

Rapport från SMHIs utsjöexpedition med R/V Aranda



Expeditionens varaktighet: 2014-02-03 - 2014-02-12
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 Kattegatt genomfördes kartering av näringsämnen. Denna expedition var den första ombord på det finska forskningsfartyget Aranda, vilket under 2014 kommer att chartras av SMHI. Denna rapport är baserad på preliminära, endast delvis kvalitetskontrollerade data.

I både Skagerrak och Kattegatt var salthalten i ytvattnet mycket lägre än normalt, vilket tyder på stor inverkan av utflödande Östersjövatten. Karteringen av näringsämnen i Kattegatt visade på små variationer och överlag normala förhållanden. 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. Planktonaktiviteten var låg i alla undersökta områden.

Nästa ordinarie expedition är planerad till vecka 9-10. Då kommer egentliga Östersjön, Skagerrak och Kattegatt att besökas. I egentliga Östersjön kommer kartering av näringsämnen att genomföras.

PRELIMINÄRA RESULTAT

Expeditionen, vilken är den första med det finska forskningsfartyget Aranda, startade i Helsingfors den 2:e februari och avslutades i Nynäshamn den 12:e februari. Ett uppehåll gjordes i Göteborg för att ta ombord kompletterande utrustning och för pressvisning av fartyget samt SMHIs verksamhet ombord. Under expeditionen första del, från Helsingfors till Göteborg var vindarna svaga till måttliga. Efter uppehållet i Göteborg ökade vinden till frisk. Åter i Östersjön var vindarna igen svaga till måttliga. Vindriktningen var i huvudsak mellan sydost och sydväst. Lufttemperaturen varierade mellan -1 och 4°C. Under expeditionen genomfördes vinterkartering av näringsämnen i Kattegatt och Öresund, där 17 stationer provtogs. Totalt under hela expeditionen besöktes ett 40-tal provtagningsstationer.

I samband med provtagning genomfördes även mätningar av löst oorganiskt kol (DIC) samt jämförande analys av tre metoder att mäta pH (med pH-elektrod, med spektrofotometer och med fluometer). Data från dessa undersökningar kommer ligga till grund för hur pH kommer analyseras i framtiden inom den svenska havsövervakningen.

Skagerrak

Temperaturen i ytlagret var lägre än normalt för årstiden och varierade mellan 1,2 - 2,1°C. Salthalten var mycket lägre än normalt och varierade från 19,4 psu närmast kusten till omkring 21,2 psu i centrala Skagerrak, vilket tyder på stor inverkan av utflödande Östersjövatten. Både termoklin och haloklin var välutvecklade och återfanns på djup mellan 10-20 meter. Närsalthalterna i ytvattnet hade generellt ökat sedan förra provtagningen i december och halterna av fosfat och summan nitrit+nitrat uppvisade koncentrationer typiska för årstiden. I centrala Skagerrak var silikathalten mycket höga, dubbelt normal koncentration. Fosfathalterna låg omkring 0,53 - 0,56 µmol/l, summan nitrit + nitrat mellan 5,96 - 6,44 µmol/l medan koncentrationerna av silikat varierade från 10,3 - 11,2 µmol/l. Planktonaktiviteten var låg i hela området vilket kunde konstateras från CTD-baserade fluorescensmätningar samt låg syremättnad i ytlagret.

Kattegatt och Öresund

Ytvattentemperaturen var något lägre än normalt och varierande mellan 1,8 - 3,0°C, lägst i det utflödande Östersjövattnet från Öresund och Bälten, högst i de norra delarna. Salthalten i Kattegatts ytvatten var, precis som i Skagerrak, lägre än normalt, 16,1 - 22,1 psu. Termoklinen och haloklin sammanföll på djup mellan 10 - 20 meter. Karteringen av näringsämnen i Kattegatt visade att halterna av fosfat i ytvattnet var normala för årstiden och uppvisade små variationer omkring 0,54 - 0,60 µmol/l. Halterna av nitrit + nitrat var också normala och varierade mellan 5,53 - 7,00 µmol/l. Högst i norr och längs den danska kusten, lägst i de östra delarna. Silikathalten uppvisade små variationer omkring 10,6 - 11,7 µmol/l, vilket är normalt. Syreförhållandena i djupvattnet var goda, det lägsta värdet uppmättes vid Kullen i södra delen av Kattegatt, 5,92 ml/l.

Viss planktonaktivitet noterades i ytlagret.

Egentliga Östersjön

Ytvattentemperaturen var normal för årstiden och varierade mellan 2,2 - 3,5°C. Salthalten i ytlagret var något förhöjd i Hanöbukten och i Bornholmsbassängen ca 7,7 - 8,0 psu, medan den i östra Gotlandsbassängen var något under det normala, 6,9 - 7,2 psu. I egentliga Östersjön var ytlagret välblandat, termoklin och haloklin sammanföll och återfanns på omkring 70 meters djup i norra, västra och östra Gotlandsbassängen, på 55 meters djup i Bornholmsbassängen och på 35 - 40 meters djup i Arkonabassängen.

Halterna av fosfat var högre än normalt, 0,74 - 0,85 µmol/l, i västra Gotlandsbassängen. I övriga områden var halterna normala för årstiden och varierade mellan 0,60 - 0,78 µmol/l. Även halterna av silikat var förhöjda i västra Gotlandsbassängen, 15,4 - 15,8 µmol/l. Normala halter uppmättes i övriga områden, 10,2 - 13,0 µmol/l, förutom i Hanöbukten där halterna var lägre än normalt, 10,4 µmol/l. Halten av nitrit+nitrat var generellt något lägre än normalt i alla områden, förutom i Arkona där halterna var normala. Summan av nitrit+nitrat varierade mellan 2,62 - 3,61 µmol/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, däremot, var de positiva effekterna av höstens inflöden fortsatt synliga och syrgashalten i bottenvattnet låg strax över 2 ml/l. I västra, östra och norra Gotlandsbassängen sågs ingen förbättring av syresituationen. Helt syrefria förhållanden återfanns från 90 - 100 meters djup och akut syrebrist från 70 - 90 meters djup.

Planktonaktivitet, baserat på fluorescensmätningar och siktdjup, var låg i hela det undersökta området.

DELTAGARE

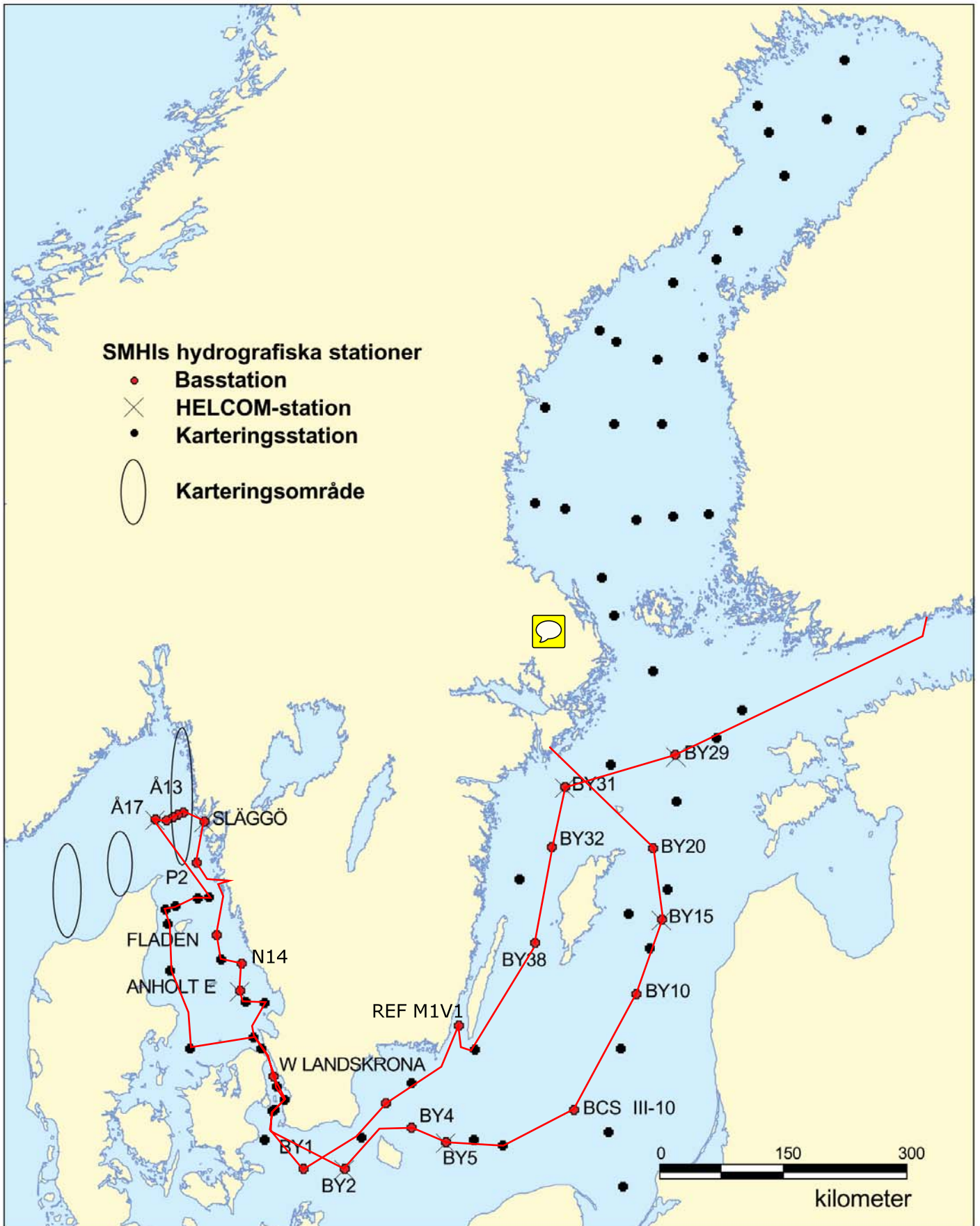
Namn	Från
Martin Hansson	Expeditionsledare SMHI
Juha Flinkman	Expeditionsledare Finnish Environment Institute (SYKE)
Anna-Kerstin Thell	SMHI
Johan Håkansson	SMHI
Kristin Andreasson	SMHI
Sari Sipilä	SMHI
Arne Svensson	SMHI
Silvie Lainela	SMHI / Tartu Universitet, Estland
Jan-Erik Bruun	Finnish Environment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

BILAGOR

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

TRACKCHART

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



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Date: 2014-02-17
Time: 12:31
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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 t	PPCPZZT Hrhhoo Cilyooa motPBw PrP l	No de	T e m p i n	S e a h y s P 4	O x 2 5	H 2 4	P 4	T N P	N N N	N T N	A S h o l i u i O o m g N a 3	S H L P O O C C m	L P T C m	P T C m	T C m										
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0101	BPEX26BAS		BY20 FÄRÖDJ	N5800	E1953	20140212	0040	197		22 6	2.4	997	9990	x	--x----	17	x	x	-	x	x	x	x	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	

Bottom water oxygen concentration (ml/l)

Country: Sweden

Ship : Aranda

Date : 20140204-20140212

Series : 0062-0101



Bottom water oxygen concentration (ml/l)

Country: Sweden

Ship : Aranda

Date : 20140204-20140212

Series : 0062-0101



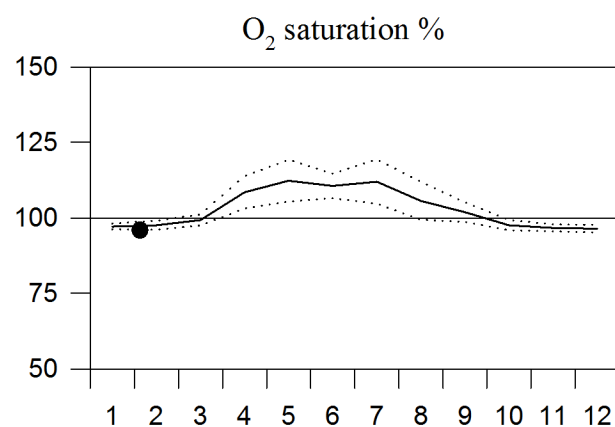
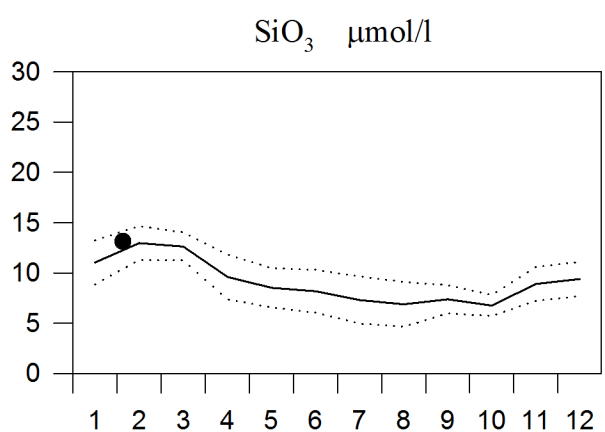
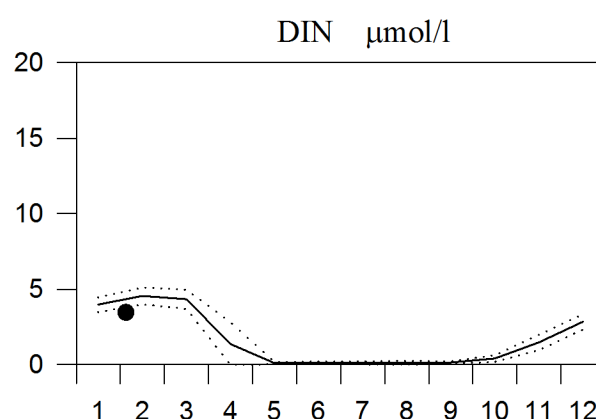
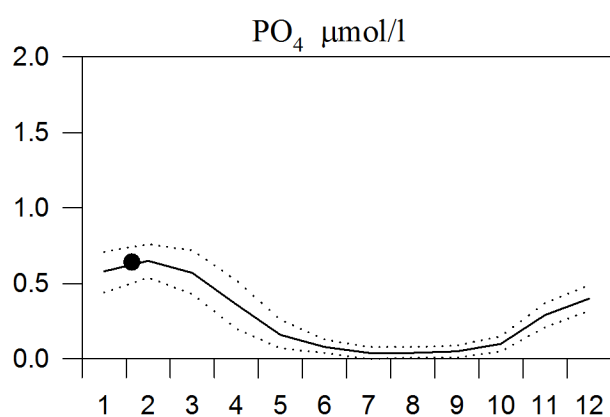
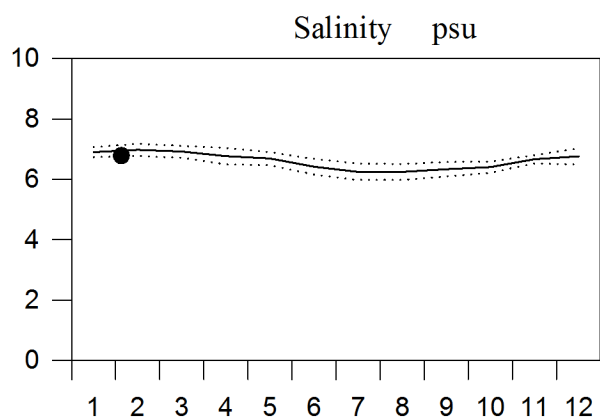
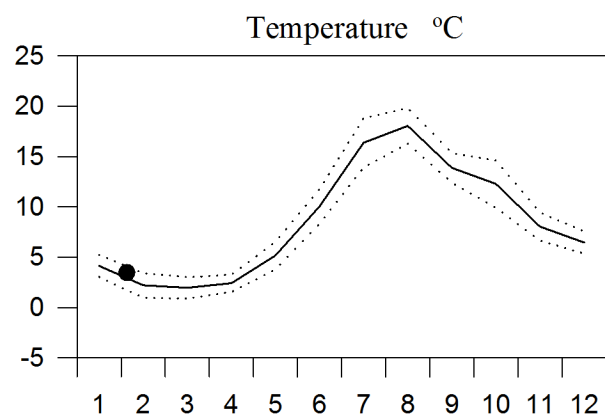
STATION BY29 SURFACE WATER

Annual Cycles

— Mean 1996-2010

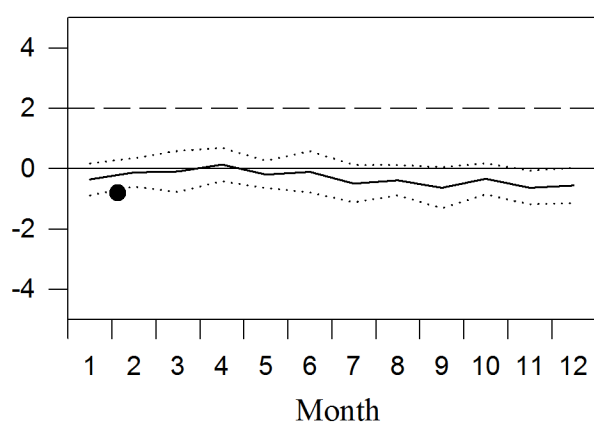
..... St.Dev.

● 2014

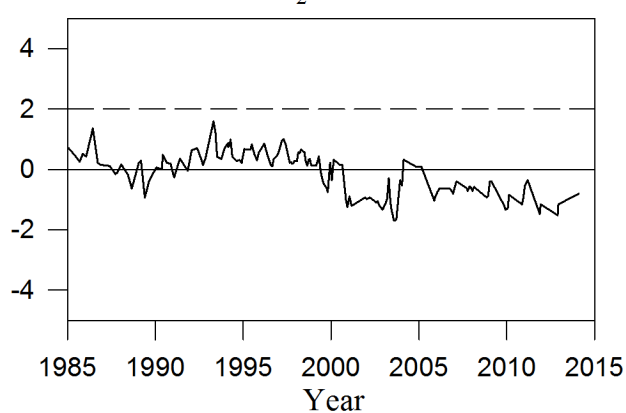


OXYGEN IN BOTTOM WATER (>=150m)

O₂ ml/l



O₂ ml/l



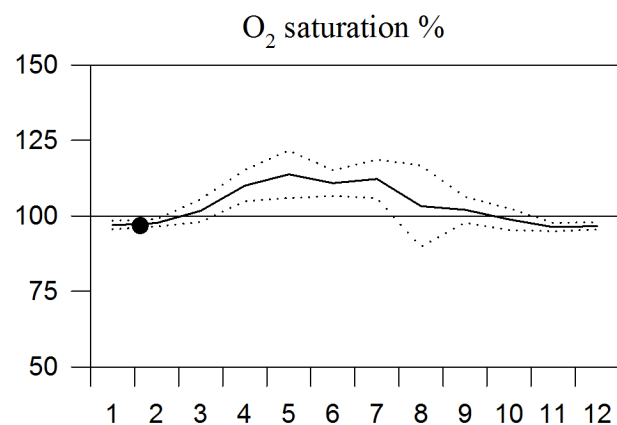
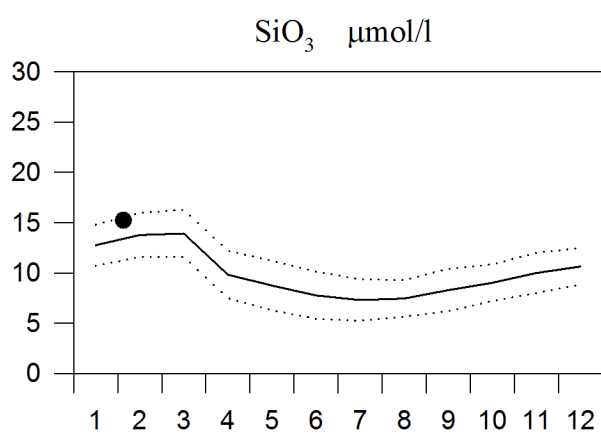
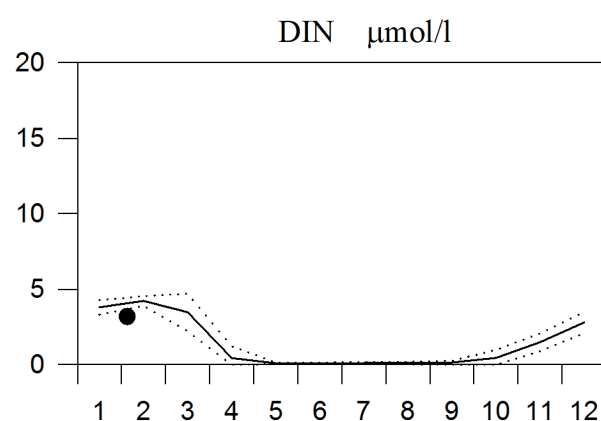
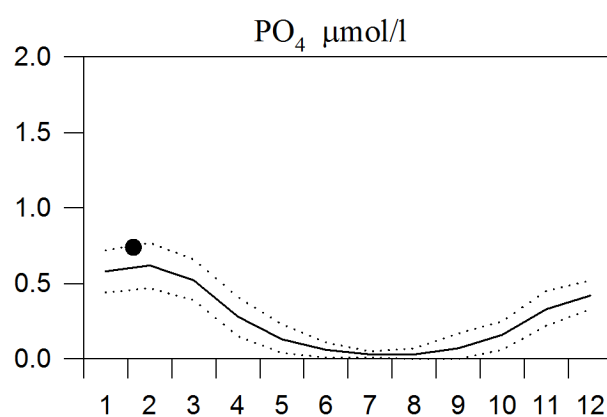
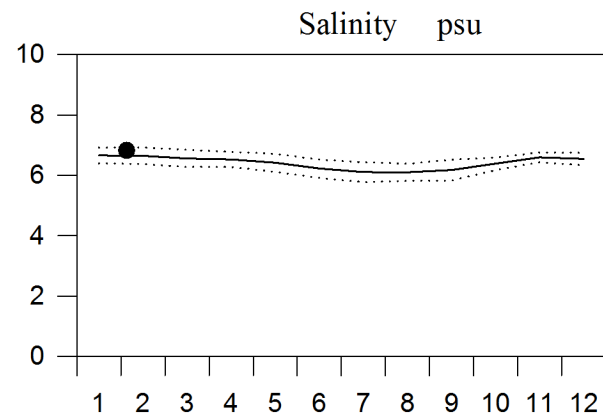
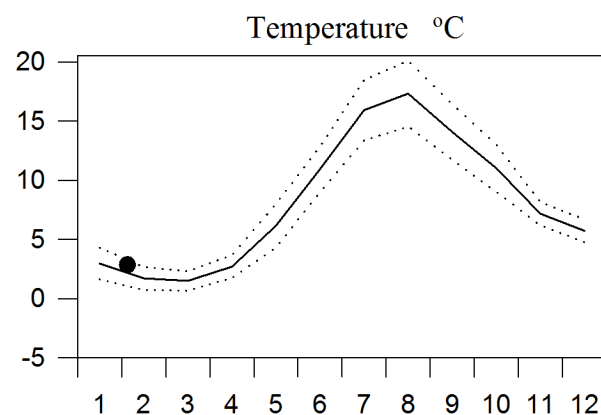
STATION BY31 SURFACE WATER

Annual Cycles

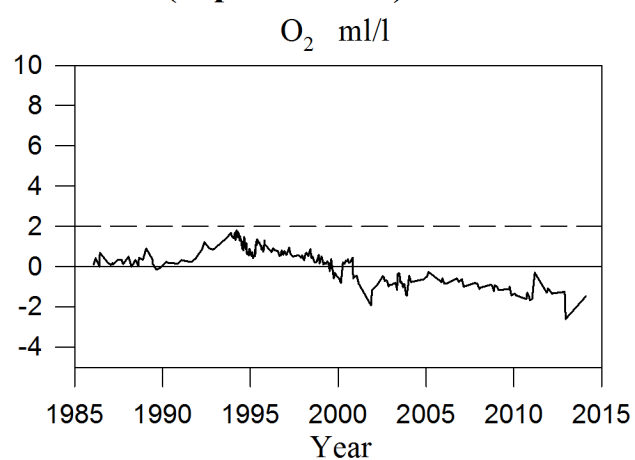
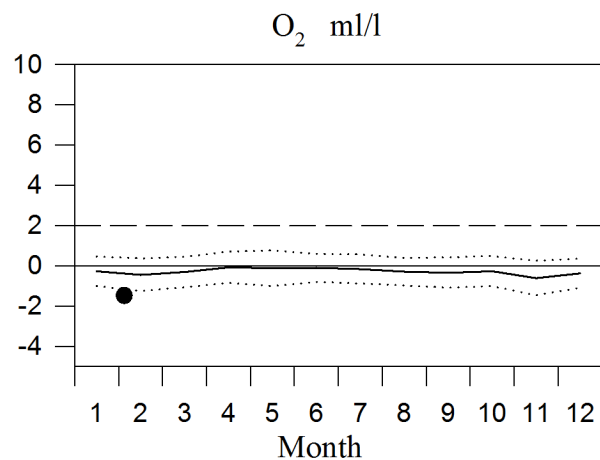
— Mean 1996-2010

..... St.Dev.

● 2014



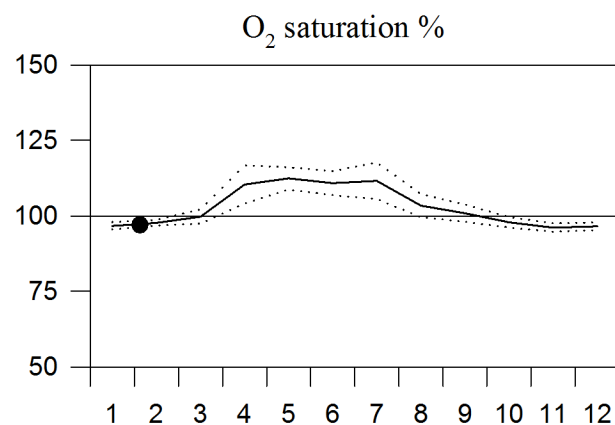
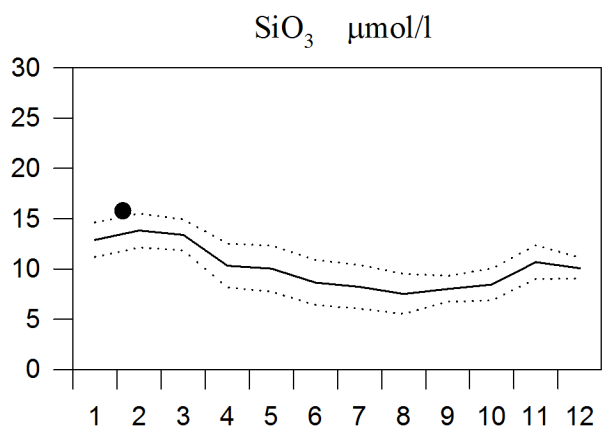
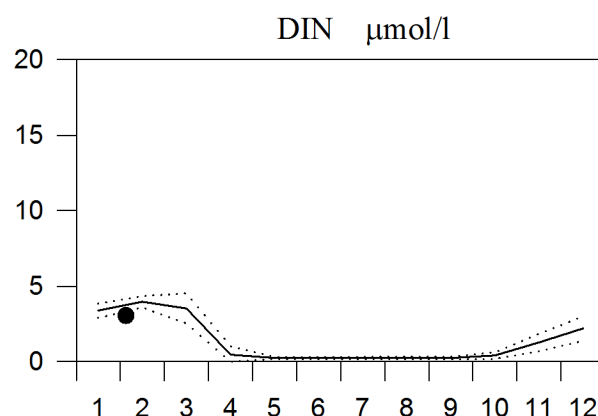
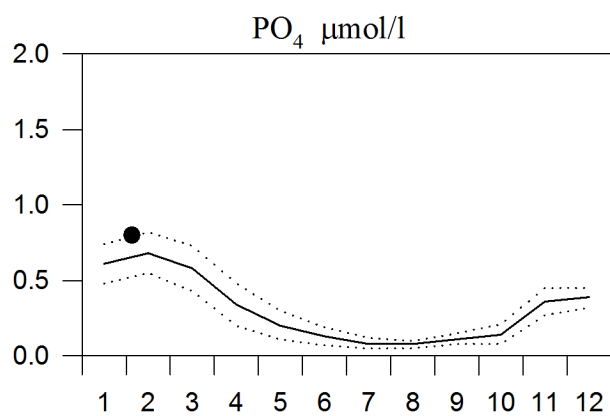
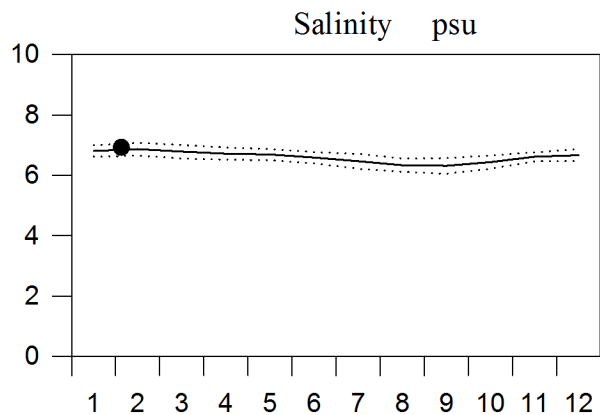
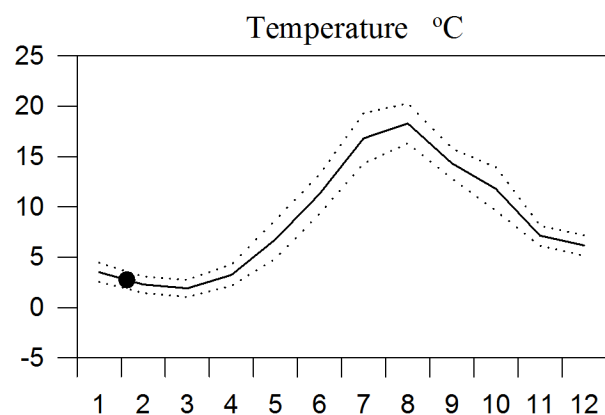
OXYGEN IN BOTTOM WATER (depth = 440m)



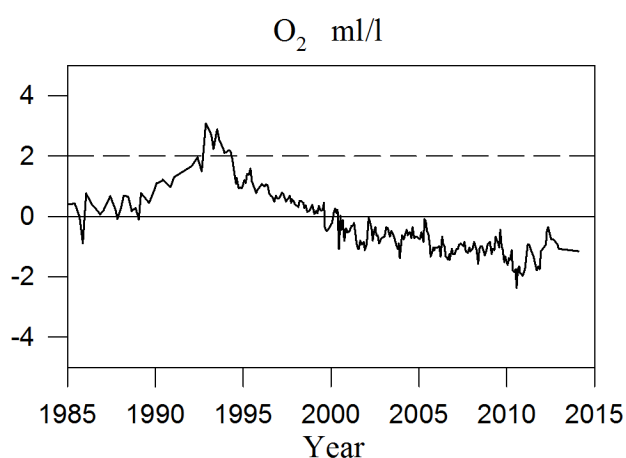
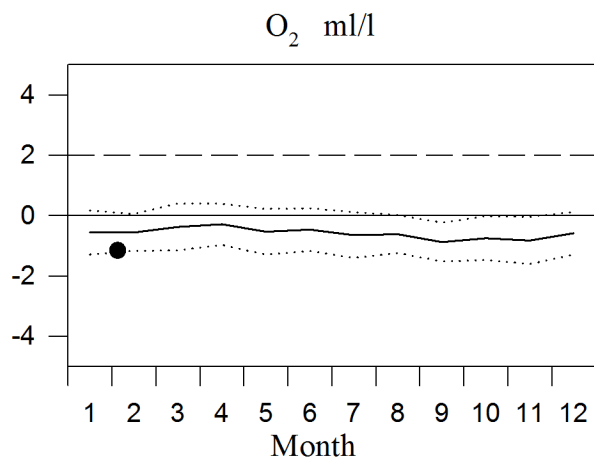
STATION BY32 SURFACE WATER

Annual Cycles

— Mean 1996-2010 St.Dev. ● 2014



OXYGEN IN BOTTOM WATER (depth > 175m)



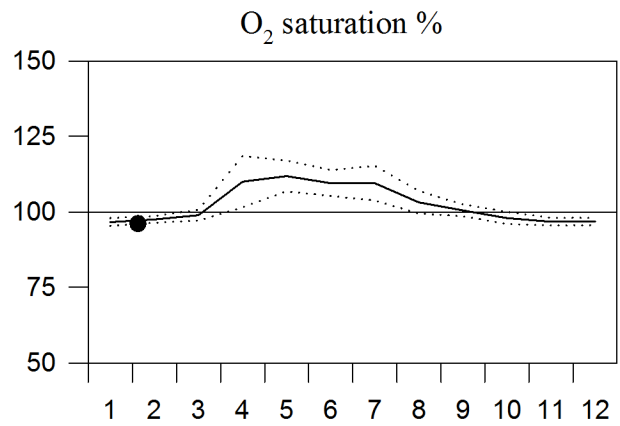
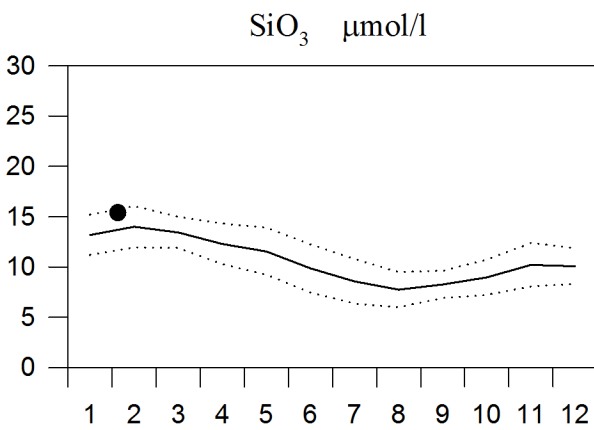
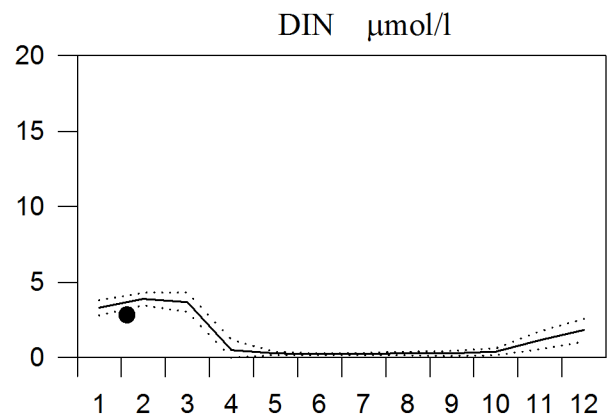
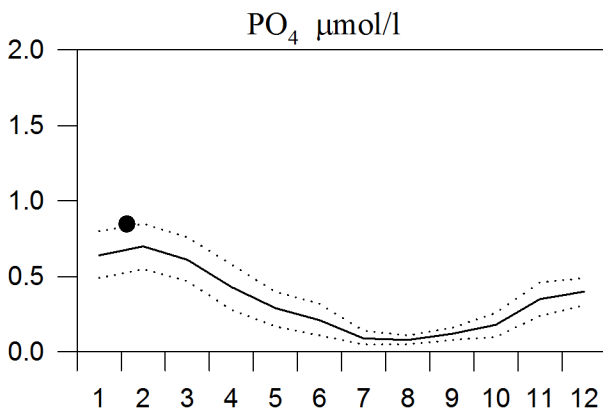
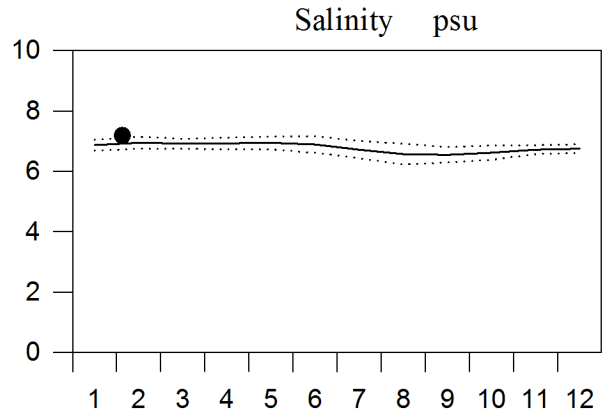
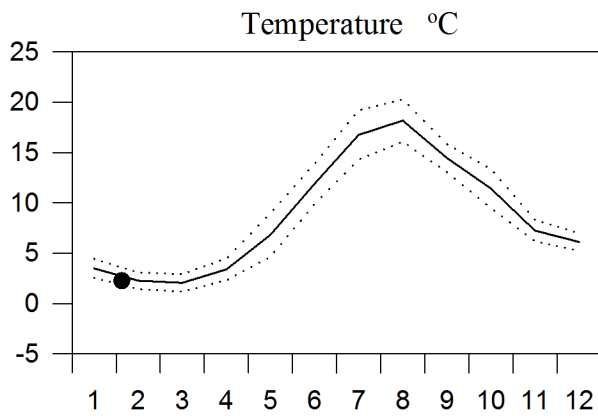
STATION BY38 SURFACE WATER

Annual Cycles

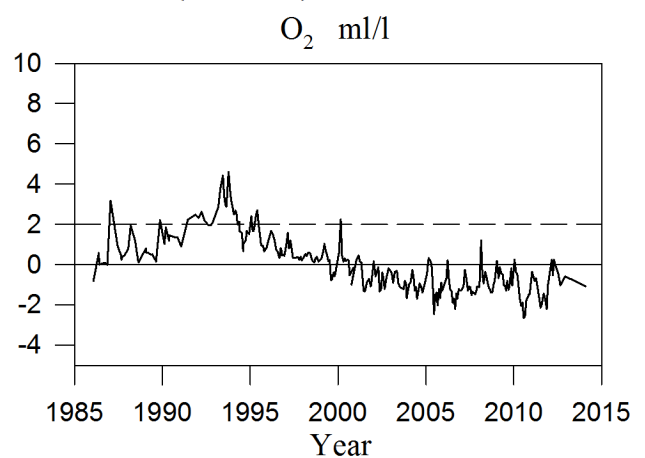
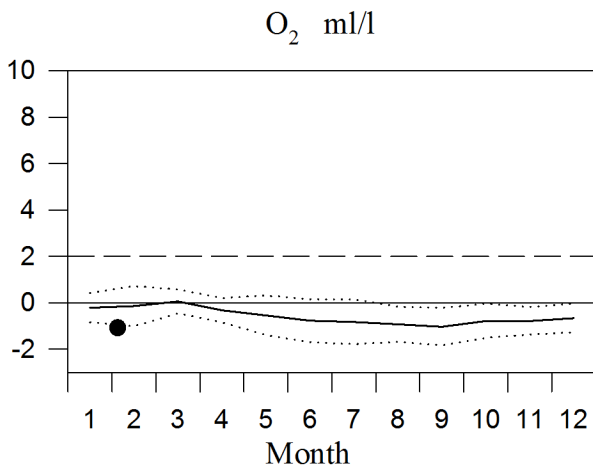
— Mean 1996-2010

..... St.Dev.

● 2014



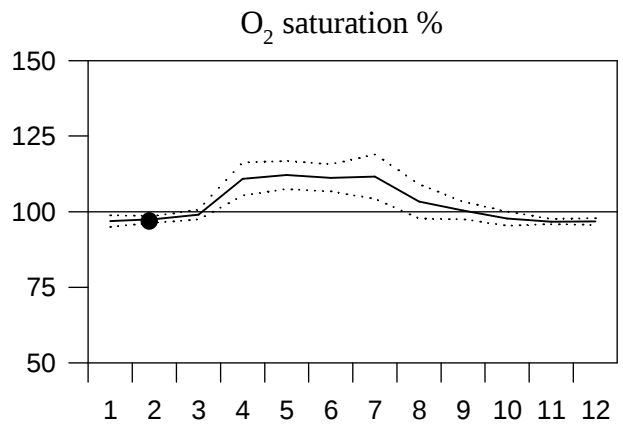
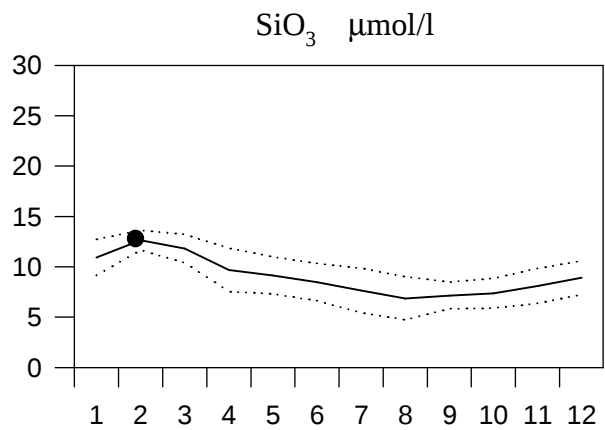
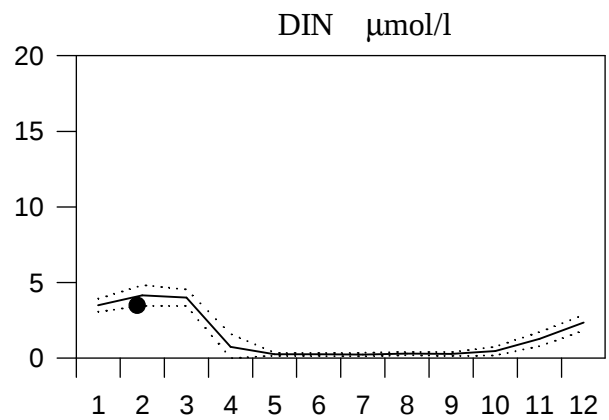
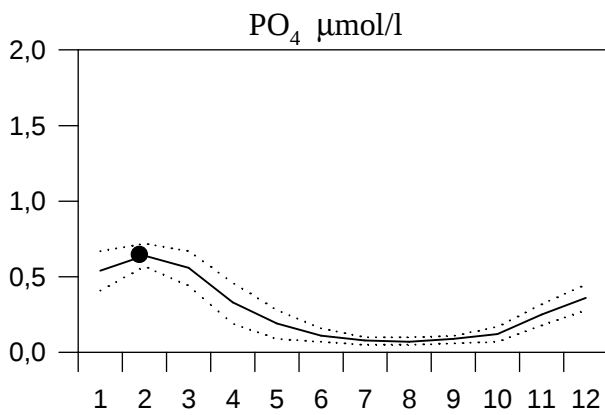
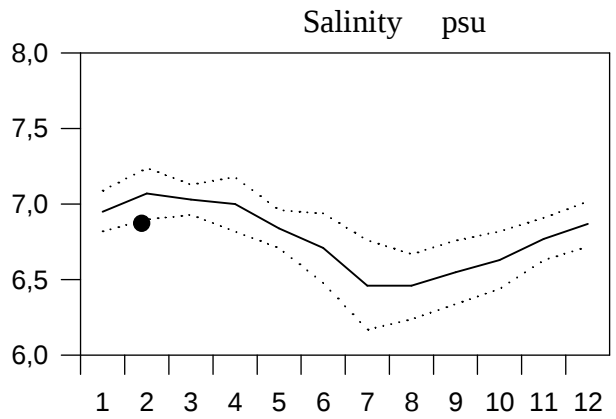
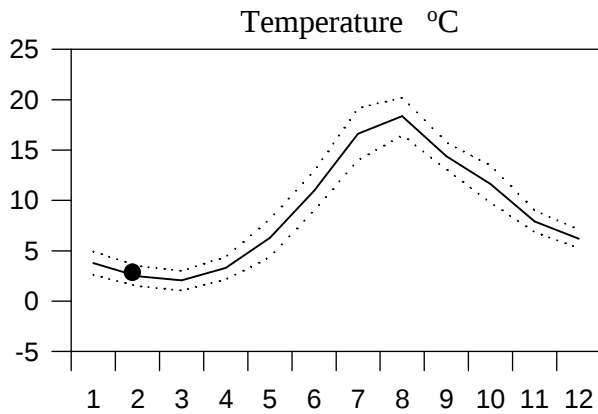
OXYGEN IN BOTTOM WATER (> 100m)



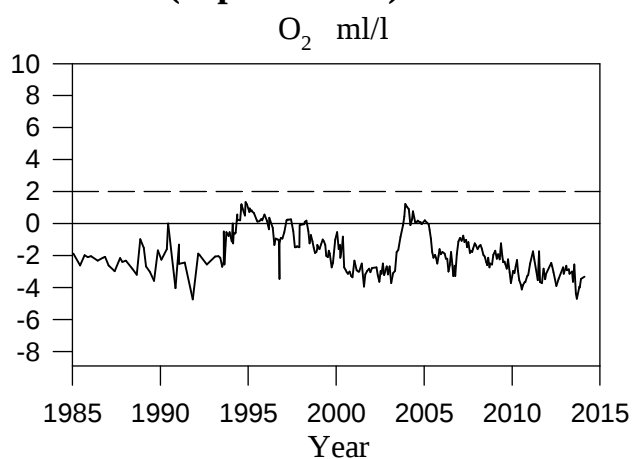
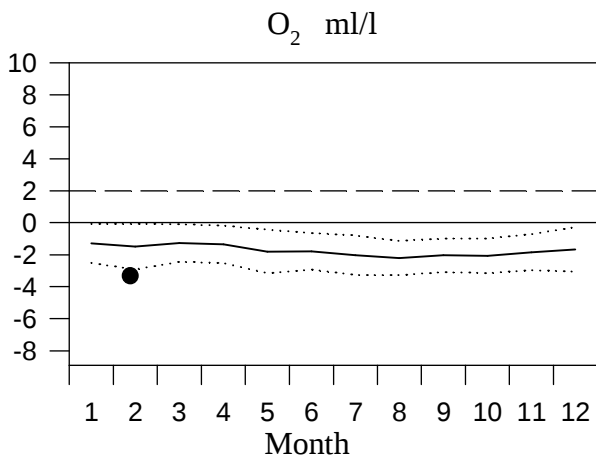
STATION BY20 SURFACE WATER

Annual Cycles

— Mean 1996-2010 St.Dev. ● 2014



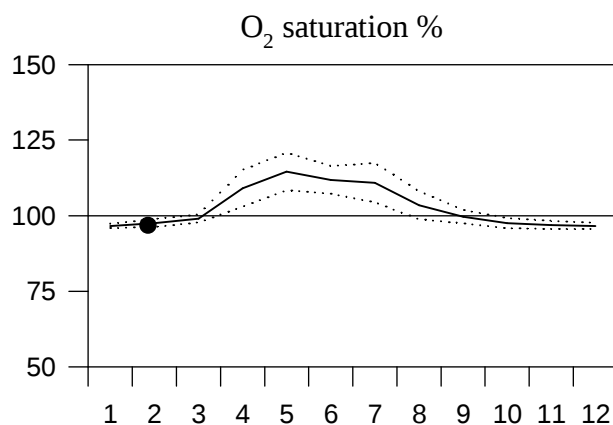
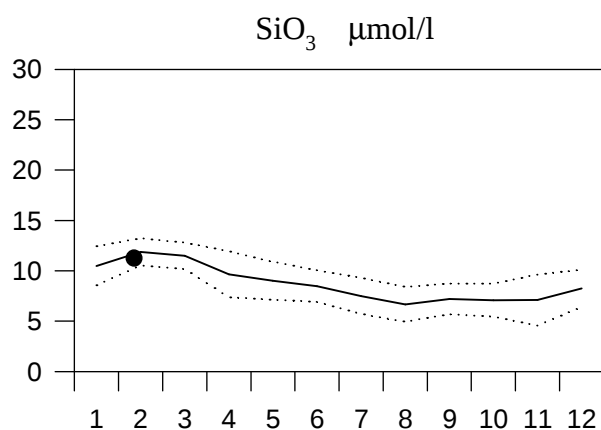
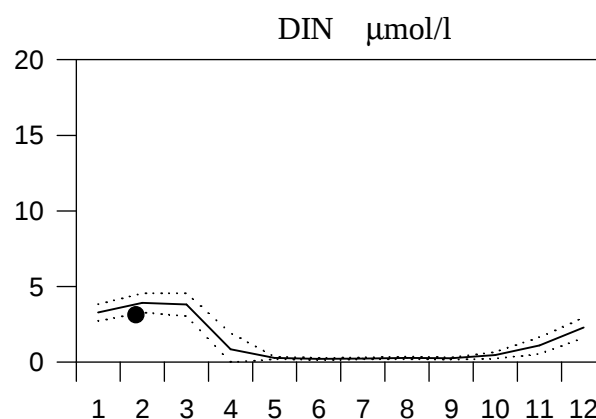
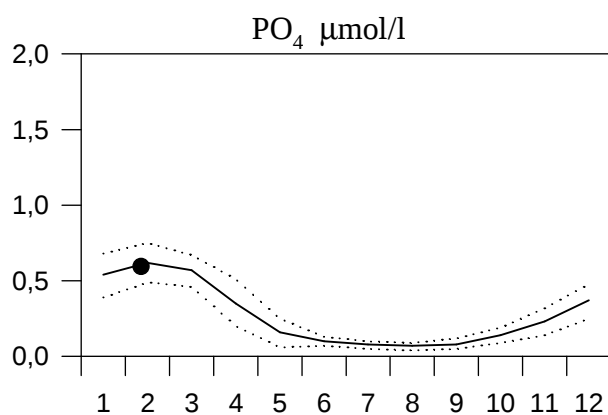
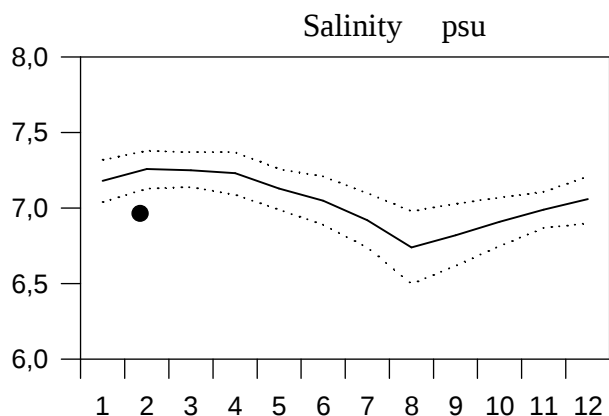
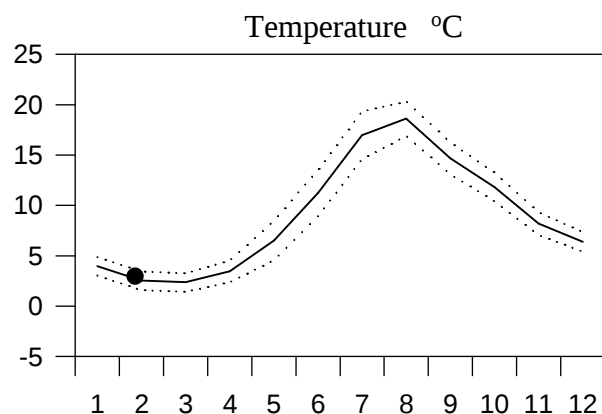
OXYGEN IN BOTTOM WATER (depth >175m)



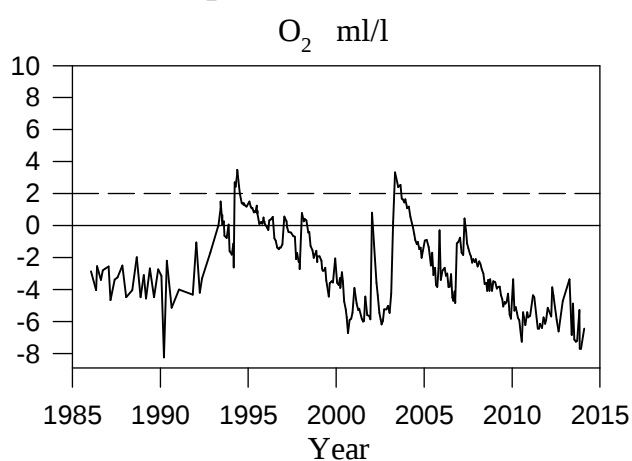
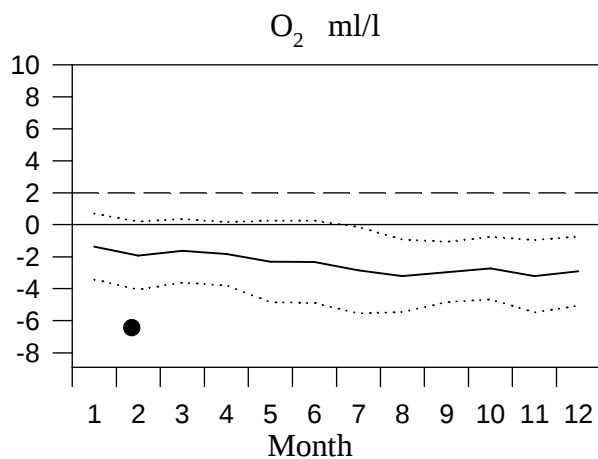
STATION BY15 SURFACE WATER

Annual Cycles

— Mean 1996-2010 St.Dev. ● 2014



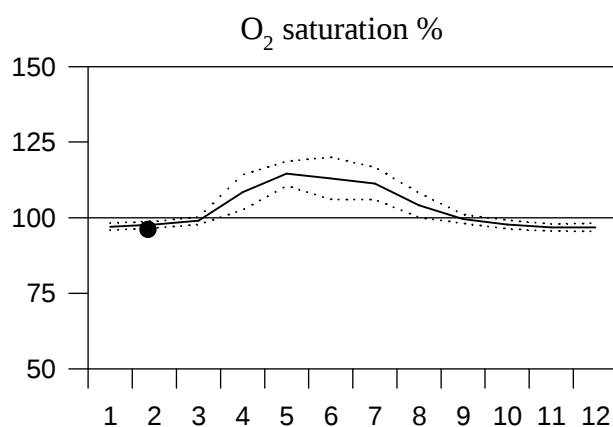
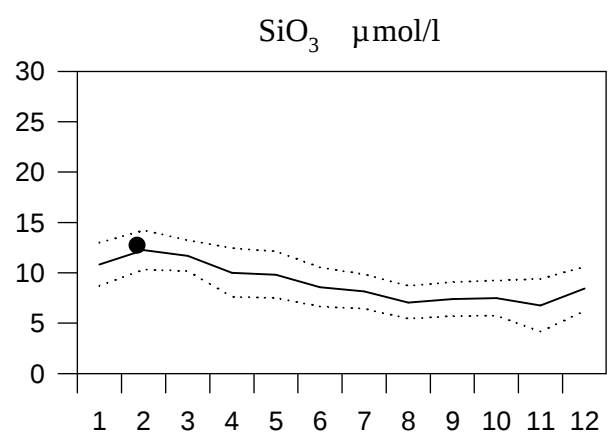
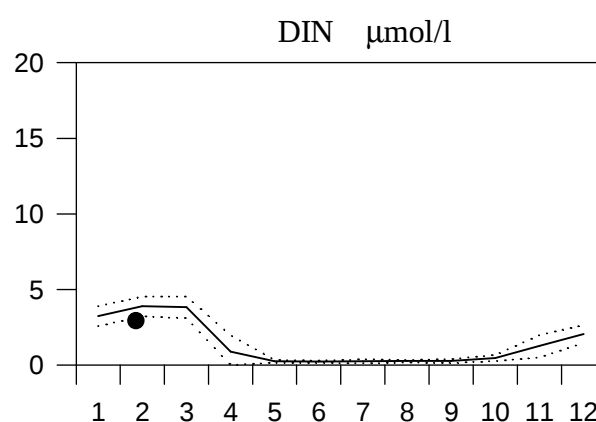
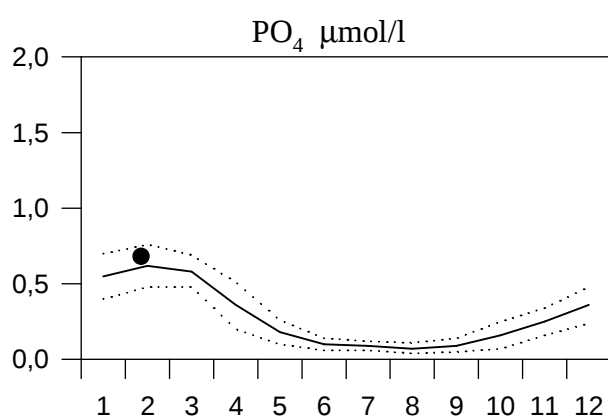
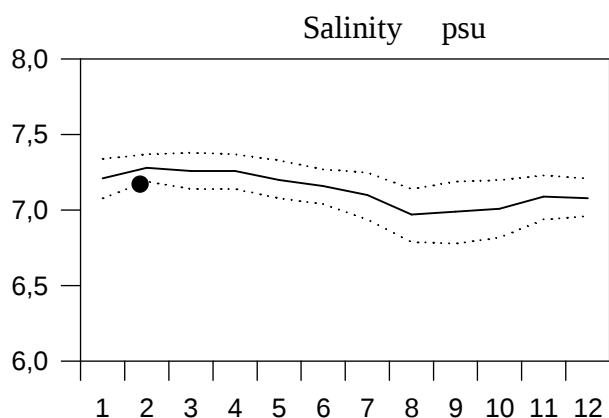
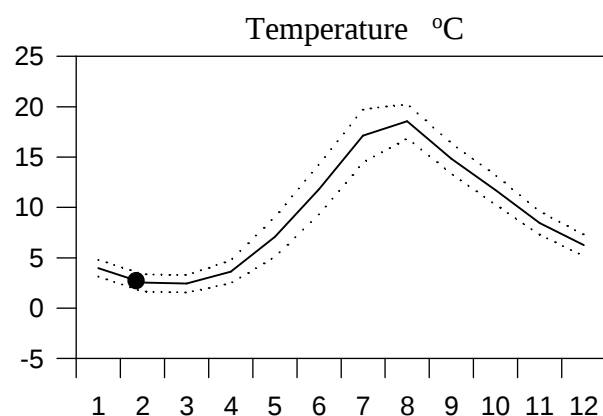
OXYGEN IN BOTTOM WATER (depth >225m)



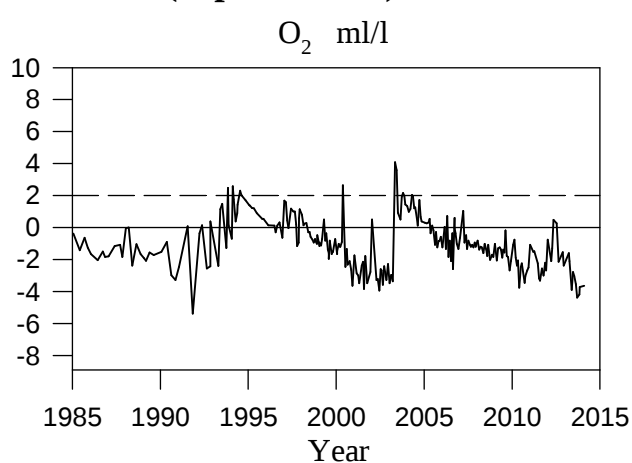
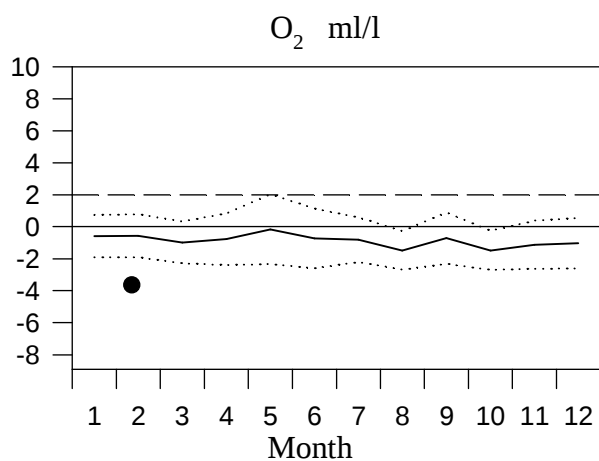
STATION BY10 SURFACE WATER

Annual Cycles

— Mean 1996-2010 St.Dev. ● 2014



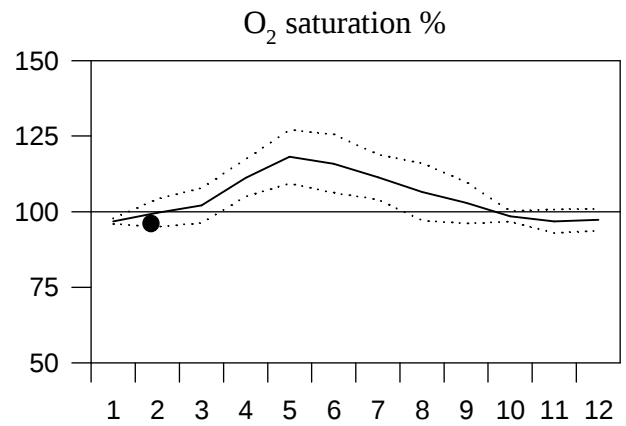
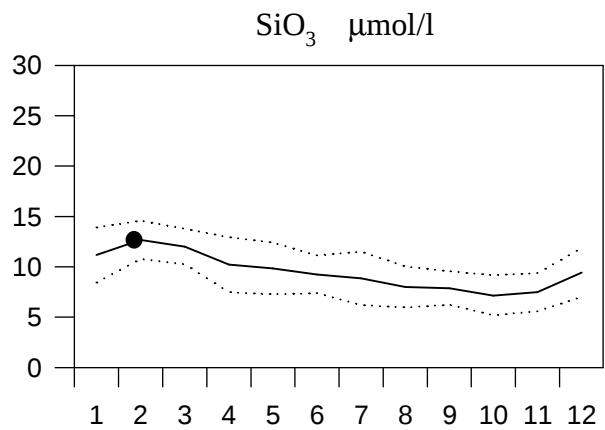
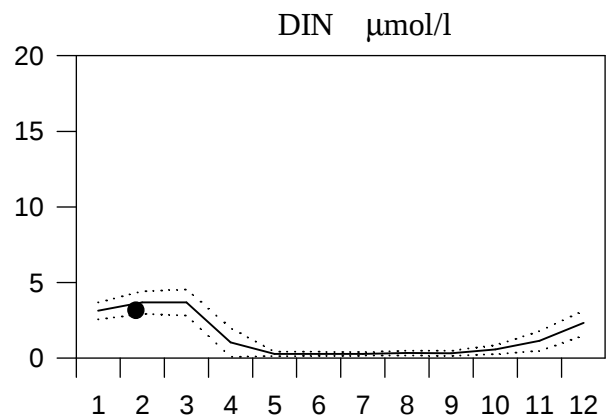
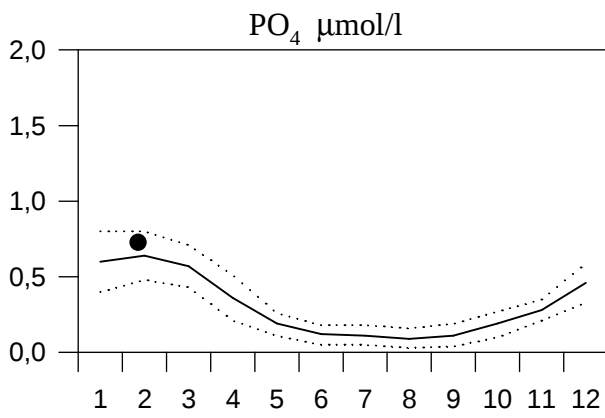
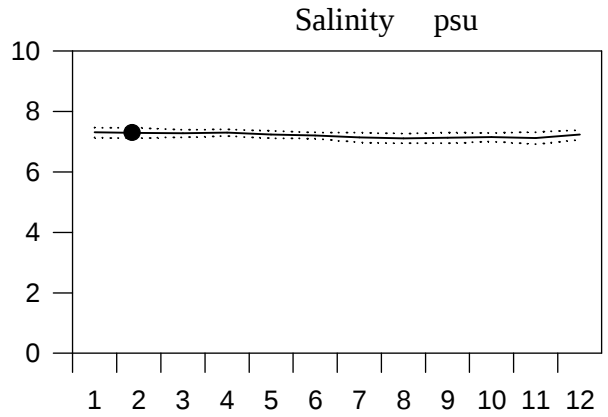
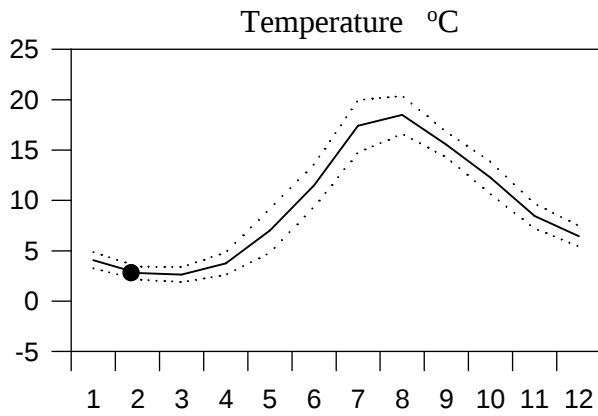
OXYGEN IN BOTTOM WATER (depth >125m)



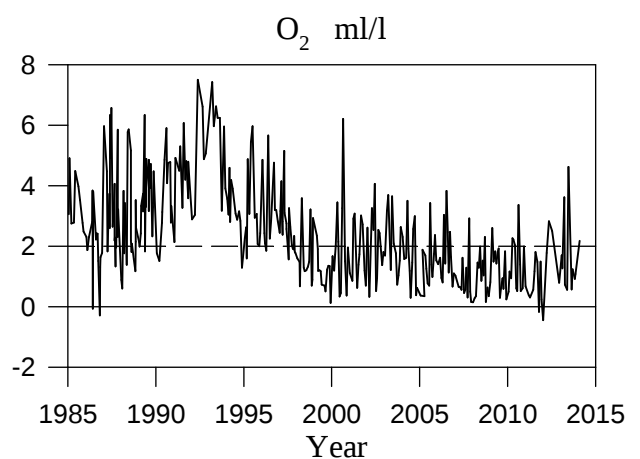
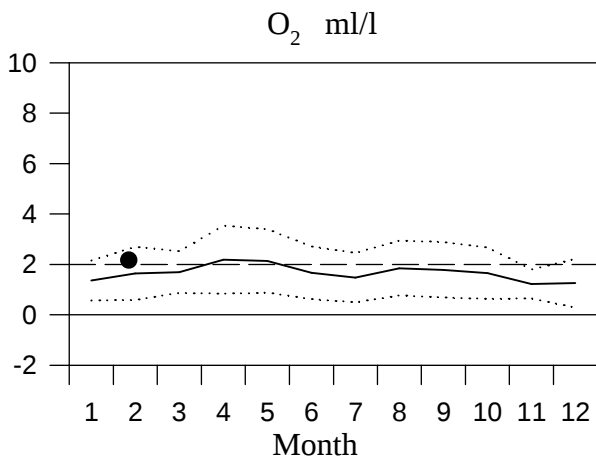
STATION BCS III-10 SURFACE WATER

Annual Cycles

— Mean 1996-2010 St.Dev. ● 2014



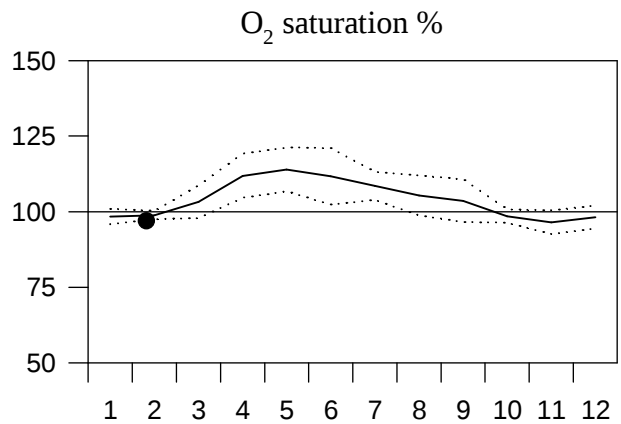
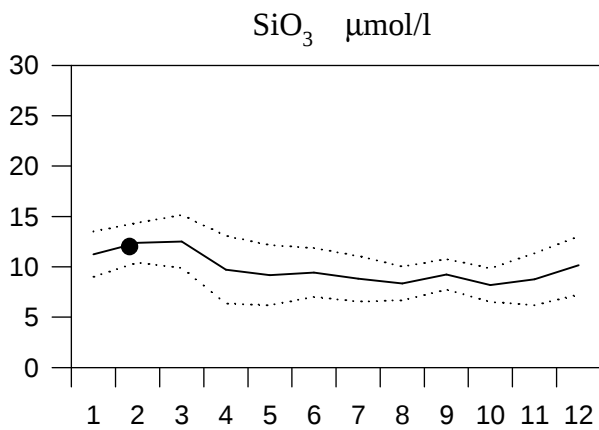
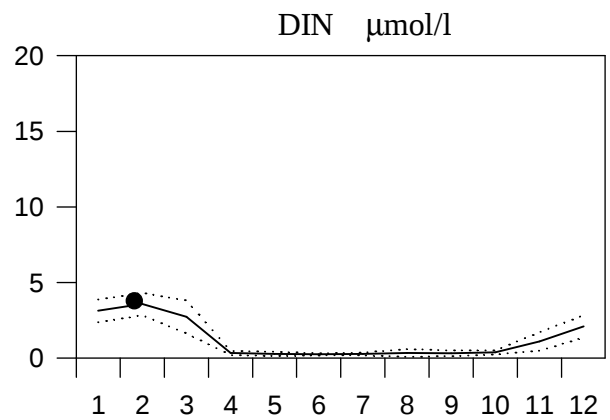
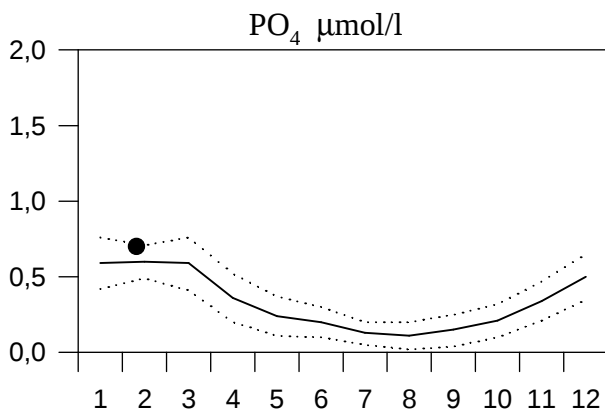
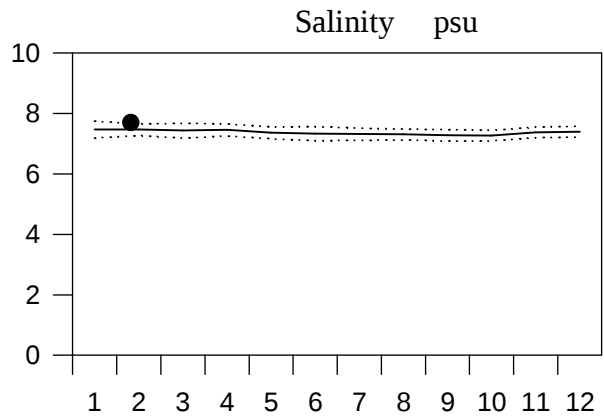
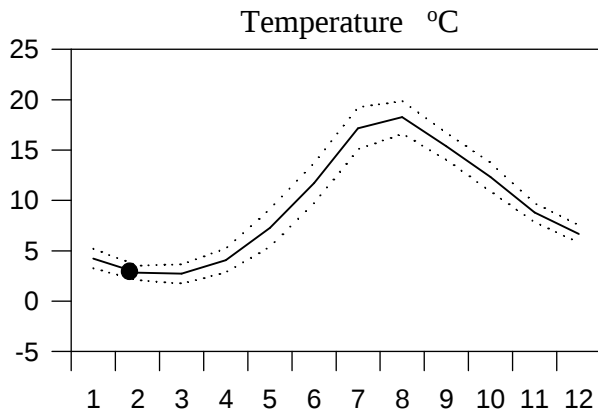
OXYGEN IN BOTTOM WATER (depth > 80m)



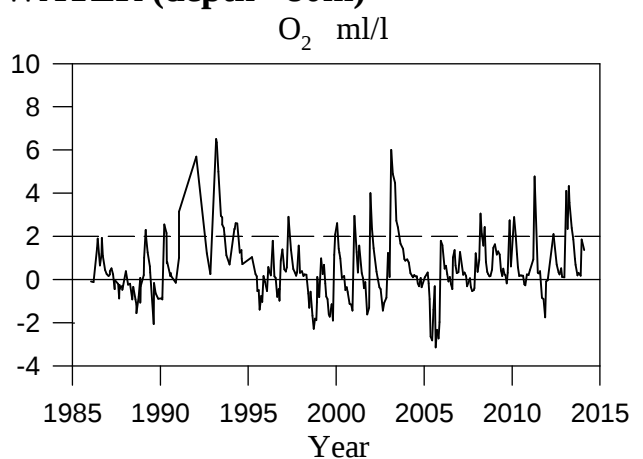
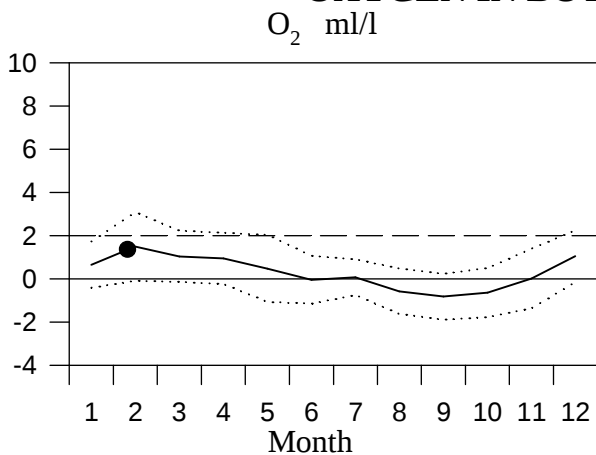
STATION BY5 SURFACE WATER

Annual Cycles

— Mean 1996-2010 St.Dev. ● 2014



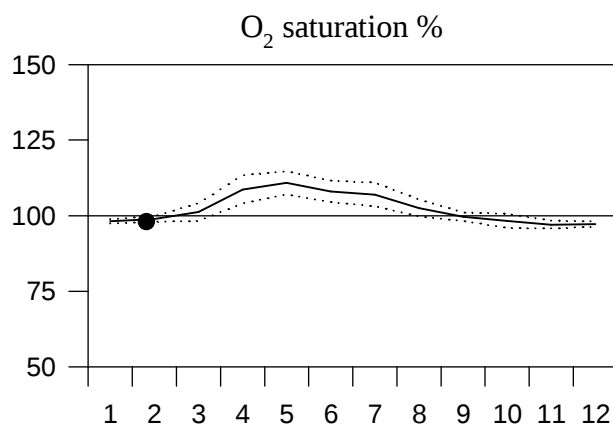
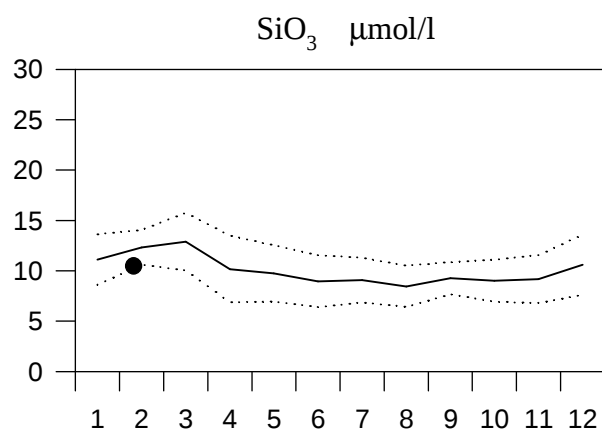
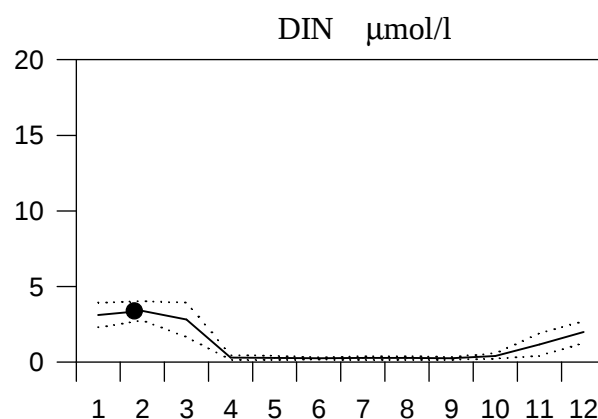
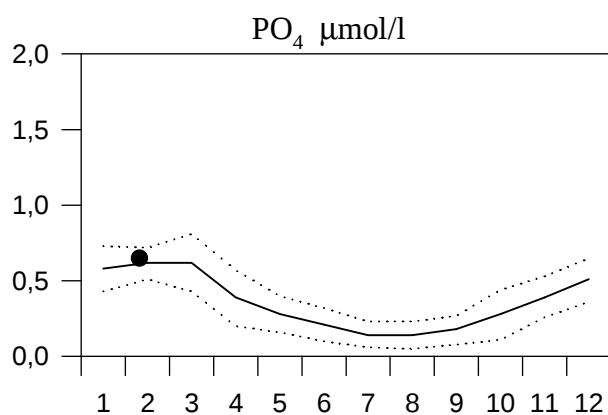
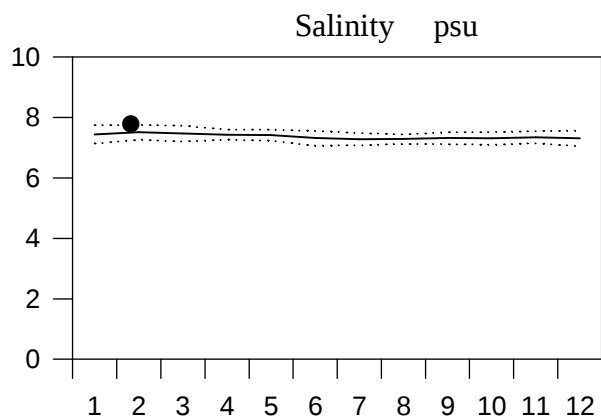
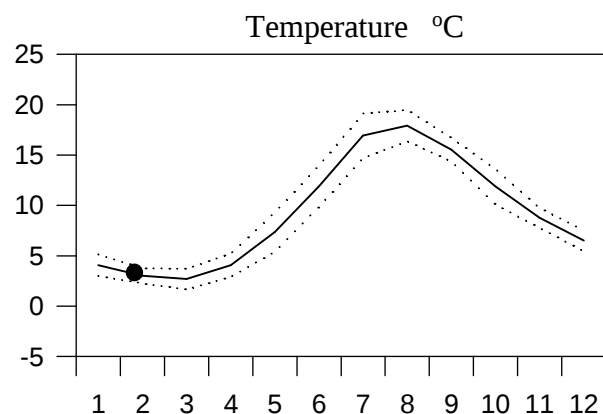
OXYGEN IN BOTTOM WATER (depth >80m)



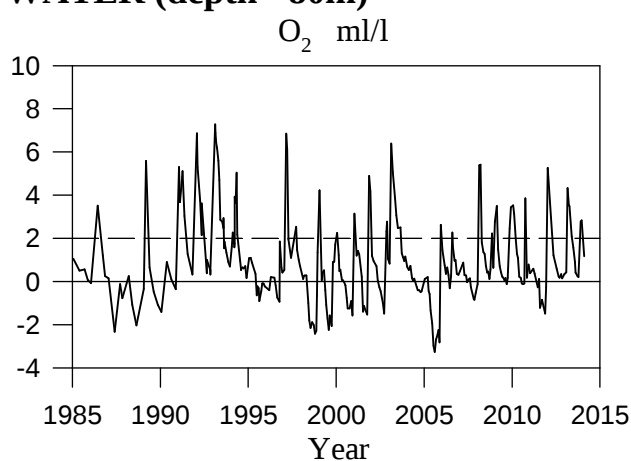
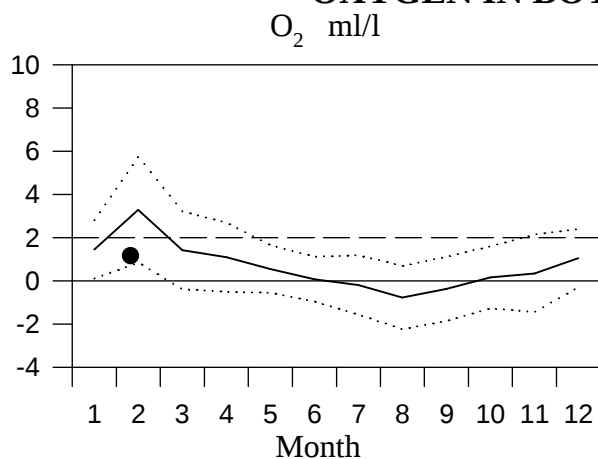
STATION BY4 SURFACE WATER

Annual Cycles

— Mean 1996-2010 St.Dev. ● 2014



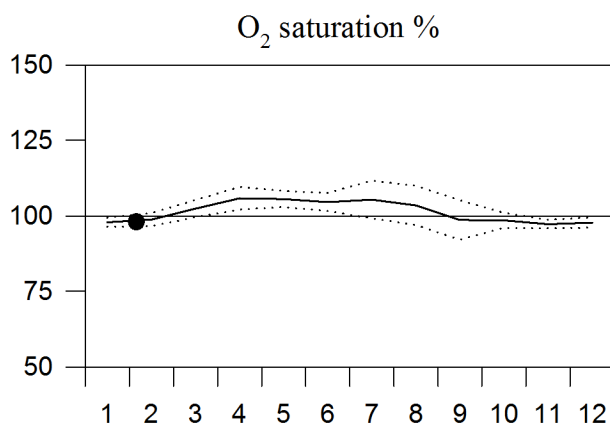
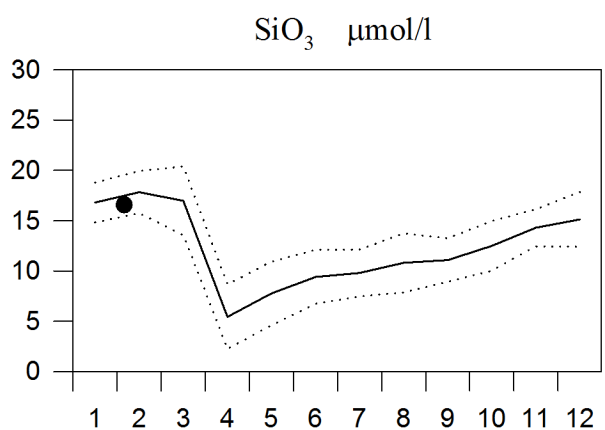
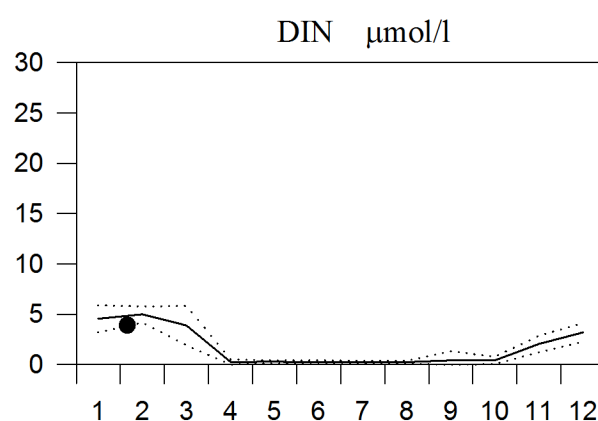
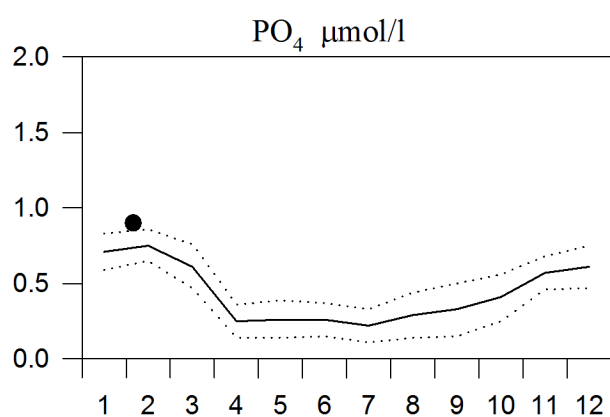
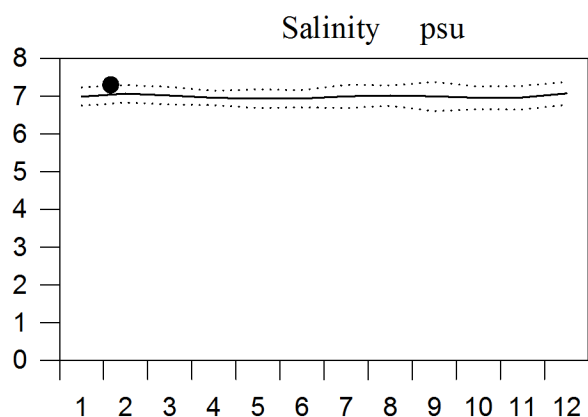
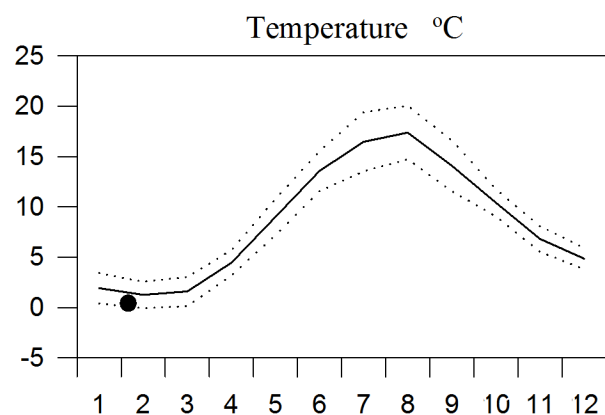
OXYGEN IN BOTTOM WATER (depth >80m)



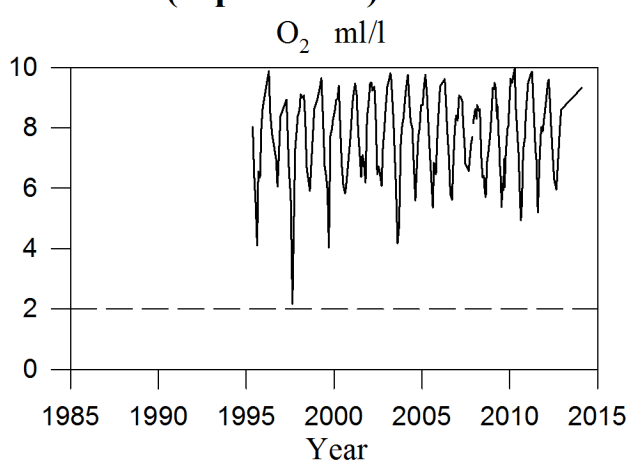
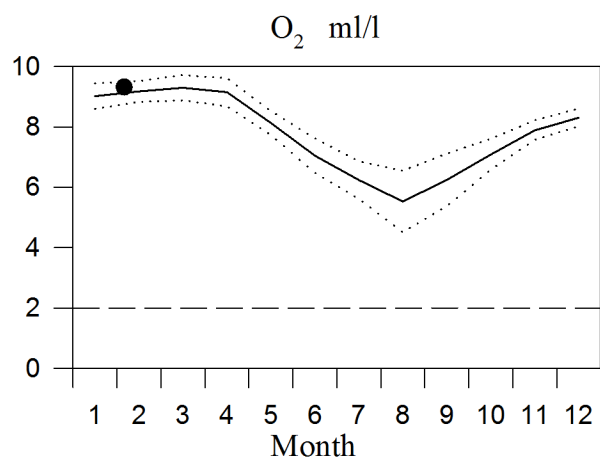
STATION REF M1V1 SURFACE WATER

Annual Cycles

— Mean 1996-2010 St.Dev. ● 2014



OXYGEN IN BOTTOM WATER (depth >15m)



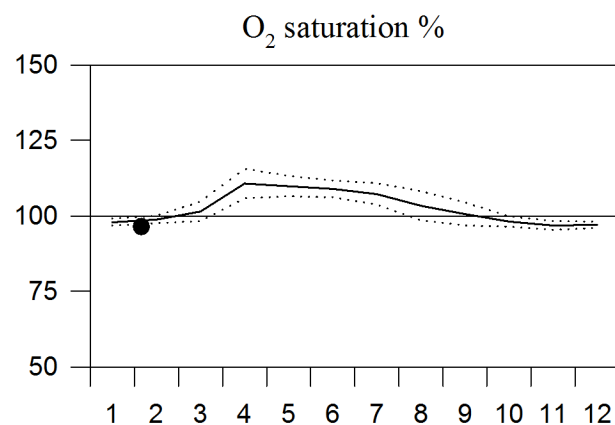
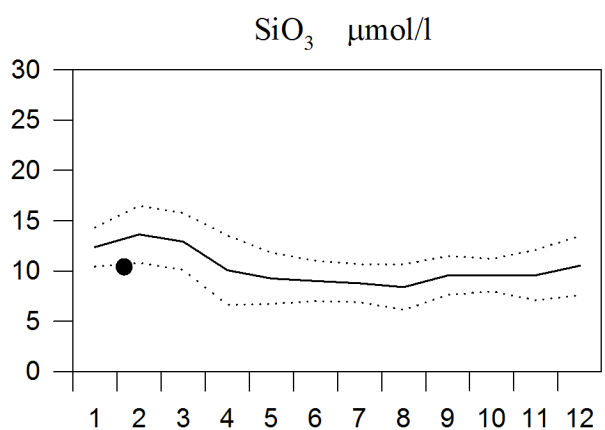
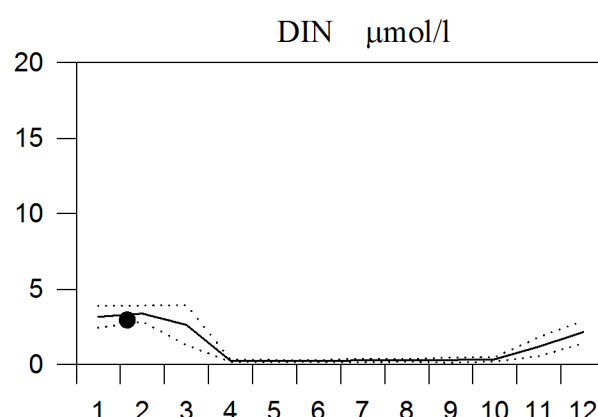
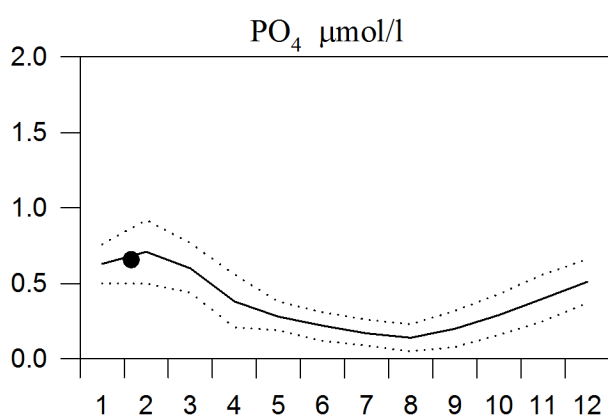
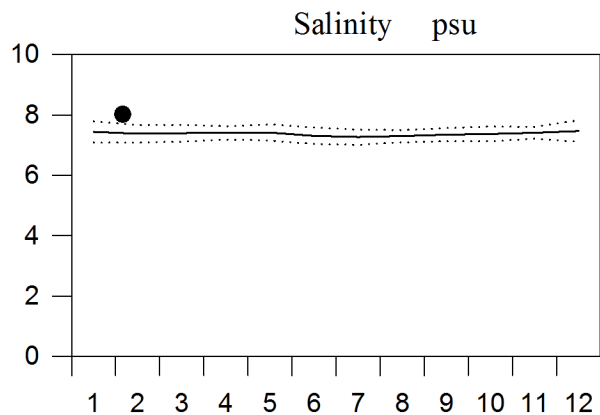
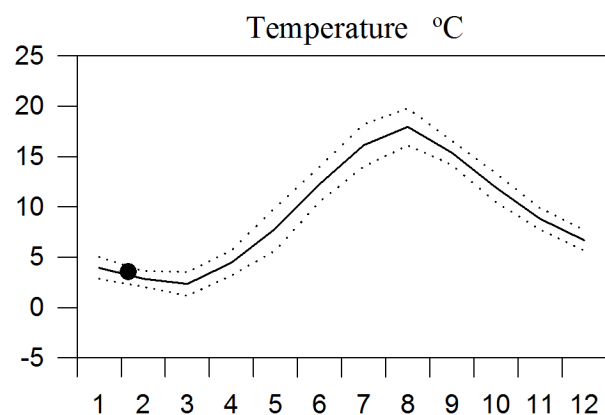
STATION HANÖBUKTEN SURFACE WATER

Annual Cycles

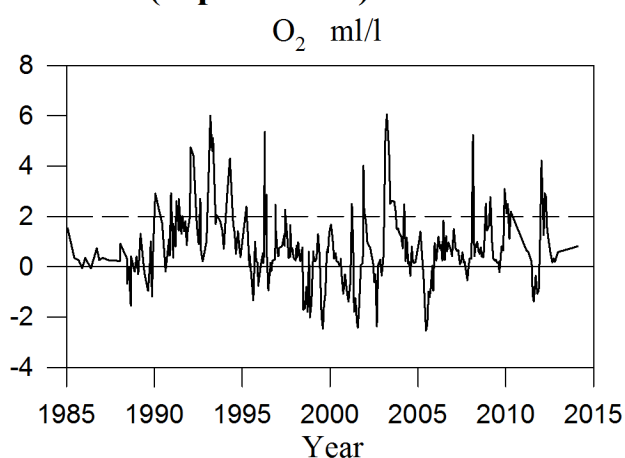
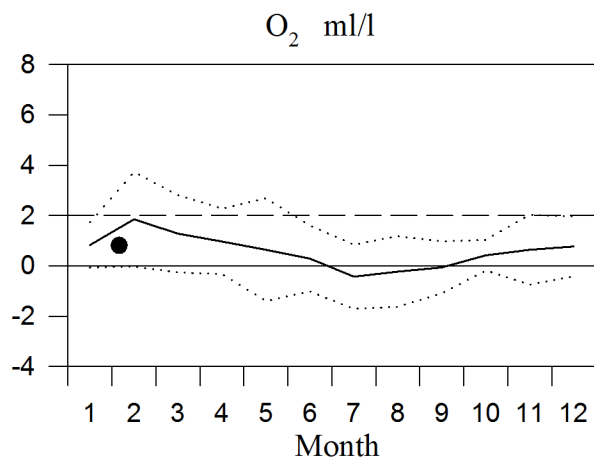
— Mean 1996-2010

..... St.Dev.

● 2014



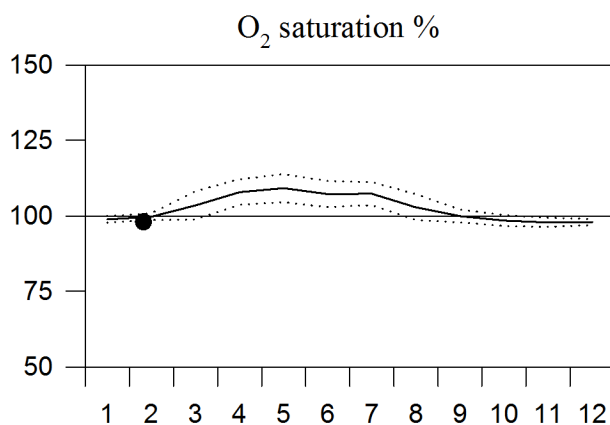
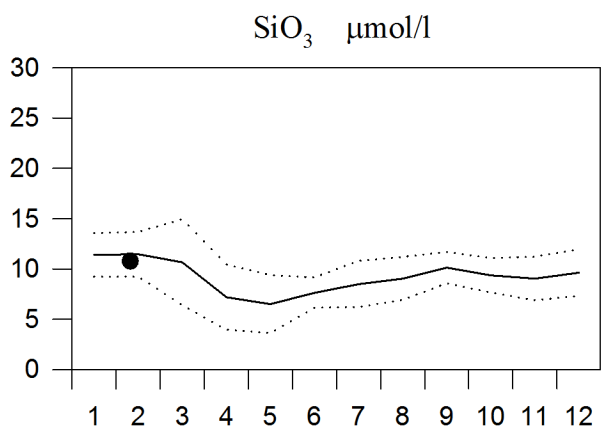
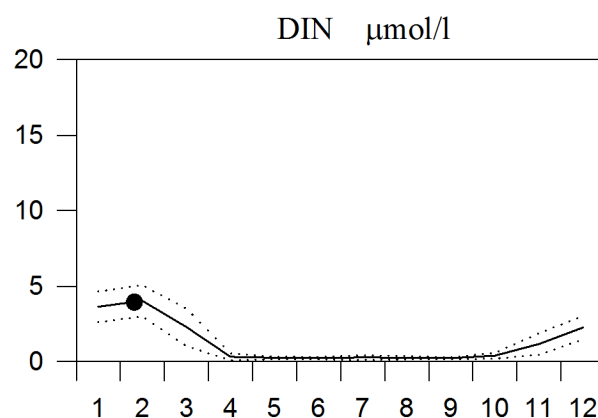
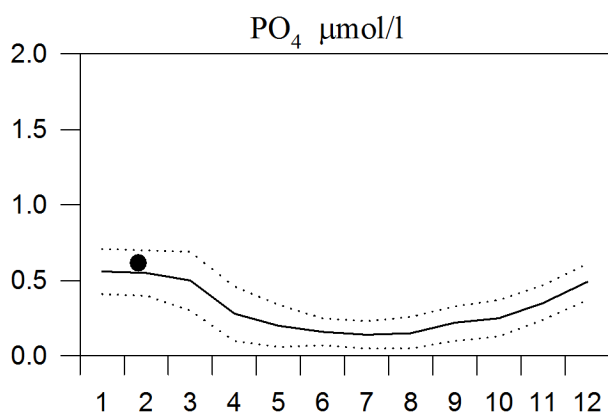
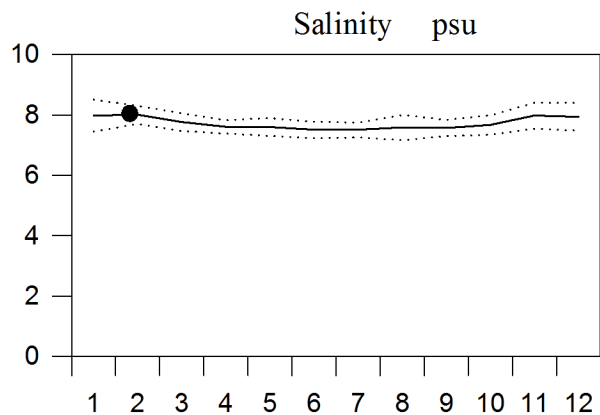
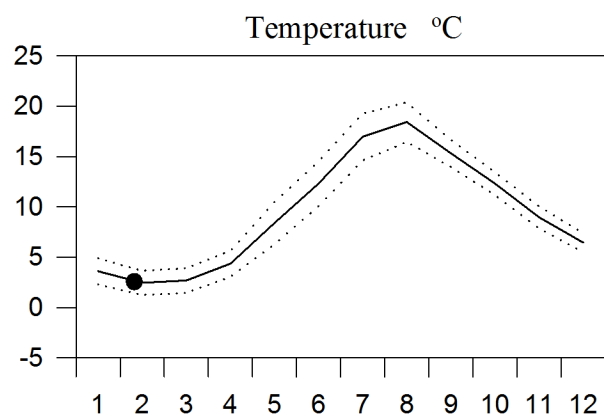
OXYGEN IN BOTTOM WATER (depth > 70m)



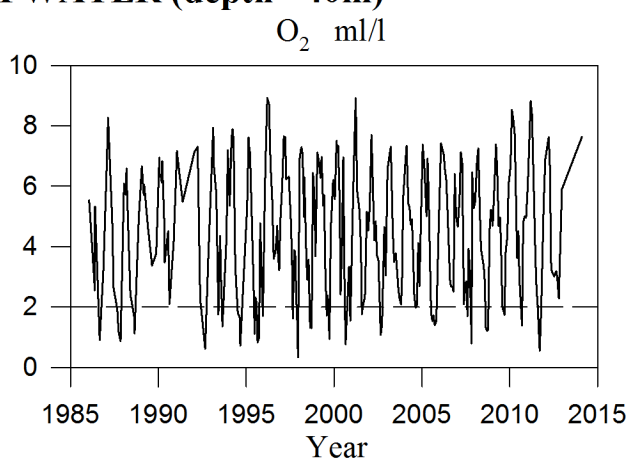
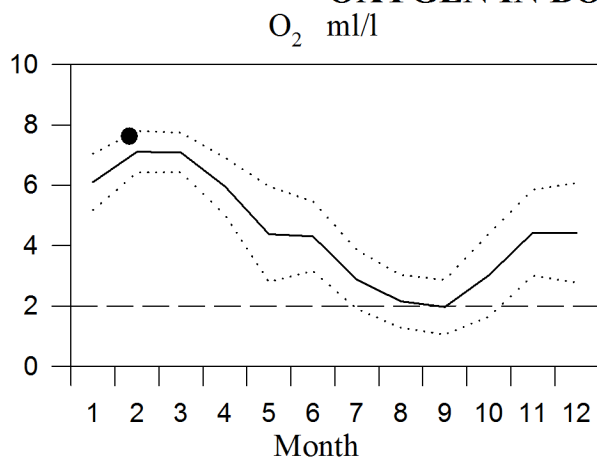
STATION BY2 SURFACE WATER

Annual Cycles

— Mean 1996-2010 St.Dev. ● 2014



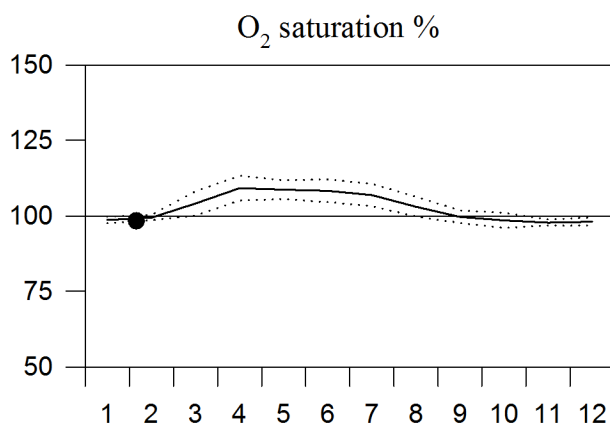
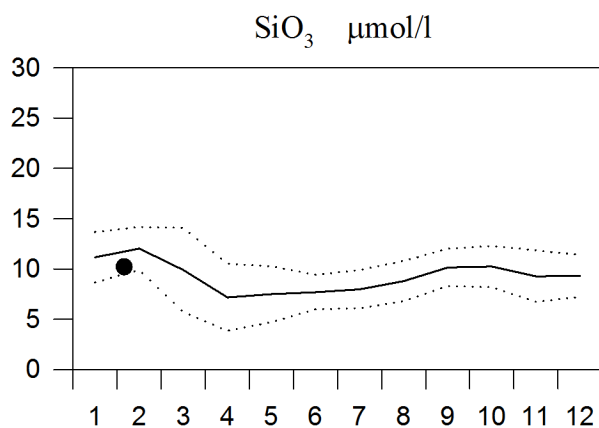
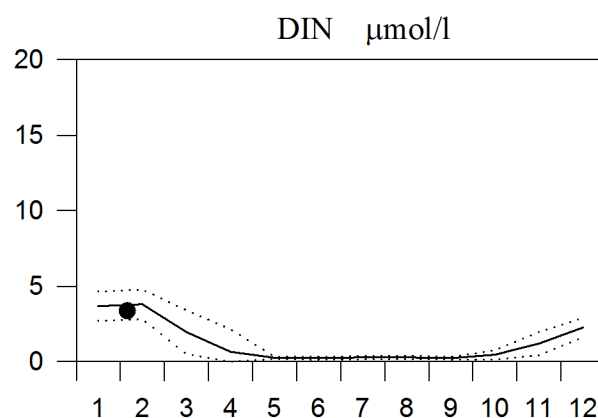
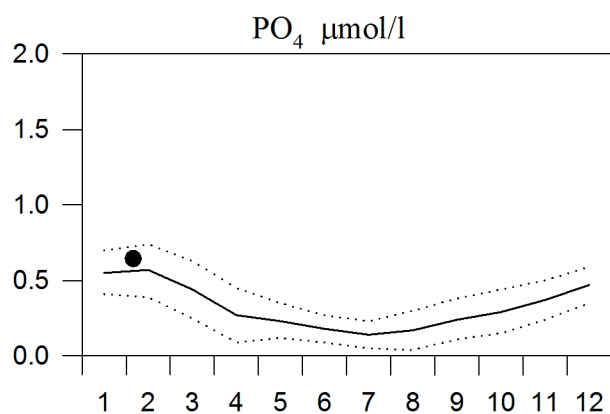
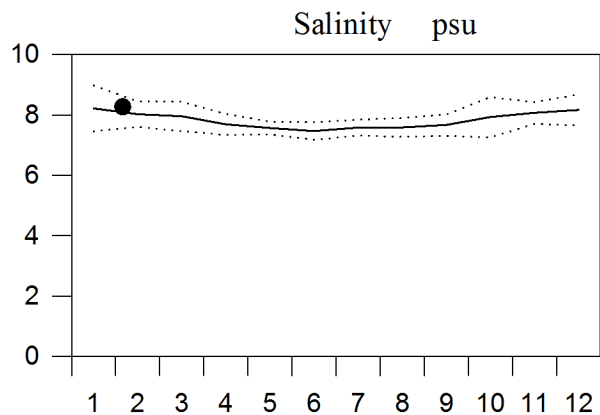
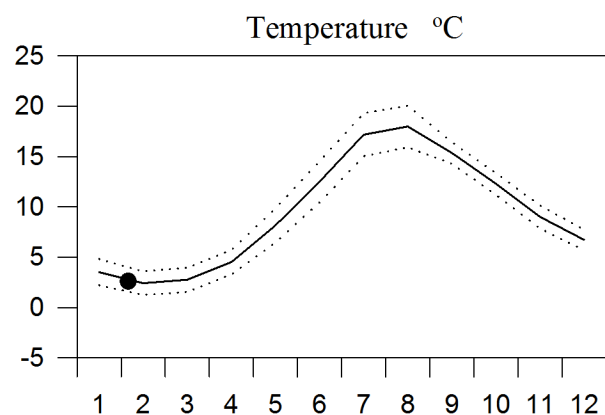
OXYGEN IN BOTTOM WATER (depth >40m)



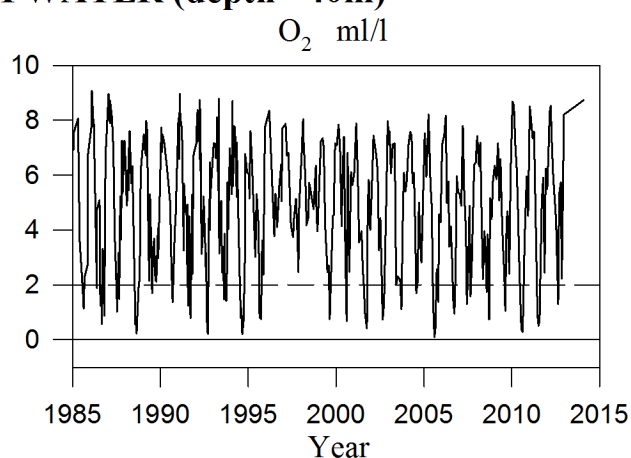
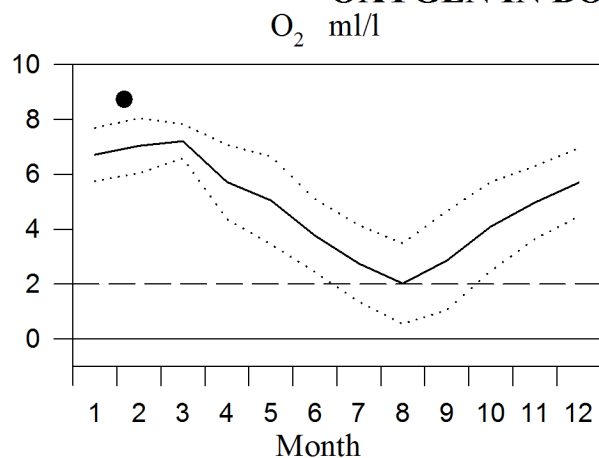
STATION BY1 SURFACE WATER

Annual Cycles

— Mean 1996-2010 St.Dev. ● 2014

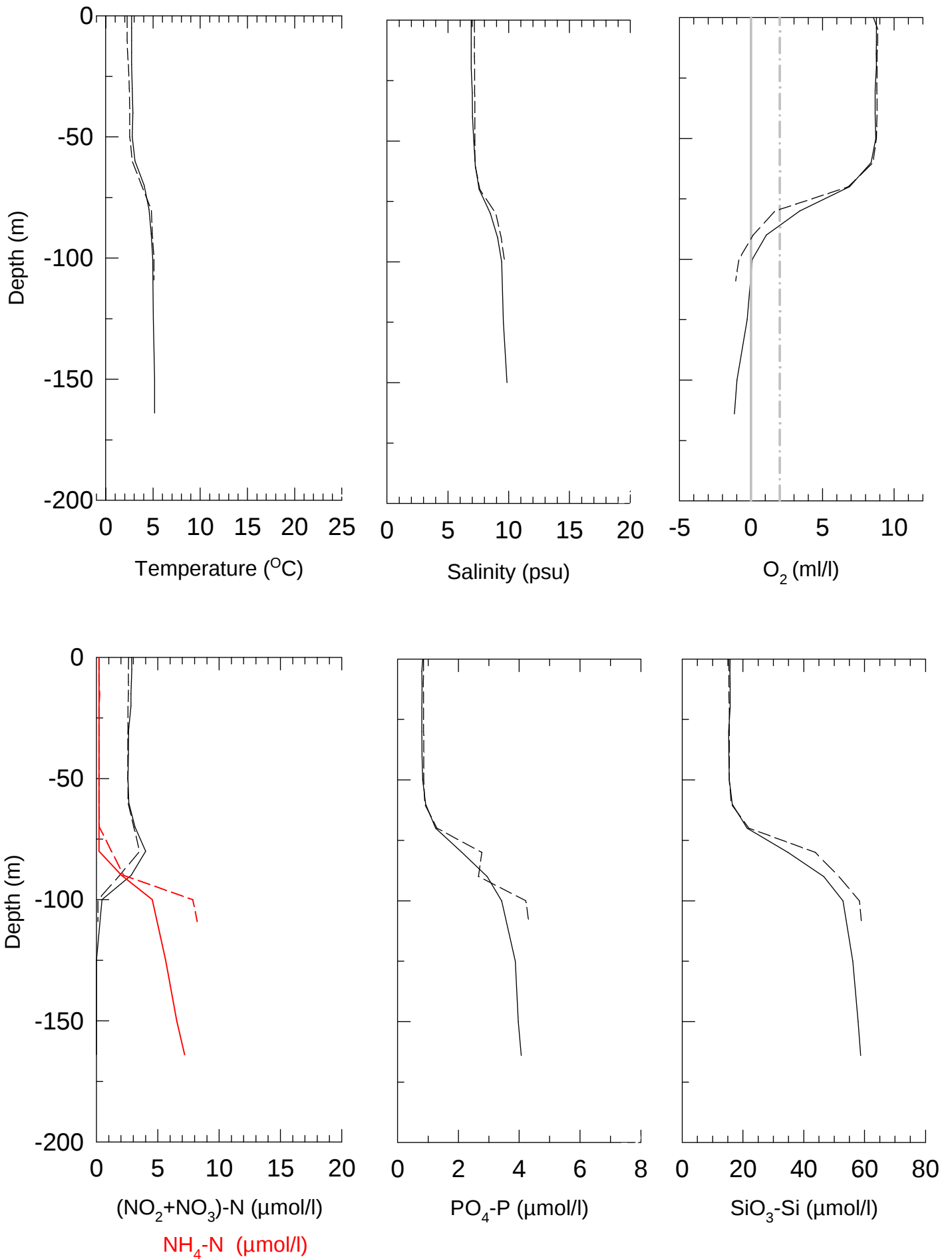


OXYGEN IN BOTTOM WATER (depth >40m)



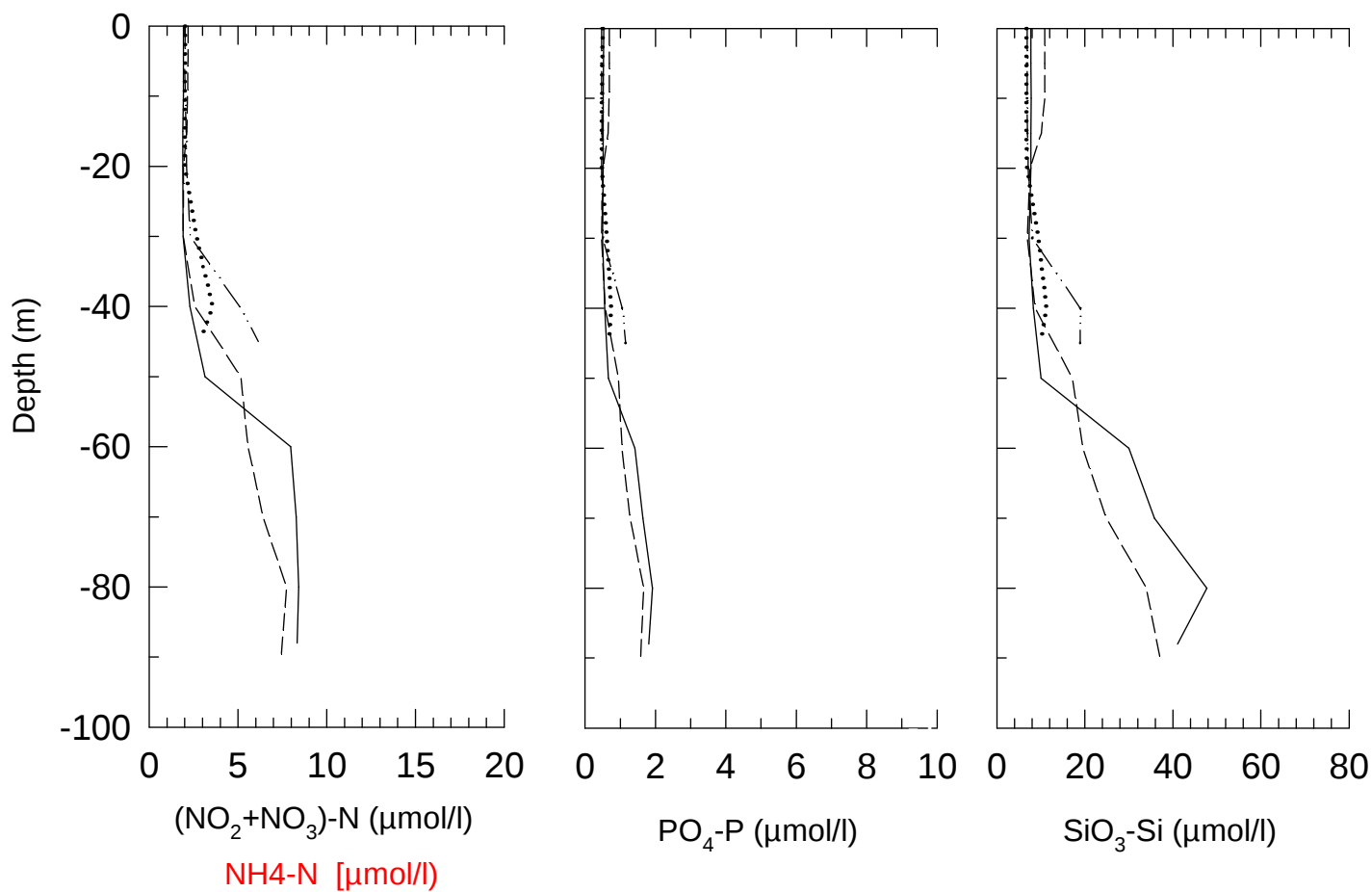
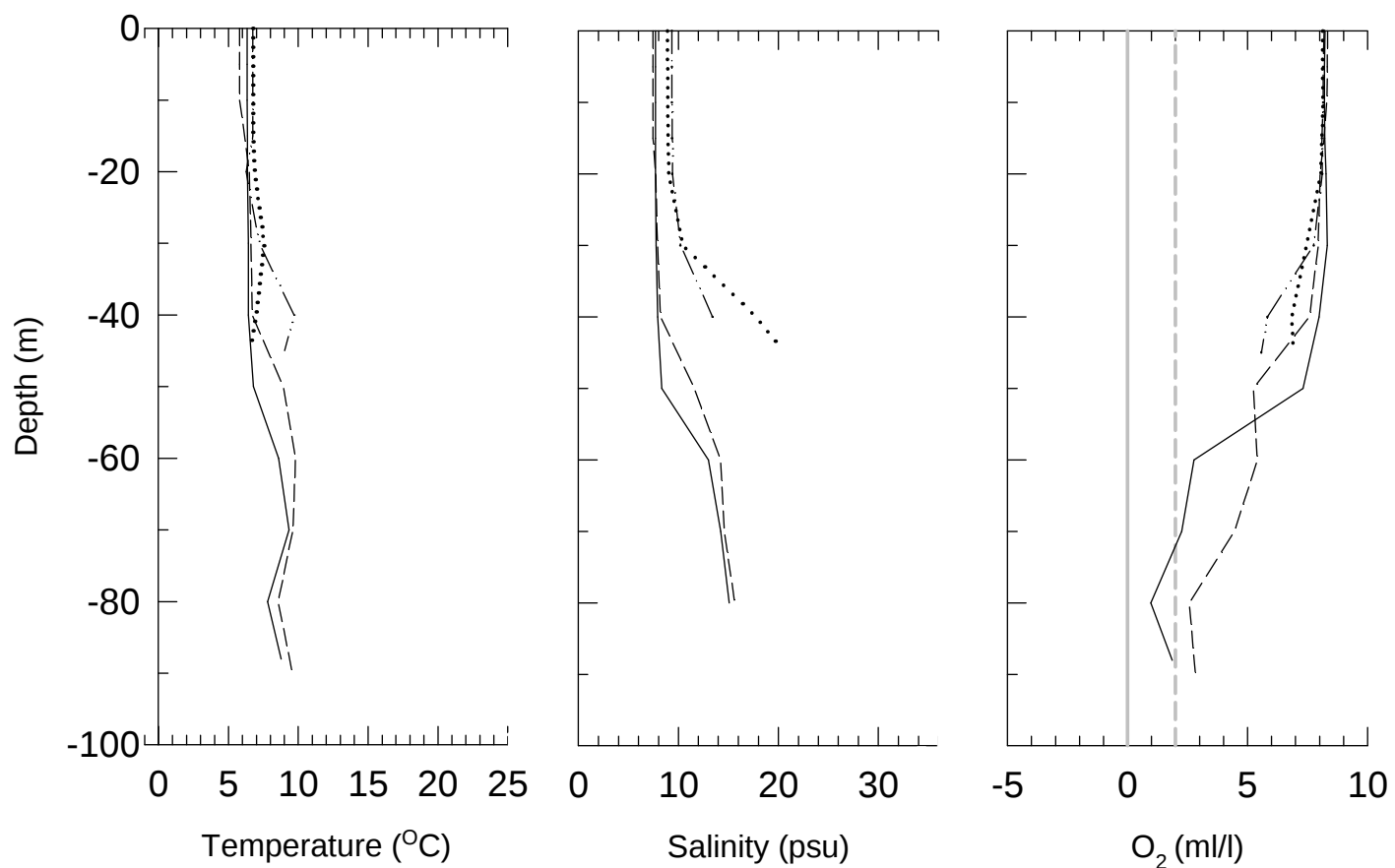
WESTERN BALTIC 2014-02-04

————— BY32 - - - - - BY38



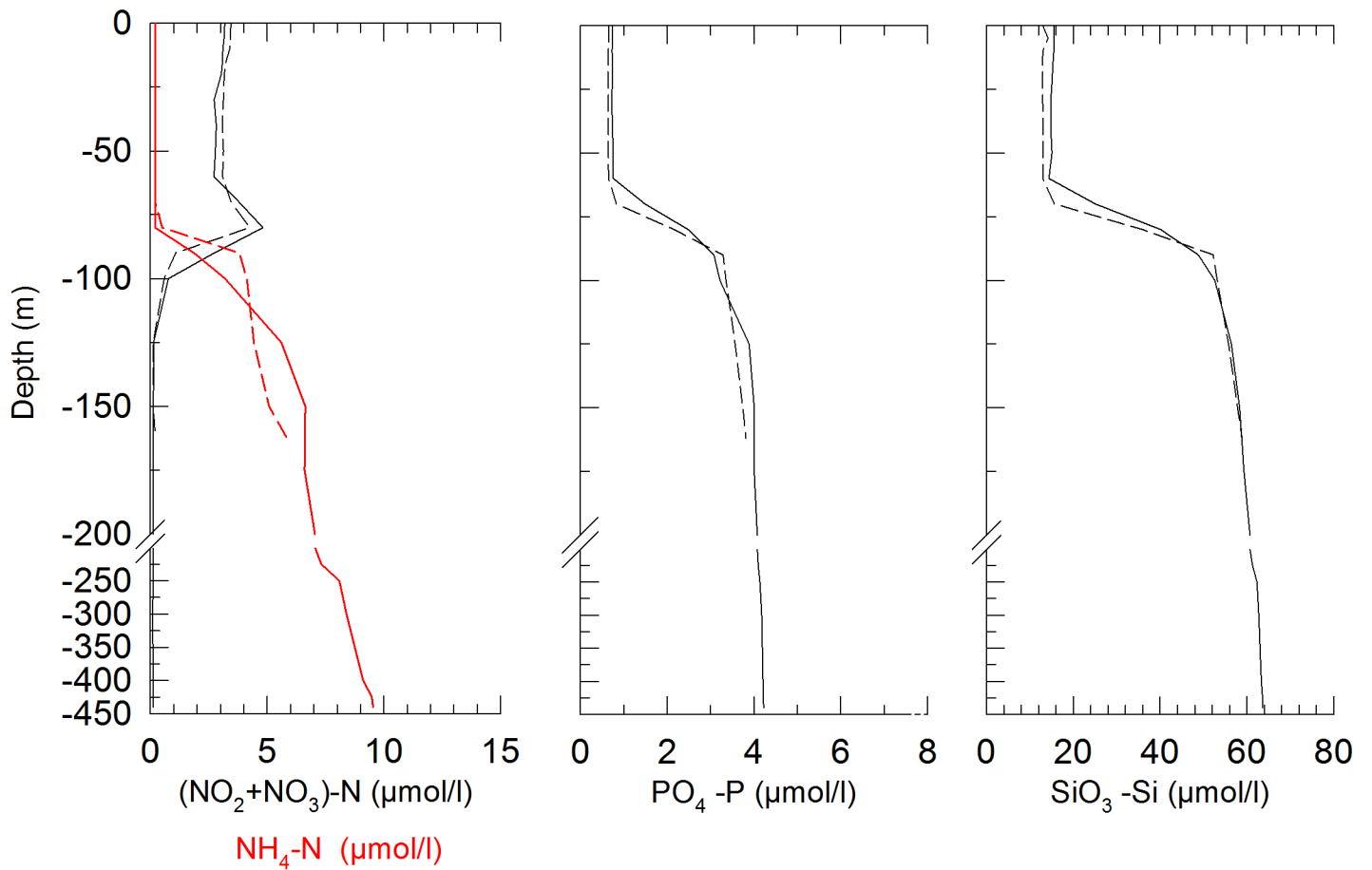
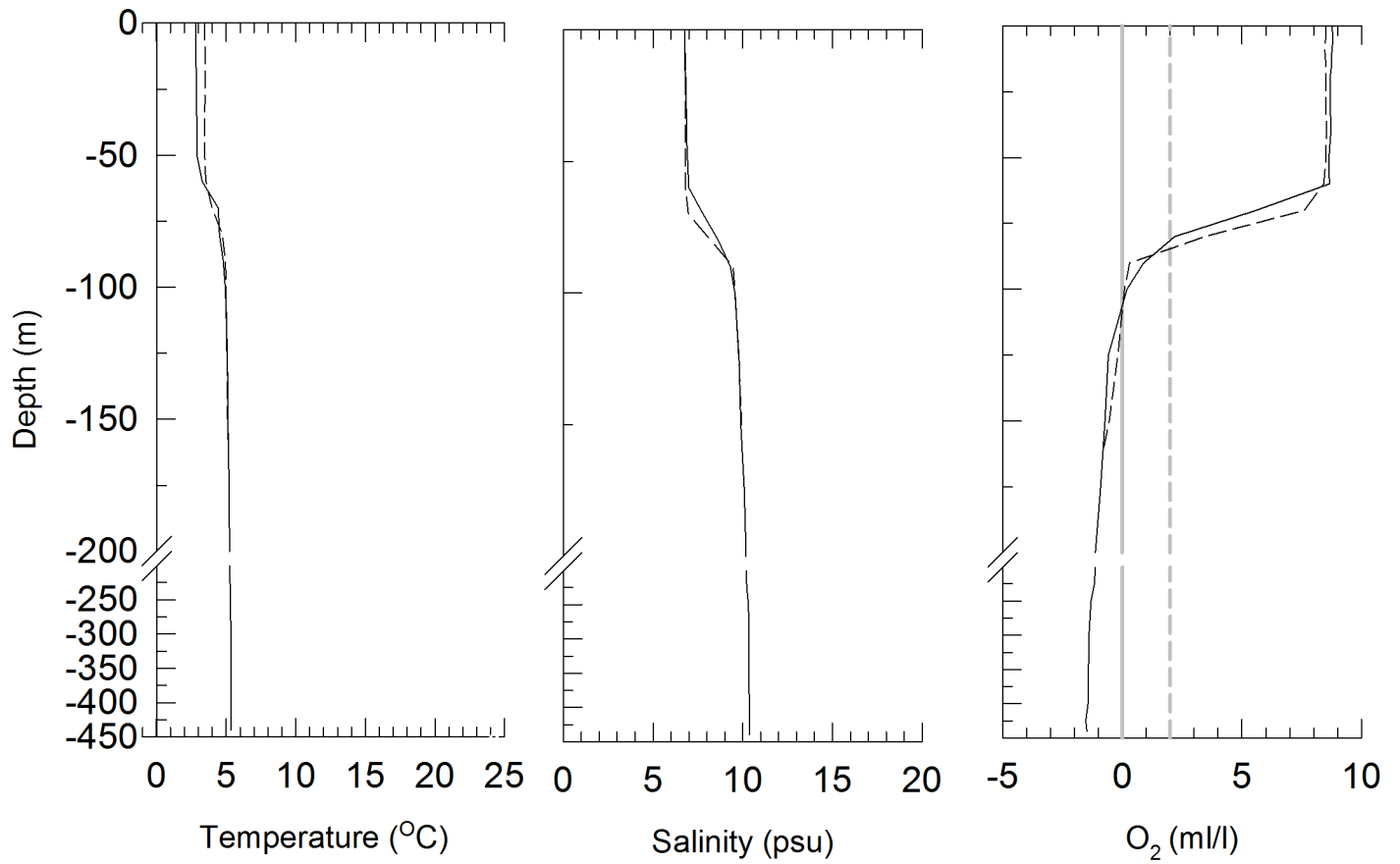
SOUTHERN BALTIC 2014-02-05/10

— BY5 - - - BY4 - · - BY2 ····· BY1



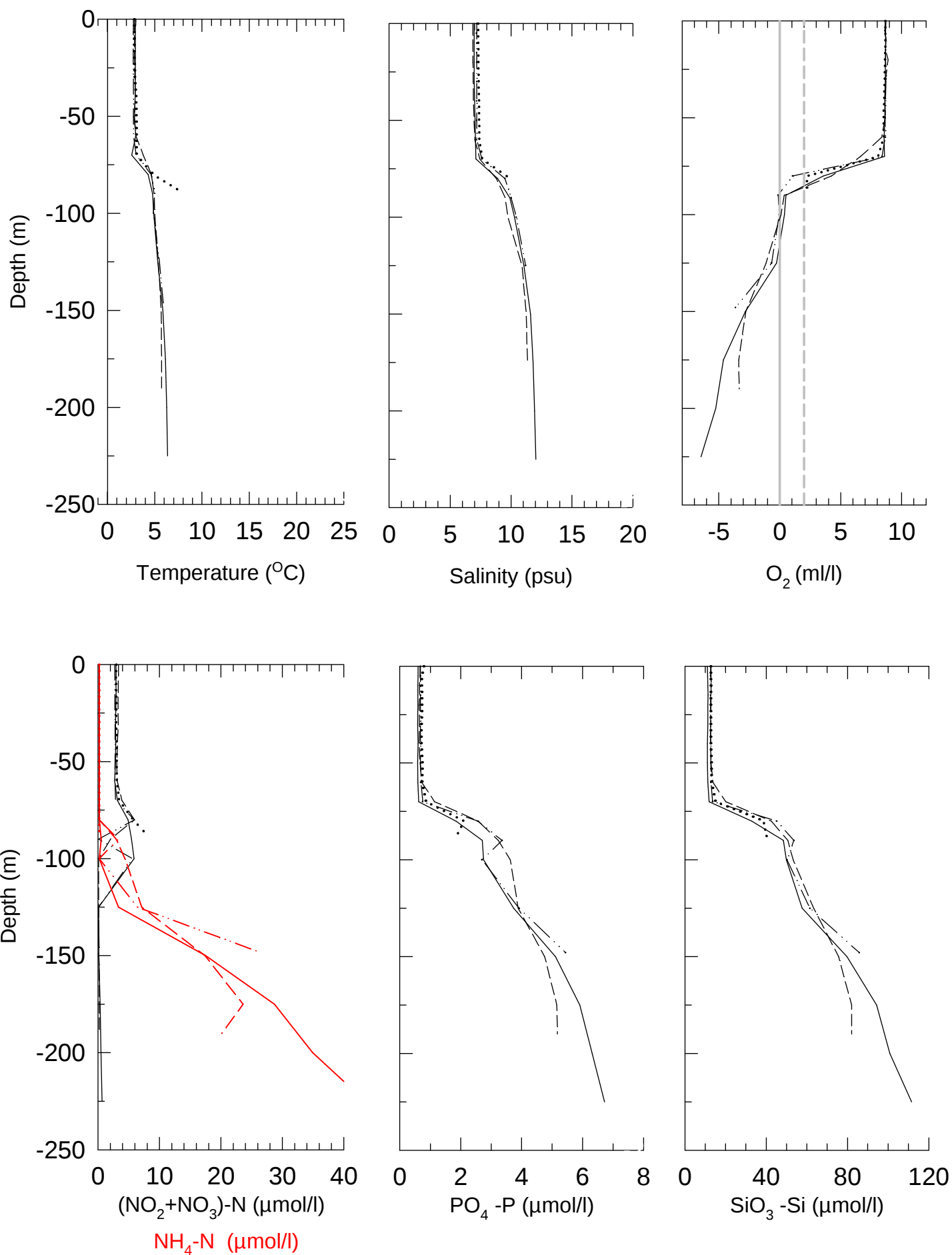
NORTHERN BALTIC 2014-02-04

----- BY29 ——— BY31



EASTERN BALTIC 2014-02-11/12

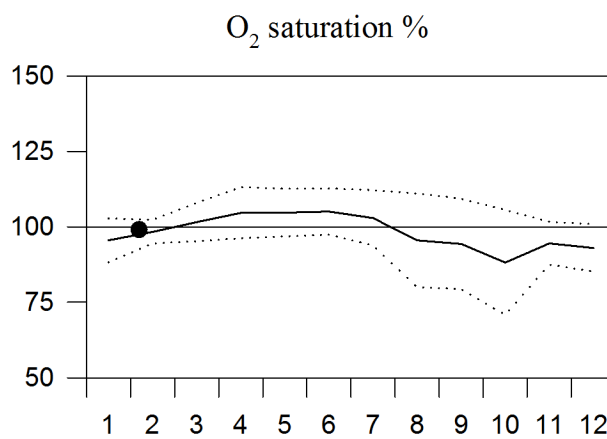
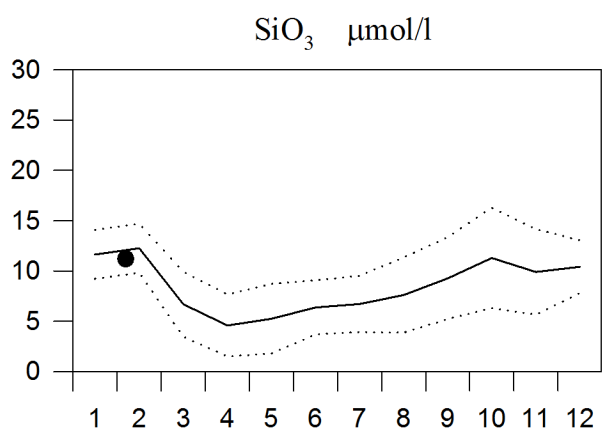
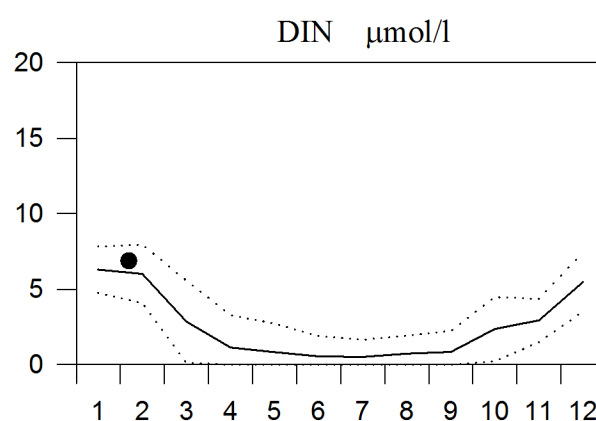
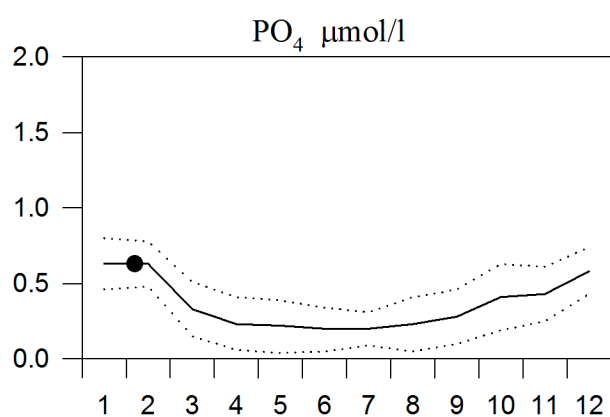
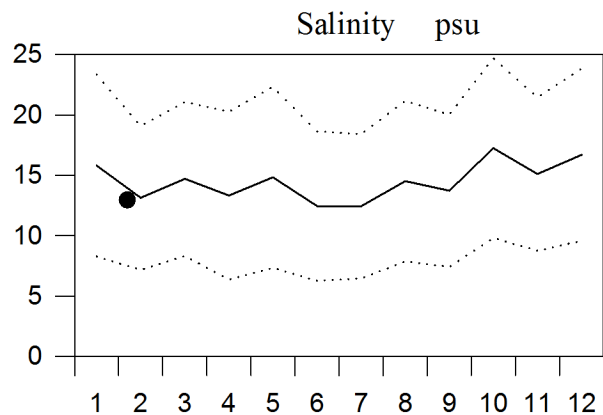
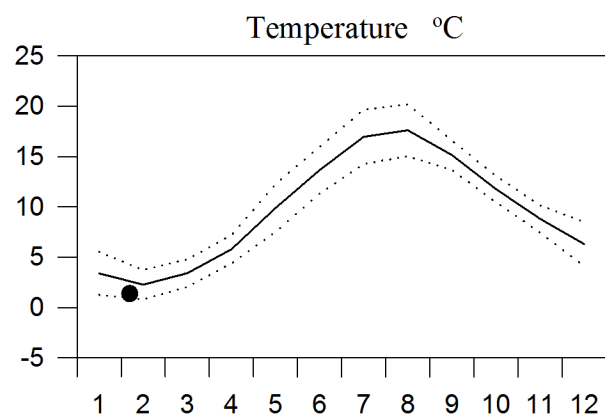
— — — BY20 — BY15 - - - BY10 BCS III-10



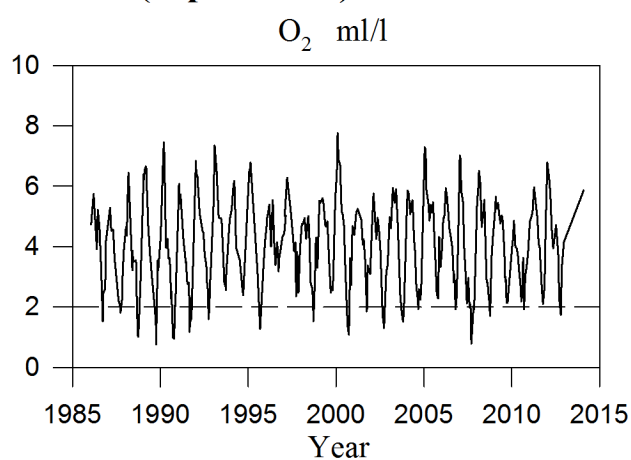
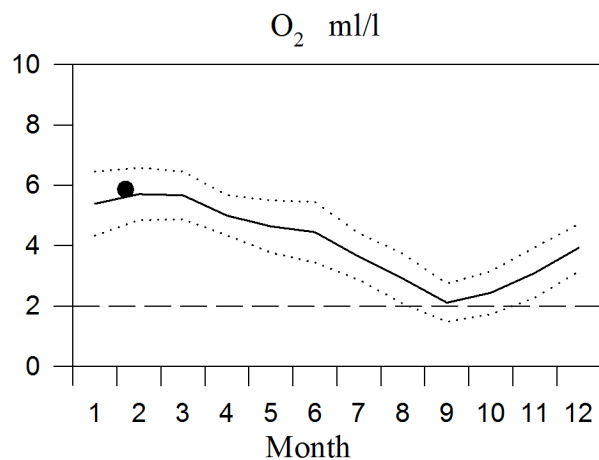
STATION W LANDSKRONA SURFACE WATER

Annual Cycles

— Mean 1996-2010 St.Dev. ● 2014



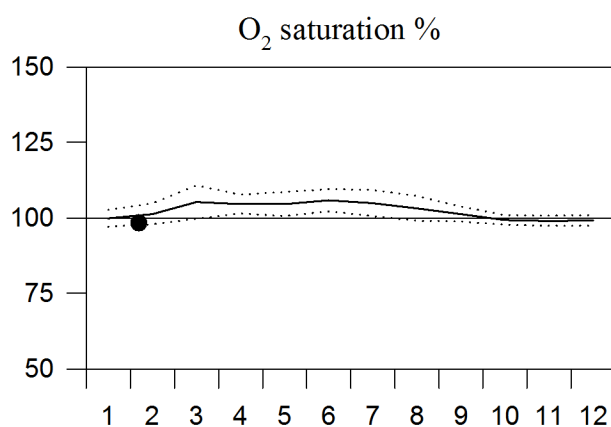
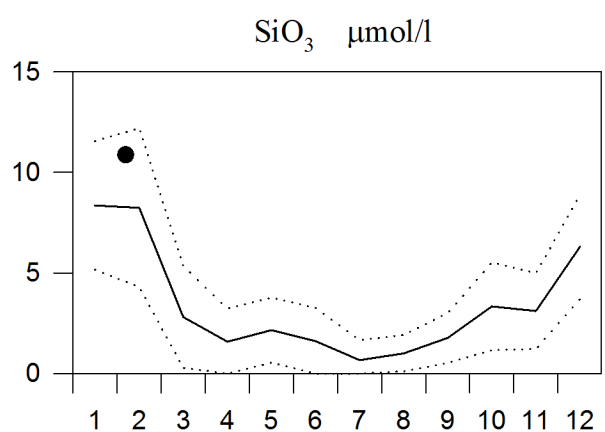
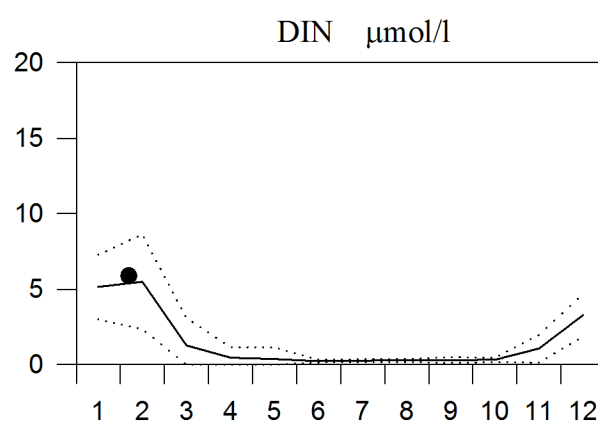
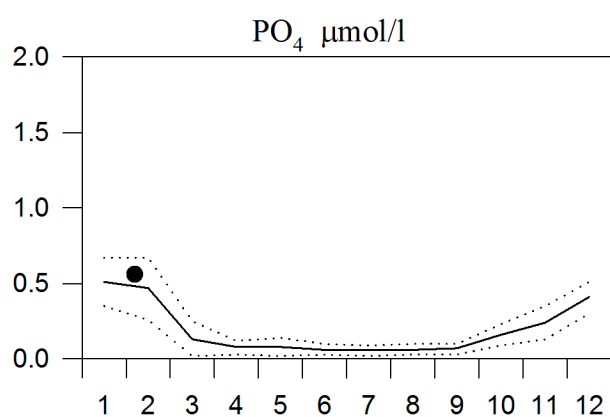
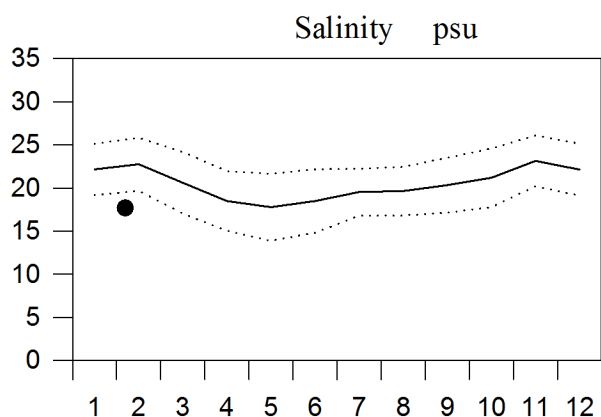
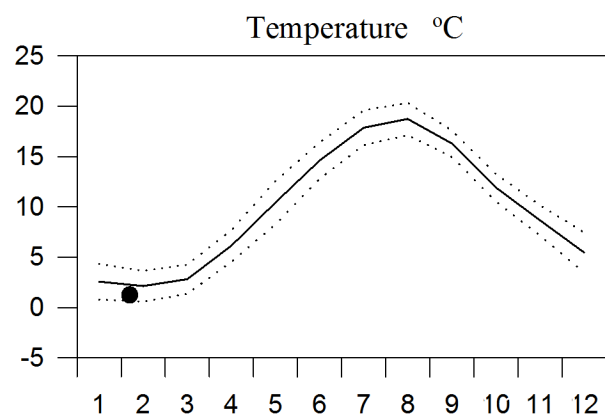
OXYGEN IN BOTTOM WATER (depth >40m)



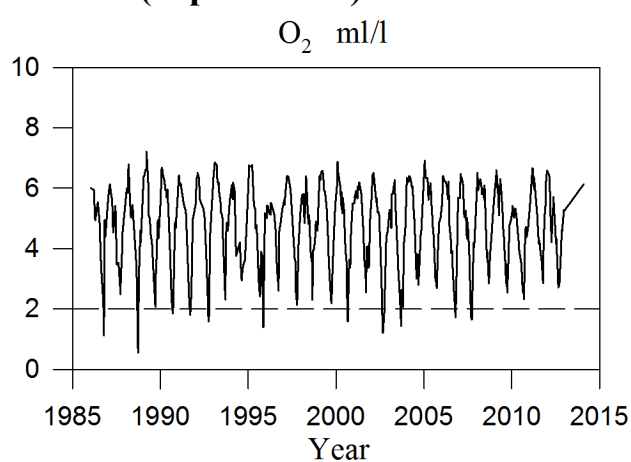
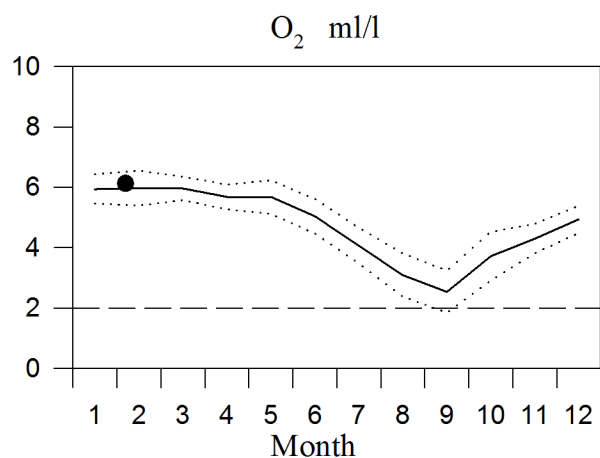
STATION ANHOLT E SURFACE WATER

Annual Cycles

— Mean 1996-2010 St.Dev. ● 2014



OXYGEN IN BOTTOM WATER (depth > 50m)



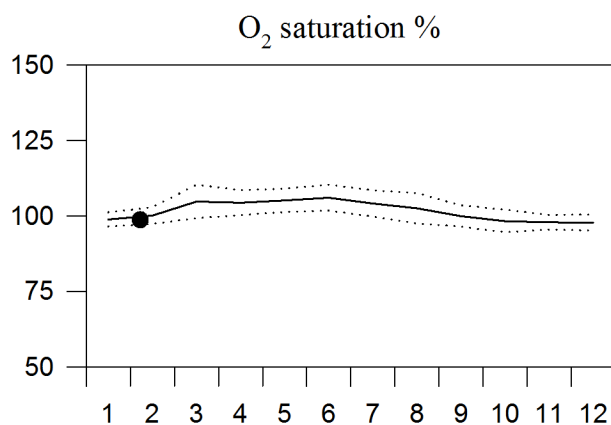
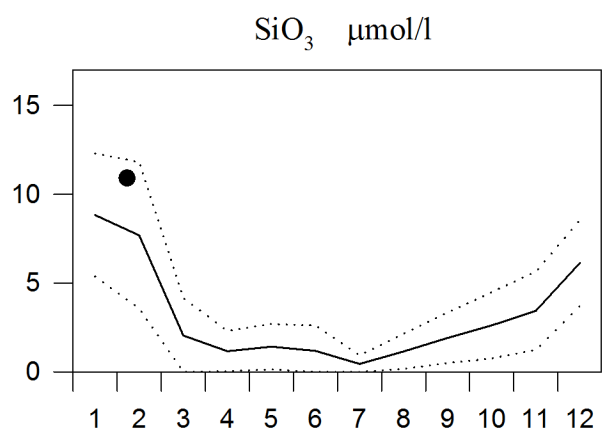
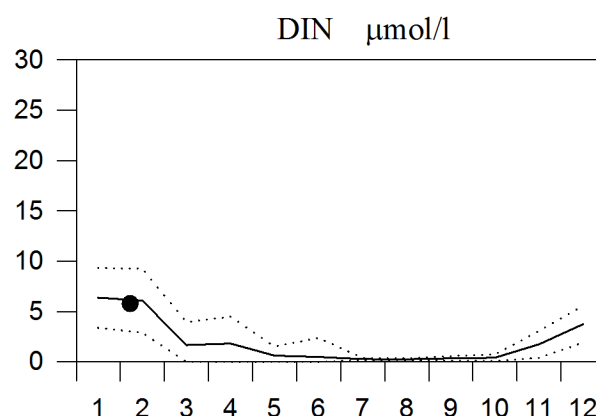
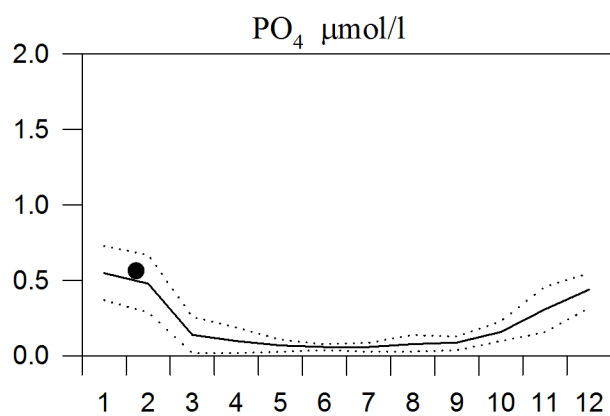
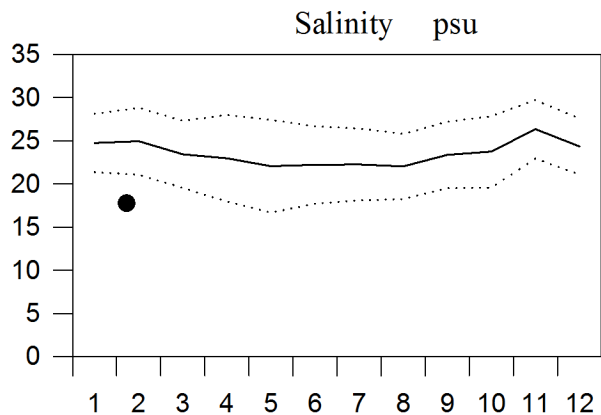
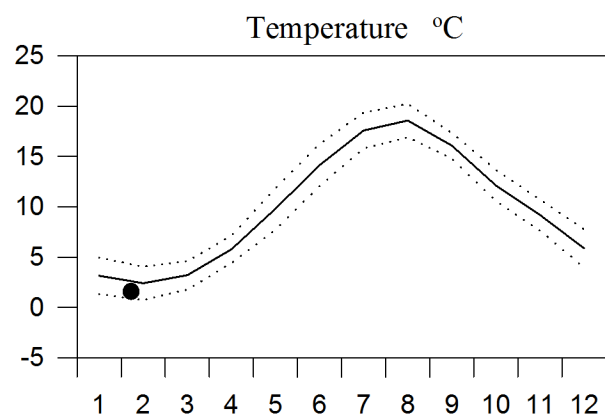
STATION FLADEN SURFACE WATER

Annual Cycles

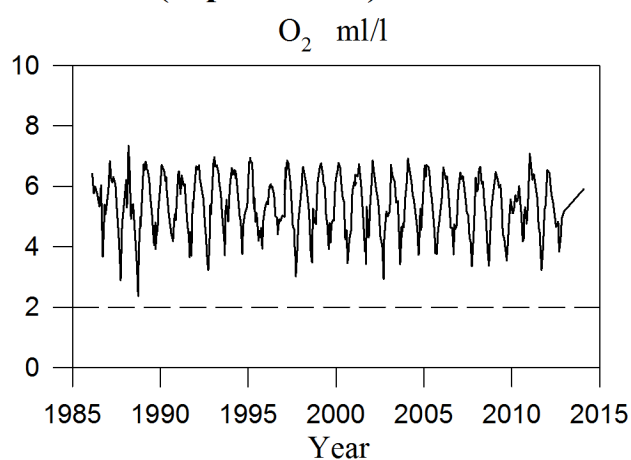
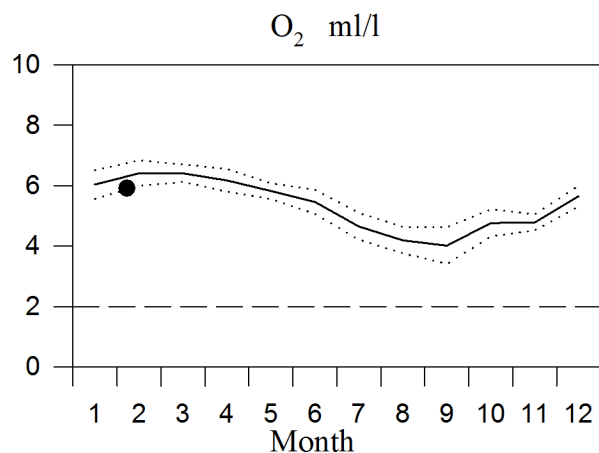
— Mean 1996-2010

..... St.Dev.

● 2014



OXYGEN IN BOTTOM WATER (depth > 70m)



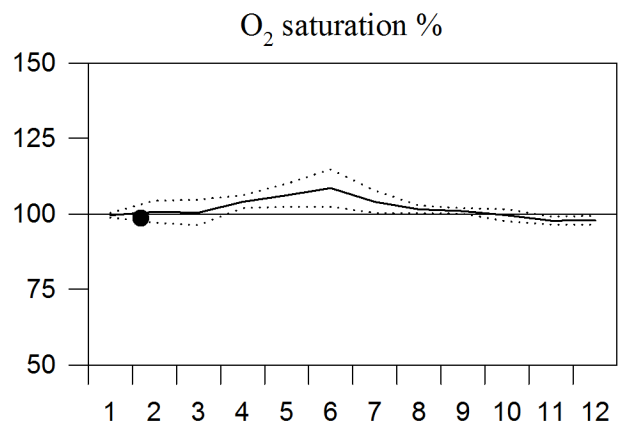
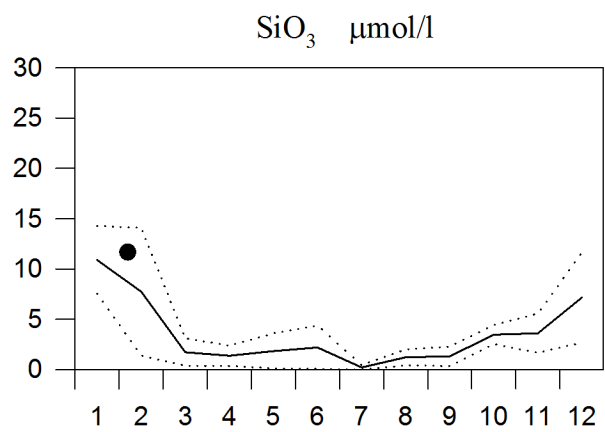
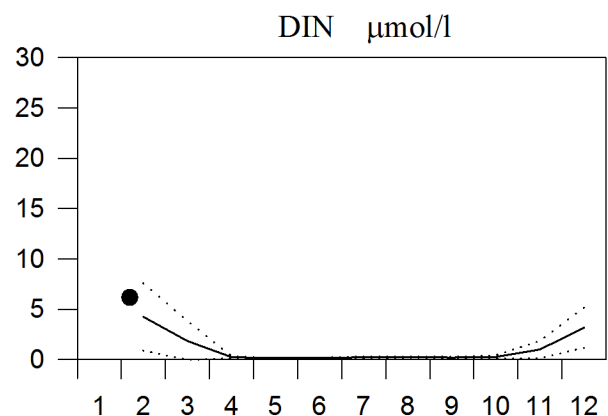
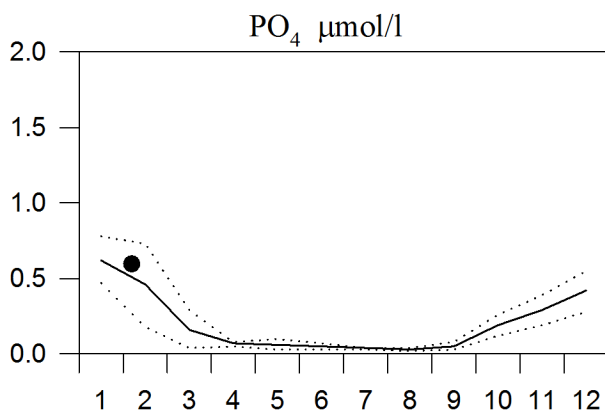
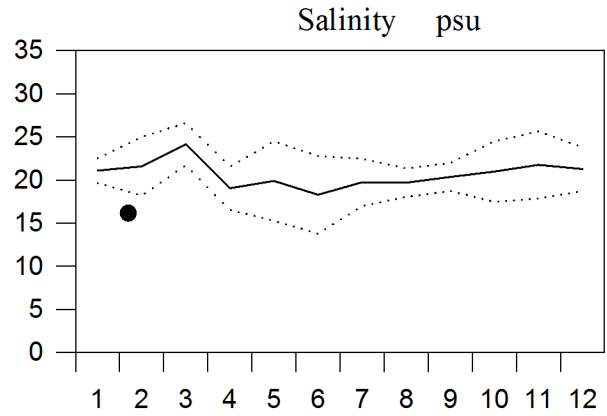
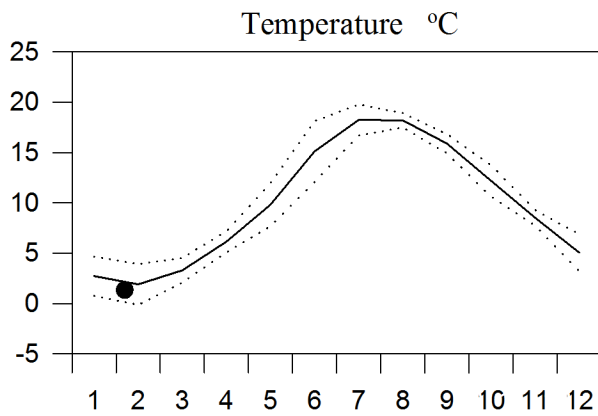
STATION N14 Falkenberg SURFACE WATER

Annual Cycles

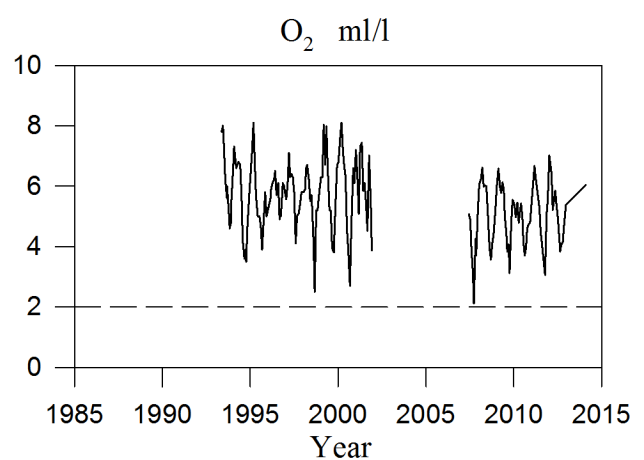
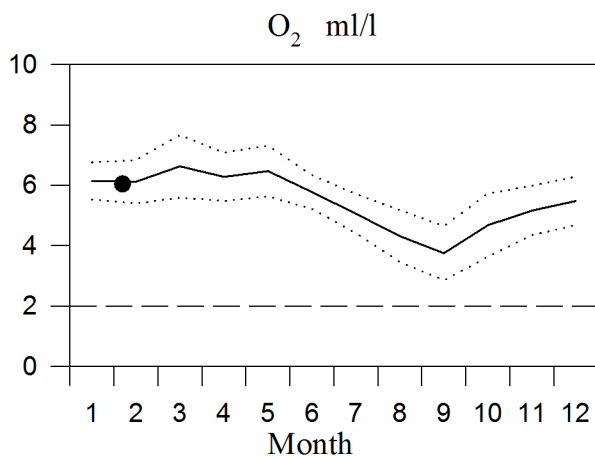
— Mean 2007-2010

..... St.Dev.

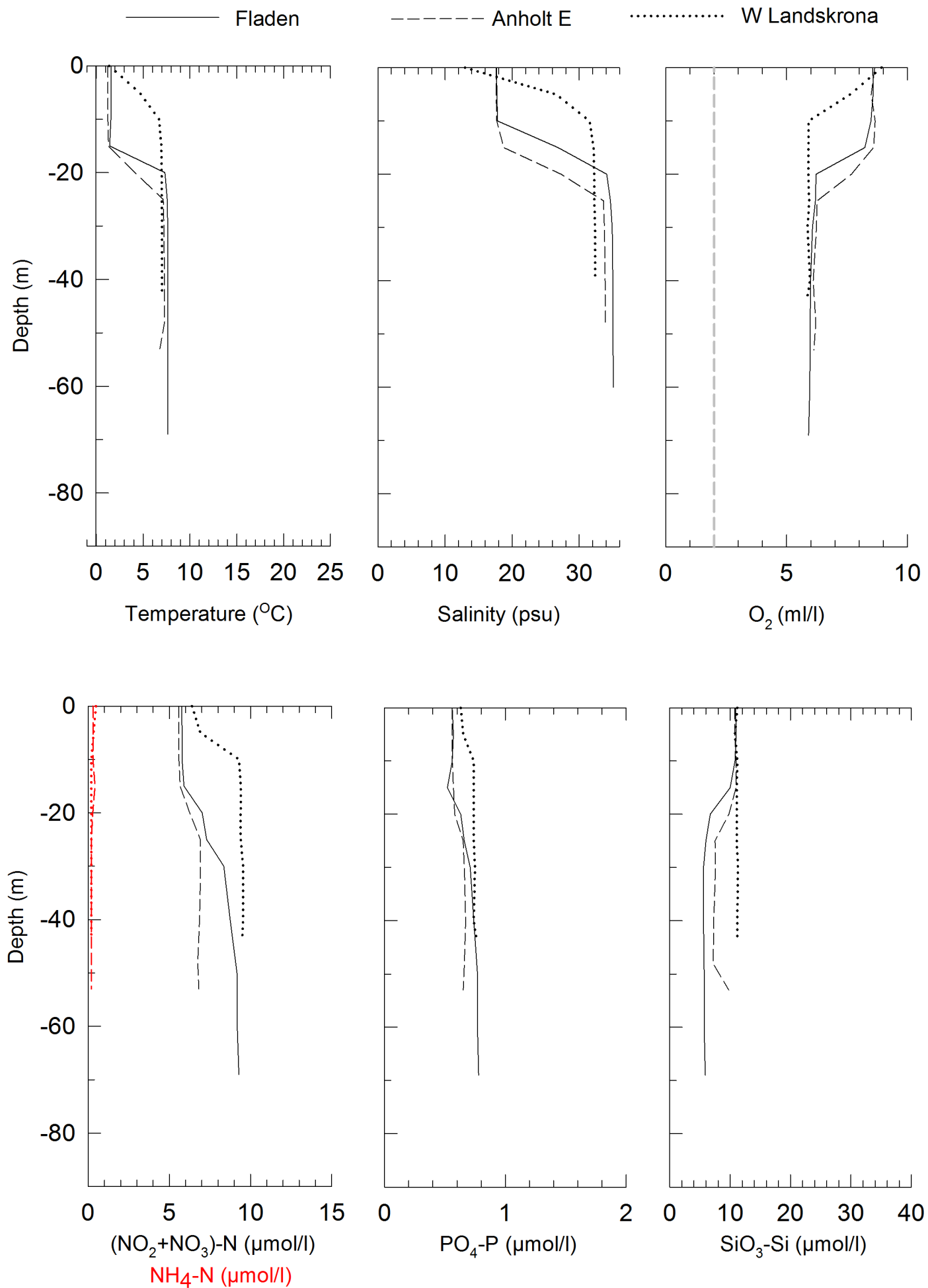
● 2014



OXYGEN IN BOTTOM WATER (depth > 25m)



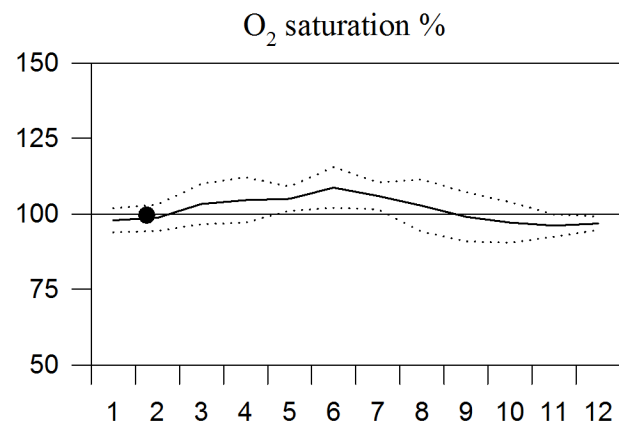
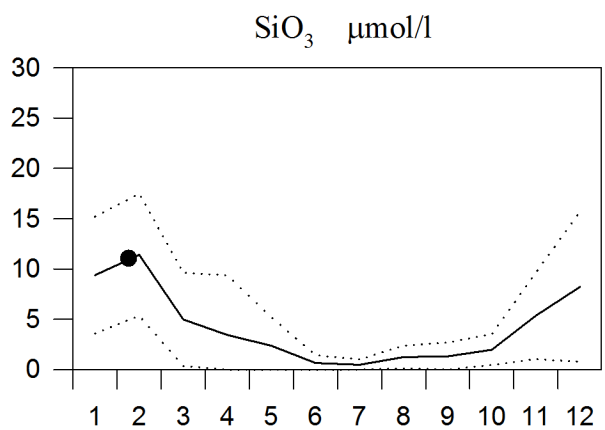
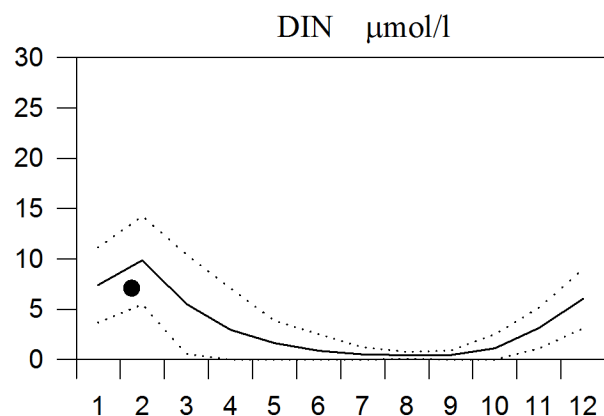
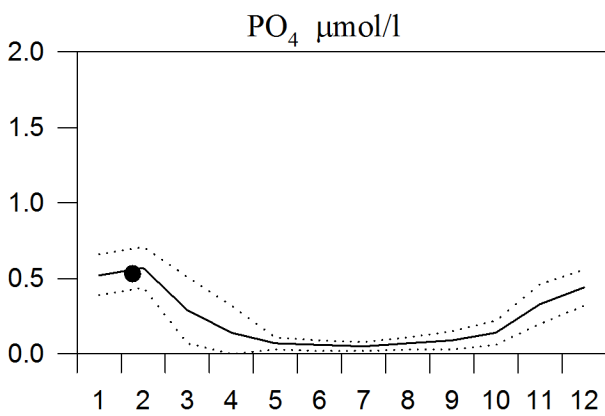
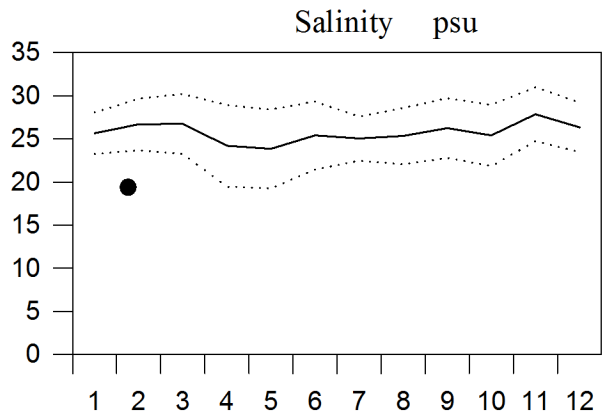
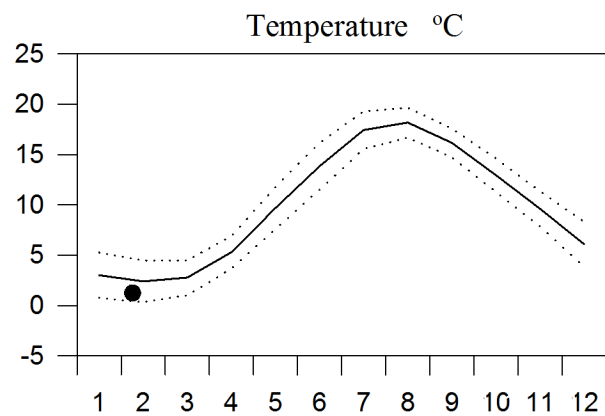
KATTEGAT and THE SOUND 2014-02-06/07



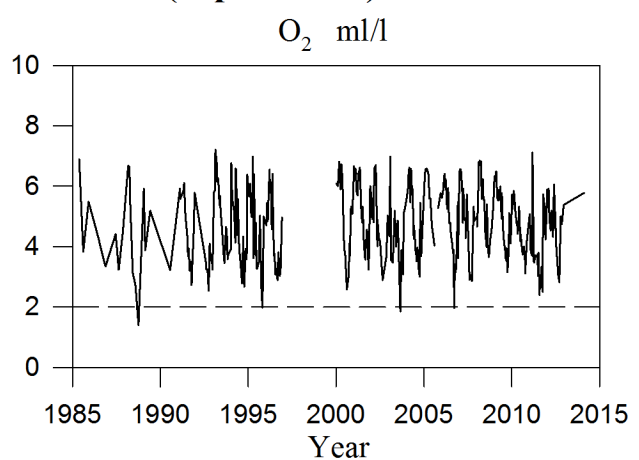
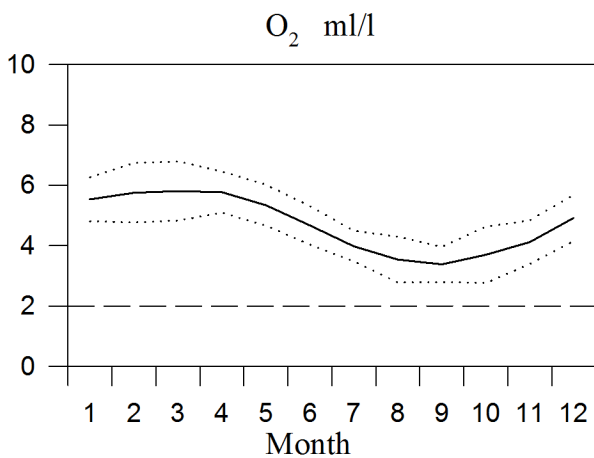
STATION SLÄGGÖ SURFACE WATER

Annual Cycles

— Mean 1996-2010 St.Dev. ● 2014



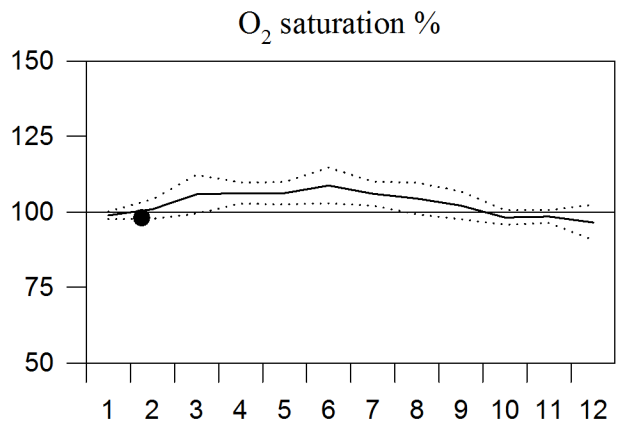
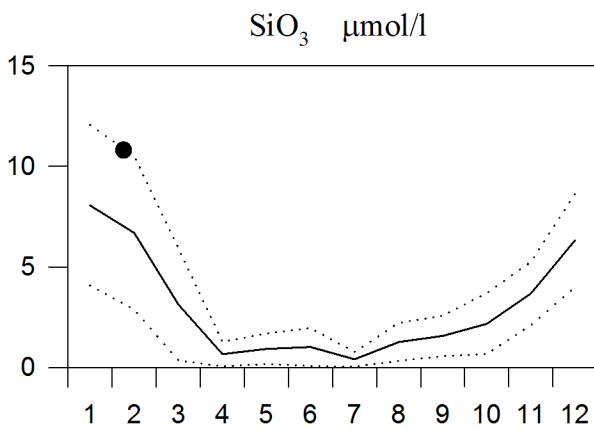
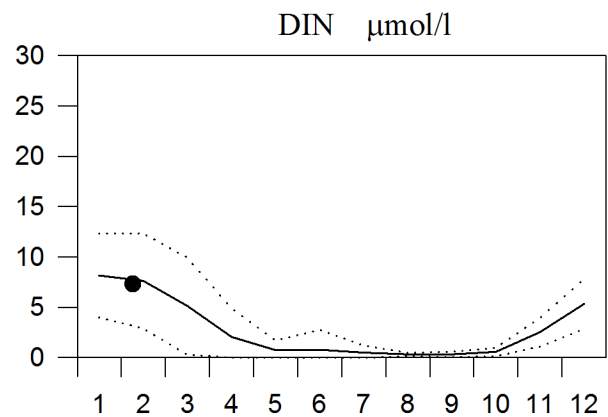
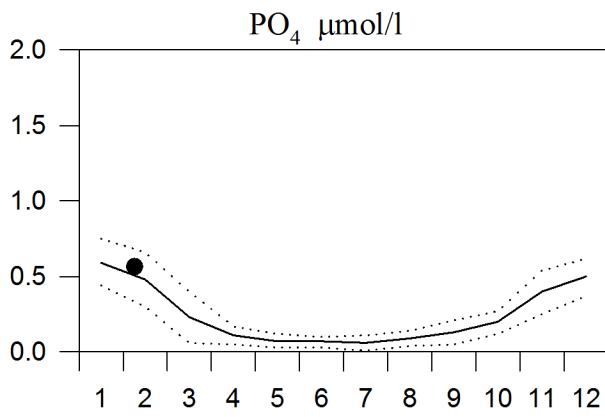
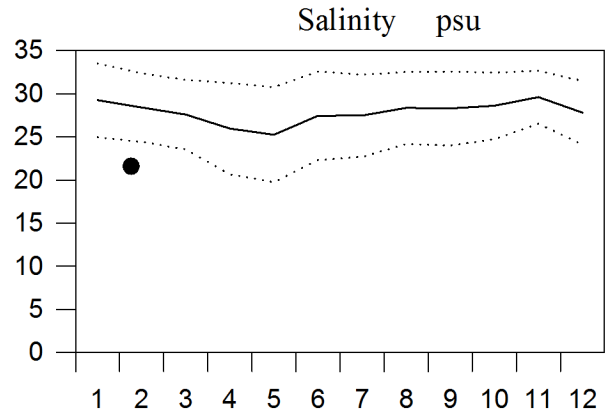
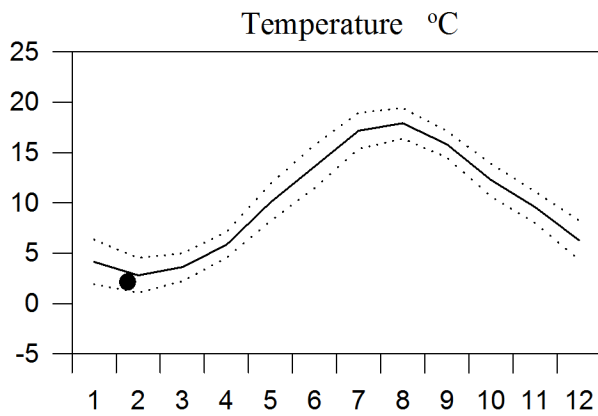
OXYGEN IN BOTTOM WATER (depth >50m)



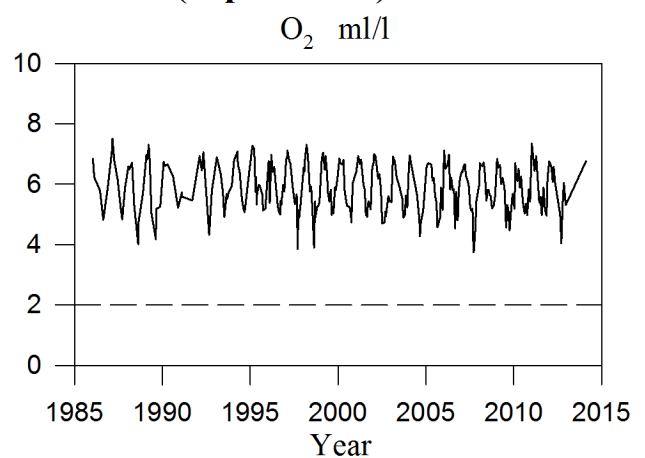
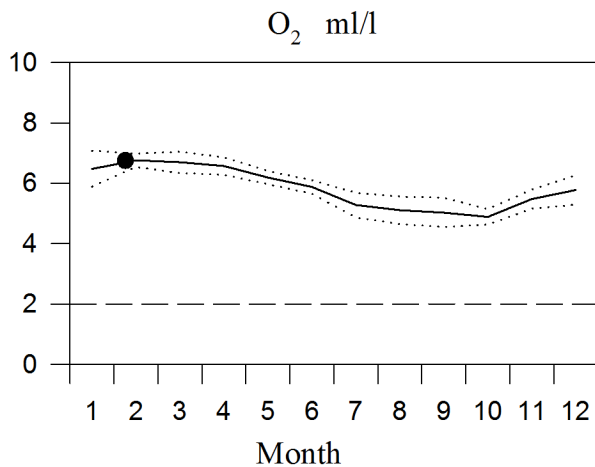
STATION P2 SURFACE WATER

Annual Cycles

— Mean 1996-2010 St.Dev. ● 2014



OXYGEN IN BOTTOM WATER (depth >75m)



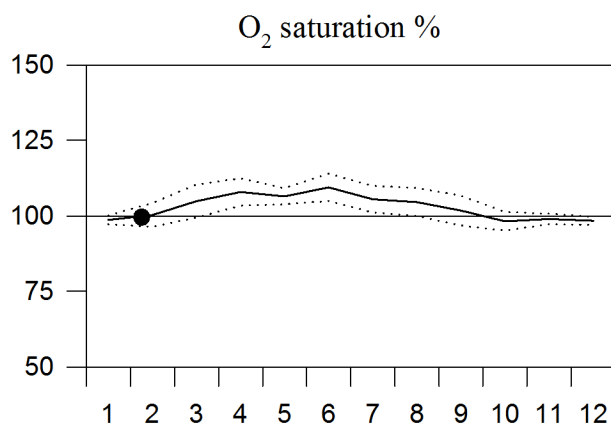
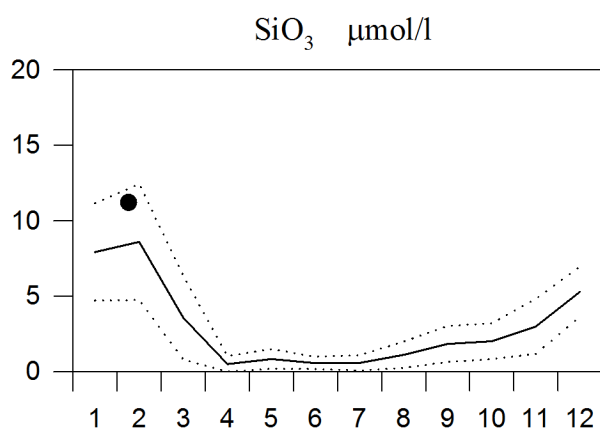
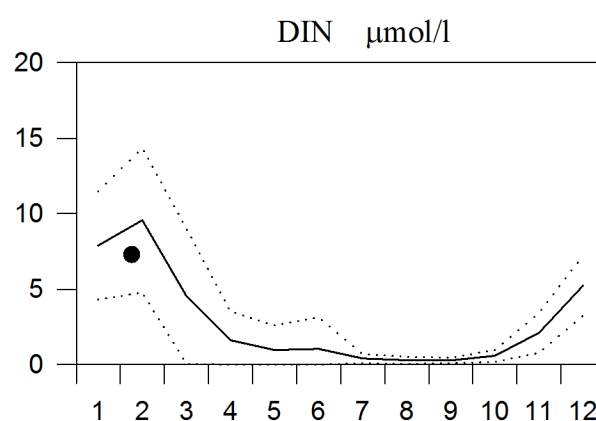
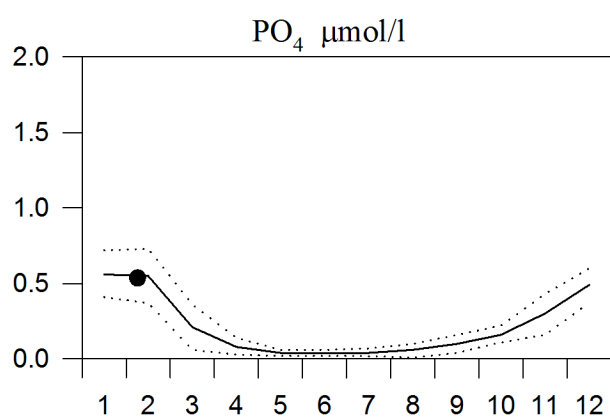
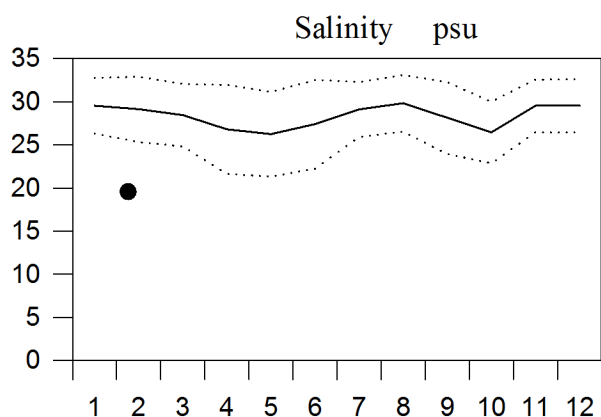
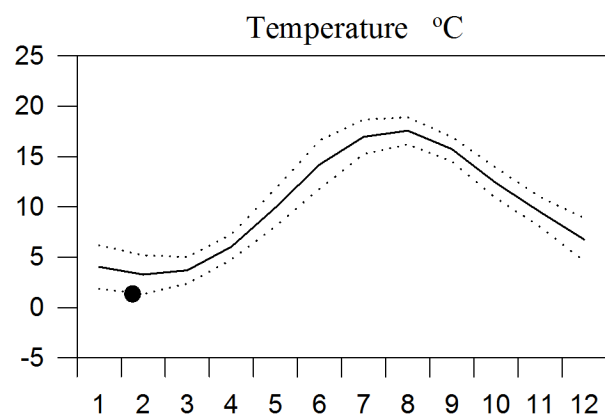
STATION Å13 SURFACE WATER

Annual Cycles

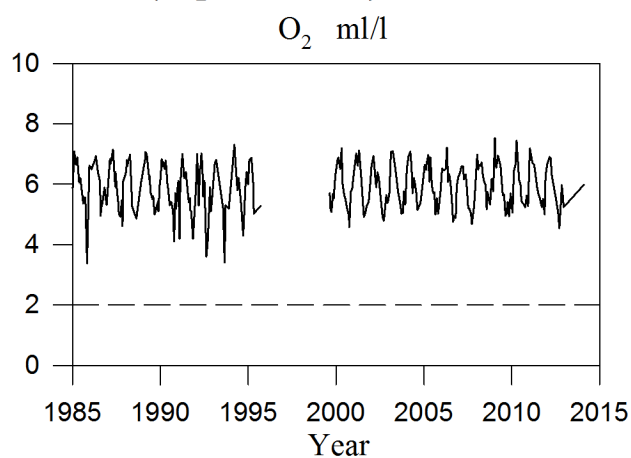
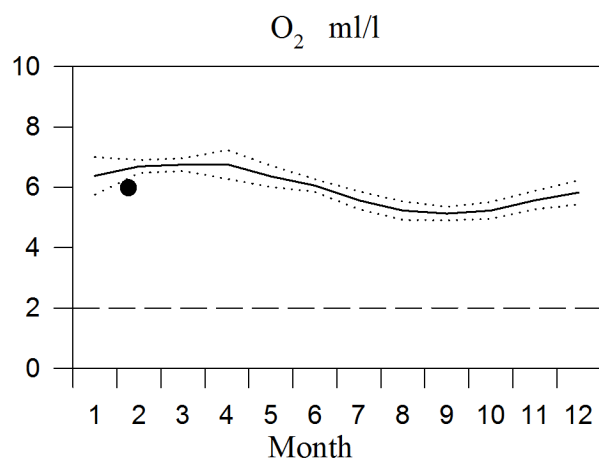
— Mean 1996-2010

..... St.Dev.

● 2014



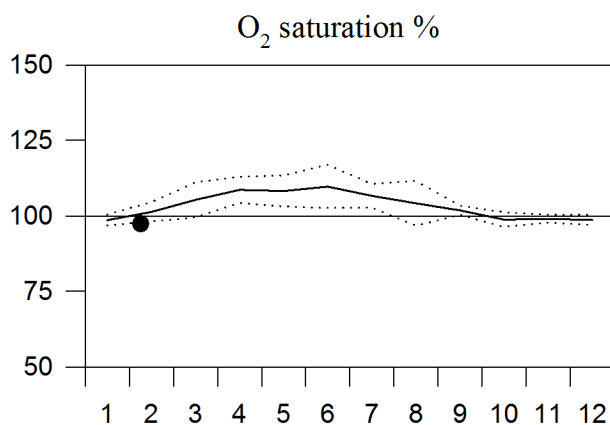
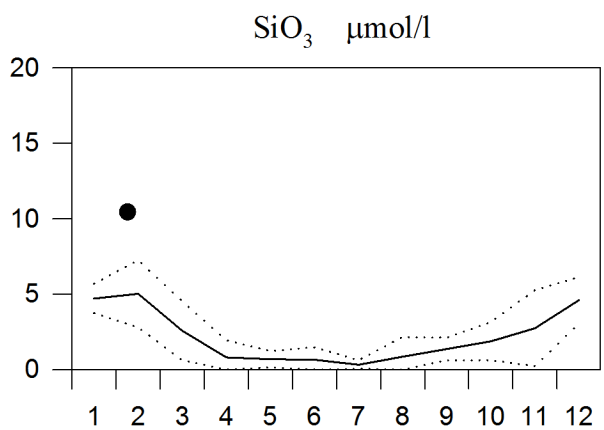
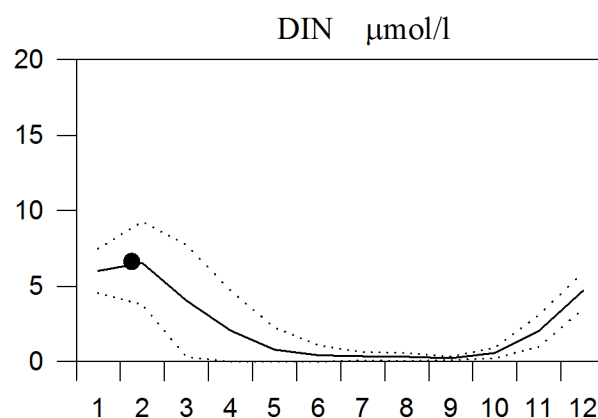
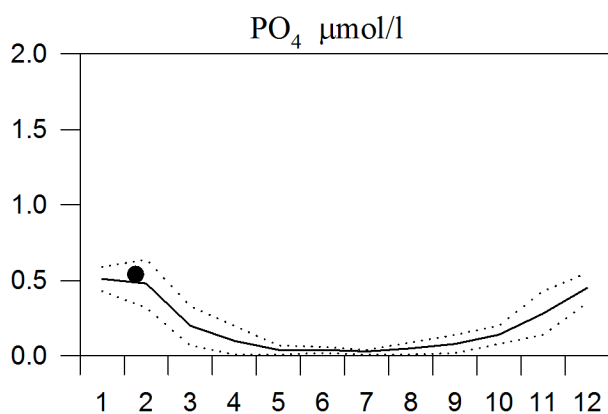
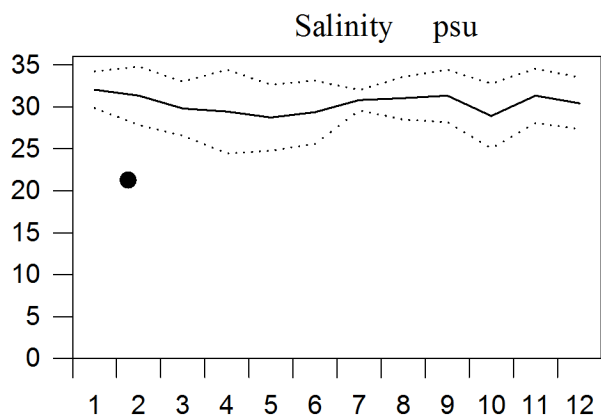
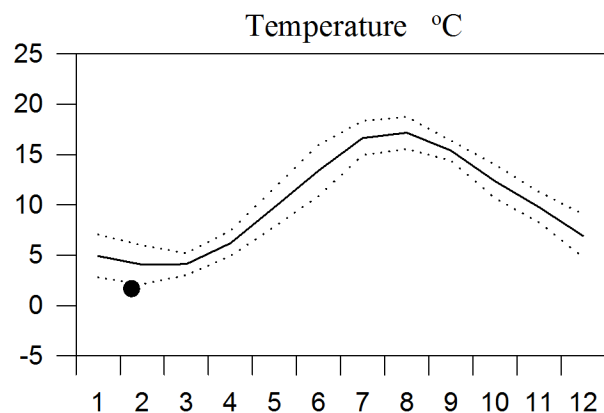
OXYGEN IN BOTTOM WATER (depth >=75m)



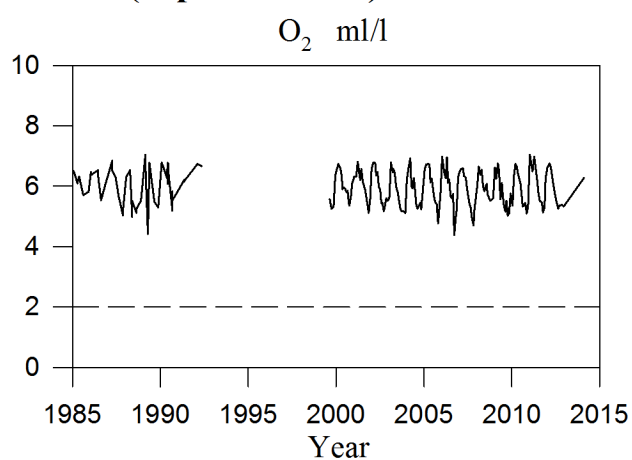
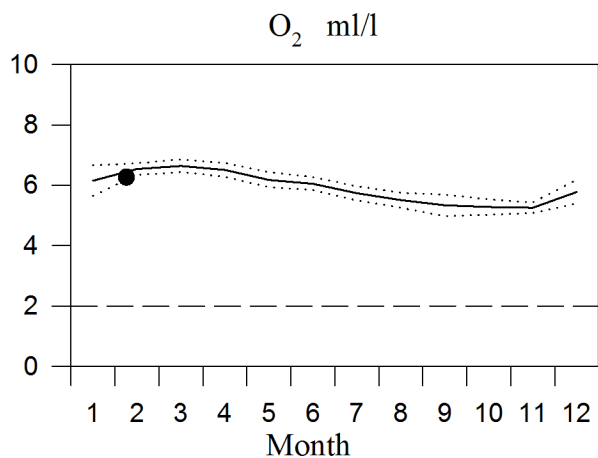
STATION Å15 SURFACE WATER

Annual Cycles

— Mean 1996-2010 St.Dev. • 2014



OXYGEN IN BOTTOM WATER (depth >=125m)



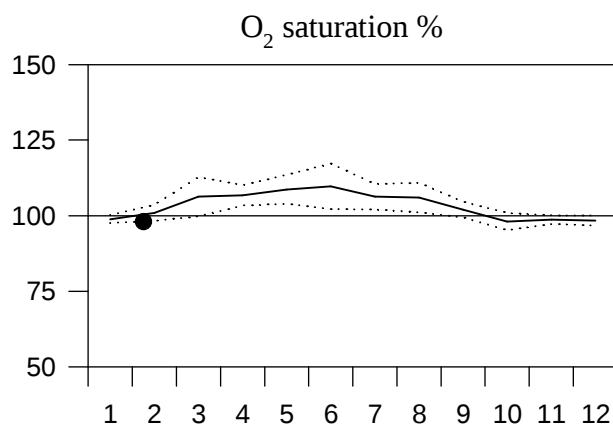
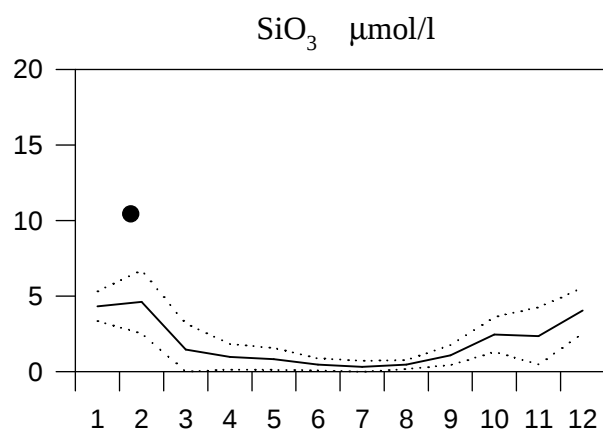
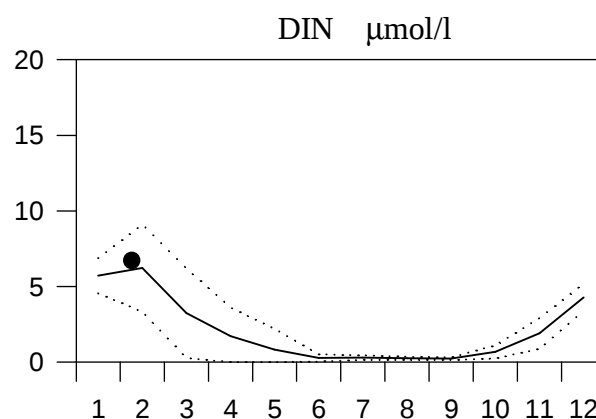
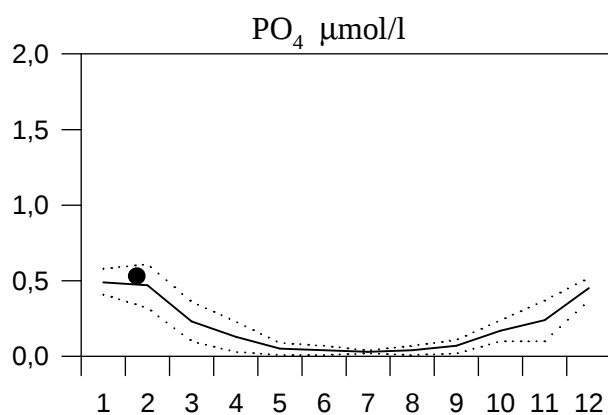
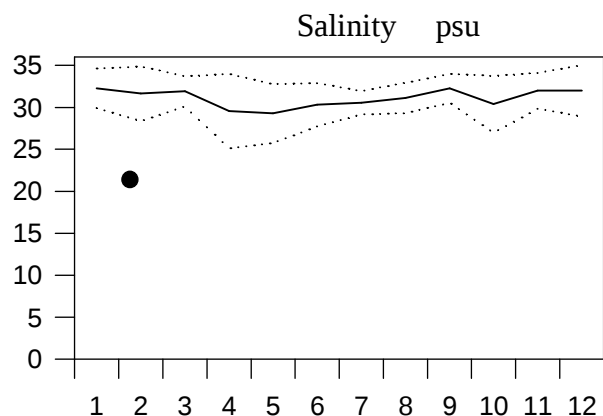
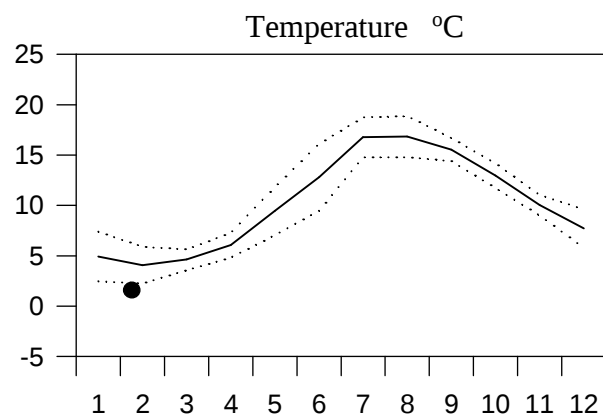
STATION Å17 SURFACE WATER

Annual Cycles

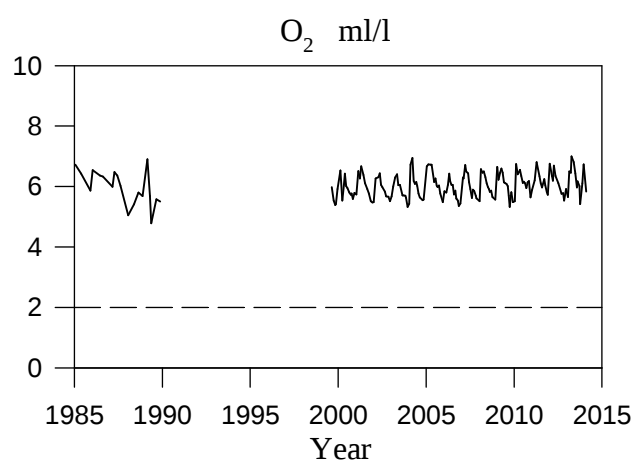
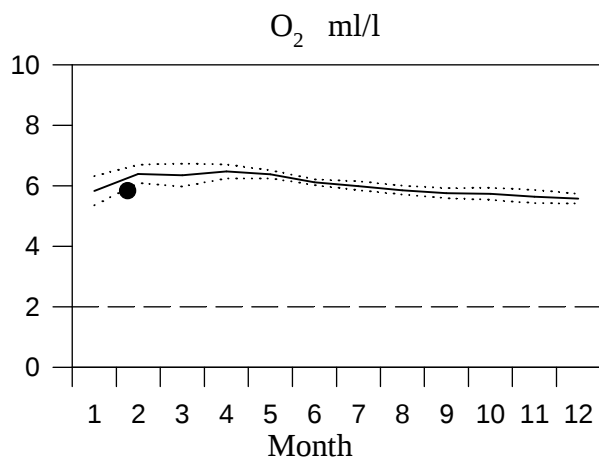
— Mean 1996-2010

..... St.Dev.

● 2014

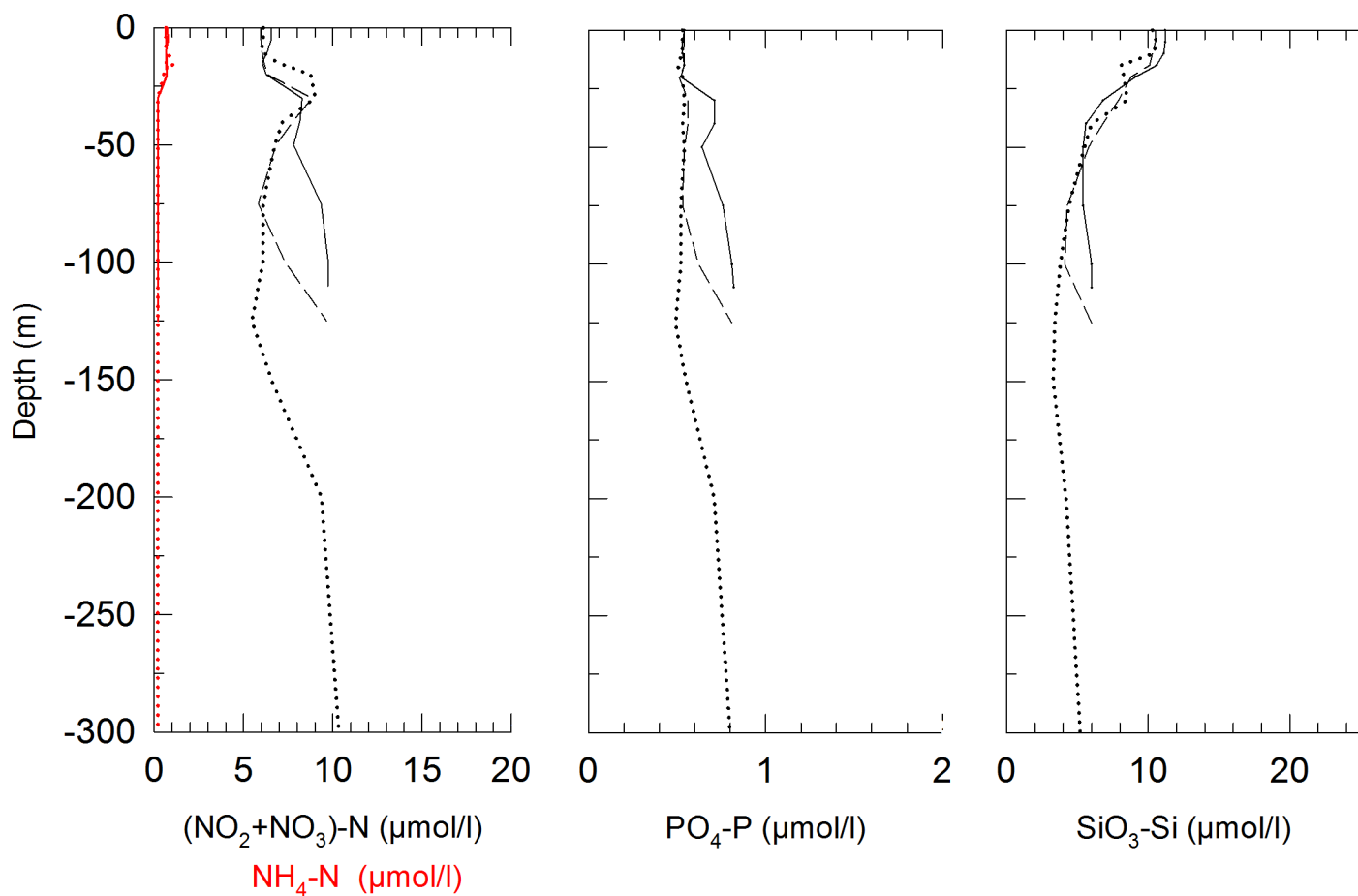
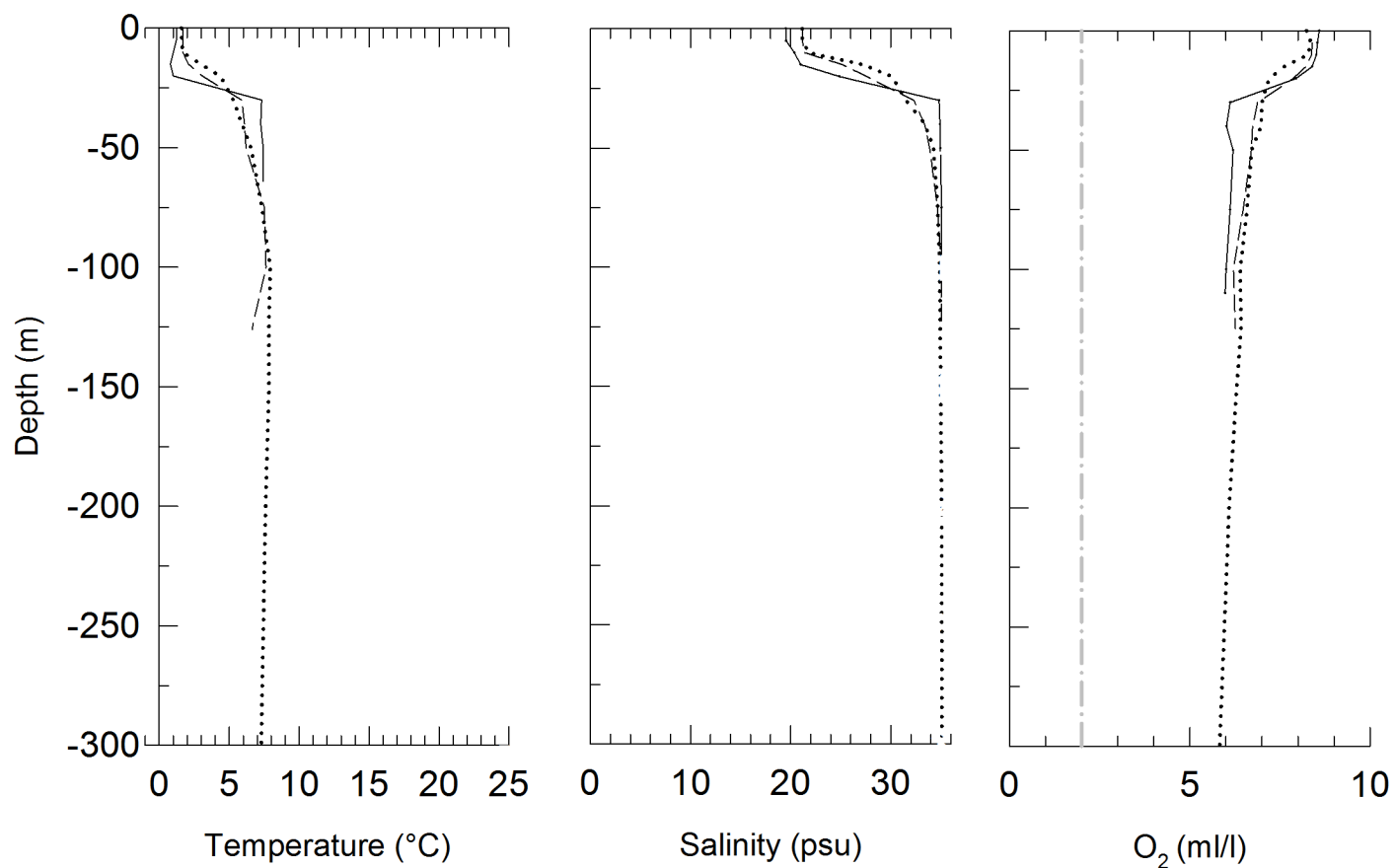


OXYGEN IN BOTTOM WATER (depth = 300m)



SKAGERRAK Å-Section 2014-02-08

—— Å13 - - - - - Å15 Å17



SKAGERRAK Coast 2014-02-08

———— P2 - - - - - Släggö

