

Rapport från SMHIs utsjöexpedition med R/V Aranda



Expeditionens varaktighet: 2014-02-24 - 2014-03-04
Undersökningsområde: Skagerrak, Kattegatt och egentliga Östersjön
Uppdragsgivare: SMHI samt Havs- och Vattenmyndigheten

SAMMANFATTNING

Under expeditionen, som ingick i det svenska havsövervakningsprogrammet, besöktes Skagerrak, Kattegatt och egentliga Östersjön. I egentliga Östersjön genomfördes kartering av näringsämnen. Denna rapport är baserad på preliminära, endast delvis kvalitetskontrollerade data.

I både Skagerrak och Kattegatt var salthalten i ytvattnet lägre än normalt, vilket tyder på inverkan av utflödande Östersjövatten. I egentliga Östersjön var halterna av fosfat och silikat högre än normalt i västra Gotlandsbassängen. Syreförhållandena i Hanöbukten och Bornholmsbassängen hade åter försämrats och akut syrebrist förekom i bottenvattnet. I västra, östra och norra Gotlandsbassängen sågs ingen förbättring av syresituationen. Helt syrefria förhållanden, återfanns från 90-100 meter djup och akut syrebrist från 70-90 meters djup. Vårblomningen pågick för fullt i Kattegatt, var i startskedet i Skagerrak. I egentliga Östersjön syntes tecken på en begynnande blomning i de södra delarna.

Nästa ordinarie expedition är planerad till vecka 12. Då kommer egentliga Östersjön, Skagerrak och Kattegatt att besökas.

PRELIMINÄRA RESULTAT

Expeditionen, vilken var den andra med det finska forskningsfartyget Aranda, startade i Helsingfors den 24:e februari och avslutades i Nynäshamn den 4:e mars. Under expeditionen genomfördes vinterkartering av näringsämnen i egentliga Östersjön. Totalt under hela expeditionen besöktes ett 40-tal provtagningsstationer. Ett uppehåll gjordes i Lysekil för att ta ombord kompletterande utrustning samt för att ta iland prover. En vågboj vid Väderöarna togs upp och ersattes med en ny. Vindriktningen var i huvudsak mellan ost och syd. Under första dygnet rådde kuling, därefter avtog vinden och varierade mellan svag och måttlig. Lufttemperaturen varierade mellan 1 och 5°C.

Skagerrak

Temperaturen i ytlagret var normal för årstiden och varierade mellan 3.4 och 4.2°C. Salthalten var lägre än normalt, dock inte lika låg som under förra expeditionen, från 23.5 psu närmast kusten till 30.1 psu i centrala Skagerrak.

Haloklinen var välutvecklad och återfanns på djup mellan 10-15 meter. Termoklinen var inte lika distinkt och varierade både i djup och vertikal utsträckning. Närsalthalterna i ytvattnet uppvisade mycket stora variationer mellan provtagningspunkterna. Fosfathalterna varierade från 0.07 till 0.43 $\mu\text{mol/l}$, silikat mellan 2.3 och 8.8 $\mu\text{mol/l}$, medan oorganiskt kväve hade koncentrationer från 3.3 till 9.8 $\mu\text{mol/l}$.

Höga fluorescenstoppar registrerades på ett flertal djup i ytlagret, dock var även i detta fall variationen mellan stationerna stor. De högsta fluorescensvärdena uppmättes vid stationen Å13 nära Bohuskusten, där även syremättnaden var som högst, 110 %.

Kattegatt och Öresund

Ytvattentemperaturen var normal, varierande mellan 3.0–3.3°C. Salthalten i Kattegatts ytvatten låg något under det normala, 19.5-20 psu, i Öresund ca.10 psu. Termoklin och haloklin sammanföll på djup mellan 8 och 20 meter. Haloklinen var mycket väl utvecklad.

Näringsämnena i Kattegatts ytvatten var normala för årstiden och hade sjunkit kraftigt sedan föregående mätning. Samtliga närsalter uppvisade stora variationer i rummet, fosfat-koncentrationerna låg mellan 0.05–0.29 $\mu\text{mol/l}$. Halterna av nitrit + nitrat varierade från under detektionsgränsen <0.10 $\mu\text{mol/l}$ till 2.8 $\mu\text{mol/l}$, medan silikat hade koncentrationer mellan 2.0 och 6.5 $\mu\text{mol/l}$.

Vårblomningen var i full gång och både fluorescens och syremättnad uppvisade höga värden. Syreförhållandena i djupvattnet var goda, det lägsta värdet i Kattegatt uppmättes vid Anholt E, 6.10 ml/l. I Öresund uppmättes som lägst 5.6 ml/l.

Egentliga Östersjön

Ytvattentemperaturen var normal för årstiden och varierade mellan 2.6–3.3°C. Salthalten i ytlagret var något förhöjd i Hanöbukten och i Bornholmsbassängen mellan 7.8–7.9 psu, medan den i östra Gotlandsbassängen låg något under det normala, 7.1 psu. I egentliga Östersjön var ytlagret välblandat, termoklin och haloklin sammanföll och återfanns på omkring 70 - 80 meters djup i norra, västra och östra Gotlandsbassängen, på 55 meters djup i Bornholmsbassängen och på 25 - 35 meters djup i Arkonabassängen.

Halterna av fosfat och silikat var högre än normalt i västra Gotlandsbassängen, 0.78–0.83 $\mu\text{mol/l}$ respektive 15.6–16.3 $\mu\text{mol/l}$. I övriga områden var halterna normala för årstiden och varierade mellan 0.60–0.70 $\mu\text{mol/l}$, respektive 11.0–14.5 $\mu\text{mol/l}$. Halten av nitrit + nitrat var generellt något lägre än normalt i alla områden, förutom i Arkona och Bornholmsbassängen där halterna var normala. Summan av nitrit+nitrat varierade mellan 2.8–3.7 $\mu\text{mol/l}$.

Sedan december 2013 och under inledningen av 2014 har inga större inflöden till Östersjön ägt rum. De små inflöden som dock inträffat har medfört goda syreförhållanden i Arkonabassängens bottenvatten. I Bornholmsbassängen och Hanöbukten, där inflöden under hösten 2013 hade förbättrat syresituationen, hade nu syresituationen återigen försämrats och halterna låg under gränsen för akut syrebrist (< 2 ml/l). Vid BCSIII-10, där halterna vid förra mättillfället låg över 2 ml/l, hade situationen nu försämrats och i bottenvattnet uppmättes endast 0.32 ml/l. Norr om BCS III-10 i södra delen av östra Gotlandsbassängen hade syresituationen förbättrats något, dock hade detta vatten ännu inte nått fram till de centrala delarna. I västra, större delen av östra samt norra Gotlandsbassängerna sågs ingen förbättring av syresituationen. Helt syrefria förhållanden återfanns från 90 - 100 meters djup och akut syrebrist från 70 - 90 meters djup.

Viss förhöjning av fluorescens märktes i Arkona, Bornholmsbassängen samt i Hanöbukten. Vid stationen BY2 i Arkona var blomningen i full gång, med kraftigt förhöjd fluorescens samt hög syremättnad i ytlagret, 108 %. I övrigt var planktonaktiviteten, baserat på fluorescensmätningar och syremättnad låg.

DELTAGARE

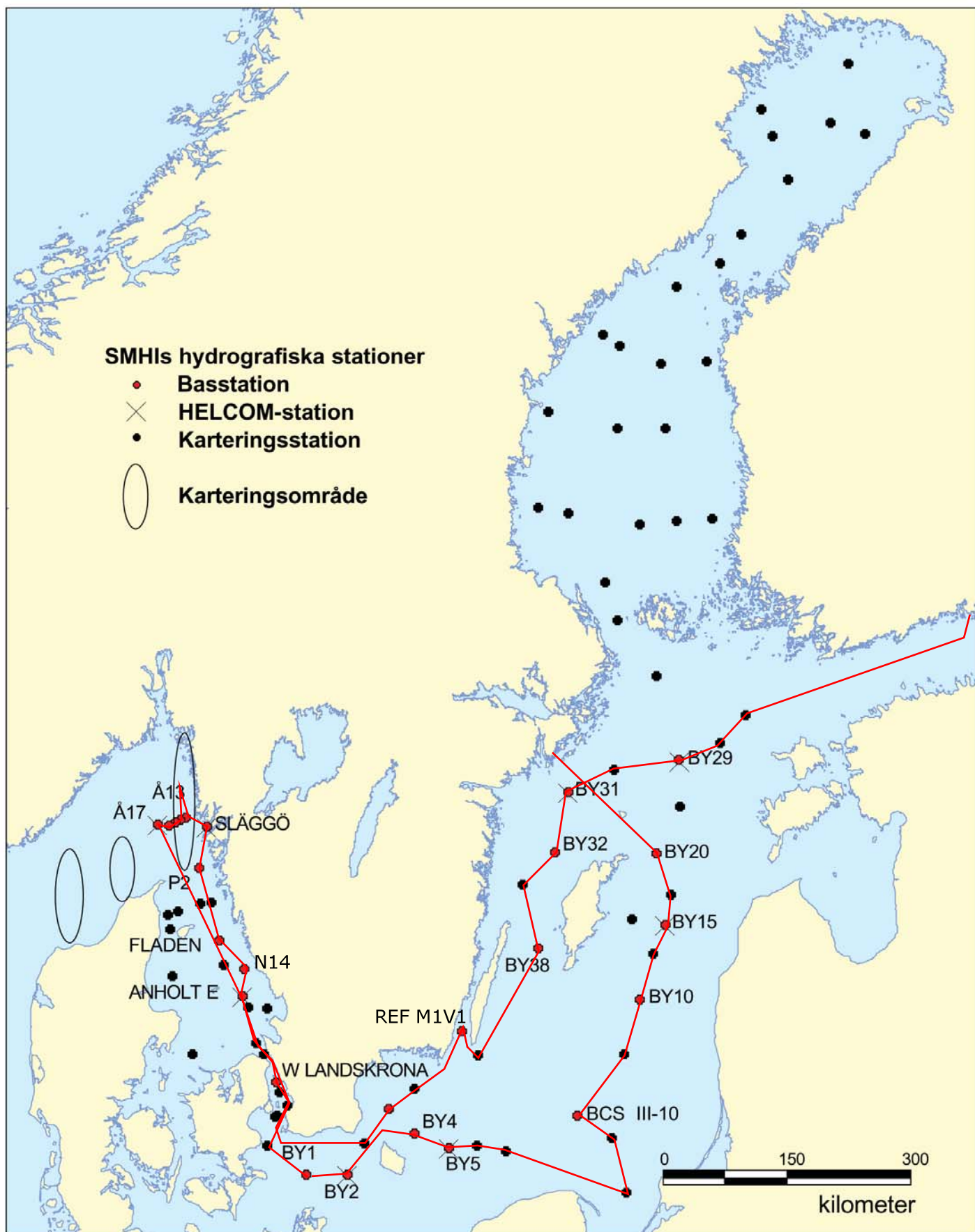
Namn		Från
Lars Andersson	Expeditionsledare	SMHI
Sara Johansson		SMHI
Vivi Månsson		SMHI
Sari Sipilä		SMHI
Arne Svensson	debarkerade 28/2	SMHI
Karin Wesslander		SMHI
Per Olsson	27/2-28/2	SMHI
Johan Svalmark	27/2-28/2	SMHI
Heini Jalli	debarkerade 28/2	Finnish Meteorological Institute (FMI)
Pekka Kosloff		Finnish Meteorological Institute (FMI)
Tuomo Roine	debarkerade 28/2	Finnish Meteorological Institute (FMI)

BILAGOR

- Färdkarta
- Tabell över stationer, antal parametrar och provtagningsdjup
- Karta över syrehalter i bottenvattnet
- Profilplottar för vissa basstationer
- Månadsmedelvärdesplottar för vissa basstationer

TRACKCHART

Country: Sweden
 Ship: R/V ARANDA
 Date: 20140224-20140304
 Series: 0103-0145



-E- (s4148T- (s1B-&l10-&l4E-&a9L-&k2S
SMHI
Ocean enh

Hydrographic
series

Ship: 01-Aranda
Year: 2014

Date: 2014-03-04
Time: 14:57

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 hd	C t	PPCPZZT Hrhhoo Cilyooa motPBw PrP l	No de	T e a	S h x	P o x	H 2 o	P S 4	T t 2	N o 3	N o 4	T h o	A l i	S u i	L o g	P N C	T C m					
0103	BPNX33BAS	BY27		N5917.8	E2134	20140224	2240	178		20 14	3.7	1021	9999	x	-----	15	x	x	-	x	x	x	x	x	x	x	x	-	x	-	-	-	-	x	
0104	BPNX34BAS	BY28		N5902	E2105	20140225	0230	183		22 14	2.4	1021	9999	x	-----	16	x	x	-	x	x	x	x	x	x	x	x	-	x	-	-	-	-	x	
0105	BPNX35BAS	BY29		N5853	E2019	20140225	0630	174	8	20 13	2.6	1022	2850	x	-----	16	x	x	-	x	x	x	x	x	x	x	x	-	x	-	-	-	-	x	
0106	BPNX36BAS	BY30		N5847	E1906	20140225	1125	183		19 10	2.8	1021	2840	x	-----	16	x	x	-	x	x	x	x	x	x	x	x	-	x	-	-	-	-	x	
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0108	BPWX38BAS	BY32	NORRKÖPINGS DJ	N5801	E1759	20140225	2100	200		16 9	3.3	1019	9990	x	--x----	17	x	x	-	x	x	x	x	x	x	x	x	-	x	-	-	-	-	x	
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0112	BPWK01BAS	REF M1V1		N5622.25	E1612.1	20140226	1605	21		12 8	2.4	1019	4920	x	-xxxx--	5	x	x	x	-	x	x	x	x	x	x	x	x	-	x	-	-	-	-	-
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0115	BPSA04BAS	BY3	HAMRARNE SUND	N5517.5	E1424	20140227	0315	46		02 3	2.4	1018	9999	x	-----	8	x	x	-	x	-	x	x	x	x	x	x	-	x	-	-	-	-	-	
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0118	KANX50BAS	N14 FALKENBERG		N5656.40	E1212.70	20140227	2205	30		12 8	3.1	1010	6990	x	-xxxx--	7	x	x	x	-	x	x	x	x	x	x	x	x	-	x	-	-	-	-	x
0119	KANX25BAS	FLADEN		N5711.5	E1140	20140228	0105	85		14 8	3.8	1008	9990	x	--x----	12	x	x	-	x	-	x	x	x	x	x	x	-	x	-	-	-	-	-	-
0120	SKEX23BAS	P2		N5752	E1118	20140228	0630	94		12 7	4.4	1006	9990	x	--x----	10	x	x	-	x	-	x	x	x	x	x	x	-	x	-	-	-	-	-	x
0121	FIBG27BAS	SLÄGGÖ		N5815.5	E1126.0	20140228	0930	76	5	12 4	5.5	1006	2830	x	--xxx--	9	x	x	-	x	-	x	x	x	x	x	x	-	x	-	-	-	-	-	-
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0123	SKEX14BAS	Å13		N5820.2	E1102	20140228	1655	104		14 6	4.7	1006	6830	x	--x----	10	x	x	-	x	-	x	x	x	x	x	x	-	x	-	-	-	-	-	-
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Date: 2014-03-04
Time: 14:57

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 hd	C PPCPZT Hrhhoo Cilyooa motPBw PrP l	No de	T e a m l	S h y S	P x 2 P	O H 4 P	H T 2 N	T N 3 N	N T 4 N	A S h o l i k a 3	S h u i o m g n	L P u n C	P T 0 C	T C 0 m			
0130	BPSA02BAS	BY1		N5500	E1318	20140301	2337	46		10 9	1.2	1004	9999	x -x-x---	8	x	x	-	x	-	x	x	x	x	x	-	x	-	-	-
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0132	BPSB06BAS	BY4	CHRISTIANSÖ	N5523	E1520	20140302	0845	91		14 9	3.1	1004	2830	x --x-x---	12	x	x	-	x	-	x	x	x	x	x	-	x	-	-	x
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0145	BPEX26BAS	BY20	FÄRÖDJ	N5800	E1953	20140304	0930	195		14 9	2.4	1012	0040	x -xxxx--	17	x	x	x	x	x	x	x	x	x	x	-	-	-	-	x

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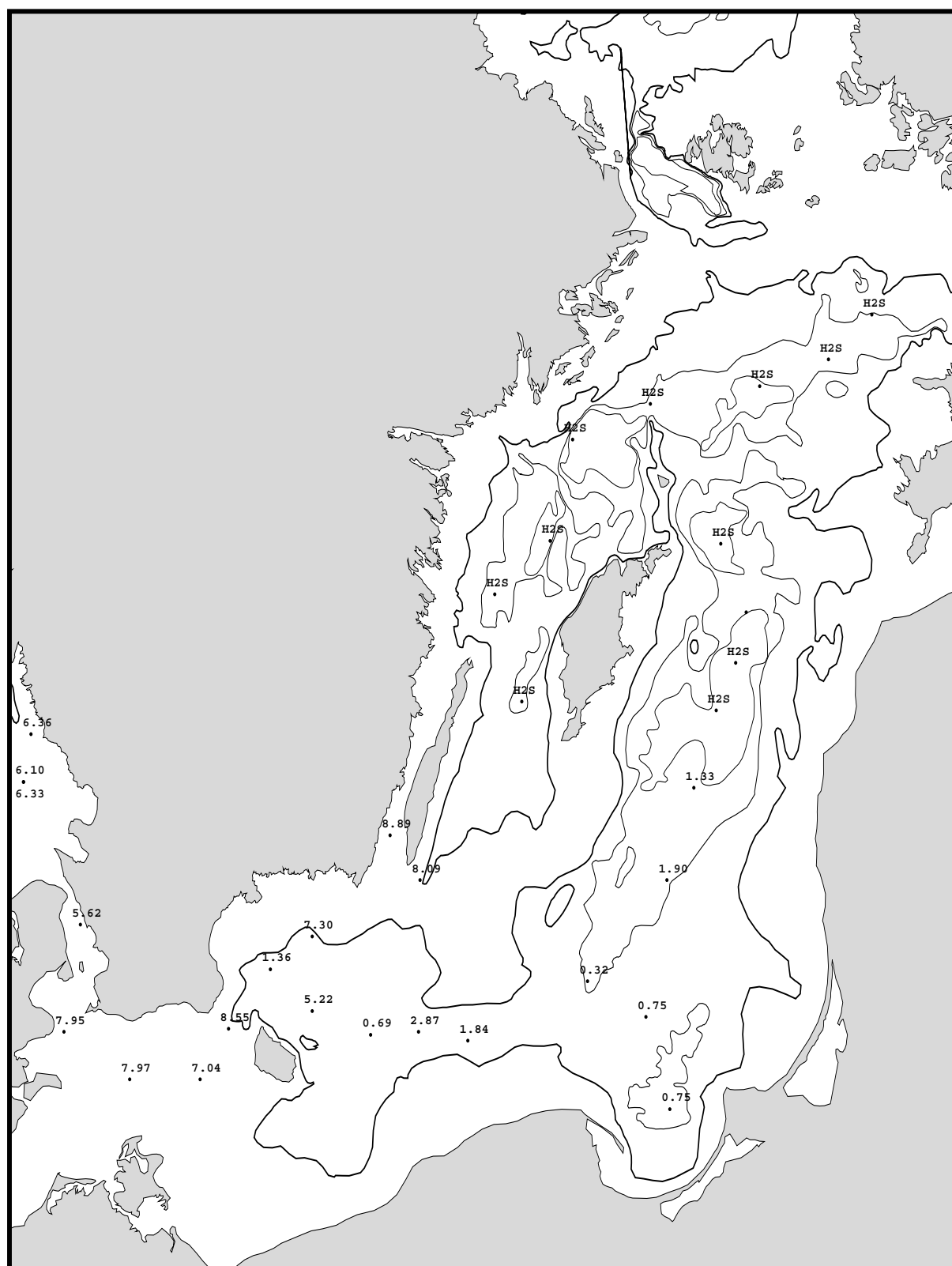
Bottom water oxygen concentration (ml/l)

Country: Finland

Ship : Aranda

Date : 20140224-20140304

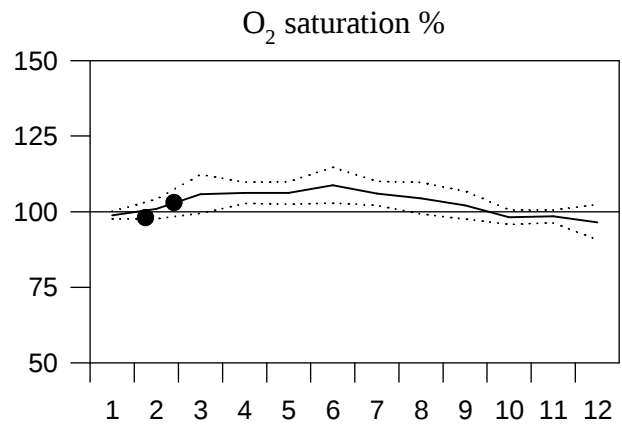
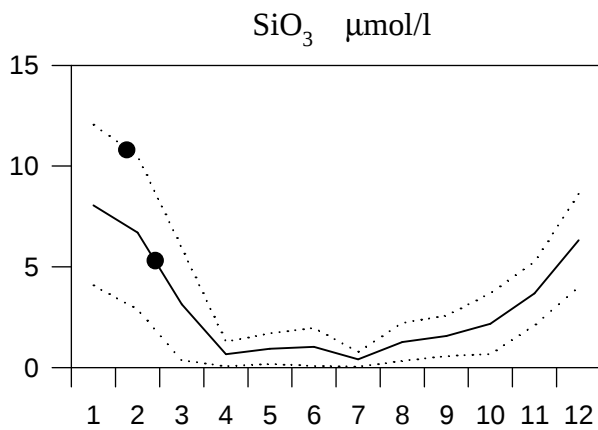
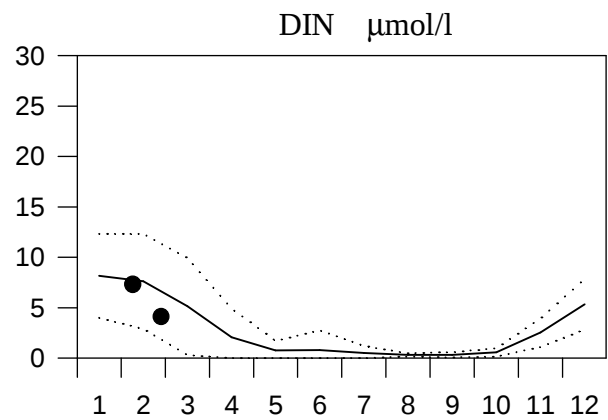
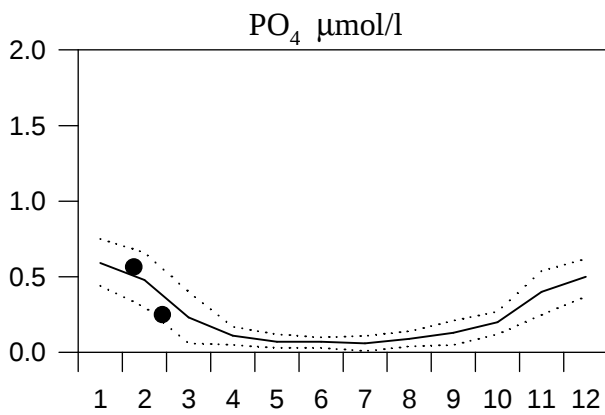
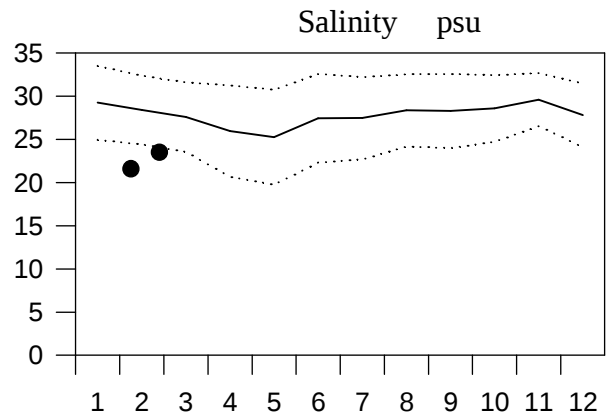
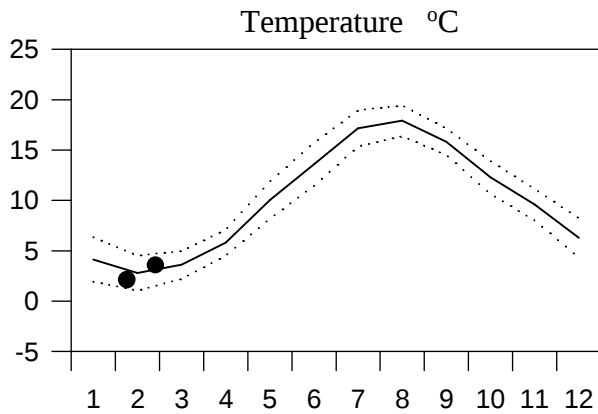
Series : 0103-0145



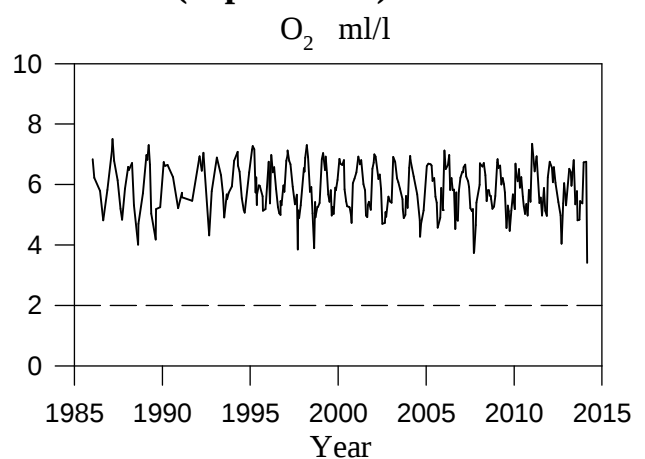
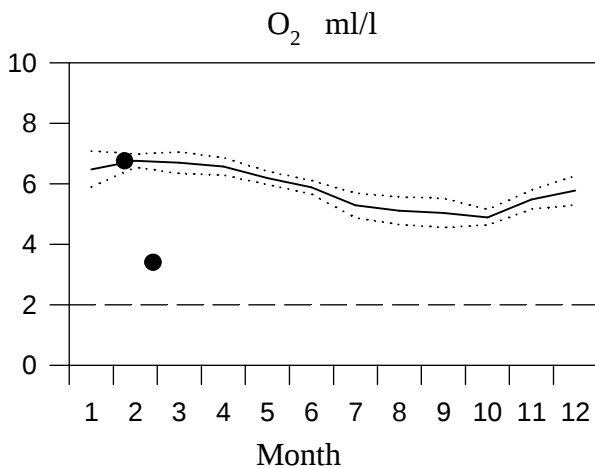
STATION P2 SURFACE WATER

Annual Cycles

— Mean 1996-2010 St.Dev. ● 2014



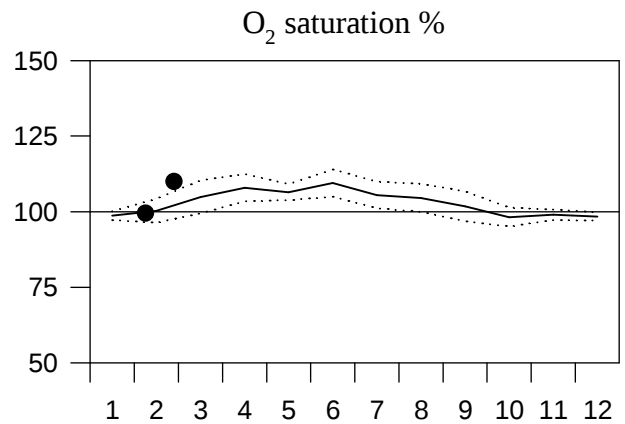
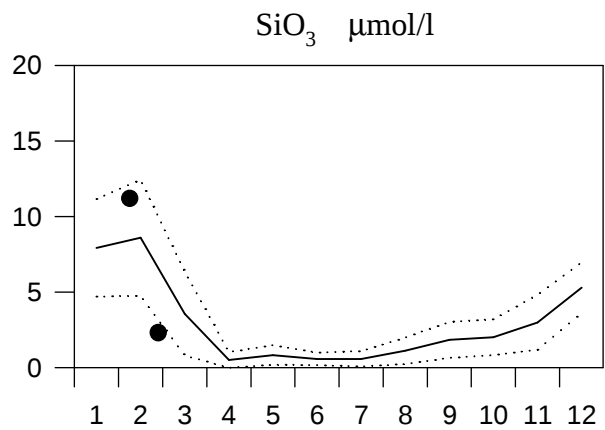
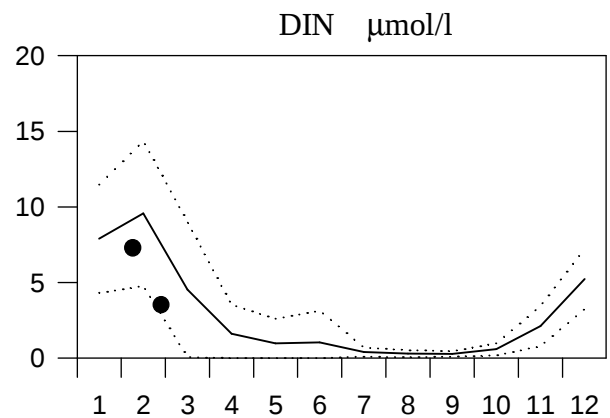
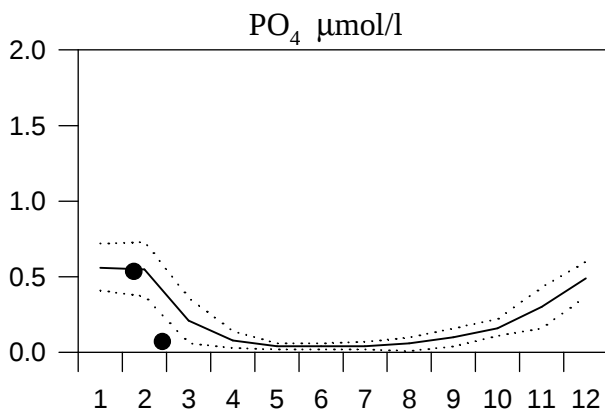
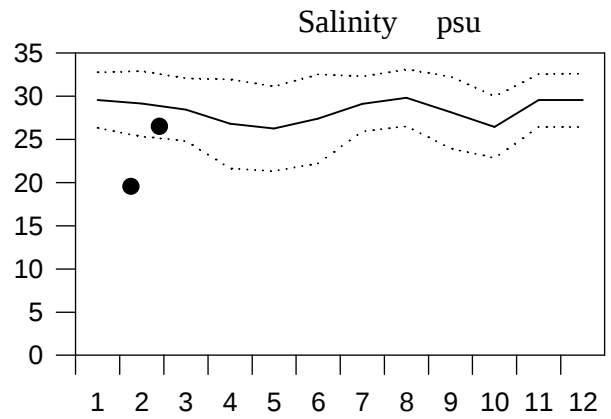
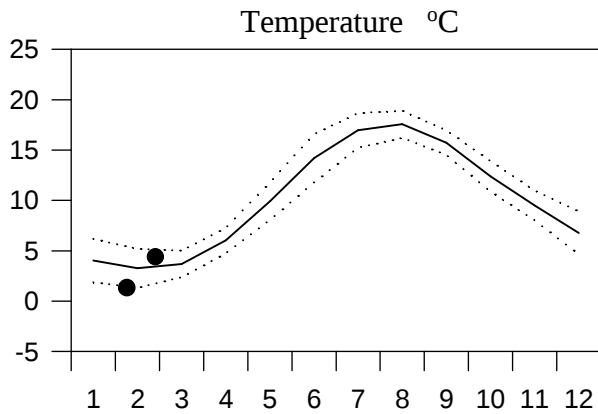
OXYGEN IN BOTTOM WATER (depth >75m)



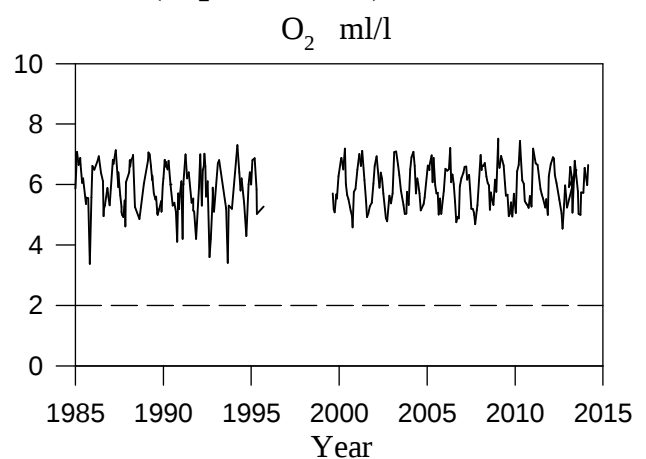
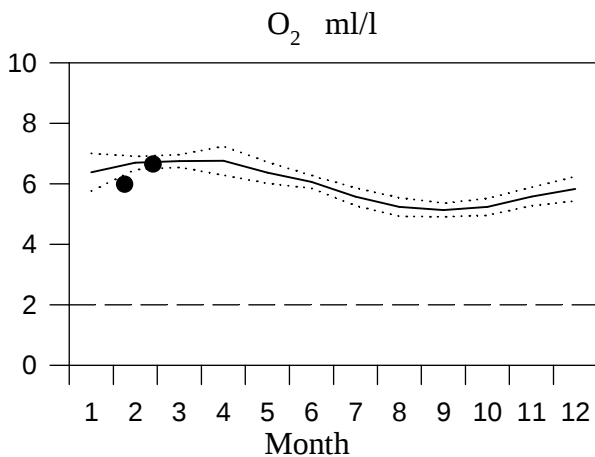
STATION Å13 SURFACE WATER

Annual Cycles

— Mean 1996-2010 St.Dev. ● 2014



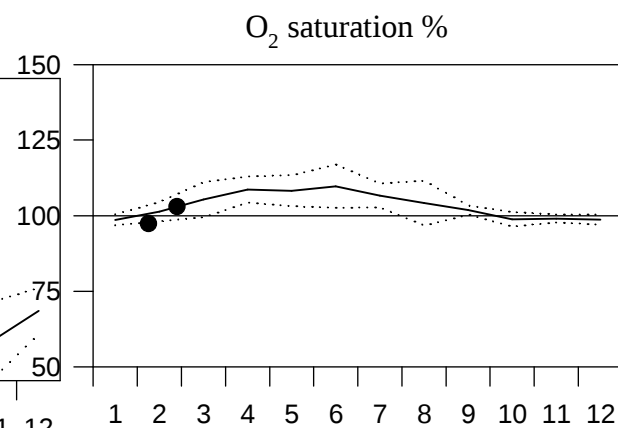
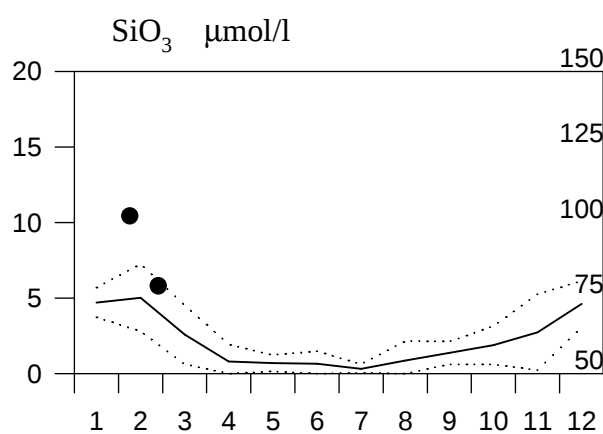
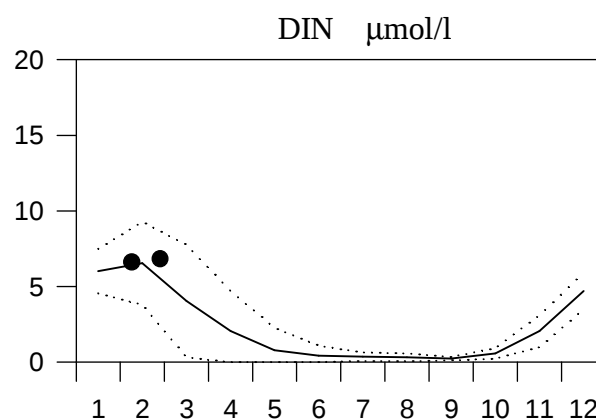
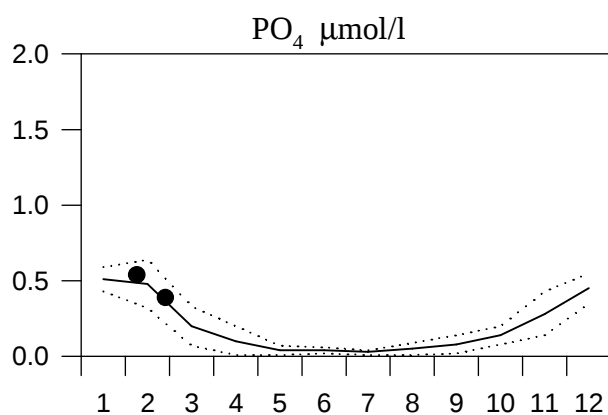
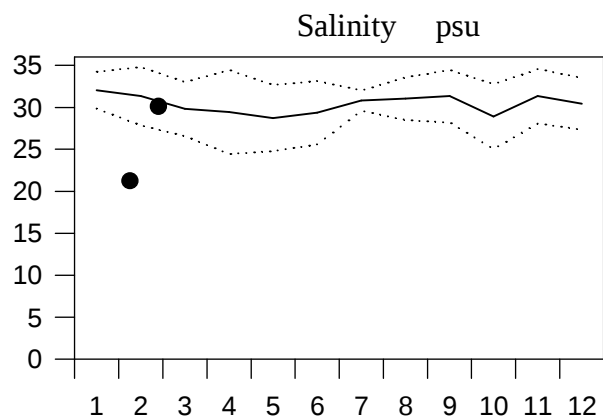
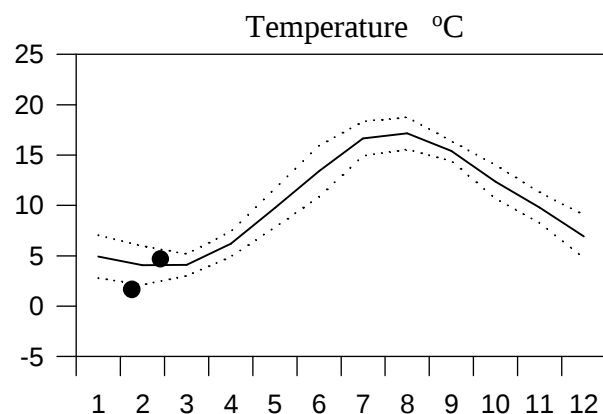
OXYGEN IN BOTTOM WATER (depth >=75m)



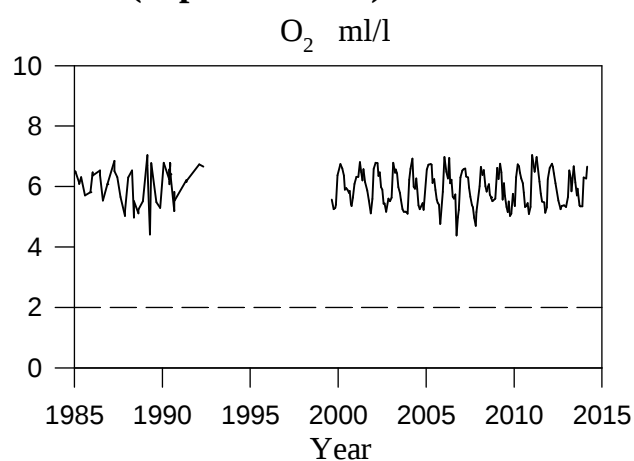
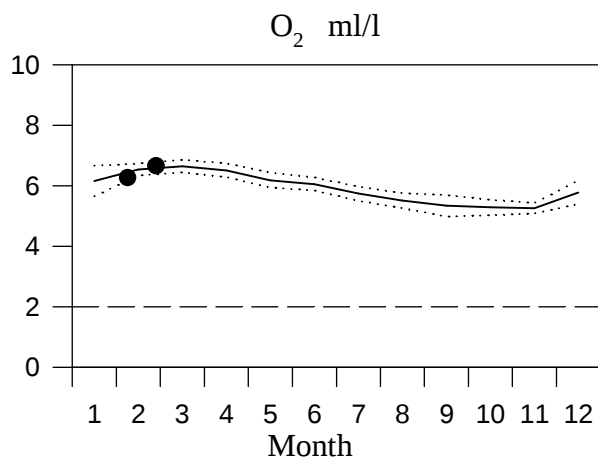
STATION Å15 SURFACE WATER

Annual Cycles

— Mean 1996-2010 St.Dev. ● 2014



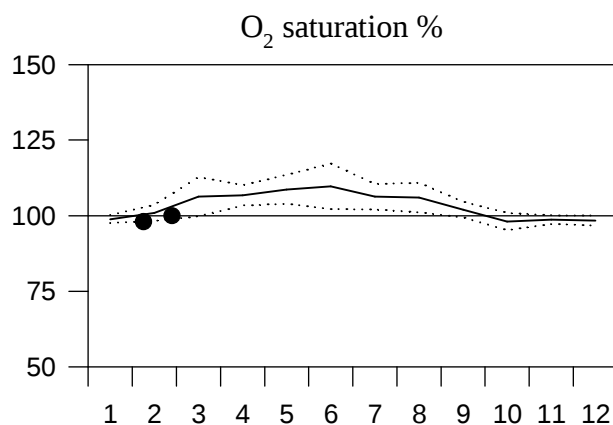
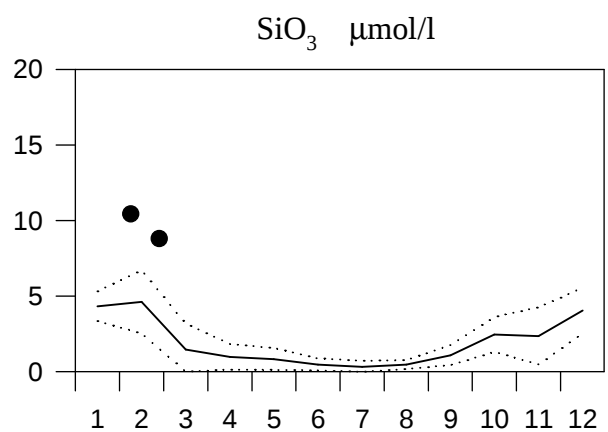
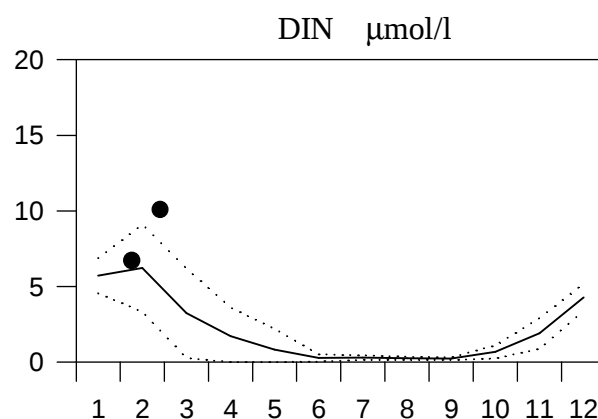
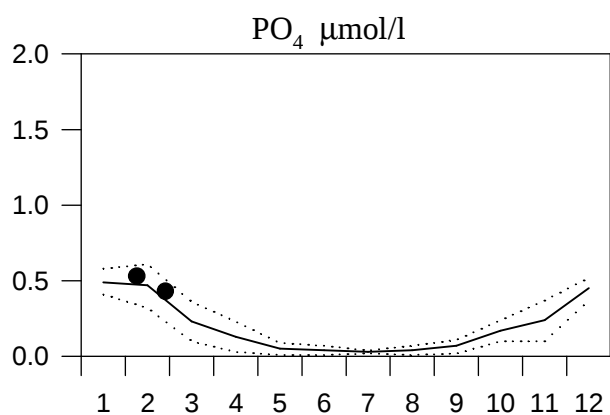
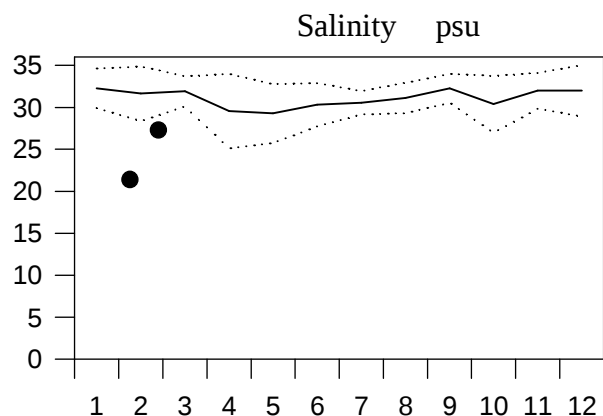
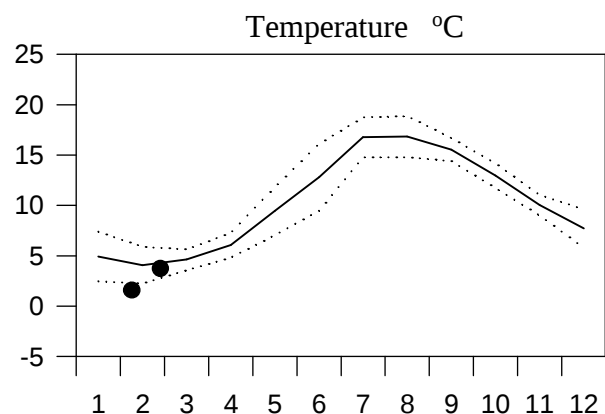
OXYGEN IN BOTTOM WATER (depth ≥125m)



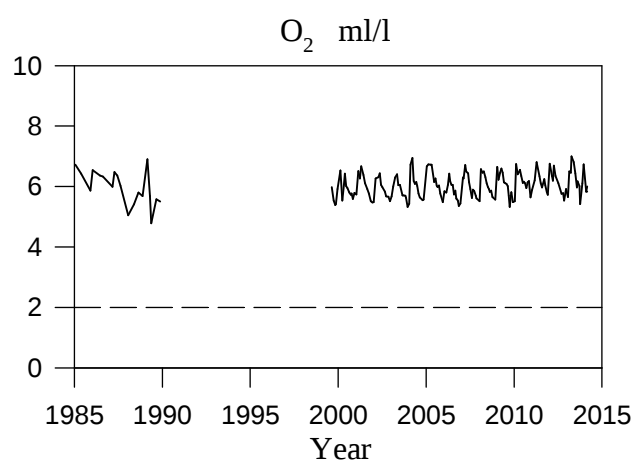
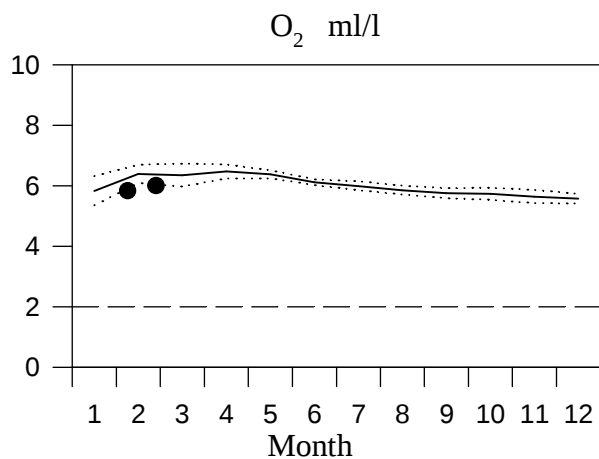
STATION Å17 SURFACE WATER

Annual Cycles

— Mean 1996-2010 St.Dev. ● 2014



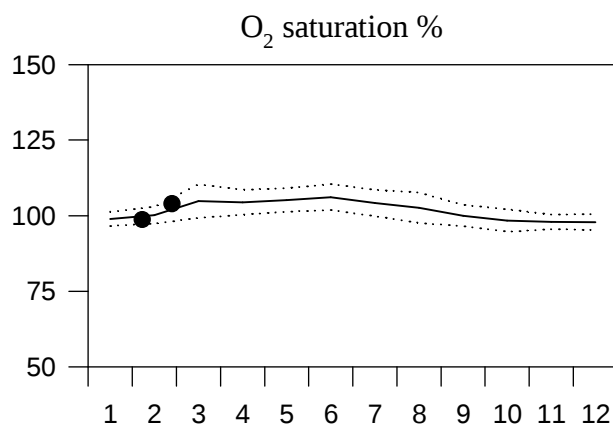
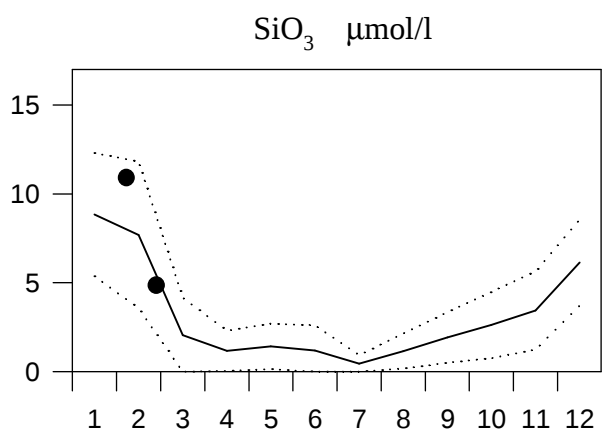
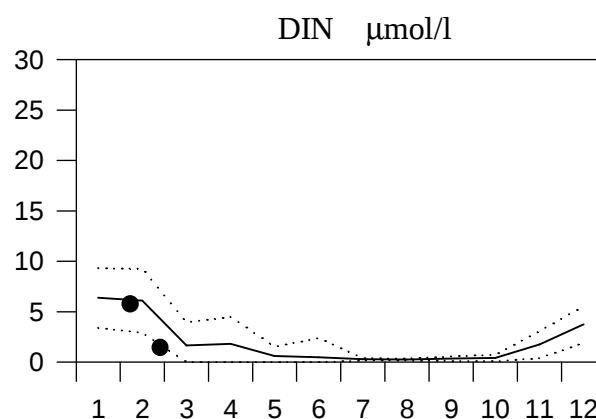
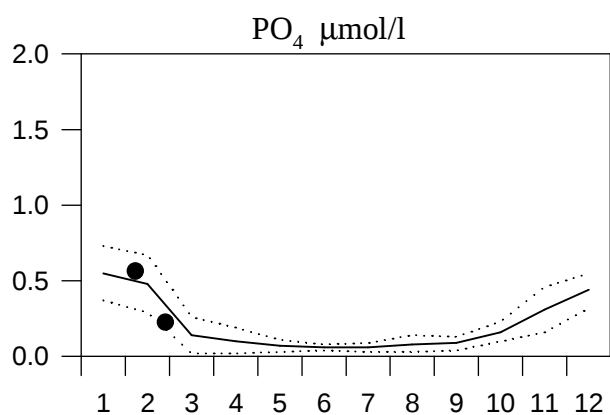
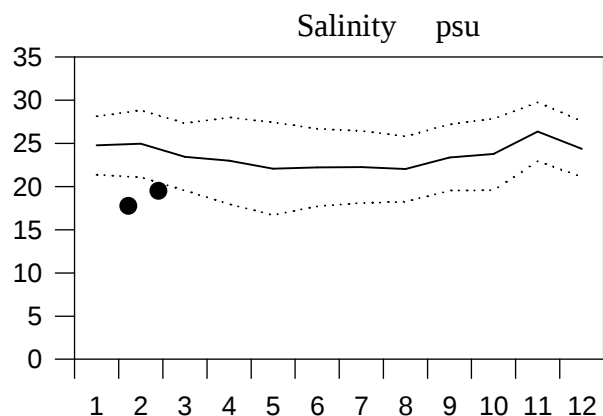
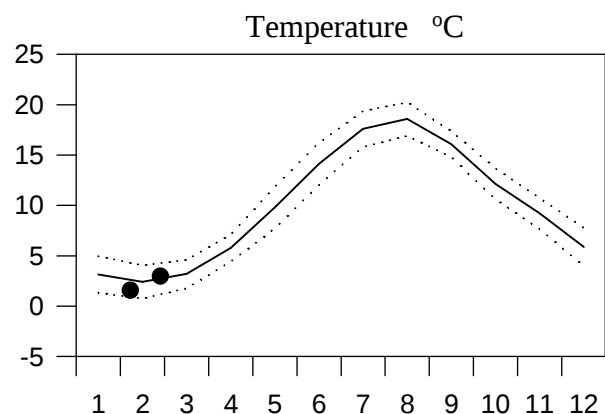
OXYGEN IN BOTTOM WATER (depth = 300m)



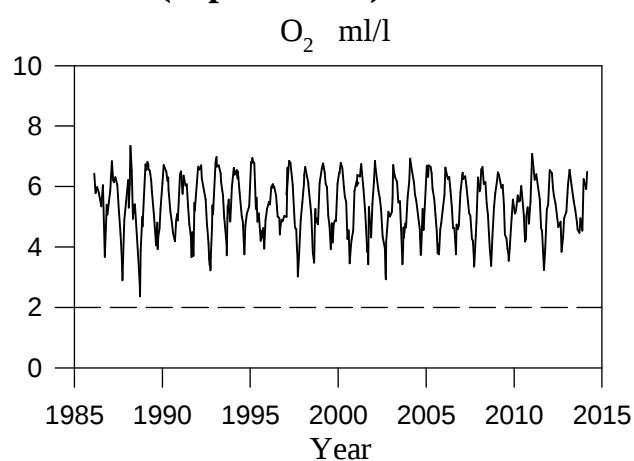
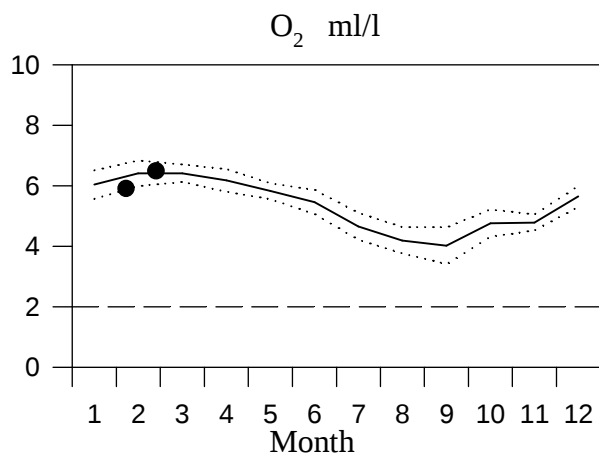
STATION FLADEN SURFACE WATER

Annual Cycles

— Mean 1996-2010 St.Dev. ● 2014



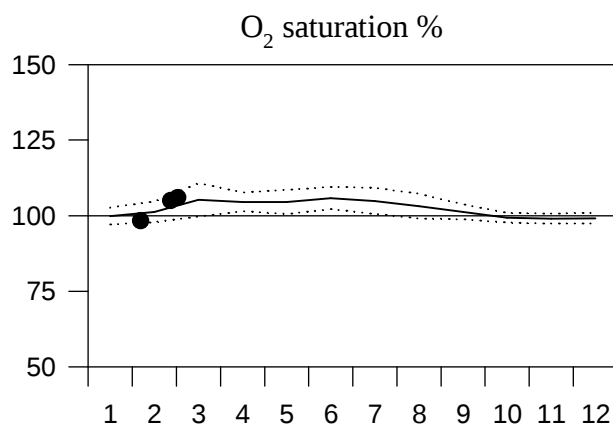
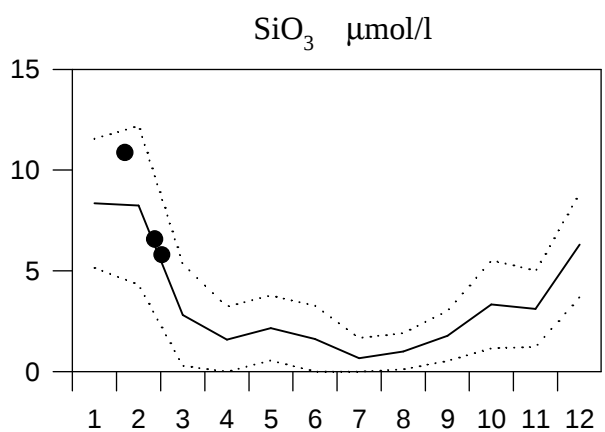
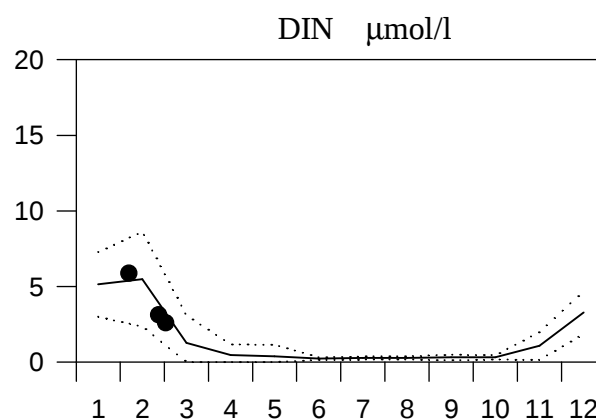
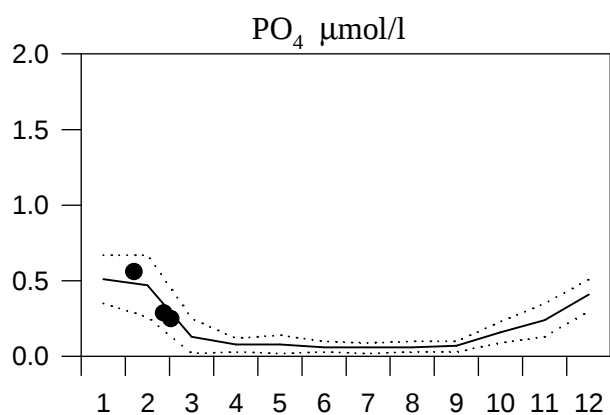
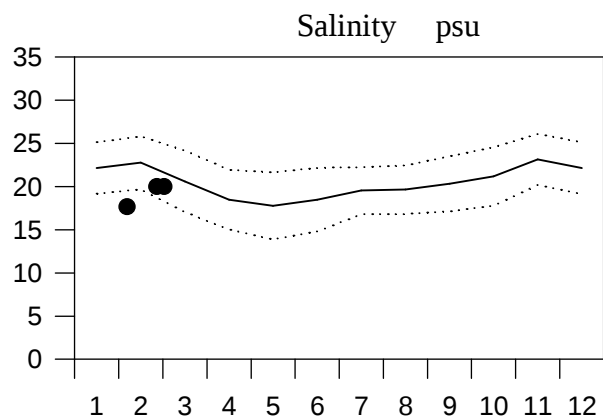
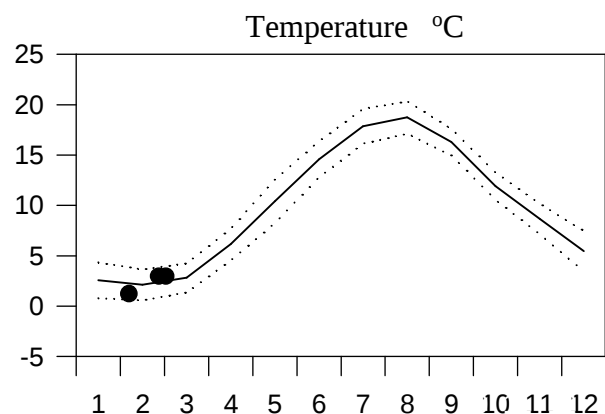
OXYGEN IN BOTTOM WATER (depth > 70m)



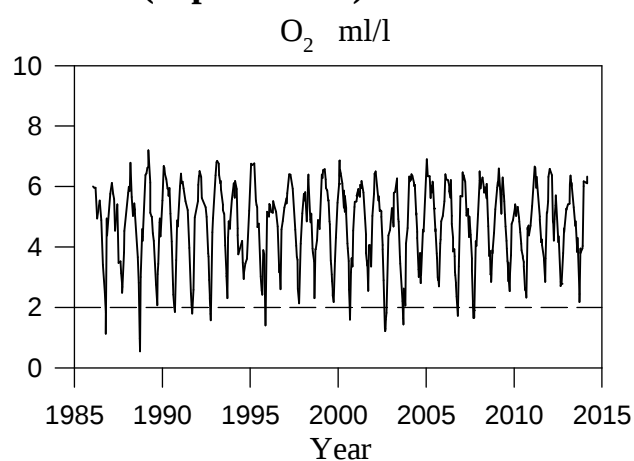
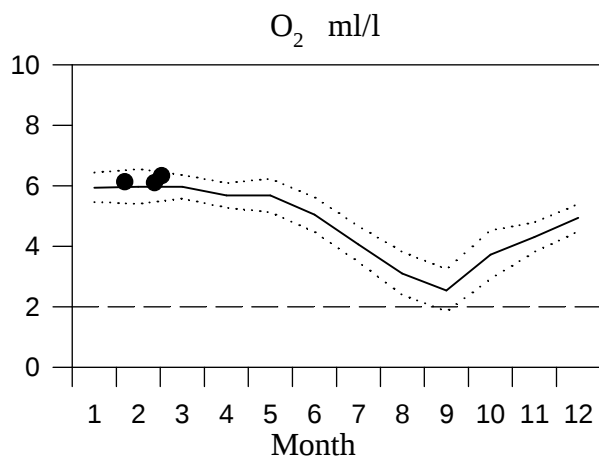
STATION ANHOLT E SURFACE WATER

Annual Cycles

— Mean 1996-2010 St.Dev. ● 2014



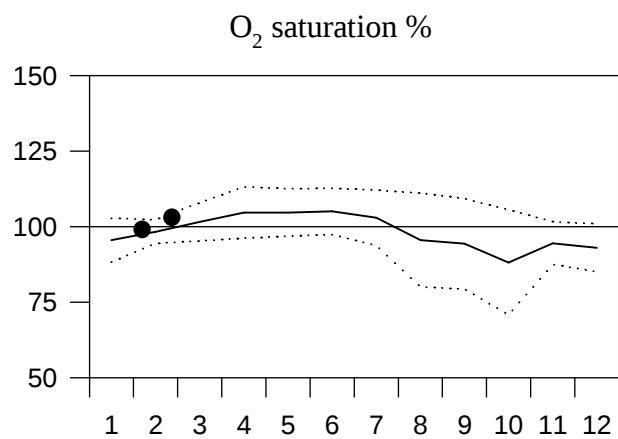
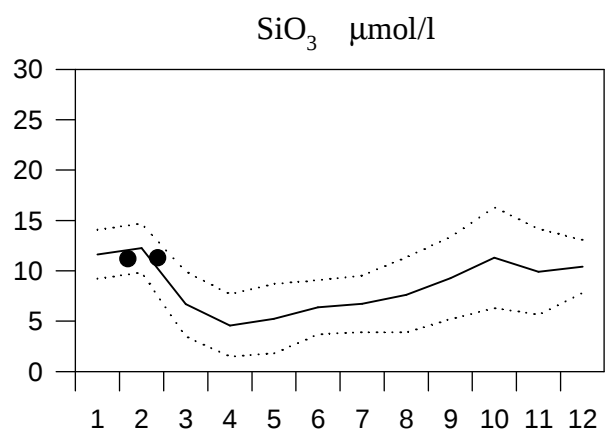
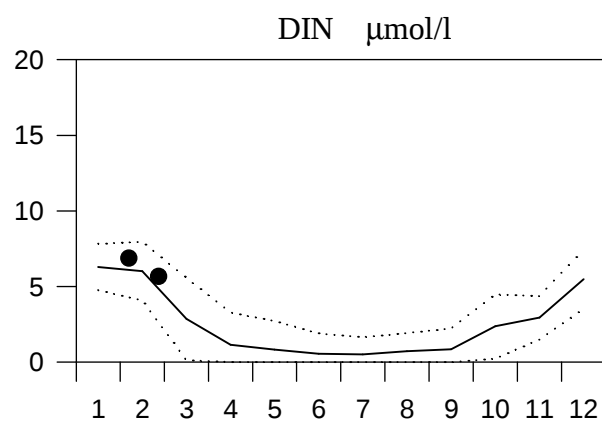
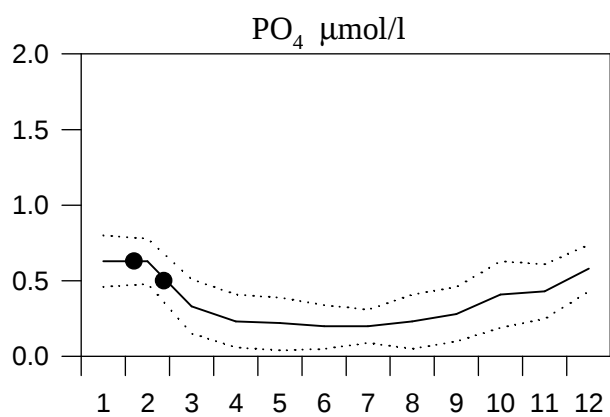
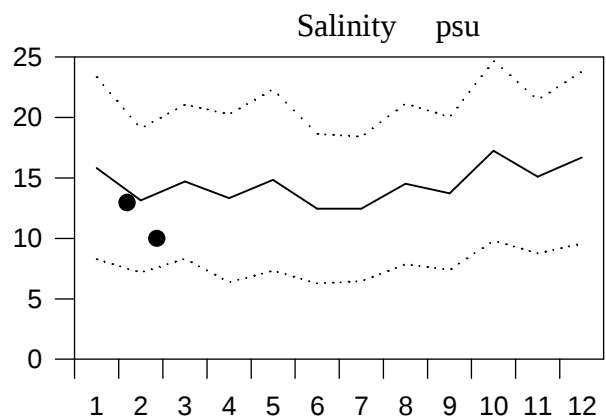
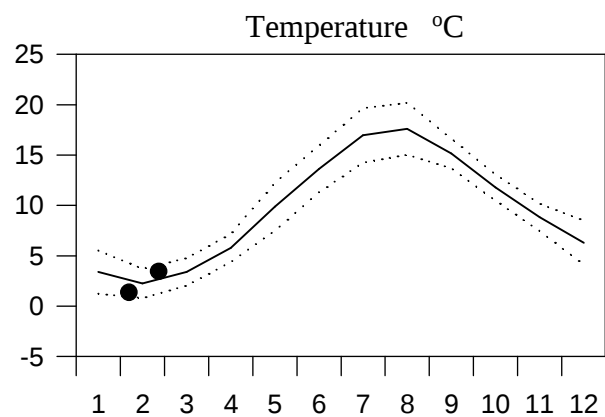
OXYGEN IN BOTTOM WATER (depth > 50m)



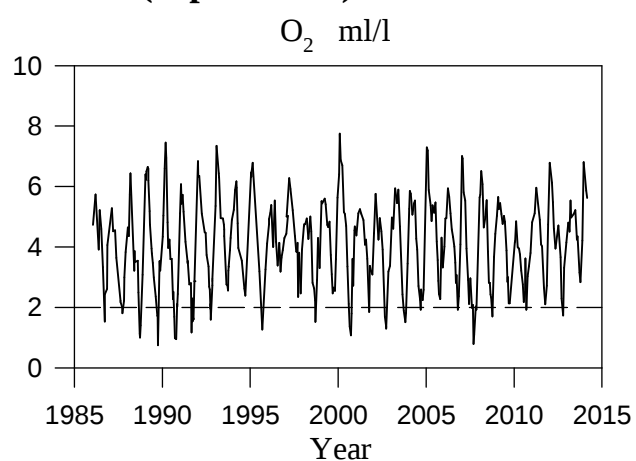
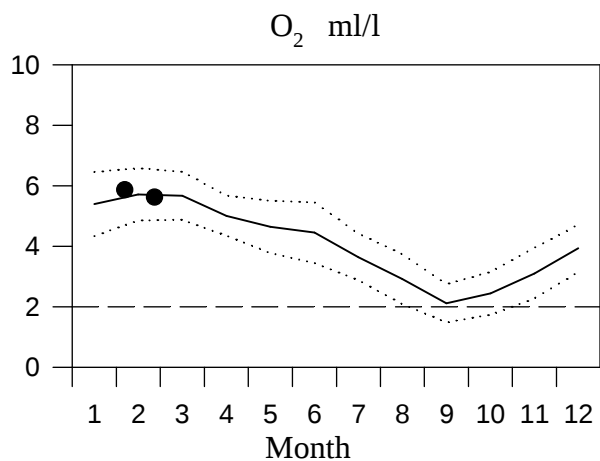
STATION W LANDSKRONA SURFACE WATER

Annual Cycles

— Mean 1996-2010 St.Dev. ● 2014



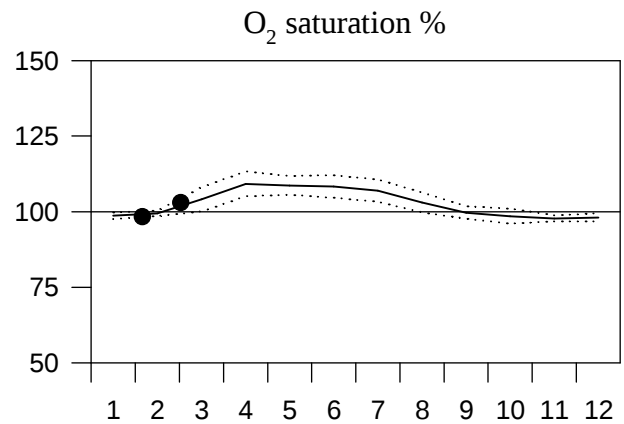
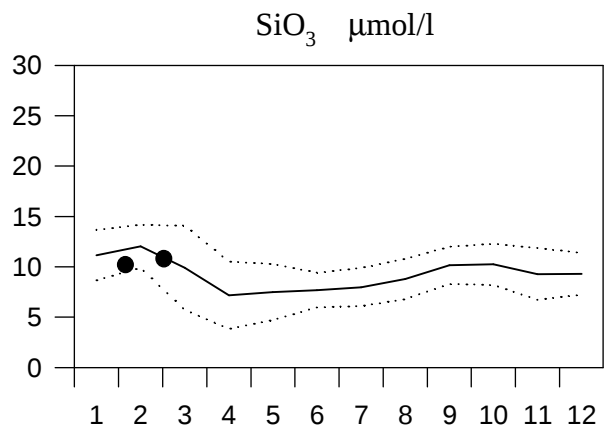
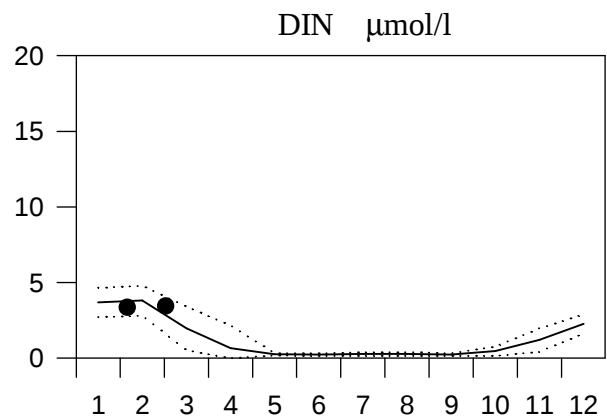
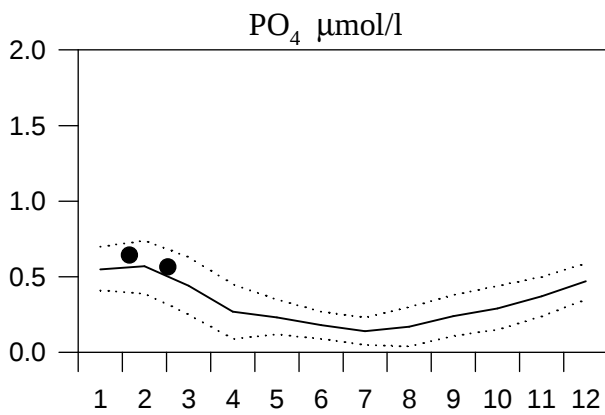
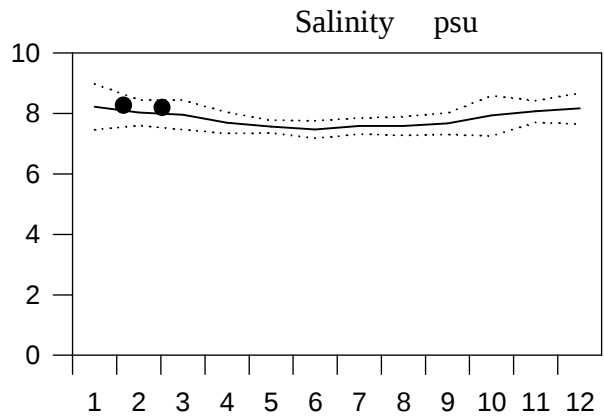
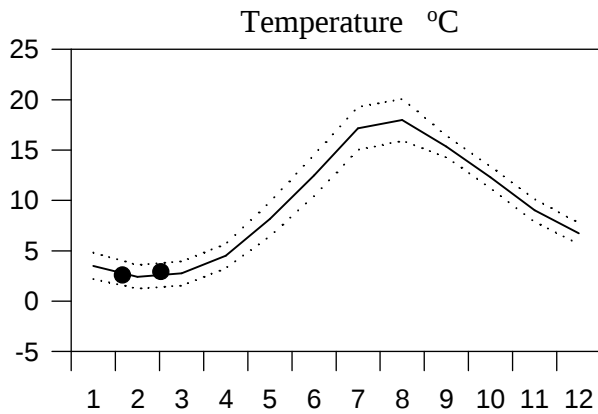
OXYGEN IN BOTTOM WATER (depth >40m)



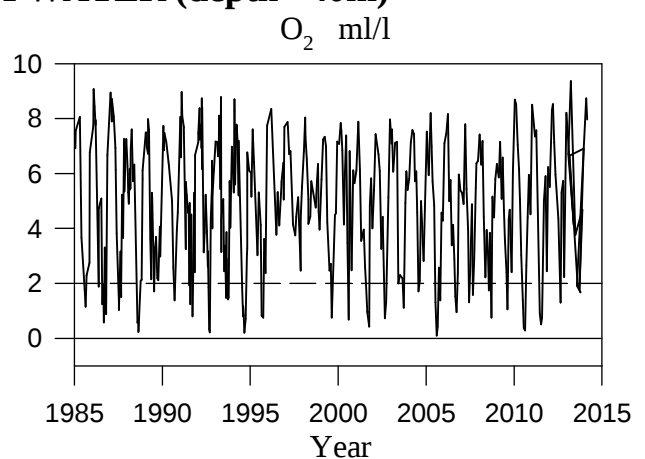
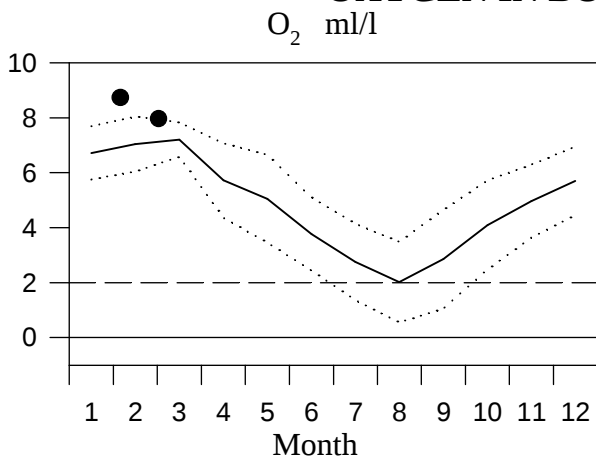
STATION BY1 SURFACE WATER

Annual Cycles

— Mean 1996-2010 St.Dev. ● 2014



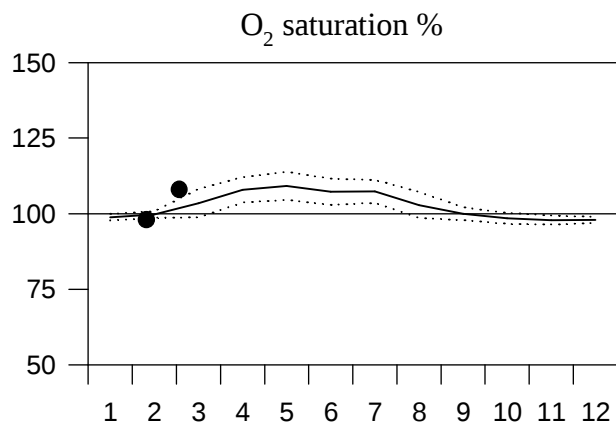
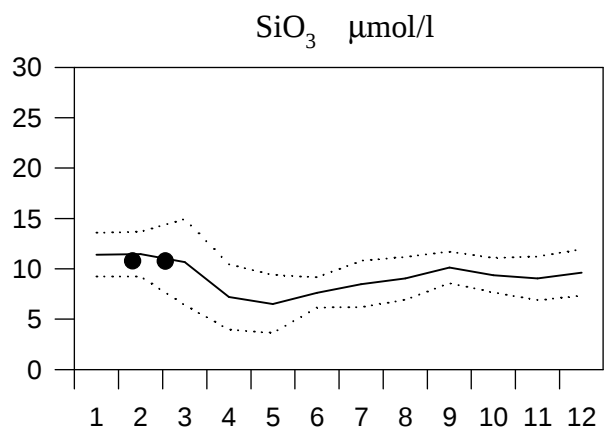
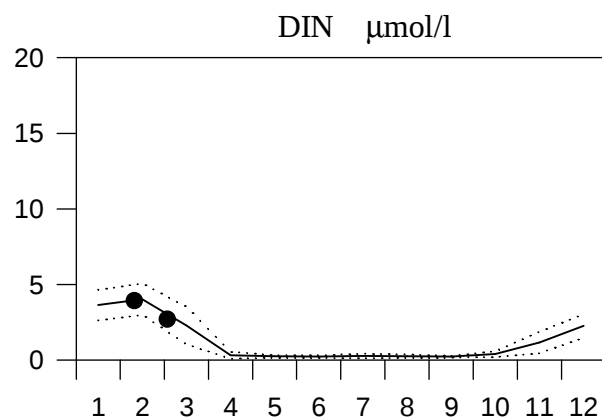
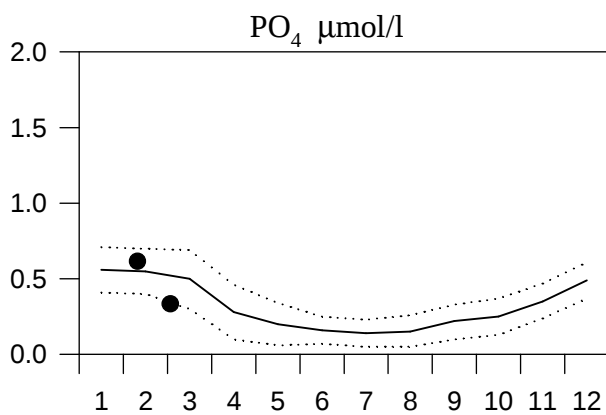
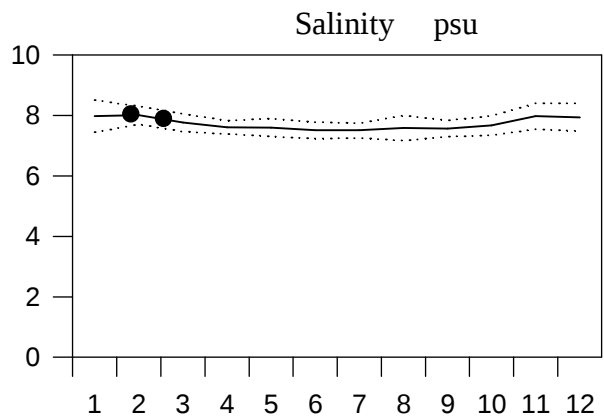
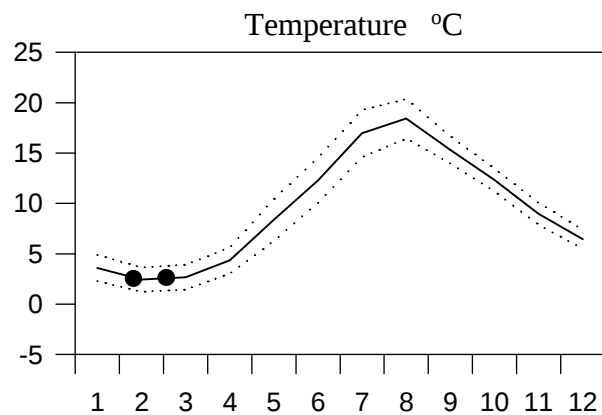
OXYGEN IN BOTTOM WATER (depth >40m)



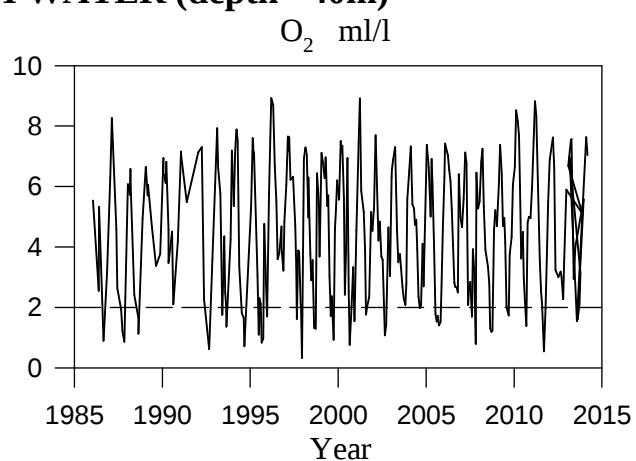
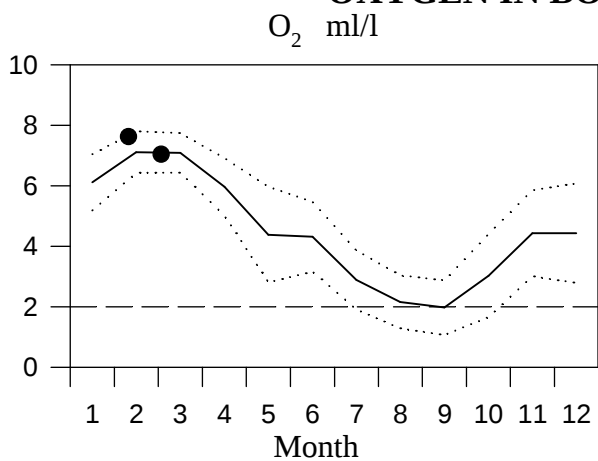
STATION BY2 SURFACE WATER

Annual Cycles

— Mean 1996-2010 St.Dev. ● 2014



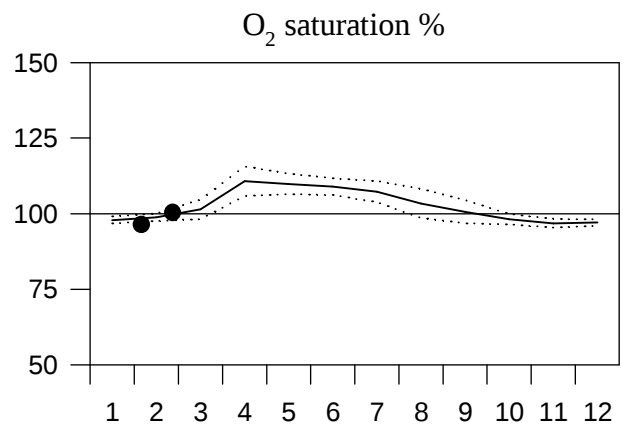
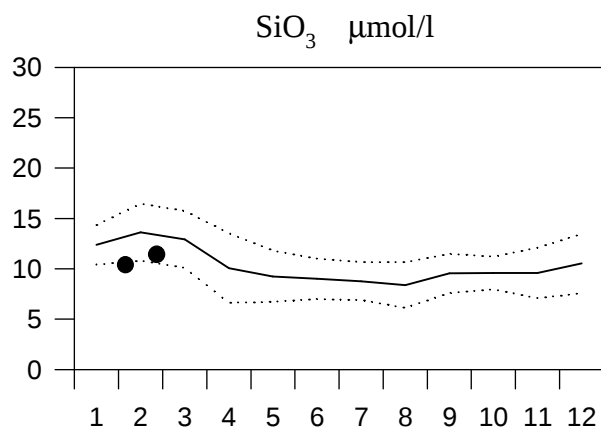
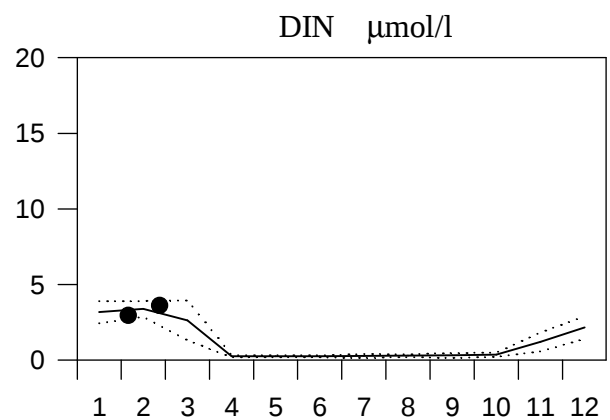
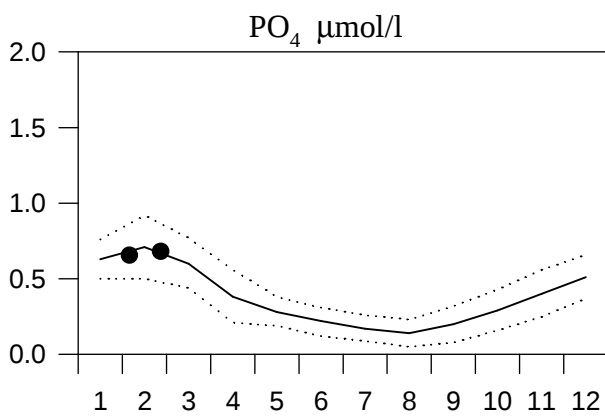
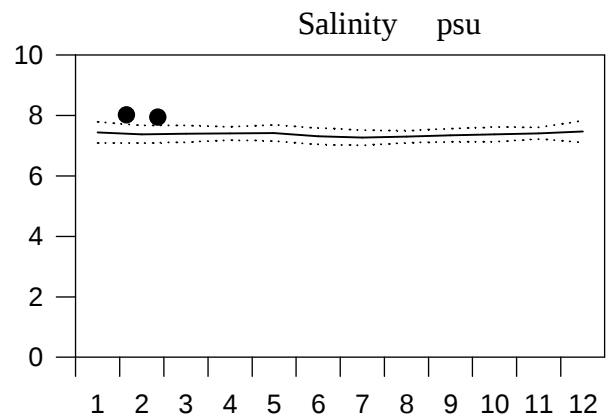
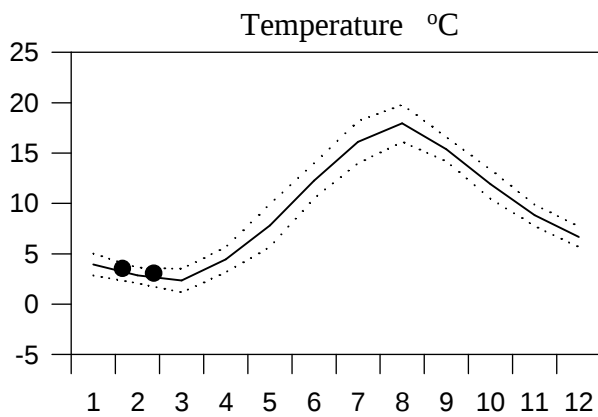
OXYGEN IN BOTTOM WATER (depth >40m)



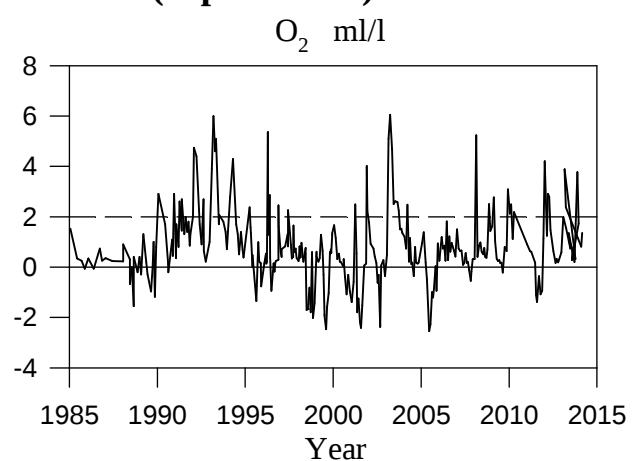
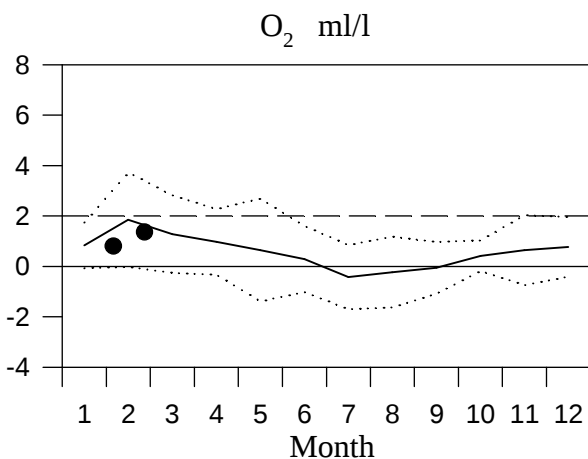
STATION HANÖBUKTEN SURFACE WATER

Annual Cycles

— Mean 1996-2010 St.Dev. ● 2014



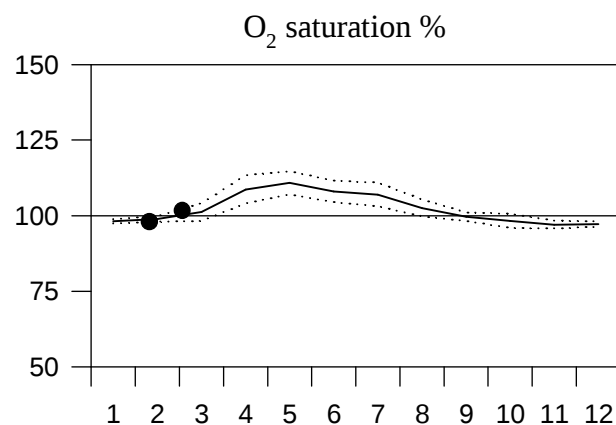
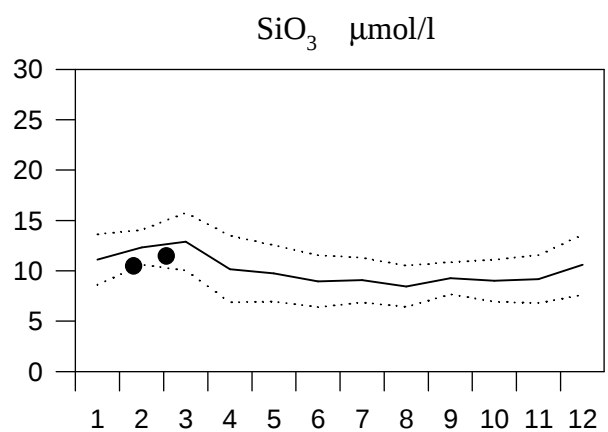
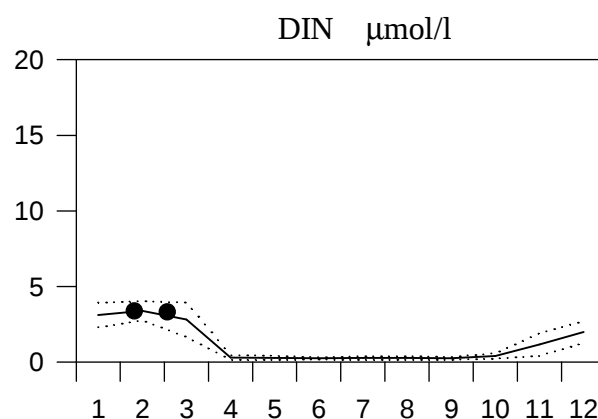
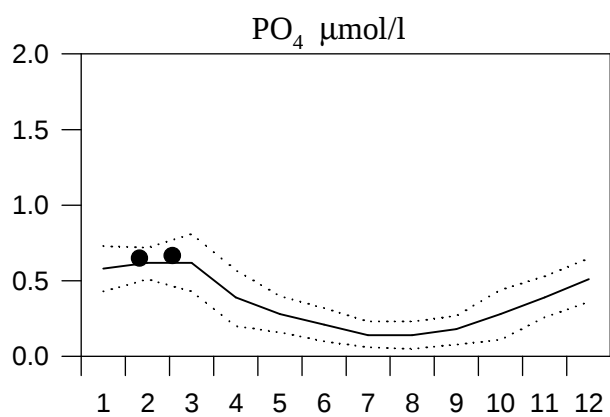
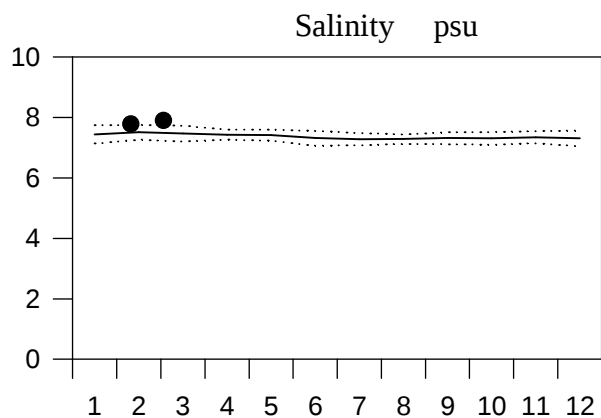
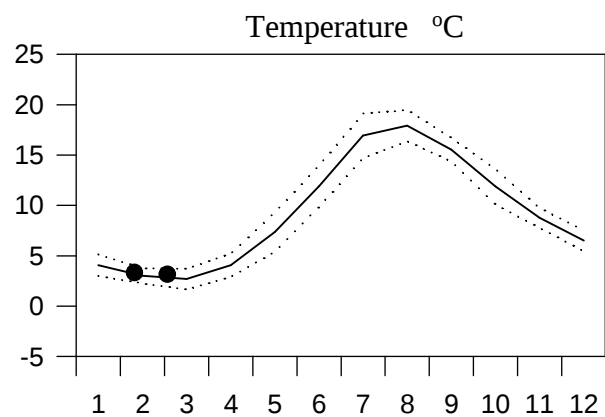
OXYGEN IN BOTTOM WATER (depth > 70m)



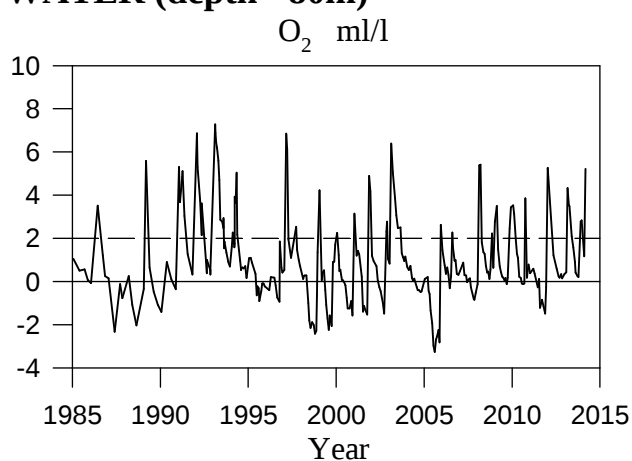
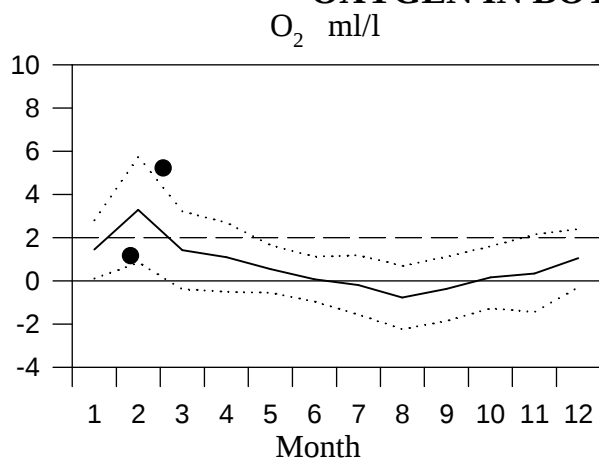
STATION BY4 SURFACE WATER

Annual Cycles

— Mean 1996-2010 St.Dev. ● 2014



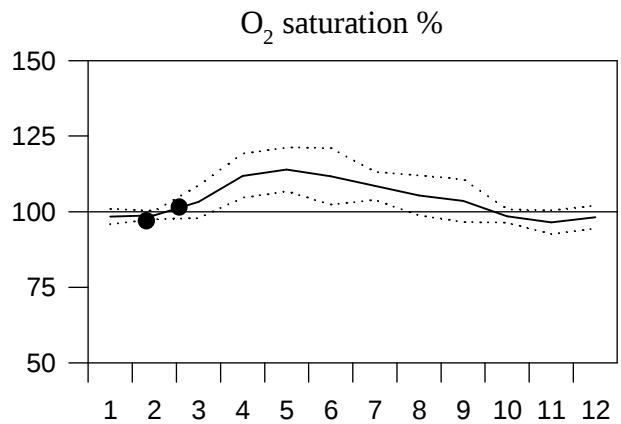
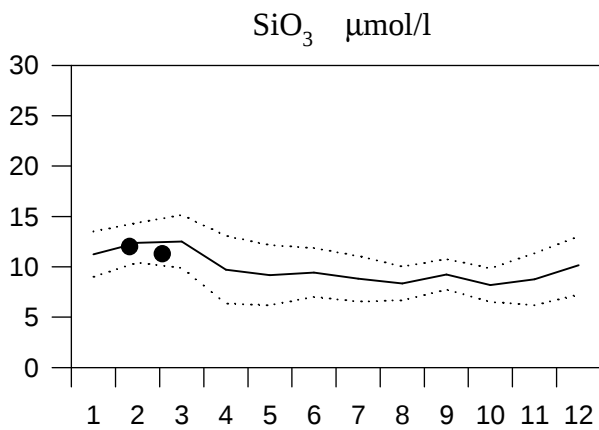
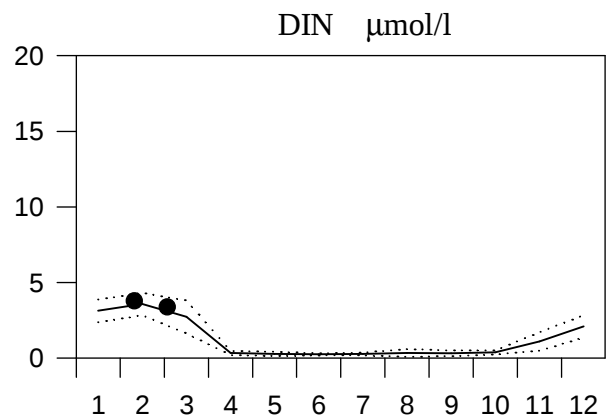
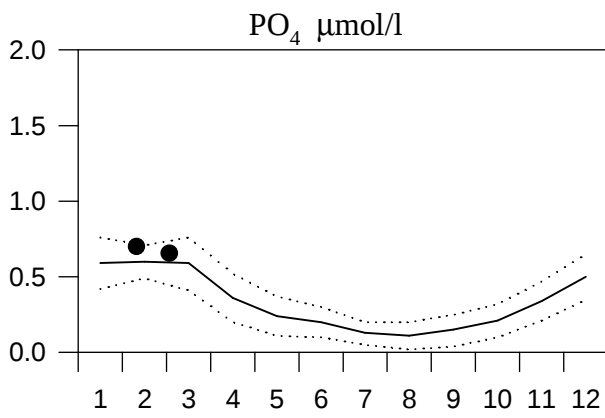
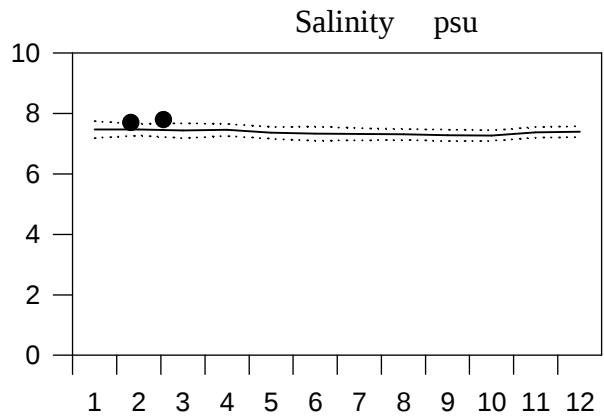
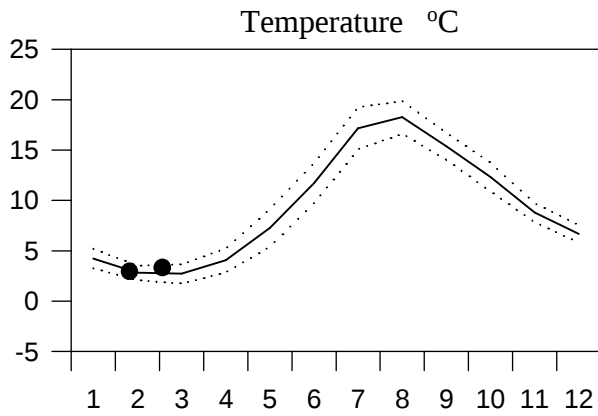
OXYGEN IN BOTTOM WATER (depth >80m)



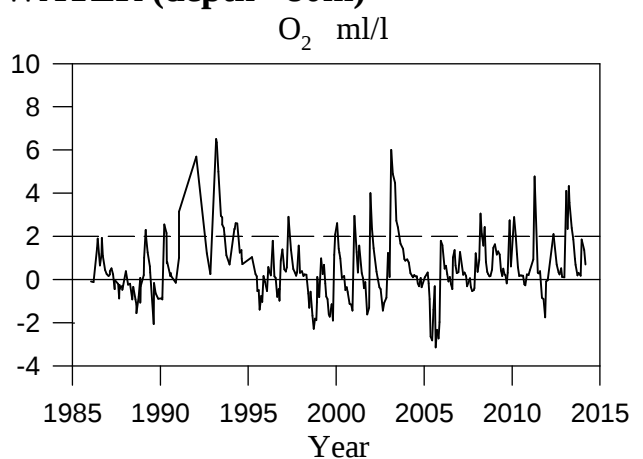
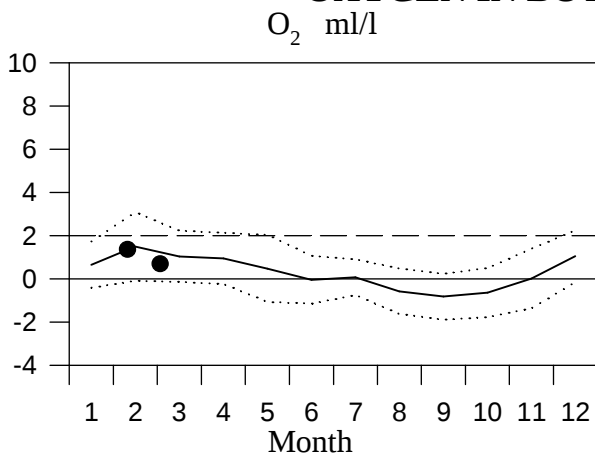
STATION BY5 SURFACE WATER

Annual Cycles

— Mean 1996-2010 St.Dev. ● 2014



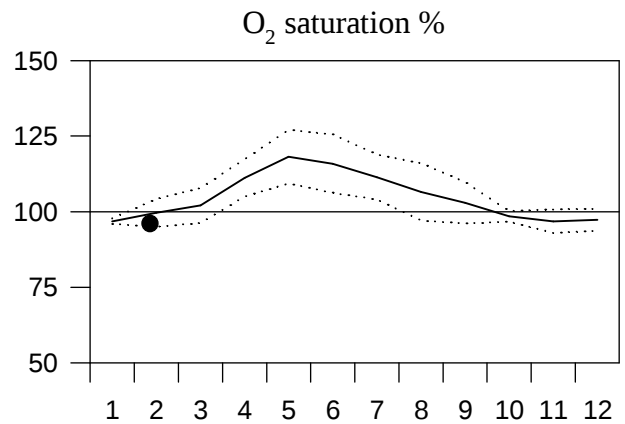
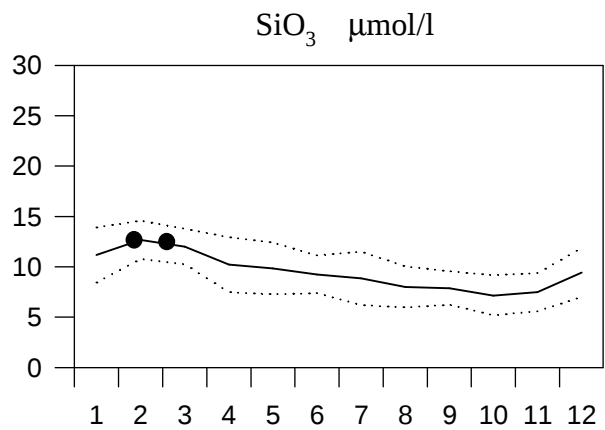
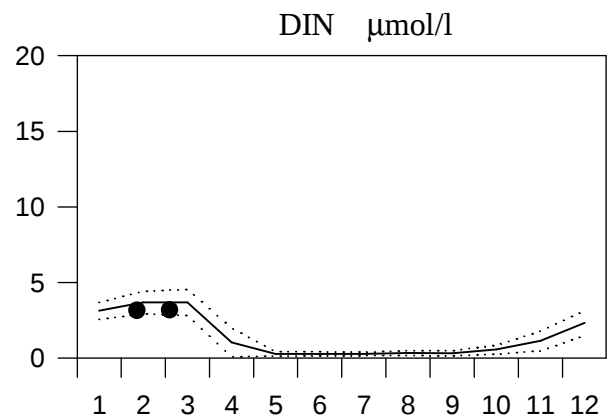
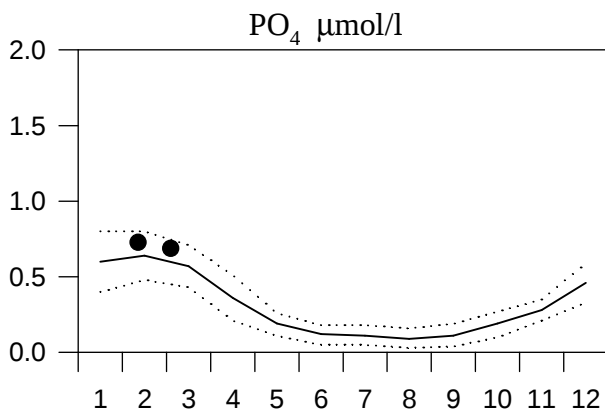
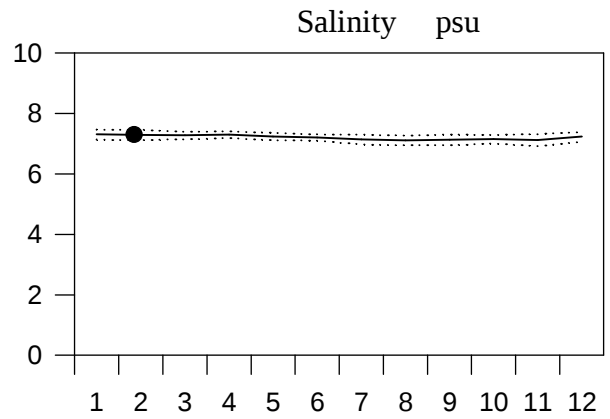
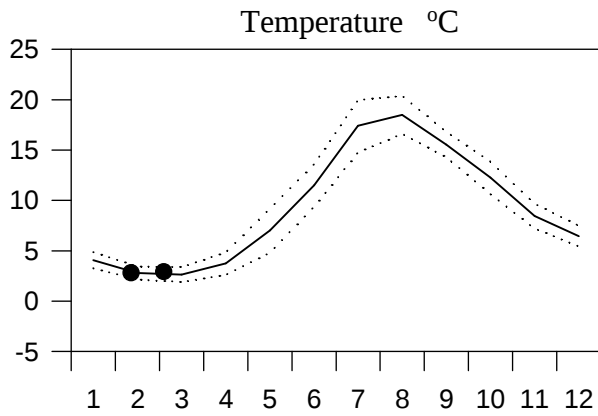
OXYGEN IN BOTTOM WATER (depth >80m)



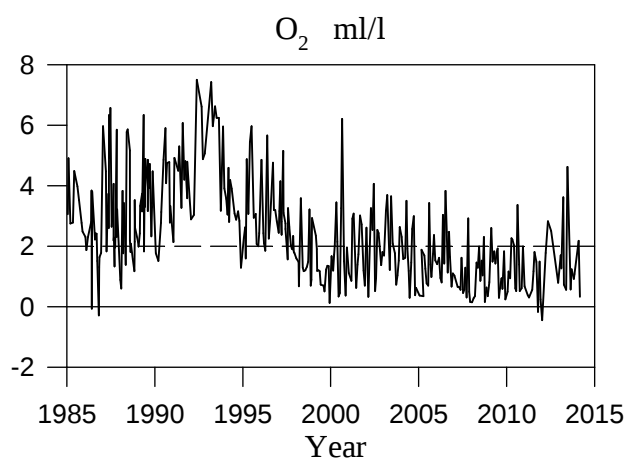
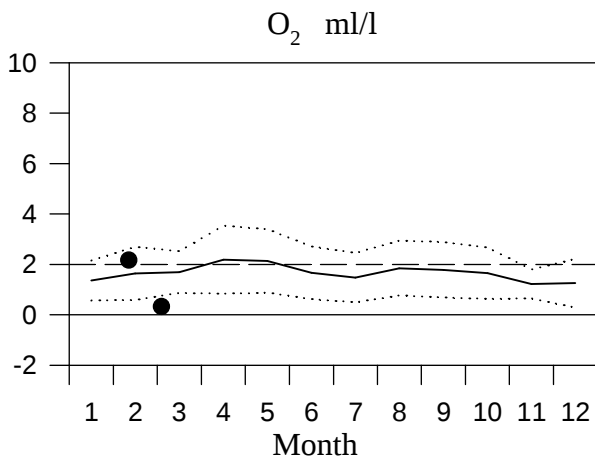
STATION BCS III-10 SURFACE WATER

Annual Cycles

— Mean 1996-2010 St.Dev. ● 2014



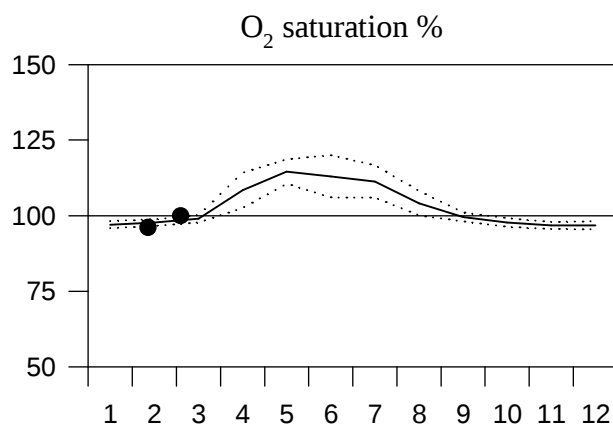
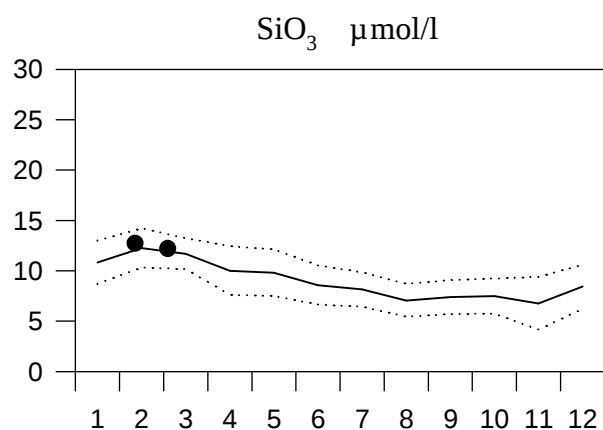
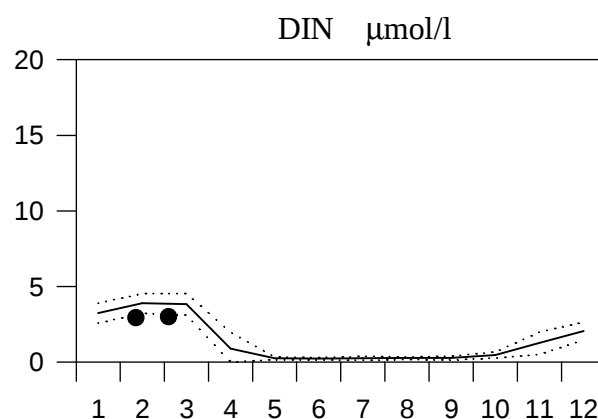
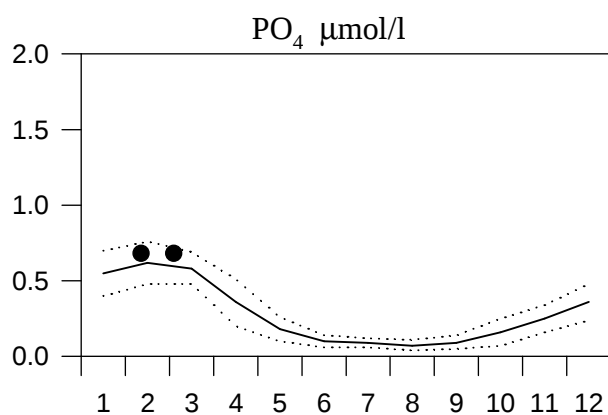
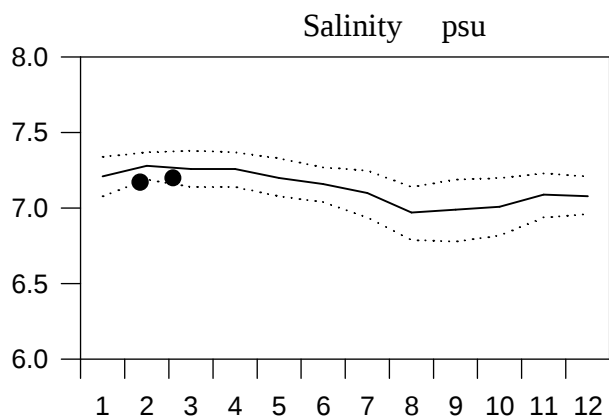
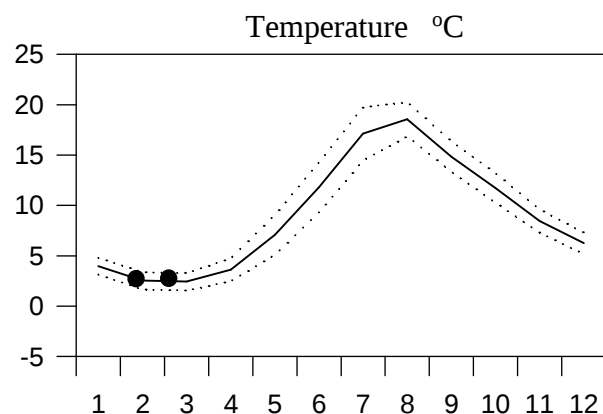
OXYGEN IN BOTTOM WATER (depth > 80m)



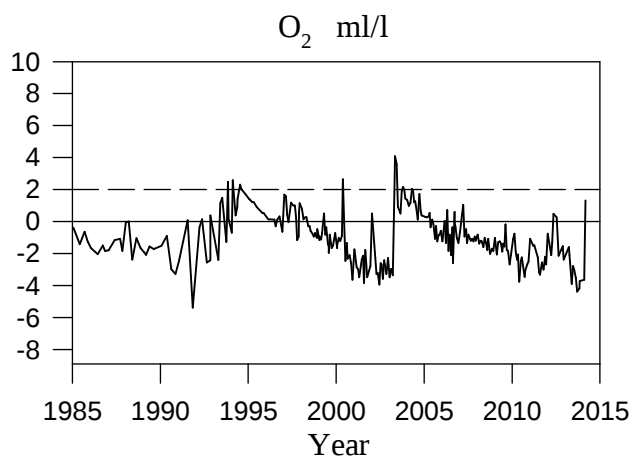
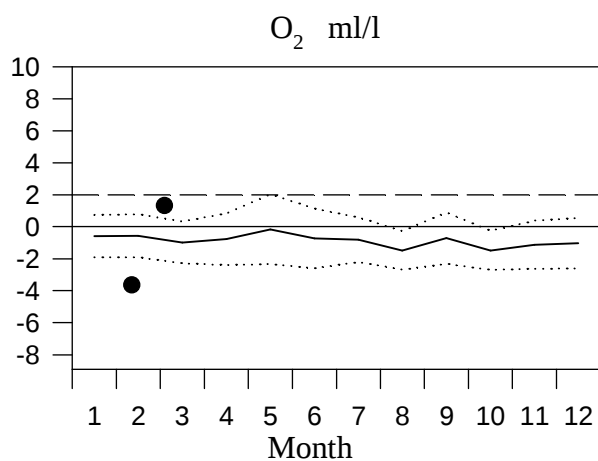
STATION BY10 SURFACE WATER

Annual Cycles

— Mean 1996-2010 St.Dev. ● 2014



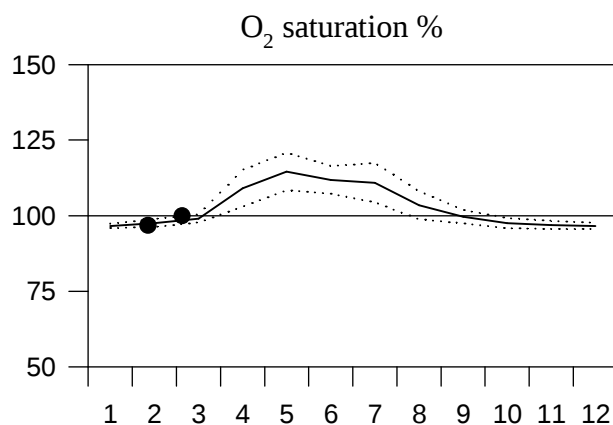
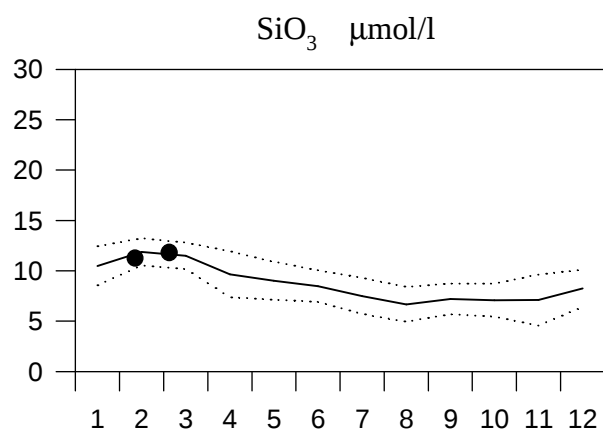
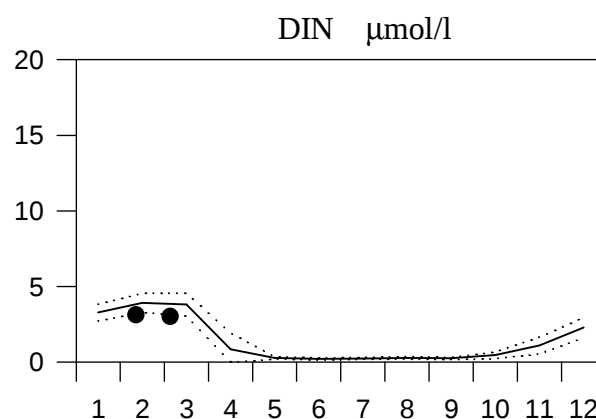
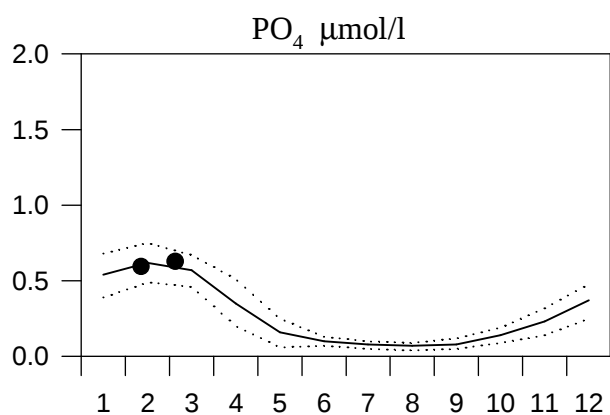
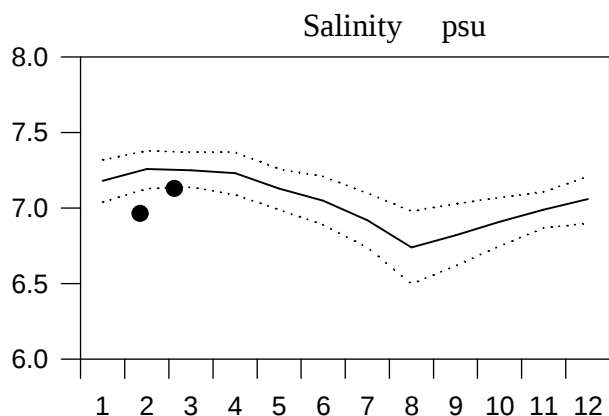
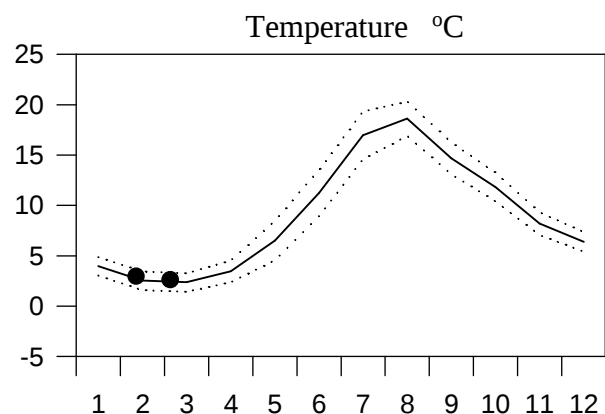
OXYGEN IN BOTTOM WATER (depth >125m)



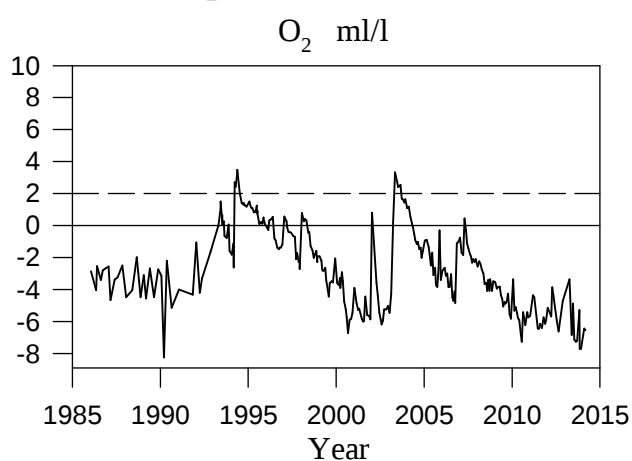
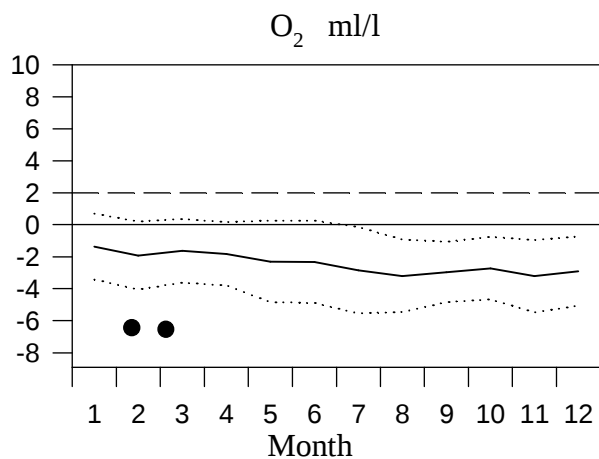
STATION BY15 SURFACE WATER

Annual Cycles

— Mean 1996-2010 St.Dev. ● 2014



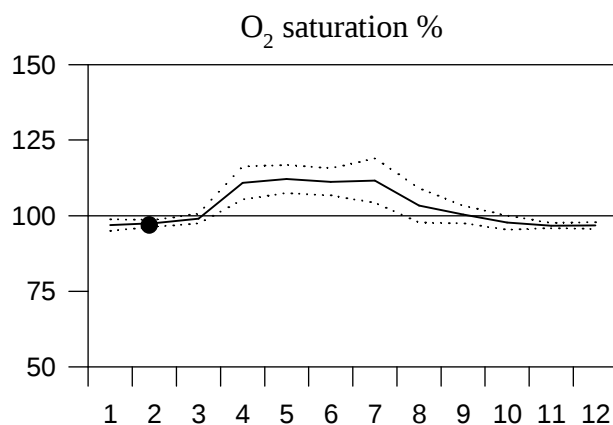
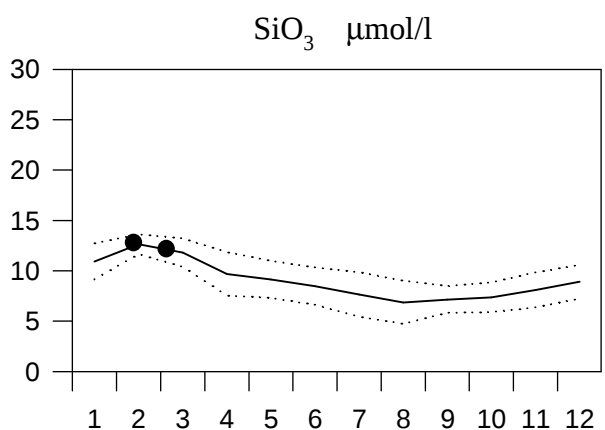
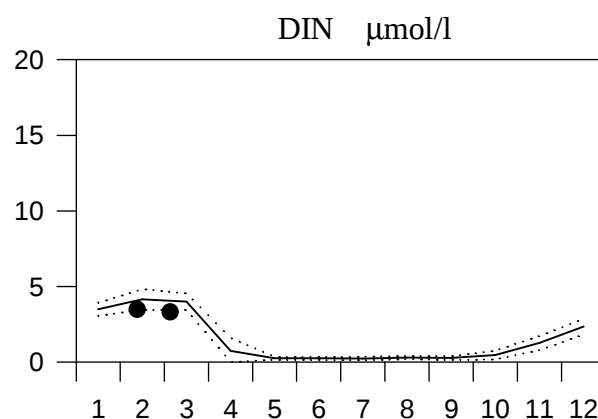
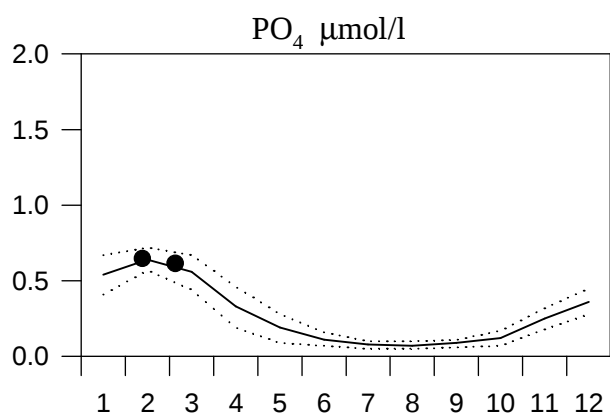
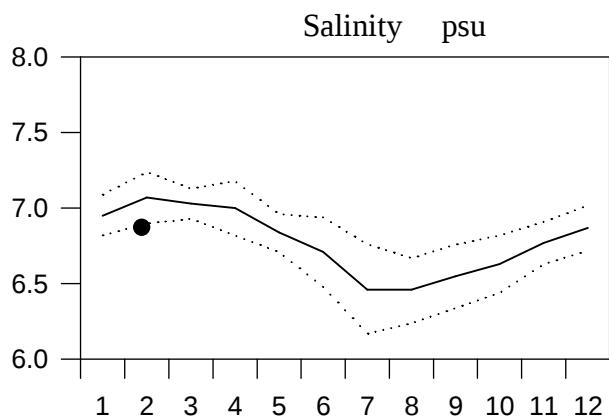
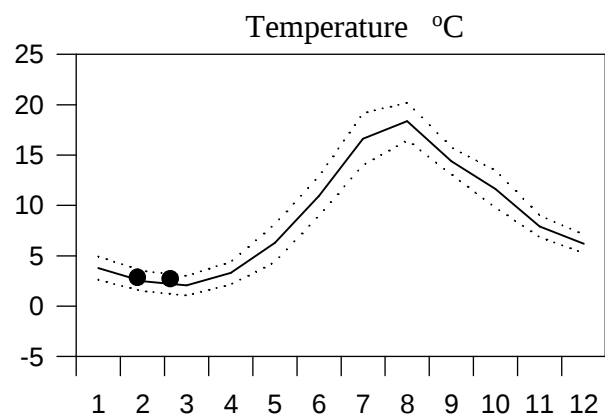
OXYGEN IN BOTTOM WATER (depth >225m)



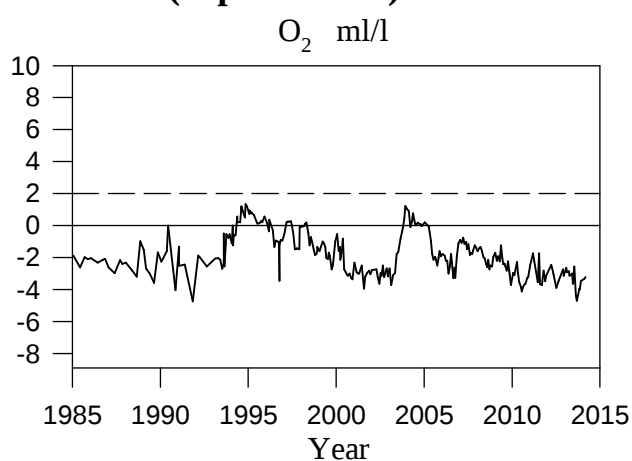
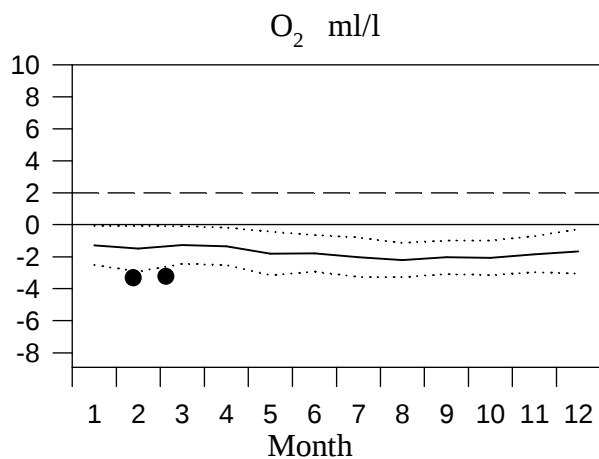
STATION BY20 SURFACE WATER

Annual Cycles

— Mean 1996-2010 St.Dev. ● 2014



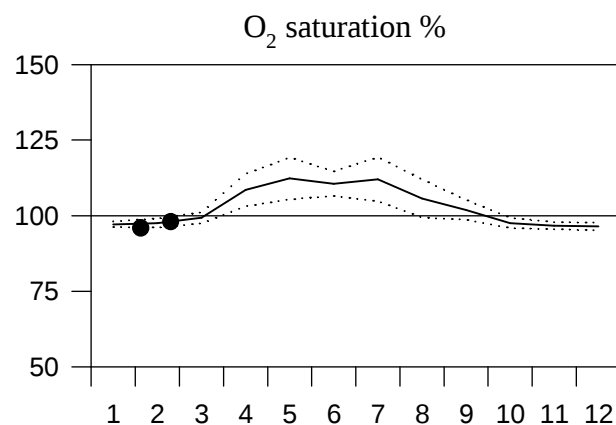
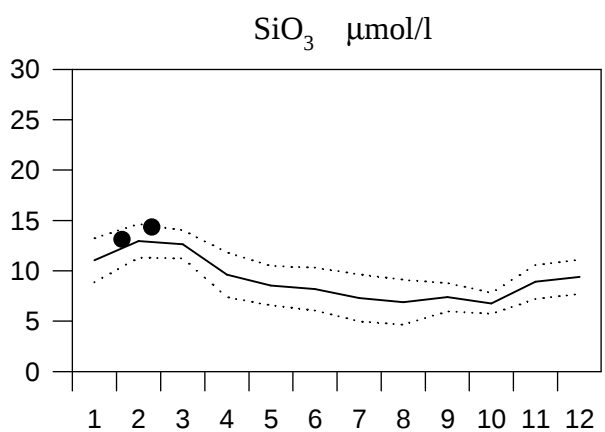
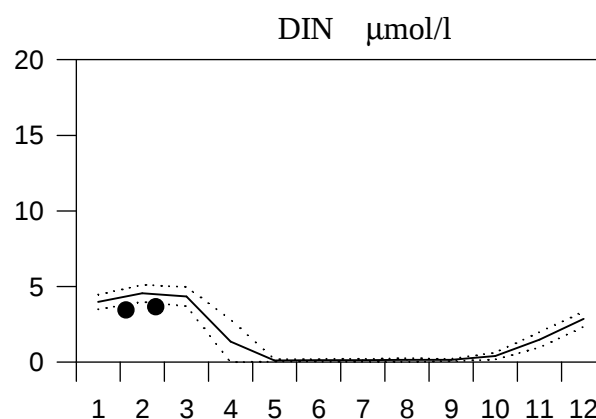
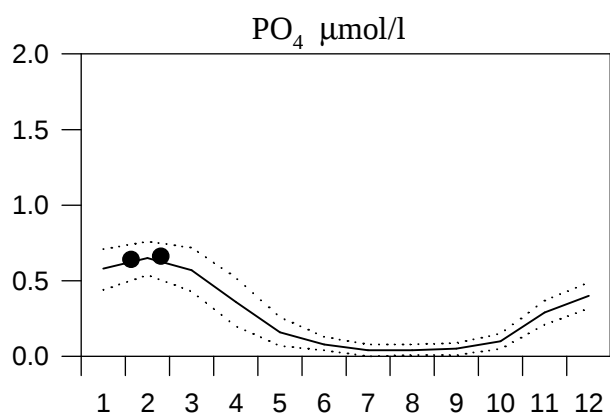
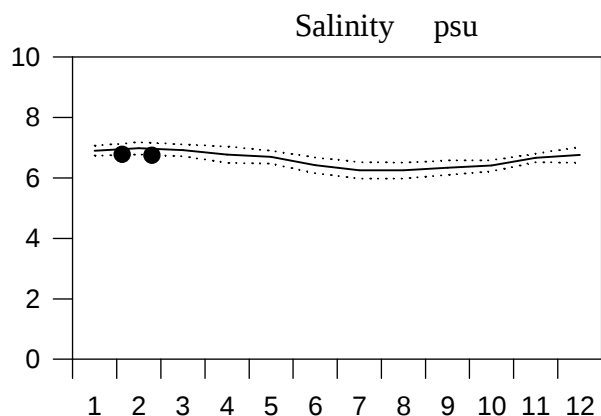
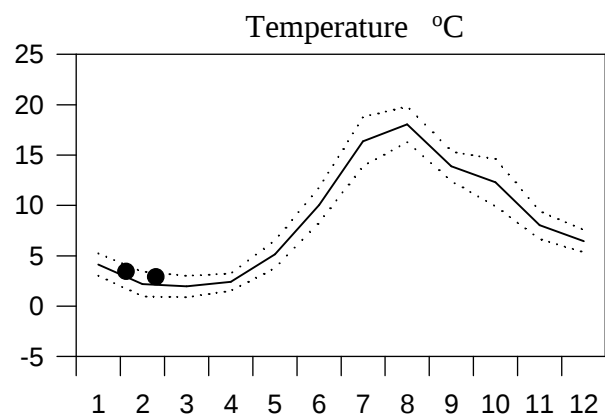
OXYGEN IN BOTTOM WATER (depth >175m)



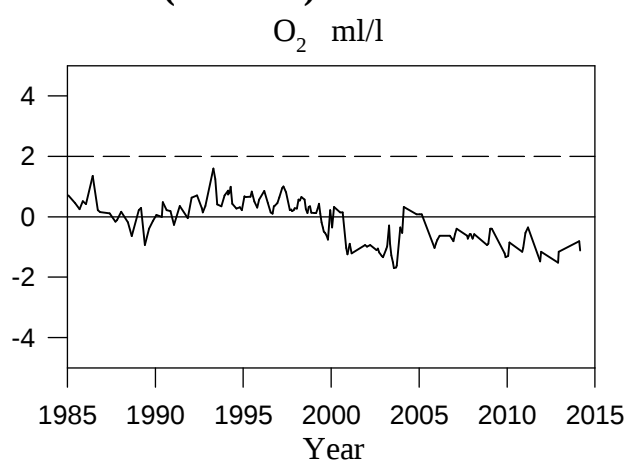
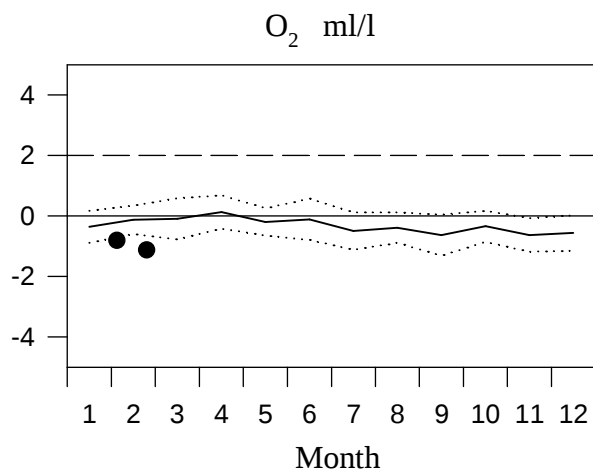
STATION BY29 SURFACE WATER

Annual Cycles

— Mean 1996-2010 St.Dev. ● 2014



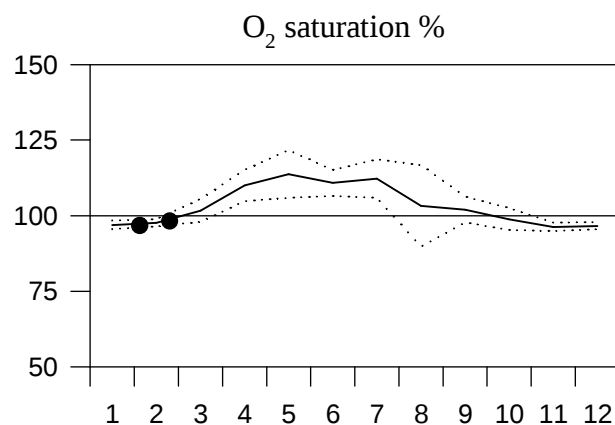
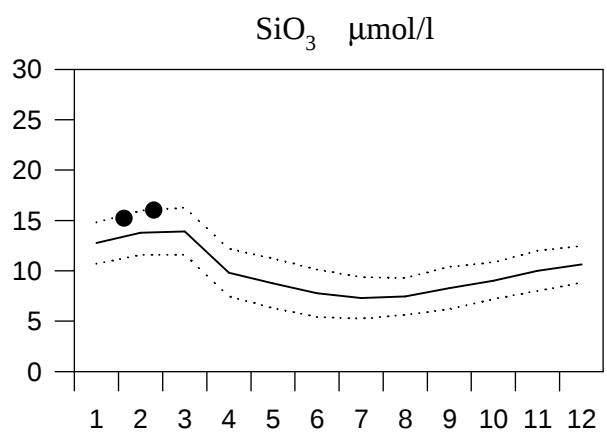
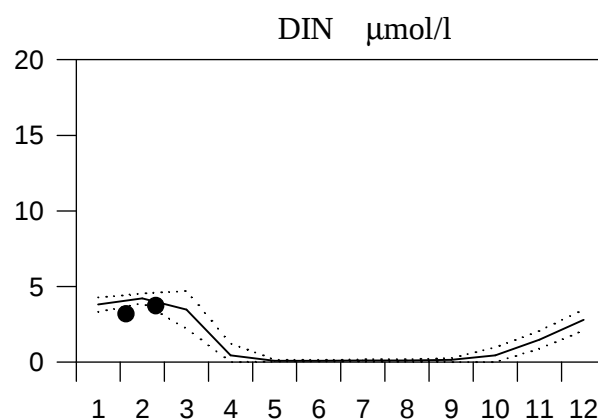
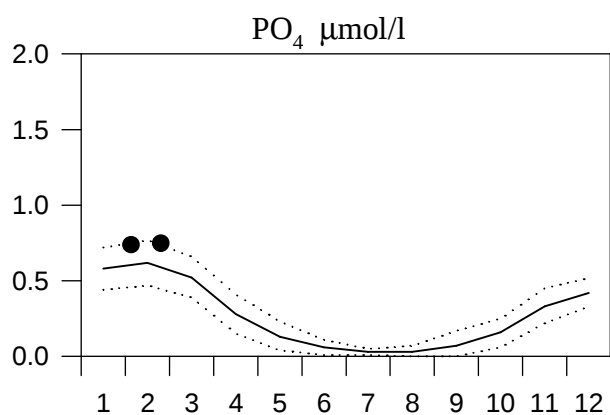
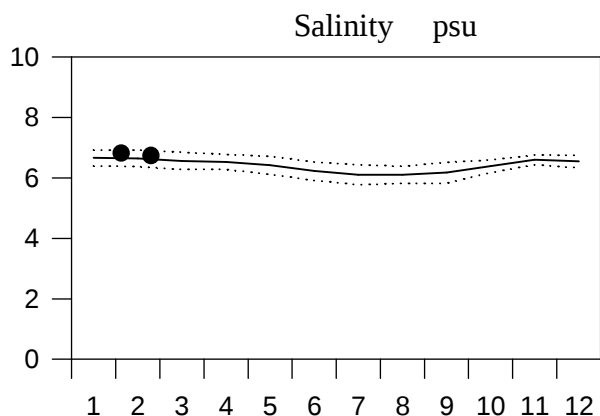
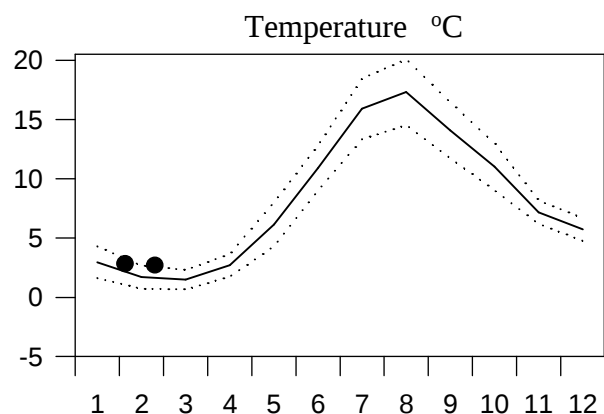
OXYGEN IN BOTTOM WATER (>=150m)



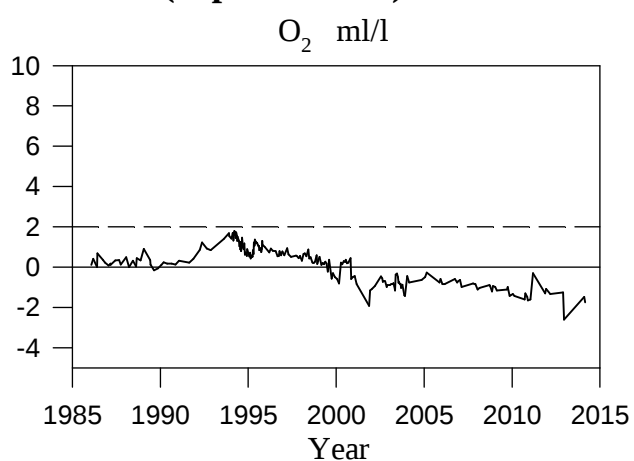
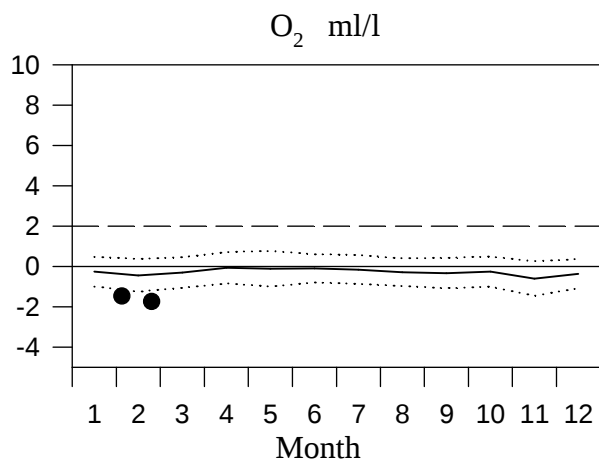
STATION BY31 SURFACE WATER

Annual Cycles

— Mean 1996-2010 St.Dev. ● 2014



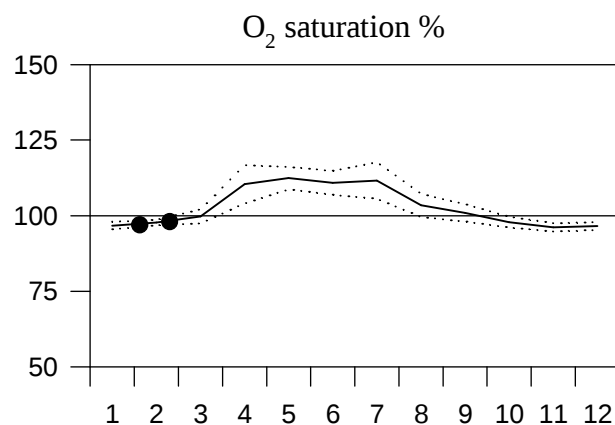
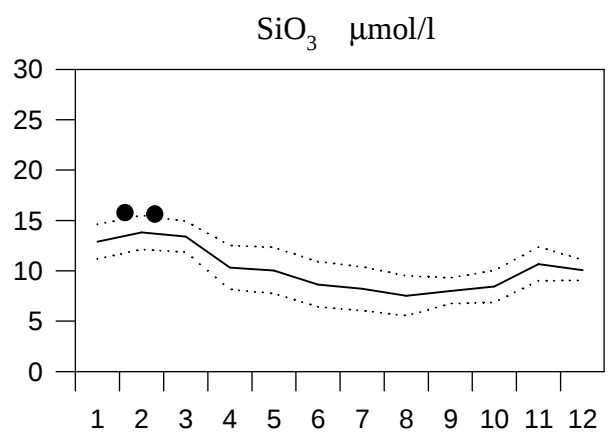
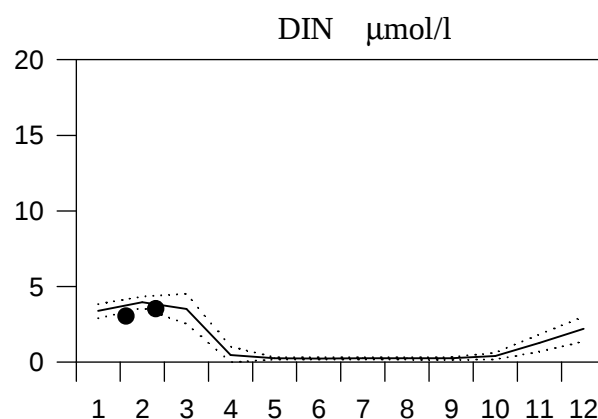
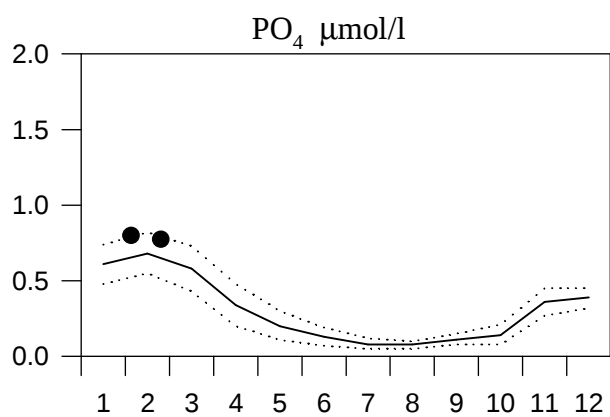
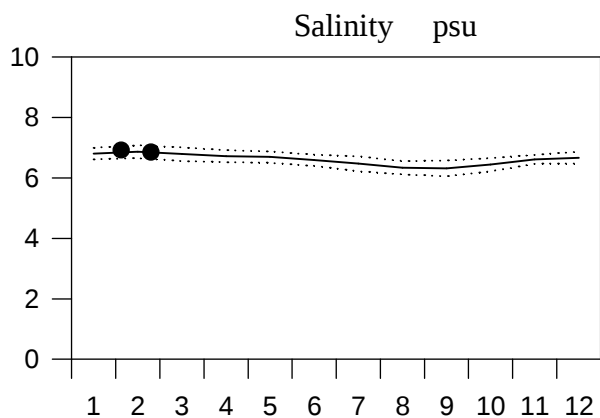
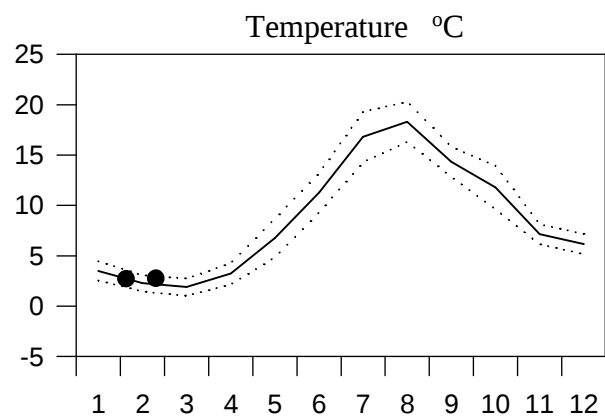
OXYGEN IN BOTTOM WATER (depth = 440m)



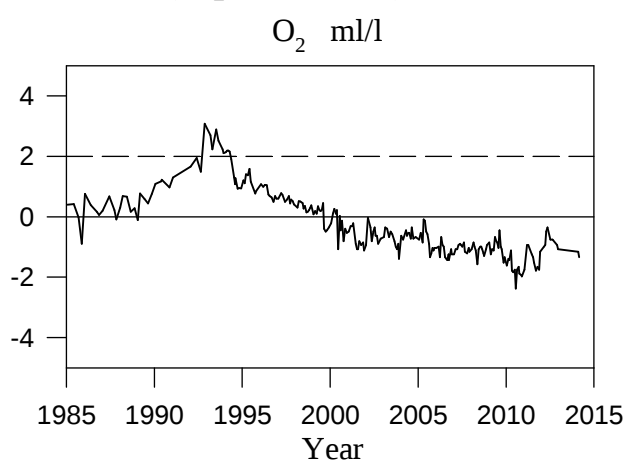
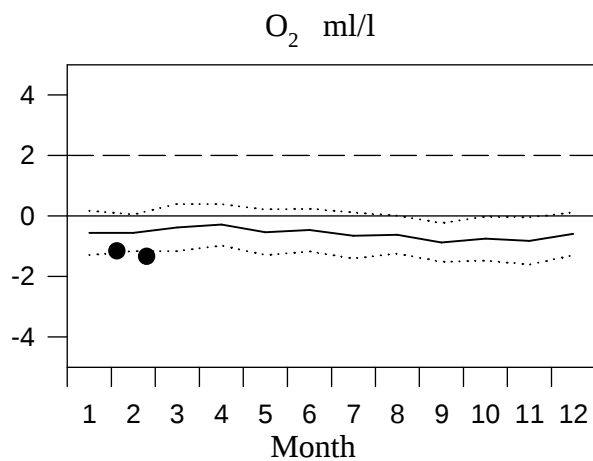
STATION BY32 SURFACE WATER

Annual Cycles

— Mean 1996-2010 St.Dev. ● 2014



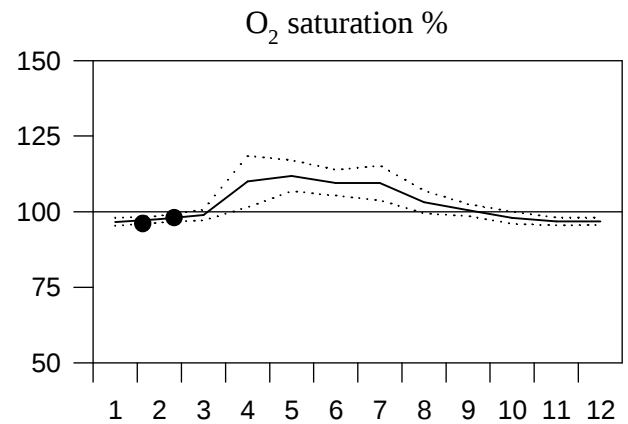
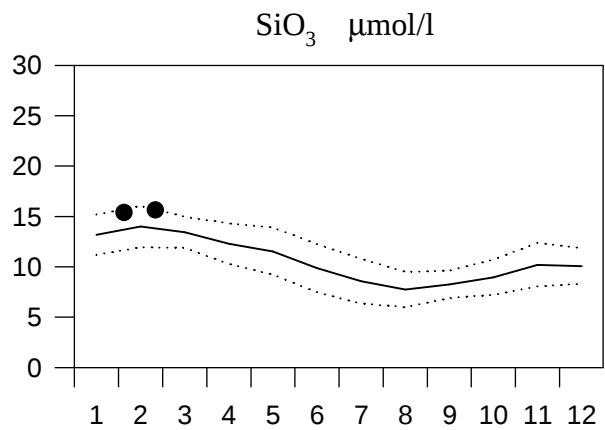
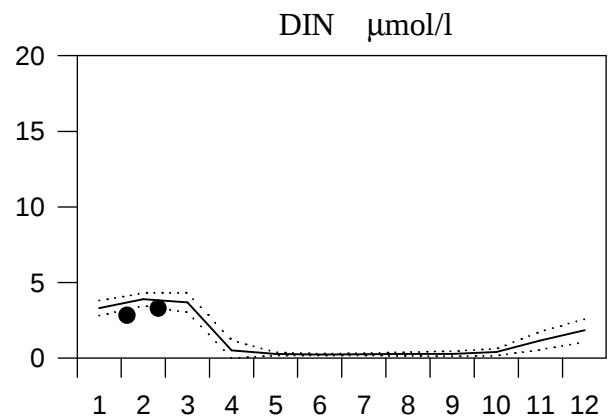
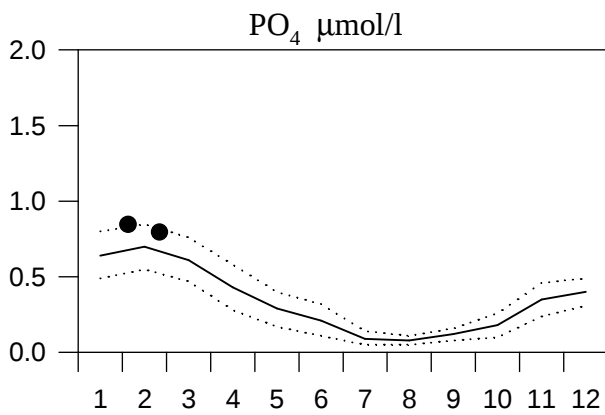
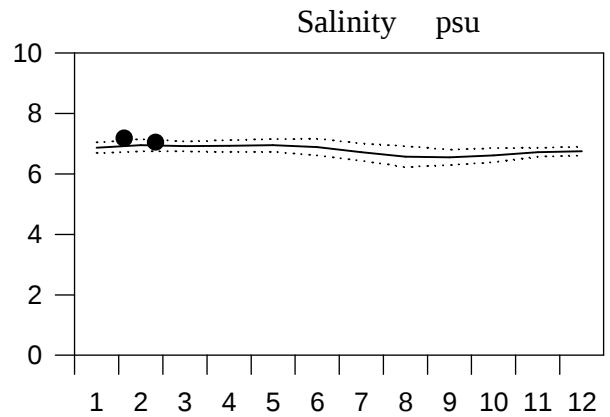
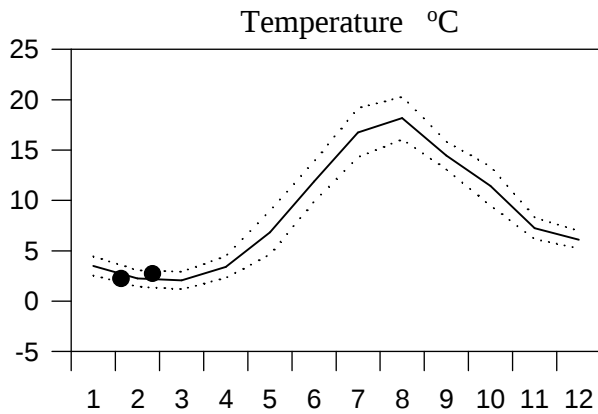
OXYGEN IN BOTTOM WATER (depth > 175m)



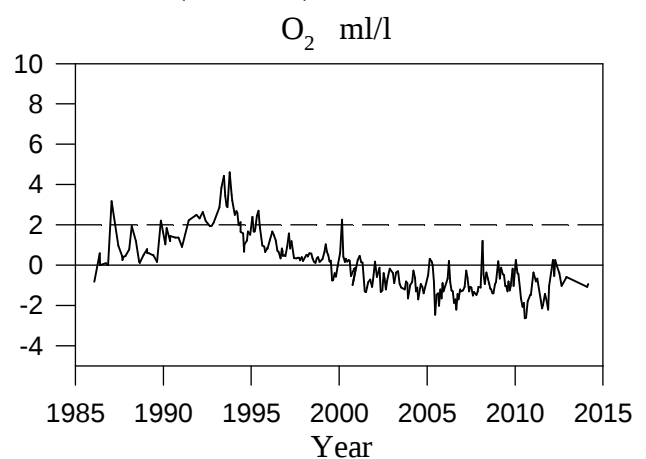
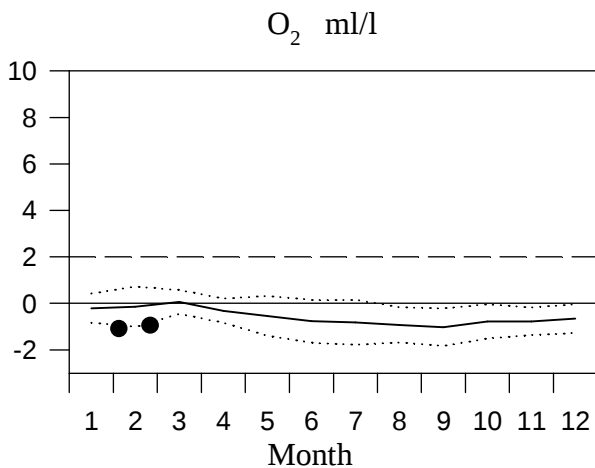
STATION BY38 SURFACE WATER

Annual Cycles

— Mean 1996-2010 St.Dev. ● 2014



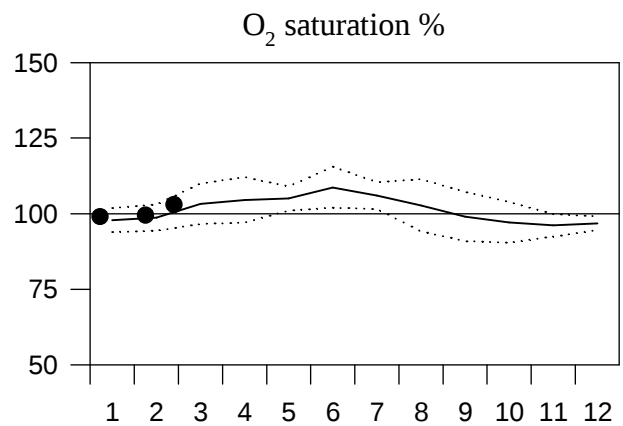
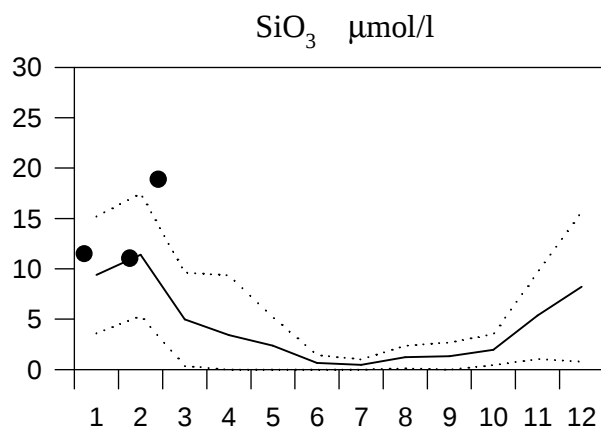
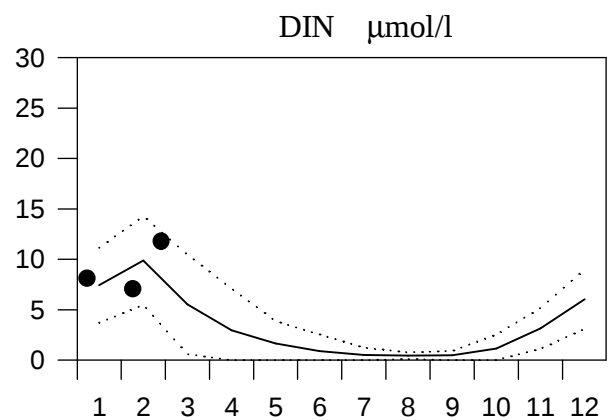
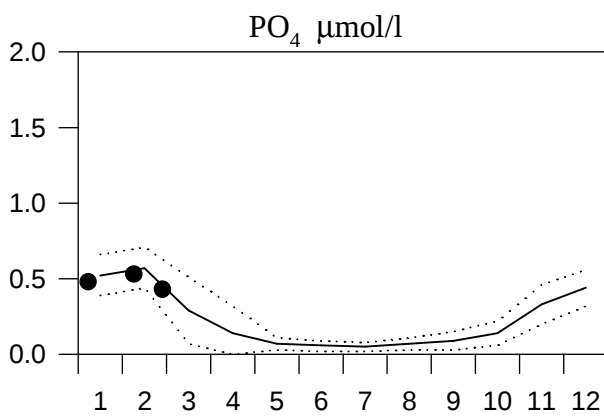
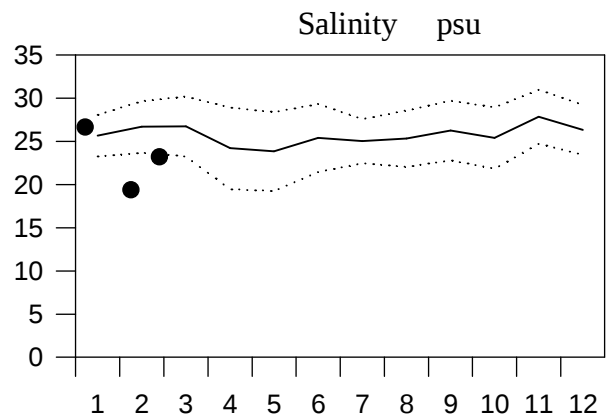
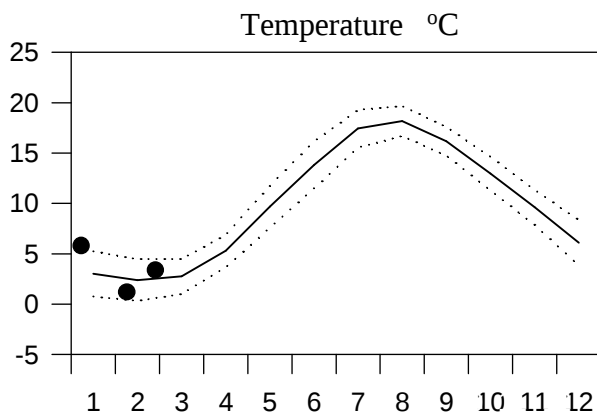
OXYGEN IN BOTTOM WATER (> 100m)



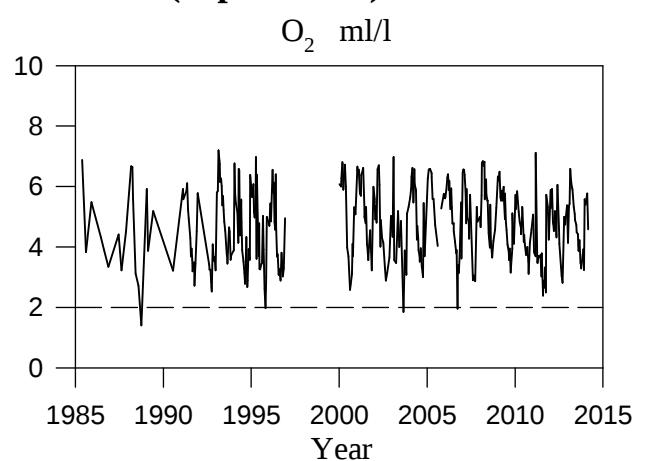
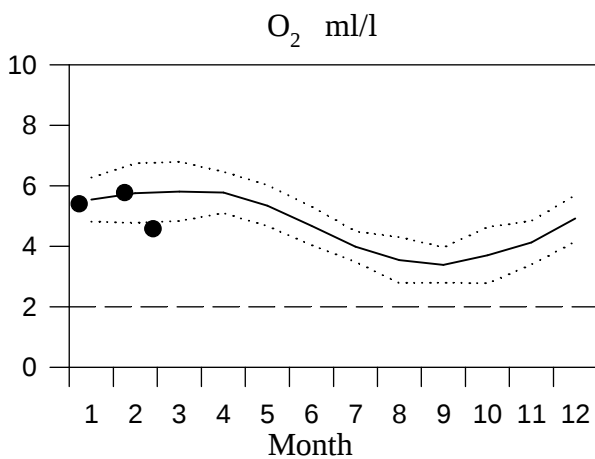
STATION SLÄGGÖ SURFACE WATER

Annual Cycles

— Mean 1996-2010 St.Dev. ● 2014



OXYGEN IN BOTTOM WATER (depth >50m)



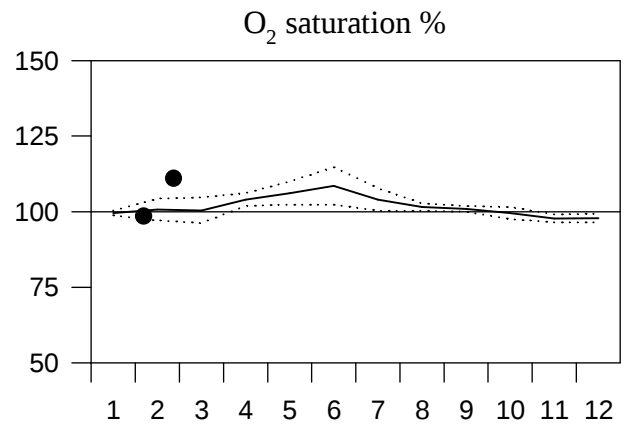
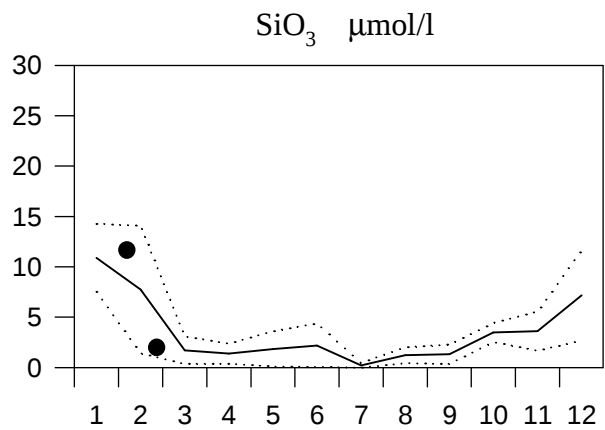
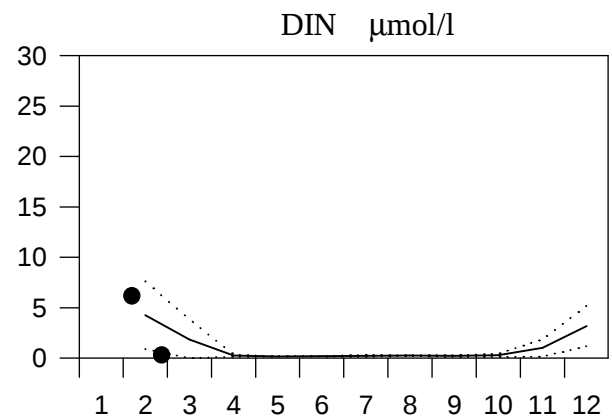
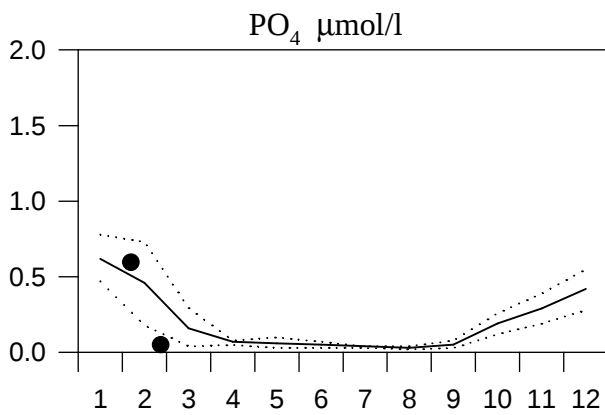
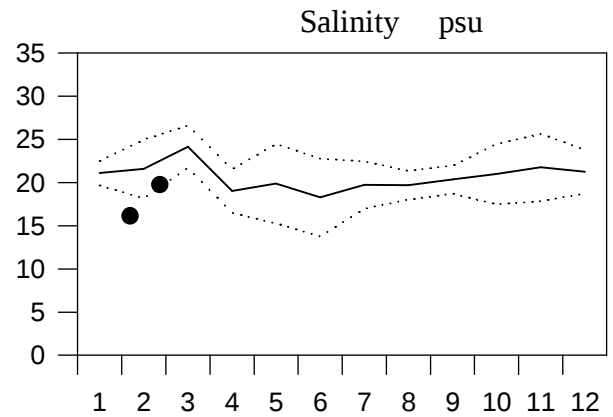
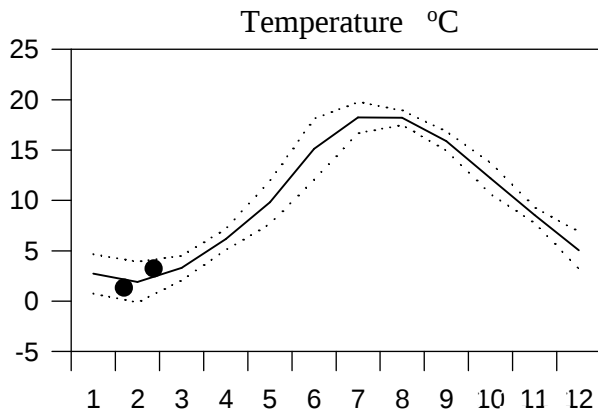
STATION N14 Falkenberg SURFACE WATER

Annual Cycles

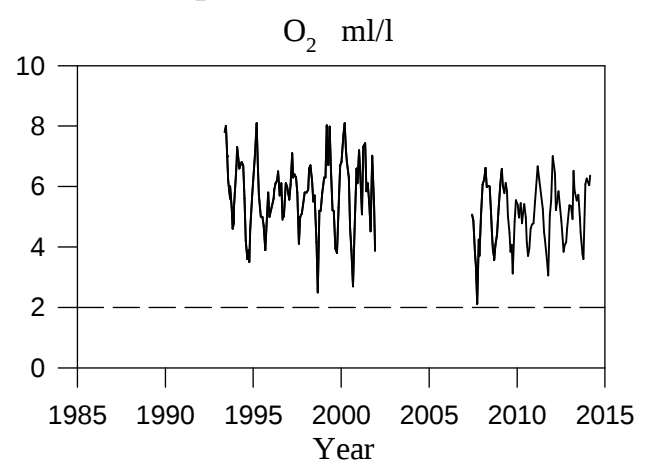
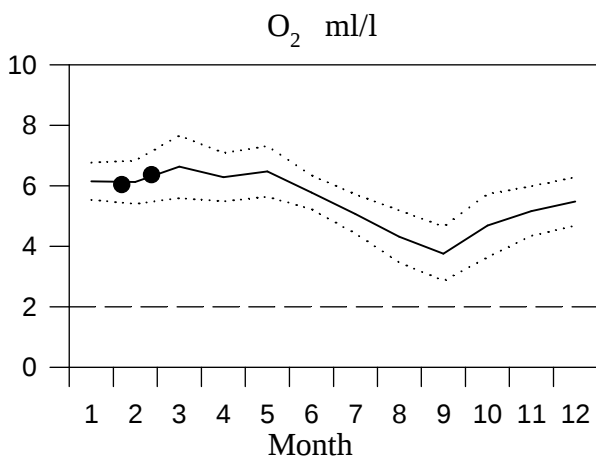
— Mean 2007-2010

..... St.Dev.

● 2014



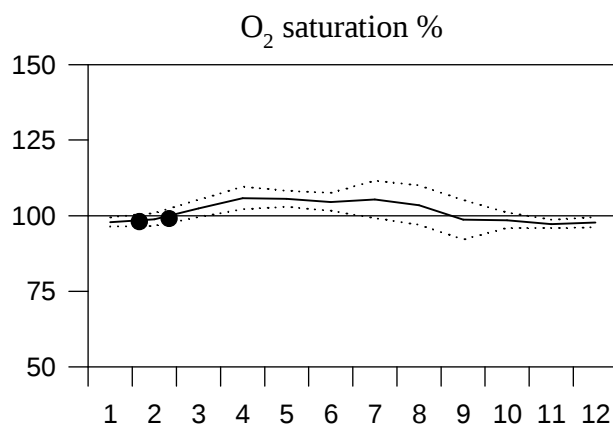
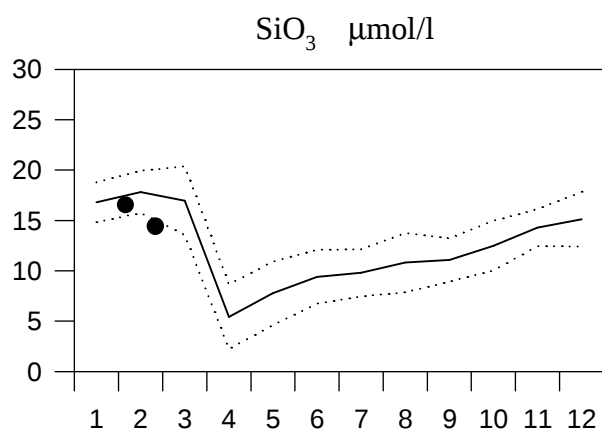
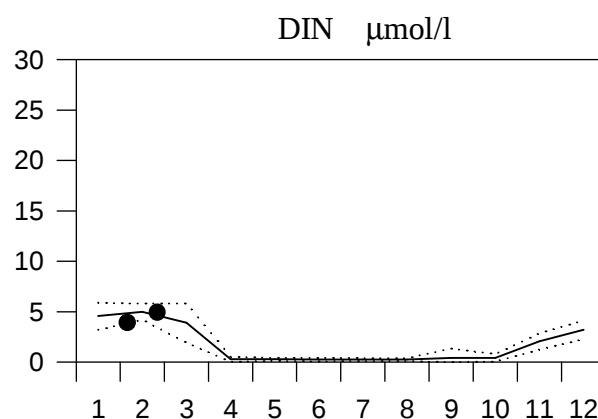
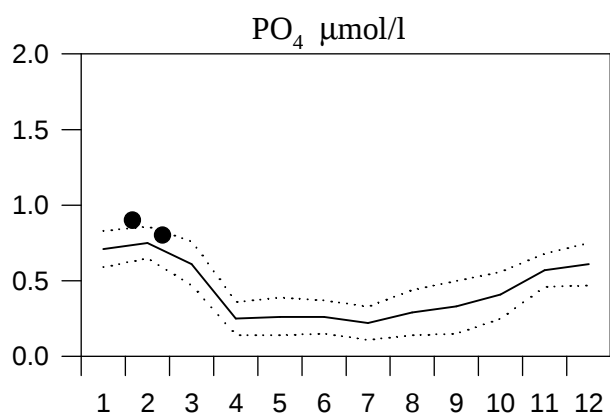
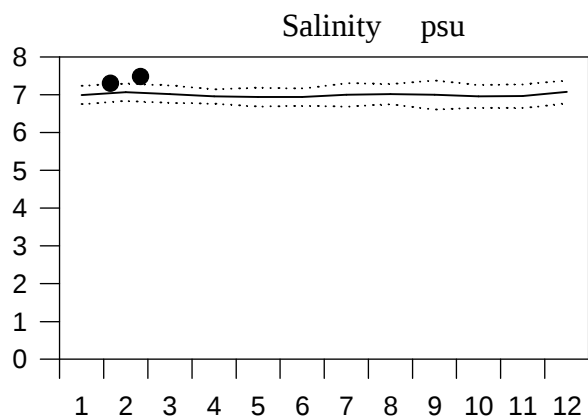
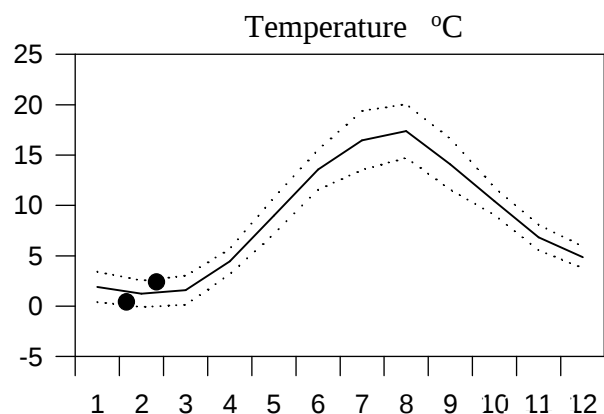
OXYGEN IN BOTTOM WATER (depth > 25m)



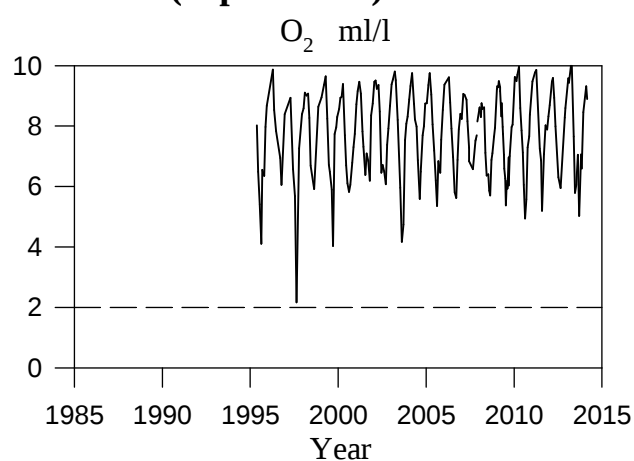
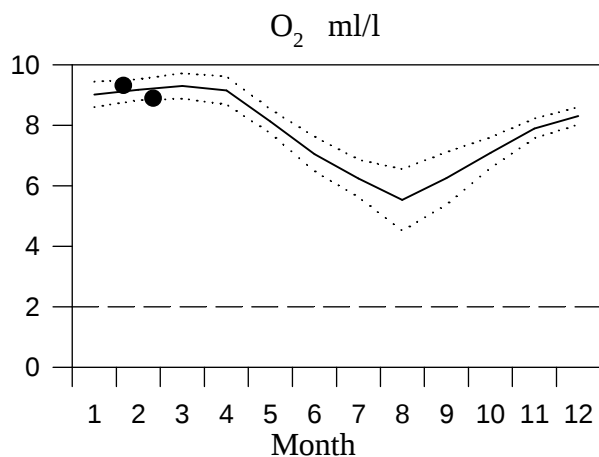
STATION REF M1V1 SURFACE WATER

Annual Cycles

— Mean 1996-2010 St.Dev. ● 2014

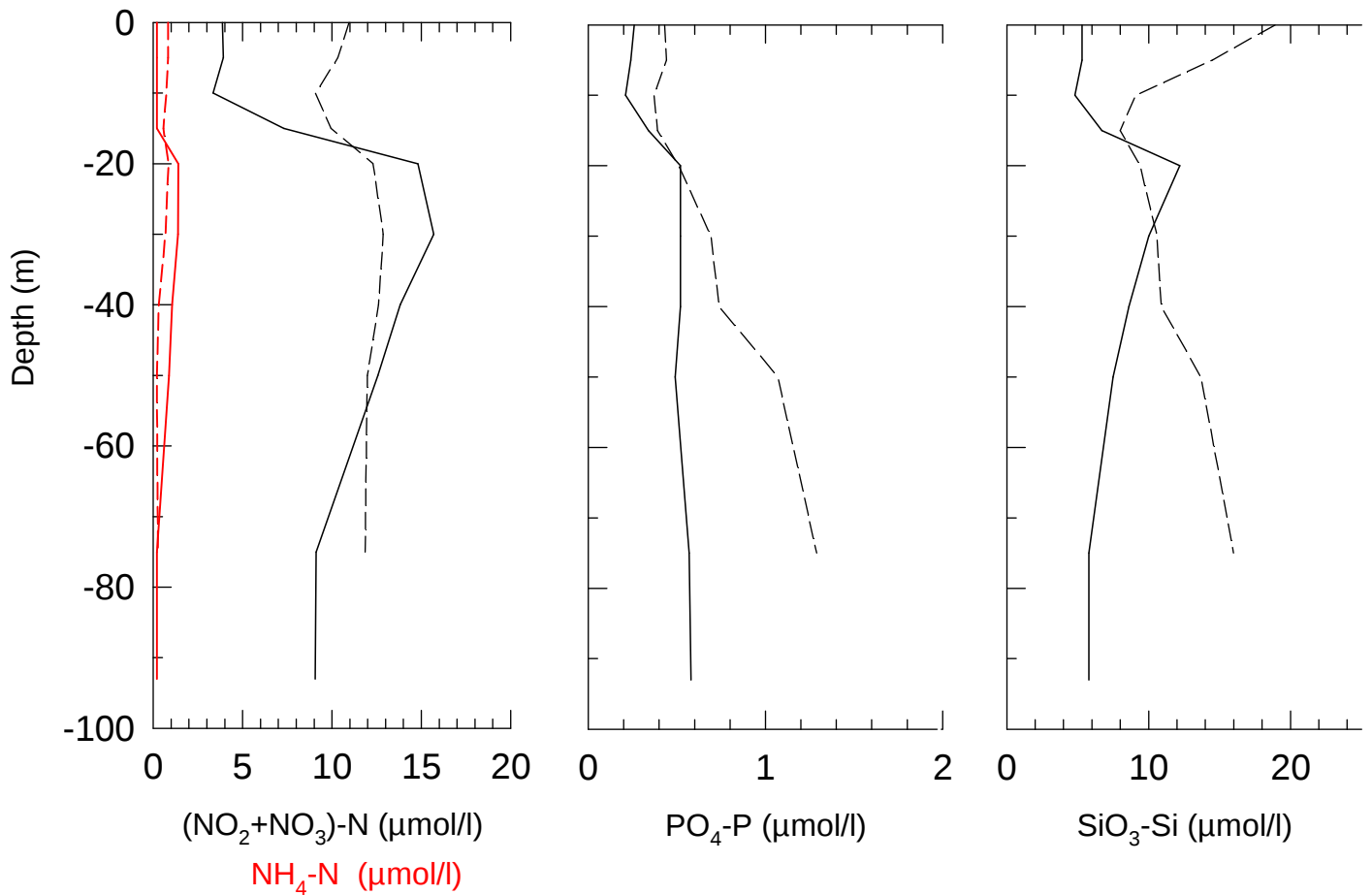
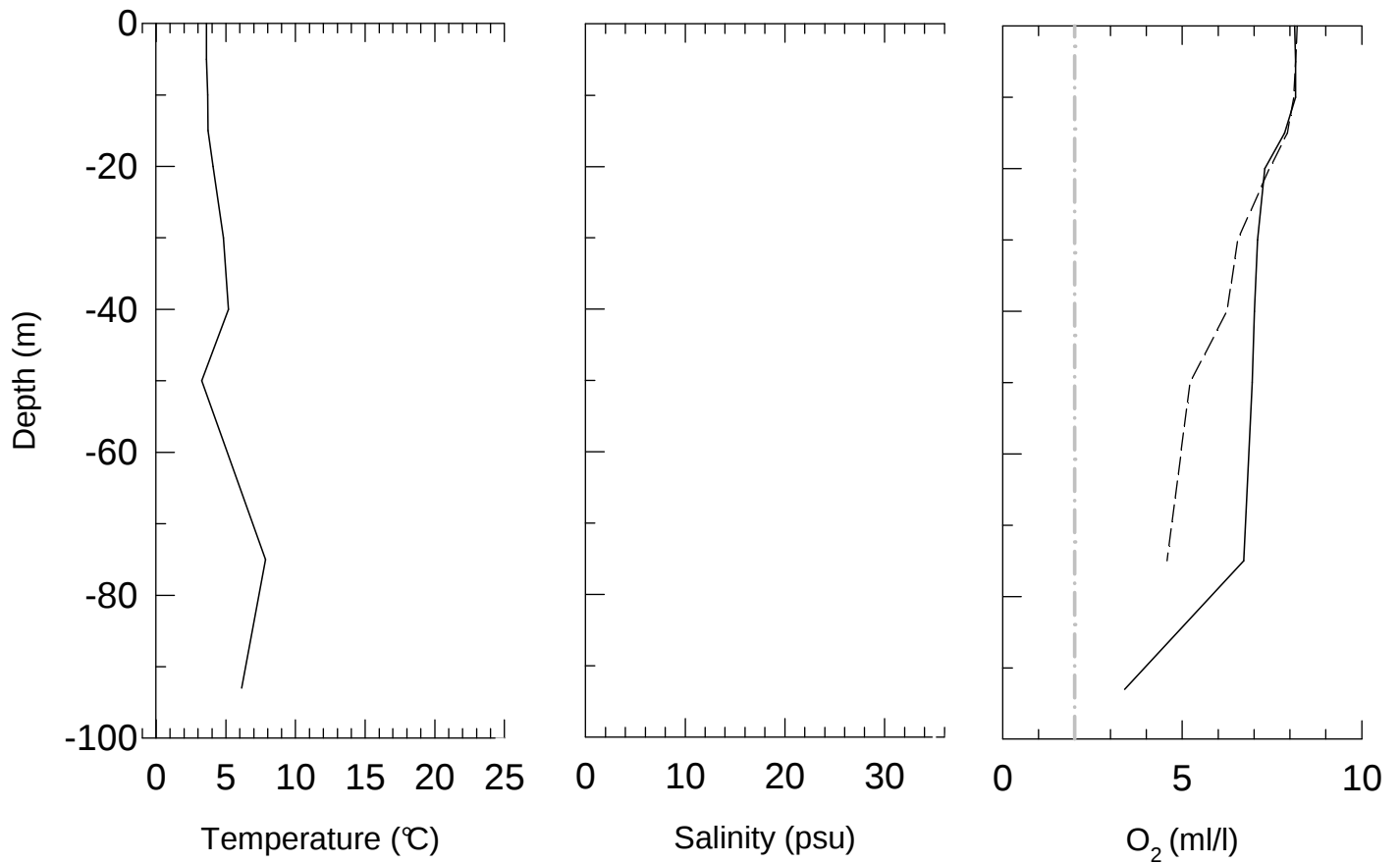


OXYGEN IN BOTTOM WATER (depth >15m)



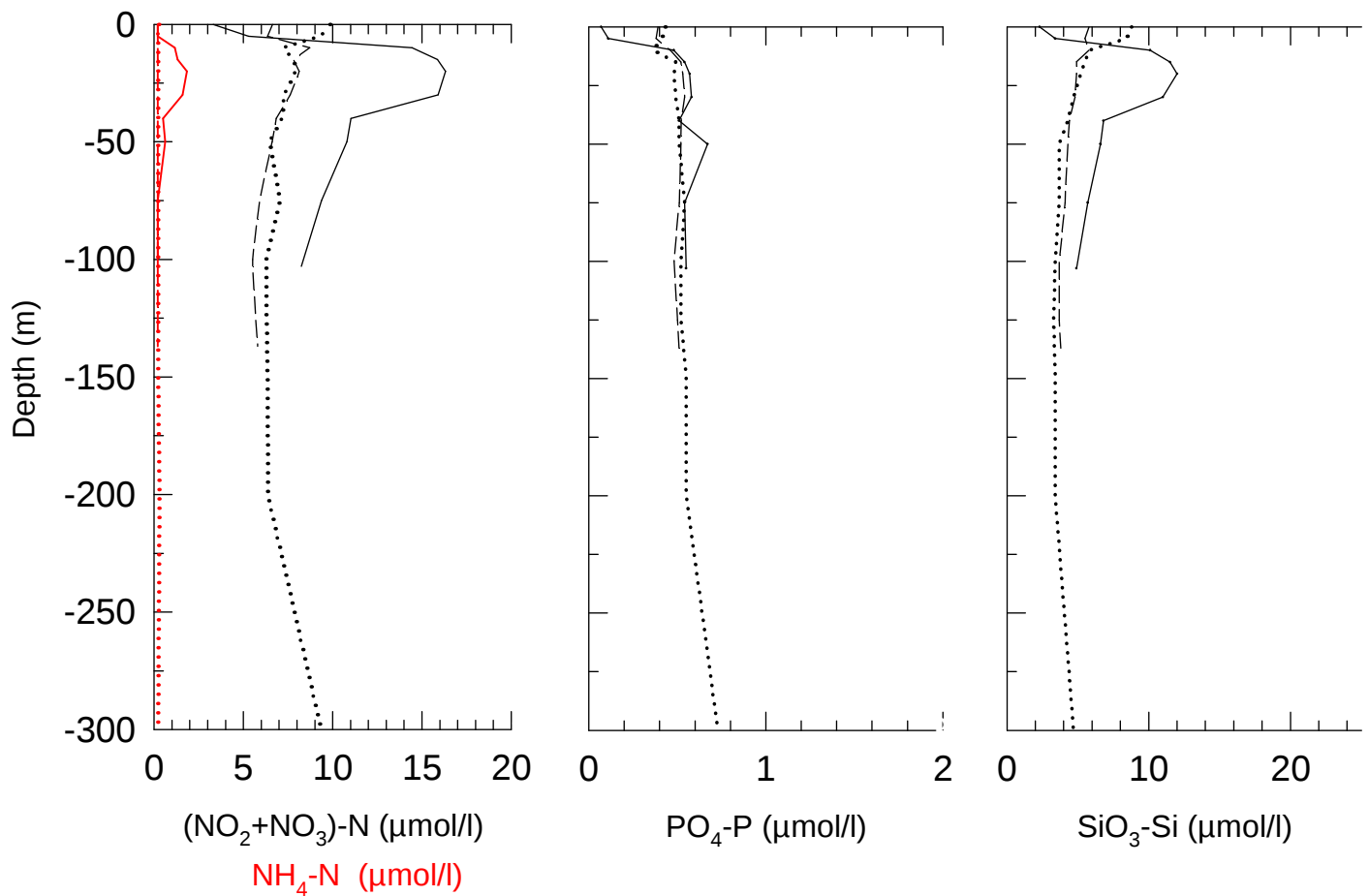
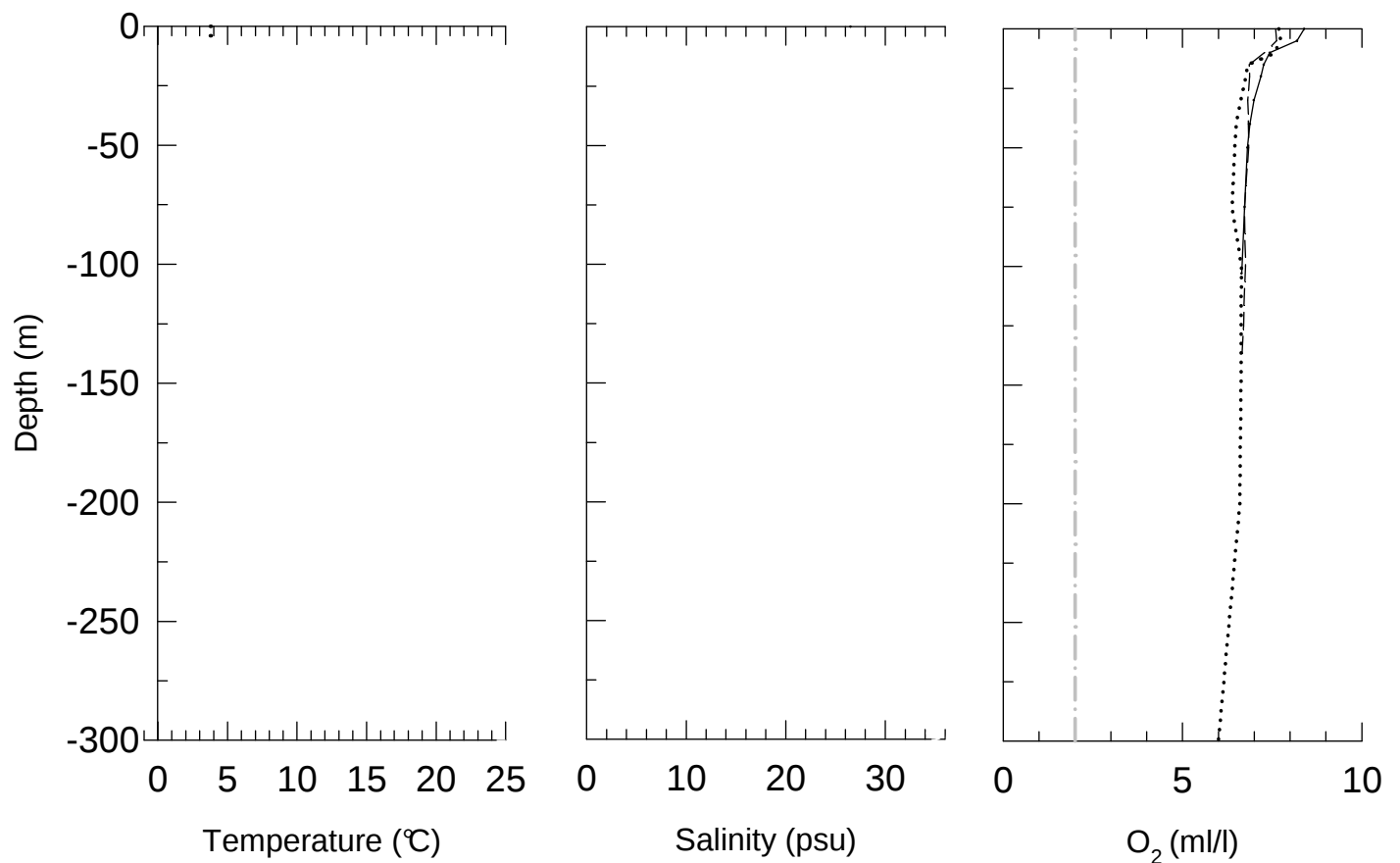
SKAGERRAK Coast 2014-02-28

—— P2 - - - - Släggö

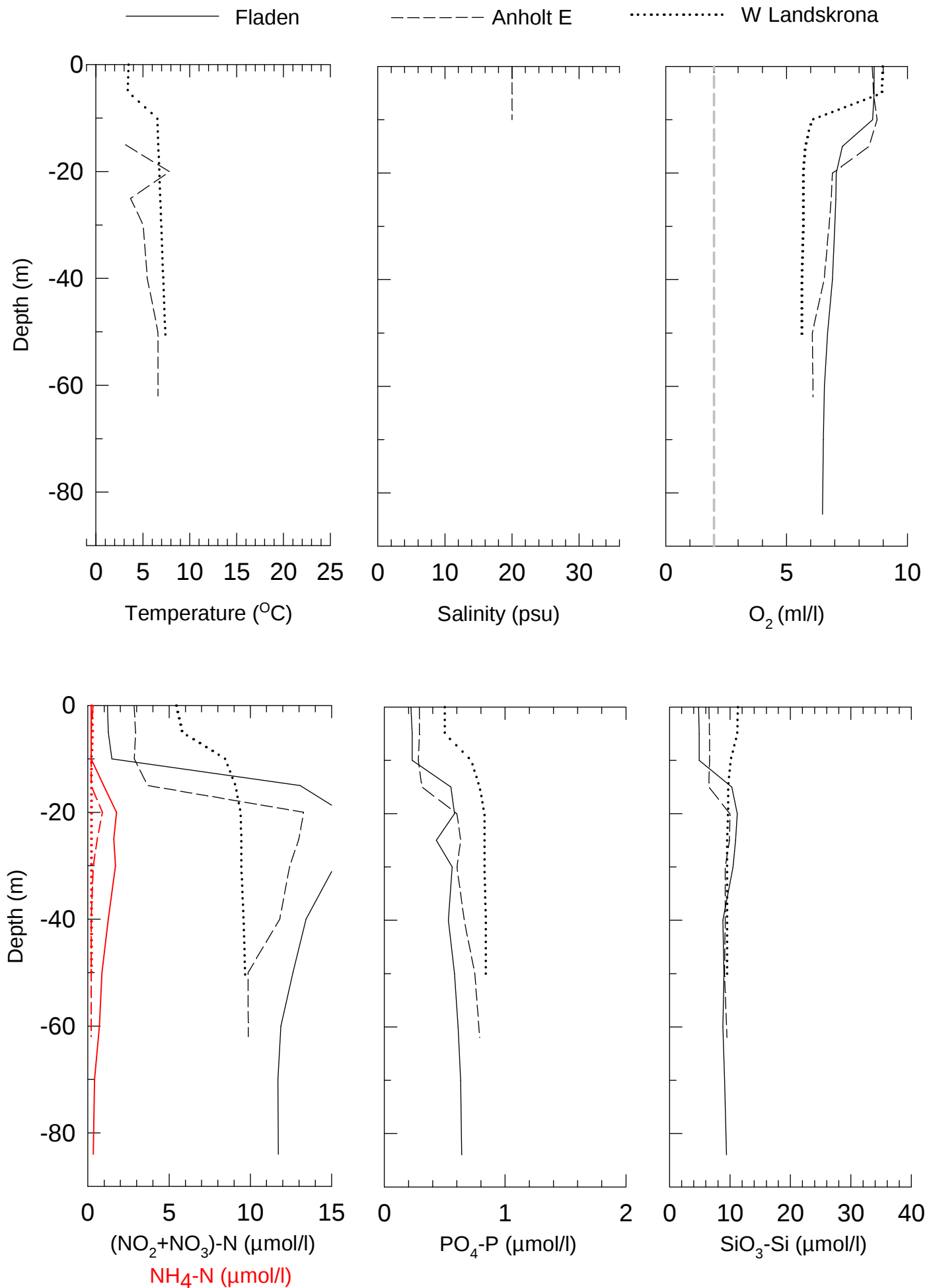


SKAGERRAK Å-Section 2014-02-28

—— Å13 - - - - - Å15 Å17

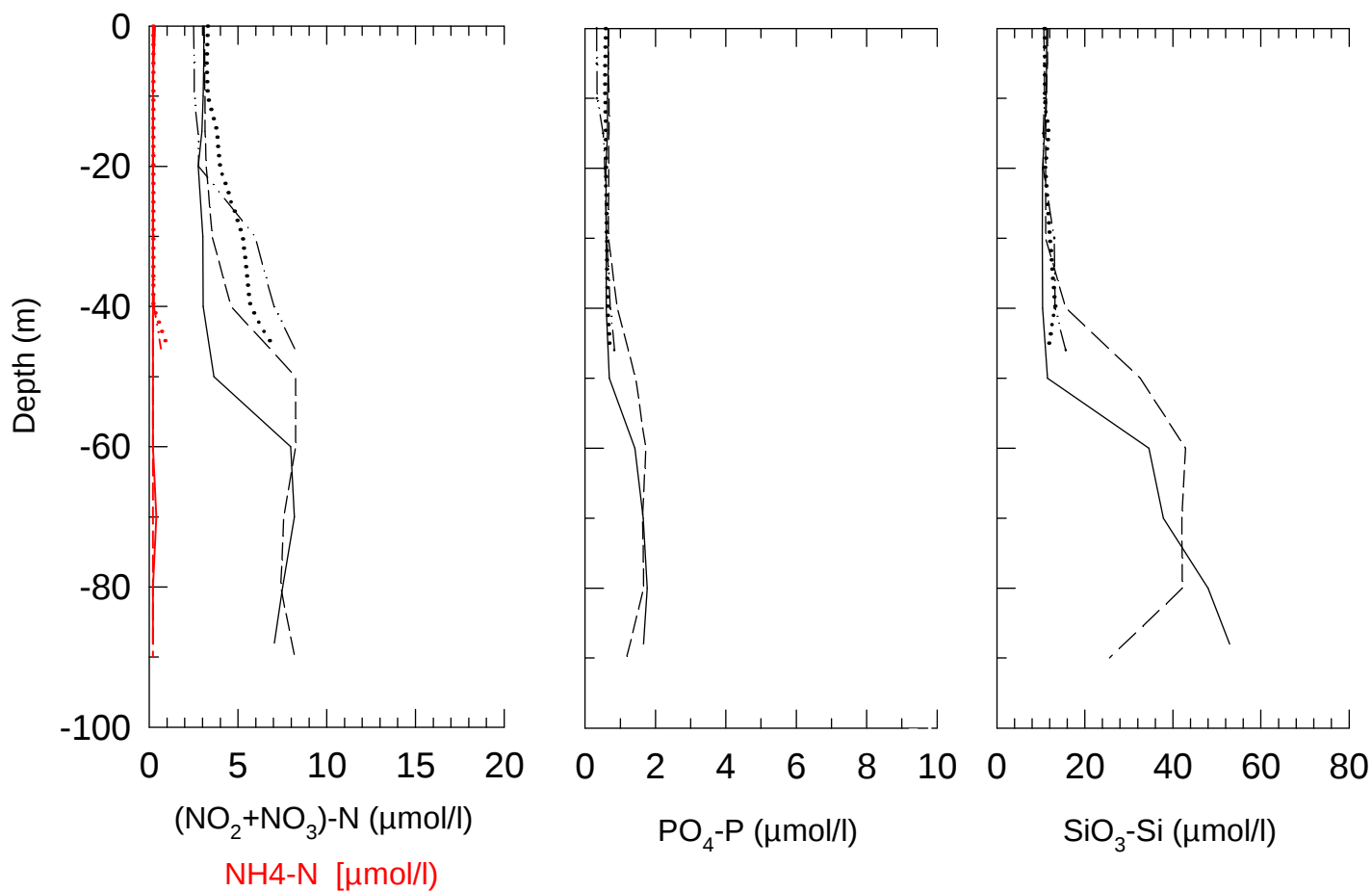
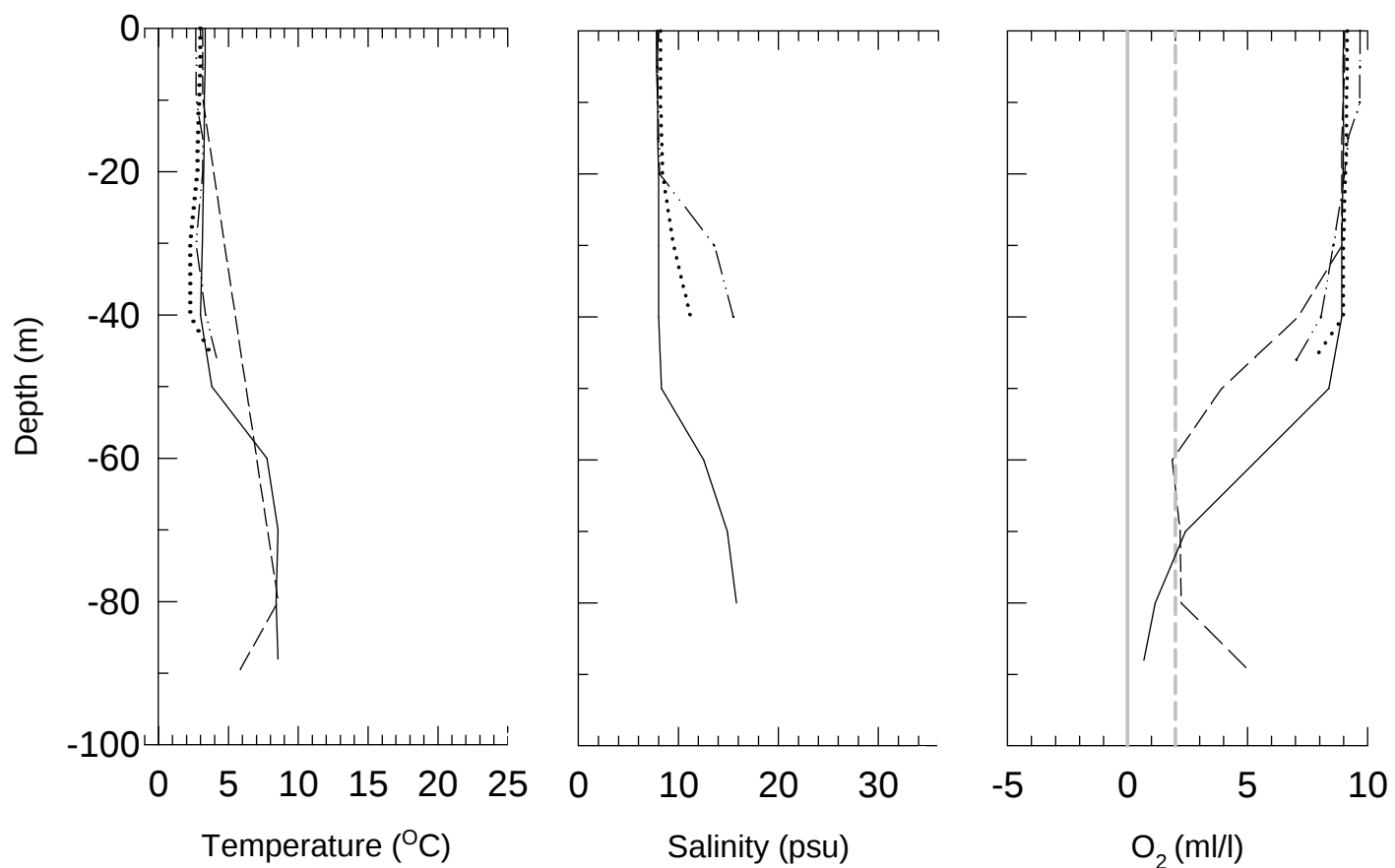


KATTEGAT and THE SOUND 2014-02-27/28



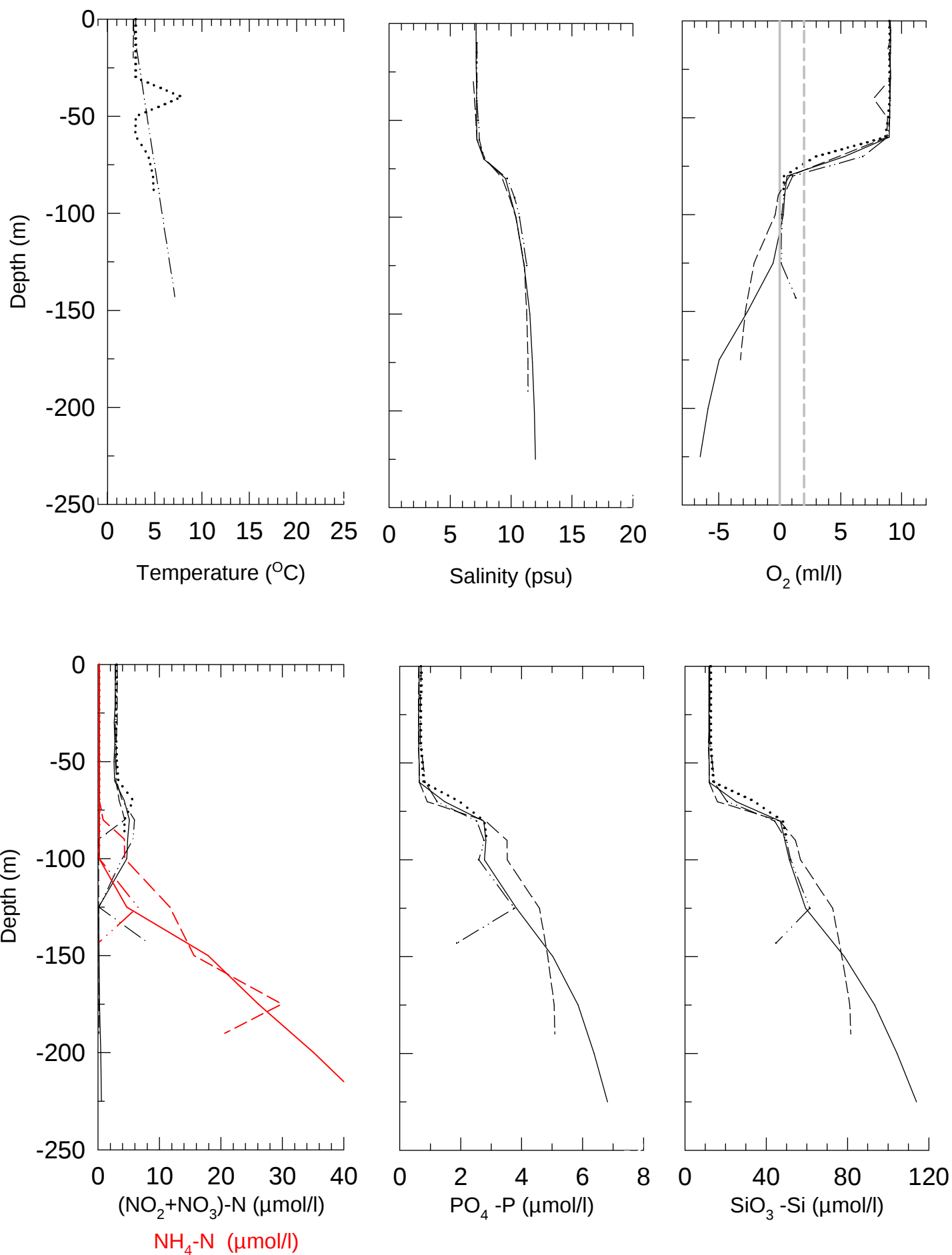
SOUTHERN BALTIC 2014-03-02

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



EASTERN BALTIC 2014-03-03/04

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



WESTERN BALTIC 2014-02-25/26

————— BY32 - - - - - BY38

