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2017-01-15
Dnr: S/Gbg-2017-4

Report from the SMHI monitoring cruise with R/V Aranda

Survey period: 2017-01-08 to 2017-01-15
Principal: The Swedish Meteorological and Hydrological Institute and the Swedish Agency for Marine and Water Management

SUMMARY

The cruise, which is part of the Swedish marine monitoring programme, covered the Skagerrak, the Kattegat, the Sound and the Baltic Proper. In Kattegat the winter pool of nutrients were mapped.

In large parts of the deep water in the Baltic Proper the oxygen concentrations were close to 0 ml/l and the concentrations of hydrogen sulphide were lower than the expedition in December. In the northern part of the Western Gotland Basin (BY31) hydrogen sulphide was found from 175 meters, and in the rest of the region from depths exceeding 80 meters. Low levels of hydrogen sulfhide were observed at the Gotland Deep from 235 meters. In the Bornholm Basin and Hanö Bight, acute hypoxia was found from 80 and 70 meters respectively. However, high oxygen concentrations were observed at the Christiansö (BY4) bottom water at 91 meters which indicates incoming water. Acute hypoxia, < 2 ml/l was found in all basins from 70-80 meters depths in the Baltic Proper.

All nutrients in the surface water were generally normal for the season, except in the southern part of the Baltic Proper where concentrations of inorganic nitrogen were higher and in the northern part where the concentrations of phosphate were higher. The surface water temperature was normal for the season except in the Bornholm Basin where it was warmer. The surface salinity was higher than normal in the Eastern and Western Gotland Basin and in the Arkona basin.

Next cruise is scheduled to start 9th of January. In addition to the normal sampling, the winter pool of nutrients will be surveyed in the Kattegat area.

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RESULTS

The cruise was performed aboard the Finnish research vessel Aranda and started in Helsinki on the 8th of January and ended in the same port on 15th of January. The winds during the cruise were mainly westerly to south westerly with varying strength. During the beginning of the cruise, in the Gulf of Finland there were strong winds which declined in the Eastern Gotland Basin. When the cruise reached Kattegat, very strong winds just above 20 m/s passed by. In the Western Gotland Basin the wind speed declined and the wind came from the north.

During the expedition, a scientist from Lund university participated who observed overwintering seabirds. The idea is to eventually include annual counting from Aranda or similar ships in the standardised monitoring of seabirds along the Swedish coast. The monitoring programme of seabirds is financed of Swedish Environmental Protection Agency (Naturvårdsverket).

During the first half of the cruise it was an inflow to the Baltic Sea through the Sound. During the strong winds in the middle of the cruise the mean flow was reversed.

Because of the strong winds and the large wave heights it was necessary to cancel all the outer stations in Skagerrak (Å-snittet and P2). These stations are instead planned to be visited during SLU's IBTS-cruise with Dana, scheduled to start 18th of January.

This report is based on data that have passed a first quality control. When data are published at the SMHI data centre some values might have changed after further quality controls have been performed. Data from this cruise are published as soon as possible on the data centres webpage, normally within one or two weeks after a cruise.

Download data here: http://www.smhi.se/klimatdata/oceanografi/havsmiljodata

The Skagerrak

The cruise reached the Skagerrak at the same time as very harsh weather with wind speeds up to 20 m/s and significant wave heights of 5 meters. The outer part of Skagerrak could therefore not be visited and only the coastal station Släggö was monitored. The temperature in the surface water was normal for the season, 5 °C, and the surface salinity was higher than normal, 30.8 psu. The halocline and thermocline coincided at 25 meters depth.

The concentration of inorganic nitrogen (nitrate+ nitrite+ammonia) and silicate was generally lower than normal in the entire water column, the surface concentration of inorganic nitrogen was 4.67 µmol/l and silicate was 5.2 µmol/l. The concentration of phosphate was 0.53 µmol/l in the surface water.

The fluorescence from the CTD was low at the station and the bottom water was well oxygenated with 5.97 ml/l.

The Kattegat and the Sound

The temperature of the surface water was normal for the season and varied between 3.1 –6.0 °C, lowest in the south easterly parts and the Sound and highest in the northern parts. The western part of Kattegat was some degree warmer. Also the surface salinities were normal for the season and

varied from 17 – 33 psu in Kattegat. Along the western side the water was well mixed while eastern Kattegat was weakly stratified and thermocline and halocline coincided at 25 meters depth. The Sound had a stronger stratification with low salinity in the surface, 10.5psu, and higher in the bottom layer, 28 psu.

The mapping of nutrients in the Kattegat showed typical concentrations in the entire region and concentrations in the surface water had increased since the December cruise, the concentrations in deeper layers remained lower than normal. Levels of silicate were however lower than normal in the surface water. The phosphate concentration was 0.51-0.53 µmol/l, the inorganic nitrogen was 4.67 - 4.95 µmol/l. The concentration of silicate was 5.6-6.5 µmol/l in Kattegat and 11.5 µmol/l in the Sound. In figure 2 the mapping of the winter pool is presented.

The deep water was well oxygenated in the whole Kattegat as well as in the Sound, which is normal for the season. The concentrations in the bottom water varied around 6.5 ml/l.

The fluorescence from the CTD indicated very low plankton activity in the whole area.

The Baltic Proper

The temperature in the surface water was lower than normal except in the Bornholm Basin where it was warmer. Variations in temperature in the Baltic Proper were 2.9-5.7 °C. The salinity was higher than normal in the surface water in the Eastern and Western Gotland Basin and Arkona Basin but normal in the remaining areas. Variations in surface salinity were 7.0-9.2 psu with lowest salinity in the Western Gotland Basin and highest in Arkona Basinu. The surface layer was well mixed to 70 meters and shallower in the southwestern parts where it was well mixed to 50 meters.

The phosphate concentrations in December were elevated but now in January it was found to be normal concentrations for the season, except in the western Gotland Basin where it was still higher than normal, variations were 0.5-0.9 µmol/l. The concentrations of inorganic nitrogen was normal except in the south and in south west where it was above normal, variations were 3.0-6.1 µmol/l. Silicate concentrations continued to be highly elevated in the whole area and varied between 11 – 21 µmol/l.

In large parts of the deep water in the Baltic Proper the oxygen concentrations were close to 0 ml/l, and the concentrations of hydrogen sulphide were lower than the expedition in December. At the stations BY38 and BY32 in the Western Gotland Basin hydrogen sulphide was present from 80 and 90 meters respectively, at BY31 Landsort Deep from 175 meters and BY29 from 125 meters. Concentrations of oxygen were close to zero in the BY20 Fårö Deep bottom water and no hydrogen sulphide was present. In the Eastern Gotland Basin at BY15 low concentrations of hydrogen sulphide was present from 235 meters. Acute hypoxia, < 2 ml/l was found in all basins from 70-80 meters depths in the Baltic Proper.

In the Bornholm Basin and Hanö Bight, acute hypoxia was found from 80 and 70 meters respectively. However, high oxygen concentrations were observed at the Christiansö (BY4) bottom water at 91 meters which indicates incoming water.

The fluorescence measurements from the CTD showed low phytoplankton activity in the whole investigated area except from the Hanö Bight and Arkona where the fluorescence was a bit higher.

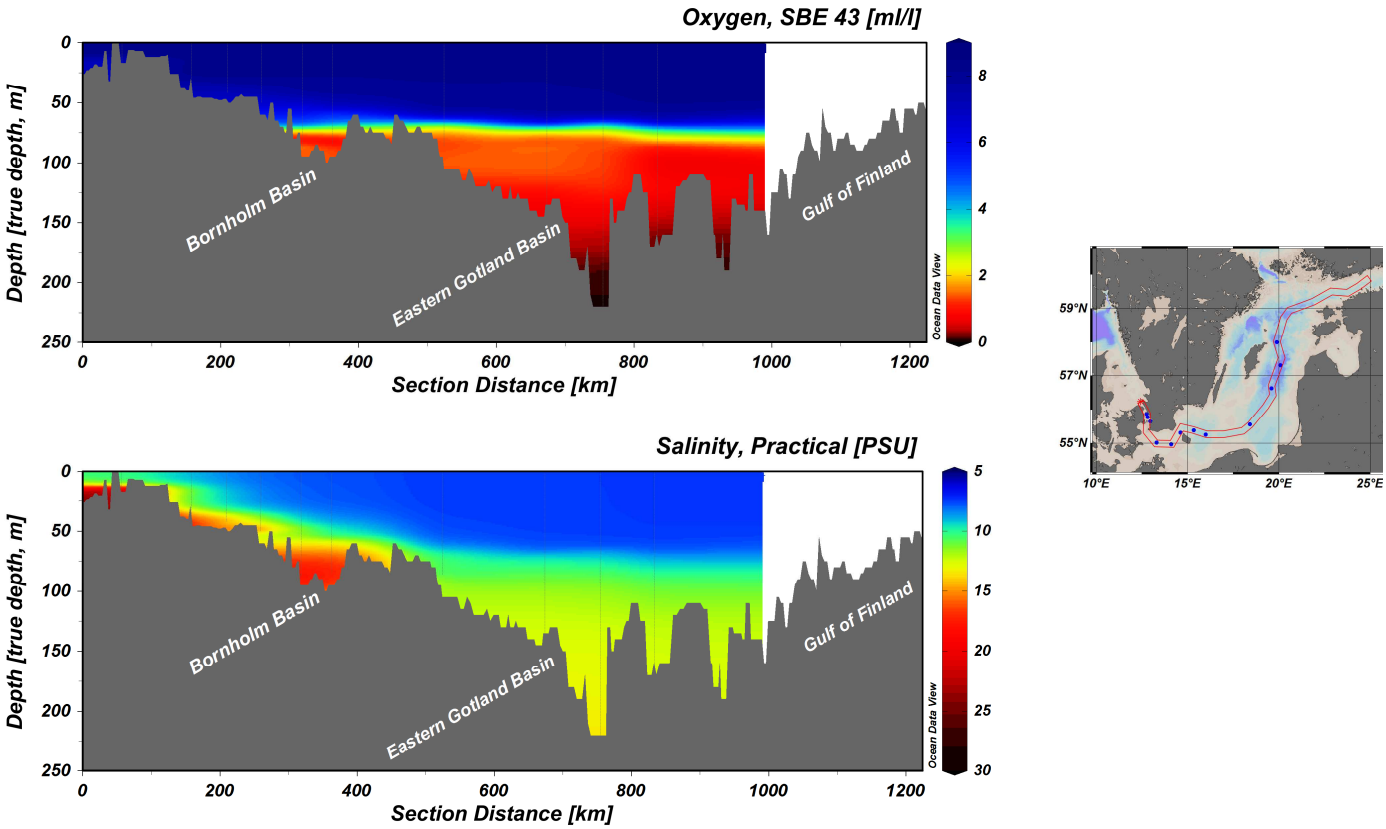

Figure 1. Transect showing oxygen and salinity through the Baltic Proper, from the Sound to the Eastern Gotland Basin.

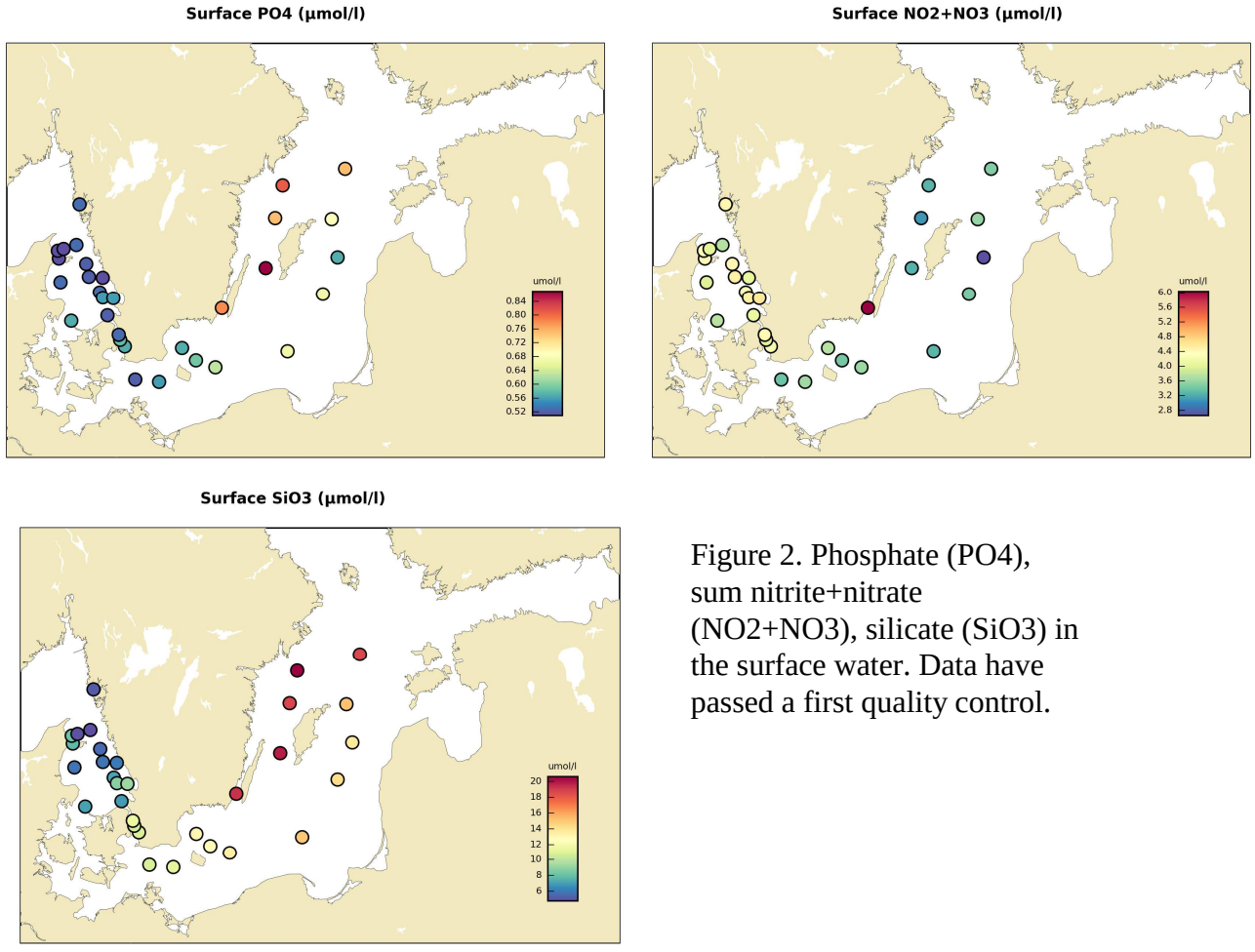

Figure 2. Phosphate (PO4), sum nitrite+nitrate (NO2+NO3), silicate (SiO3) in the surface water. Data have passed a first quality control.

PARTICIPANTS

Name	Leg	Institute
Karin Wesslander, Chief Scientist		SMHI
Örjan Bäck	Helsinki-Lysekil	SMHI
Jenny Lycken		SMHI
Johan Kronsell		SMHI
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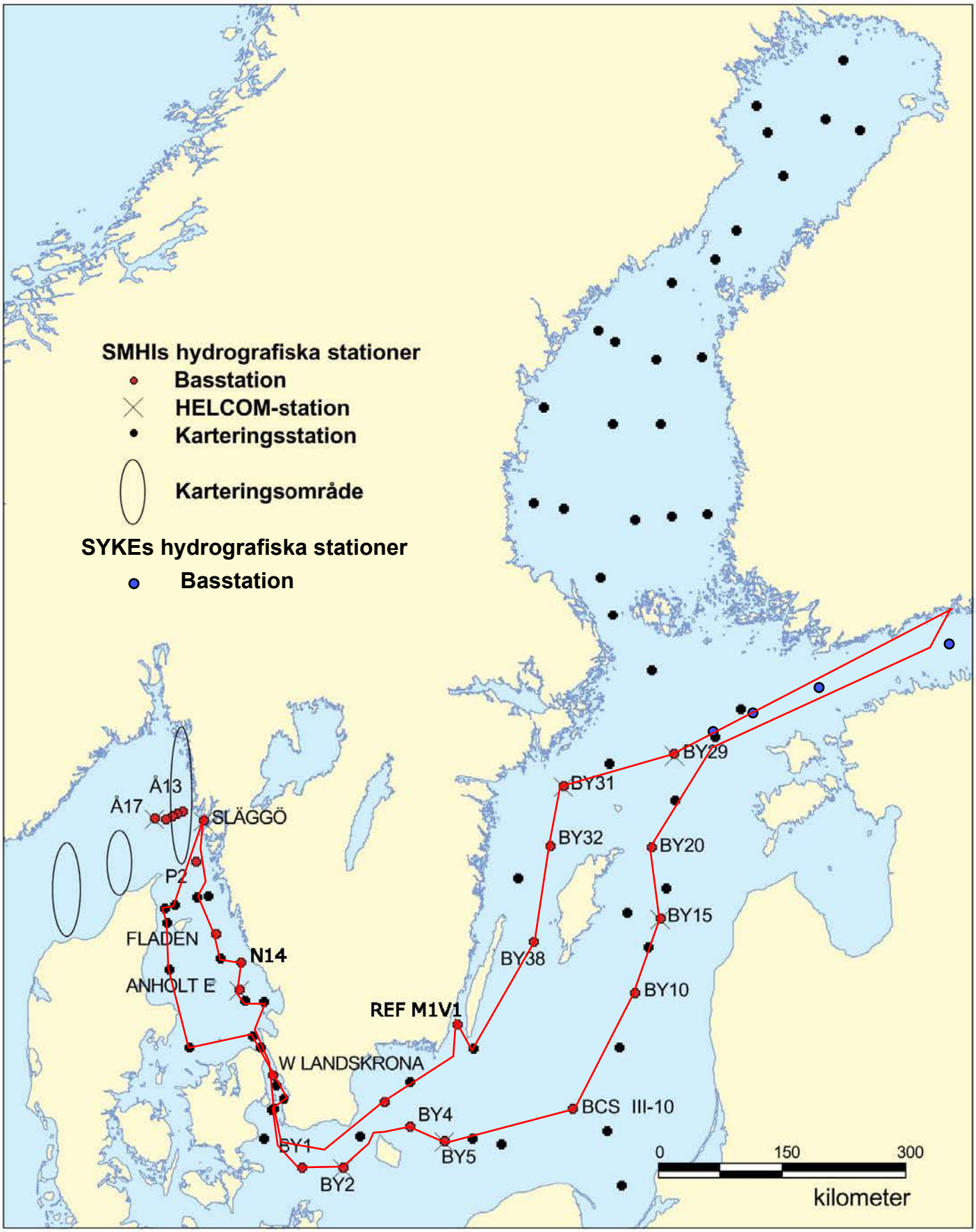
Anna-Kerstin Thell	Lysekil-Helsinki	SMHI
Fredrik Haas	Lysekil-Helsingfors	Lund university

APPENDICES

- Track chart
- Table over stations, analysed parameters and number of sampling depths
- Map showing bottom oxygen concentrations
- Vertical profiles for normal monitoring stations
- Monthly average surface water plots for normal monitoring stations

SMHI
Havs
och Vatten
myndigheten

TRACKCHART
Country: Sweden
Ship: R/V ARANDA
Date: 20170108-20170115
Series: 0001-0033



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Time: 23:09

Ship: AR
Year: 2017

Ser no	Cru no	Stat code	Proj	Stat name	Lat	Lon	Start date yyyymmdd	Start time hhmm	Bottom depth m	Secchi depth m	Wind di ve	Air temp C	Air pres hPa	WCWI elac aove tueo hdsb	BSHP imop gas le nl e tn e t	No de	T e m p _ b t l	T e m p _ c t d	S a l t _ b t l	S a l t _ c t d	P h o x y _ b t l	D o x y _ c t d	H 2 s	P h t o s	P t r s	N t r i	N t r a	N t r z	N t m o n	A t o t	N t y	A l k 3 - s i	S i u s	H u m l	C l	T p h	P o c n	L i g h t	Y e n l o w	C l d _ 2 5	C o m n t _ v i s i t
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0002	1	BPEX21	BAS	BY15 GOTLANDSDJ	5718.73	02004.57	20170109	1450	239		22	9	2	1017	2840	xxx-	19	x	x	-	x	x	x	x	x	-	x	x	x	x	-	-	x	-	-	-	-	-	-	-	-
0004	1	BPEX13	BAS	BY10	5638.02	01935.09	20170109	2121	143		23	11.4	3	1017	9999	----	15	x	x	-	x	-	x	x	-	x	-	x	x	x	-	-	x	-	-	-	-	-	-	-	-
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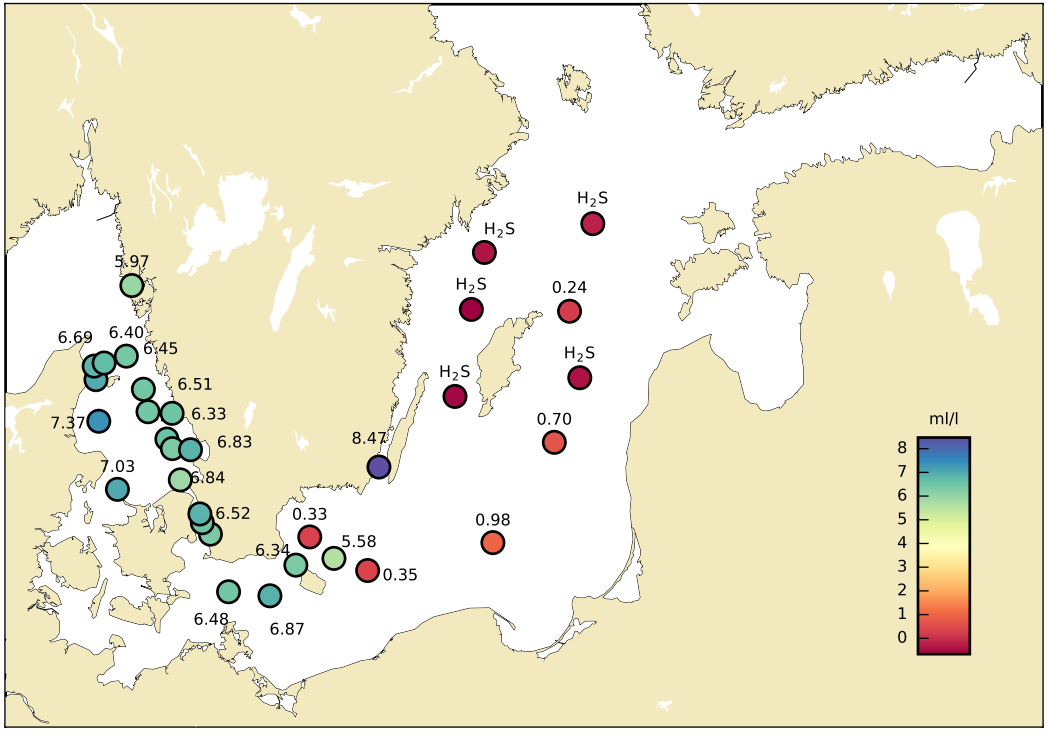
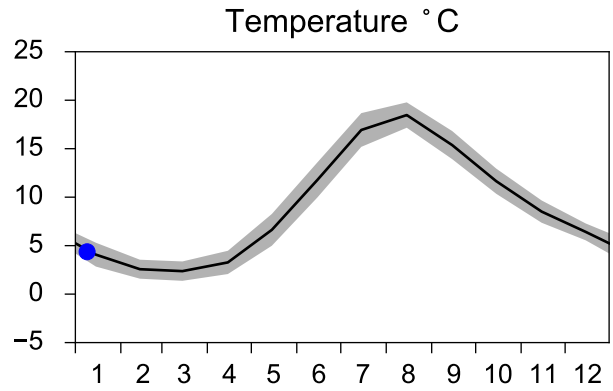
Date: 20170109-20170115
Series: 0001-0033

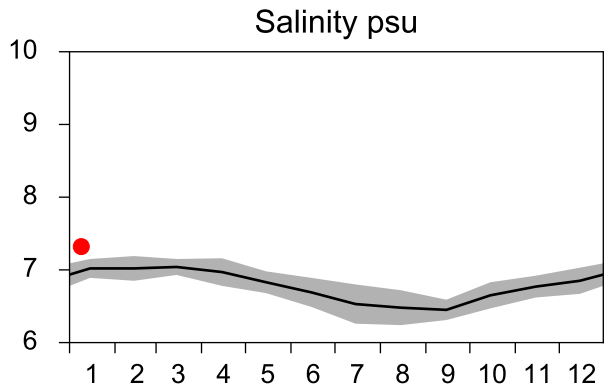


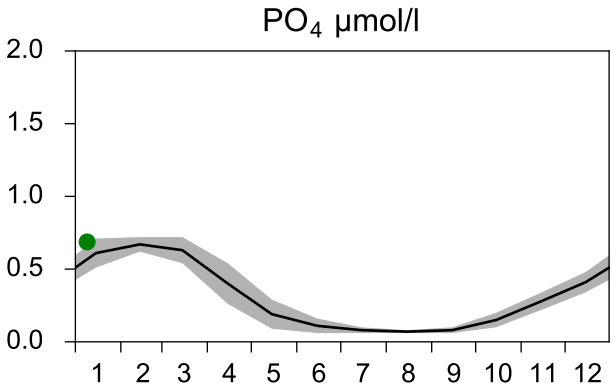
STATION BY20 FÅRÖDJ SURFACE WATER (0-10 m)

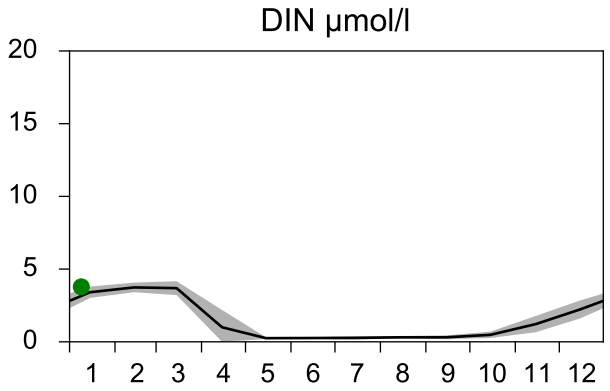
Annual Cycles

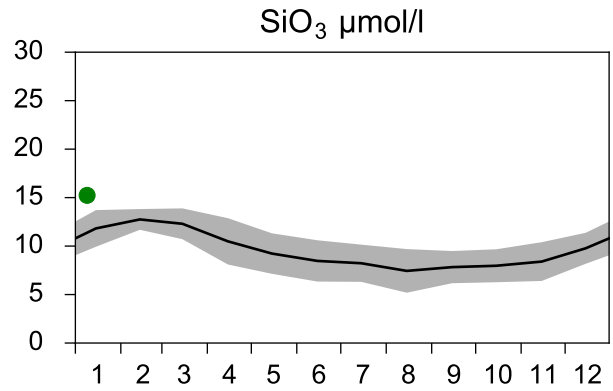
Mean 2001-2015 St.Dev. 2017

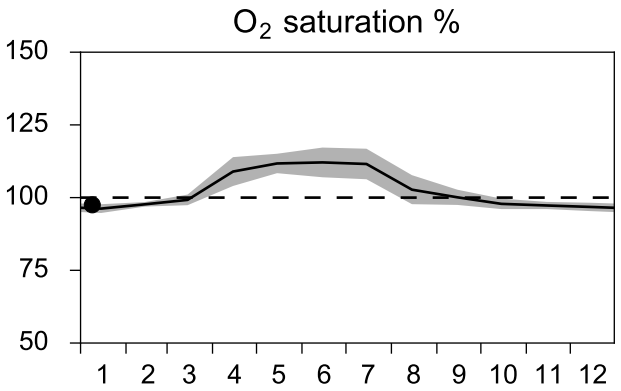




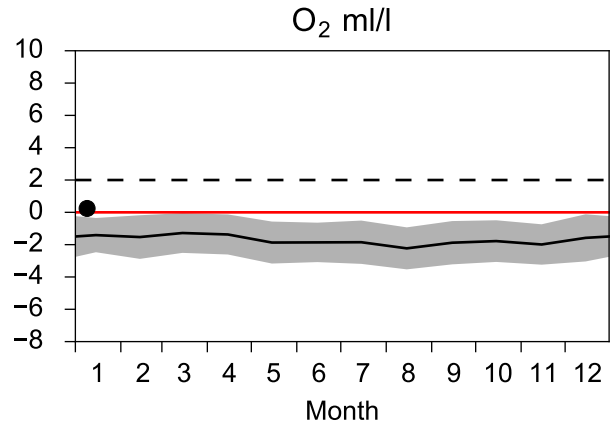


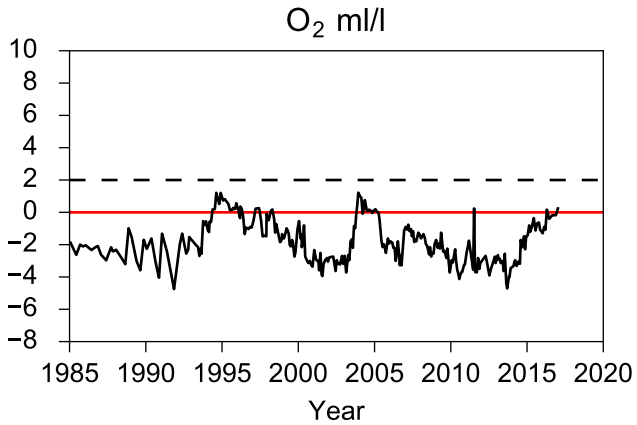




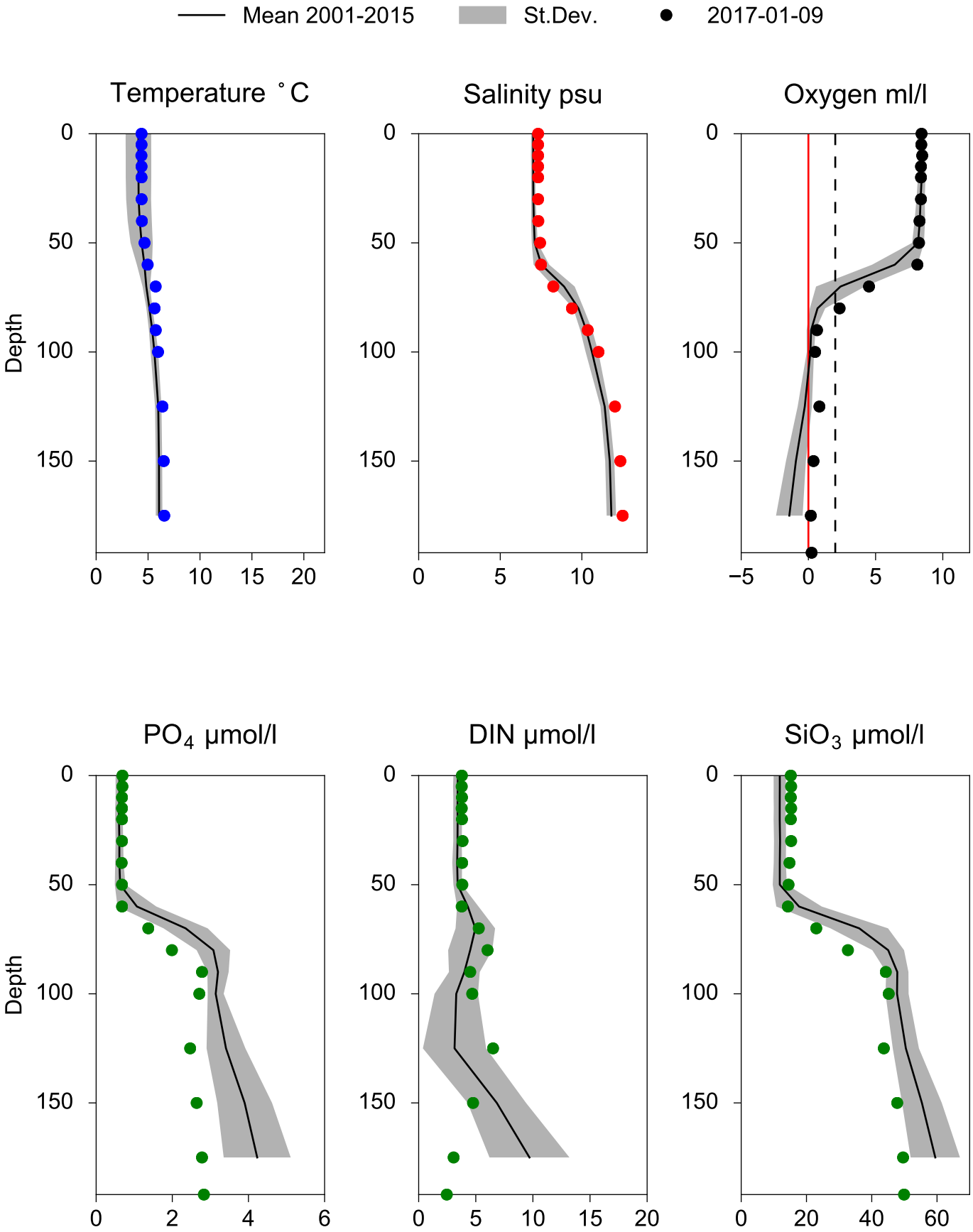


OXYGEN IN BOTTOM WATER (depth >= 175 m)





Vertical profiles BY20 FÅRÖDJ
January

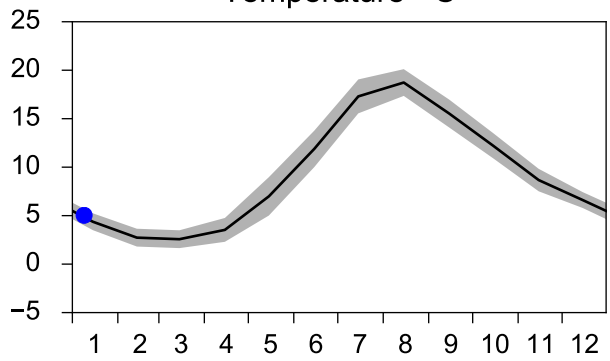


STATION BY15 GOTLANDSDJ SURFACE WATER (0-10 m)

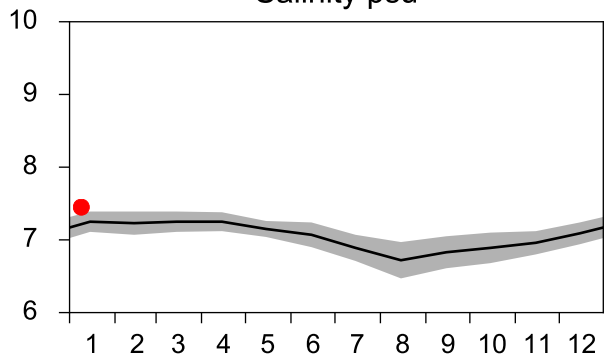
Annual Cycles

Mean 2001-2015 St.Dev. 2017

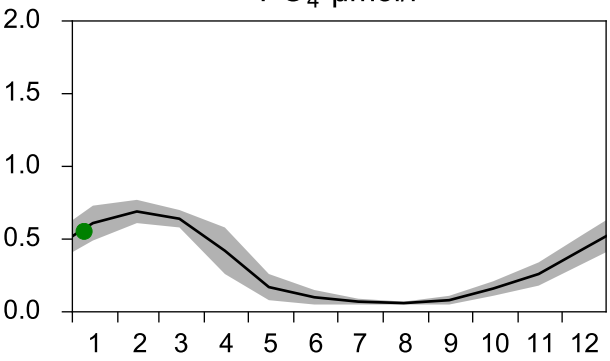
Temperature ˚C



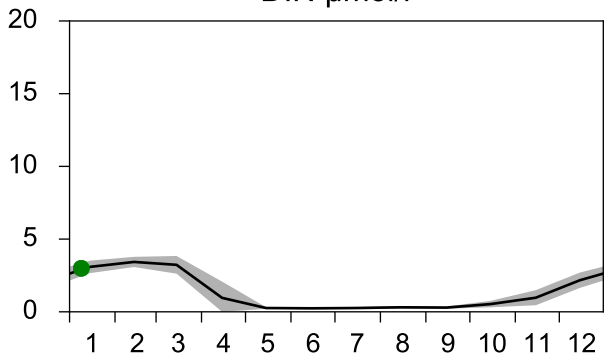
Salinity psu



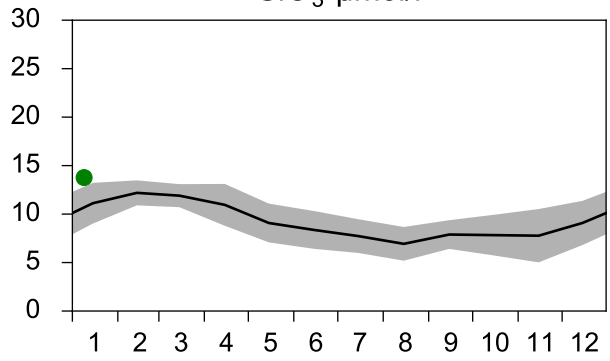
PO_4 µmol/l



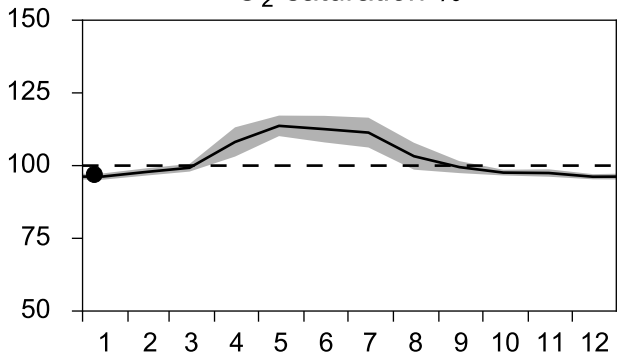
DIN µmol/l



SiO_3 µmol/l

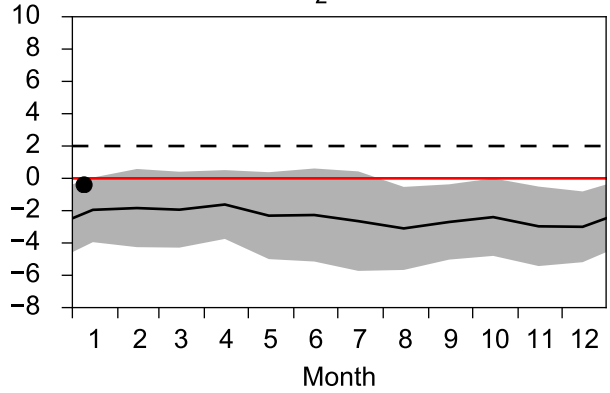


O_2 saturation %

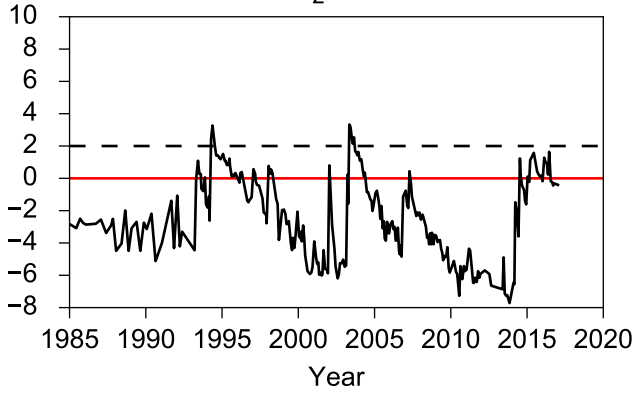


OXYGEN IN BOTTOM WATER (depth >= 225 m)

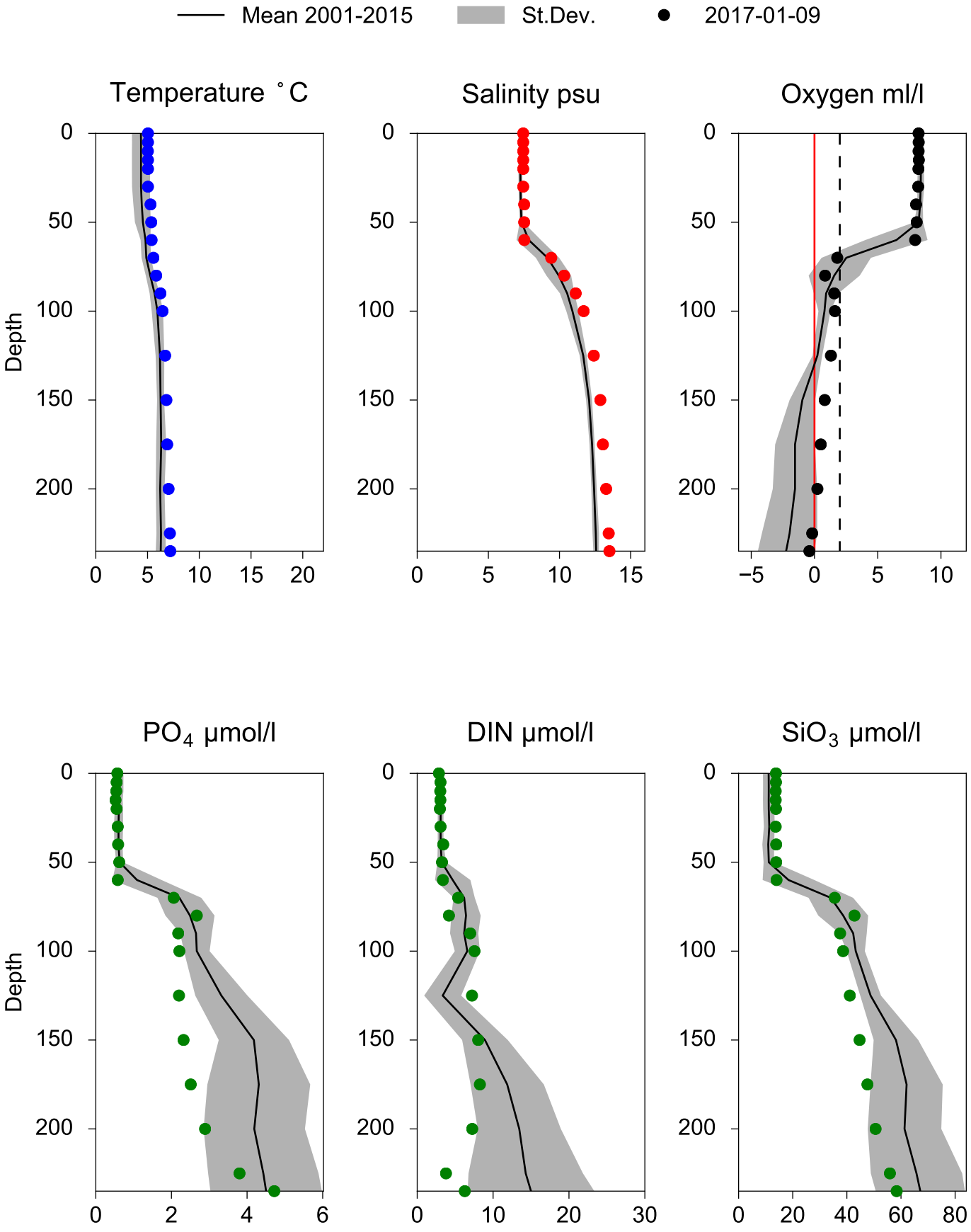
O_2 ml/l



O_2 ml/l



Vertical profiles BY15 GOTLANDSDJ
January

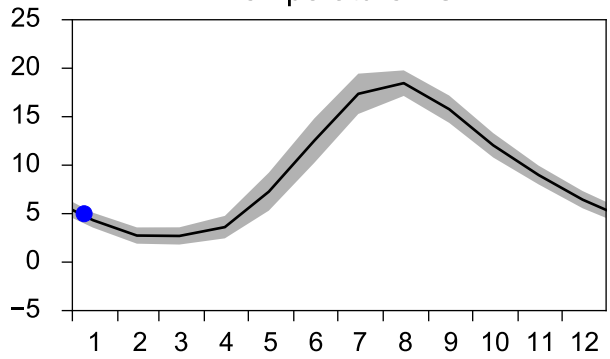


STATION BY10 SURFACE WATER (0-10 m)

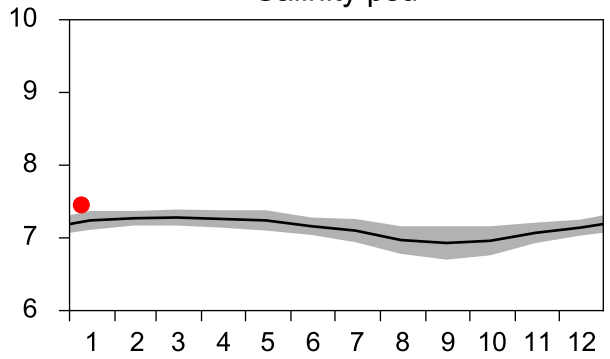
Annual Cycles

Mean 2001-2015 St.Dev. 2017

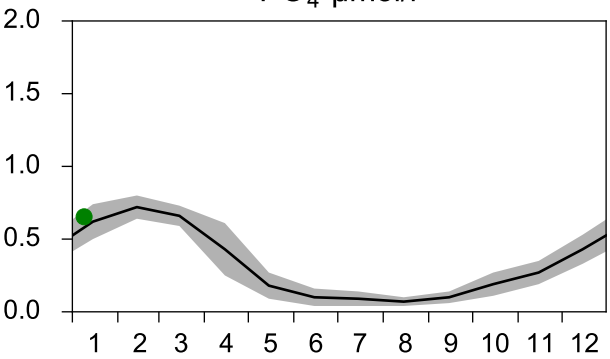
Temperature ˚C



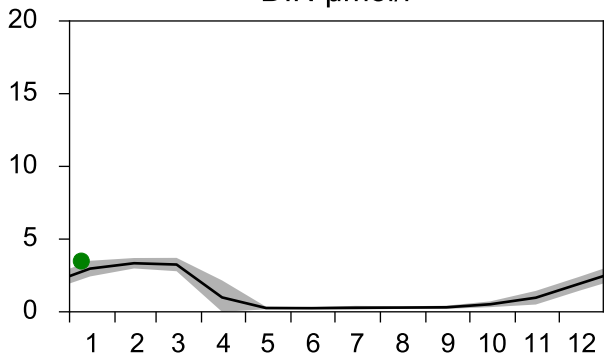
Salinity psu



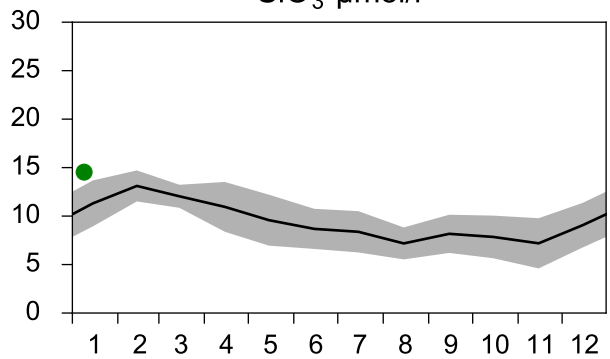
PO_4 µmol/l



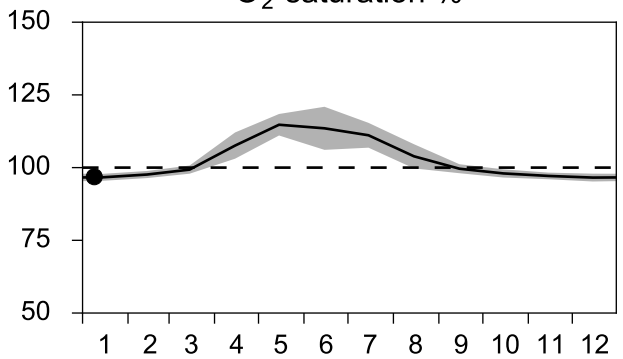
DIN µmol/l



SiO_3 µmol/l

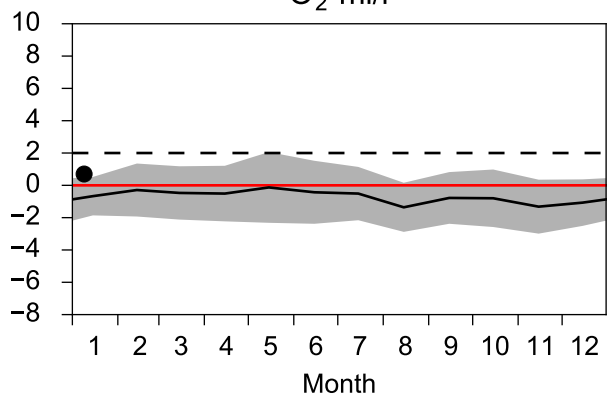


O_2 saturation %

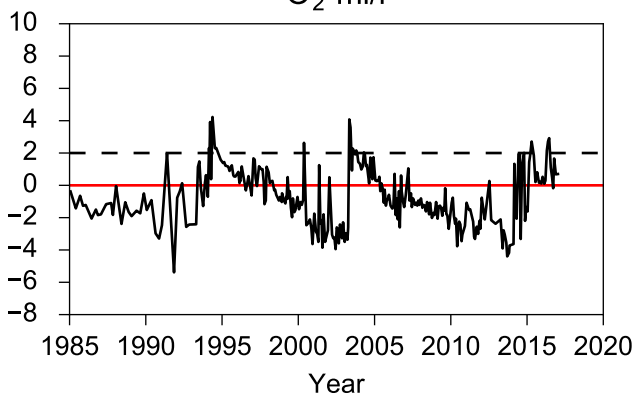


OXYGEN IN BOTTOM WATER (depth >= 125 m)

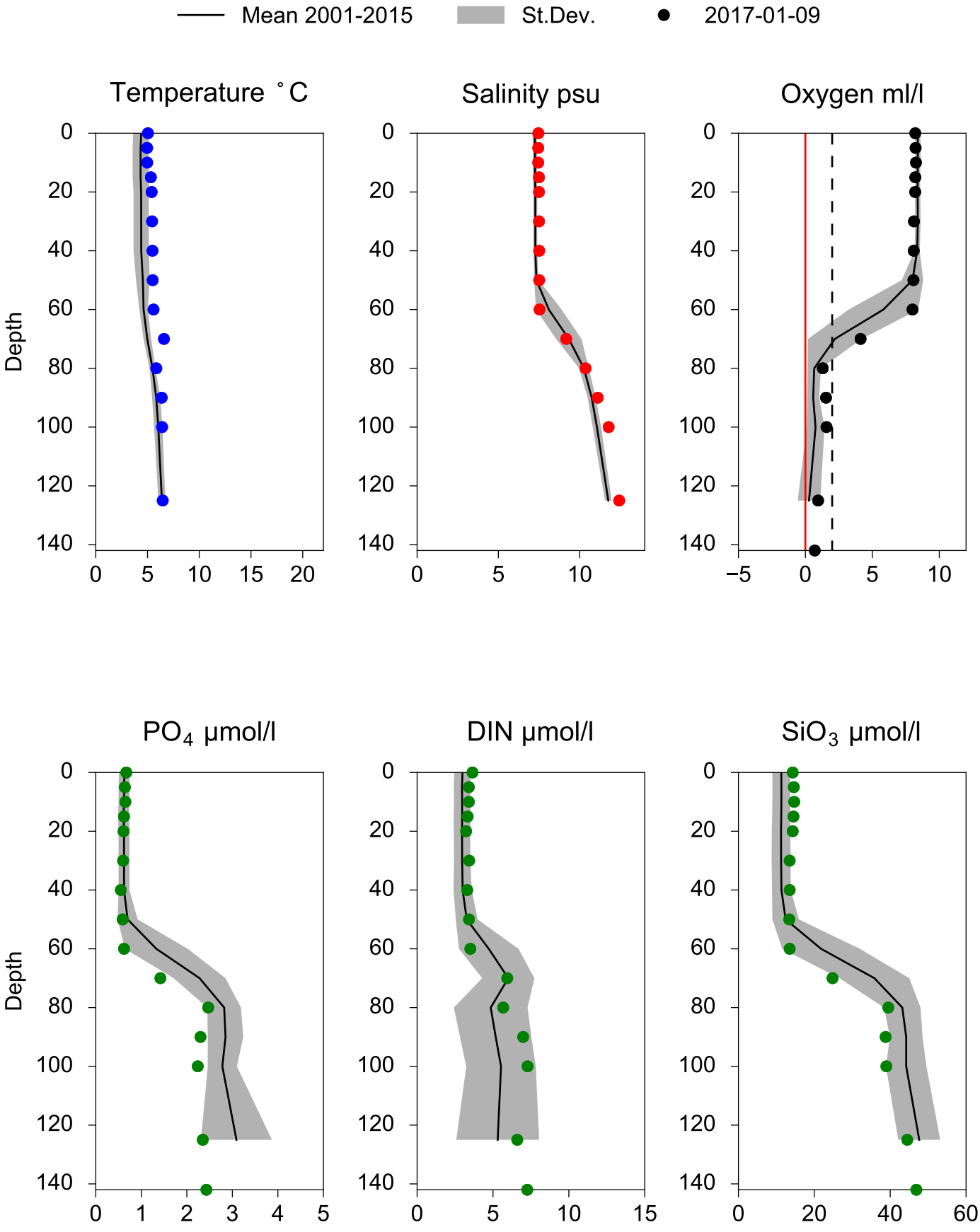
O_2 ml/l



O_2 ml/l

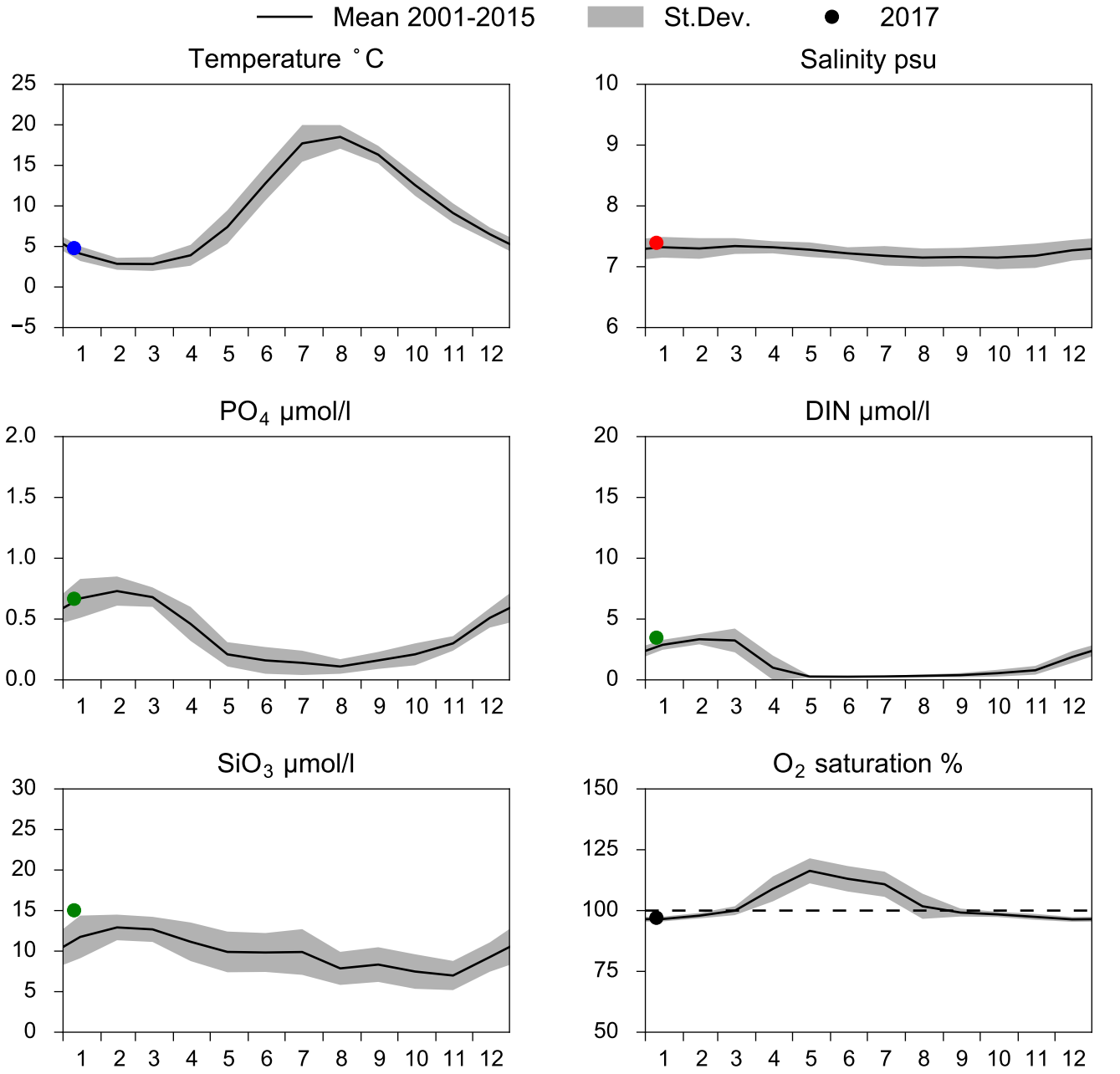


Vertical profiles BY10
January

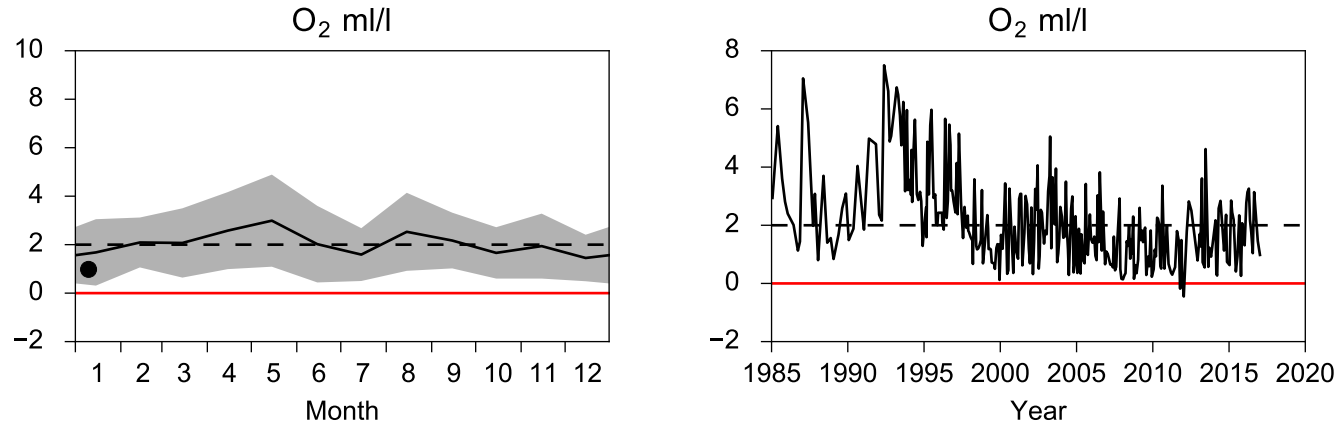


STATION BCS III-10 SURFACE WATER (0-10 m)

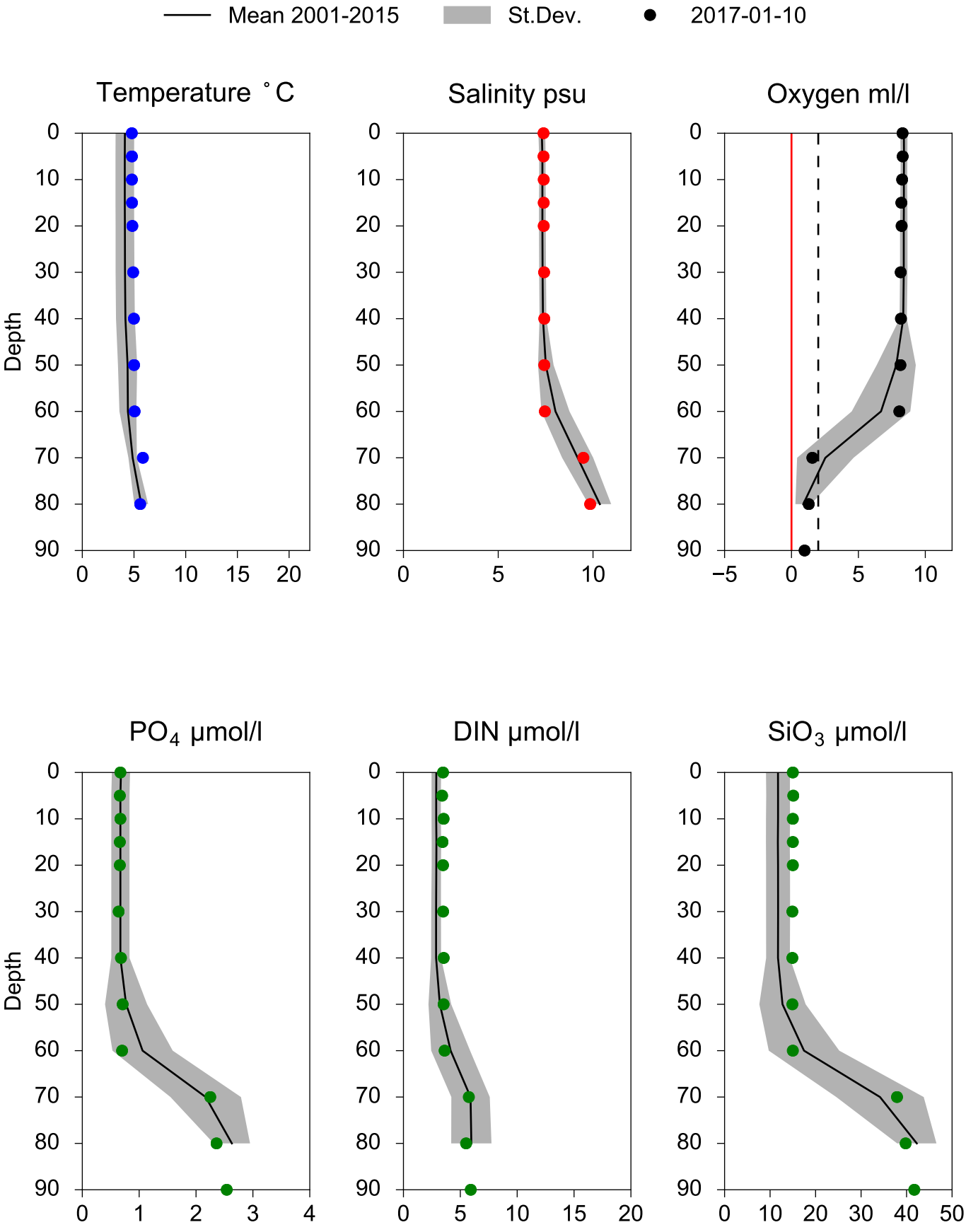
Annual Cycles



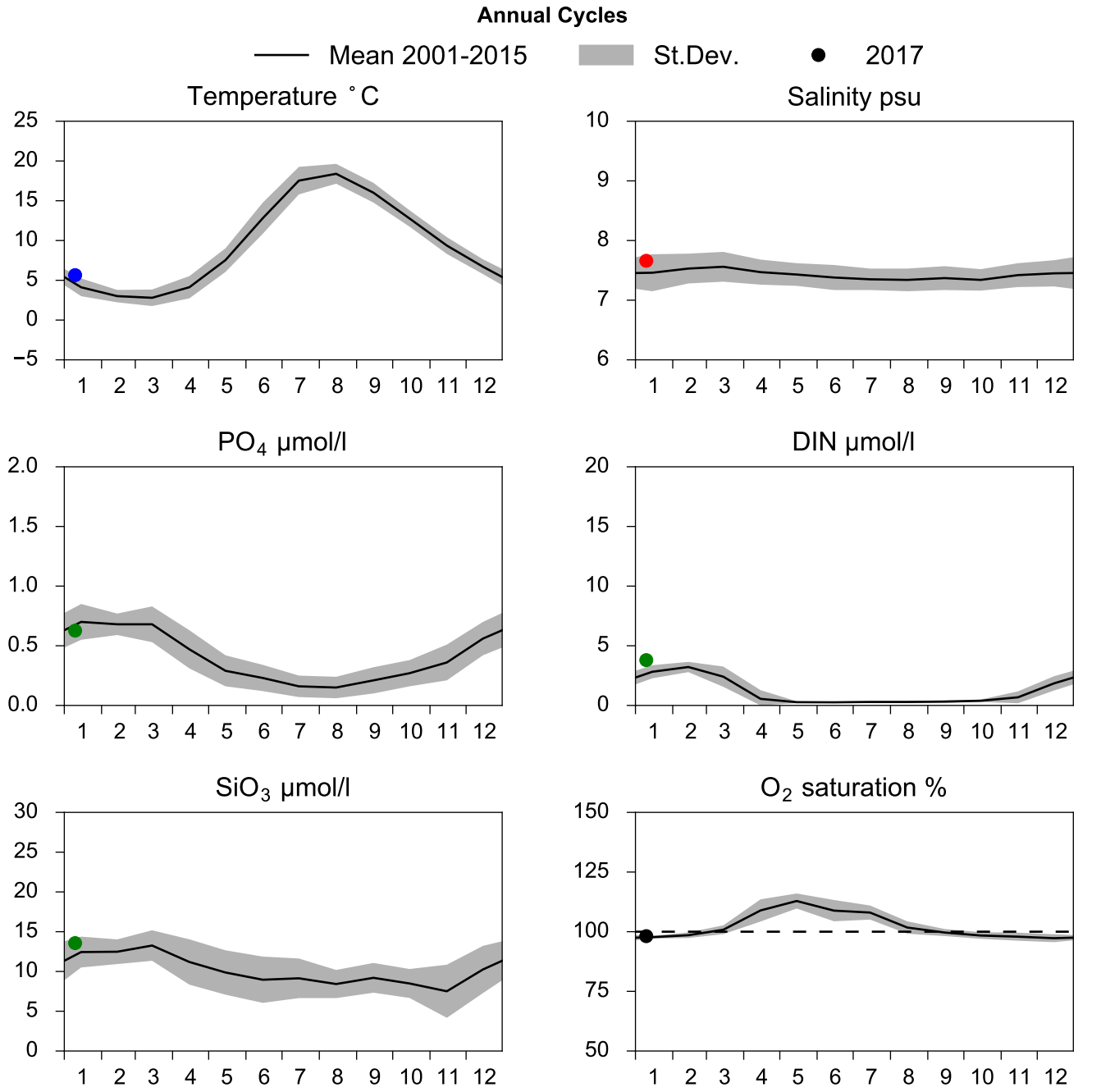
OXYGEN IN BOTTOM WATER (depth >= 80 m)



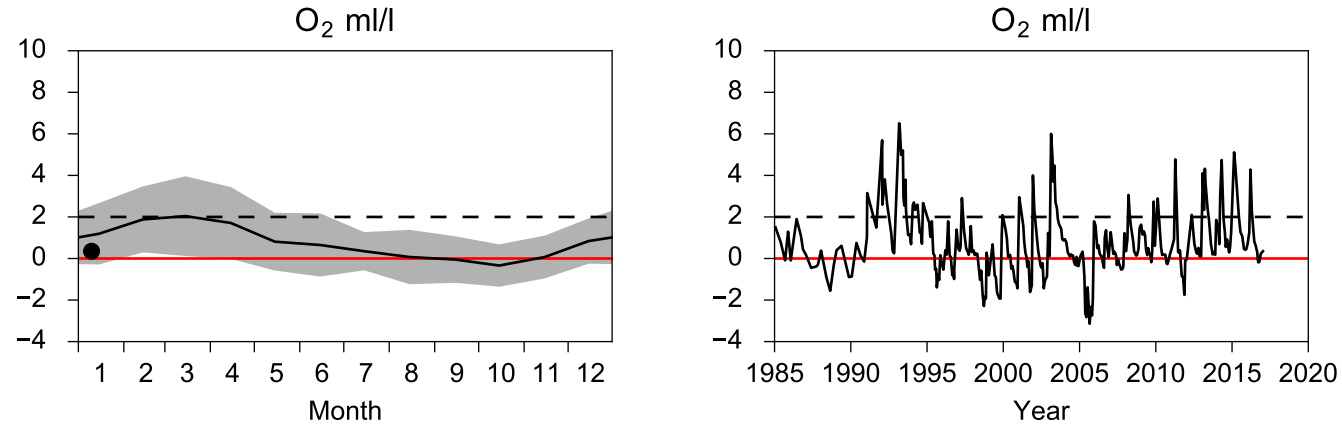
Vertical profiles BCS III-10
January



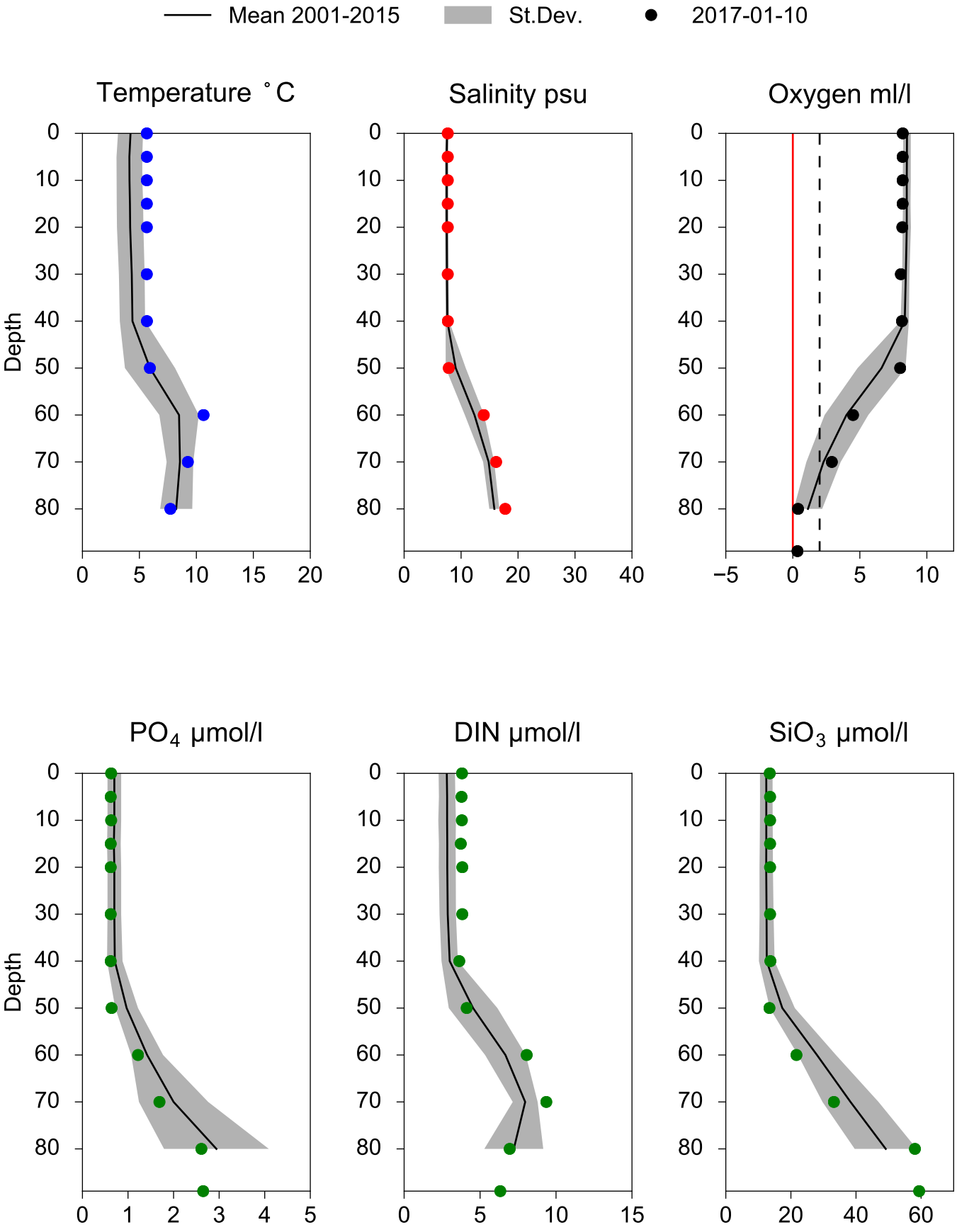
STATION BY5 BORNHOLMSDJ SURFACE WATER (0-10 m)



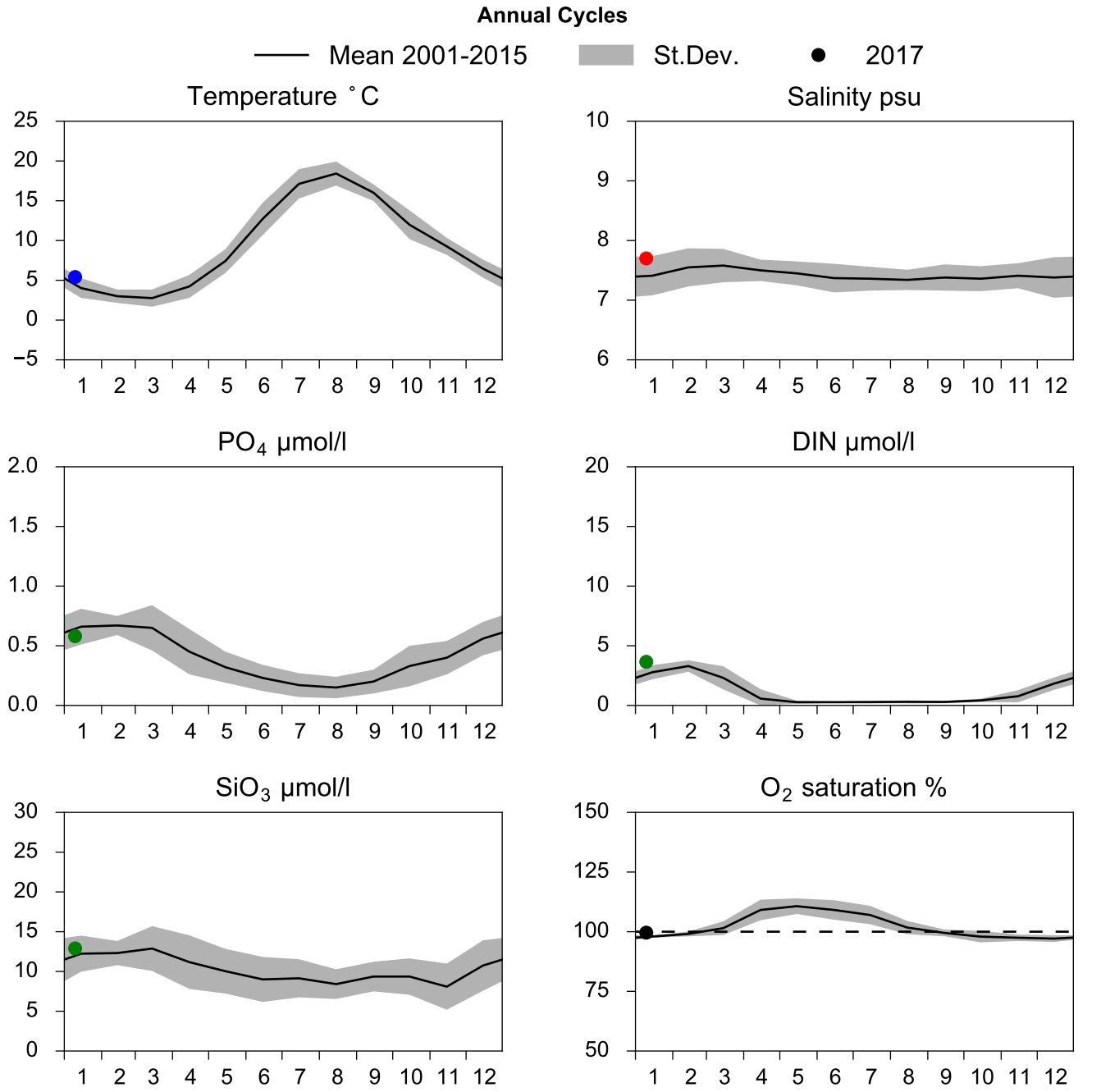
OXYGEN IN BOTTOM WATER (depth >= 80 m)



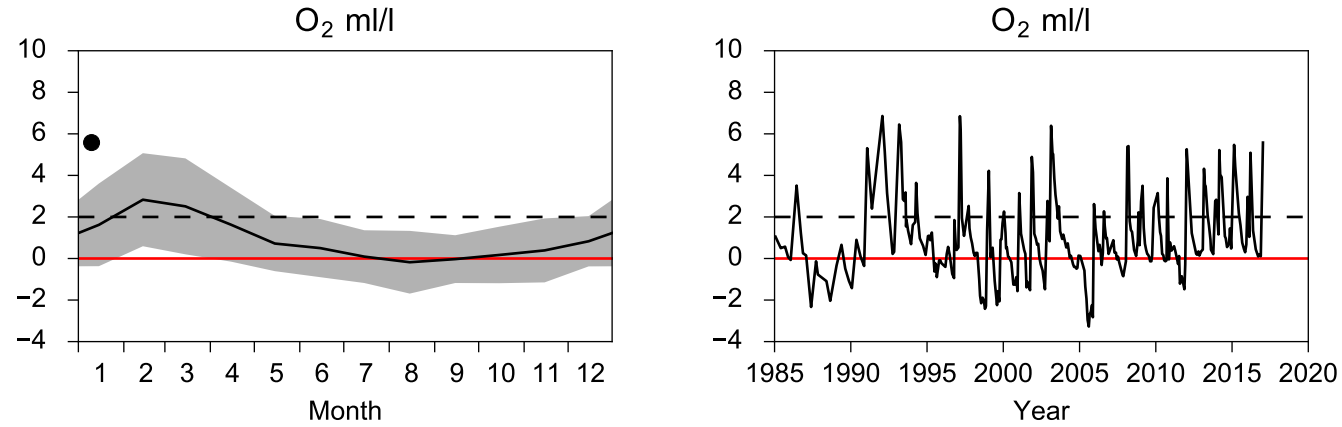
Vertical profiles BY5 BORNHOLMSDJ
January



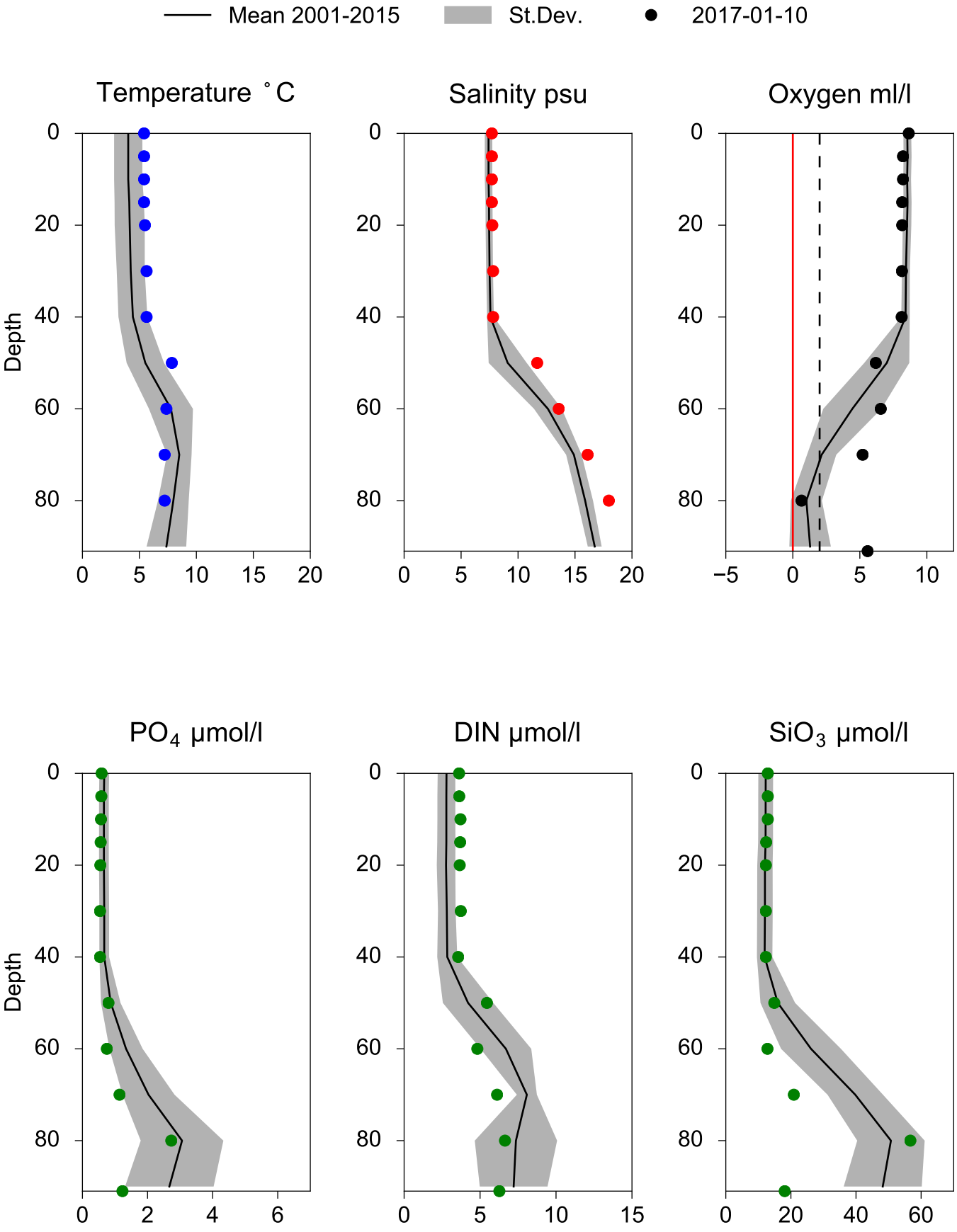
STATION BY4 CHRISTIANSÖ SURFACE WATER (0-10 m)



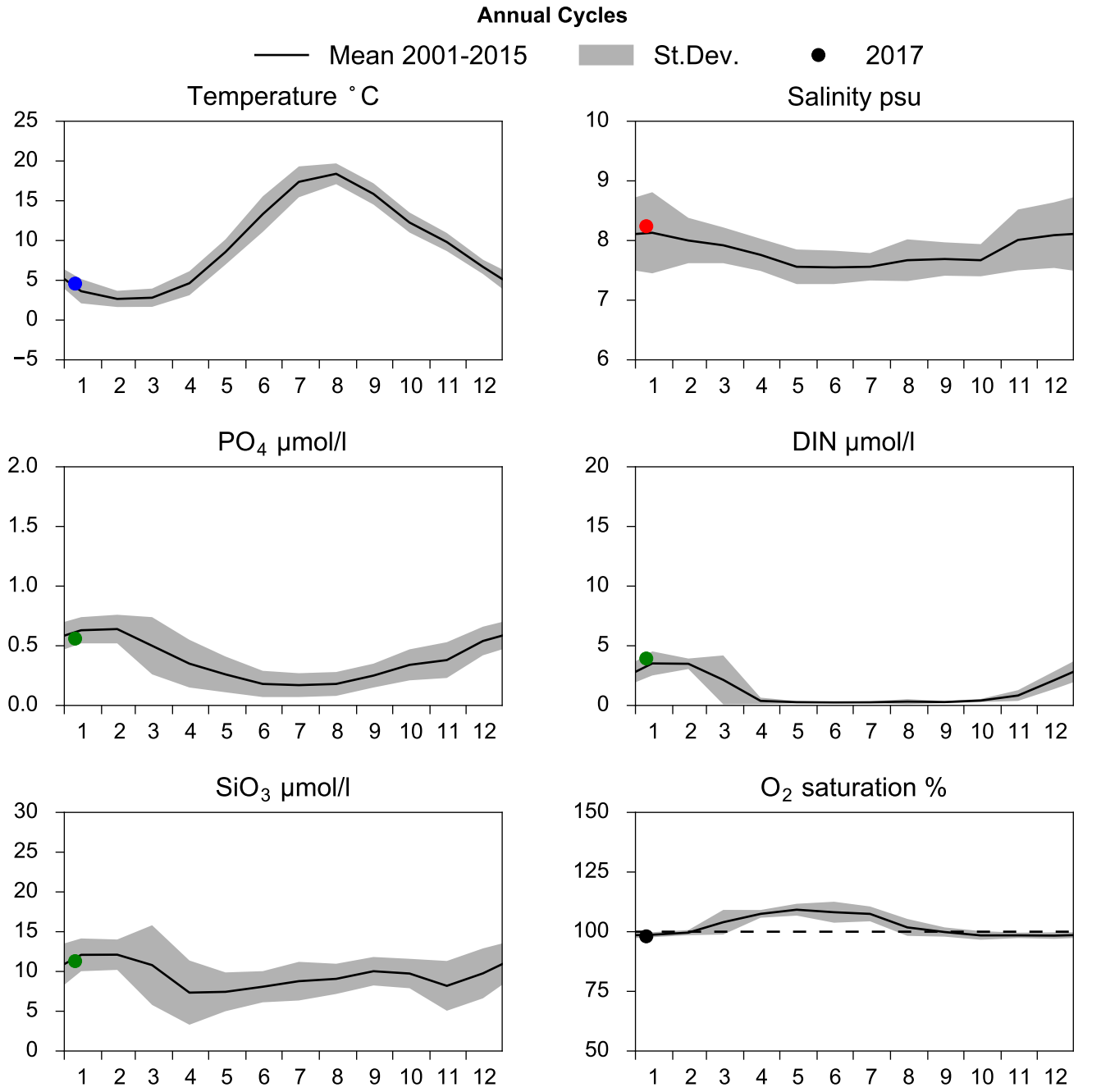
OXYGEN IN BOTTOM WATER (depth >= 80 m)



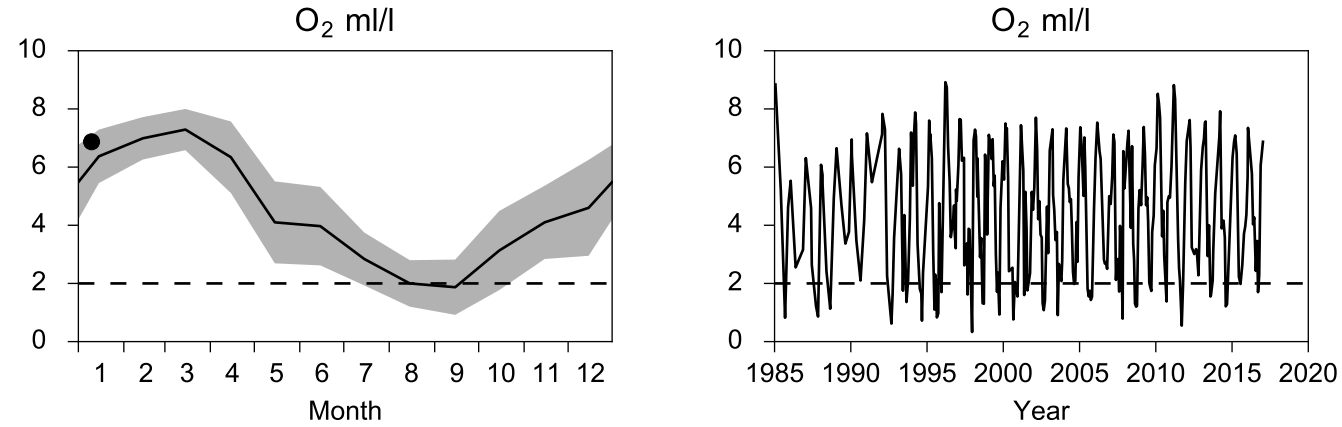
Vertical profiles BY4 CHRISTIANSÖ
January



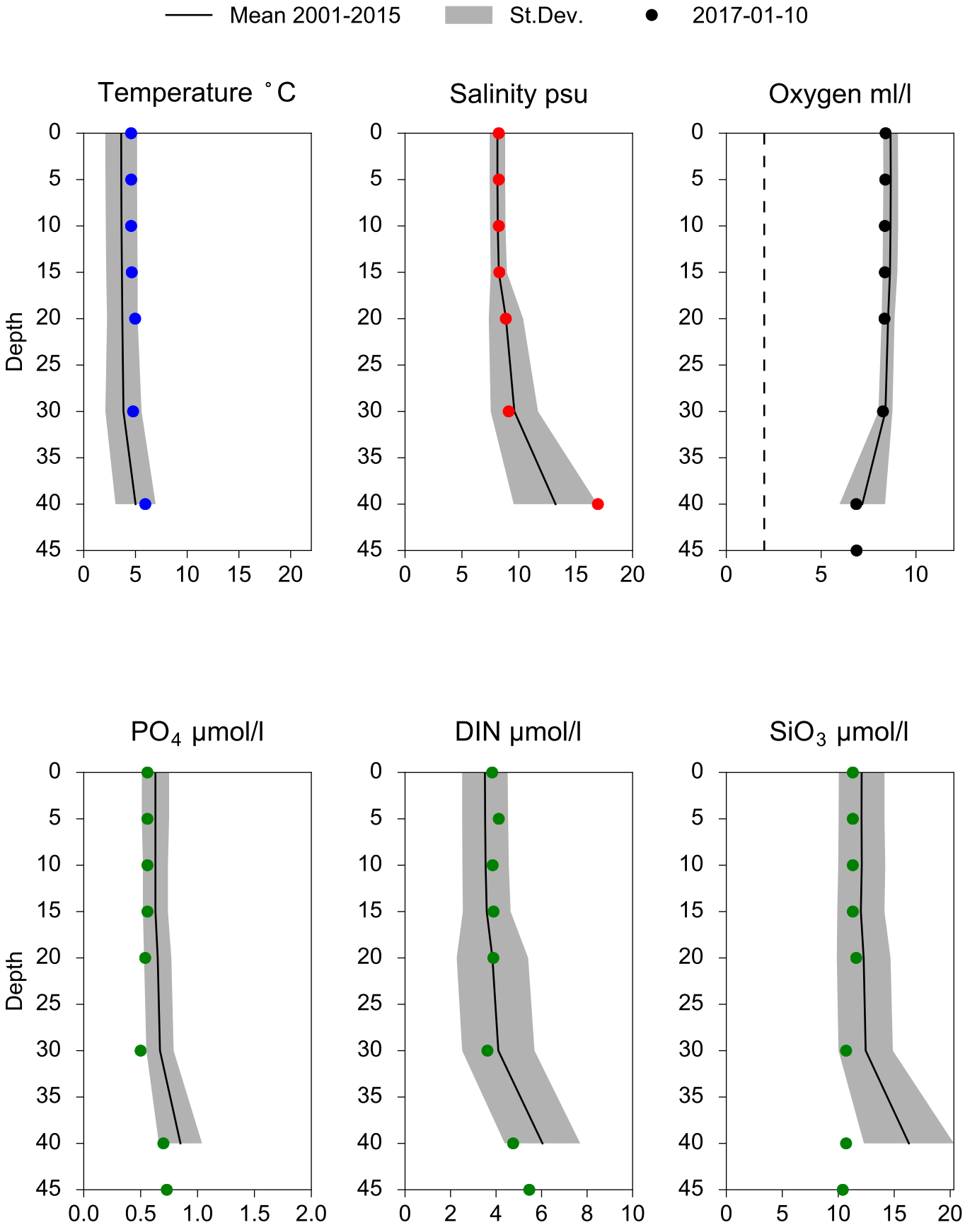
STATION BY2 ARKONA SURFACE WATER (0-10 m)



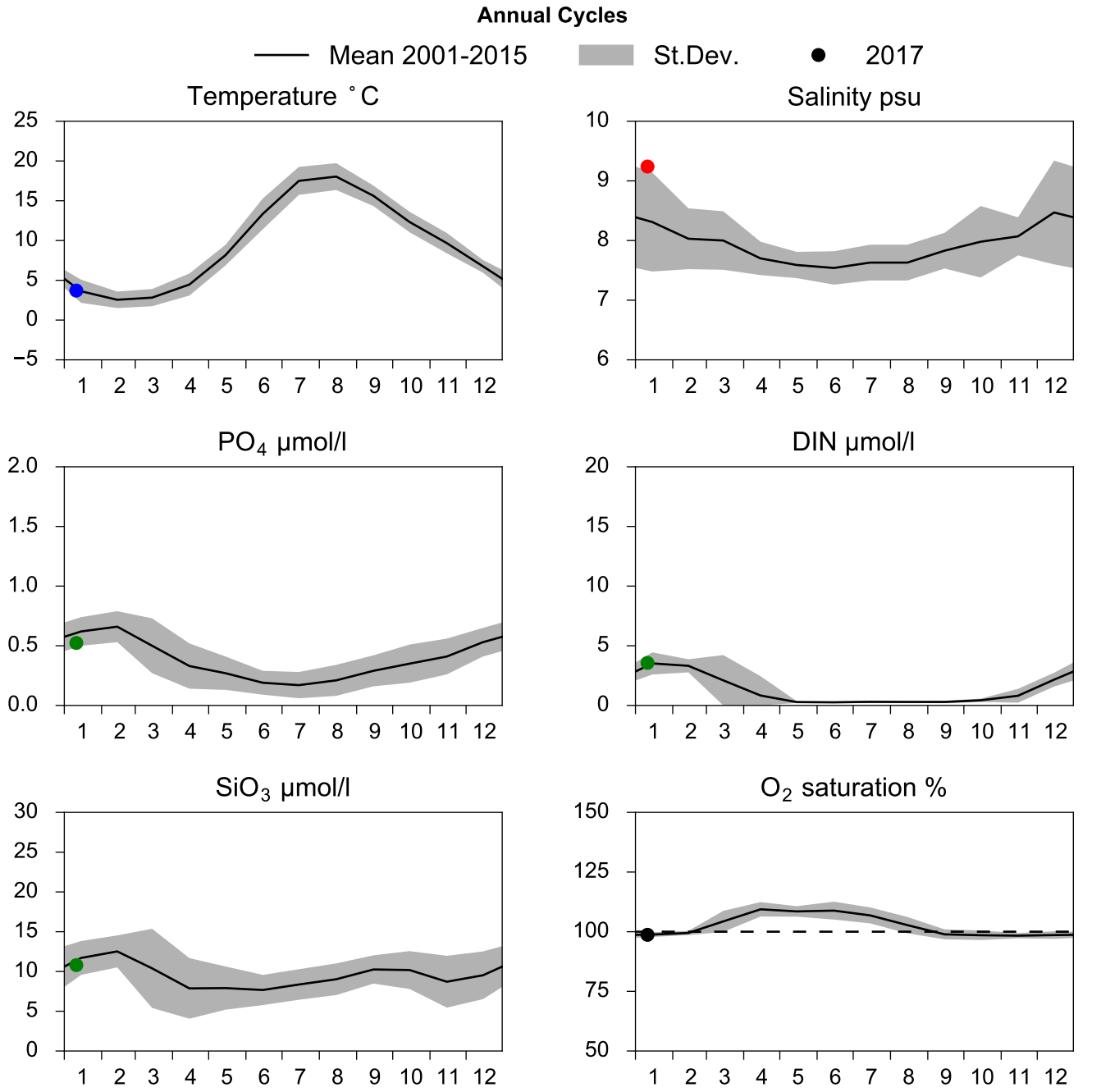
OXYGEN IN BOTTOM WATER (depth >= 40 m)



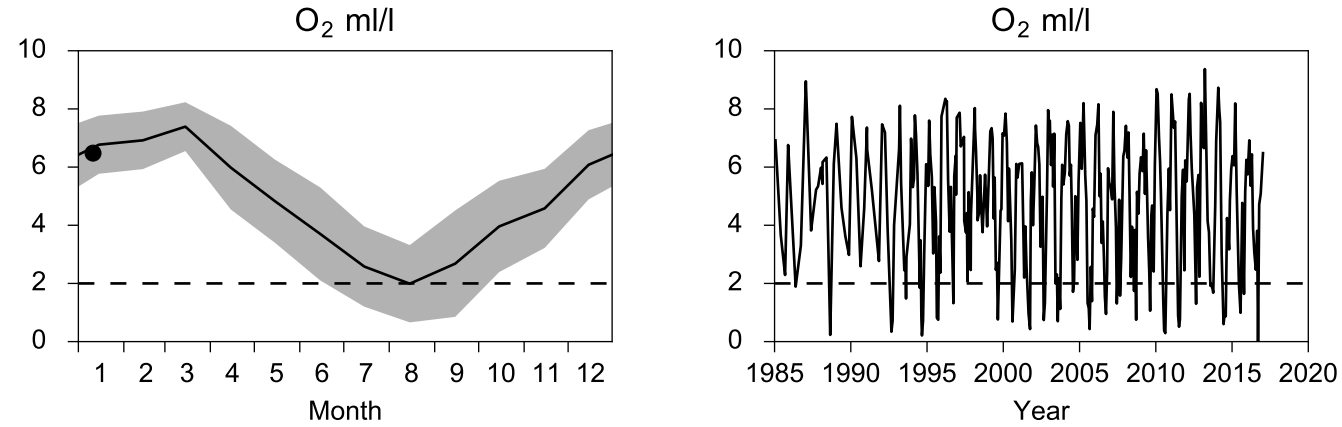
Vertical profiles BY2 ARKONA
January



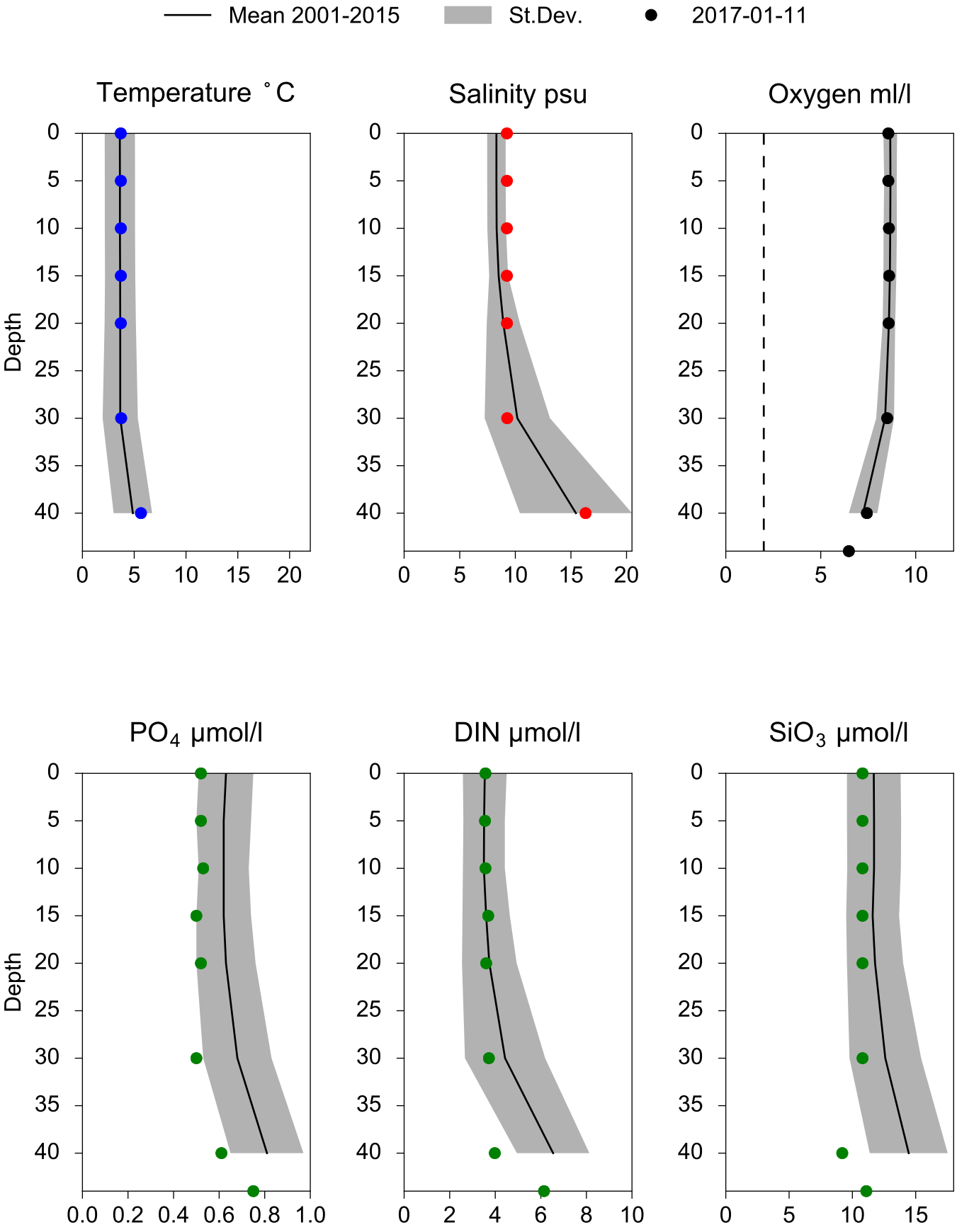
STATION BY1 SURFACE WATER (0-10 m)



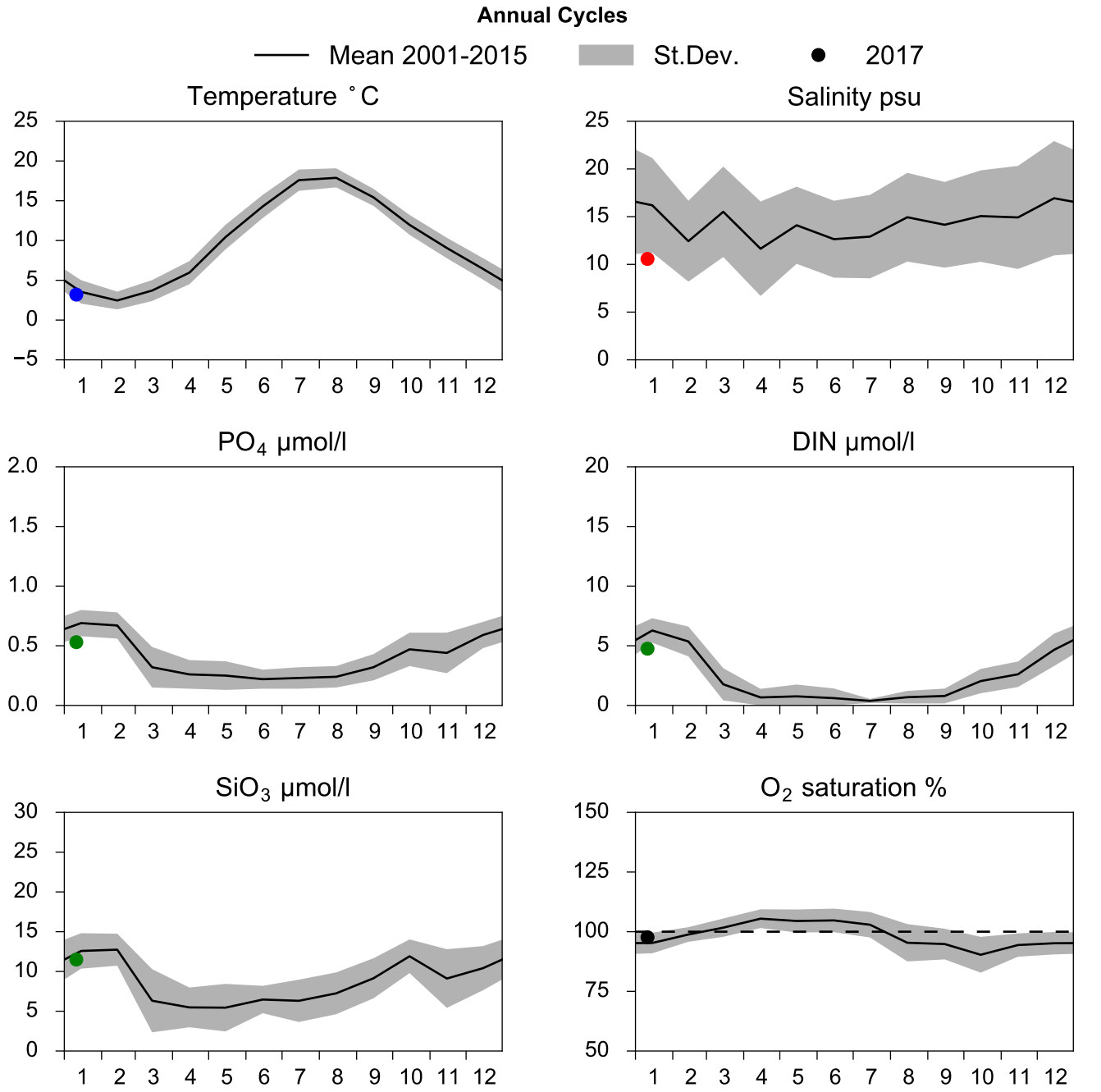
OXYGEN IN BOTTOM WATER (depth >= 40 m)



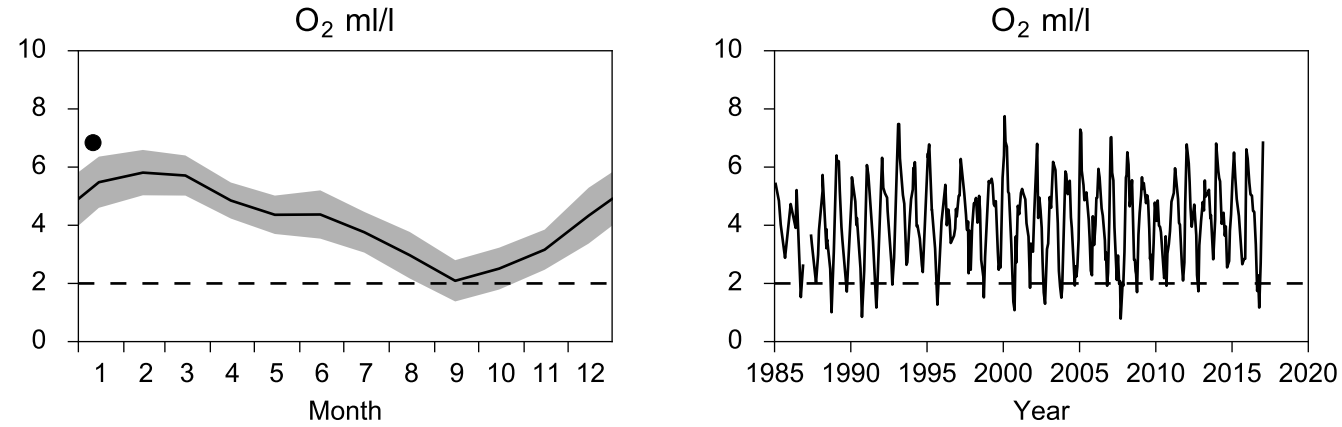
Vertical profiles BY1
January



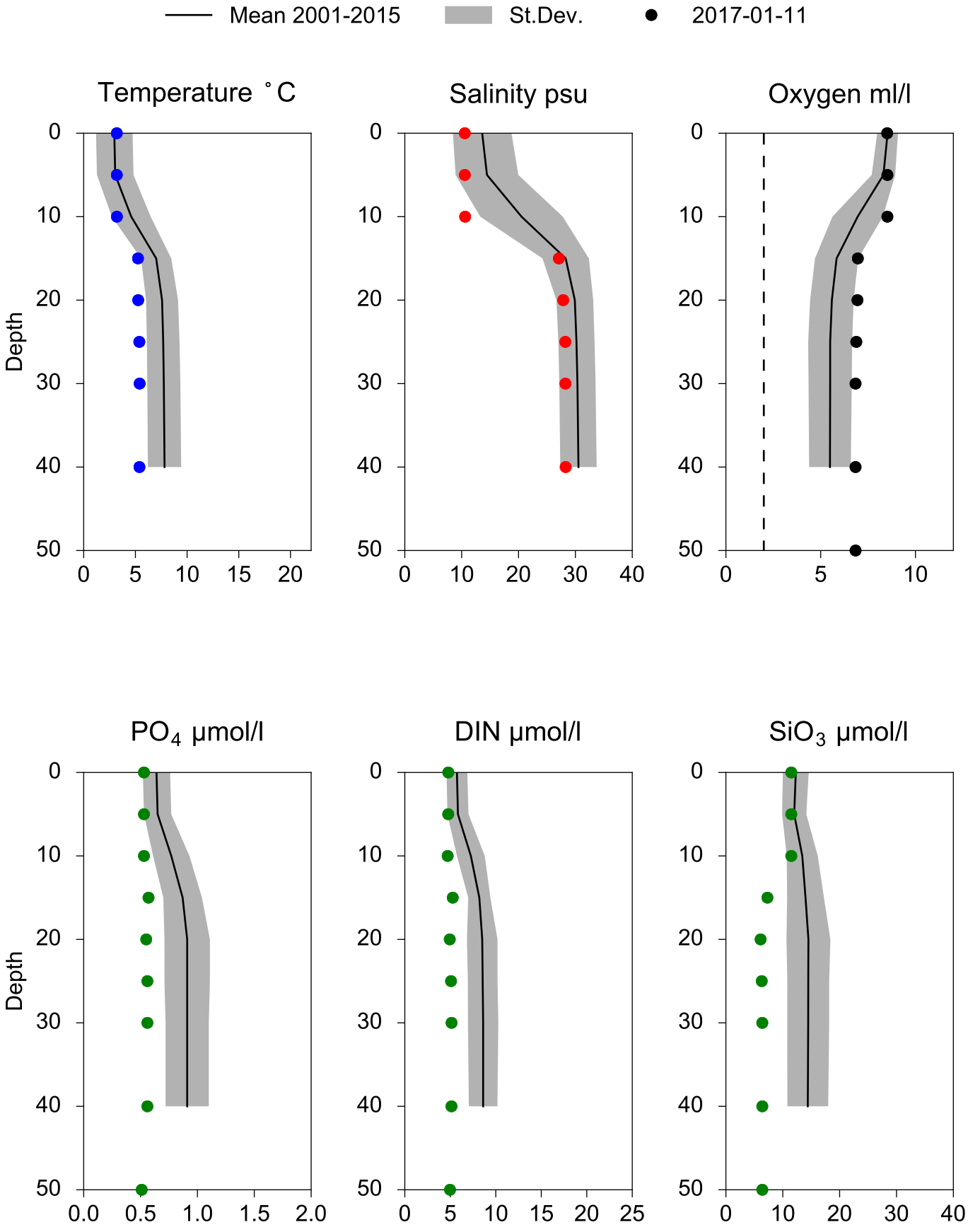
STATION W LANDSKRONA SURFACE WATER (0-10 m)



OXYGEN IN BOTTOM WATER (depth >= 40 m)

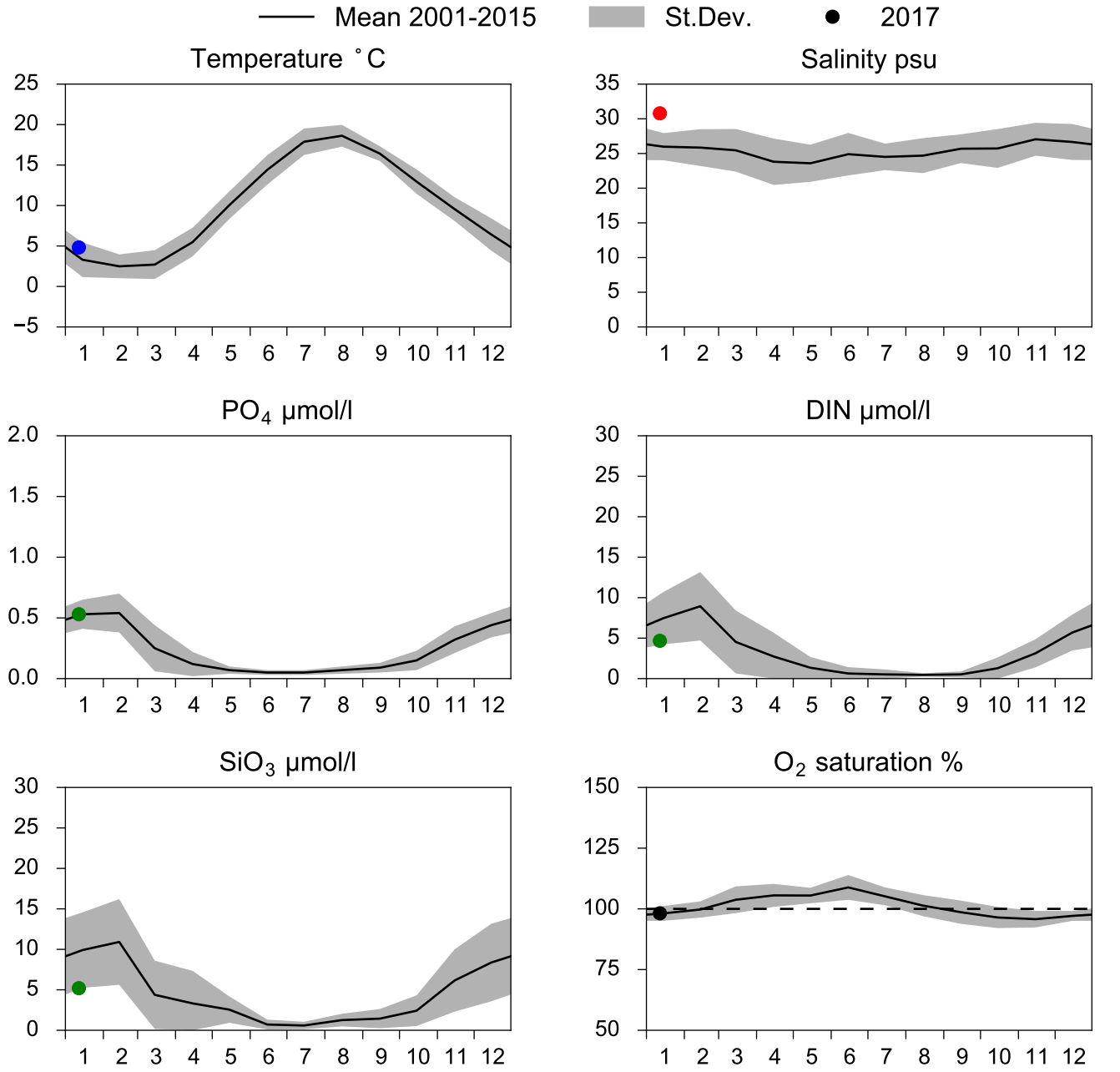


Vertical profiles W LANDSKRONA
January

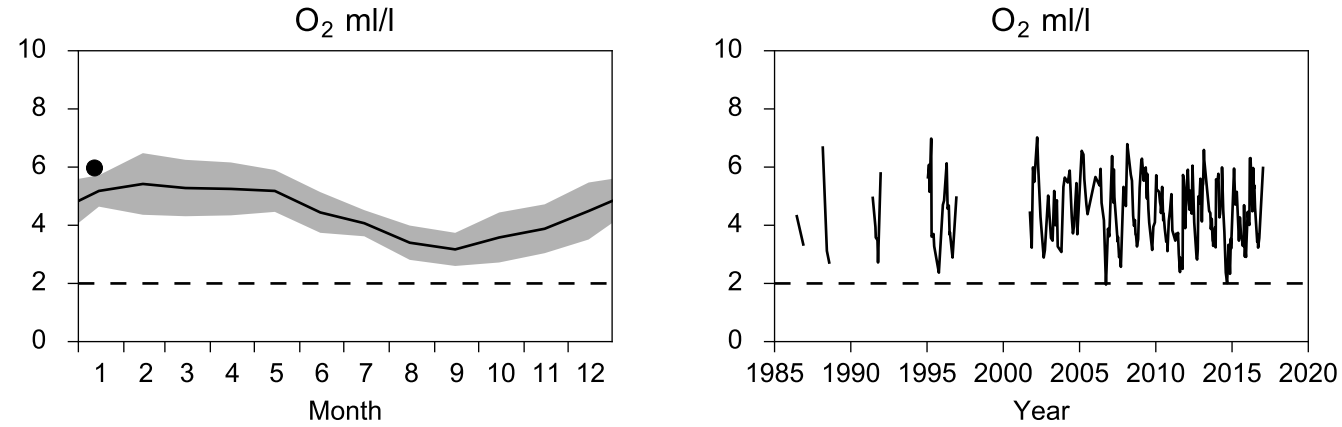


STATION SLÄGGÖ SURFACE WATER (0-10 m)

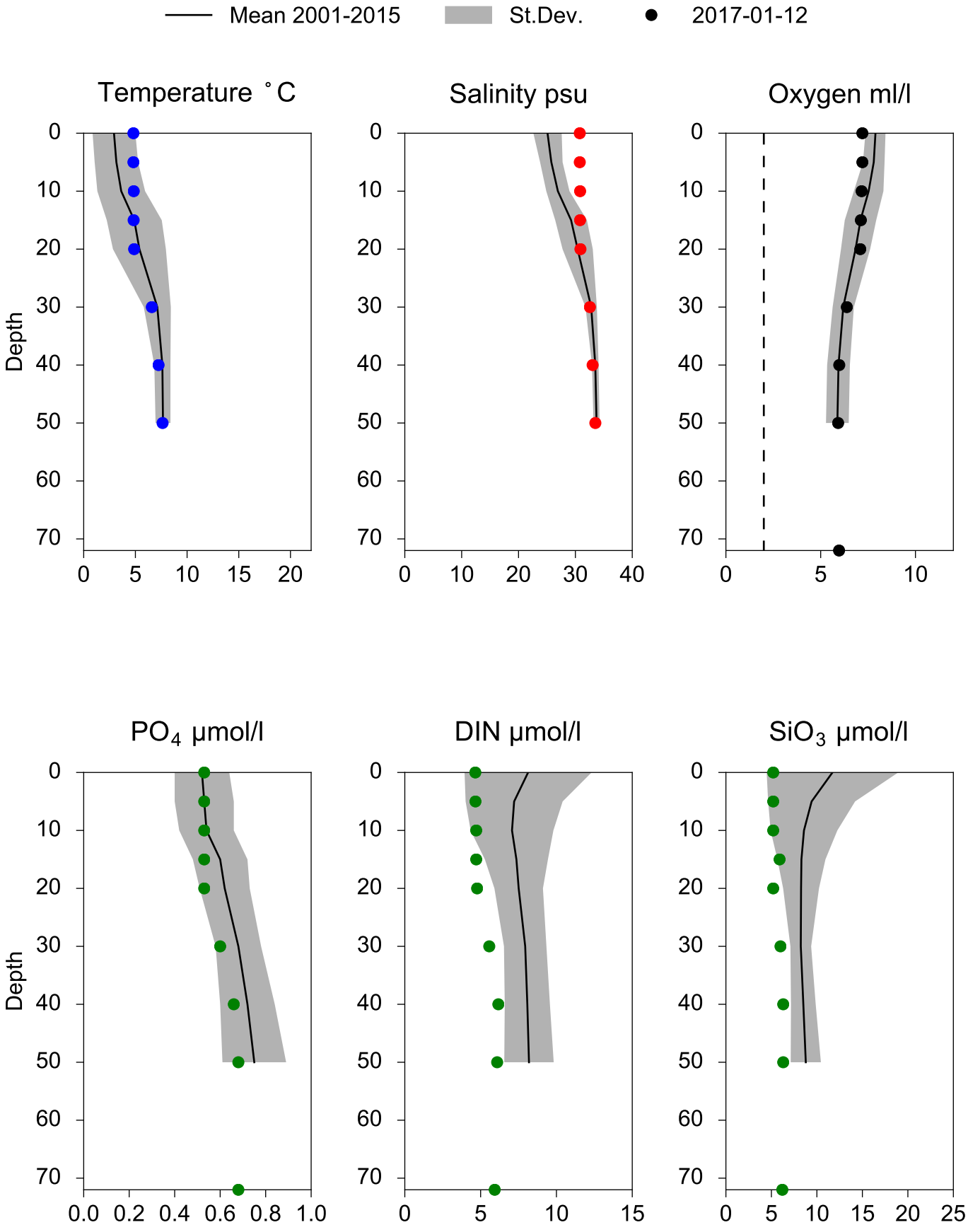
Annual Cycles



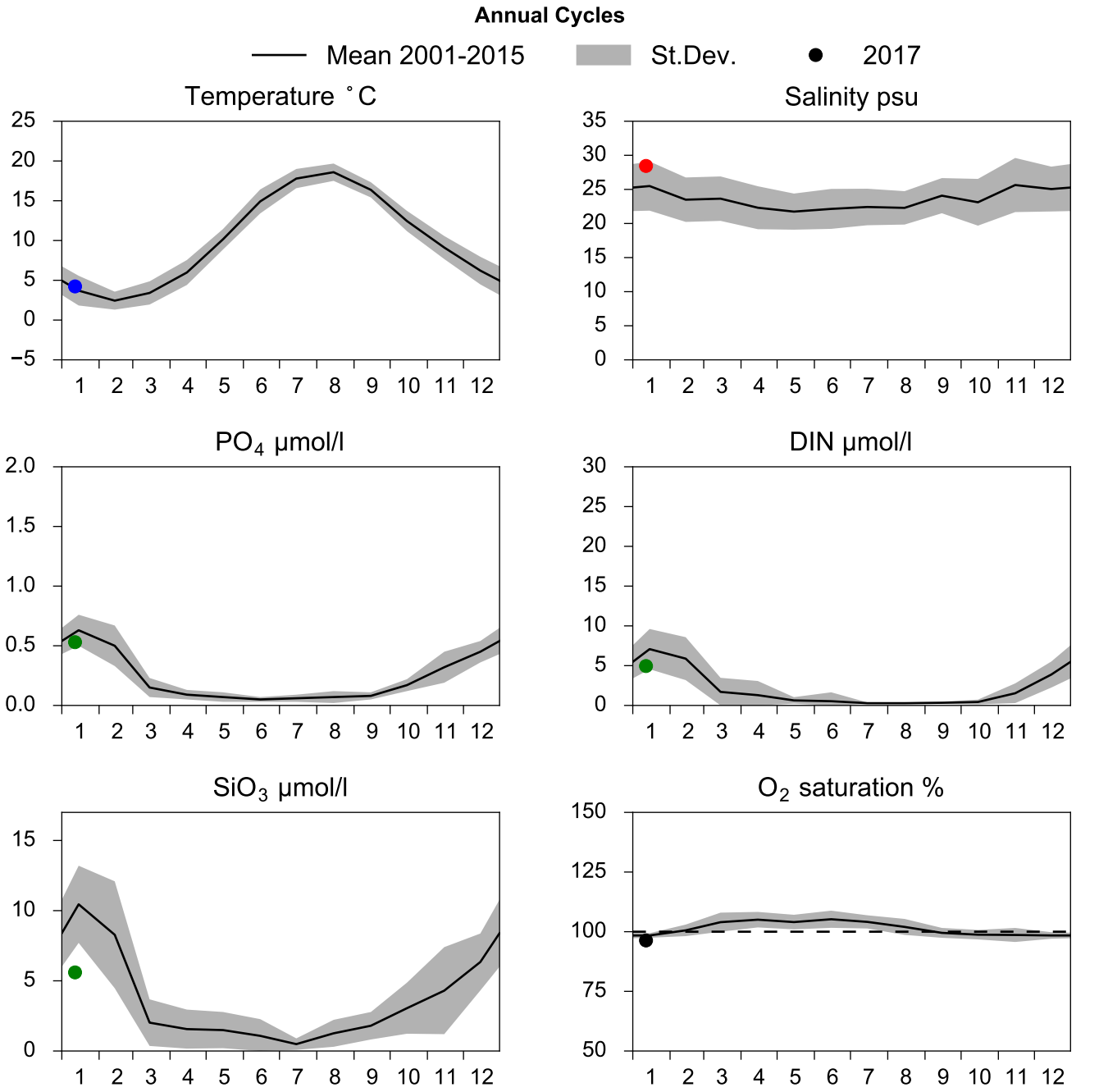
OXYGEN IN BOTTOM WATER (depth >= 64 m)



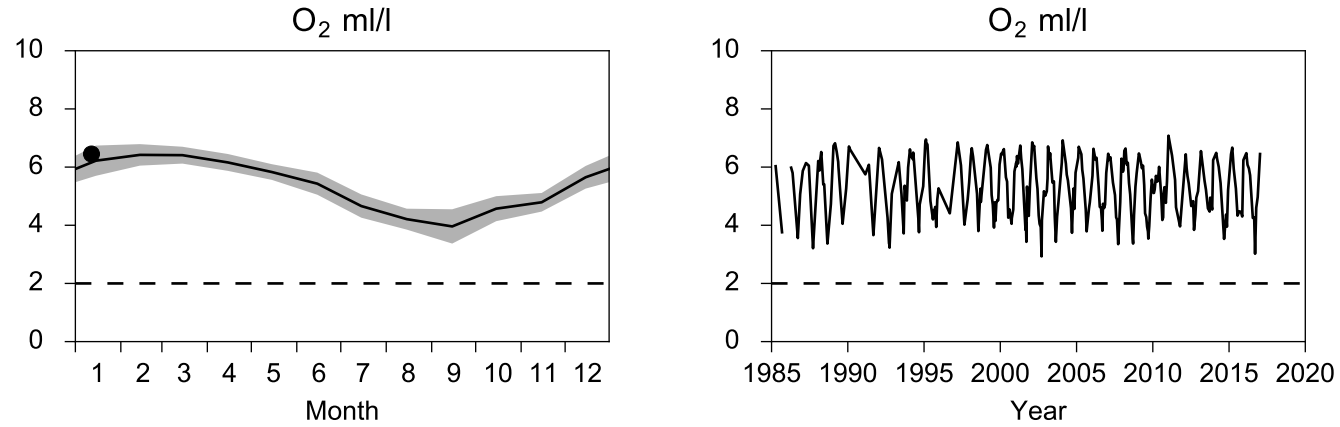
Vertical profiles SLÄGGÖ
January



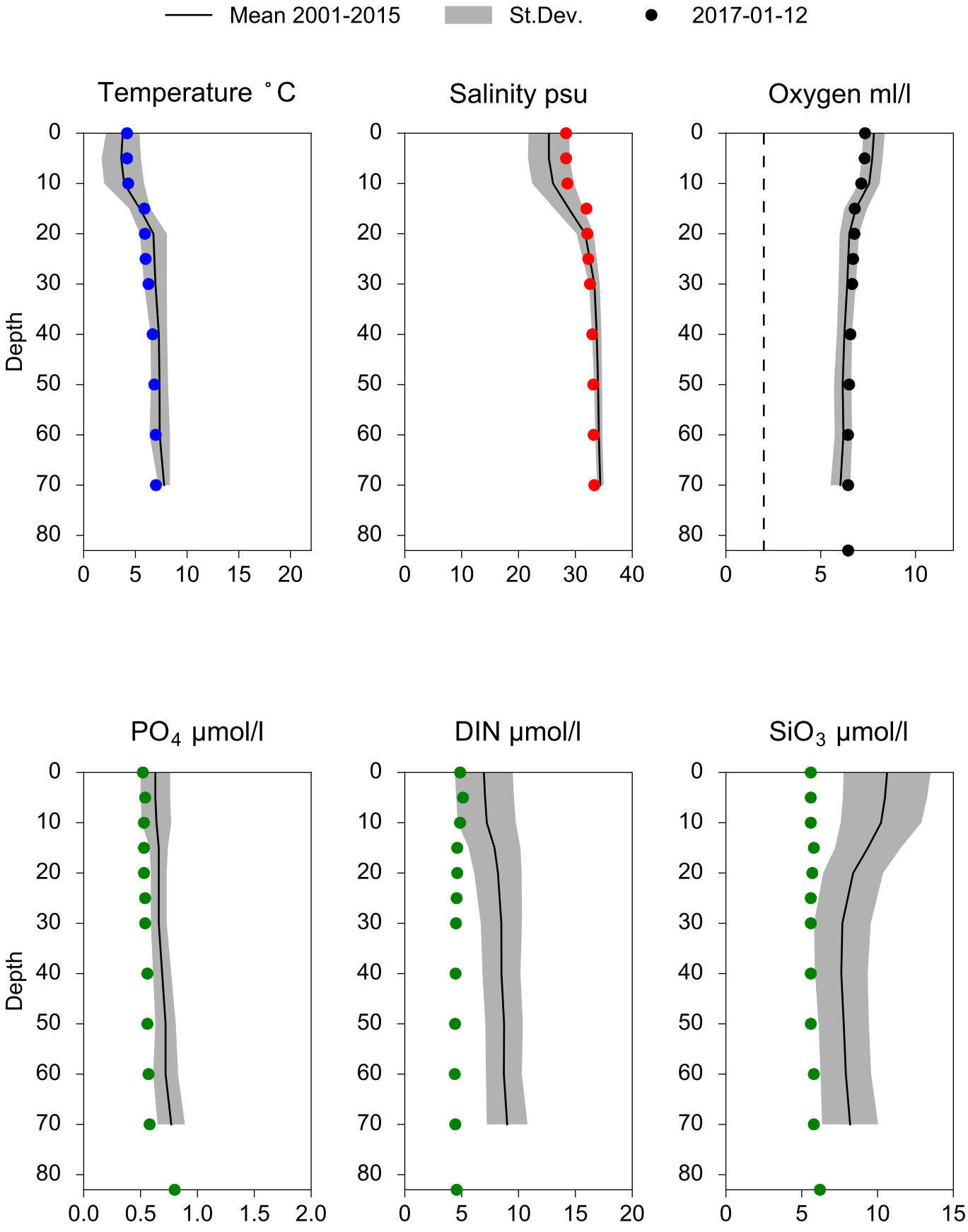
STATION FLADEN SURFACE WATER (0-10 m)



OXYGEN IN BOTTOM WATER (depth >= 74 m)

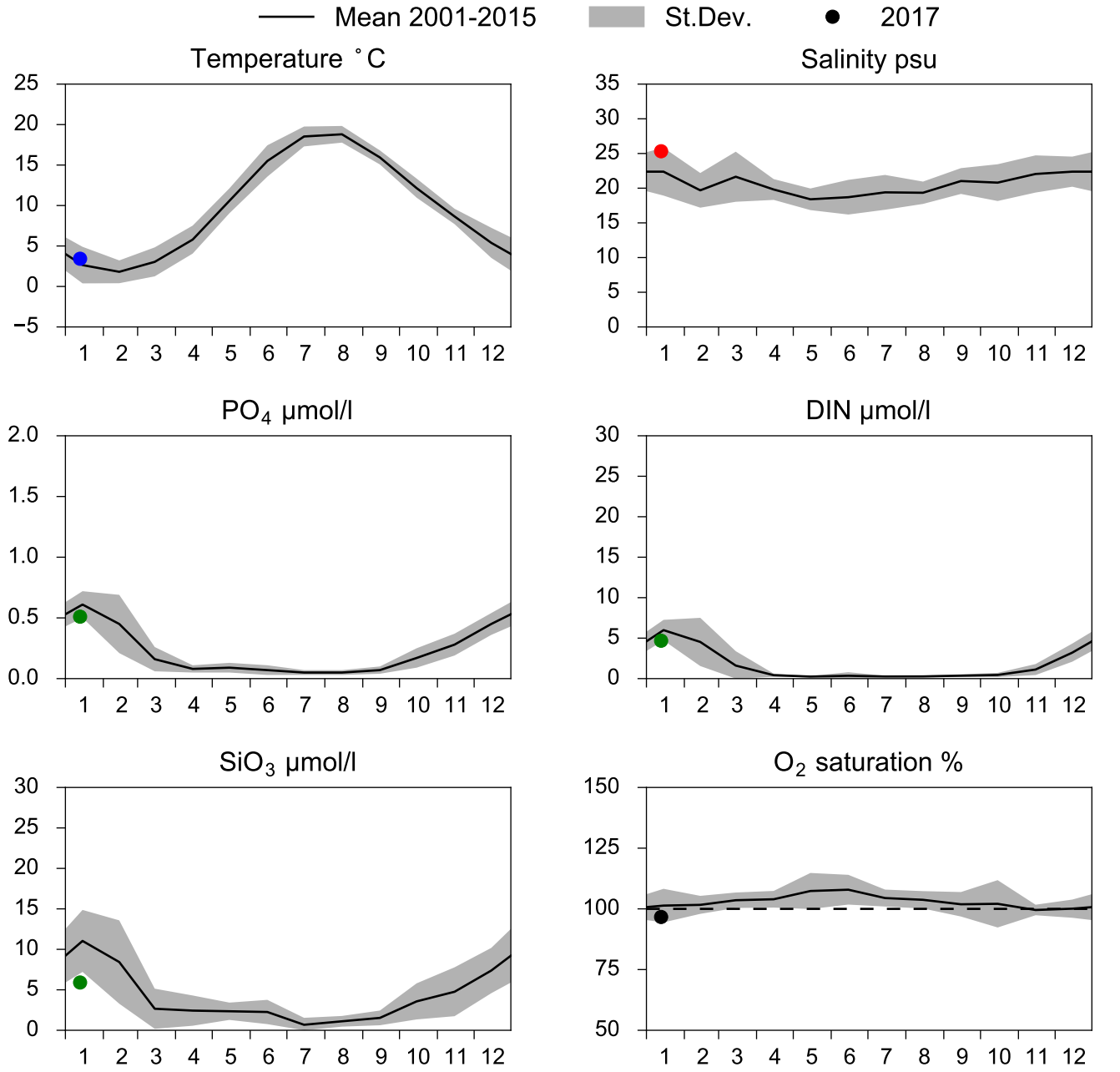


Vertical profiles FLADEN
January

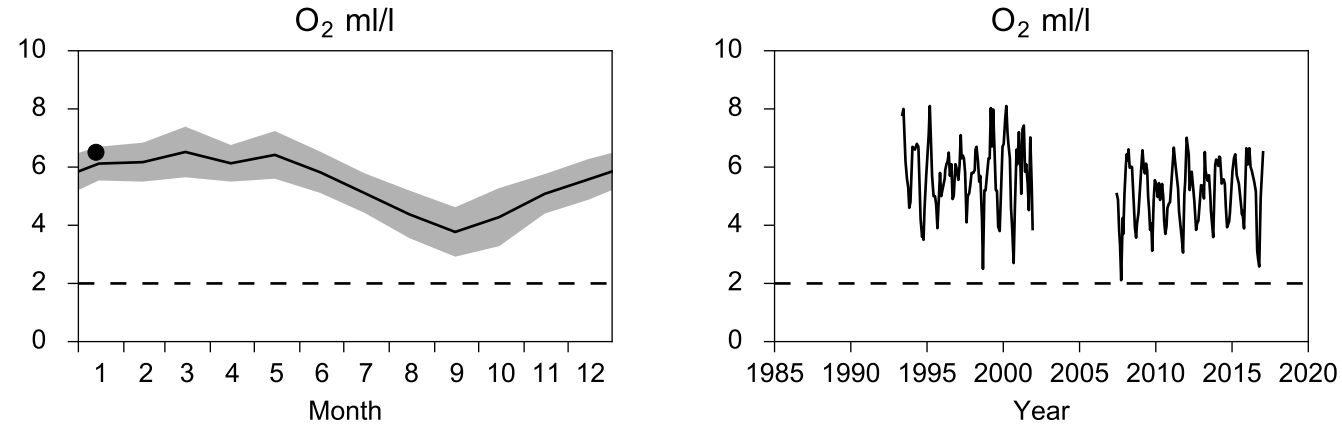


STATION N14 FALKENBERG SURFACE WATER (0-10 m)

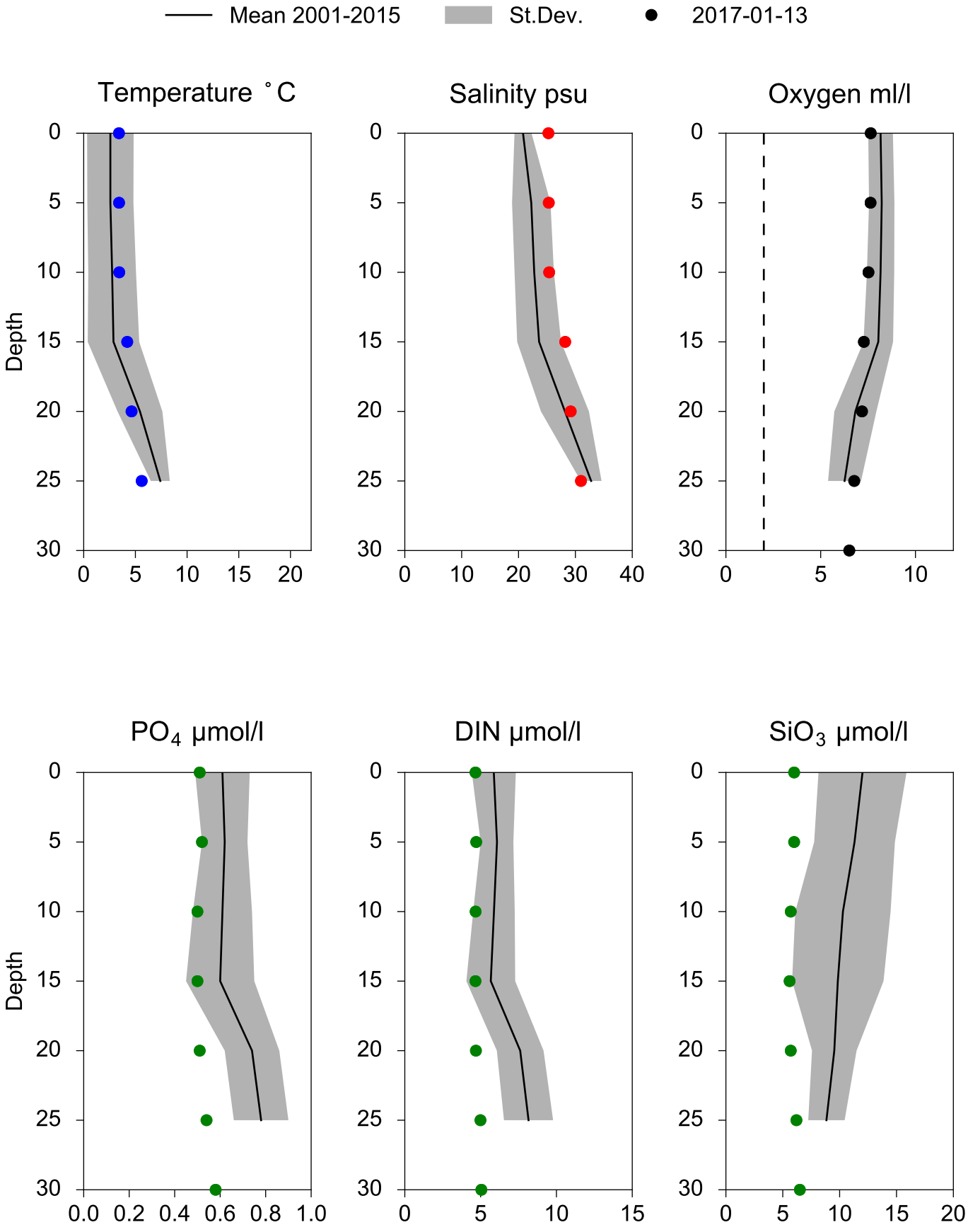
Annual Cycles



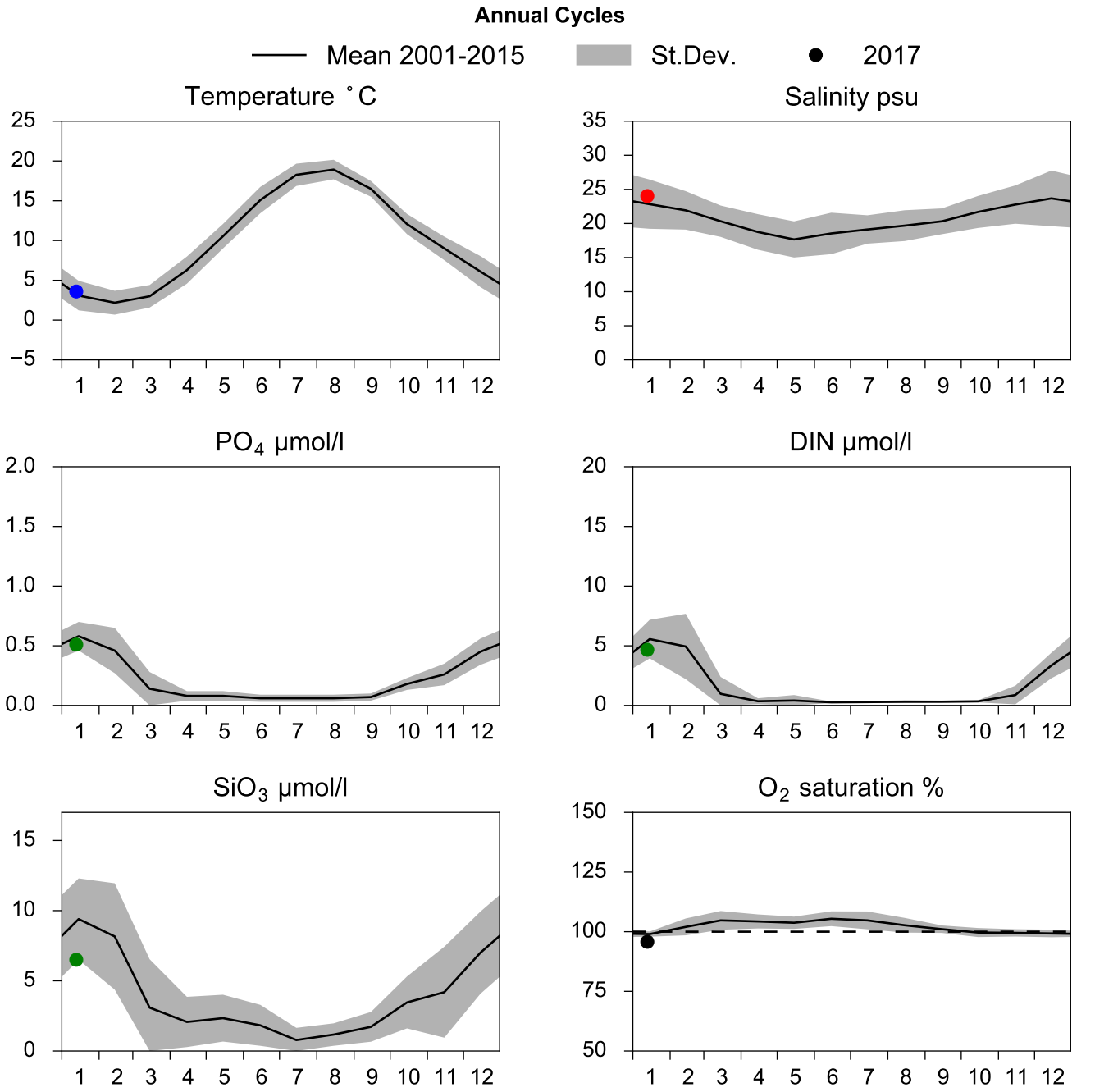
OXYGEN IN BOTTOM WATER (depth >= 25 m)



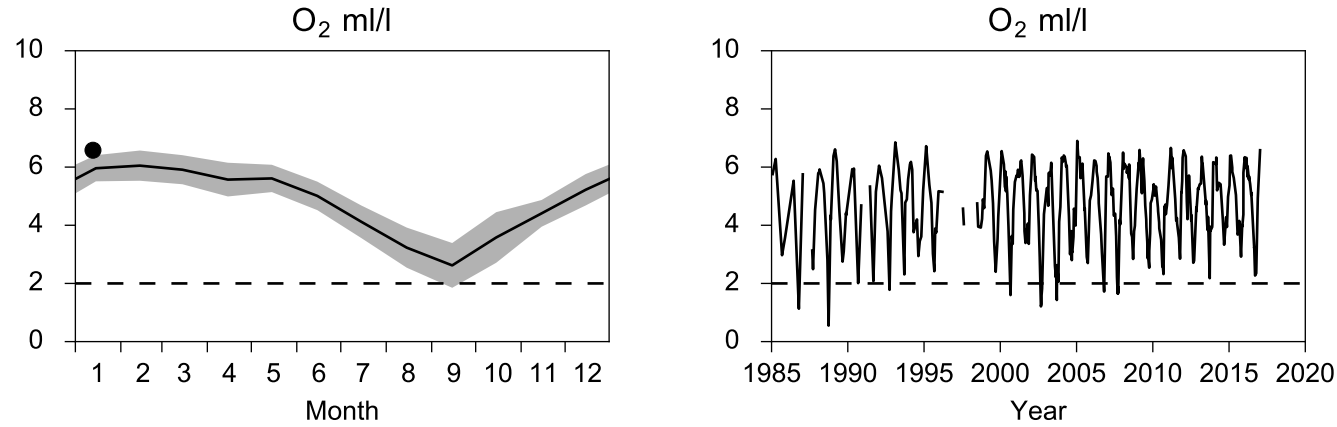
Vertical profiles N14 FALKENBERG
January



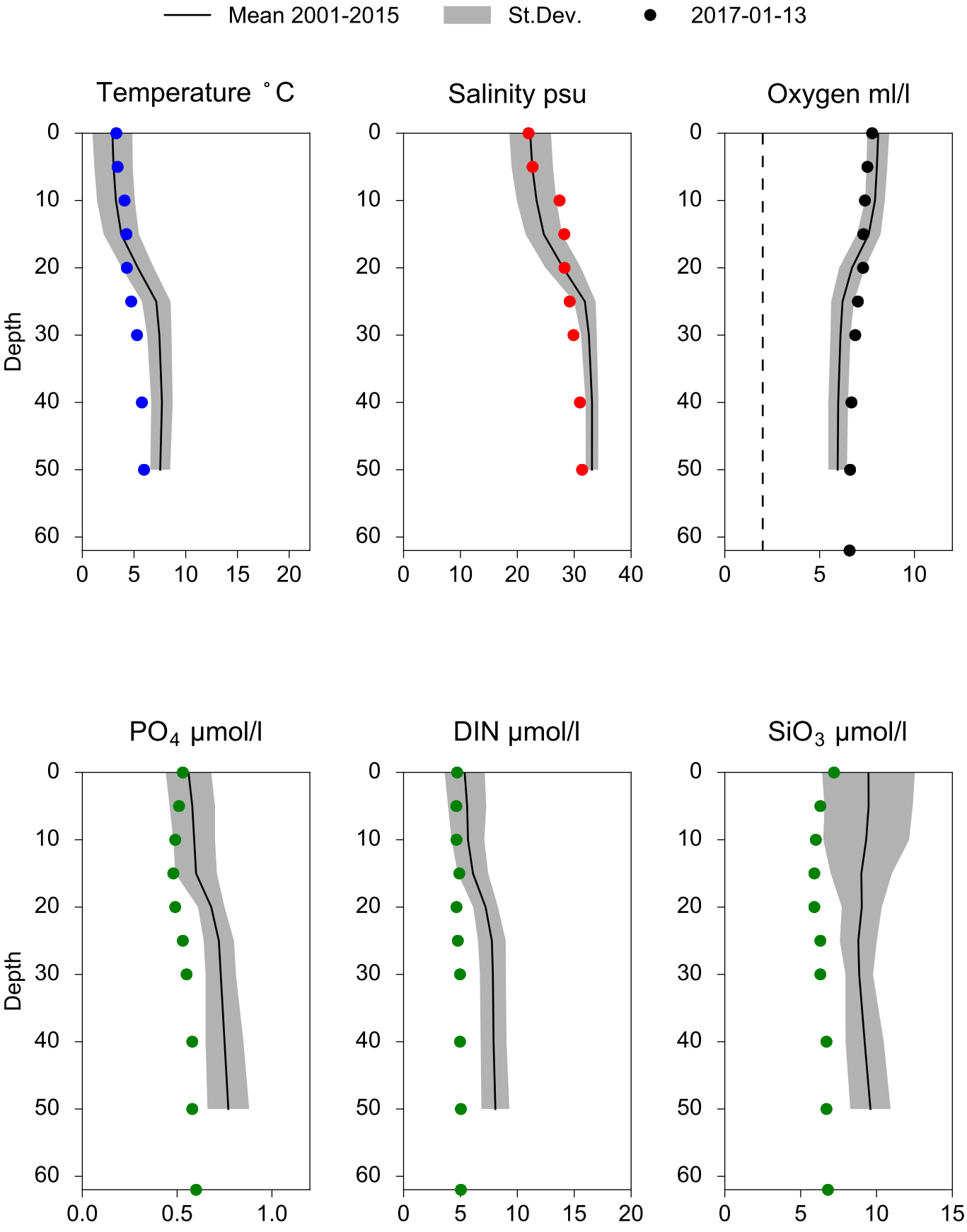
STATION ANHOLT E SURFACE WATER (0-10 m)



OXYGEN IN BOTTOM WATER (depth >= 52 m)

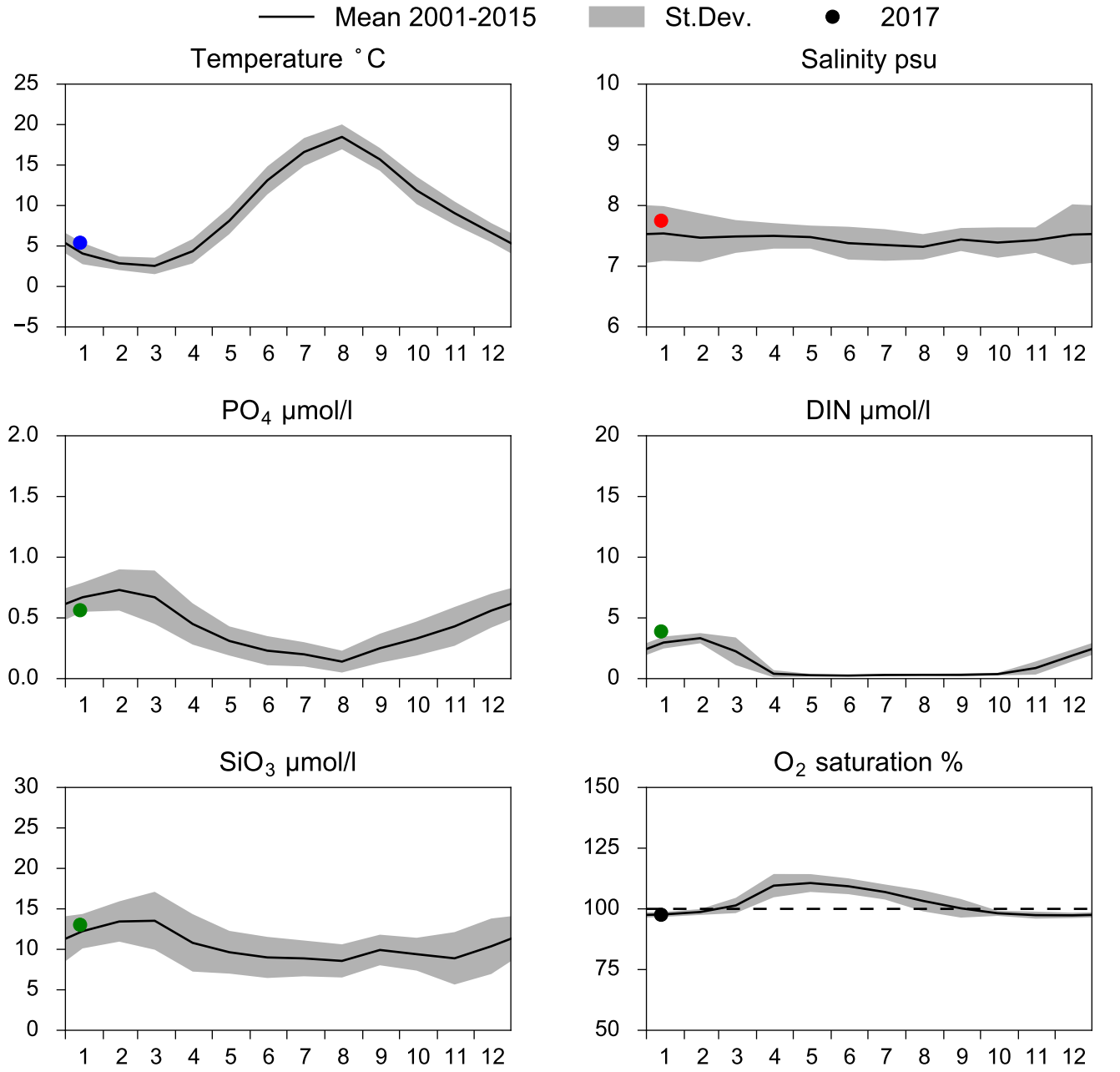


Vertical profiles ANHOLT E
January

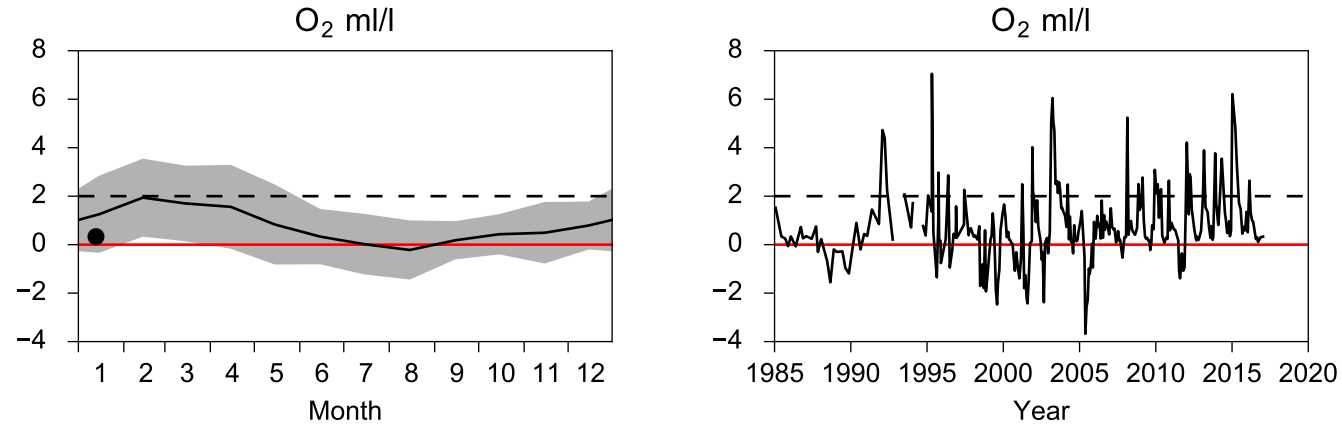


STATION HANÖBUKTEN SURFACE WATER (0-10 m)

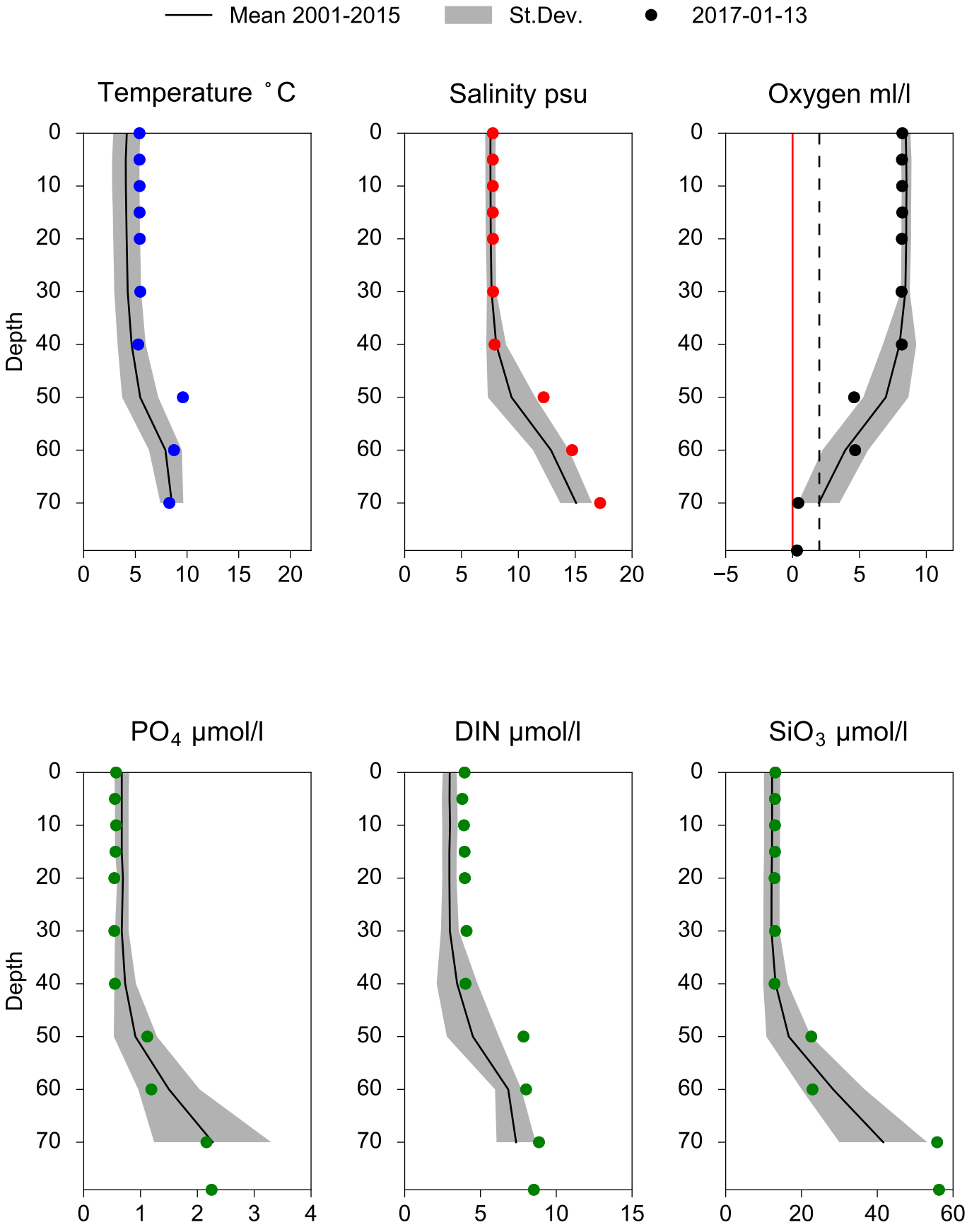
Annual Cycles



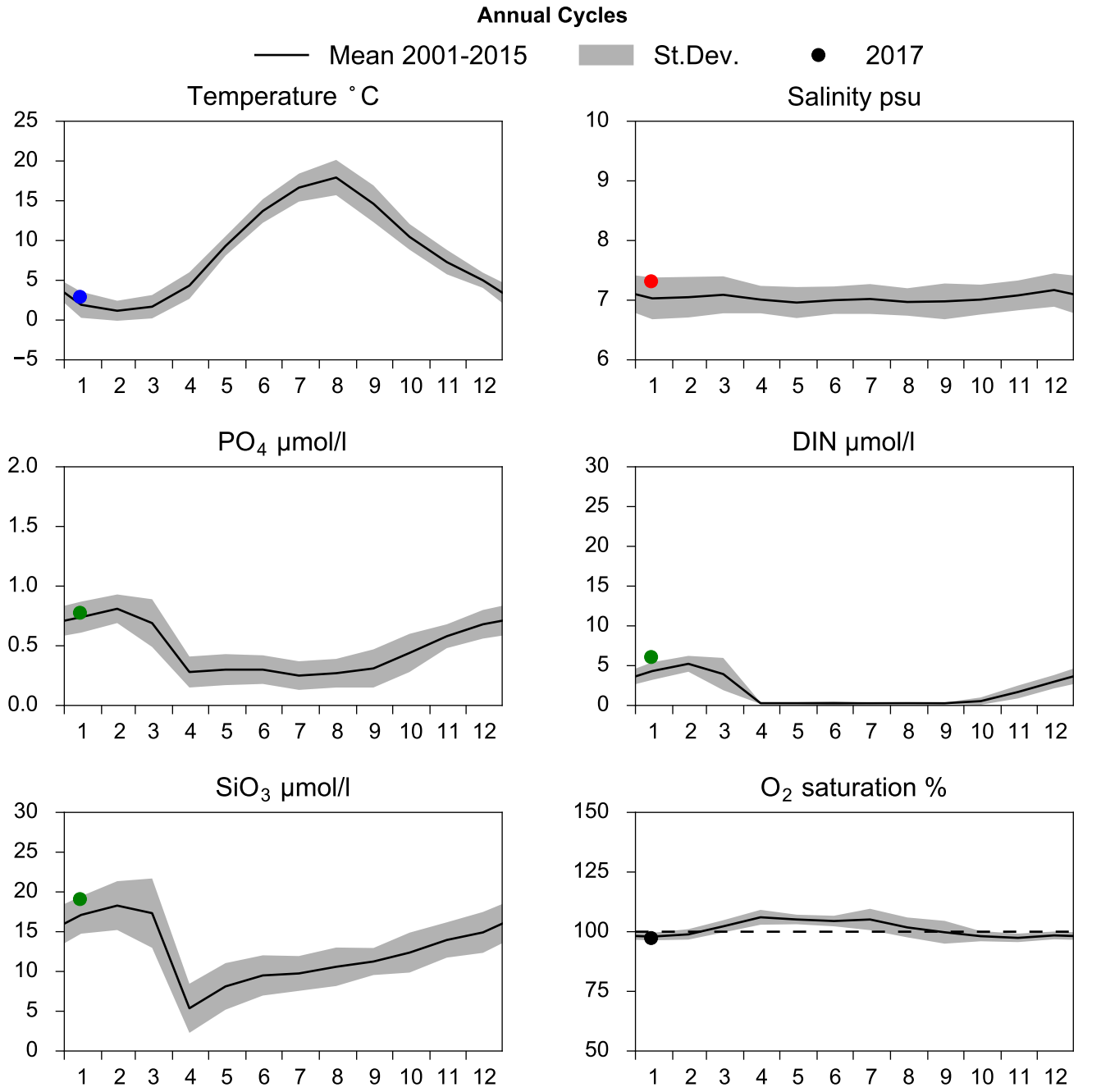
OXYGEN IN BOTTOM WATER (depth >= 70 m)



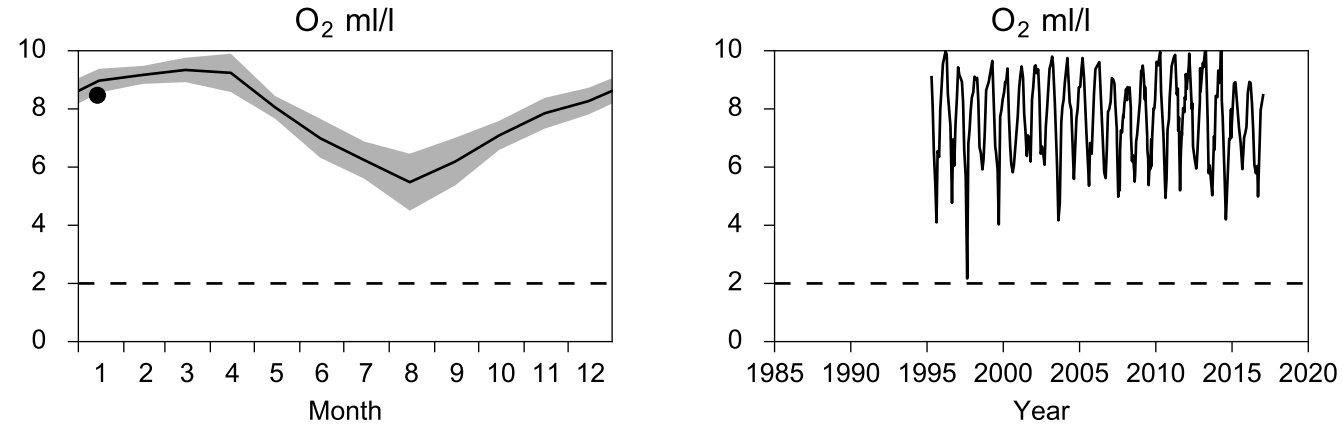
Vertical profiles HANÖBUKTEN
January



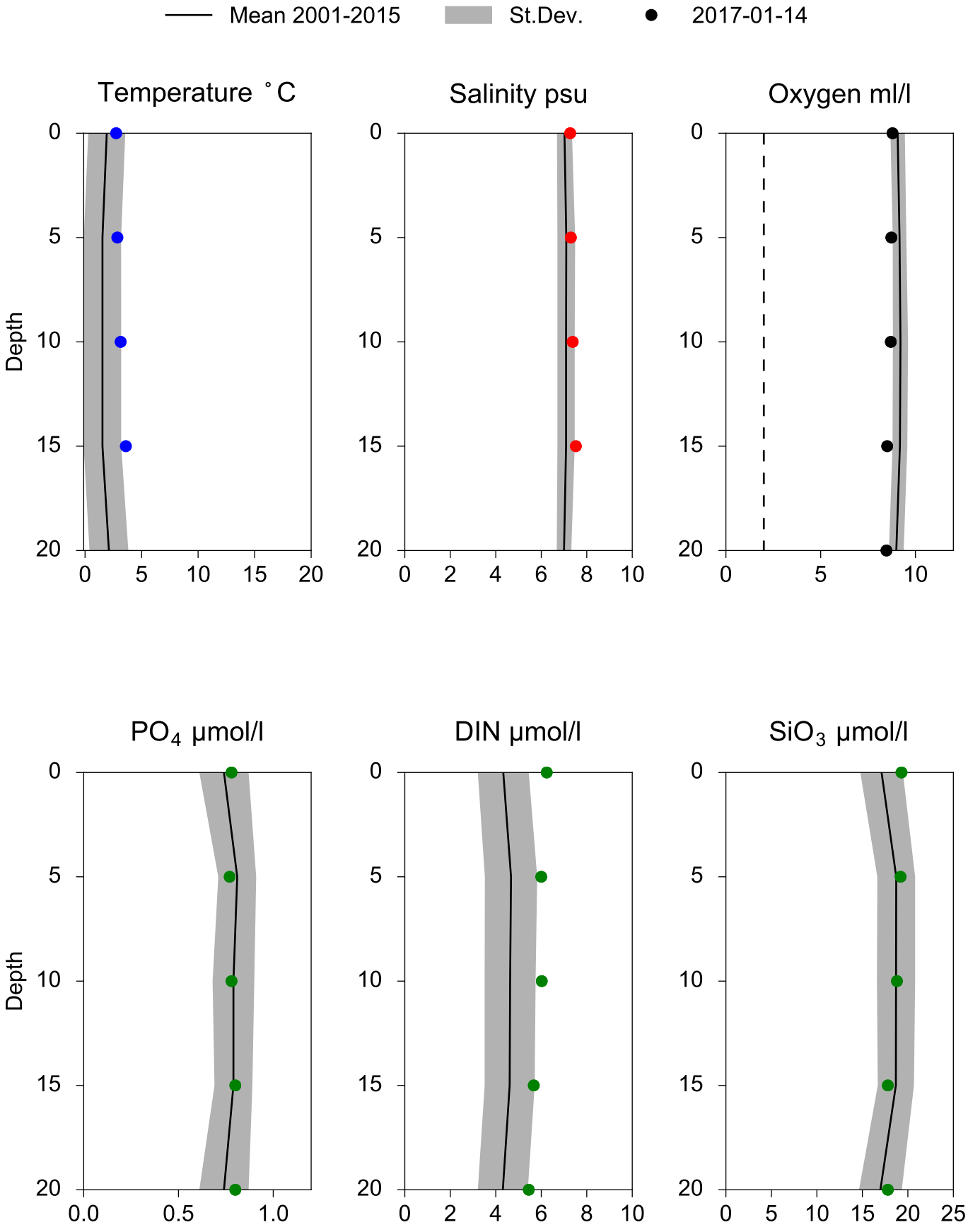
STATION REF M1V1 SURFACE WATER (0-10 m)



OXYGEN IN BOTTOM WATER (depth >= 17 m)

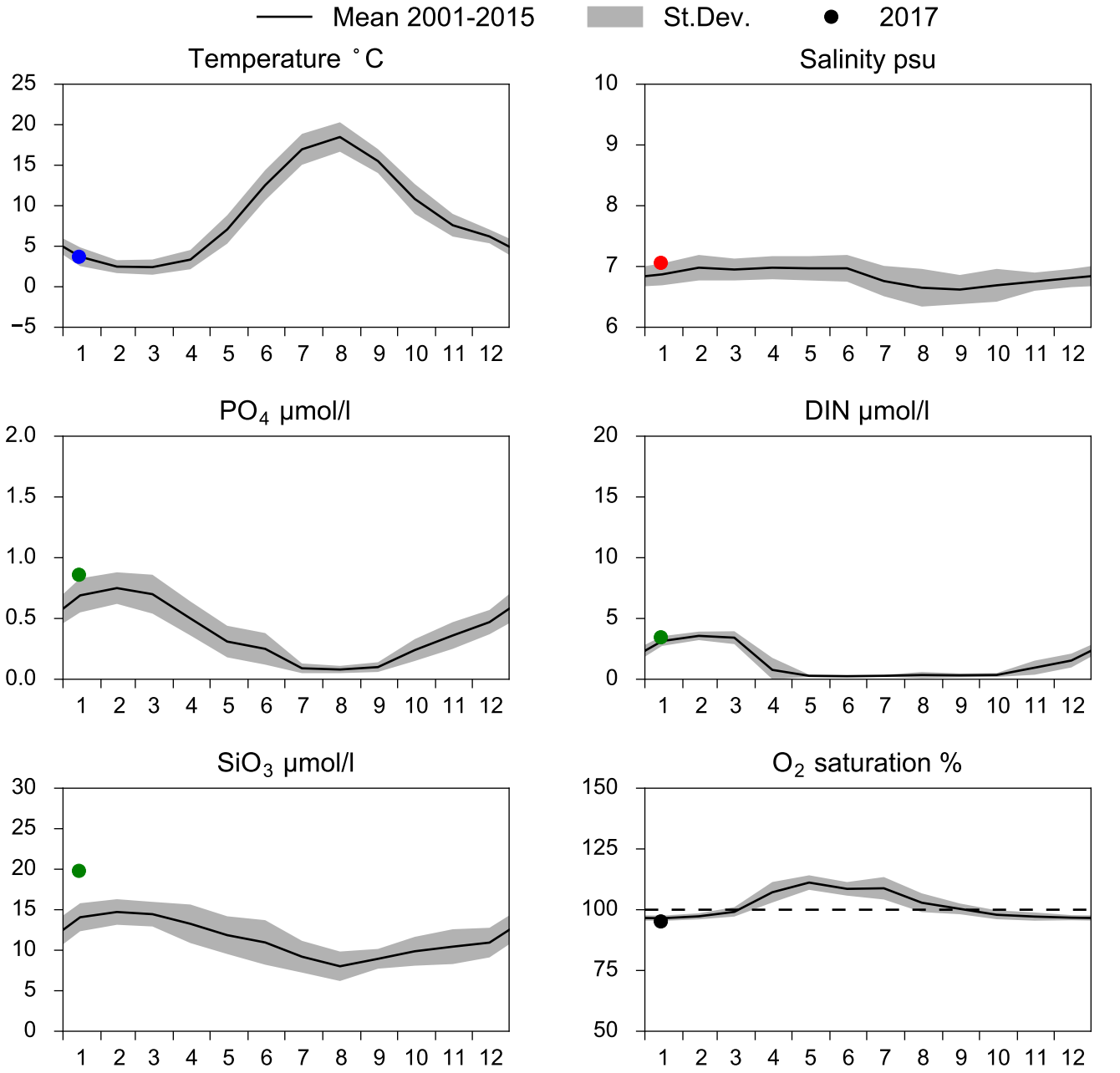


Vertical profiles REF M1V1
January

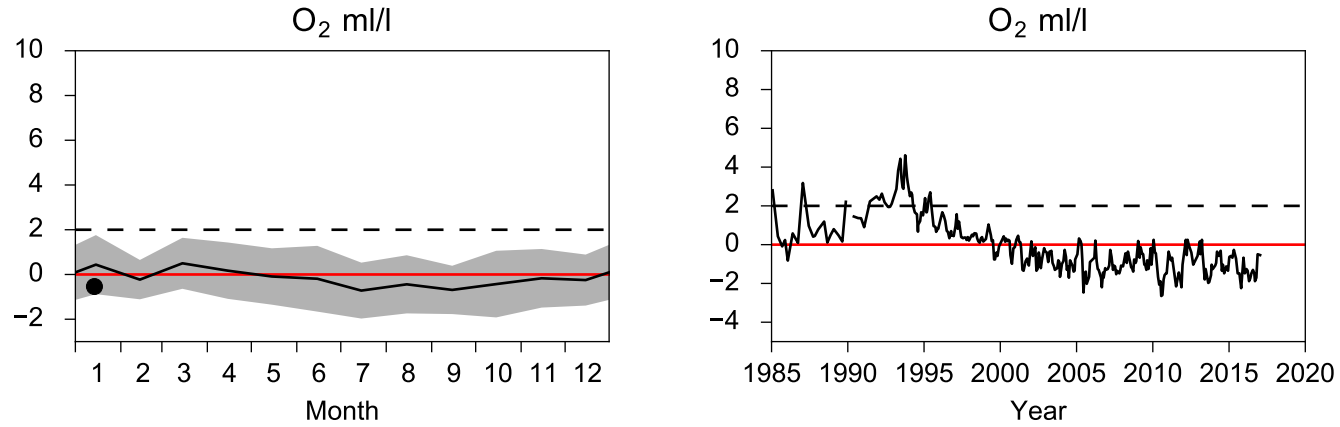


STATION BY38 KARLSÖDJ SURFACE WATER (0-10 m)

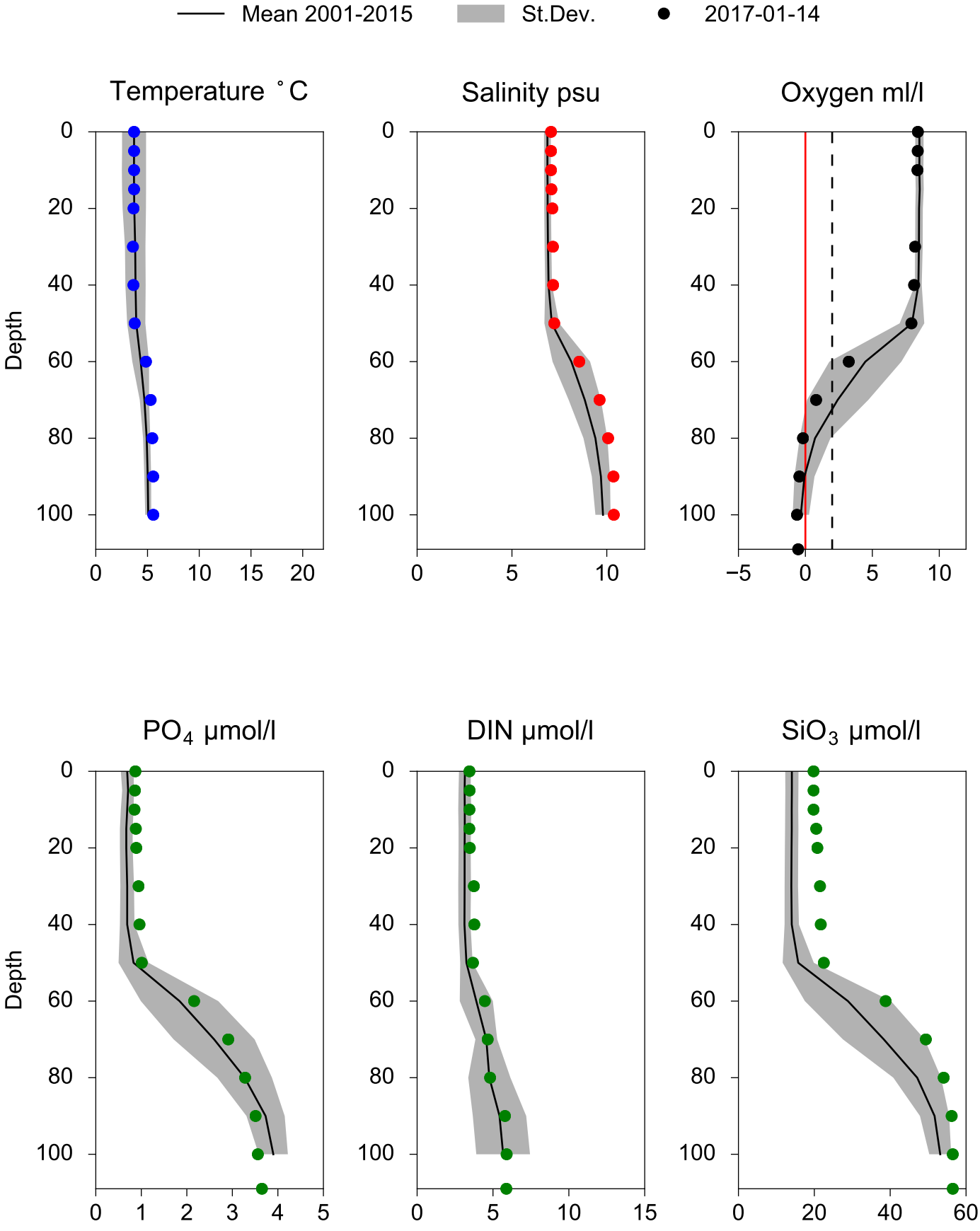
Annual Cycles



OXYGEN IN BOTTOM WATER (depth >= 100 m)



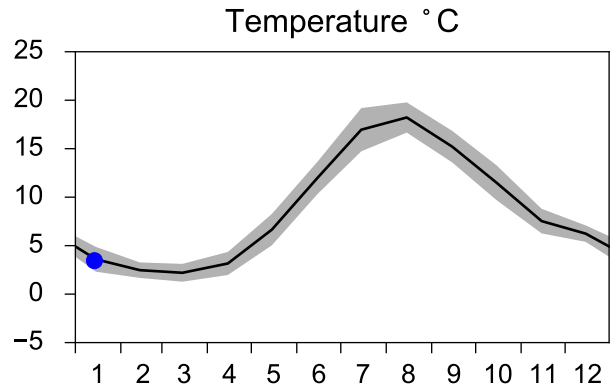
Vertical profiles BY38 KARLSÖDJ
January

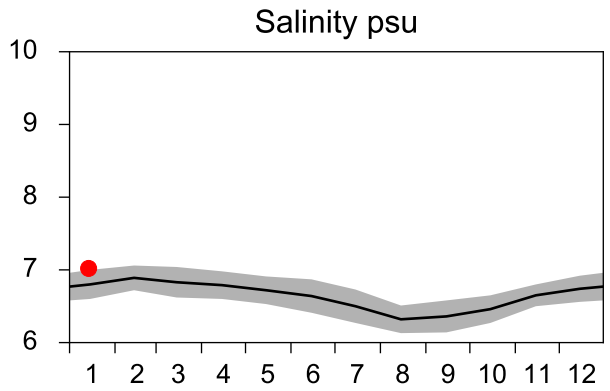


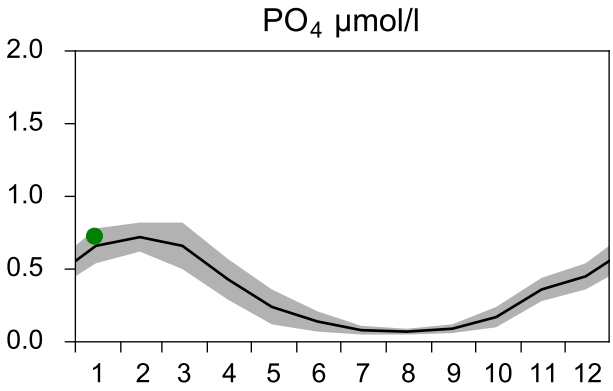
STATION BY32 NORRKÖPINGSDJ SURFACE WATER (0-10 m)

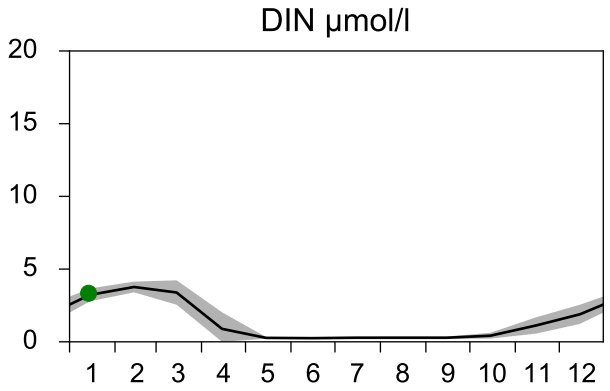
Annual Cycles

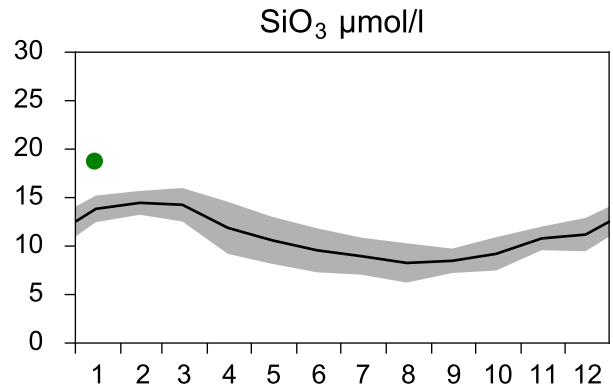
Mean 2001-2015 St.Dev. 2017

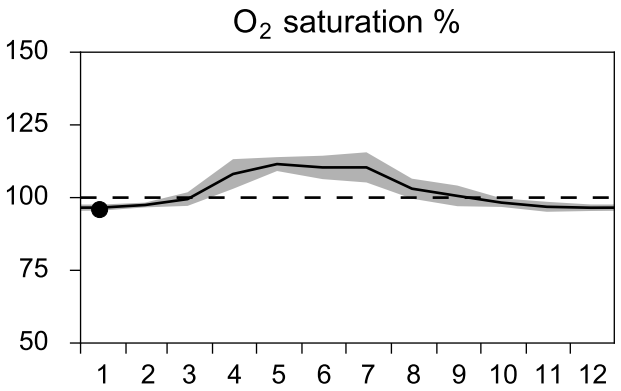




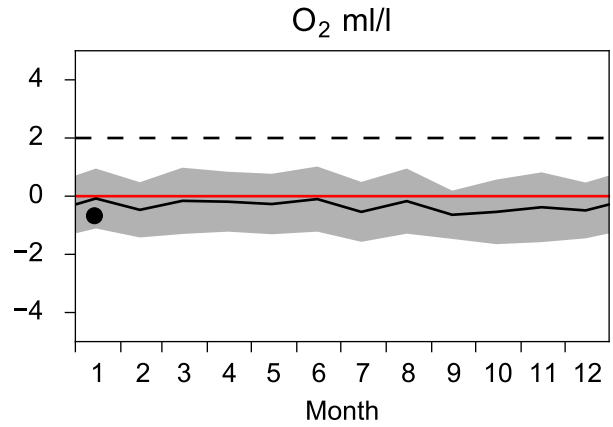


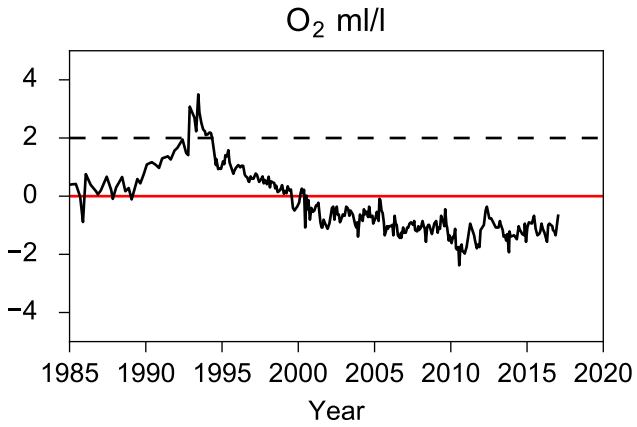




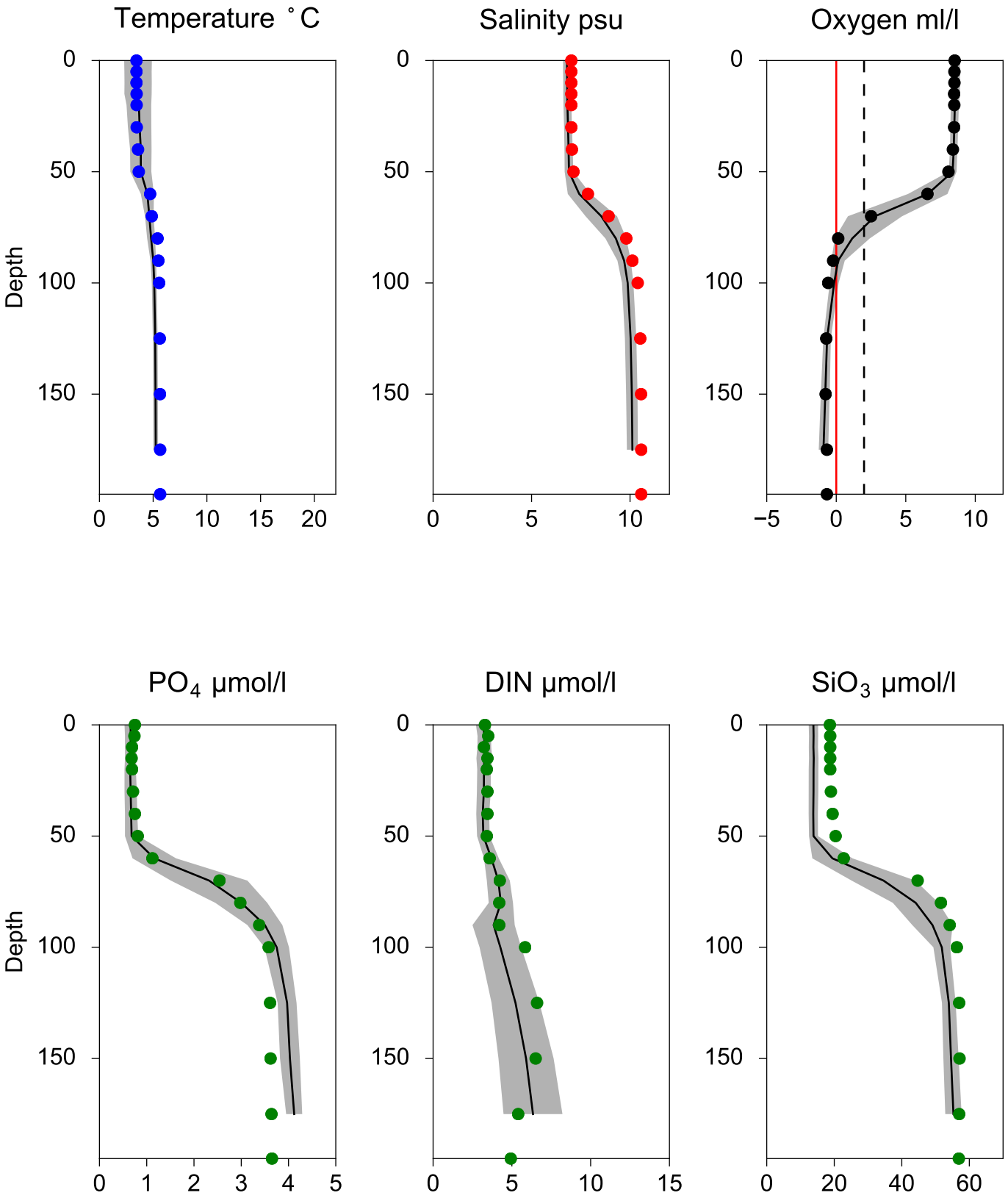


OXYGEN IN BOTTOM WATER (depth >= 175 m)





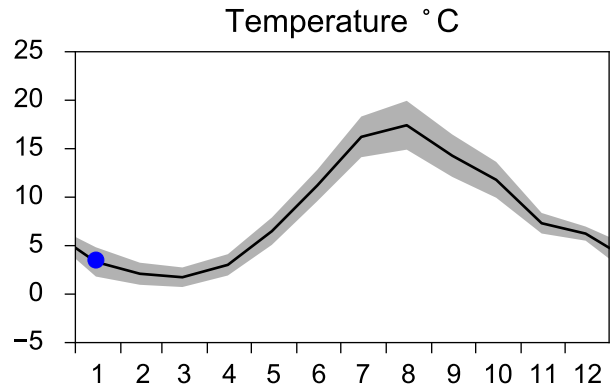
Vertical profiles BY32 NORRKÖPINGSDJ
January

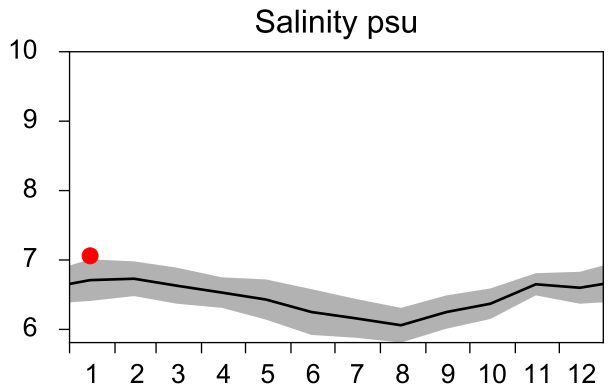


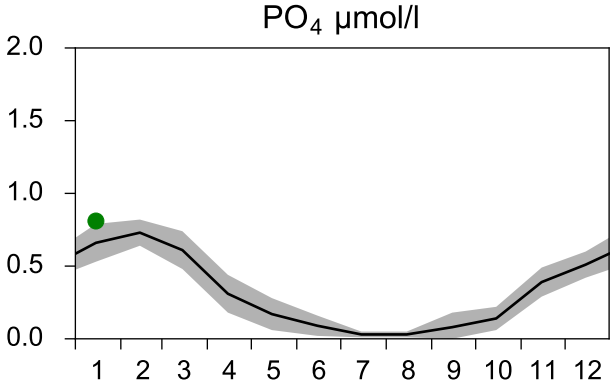
STATION BY31 LANDSORTSDJ SURFACE WATER (0-10 m)

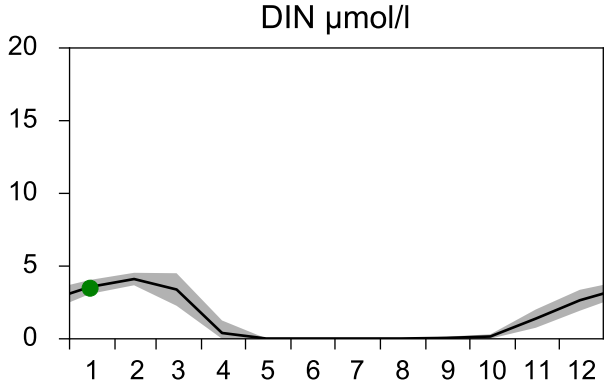
Annual Cycles

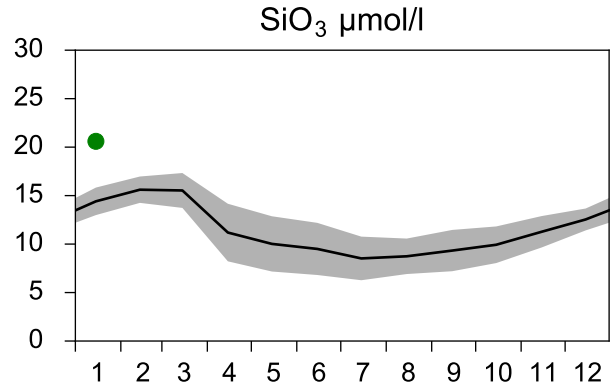
Mean 2001-2015 St.Dev. 2017

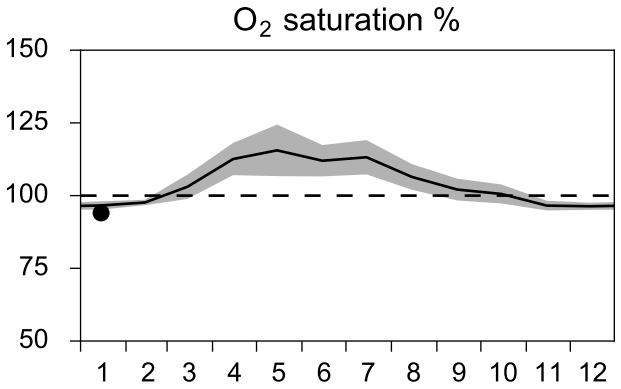




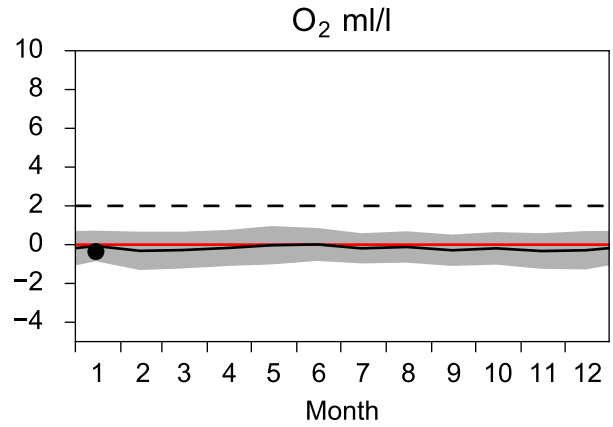


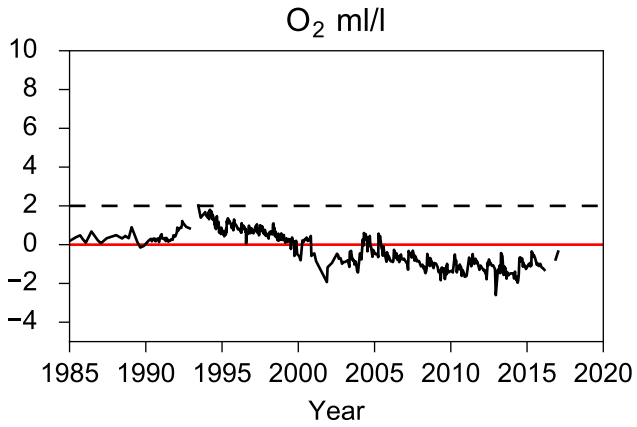




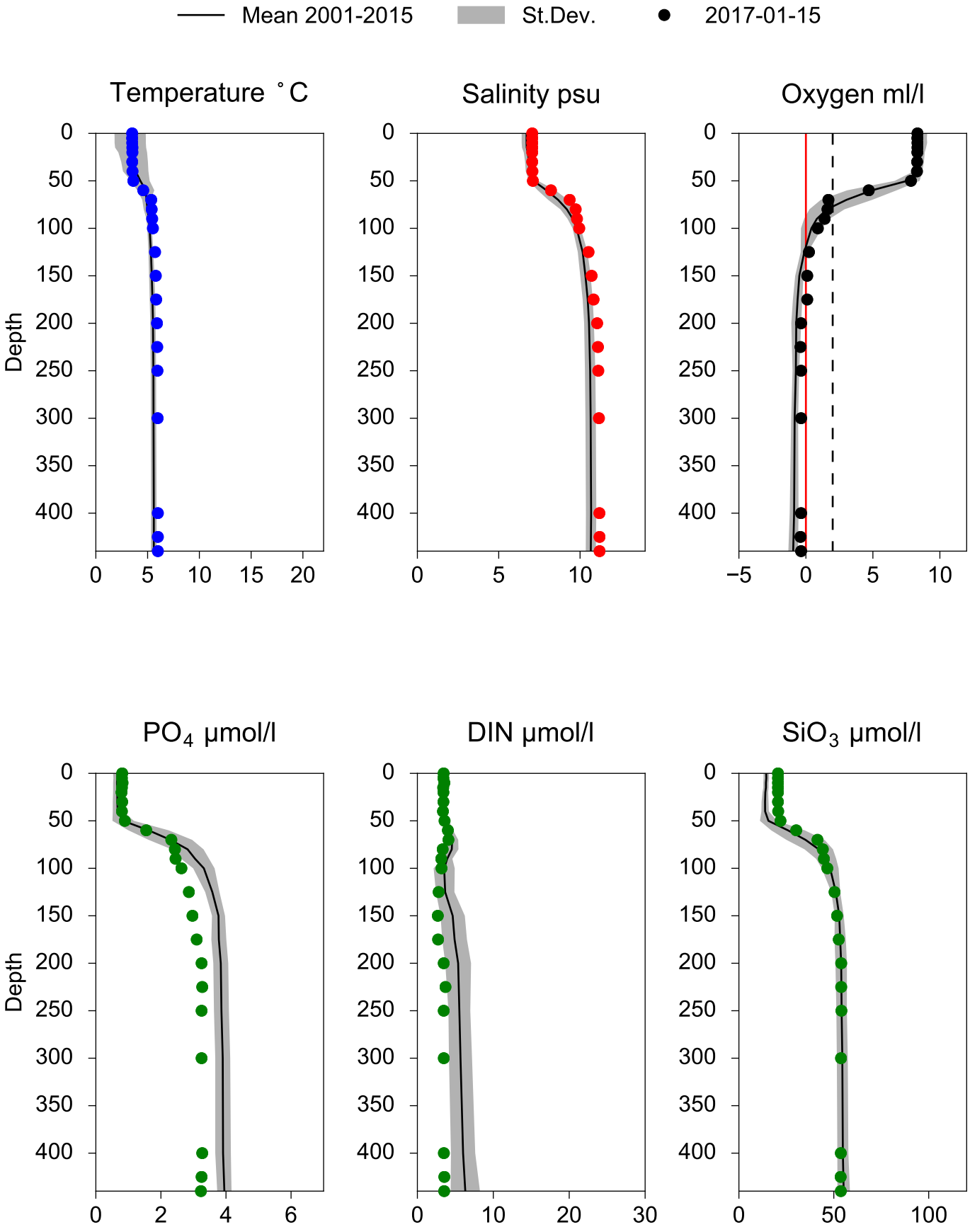


OXYGEN IN BOTTOM WATER (depth >= 425 m)





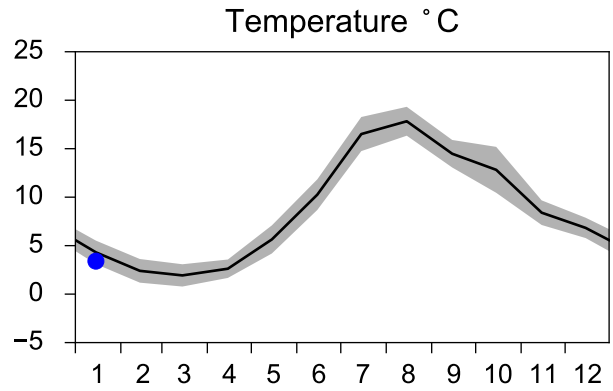
Vertical profiles BY31 LANDSORTSDJ
January

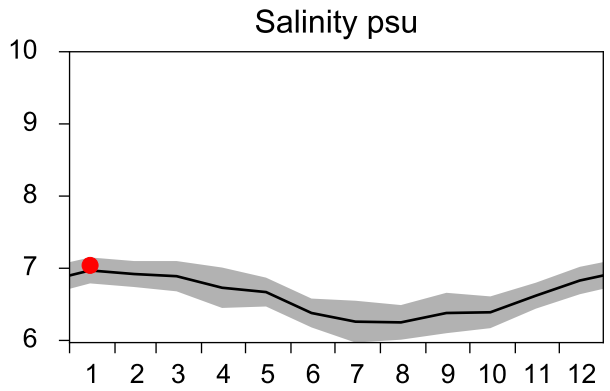


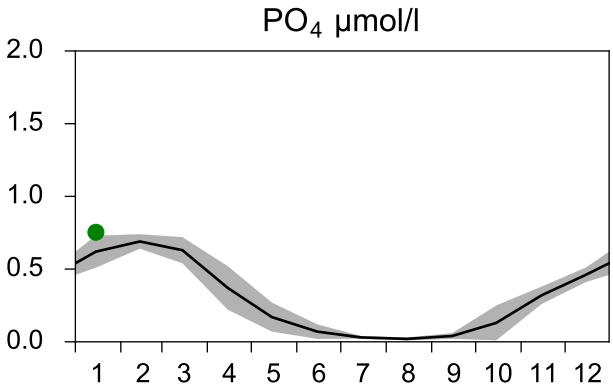
STATION BY29 / LL19 SURFACE WATER (0-10 m)

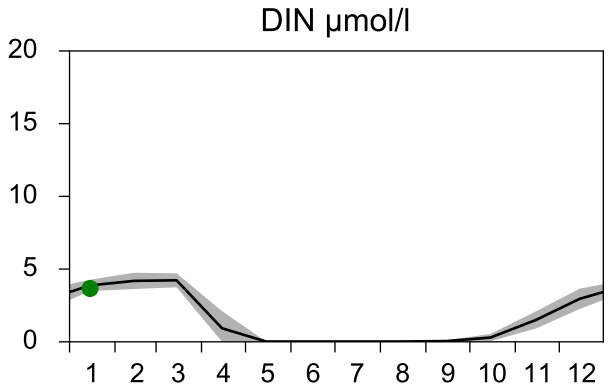
Annual Cycles

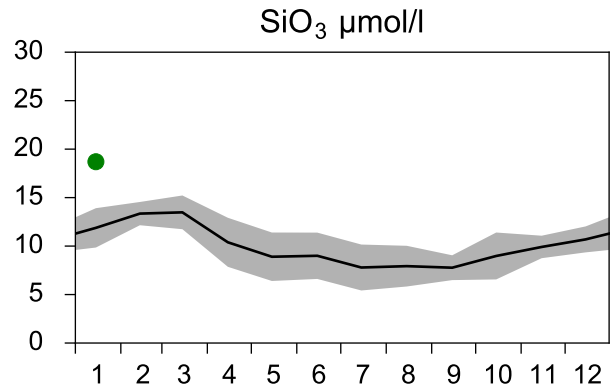
Mean 2001-2015 St.Dev. 2017

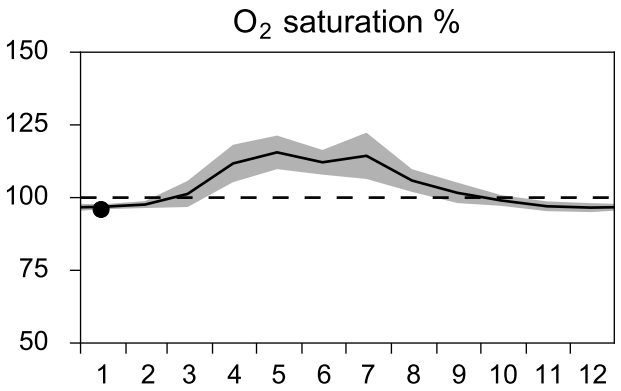




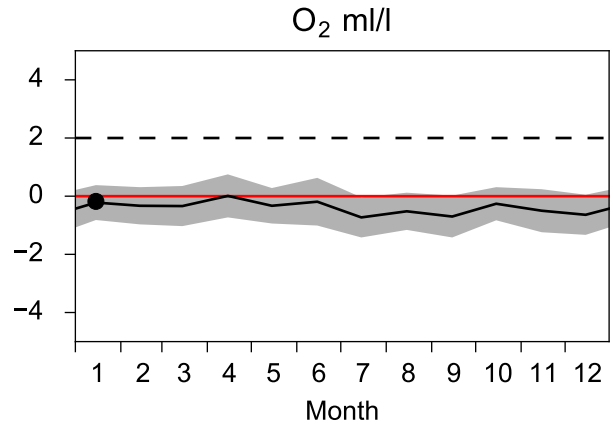


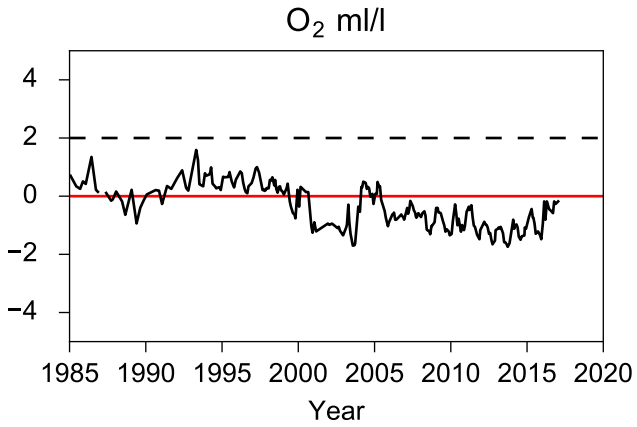






OXYGEN IN BOTTOM WATER (depth >= 150 m)





Vertical profiles BY29 / LL19
January