

Report from the SMHI monitoring cruise with R/V Aranda



Survey period: 2014-07-10 - 2014-07-14
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. Data presented in this report have been subject to preliminary quality control procedures only.

Surface water temperatures were above normal in most of the investigated areas, with the exception of the Western Baltic Proper, where temperatures were below normal. Nutrients in the surface layer showed concentrations normal for the season in all areas. The oxygen situation in the Hanö Bight and Bornholm Basins had worsened and was below acute hypoxia. In the south eastern part of the Baltic Proper signs of an earlier inflow were seen and the BY15 deep water was oxygenated for the first time since April 2007. Oxygen free conditions, anoxia, were found from 90 – 125 meters depth and acute hypoxia from ca. 80 meters. No surface accumulations of cyanobacteria were seen but analyses showed large amounts in the water. For a detailed algae report go to:
<http://www.smhi.se/en/Publications/algae-report-number-5-2014-1.38050>

The next cruise will begin on 1st of August and will cover the Skagerrak, Kattegat and the Baltic Proper.

PRELIMINARY RESULTS

The cruise, part of the Swedish regular marine monitoring programme, began in Falkenberg on July 10th and ended in Nynäshamn on July 14th. Due to a wrongly dated permission, Polish waters could not be visited. The winds were weak to moderate with varying directions during the expedition. The air temperature varied between 15 to 23 °C.

The Skagerrak

The surface temperatures were normal or just above normal for the season and varied between 15.8 and 20.8 °C. The salinity in the surface layer was 21.4 – 31.0 psu which ranges from normal to below normal. The thermocline and the halocline were both found between 10 and 30 meters. All nutrients had concentrations that are normal for the season; phosphate varied between 0.02 – 0.05 µmol/l and silicate between 0.3 – 0.9 µmol/l. The amount of nitrite + nitrate was below the detection limit (< 0.10 µmol/l).

Fluorescence maxima were found at about 30 meters depth.

The Kattegat and the Sound

Also in this area surface water temperatures were above normal, around 19°C. The salinity of the surface water was normal or below normal and varied between 12.8 and 19.9 psu in the Kattegat, while it was 8.5 psu in the Sound. Thermocline and halocline coincided at depths between 10 and 15 meters in the whole area.

All nutrients in the surface layer showed, for the season, normal values, except at Anholt E where the silicate concentration had increased and was above normal at the second visit. In the Kattegat phosphate concentrations were between 0.03 – 0.14 µmol/l and in the Sound 0.26 µmol/l. Silicate values were in the range 1.1 to 4.1 µmol/l in the Kattegat, and 6.6 µmol/l in the Sound. The amount of nitrite + nitrate was below the detection limit (< 0.10 µmol/l) in both areas.

Fluorescence maxima were found at 17 meters at stations Fladen and W Landskrona and at 30 meters depth at Anholt E.

The lowest oxygen concentration in the Kattegat area, 4.3 ml/l, was found at the station Anholt E. In the Sound, 3.6 ml/l was the lowest registered concentration.

The Baltic Proper

Surface water temperatures varied from normal to just above normal in the southern and eastern parts (16.2 – 18.3°C). In the western parts temperatures were found to be just below normal (ca. 15°C). The salinity in the surface layer varied between 6.6 – 8.0 psu, normal or just above normal in most areas. However, at the stations BY10 and BY15 surface salinity was below normal, at BY15 this has been the case since last summer. The halocline was found at depths between 70 and 80 meters in the Northern, Western and Eastern Gotland Basins, while it was located shallower, between 50 and 60 meters in the southern parts. A thermocline was found at depths between 15 and 30 meters.

All nutrients in the surface layer showed, for the season, normal values except in the northern and eastern parts where the silicate concentrations were enhanced. Concentrations of phosphate was in the interval 0.09-0.20 µmol/l and silicate varied between 7.5 and 11.2 µmol/l. Inorganic nitrogen (nitrite + nitrate) was close to or below the detection limit in the whole area. In the bottom water of the Arkona Basin, the oxygen situation was better since the previous sampling at station BY1 (0.6 ml/l), and the situation at station BY2 was still relatively good (3.58 ml/l). In the Bornholm Basin and Hanö Bight, oxygen concentrations in the bottom water had decreased and were below the limit for acute hypoxic conditions (< 2 ml/l). During February-March, inflows through the Sound occurred with a total volume of ca. 35 km³. This oxygenated water had now reached BY15 where oxygen was found in the bottom water for the first time since April 2007. At the stations BY10 and



BY15 hydrogen sulphide was present at intermediate depths between 125 - 200 meters. Completely oxygen free conditions, (anoxia) were generally found from 90 - 125 meters depth and acute hypoxia from ca. 80 meters.

No surface accumulations of cyanobacteria were observed due to winds and waves, but analyses revealed large amounts of cyanobacteria in the water that will rise and cause new surface accumulations once the weather is calmer.

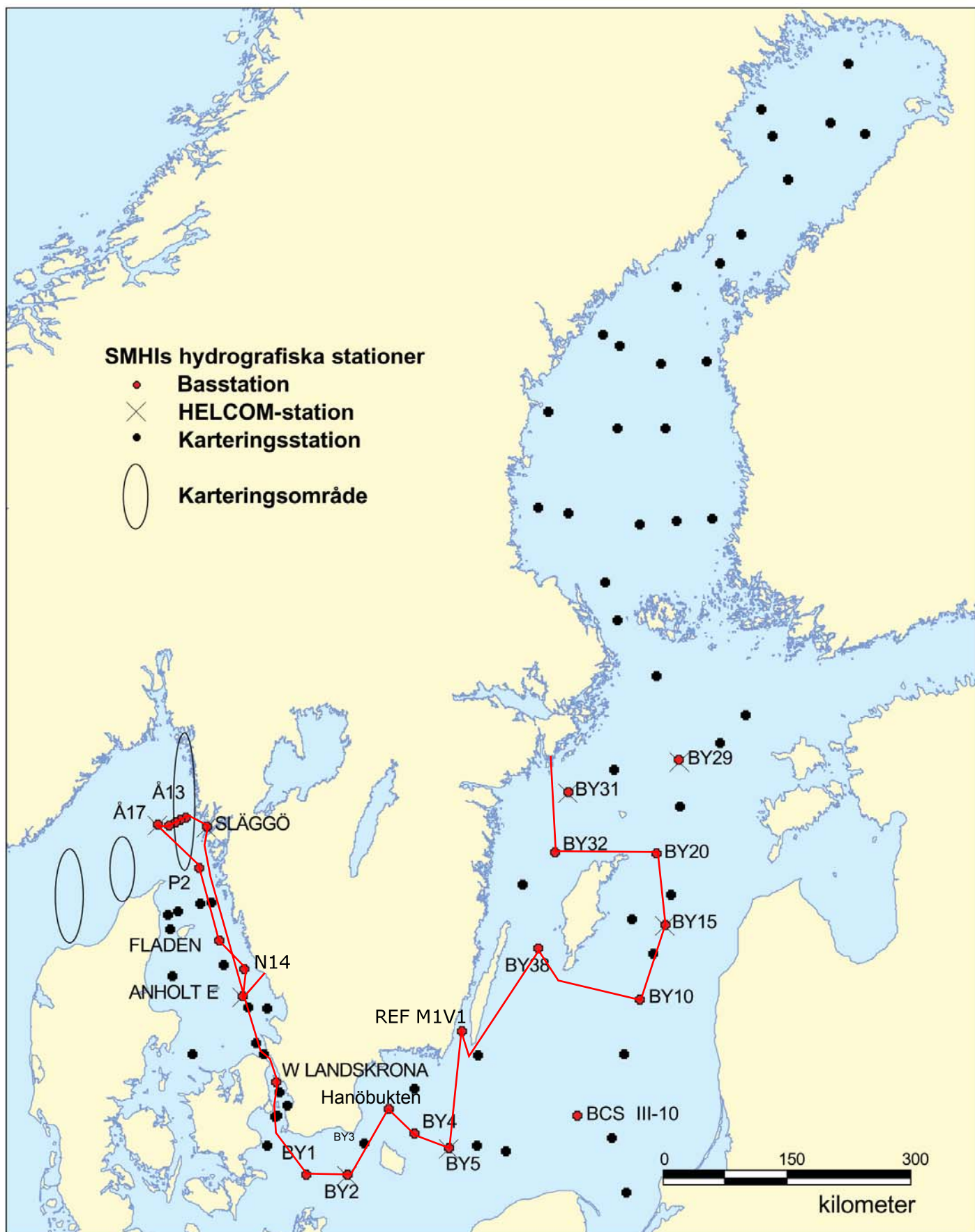
PARTICIPANTS

Name		Institute
Anna-Kerstin Thell	Cruise leader	SMHI
Kristin Andreasson		SMHI
Daniel Bergman-Sjöstrand		SMHI
Sara Johansson		SMHI
Vivi Månsson		SMHI
Ann-Turi Skjevik		SMHI
Yue Hu		KTH

APPENDICES

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

TRACKCHART
Country: Sweden
Ship: R/V ARANDA
Date: 20140710-20140714
Series: 0450-0471



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Date: 2014-07-16
Time: 11:02
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Ser no	Stat code	P r o j	Station-----	Lat-----	Lon-----	Date yyyymmdd	Time hhmm utc	Bottom depth m	Secchi depth m	Wind di ve	Air temp C	Air pres hPa	WCSI elec aoae tu hd	C PPCPZT Hrhhoo t Cilyooa PrP l	No de	T e a h m i g n	P O H x 2 o o S P Y P	H P T N N P P	N N N N N	N T A S H L I P O T C O o
0450	KAEX29BAS		ANHOLT E	N5640.0	E1207.0	20140710	2205	62		09 6	22.4	1016	9990	x --x----	9	x x x x -	- x x x x -	x x x x x -	x x x x x -	l s i
0451	KANX50BAS		N14 FALKENBERG	N5656.40	E1212.70	20140711	0020	31		07 5	21.0	1017	9990	x -xxxx--	7	x x x x -	- x x x x x -	x x x x x -	x x x x x -	- - - - x
0452	KANX25BAS		FLADEN	N5711.5	E1140	20140711	0350	85	7	10 6	20	1017	1230	x --x----	12	x x - x -	- x x x x x -	x x x x x -	x x x x x -	- - - - x
0453	SKEX23BAS	P2		N5752	E1118	20140711	0825	93	8	05 2	19.3	1019	1120	x --x----	10	x x - x -	- x x x x x -	x x x x x -	x x x x x -	- - - - -
0454	SKEX18BAS	Å17		N5816.5	E1030.8	20140711	1150	350	11	06 3	21.2	1019	1220	x --xxx--	14	x x x x -	- x x x x x -	x x x x x -	x x x x x -	- - - - x
0455	SKEX16BAS	Å15		N5817.7	E1051	20140711	1410	136	10	06 3	23.6	1018	1220	x --x----	12	x x - x -	- x x x x x -	x x x x x -	x x x x x -	- - - - x
0456	SKEX14BAS	Å13		N5820.2	E1102	20140711	1545	109		09 8	22.9	1018	1230	x --x----	10	x x - x -	- x x x x x -	x x x x x -	x x x x x -	- - - - -
0457	FIBG27BAS	SLÄGGÖ		N5815.5	E1126.0	20140711	1805	77		06 8	22.2	1017	1320	x -xxxx--	9	x x x x -	- x x x x x -	x x x x x -	x x x x x -	- - - - x
0458	KAEX29BAS		ANHOLT E	N5640.0	E1207.0	20140712	0415	64	9	10 6	16.1	1016	1230	x -xxxx--	10	x x x x -	- x x x x x -	x x x x x -	x x x x x -	- - - - x
0459	SOCX39BAS	W LANDSKRONA		N5552.0	E1245.0	20140712	1015	52	8	34 2	18.3	1011	2720	x --x----	9	x x - x -	- x x x x x -	x x x x x -	x x x x x -	- - - - x
0460	BPSA02BAS	BY1		N5500	E1318	20140712	1610	46		35 3	16.5	1011	6730	x --x----	8	x x - x -	- x x x x x -	x x x x x -	x x x x x -	- - - - x
0461	BPSA03BAS	BY2	ARKONA	N5500	E1405	20140712	1910	47		03 10	15.3	1010	6840	x --xxxx--	8	x x - x -	- x x x x x -	x x x x x -	x x x x x -	- - - - x
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0463	BPSB06BAS	BY4	CHRISTIANSÖ	N5523	E1520	20140713	0310	92		25 3	15.6	1004	5840	x --x----	12	x x - x -	- x x x x x -	x x x x x -	x x x x x -	- - - - x
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0469	BPEX21EXT	BY15	GOTLANDSDJ	N5720	E2003	20140714	1045	238	4	15 6	16.9	1010	2830	x -----	5	x x - x x	- x x x x x -	x x x x x -	x x x x x -	- - - - x
0470</																				

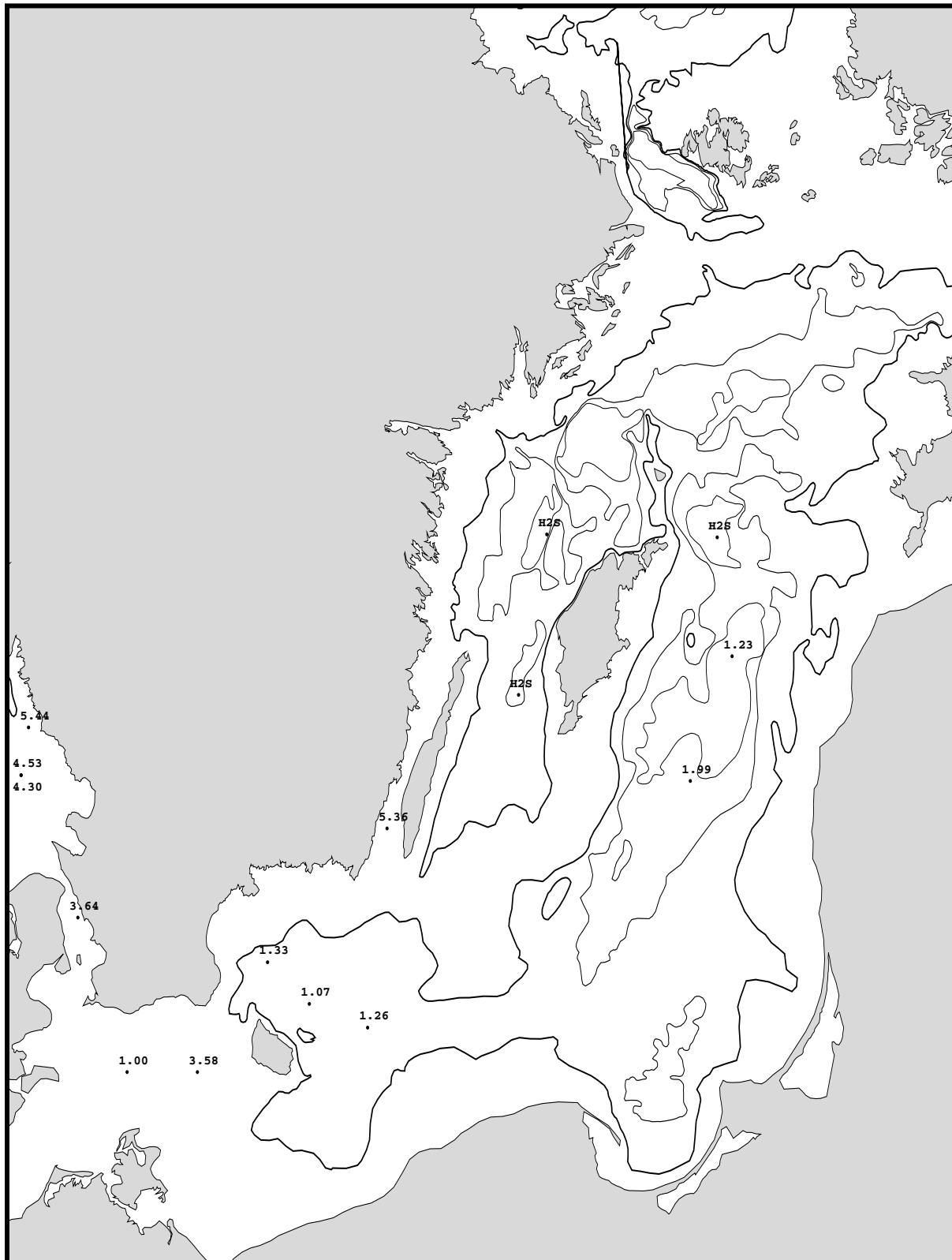
Bottom water oxygen concentration (ml/l)

Country: Finland

Ship : Aranda

Date : 20140710-20140714

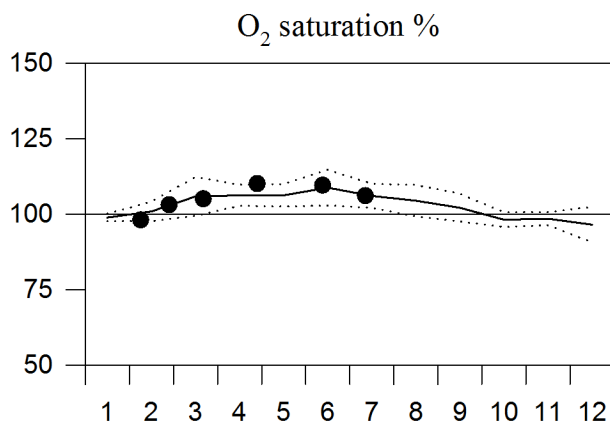
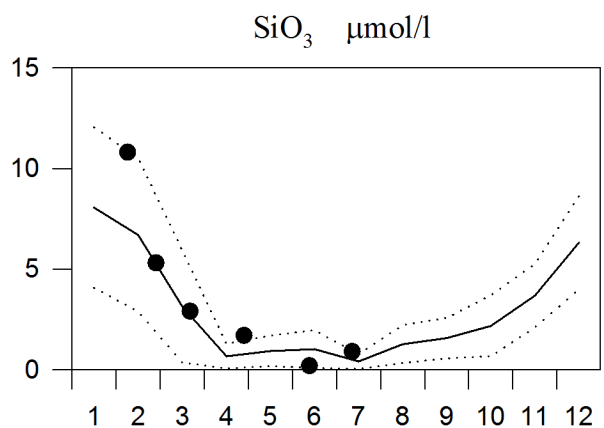
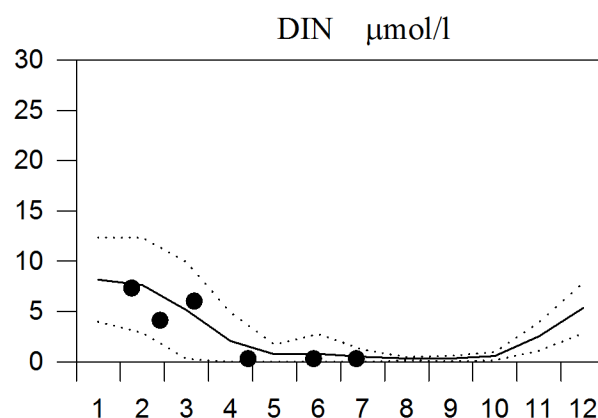
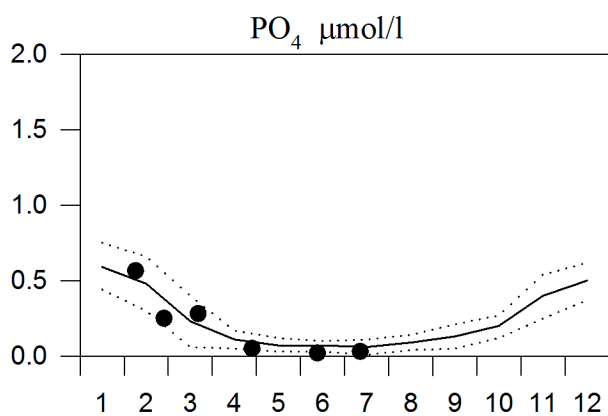
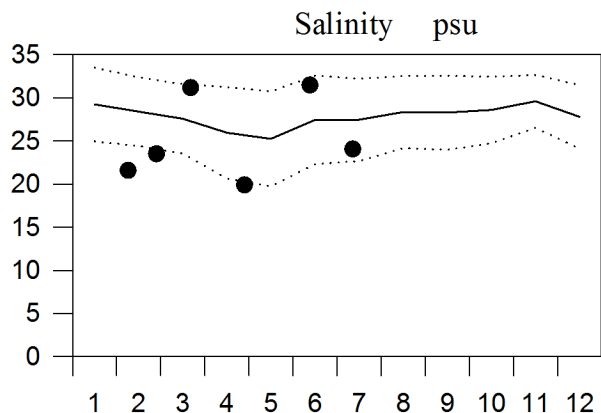
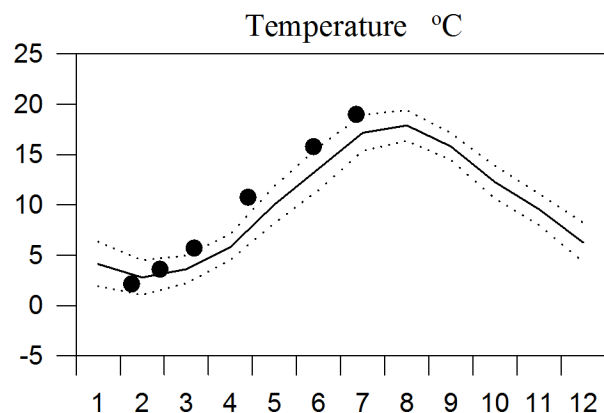
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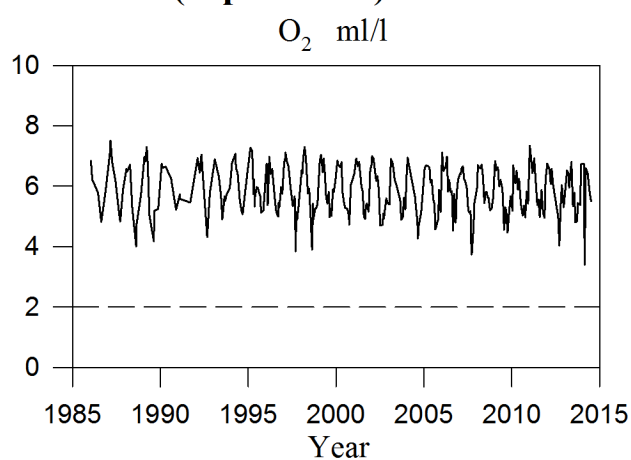
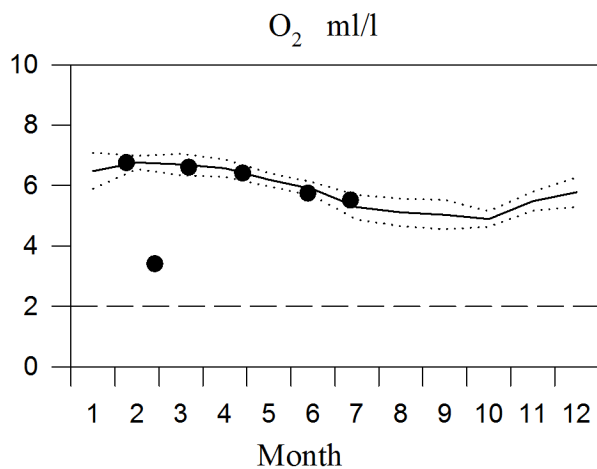
STATION P2 SURFACE WATER

Annual Cycles

— Mean 1996-2010 St.Dev. ● 2014

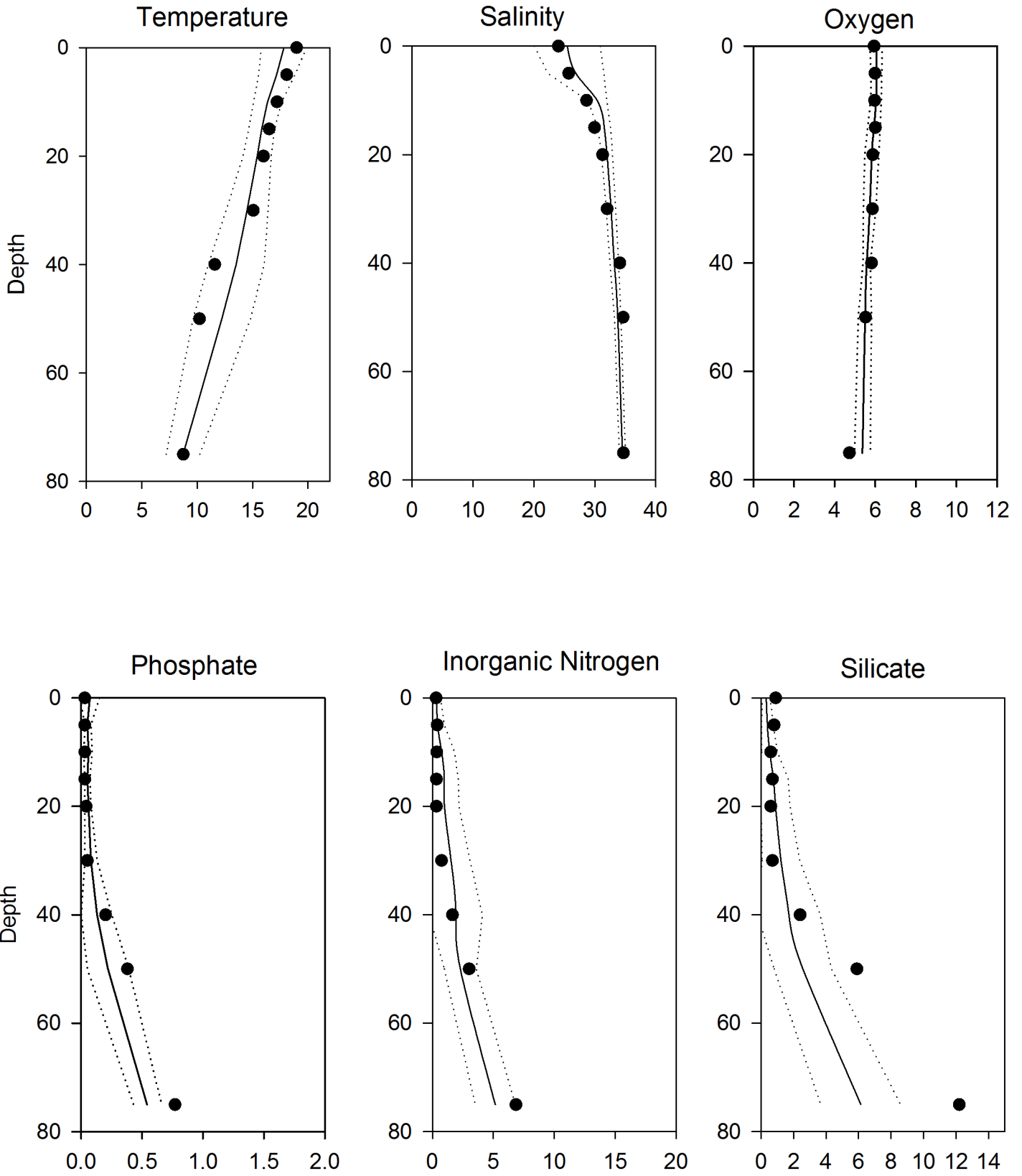


OXYGEN IN BOTTOM WATER (depth >75m)



Vertical profiles P2 July

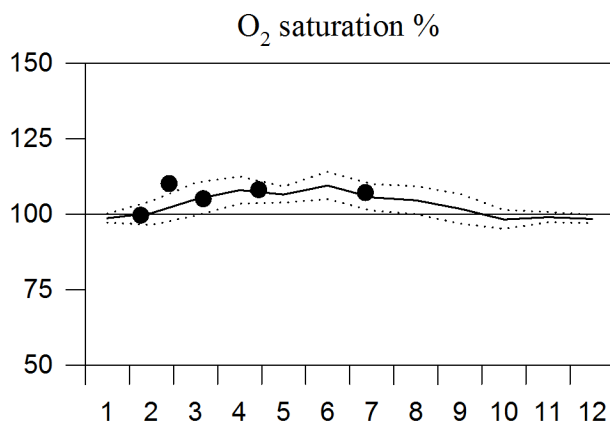
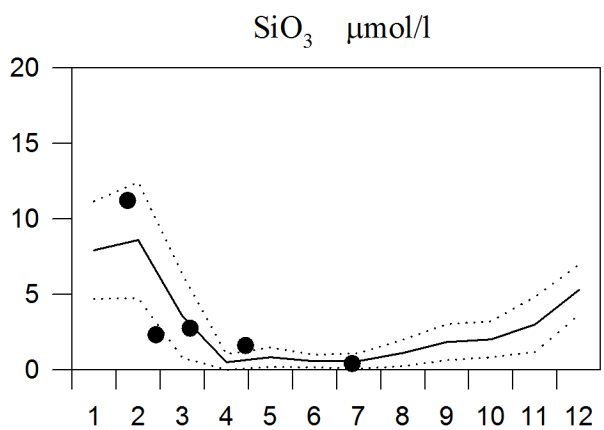
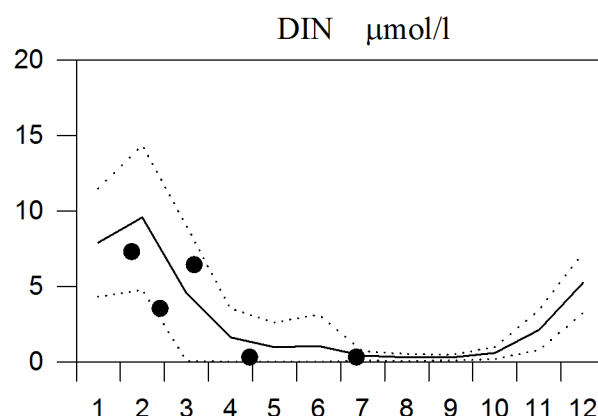
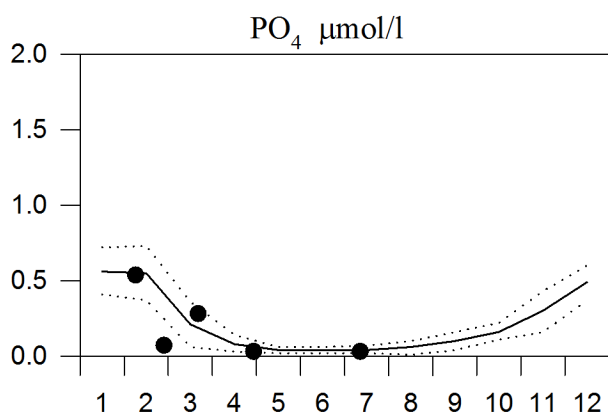
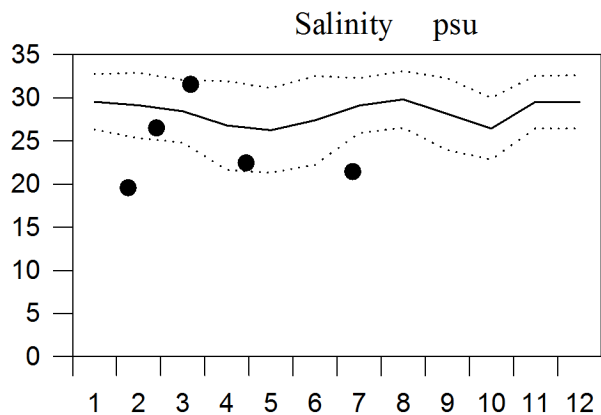
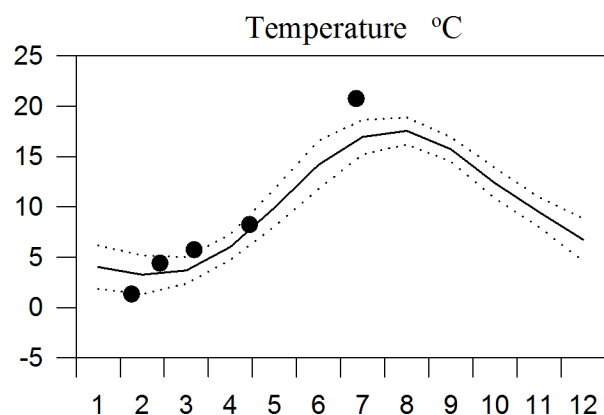
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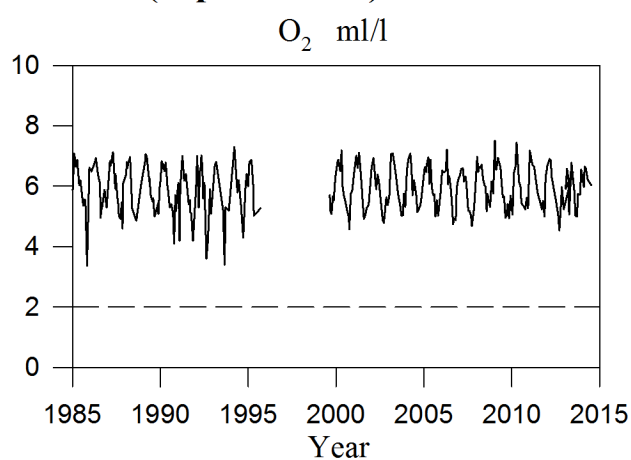
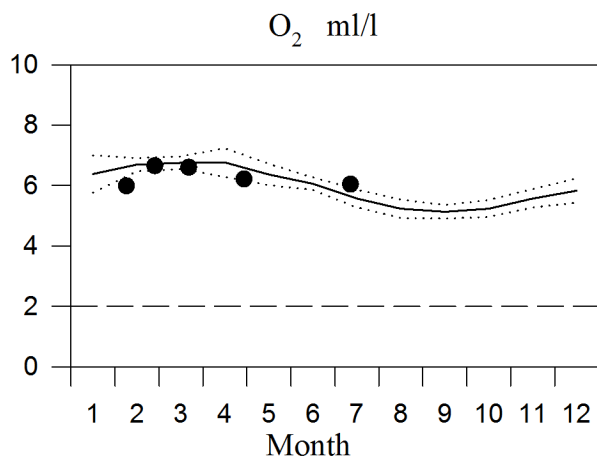
STATION Å13 SURFACE WATER

Annual Cycles

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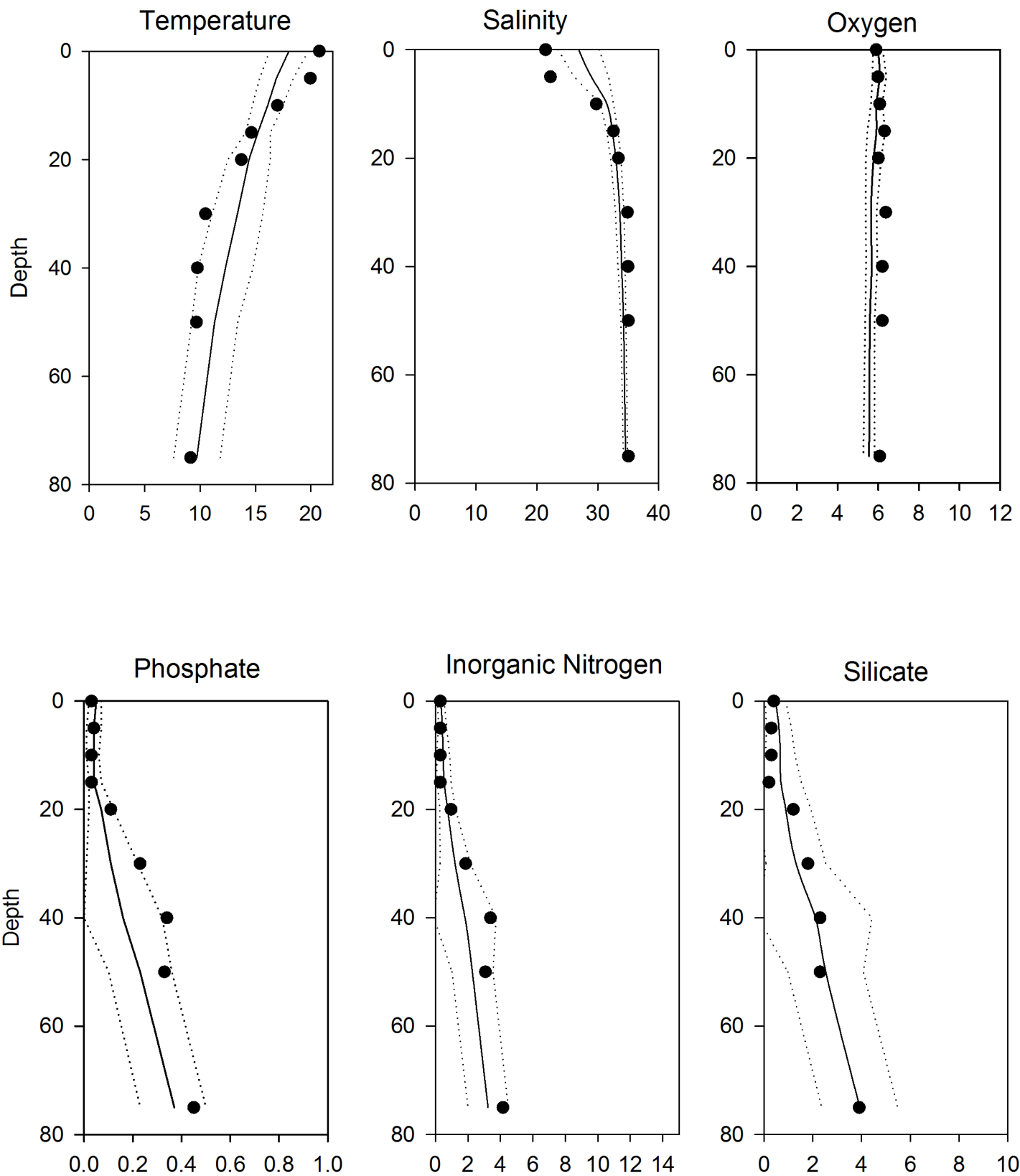


OXYGEN IN BOTTOM WATER (depth >=75m)



Vertical profiles Å13 July

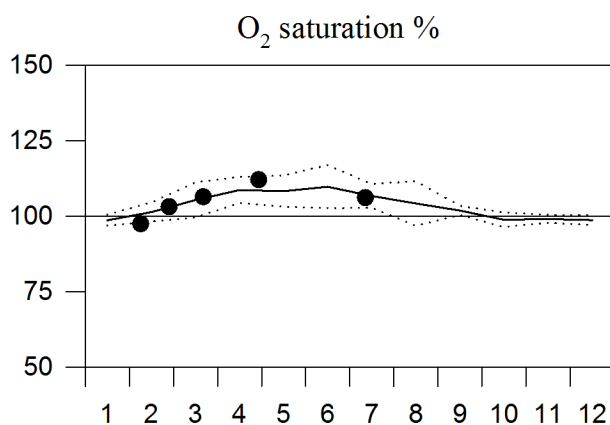
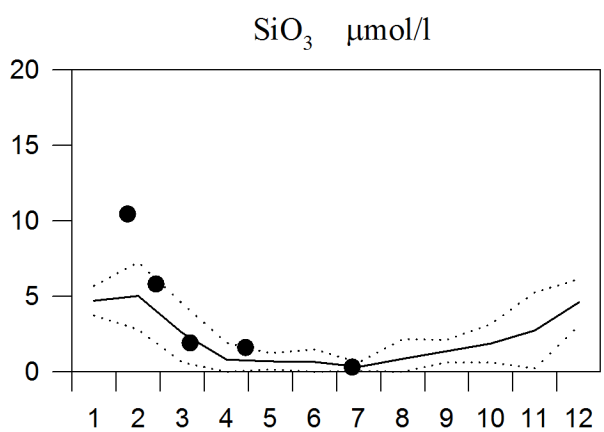
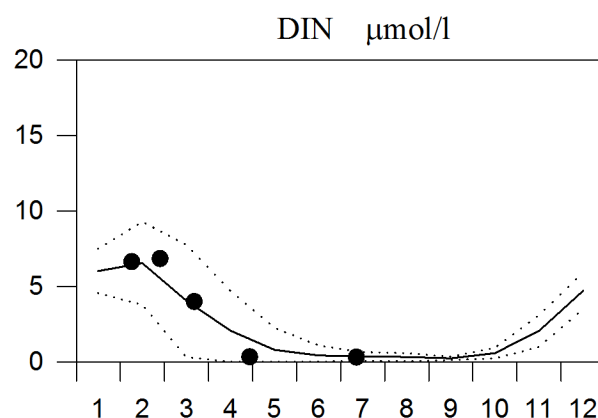
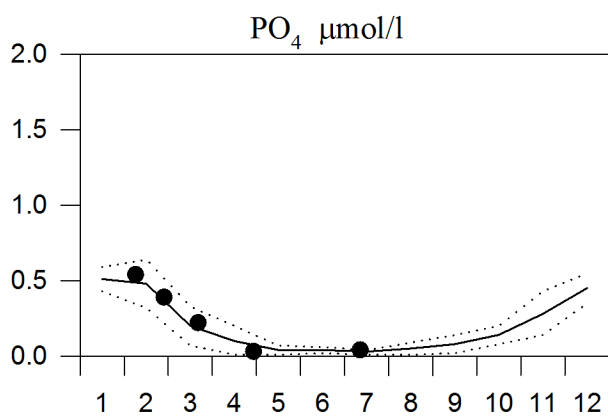
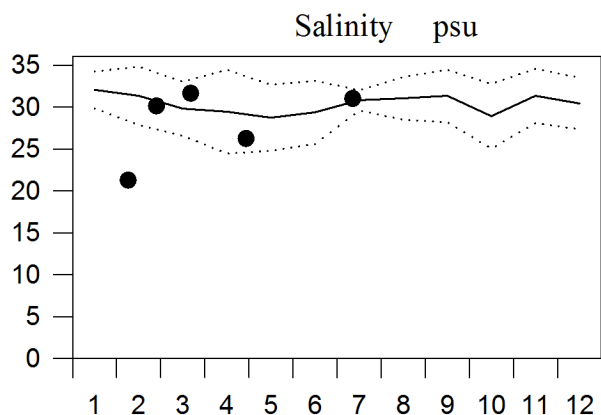
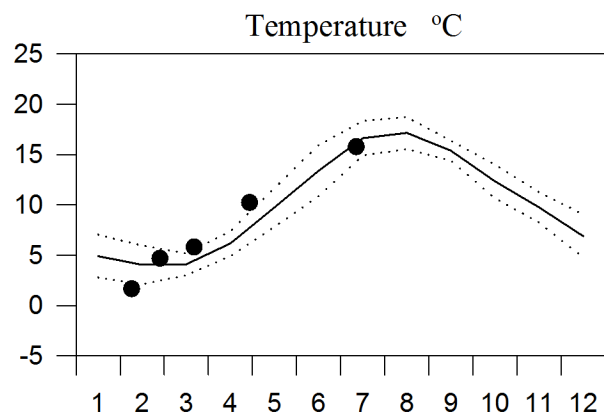
— Mean 1996-2010 St.Dev. ● 2014



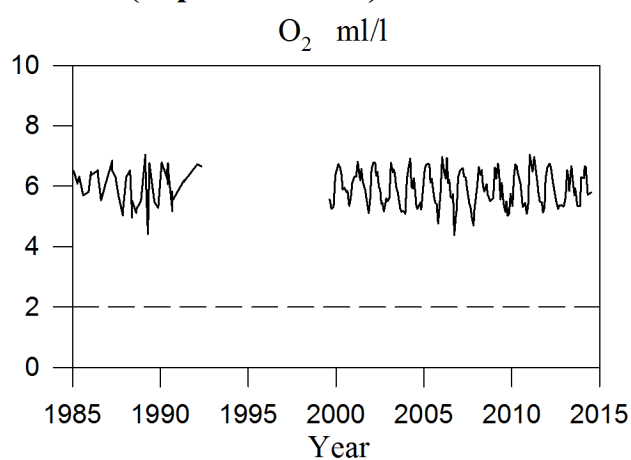
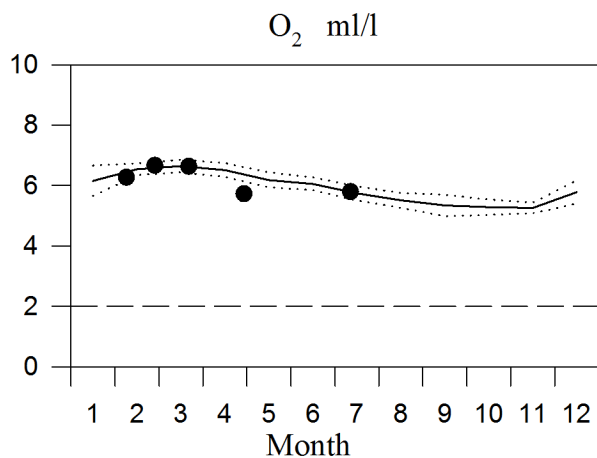
STATION Å15 SURFACE WATER

Annual Cycles

— Mean 1996-2010 St.Dev. ● 2014



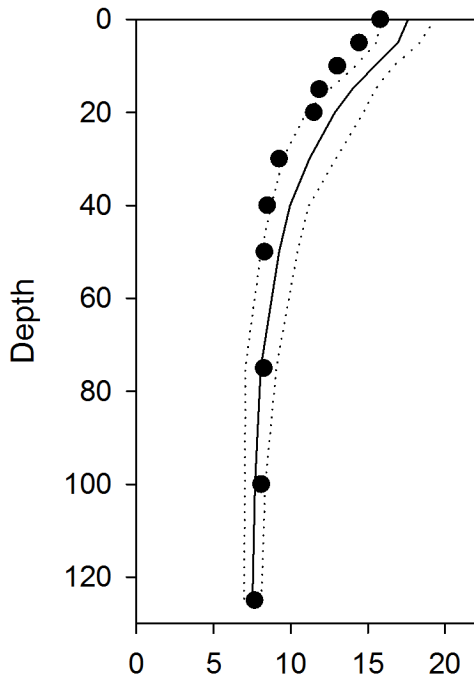
OXYGEN IN BOTTOM WATER (depth >=125m)



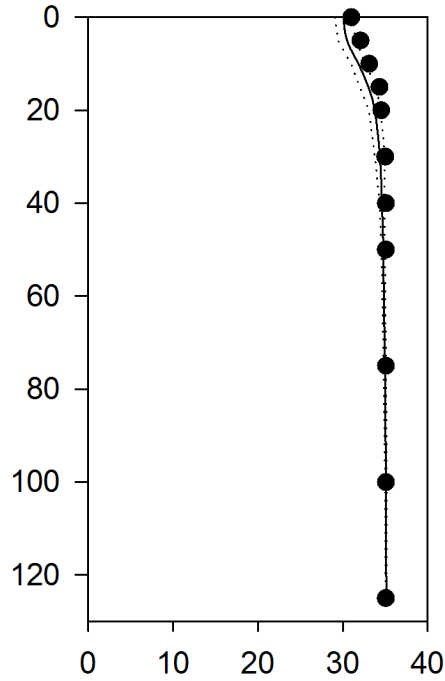
Vertical profiles Å15 July

— Mean 1996-2010 St.Dev. ● 2014

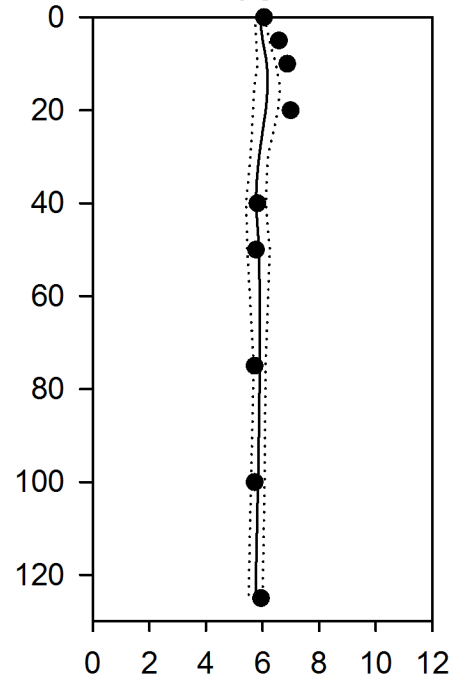
Temperature



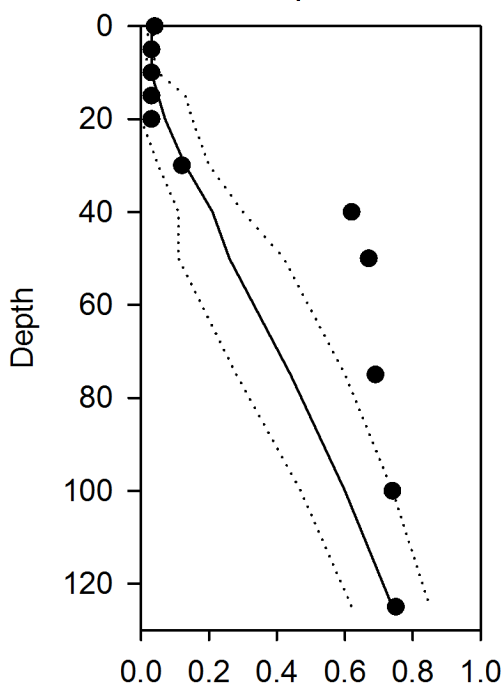
Salinity



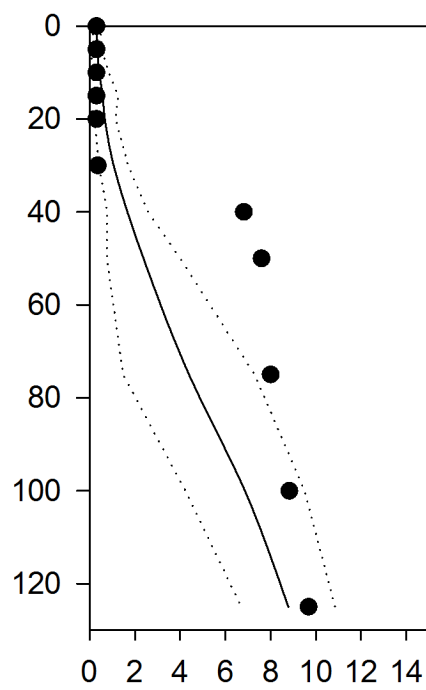
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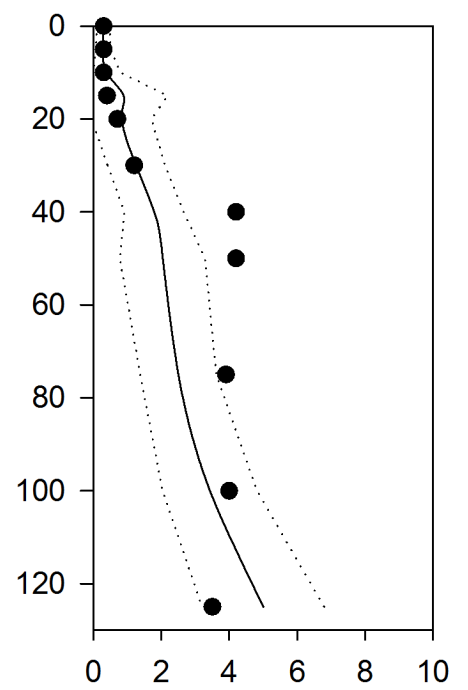
Phosphate



Inorganic Nitrogen



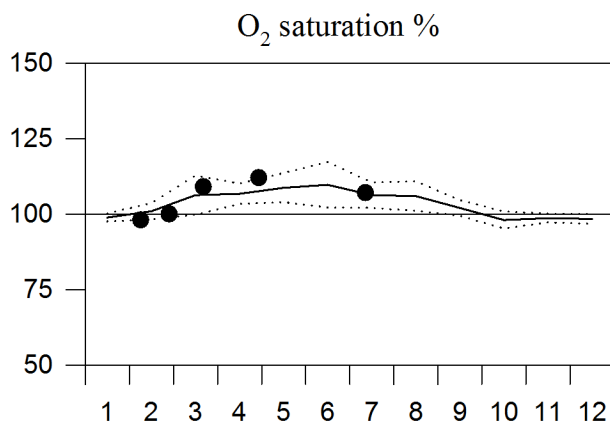
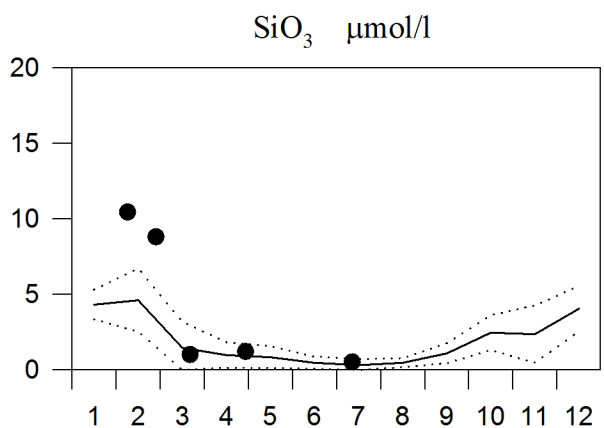
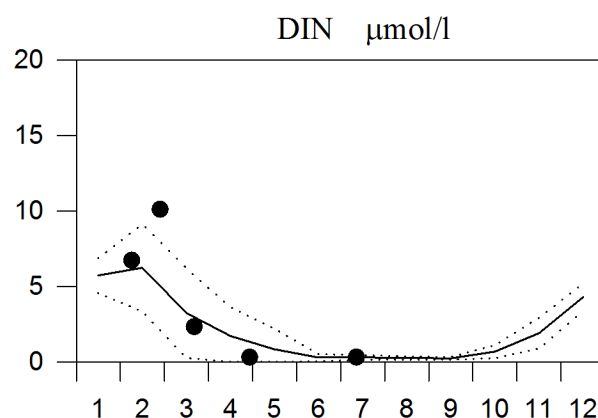
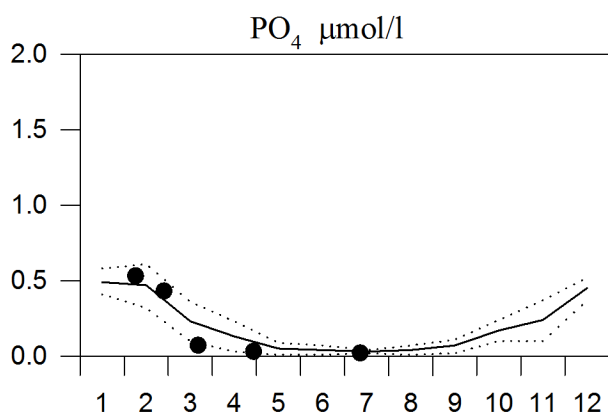
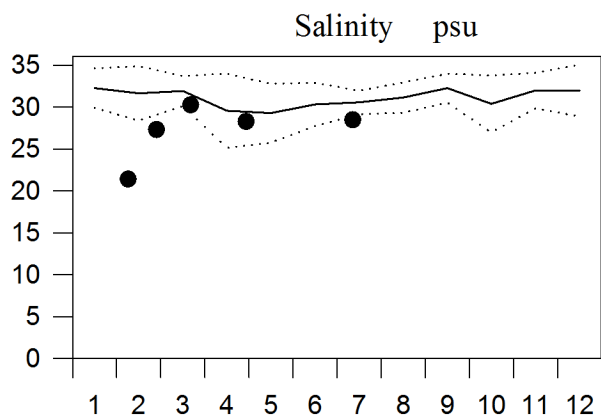
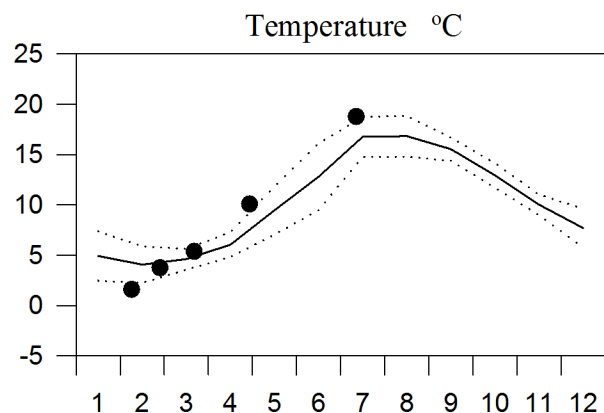
Silicate



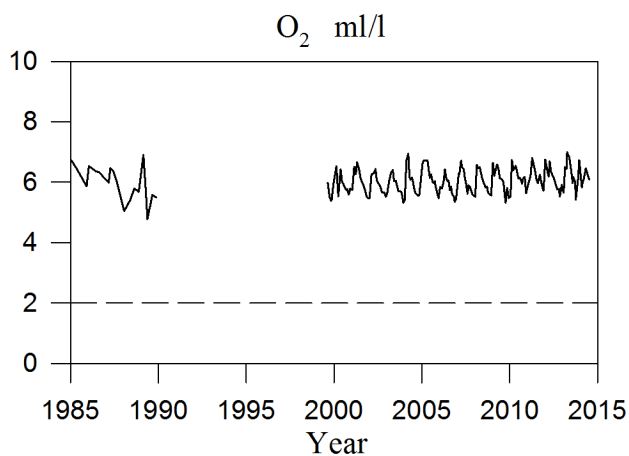
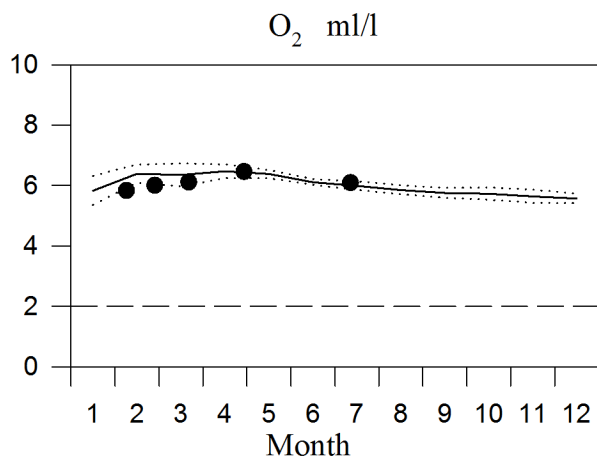
STATION Å17 SURFACE WATER

Annual Cycles

— Mean 1996-2010 St.Dev. ● 2014



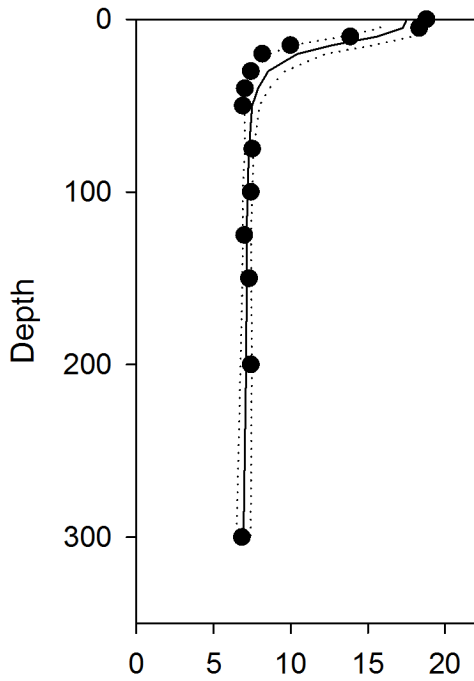
OXYGEN IN BOTTOM WATER (depth = 300m)



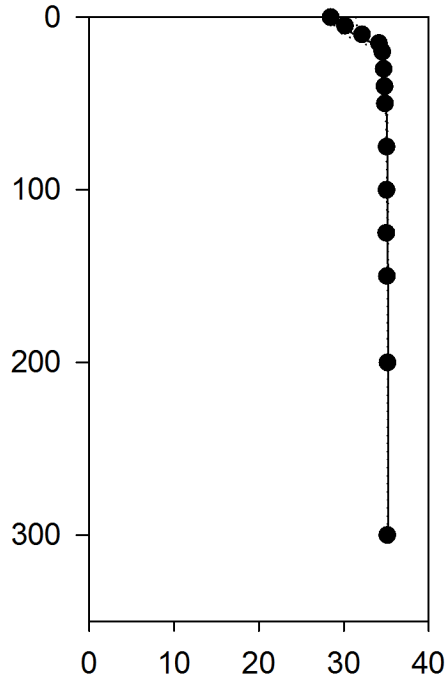
Vertical profiles Å17 July

— Mean 1996-2010 St.Dev. ● 2014

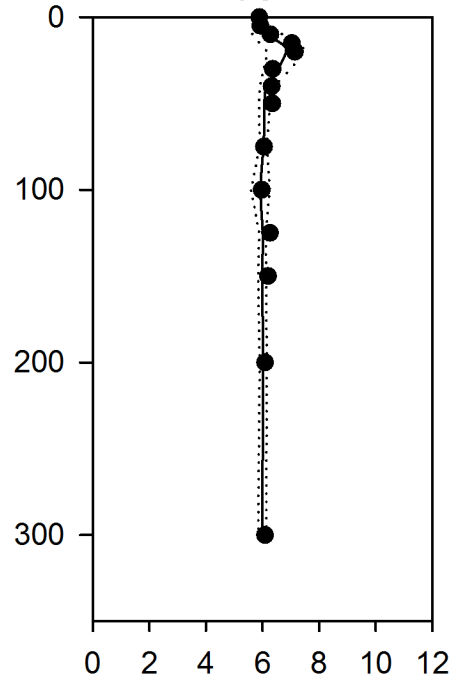
Temperature



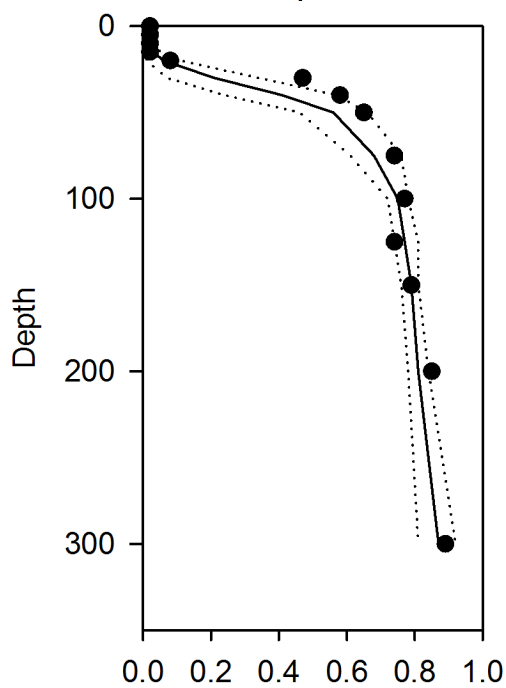
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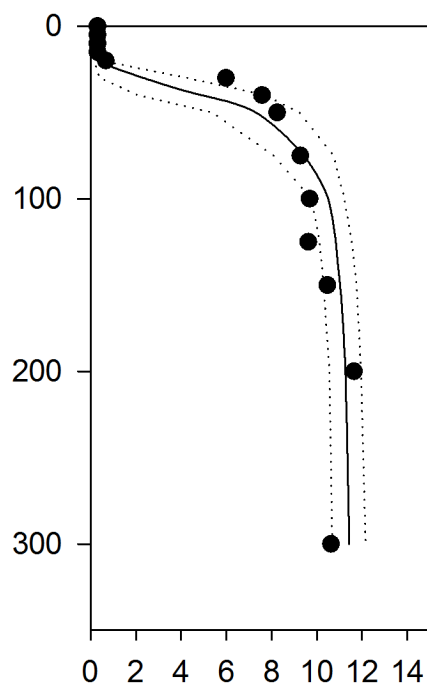
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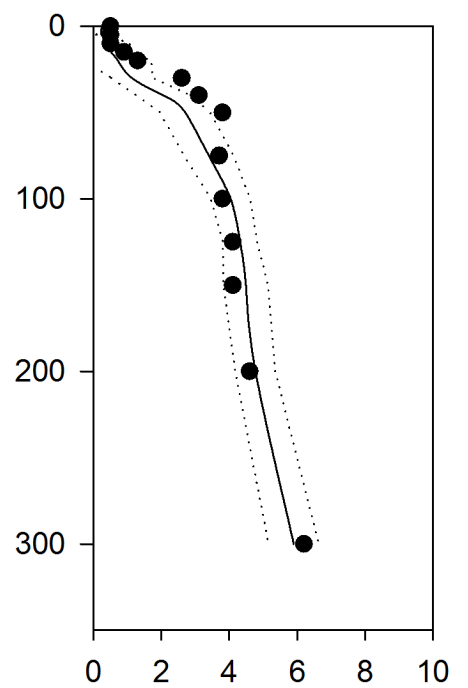
Phosphate



Inorganic Nitrogen



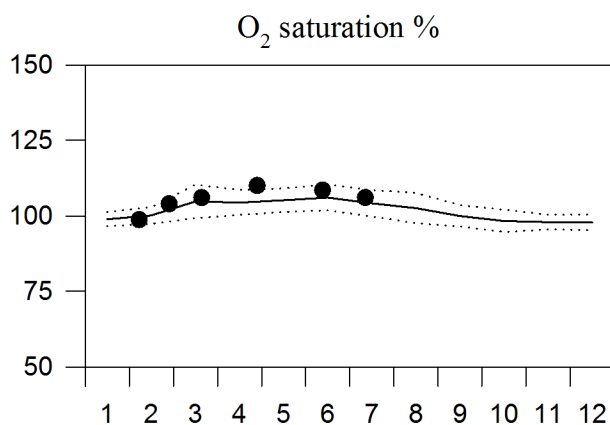
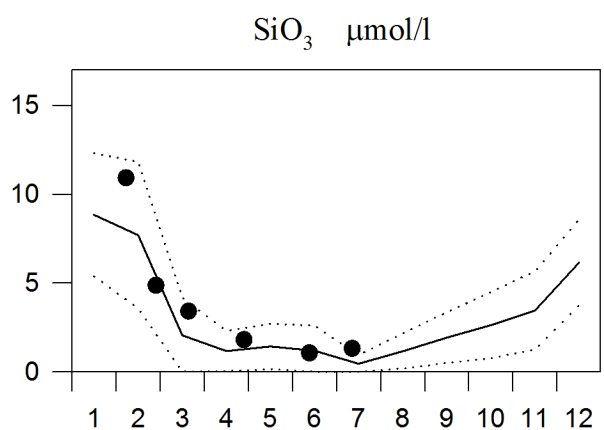
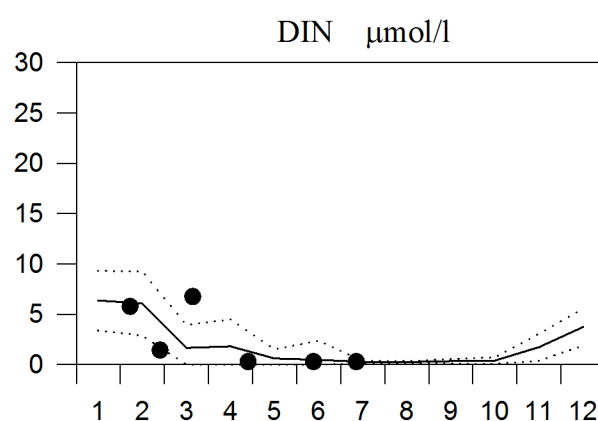
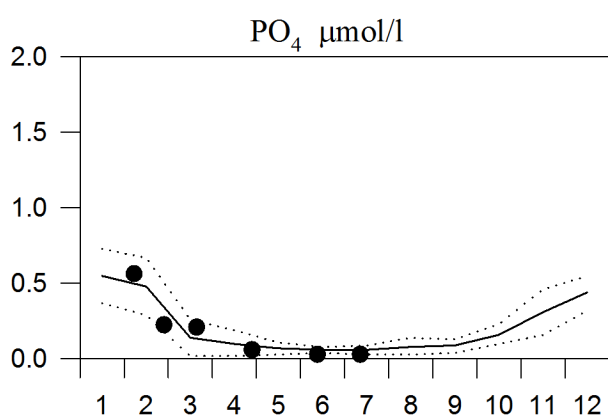
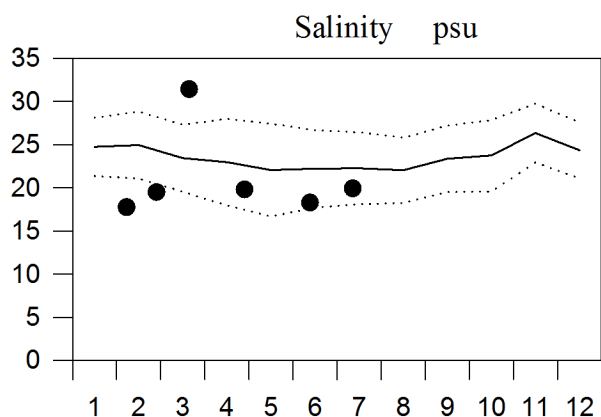
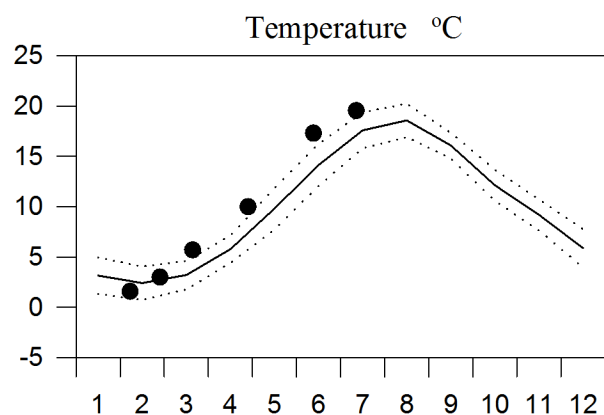
Silicate



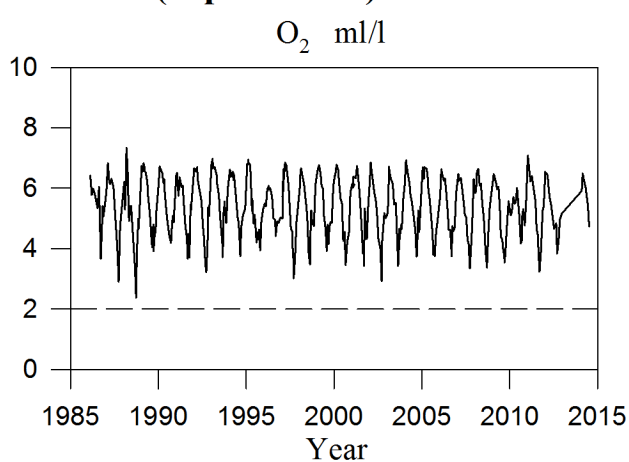
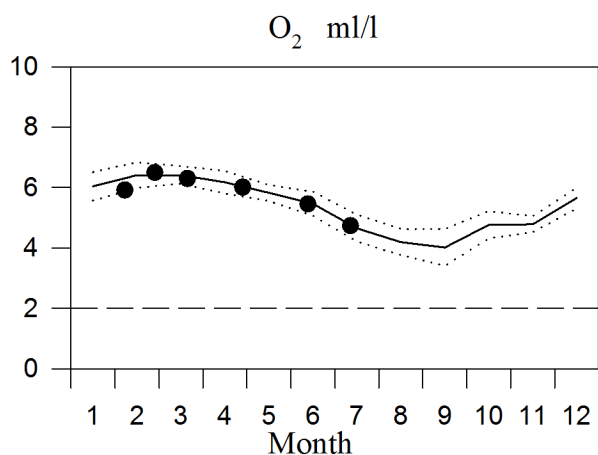
STATION FLADEN SURFACE WATER

Annual Cycles

— Mean 1996-2010 St.Dev. ● 2014

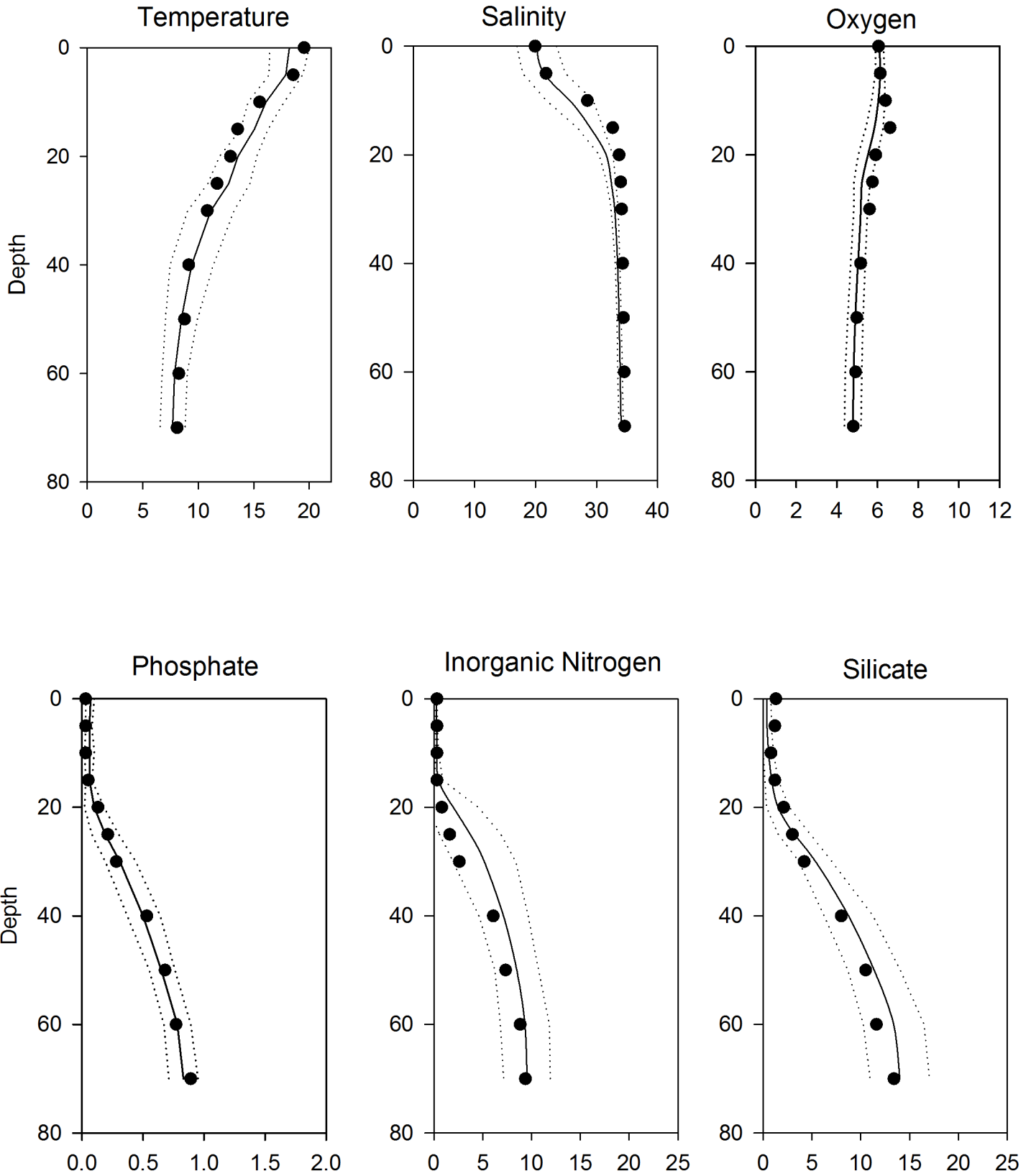


OXYGEN IN BOTTOM WATER (depth > 70m)



Vertical profiles Fladen July

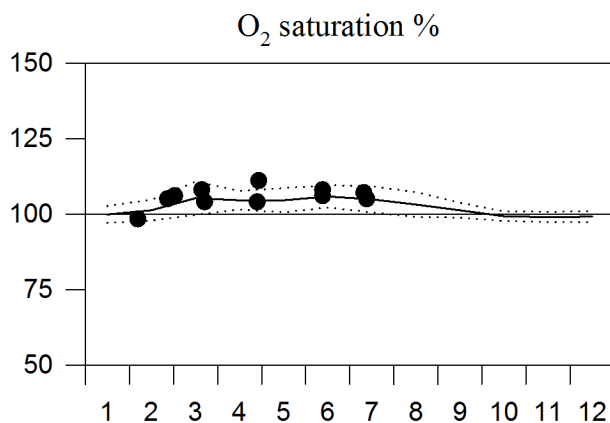
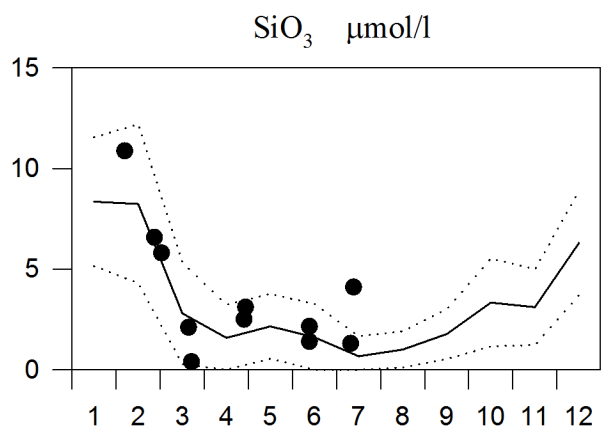
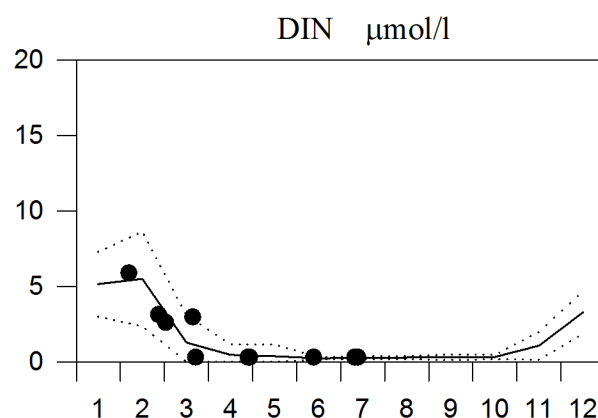
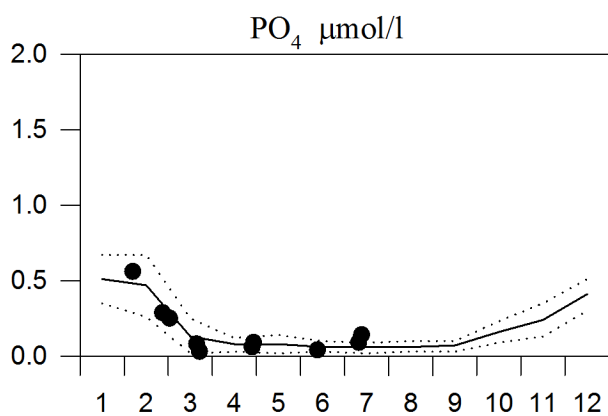
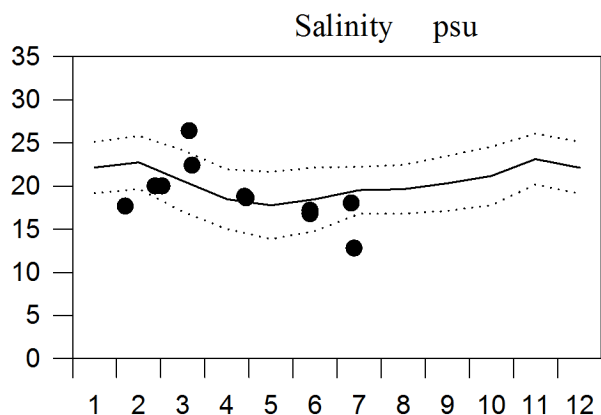
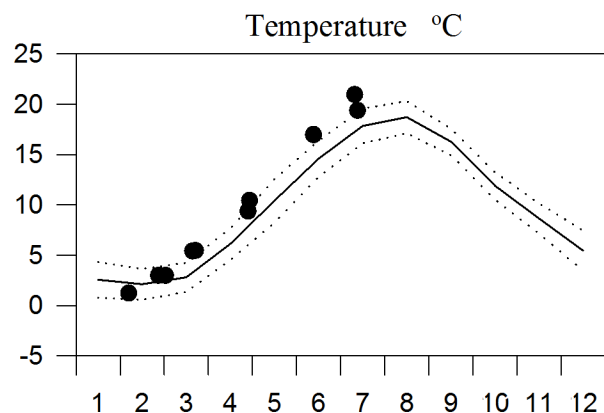
— Mean 1996-2010 St.Dev. ● 2014



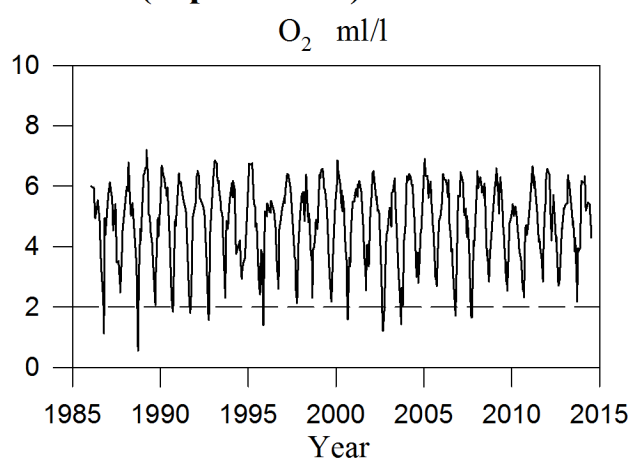
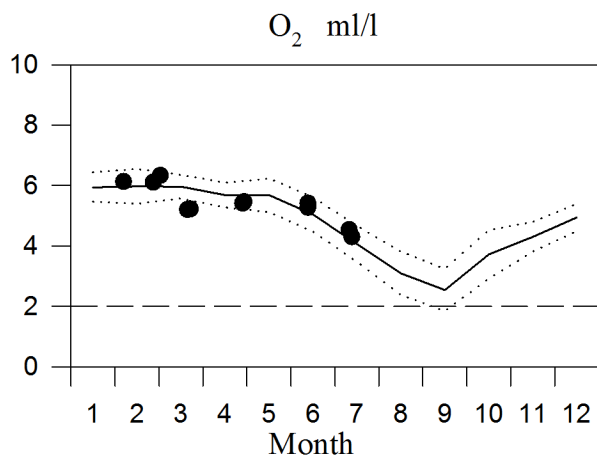
STATION ANHOLT E SURFACE WATER

Annual Cycles

— Mean 1996-2010 St.Dev. ● 2014

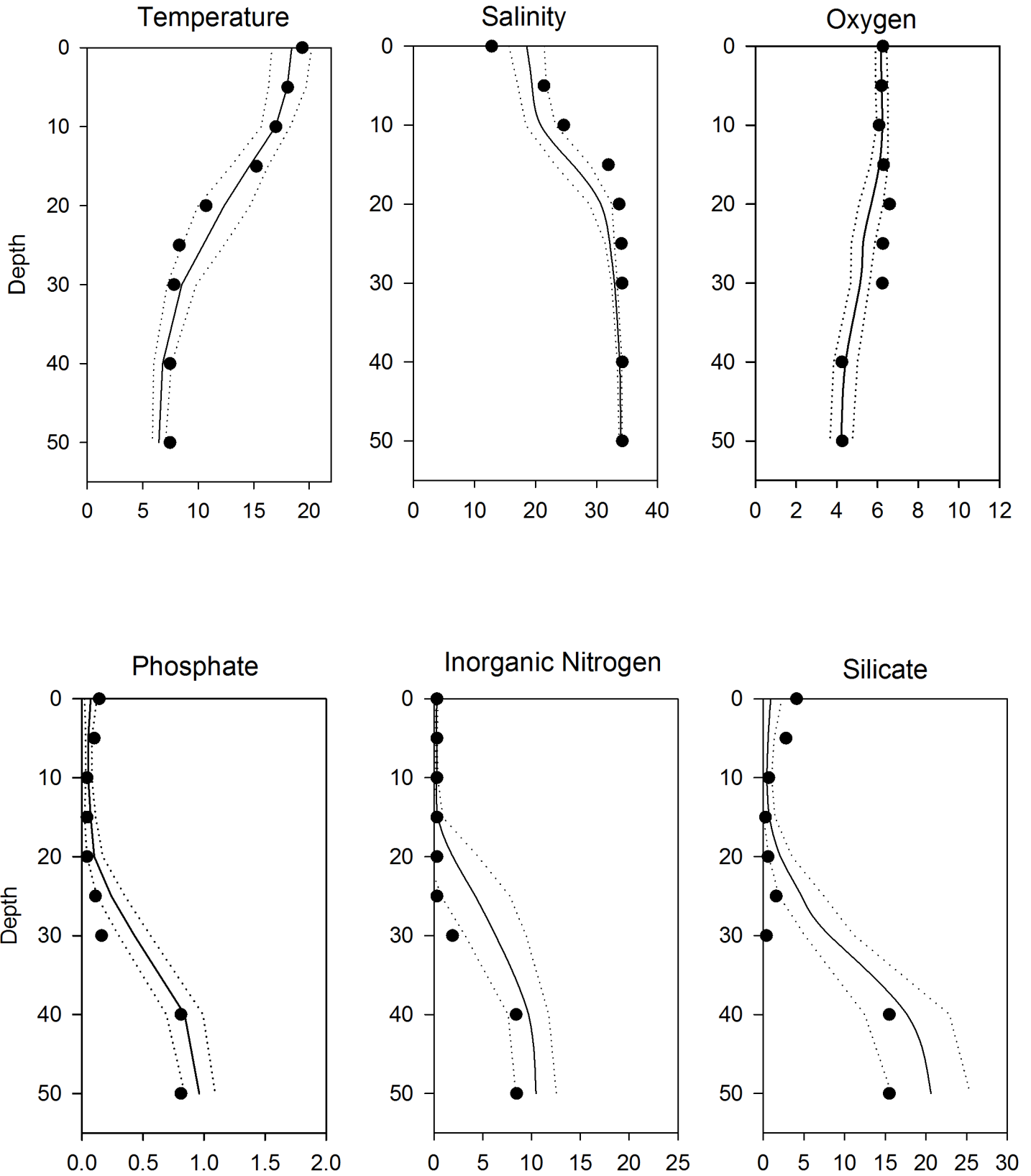


OXYGEN IN BOTTOM WATER (depth > 50m)



Vertical profiles Anholt E July

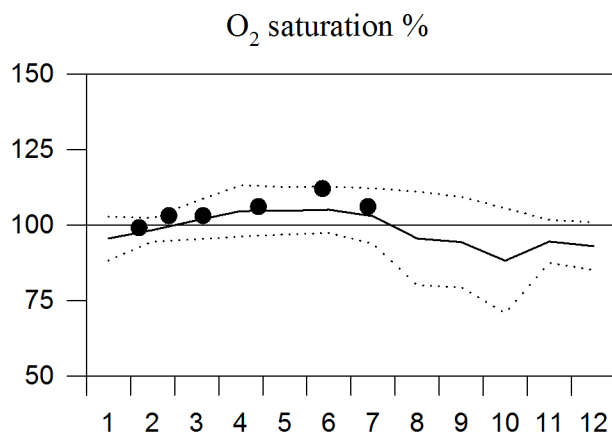
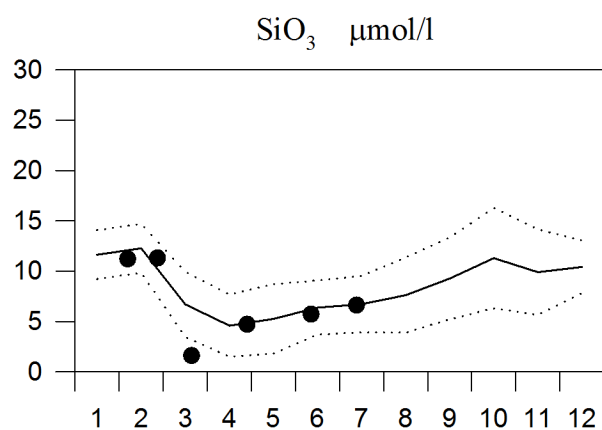
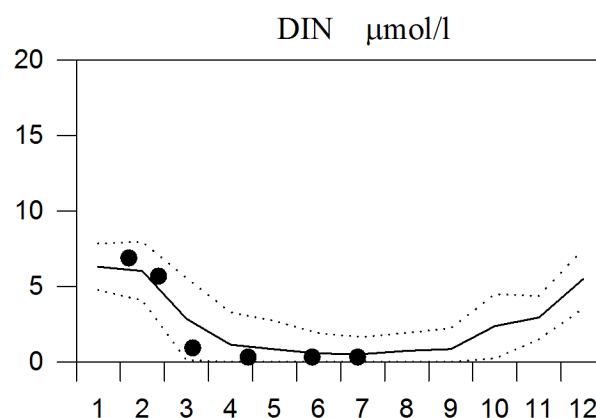
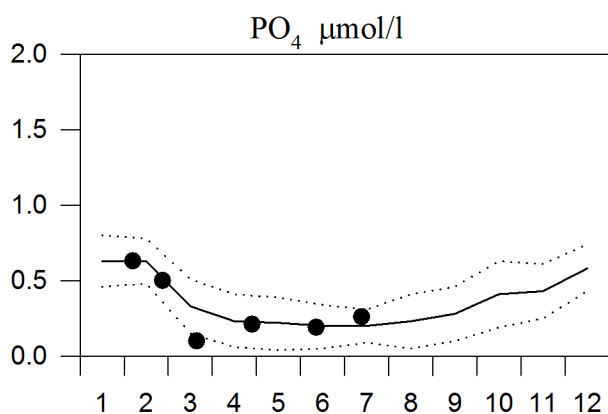
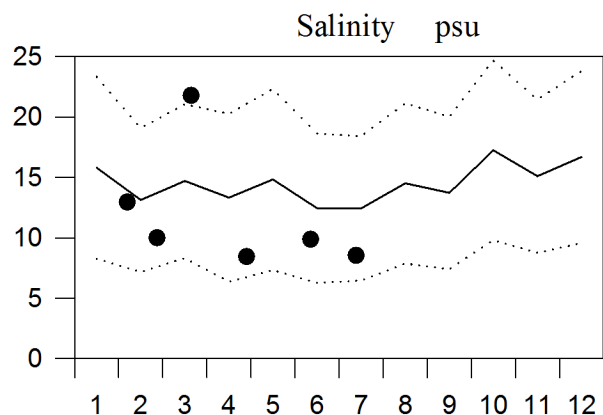
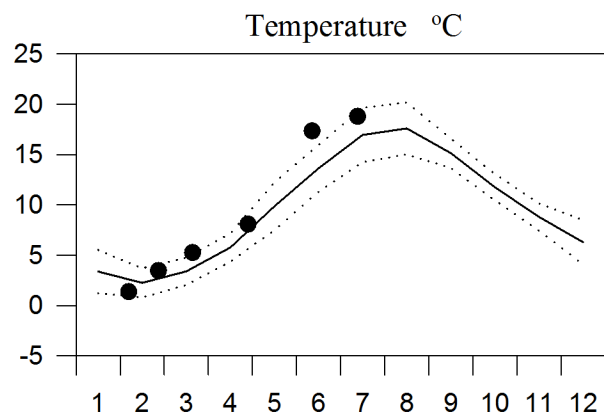
— Mean 1996-2010 St.Dev. ● 2014



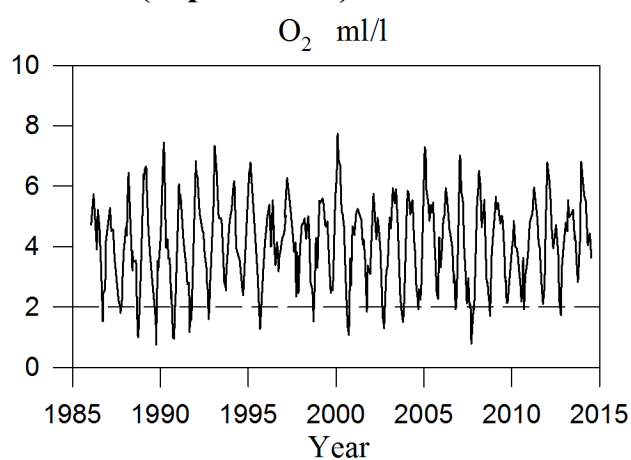
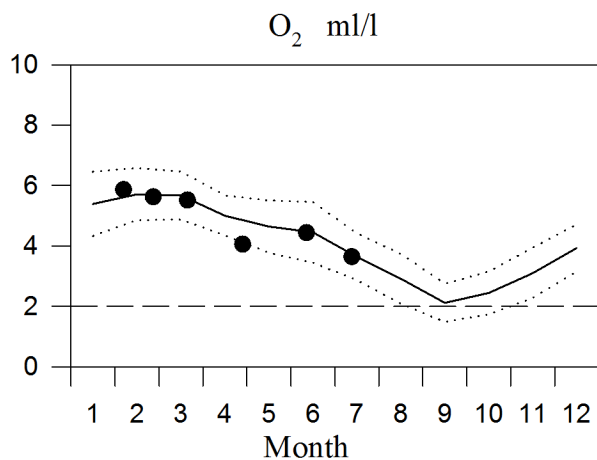
STATION W LANDSKRONA SURFACE WATER

Annual Cycles

— Mean 1996-2010 St.Dev. ● 2014

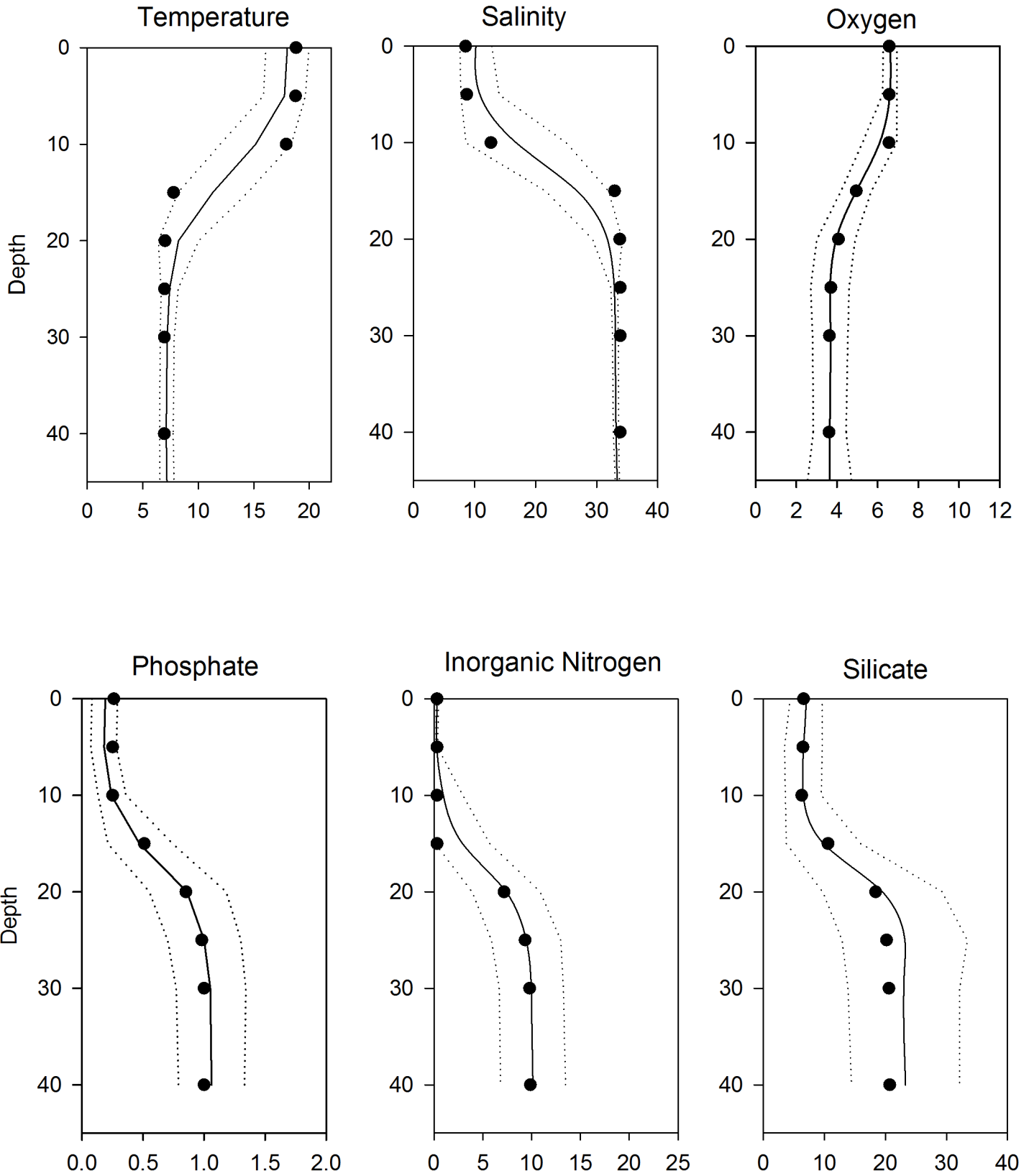


OXYGEN IN BOTTOM WATER (depth >40m)



Vertical profiles W Landskrona July

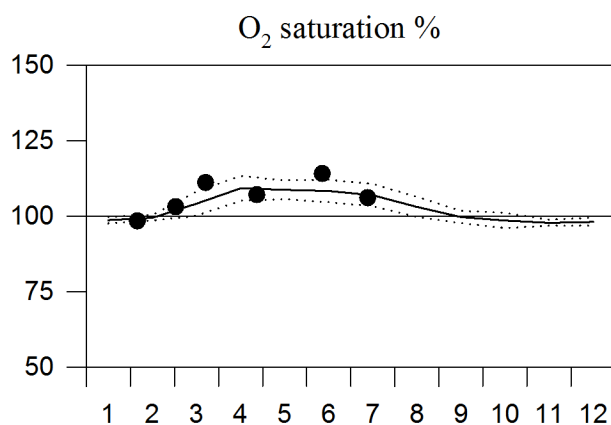
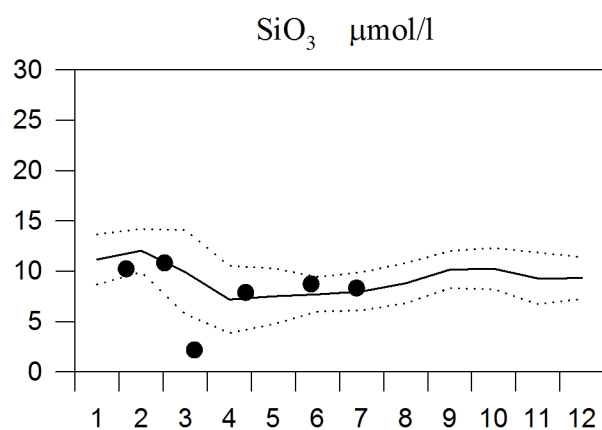
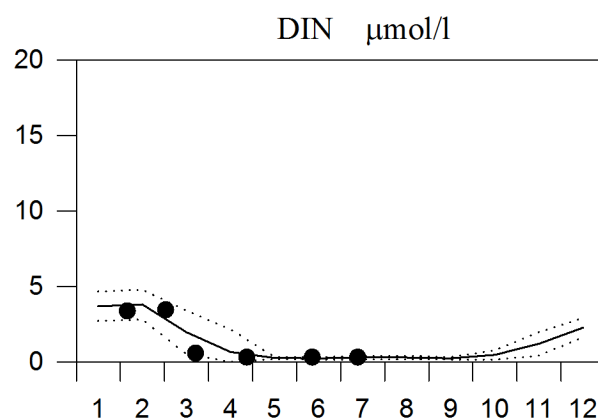
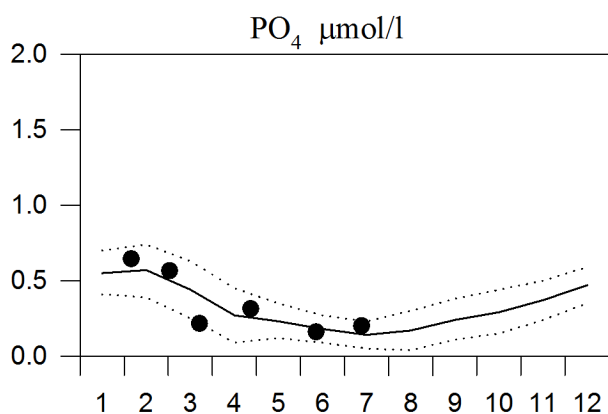
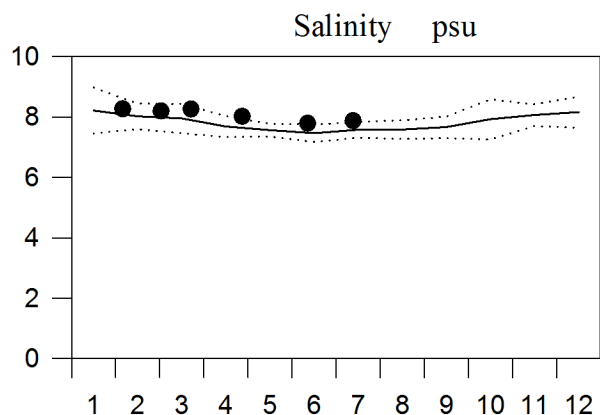
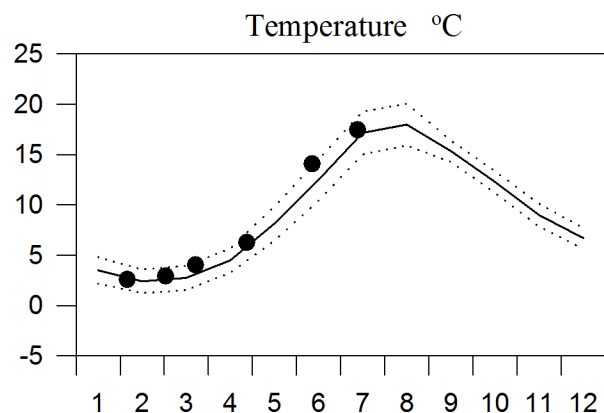
— Mean 1996-2010 St.Dev. ● 2014



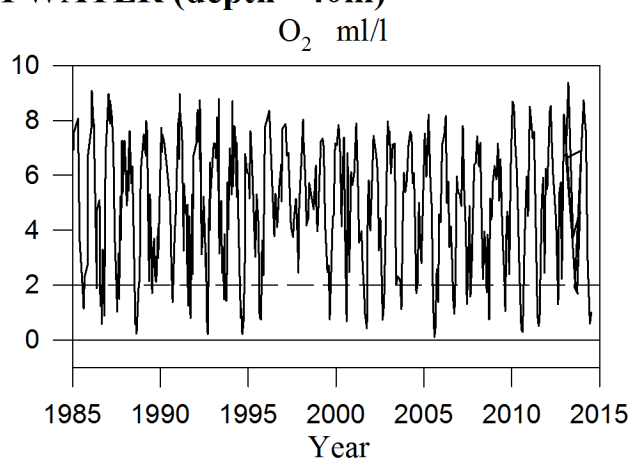
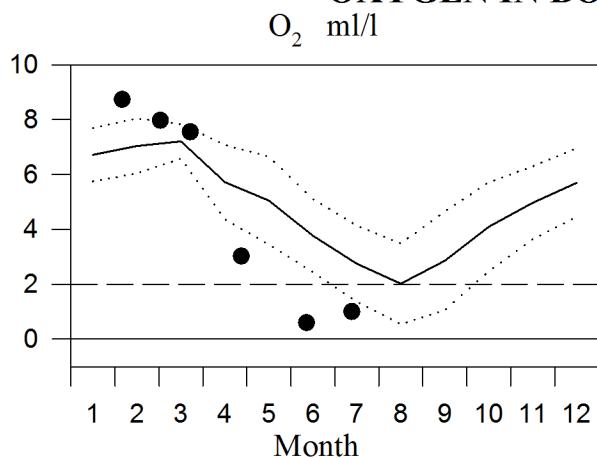
STATION BY1 SURFACE WATER

Annual Cycles

— Mean 1996-2010 St.Dev. ● 2014

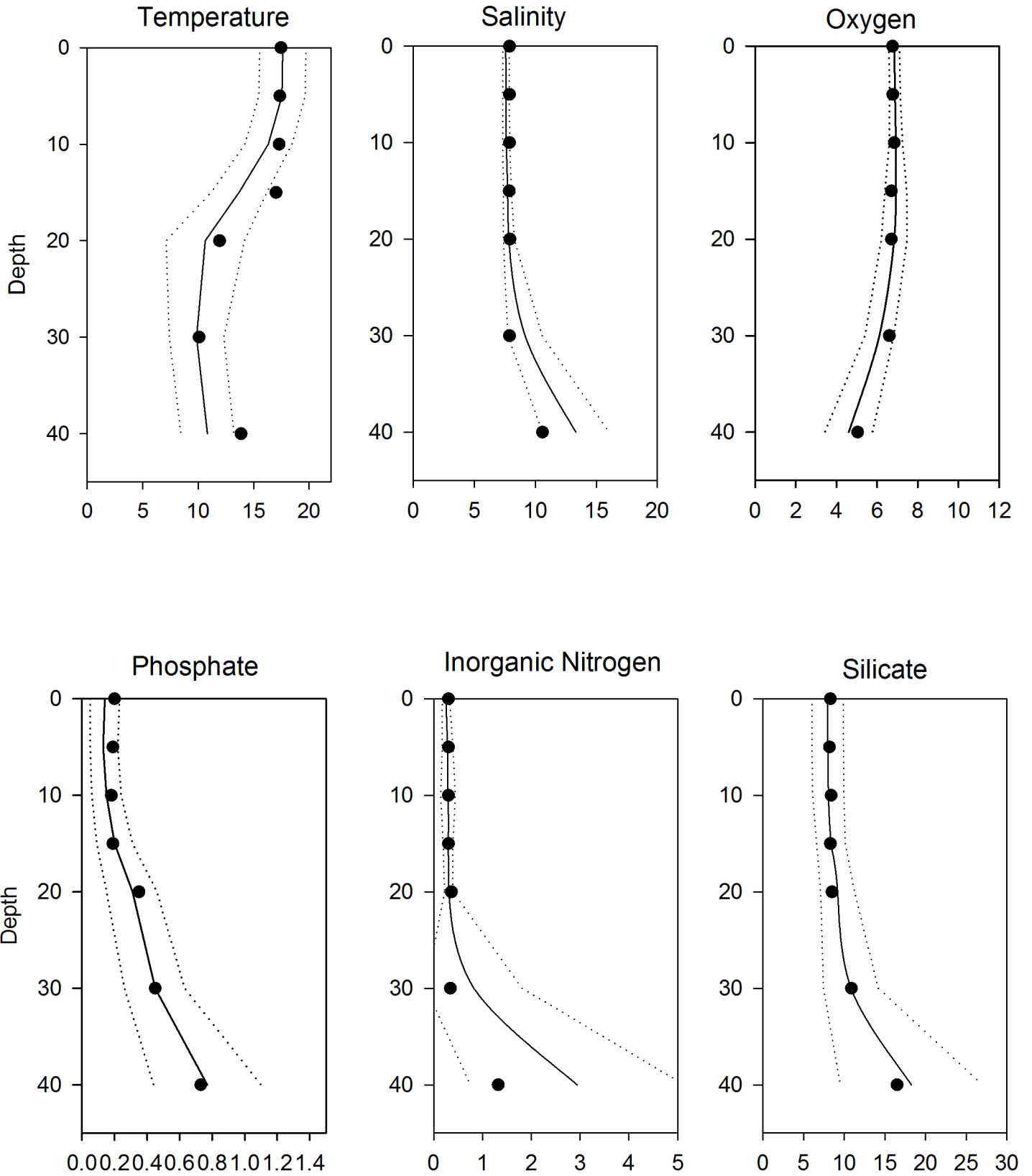


OXYGEN IN BOTTOM WATER (depth >40m)



Vertical profiles BY1 July

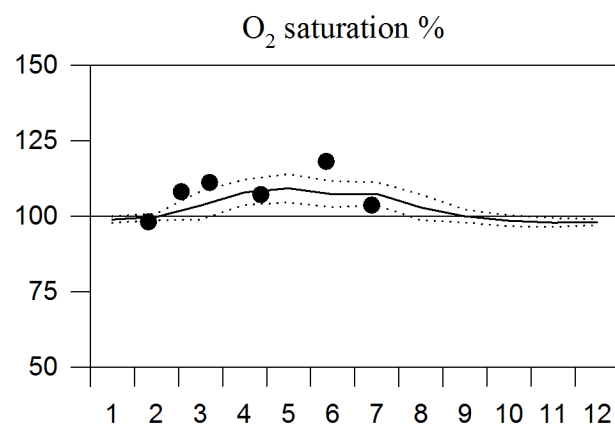
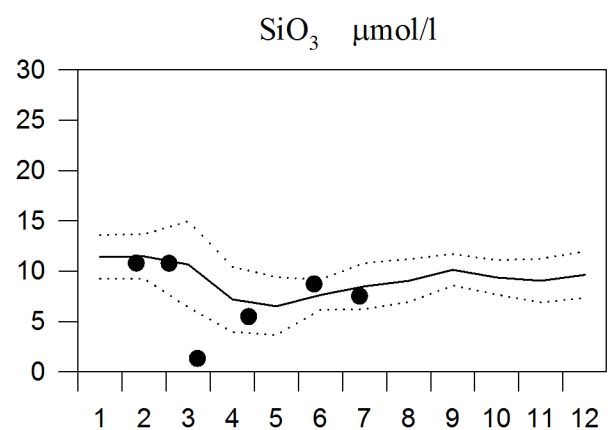
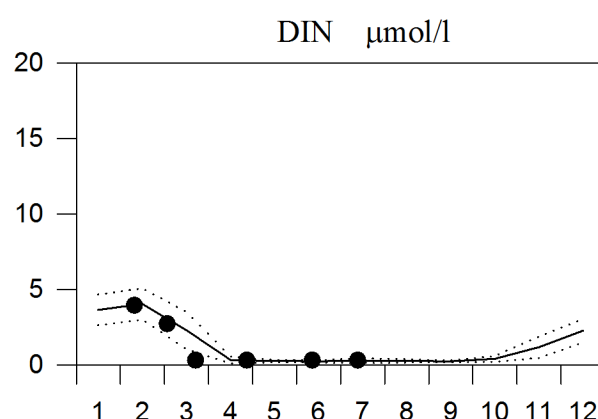
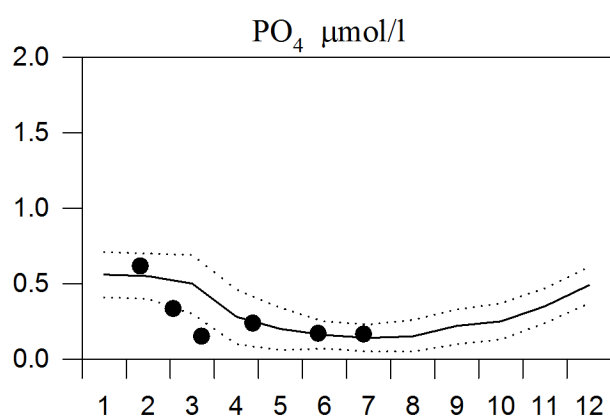
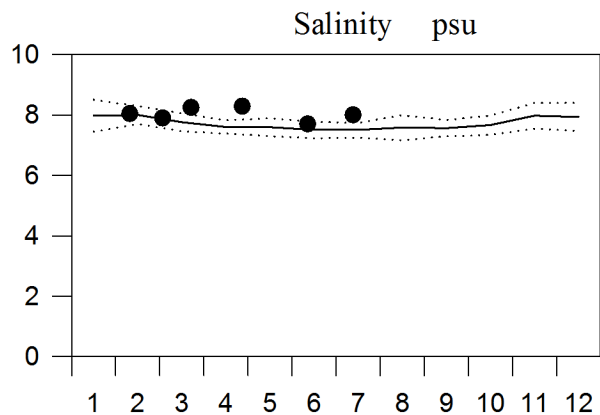
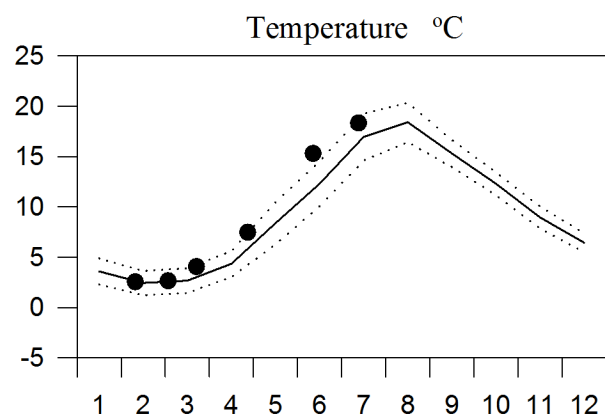
— Mean 1996-2010 St.Dev. ● 2014



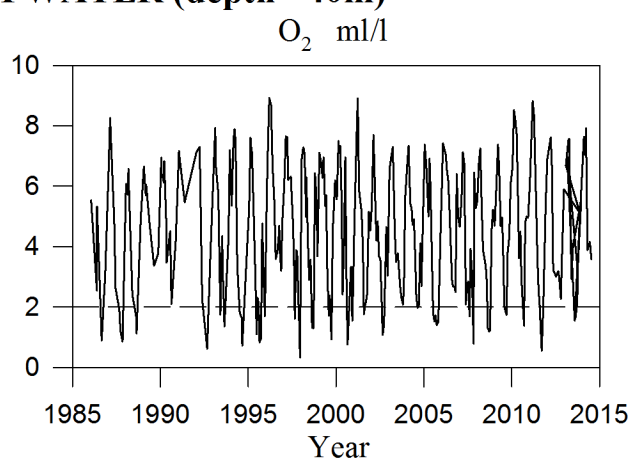
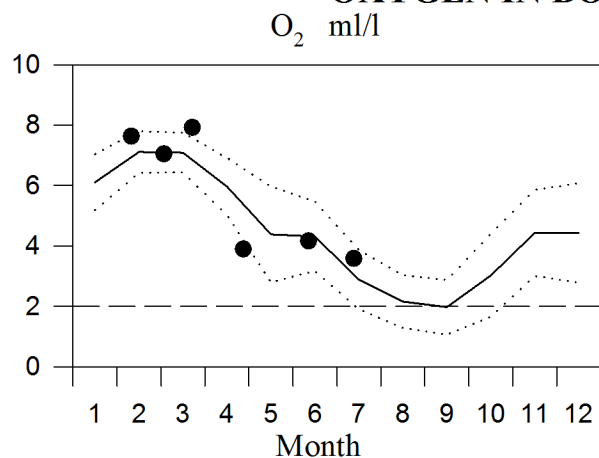
STATION BY2 SURFACE WATER

Annual Cycles

— Mean 1996-2010 St.Dev. ● 2014

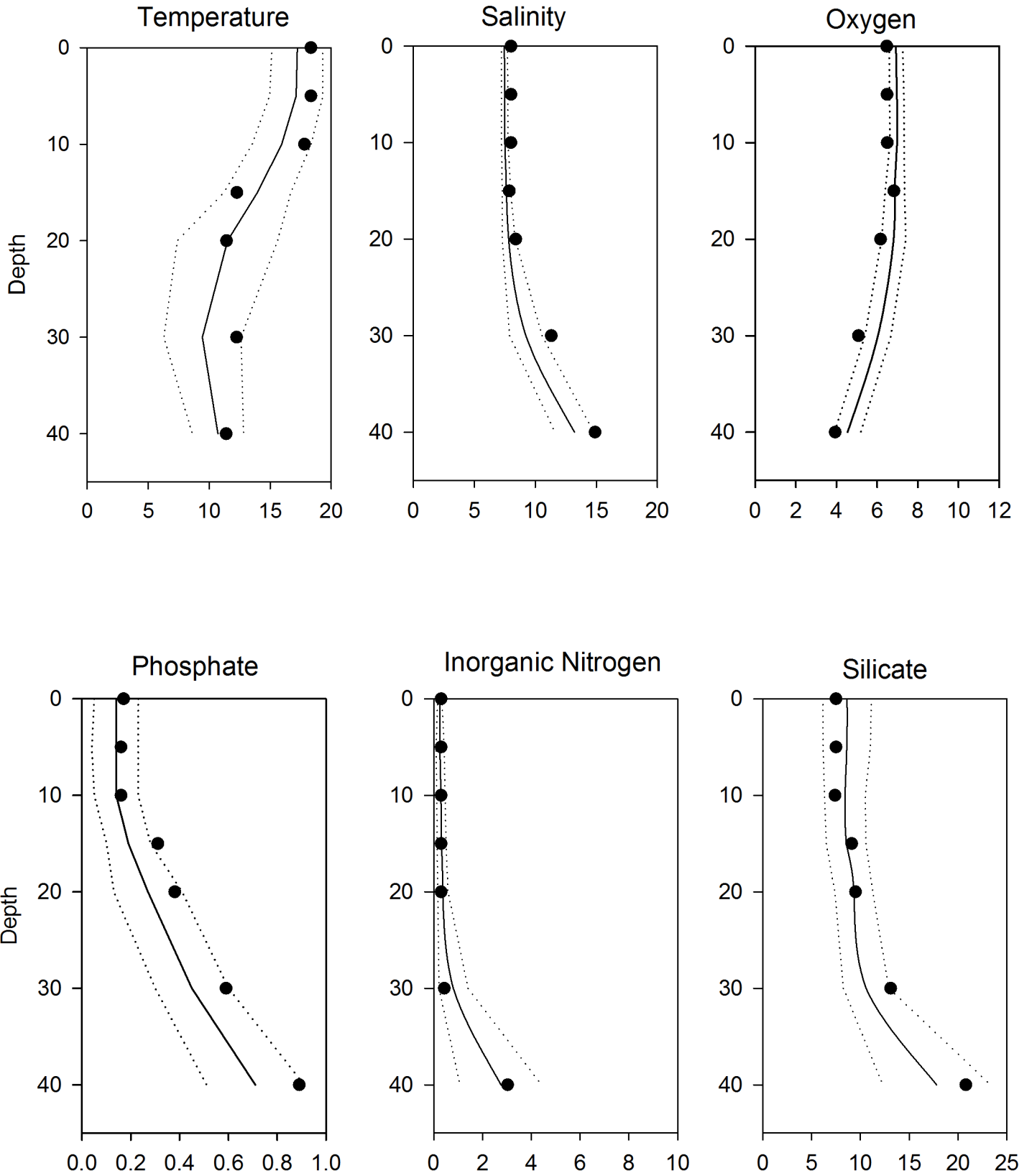


OXYGEN IN BOTTOM WATER (depth >40m)



Vertical profiles BY2 July

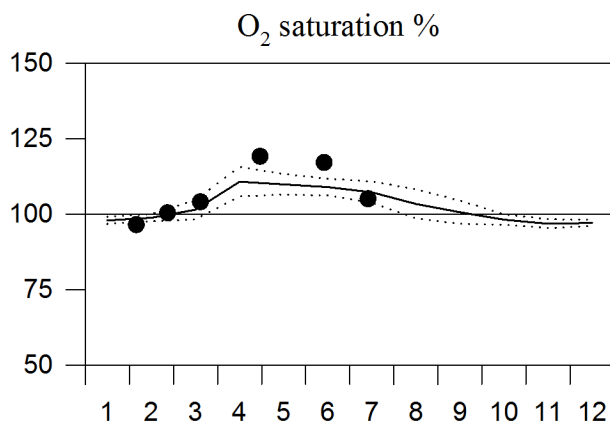
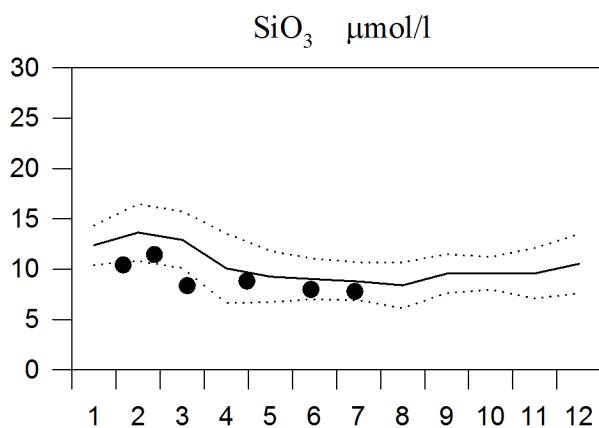
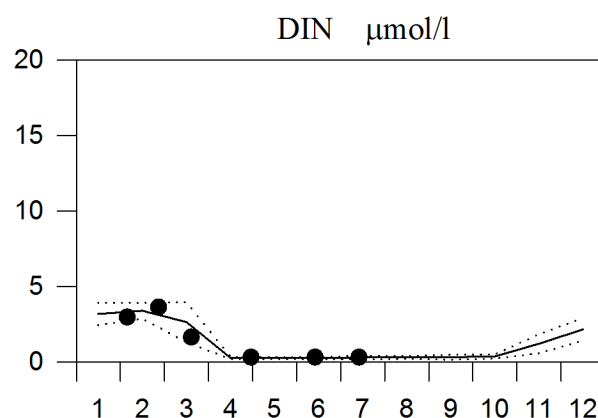
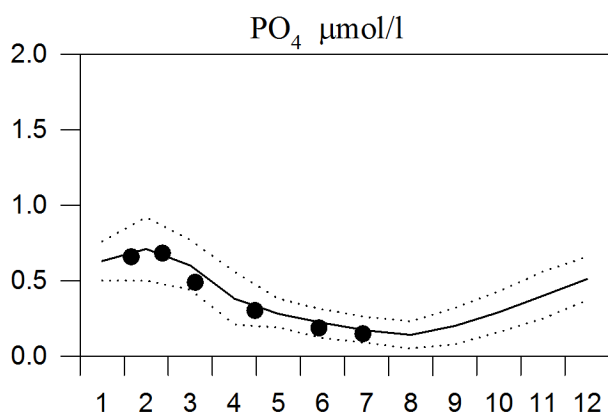
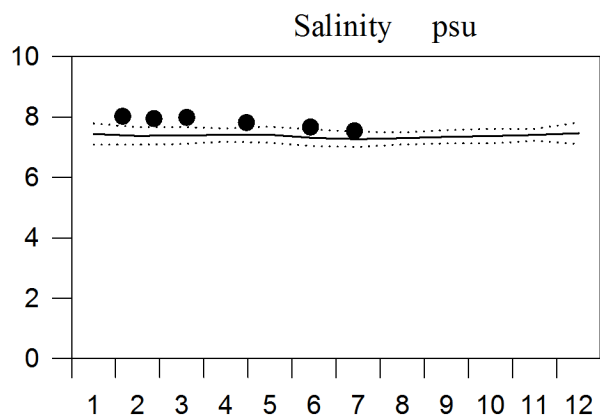
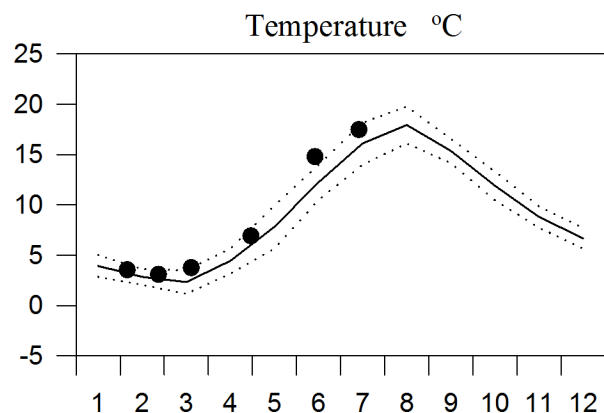
— Mean 1996-2010 St.Dev. ● 2014



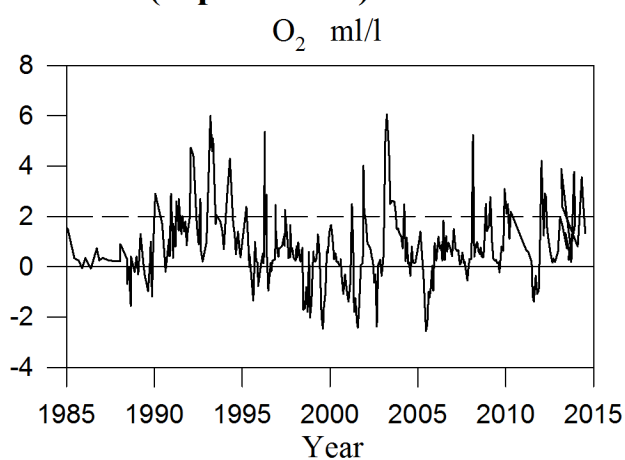
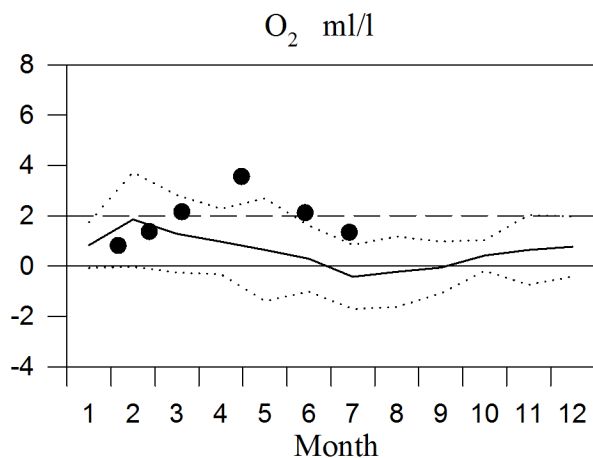
STATION HANÖBUKTEN SURFACE WATER

Annual Cycles

— Mean 1996-2010 St.Dev. ● 2014

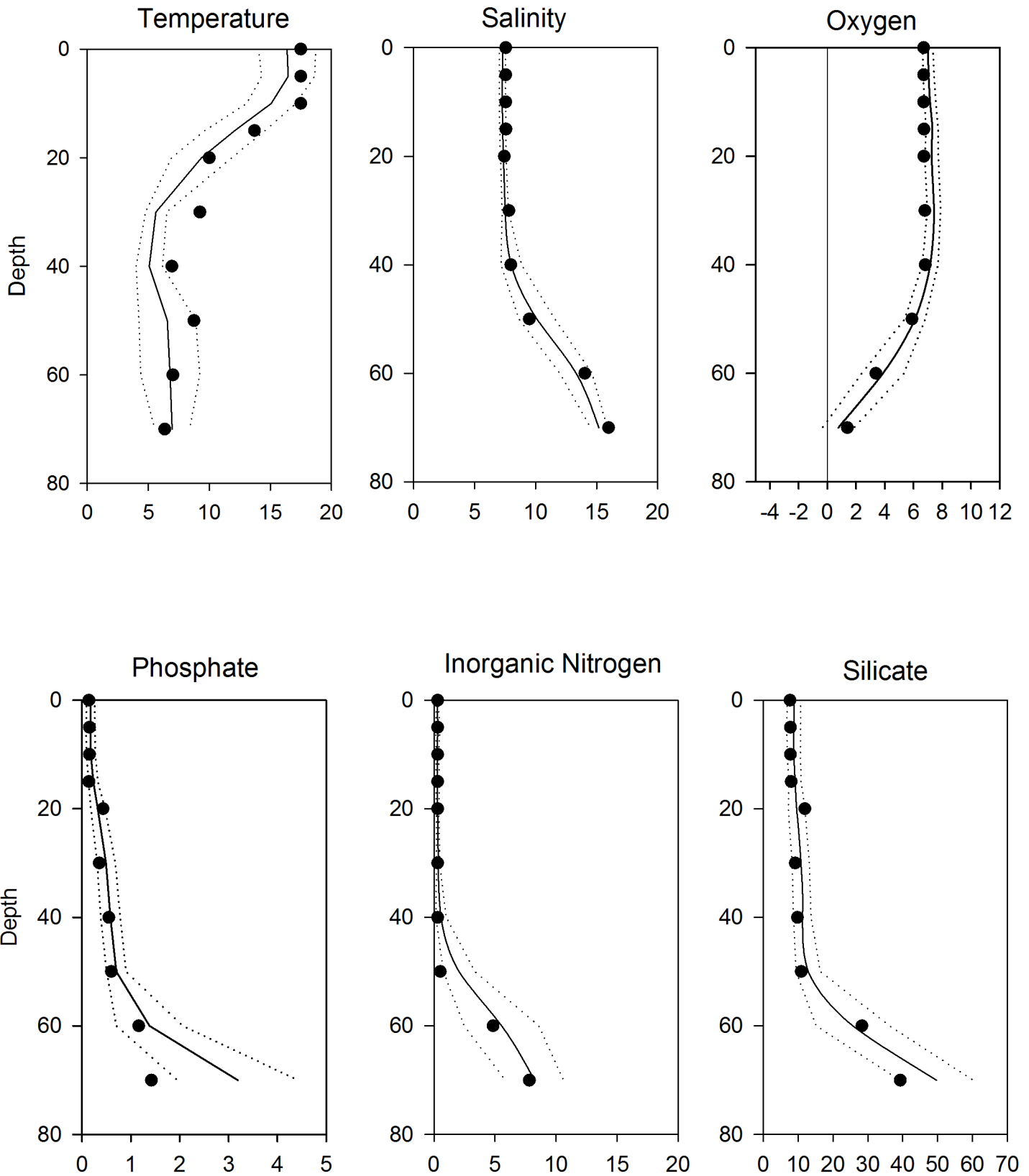


OXYGEN IN BOTTOM WATER (depth > 70m)



Vertical profiles Hanöbukten July

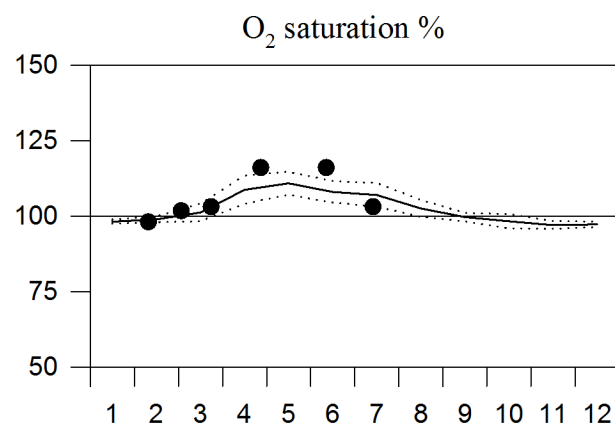
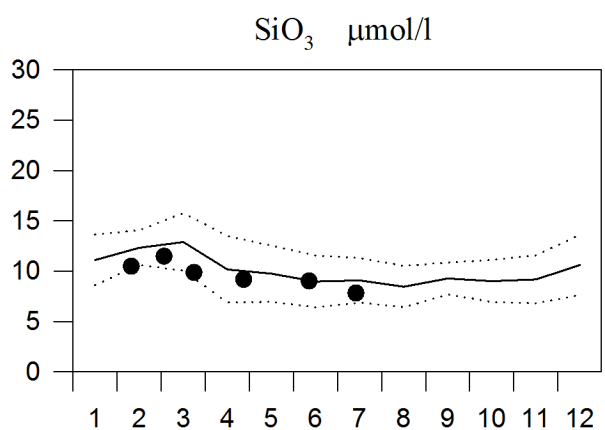
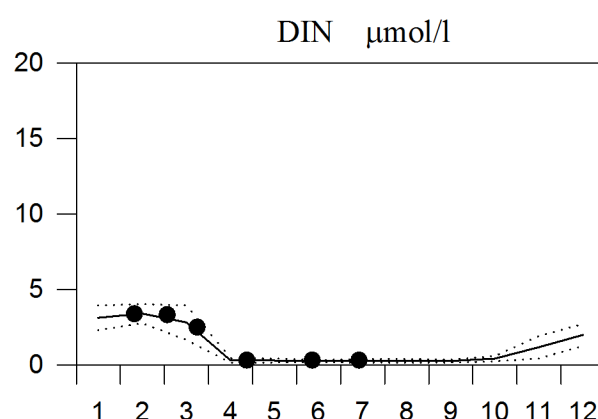
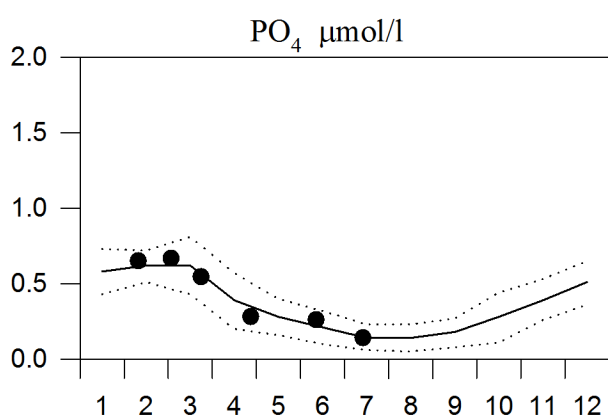
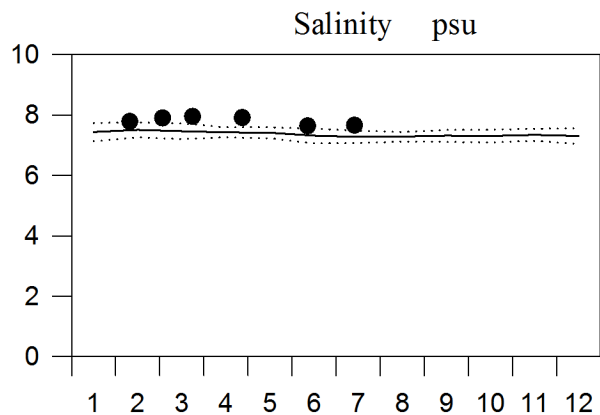
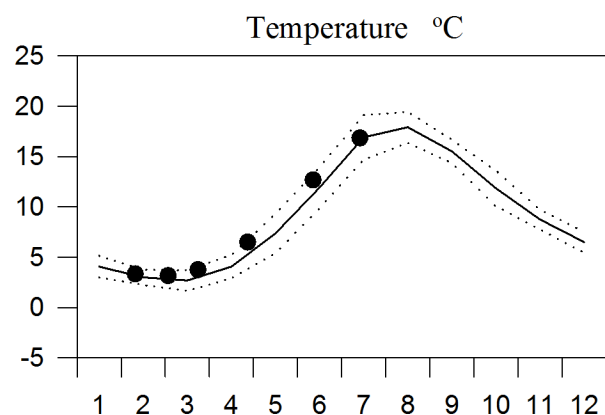
— Mean 1996-2010 St.Dev. ● 2014



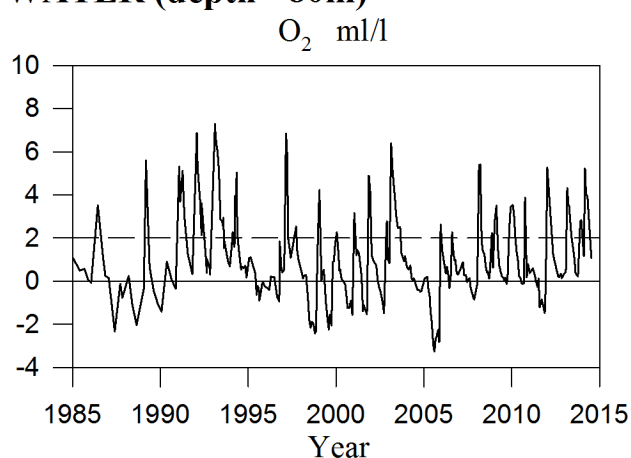
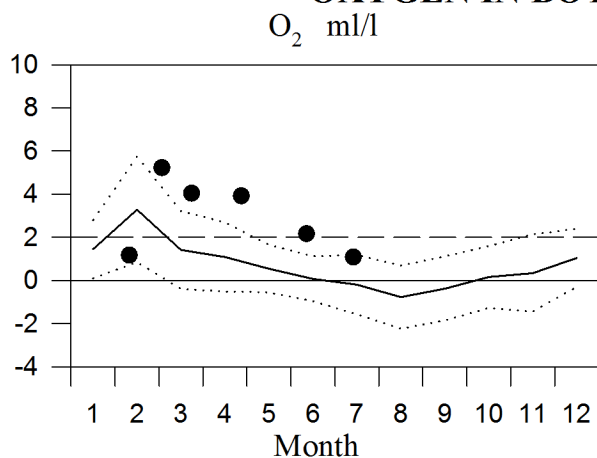
STATION BY4 SURFACE WATER

Annual Cycles

— Mean 1996-2010 St.Dev. ● 2014



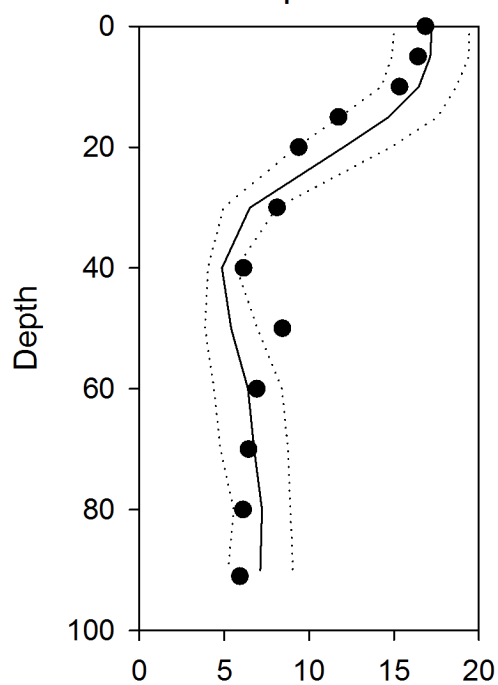
OXYGEN IN BOTTOM WATER (depth >80m)



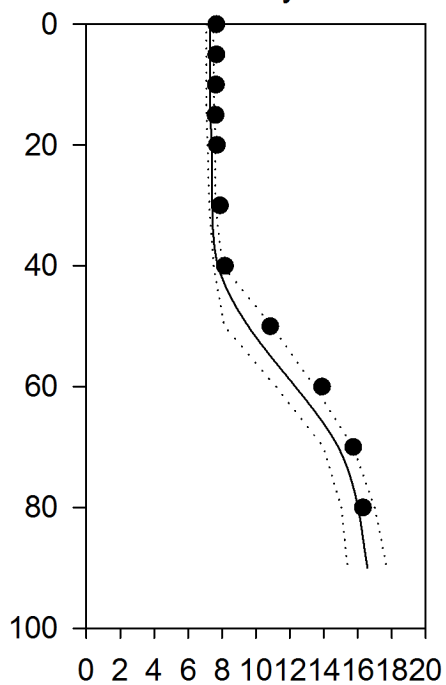
Vertical profiles BY4 July

— Mean 1996-2010 St.Dev. ● 2014

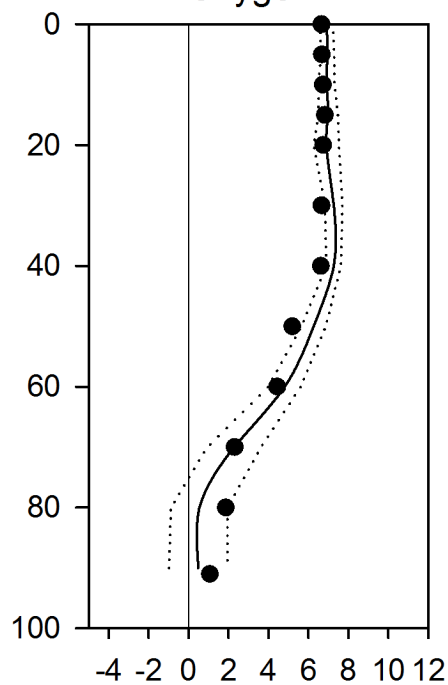
Temperature



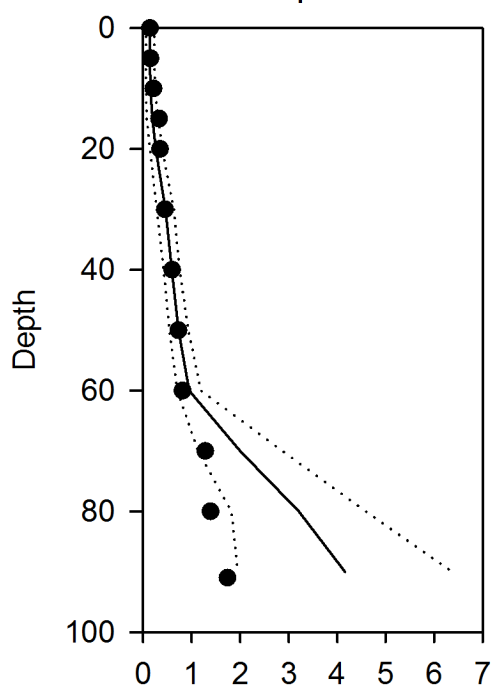
Salinity



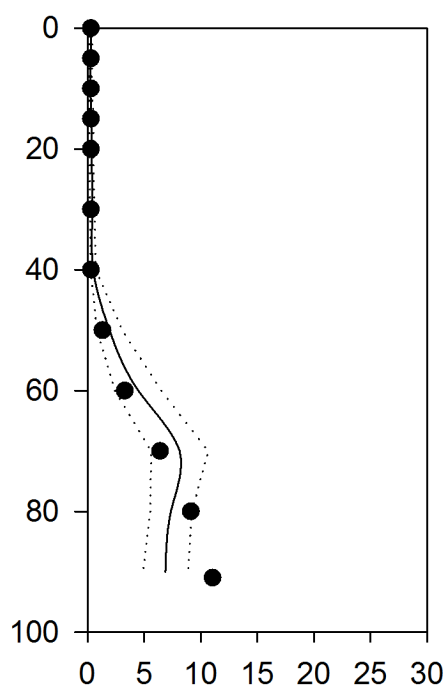
Oxygen



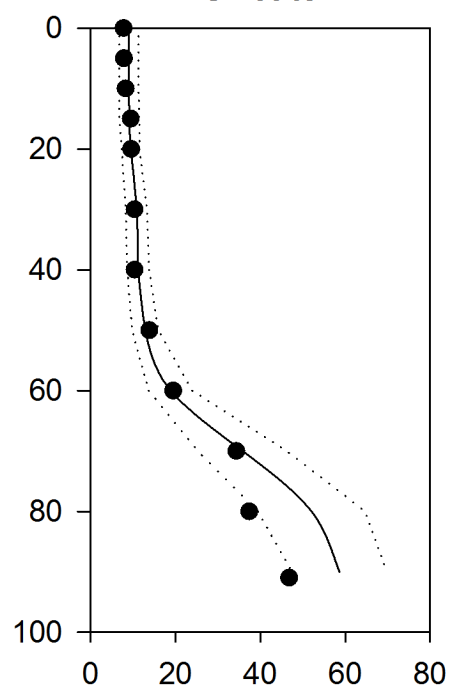
Phosphate



Inorganic Nitrogen



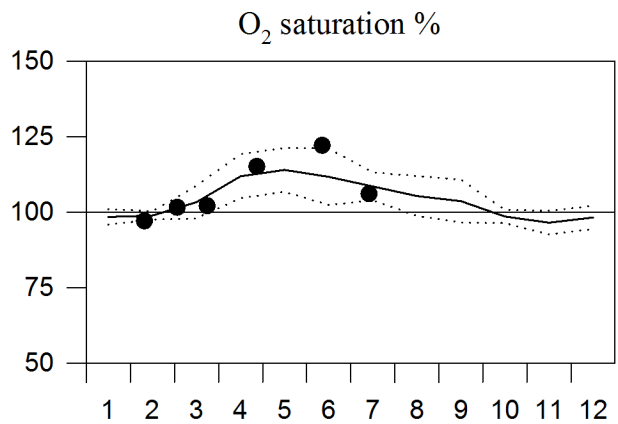
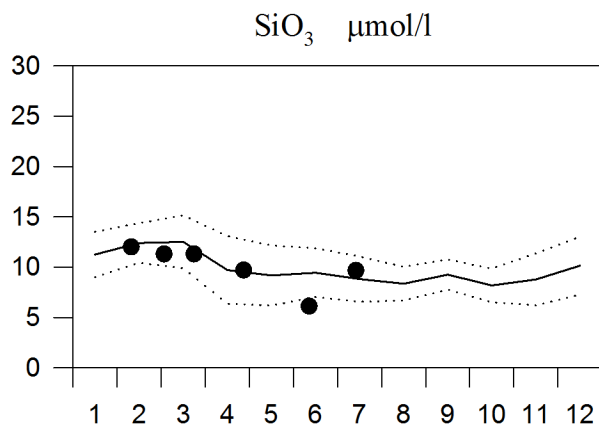
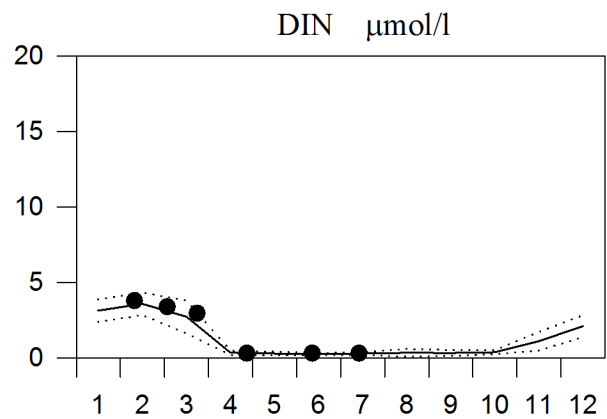
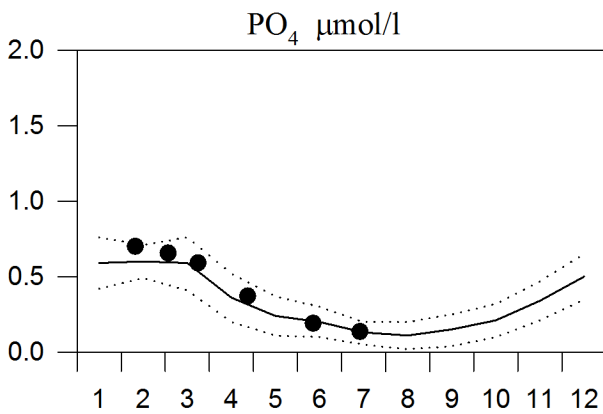
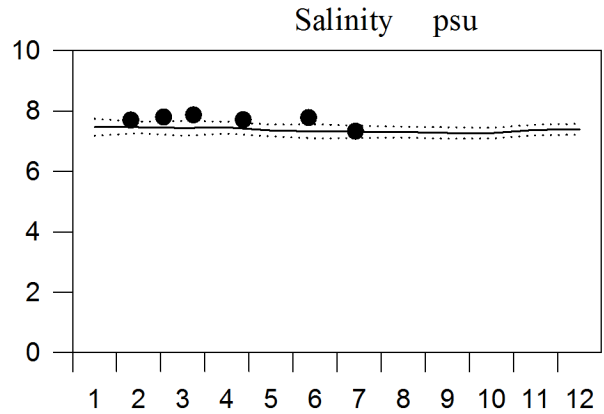
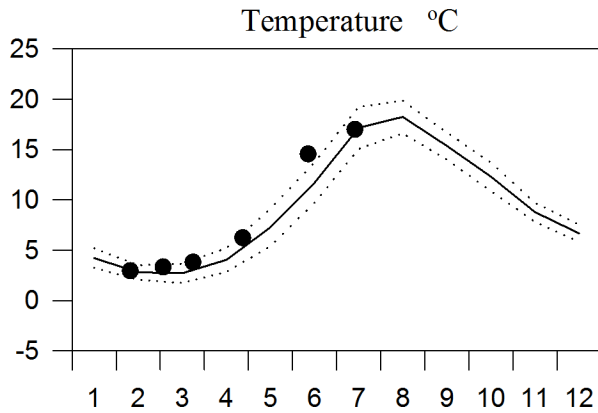
Silicate



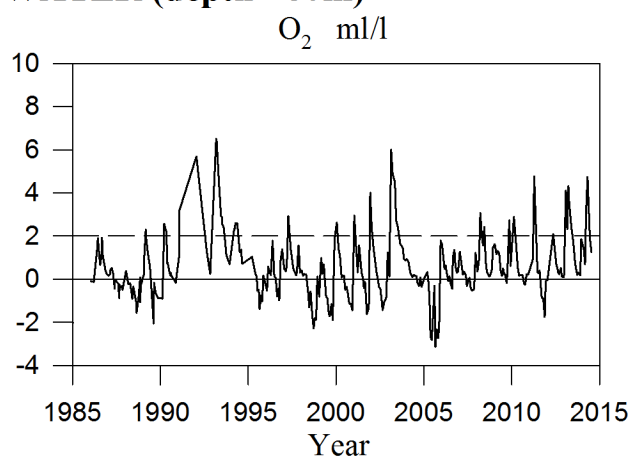
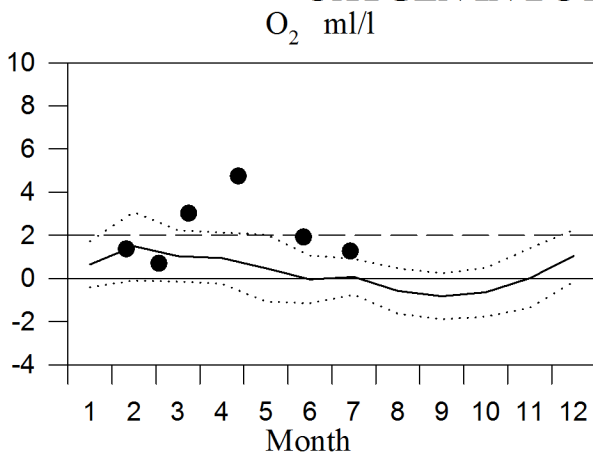
STATION BY5 SURFACE WATER

Annual Cycles

— Mean 1996-2010 St.Dev. ● 2014

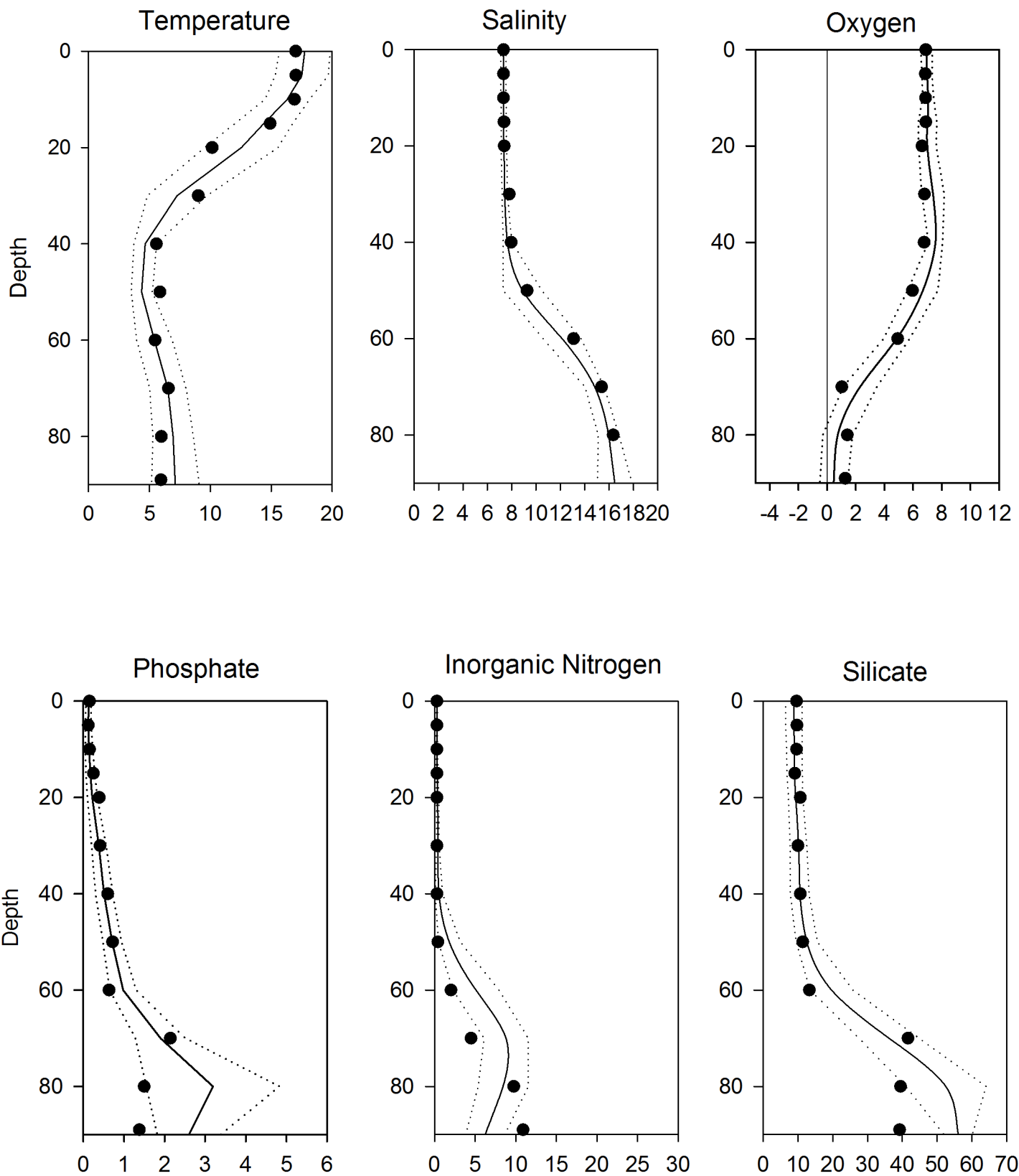


OXYGEN IN BOTTOM WATER (depth >80m)



Vertical profiles BY5 July

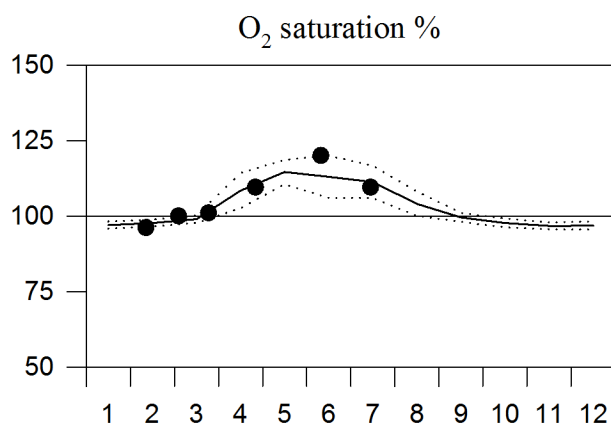
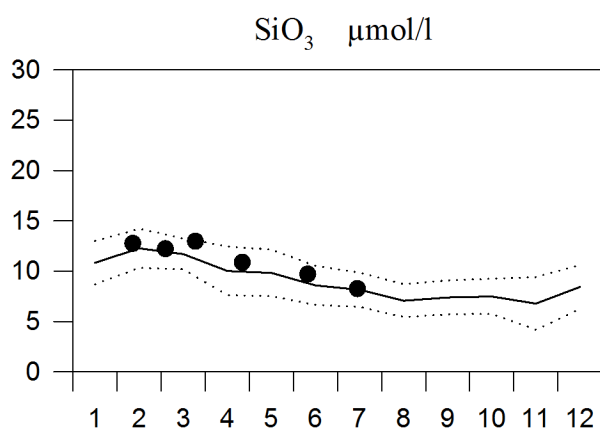
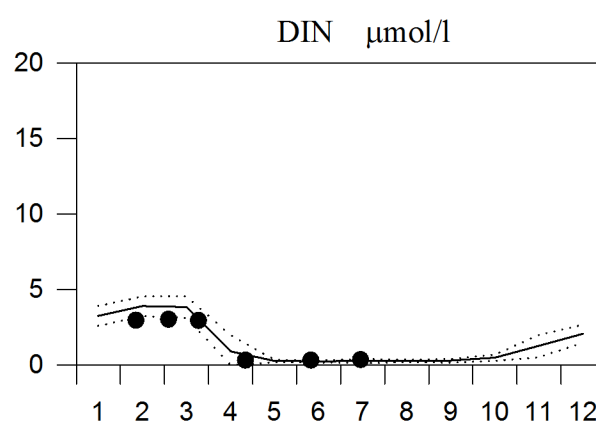
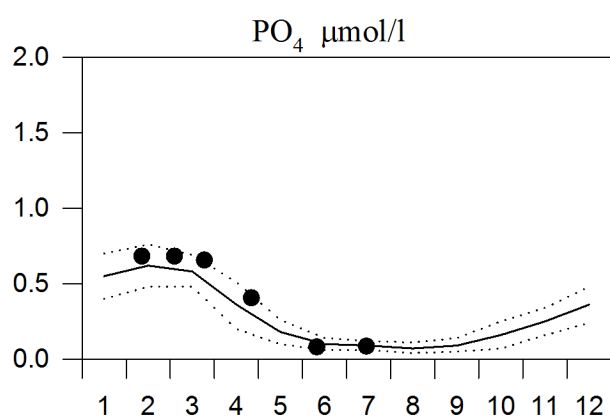
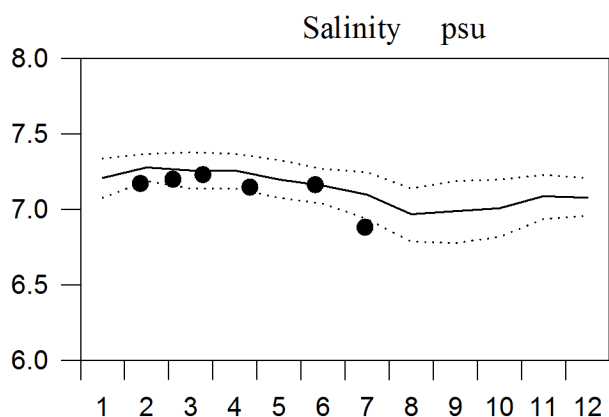
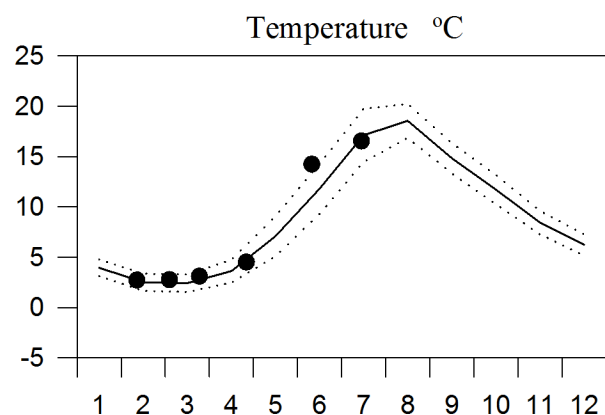
— Mean 1996-2010 St.Dev. ● 2014



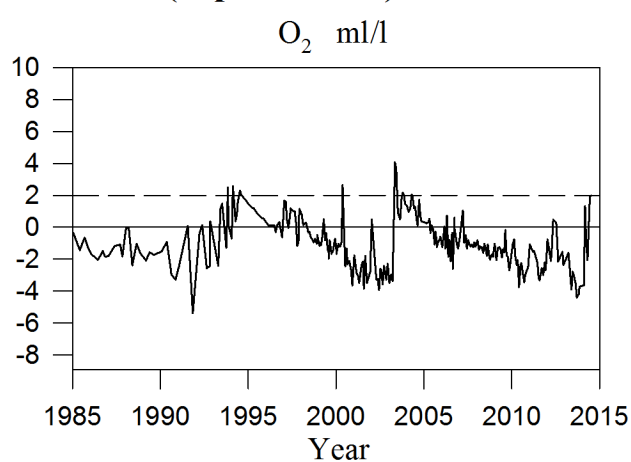
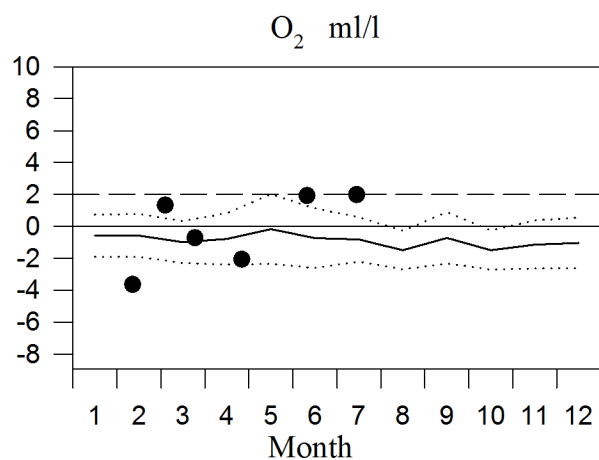
STATION BY10 SURFACE WATER

Annual Cycles

— Mean 1996-2010 St.Dev. ● 2014

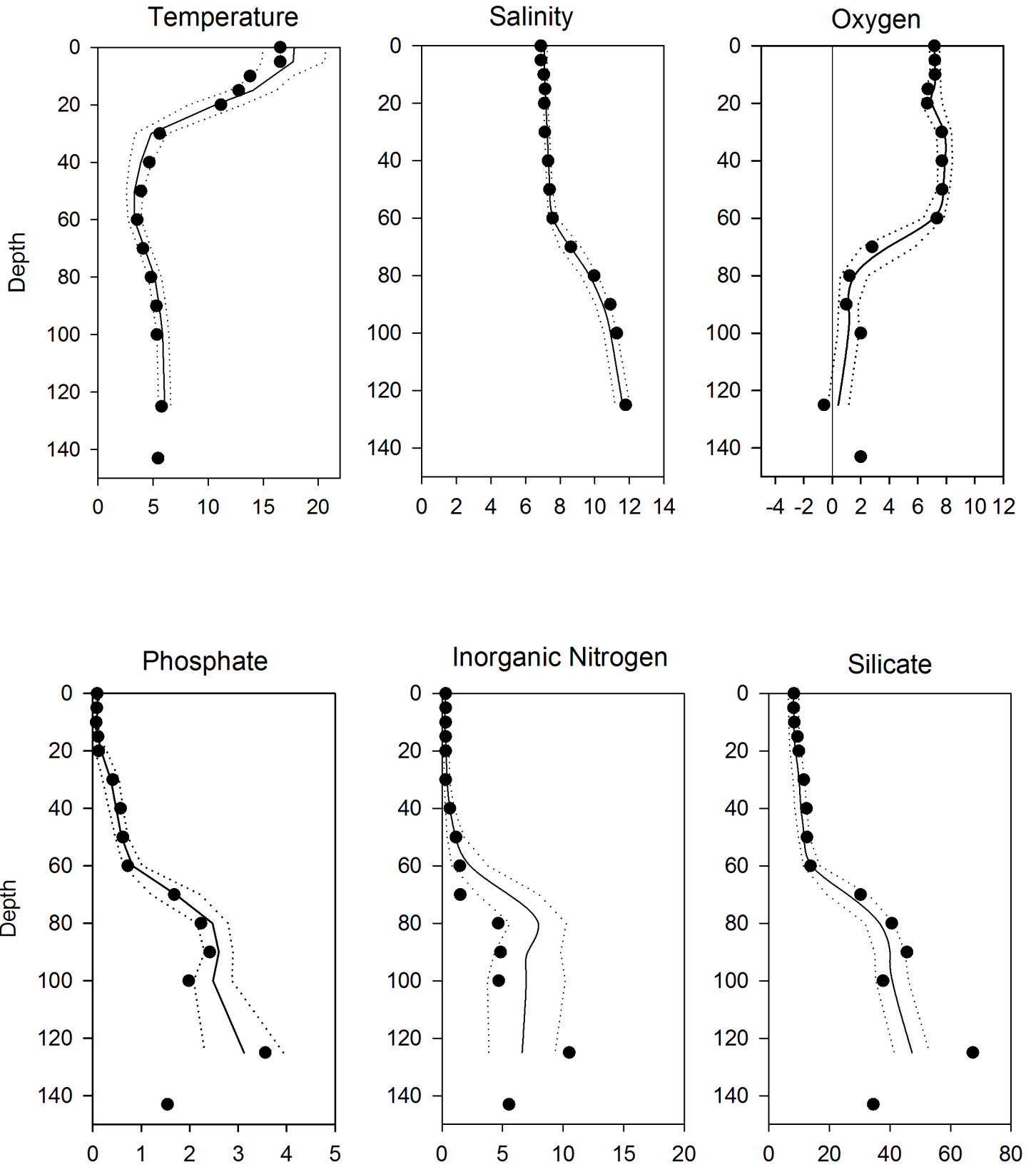


OXYGEN IN BOTTOM WATER (depth >125m)



Vertical profiles BY10 July

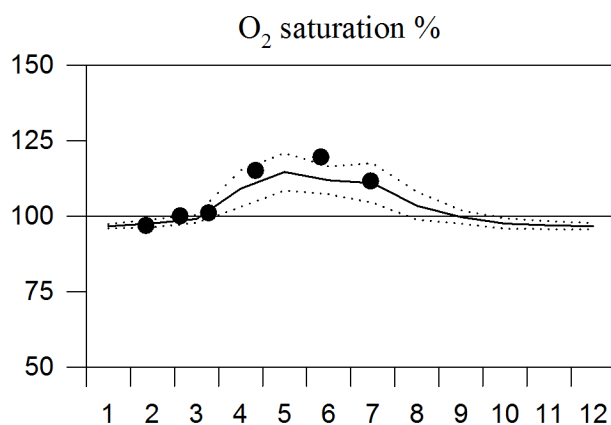
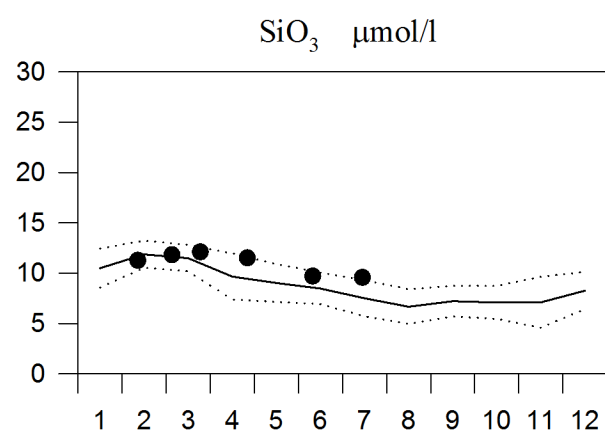
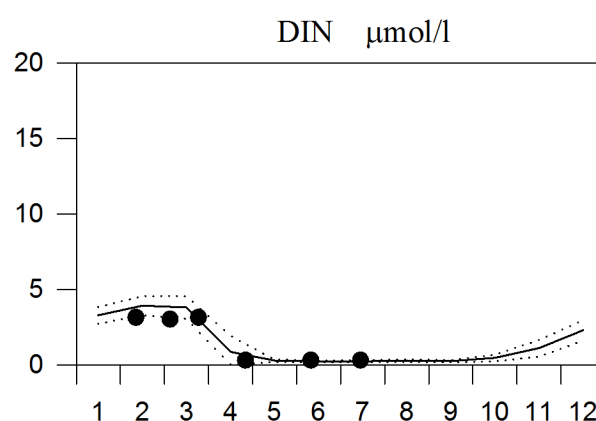
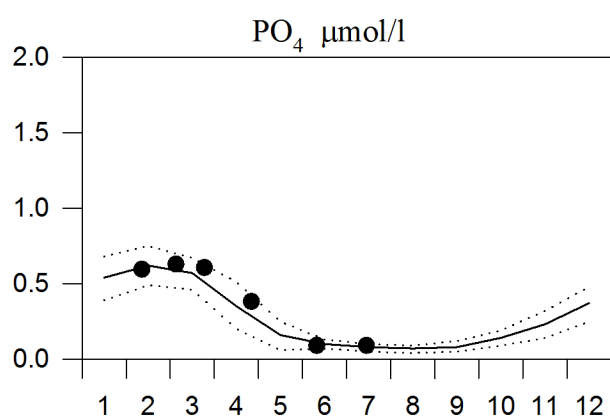
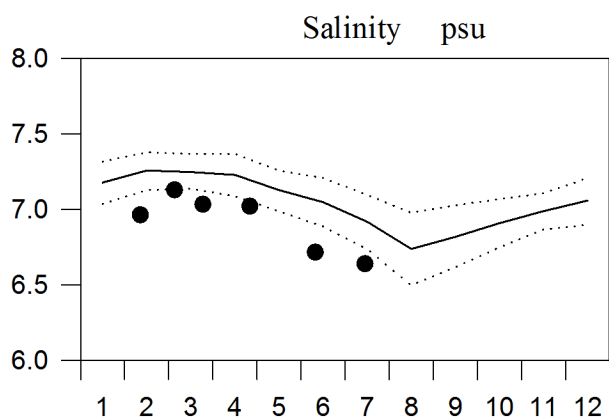
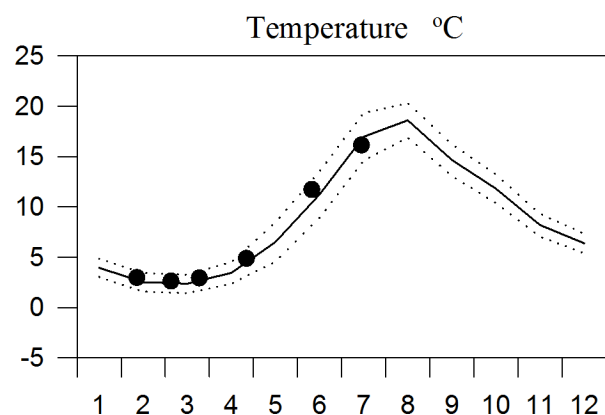
— Mean 1996-2010 St.Dev. ● 2014



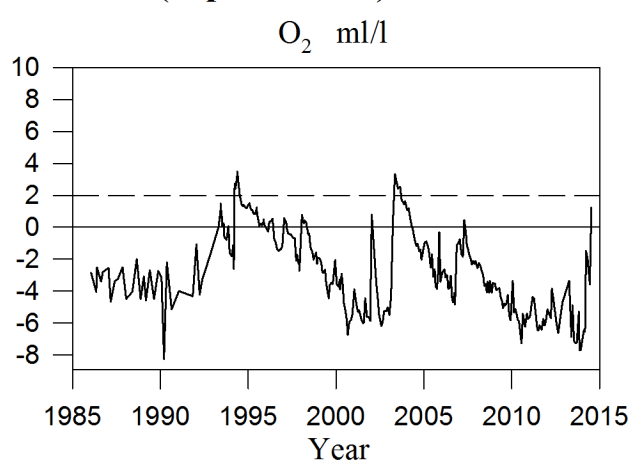
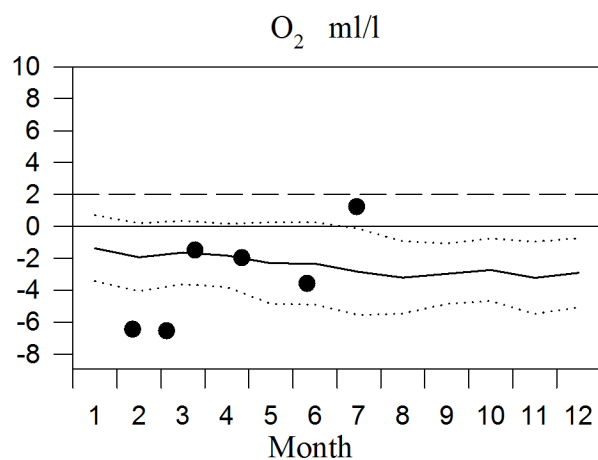
STATION BY15 SURFACE WATER

Annual Cycles

— Mean 1996-2010 St.Dev. ● 2014



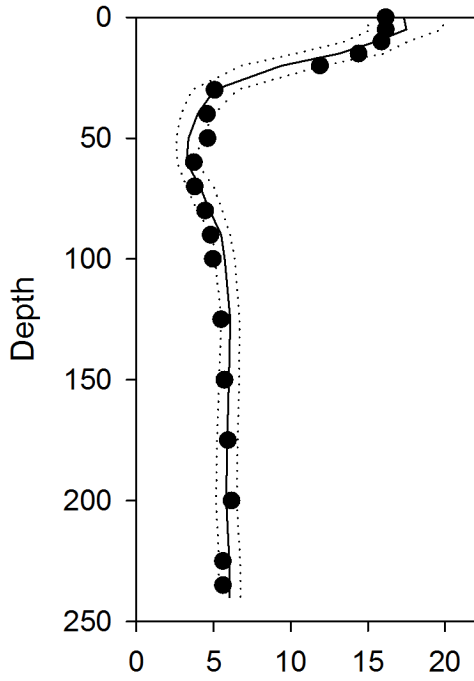
OXYGEN IN BOTTOM WATER (depth >225m)



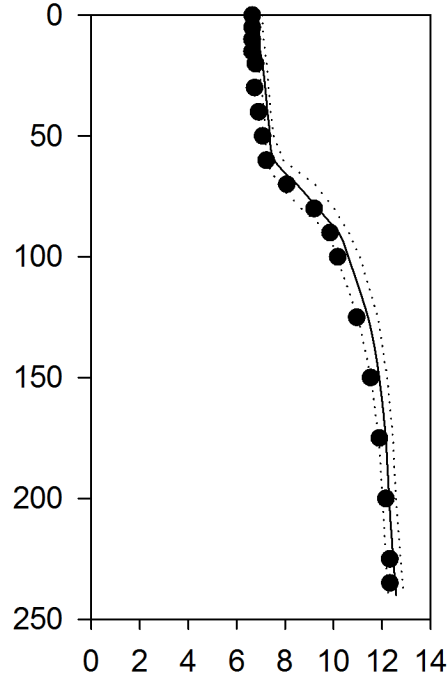
Vertical profiles BY15 July

— Mean 1996-2010 St.Dev. ● 2014

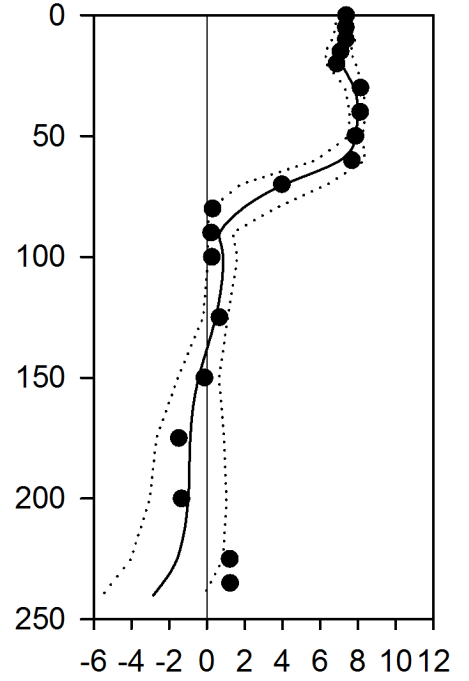
Temperature



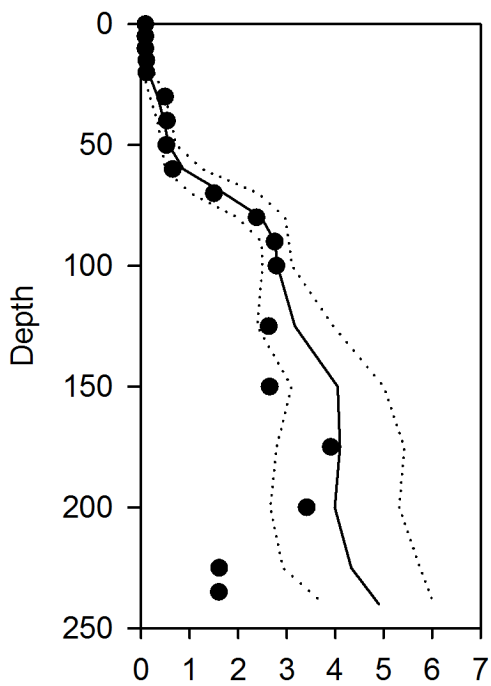
Salinity



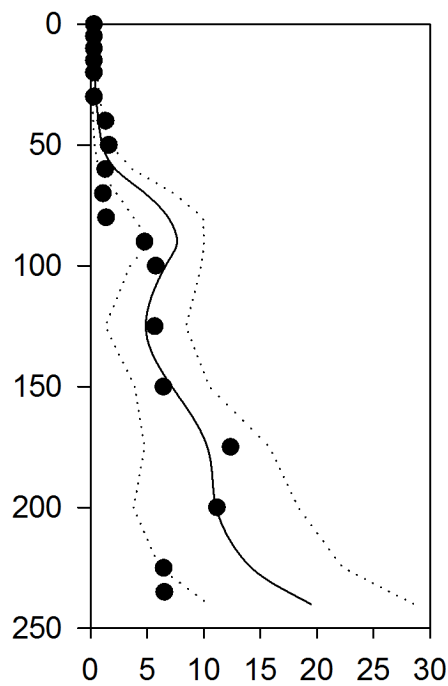
Oxygen



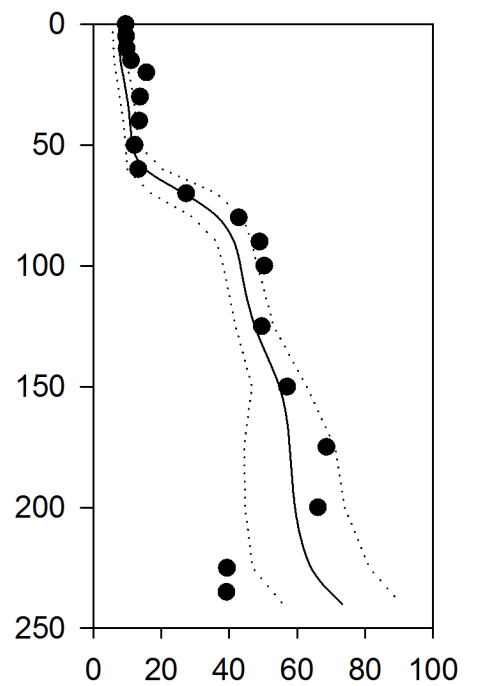
Phosphate



Inorganic Nitrogen



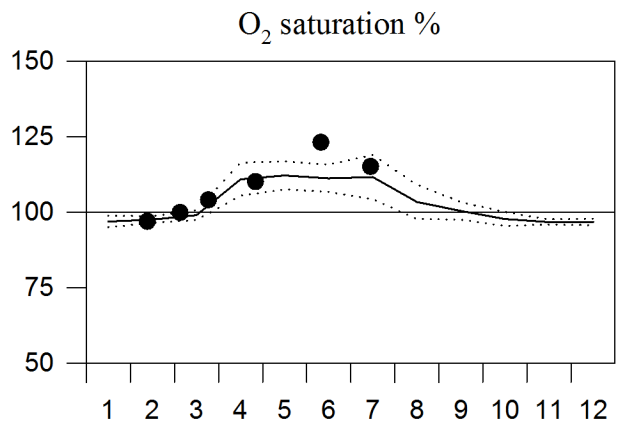
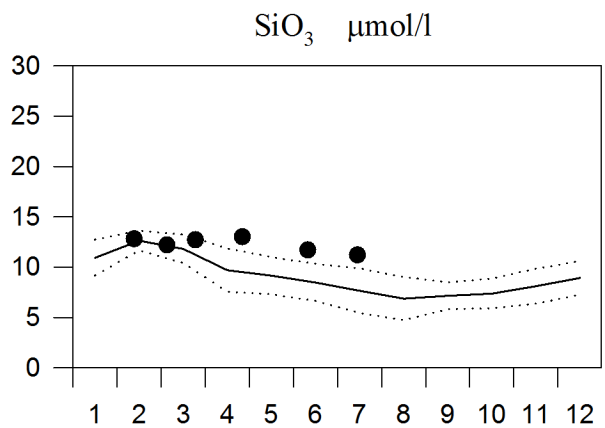
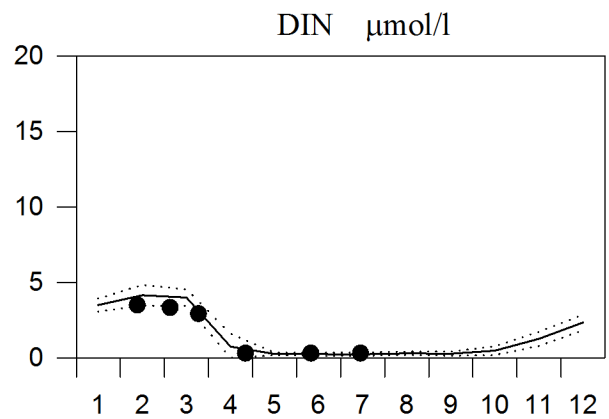
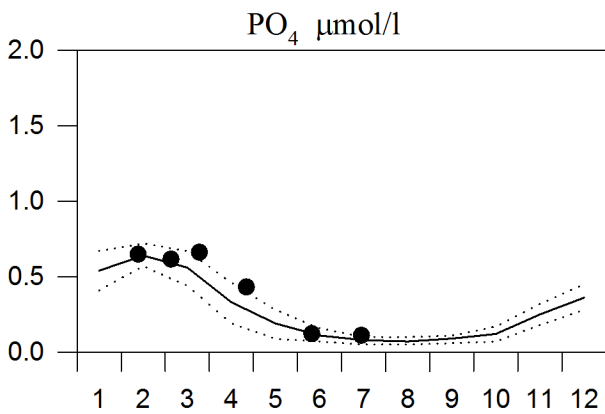
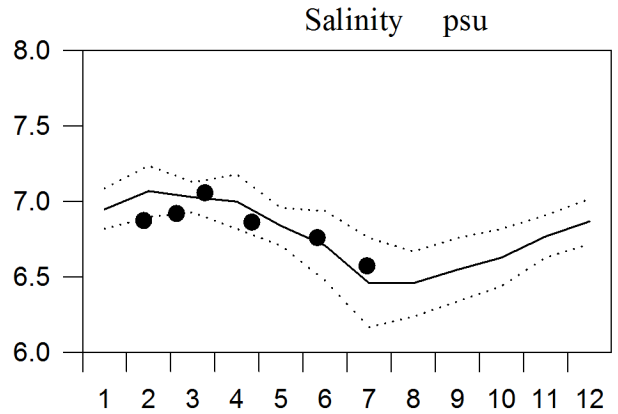
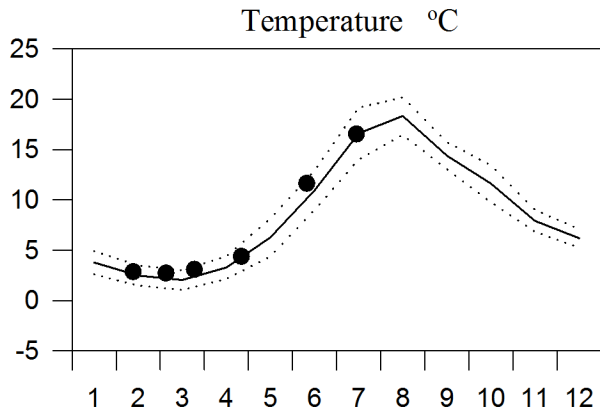
Silicate



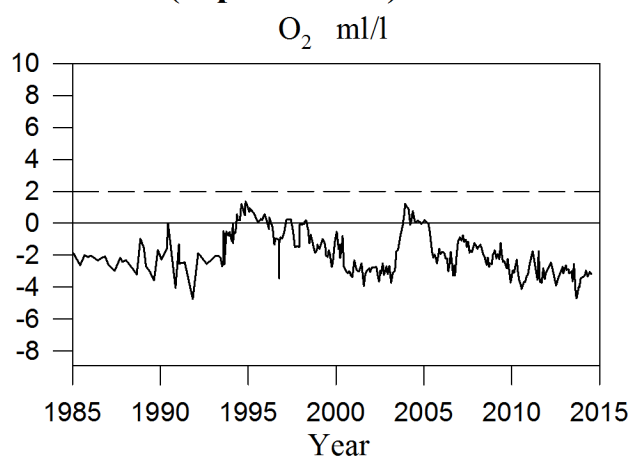
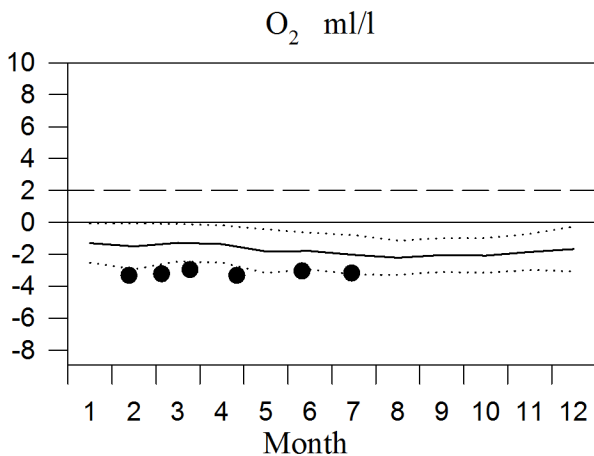
STATION BY20 SURFACE WATER

Annual Cycles

— Mean 1996-2010 St.Dev. ● 2014

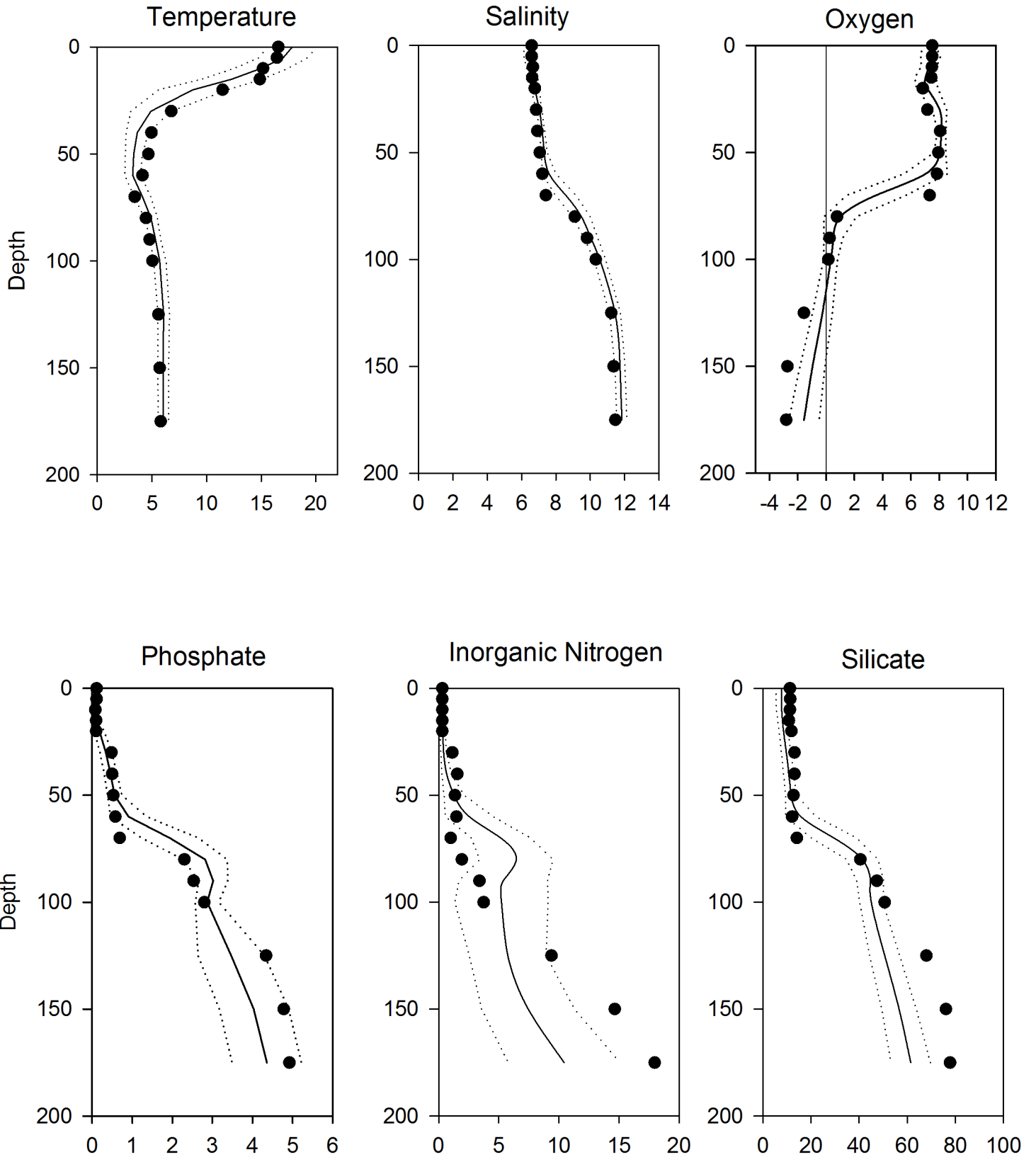


OXYGEN IN BOTTOM WATER (depth >175m)



Vertical profiles BY20 July

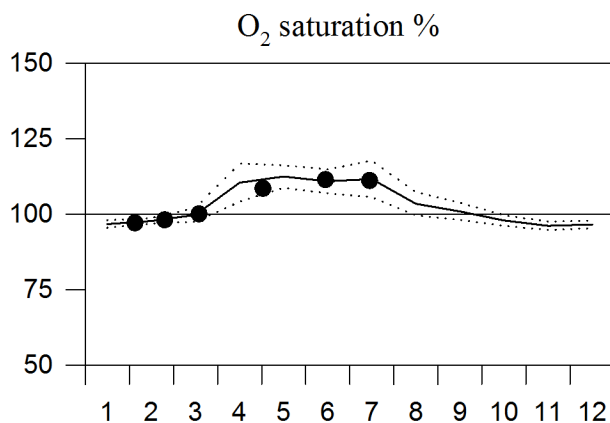
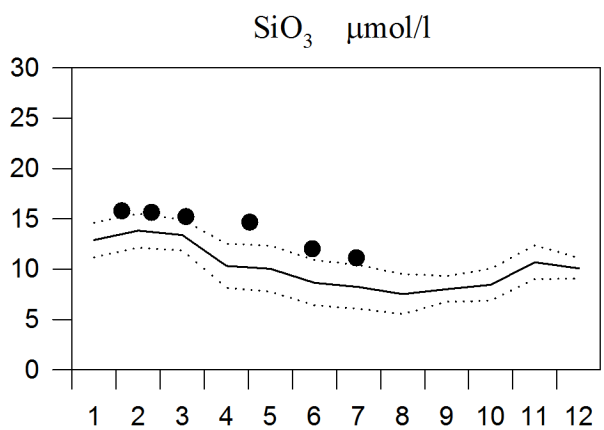
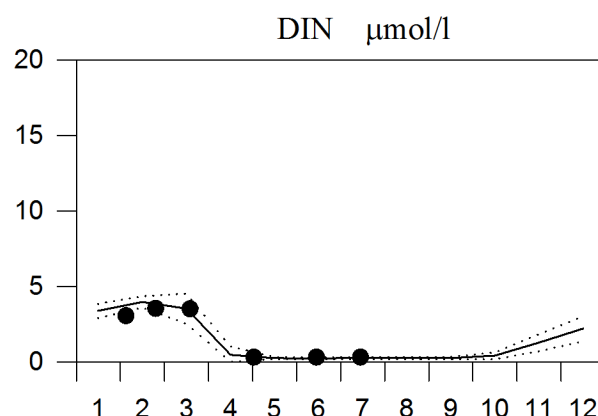
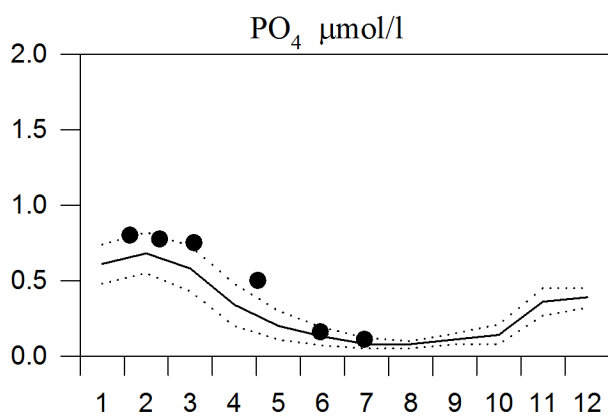
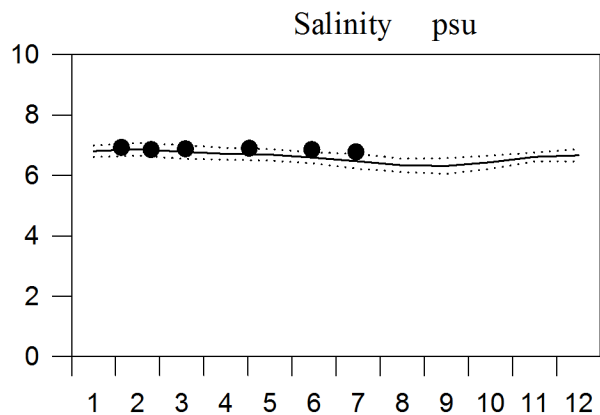
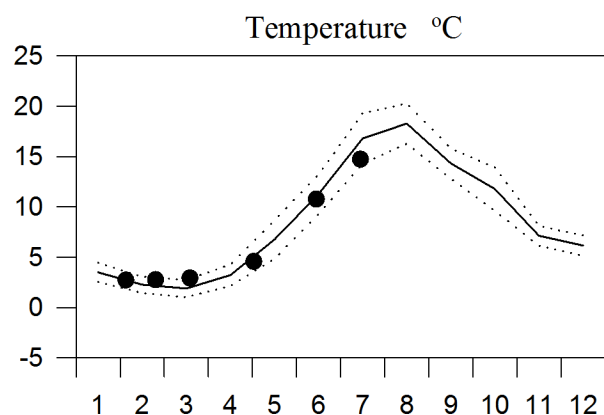
— Mean 1996-2010 St.Dev. ● 2014



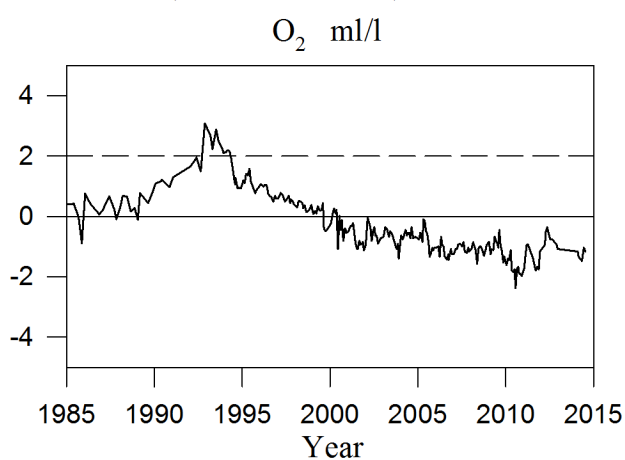
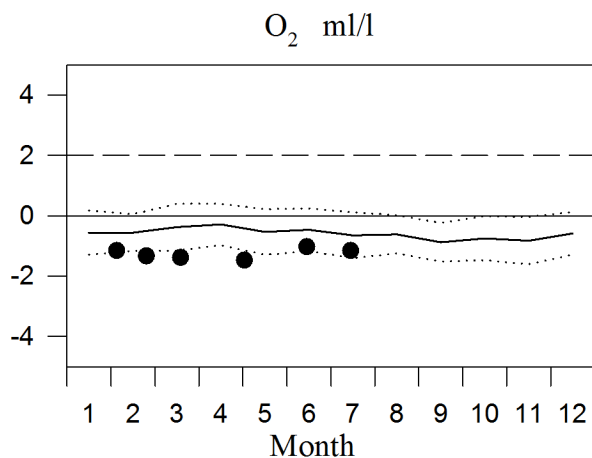
STATION BY32 SURFACE WATER

Annual Cycles

— Mean 1996-2010 St.Dev. ● 2014



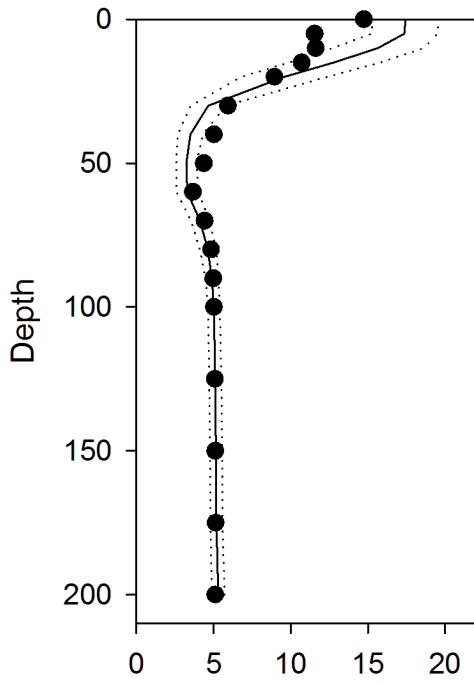
OXYGEN IN BOTTOM WATER (depth > 175m)



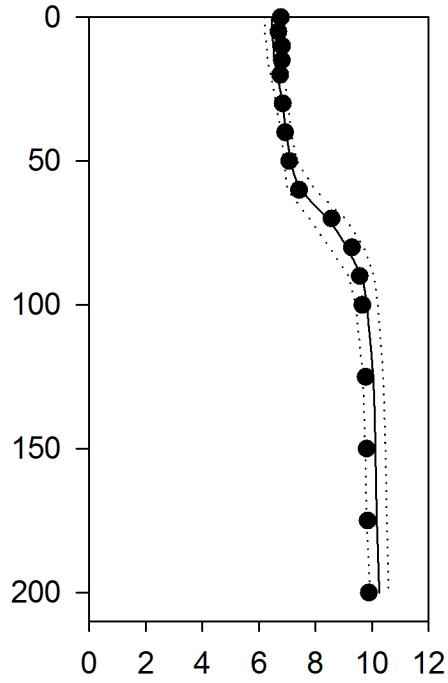
Vertical profiles BY32 July

— Mean 1996-2010 St.Dev. ● 2014

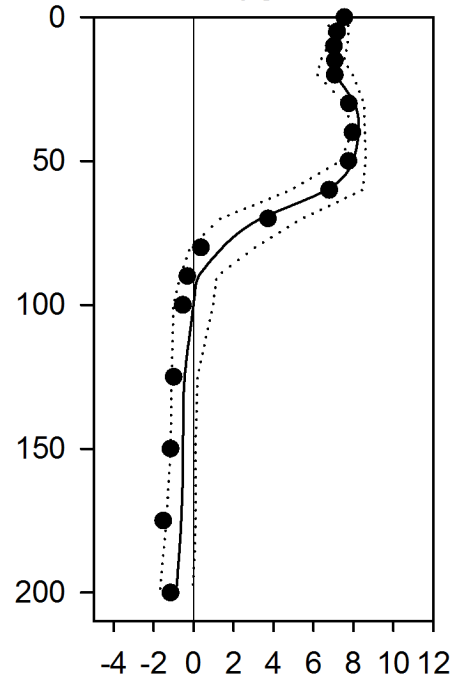
Temperature



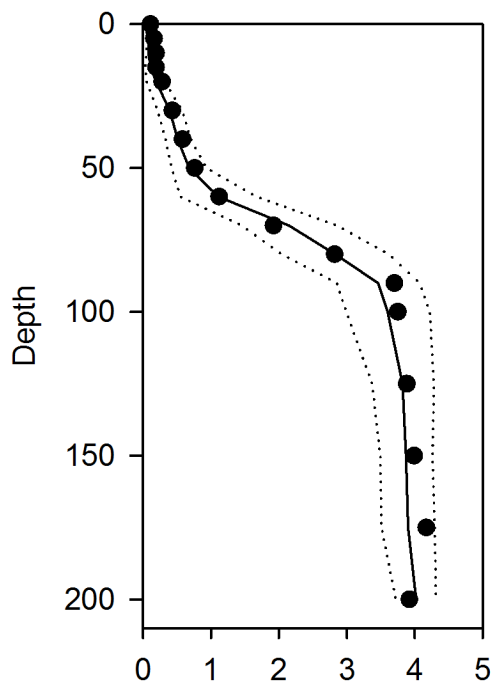
Salinity



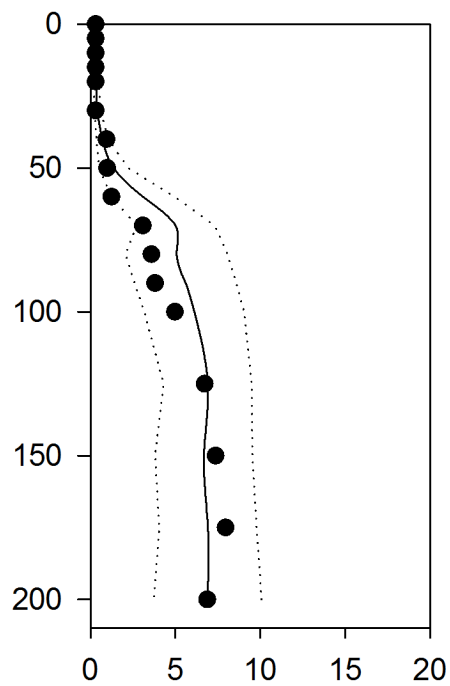
Oxygen



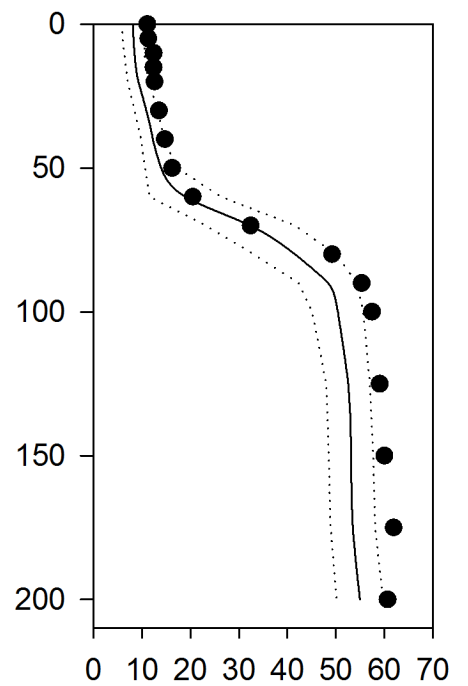
Phosphate



Inorganic Nitrogen



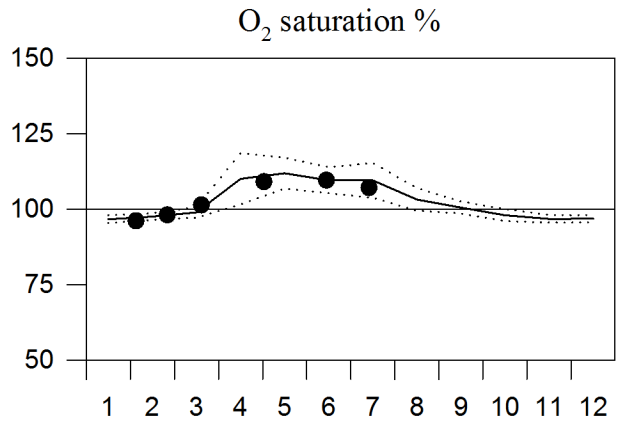
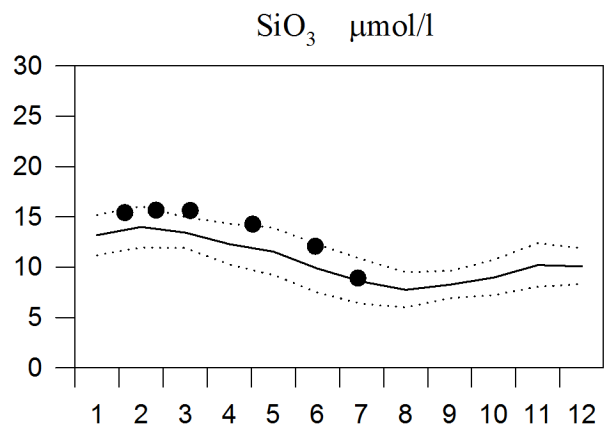
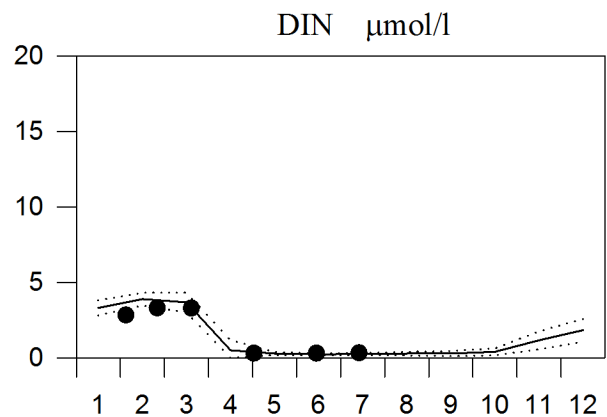
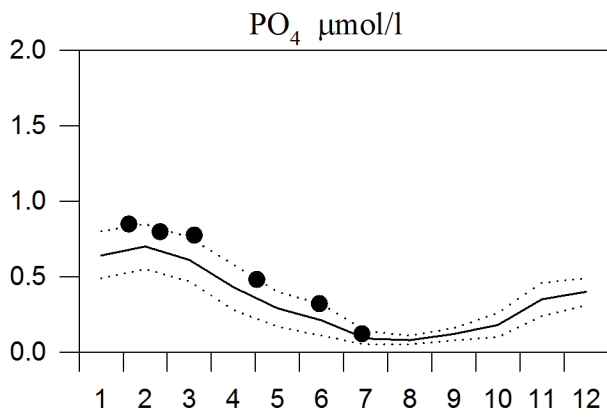
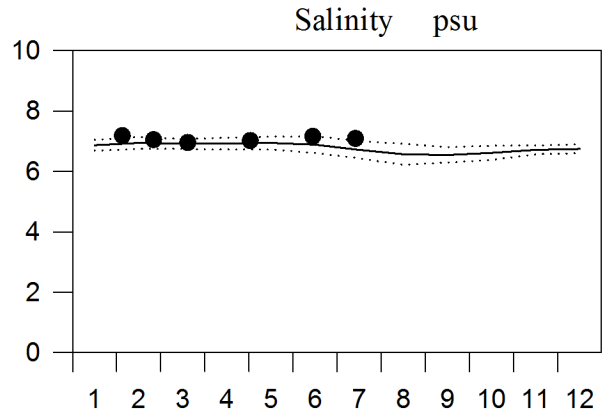
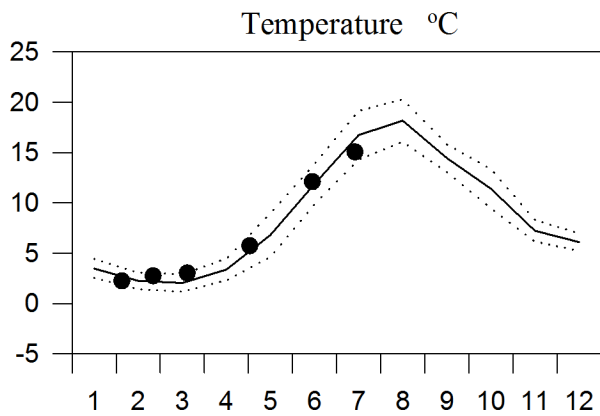
Silicate



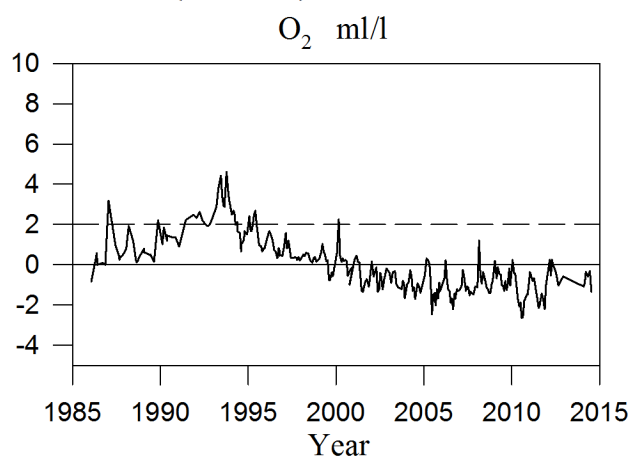
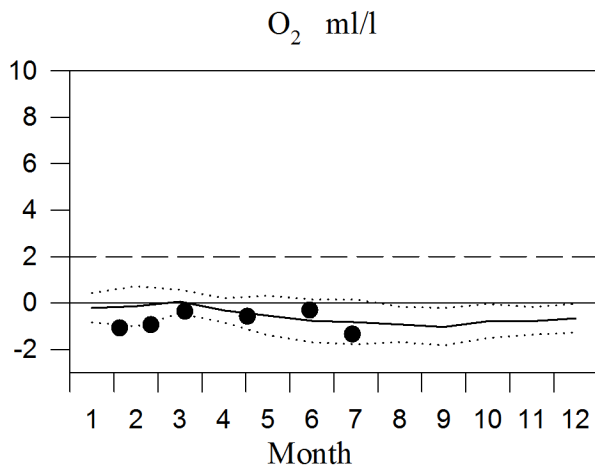
STATION BY38 SURFACE WATER

Annual Cycles

— Mean 1996-2010 St.Dev. ● 2014

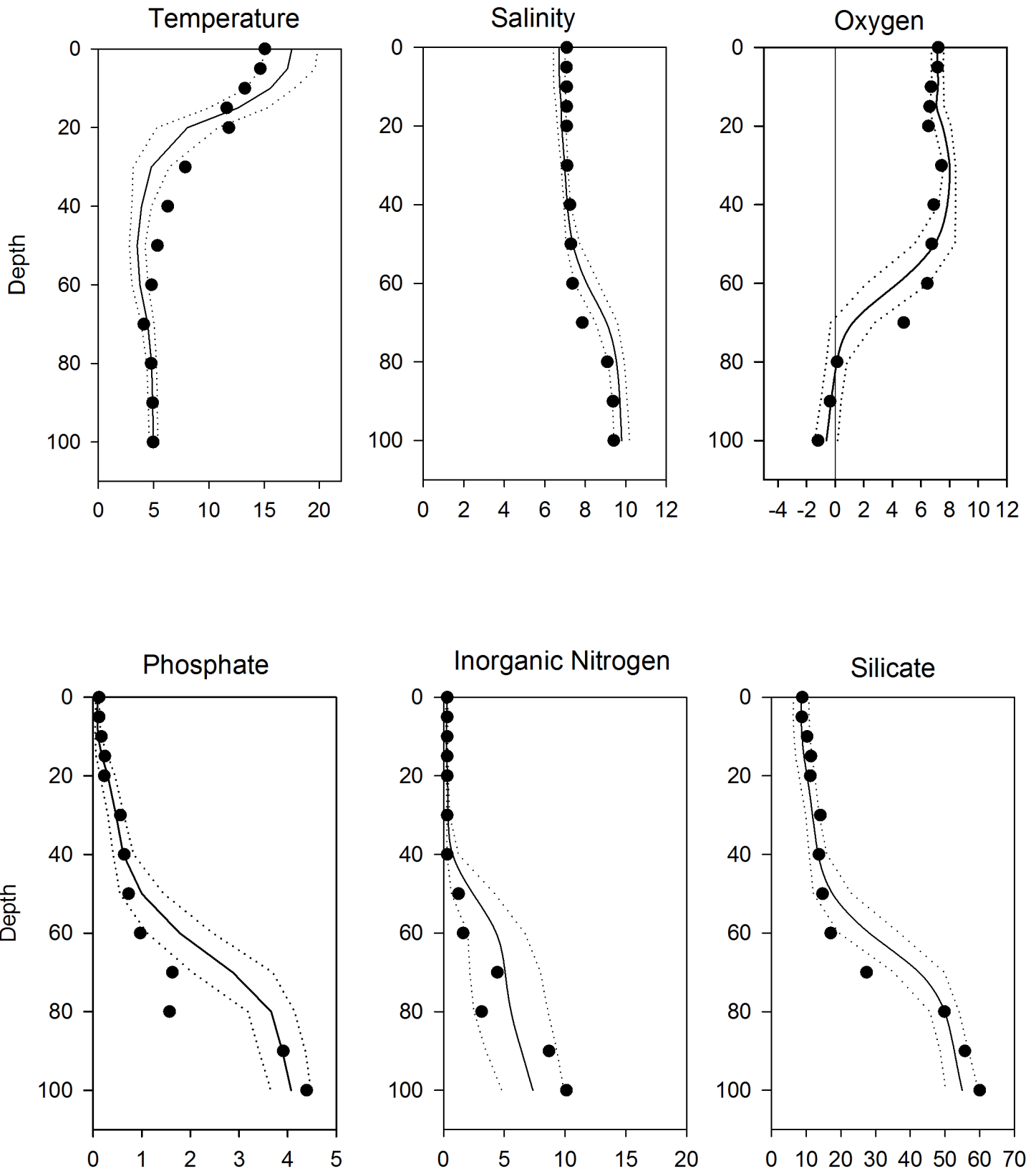


OXYGEN IN BOTTOM WATER (> 100m)



Vertical profiles BY38 July

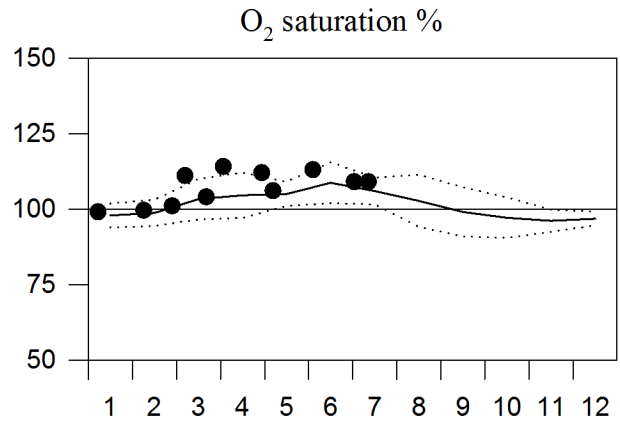
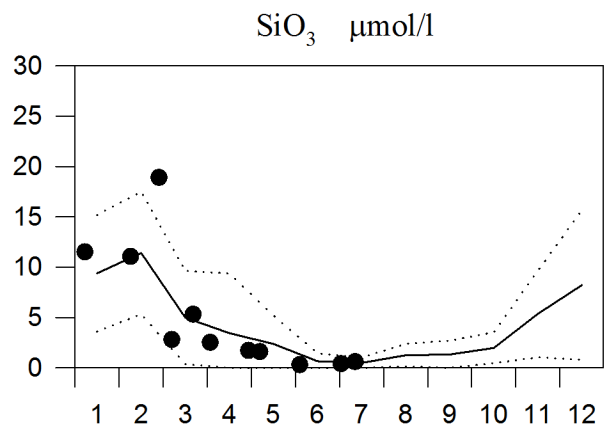
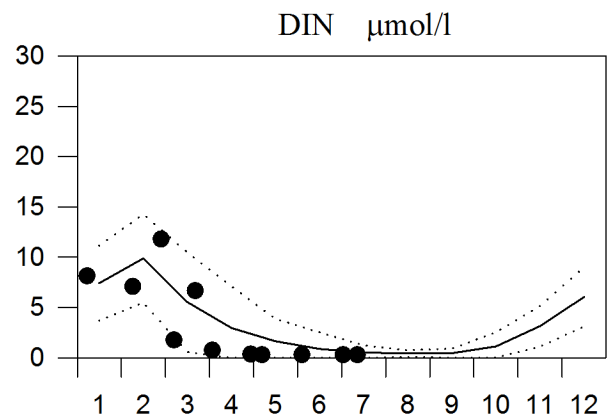
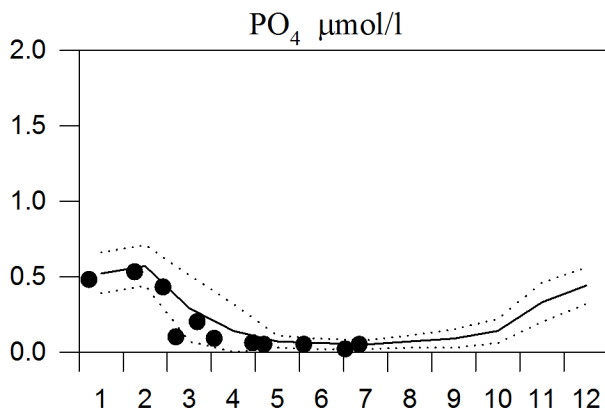
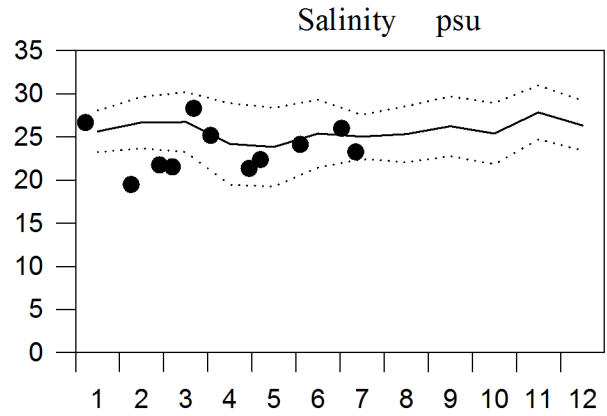
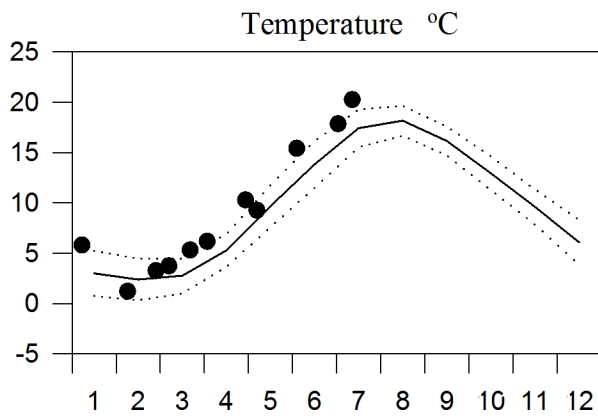
— Mean 1996-2010 St.Dev. ● 2014



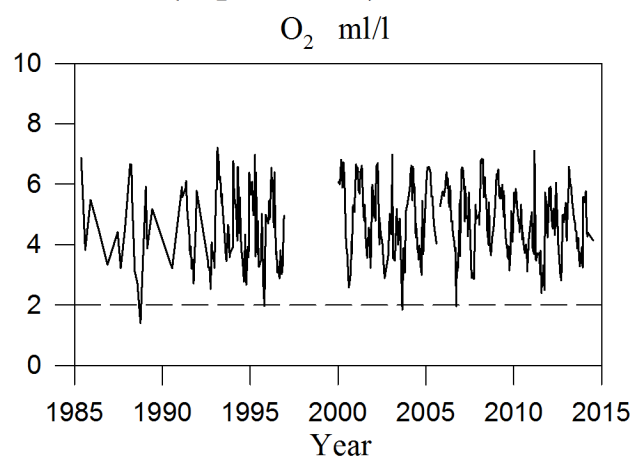
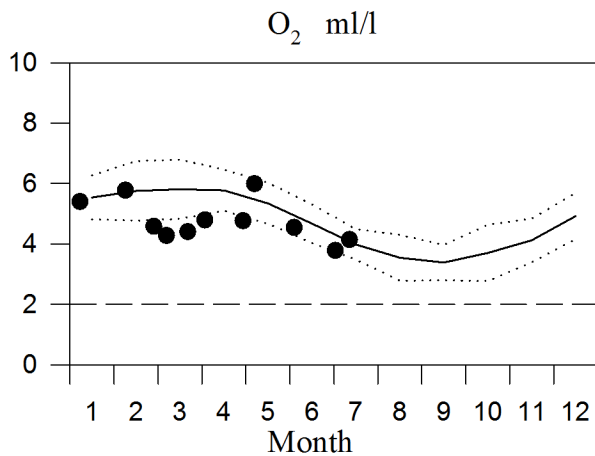
STATION SLÄGGÖ SURFACE WATER

Annual Cycles

— Mean 1996-2010 St.Dev. ● 2014

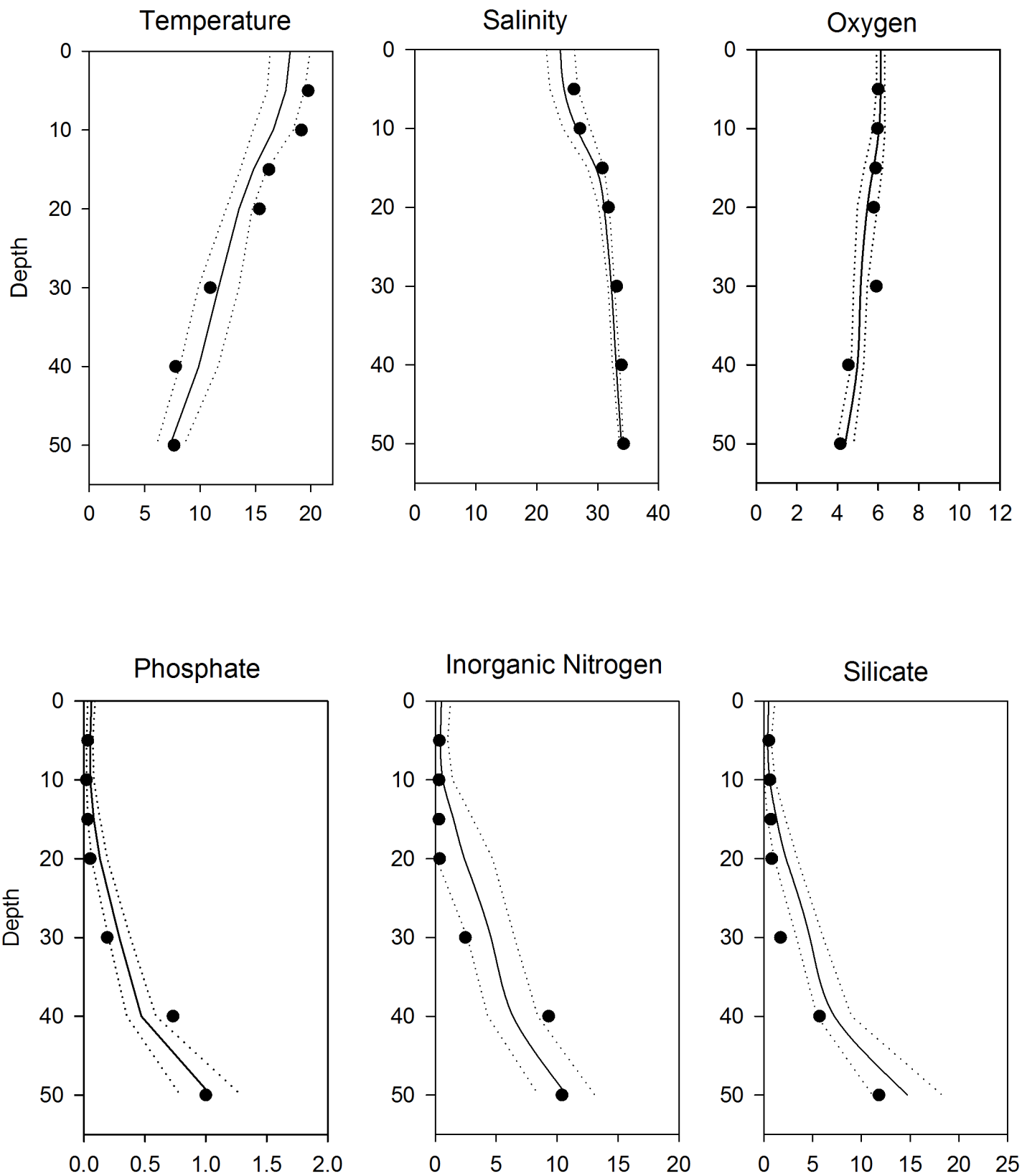


OXYGEN IN BOTTOM WATER (depth >50m)



Vertical profiles Släggö July

— Mean 1996-2010 St.Dev. ● 2014



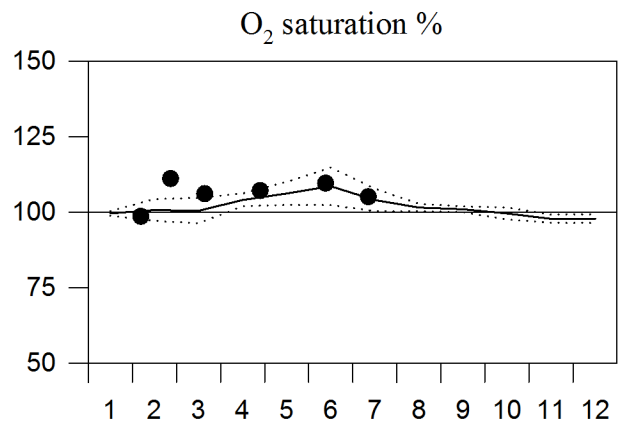
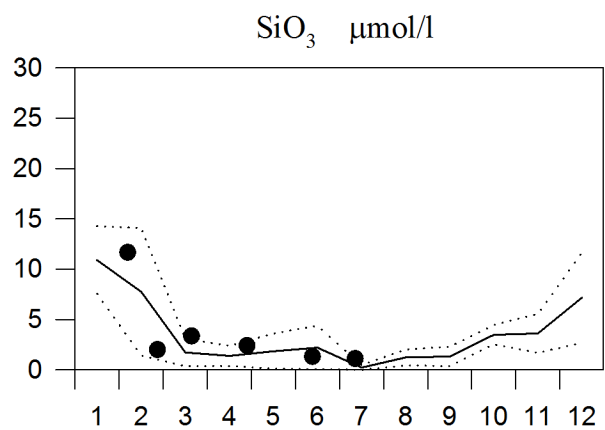
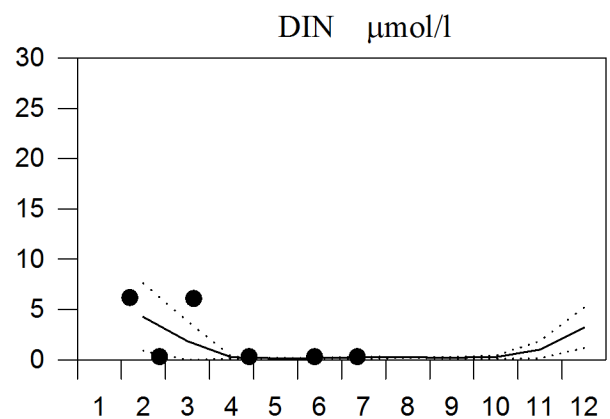
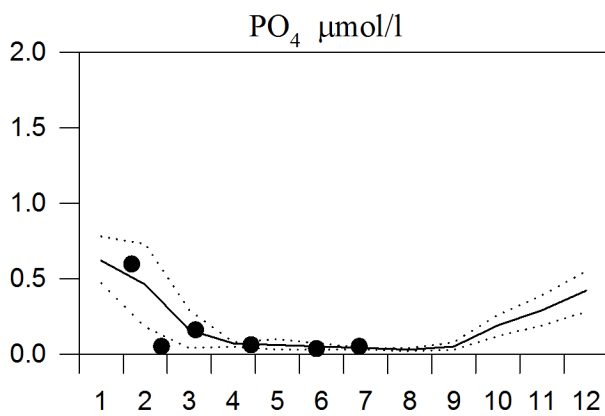
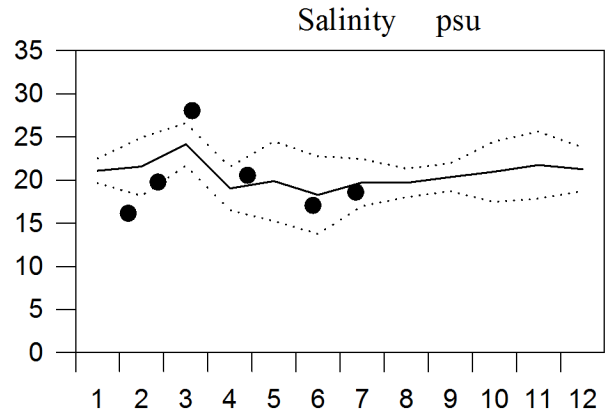
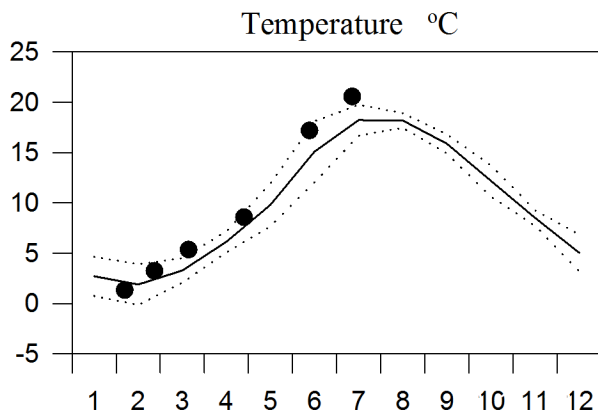
STATION N14 Falkenberg SURFACE WATER

Annual Cycles

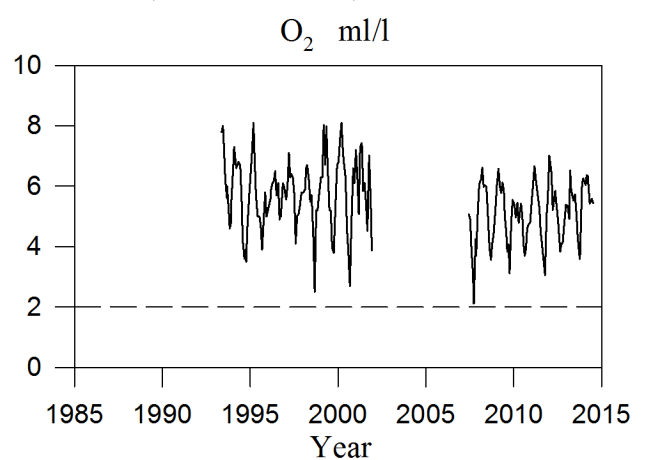
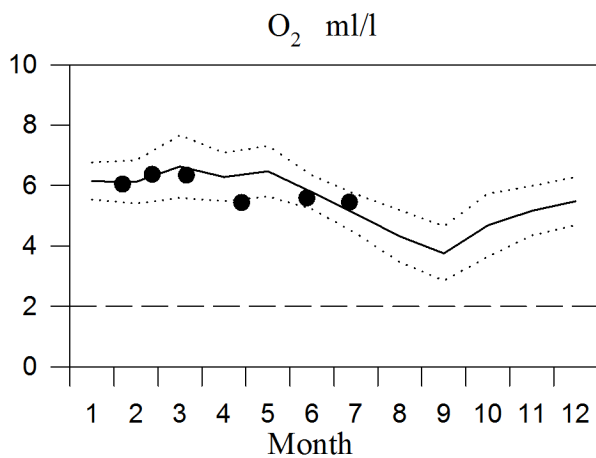
— Mean 2007-2010

..... St.Dev.

● 2014

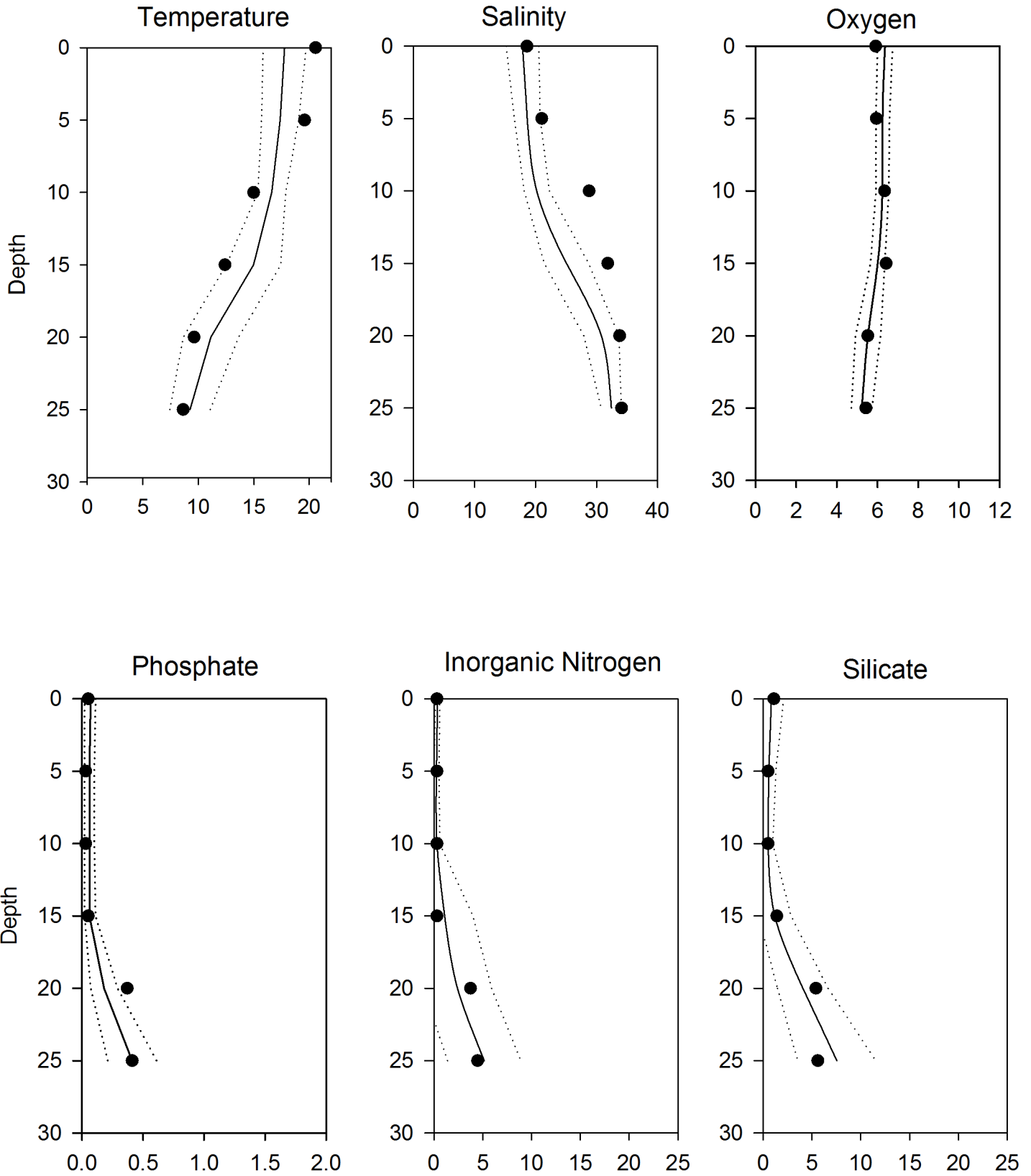


OXYGEN IN BOTTOM WATER (depth > 25m)



Vertical profiles N14 Falkenberg July

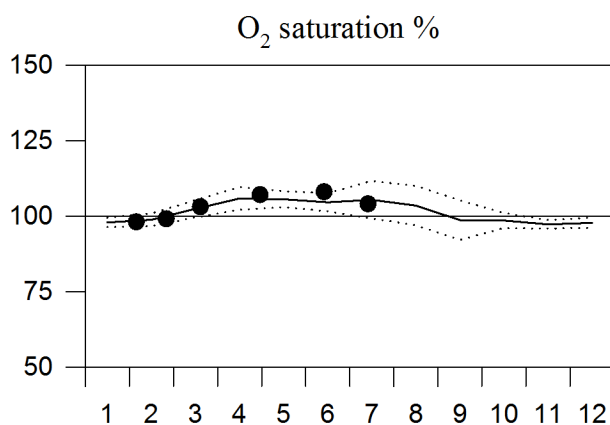
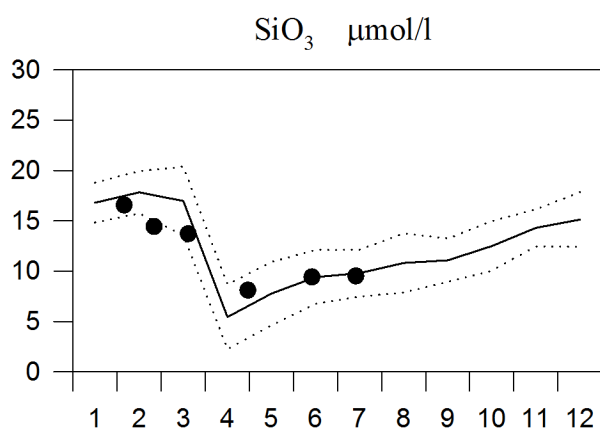
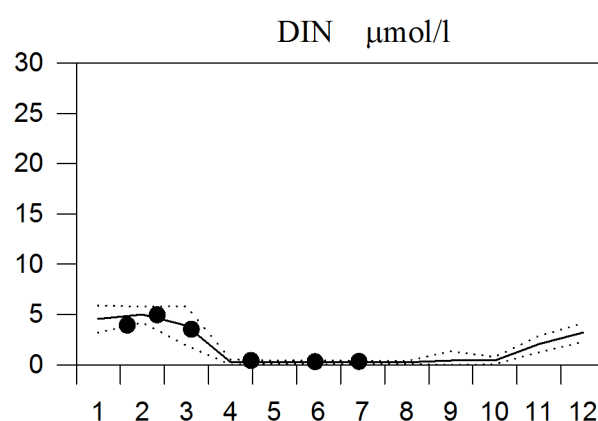
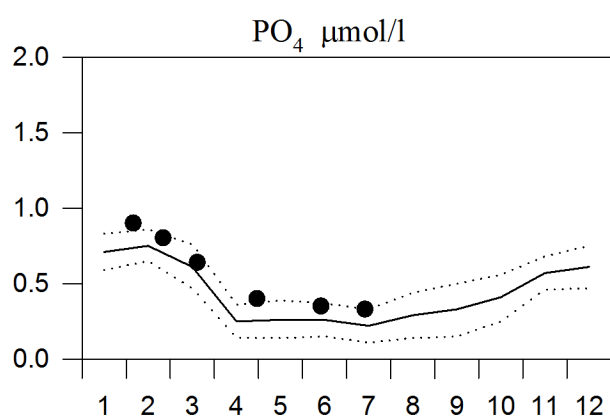
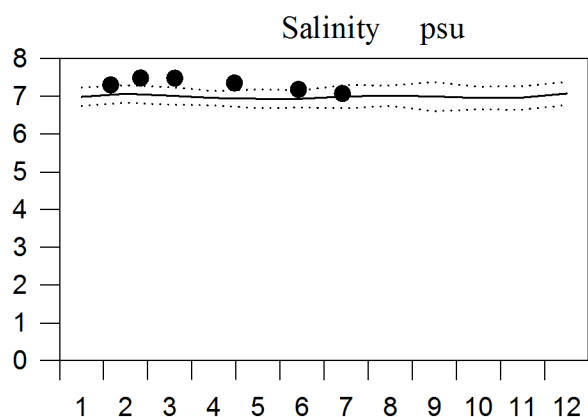
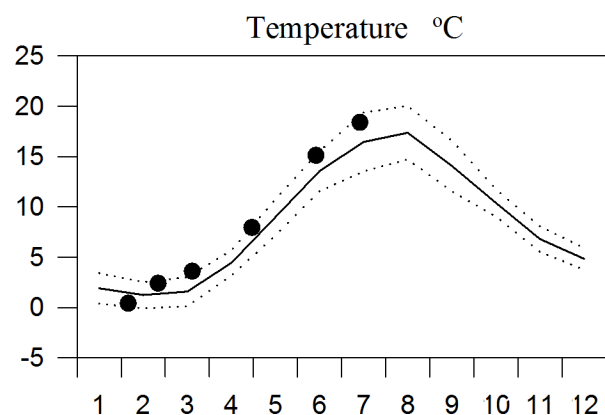
— Mean 1996-2010 St.Dev. ● 2014



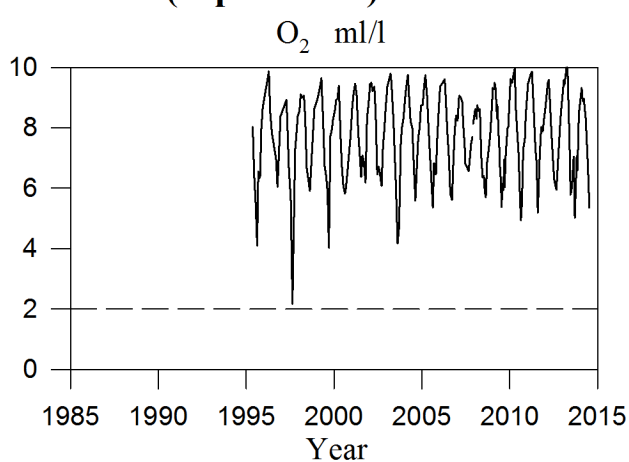
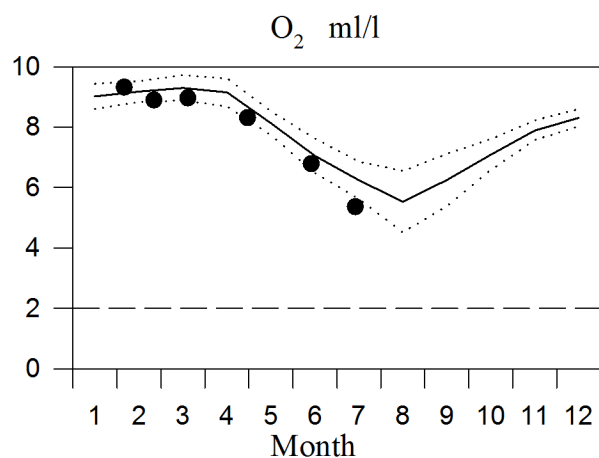
STATION REF M1V1 SURFACE WATER

Annual Cycles

— Mean 1996-2010 St.Dev. ● 2014



OXYGEN IN BOTTOM WATER (depth >15m)



Vertical profiles Ref M1V1 July

— Mean 1996-2010 St.Dev. ● 2014

