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2016-12-02
Dnr: S/Gbg-2016-134

Report from the SMHI monitoring cruise with R/V Aranda

Survey period: 2016-11-14 to 2016-11-21
Principal: Swedish Meteorological and Hydrological Institute, the Swedish Agency for Marine and Water Management and Finnish Environment Institute

SUMMARY

The cruise, which is part of the Swedish marine monitoring programme, covered the Skagerrak, the Kattegat, the Sound, the Gulf of Finland and the Baltic Proper.

The temperature in the surface water was now normal or slightly lower than normal for the season. The salinity showed normal values except in the eastern part of Skagerrak, the Sound and the Gotland Deep (station BY15) where the salinity was above normal.

The nutrient concentration in the surface water was below normal in the Kattegat and the Sound because of high plankton activity. In all other areas the nutrient concentration was normal or slightly above normal. The silicate concentration in the whole Baltic Proper continued to be highly elevated.

In the Baltic Proper and the Gulf of Finland acute hypoxia was found from depth exceeding 60-70 meters depth. Anoxia (O_2 = 0 ml/l) was found in the Western and Northern Gotland basin and Gulf of Finland from depth over 80-90 meters and in the Eastern Gotland basin from 225 meters to the bottom.

Next regular cruise is scheduled to start 7th of December.

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RESULTS

The cruise was conducted aboard the Finnish research vessel Aranda and started in Helsinki on the 14th of November and ended in the same port on 21th of November. The winds during the cruise were weak to moderate and from varying directions except from Skagerrak where the wind was strong and from SSW.

During the expedition extra zooplankton samples were taken at the stations; BY15, BY5, BY2, Anholt E and Släggö, on behalf of Umeå University for future analysis of mercury.

At N Midsjöbanken two hydrophones were retrieved for the Swedish Defence Research Agency. The instruments have measured marine noise and registered “click” sounds from harbour porpoise since April 2016.

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. Preliminary 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 temperature in the surface water was normal to slightly below normal for the season and varied around 8-9°C. The surface salinity was above normal in the eastern and southern parts of Skagerrak, while normal in the remaining areas. The lowest salinities were found at the station Å17, ~32 psu and highest at P2 and Å13, ~34 psu. The halocline coincided with the upper thermocline in the outer area at 25 meters while there was no stratification in the eastern parts.

The surface concentration of phosphate and nitrogen was normal while silicate was lower than normal for the season. The concentration of phosphate varied between 0.15-0.34 µmol/l and the concentration of nitrite + nitrate varied around 0.59-3.70 µmol/l. The silicate concentrations showed values between 0.5 and 2.1µmol/l.

The fluorescence from the CTD was low at all stations but some phytoplankton activity could be seen in the surface layer.

The bottom water was well oxygenated, even at the coastal station; Släggö.

The Kattegat and the Sound

The temperature of the surface water was slightly lower than normal for the season and varied around 6.5°C. The surface salinity was normal in Kattegat and varied around 19-24 psu. In the Sound the salinity was around 15 psu which is above normal. The halocline and thermocline coincided at 10-15 meters depth.

All nutrients in the surface water were lower than normal for the season, except in the Sound where they were normal. The phosphate concentration was 0.09-0.14 µmol/l except in the Sound where it was 0.30 µmol/l. The sum of nitrate + nitrite was below the detection limit, 0.10 µmol/l, in the Kattegat while in the Sound concentrations of 1.40 µmol/l were found. Silicate varied around 0.2-1.9 µmol/l in Kattegat and 6.7 µmol/l in the Sound.

The oxygen concentration in the deep water was again normal in the whole Kattegat as well as in the Sound.

The fluorescence from the CTD indicated phytoplankton activity at 10 meters depth in the whole area.

The Baltic Proper

The water temperature in the surface water was normal for the season in the whole area and varied between 6 and 9 °C, lowest in the Gulf of Finland and highest in the Arkona Basin. The salinity was normal in the investigated area except at the BY15 Gotland Deep where it was above normal. The lowest salinity was found in the Gulf of Finland, ~5 psu and highest in the Arkona Basin, ~8 psu. The halocline and the thermocline followed each other at about 25-35 meters depth in the Arkona Basin and at 40-60 meters depth in other areas.

The concentrations of phosphate were normal in the whole area except in the Eastern Gotland Basin where they were slightly above normal. Phosphate concentrations varied between 0.35 and 0.78 µmol/l. The sum of nitrite+nitrate was just above normal in the whole area and varied between 1.84 and 5.20 µmol/l. The concentrations of silicate were above or highly above normal in the whole area and varied between 10.9 and 16.6 µmol/l.

In the Western Gotland Basin the oxygen situation was still severe. Anoxic conditions were found already at depths exceeding 80-100 meters. Also in the Eastern Gotland Basin anoxic condition was now found from 225 meters to the bottom at BY15 Gotland Deep while. Anoxia was found from 60-80 meters in the Northern Gotland Basin and in the Gulf of Finland. Acute hypoxia, <2 ml/l, was found from 60-80 meters depth in the whole Baltic Proper.

Usually, an extra series of water samples are taken at the station BY 15 Gotland Deep. The purpose of this extra series is to, with an accuracy of 5 meters, determine at what depth the layer of hydrogen sulphide starts. Since the inflow event 2014, the station BY15 has either been well oxygenated or it has been variable intermediate layers with anoxic water and therefore the extra series has not been taken at several months. The present situation at station BY15 Gotland Deep, with an anoxic layer close to the bottom, is similar to the situation before the salt water inflow 2014 and therefore the work with an extra series has now started again.

The fluorescence measurements from the CTD showed low phytoplankton activity in the whole investigated area.

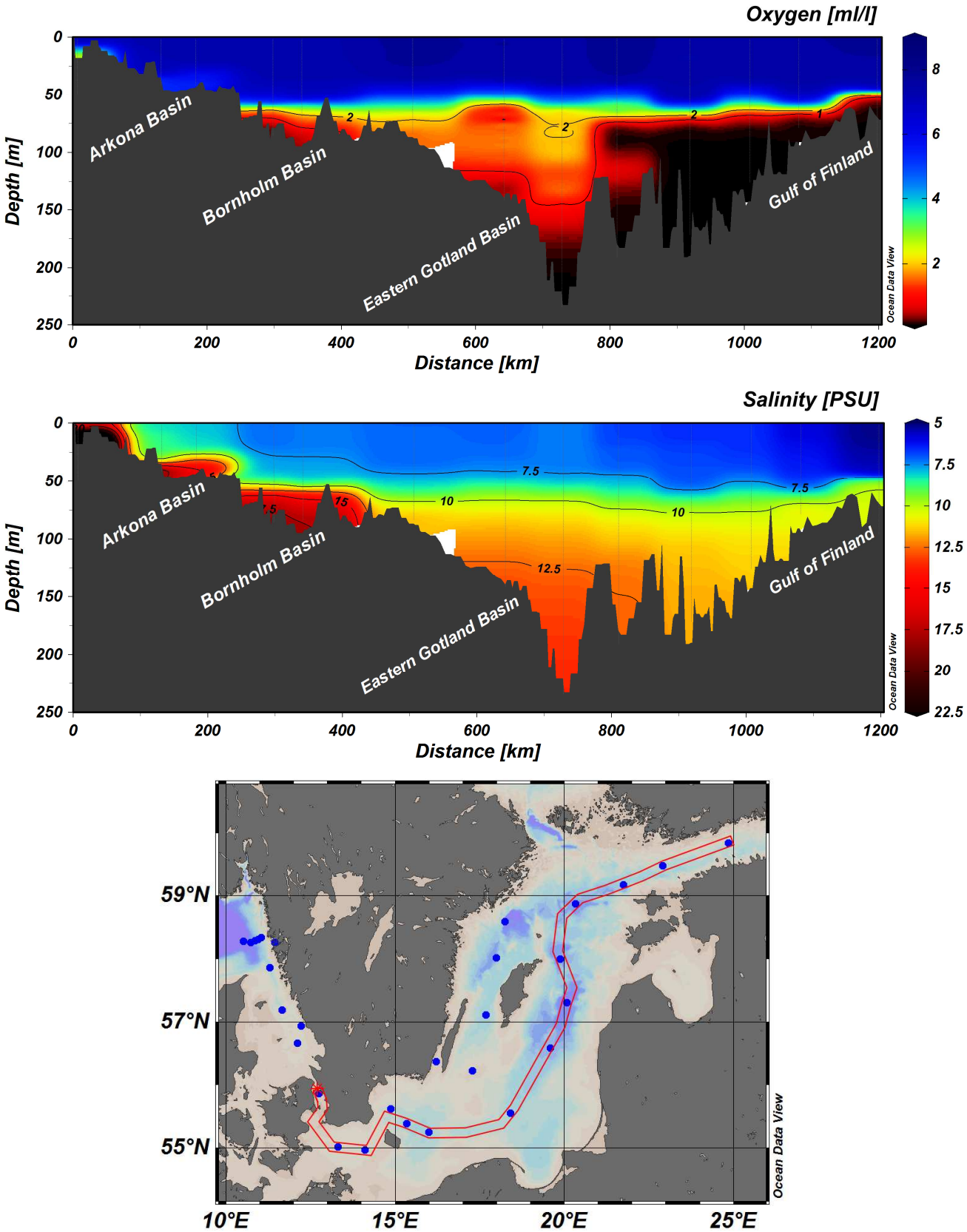

Figure 2. Transect showing oxygen and salinity through the Baltic Proper, from the Sound to the Eastern Gotland Basin.

PARTICIPANTS

Name		Institute
Anna-Kerstin Thell	Chief Scientist	SMHI
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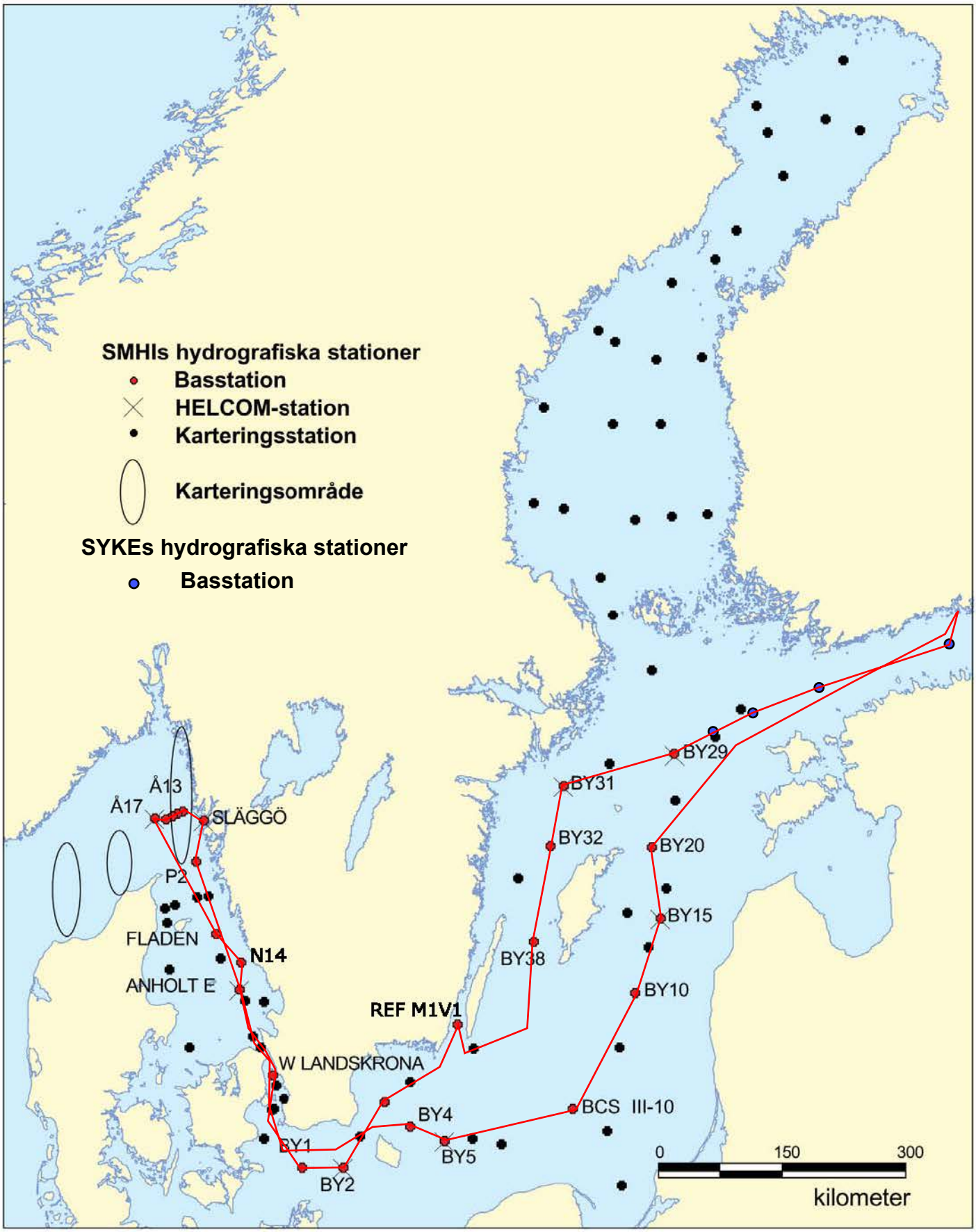
Ann-Turi Skjevik		SMHI

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

TRACKCHART
Country: Sweden
Ship: R/V ARANDA
Date: 20161114-20161121
Series: 0571-0601



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Time: 15:24

Ship: AR
Year: 2016

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	Wind ve	Air temp C	Air pres hPa	WCWI	BSHP imop gas	No de	Temp_bottle	Temp_bottle	Salt_bottle	Salt_bottle	Phosphate	Phosphate	Nitrite	Nitrate	Nitrogen	Ammonia	Silicate	Silicate	Hydrogen sulphide	Cadmium	Copper	Chromium	Nickel	Lead	Yellow_gelbin	Aluminium	Cobalt	Comment_vis
0571	19	GFXX29	SYK	BY23/LL7	5950.79	02450.27	20161114	1250	102		14	3	1	1024	1420	----	14	-	x	-	x	-	-	x	x	x	-	x	x	x	-	-	x	-	-	-	-	-	-	-	x
0572	19	BPNX60	SYK	LL12	5929.01	02253.81	20161114	1855	83		15	5	1	1023	9999	----	11	x	x	-	x	-	-	x	x	x	-	x	x	x	-	-	x	-	x	-	-	-	-	-	-	-
0573	19	BPNX62	SYK	LL15	5910.99	02144.85	20161114	2320	132		14	6	1	1022	9990	----	14	x	x	-	x	-	-	x	x	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	x
0574	19	BPNX35	BAS	BY29/LL19	5852.91	02019.67	20161115	0400	177		20	9	5	1017	9999	-xx-	16	x	x	-	x	-	x	x	x	x	-	x	x	x	-	-	x	-	x	-	-	-	-	-	-	x
0575	19	BPNX37	BAS	BY31 LANDSORTSDJ	5835.62	01814.18	20161115	1030	446	9	22	10	4	1009	2830	2xx-	23	x	x	-	x	x	x	x	x	-	x	x	x	x	-	x	x	x	x	-	-	-	-	-	-	x
0576	19	BPWX38	BAS	BY32 NORRKÖPING	5801.01	01759.06	20161115	1610	206		23	10	5	1005	9990	----	17	x	x	-	x	-	x	x	x	-	x	x	x	x	-	-	x	-	x	-	-	-	-	-	-	-
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0579	19	BPWK01	BAS	Ref M1V1	5622.24	01612.10	20161116	1205	21	4	24	5	3	1008	4820	1xx-	5	x	x	-	x	x	x	-	x	-	x	x	x	x	-	x	x	-	x	-	-	-	-	-	-	-
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0583	19	SOCX39	BAS	W LANDSKRONA	5552	01244.89	20161117	0855	53	6	22	9	6	1000	1120	----	9	x	x	-	x	-	x	x	-	x	-	x	x	x	-	-	x	-	x	-	-	-	-	-	-	x
0584	19	KAEX29	BAS	ANHOLT E	5640.12	01206.67	20161117	1415	63		19	12	6	996	2730	1xx-	10	x	x	-	x	x	x	x	-	x	-	x	x	x	-	x	x	x	x	-	-	-	-	-	-	x
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0587	19	SKEX18	BAS	Å17	5817.07	01030.30	20161118	0330	350		18	18	7	979	9990	-xx-	14	x	x	-	x	x	x	x	-	x	-	x	x	x	-	x	x	-	x	-	-	-	-	-	-	x
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0592	19	FIBG27	BAS	SLÄGGÖ	5815.59	01126.14	20161118	1035	74		20	11	6	985	1520	-xx-	9	x	x	-	x	-	x	x	-	x	-	x	x	x	-	-	x	-	x	-	-	-	-	-	-	-
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0595	19	BPSB06	BAS	BY4 CHRISTIANSÖ	5522.98	01520.03	20161119	1650	92		18	8	8	1005	9990	----	12	x	x	-	x	-	x	x	-	x	-	x	x	x	-	-	x	-	x	-	-	-	-	-	-	-
0596	19	BPSB07	BAS	BY5 BORNHOLMSDJ	5515.00	01559.05	20161119	2000	89		24	9	7	1005	6990	2xx-	12	x	x	-	x	-	x	x	-	x	-	x	x	x	-	x	x	x	x	-	-	-	-	-	-	x
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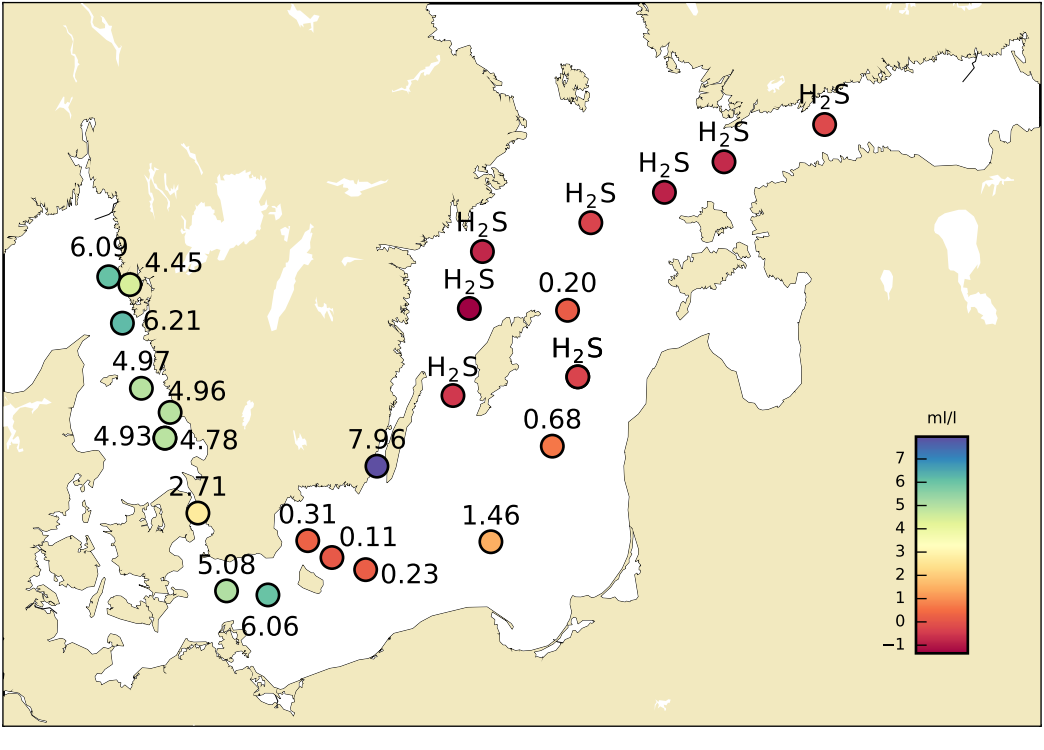
0598	19	BPEX13	BAS	BY10	5635.02	01935.09	20161120	1115	148	8	21	9	6	1021	2830	----	16	x	x	-	x	-	x	x	-	x	-	x	x	x	-	-	x	-	x	-	-	-	-	-	-	x
0599	19	BPEX21	BAS	BY15 GOTLANDSDJ	5718.74	02004.56	20161120	1600	240		16	12	6	1012	9990	2xx-	19	x	x	-	x	x	x	x	x	-	x	x	x	x	-	x	x	x	x	-	-	-	-	-	-	x
0601	19	BPEX26	BAS	BY20 FÅRÖDJUPET	5759.89	01952.73	20161120	2200	196		16	14	6	1007	9990	----	17	x	x	-	x	-	x	x	x	-	x	x	x	x	-	-	x	-	x	-	-	-	-	-	-	-

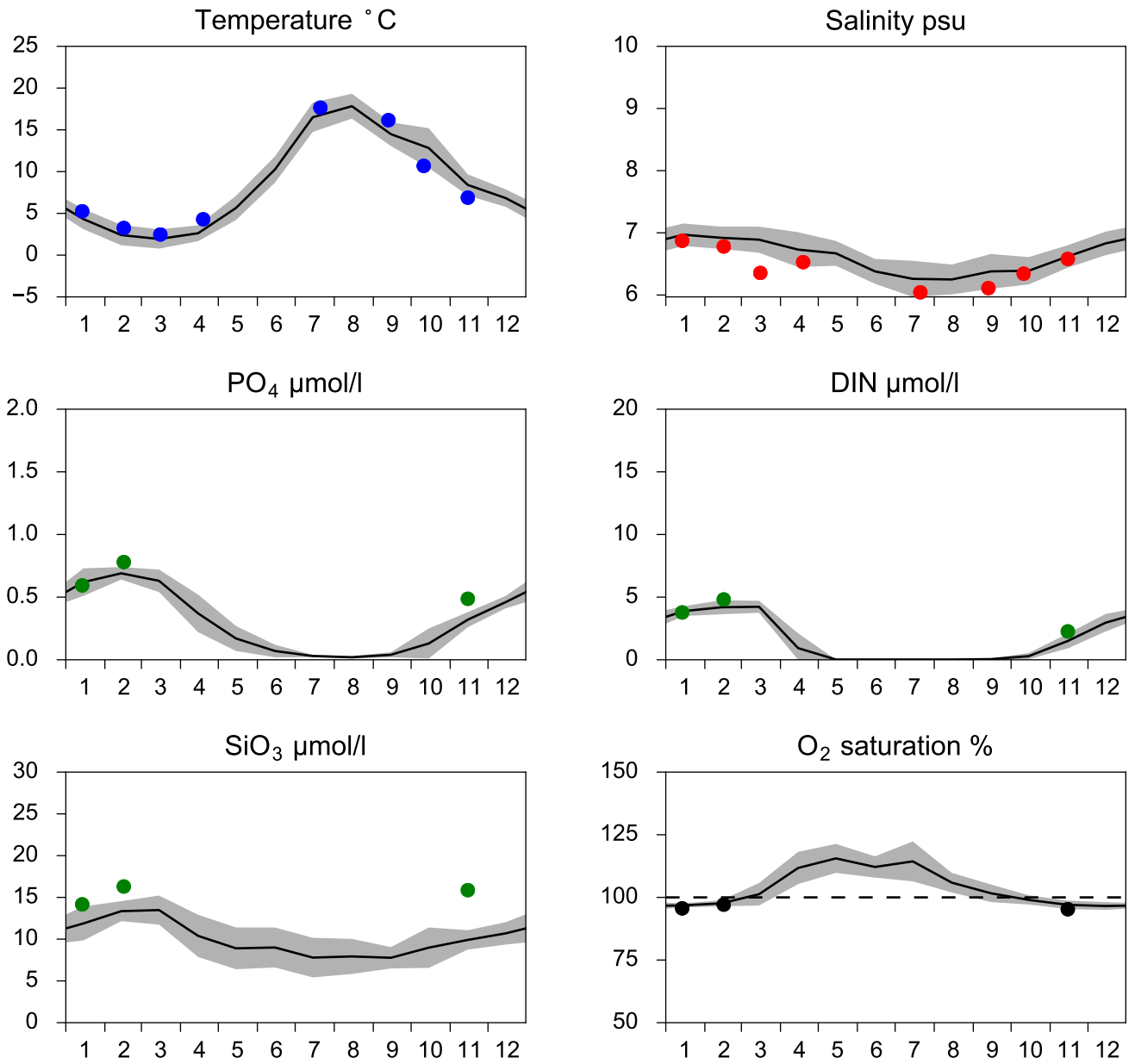
Bottom water oxygen concentration (ml/l)
Country: Finland
Ship: Aranda
Date: 20161114-20161120
Series: 0571-0601



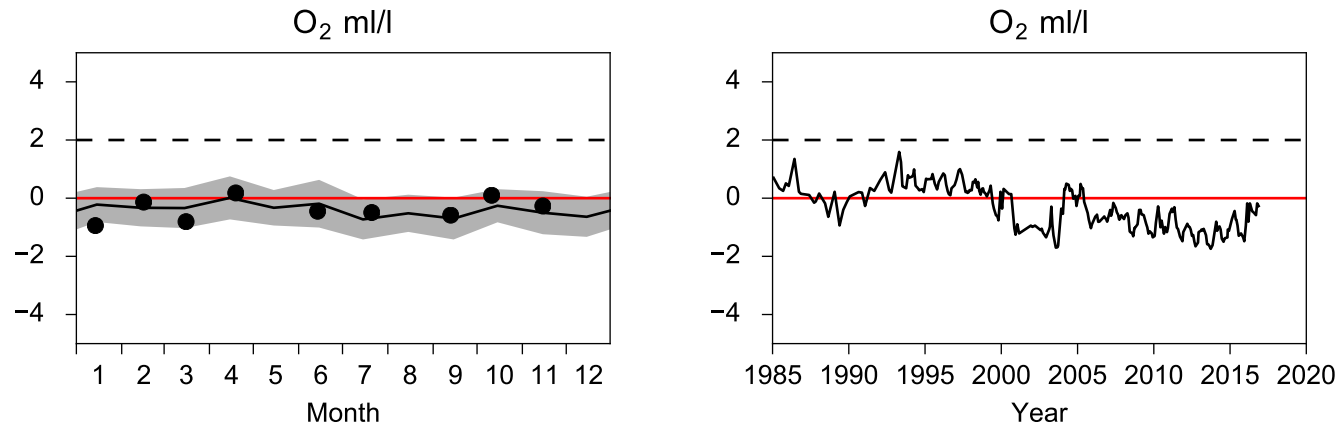
STATION BY29 / LL19 SURFACE WATER (0-10m)

Annual Cycles

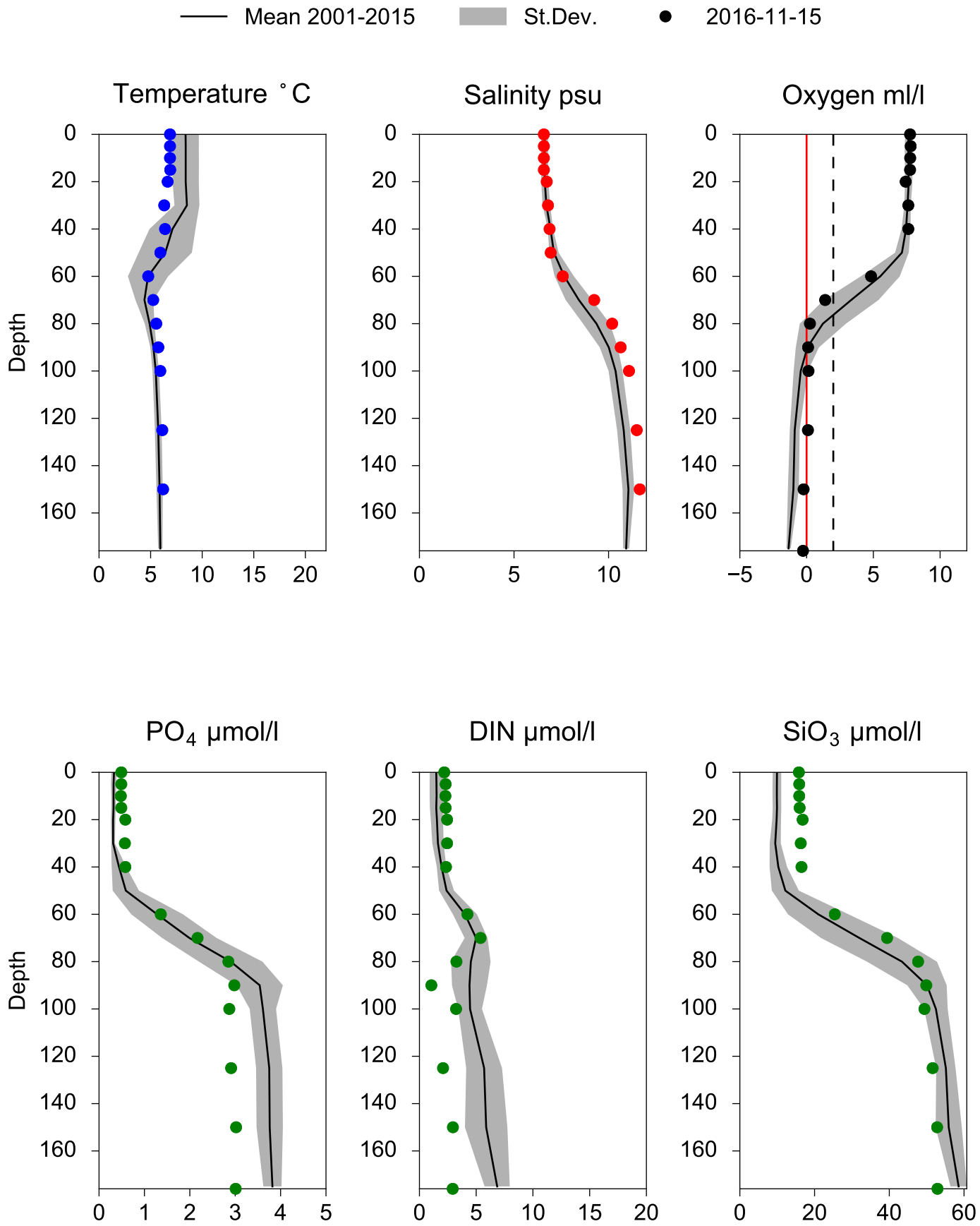
Mean 2001-2015 | St.Dev. | 2016



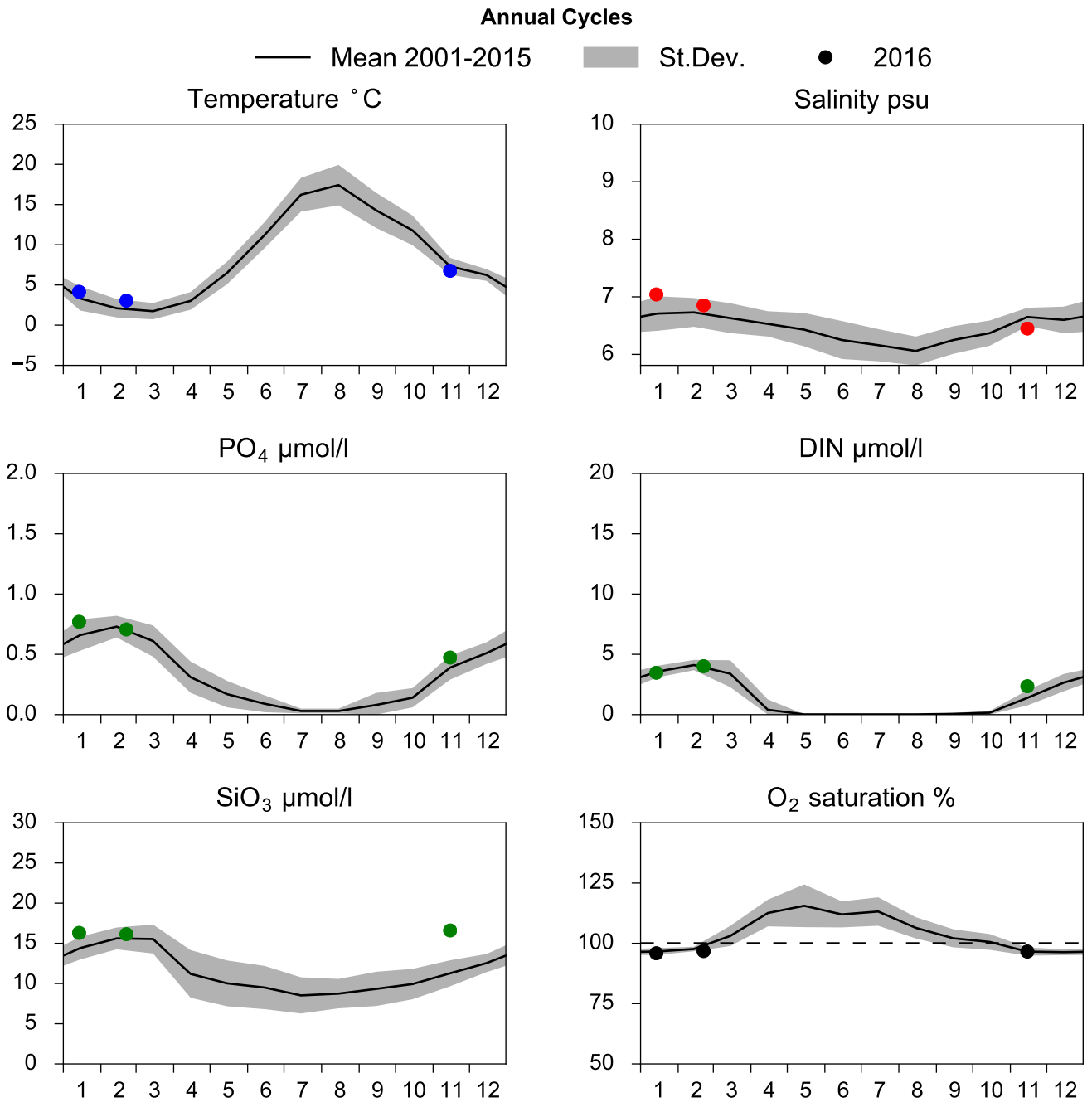
OXYGEN IN BOTTOM WATER (depth >= 150 m)



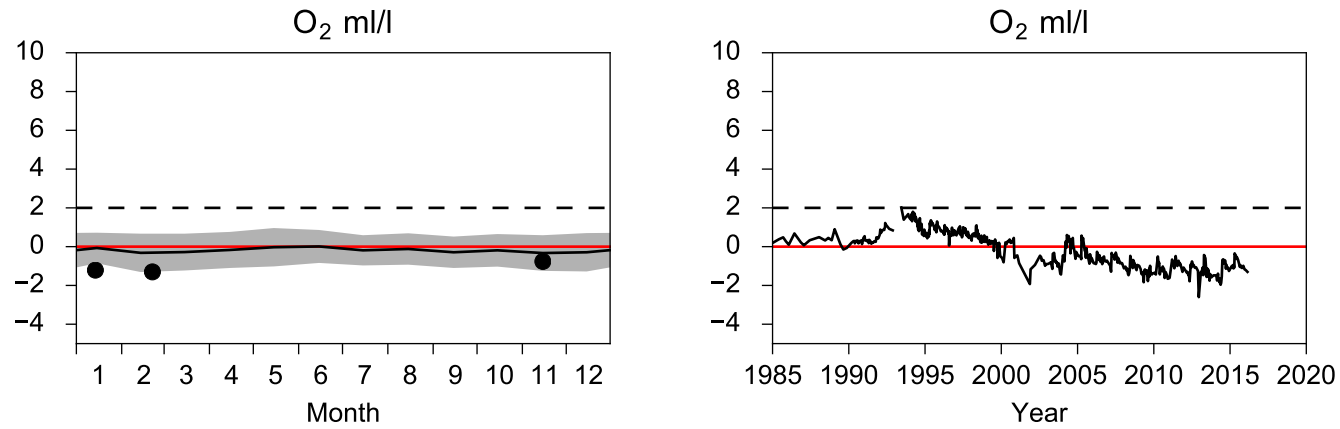
Vertical profiles BY29 / LL19
November



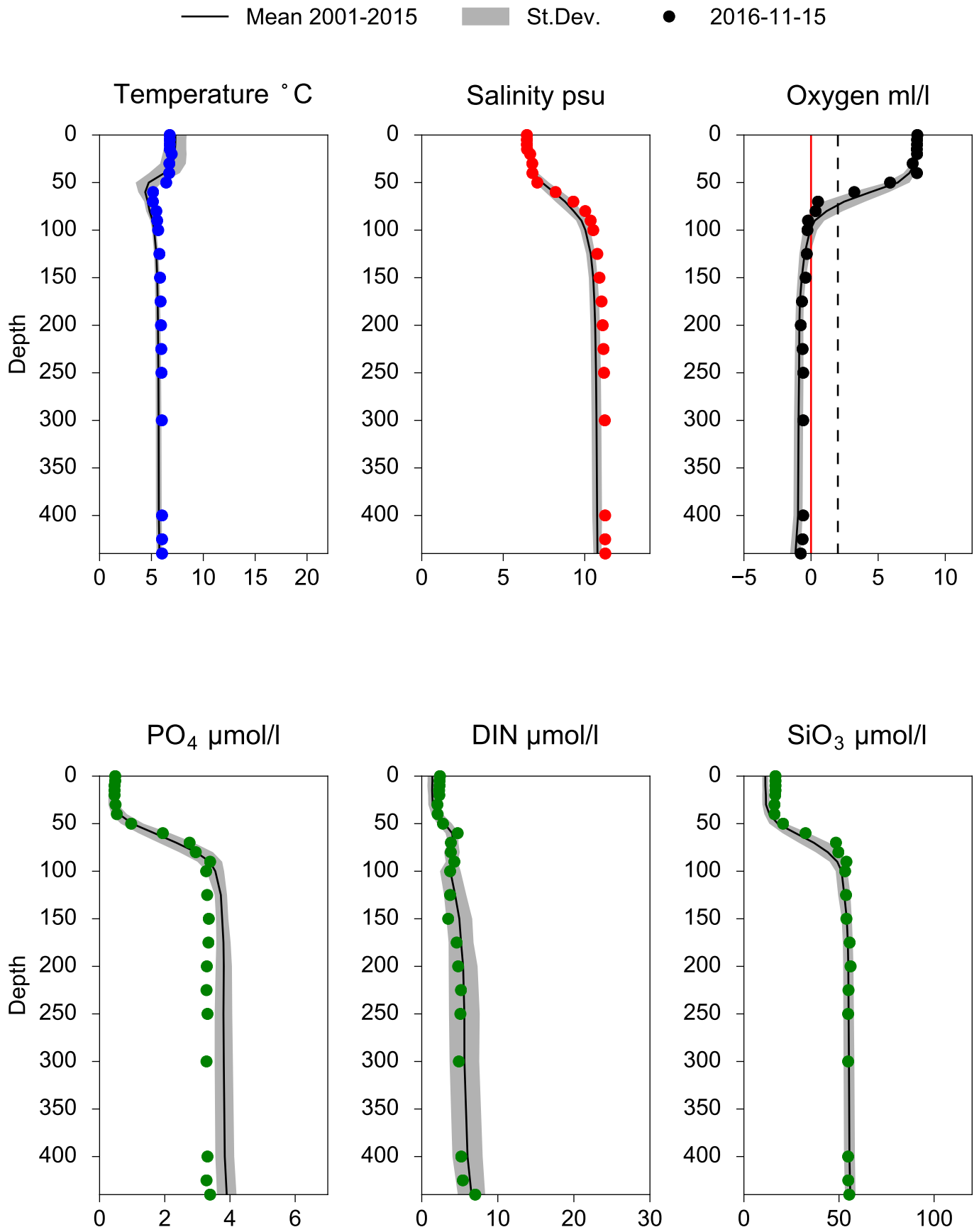
STATION BY31 LANDSORTSDJ SURFACE WATER (0-10m)



OXYGEN IN BOTTOM WATER (depth >= 425 m)



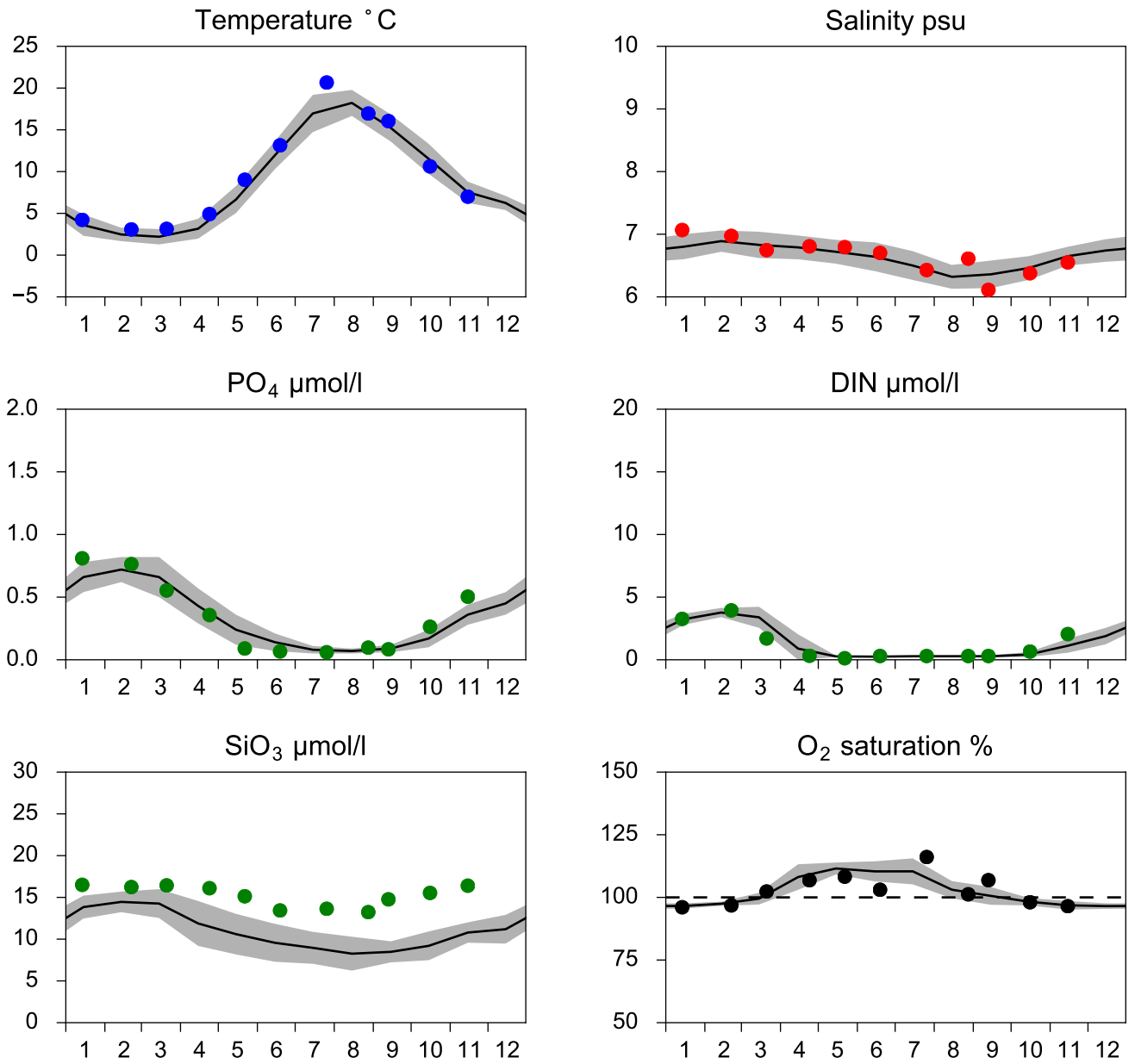
Vertical profiles BY31 LANDSORTSDJ
November



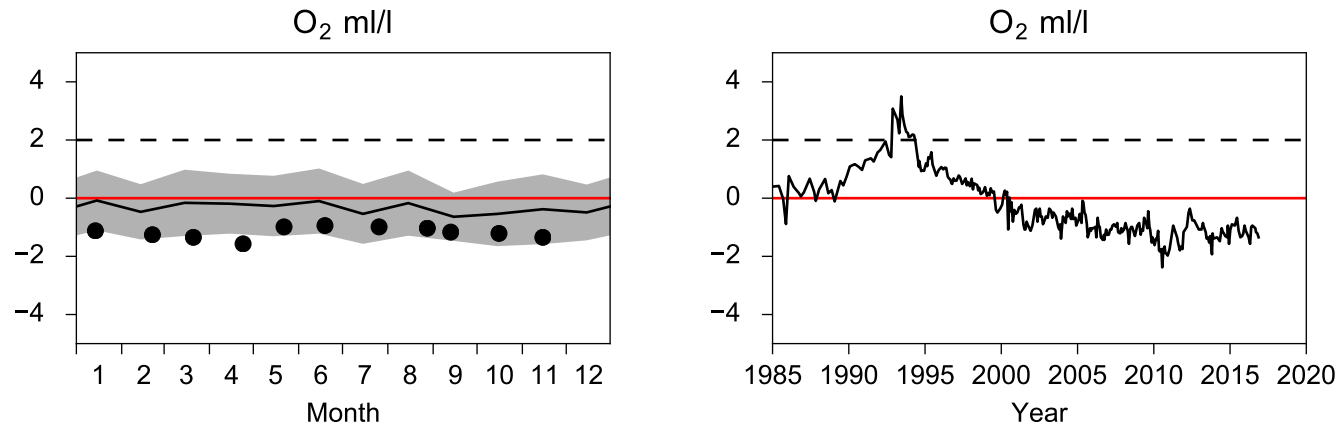
STATION BY32 NORRKÖPINGSDJ SURFACE WATER (0-10m)

Annual Cycles

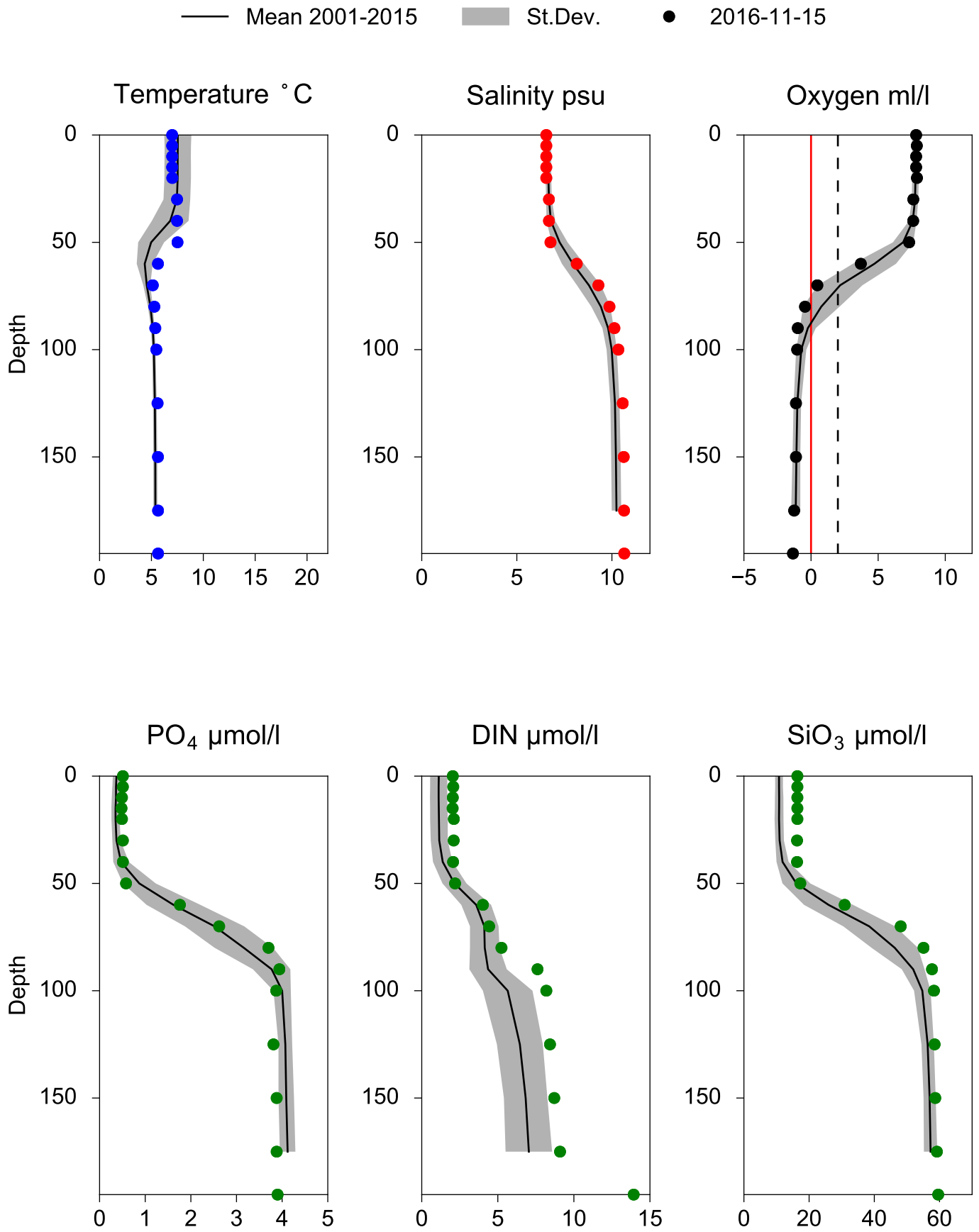
Mean 2001-2015 | St.Dev. | 2016



OXYGEN IN BOTTOM WATER (depth >= 175 m)



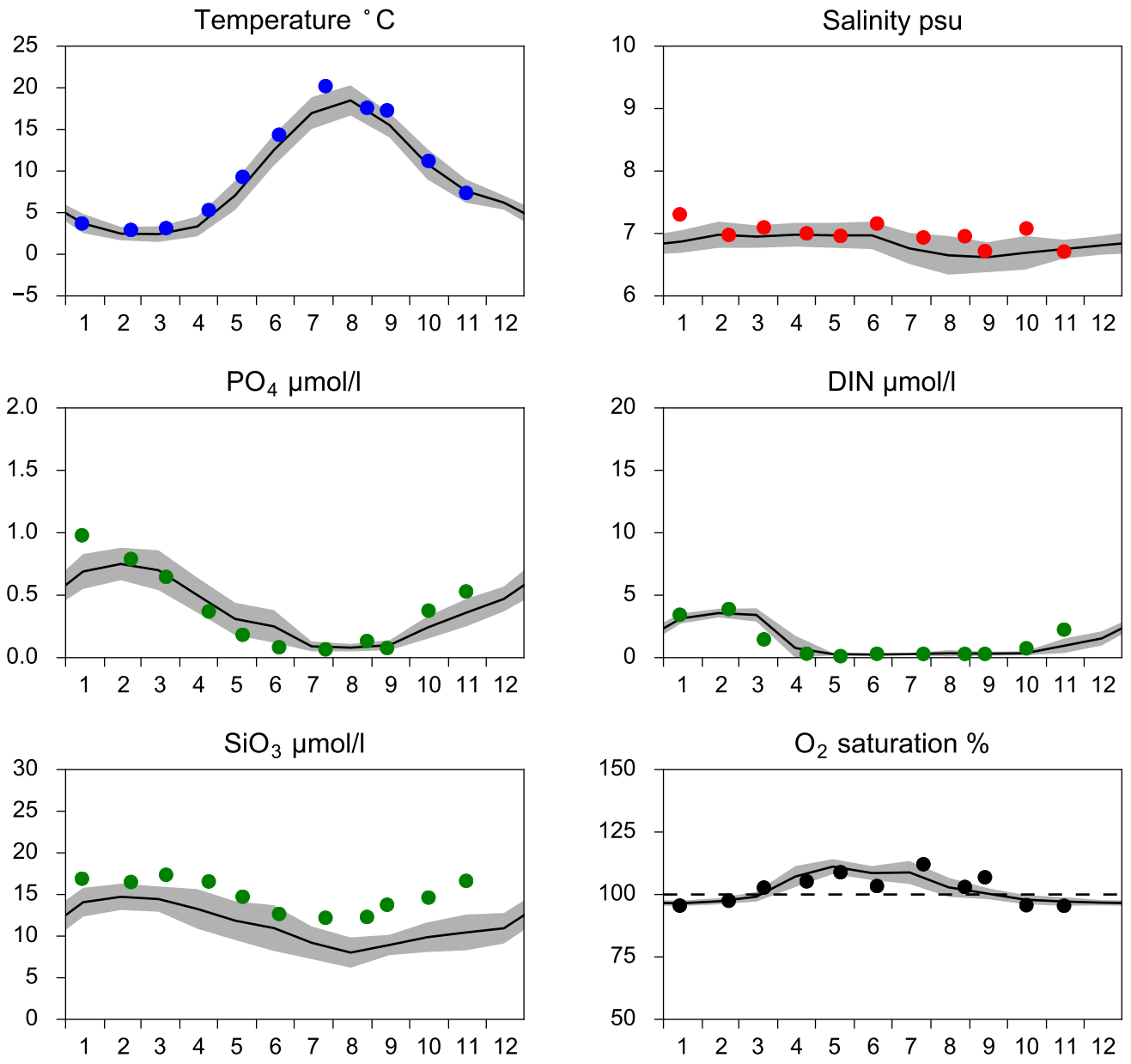
Vertical profiles BY32 NORRKÖPINGSDJ
November



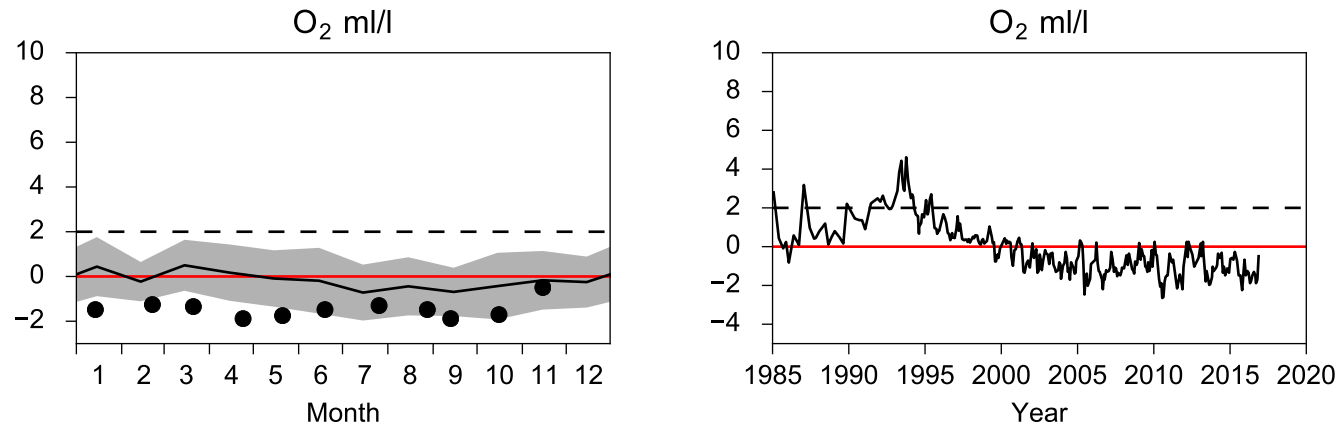
STATION BY38 KARLSÖDJ SURFACE WATER (0-10m)

Annual Cycles

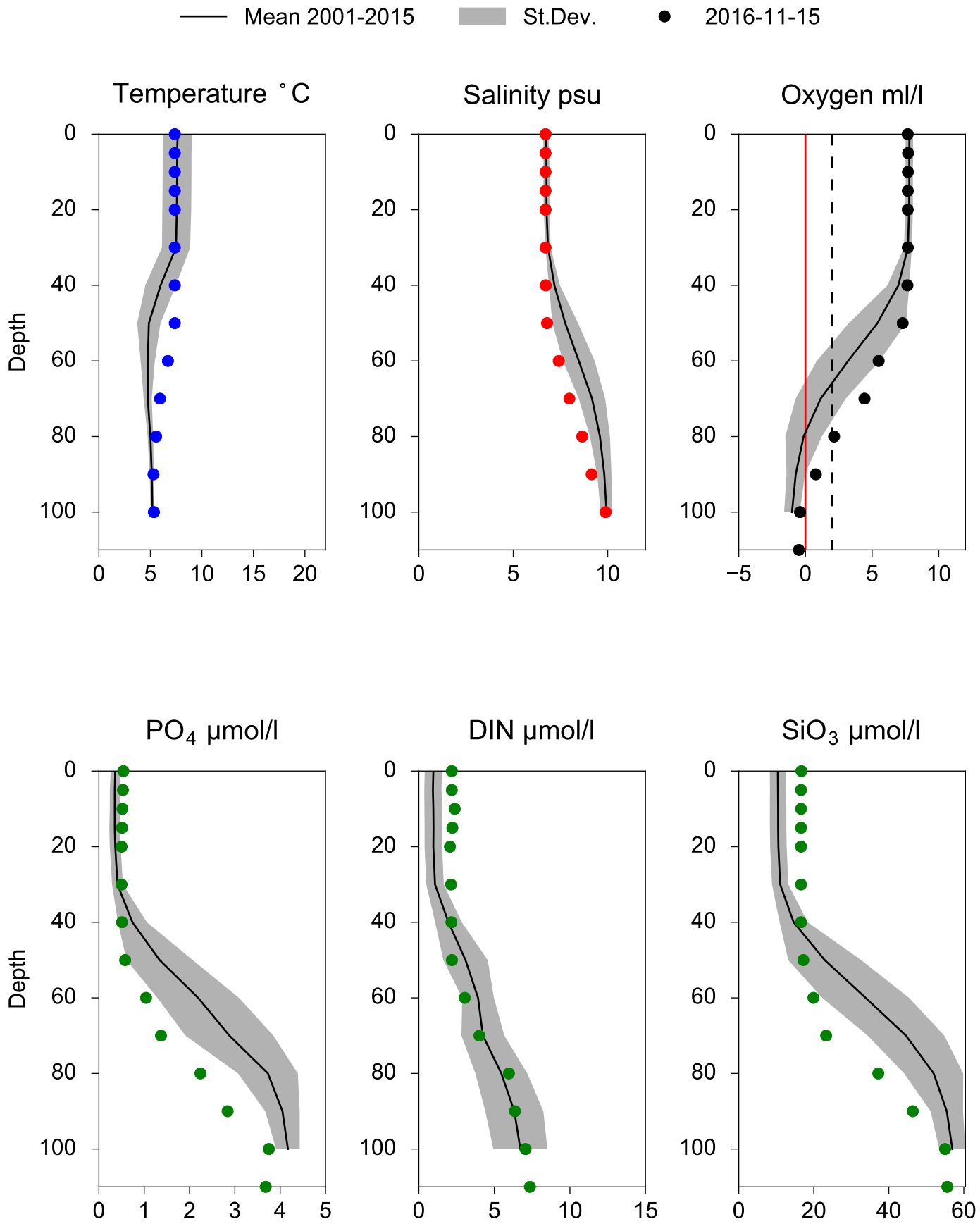
Mean 2001-2015 | St.Dev. | 2016



OXYGEN IN BOTTOM WATER (depth >= 100 m)



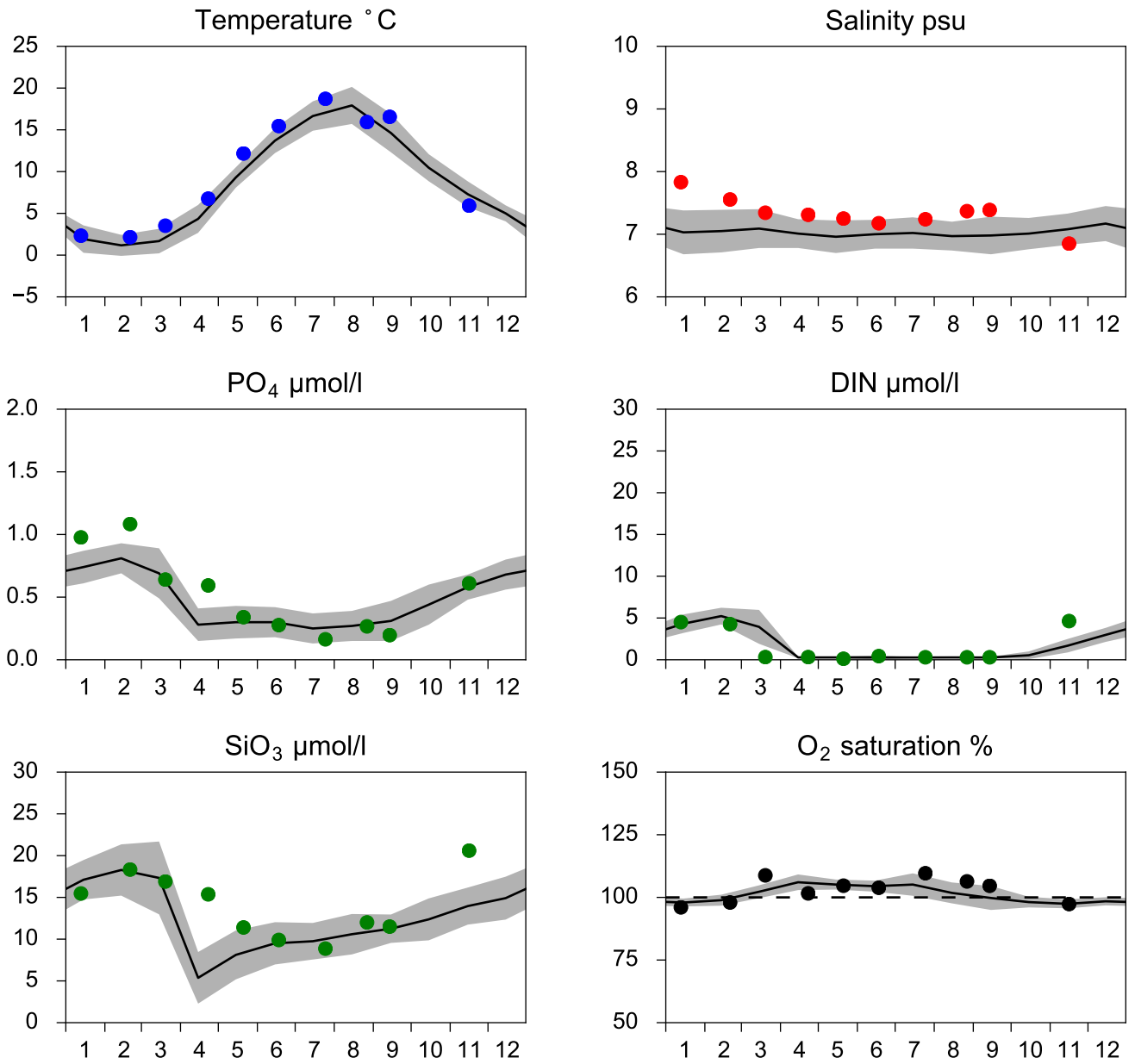
Vertical profiles BY38 KARLSÖDJ
November



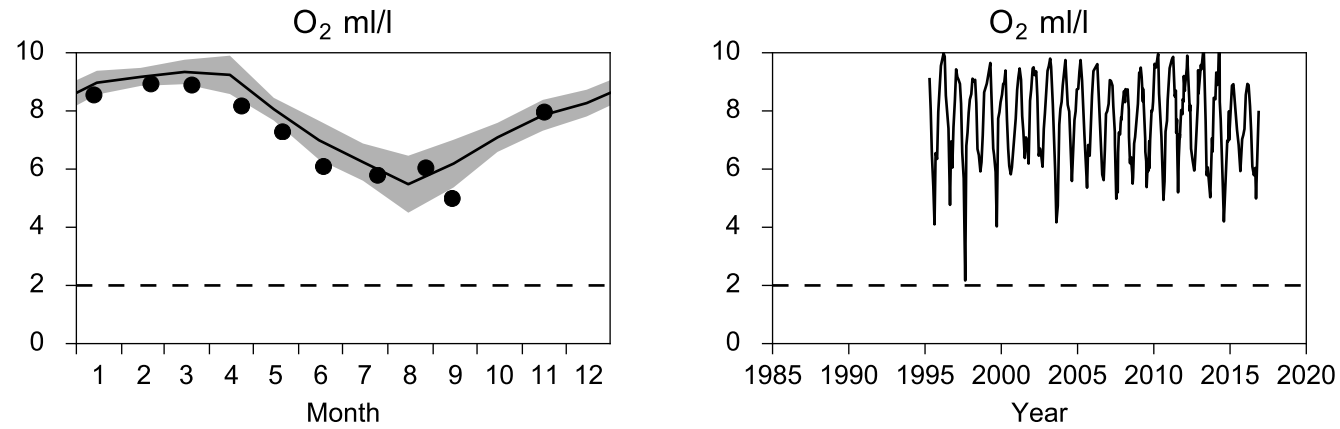
STATION REF M1V1 SURFACE WATER (0-10m)

Annual Cycles

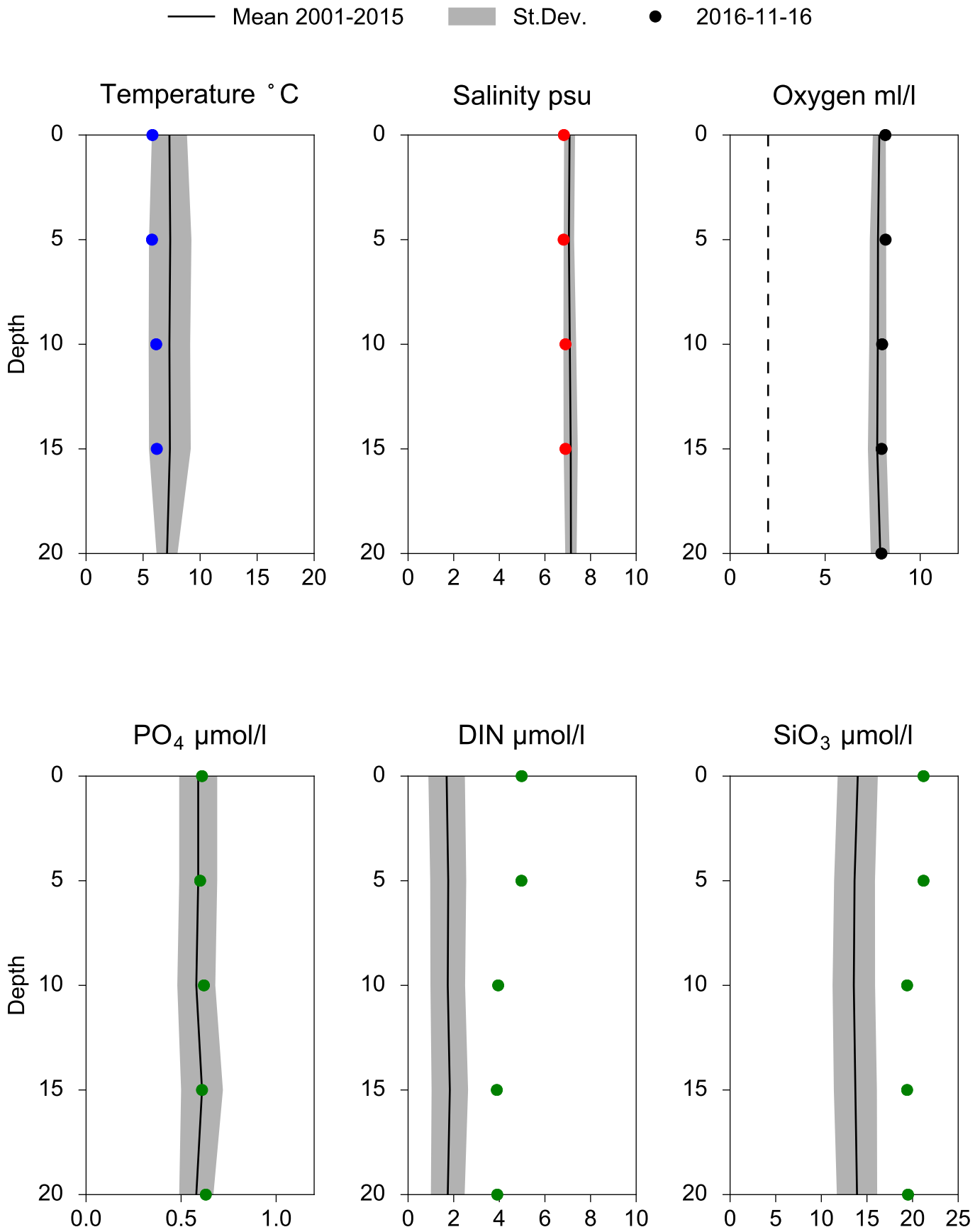
Mean 2001-2015 | St.Dev. | 2016



OXYGEN IN BOTTOM WATER (depth >= 17 m)

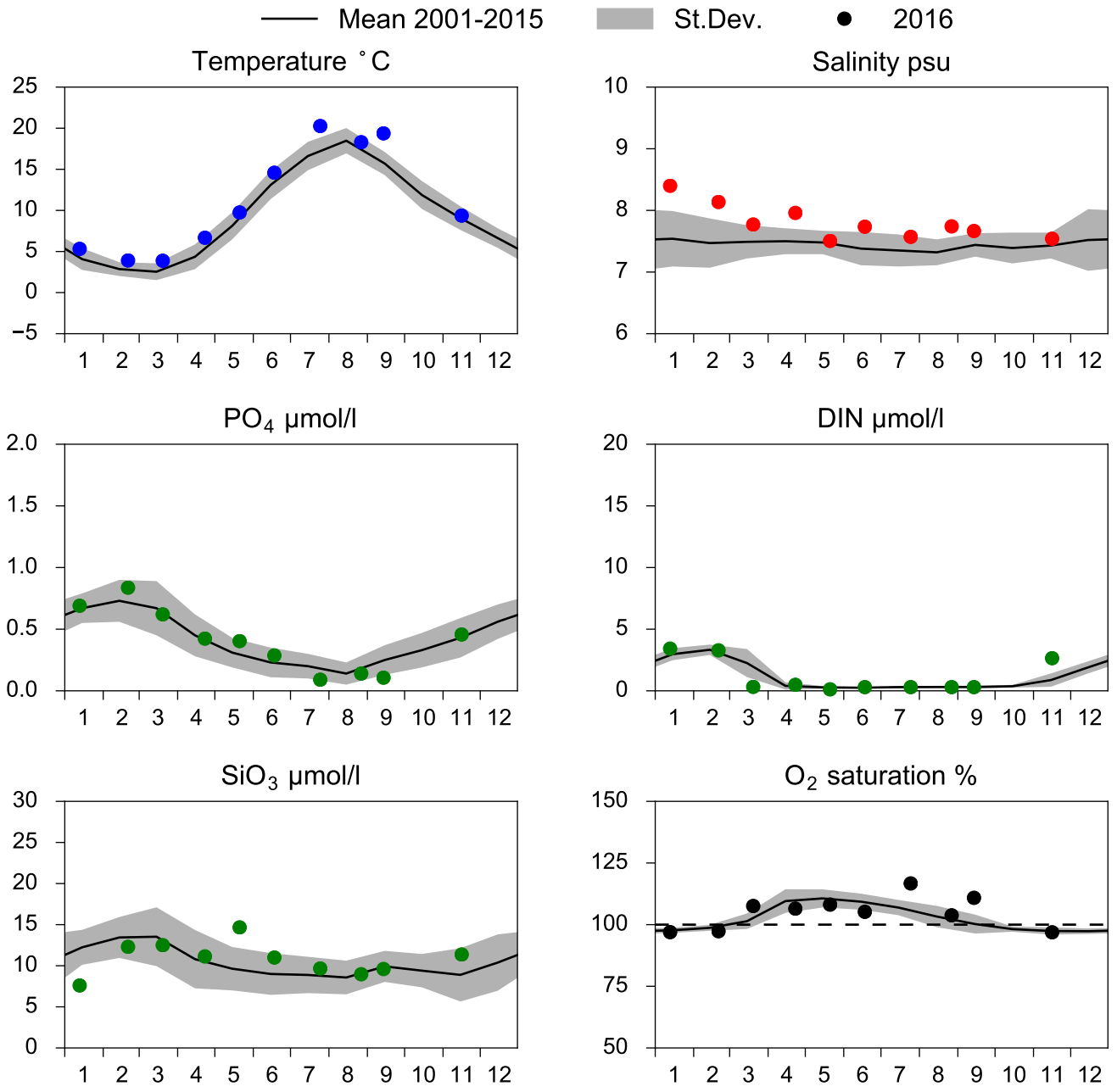


Vertical profiles REF M1V1
November

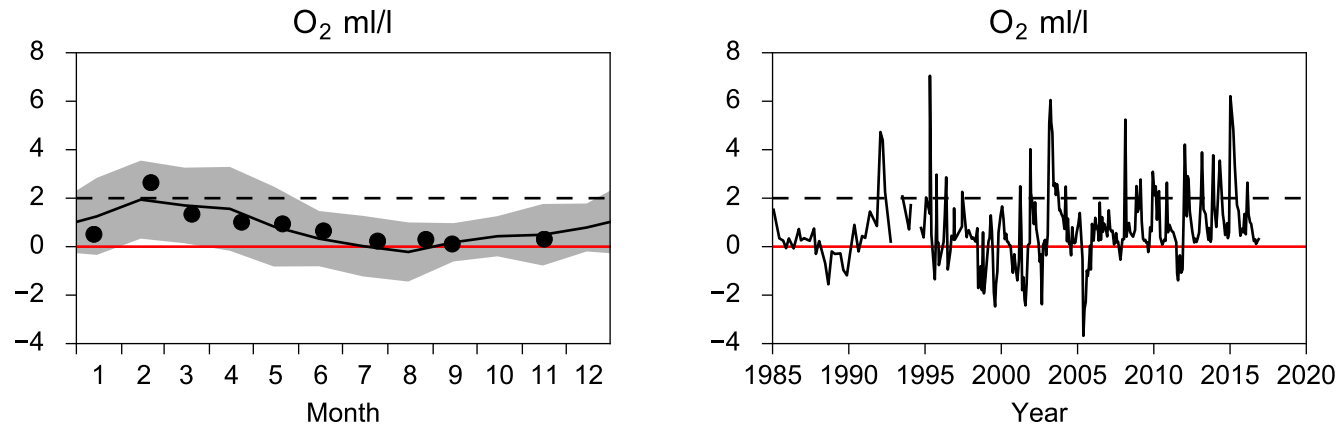


STATION HANÖBUKTEN SURFACE WATER (0-10m)

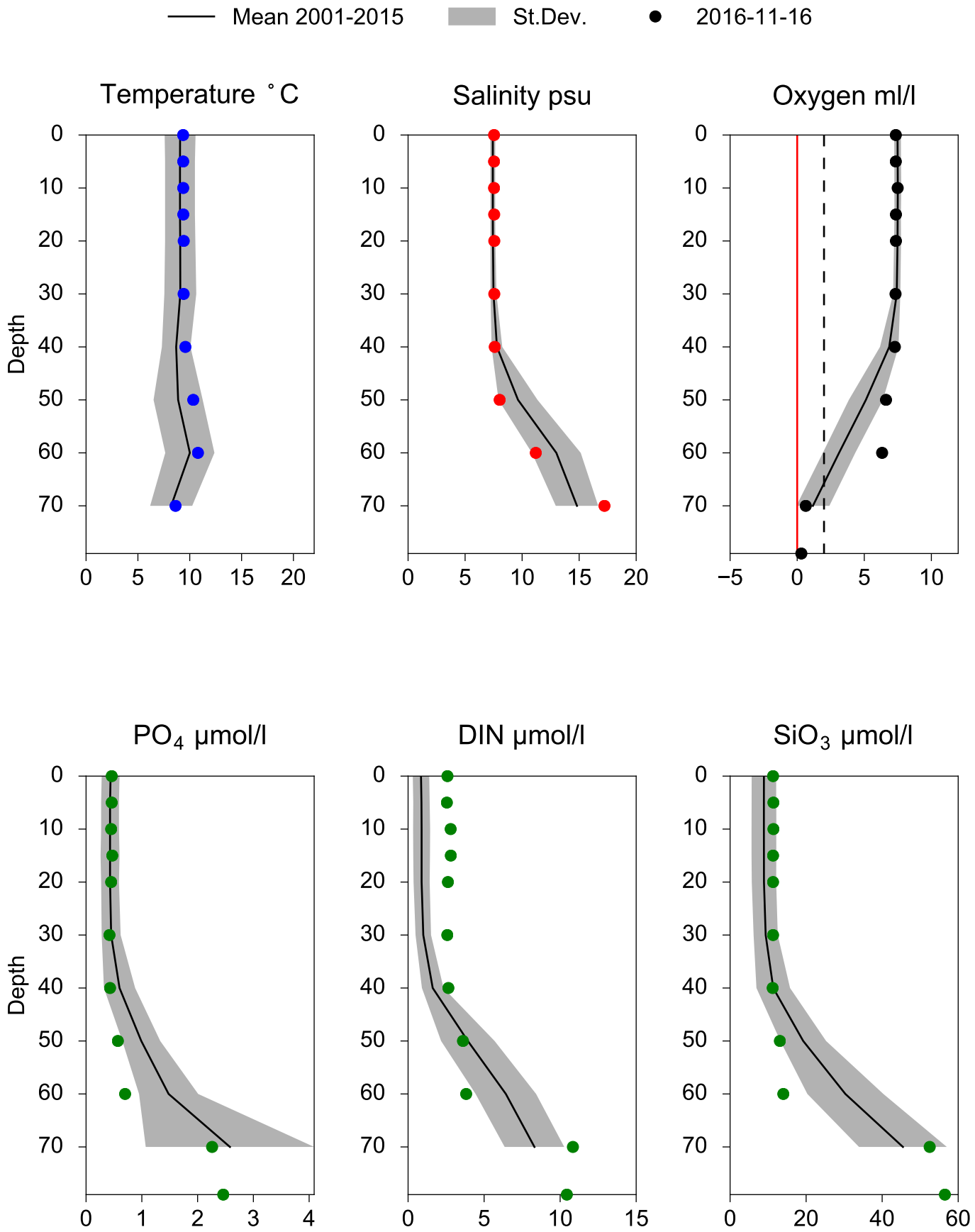
Annual Cycles



OXYGEN IN BOTTOM WATER (depth >= 70 m)



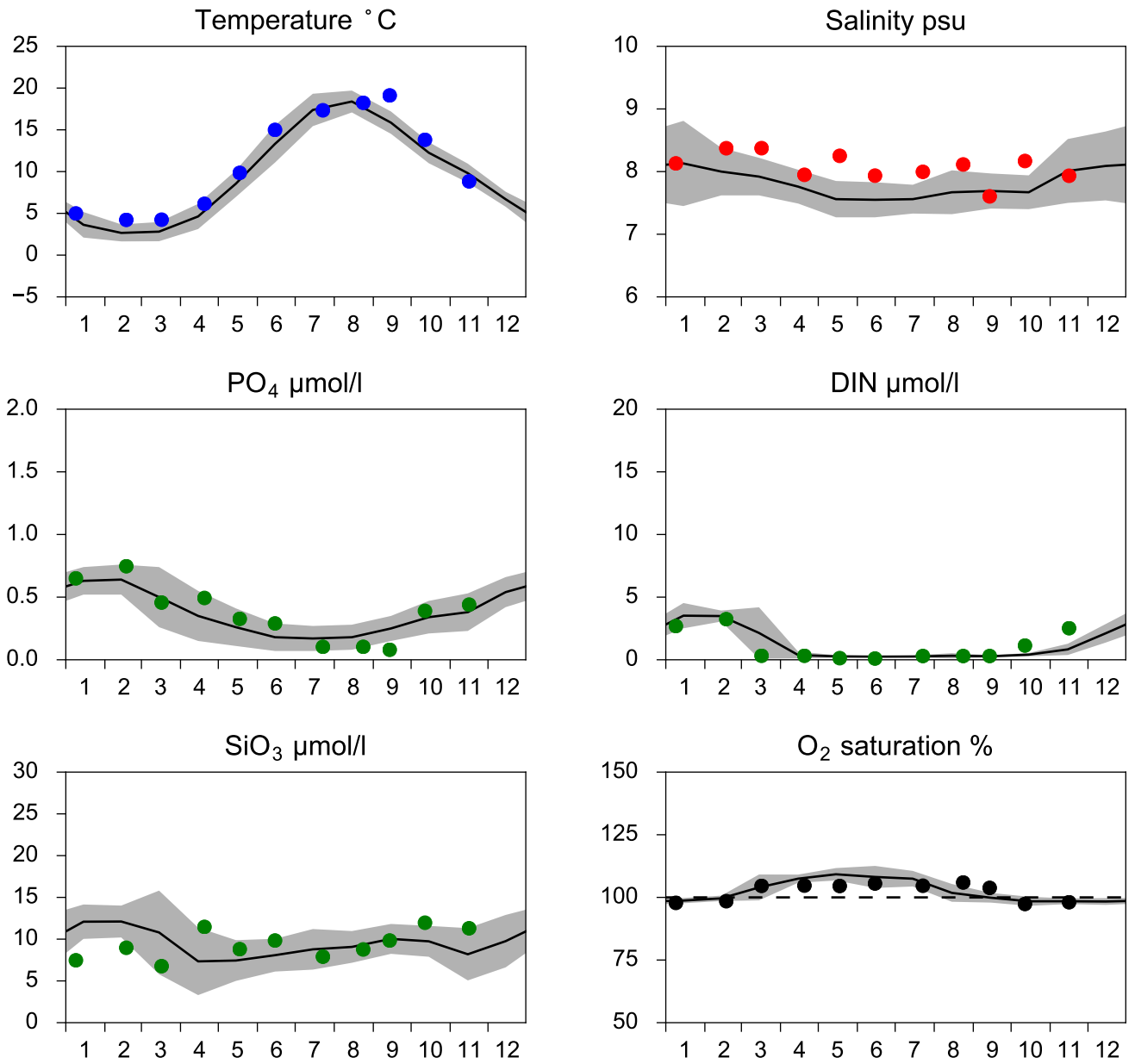
Vertical profiles HANÖBUKTEN
November



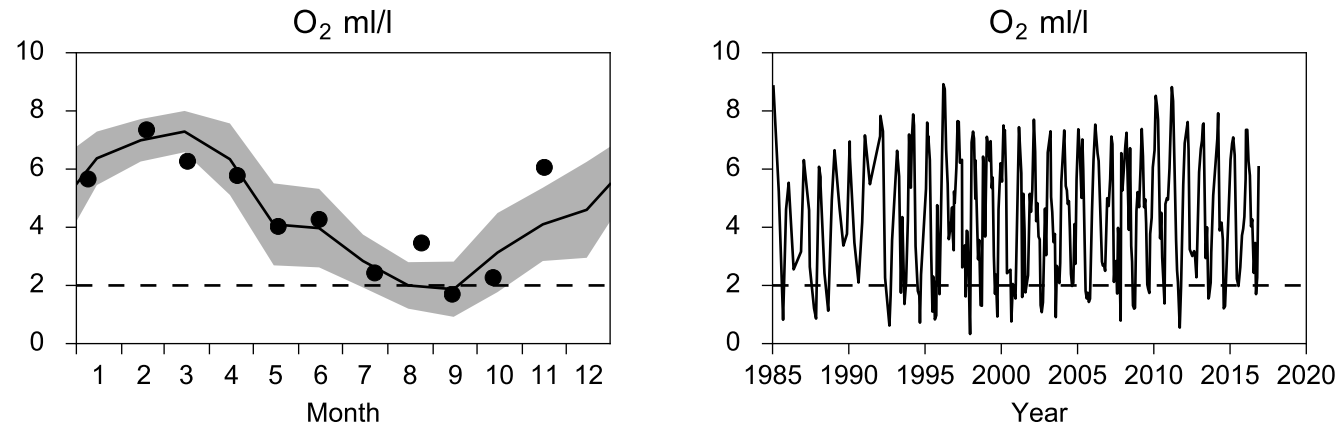
STATION BY2 ARKONA SURFACE WATER (0-10m)

Annual Cycles

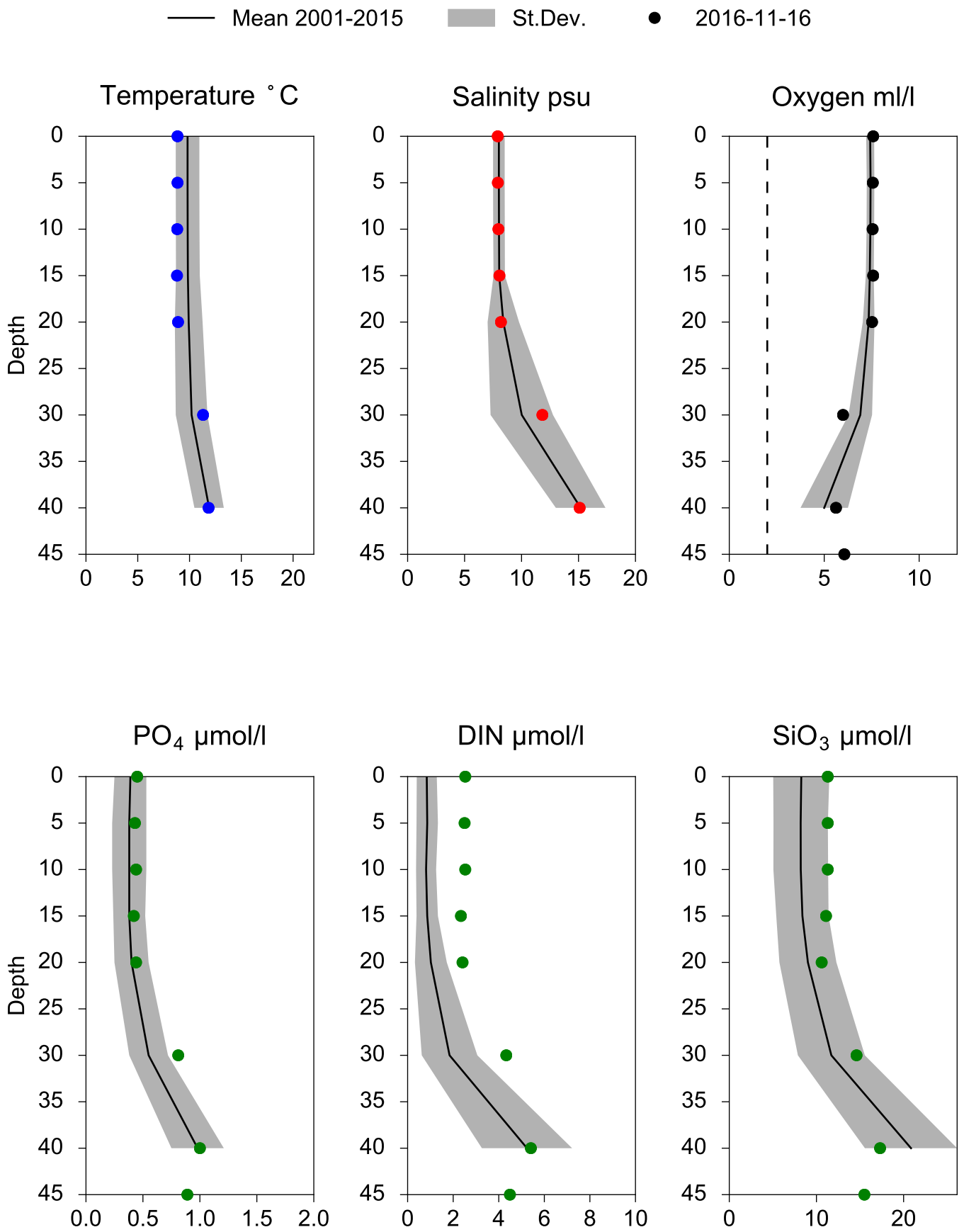
Mean 2001-2015 | St.Dev. | 2016



OXYGEN IN BOTTOM WATER (depth >= 40 m)

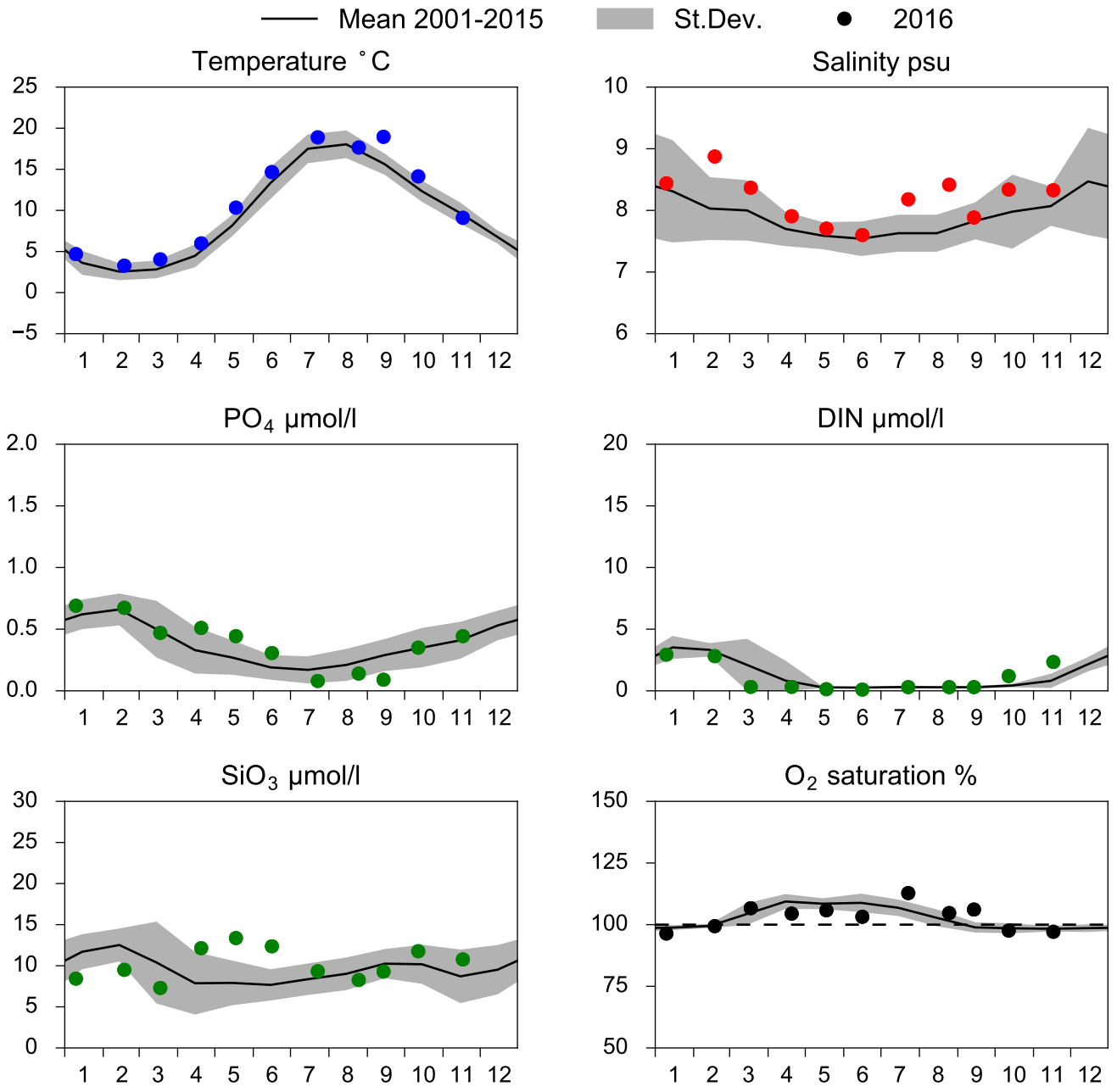


Vertical profiles BY2 ARKONA
November

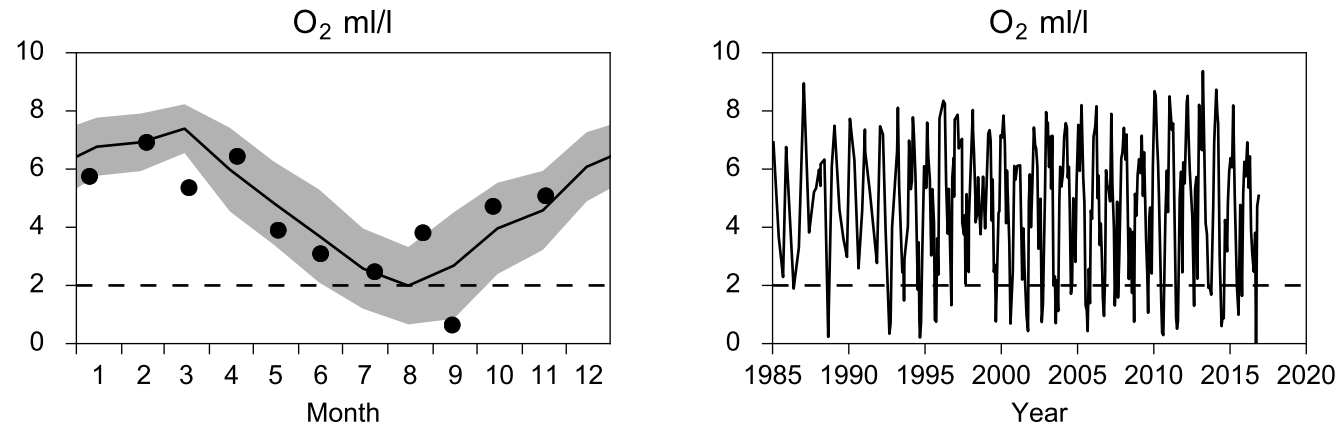


STATION BY1 SURFACE WATER (0-10m)

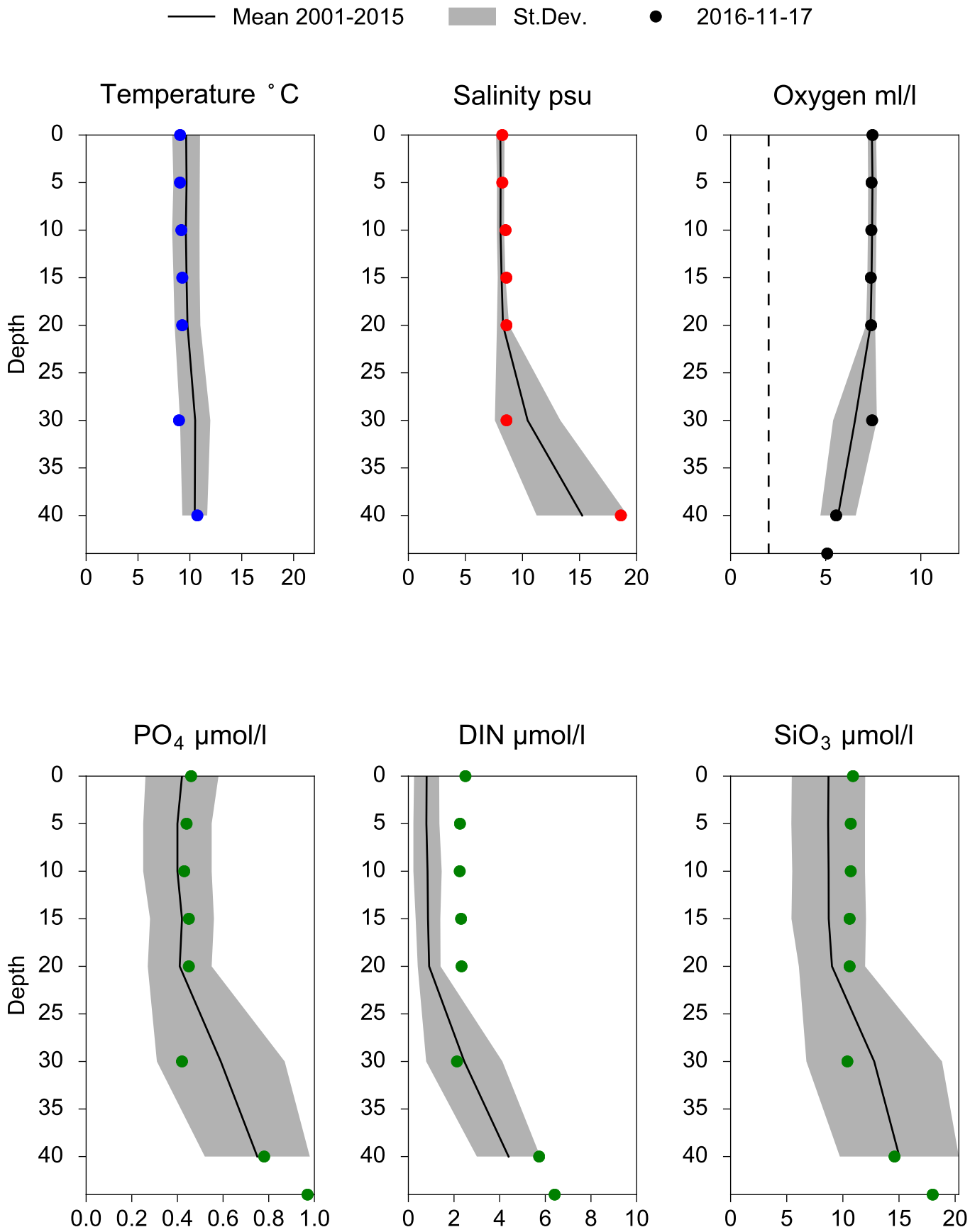
Annual Cycles



OXYGEN IN BOTTOM WATER (depth >= 40 m)



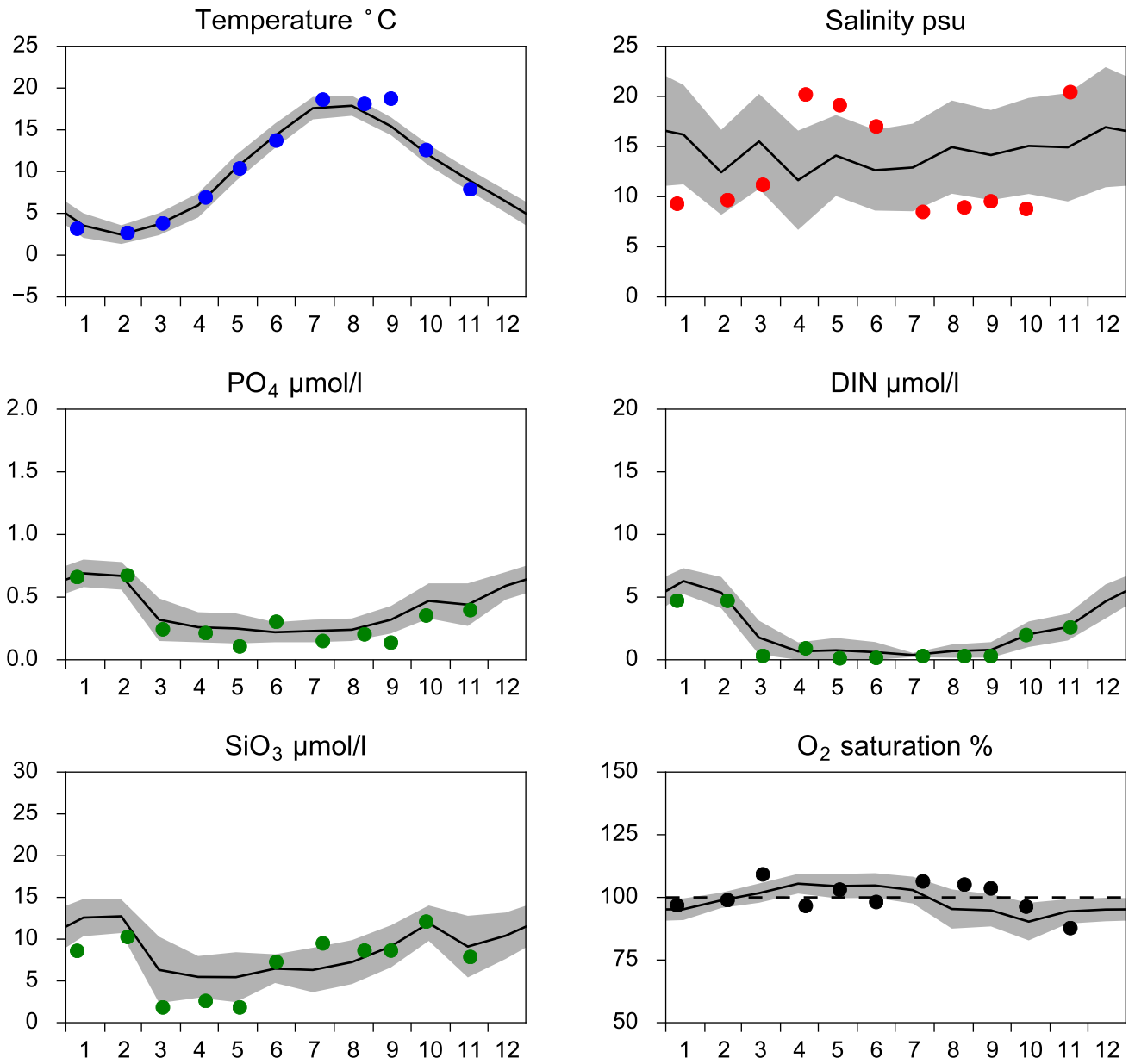
Vertical profiles BY1
November



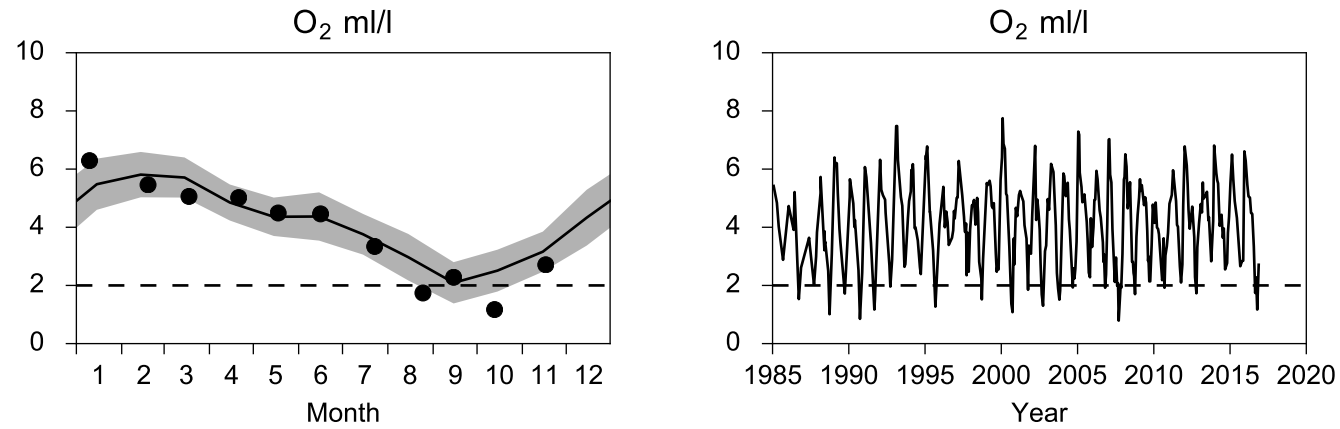
STATION W LANDSKRONA SURFACE WATER (0-10m)

Annual Cycles

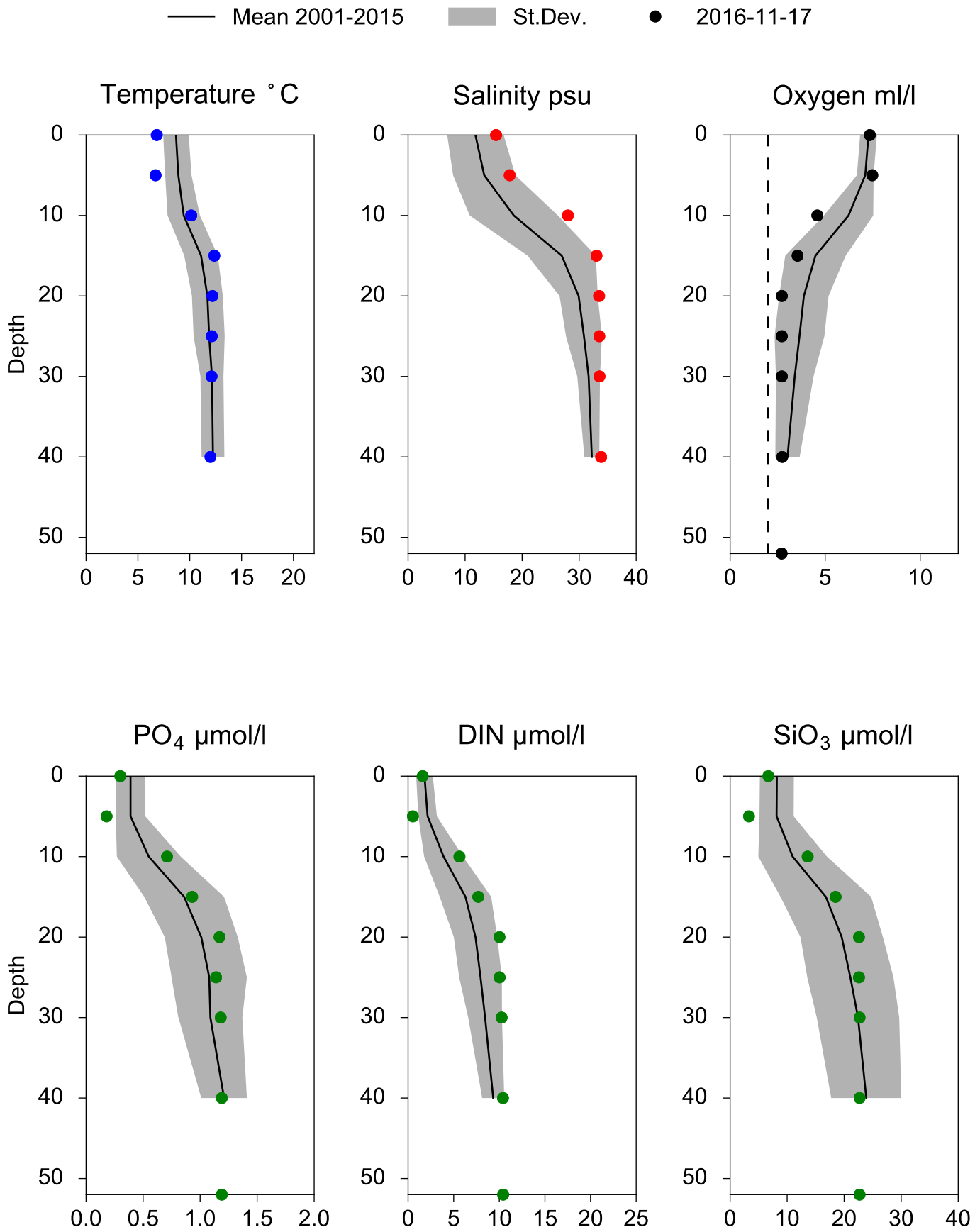
Mean 2001-2015 | St.Dev. | 2016



OXYGEN IN BOTTOM WATER (depth >= 40 m)



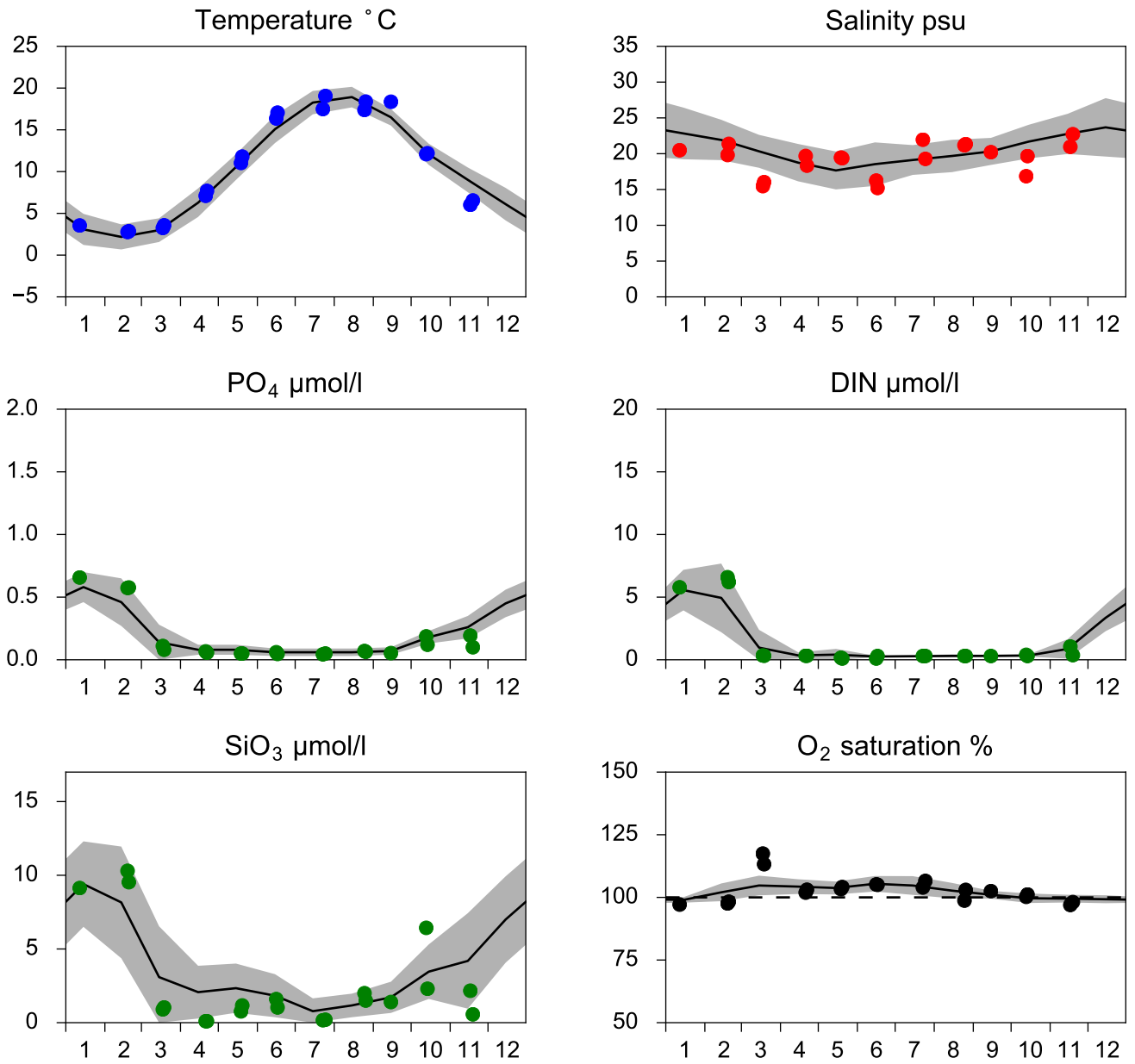
Vertical profiles W LANDSKRONA
November



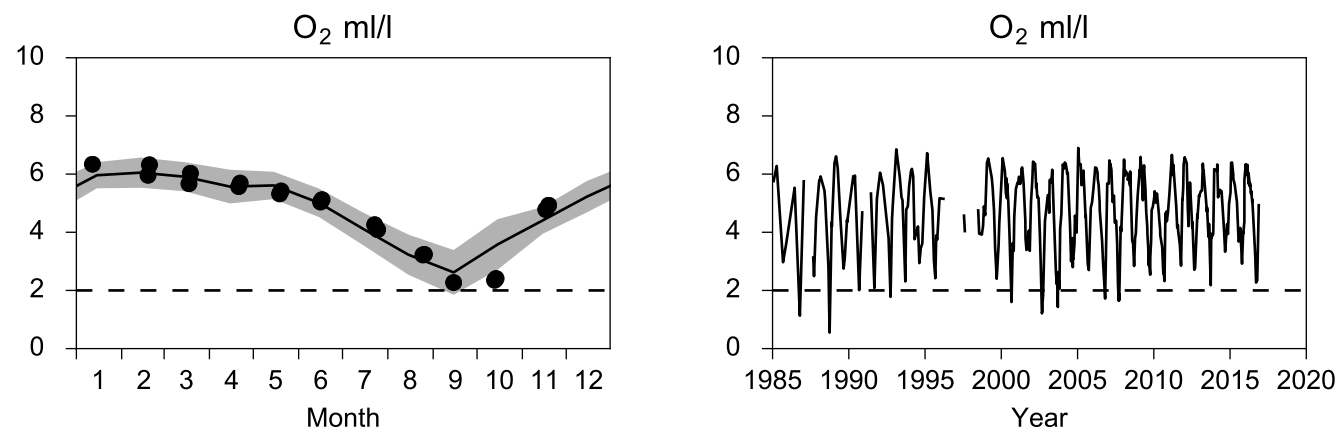
STATION ANHOLT E SURFACE WATER (0-10m)

Annual Cycles

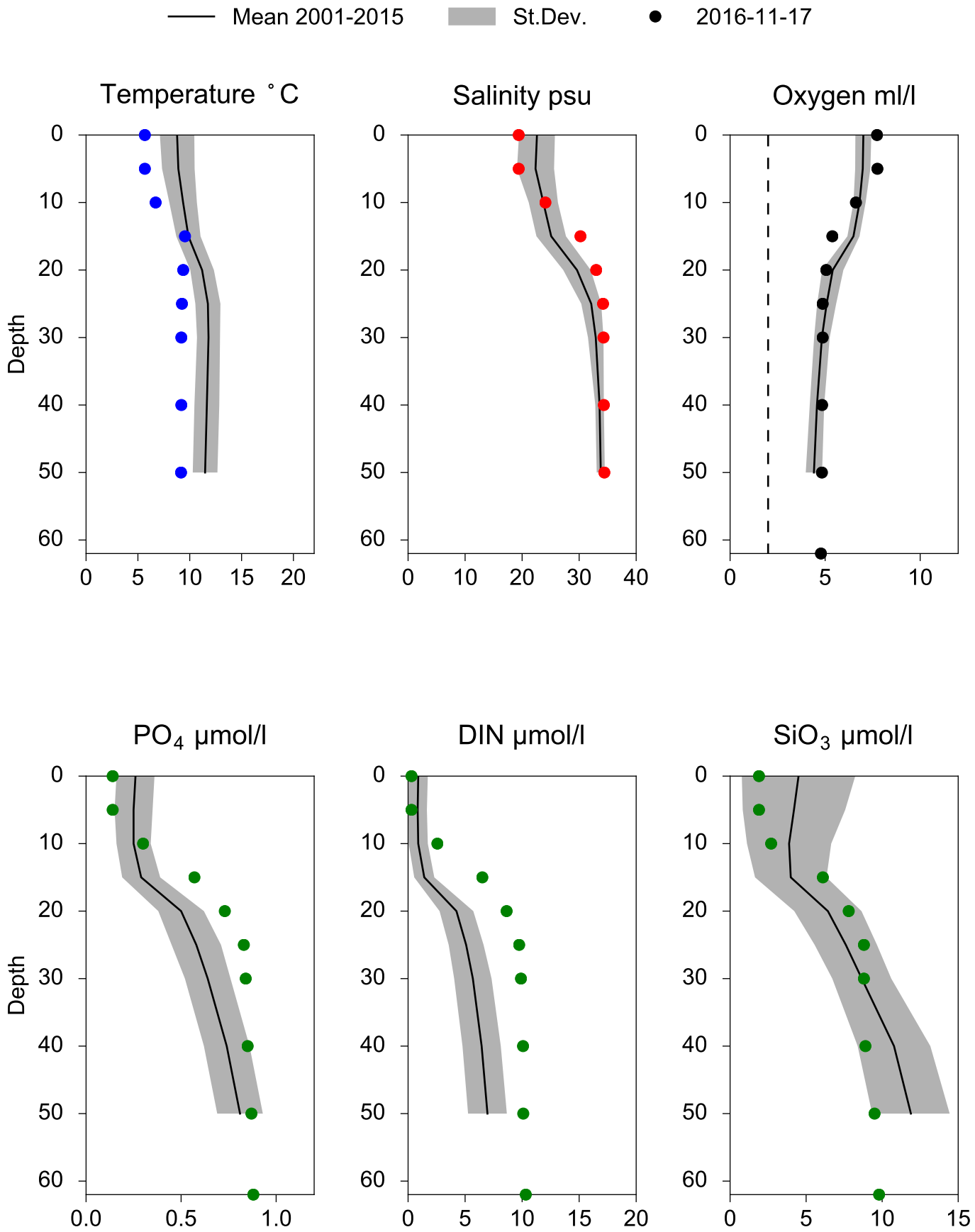
Mean 2001-2015 | St.Dev. | 2016



OXYGEN IN BOTTOM WATER (depth >= 52 m)



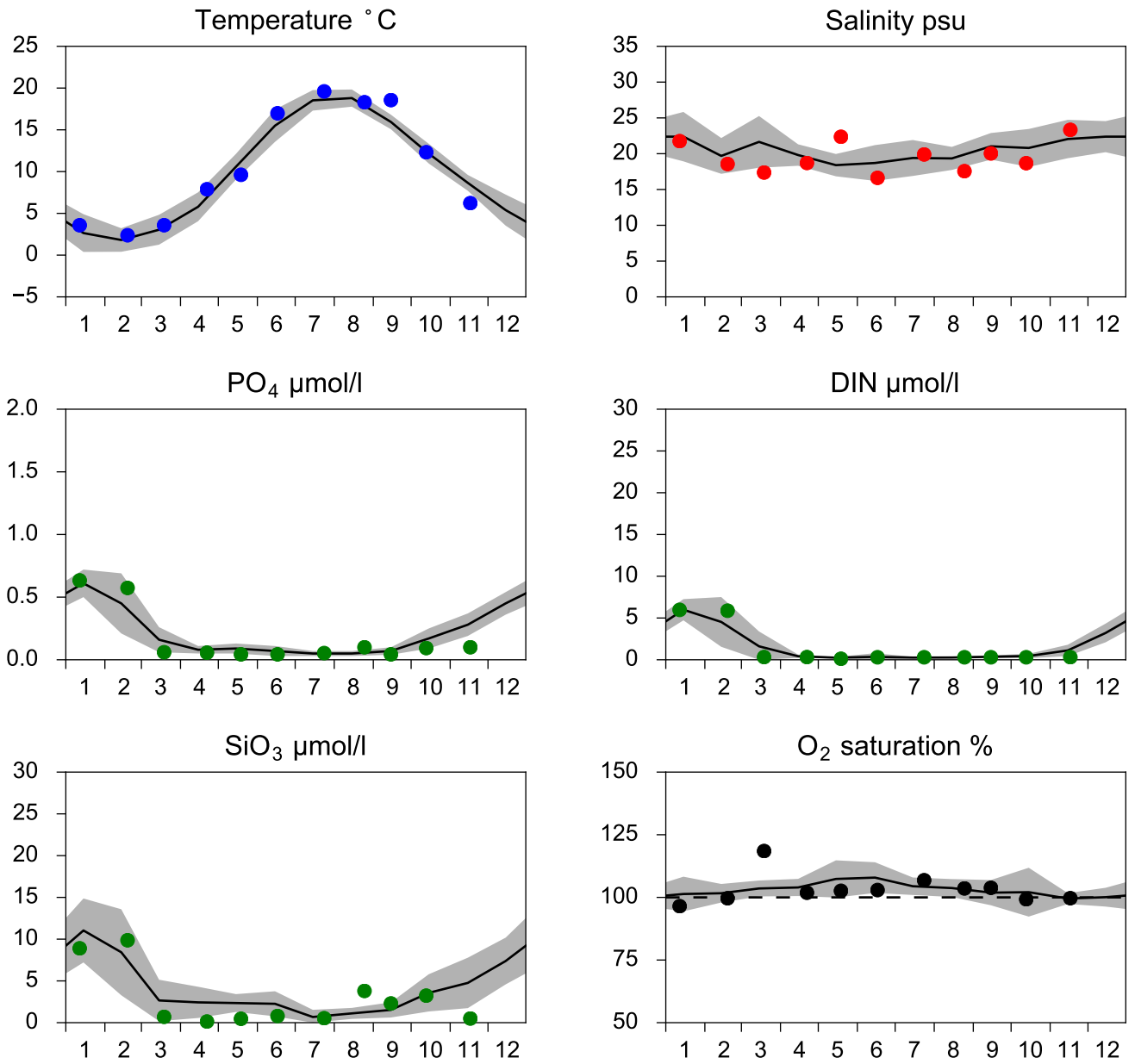
Vertical profiles ANHOLT E
November



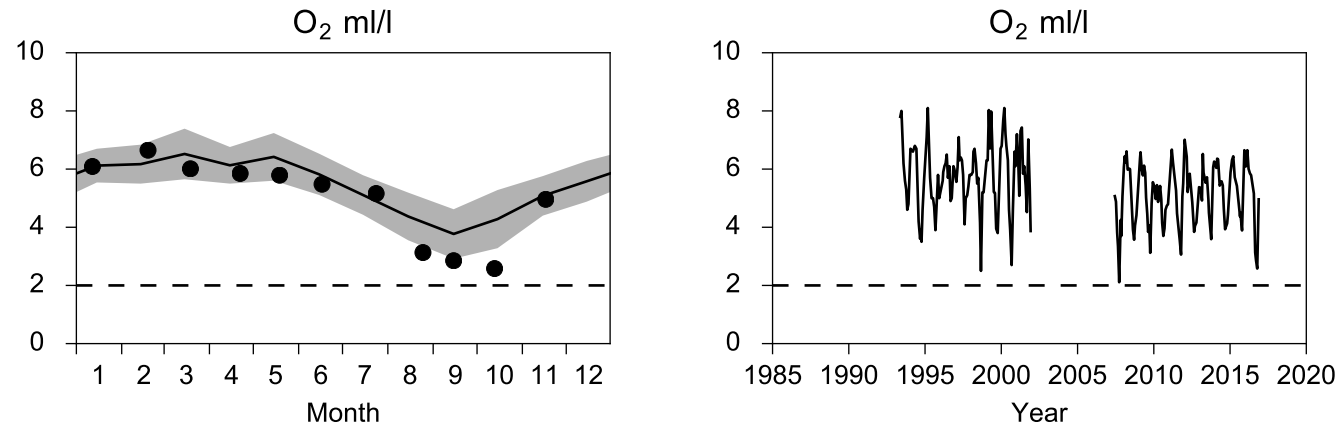
STATION N14 FALKENBERG SURFACE WATER (0-10m)

Annual Cycles

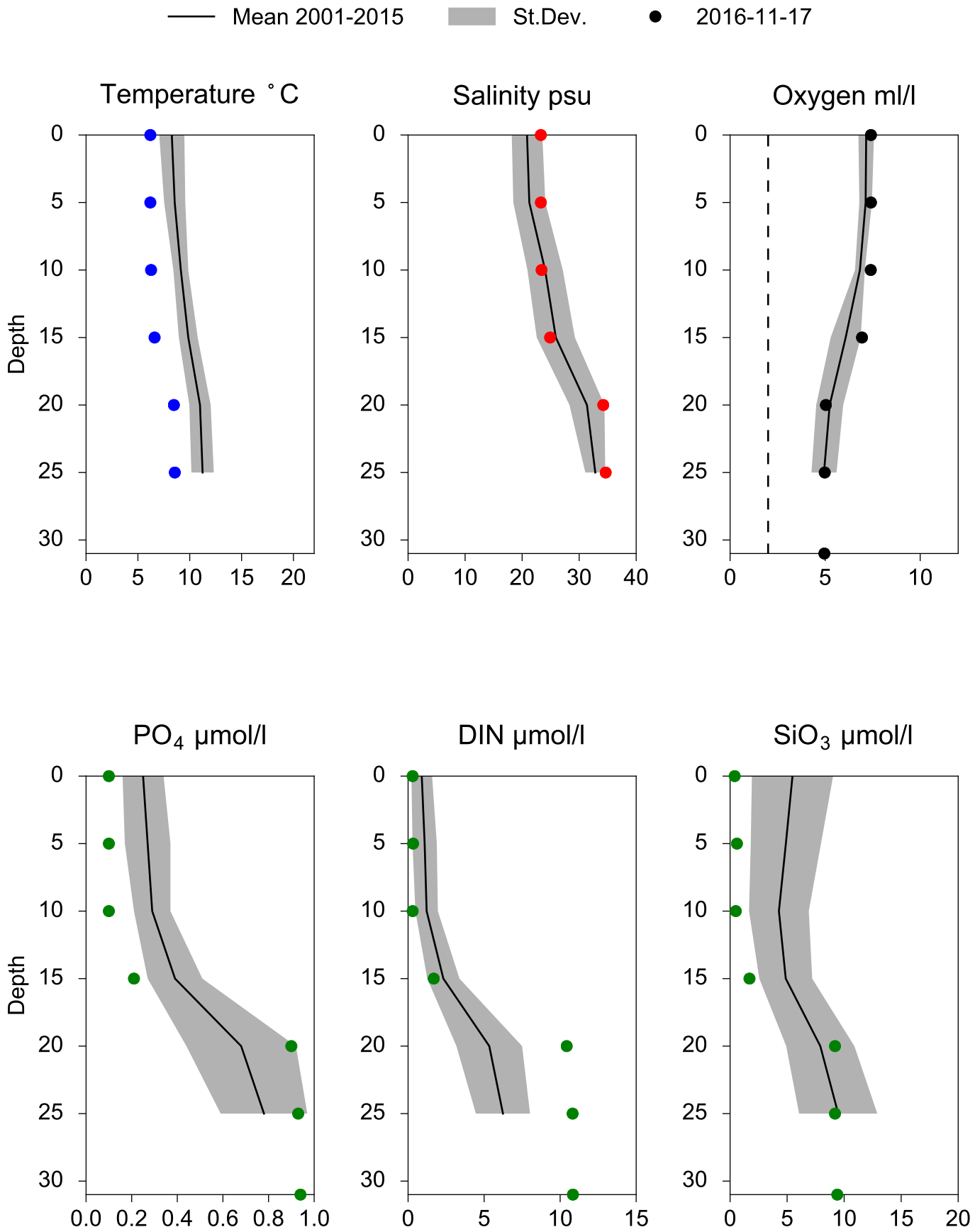
Mean 2001-2015 | St.Dev. | 2016



OXYGEN IN BOTTOM WATER (depth >= 25 m)



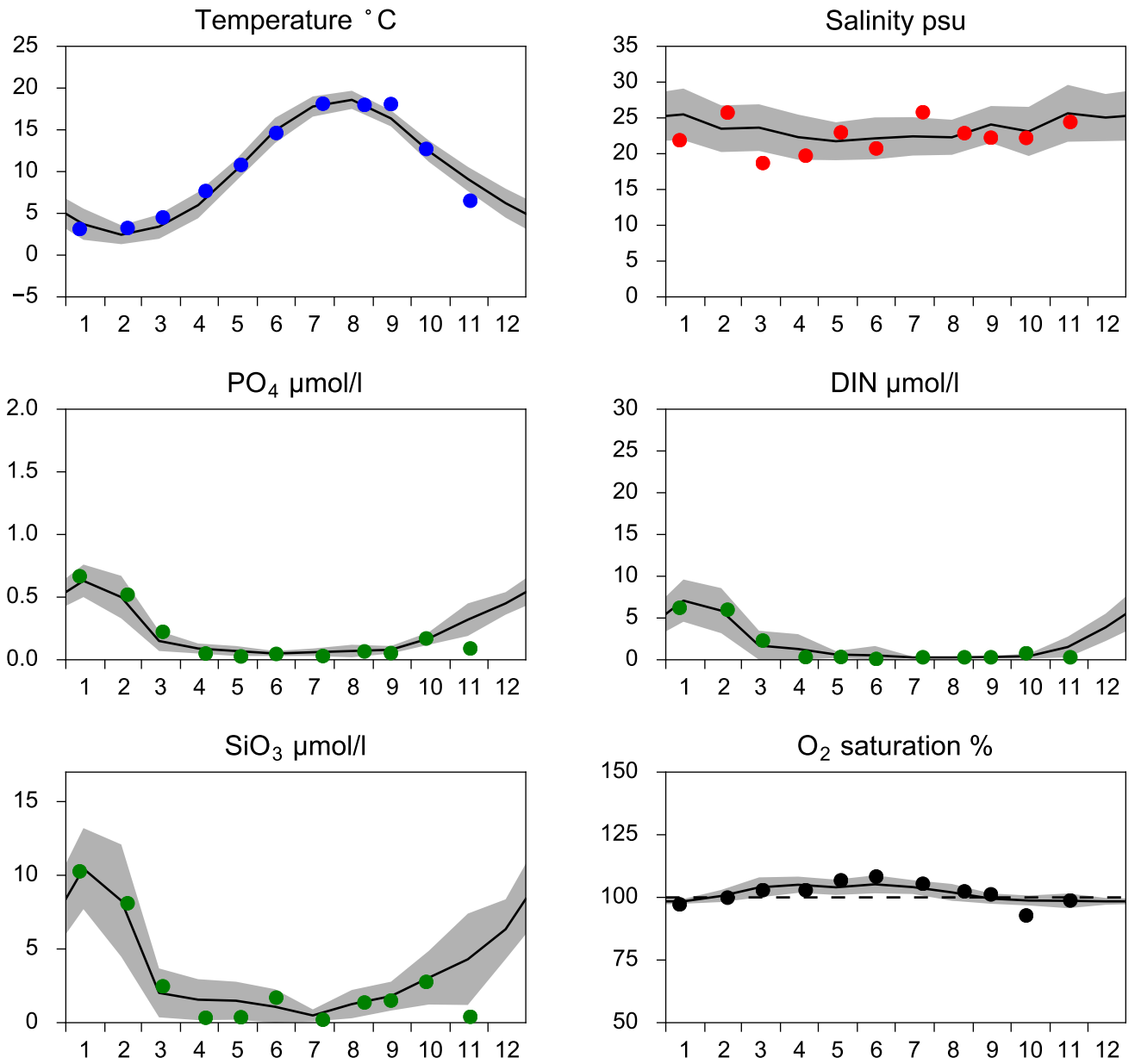
Vertical profiles N14 FALKENBERG
November



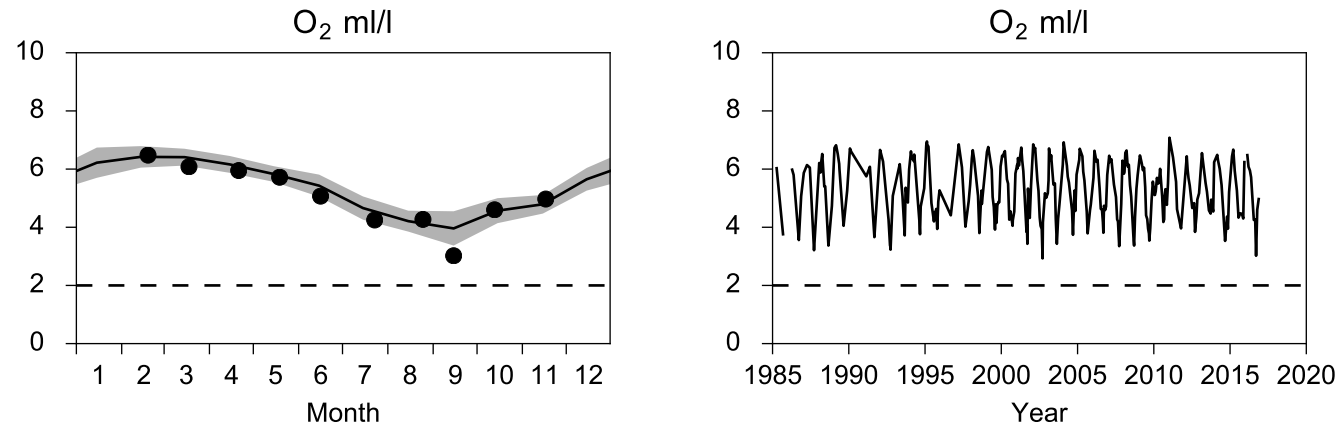
STATION FLADEN SURFACE WATER (0-10m)

Annual Cycles

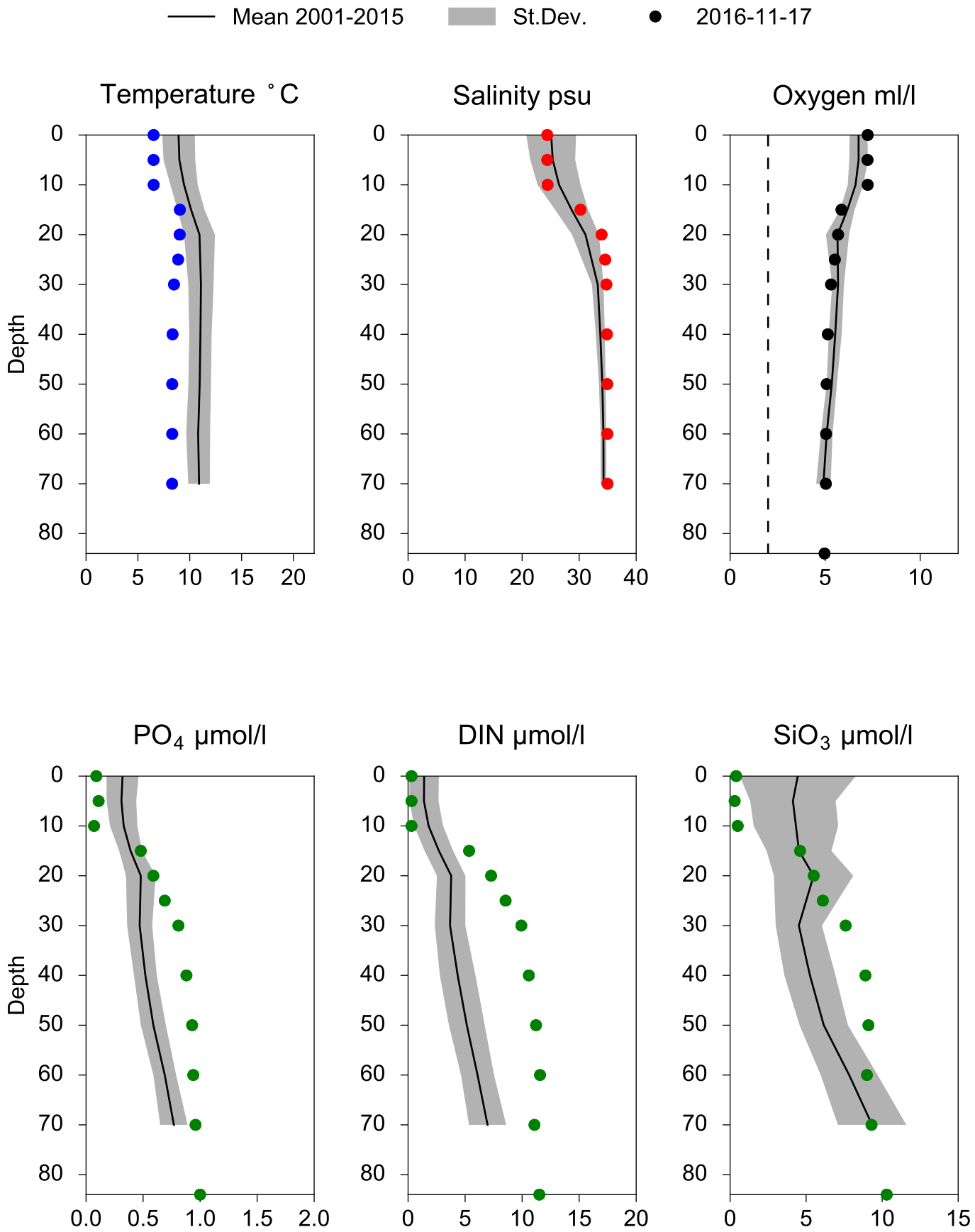
Mean 2001-2015 | St.Dev. | 2016



OXYGEN IN BOTTOM WATER (depth >= 74 m)



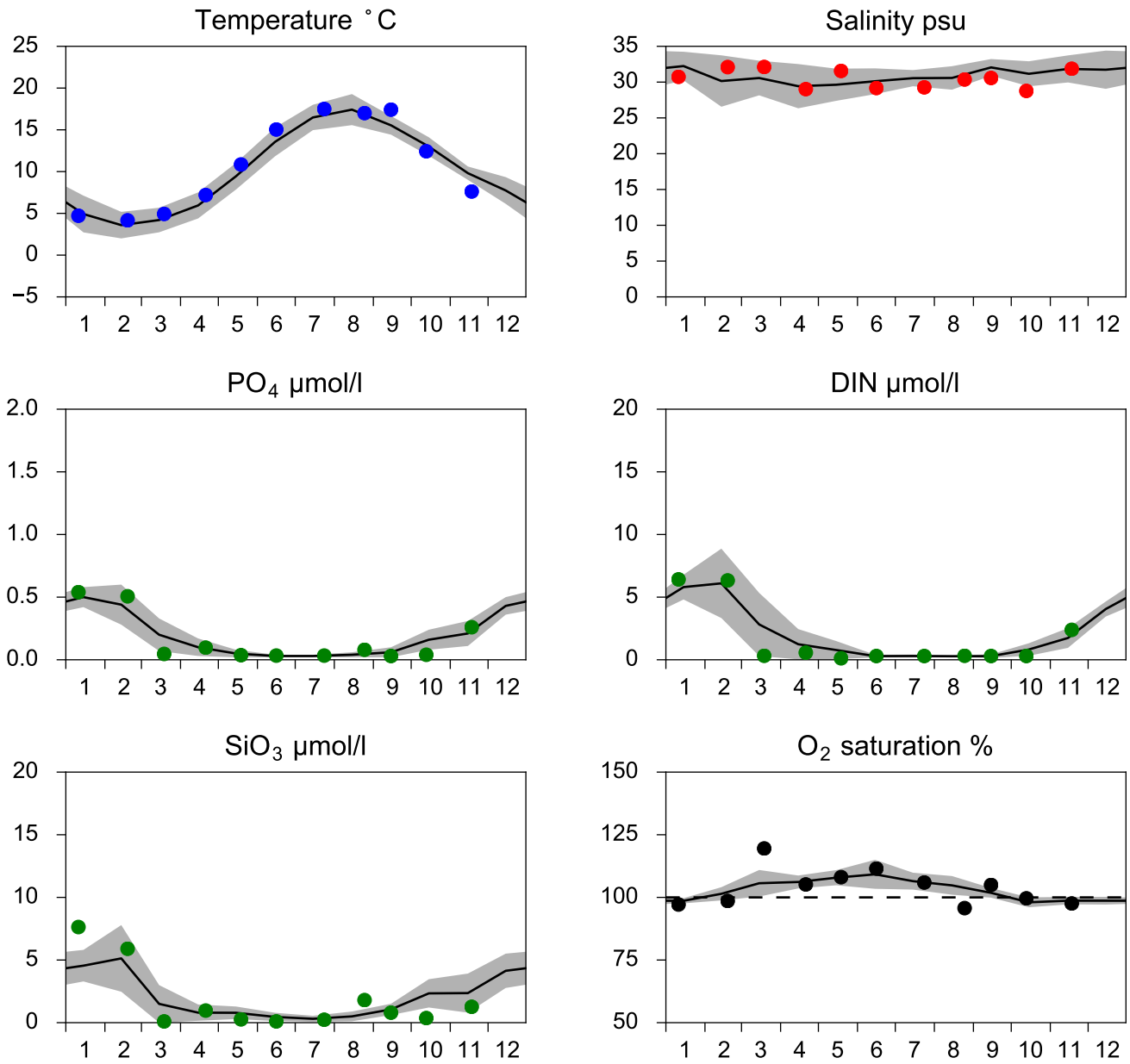
Vertical profiles FLADEN
November



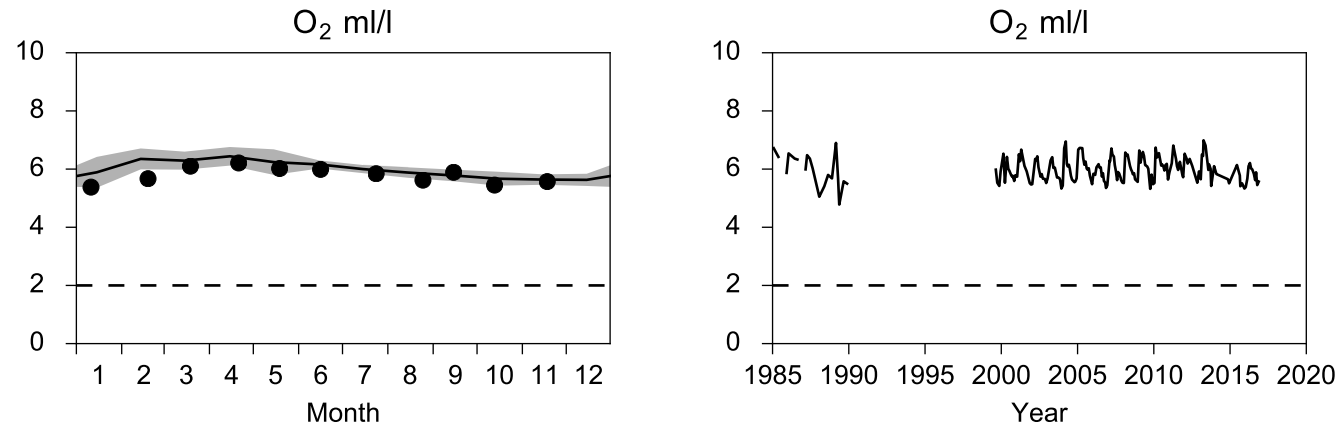
STATION Å17 SURFACE WATER (0-10m)

Annual Cycles

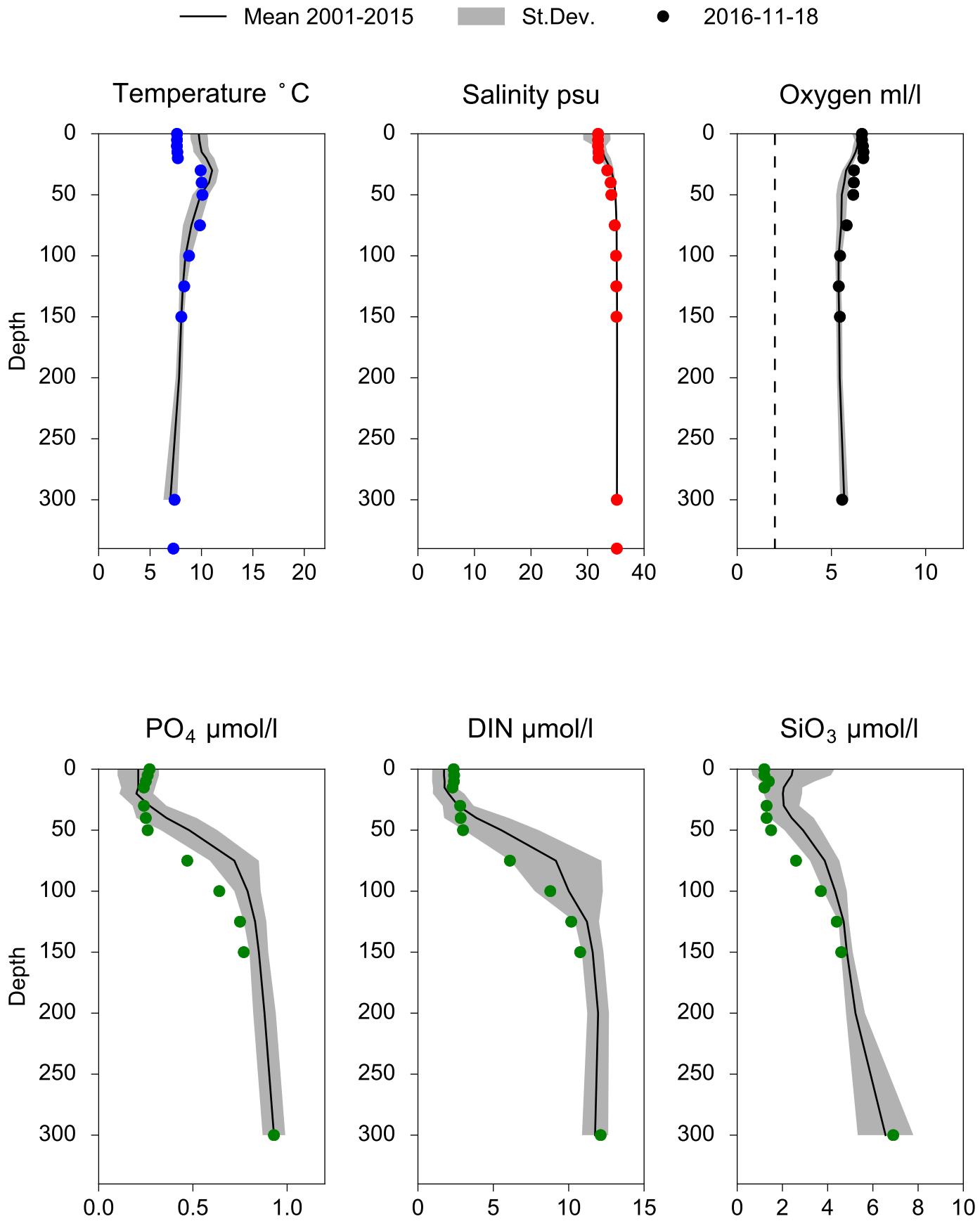
Mean 2001-2015 | St.Dev. | 2016



OXYGEN IN BOTTOM WATER (depth >= 300 m)

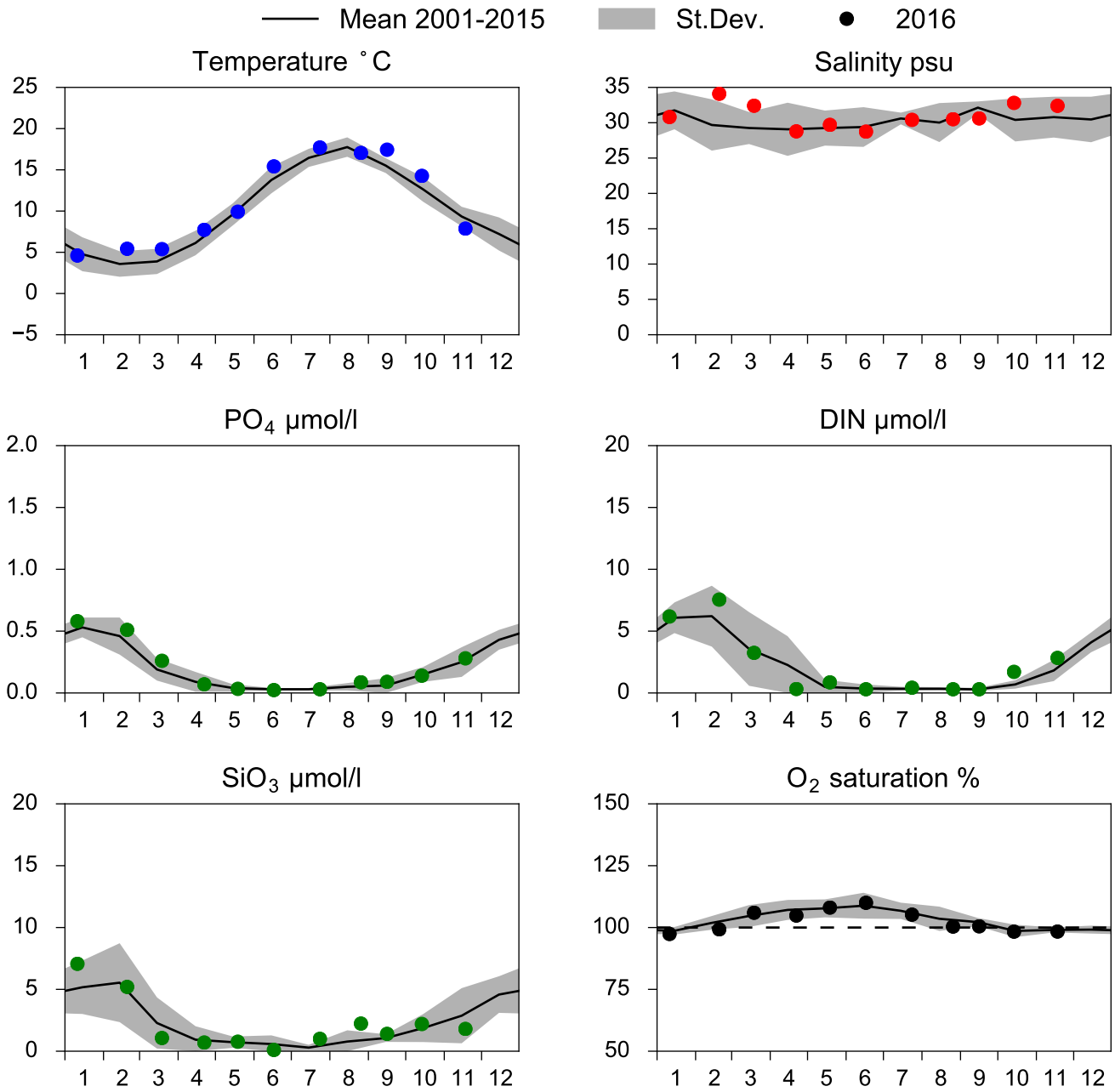


Vertical profiles Å17
November

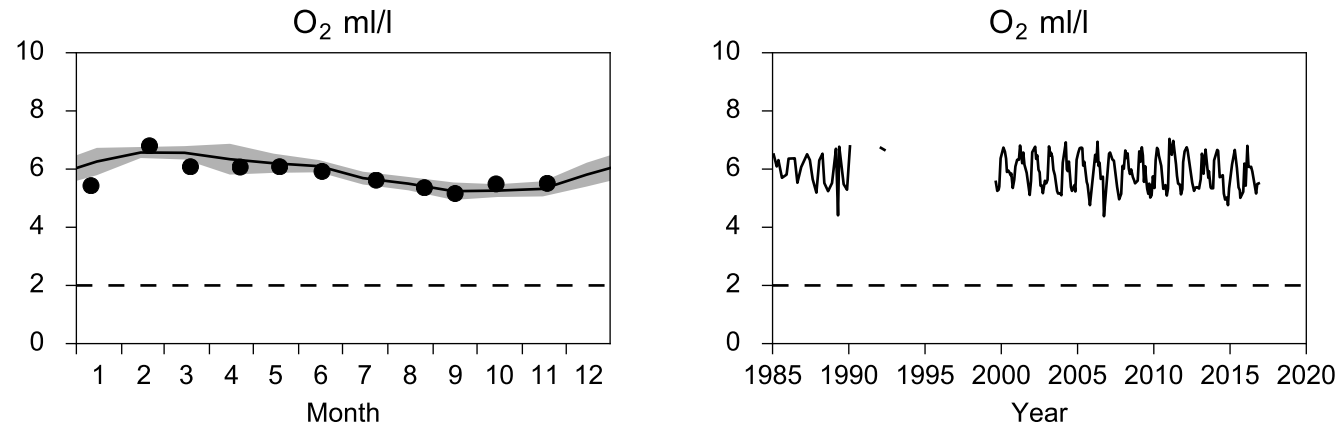


STATION Å15 SURFACE WATER (0-10m)

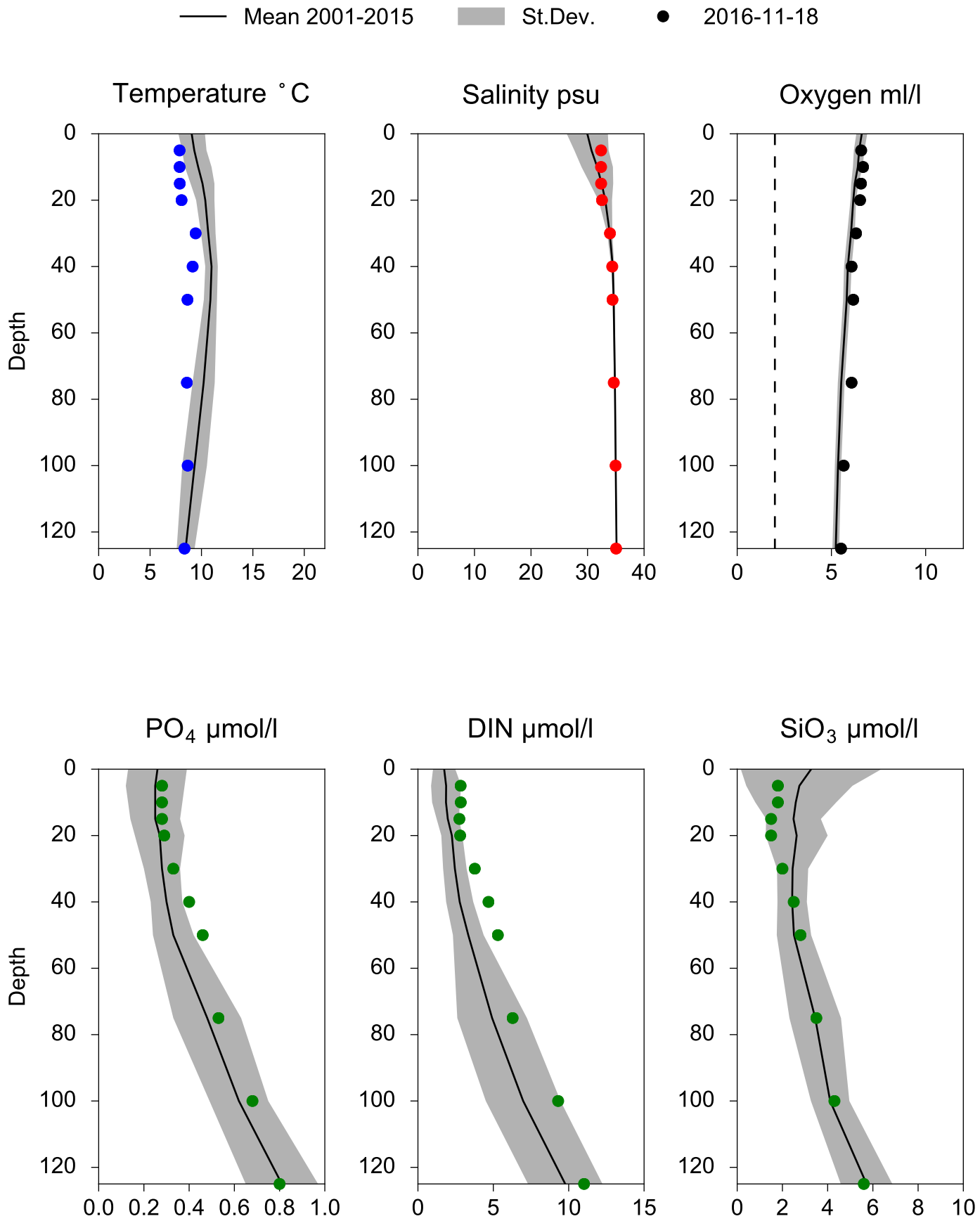
Annual Cycles



OXYGEN IN BOTTOM WATER (depth >= 125 m)



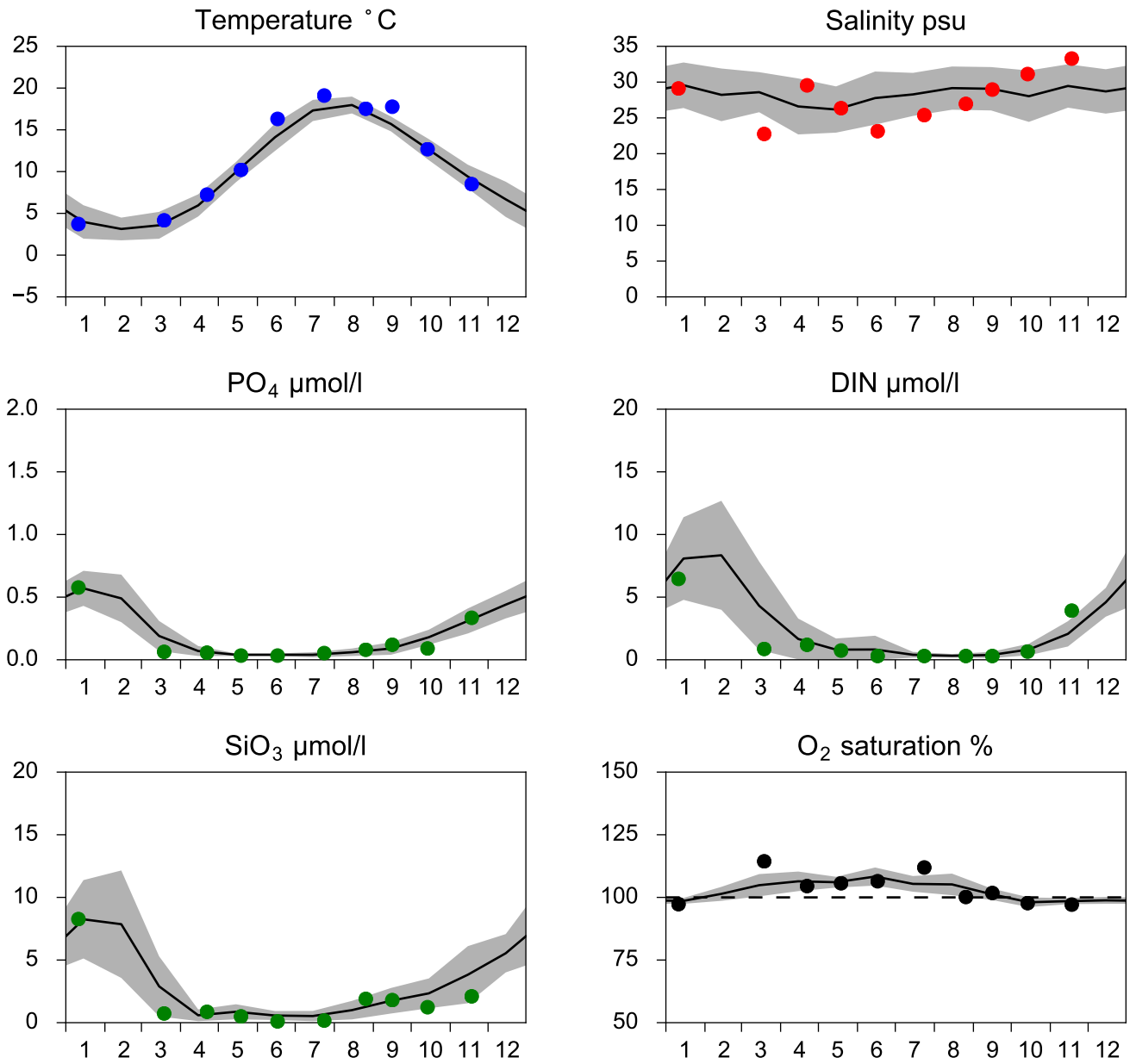
Vertical profiles Å15
November



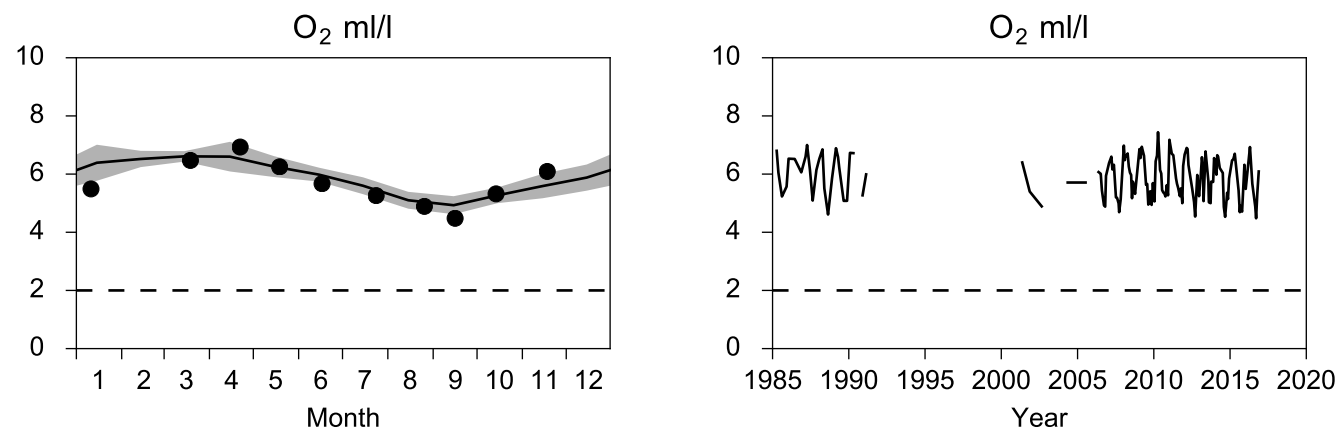
STATION Å13 SURFACE WATER (0-10m)

Annual Cycles

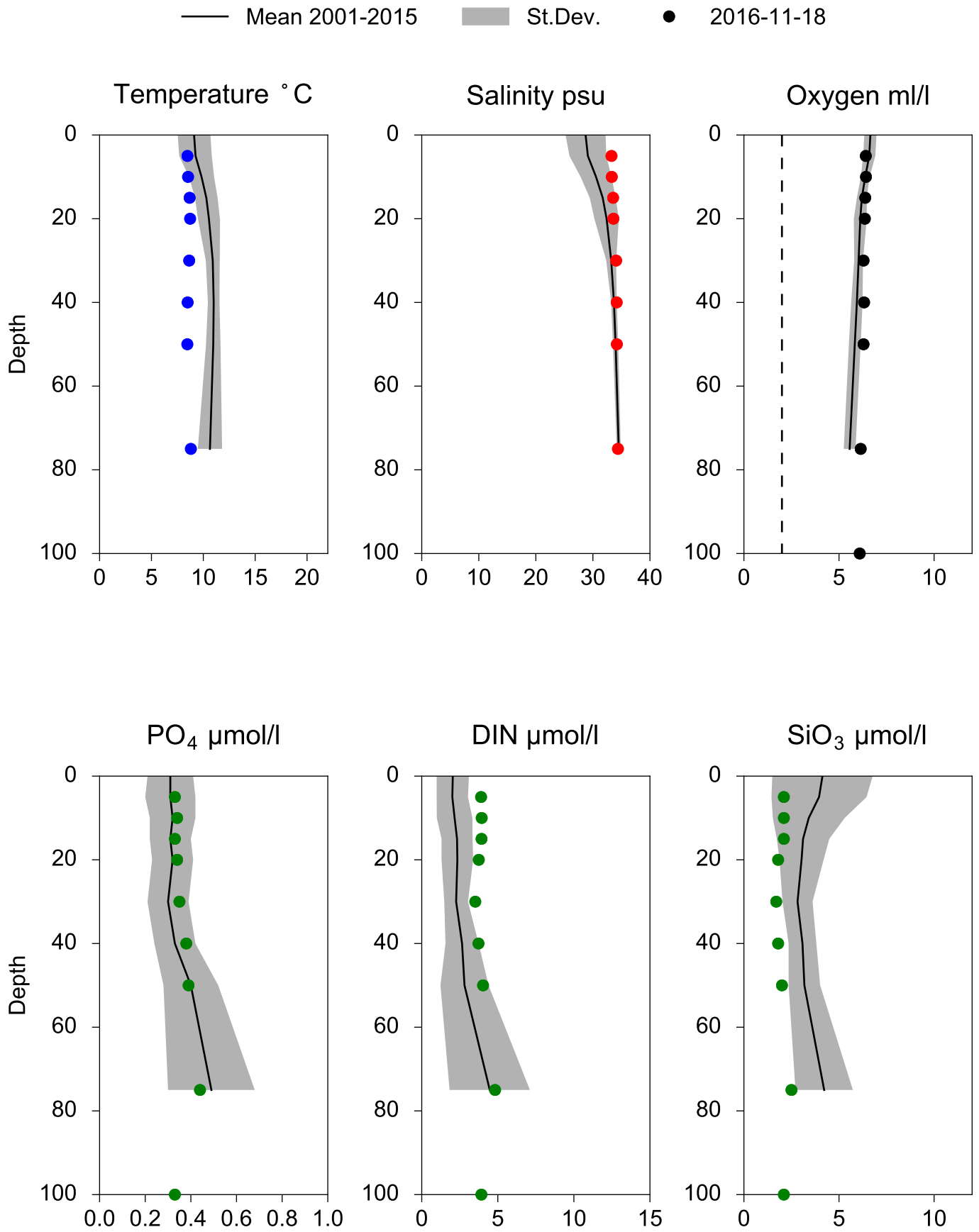
Mean 2001-2015 | St.Dev. | 2016



OXYGEN IN BOTTOM WATER (depth >= 82 m)



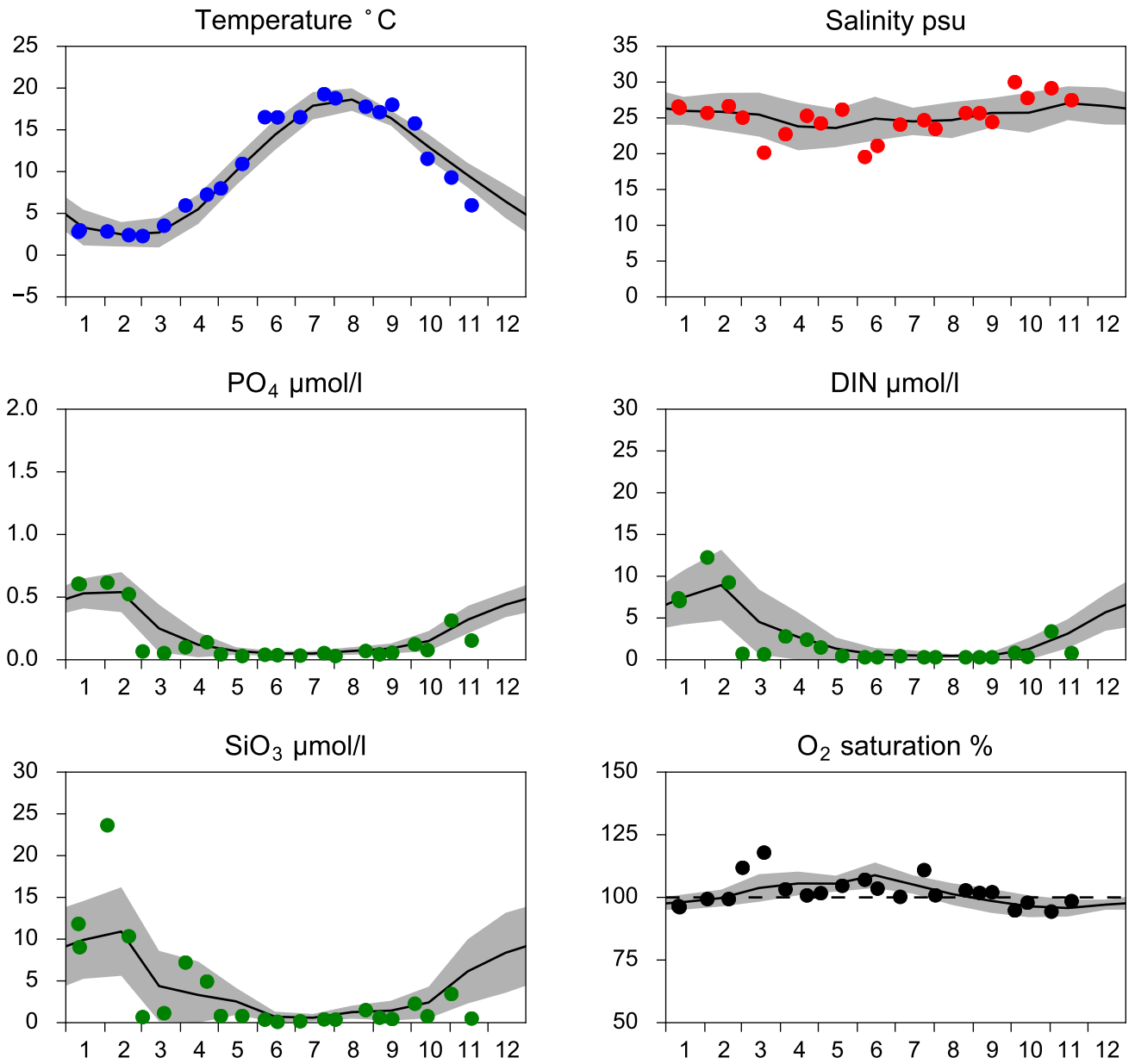
Vertical profiles Å13
November



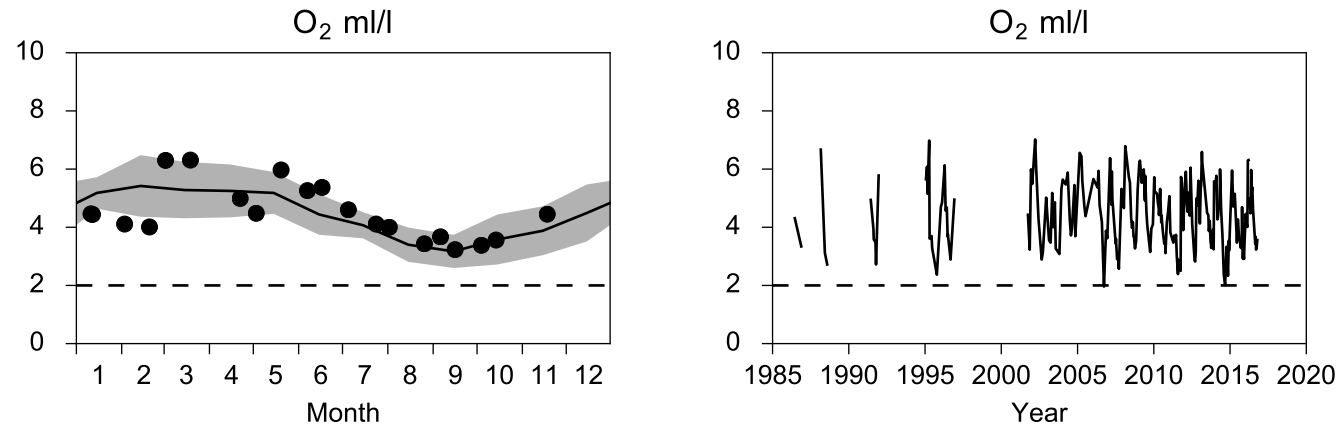
STATION SLÄGGÖ SURFACE WATER (0-10m)

Annual Cycles

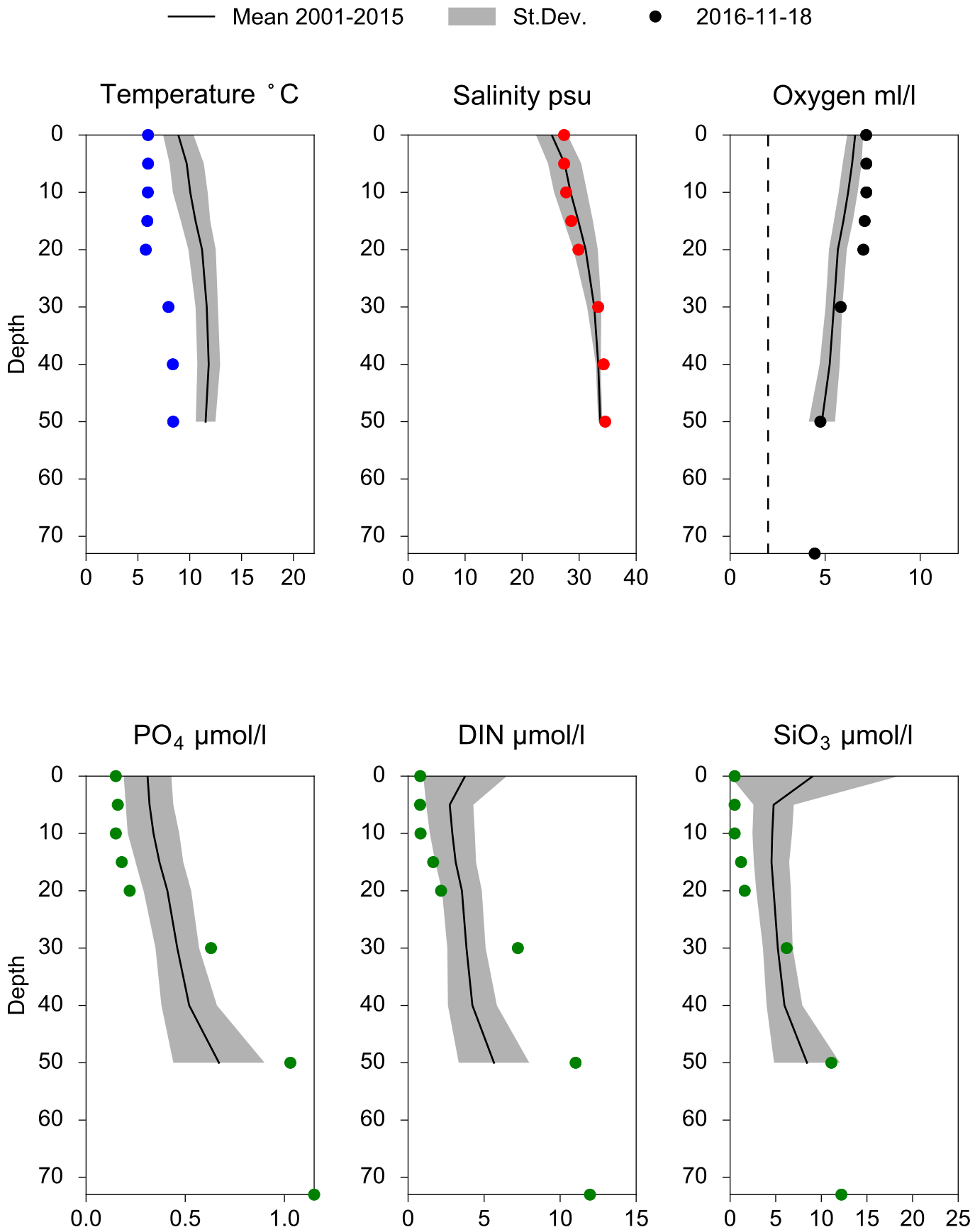
Mean 2001-2015 | St.Dev. | 2016



OXYGEN IN BOTTOM WATER (depth >= 64 m)

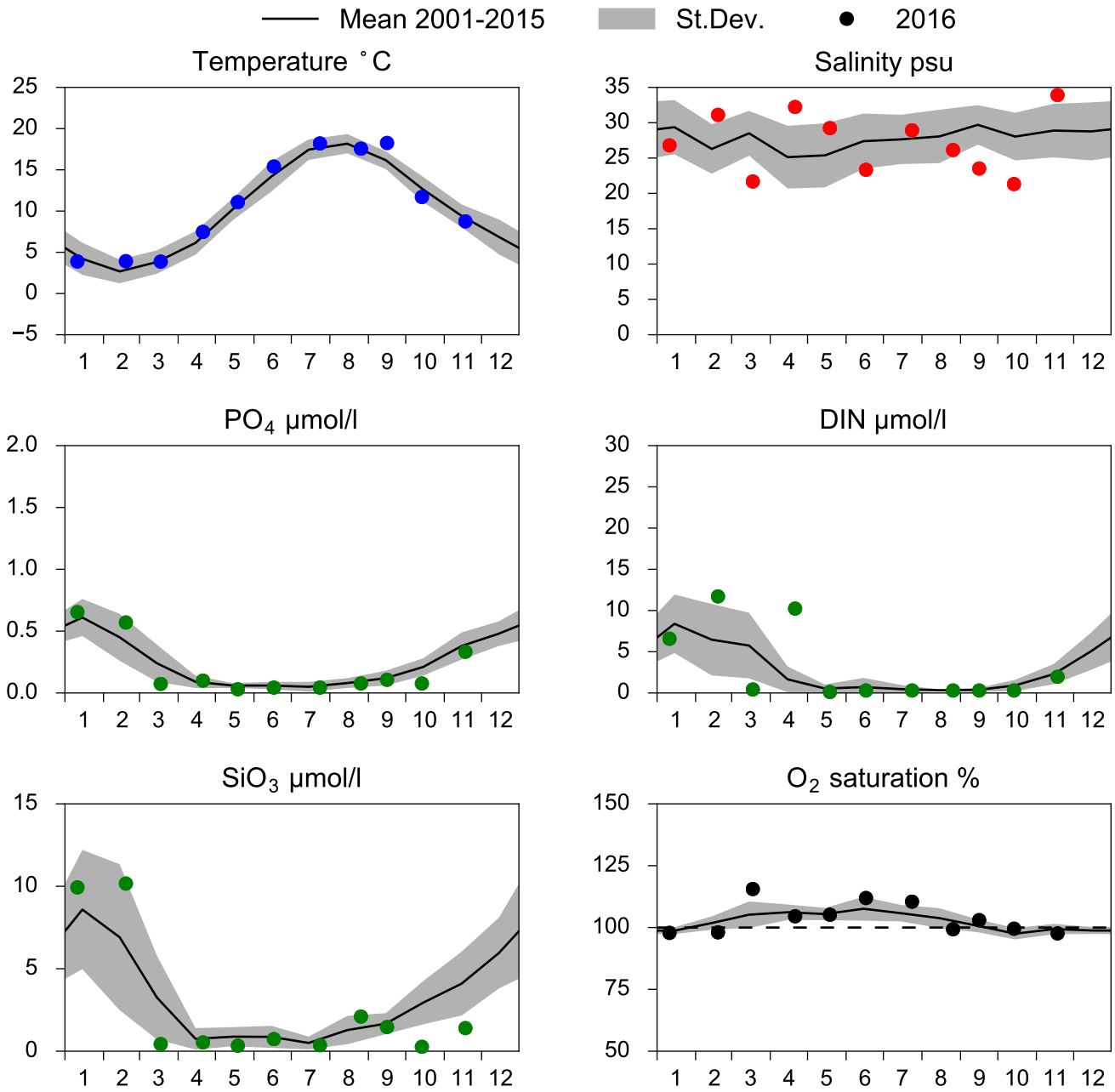


Vertical profiles SLÄGGÖ
November

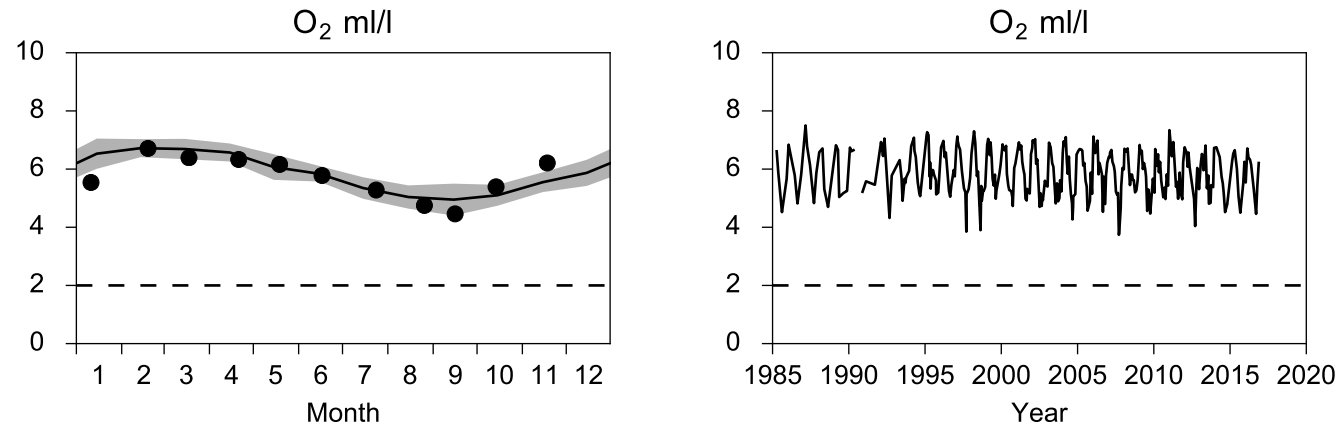


STATION P2 SURFACE WATER (0-10m)

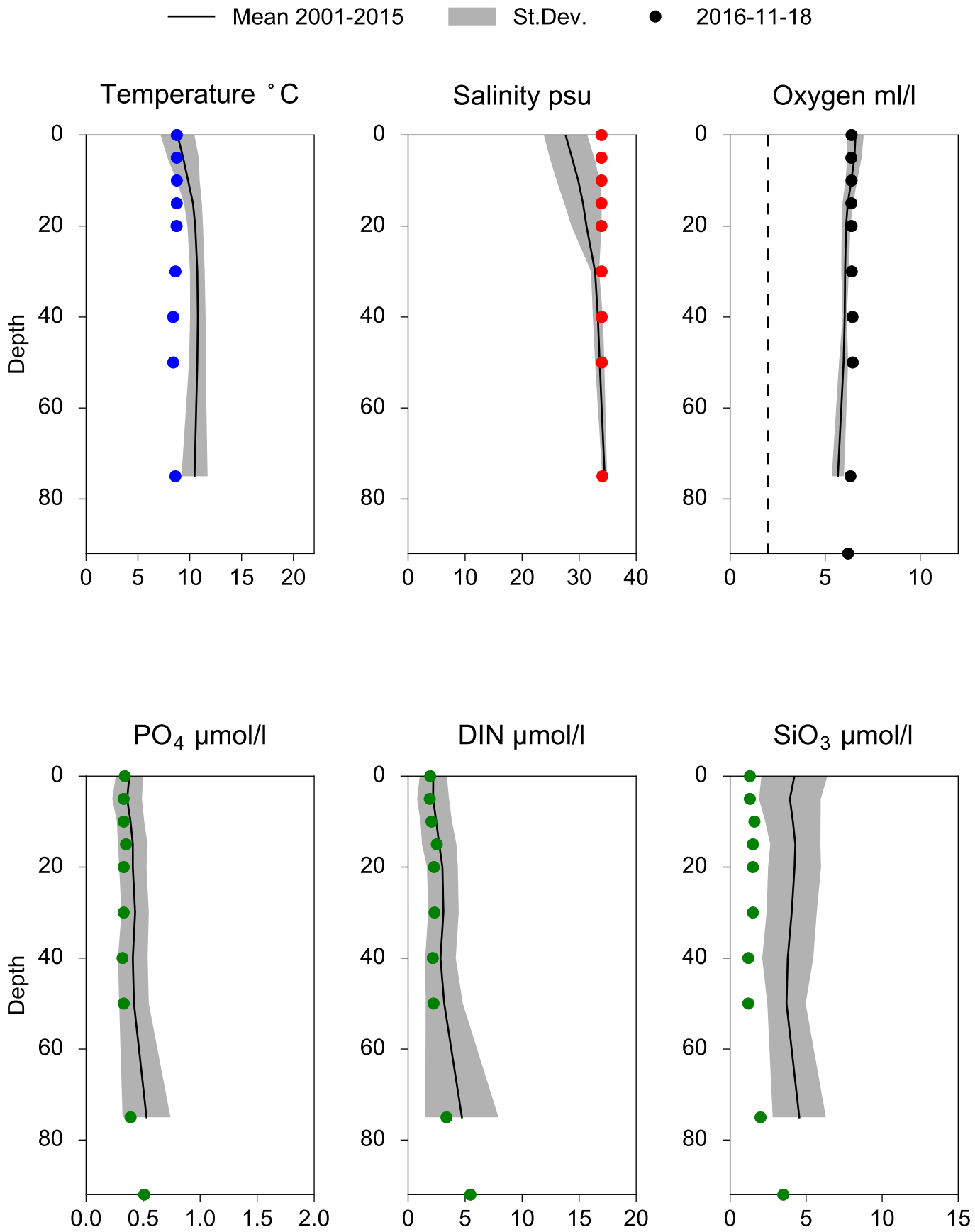
Annual Cycles



OXYGEN IN BOTTOM WATER (depth >= 75 m)



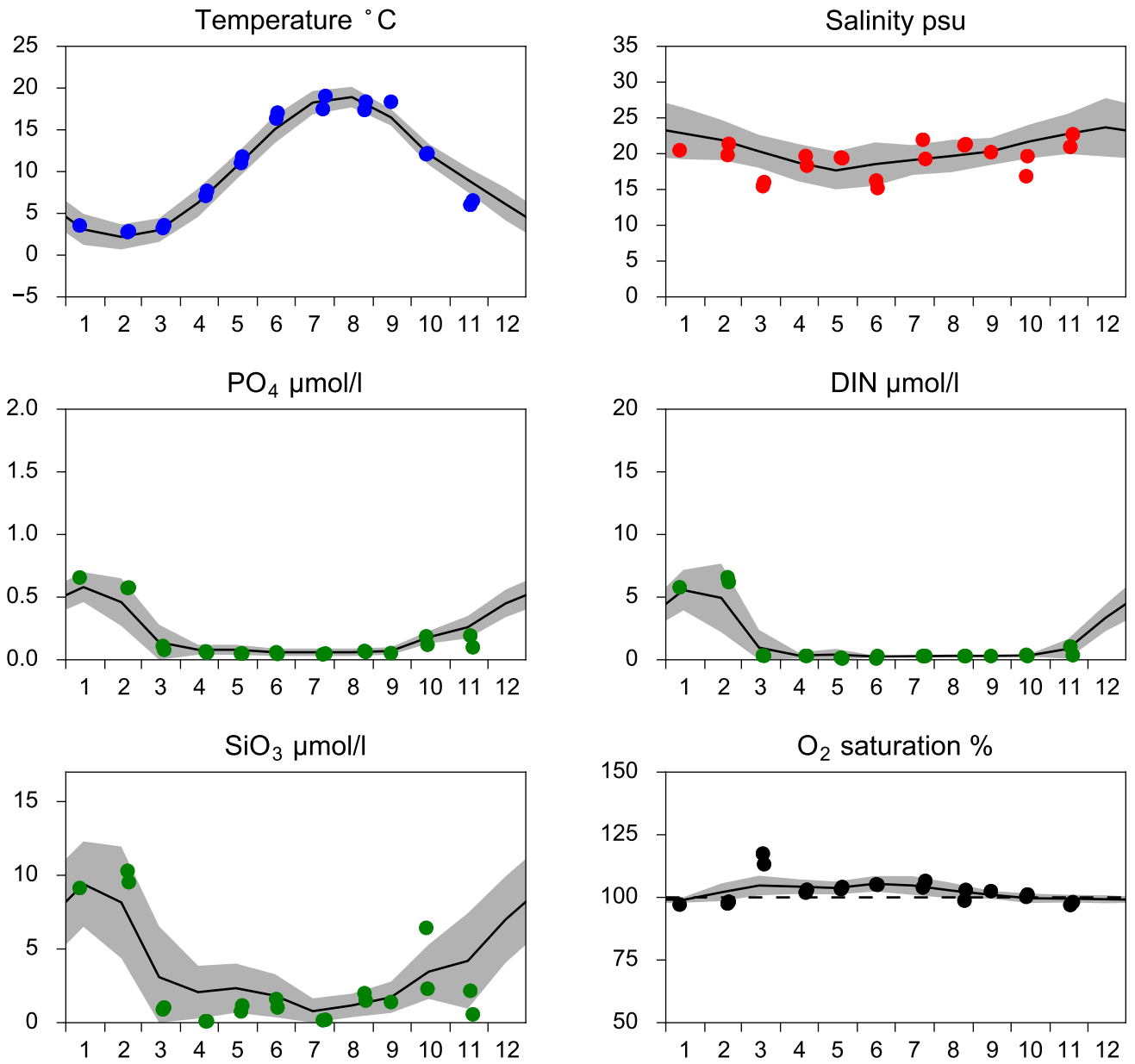
Vertical profiles P2
November



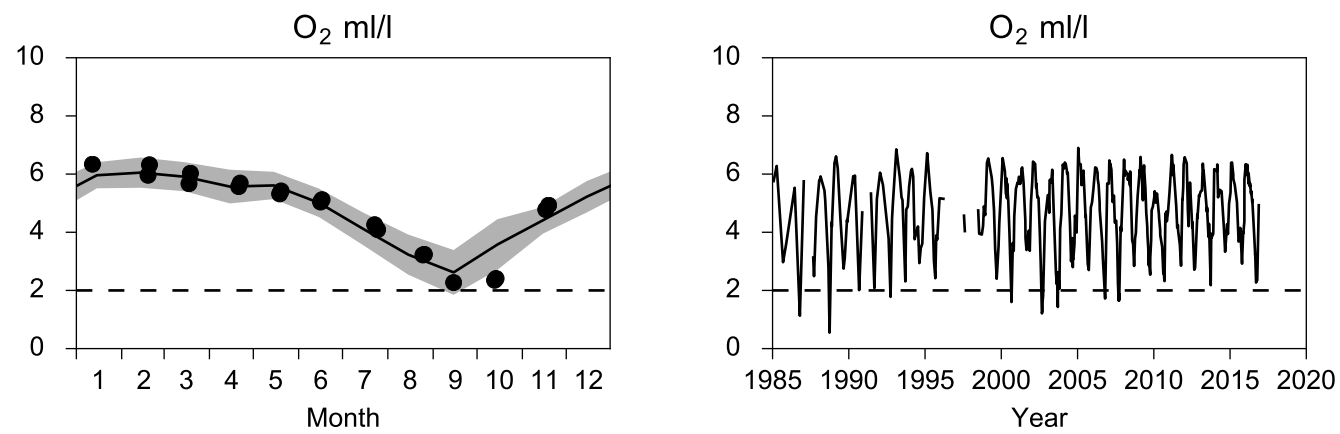
STATION ANHOLT E SURFACE WATER (0-10m)

Annual Cycles

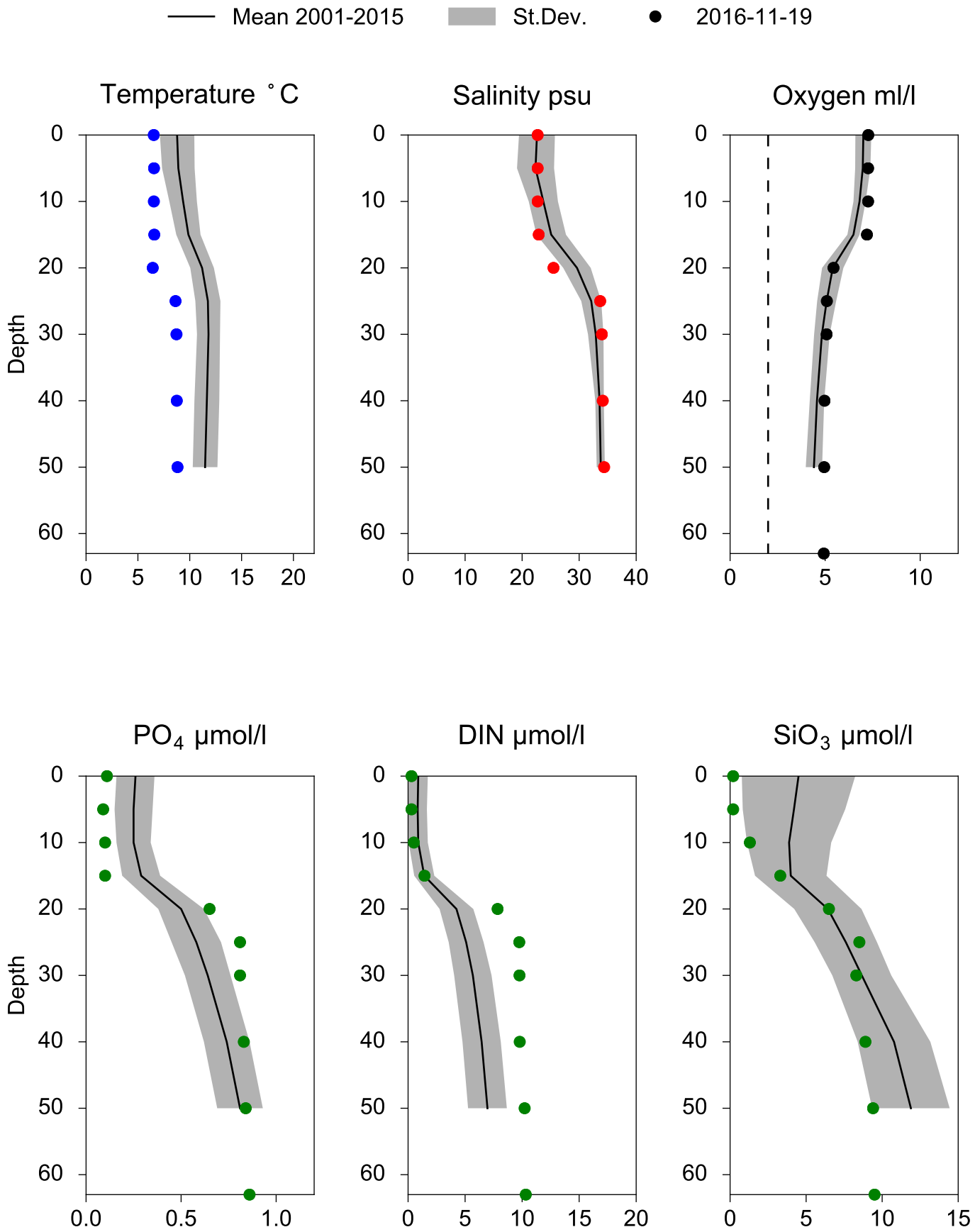
Mean 2001-2015 | St.Dev. | 2016



OXYGEN IN BOTTOM WATER (depth >= 52 m)



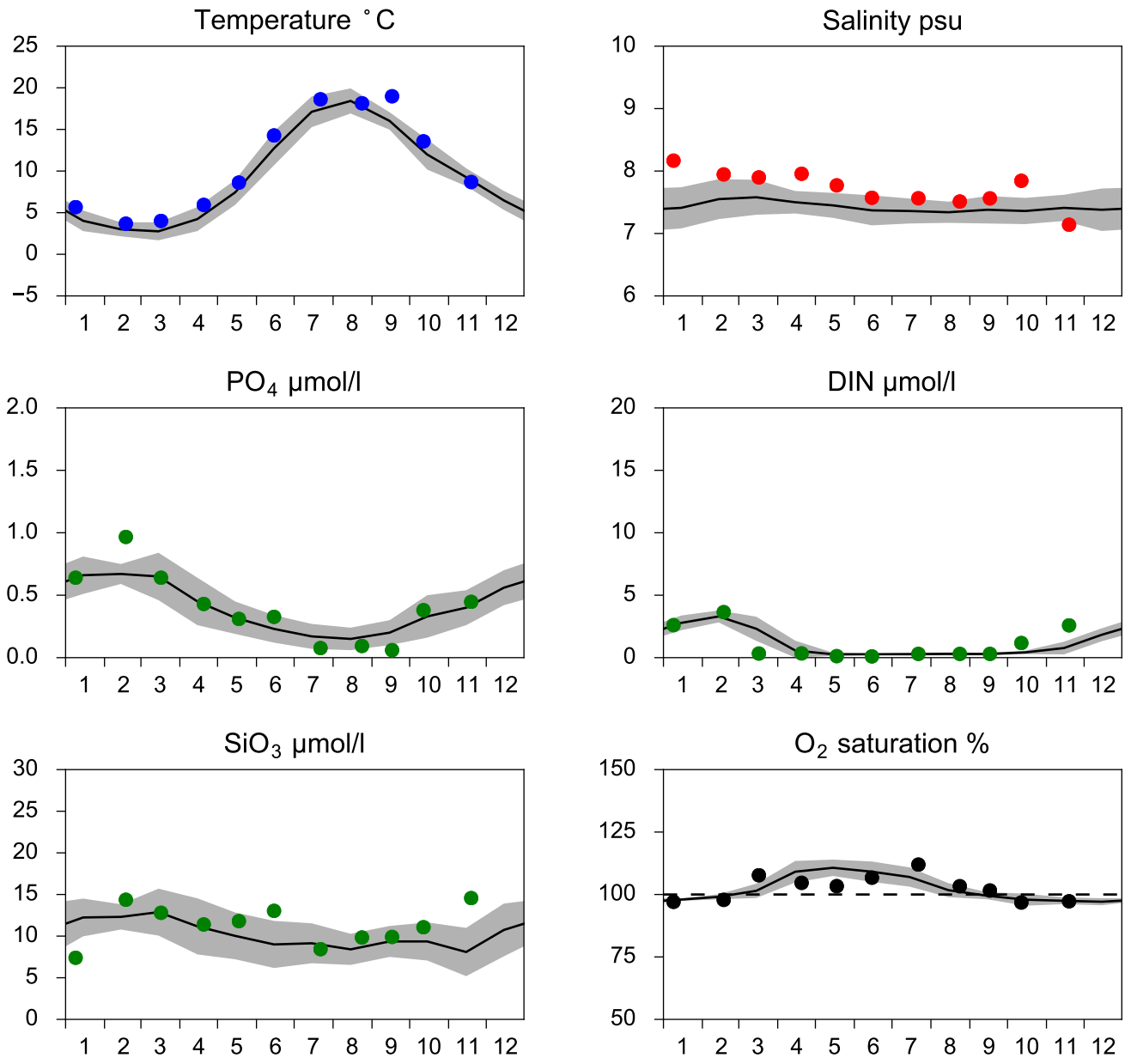
Vertical profiles ANHOLT E
November



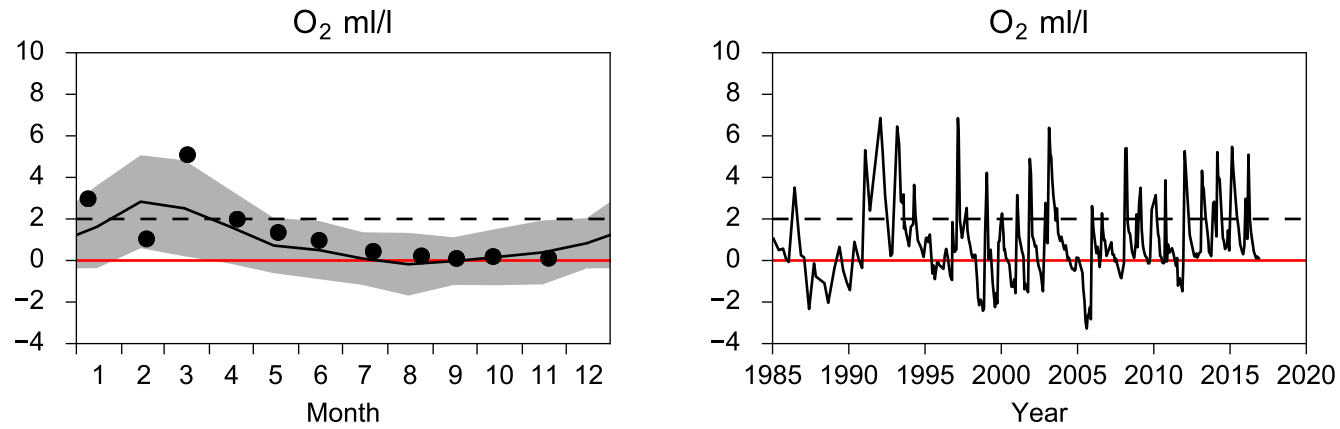
STATION BY4 CHRISTIANSÖ SURFACE WATER (0-10m)

Annual Cycles

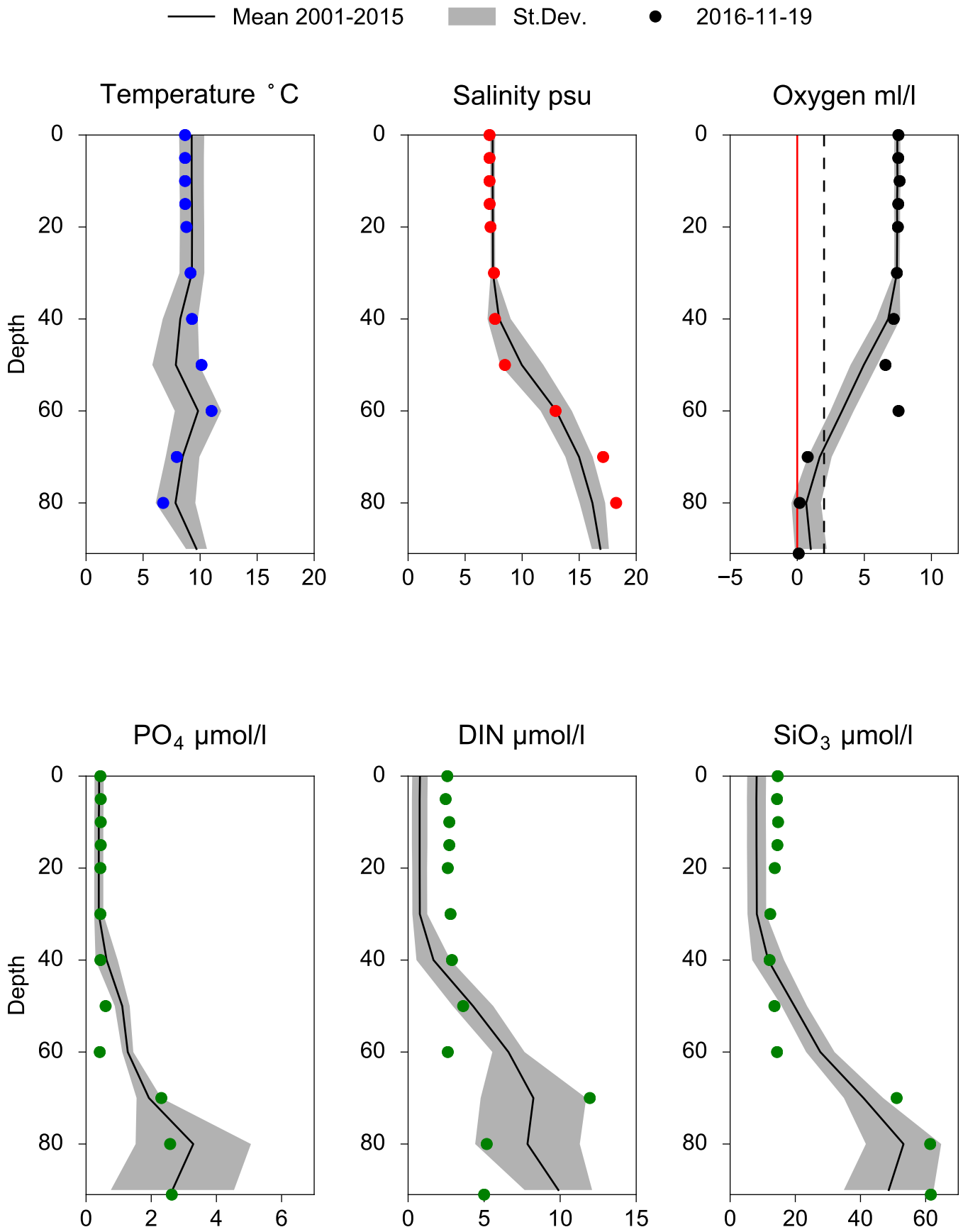
Mean 2001-2015 | St.Dev. | 2016



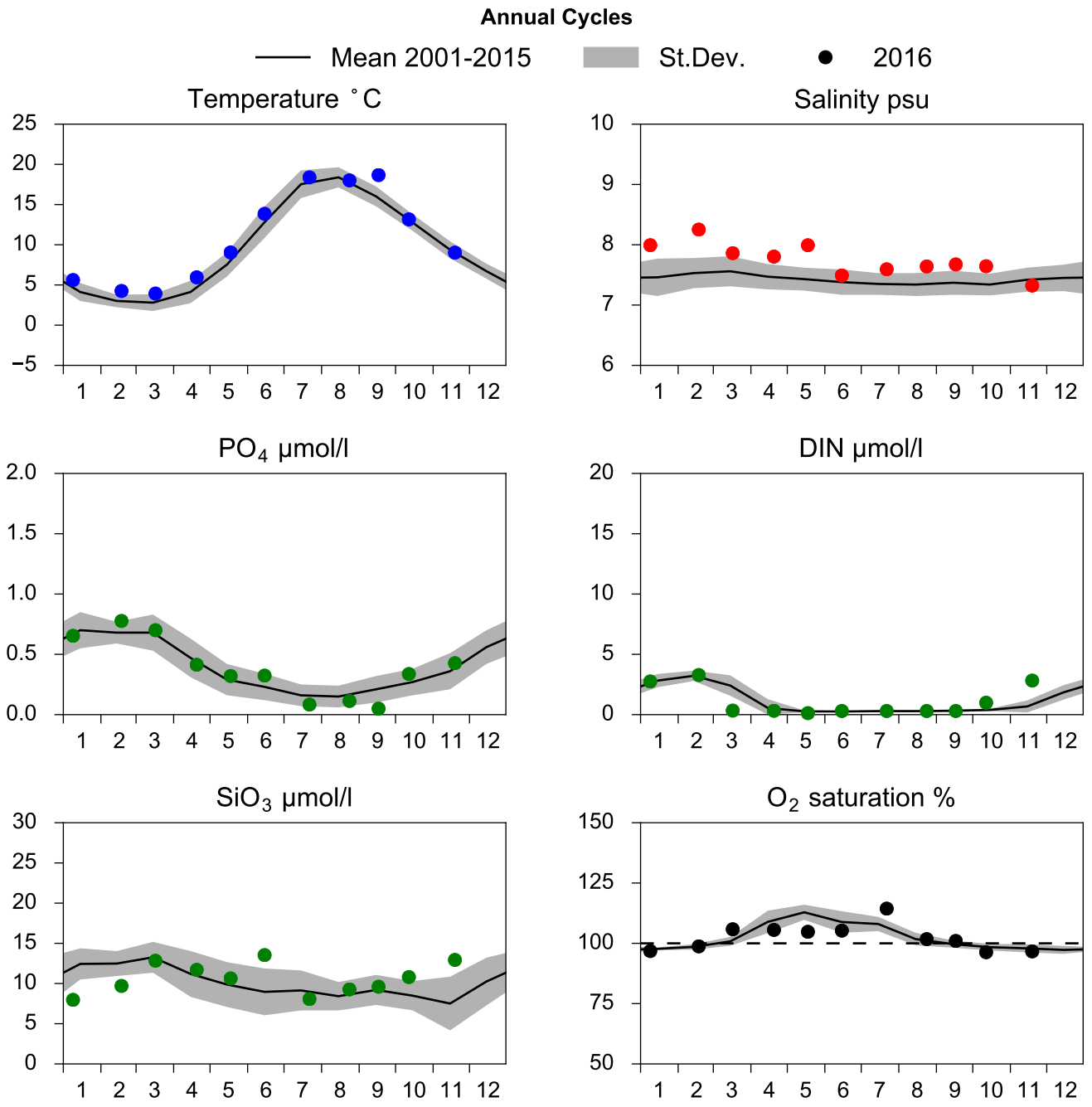
OXYGEN IN BOTTOM WATER (depth >= 80 m)



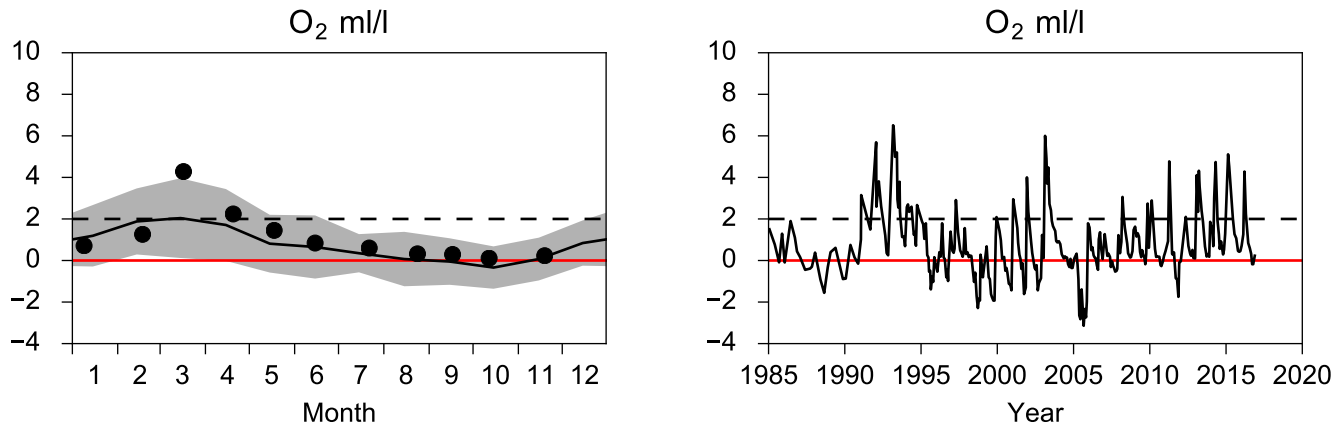
Vertical profiles BY4 CHRISTIANSÖ
November



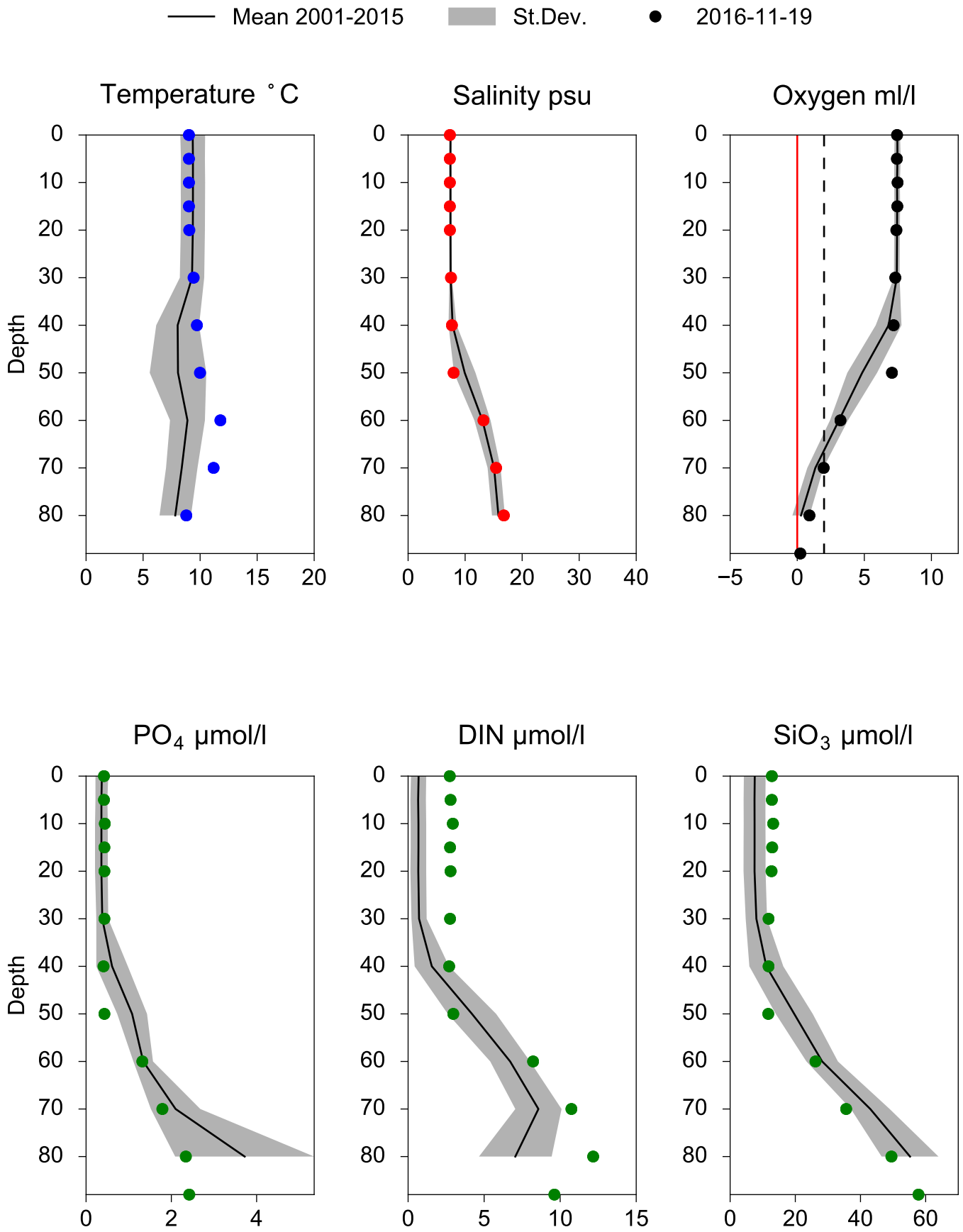
STATION BY5 BORNHOLMSDJ SURFACE WATER (0-10m)



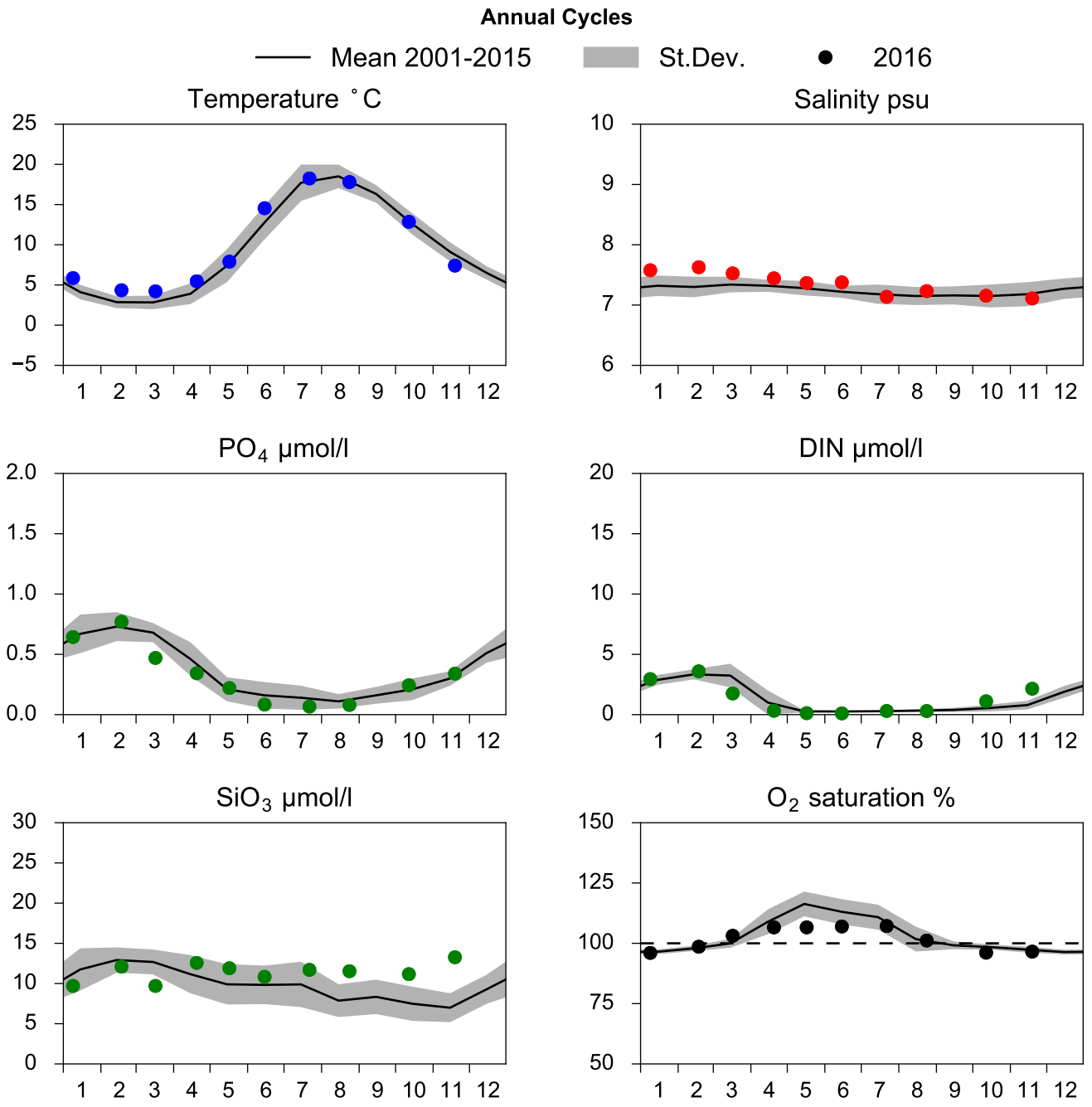
OXYGEN IN BOTTOM WATER (depth >= 80 m)



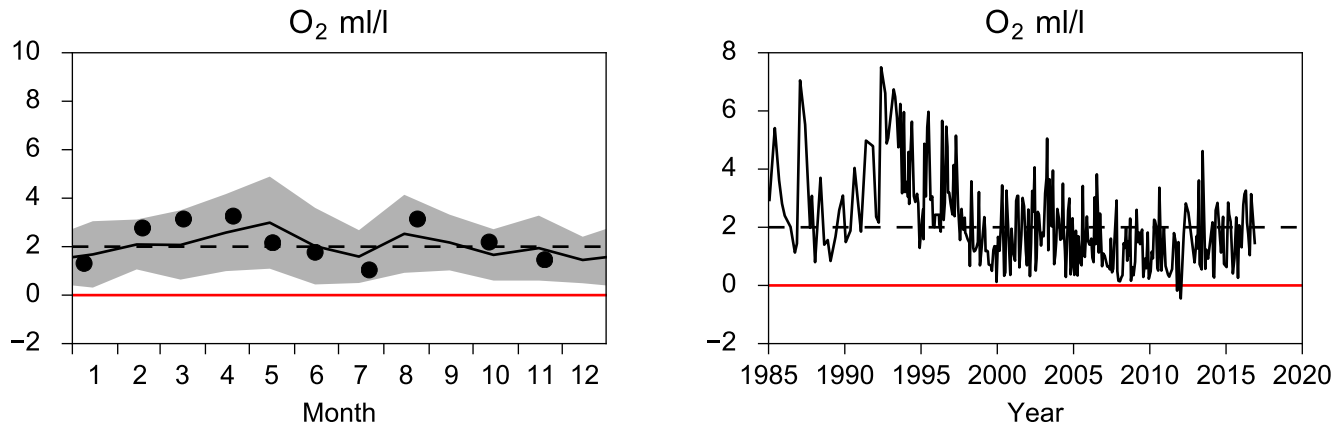
Vertical profiles BY5 BORNHOLMSDJ
November



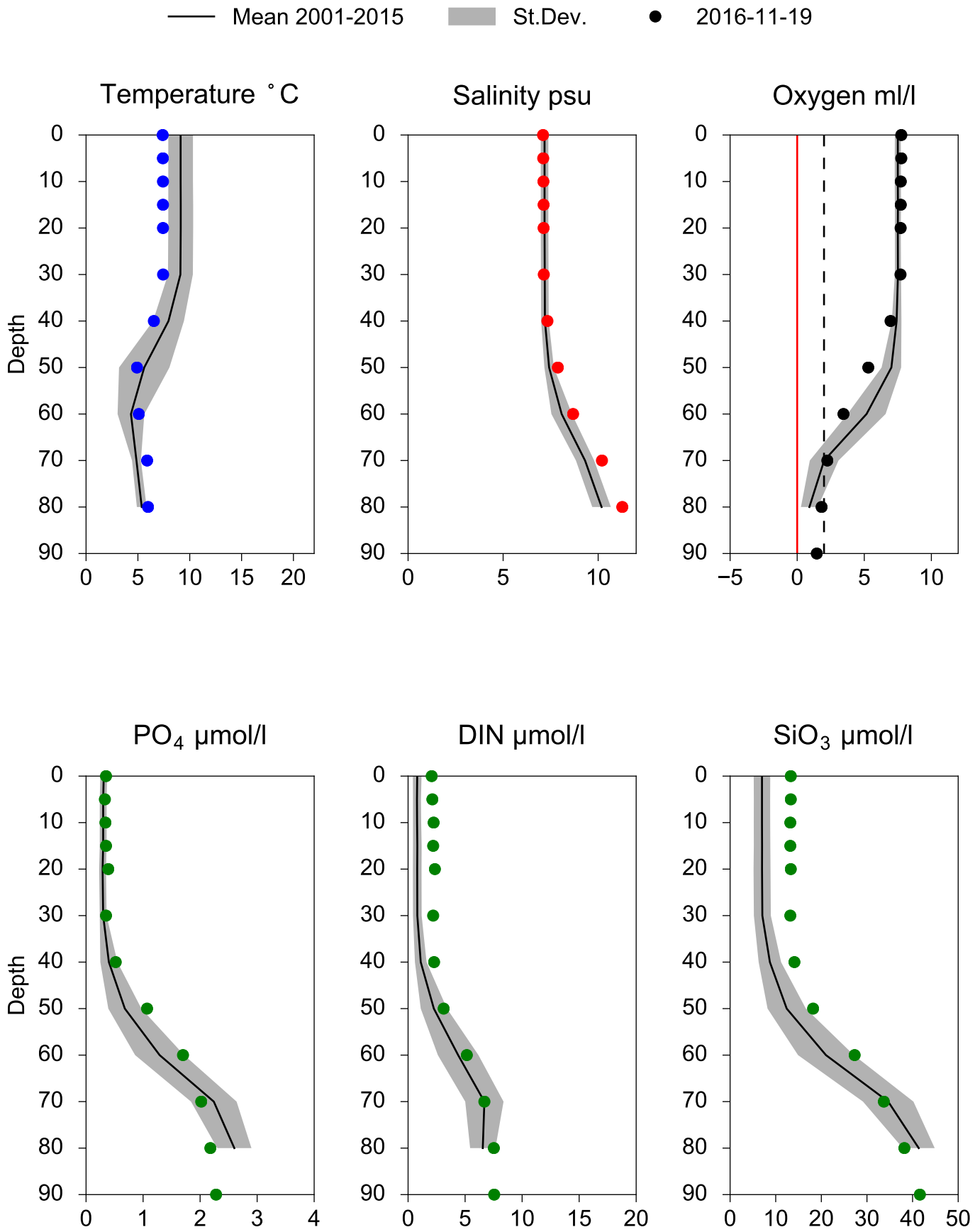
STATION BCS III-10 SURFACE WATER (0-10m)



OXYGEN IN BOTTOM WATER (depth >= 80 m)



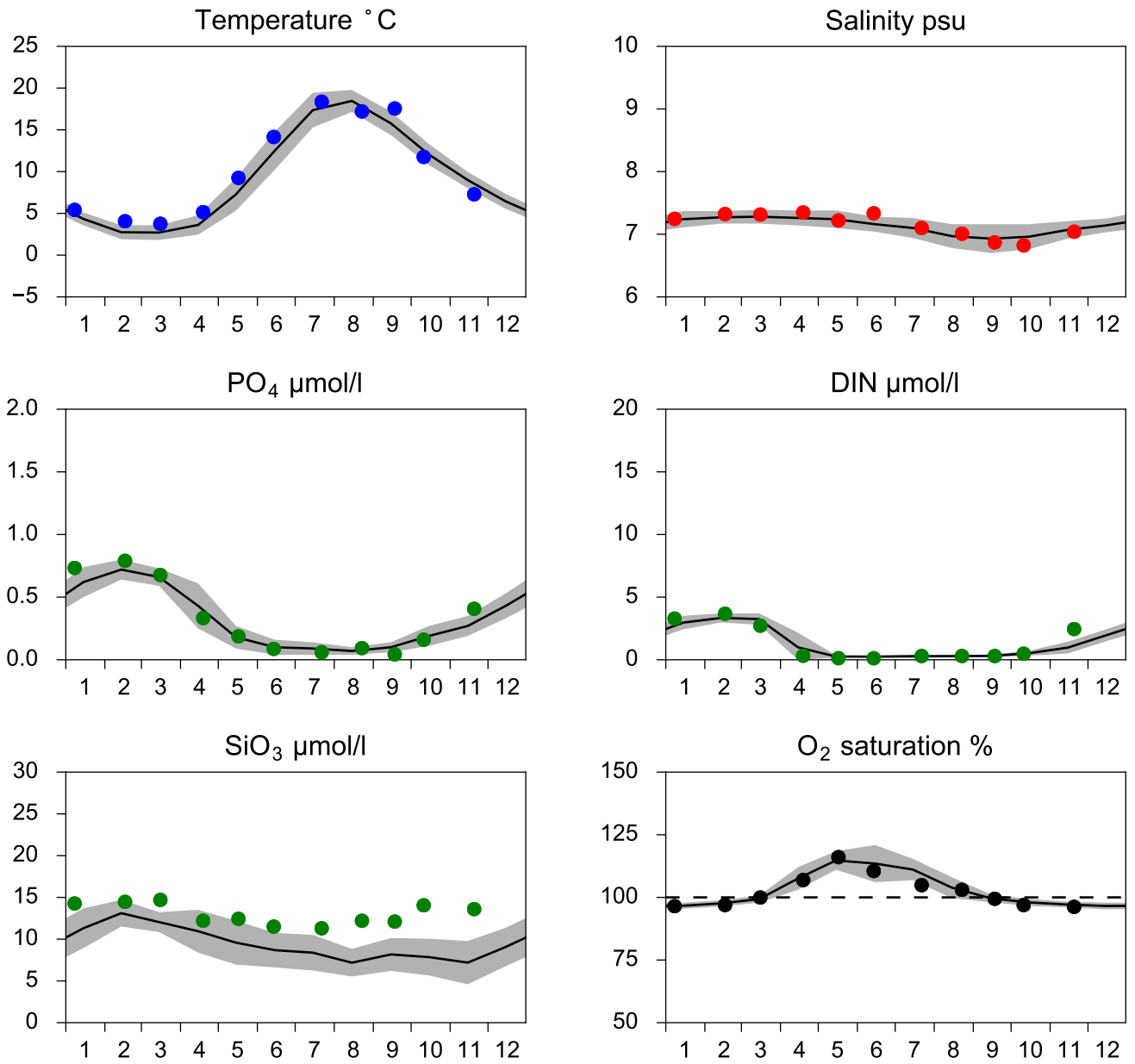
Vertical profiles BCS III-10
November



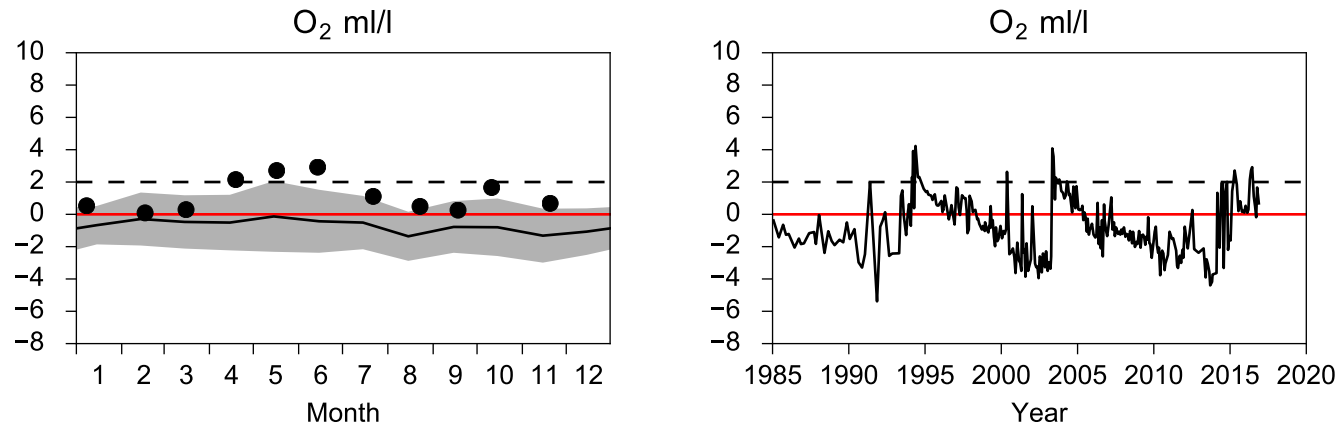
STATION BY10 SURFACE WATER (0-10m)

Annual Cycles

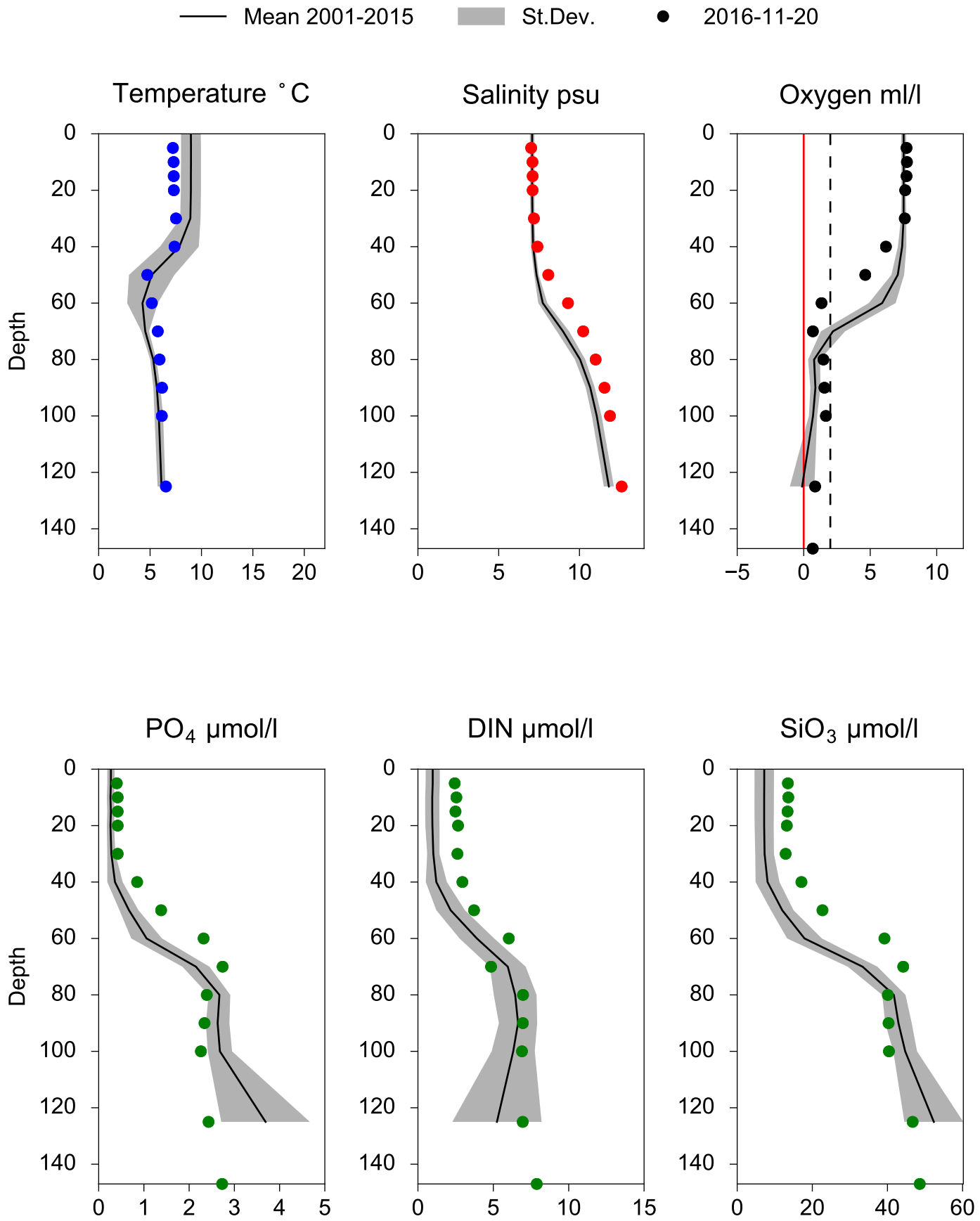
Mean 2001-2015 | St.Dev. | 2016



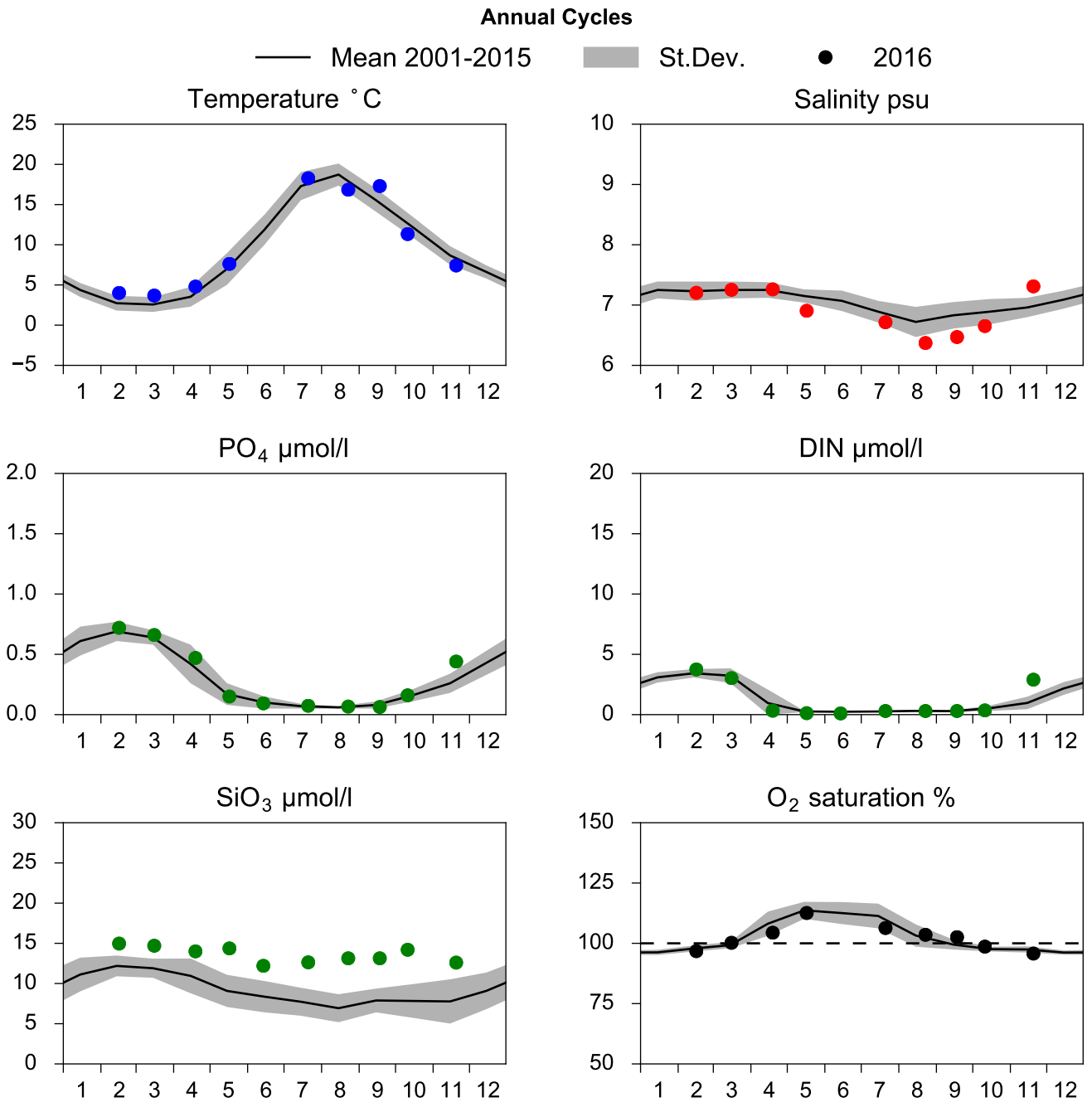
OXYGEN IN BOTTOM WATER (depth >= 125 m)



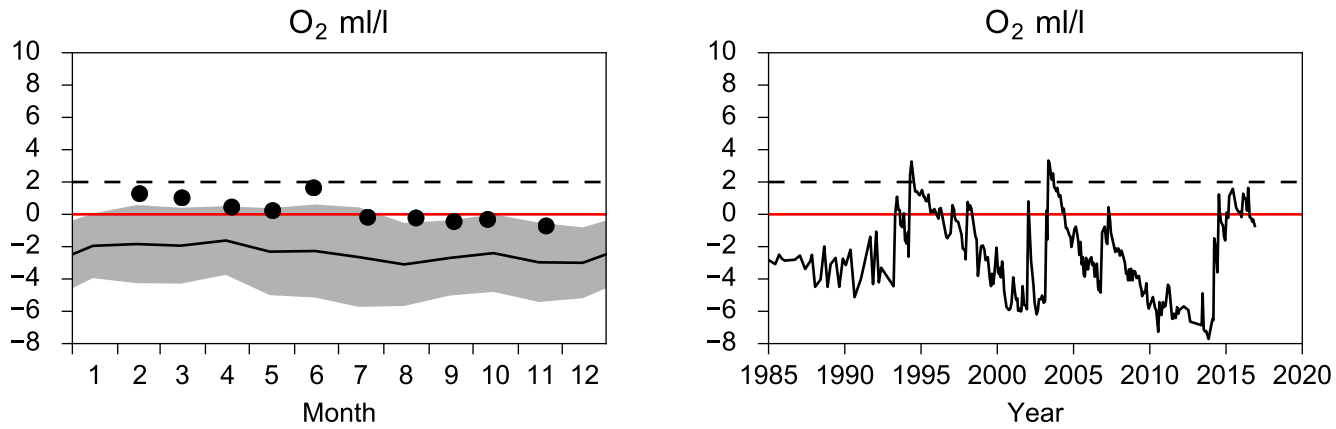
Vertical profiles BY10
November



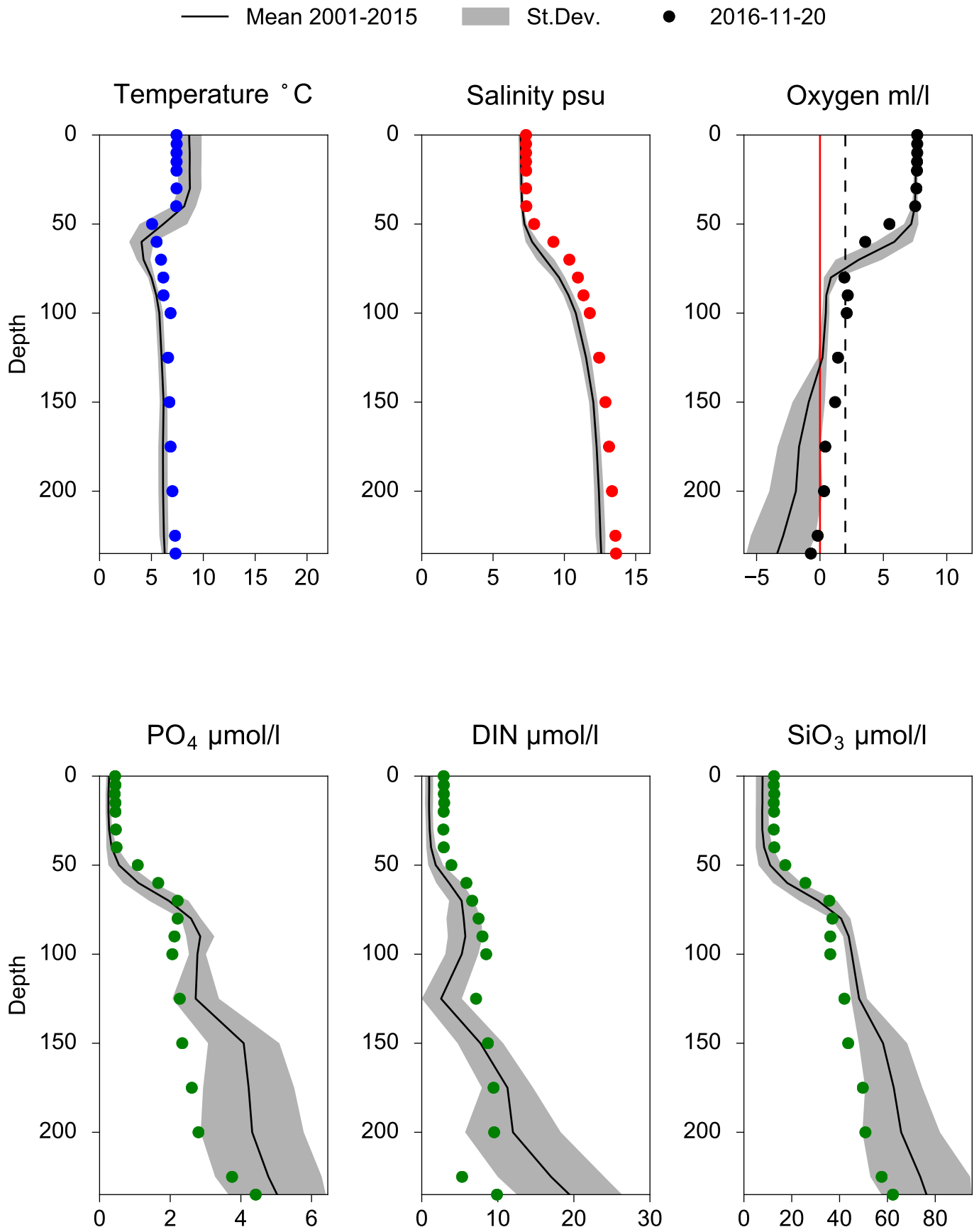
STATION BY15 GOTLANDSDJ SURFACE WATER (0-10m)



OXYGEN IN BOTTOM WATER (depth >= 225 m)



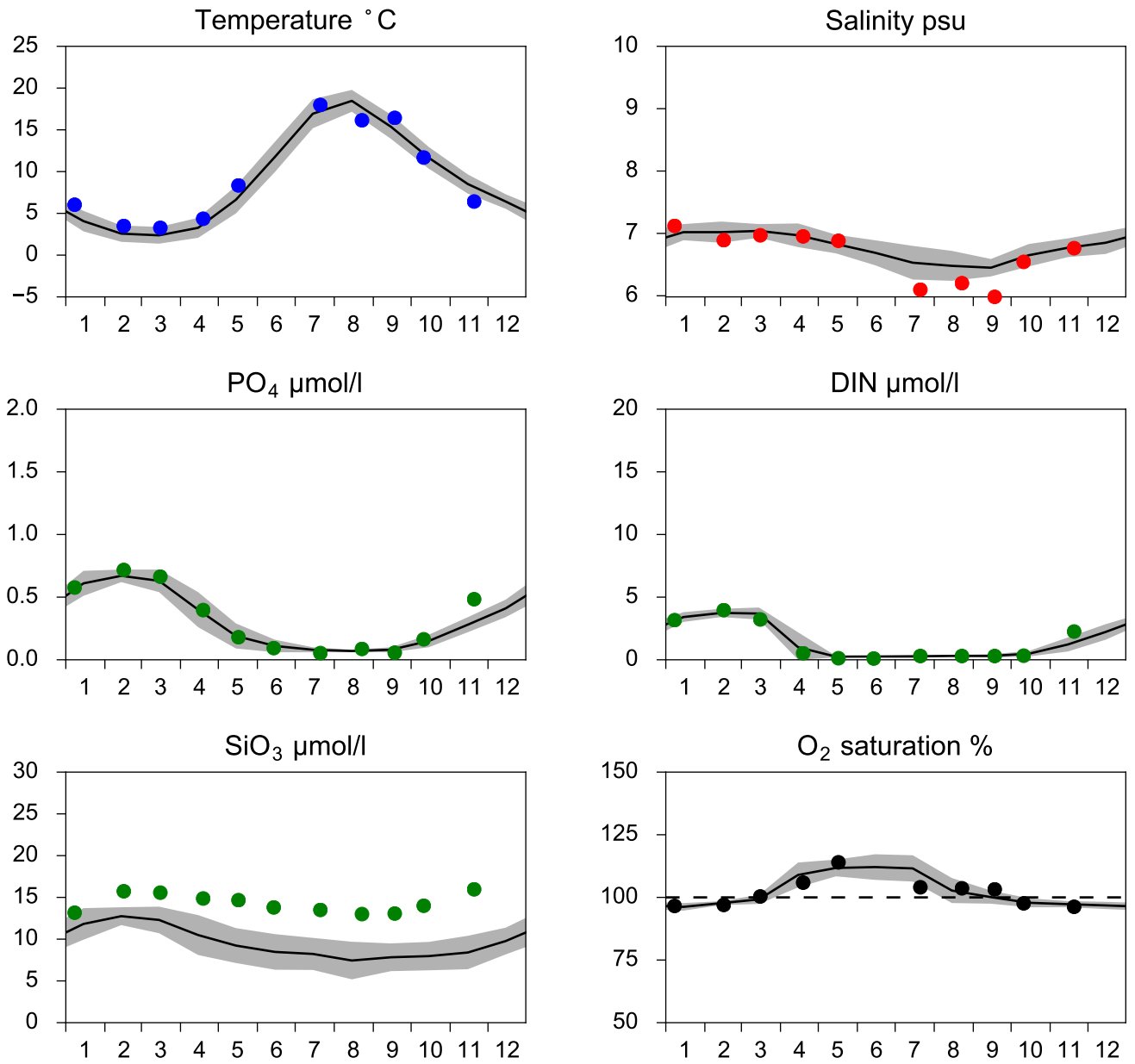
Vertical profiles BY15 GOTLANDSDJ
November



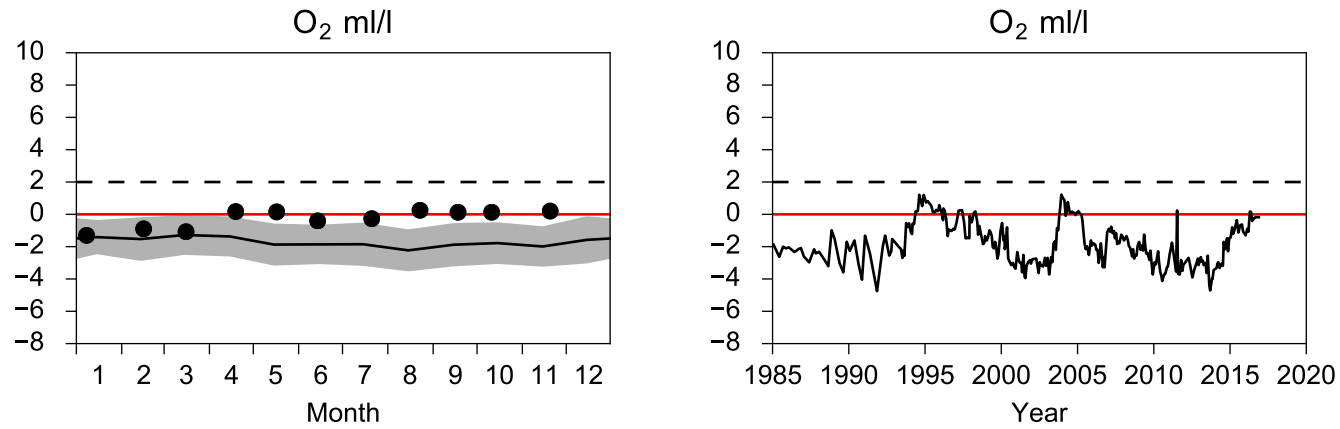
STATION BY20 FÅRÖDJ SURFACE WATER (0-10m)

Annual Cycles

Mean 2001-2015 | St.Dev. | 2016



OXYGEN IN BOTTOM WATER (depth >= 175 m)



Vertical profiles BY20 FÅRÖDJ
November