

Rapport från SMHIs utsjöexpedition med R/V Aranda



Expeditionens varaktighet: 2015-04-20 - 2015-04-27
Undersökningsområde: Skagerrak, Kattegatt, Öresund och egentliga Östersjön
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.

Vattentemperaturen i ytlagret var i huvudsak normal för årstiden. I Skagerrak hade närsalthalterna i ytvattnet stigit något sedan föregående mättillfälle medan de i Kattegatt uppvisade, för årstiden typiska koncentrationer. Fosfat- och silikathalterna var generellt över det normala i stora delar av egentliga Östersjön, medan halterna av oorganiskt kväve låg under detektionsgränsen i, i stort sett, hela området. I östra Gotlandsbassängen, pågick en blomning och där registrerades hög fluorescens. I övriga områden var planktonaktiviteten låg.

Effekterna av inflödet under december 2014 syntes nu tydligt i de centrala delarna av östra Gotlandsbassängen. I västra Gotlandsbassängen var syresituationen dock fortfarande allvarlig då akut syrebrist förekom från djup överstigande 70 - 80 meter och svavelväte från ca 90 meters djup.

Nästa ordinarie expedition är planerad till vecka 24 i juni 2015.

PRELIMINÄRA RESULTAT

Expeditionen genomfördes ombord det finska forskningsfartyget Aranda och startade i Helsingfors den 20:e april och avslutades i samma hamn den 27:e.

Vindarna under expeditionen var i huvudsak svaga till måttliga. Lufttemperaturen varierade mellan 4.5 och 10.5 °C. Stationen BY15 i östra Gotlandsbassängen kunde ej provtas, utan flyttades till svenskt vatten något längre västerut, på grund av Ryska marinens övningar i området.

Två forskare från Helsingfors Universitet var med ombord för att mäta N₂O i hypoxiska vatten.

Skagerrak

Salthalten i ytlagret uppvisade små variationer kring 30 psu. Ytvattentemperaturen var normal för årstiden och låg mellan 7.1 och 7.8 °C. Haloklinen och termoklinen var svagt utvecklad invid kusten medan den i utsjön var skarpare och återfanns på omkring 10-15 meters djup.

Närsalterna i ytvattnet hade generellt stigit något jämfört med föregående mättillfälle i mars då samtliga närsalter var i stort sett förbrukade. Fosfatkoncentrationerna i ytvattnet låg i intervallet 0.04 och 0.09 µmol/l, nitrit + nitrat varierade från 0.3 till 2.1 µmol/l, medan halterna av silikat varierade mellan 0.7 och 1.3 µmol/l.

Fluorescensmätningar tillsammans med syremättnad visade låg biologisk aktivitet förutom i yttre Skagerrak där en kraftig blomning påträffades på 15 meter djup. Kraftigt turkosfärgat vatten antyder att pågick en kiselalgsblomning av *Emiliania Huxleyi*.

Kattegatt och Öresund

Temperaturen i ytvattnet var normal för årstiden och varierade från 8 °C i söder till 9 °C i norr. I Kattegatt var ytsalthalten normal, mellan 20.1 - 23.5 psu. I Öresund var salthalten dock något lägre än normalt, omkring 10 psu. Haloklin och termoklin återfanns på 5 till 15 meters djup.

Halterna av näringsämnen i ytvattnet var normala för årstiden förutom när det gäller silikat som uppvisade halter som var högre än normalt. En blomningen pågick och höga fluorescensvärden uppmättes i anslutning till haloklinen. Fosfatkoncentrationerna låg mellan 0.06 i norr och 0.11 µmol/l i söder, silikat i intervallet 2.9 till 4.0 µmol/l. I Öresund var motsvarande värden 0.27 för fosfat och 5.8 µmol/l för silikat. Oorganiskt kväve låg under detektionsgränsen i södra Kattegatt och Öresund samt omkring 0.4 µmol/l i norra Kattegatt.

De lägsta syrehalterna i bottenvattnet uppmättes vid Anholt E i Kattegatt, 5.6 ml/l samt vid W Landskrona i Öresund, 4.9 ml/l.

Egentliga Östersjön

Temperaturen i ytskiktet låg strax över medel för årstiden och varierade från 4.1°C i nordost till 7.0°C i sydväst. Ytsalthalten var något över det normala i Arkonabassängen och

Bornholmsbassängen och varierade från 6.8 psu i nordost till 8.3 psu. Haloklinen återfanns på 60 till 70 meters djup i västra och östra Gotlandsbassängerna, medan den låg grundare i de södra delarna, på djup mellan 30 och 50 meter.

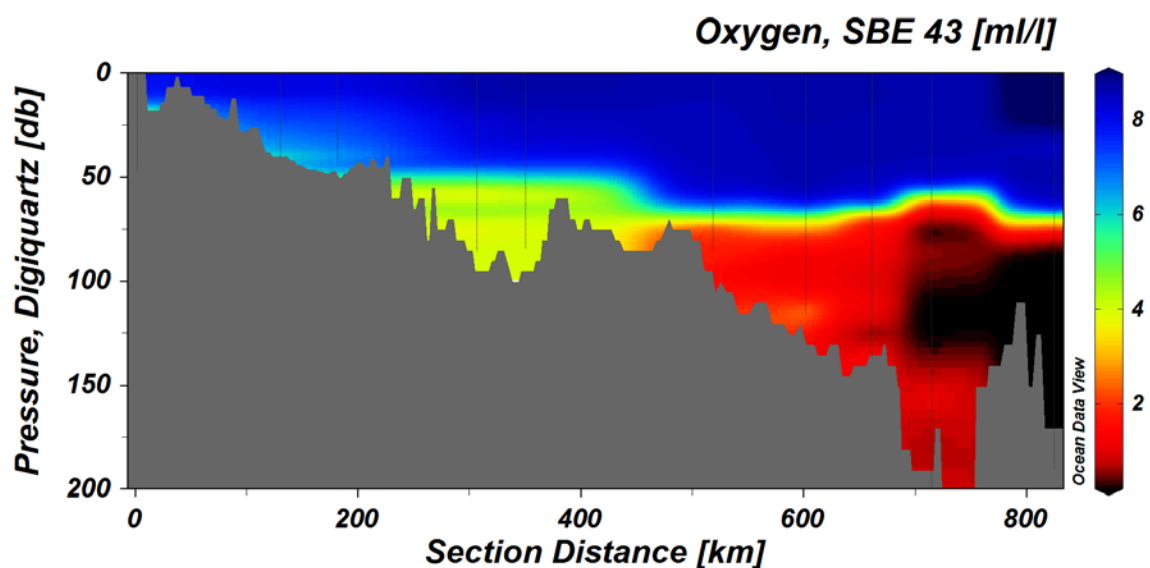
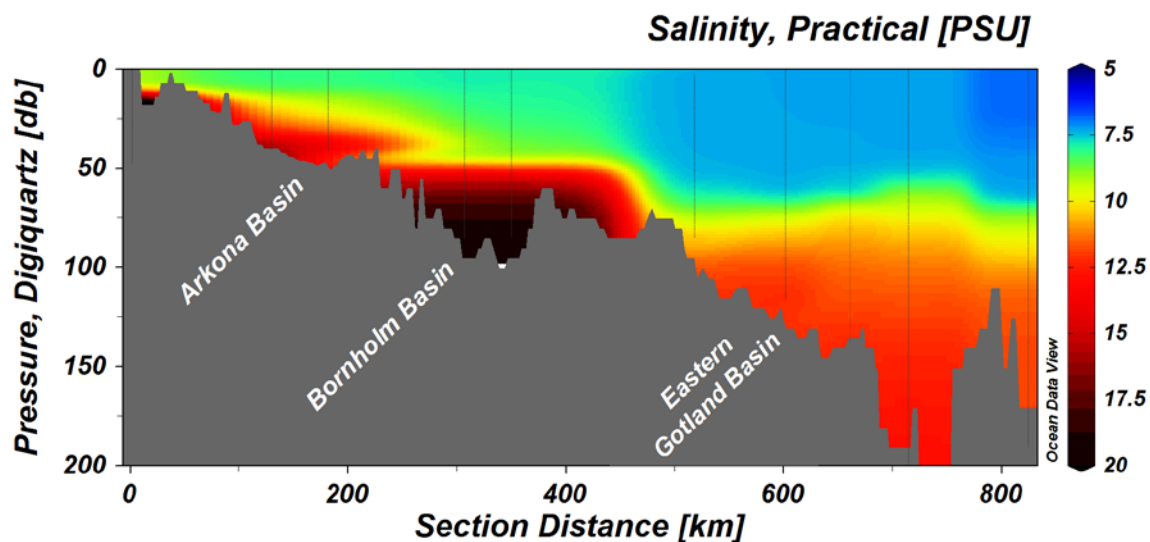
Fosfat- och silikalthalterna var generellt över det normala och varierade mellan 0.3 - 0.7 µmol/l och 10 - 18 µmol/l respektive. Halterna av oorganiskt kväve låg under detektionsgränsen i hela området, förutom i de sydöstra delarna där halterna låg omkring 1.2 µmol/l.

Vårblomningen pågick i de norra delarna av Östra Gotlandsbassängen, där hög fluorescens noterades på 5-25 meters djup. I övriga områden var planktonaktiviteten låg.

Det inflöde till Östersjön som inträffade under december 2014 hade nu nått de centrala delarna av Östra Gotlandsbassängen. Vid Gotlandsdjupet förekom akut syrebrist från 70 meters djup och svavelväte (helt syrefria förhållanden) på intermediärt djup mellan 125-150. Under detta syrefria skikt var bottenvattnet syresatt och syrgashalterna hade ökat från ca 1 ml/l till ca 3 ml/l sedan förra mättillfället i mars. Salthalten i bottenvattnet hade också ökat med omkring 0.5 psu. I den norra delen av Östra Gotlandsbassängen syntes inga effekter av inflödet och svavelväte noterades från djup överstigande 90 meter.

I Bornholmsbassängen, Arkonabassängen och i Hanöbukten förekom ingen syrebrist i bottenvattnet men syrgashalterna hade minskade sedan förra mättillfället med 0.5-1 ml/l.

I Västra Gotlandsbassängen var syresituationen fortsatt allvarlig. Helt syrefria förhållanden återfanns från 90 meter och akut syrebrist ($< 2\text{ ml/l}$) från omkring 70 meter.



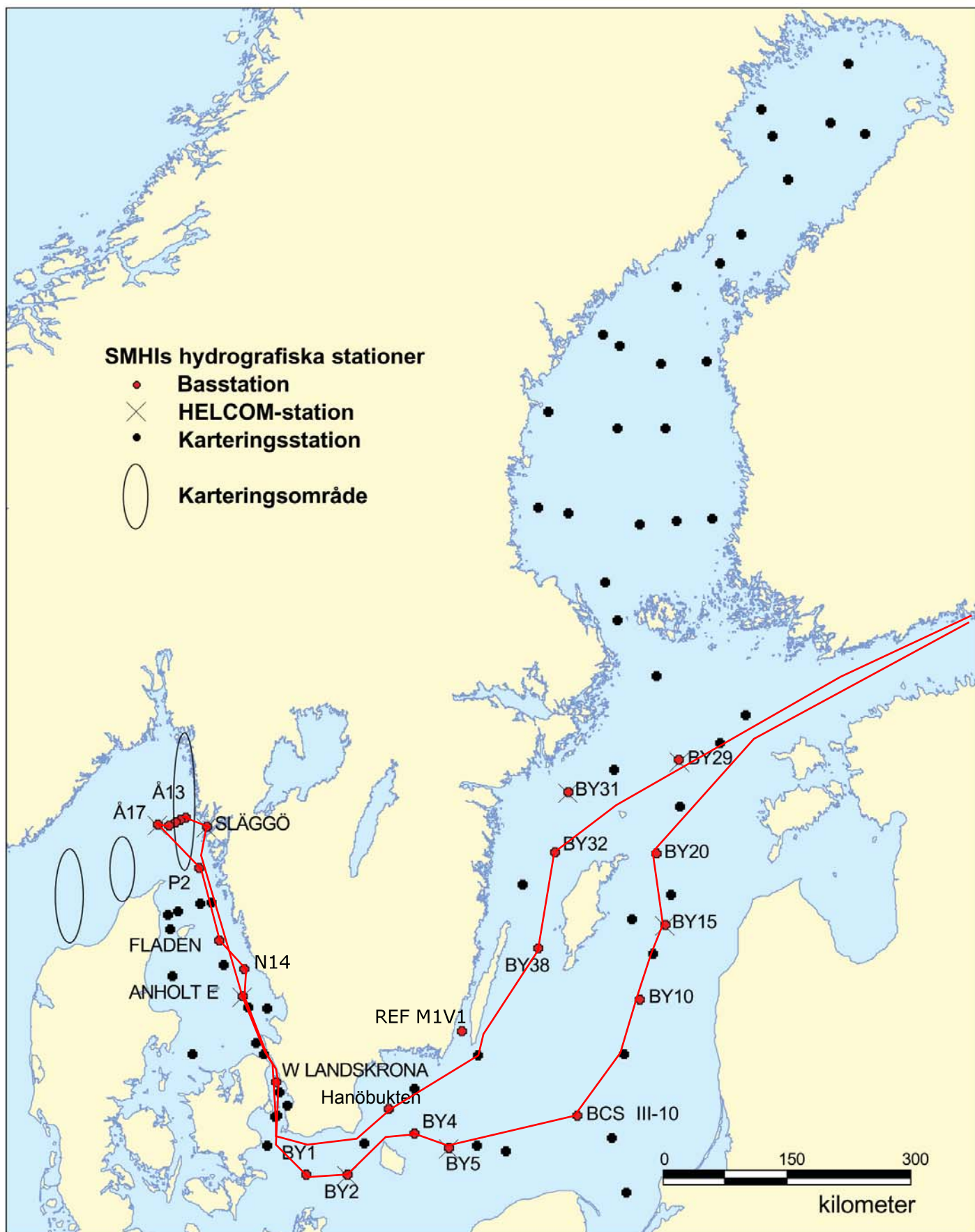
DELTAGARE

Namn		Från
Lars Andersson	Expeditionsledare	SMHI
Daniel Bergman-Sjöstrand		SMHI
Martin Hansson (Lysekil-Helsingfors)		SMHI
Sara Johansson		SMHI
Johan Kronsell		SMHI
Sari Sipilä		SMHI
Magnus Wenzer (Helsingfors-Lysekil)		SMHI
Jukka-Pekka Myllykangas	Helsingfors Universitet	
Gunnar Jacobs	Helsingfors 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: 20150420-20150427
Series: 0177-0206



Date: 2015-04-27
Time: 06:14

Ser no	Stat code	P r o j	Station-----	Lat-----	Lon-----	Date yyyymmdd	Time hhmm utc	Bottom depth m	Secchi depth m	Wind di ve	Air temp C	Air pres hPa	WCSI elec aoae t hd	C PPCPZT Hrhhoo ml Cilyooa PrP l	No de	T e a l p i g n	S h y s 2 0 4 t P P	O H o o N N	P T N N	N N N N	N T N N	A S h o l i u m a 3 u n l s i	S H L P T C	P T C	O O C m					
0177	BPEX26BAS	BY20	FÄRÖDJ	N5800	E1953	20150421	0420	195		35 10	4.7	1018	1230	x --x----	17	x	x	-	x	x	x	x	x	x	-	x	-	-	-	x
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0179	BPEX21EXT	BY15	W	N5718.79	E1956.09	20150421	0945	224		36 8	5.0	1021	1130	x -----	6	x	x	-	x	x	x	x	x	x	-	x	-	-	-	x
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0183	BPSE11BAS	BCS	III-10	N5533.3	E1824	20150421	2358	90		32 3	4.7	1023	9990	x --x----	12	x	x	-	x	x	x	x	x	x	-	x	-	-	-	-
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0186	BPSA03BAS	BY2	ARKONA	N5500	E1405	20150422	1704	48		25 8	7.5	1021	1130	x --xxxx--	8	x	x	-	x	x	x	x	x	x	-	x	-	-	-	-
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0189	KAEX29BAS	ANHOLT	E	N5640.0	E1207.0	20150423	0830	63		28 14	8.3	1012	2740	x -xxxx--	10	x	x	x	-	x	x	x	x	x	x	x	-	-	-	x
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SMHI
Ocean enh

***** Hydrographic
series

Ship: 01-Aranda
Year: 2015

Date: 2015-04-27
Time: 06:14

Ser no	Stat code	P r o j	Station-----	Lat-----	Lon-----	Date yyyymmdd	Time hhmm utc	Bottom depth m	Secchi depth m	Wind di ve	Air temp C	Air pres hPa	WCSI elec aoae tu hd	C t d	PPCPZZT Hrhhhoor Cilyooa motPBw PrP l	No de	T e	S a	P h	O x	H 2	P o	T o	N o	N o	N o	T h	A o	S l	H i	L u	P i	P 0	T 0	C 0	
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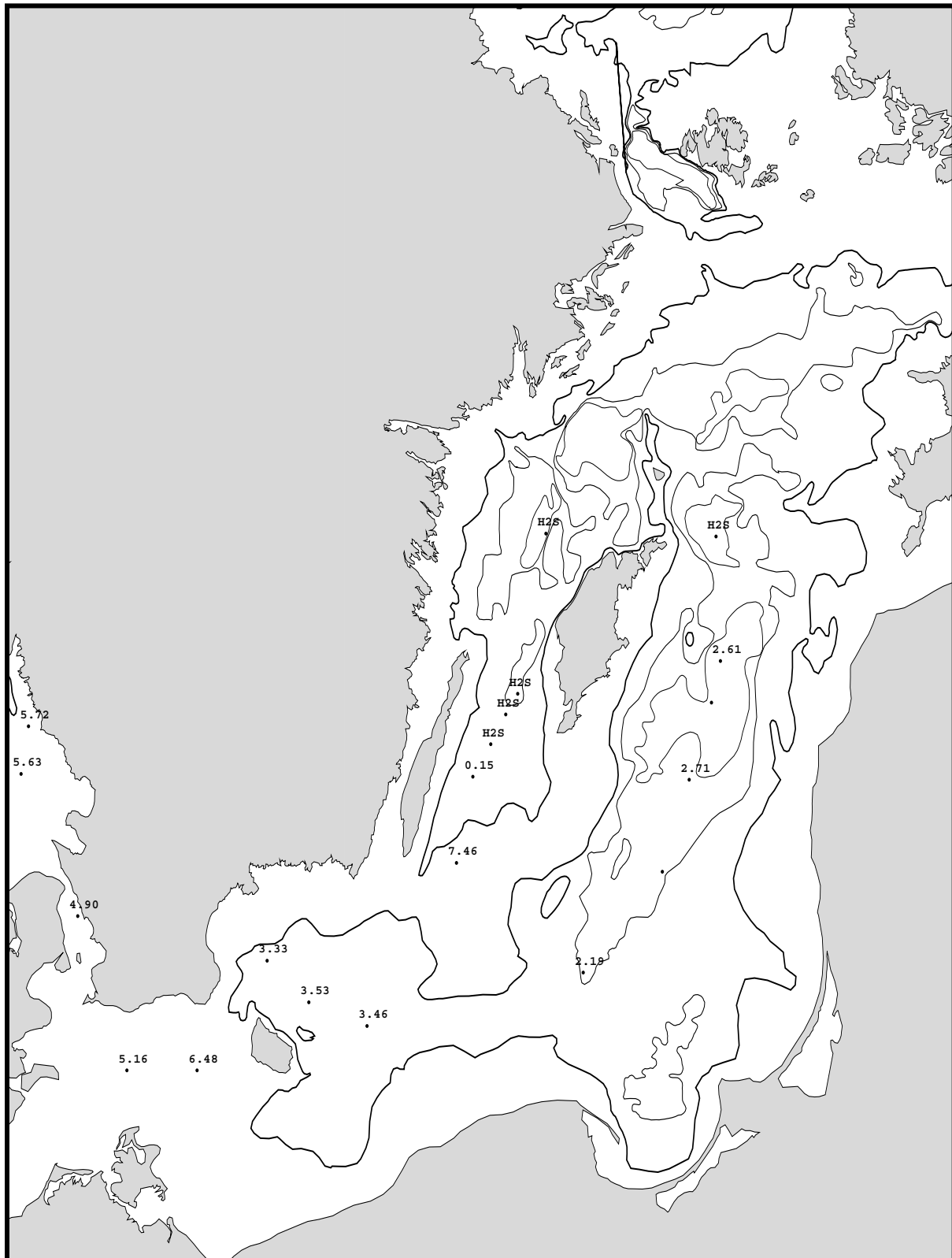
Bottom water oxygen concentration (ml/l)

Country: Finland

Ship : Aranda

Date : 20150421-20150426

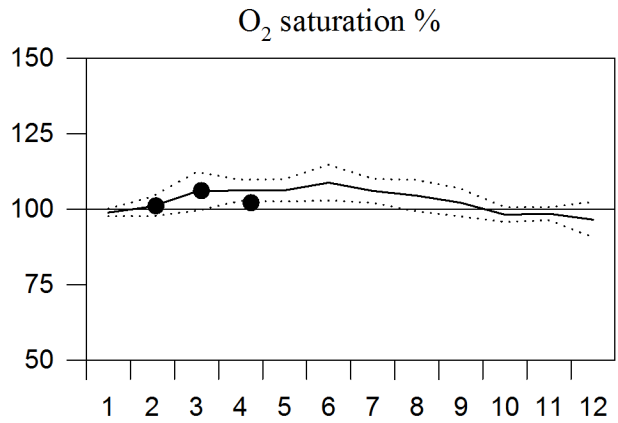
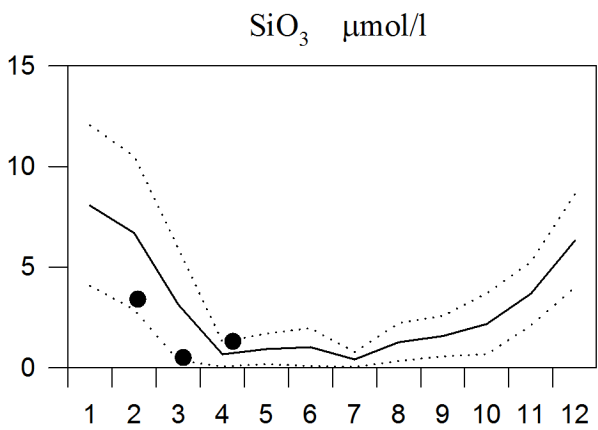
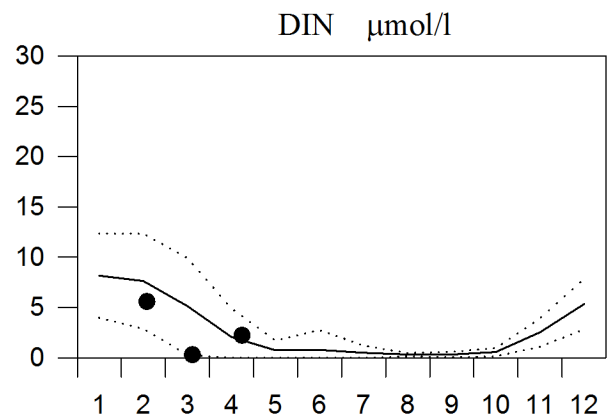
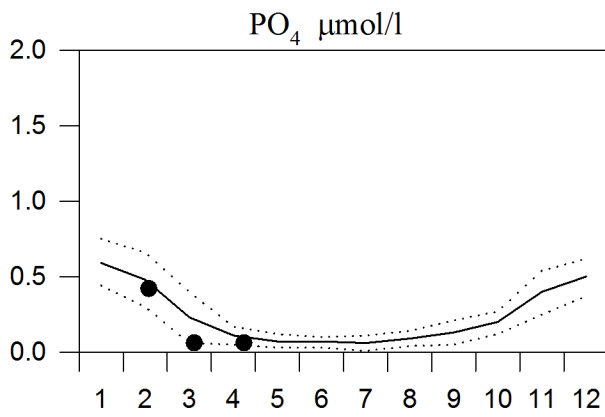
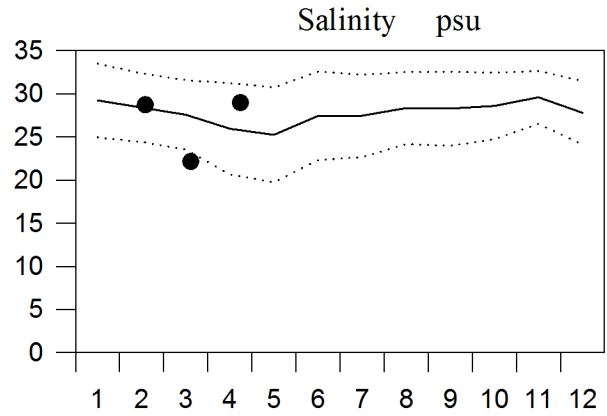
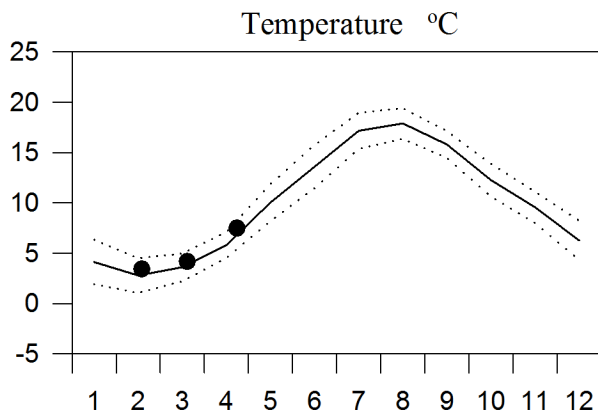
Series : 0177-0206



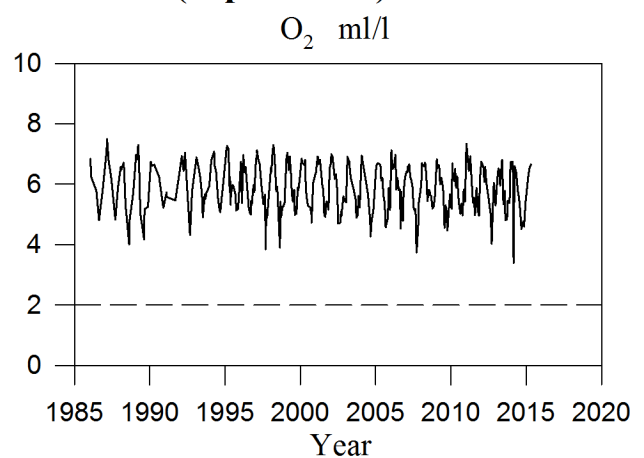
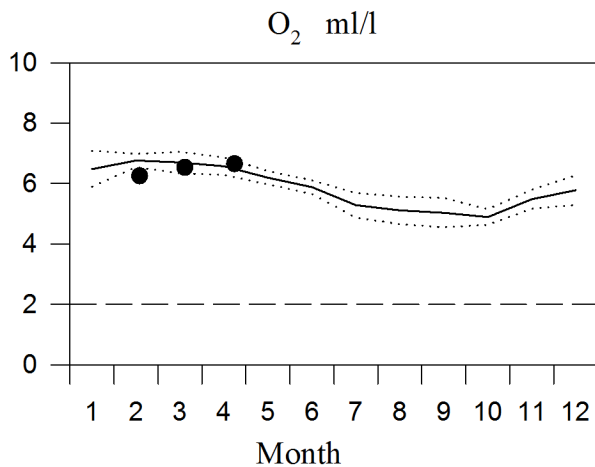
STATION P2 SURFACE WATER

Annual Cycles

— Mean 1996-2010 St.Dev. ● 2015

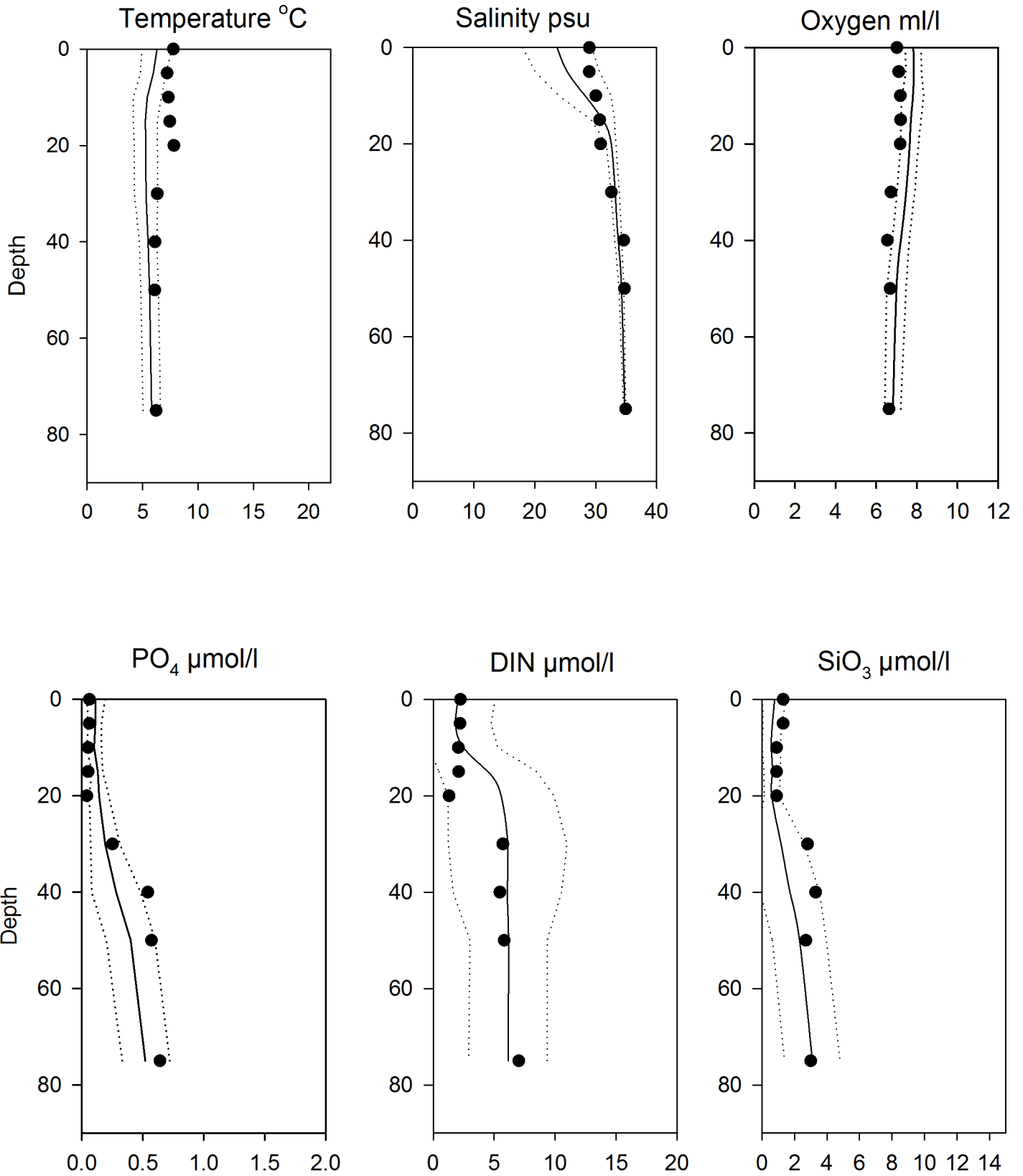


OXYGEN IN BOTTOM WATER (depth >75m)



Vertical profiles P2 April

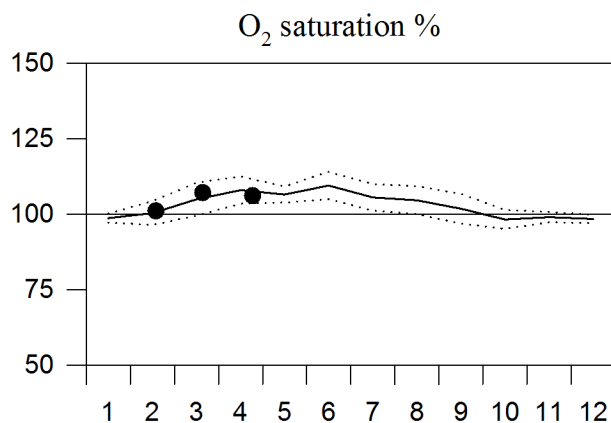
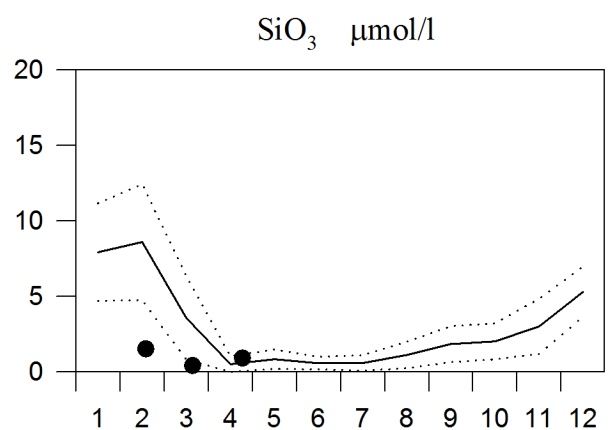
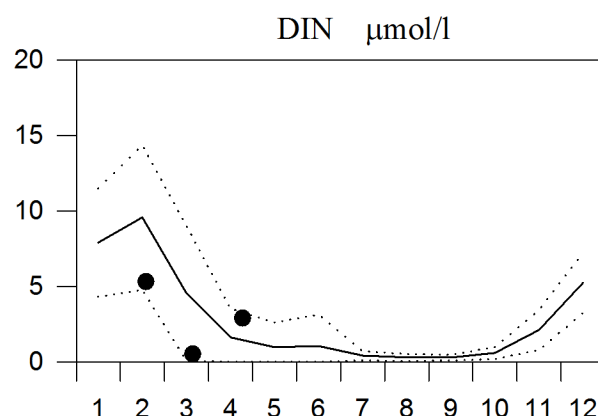
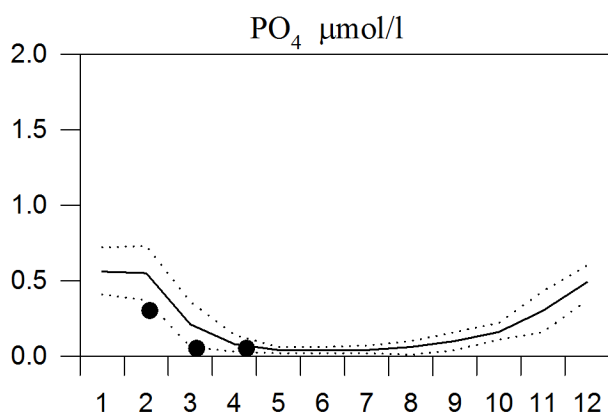
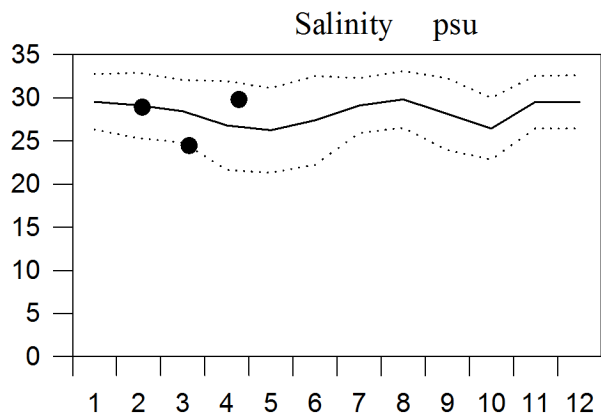
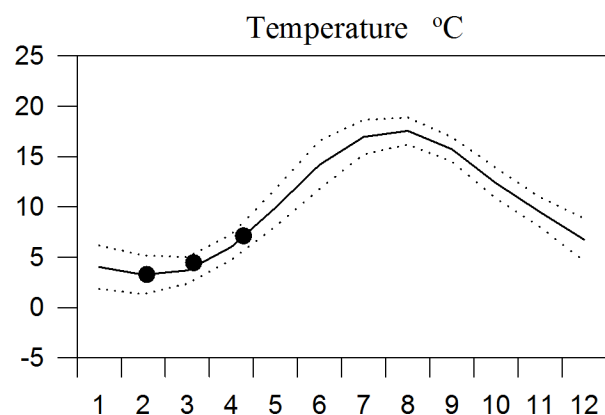
— Mean 1996-2010 St.Dev. ● 2015



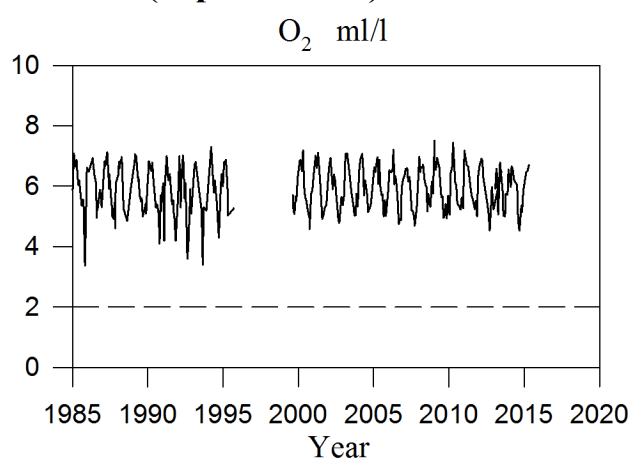
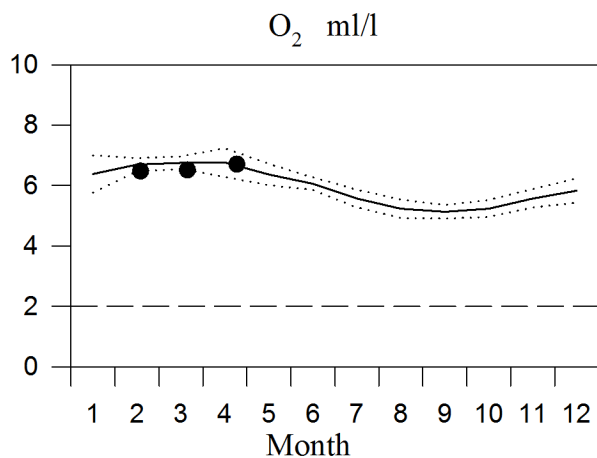
STATION Å13 SURFACE WATER

Annual Cycles

— Mean 1996-2010 St.Dev. ● 2015

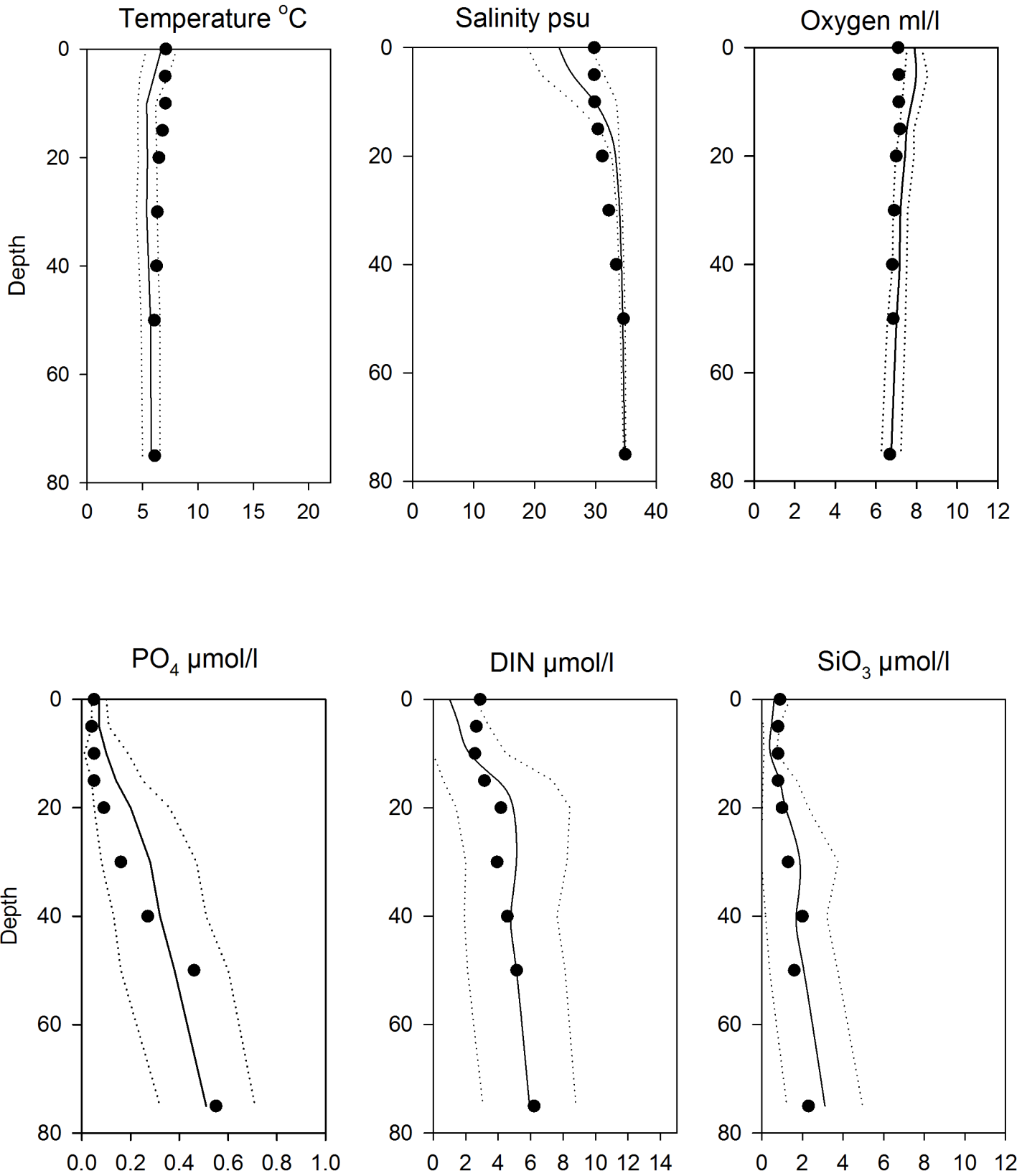


OXYGEN IN BOTTOM WATER (depth >=75m)



Vertical profiles Å13 April

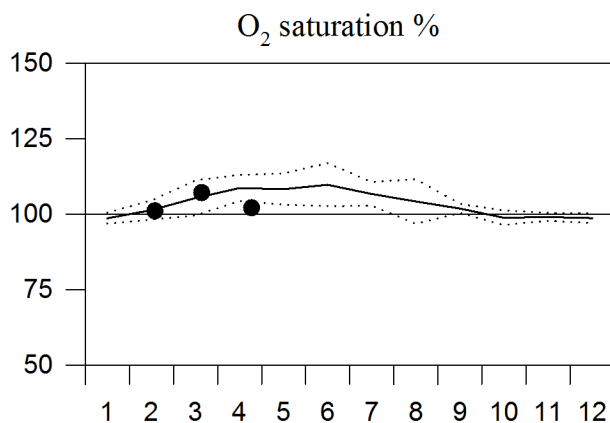
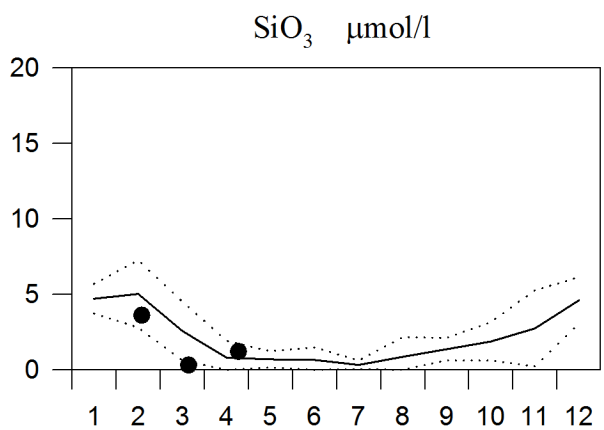
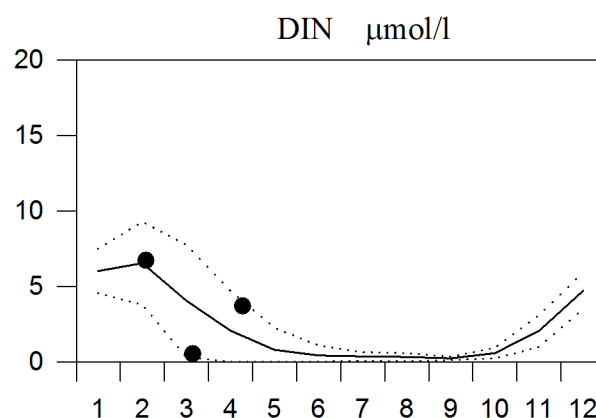
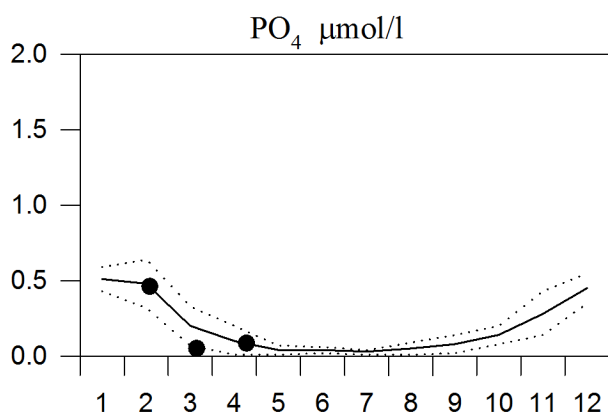
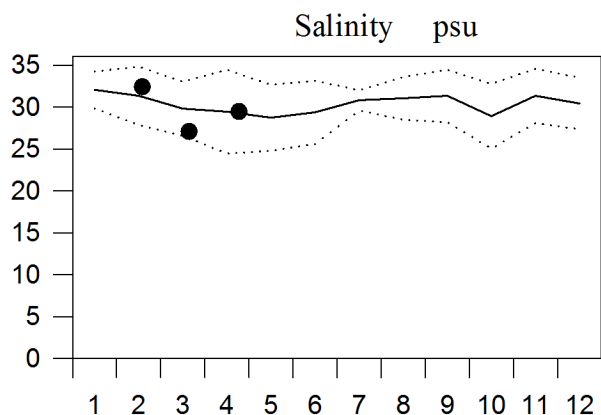
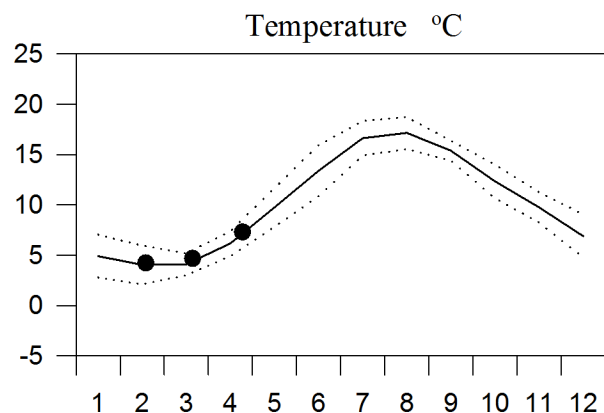
— Mean 1996-2010 St.Dev. ● 2015



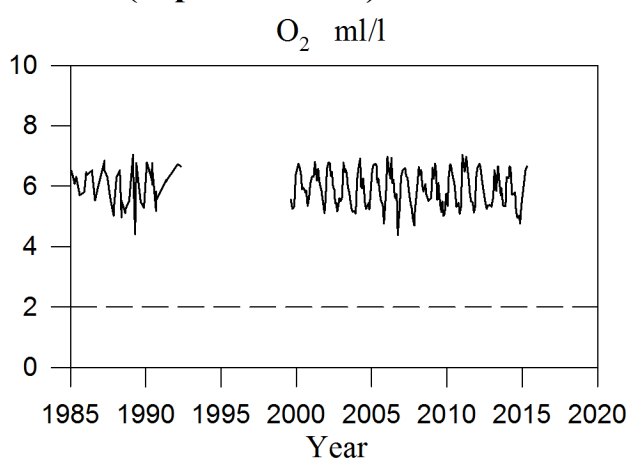
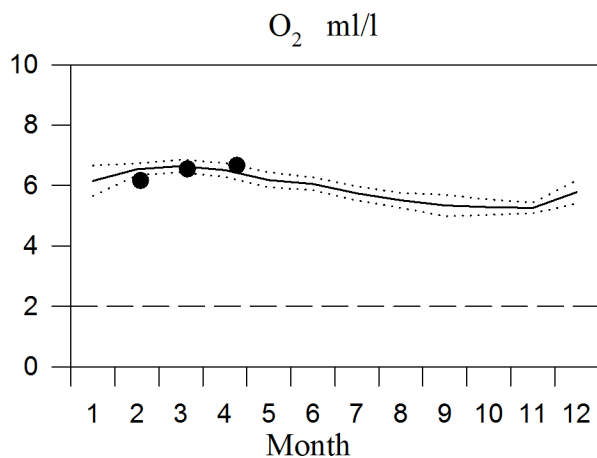
STATION Å15 SURFACE WATER

Annual Cycles

— Mean 1996-2010 St.Dev. ● 2015

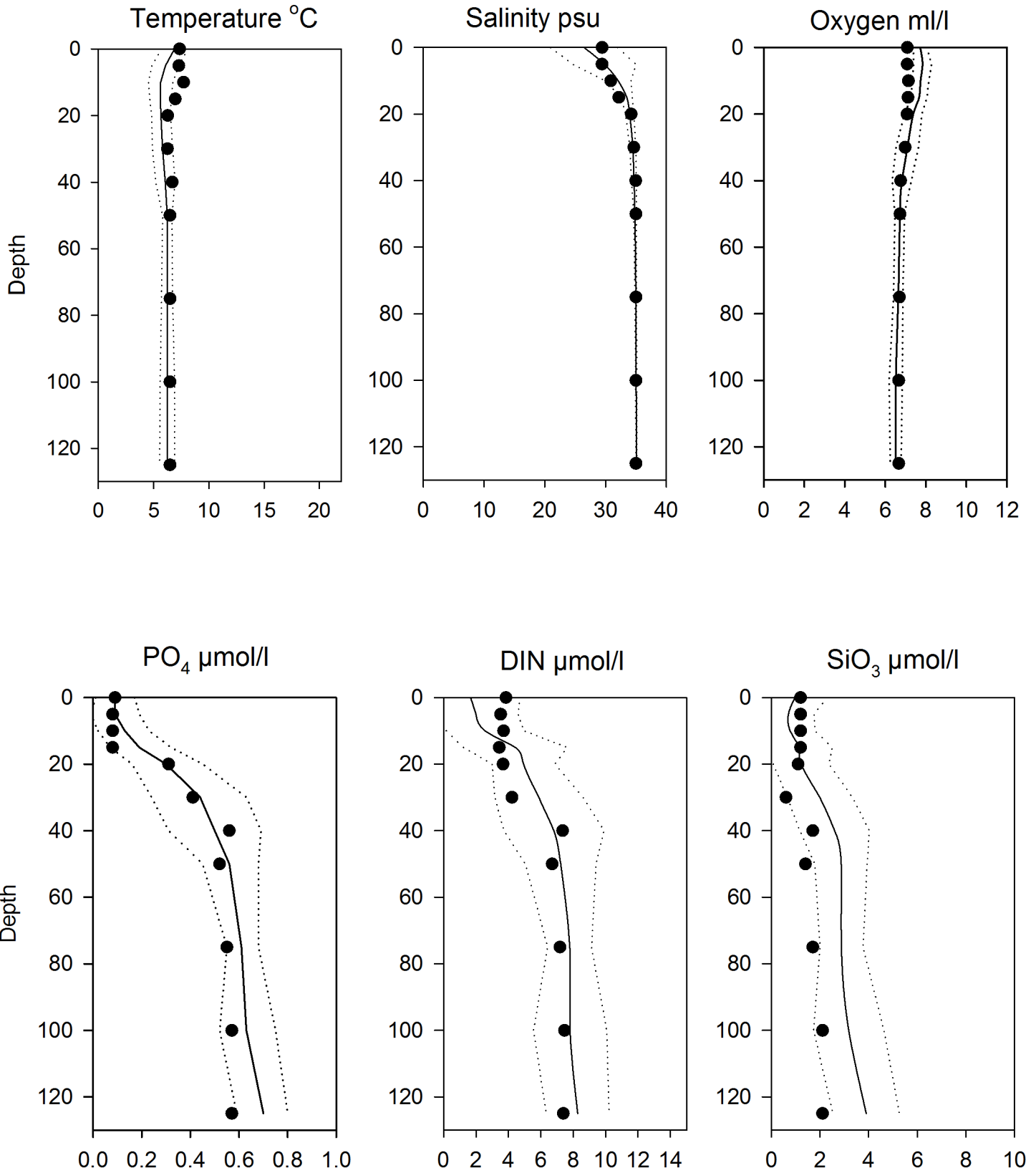


OXYGEN IN BOTTOM WATER (depth >=125m)



Vertical profiles Å15 April

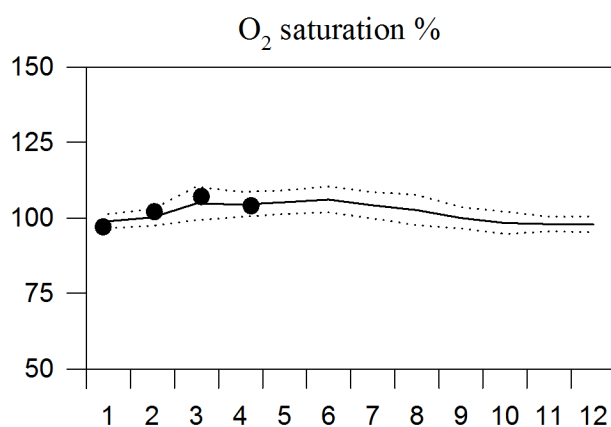
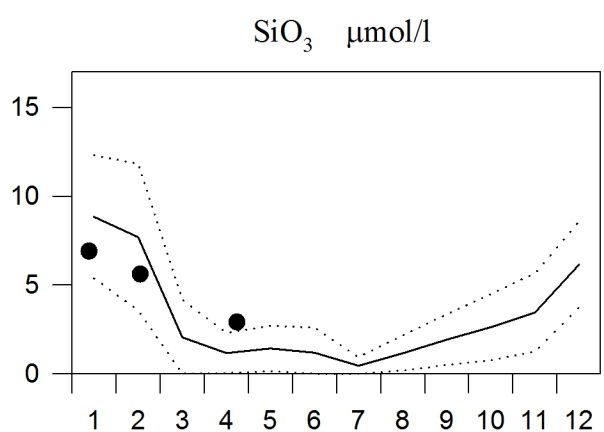
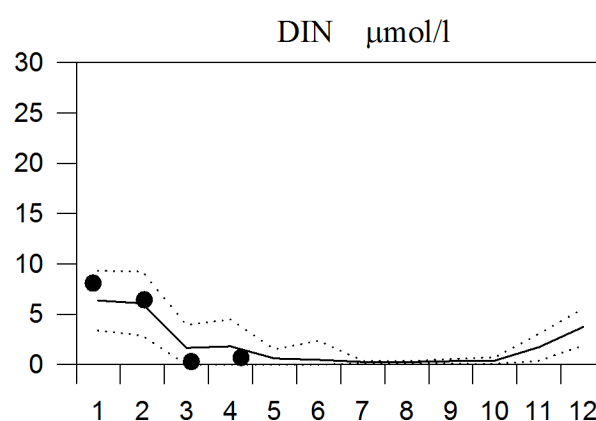
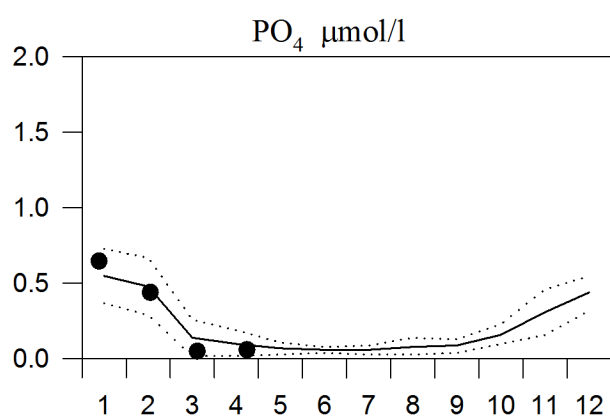
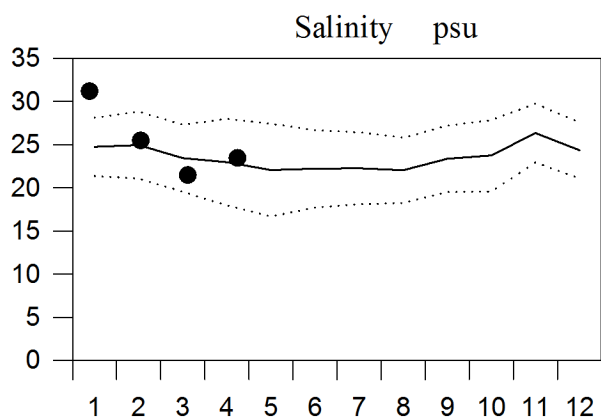
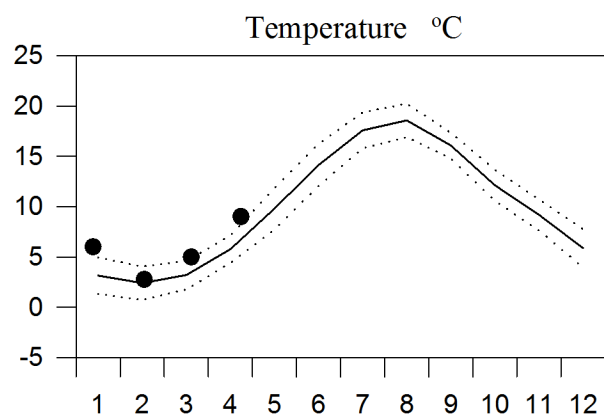
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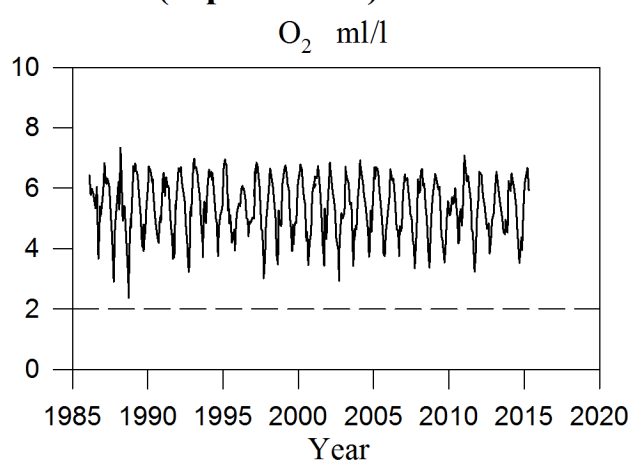
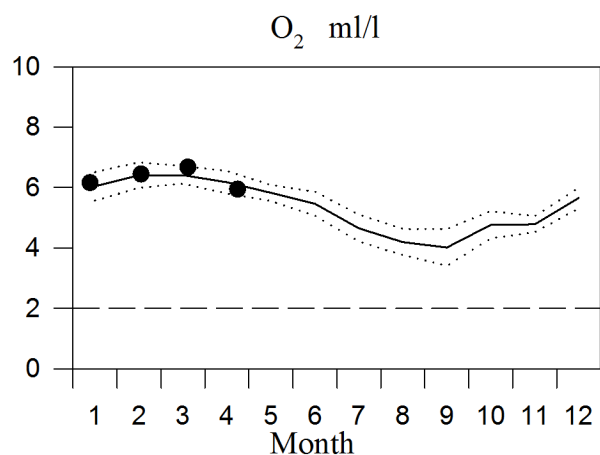
STATION FLADEN SURFACE WATER

Annual Cycles

— Mean 1996-2010 St.Dev. ● 2015

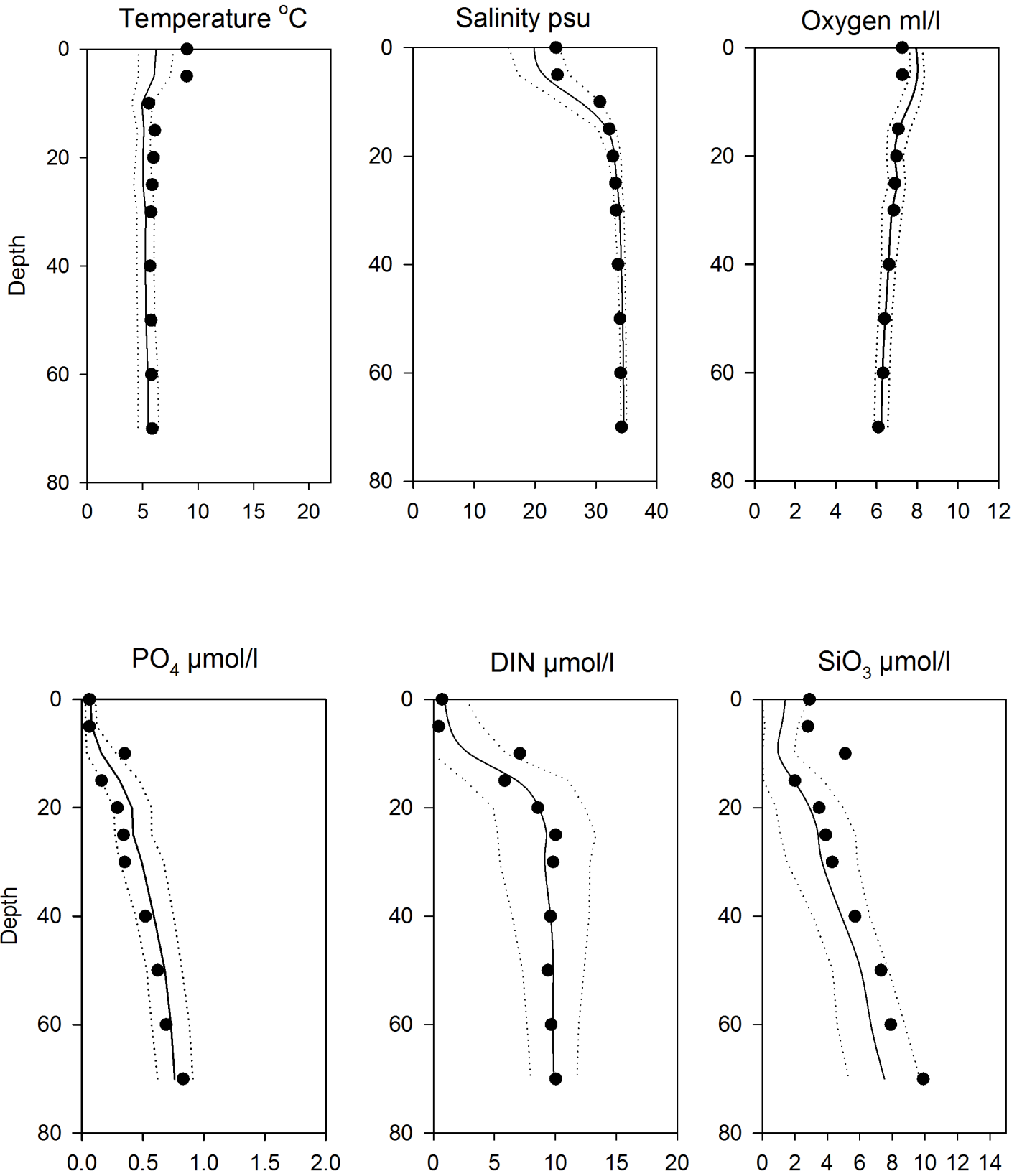


OXYGEN IN BOTTOM WATER (depth > 70m)



Vertical profiles Fladen April

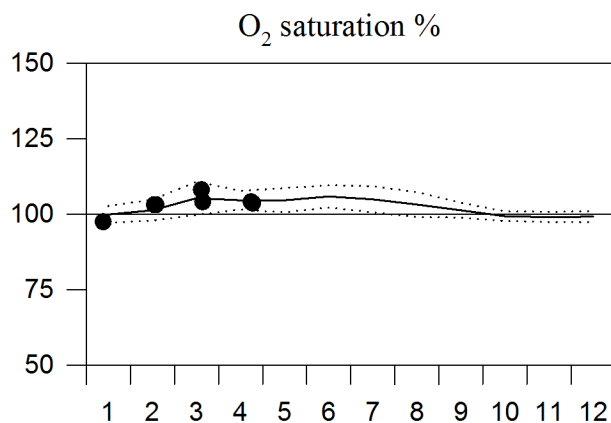
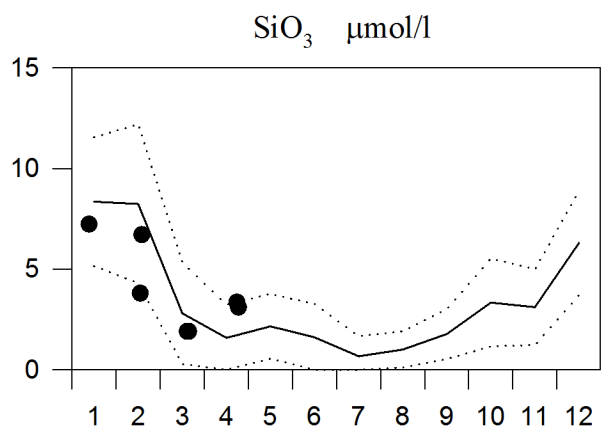
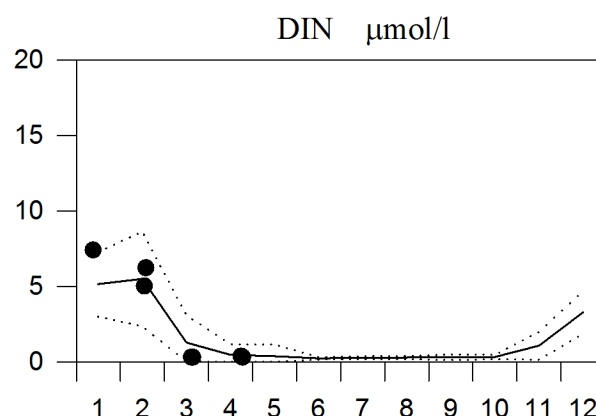
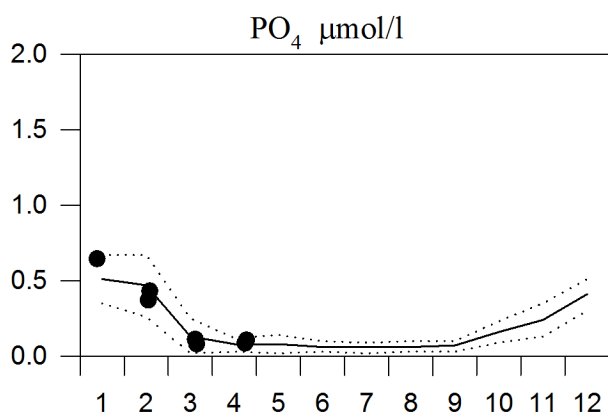
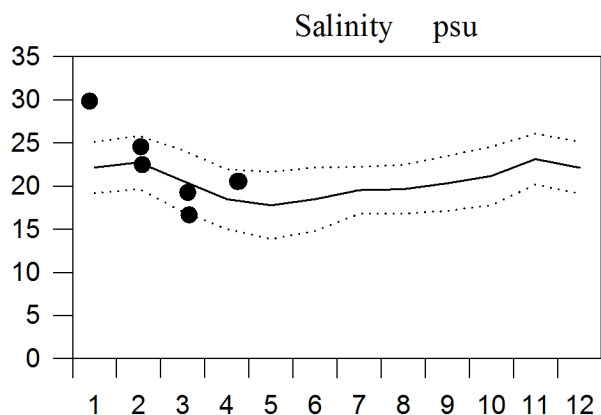
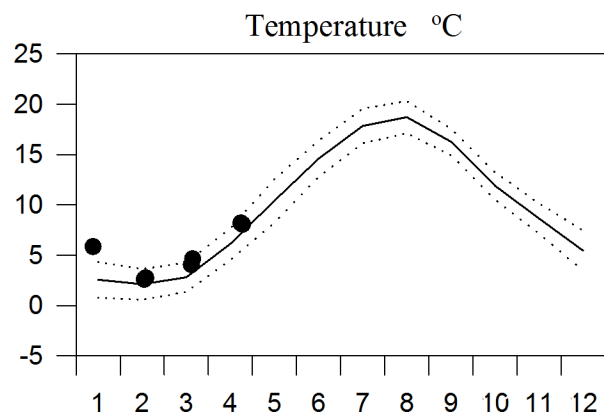
— Mean 1996-2010 St.Dev. ● 2015



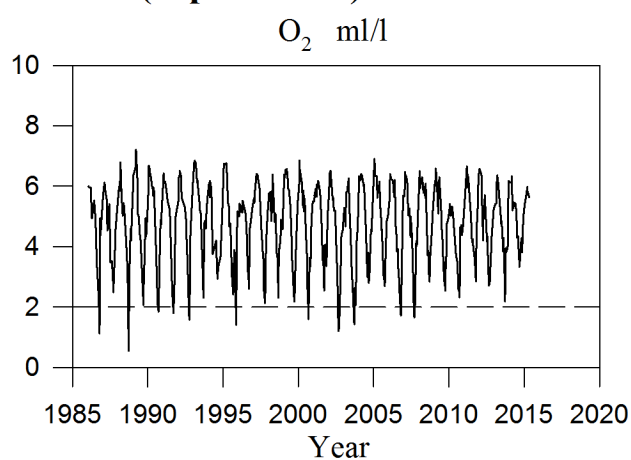
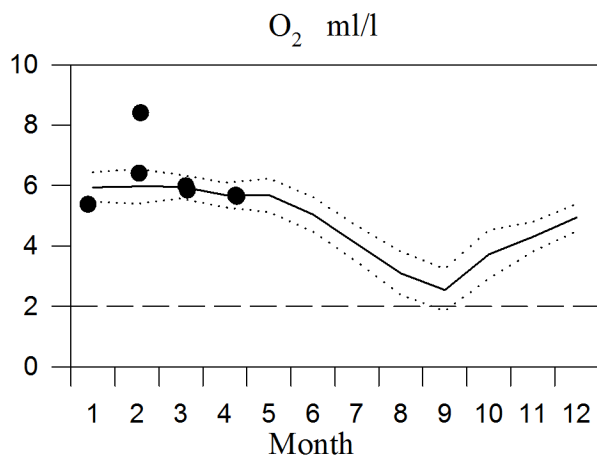
STATION ANHOLT E SURFACE WATER

Annual Cycles

— Mean 1996-2010 St.Dev. ● 2015

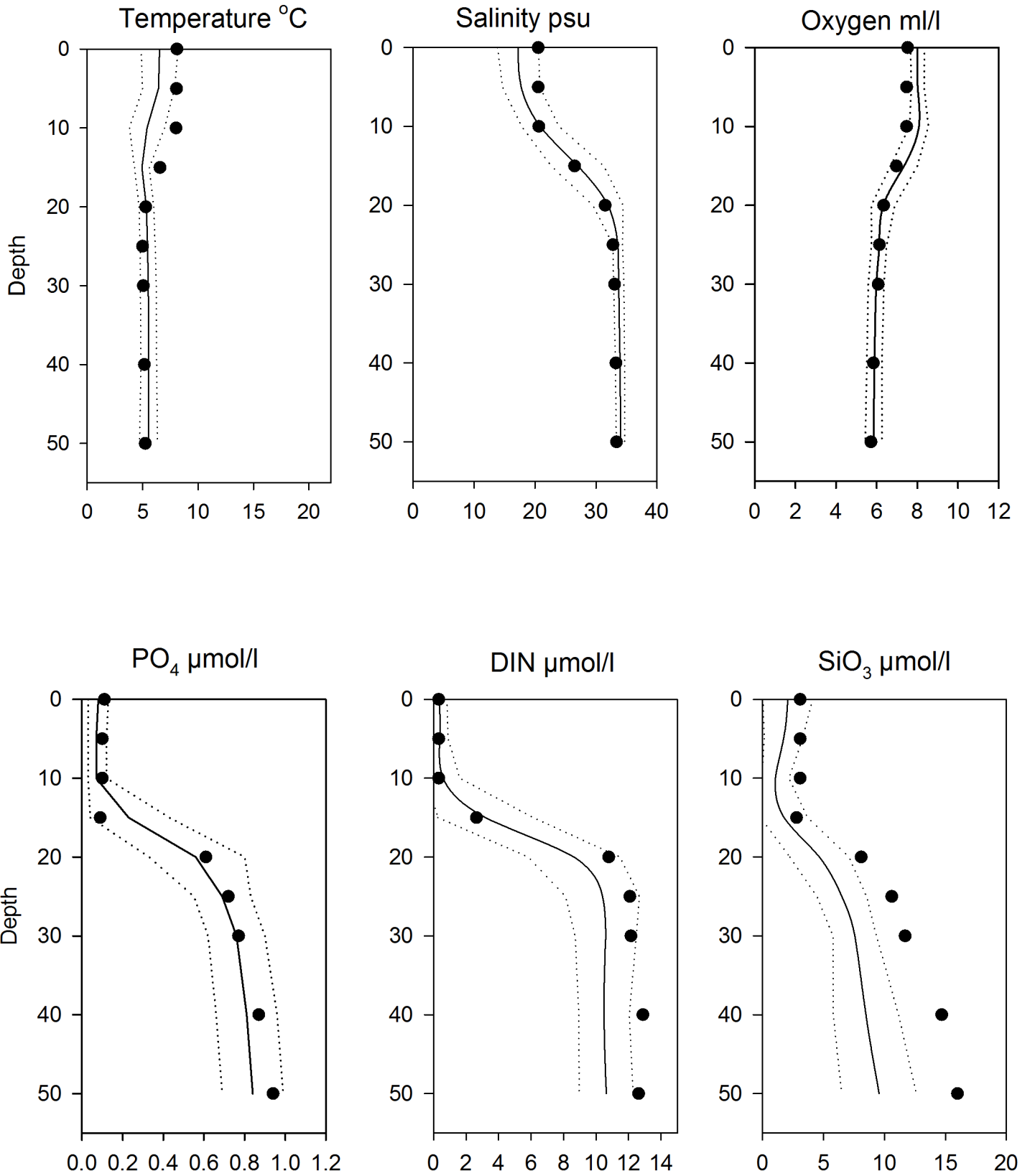


OXYGEN IN BOTTOM WATER (depth > 50m)



Vertical profiles Anholt E April

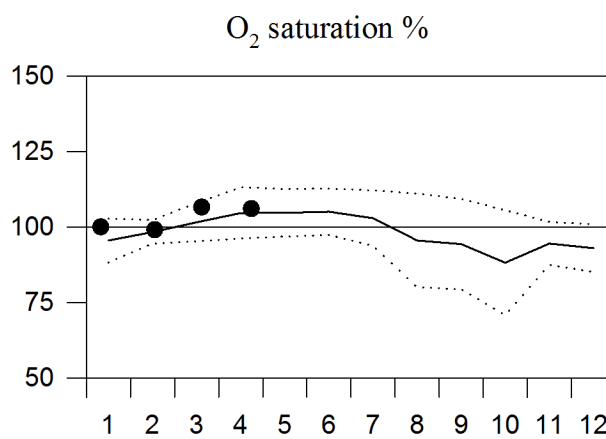
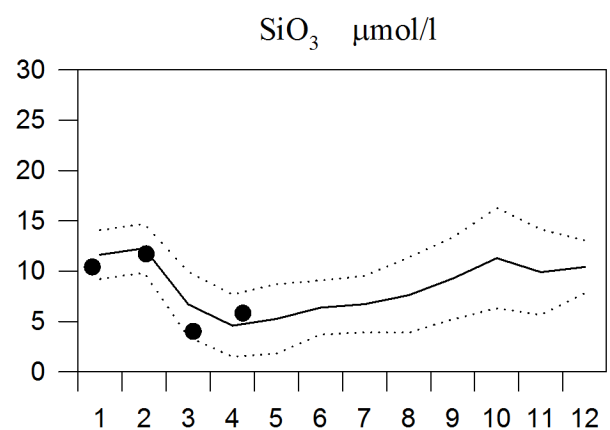
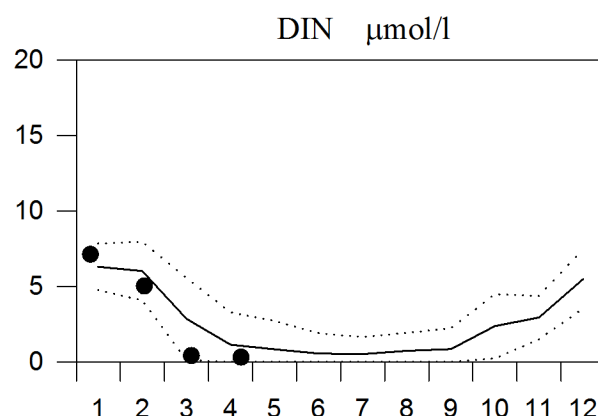
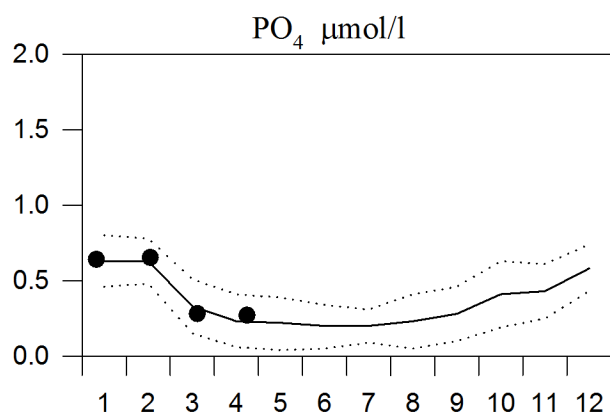
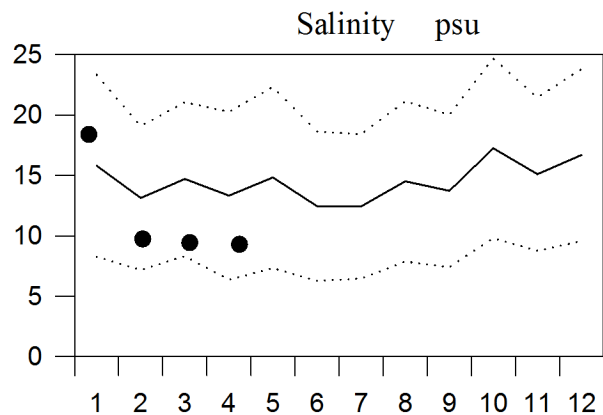
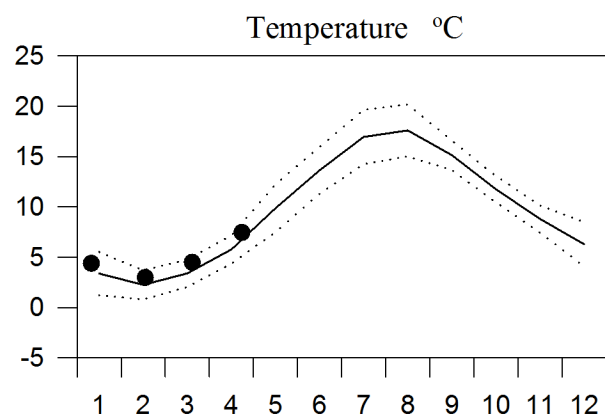
— Mean 1996-2010 St.Dev. ● 2015



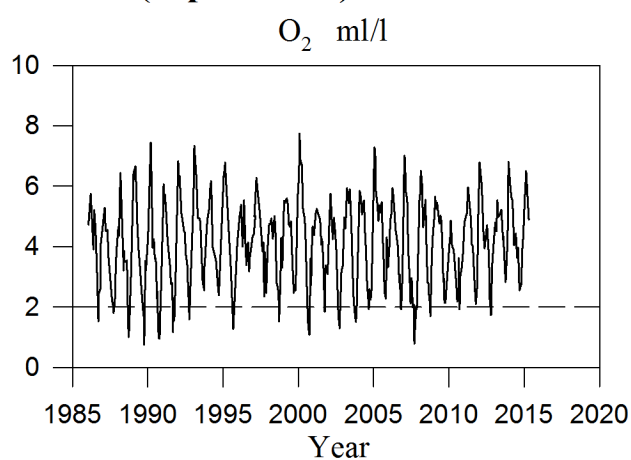
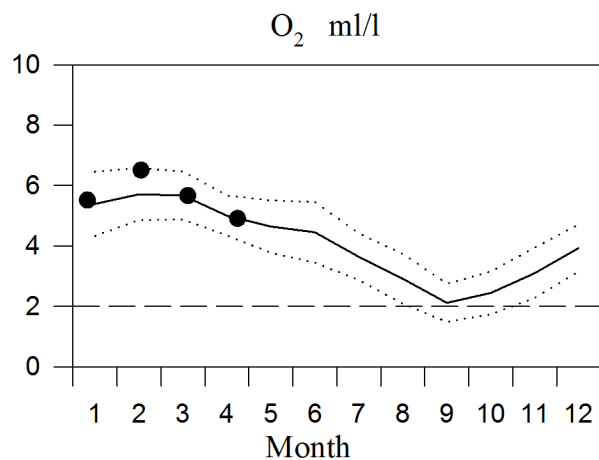
STATION W LANDSKRONA SURFACE WATER

Annual Cycles

— Mean 1996-2010 St.Dev. ● 2015

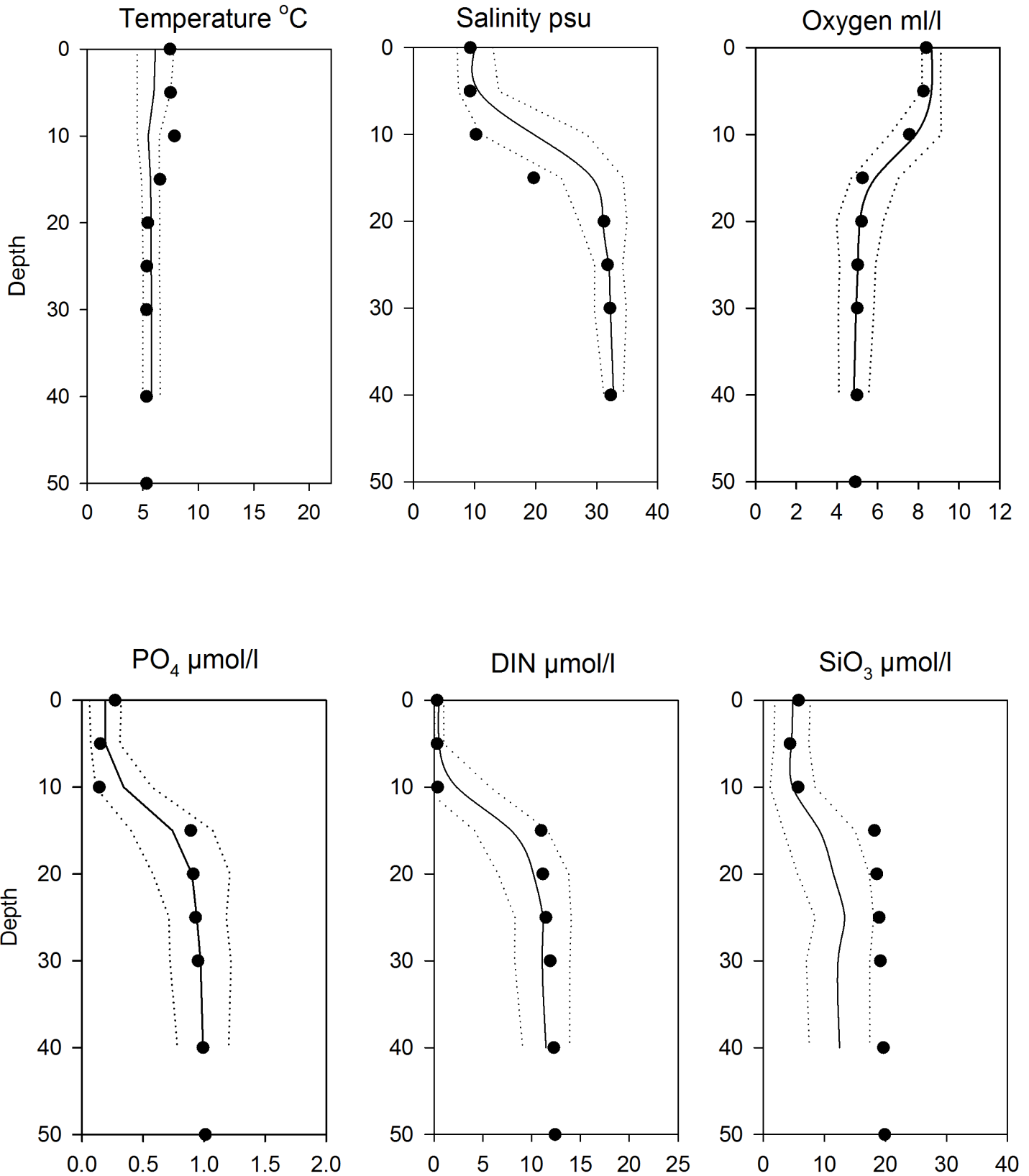


OXYGEN IN BOTTOM WATER (depth >40m)



Vertical profiles W Landskrona April

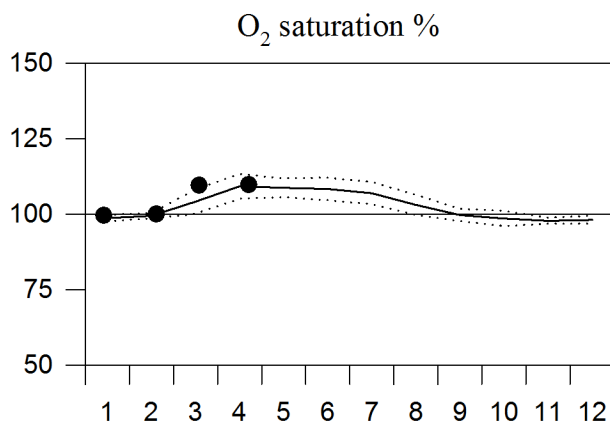
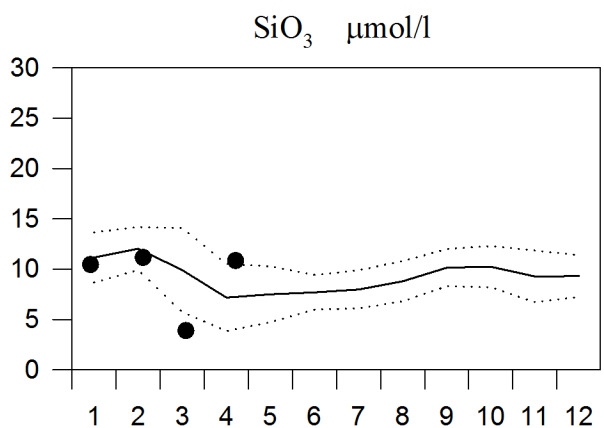
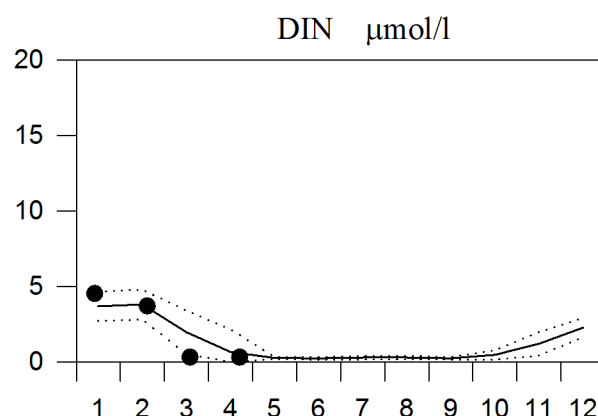
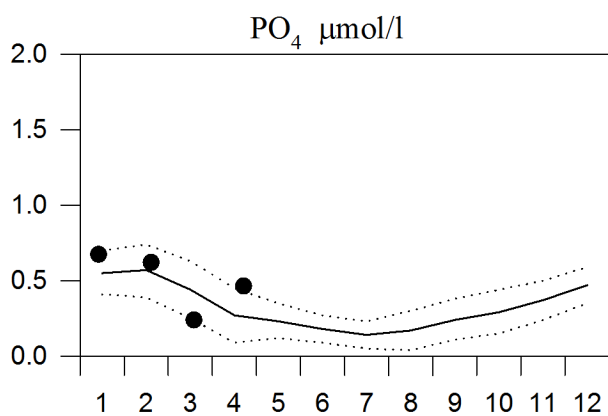
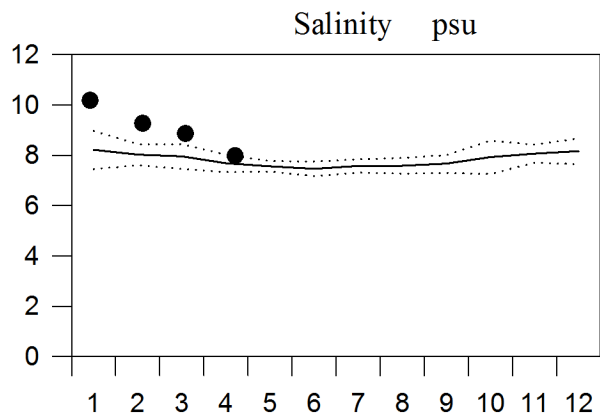
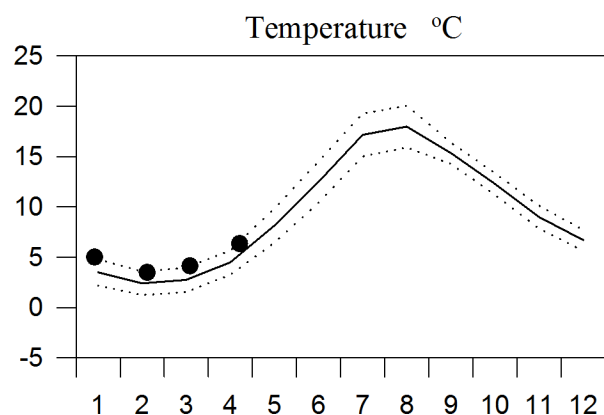
— Mean 1996-2010 St.Dev. ● 2015



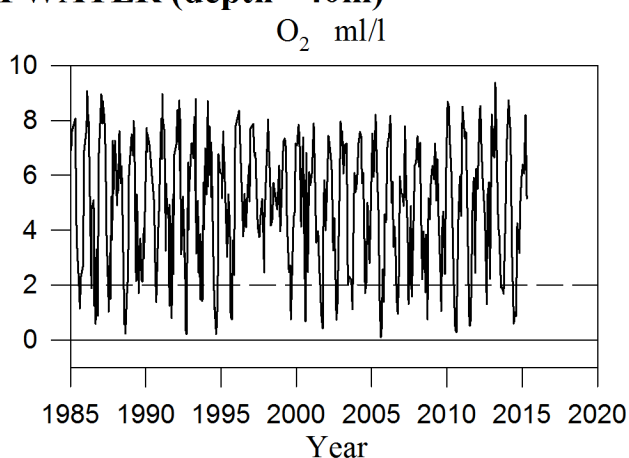
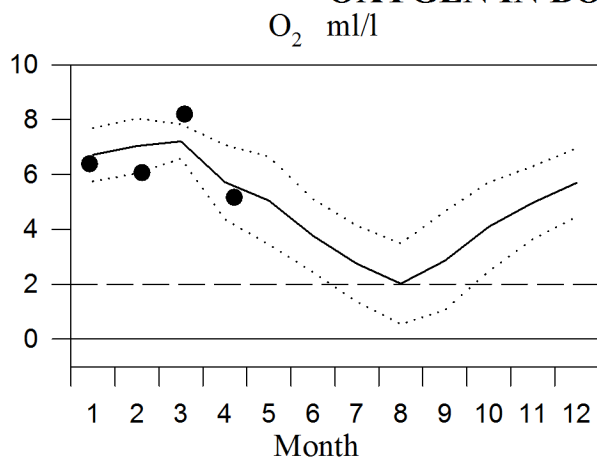
STATION BY1 SURFACE WATER

Annual Cycles

— Mean 1996-2010 St.Dev. ● 2015

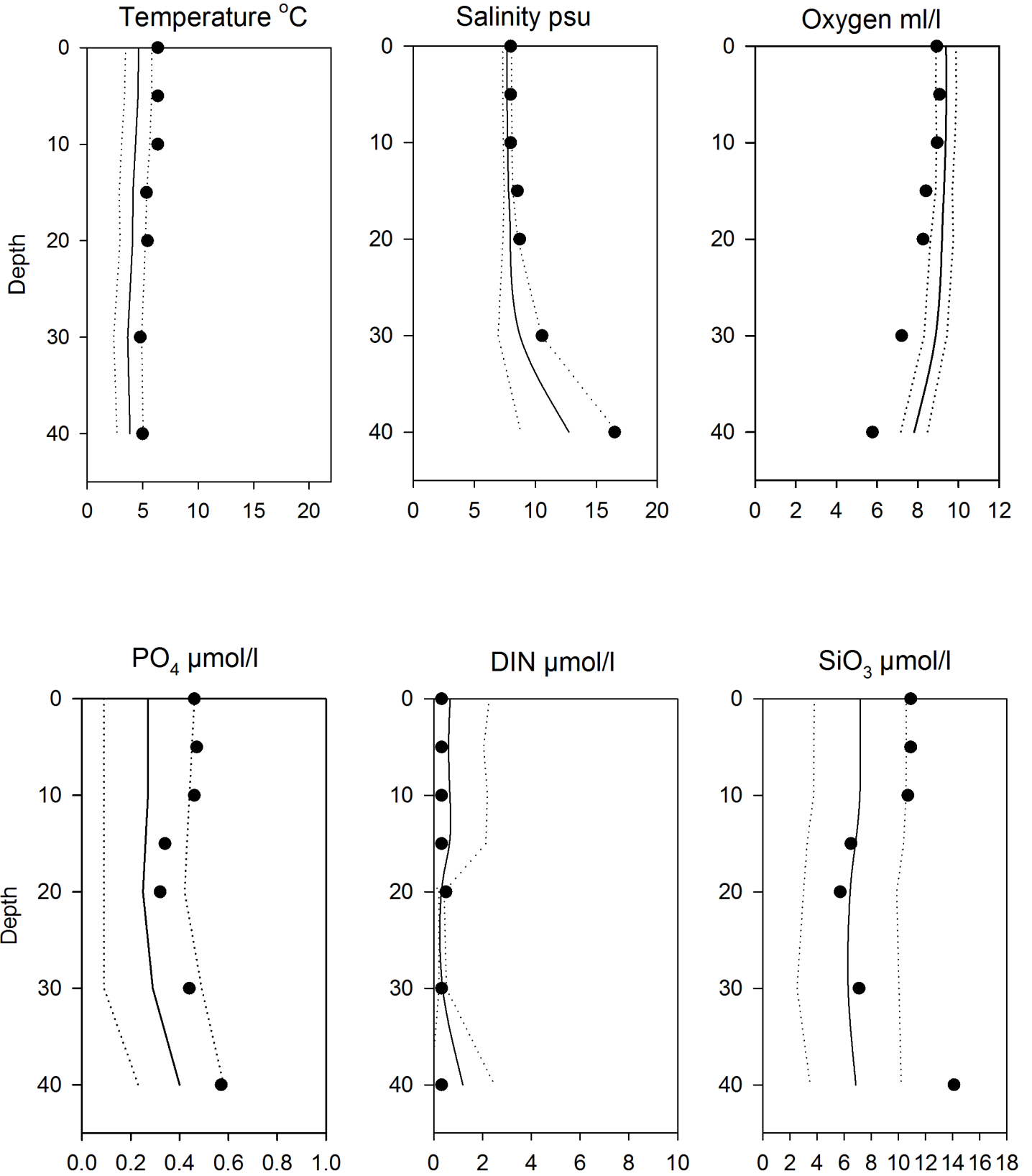


OXYGEN IN BOTTOM WATER (depth >40m)



Vertical profiles BY1 April

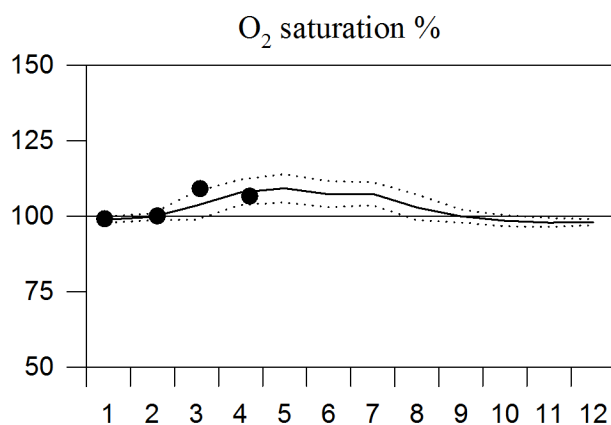
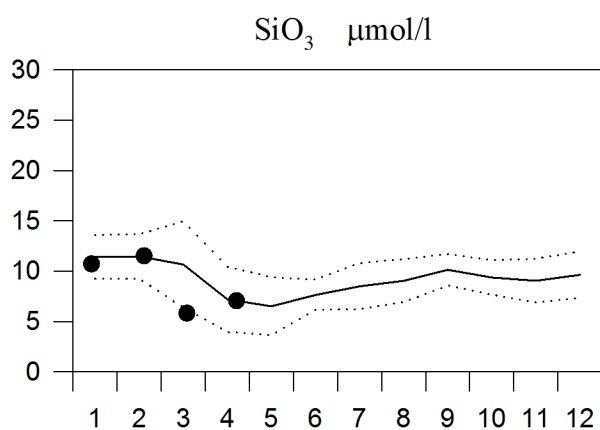
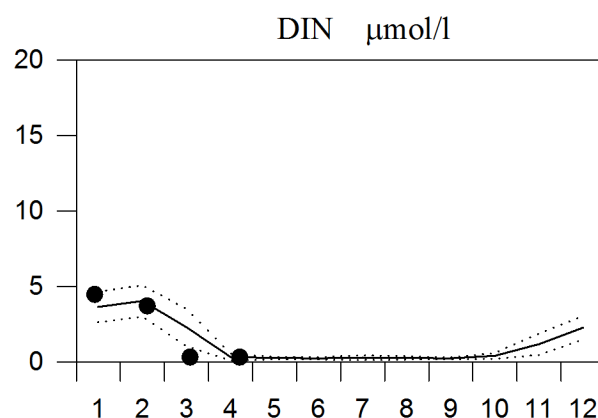
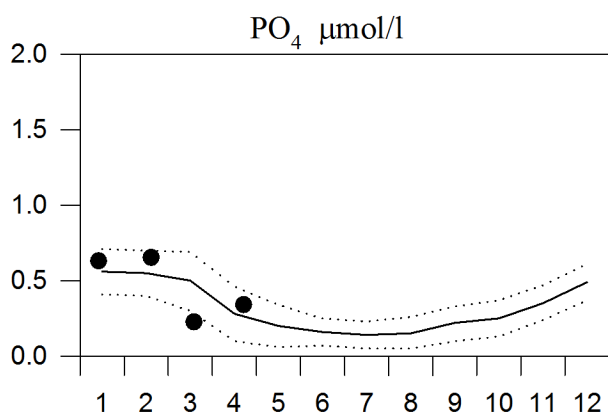
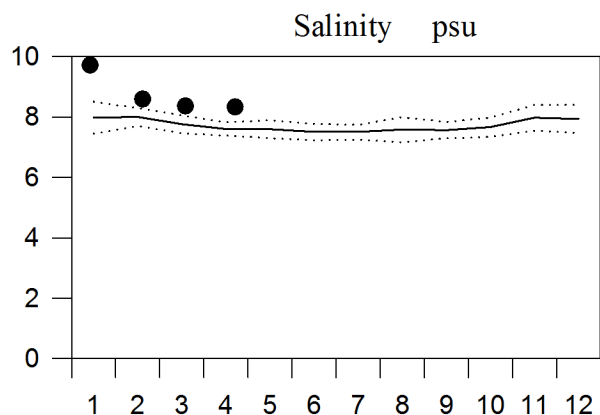
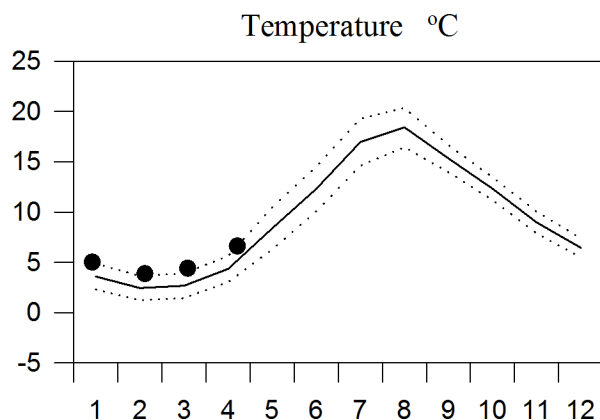
— Mean 1996-2010 St.Dev. ● 2015



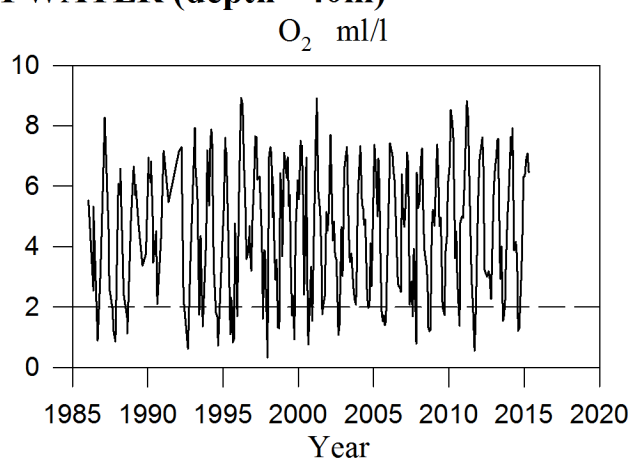
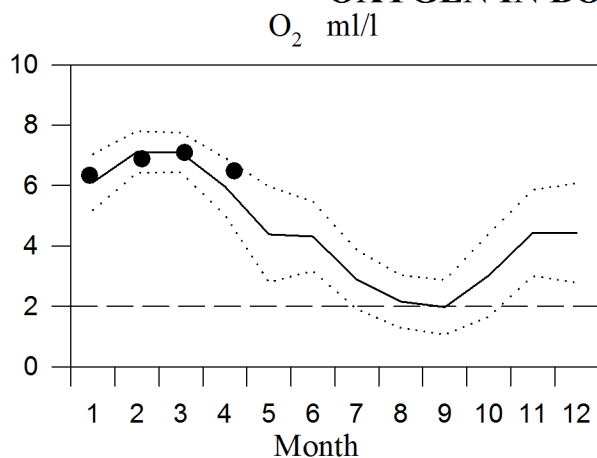
STATION BY2 SURFACE WATER

Annual Cycles

— Mean 1996-2010 St.Dev. ● 2015

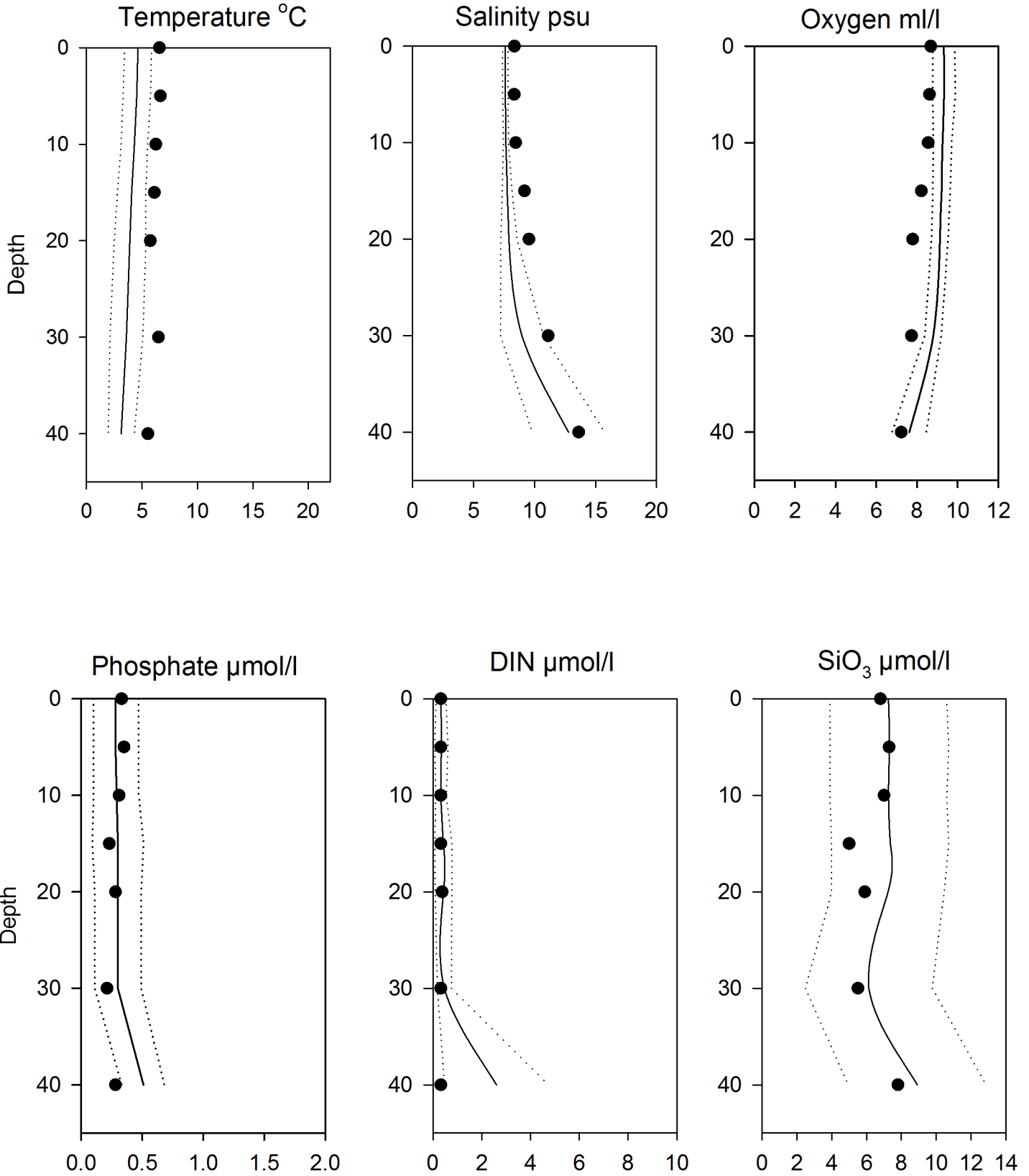


OXYGEN IN BOTTOM WATER (depth >40m)



Vertical profiles BY2 April

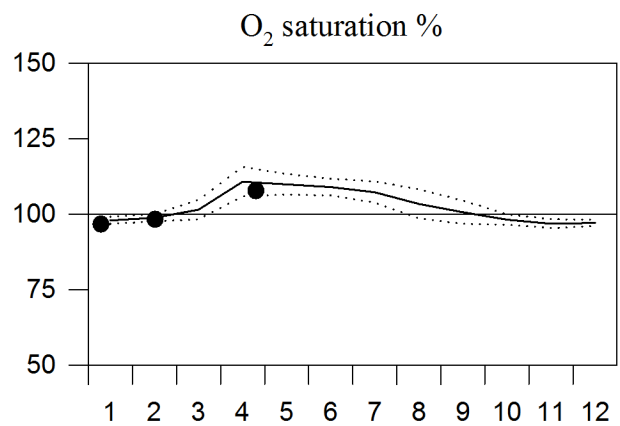
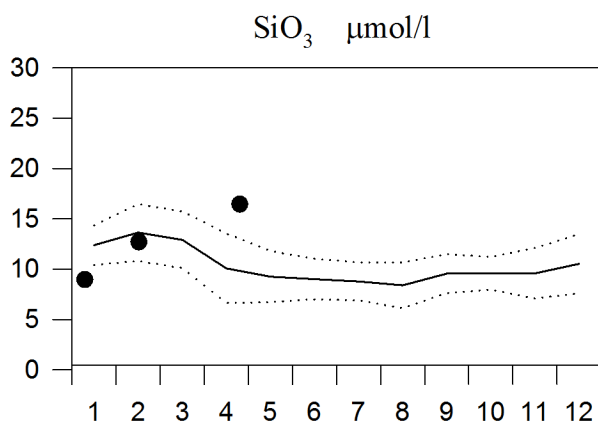
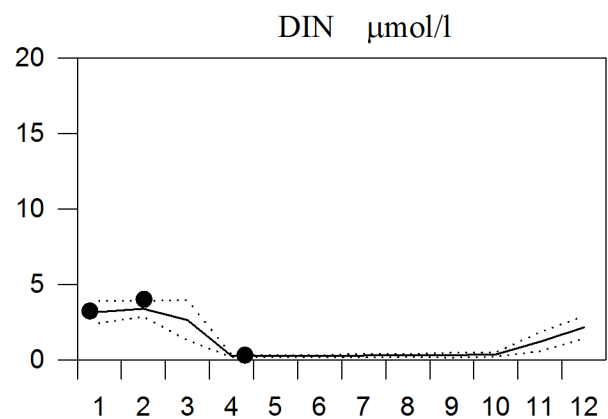
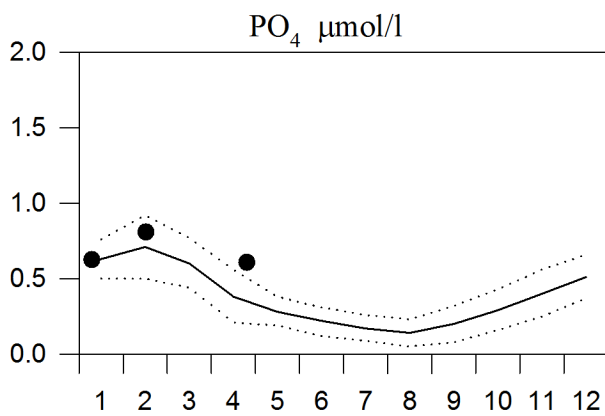
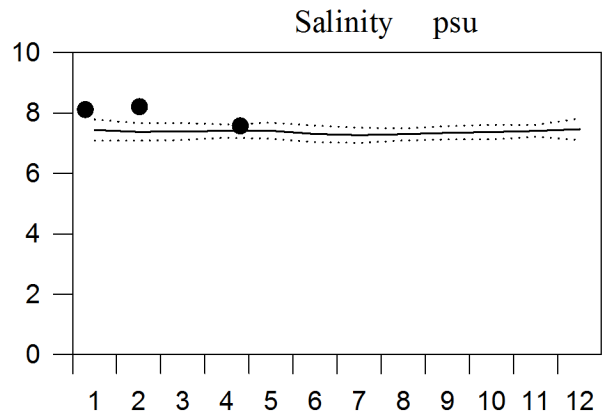
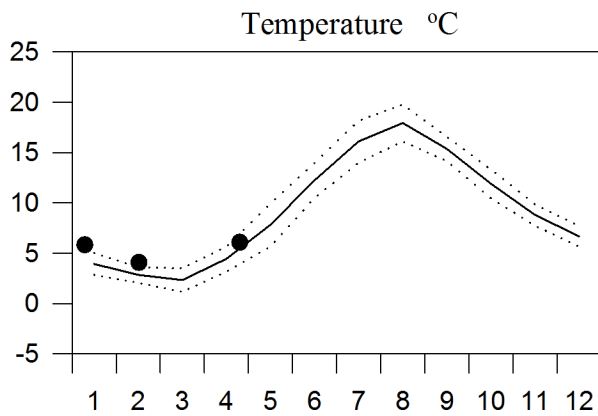
— Mean 1996-2010 St.Dev. ● 2015



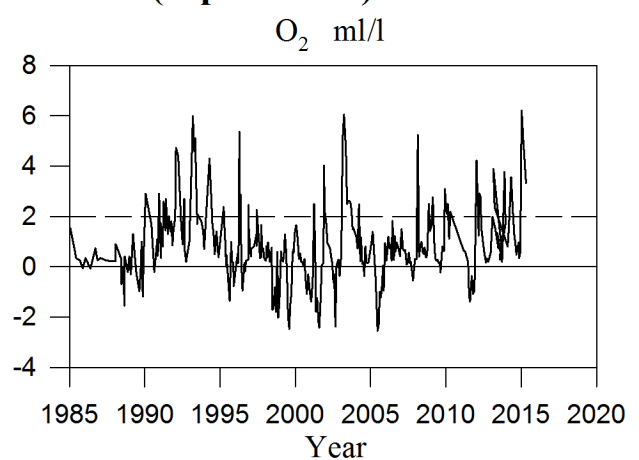
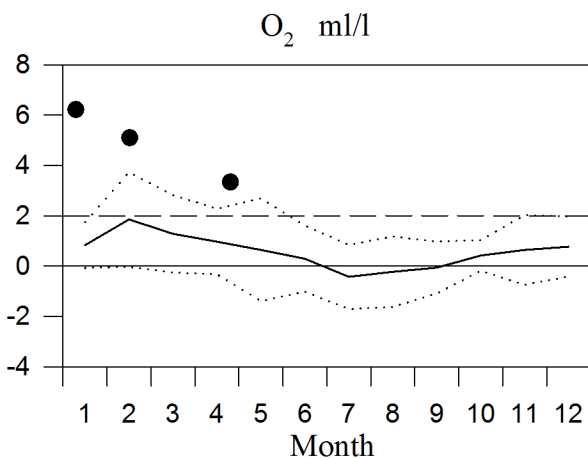
STATION HANÖBUKTEN SURFACE WATER

Annual Cycles

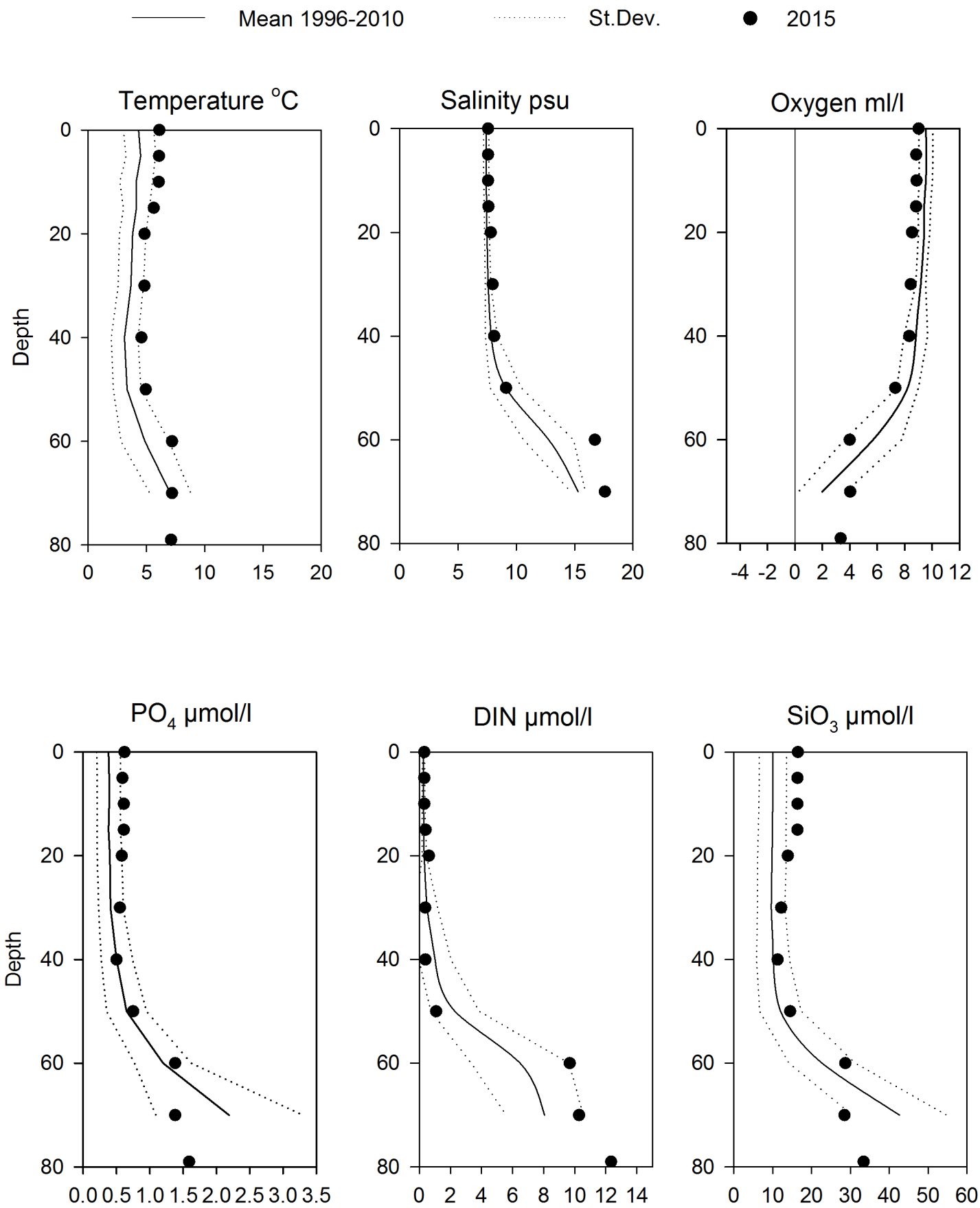
— Mean 1996-2010 St.Dev. ● 2015



OXYGEN IN BOTTOM WATER (depth > 70m)



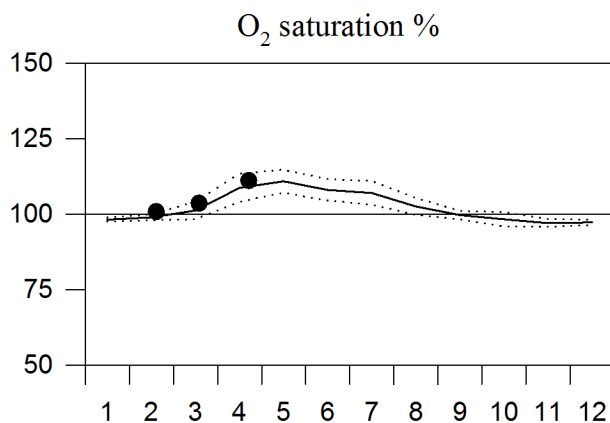
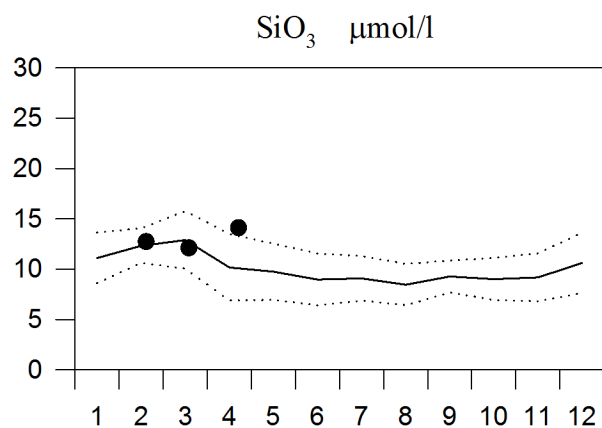
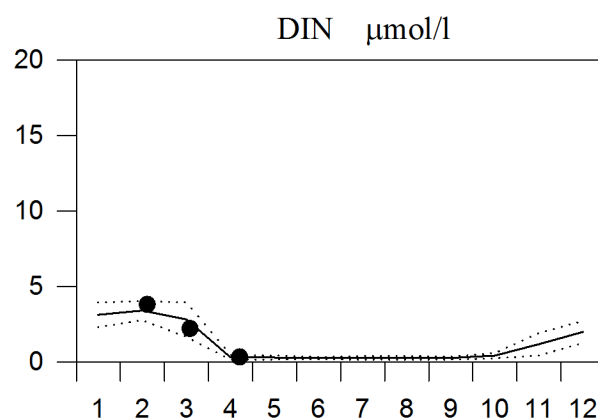
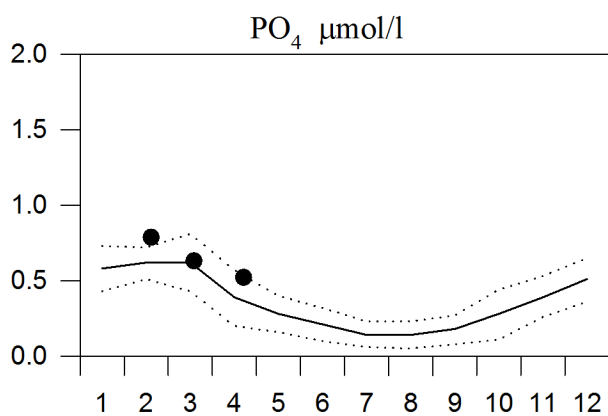
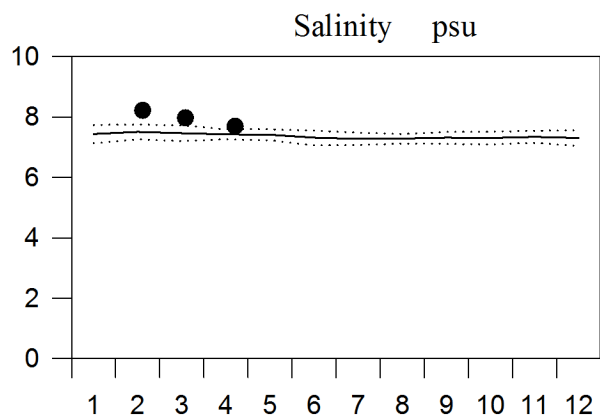
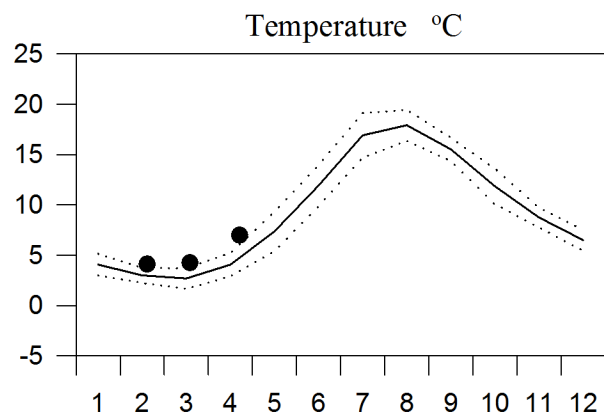
Vertical profiles Hanöbukten April



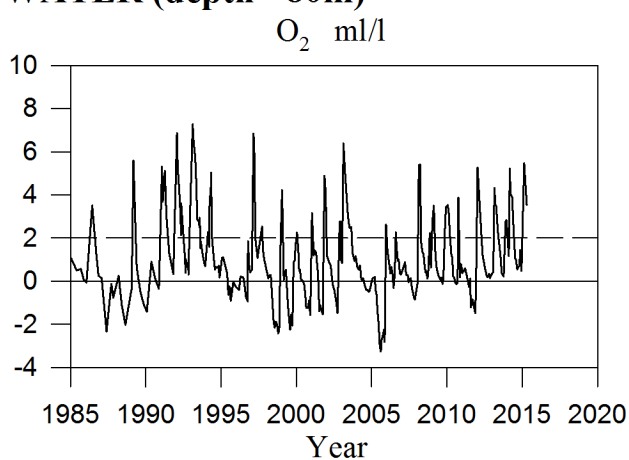
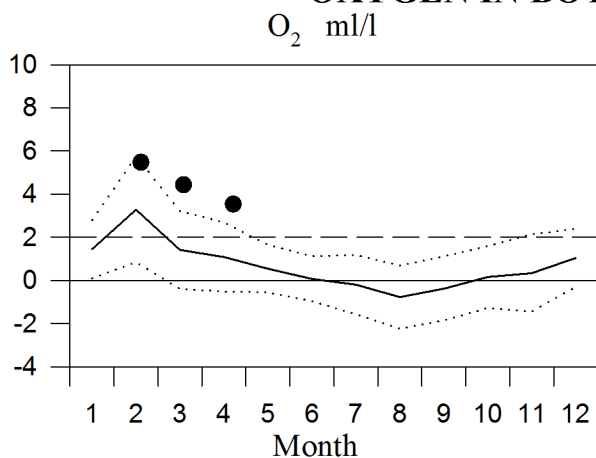
STATION BY4 SURFACE WATER

Annual Cycles

— Mean 1996-2010 St.Dev. ● 2015

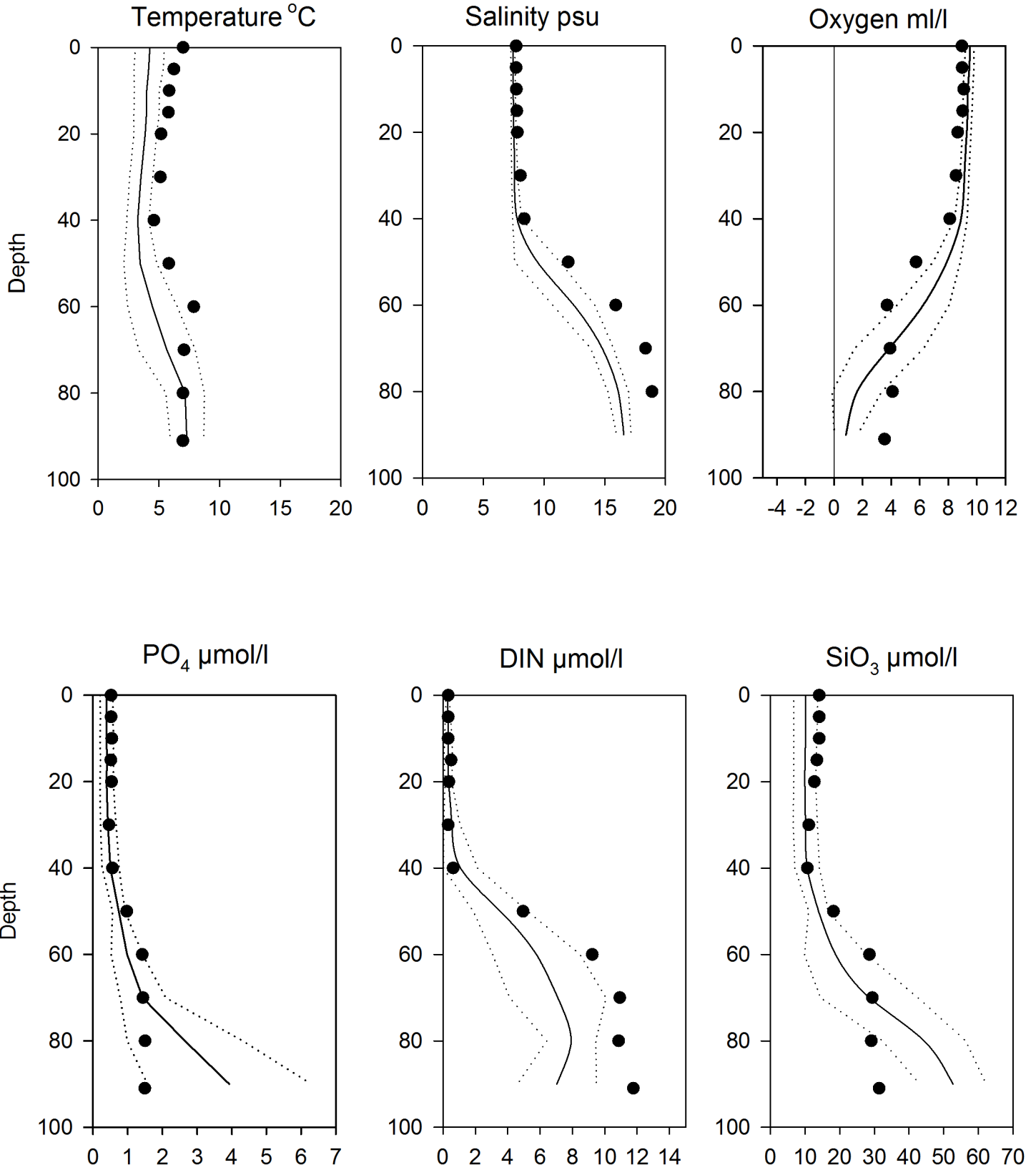


OXYGEN IN BOTTOM WATER (depth >80m)



Vertical profiles BY4 April

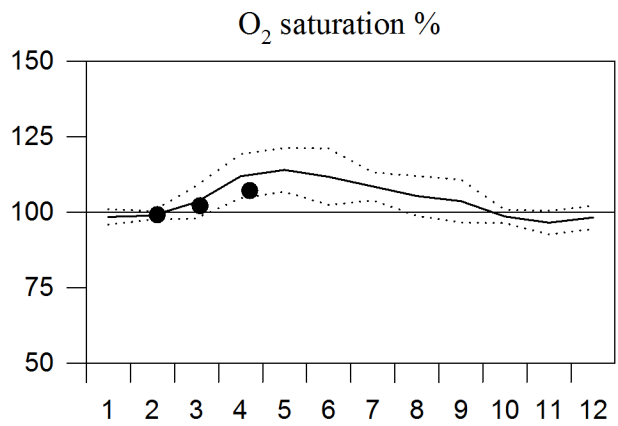
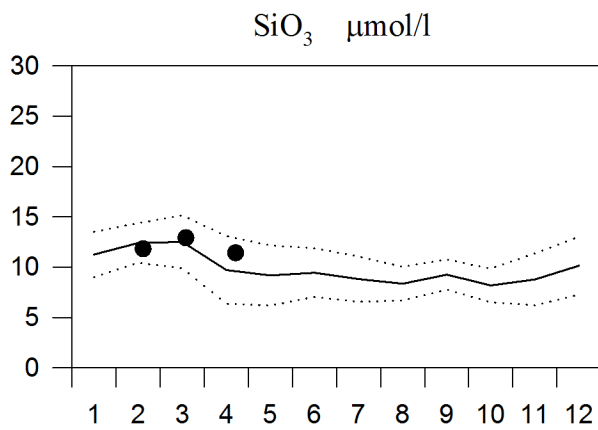
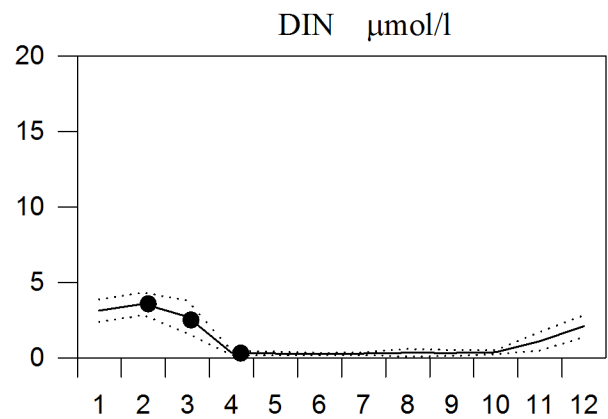
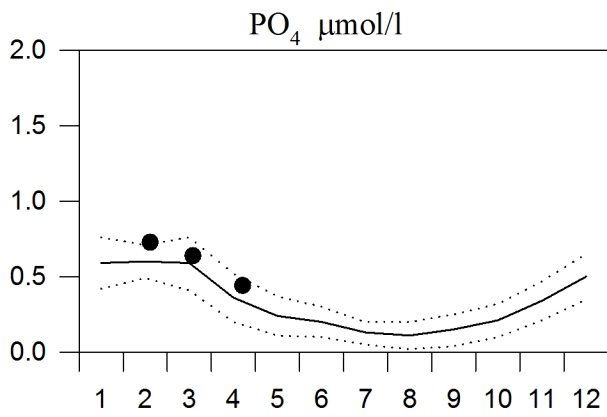
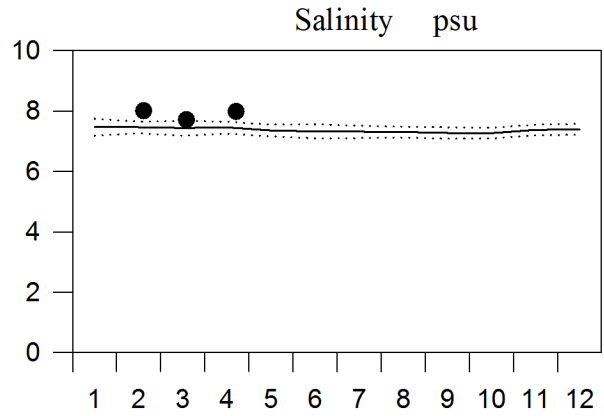
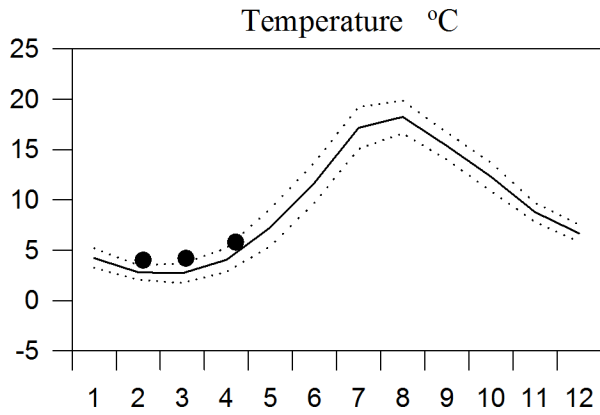
— Mean 1996-2010 St.Dev. ● 2015



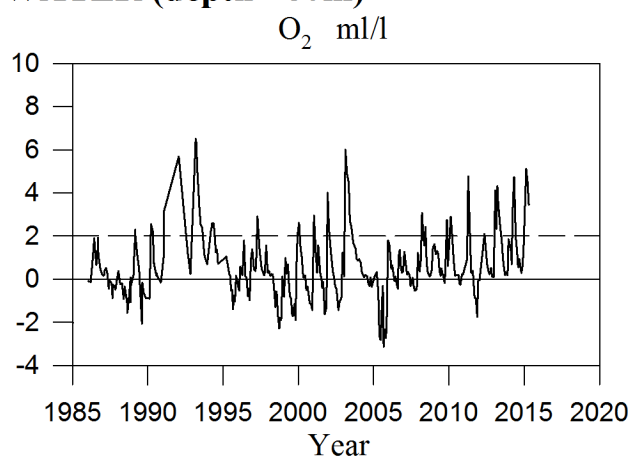
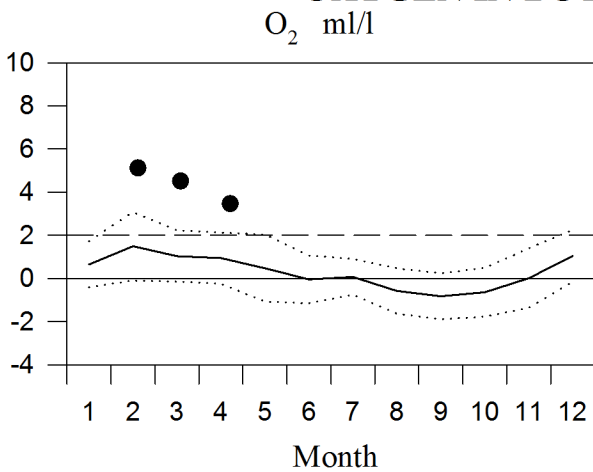
STATION BY5 SURFACE WATER

Annual Cycles

— Mean 1996-2010 St.Dev. ● 2015

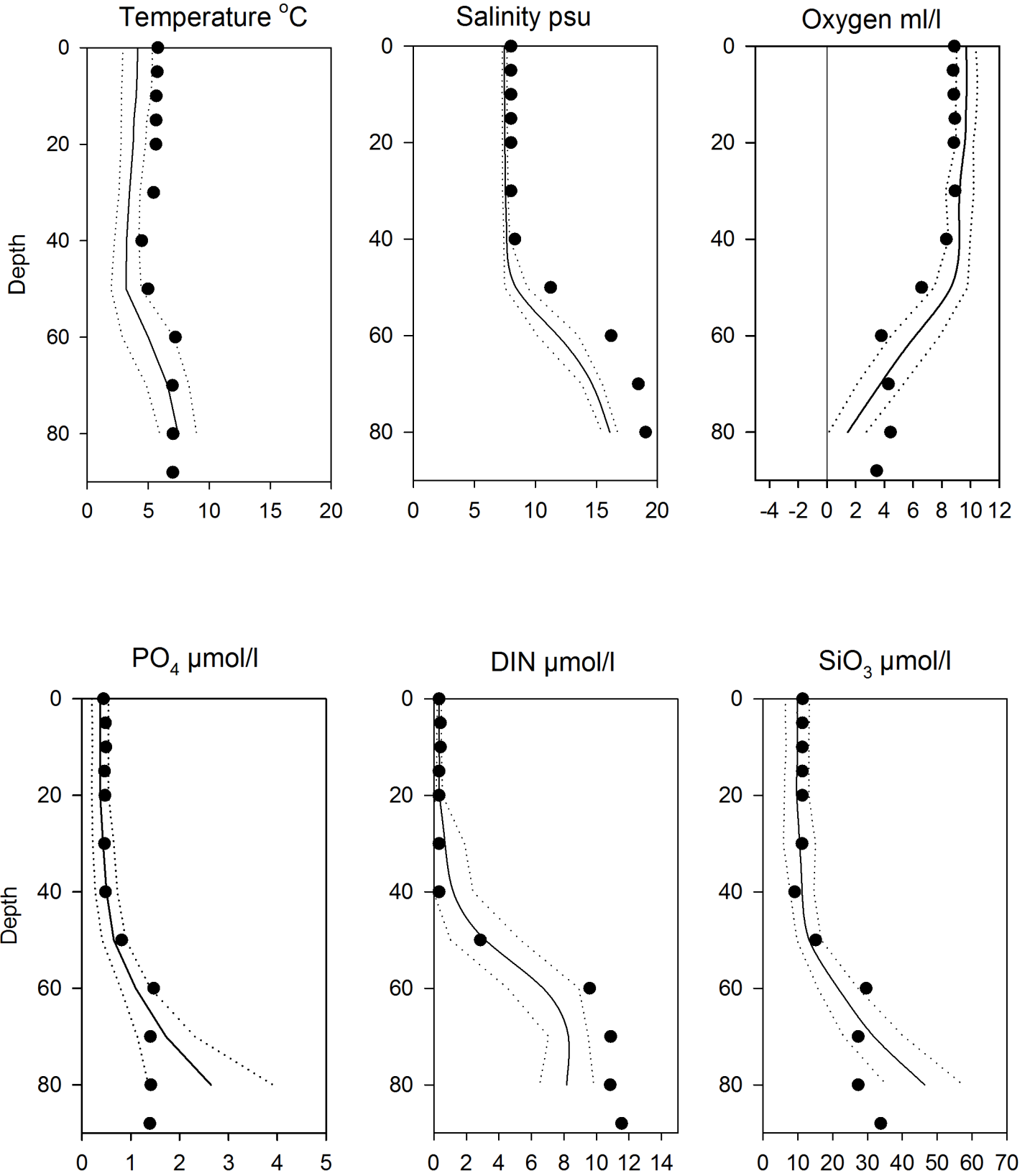


OXYGEN IN BOTTOM WATER (depth >80m)



Vertical profiles BY5 April

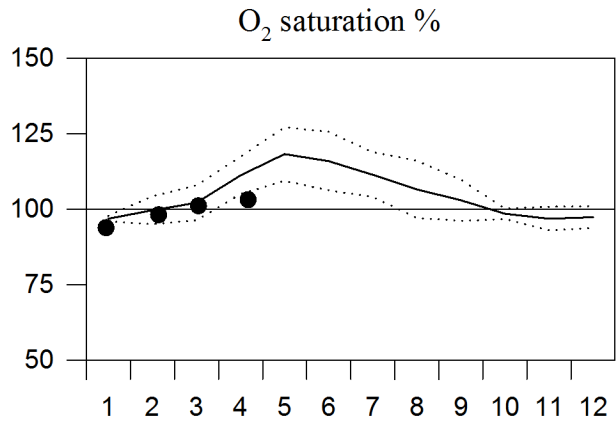
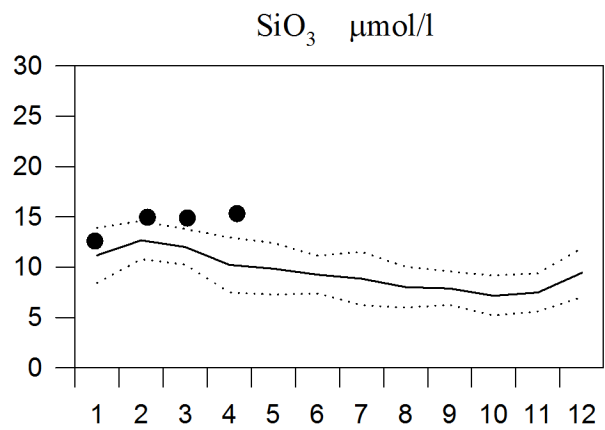
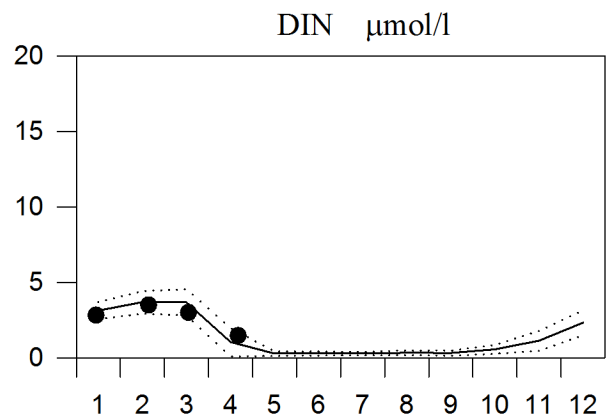
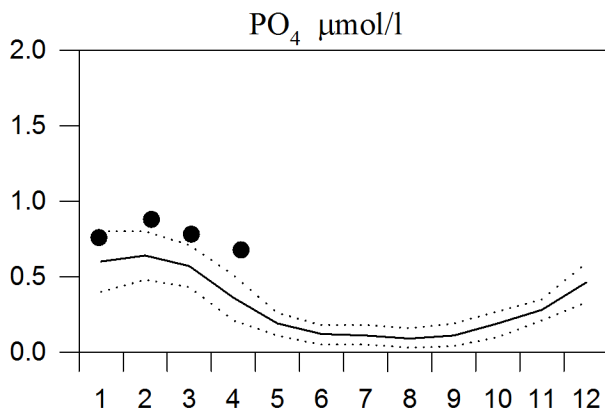
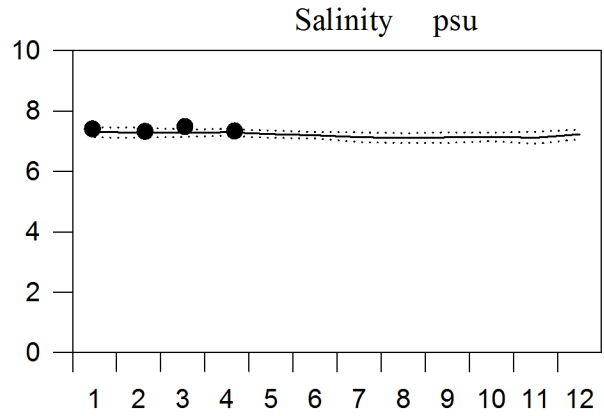
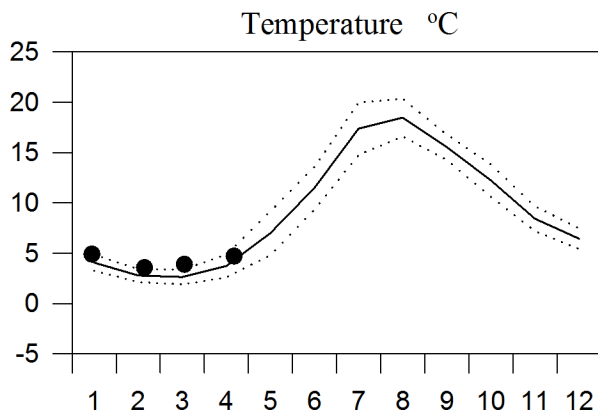
— Mean 1996-2010 St.Dev. ● 2015



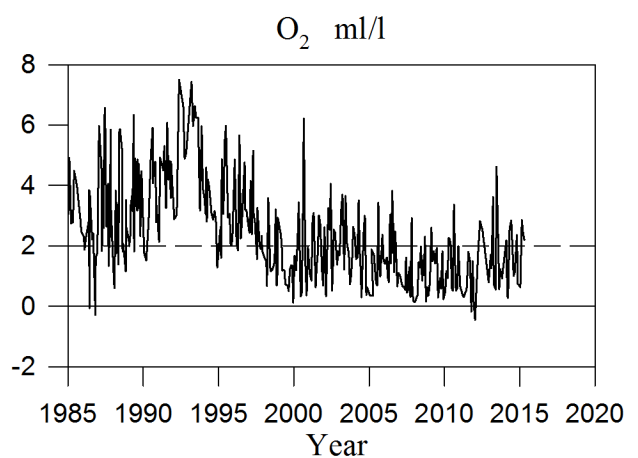
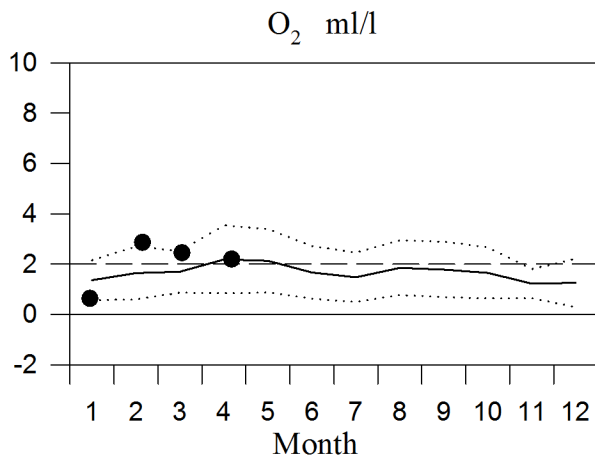
STATION BCS III-10 SURFACE WATER

Annual Cycles

— Mean 1996-2010 St.Dev. ● 2015

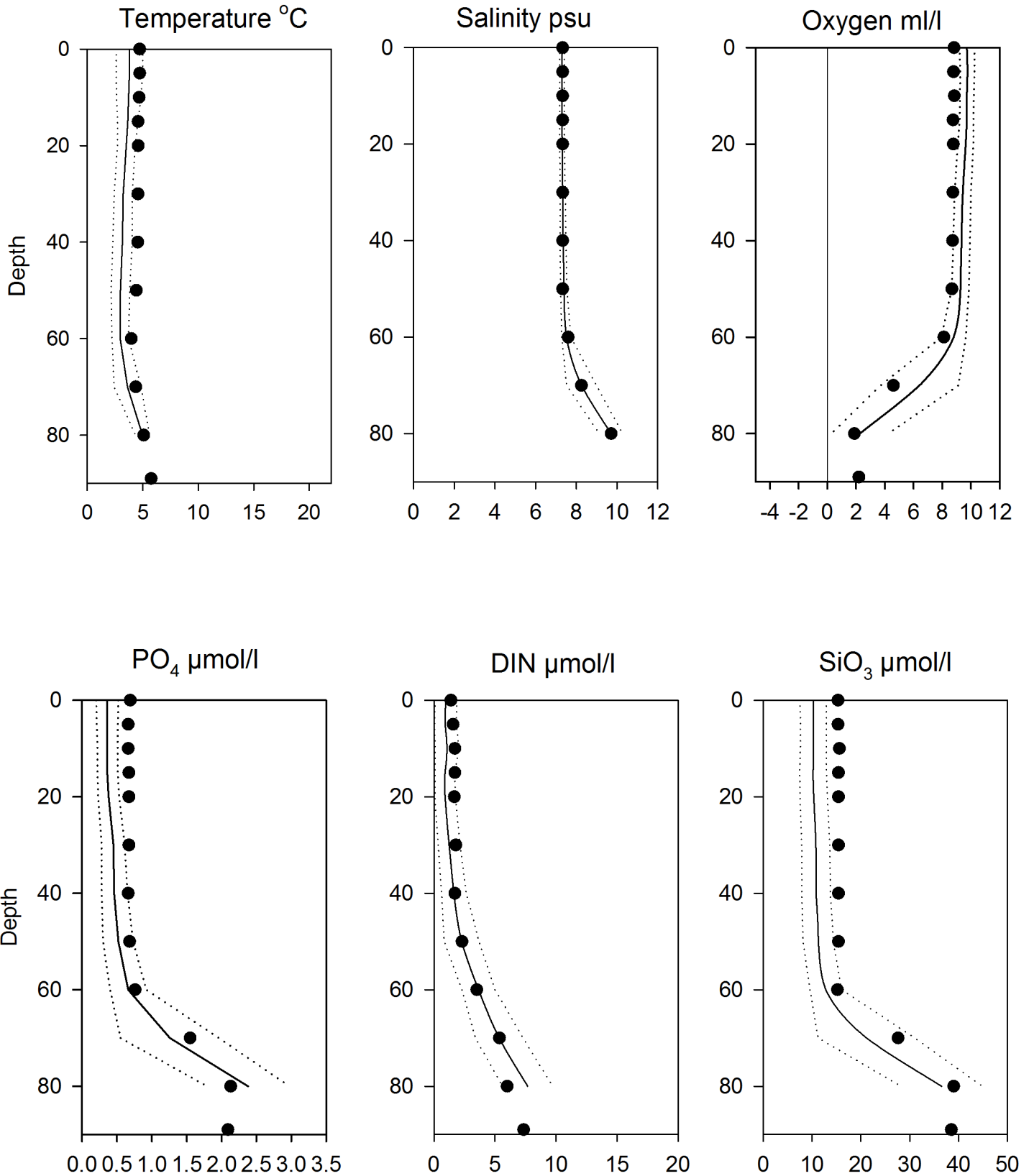


OXYGEN IN BOTTOM WATER (depth > 80m)



Vertical profiles BCS III-10 April

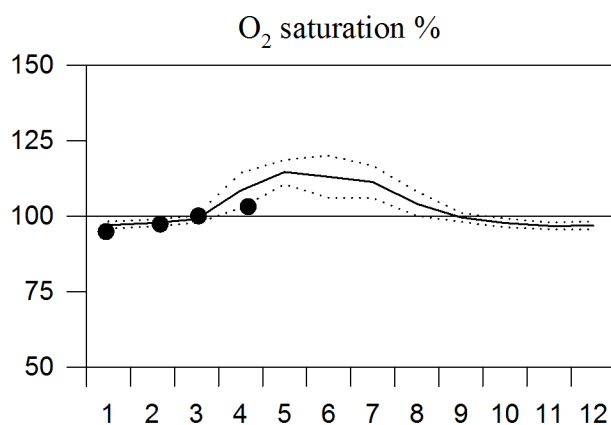
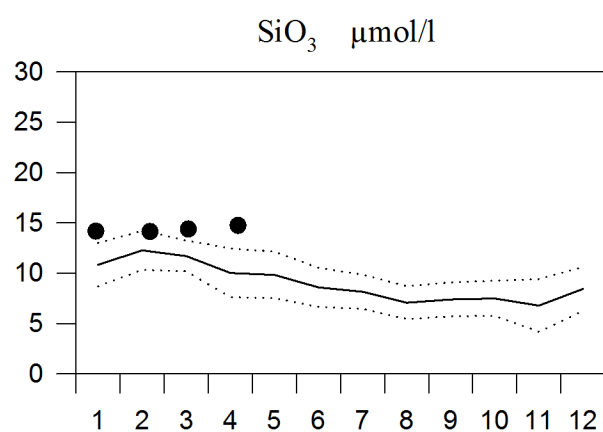
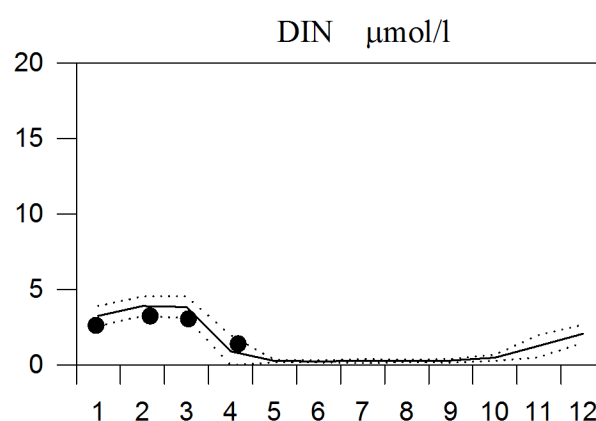
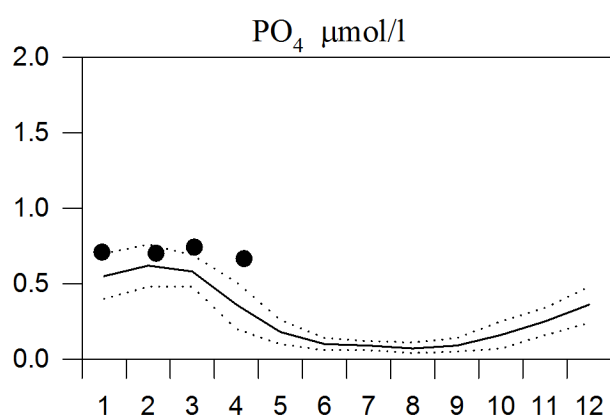
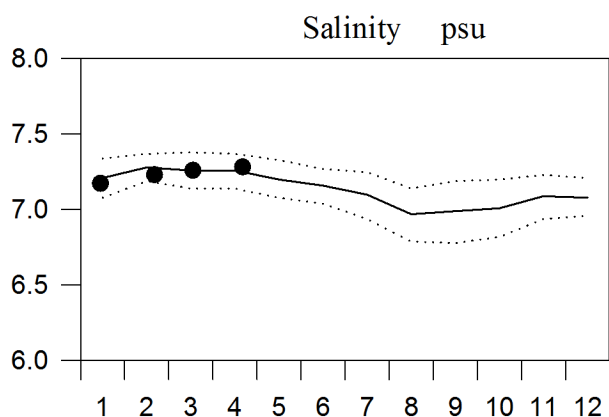
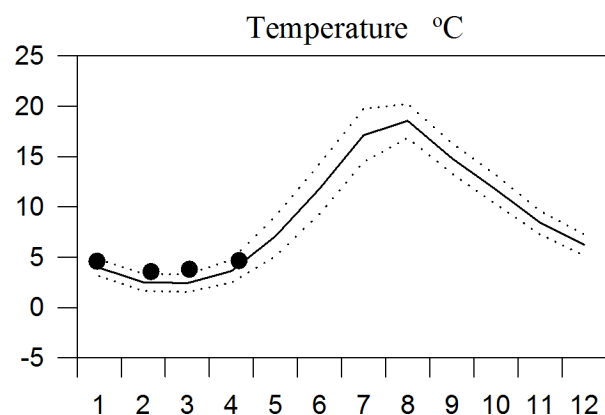
— Mean 1996-2010 St.Dev. ● 2015



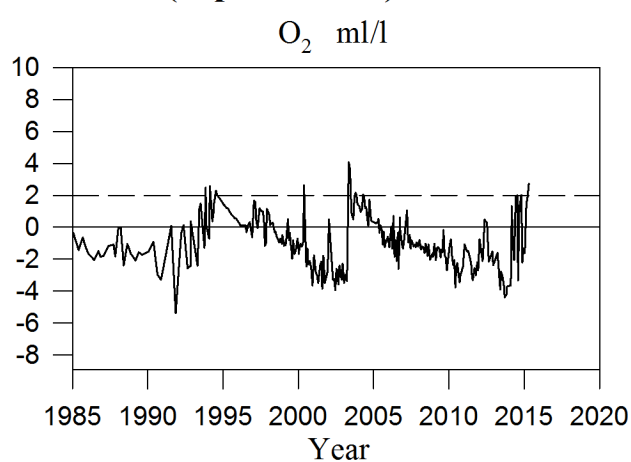
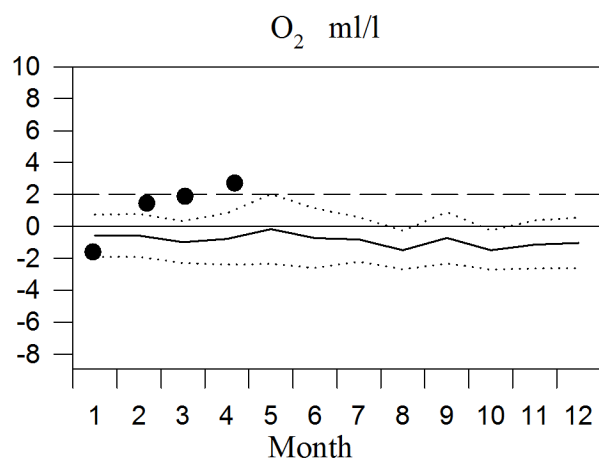
STATION BY10 SURFACE WATER

Annual Cycles

— Mean 1996-2010 St.Dev. ● 2015

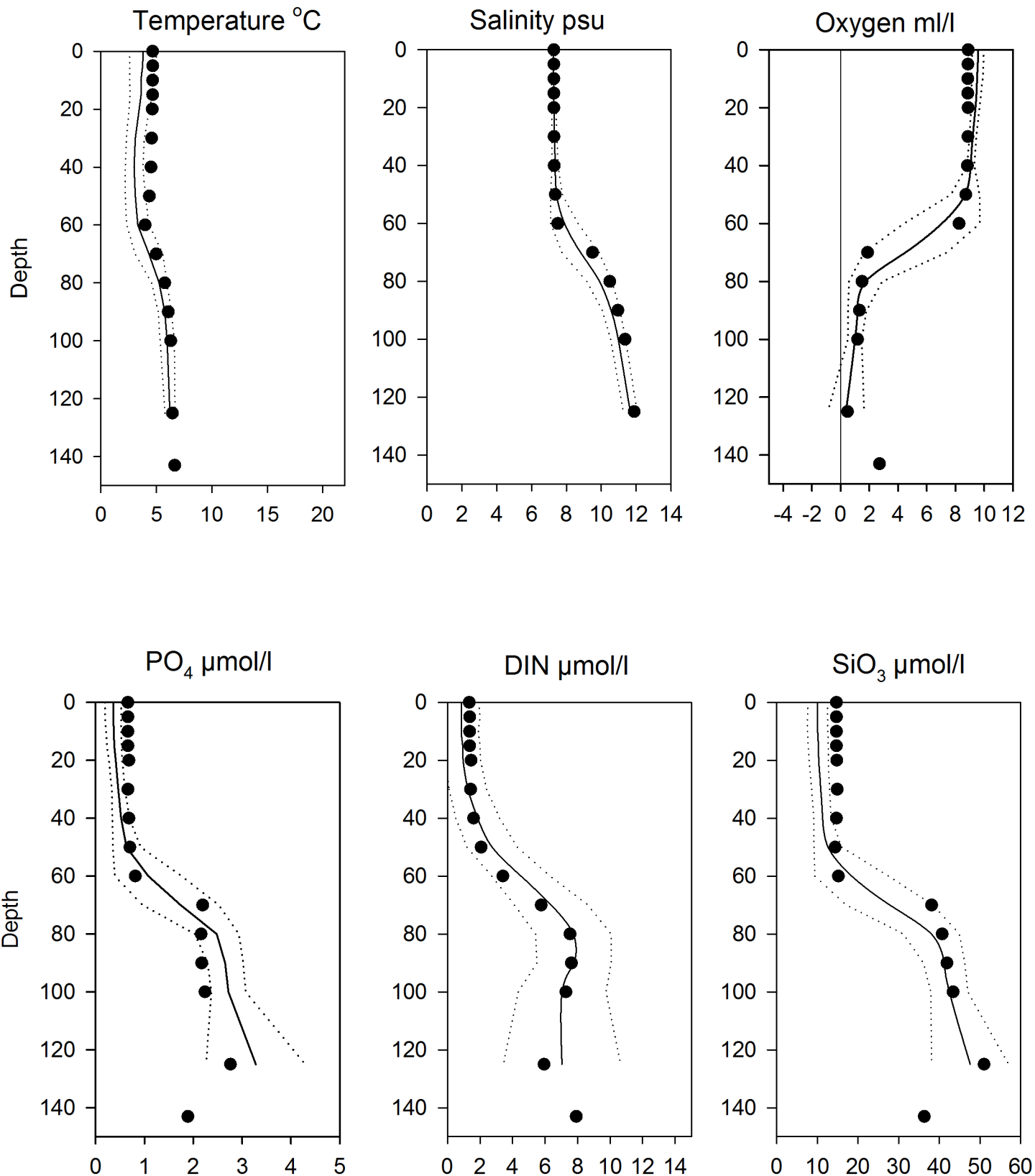


OXYGEN IN BOTTOM WATER (depth >125m)



Vertical profiles BY10 April

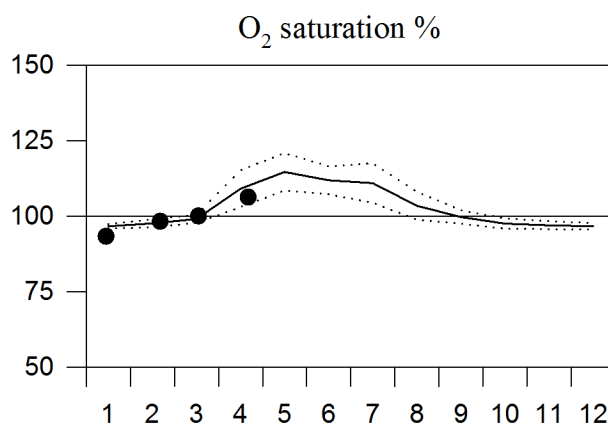
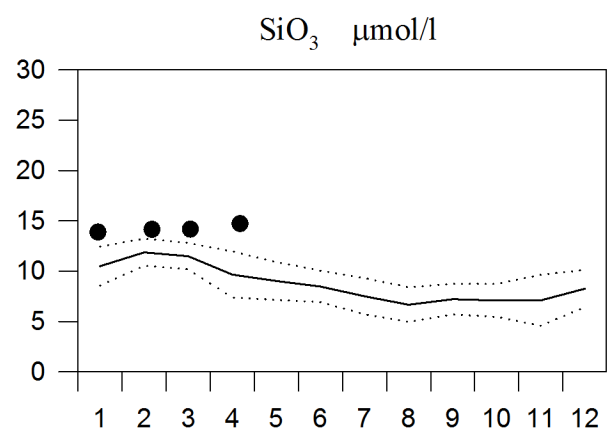
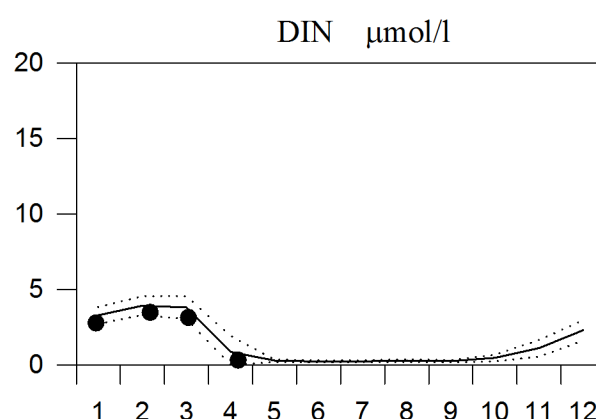
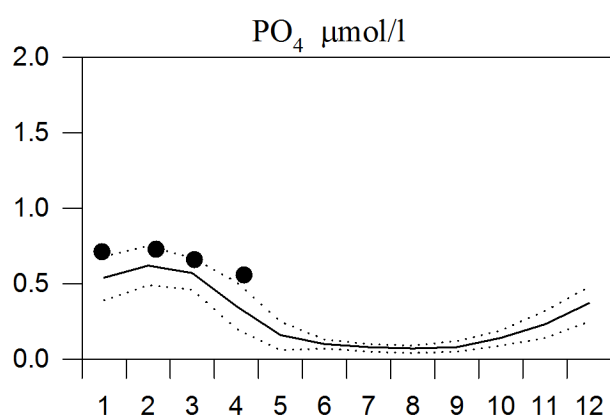
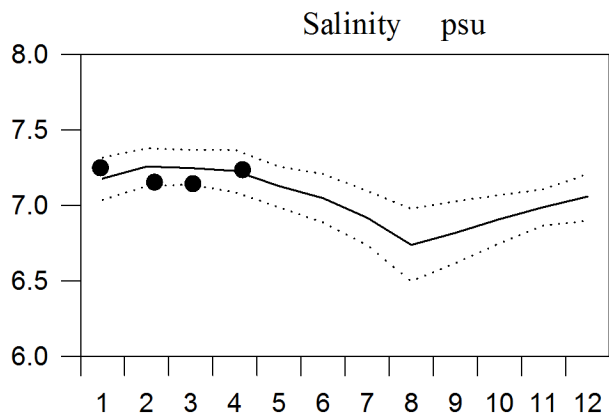
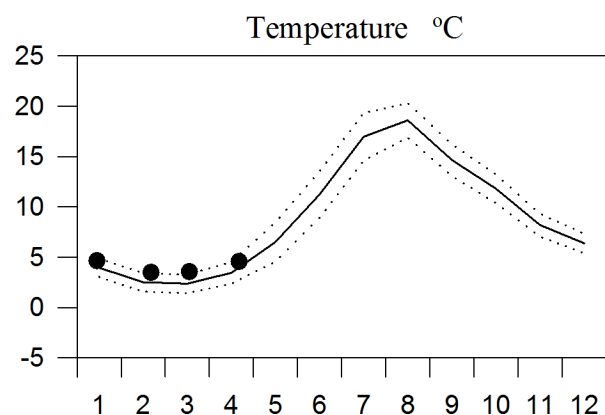
— Mean 1996-2010 St.Dev. ● 2015



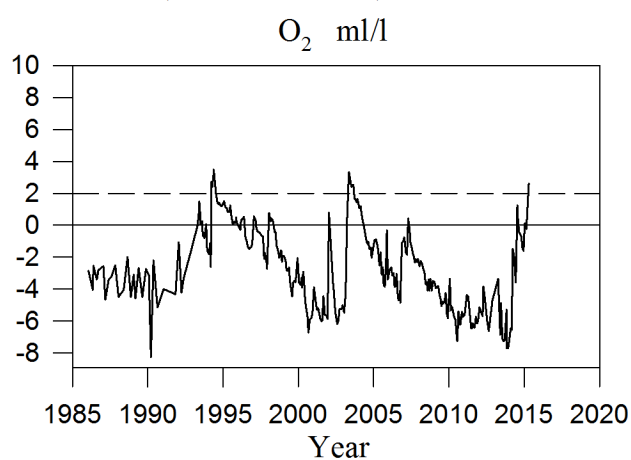
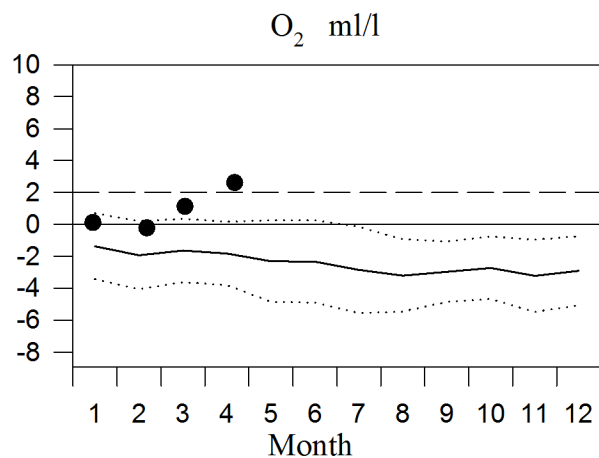
STATION BY15 SURFACE WATER

Annual Cycles

— Mean 1996-2010 St.Dev. ● 2015

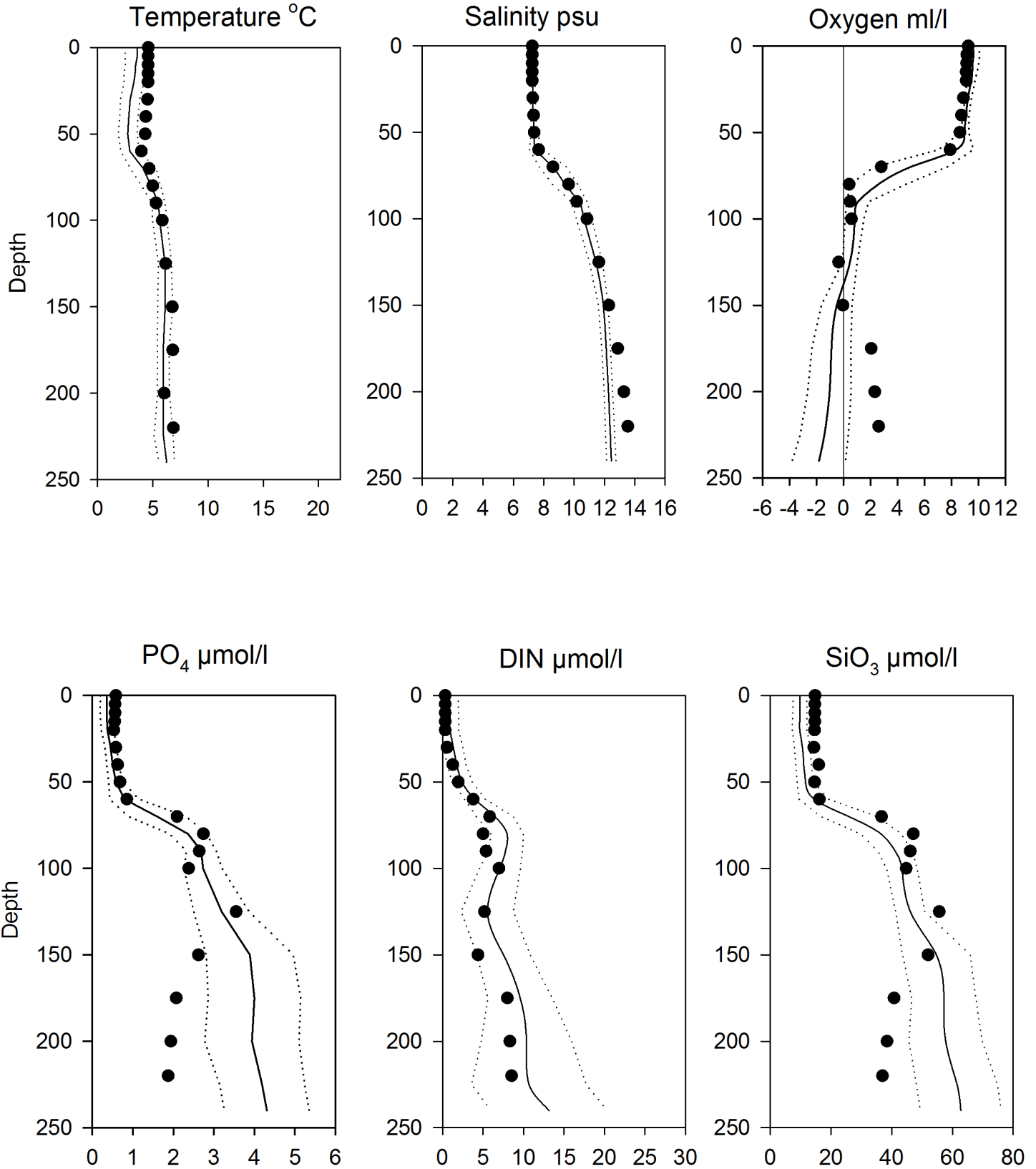


OXYGEN IN BOTTOM WATER (depth >225m)



Vertical profiles BY15 April

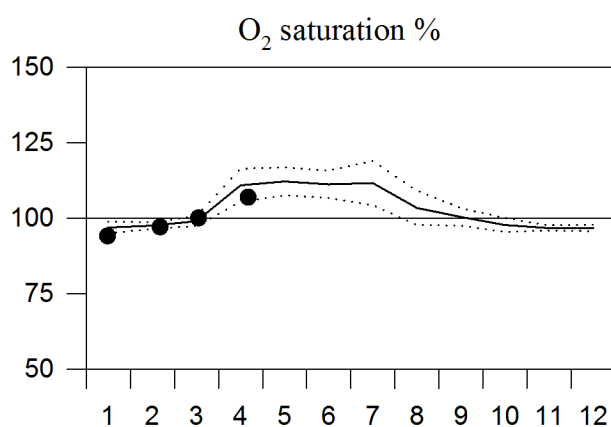
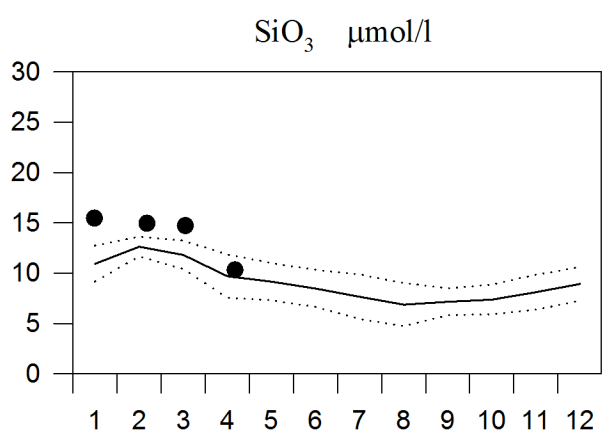
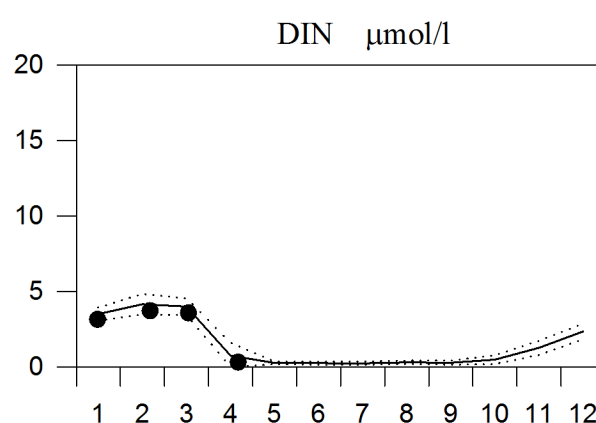
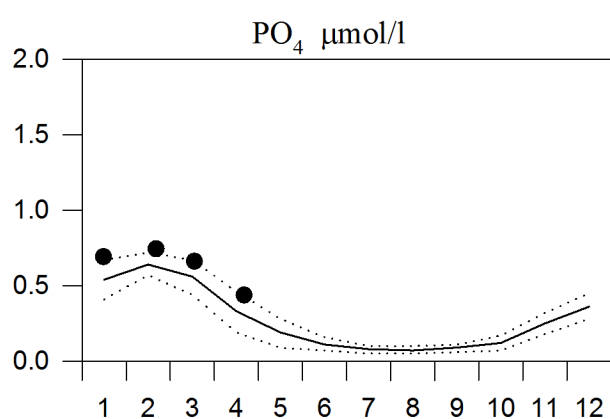
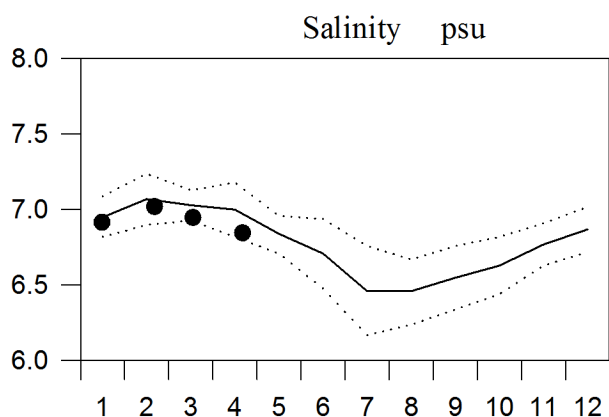
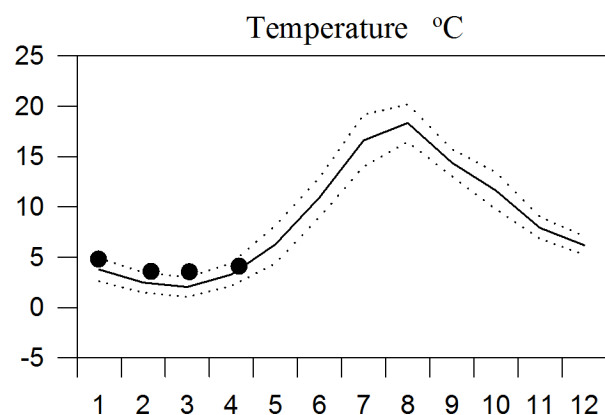
— Mean 1996-2010 St.Dev. ● 2015



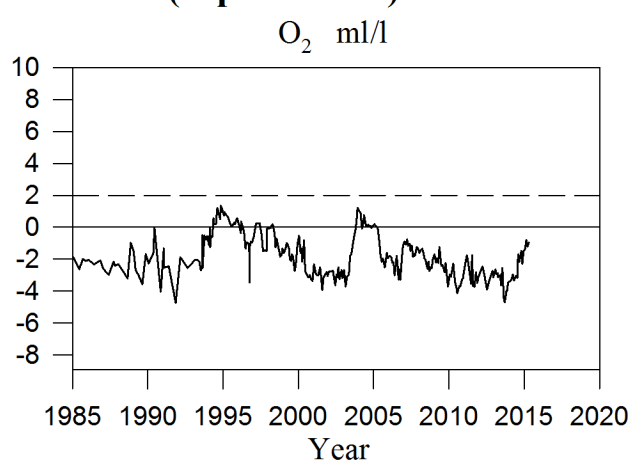
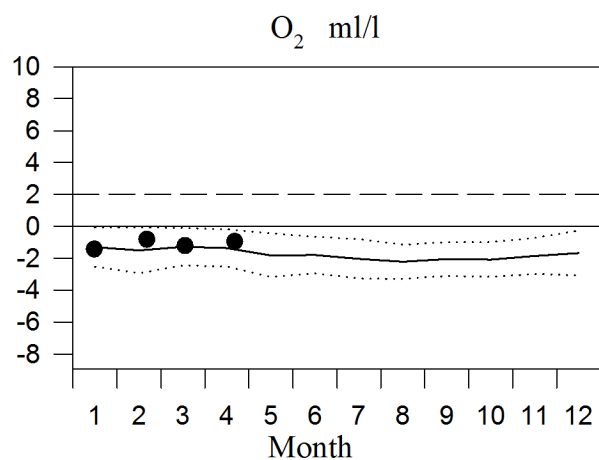
STATION BY20 SURFACE WATER

Annual Cycles

— Mean 1996-2010 St.Dev. ● 2015

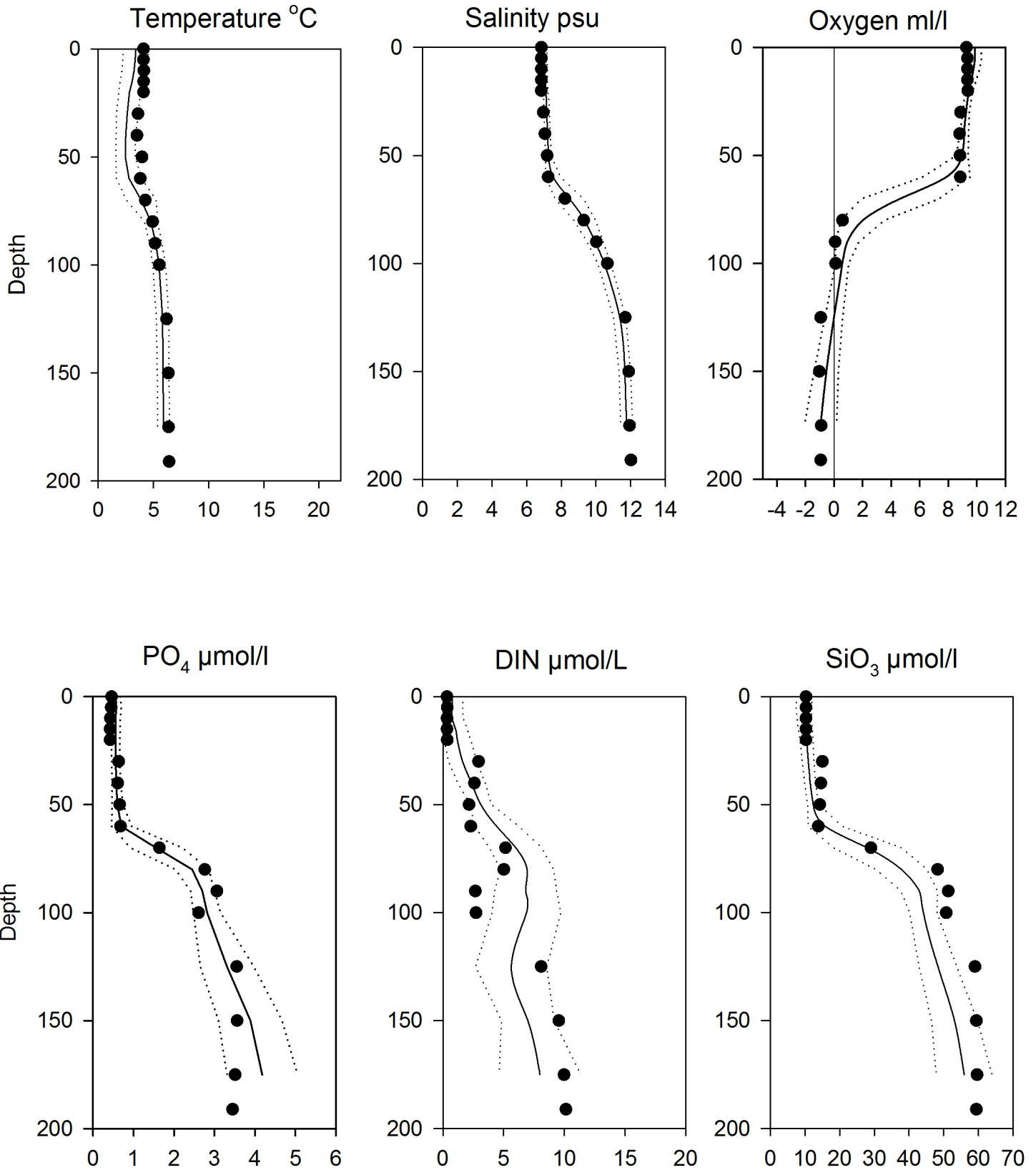


OXYGEN IN BOTTOM WATER (depth >175m)



Vertical profiles BY20 April

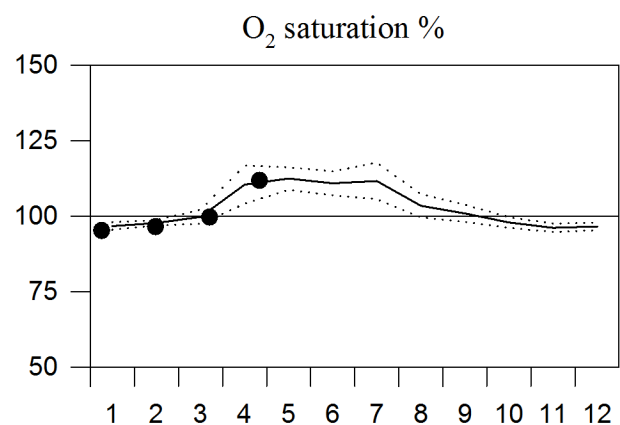
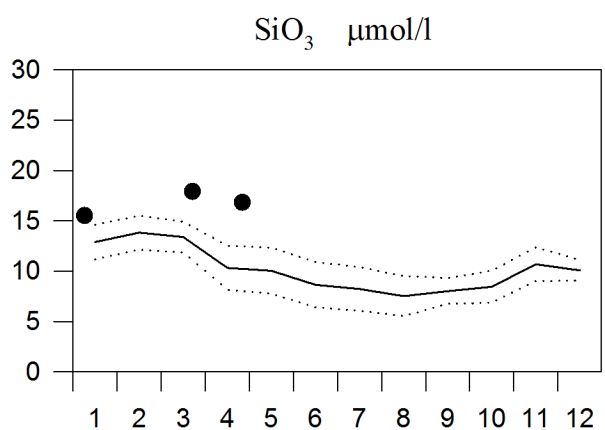
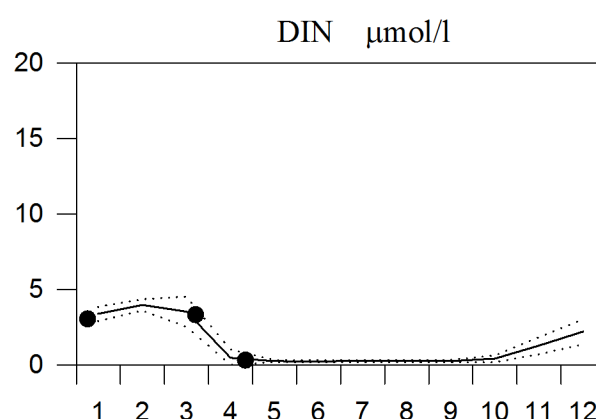
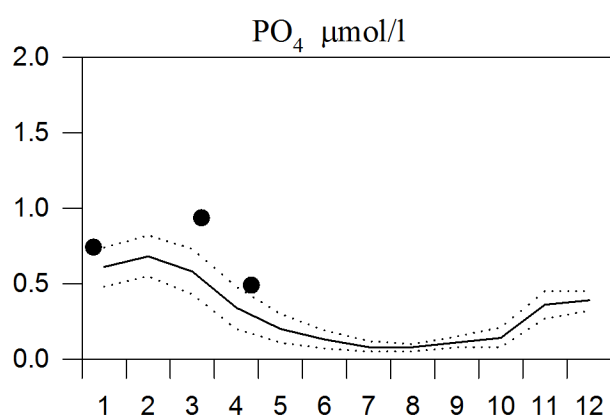
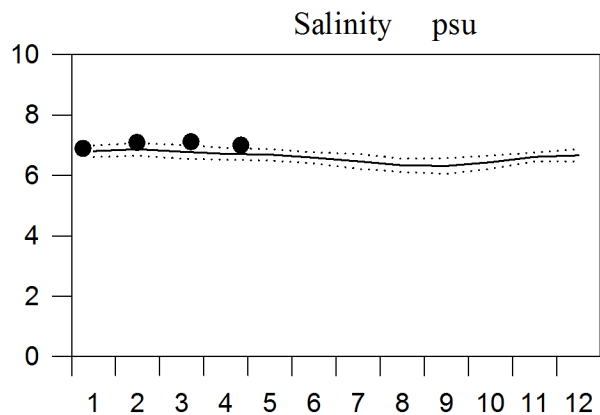
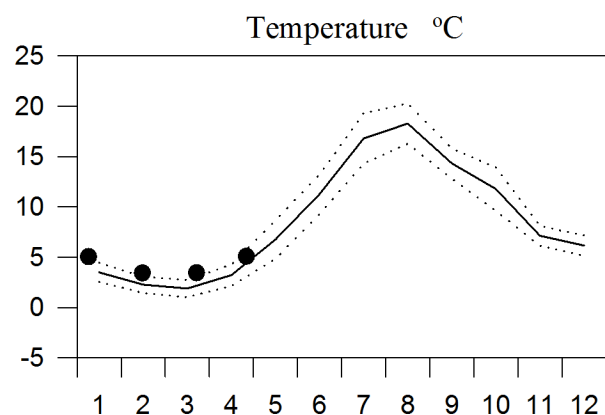
— Mean 1996-2010 St.Dev. ● 2015



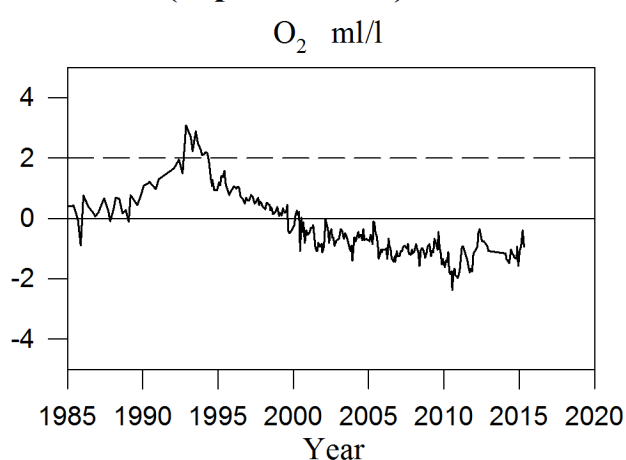
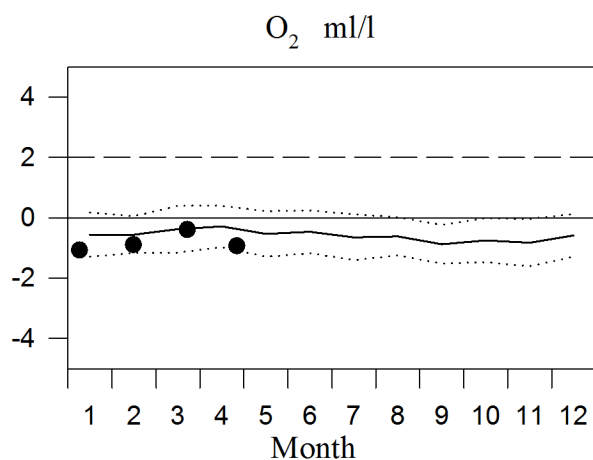
STATION BY32 SURFACE WATER

Annual Cycles

— Mean 1996-2010 St.Dev. ● 2015



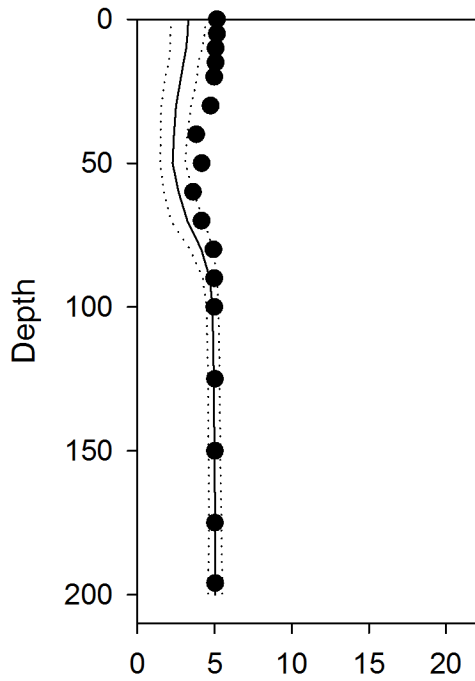
OXYGEN IN BOTTOM WATER (depth > 175m)



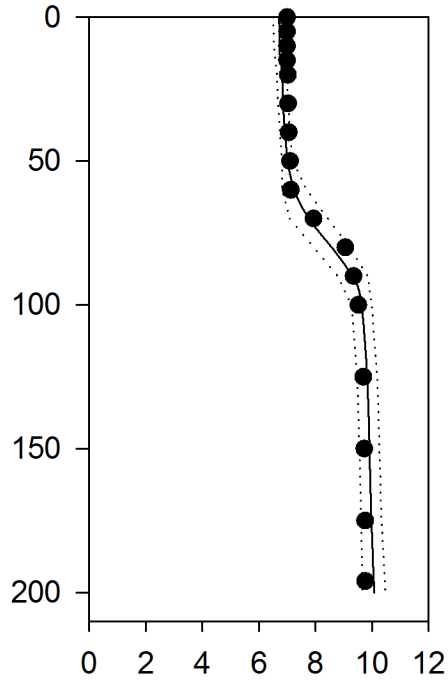
Vertical profiles BY32 April

— Mean 1996-2010 St.Dev. ● 2015

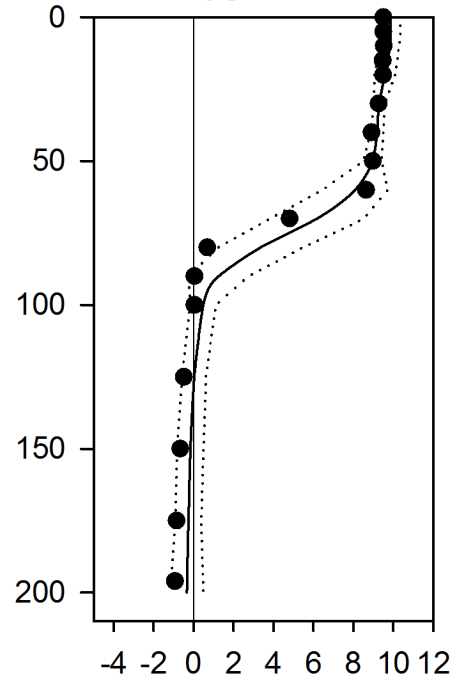
Temperature °C



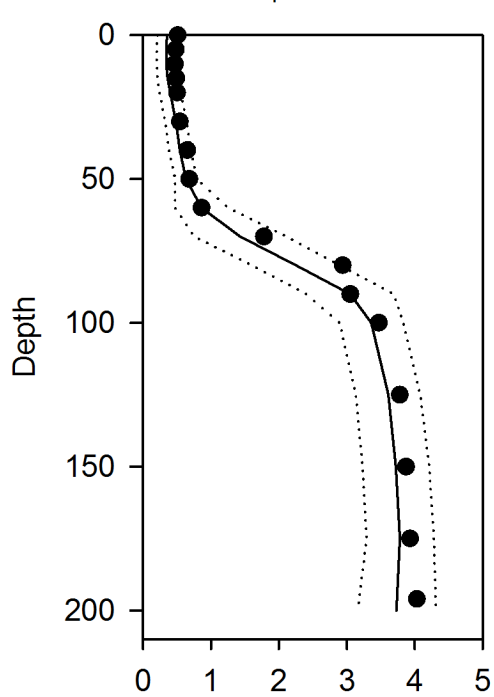
Salinity psu



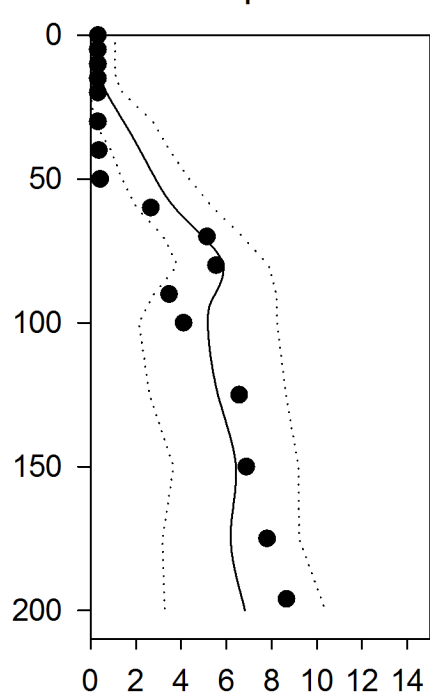
Oxygen ml/l



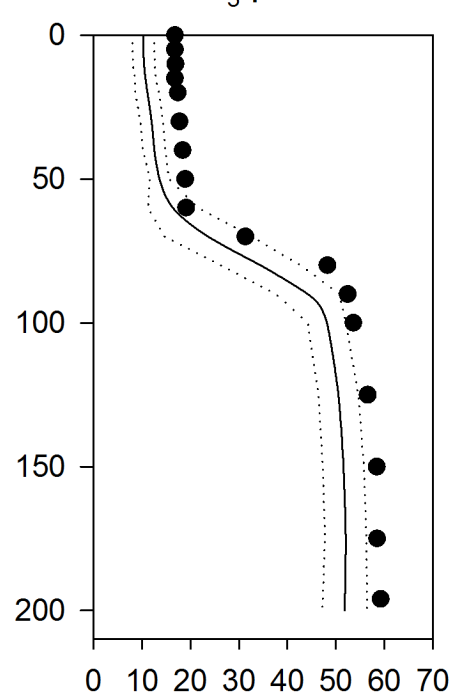
PO₄ μmol/l



DIN μmol/l



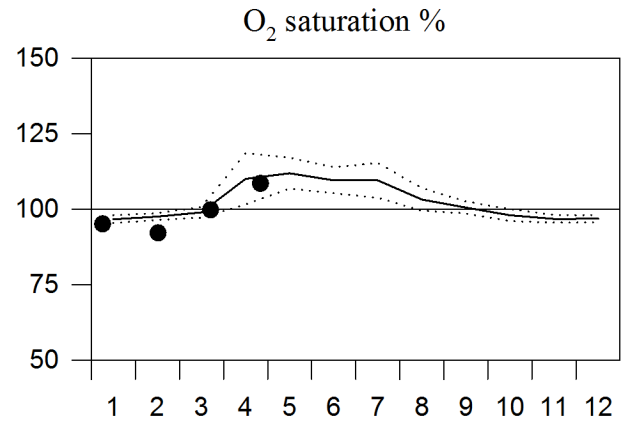
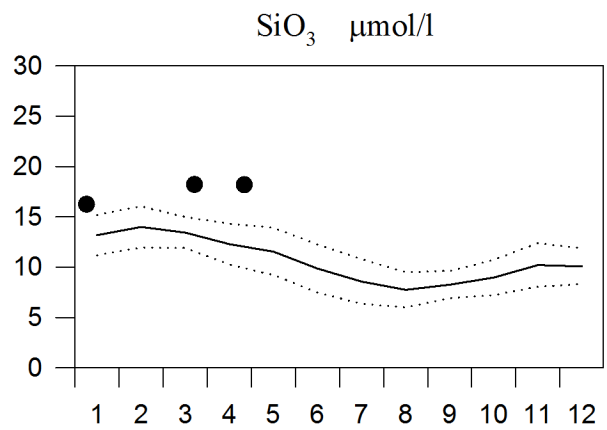
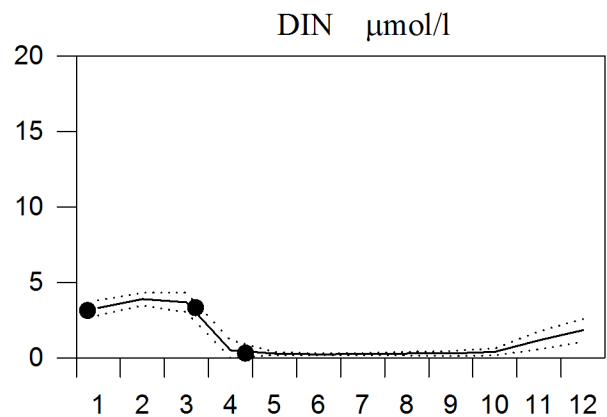
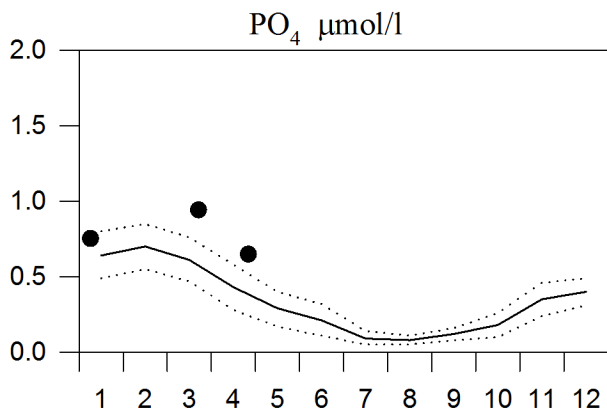
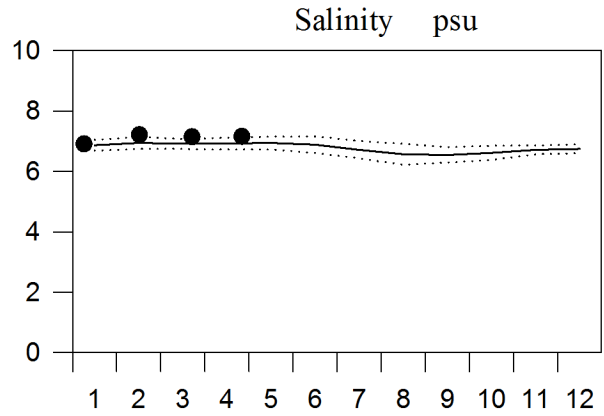
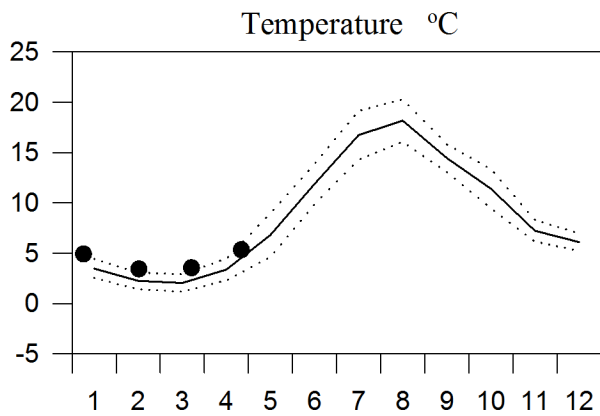
SiO₃ μmol/l



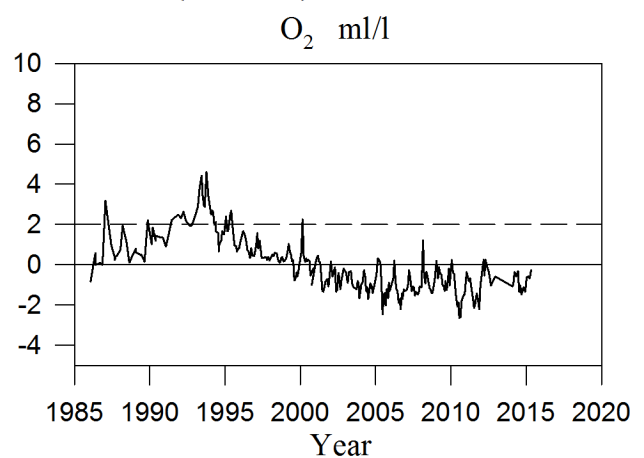
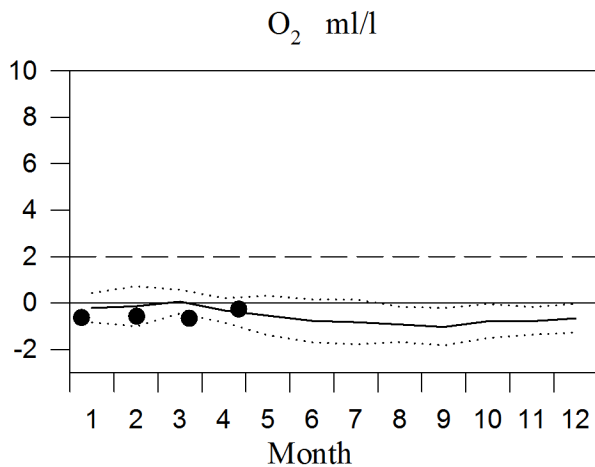
STATION BY38 SURFACE WATER

Annual Cycles

— Mean 1996-2010 St.Dev. ● 2015

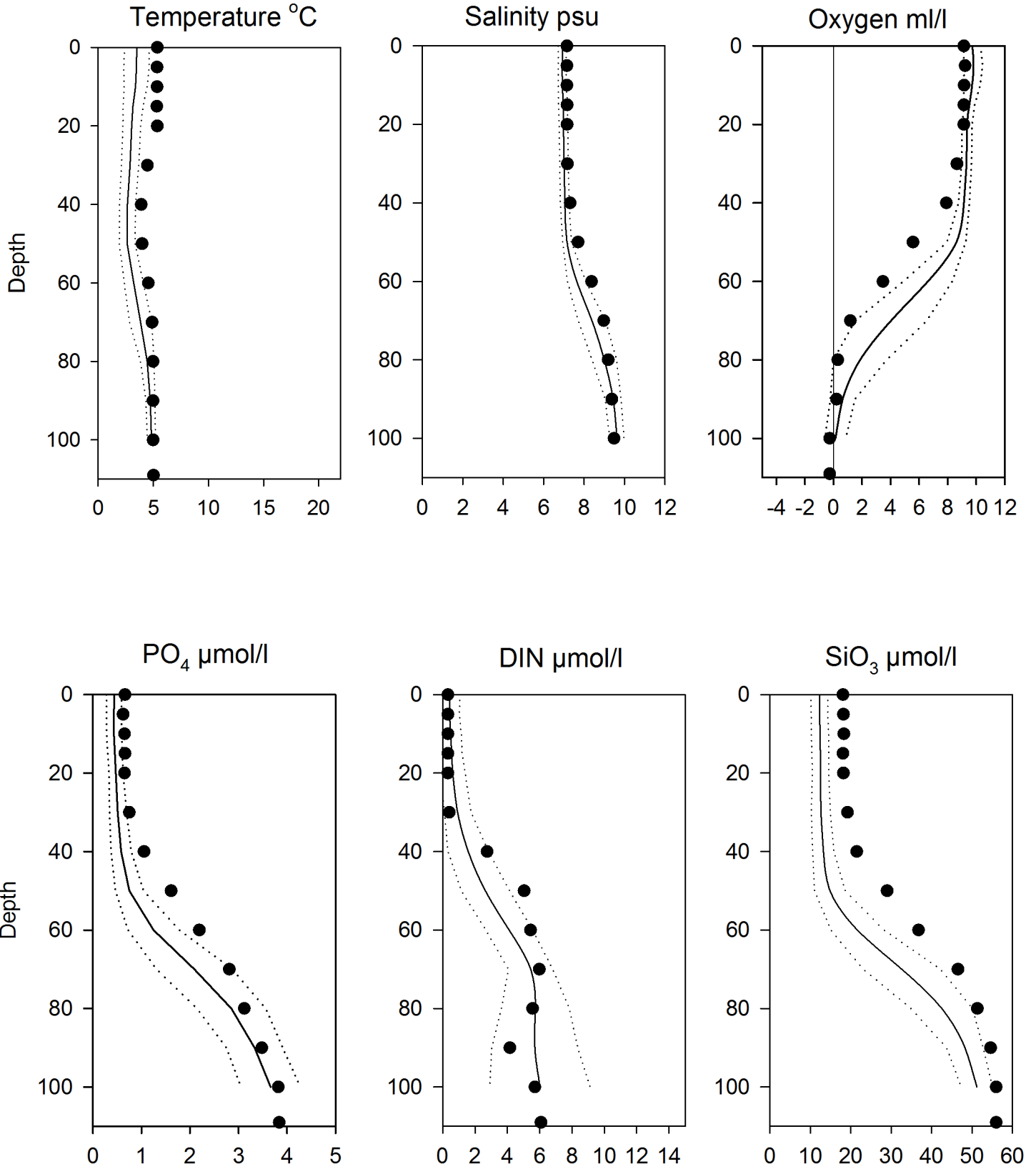


OXYGEN IN BOTTOM WATER (> 100m)



Vertical profiles BY38 April

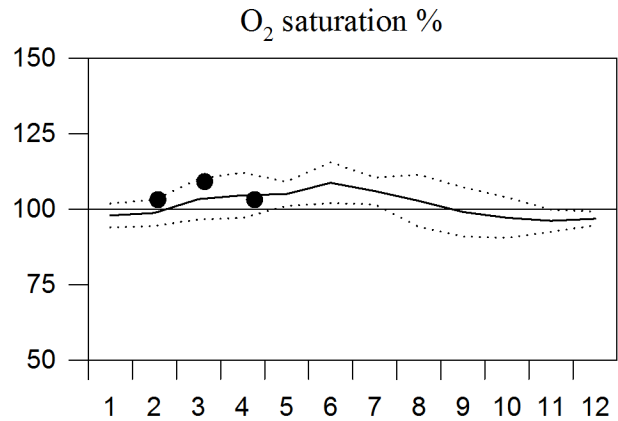
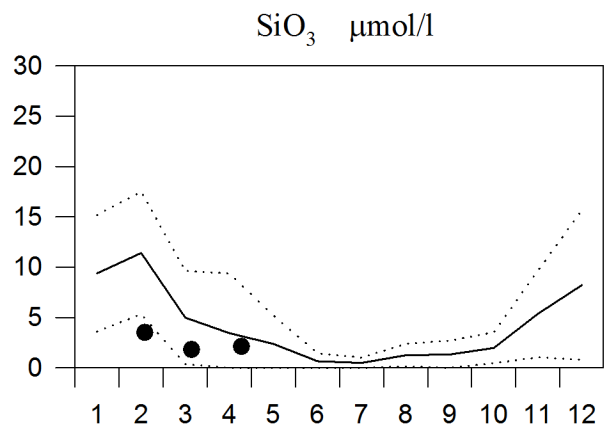
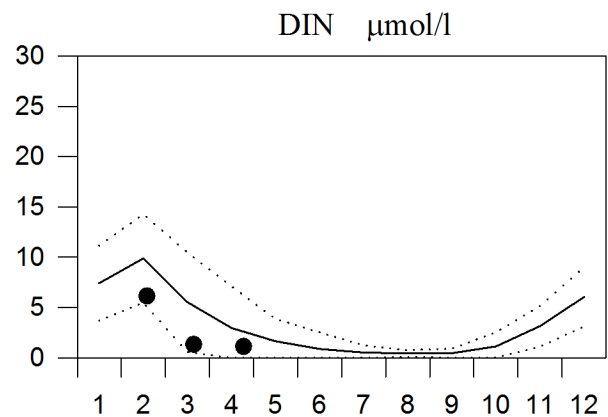
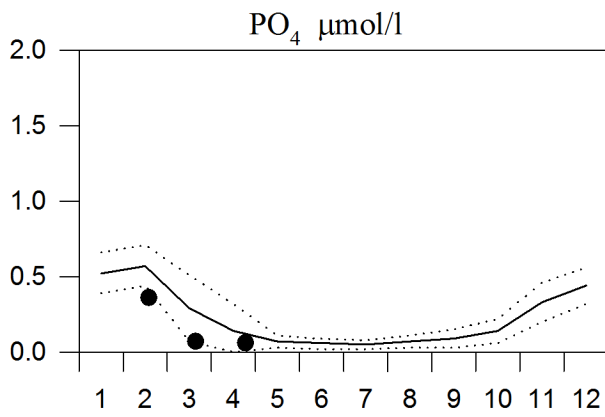
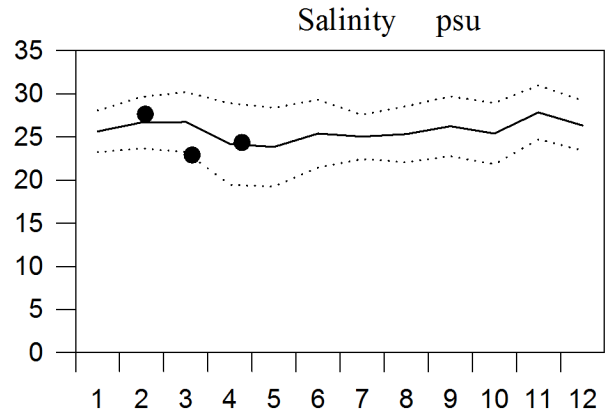
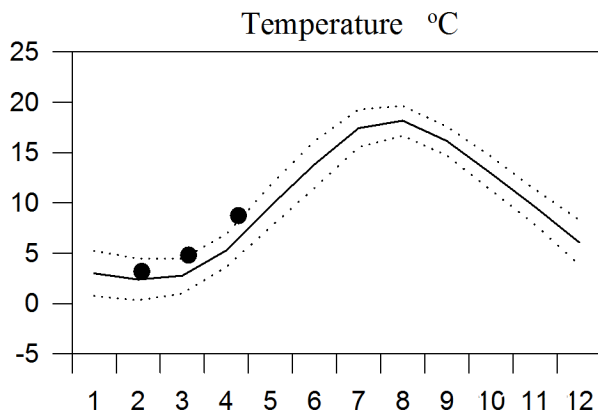
— Mean 1996-2010 St.Dev. ● 2015



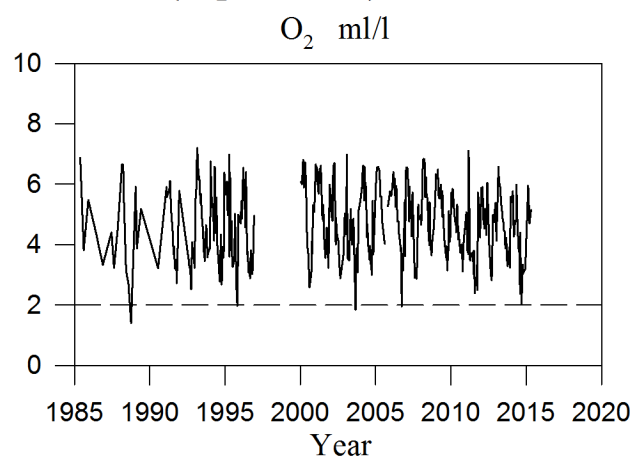
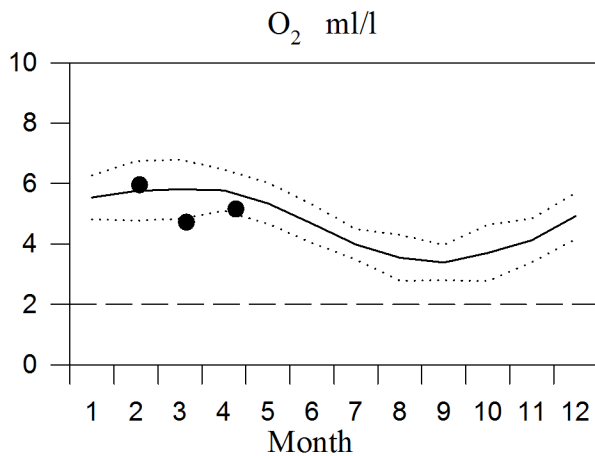
STATION SLÄGGÖ SURFACE WATER

Annual Cycles

— Mean 1996-2010 St.Dev. ● 2015

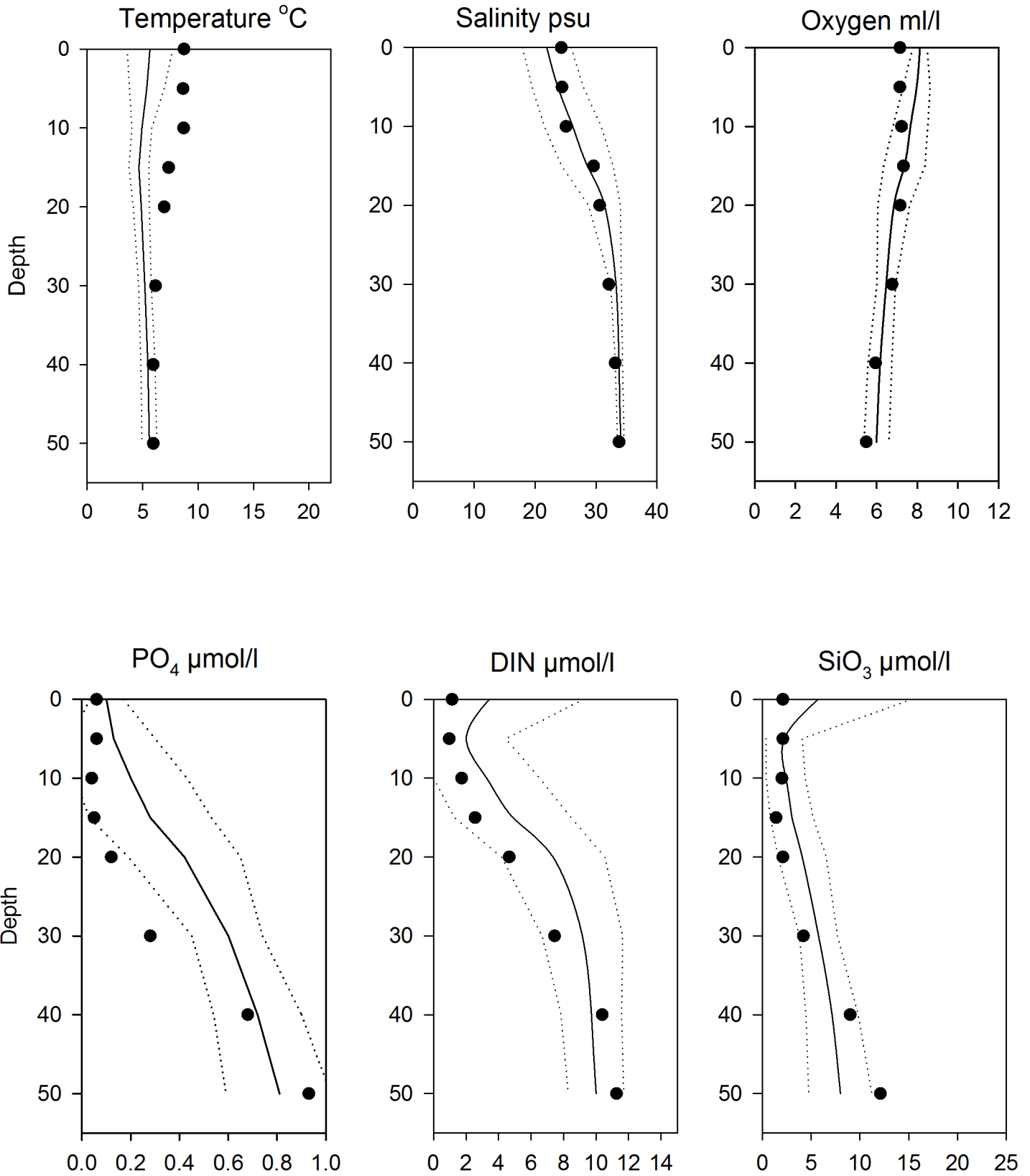


OXYGEN IN BOTTOM WATER (depth >50m)



Vertical profiles Släggö April

— Mean 1996-2010 St.Dev. ● 2015



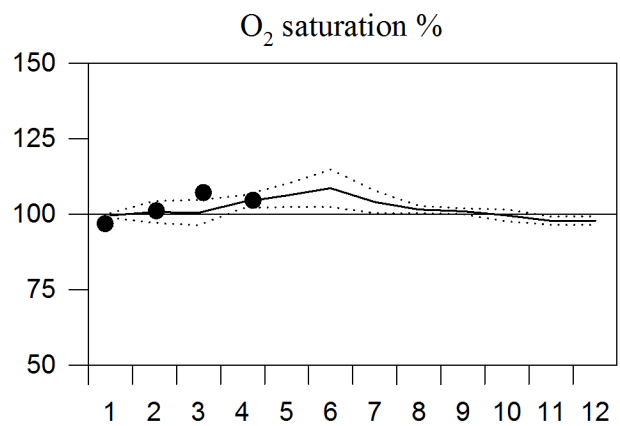
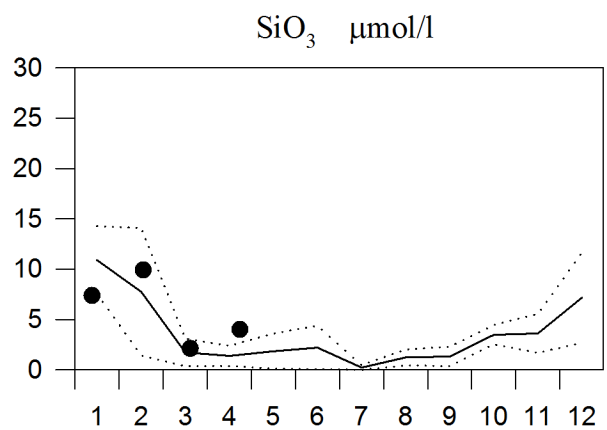
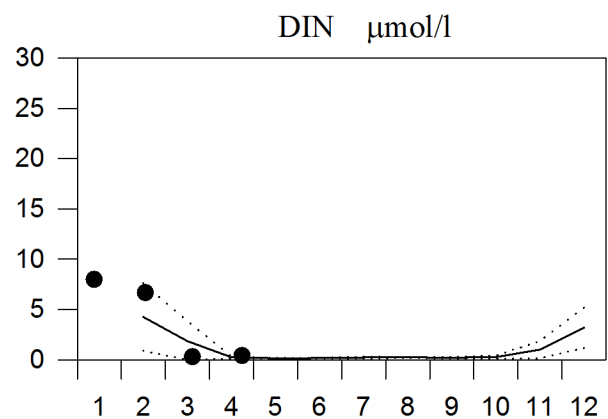
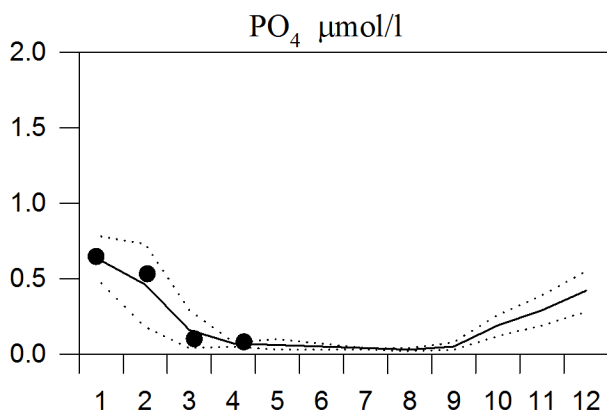
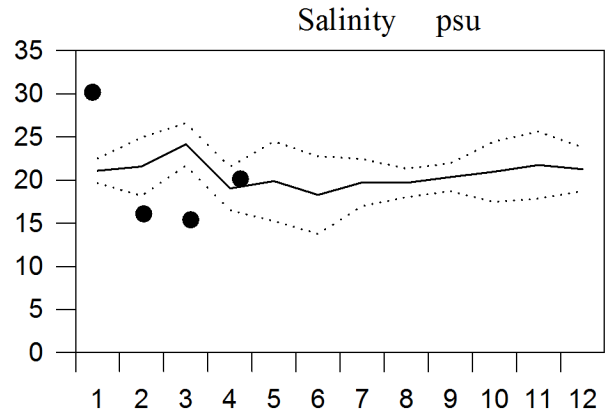
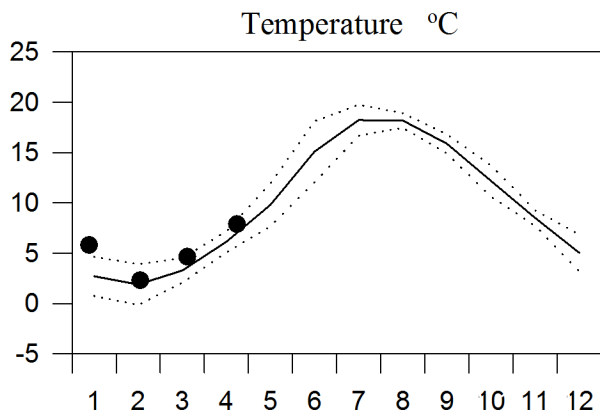
STATION N14 Falkenberg SURFACE WATER

Annual Cycles

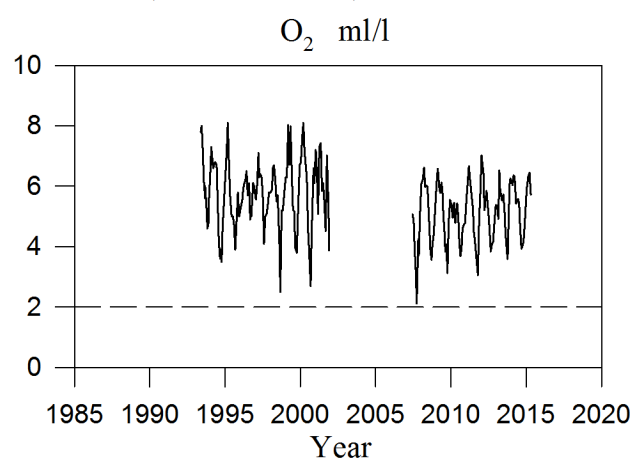
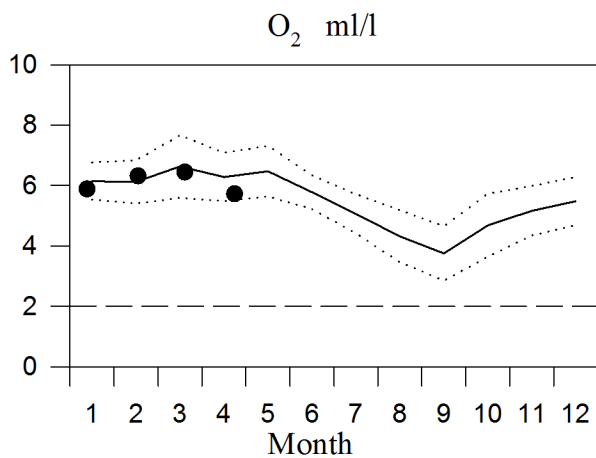
— Mean 2007-2010

..... St.Dev.

● 2015



OXYGEN IN BOTTOM WATER (depth > 25m)



———— Mean 1996-2010 St.Dev. ● 2015

- 2015

