

Rapport från SMHIs utsjöexpedition med R/V Aranda



Expeditionens varaktighet: 2016-01-07 - 2016-01-15
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. I Kattegatt genomförde kartering av närsalter. Denna rapport är baserad på preliminära, endast delvis kvalitetskontrollerade data.

Temperaturen i den övre vattenmassan låg över det normala i hela egentliga Östersjön. Halterna av närsalter i ytvattnet var generellt normala för årstiden i Västerhavet. I Östersjön uppvisade fosfat halter över det normala i de västra delarna medan silikat låg klart under medel för årstiden i de södra delarna.

Effekten av det stora inflödet under december 2014 kunde inte följas längre norrut än till stationen BY20 i östra Gotlandsbassängen. Vid Gotlandsdjupet BY15 uppmättes åter svavelväte i bottenvattnet. I västra samt norra Gotlandsbassängen var syresituationen fortsatt mycket allvarlig då helt syrefria förhållanden uppmättes från djup överstigande 70-100 meters djup. Akut syrebrist i bottenvattnet återfanns i Hanöbukten, Bornholmsbassängen och i de sydöstra delarna av egentliga Östersjön.

Nästa ordinarie expedition är planerad starta 15:e februari.

PRELIMINÄRA RESULTAT

Expeditionen genomfördes ombord det finska forskningsfartyget Aranda och startade i Helsingfors den 7:e december samt avslutades i samma hamn den 15:e. Vindarna under expeditionen var i huvudsak sydostliga till nordliga, och varierade i styrka från svaga till hårda. Lufttemperaturen varierade mellan -14 och +4°C. I Kattegatt och Öresund genomfördes kartering av vinterpoolen av närsalter. Utöver de ordinarie 4 stationerna besöktes 12 karteringsstationer i det aktuella havsområdet.

Skagerrak

Temperaturen i ytvattnet var normal för årstiden och varierade mellan 2,6 och 4,6 °C, lägst vid kusten och högst i utsjön. Salthalten i ytlagret, även den normal för årstiden, varierade mellan 26,2 och 30,8 psu. Skiktningen, både när det gäller temperatur och salthalt, var svagt utvecklad.

Närsalthalterna uppvisade typiska koncentrationer för årstiden förutom silikat där koncentrationen var över det normala i centrala delarna. I ytvattnet låg halterna av fosfat i intervallet 0,52 – 0,66 µmol/l, oorganiskt kväve (nitrit + nitrat) mellan 5,7 och 6,8 µmol/l medan silikat varierade från 7,1 till 14,5 µmol/l. De lägsta syrehalterna i bottenvattnet uppmättes vid Släggö i Gullmarsfjorden mynning, 4,5 ml/l. Fluorescensmätningarna visade på låg 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 2,7 och 4,6°C. Salthalten i ytlagret var generellt lägre än normalt och varierade i de sydliga delarna mellan 15,3 – 18,8 psu och i de norra omkring 20,2 – 23,2 psu. I Öresund var salthalten omkring 9 psu vilket är lägre än normalt. En svag skiktning återfanns på omkring 10-20 meters djup.

Karteringen av vinterpoolen av närsalter visade att halterna i ytvattnet var normala eller något lägre än normalt för årstiden, med undantag för stationen Fladen där fosfat och silikat uppvisade högre halter än normalt. Generellt hade halterna av samtliga närsalter ökat sedan senaste besöket i december och de högsta halterna återfanns i de västra delarna av området. Fosfatkoncentrationerna låg nu mellan 0,6 och 0,8 µmol/l. Summa nitrit+nitrat i intervallet 3,2 – 6,2 µmol/l och silikat mellan 7,8 och 12,7 µmol/l.

På grund av den svaga skiktningen var syreförhållandena i djupvattnet goda. Vid samtliga stationer uppmättes syrehalter över 6 ml/l i bottenvattnet. Planktonaktiviteten var låg i hela det undersökta området.

Egentliga Östersjön

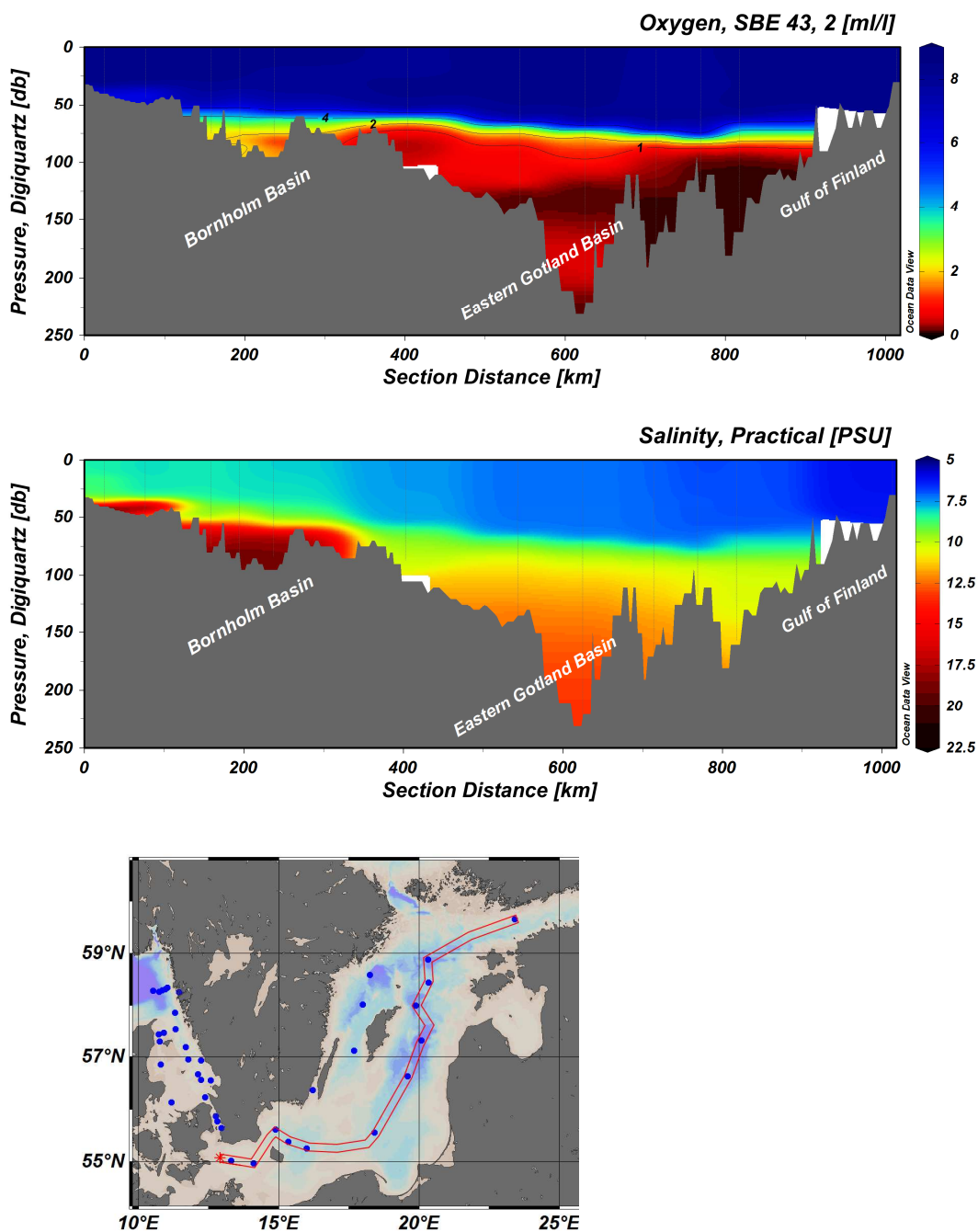
Temperaturen i vattenmassan över språngskiktet var högre än normalt i hela området och varierade mellan och varierade från 3,7°C till 6,1°C. Ytsalthalten var förhöjd i Hanöbukten, Bornholmsbassängen samt i västra Gotlandsbassängen, i övriga områden normal. Haloklin och termoklin sammanföll och återfanns på 50-70 meters djup i västra- och på 60-80 meters djup i östra- och norra Gotlandsbassängen, medan de låg något grundare i de södra delarna.

Fosfathalterna i ytvattnet hade stigit ytterligare sedan föregående mätning och i västra Gotlandsbassängen uppmättes halter klart över det normal, 0,8-1,0 µmol/l. I övriga områden låg fosfathalten mellan 0,6 - 0,7 µmol/l. Halterna av nitrit+nitrat var normala i hela det undersökta området och varierade från 2,3 till 3,2 µmol/l. Precis som vid förra besöket i december var koncentrationen av silikat klart under det normala i de södra delarna medan de var förhöjda i övriga områden. Halterna varierade mellan 7,4 och 16,8 µmol/l.

I östra Gotlandsbassängen observerades akut syrebrist (< 2 ml/l) på djup överstigande 70-80 meter. Svavelväte förekom, liksom vid föregående mättillfälle, i den norra delen (BY20 och BY21) från omkring 125 meters djup. Vid Gotlandsdjupet BY15 uppmättes åter svavelväte i bottenvattnet och från 150-225 meters djup var halterna av syre mycket låga $< 0,7$ ml/l.

I västra samt norra Gotlandsbassängen var syresituationen fortsatt mycket allvarlig. I västra Gotlandsbassängen återfanns helt syrefria förhållanden, då svavelväte bildas, från 70-90 meter medan akut syrebrist, < 2 ml/l, förekom från 50-70 meter. Den norra delen hade helt syrefria förhållanden från 100 meters djup och akut syrebrist från 80-90 meter.

Akut syrebrist i djupvattnet observerades också i Hanöbukten, Bornholmsbassängen samt i de sydöstra delarna av egentliga Östersjön.



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



DELTAGARE

Namn

Martin Hansson Expeditionsledare
Daniel Bergman Sjöstrand
Johan Håkansson
Johan Kronsell
Sari Sipilä
Kristin Andreasson

Från

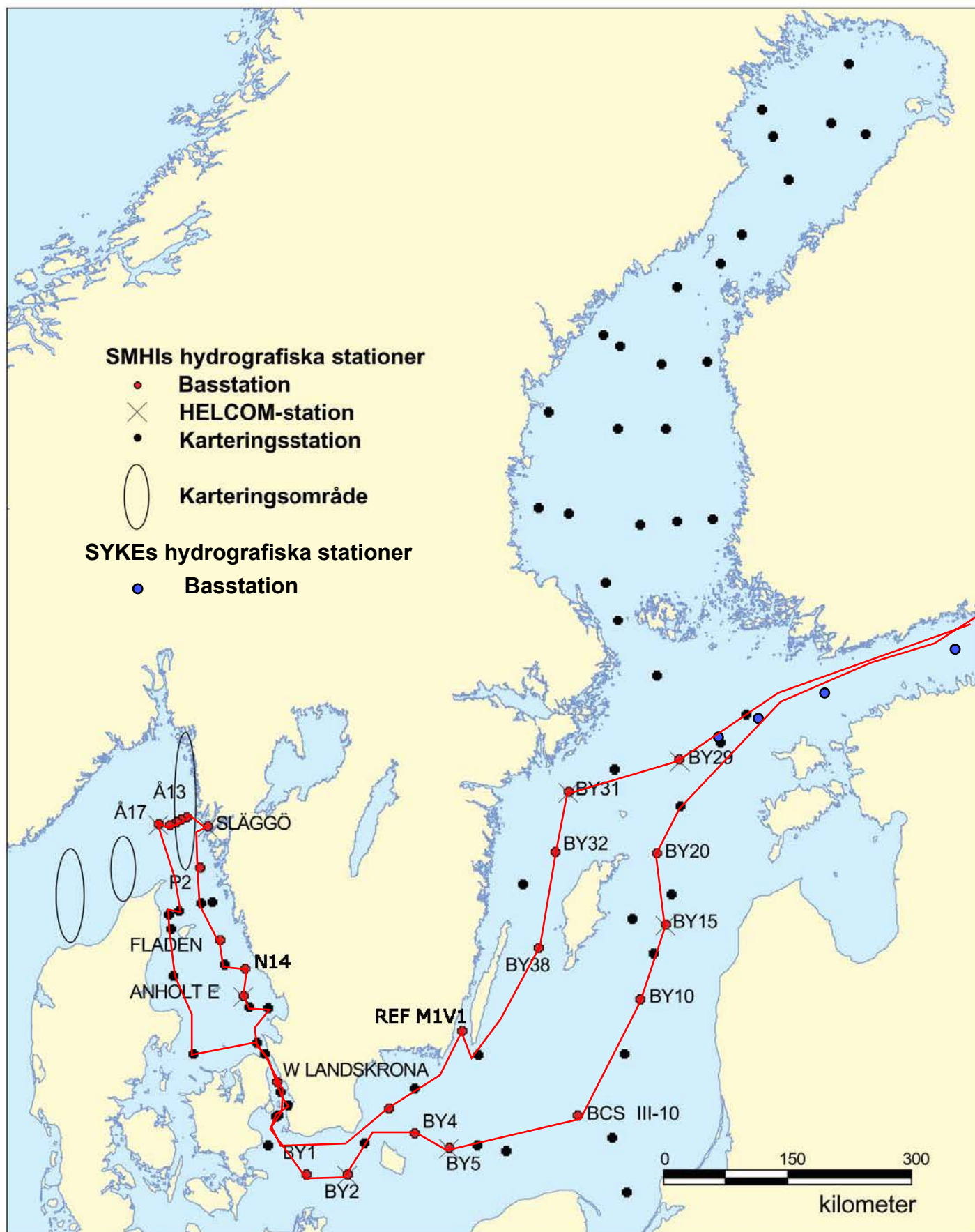
SMHI
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BILAGOR

- 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: 20160107-20160115
 Series: 0001-0040



Date: 2016-01-20
Time: 22:09

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 hd	C PPCPZT Hrhhoo Cilyooa PrPl	No de	T e a m l p i g n	P h x 2 o y S 4 P P N	O H x 2 o y S 4 P P N	P T N N N N N	N T o h o l i N a 3 u n	A S h o l i u i o m g N C	S H L i u i o m g N C	P T o o o C m	P T o o o C m		
0001	GFXHX00EXT		CTD TEST	N5939.51	E2323.92	20160107	1910	50		04 4	-14.0	1014	7999	x	-----	8	-	-	-	-	-	-	-	-	-	x
0002	BPNX27EXT		BY21	N5826.5	E2020	20160108	0502	121		12 8	-6.6	1009	7990	x	-----	14	x	x	-	x	-	-	-	-	-	-
0003	BPEX26BAS		BY20 FÄRÖDJ	N5800	E1953	20160108	0822	195	8	13 11	-7.5	1007	2740	x	--x----	17	x	x	-	x	x	x	x	x	-	-
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Bottom water oxygen concentration (ml/l)

Country: Finland

Ship : Aranda

Date : 20160107-20160114

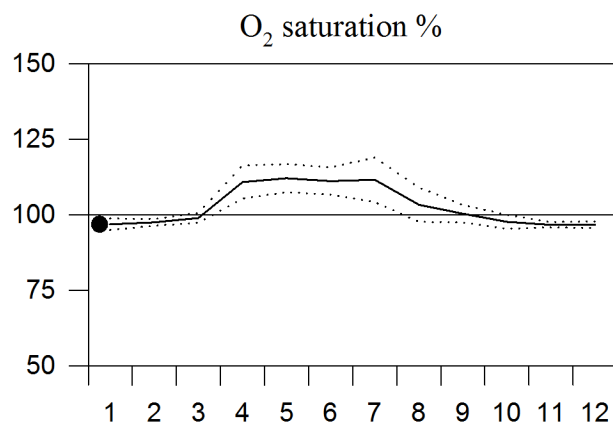
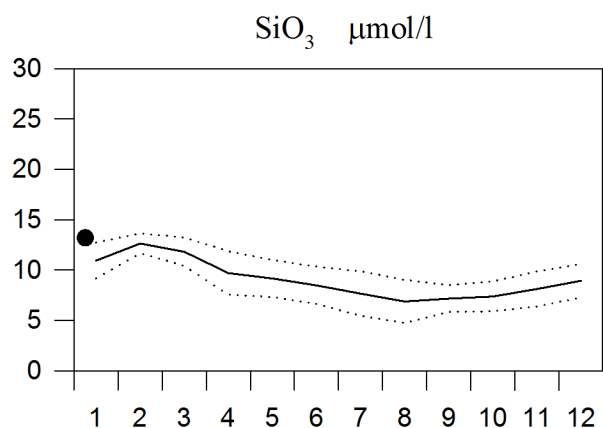
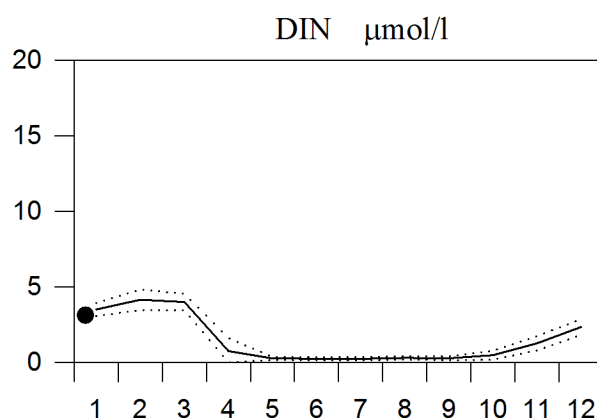
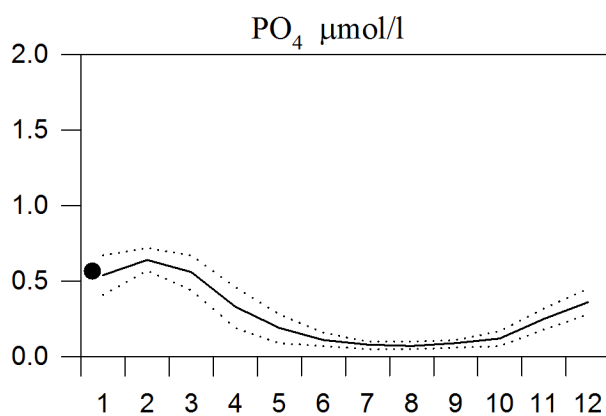
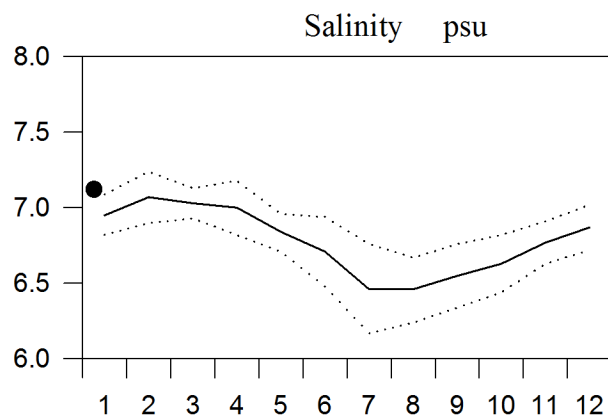
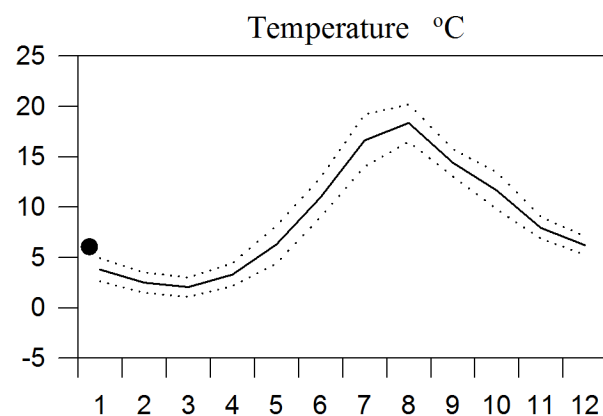
Series : 0001-0040



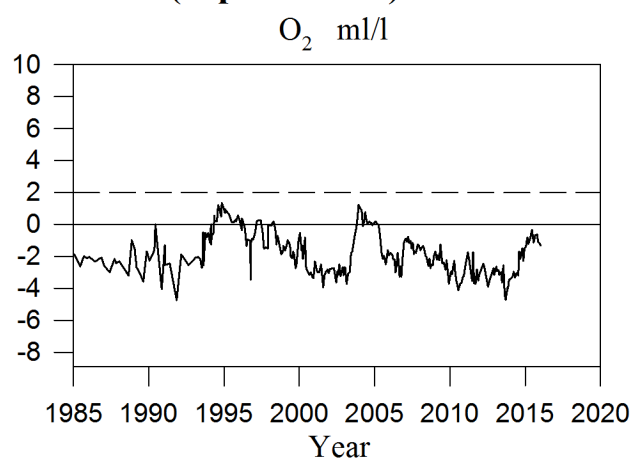
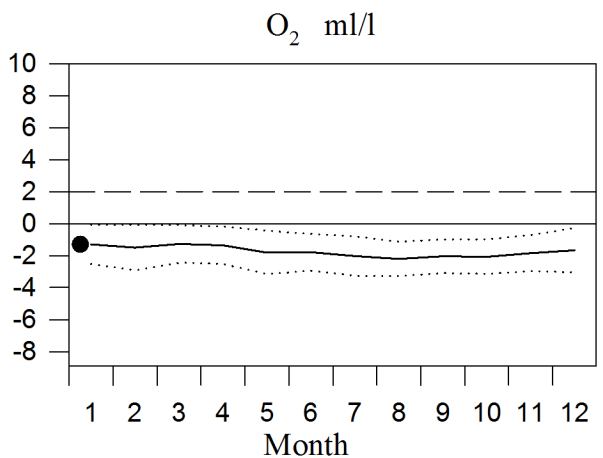
STATION BY20 SURFACE WATER

Annual Cycles

— Mean 1996-2010 St.Dev. ● 2016



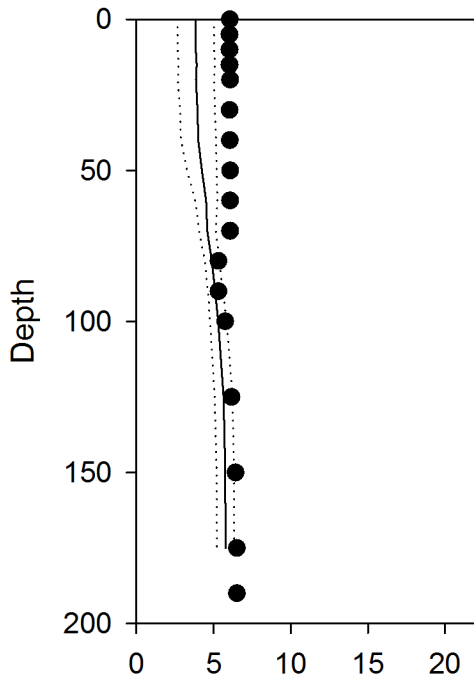
OXYGEN IN BOTTOM WATER (depth >175m)



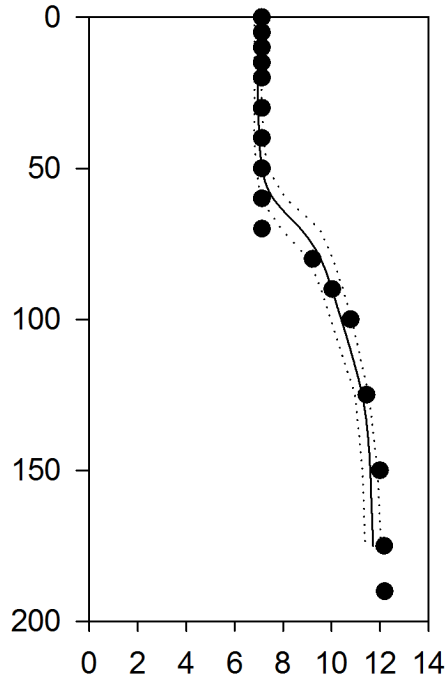
Vertical profiles BY20 January

— Mean 1996-2010 St.Dev. ● 2016

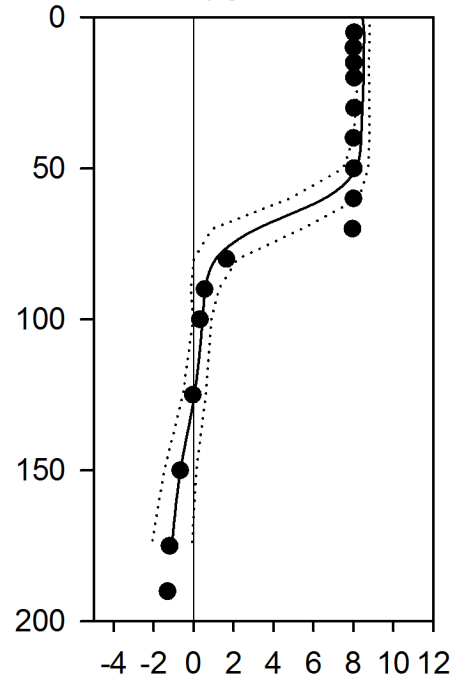
Temperature °C



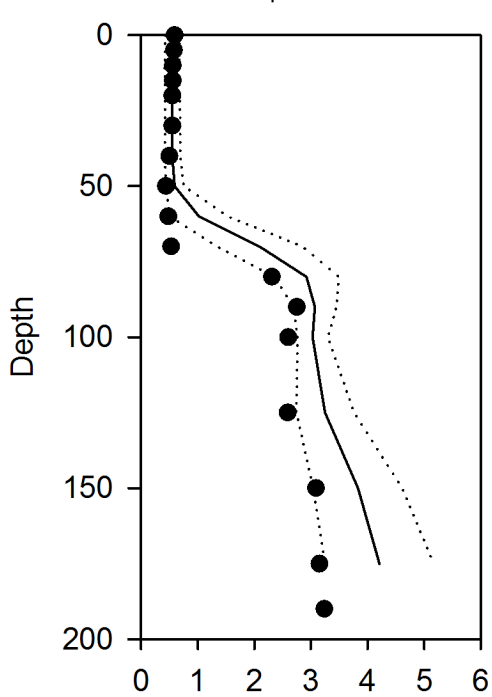
Salinity psu



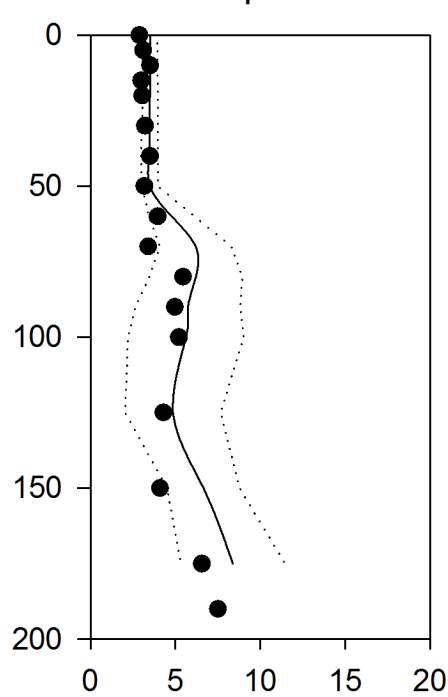
Oxygen ml/l



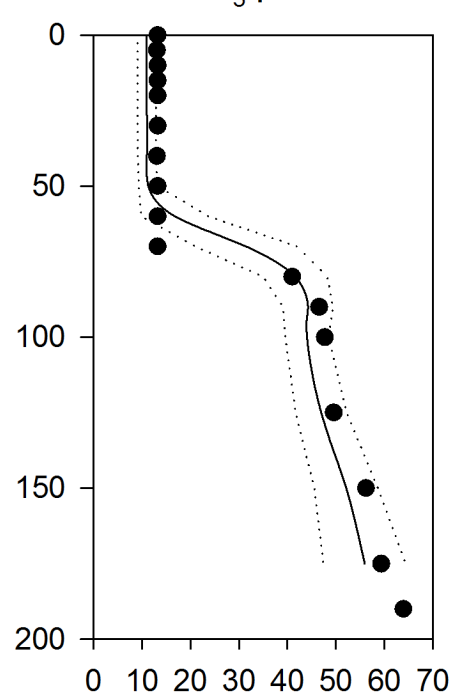
PO₄ μmol/l



DIN μmol/l



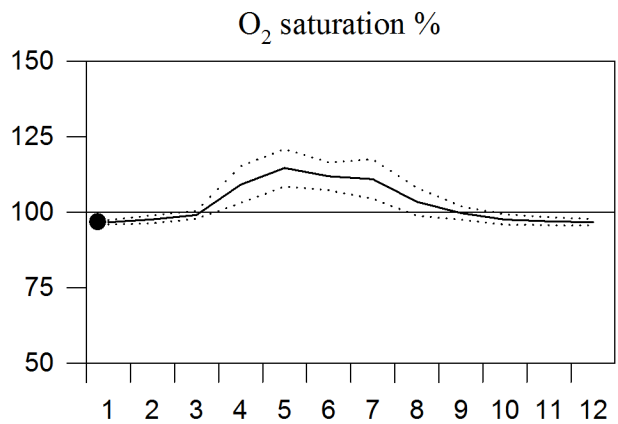
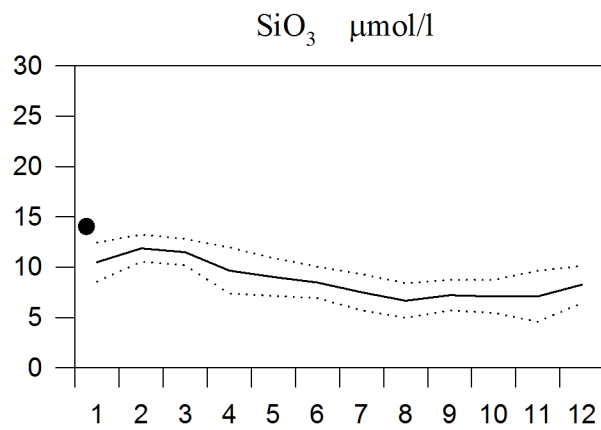
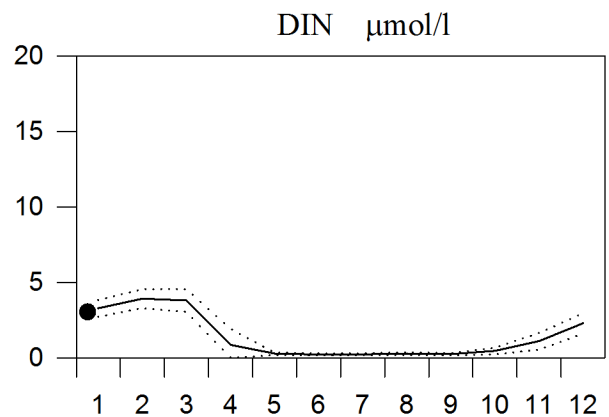
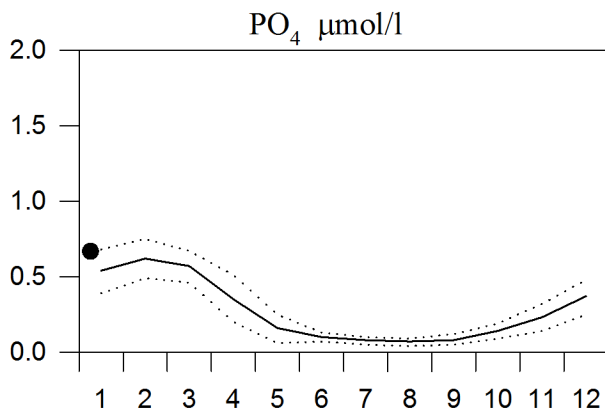
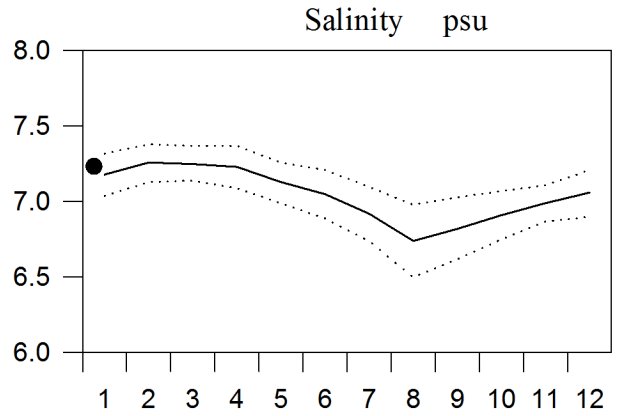
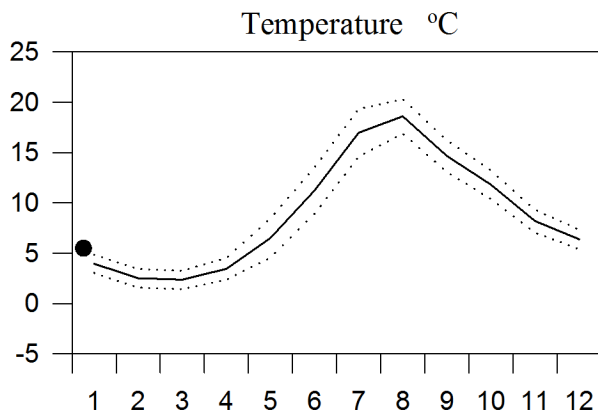
SiO₃ μmol/l



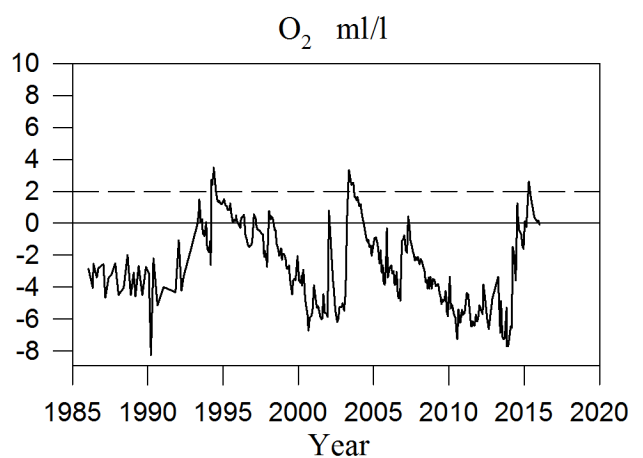
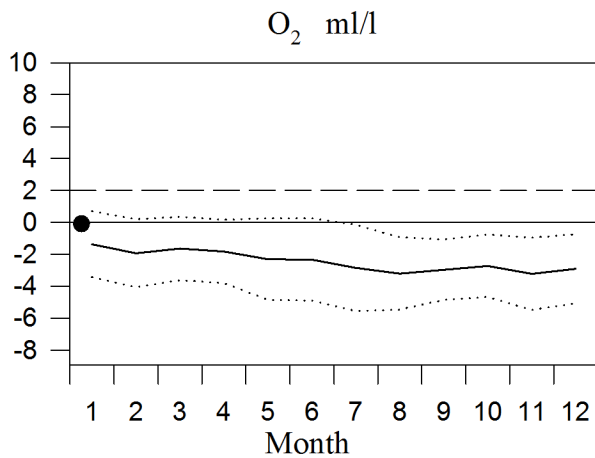
STATION BY15 SURFACE WATER

Annual Cycles

— Mean 1996-2010 St.Dev. ● 2016



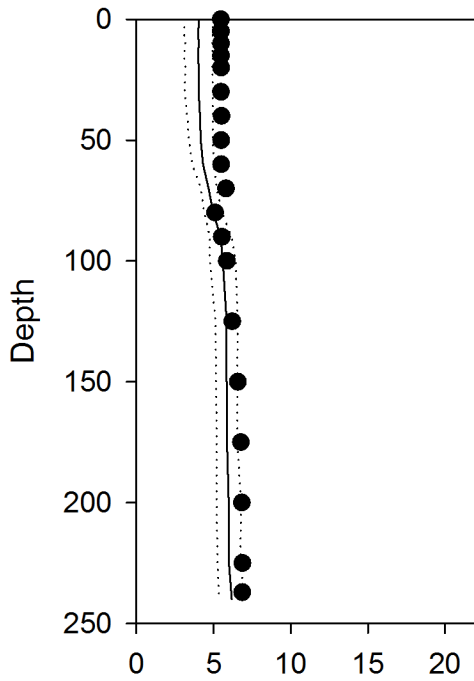
OXYGEN IN BOTTOM WATER (depth >225m)



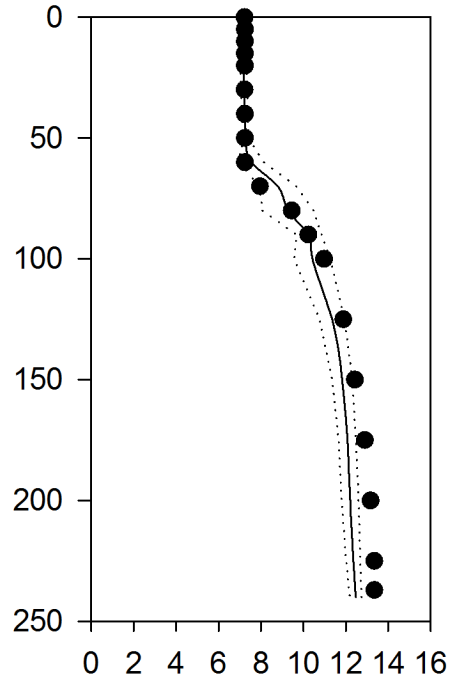
Vertical profiles BY15 January

— Mean 1996-2010 St.Dev. ● 2016

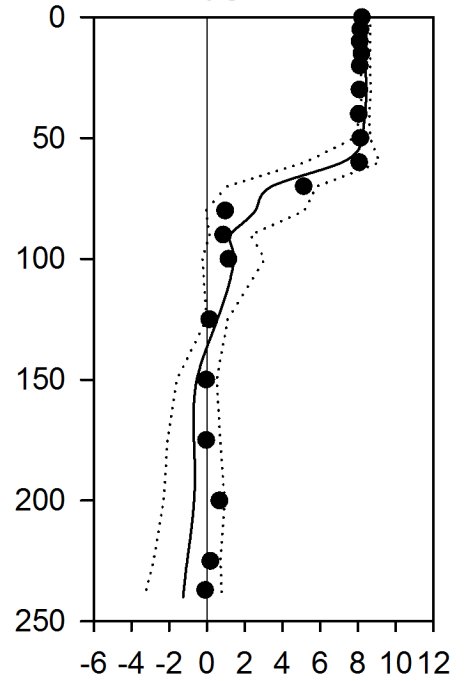
Temperature °C



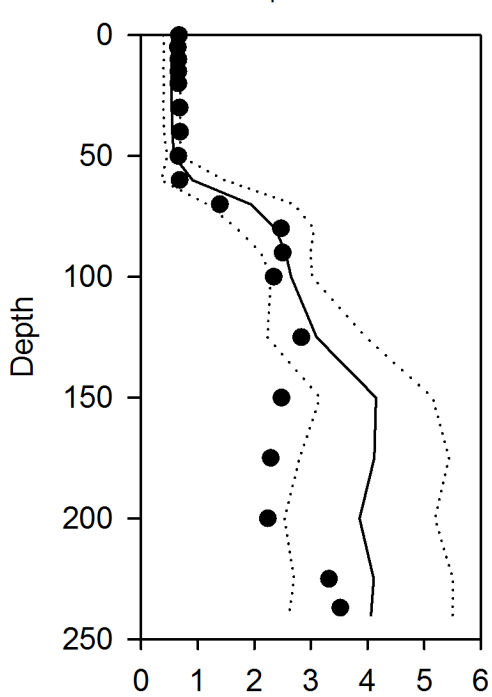
Salinity psu



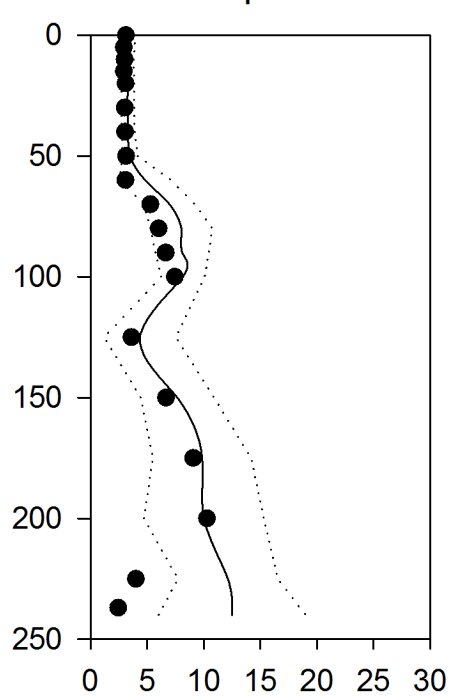
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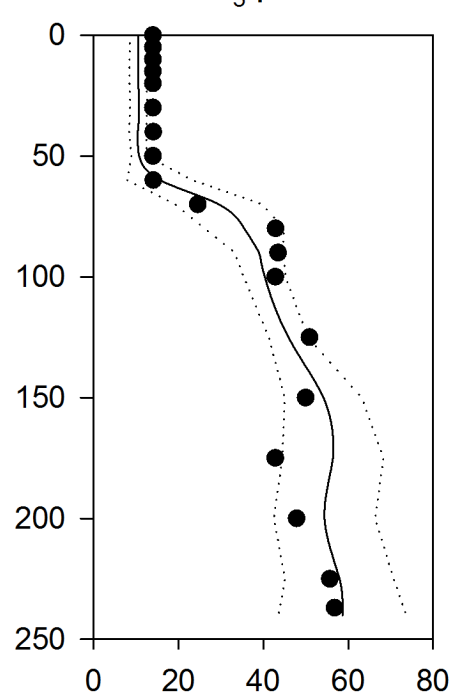
PO₄ μmol/l



DIN μmol/l



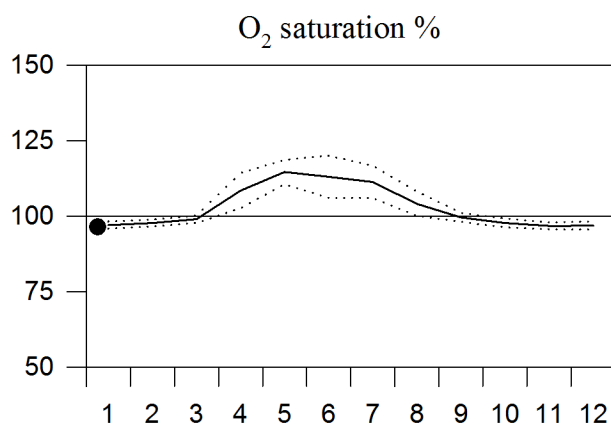
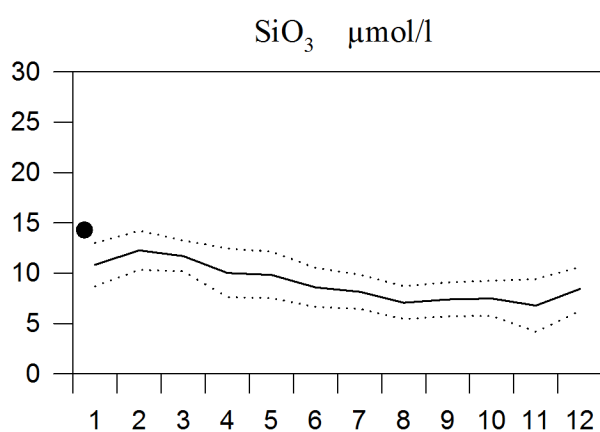
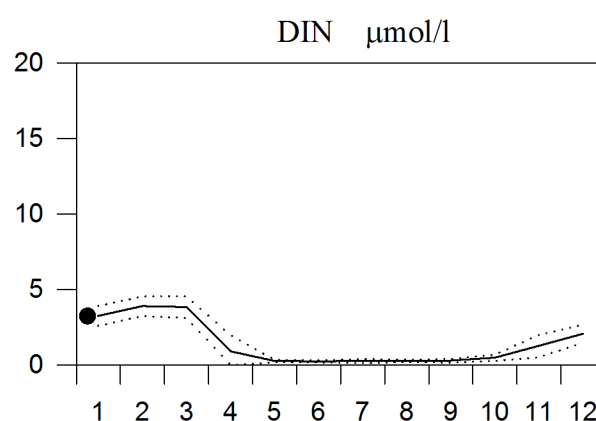
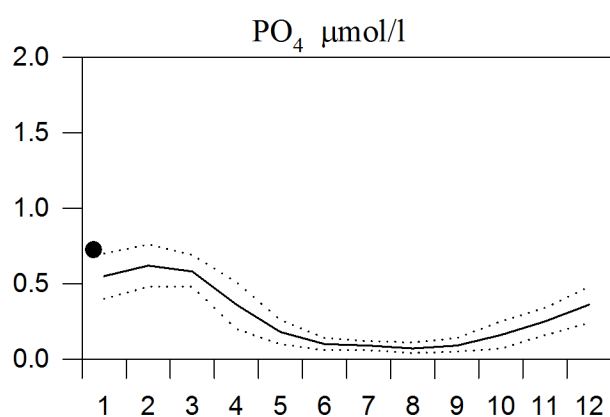
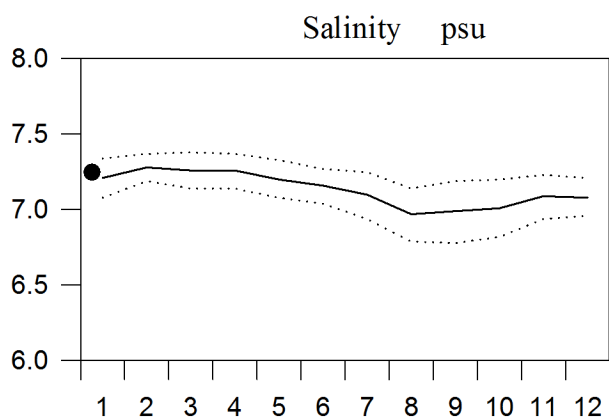
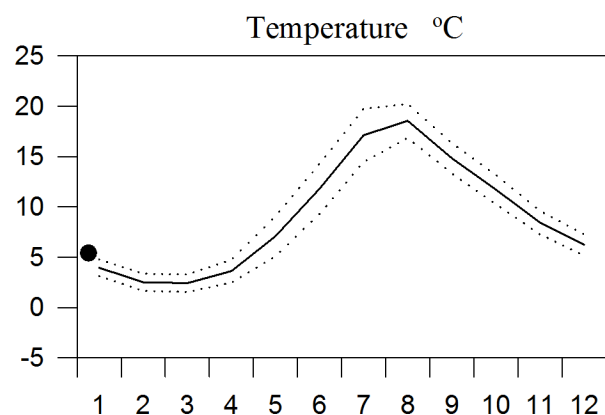
SiO₃ μmol/l



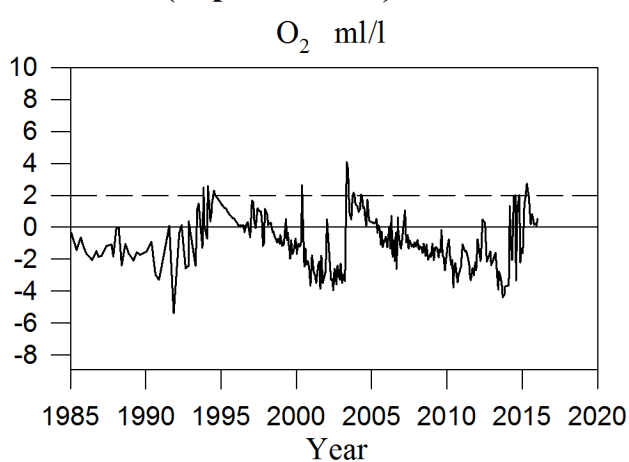
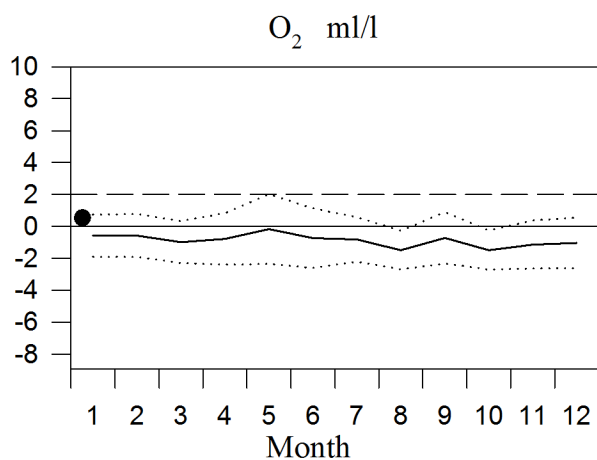
STATION BY10 SURFACE WATER

Annual Cycles

— Mean 1996-2010 St.Dev. ● 2016

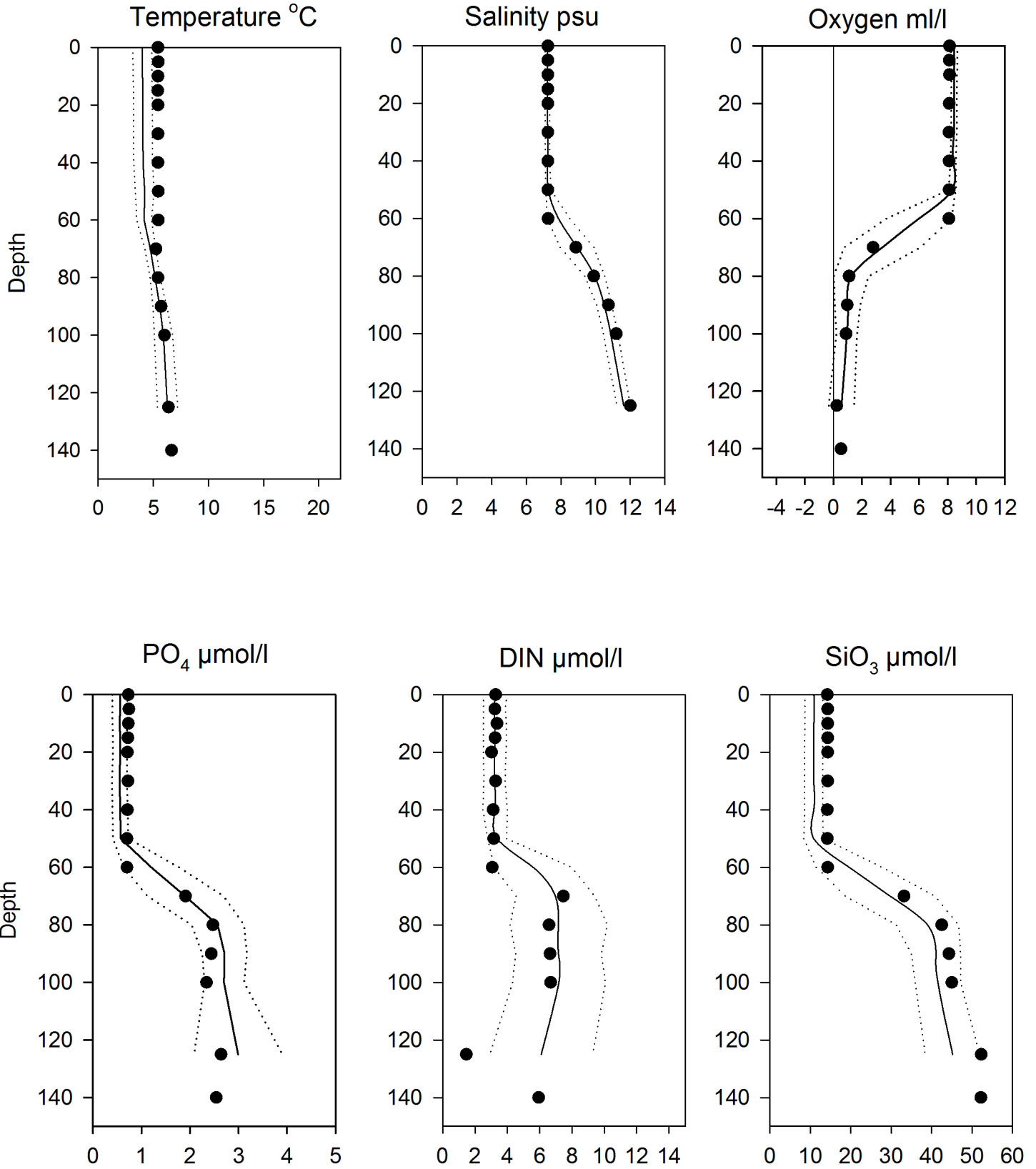


OXYGEN IN BOTTOM WATER (depth >125m)



Vertical profiles BY10 January

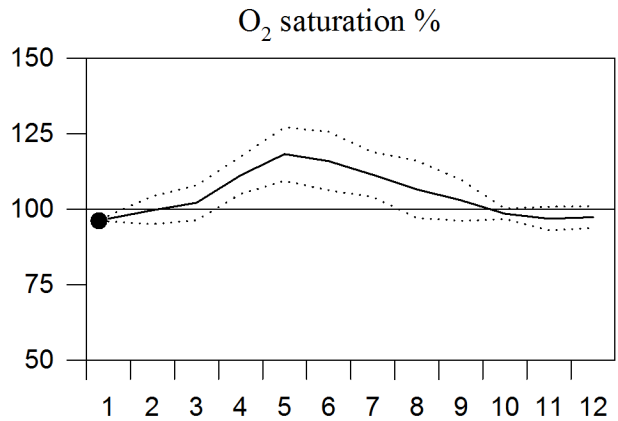
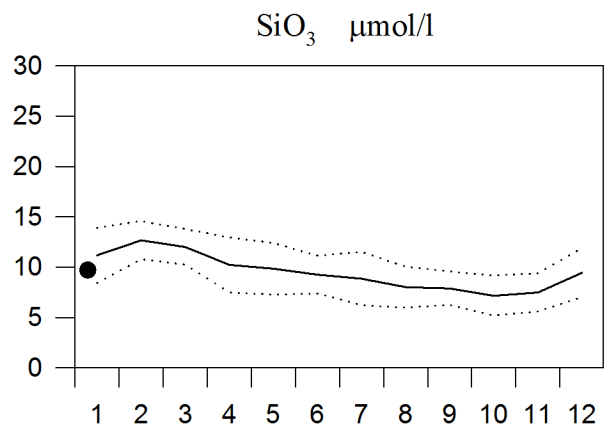
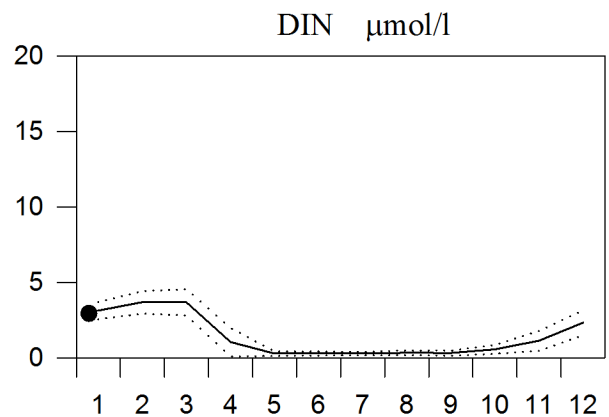
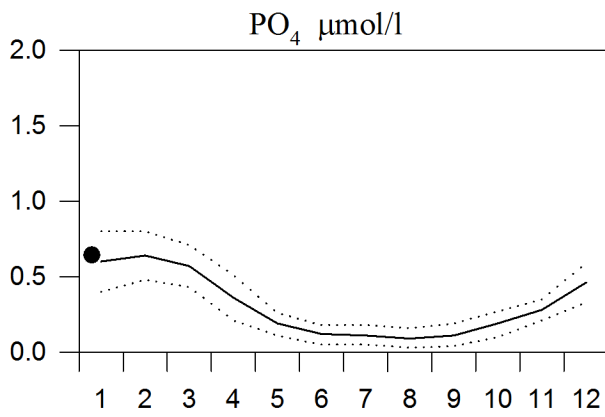
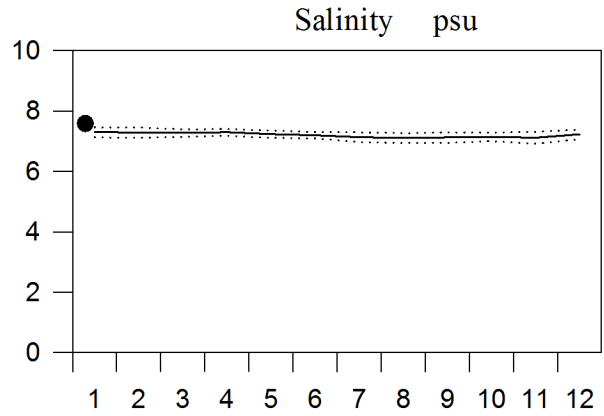
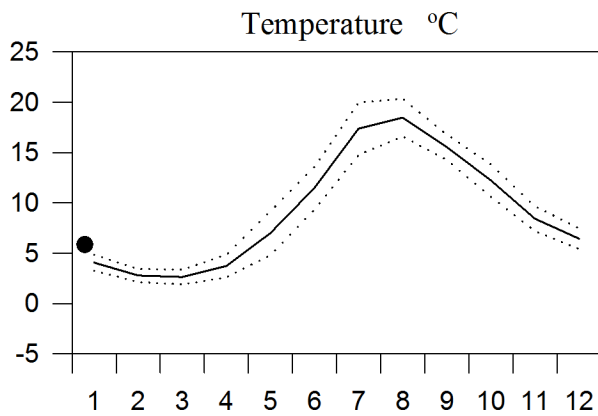
— Mean 1996-2010 St.Dev. ● 2016



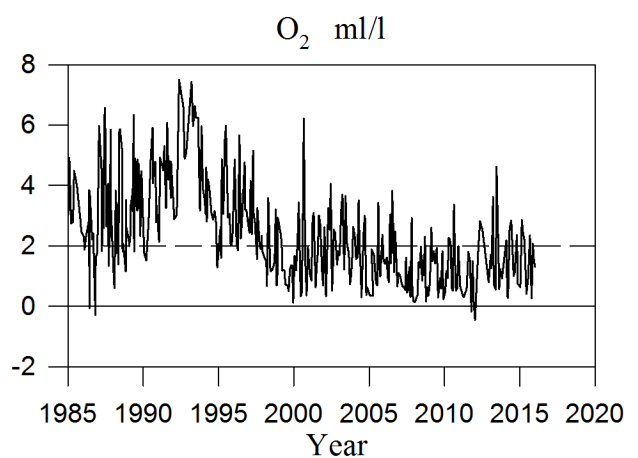
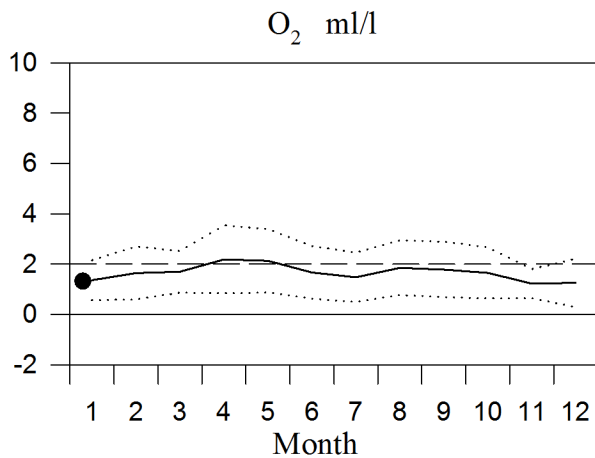
STATION BCS III-10 SURFACE WATER

Annual Cycles

— Mean 1996-2010 St.Dev. ● 2016

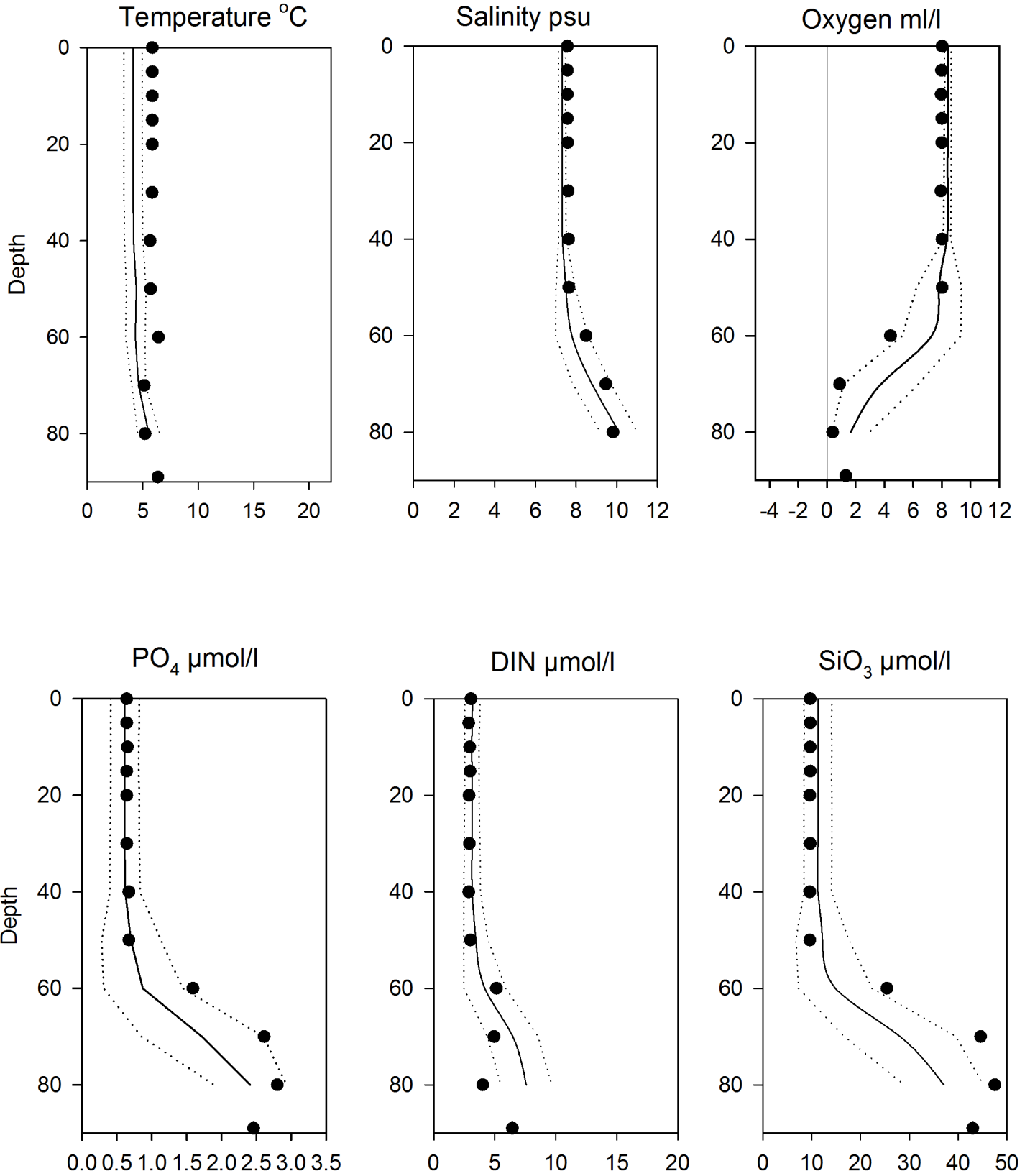


OXYGEN IN BOTTOM WATER (depth > 80m)



Vertical profiles BCS III-10 January

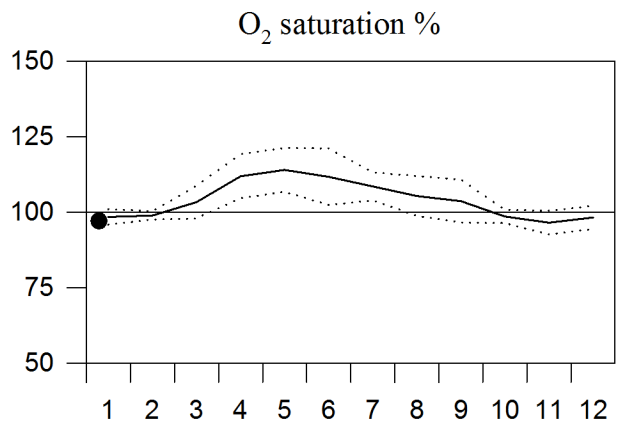
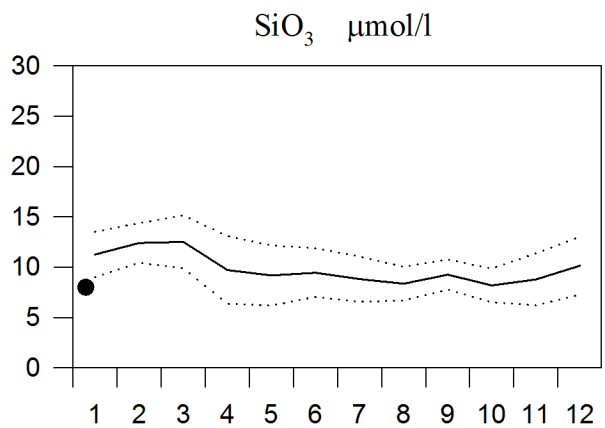
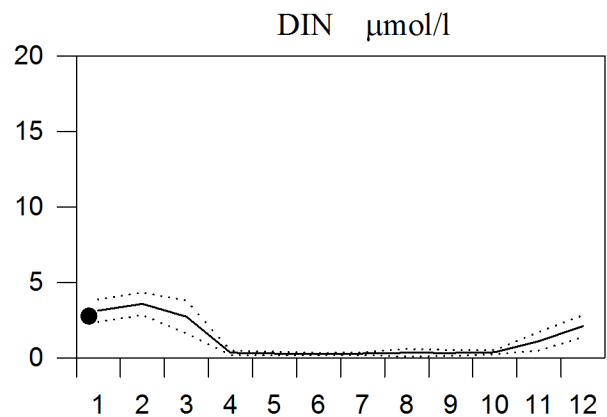
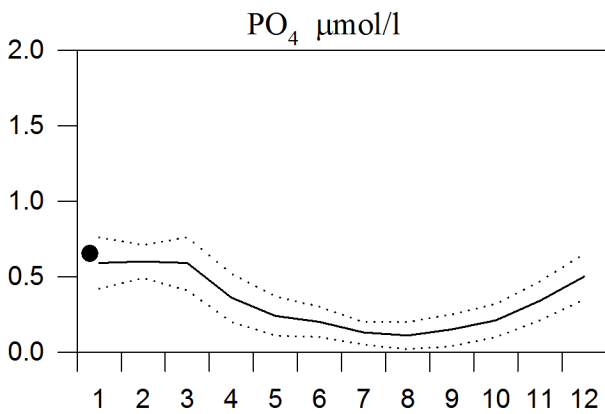
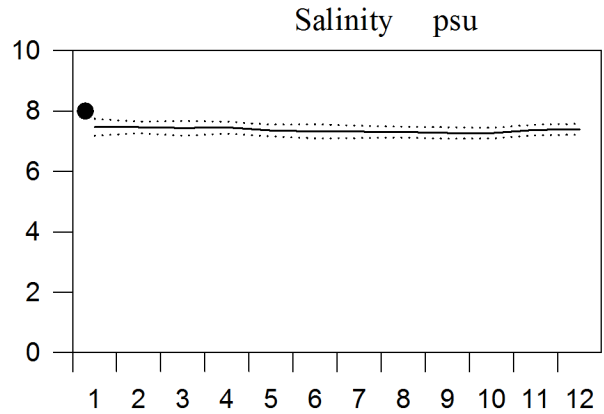
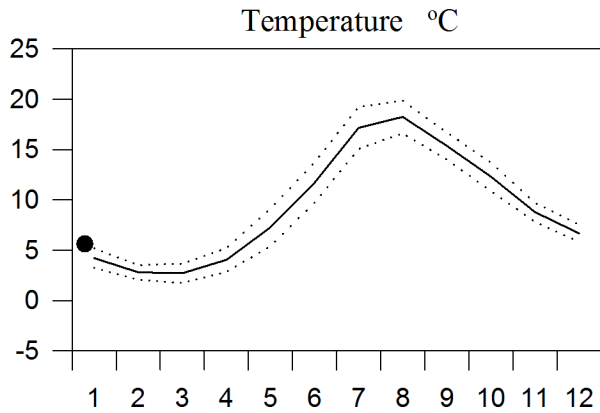
— Mean 1996-2010 St.Dev. ● 2016



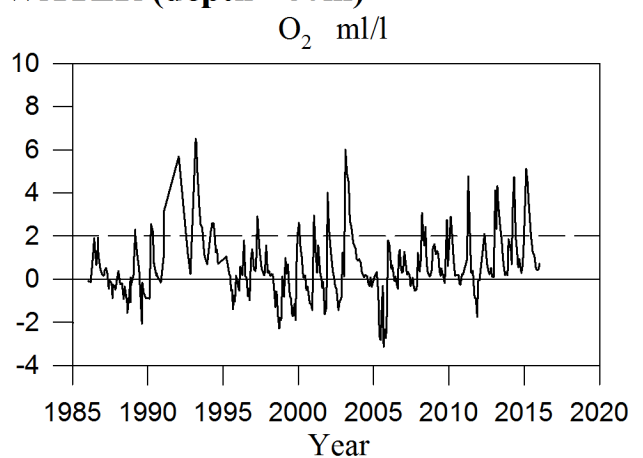
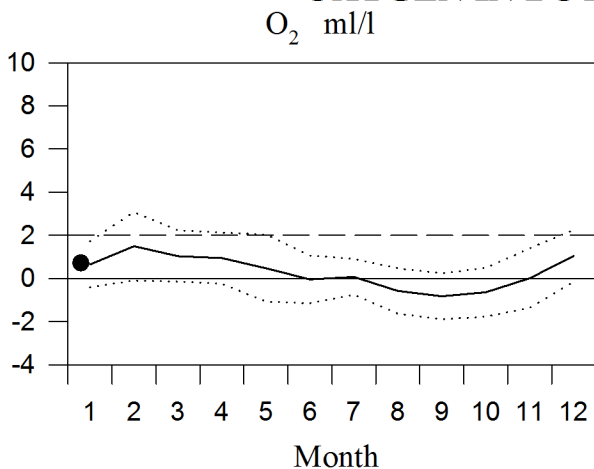
STATION BY5 SURFACE WATER

Annual Cycles

— Mean 1996-2010 St.Dev. ● 2016

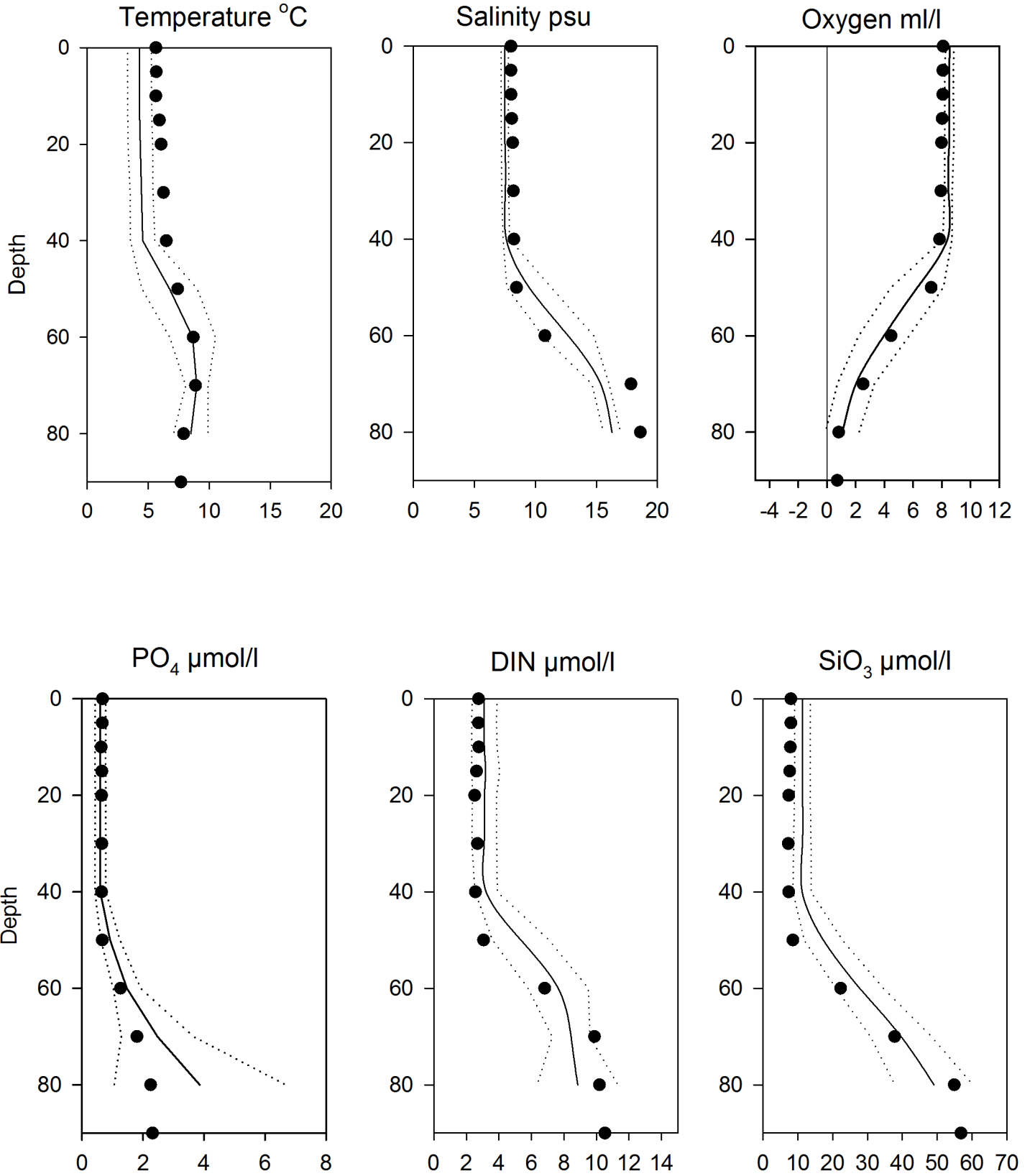


OXYGEN IN BOTTOM WATER (depth >80m)



Vertical profiles BY5 January

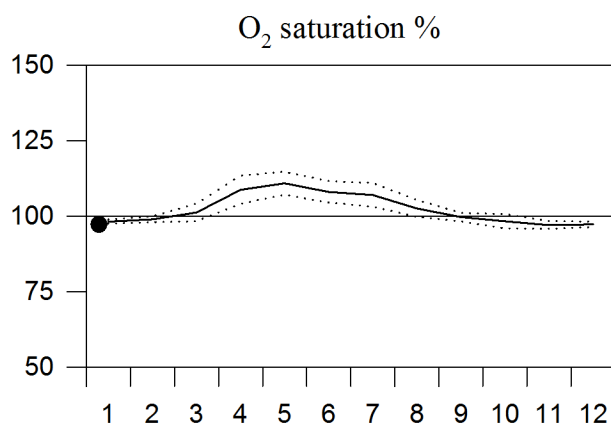
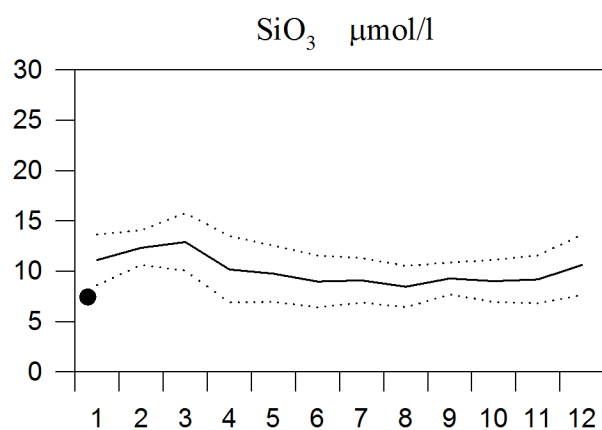
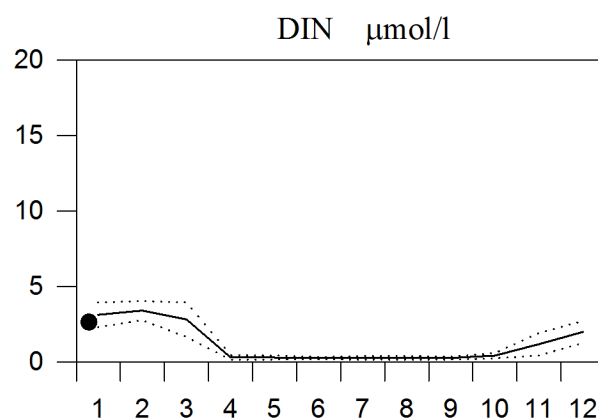
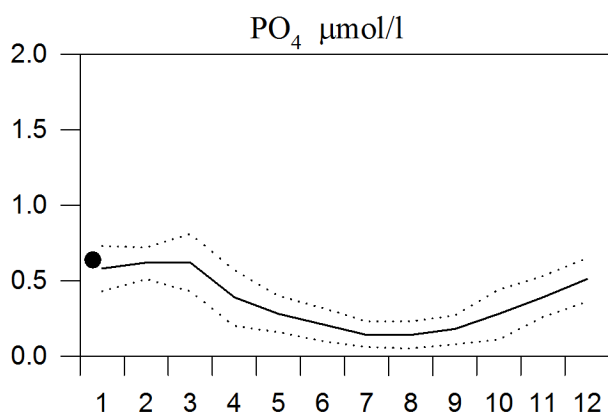
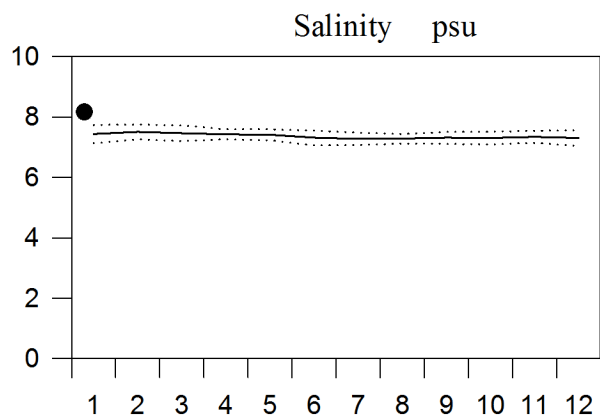
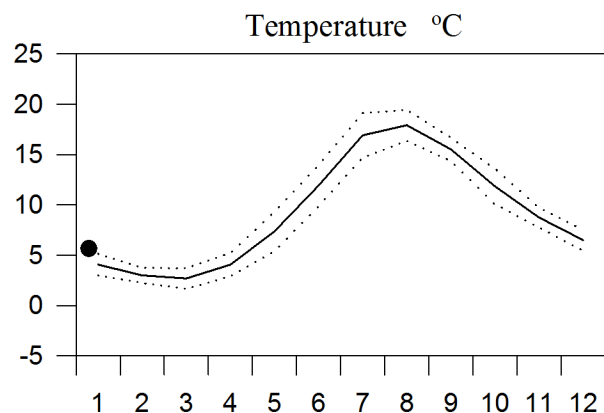
— Mean 1996-2010 St.Dev. ● 2016



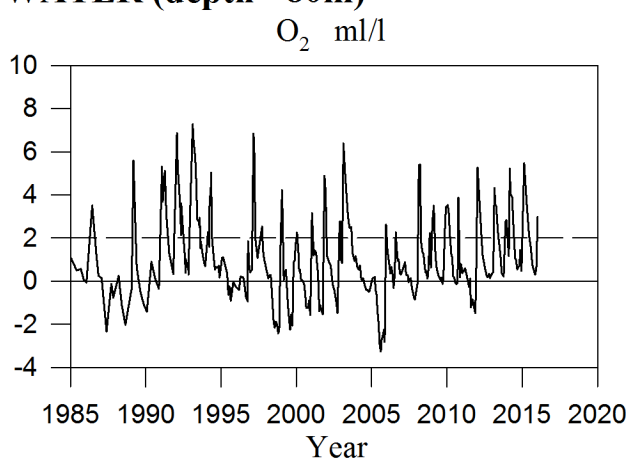
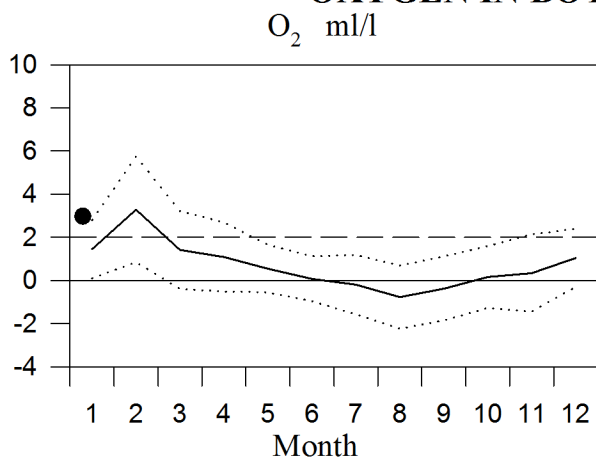
STATION BY4 SURFACE WATER

Annual Cycles

— Mean 1996-2010 St.Dev. ● 2016

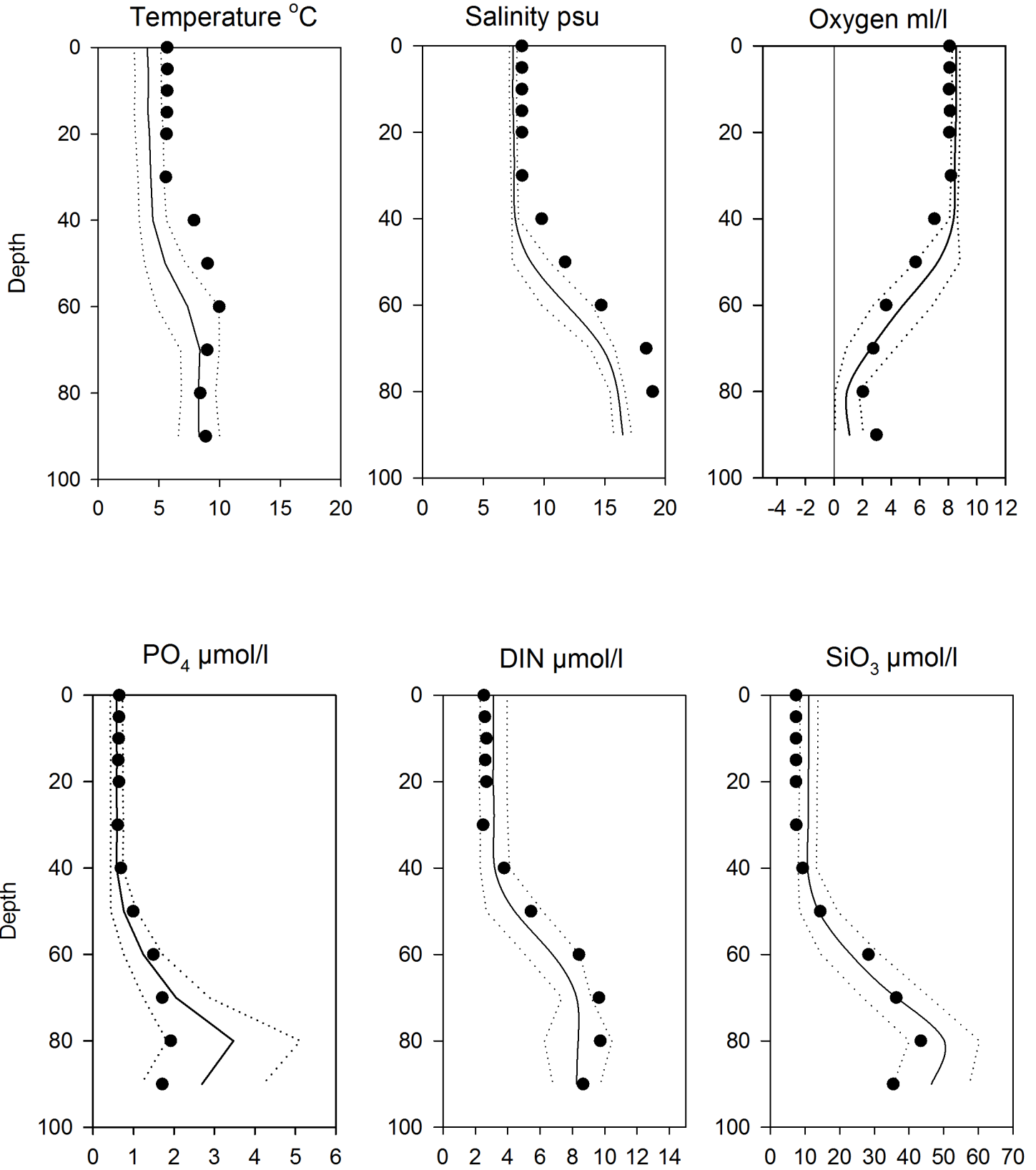


OXYGEN IN BOTTOM WATER (depth >80m)



Vertical profiles BY4 January

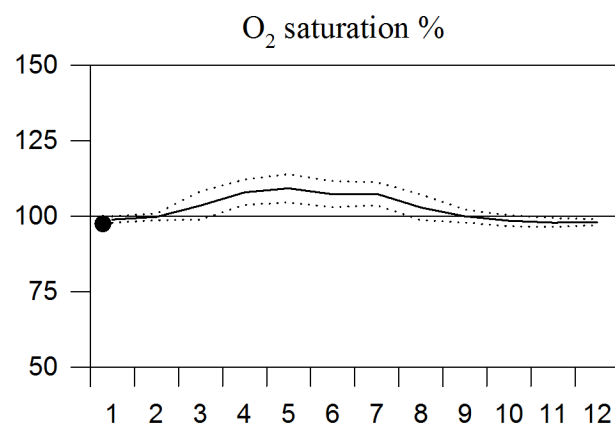
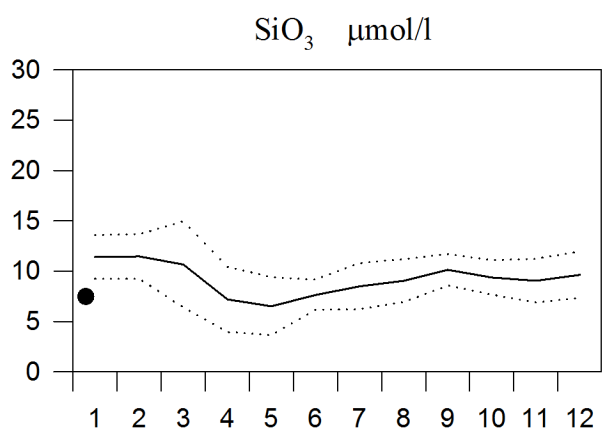
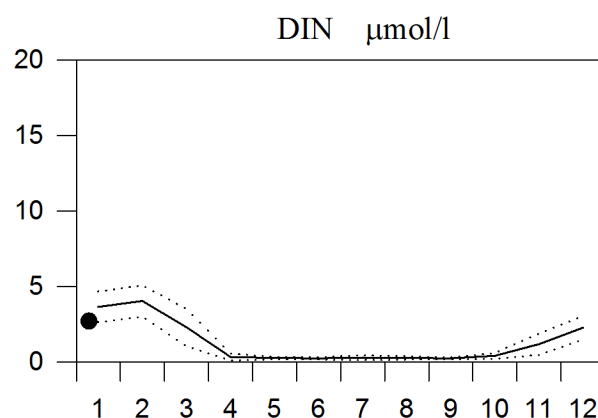
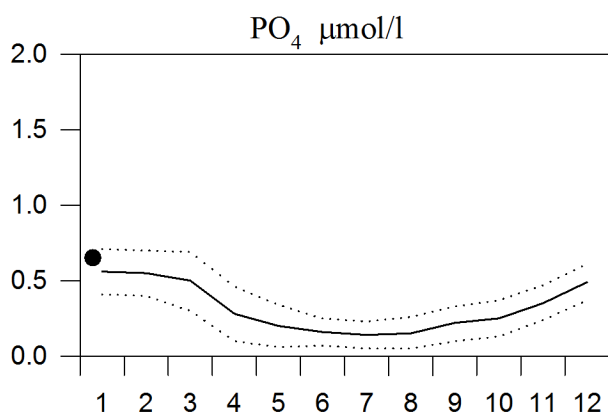
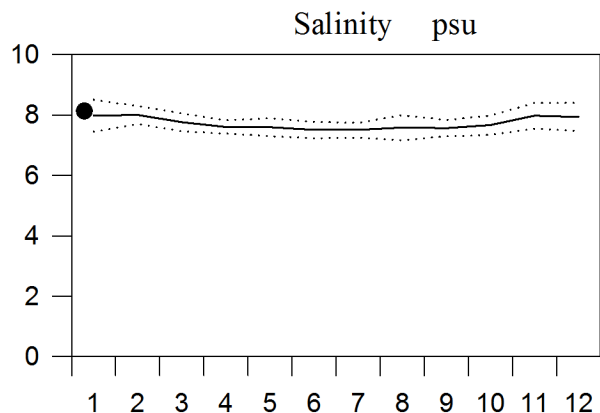
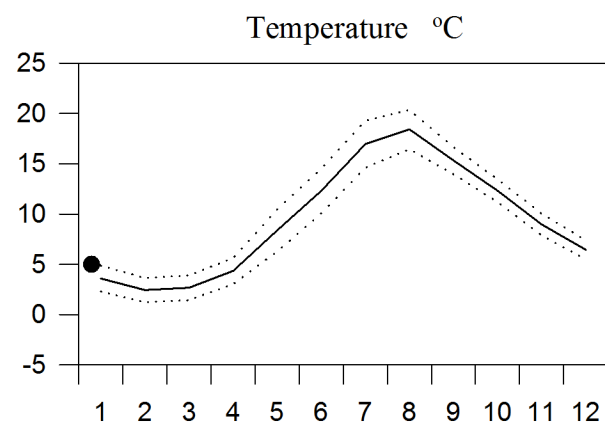
— Mean 1996-2010 St.Dev. ● 2016



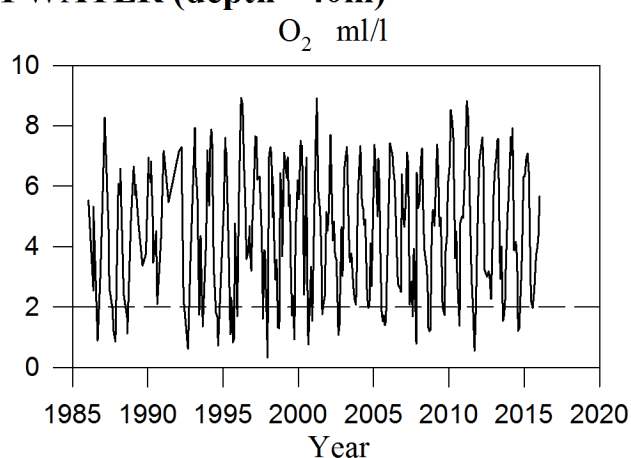
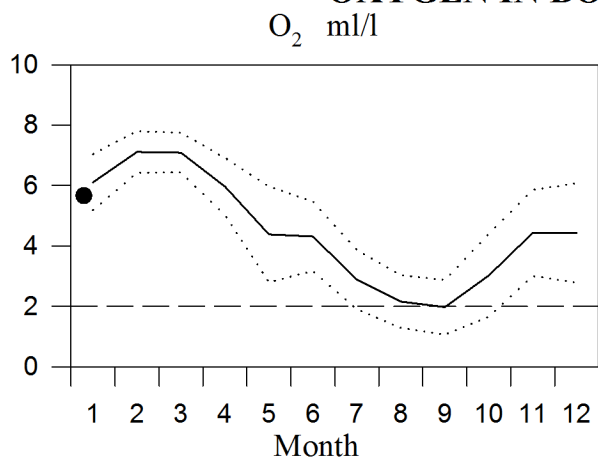
STATION BY2 SURFACE WATER

Annual Cycles

— Mean 1996-2010 St.Dev. ● 2016

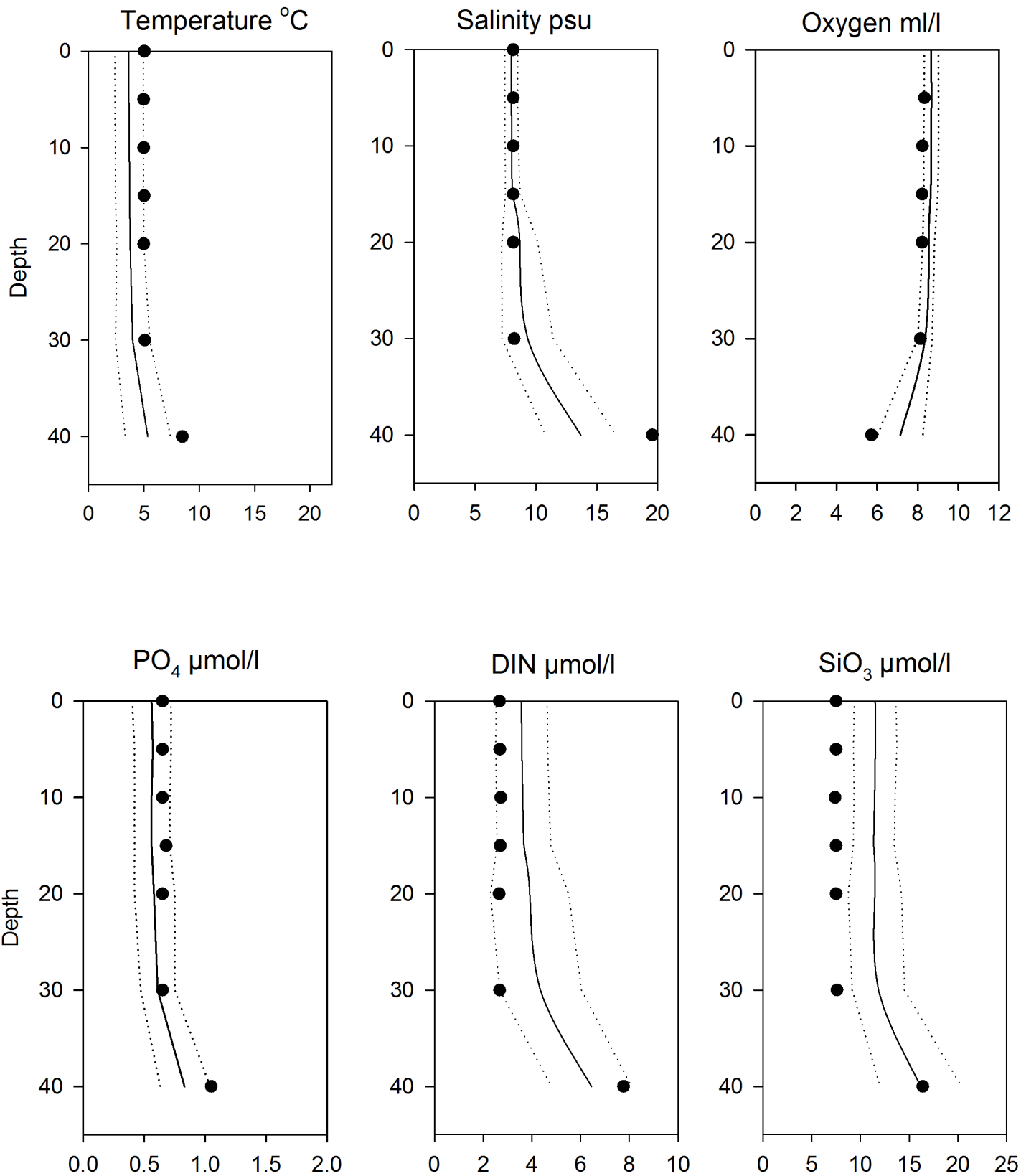


OXYGEN IN BOTTOM WATER (depth >40m)



Vertical profiles BY2 January

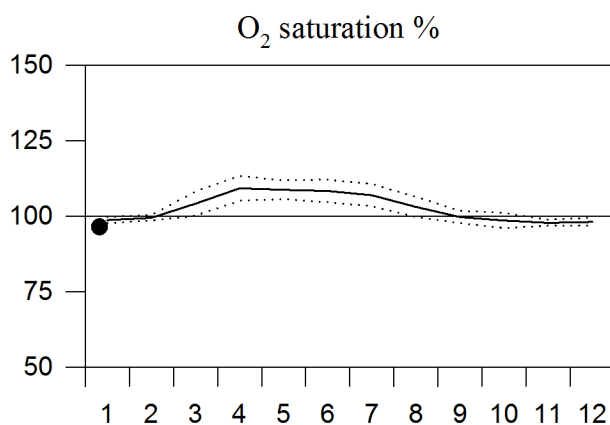
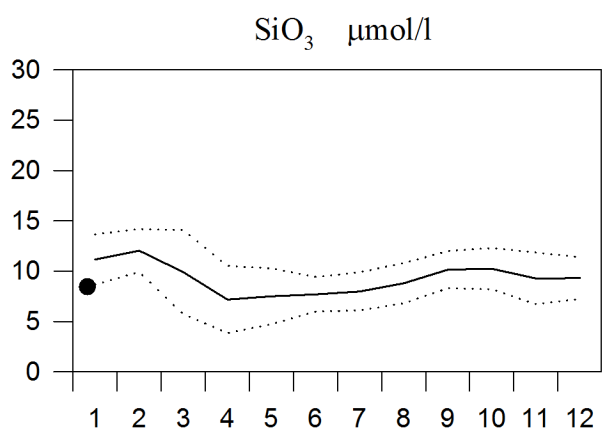
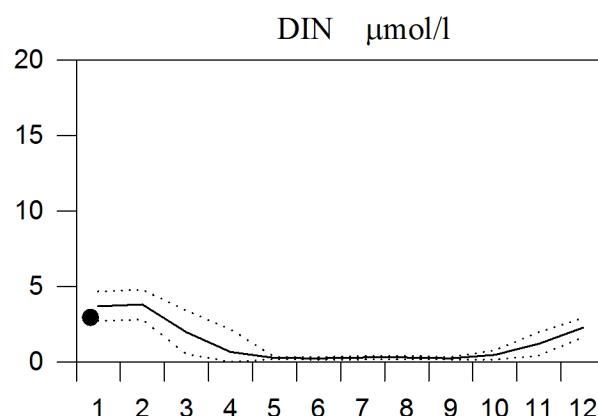
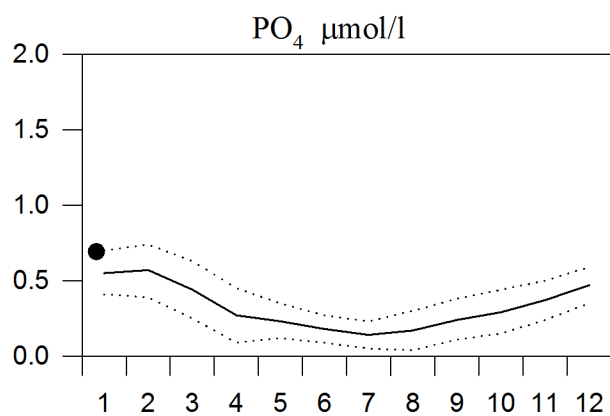
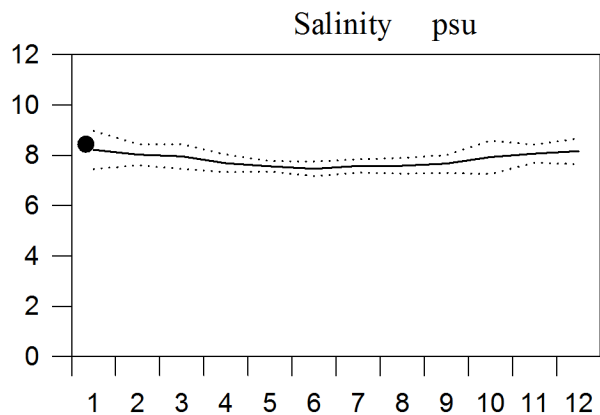
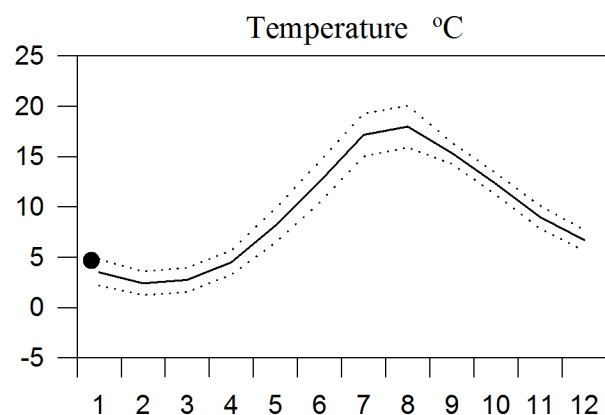
— Mean 1996-2010 St.Dev. ● 2016



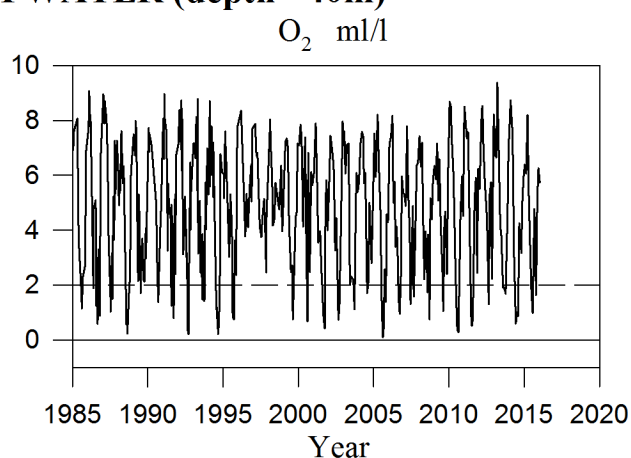
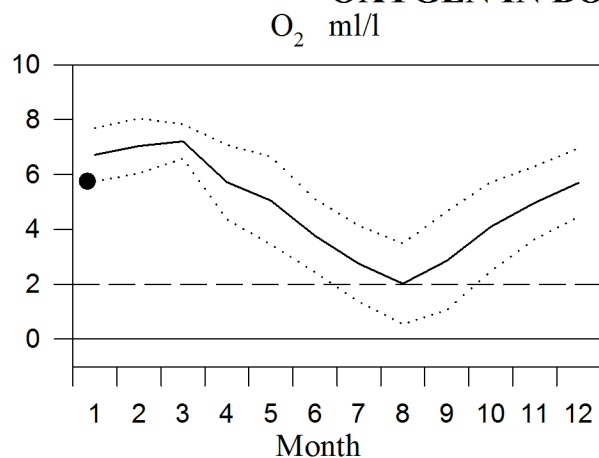
STATION BY1 SURFACE WATER

Annual Cycles

— Mean 1996-2010 St.Dev. ● 2016

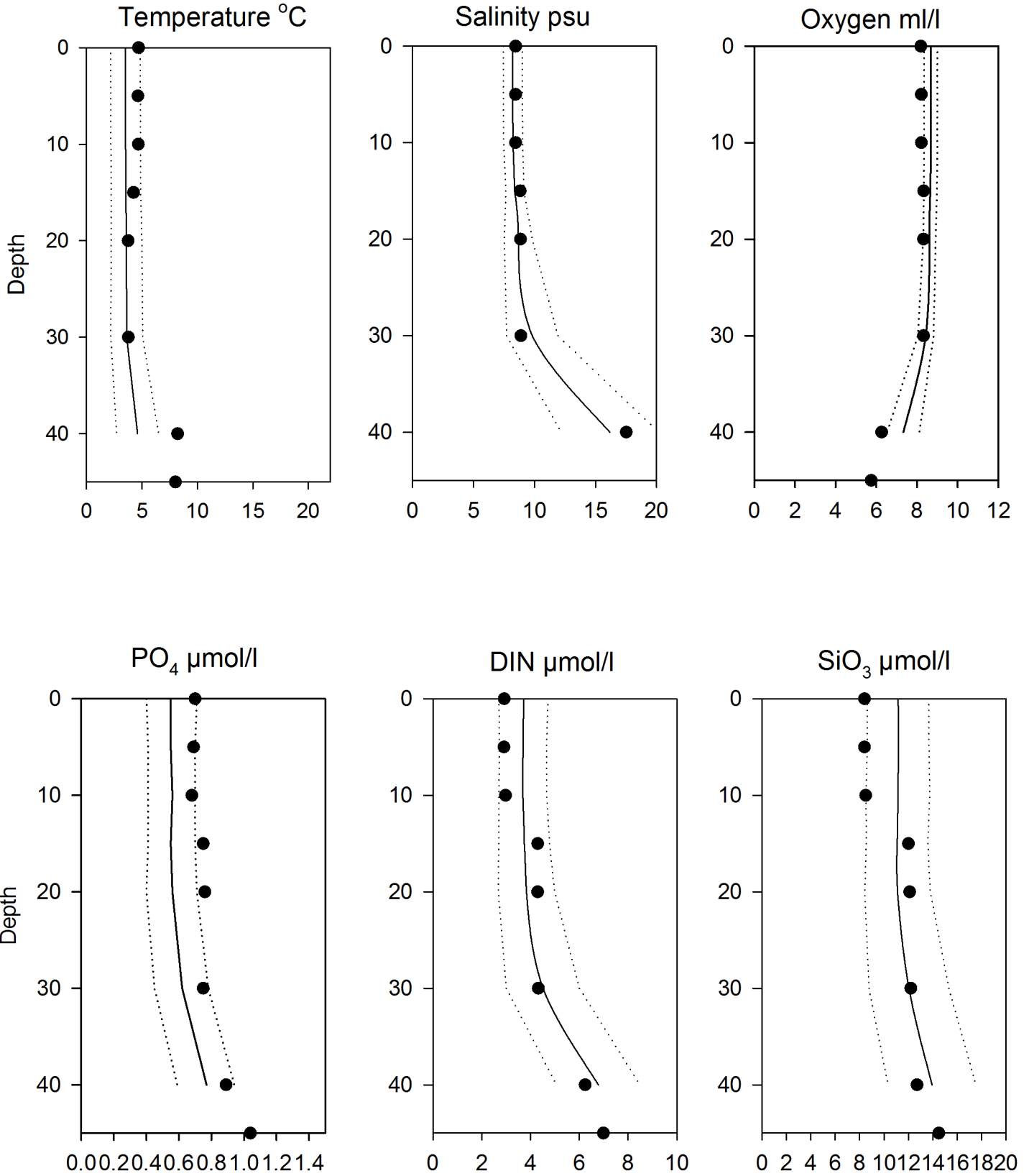


OXYGEN IN BOTTOM WATER (depth >40m)



Vertical profiles BY1 January

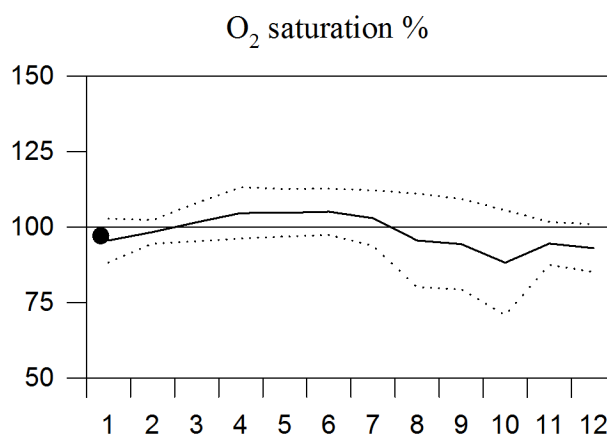
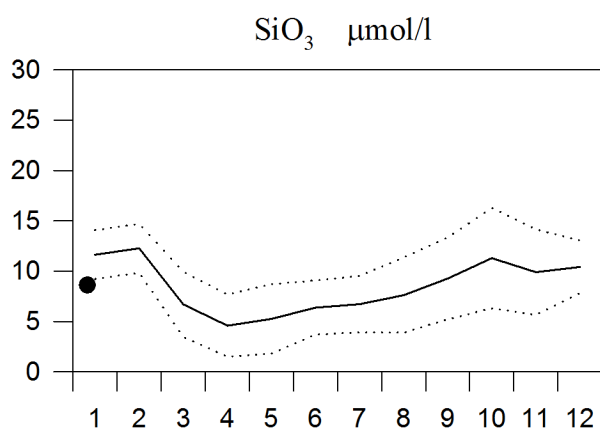
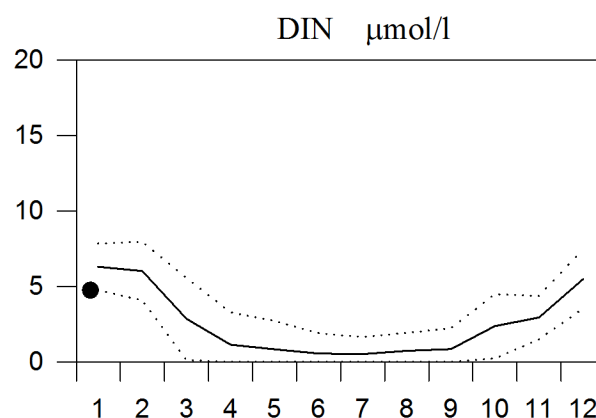
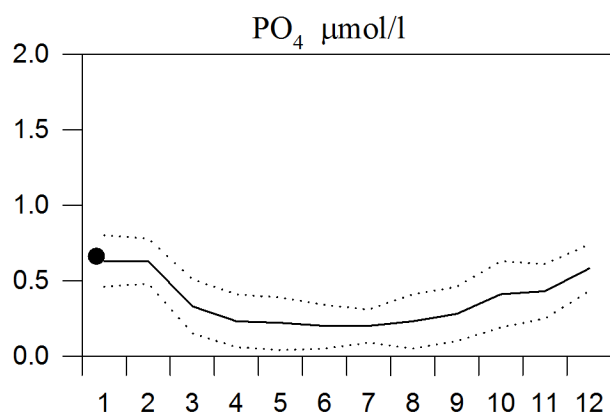
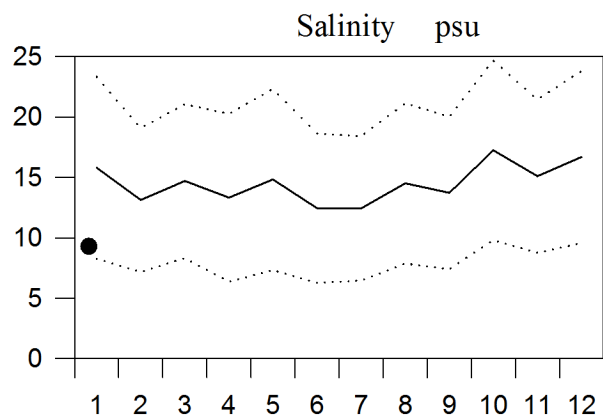
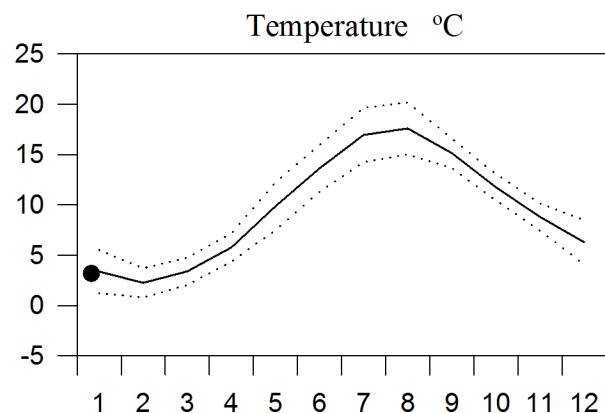
— Mean 1996-2010 St.Dev. ● 2016



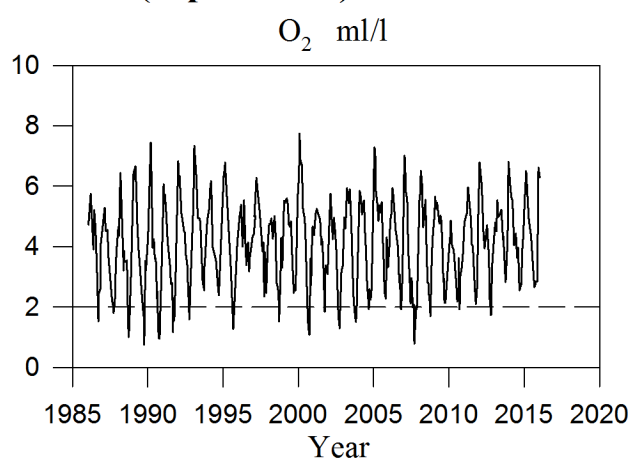
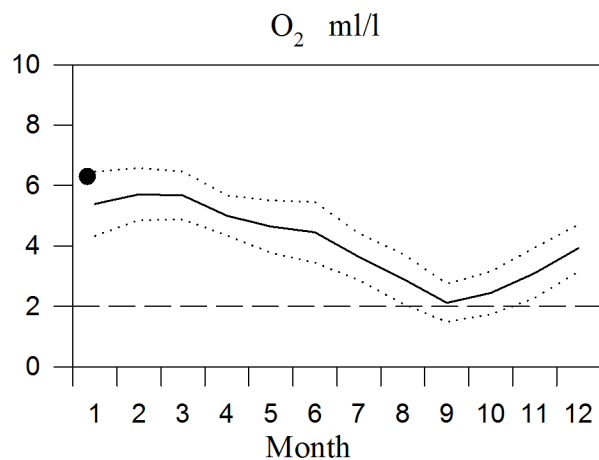
STATION W LANDSKRONA SURFACE WATER

Annual Cycles

— Mean 1996-2010 St.Dev. ● 2016

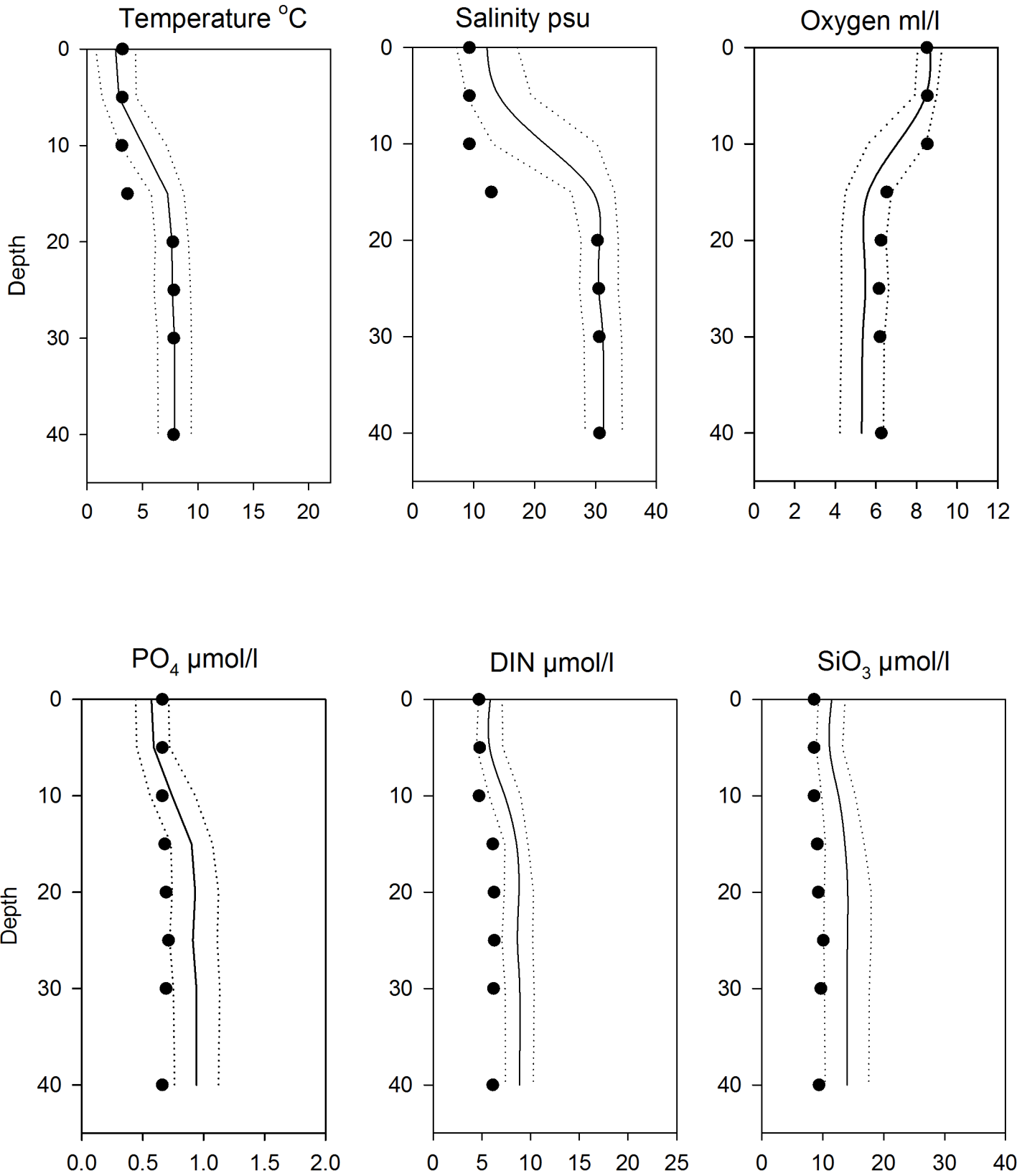


OXYGEN IN BOTTOM WATER (depth >40m)



Vertical profiles W Landskrona January

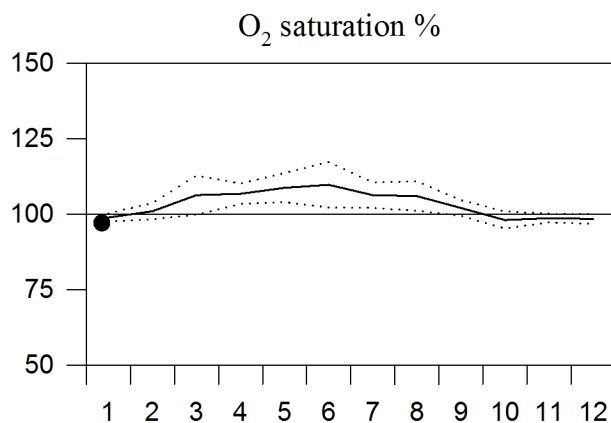
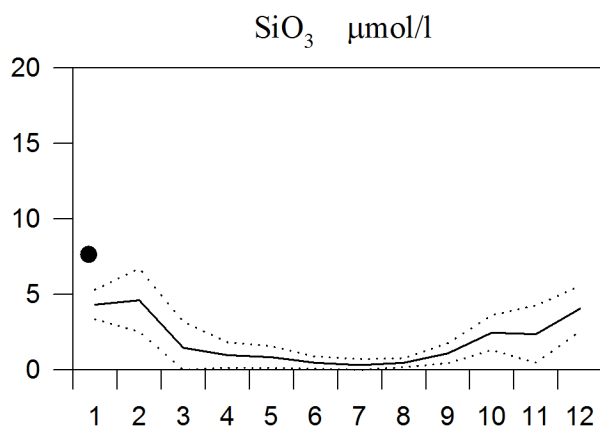
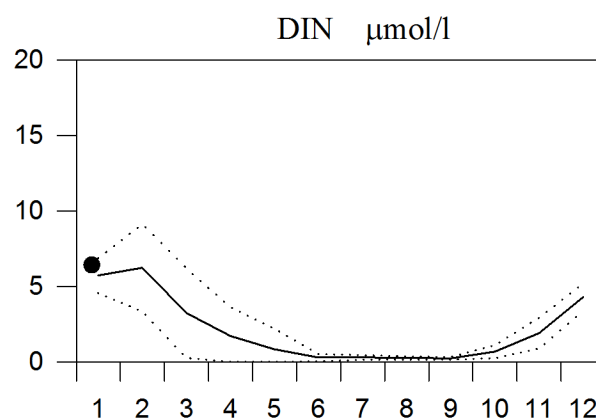
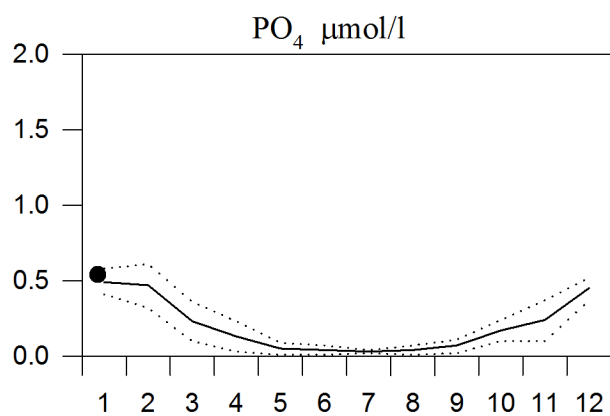
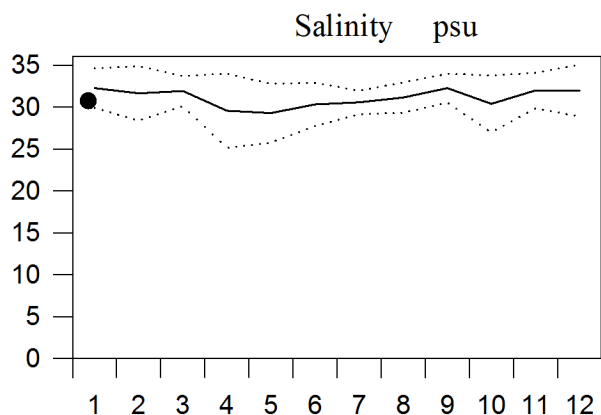
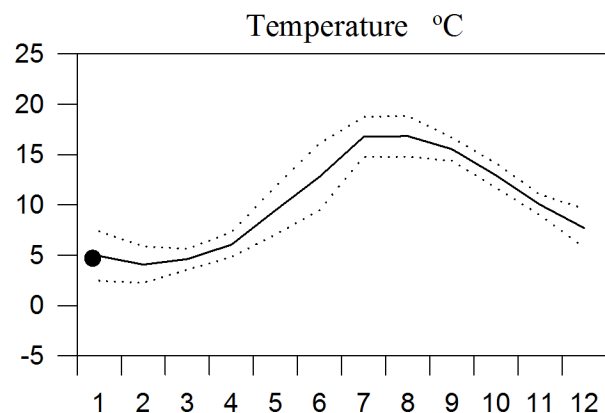
— Mean 1996-2010 St.Dev. ● 2016



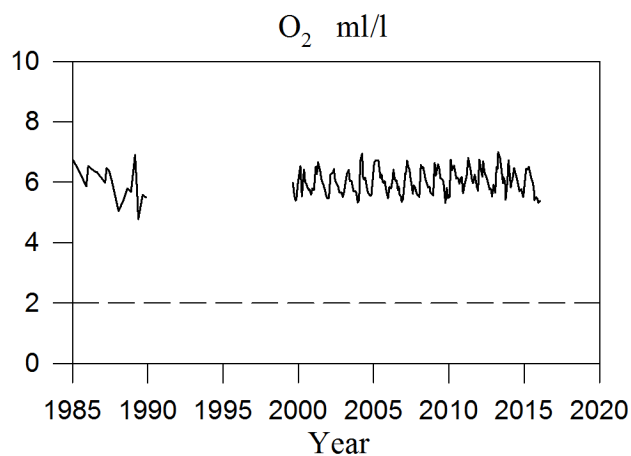
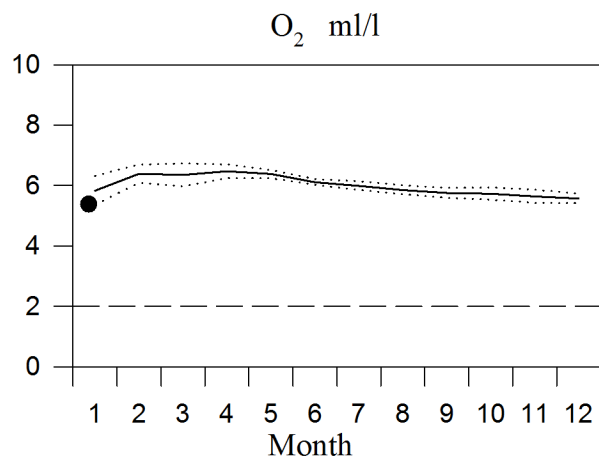
STATION Å17 SURFACE WATER

Annual Cycles

— Mean 1996-2010 St.Dev. ● 2016

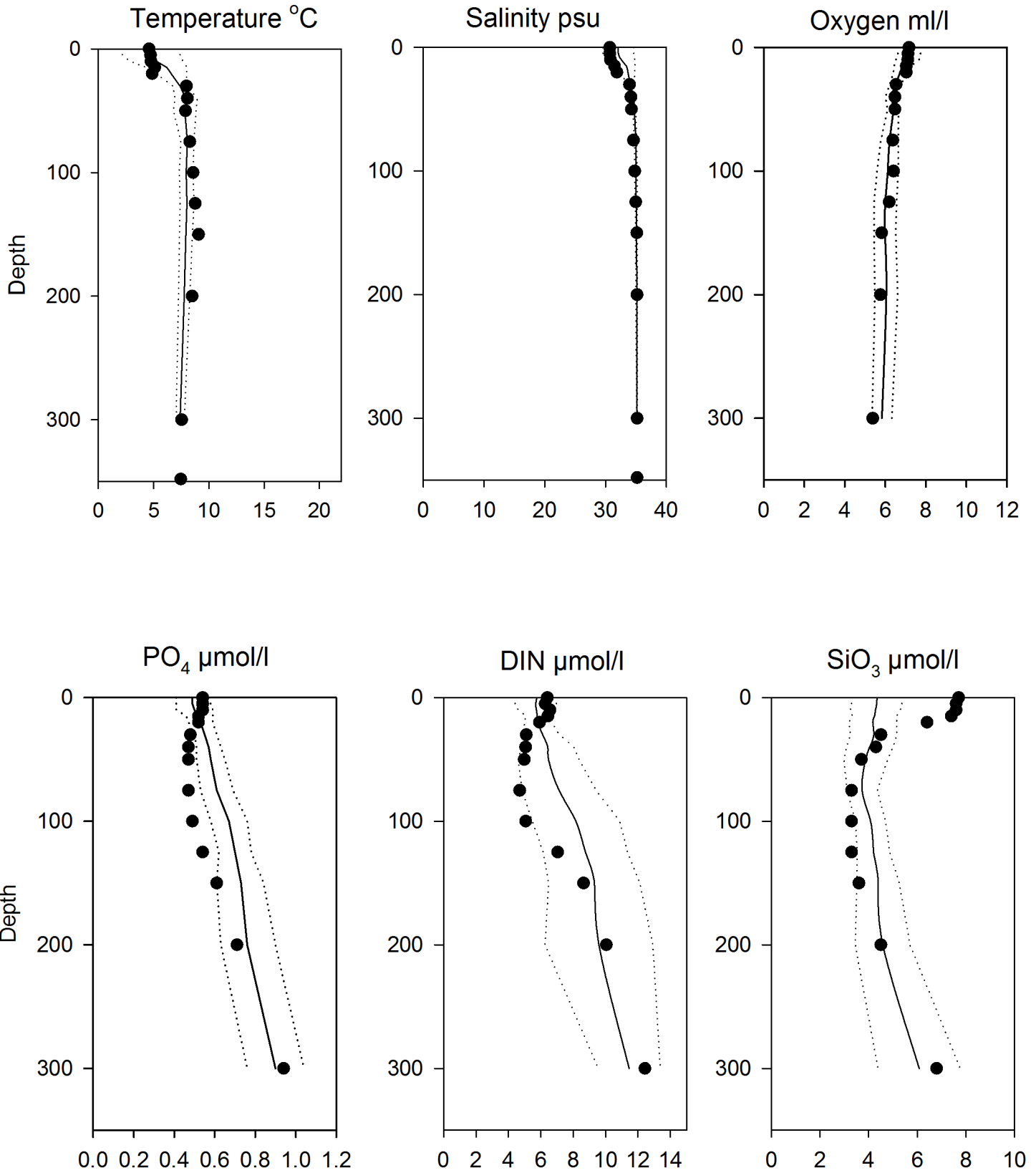


OXYGEN IN BOTTOM WATER (depth = 300m)



Vertical profiles Å17 January

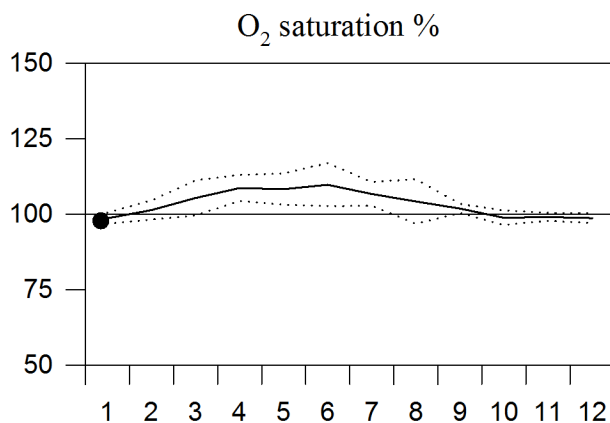
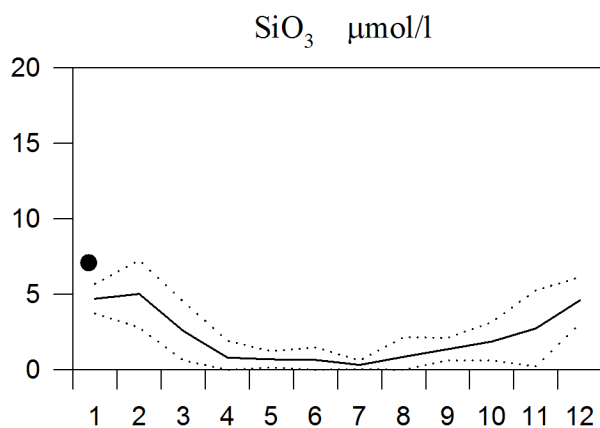
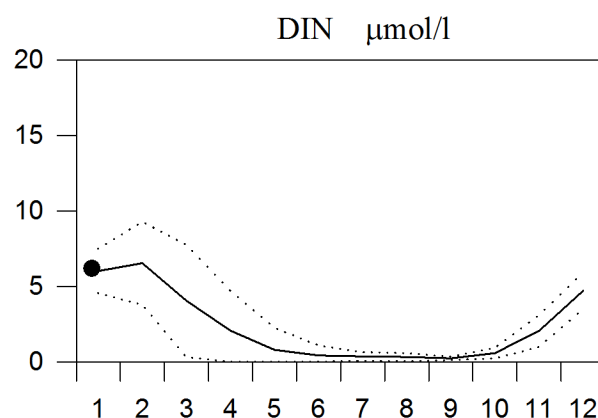
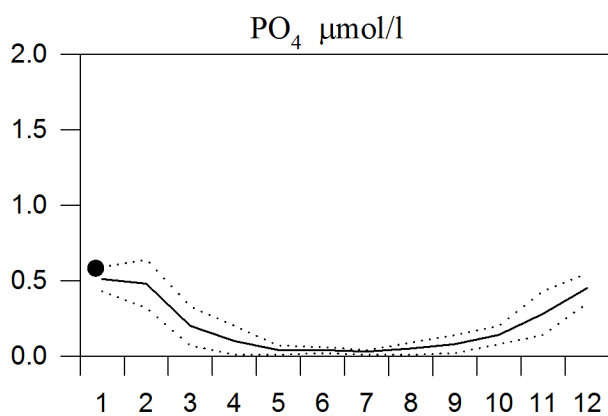
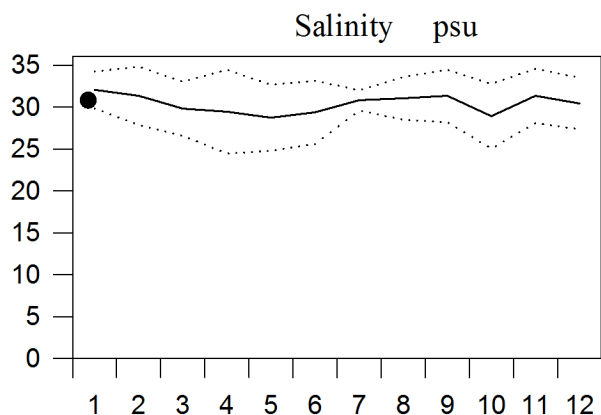
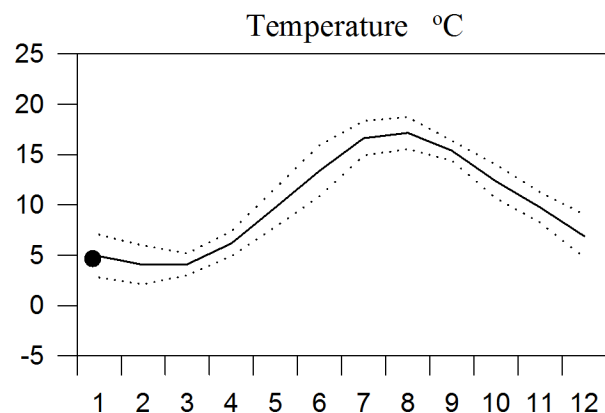
— Mean 1996-2010 St.Dev. ● 2016



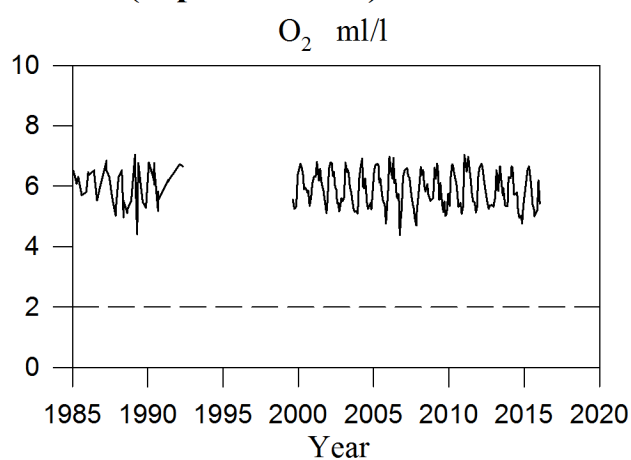
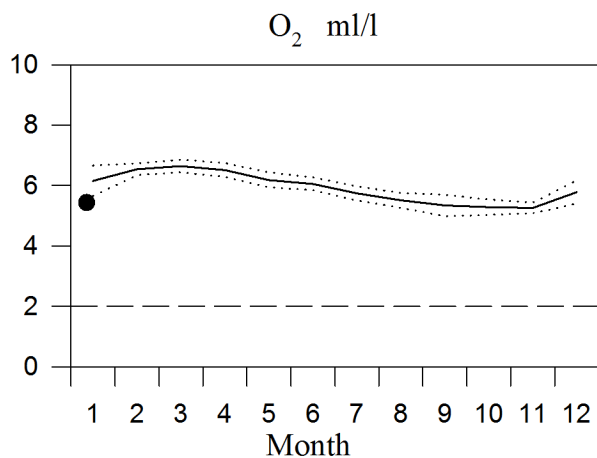
STATION Å15 SURFACE WATER

Annual Cycles

— Mean 1996-2010 St.Dev. ● 2016

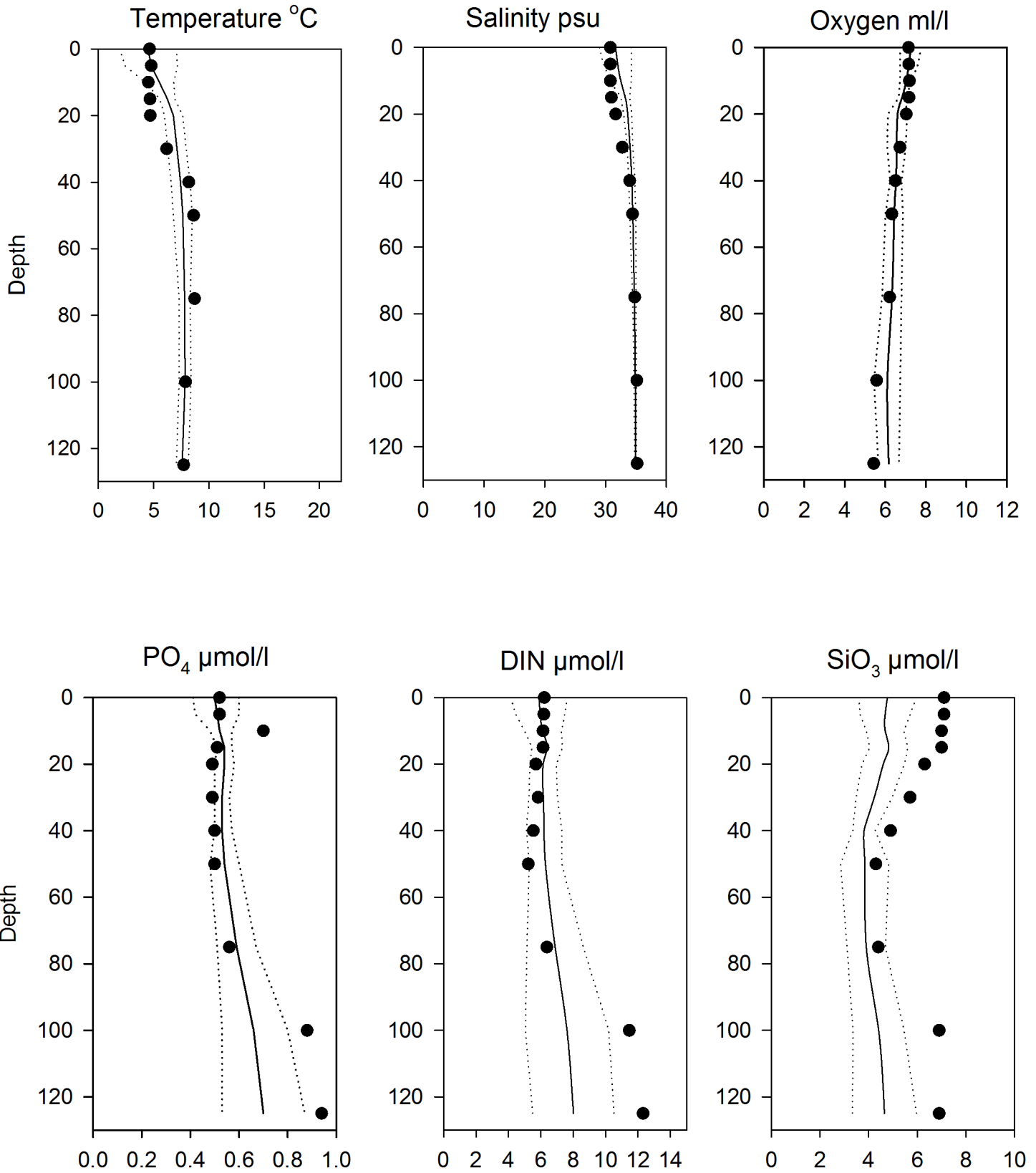


OXYGEN IN BOTTOM WATER (depth >=125m)



Vertical profiles Å15 January

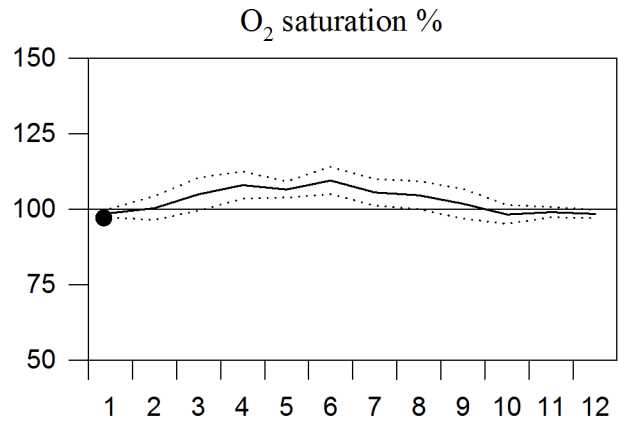
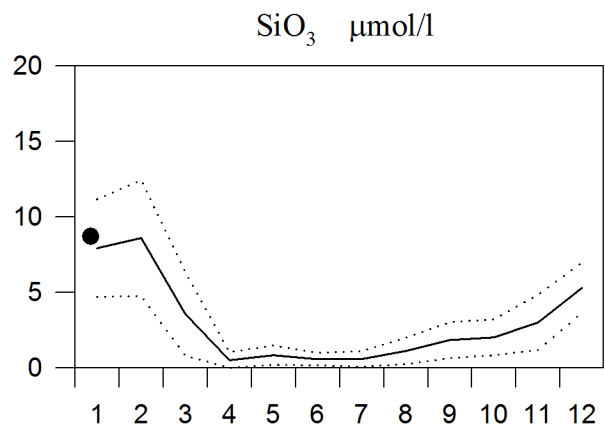
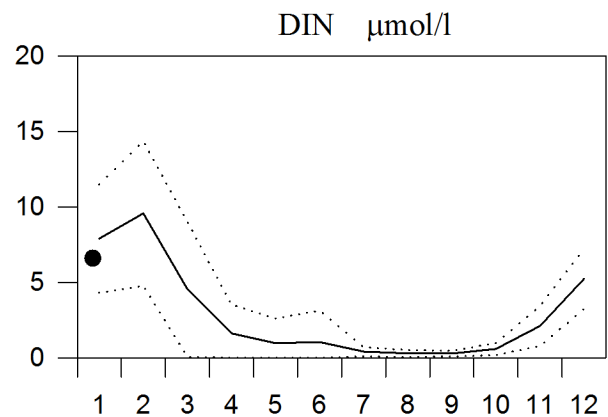
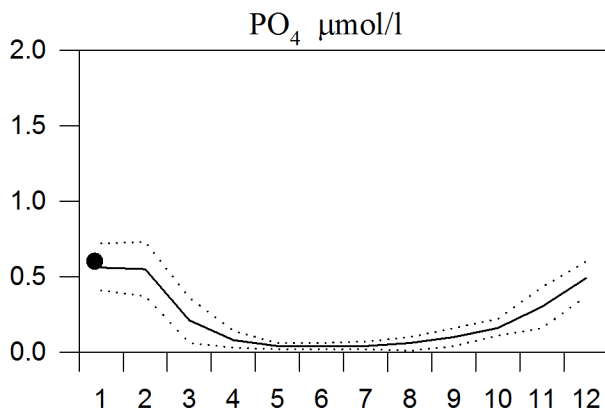
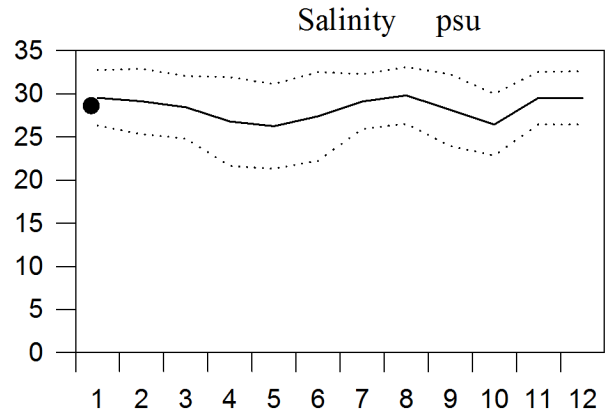
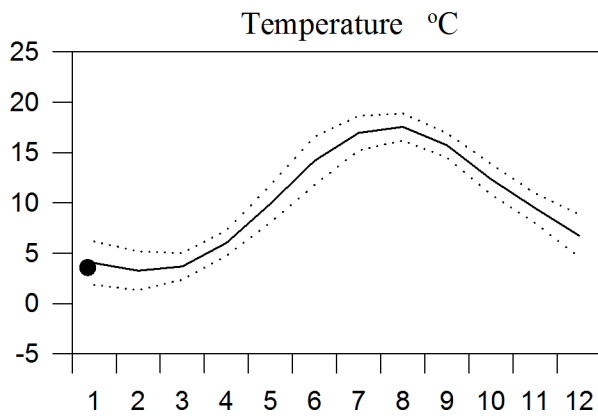
— Mean 1996-2010 St.Dev. ● 2016



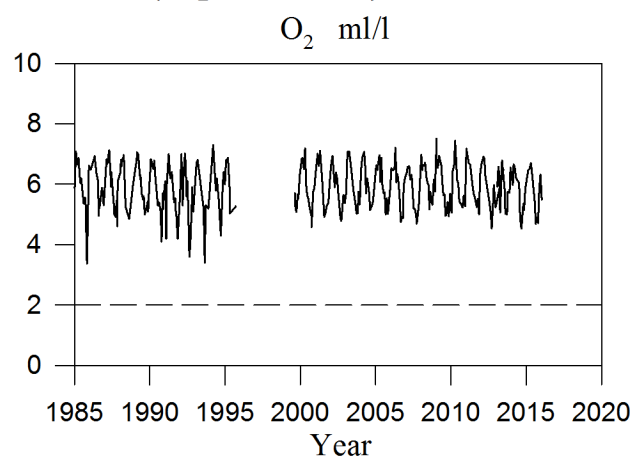
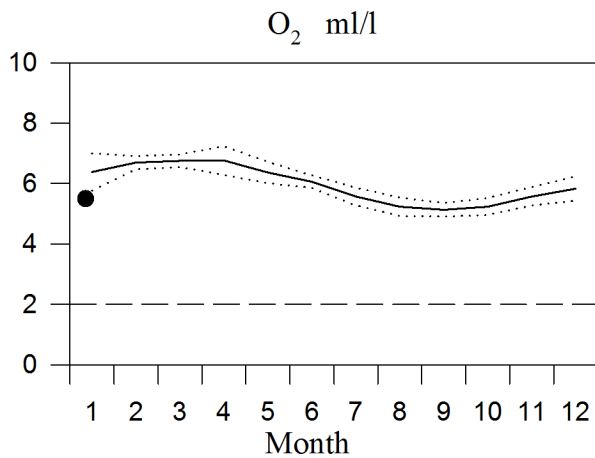
STATION Å13 SURFACE WATER

Annual Cycles

— Mean 1996-2010 St.Dev. ● 2016

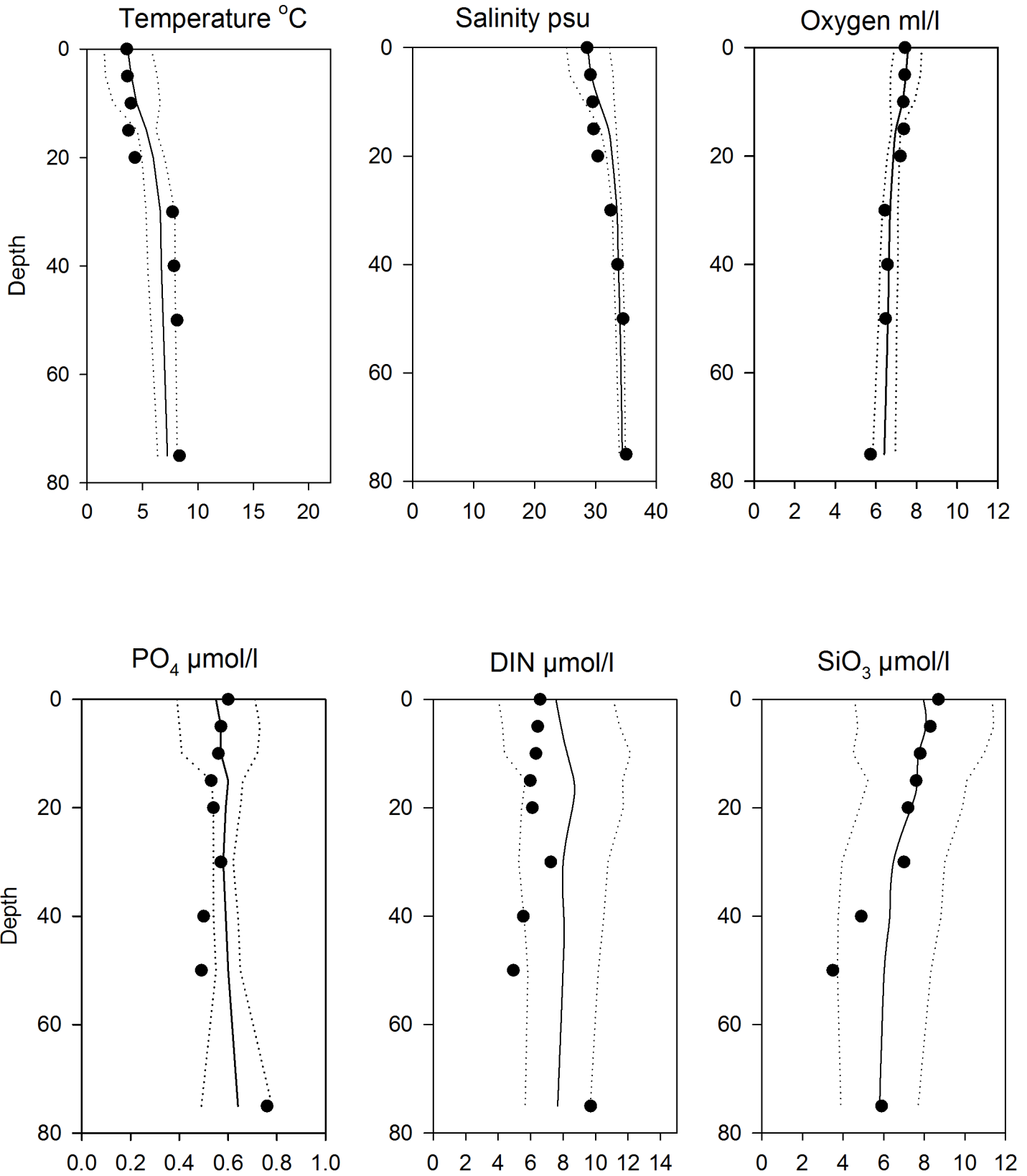


OXYGEN IN BOTTOM WATER (depth >=75m)



Vertical profiles Å13 January

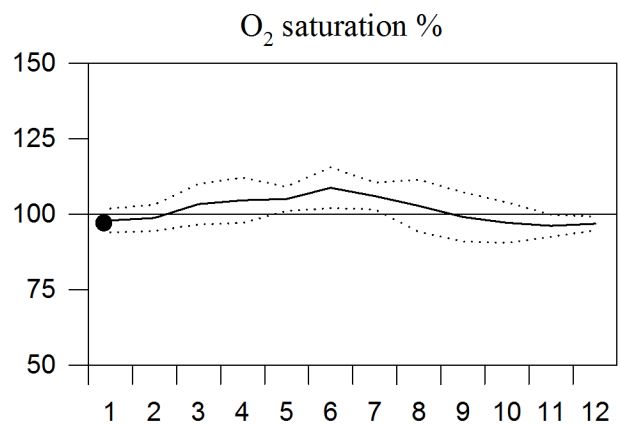
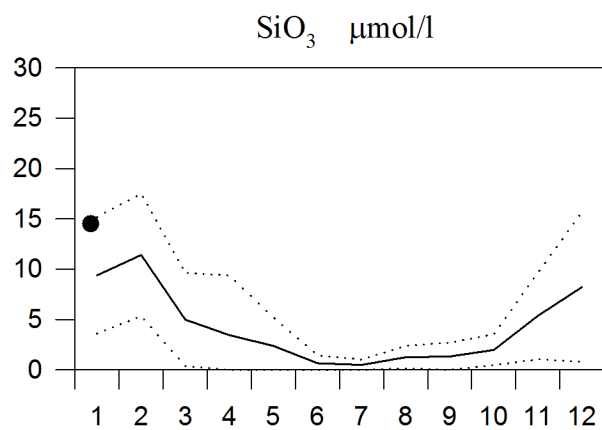
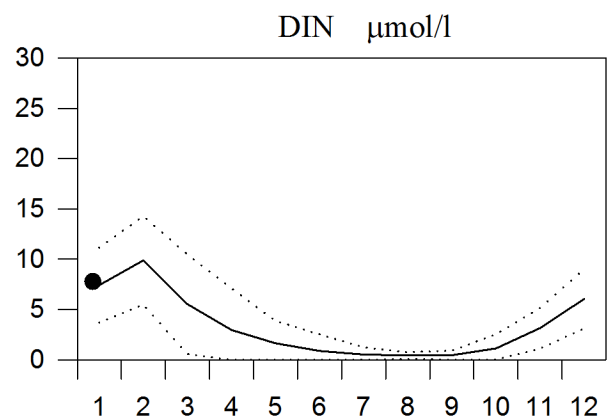
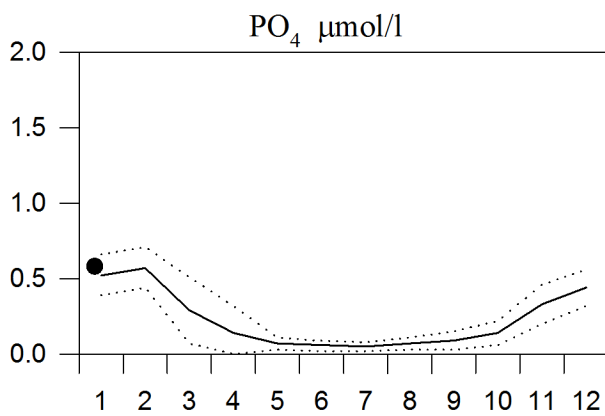
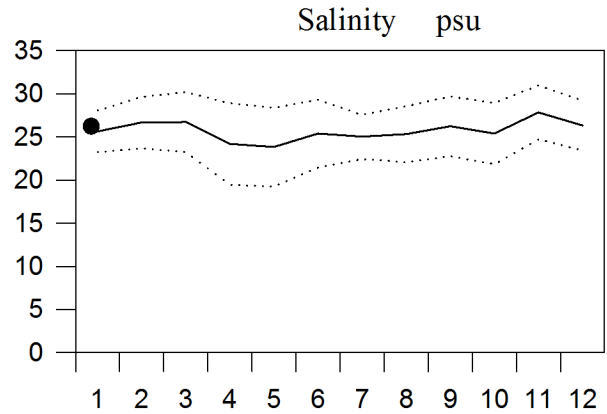
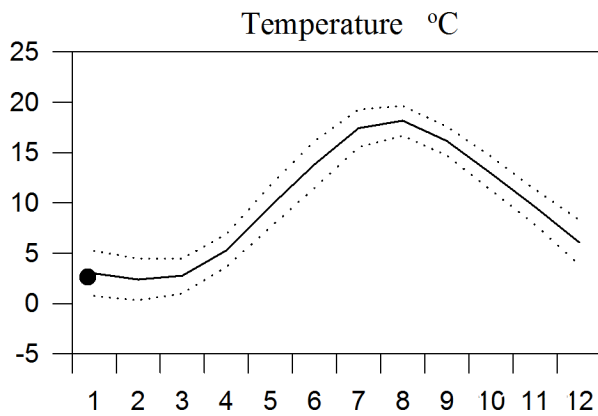
— Mean 1996-2010 St.Dev. ● 2016



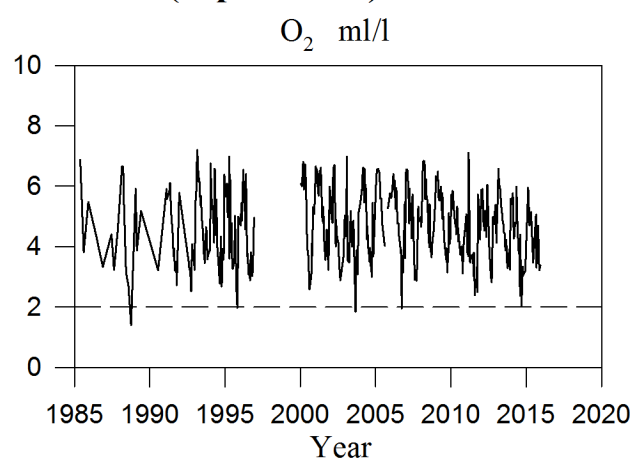
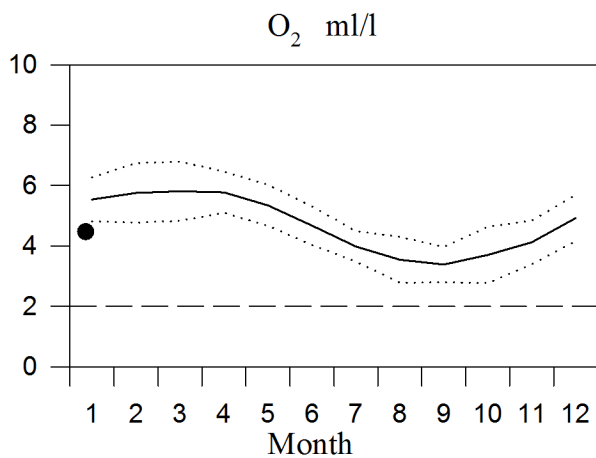
STATION SLÄGGÖ SURFACE WATER

Annual Cycles

— Mean 1996-2010 St.Dev. ● 2016

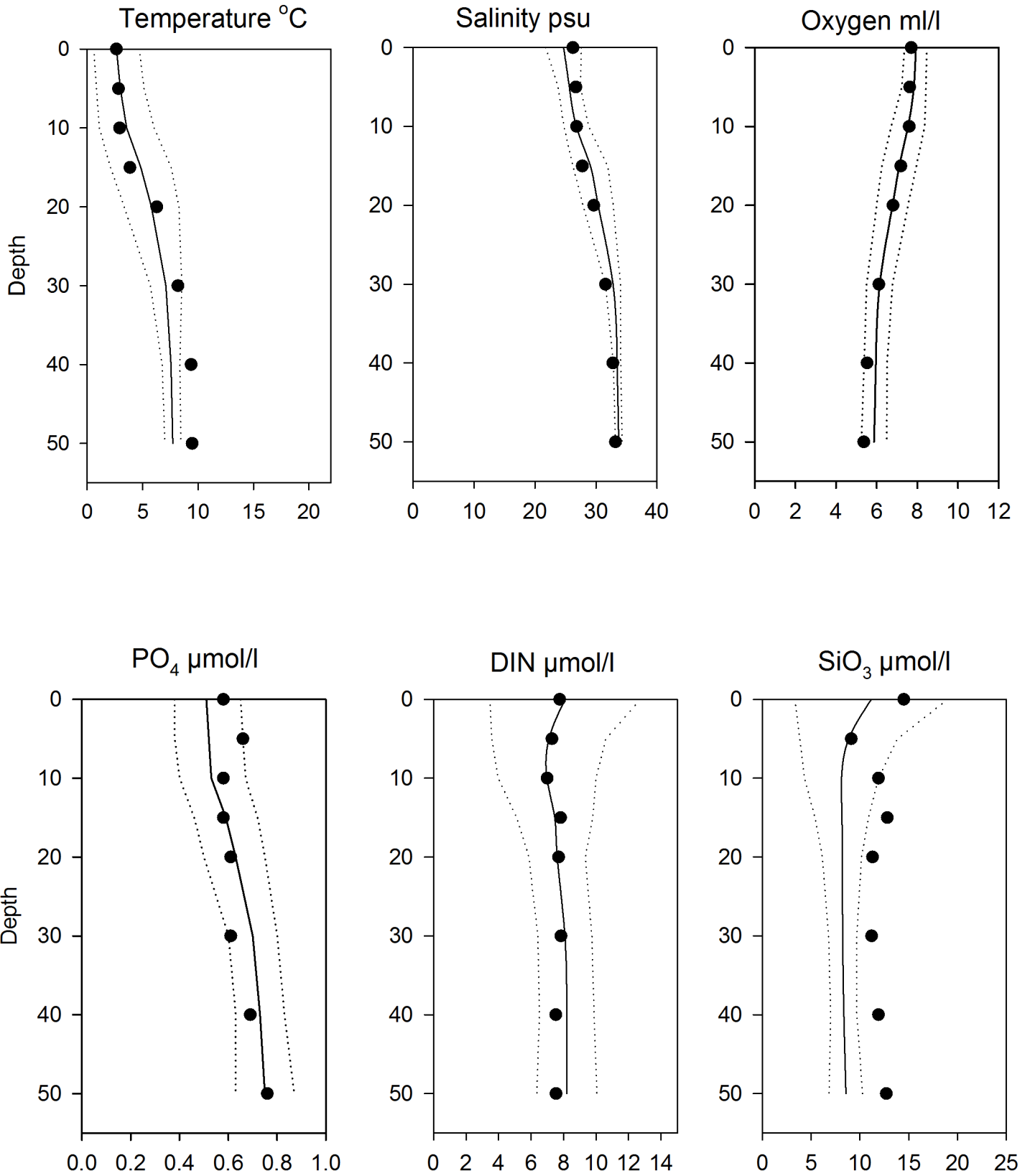


OXYGEN IN BOTTOM WATER (depth >50m)



Vertical profiles Släggö January

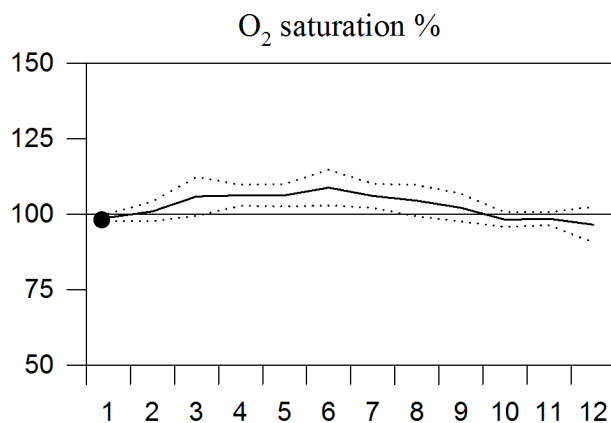
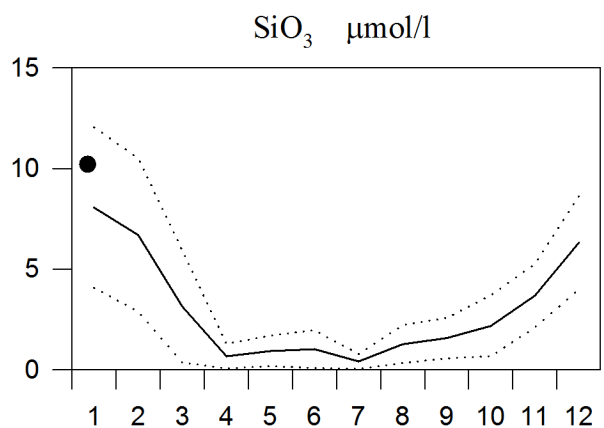
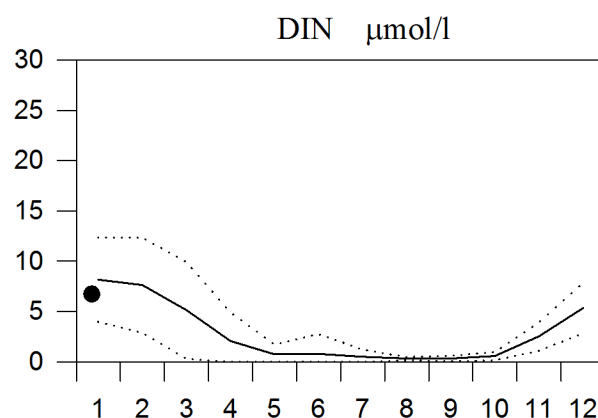
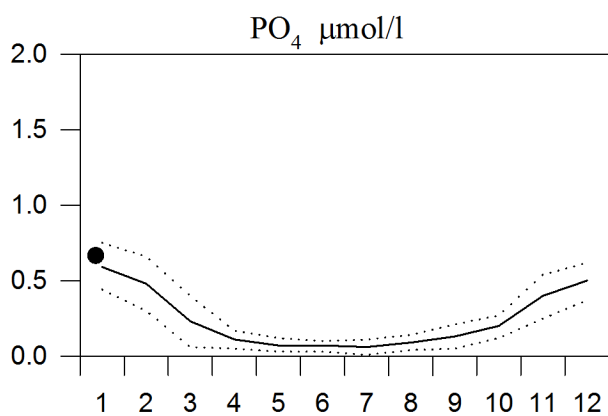
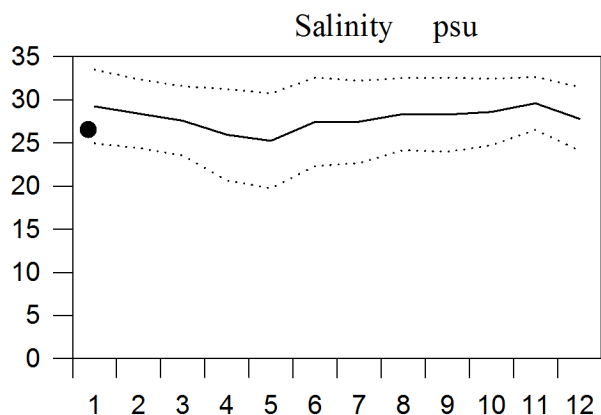
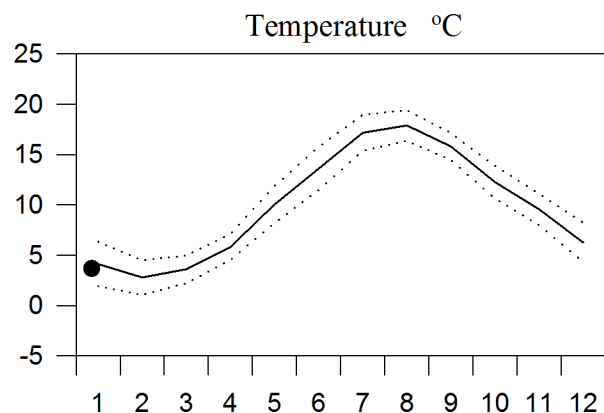
— Mean 1996-2010 St.Dev. ● 2016



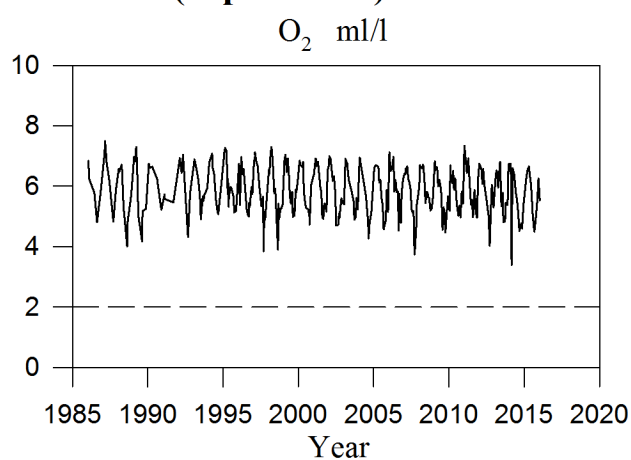
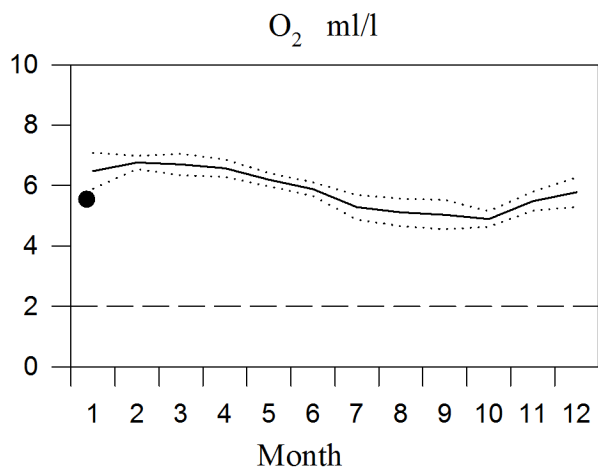
STATION P2 SURFACE WATER

Annual Cycles

— Mean 1996-2010 St.Dev. ● 2016

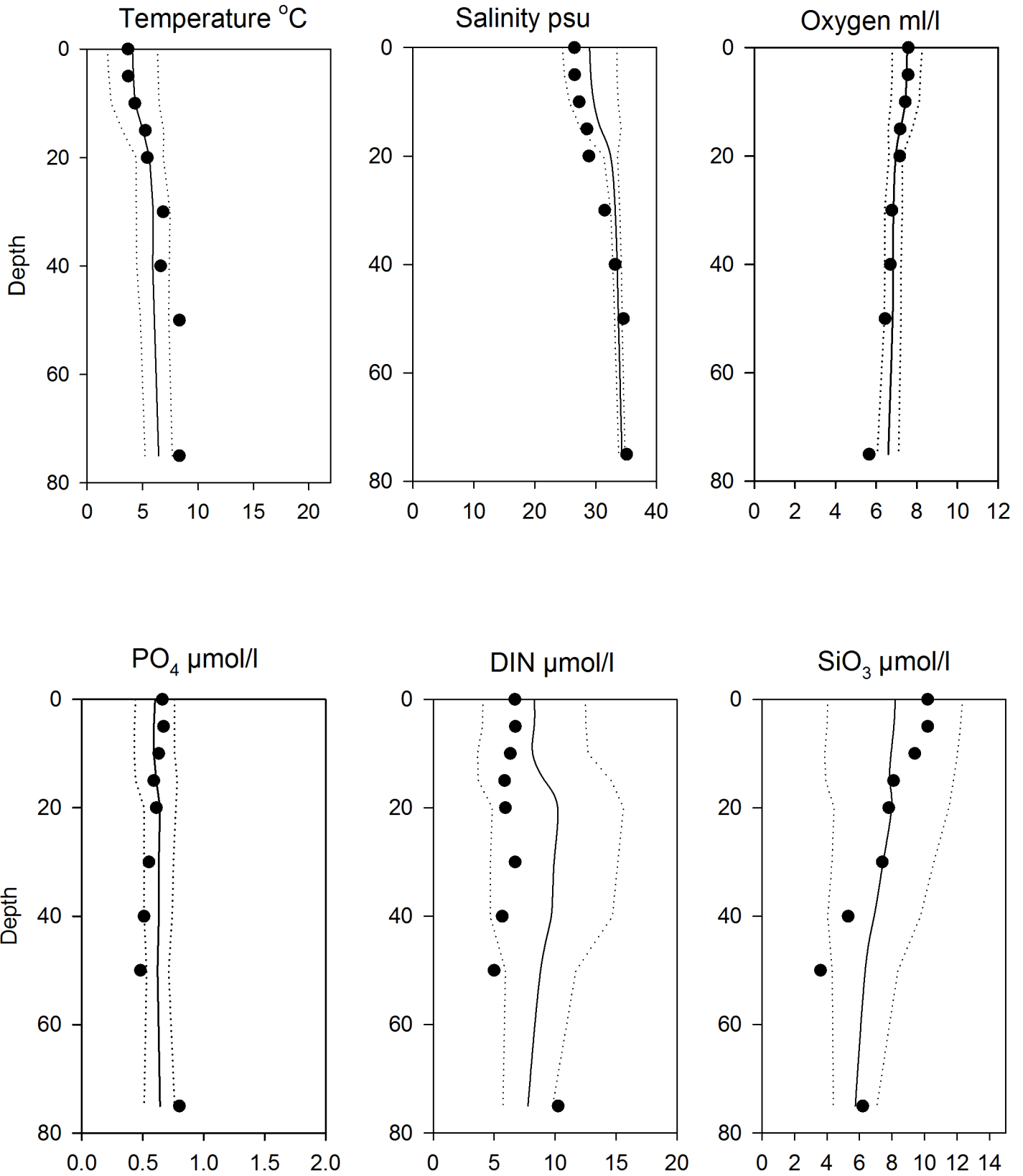


OXYGEN IN BOTTOM WATER (depth >75m)



Vertical profiles P2 January

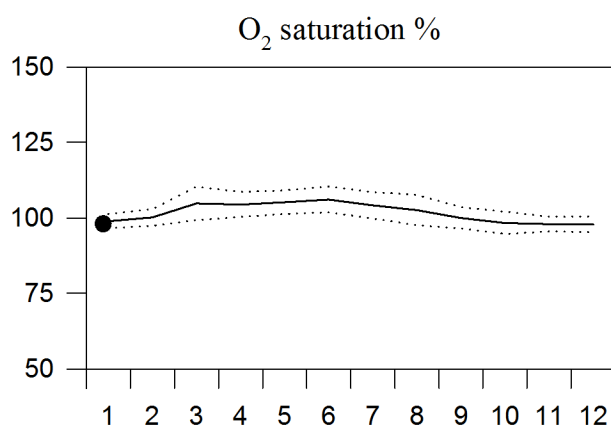
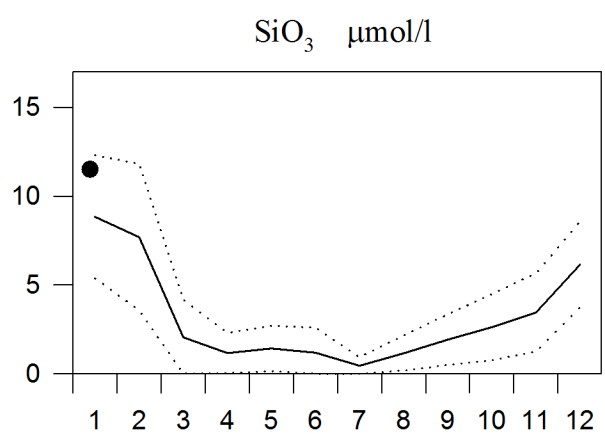
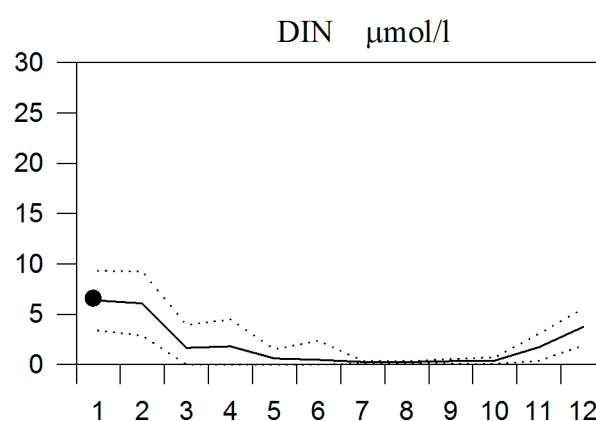
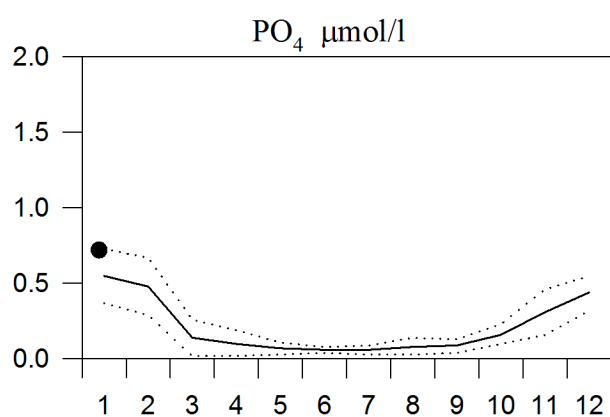
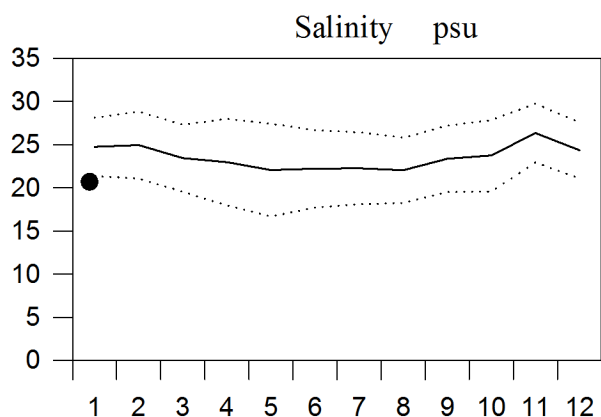
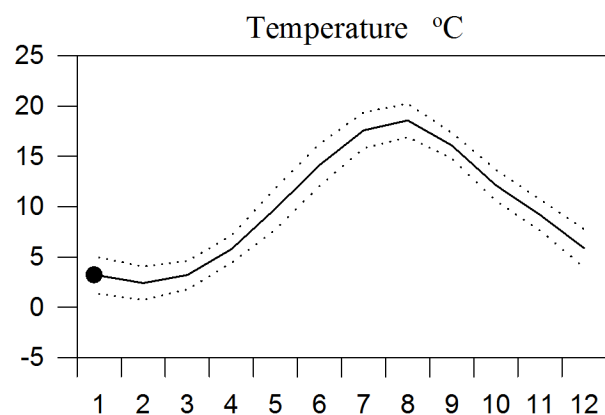
— Mean 1996-2010 St.Dev. ● 2016



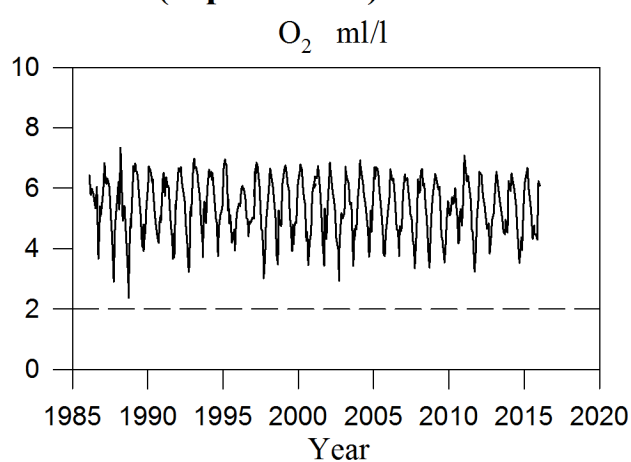
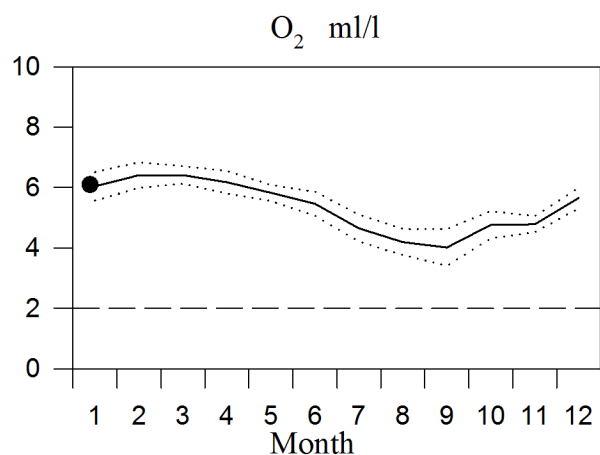
STATION FLADEN SURFACE WATER

Annual Cycles

— Mean 1996-2010 St.Dev. ● 2016

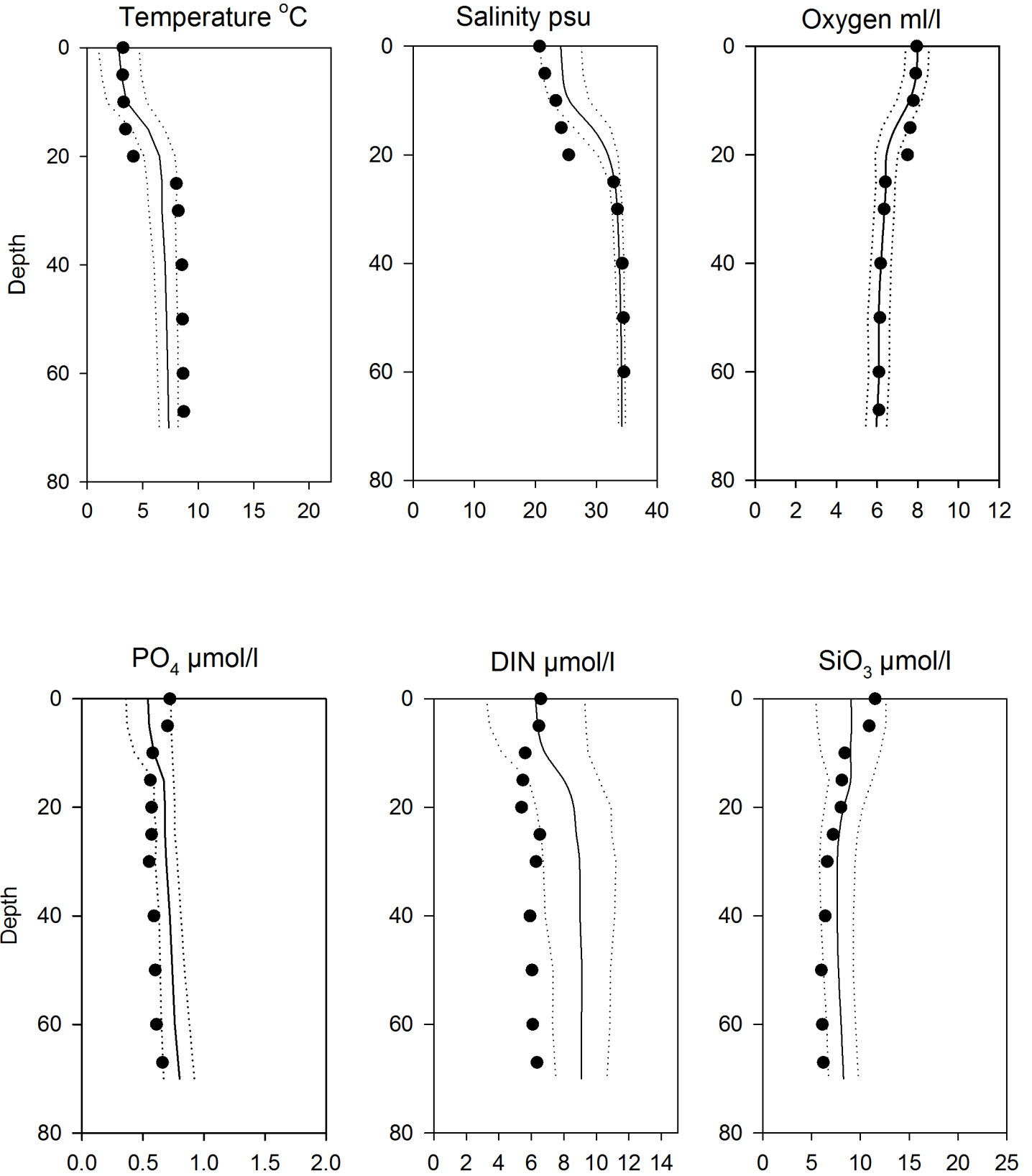


OXYGEN IN BOTTOM WATER (depth > 70m)



Vertical profiles Fladen January

— Mean 1996-2010 St.Dev. ● 2016



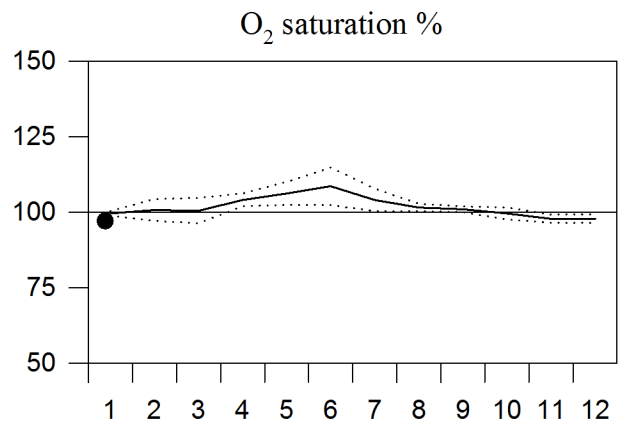
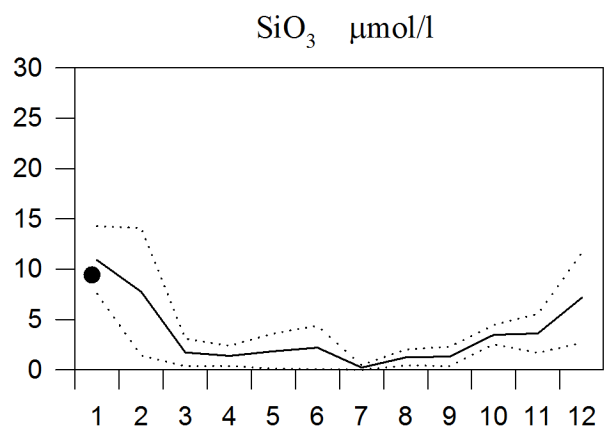
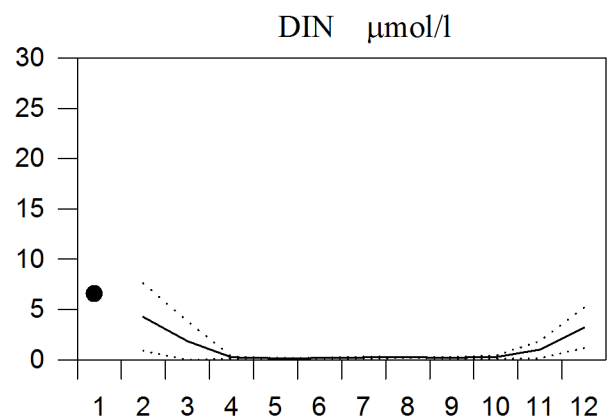
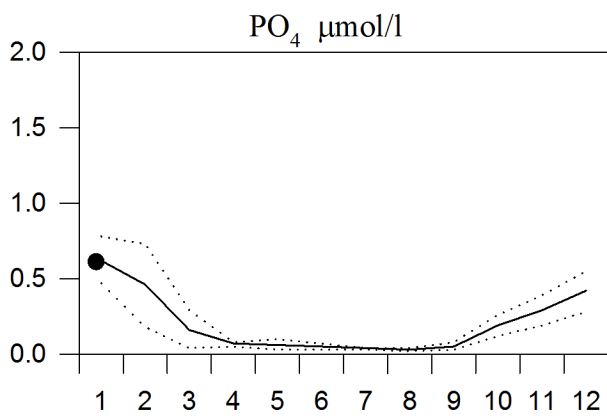
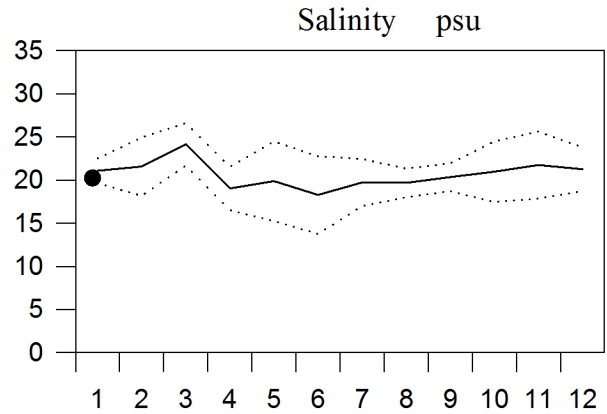
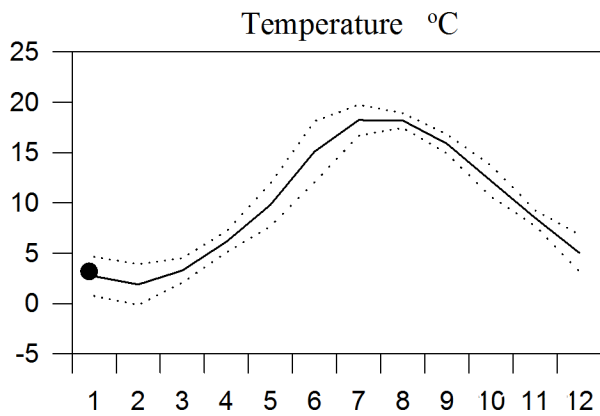
STATION N14 Falkenberg SURFACE WATER

Annual Cycles

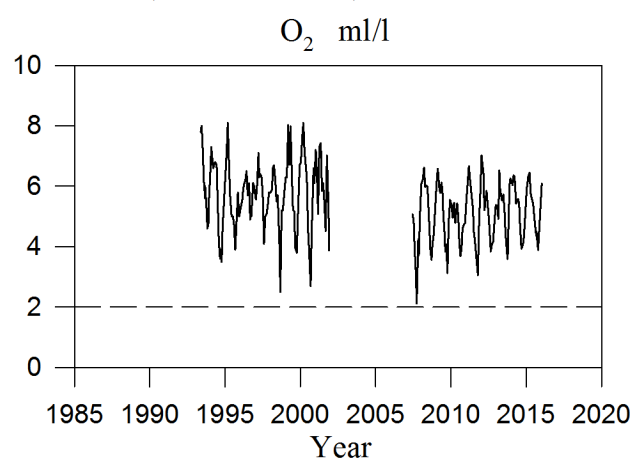
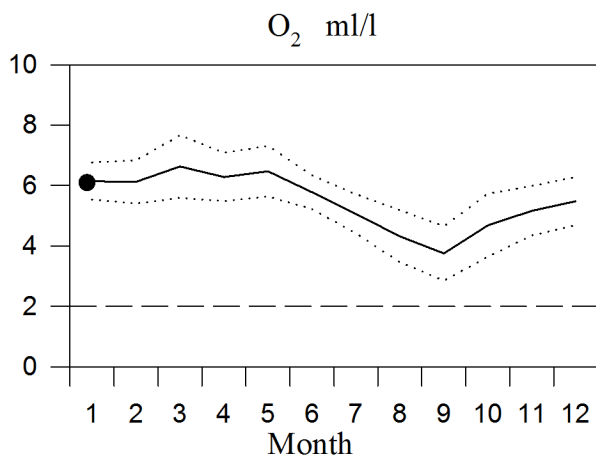
— Mean 2007-2010

..... St.Dev.

● 2016

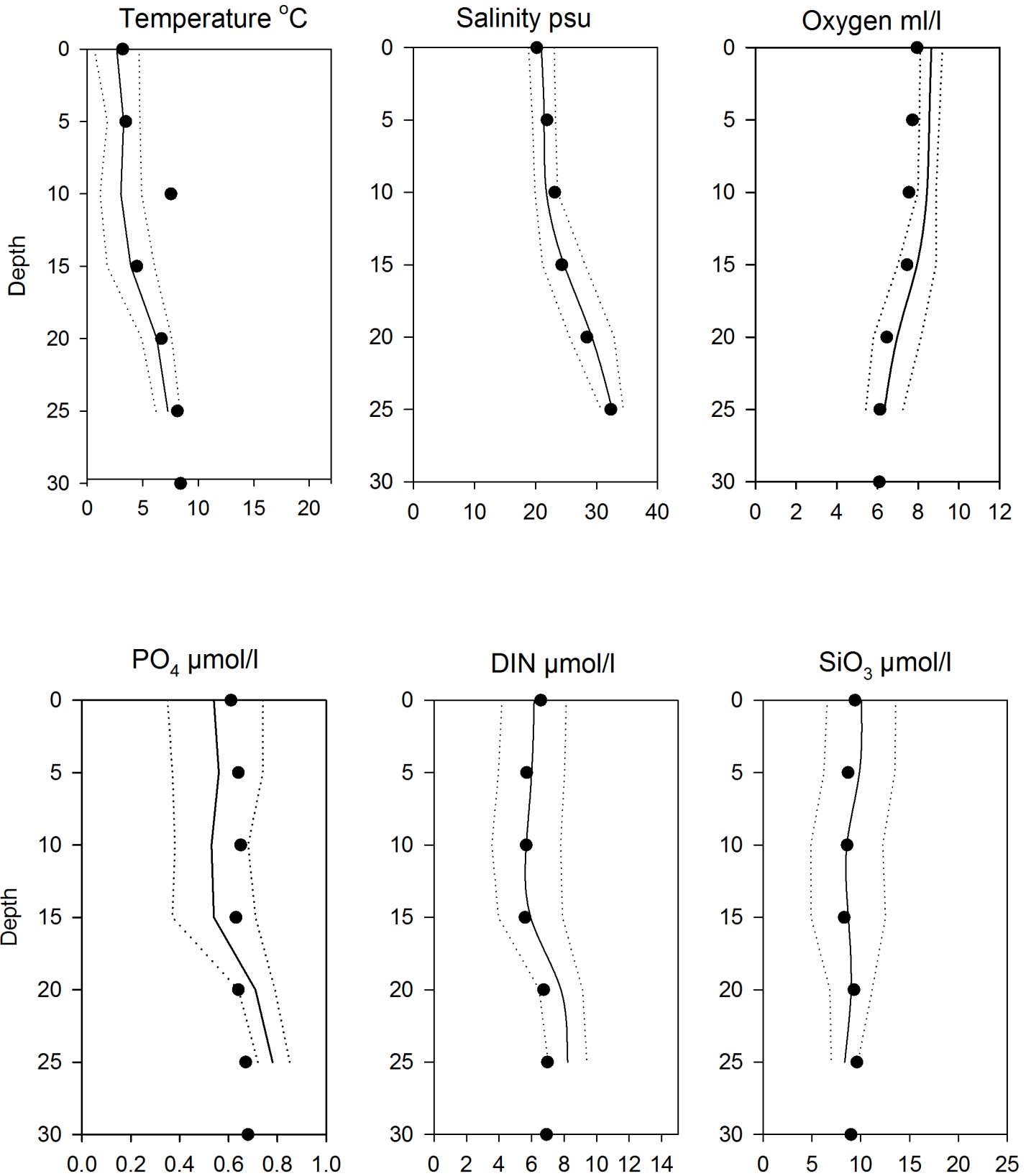


OXYGEN IN BOTTOM WATER (depth > 25m)



———— Mean 1996-2010 St.Dev. ● 2016

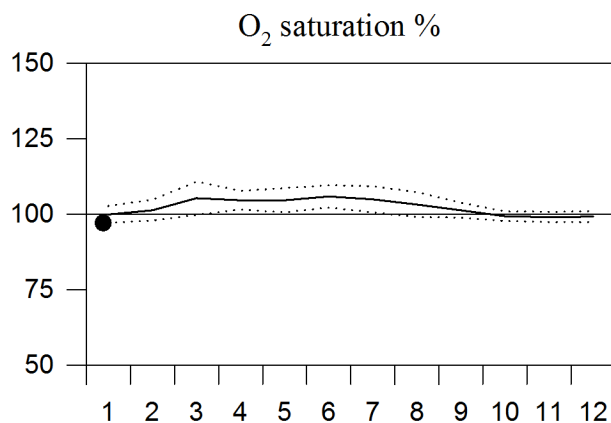
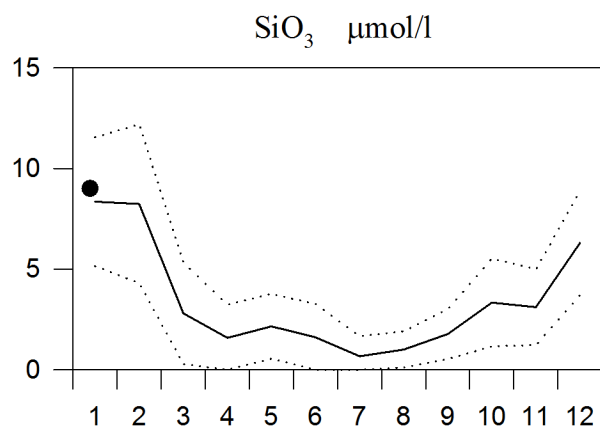
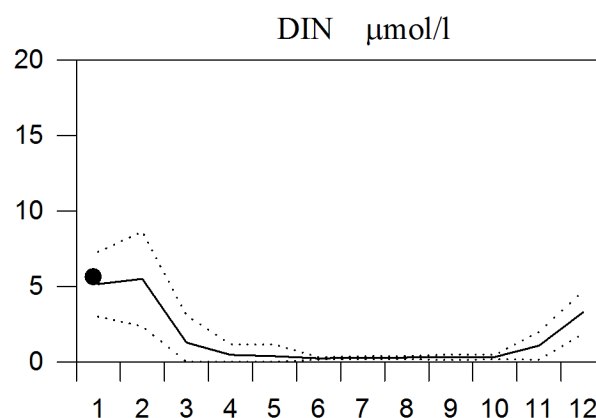
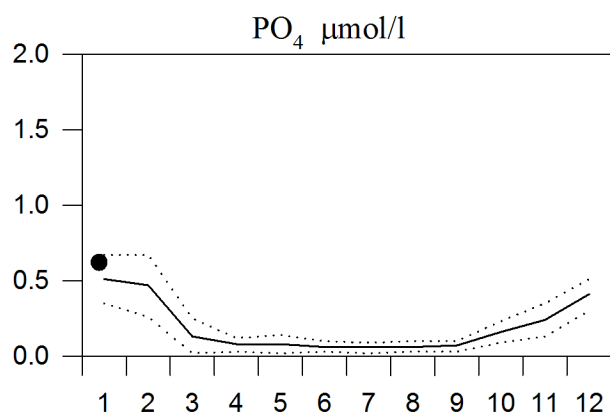
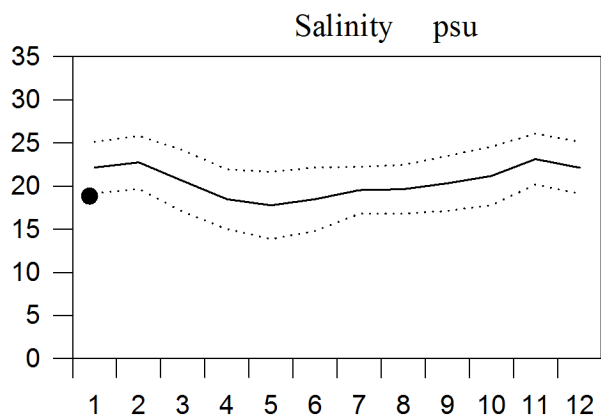
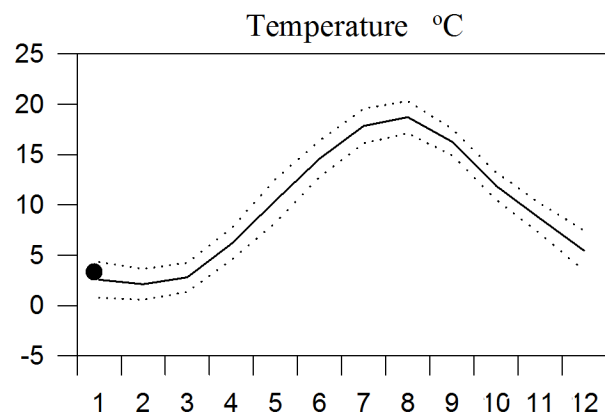
2016



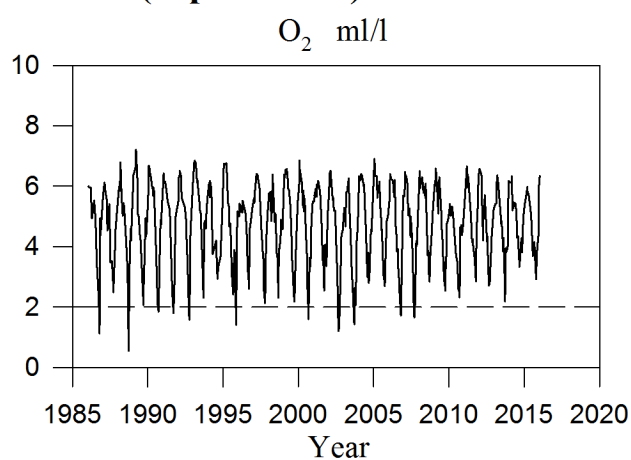
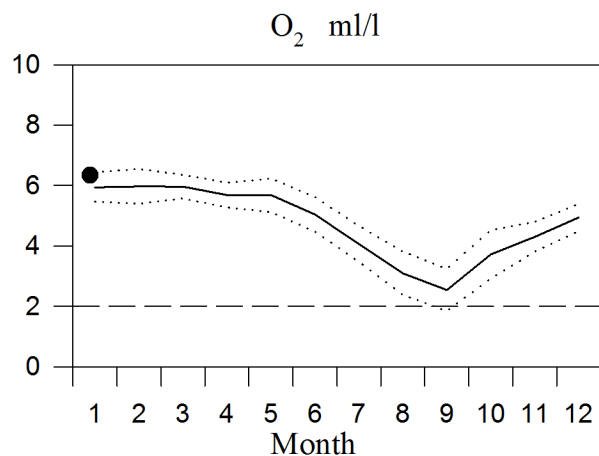
STATION ANHOLT E SURFACE WATER

Annual Cycles

— Mean 1996-2010 St.Dev. ● 2016

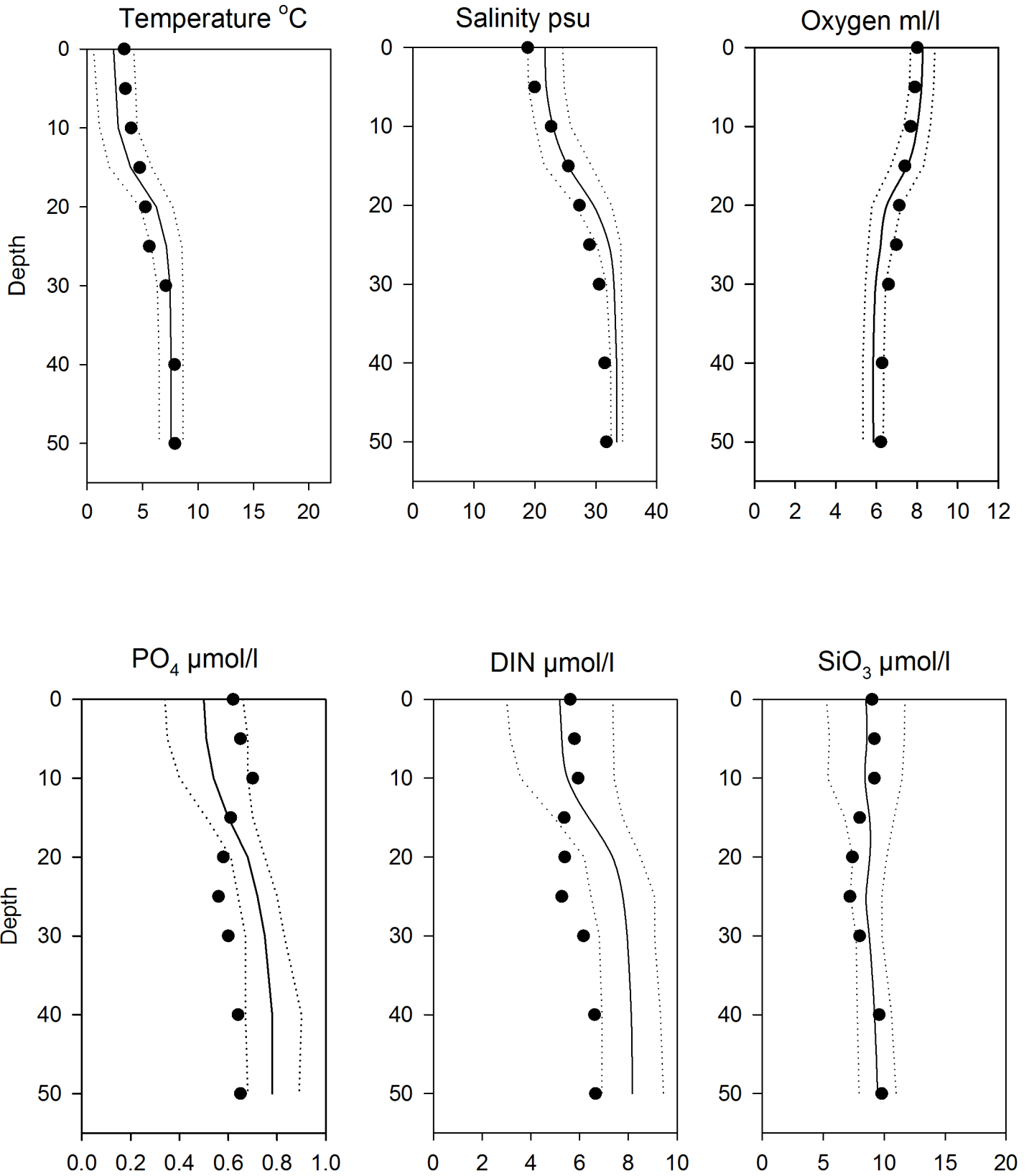


OXYGEN IN BOTTOM WATER (depth > 50m)



Vertical profiles Anholt E January

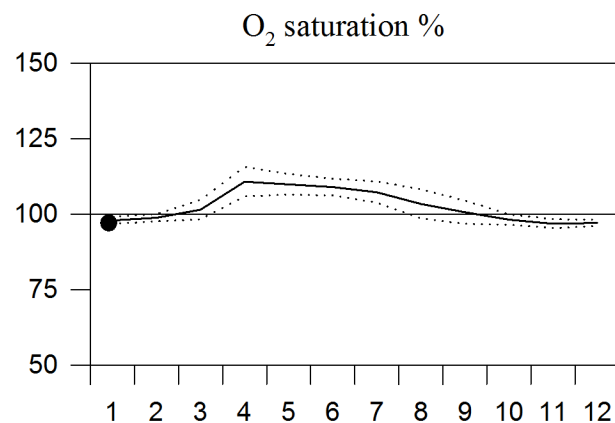
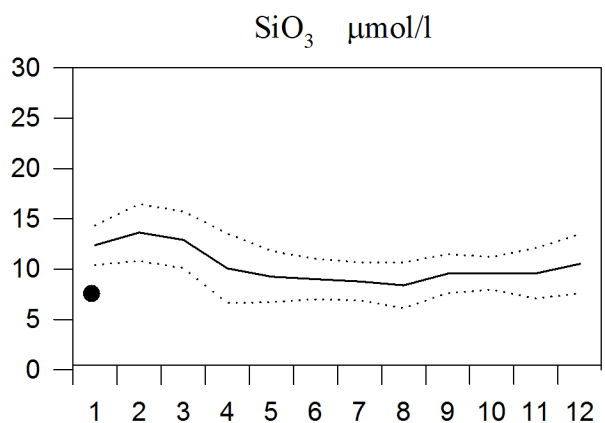
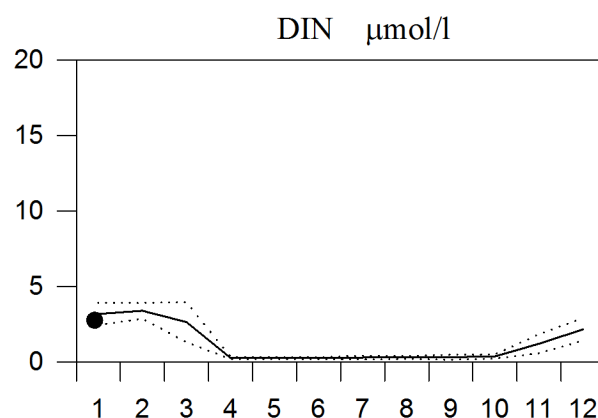
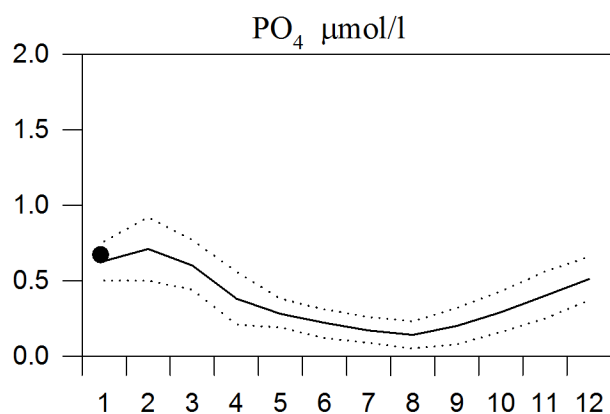
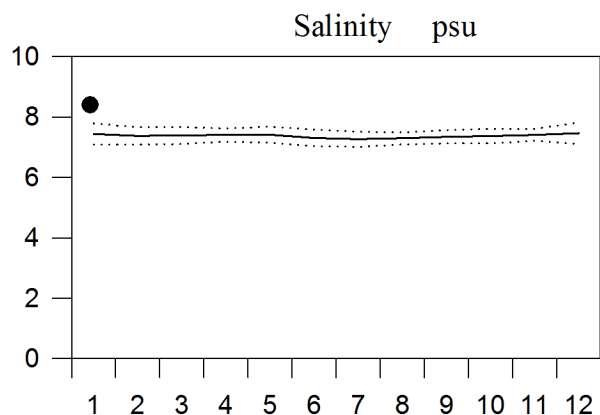
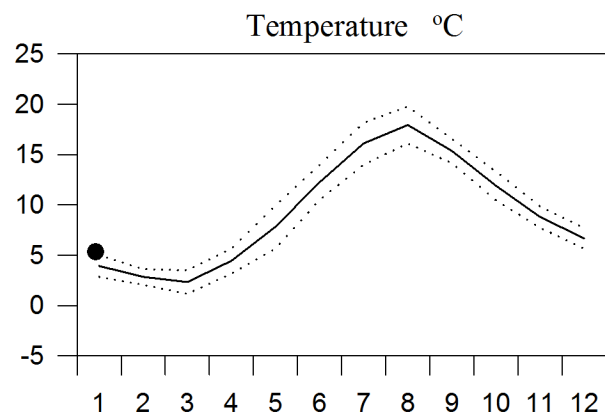
— Mean 1996-2010 St.Dev. ● 2016



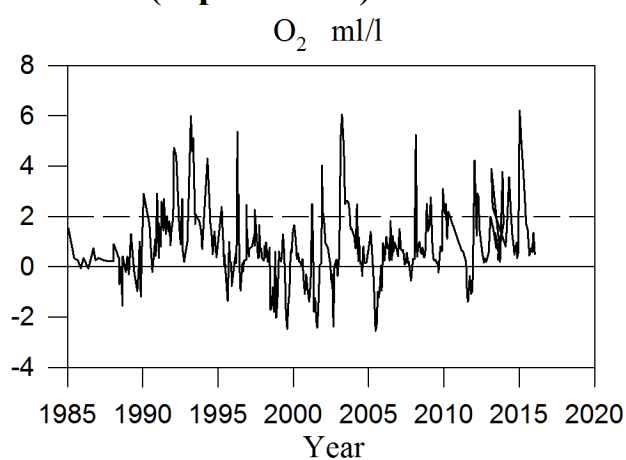
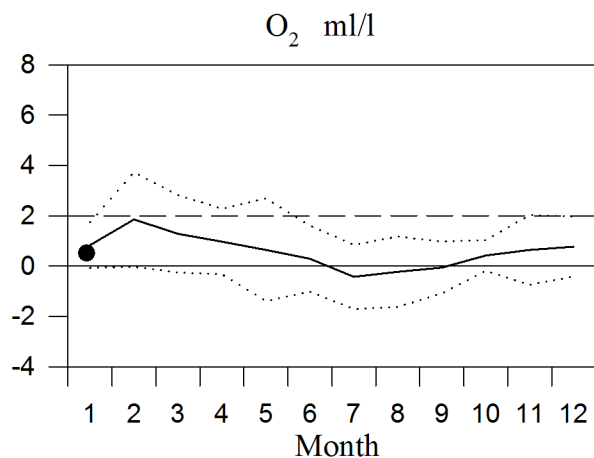
STATION HANÖBUKTEN SURFACE WATER

Annual Cycles

— Mean 1996-2010 St.Dev. ● 2016

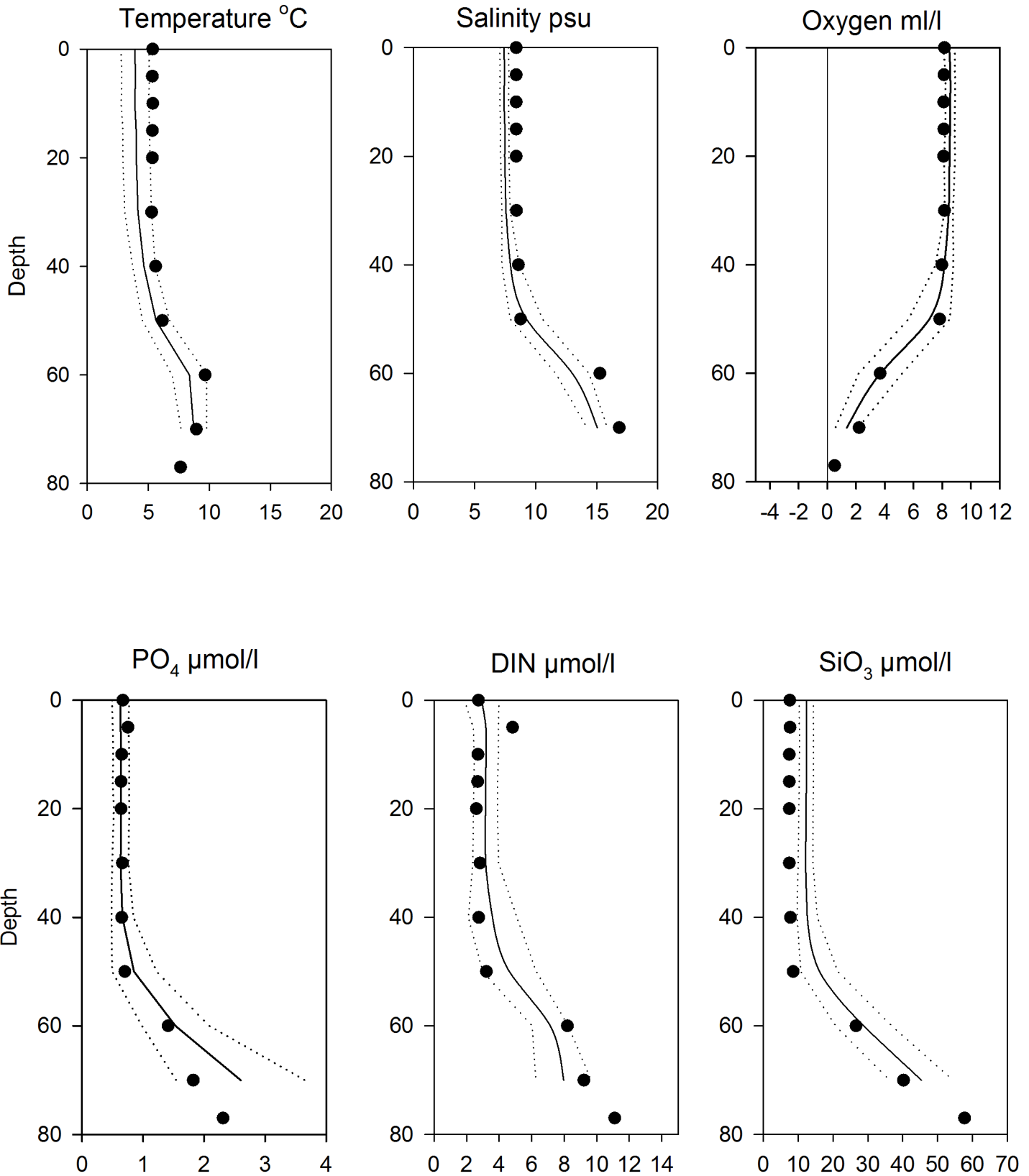


OXYGEN IN BOTTOM WATER (depth > 70m)



Vertical profiles Hanöbukten January

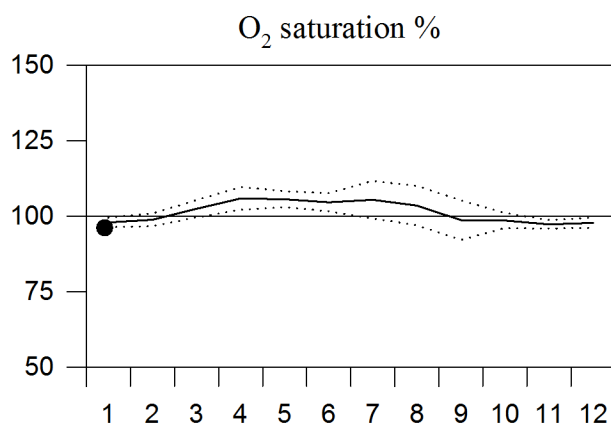
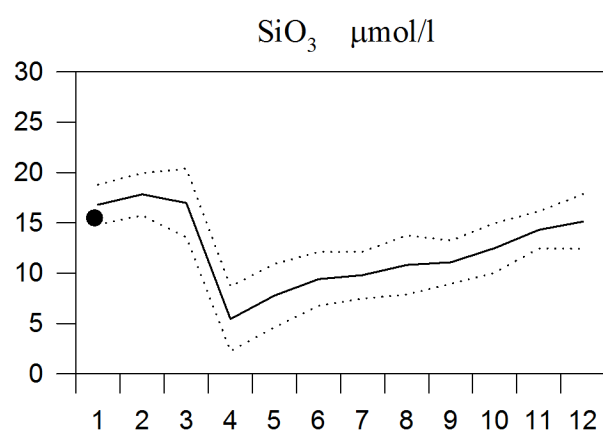
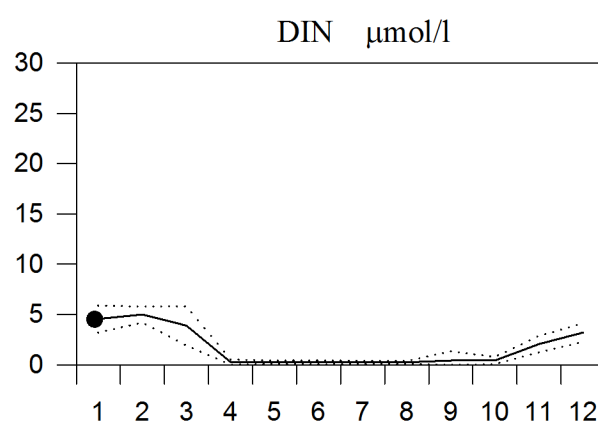
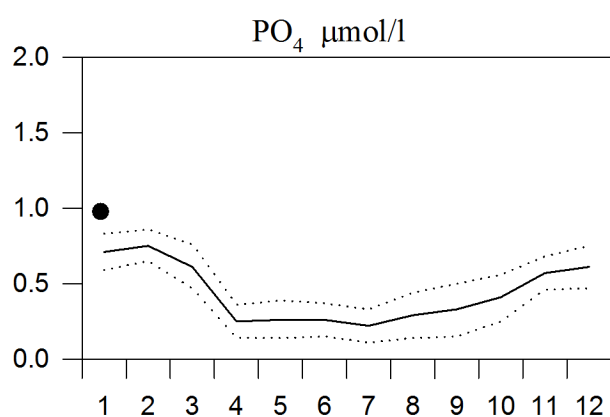
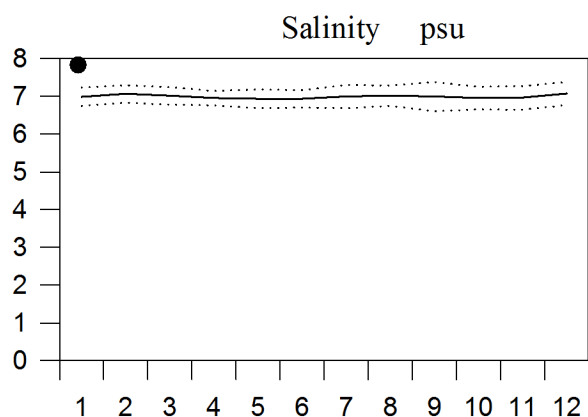
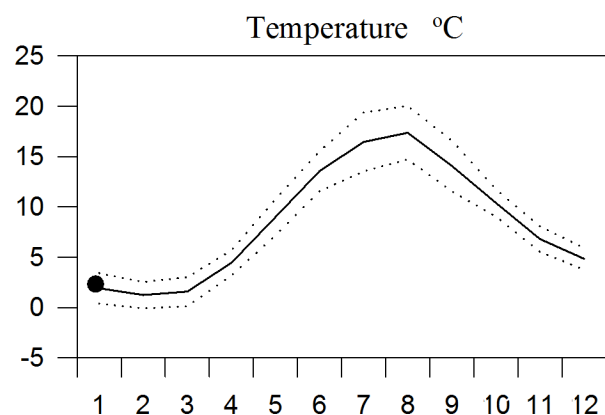
— Mean 1996-2010 St.Dev. ● 2016



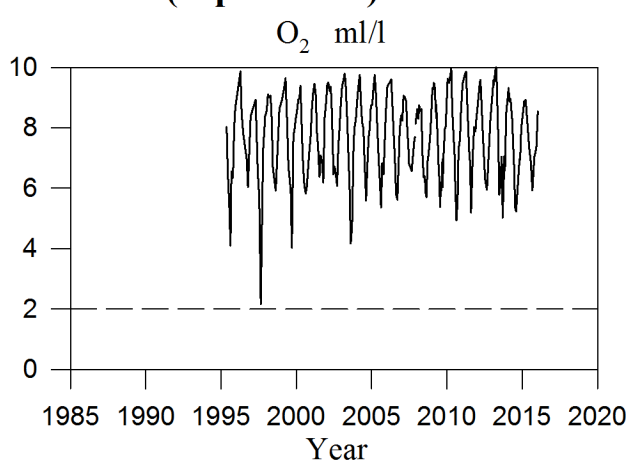
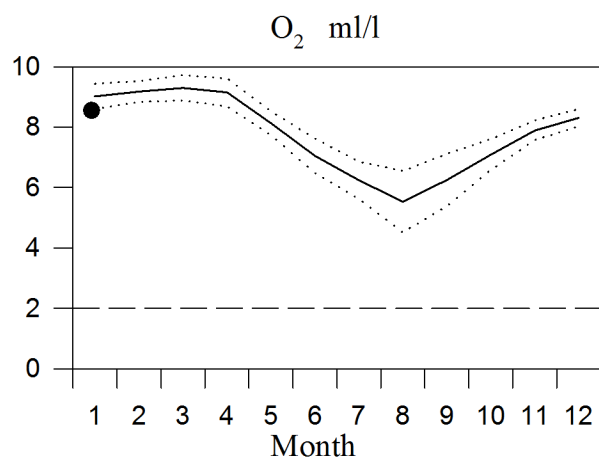
STATION REF M1V1 SURFACE WATER

Annual Cycles

— Mean 1996-2010 St.Dev. ● 2016



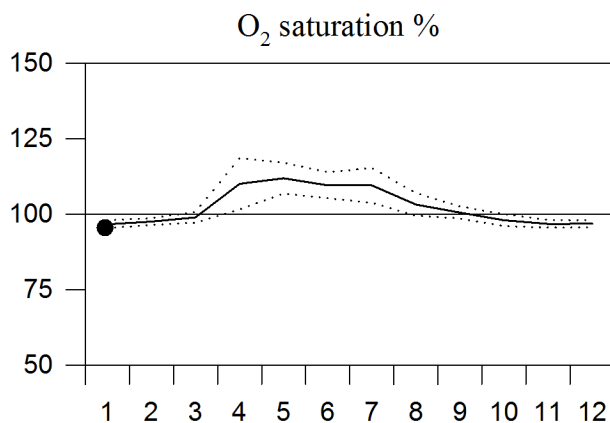
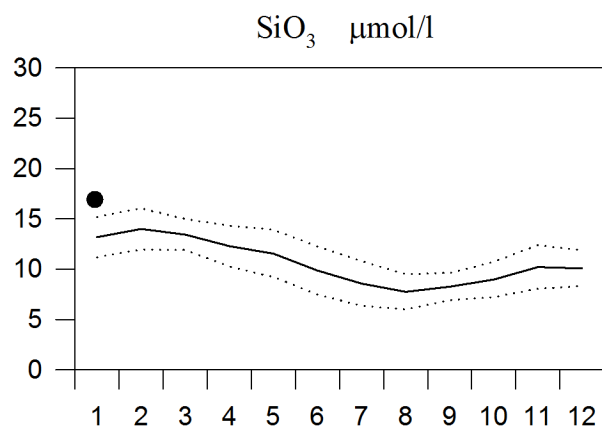
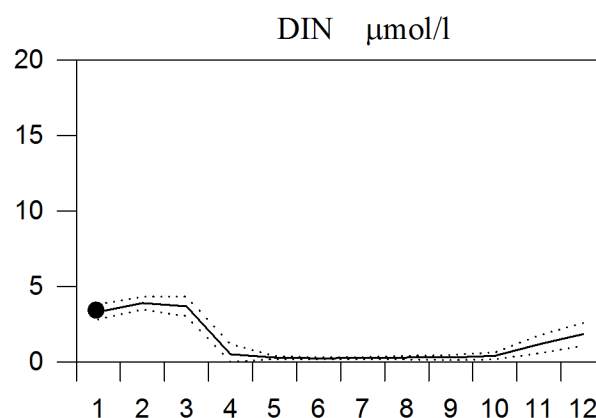
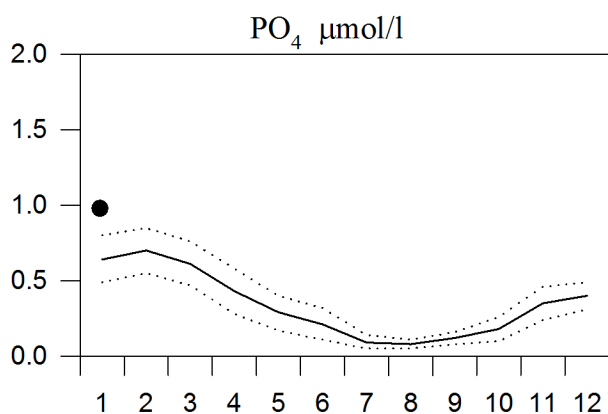
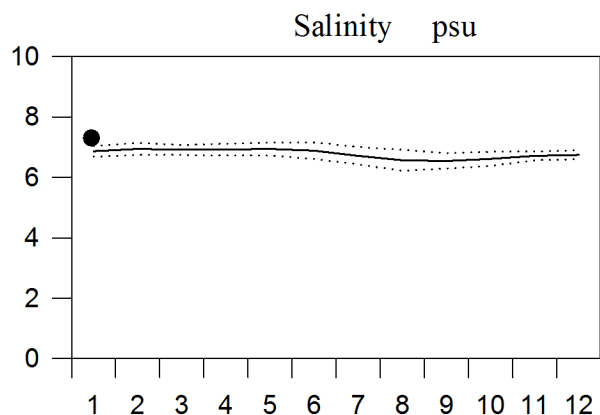
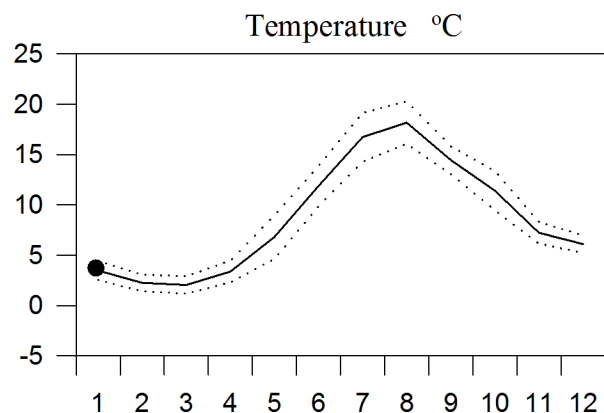
OXYGEN IN BOTTOM WATER (depth >15m)



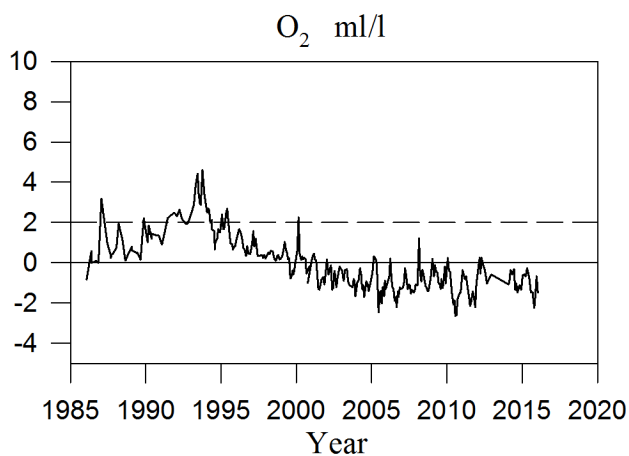
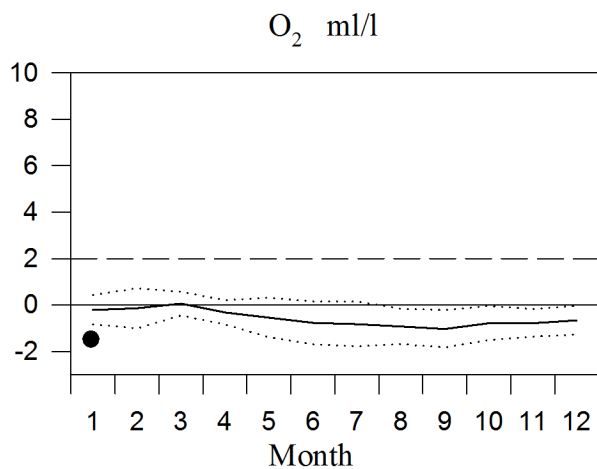
STATION BY38 SURFACE WATER

Annual Cycles

— Mean 1996-2010 St.Dev. ● 2016

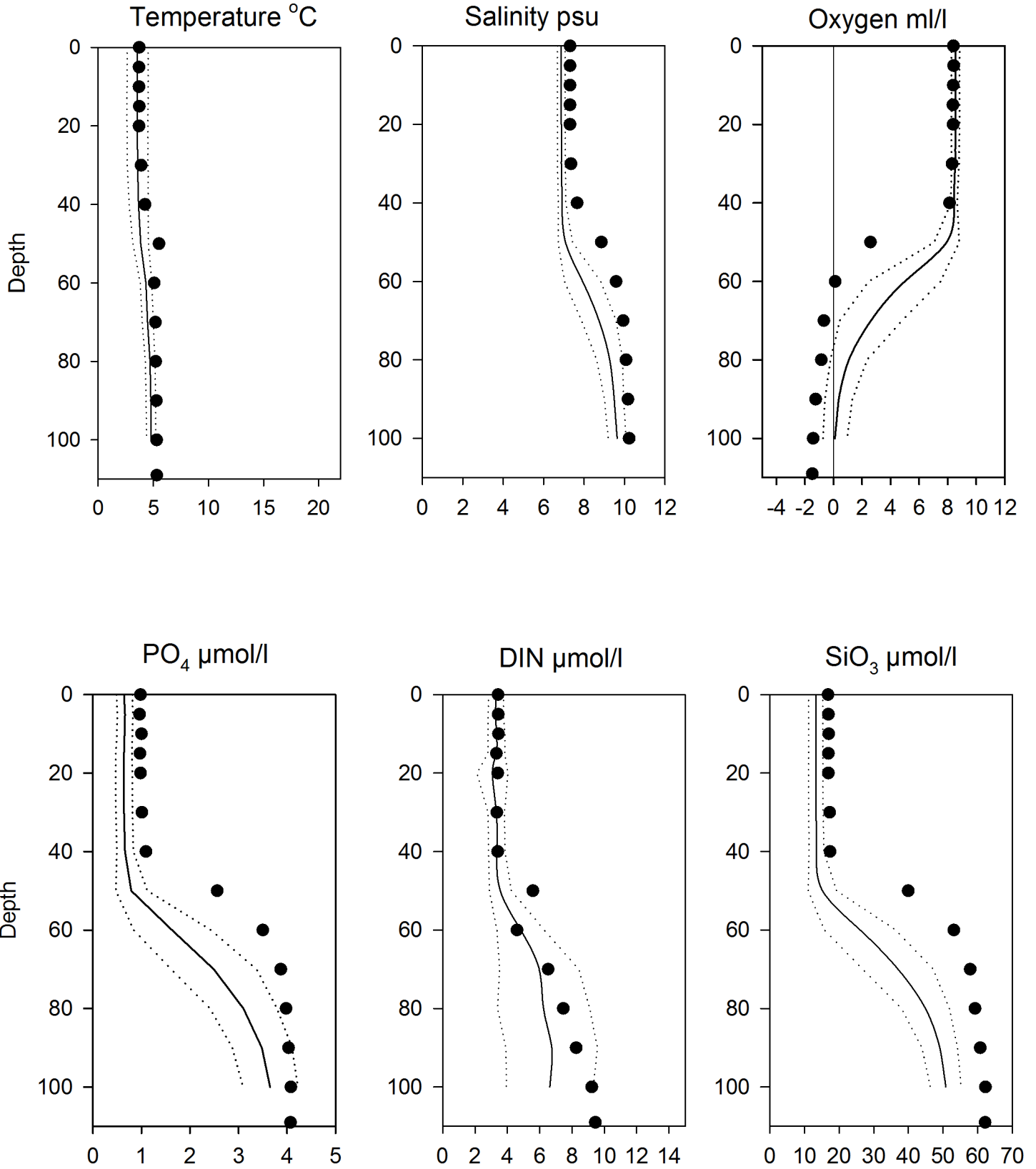


OXYGEN IN BOTTOM WATER (> 100m)



Vertical profiles BY38 January

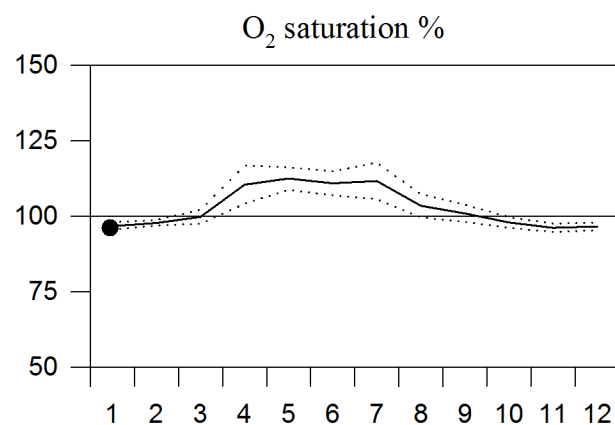
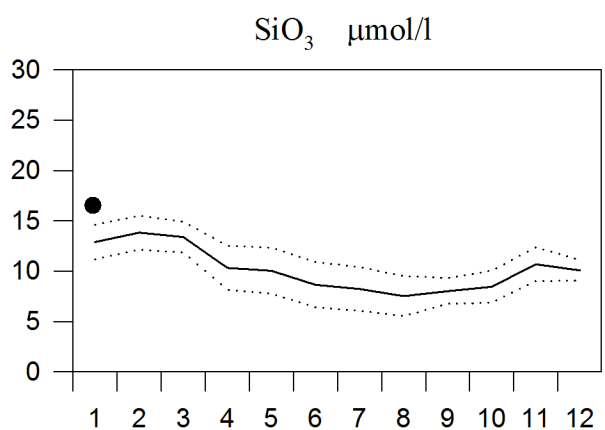
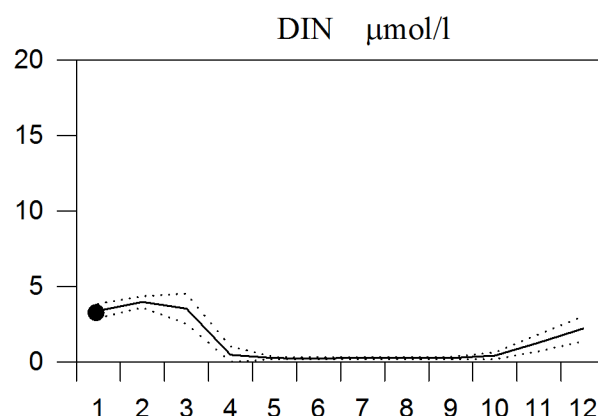
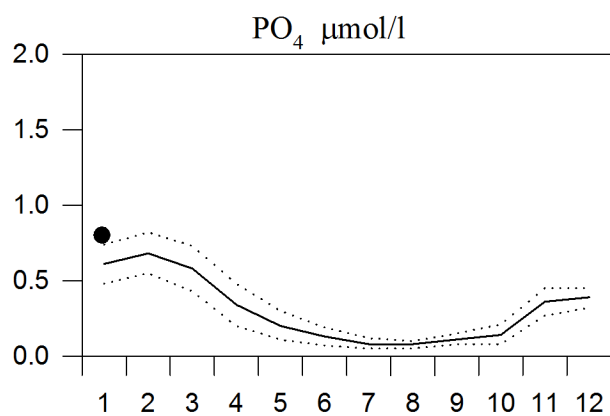
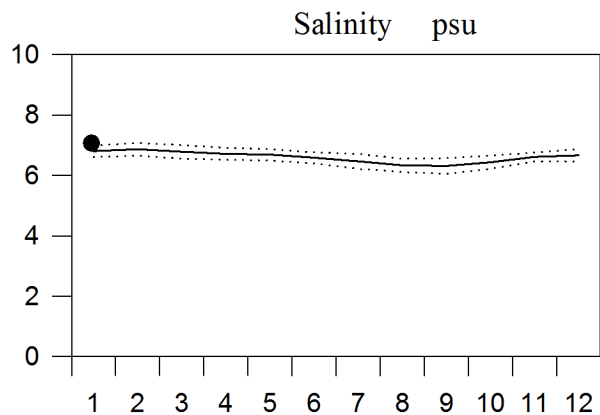
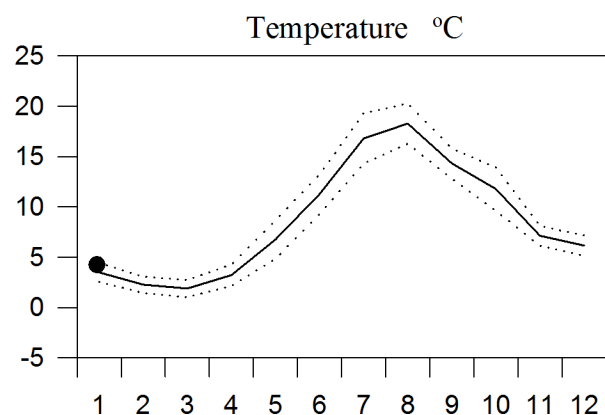
— Mean 1996-2010 St.Dev. ● 2016



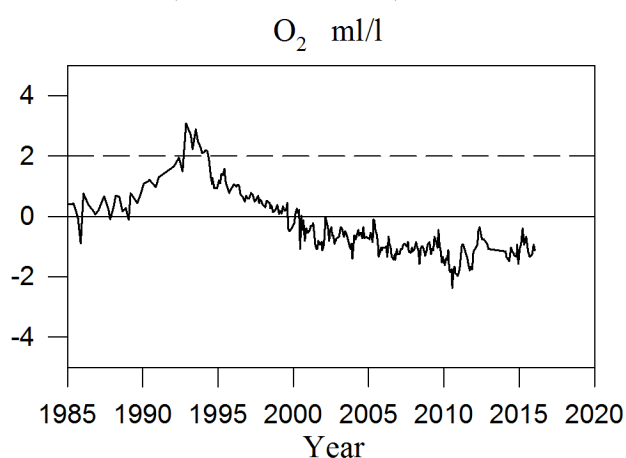
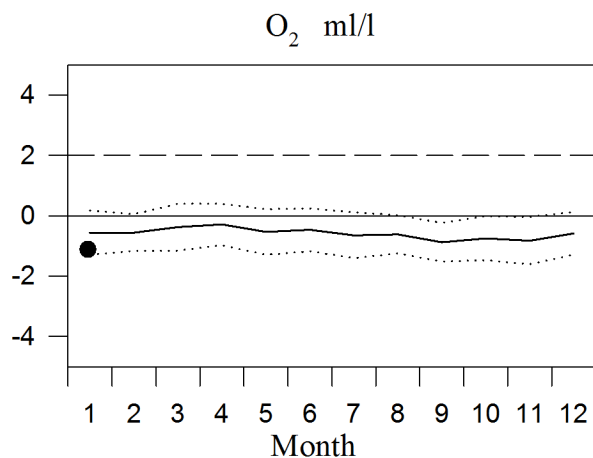
STATION BY32 SURFACE WATER

Annual Cycles

— Mean 1996-2010 St.Dev. ● 2016



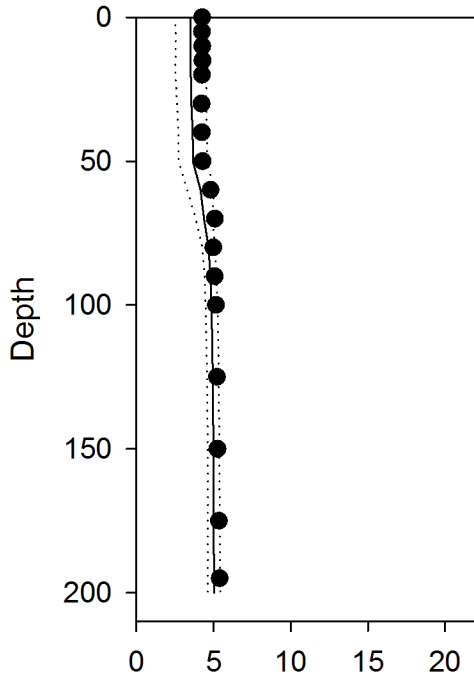
OXYGEN IN BOTTOM WATER (depth > 175m)



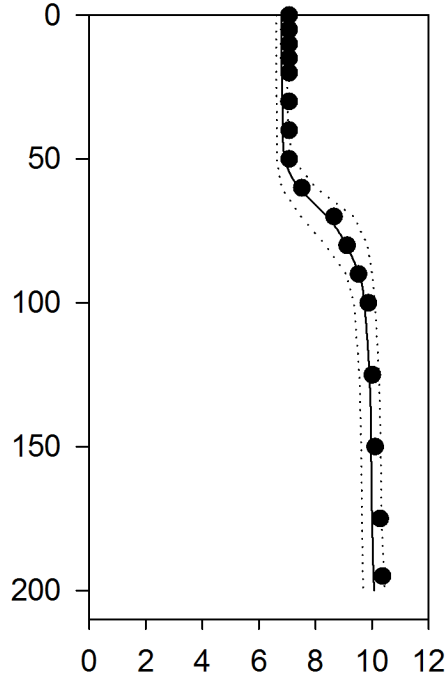
Vertical profiles BY32 January

— Mean 1996-2010 St.Dev. ● 2016

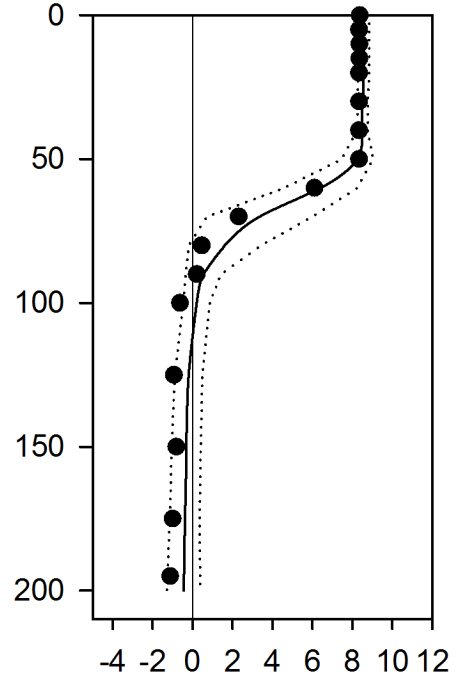
Temperature °C



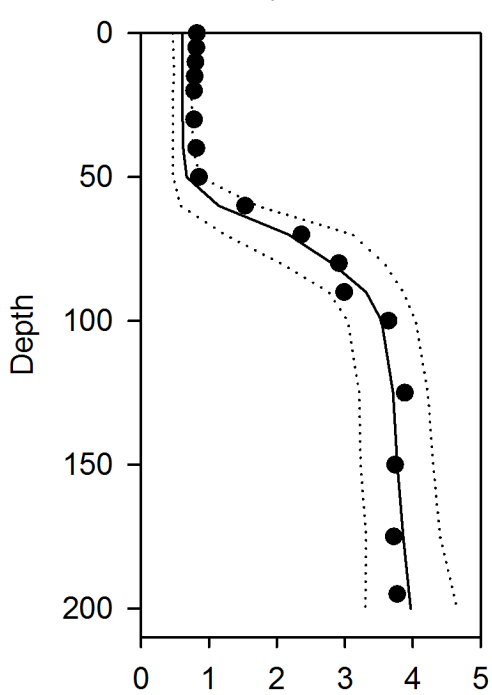
Salinity psu



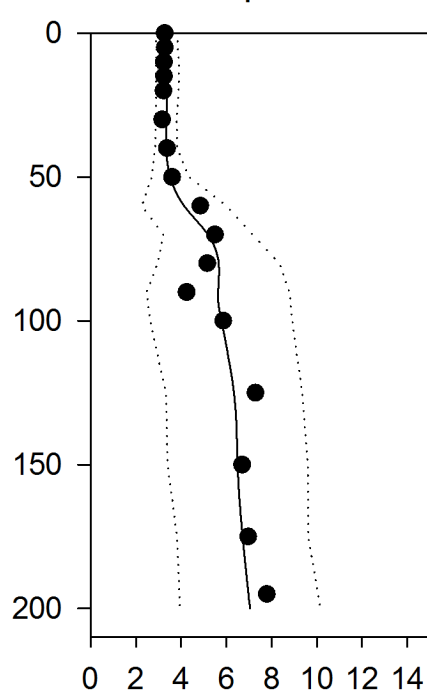
Oxygen ml/l



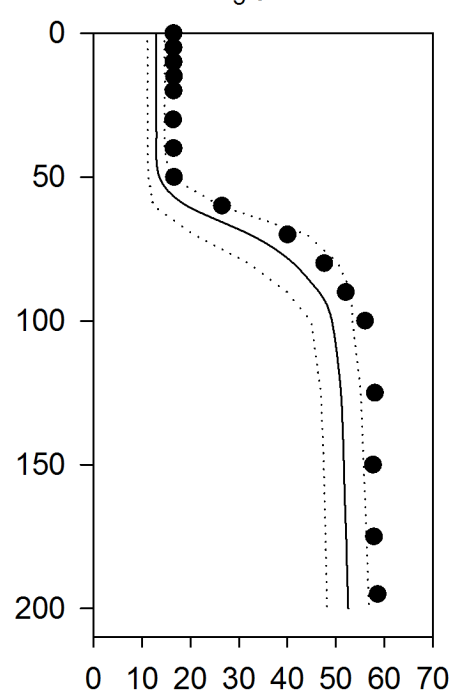
PO₄ μmol/l



DIN μmol/l



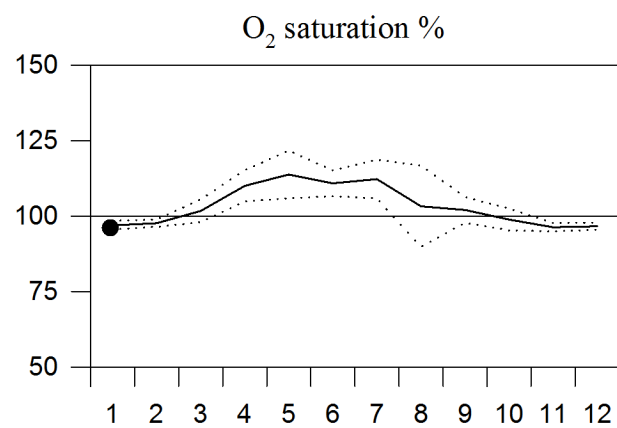
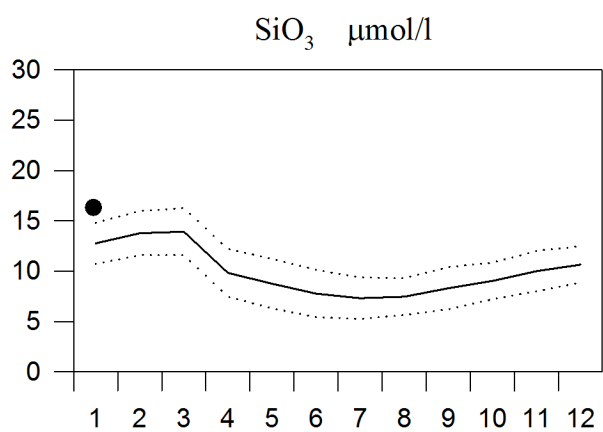
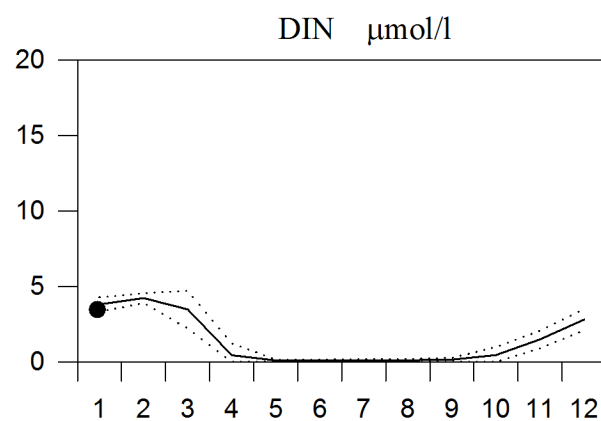
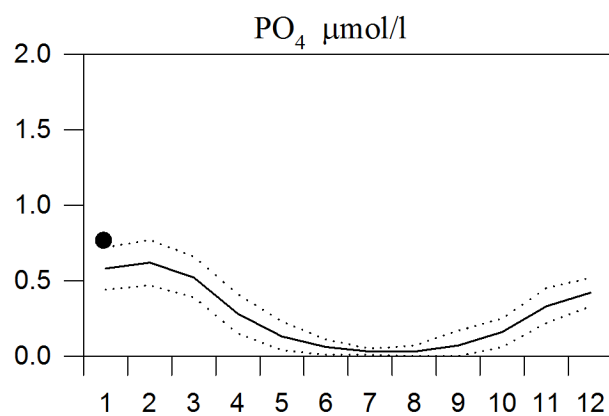
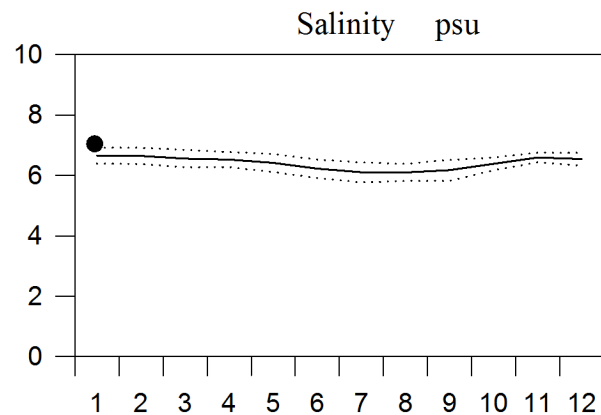
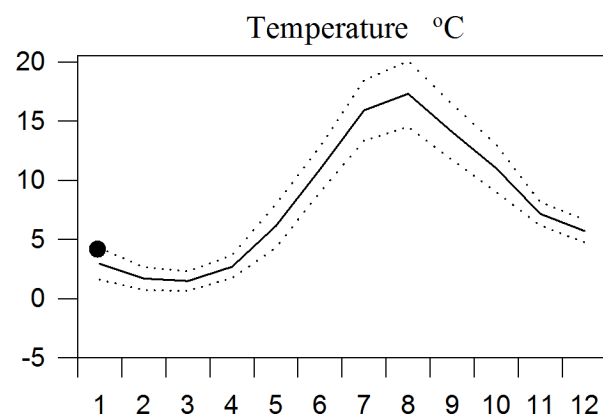
SiO₃ μmol/l



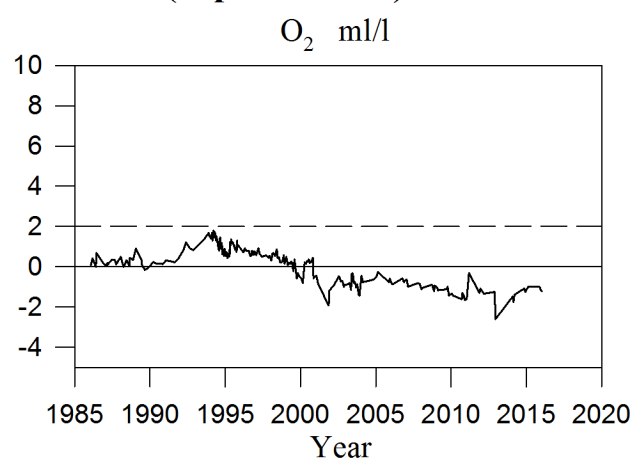
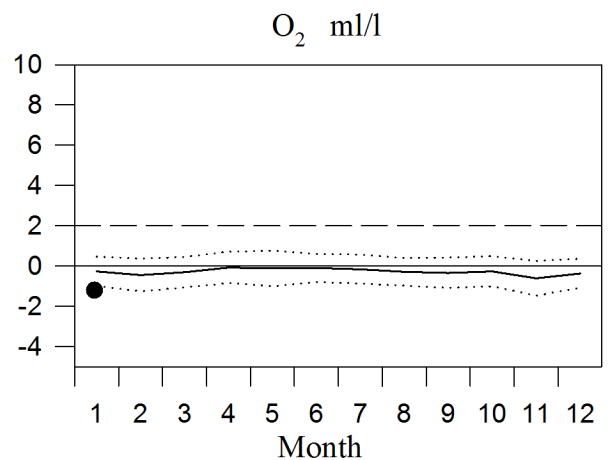
STATION BY31 SURFACE WATER

Annual Cycles

— Mean 1996-2010 St.Dev. ● 2016



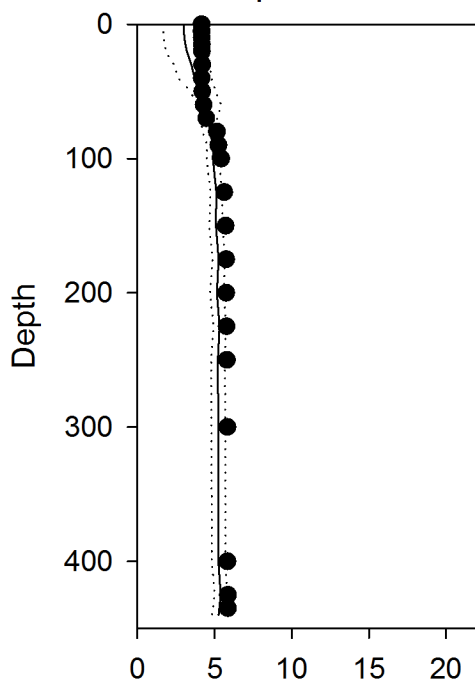
OXYGEN IN BOTTOM WATER (depth = 440m)



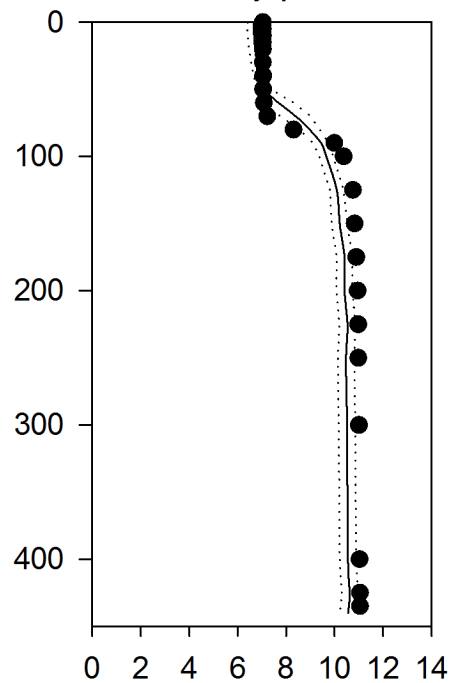
Vertical profiles BY31 January

— Mean 1996-2010 St.Dev. ● 2016

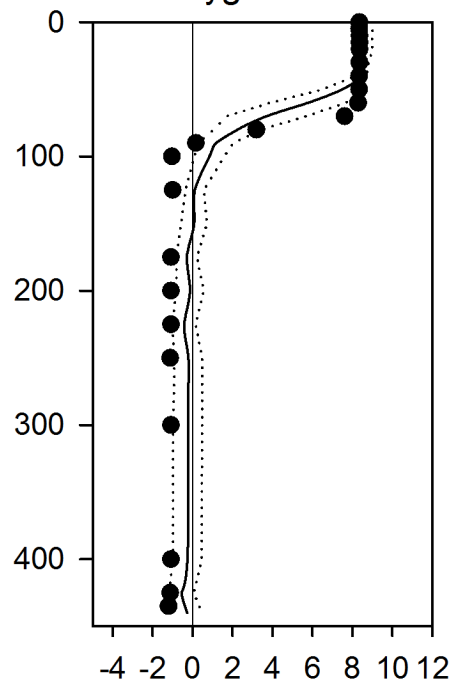
Temperature °C



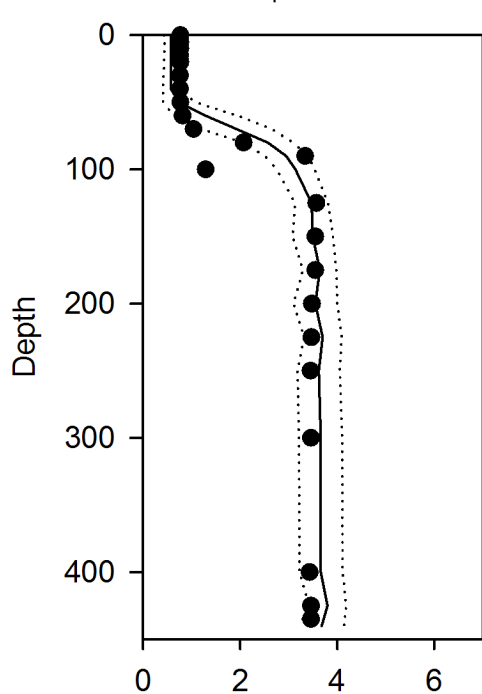
Salinity psu



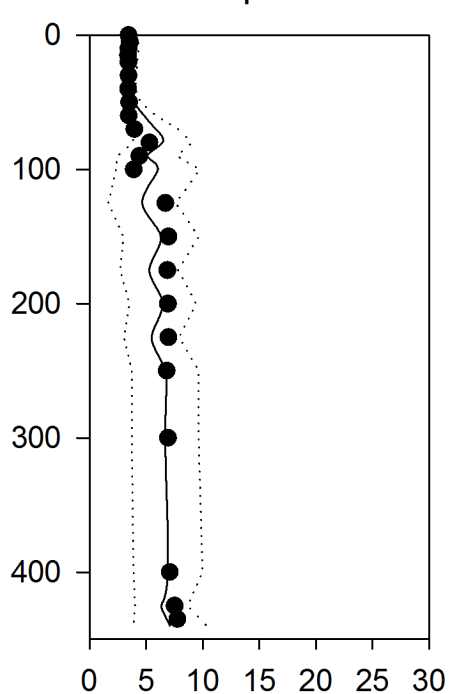
Oxygen ml/l



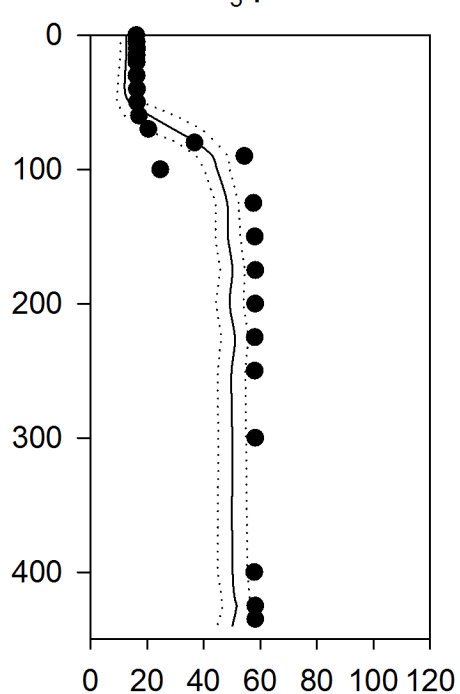
PO₄ μmol/l



DIN μmol/l



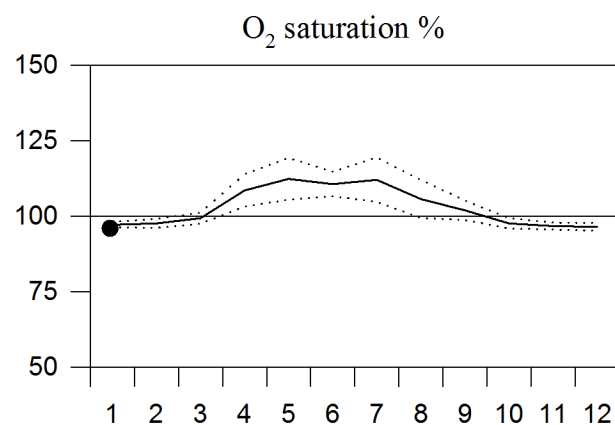
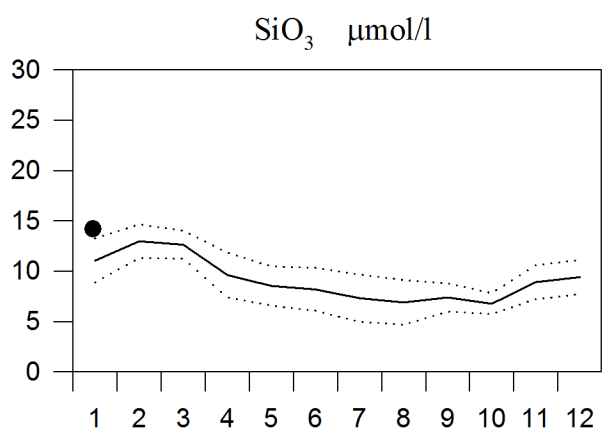
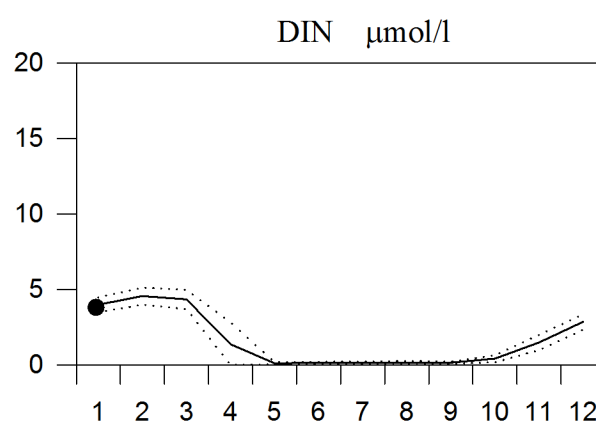
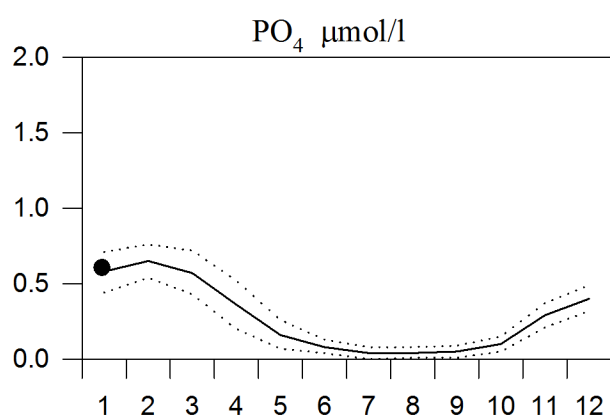
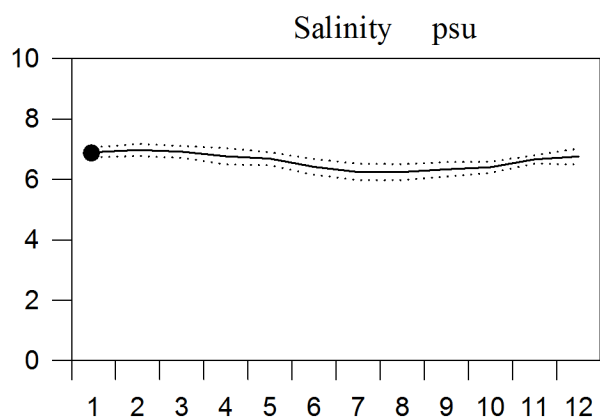
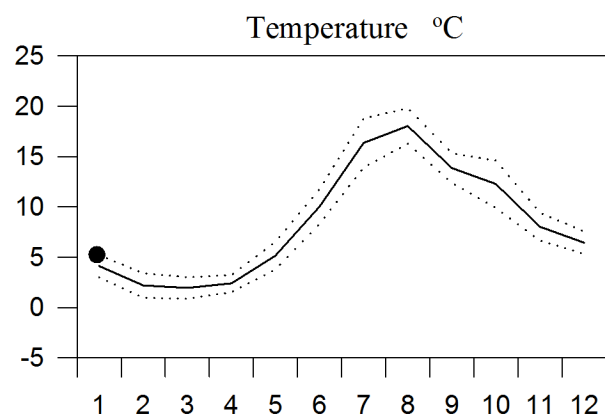
SiO₃ μmol/l



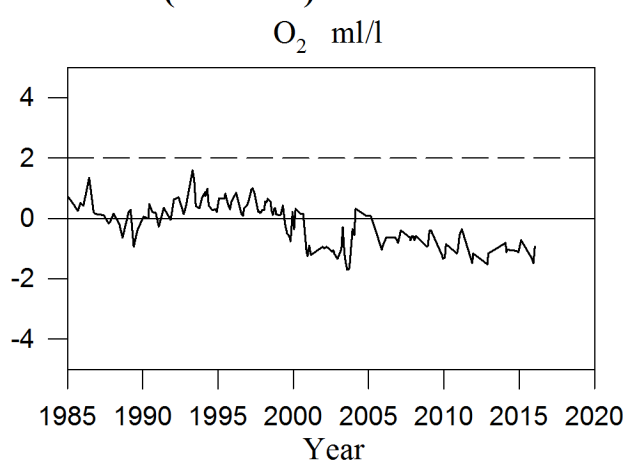
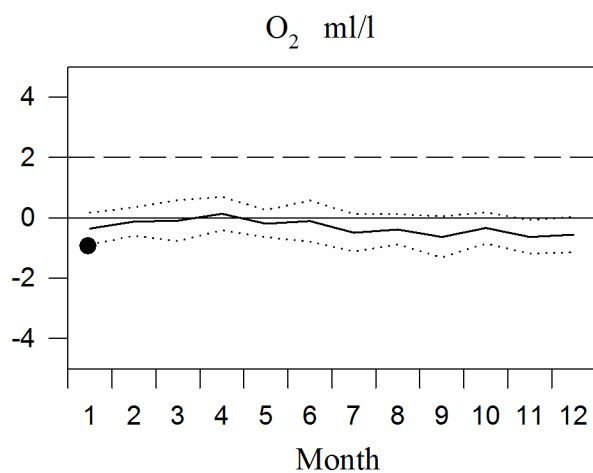
STATION BY29 SURFACE WATER

Annual Cycles

— Mean 1996-2010 St.Dev. ● 2016



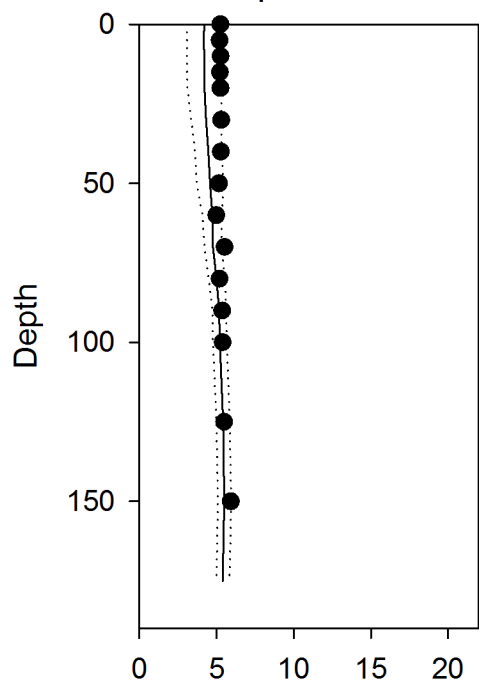
OXYGEN IN BOTTOM WATER (>=150m)



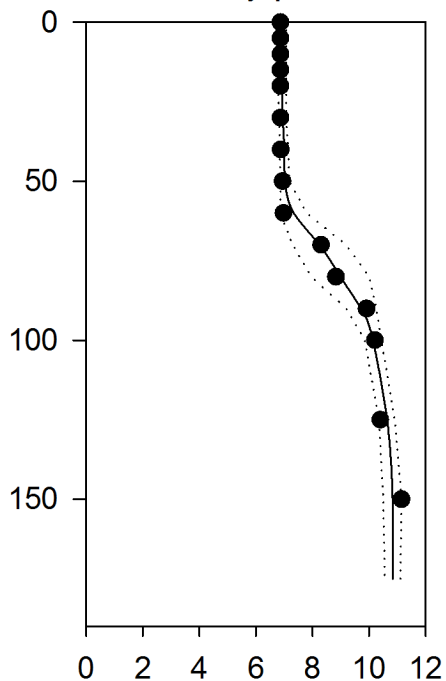
Vertical profiles BY29 January

— Mean 1996-2010 St.Dev. ● 2016

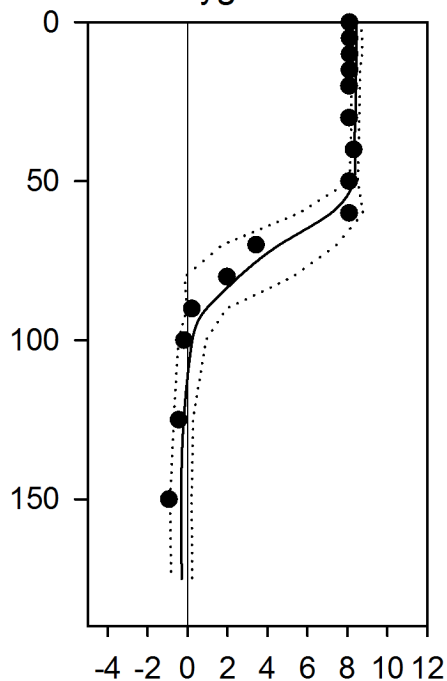
Temperature °C



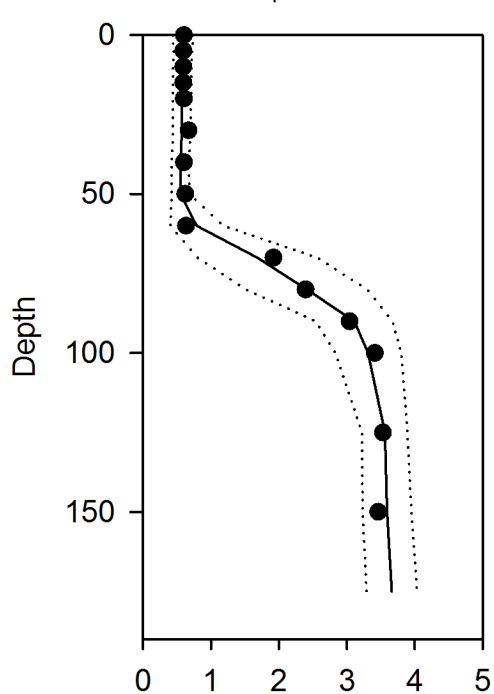
Salinity psu



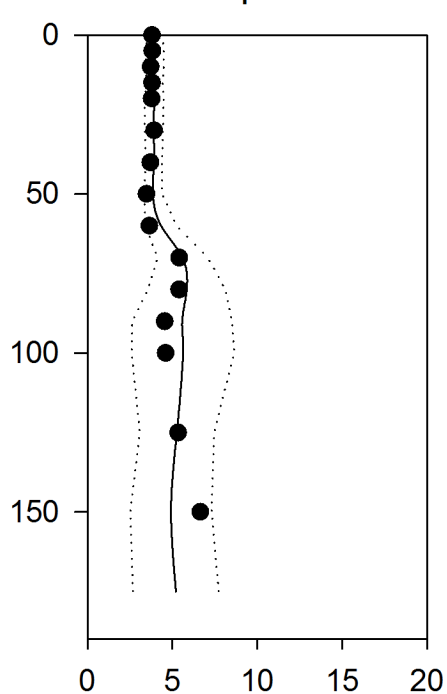
Oxygen ml/l



PO₄ μmol/l



DIN μmol/l



SiO₃ μmol/l

