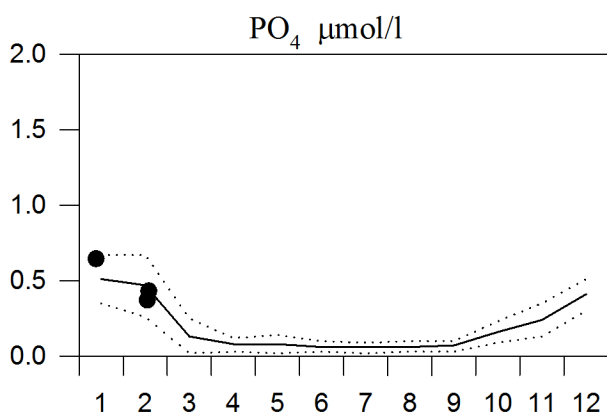
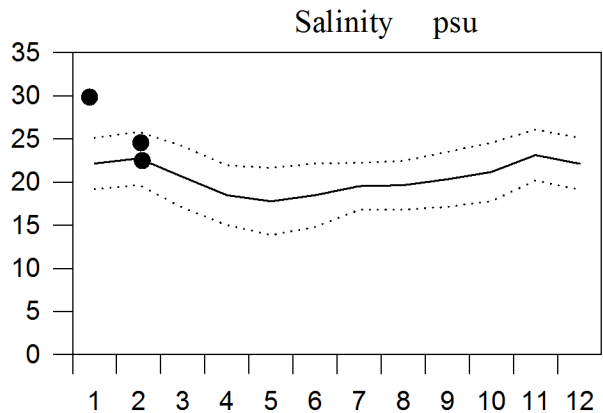
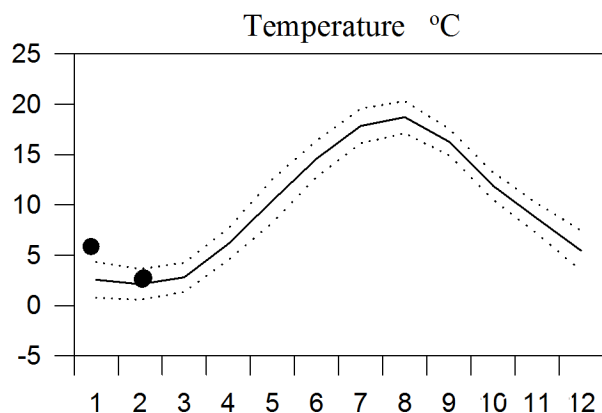
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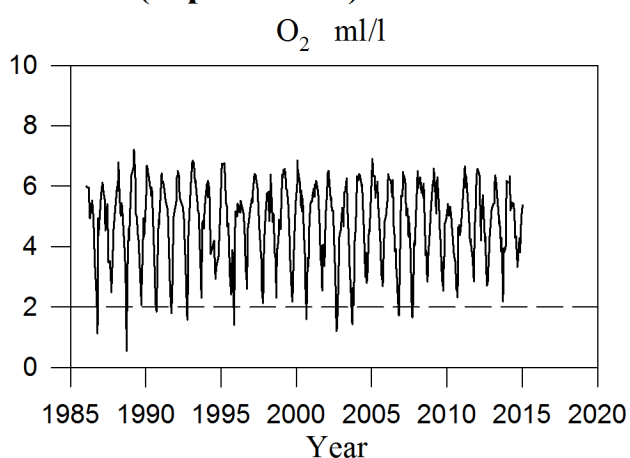
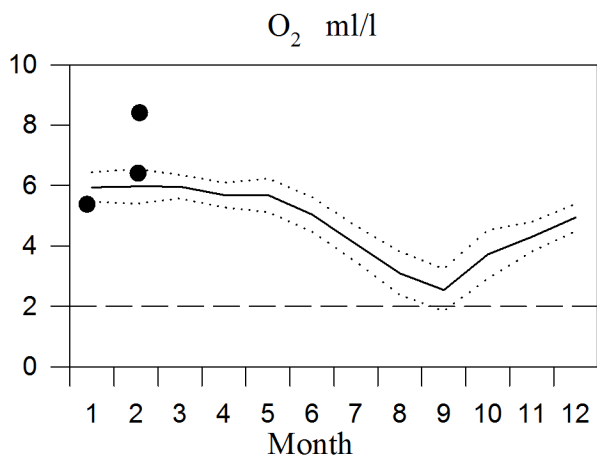
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## Annual Cycles

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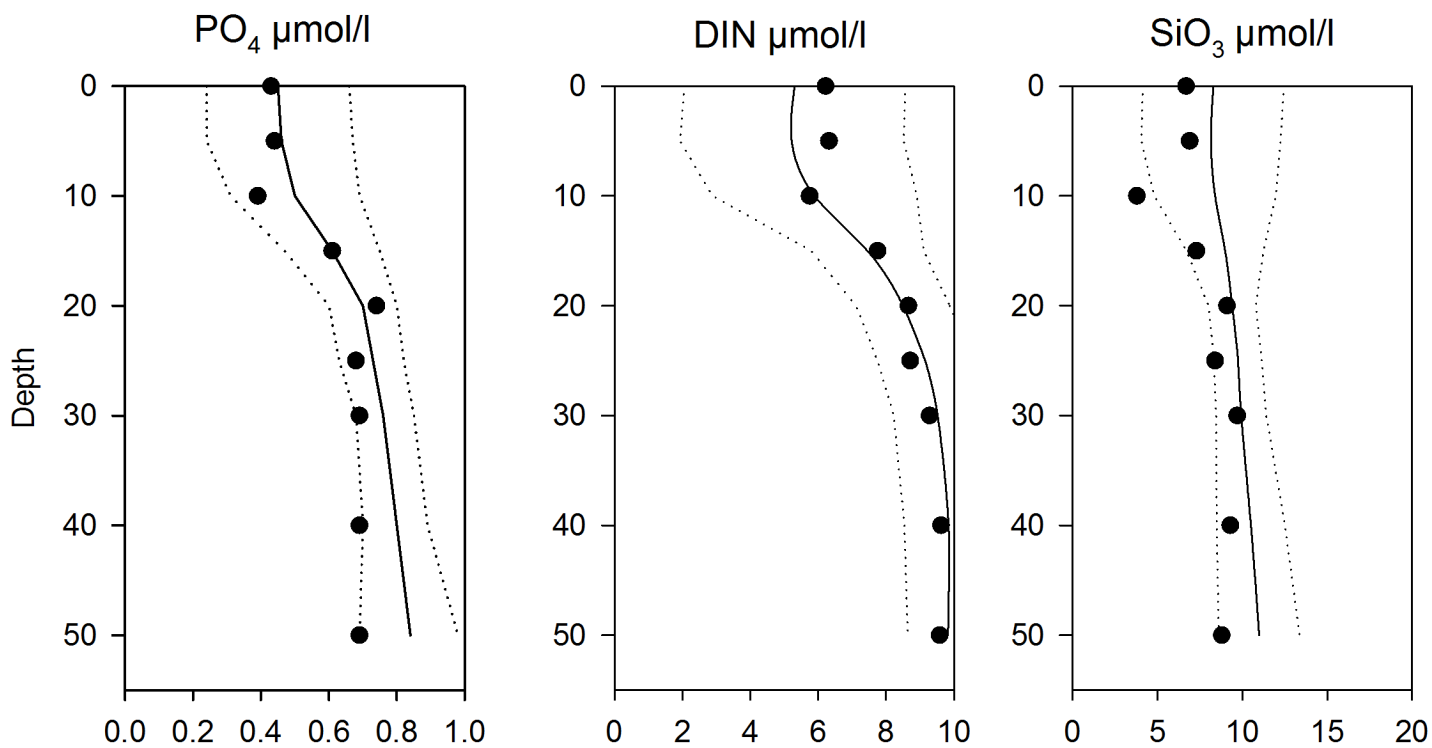
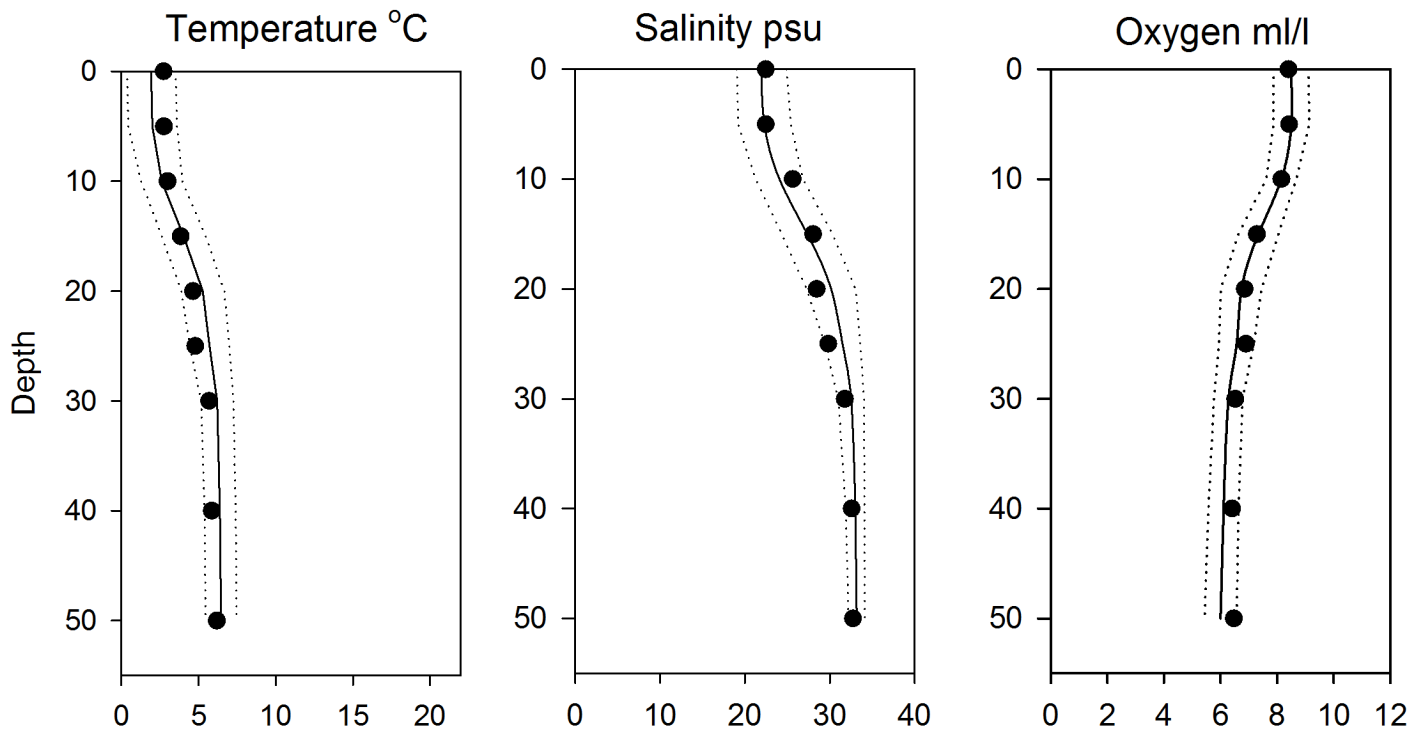


## OXYGEN IN BOTTOM WATER (depth > 50m)



# Vertical profiles Anholt E February

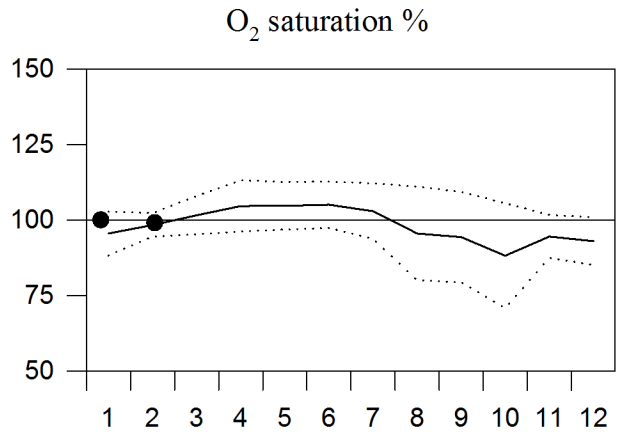
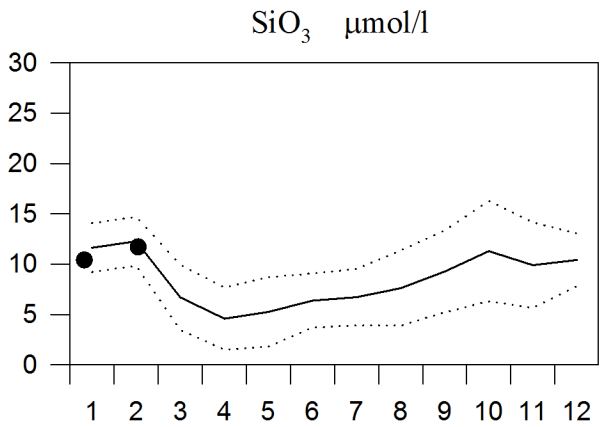
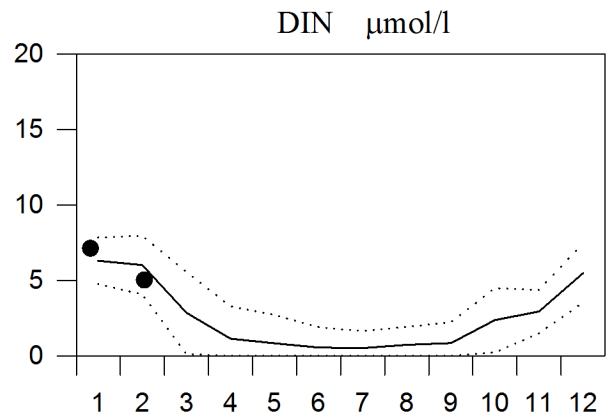
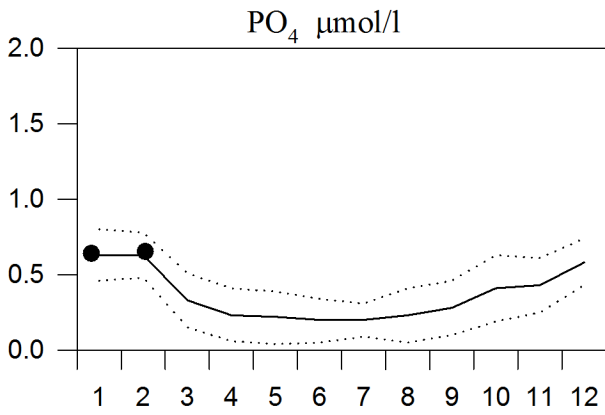
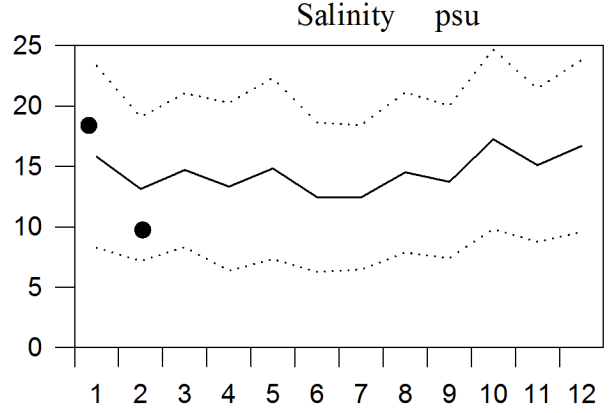
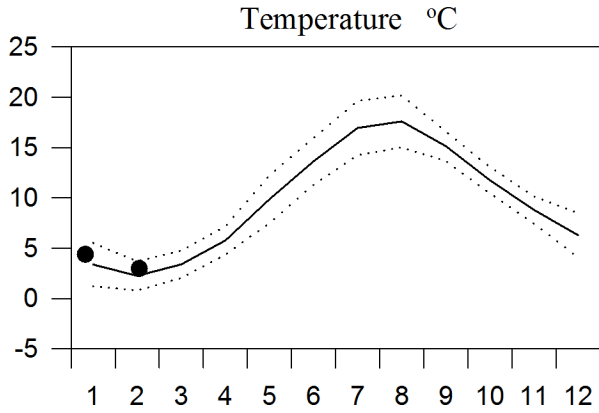
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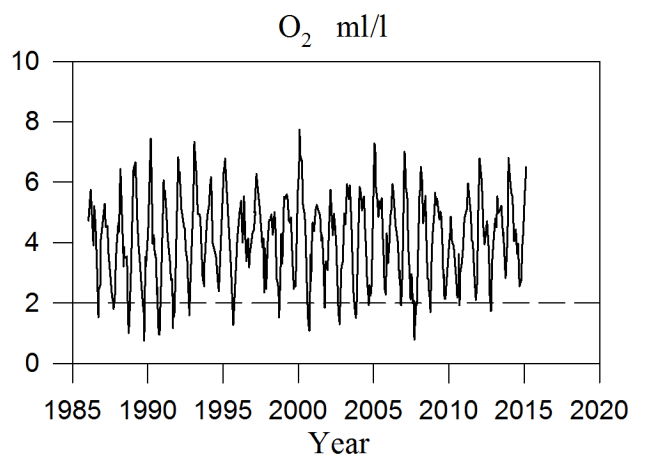
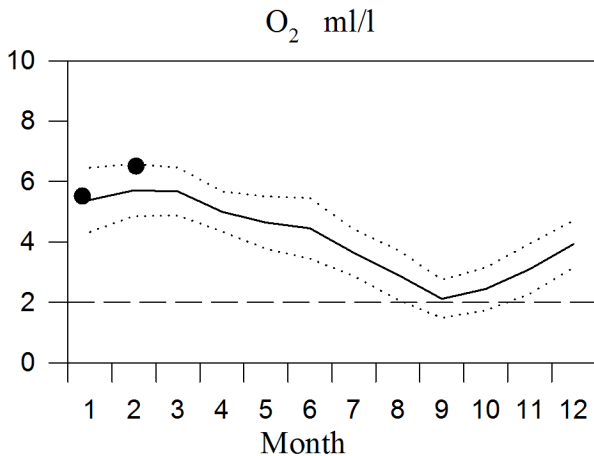
# STATION W LANDSKRONA SURFACE WATER

## Annual Cycles

— Mean 1996-2010      ..... St.Dev.      ● 2015

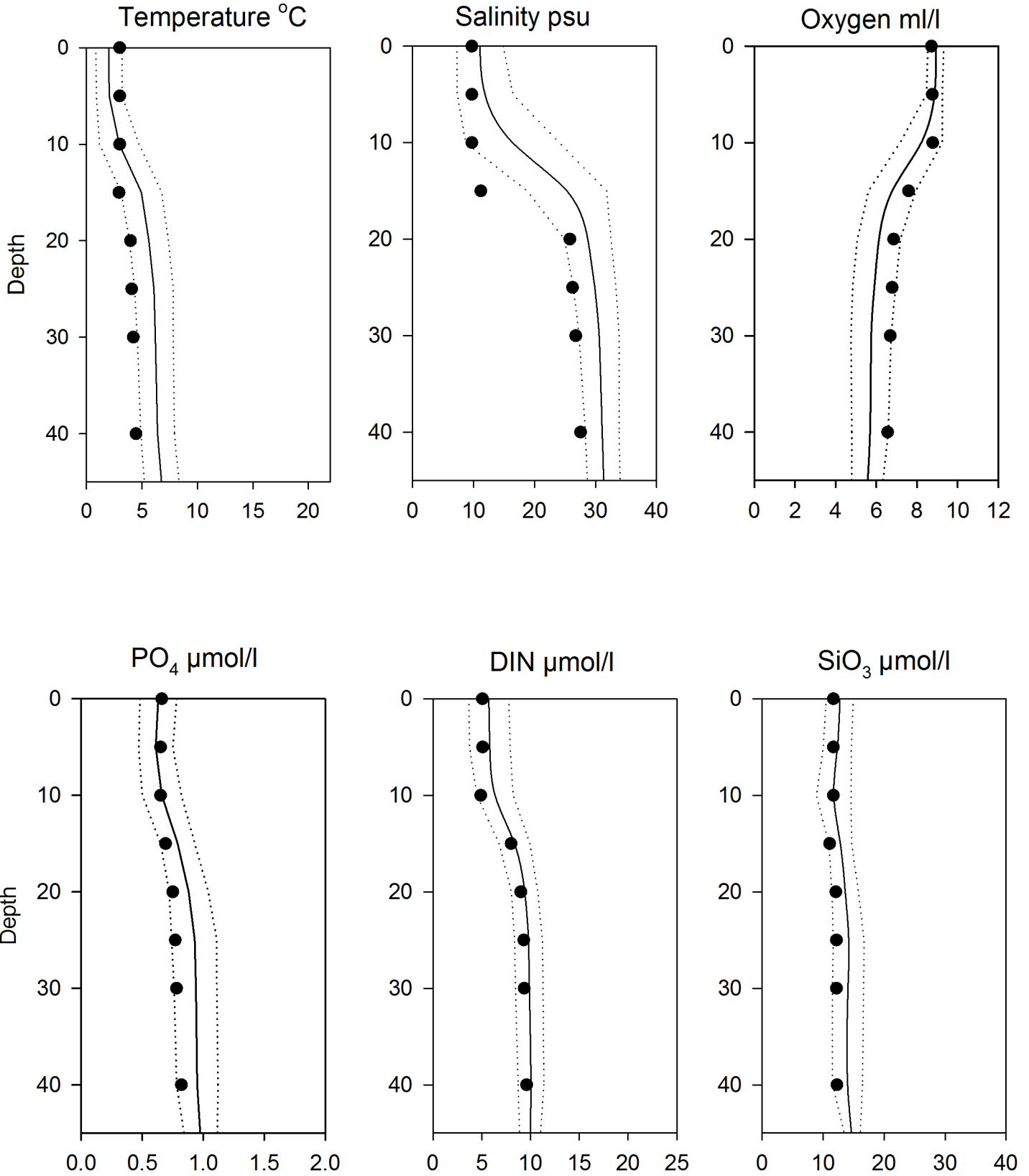


## OXYGEN IN BOTTOM WATER (depth >40m)



# Vertical profiles W Landskrona Febuary

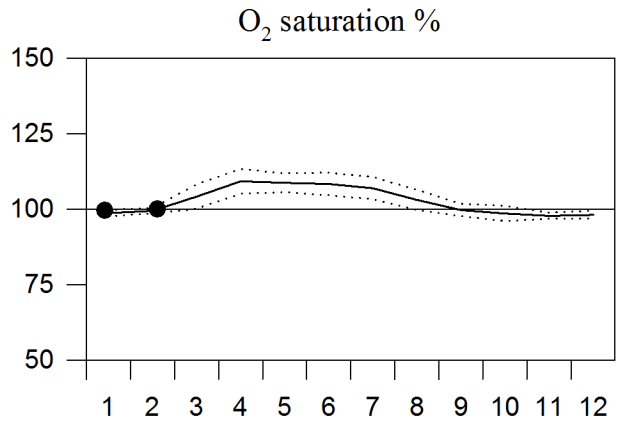
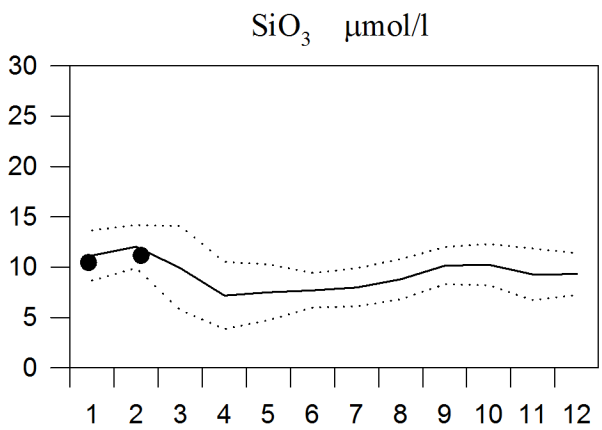
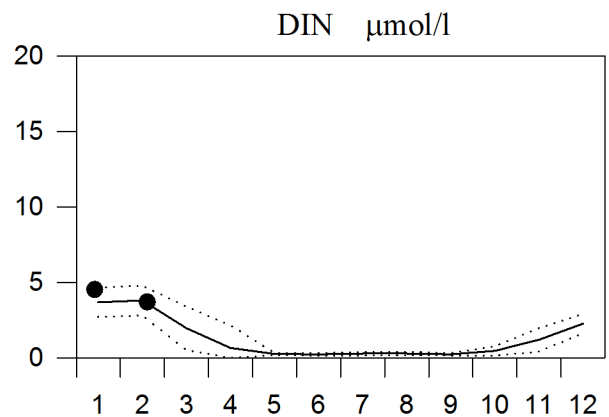
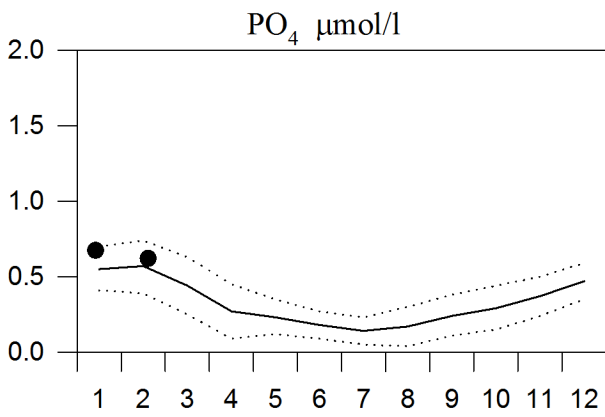
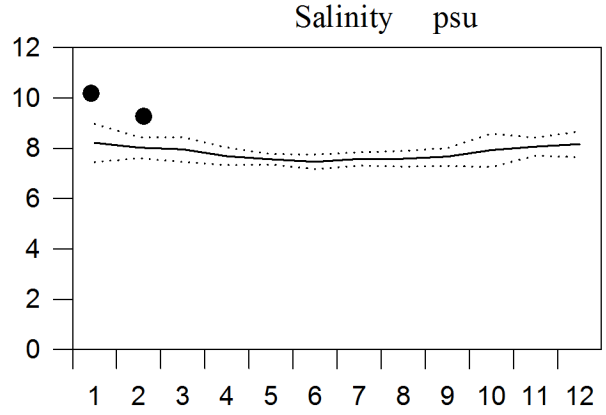
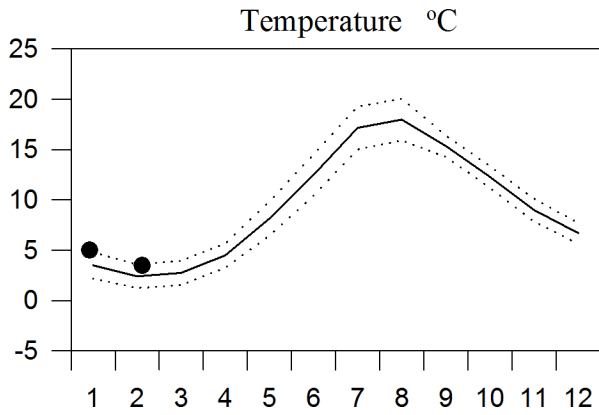
— Mean 1996-2010      ..... St.Dev.      ● 2015



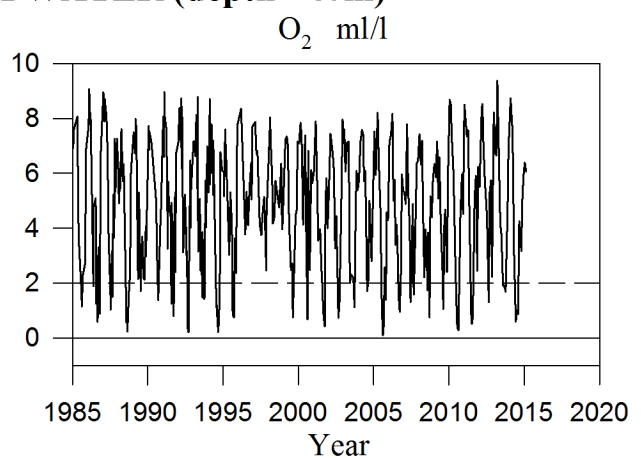
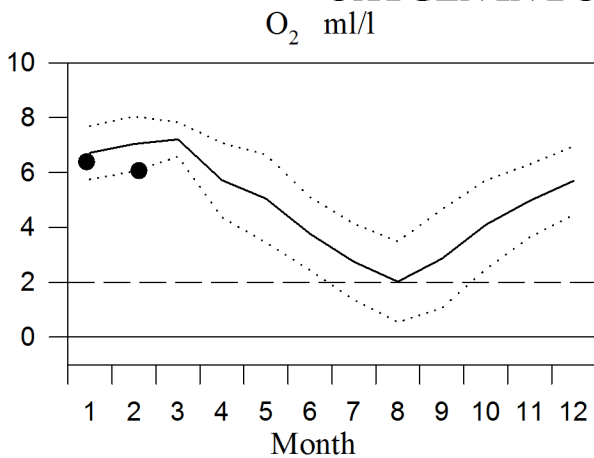
# STATION BY1 SURFACE WATER

## Annual Cycles

— Mean 1996-2010      ..... St.Dev.      ● 2015

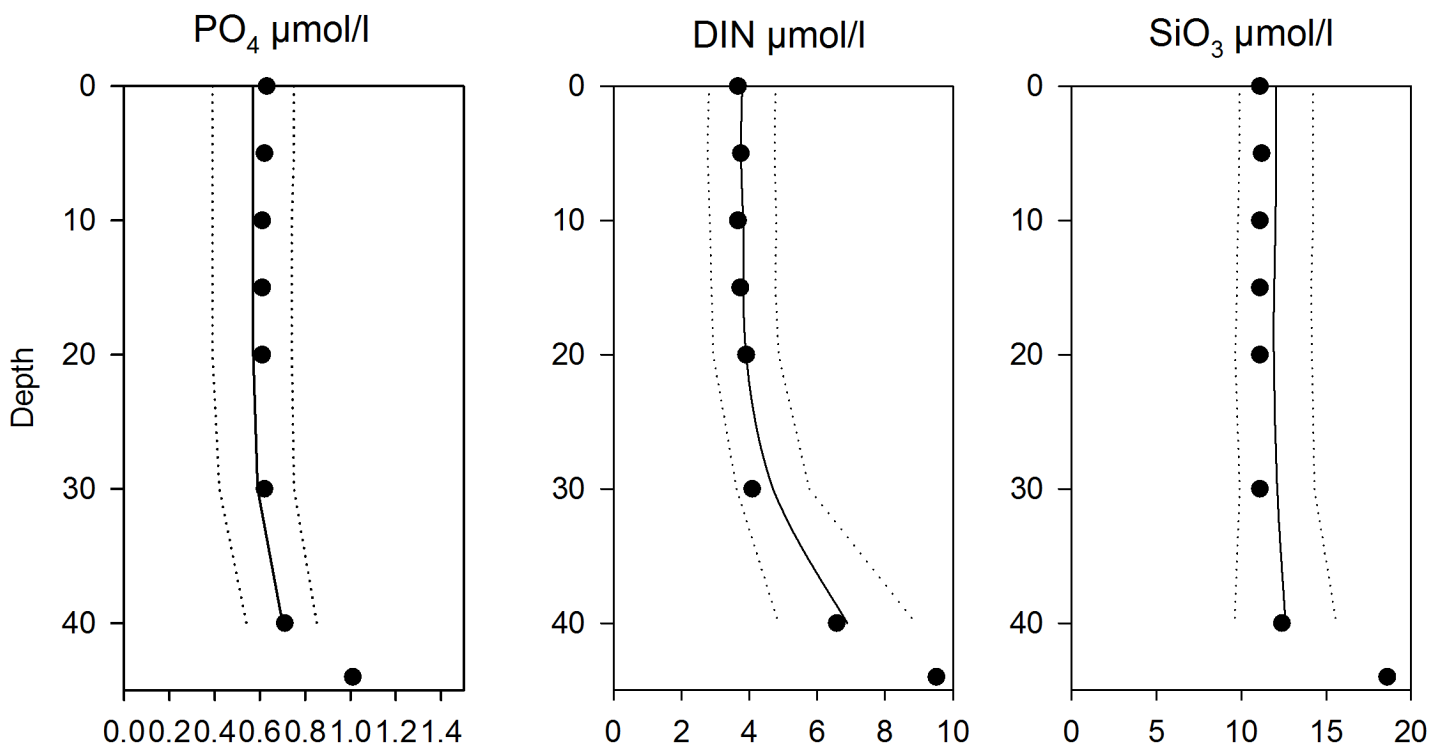
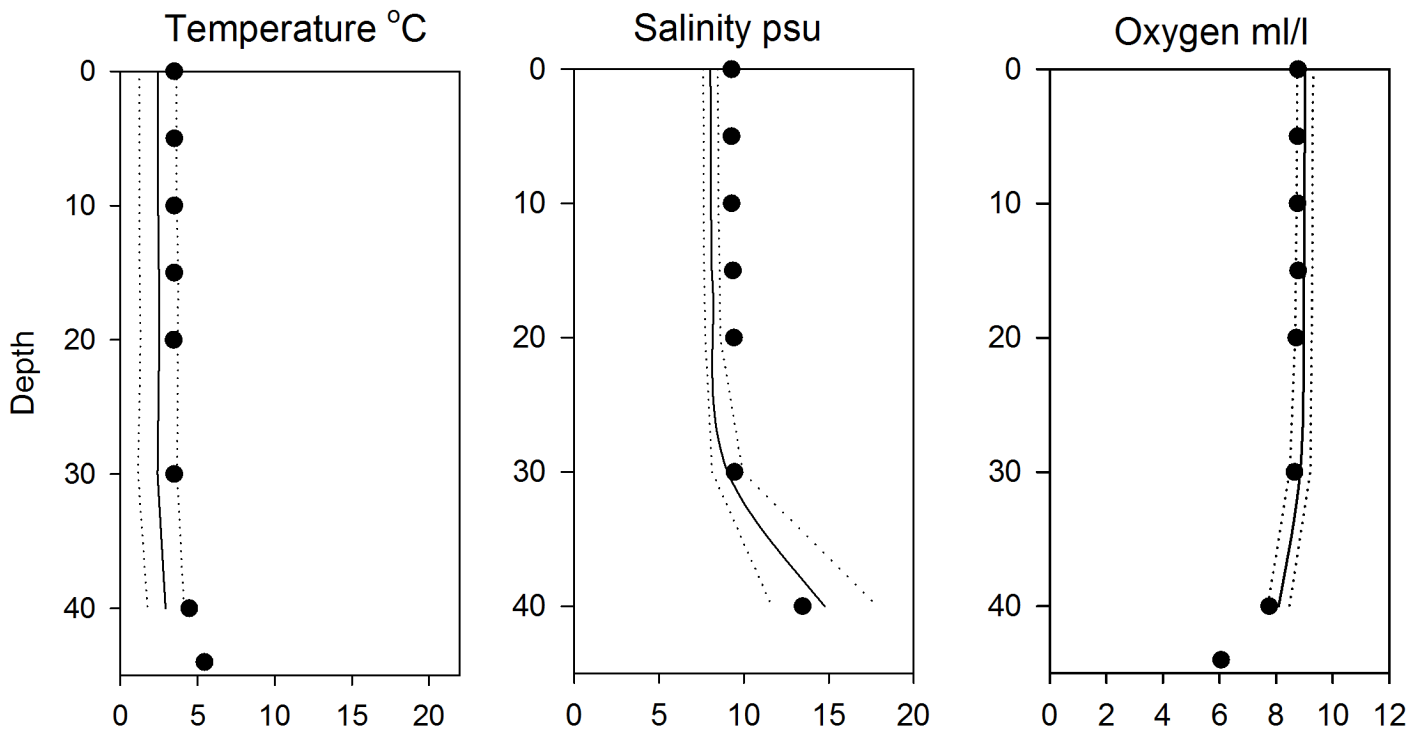


## OXYGEN IN BOTTOM WATER (depth >40m)



# Vertical profiles BY1 February

— Mean 1996-2010      ····· St.Dev.      ● 2015

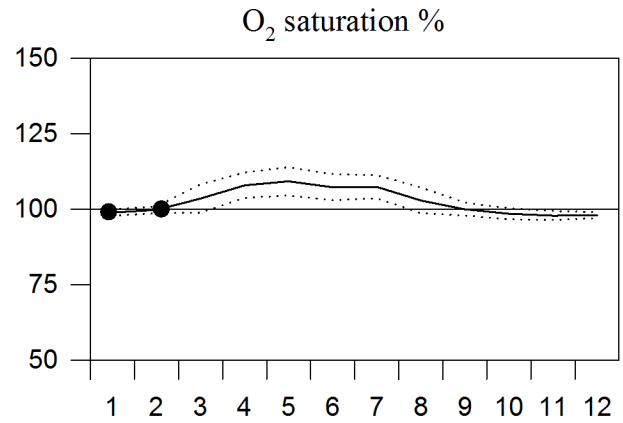
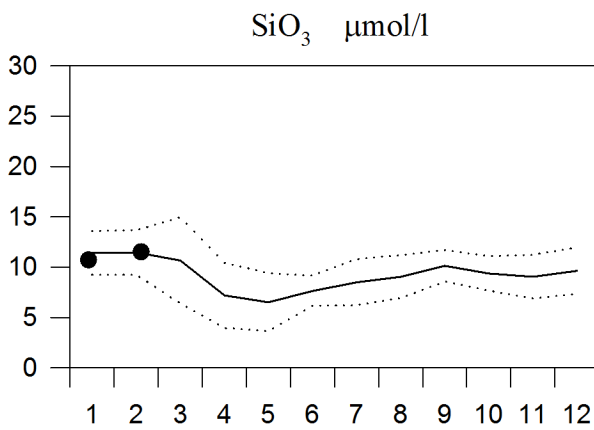
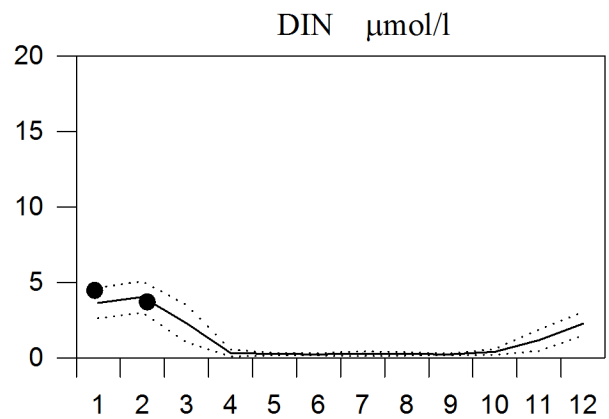
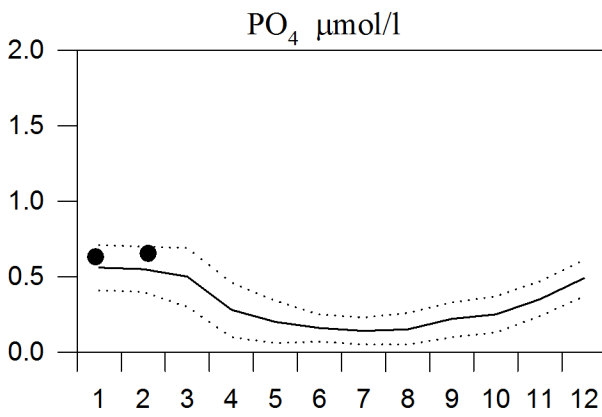
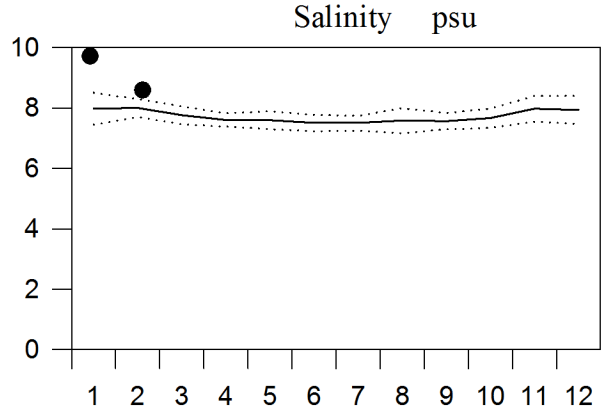
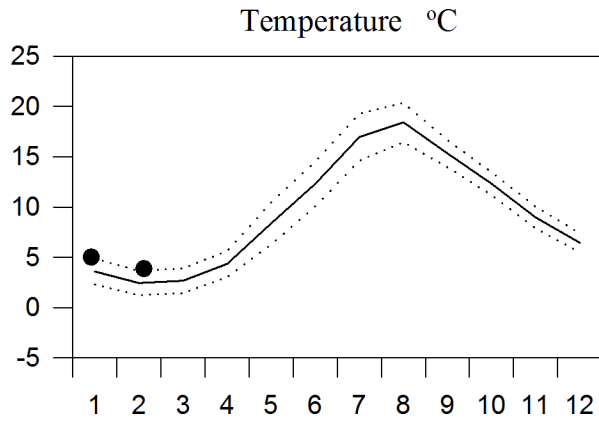




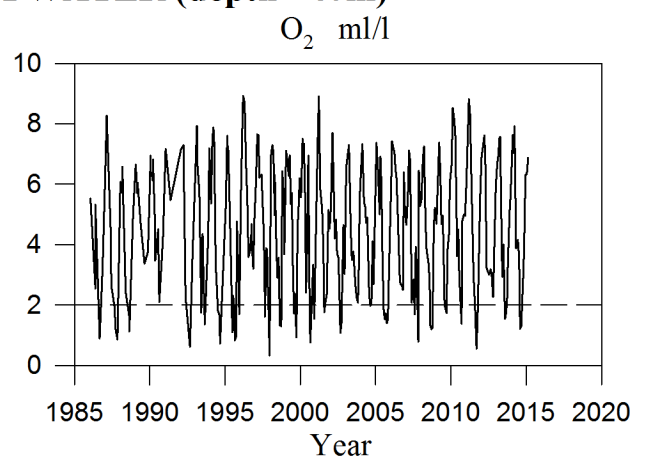
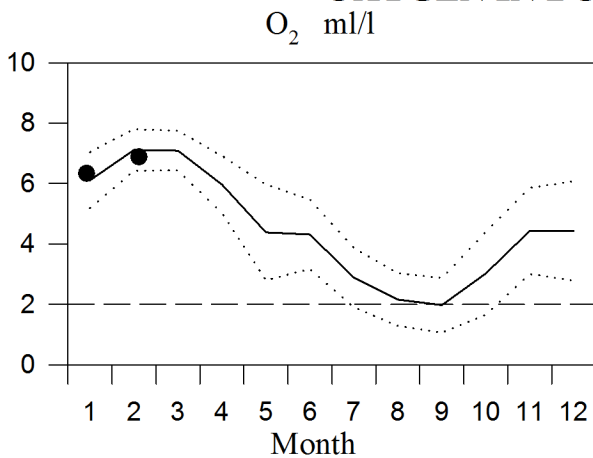
# STATION BY2 SURFACE WATER

## Annual Cycles

— Mean 1996-2010      ..... St.Dev.      ● 2015

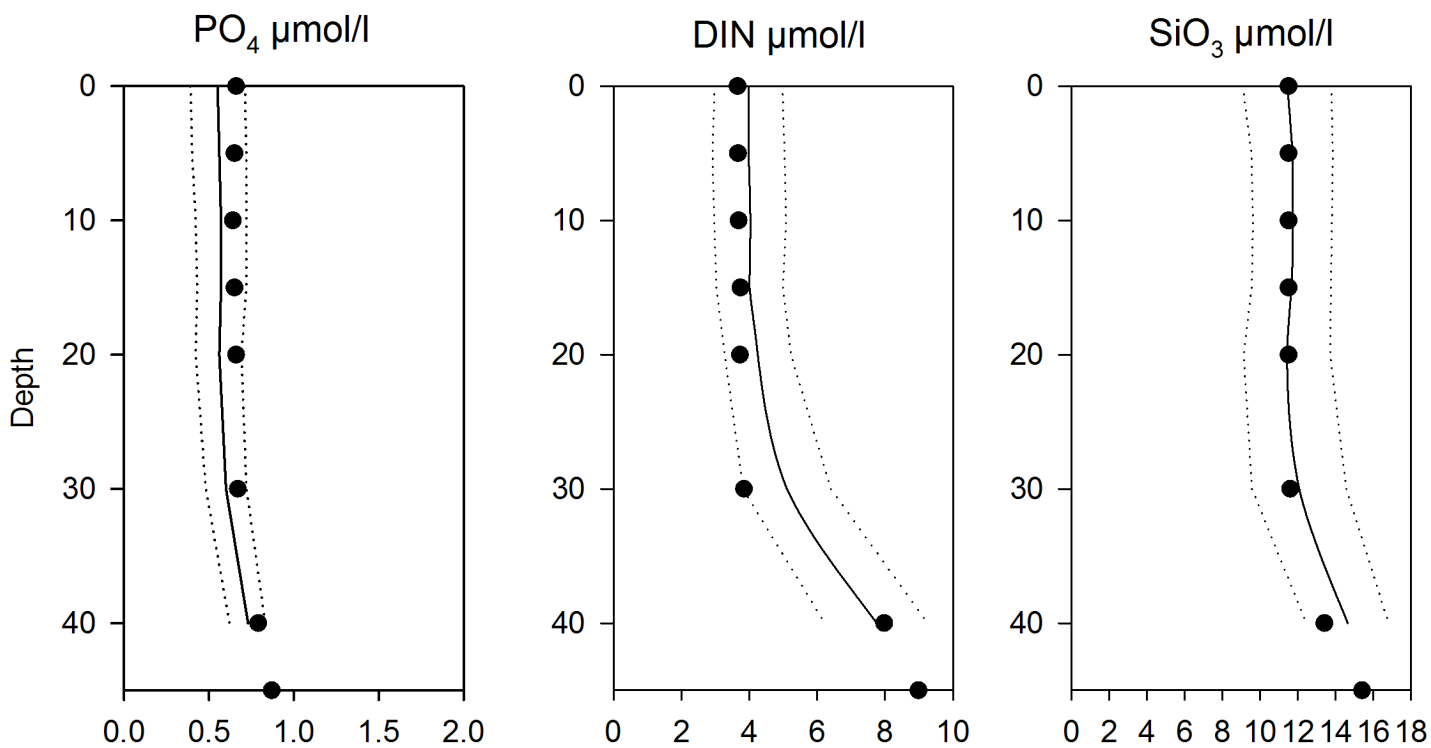
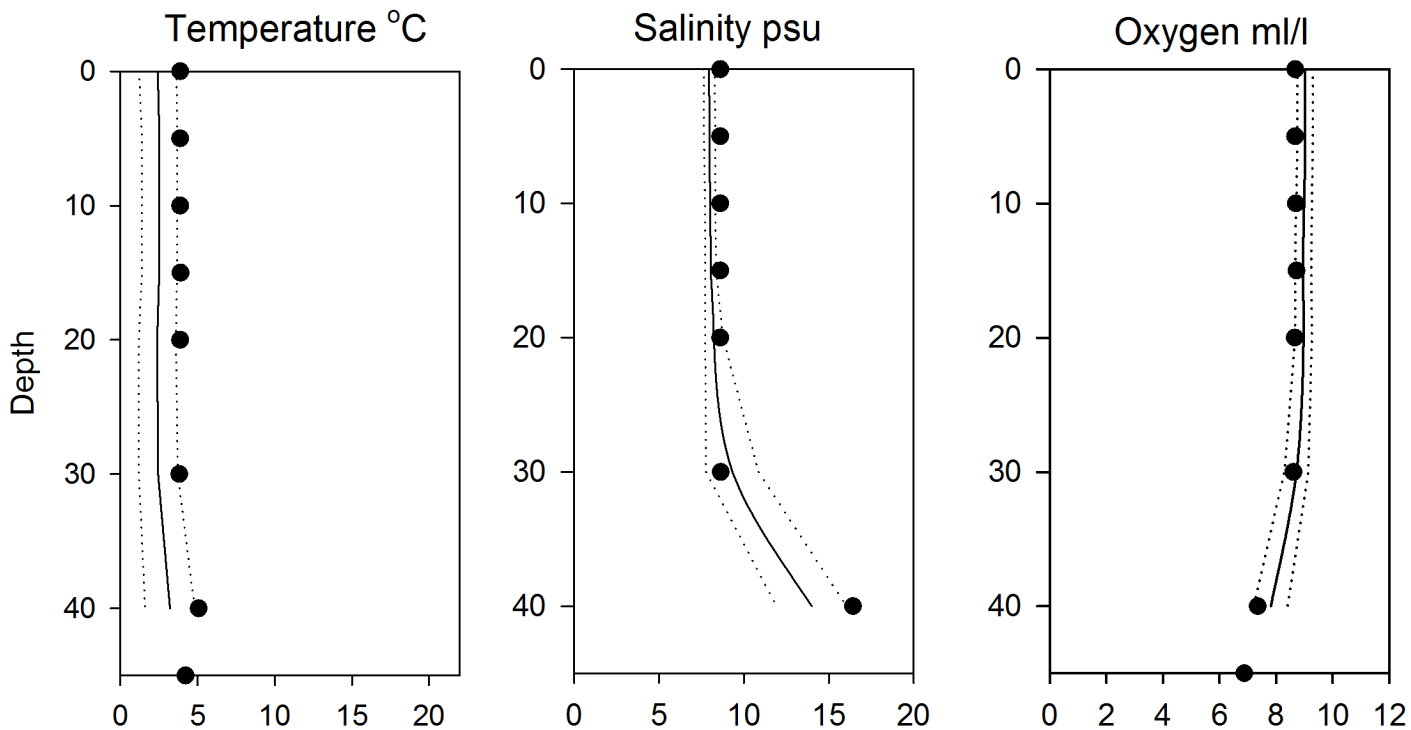


## OXYGEN IN BOTTOM WATER (depth >40m)



# Vertical profiles BY2 February

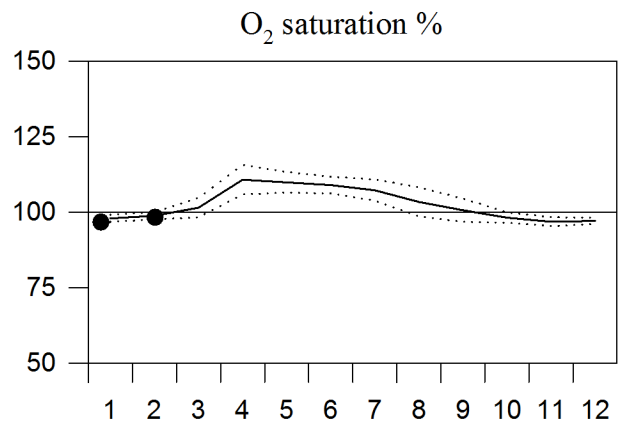
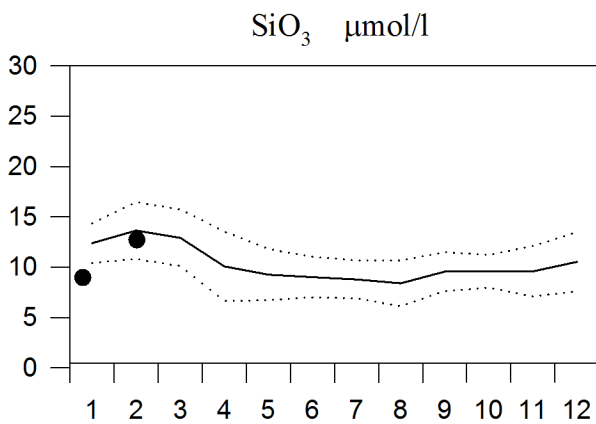
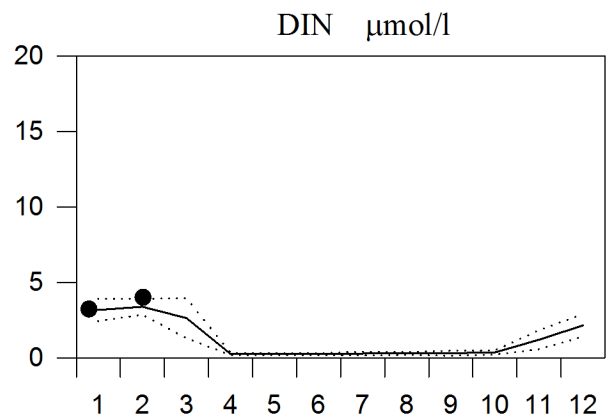
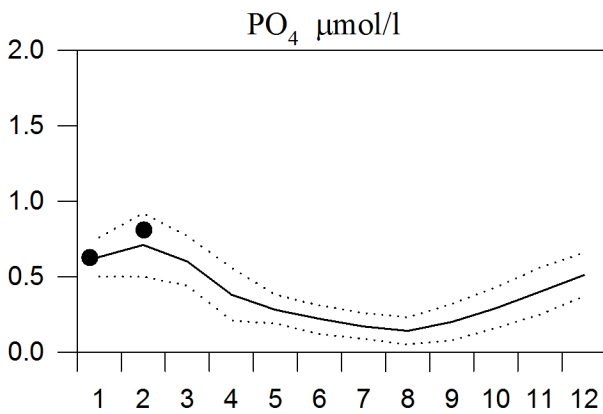
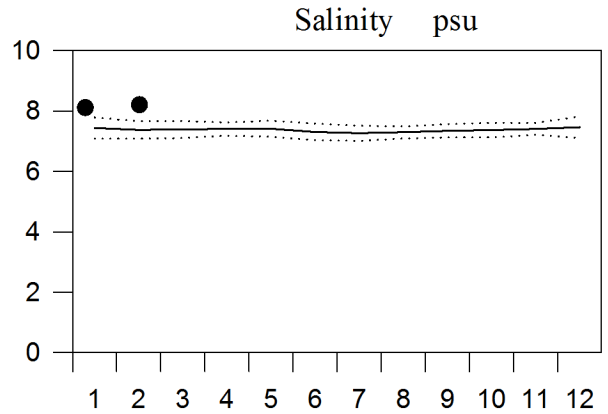
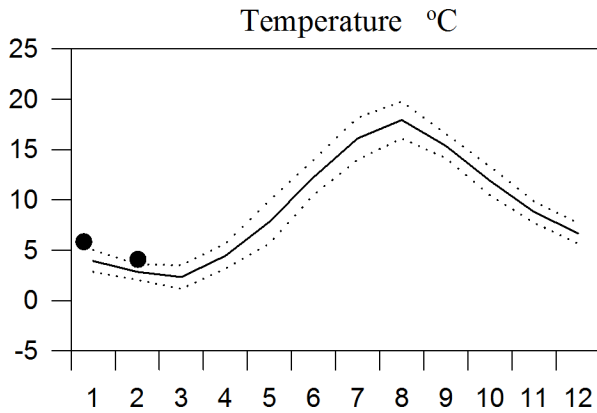
— Mean 1996-2010      ····· St.Dev.      ● 2015



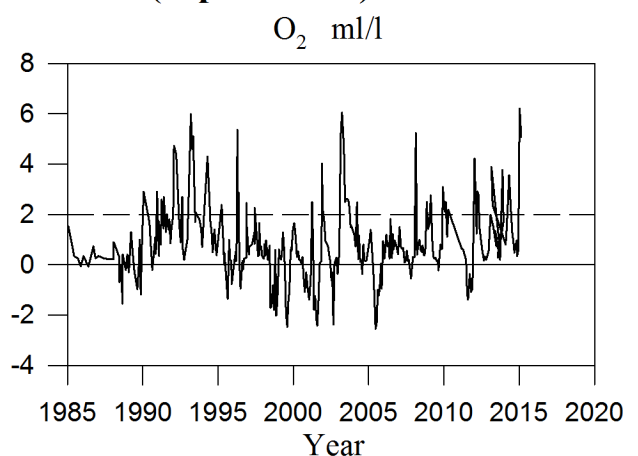
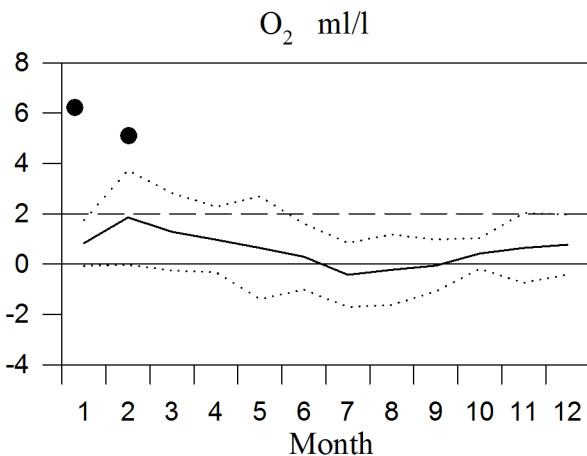
# STATION HANÖBUKTEN SURFACE WATER

## Annual Cycles

— Mean 1996-2010      ..... St.Dev.      ● 2015

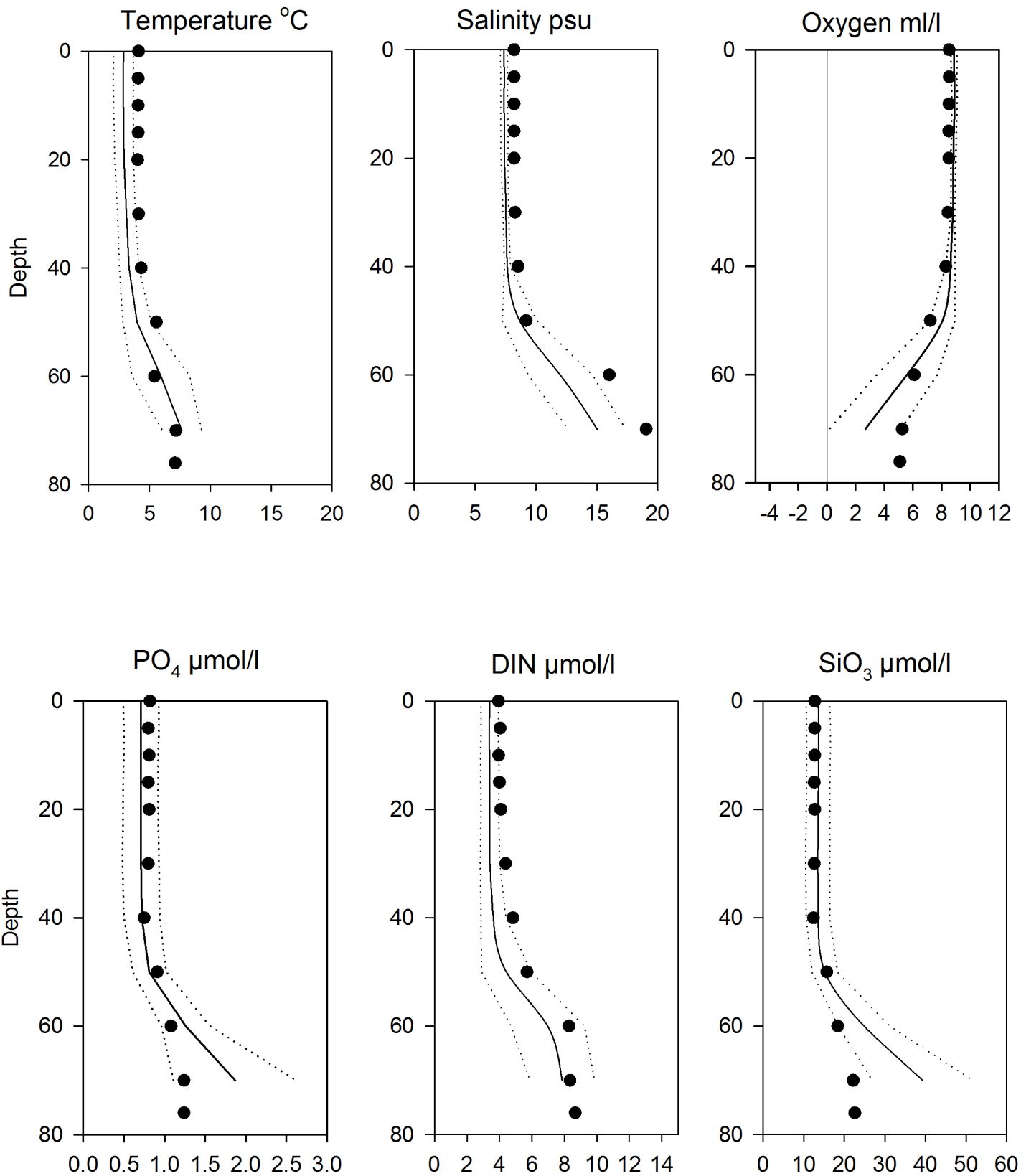


## OXYGEN IN BOTTOM WATER (depth > 70m)



# Vertical profiles Hanöbukten February

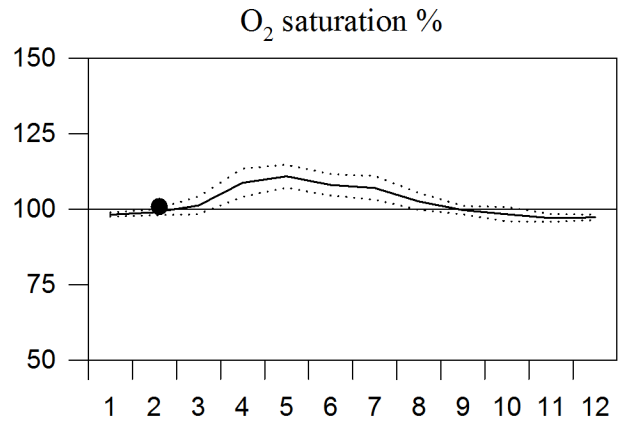
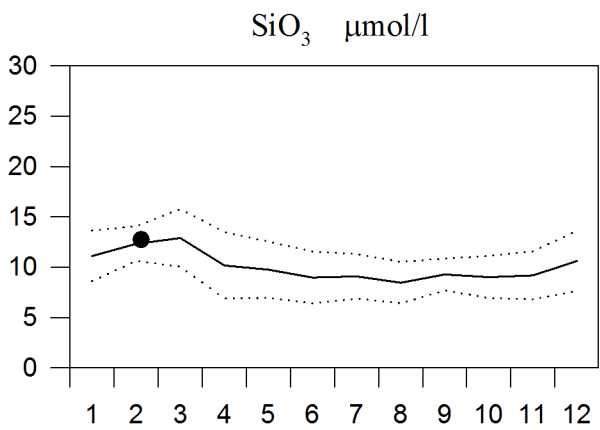
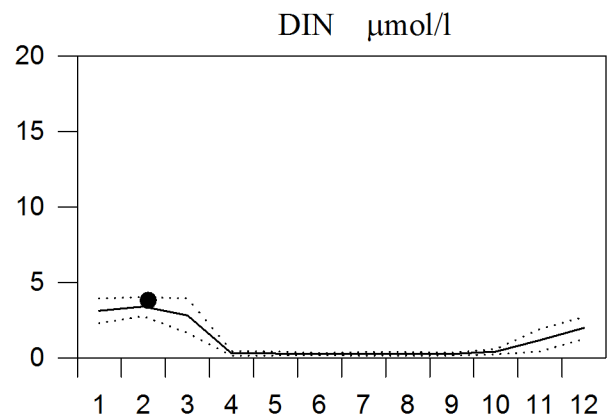
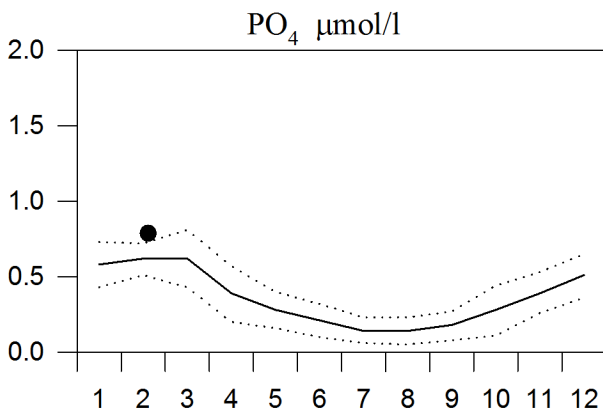
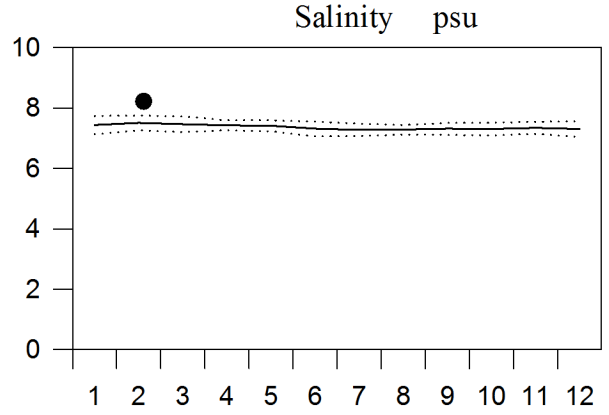
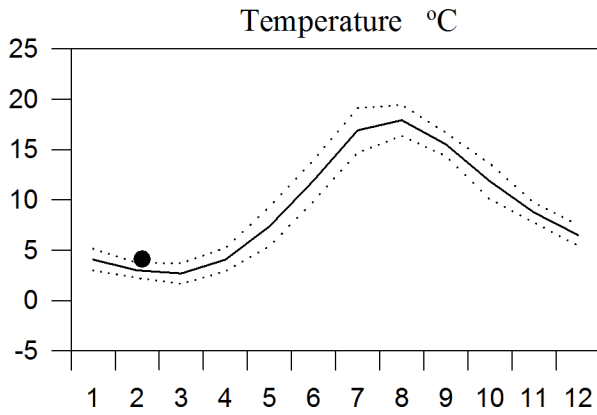
— Mean 1996-2010      ····· St.Dev.      ● 2015



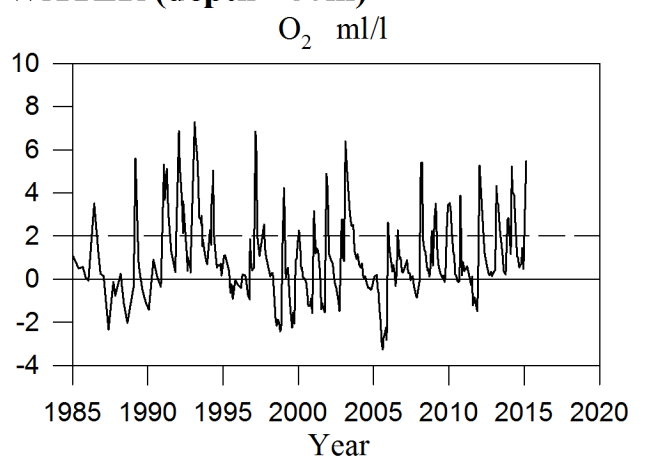
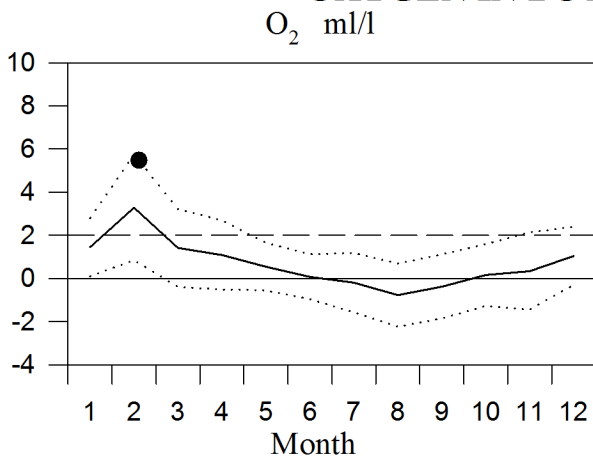
# STATION BY4 SURFACE WATER

## Annual Cycles

— Mean 1996-2010      ..... St.Dev.      ● 2015

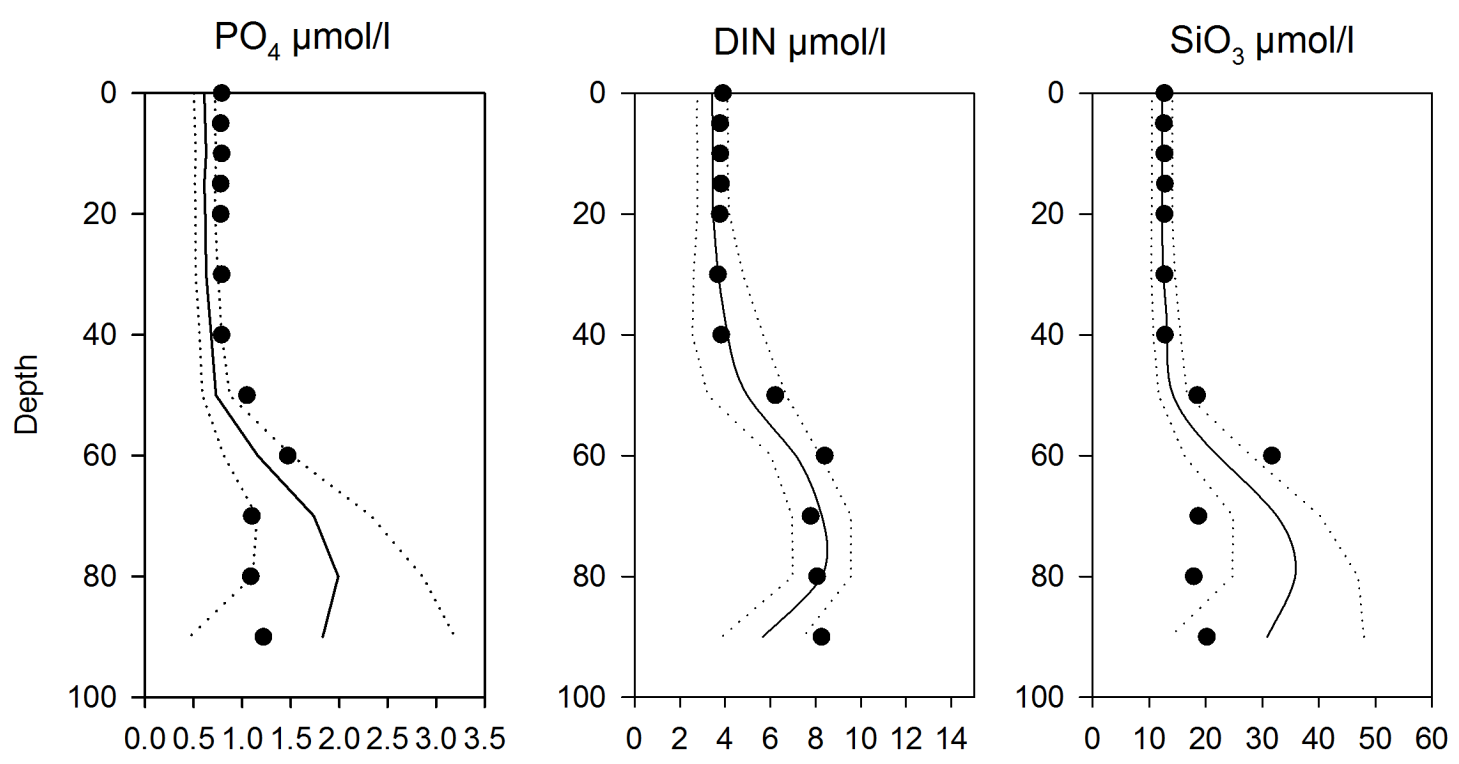
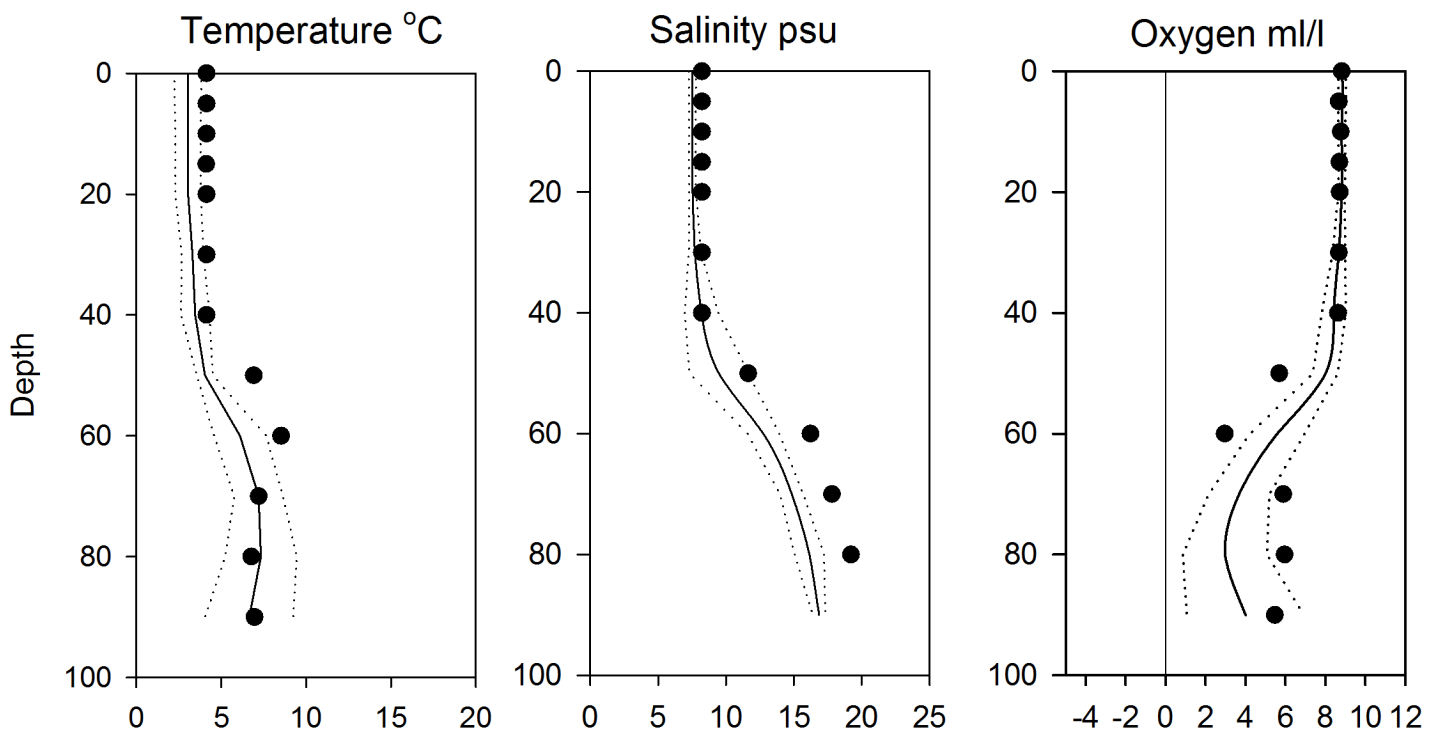


## OXYGEN IN BOTTOM WATER (depth >80m)



# Vertical profiles BY4 February

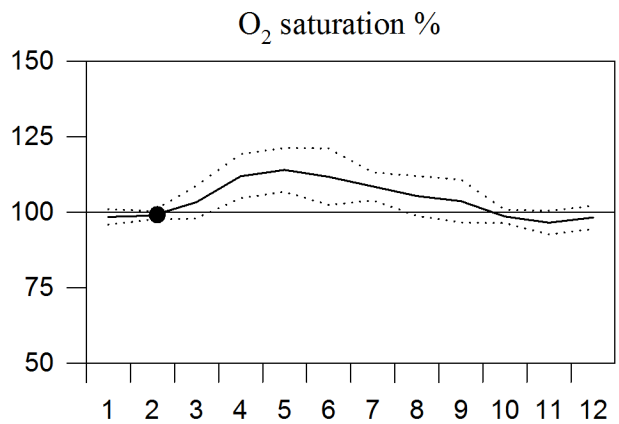
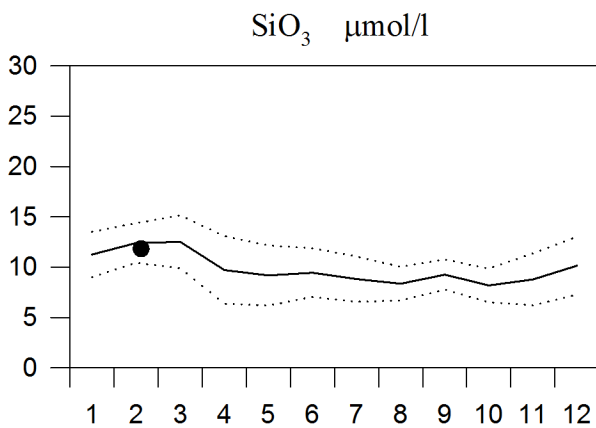
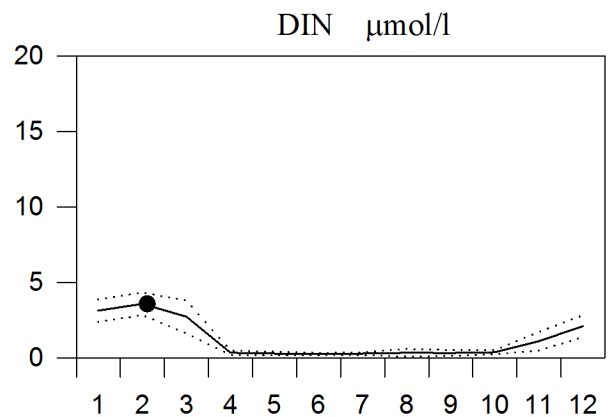
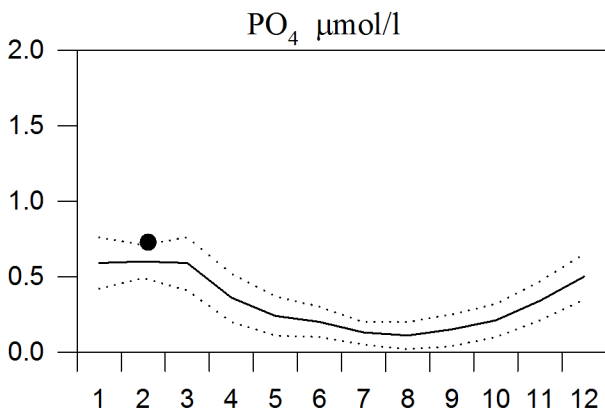
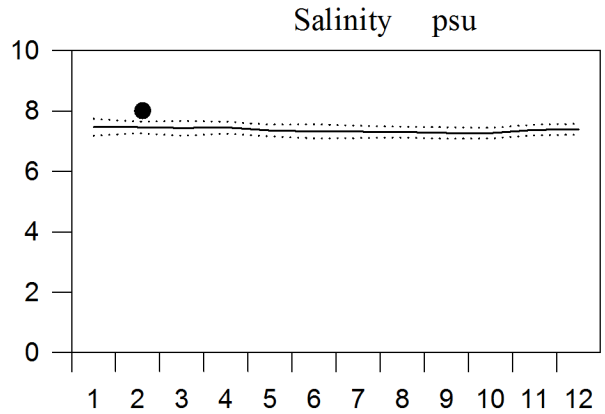
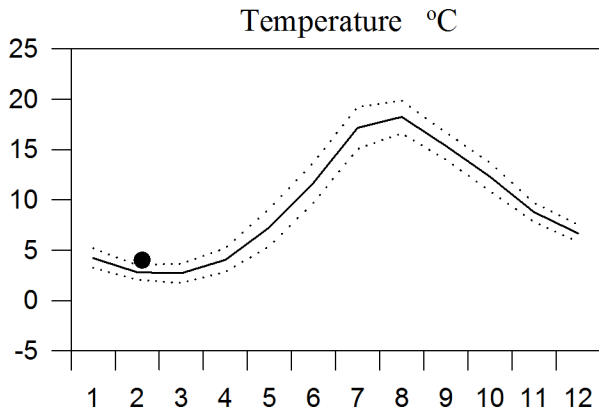
— Mean 1996-2010      ····· St.Dev.      ● 2015



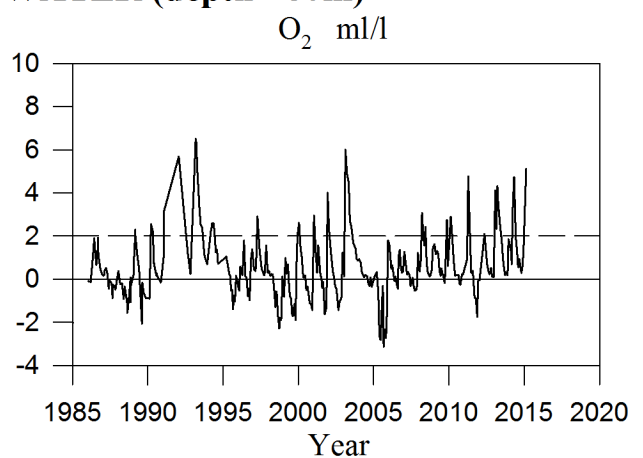
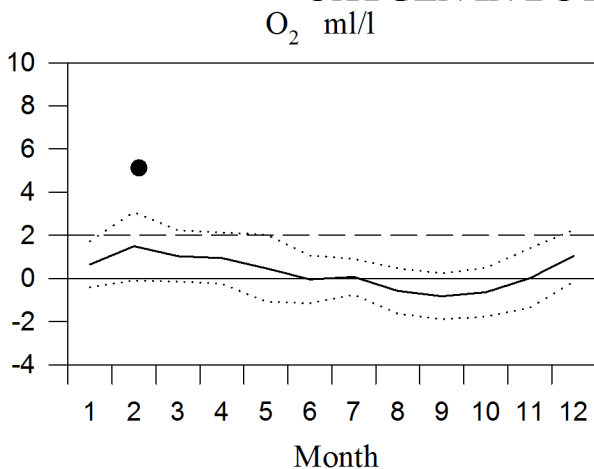
# STATION BY5 SURFACE WATER

## Annual Cycles

— Mean 1996-2010      ····· St.Dev.      ● 2015

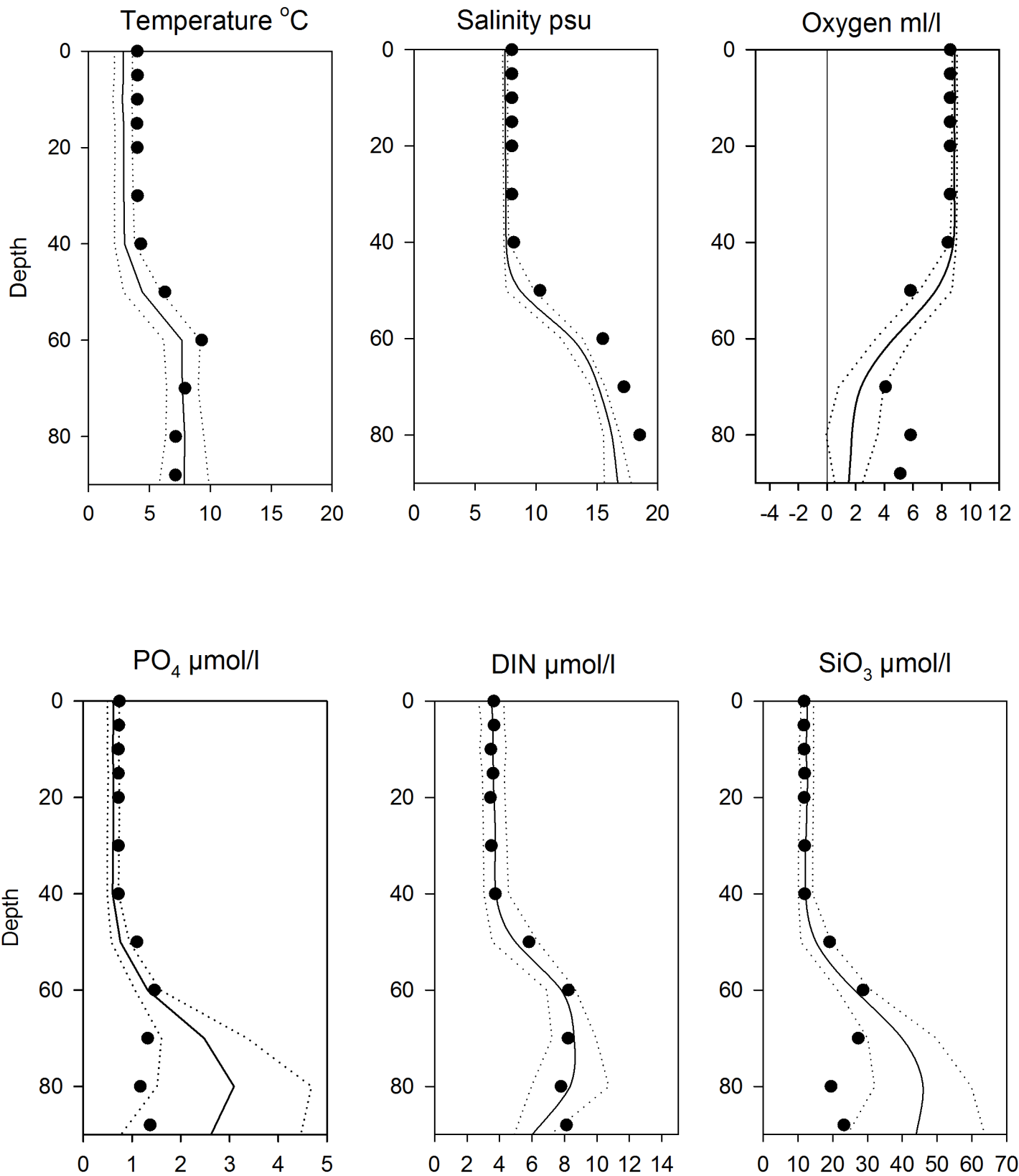


## OXYGEN IN BOTTOM WATER (depth >80m)



# Vertical profiles BY5 February

— Mean 1996-2010      ····· St.Dev.      ● 2015

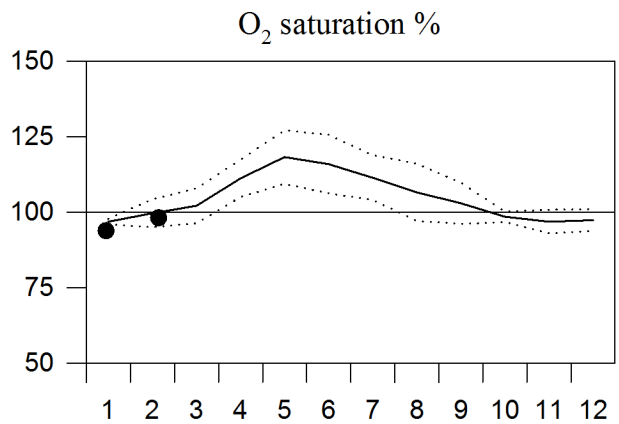
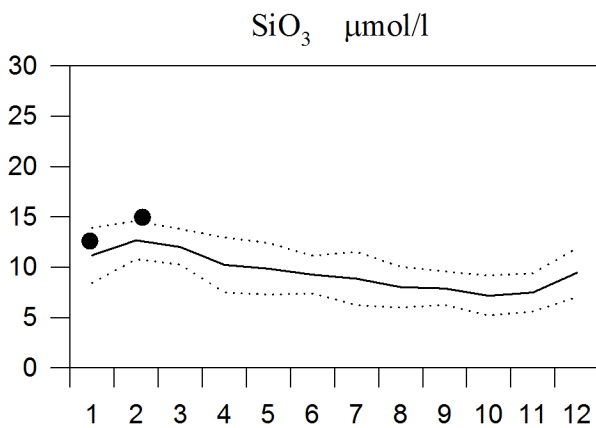
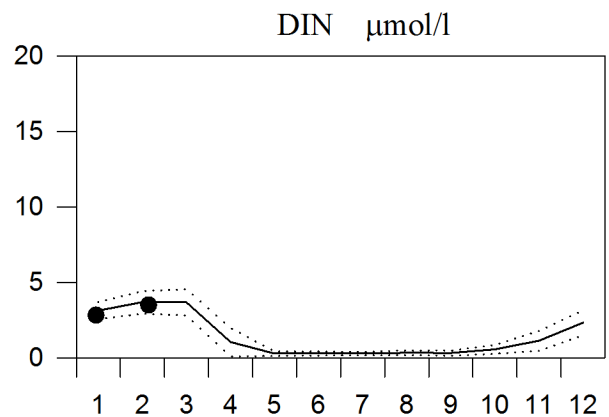
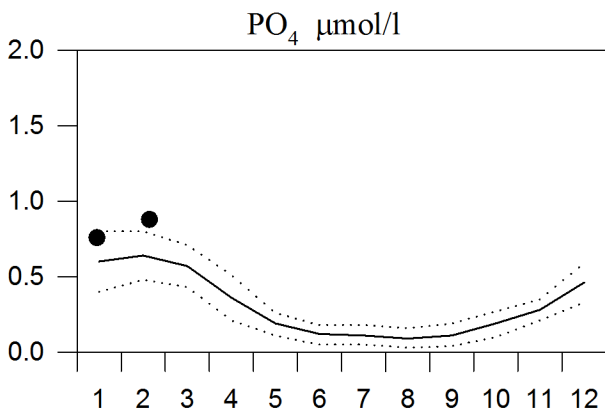
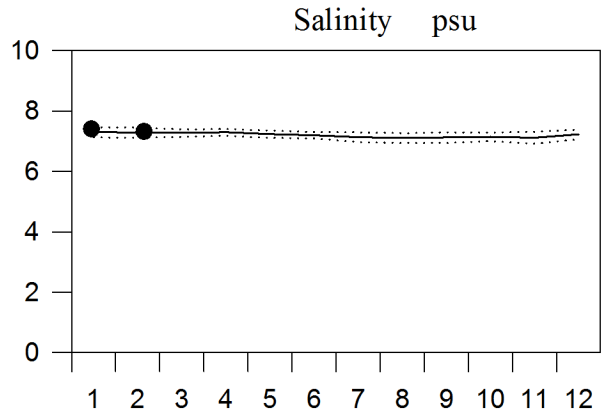
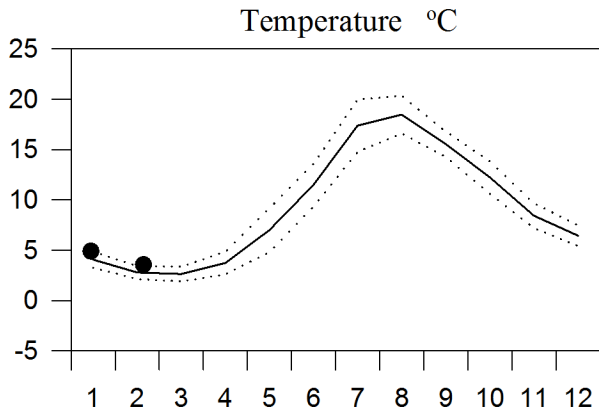




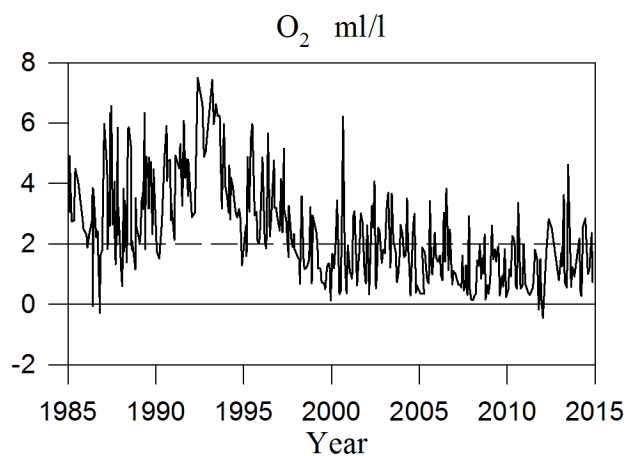
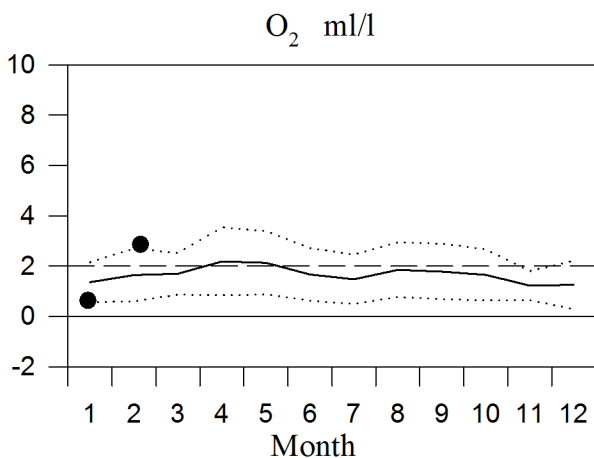
# STATION BCS III-10 SURFACE WATER

## Annual Cycles

— Mean 1996-2010      ..... St.Dev.      ● 2015

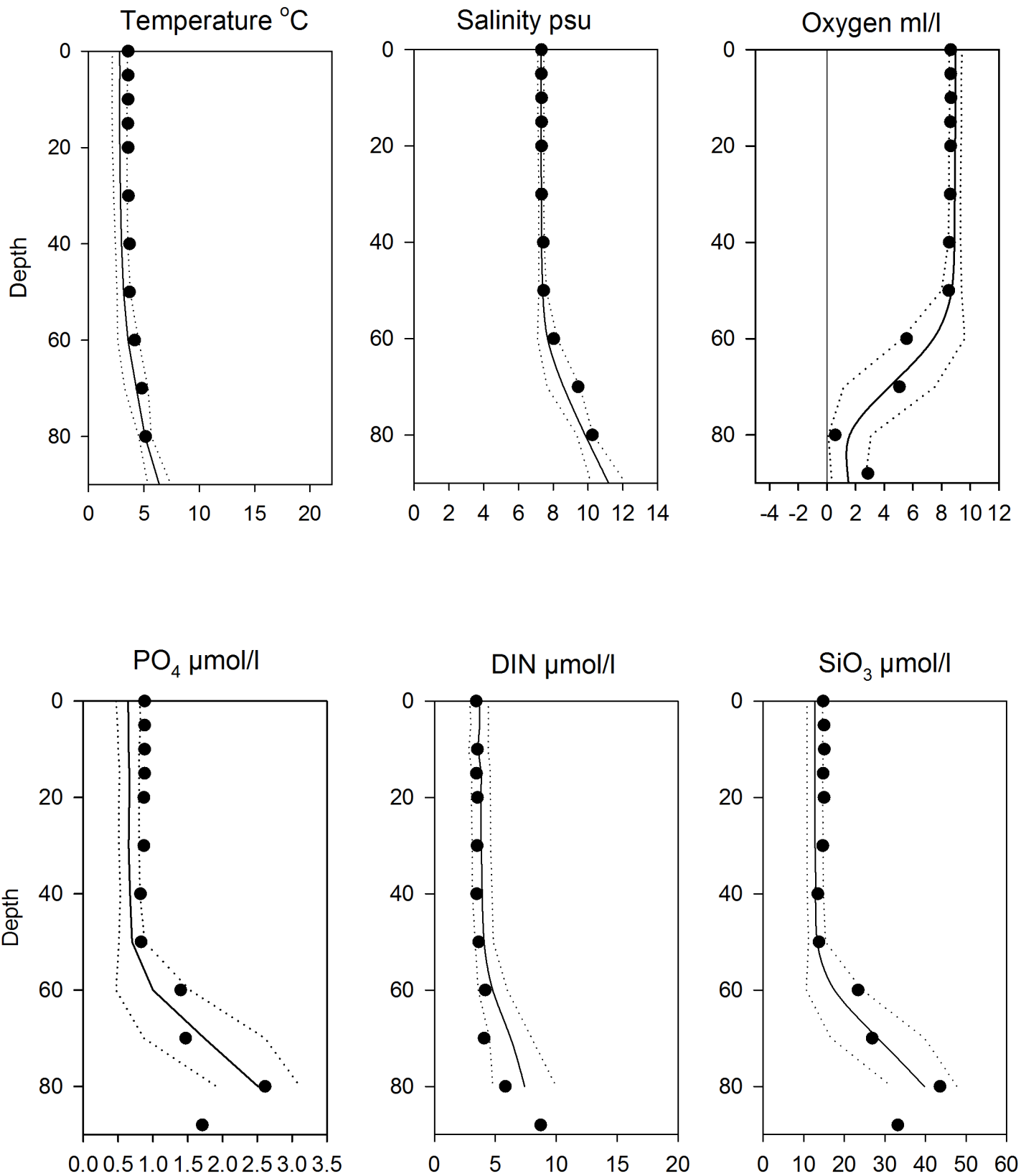


## OXYGEN IN BOTTOM WATER (depth > 80m)



# Vertical profiles BCS III-10 February

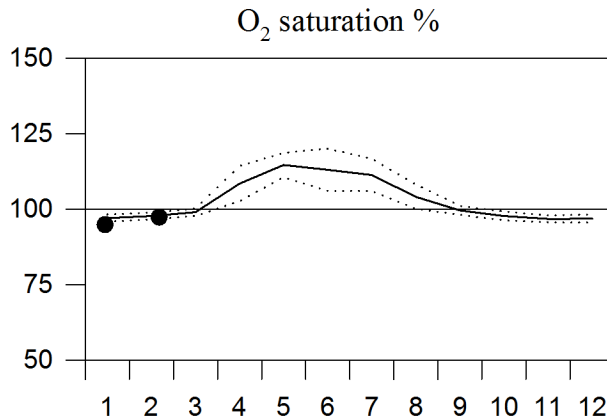
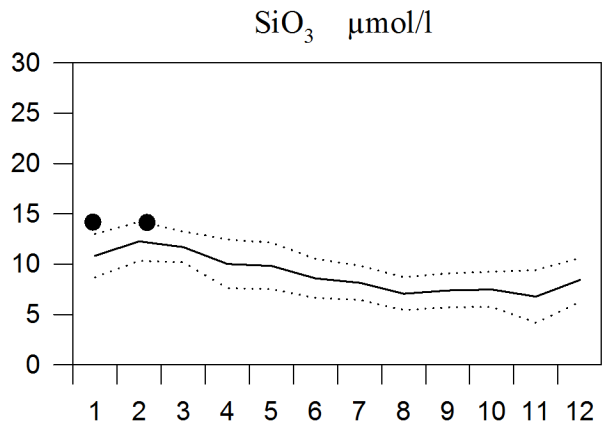
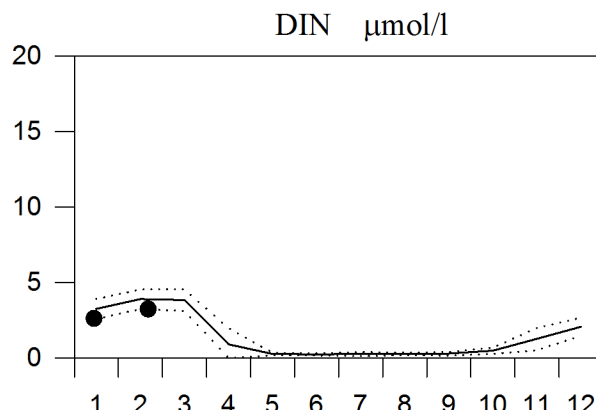
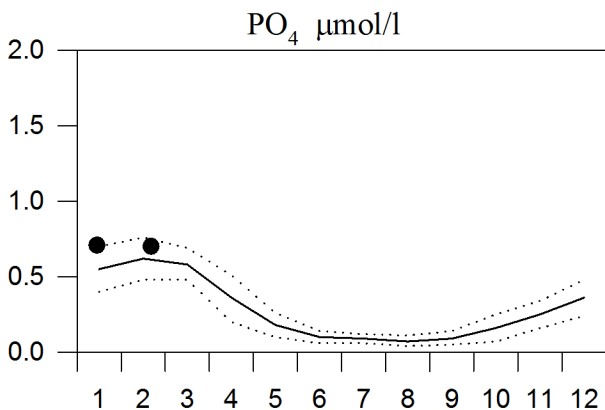
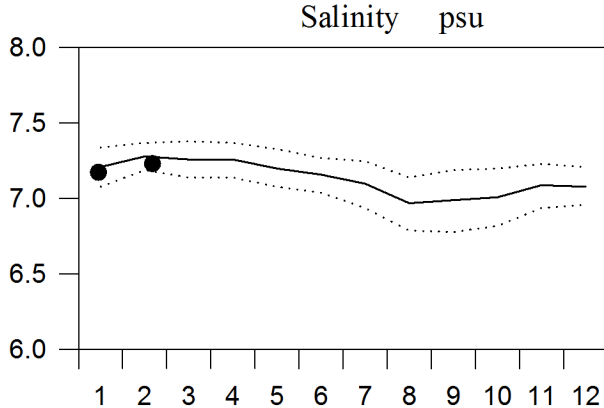
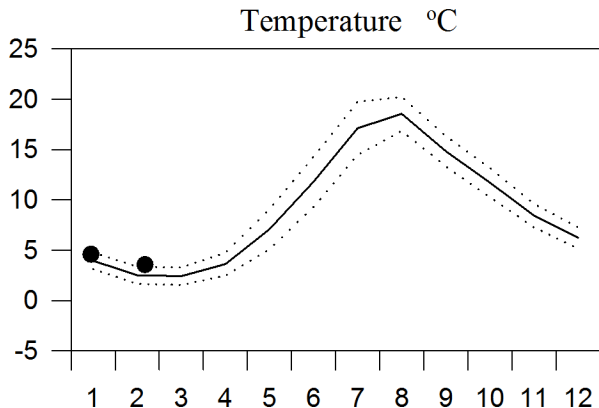
— Mean 1996-2010      ..... St.Dev.      ● 2015



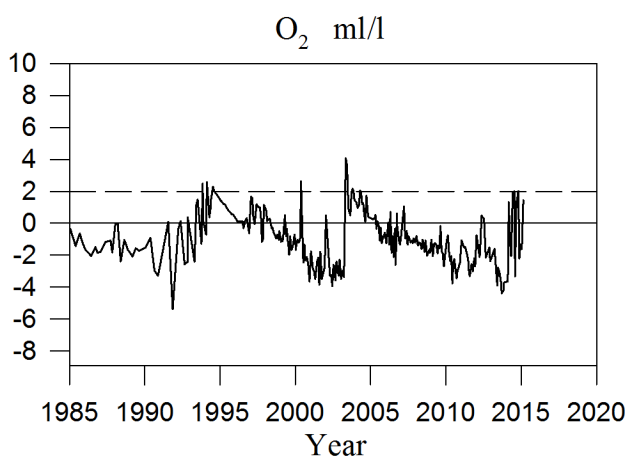
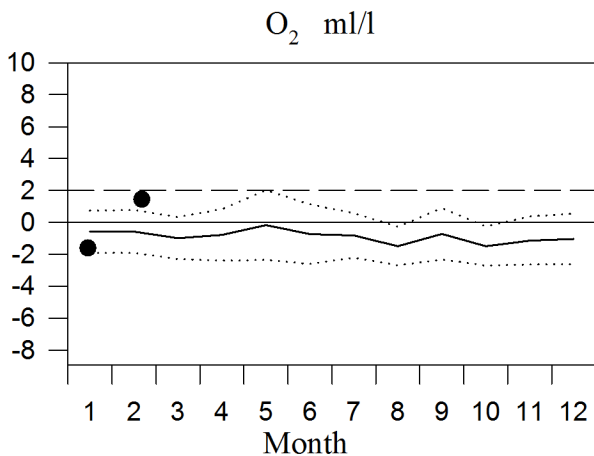
# STATION BY10 SURFACE WATER

## Annual Cycles

— Mean 1996-2010      ..... St.Dev.      ● 2015

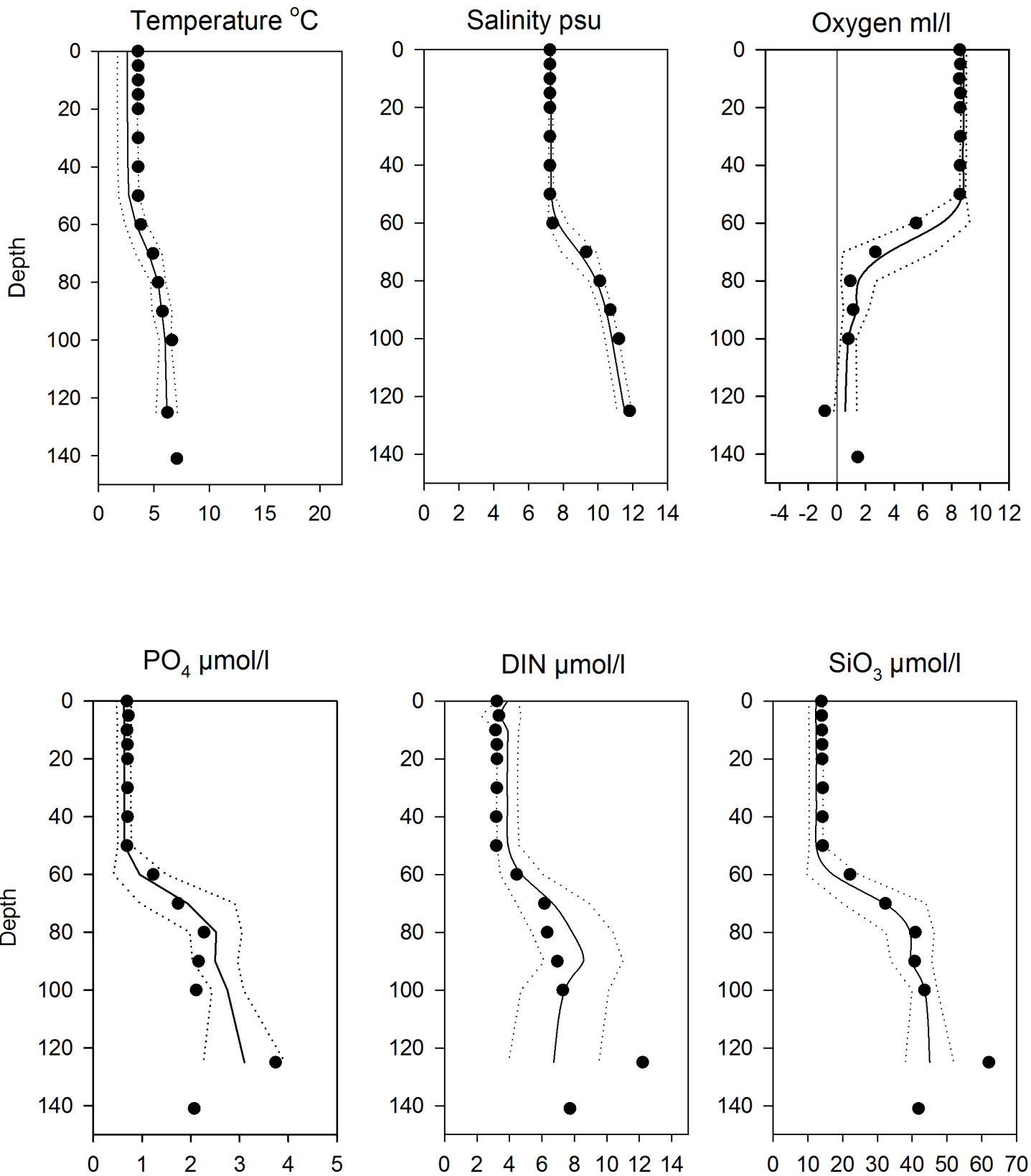


## OXYGEN IN BOTTOM WATER (depth >125m)



# Vertical profiles BY10 February

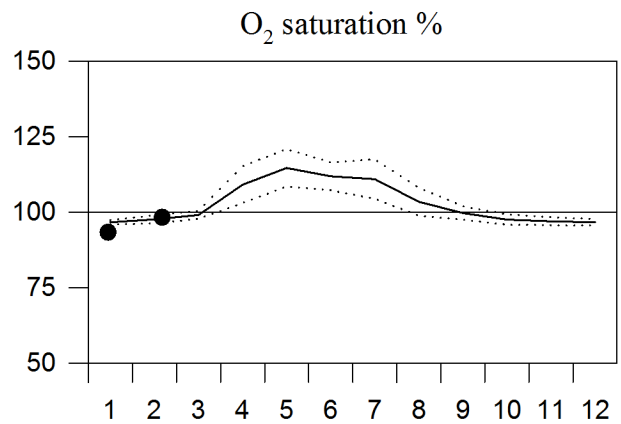
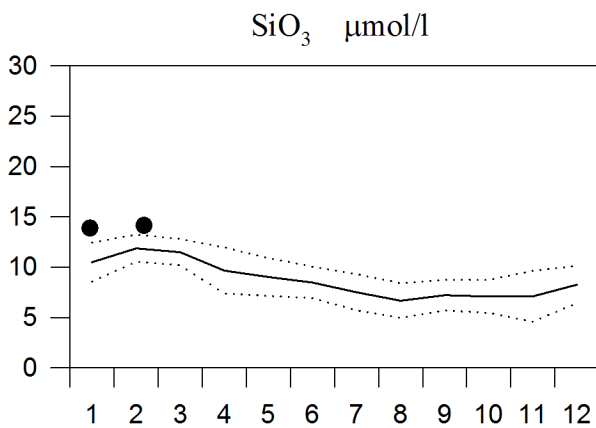
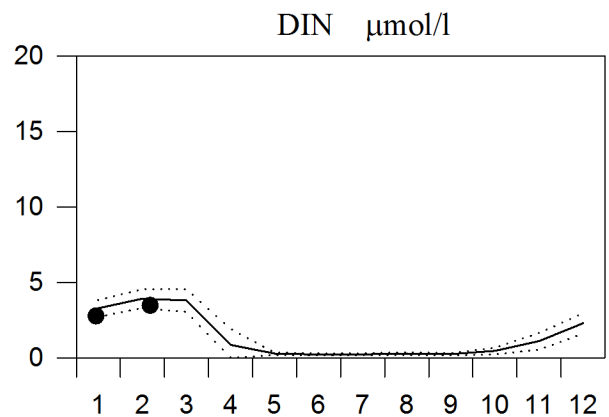
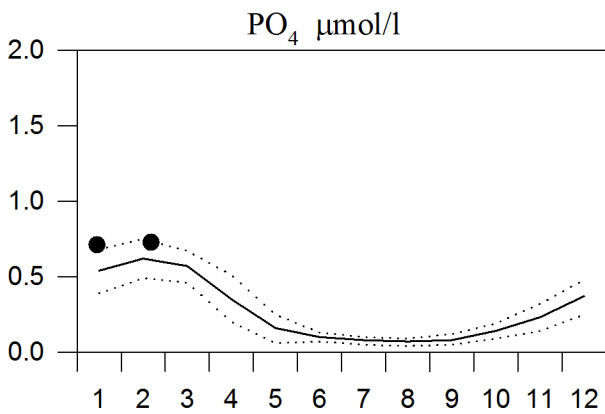
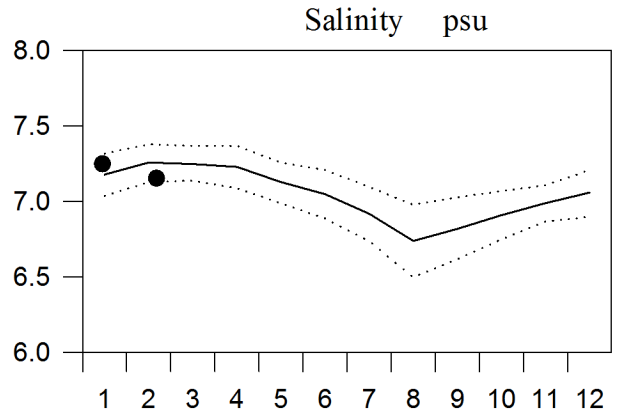
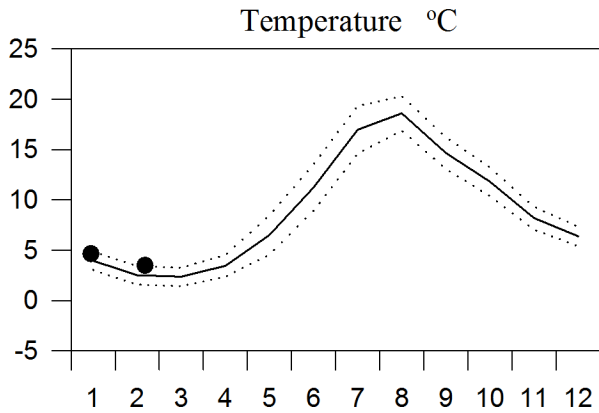
— Mean 1996-2010      ····· St.Dev.      ● 2015



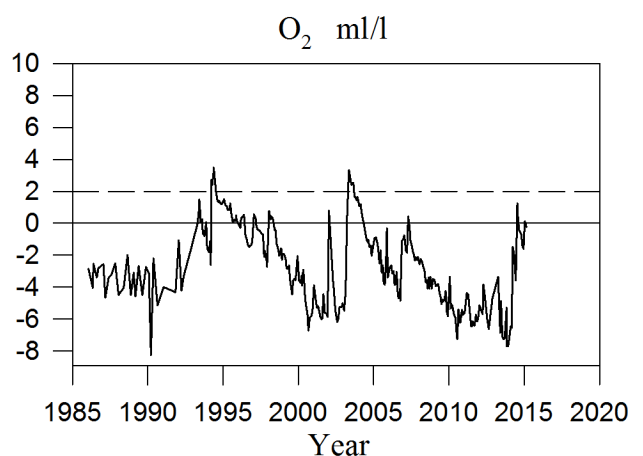
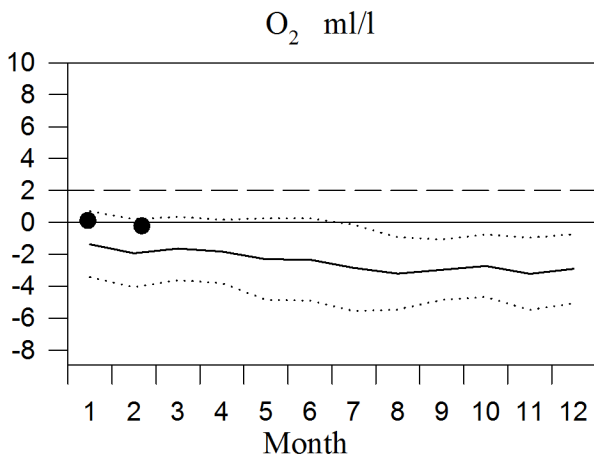
# STATION BY15 SURFACE WATER

## Annual Cycles

— Mean 1996-2010      ..... St.Dev.      ● 2015

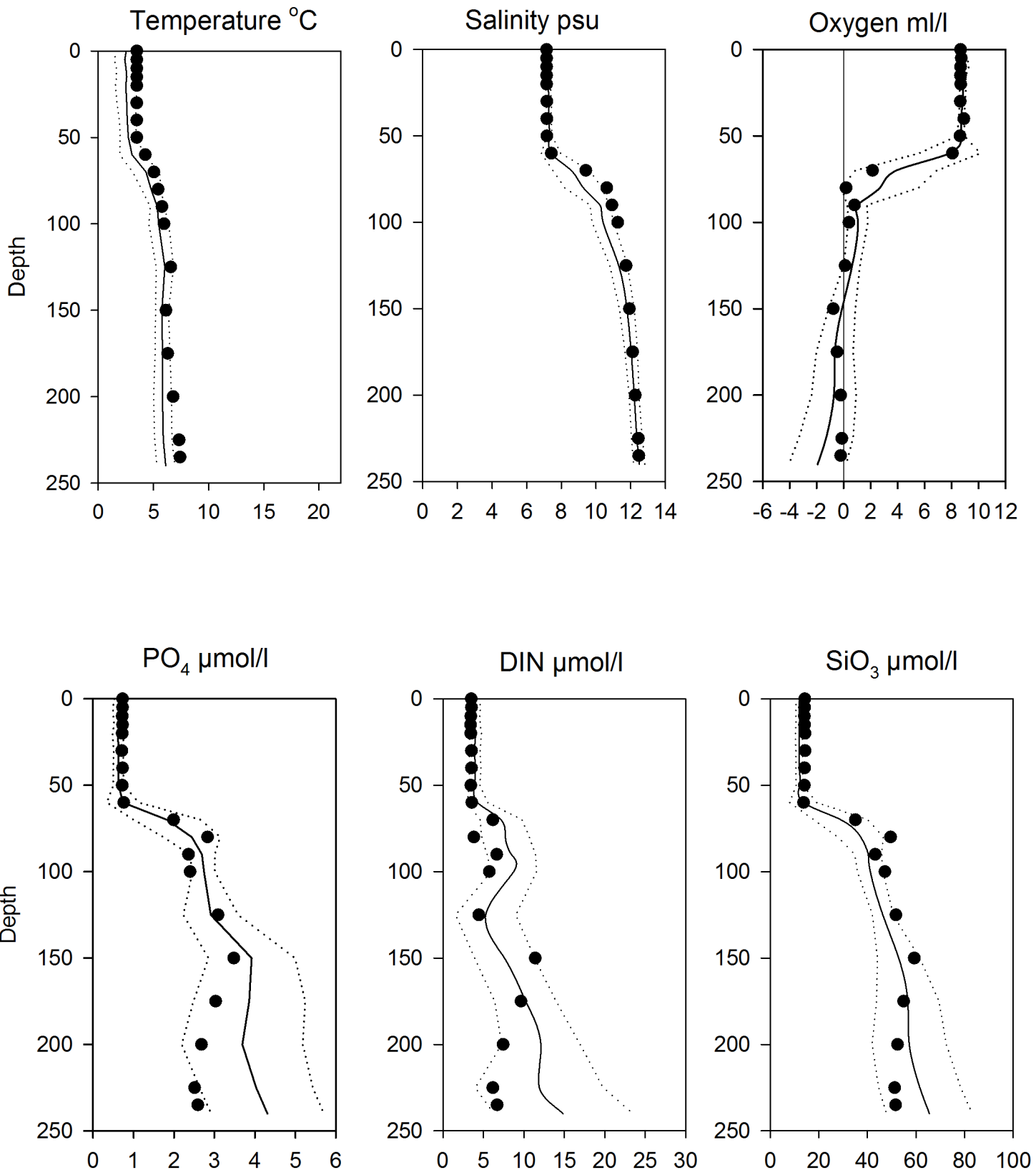


## OXYGEN IN BOTTOM WATER (depth >225m)



# Vertical profiles BY15 February

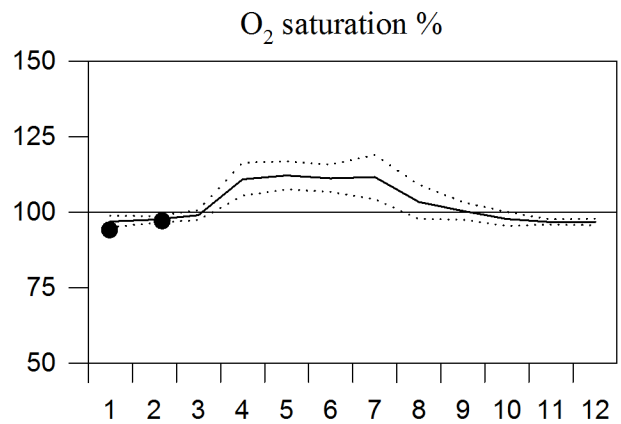
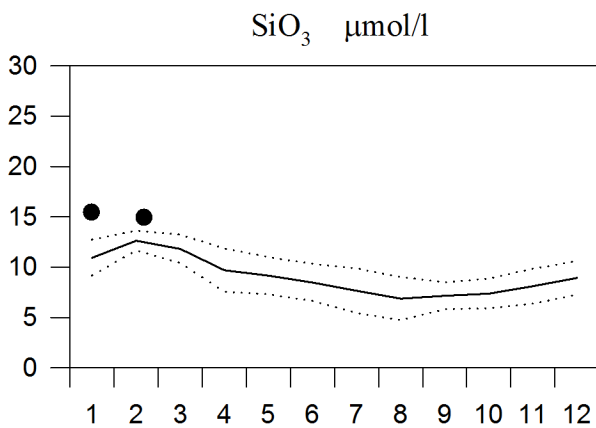
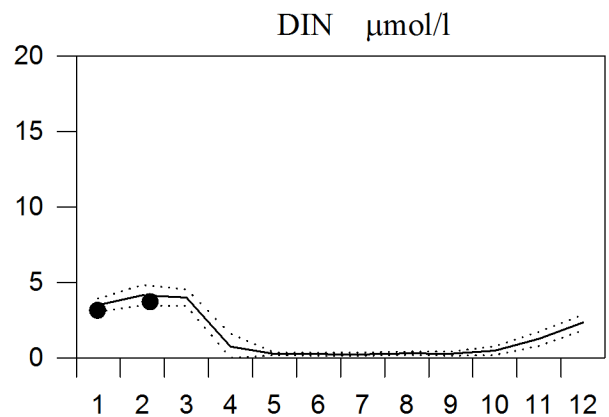
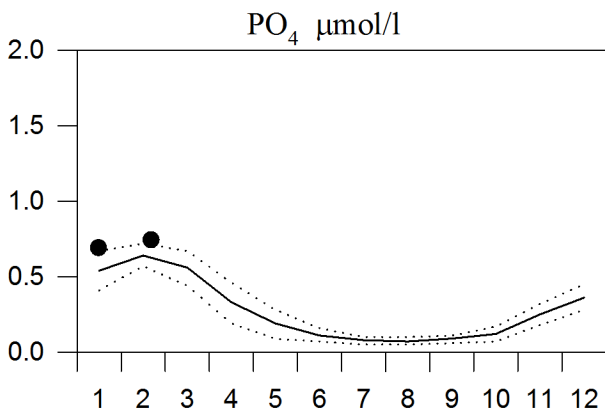
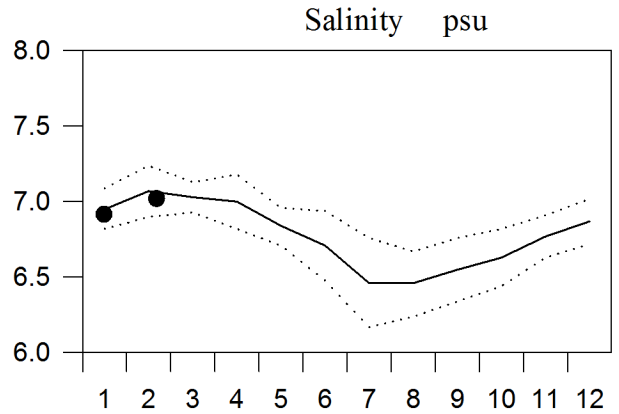
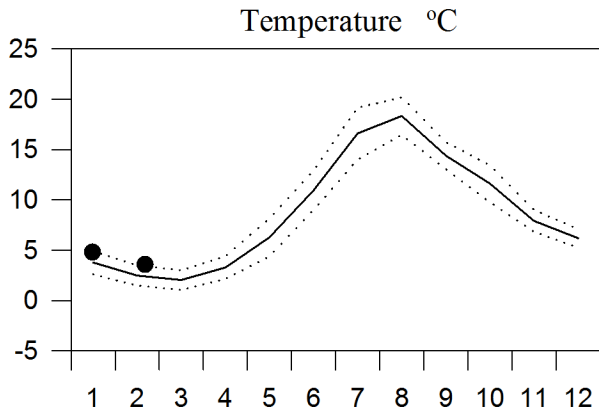
— Mean 1996-2010      ····· St.Dev.      ● 2015



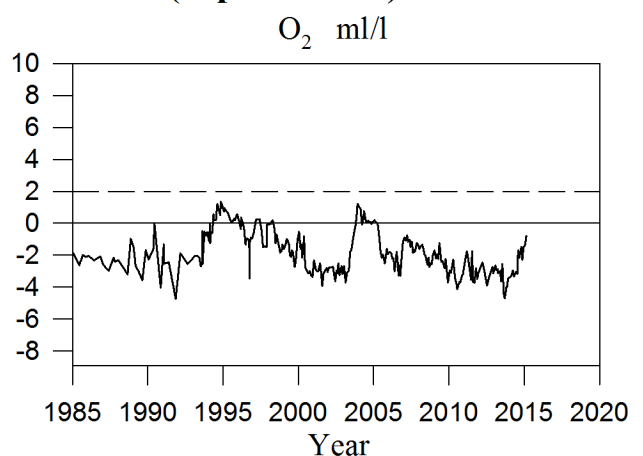
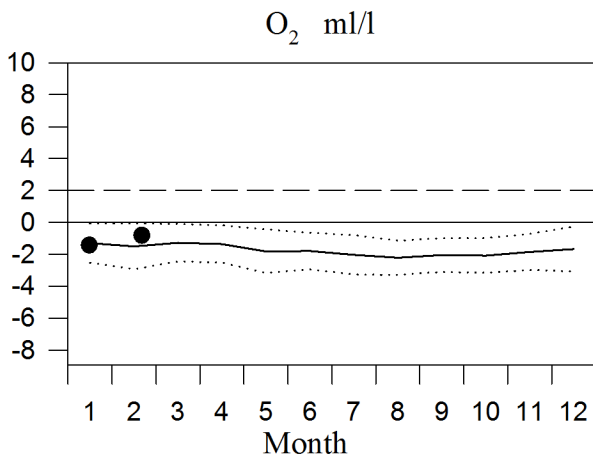
# STATION BY20 SURFACE WATER

## Annual Cycles

— Mean 1996-2010      ..... St.Dev.      ● 2015

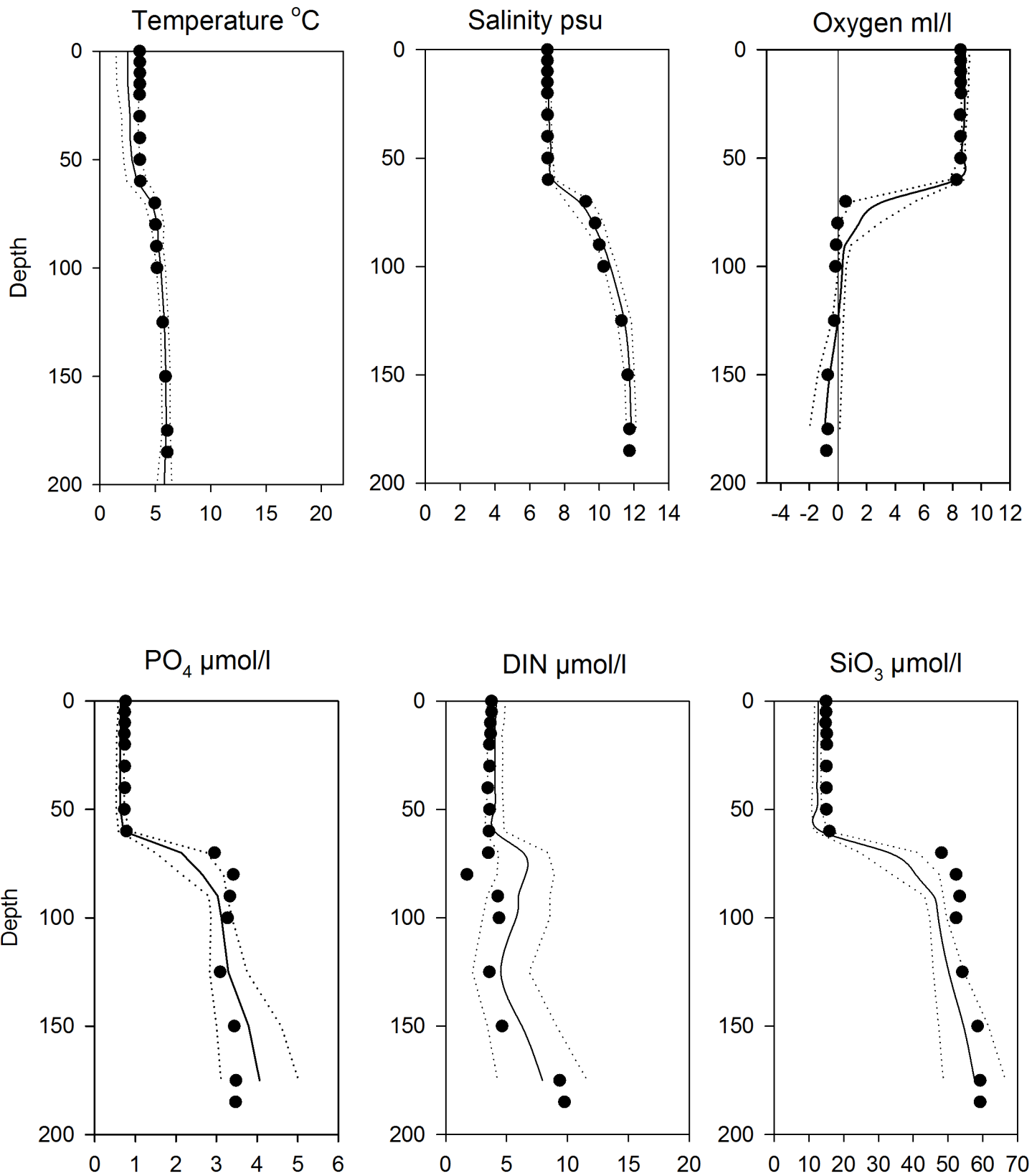


## OXYGEN IN BOTTOM WATER (depth >175m)



# Vertical profiles BY20 February

— Mean 1996-2010      ····· St.Dev.      ● 2015

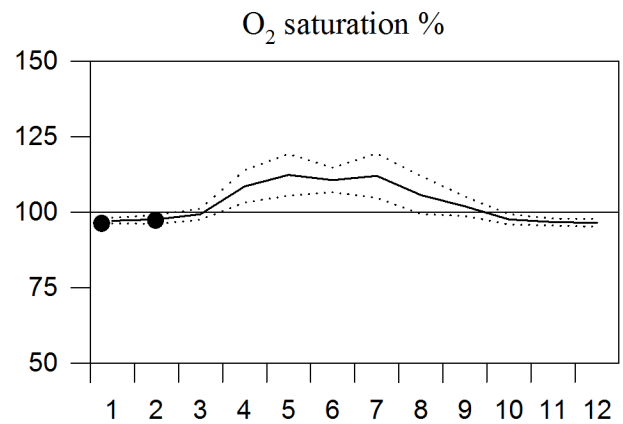
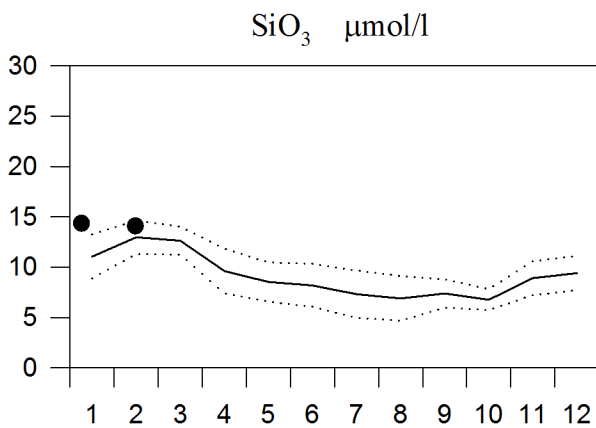
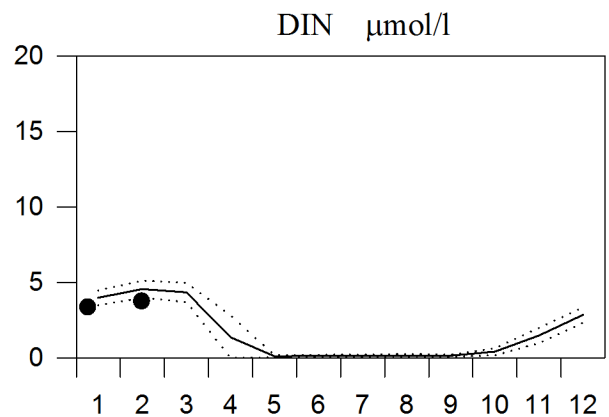
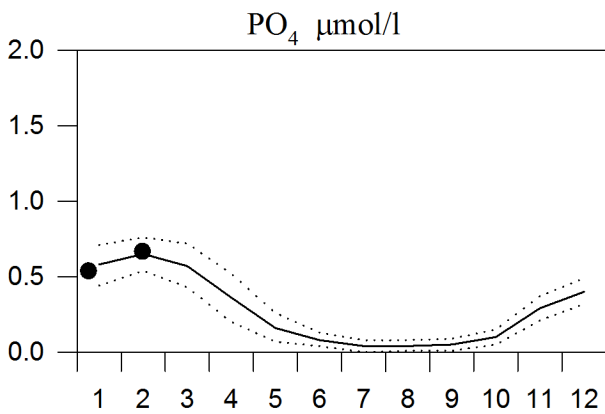
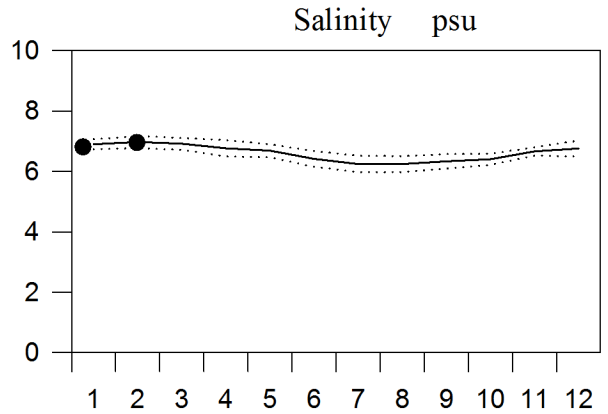
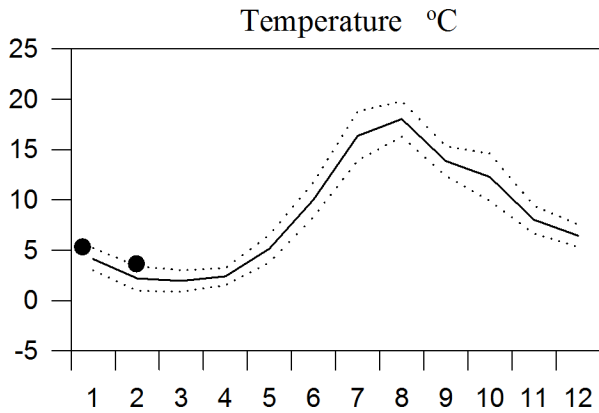




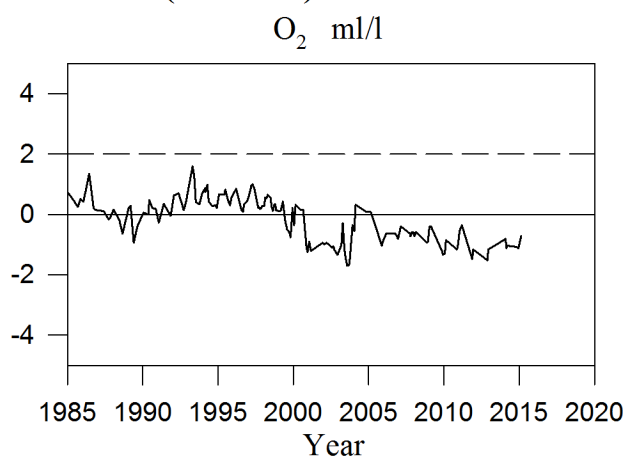
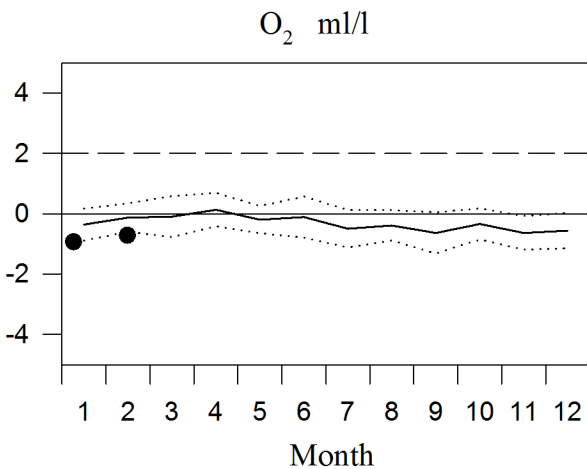
# STATION BY29 SURFACE WATER

## Annual Cycles

— Mean 1996-2010      ..... St.Dev.      ● 2015

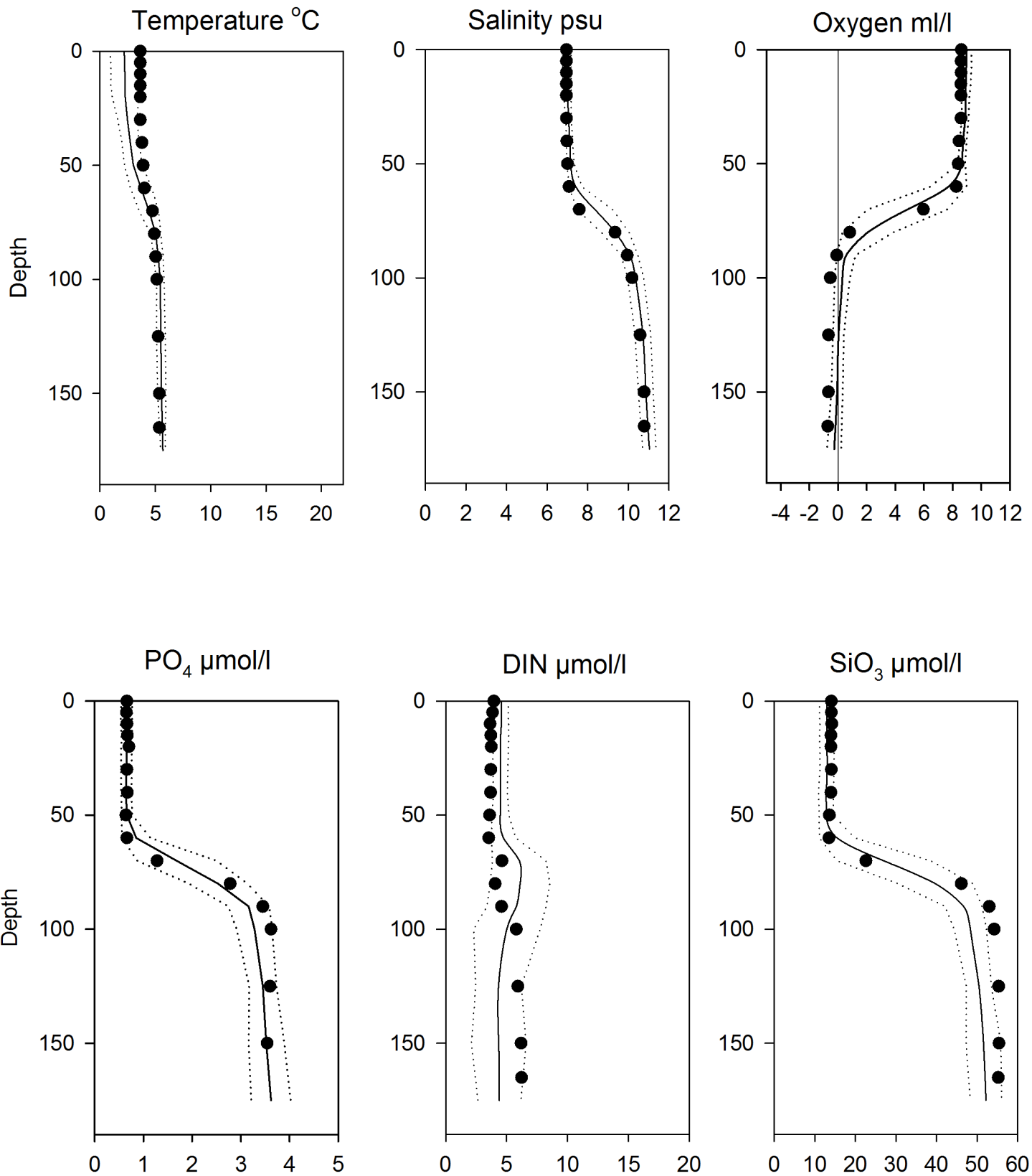


## OXYGEN IN BOTTOM WATER (>=150m)



# Vertical profiles BY29 February

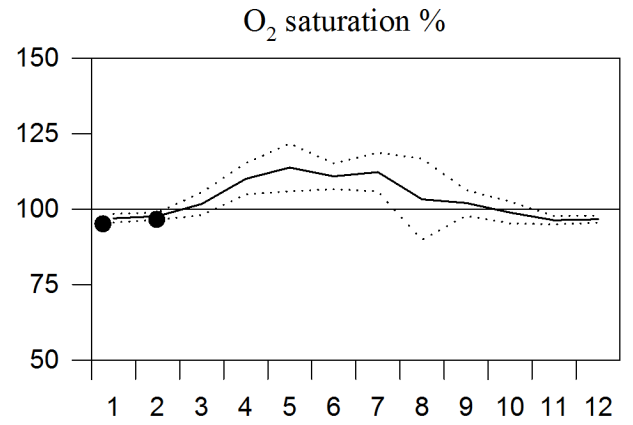
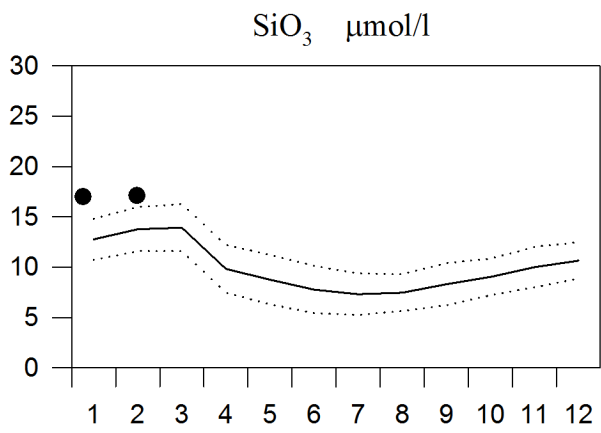
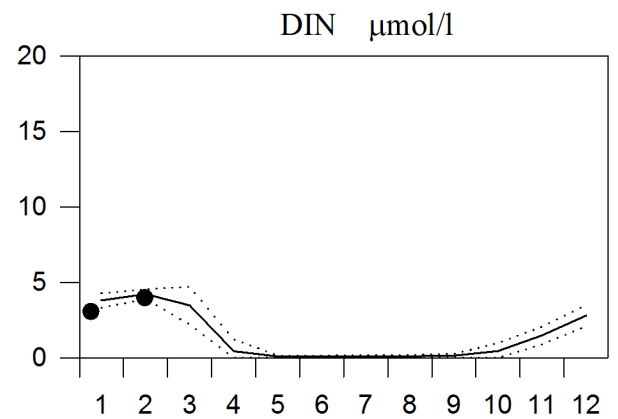
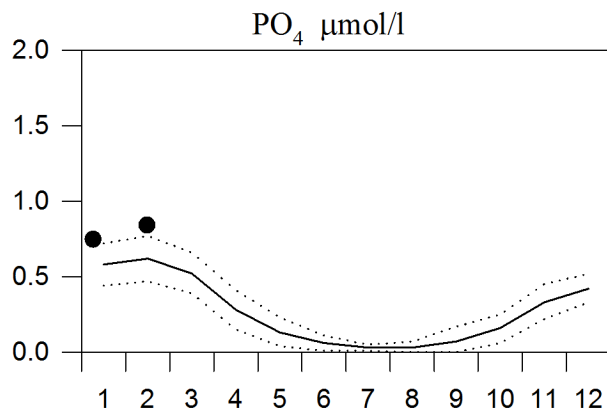
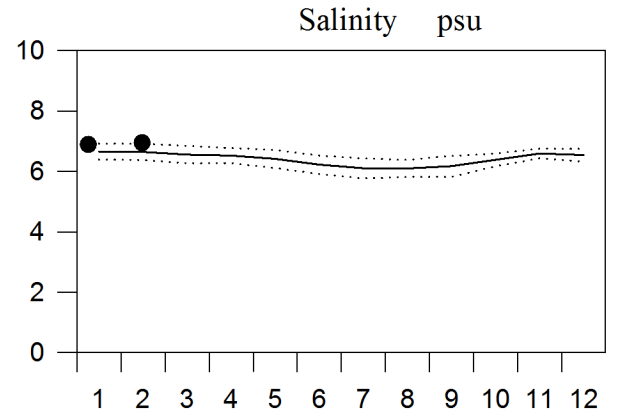
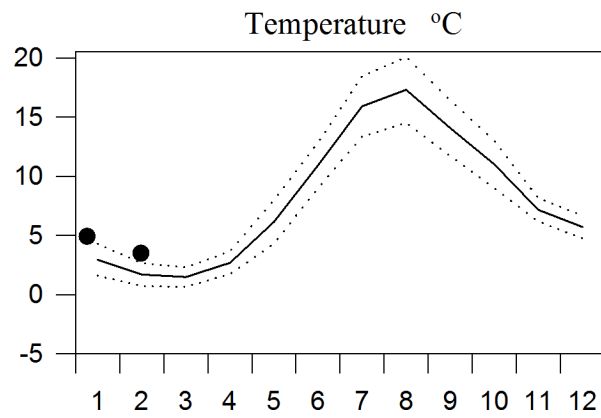
— Mean 1996-2010      ····· St.Dev.      ● 2015



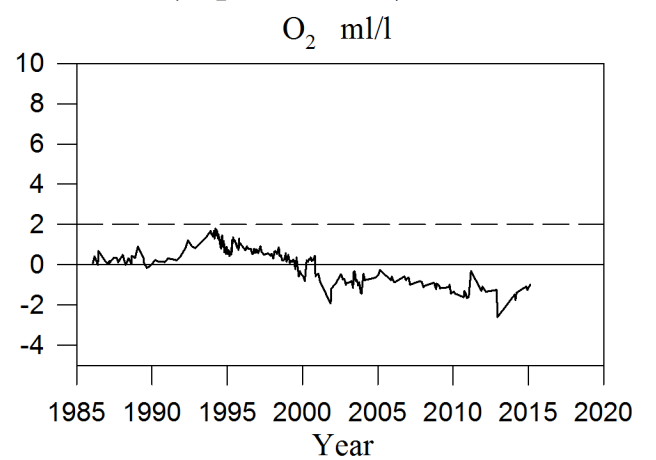
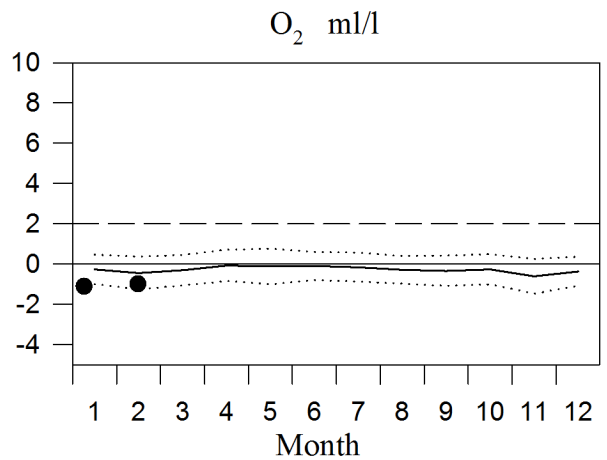
# STATION BY31 SURFACE WATER

## Annual Cycles

— Mean 1996-2010    ..... St.Dev.    ● 2015

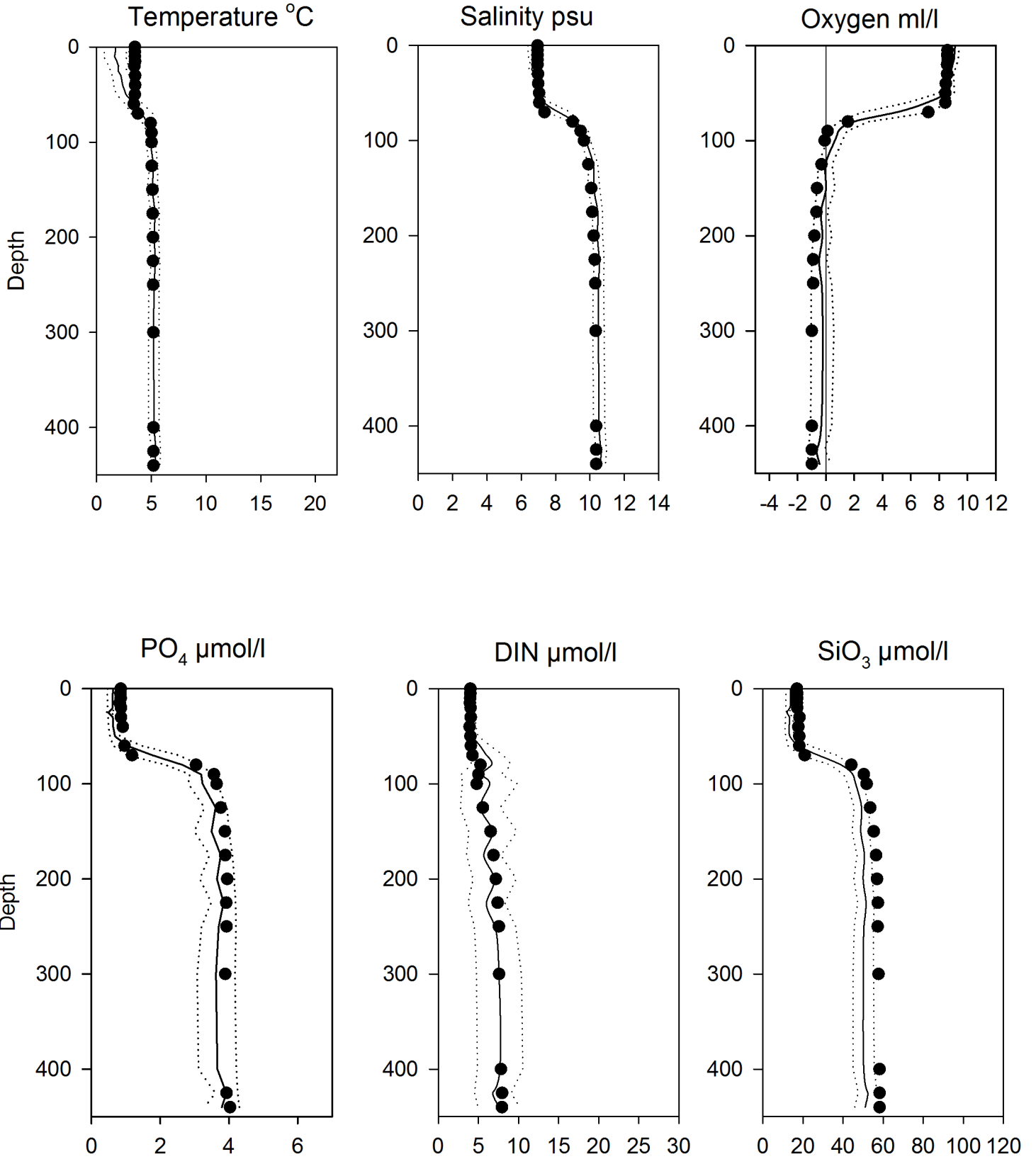


## OXYGEN IN BOTTOM WATER (depth = 440m)



# Vertical profiles BY31 February

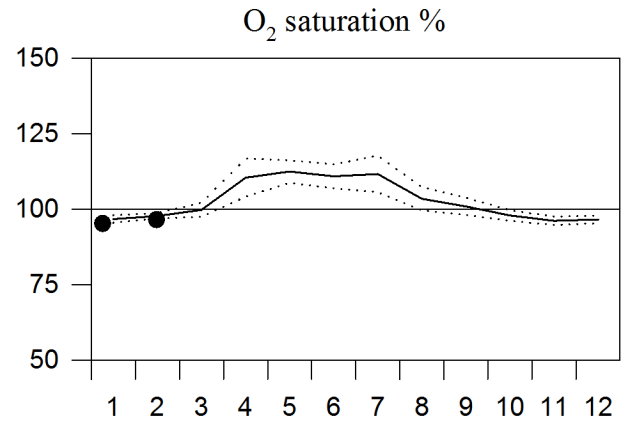
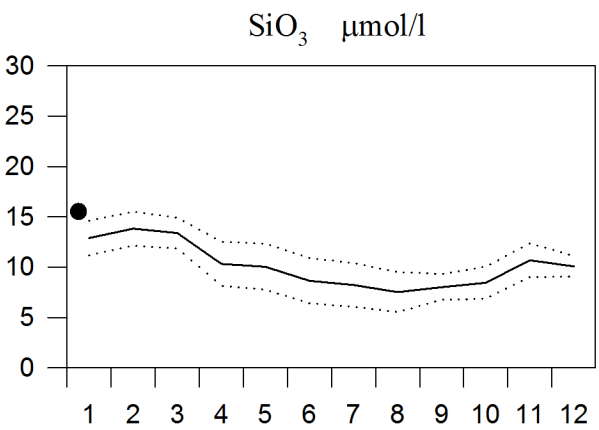
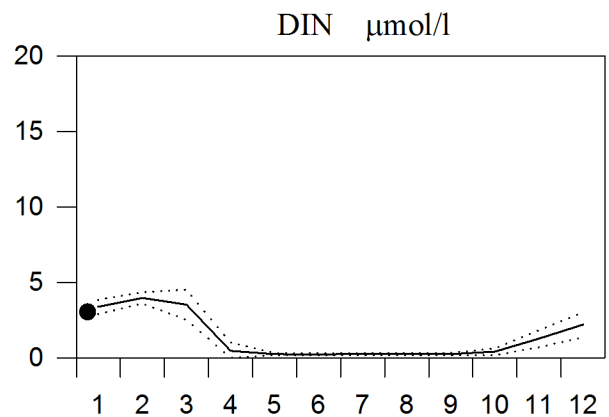
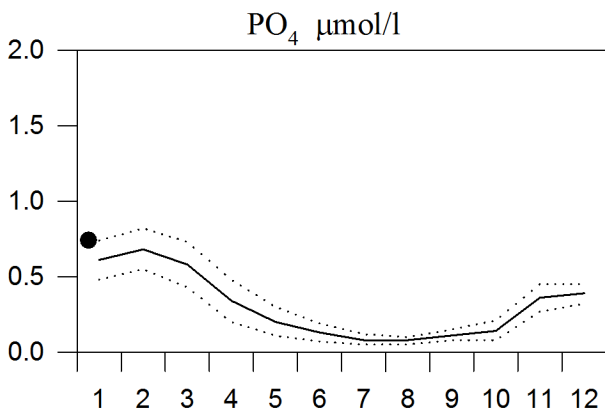
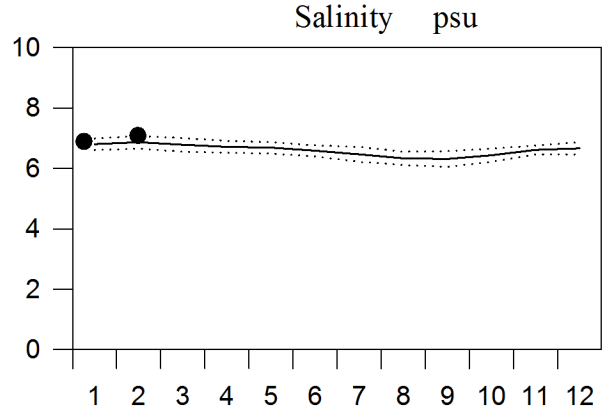
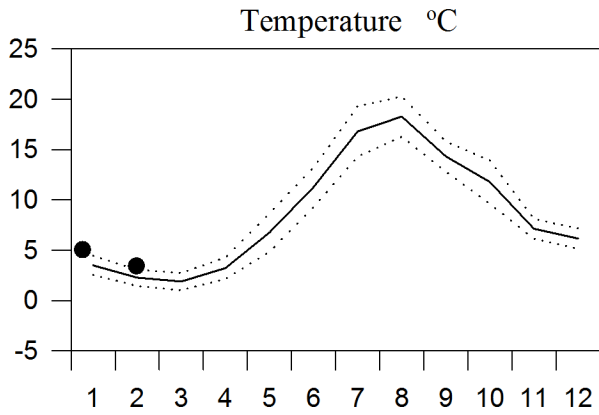
— Mean 1996-2010      ····· St.Dev.      ● 2015



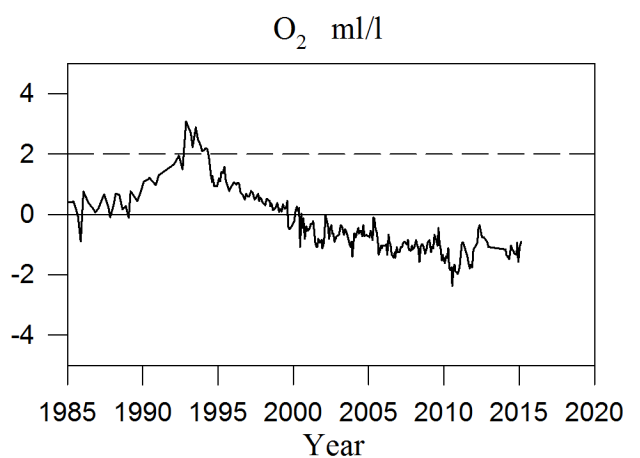
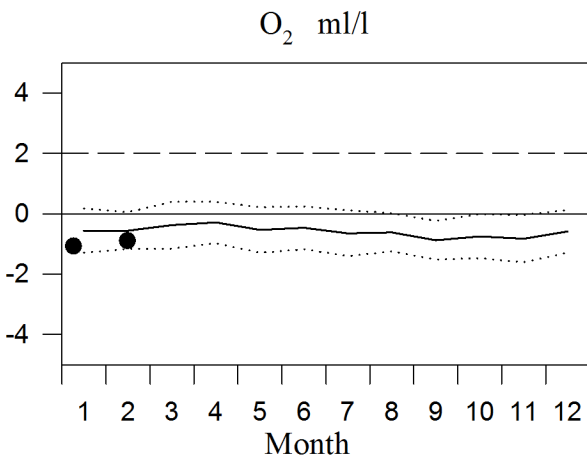
# STATION BY32 SURFACE WATER

## Annual Cycles

— Mean 1996-2010      ..... St.Dev.      ● 2015

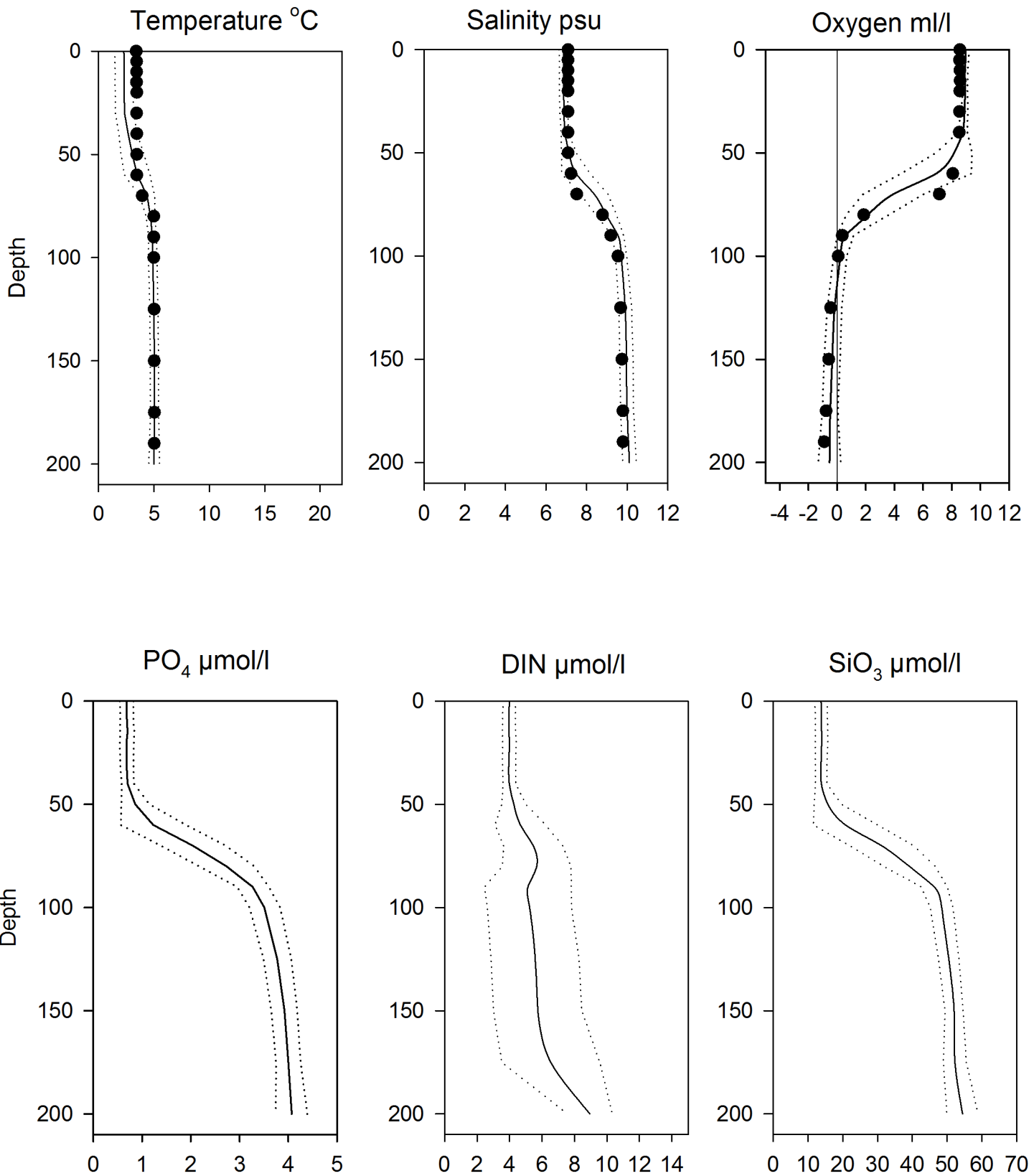


## OXYGEN IN BOTTOM WATER (depth > 175m)



# Vertical profiles BY32 February

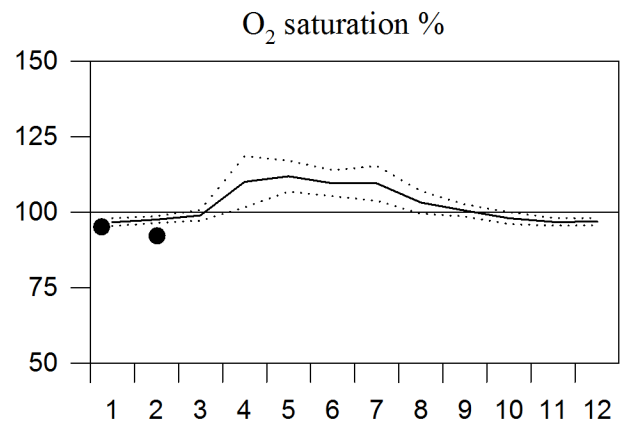
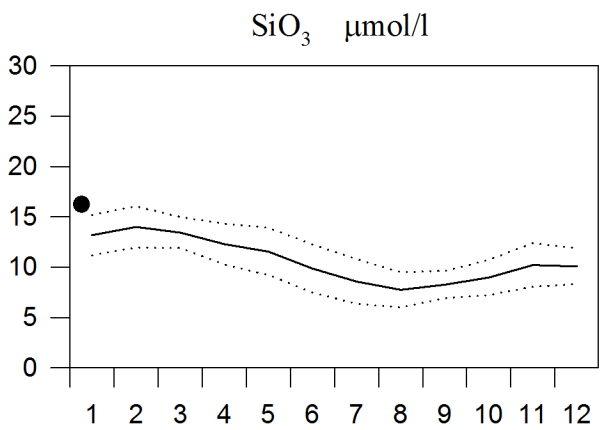
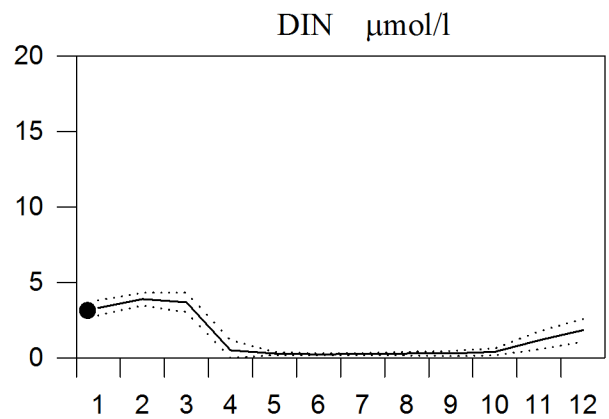
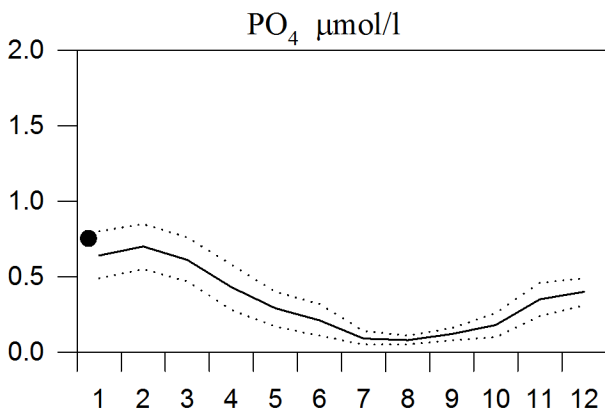
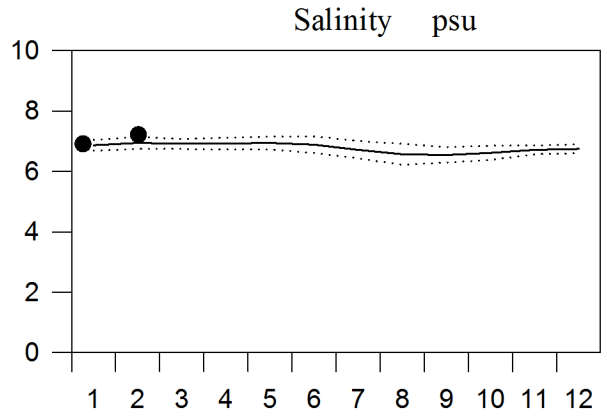
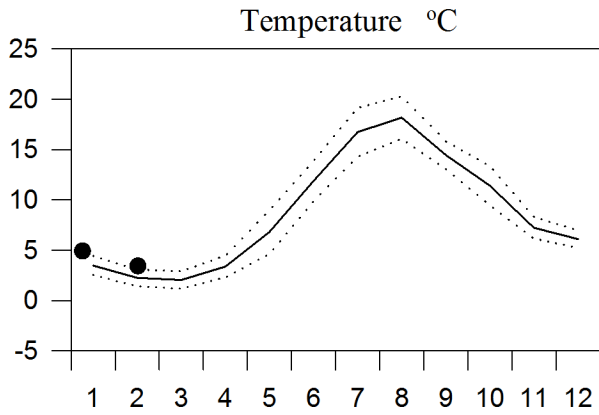
— Mean 1996-2010      ..... St.Dev.      ● 2015



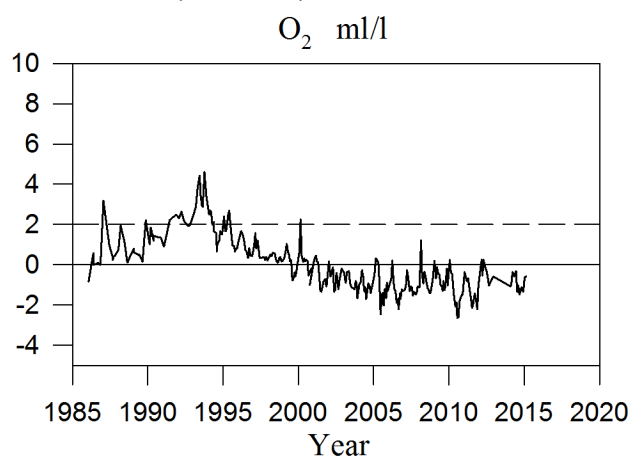
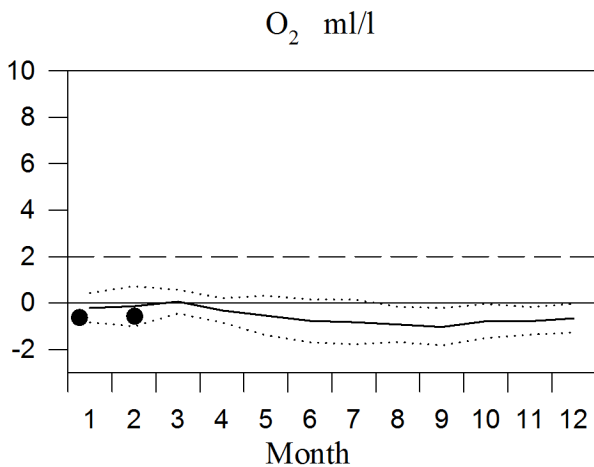
# STATION BY38 SURFACE WATER

## Annual Cycles

— Mean 1996-2010      ..... St.Dev.      ● 2015

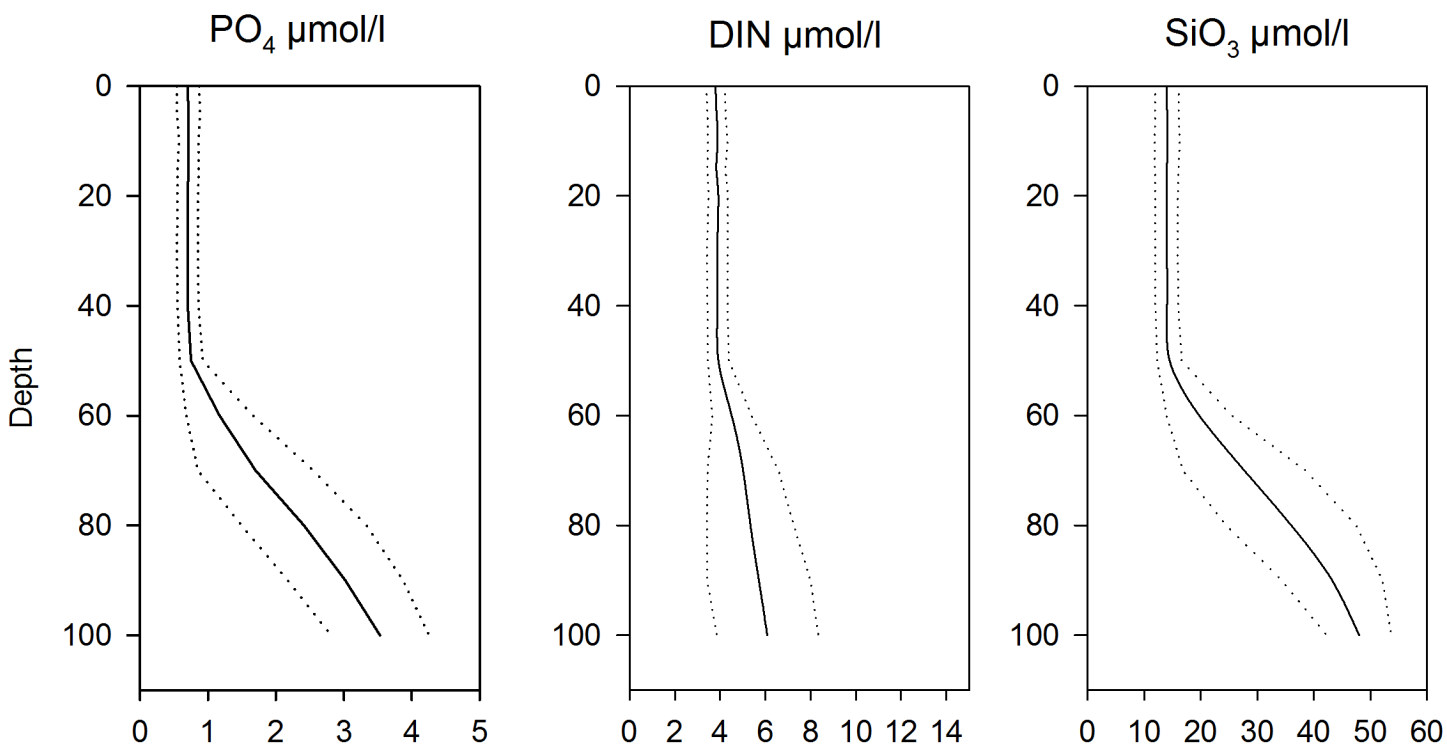
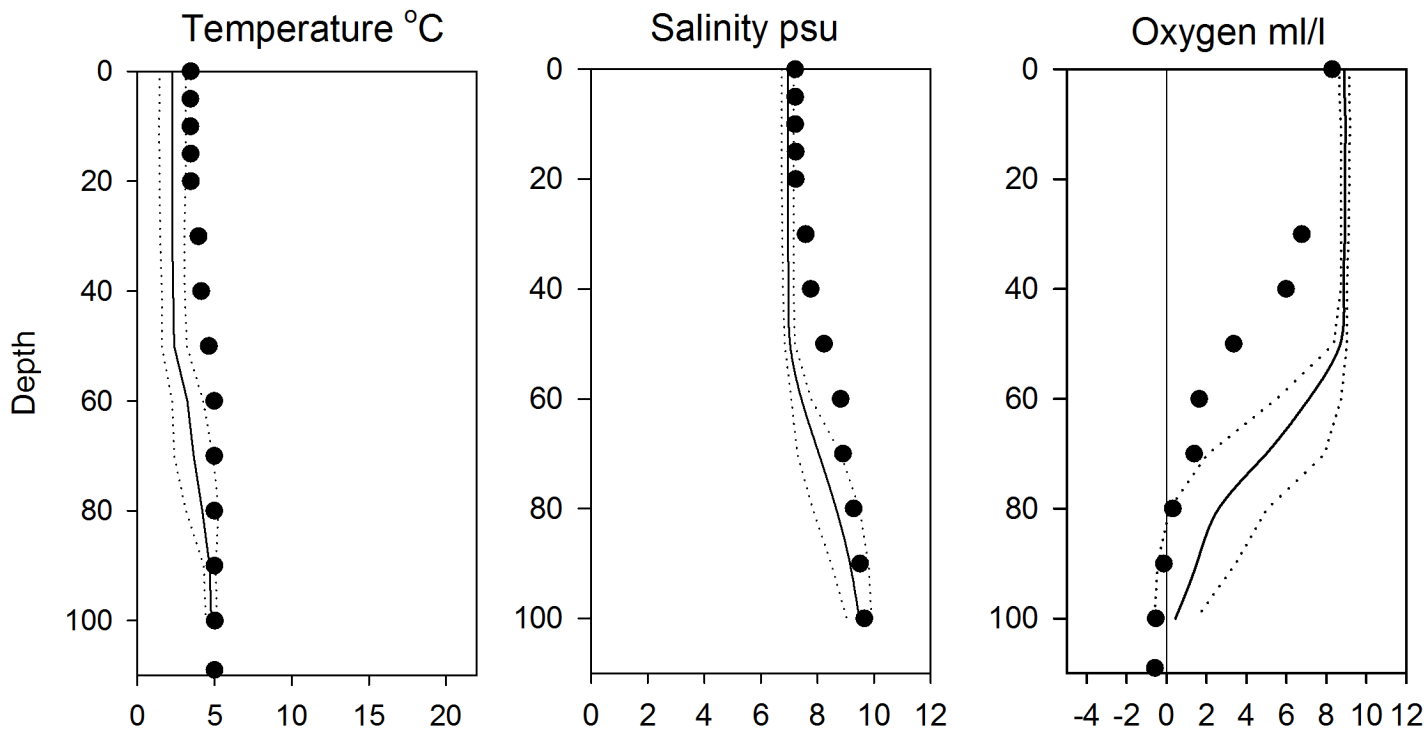


## OXYGEN IN BOTTOM WATER (> 100m)



# Vertical profiles BY38 February

— Mean 1996-2010      ····· St.Dev.      ● 2015

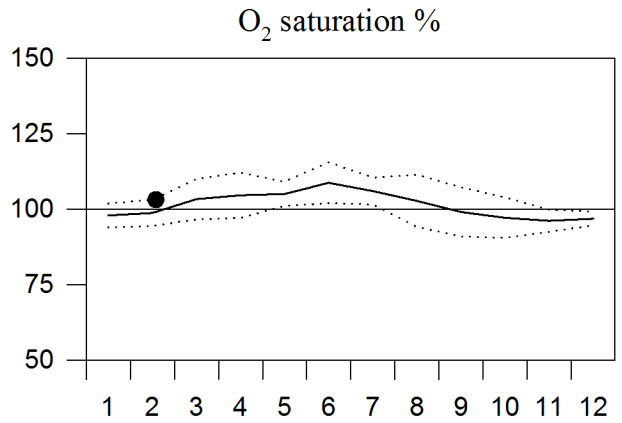
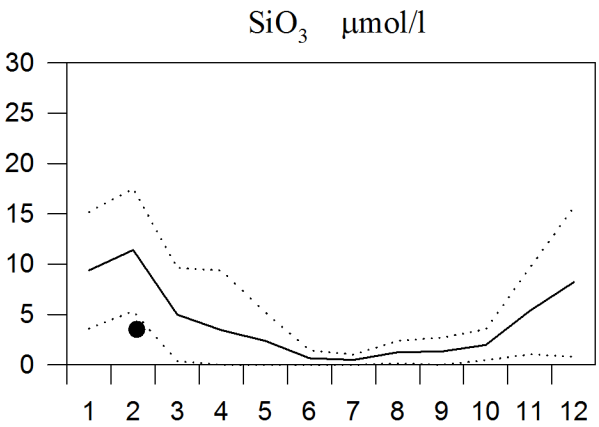
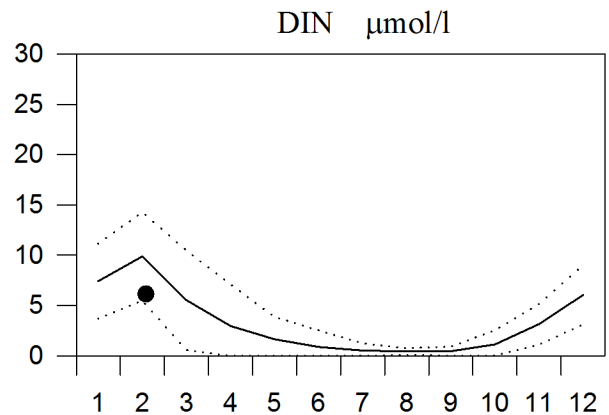
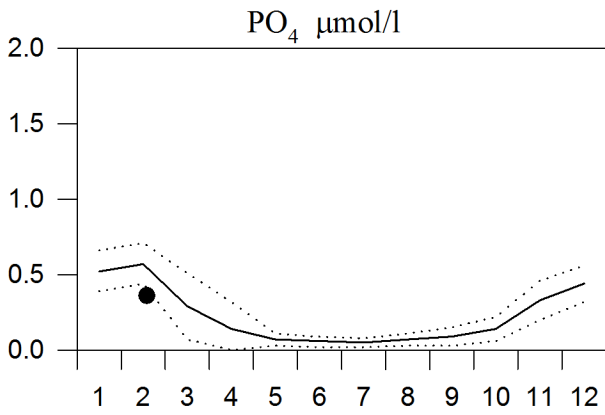
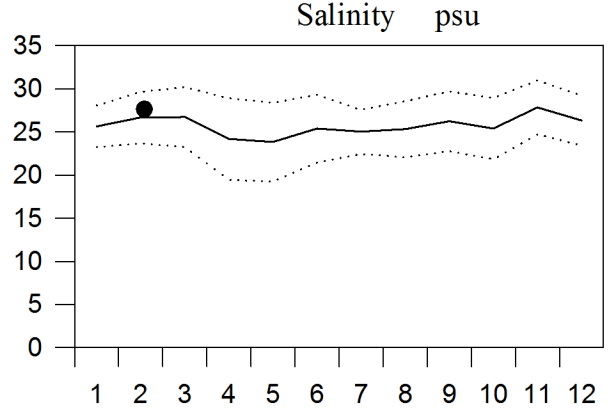
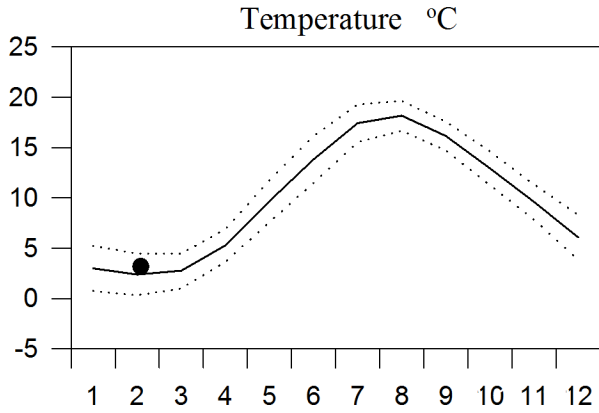




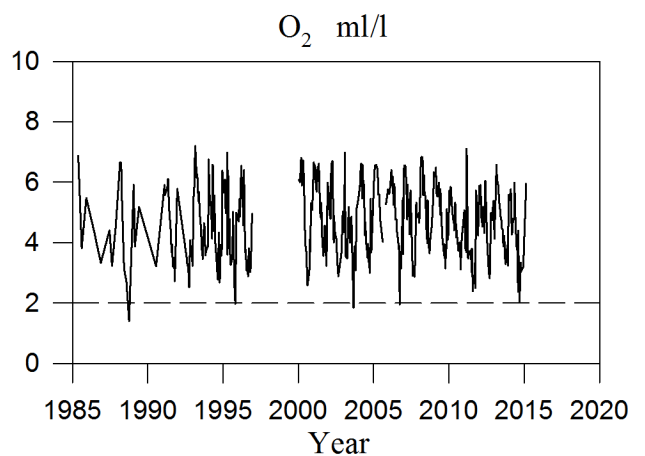
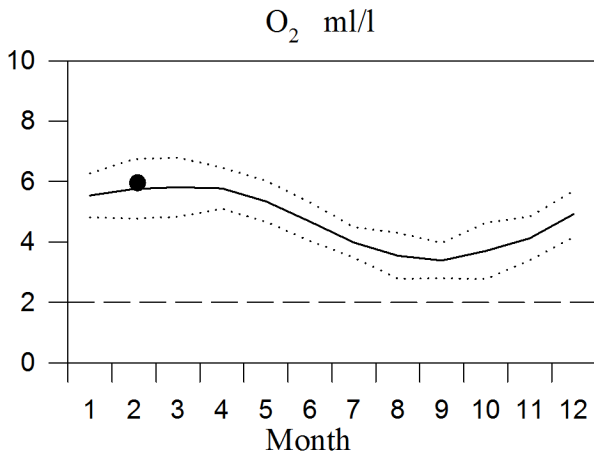
# STATION SLÄGGÖ SURFACE WATER

## Annual Cycles

— Mean 1996-2010      ..... St.Dev.      ● 2015

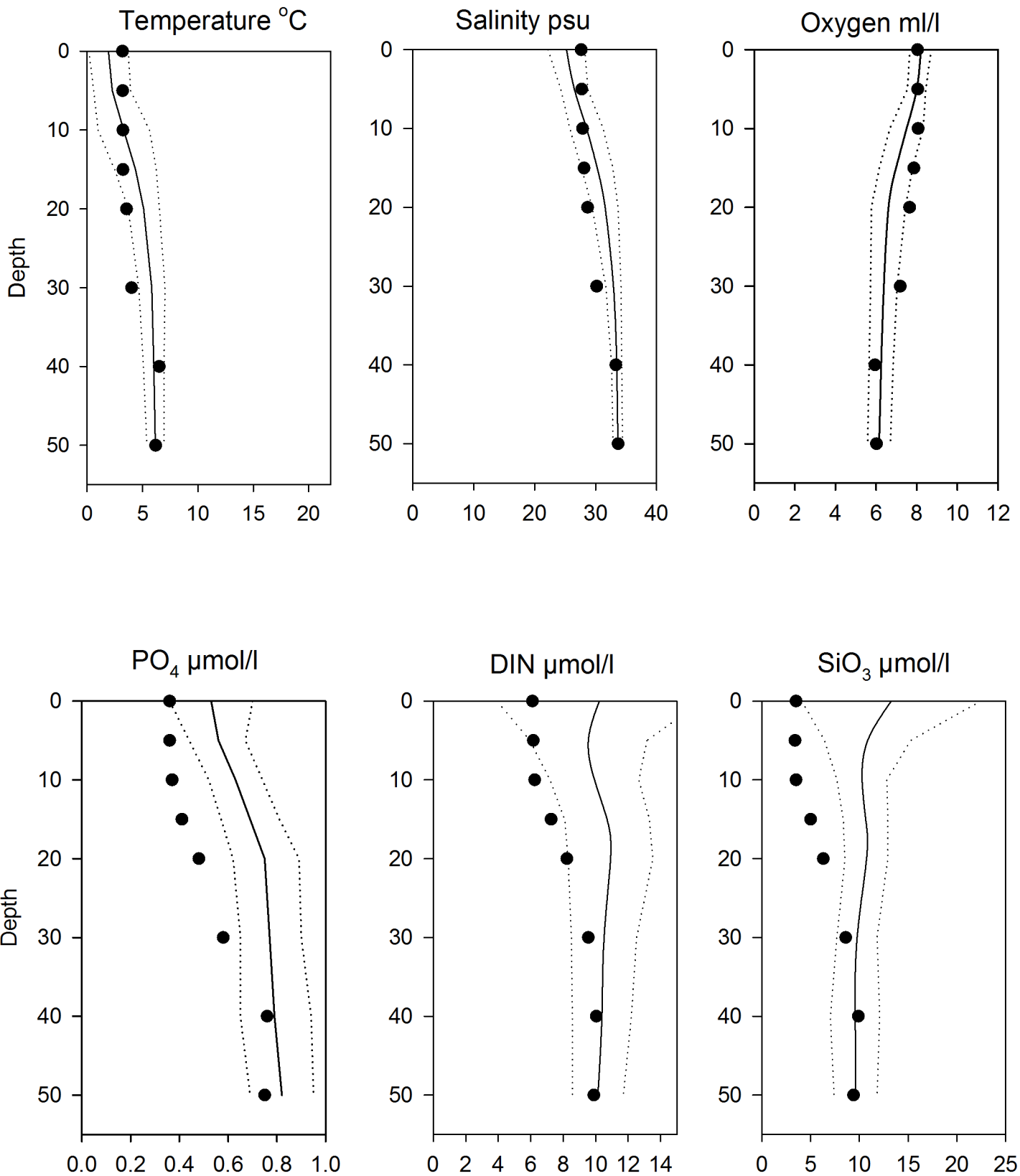


## OXYGEN IN BOTTOM WATER (depth >50m)



# Vertical profiles Släggö February

— Mean 1996-2010      ..... St.Dev.      ● 2015



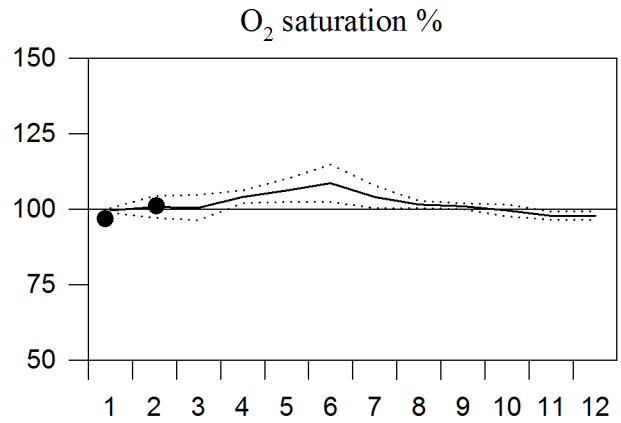
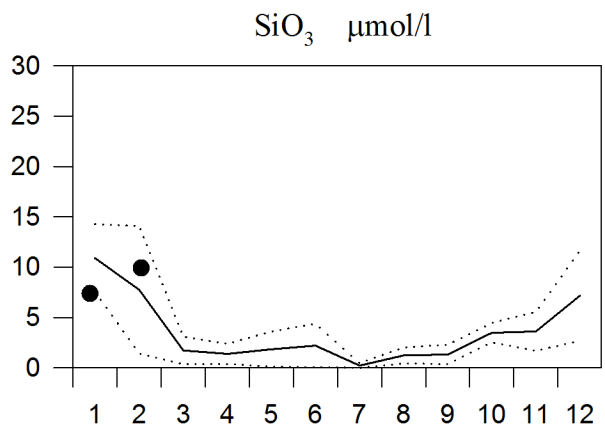
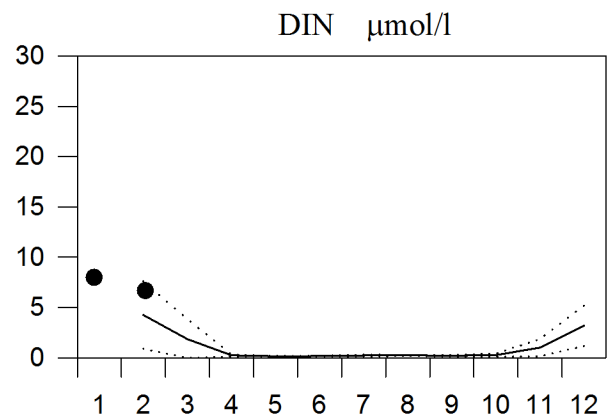
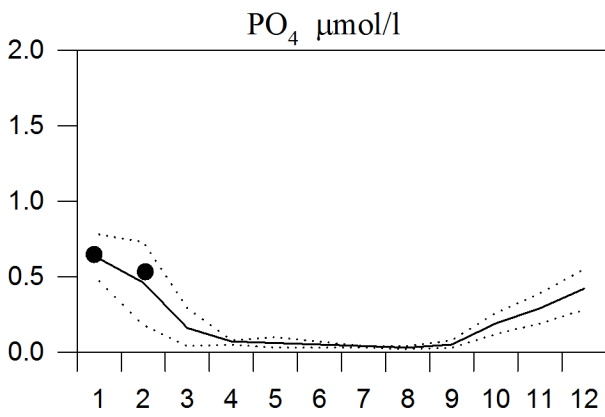
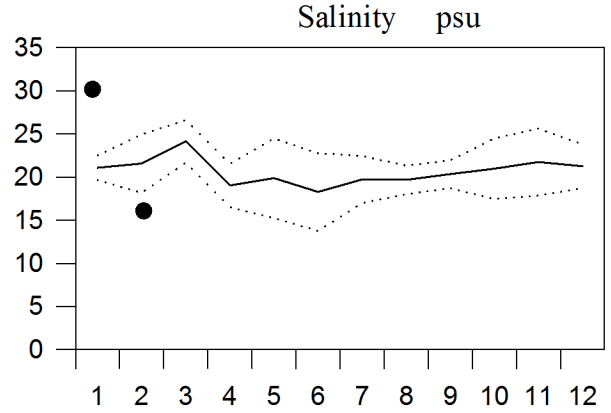
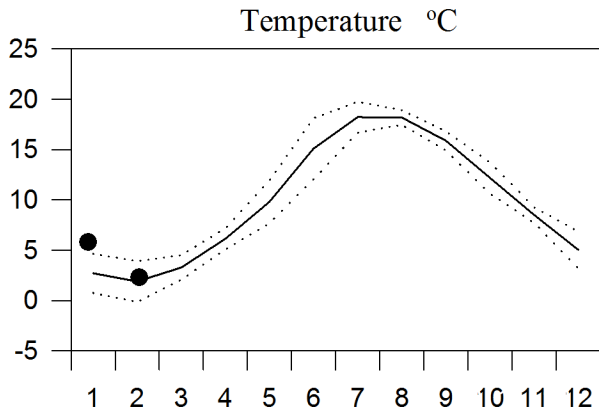
# STATION N14 Falkenberg SURFACE WATER

## Annual Cycles

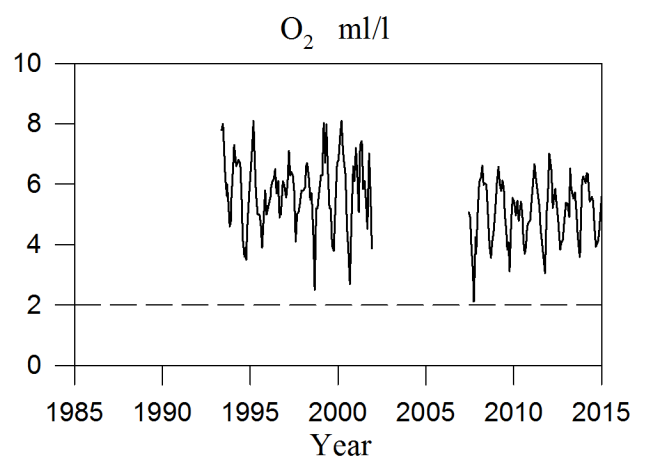
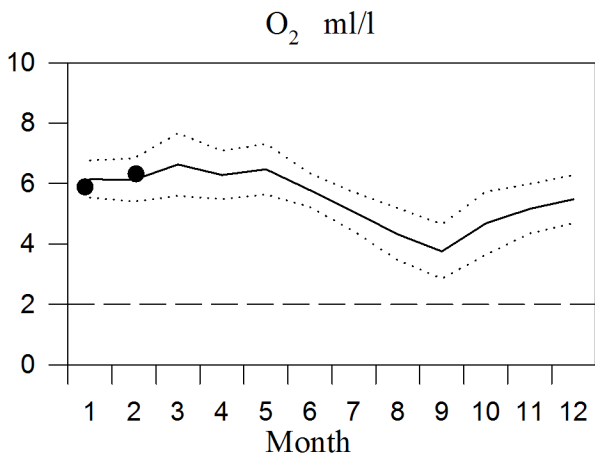
— Mean 2007-2010

..... St.Dev.

● 2015

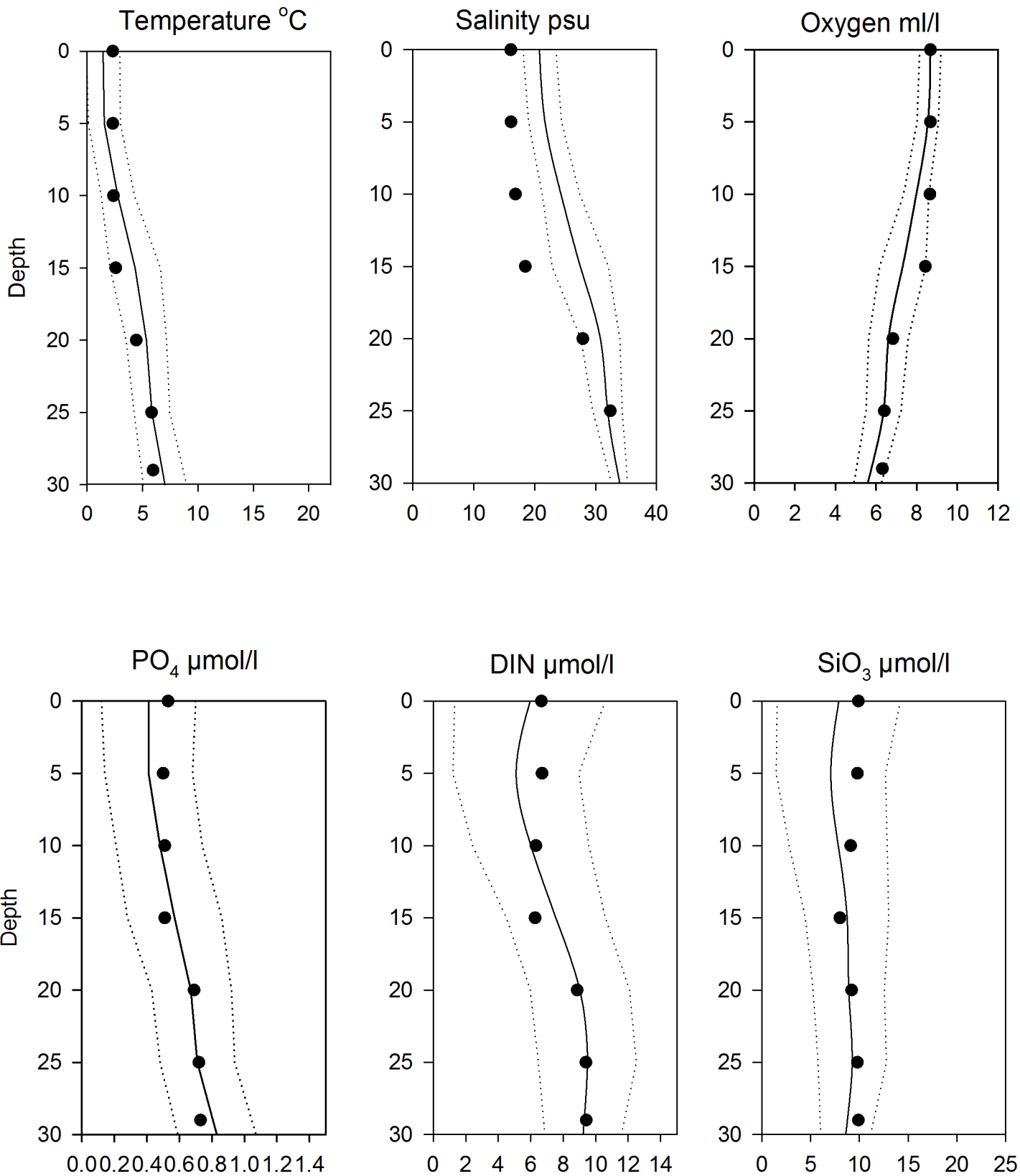


## OXYGEN IN BOTTOM WATER (depth > 25m)



# Vertical profiles N14 Falkenberg February

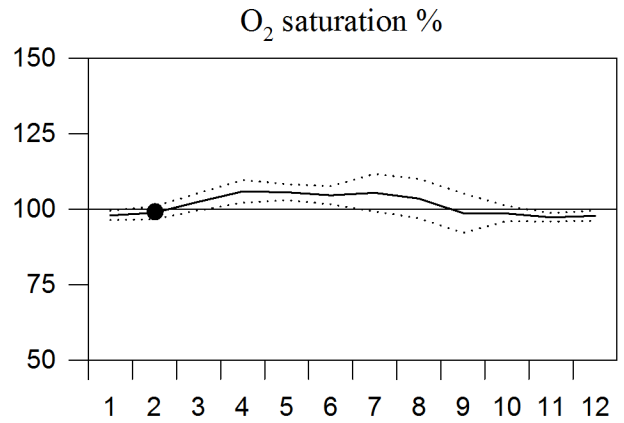
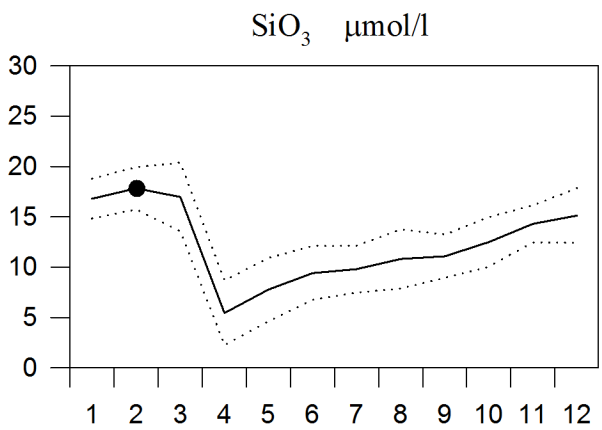
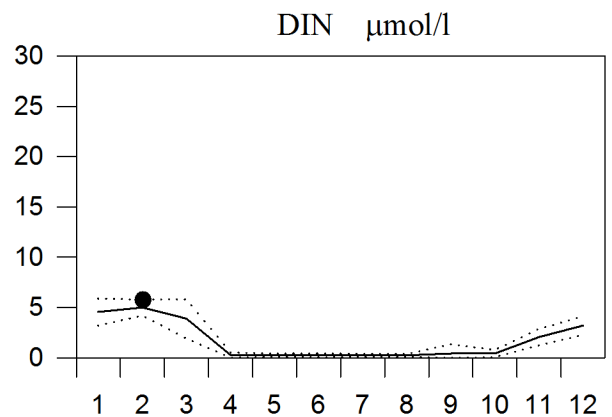
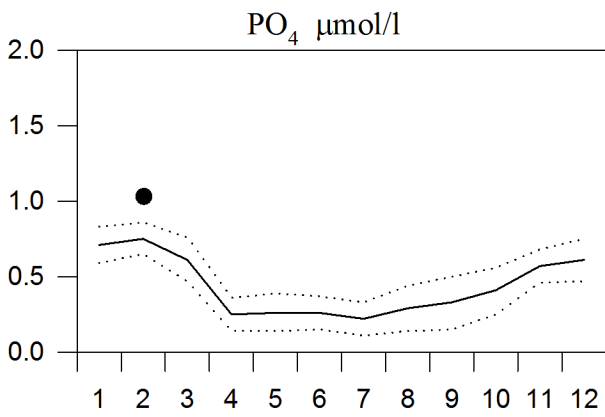
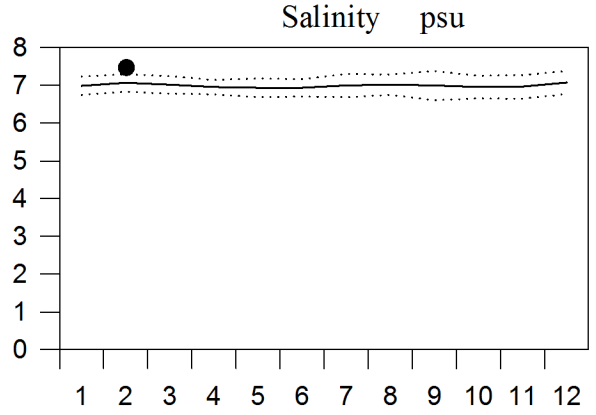
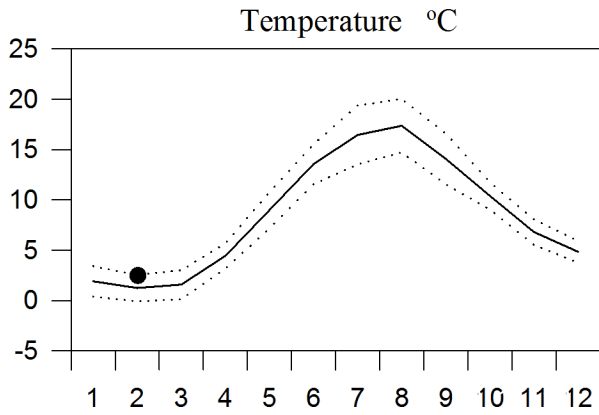
— Mean 1996-2010      ..... St.Dev.      ● 2015



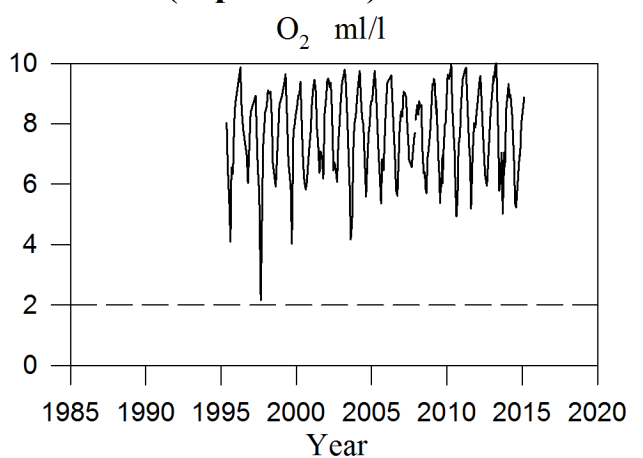
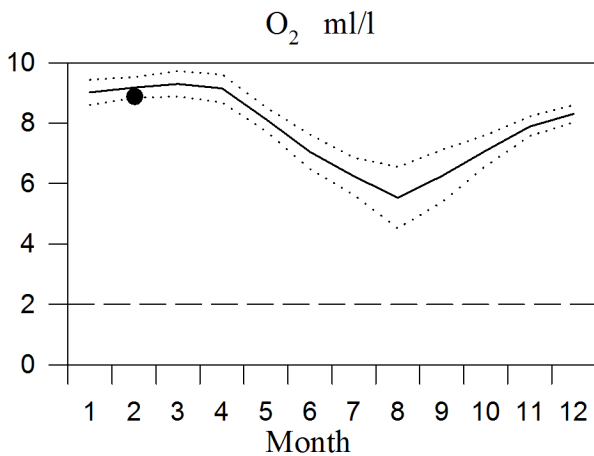
# STATION REF M1V1 SURFACE WATER

## Annual Cycles

— Mean 1996-2010      ..... St.Dev.      ● 2015



## OXYGEN IN BOTTOM WATER (depth >15m)



# Vertical profiles Ref M1V1 February

— Mean 1996-2010      ····· St.Dev.      ● 2015

