

## Rapport från SMHIs utsjöexpedition med R/V Aranda



**Expeditionens varaktighet:** 2015-03-16 - 2015-03-23  
**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 Kattegatt samt Skagerraks kustvatten pågick vårblomningen för fullt och närsalterna uppvisade låga halter. I Östersjön hade blomningen startat i Arkona medan det rådde vinterförhållanden i övriga Östersjön. Höga fosfat- samt silikathalter registrerades i västra Gotlandsbassängen. Effekterna av inflödet under december 2014 syntes nu tydligt i stora delar av Östersjön. I västra Gotlandsbassängen var syresituationen dock fortfarande allvarlig då akut syrebrist förekom från djup överstigande 70 - 80 meter och svavelväte från ca 100 meters djup.

Nästa ordinarie expedition är planerad till vecka 17 i april 2015.

## **PRELIMINÄRA RESULTAT**

Expeditionen genomfördes ombord det finska forskningsfartyget Aranda och startade i Helsingfors den 16:e mars och avslutades i samma hamn den 23:e.

Vindarna under expeditionen var i huvudsak svaga till måttliga. Under de sista dyggen ökade dock vinden och vid ett par tillfällen rådde kulingstyrka. Lufttemperaturen varierade mellan -1 och 6°C. Två forskare från Helsingfors Universitet var med ombord för att mäta N<sub>2</sub>O i hypoxiska vatten.

### **Skagerrak**

Ytvattentemperaturen var normal för årstiden och låg mellan 4.2 och 4.8 °C. Salthalten i ytlagret varierade från 22 psu invid kusten till normala 31 psu i de centrala delarna. Haloklinen stäckte sig från ytan ner till ett djup av ca 20 m. En markerad termoklin återfanns endast vid stationen Å17, längst västerut och låg där på 20 meters djup.

Närsalterna i ytvattnet var i stort sett förbrukade invid kusten, medan de uppvisade normala halter längre västerut. Fosfatkoncentrationerna i ytvattnet låg i intervallet 0.05 och 0.13 µmol/l, nitrit + nitrat varierade från under detektionsgränsen (< 0.10µmol/l) till 2.1 µmol/l, medan halterna av silikat varierade mellan 0.3 och 0.7 µmol/l.

Fluorescensmätningar tillsammans med syremättnad visade att vårbloomingen fortfarande pågick och det förekom fluorescensstoppar på 10 till 20 meters djup.

### **Kattegatt och Öresund**

Temperaturen i ytvattnet, var normal för årstiden och låg mellan 4 och 5°C. I norra Kattegatt var ytsalthalten normal, 21.5psu. I de södra delarna sjönk den från normala 19.2 till 16.6 psu, vilket är klart under medel, på en tid av ett och ett halvt dygn. I Öresund var temperaturen 4.5°C och salthalten 9.4 psu. Haloklin och termoklin låg på 15 till 20 meters djup, termoklinen dock svagt utvecklad. En mycket skarp haloklin registrerades i Öresund på ett djup av 15 meter.

Halterna av näringsämnen, i ytvattnet, hade sjunkit kraftigt sedan föregående besök i februari. Vårbloomingen pågick fortfarande och höga fluorescensvärden uppmättes i anslutning till haloklinen. Fosfatkoncentrationerna låg mellan 0.05 och 0.11 µmol/l, silikat i intervallet 1 till 2 µmol/l. I Öresund var mosvarande värden 0.29 för fosfat och 4 µmol/l för silikat. Oorganiskt kväve låg under detektionsgränsen i hela området.

De lägsta syrehalterna i bottenvattnet uppmättes vid Anholt E i Kattegatt, 5.9 ml/l samt vid W Landskrona i Öresund, 5.6 ml/l.

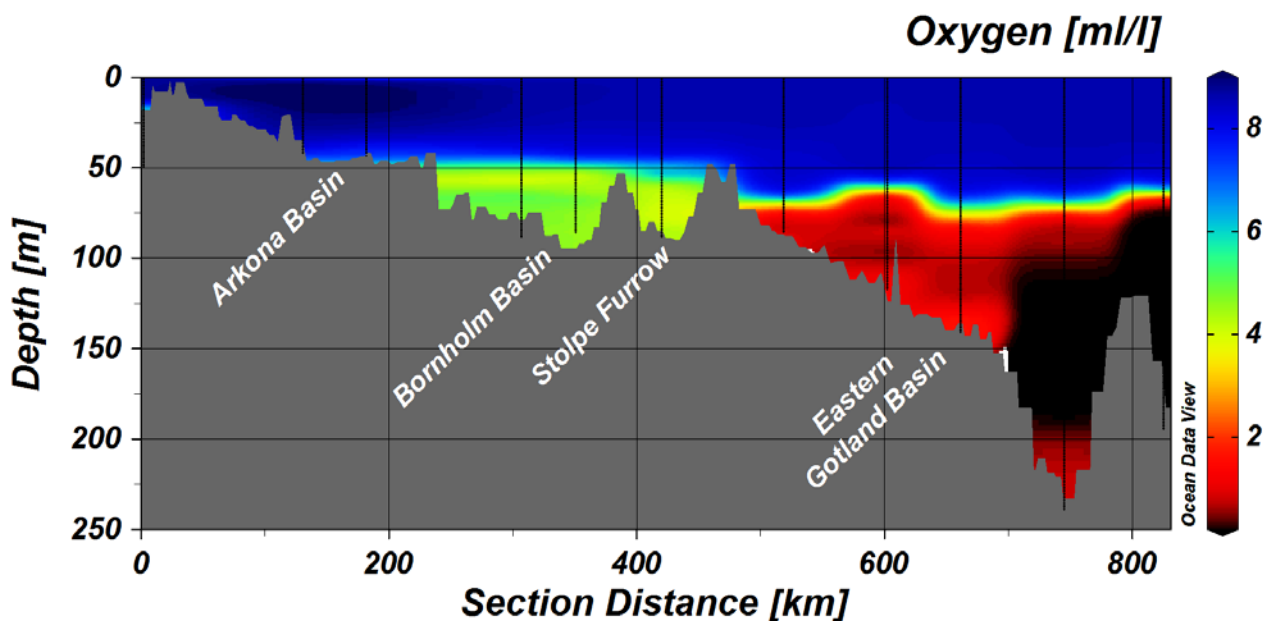
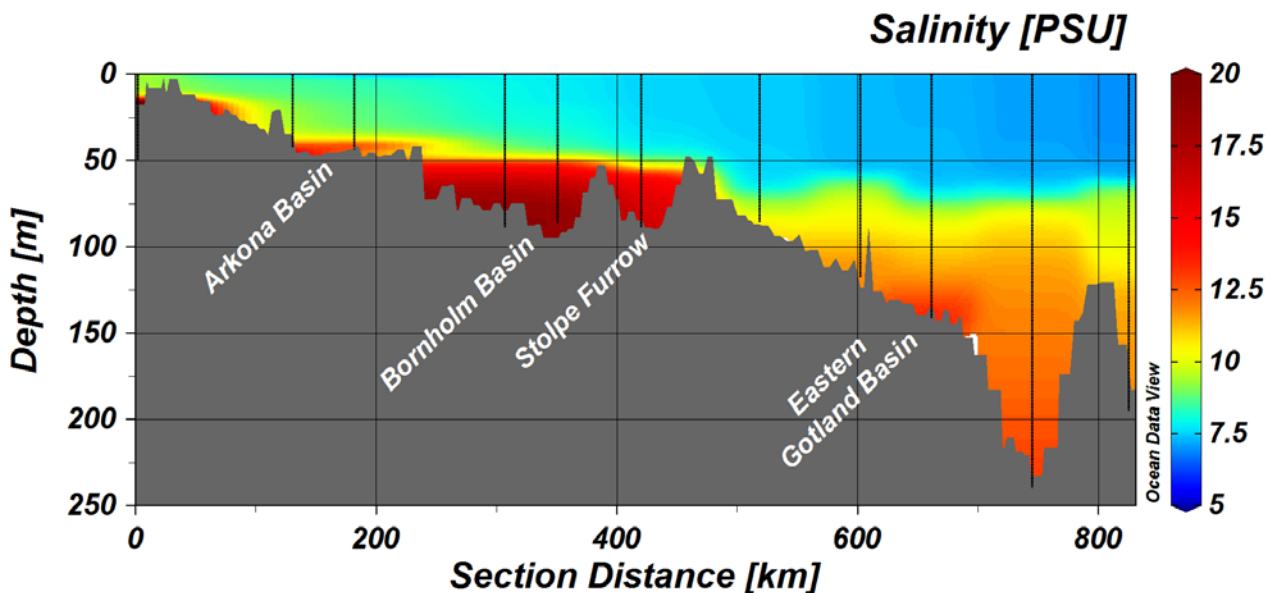
### **Egentliga Östersjön**

Vattentemperaturen i ytskiktet låg strax över medel för årstiden och varierade från 3.5°C i norr till 4.4°C i sydväst. Ytsalthalten var något över det normala i Arkonabassängen 8.8 psu och något under medel, 7.1 psu, i östra Gotlandsbassängen, i övrigt normal ökande från 6.9 psu i norr till 7.9 psu i söder. Haloklinen återfanns på 60 till 80 meters djup i västra och östra Gotlandsbassängerna, medan den låg grundare i de södra delarna, på djup mellan 40 och 50 meter.

Närsalterna uppvisade i stort sett normala halter för årstiden i ytlagret, med undantag för västra Gotlandsbassängen där fosfat och silikat var kraftigt förhöjda, fosfathalterna här låg på 0.9 µmol/l och silikat på 18 µmol/l. I övriga områden varierade halterna inom följande intervall, fosfat 0.2 – 0.8 µmol/l, nitrit + nitrat < 0.10 – 3.4 µmol/l och silikat 4 – 15 µmol/l, med de lägsta värdena i Arkonabassängen där vårbloomingen pågick. I övriga områden var planktonaktiviteten låg.

Effekterna av de inflöden som ägde rum i slutet av 2014, speciellt det stora inflödet under december, syntes nu tydligt i sydost samt i östra Gotlandsbassängen. Bornholmsbassängen var fylld upp till tröskeldjupet med vatten med en salthalt av ca 18 psu och en syrehalt på ca 5 ml/l. I Stolpe

Ränna återfanns vatten med en salthalt på 16 psu och en syrehalt på 4 ml/l på djup överstigande 60 meter. Även i östra Gotlandsbassängen syntes nu effekterna av det stora inflödet, även om det djupvatten som nu nått dit snarare härrör från de tidigare inflödena under 2014. Vid stationen BY15, Gotlandsdjupet, förekom nu svavelväte intermediärt mellan 120 och 190 meters djup, medan bottenvattnet var syresatt med en syrekonzentration på ca 1 ml/l. Salthalten i bottenvattnet hade ökat från 12.4 psu vid besöket i februari till 13.2 psu.



Arkona- och Bornholmsbassängen samt Hanöbukten var väl syresatta. Generellt sett förekom akut syrebrist från 70 till 80 meters djup. Svavelväte förekom i norra delen av östra Gotlandsbassängen från 90 meters djup samt i västra Gotlandsbassängen på djup överstigande 100 meter.

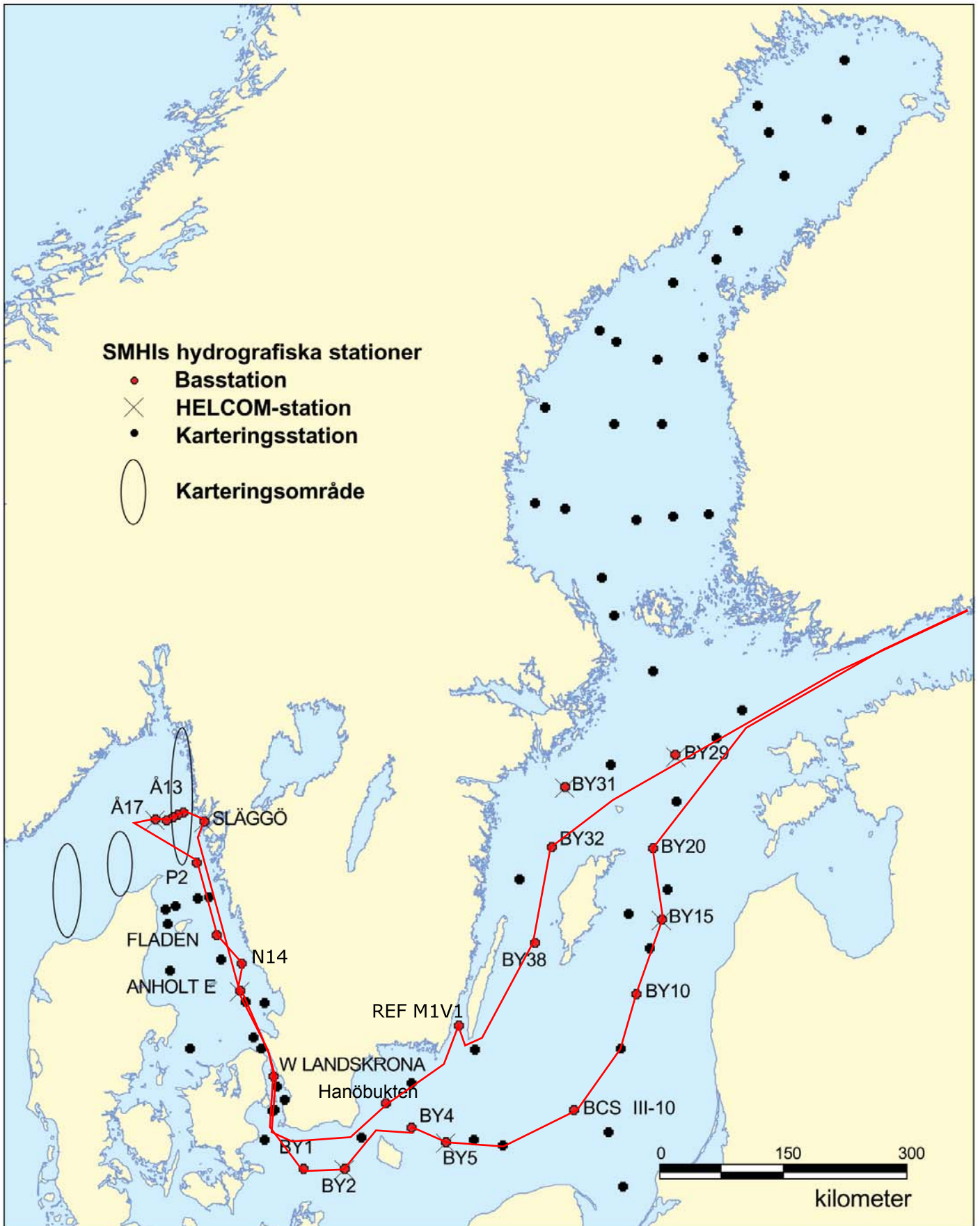
## **DELTAGARE**

<b>Namn</b>		<b>Från</b>
Anna-Kerstin Thell	Expeditionsledare	SMHI
Lars Andersson (Lysekil-Helsingfors)		SMHI
Daniel Bergman-Sjöstrand		SMHI
Martin Hansson (Helsingfors-Lysekil)		SMHI
Sara Johansson		SMHI
Sari Sipilä		SMHI
Magnus Wenzer		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: 20150316-20150323  
Series: 0145-0176





SMHI  
Ocean enh

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\*\*\*\*\* Hydrographic series

Ship: 01-Aranda  
Year: 2015

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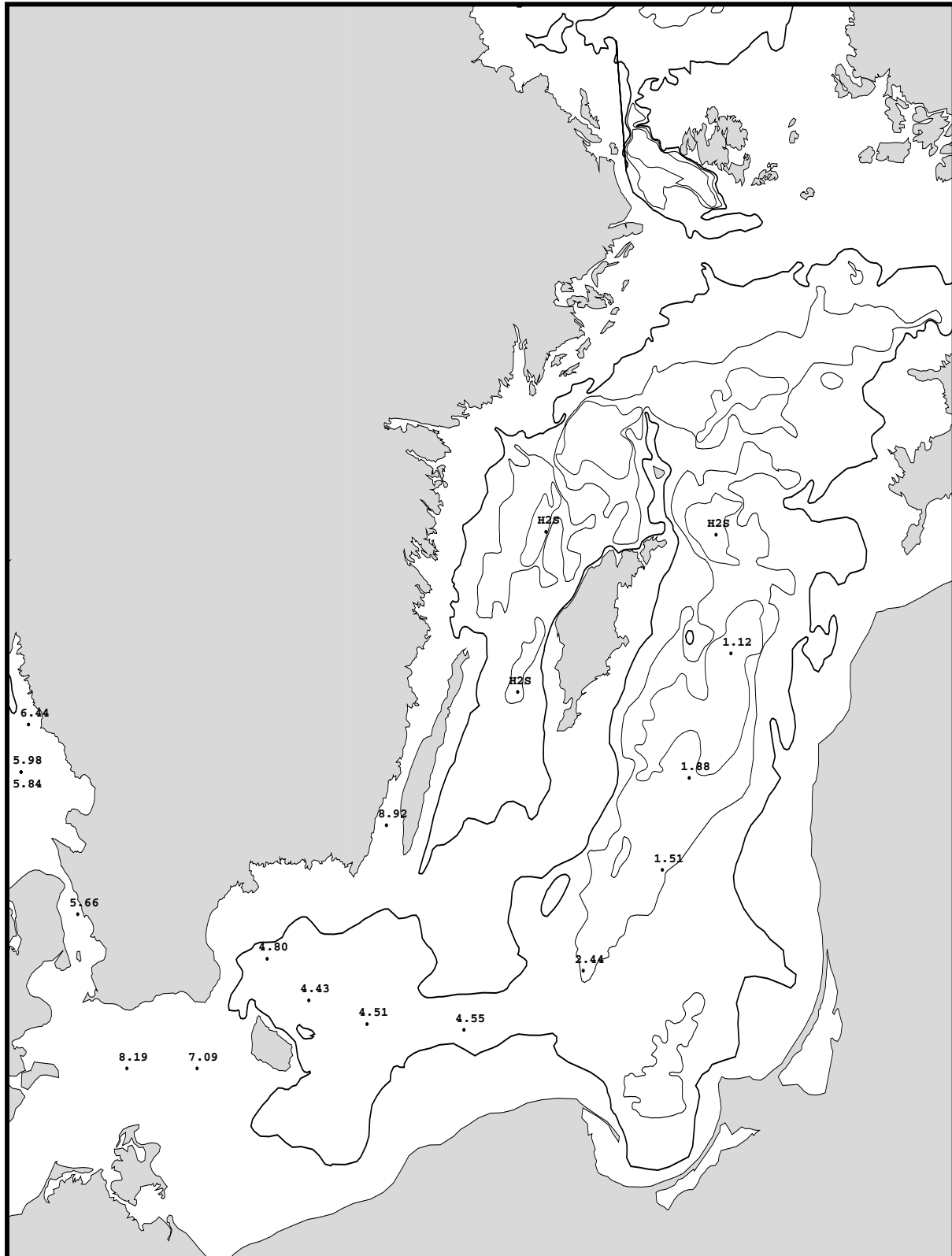
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Time: 11:39

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 Hrhhoor d Cilyooa m l y S 4 t 2 3 4 t k 0 m g N C C m	PCPZT No	T de e a h x 2 o o o o h o l i u i O O O o	S x	P x	O x	H x	P 2	T o o o o	N h o l i u i	N O O O o	T h o l i u i	A O O O o	S h o l i u i	H O O O o	L O O O o	P O O O o	P O O O o	T O O O o	C O O O o				
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0173	BPSE00EXT	4.5	NO ÖLANDS SÖDRA	N5610.06	E1638.64	20150322	0640	60		36 6	0.1	1029	1330	x	9	x	x	-	x	-	x	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	x
0174	BPWX00EXT	14	SE KAPELLUDDEN	N5639.5	E1710.13	20150322	1040	84		24 8	1.2	1027	1530	x	11	x	x	-	x	-	x	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
0175	BPWX45BAS	BY38	KARLSÖDJ	N5707	E1740	20150322	1410	110	11	24 11	2.3	1023	2730	x --x----	14	x	x	-	x	x	x	x	x	x	x	x	x	-	x	-	-	-	-	-	-	-	-
0176	BPWX38BAS	BY32	NORRKÖPINGSDJ	N5801	E1759	20150322	1945	202		14 13	2.7	1017	9990	x --x----	17	x	x	-	x	x	x	x	x	x	x	x	-	x	-	-	-	-	-	-	-	-	-

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# Bottom water oxygen concentration (ml/l)

Country: Finland  
Ship : Aranda  
Date : 20150317-20150322  
Series : 0145-0176

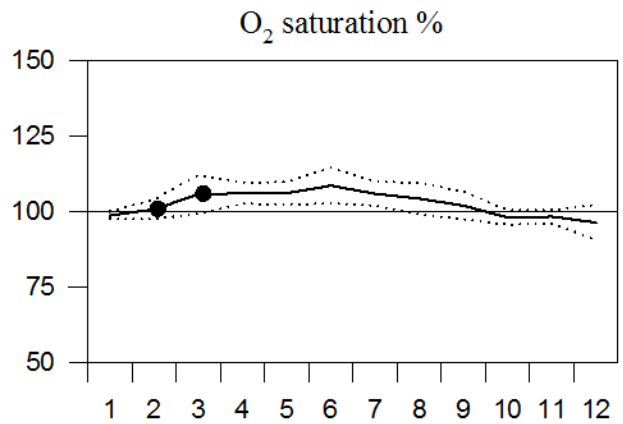
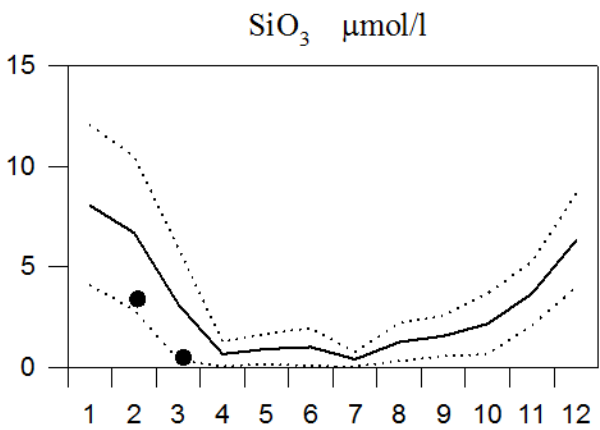
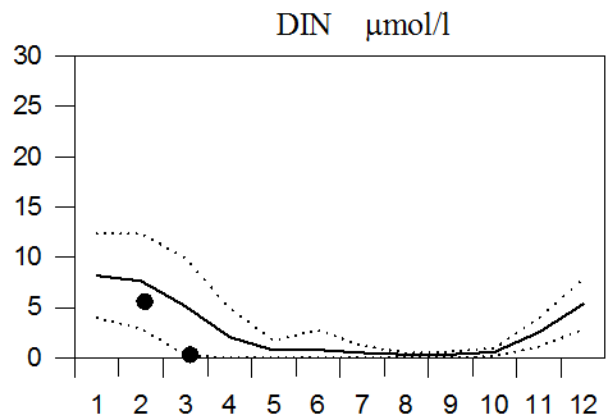
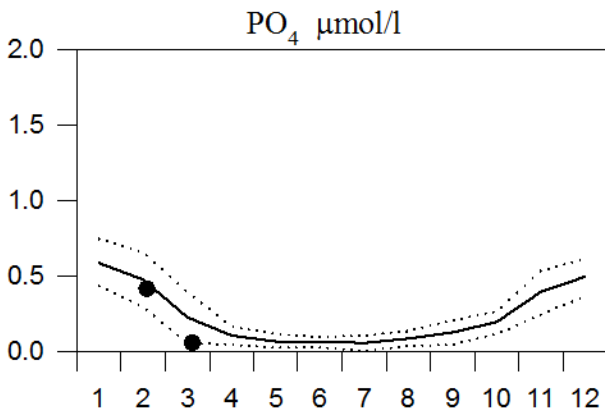
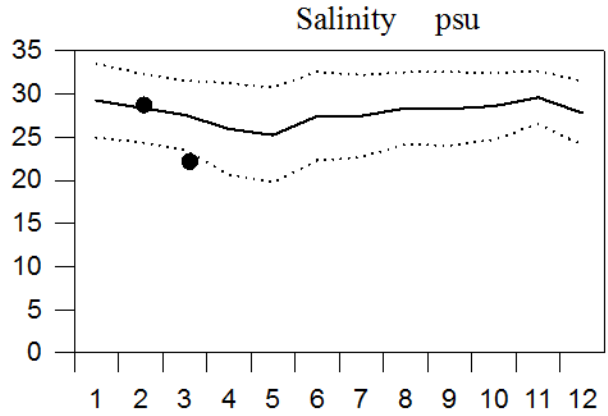
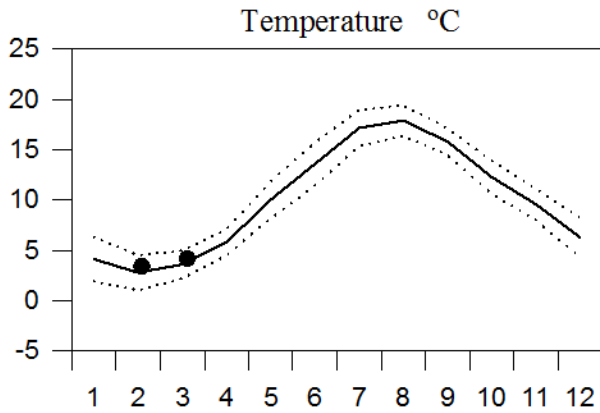




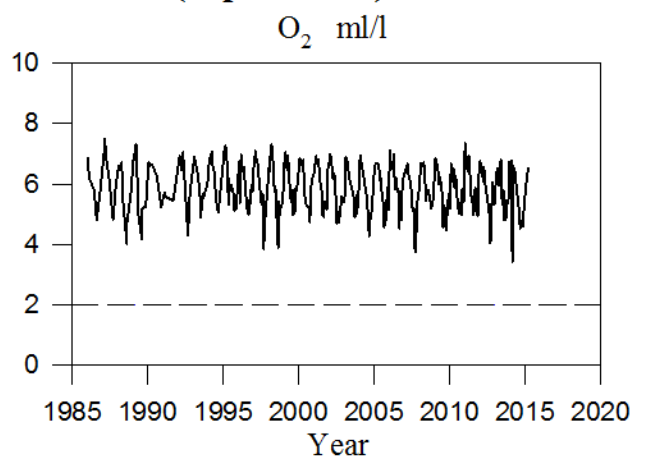
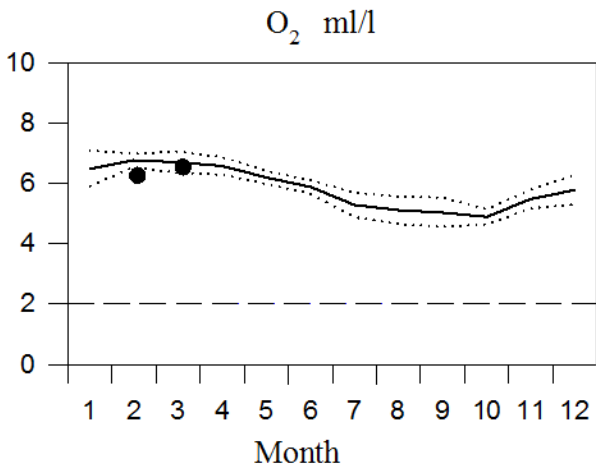
# STATION P2 SURFACE WATER

## Annual Cycles

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

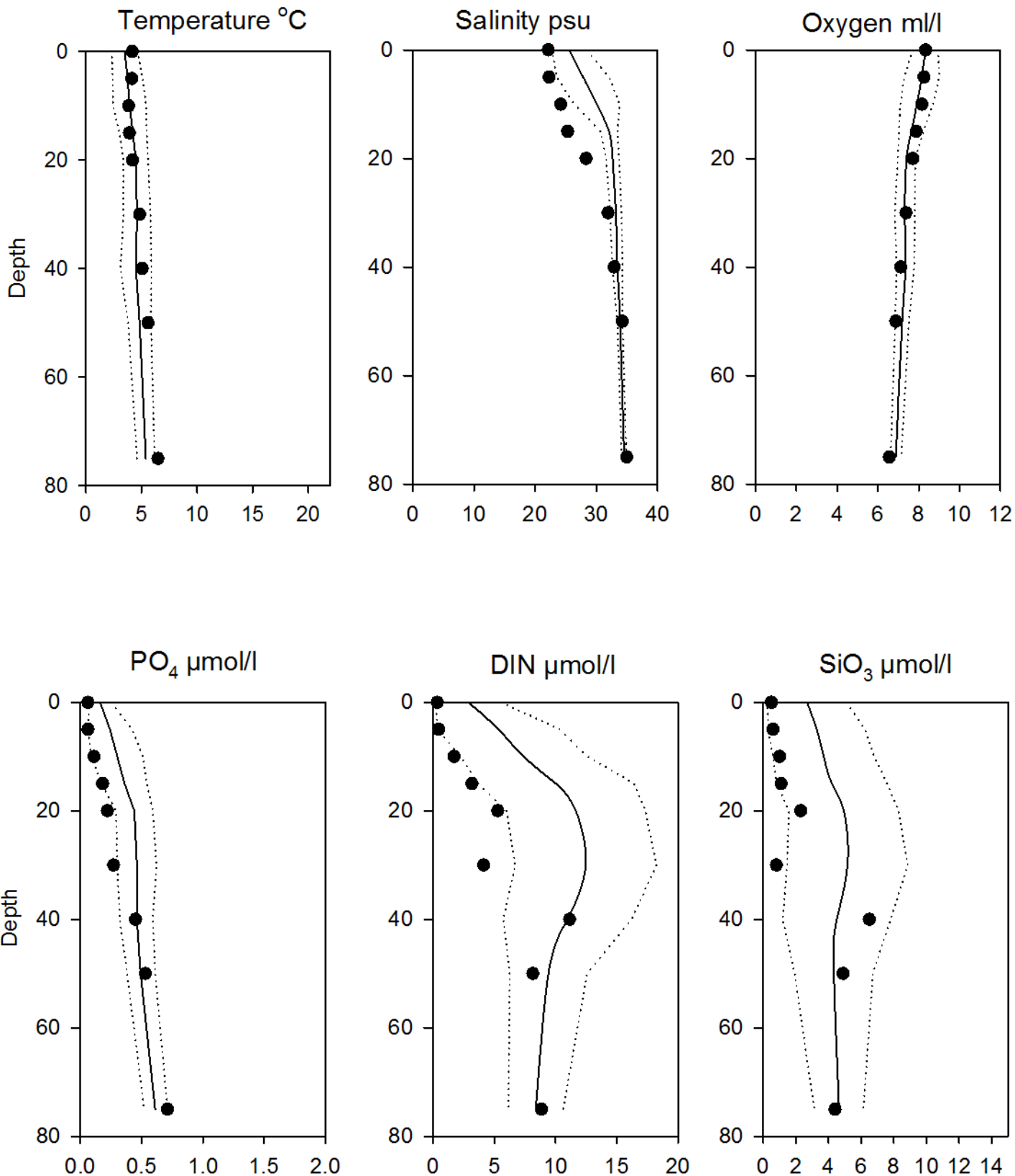


## OXYGEN IN BOTTOM WATER (depth >75m)



# Vertical profiles P2 March

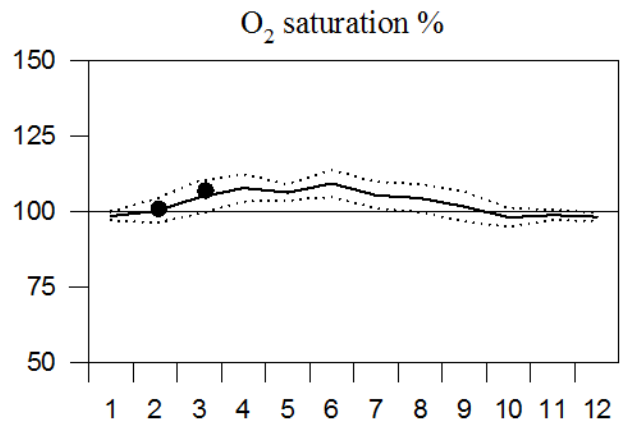
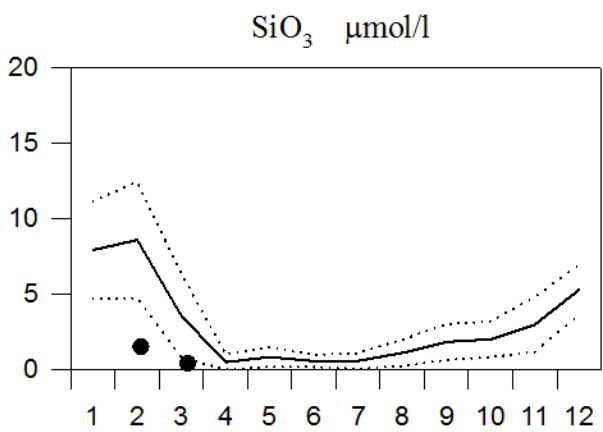
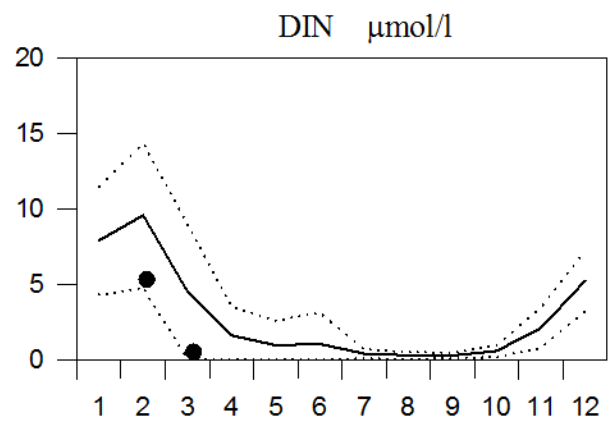
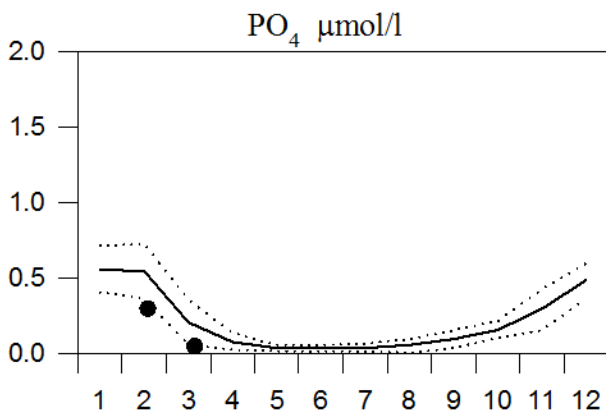
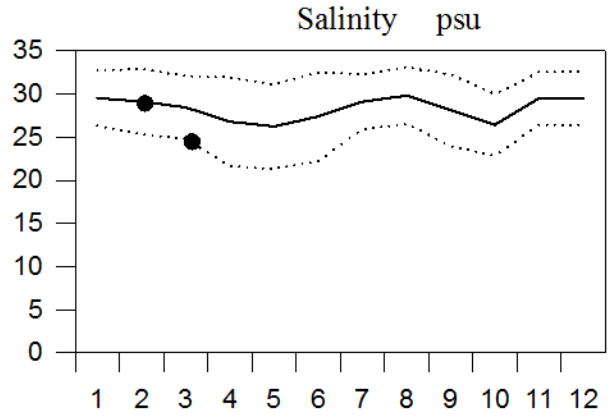
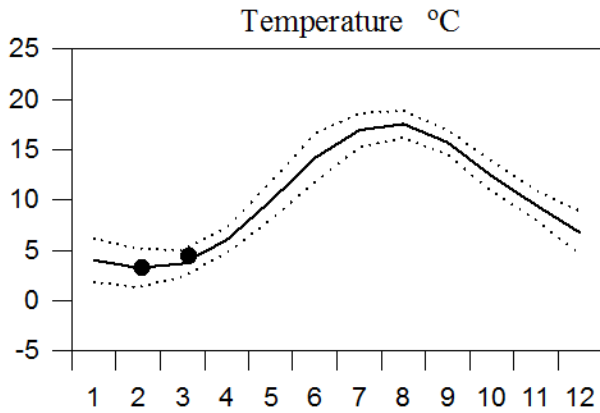
— Mean 1996-2010      ..... St.Dev.      ● 2015



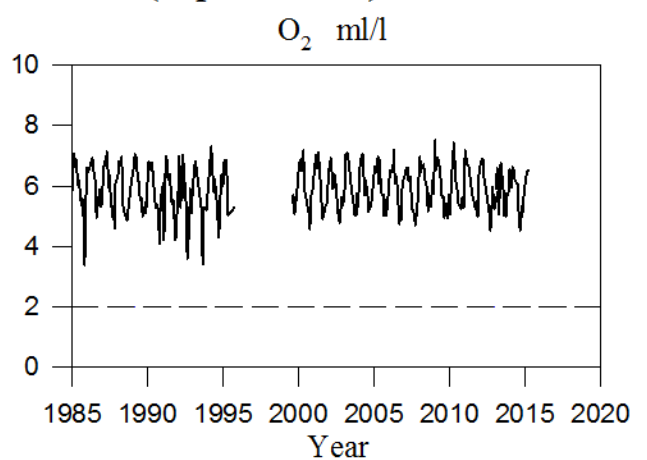
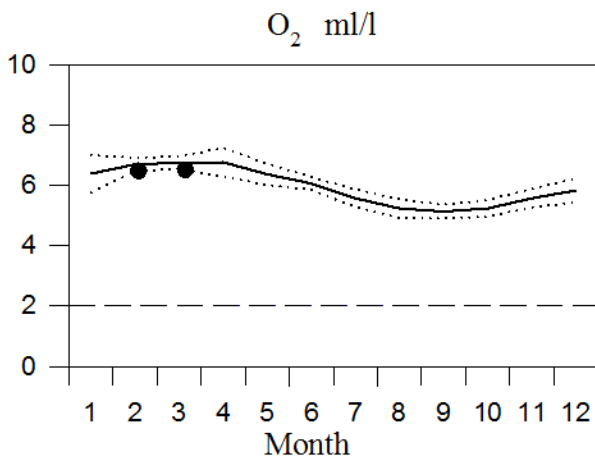
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## Annual Cycles

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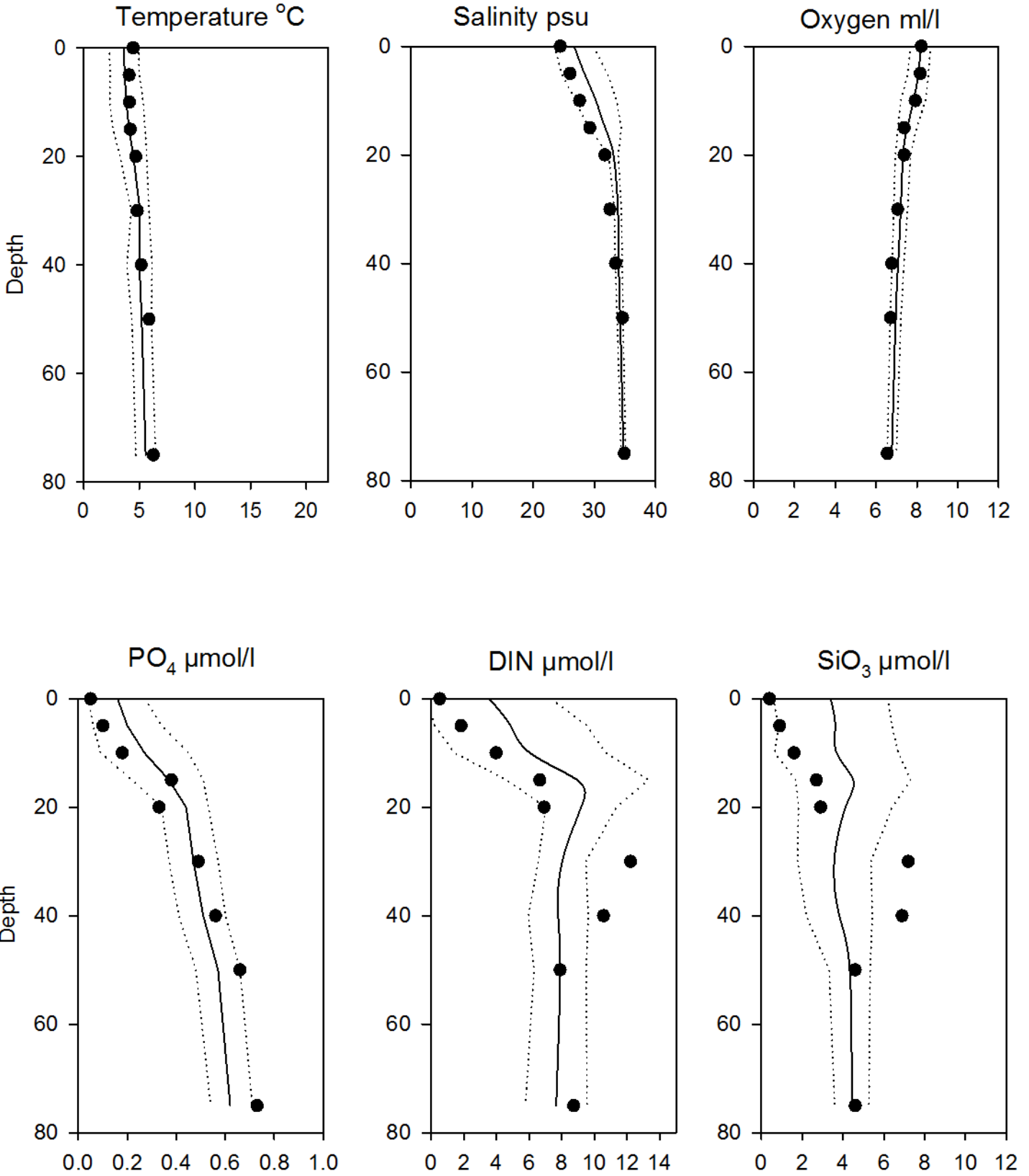


## OXYGEN IN BOTTOM WATER (depth >=75m)



# Vertical profiles Å13 March

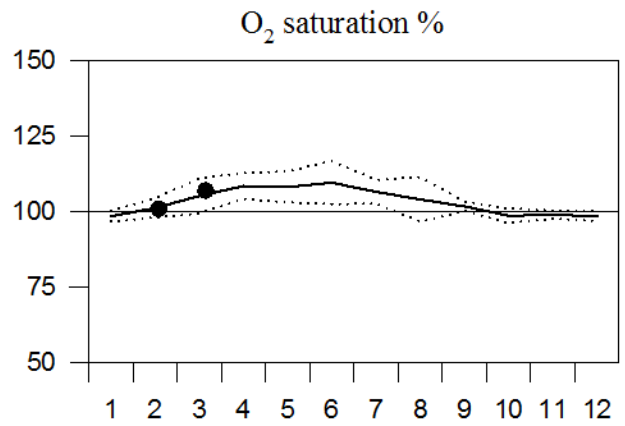
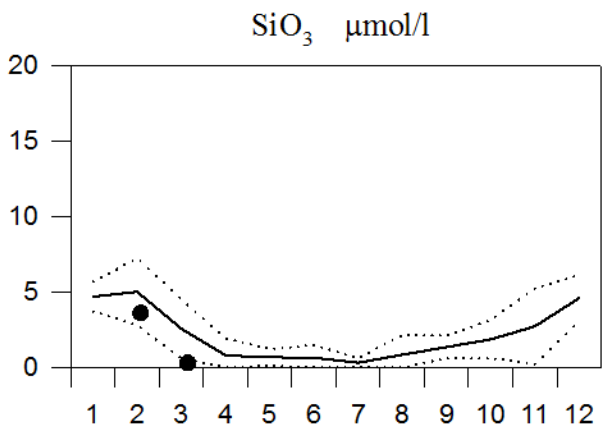
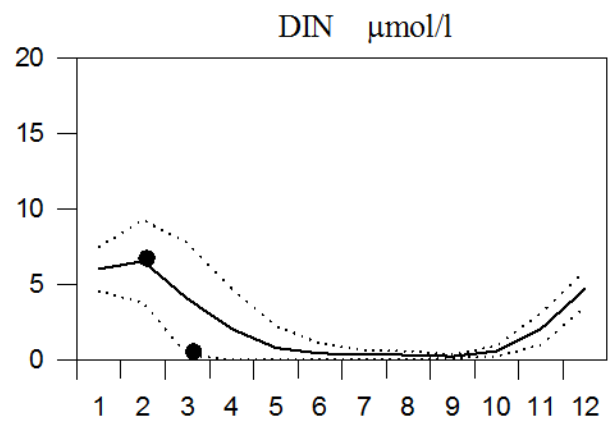
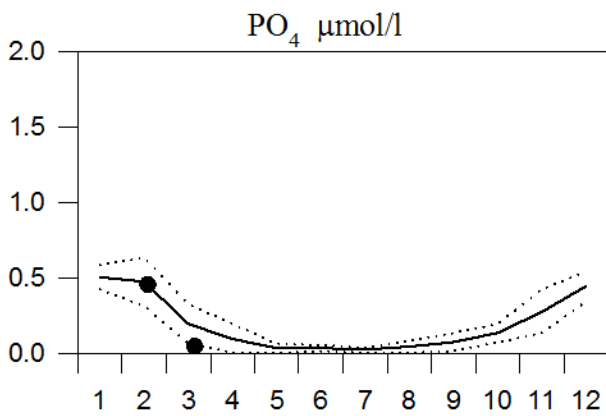
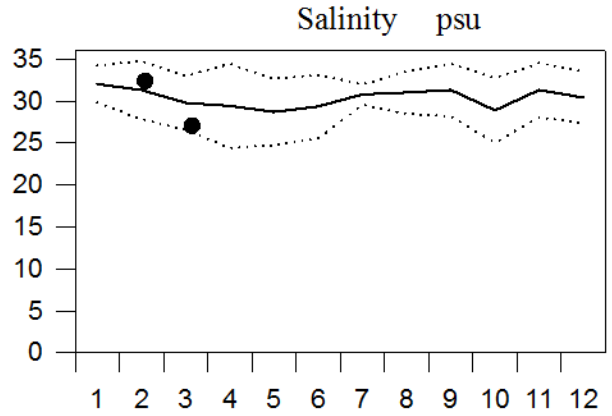
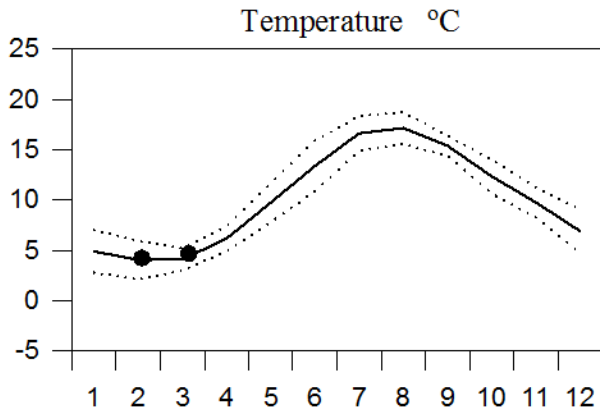
— Mean 1996-2010      ..... St.Dev.      ● 2015



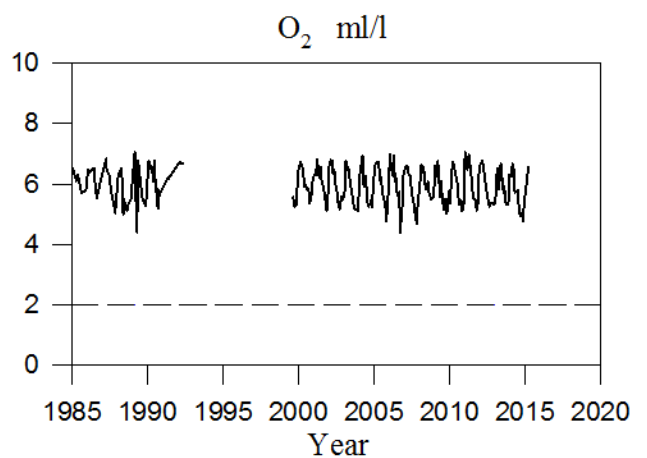
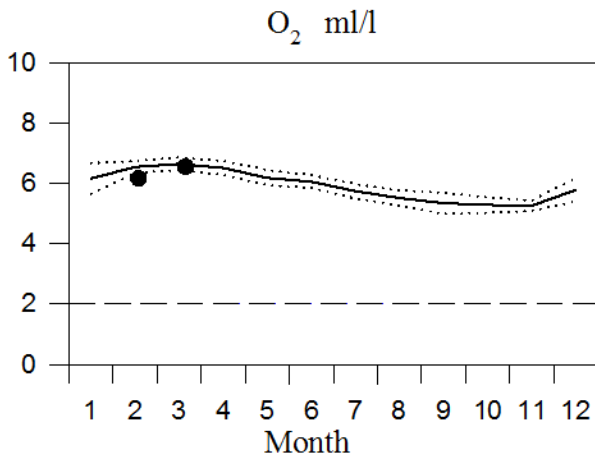
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## Annual Cycles

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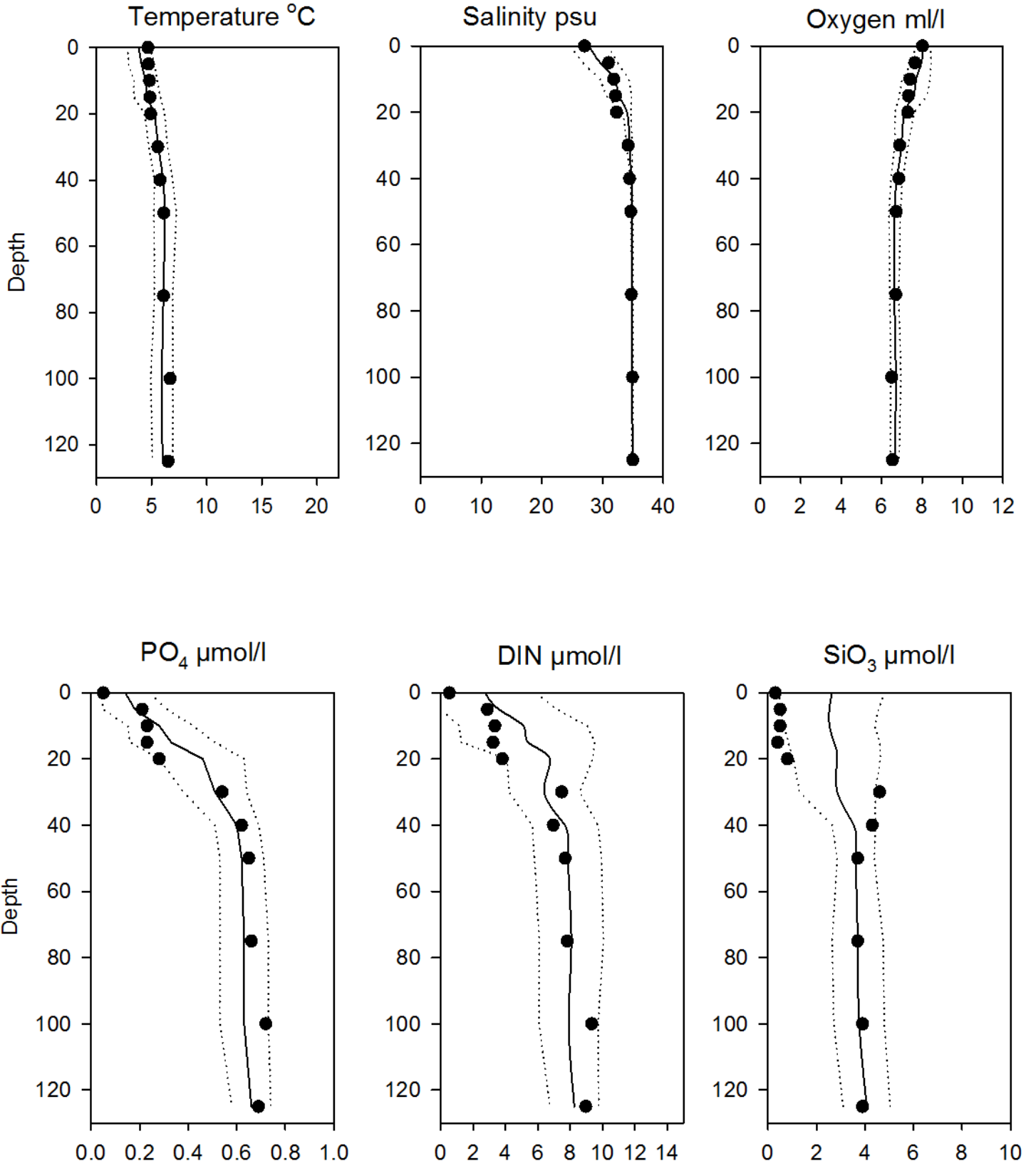


## OXYGEN IN BOTTOM WATER (depth >=125m)



# Vertical profiles Å15 March

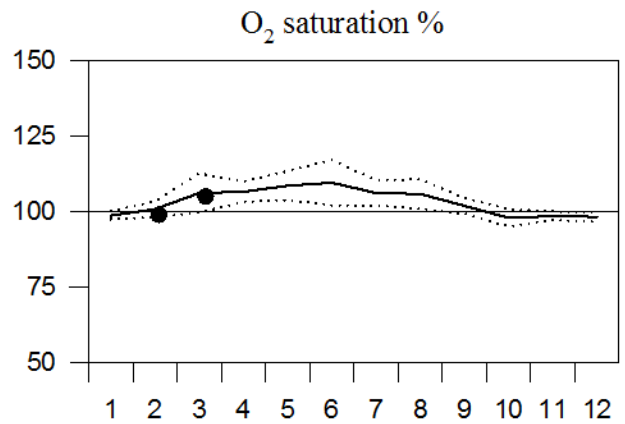
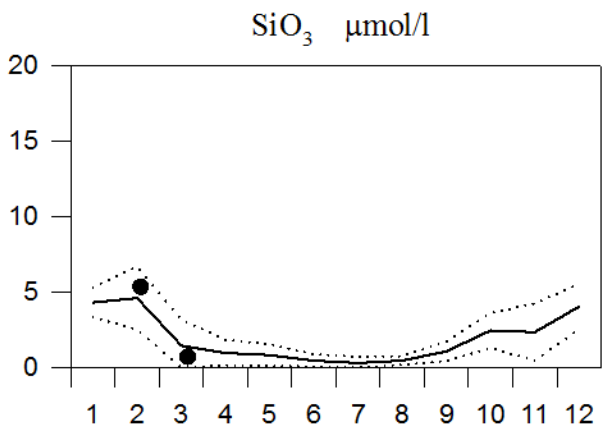
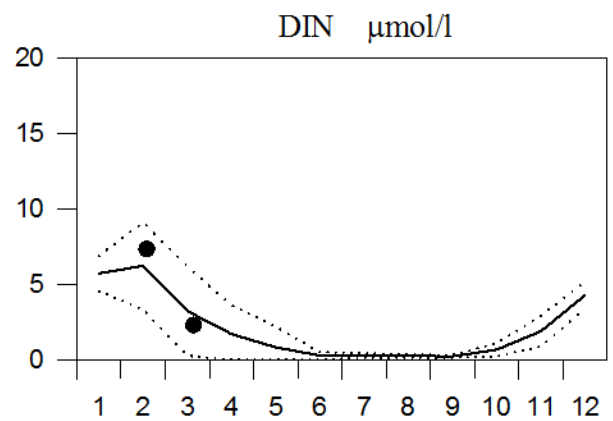
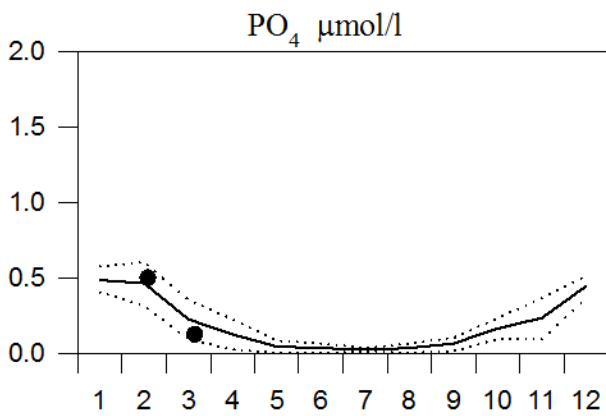
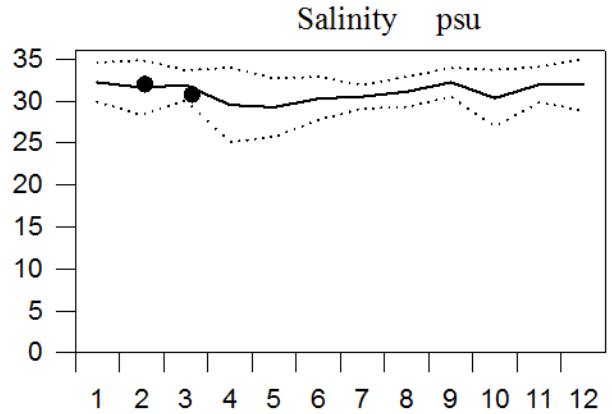
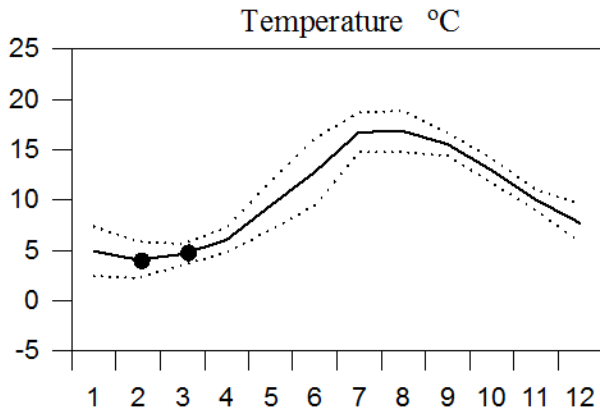
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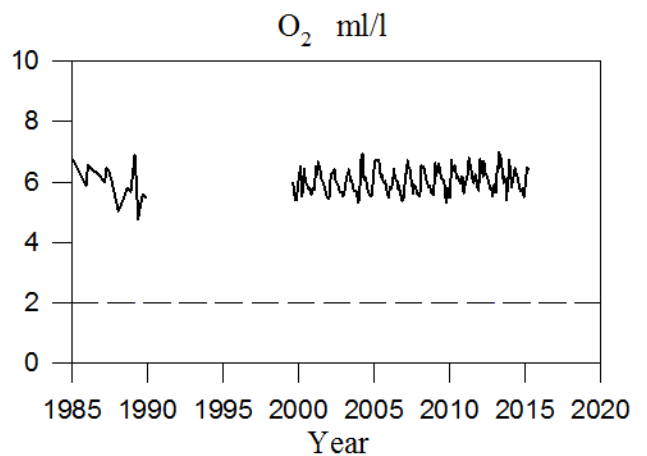
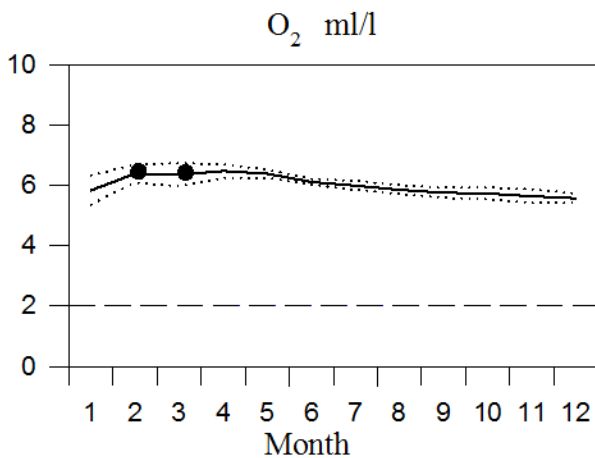
# STATION Å17 SURFACE WATER

## Annual Cycles

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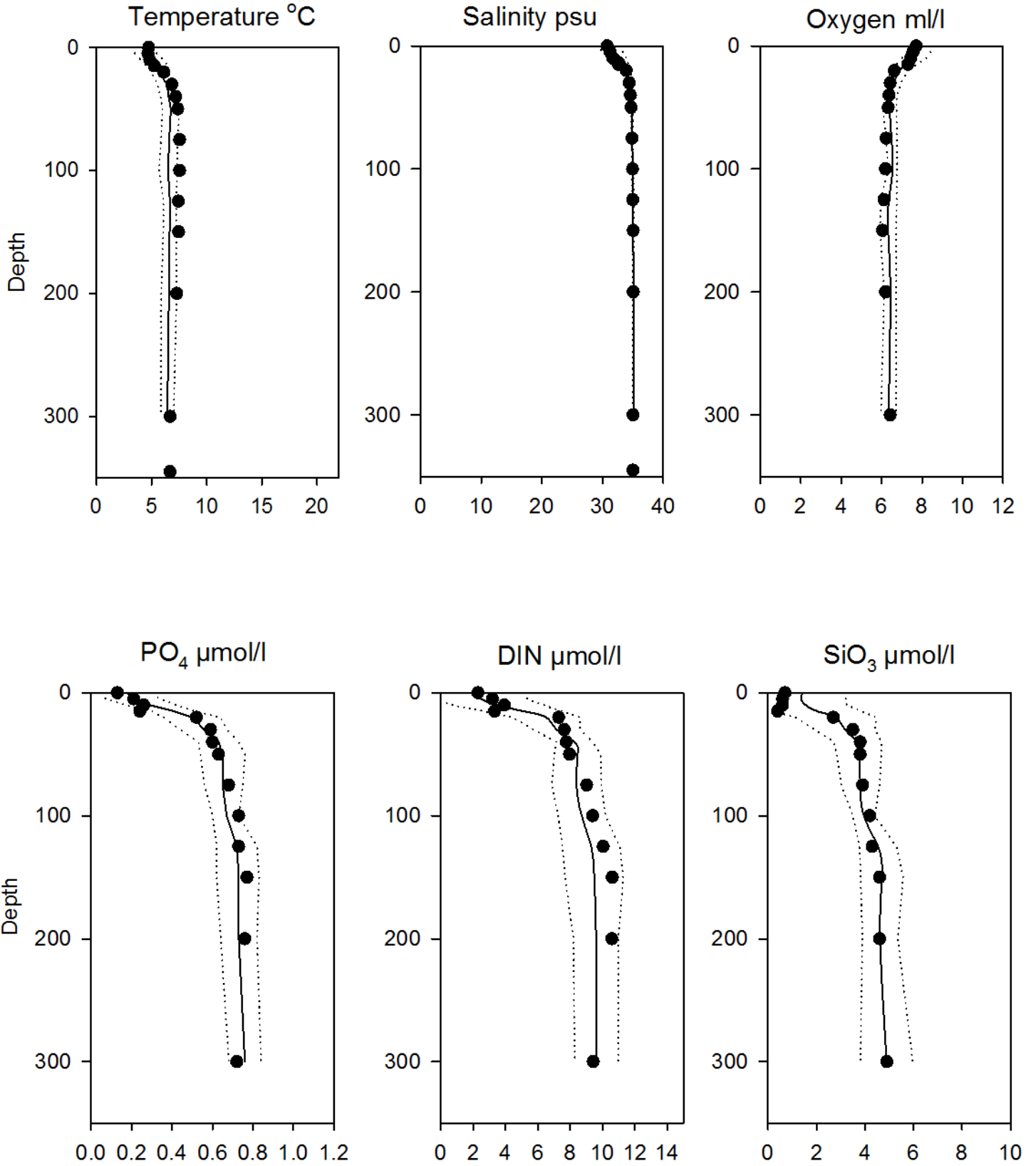


## OXYGEN IN BOTTOM WATER (depth = 300m)



# Vertical profiles Å17 March

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

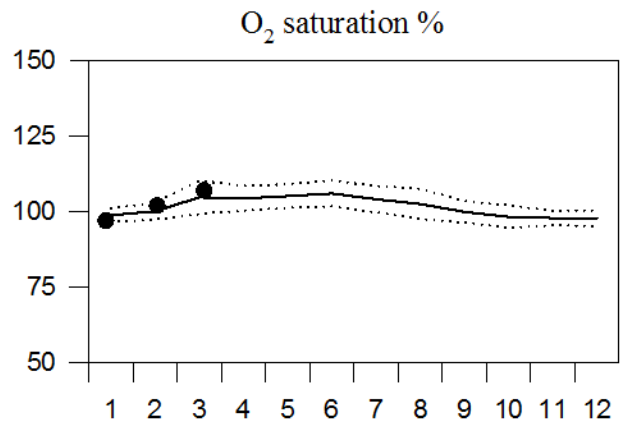
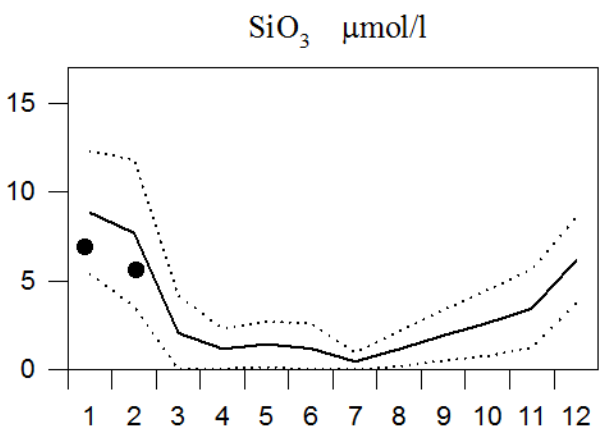
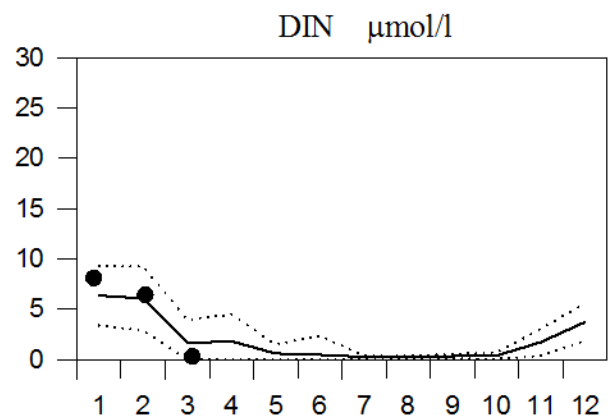
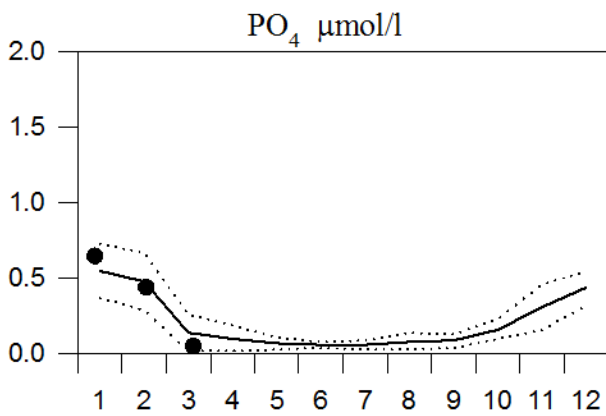
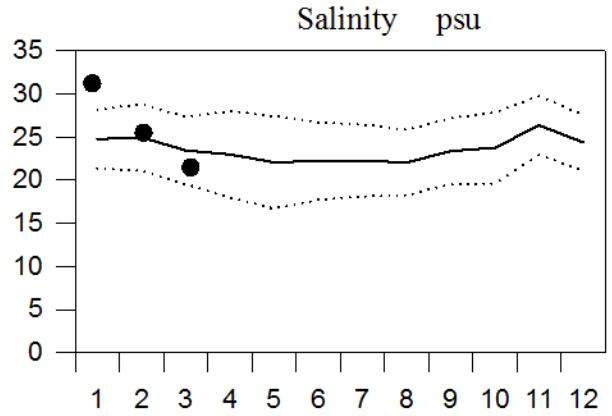
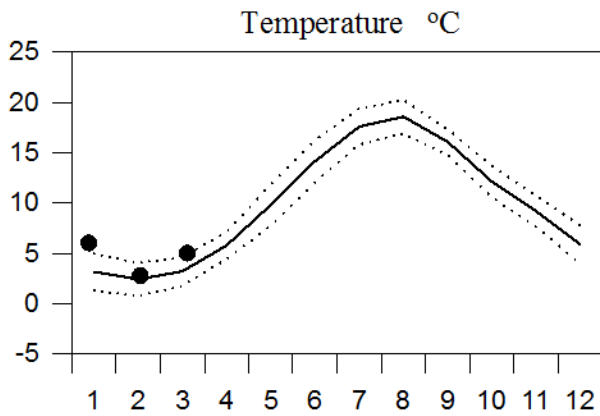




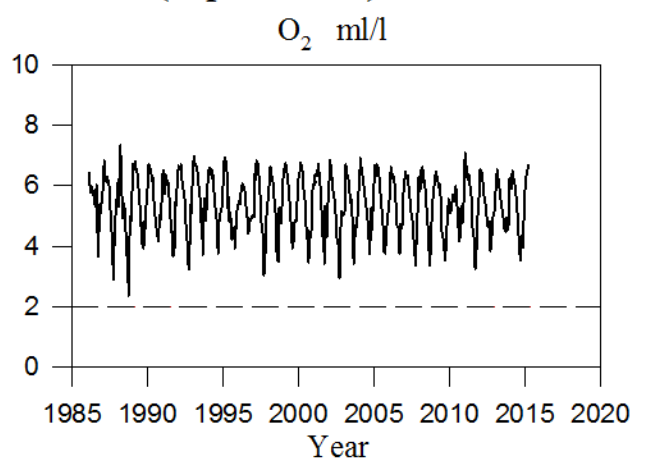
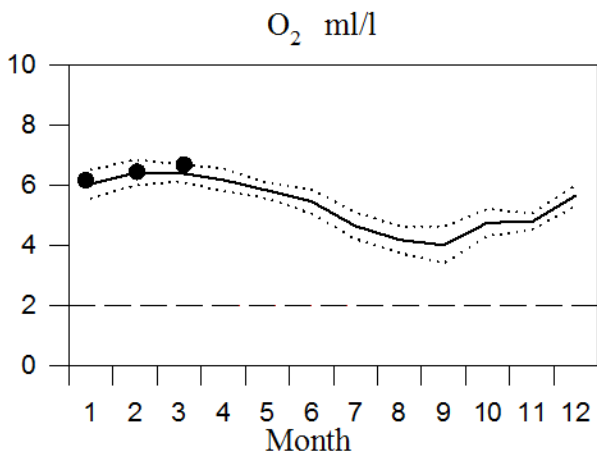
# STATION FLADEN SURFACE WATER

## Annual Cycles

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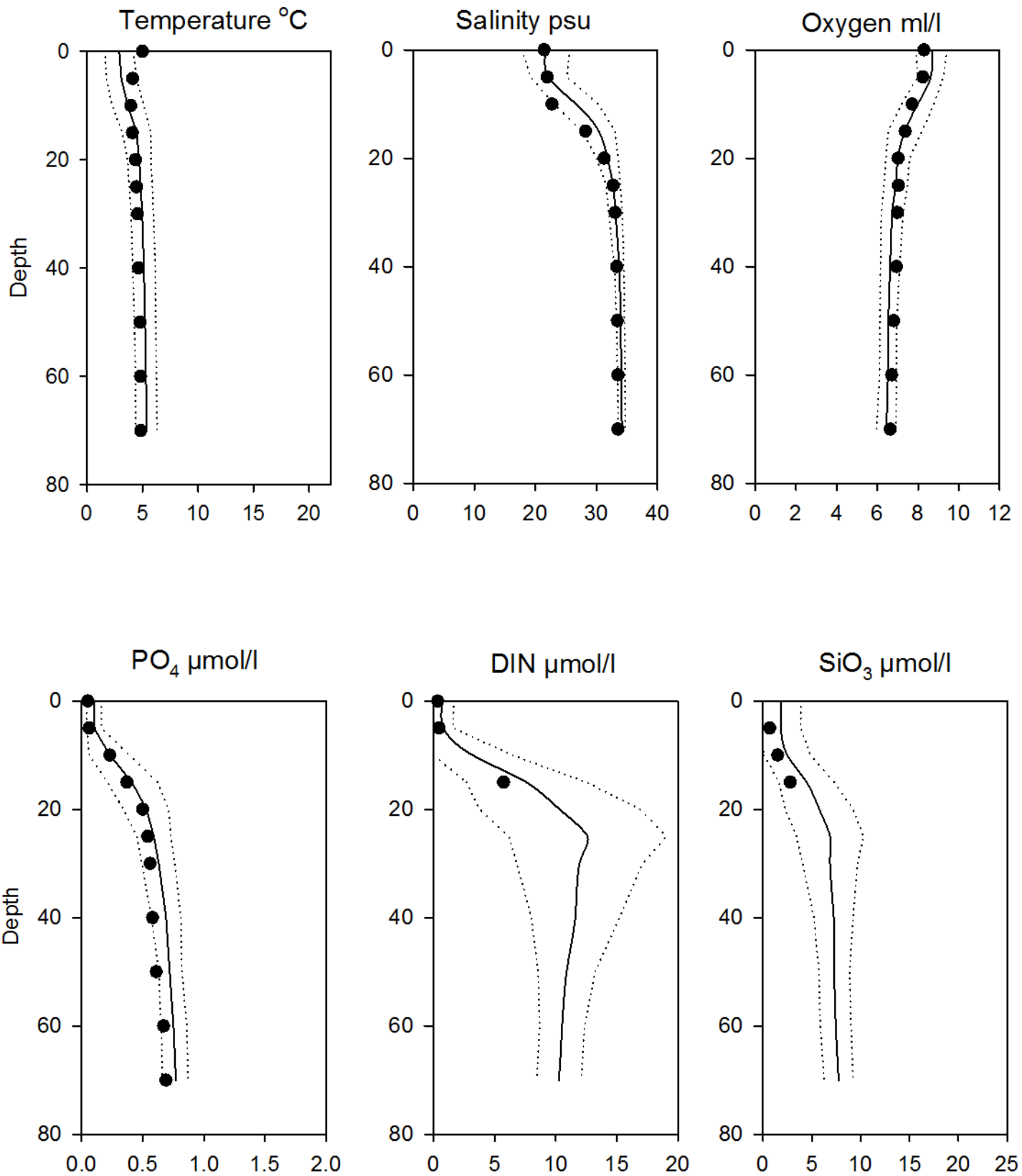


## OXYGEN IN BOTTOM WATER (depth > 70m)



# Vertical profiles Fladen March

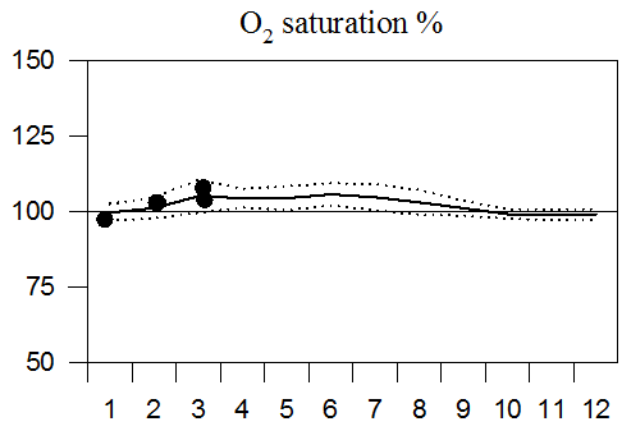
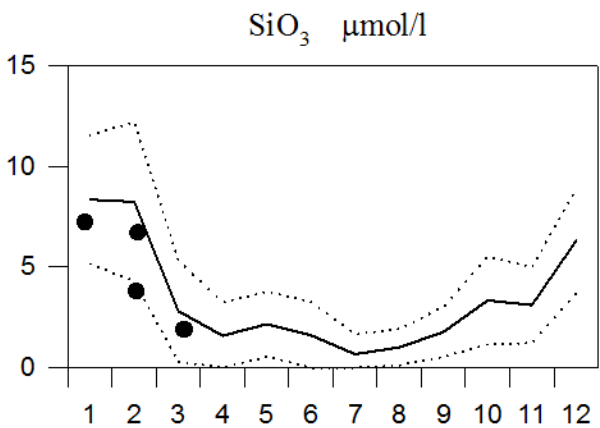
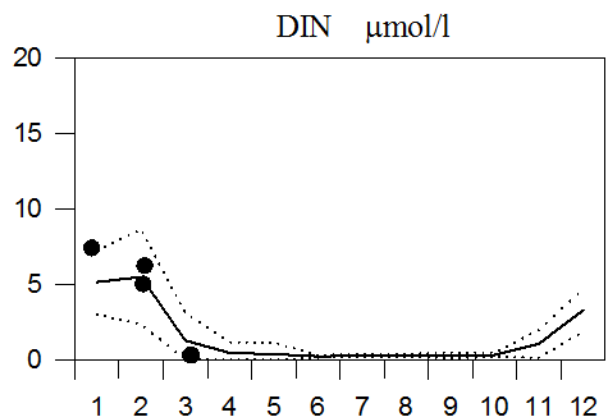
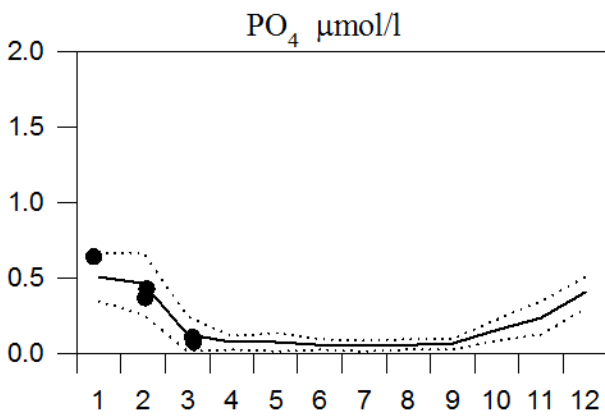
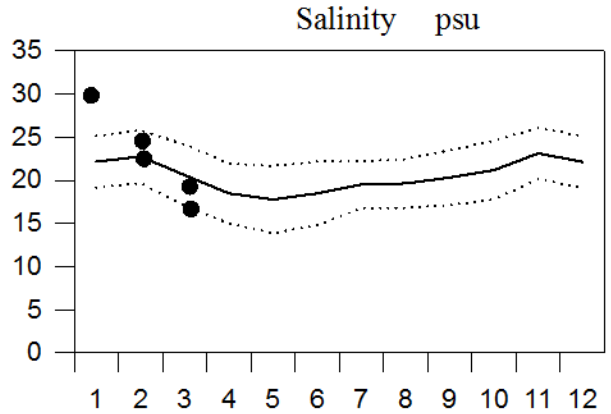
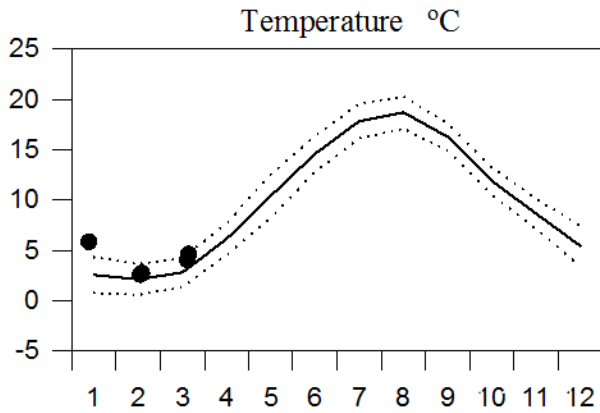
— Mean 1996-2010      ..... St.Dev.      ● 2015



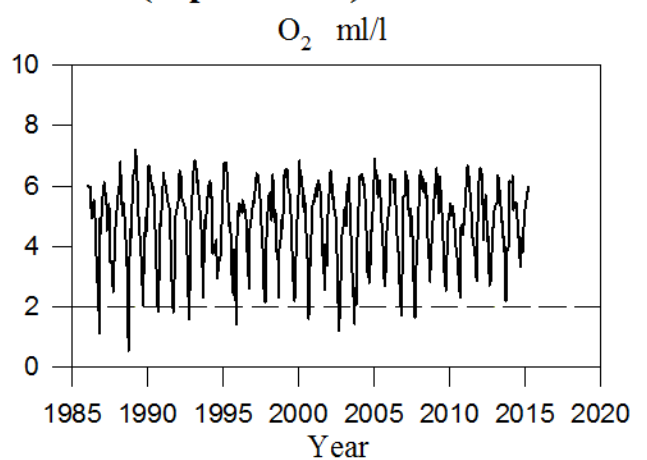
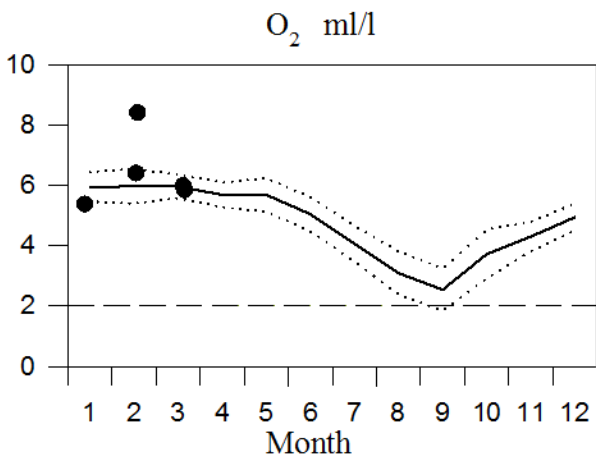
# STATION ANHOLT E SURFACE WATER

## Annual Cycles

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

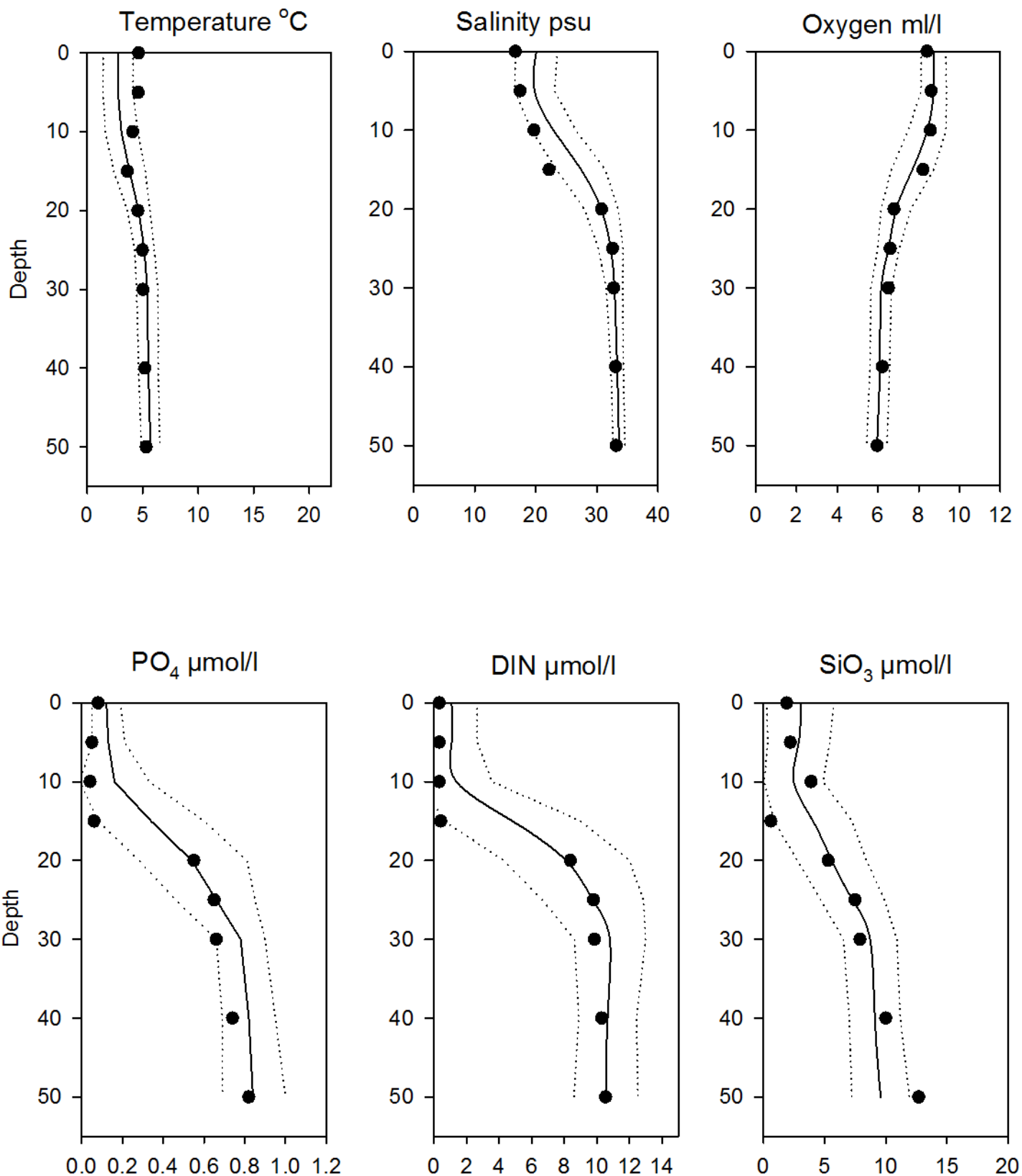


## OXYGEN IN BOTTOM WATER (depth > 50m)



# Vertical profiles Anholt E March

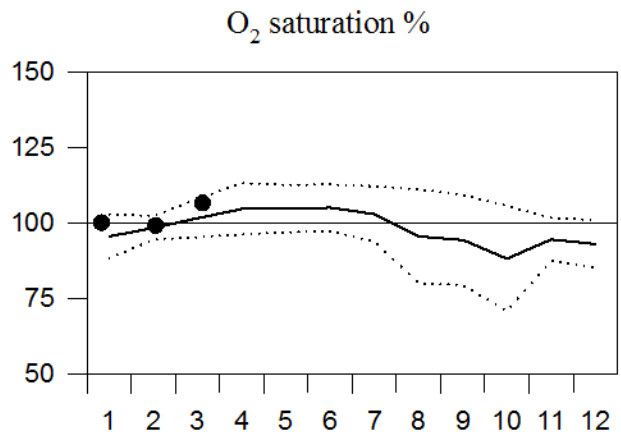
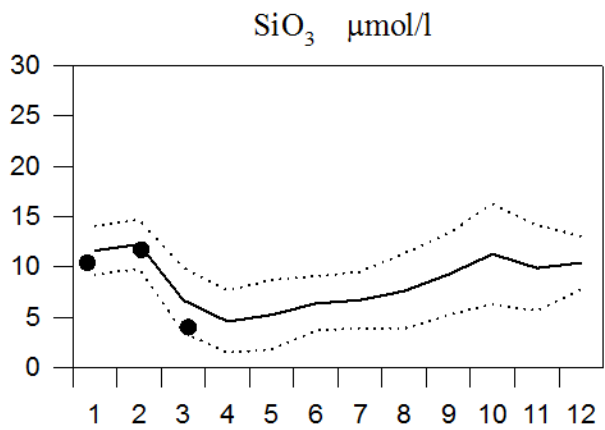
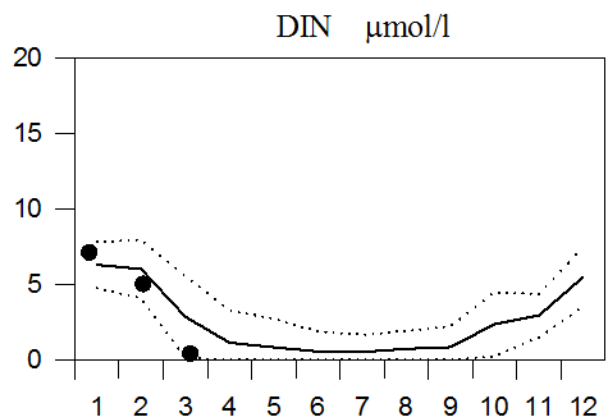
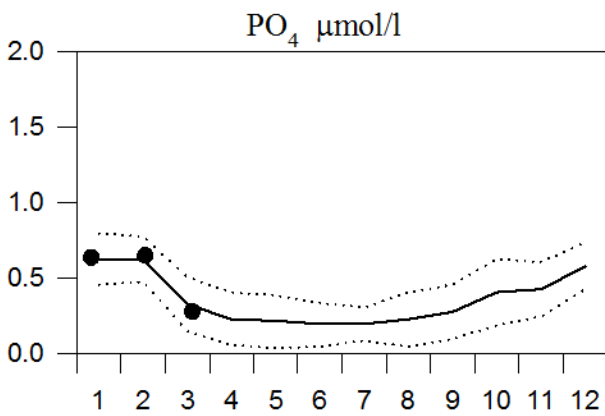
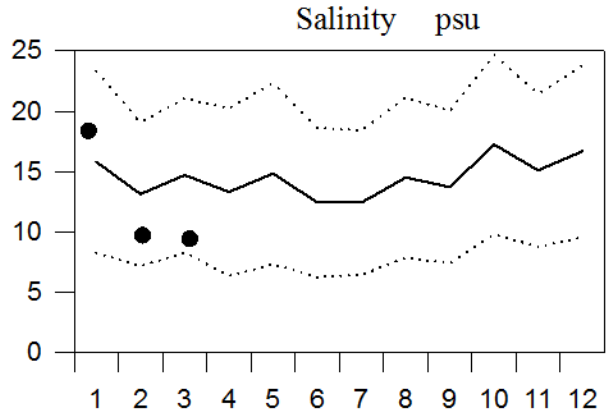
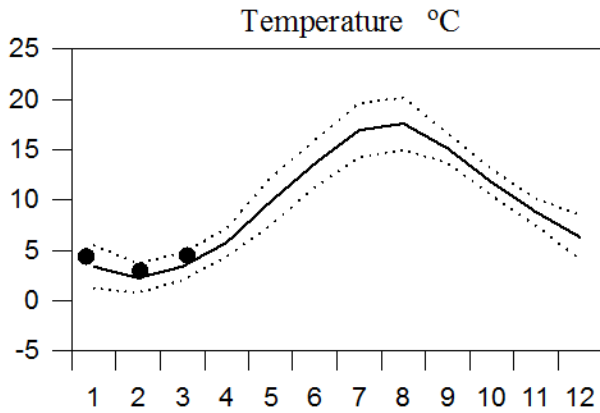
— Mean 1996-2010      ..... St.Dev.      ● 2015



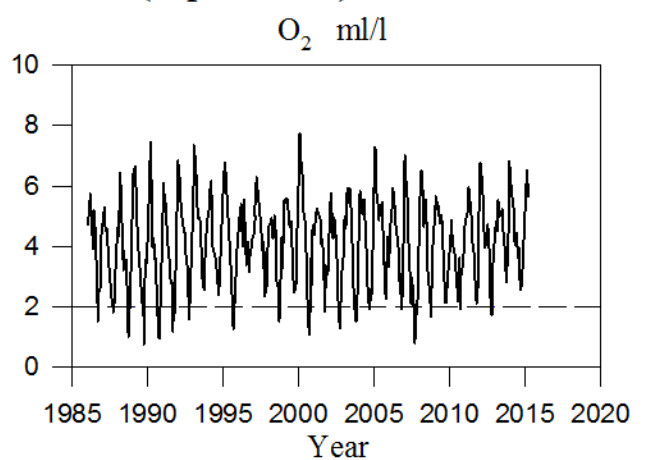
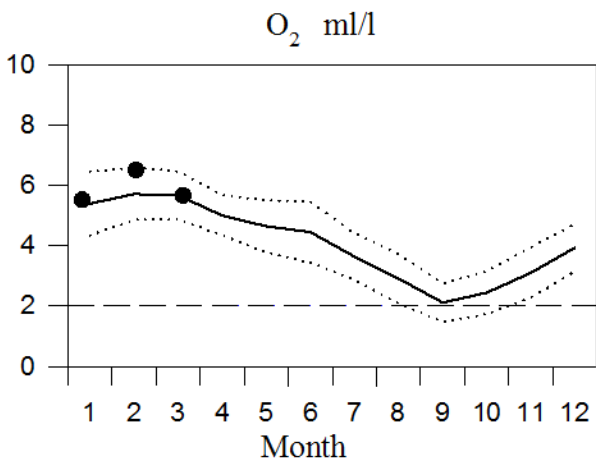
# STATION W LANDSKRONA SURFACE WATER

## Annual Cycles

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

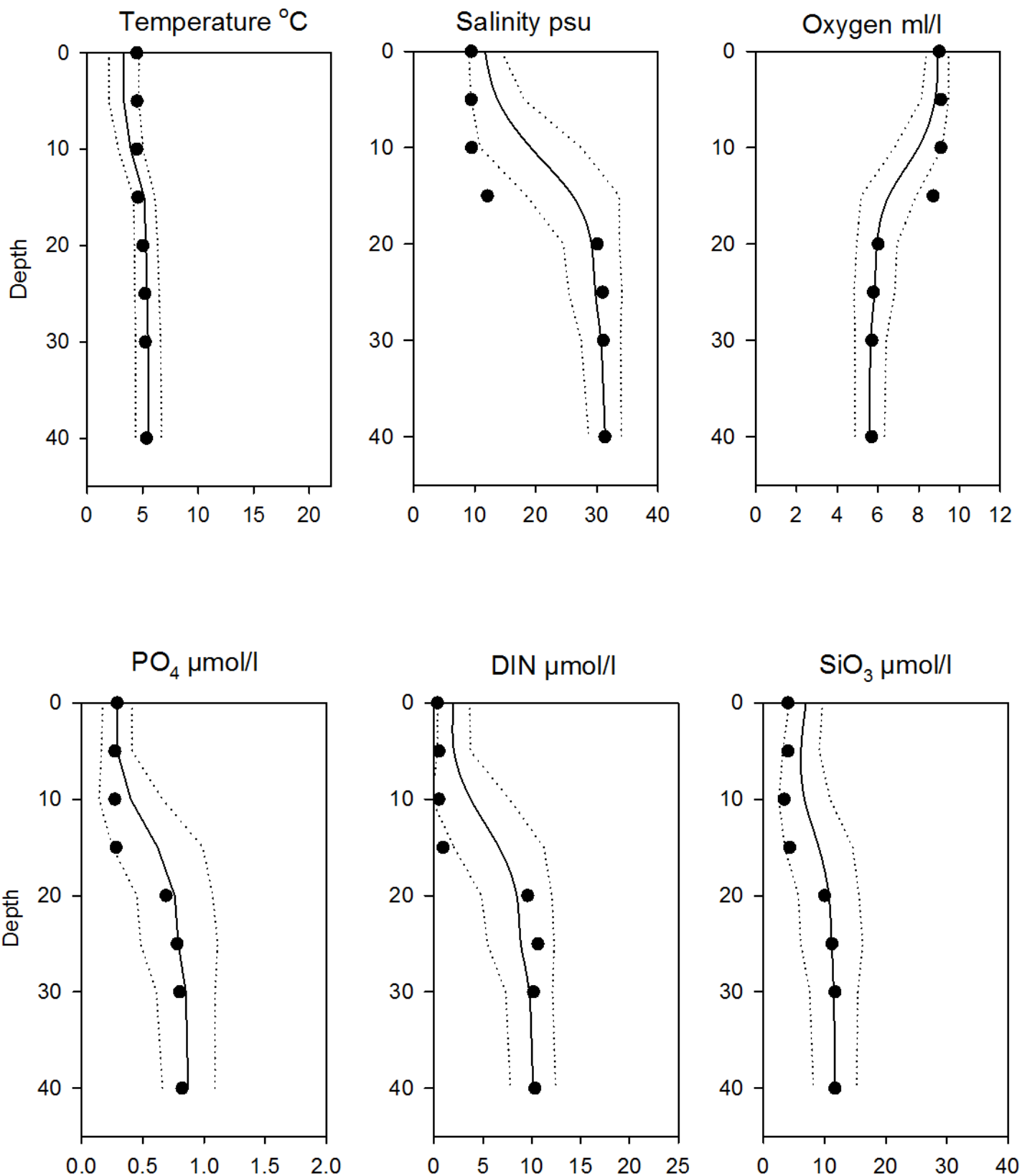


## OXYGEN IN BOTTOM WATER (depth >40m)



# Vertical profiles W Landskrona March

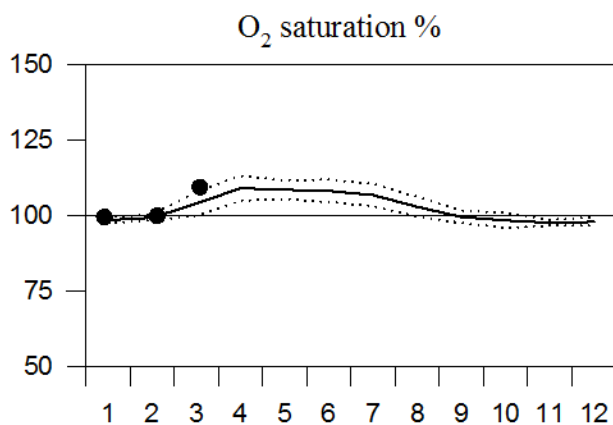
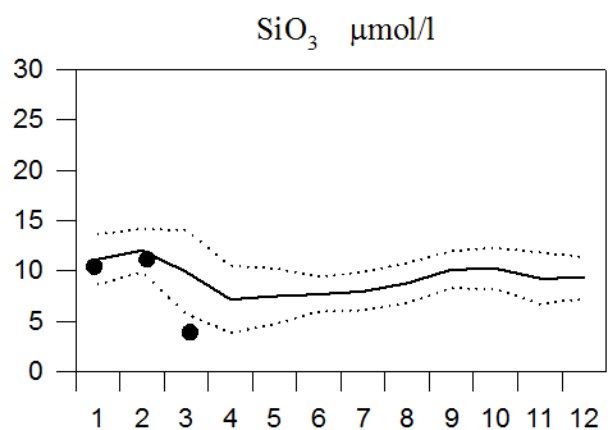
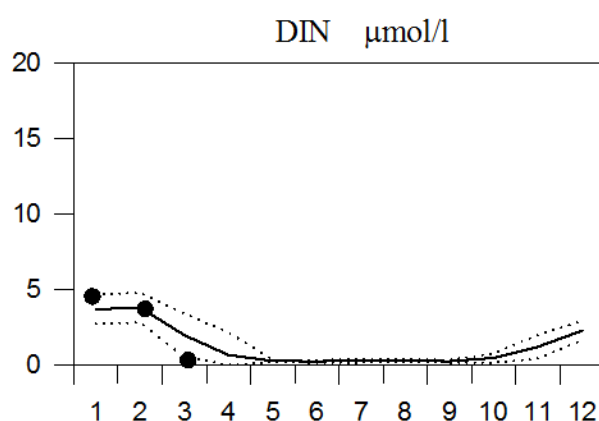
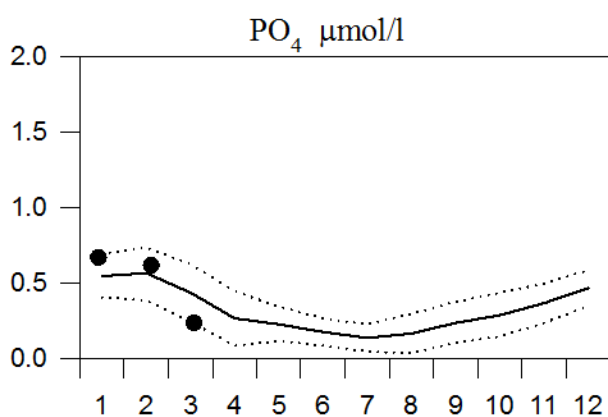
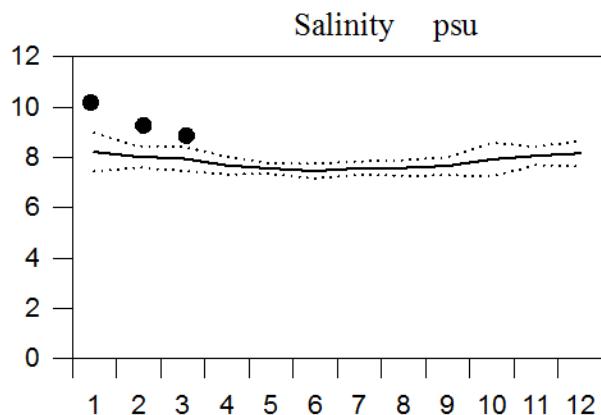
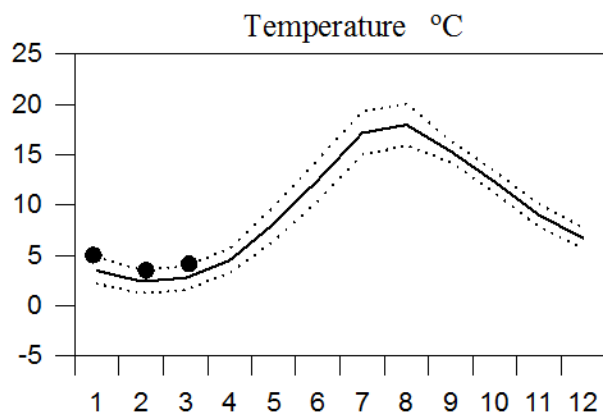
— Mean 1996-2010      ..... St.Dev.      ● 2015



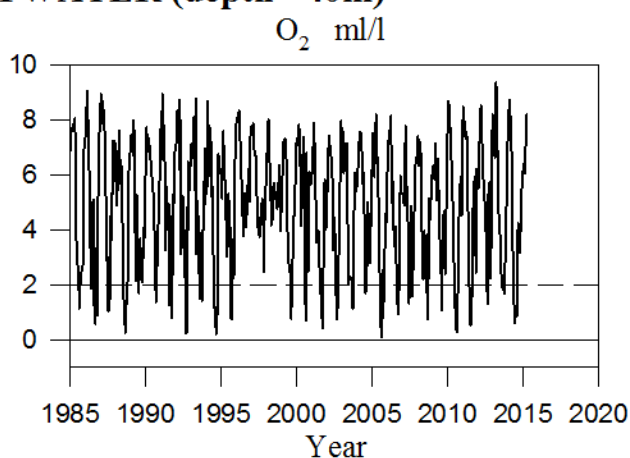
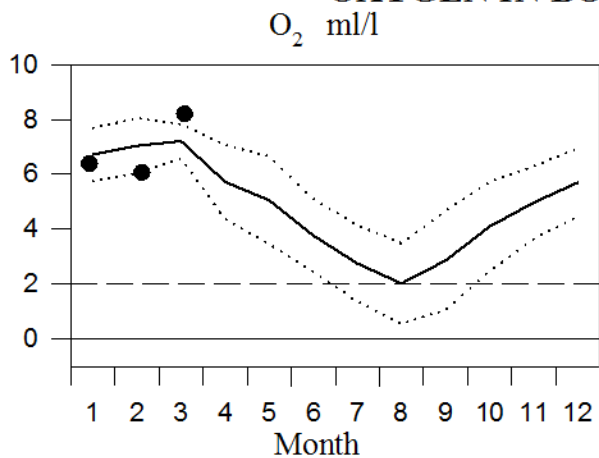
# STATION BY1 SURFACE WATER

## Annual Cycles

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

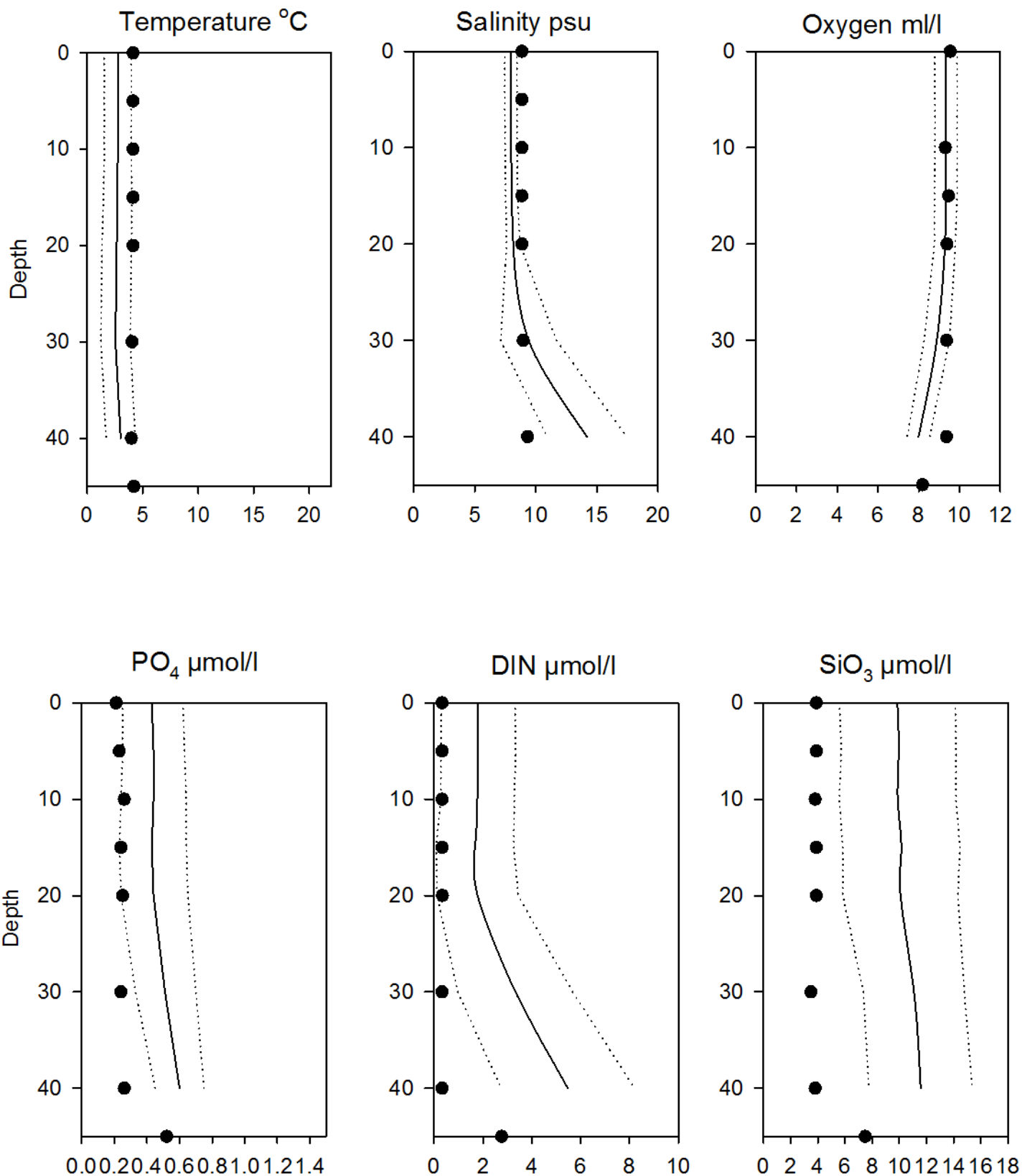


## OXYGEN IN BOTTOM WATER (depth >40m)



# Vertical profiles BY1 March

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

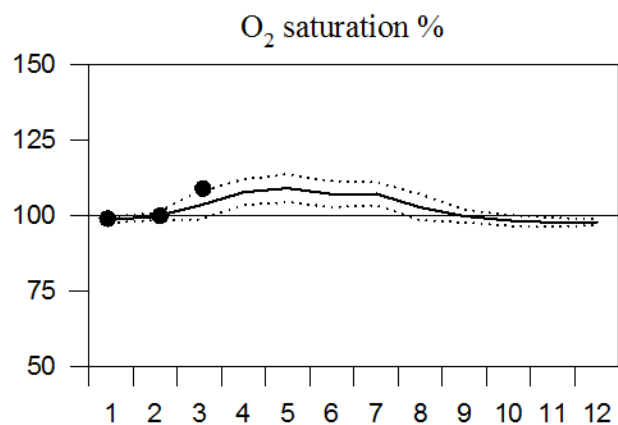
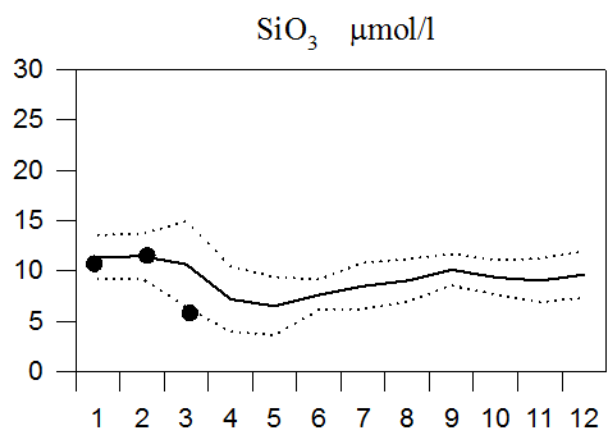
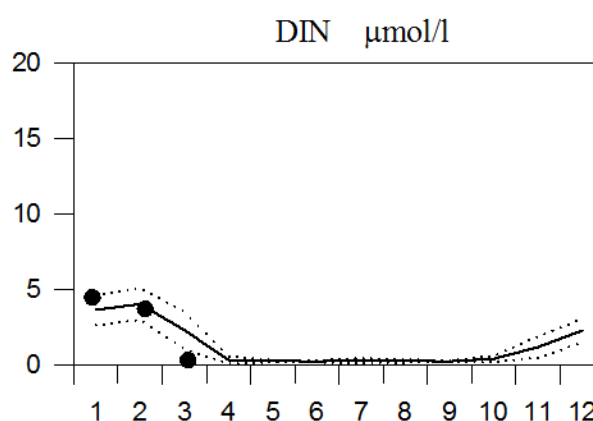
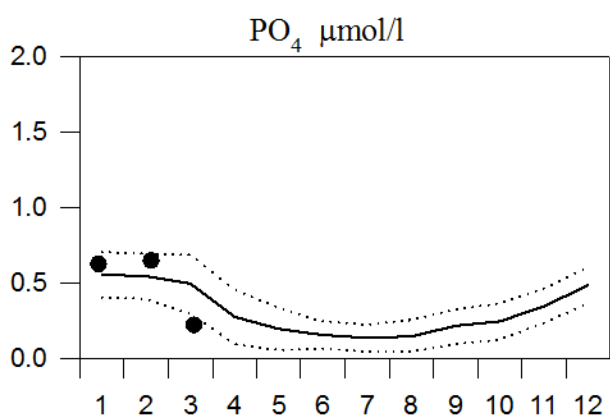
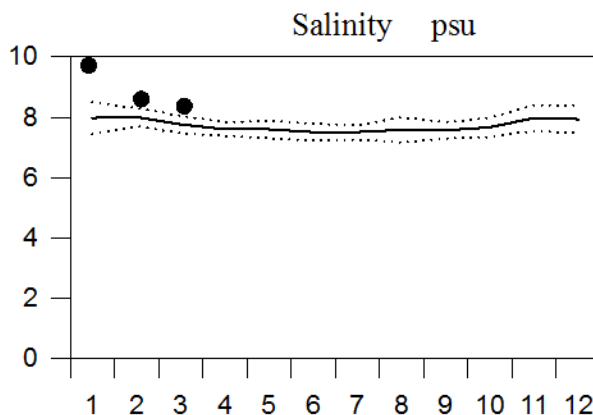
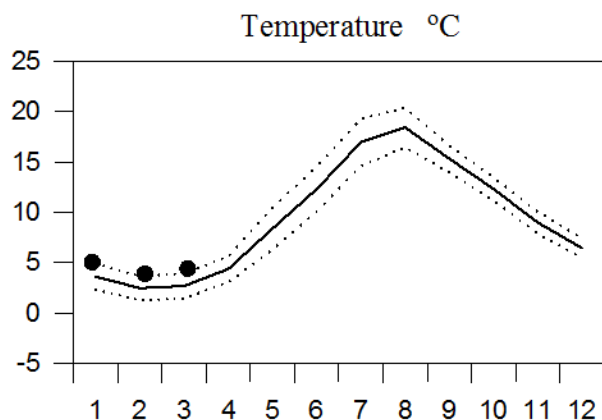




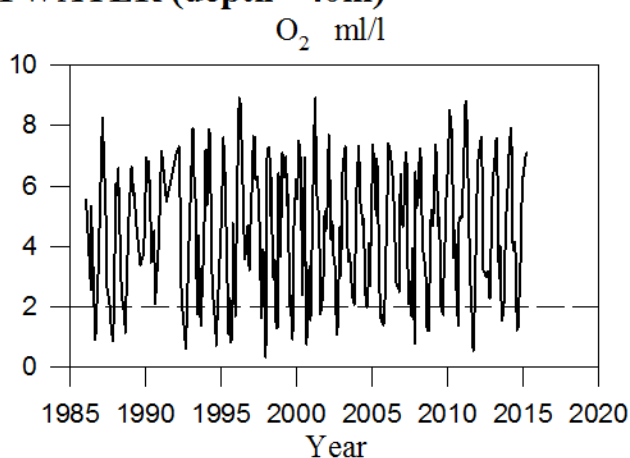
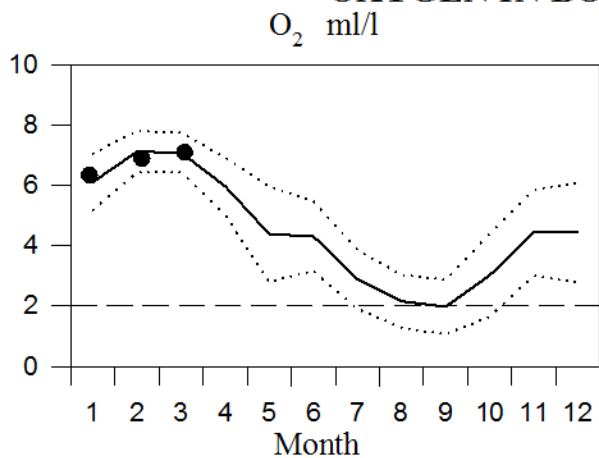
# STATION BY2 SURFACE WATER

## Annual Cycles

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

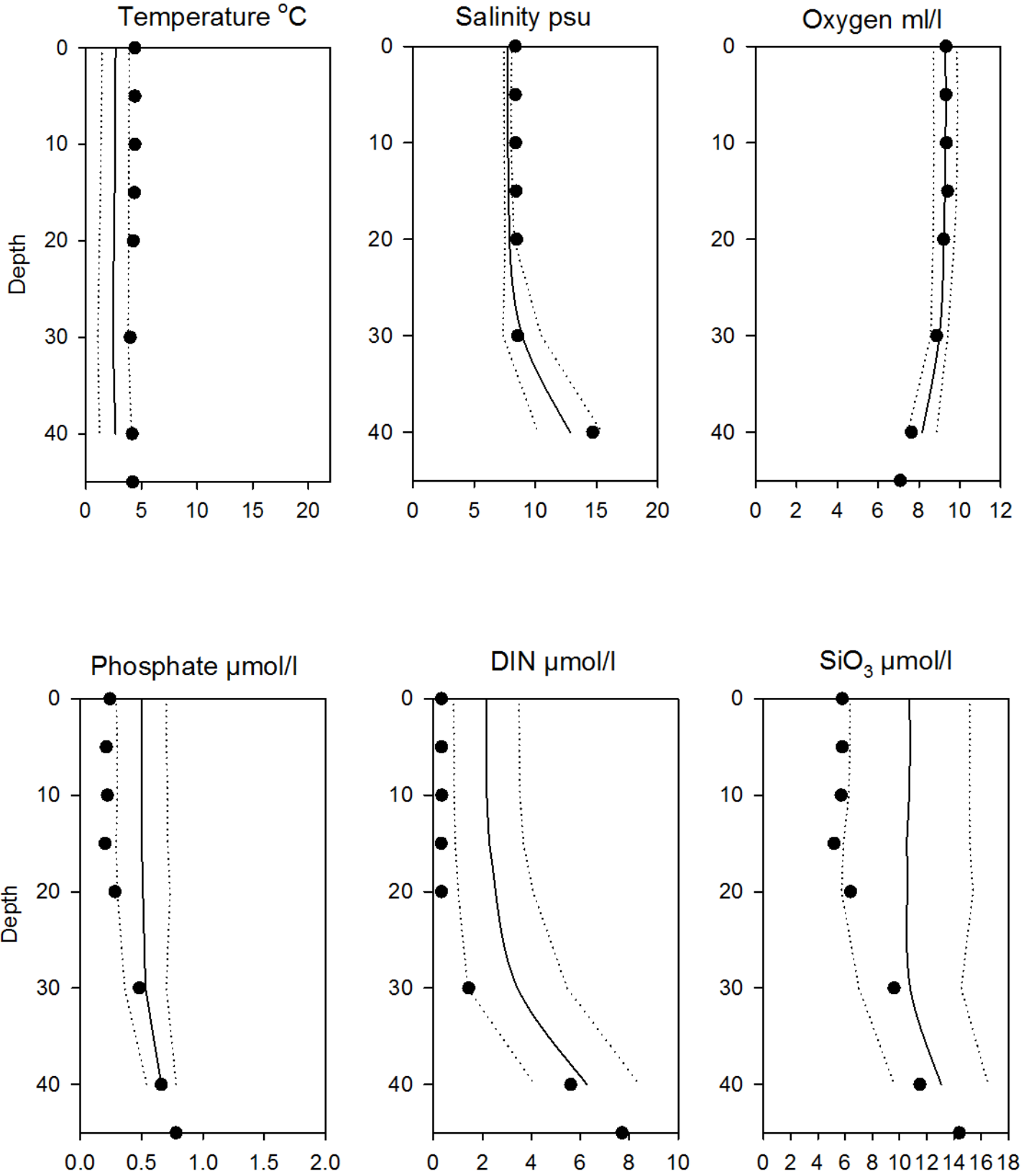


## OXYGEN IN BOTTOM WATER (depth >40m)



# Vertical profiles BY2 March

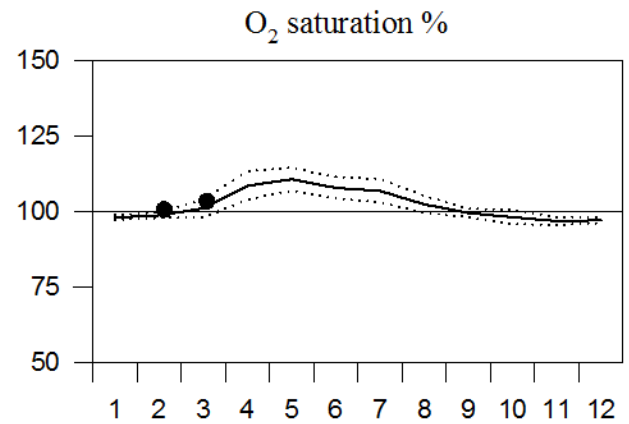
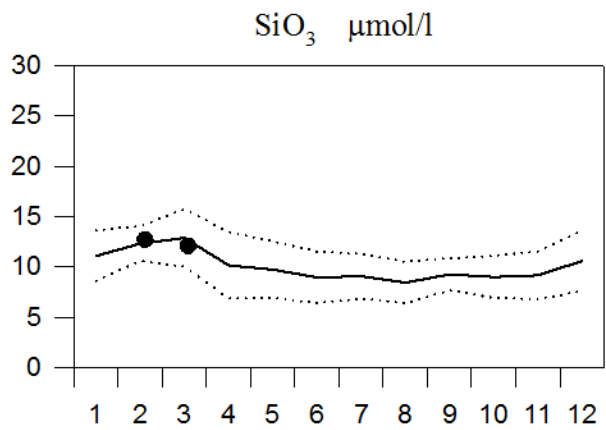
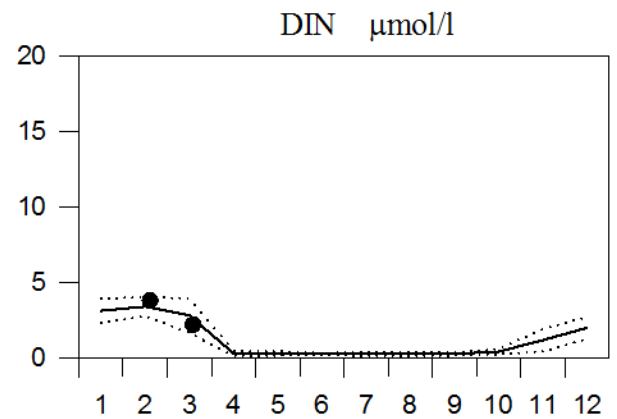
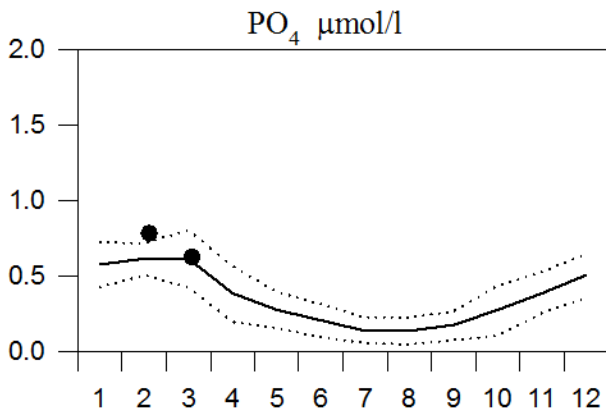
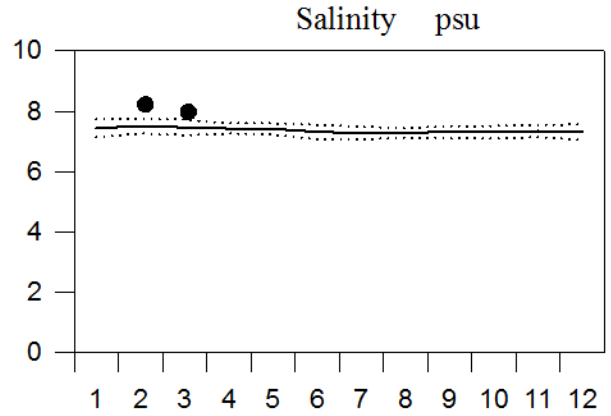
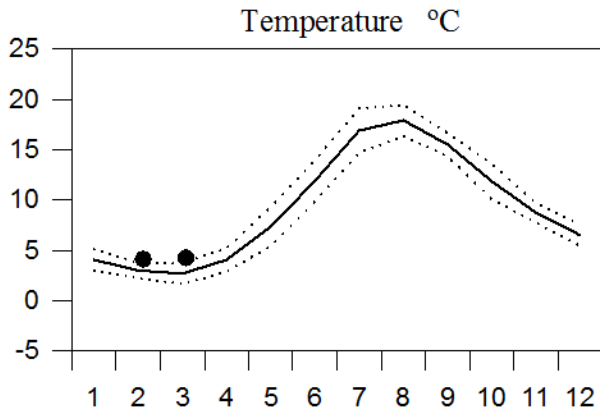
— Mean 1996-2010      ..... St.Dev.      ● 2015



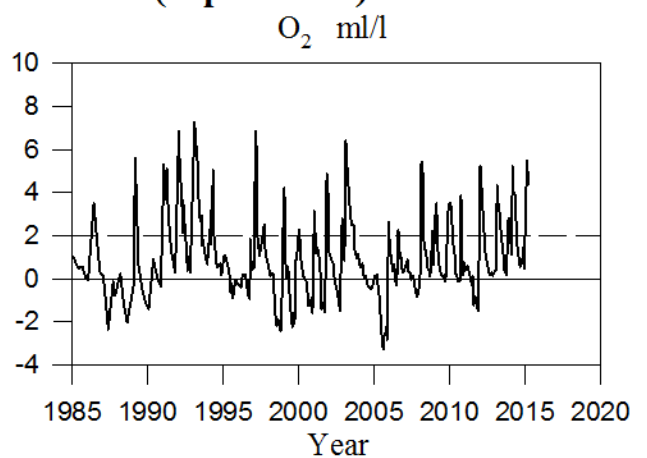
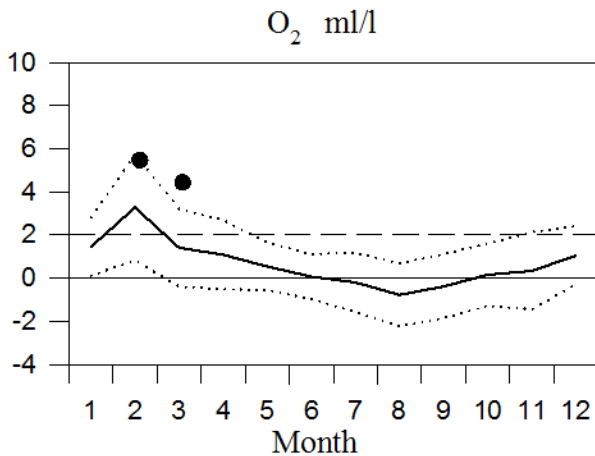
# STATION BY4 SURFACE WATER

## Annual Cycles

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

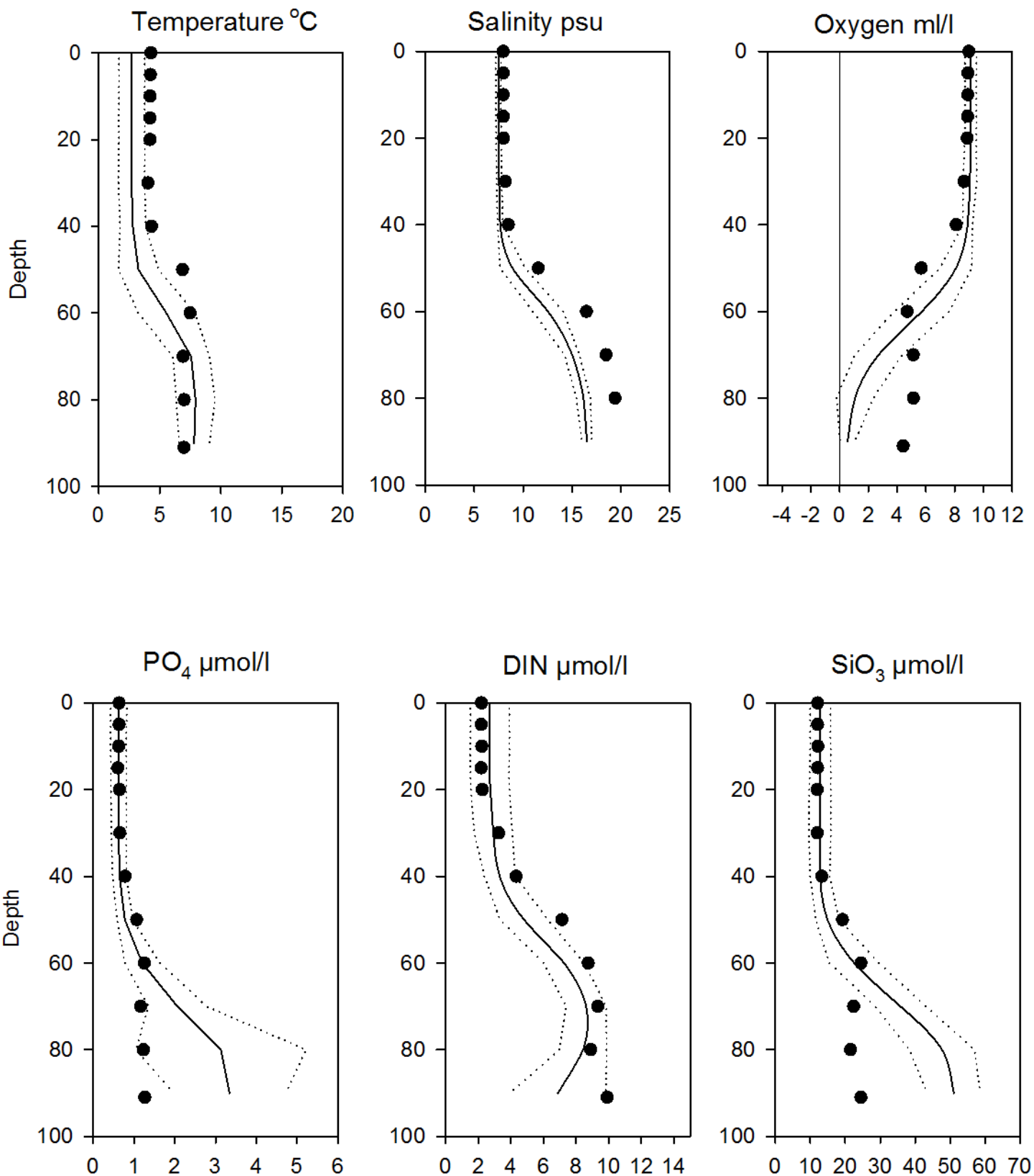


## OXYGEN IN BOTTOM WATER (depth >80m)



# Vertical profiles BY4 March

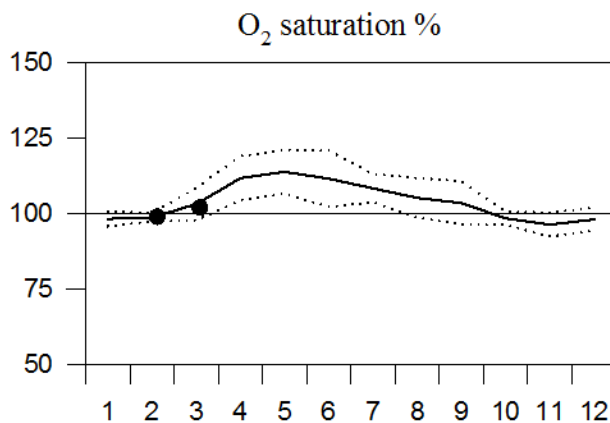
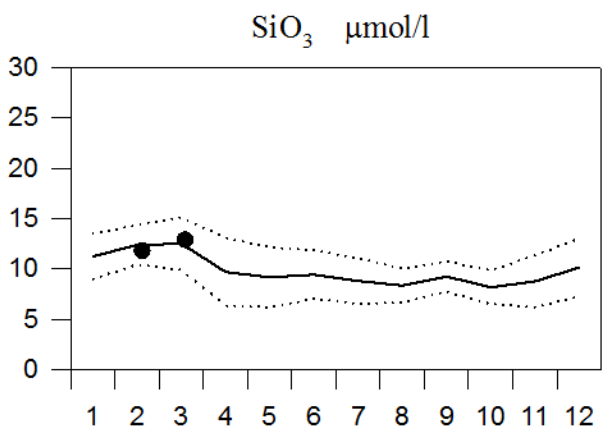
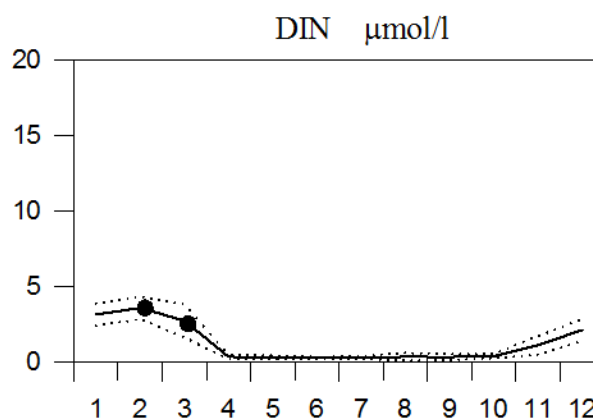
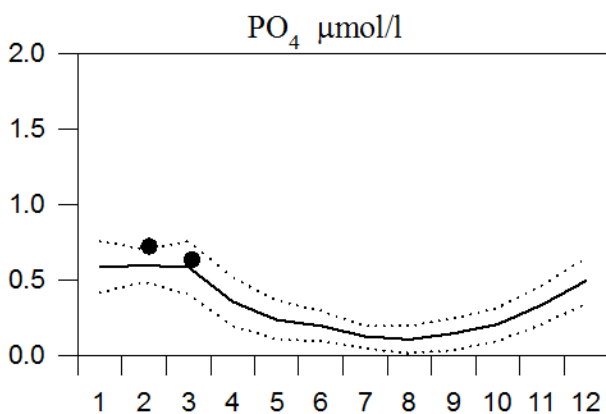
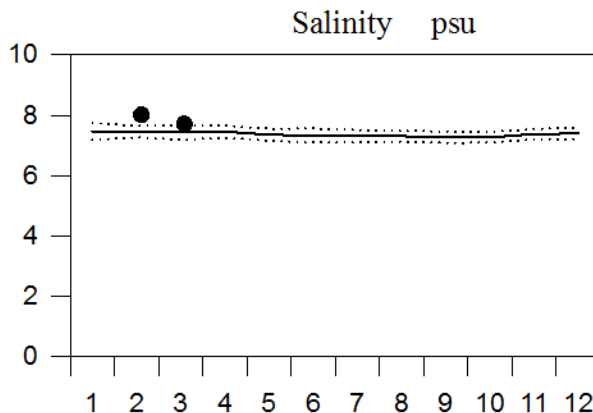
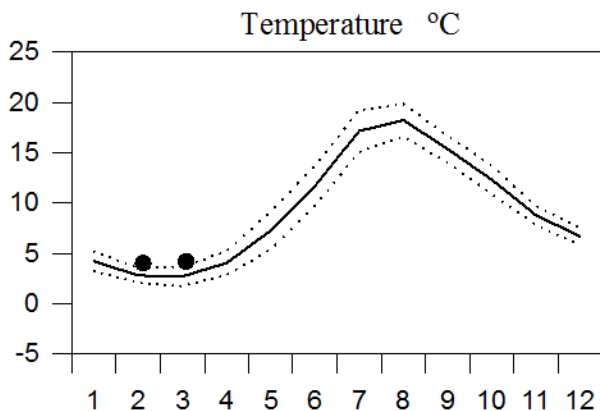
— Mean 1996-2010      ..... St.Dev.      ● 2015



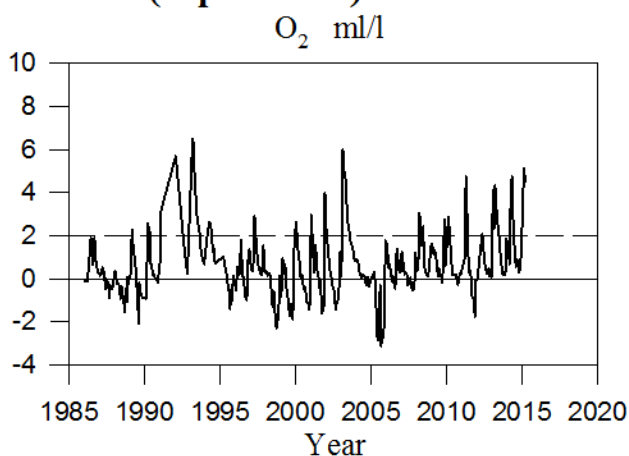
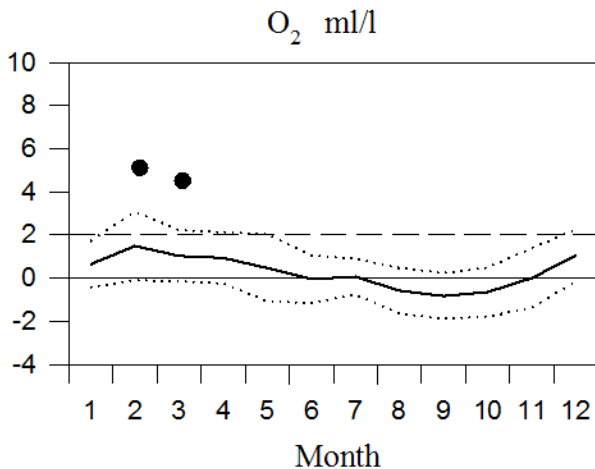
# STATION BY5 SURFACE WATER

## Annual Cycles

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

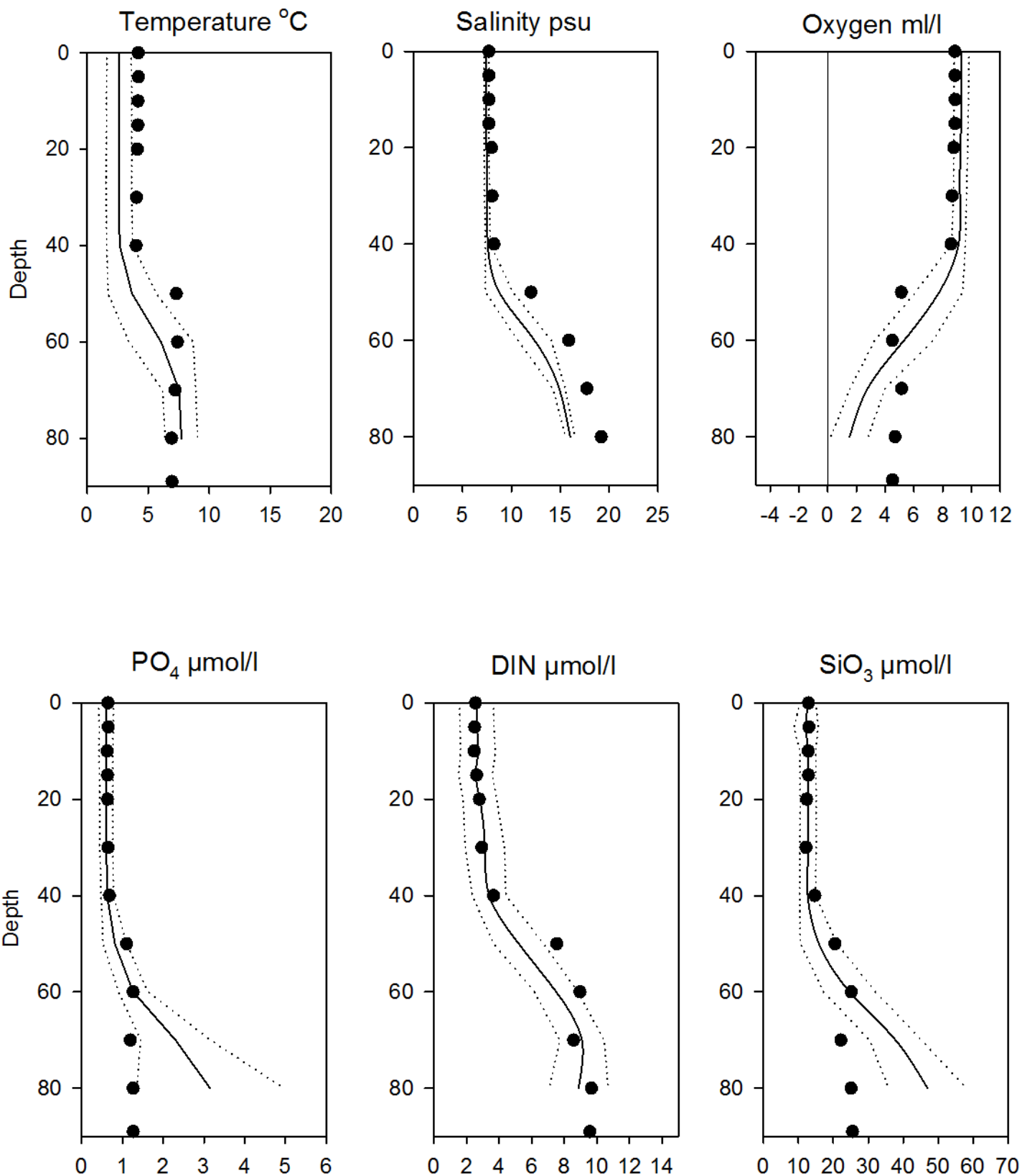


## OXYGEN IN BOTTOM WATER (depth >80m)



# Vertical profiles BY5 March

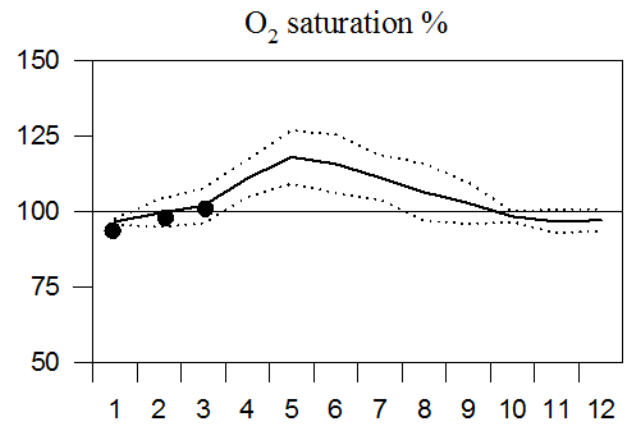
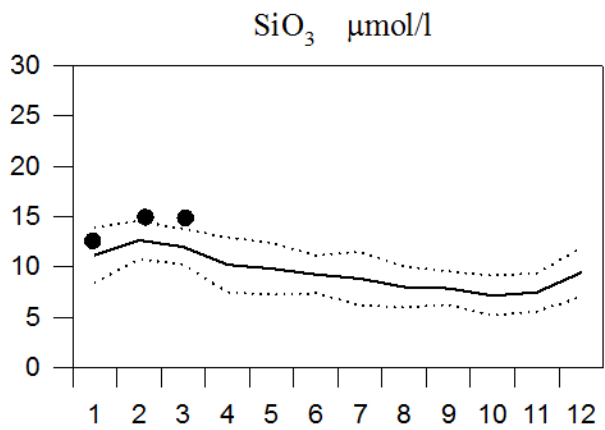
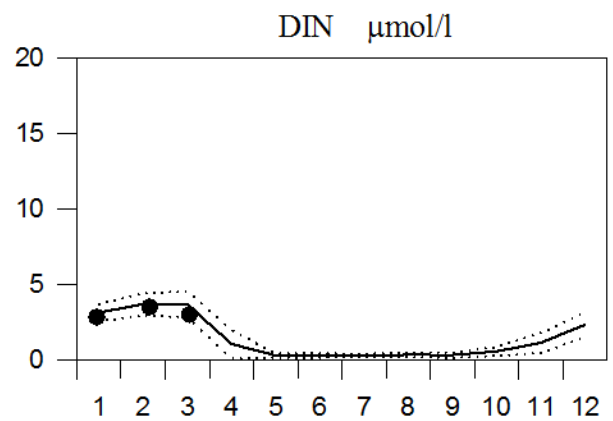
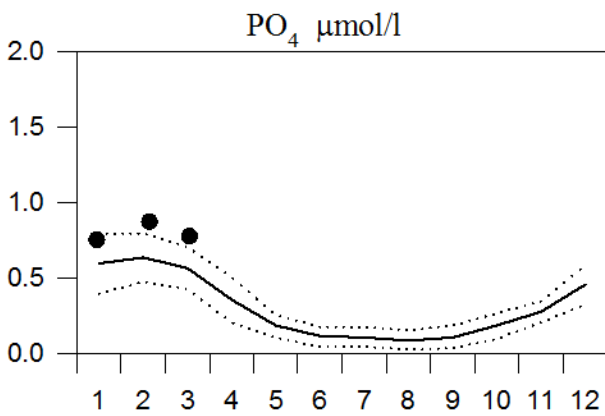
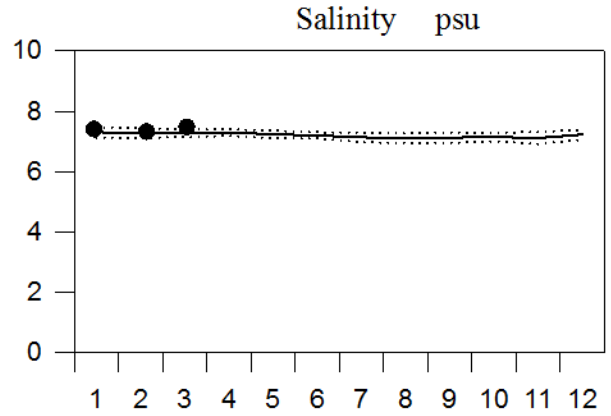
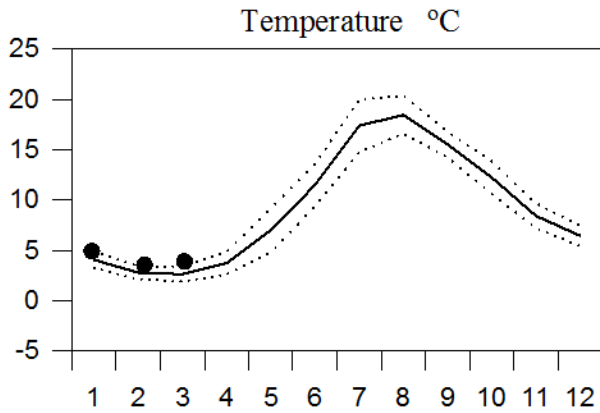
— Mean 1996-2010      ..... St.Dev.      ● 2015



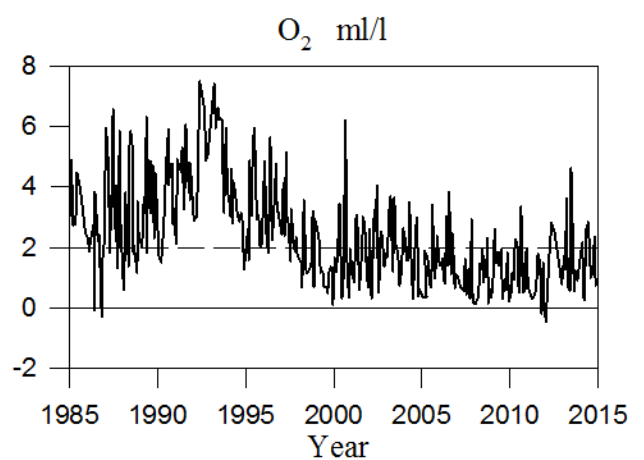
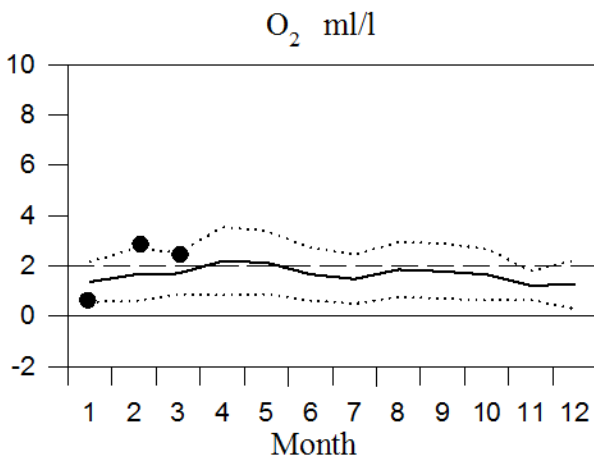
# STATION BCS III-10 SURFACE WATER

## Annual Cycles

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

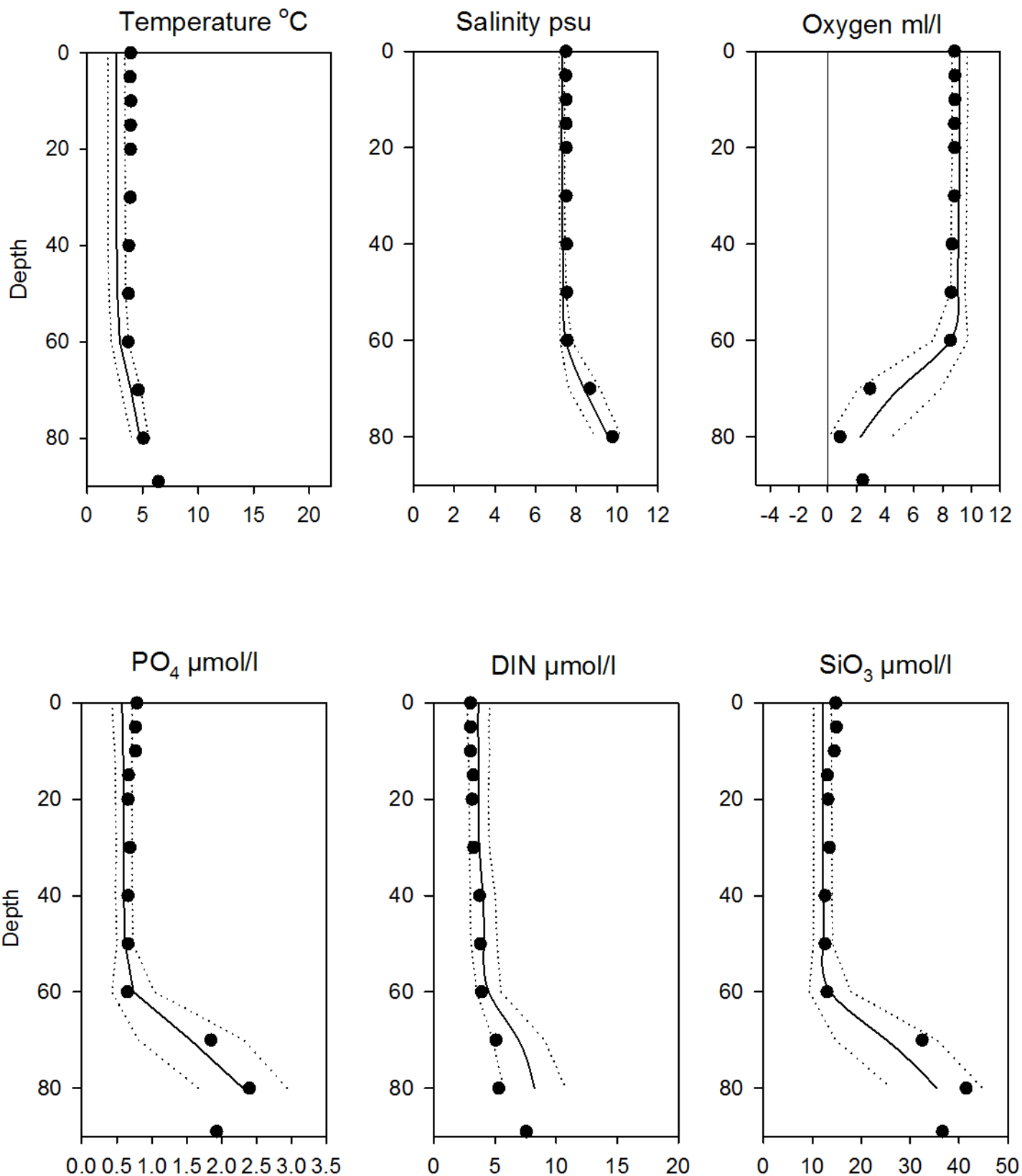


## OXYGEN IN BOTTOM WATER (depth > 80m)



# Vertical profiles BCS III-10 March

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

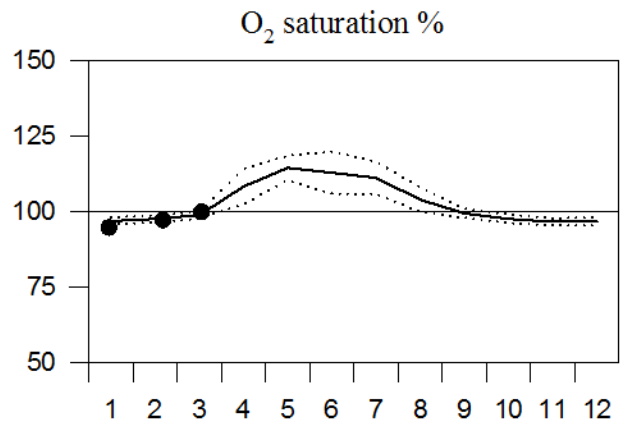
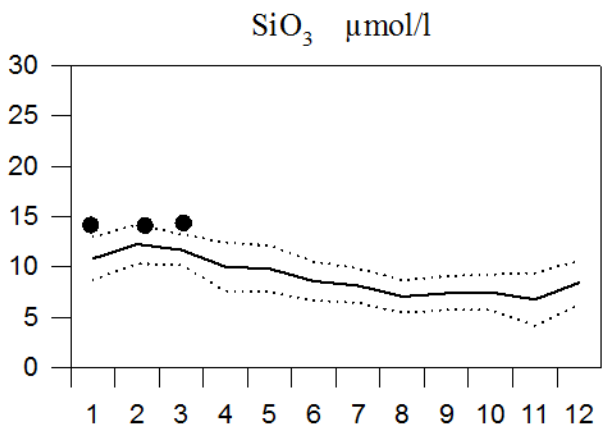
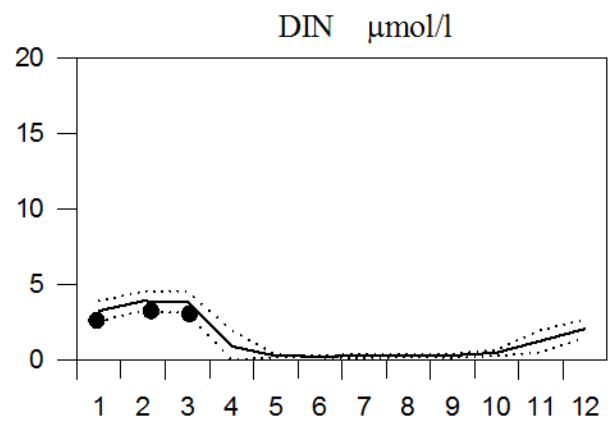
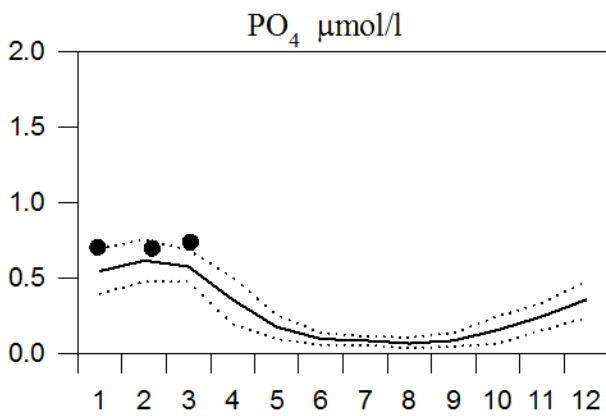
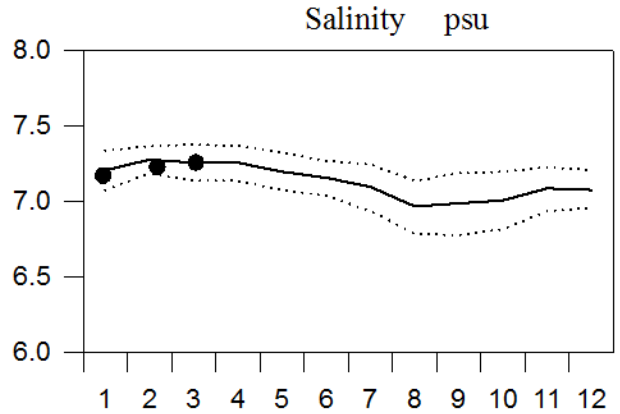
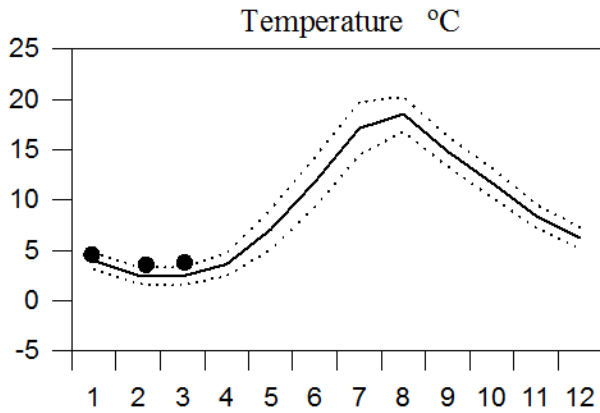




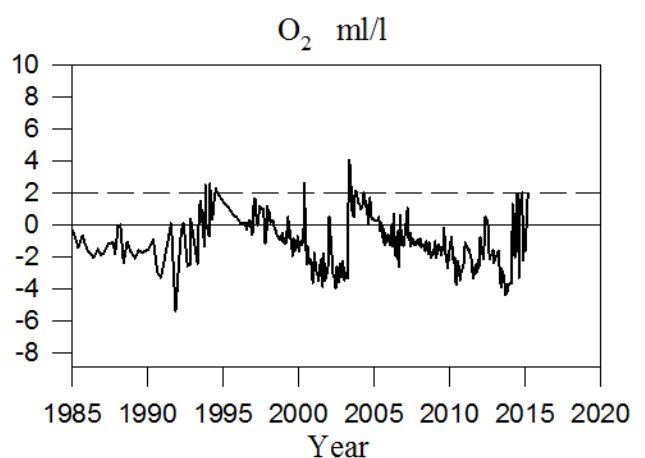
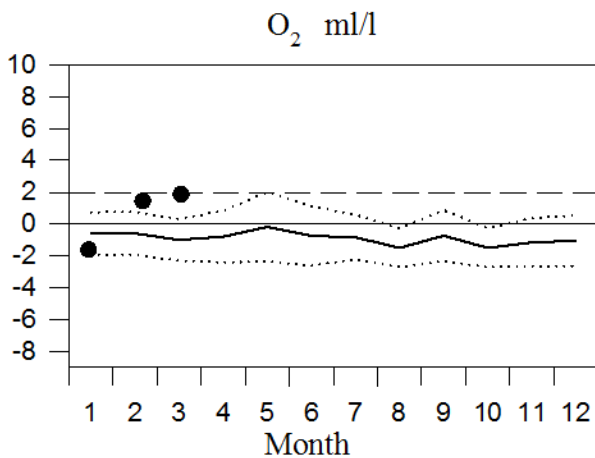
# STATION BY10 SURFACE WATER

## Annual Cycles

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

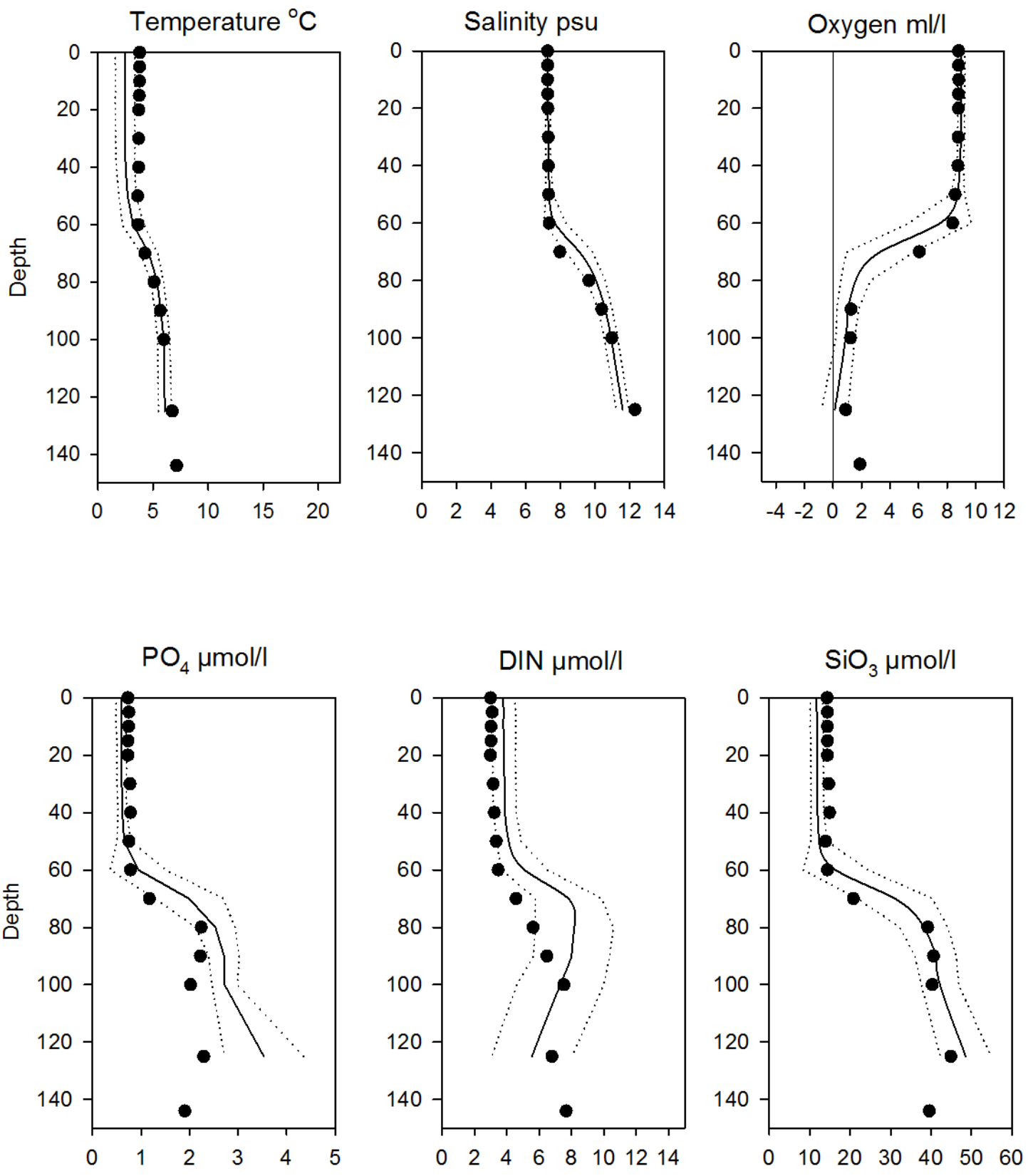


## OXYGEN IN BOTTOM WATER (depth >125m)



# Vertical profiles BY10 March

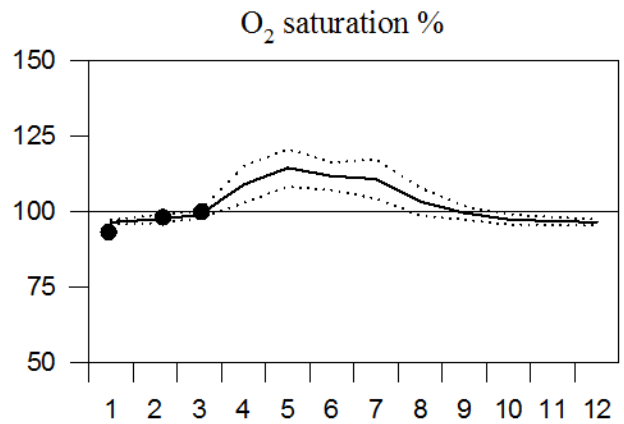
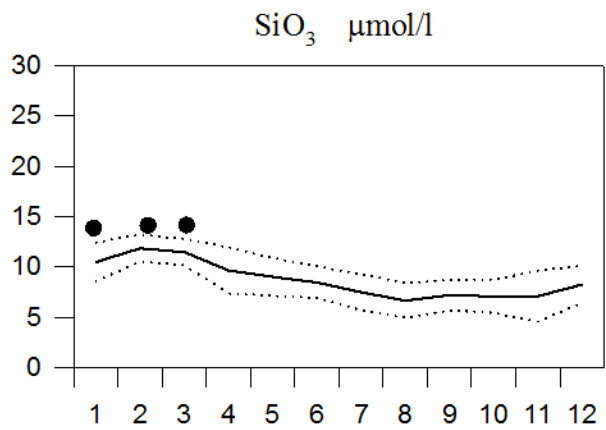
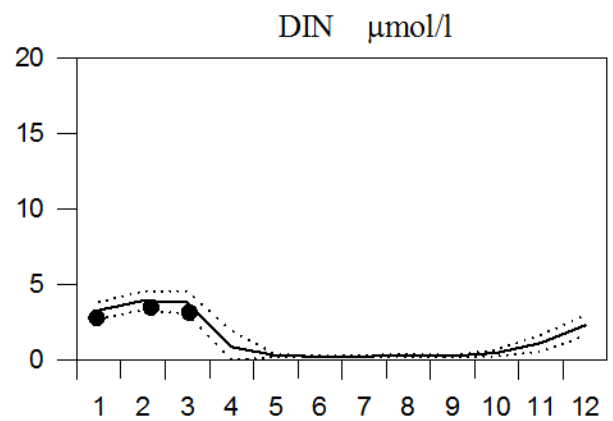
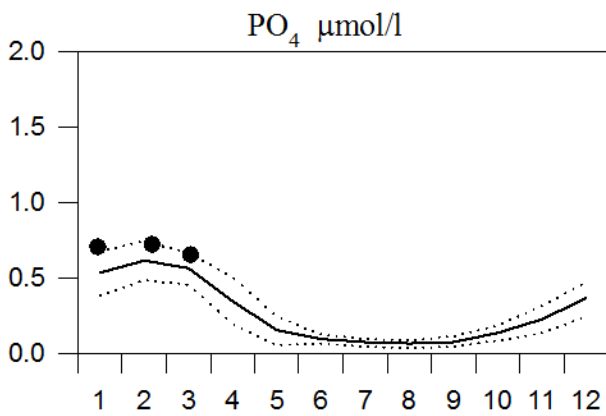
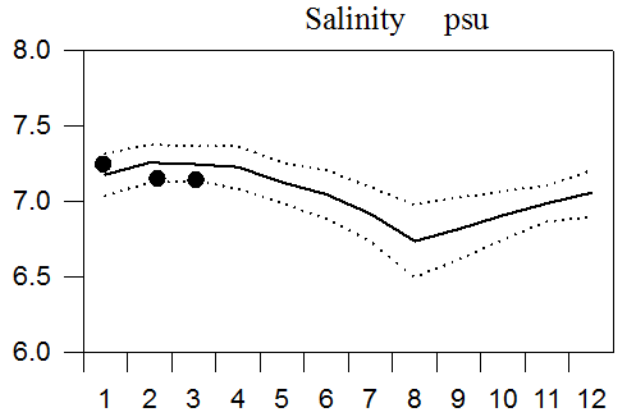
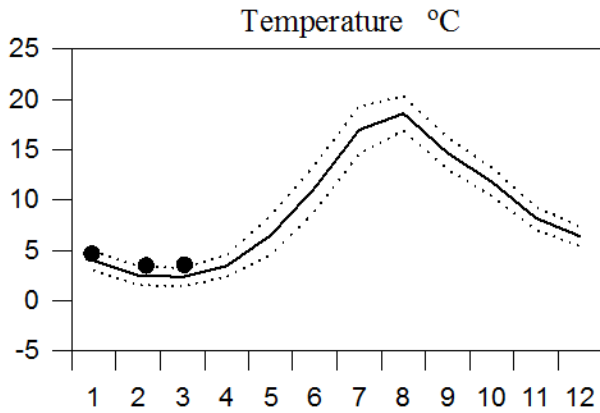
— Mean 1996-2010      ..... St.Dev.      ● 2015



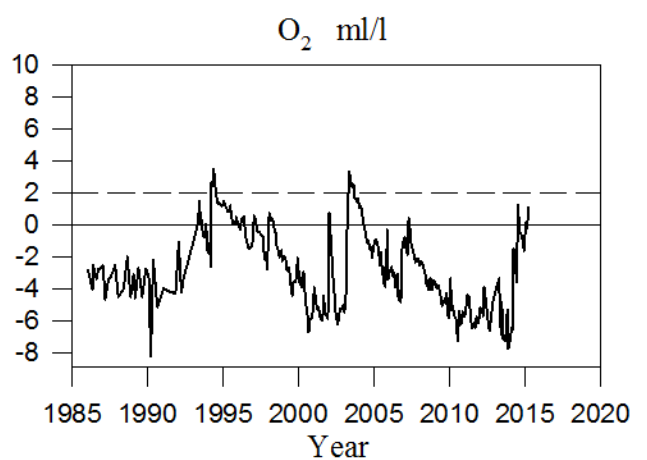
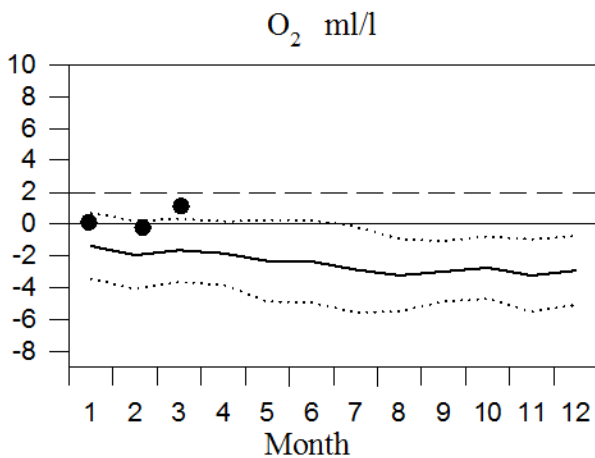
# STATION BY15 SURFACE WATER

## Annual Cycles

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

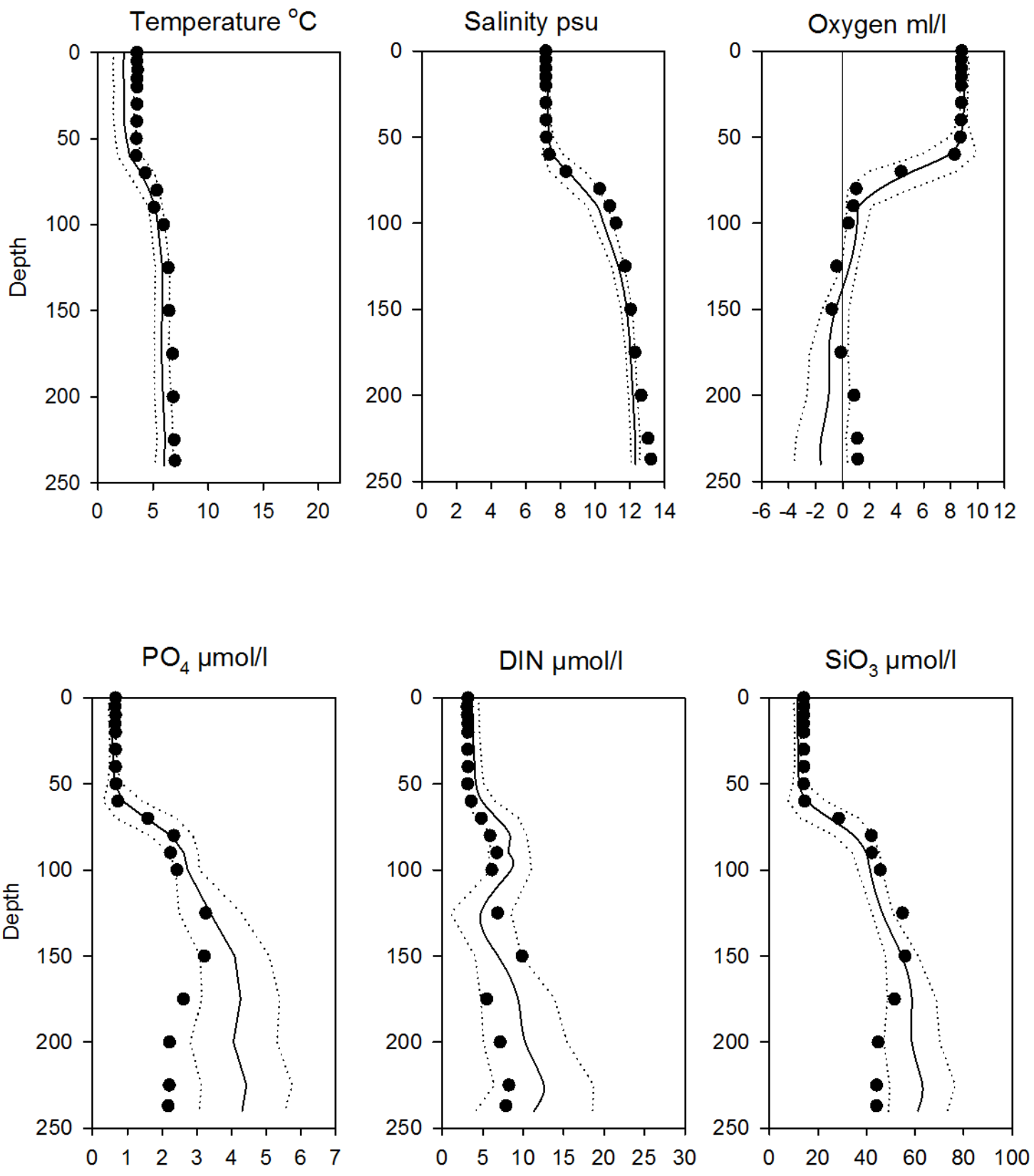


## OXYGEN IN BOTTOM WATER (depth >225m)



# Vertical profiles BY15 March

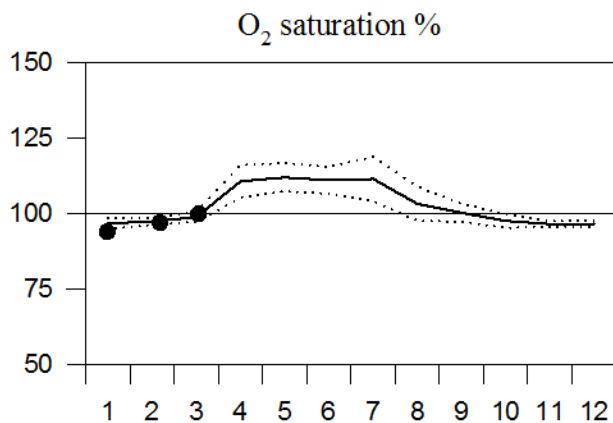
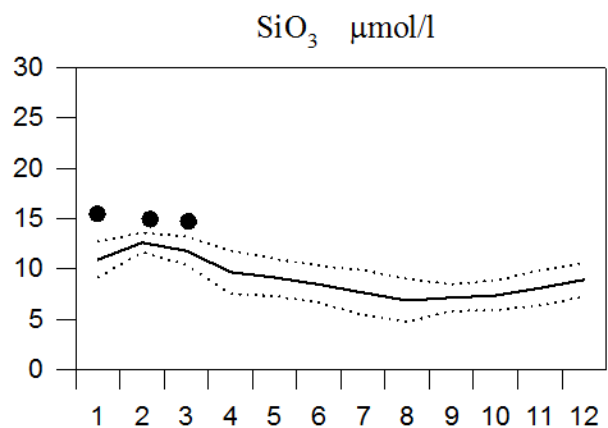
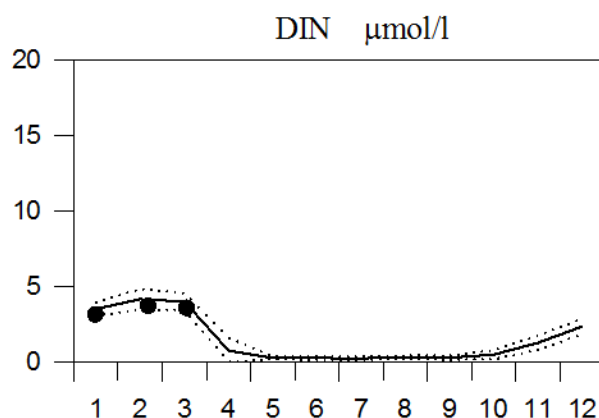
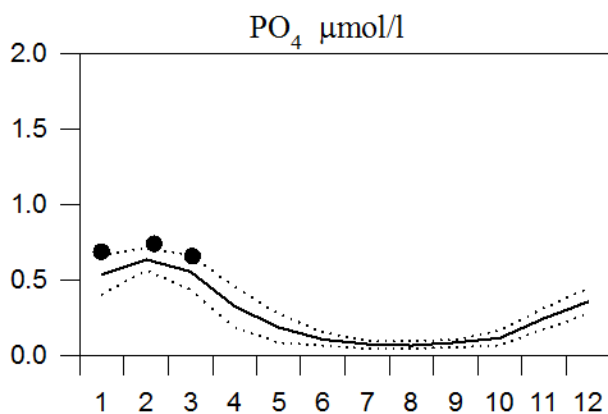
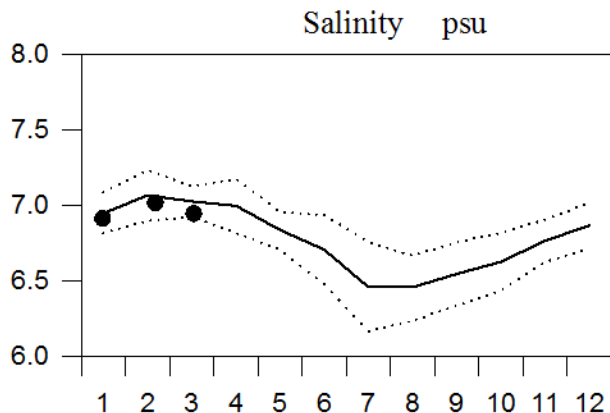
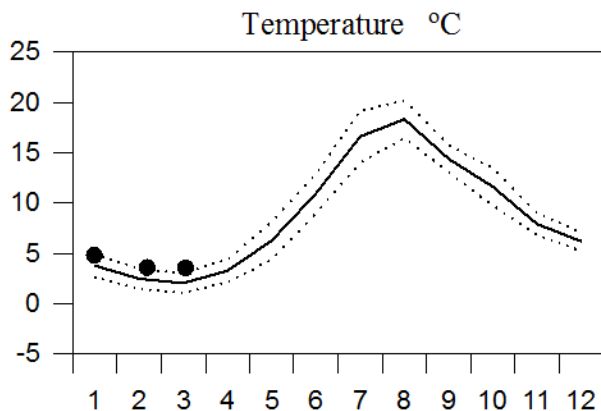
— Mean 1996-2010      ..... St.Dev.      ● 2015



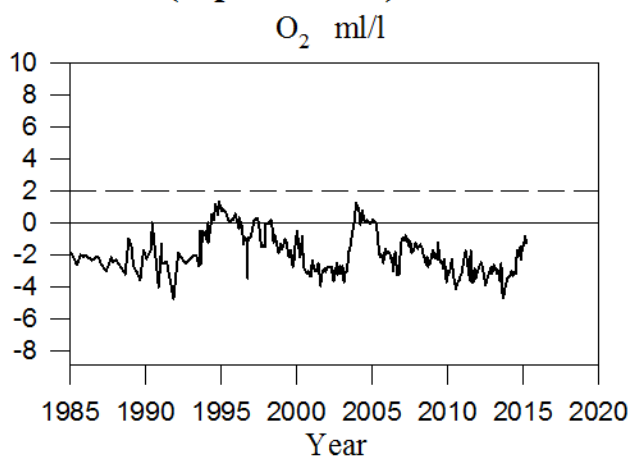
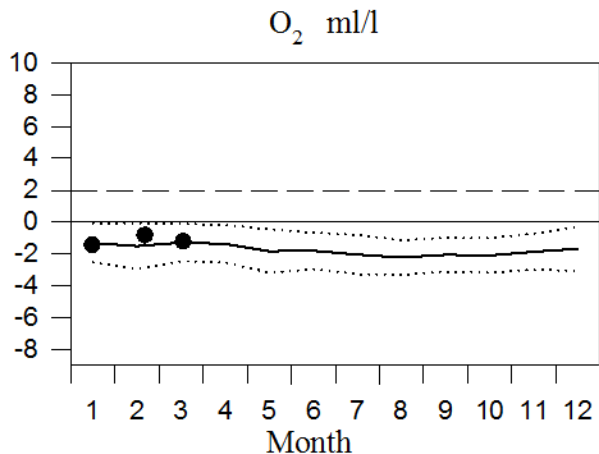
# STATION BY20 SURFACE WATER

## Annual Cycles

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

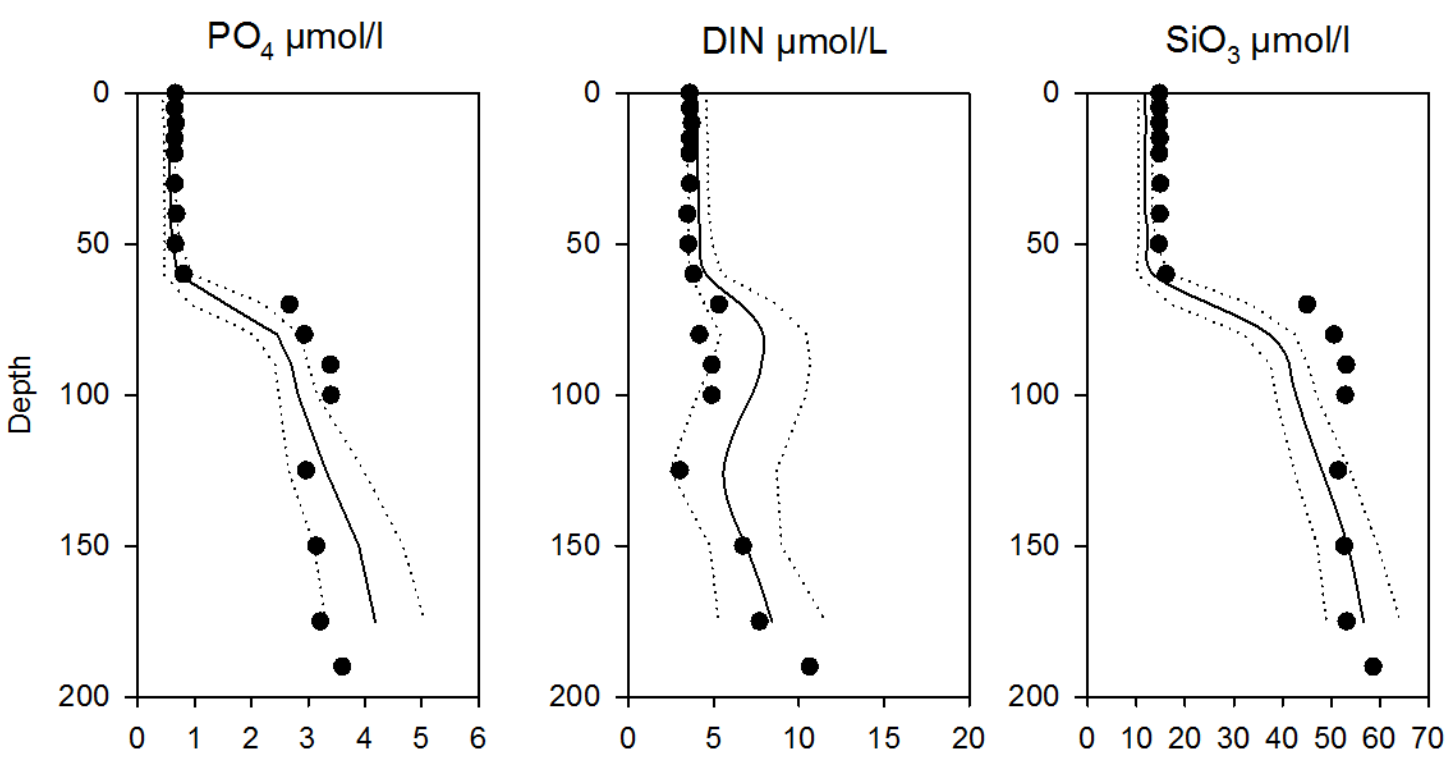
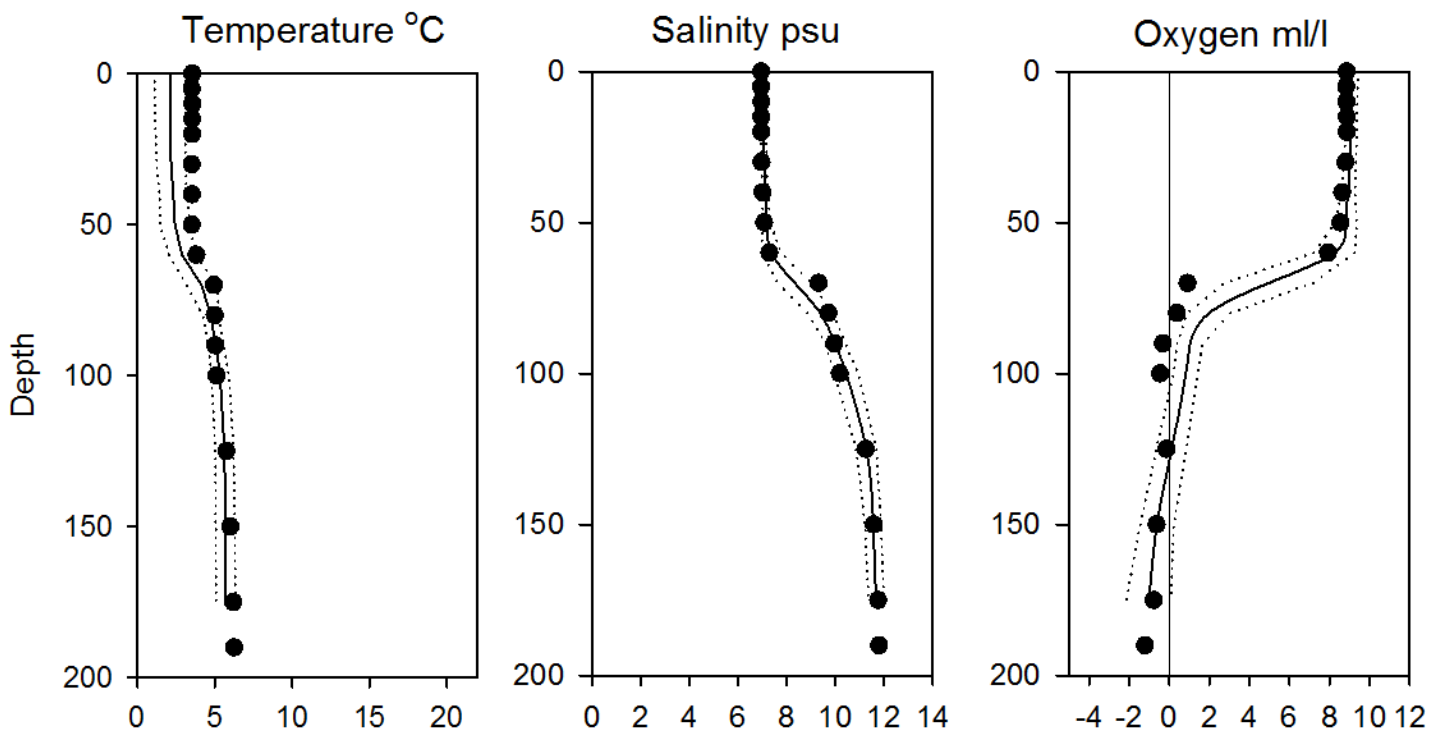


## OXYGEN IN BOTTOM WATER (depth >175m)



# Vertical profiles BY20 March

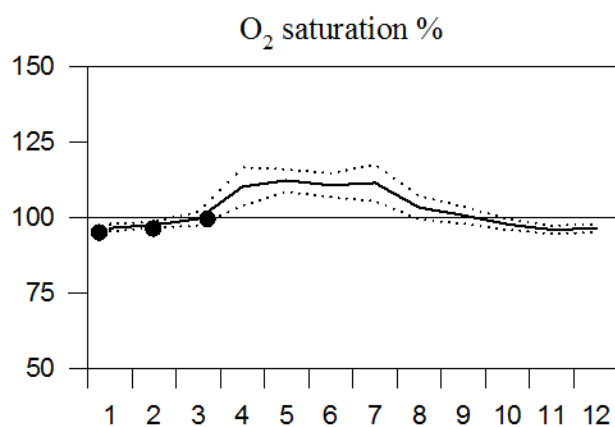
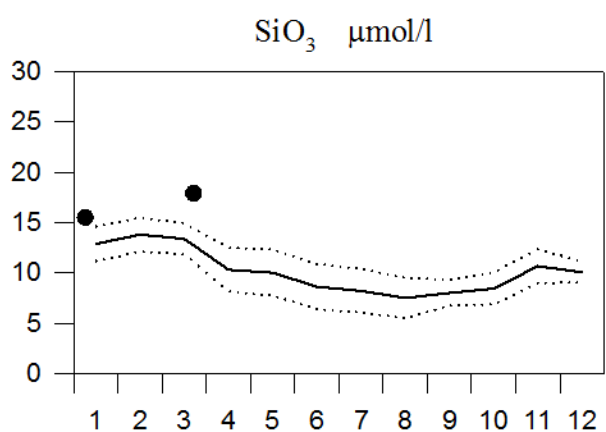
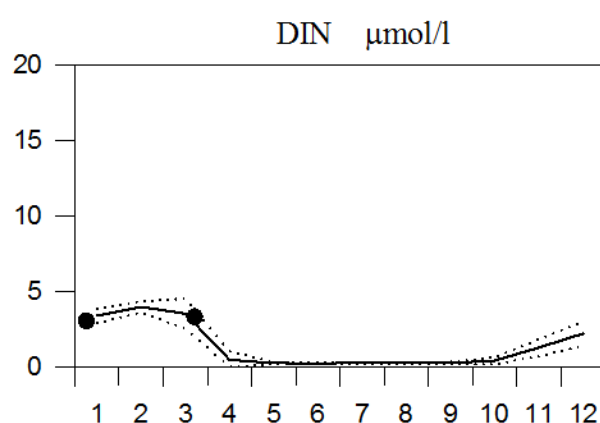
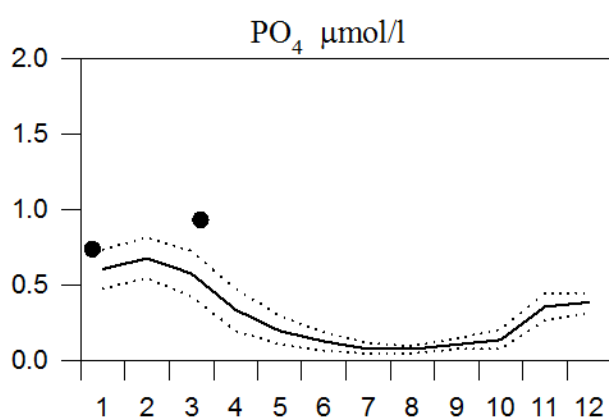
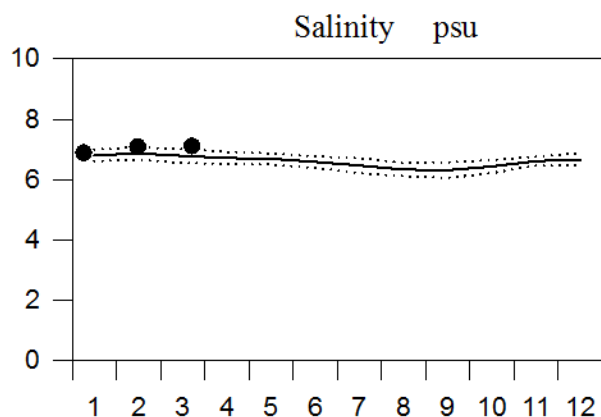
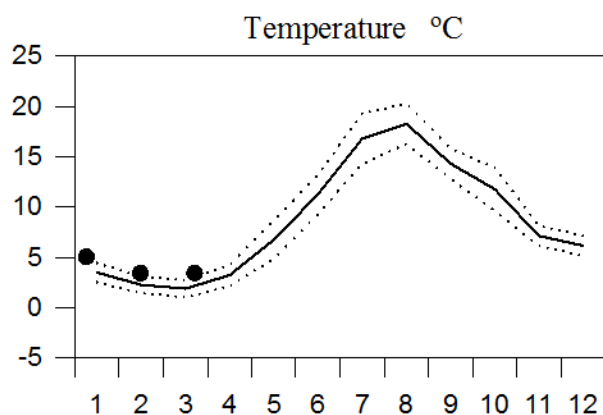
— Mean 1996-2010      ..... St.Dev.      ● 2015



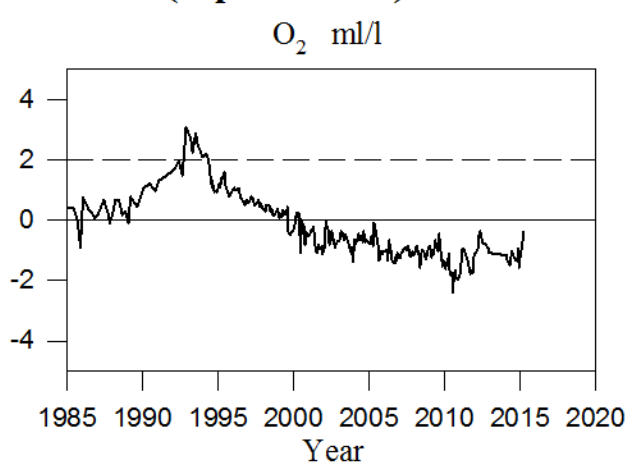
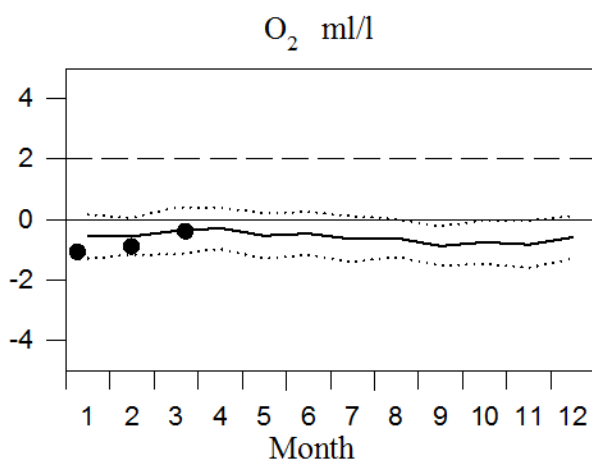
# STATION BY32 SURFACE WATER

## Annual Cycles

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

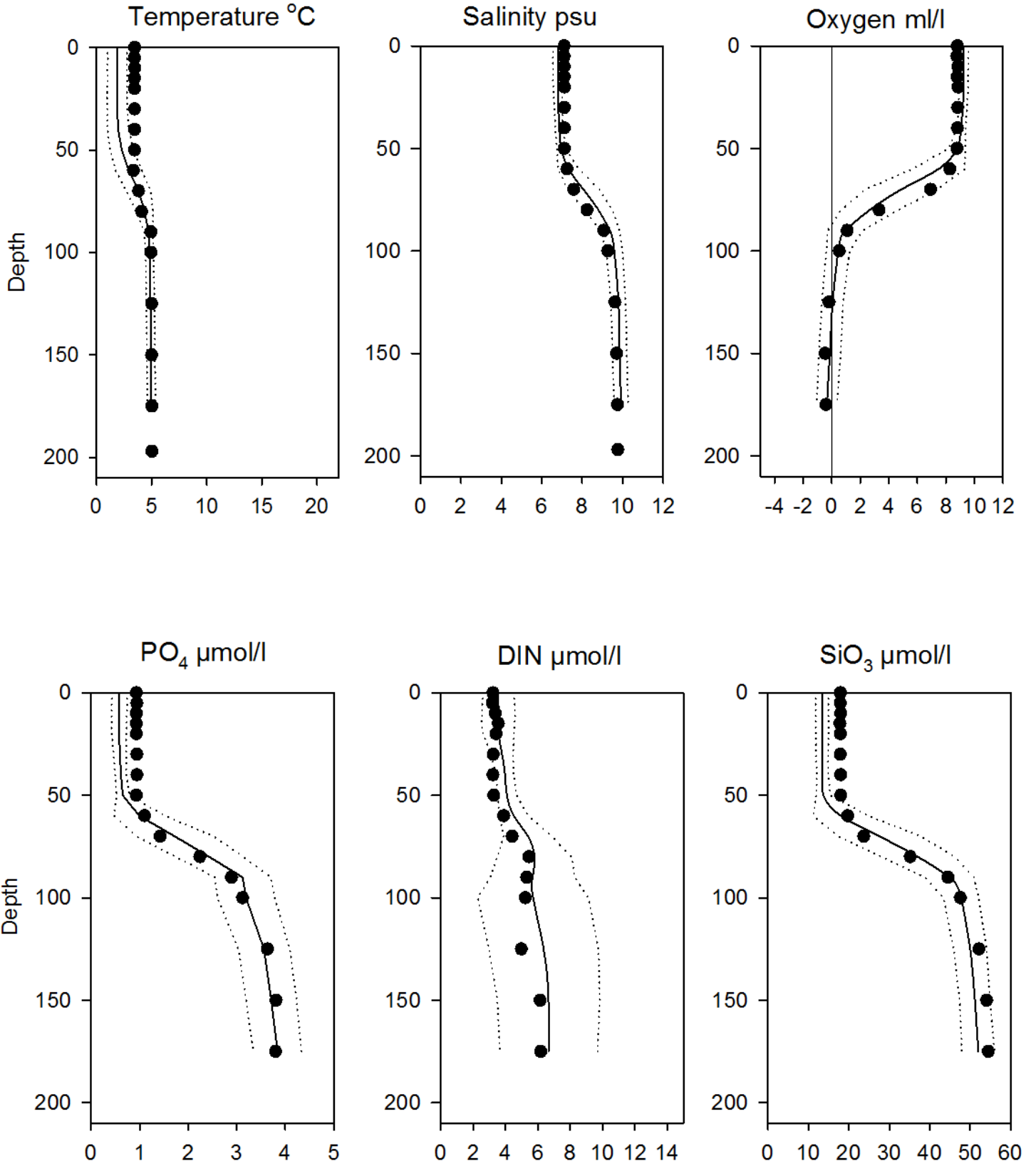


## OXYGEN IN BOTTOM WATER (depth > 175m)



# Vertical profiles BY32 March

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

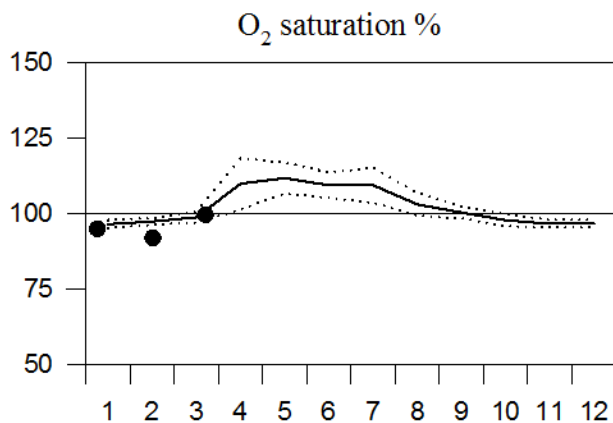
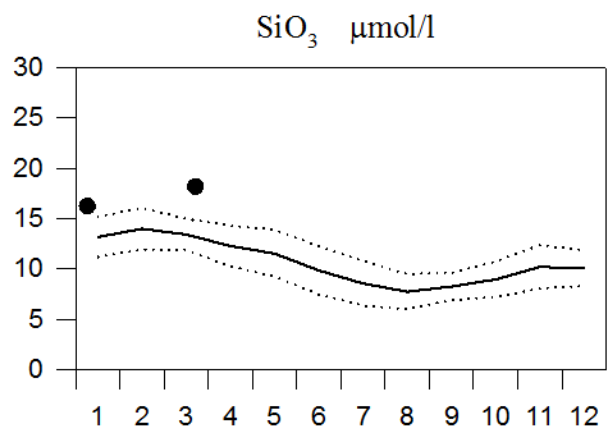
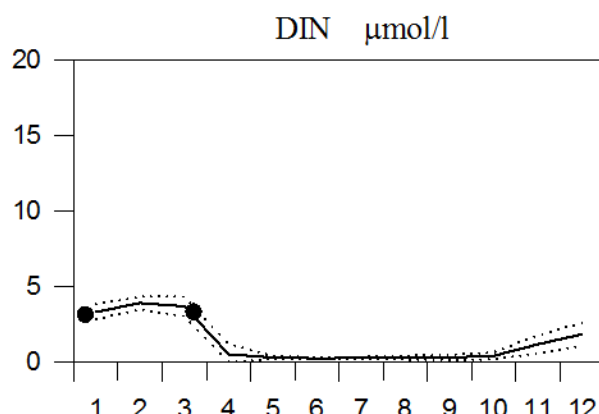
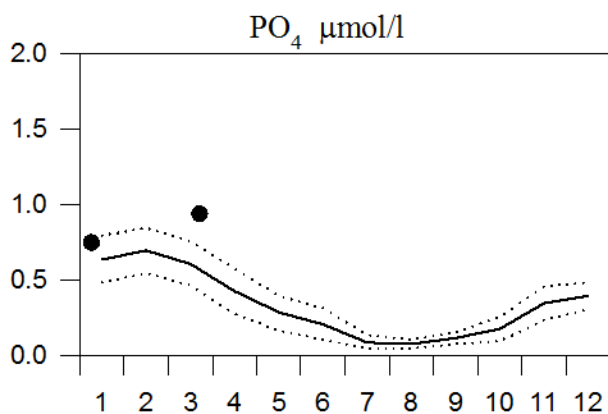
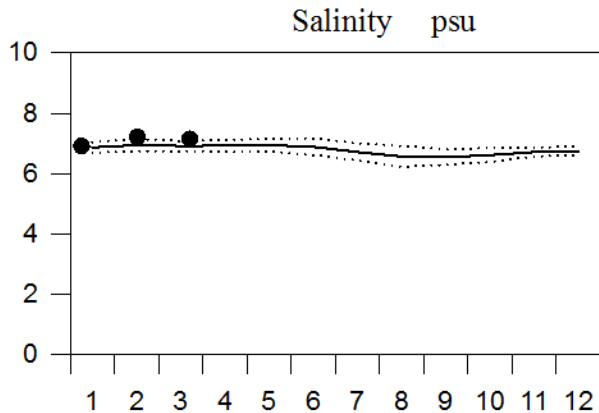
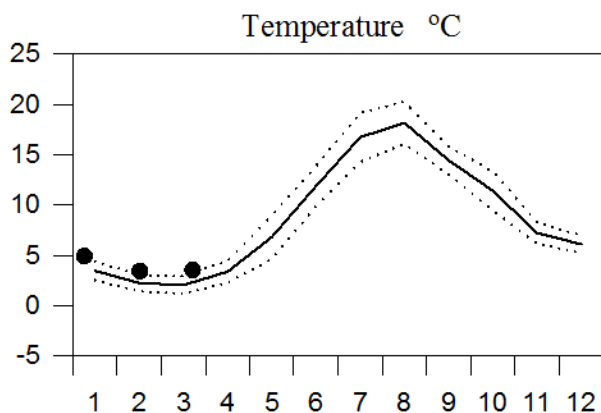




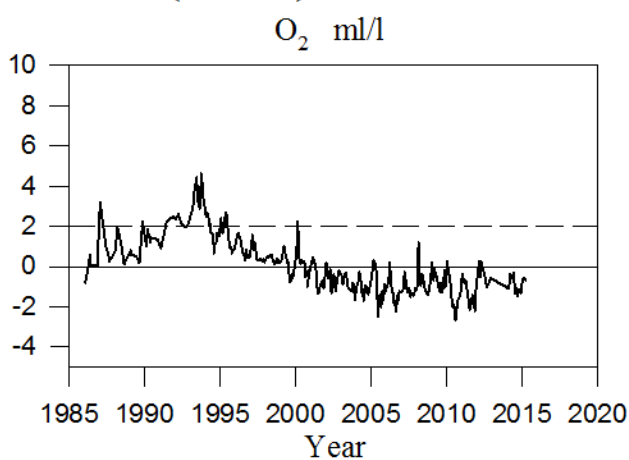
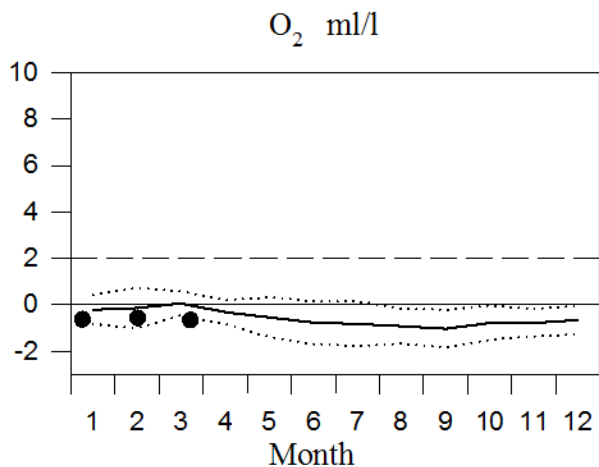
# STATION BY38 SURFACE WATER

## Annual Cycles

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

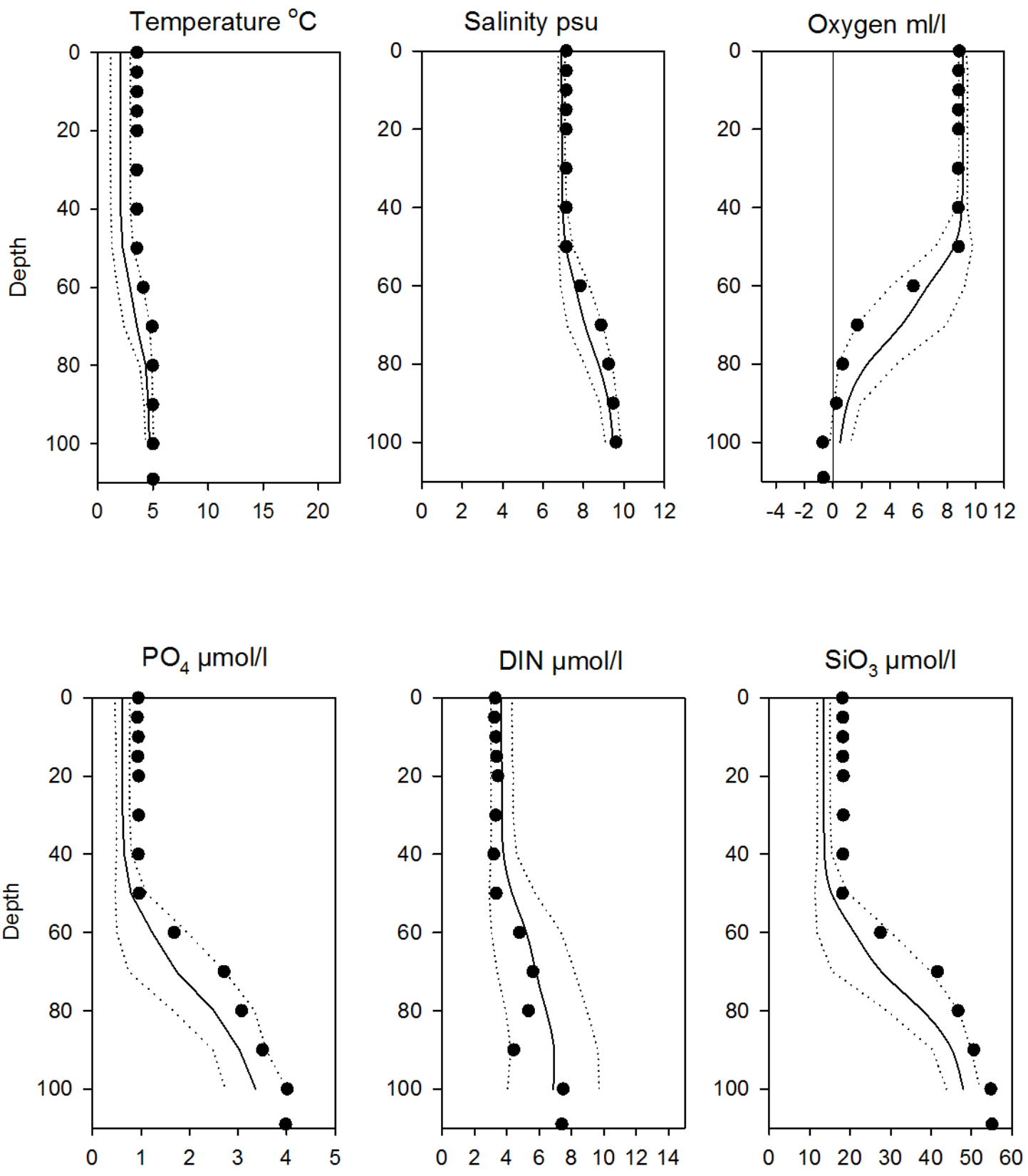


## OXYGEN IN BOTTOM WATER (> 100m)



# Vertical profiles BY38 March

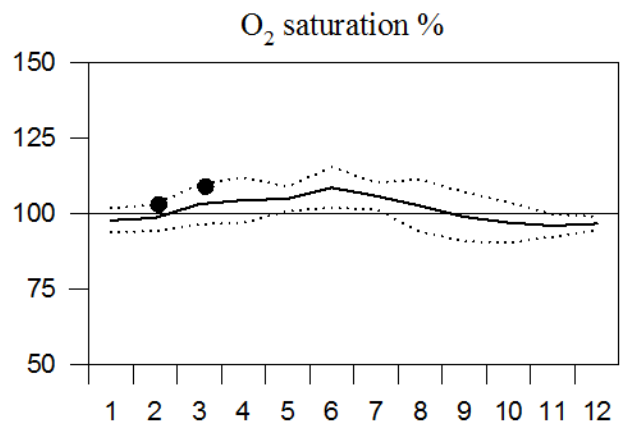
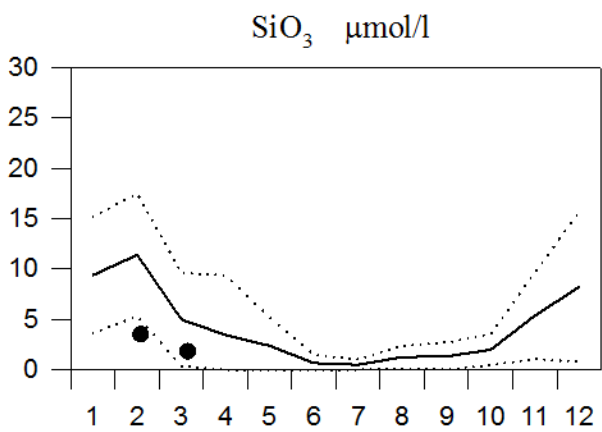
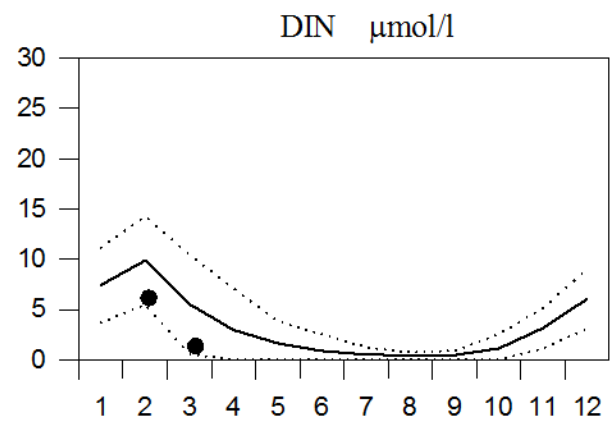
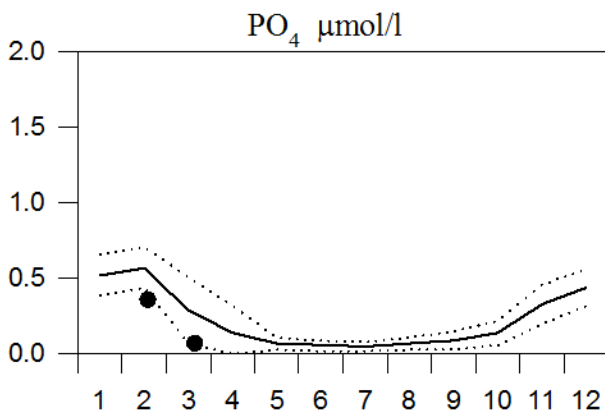
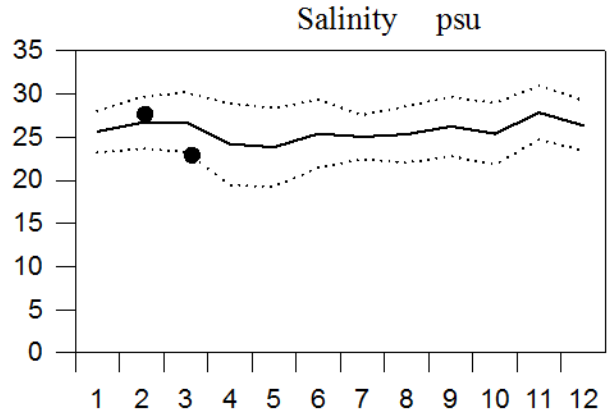
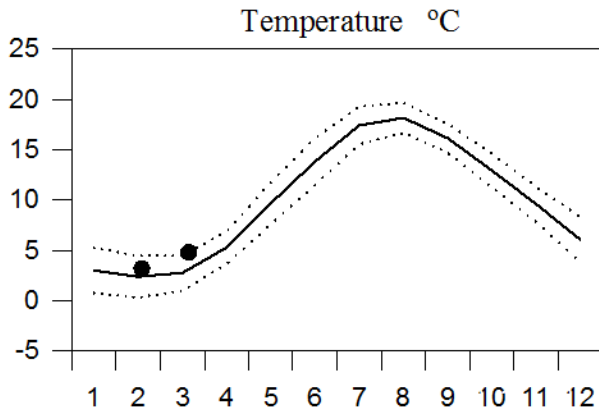
— Mean 1996-2010      ..... St.Dev.      ● 2015



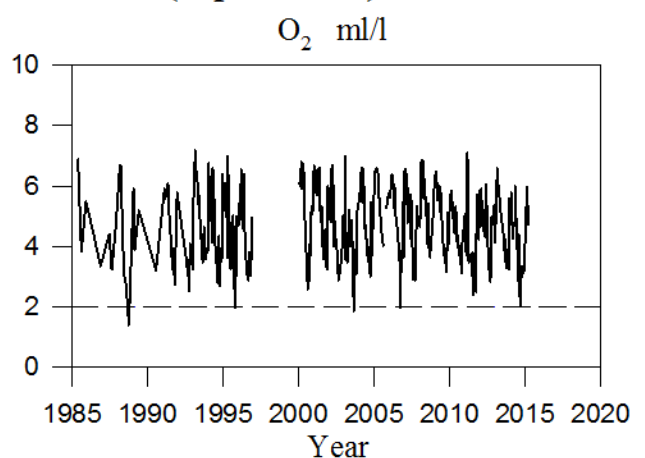
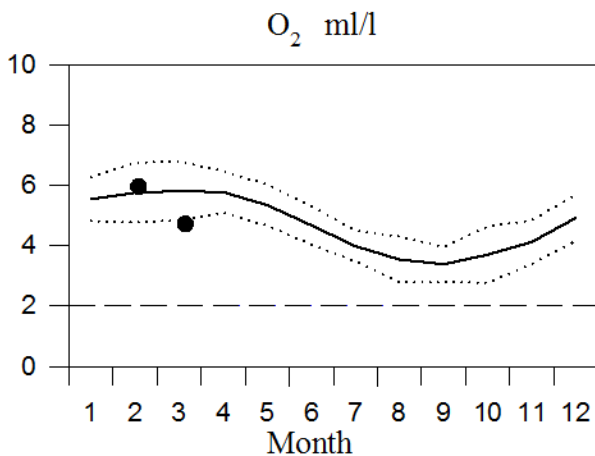
# STATION SLÄGGÖ SURFACE WATER

## Annual Cycles

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

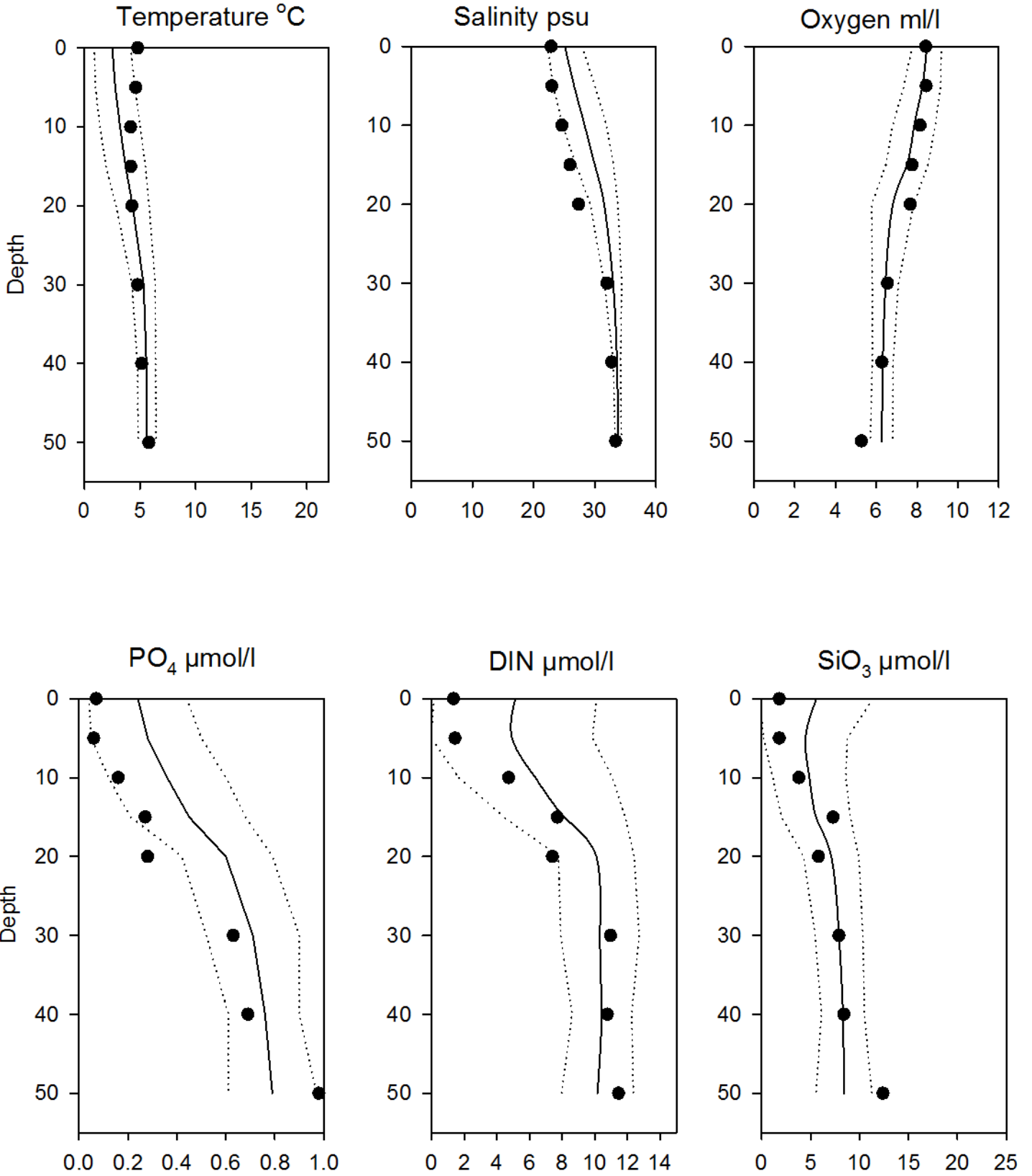


## OXYGEN IN BOTTOM WATER (depth >50m)



# Vertical profiles Släggö March

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



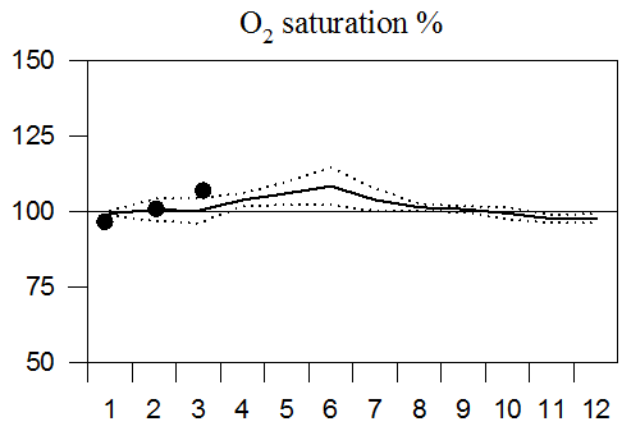
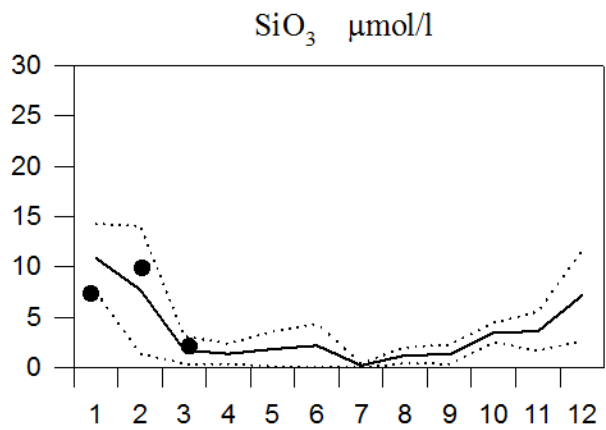
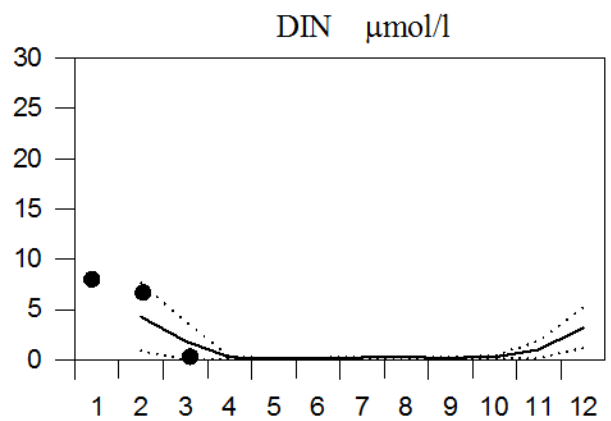
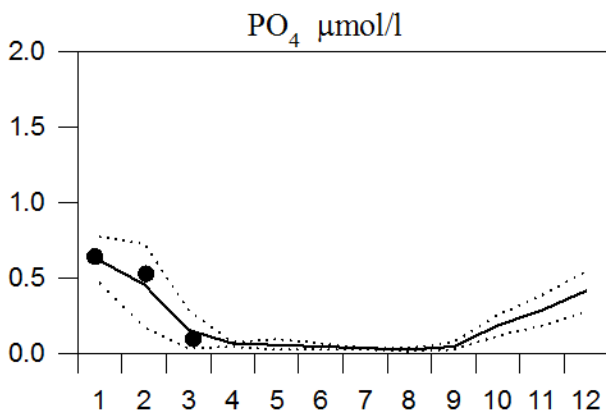
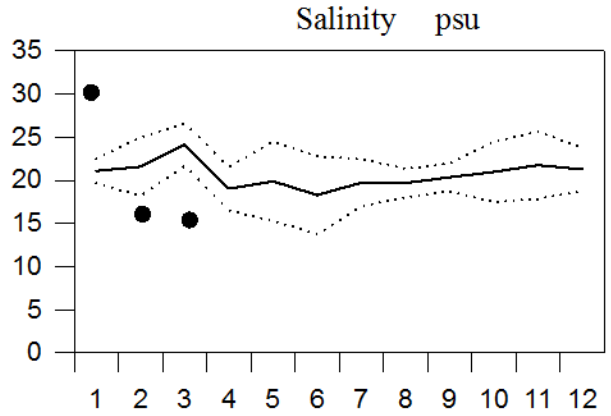
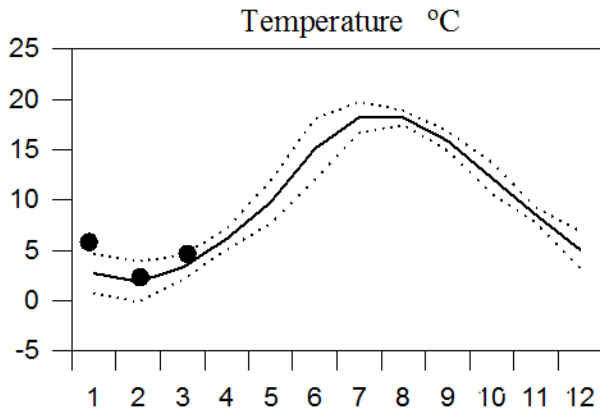
# STATION N14 Falkenberg SURFACE WATER

## Annual Cycles

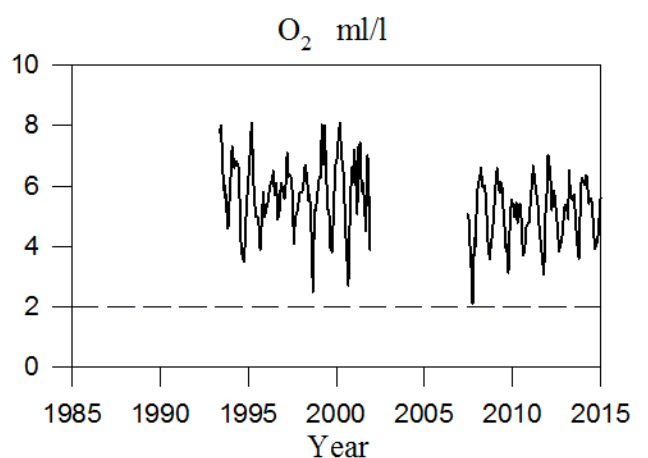
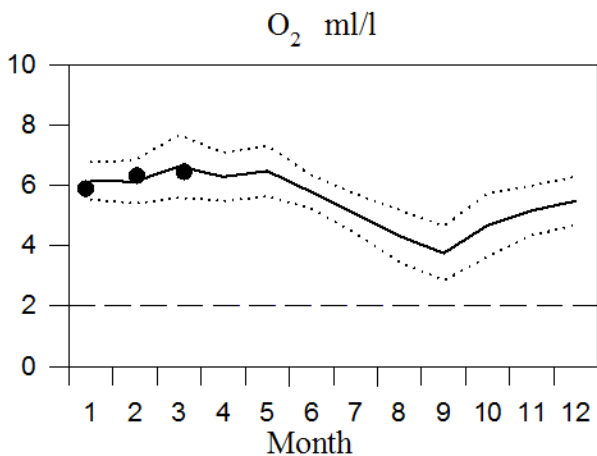
— Mean 2007-2010

..... St.Dev.

● 2015

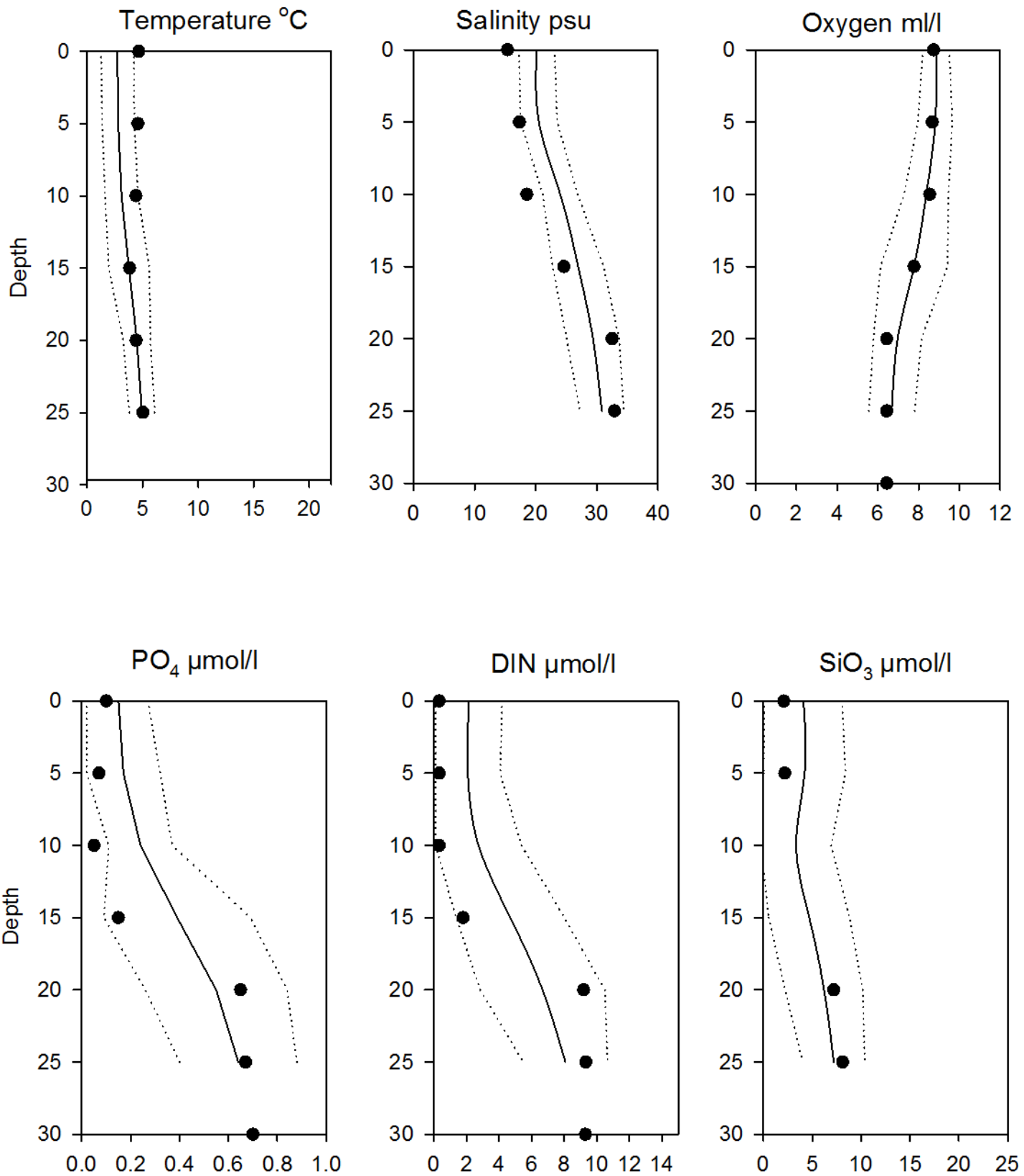


## OXYGEN IN BOTTOM WATER (depth > 25m)



# Vertical profiles N14 Falkenberg March

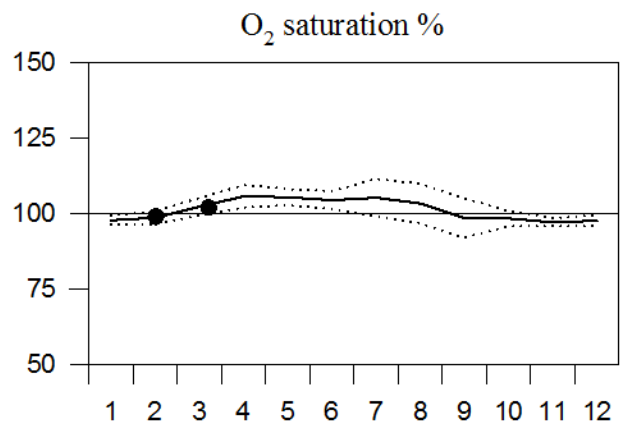
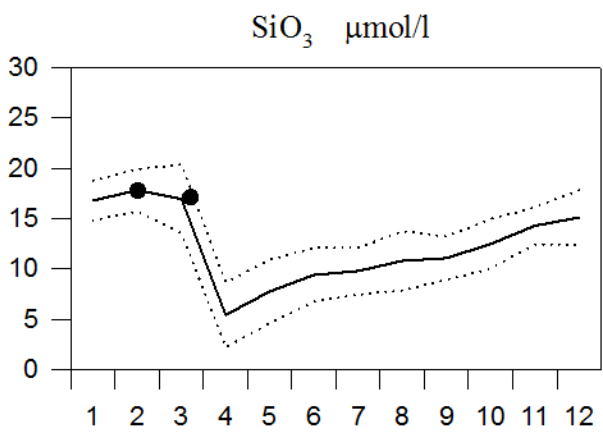
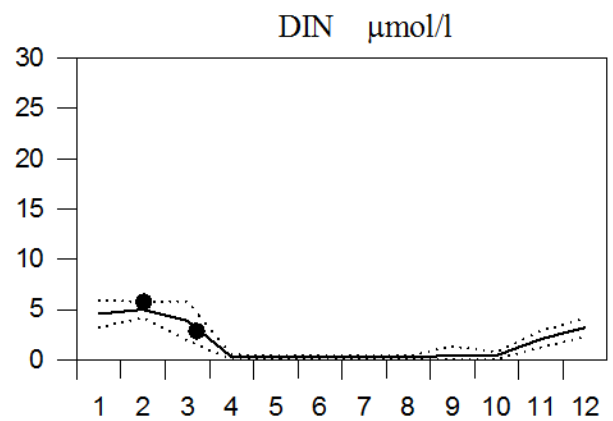
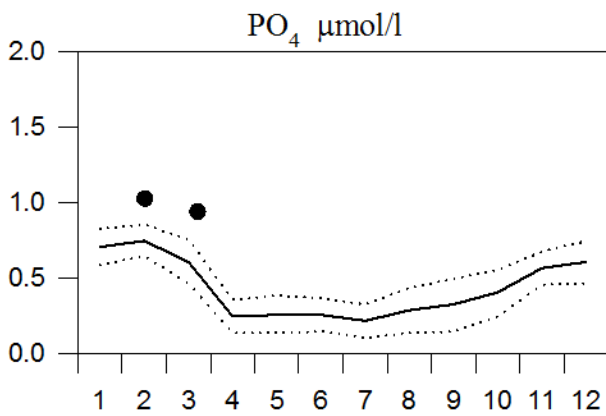
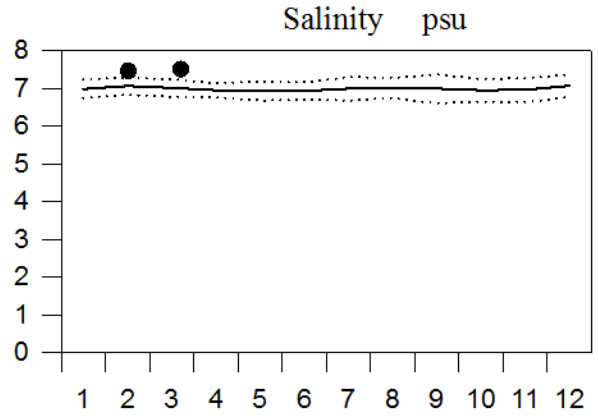
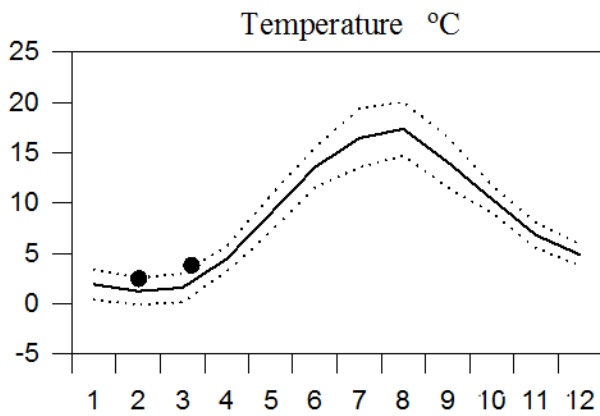
— Mean 1996-2010      ..... St.Dev.      ● 2015



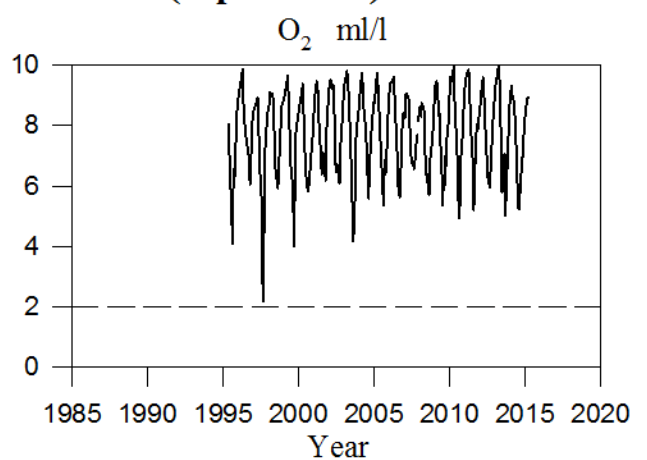
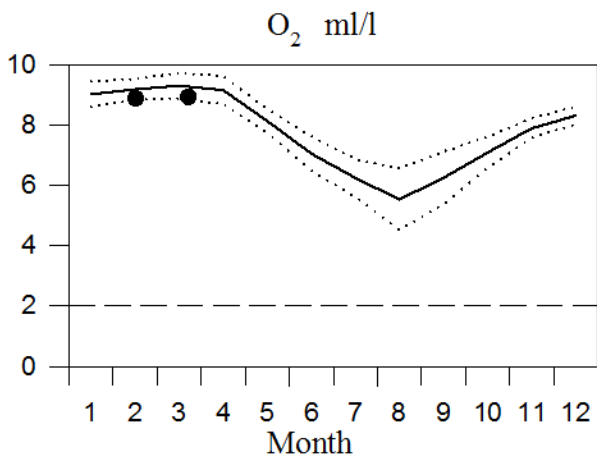
# STATION REF M1V1 SURFACE WATER

## Annual Cycles

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



## OXYGEN IN BOTTOM WATER (depth >15m)



# Vertical profiles Ref M1V1 March

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

