

Rapport från SMHIs utsjöexpedition med R/V Aranda



Expeditionens varaktighet: 2016-03-15 - 2016-03-22
Undersökningsområde: Skagerrak, Kattegatt, Öresund, Egentliga Östersjön och Finska viken
Uppdragsgivare: SMHI samt Havs- och Vattenmyndigheten

SAMMANFATTNING

Under expeditionen, vilken ingick i det svenska havsövervakningsprogrammet, besöktes Skagerrak, Kattegatt, Öresund och egentliga Östersjön. Denna rapport är baserad på preliminära, endast delvis kvalitetskontrollerade data.

Temperaturen i den övre vattenmassan låg något över det normala i hela egentliga Östersjön. Vårblomningen hade startat i Västerhavet och sydvästra Östersjön. I sydvästra Östersjön var oorganiskt kväve helt förbrukat ner till 10 meter. Fosfathalterna i Östersjöns ytvatten, som tidigare varit förhöjda, var nu normala för årstiden. Koncentrationen av silikat var fortfarande högre än normalt i västra- och östra Gotlandsbassängen.

Vid Gotlandsdjupet BY15 uppmättes inget svavelväte i bottenvattnet men mycket låga syrgaskoncentrationer observerades. Vid 225 meter hade syrgaskoncentrationen sjunkit med 0,5 ml/l, till 1,02 ml/l, sedan förra mättillfället i februari. I västra Gotlandsbassängen återfanns helt syrefria förhållanden, då svavelväte bildas, från 90 meter medan akut syrebrist, <2 ml/l, förekom från 80 meter. I Hanöbukten observerades akut syrebrist endast närmast botten. Syrerikt bottenvatten har nått de sydvästra och södra delarna av Östersjön.

Nästa ordinarie expedition är planerad starta 18:e april.

PRELIMINÄRA RESULTAT

Expeditionen genomfördes ombord det finska forskningsfartyget Aranda och startade i Helsingfors den 15:e mars samt avslutades i samma hamn den 22:e. Vindarna under expeditionen var i huvudsak svaga från sydväst. Lufttemperaturen varierade mellan 0 och +5°C.

Under expeditionen deltog även forskare från Lunds universitet som samlade in vattenprover för analys av kiselisotoper. Med ombord var också forskare från SYKE för interkalibrering mellan SMHI och SYKE.

Skagerrak

Temperaturen i ytvattnet var normal för årstiden och varierade mellan 4,0 och 5,0 °C, lägst vid kusten och högst i utsjön. Ytsalthalten i yttre Skagerrak var normal för årstiden och lägre än normalt vid kusten, salthalten varierade mellan 16,7 och 31,6. Skiktningen, både när det gäller temperatur och salthalt, var väl utvecklad. I yttre delarna låg skiktningen kring 10-20 m och grundare närmare kusten.

Vårblomningen hade startat och samtliga närsalter var nästan helt uttömda ner till 5 meter i hela Skagerrak. I ytvattnet låg halterna av fosfat i intervallet under detektionsgränsen (0,02 µmol/l) – 0,06 µmol/l, oorganiskt kväve (nitrit + nitrat) kring detektionsgränsen (0,1 µmol/l) medan silikat varierade från detektionsgränsen (0,1 µmol/l) i utsjön till 0,8 µmol/l nära kusten. Bottenvattnet var väl syresatt, även vid Släggö i Gullmarsfjordens mynning. Fluorescensmätningarna visade på hög biologisk aktivitet i ytlagret. För mer detaljer rörande algsituationen se separat rapport AlgAware.

Kattegatt och Öresund

Temperaturen i ytvattnet var normal för årstiden och varierade mellan 3,7 och 4,5°C. Salthalten i ytlagret var lägre än normalt för årstiden och varierade mellan 17,2 – 13,0. I Öresund var salthalten omkring 9 vilket också är lägre än normalt. I den norra delen återfanns en stark skiktning kring 5-10 meter. I den södra delen låg skiktningen något djupare, kring 15 meter. I Öresund återfanns en stark skiktning på 10-15 meters djup.

Vårblomningen var i full gång i hela Kattegatt och Öresund, vilket är normalt för årstiden, och samtliga närsalter i ytvattnet hade sjunkit sedan februari och låga koncentrationer uppmättes. Fosfatkoncentrationerna låg nu mellan 0,08 och 0,12 µmol/l, summa nitrit+nitrat var under detektionsgränsen (<0,1 µmol/l), och silikat varierade mellan 1,0 och 2,3 µmol/l. I Öresund var koncentrationen av fosfat något högre, 0,29 µmol/l. Syreförhållandena i djupvattnet var goda och lägsta koncentrationen uppmättes i Öresund, 5,06 ml/l. Vid framför allt Anholt E visade fluorescensmätningarna på hög planktonaktivitet.

Egentliga Östersjön

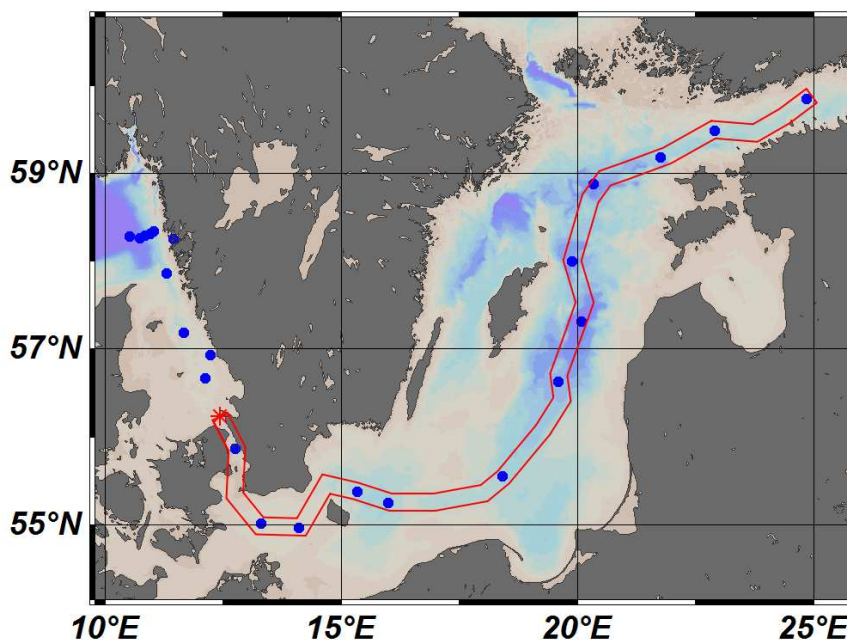
Temperaturen i vattenmassan över språngskiktet var något högre än normalt i hela området och varierade från 2,4°C till 4,2°C. Ytsalthalten var också generellt något förhöjd i hela området och varierade mellan 6,4 i norra delen till 8,4 i den sydvästra delen. Haloklin och termoklin sammanföll och återfanns på 50-70 meters djup i västra- och på 70-80 meters djup i östra- och norra Gotlandsbassängen samt de södra delarna. I norra och sydvästra delarna fanns även en svag skiktning kring 10-15 meter.

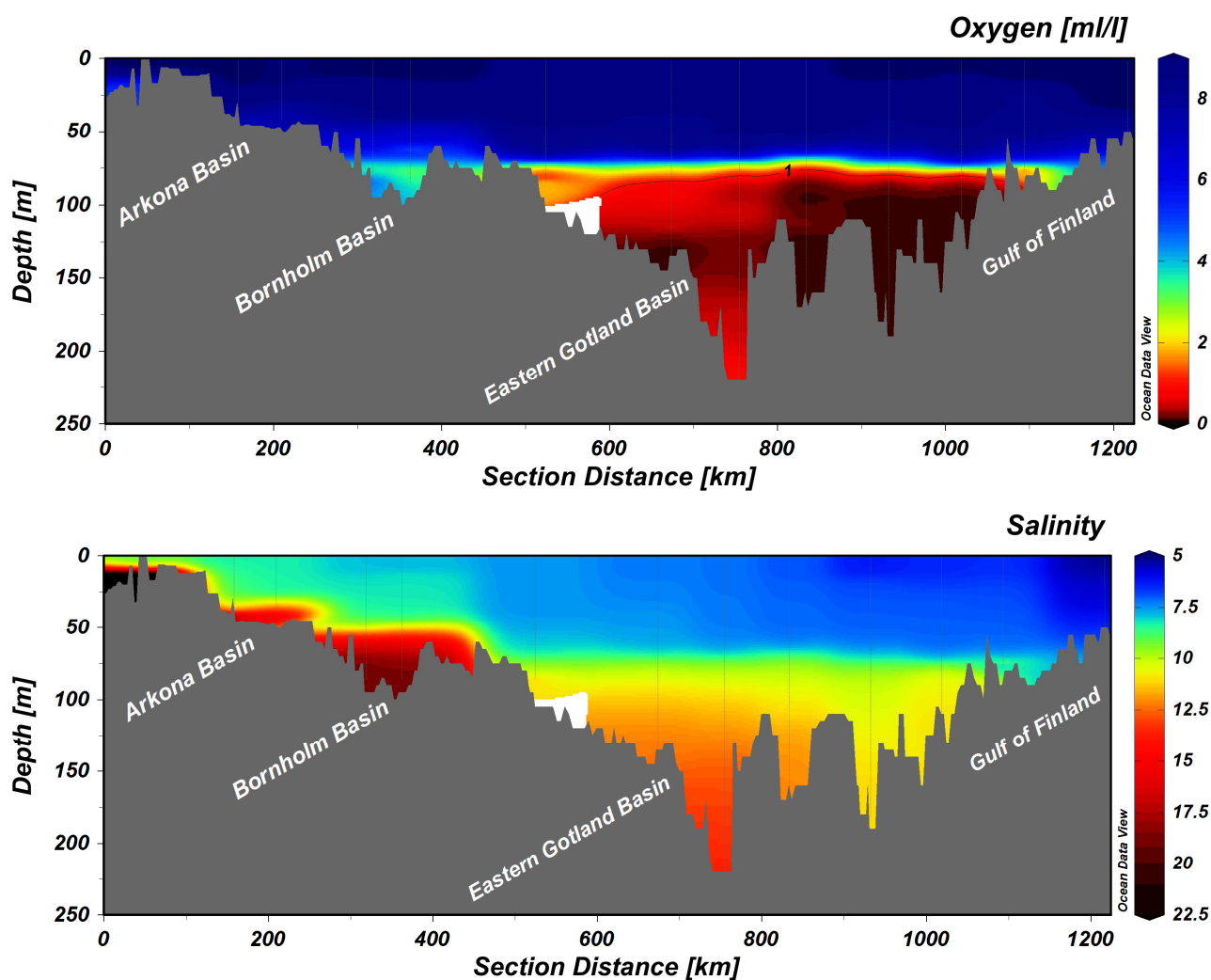
Närmast botten i södra Östersjön vid station BCSIII-10 fanns ett tunt skikt med varmare och saltare vatten. Detta skikt hade även ett högre syreinhåll.

Närsalterna, främst fosfat och oorganiskt kväve, var nu generellt lägre än i februari. Vårblomningen var i full gång i Arkona- och Bornholmsbassängen samt i Hanöbukten där oorganiskt kväve var helt uttömt ner till 10 meter. Fosfathalterna i ytvattnet, som tidigare varit förhöjda, var nu normala för årstiden i hela det undersökta området och varierade mellan 0,47 och 0,71 $\mu\text{mol/l}$. Halterna av nitrit+nitrat var normala i östra- och västra Gotlandsbassängen samt i de södra delarna och variationen var mellan 1,2 till 3,0 $\mu\text{mol/l}$. I sydvästra Östersjön var oorganiskt kväve däremot lägre än normalt och under detektionsgränsen ($<0,1 \mu\text{mol/l}$). Koncentrationen av silikat var fortfarande högre än normalt i västra- och östra Gotlandsbassängen medan de var normala i de södra och sydvästra delarna. Halterna varierade mellan 6,8 och 17,4 $\mu\text{mol/l}$.

Vid Fårödjupet var det akut syrebrist från 70 meter och svavelväte från 150 meter. I östra Gotlandsbassängen observerades akut syrebrist ($< 2 \text{ ml/l}$) på djup överstigande 70-80 meter. Vid Gotlandsdjupet BY15 uppmättes inget svavelväte i bottenvattnet men mycket låga syrgaskoncentrationer observerades. Vid 225 meter hade syrgaskoncentrationen sjunkit med 0,5 ml/l till 1,02 ml/l sedan förra mättillfället i februari. I västra Gotlandsbassängen återfanns helt syrefria förhållanden, då svavelväte bildas, från 90 meter medan akut syrebrist, $<2 \text{ ml/l}$, förekom från 80 meter. I Hanöbukten observerades akut syrebrist endast närmast botten. Syrerikt bottenvatten har nått de sydvästra och södra delarna av Östersjön. Bornholmsbassängen hade 4,28 ml/l på 88 meter och stationen BCSIII-10 hade 3,14 ml/l på 89 meter. Vid förra mättillfället i februari var det akut syrebrist i Bornholmsbassängen och något lägre syrgashalter vid BCSIII-10.

Fluorescensmätningarna visade på biologisk aktivitet i ytlagret i hela Östersjön.





Figur 1. Snitt som visar syre- och salthalt genom Egentliga Östersjön från Öresund till Finska viken.

DELTAGARE

Namn

Örjan Bäck / Karin Wesslander Expeditionsledare
 Jenny Lycken
 Johan Kronsell
 Sari Sipilä
 Kristin Andreasson
 Ilkka Lastumäki
 Jere Riikonen
 Carla Nantke
 Zhouling Zhang

Från

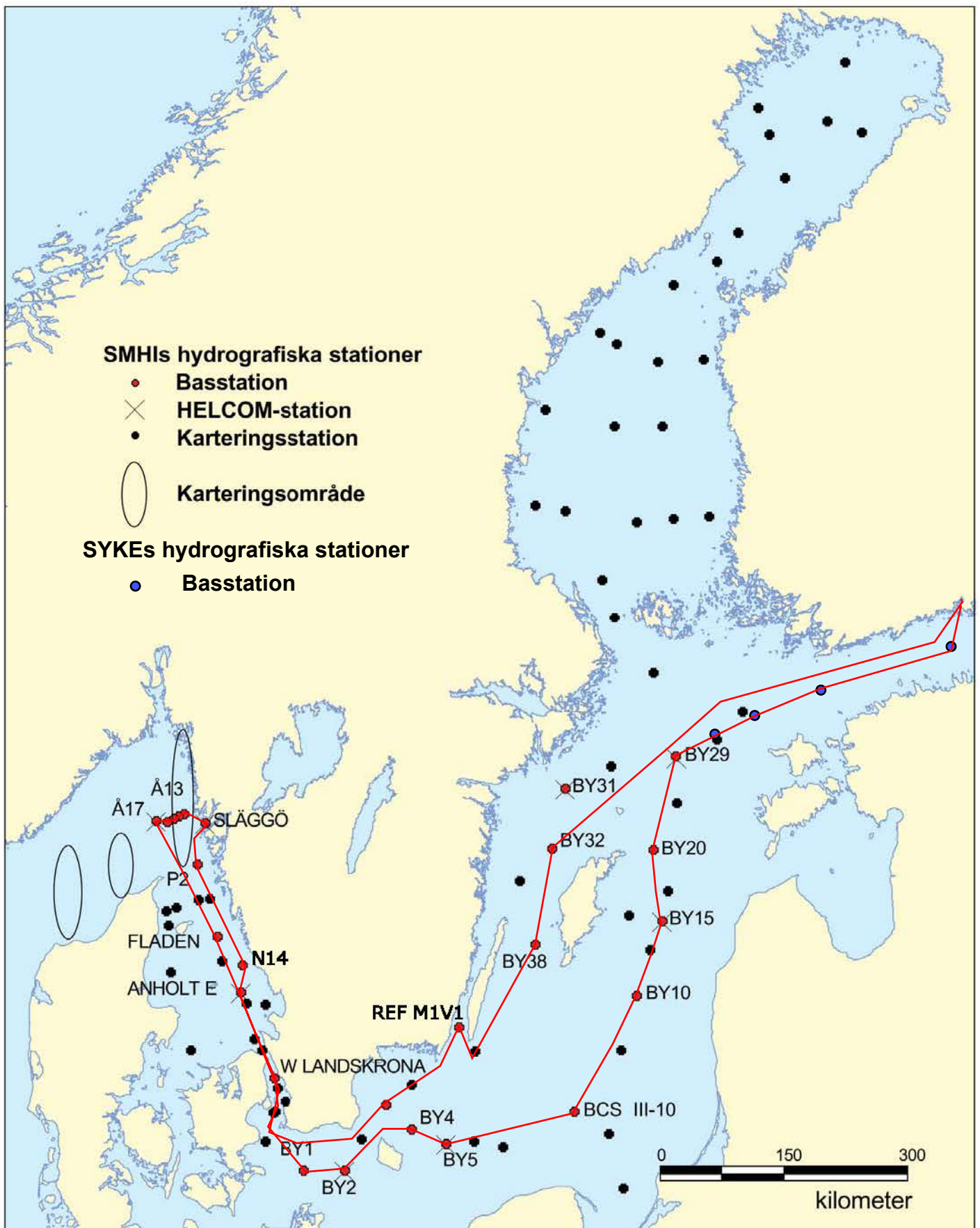
SMHI
 SMHI
 SMHI
 SMHI
 SMHI
 SYKE
 SYKE
 Lunds universitet
 Lunds universitet

BILAGOR

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

TRACKCHART

Country: Sweden
 Ship: R/V ARANDA
 Date: 20160315-20160322
 Series: 0152-0179



Date: 2016-03-22
Time: 05:12

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 t aoae tu hd	C PPCPZZT Hrhhoor Cillyooa motPBw PrP l	No de	T e a h x m l y p i g	P O H P T N N N T A S H L P P T C	O o o o o o o o o o o o o o o o o m g n c c m
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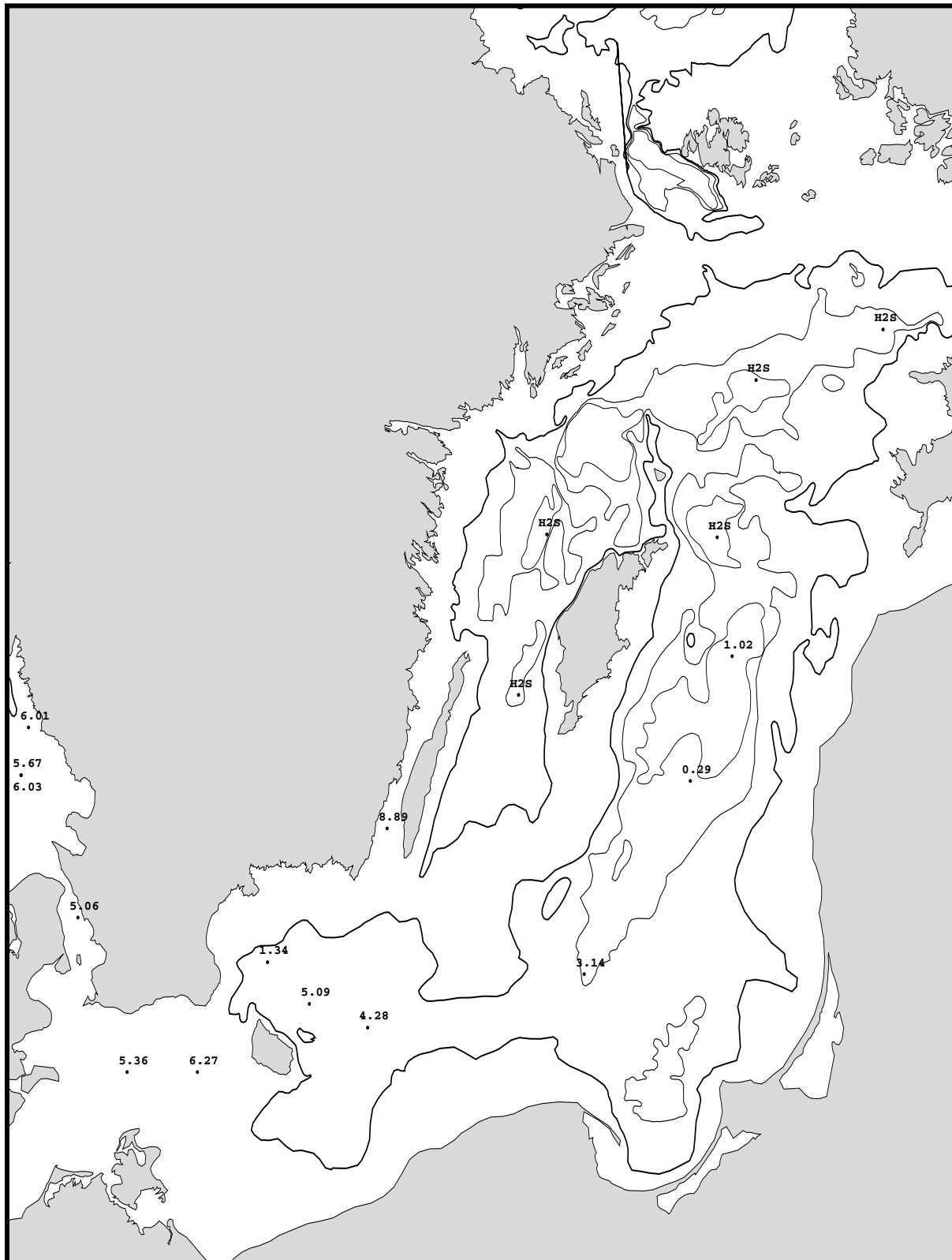
Bottom water oxygen concentration (ml/l)

Country: Finland

Ship : Aranda

Date : 20160315-20160321

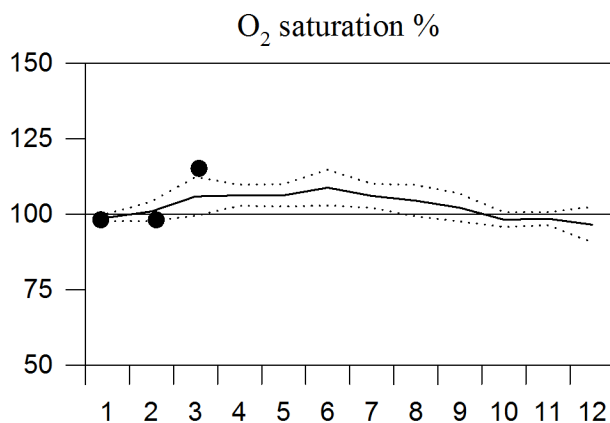
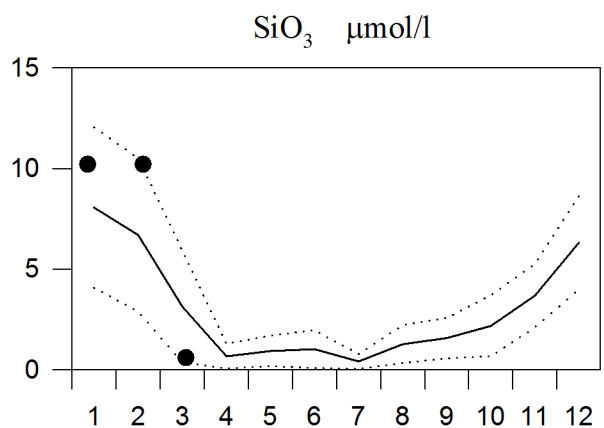
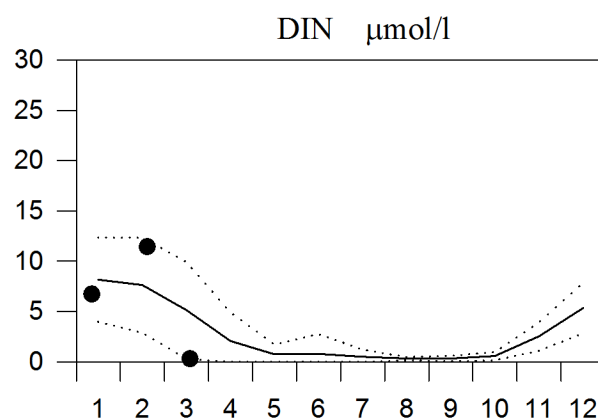
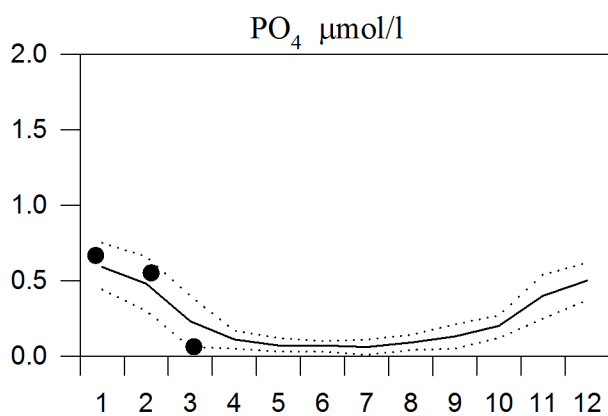
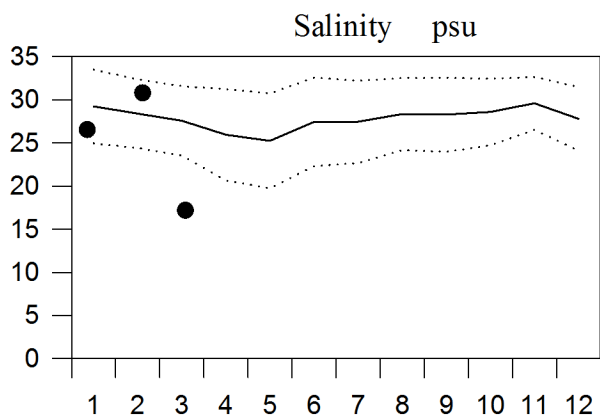
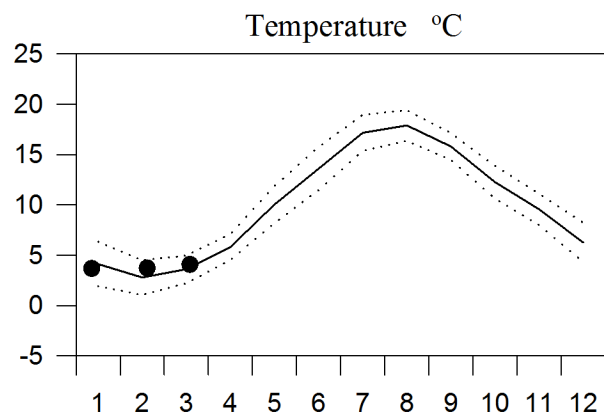
Series : 0152-0179



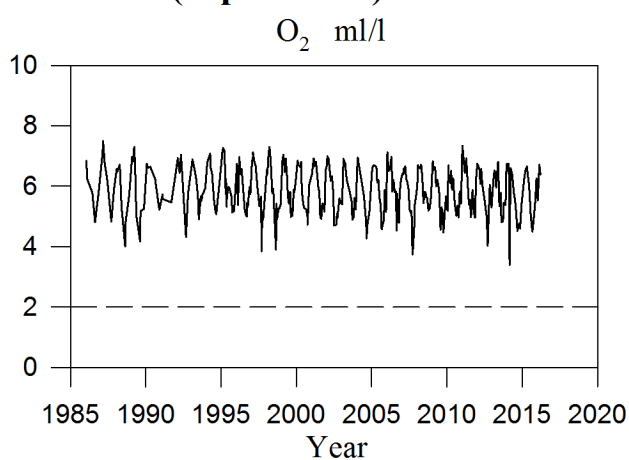
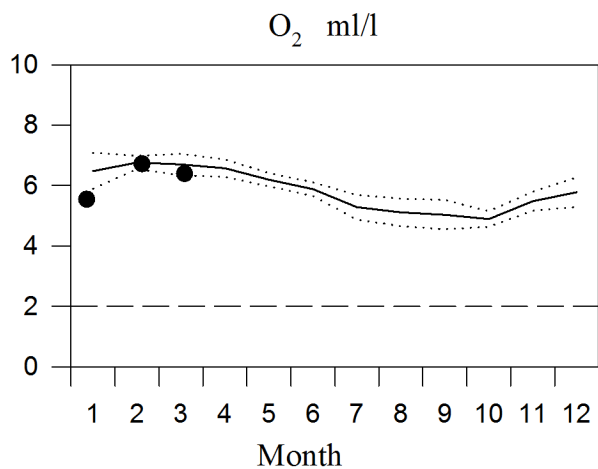
STATION P2 SURFACE WATER

Annual Cycles

— Mean 1996-2010 St.Dev. ● 2016

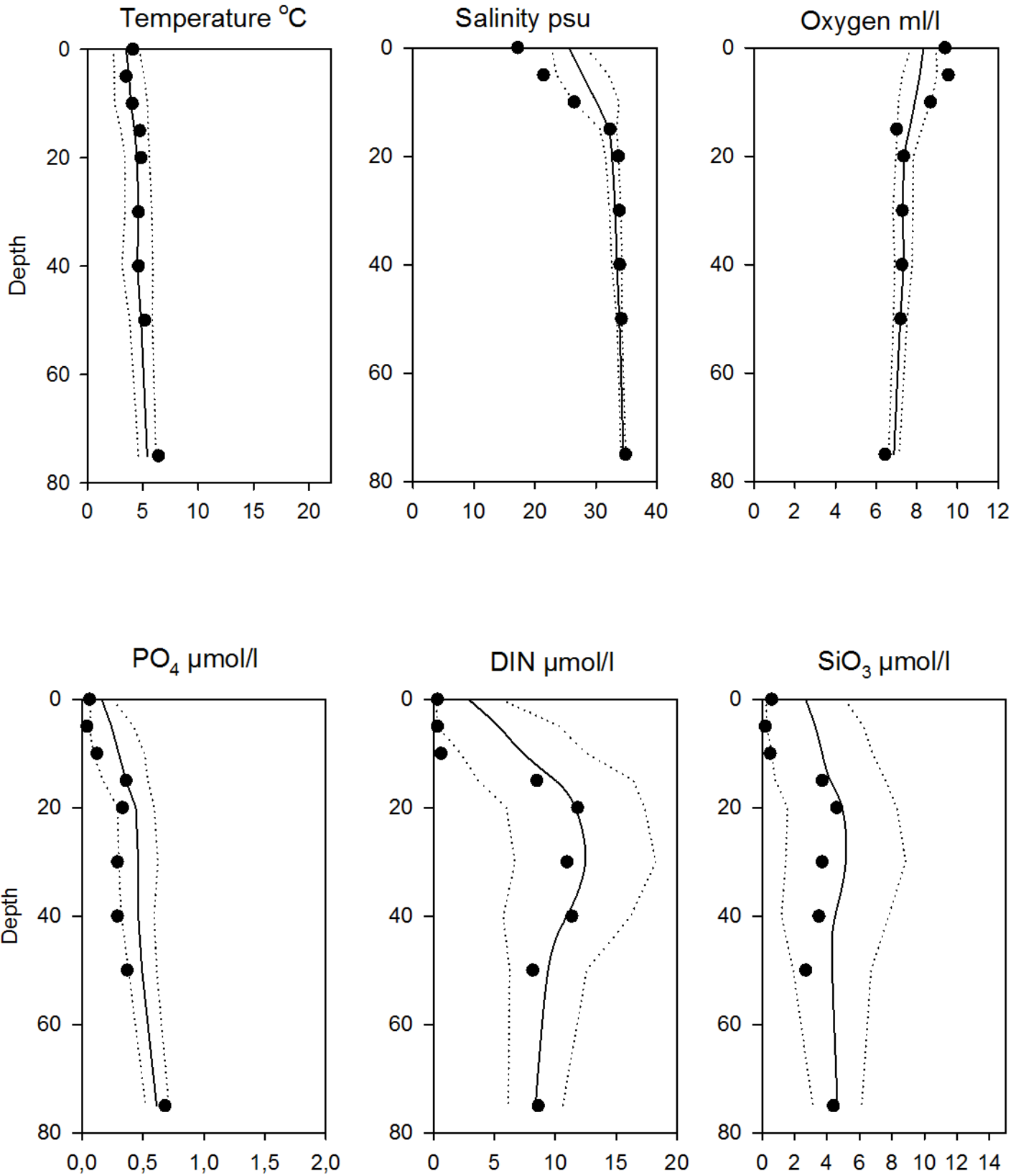


OXYGEN IN BOTTOM WATER (depth >75m)



Vertical profiles P2 March

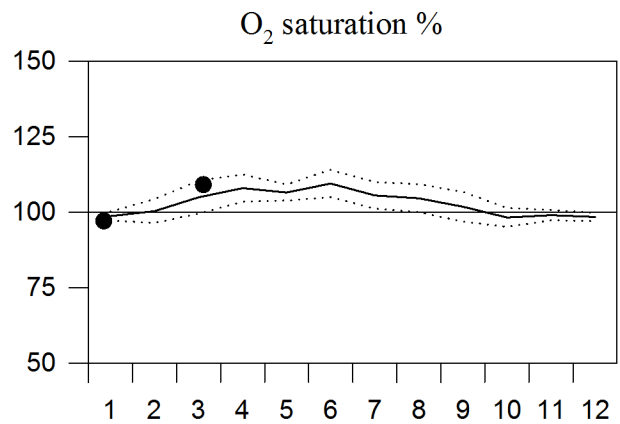
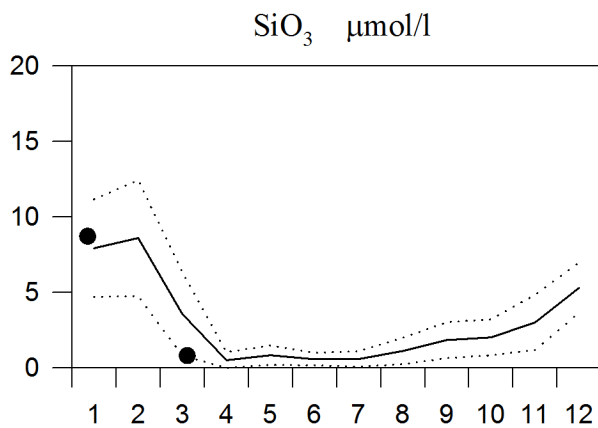
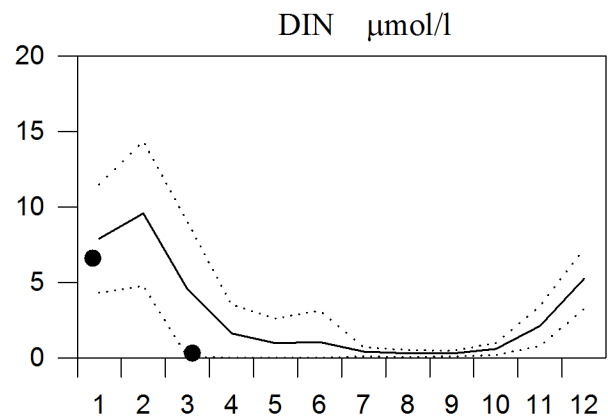
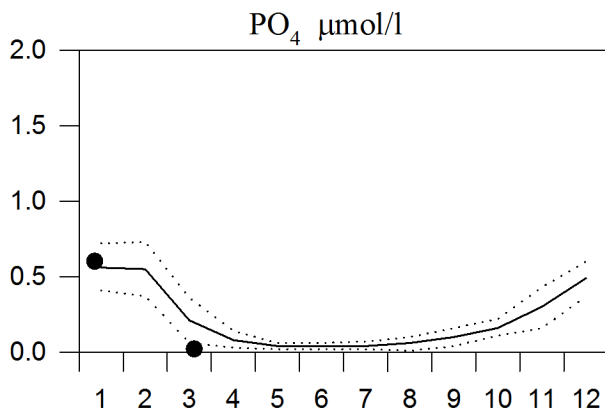
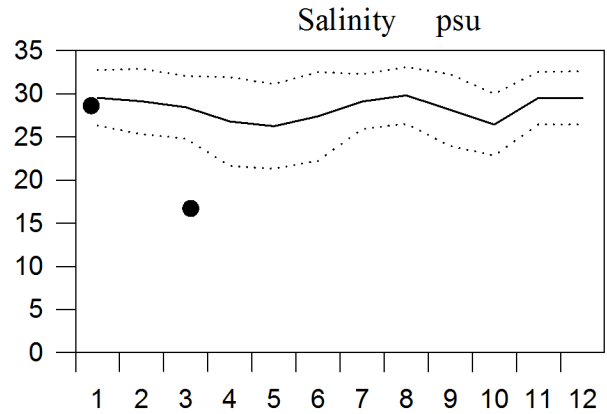
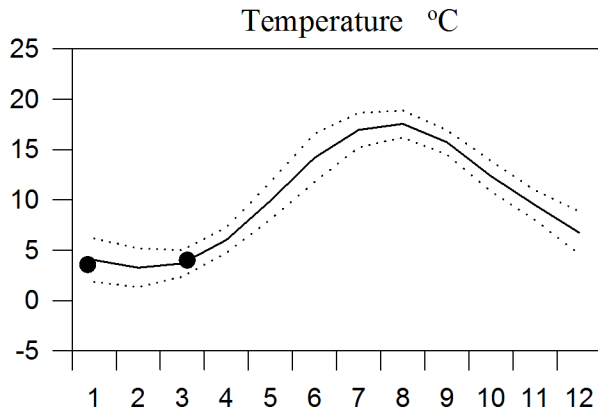
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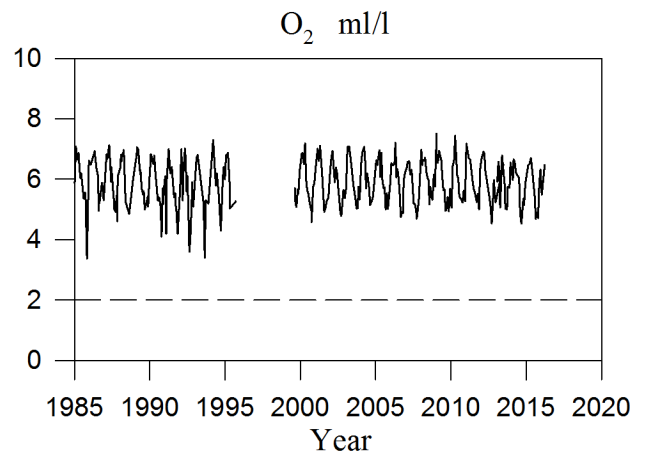
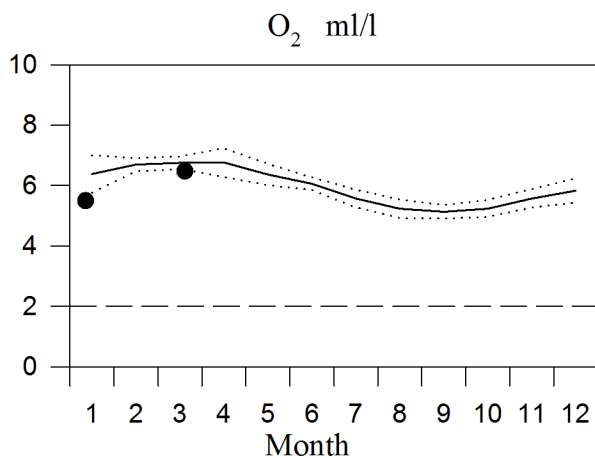
STATION Å13 SURFACE WATER

Annual Cycles

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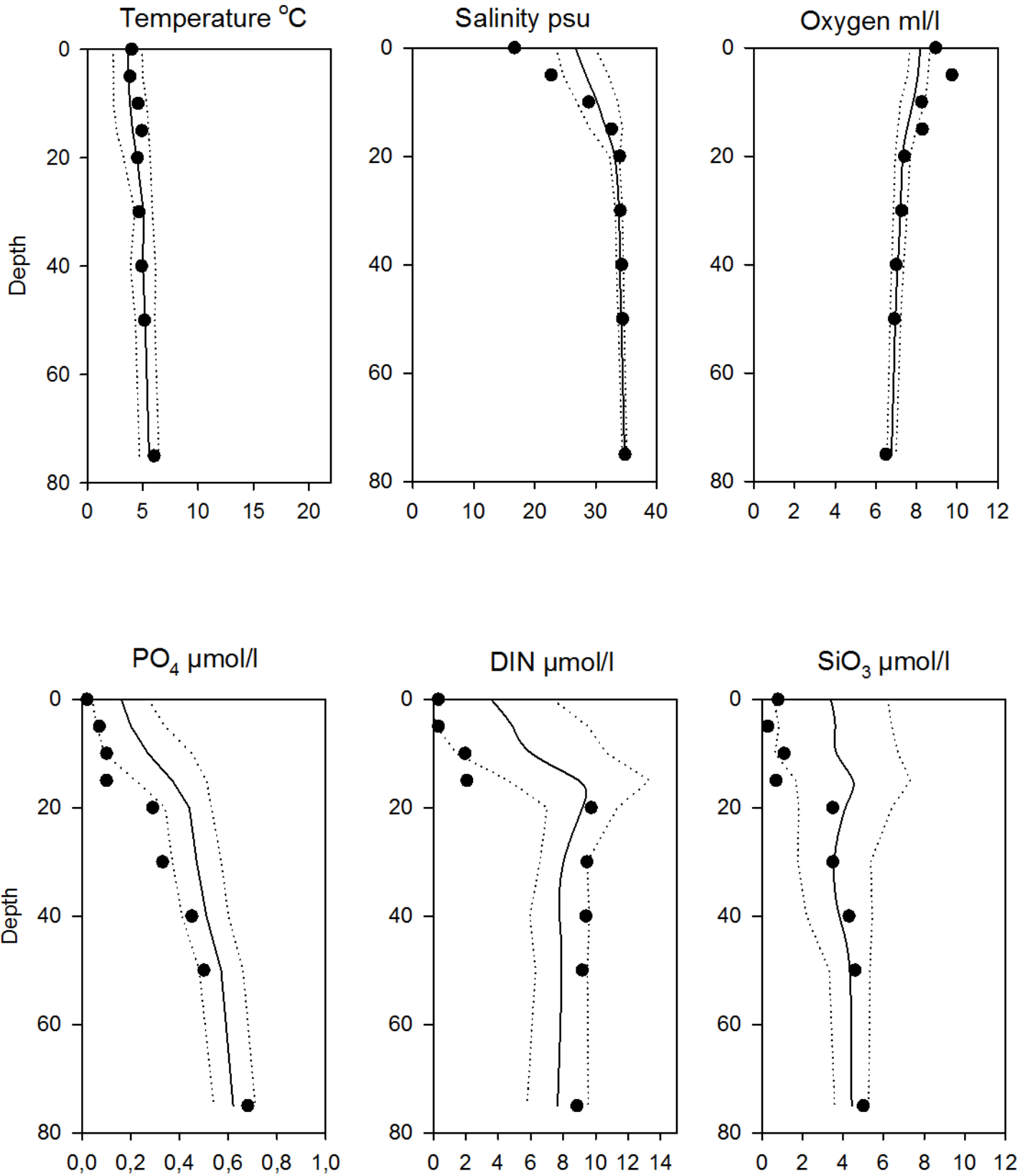


OXYGEN IN BOTTOM WATER (depth >=75m)



Vertical profiles Å13 March

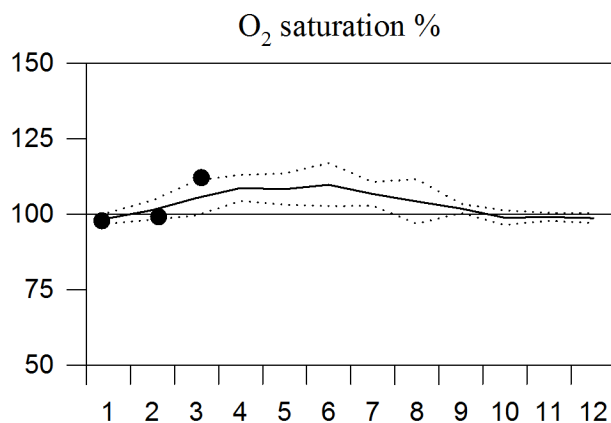
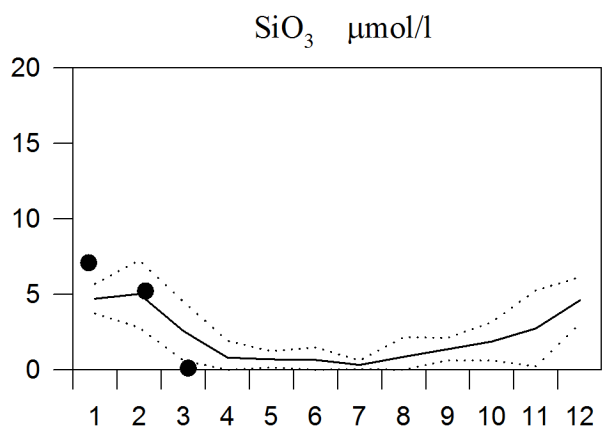
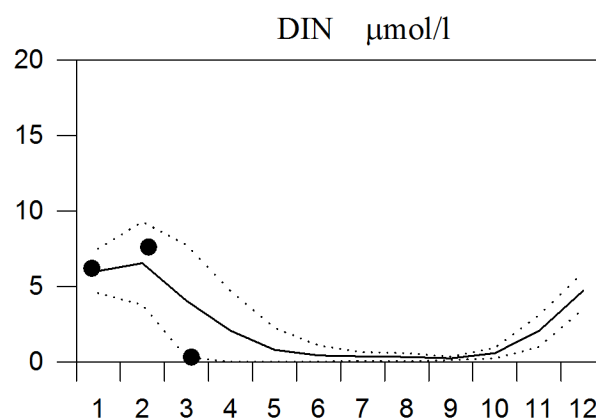
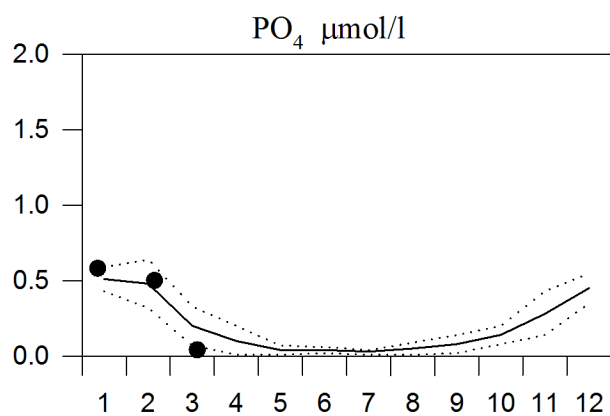
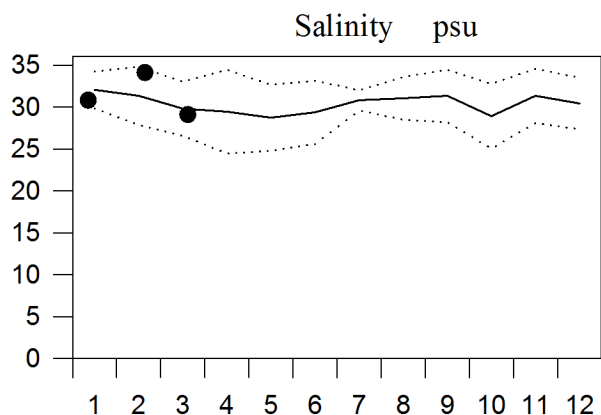
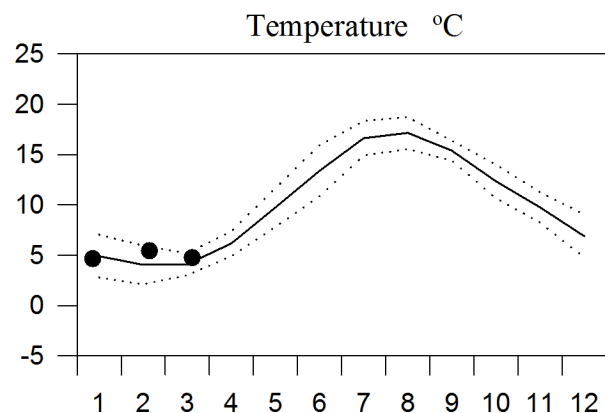
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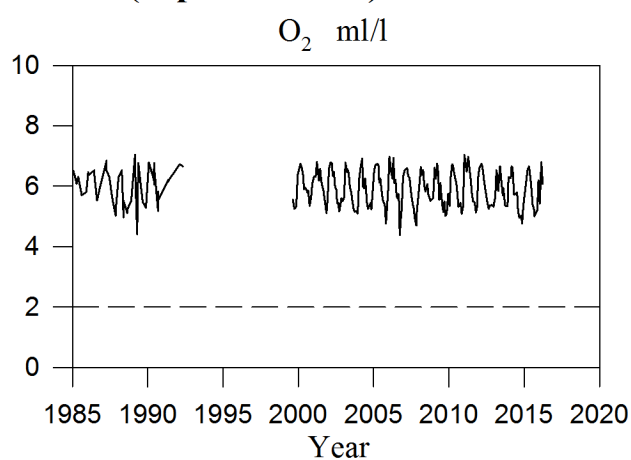
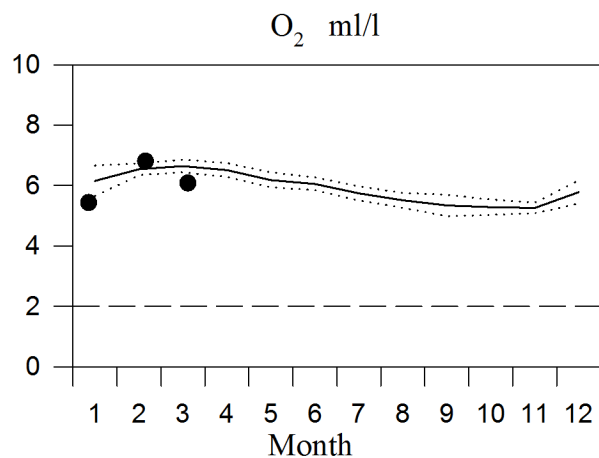
STATION Å15 SURFACE WATER

Annual Cycles

— Mean 1996-2010 St.Dev. ● 2016

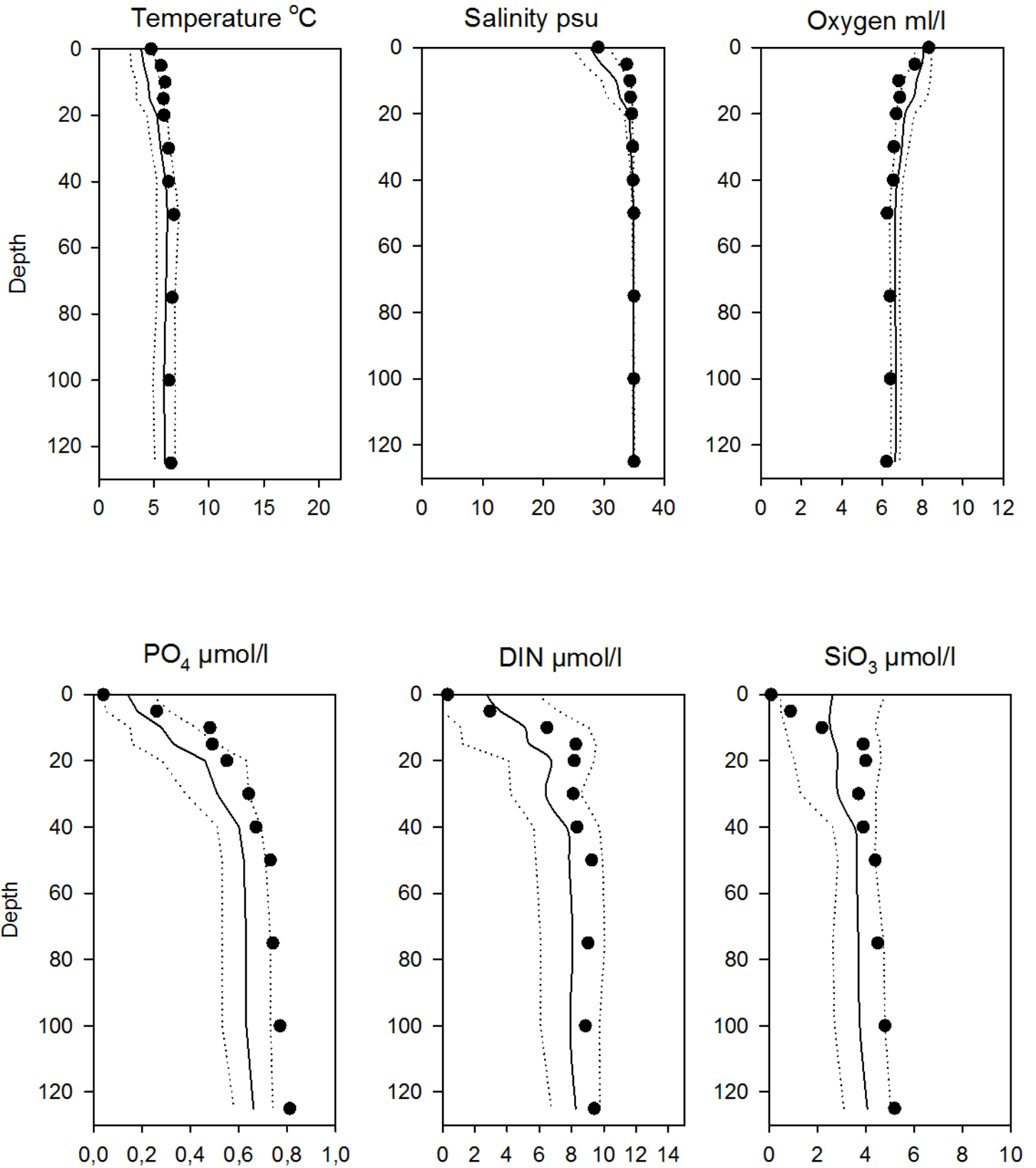


OXYGEN IN BOTTOM WATER (depth >=125m)



Vertical profiles Å15 March

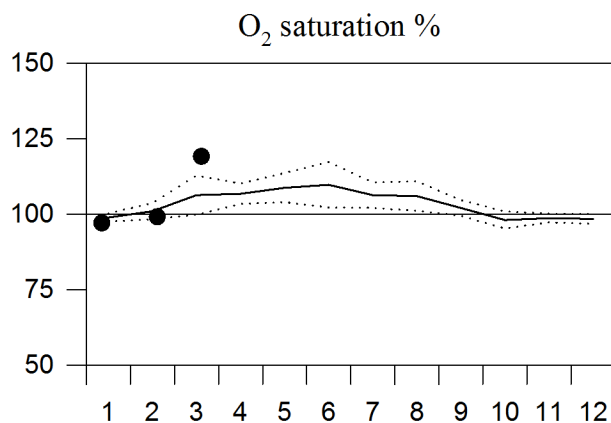
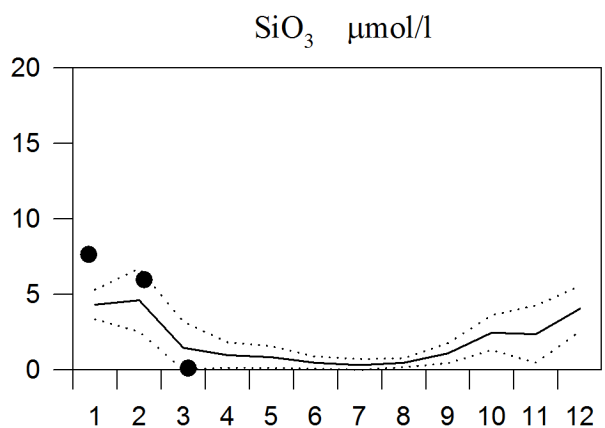
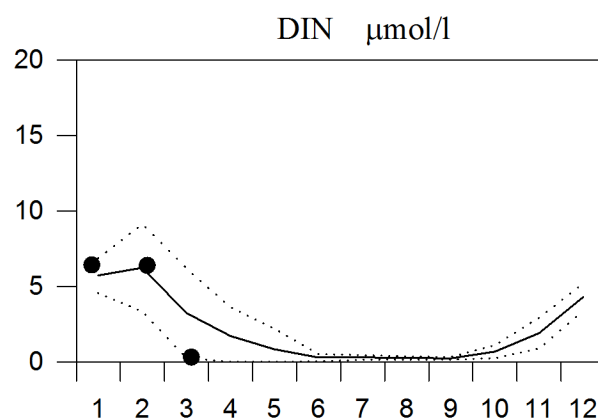
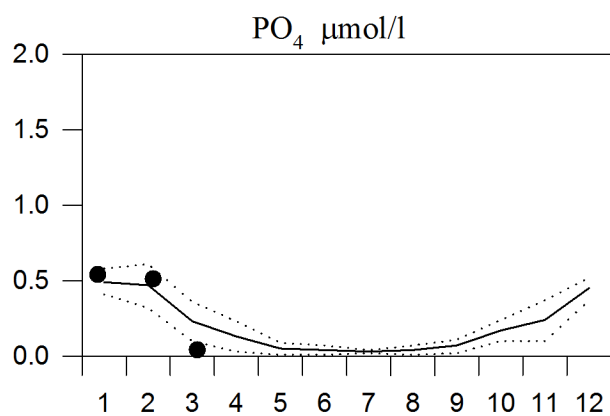
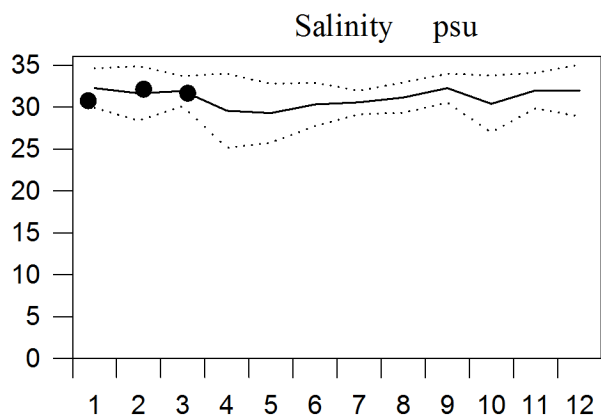
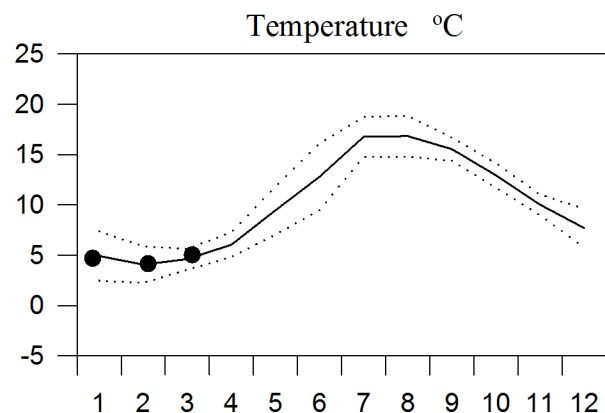
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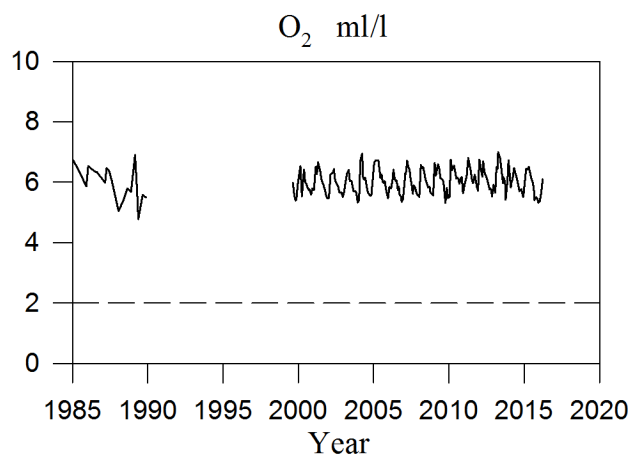
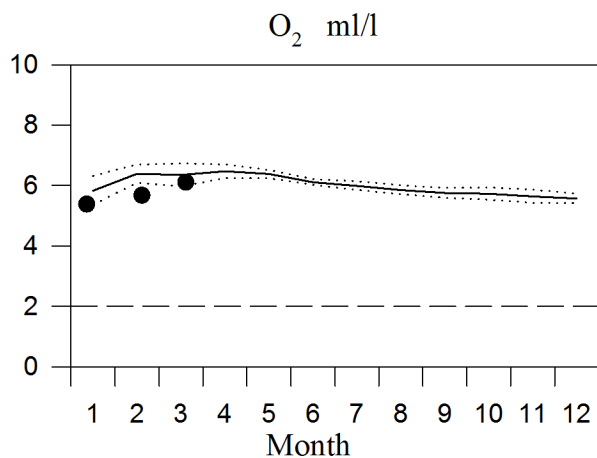
STATION Å17 SURFACE WATER

Annual Cycles

— Mean 1996-2010 St.Dev. ● 2016

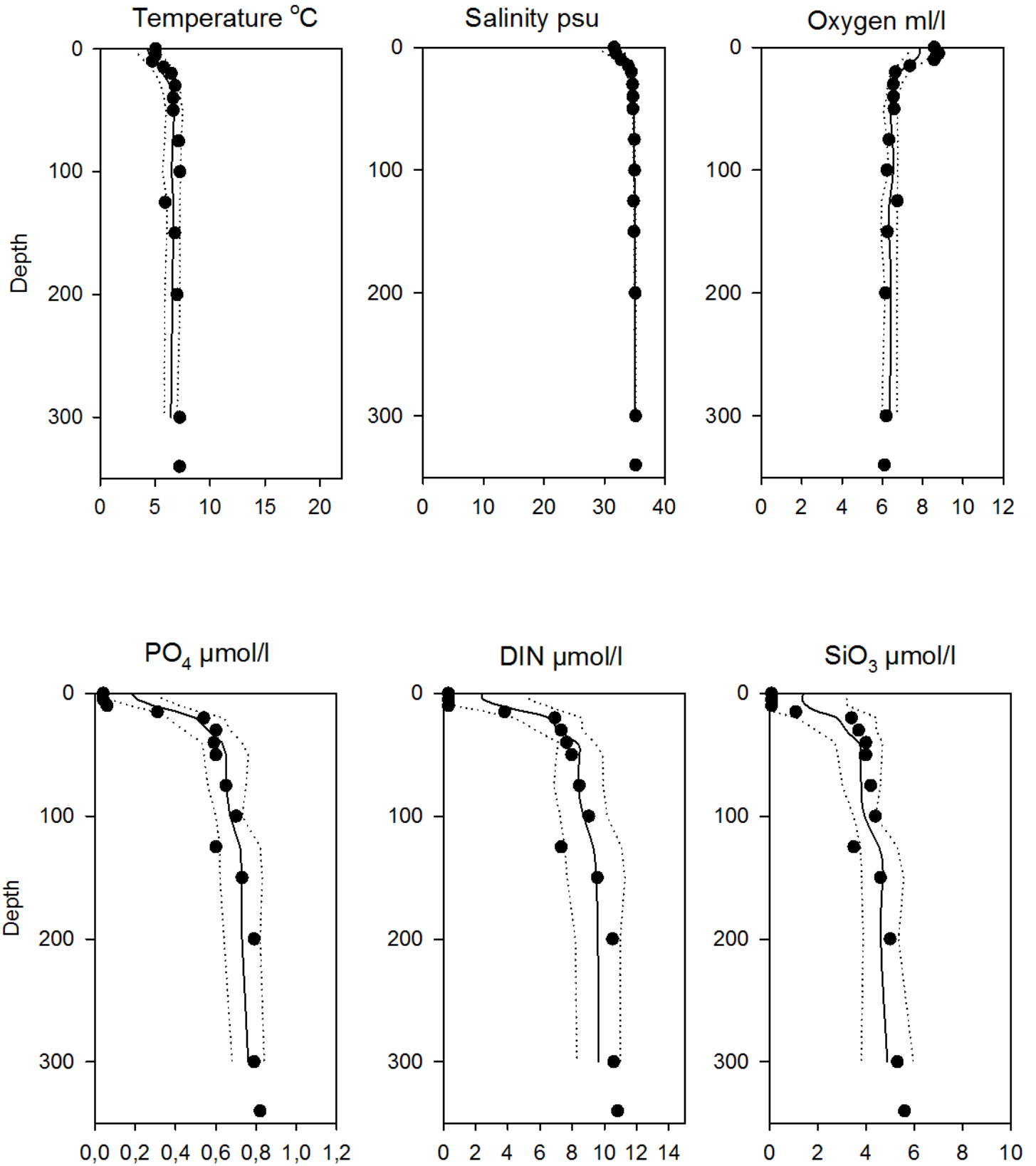


OXYGEN IN BOTTOM WATER (depth = 300m)



Vertical profiles Å17 March

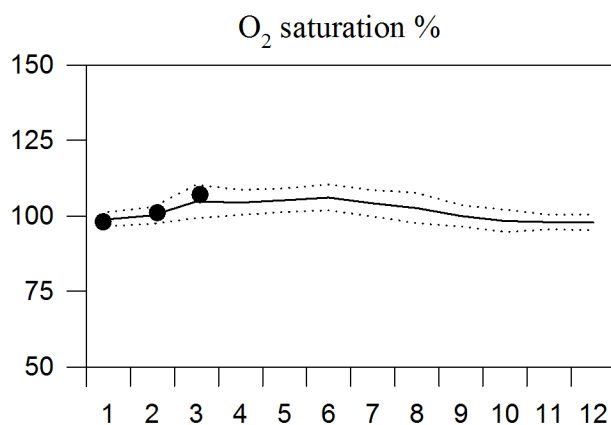
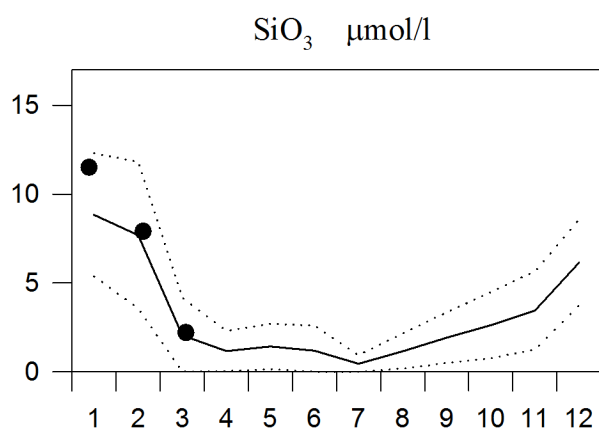
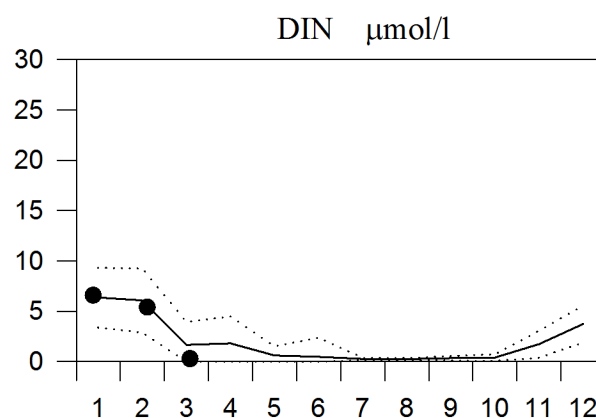
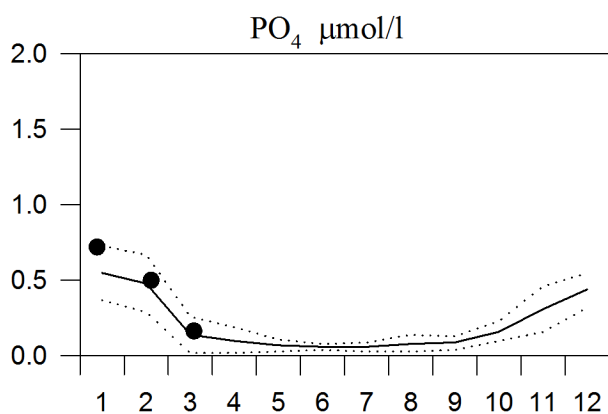
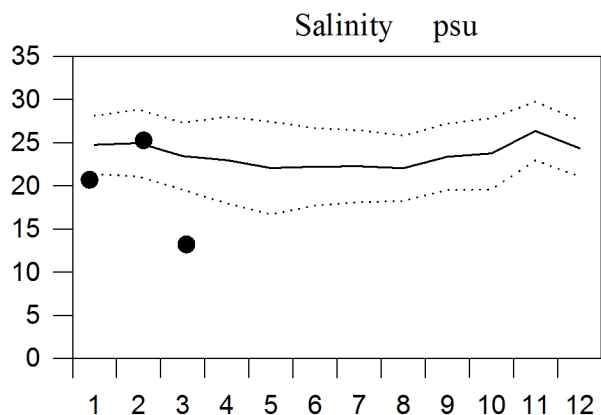
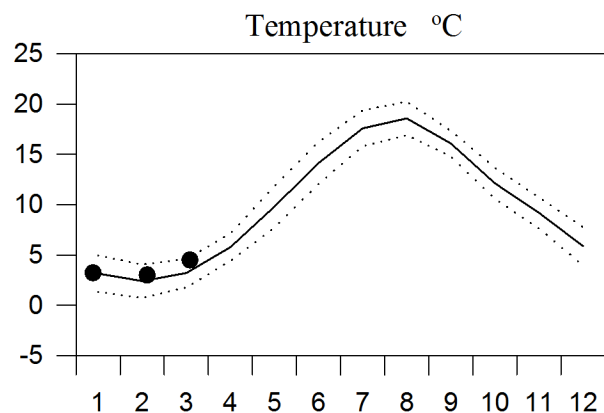
— Mean 1996-2010 St.Dev. ● 2016



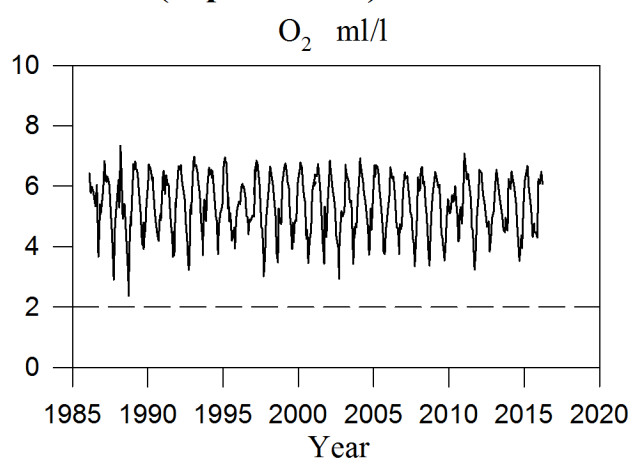
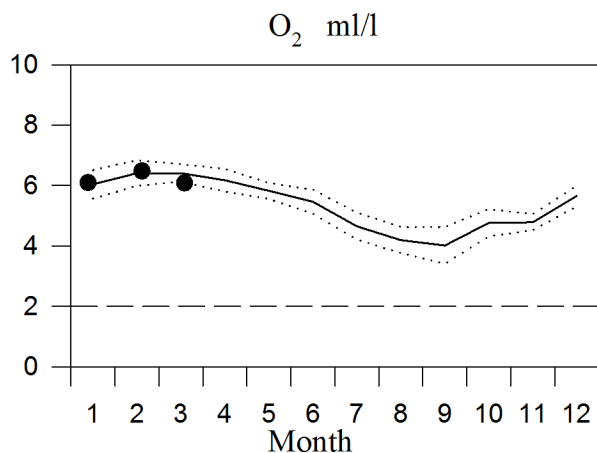
STATION FLADEN SURFACE WATER

Annual Cycles

— Mean 1996-2010 St.Dev. ● 2016

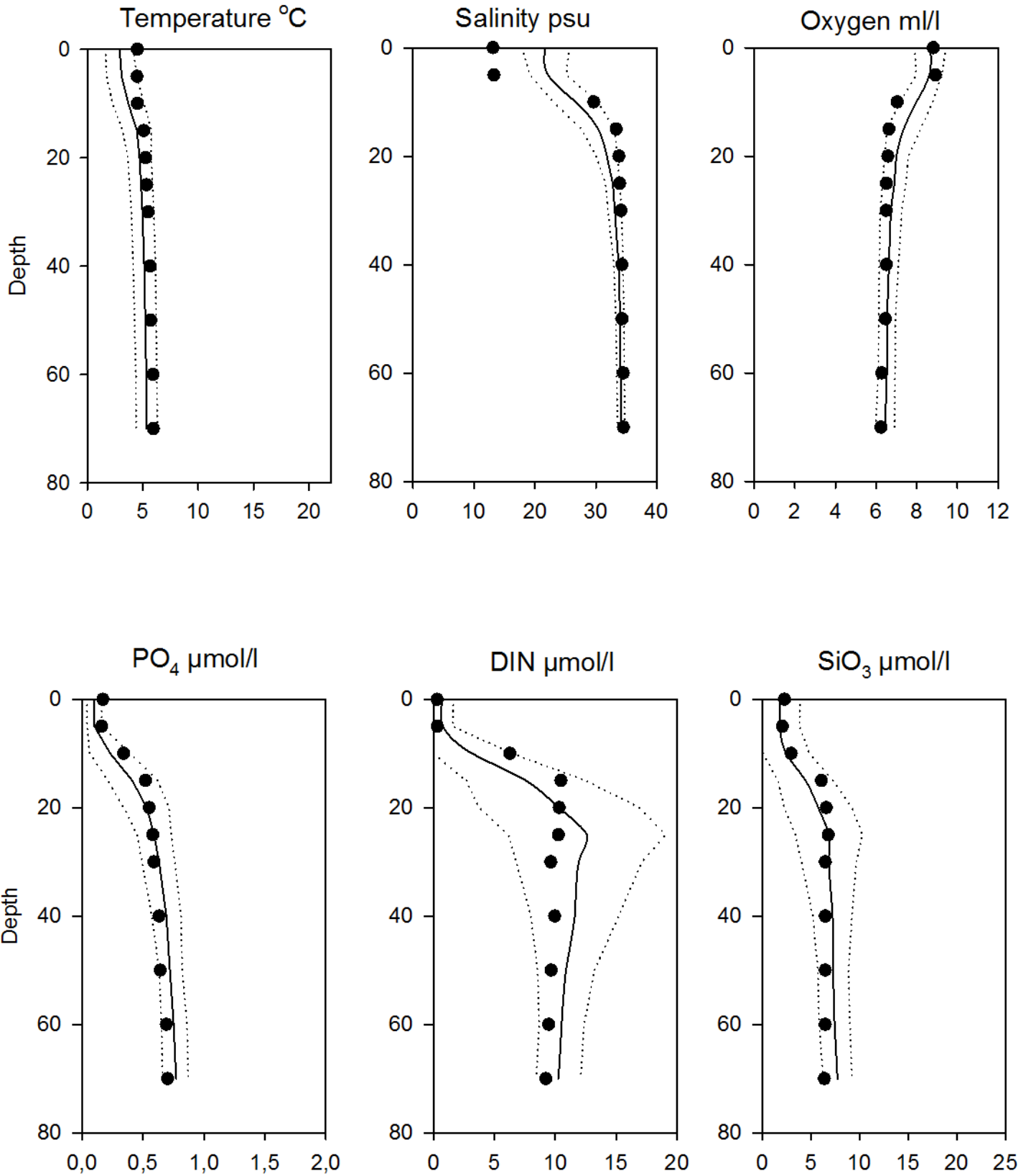


OXYGEN IN BOTTOM WATER (depth > 70m)



Vertical profiles Fladen March

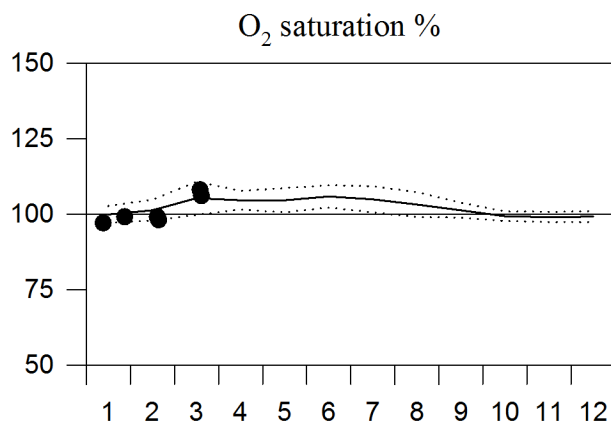
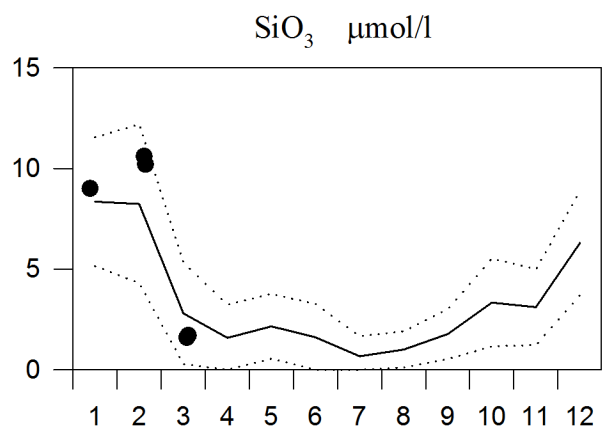
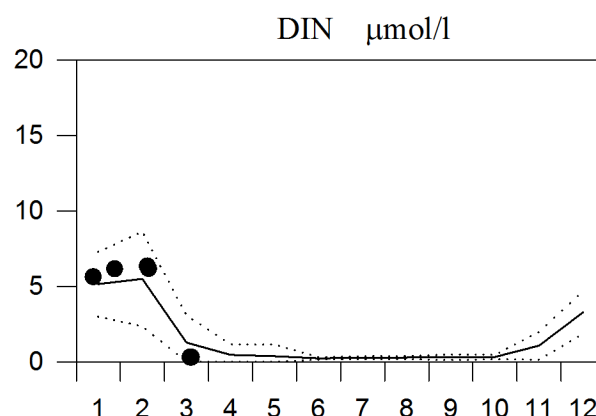
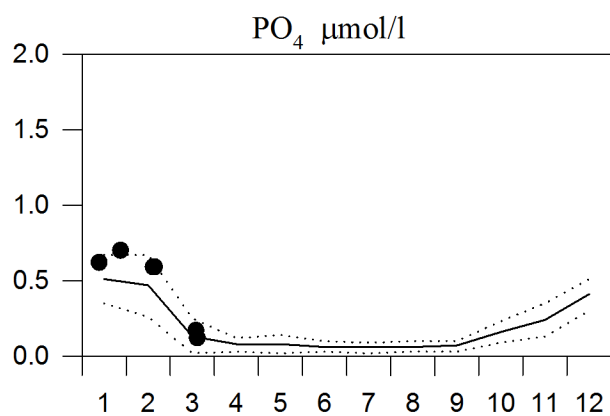
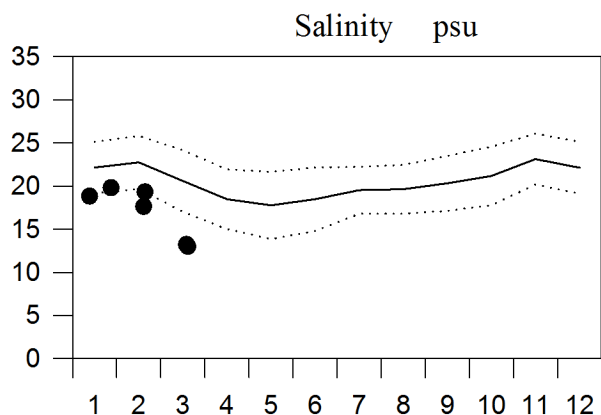
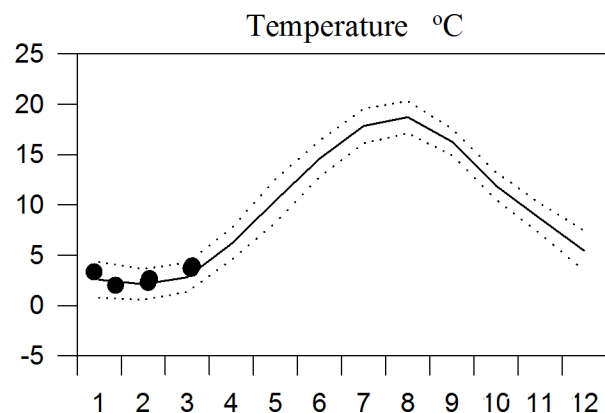
— Mean 1996-2010 St.Dev. ● 2016



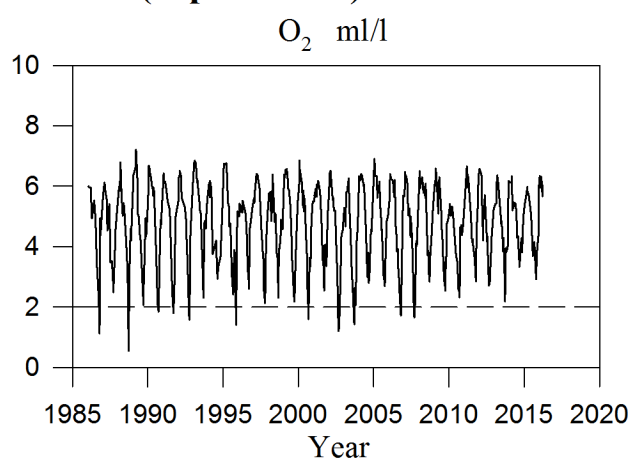
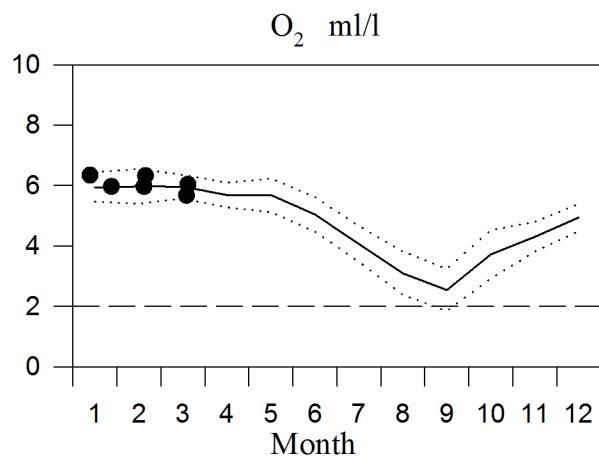
STATION ANHOLT E SURFACE WATER

Annual Cycles

— Mean 1996-2010 St.Dev. ● 2016

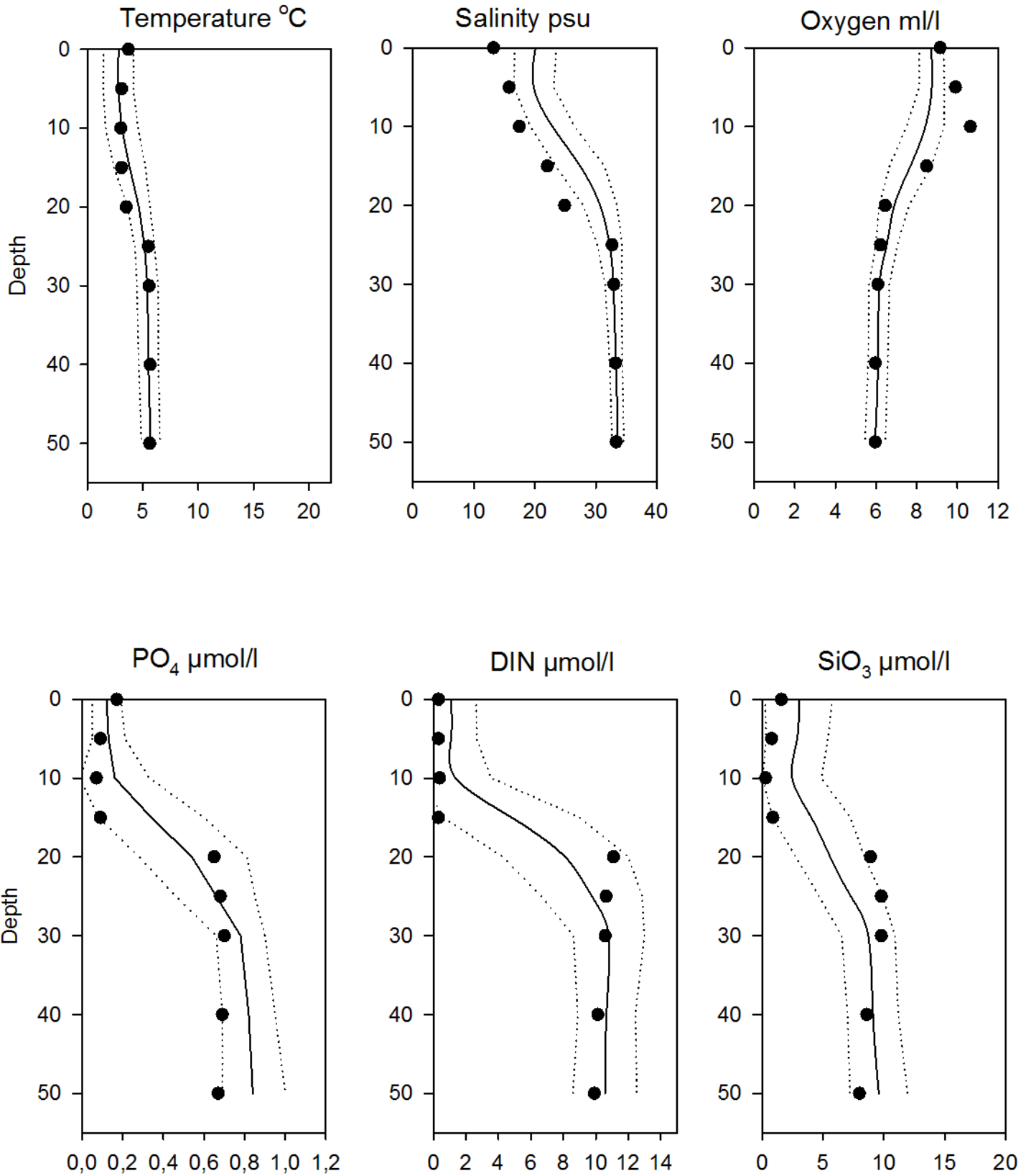


OXYGEN IN BOTTOM WATER (depth > 50m)



Vertical profiles Anholt E March

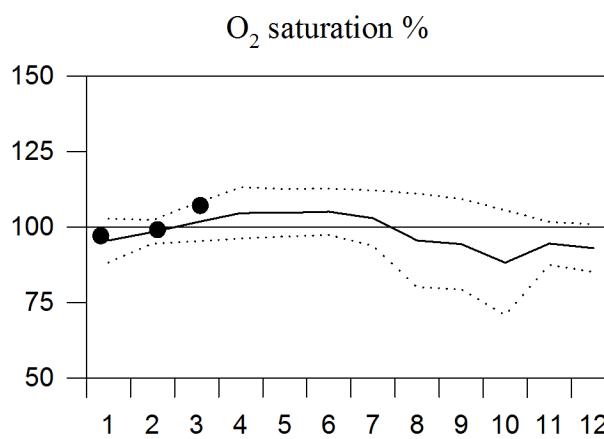
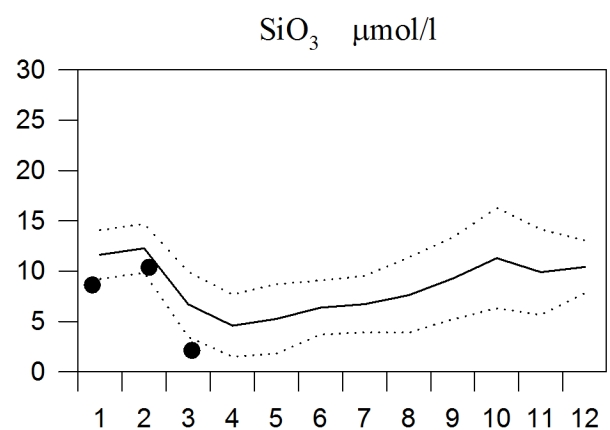
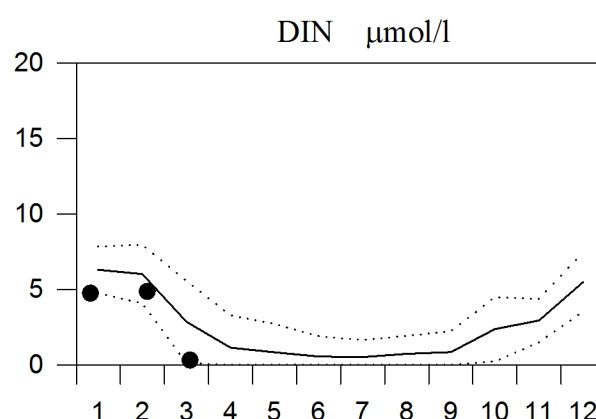
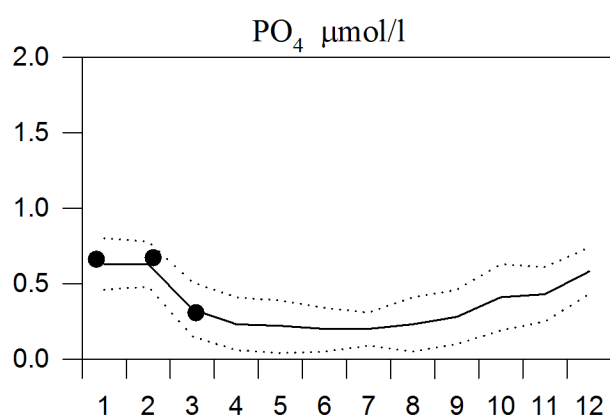
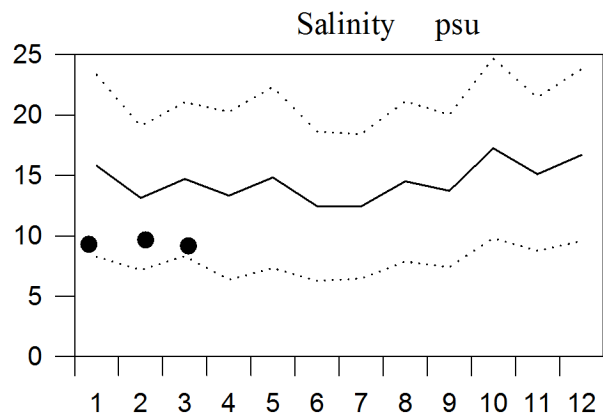
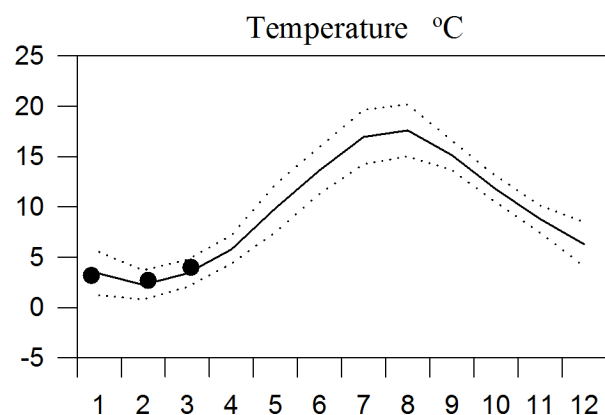
— Mean 1996-2010 St.Dev. ● 2016



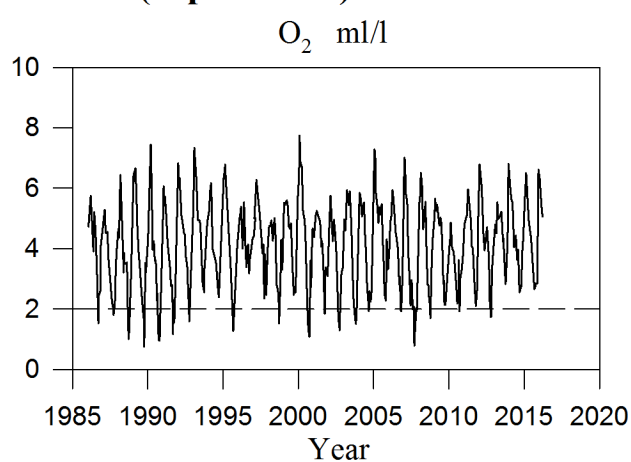
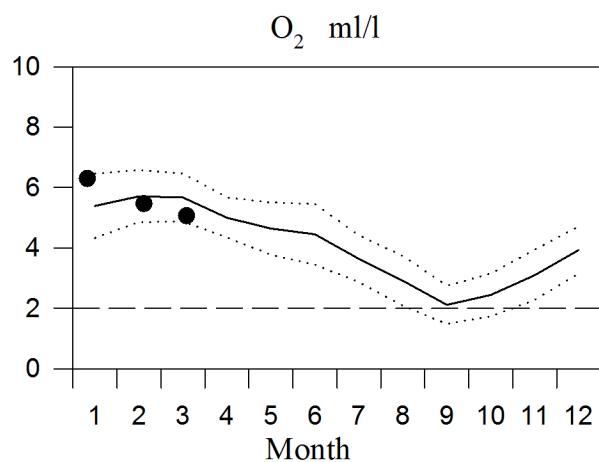
STATION W LANDSKRONA SURFACE WATER

Annual Cycles

— Mean 1996-2010 St.Dev. ● 2016

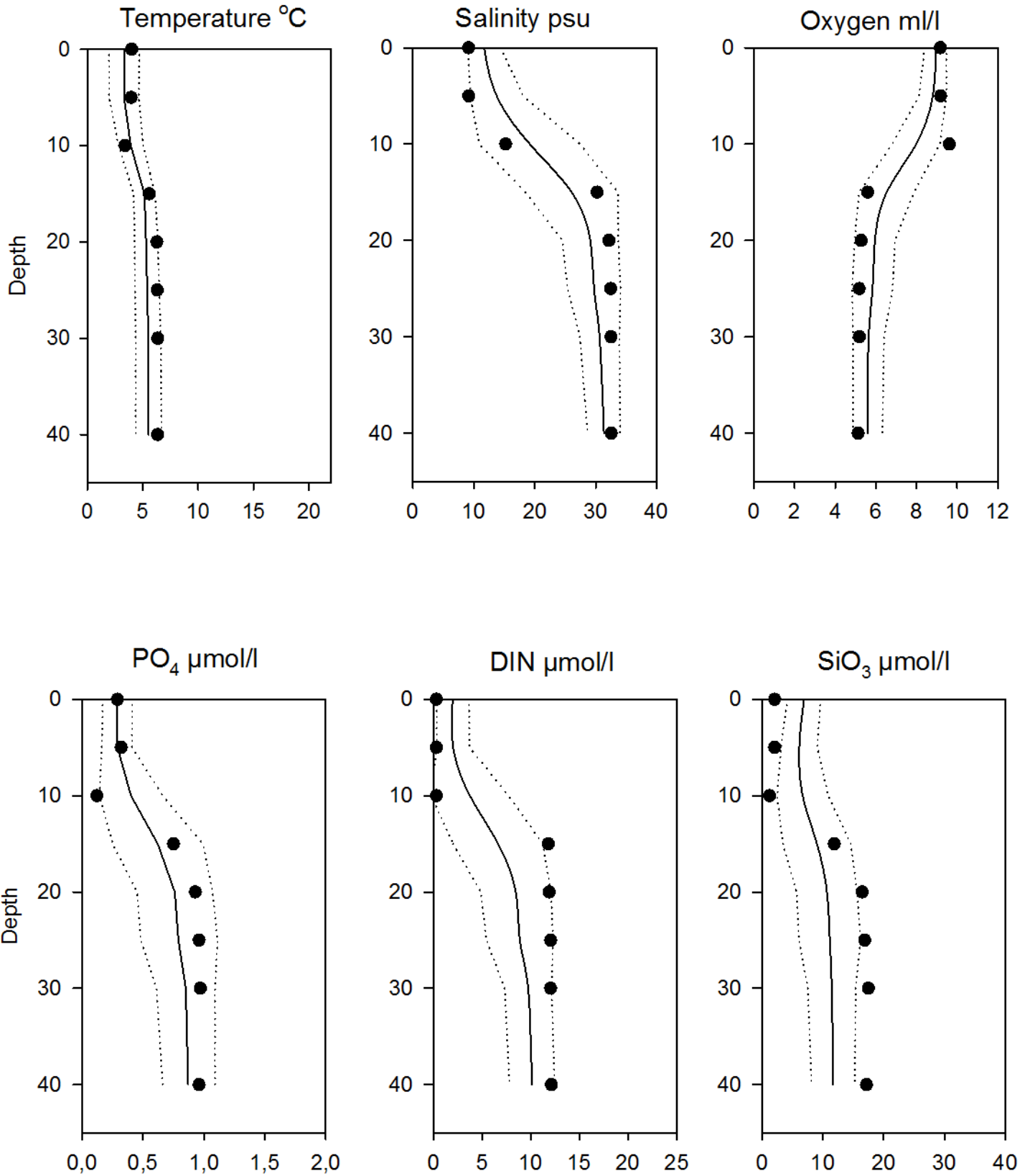


OXYGEN IN BOTTOM WATER (depth >40m)



Vertical profiles W Landskrona March

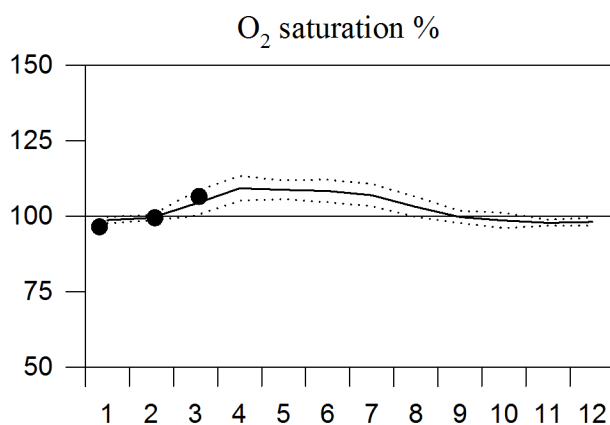
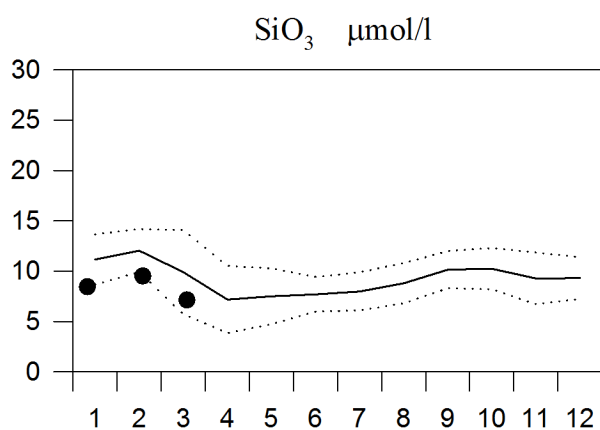
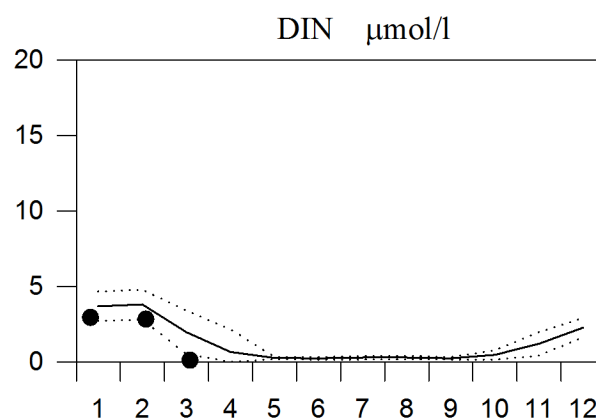
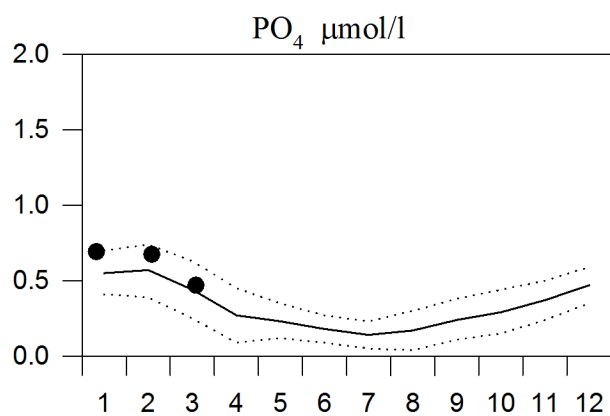
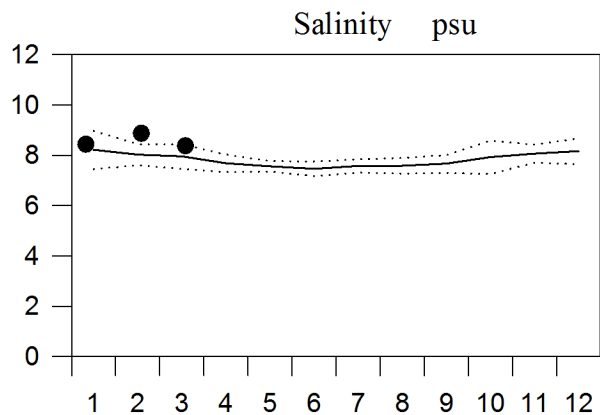
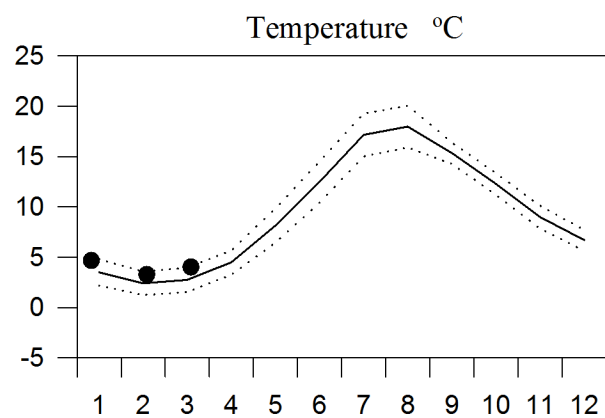
— Mean 1996-2010 St.Dev. ● 2016



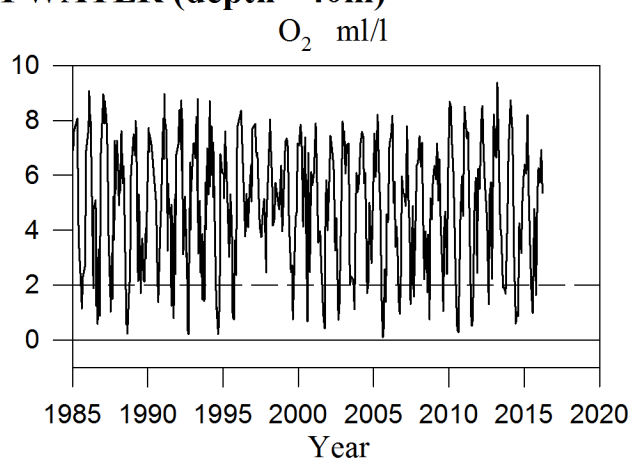
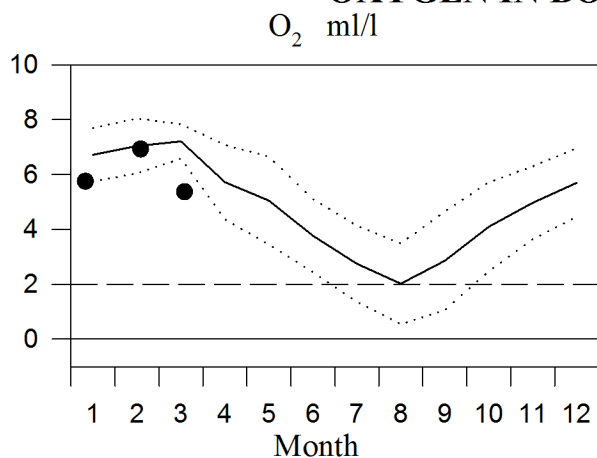
STATION BY1 SURFACE WATER

Annual Cycles

— Mean 1996-2010 St.Dev. ● 2016

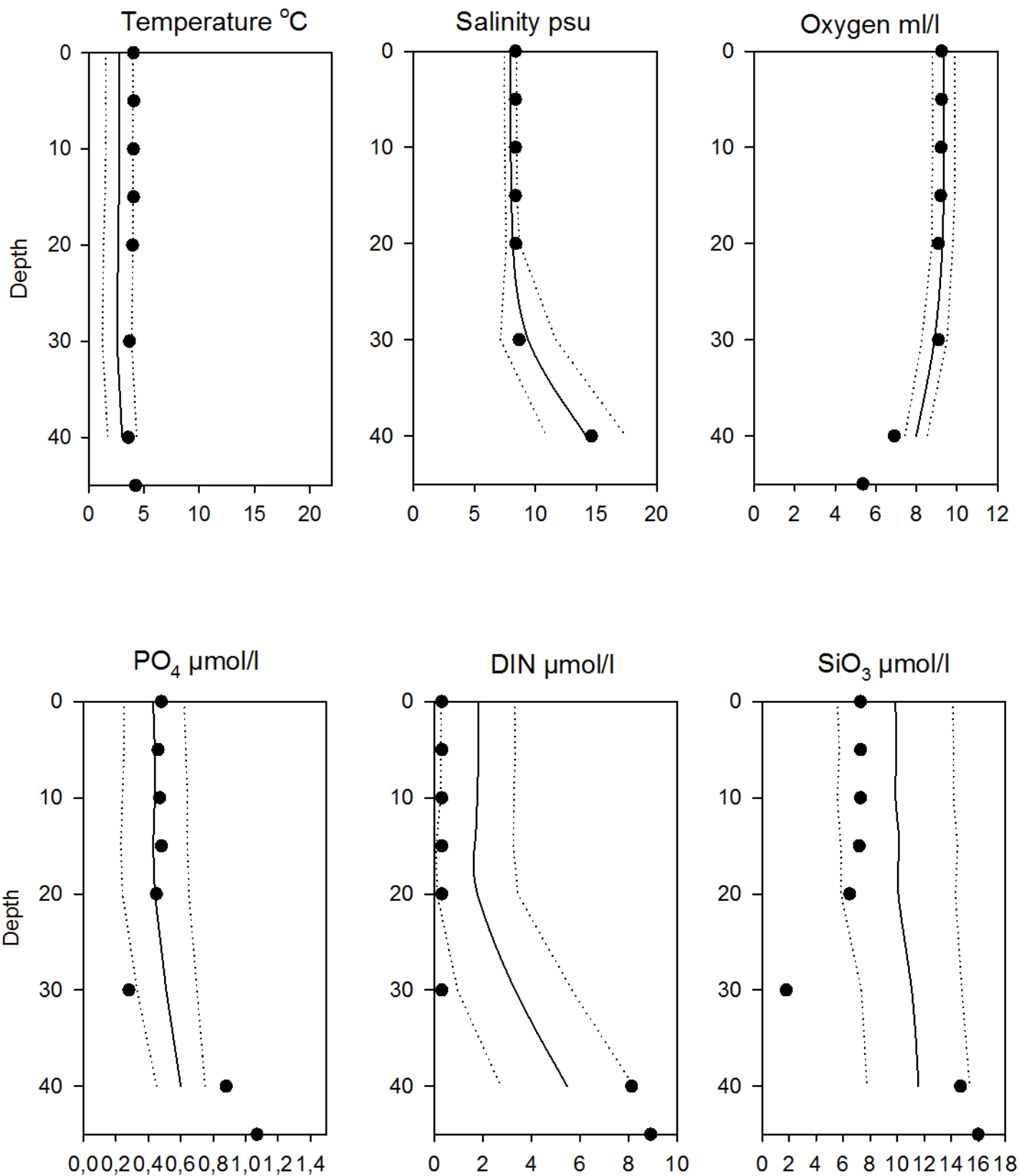


OXYGEN IN BOTTOM WATER (depth >40m)



Vertical profiles BY1 March

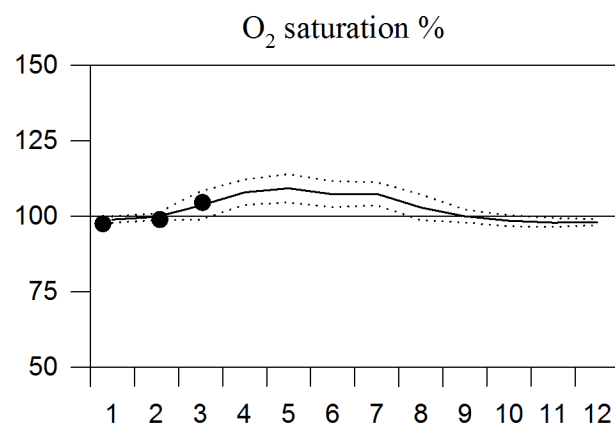
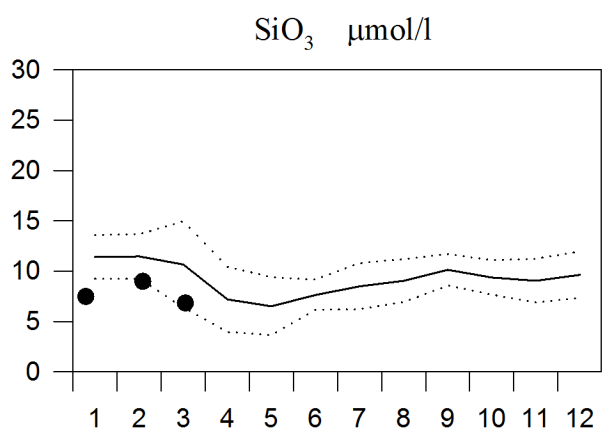
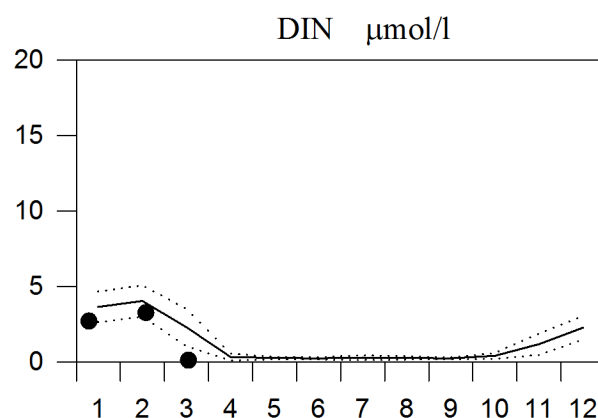
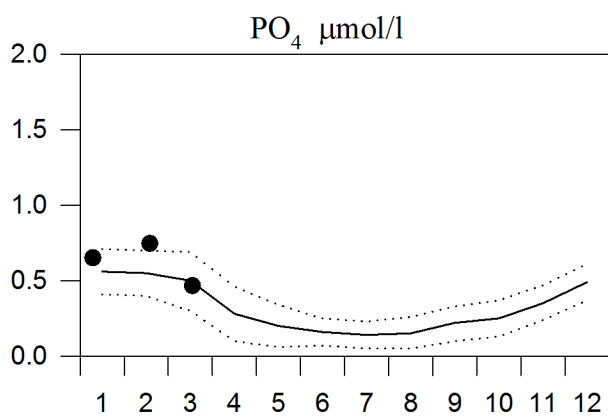
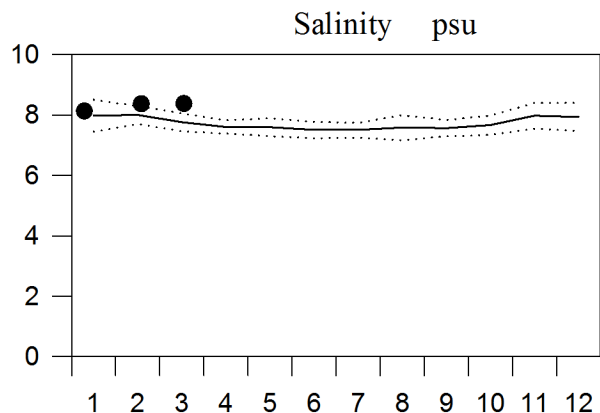
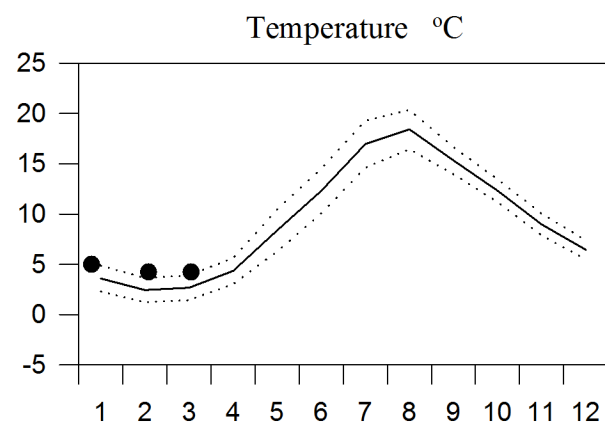
— Mean 1996-2010 St.Dev. ● 2016



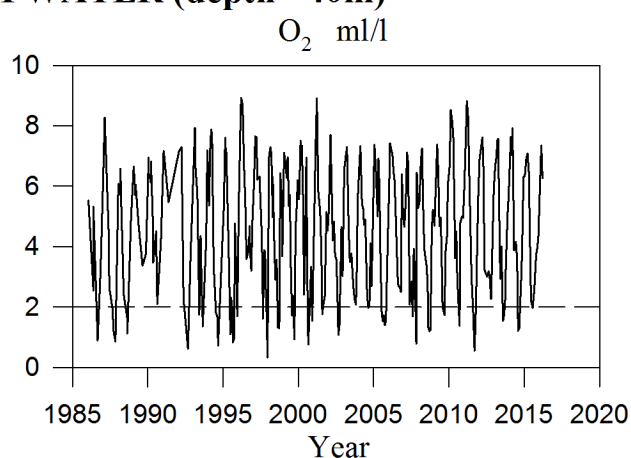
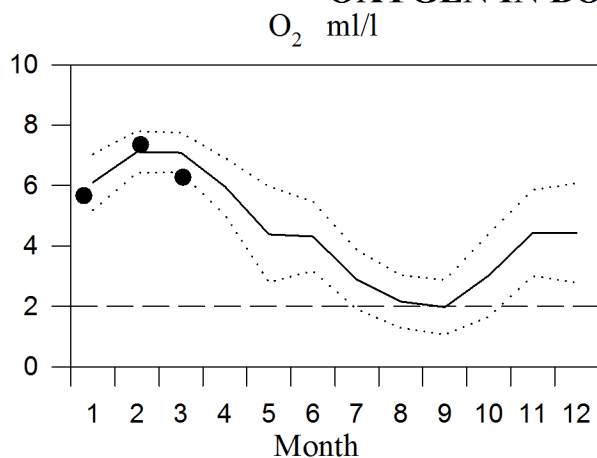
STATION BY2 SURFACE WATER

Annual Cycles

— Mean 1996-2010 St.Dev. ● 2016

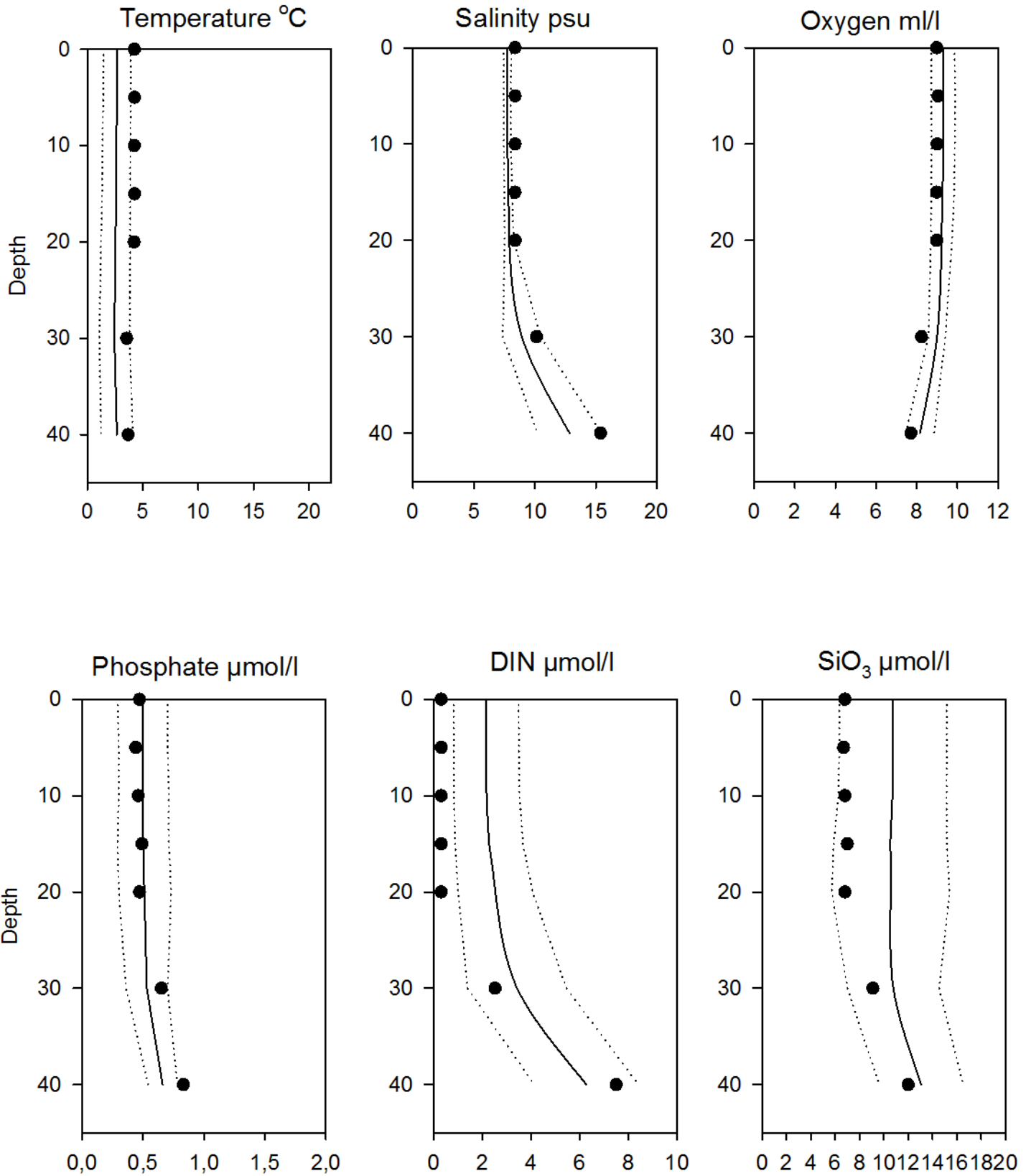


OXYGEN IN BOTTOM WATER (depth >40m)



Vertical profiles BY2 March

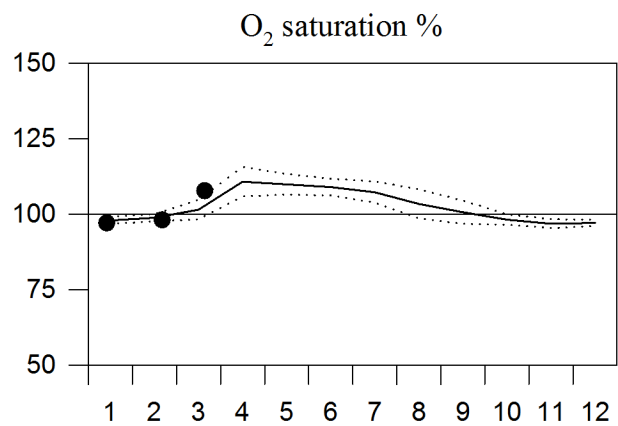
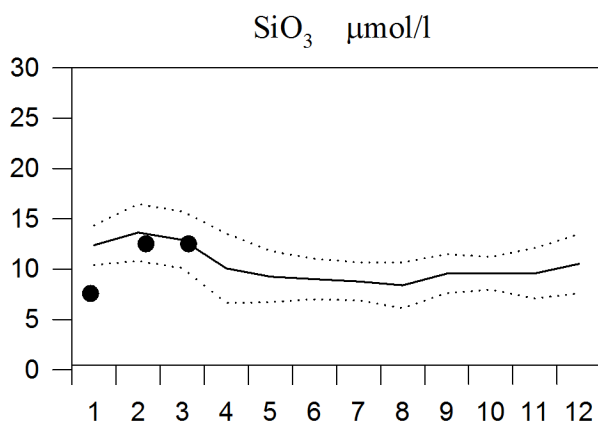
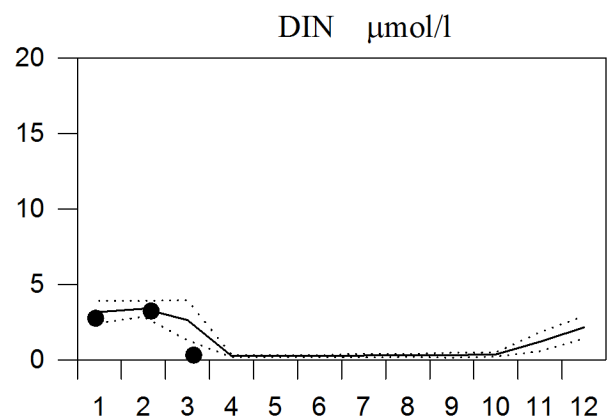
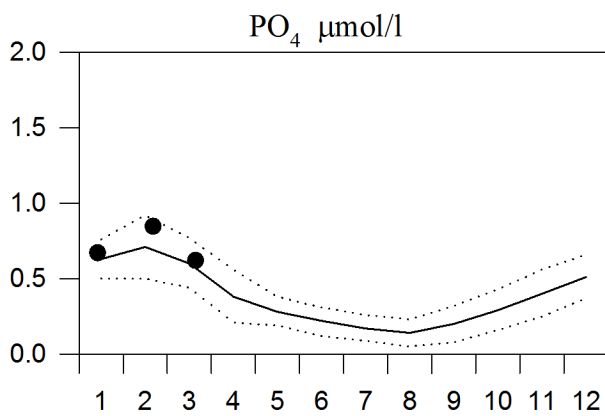
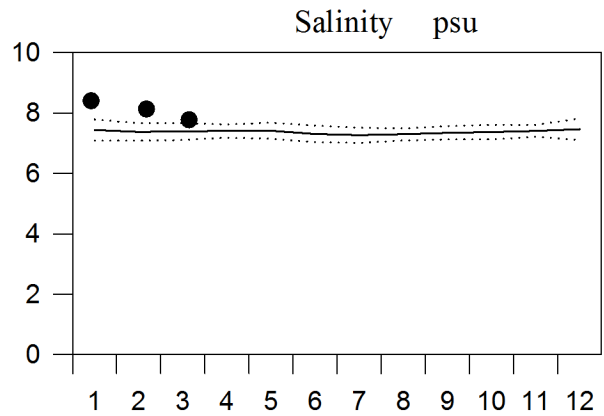
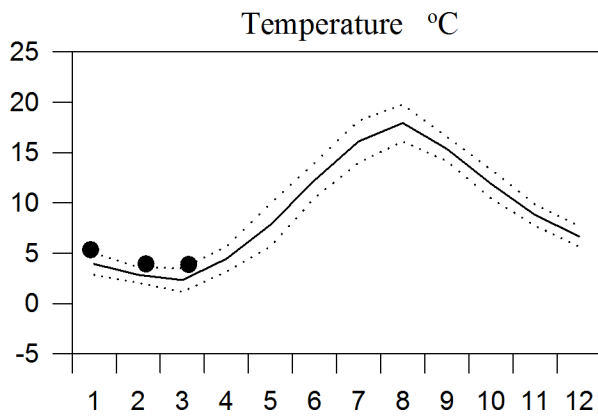
— Mean 1996-2010 St.Dev. ● 2016



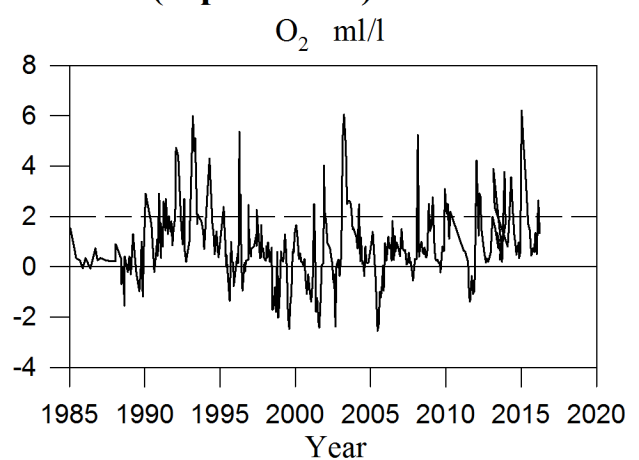
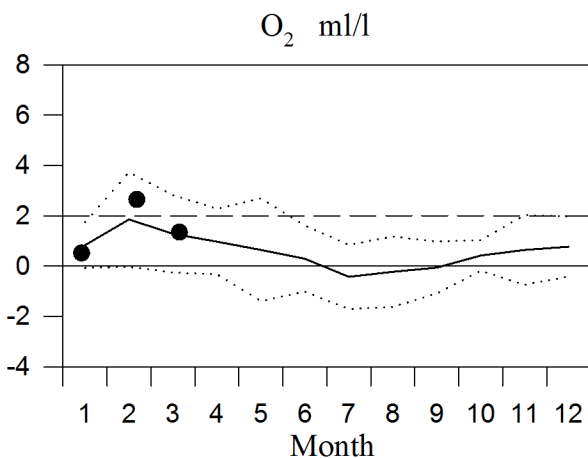
STATION HANÖBUKTEN SURFACE WATER

Annual Cycles

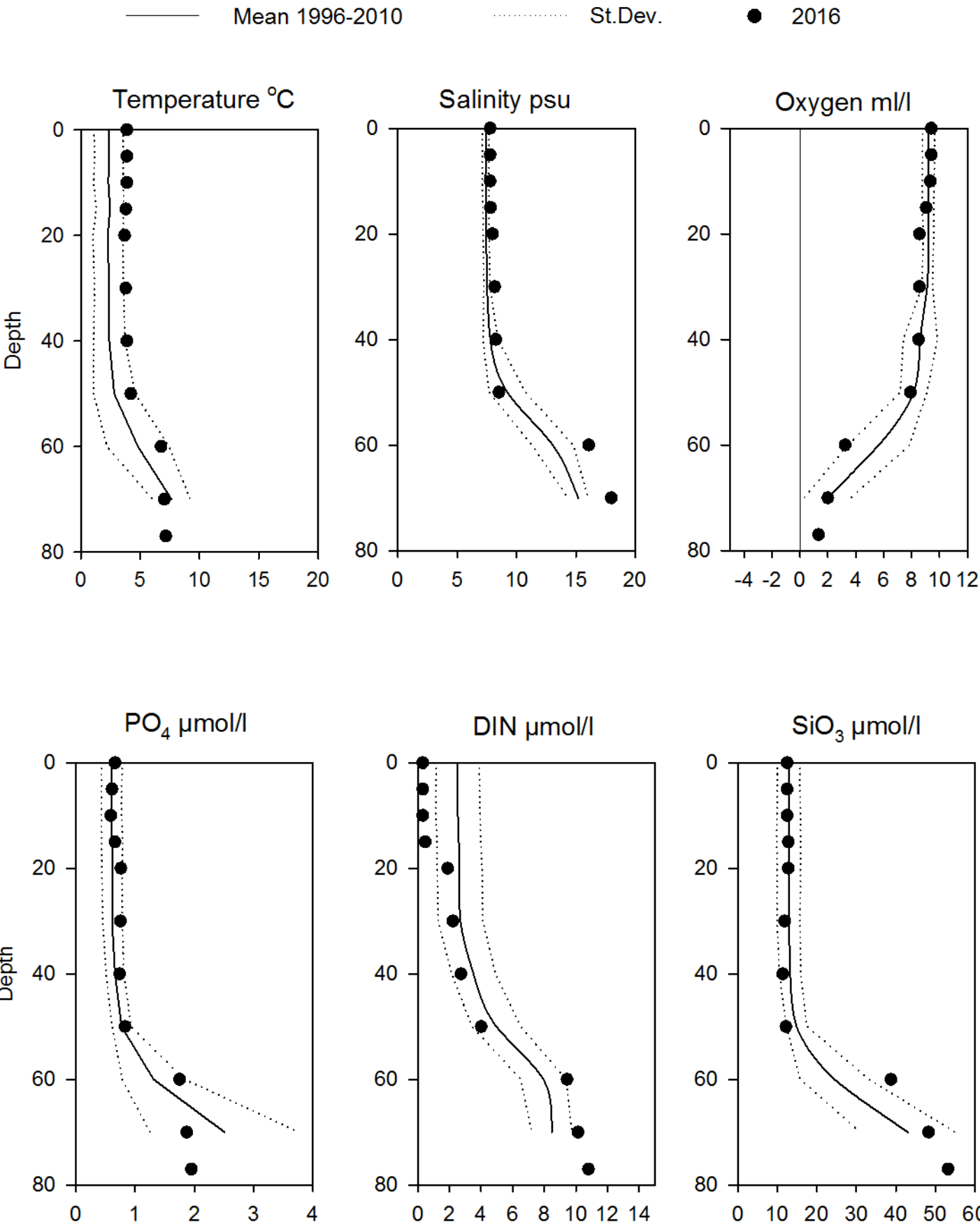
— Mean 1996-2010 St.Dev. ● 2016



OXYGEN IN BOTTOM WATER (depth > 70m)



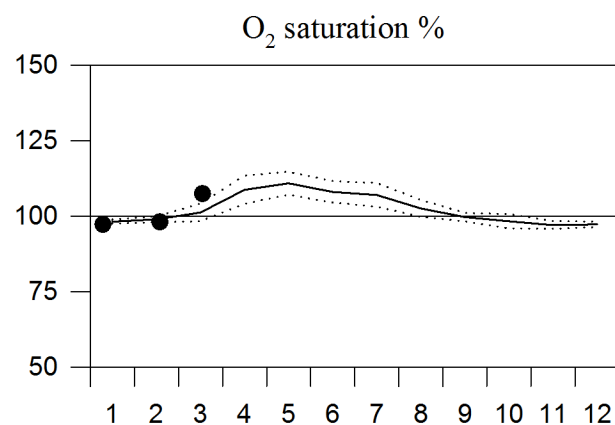
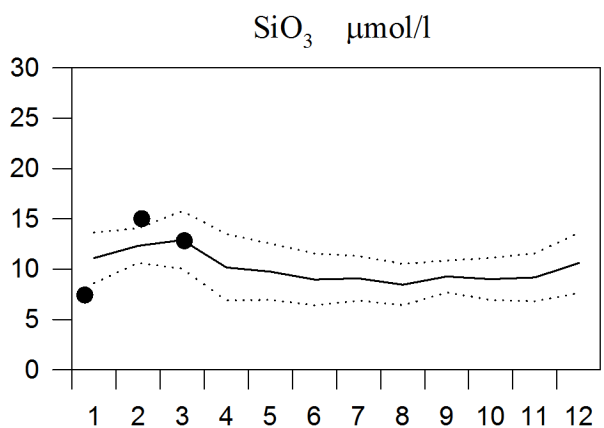
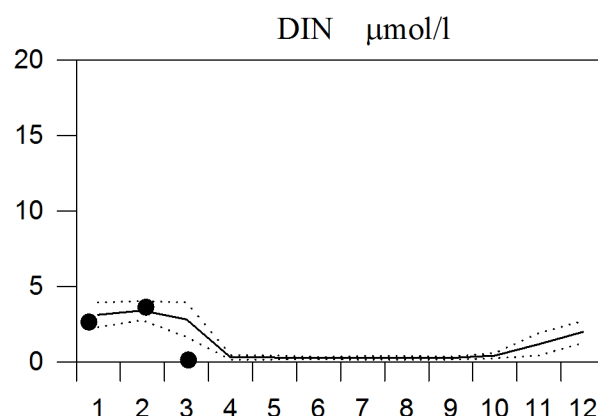
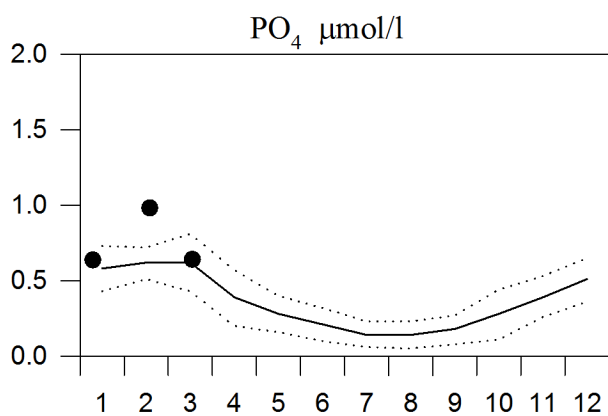
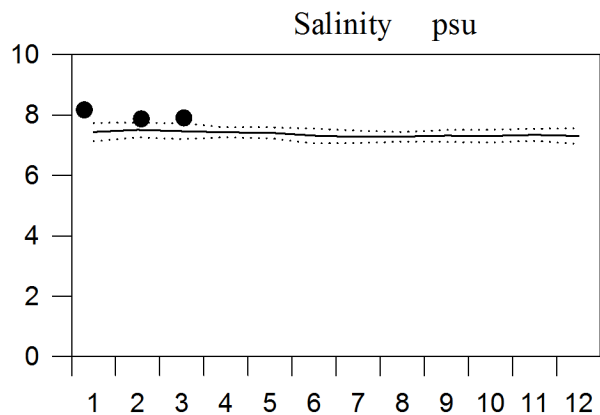
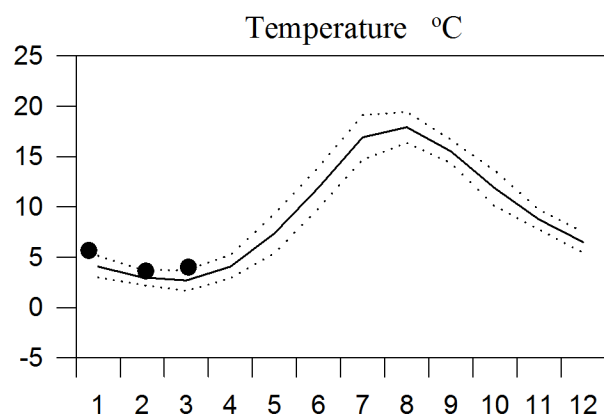
Vertical profiles Hanöbukten March



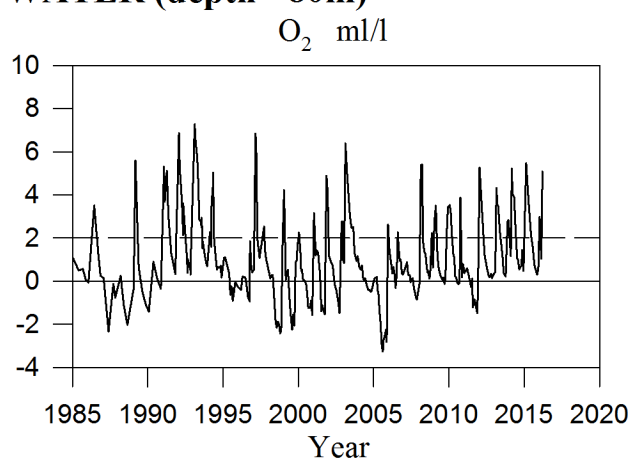
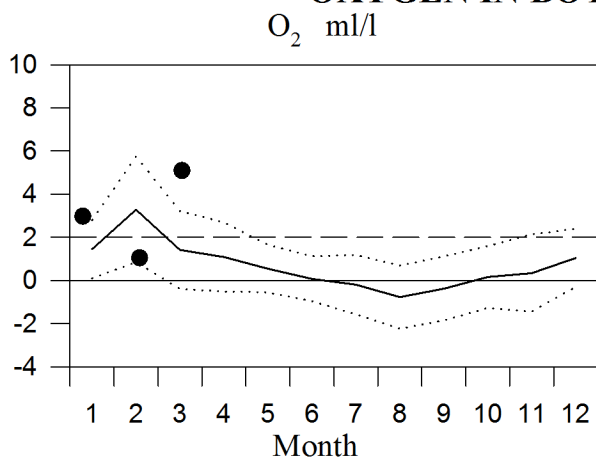
STATION BY4 SURFACE WATER

Annual Cycles

— Mean 1996-2010 St.Dev. ● 2016

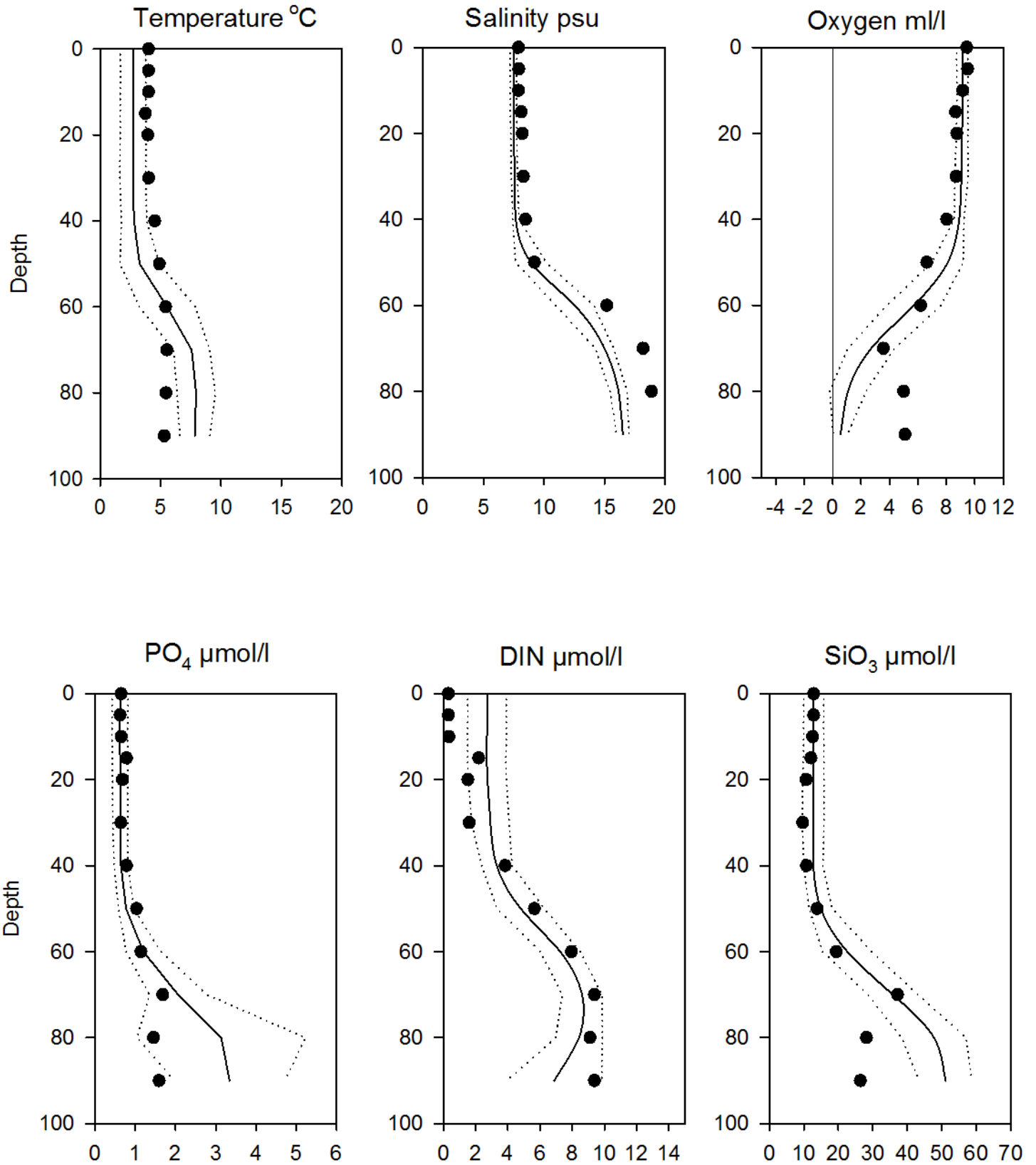


OXYGEN IN BOTTOM WATER (depth >80m)



Vertical profiles BY4 March

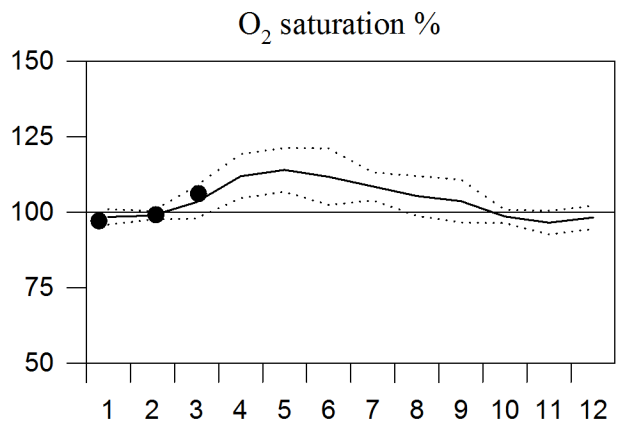
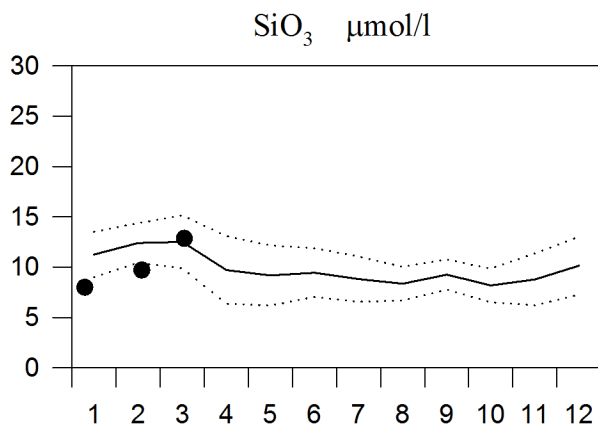
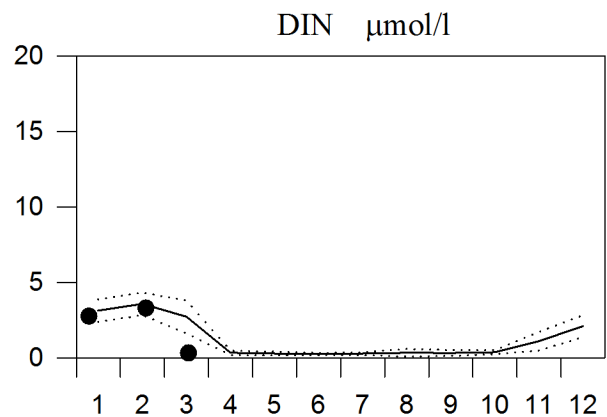
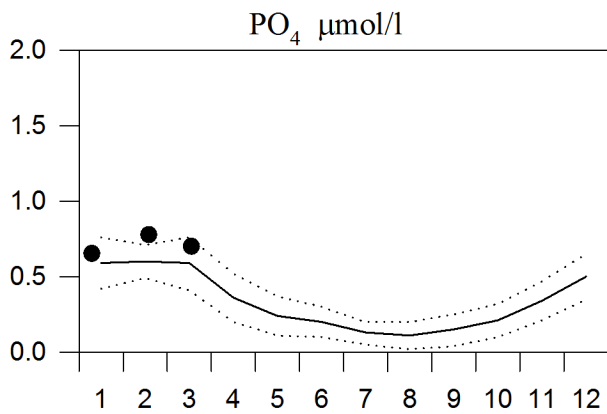
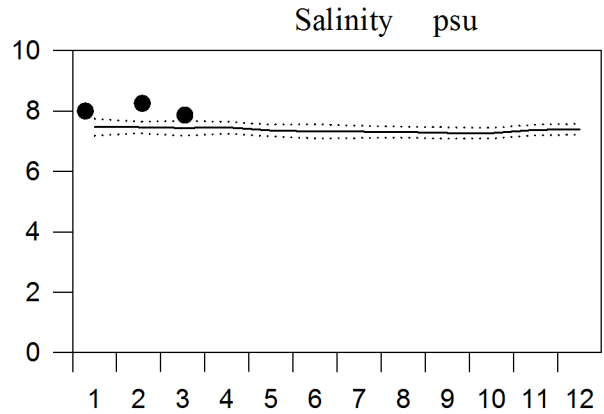
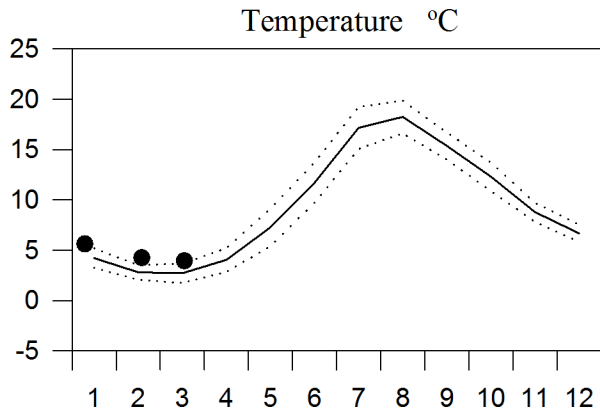
— Mean 1996-2010 St.Dev. ● 2016



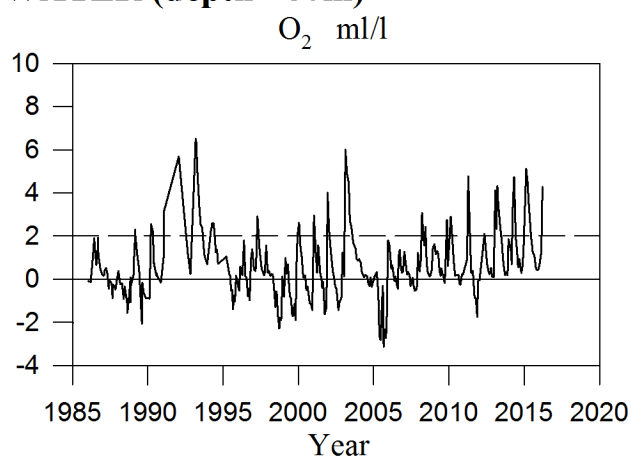
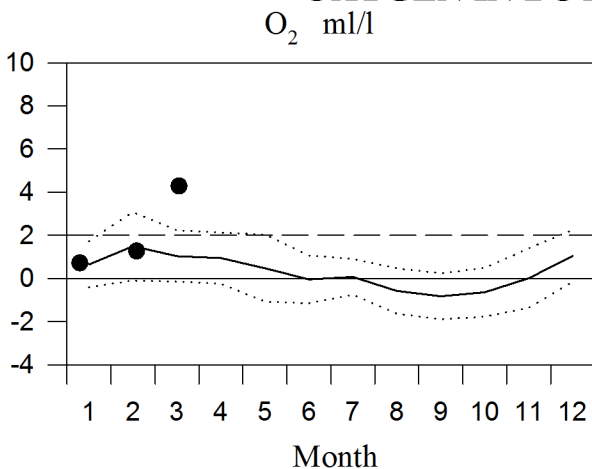
STATION BY5 SURFACE WATER

Annual Cycles

— Mean 1996-2010 St.Dev. ● 2016

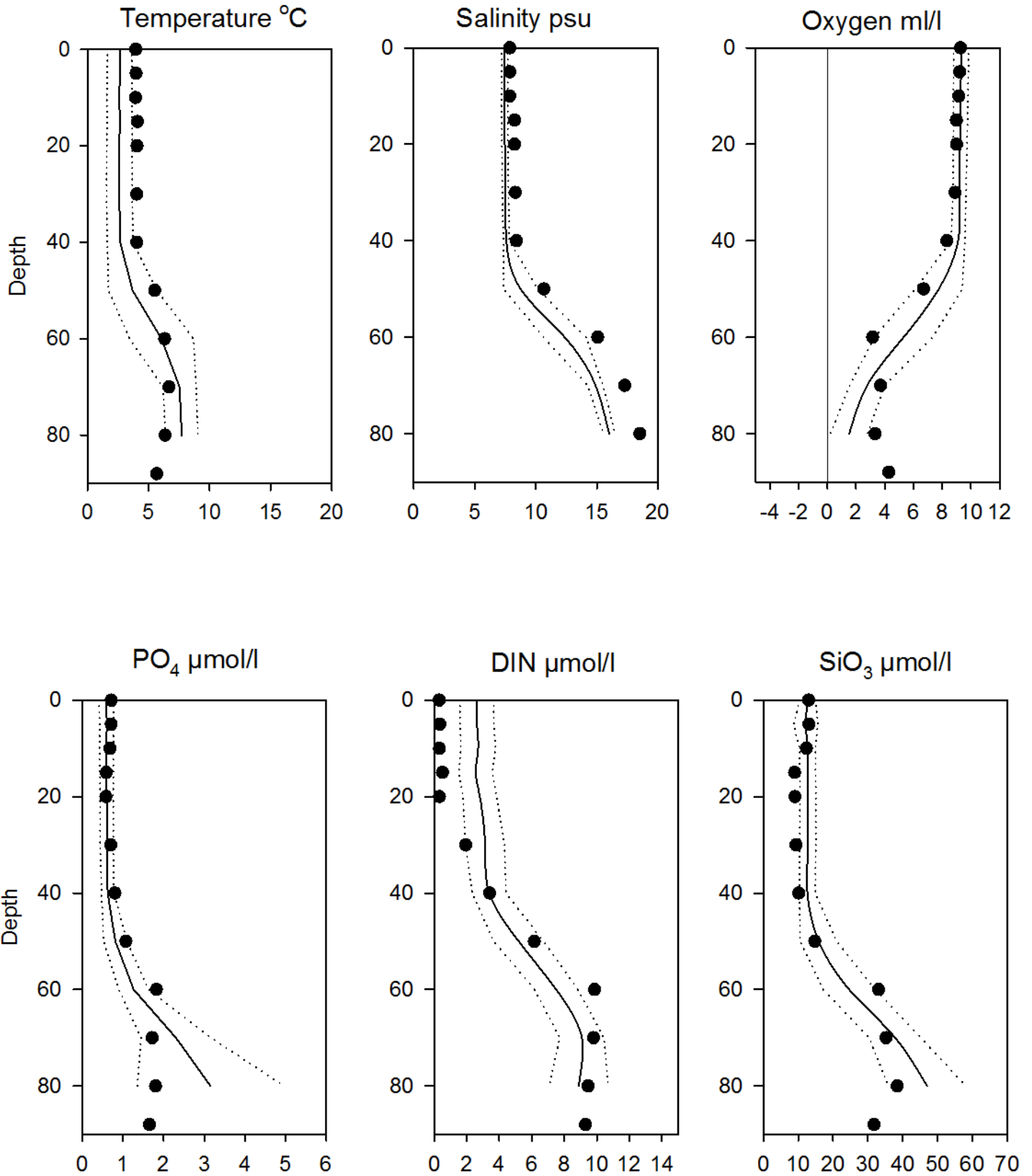


OXYGEN IN BOTTOM WATER (depth >80m)



Vertical profiles BY5 March

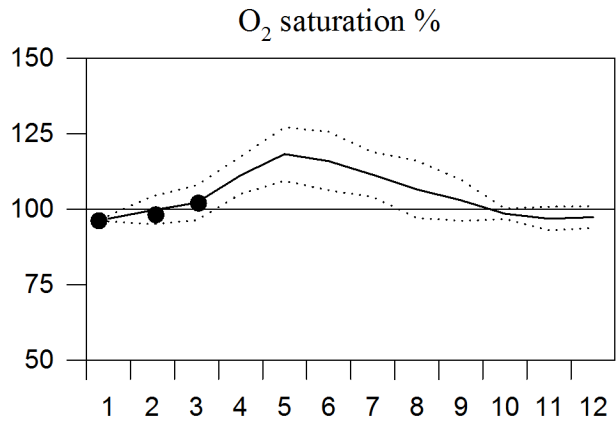
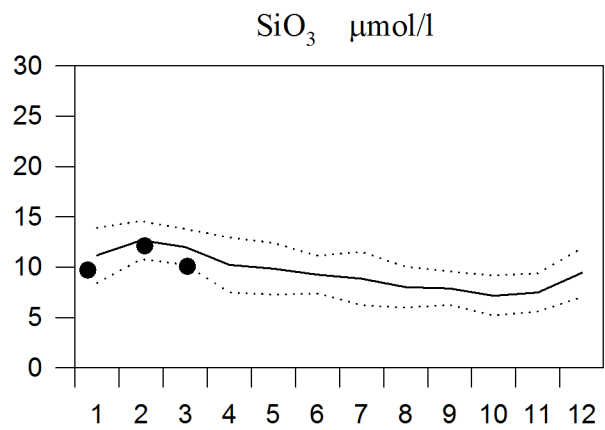
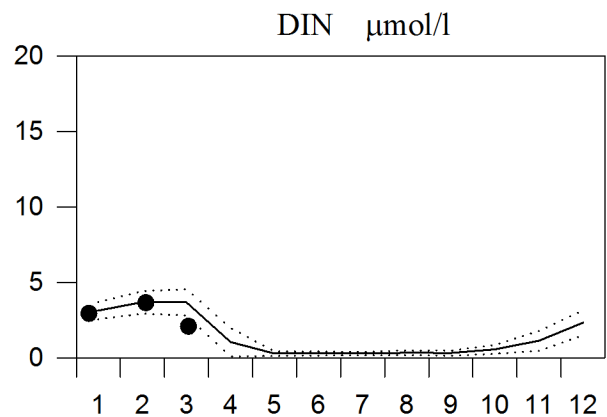
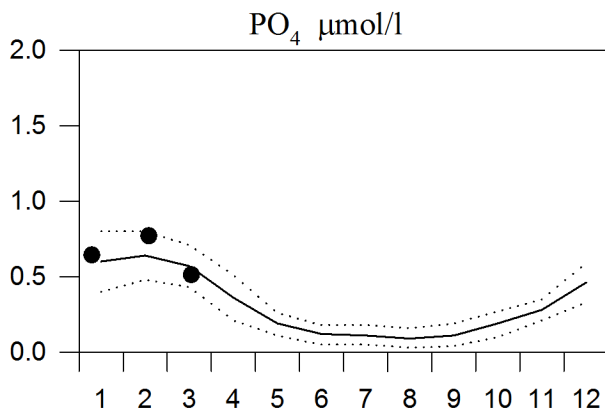
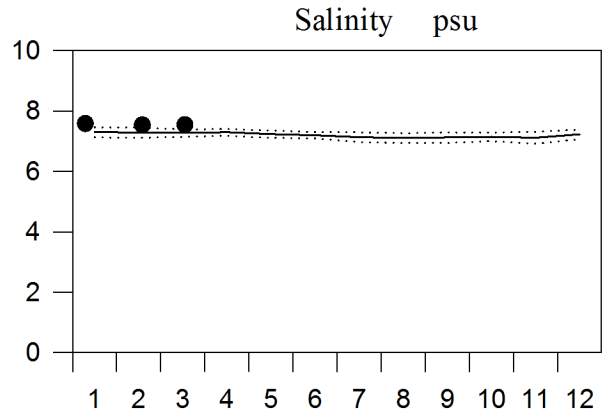
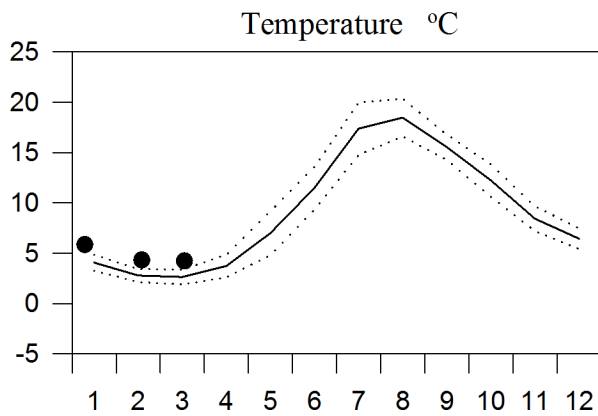
— Mean 1996-2010 St.Dev. ● 2016



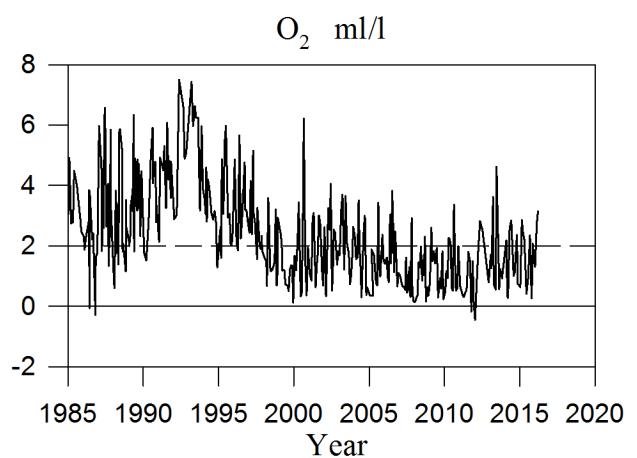
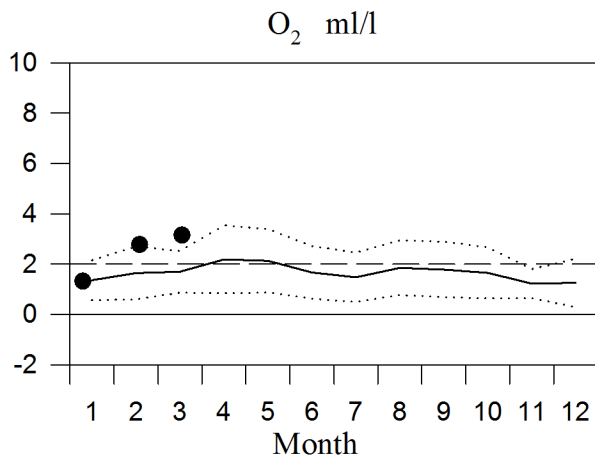
STATION BCS III-10 SURFACE WATER

Annual Cycles

— Mean 1996-2010 St.Dev. ● 2016

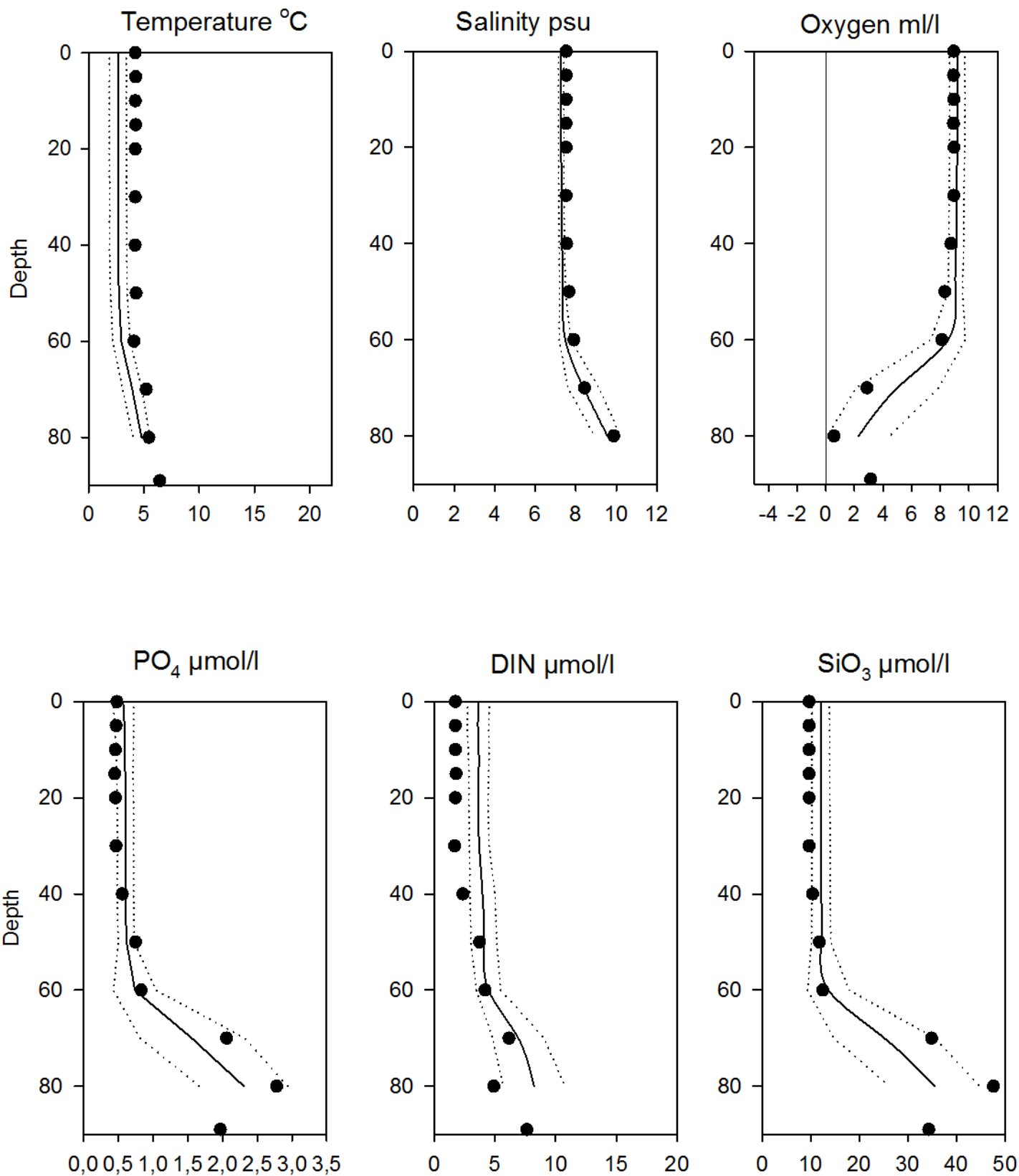


OXYGEN IN BOTTOM WATER (depth > 80m)



Vertical profiles BCS III-10 March

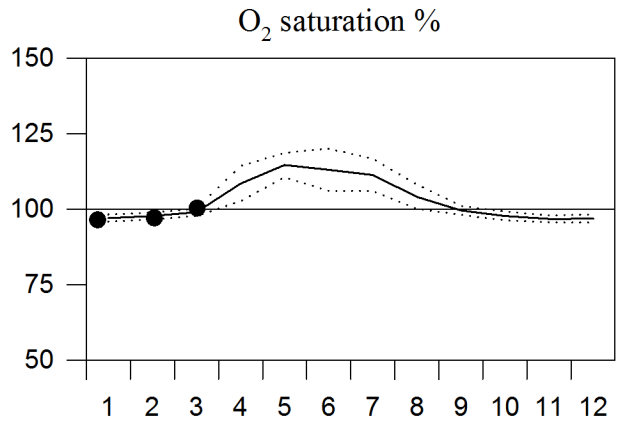
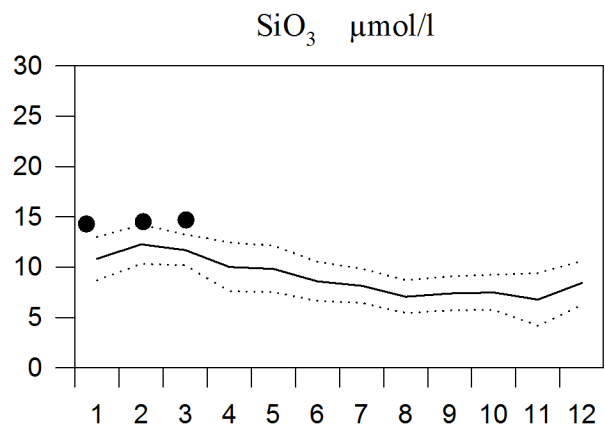
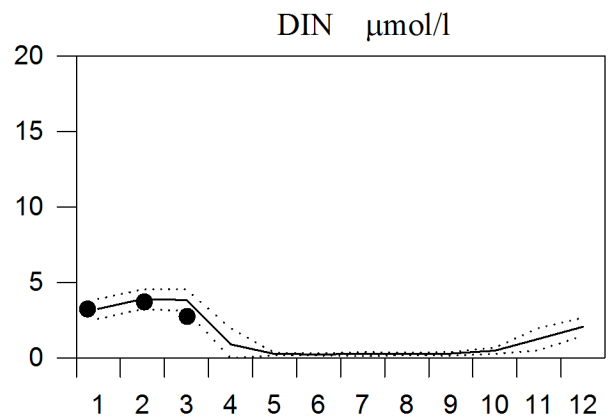
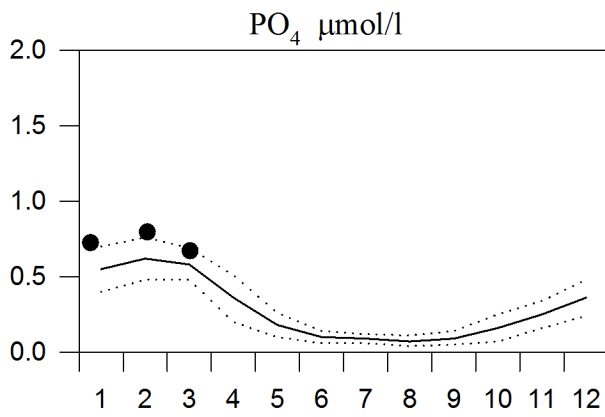
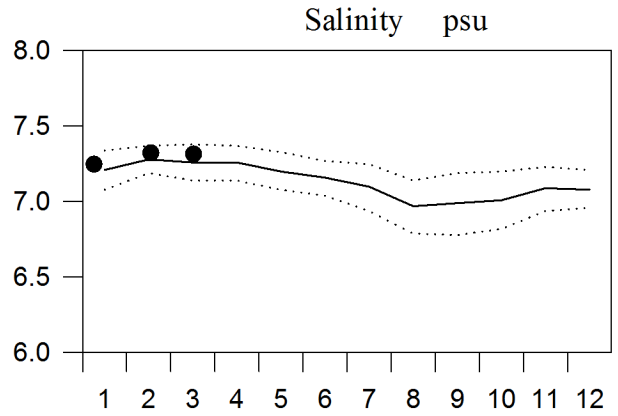
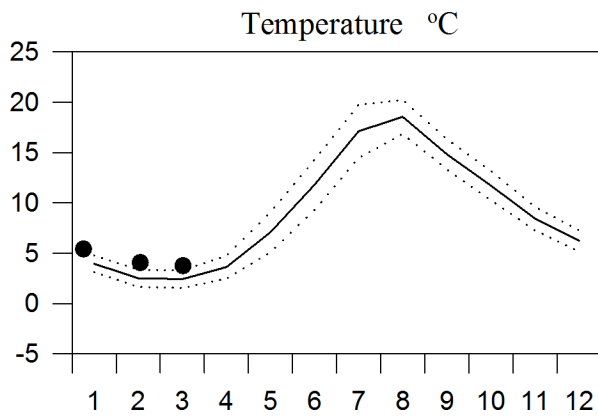
— Mean 1996-2010 St.Dev. ● 2016



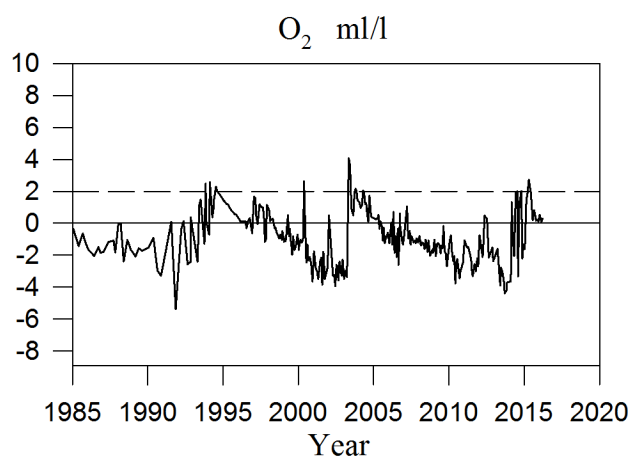
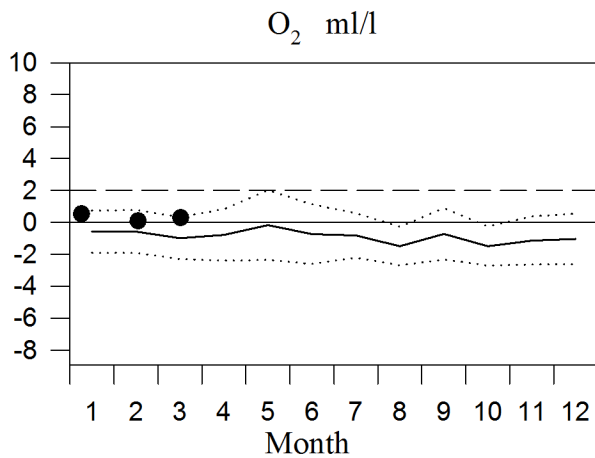
STATION BY10 SURFACE WATER

Annual Cycles

— Mean 1996-2010 St.Dev. ● 2016

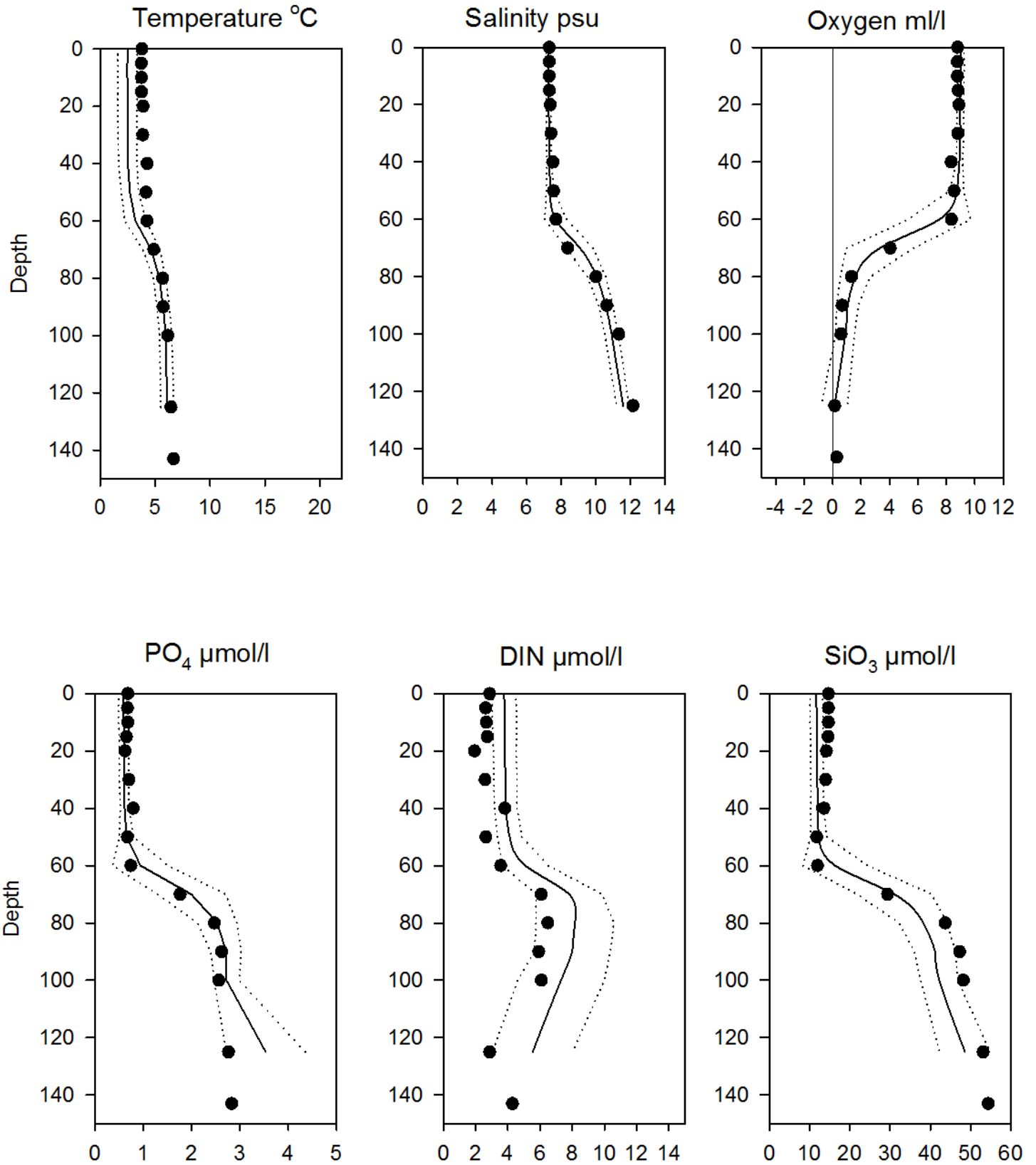


OXYGEN IN BOTTOM WATER (depth >125m)



Vertical profiles BY10 March

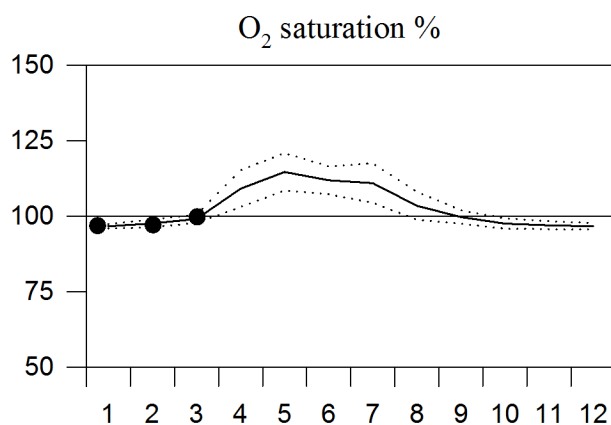
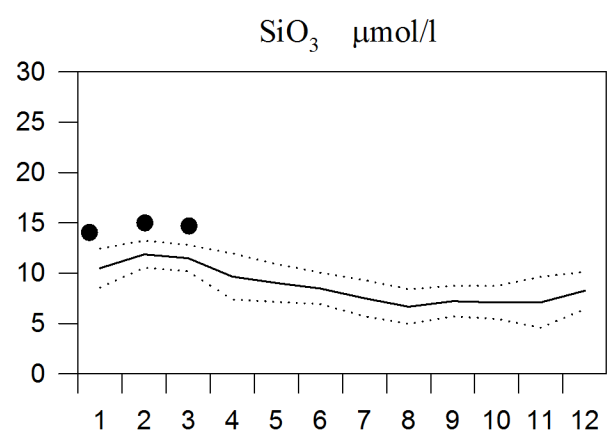
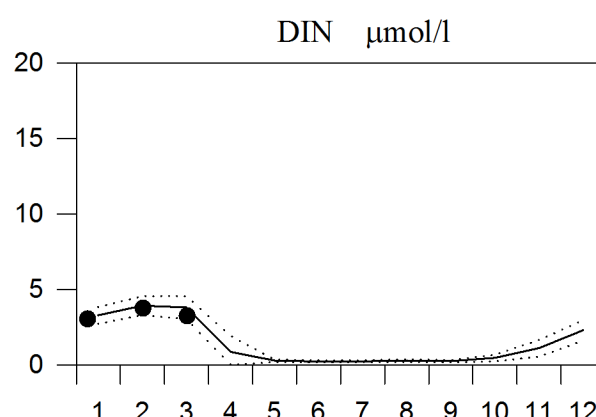
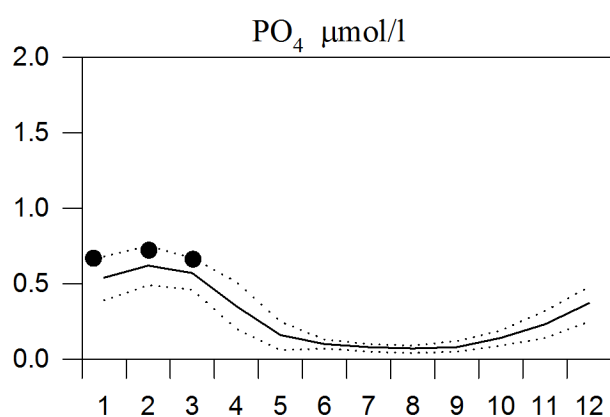
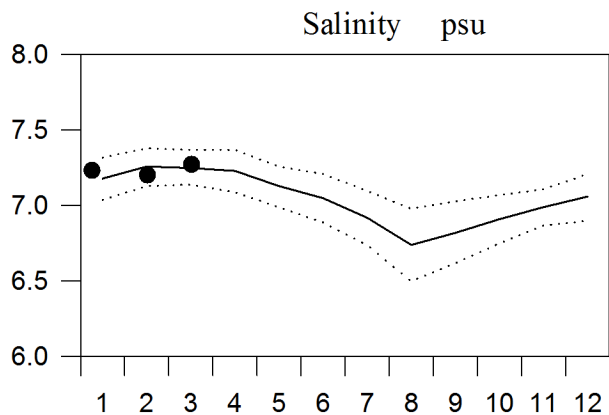
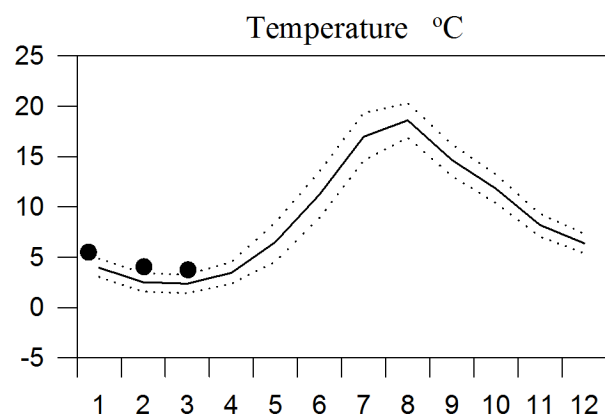
— Mean 1996-2010 St.Dev. ● 2016



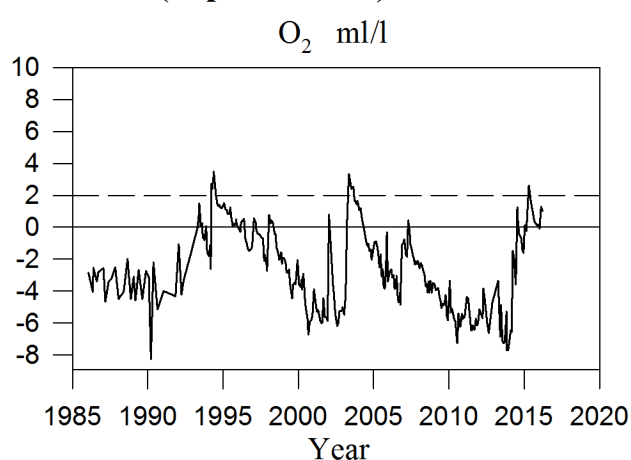
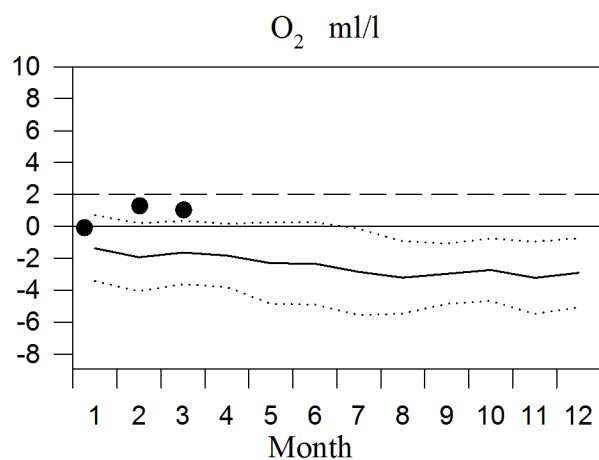
STATION BY15 SURFACE WATER

Annual Cycles

— Mean 1996-2010 St.Dev. ● 2016

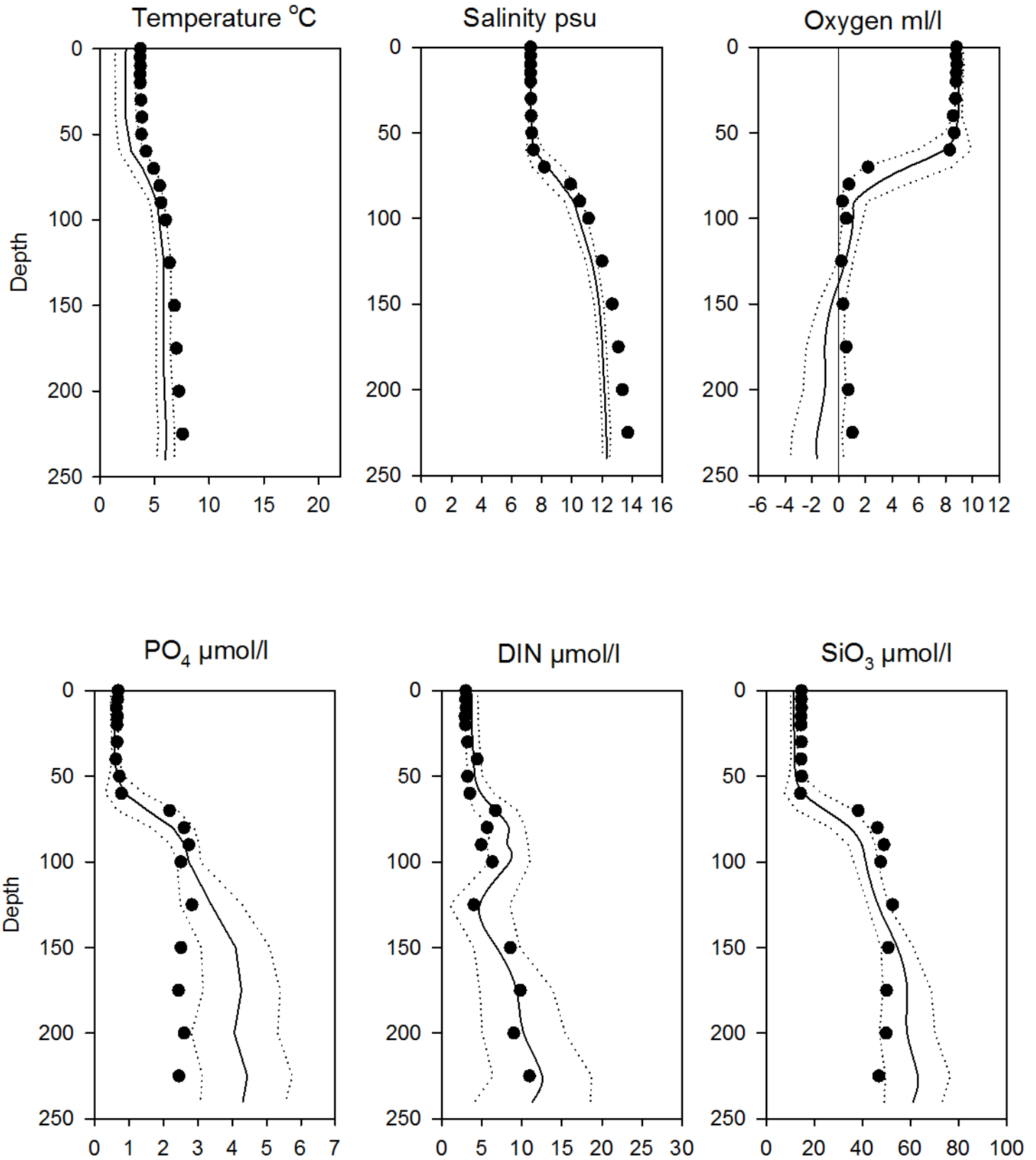


OXYGEN IN BOTTOM WATER (depth >225m)



Vertical profiles BY15 March

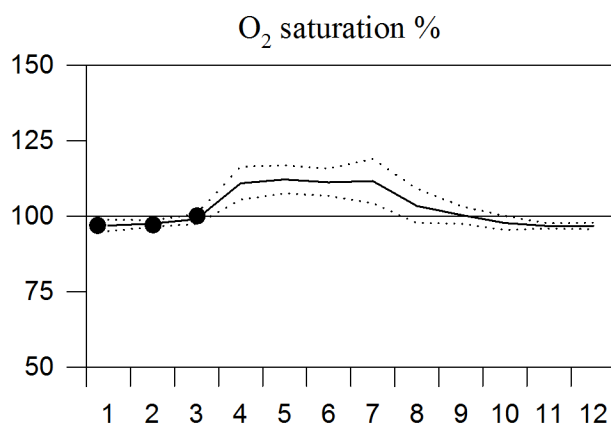
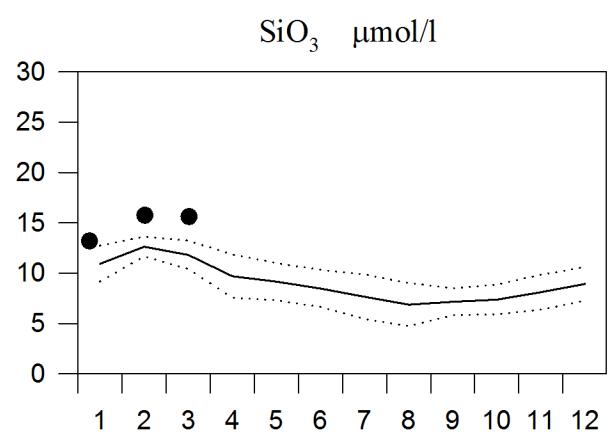
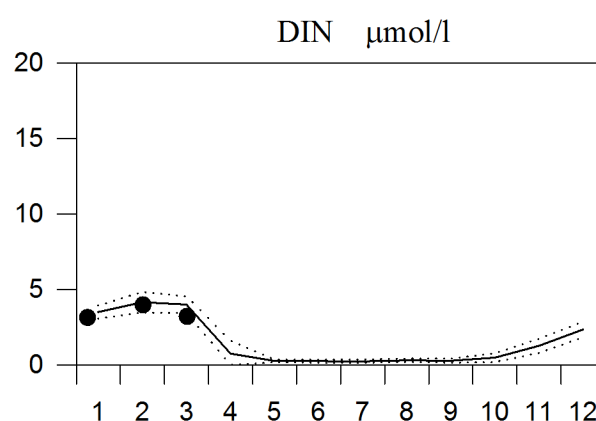
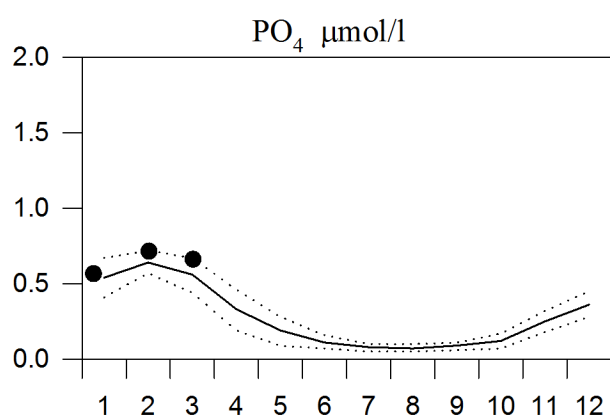
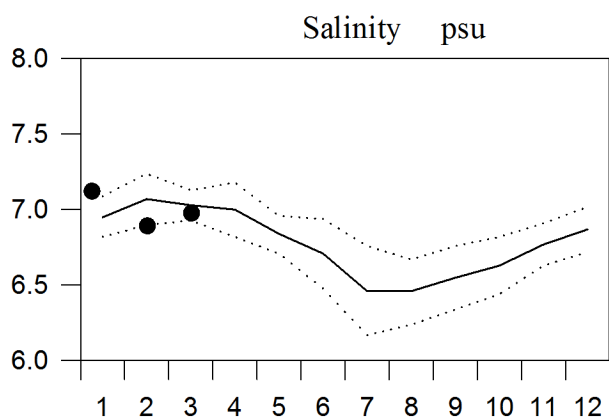
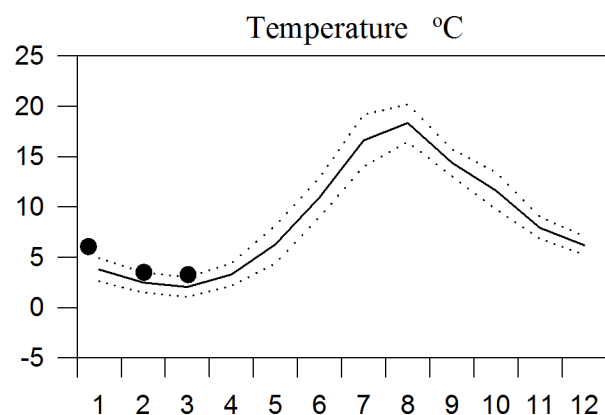
— Mean 1996-2010 St.Dev. ● 2015



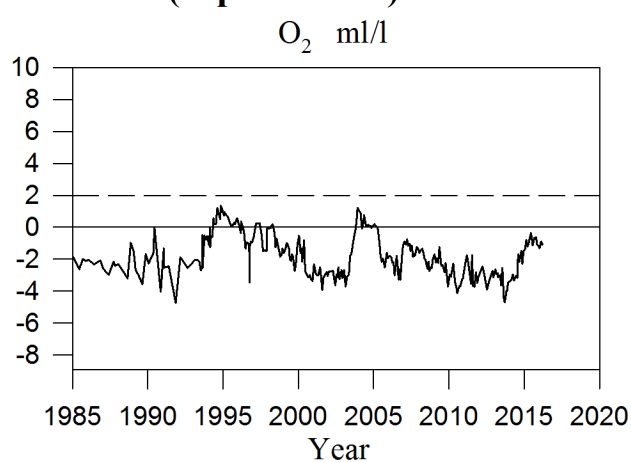
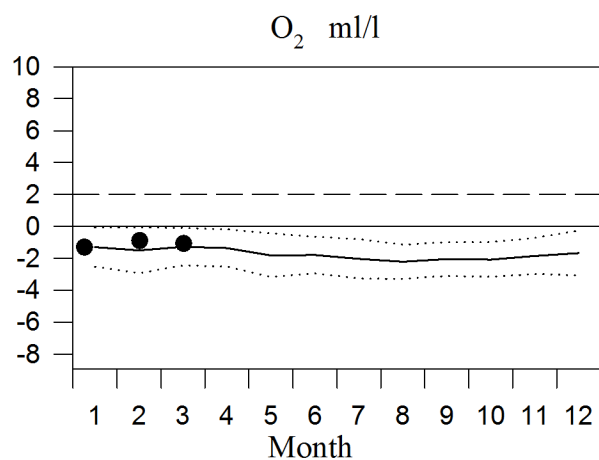
STATION BY20 SURFACE WATER

Annual Cycles

— Mean 1996-2010 St.Dev. ● 2016

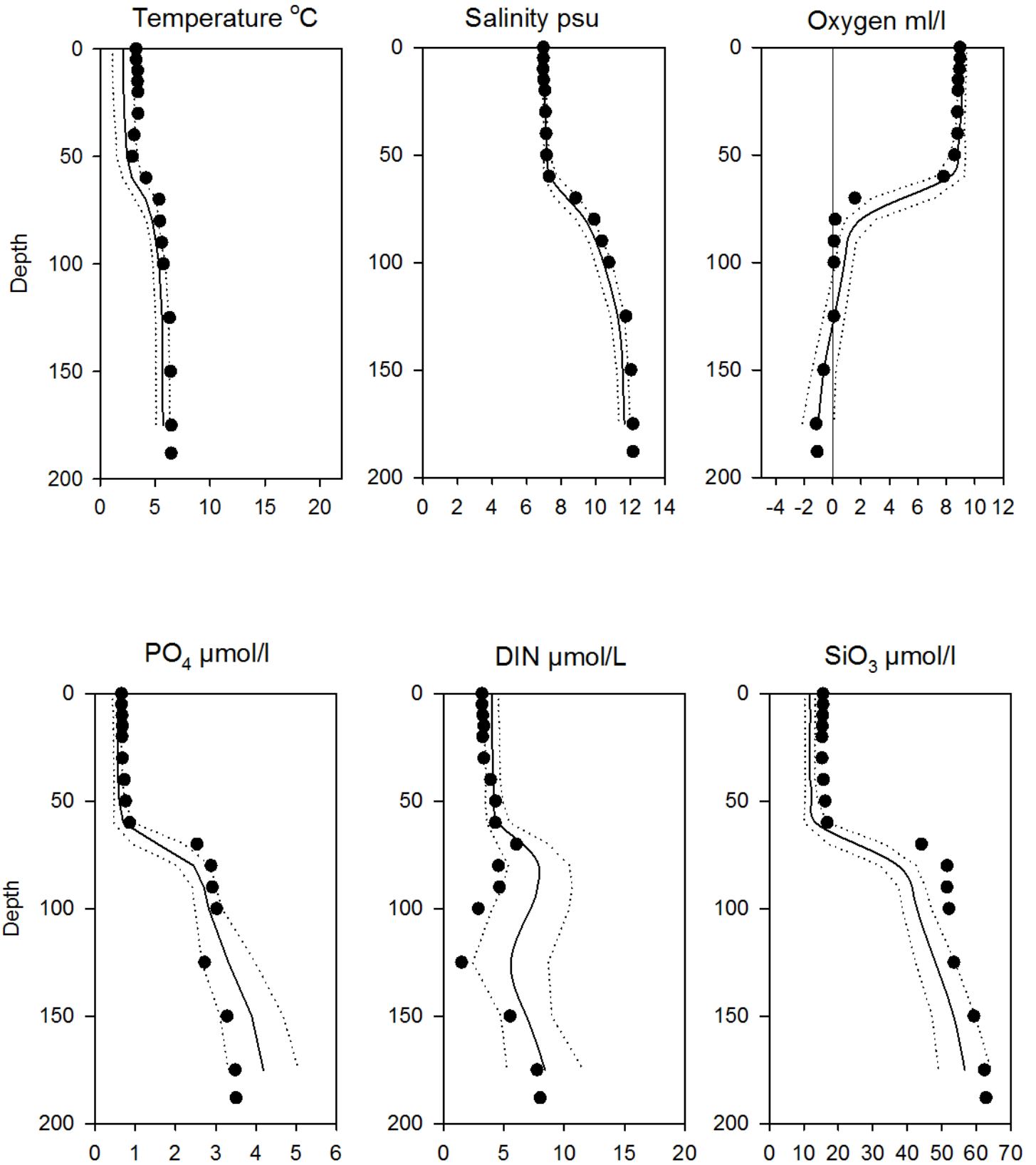


OXYGEN IN BOTTOM WATER (depth >175m)



Vertical profiles BY20 March

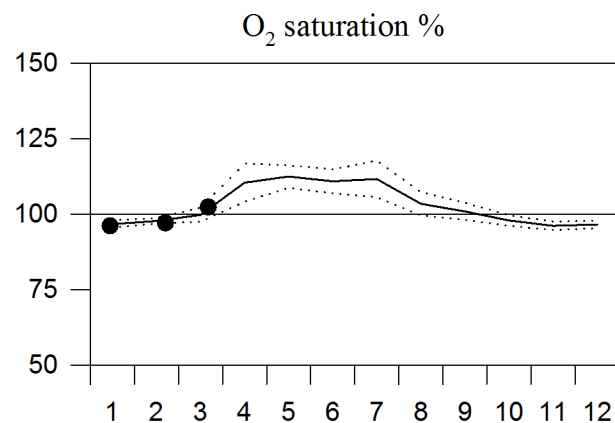
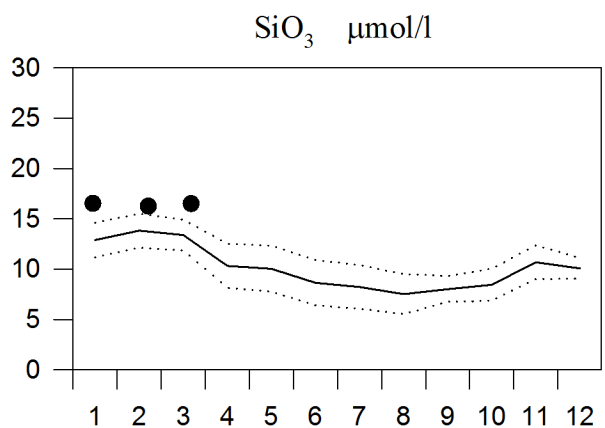
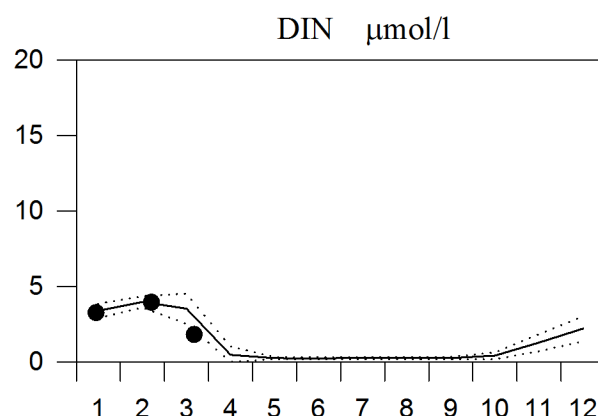
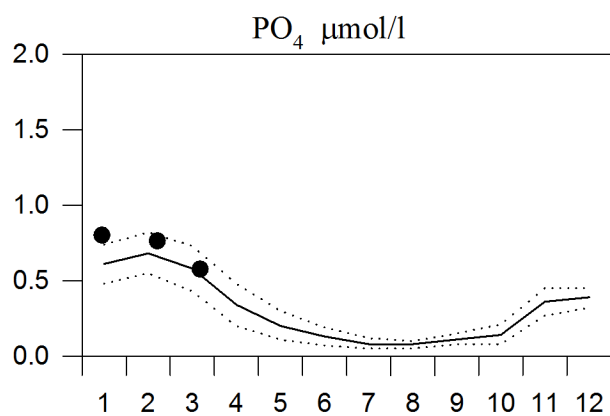
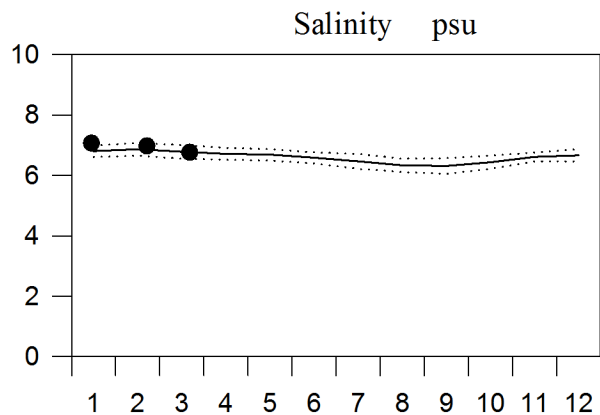
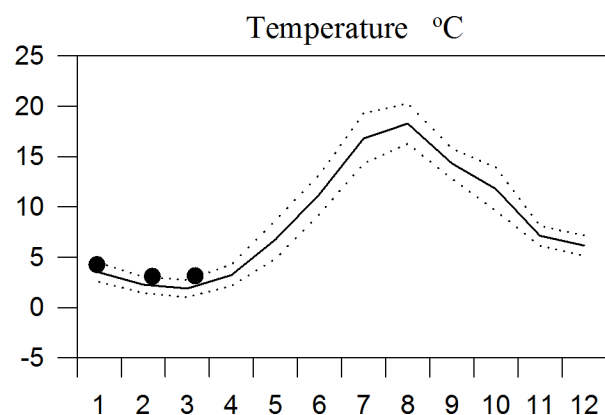
— Mean 1996-2010 St.Dev. ● 2016



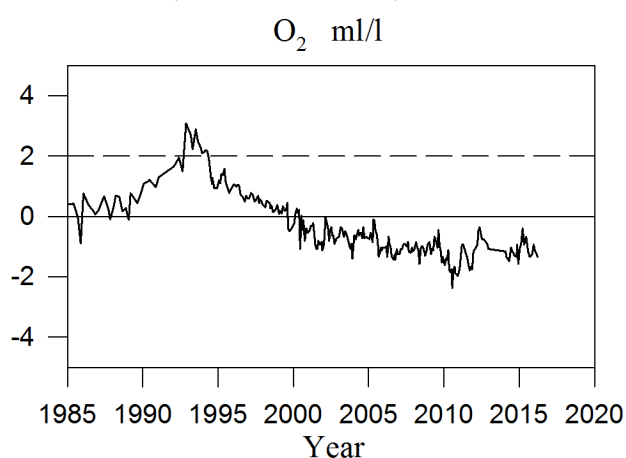
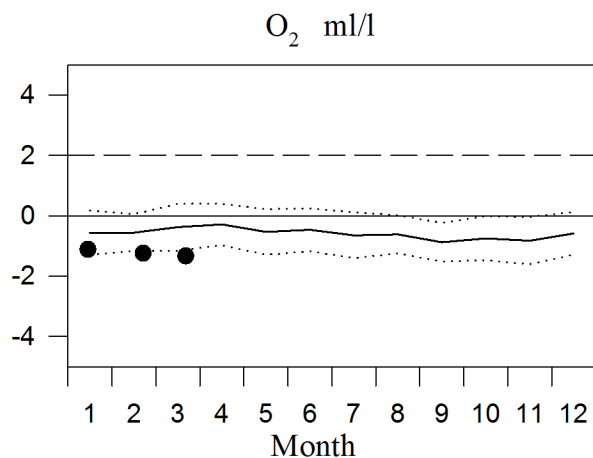
STATION BY32 SURFACE WATER

Annual Cycles

— Mean 1996-2010 St.Dev. ● 2016

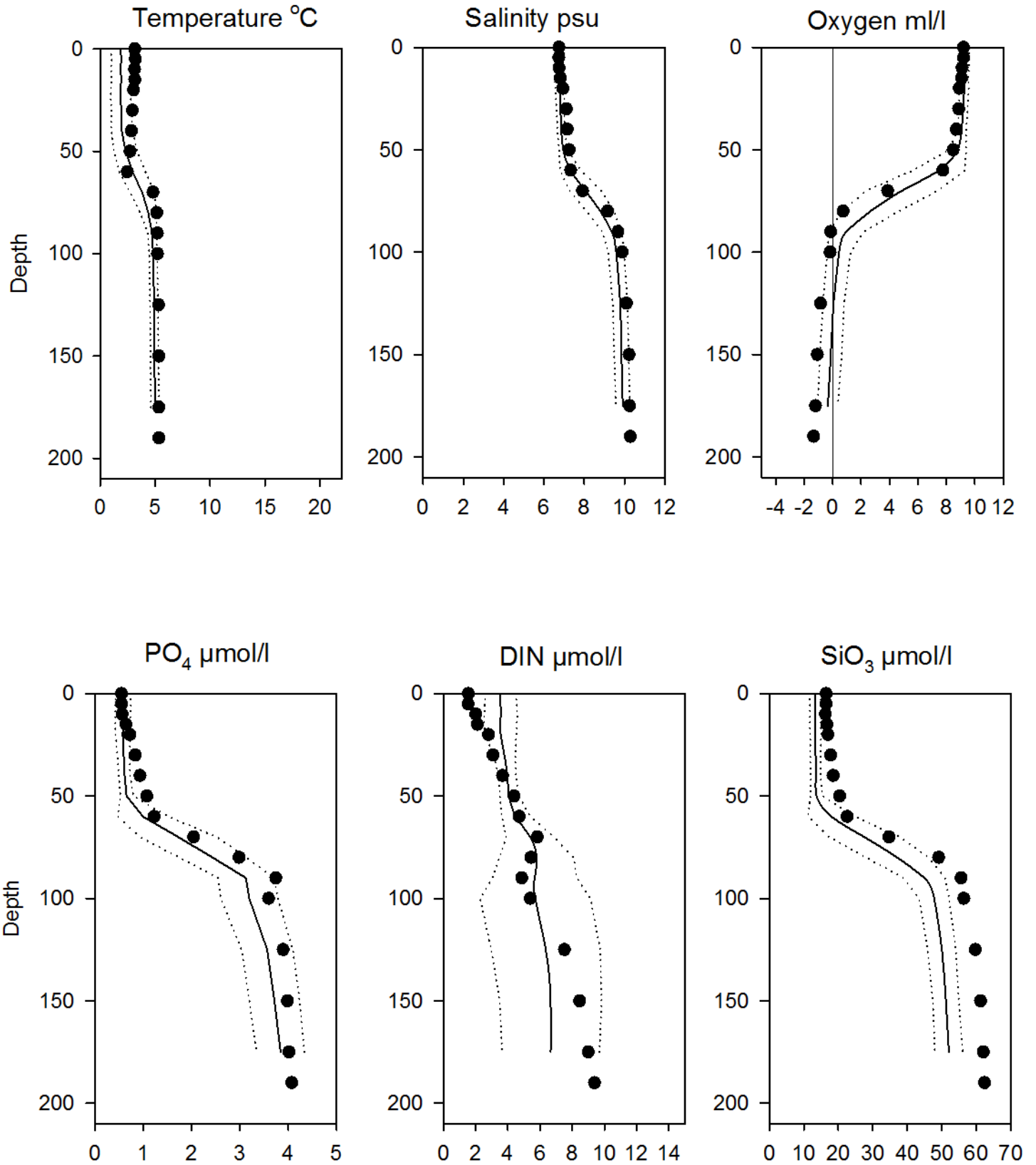


OXYGEN IN BOTTOM WATER (depth > 175m)



Vertical profiles BY32 March

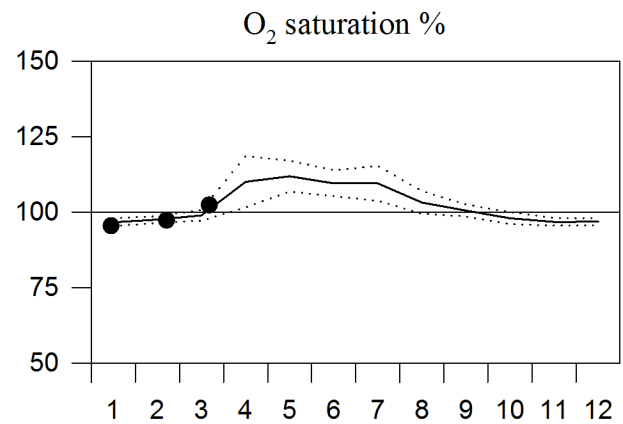
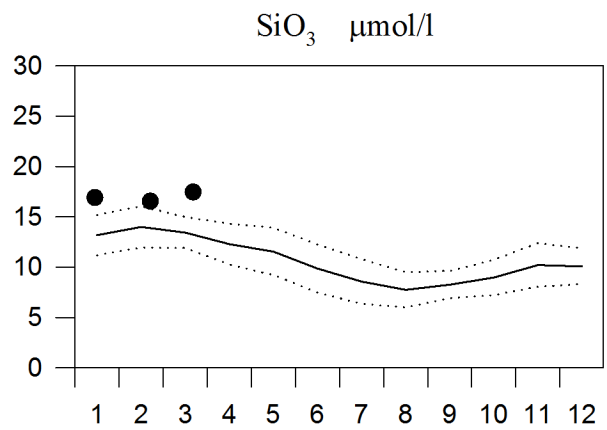
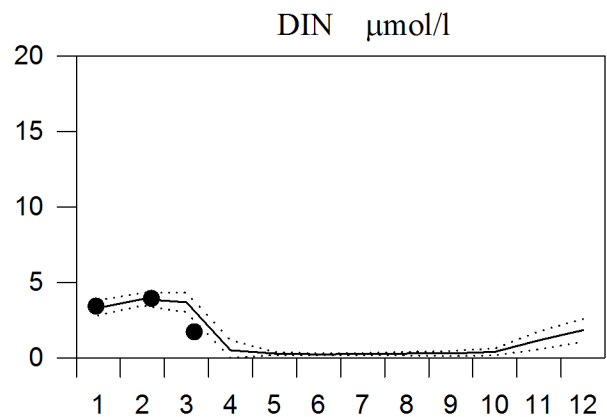
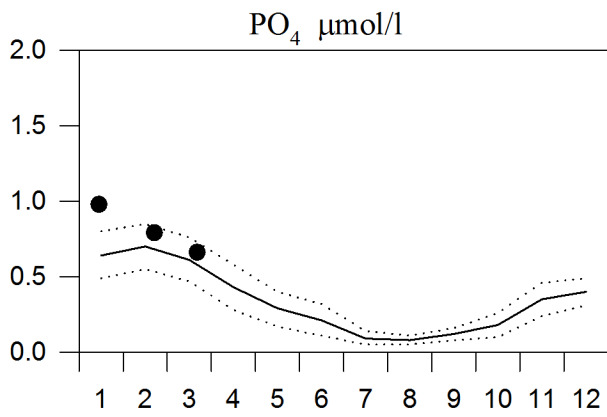
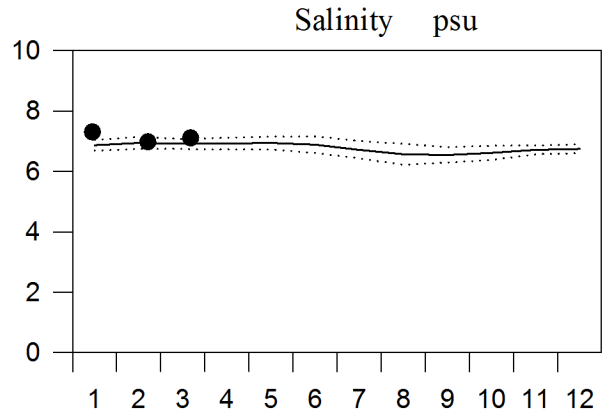
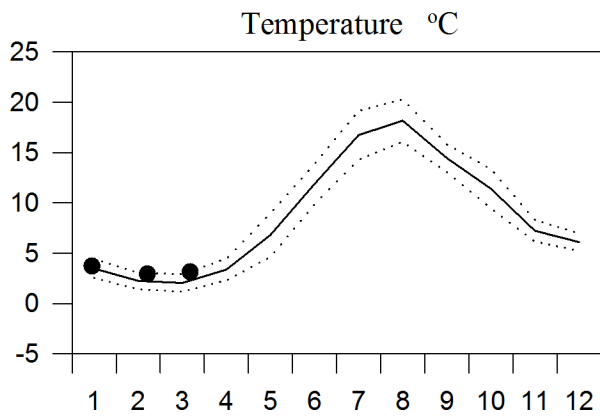
— Mean 1996-2010 St.Dev. ● 2016



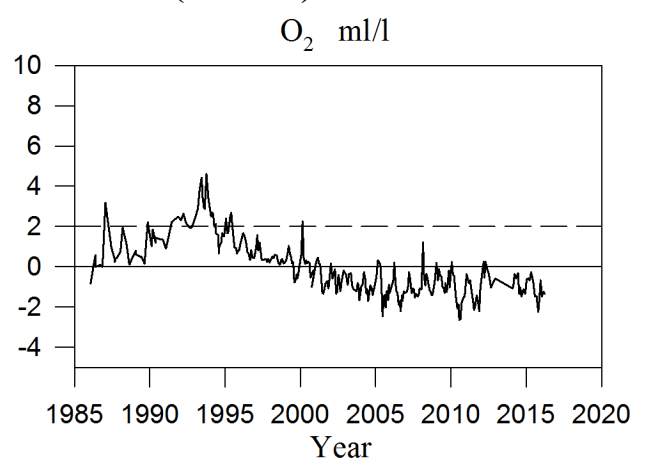
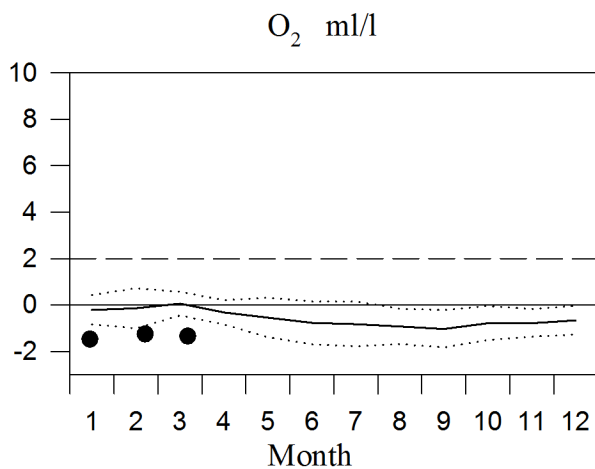
STATION BY38 SURFACE WATER

Annual Cycles

— Mean 1996-2010 St.Dev. ● 2016

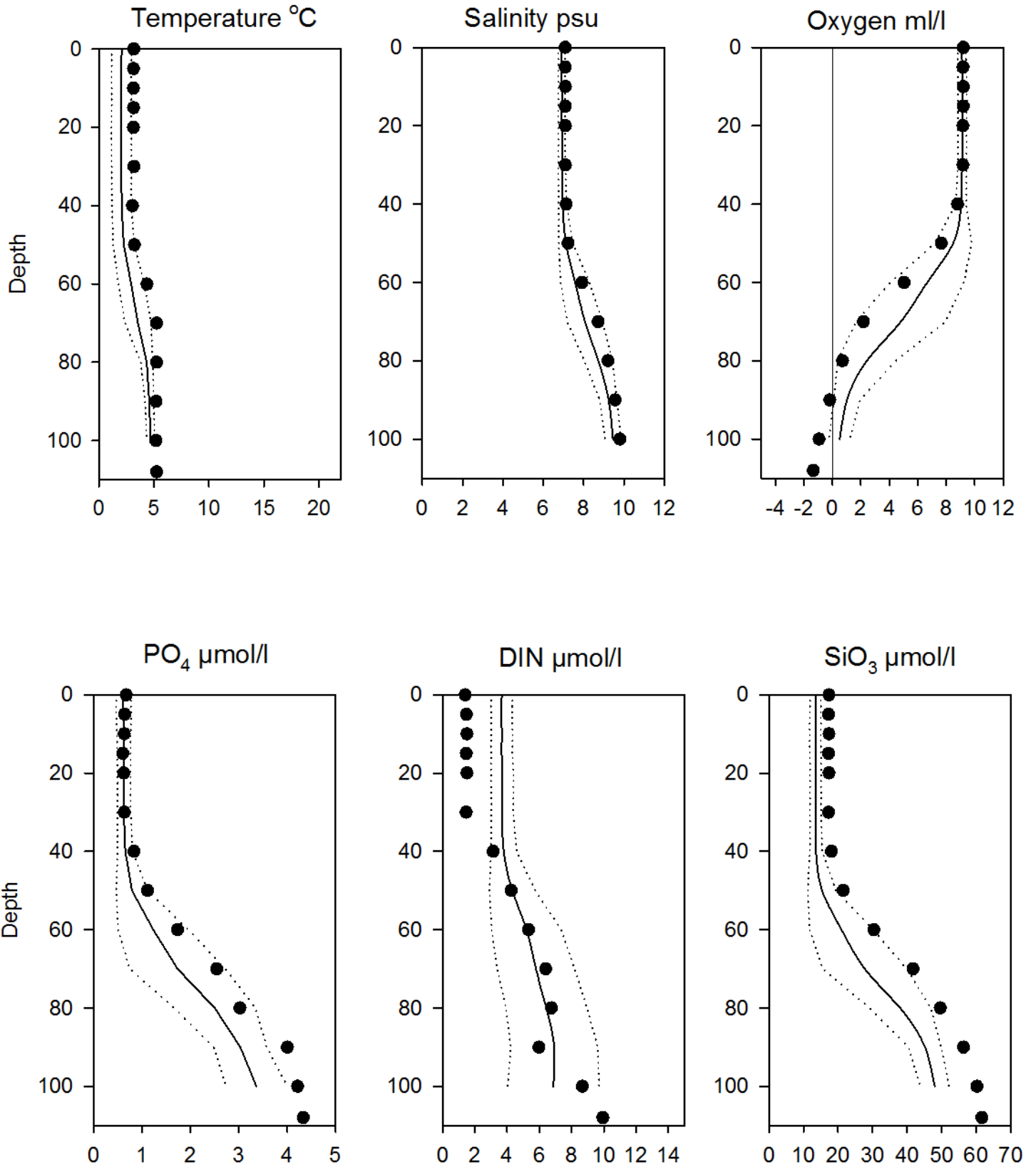


OXYGEN IN BOTTOM WATER (> 100m)



Vertical profiles BY38 March

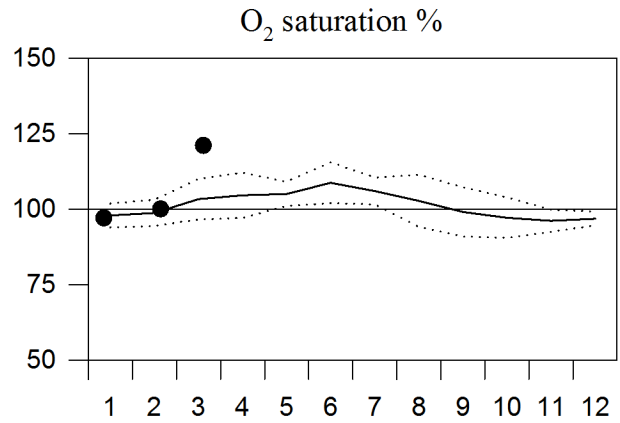
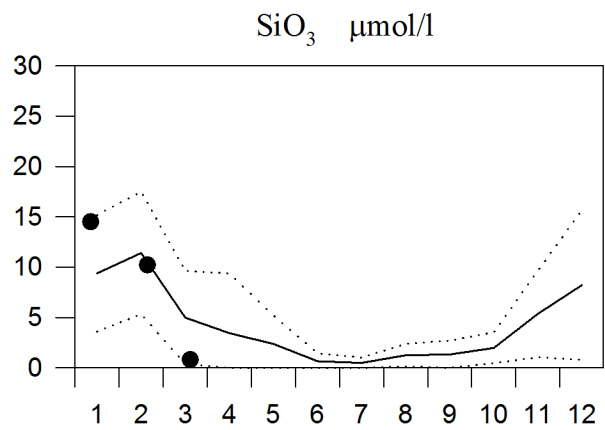
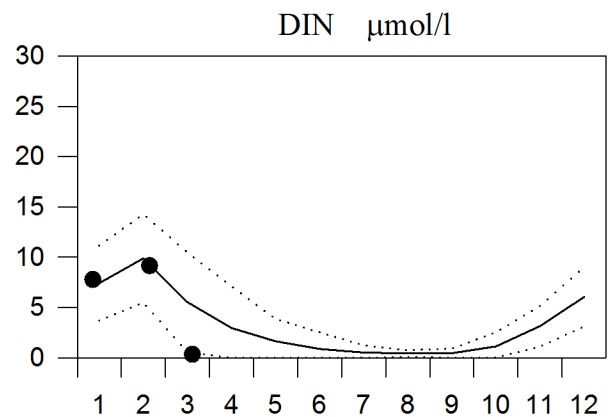
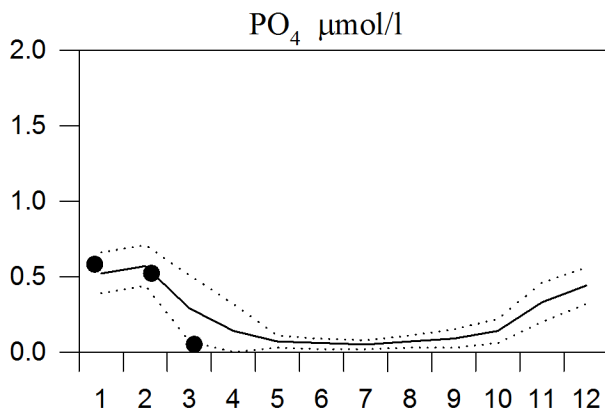
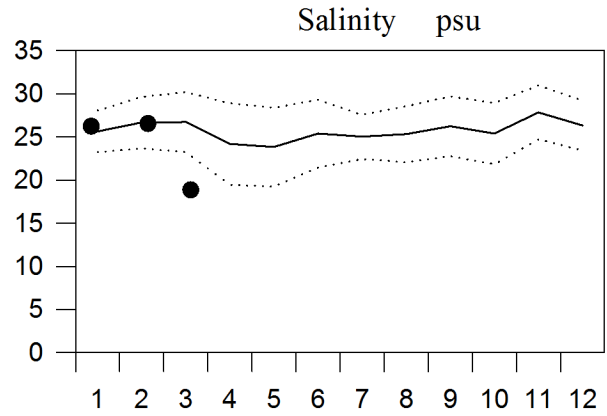
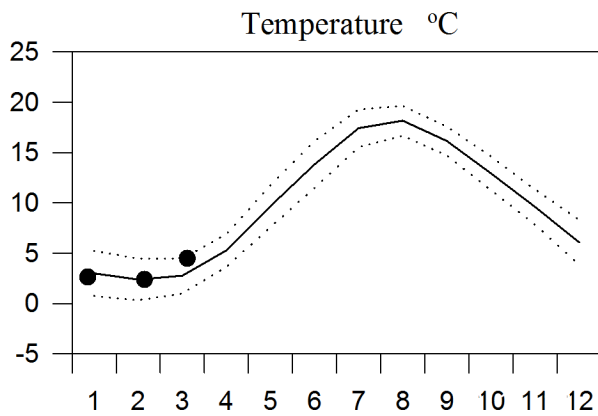
— Mean 1996-2010 St.Dev. ● 2016



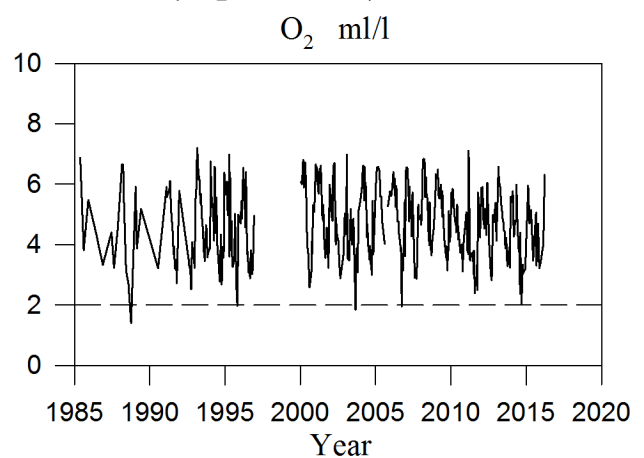
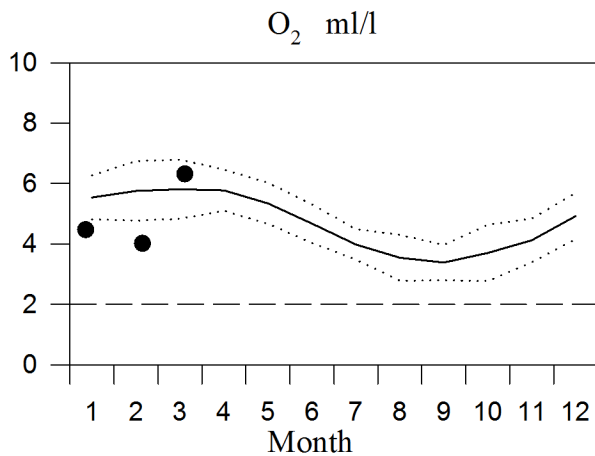
STATION SLÄGGÖ SURFACE WATER

Annual Cycles

— Mean 1996-2010 St.Dev. ● 2016

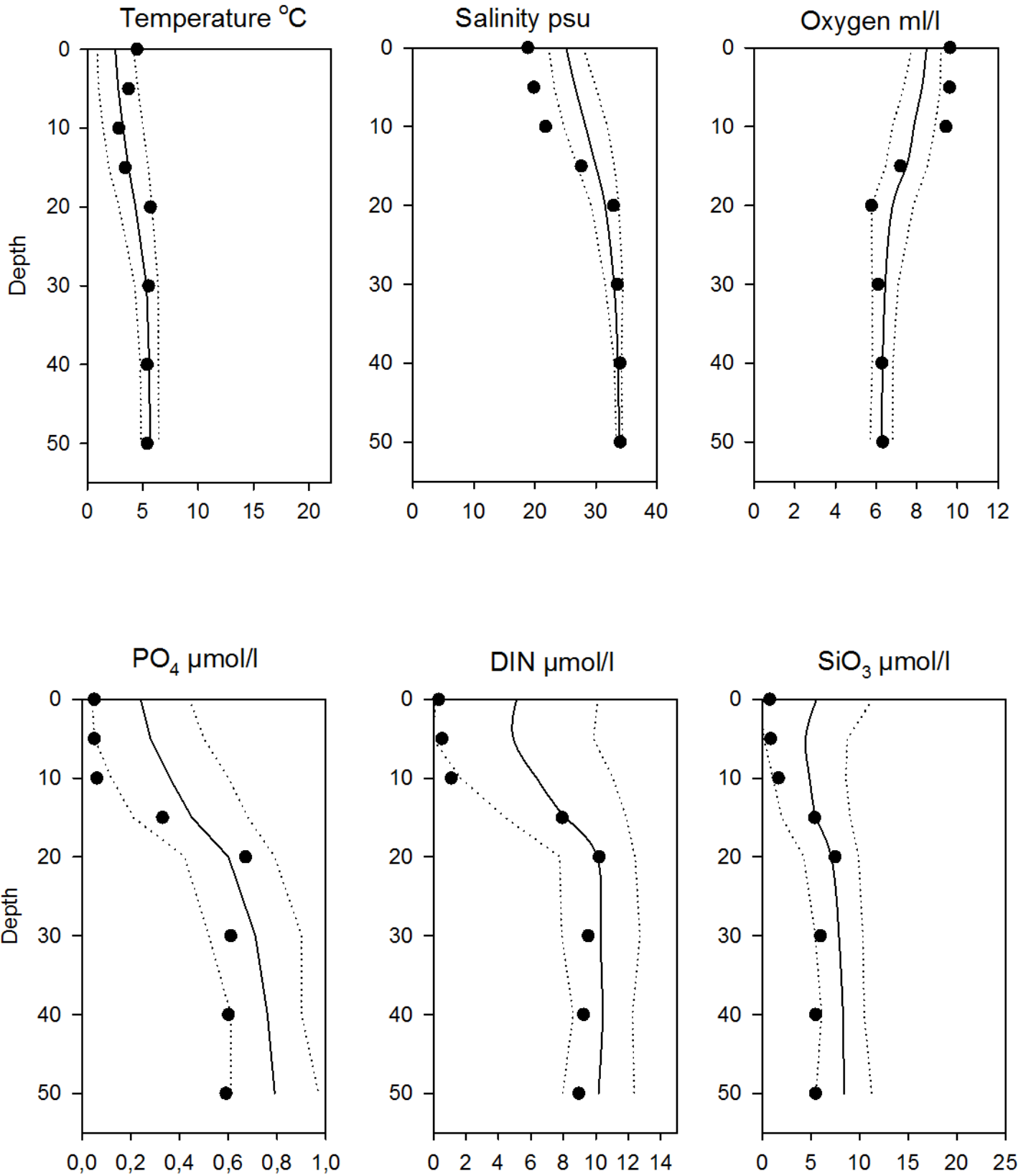


OXYGEN IN BOTTOM WATER (depth >50m)



Vertical profiles Släggö March

— Mean 1996-2010 St.Dev. ● 2016



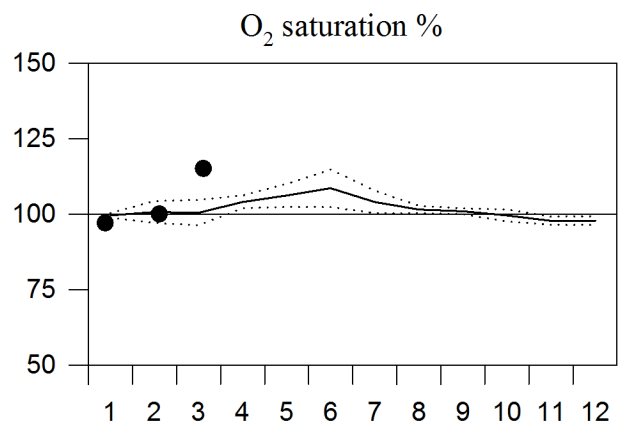
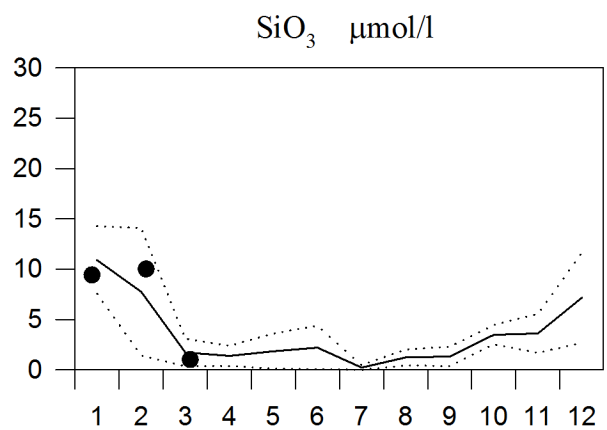
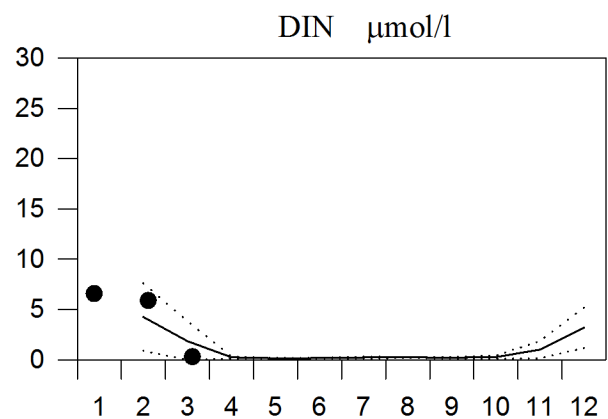
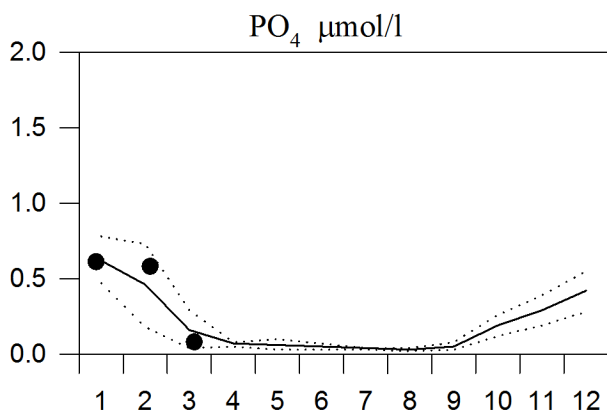
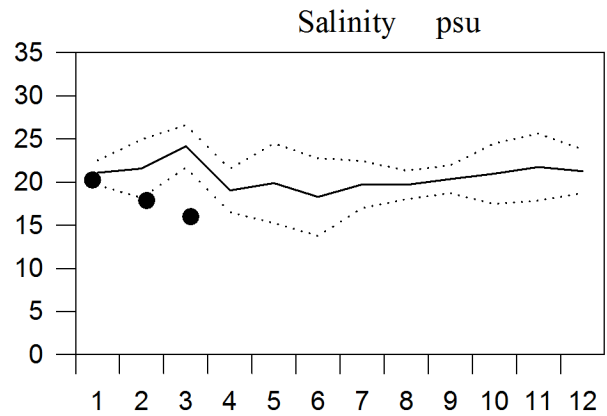
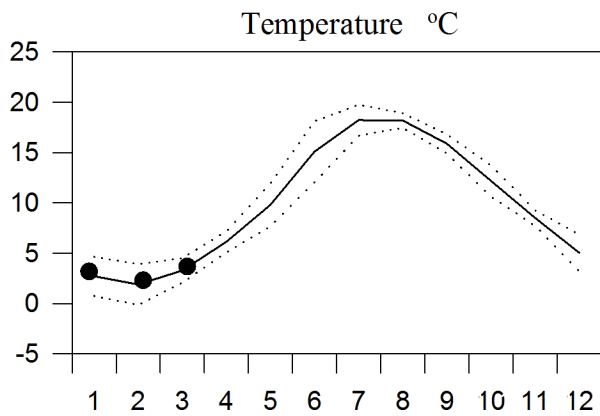
STATION N14 Falkenberg SURFACE WATER

Annual Cycles

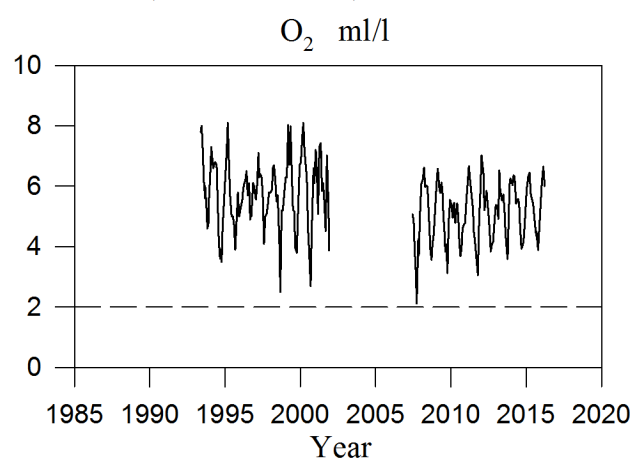
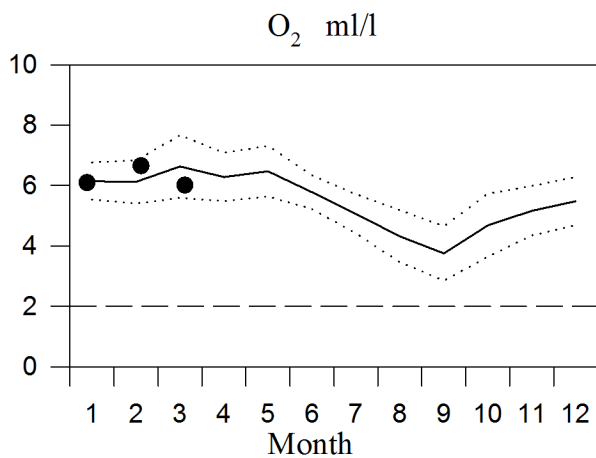
— Mean 2007-2010

..... St.Dev.

● 2016

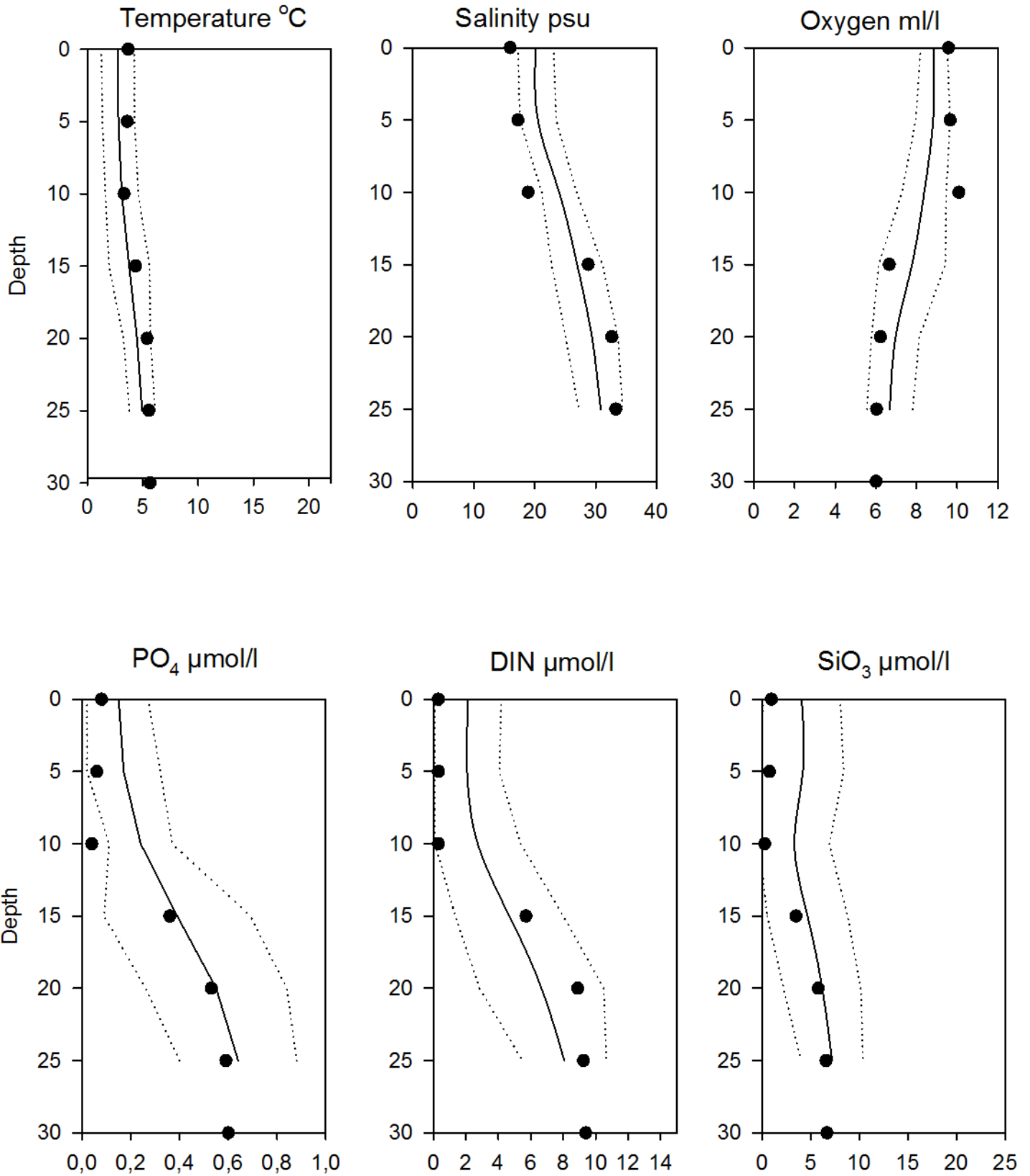


OXYGEN IN BOTTOM WATER (depth > 25m)



Vertical profiles N14 Falkenberg March

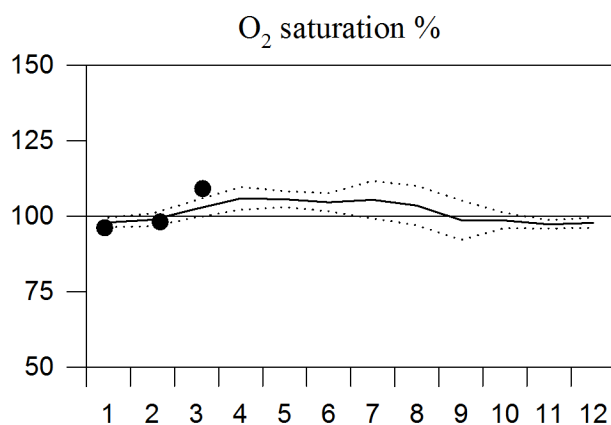
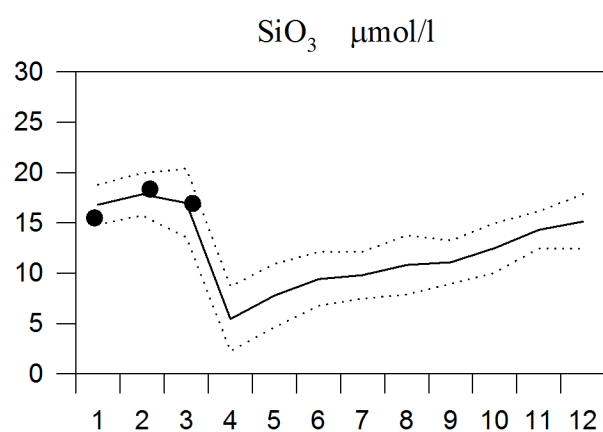
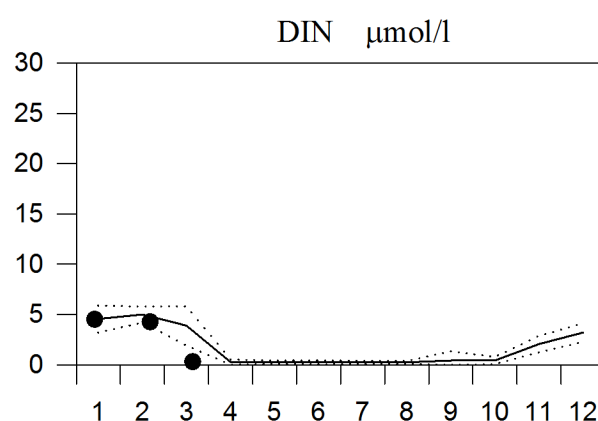
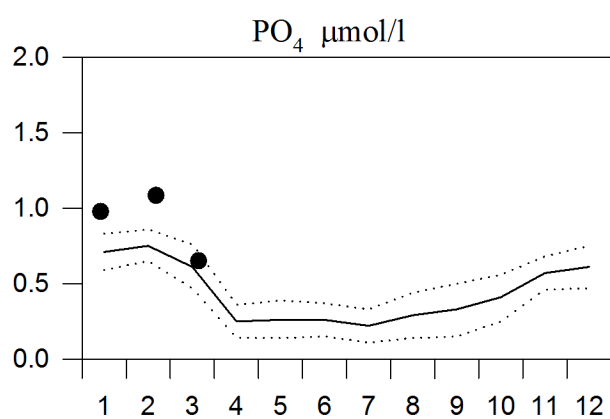
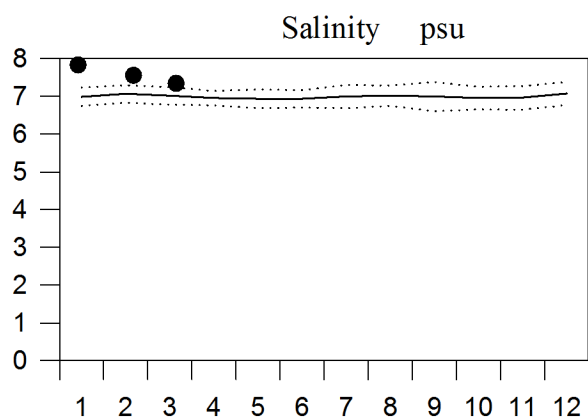
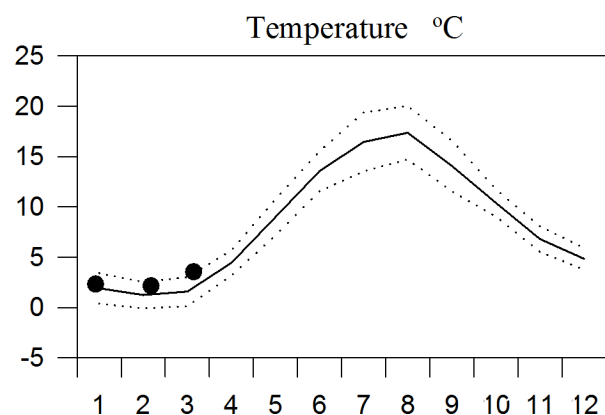
— Mean 1996-2010 St.Dev. ● 2016



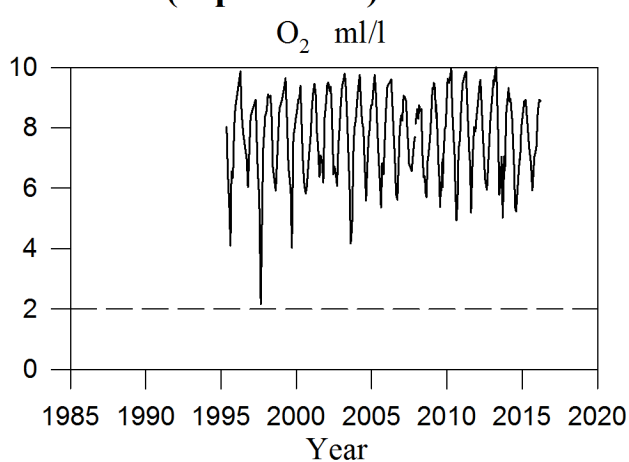
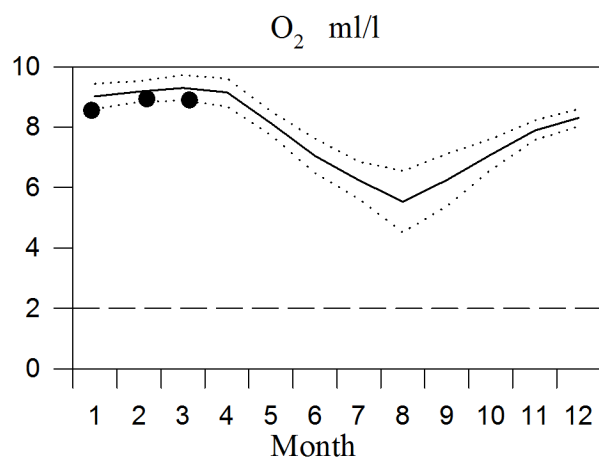
STATION REF M1V1 SURFACE WATER

Annual Cycles

— Mean 1996-2010 St.Dev. ● 2016



OXYGEN IN BOTTOM WATER (depth >15m)



Vertical profiles Ref M1V1 March

— Mean 1996-2010 St.Dev. ● 2016

