Karin Wesslander

Swedish Meteorological and Hydrological Institute
Oceanographic Laboratory

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Report from the SMHI monitoring cruise with R/V Aranda

Survey period: 2016-05-16 - 2016-05-23
Survey area: Skagerrak, Kattegat, the Sound and the Baltic Proper
Principal: SMHI and the Swedish Agency for Marine and Water Management

SUMMARY

The expedition was part of the Swedish regular marine monitoring programme and covered the Skagerrak, the Kattegat, the Sound and the Baltic Proper. Data presented in this report has been subject to preliminary quality control procedures only.

All nutrients in the surface water were very low in the Skagerrak and the Kattegat. At 15-20 meters, peaks in the fluorescence were observed together with high saturation of oxygen and also higher levels in nutrients. In Baltic Proper, the inorganic nitrogen (nitrite+nitrate) was used up down to 40 meter but phosphate was still present. The silicate levels were still above normal in the entire Baltic Proper.

Acute hypoxia (<2ml/l) was measured from 70-80 meters depth in the Eastern and Western Gotland Basins, and also from 70 meters at the Hanö Bight and from 80 meters in the Bornholm Basin. Hydrogen sulphide was only present intermediary (125-150 meter) at the Fårö Deep and from 90 meters depth in the Western Gotland Basin. The entire water column at the Gotland Deep (BY15) was still oxygenated.

The next regular cruise is scheduled to start June 13, 2016.

Address:
Sven Källfelts gata 15
SE-426 71 Västra Frölunda
SWEDEN

Telephone:
+46 11 4958000

E-mail:
lars.andersson@smhi.se
WWW:
http://www.smhi.se/

SMHI

PRELIMINARY RESULTS

The expedition was conducted aboard the Finnish research vessel Aranda. It commenced in Helsinki on May 16 and ended in the same port on May 23. The winds during the expedition were predominantly southeast to northwest and weak, 1.6-10.0 m/s. Air temperatures ranged between +7.6 and +13.5 ° C, lowest in the Baltic Sea.

At the end of cruise, the ocean buoy at Huvudskär was visited for a reference measurement.
A scientist from Tartu University in Estonia joined the cruise and she compared different methods for analysing pH.
The concentrations of ammonia (NH4) could unfortunately not be analysed during this cruise due to instrumental problems. Figures presenting DIN in the surface layer therefor only includes nitrite+nitrate. DIN is not shown at all in the vertical profiles.

The Skagerrak

The temperature of the surface water varied between 10.8 and 12.8°C, which are normal for the season. In the off shore parts, the salinity in the surface layer was normal for the season while it was a bit higher in the southern part, variations were between 25.6 and 29.1 psu. The stratification in both temperature and salinity was found at depth between 5 and 15 meters except from the outermost parts where the stratification was between 10-30 m.

All nutrients in the surface layer were very low in the entire area, which is normal for the season. The concentration of phosphate varied between 0.03-0.04 µmol/l, concentrations of nitrite+nitrate were at the detection limit (<0.1µmol/l), and silicate varied between 0.3-0.4 µmol/l. A peak in fluorescence was observed at all stations at 15-20 m. The water at these peaks was also over saturated with oxygen which indicates higher plankton activity, levels of nutrients were also higher. The bottom water was well oxygenated, also at Släggö in the mouth of Gullmarsfjorden.
For more details on species composition see the separate algal report.

The Kattegat and the Sound

The temperature of the surface water was normal for the season and varied between 9.9 and 11.7°C. The salinity of the surface layer was normal for the season except from nearest the coast where it was slightly higher. Surface salinity ranged between 18.1-20.7 psu. The stratification in Kattegat was developed between 10 and 15 meters. In the Sound, the salinity was 18.2 psu which is higher than normal and the stratification was at 15-25 meters depth.

All nutrient levels in the surface water were very low, which is normal the season. Phosphate concentrations in the surface layer varied between 0.03 and 0.11 µmol/l, the sum of nitrite + nitrate was below detection limit (<0.1 µmol/l) and silicate varied between 0.3 and 1.9 µmol/l. The highest levels of nutrient concentrations were found in the Sound.
The oxygen conditions in the deep water were good, and the lowest concentrations were measured in the Sound, 4.49 ml/l. A peak in fluorescence was observed at all stations at 15-20 m, highest at Anholt. The water at these peaks was also over saturated with oxygen which indicates higher plankton activity, levels of nutrients were also higher.
For more details on species composition see the separate algal report.

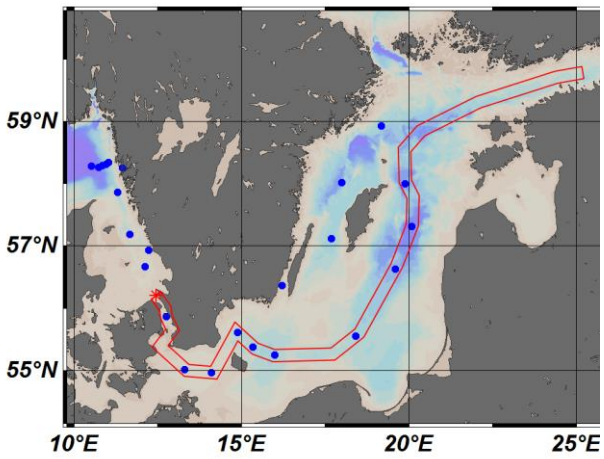
The Baltic Proper

The temperature of the surface layer was slightly above normal for the season and varied from 7.9 to 12.3°C. Surface salinity was generally normal for the season except in the Bornholm Basin where it was higher and in the eastern Gotland Basin where it was much lower. Surface salinity varied between 6.8 in the northwest to 8.3 in the southwest. The halocline and thermocline coincided and were found at 50-80 metres in the area. A summer thermocline was stared at 15 meters.

The concentrations of nitrite + nitrate were below detection limit (<0.1 µmol/l) down to 40 meters depth, which is normal for the season. The phosphate concentration in the surface water was also normal for the season except in the Western Gotland Basin were it was lower and in the Hanö Bight where it was higher. Phosphate levels ranged between 0.1 and 0.44 µmol/l with the lowest levels in the northwest part and highest in the southwest. The concentrations of silicate were above or high above normal in the entire area and ranged between 10.7 and 15.5 µmol/l.

In the northern part of the Western Gotland Basin, there was a short changeover between the oxic and the anoxic layer at 90 meter, in the southern part (BY38) acute hypoxia (< 2 ml/l) was observed from 70 meters and hydrogen sulphide from 90 meters. In the northern part of the Eastern Gotland Basin (BY20), acute hypoxia was observed from 80 meters but hydrogen sulphide was only measured at 125 and 150 meters depth. At the Gotland Deep, the entire water column was still oxygenated even though it was low concentrations in the bottom water and acute hypoxia from 80 meters.
Acute hypoxia was also observed from 70 meters at the Hanö Bight and from 80 meters in the Bornholm Basin.

Fluorescence measurements showed biological activity in the surface layer in the entire Baltic Proper, and peaks were observed at 15 meters. For more details on species composition see the separate algal report.



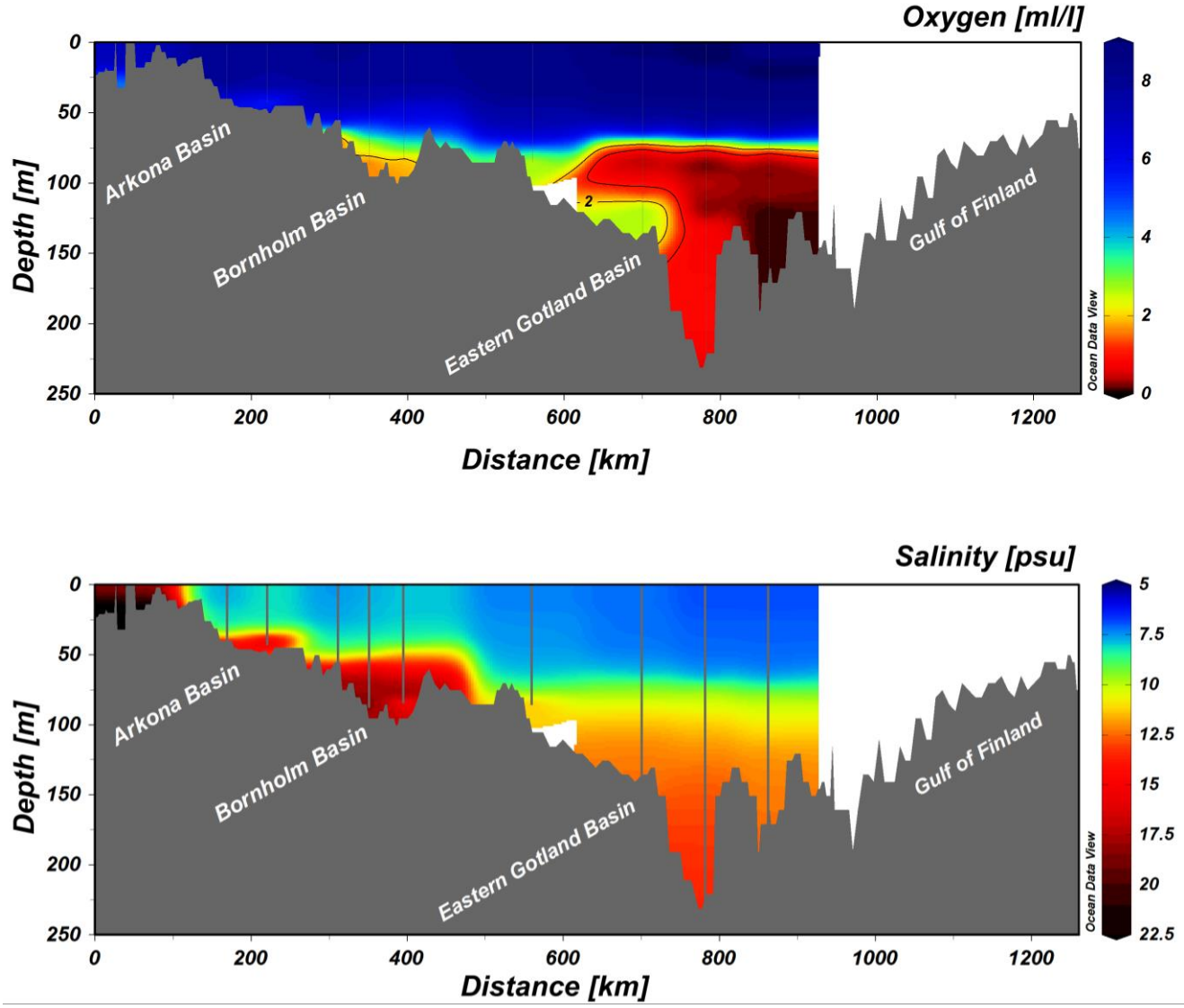


Figure 1. Transect showing the oxygen and salinity from the Sound to the Gulf of Finland.

PARTICIPANTS

Name		**Institute**
Karin Wesslander	Chief scientist	SMHI
Örjan Bäck	Helsinki-Lysekil	SMHI
Martin Hansson	Lysekil-Helsinki	SMHI
Johan Kronsell		SMHI
Johanna Linders	Helsinki-Lysekil	SMHI
Jenny Lycken		SMHI
Daniel Simonsson		SMHI
Silvie Lainela		Tartu University

APPENDICES

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

TRACKCHART
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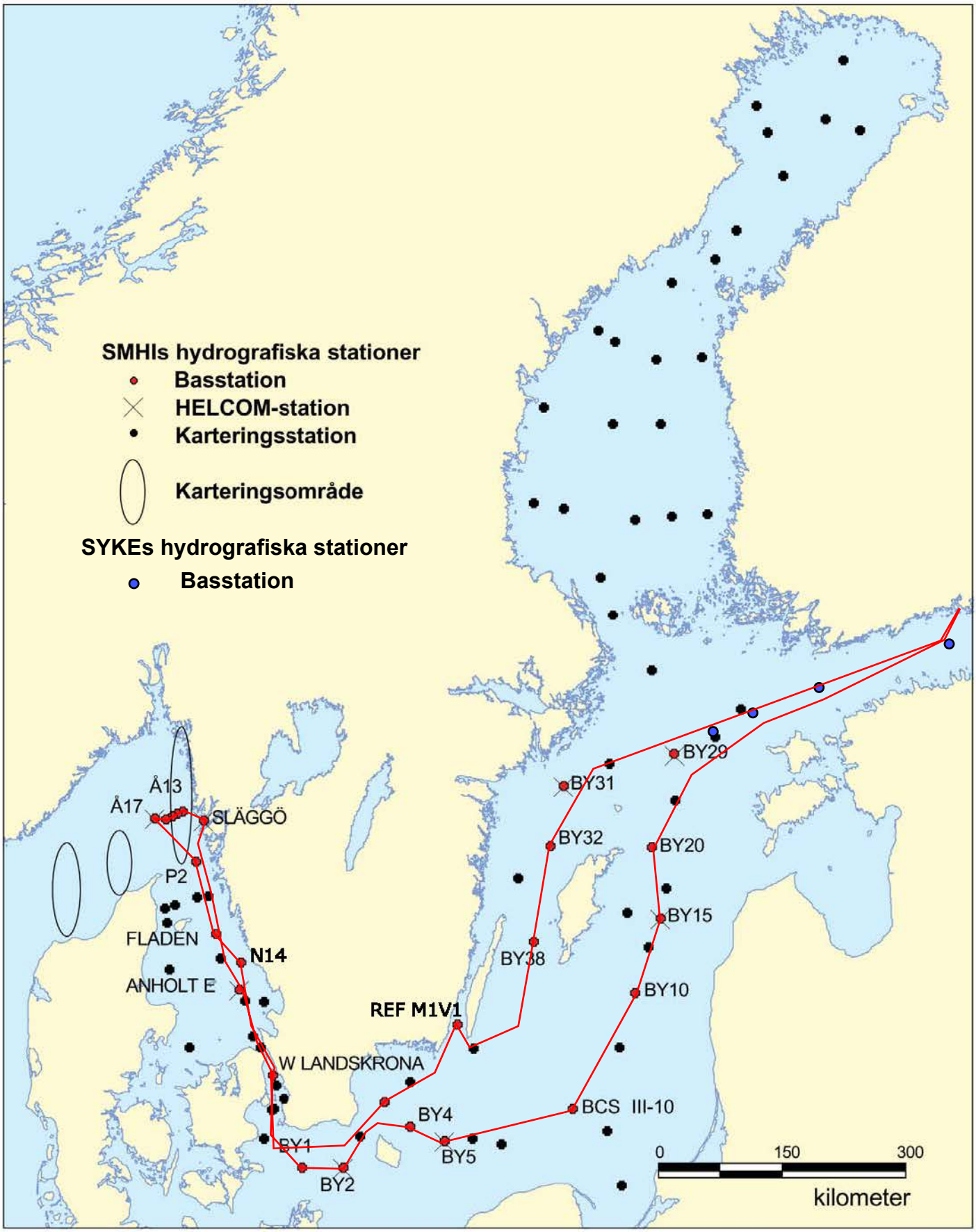
Ship: R/V ARANDA
Date: 20160516-20160523
Series: 0258-0282



SMHI ***** Hydrographic series Ship: 01-Aranda ****** Date: 2016-05-22
Ocean enh ***** series Year: 2016 ****** Time: 16:37

Ser no	Stat code	Proj	Station----------	Lat-----	Lon-----	Date yyyymmdd	Time hhmm utc	Bottom depth m	Secchi depth m	Wind dir	Wind vel	Air temp C	Air pres hPa	WCSI aoae tu hd	Cloud	PPCPZZT Hrhhoor Cilyooa motPBw PrP l	No de	Tem pin	Salin	Phy	Oxyg	H2S	Po4P	Tot P	Nto2N	Nno3N	Nto4N	Total N	Alk1	Sio3	Humus	Lign is	POC	PON	Tot C	Comm
0258	BPEX26BAS	BY20	FÅRÖDJ	N5800	E1953	20160517	0300	196		13	7	7.6	1002	2730	x	--x----	17	x	x	-	x	x	x	x	x	x	-	x	-	x	-	-	-	-	-	x
0259	BPEX21BAS	BY15	GOTLANDSDJ	N5720	E2003	20160517	0725	239	6	13	5	7.8	1003	2730	x	-xxxx--	19	x	-	x	x	-	x	x	x	x	-	x	x	x	-	-	-	-	-	-
0260	BPEX13BAS	BY10		N5638	E1935	20160517	1300	147	6	30	5	9.0	1006	1630	x	--x----	15	x	x	-	x	-	x	x	x	x	-	x	-	x	-	-	-	-	-	-
0261	BPSE11BAS	BCS III-10		N5533.3	E1824	20160517	2030	90		23	5	8.7	1009	9999	x	--x----	12	x	x	-	x	-	x	x	x	x	-	x	-	x	-	-	-	-	-	-
0262	BPSB07BAS	BY5	BORNHOLMSDJ	N5515	E1559	20160518	0410	90	6.5	27	4	9.2	1010	1220	x	-xxxx--	12	x	x	x	x	-	x	x	x	x	-	x	x	x	-	-	-	-	-	-
0263	BPSB06BAS	BY4	CHRISTIANSÖ	N5523	E1520	20160518	0745	92	6	25	5	9.2	1010	2820	x	-------	12	x	x	-	x	-	x	x	x	x	-	x	-	x	-	-	-	-	-	-
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0266	SOCX39BAS	W LANDSKRONA		N5552.0	E1245.0	20160518	2250	51		12	5	9.4	1008	9999	x	--x----	9	x	x	-	x	-	x	x	x	x	-	x	-	x	-	-	-	-	-	-
0267	KAEX29BAS	ANHOLT E		N5640.0	E1207.0	20160519	0350	63		15	6	10.3	1008	1430	x	-xxxx--	10	x	x	x	x	-	x	x	x	x	-	x	x	x	-	-	-	-	-	x
0268	KANX50BAS	N14 FALKENBERG		N5656.40	E1212.70	20160519	0640	31	8.5	16	7	9.8	1009	1330	x	-xxx---	7	x	x	x	x	-	x	x	x	x	-	x	x	x	-	-	-	-	-	x
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0271	SKEX18BAS	Å17		N5816.5	E1030.8	20160519	1800	349	7.5	22	6	10.1	1010	1130	x	--xxx--	14	x	-	x	x	-	x	x	x	x	-	x	x	x	-	-	-	-	-	-
0272	SKEX17BAS	Å16		N5816	E1043.5	20160519	2000	201		20	5	11.8	1010	1630	x	-------	13	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
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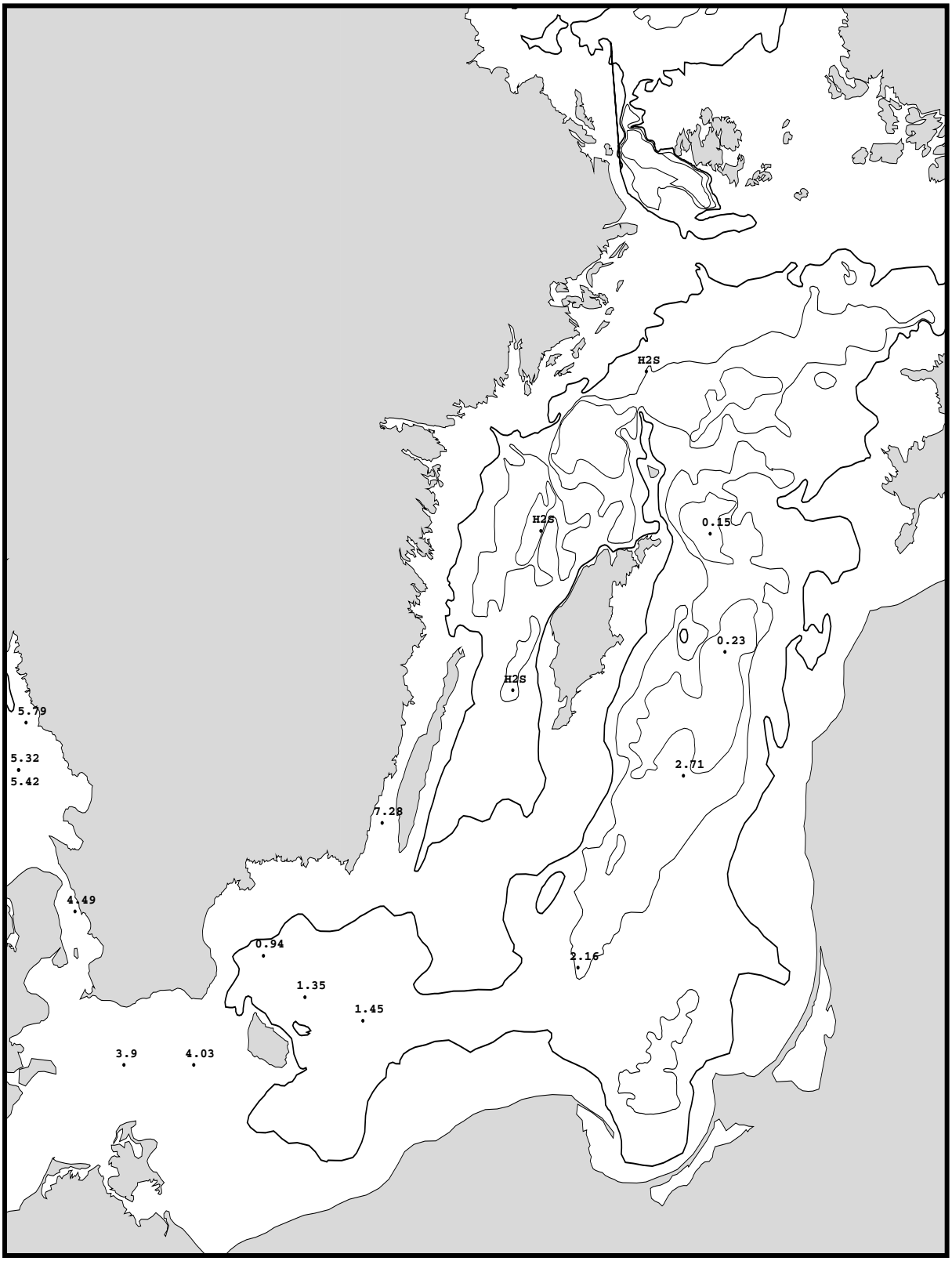
0280	BPWX45BAS	BY38	KARLSÖDJ	N5707	E1740	20160521	2300	110		24	6	10.9	1015	9990	x	--x----	14	x	x	-	x	x	x	x	x	x	-	x	-	x	-	-	-	-	-	-
0281	BPWX38BAS	BY32	NORRKÖPINGSDJ	N5801	E1759	20160522	0400	200	7	21	5	10.5	1014	2620	x	--x----	17	x	x	-	x	x	x	x	x	x	-	x	-	x	-	-	-	-	-	-
0282	BPNX00BAS	HUVUDSKÄR		N5855.91	E1910.01	20160522	1025	92		20	5	10.0	1015	2820	x	-------	12	x	-	-	x	x	-	-	-	-	-	-	-	-	-	-	-	-	-	x

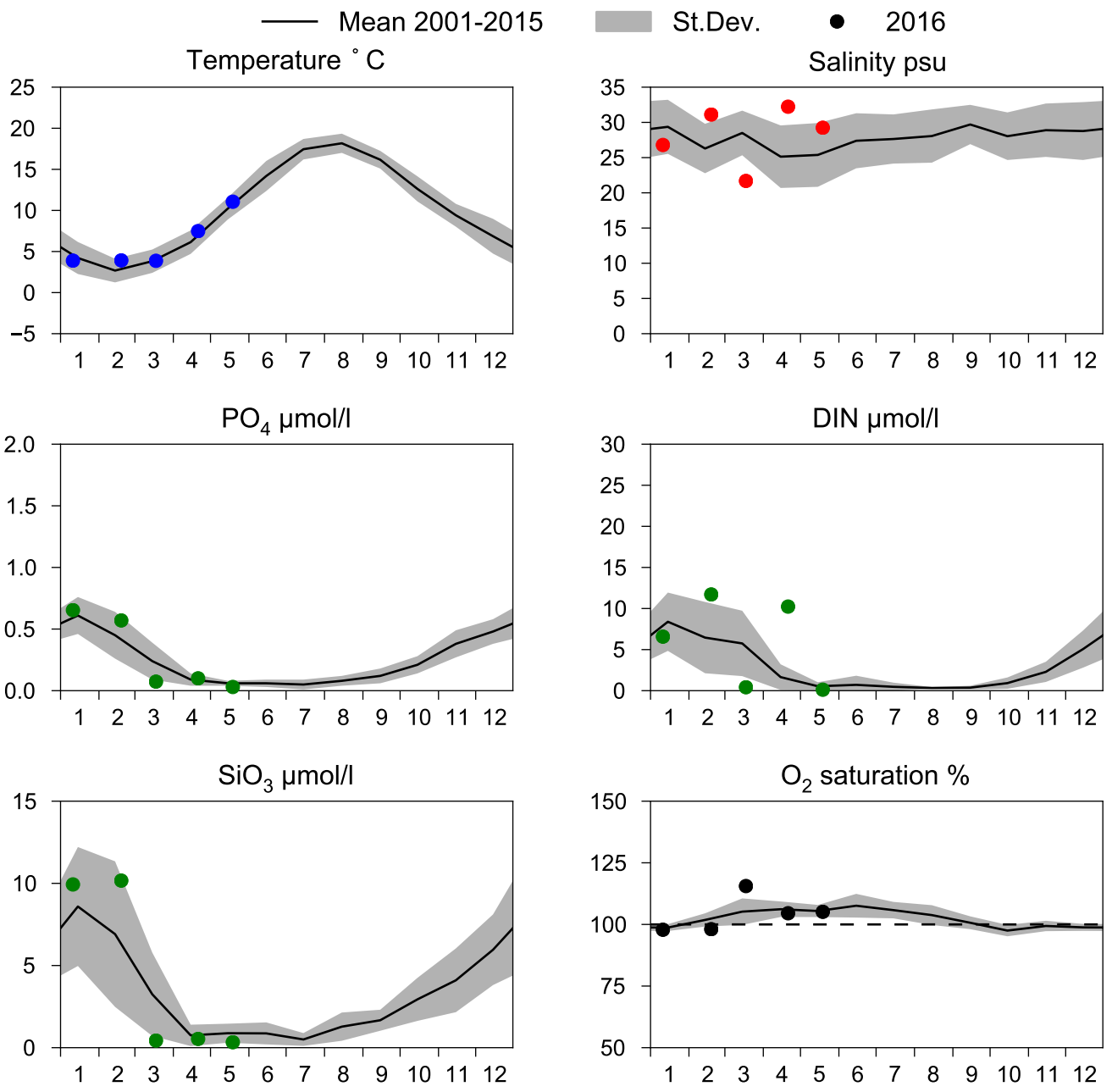
Bottom water oxygen concentration (ml/l)

Country: Finland
Ship : Aranda
Date : 20160517-20160522
Series : 0258-0282

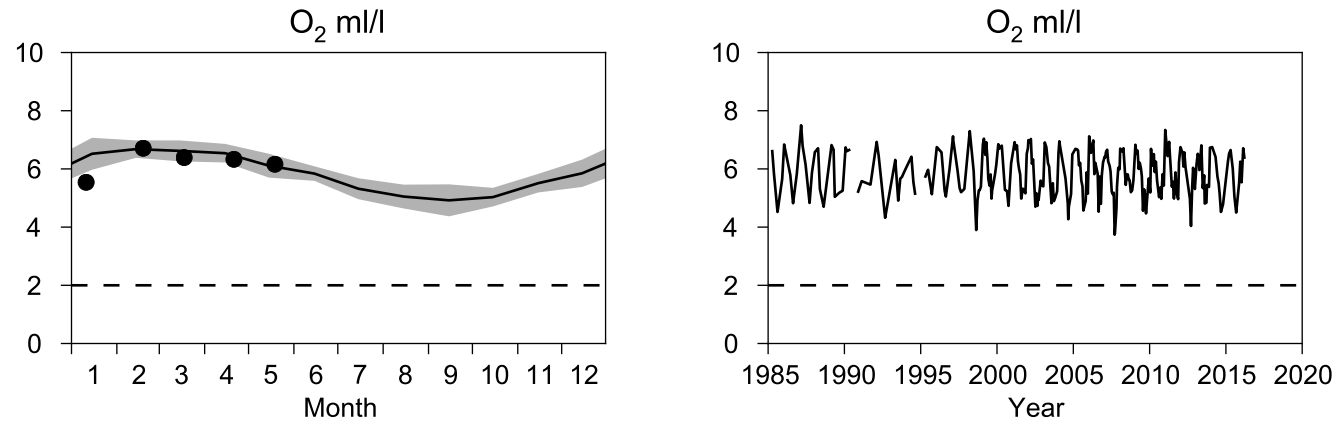


STATION P2 SURFACE WATER (0-10m)

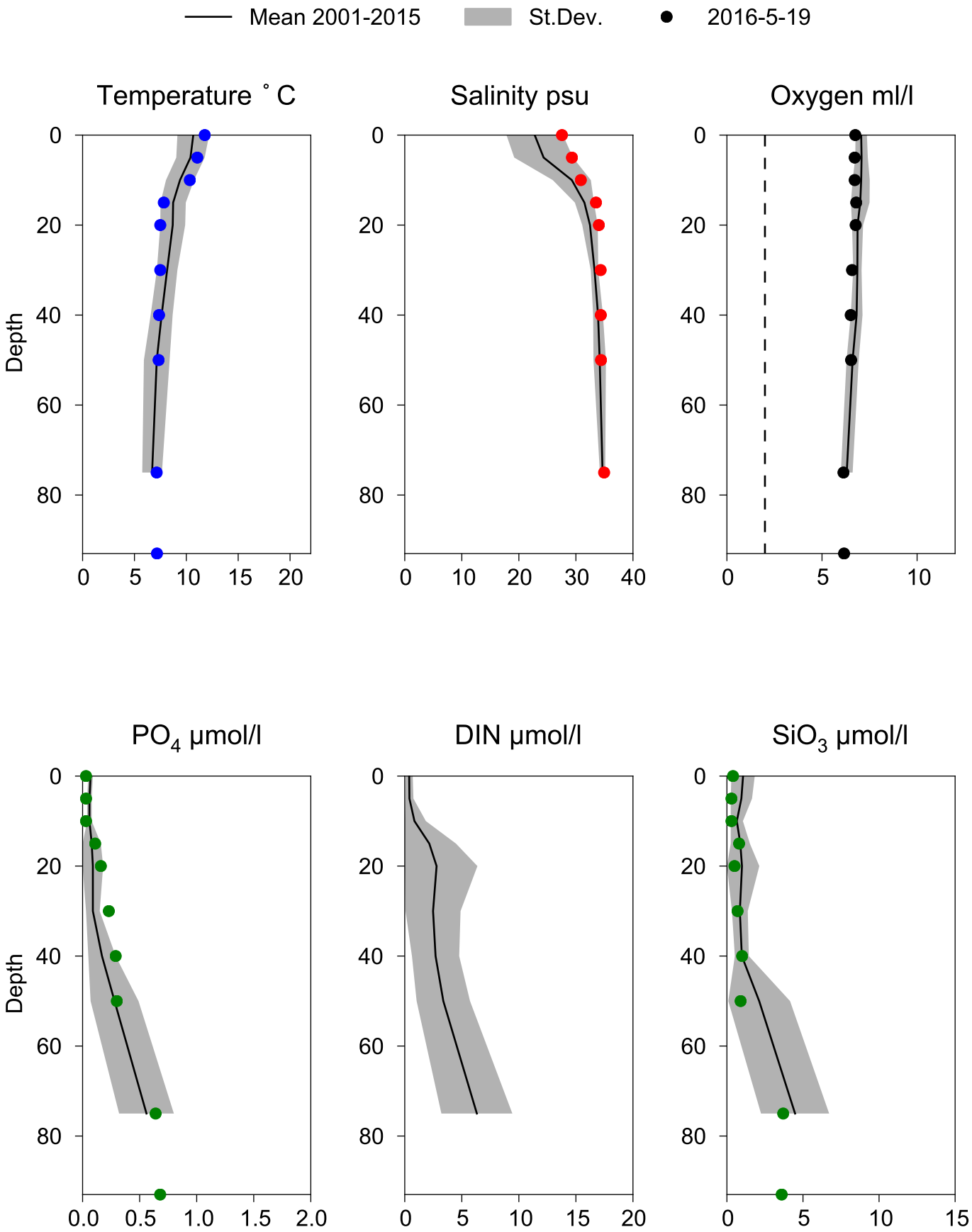
Annual Cycles



OXYGEN IN BOTTOM WATER (depth >= 80 m)

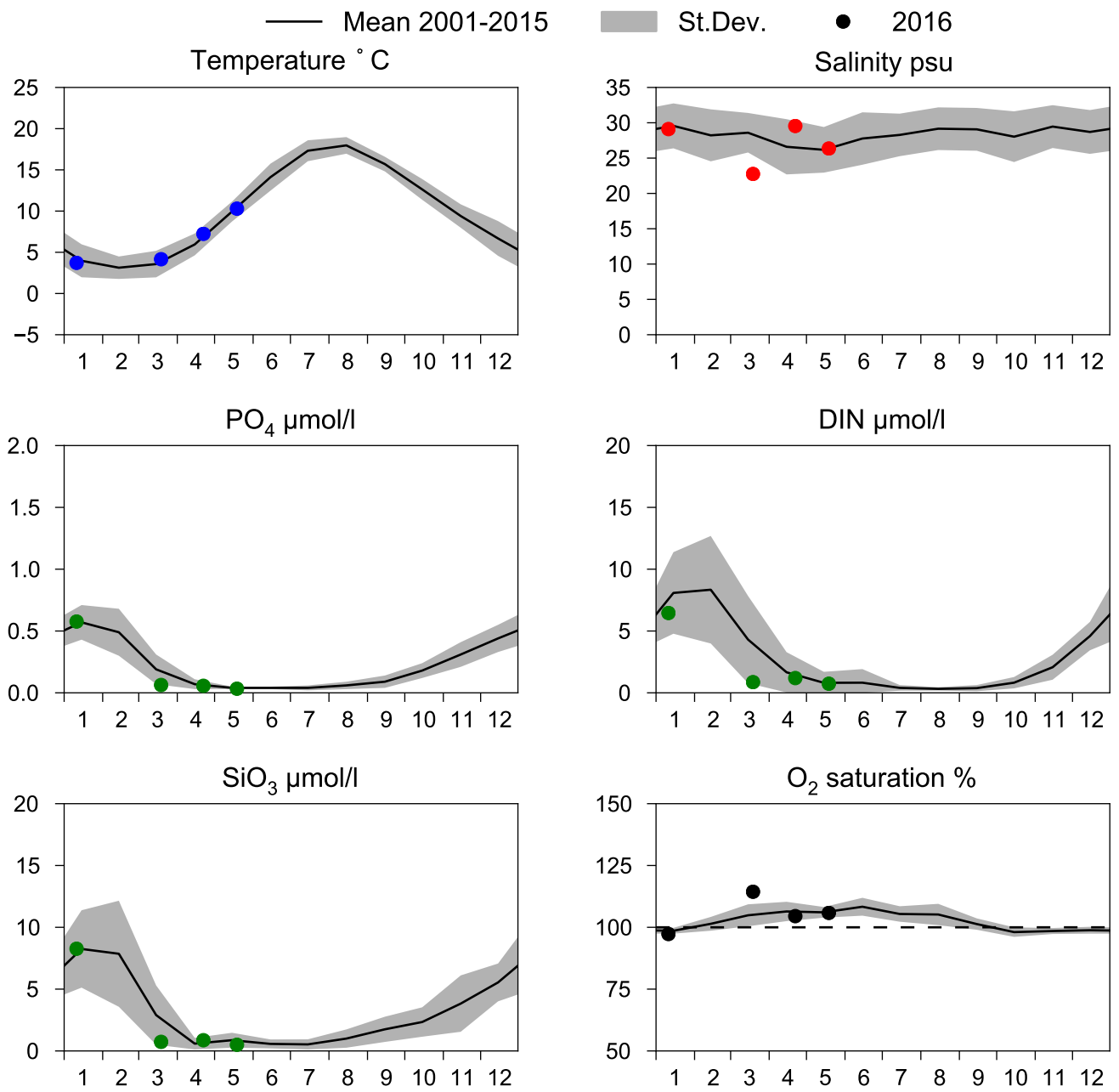


Vertical profiles P2
May

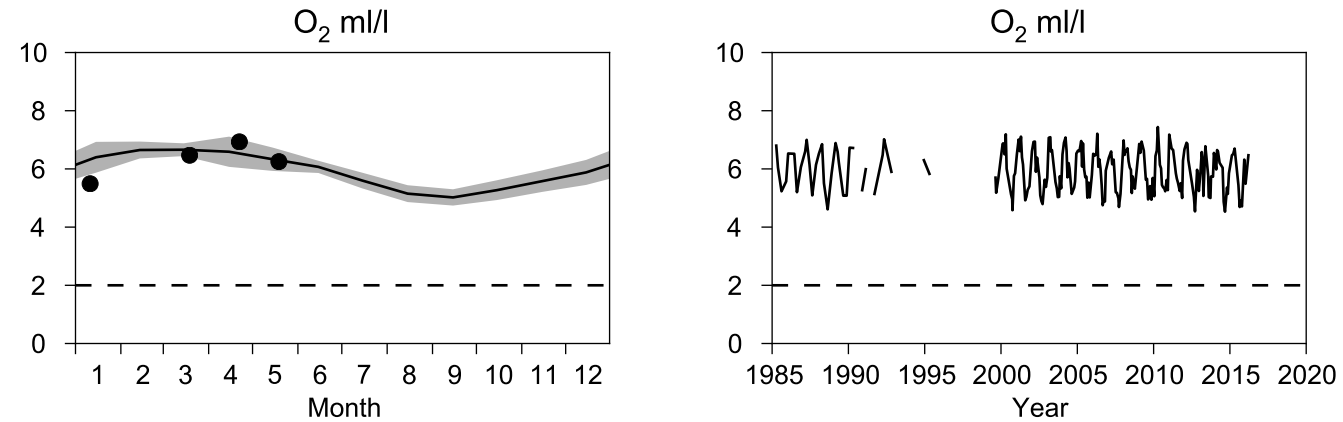


STATION Å13 SURFACE WATER (0-10m)

Annual Cycles



OXYGEN IN BOTTOM WATER (depth >= 75 m)



Vertical profiles Å13
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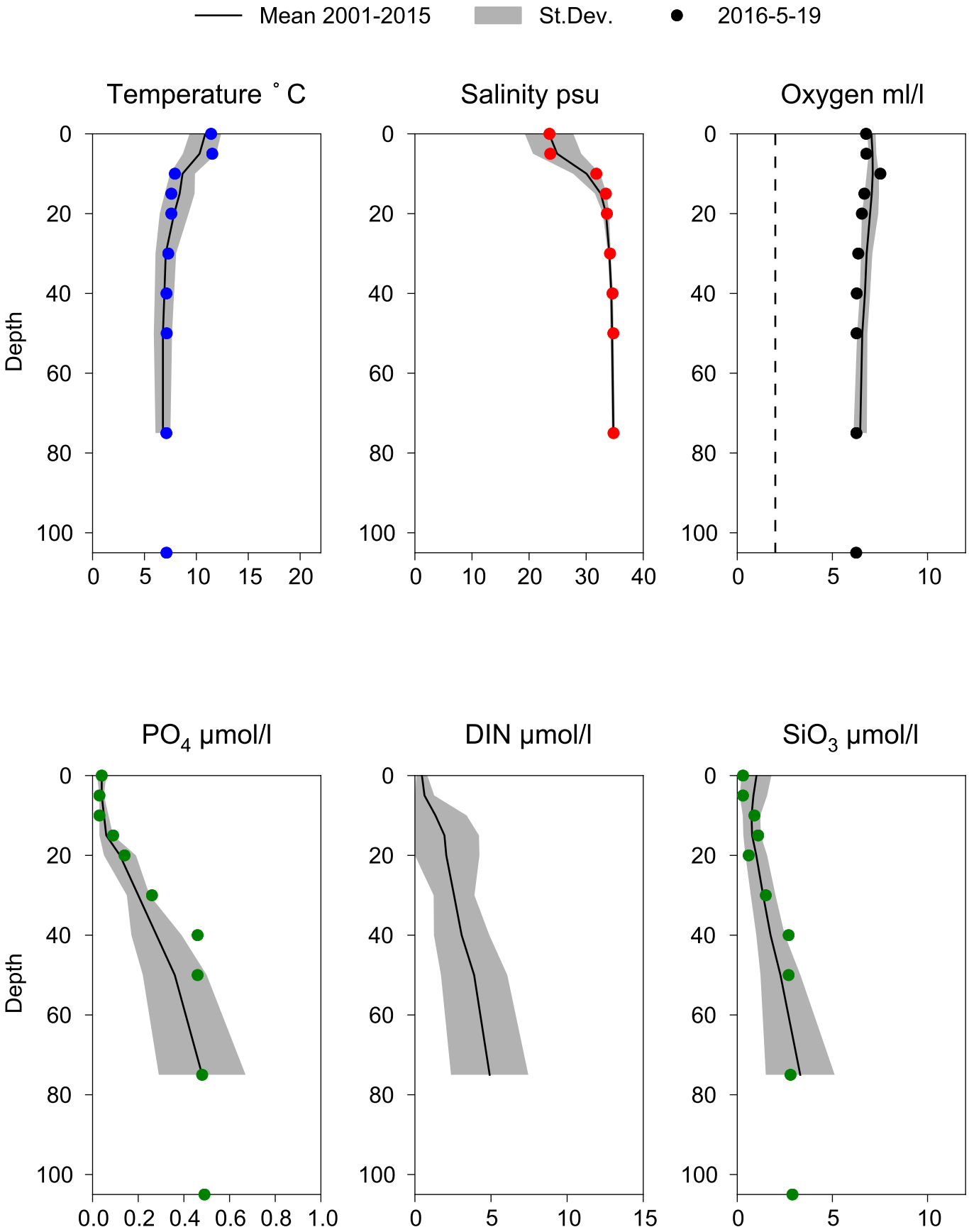
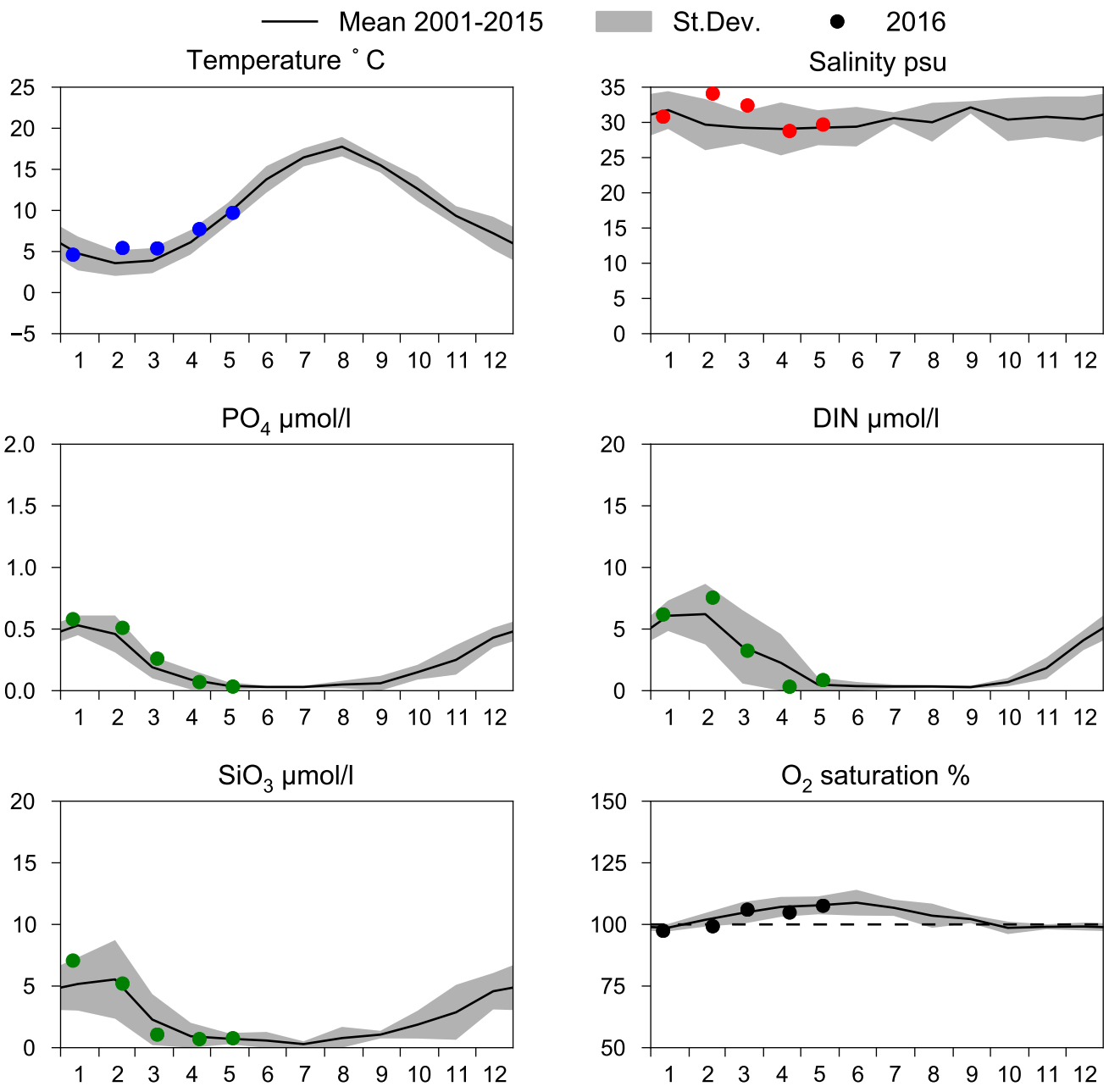
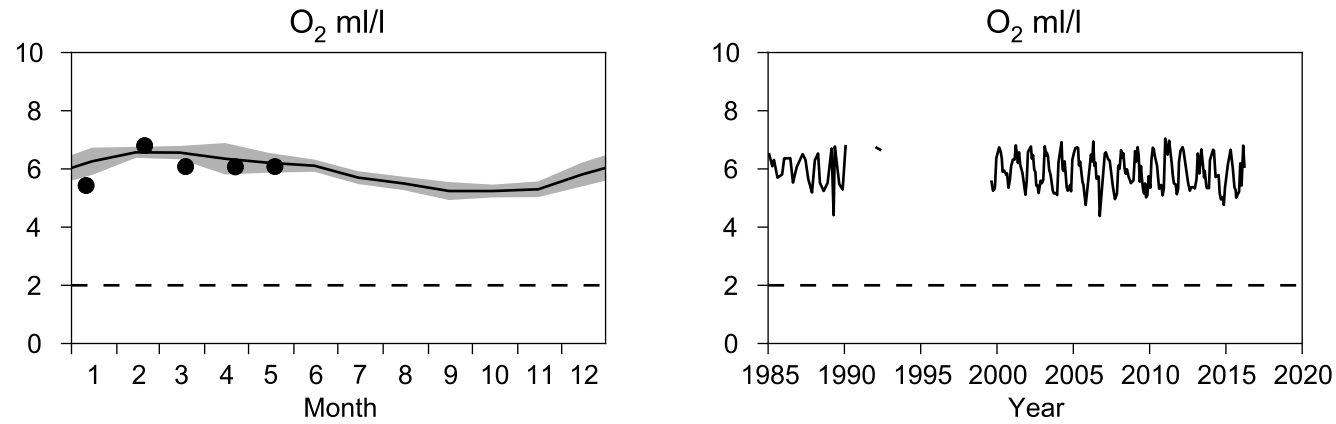


STATION Å15 SURFACE WATER (0-10m)

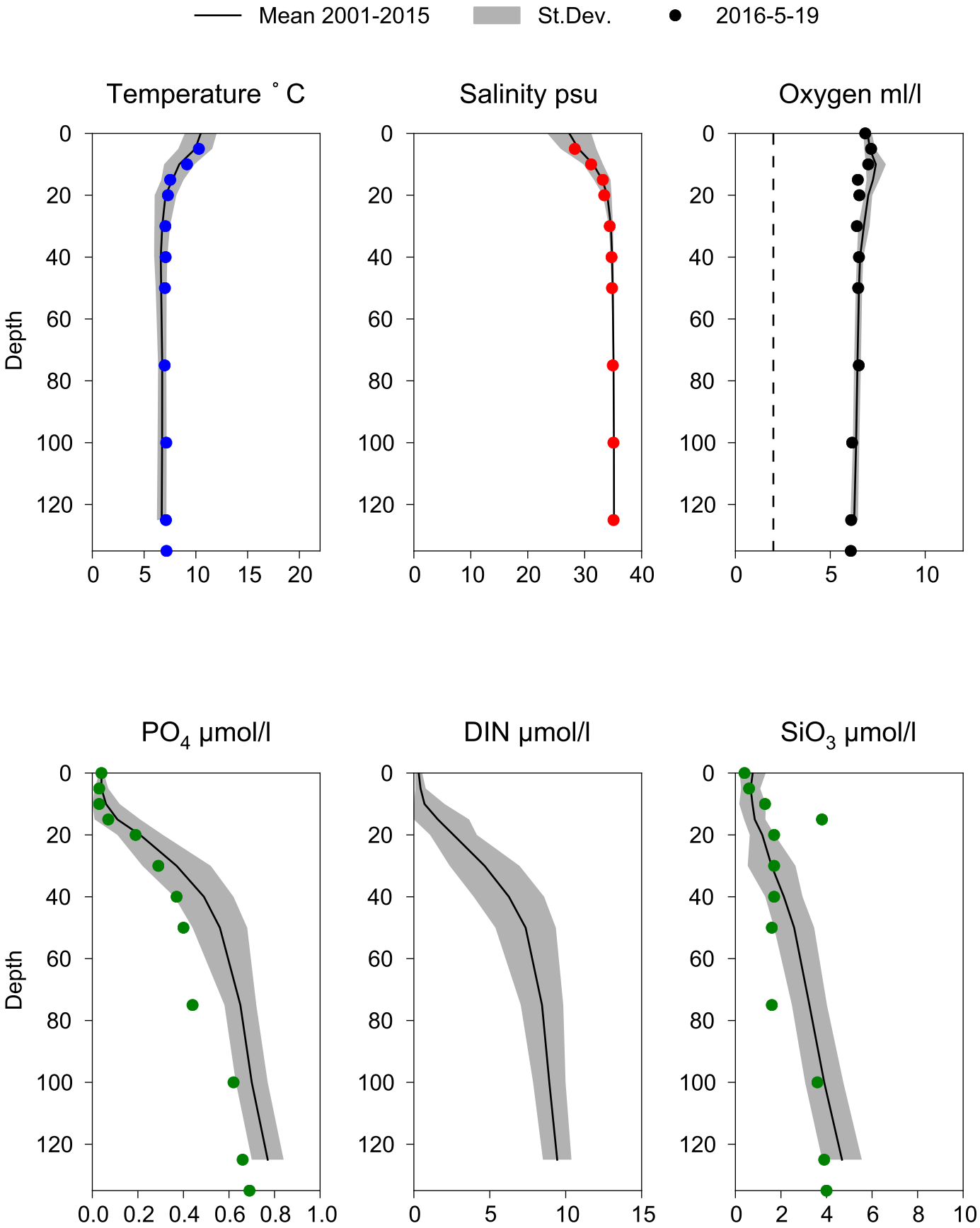
Annual Cycles



OXYGEN IN BOTTOM WATER (depth >= 125 m)

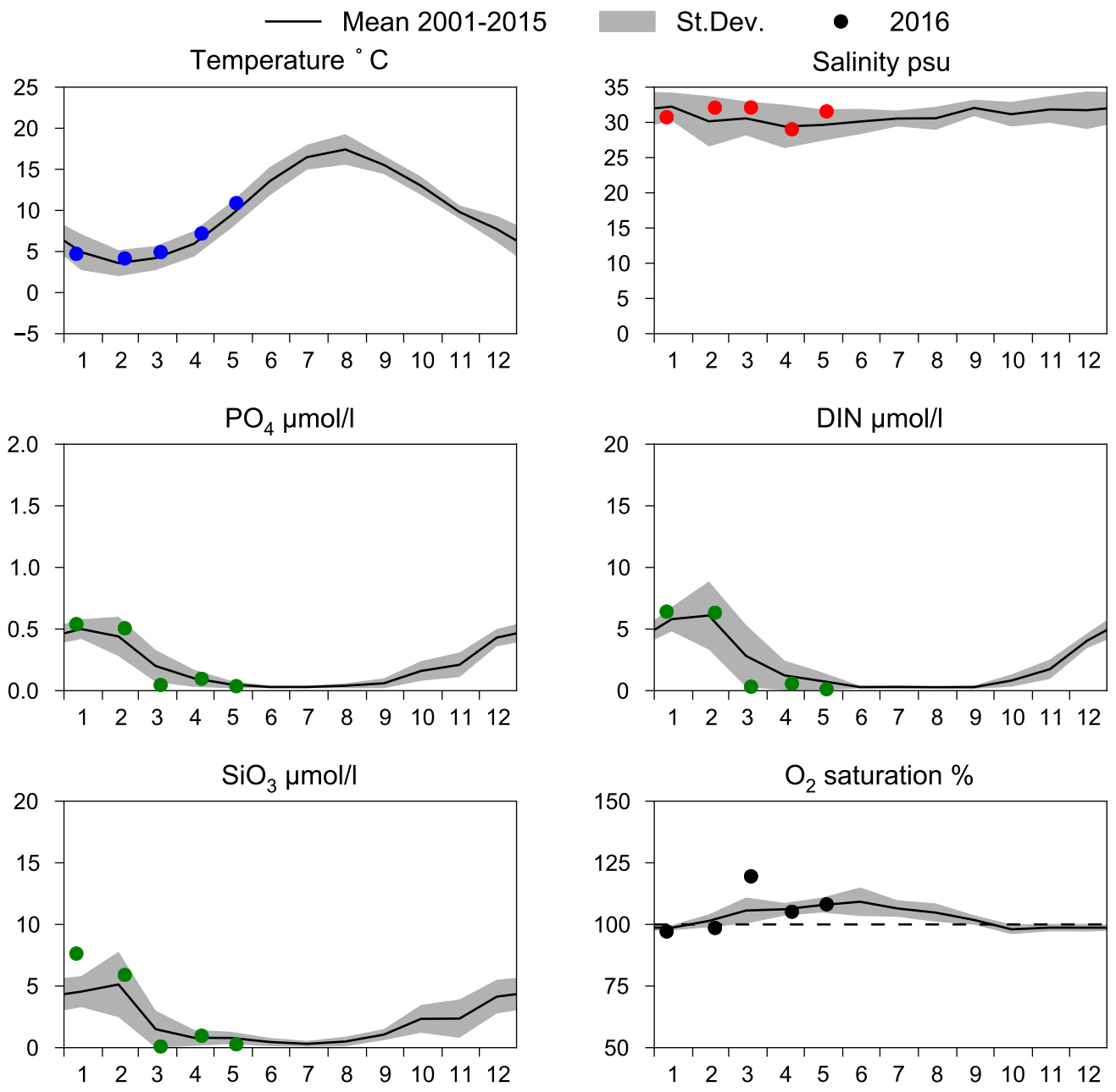


Vertical profiles Å15
May

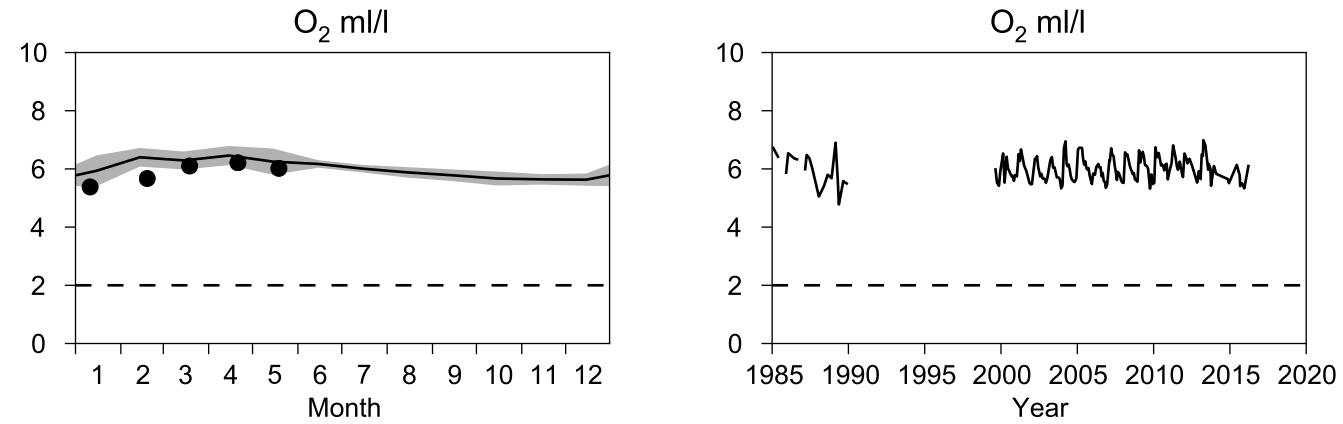


STATION Å17 SURFACE WATER (0-10m)

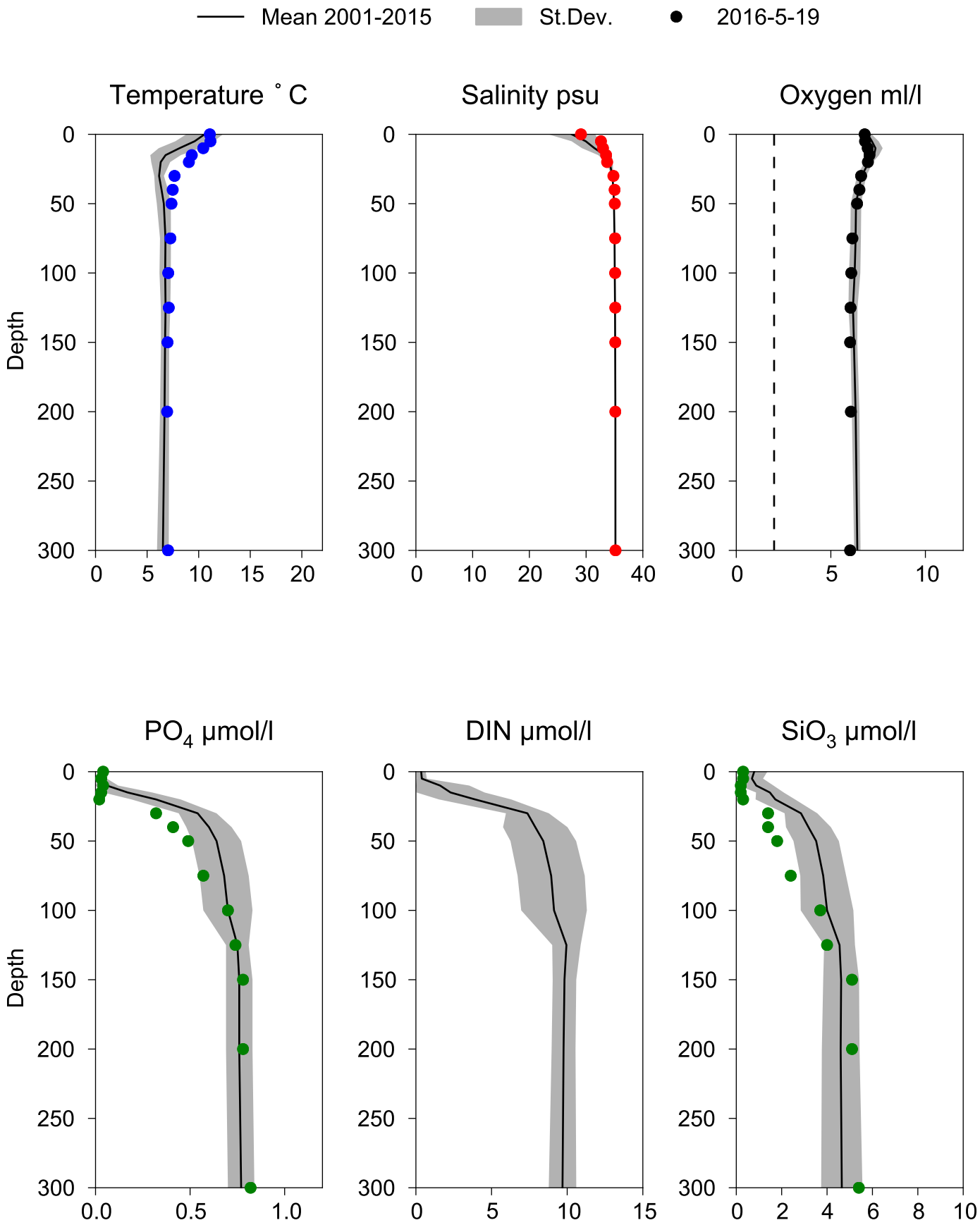
Annual Cycles



OXYGEN IN BOTTOM WATER (depth >= 300 m)

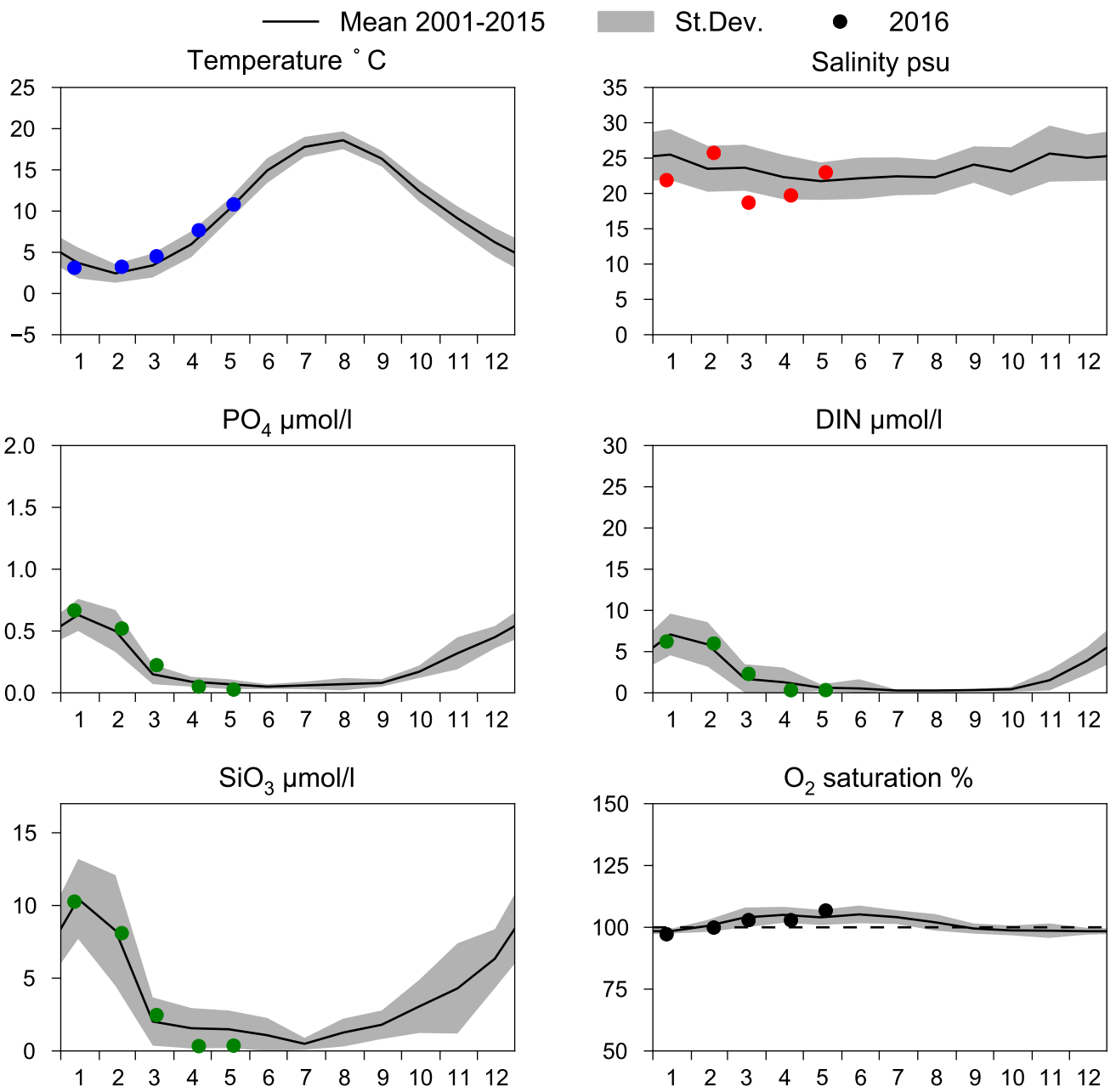


Vertical profiles Å17
May

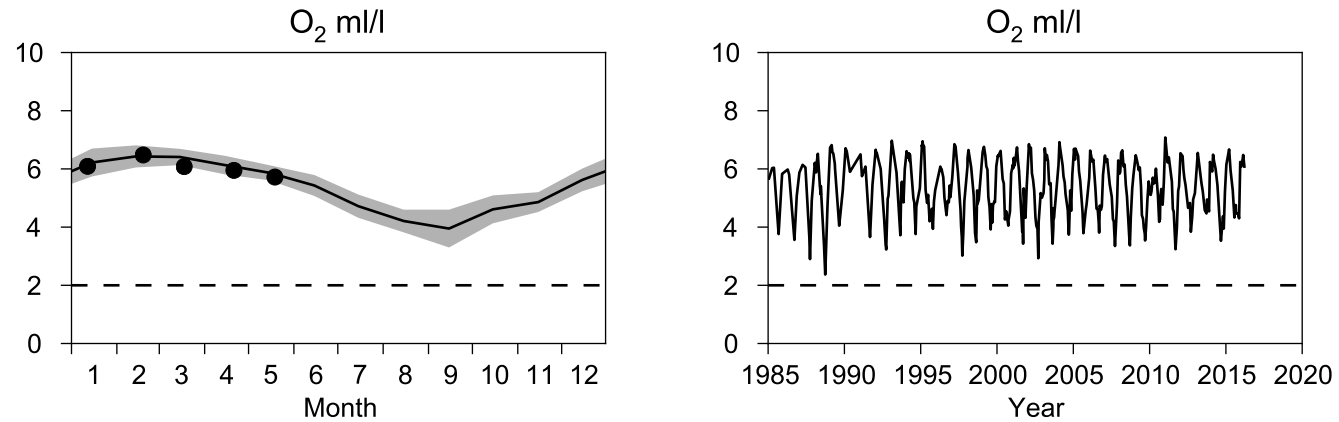


STATION FLADEN SURFACE WATER (0-10m)

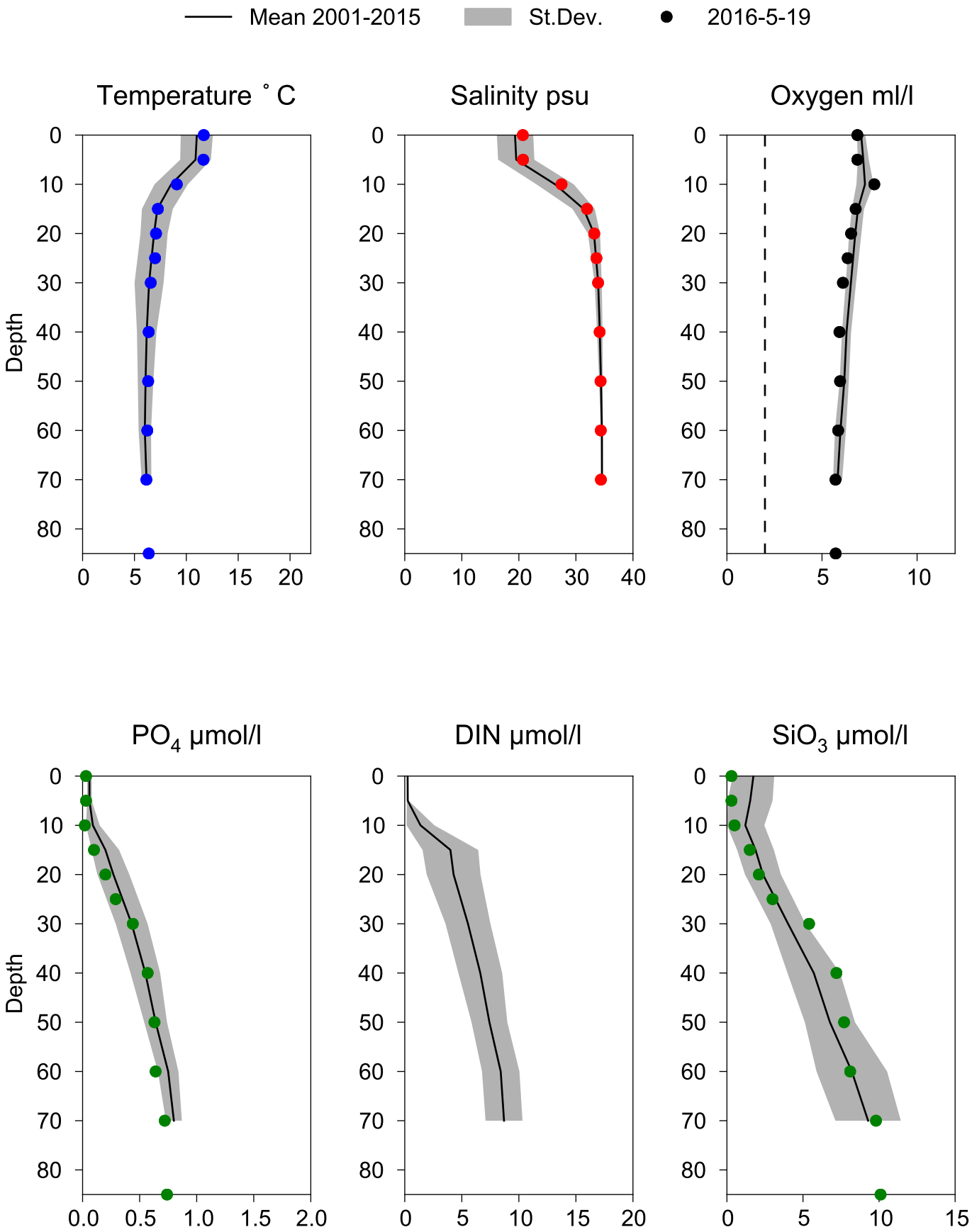
Annual Cycles



OXYGEN IN BOTTOM WATER (depth >= 65 m)

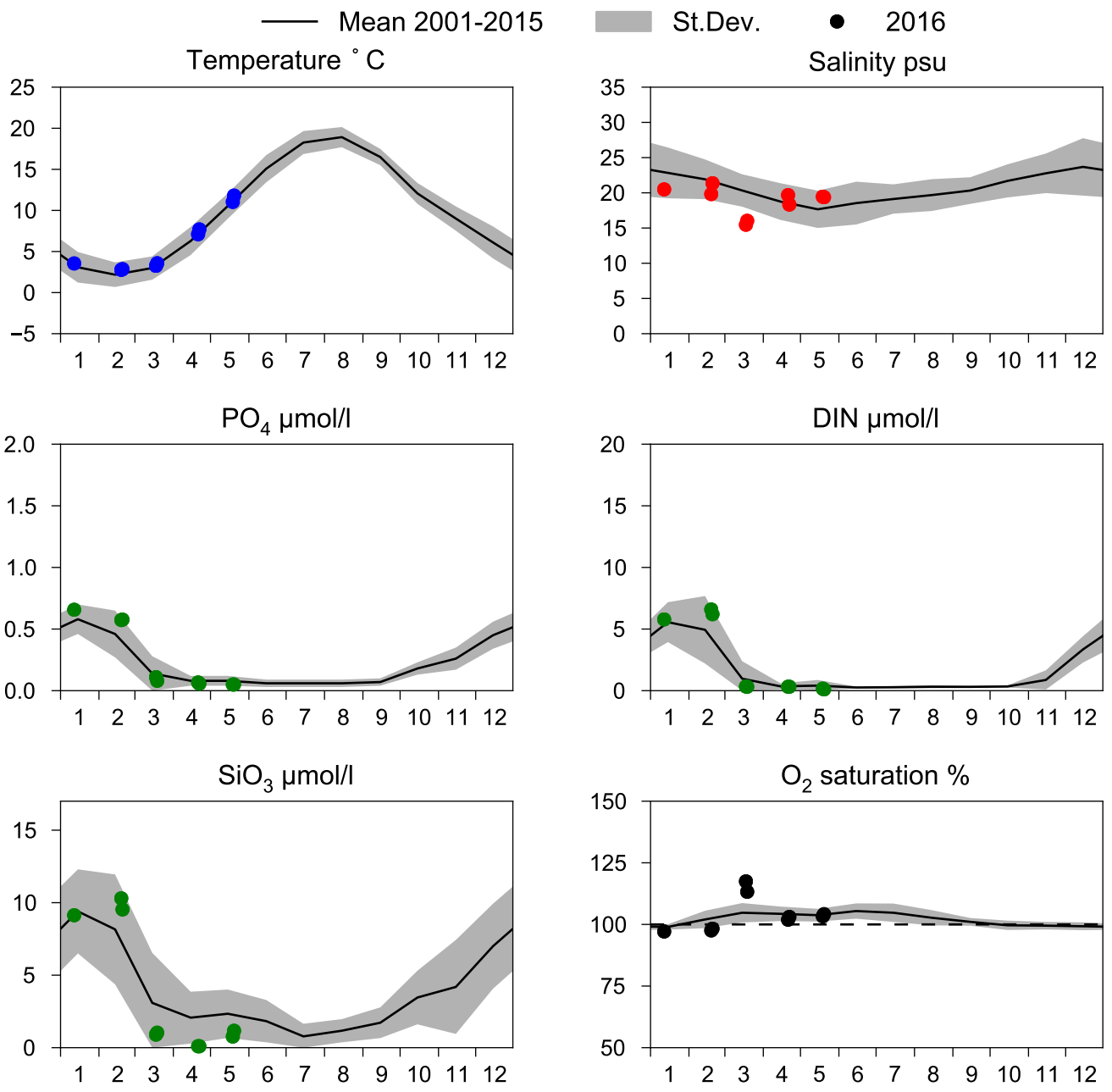


Vertical profiles FLADEN
May

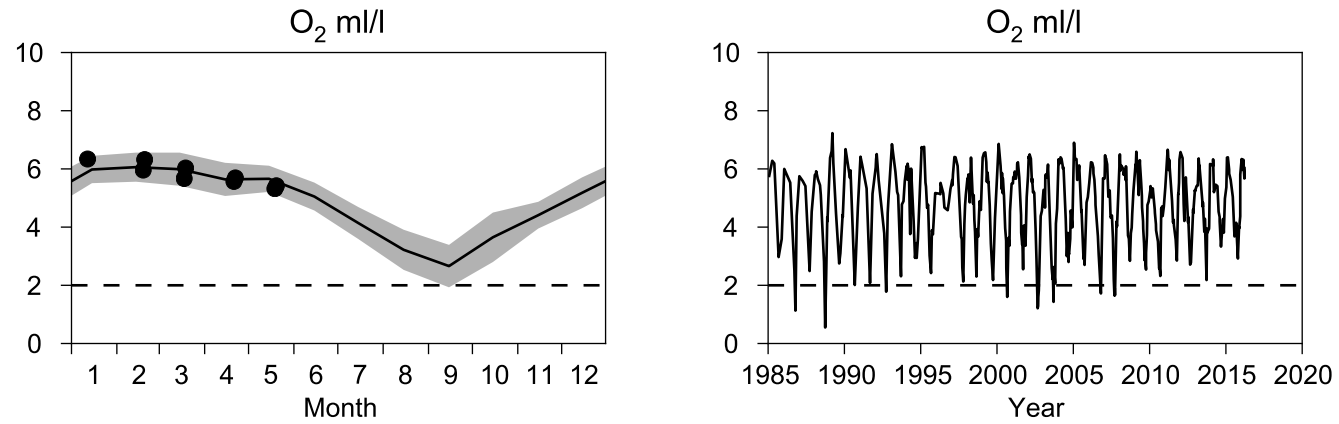


STATION ANHOLT E SURFACE WATER (0-10m)

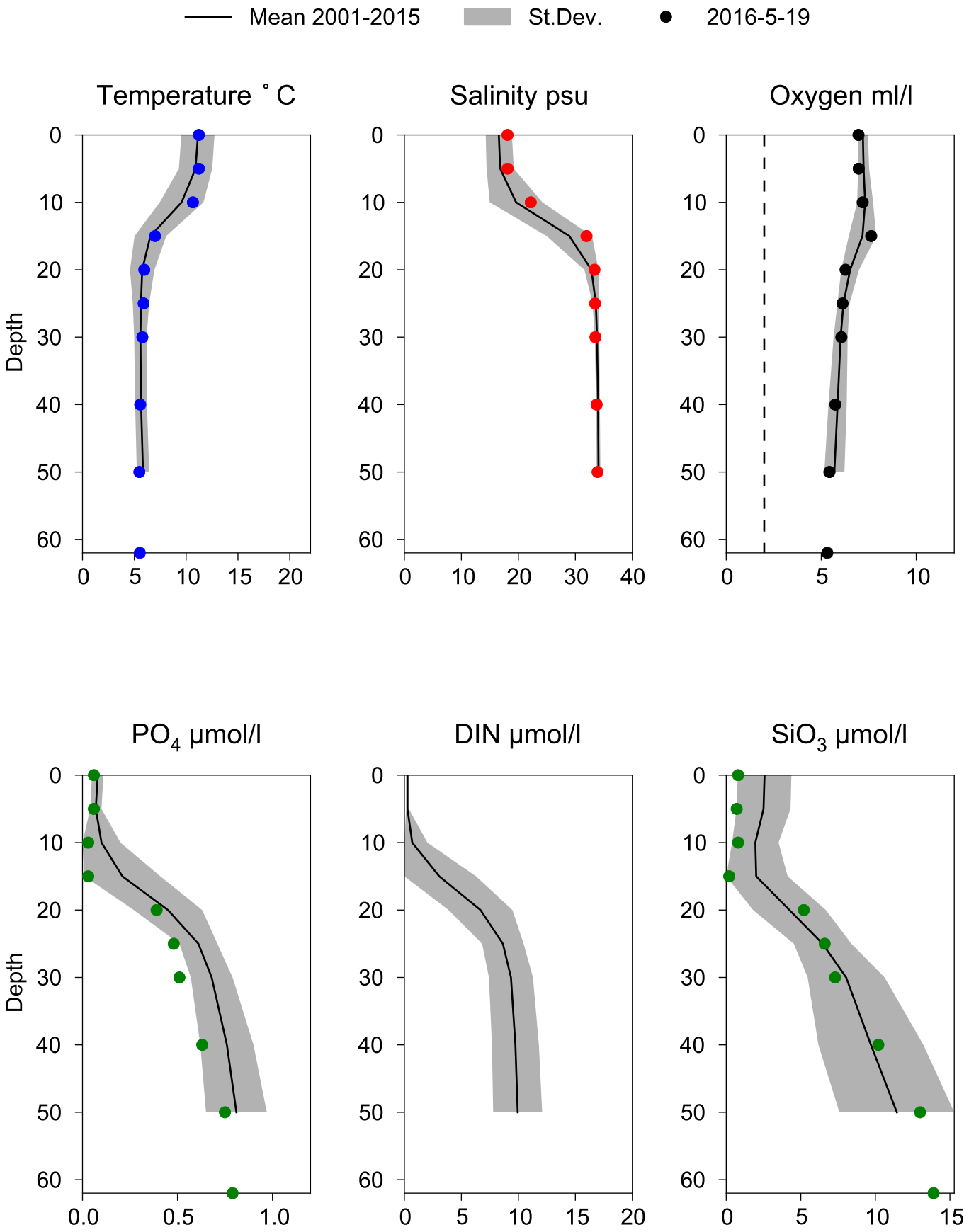
Annual Cycles



OXYGEN IN BOTTOM WATER (depth >= 45 m)

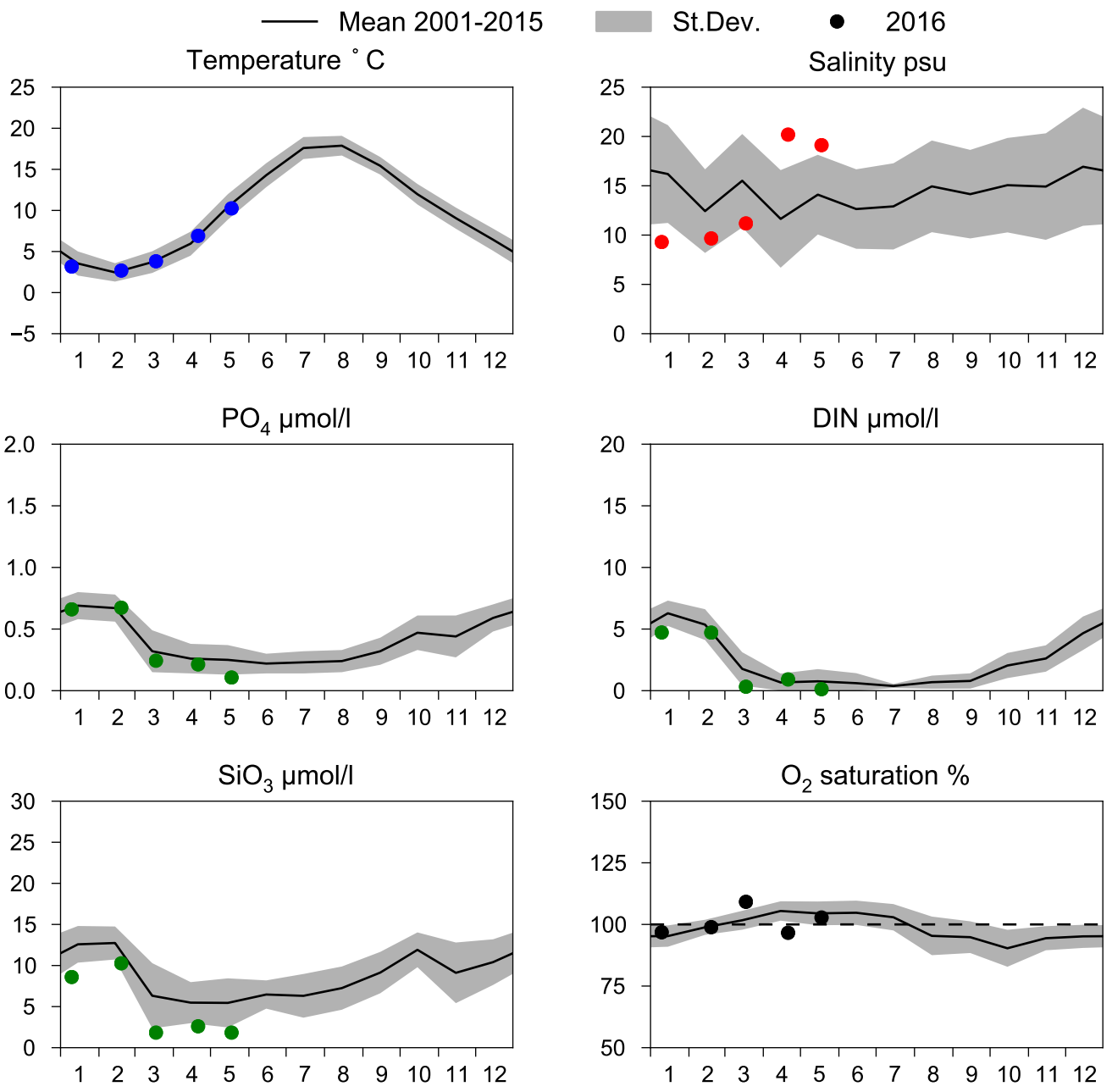


Vertical profiles ANHOLT E
May

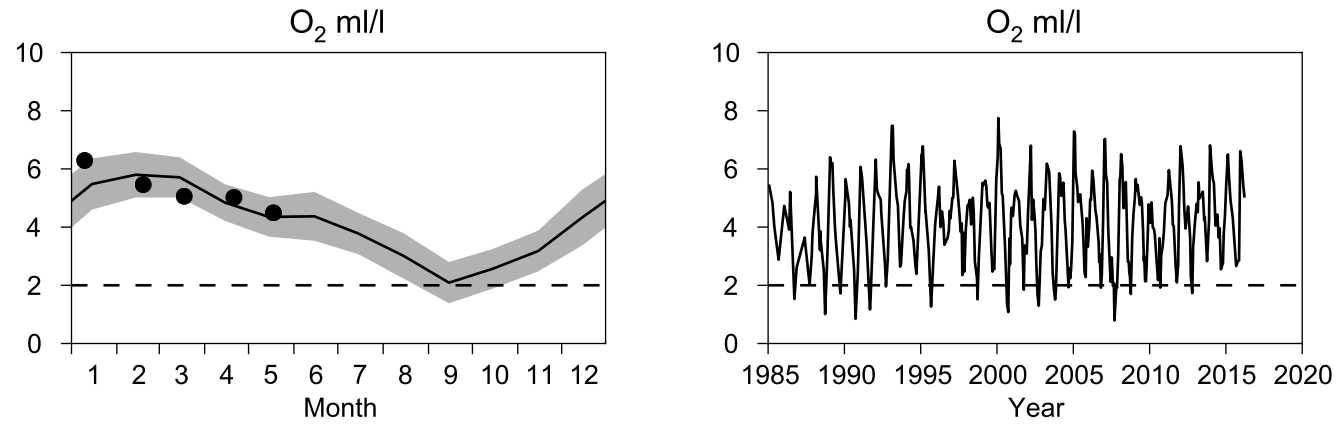


STATION W LANDSKRONA SURFACE WATER (0-10m)

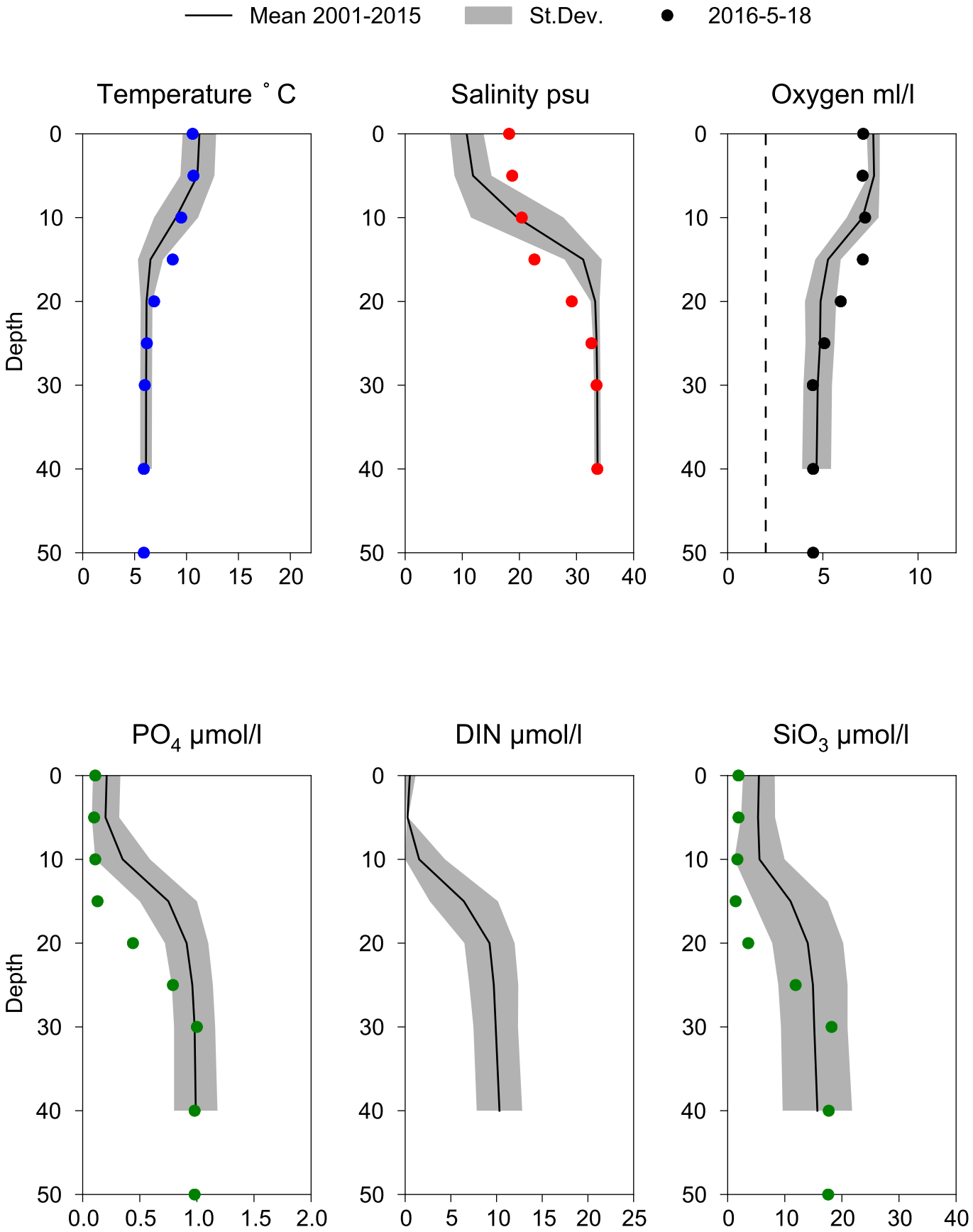
Annual Cycles



OXYGEN IN BOTTOM WATER (depth >= 40 m)

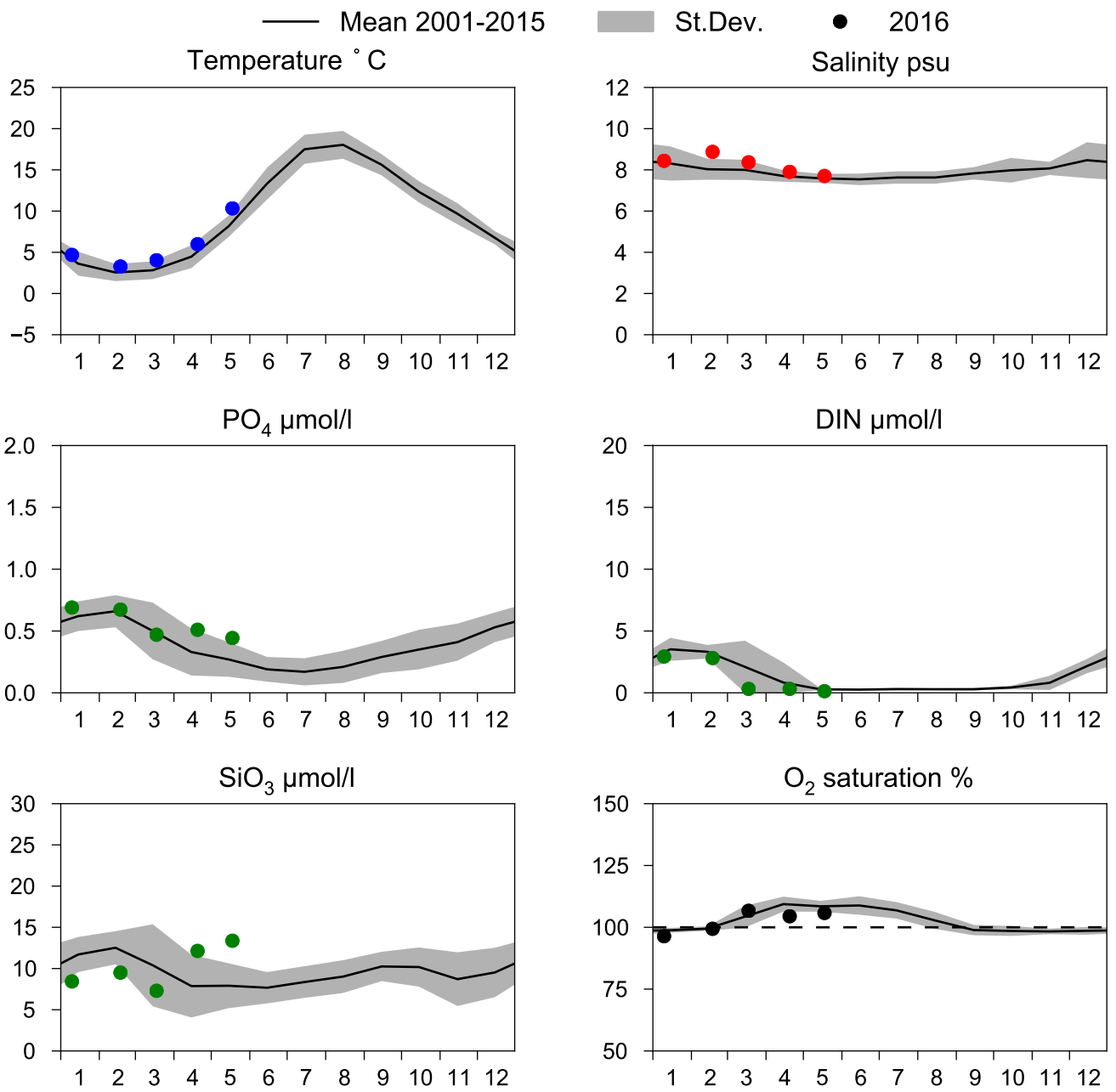


Vertical profiles W LANDSKRONA
May

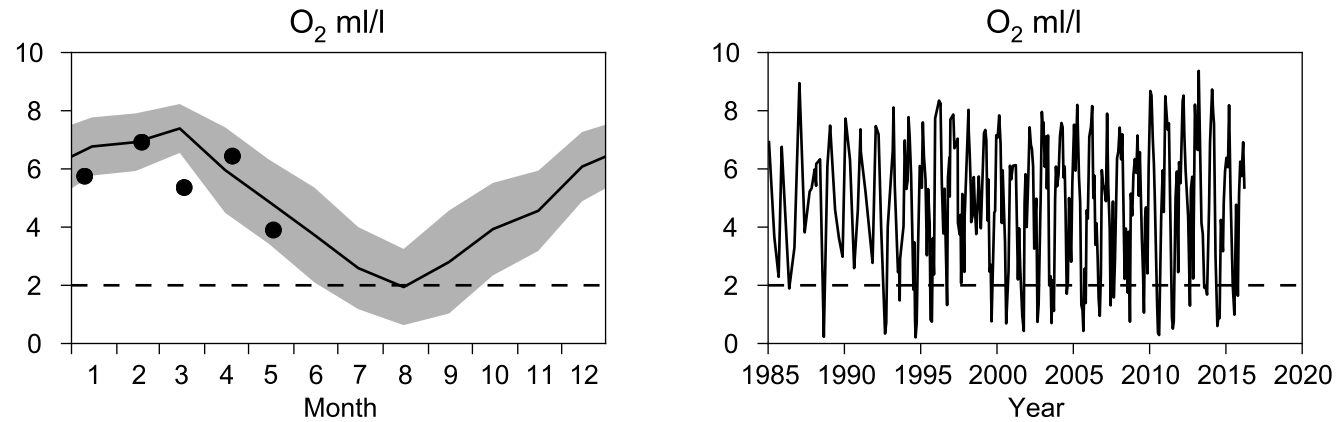


STATION BY1 SURFACE WATER (0-10m)

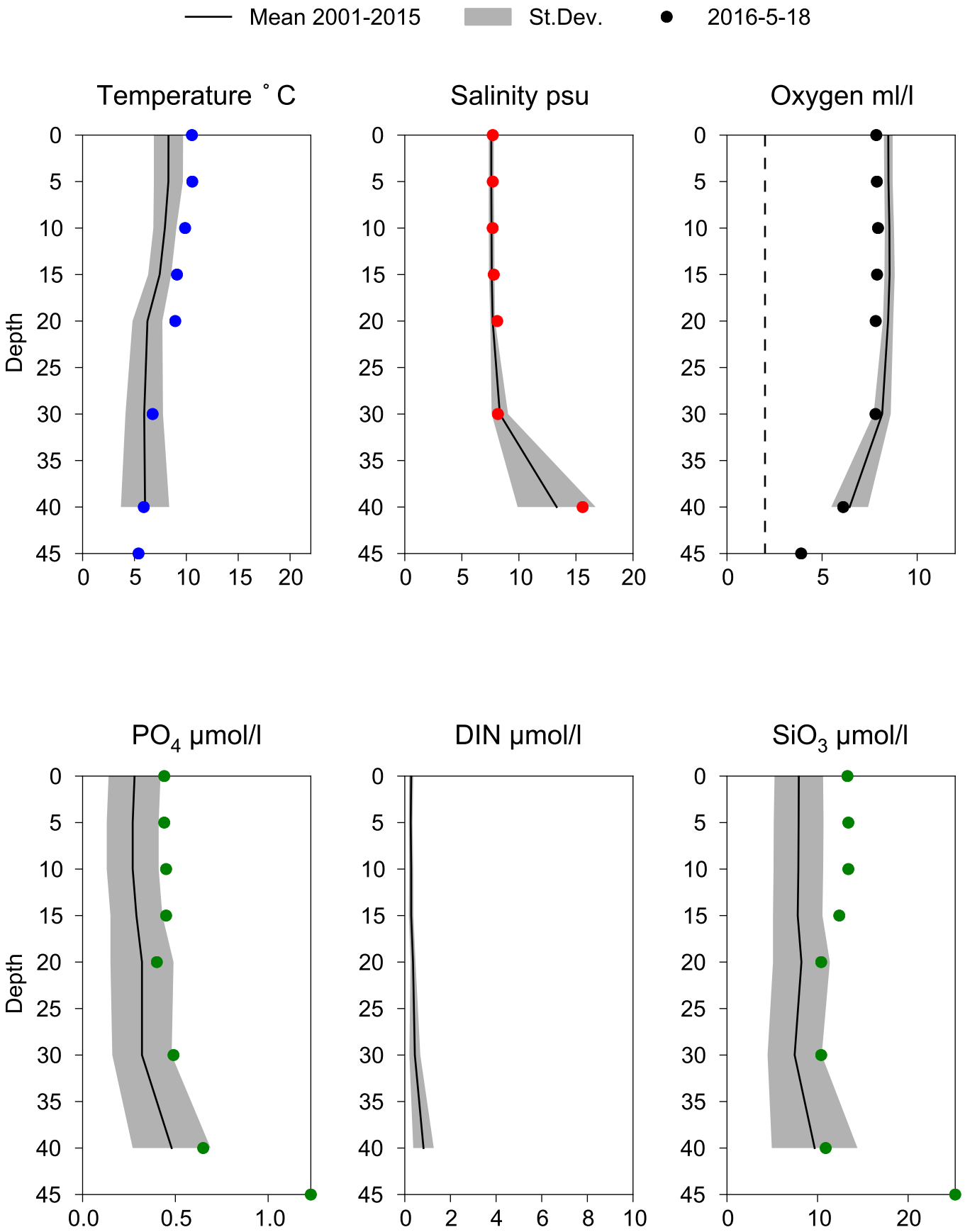
Annual Cycles



OXYGEN IN BOTTOM WATER (depth >= 40 m)

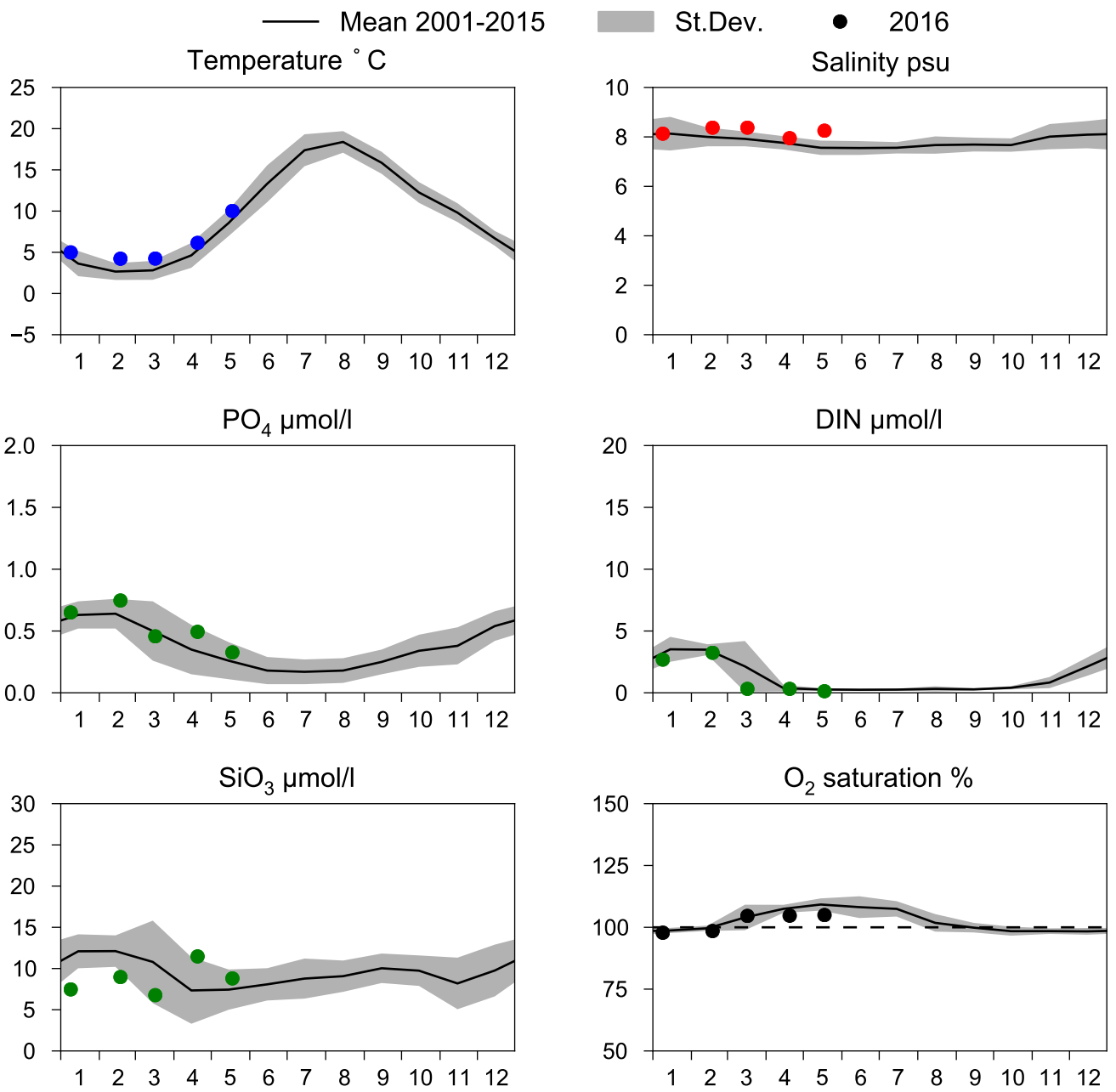


Vertical profiles BY1
May

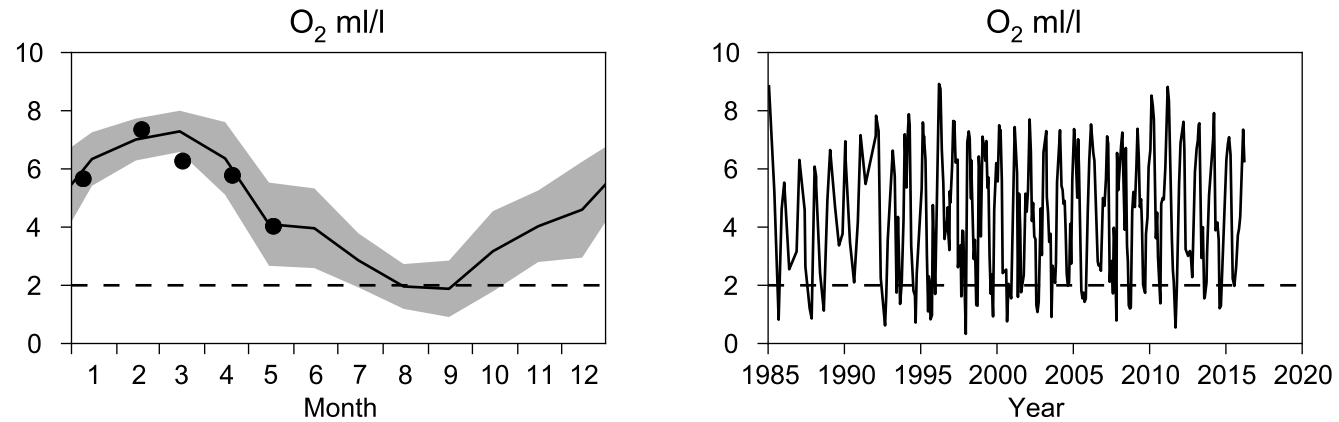


STATION BY2 ARKONA SURFACE WATER (0-10m)

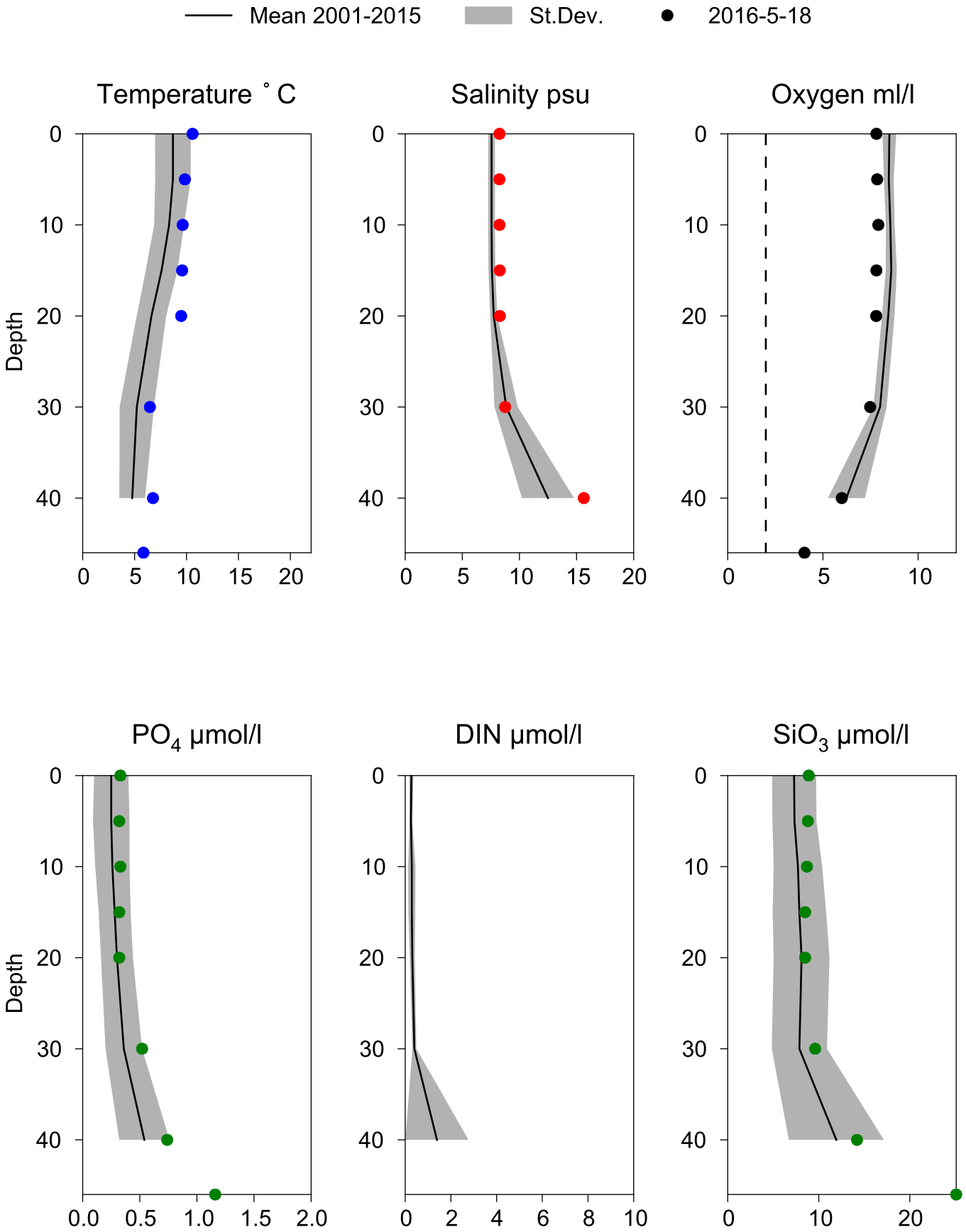
Annual Cycles



OXYGEN IN BOTTOM WATER (depth >= 40 m)

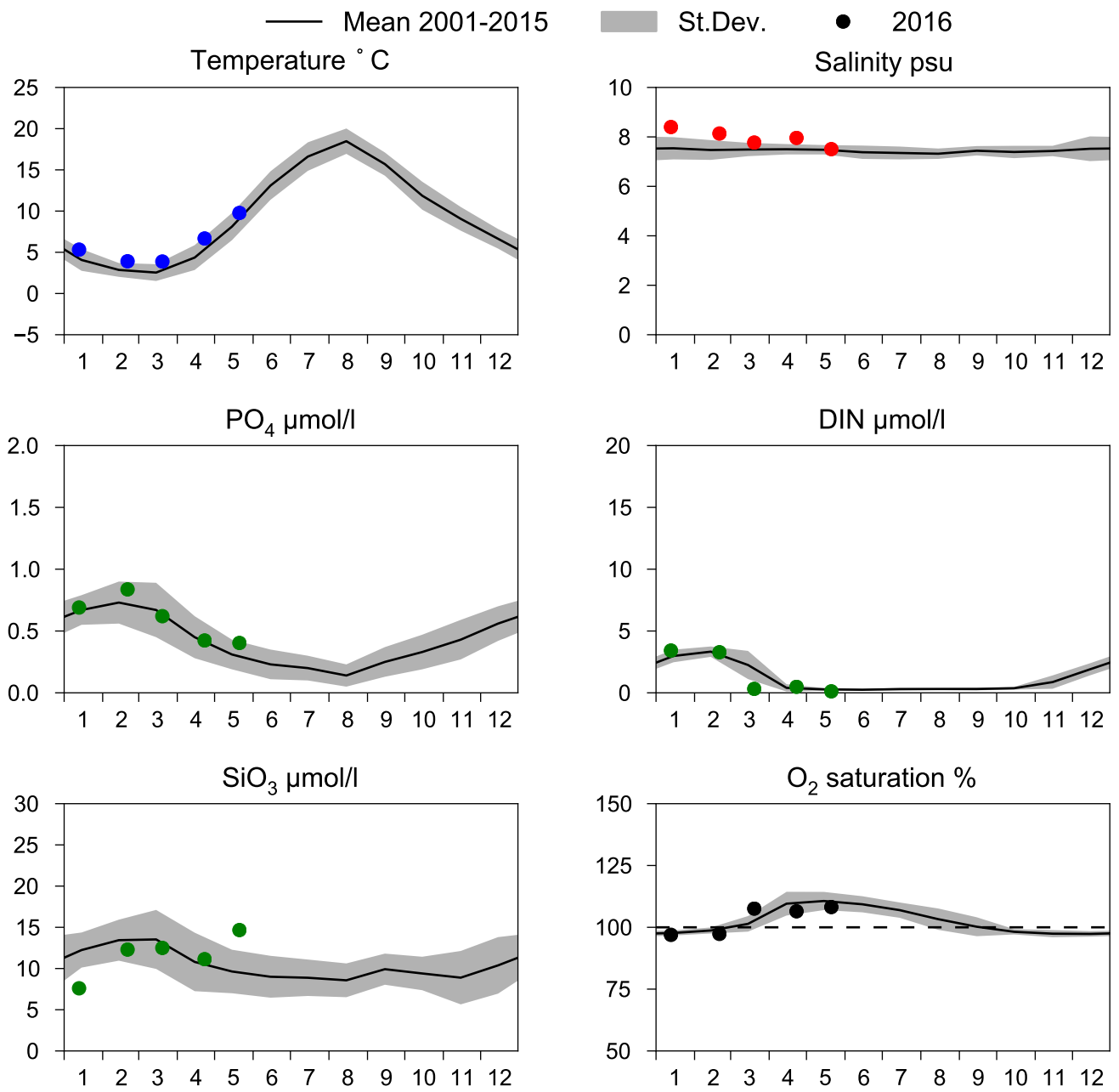


Vertical profiles BY2 ARKONA
May

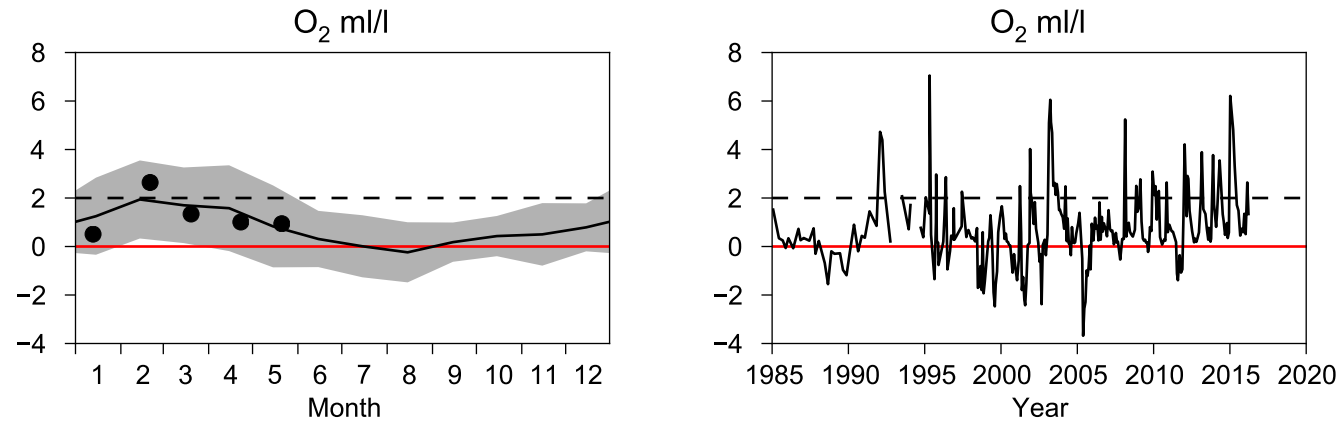


STATION HANÖBUKTEN SURFACE WATER (0-10m)

Annual Cycles

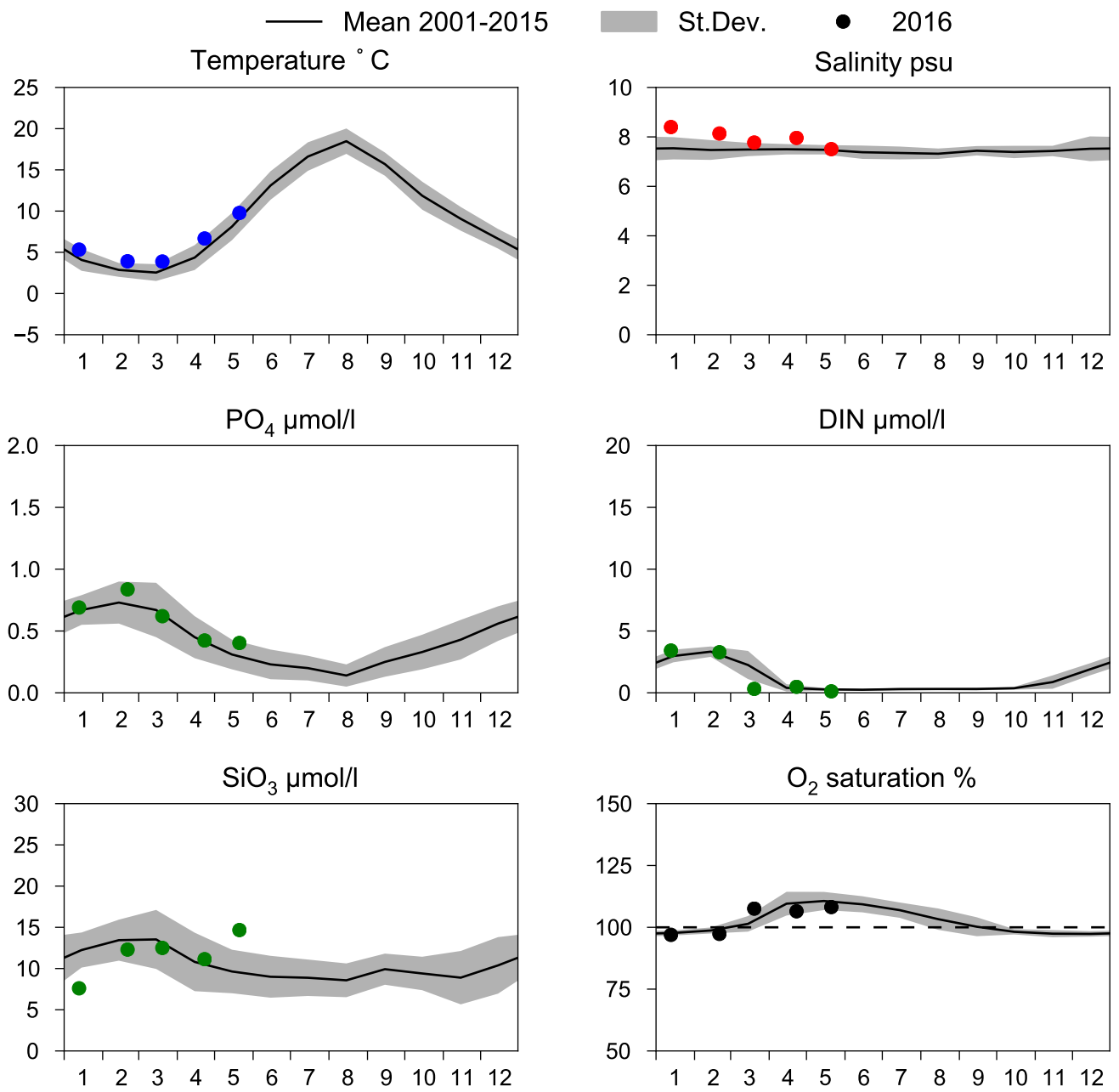


OXYGEN IN BOTTOM WATER (depth >= 70 m)

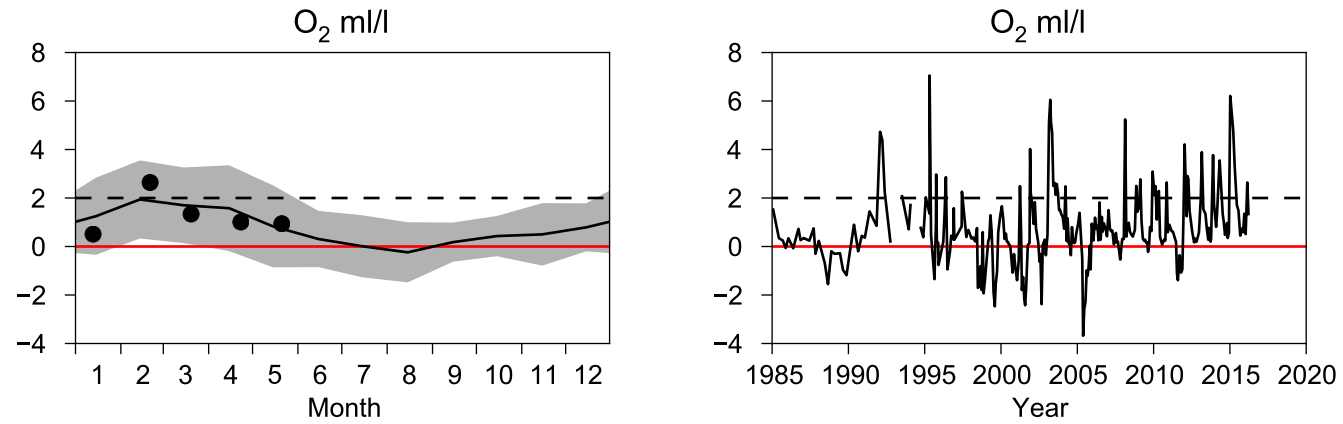


STATION HANÖBUKTEN SURFACE WATER (0-10m)

Annual Cycles

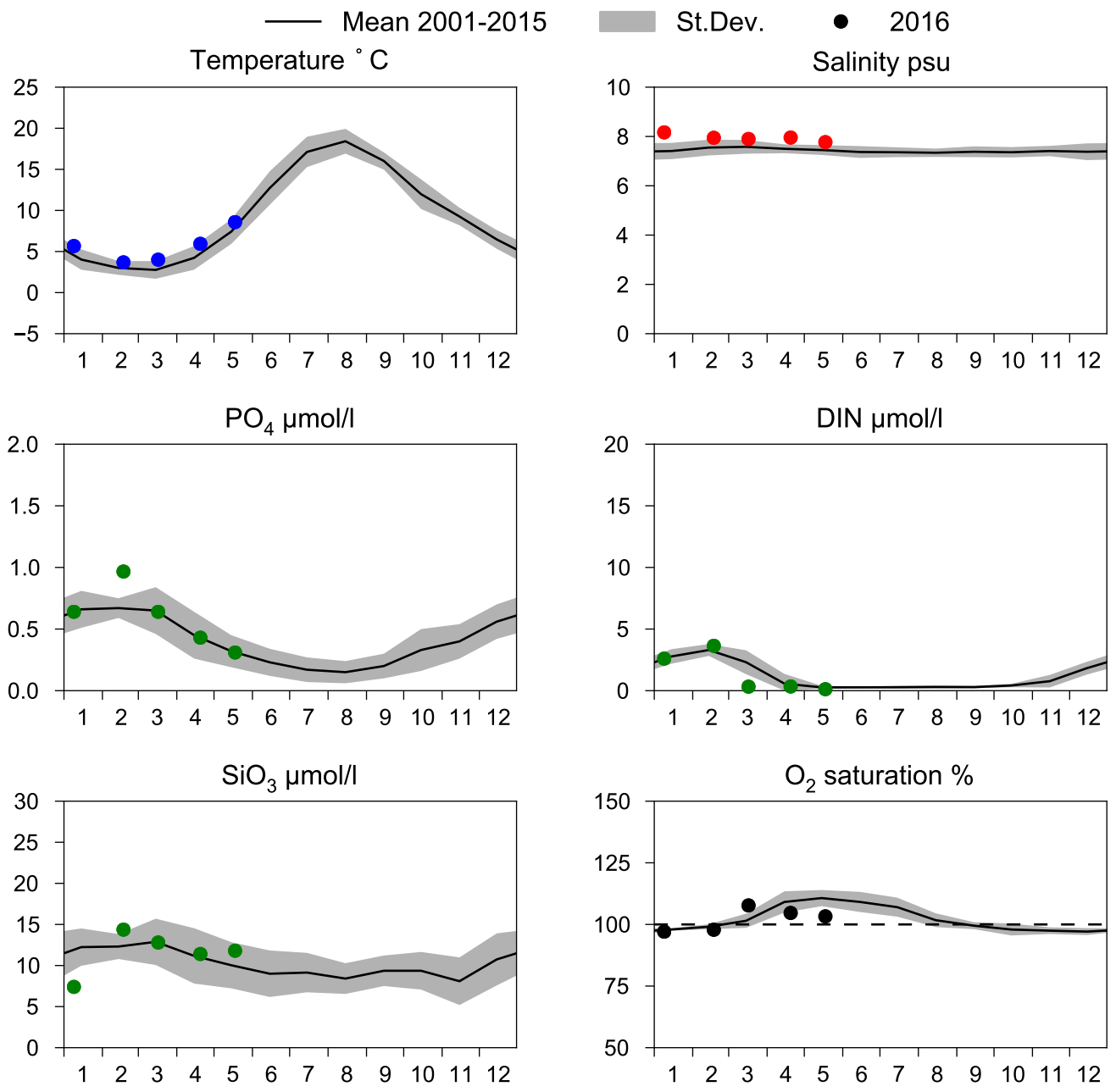


OXYGEN IN BOTTOM WATER (depth >= 70 m)

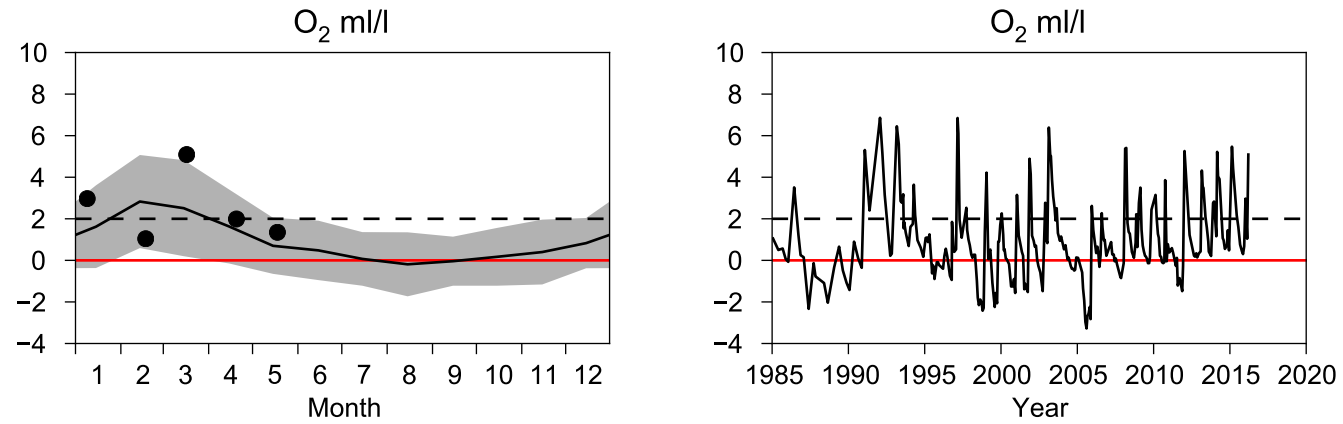


STATION BY4 CHRISTIANSÖ SURFACE WATER (0-10m)

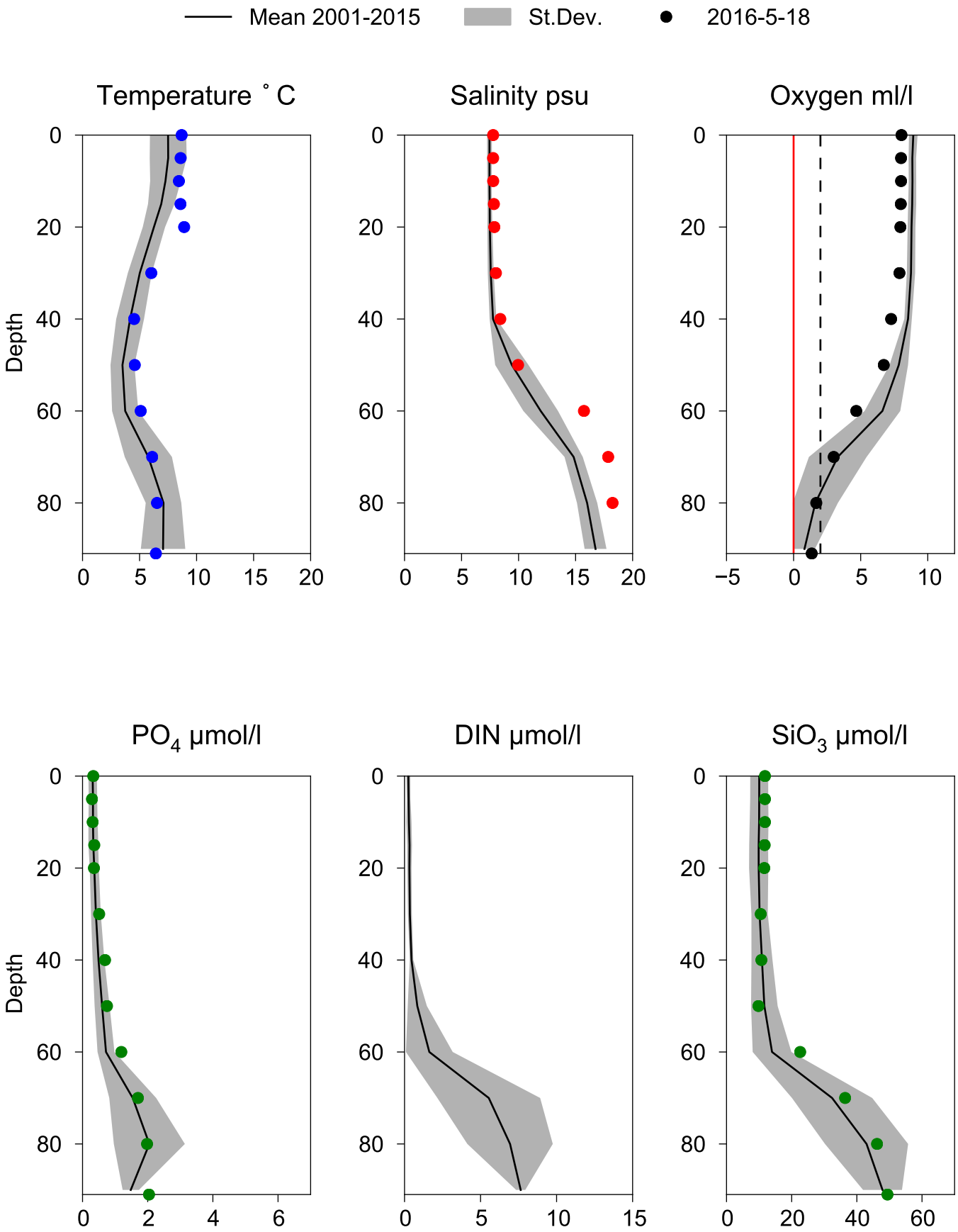
Annual Cycles



OXYGEN IN BOTTOM WATER (depth >= 80 m)

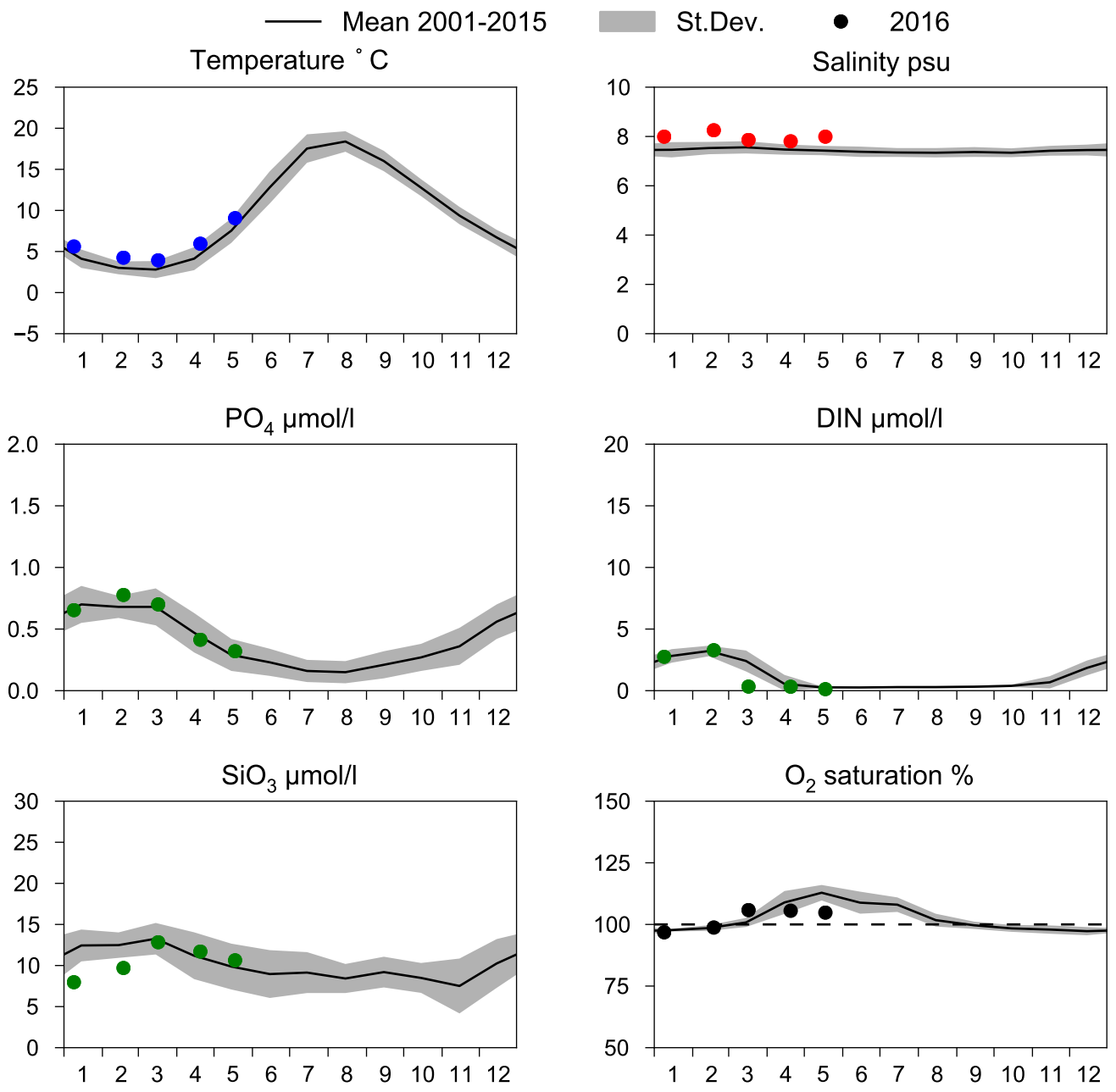


Vertical profiles BY4 CHRISTIANSÖ
May

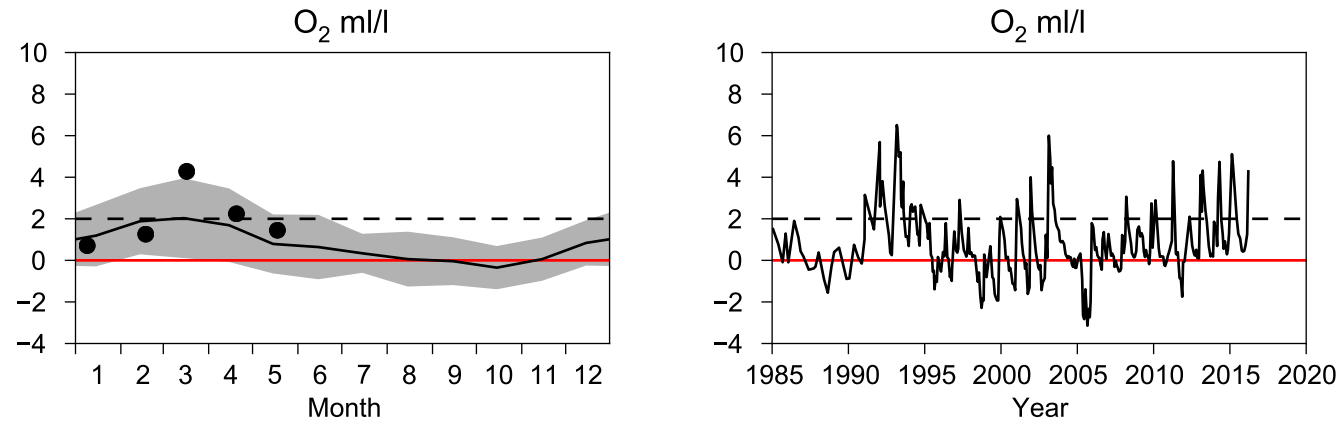


STATION BY5 BORNHOLMSDJ SURFACE WATER (0-10m)

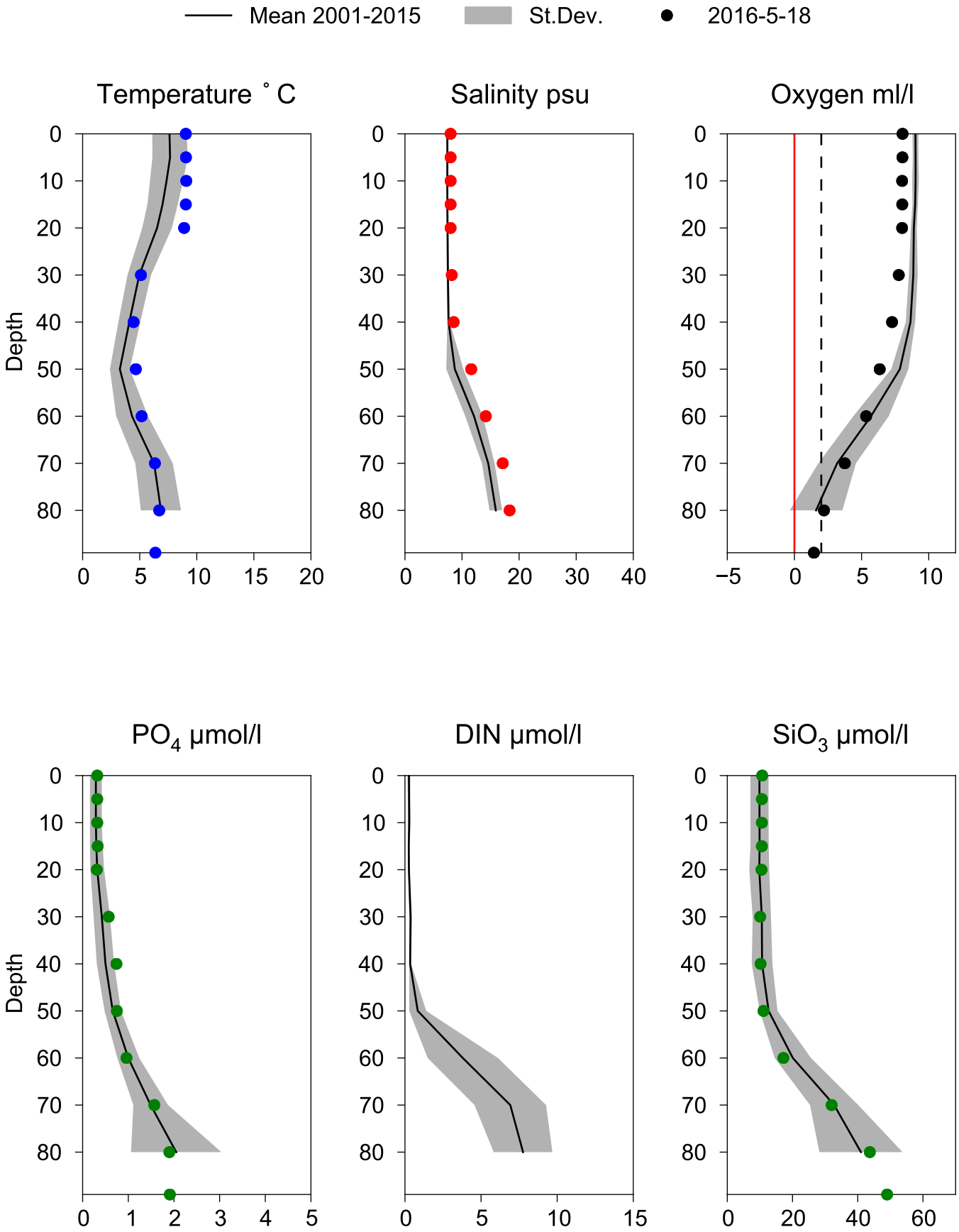
Annual Cycles



OXYGEN IN BOTTOM WATER (depth >= 80 m)

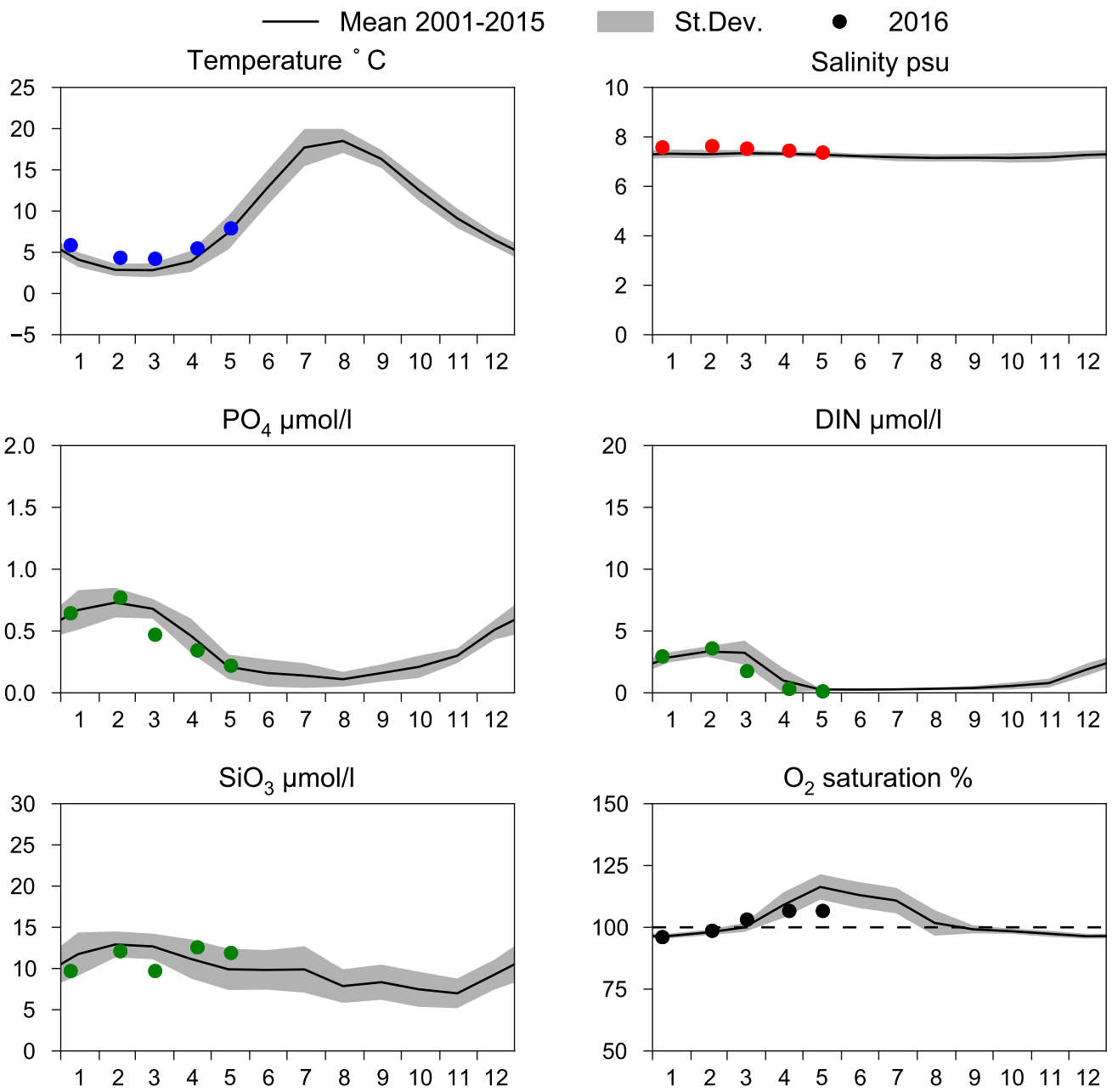


Vertical profiles BY5 BORNHOLMSDJ
May

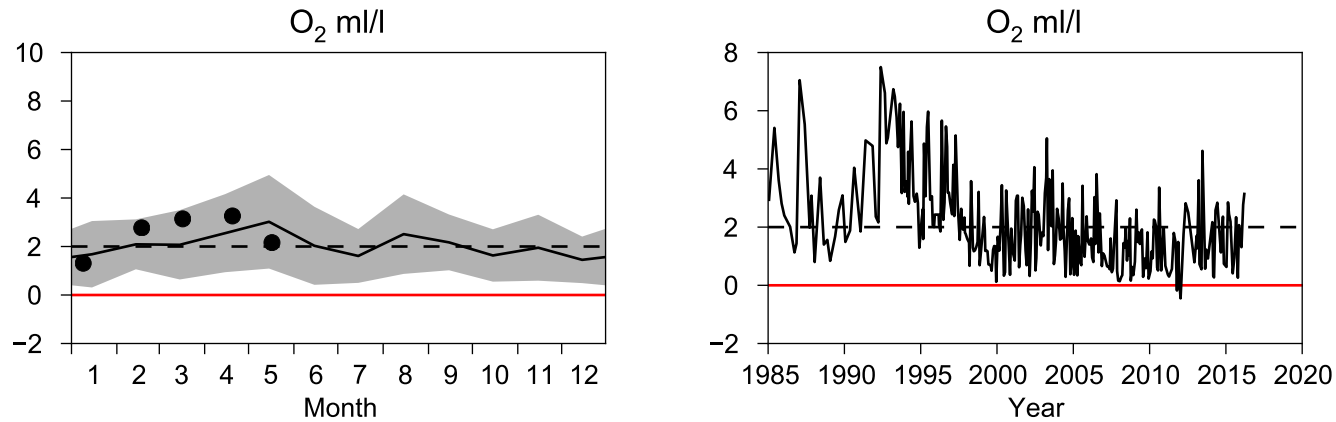


STATION BCS III-10 SURFACE WATER (0-10m)

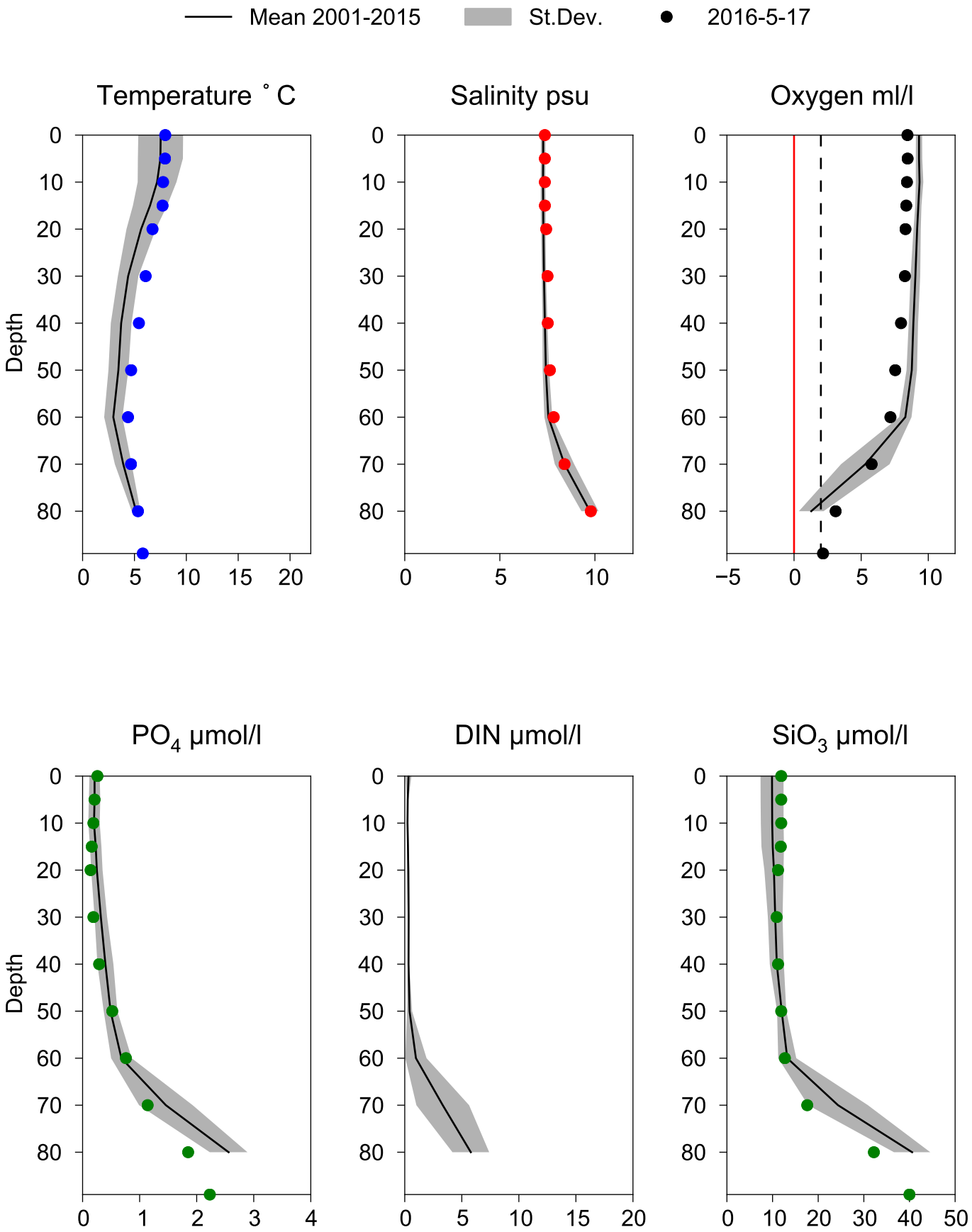
Annual Cycles



OXYGEN IN BOTTOM WATER (depth >= 80 m)

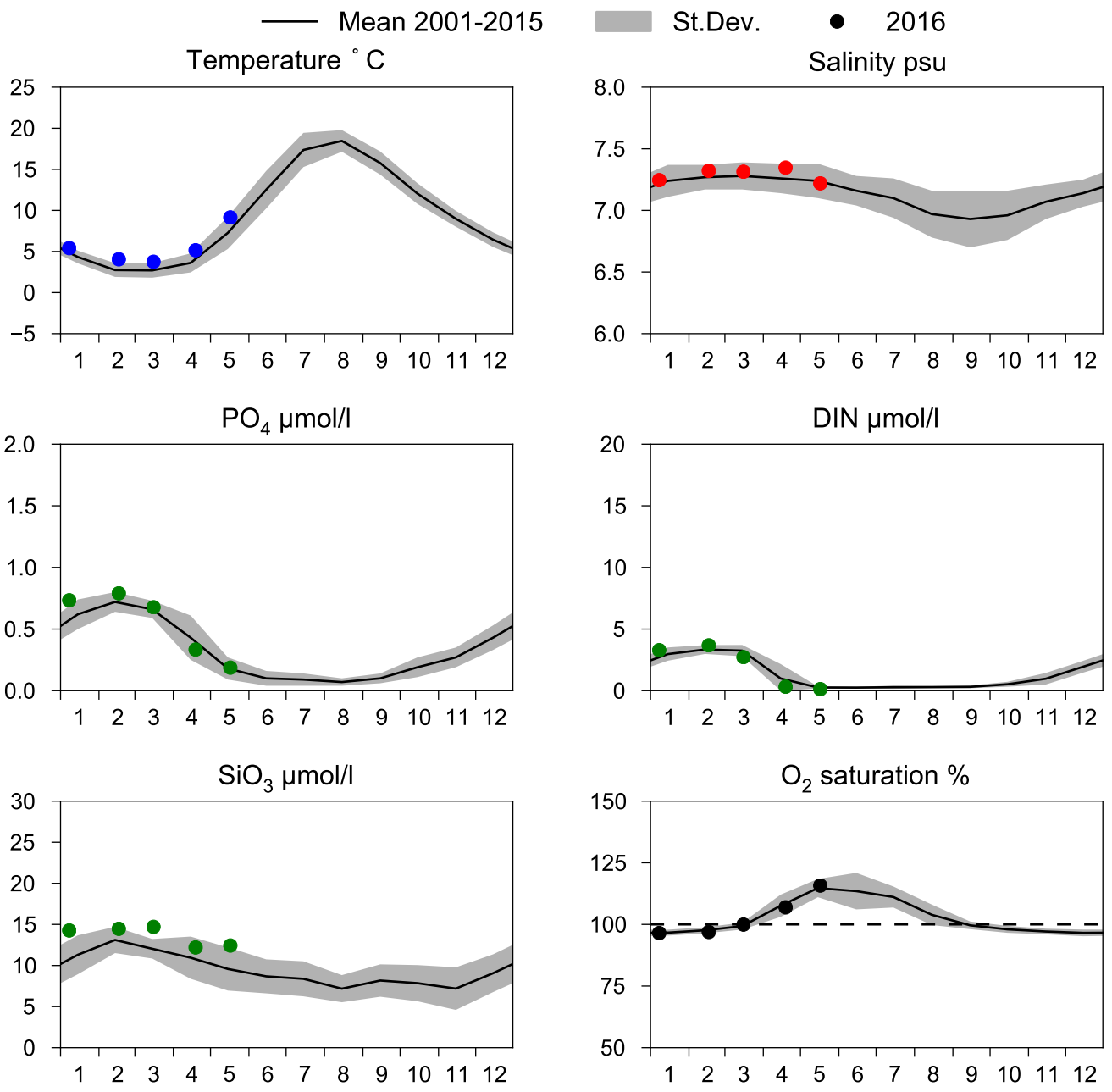


Vertical profiles BCS III-10
May

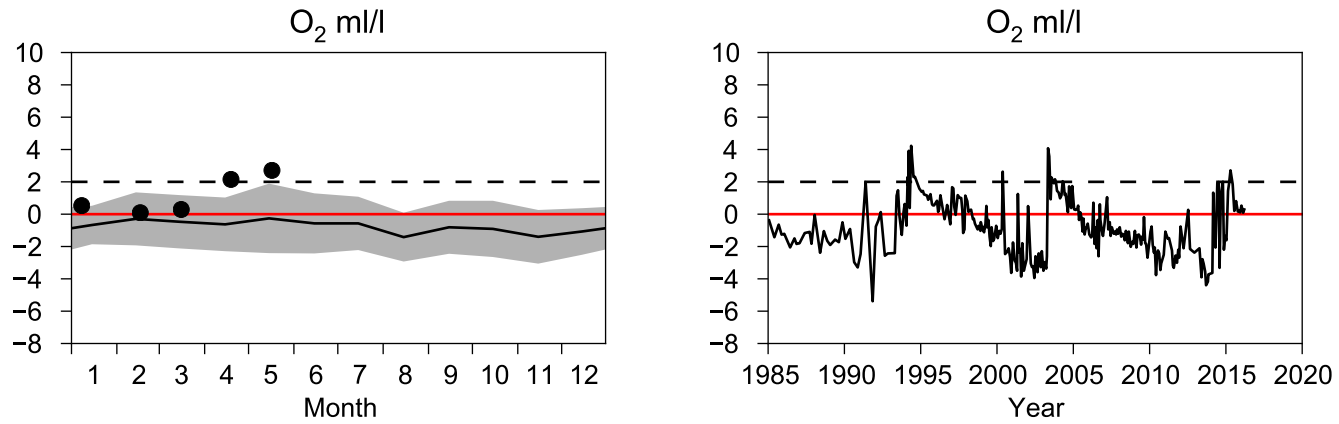


STATION BY10 SURFACE WATER (0-10m)

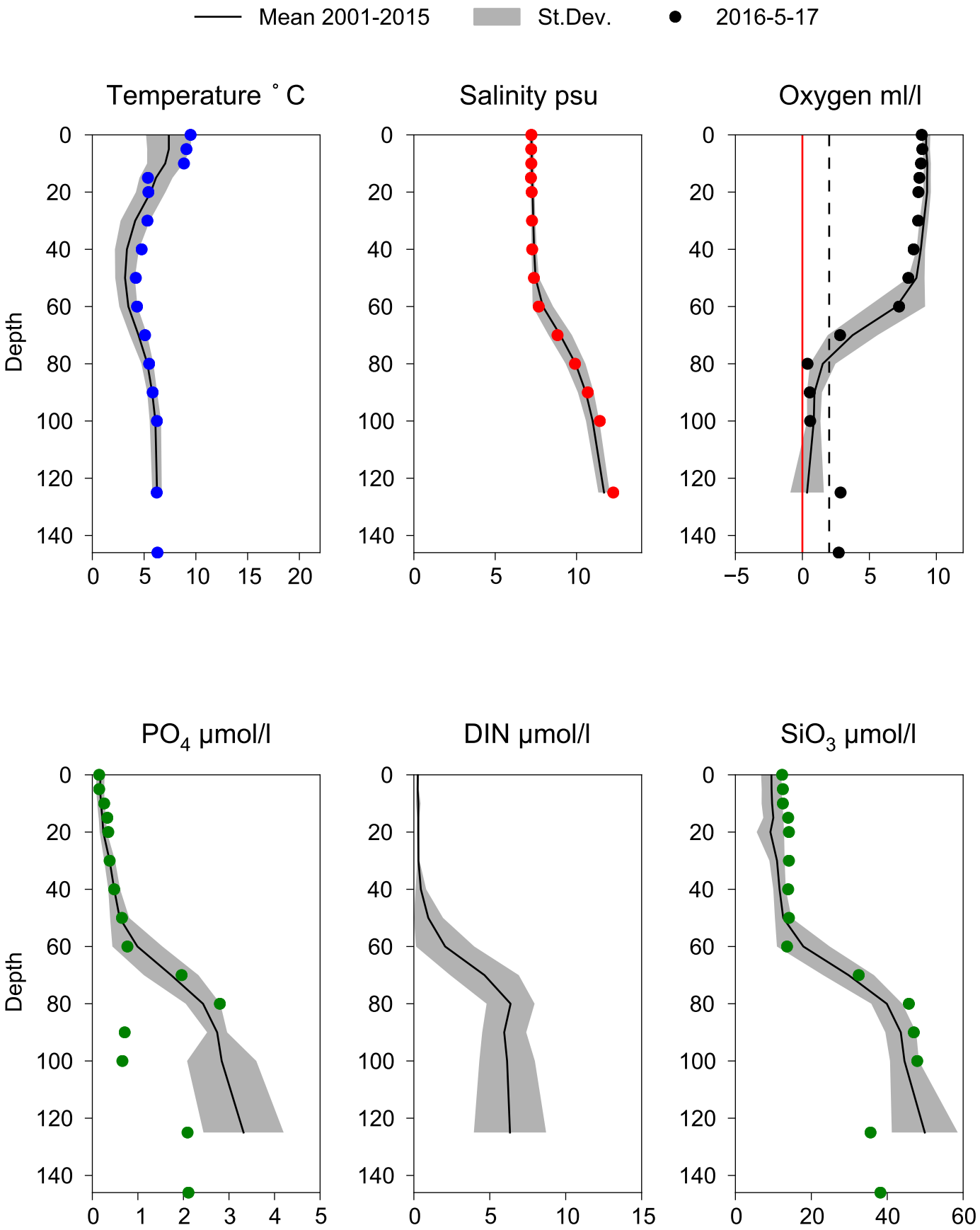
Annual Cycles



OXYGEN IN BOTTOM WATER (depth >= 125 m)

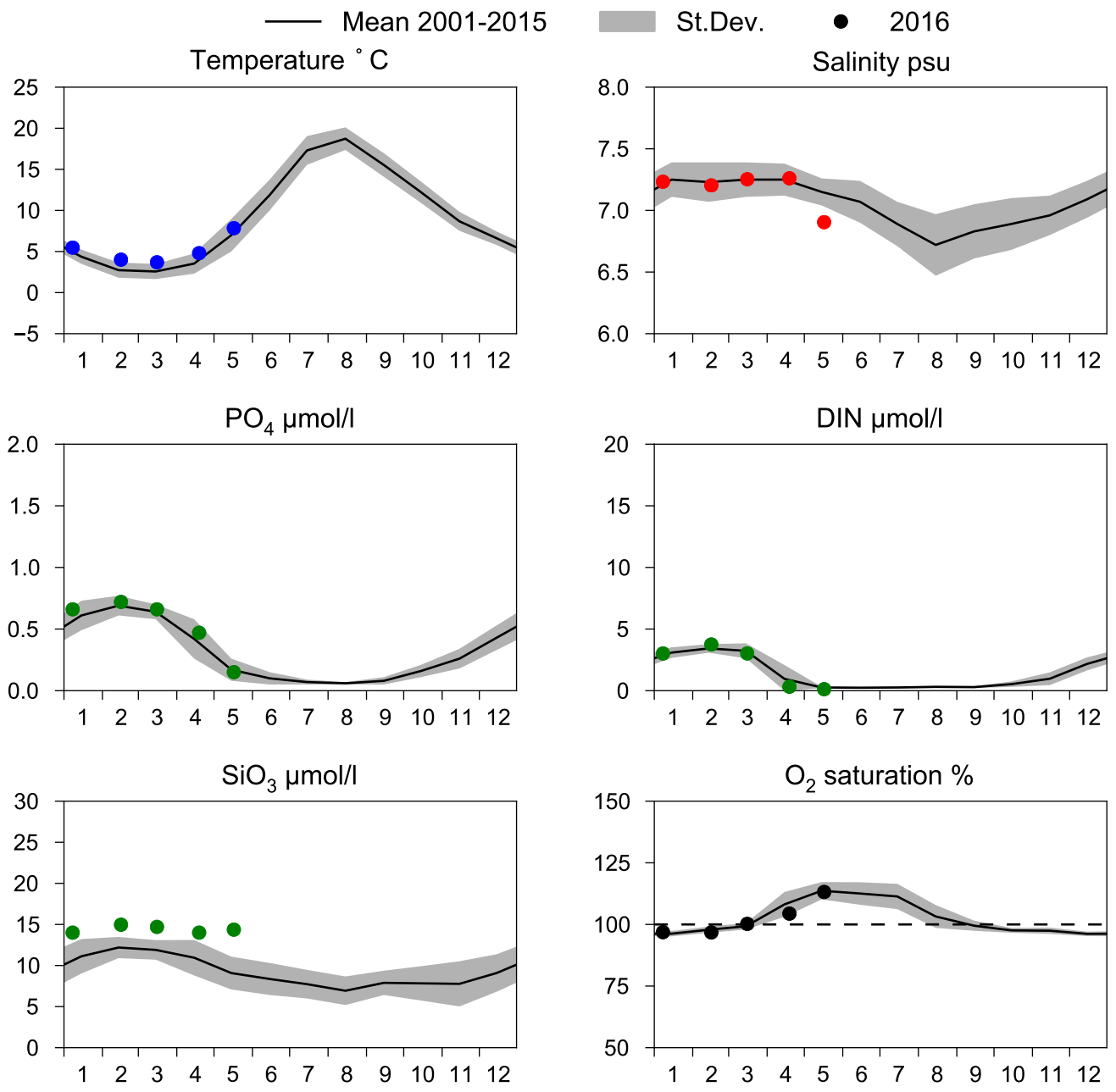


Vertical profiles BY10
May

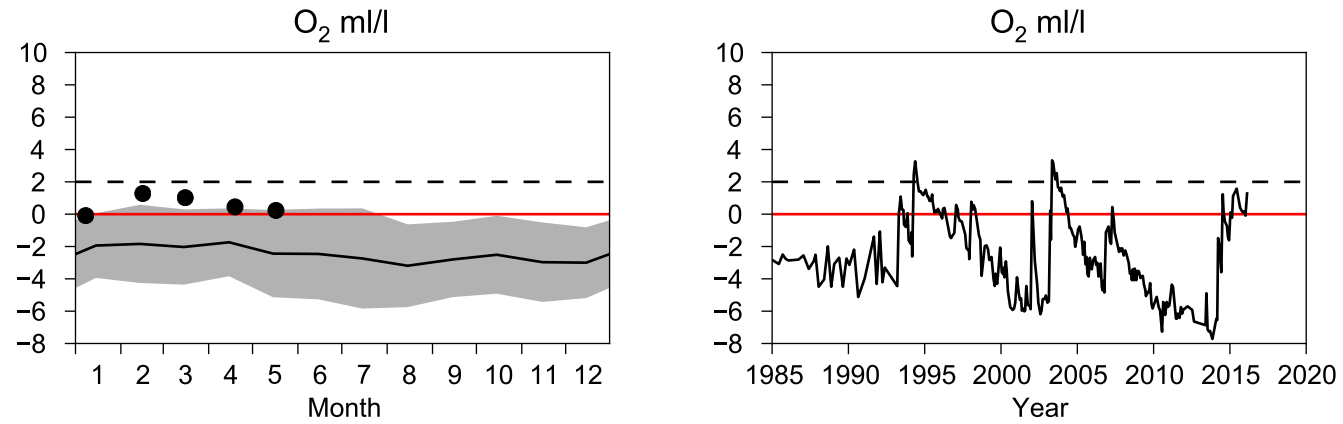


STATION BY15 GOTLANDSDJ SURFACE WATER (0-10m)

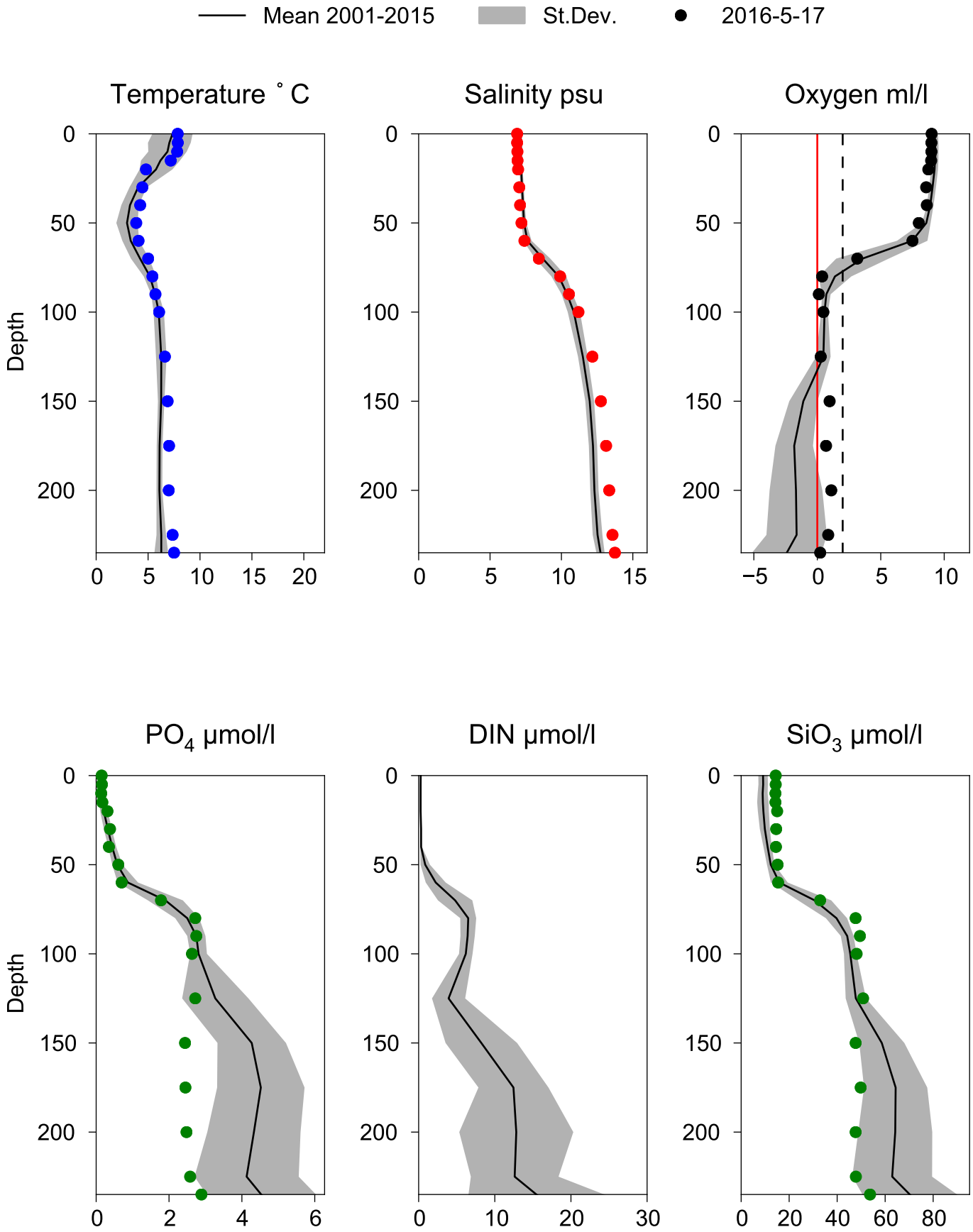
Annual Cycles



OXYGEN IN BOTTOM WATER (depth >= 225 m)

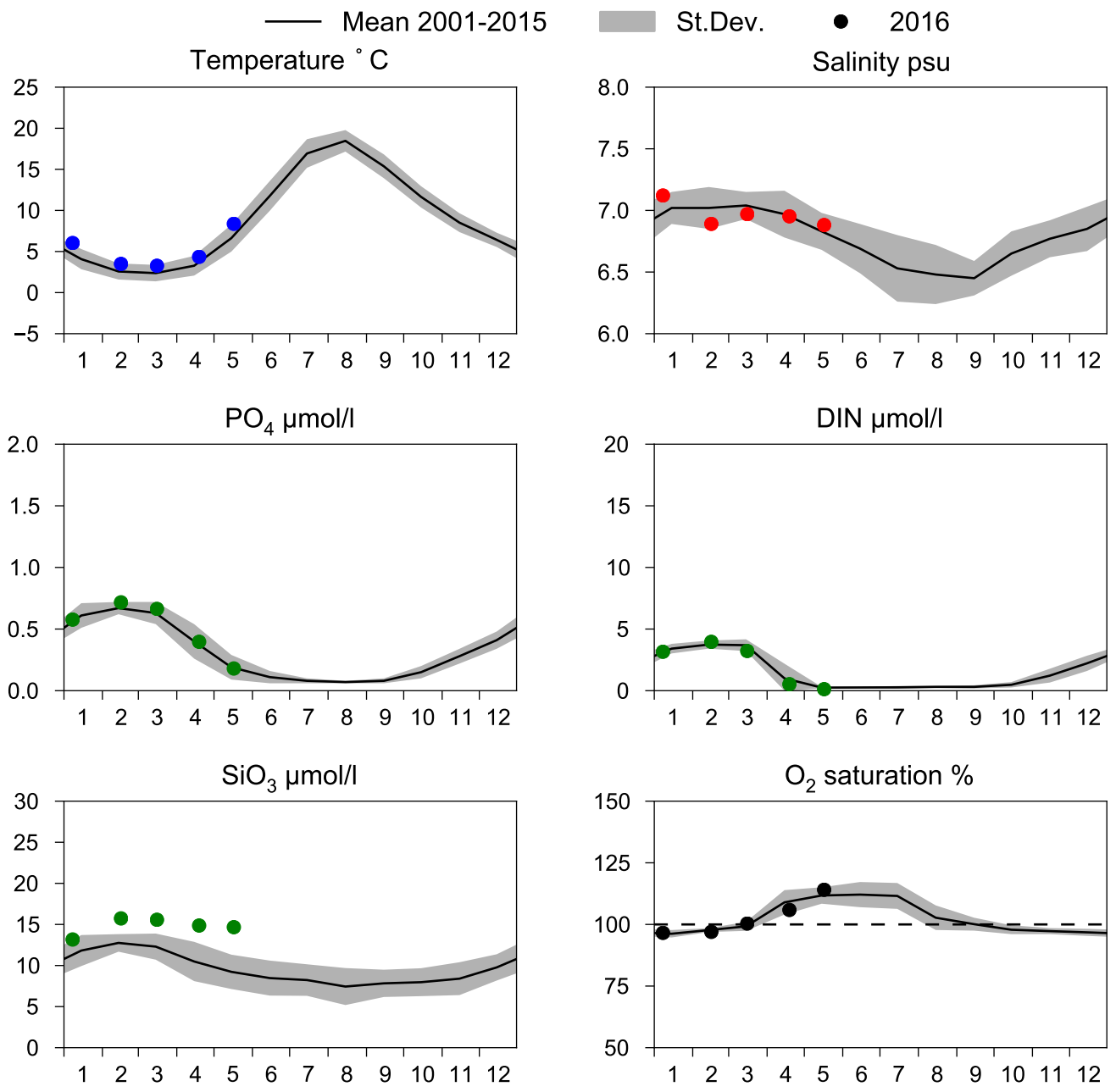


Vertical profiles BY15 GOTLANDSDJ
May

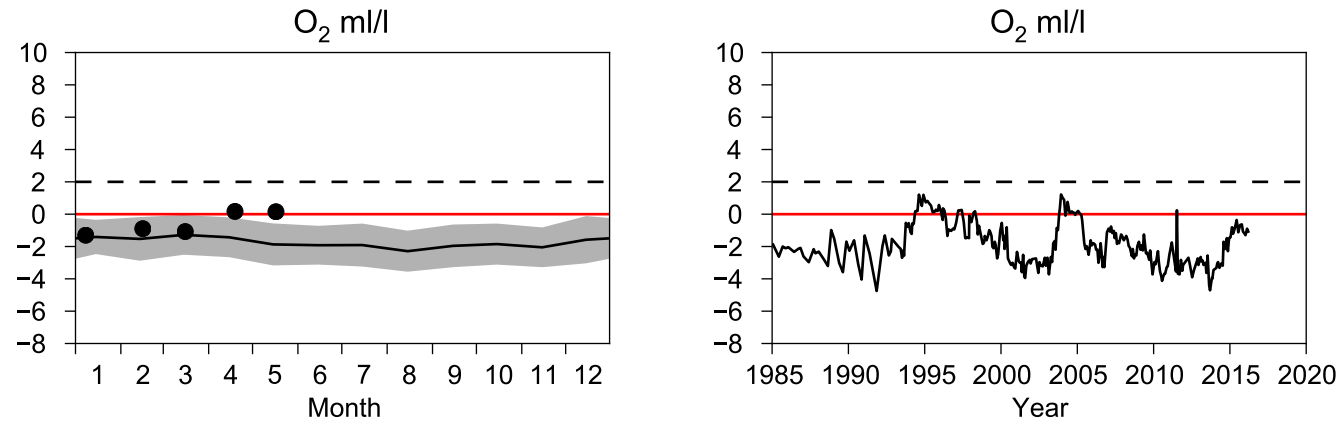


STATION BY20 FÅRÖDJ SURFACE WATER (0-10m)

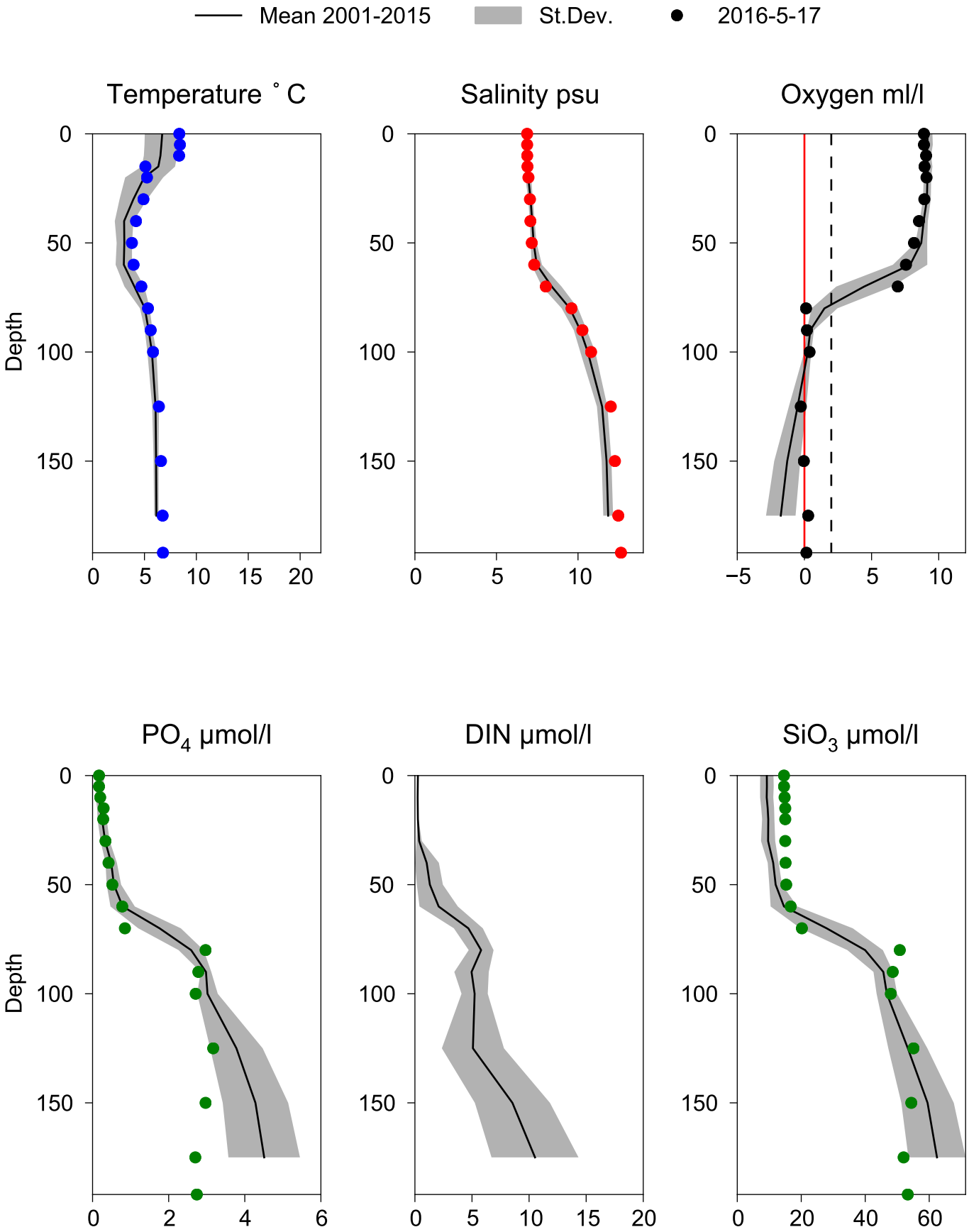
Annual Cycles



OXYGEN IN BOTTOM WATER (depth >= 175 m)

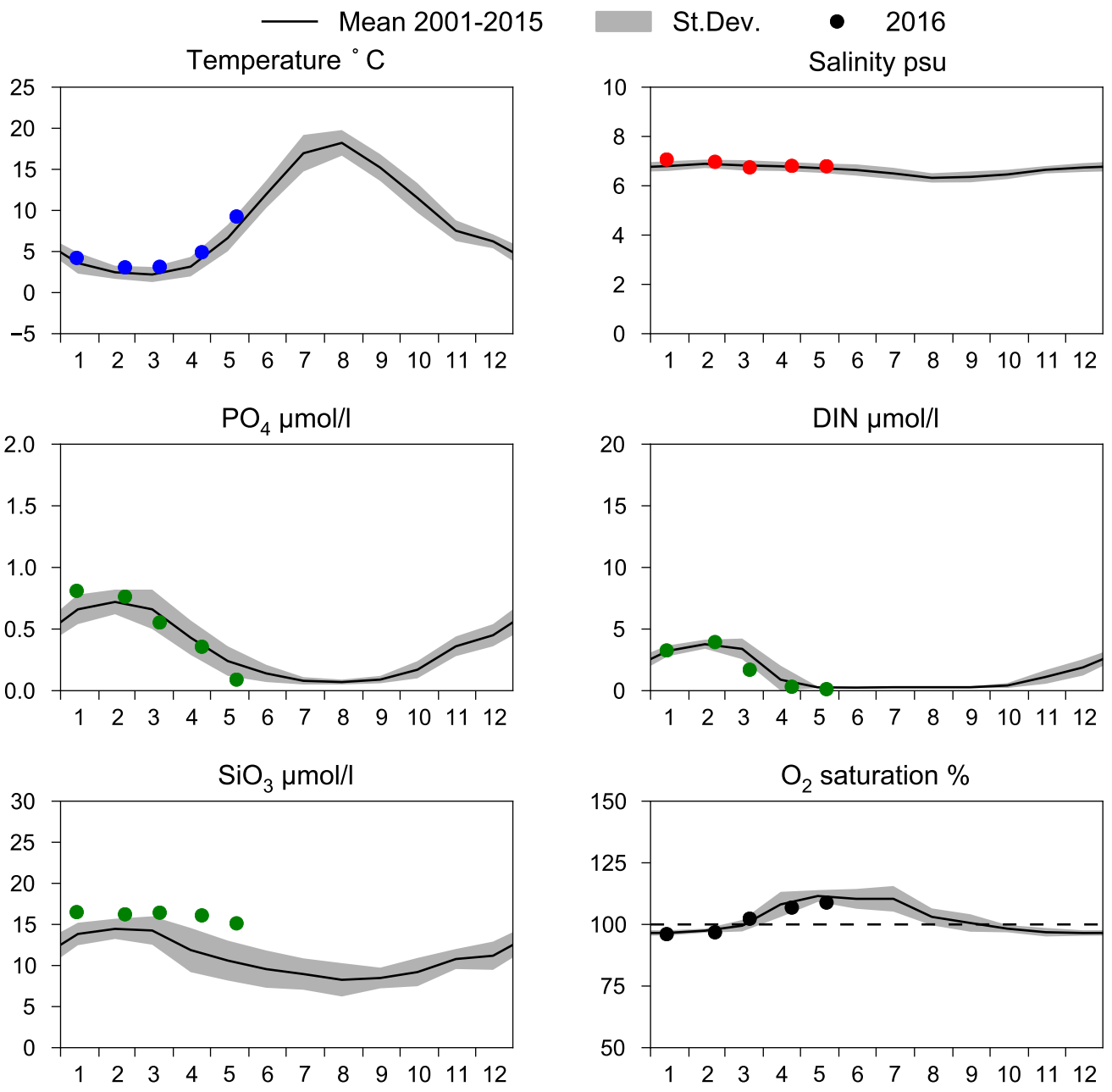


Vertical profiles BY20 FÅRÖDJ
May

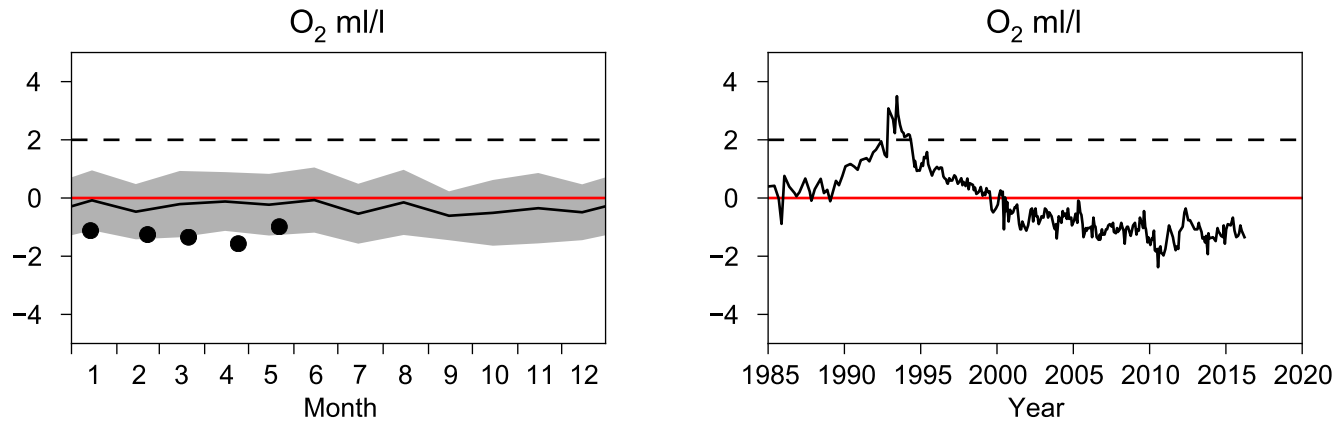


STATION BY32 NORRKÖPINGSDJ SURFACE WATER (0-10m)

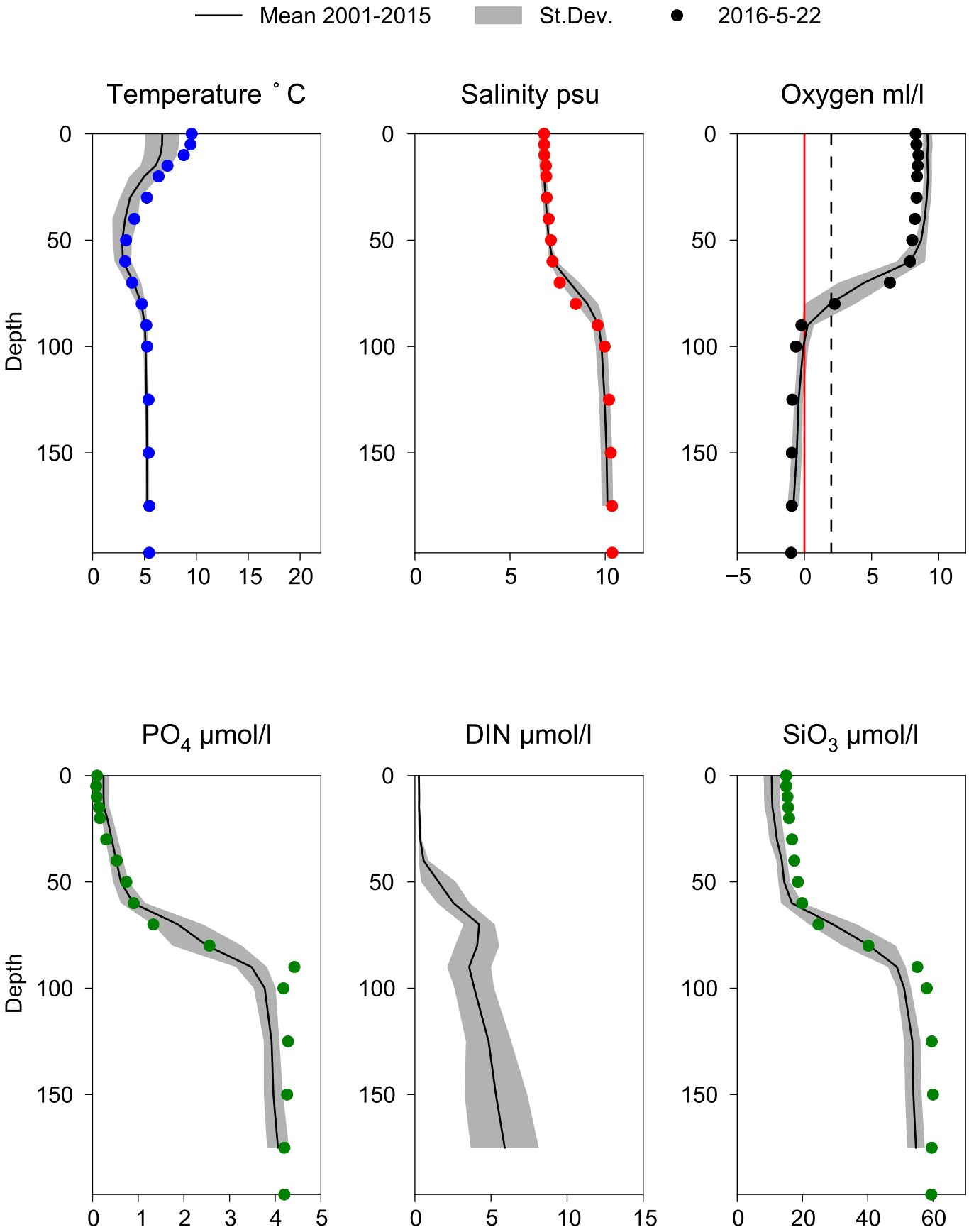
Annual Cycles



OXYGEN IN BOTTOM WATER (depth >= 175 m)

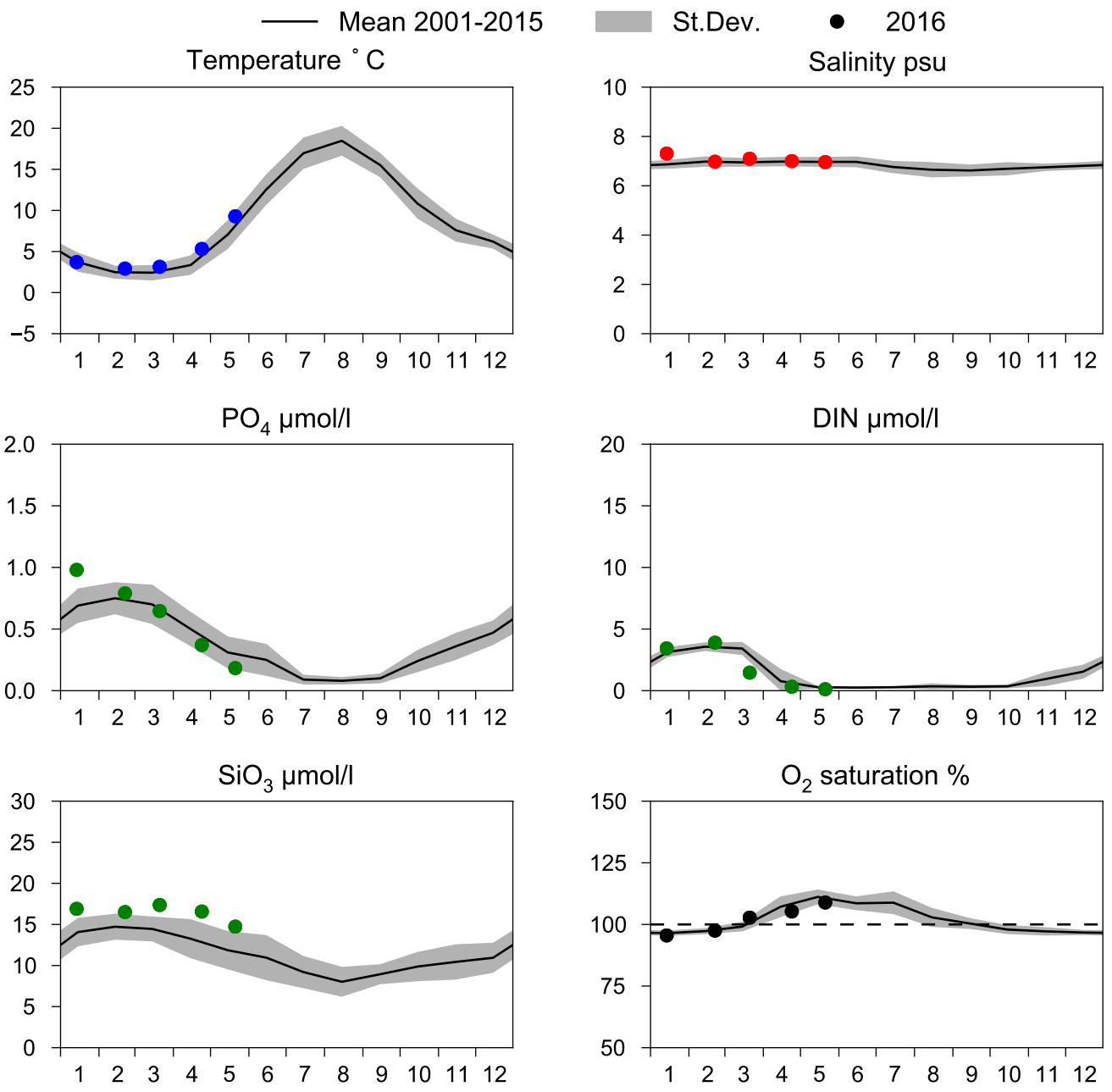


Vertical profiles BY32 NORRKÖPINGSDJ
May

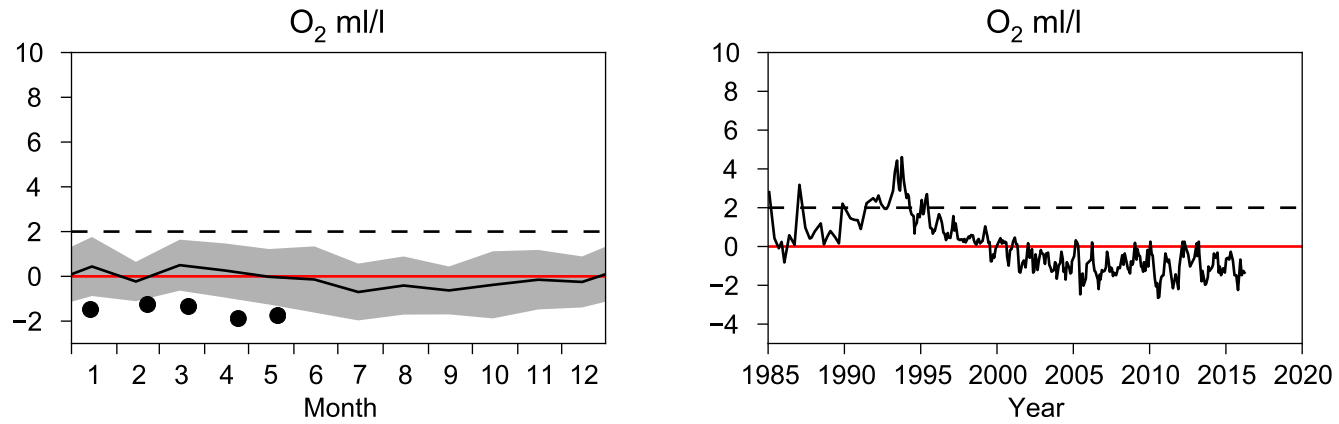


STATION BY38 KARLSÖDJ SURFACE WATER (0-10m)

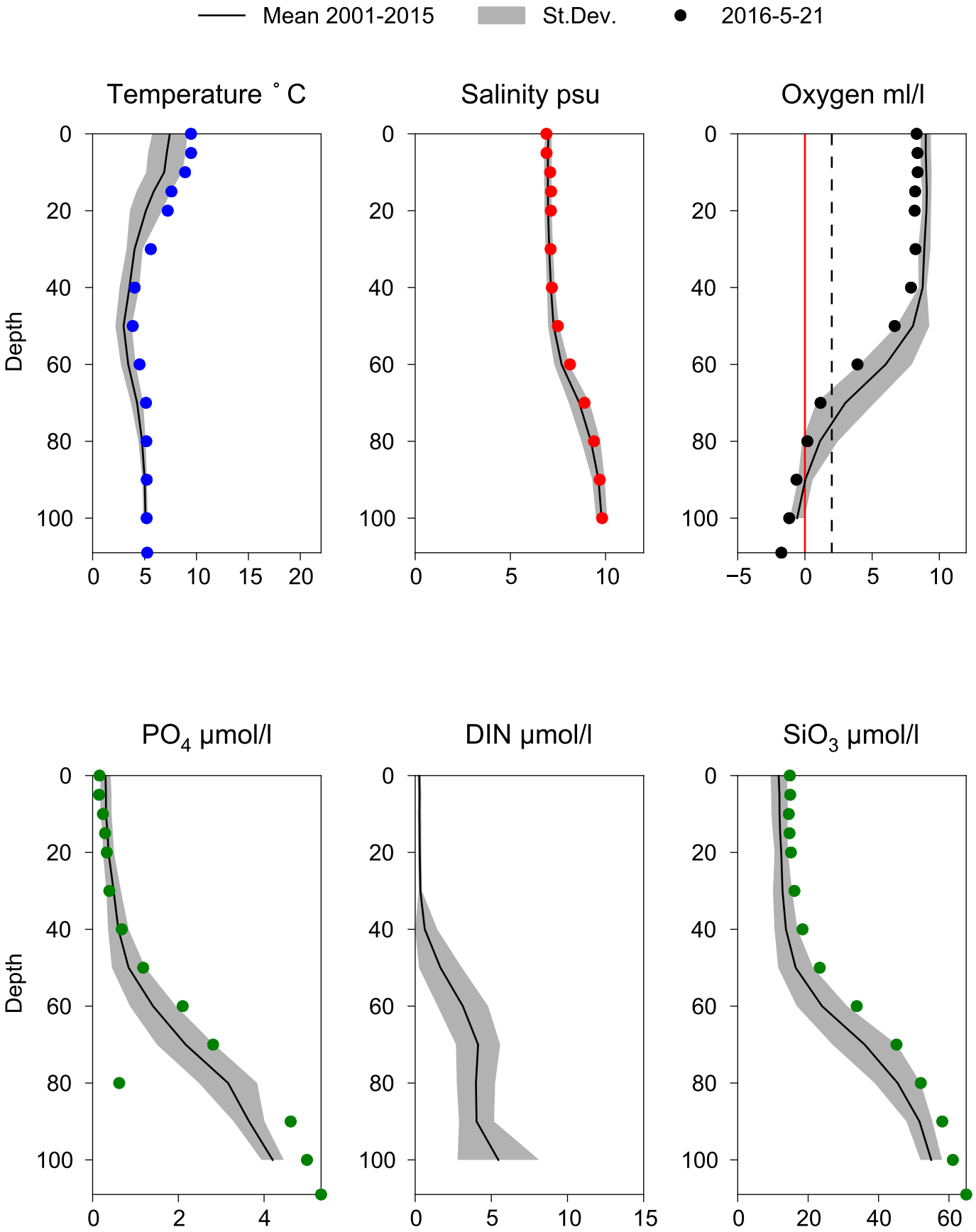
Annual Cycles



OXYGEN IN BOTTOM WATER (depth >= 100 m)

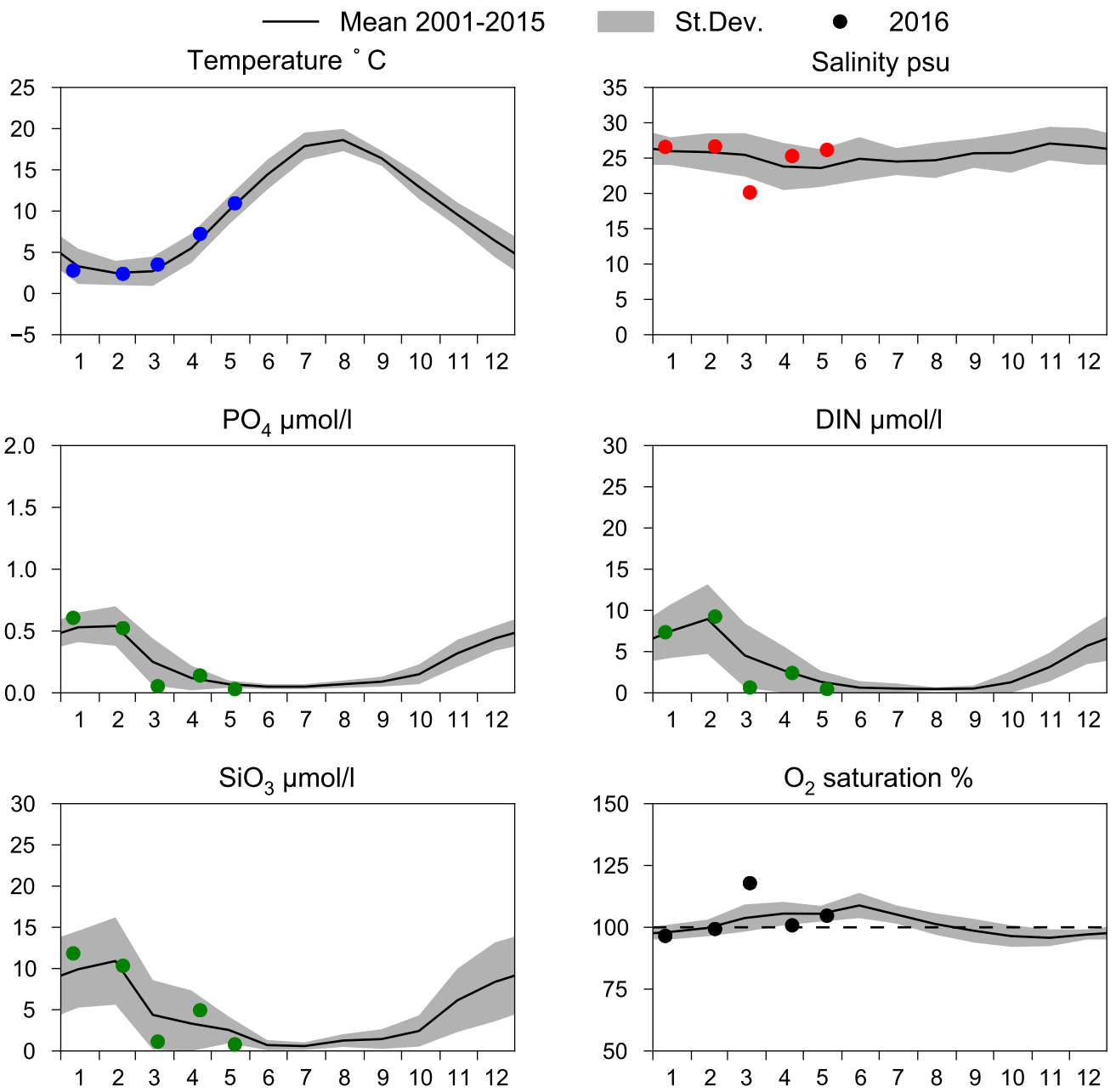


Vertical profiles BY38 KARLSÖDJ
May

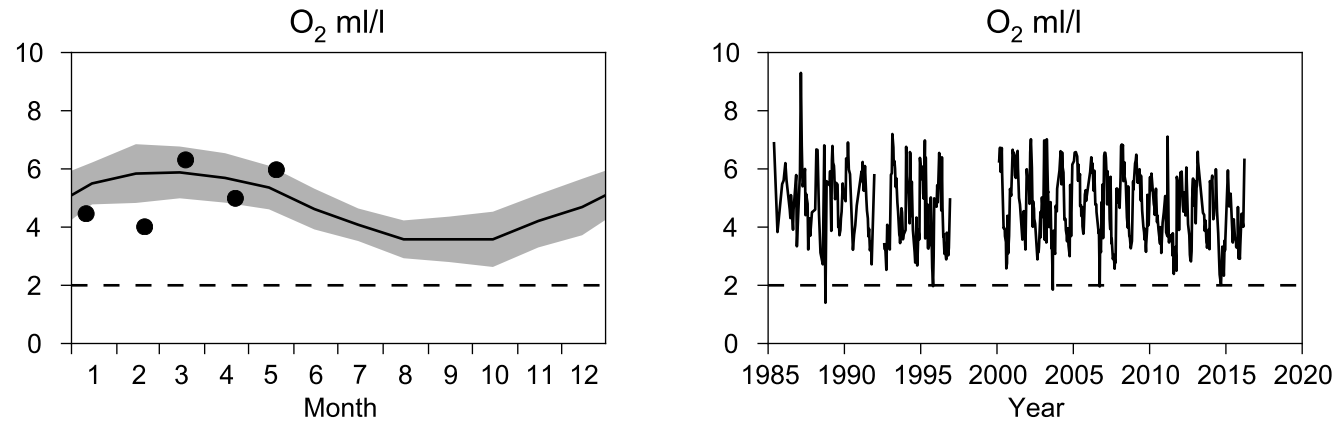


STATION SLÄGGÖ SURFACE WATER (0-10m)

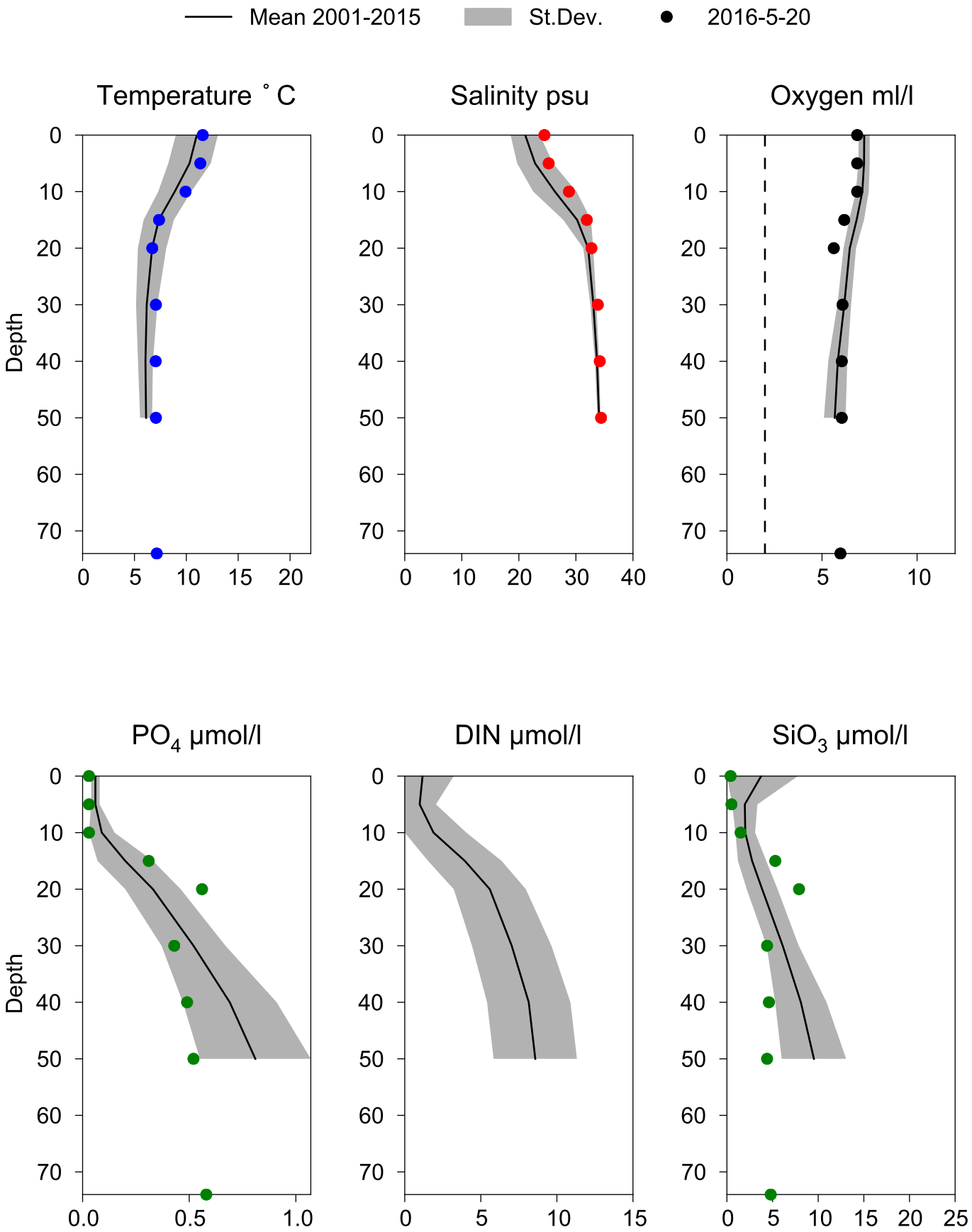
Annual Cycles



OXYGEN IN BOTTOM WATER (depth >= 50 m)

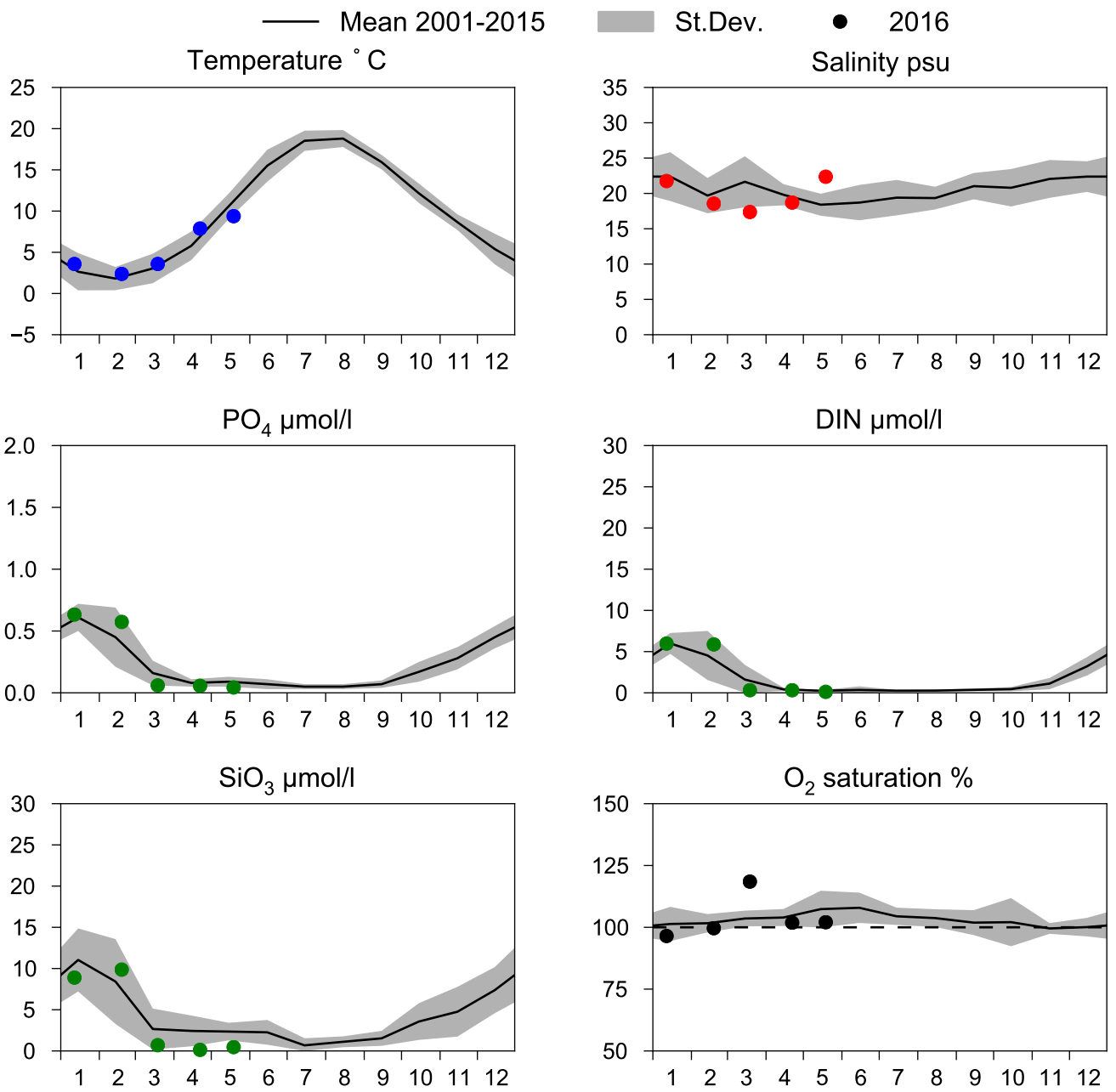


Vertical profiles SLÄGGÖ
May

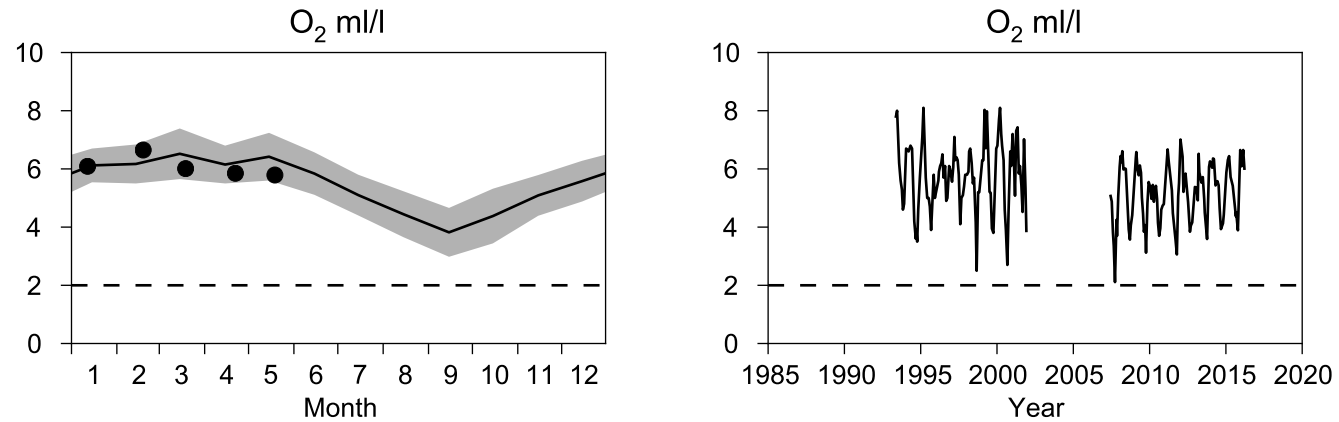


STATION N14 FALKENBERG SURFACE WATER (0-10m)

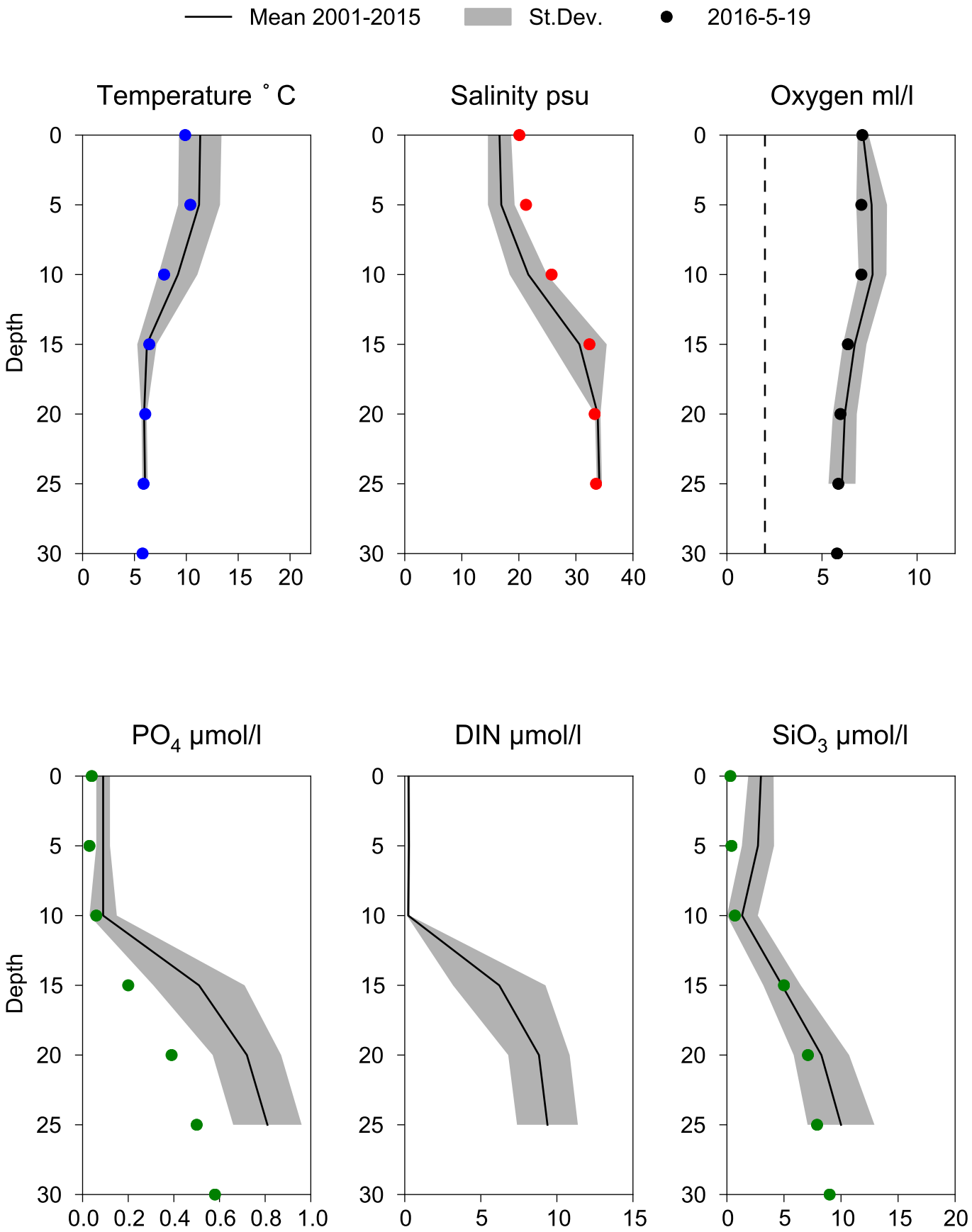
Annual Cycles



OXYGEN IN BOTTOM WATER (depth >= 25 m)



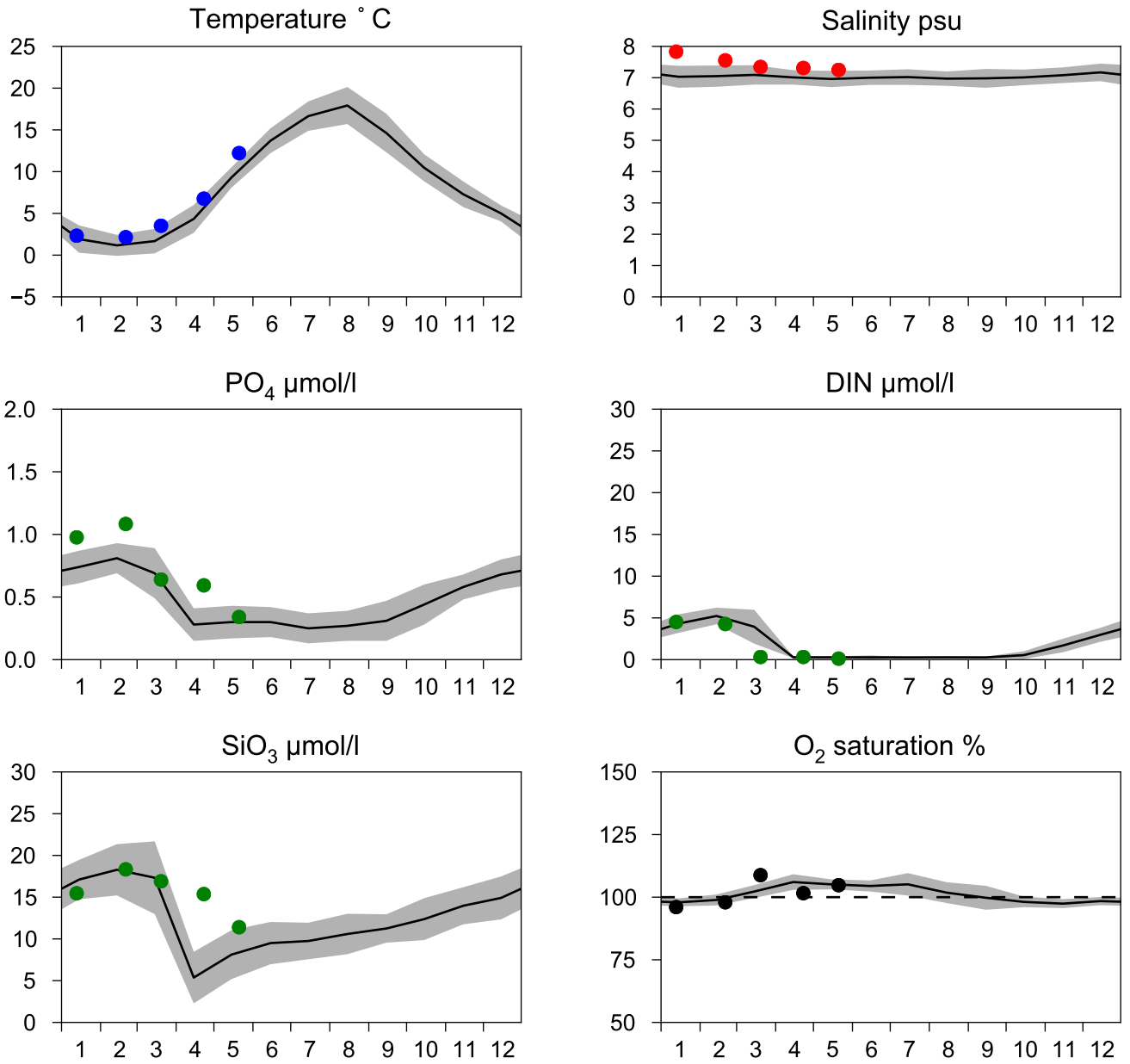
Vertical profiles N14 FALKENBERG
May



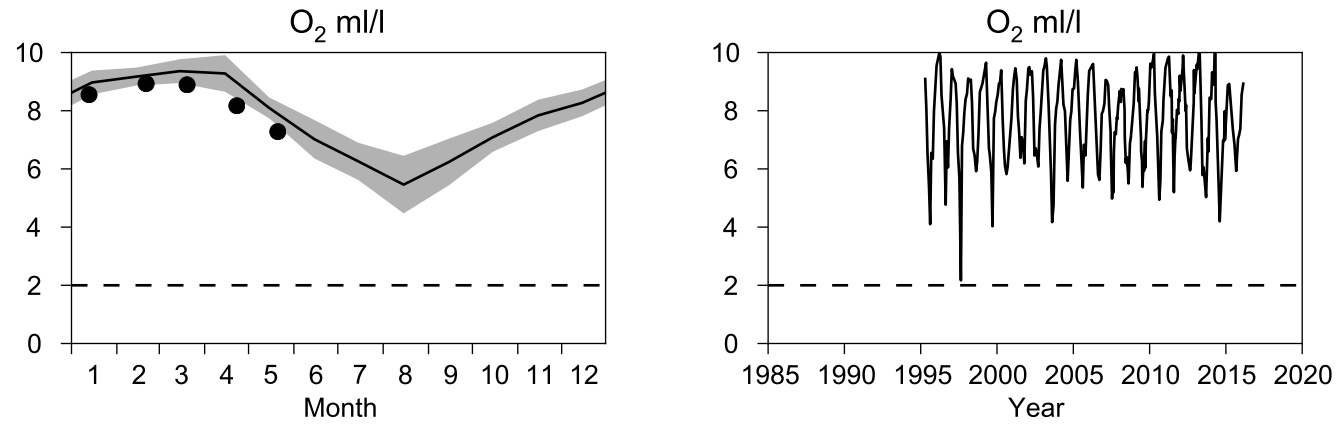
STATION REF M1V1 SURFACE WATER (0-10m)

Annual Cycles

Mean 2001-2015 | St.Dev. | 2016



OXYGEN IN BOTTOM WATER (depth >= 17 m)



Vertical profiles REF M1V1
May