

Report from the SMHI monitoring cruise with R/V Aranda



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Survey period: 2014-12-06 - 2014-12-14
Survey area: Skagerrak, 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 Skagerrak, Kattegat, the Sound and the Baltic Proper. Data presented in this report have been subject to preliminary quality control procedures only.

The temperature of the surface water remained above normal, but not as pronounced as during the November expedition. Surface nutrients showed, for the season almost normal values, except silicate in the Baltic Proper. In the Bornholm Basin and Hanö Bight acute hypoxia (<2 ml / l) occurred from depths exceeding 70 meters. In the Eastern Gotland Basin completely oxygen-free conditions were registered from depths exceeding 125 meters (at BY20 already from 90 m) and acute hypoxia from 70 -80 meters. In western Gotland Basin, the oxygen situation is still serious as acute hypoxia already occurred from depths exceeding 70 meters and hydrogen sulphide from 80-90 meters depth.

The next regular expedition will start on the 7th of January 2015.

PRELIMINARY RESULTS

The cruise, performed on board the Finnish research vessel Aranda, began in Turku on 6th of December and ended in Helsinki on the 13th. The winds during the expedition were essentially fresh to hard, between 15 and 20 m/s mainly from the southwest. Air temperatures ranged between 5-6 °C.

During the expedition an inflow to the Baltic Sea took place. Through the Sound about 40 km³ flowed into the Baltic Sea.

The Skagerrak

Surface water temperatures had since the previous cruise in November, decreased to values normal for the season, about 7°C. However, there was still a clear excess in temperatures at depths between 20 and 50 meters. At 30 meters a temperature of just above 12°C were registered, which is approximately 3 degrees above normal. Surface salinity was below normal, about 25 psu. At the station P2 in the southeast, however, both salinity and temperature were above normal and the water homogenous from surface down to 70 meters. Salinity here was 32.5 psu and the temperature 8.9°C. Phosphate and inorganic nitrogen (nitrite + nitrate) showed concentrations normal for the season, while the levels of silicate were elevated. Phosphate showed values of 0.45 µmol/l, nitrite + nitrate 3.3 µmol/l. while the concentrations of silicate were in the range 6.5 – 7 µmol/l.

Fluorescence measurements showed some plankton activity in the surface layer.

The lowest oxygen level in the bottom waters, 3.2 ml/l were measured at the station Släggö, in the mouth of the Gullmar fjord, an increase with 1 ml/l since the previous visit in November.

The Kattegat and the Sound

In this area, the surface temperature was still above normal, with values of ca. 7°C compared to normal 5°C. Thermocline and halocline coincided and were found at depths between 15 and 20 meters. The salinity of the surface water in Kattegat was normal about 23 psu, while it in the Sound was high above normal 22 psu.

The concentrations of phosphate and inorganic nitrogen showed values typical for the season, while silicate levels were higher than normal. Phosphate concentrations were ca. 0.5 µmol/l, nitrite + nitrate ca. 3.5 µmol/l, while silicate varied between 7 and 10.6 µmol/l.

Fluorescence measurements showed some plankton activity in the surface layer.

The lowest oxygen levels in the bottom waters were measured at W Landskrona, in the Sound, 4.36 ml/l.

The Baltic Proper

The water temperature in the surface layer remained above normal throughout the area, varying between 6.6 and 8.9°C. The salinity of the surface water was normal in most of the area, between 6.5 and 8.6 psu. In the eastern Gotland Basin, at BY15, surface salinity was still lower than normal, about 6.8 psu. The halocline was found at depths about 60 to 80 meters in the Northern, Western and Eastern Gotland Basins, while it was more shallow in the south, at depths between 30 and 60 meters.

The nutrients showed almost normal levels for the season in the surface layer, phosphate concentrations were in the range 0.44 to 0.56 µmol/l, while concentrations of inorganic nitrogen (nitrite + nitrate) ranged from 1.24 to 2.63 µmol/l. Silicate showed slightly elevated concentrations in the northern and central parts, while concentrations in the southern regions were lower than normal. The concentrations ranged between 6.3 and 14.6 µmol/l.

Fluorescence measurements showed that plankton activity was low throughout the area.

SMHI

During the expedition an inflow to the Baltic Sea took place. Between the 2nd and 15th of December a total of 40 km³ entered through the Sound. The effects of this inflow were seen only at stations in the Arkona Basin where the oxygen concentration in the bottom water was high, 6-7 ml/l. Acute hypoxia occurred in the Bornholm Basin and Hanö Bight from 70 meters depth.

In the central parts of Eastern Gotland Basin acute hypoxia were measured from 70-80 meters depth and hydrogen sulfide at the depths exceeding 125 meters. At the station BY20, in the north, hydrogen sulphide was present already at 90 meters depth. In Western Gotland Basin oxygen situation was serious when acute hypoxia occurred from depths exceeding 70-80 meters and hydrogen sulphide from 80-90 meters depth.

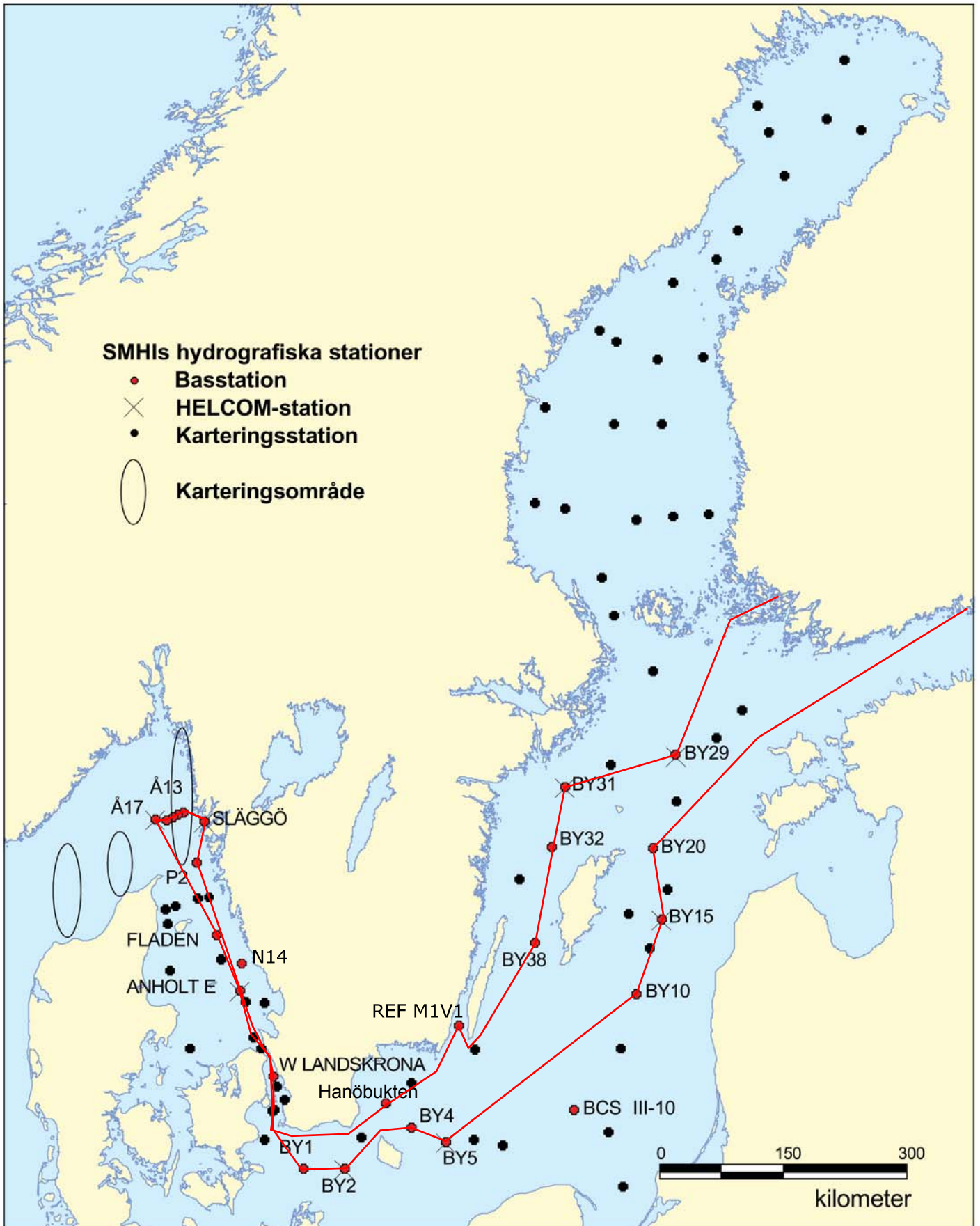
PARTICIPANTS

Name		Institute
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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

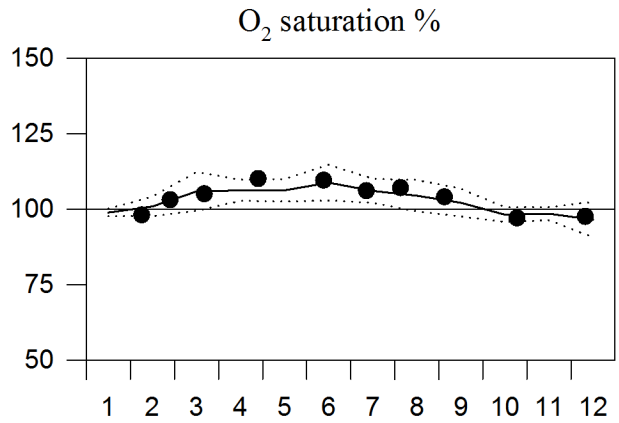
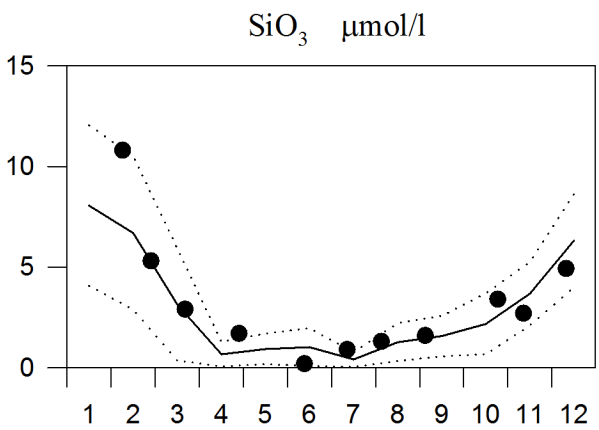
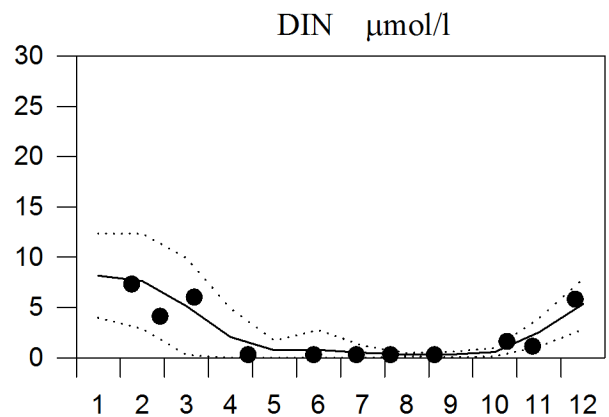
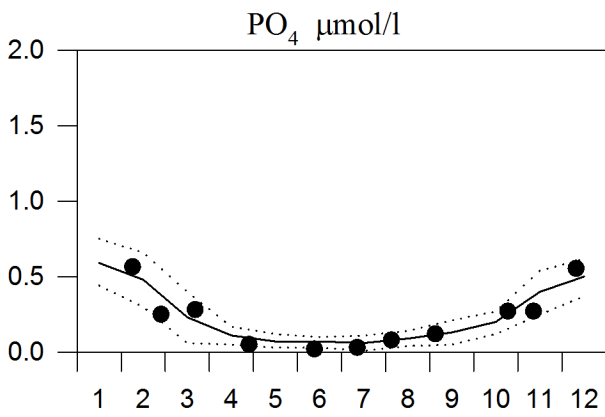
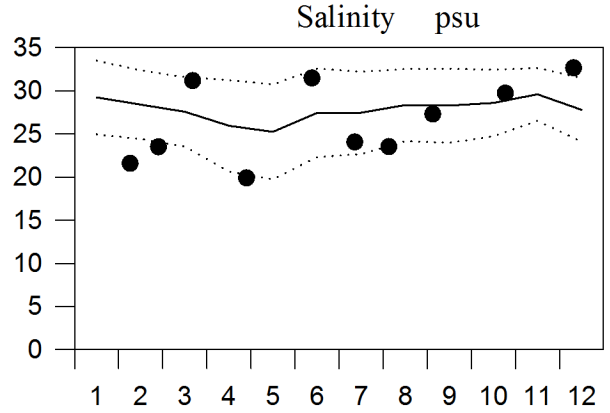
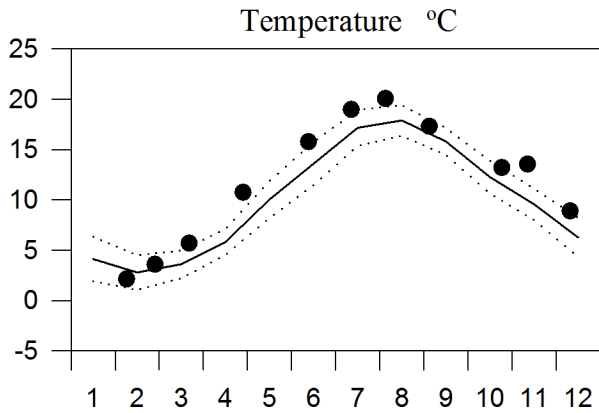
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Series: 0772-0797



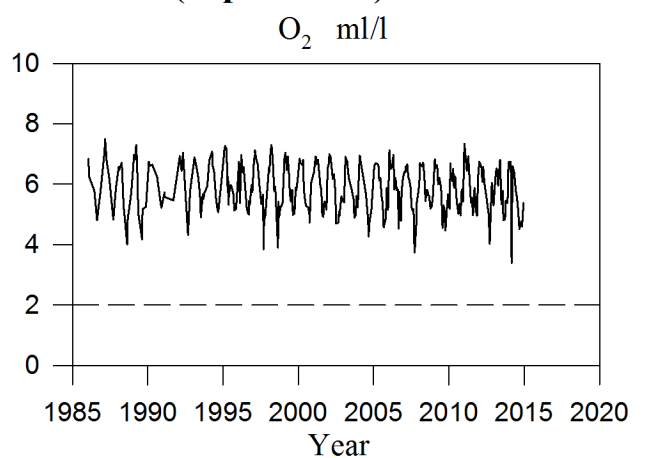
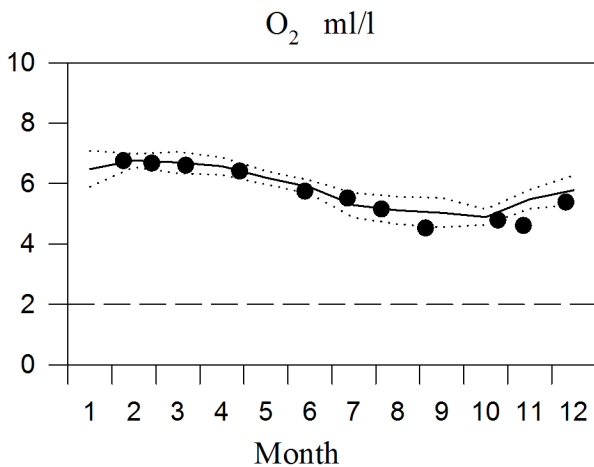
STATION P2 SURFACE WATER

Annual Cycles

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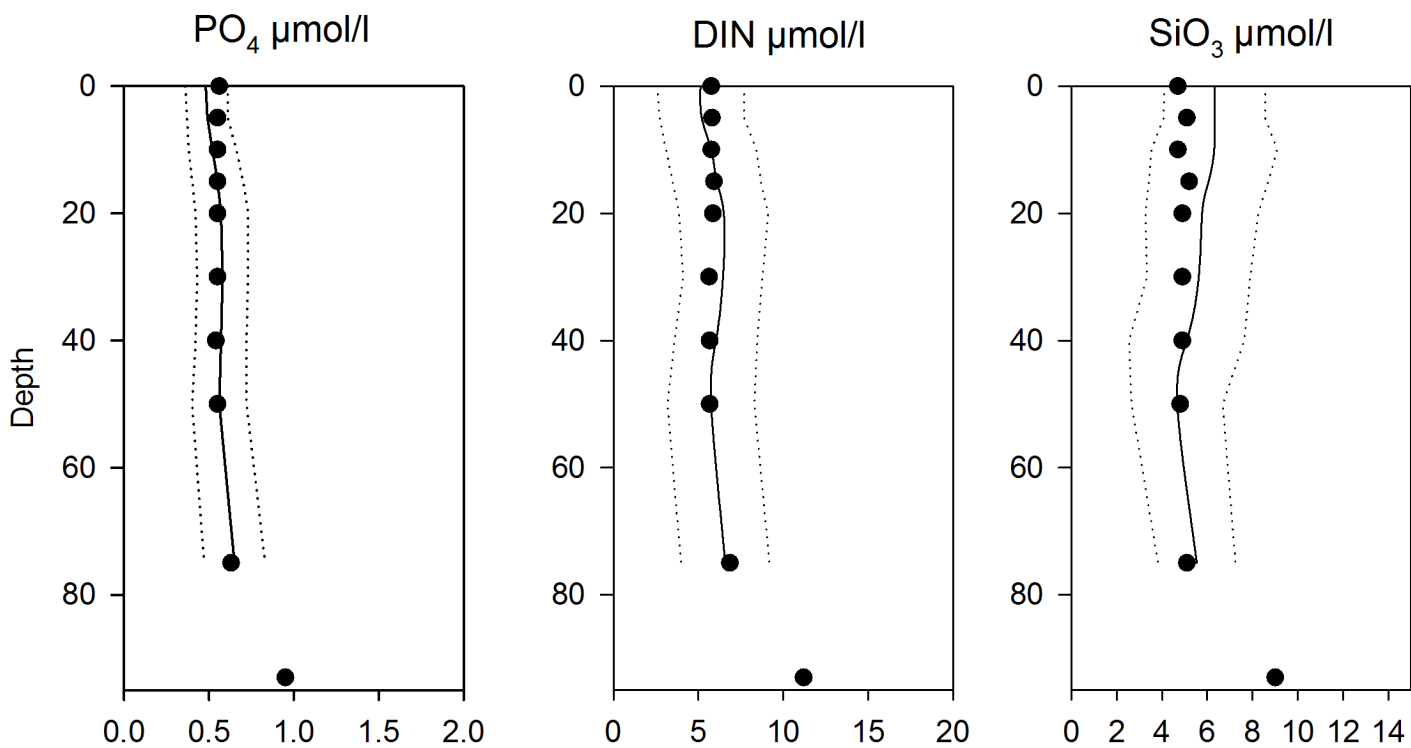
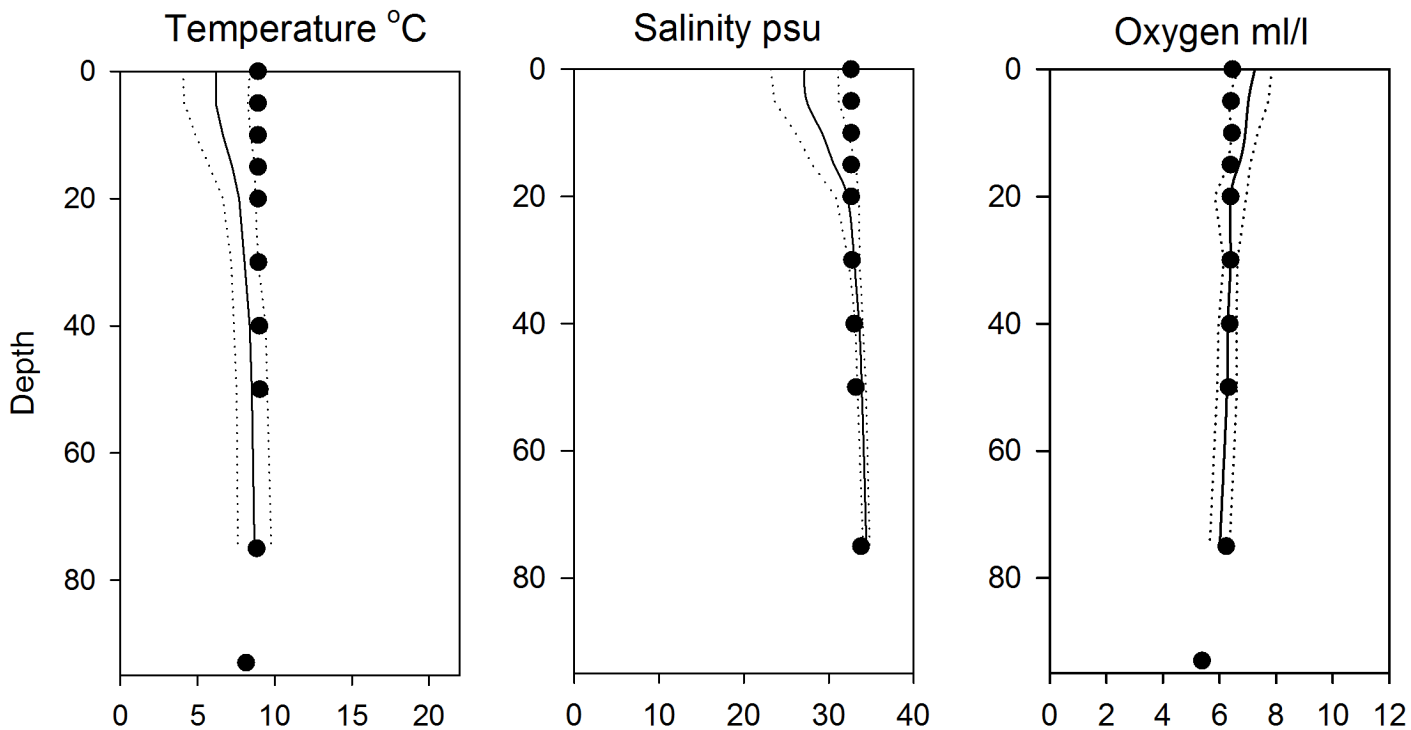


OXYGEN IN BOTTOM WATER (depth >75m)



Vertical profiles P2 December

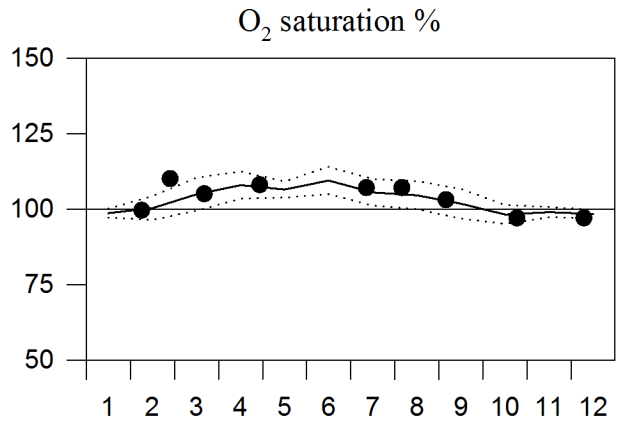
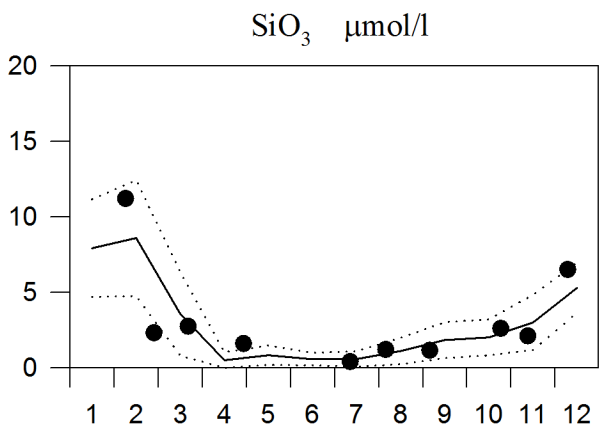
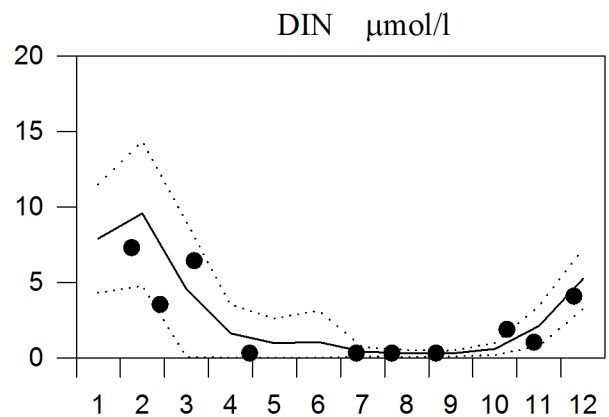
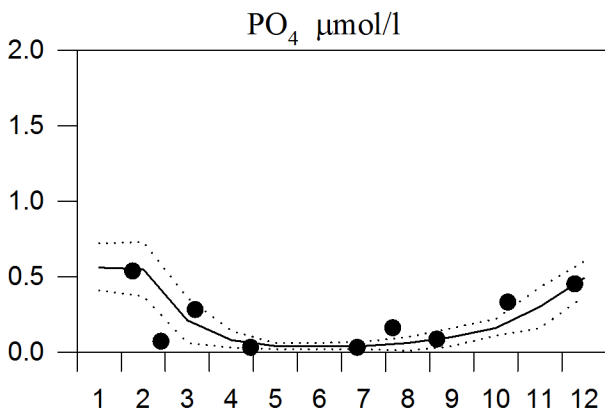
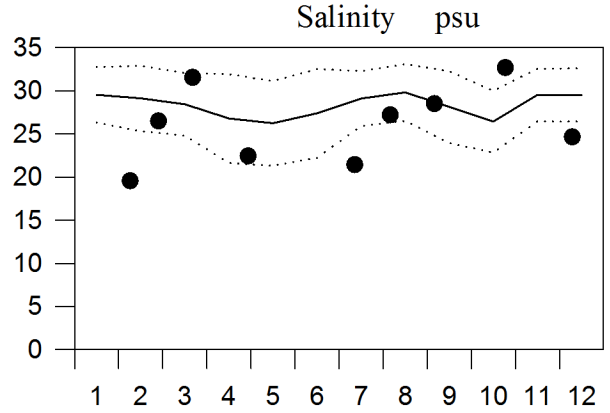
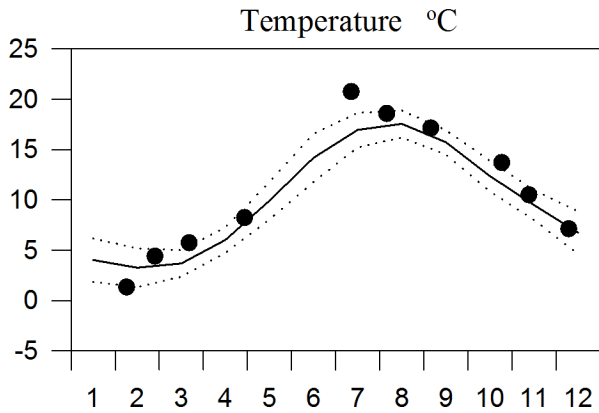
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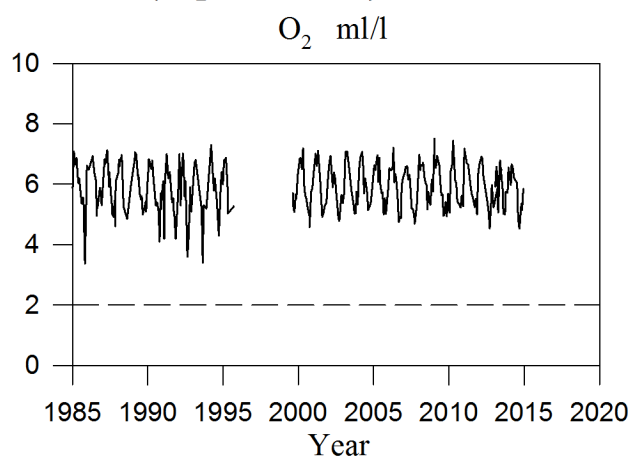
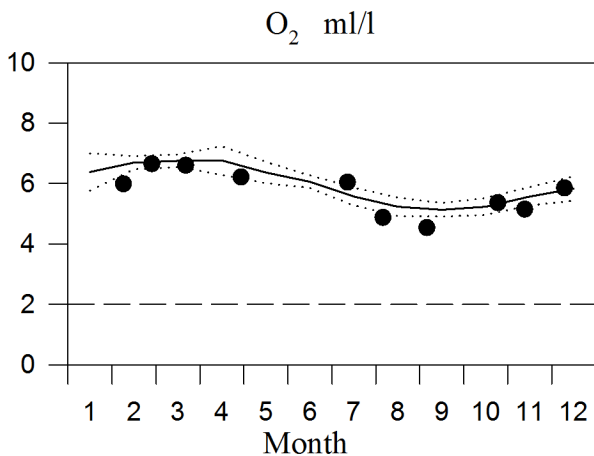
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Annual Cycles

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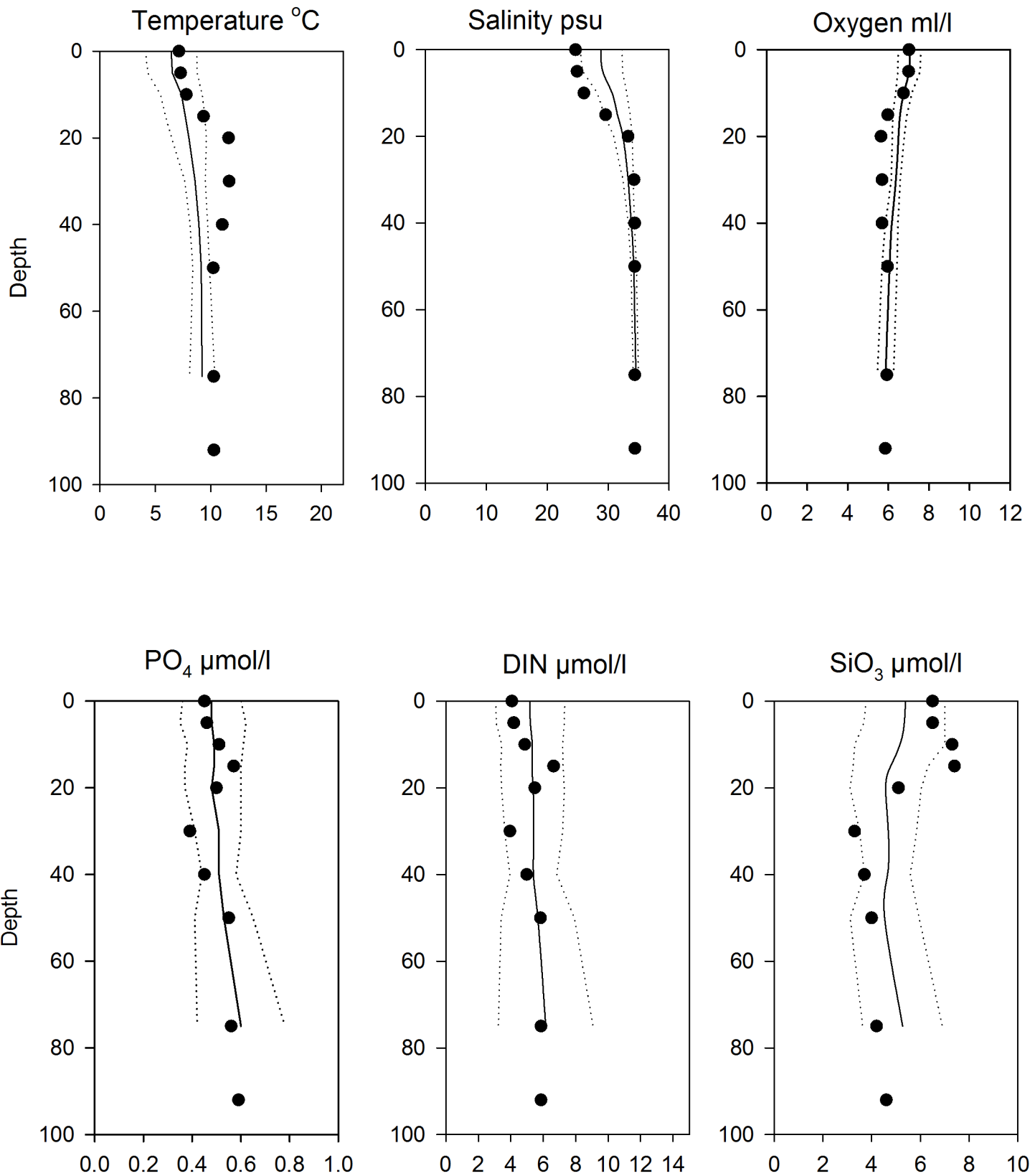


OXYGEN IN BOTTOM WATER (depth >=75m)



Vertical profiles Å13 December

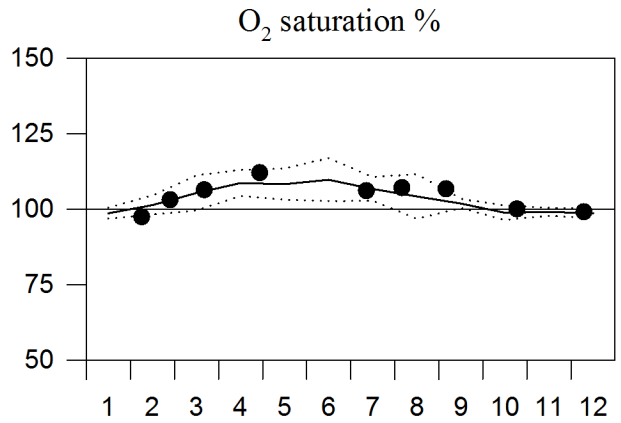
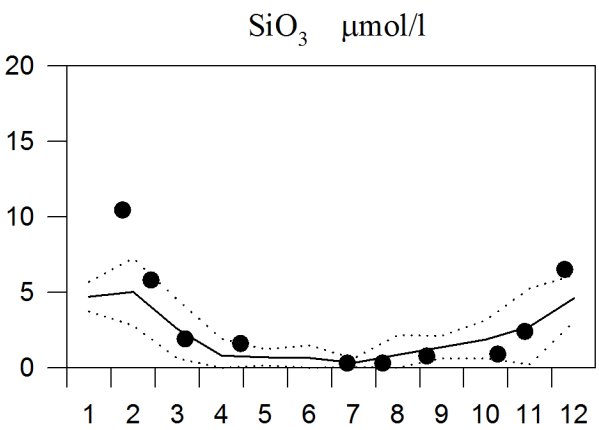
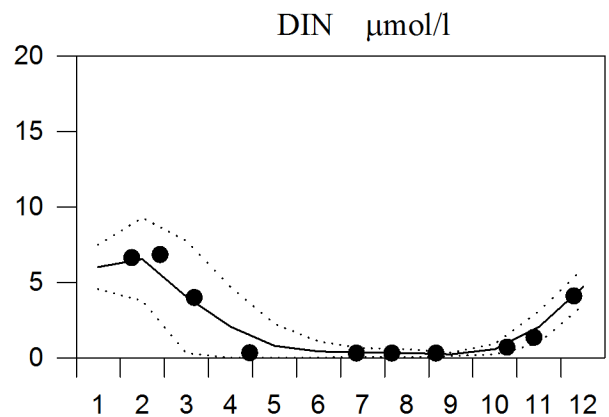
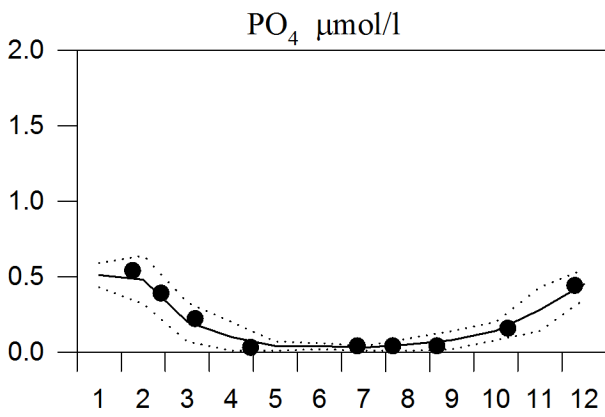
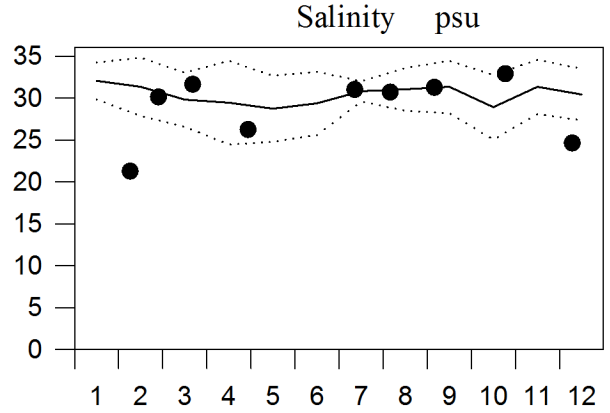
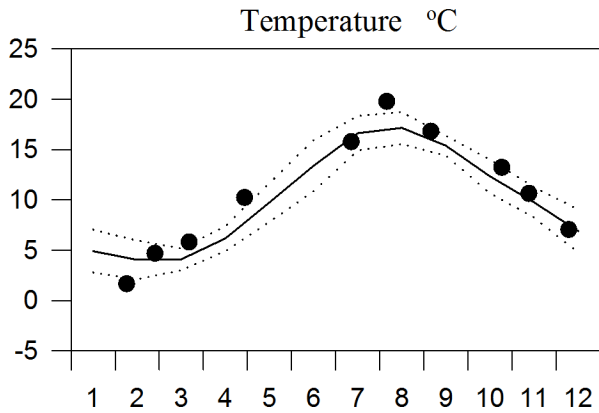
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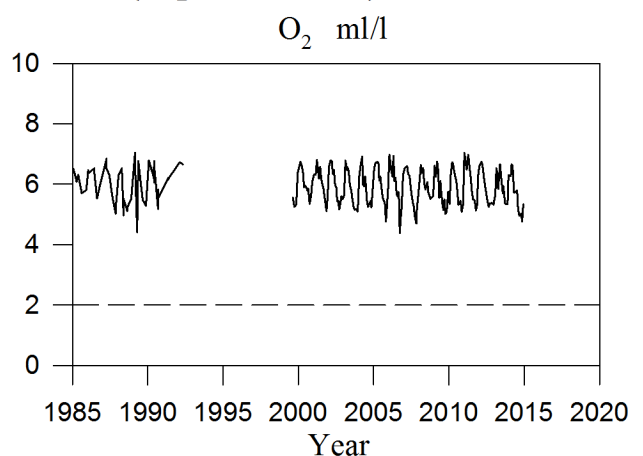
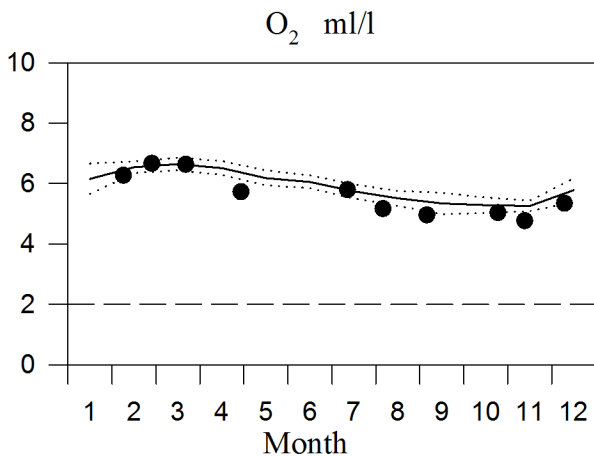
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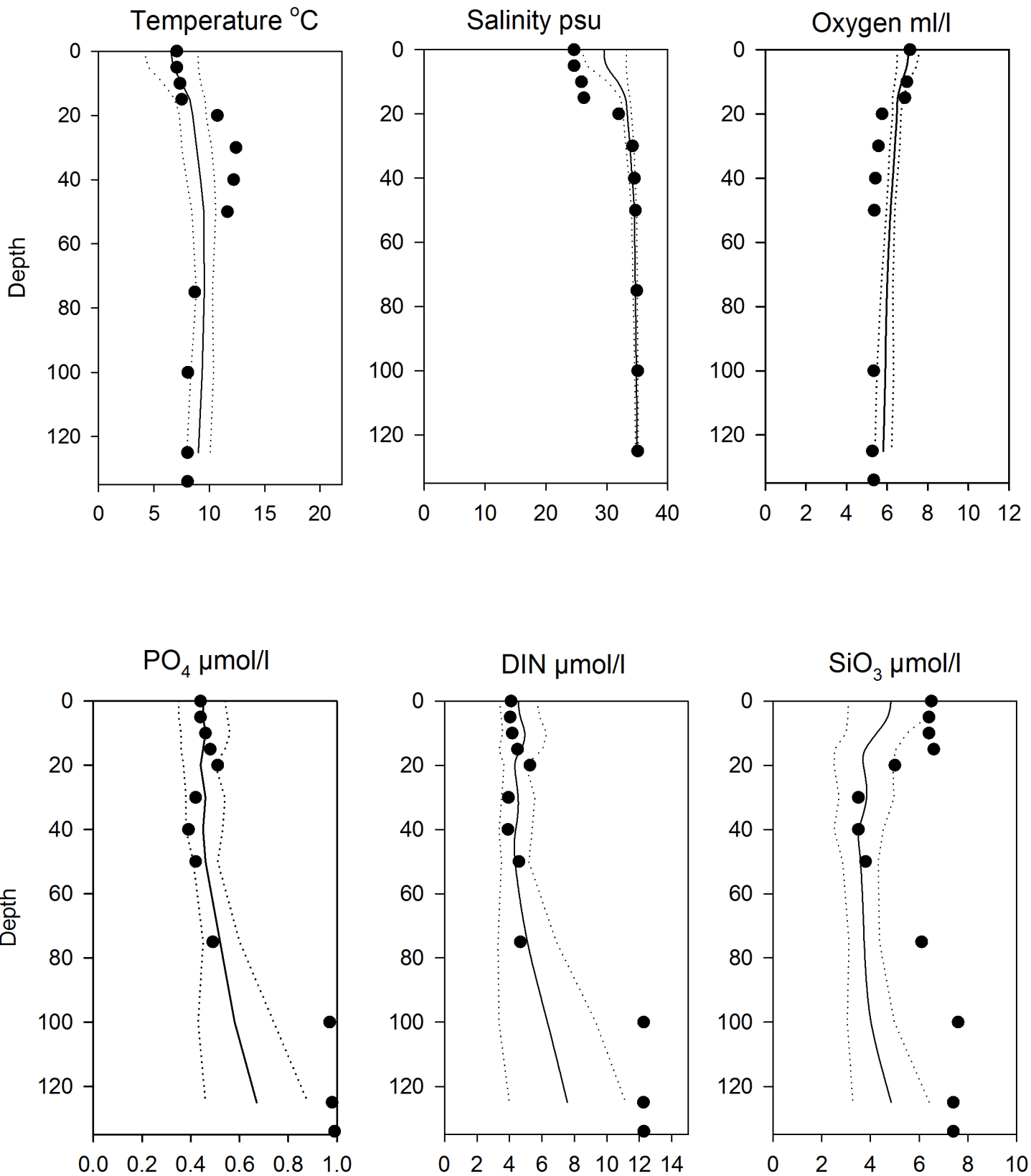


OXYGEN IN BOTTOM WATER (depth >=125m)



Vertical profiles Å15 December

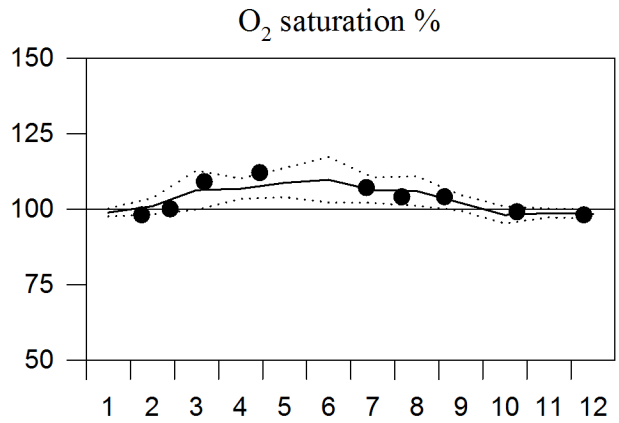
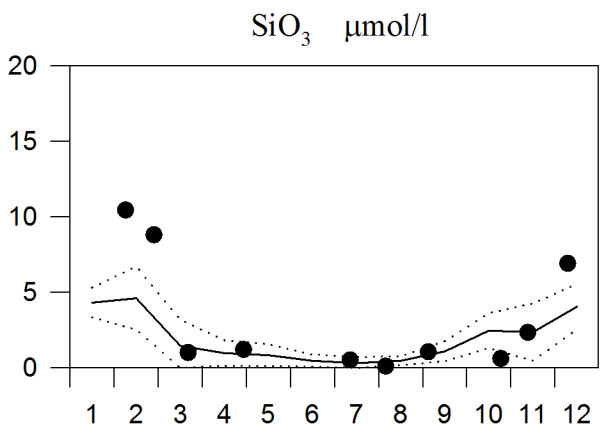
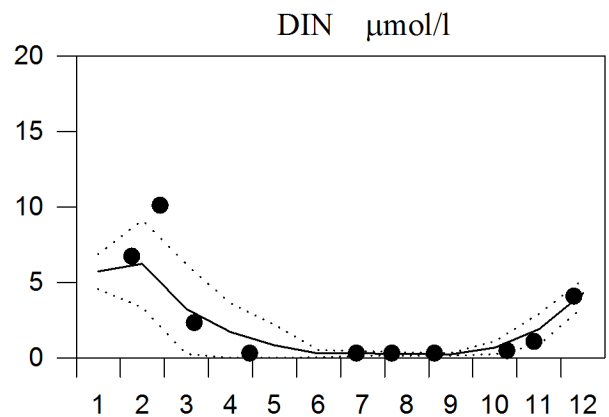
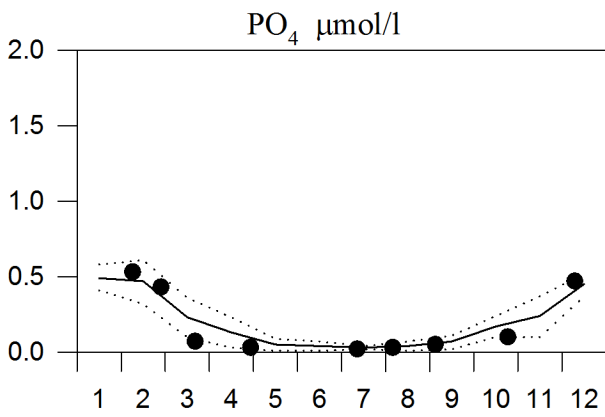
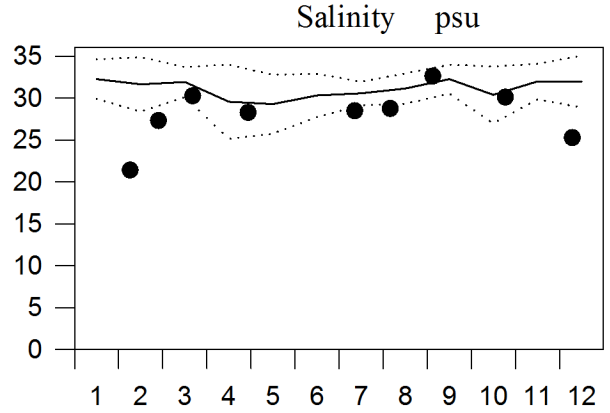
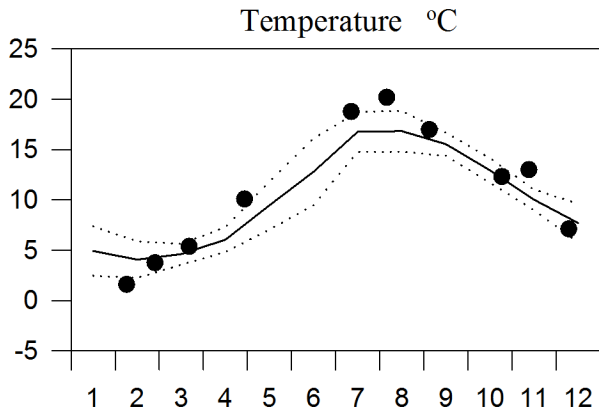
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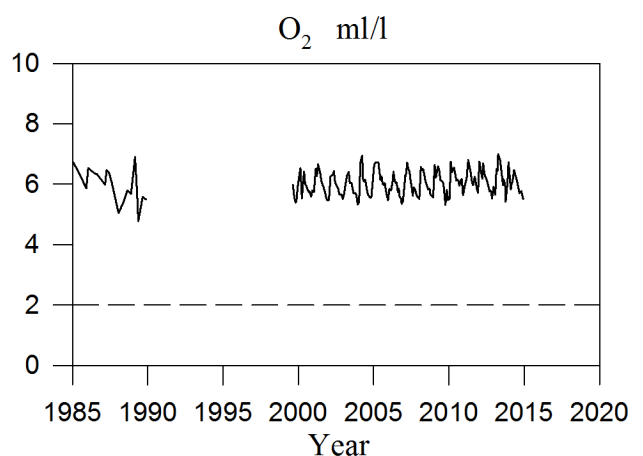
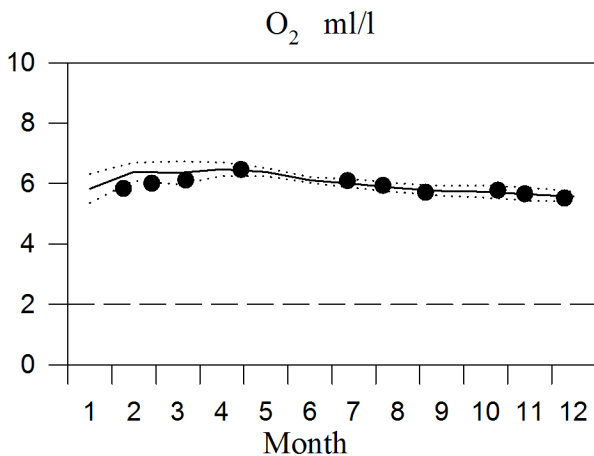
STATION Å17 SURFACE WATER

Annual Cycles

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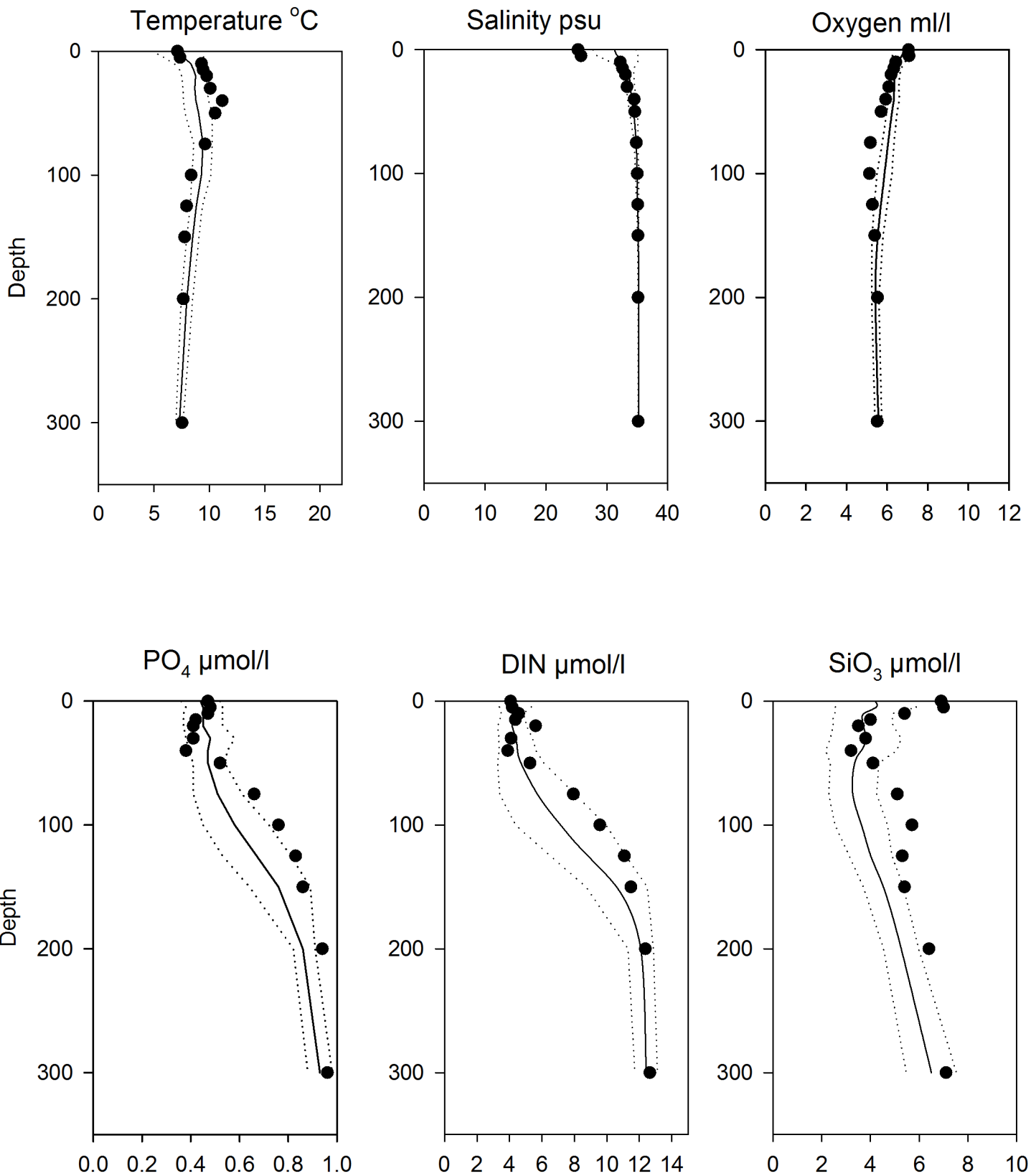


OXYGEN IN BOTTOM WATER (depth = 300m)



Vertical profiles Å17 December

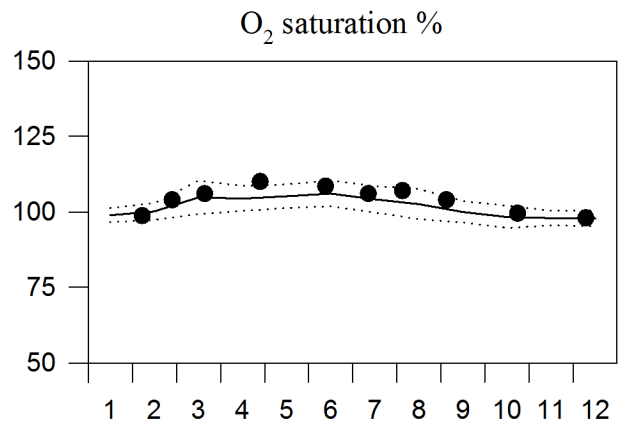
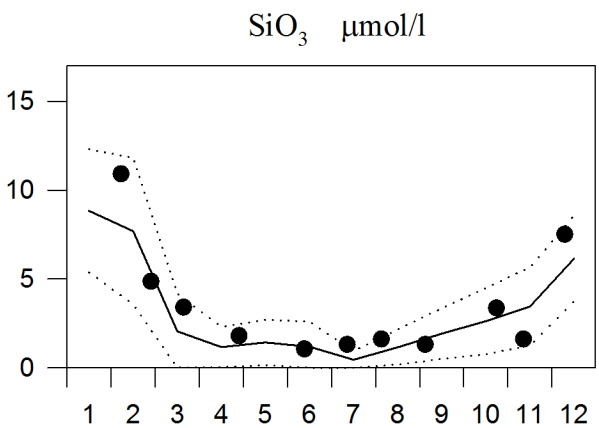
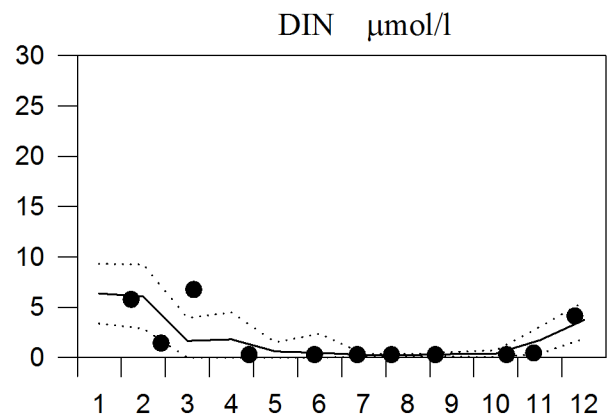
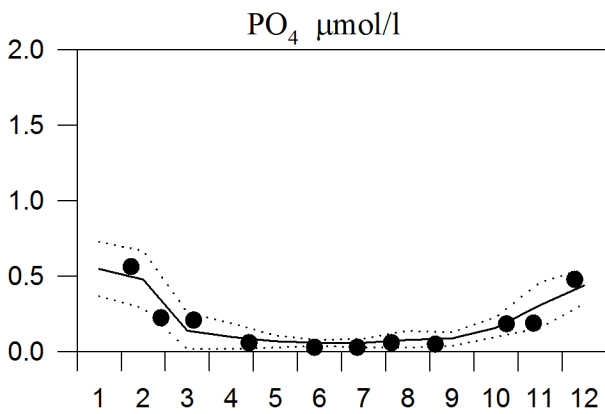
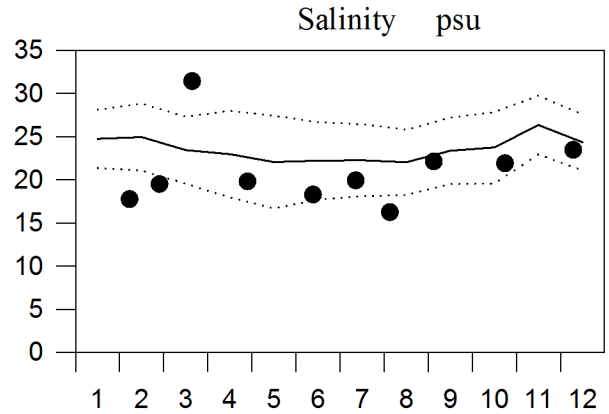
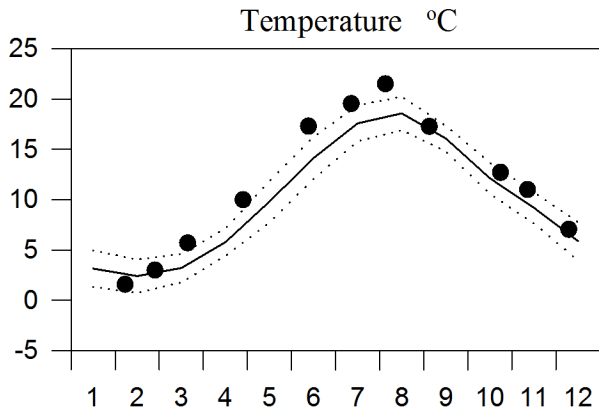
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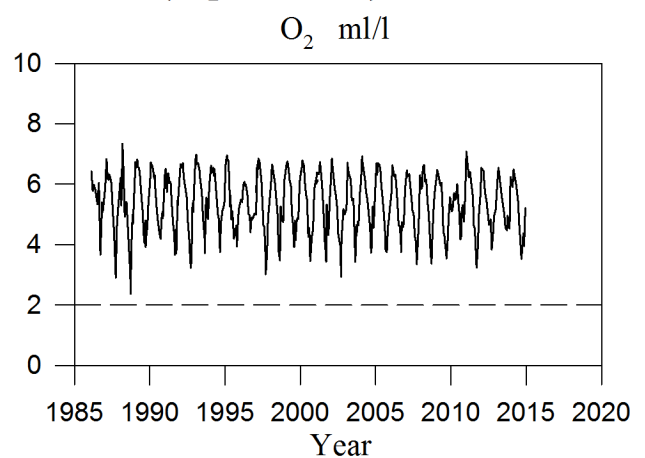
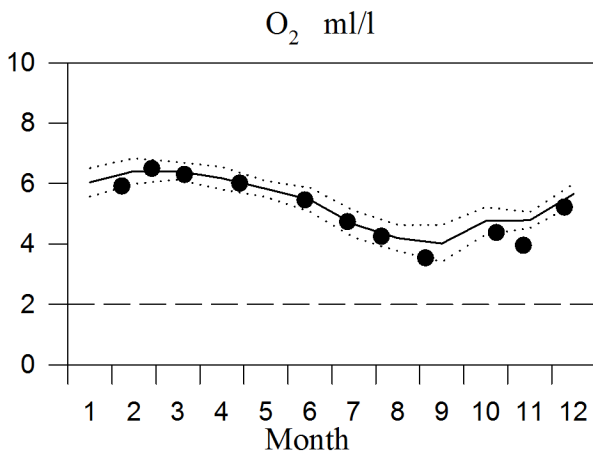
STATION FLADEN SURFACE WATER

Annual Cycles

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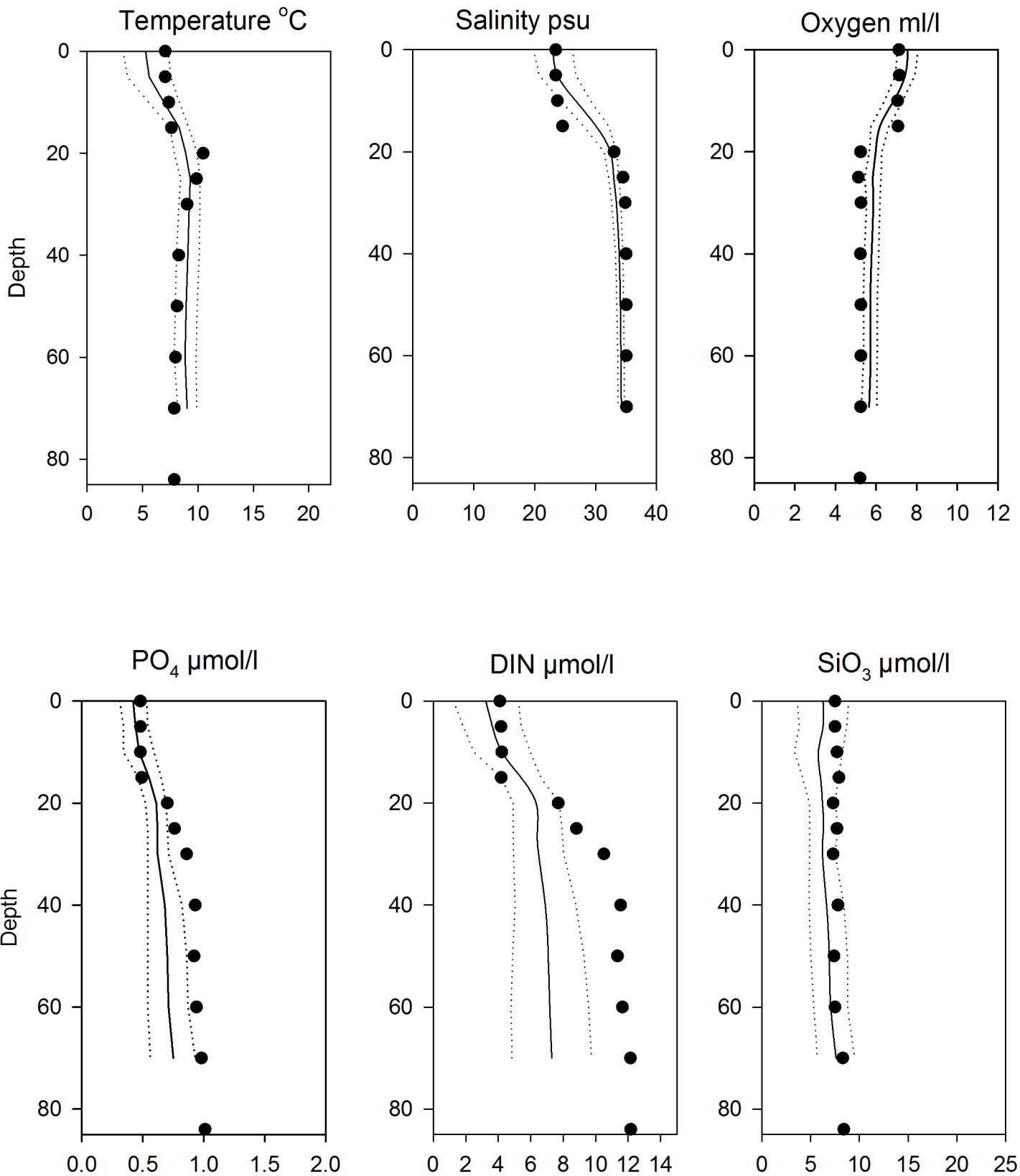


OXYGEN IN BOTTOM WATER (depth > 70m)



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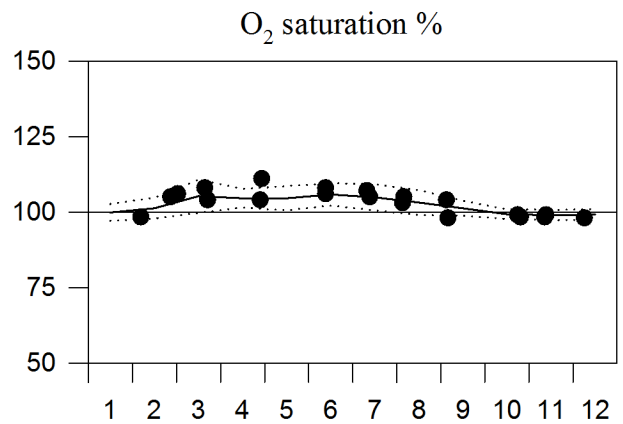
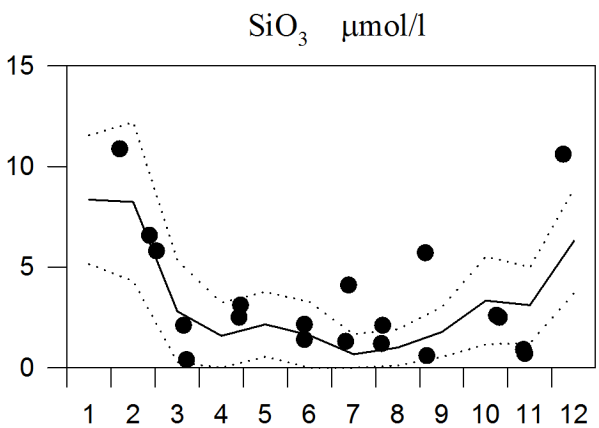
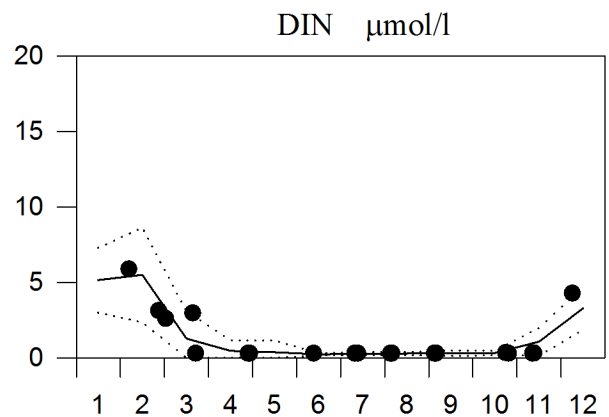
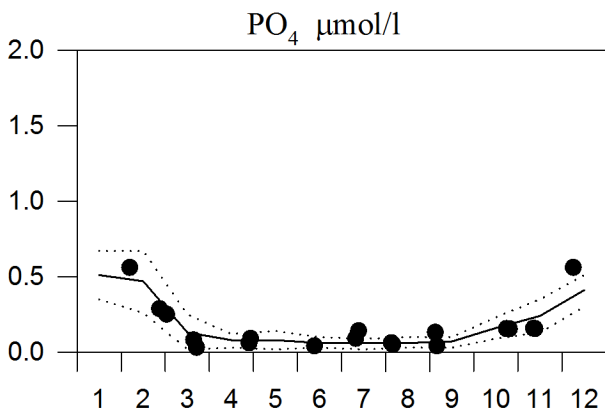
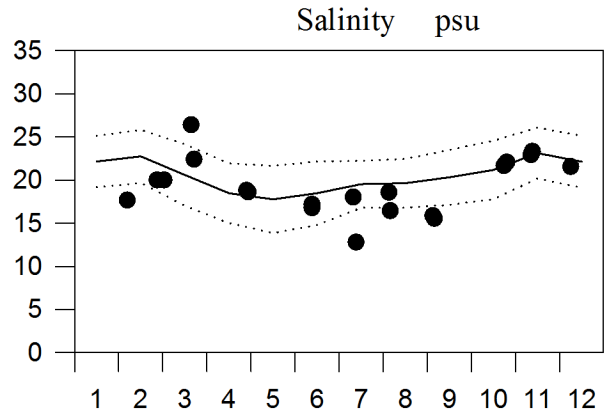
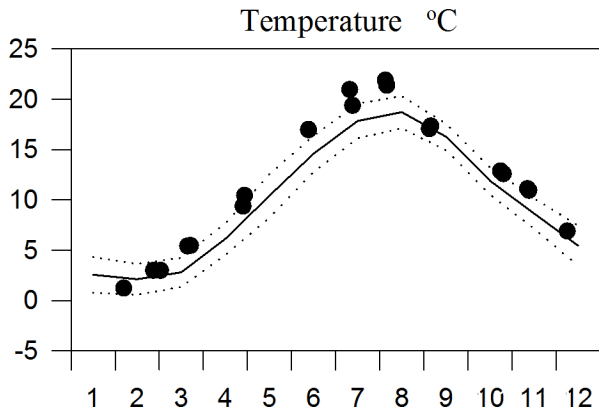
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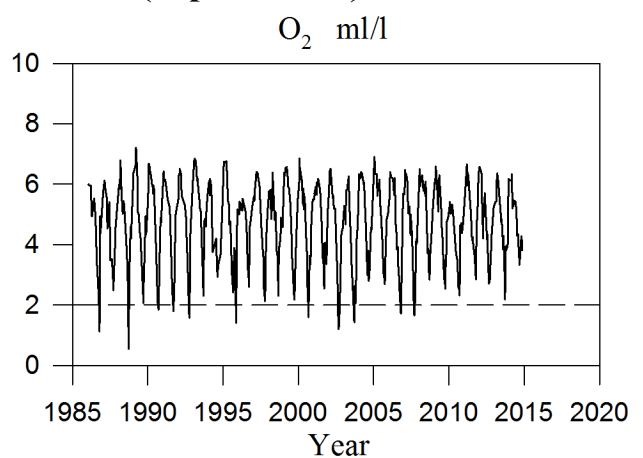
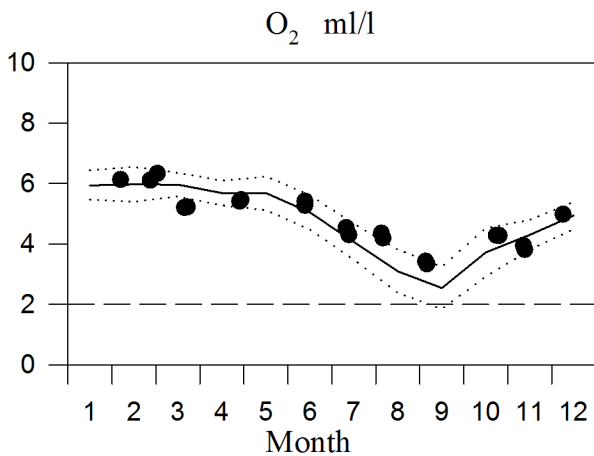
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Annual Cycles

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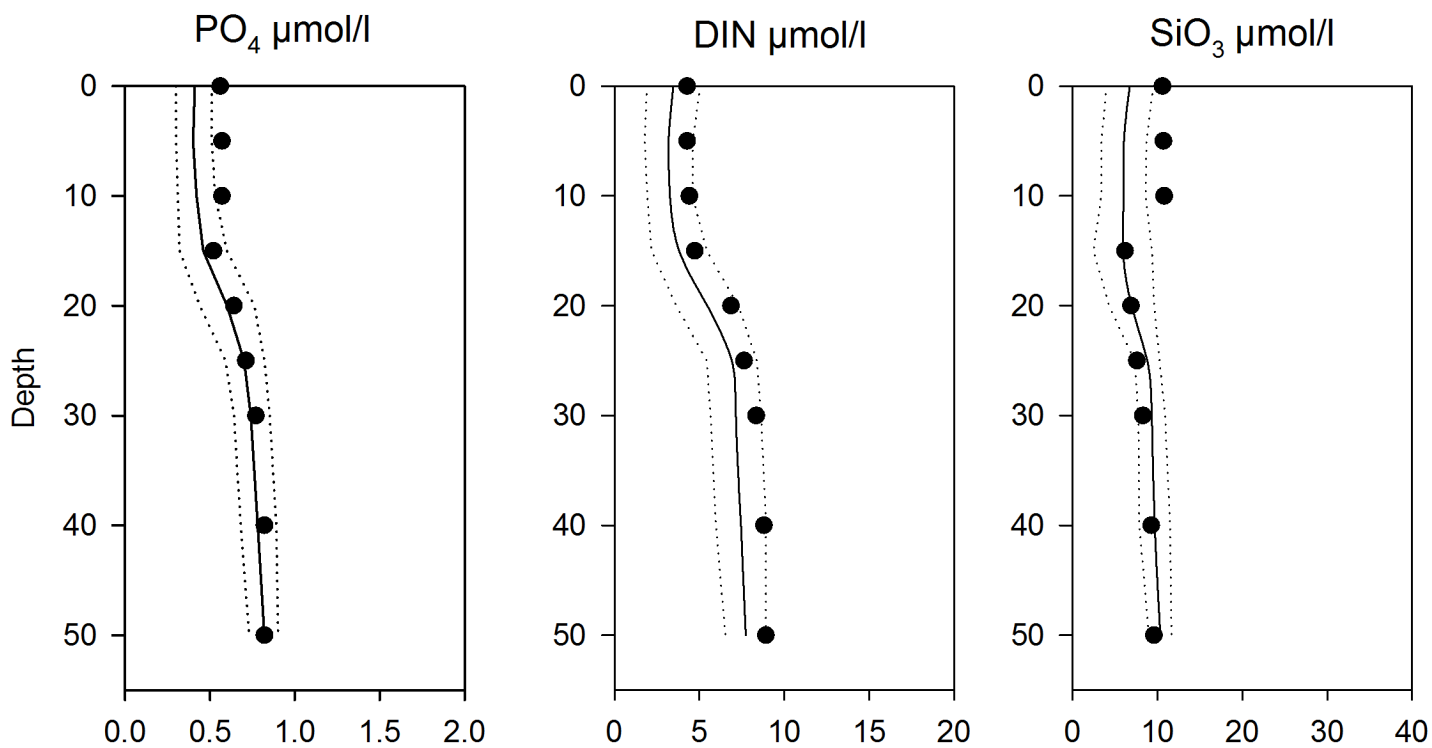
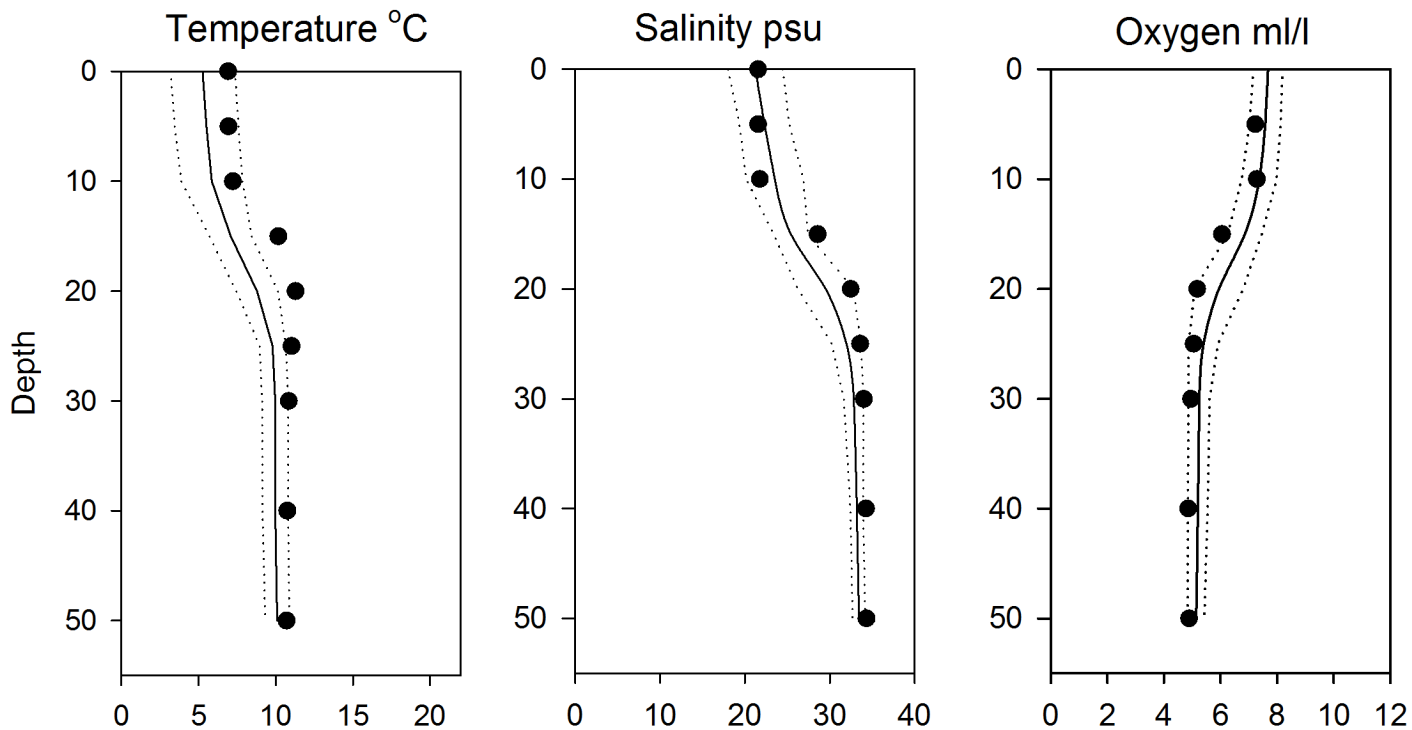


OXYGEN IN BOTTOM WATER (depth > 50m)



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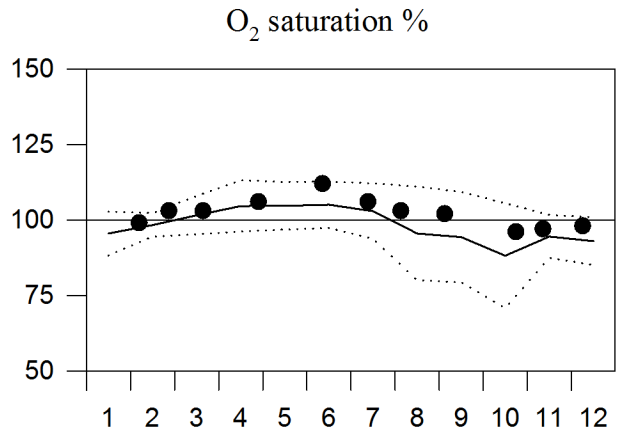
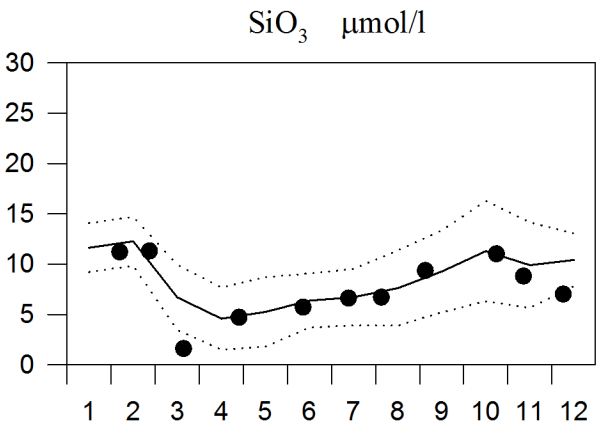
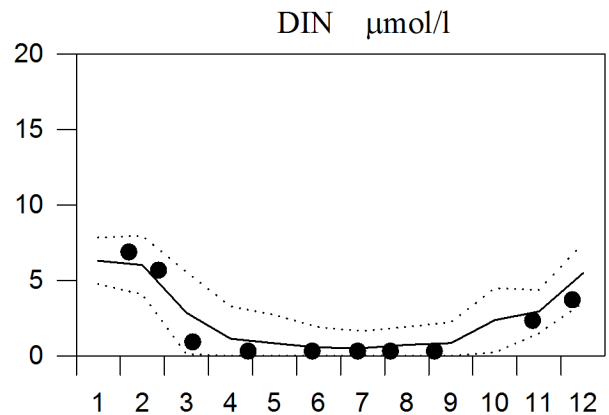
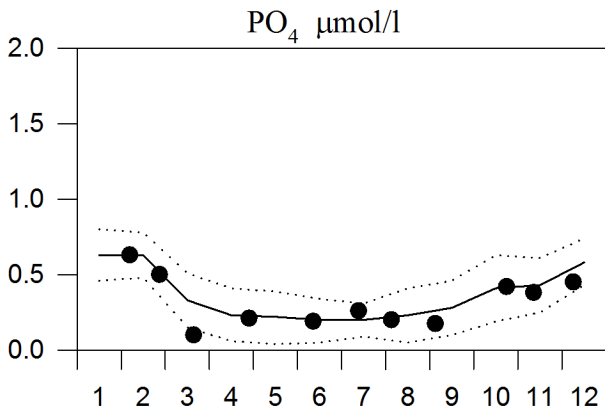
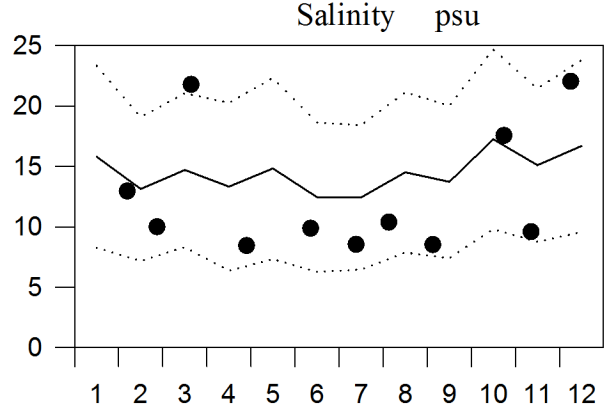
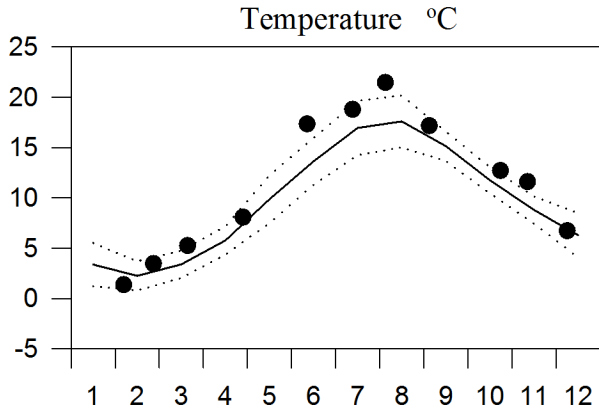
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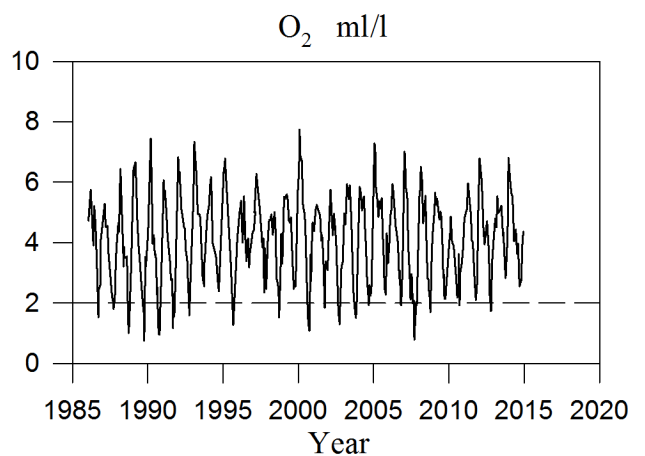
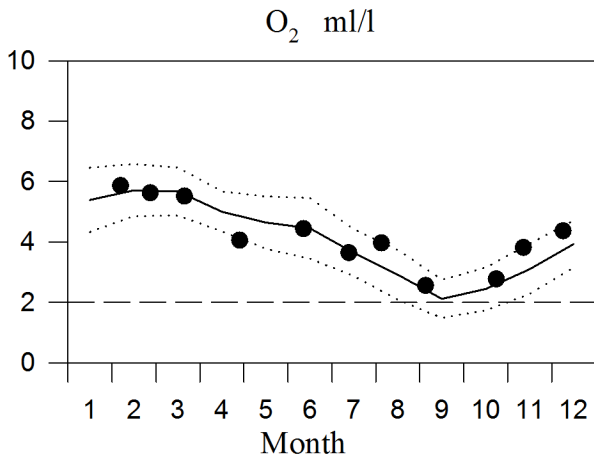
STATION W LANDSKRONA SURFACE WATER

Annual Cycles

— Mean 1996-2010 St.Dev. ● 2014

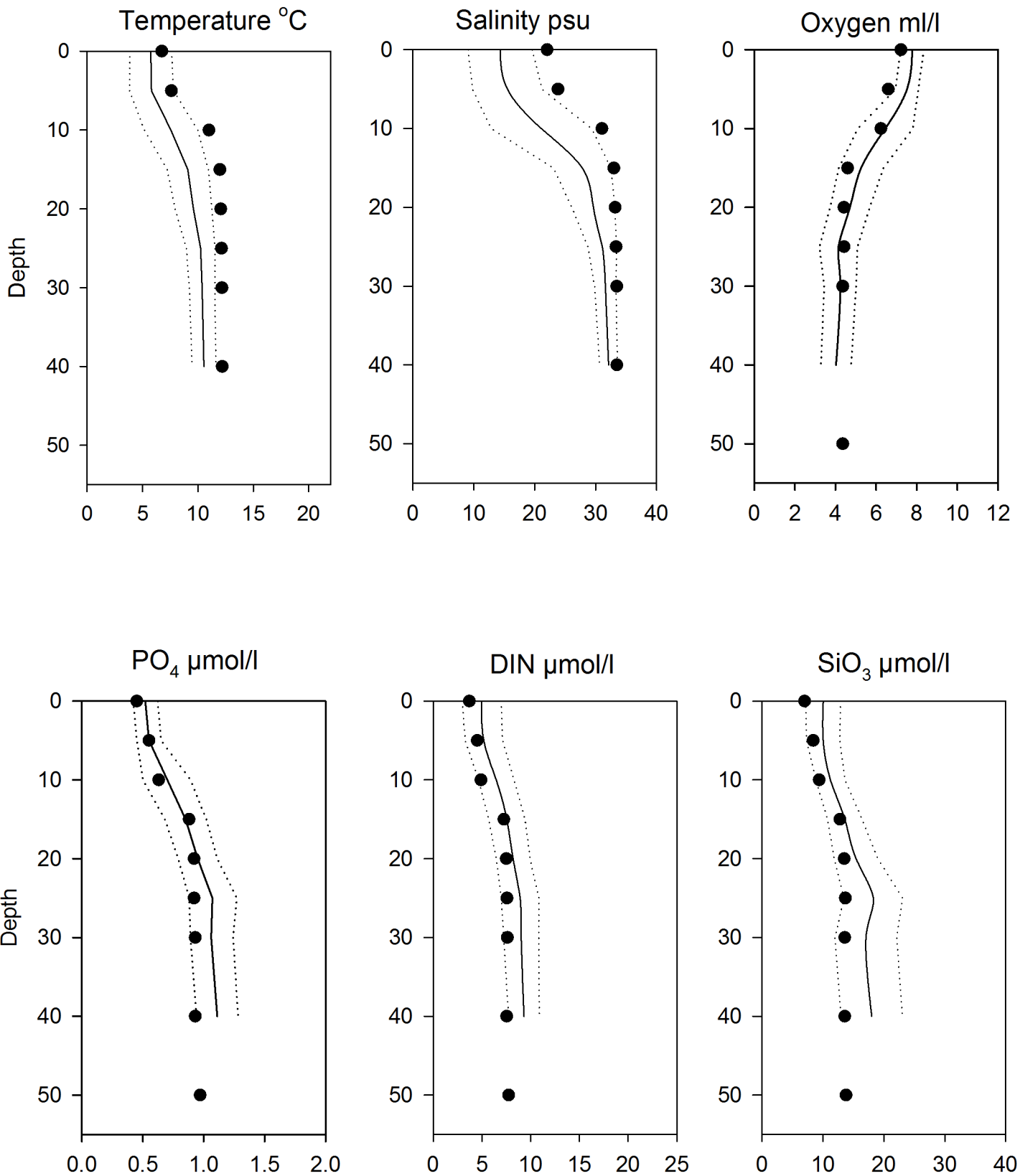


OXYGEN IN BOTTOM WATER (depth >40m)



Vertical profiles W Landskrona December

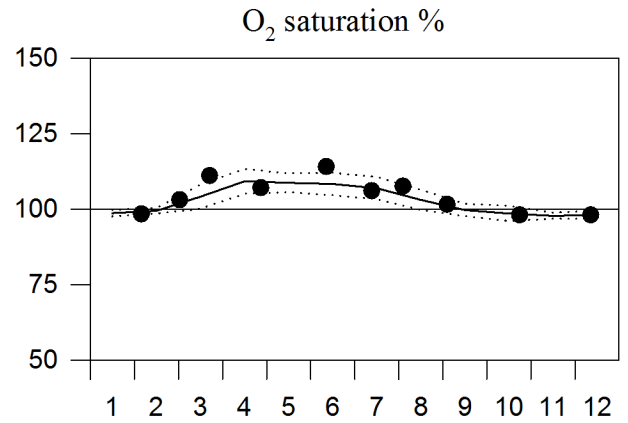
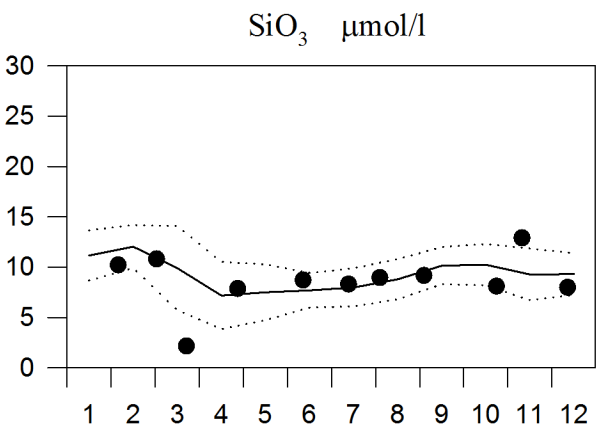
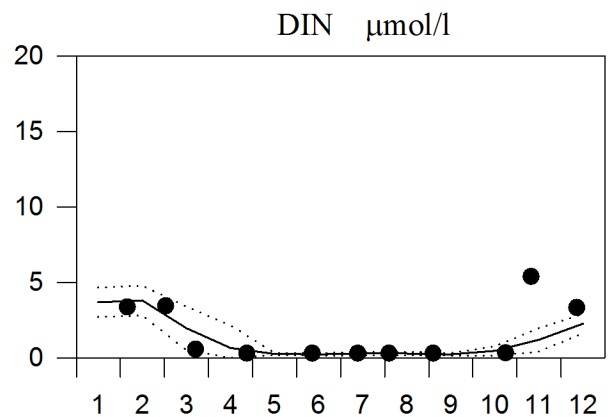
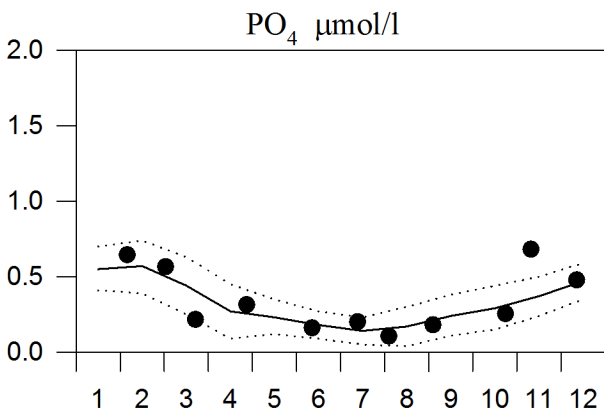
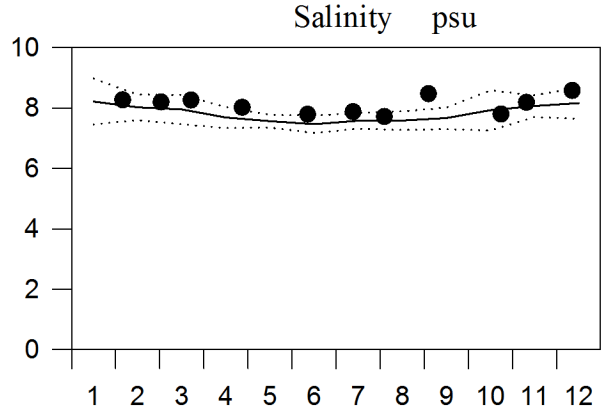
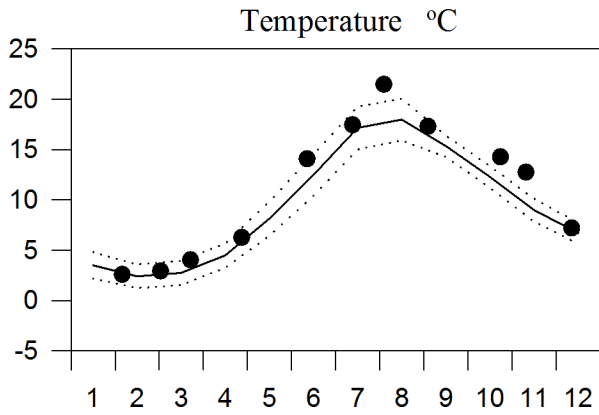
— Mean 1996-2010 St.Dev. ● 2014



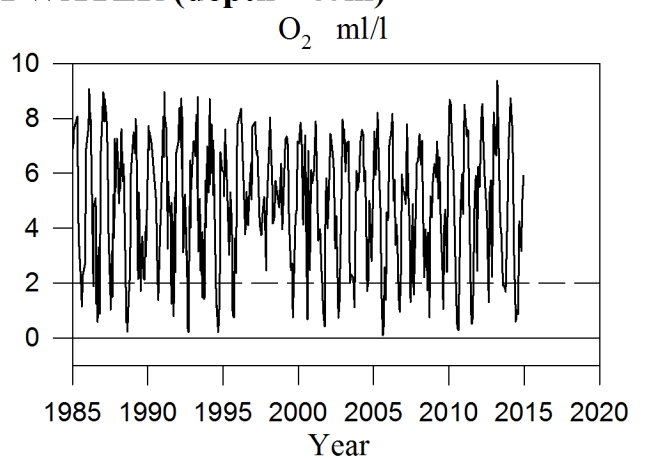
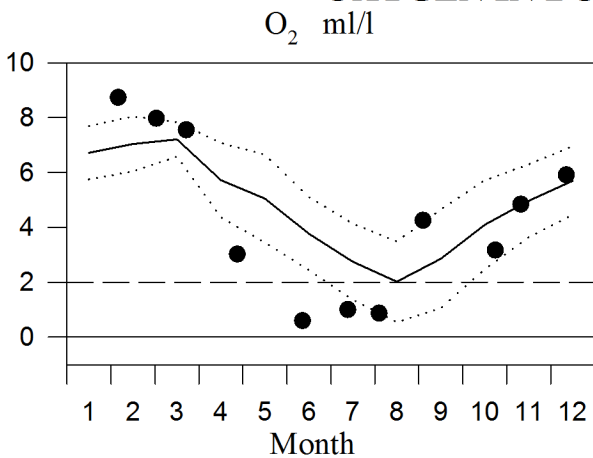
STATION BY1 SURFACE WATER

Annual Cycles

— Mean 1996-2010 ····· St.Dev. ● 2014

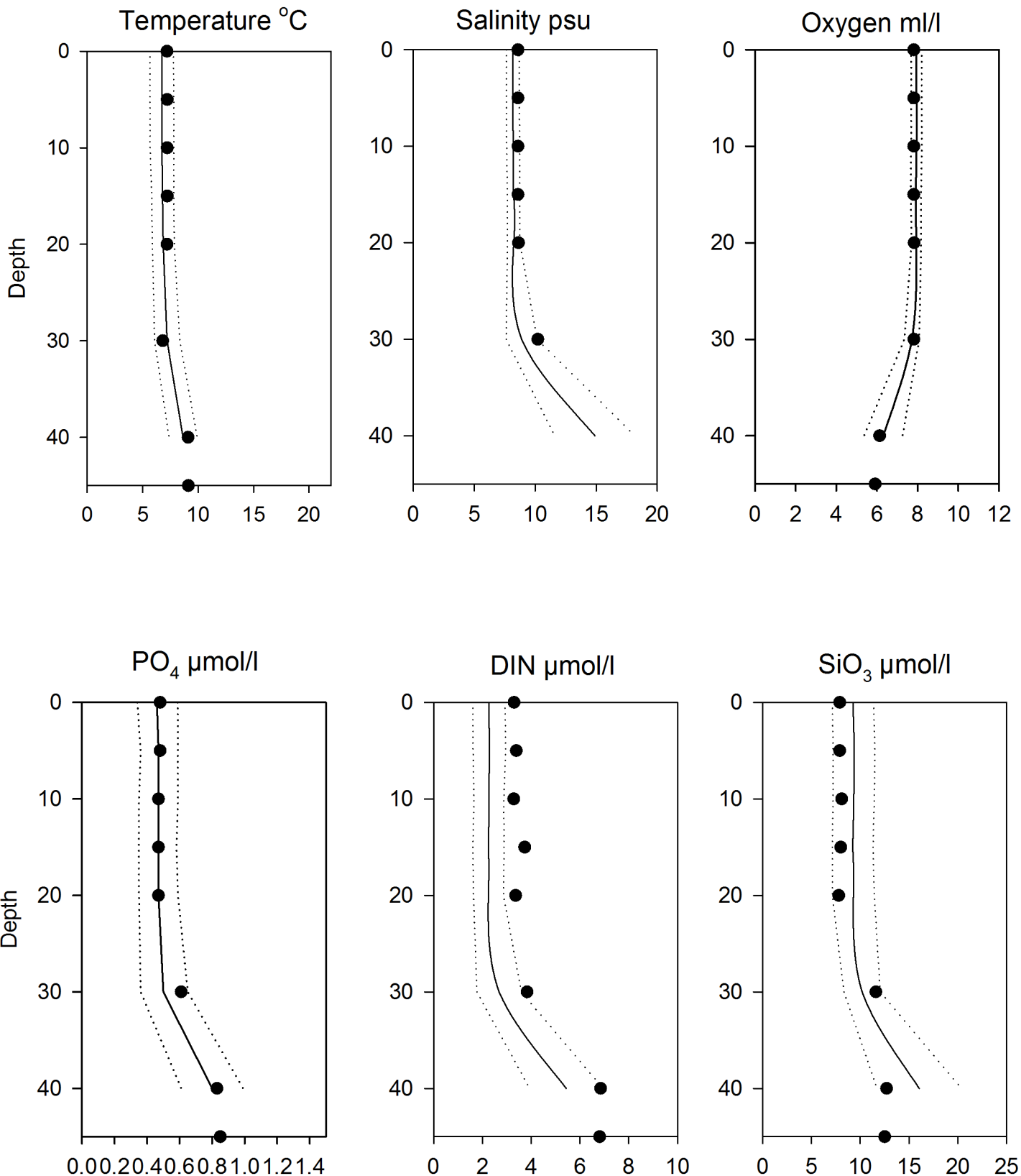


OXYGEN IN BOTTOM WATER (depth >40m)



Vertical profiles BY1 December

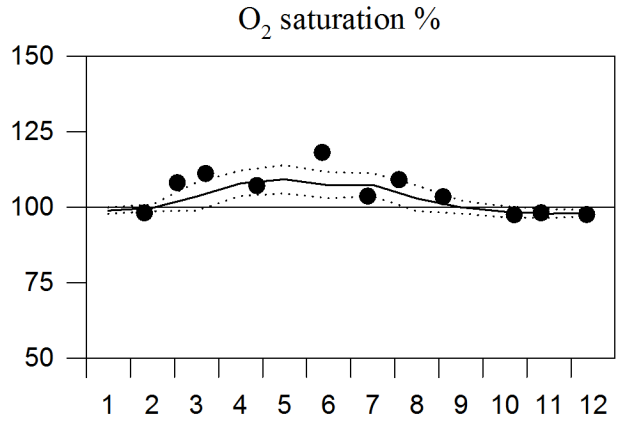
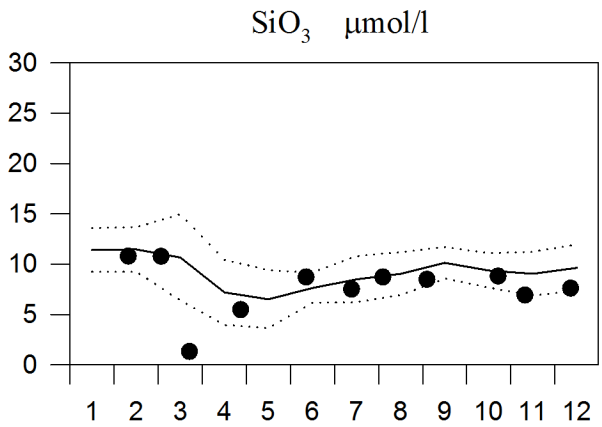
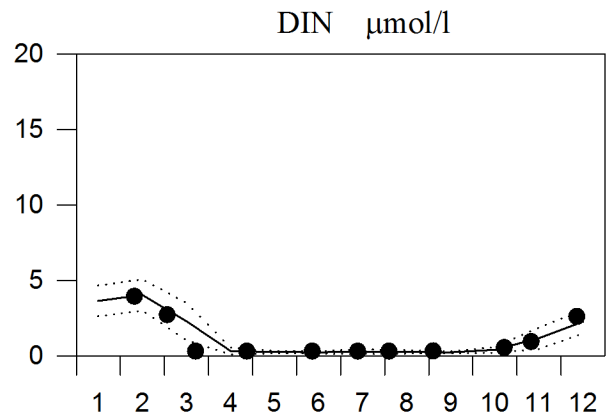
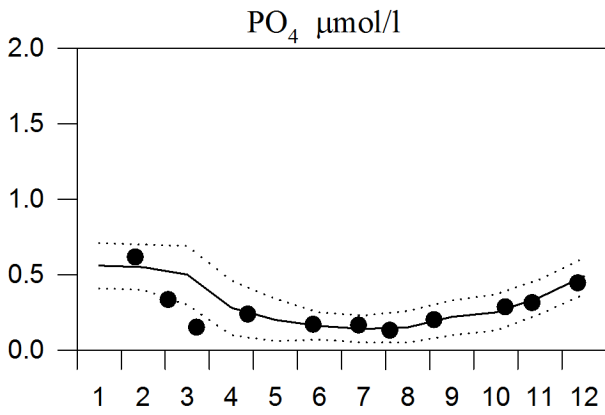
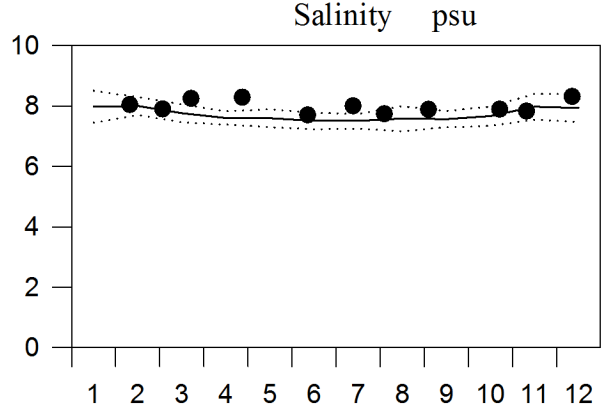
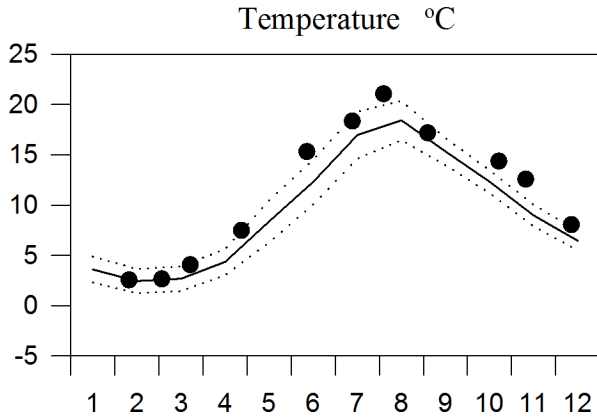
— Mean 1996-2010 ····· St.Dev. ● 2014



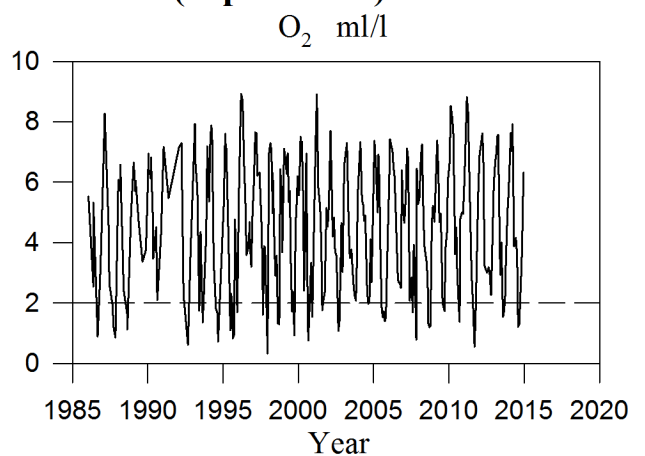
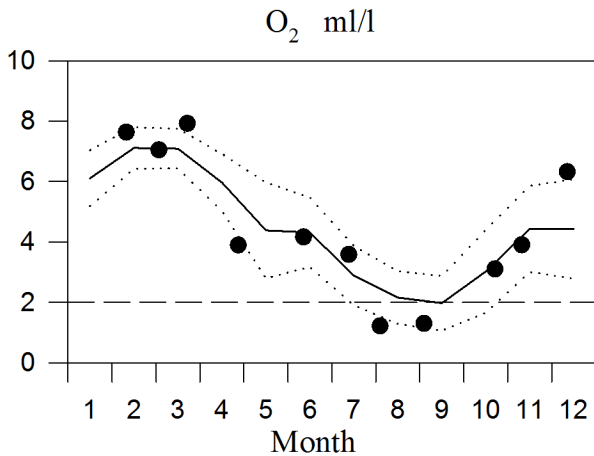
STATION BY2 SURFACE WATER

Annual Cycles

— Mean 1996-2010 ····· St.Dev. ● 2014

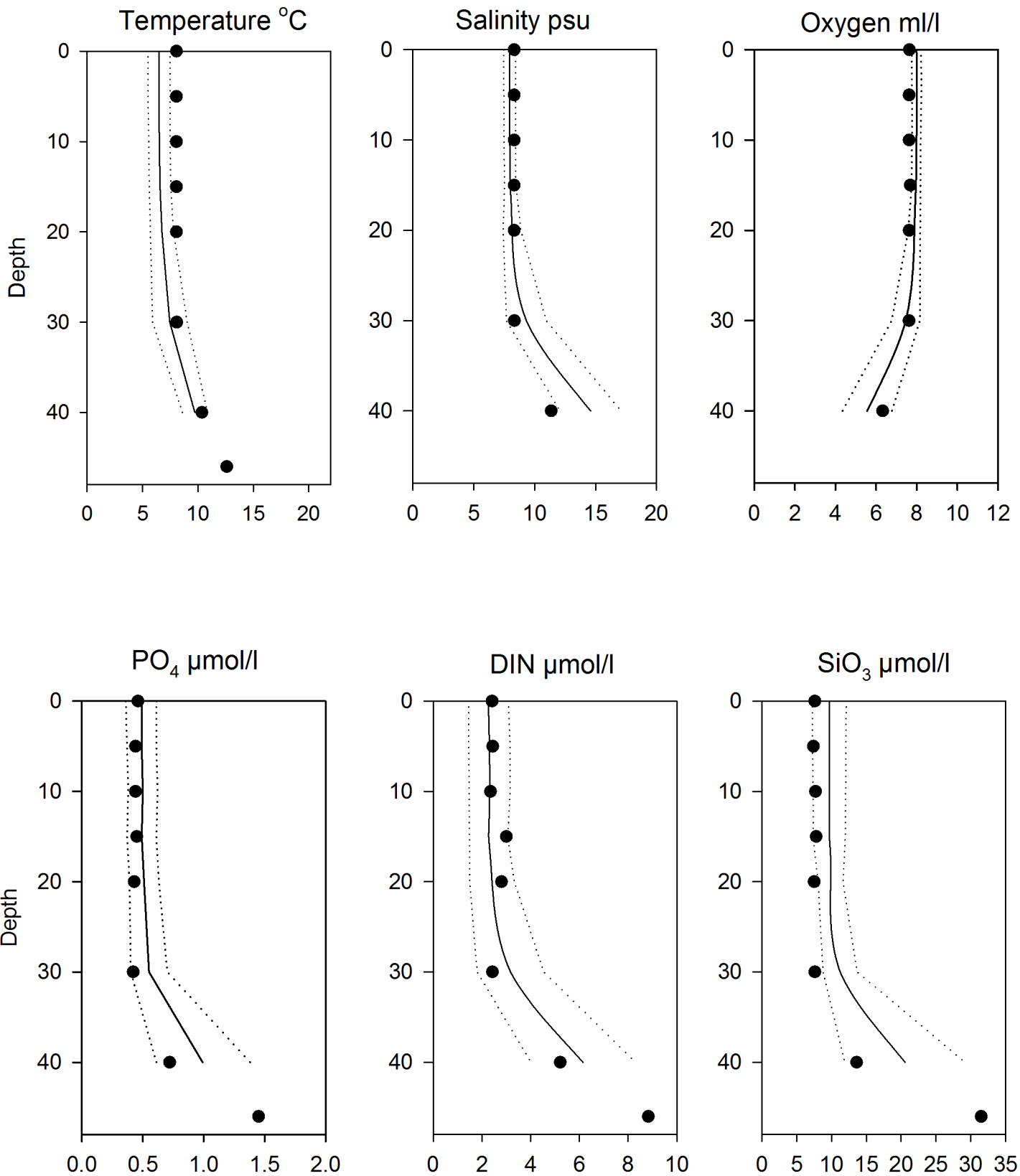


OXYGEN IN BOTTOM WATER (depth >40m)



Vertical profiles BY2 December

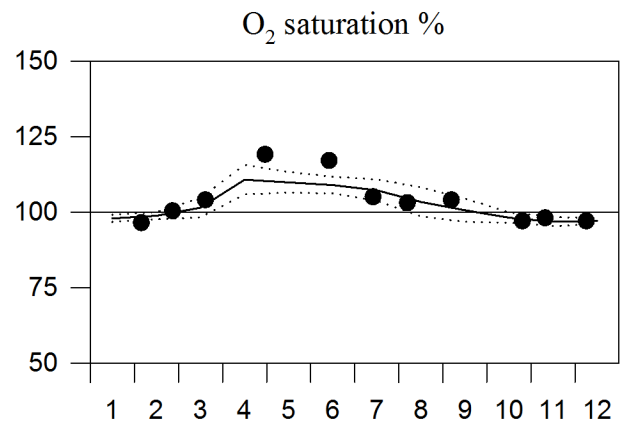
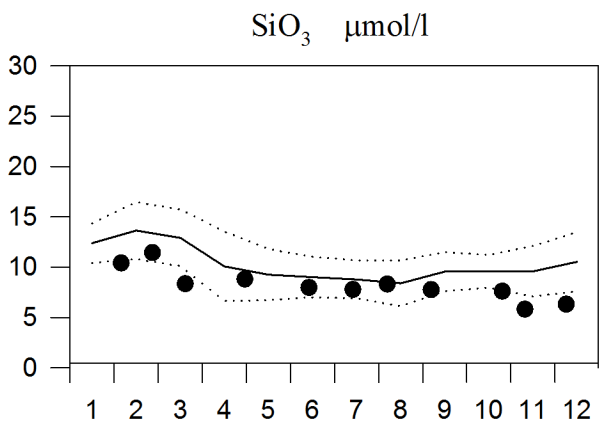
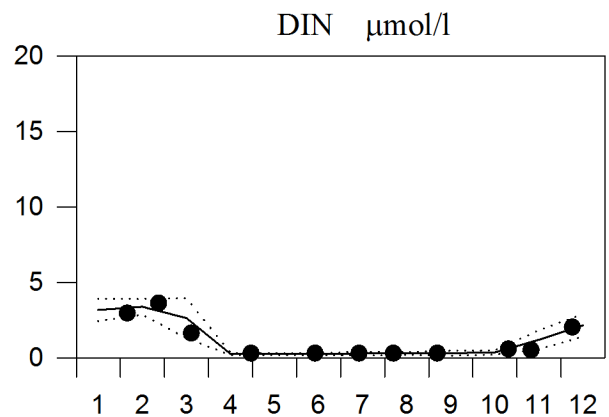
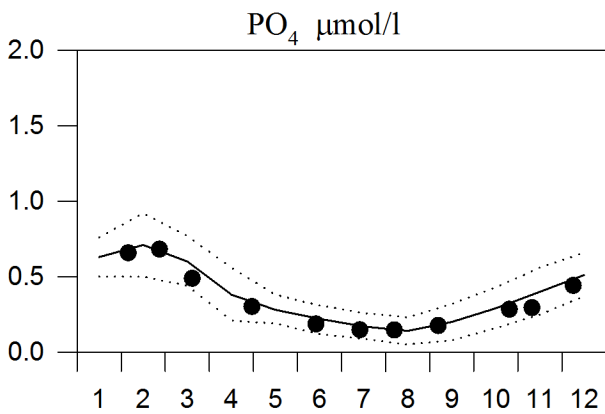
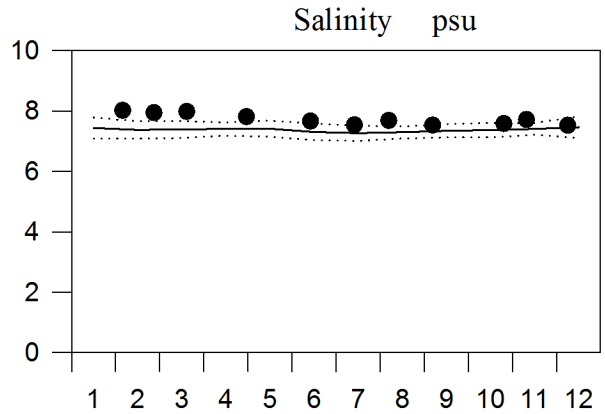
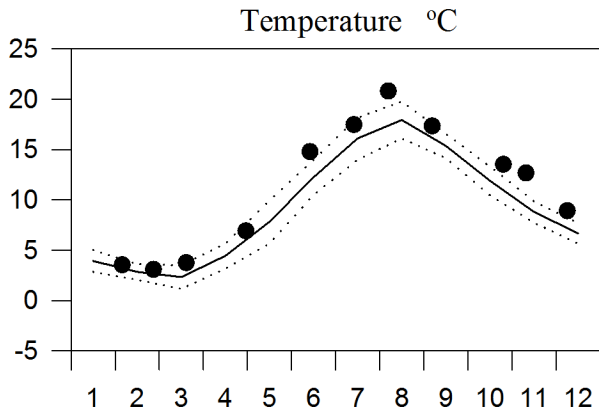
— Mean 1996-2010 ····· St.Dev. ● 2014



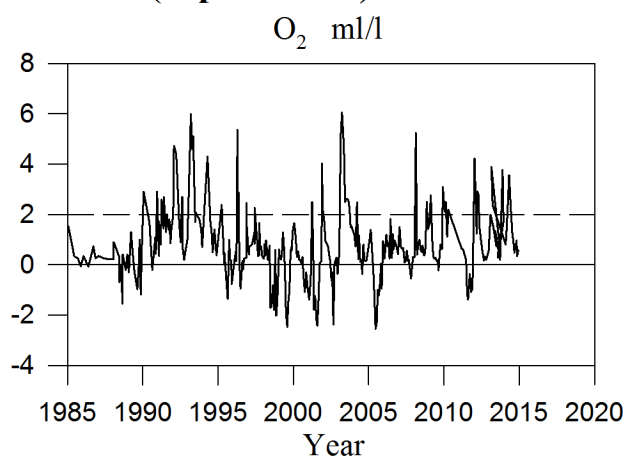
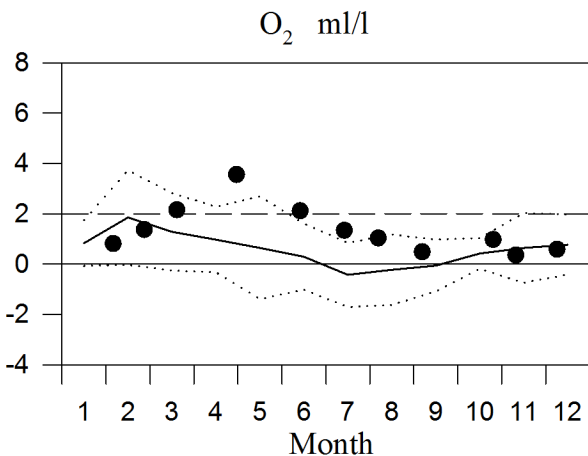
STATION HANÖBUKTEN SURFACE WATER

Annual Cycles

— Mean 1996-2010 St.Dev. ● 2014

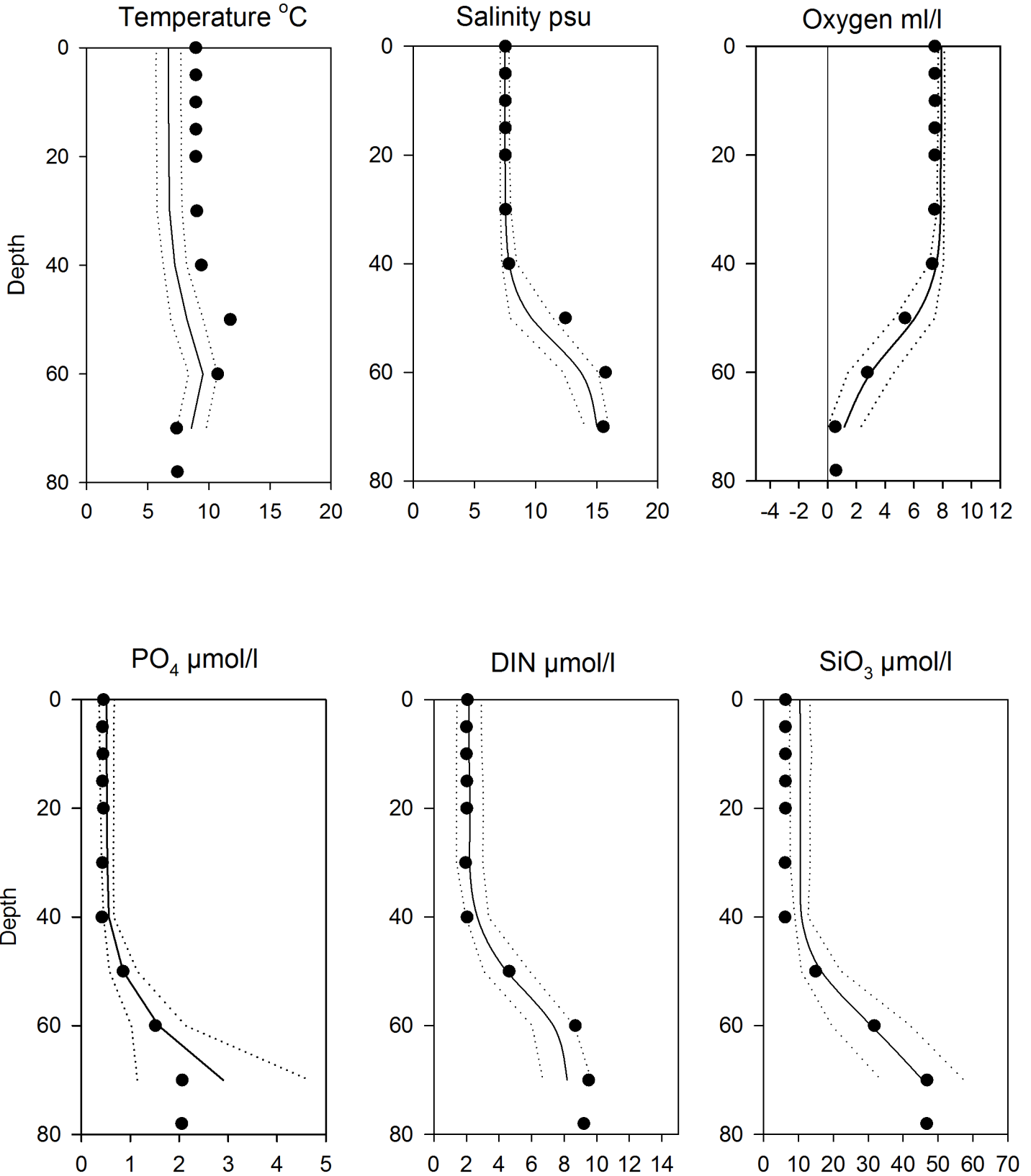


OXYGEN IN BOTTOM WATER (depth > 70m)



Vertical profiles Hanöbukten December

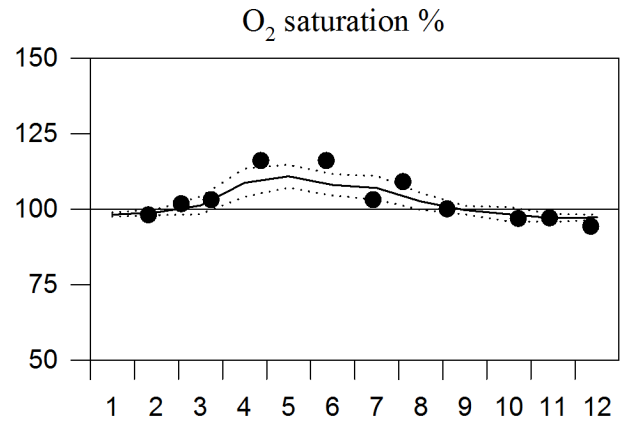
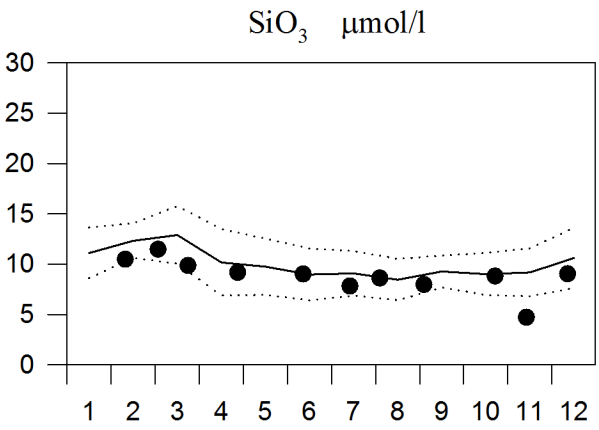
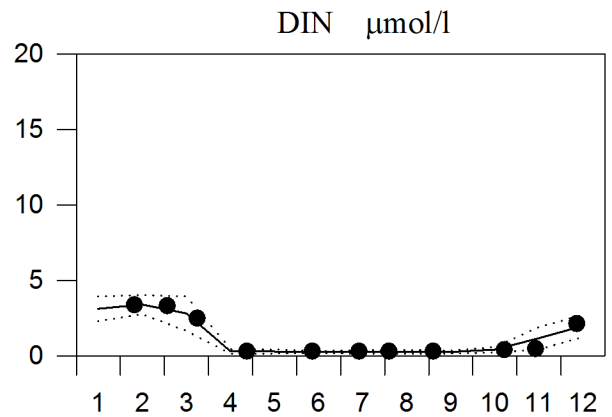
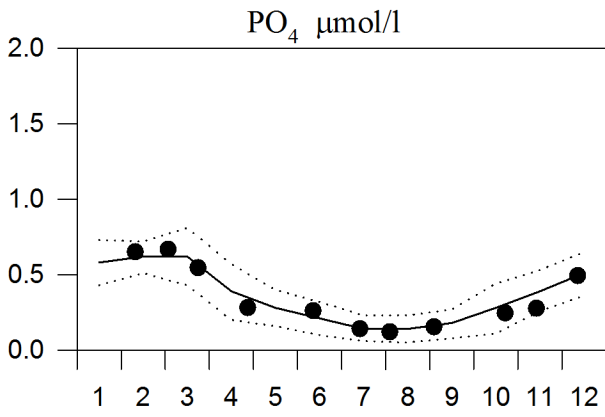
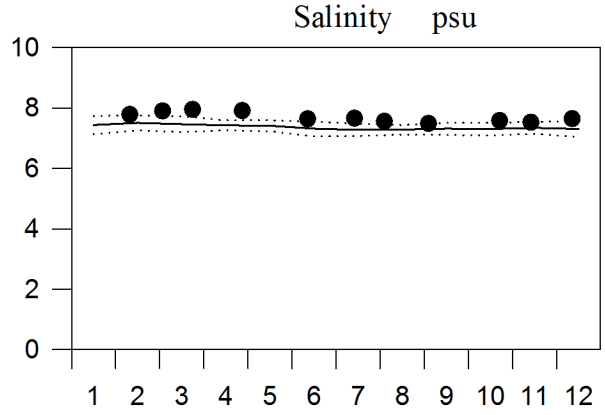
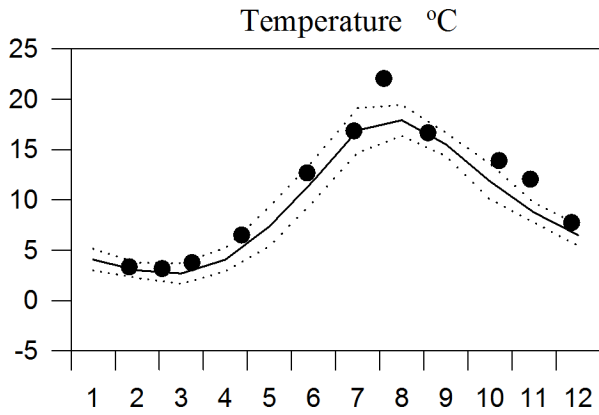
— Mean 1996-2010 ····· St.Dev. ● 2014



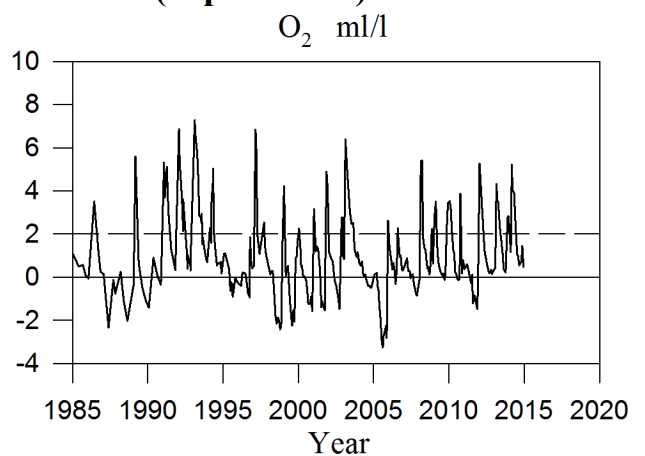
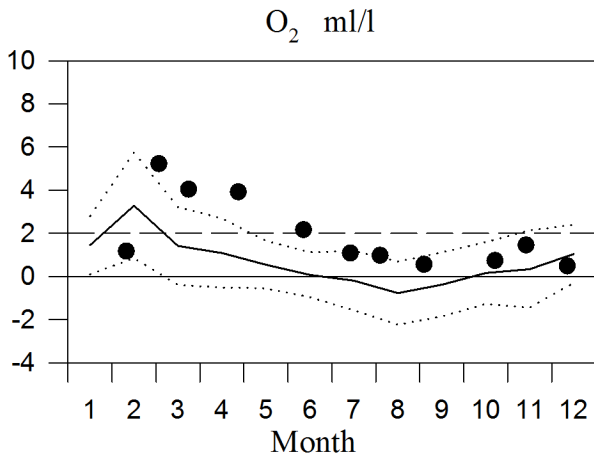
STATION BY4 SURFACE WATER

Annual Cycles

— Mean 1996-2010 St.Dev. ● 2014

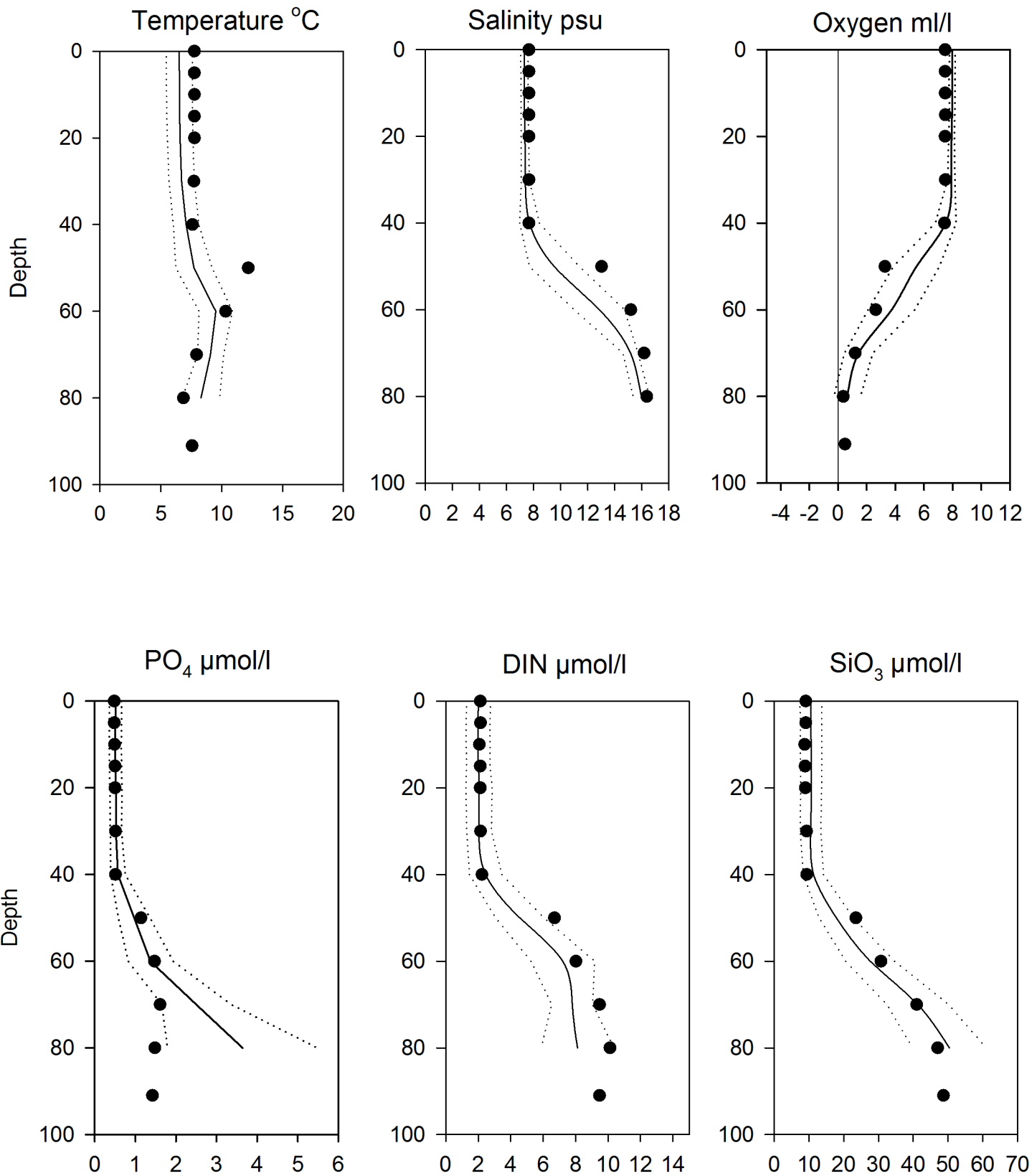


OXYGEN IN BOTTOM WATER (depth >80m)



Vertical profiles BY4 December

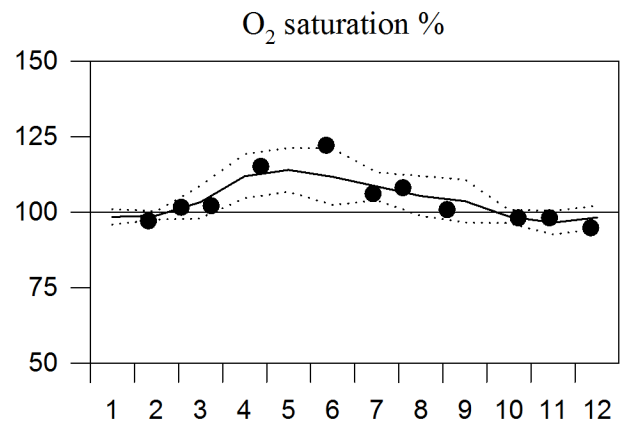
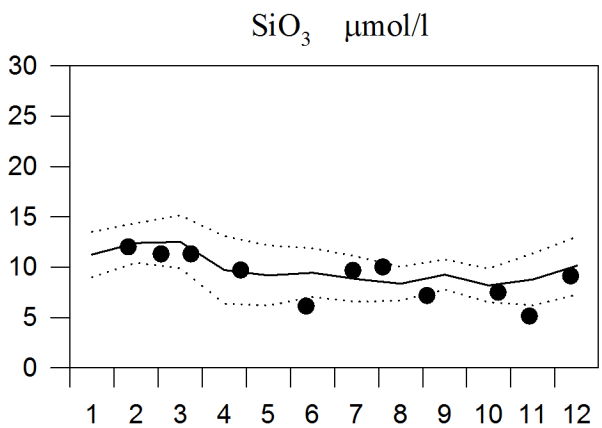
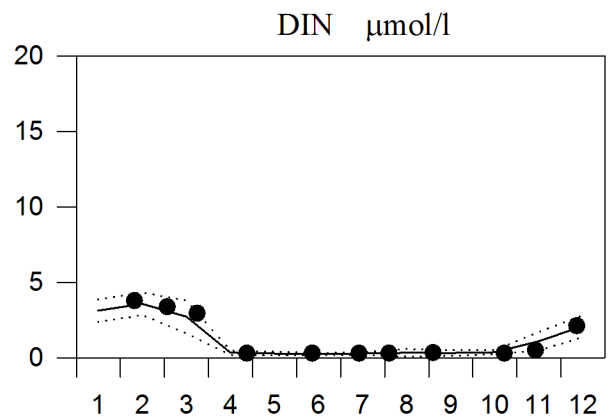
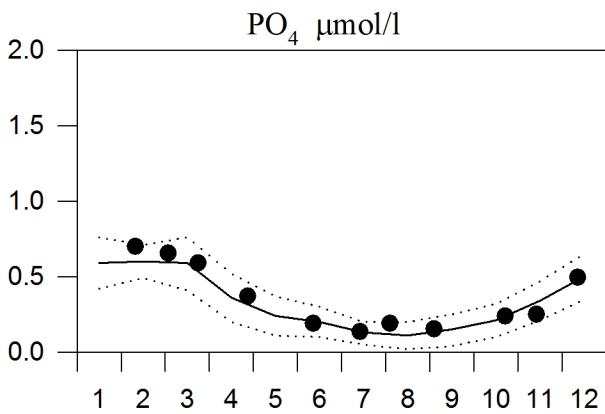
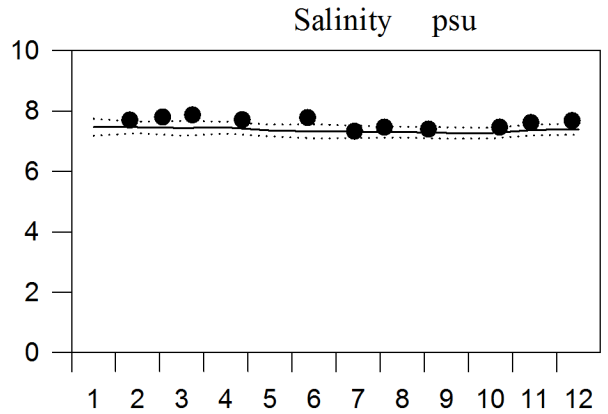
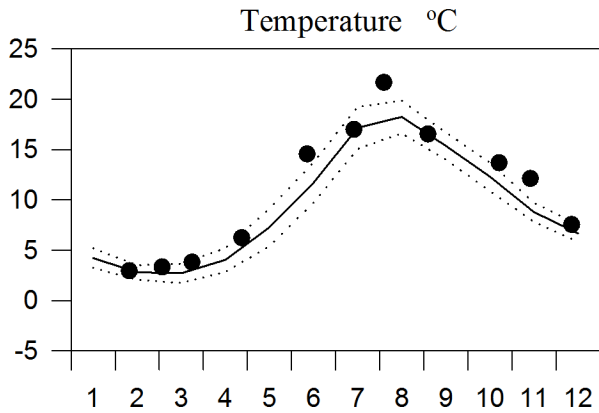
— Mean 1996-2010 ····· St.Dev. ● 2014



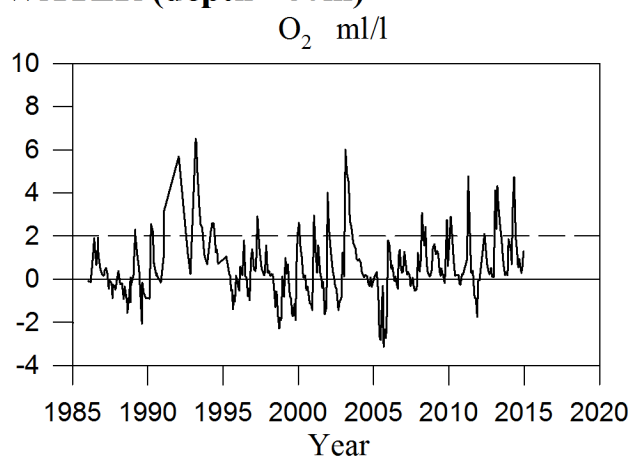
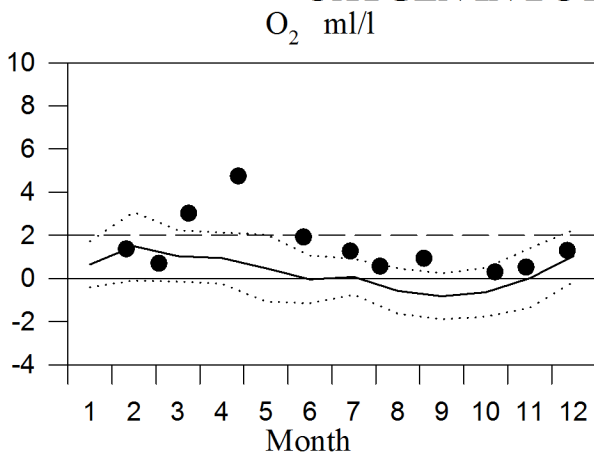
STATION BY5 SURFACE WATER

Annual Cycles

— Mean 1996-2010 St.Dev. ● 2014

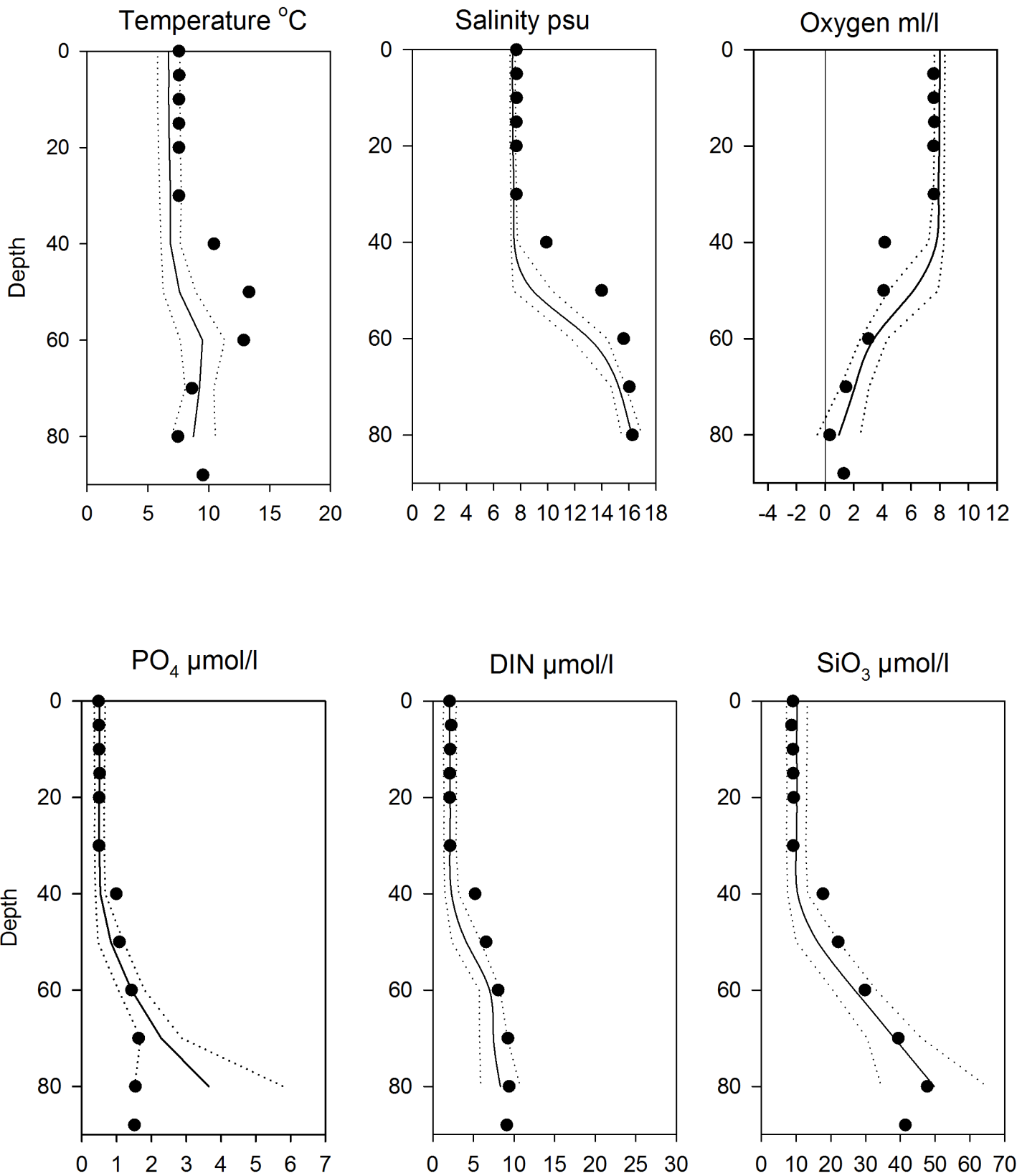


OXYGEN IN BOTTOM WATER (depth >80m)



Vertical profiles BY5 December

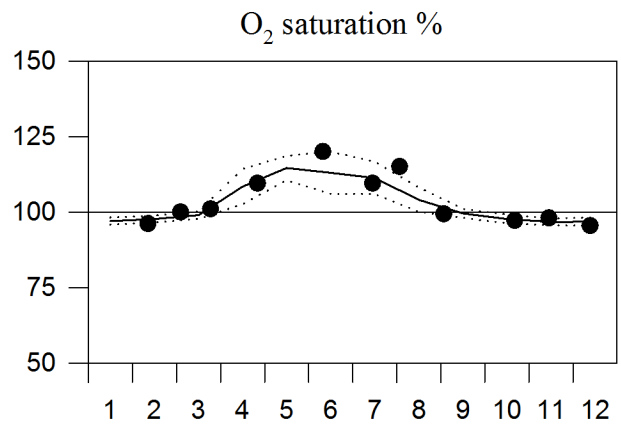
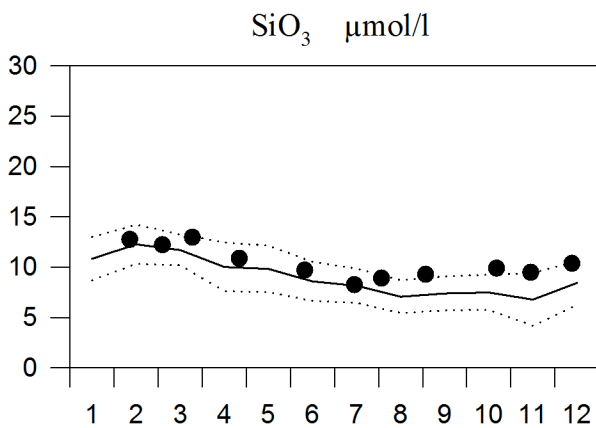
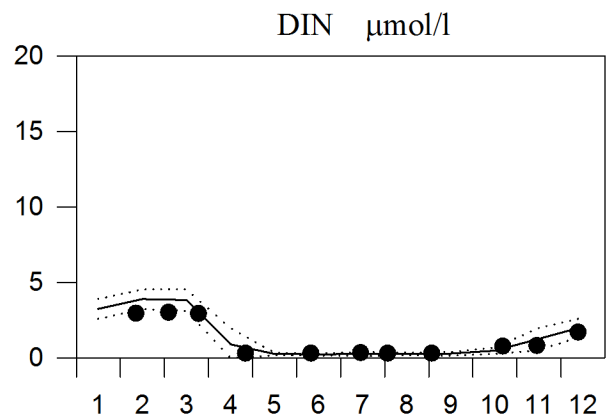
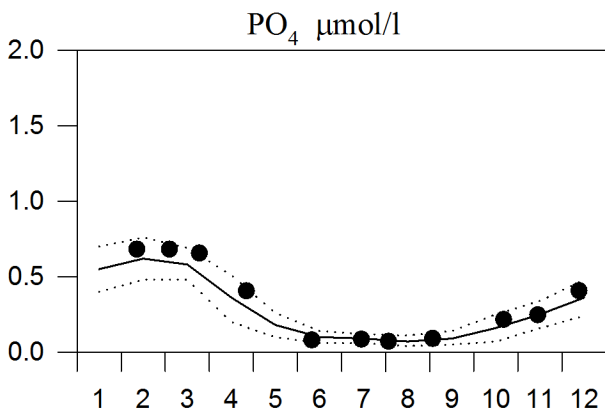
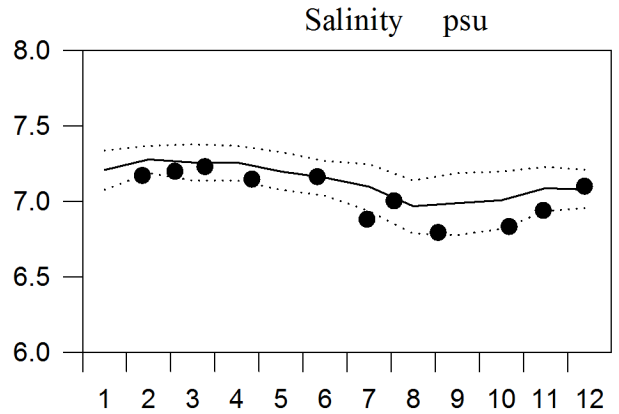
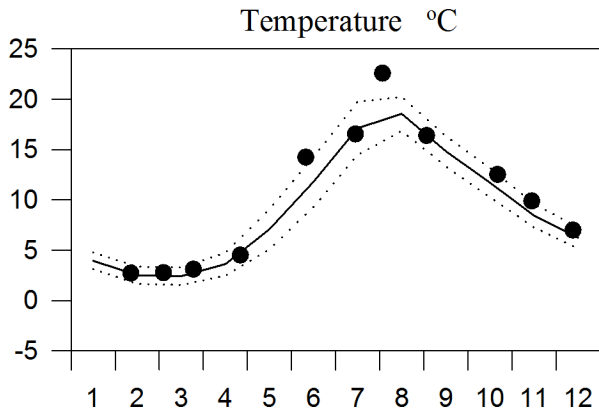
— Mean 1996-2010 ····· St.Dev. ● 2014



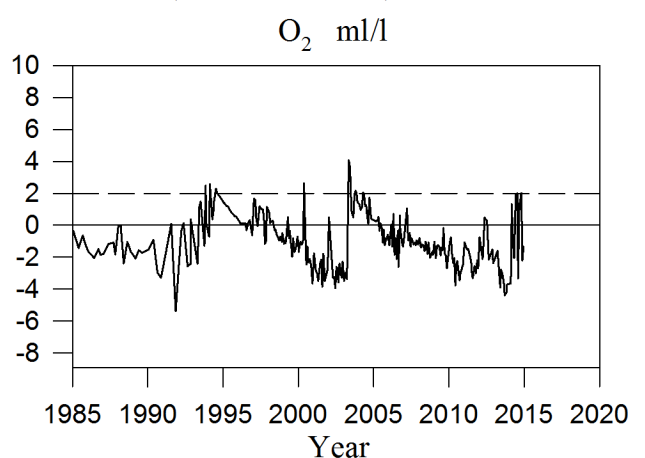
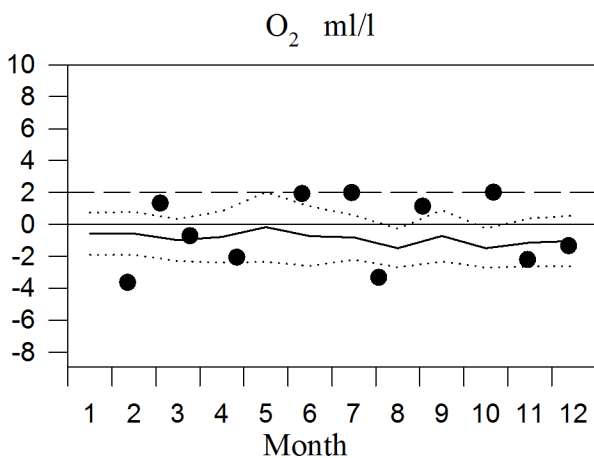
STATION BY10 SURFACE WATER

Annual Cycles

— Mean 1996-2010 St.Dev. ● 2014

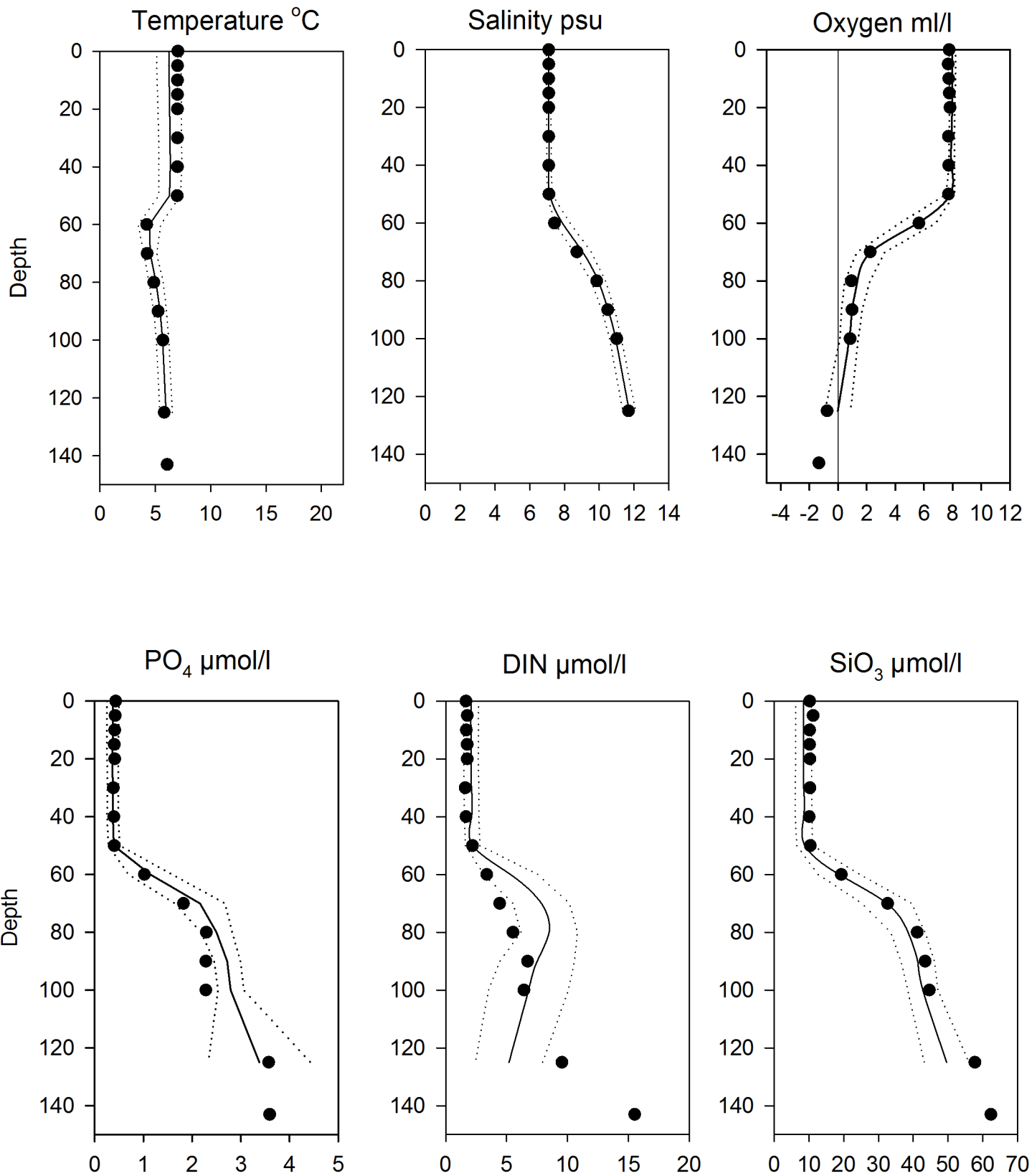


OXYGEN IN BOTTOM WATER (depth >125m)



Vertical profiles BY10 December

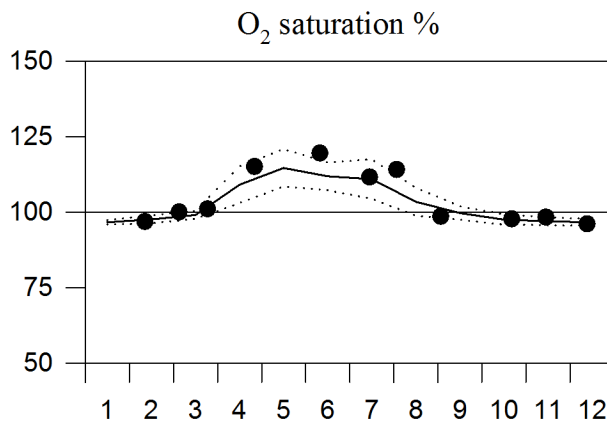
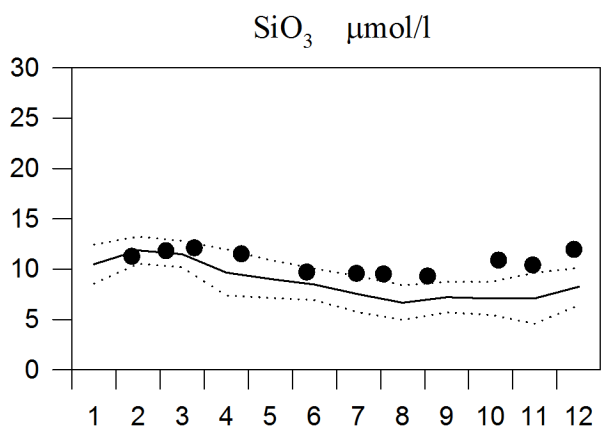
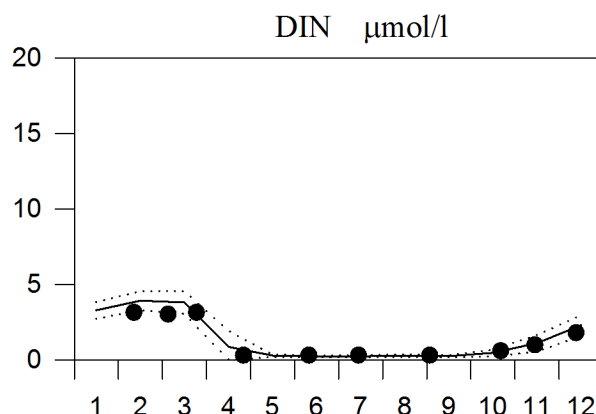
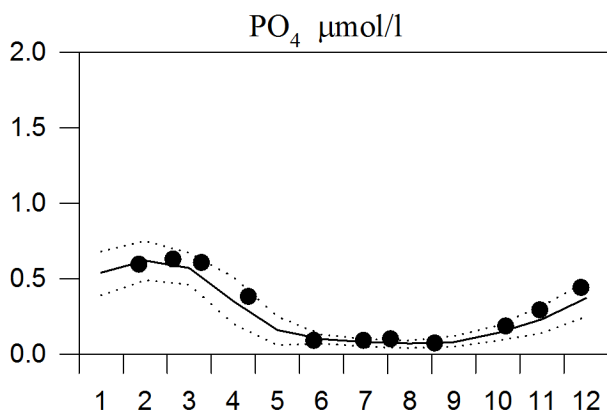
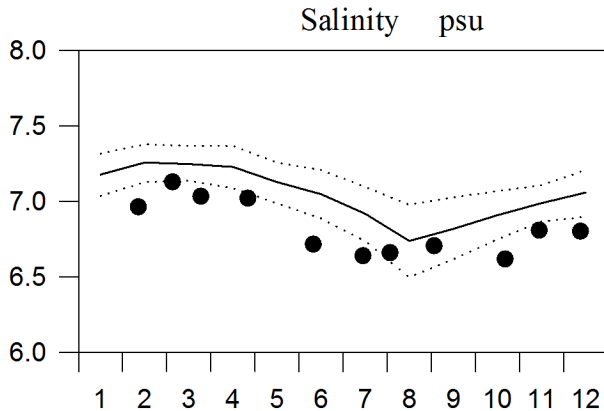
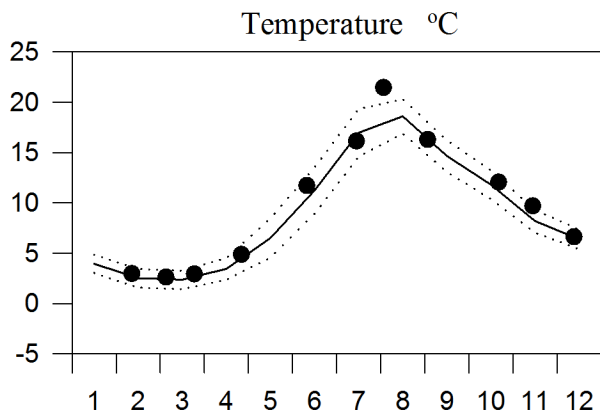
— Mean 1996-2010 ····· St.Dev. ● 2014



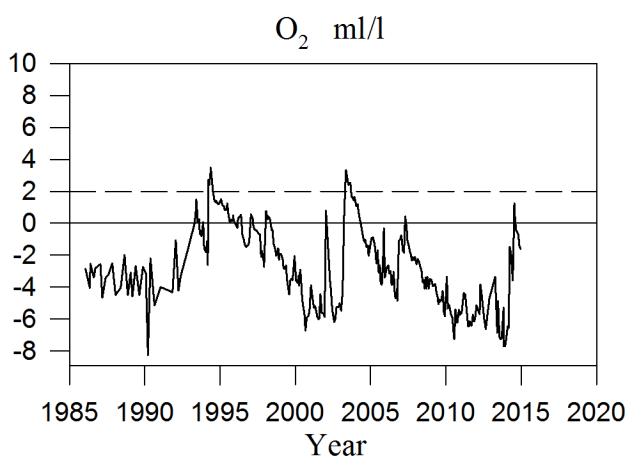
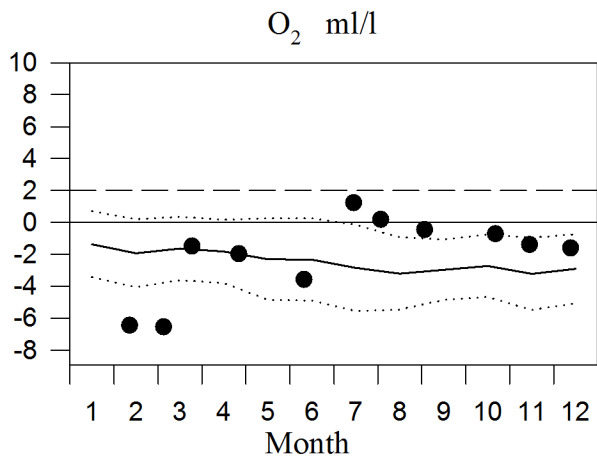
STATION BY15 SURFACE WATER

Annual Cycles

— Mean 1996-2010 ····· St.Dev. ● 2014

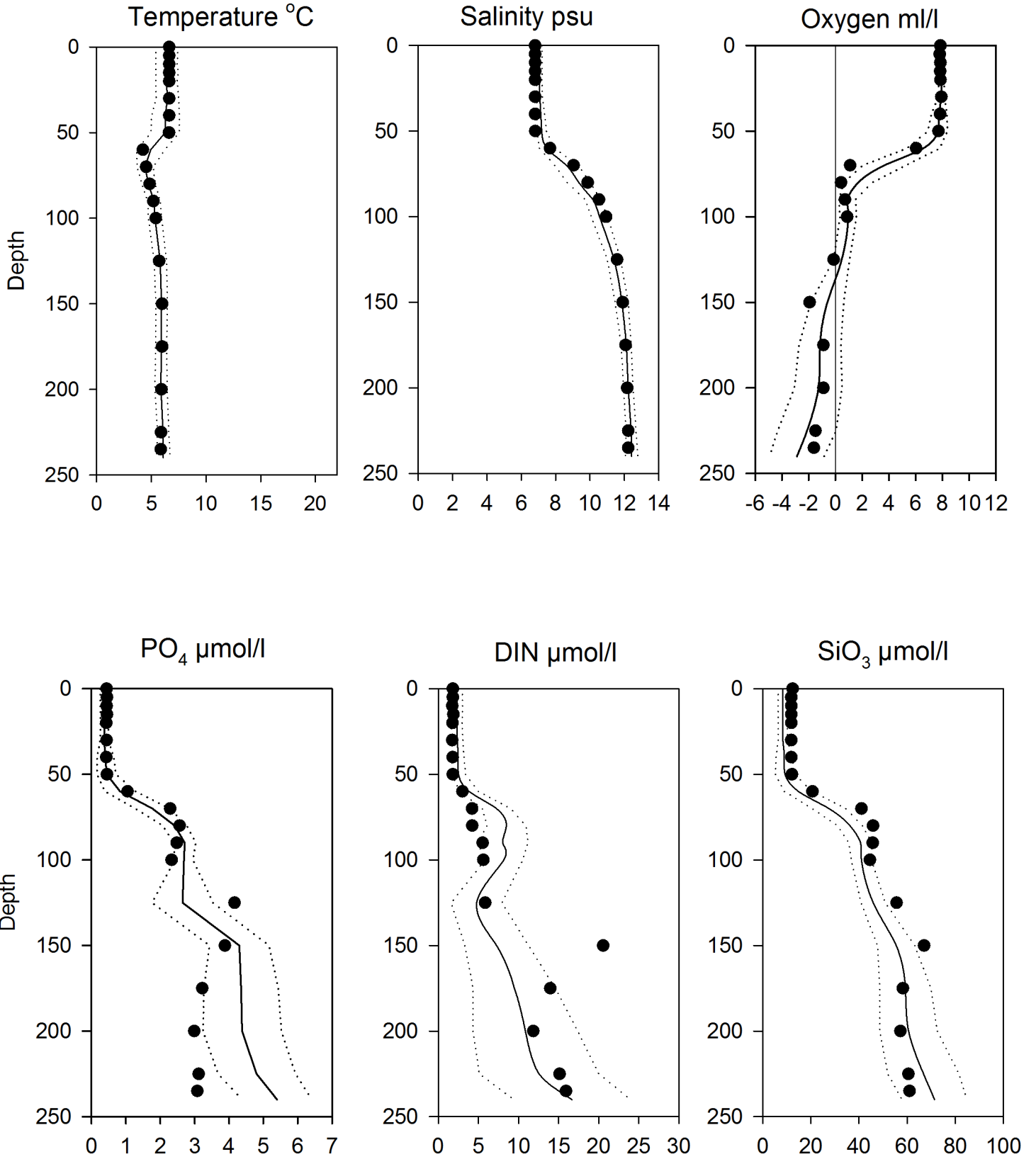


OXYGEN IN BOTTOM WATER (depth >225m)



Vertical profiles BY15 December

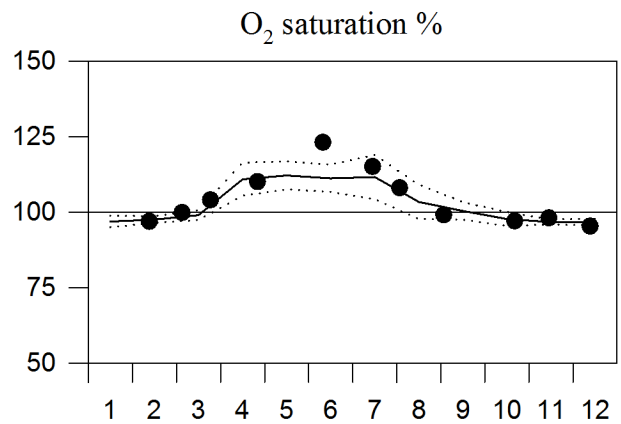
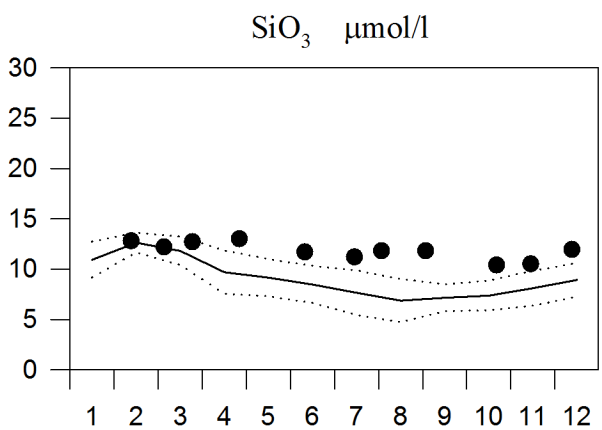
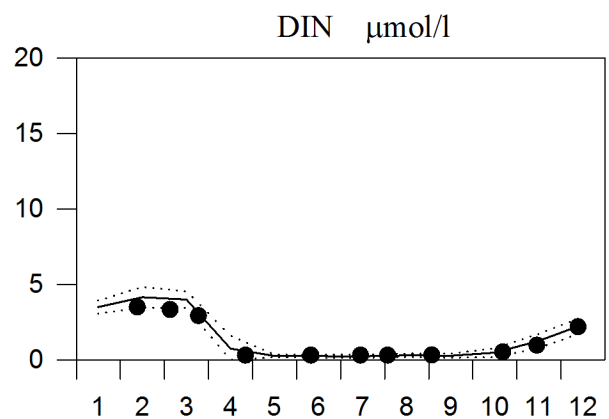
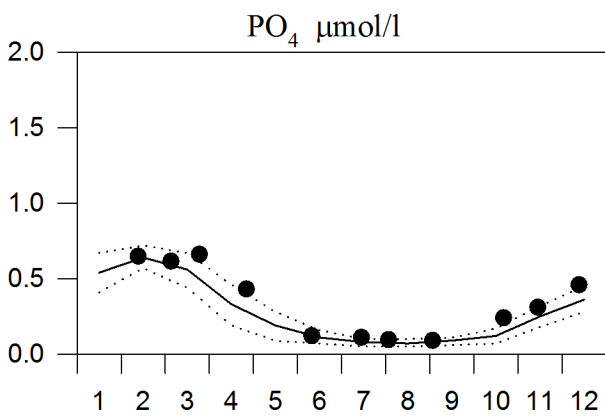
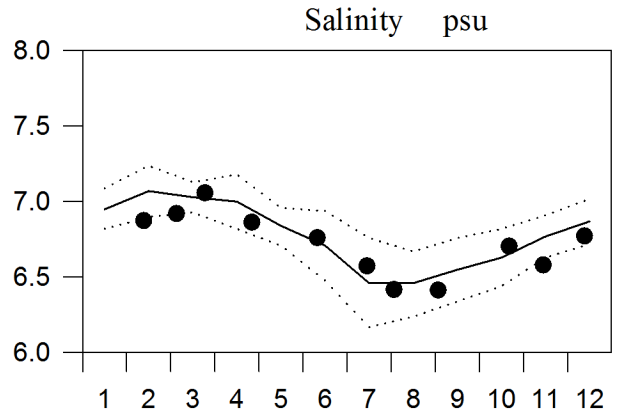
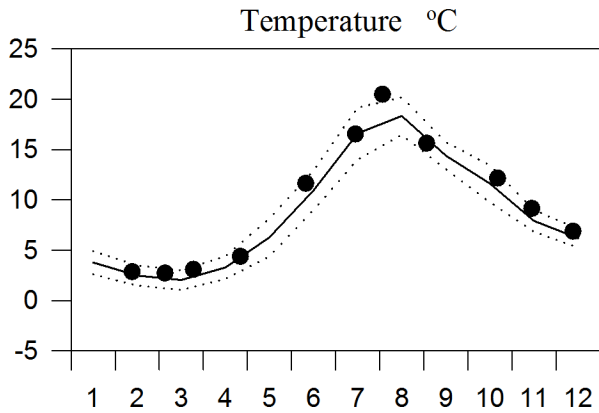
— Mean 1996-2010 ····· St.Dev. ● 2014



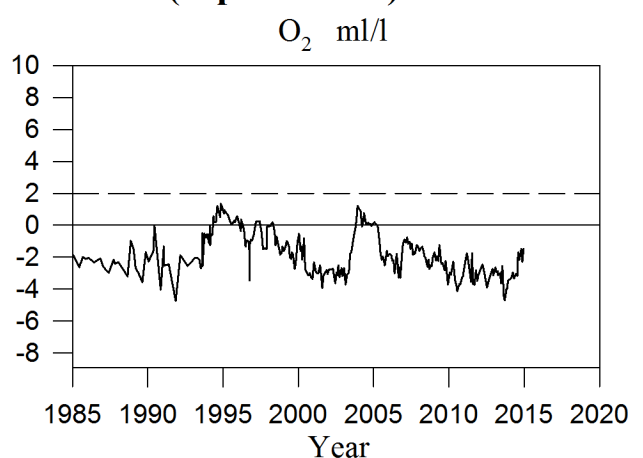
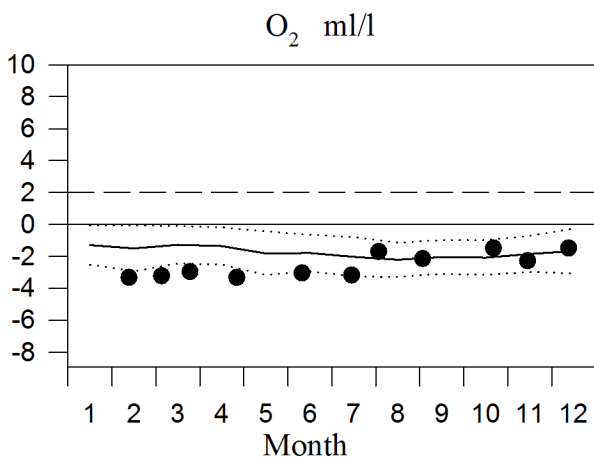
STATION BY20 SURFACE WATER

Annual Cycles

— Mean 1996-2010 St.Dev. ● 2014

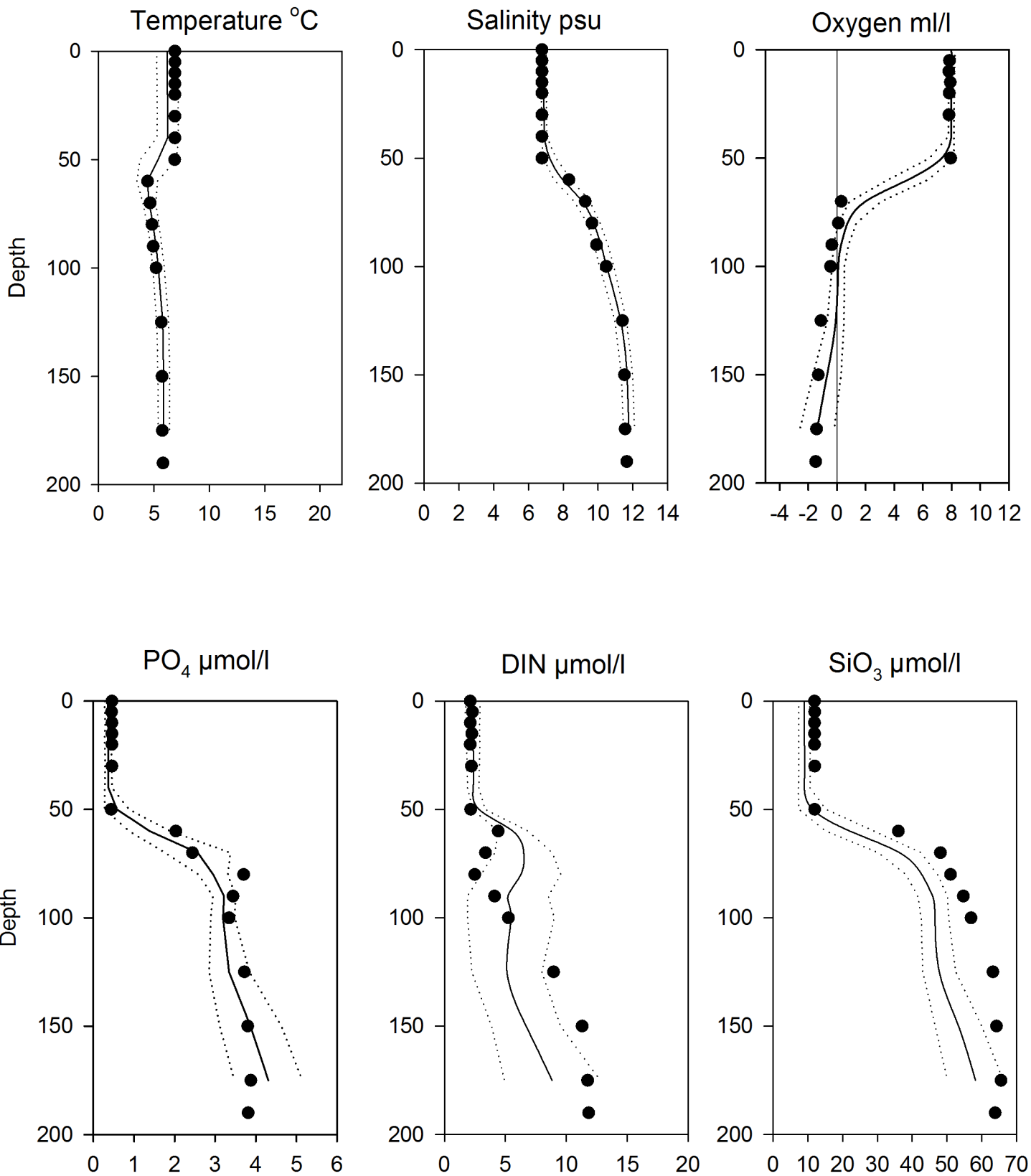


OXYGEN IN BOTTOM WATER (depth >175m)



Vertical profiles BY20 December

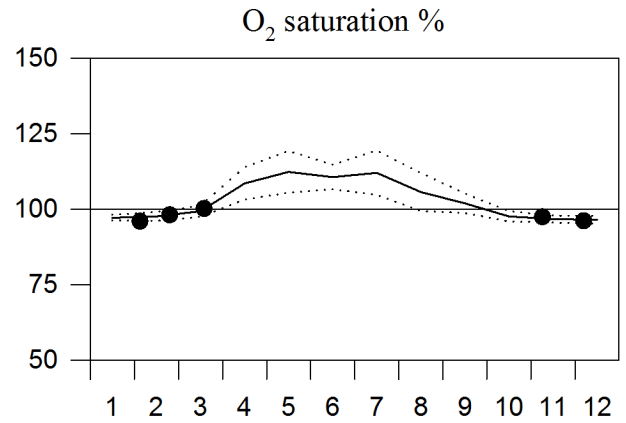
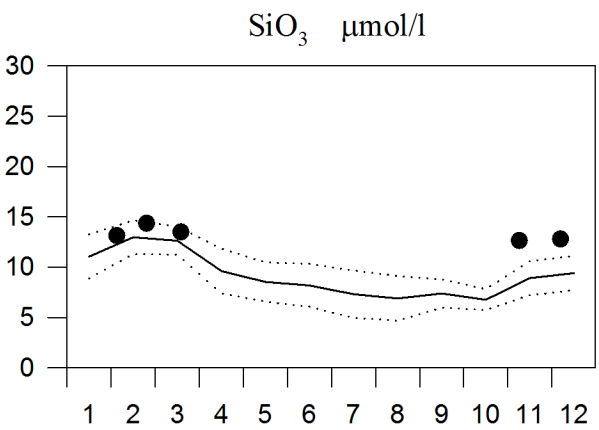
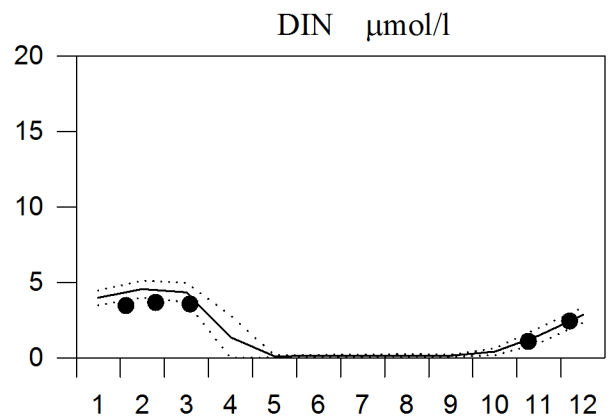
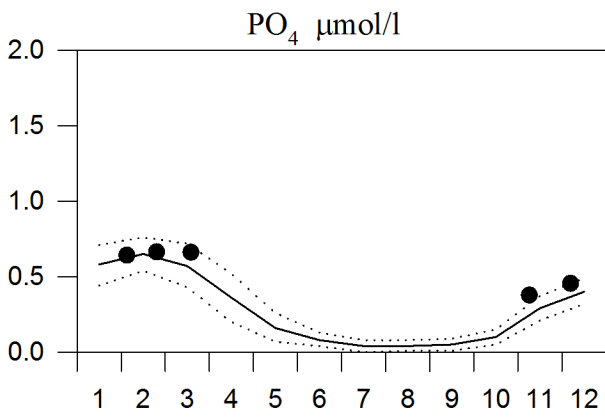
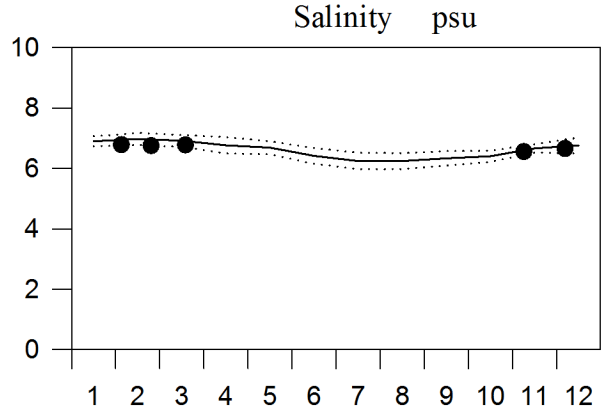
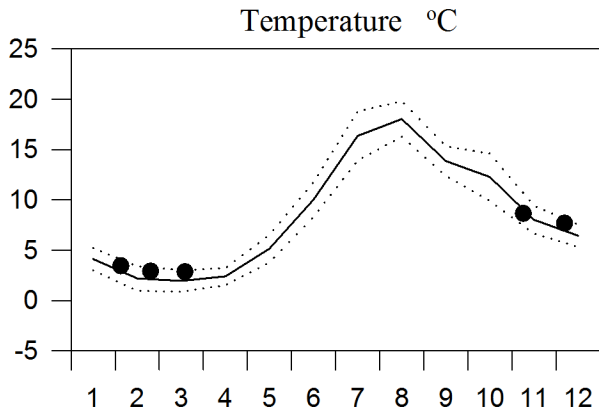
— Mean 1996-2010 ····· St.Dev. ● 2014



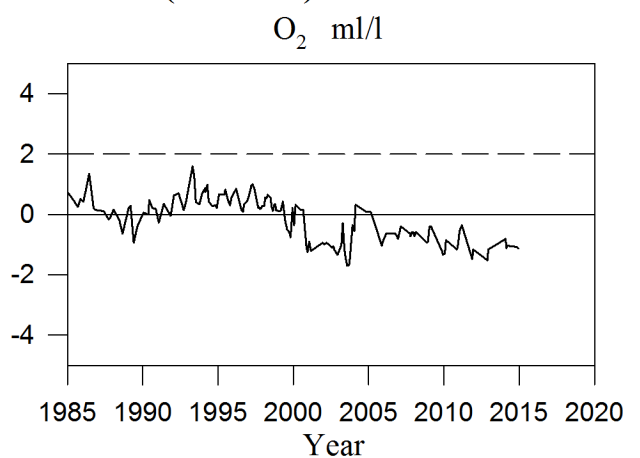
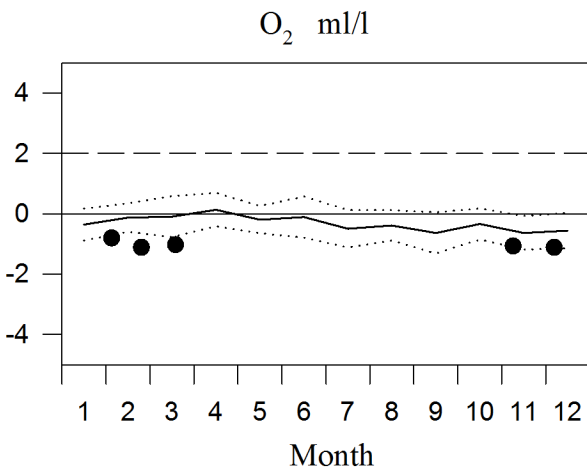
STATION BY29 SURFACE WATER

Annual Cycles

— Mean 1996-2010 St.Dev. ● 2014

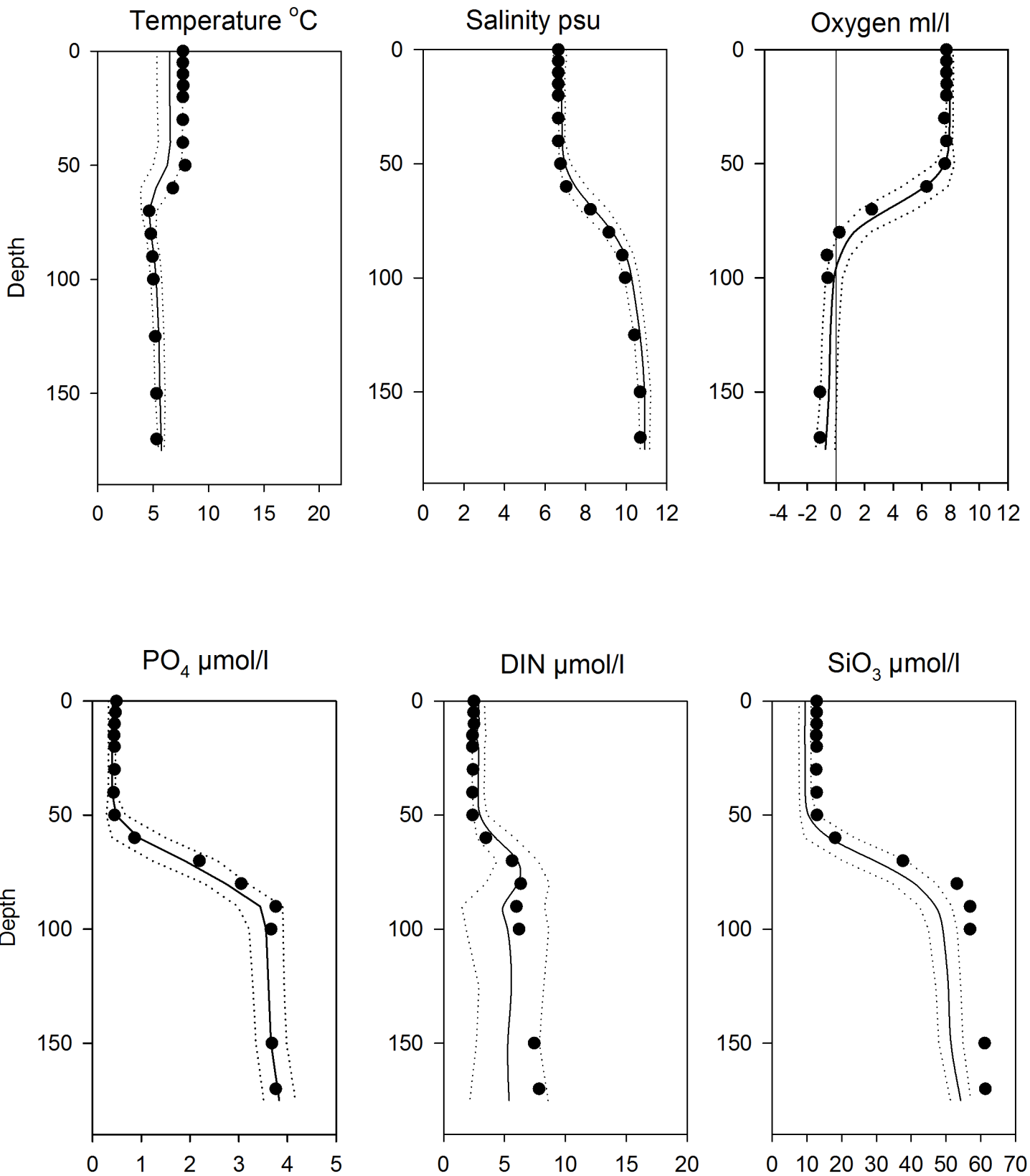


OXYGEN IN BOTTOM WATER (>=150m)



Vertical profiles BY29 December

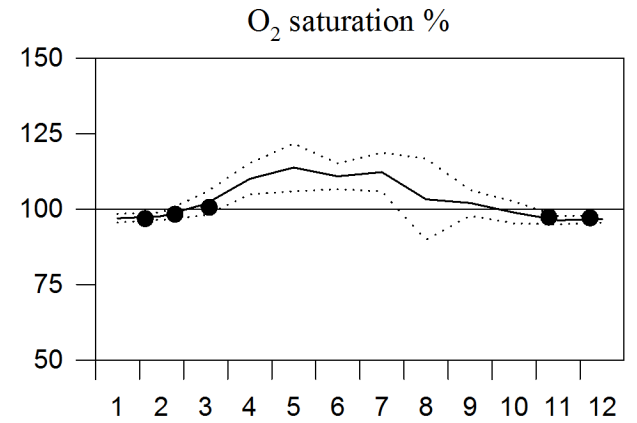
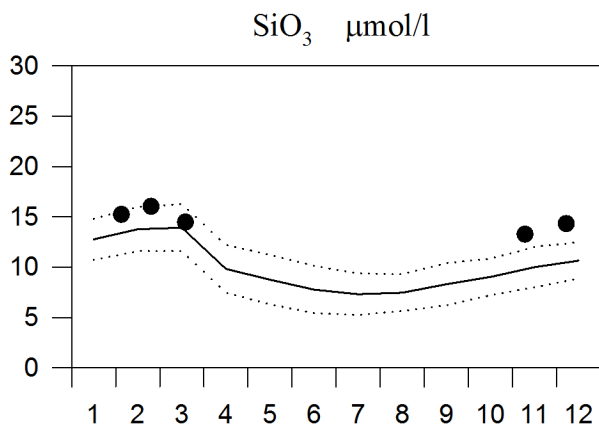
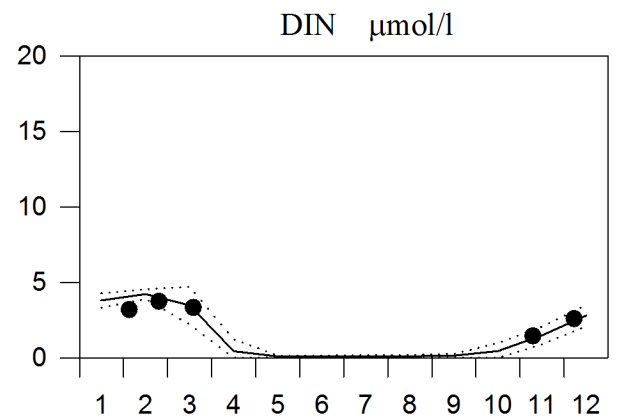
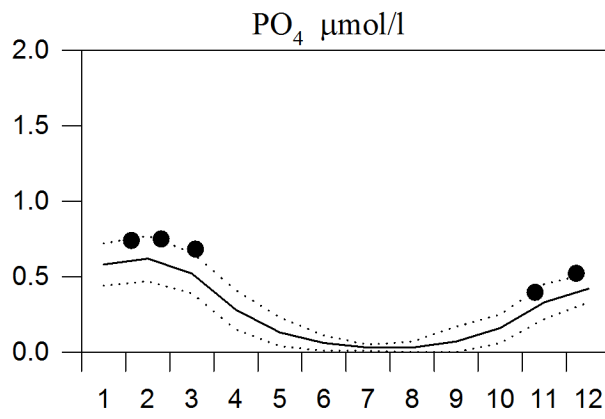
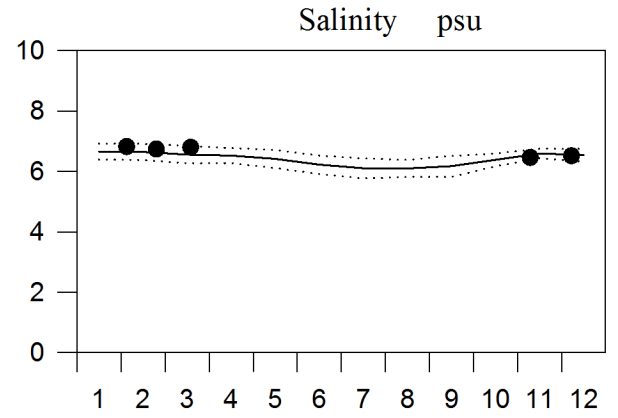
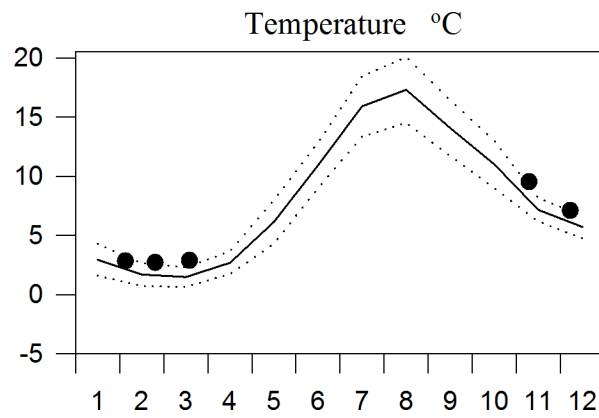
— Mean 1996-2010 ····· St.Dev. ● 2014



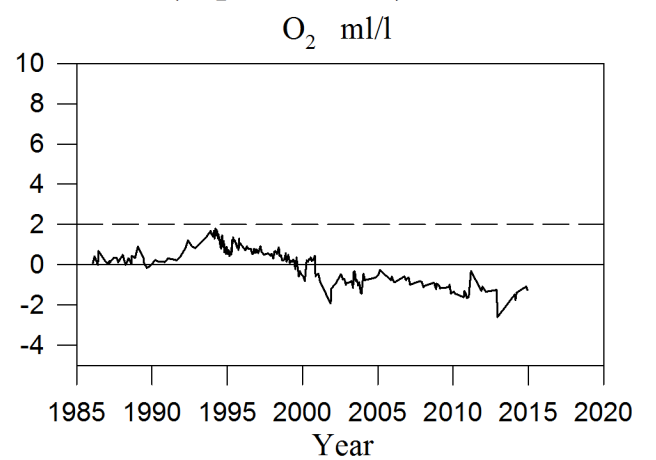
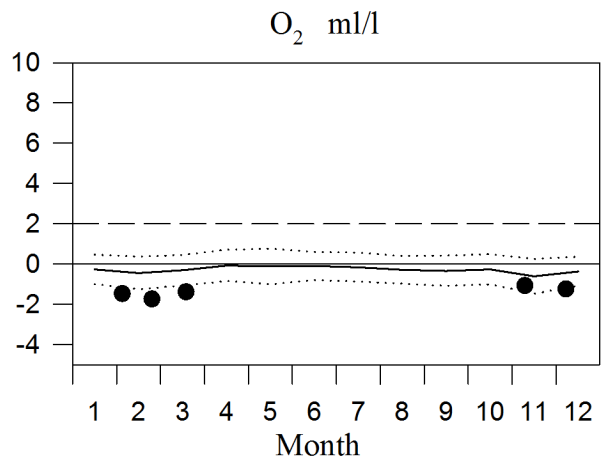
STATION BY31 SURFACE WATER

Annual Cycles

— Mean 1996-2010 St.Dev. ● 2014

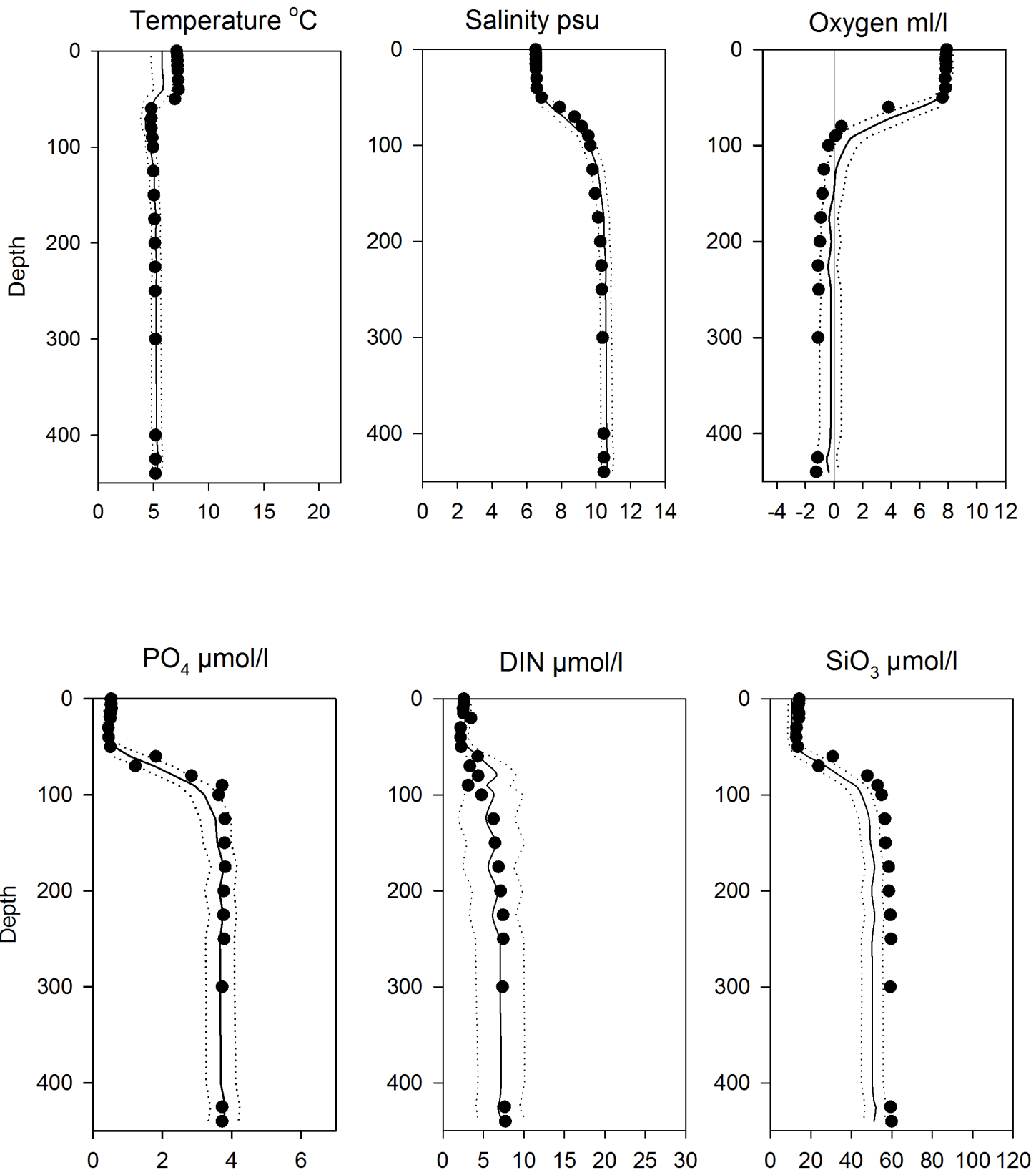


OXYGEN IN BOTTOM WATER (depth = 440m)



Vertical profiles BY31 December

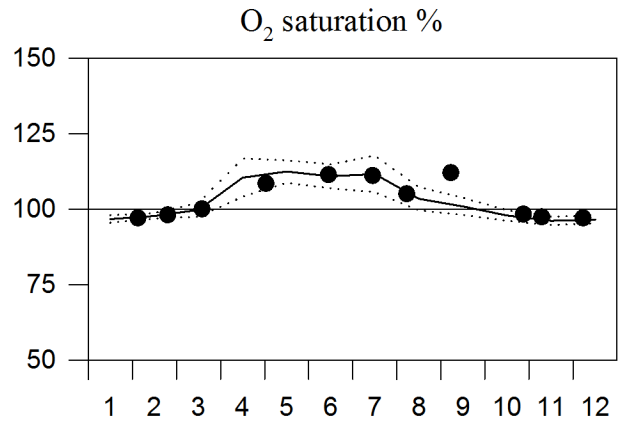
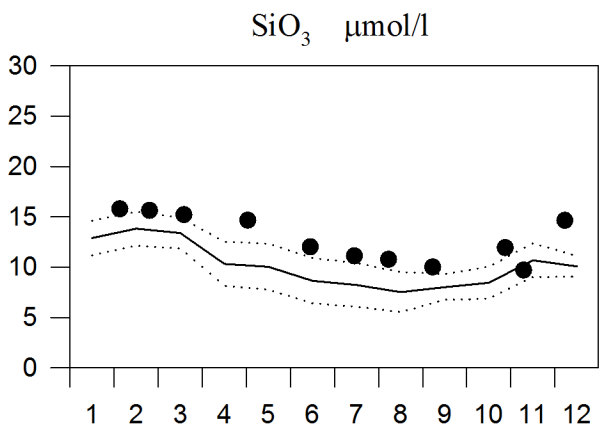
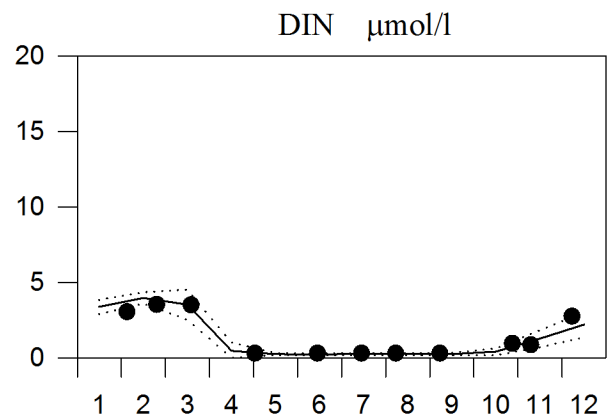
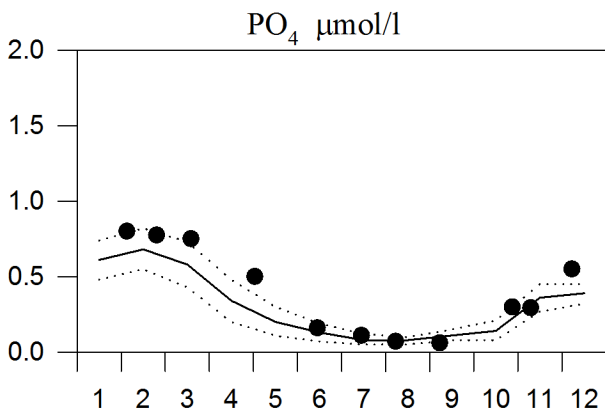
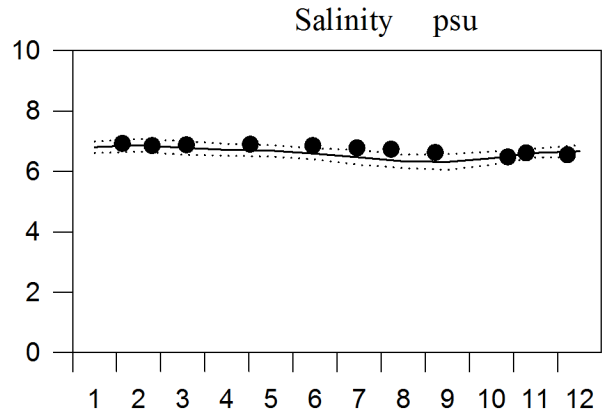
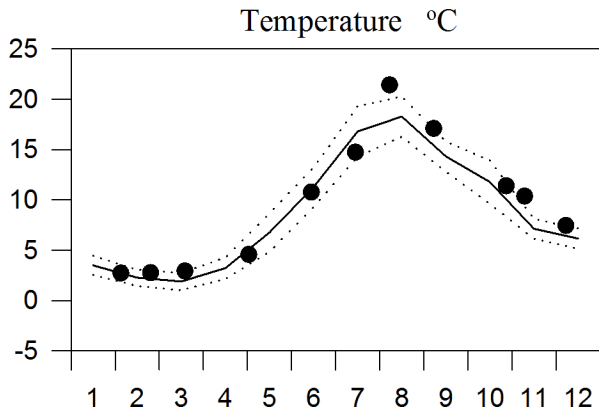
— Mean 1996-2010 ····· St.Dev. ● 2014



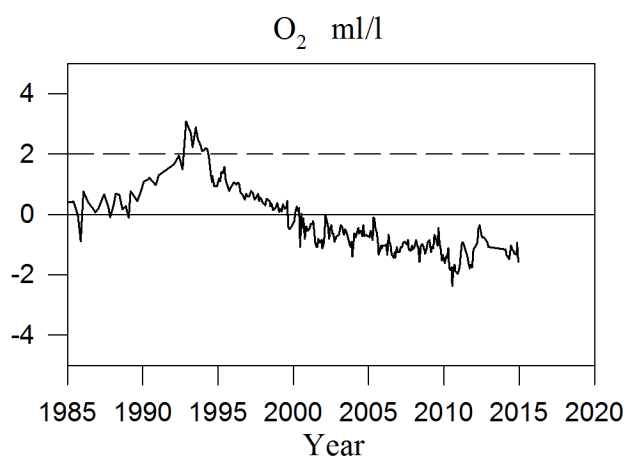
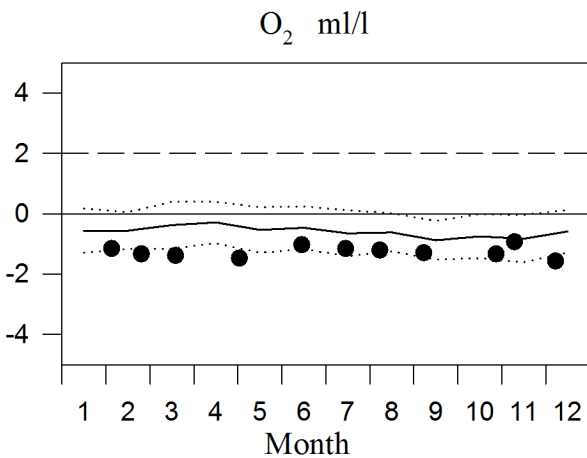
STATION BY32 SURFACE WATER

Annual Cycles

— Mean 1996-2010 St.Dev. ● 2014

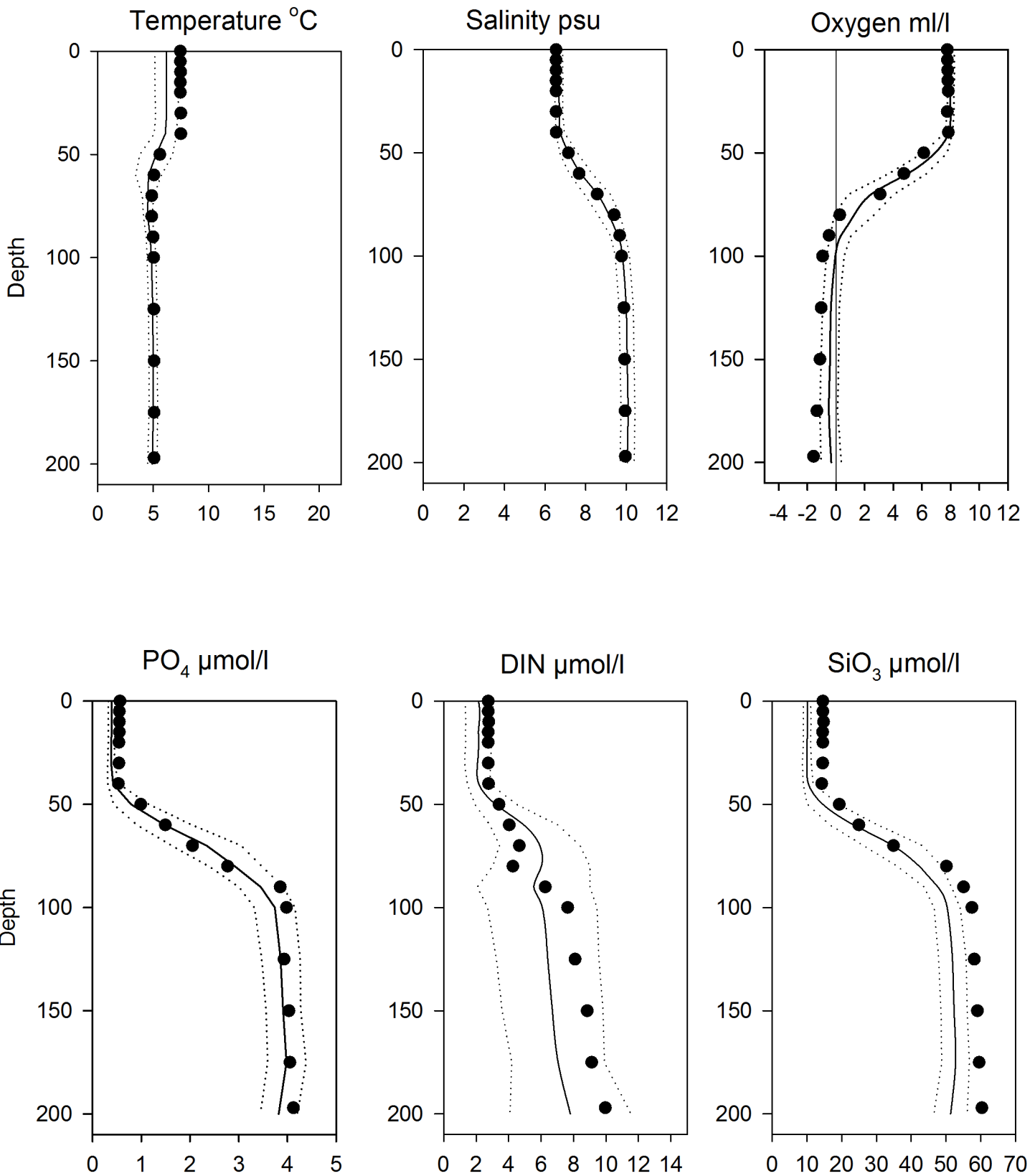


OXYGEN IN BOTTOM WATER (depth > 175m)



Vertical profiles BY32 December

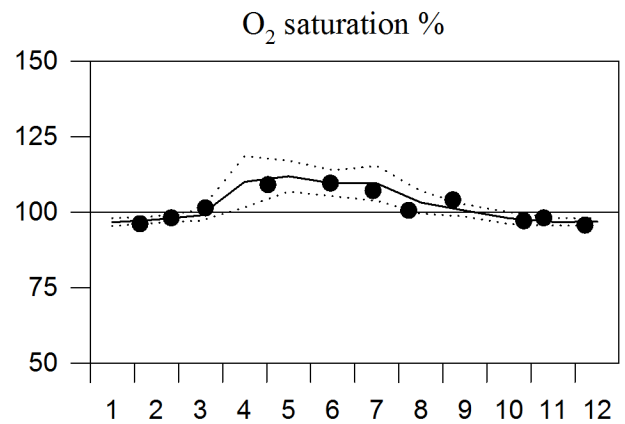
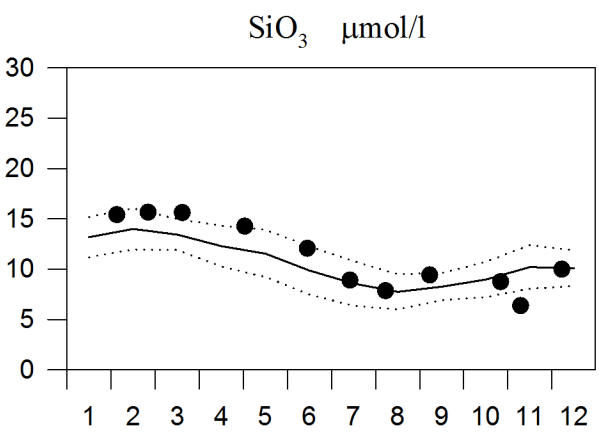
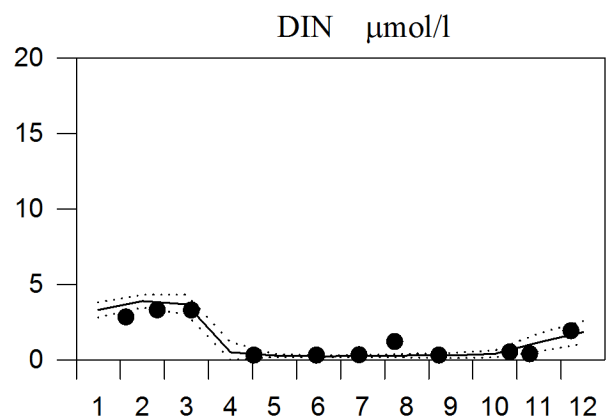
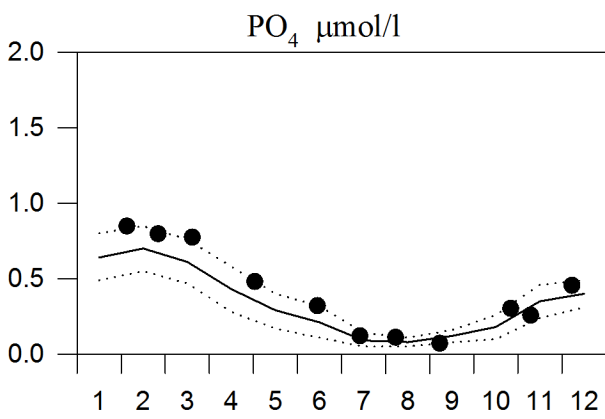
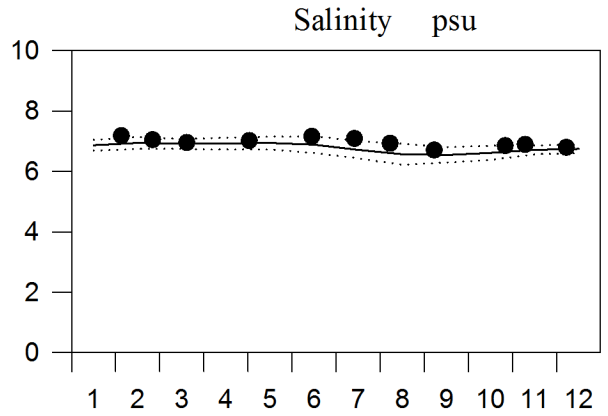
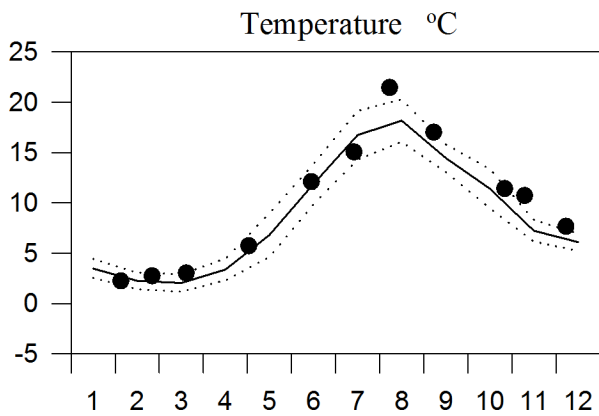
— Mean 1996-2010 ····· St.Dev. ● 2014



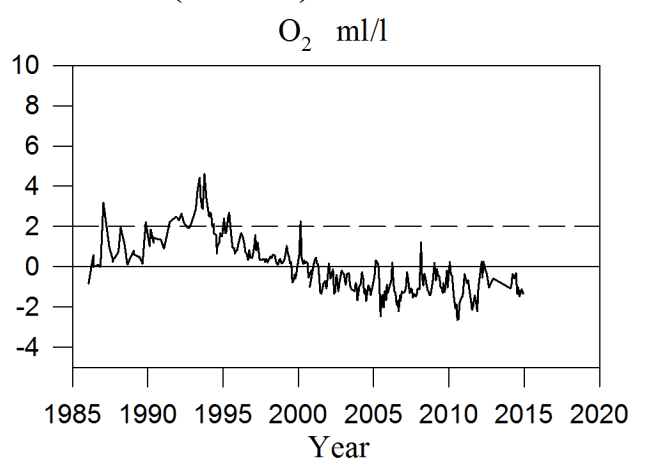
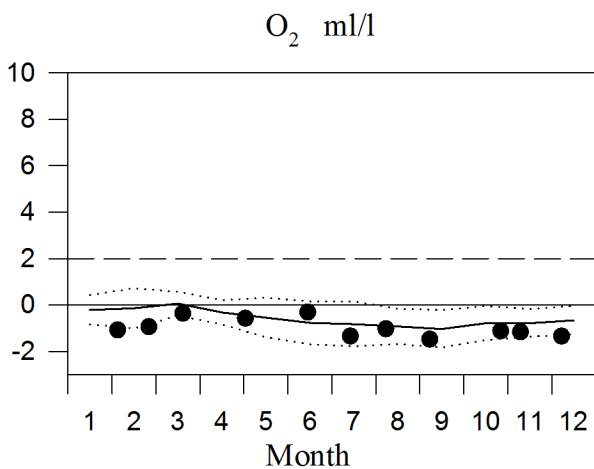
STATION BY38 SURFACE WATER

Annual Cycles

— Mean 1996-2010 St.Dev. ● 2014

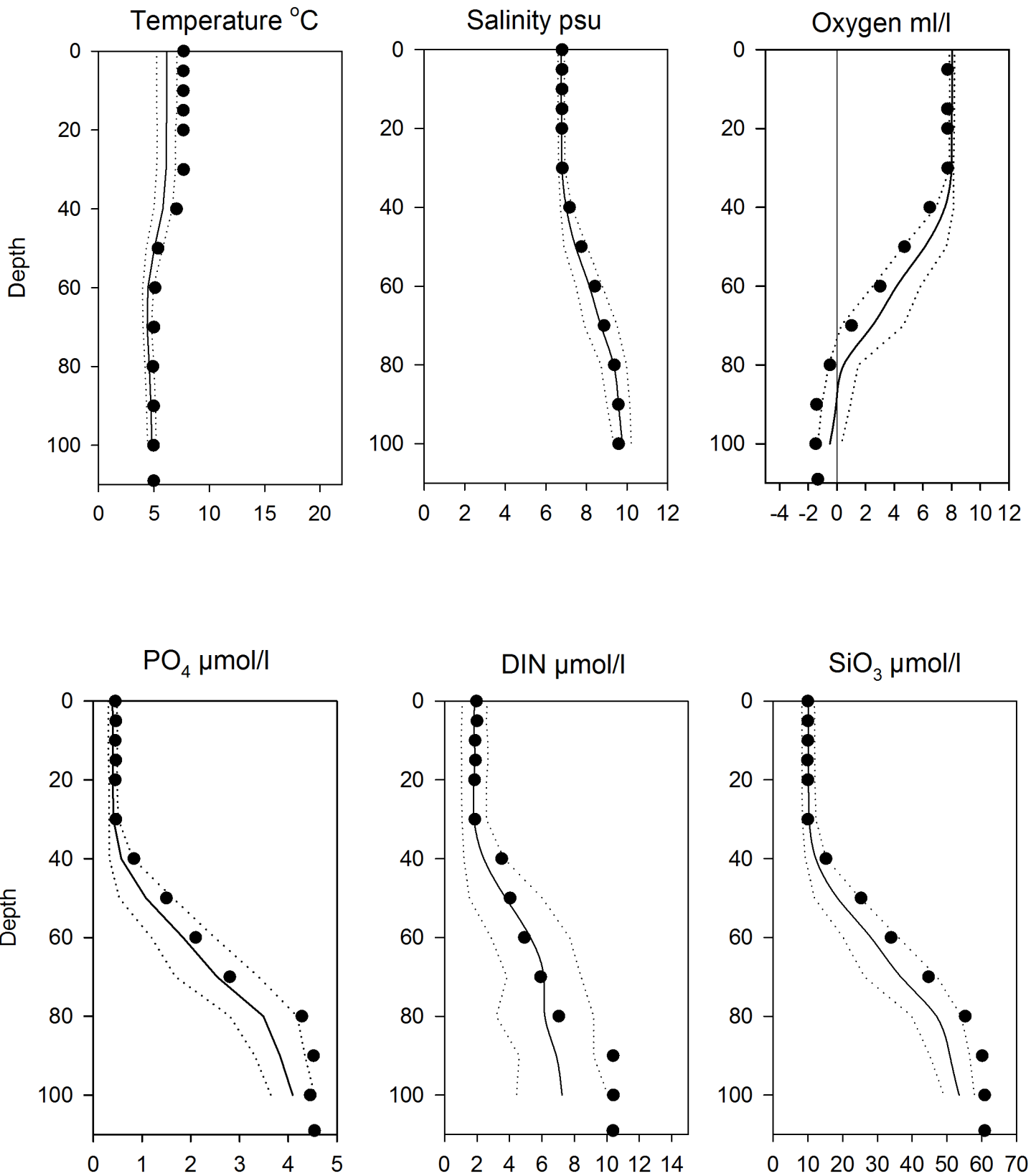


OXYGEN IN BOTTOM WATER (> 100m)



Vertical profiles BY38 December

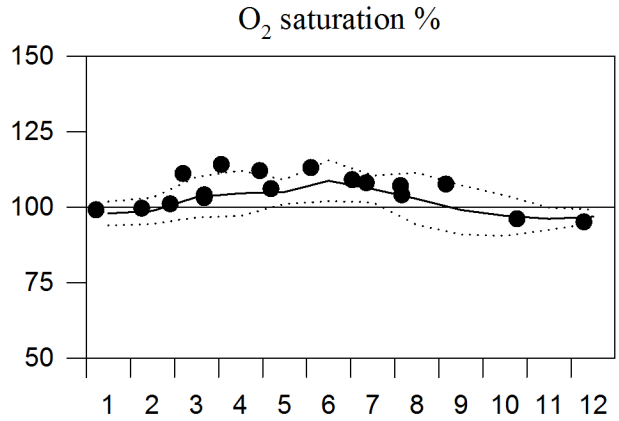
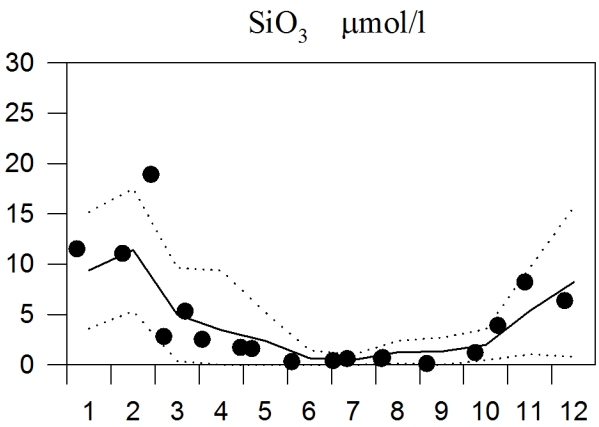
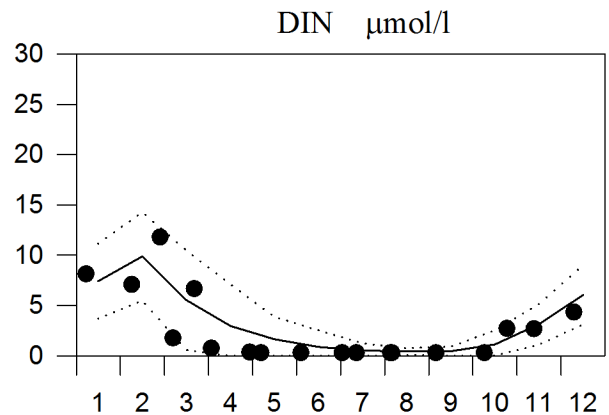
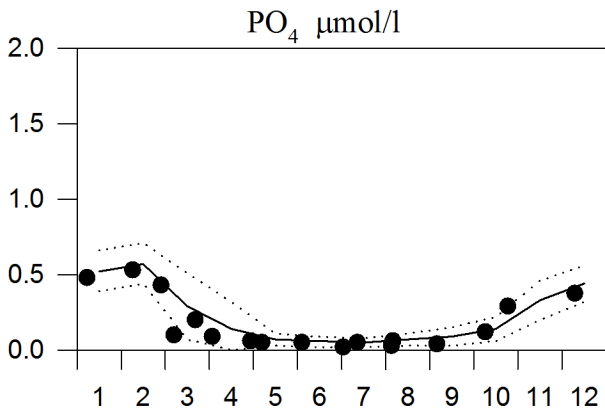
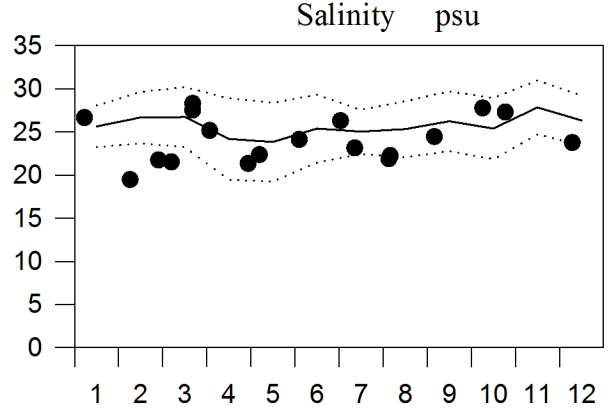
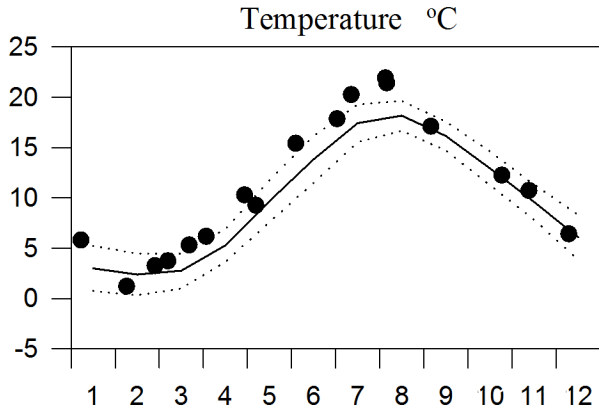
— Mean 1996-2010 ····· St.Dev. ● 2014



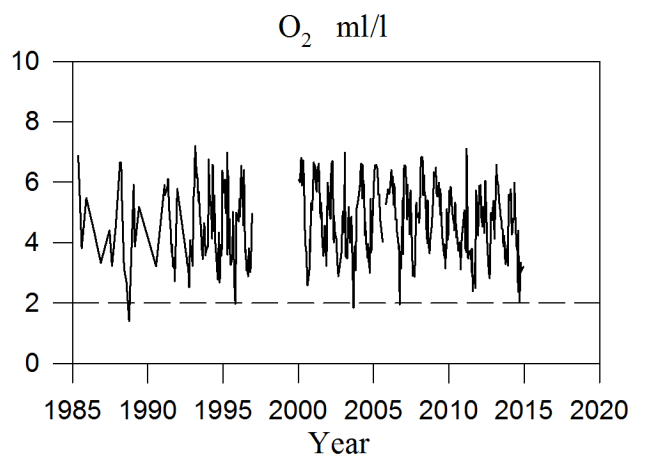
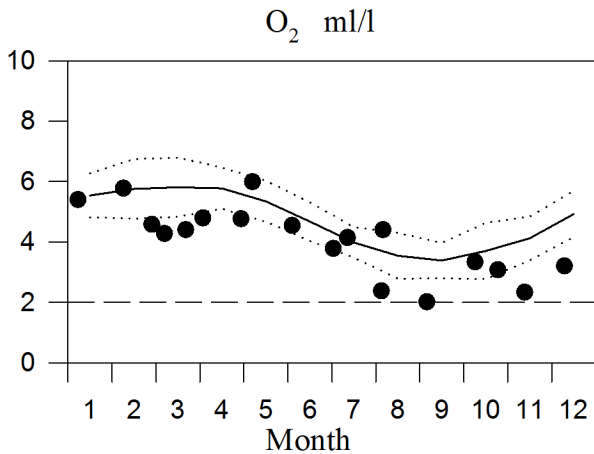
STATION SLÄGGÖ SURFACE WATER

Annual Cycles

— Mean 1996-2010 St.Dev. ● 2014

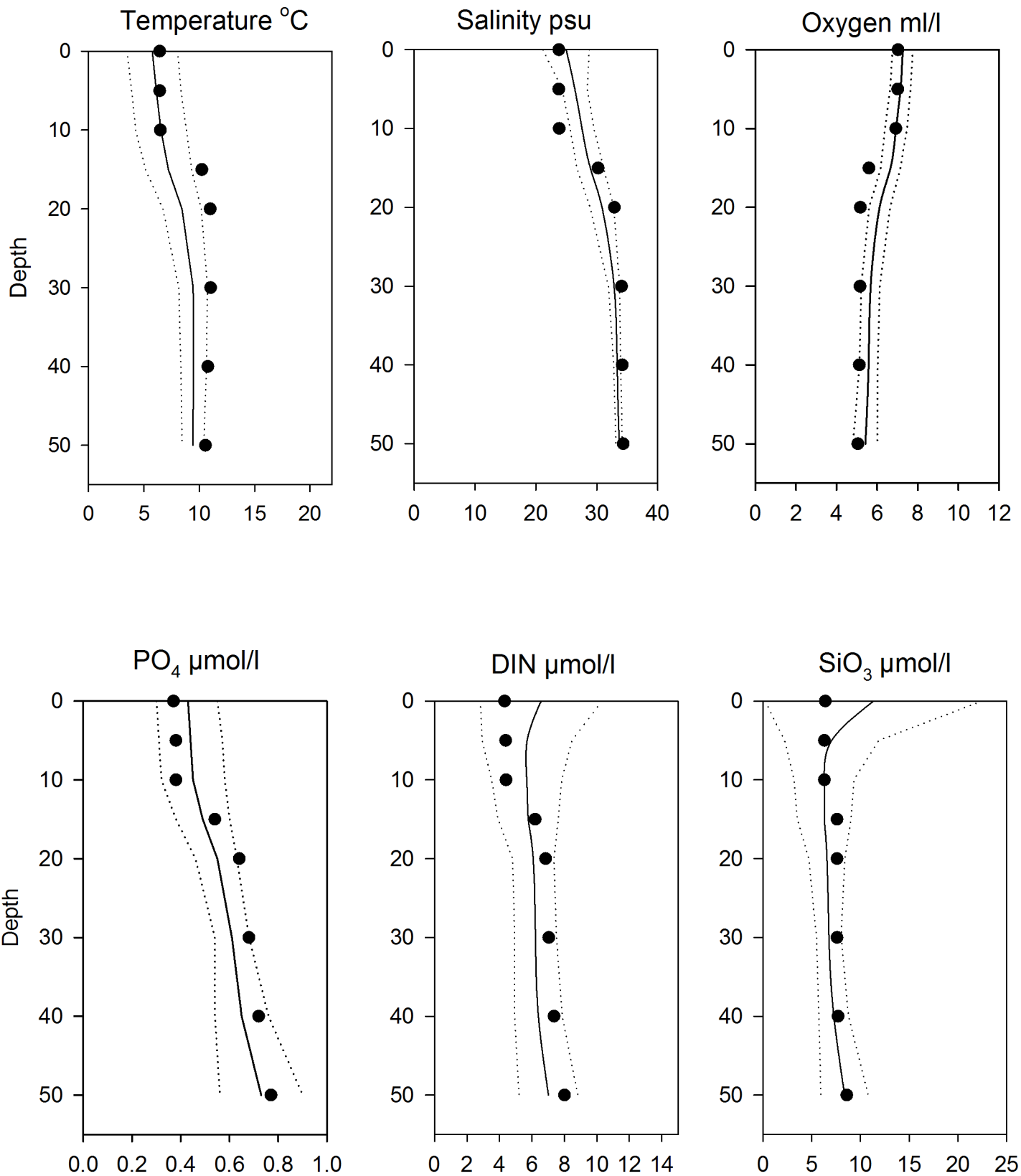


OXYGEN IN BOTTOM WATER (depth >50m)



Vertical profiles Släggö December

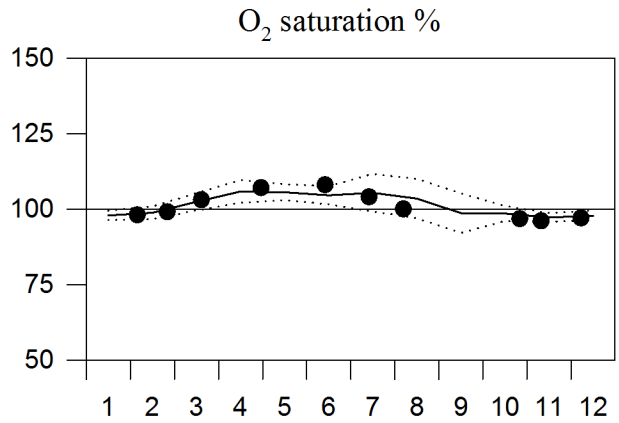
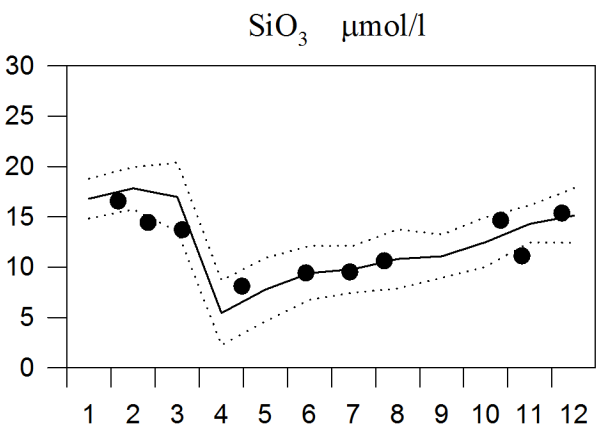
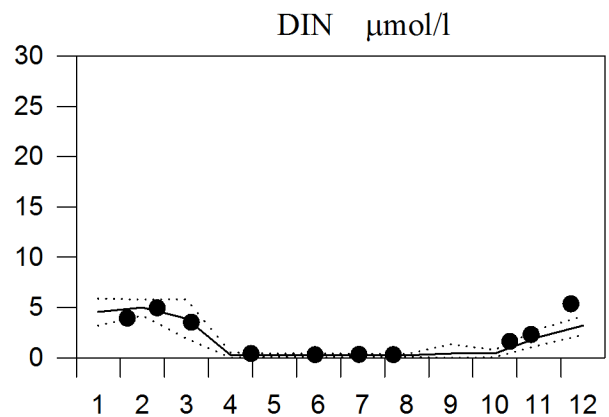
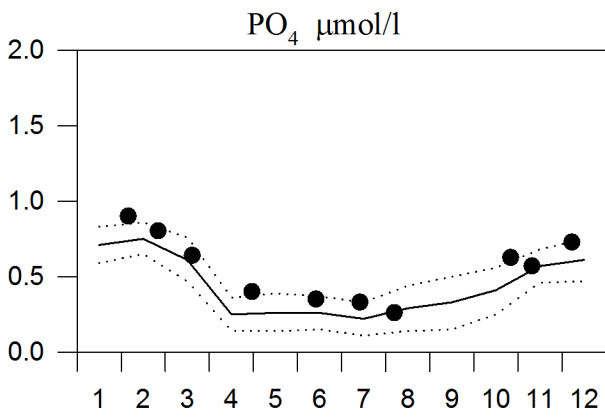
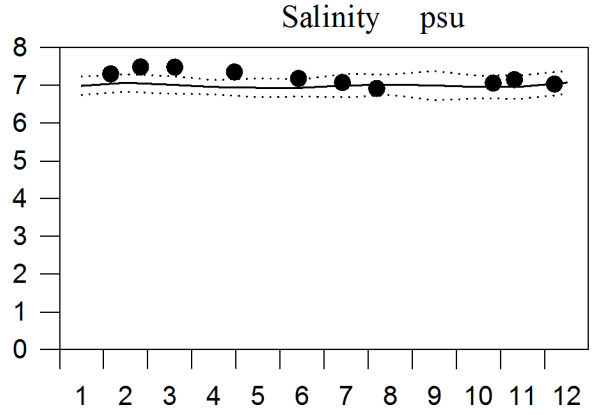
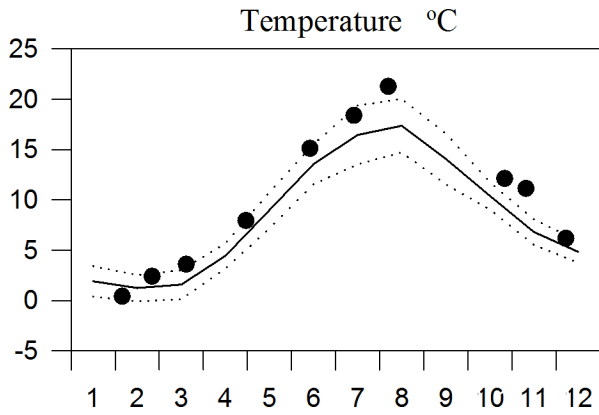
— Mean 1996-2010 St.Dev. ● 2014



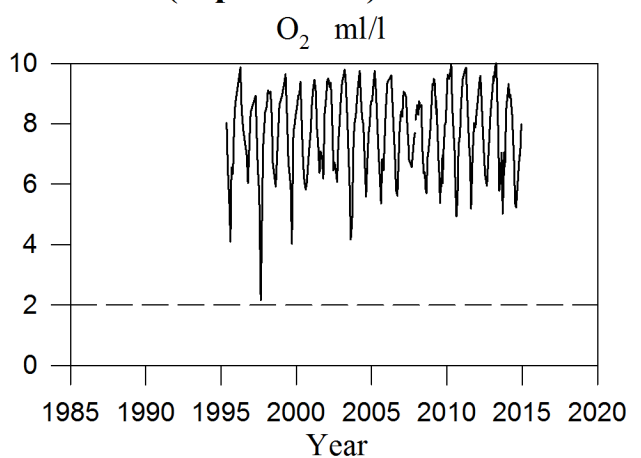
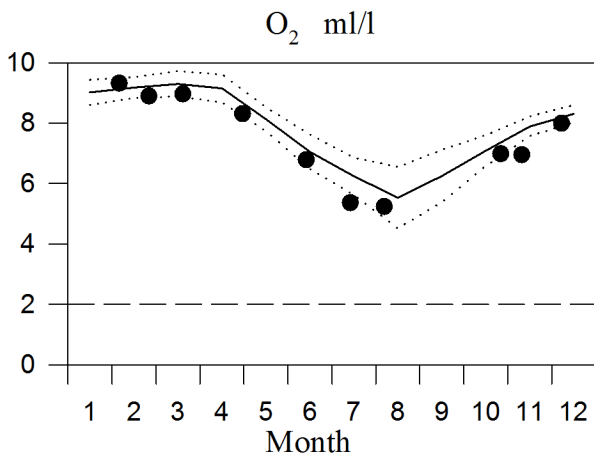
STATION REF M1V1 SURFACE WATER

Annual Cycles

— Mean 1996-2010 St.Dev. ● 2014



OXYGEN IN BOTTOM WATER (depth >15m)



Vertical profiles Ref M1V1 December

— Mean 1996-2010 ····· St.Dev. ● 2014

