

Report from the SMHI monitoring cruise with R/V Aranda



© Ilkka Lastumäki
<http://tammi.kuvat.fi>

Survey period: 2014-02-03 - 2014-02-12
Survey area: Skagerrak, Kattegat 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 the Skagerrak, Kattegat and the Baltic Proper. Mapping of winter nutrients were performed in Kattegat. This cruise was the first with the Finnish research vessel Aranda that during 2014 will be chartered by SMHI. Data presented in this report have been subject to preliminary quality control procedures only.

In Skagerrak and Kattegat, surface salinity was much lower than usual, which indicate a strong influence of outflowing Baltic water. The mapping of nutrients in the Kattegat showed small variations and overall normal concentrations. In the Baltic Proper the concentrations of phosphate and silicate were elevated in the Western Gotland basin. The oxygen concentrations in the bottom water in Hanö Bight and the Bornholm basin had decreased to acute hypoxia. Oxygen free conditions, anoxia, were found from 90 – 100 meters depth and acute hypoxia from 70 – 90 meters depth in the Western, Northern and Eastern Gotland Basins. The phytoplankton activity was low in the whole investigated area.

The next cruise will begin on 24th February and will cover the Skagerrak, Kattegat and the Baltic Proper. Mapping of the winter pool of nutrients will be performed in the Baltic Proper.

PRELIMINARY RESULTS

The cruise, which is the first with the Finnish research vessel Aranda, began in Helsinki on February 2nd and ended in Nynäshamn on February 12th. A short visit was made to the port of Gothenburg for loading of complementing instruments and for press preview of the research vessel and SMHI's work on-board. During the first leg, between Helsinki and the port of Gothenburg, the winds were weak to moderate. After the stop in Gothenburg the wind increased to strong. Thereafter, back in the Baltic Sea the winds were again weak or moderate. Wind directions were mainly from southeast and southwest. The air temperature varied between -1 and 4°C. During the cruise the winter pool of nutrients were mapped in the Kattegat and the Sound and 17 stations were visited in this area. Totally, during the whole cruise about 40 stations were visited.

Sampling was also carried out for measuring of dissolved inorganic carbon (DIC) and comparative analysis of three methods of measuring pH (pH-electrode, by spectrophotometer and with fluorometers). Data from these studies will form the basis for how the pH will be analysed in the future within the Swedish maritime monitoring programme.

The Skagerrak

The surface temperatures were lower than normal and varied between 1.2 and 2.1°C. The salinity was much lower than normal and varied from 19.4 psu close to the coast to 21.2 psu in the central part of Skagerrak, which indicate strong influence of outflowing Baltic water. Both thermocline and halocline were well developed and found at 10 – 20 meters depth.

Generally, the concentrations of all nutrients in the surface layer had increased since the last measurements in December. Phosphate and the sum of nitrite + nitrate showed normal levels typical for the season. However, high silicate levels, double normal values, were found in the central Skagerrak. Phosphate concentration were between 0.53 - 0.56 µmol/l, the sum of nitrite + nitrate varied between 5.96 - 6.44 µmol/l, while silicate concentrations varied from 10.3 - 11.2 µmol/l.

Plankton activity based on CTD fluorescence measurements and oxygen saturation was low.

The Kattegat and the Sound

The temperature in the surface water was lower than normal and varied between 1.8 – 3.0°C, lowest in the outflowing Baltic water from the Sound and the Belt and highest in the northern parts. As in Skagerrak, the salinity of the surface water was lower than normal, 16.1 – 22.1 psu. The thermocline and halocline was located at a depth of 10 - 20 meters.

The mapping of the winter pool of nutrient showed that the concentrations of phosphate in the surface water were normal and that the variations were small, 0.54 – 0.60 µmol/l. The concentration of nitrite + nitrate was also normal and varied between 5.53 – 7.00 µmol/l, highest in the northern parts and along the Danish coast. The silicate concentrations also showed small variations around 10.6 – 11.7 µmol/l, which is normal.

The oxygen situation in the deep water was good. The lowest oxygen concentration, 5.92 ml/l, was measured at the station Kullen in the southeastern part.

Plankton activity based on CTD fluorescence measurements and oxygen saturation was present but low in the whole investigated area.

The Baltic Proper

Surface temperatures were normal for the season, 2.2 - 3.5°C. Salinity in the surface layer was elevated in the Hanö Bight and in the Bornholm Basin, 7.7 - 8.0 psu, while in the Eastern Gotland Basin lower than normal, 6.9 - 7.2 psu. The surface layer of the Baltic Proper was well mixed, both thermocline and halocline was found at about 70 meters depth in the Northern, Western and Eastern Gotland Basins, at 55 meters depth in the Bornholm basin and at 35 - 40 meters depth in the Arkona Basin.

The concentrations of phosphate were higher than normal, 0.74 – 0.85 µmol/l in the Western Gotland Basin. In the remaining areas the concentrations were normal and varied around 0.60 – 0.78 µmol/l. Also the concentration of silicate was elevated in the Western Gotland Basin, 15.4 – 15.8 µmol/l. Normal concentrations were found in all the other areas with the exception of Hanö Bight where it was lower than normal, 10.4 µmol/l. The amount of nitrite + nitrate was generally lower than normal and varied between 2.62 – 3.61 µmol/l.

Since December 2013 and during the beginning of 2014 there have been no significant inflows to the Baltic Sea. Small inflows that have occurred have improved the oxygen situation in the deep water in the Arkona Basin. In the Bornholm Basin and in the Hanö Bight, where inflows during the autumn 2013 had improved the oxygen conditions, oxygen concentrations in the bottom water had now decreased to acute hypoxic conditions (< 2 ml/l). At the station BCSIII-10 the influence of the autumn inflows 2013 could still be seen and the bottom oxygen was just above 2 ml/l. Completely oxygen free conditions, (anoxia) were found from 90 - 100 meters depth in the Western, Eastern and Northern Gotland Basins and acute hypoxia from 70 – 90 meters depth.

The plankton activity was low in the whole investigated area.

PARTICIPANTS

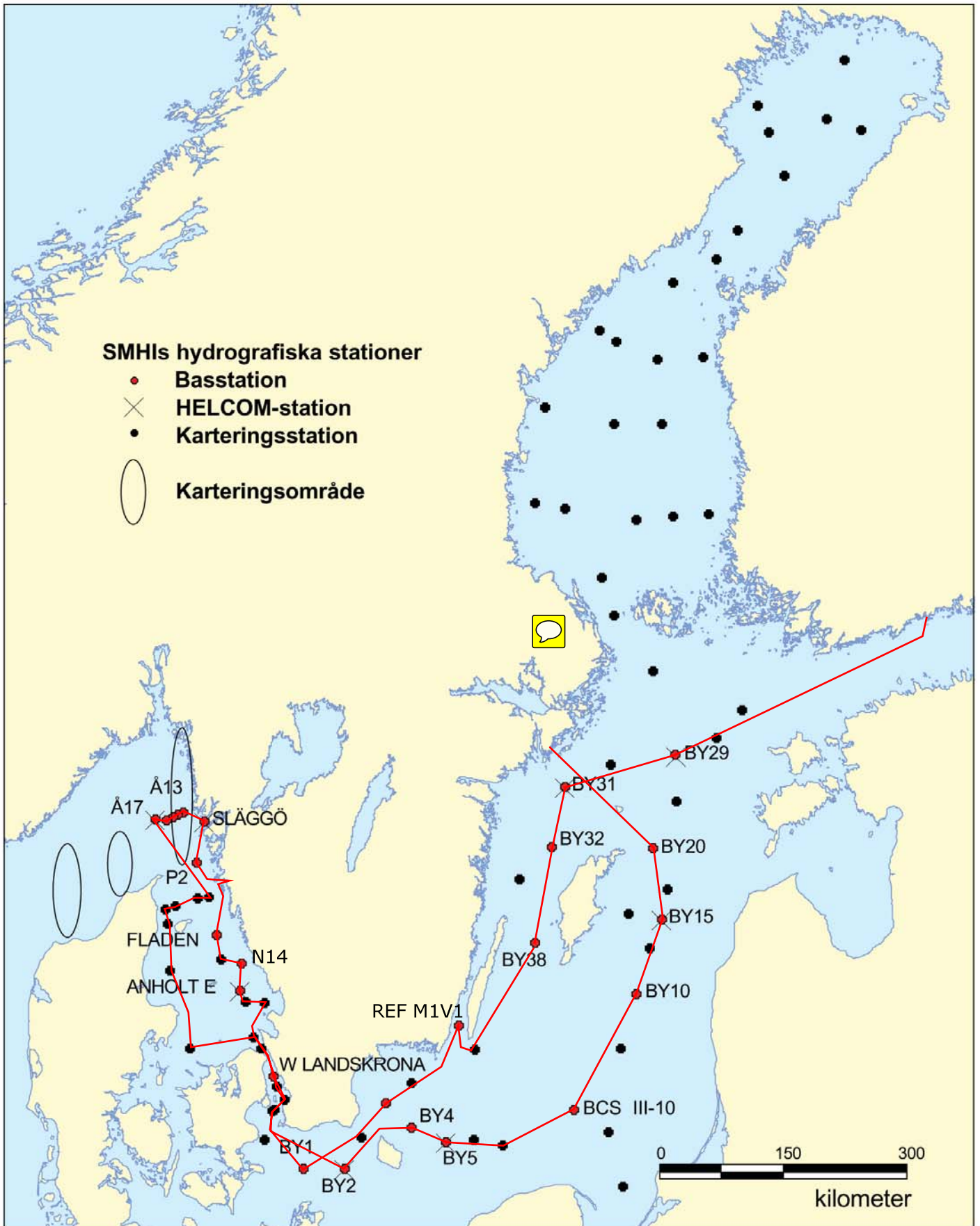
Name		Institute
Martin Hansson	Chief scientist	SMHI
Juha Flinkman	Chief scientist	Finnish Environment Institute (SYKE)
Anna-Kerstin Thell		SMHI
Johan Håkansson		SMHI
Kristin Andreasson		SMHI
Sari Sipilä		SMHI
Arne Svensson		SMHI
Silvie Lainela		SMHI / Tartu Universitet, Estland
Jan-Erik Bruun		Finnish Environment Institute (SYKE)
Tuomo Roine		Finnish Meteorological Institute (FMI)

APPENDICES

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

TRACKCHART

Country: Sweden
Ship: R/V ARANDA
Date: 20140203-20140212
Series: 0062-0101



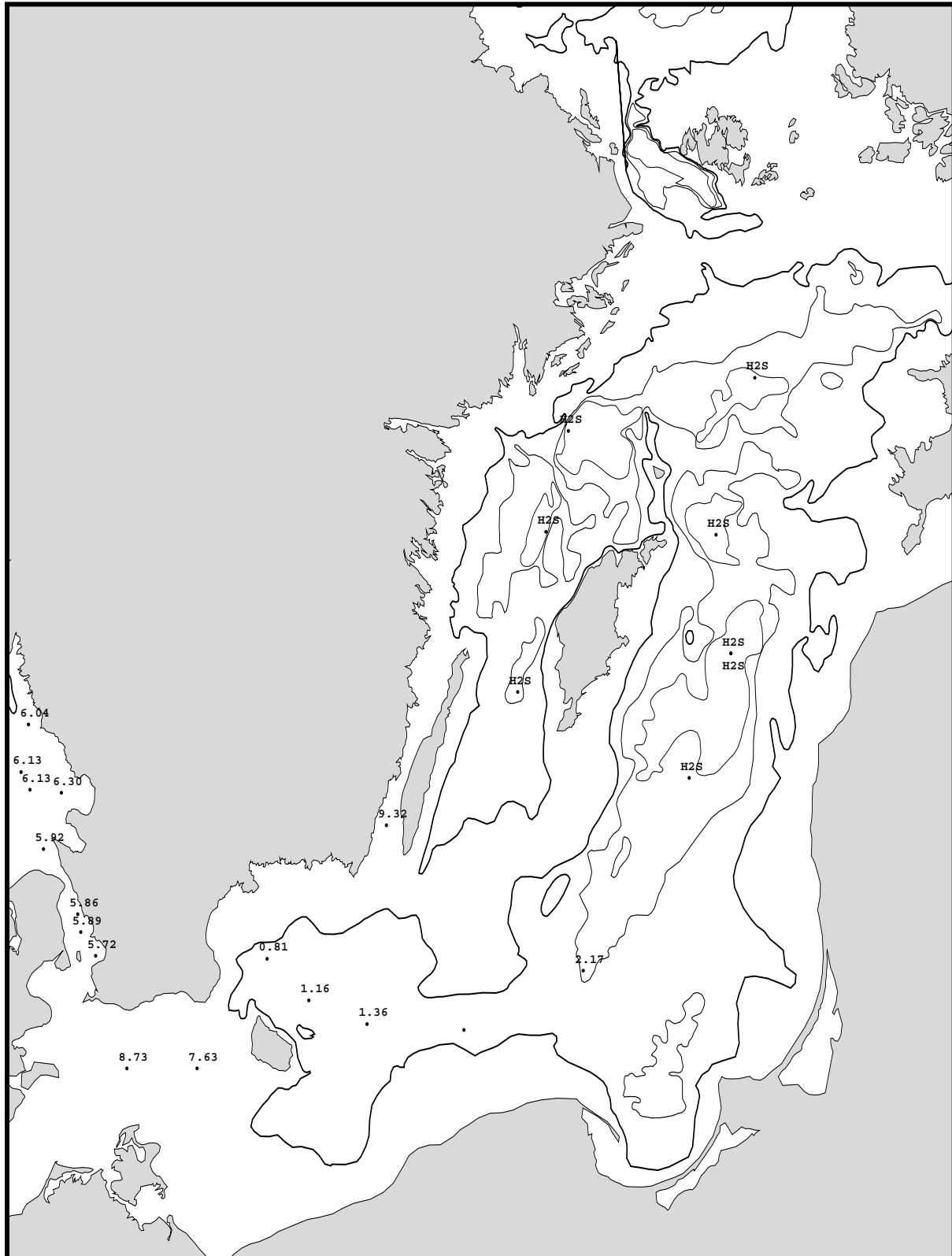
Bottom water oxygen concentration (ml/l)

Country: Sweden
Ship : Aranda
Date : 20140204-20140212
Series : 0062-0101



Bottom water oxygen concentration (ml/l)

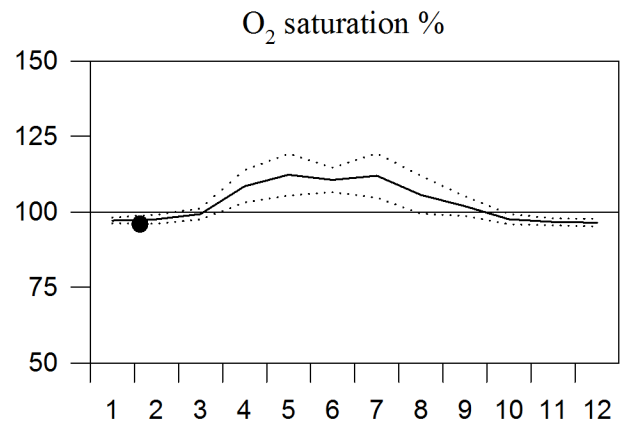
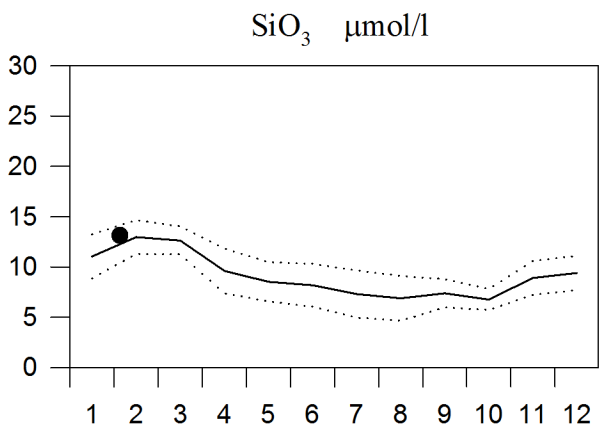
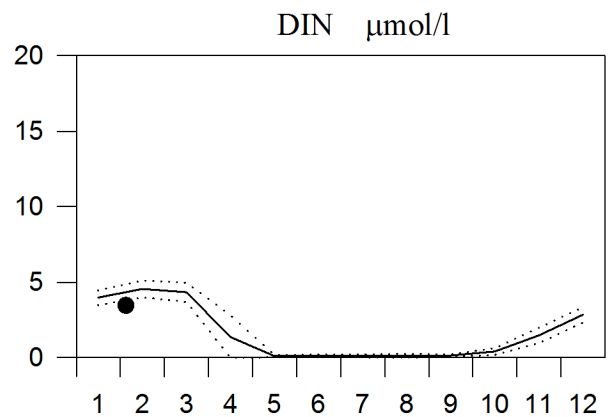
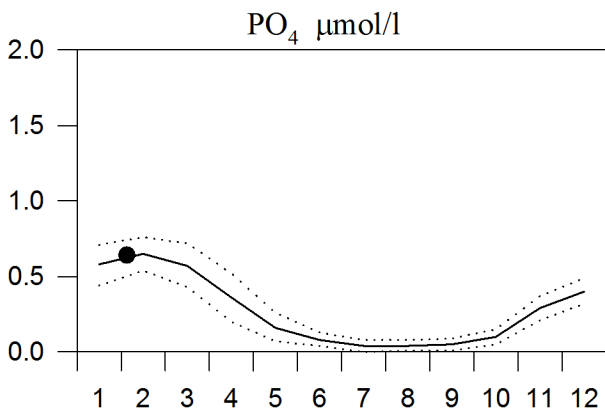
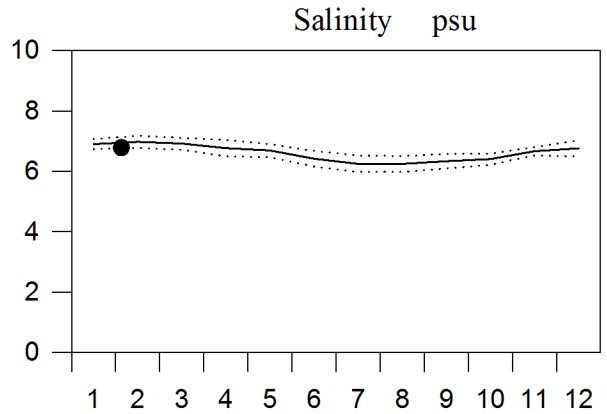
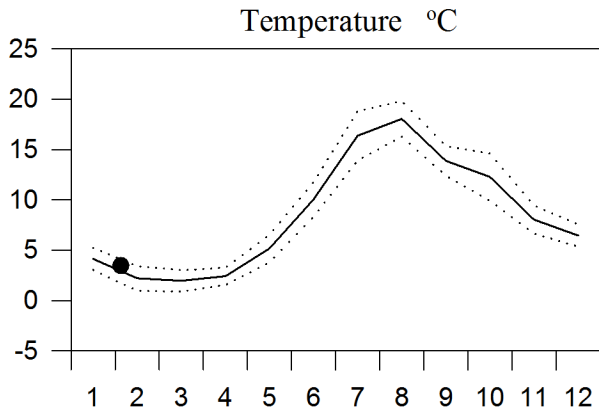
Country: Sweden
Ship : Aranda
Date : 20140204-20140212
Series : 0062-0101



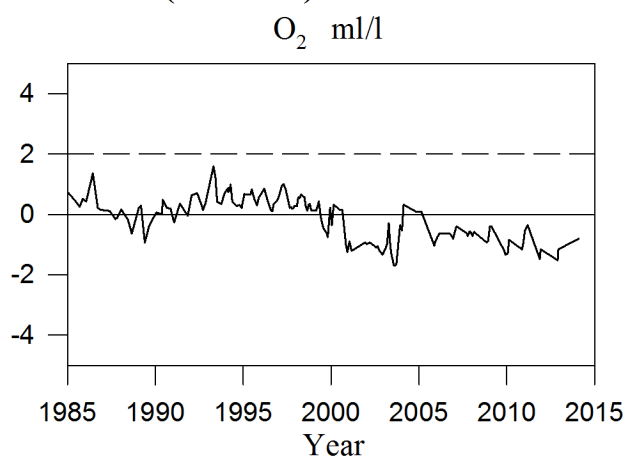
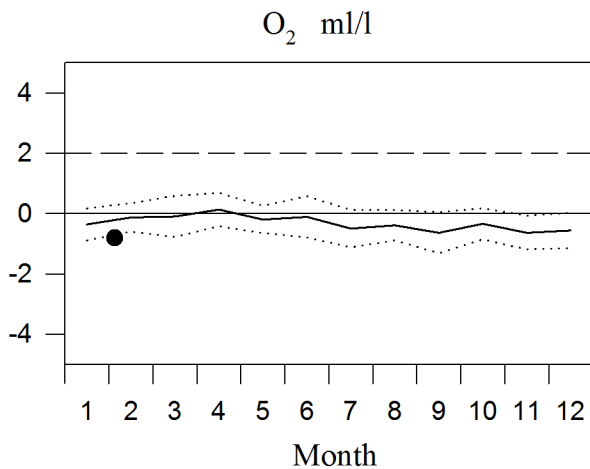
STATION BY29 SURFACE WATER

Annual Cycles

— Mean 1996-2010 St.Dev. ● 2014



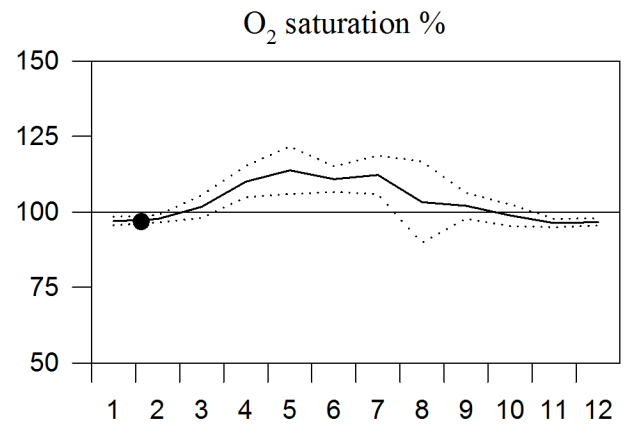
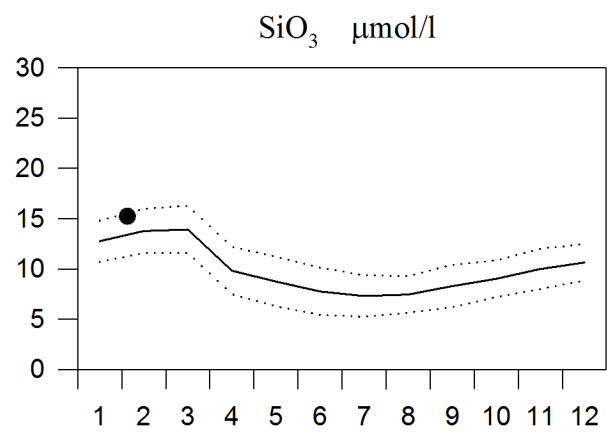
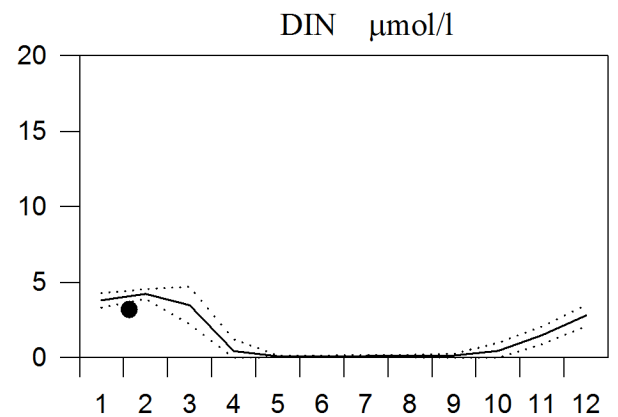
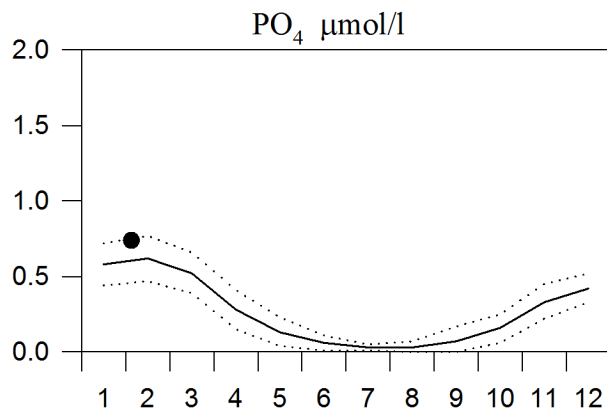
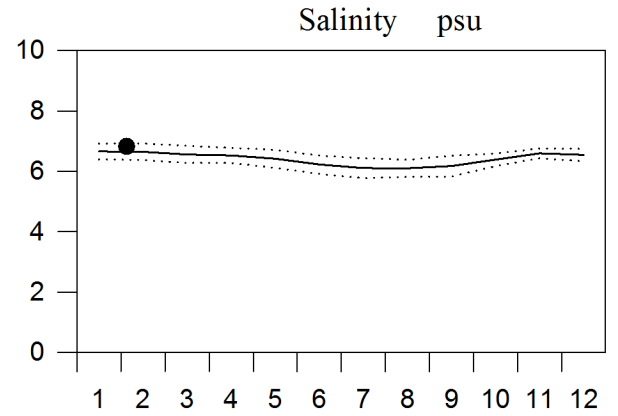
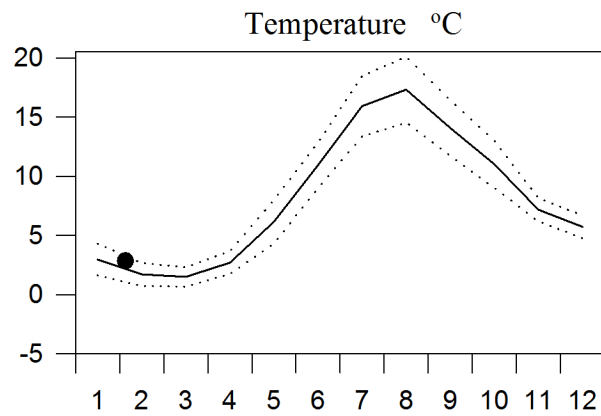
OXYGEN IN BOTTOM WATER (>=150m)



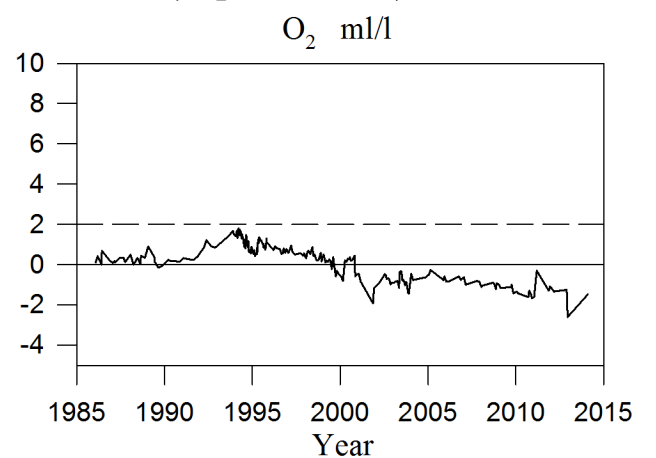
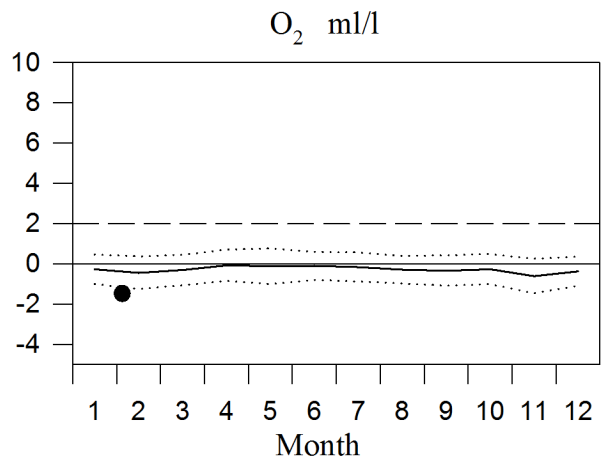
STATION BY31 SURFACE WATER

Annual Cycles

— Mean 1996-2010 St.Dev. ● 2014



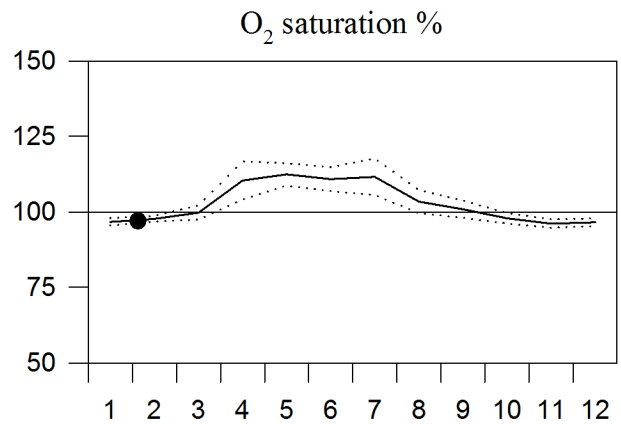
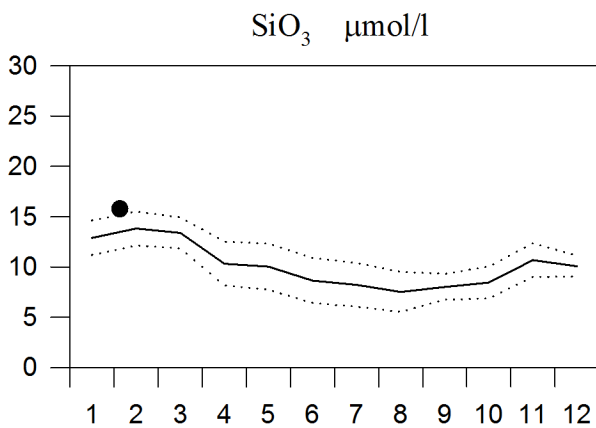
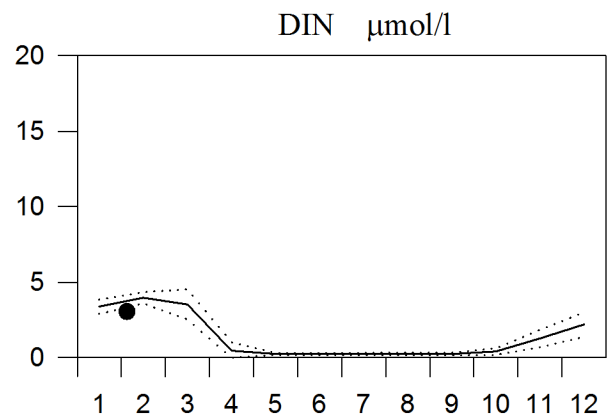
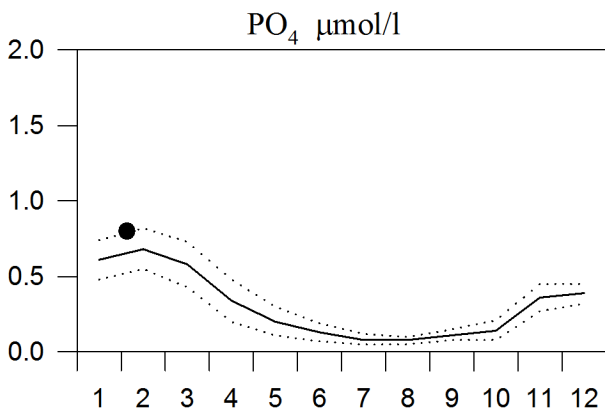
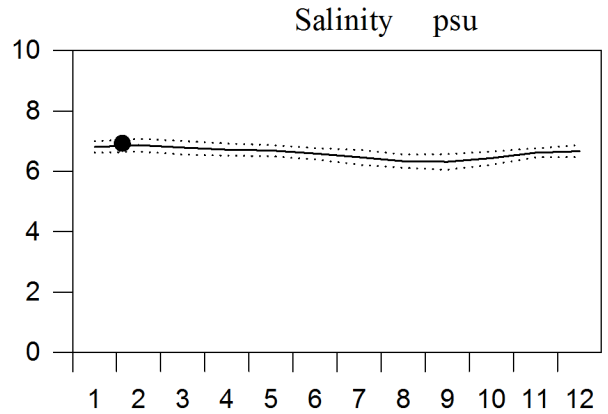
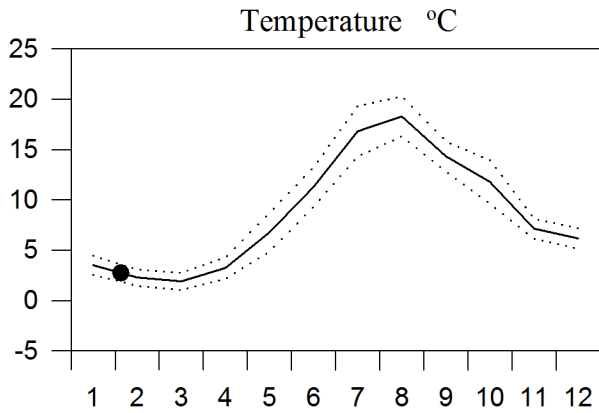
OXYGEN IN BOTTOM WATER (depth = 440m)



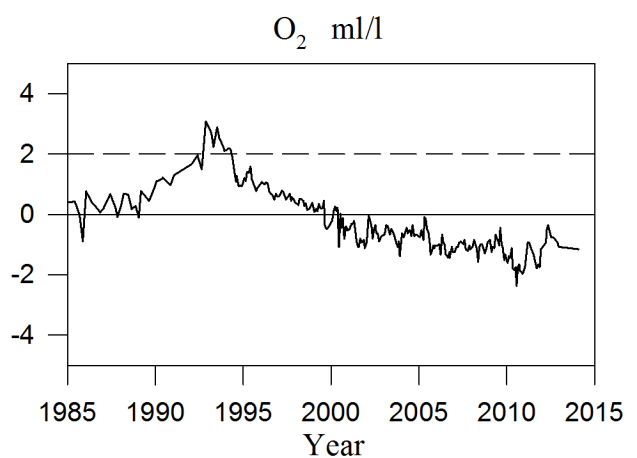
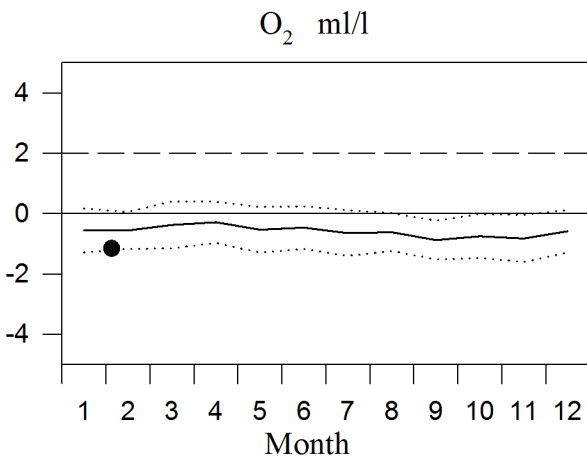
STATION BY32 SURFACE WATER

Annual Cycles

— Mean 1996-2010 St.Dev. ● 2014



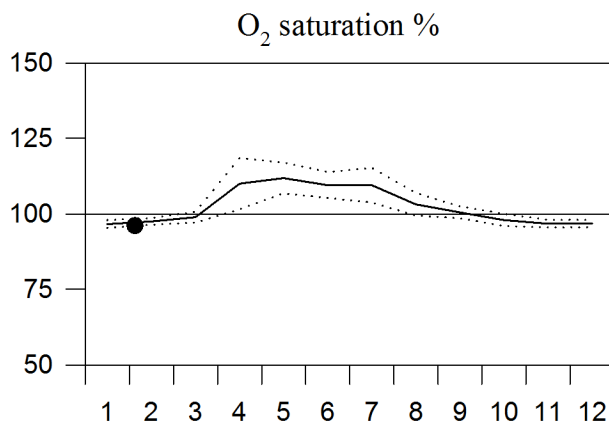
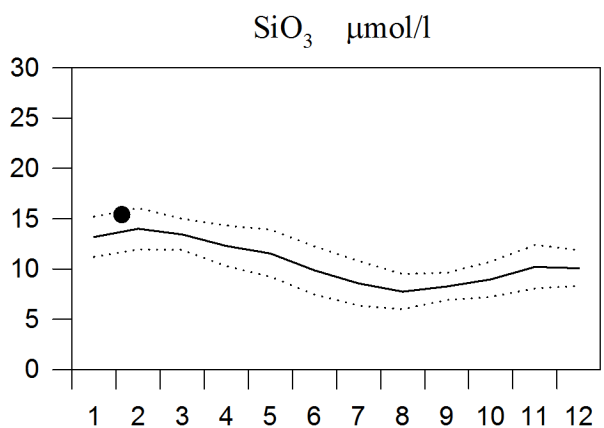
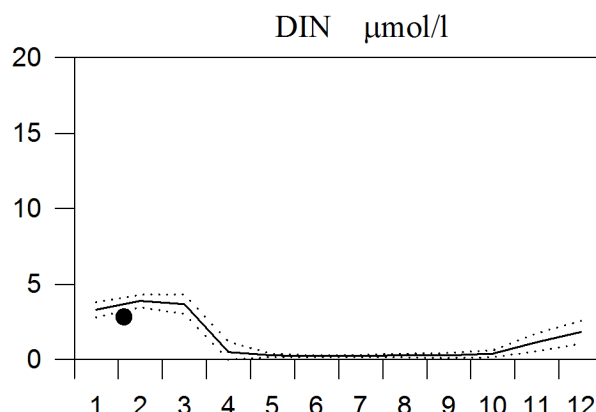
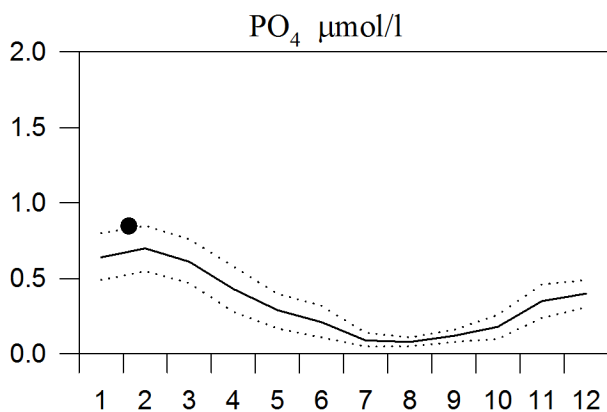
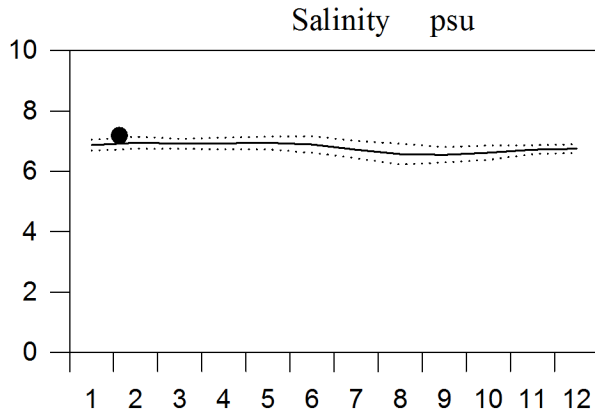
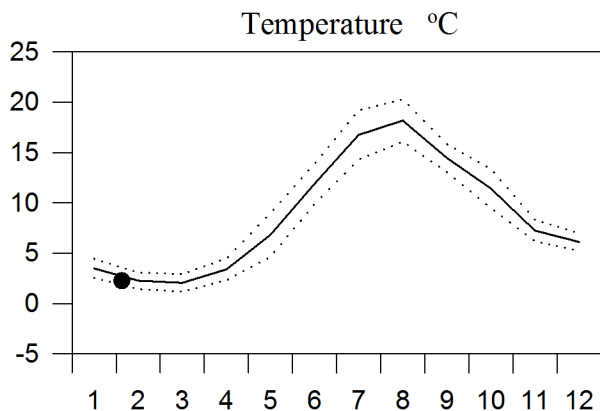
OXYGEN IN BOTTOM WATER (depth > 175m)



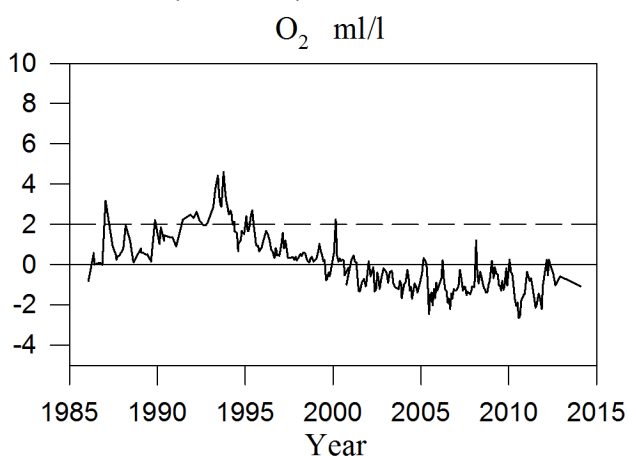
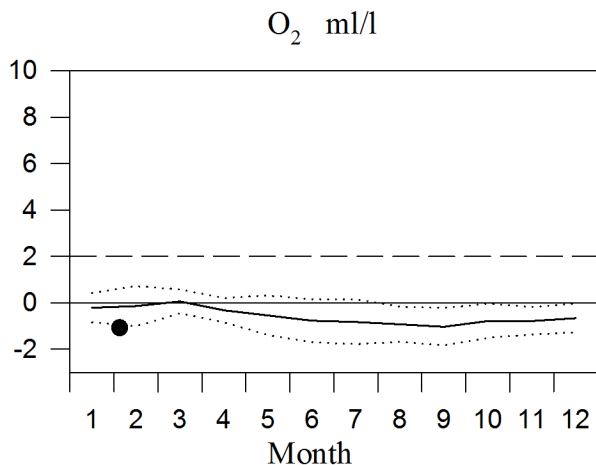
STATION BY38 SURFACE WATER

Annual Cycles

— Mean 1996-2010 St.Dev. ● 2014



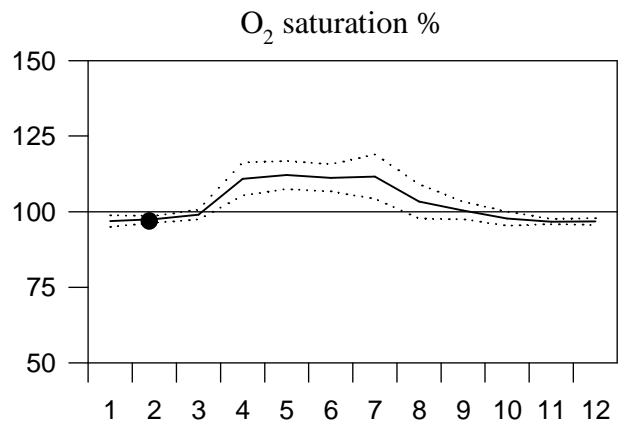
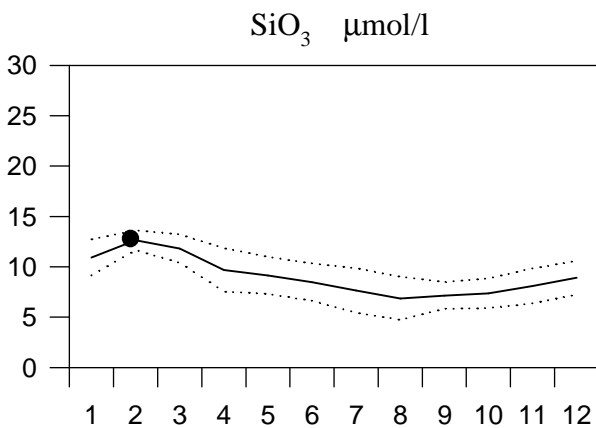
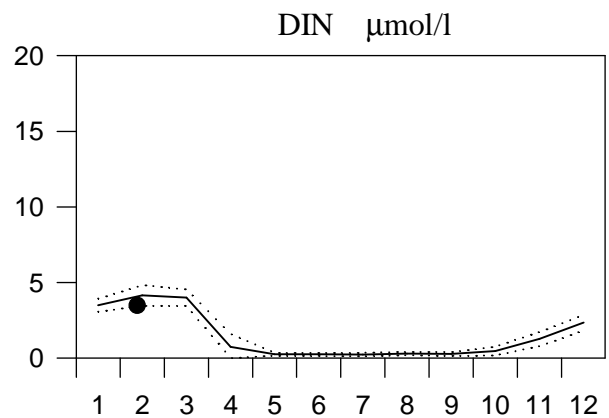
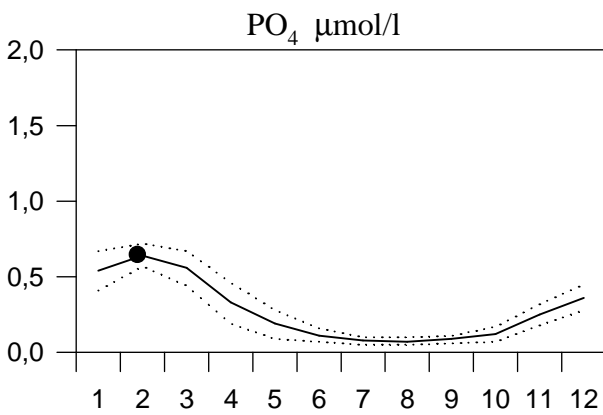
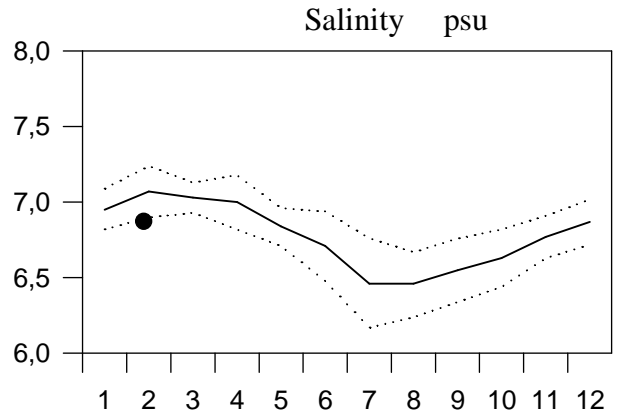
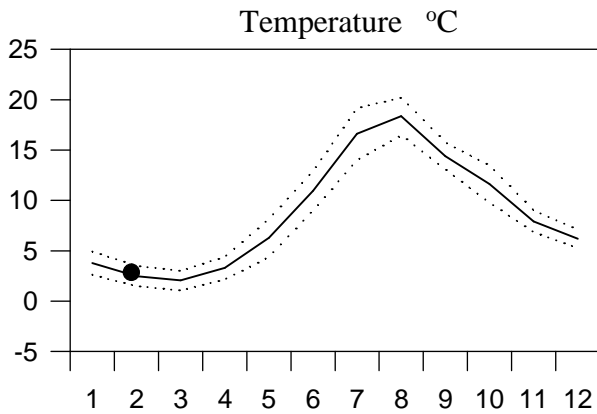
OXYGEN IN BOTTOM WATER (> 100m)



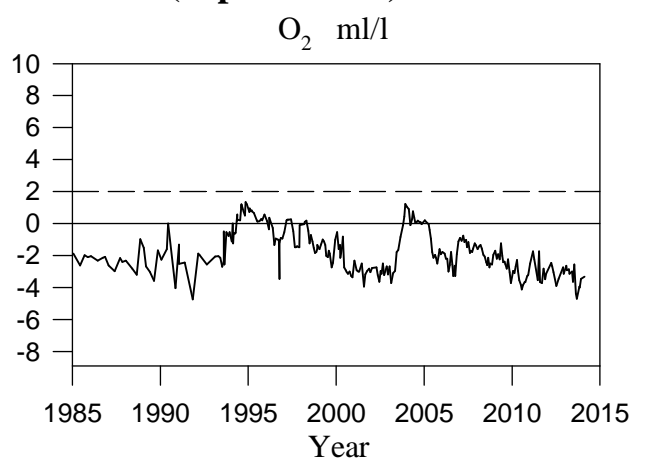
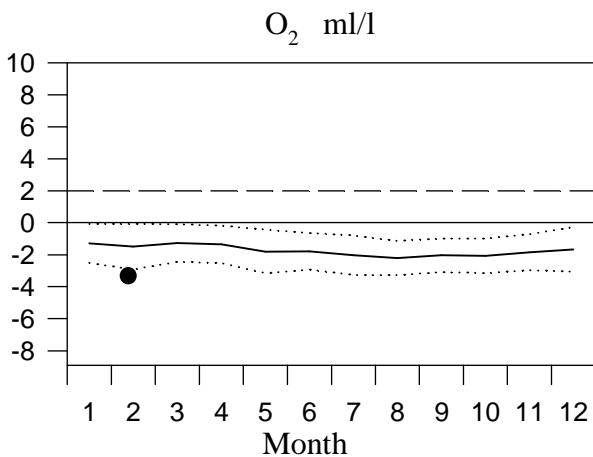
STATION BY20 SURFACE WATER

Annual Cycles

— Mean 1996-2010 St.Dev. ● 2014



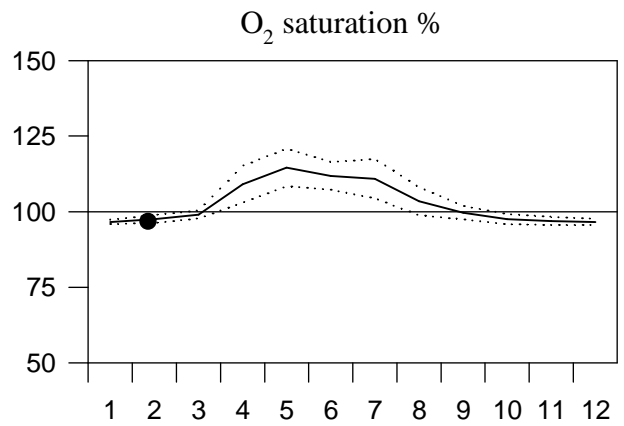
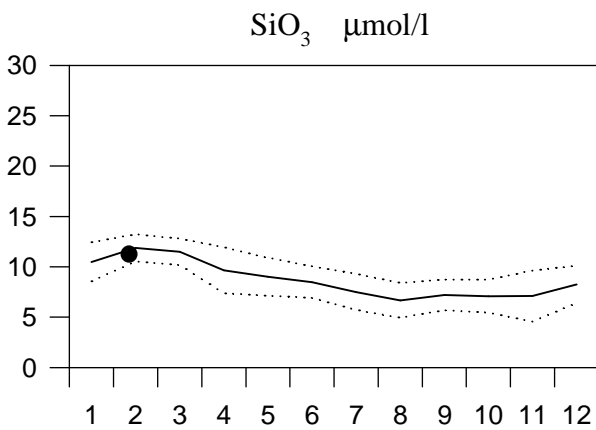
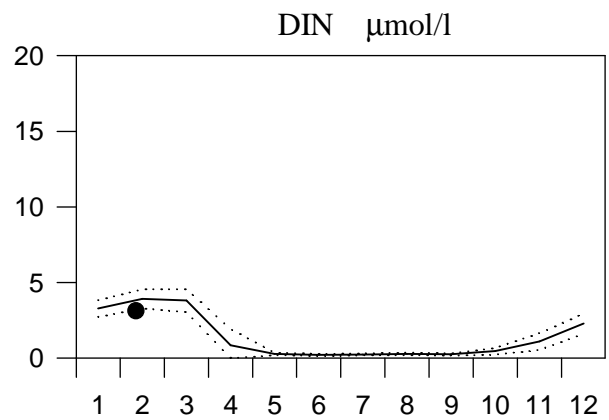
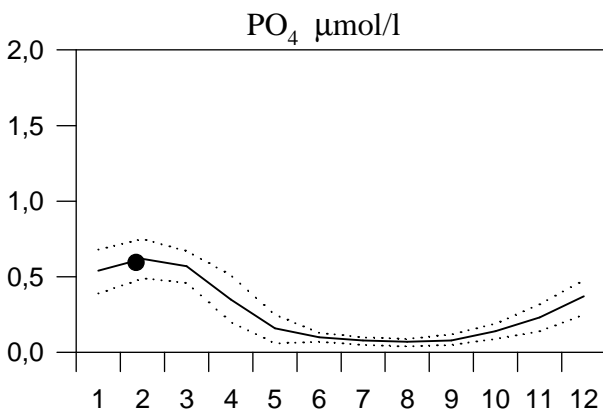
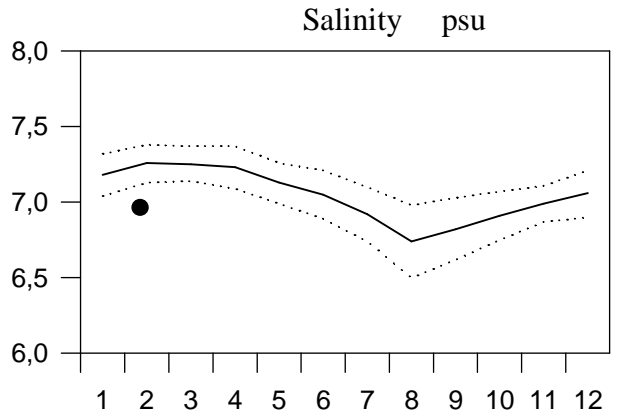
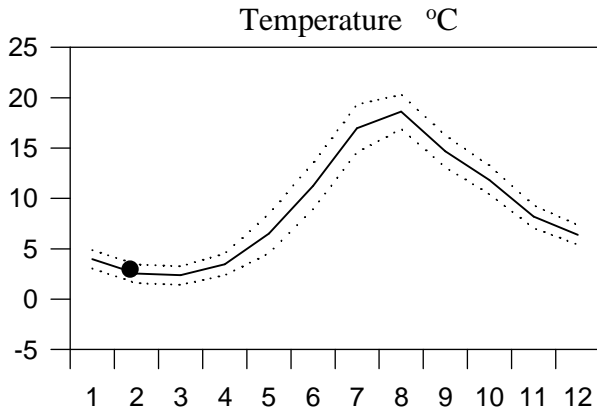
OXYGEN IN BOTTOM WATER (depth >175m)



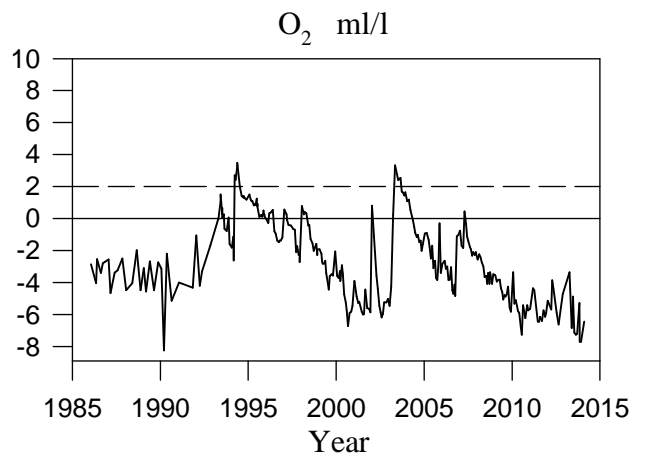
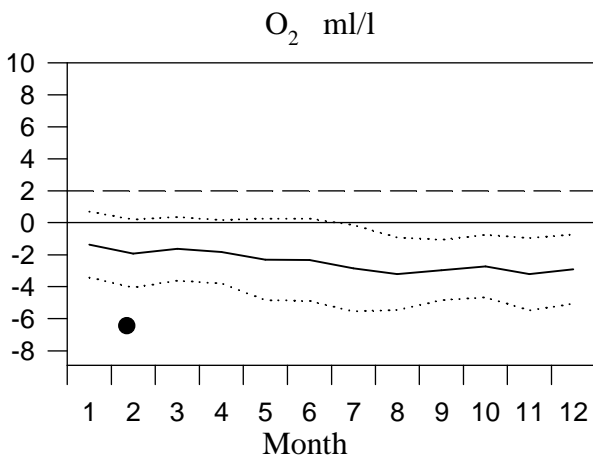
STATION BY15 SURFACE WATER

Annual Cycles

— Mean 1996-2010 St.Dev. ● 2014



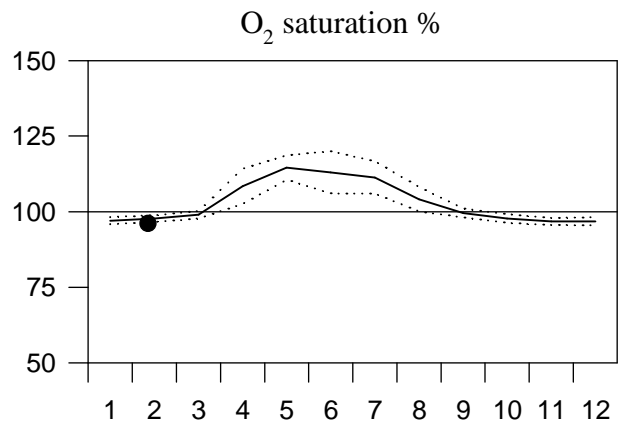
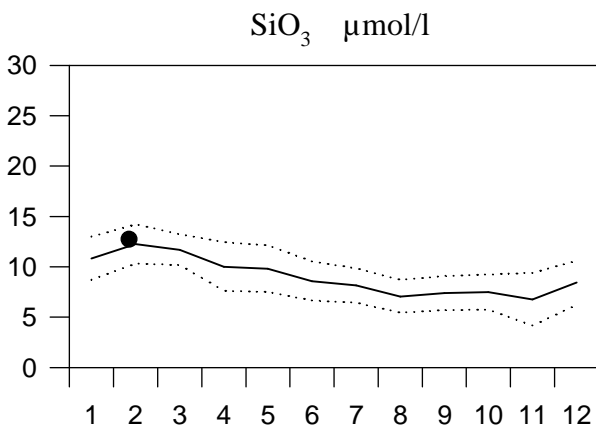
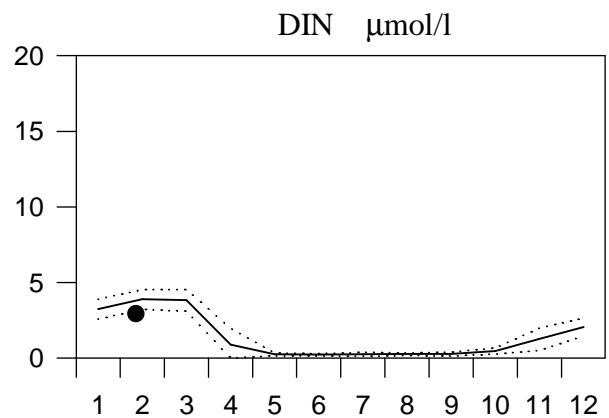
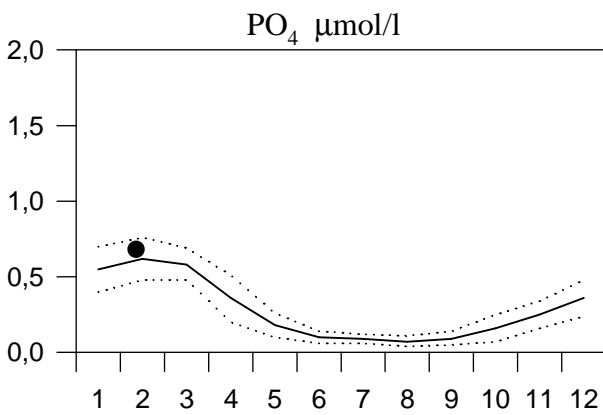
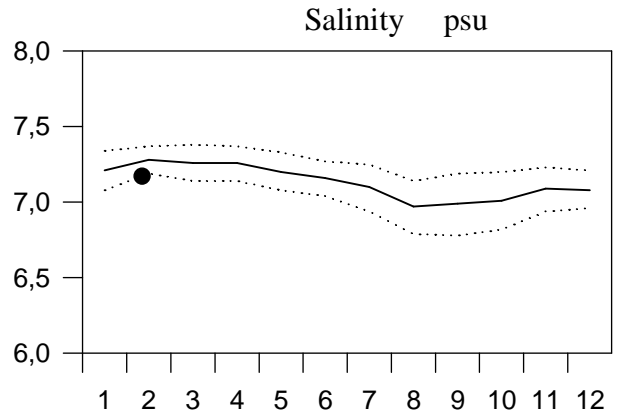
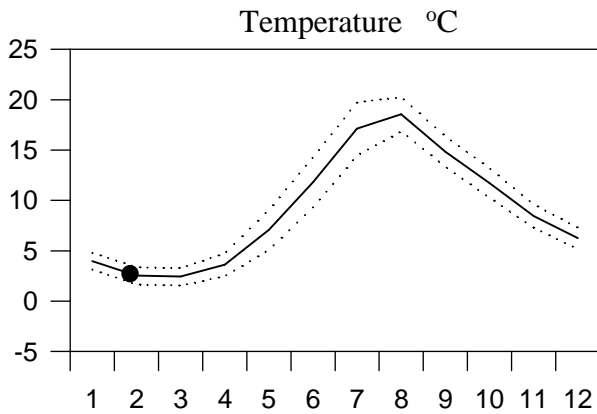
OXYGEN IN BOTTOM WATER (depth >225m)



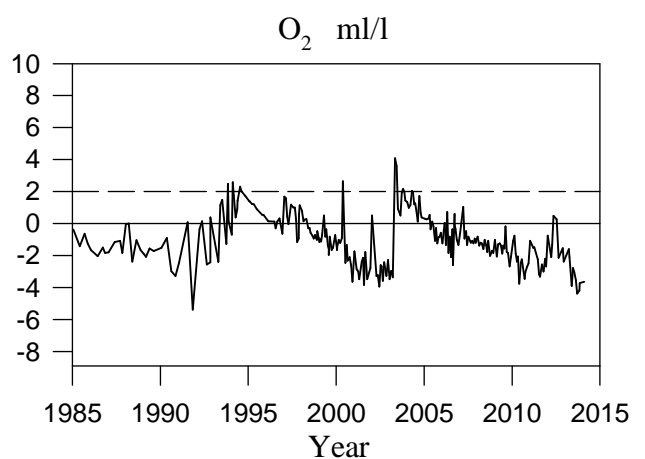
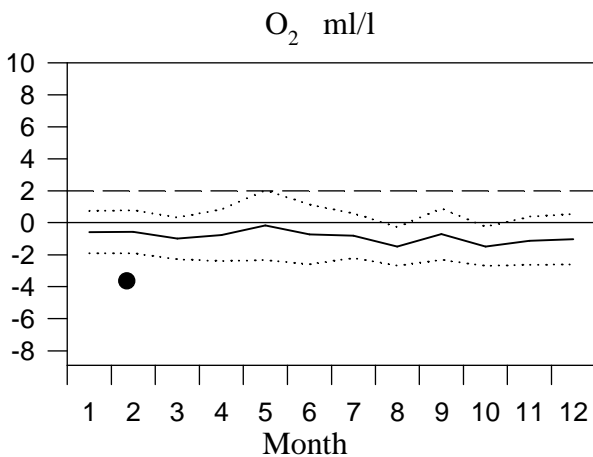
STATION BY10 SURFACE WATER

Annual Cycles

— Mean 1996-2010 St.Dev. ● 2014



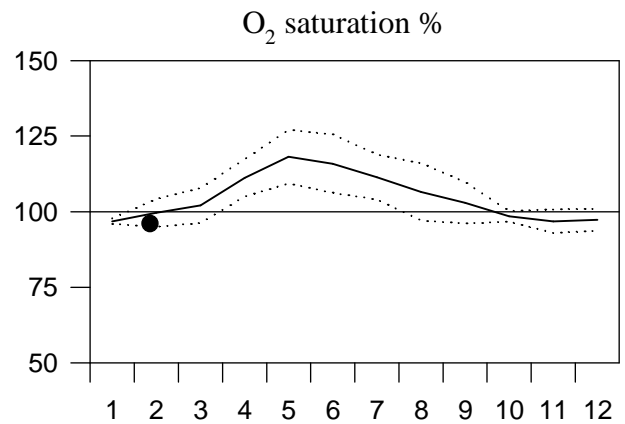
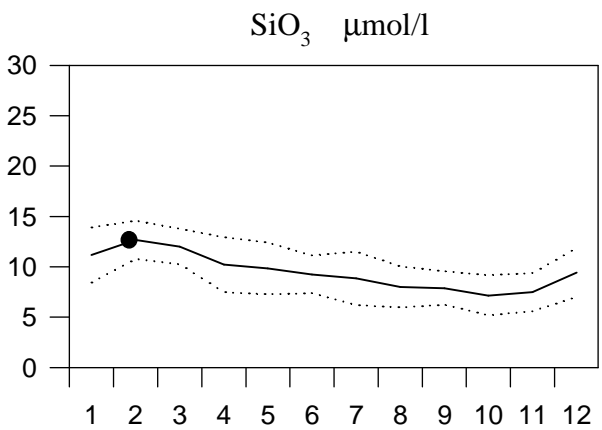
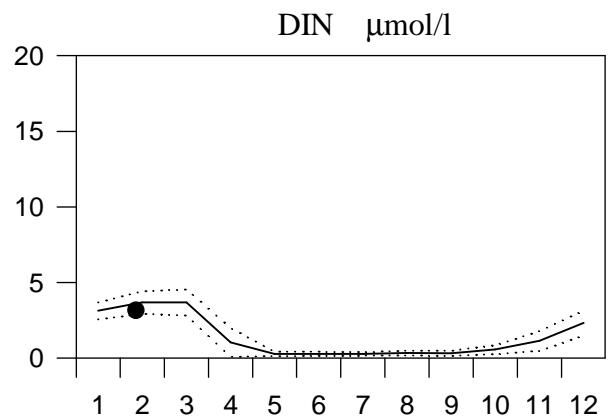
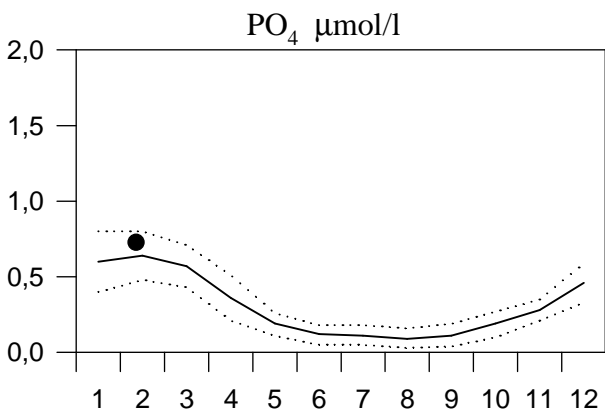
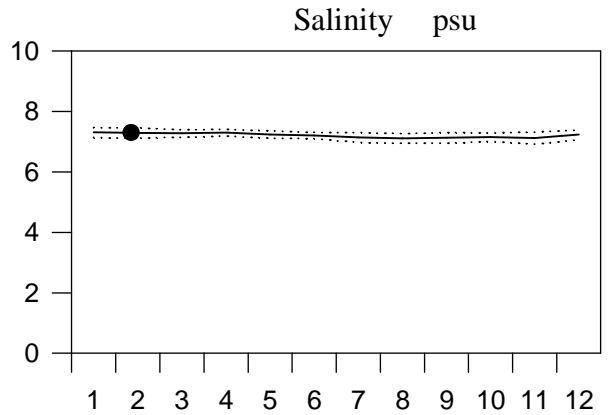
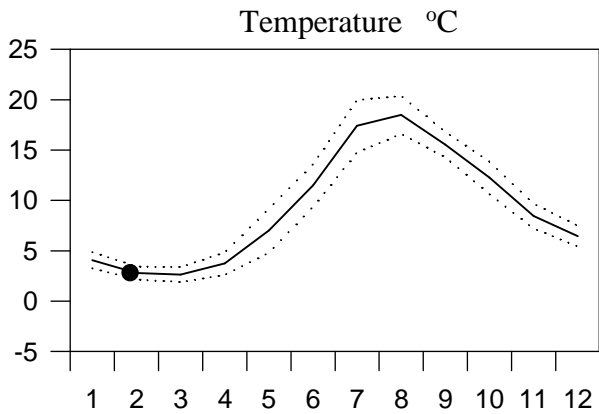
OXYGEN IN BOTTOM WATER (depth >125m)



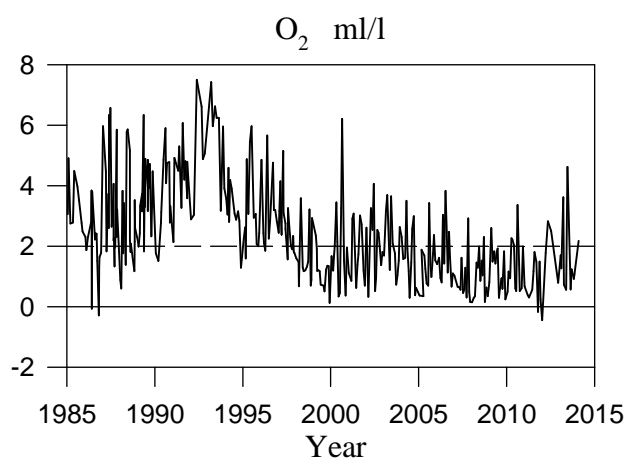
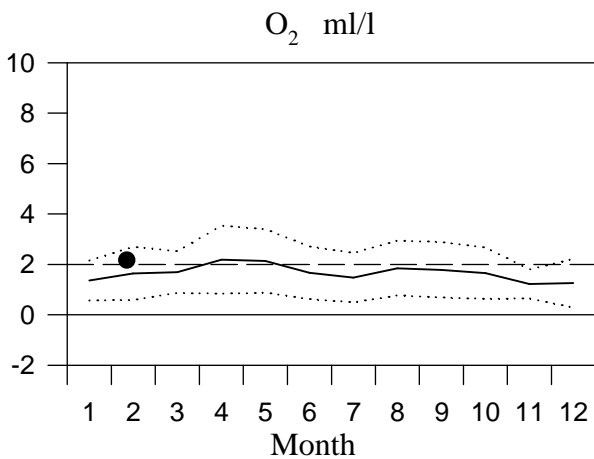
STATION BCS III-10 SURFACE WATER

Annual Cycles

— Mean 1996-2010 ····· St.Dev. ● 2014



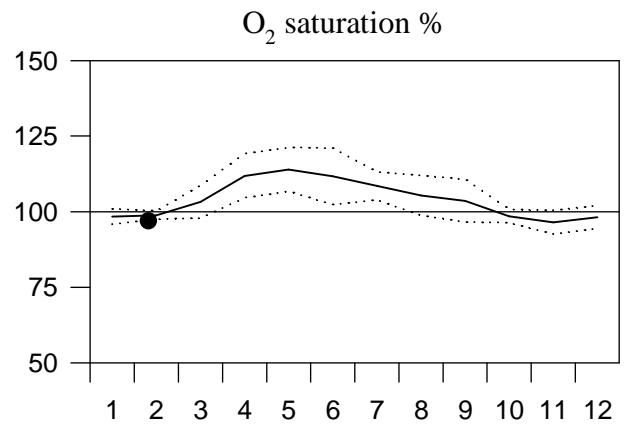
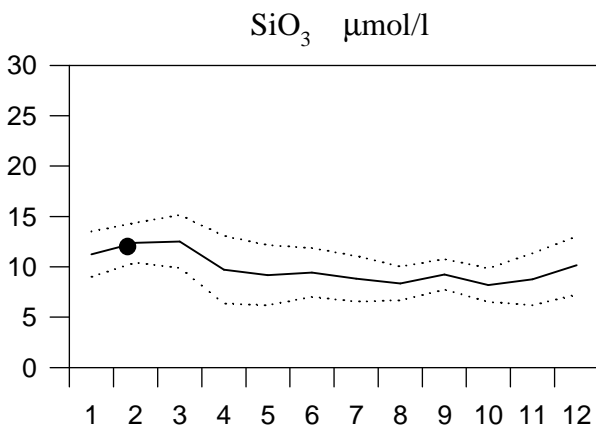
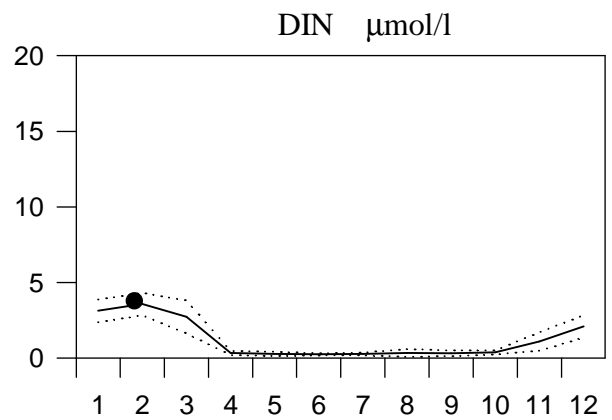
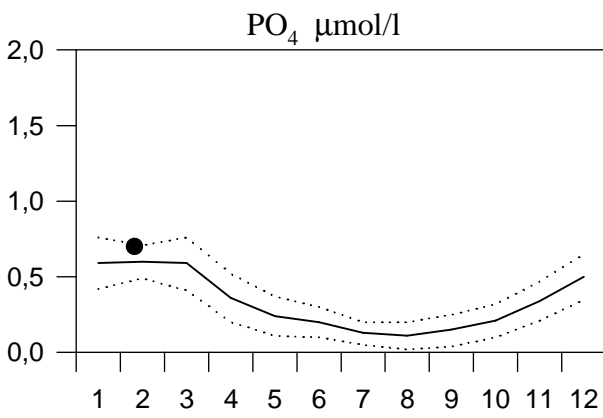
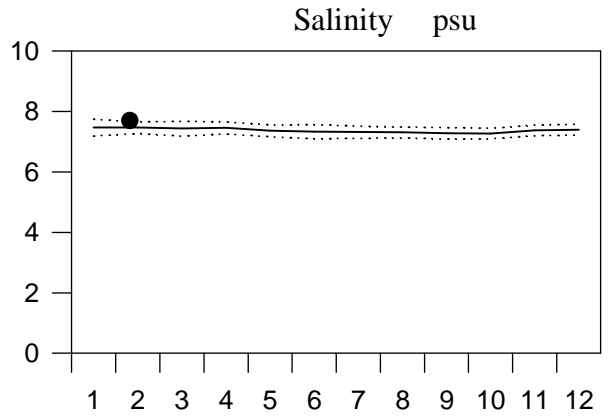
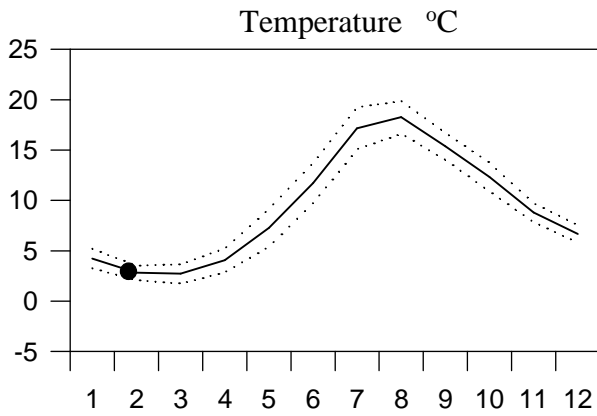
OXYGEN IN BOTTOM WATER (depth > 80m)



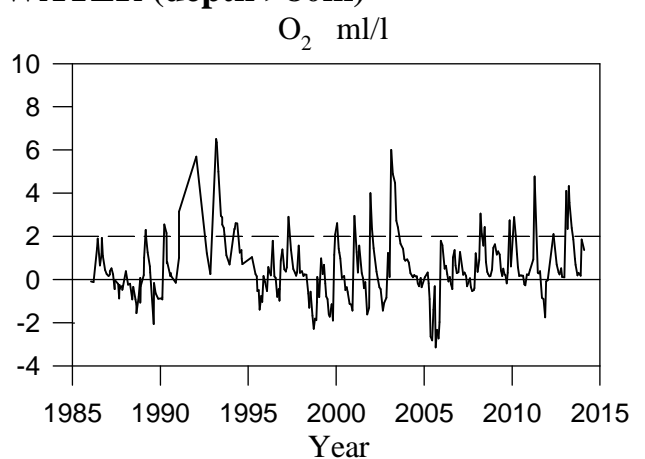
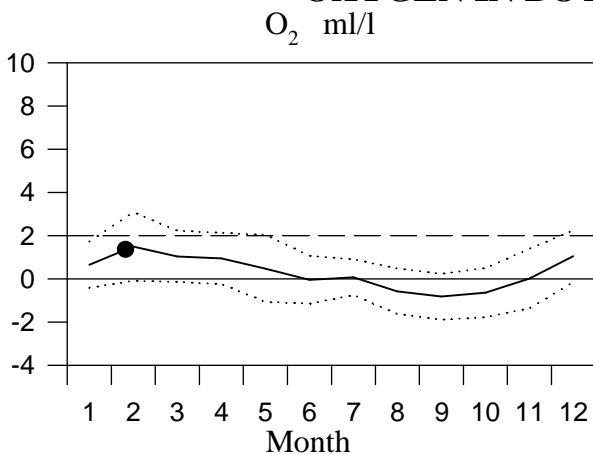
STATION BY5 SURFACE WATER

Annual Cycles

— Mean 1996-2010 St.Dev. ● 2014



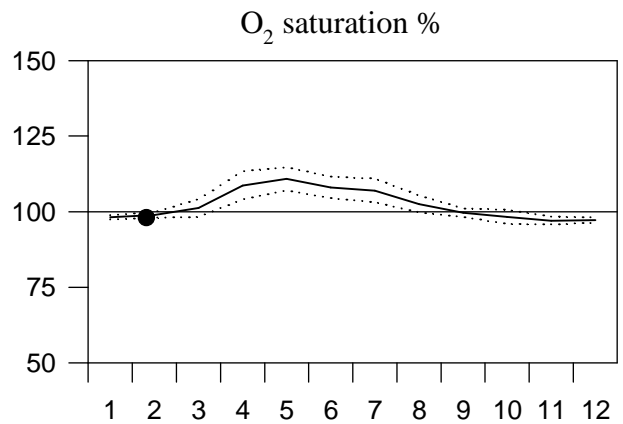
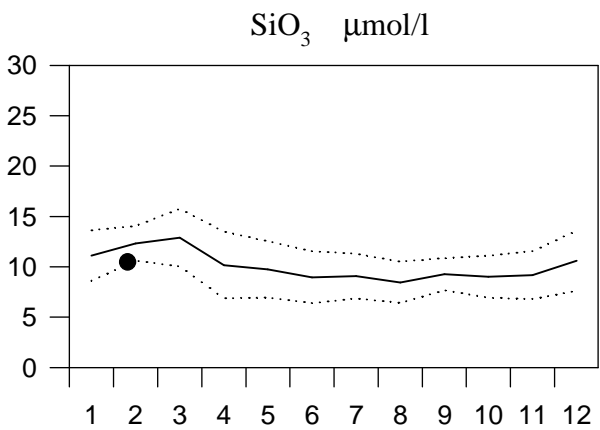
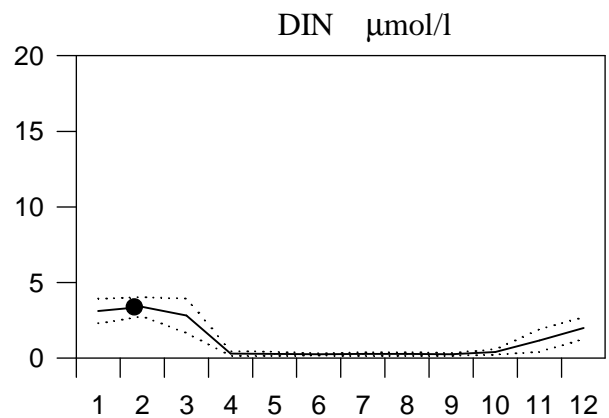
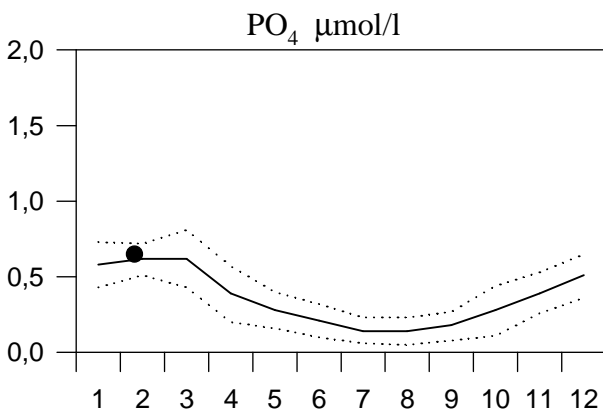
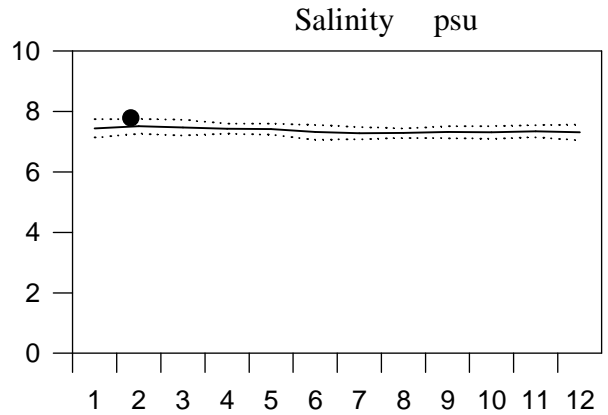
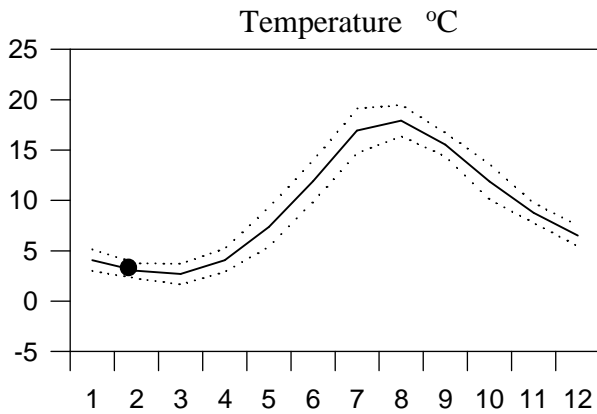
OXYGEN IN BOTTOM WATER (depth >80m)



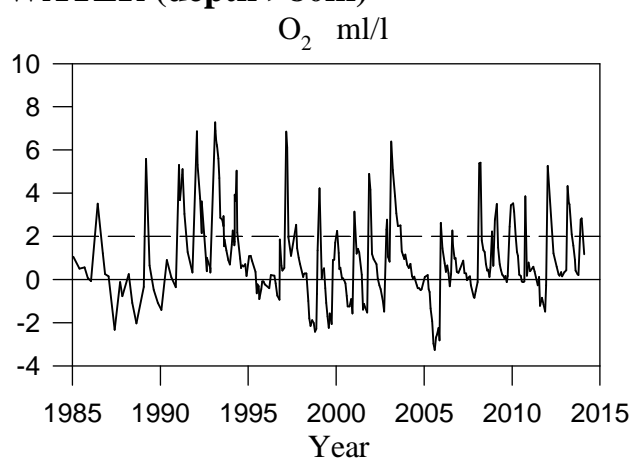
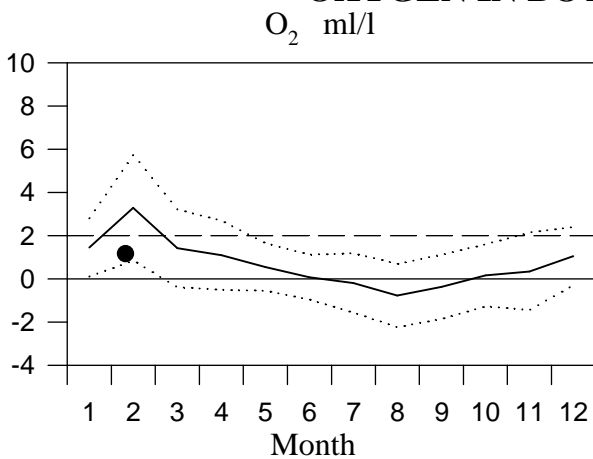
STATION BY4 SURFACE WATER

Annual Cycles

— Mean 1996-2010 St.Dev. ● 2014



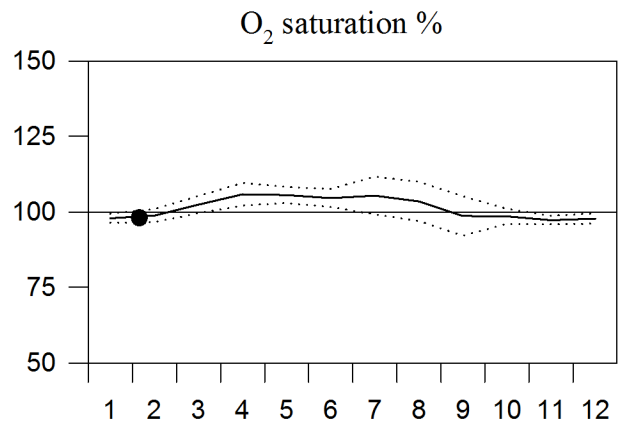
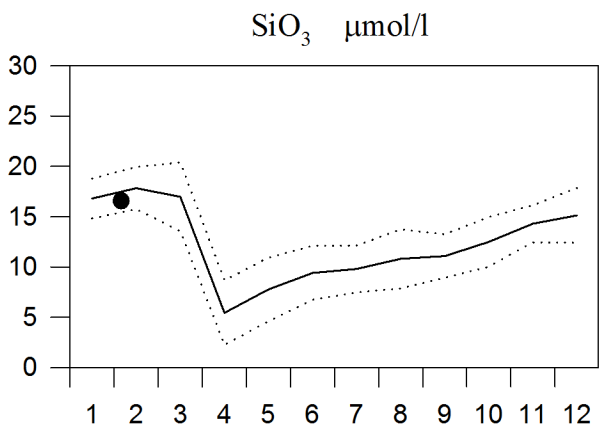
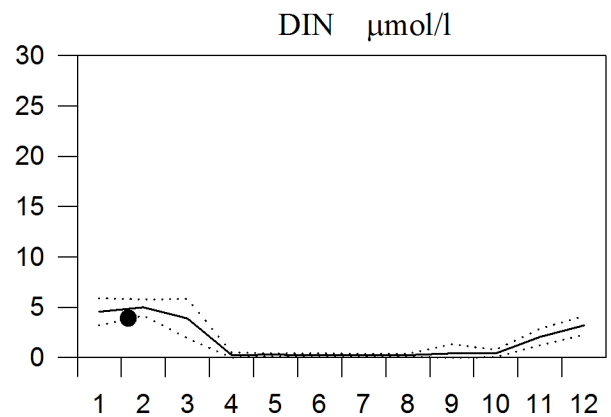
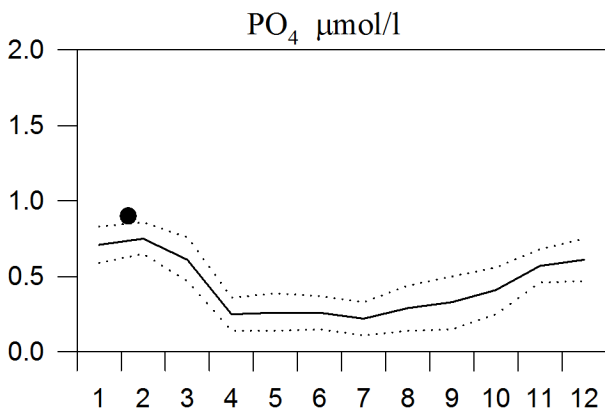
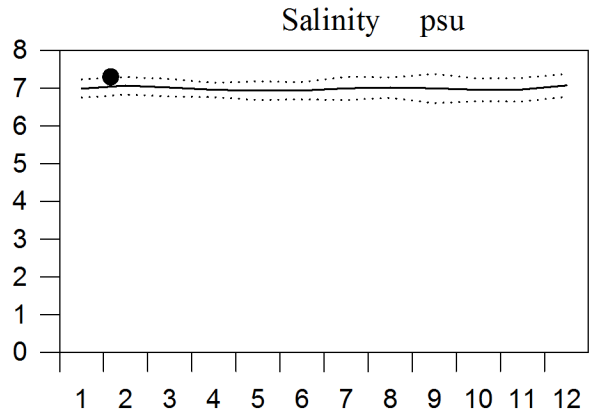
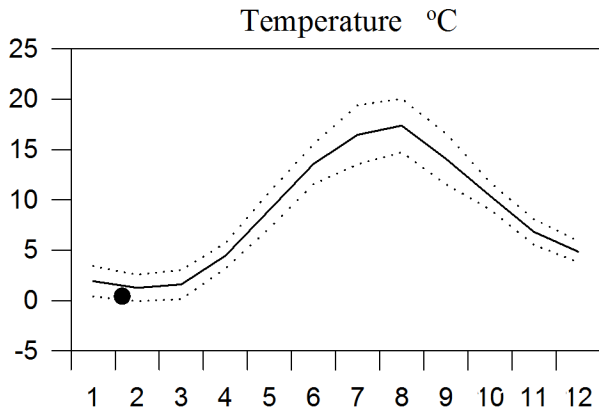
OXYGEN IN BOTTOM WATER (depth >80m)



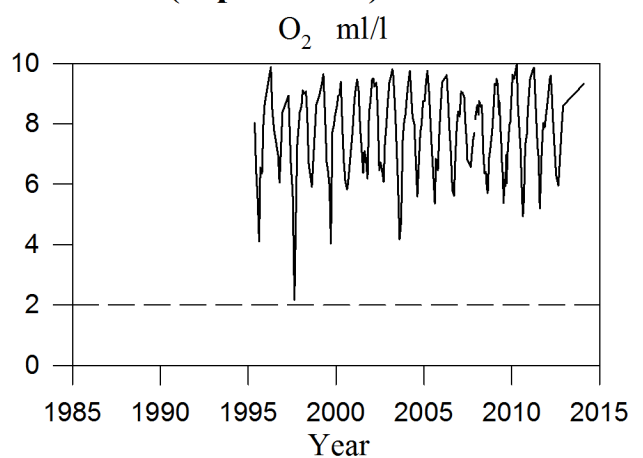
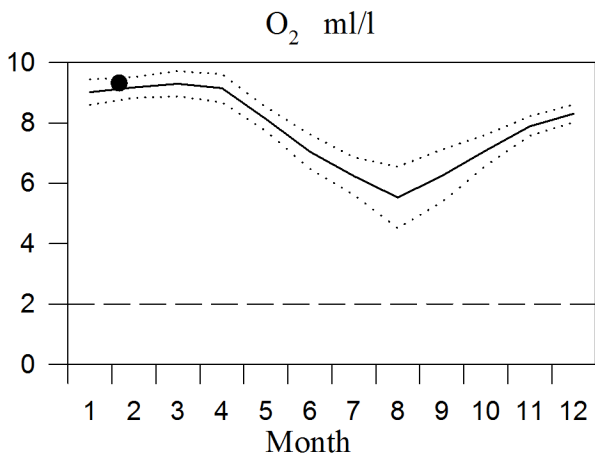
STATION REF M1V1 SURFACE WATER

Annual Cycles

— Mean 1996-2010 St.Dev. ● 2014



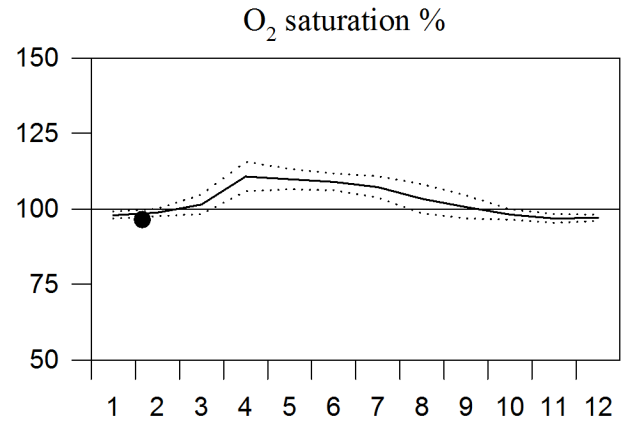
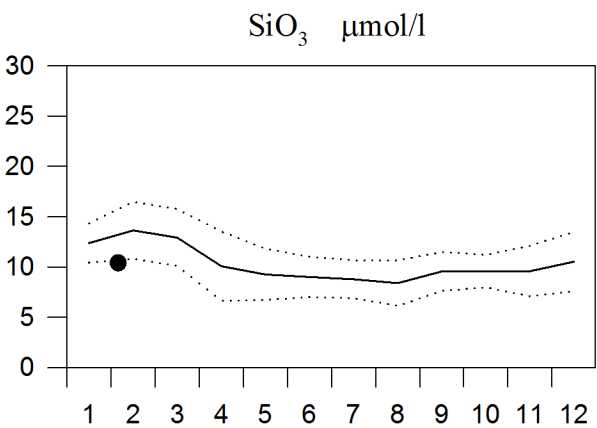
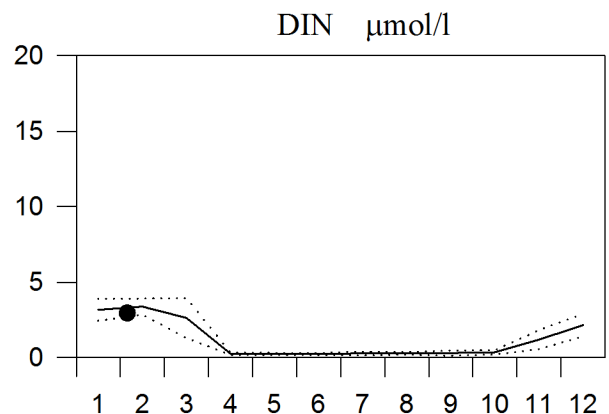
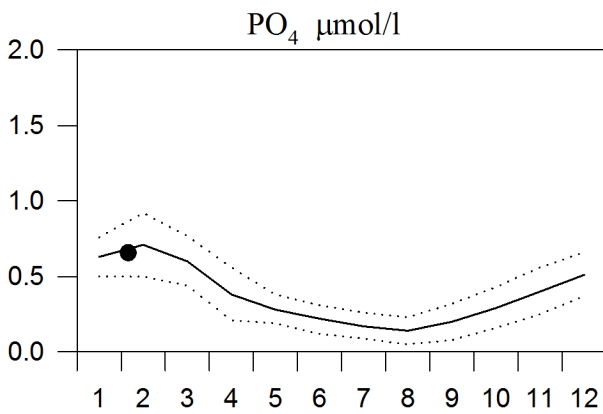
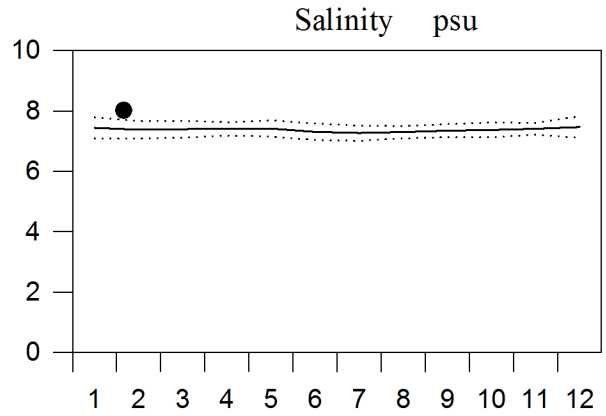
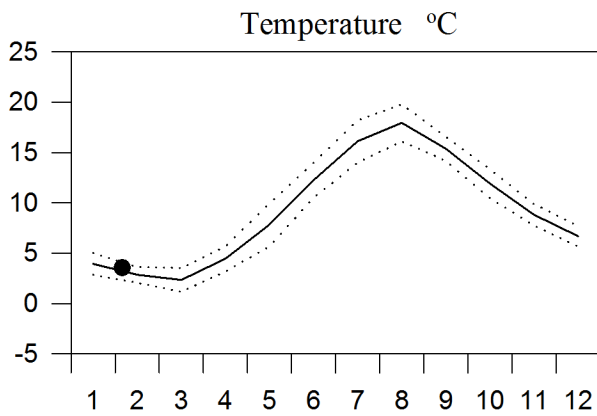
OXYGEN IN BOTTOM WATER (depth >15m)



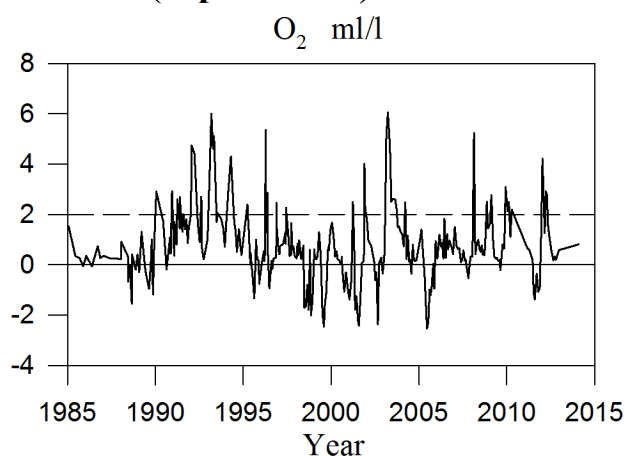
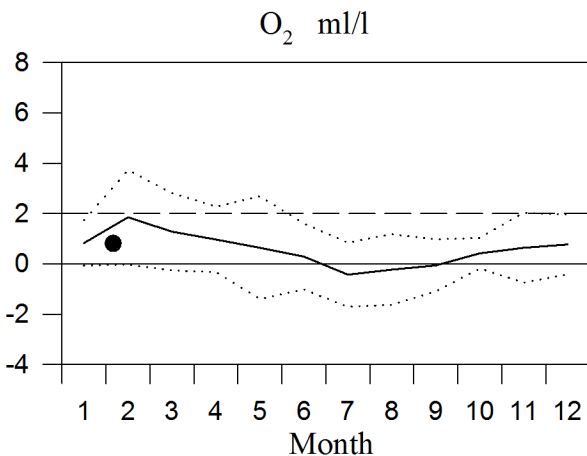
STATION HANÖBUKTEN SURFACE WATER

Annual Cycles

— Mean 1996-2010 St.Dev. ● 2014



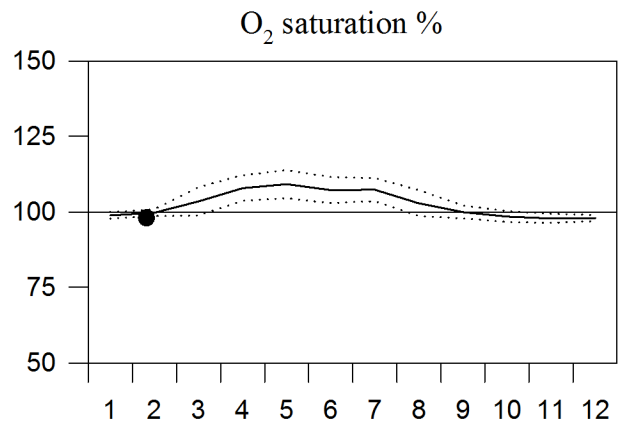
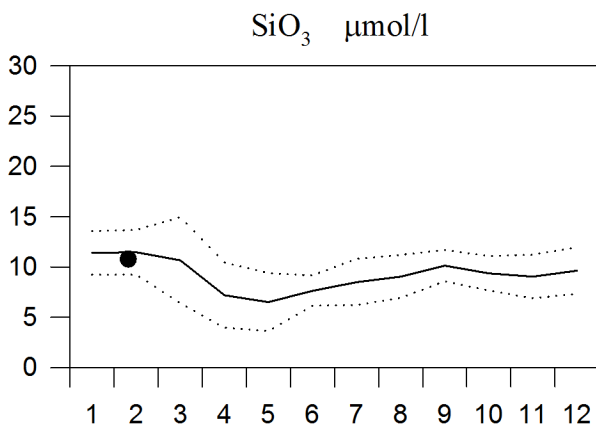
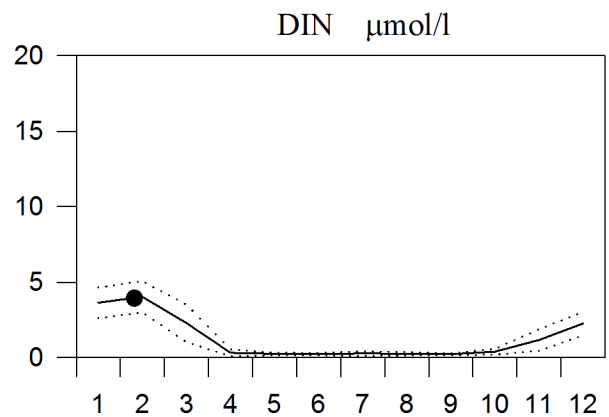
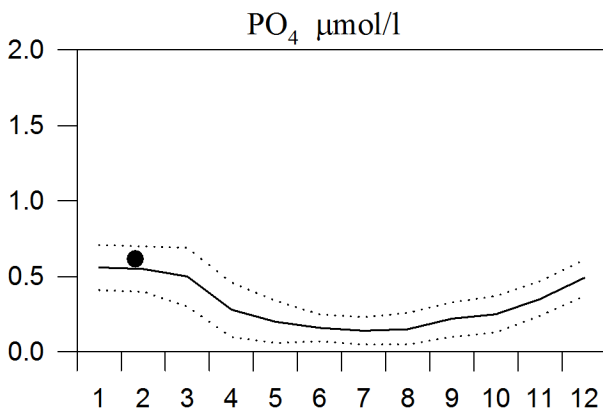
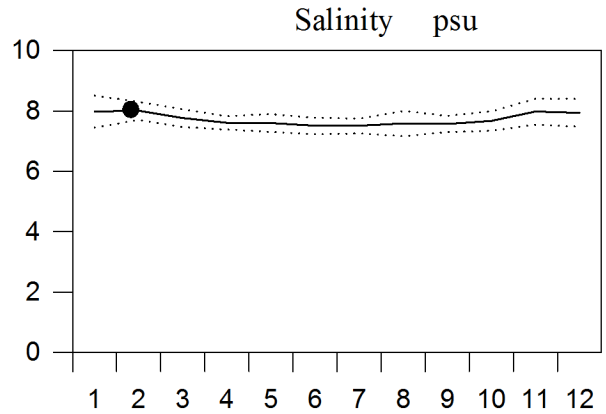
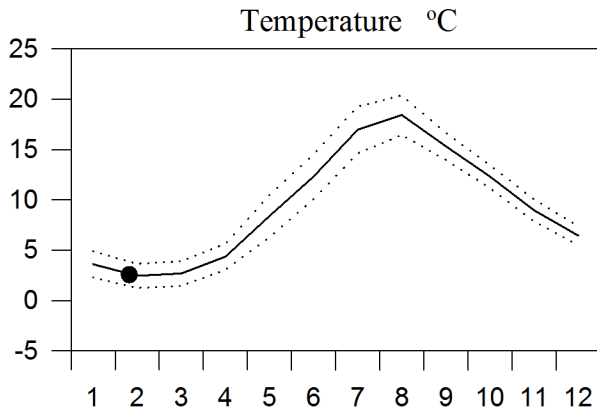
OXYGEN IN BOTTOM WATER (depth > 70m)



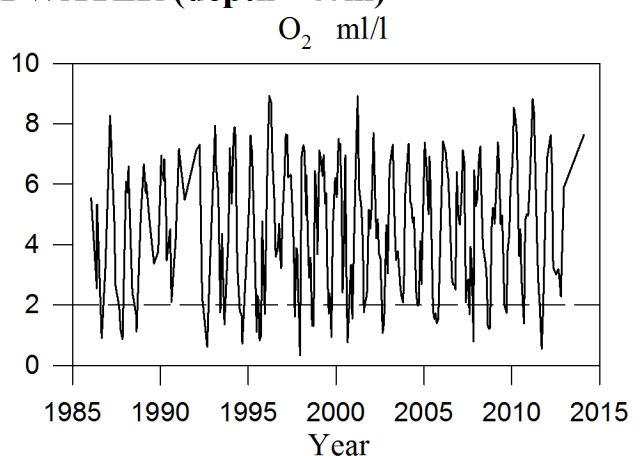
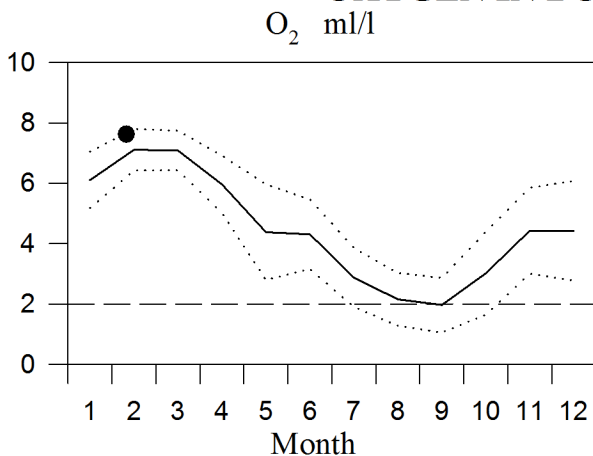
STATION BY2 SURFACE WATER

Annual Cycles

— Mean 1996-2010 St.Dev. ● 2014



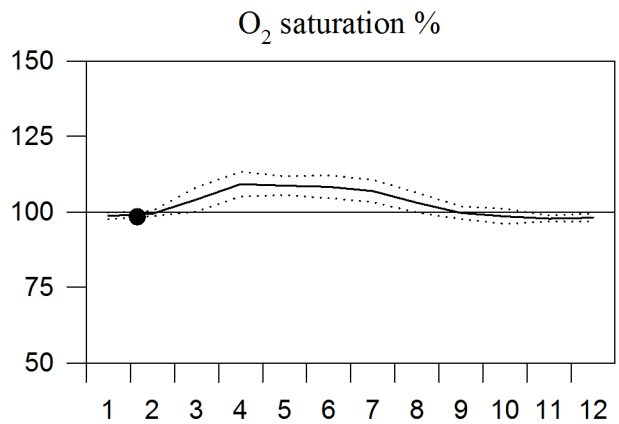
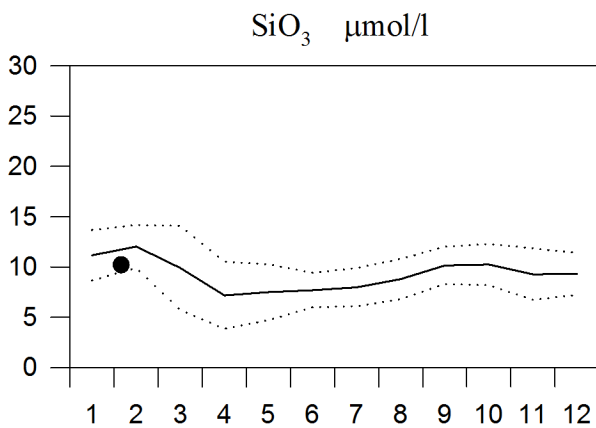
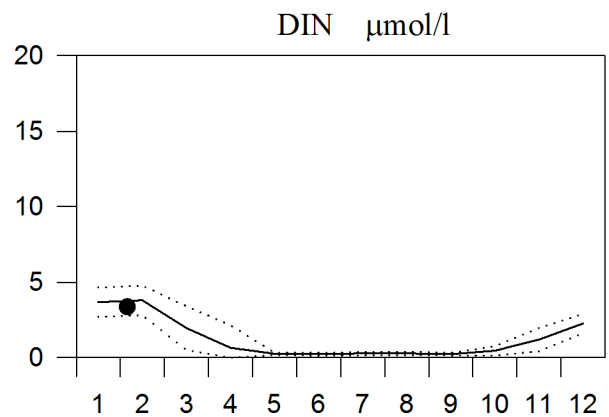
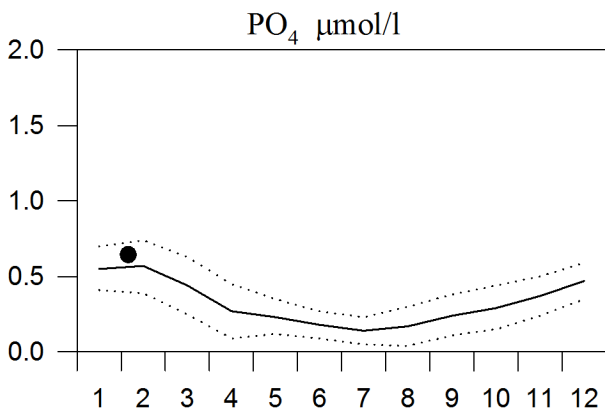
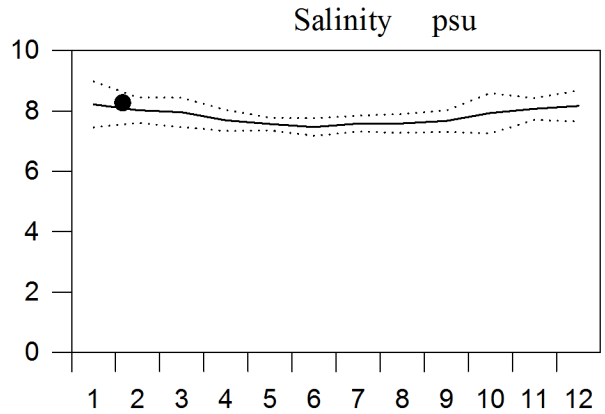
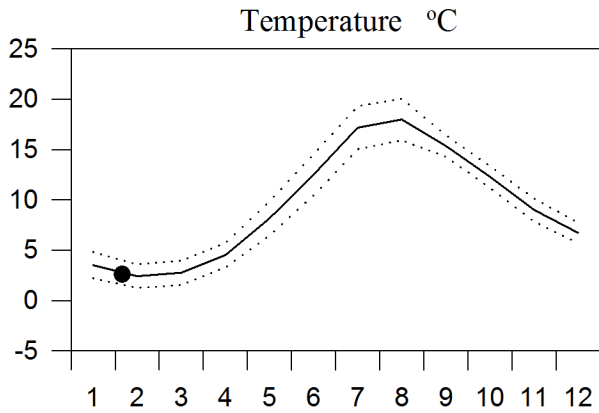
OXYGEN IN BOTTOM WATER (depth >40m)



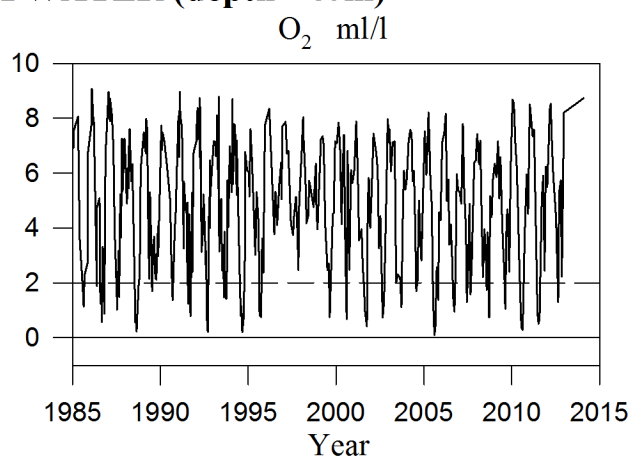
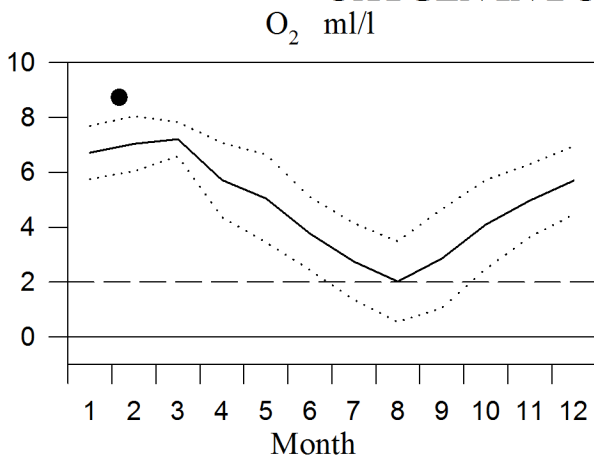
STATION BY1 SURFACE WATER

Annual Cycles

— Mean 1996-2010 St.Dev. ● 2014

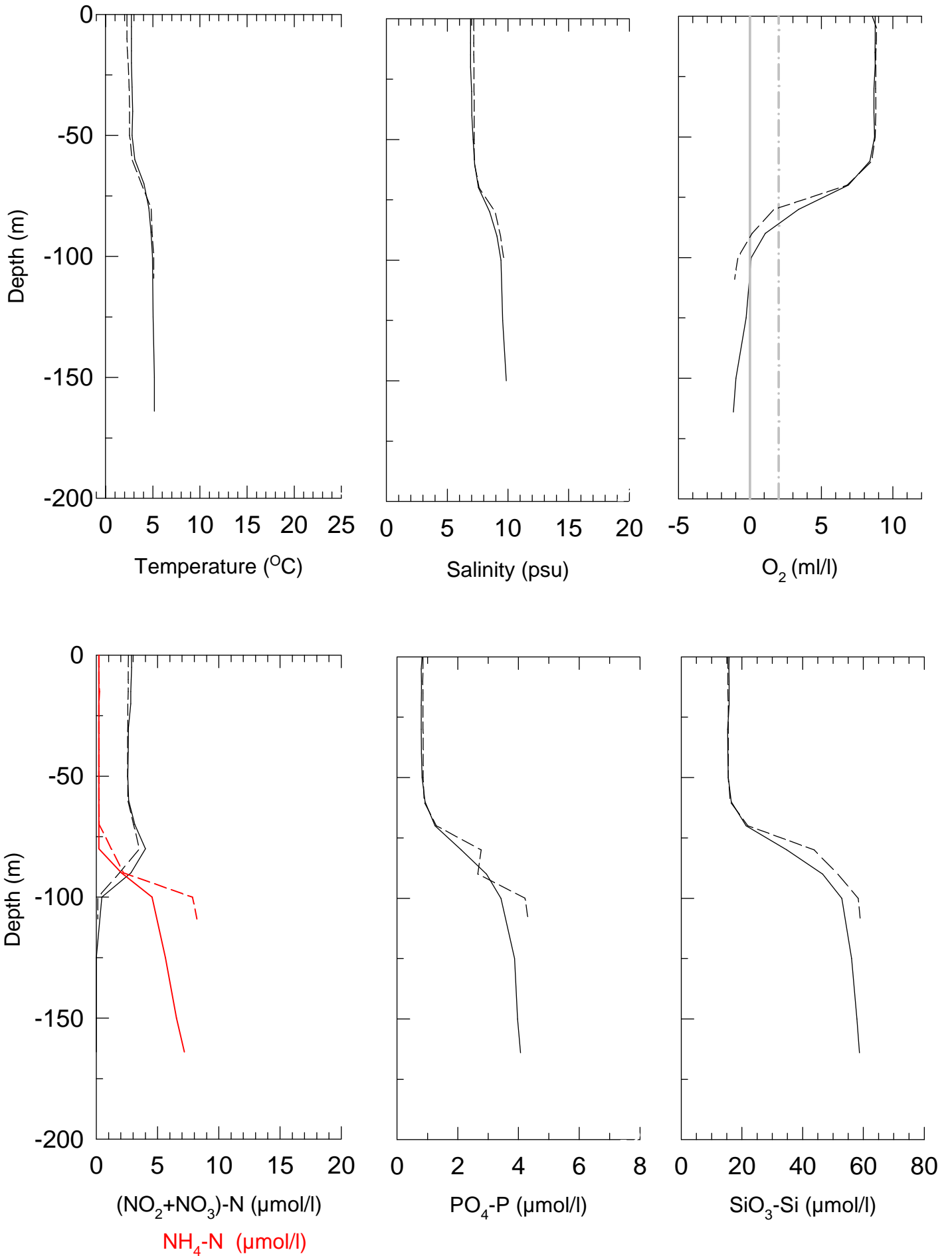


OXYGEN IN BOTTOM WATER (depth >40m)



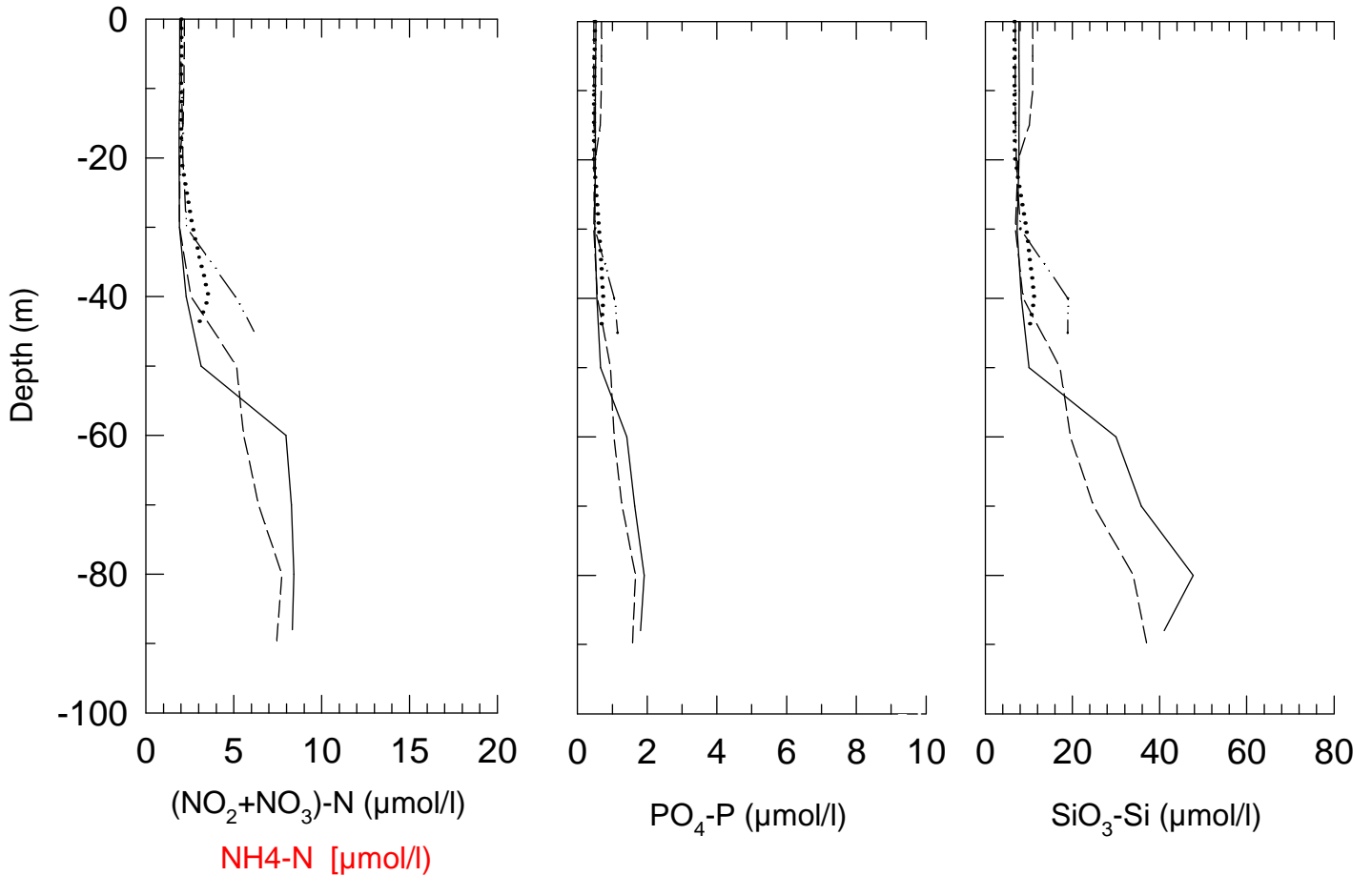
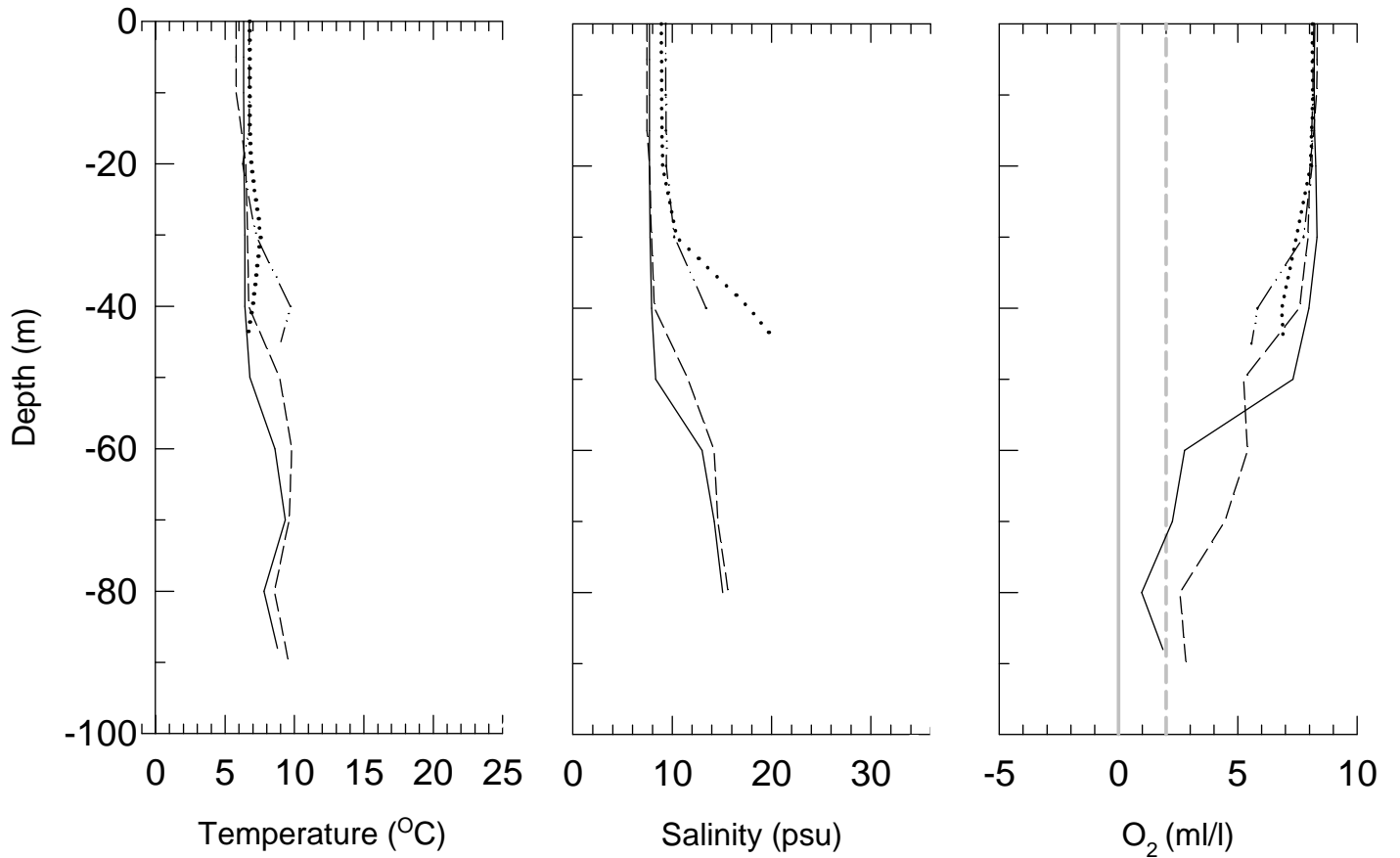
WESTERN BALTIC 2014-02-04

————— BY32 - - - - - BY38



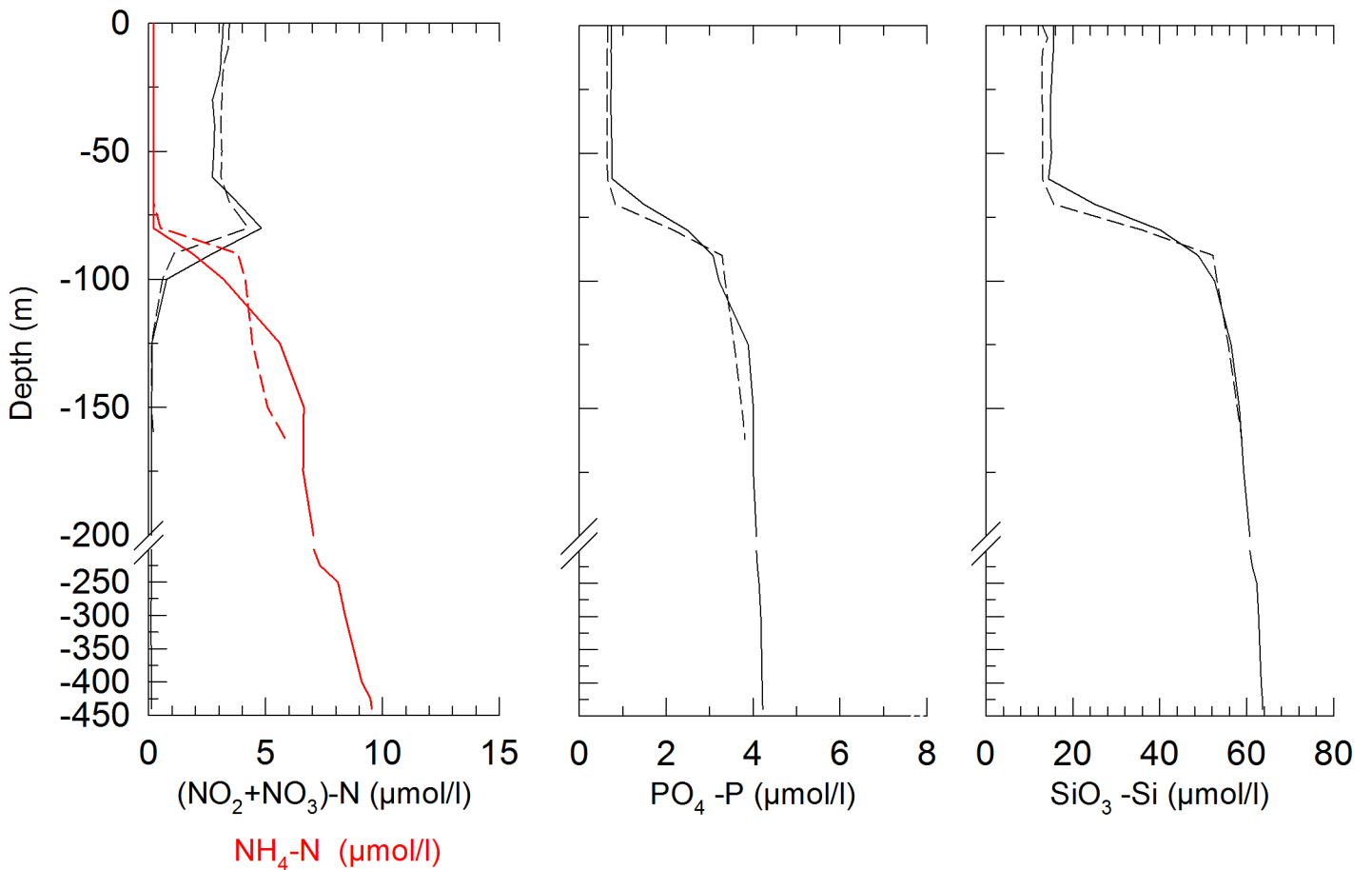
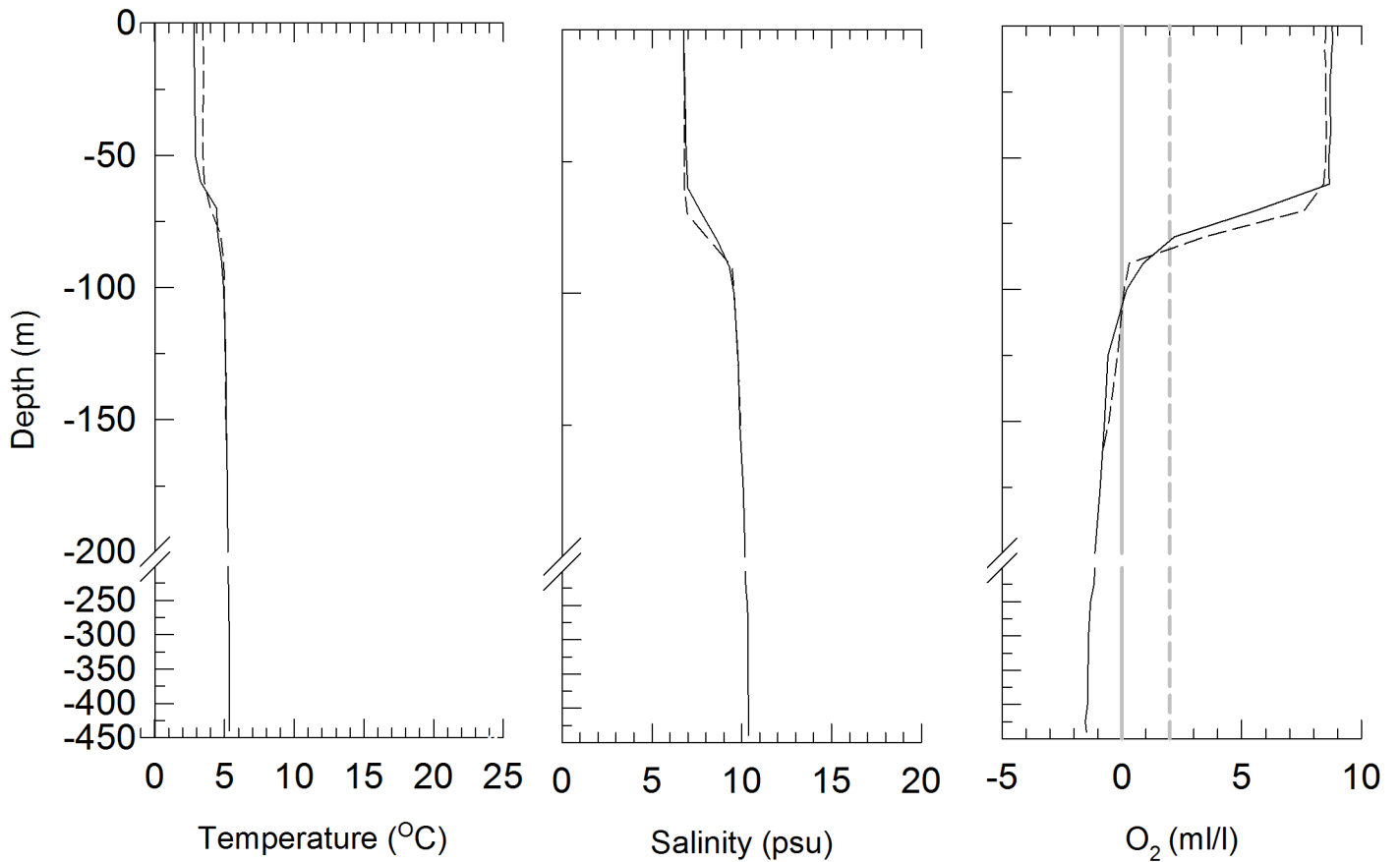
SOUTHERN BALTIC 2014-02-05/10

— BY5 - - - BY4 - · - · - BY2 ····· BY1



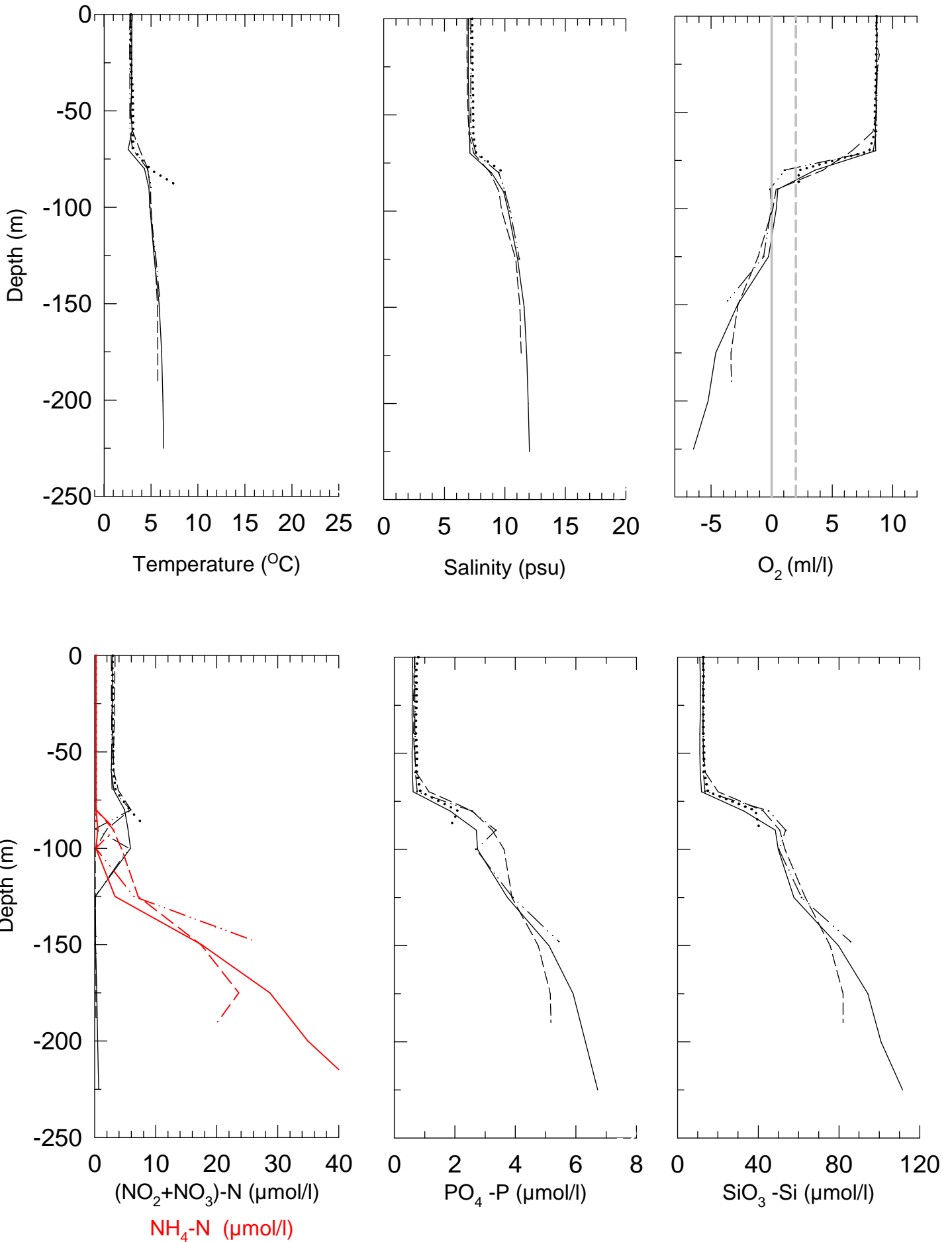
NORTHERN BALTIC 2014-02-04

----- BY29 _____ BY31



EASTERN BALTIC 2014-02-11/12

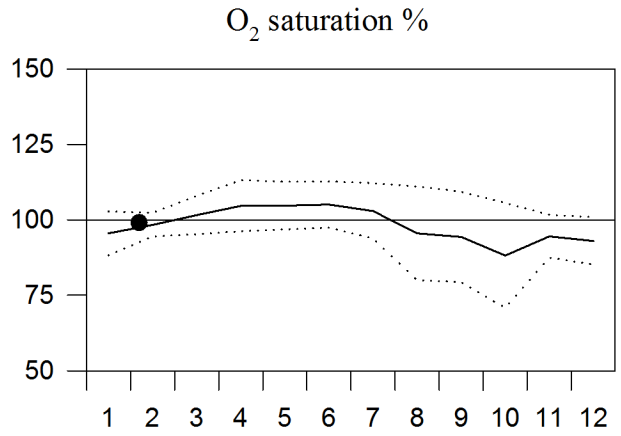
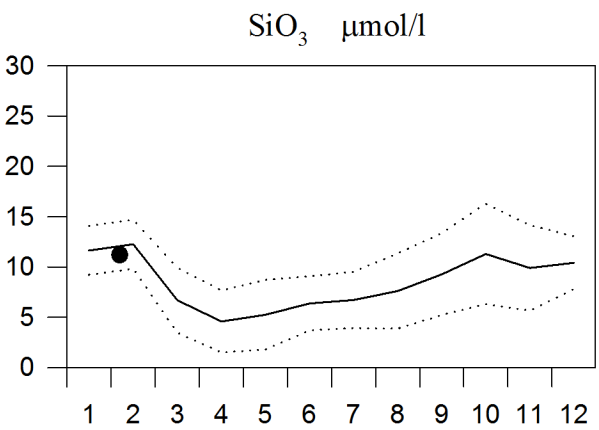
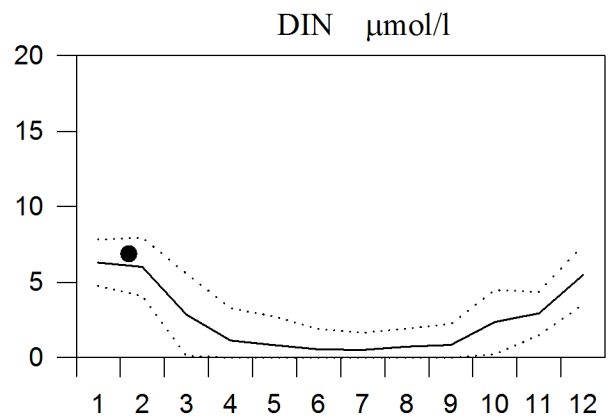
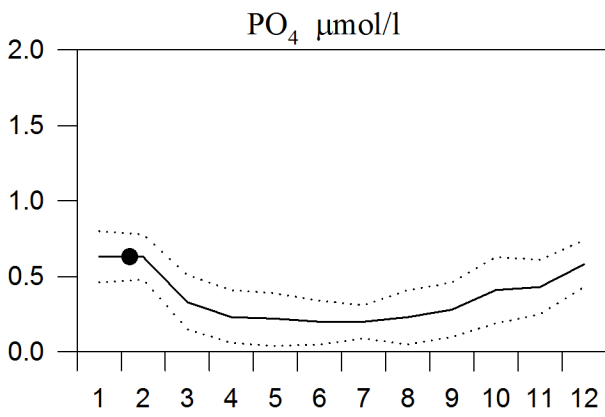
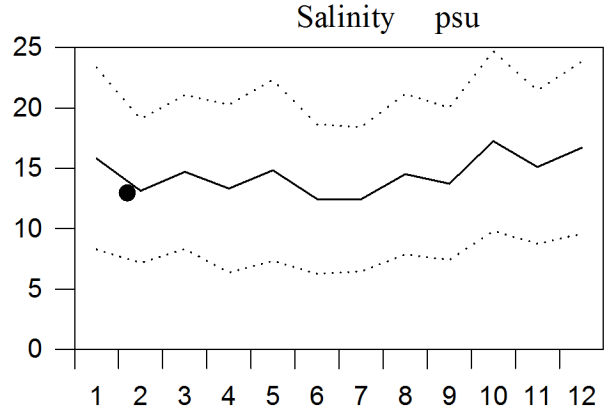
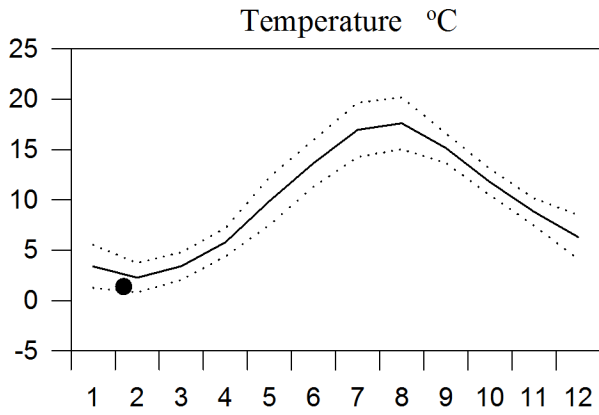
--- BY20 — BY15 -·-·- BY10 ····· BCS III-10



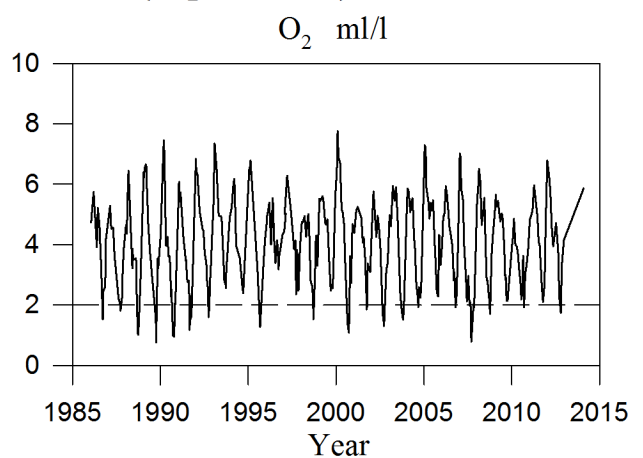
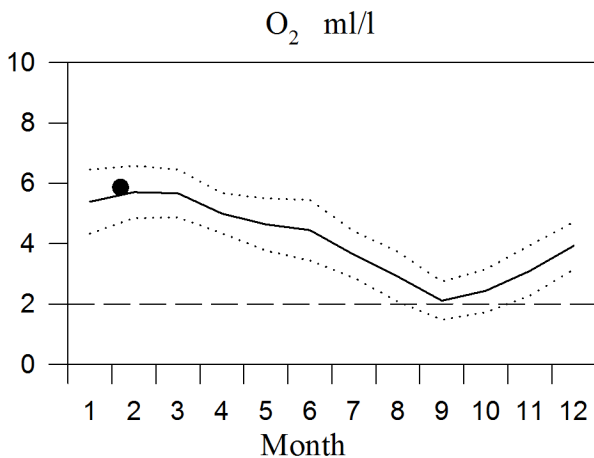
STATION W LANDSKRONA SURFACE WATER

Annual Cycles

— Mean 1996-2010 St.Dev. ● 2014



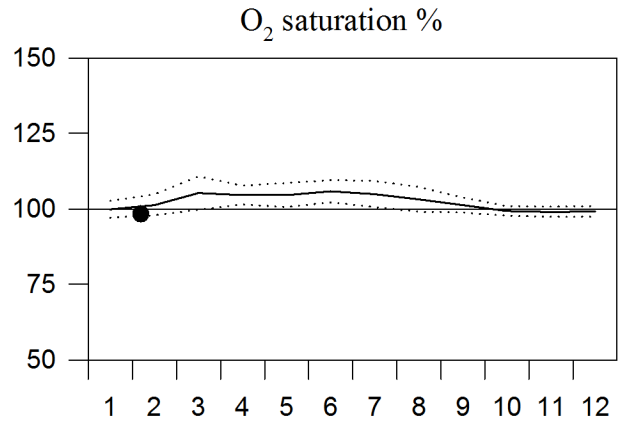
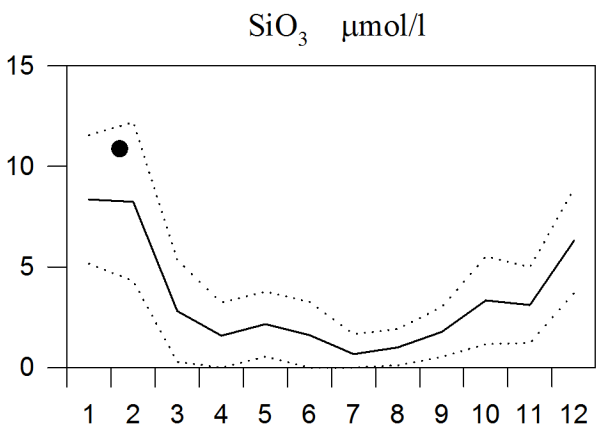
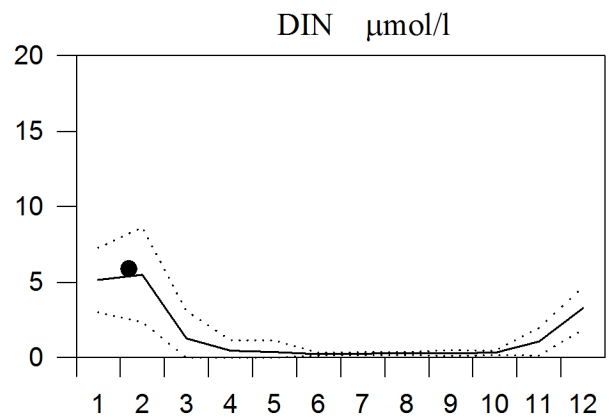
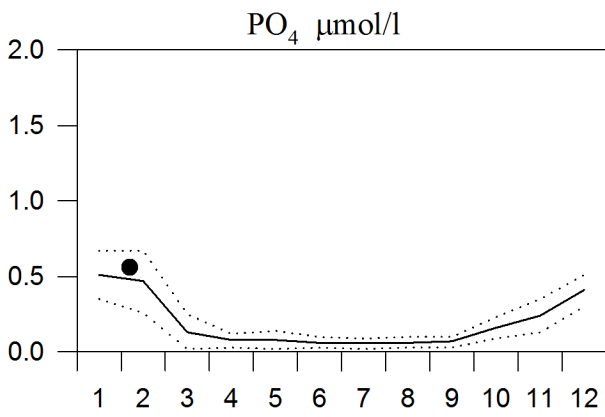
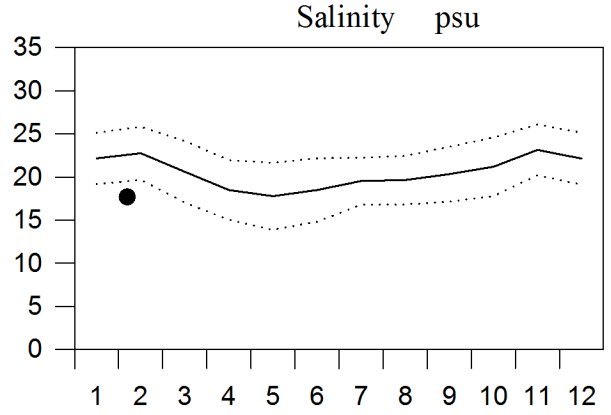
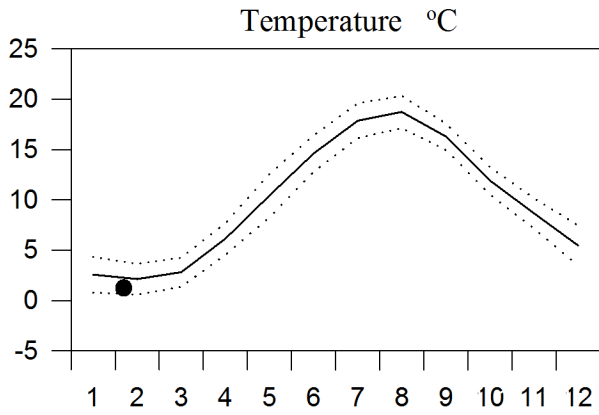
OXYGEN IN BOTTOM WATER (depth >40m)



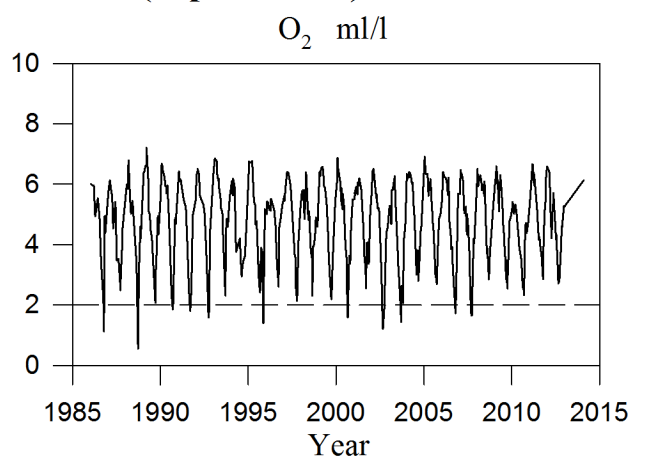
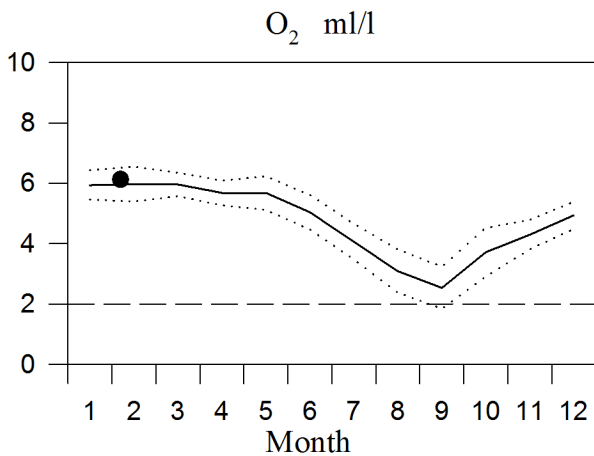
STATION ANHOLT E SURFACE WATER

Annual Cycles

— Mean 1996-2010 St.Dev. ● 2014



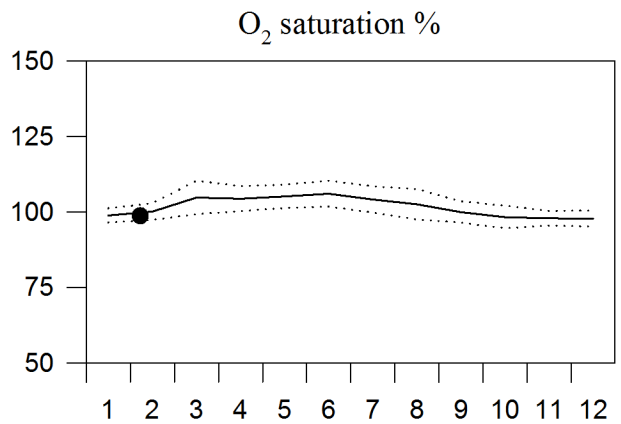
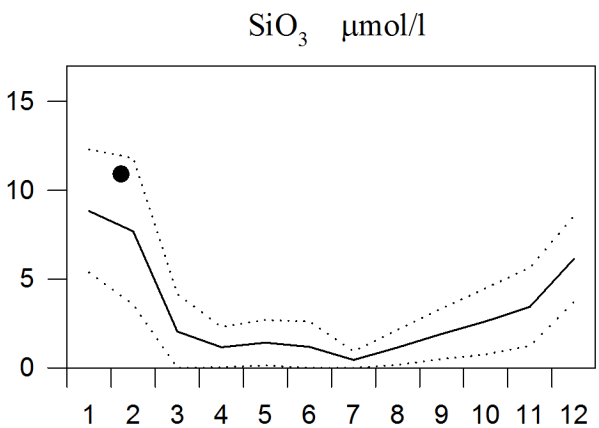
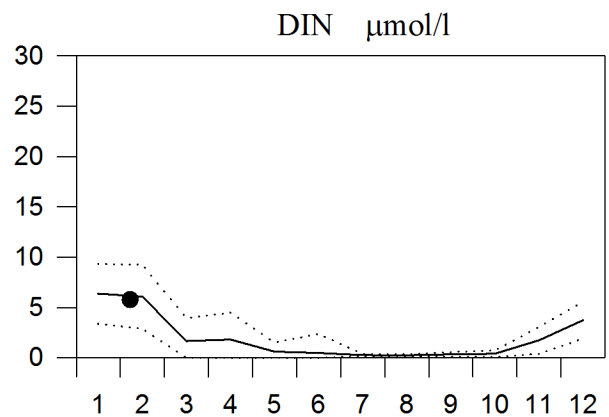
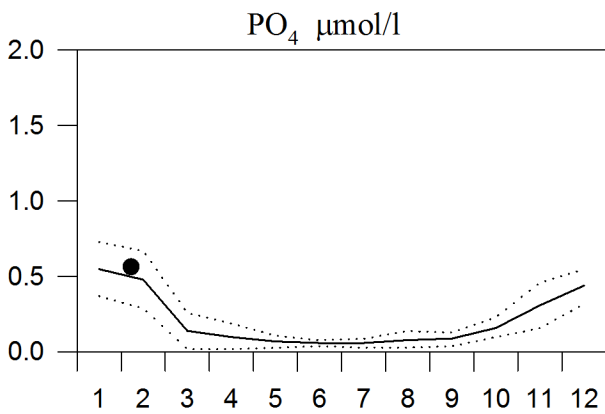
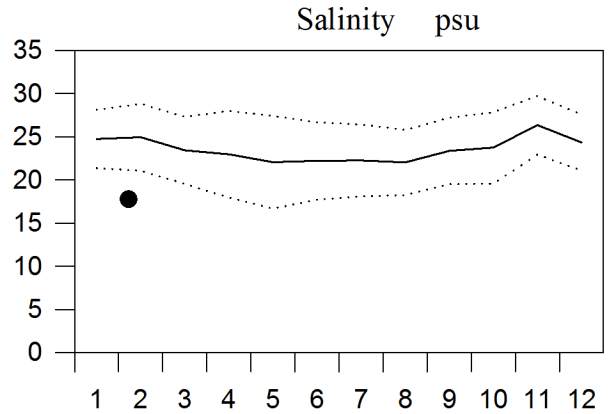
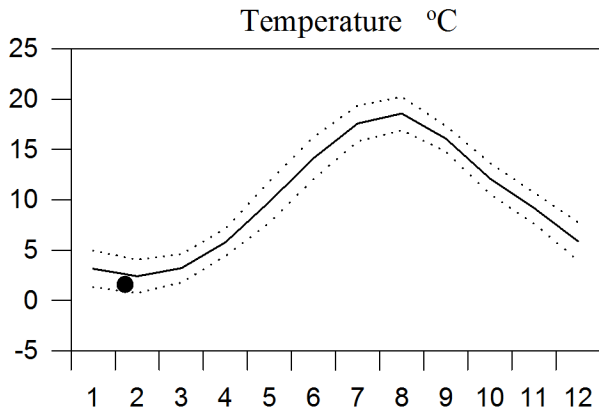
OXYGEN IN BOTTOM WATER (depth > 50m)



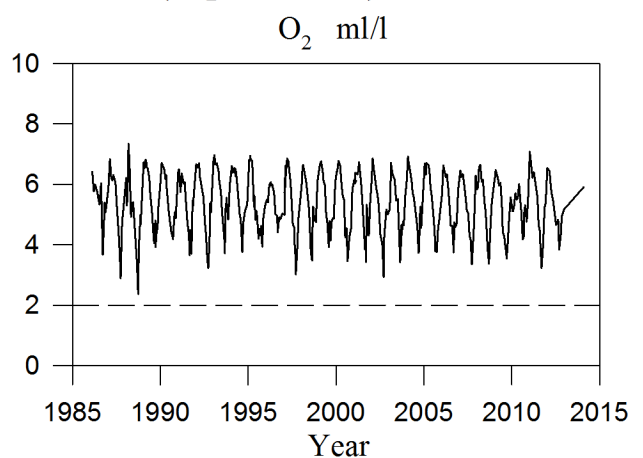
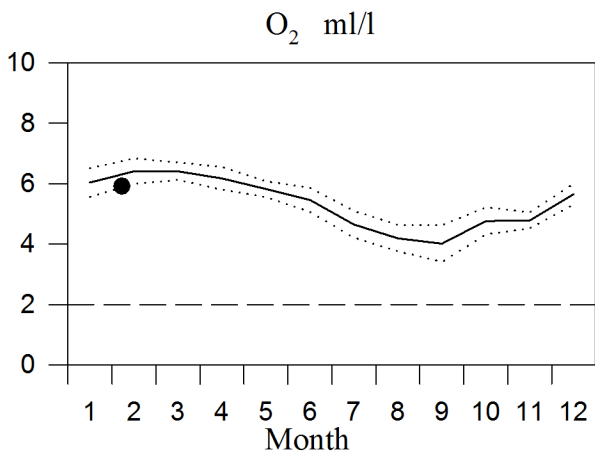
STATION FLADEN SURFACE WATER

Annual Cycles

— Mean 1996-2010 St.Dev. ● 2014



OXYGEN IN BOTTOM WATER (depth > 70m)



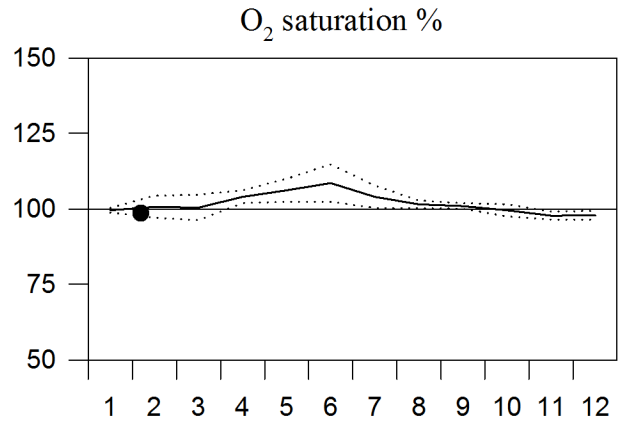
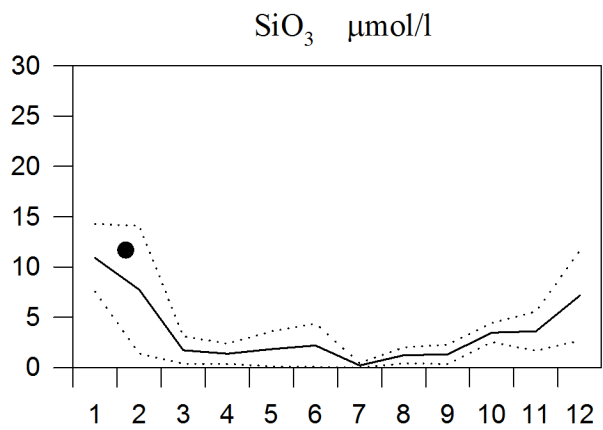
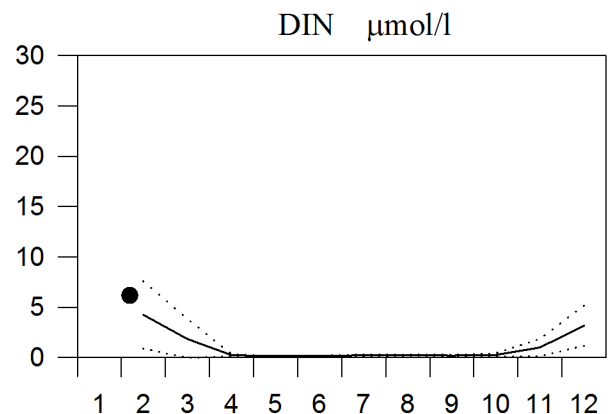
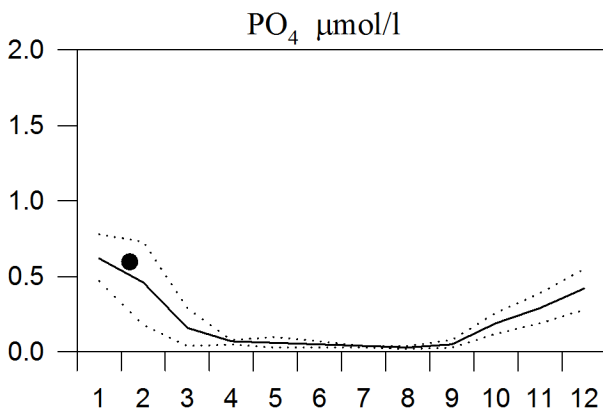
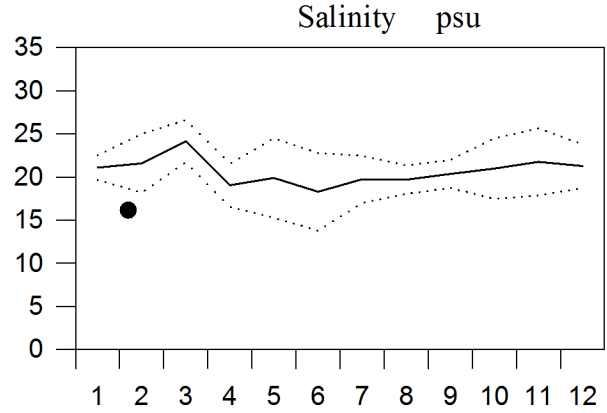
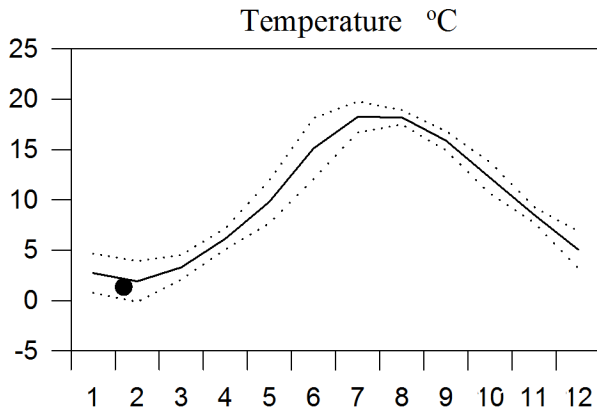
STATION N14 Falkenberg SURFACE WATER

Annual Cycles

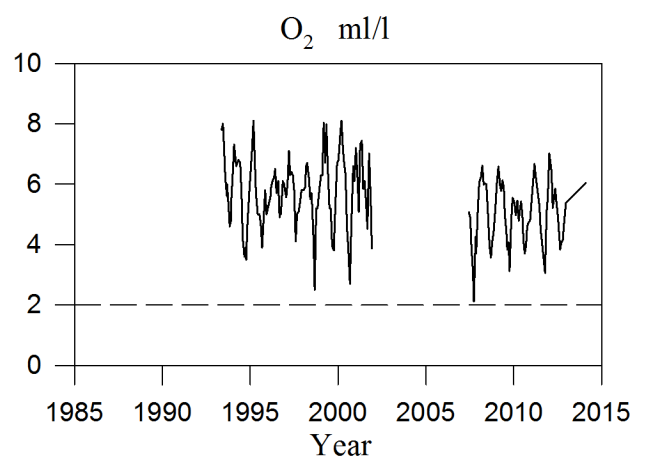
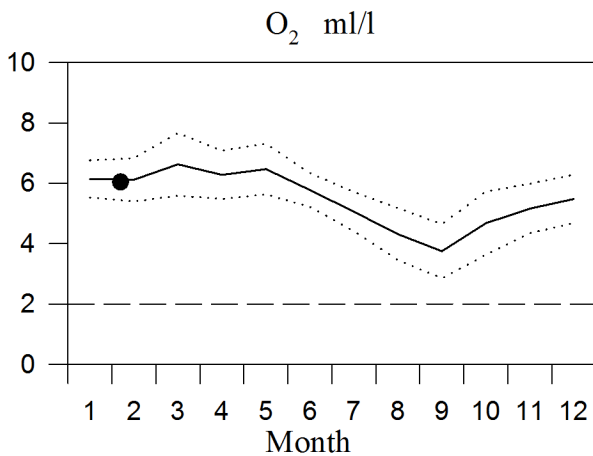
— Mean 2007-2010

..... St.Dev.

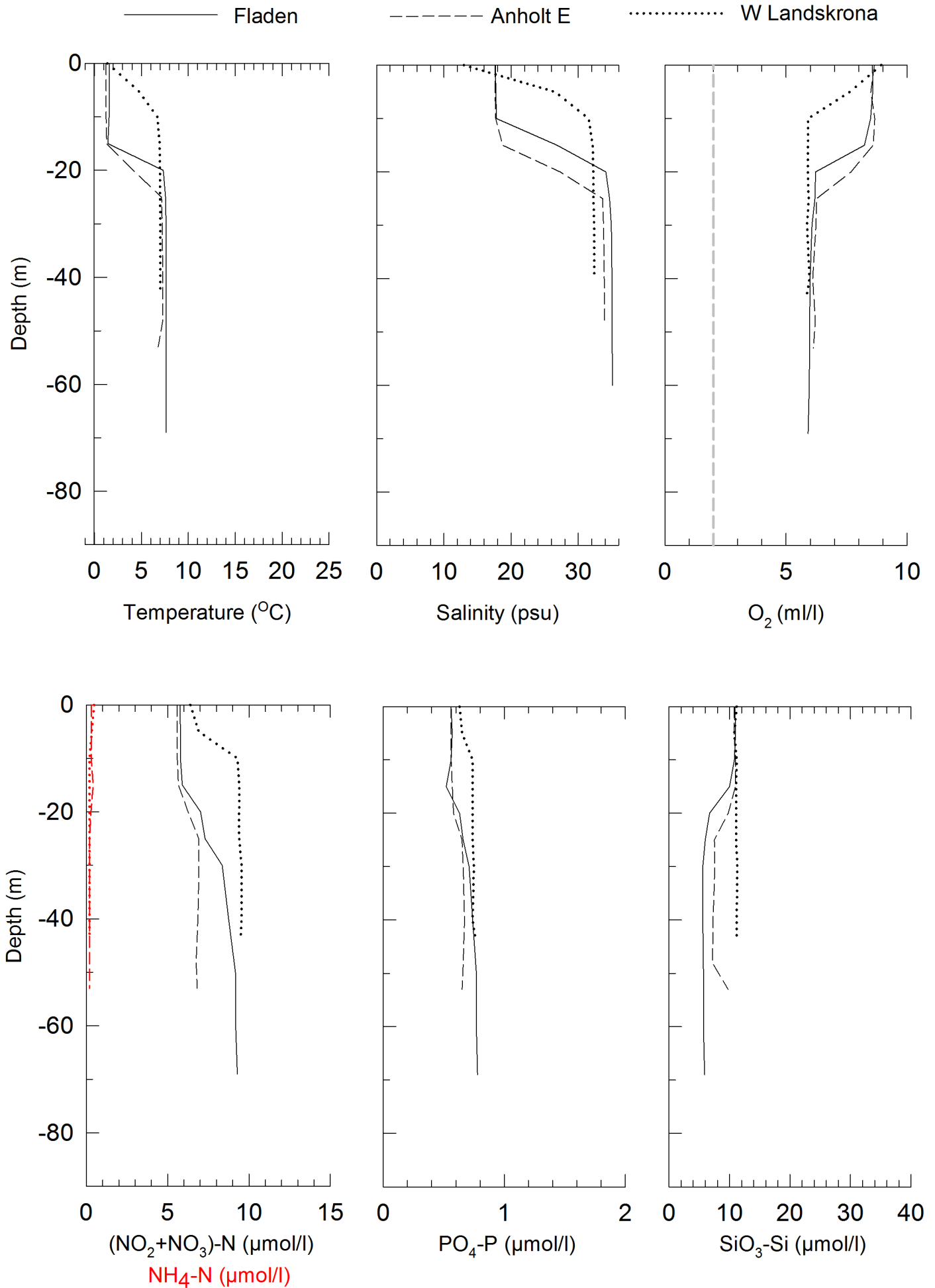
● 2014



OXYGEN IN BOTTOM WATER (depth > 25m)



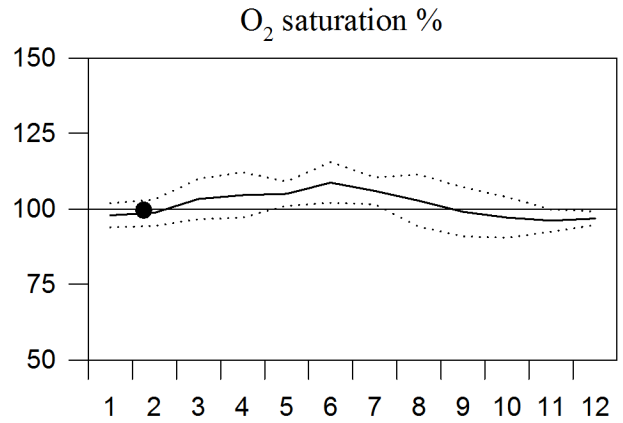
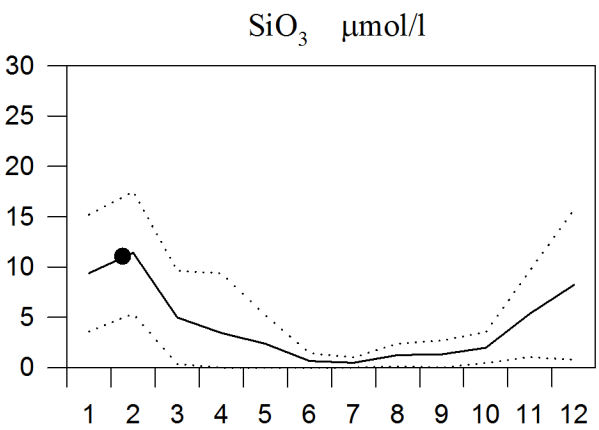
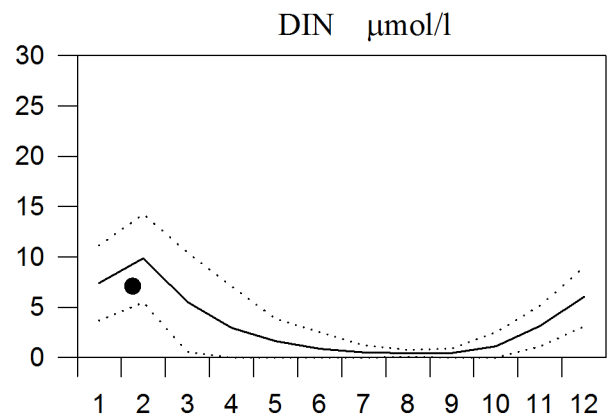
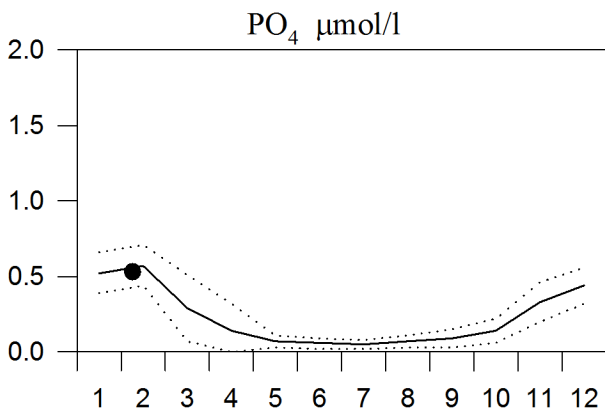
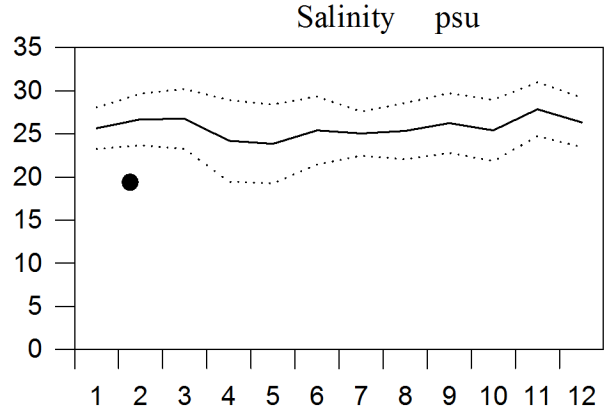
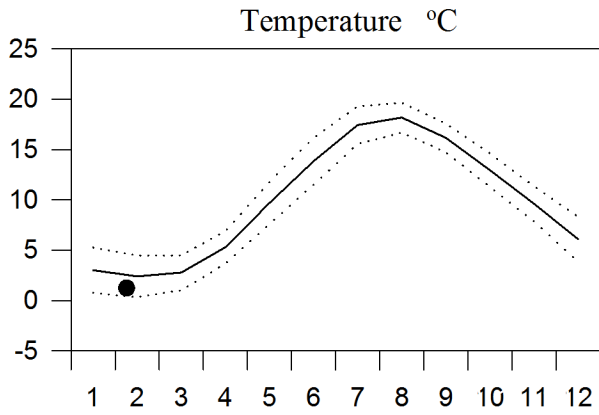
KATTEGAT and THE SOUND 2014-02-06/07



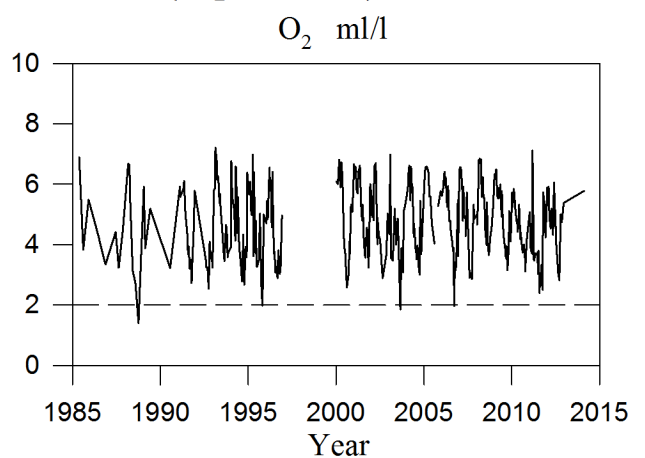
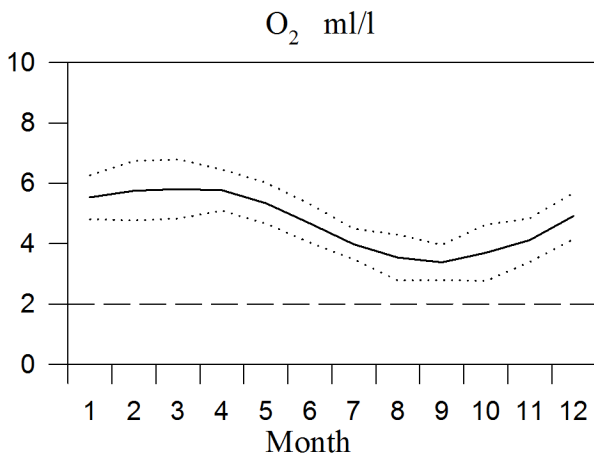
STATION SLÄGGÖ SURFACE WATER

Annual Cycles

— Mean 1996-2010 St.Dev. ● 2014



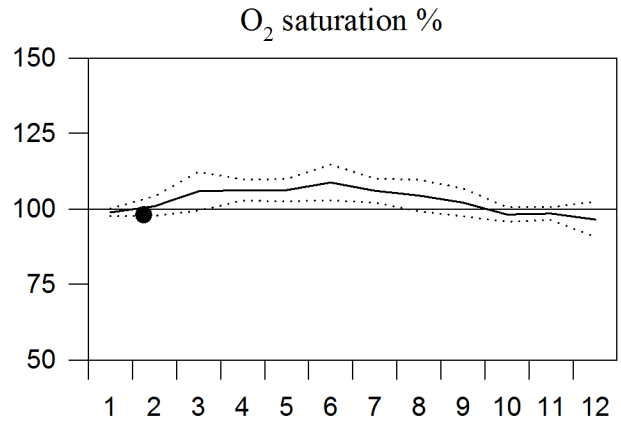
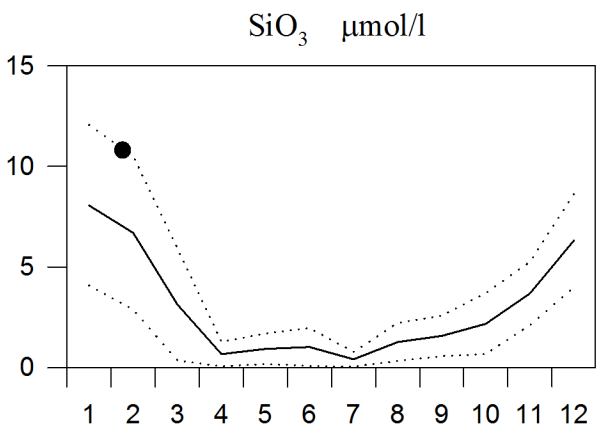
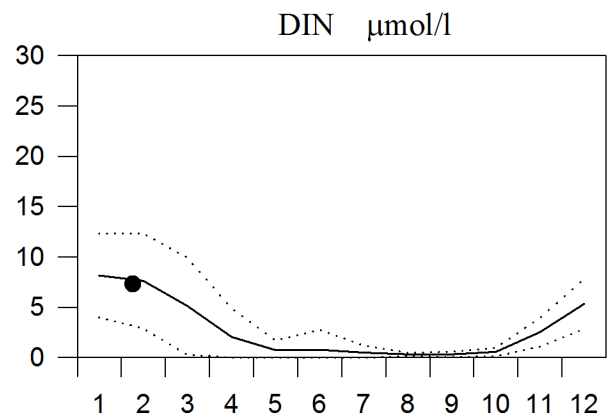
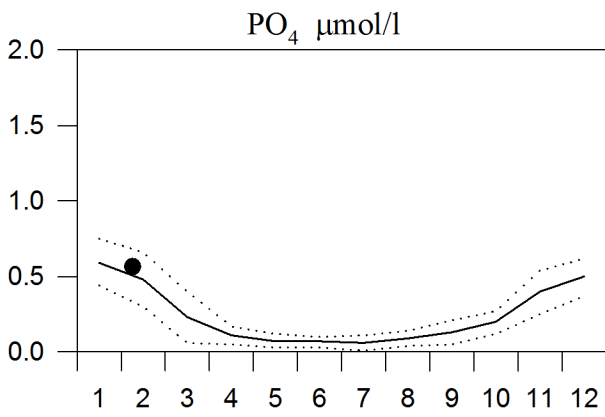
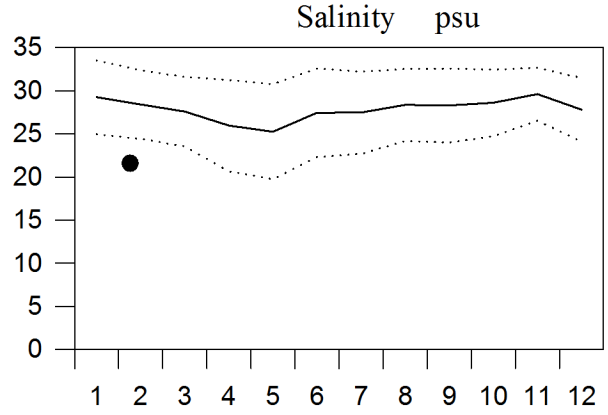
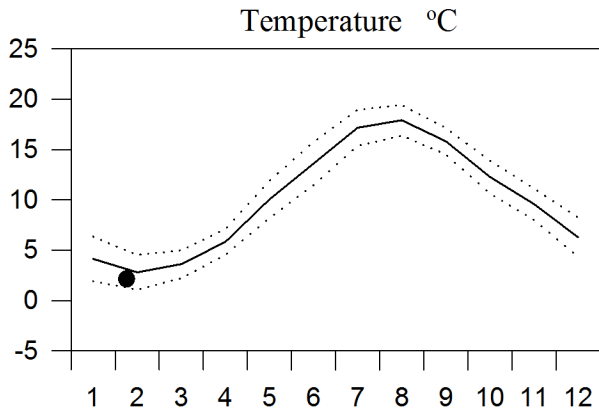
OXYGEN IN BOTTOM WATER (depth >50m)



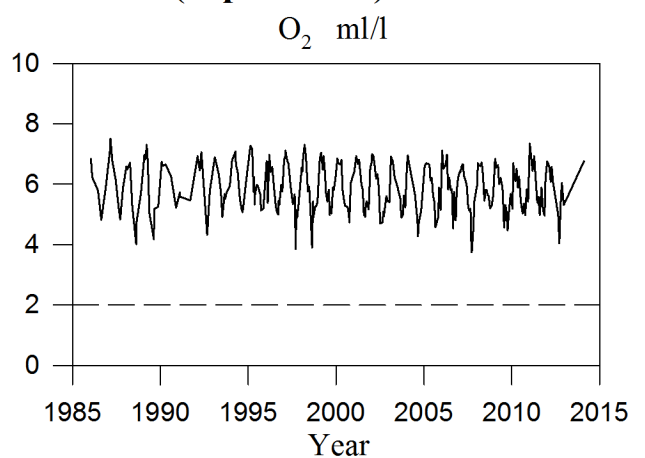
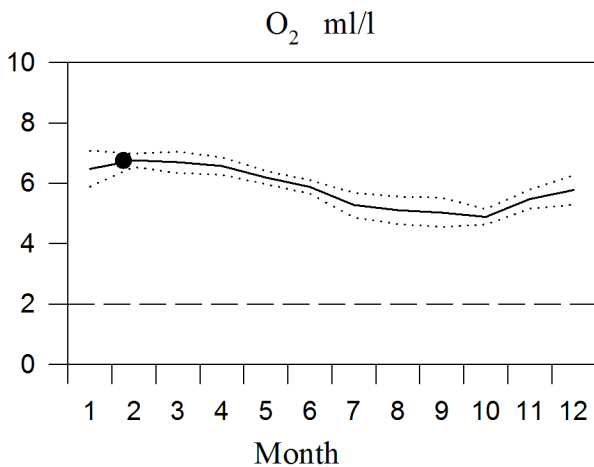
STATION P2 SURFACE WATER

Annual Cycles

— Mean 1996-2010 St.Dev. ● 2014



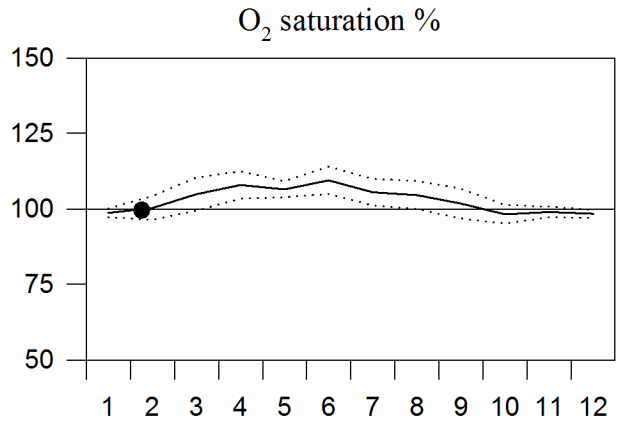
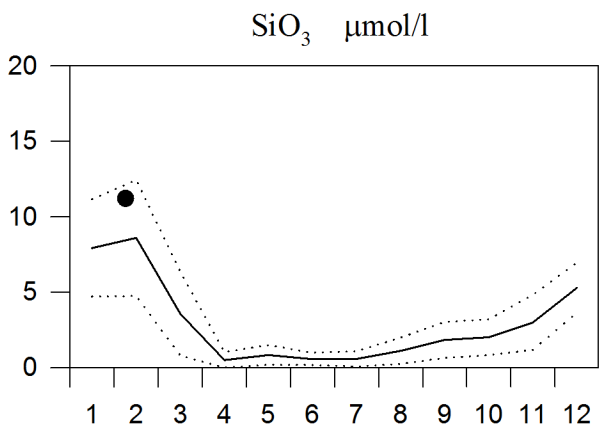
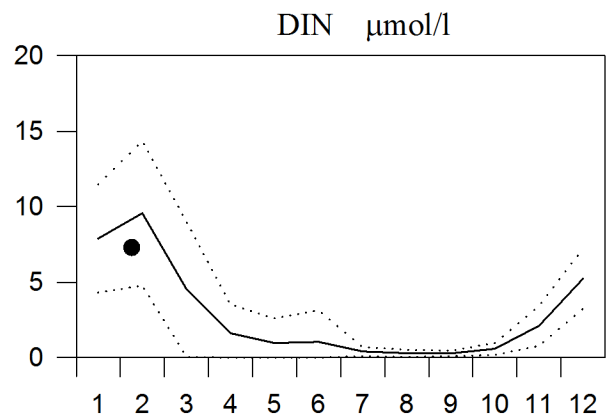
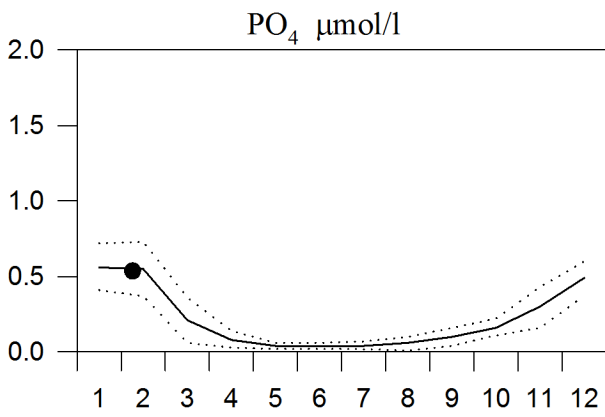
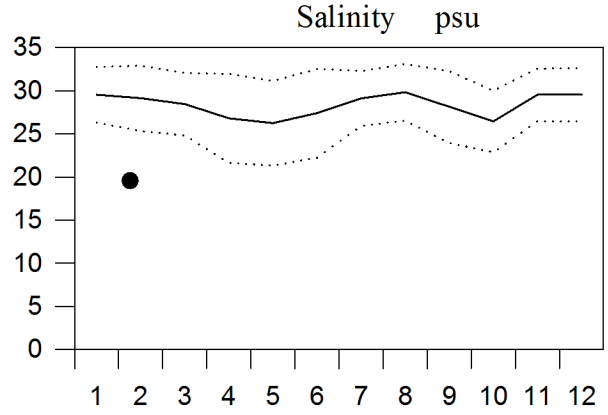
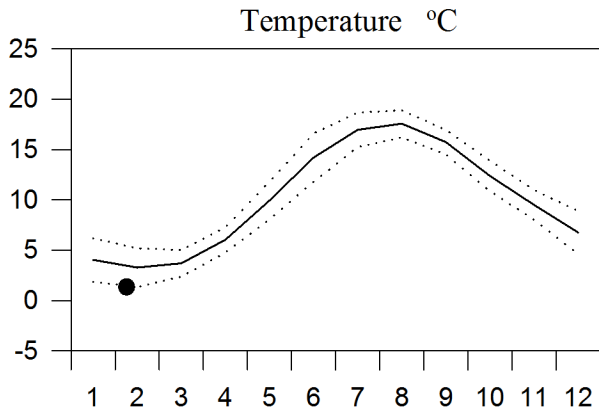
OXYGEN IN BOTTOM WATER (depth >75m)



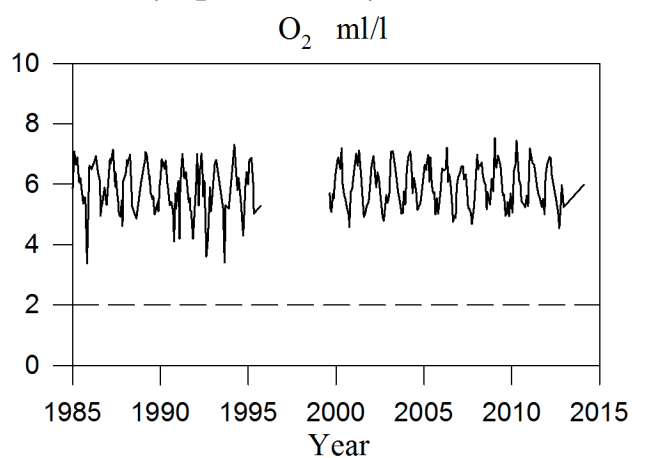
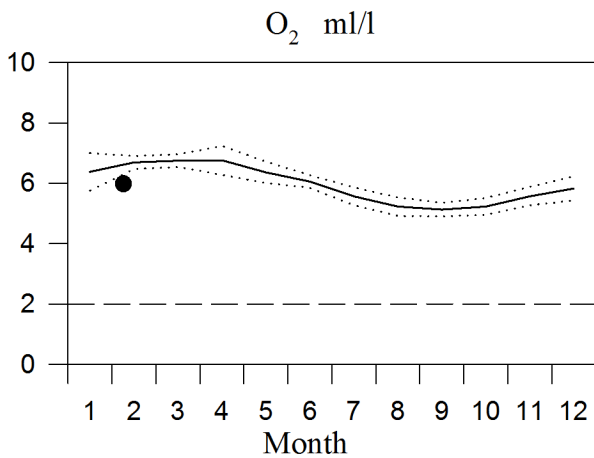
STATION Å13 SURFACE WATER

Annual Cycles

— Mean 1996-2010 St.Dev. ● 2014



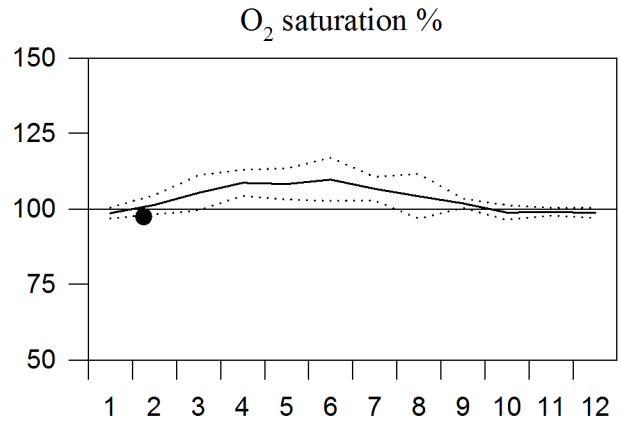
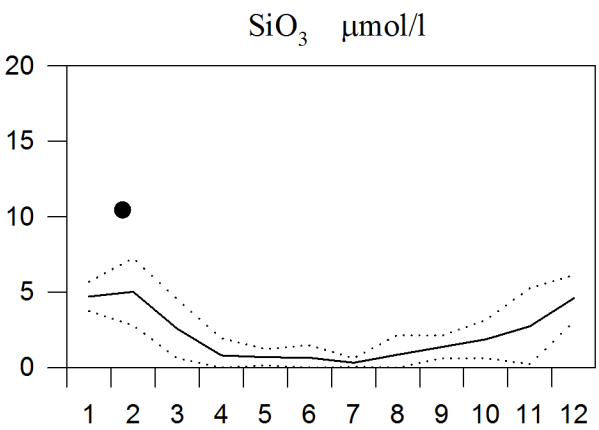
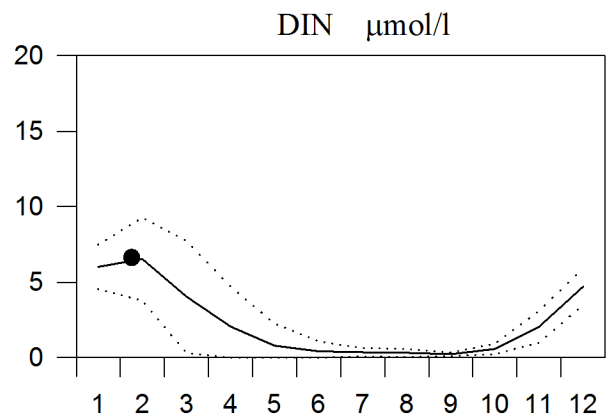
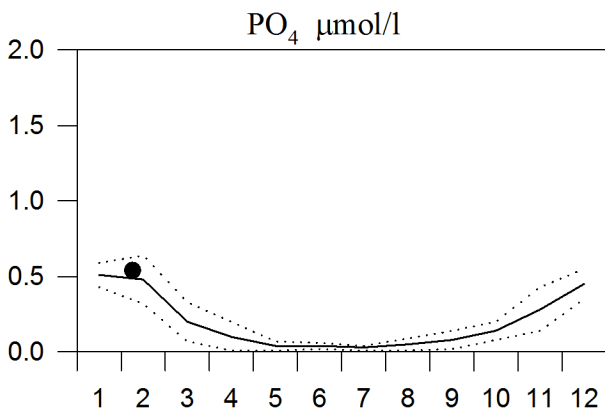
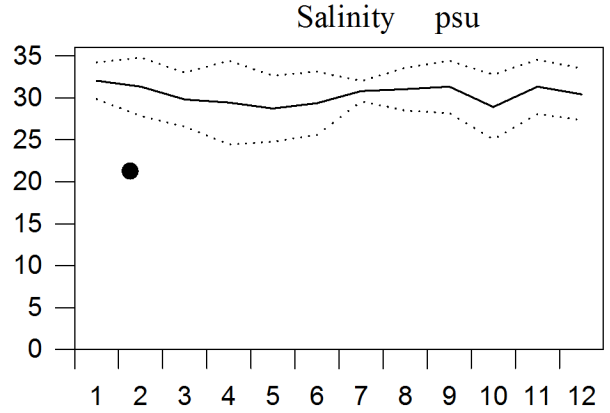
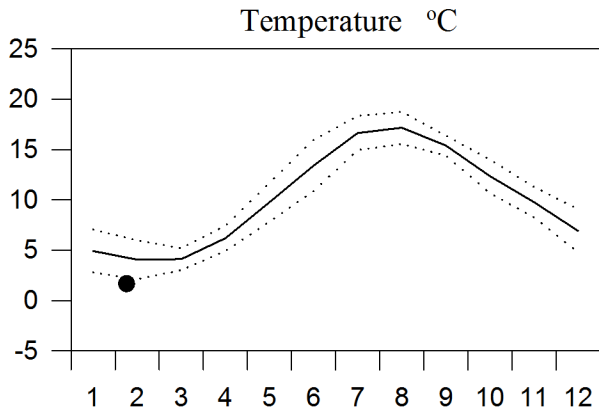
OXYGEN IN BOTTOM WATER (depth >=75m)



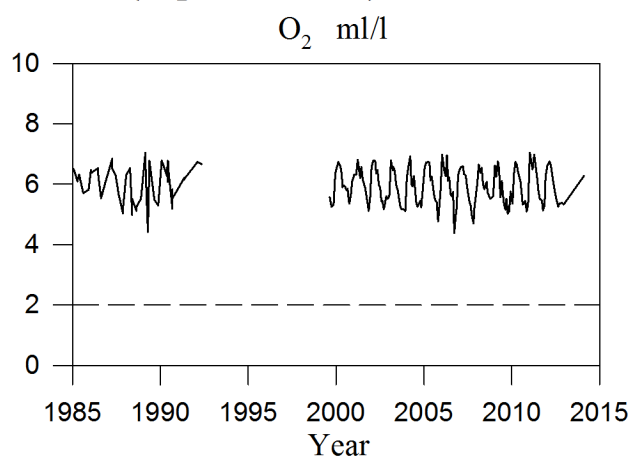
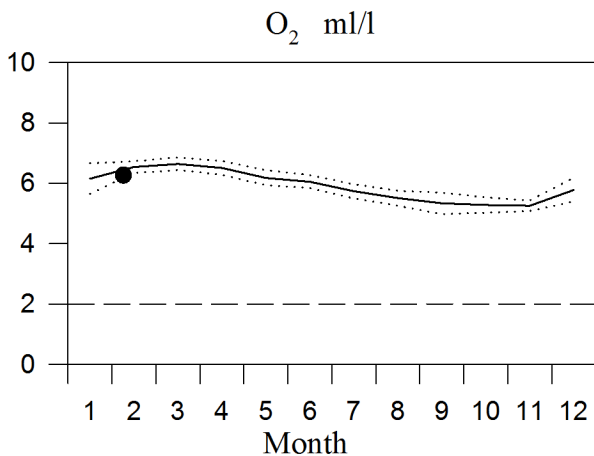
STATION Å15 SURFACE WATER

Annual Cycles

— Mean 1996-2010 St.Dev. ● 2014



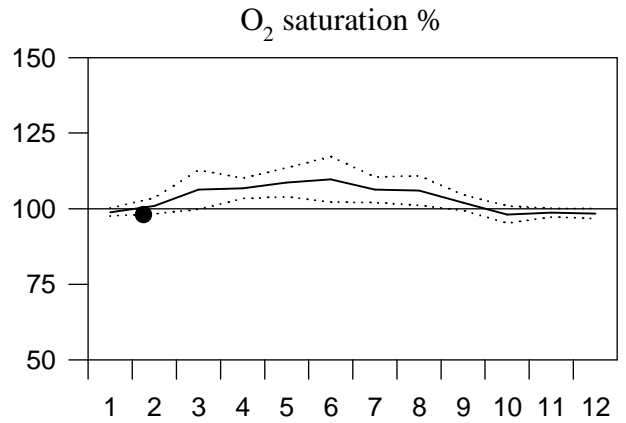
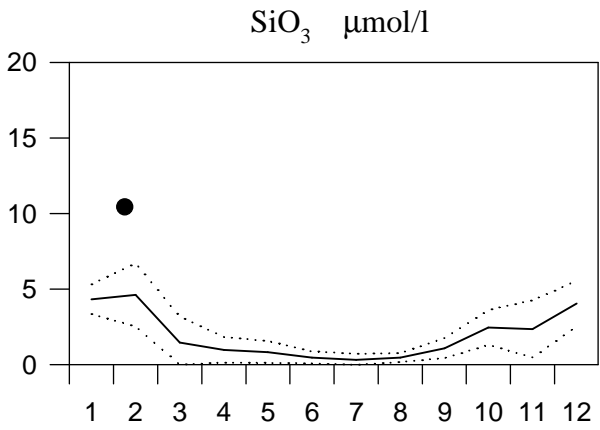
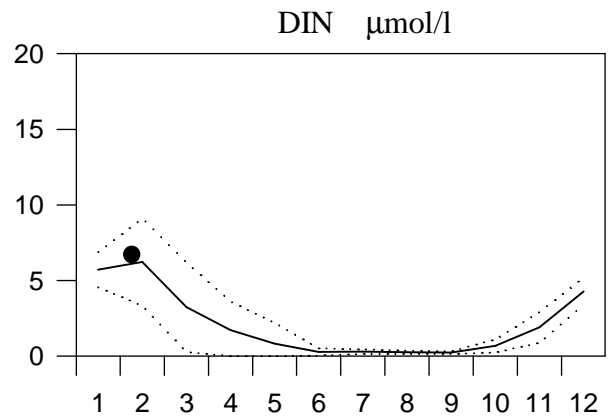
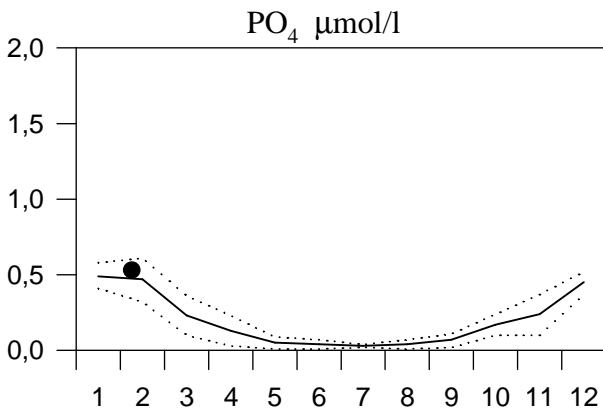
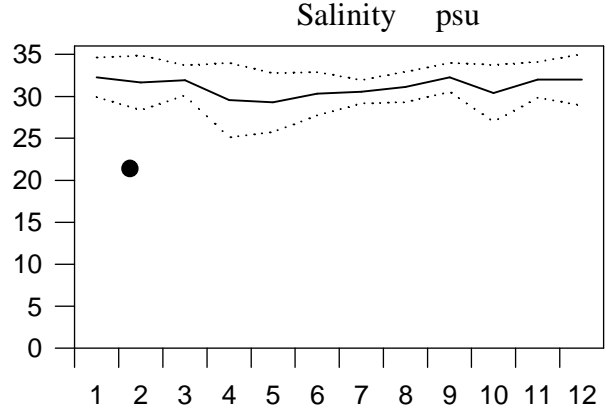
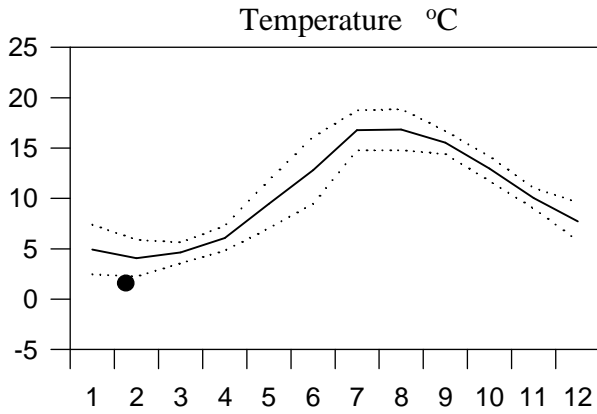
OXYGEN IN BOTTOM WATER (depth >=125m)



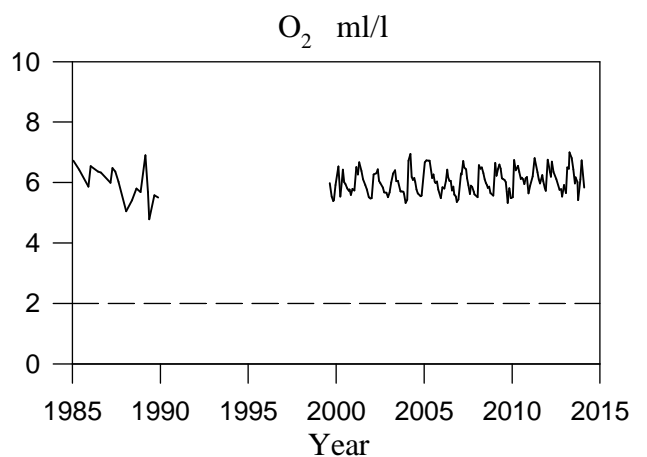
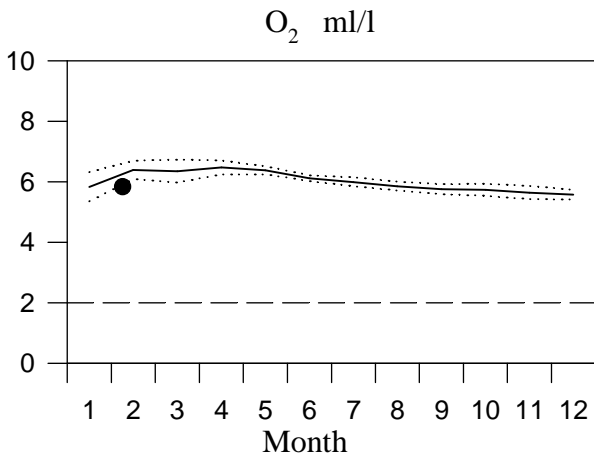
STATION Å17 SURFACE WATER

Annual Cycles

— Mean 1996-2010 St.Dev. ● 2014

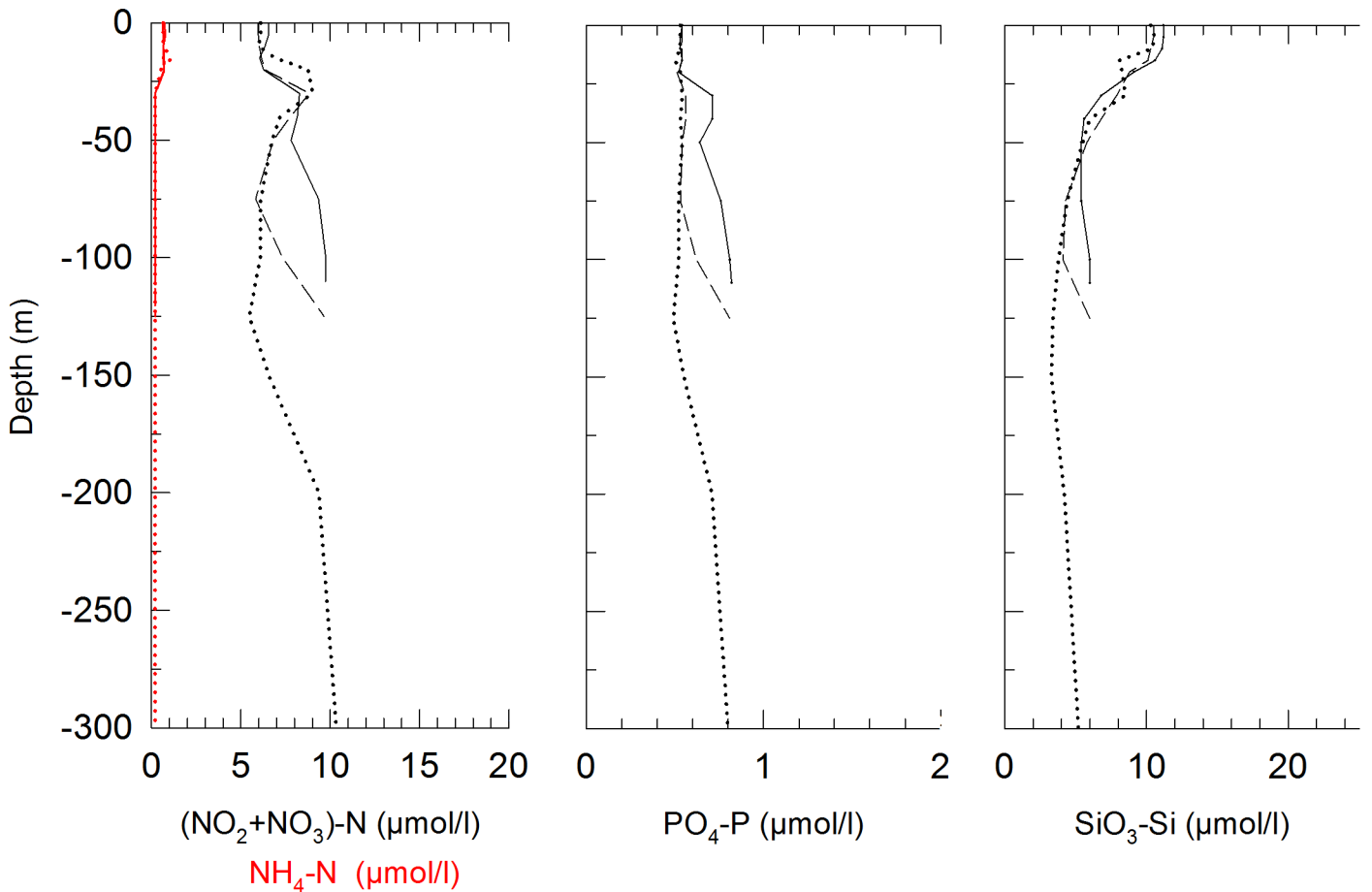
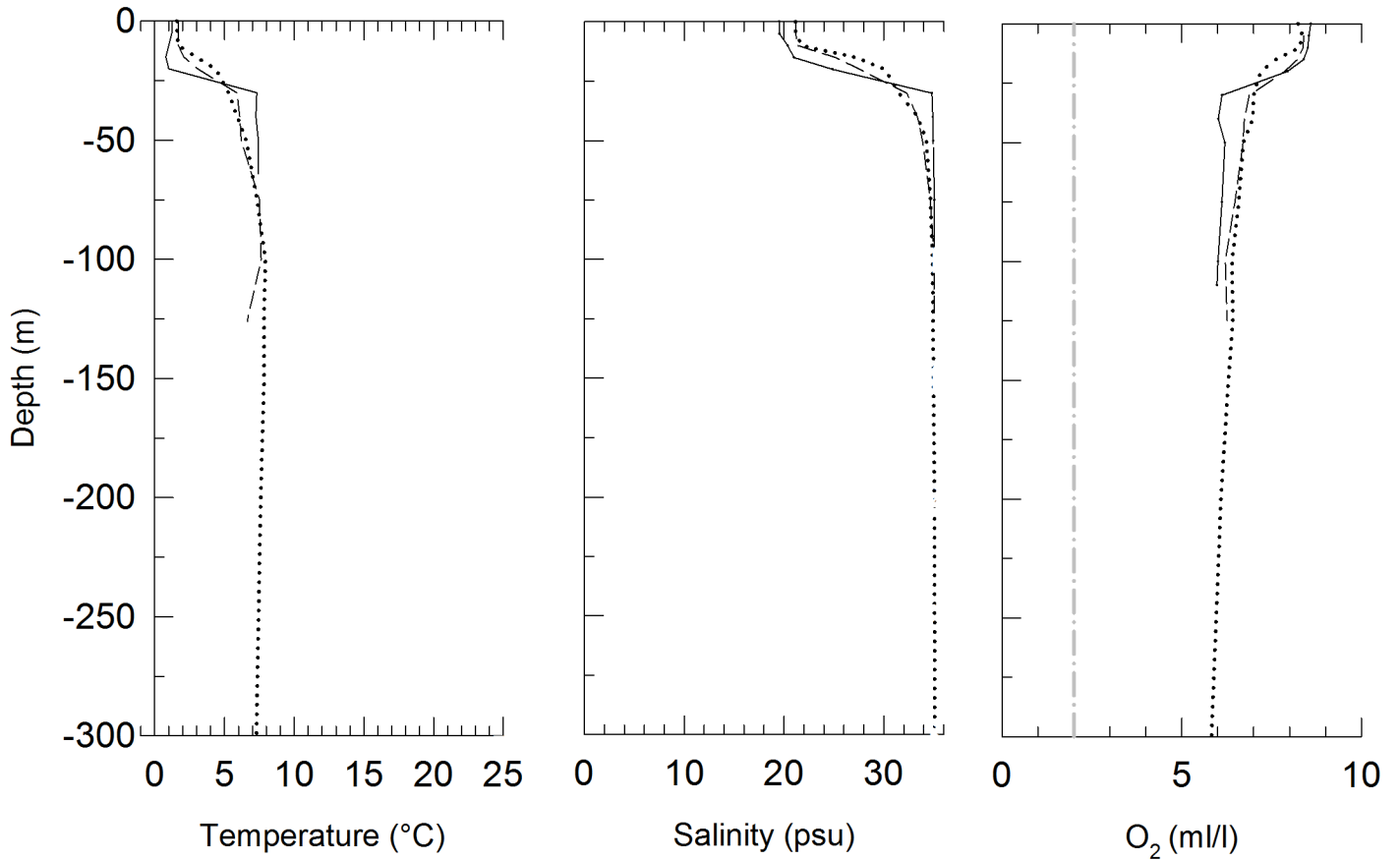


OXYGEN IN BOTTOM WATER (depth = 300m)



SKAGERRAK Å-Section 2014-02-08

—— Å13 - - - - - Å15 ······ Å17



SKAGERRAK Coast 2014-02-08

———— P2 - - - - Släggö

