

Rapport från SMHIs utsjöexpedition med R/V Aranda



Expeditionens varaktighet: 2015-11-09 - 2015-11-16
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, Egentliga Östersjön och Finska viken. Denna rapport är baserad på preliminära, endast delvis kvalitetskontrollerade data.

Skiktningen i utsjön i Skagerrak var mycket svag. I Kattegatt liksom i egentliga Östersjön uppvisade ytvattentemperaturen värden något över det normala. Närsalterna i ytvattnet uppvisade i stort sett värden typiska för årstiden, med undantag för silikat som hade koncentrationer klart över det normala i östra Gotlandsbassängen och halter under det normala i de södra delarna av egentliga Östersjön.

Det stora inflödet under december 2014 hade inte kommit längre norrut än vid förra provtagningen i oktober och syresituationen i djupvattnet hade försämrats något. Svavelväte förekommer fortfarande i västra och norra Gotlandsbassängerna.

Planktonaktiviteten var generellt låg.

Nästa ordinarie expedition är planerad att starta 7:e december.

PRELIMINÄRA RESULTAT

Expeditionen genomfördes ombord det finska forskningsfartyget Aranda och startade i Helsingfors den 9:e november samt avslutades i samma hamn den 16:e. Vindarna under expeditionen varierade i styrka, från friska upp till kuling, i huvudsak från väst. Lufttemperaturen varierade mellan 6 och 12°C. Under expeditionen pågick ett inflöde, på ca 25 km³, genom Öresund till Östersjön.

I Finska viken och norra Egentliga Östersjön besöktes även denna resa fyra stationer som vanligtvis provtas av Finlands Miljöcentral (SYKE). Den här utökade provtagningen ingår i ett nytt samarbete mellan SMHI och SYKE med syfte att bl.a. öka provtagningsfrekvensen på svenska och finska övervakningsstationer.

Skagerrak

Temperaturen i ytvattnet varierade mellan 11.3 och 11.9°C, något lägre 10.3°C vid Släggö i Gullmarsfjordens mynning. Längst i väster återfanns en termoklin och haloklin på 40 meters djup, i övriga delar av det undersökta området var hela vattenpelaren i stort sett helt homogen, både avseende temperatur och salthalt. Vid kuststationen Släggö återfanns en klar skiktning i både temperatur och salthalt på 10 meters djup och salthalten här låg strax under 26 psu i ytan. Samtliga närsalter i ytvattnet hade nu stigit något sedan föregående mättillfälle och uppvisade koncentrationer normala för årstiden. Fosfathalterna låg i intervallet 0.2-0.3 µmol/l, oorganiskt kväve (nitrit + nitrat) 0.7-1.7 µmol/l och silikat 1.7-2 µmol/l. De lägsta syrehalterna i bottenvattnet uppmättes vid Släggö 3.2 ml/l på 72 meters djup motsvarande en mättnad av ca 50%.

Fluorescensmätningarna visade på låg biologisk aktivitet i ytlagret 0-10 m. För mer detaljer om artsammansättning se separat rapport om algsituationen.

Kattegatt och Öresund

I Kattegatt låg temperaturen i ytvattnet i intervallet 10.7 - 11.0°C, vilket är normalt till något högre än normalt för årstiden. Salthalten i ytlagret varierade mellan 26.5 och 28.5 psu i Kattegatt, vilket är över det normala. Salthaltsdata från Öresund saknas. Temperaturskiktningen var mycket svag. Haloklinen, även den svagt utvecklad, återfanns på djup mellan 15 och 30 meter. Även i Kattegatt, liksom i Skagerrak, hade närsalthalterna i ytvattnet börjat stiga. Fosfathalten låg kring 0.24 µmol/l, nitrit + nitrat mellan 0.5 och 1.2 µmol/l och silikat i intervallet 1.9 - 2.3 µmol/l. I Öresunds ytvatten var fosfathalten 0.23 µmol/l, halten av oorganiskt kväve 0.6 µmol/l och silikatkoncentrationen 2.9 µmol/l, samtliga halter under det normala. De lägsta syrehalterna i bottenvattnet uppmättes vid Anholt E i Kattegatt, ca 4 ml/l, samt vid W Landskrona i Öresund, 2.9 ml/l.

En viss planktonaktivitet förekom i ytvattnet, 0-15 m. För mer detaljer om artsammansättning se separat rapport om algsituationen.

Egentliga Östersjön

Temperaturen i ytskiktet var normal eller något över det normala för årstiden och varierade från 9°C i de norra delarna till 11.5°C i sydväst. I de norra och centrala delarna var termoklinen väl utvecklad och återfanns på djup mellan 30 och 40 meter. I Bornholmsbassängen samt i Hanöbukten återfanns flera olika lager med varierande temperaturer under 40 meters djup. I Arkonabassängen var temperaturskiktningen mycket svag. Ytsalthalten var kring det normala för årstiden och låg i intervallet 6.5 till 8.7 psu. Haloklinen återfanns på 40 till 70 meters djup i västra samt norra

Gotlandsbassängerna och på 50-80 meters djup i östra Gotlandsbassängen, medan den låg något grundare i de södra delarna.

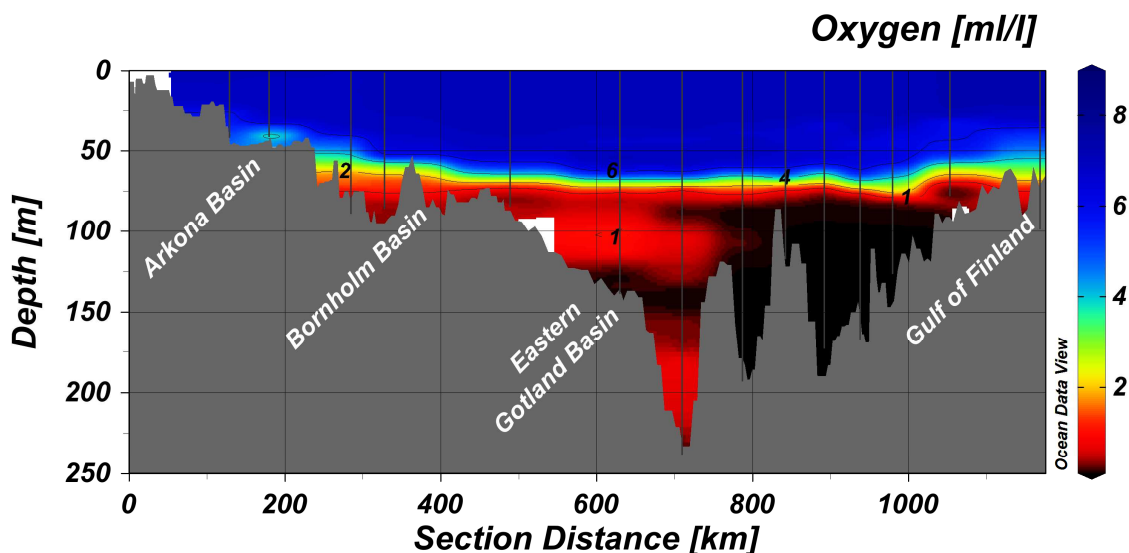
Halterna av fosfat varierade från 0.2 $\mu\text{mol/l}$ i norra egentliga Östersjön till 0.4 $\mu\text{mol/l}$ i söder, vilket är normalt. Dock avvek stationen BY31, i nordväst, där koncentrationen var över det normala, 0.5 $\mu\text{mol/l}$. Halterna av oorganiskt kväve, även de normala, varierade från ca 0.2 $\mu\text{mol/l}$ i söder till ca 1 $\mu\text{mol/l}$ i norr. Även här avvek stationen BY31, där halterna låg på 1.7 $\mu\text{mol/l}$. Koncentrationerna av silikat ökade från 4 $\mu\text{mol/l}$ i sydväst till 10 $\mu\text{mol/l}$ i norr (vid BY31 13 $\mu\text{mol/l}$), halterna var förhöjda i östra Gotlandsbassängen, normala i västra samt under det normala i Bornholms- och Arkonabassängen samt Hanöbukten.

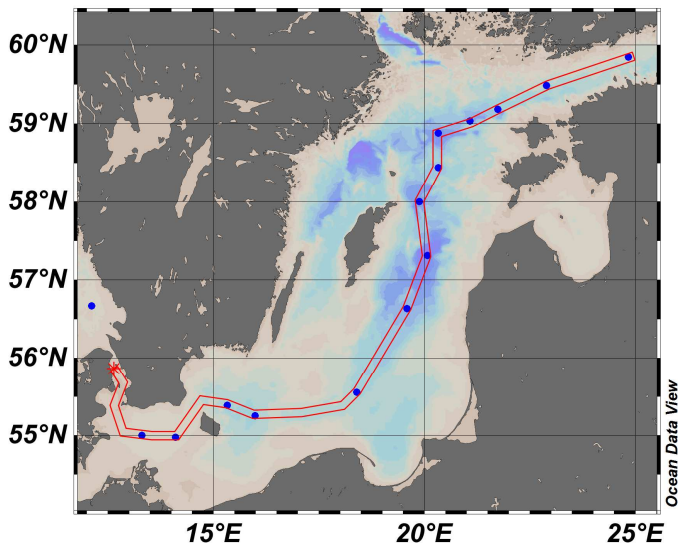
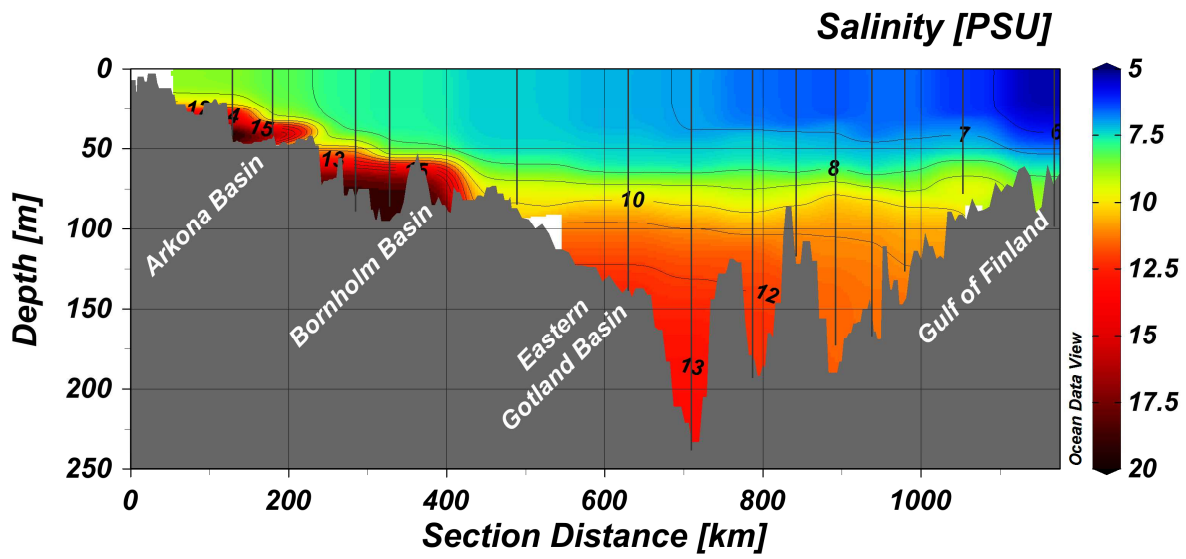
Precis som vid förra provtagningen i oktober syntes effekter av inflödet vid BY20, men ej vid BY21, längre norrut. Vid BY20 förekom nu svavelväte på 90 meters djup, därunder återfanns ett lager med syresatt vatten ner till ca 130 meters djup, varifrån vattnet återigen var helt syrefritt ner till botten.

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

I Gotlandsdjupet, i östra Gotlandsbassängen, förekom akut syrebrist (<2 ml/l) vid djup överstigande 70 meter. Hela djupvattnet var nu syresatt och inget svavelväte uppmättes. Koncentrationen av syre hade dock minskat ytterligare något sedan förra expeditionen i oktober och låg nu, i bottenvattnet, kring 0.1 ml/l. I Bornholmsbassängen och Hanöbukten rådde akut syrebrist på djup överstigande 60 till 70 meter.

Fluorescensmätningarna visade på låg biologisk aktivitet över språngskiktet. För mer detaljer om artsammansättning se separat rapport om algsituationen.





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

DELTAGARE

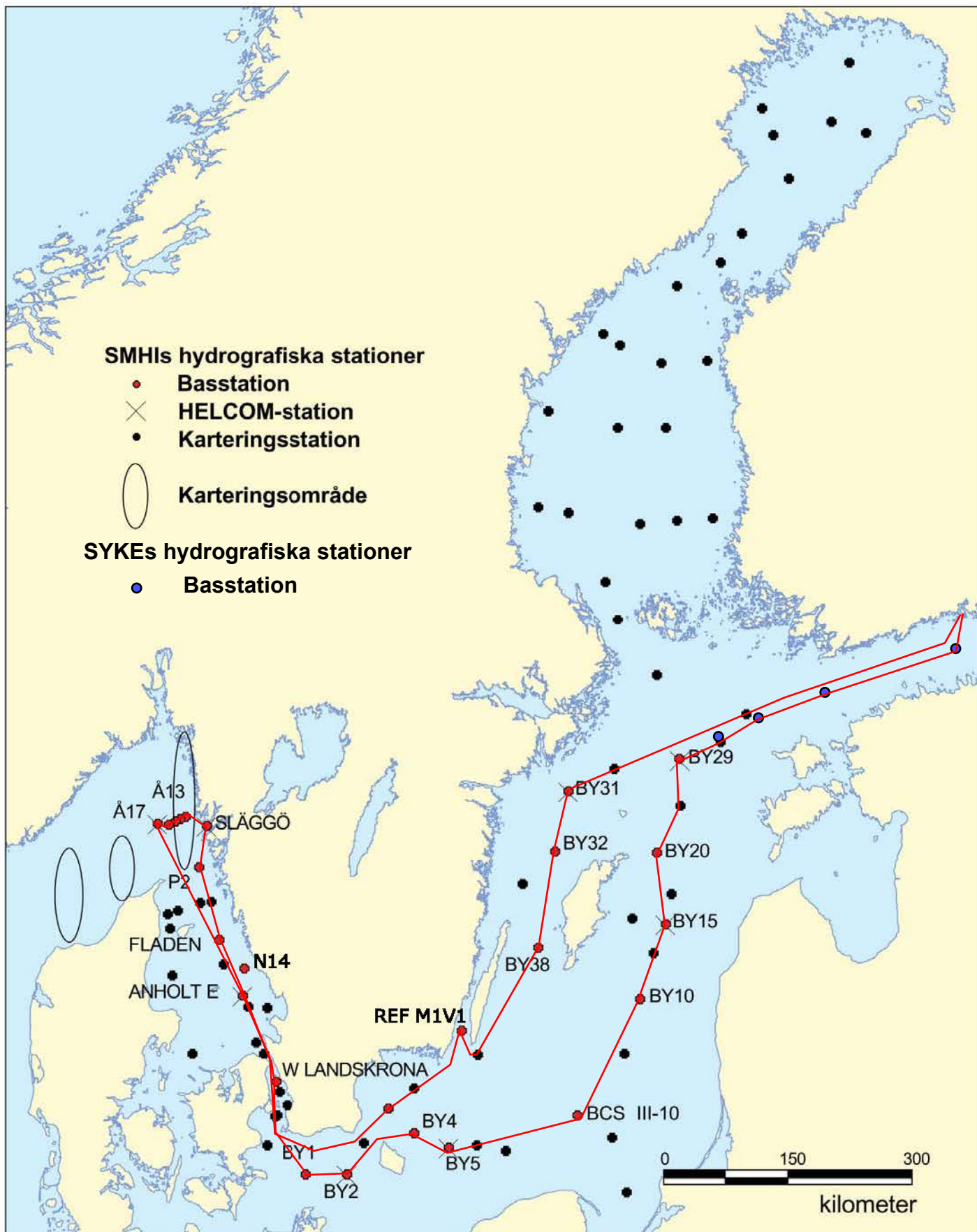
Namn		Från
Daniel Bergman-Sjöstrand	Expeditionsledare	SMHI
Örjan Bäck		SMHI
Sara Johansson		SMHI
Daniel Simonsson		SMHI
Anna-Kerstin Thell		SMHI
Magnus Wenzer	Helsingfors-Lysekil	SMHI

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: 20151109-20151116
Series: 0637-0665



SMHI
Ocean enh

Hydrographic
series

Ship: 01-Aranda
Year: 2015

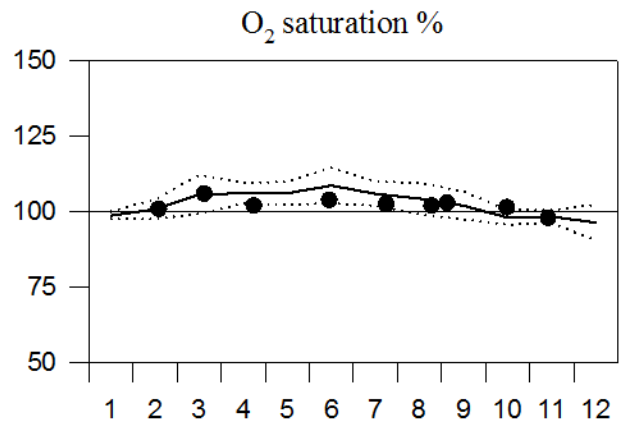
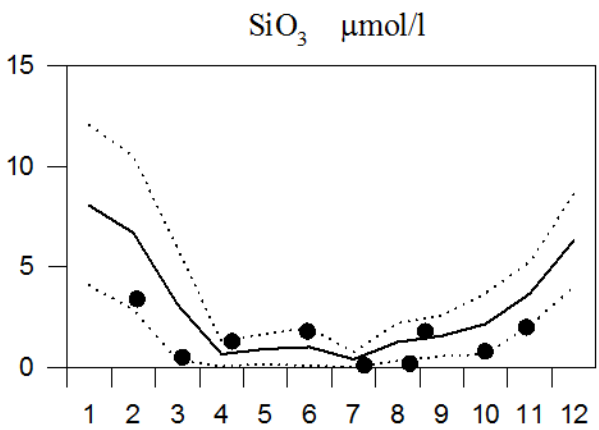
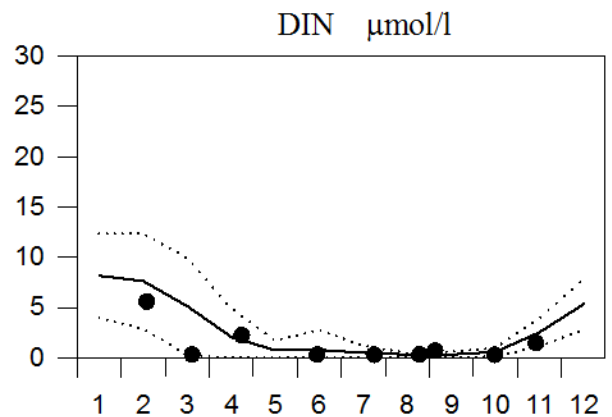
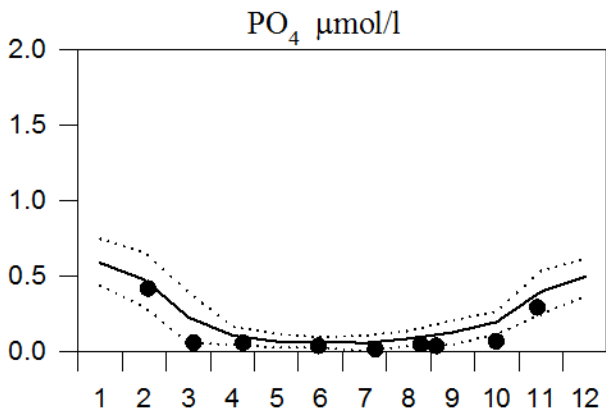
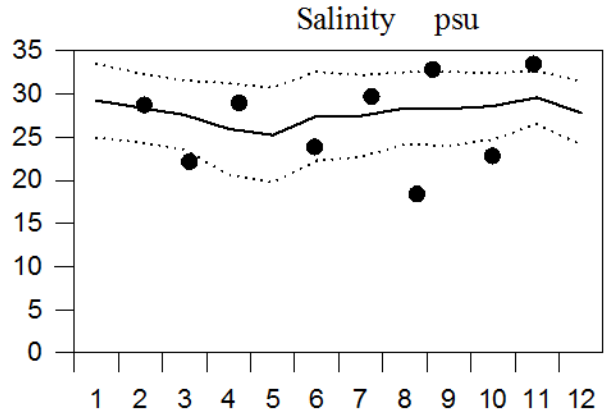
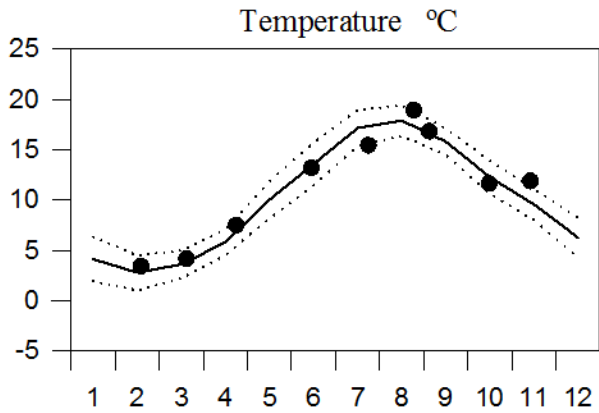
Date: 2015-11-16
Time: 16:44

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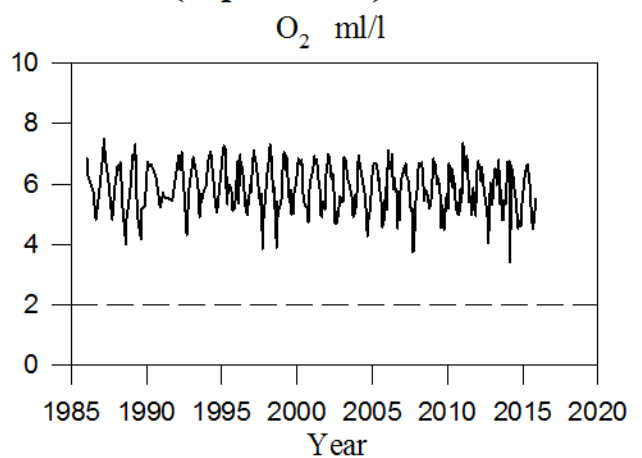
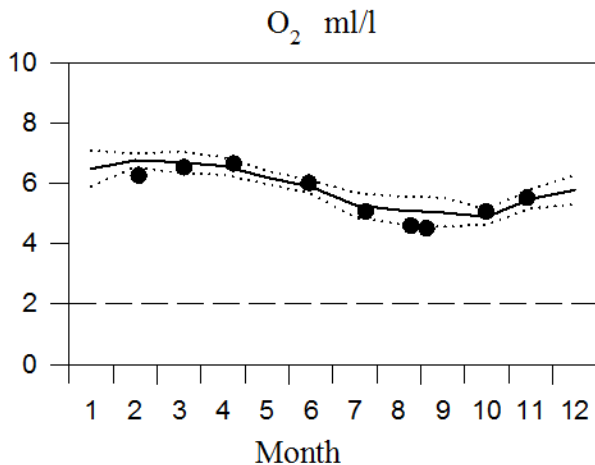
STATION P2 SURFACE WATER

Annual Cycles

— Mean 1996-2010 St.Dev. ● 2015

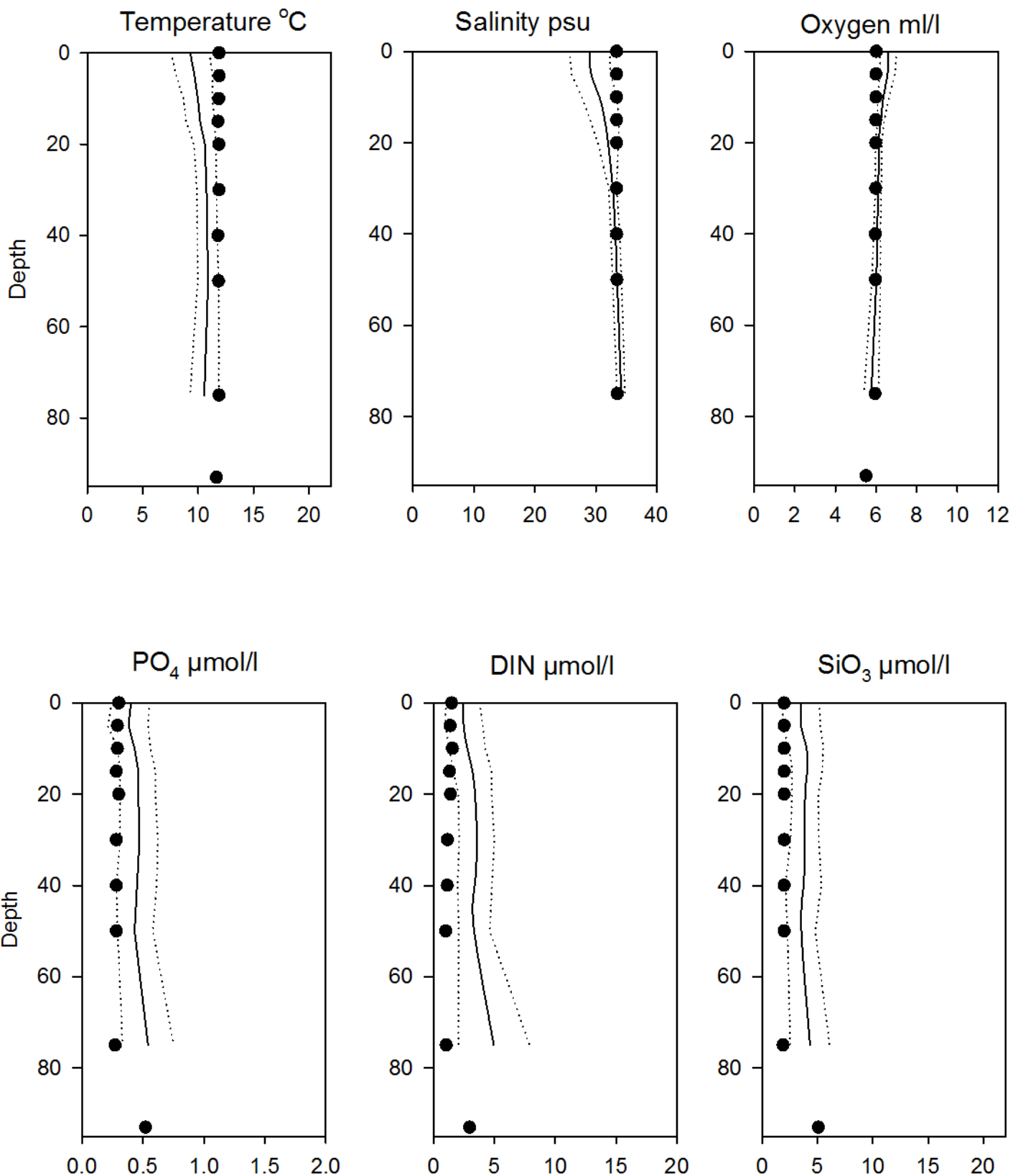


OXYGEN IN BOTTOM WATER (depth >75m)



Vertical profiles P2 November

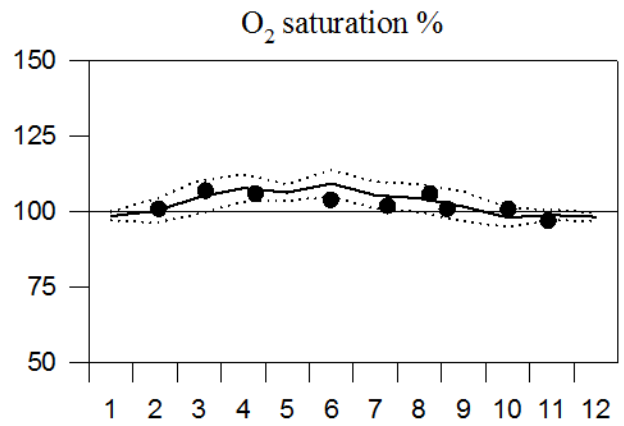
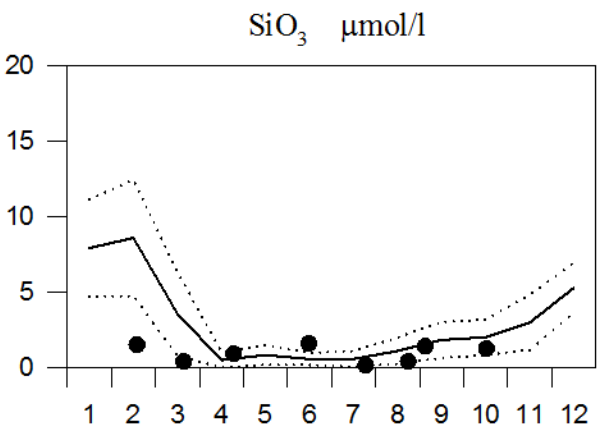
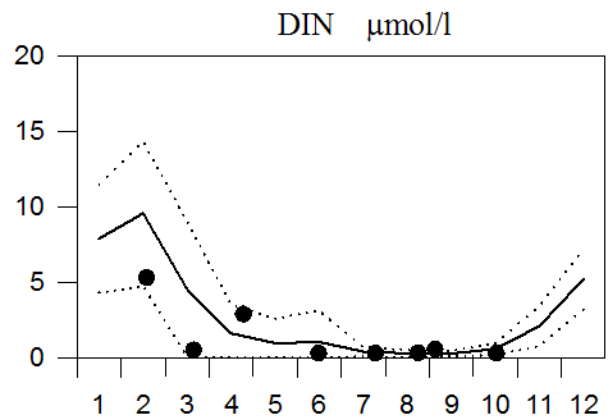
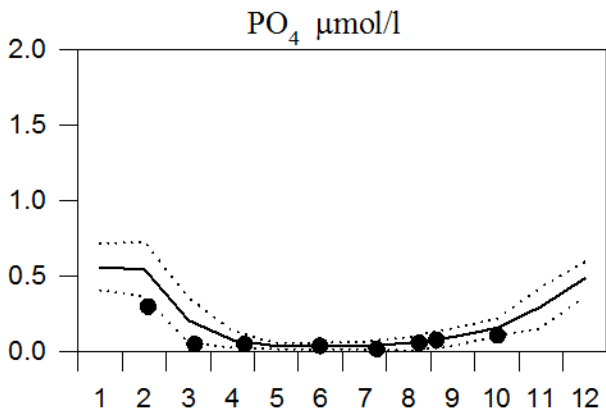
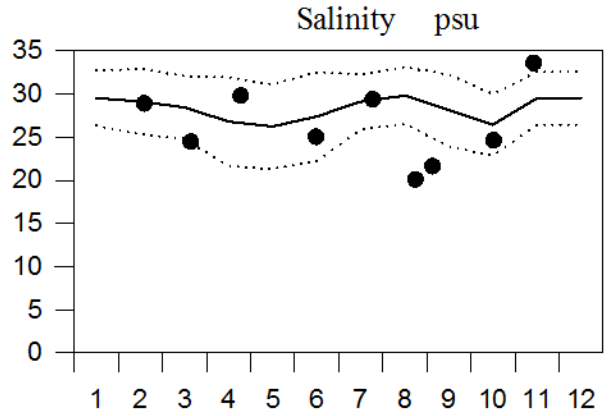
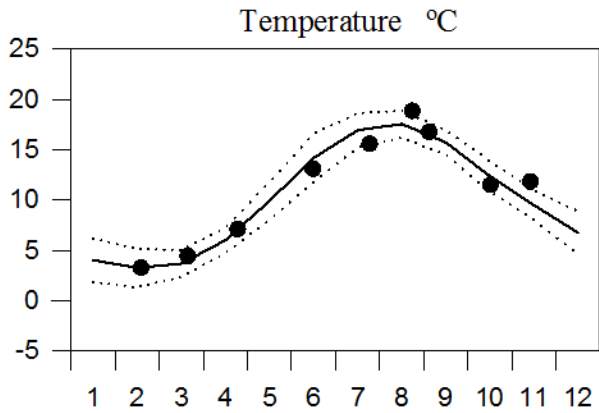
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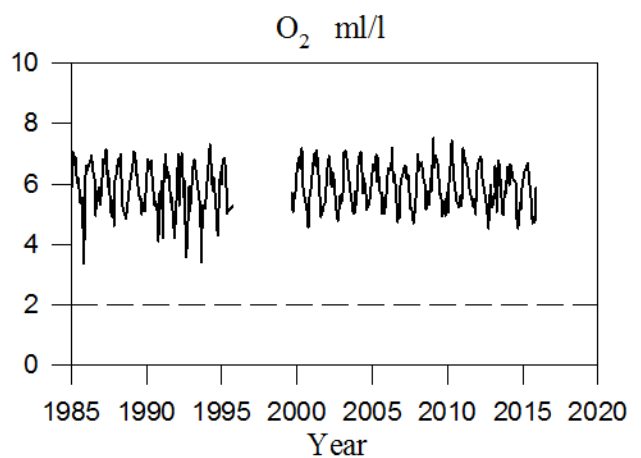
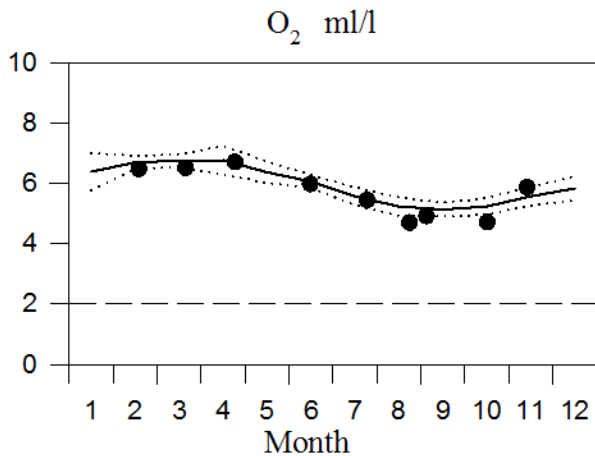
STATION Å13 SURFACE WATER

Annual Cycles

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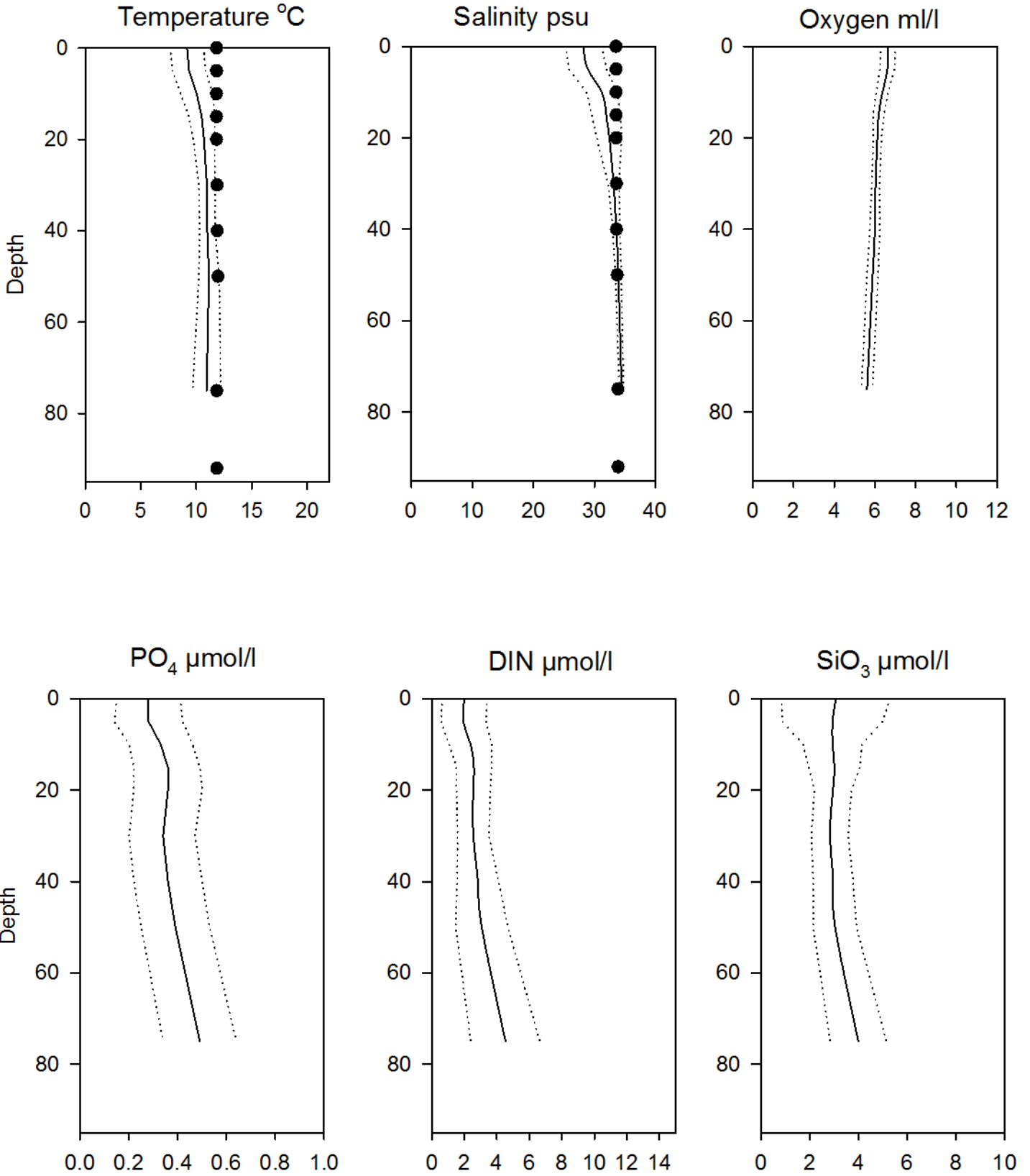


OXYGEN IN BOTTOM WATER (depth >=75m)



Vertical profiles Å13 November

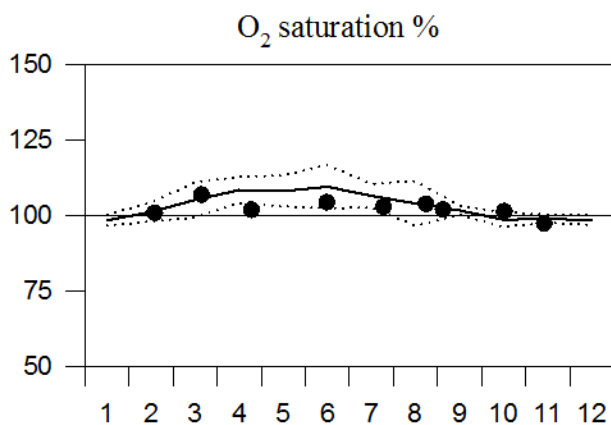
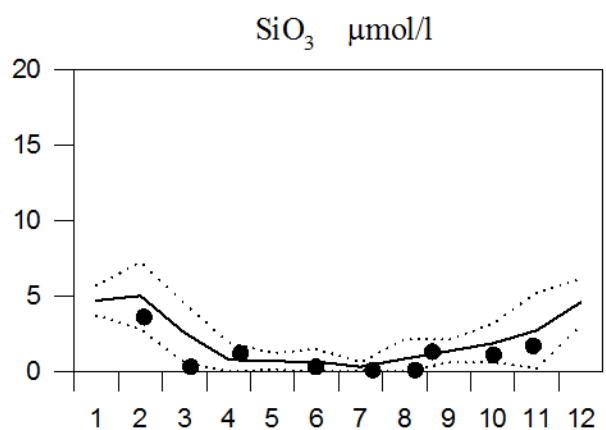
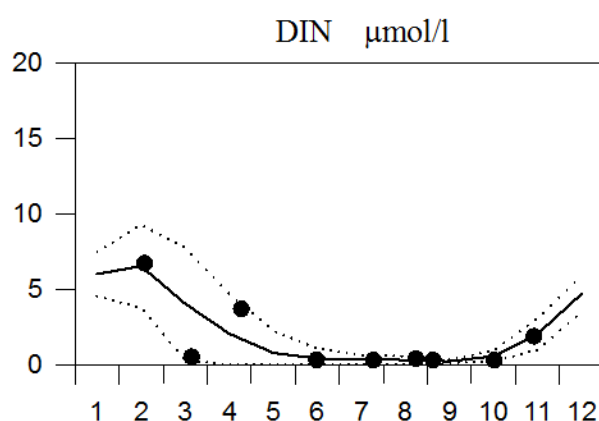
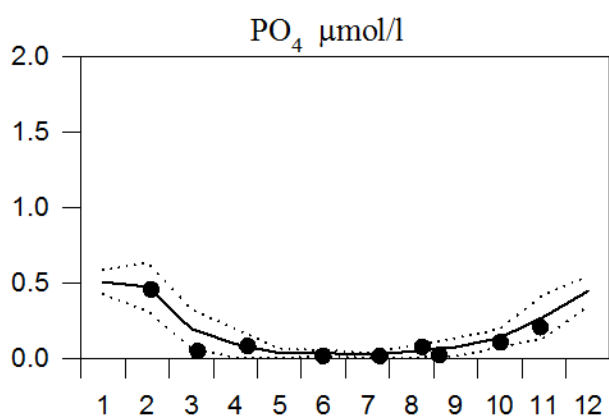
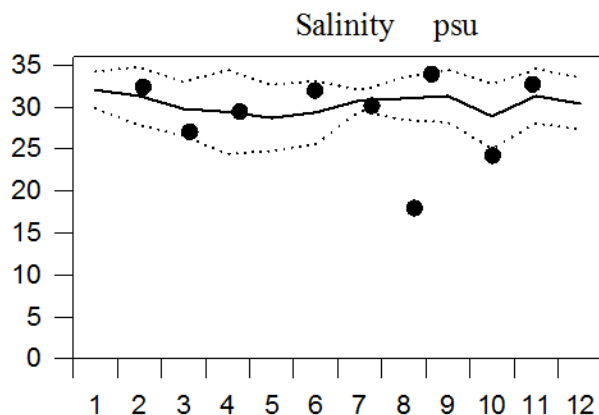
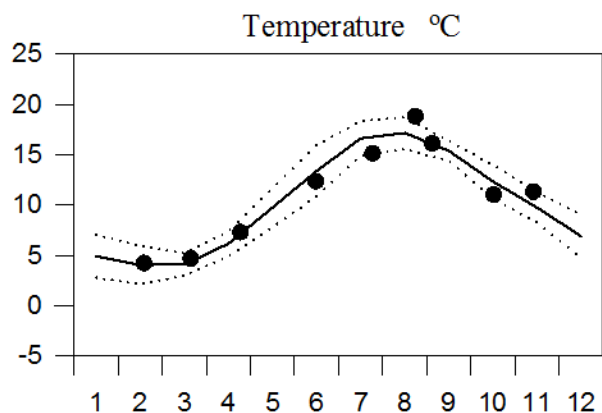
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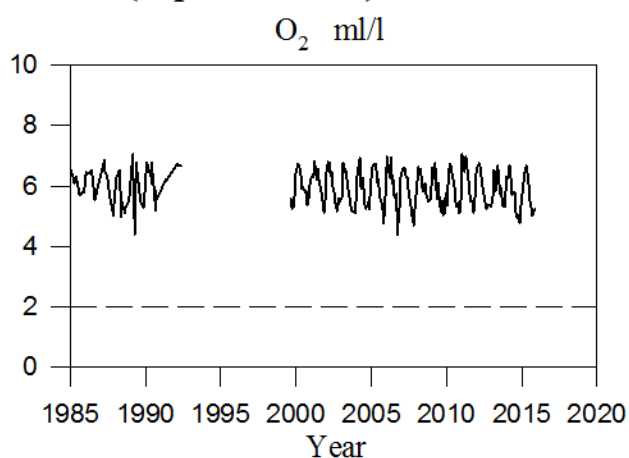
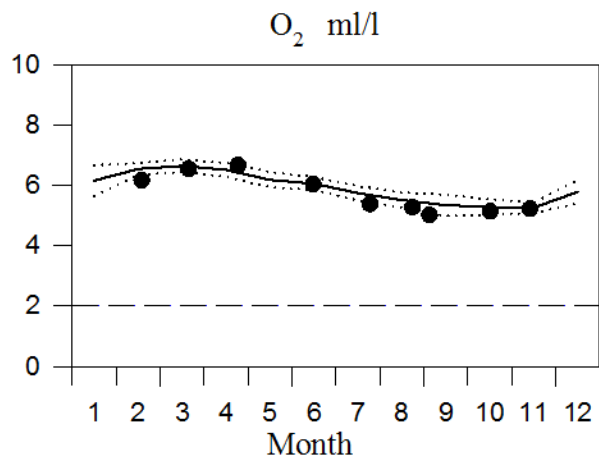
STATION Å15 SURFACE WATER

Annual Cycles

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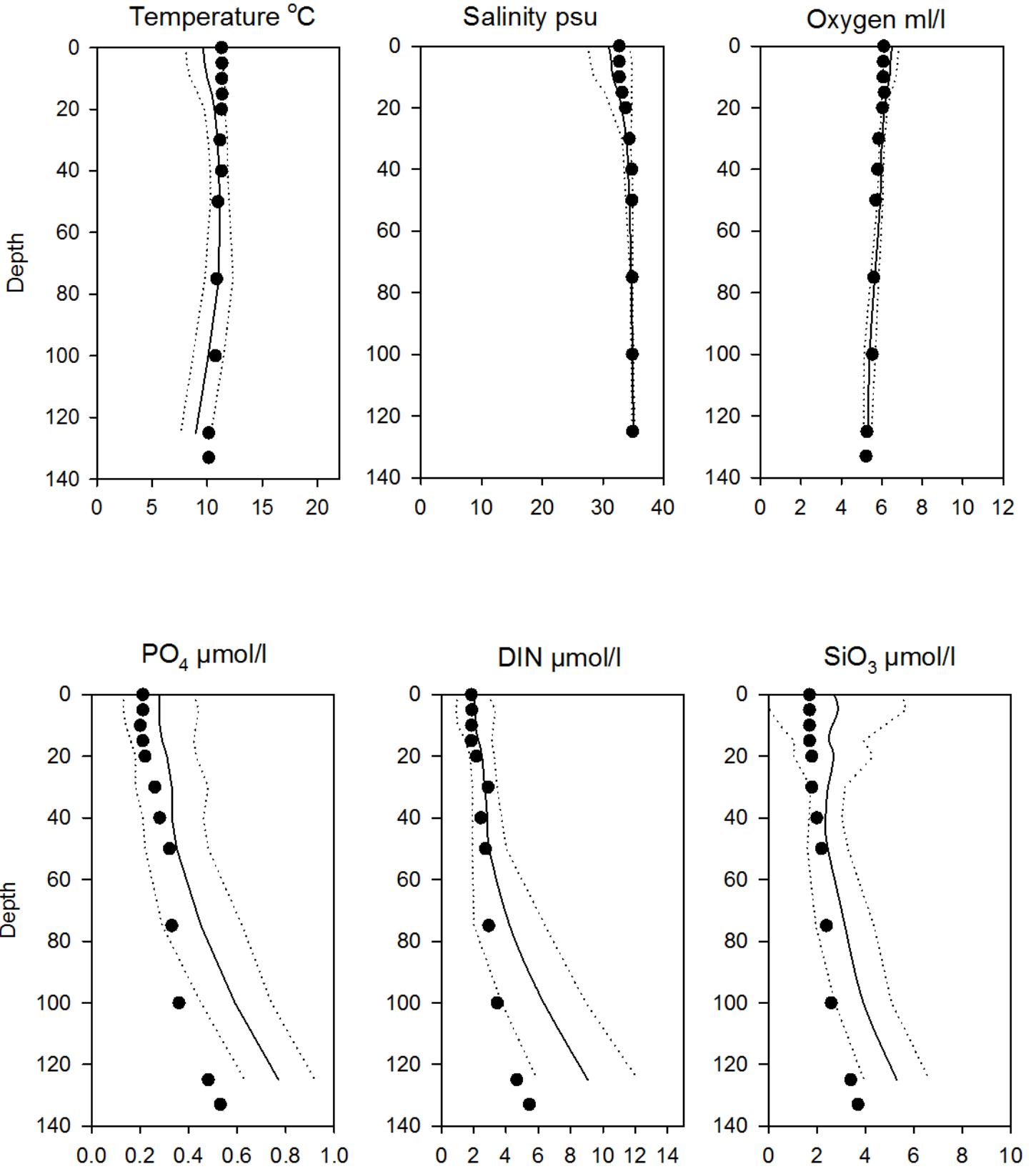


OXYGEN IN BOTTOM WATER (depth >=125m)



Vertical profiles Å15 November

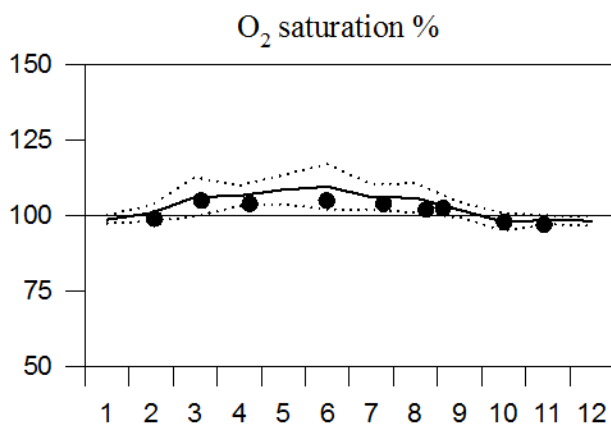
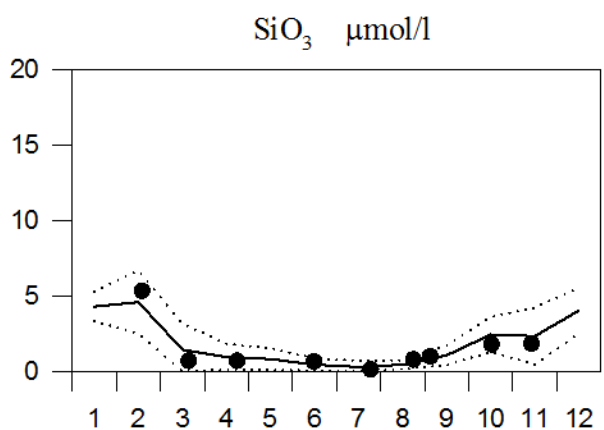
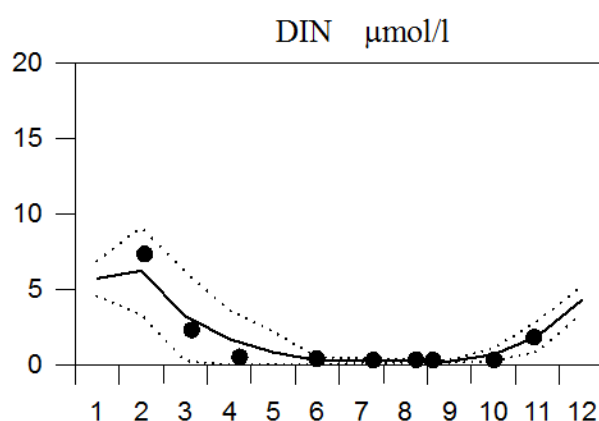
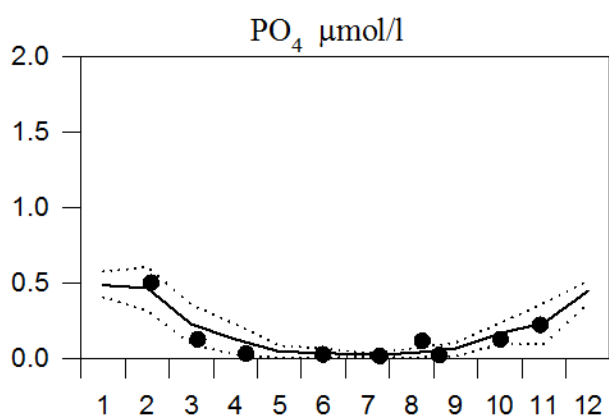
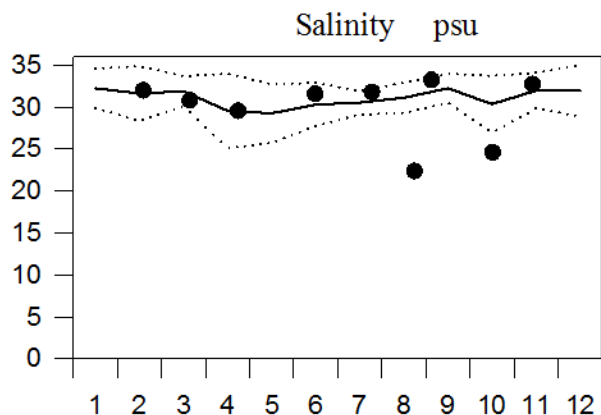
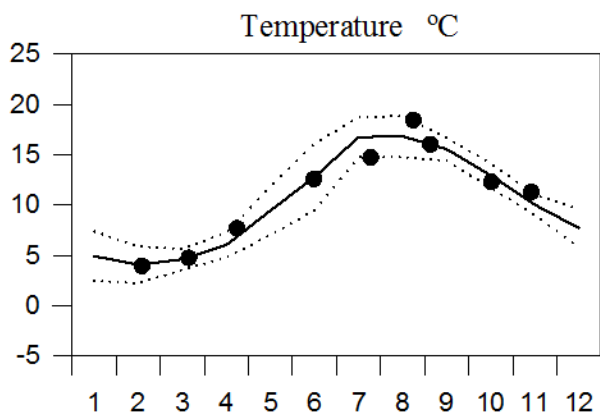
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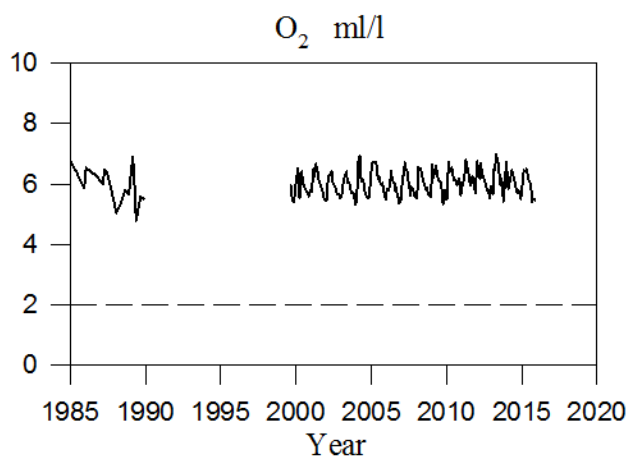
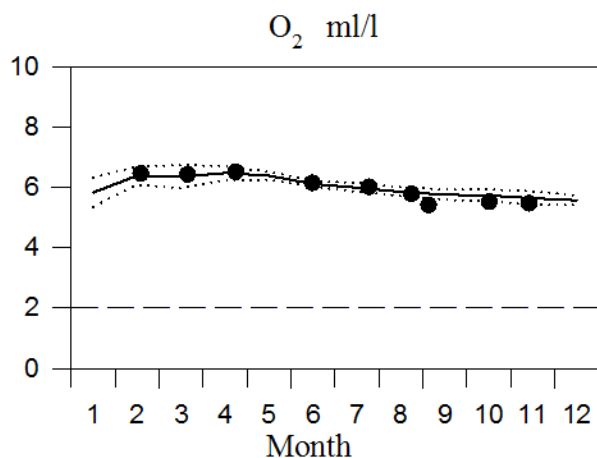
STATION Å17 SURFACE WATER

Annual Cycles

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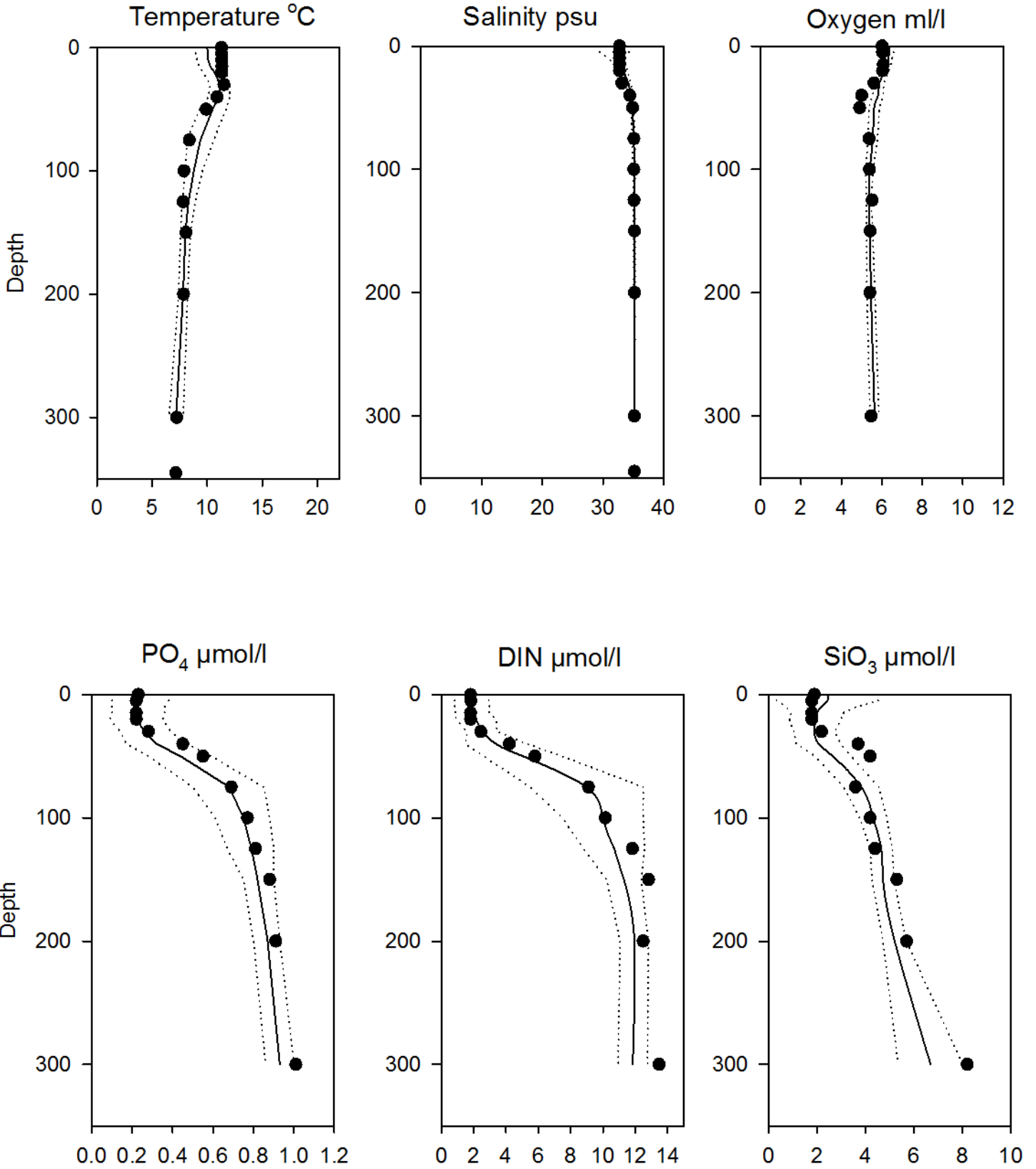


OXYGEN IN BOTTOM WATER (depth = 300m)



Vertical profiles Å17 November

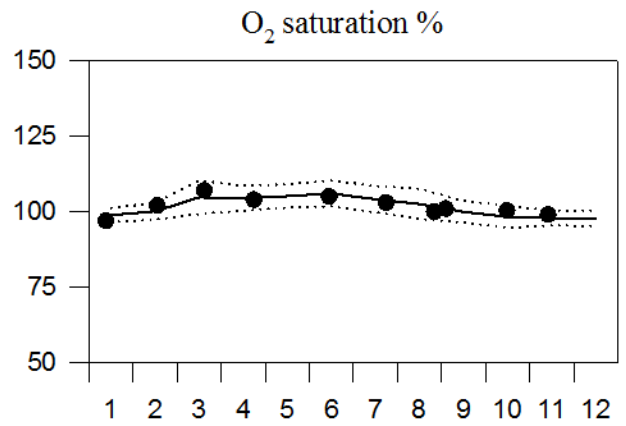
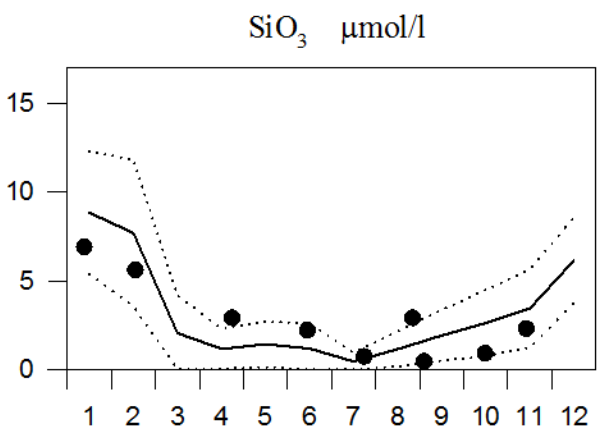
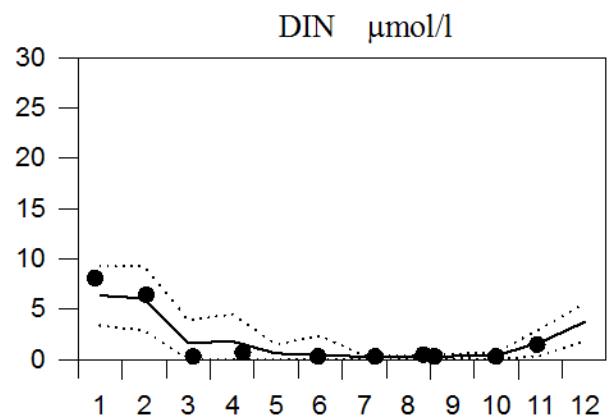
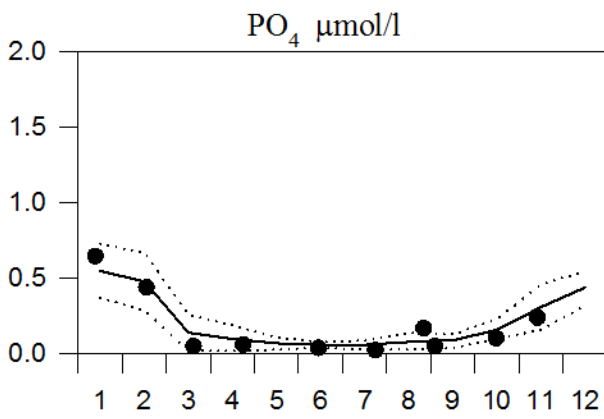
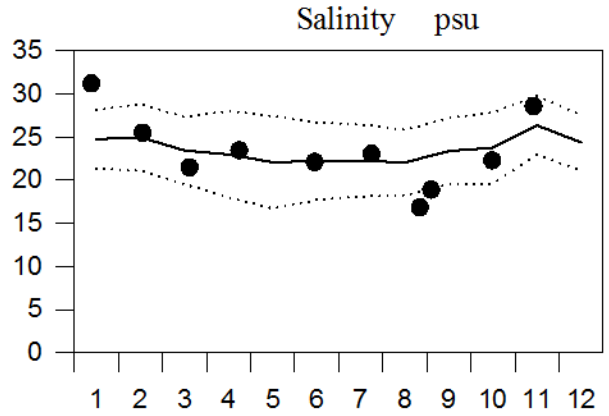
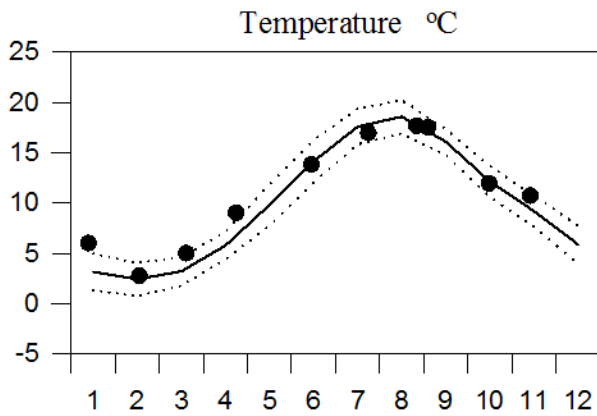
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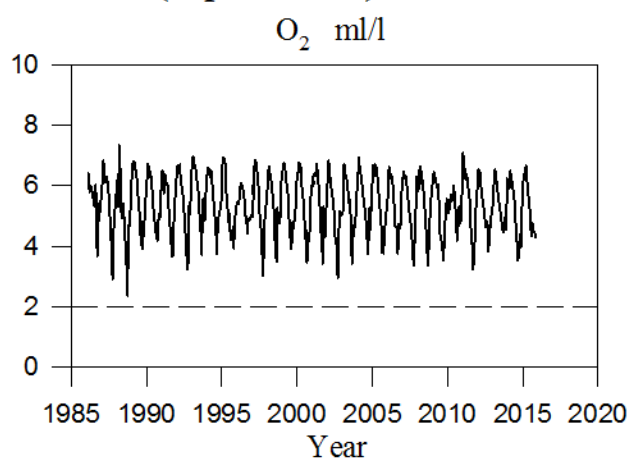
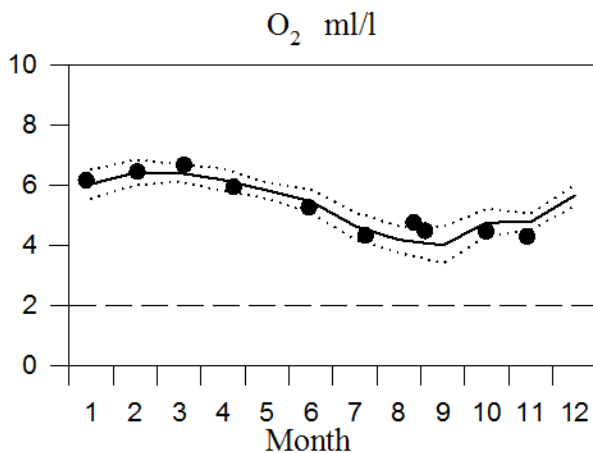
STATION FLADEN SURFACE WATER

Annual Cycles

— Mean 1996-2010 St.Dev. ● 2015

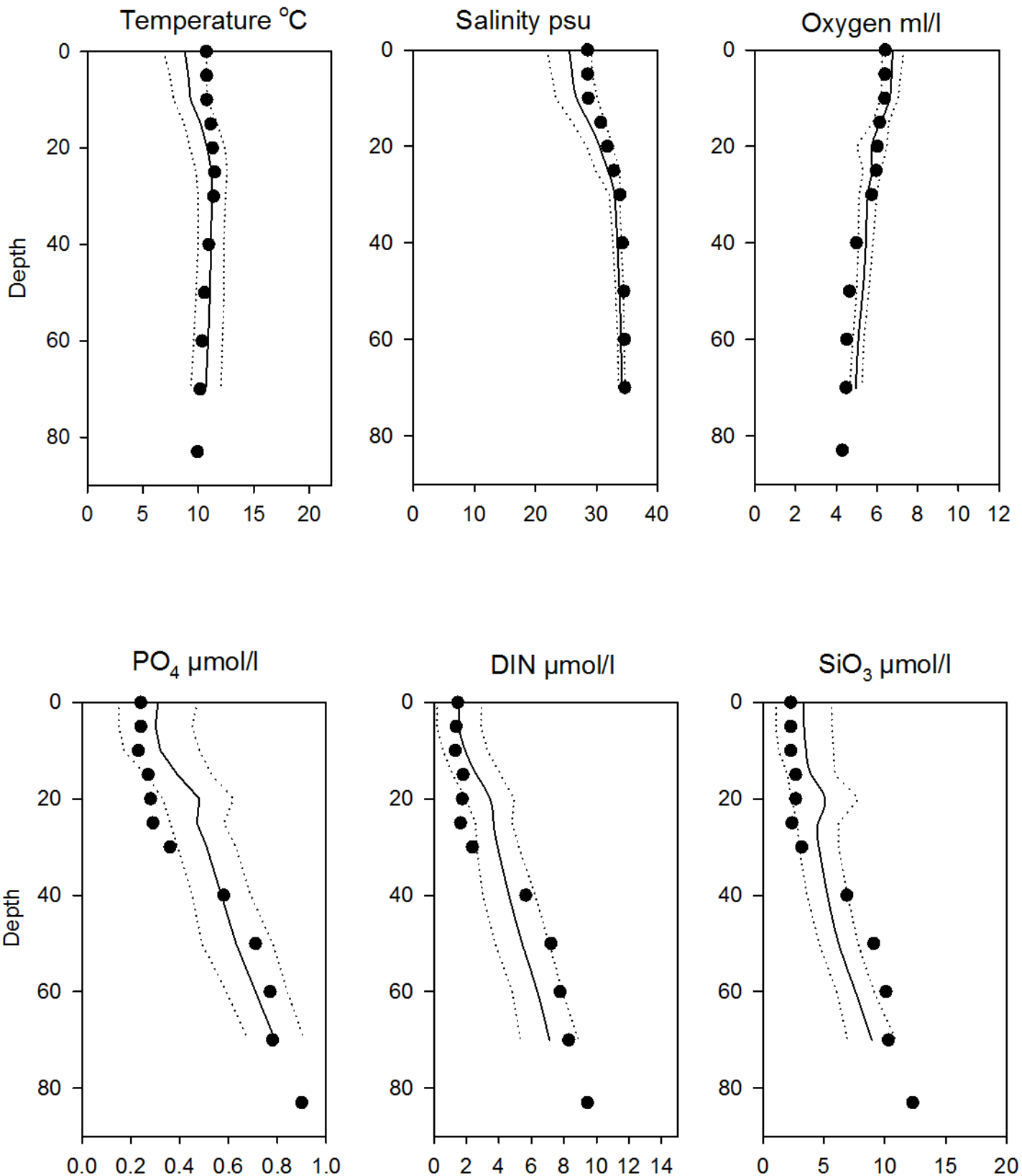


OXYGEN IN BOTTOM WATER (depth > 70m)



Vertical profiles Fladen November

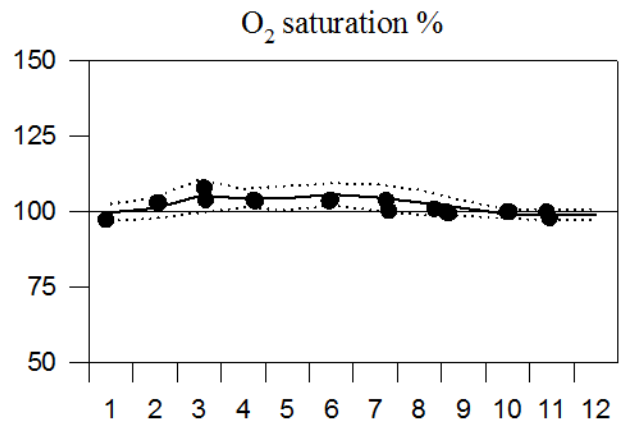
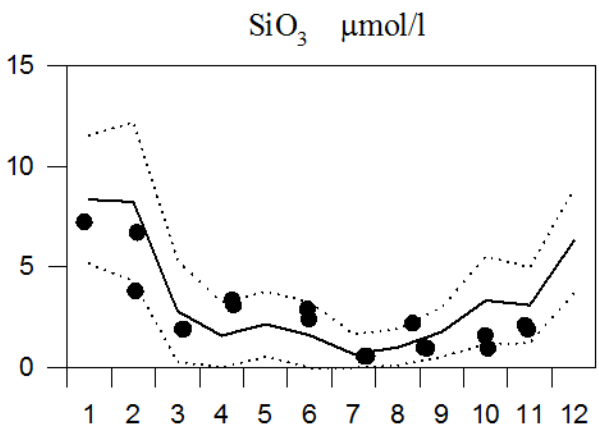
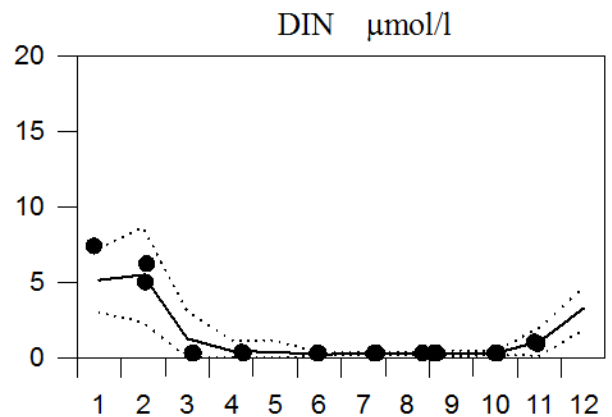
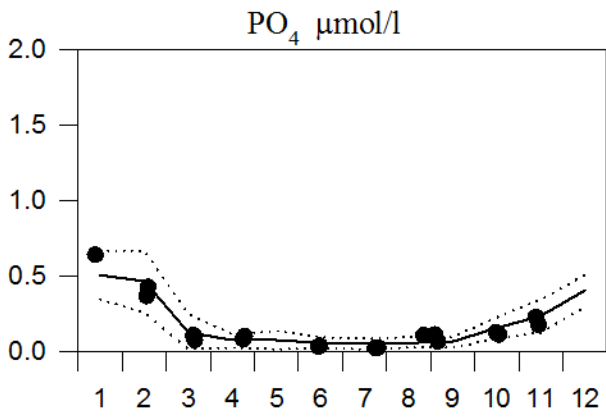
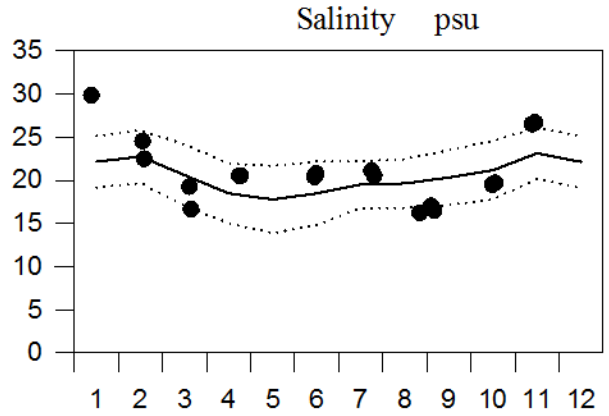
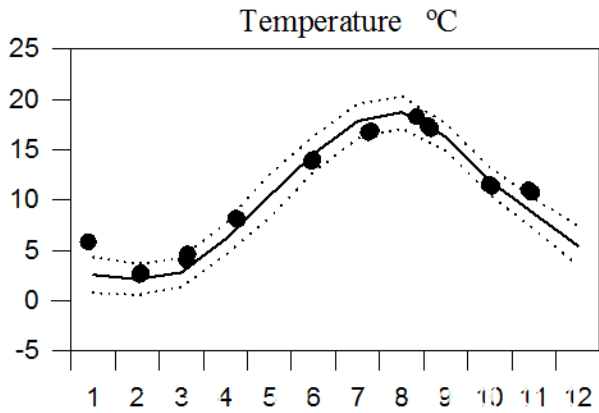
— Mean 1996-2010 St.Dev. ● 2015



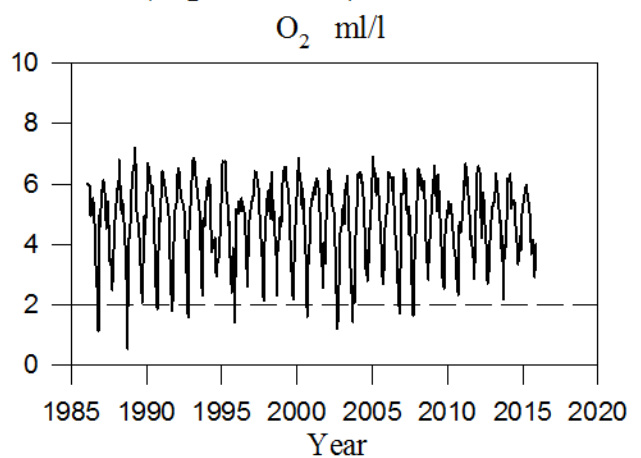
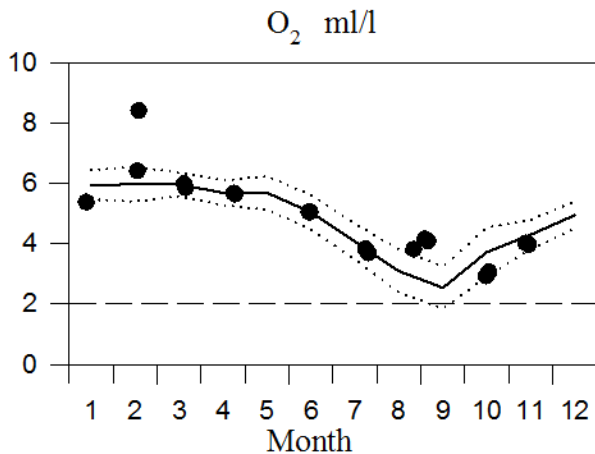
STATION ANHOLT E SURFACE WATER

Annual Cycles

— Mean 1996-2010 St.Dev. ● 2015



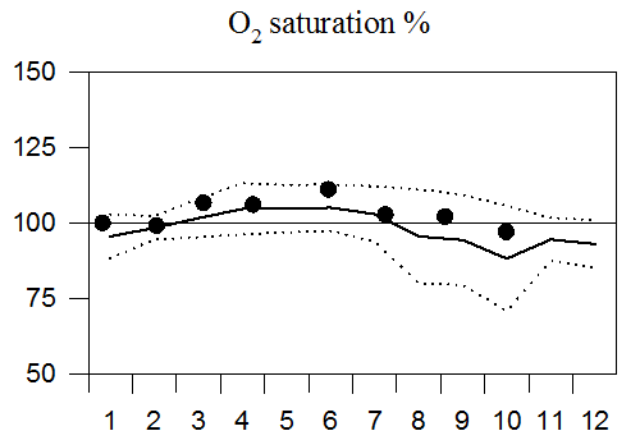
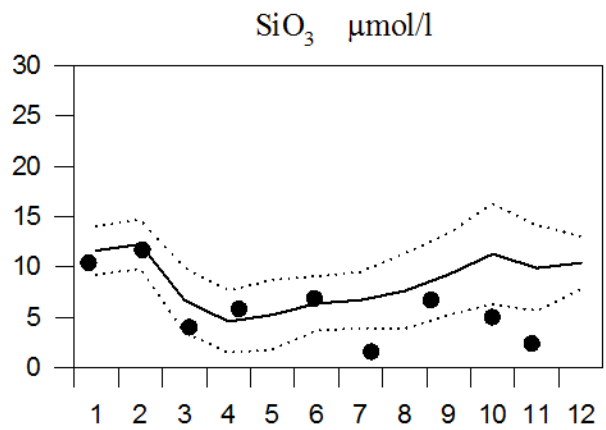
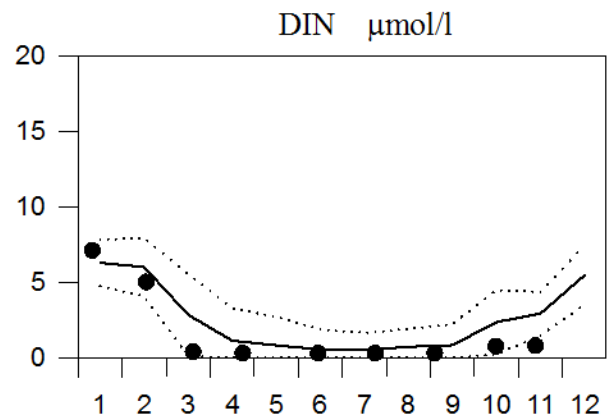
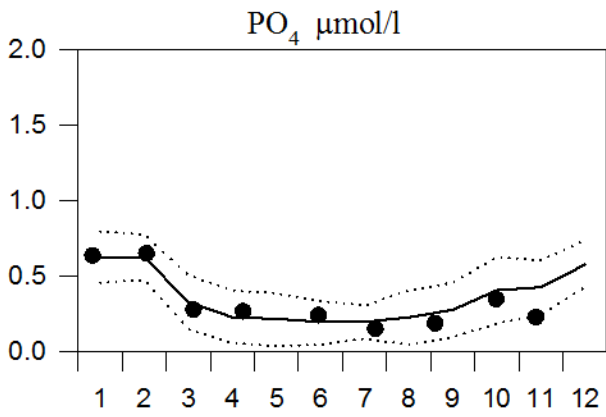
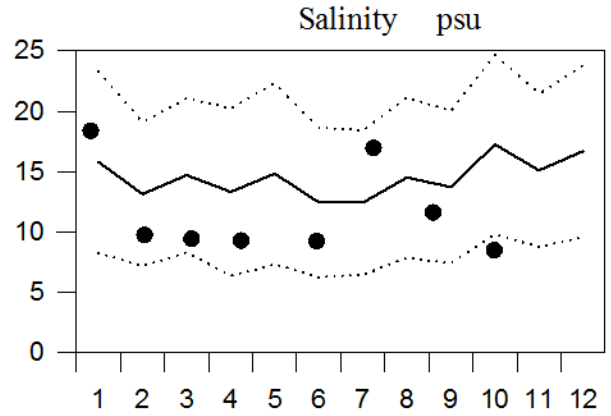
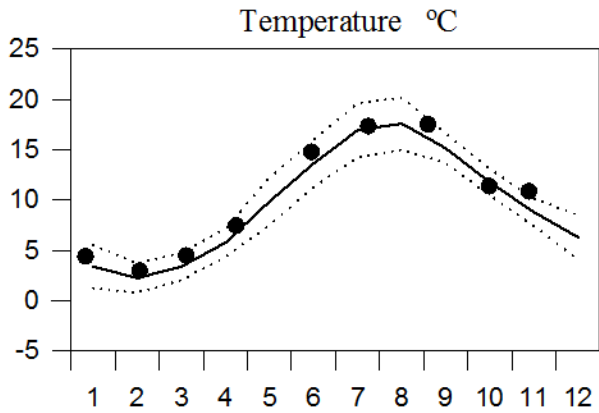
OXYGEN IN BOTTOM WATER (depth > 50m)



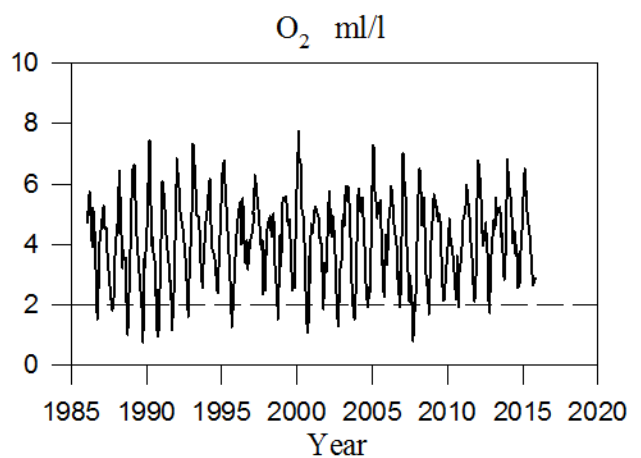
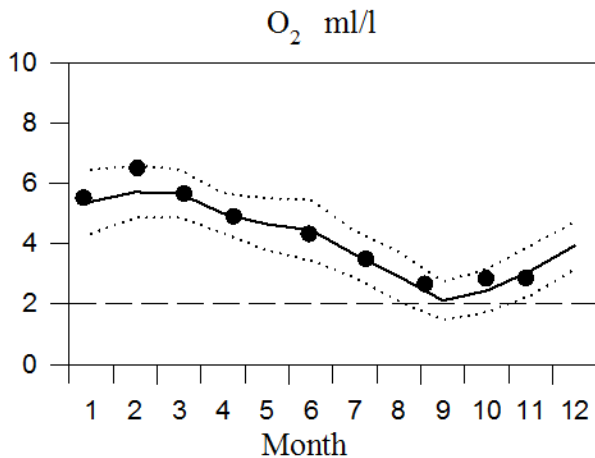
STATION W LANDSKRONA SURFACE WATER

Annual Cycles

— Mean 1996-2010 St.Dev. ● 2015

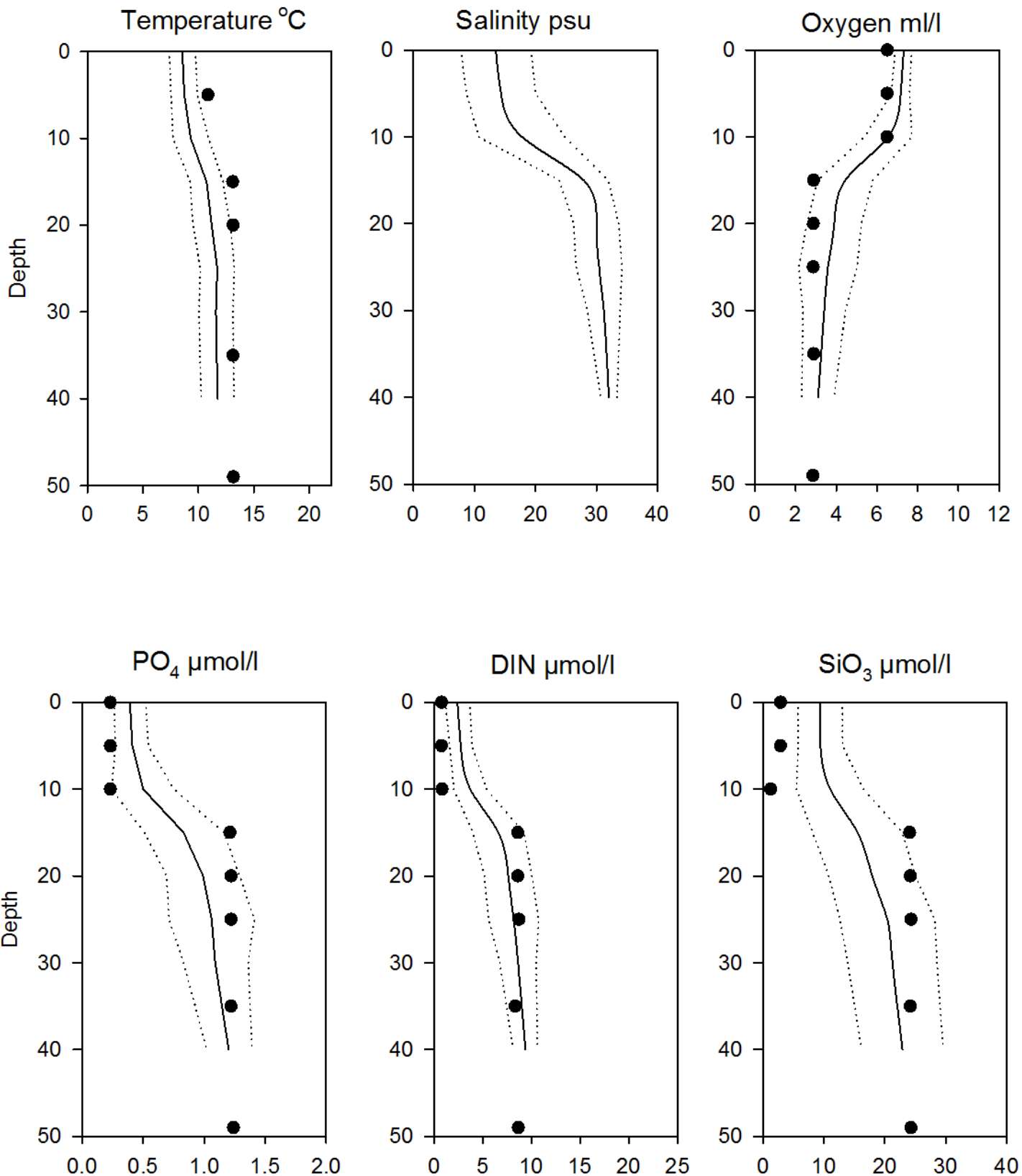


OXYGEN IN BOTTOM WATER (depth >40m)



Vertical profiles W Landskrona November

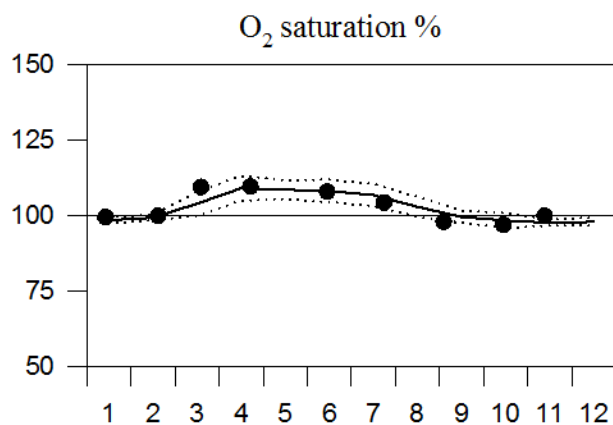
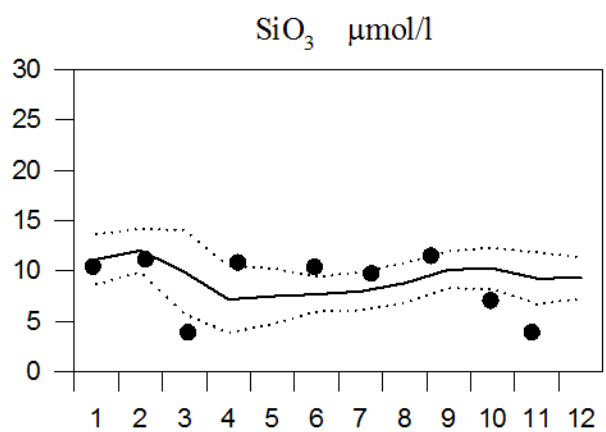
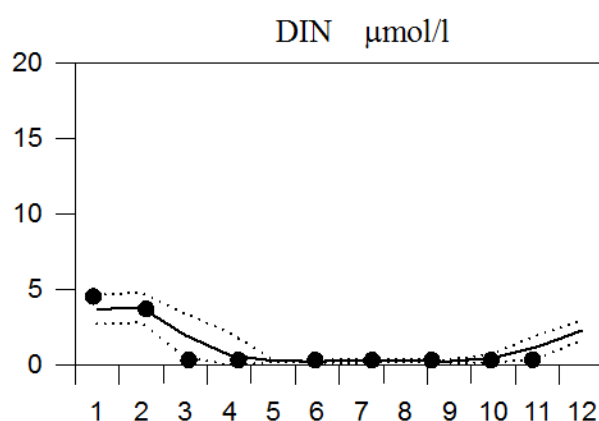
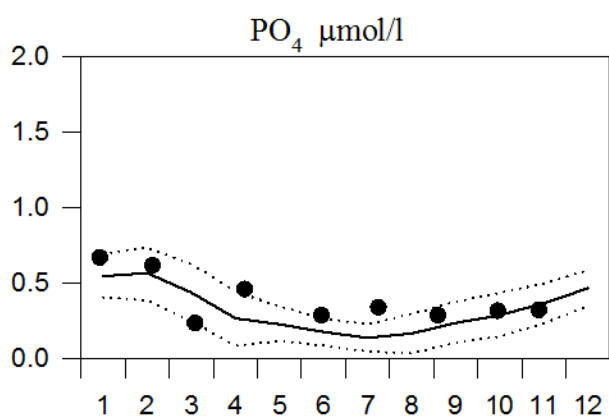
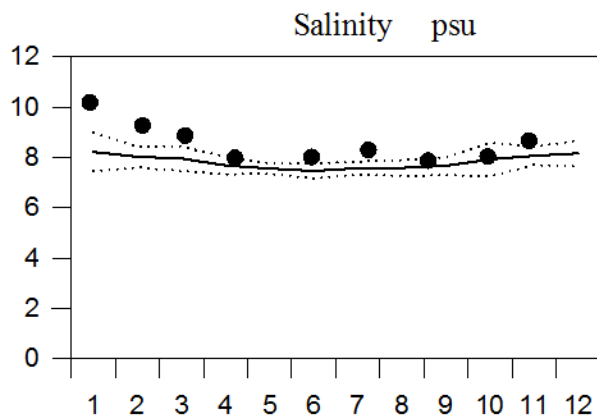
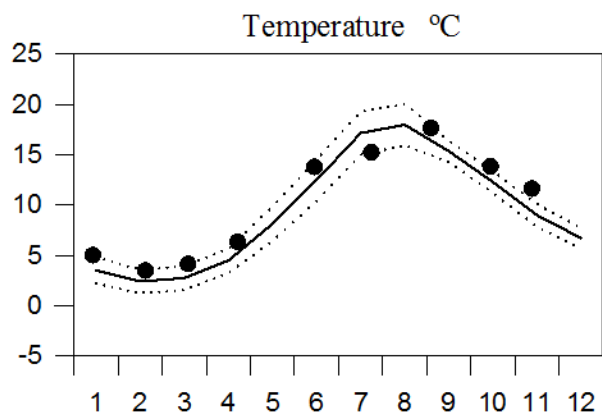
— Mean 1996-2010 St.Dev. ● 2015



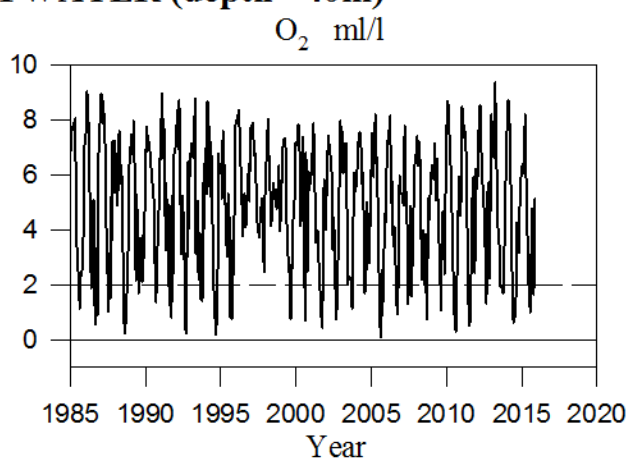
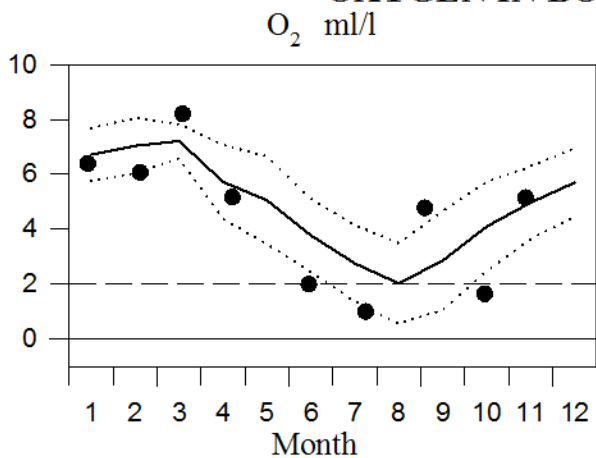
STATION BY1 SURFACE WATER

Annual Cycles

— Mean 1996-2010 ····· St.Dev. ● 2015

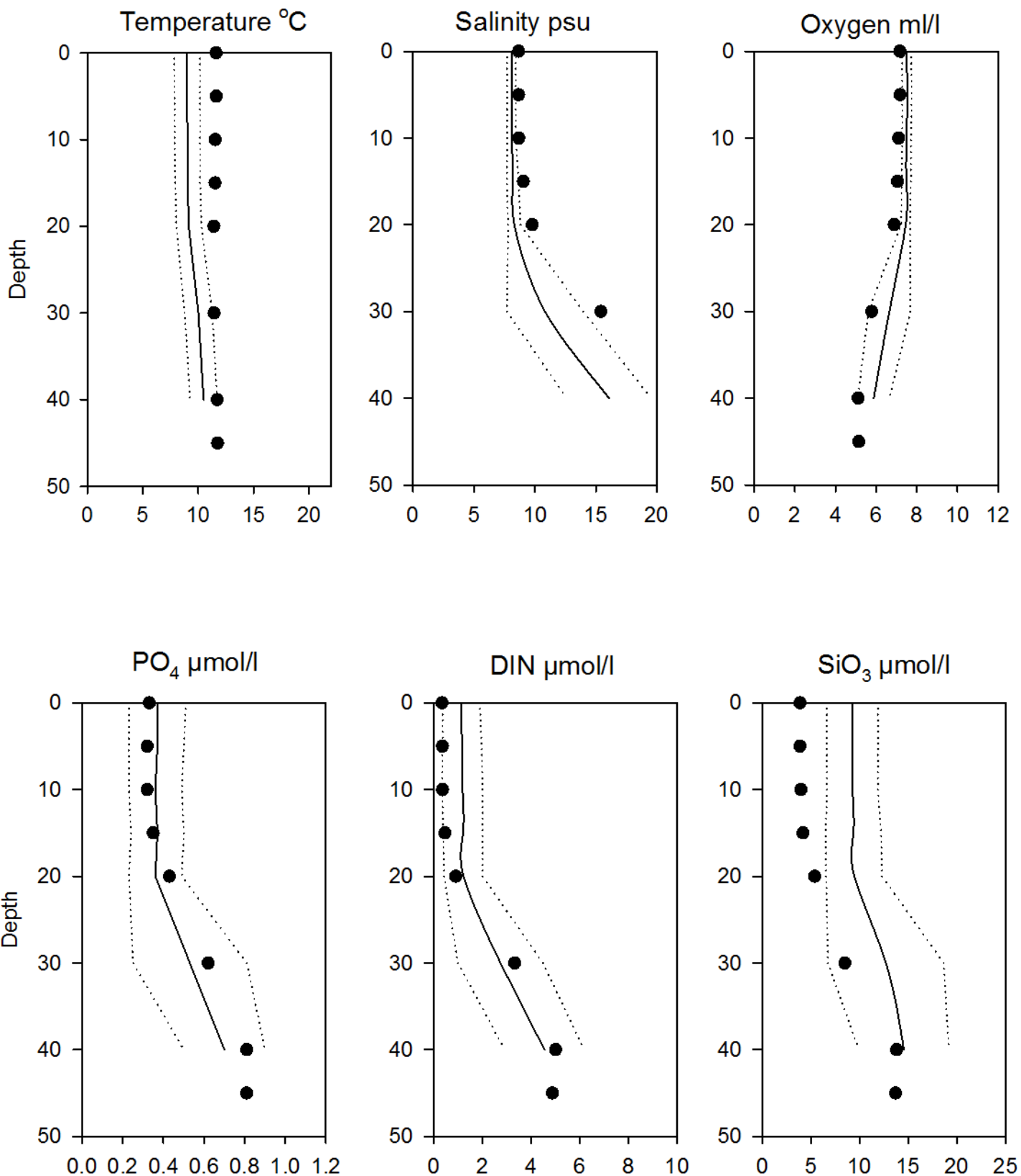


OXYGEN IN BOTTOM WATER (depth >40m)



Vertical profiles BY1 November

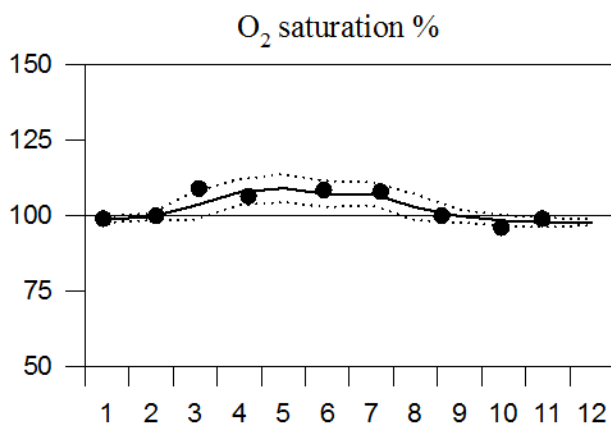
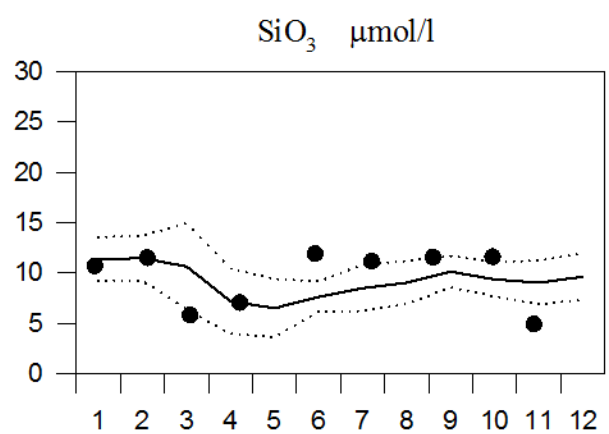
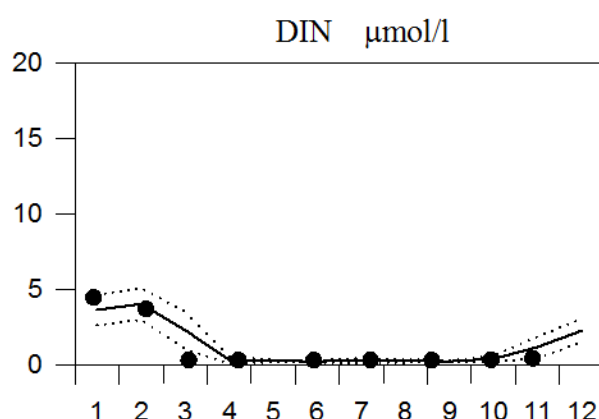
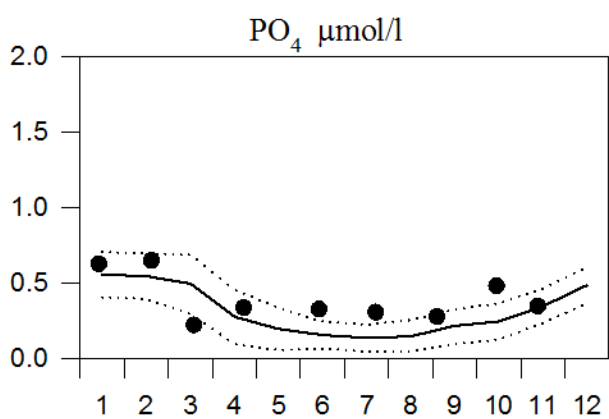
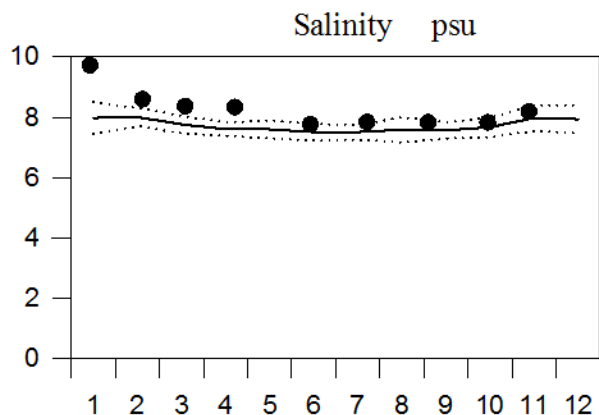
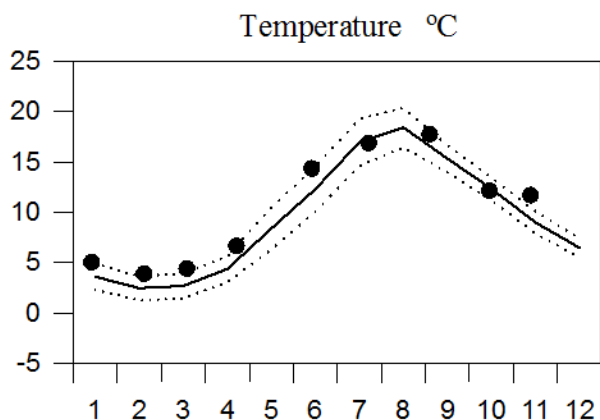
— Mean 1996-2010 St.Dev. ● 2015



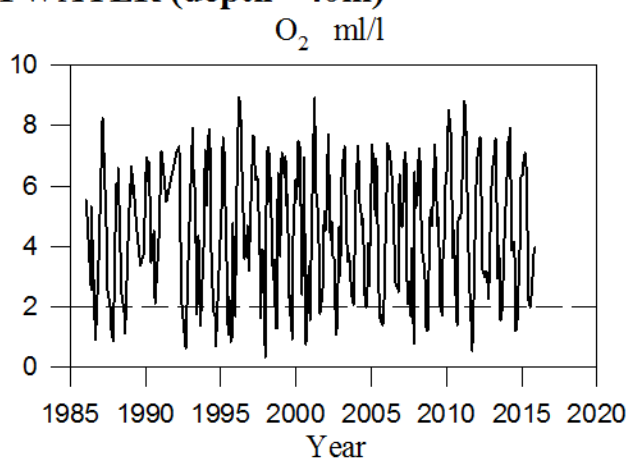
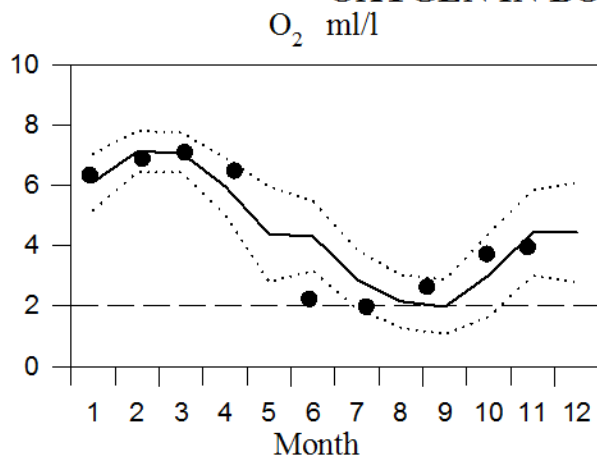
STATION BY2 SURFACE WATER

Annual Cycles

— Mean 1996-2010 ····· St.Dev. ● 2015

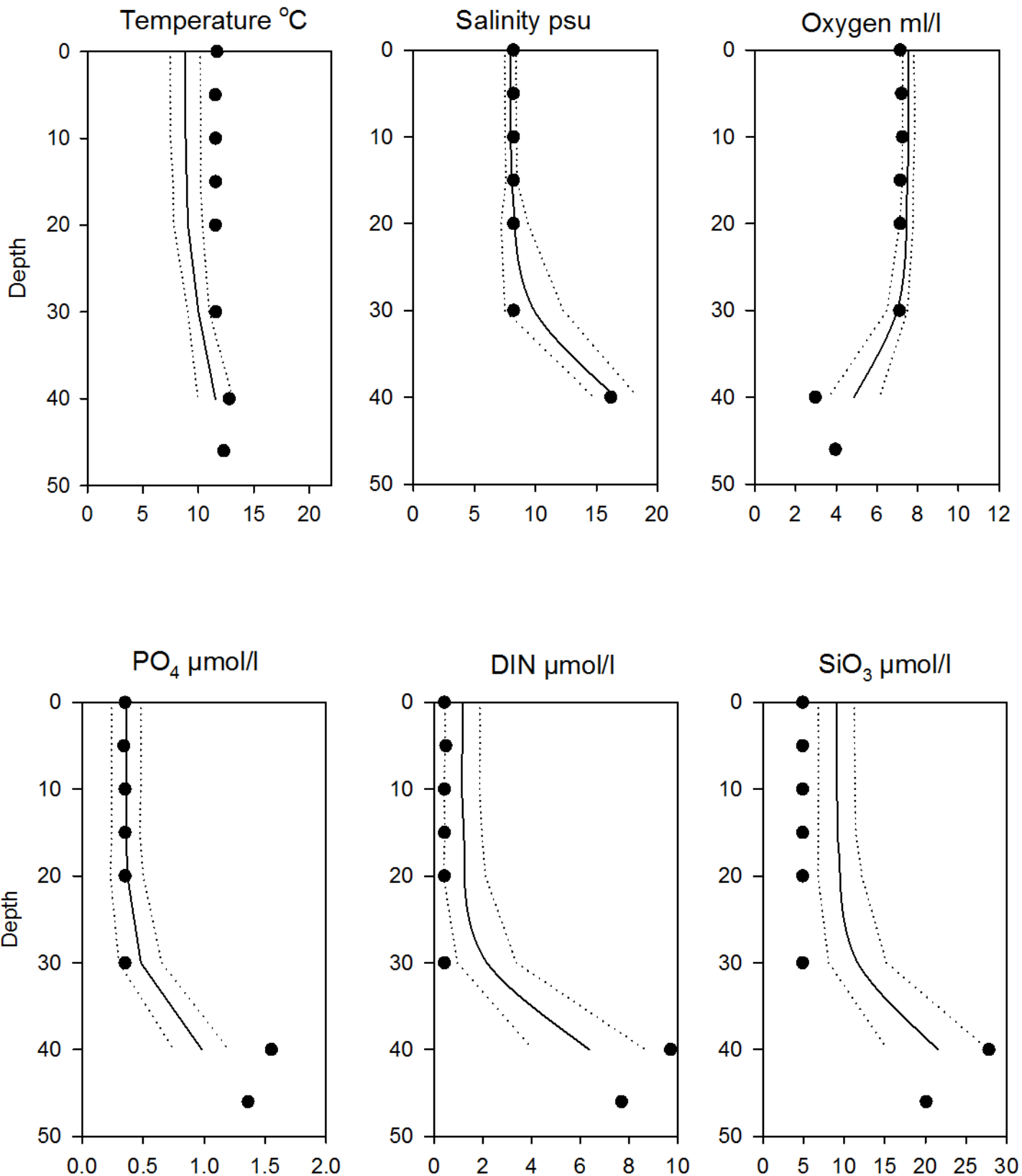


OXYGEN IN BOTTOM WATER (depth >40m)



Vertical profiles BY2 November

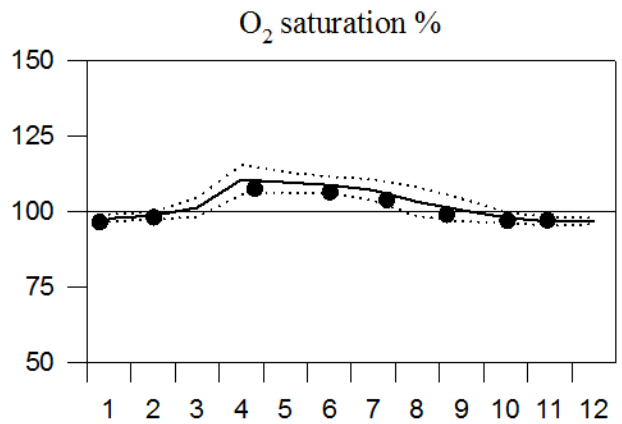
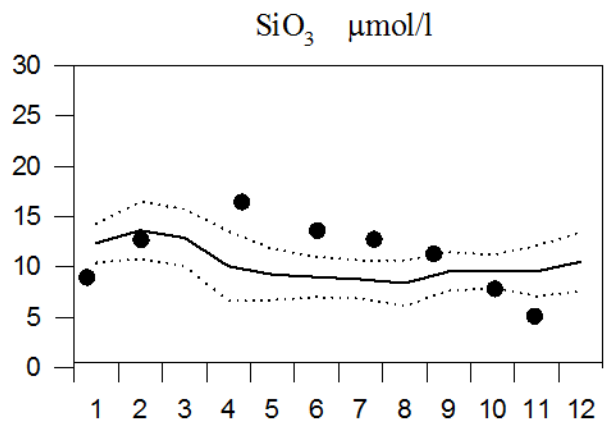
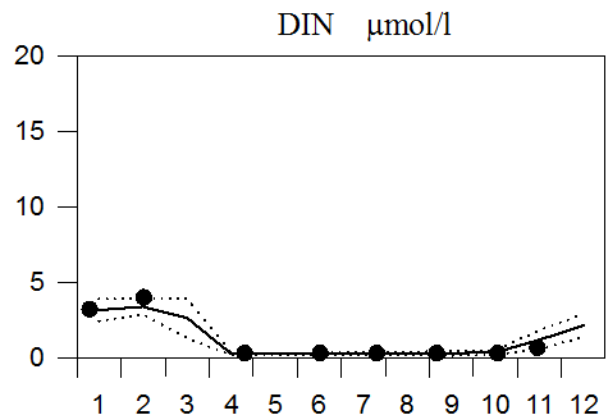
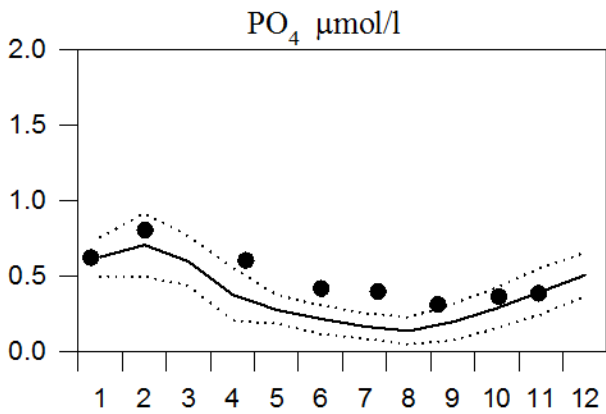
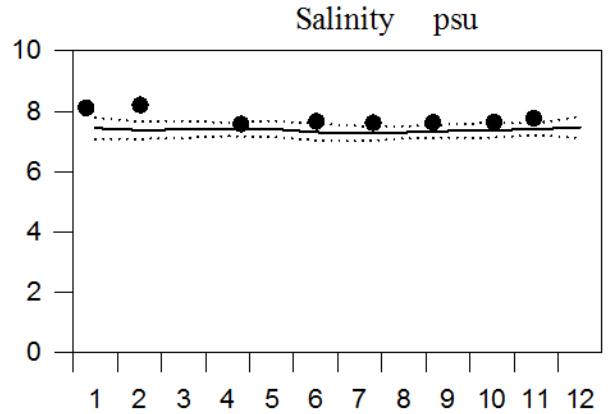
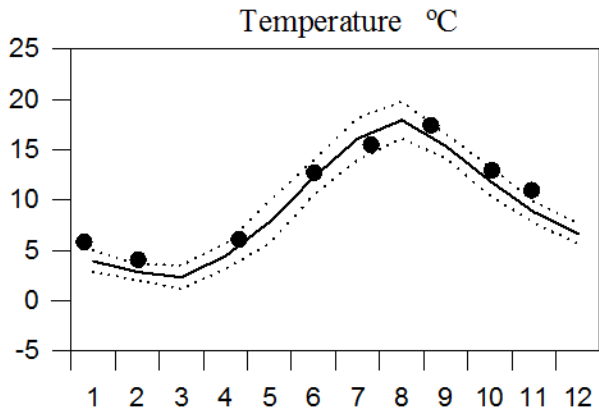
— Mean 1996-2010 St.Dev. ● 2015



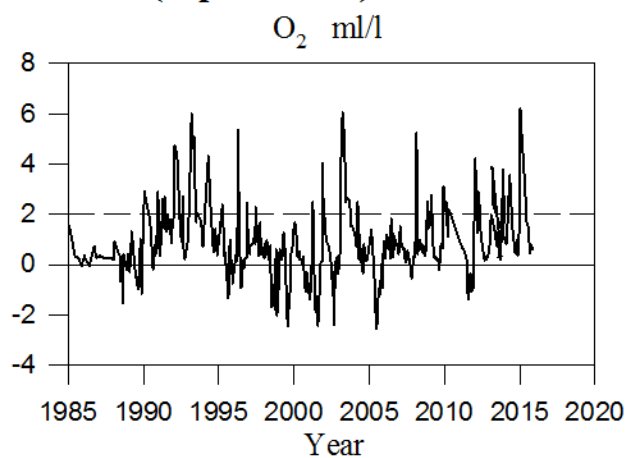
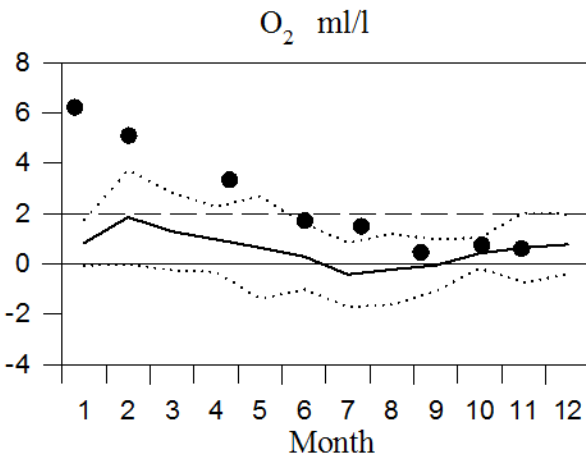
STATION HANÖBUKTEN SURFACE WATER

Annual Cycles

— Mean 1996-2010 ····· St.Dev. ● 2015

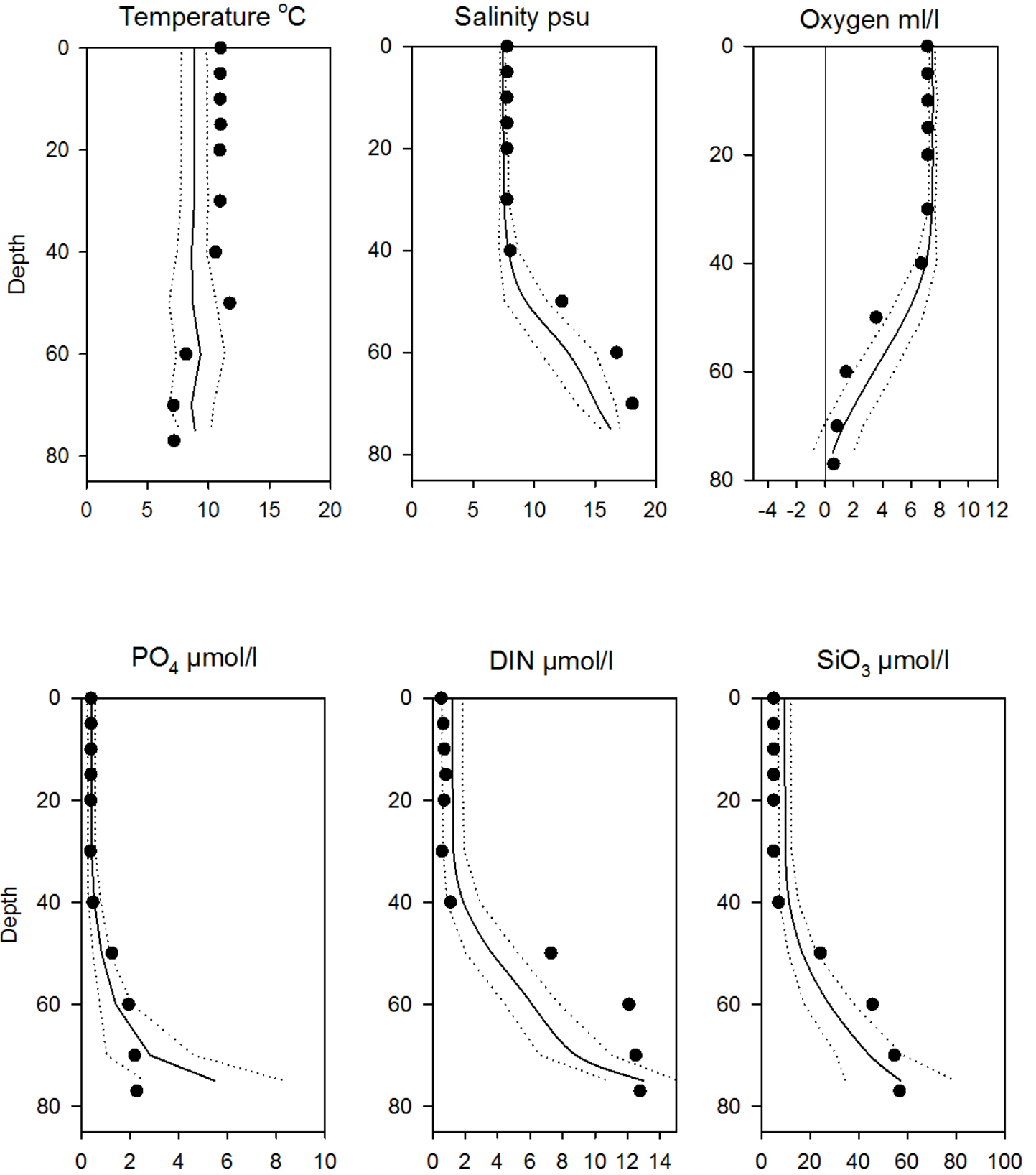


OXYGEN IN BOTTOM WATER (depth > 70m)



Vertical profiles Hanöbukten November

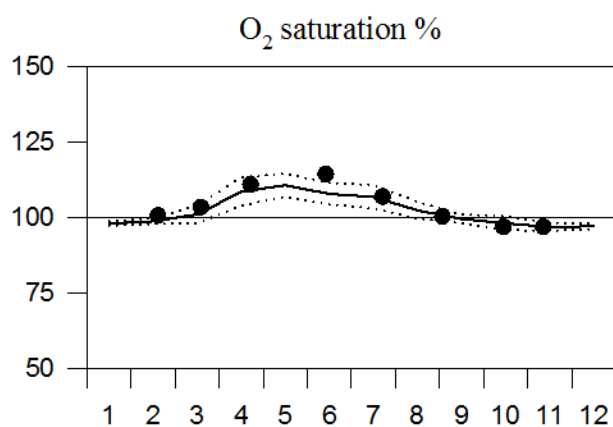
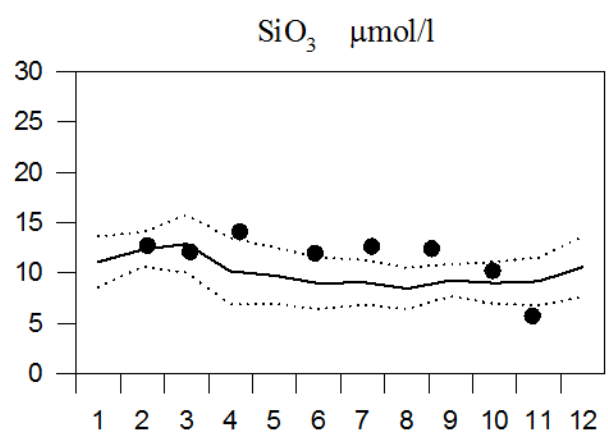
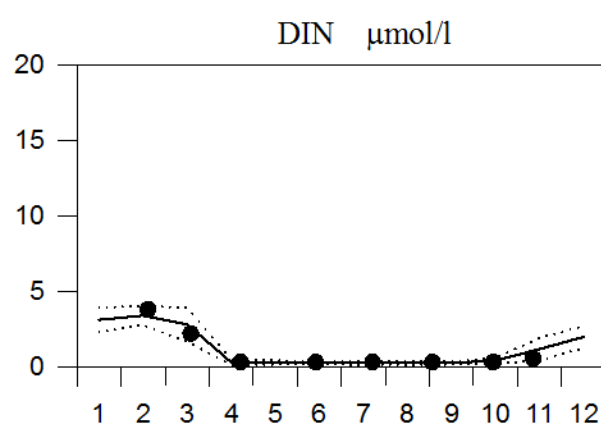
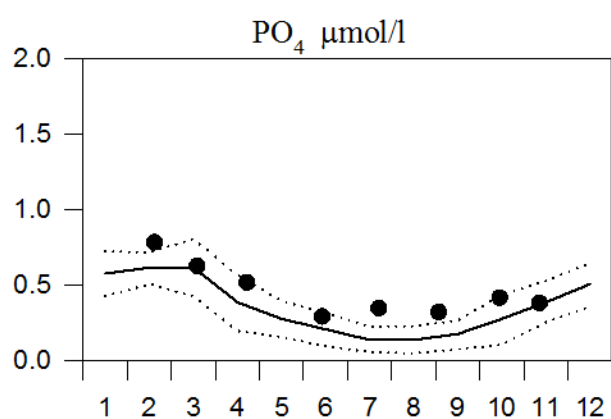
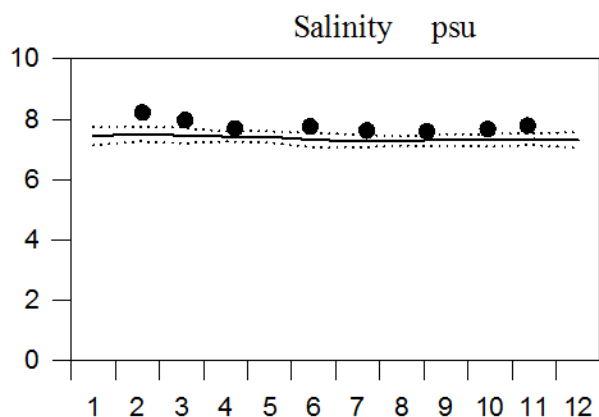
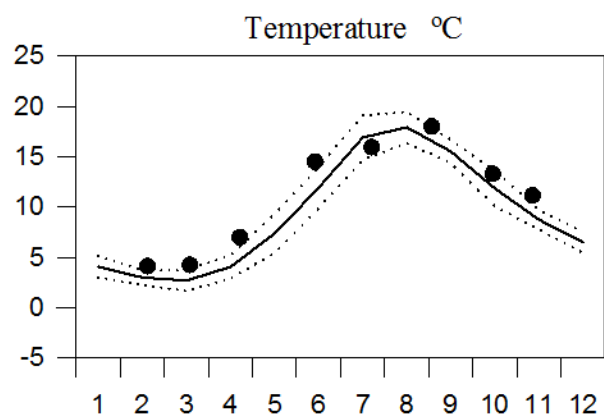
— Mean 1996-2010 ····· St.Dev. ● 2015



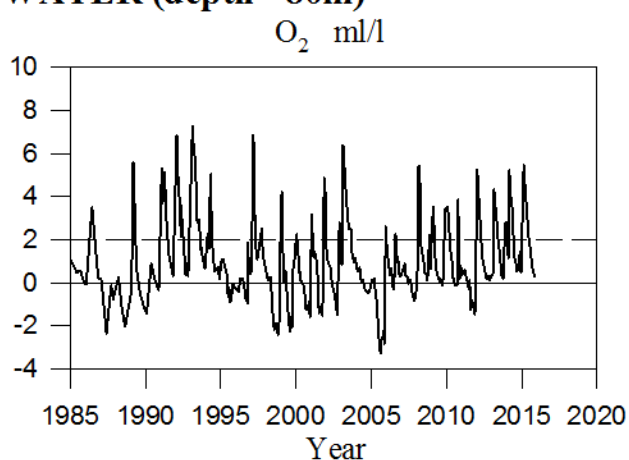
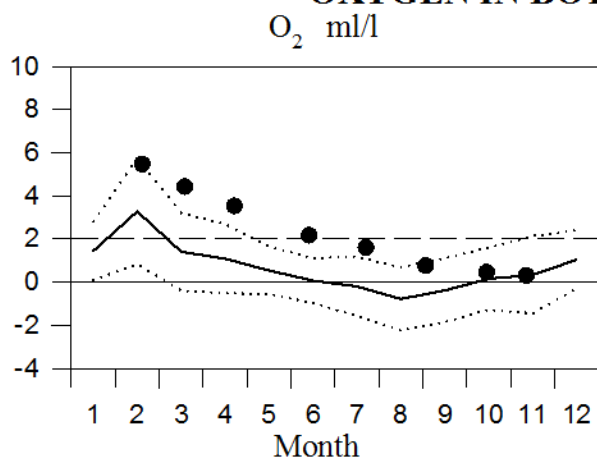
STATION BY4 SURFACE WATER

Annual Cycles

— Mean 1996-2010 St.Dev. ● 2015

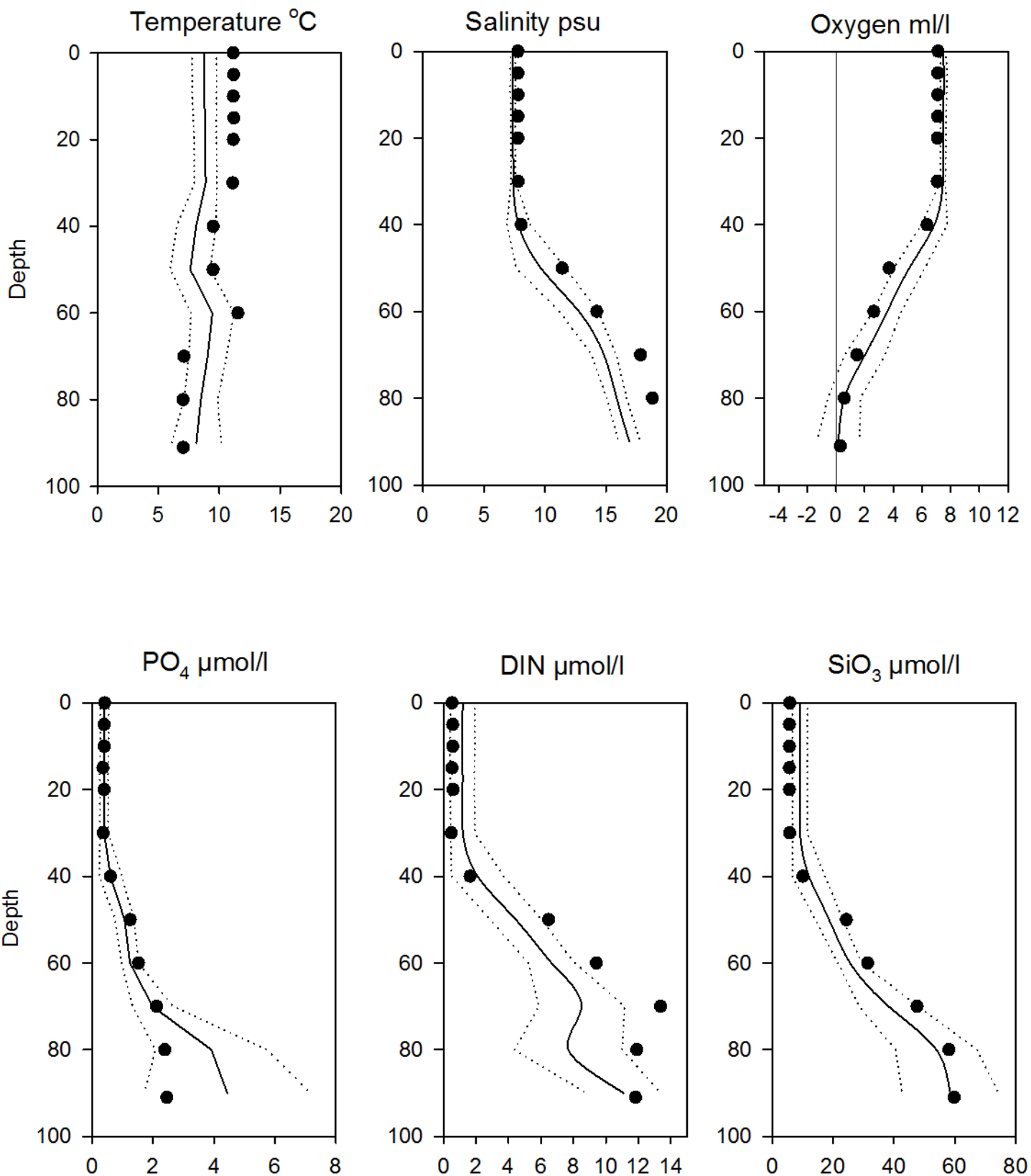


OXYGEN IN BOTTOM WATER (depth >80m)



Vertical profiles BY4 November

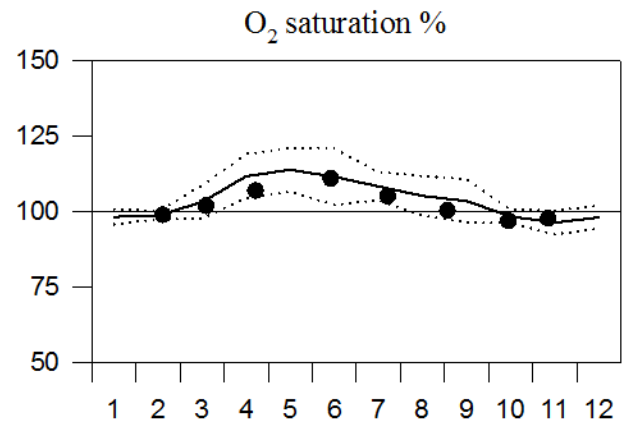
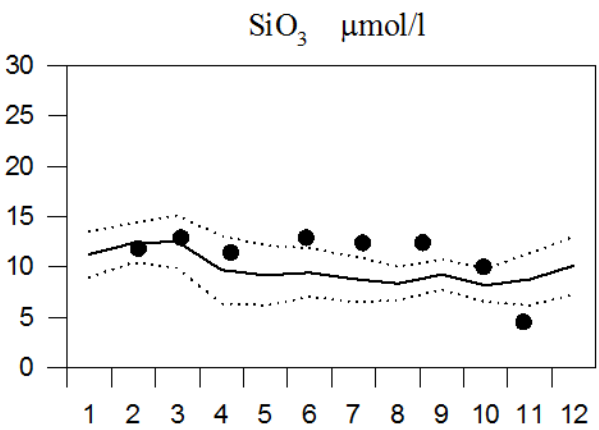
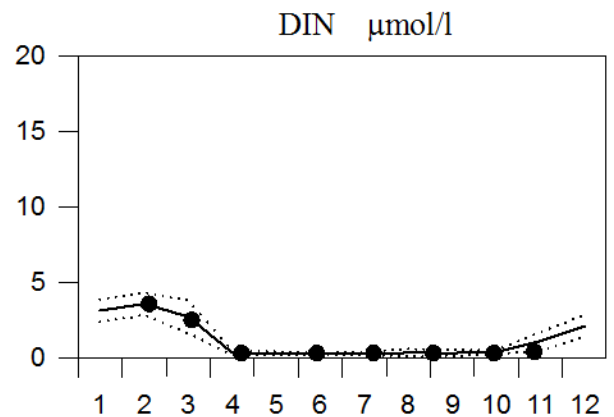
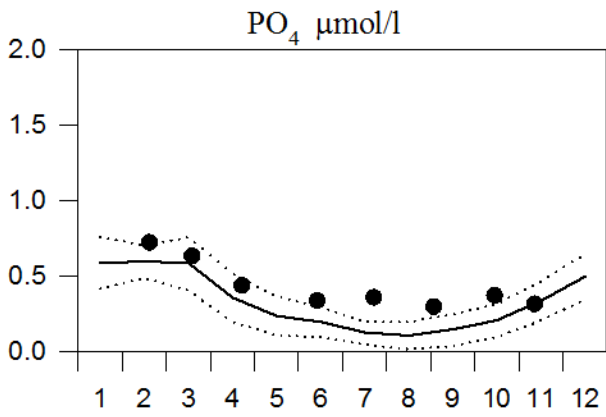
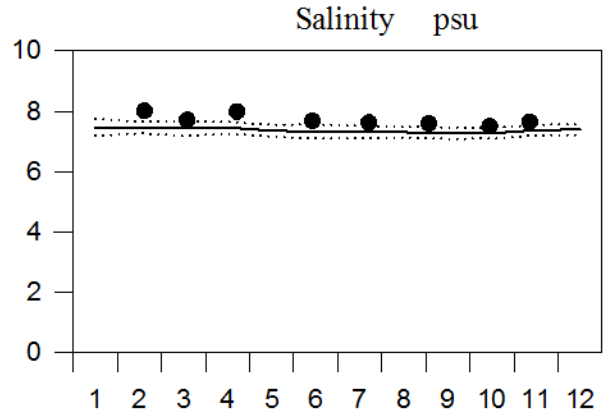
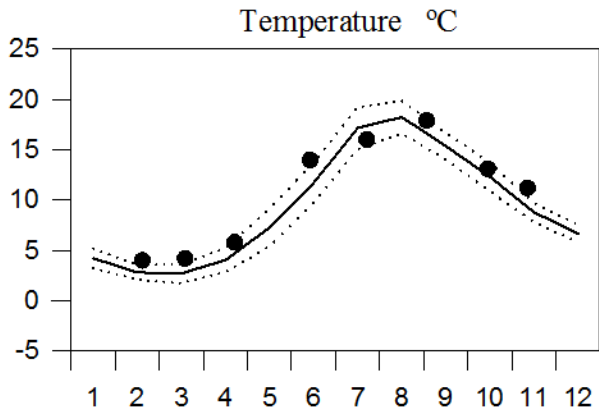
— Mean 1996-2010 St.Dev. ● 2015



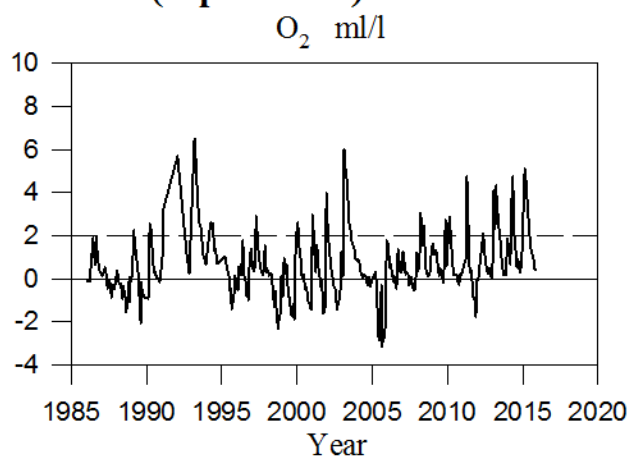
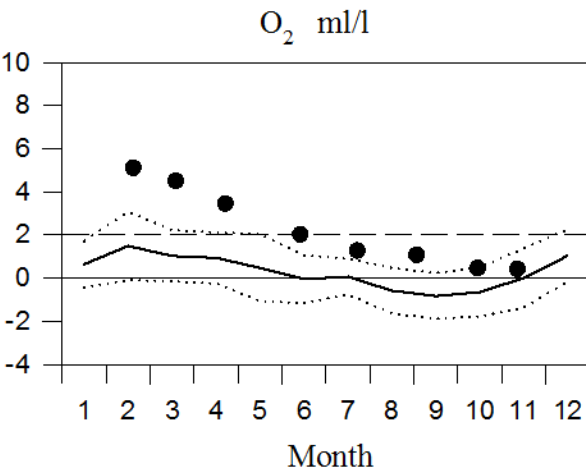
STATION BY5 SURFACE WATER

Annual Cycles

— Mean 1996-2010 ····· St.Dev. ● 2015

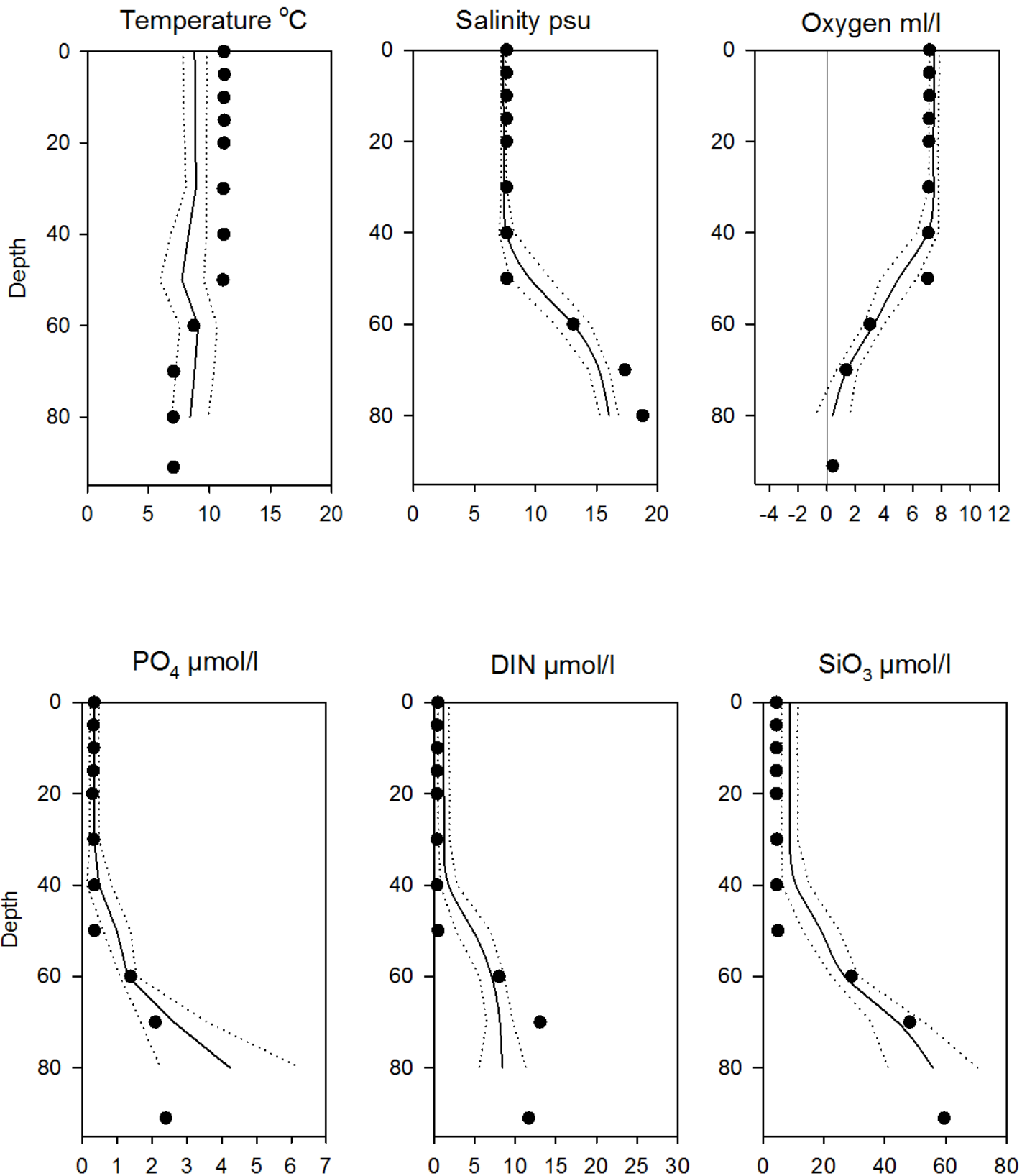


OXYGEN IN BOTTOM WATER (depth >80m)



Vertical profiles BY5 November

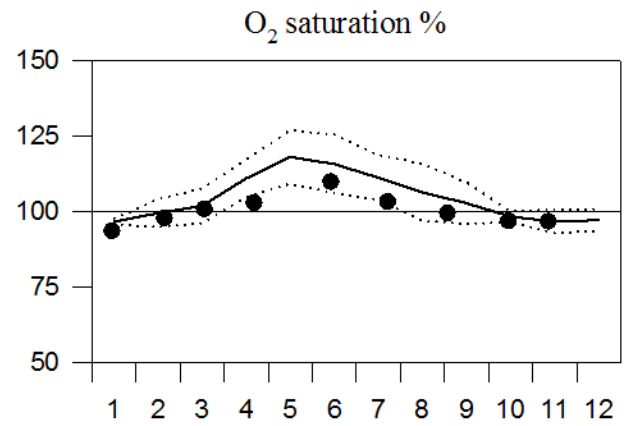
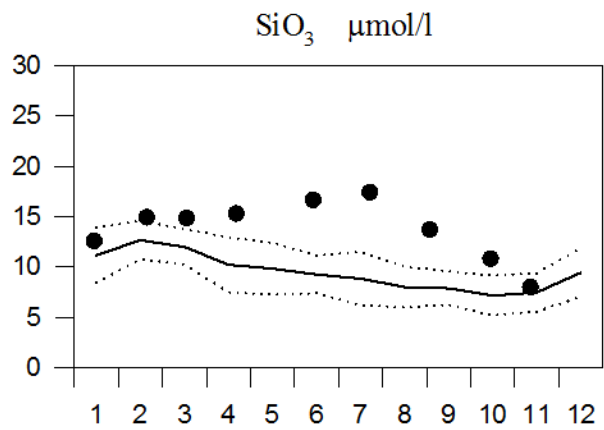
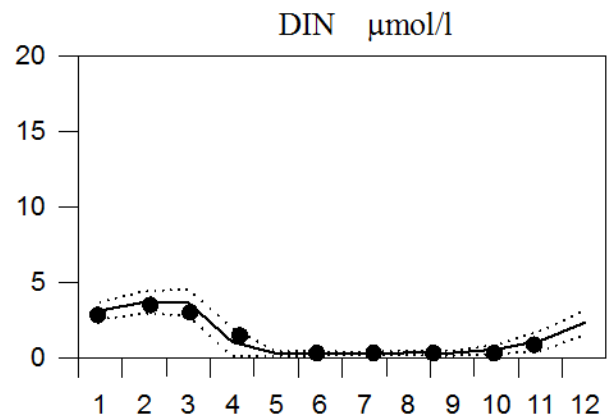
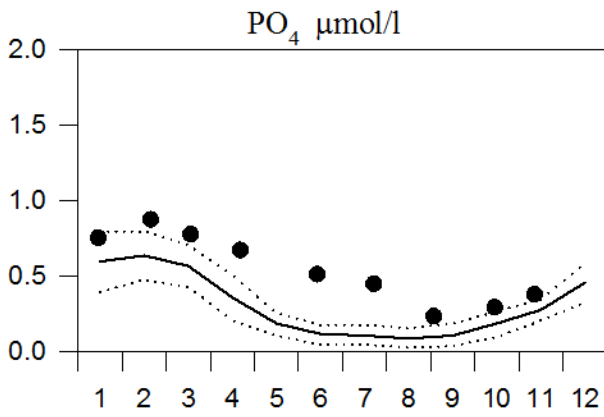
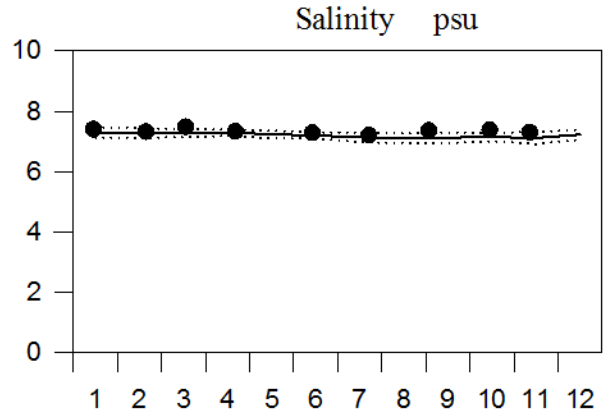
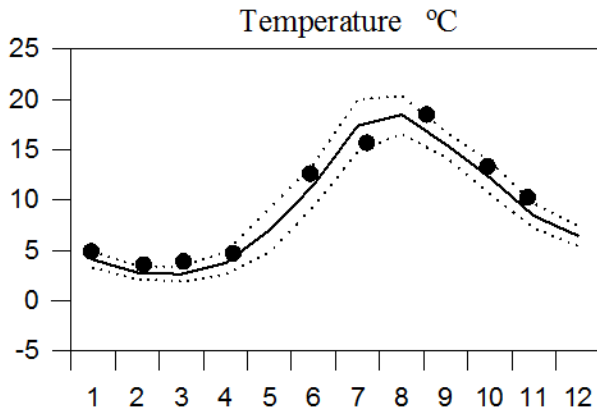
— Mean 1996-2010 St.Dev. ● 2015



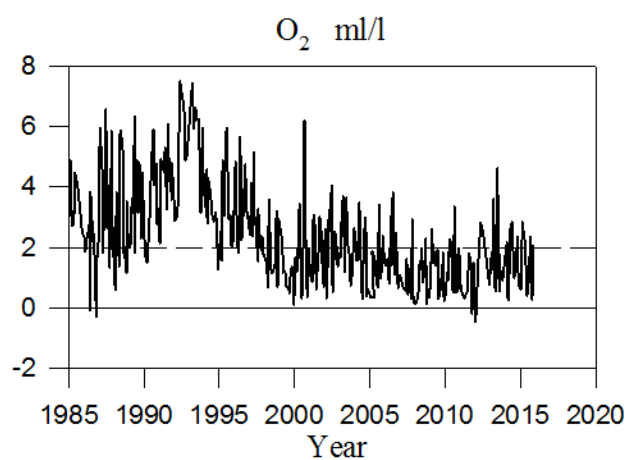
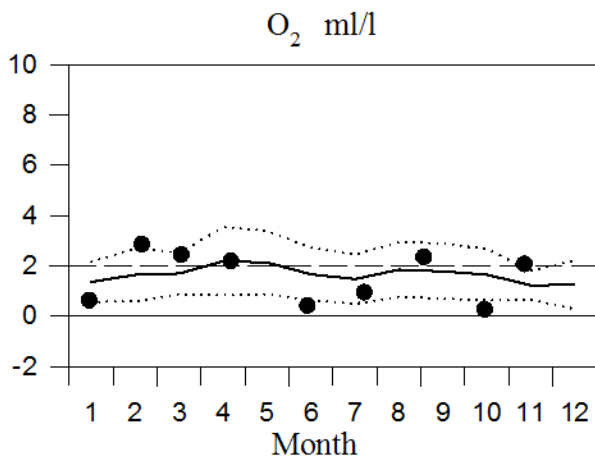
STATION BCS III-10 SURFACE WATER

Annual Cycles

— Mean 1996-2010 St.Dev. ● 2015

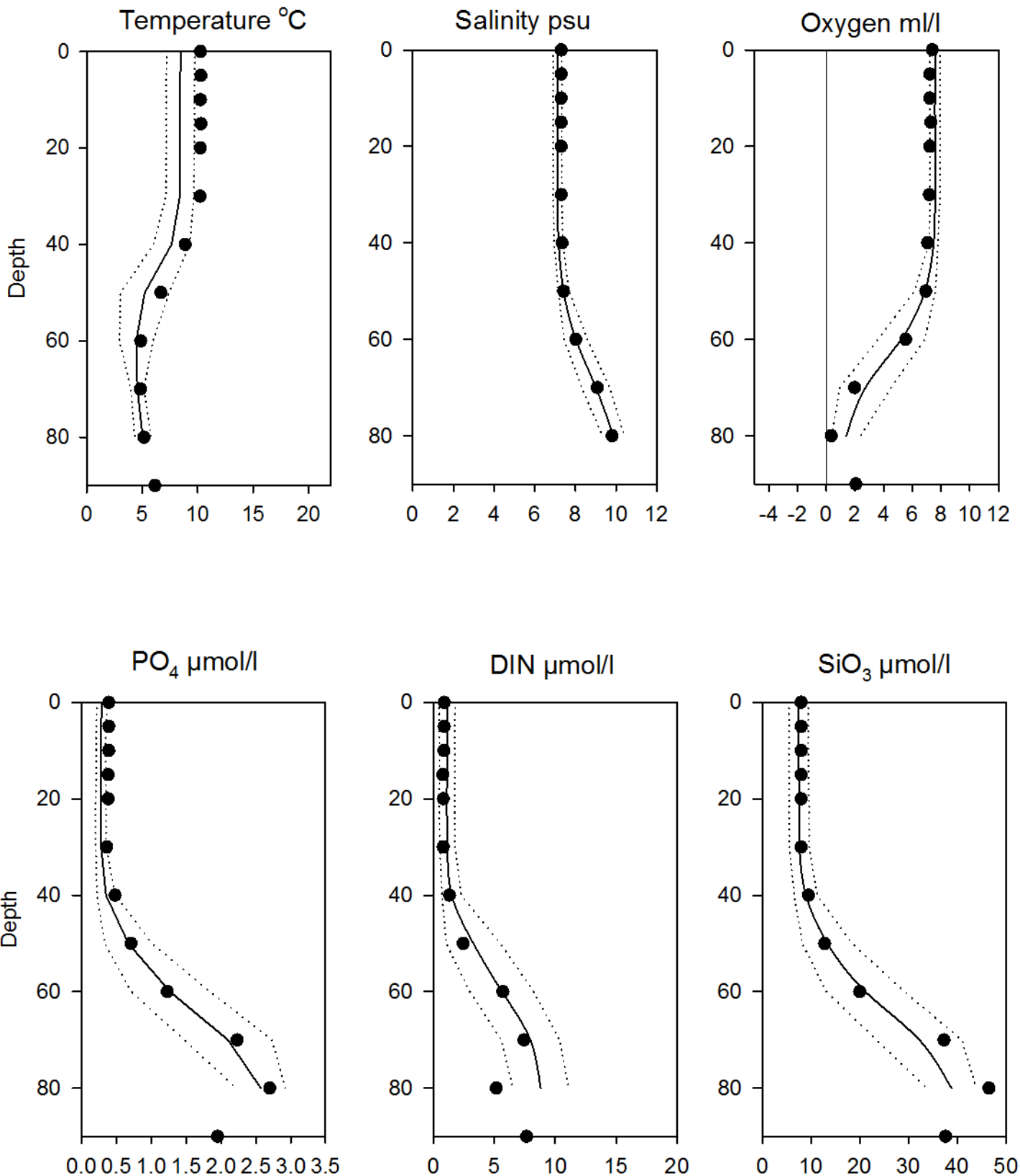


OXYGEN IN BOTTOM WATER (depth > 80m)



Vertical profiles BCS III-10 November

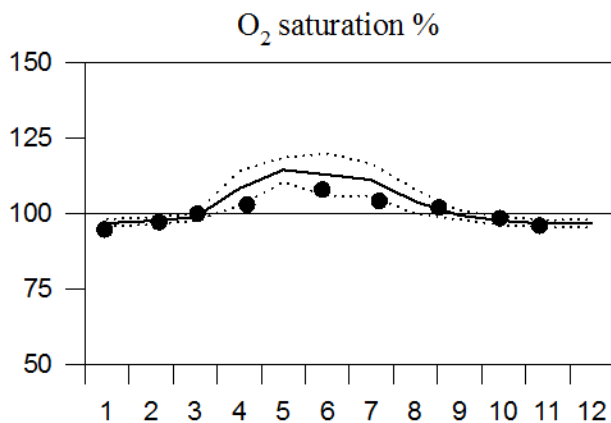
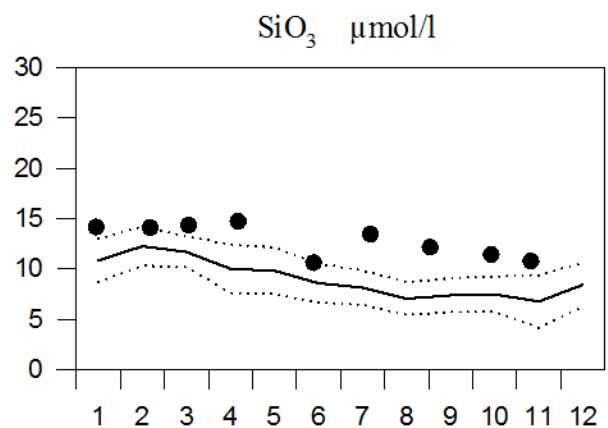
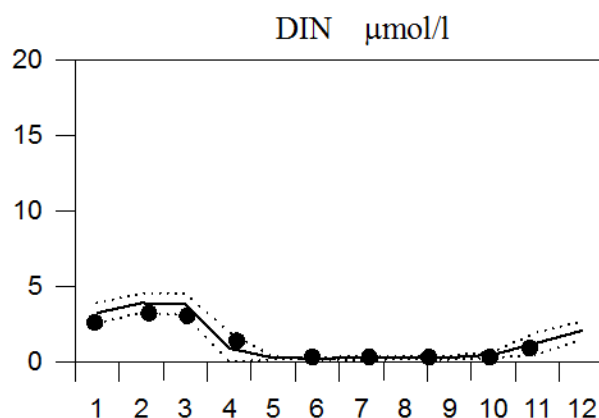
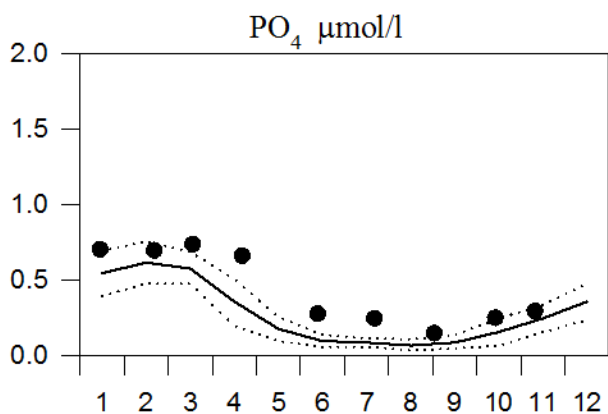
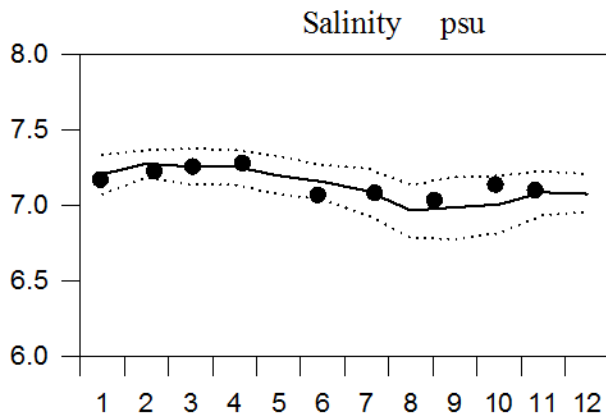
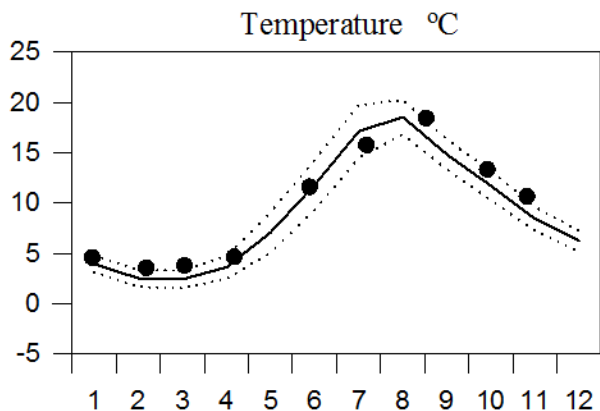
— Mean 1996-2010 St.Dev. ● 2015



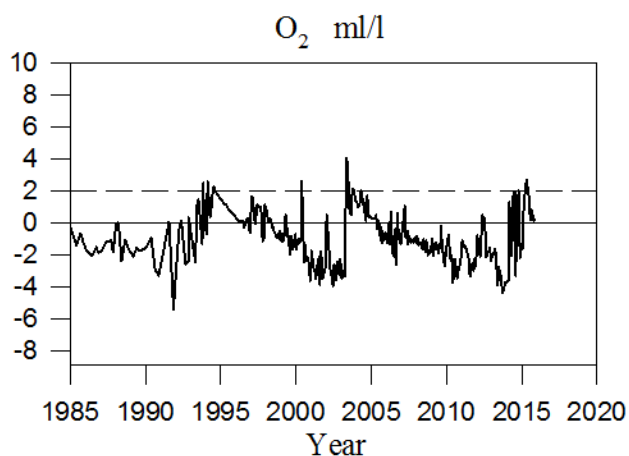
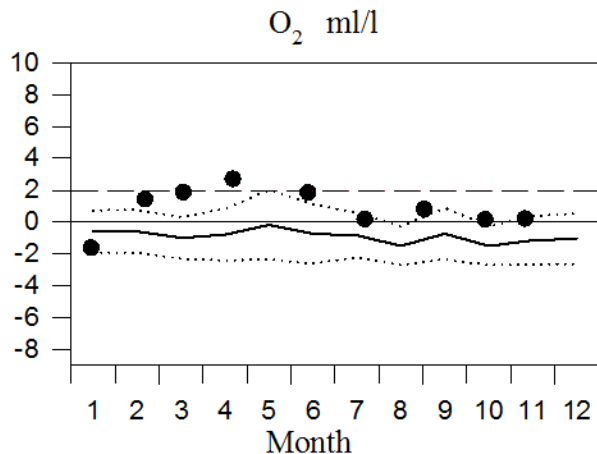
STATION BY10 SURFACE WATER

Annual Cycles

— Mean 1996-2010 ····· St.Dev. ● 2015

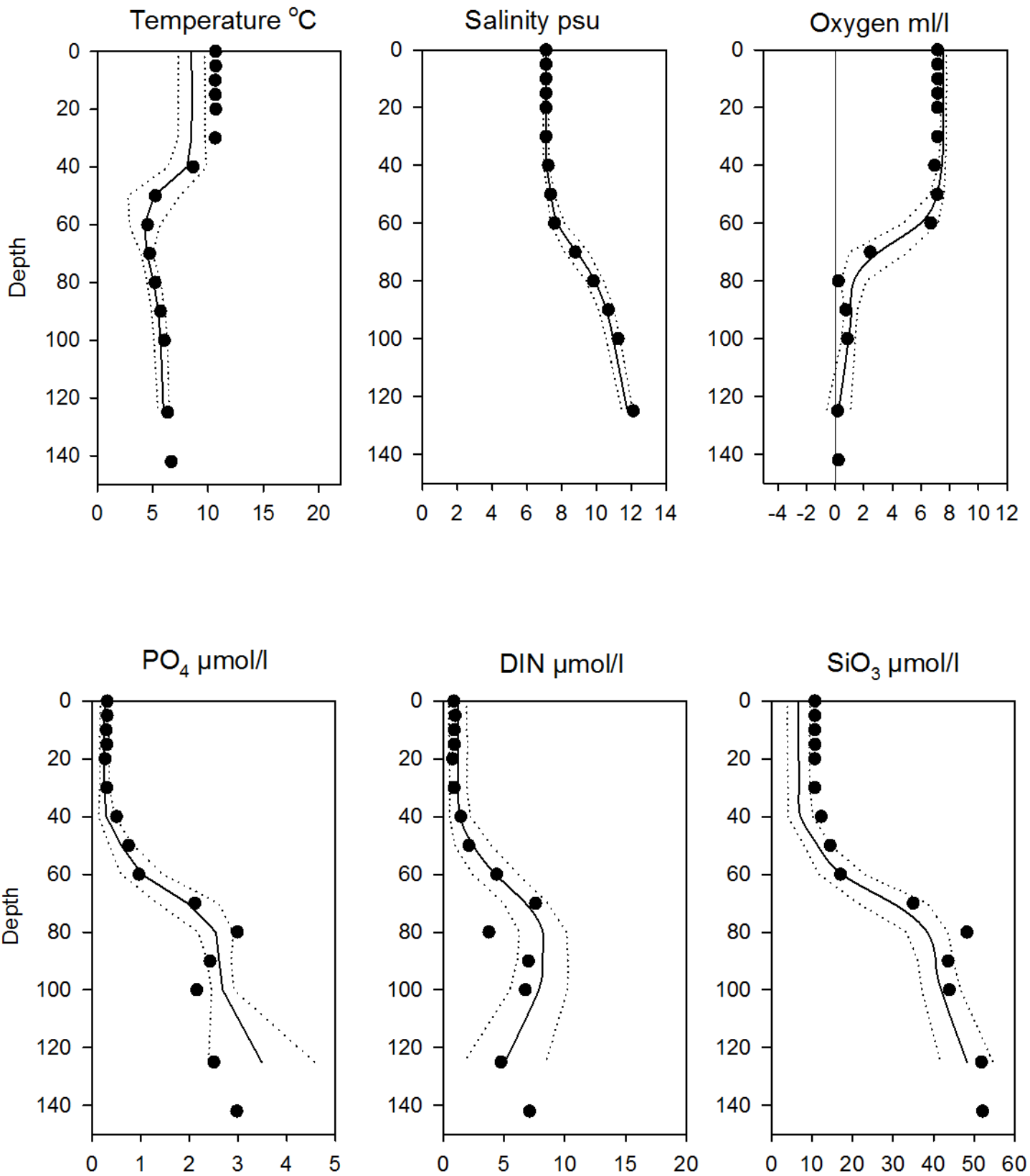


OXYGEN IN BOTTOM WATER (depth >125m)



Vertical profiles BY10 November

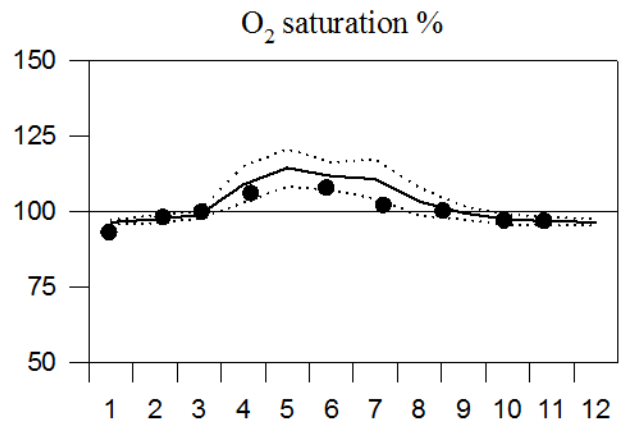
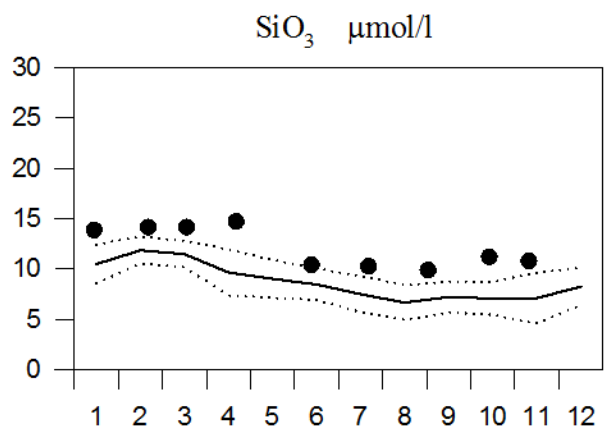
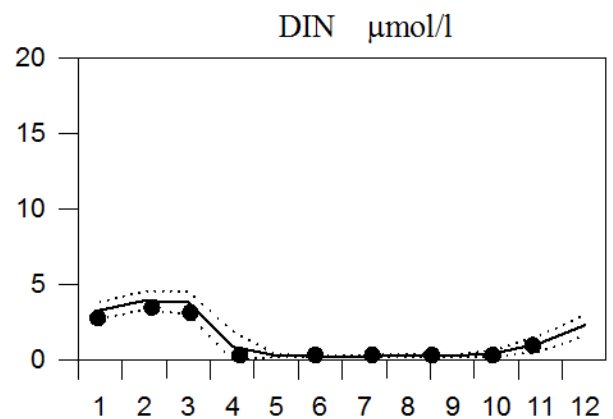
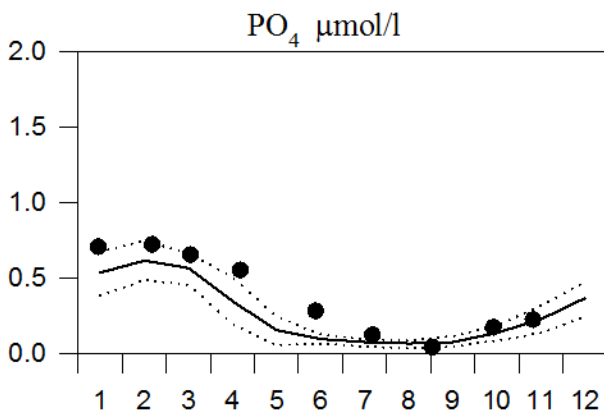
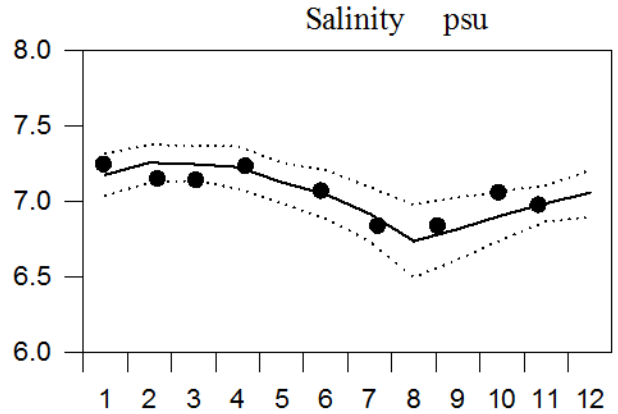
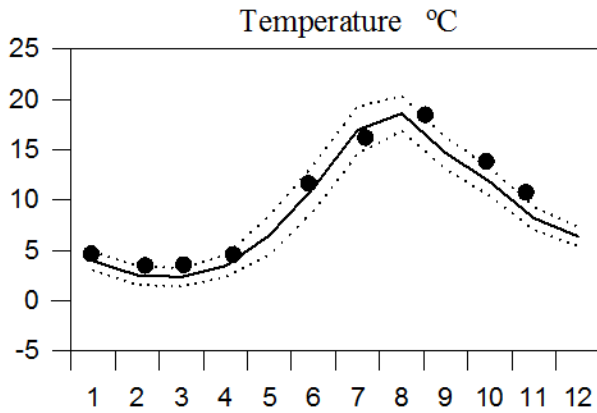
— Mean 1996-2010 St.Dev. ● 2015



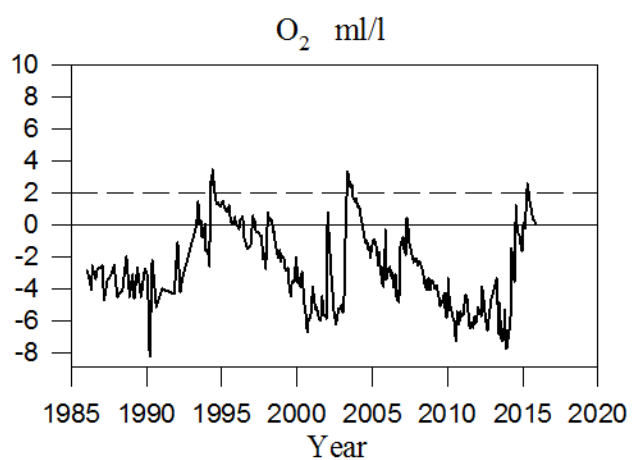
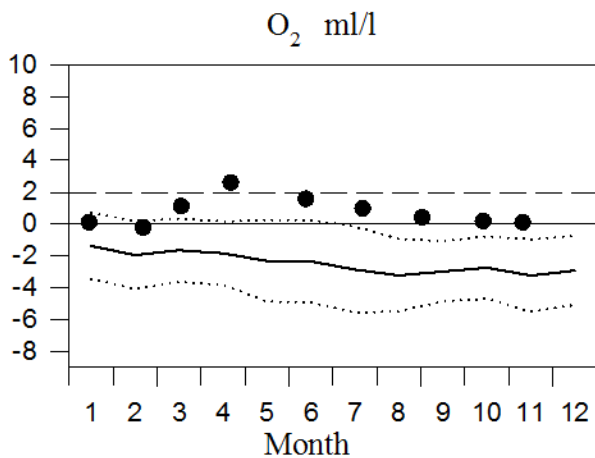
STATION BY15 SURFACE WATER

Annual Cycles

— Mean 1996-2010 ····· St.Dev. ● 2015

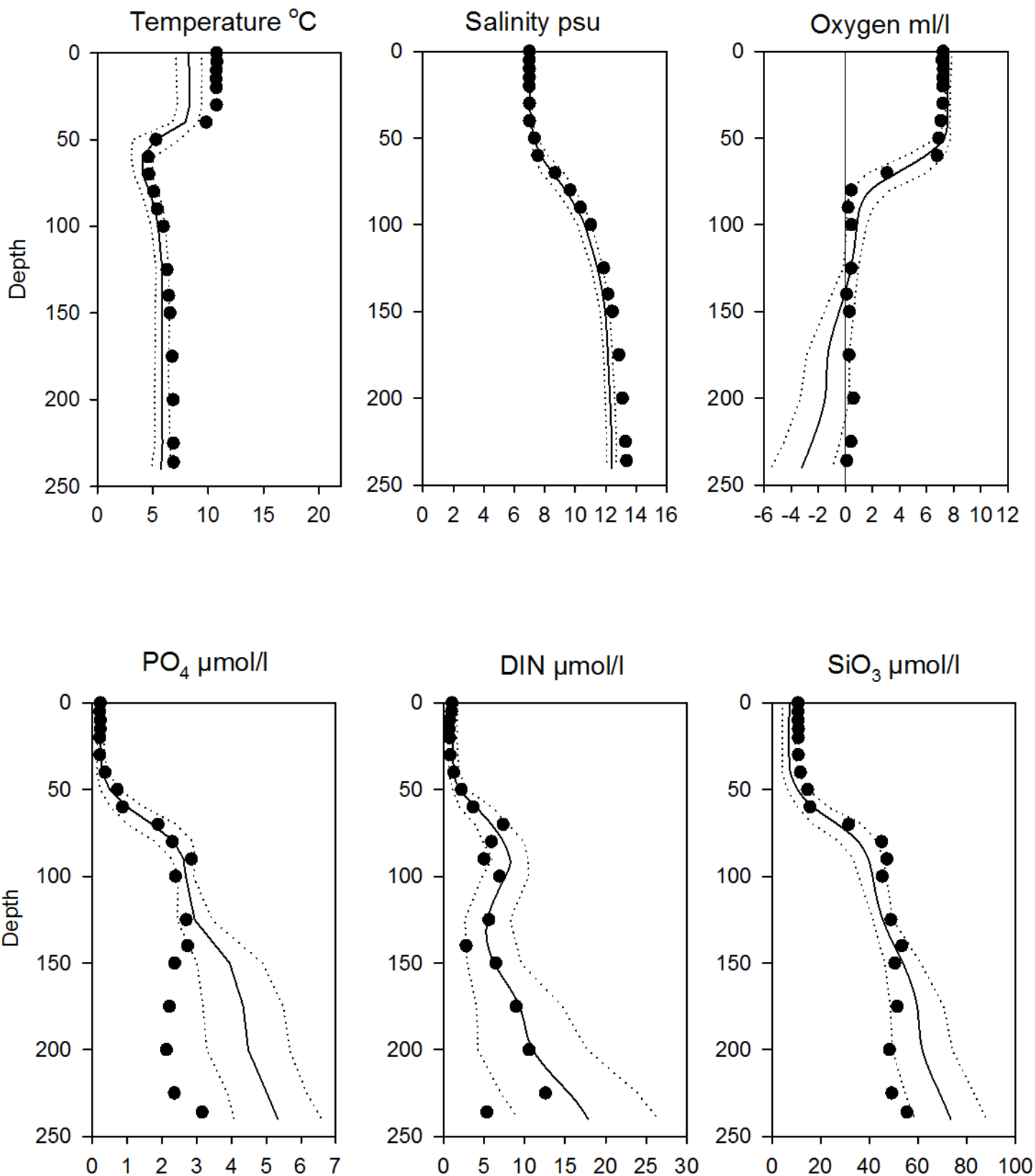


OXYGEN IN BOTTOM WATER (depth >225m)



Vertical profiles BY15 November

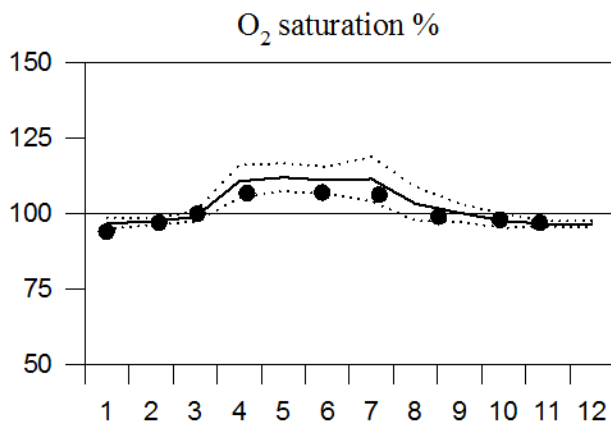
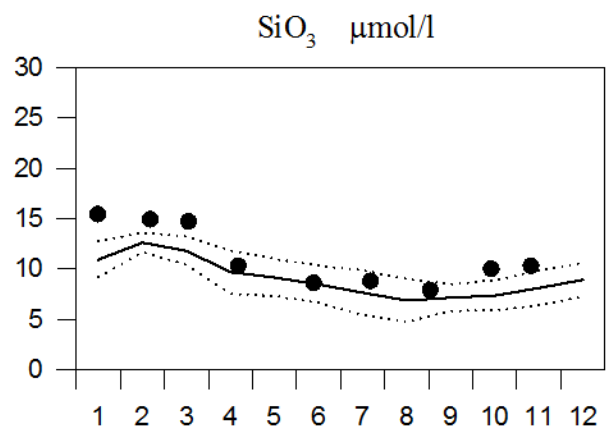
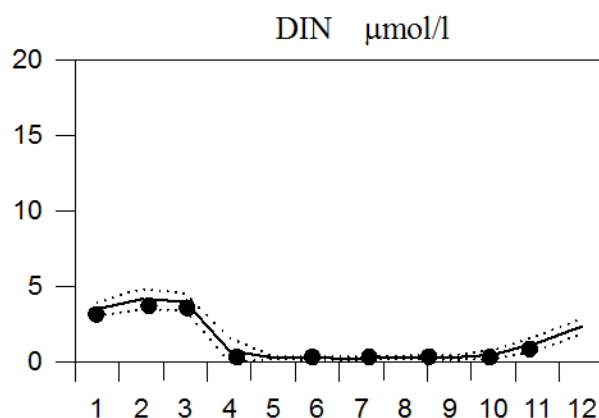
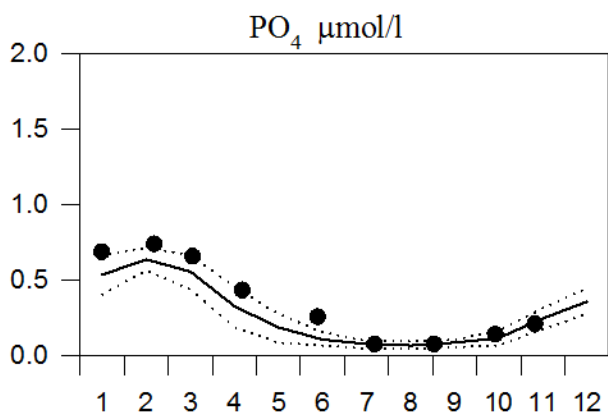
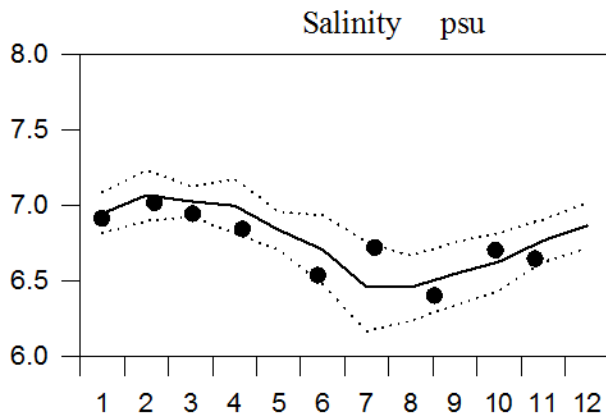
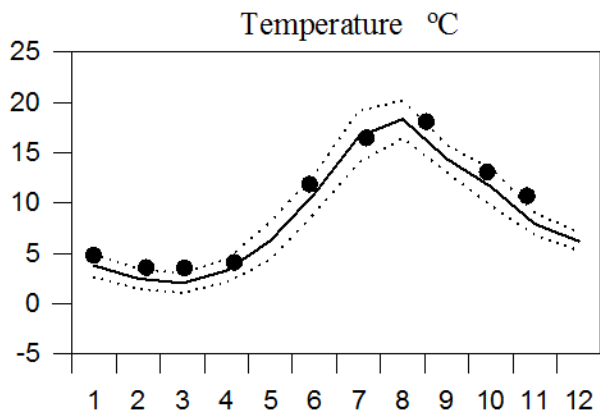
— Mean 1996-2010 St.Dev. ● 2015



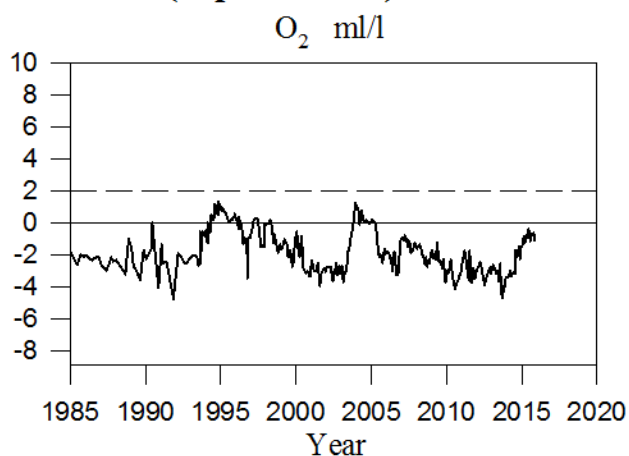
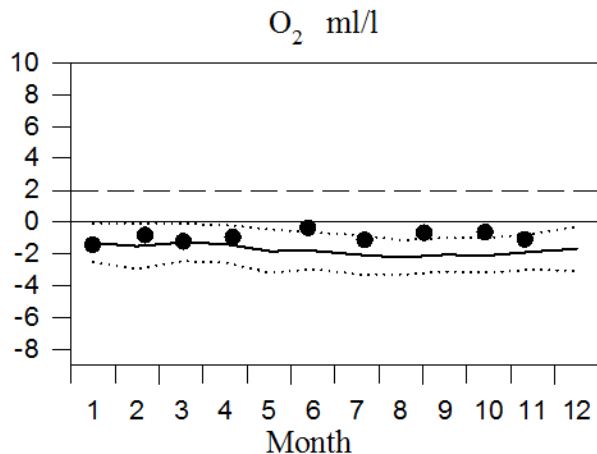
STATION BY20 SURFACE WATER

Annual Cycles

— Mean 1996-2010 St.Dev. ● 2015

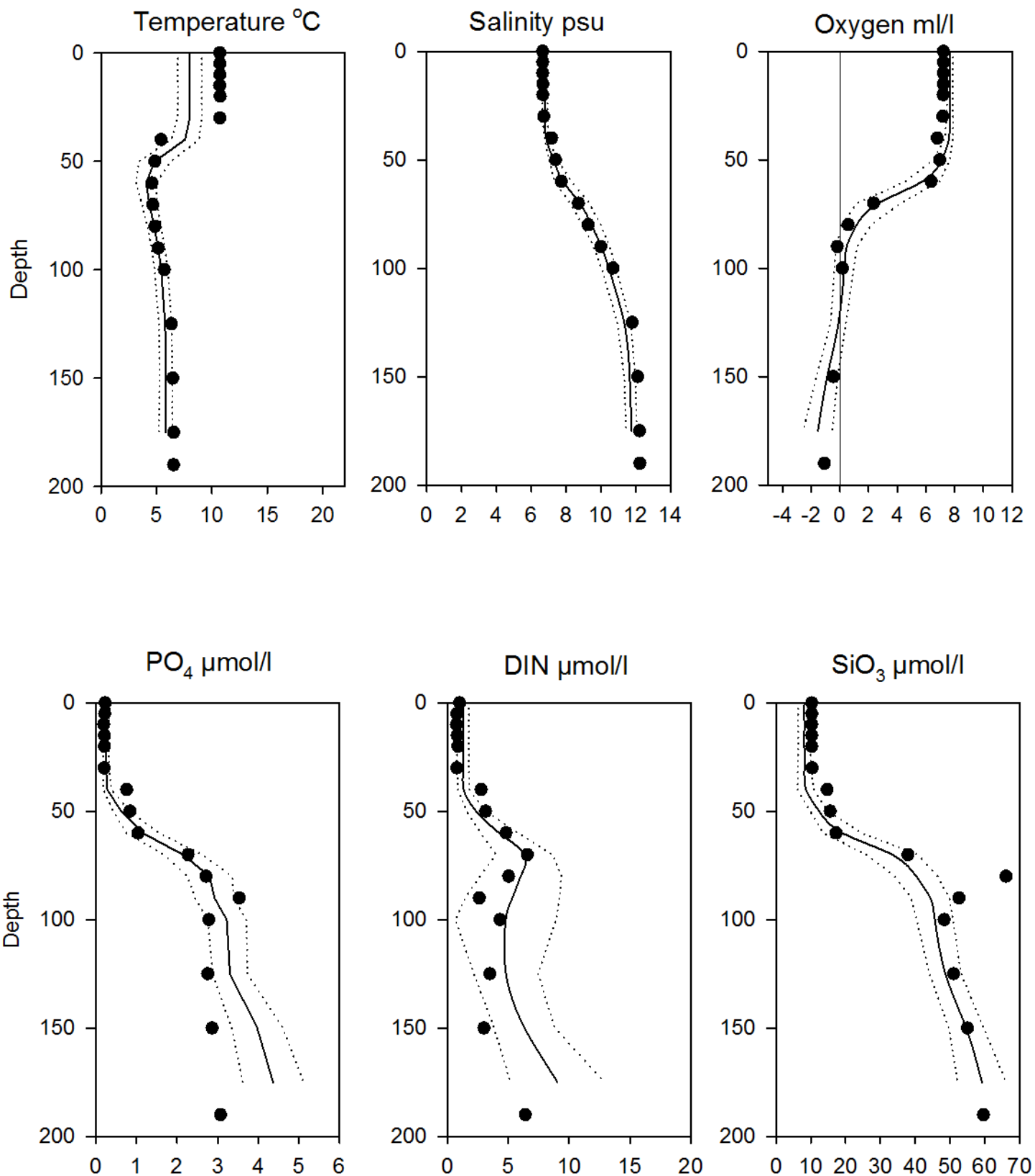


OXYGEN IN BOTTOM WATER (depth >175m)



Vertical profiles BY20 November

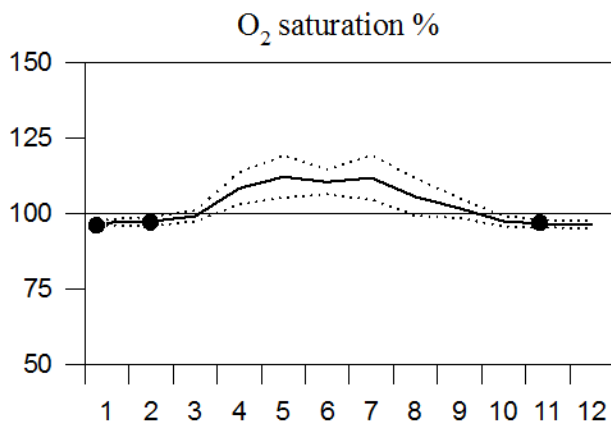
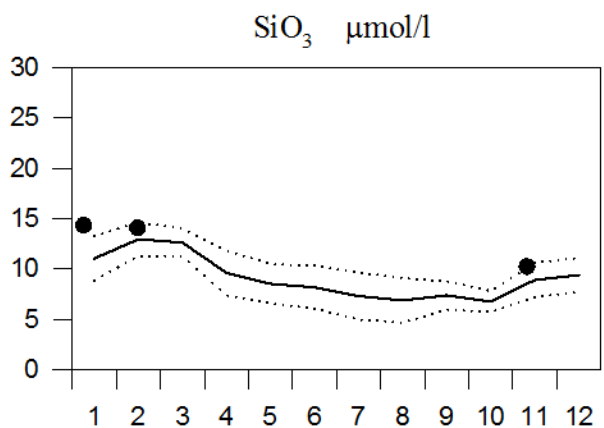
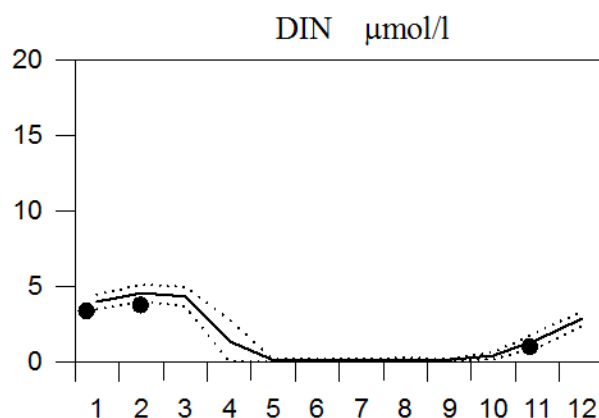
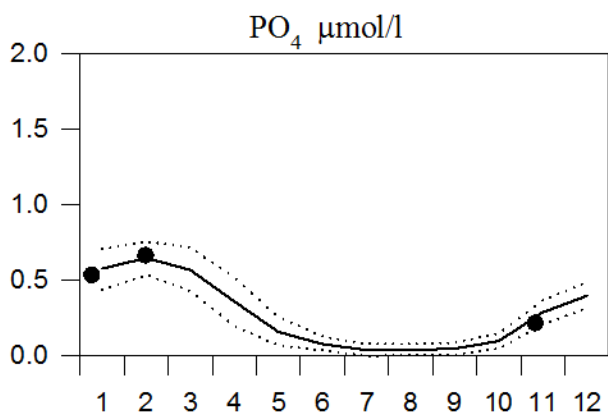
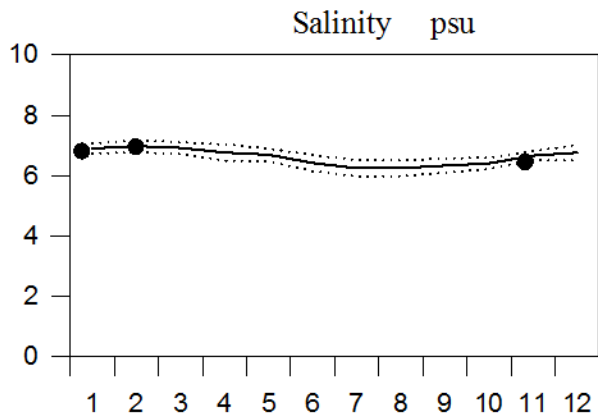
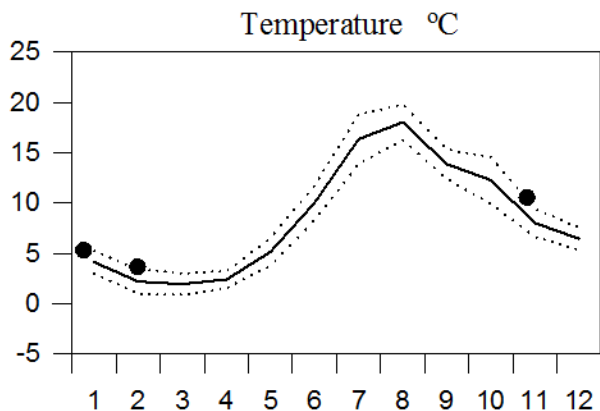
— Mean 1996-2010 St.Dev. ● 2015



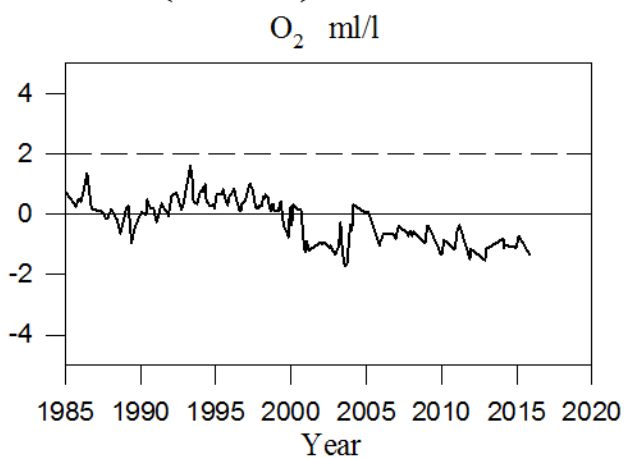
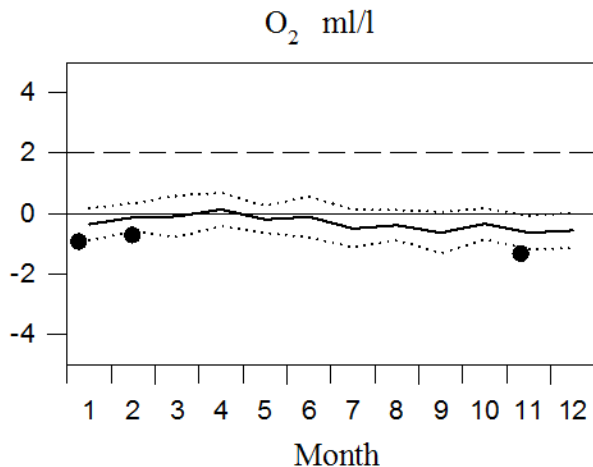
STATION BY29 SURFACE WATER

Annual Cycles

— Mean 1996-2010 St.Dev. ● 2015

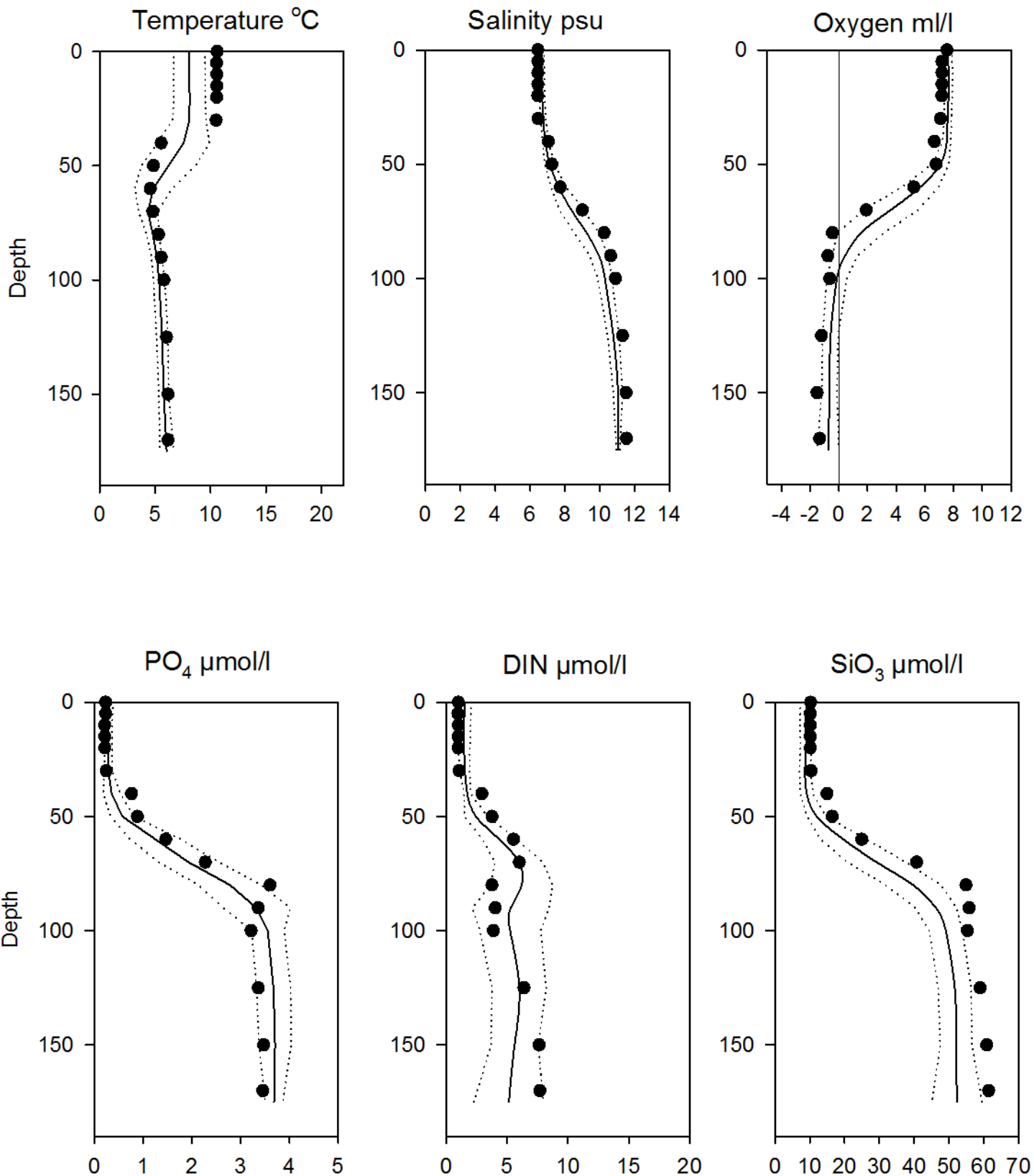


OXYGEN IN BOTTOM WATER (>=150m)



Vertical profiles BY29 November

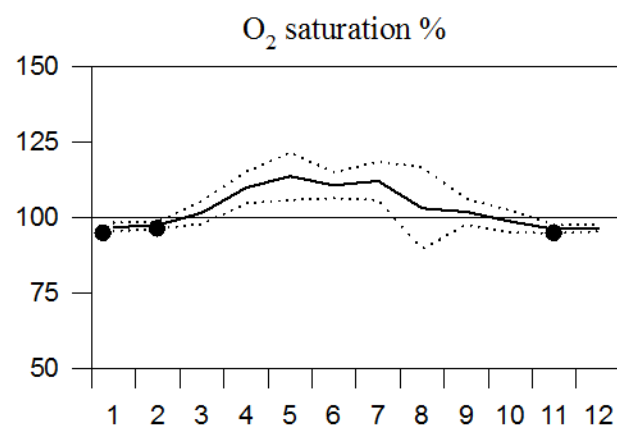
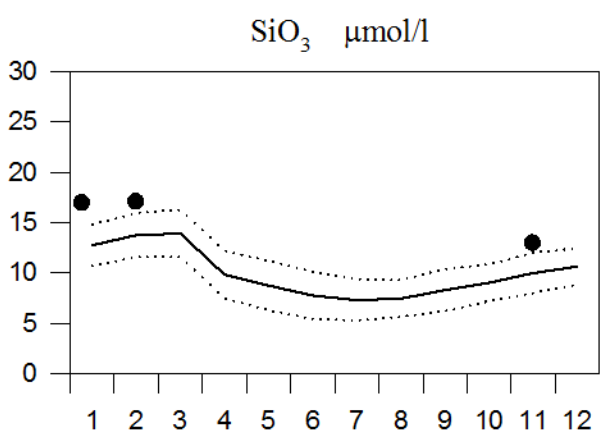
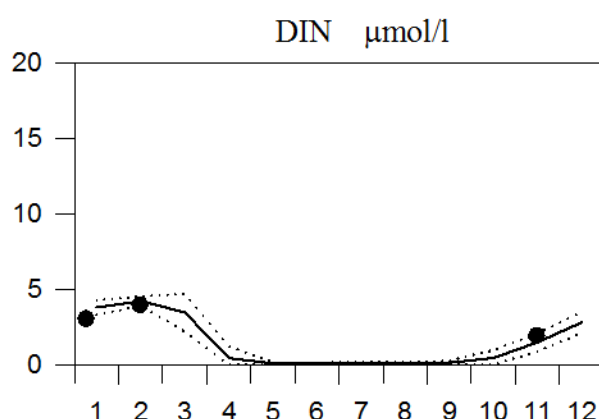
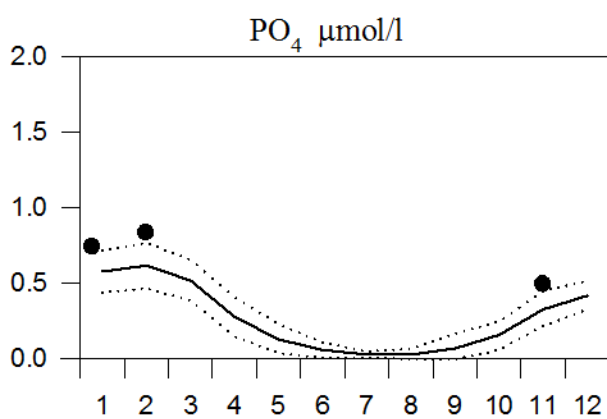
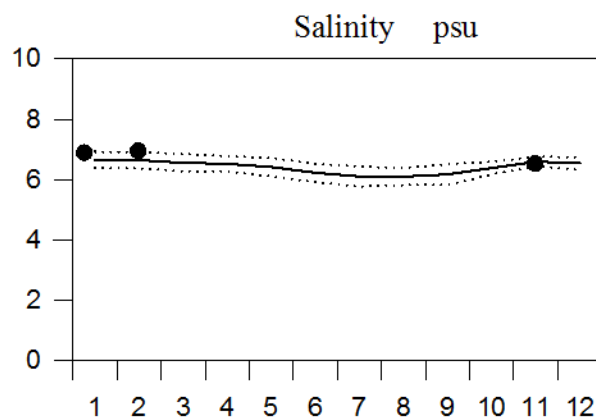
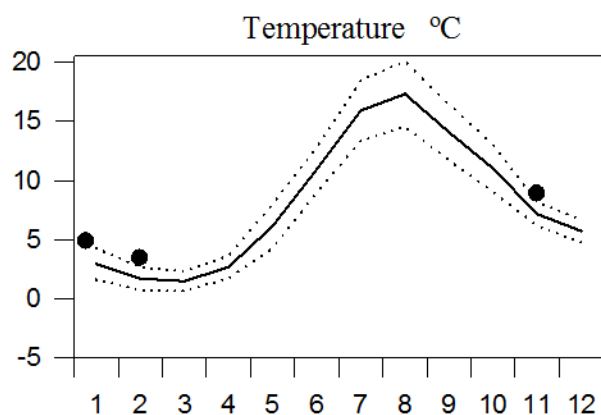
— Mean 1996-2010 St.Dev. ● 2015



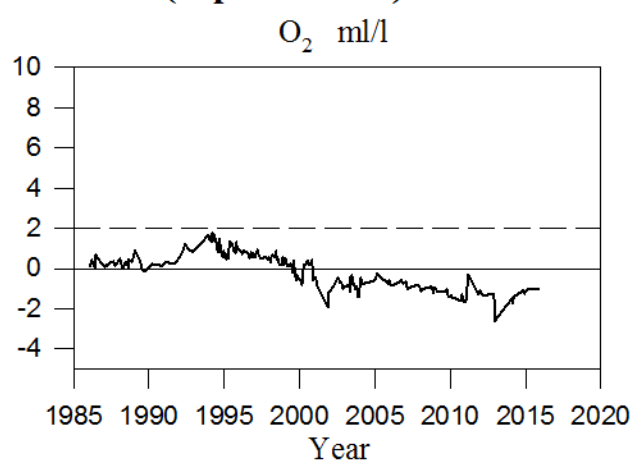
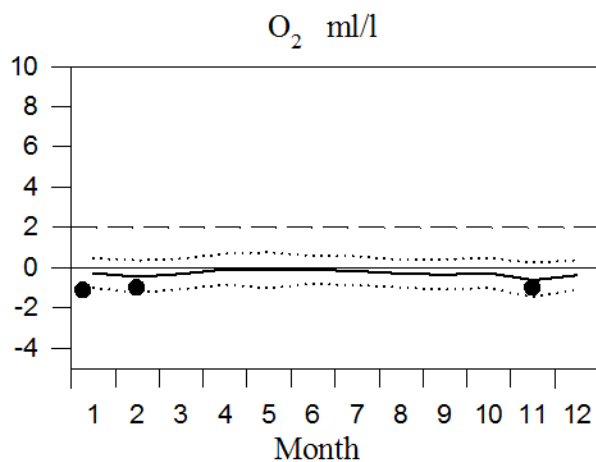
STATION BY31 SURFACE WATER

Annual Cycles

— Mean 1996-2010 St.Dev. ● 2015

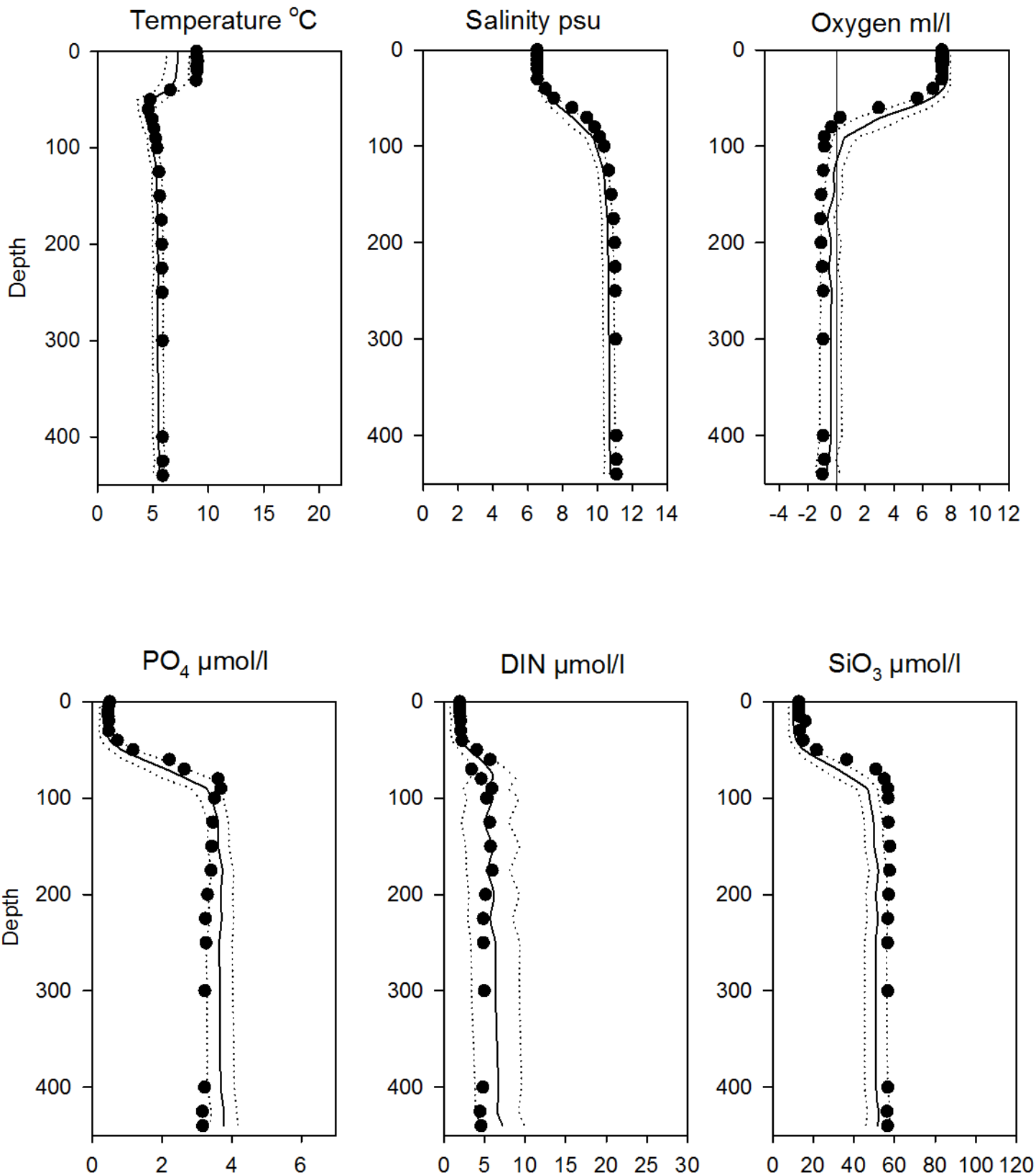


OXYGEN IN BOTTOM WATER (depth = 440m)



Vertical profiles BY31 November

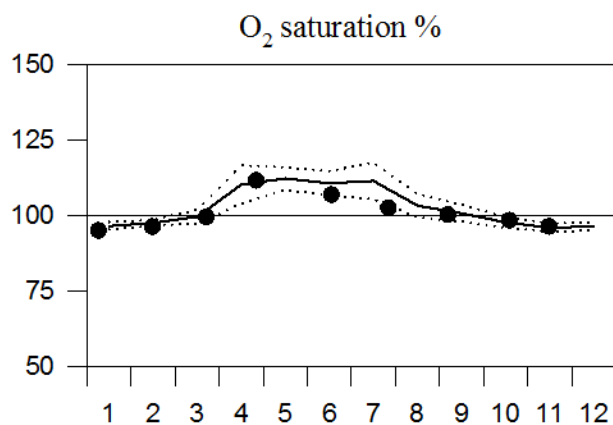
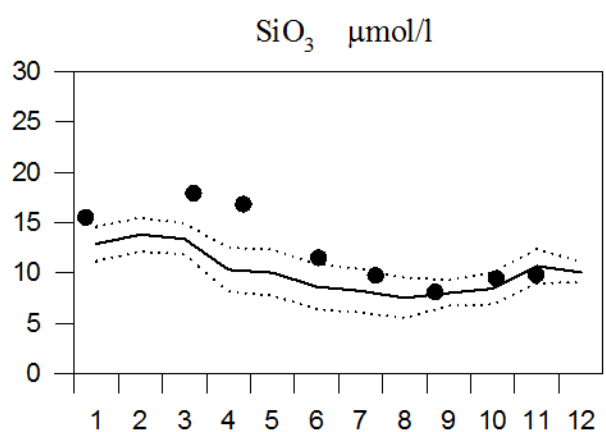
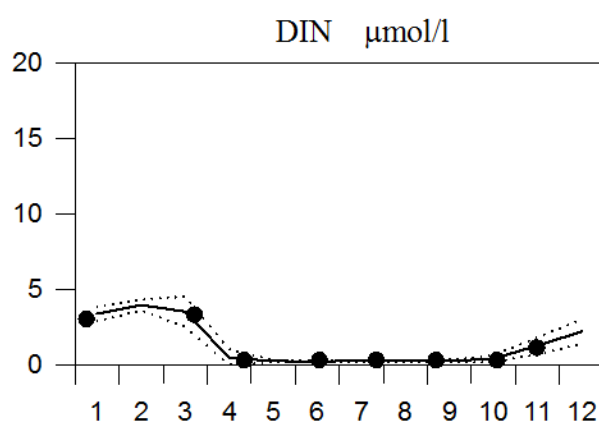
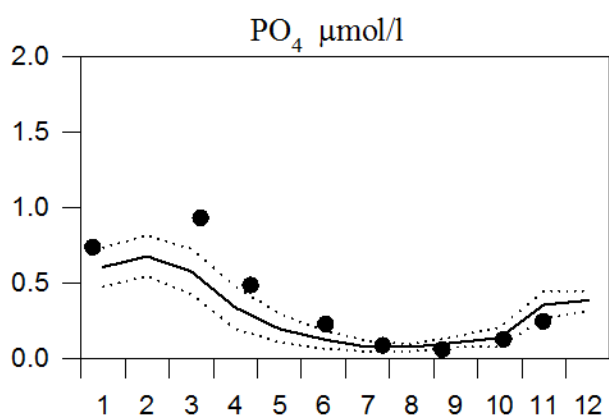
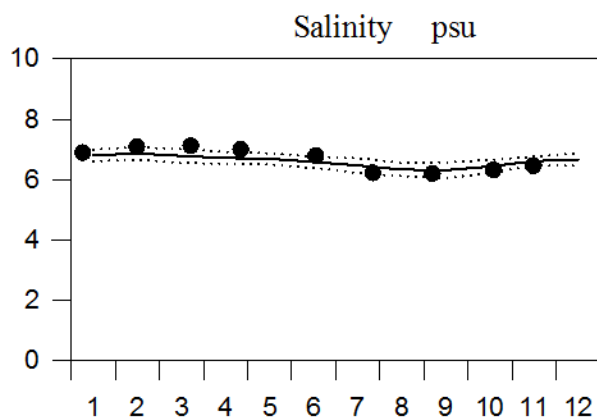
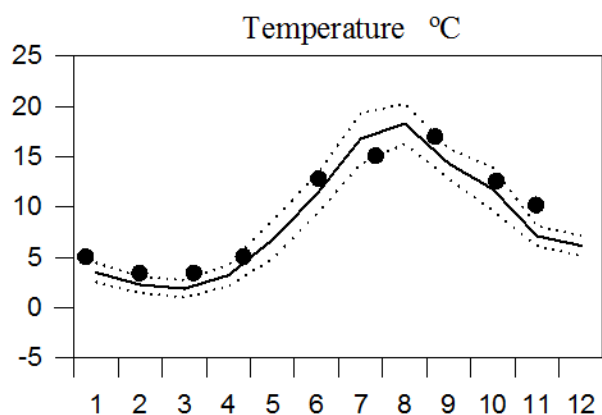
— Mean 1996-2010 ····· St.Dev. ● 2015



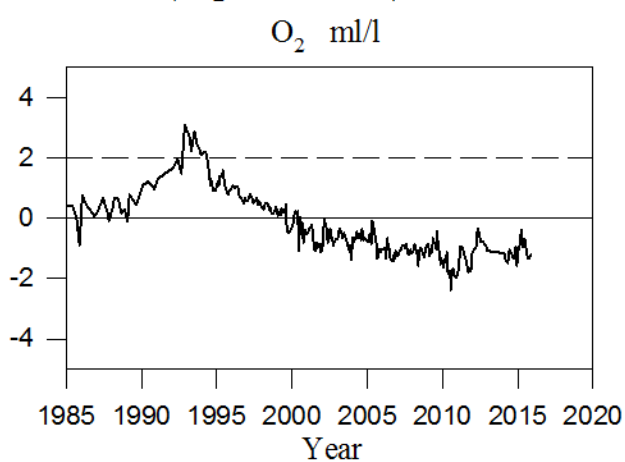
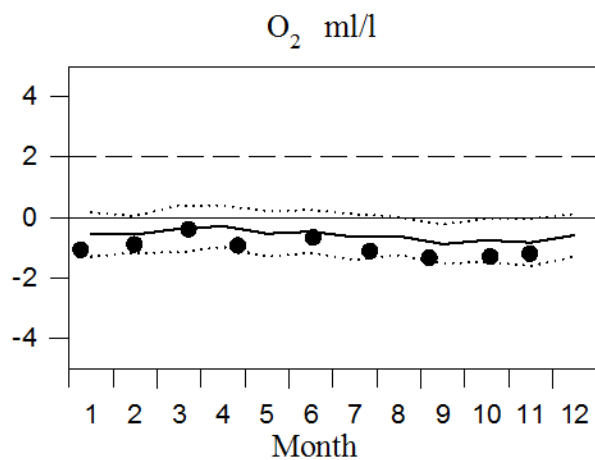
STATION BY32 SURFACE WATER

Annual Cycles

— Mean 1996-2010 St.Dev. ● 2015

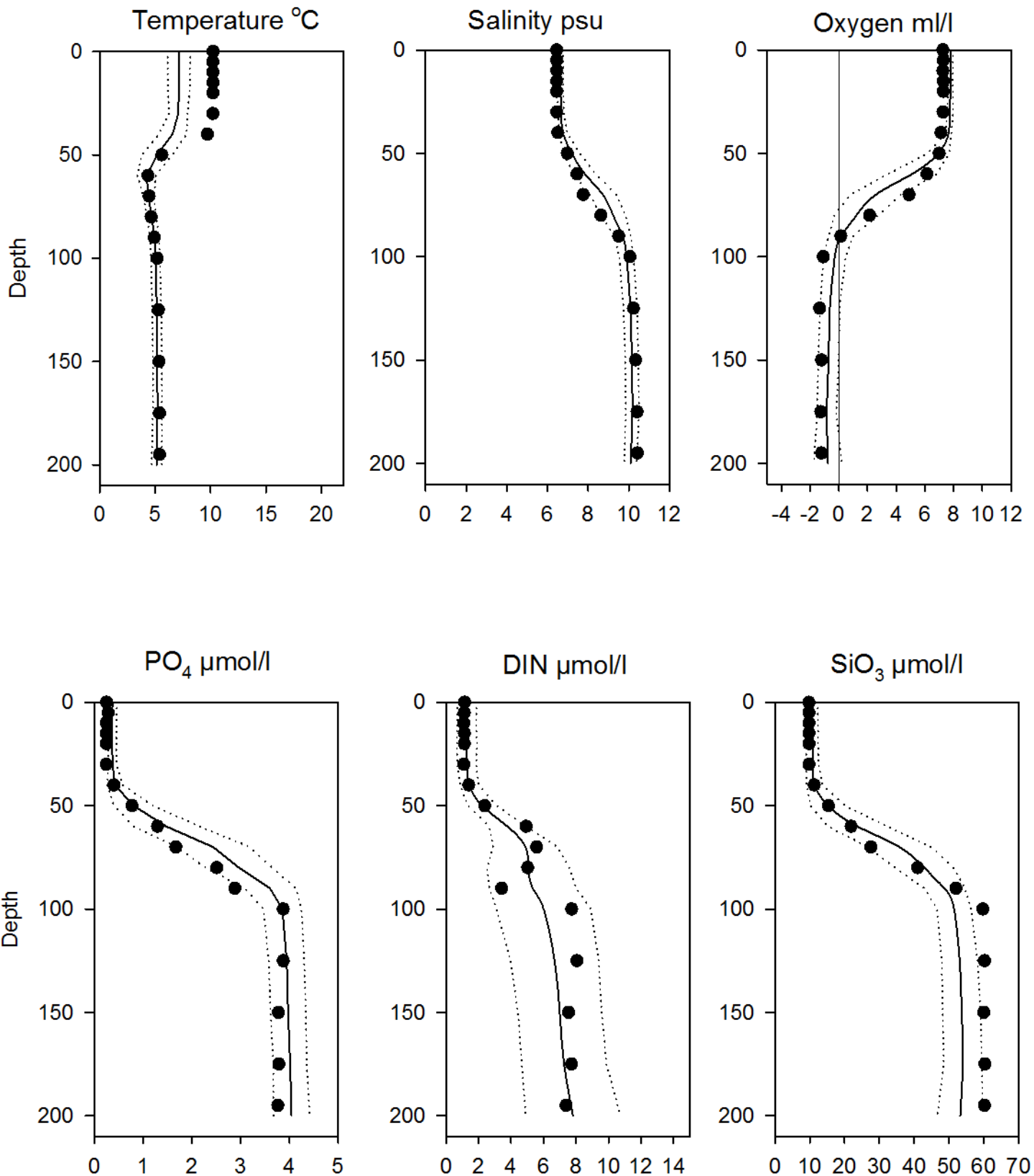


OXYGEN IN BOTTOM WATER (depth > 175m)



Vertical profiles BY32 November

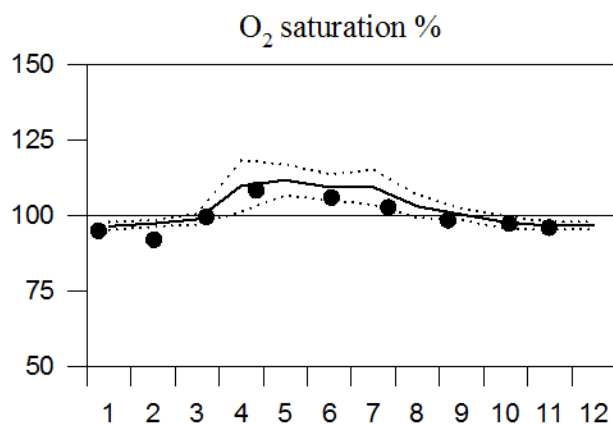
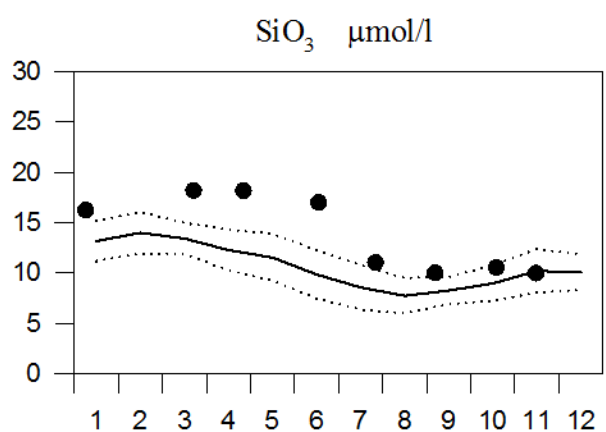
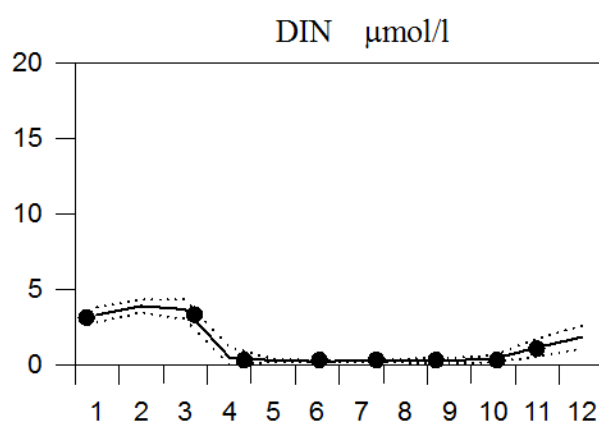
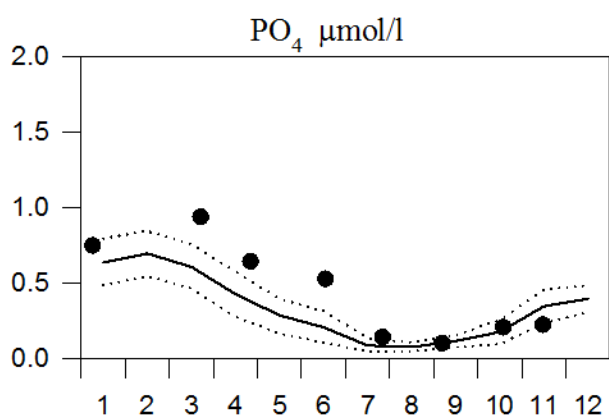
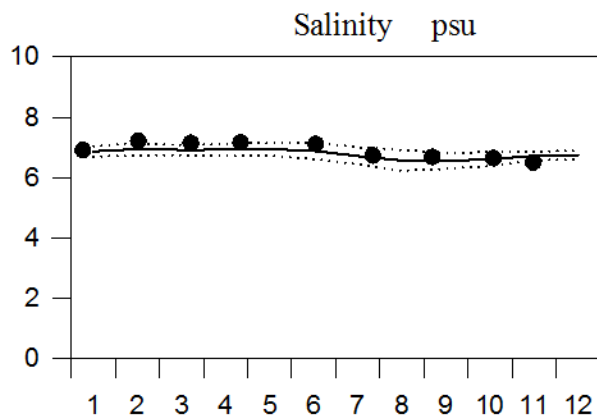
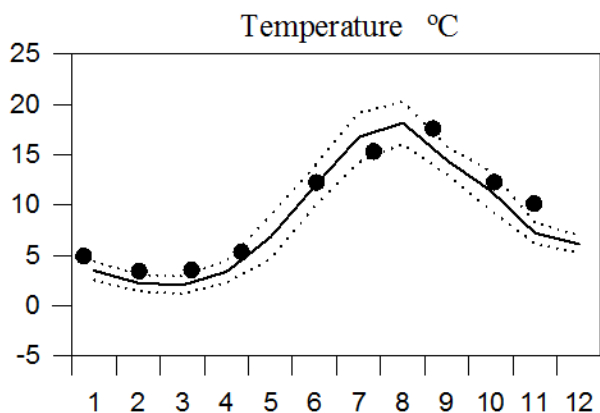
— Mean 1996-2010 St.Dev. ● 2015



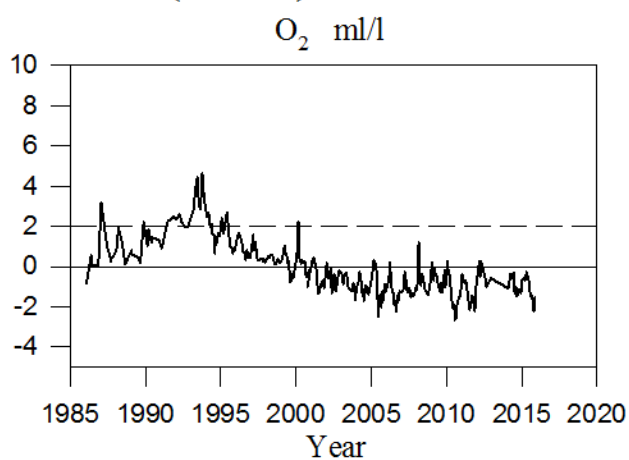
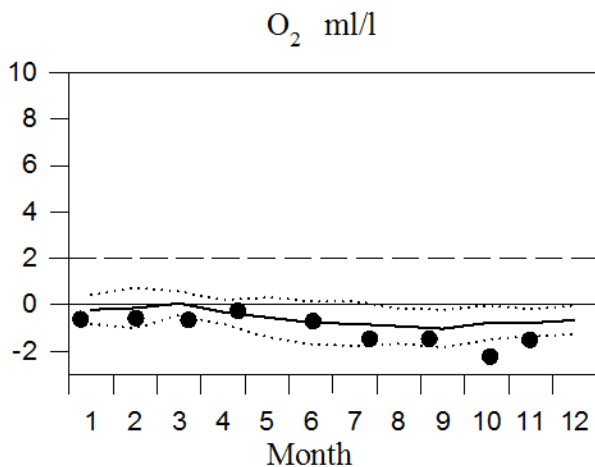
STATION BY38 SURFACE WATER

Annual Cycles

— Mean 1996-2010 St.Dev. ● 2015

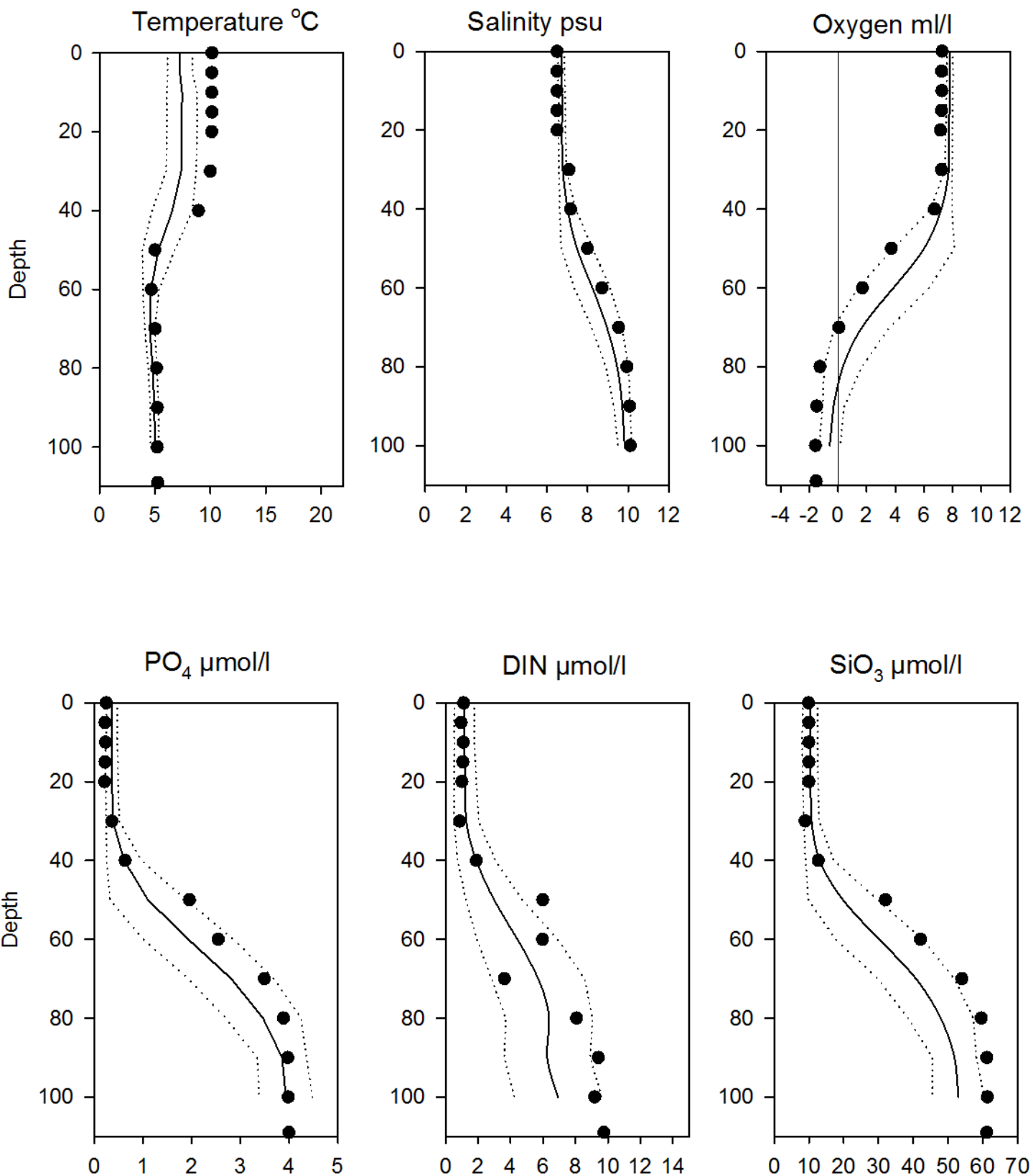


OXYGEN IN BOTTOM WATER (> 100m)



Vertical profiles BY38 November

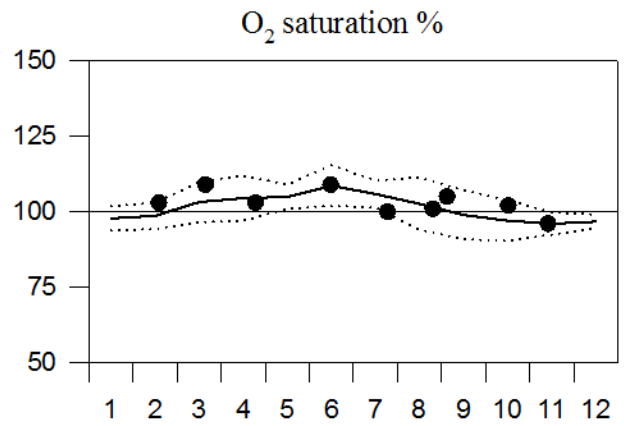
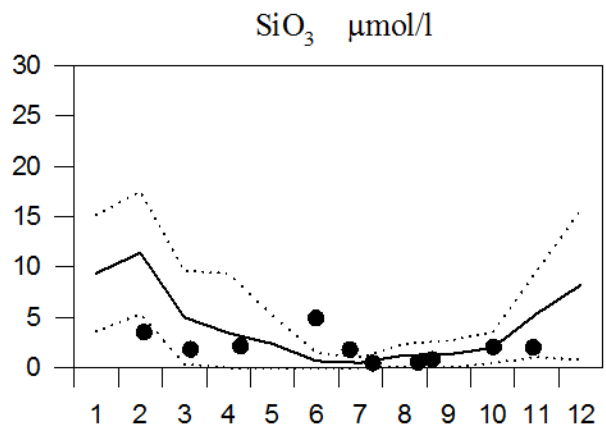
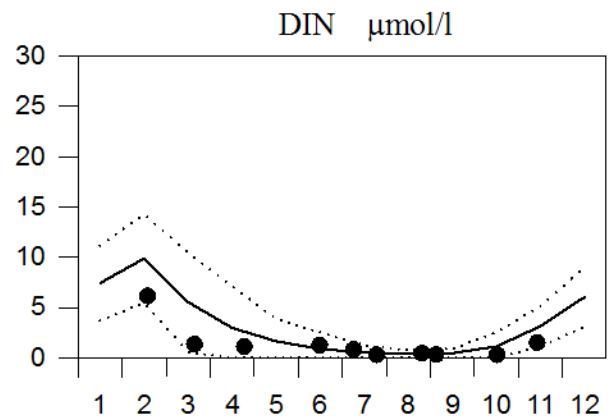
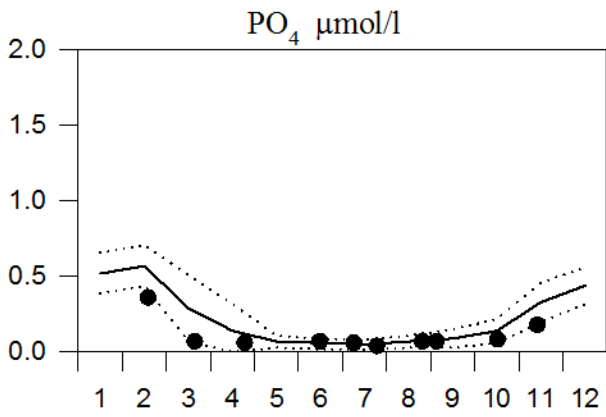
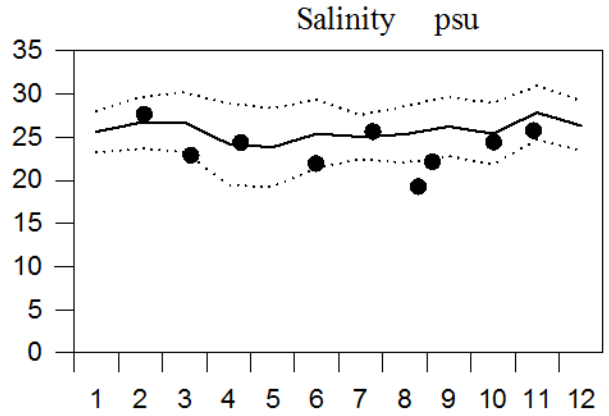
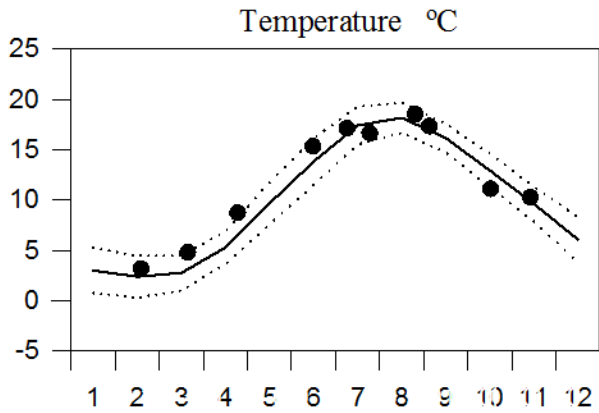
— Mean 1996-2010 St.Dev. ● 2015



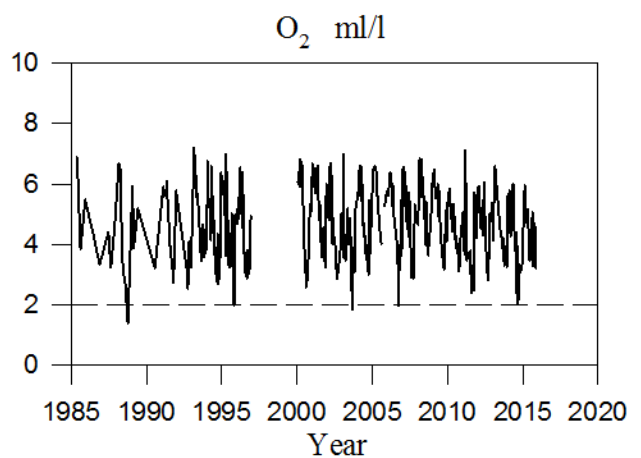
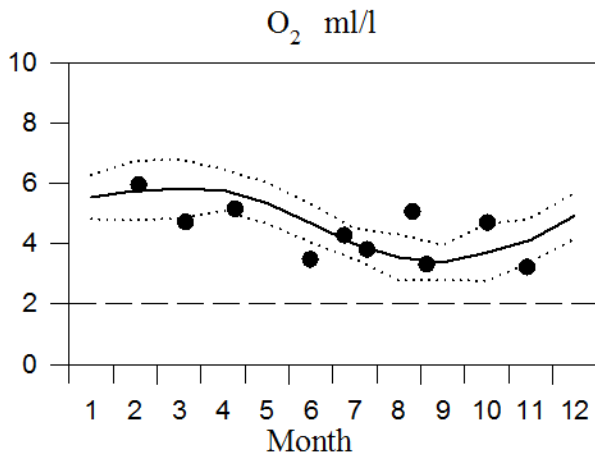
STATION SLÄGGÖ SURFACE WATER

Annual Cycles

— Mean 1996-2010 St.Dev. ● 2015

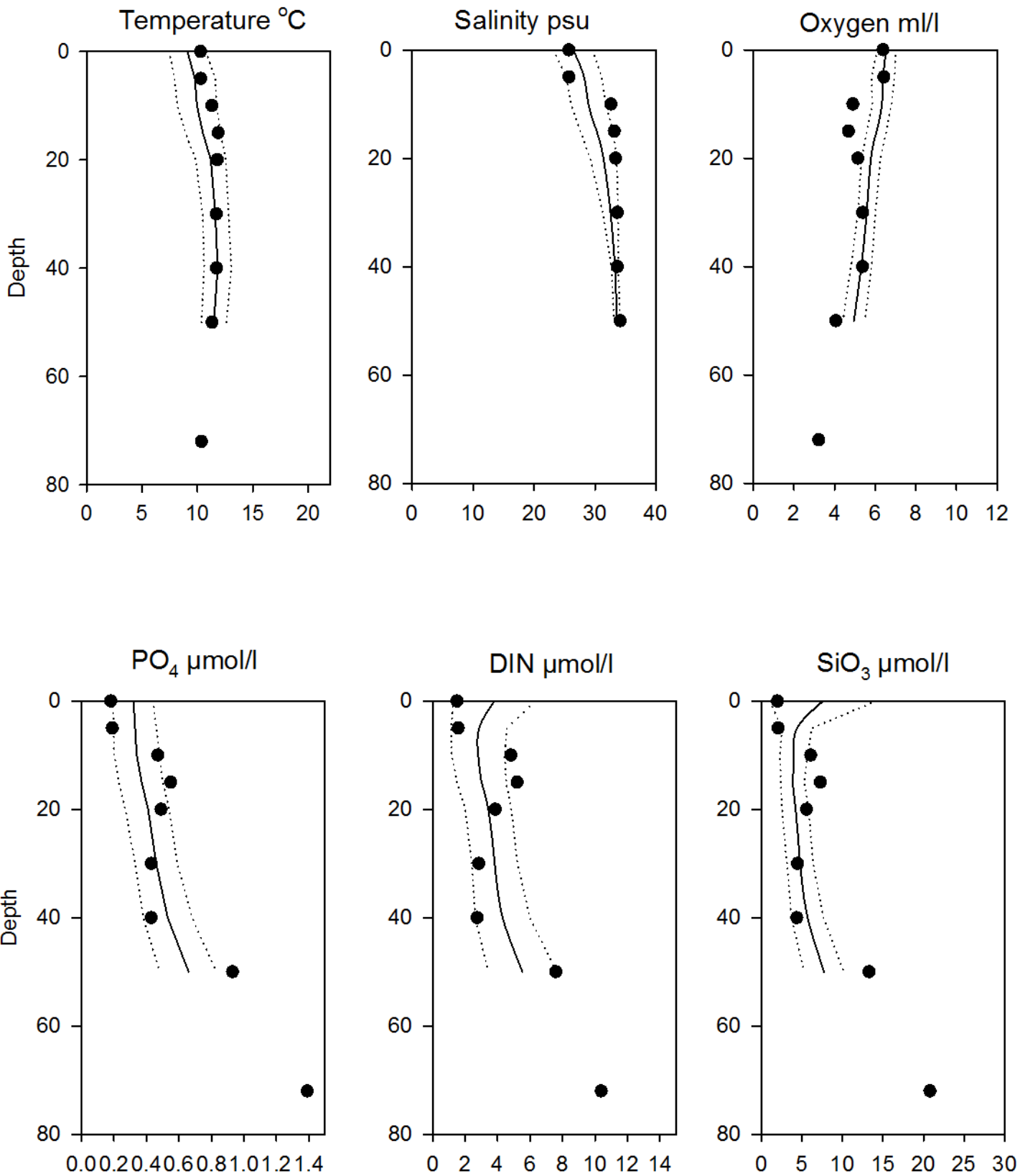


OXYGEN IN BOTTOM WATER (depth >50m)



Vertical profiles Släggö November

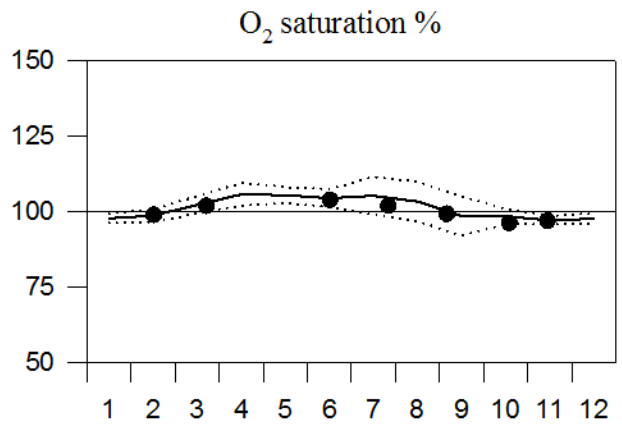
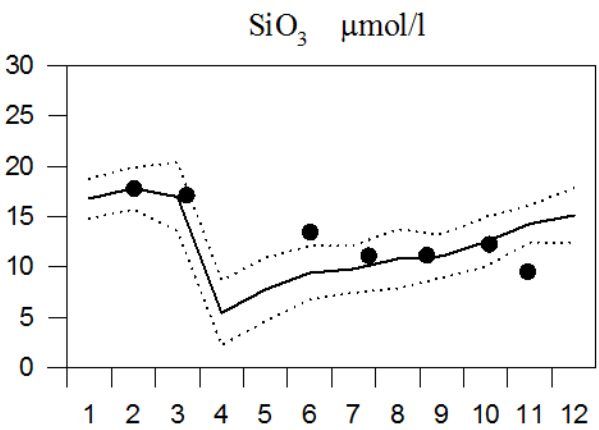
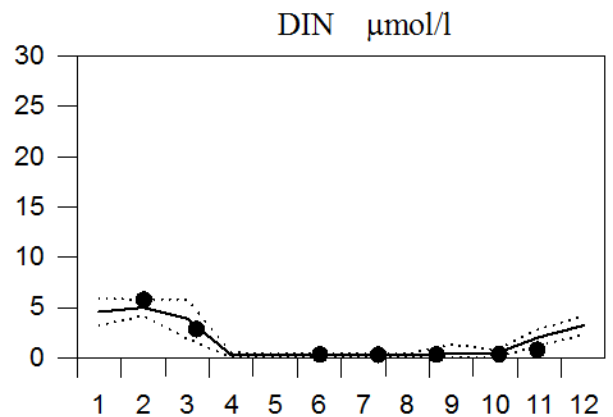
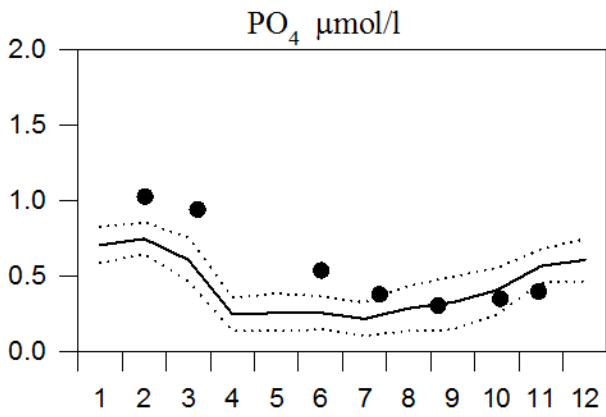
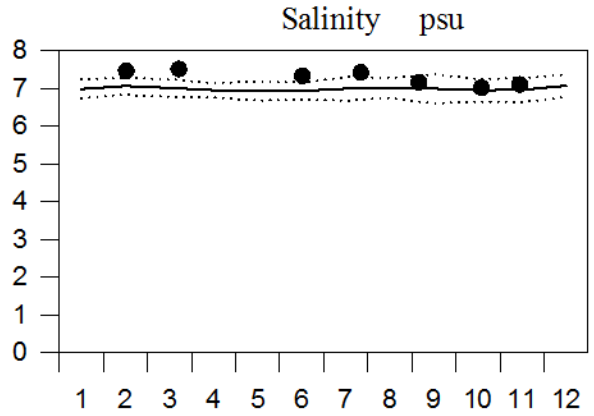
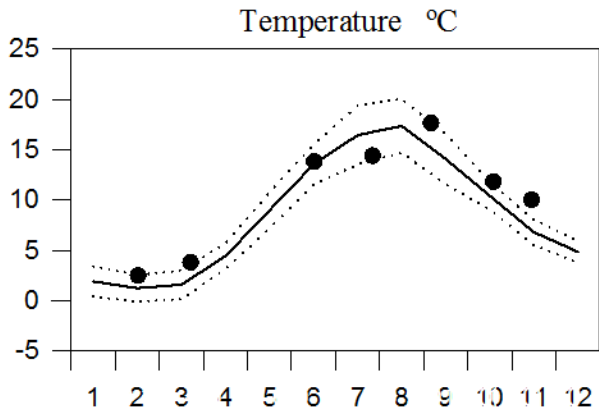
— Mean 1996-2010 St.Dev. ● 2015



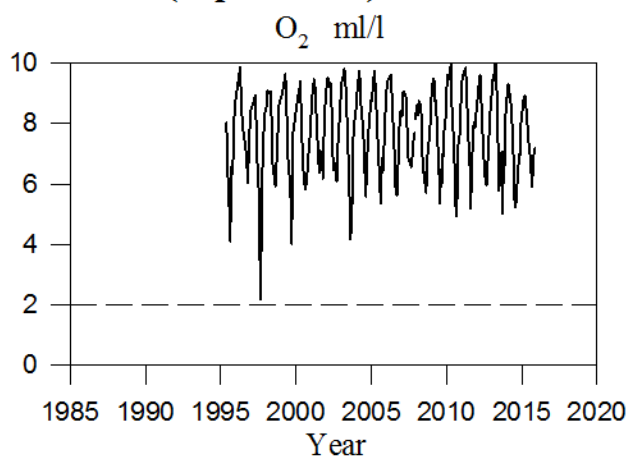
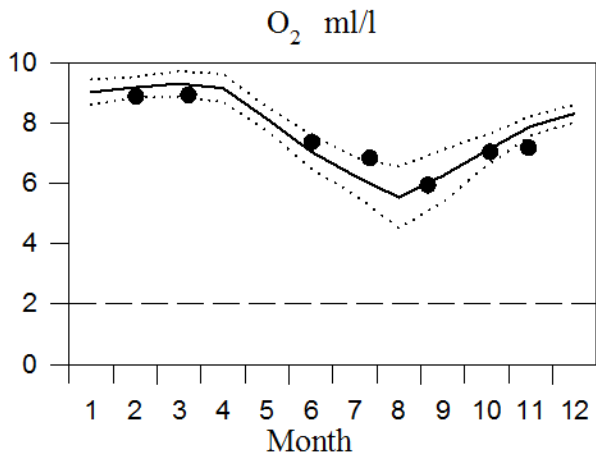
STATION REF M1V1 SURFACE WATER

Annual Cycles

— Mean 1996-2010 St.Dev. ● 2015



OXYGEN IN BOTTOM WATER (depth >15m)



Vertical profiles Ref M1V1 November

— Mean 1996-2010 St.Dev. ● 2015

