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Dnr: S/Gbg-2016-91

Report from the SMHI monitoring cruise with R/V Aranda

Survey period: 2016-07-20 - 2016-07-27
Survey area: Skagerrak, Kattegat, Sound, Gulf of Finland and the Baltic Proper
Principal: Swedish Meteorological and Hydrological Institute, SMHI, the Swedish Agency for Marine and Water Management and SYKE.

SUMMARY

The cruise was part of the Swedish regular marine monitoring programme covering the Skagerrak, the Kattegat, the Sound, the Gulf of Finland and the Baltic Proper. This report is based on data that have only undergone a first quality control, when data is published at the data host some values might have changed after further quality controls have been performed.

Due to a period of sunny and calm weather the surface temperature was over normal in several of the investigated areas. The nutrient concentrations of phosphate and nitrogen were low or totally consumed in the surface water. The silicate concentration was still higher than normal in some parts of the Baltic Proper.

Anoxic areas were found in the Western Gotland Basin and in the Gulf of Finland from depth exceeding 90 meters. In the northern parts of the Eastern Gotland Basin the near bottom areas were still anoxic and hydrogen sulphide was now again present near the bottom at BY15, in the central parts of the basin. Acute hypoxia (< 2ml/l oxygen) was found at depth over 70 meters in the whole Baltic Proper.

Surface accumulations of cyanobacteria were found in large areas of the Baltic Proper. A summary of the algae situation can be found in this report.

Next regular cruise is scheduled to start 22th of August.

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RESULTS

The cruise was performed onboard the Finnish research vessel Aranda. It started in Helsinki the 20th of July and ended in the same port the 27th. The weather during the cruise was sunny, warm and calm.

During the cruise, scientists from Stockholm, Umeå and Pau (France) University collected water-, phytoplankton- and zooplankton samples for analysis of mercury. Extra phytoplankton samples were also taken for analysis of the algae toxin nodularin.

Phytoplankton samples were analyzed during the cruise and the results are presented in a separate report.
Algaware http://www.smhi.se/oceanografi/oce_info_data/reports/alg/algsit16_7.pdf,

SMHI produce daily algae maps from satellite. This can be found at:
http://www.smhi.se/vadret/hav-och-kust/algsituationen.

Summary of the algae situation during the cruise:

Filamentous cyanobacteria were present as small grains in the water at the first sampling stations in the outer parts of the Gulf of Finland and in small amounts east of Gotland. At BY5, in the Bornholm Basin, surface accumulations with streaks of different sizes started to appear and continued to appear until the Sound. *Aphanizomenon flos-aquae* was the most abundant of the filamentous cyanobacteria in the Gulf of Finland, but *Nodularia spumigena* increased in concentrations going south.

The surface accumulations had grown to larger areas in the southern parts of the Baltic Proper when going back. Irregular areas of surface accumulations in the shape of lighter green to more intense orange coloured patches or streaks could also be seen between in the Western Gotland Basin as approaching the entrance of the Finnish Bay.

The Skagerrak

Due to the sunny and calm weather, the surface water temperature was over normal in the whole area. Closer to the coast the temperature was just over 20°C and somewhat lower, around 18°C, in the offshore areas.

The surface salinity was generally normal for the season but lower than normal near the coast at Å13. In the offshore areas the salinity varied between 27 and 29 psu and at the coast it varied around 23 psu. The stratification, both the thermocline and the halocline, was weakly developed; hence no sharp borders were found between the different water masses.

All nutrients showed low concentrations in the whole area, which is normal for this season. The concentration of phosphate varied around 0.05 µmol/l, nitrate+nitrite was below the limit of quantification (<0.10 µmol/l). The silicate concentration varied between 0.1 and 0.3 µmol/l except at the station Å15 were 1.8 µmol/l was measured.

The bottom water was well oxygenated in the whole area, which is normal.

The Kattegat and the Sound

In Kattegat the surface temperature was normal or above normal, 18-20°C. The salinity in the surface was higher than normal in the northern parts, 23 psu, and lower than usual in the Sound, 8 psu. The stratification was found at various depths between 5 and 30 meters.

All nutrient concentration in the surface water was normal for the season. The phosphate concentration varied around 0.5 µmol/l in the central parts of Kattegat, while in the Sound it was higher, 0.16 µmol/l. Ammonia, nitrite and nitrate was completely consumed. Silicate was 0.2-0.9 µmol/l except from the Sound where it was 9.8 µmol/l.

The oxygen concentrations in the deep water had declined at all stations since the last visit in June. But no hypoxic areas were found. The lowest oxygen concentration was found in the Sound, 3.3 ml/l.

The Baltic Proper

In the Baltic Proper, the temperature in the surface water was normal in the eastern and south eastern parts of the Baltic Proper and varied around 18°C. The south and western parts of the areas had temperatures over normal due to the sunny and calm weather. The temperature varied here between 19 and 21°C. The surface salinity, which ranged from 6 to 8 psu, was below normal in the Eastern Gotland Basin and over normal in the Arkona Basin. The halocline was found between 50 and 80 meters depth, except for Arkona Basin were it was found at 35-40 meters depth. A fully developed summer thermocline was found at 15-20 meters depth in the whole area.

Nitrate, nitrite and ammonium were all below and just above the limit of quantification. The nutrient concentrations were increasing first at depths exceeding 20 meters. The phosphate concentration varied between 0.06 and 0.10 µmol/l. Silicate was higher than normal, 10-13 µmol/l in the whole area except in the south western parts were it was normal and varied between 6 and 10 µmol/l.

The severe oxygen conditions in the Northern and Western Gotland Basin and the Gulf of Finland remains. In the central and outer parts of the Gulf of Finland anoxia was found from depth exceeding 80-90 meters and acute hypoxia (<2ml/l oxygen) was found at depth exceeding 65-70 meters. In the Western Gotland Basin there was a distinct change from oxygenated to anoxic water at approximate 80 meters. At the station BY38 acute hypoxia was found from 70 meters. In the northern parts of the Eastern Gotland Basin, at BY20, the oxygen concentration varied just above 0 ml/l, from 80 meters but hydrogen sulphide was only present at the bottom. At BY15, the Gotland Deep, the whole water column was oxygenated except for the bottom water were hydrogen sulphide again was present. Acute hypoxia was found already from 70 meters.

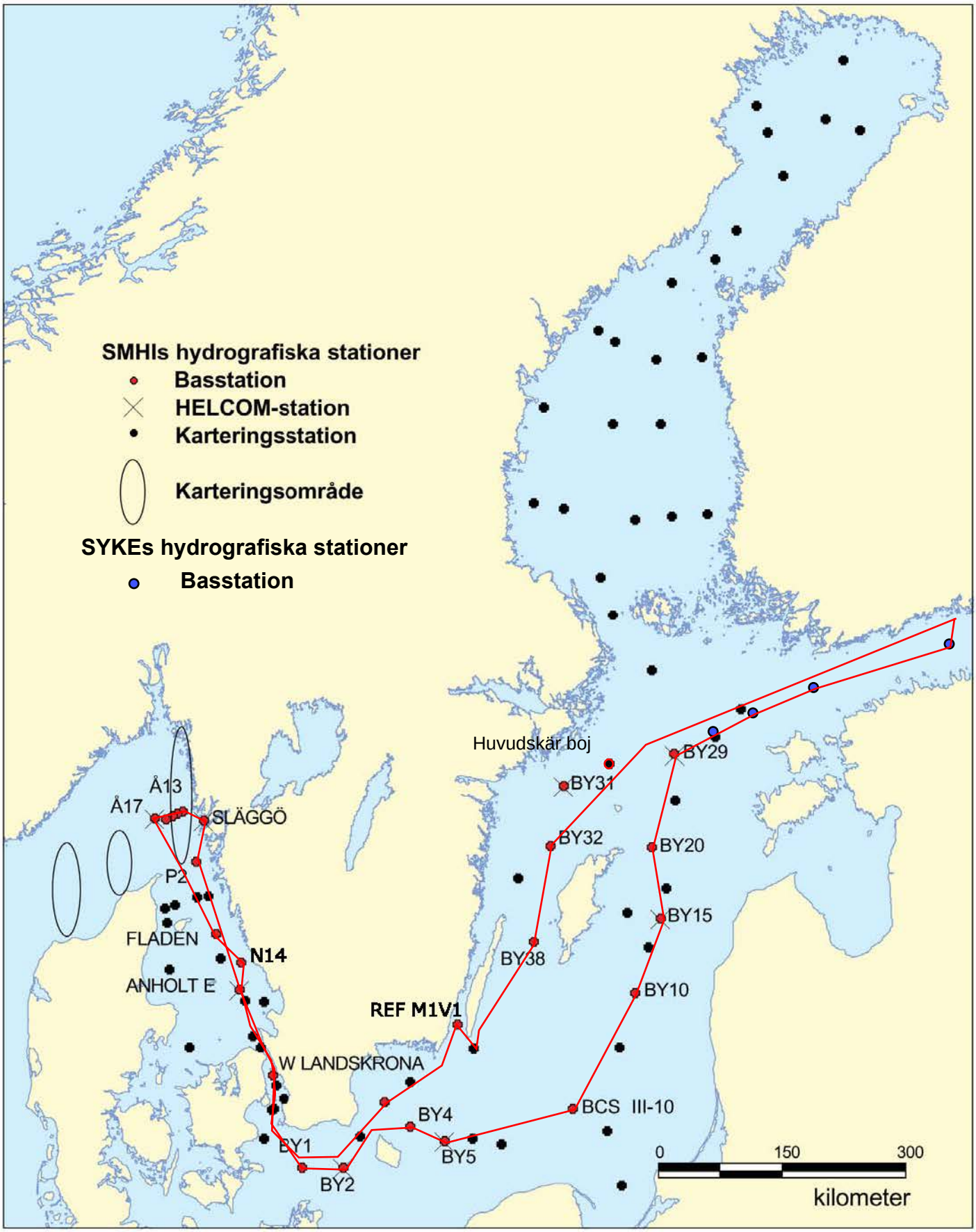
Acute hypoxia was also found in the Hanö Bight from 70 meters and in the Bornholm Basin from 70-75 meters.

PARTICIPANTS

Name		From
Martin Hansson	Cruise leader	SMHI
Kristin Andreasson		SMHI
Jenny Lycken		SMHI
Sari Sipilä		SMHI
Ann-Turi Skjevik		SMHI
Marie Johansen		SMHI
Anne Soerensen		Stockholm University
Aleksandra Skrobonja		Umeå University
David Amouroux		Pau University, Frankrike
Sylvain Bouchet		Pau University, Frankrike

APPENDICES

- Track chart
- Table over stations, analyzed 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


SMHIs hydrografiska stationer
Basstation
HELCOM-station
Karteringsstation
Karteringsområde
SYKEs hydrografiska stationer
Basstation
Huvudskär boj
BY29
BY31
BY32
BY20
BY15
BY38
BY10
REF M1V1
BCS III-10
BY4
BY5
BY1
BY2
W LANDSKRONA
N14
ANHOLT E
FLADEN
P2
Å13
Å17
SLÄGGÖ
0
150
300
kilometer

Date: 2016-07-28

Ship: 01
Year: 2016

Ser 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 (weath cloud waves icobs)	No de	Temp_btl	Temp_ctd	Salt_btl	Salt_ctd	Ph	Doxy_btl	Doxy_ctd	H2s	Phos	Ptot	Ntri	Ntra	Ntrz	Amon	Ntot	Alky	Sio3-si	Humus	Cphl	Doc	Poc	Toc	Pon	Lignin	Yellow	Alc	Urea_25	Cdom	Cnt_visit
0355	GFXX29	BAS	BY23/LL 7	5950.79	02450.27	2016-07-20	16:00	103		35	5.9	18	1014	2830	13	x	x	-	x	-	x	-	x	x	-	x	x	x	x	-	-	x	-	-	-	-	-	-	-	-	-	-	-	x
0356	BPNX60	BAS	LL12	5929.01	02253.81	2016-07-20	22:15	84		34	6.7	17	1015	9990	11	-	x	-	x	-	x	-	-	x	-	x	x	x	x	-	-	x	-	-	-	-	-	-	-	-	-	-	-	-
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0358	BPNX35	BAS	LL19	5852.62	02019.308	2016-07-21	07:20	194	5	02	8.4	17	1015	1430	17	x	x	-	x	-	-	-	x	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	x
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0362	BPEX13	BAS	BY10	5638.02	01935.11	2016-07-22	00:35	145		02	8.5	18	1015	9990	15	x	x	-	x	-	x	-	-	x	-	x	x	x	x	-	-	x	-	-	-	-	-	-	-	-	-	-	-	-
0363	BPSE11	BAS	BCS III-10	5533.15	01823.75	2016-07-22	07:20	91	5	00	10.3	17	1016	2830	12	x	x	-	x	x	x	-	-	x	-	x	x	x	x	-	-	x	-	-	-	-	-	-	-	-	-	-	-	x
0364	BPSB07	BAS	BY5 BORNHOLMSDJ	5515	01559.44	2016-07-22	15:30	91	6	08	0.0	20	1018	0020	12	x	x	-	x	x	x	-	-	x	-	x	x	x	x	-	-	x	-	-	-	-	-	-	-	-	-	-	-	x
0365	BPSB06	BAS	BY4 CHRISTIANSÖ	5522.95	01519.99	2016-07-22	19:27	93		20	3.0	20	1019	1120	13	x	x	-	x	-	x	-	-	x	-	x	x	x	x	-	-	x	-	-	-	-	-	-	-	-	-	-	-	-
0366	BPSA03	BAS	BY2 ARKONA	5458.27	01405.94	2016-07-23	00:58	47		21	2.6	19	1019	1110	8	x	x	-	x	-	x	-	-	x	-	x	x	x	x	-	-	x	-	-	-	-	-	-	-	-	-	-	-	x
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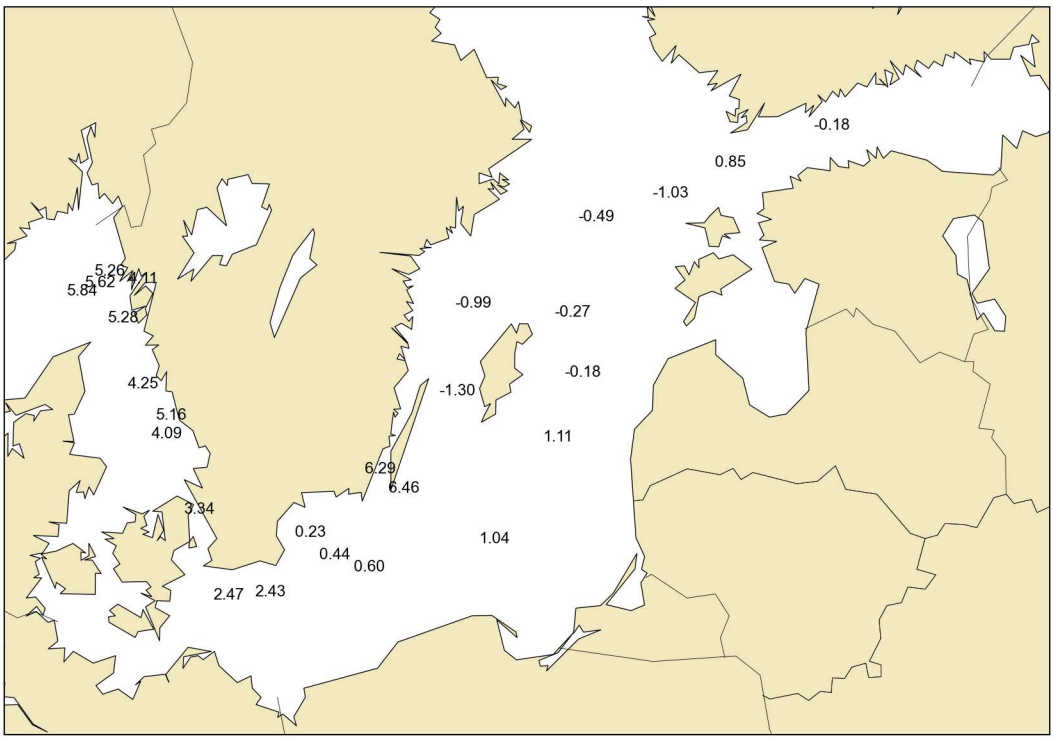
0386	BPWX38	EXT	BY32 NORRKÖPING	5800.83	01758.89	2016-07-26	16:30	202		04	0.0	20	1014	1630	17	-	x	-	x	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	x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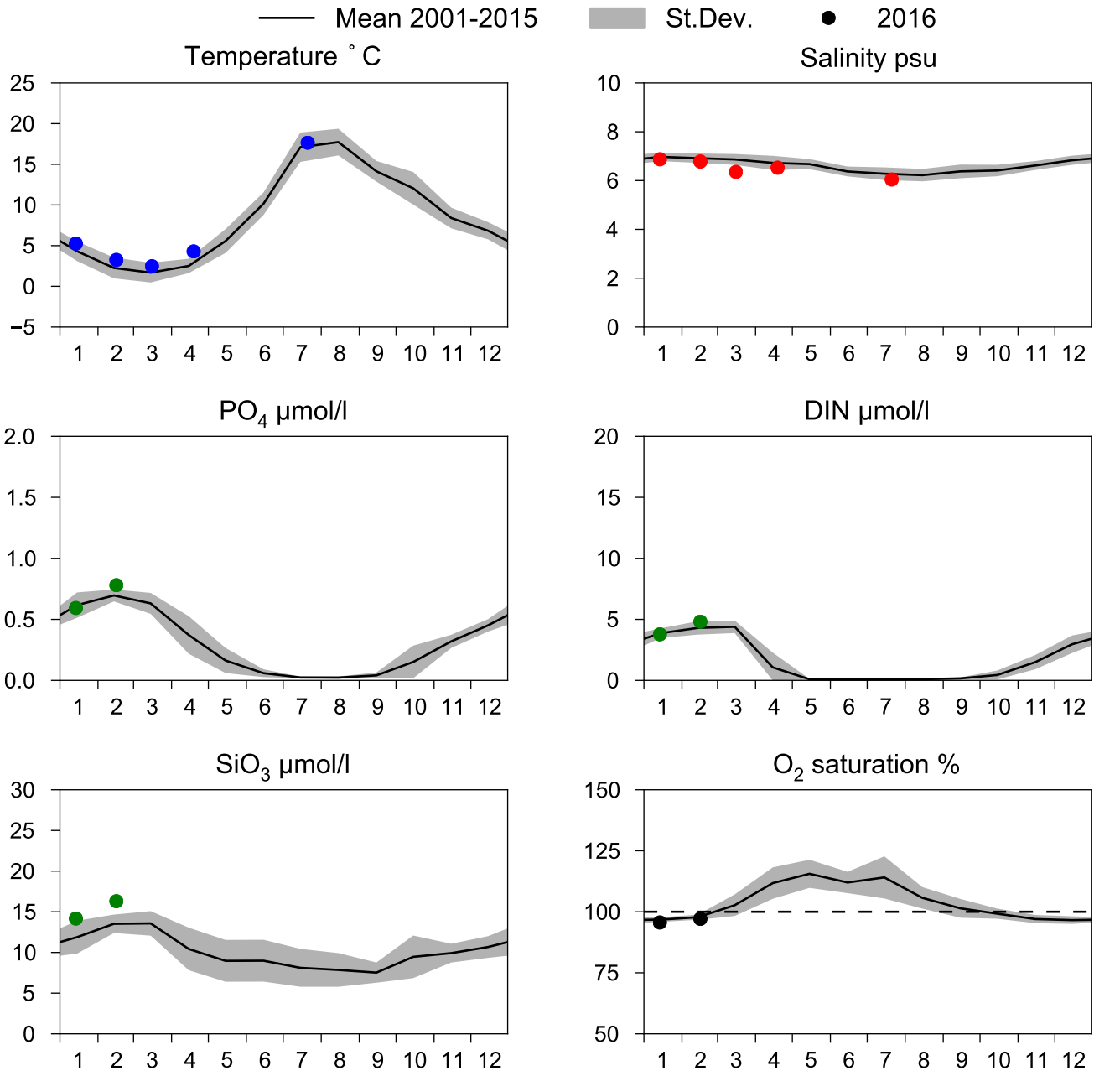
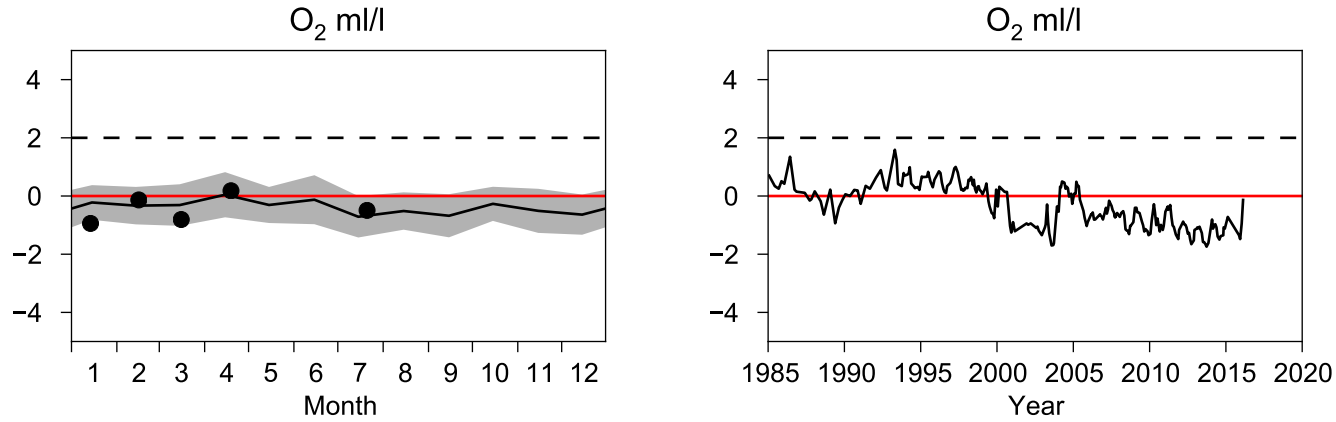
STATION BY29 SURFACE WATER

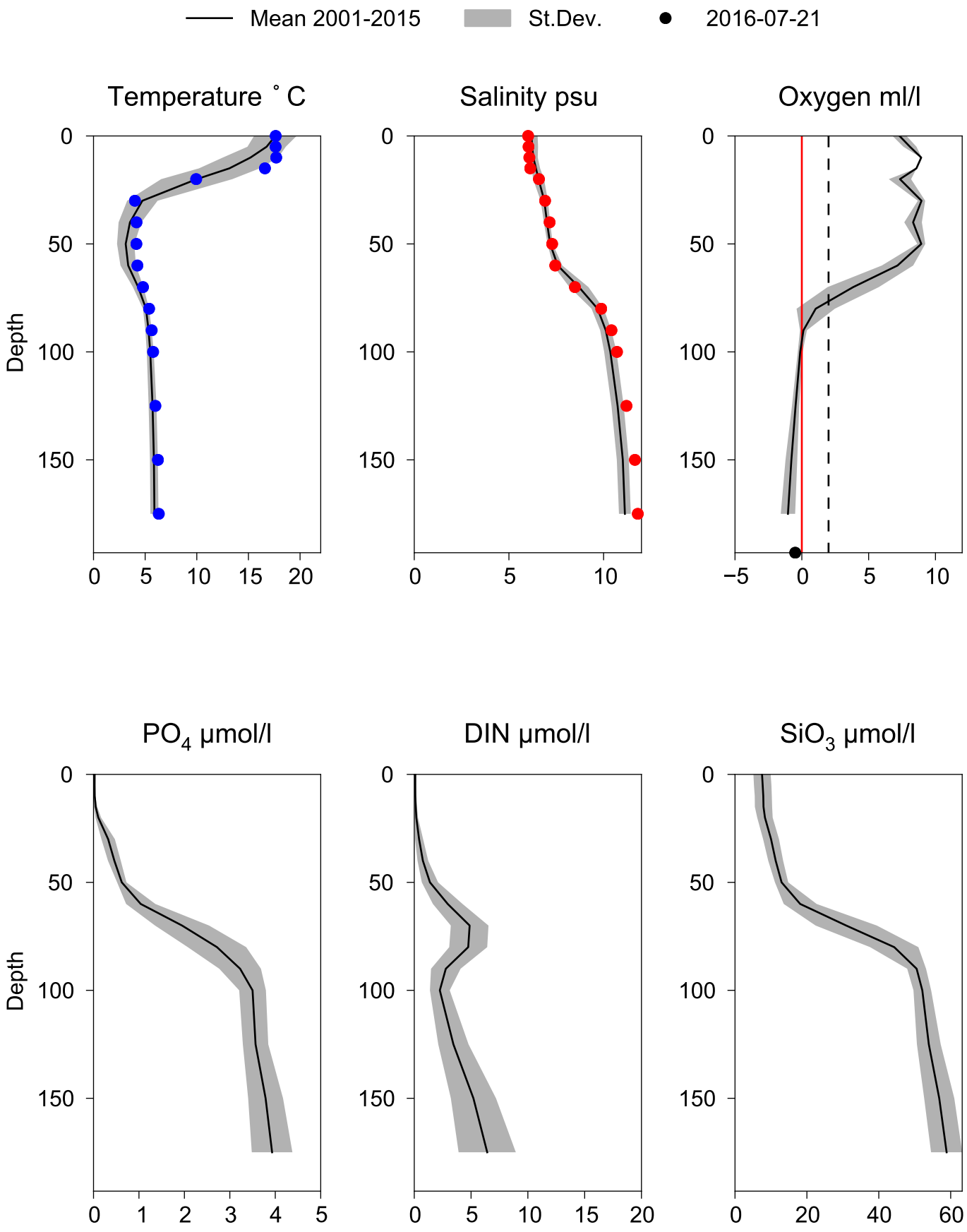
Annual Cycles



OXYGEN IN BOTTOM WATER (depth >= 150 m)



Vertical profiles BY29
July

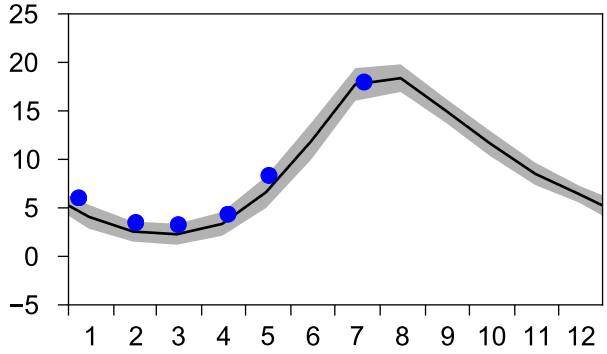


STATION BY20 FÅRÖDJ SURFACE WATER

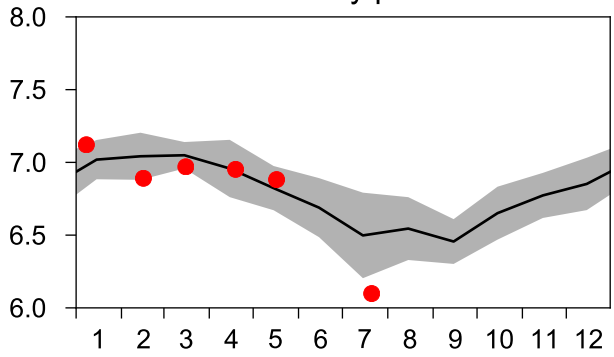
Annual Cycles

Mean 2001-2015 St.Dev. 2016

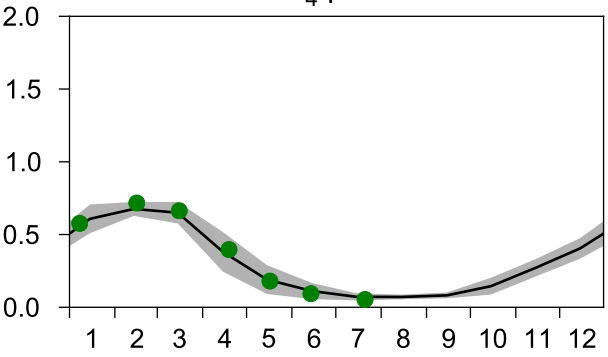
Temperature ˚C



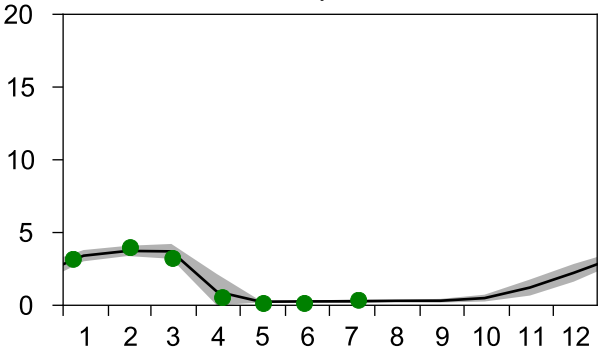
Salinity psu



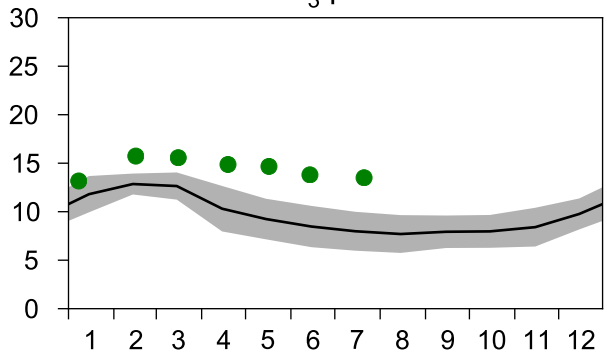
PO_4 µmol/l



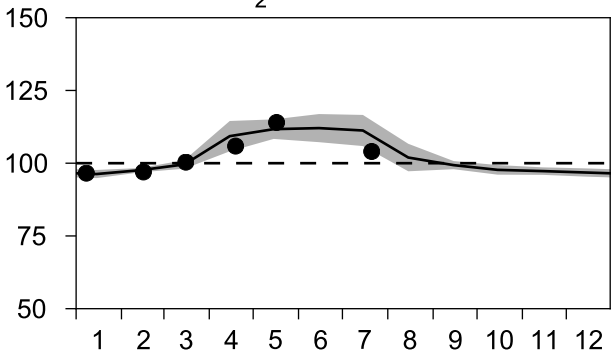
DIN µmol/l



SiO_3 µmol/l

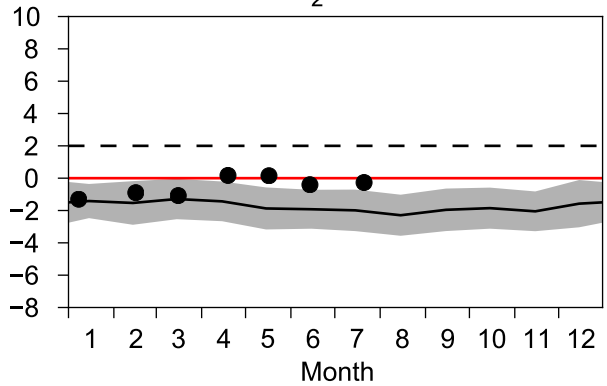


O_2 saturation %



OXYGEN IN BOTTOM WATER (depth >= 175 m)

O_2 ml/l



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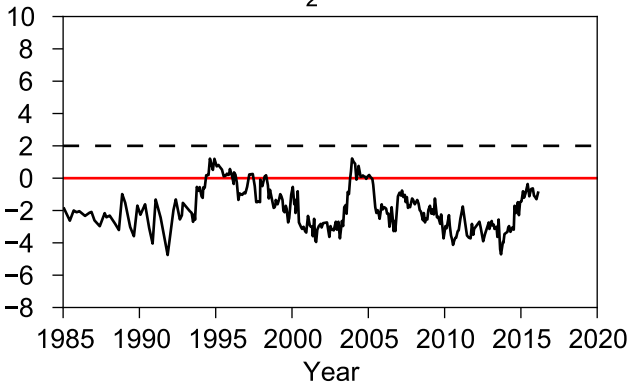
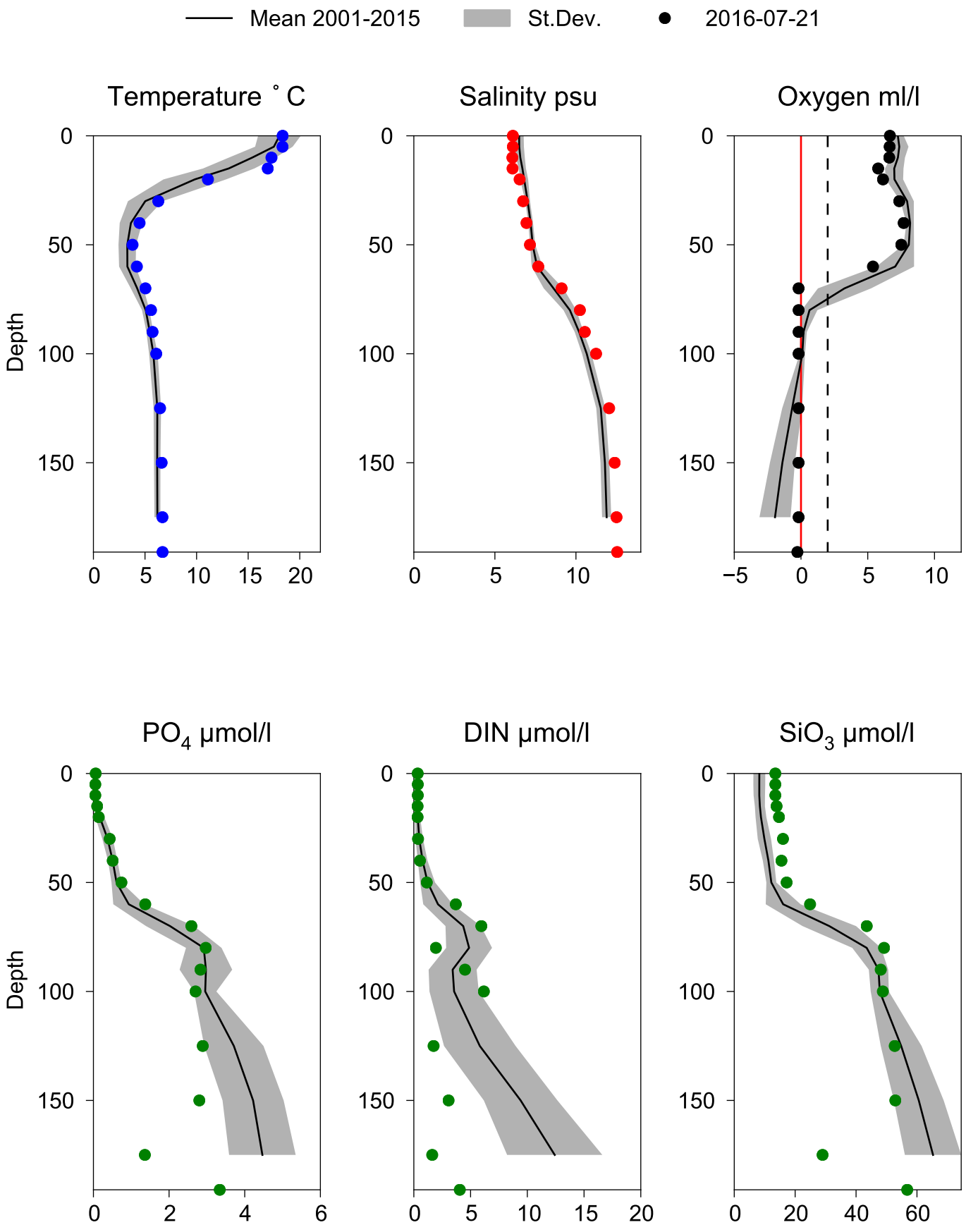
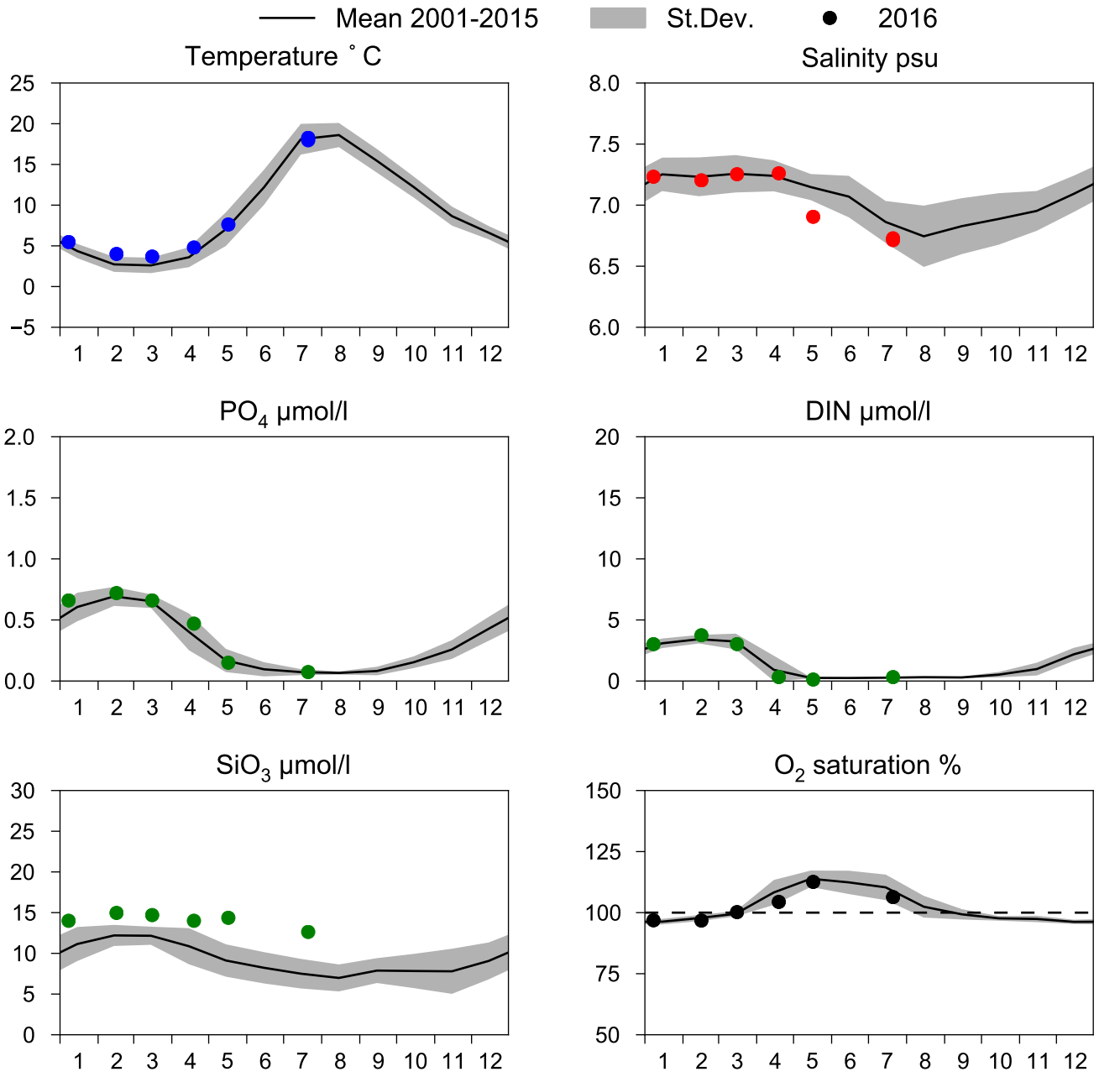


Vertical profiles BY20 FÅRÖDJ
July

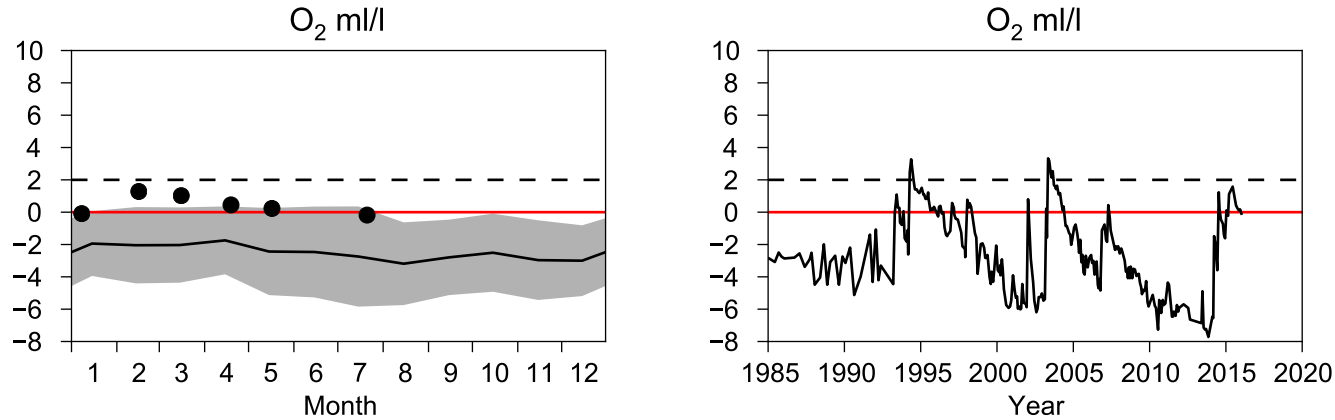


STATION BY15 GOTLANDSDJ SURFACE WATER

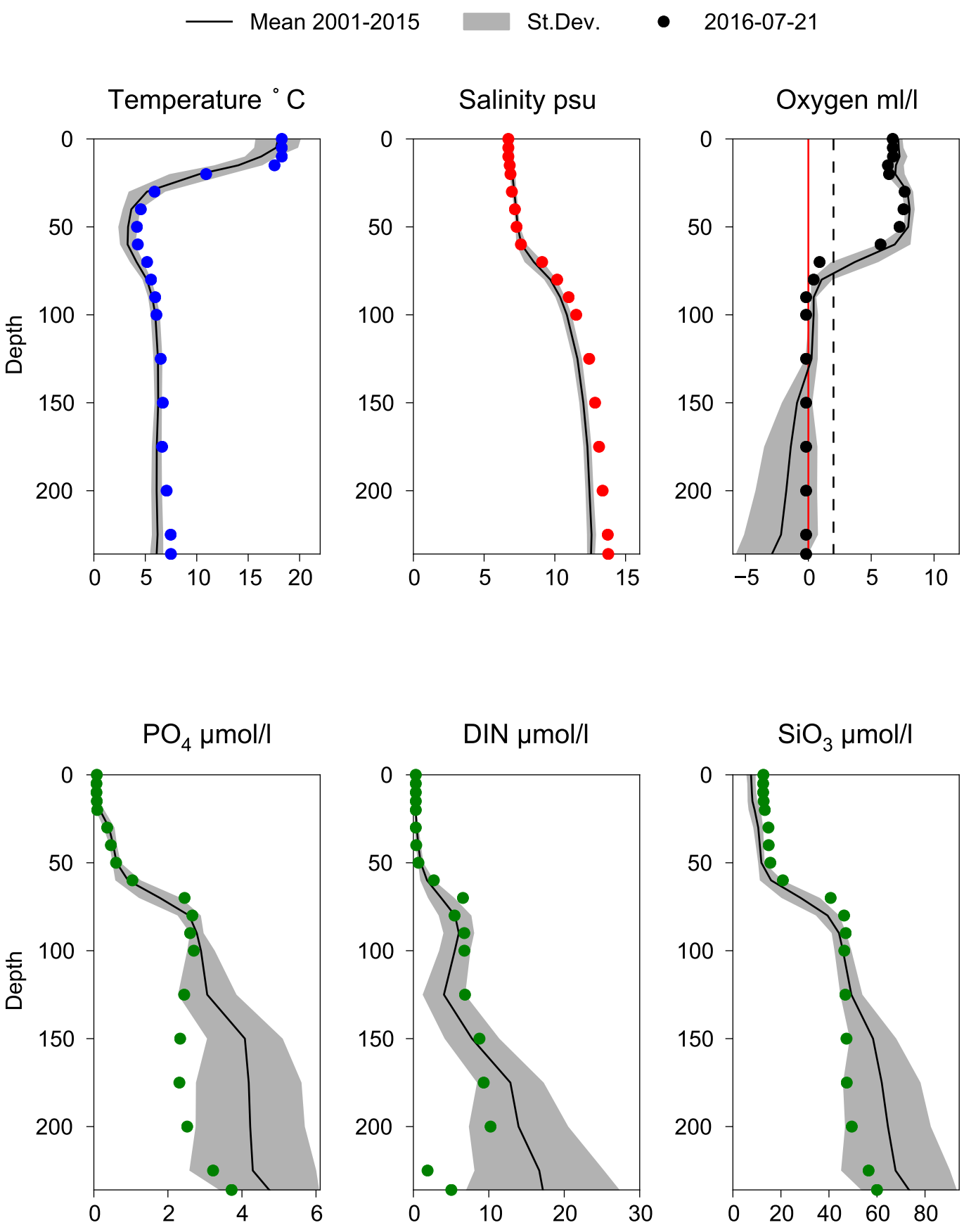
Annual Cycles



OXYGEN IN BOTTOM WATER (depth >= 225 m)

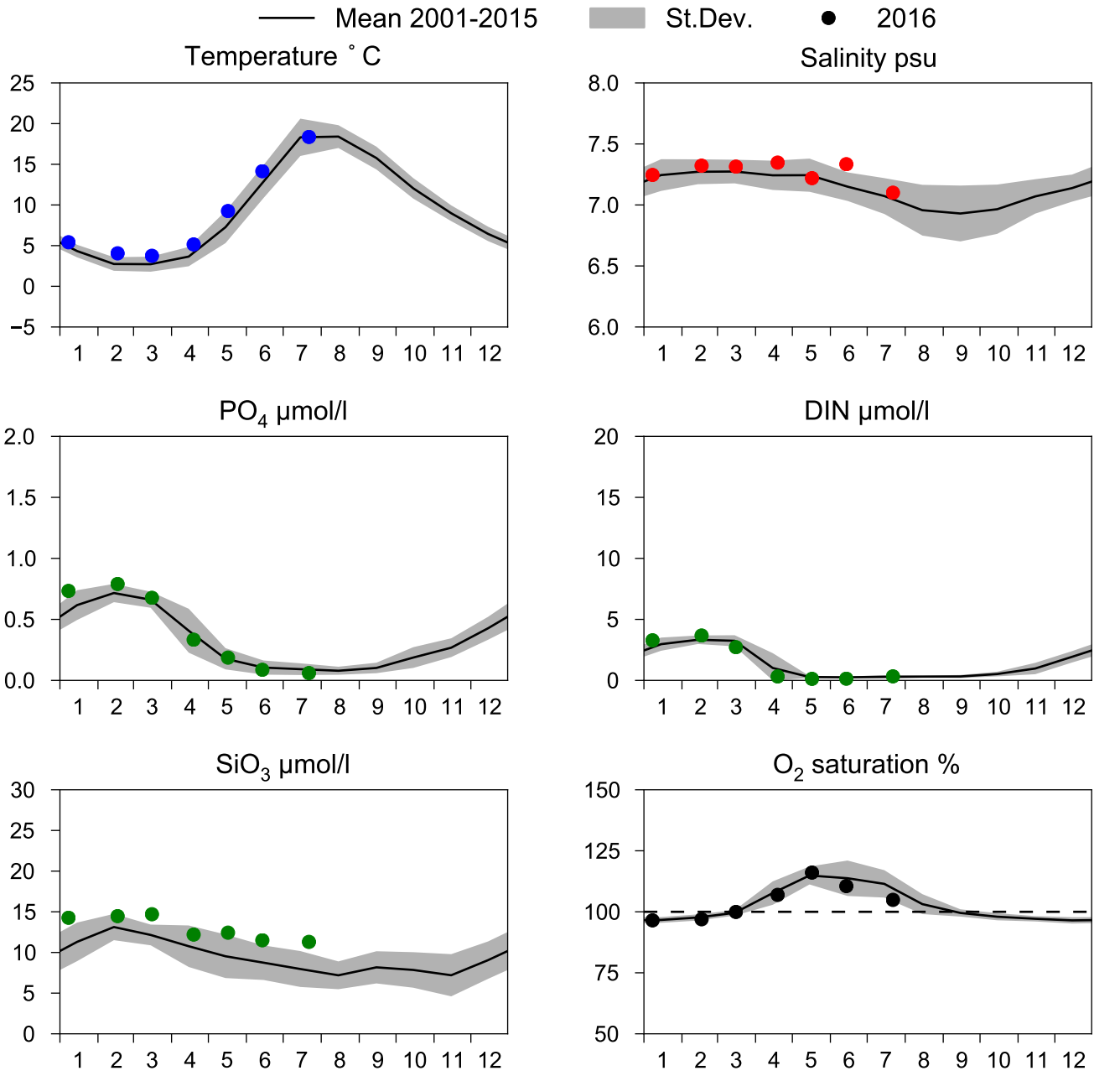


Vertical profiles BY15 GOTLANDSDJ
July

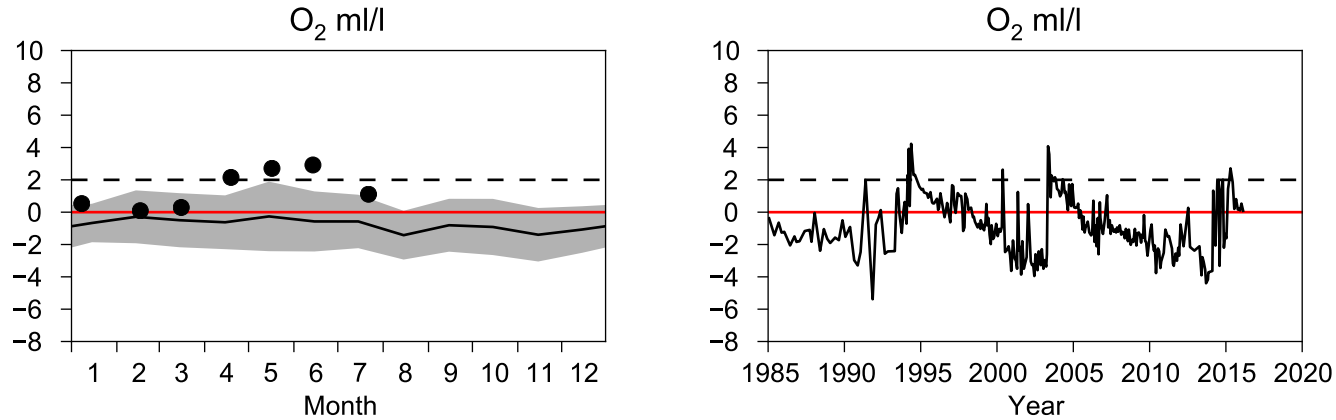


STATION BY10 SURFACE WATER

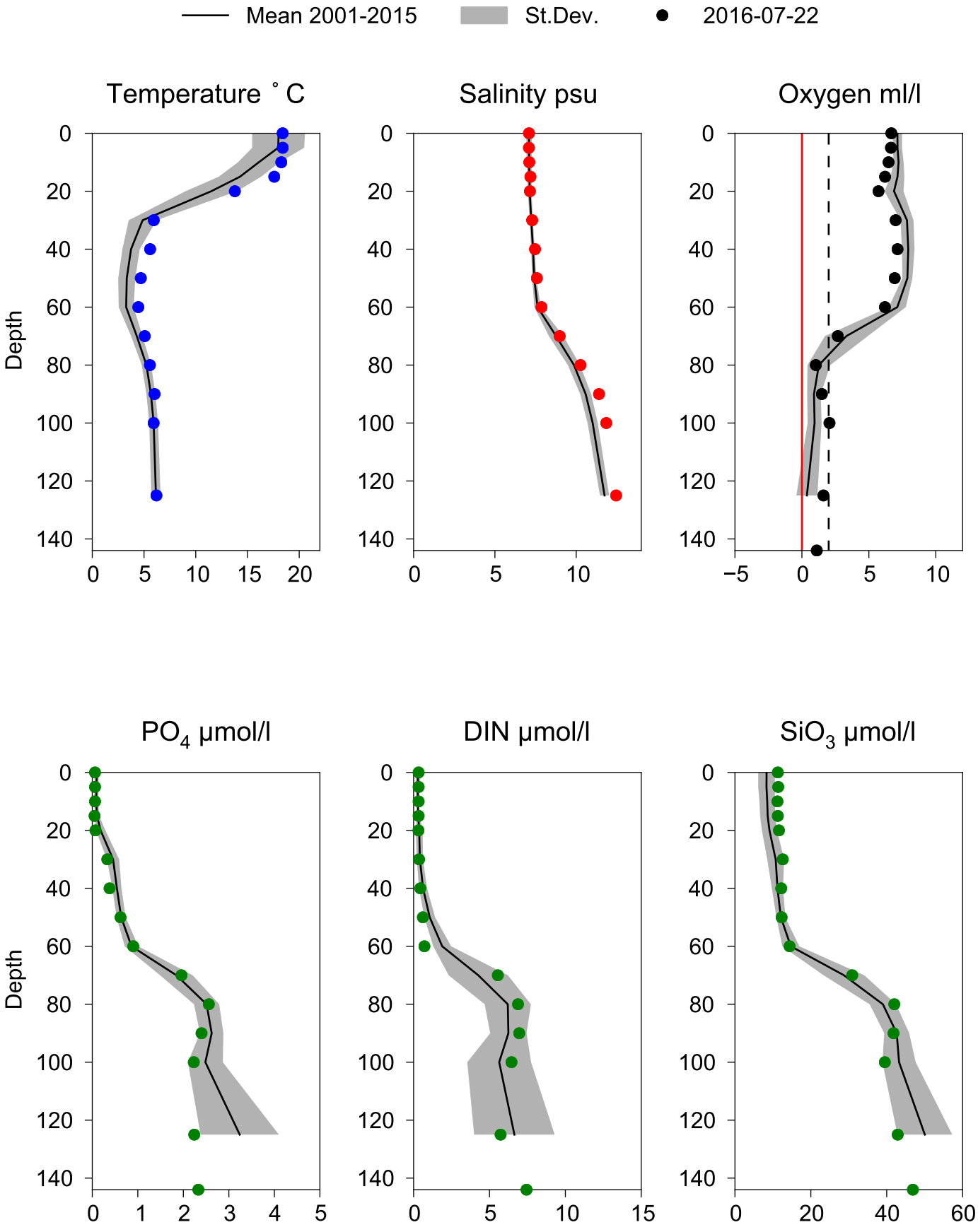
Annual Cycles



OXYGEN IN BOTTOM WATER (depth >= 125 m)

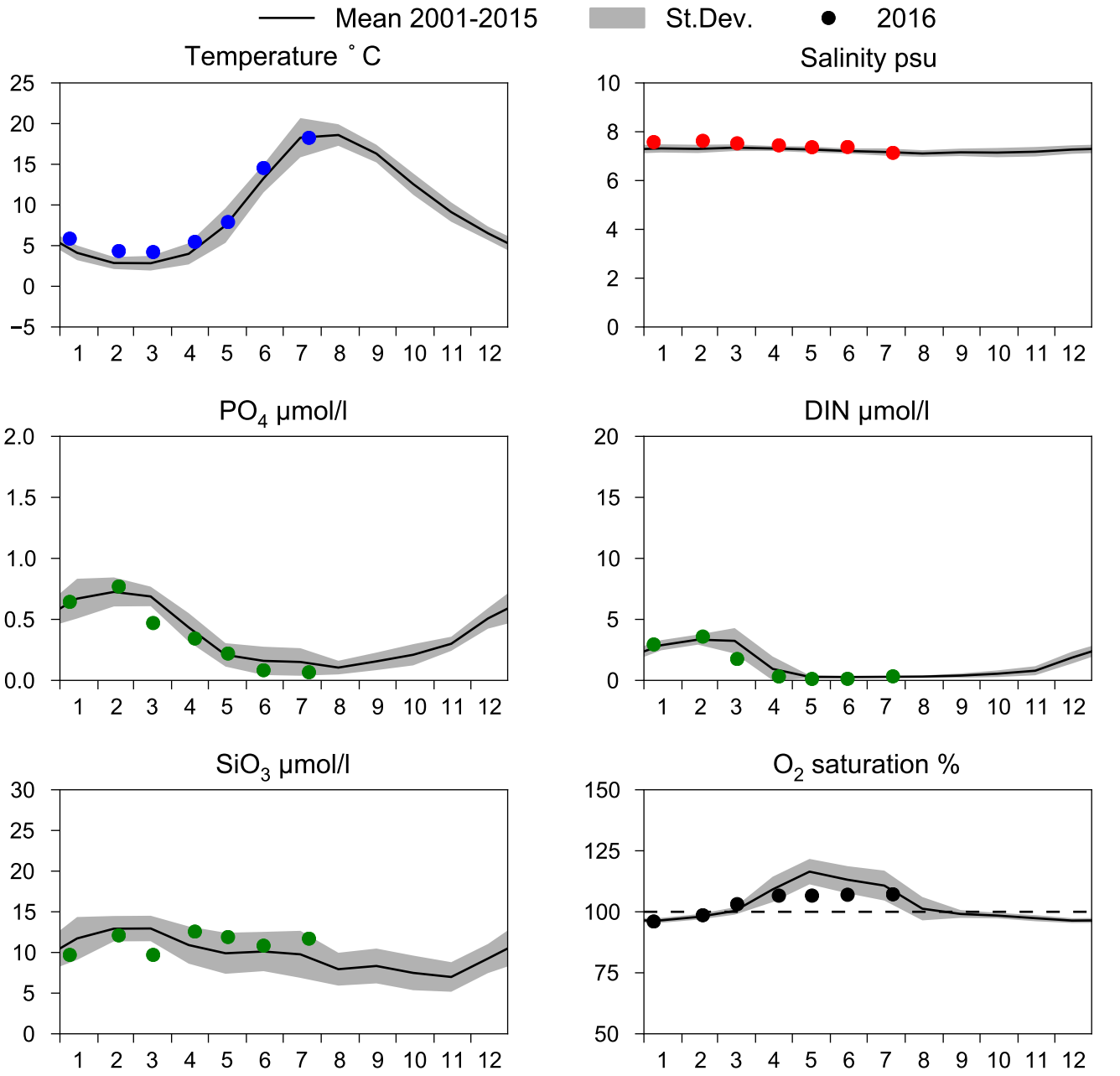


Vertical profiles BY10
July

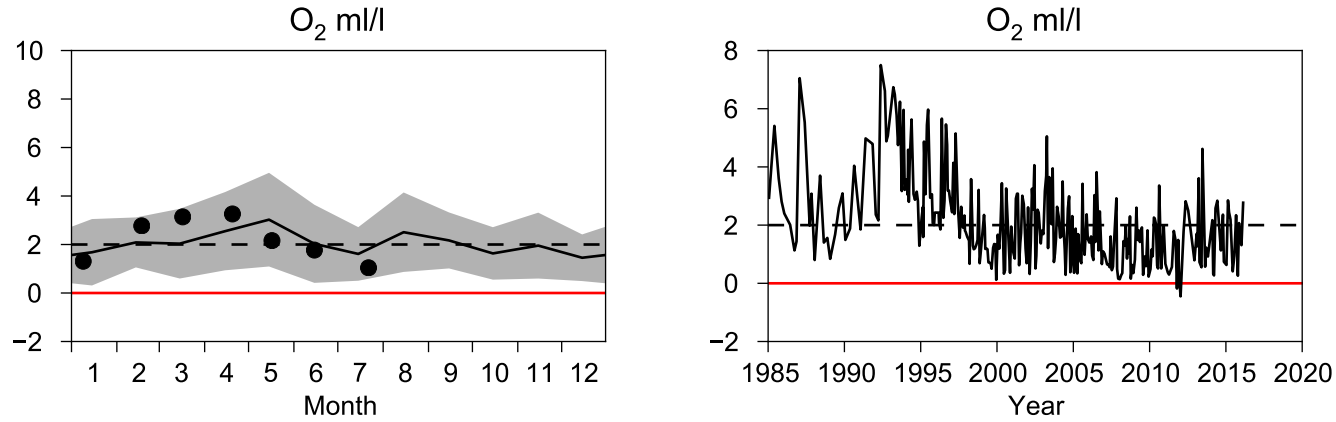


STATION BCS III-10 SURFACE WATER

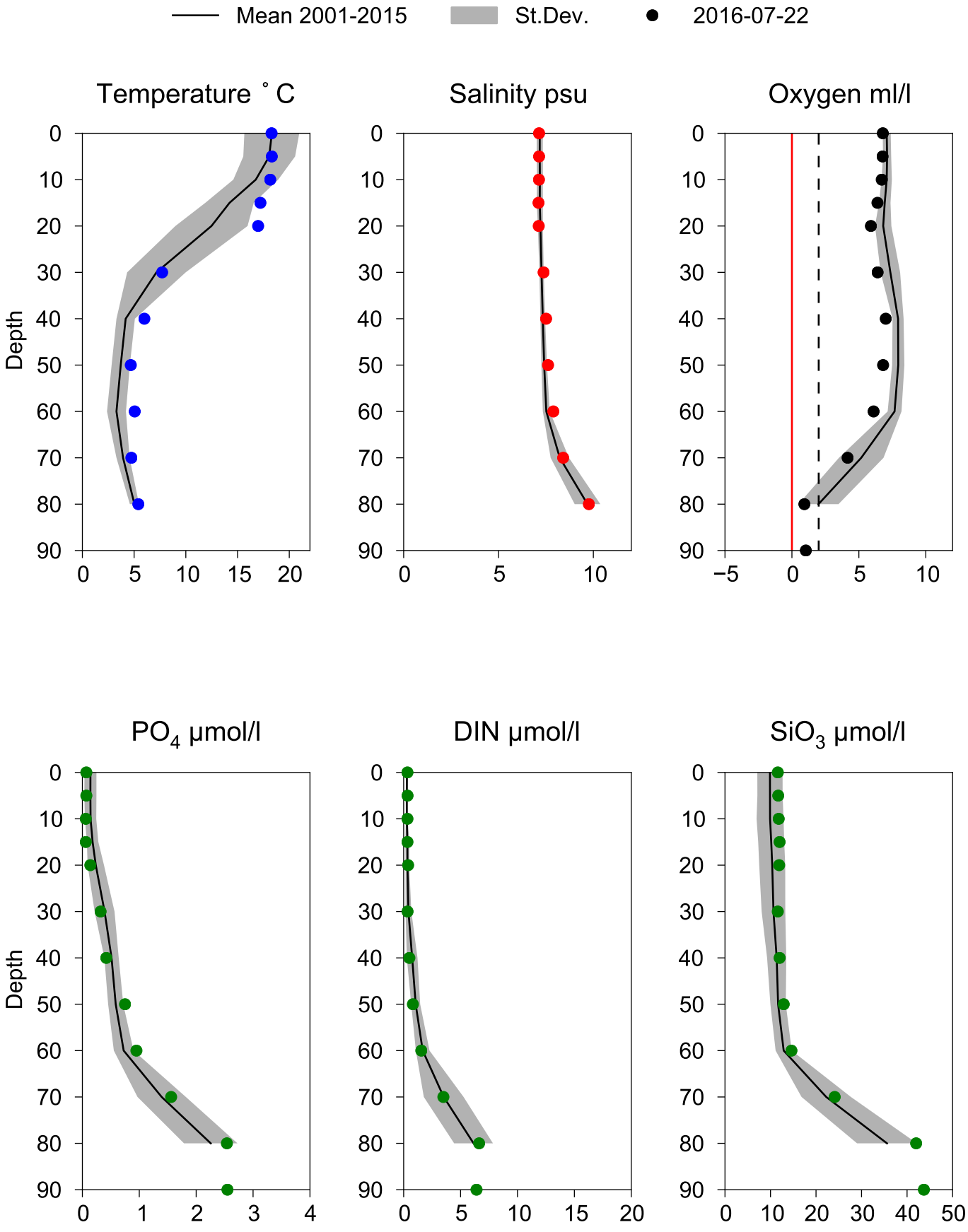
Annual Cycles



OXYGEN IN BOTTOM WATER (depth >= 80 m)

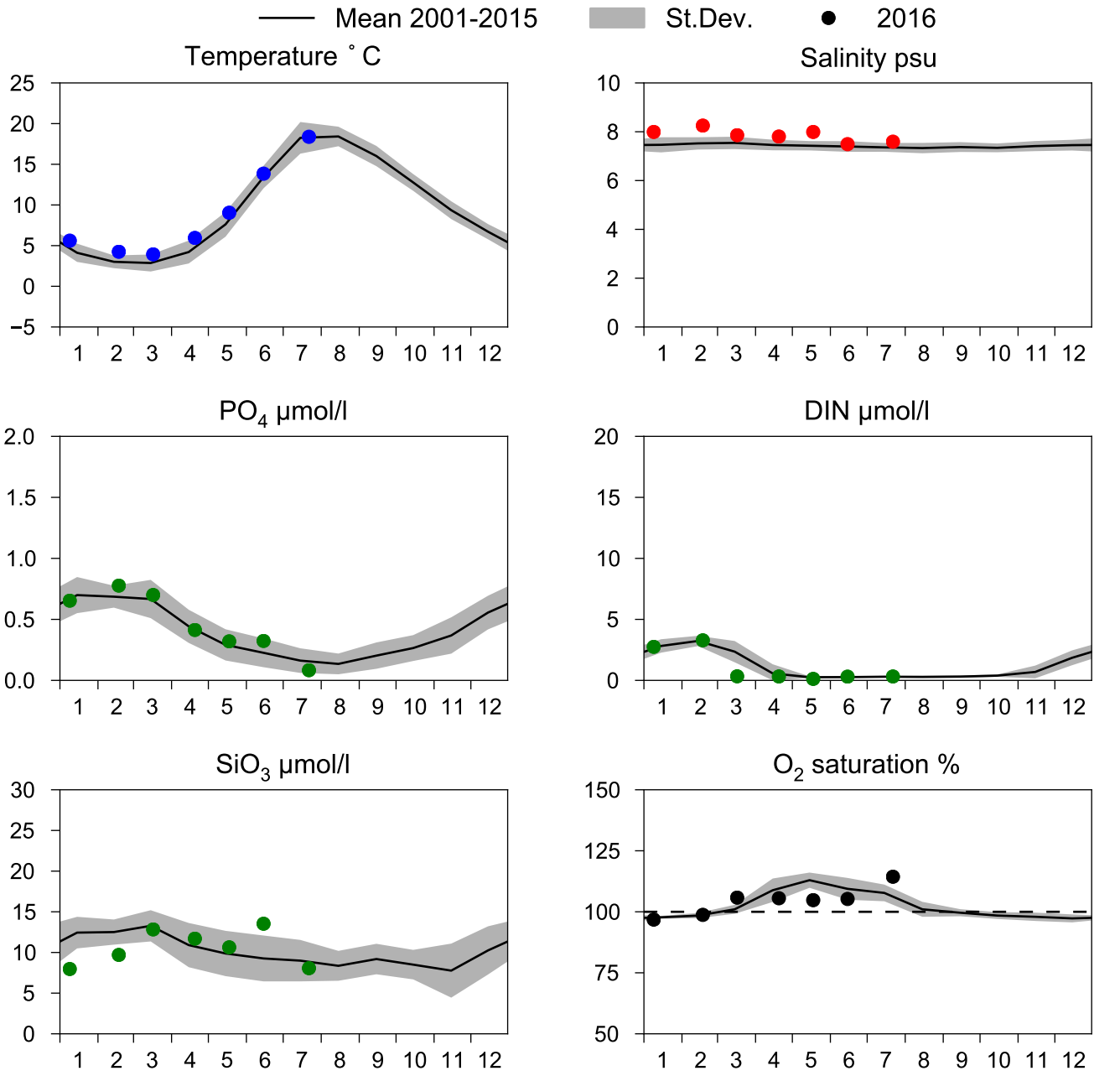


Vertical profiles BCS III-10
July

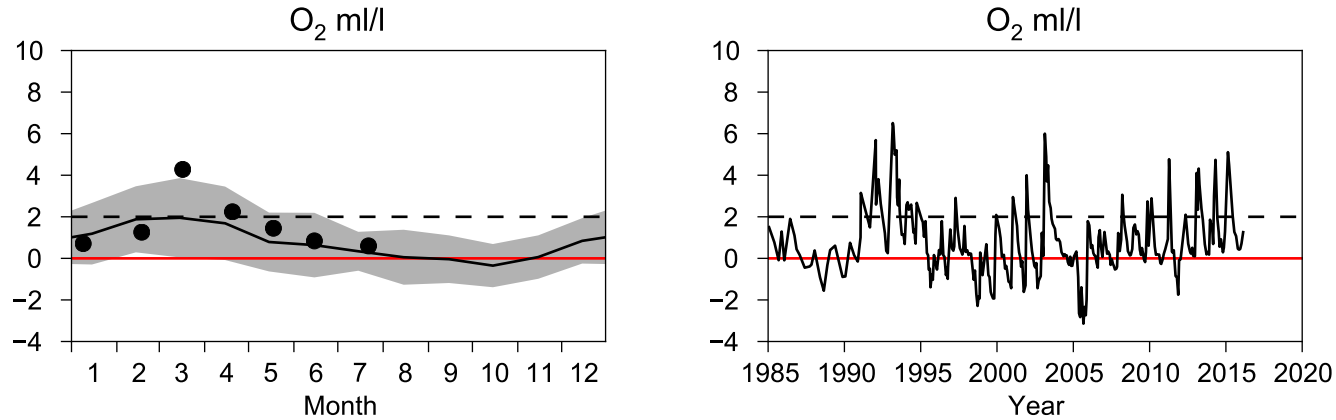


STATION BY5 BORNHOLMSDJ SURFACE WATER

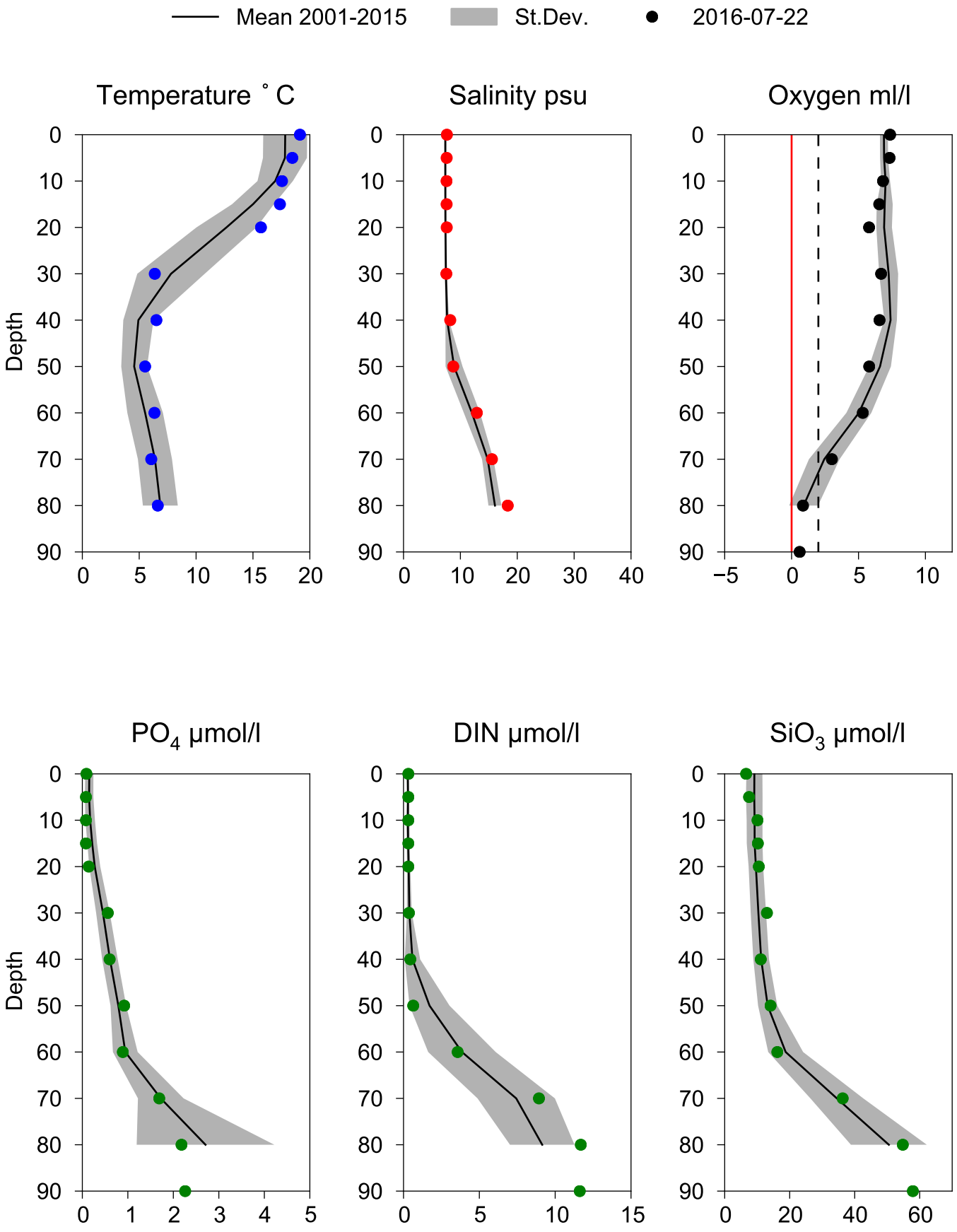
Annual Cycles



OXYGEN IN BOTTOM WATER (depth >= 80 m)

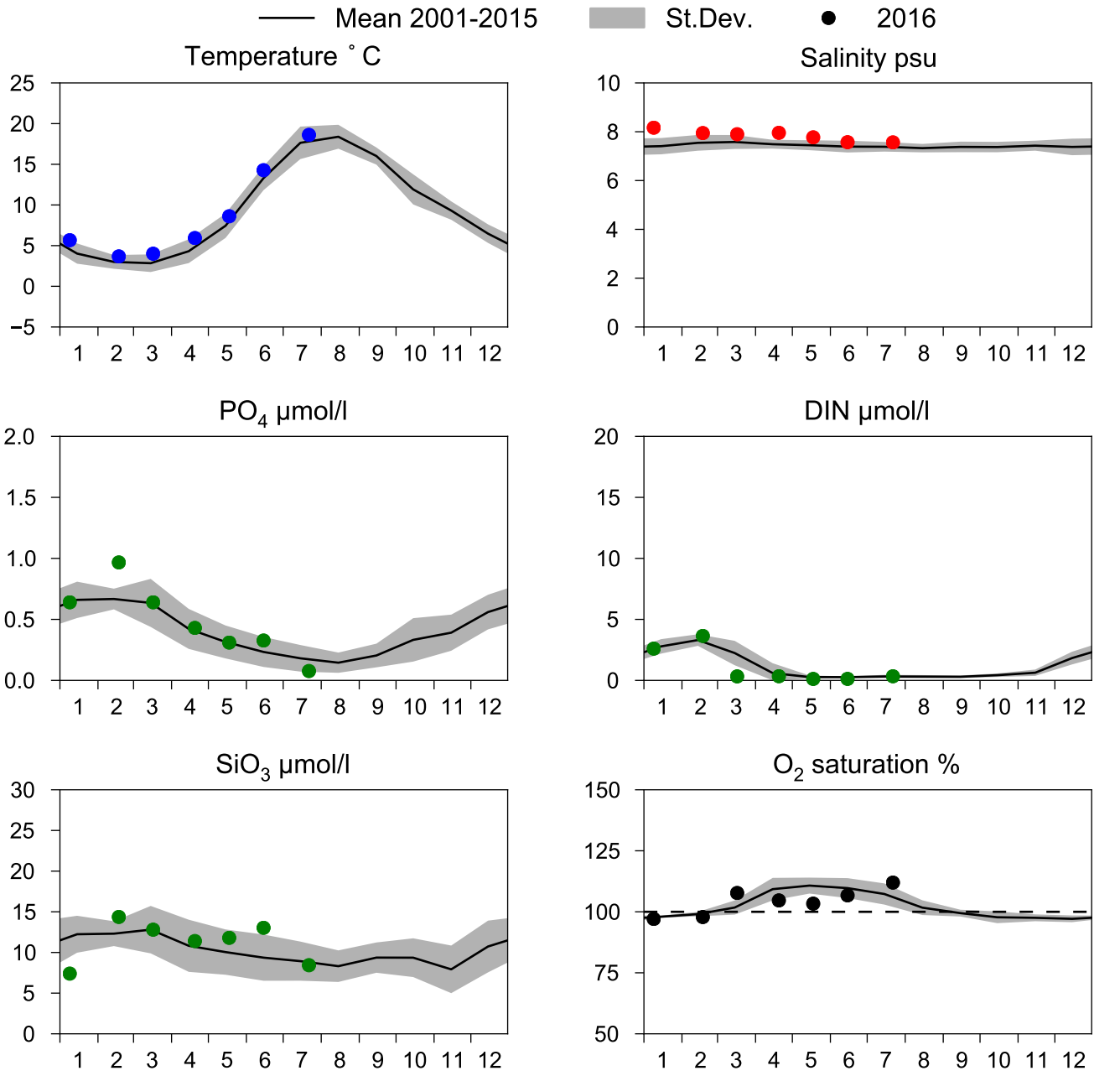


Vertical profiles BY5 BORNHOLMSDJ
July

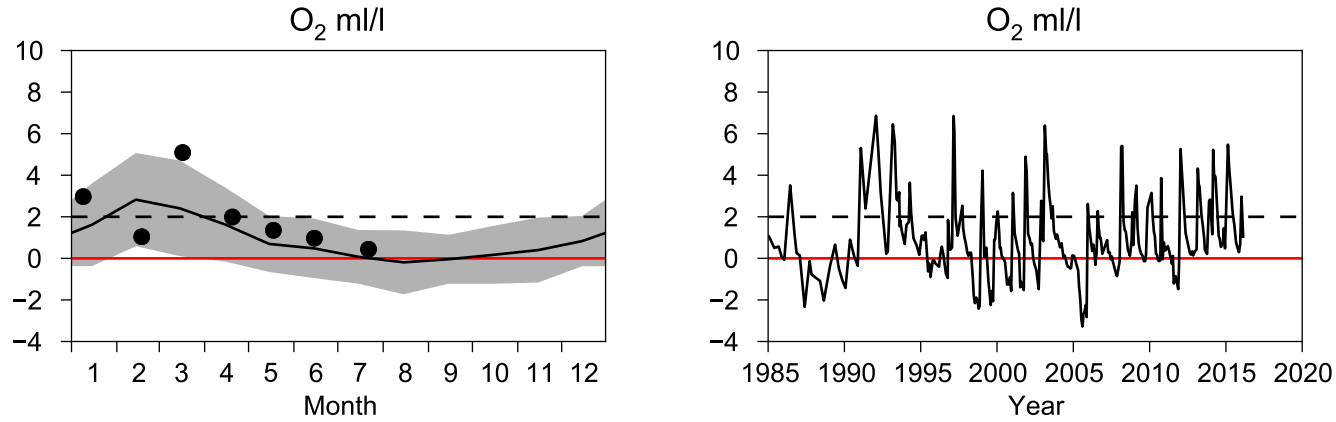


STATION BY4 CHRISTIANSÖ SURFACE WATER

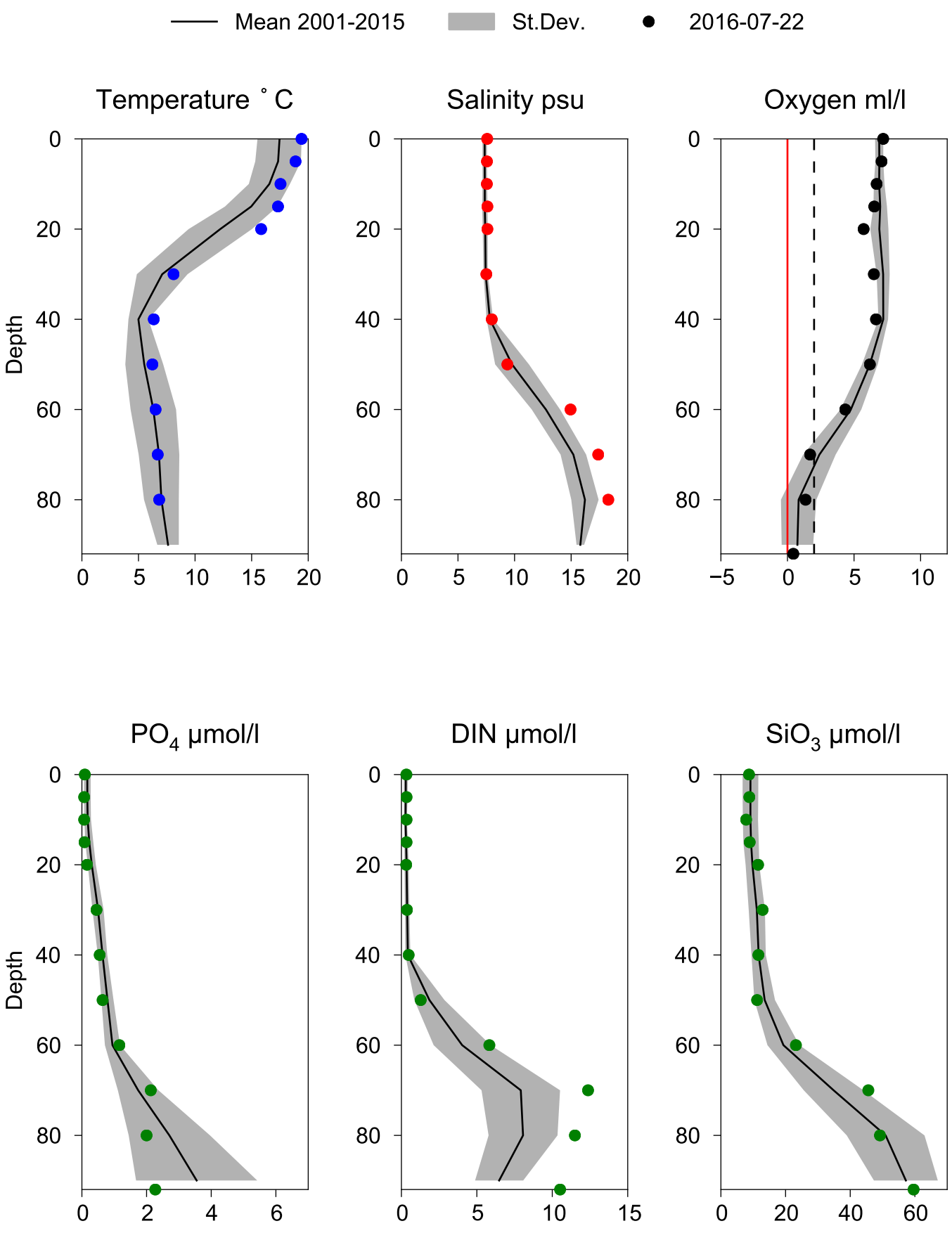
Annual Cycles



OXYGEN IN BOTTOM WATER (depth >= 80 m)

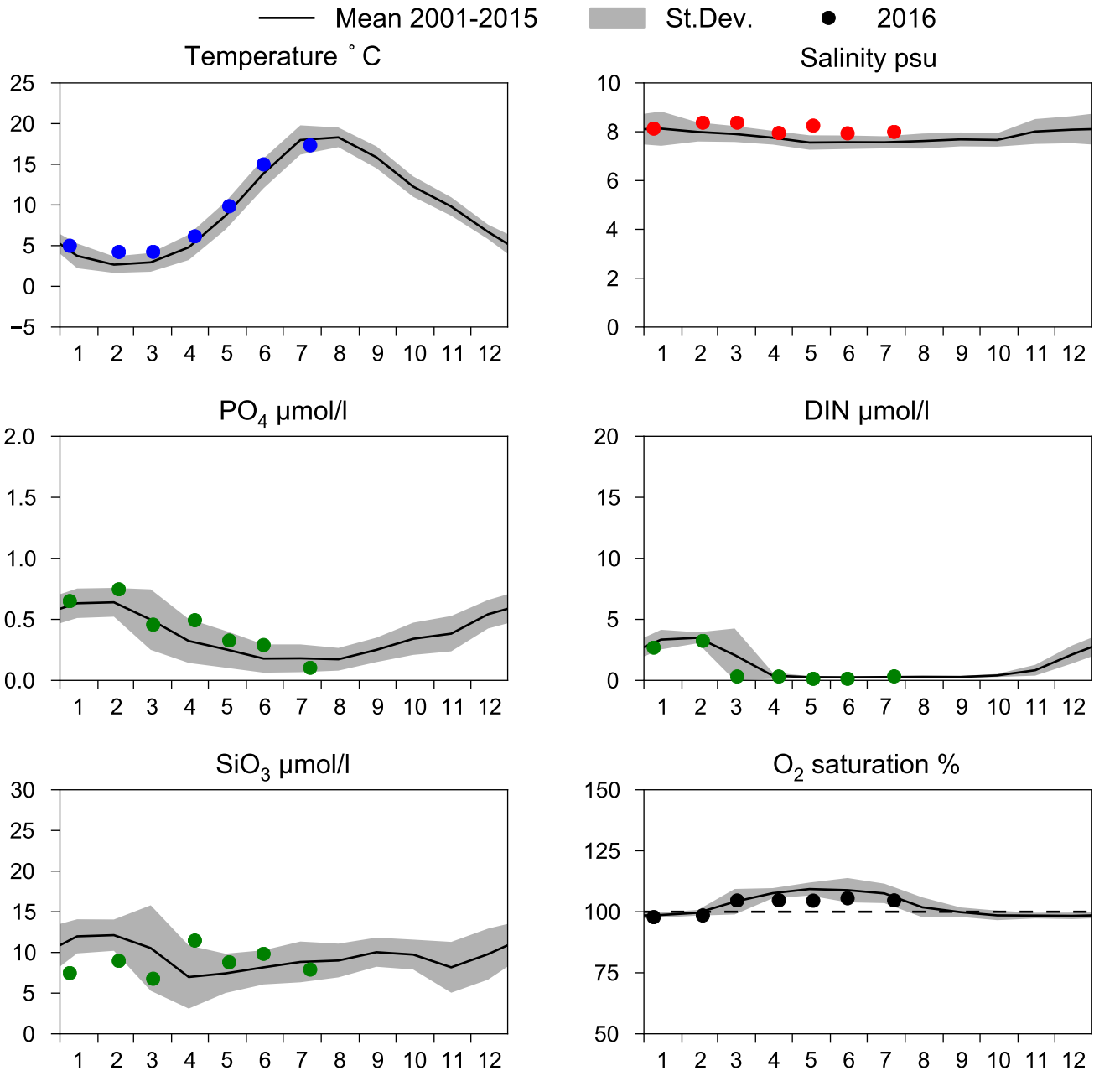


Vertical profiles BY4 CHRISTIANSÖ
July

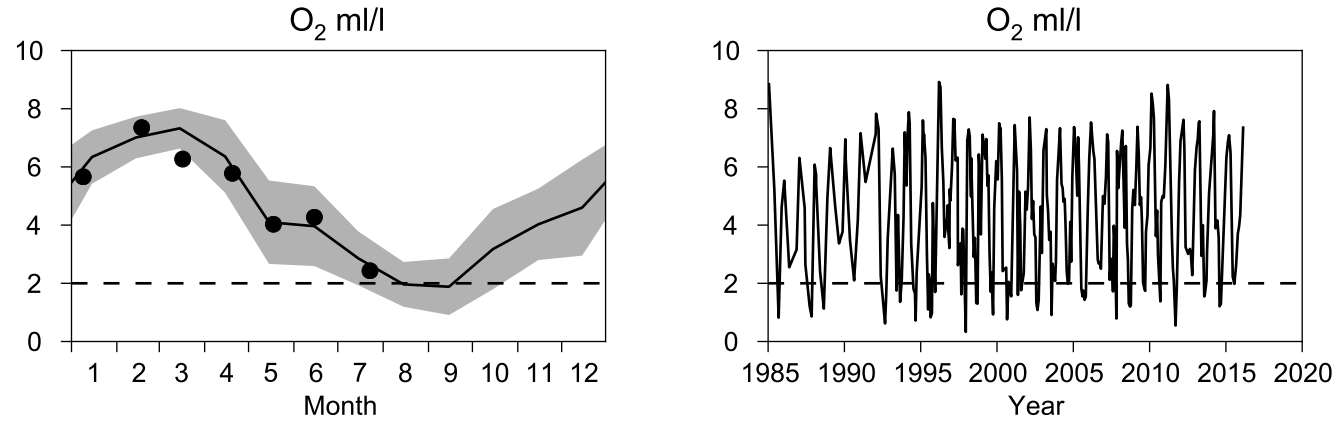


STATION BY2 ARKONA SURFACE WATER

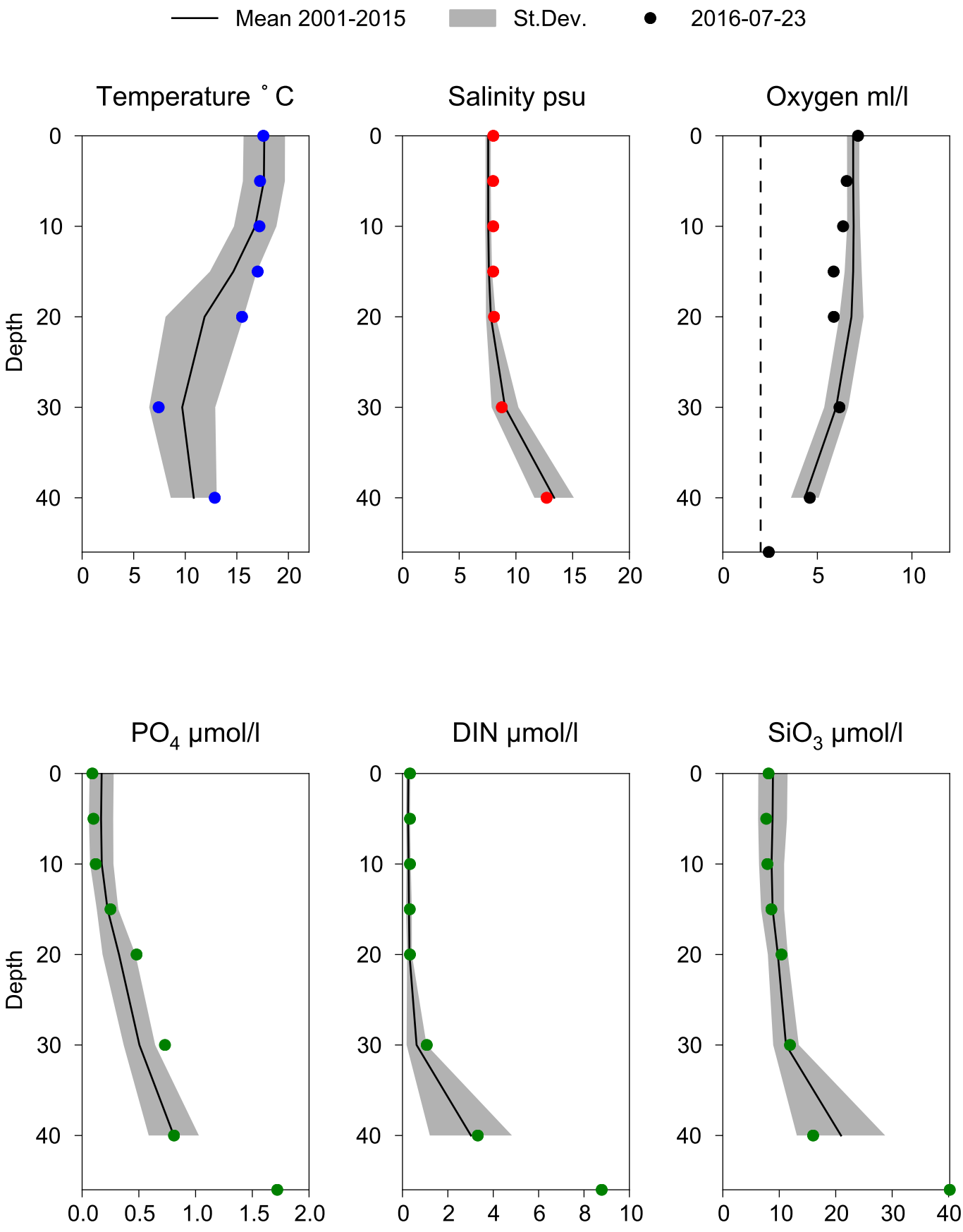
Annual Cycles



OXYGEN IN BOTTOM WATER (depth >= 40 m)

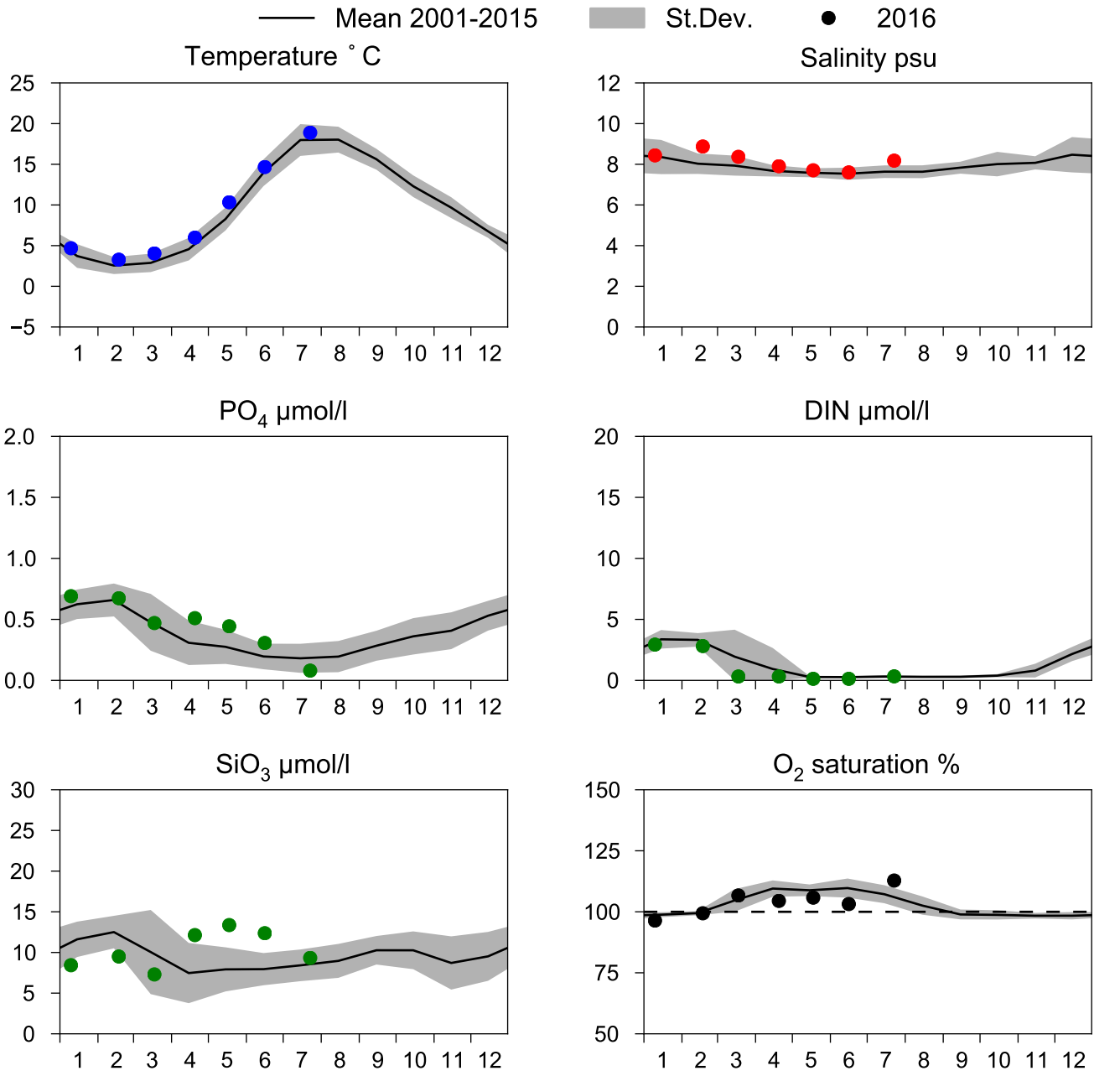


Vertical profiles BY2 ARKONA
July

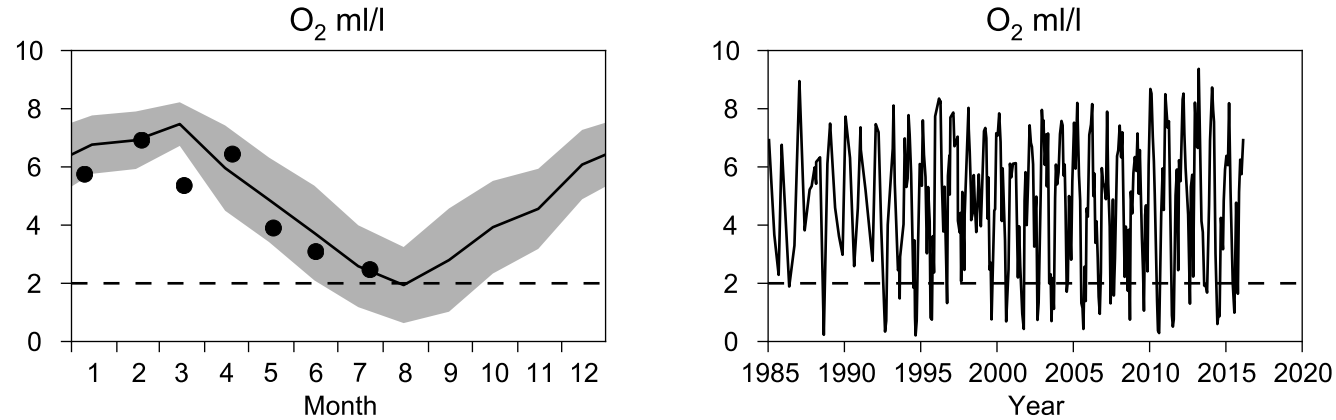


STATION BY1 SURFACE WATER

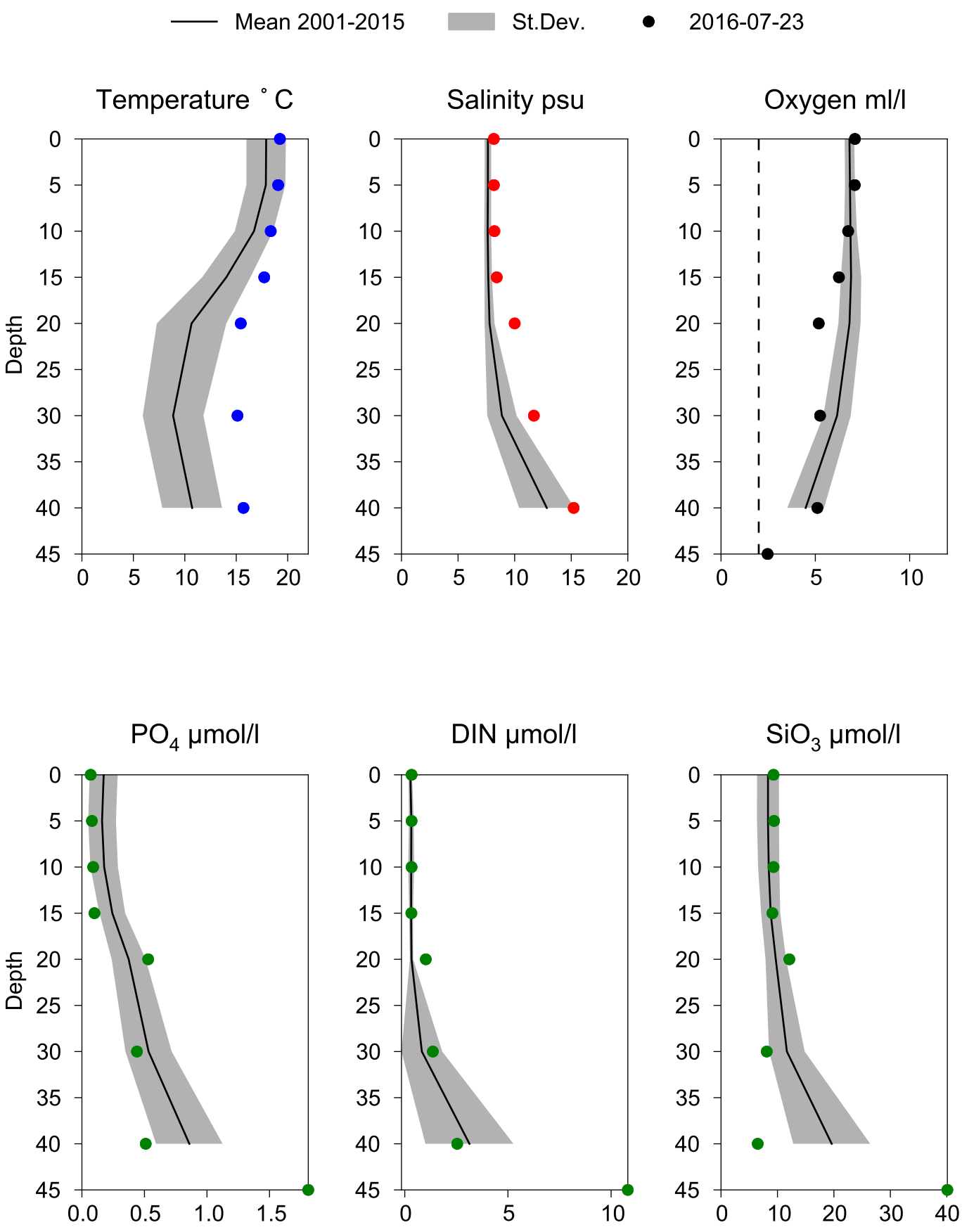
Annual Cycles



OXYGEN IN BOTTOM WATER (depth >= 40 m)

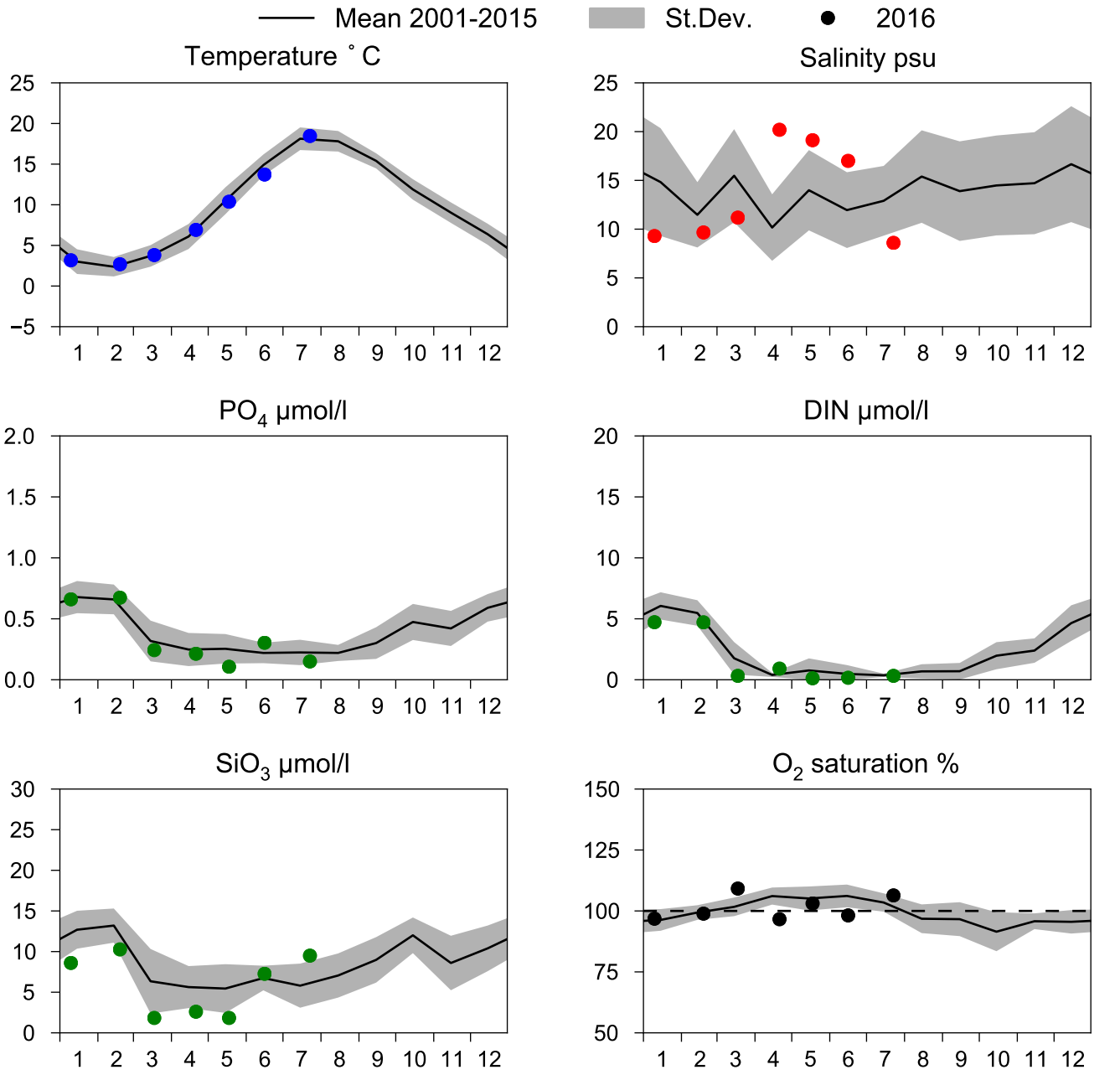


Vertical profiles BY1
July

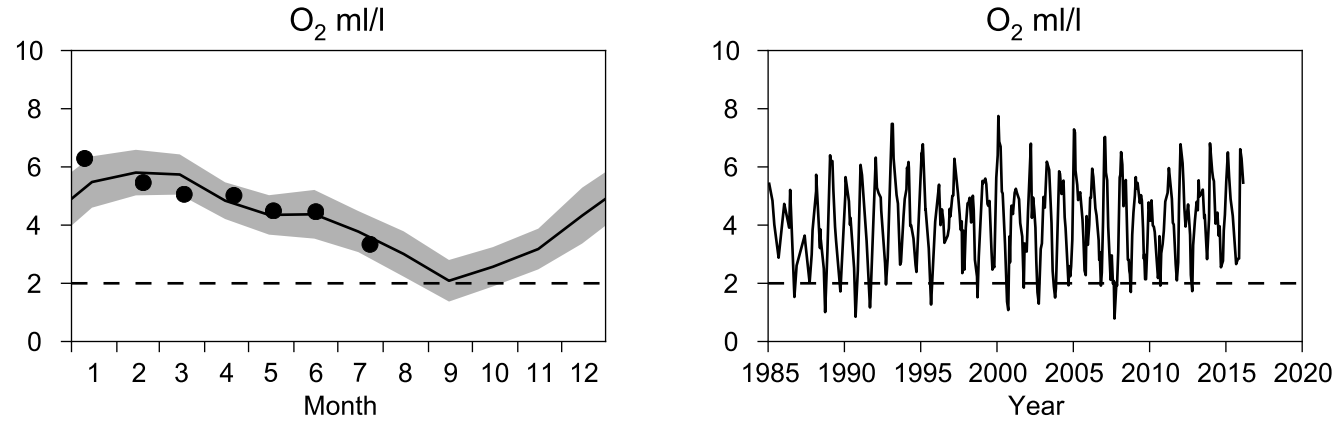


STATION W LANDSKRONA SURFACE WATER

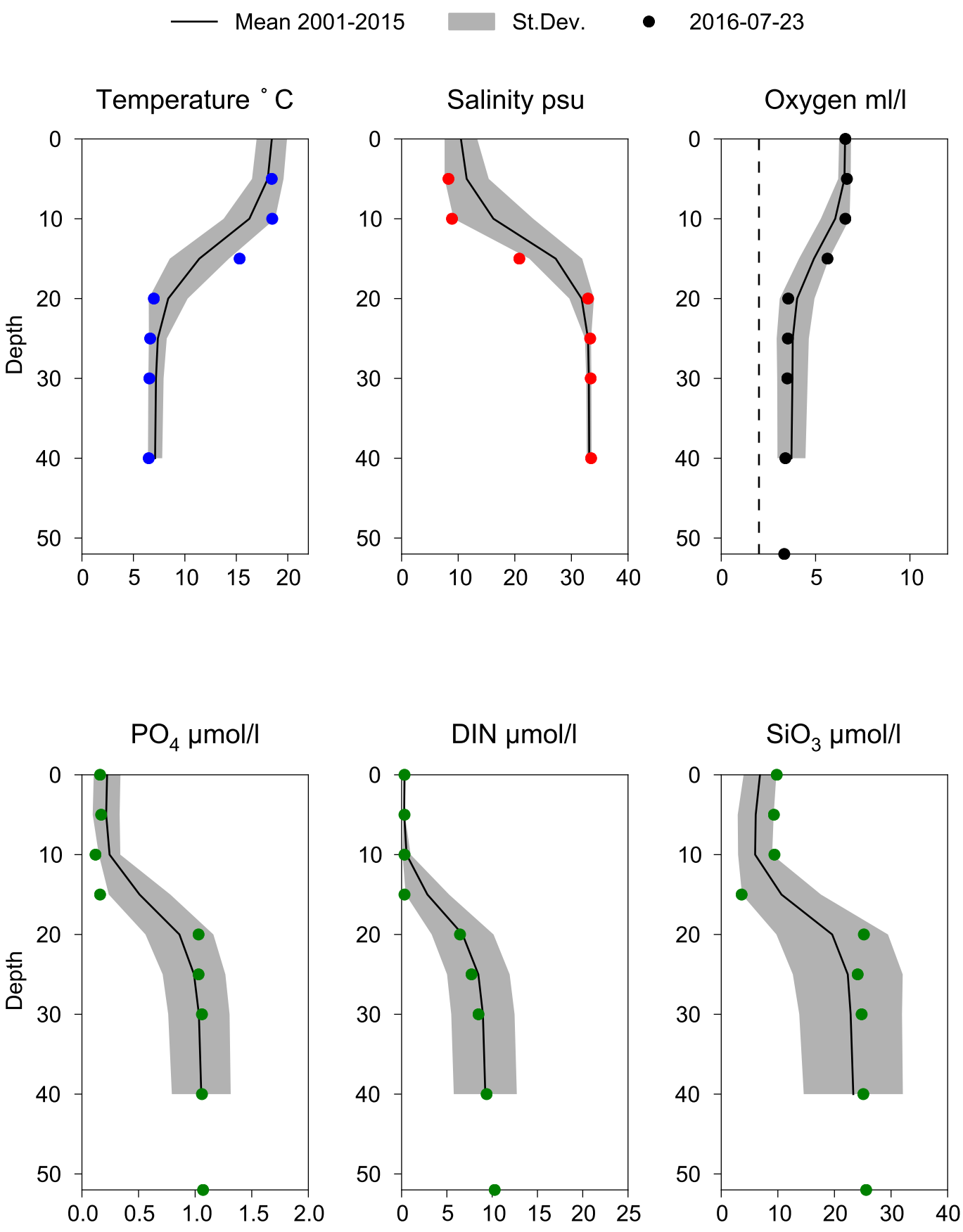
Annual Cycles



OXYGEN IN BOTTOM WATER (depth >= 40 m)

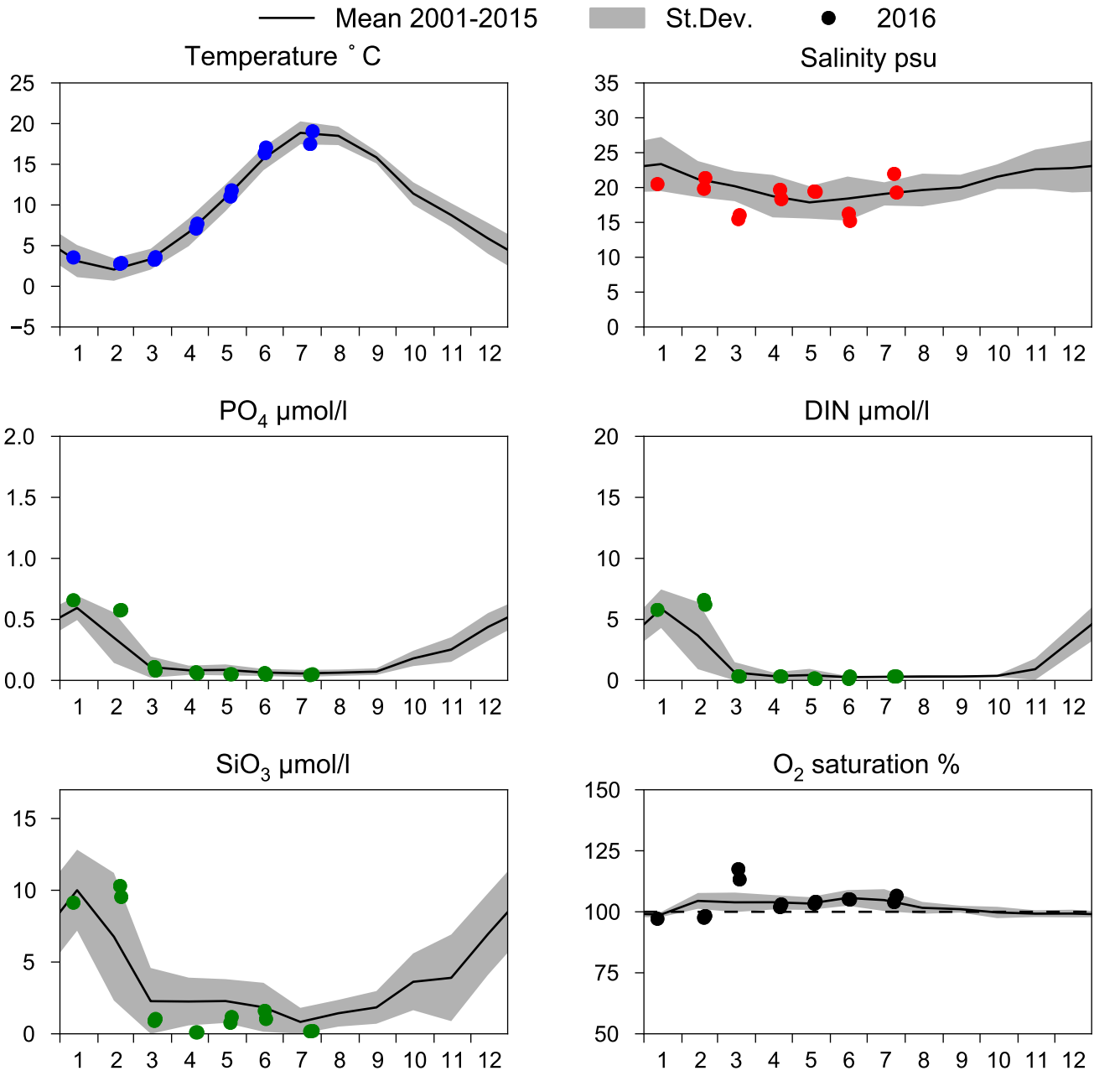


Vertical profiles W LANDSKRONA
July

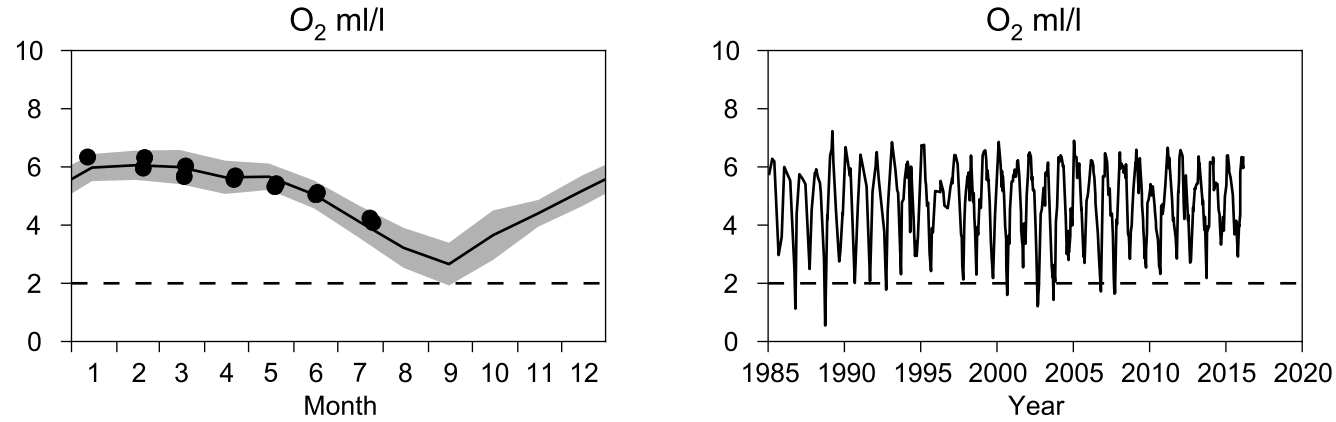


STATION ANHOLT E SURFACE WATER

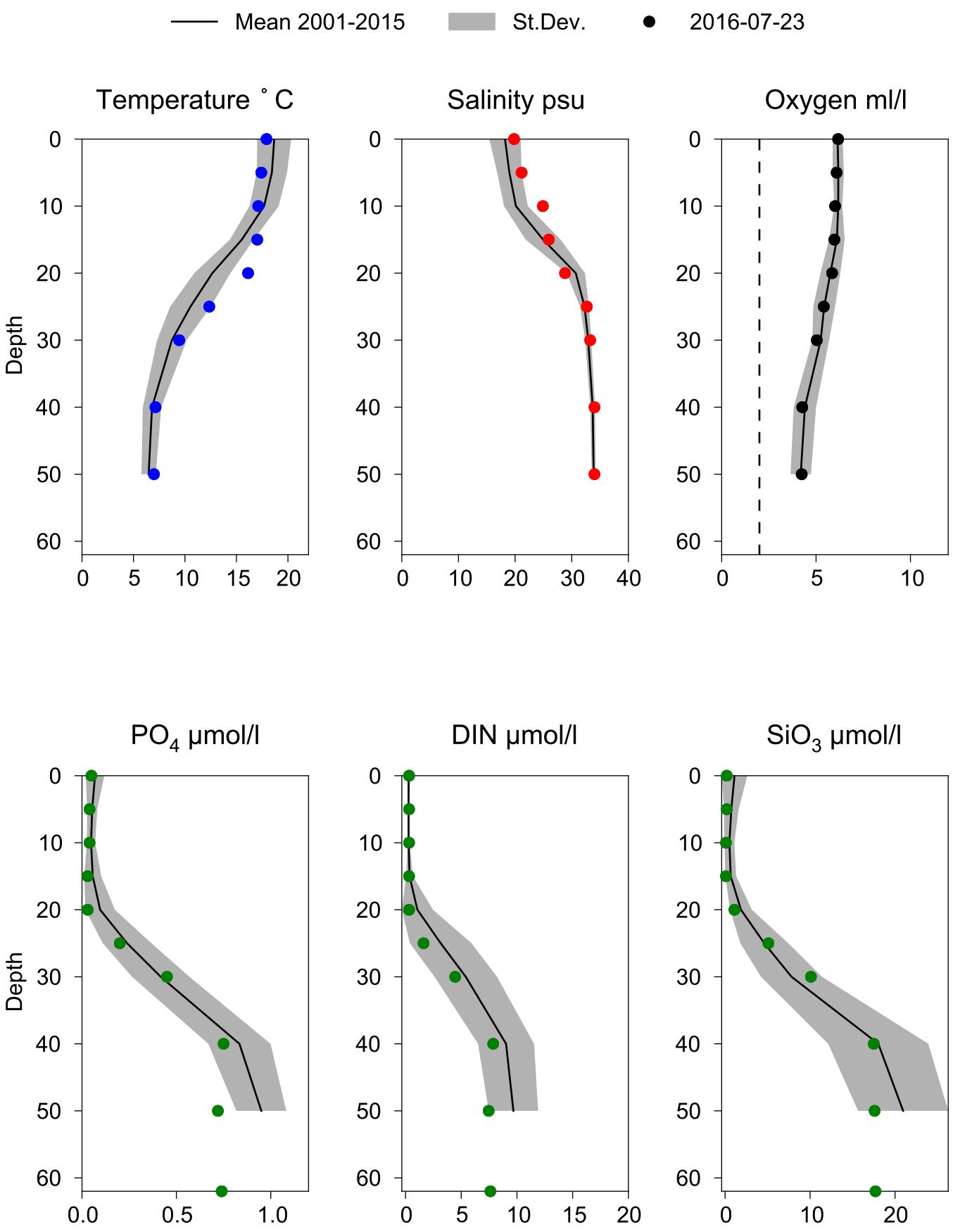
Annual Cycles



OXYGEN IN BOTTOM WATER (depth >= 45 m)

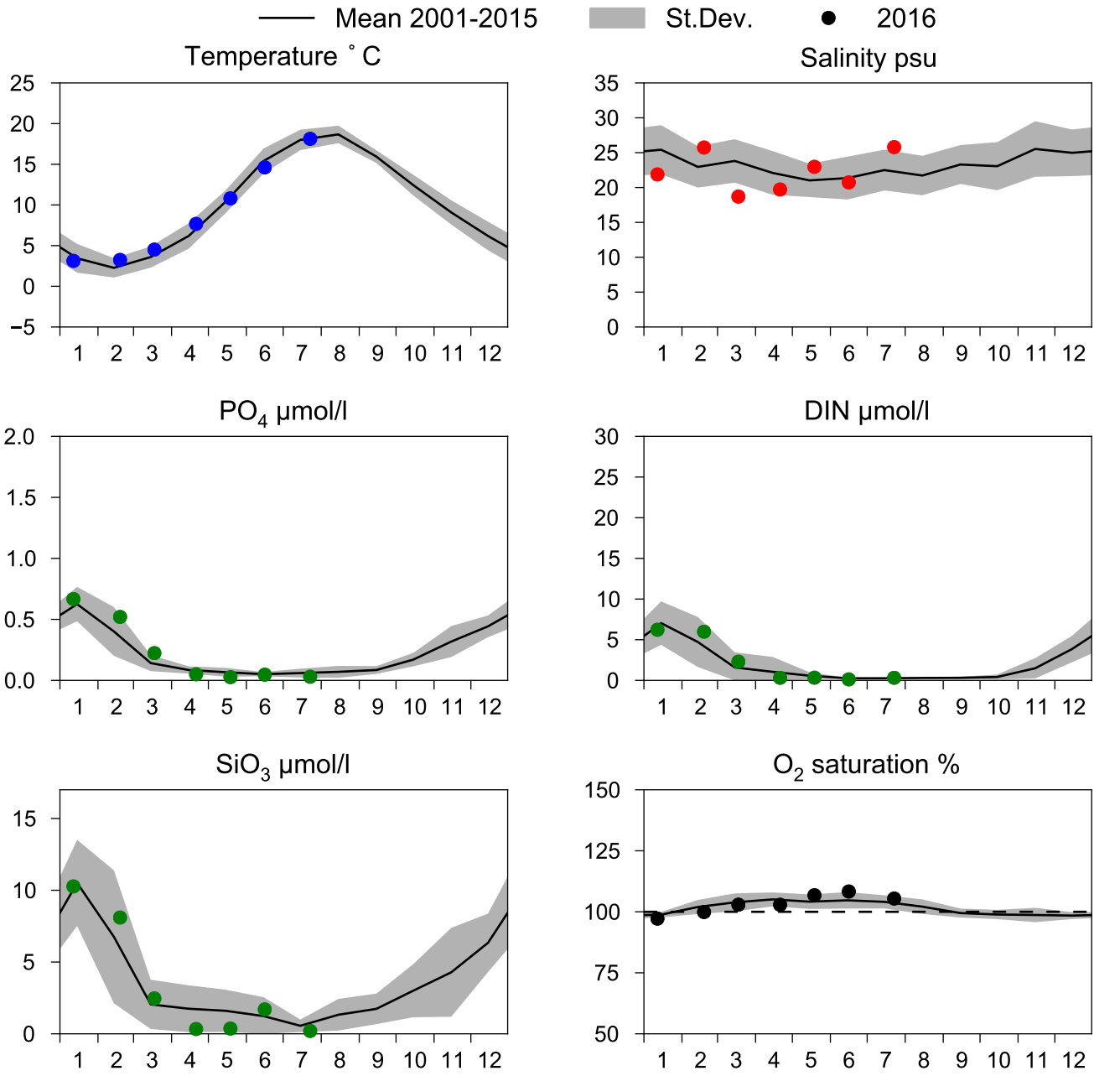


Vertical profiles ANHOLT E
July

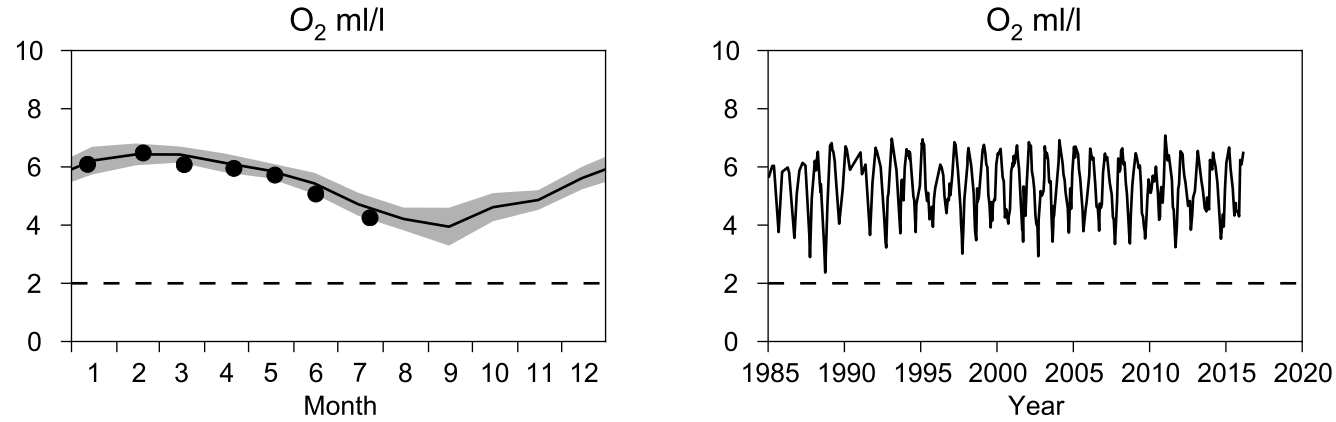


STATION FLADEN SURFACE WATER

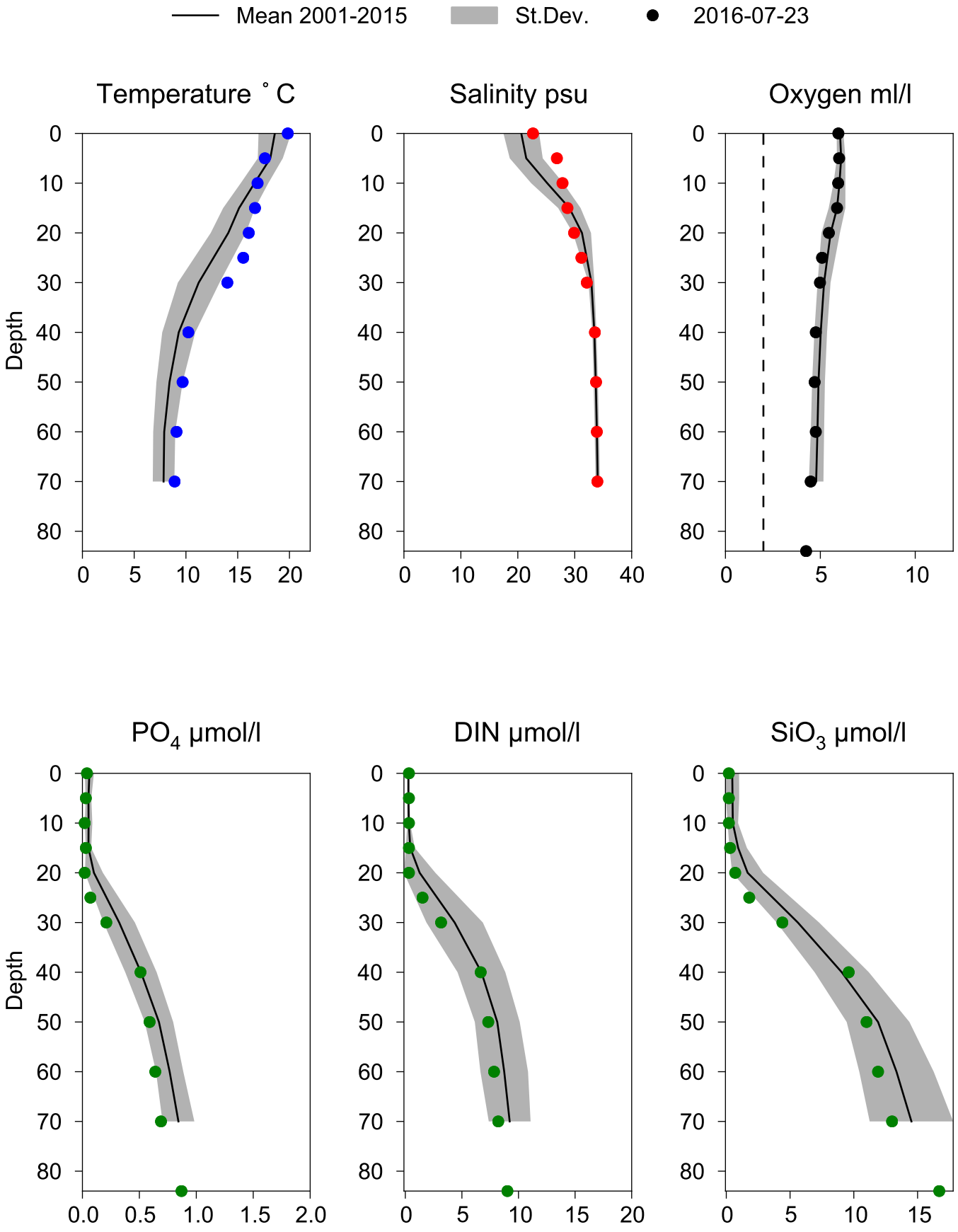
Annual Cycles



OXYGEN IN BOTTOM WATER (depth >= 65 m)

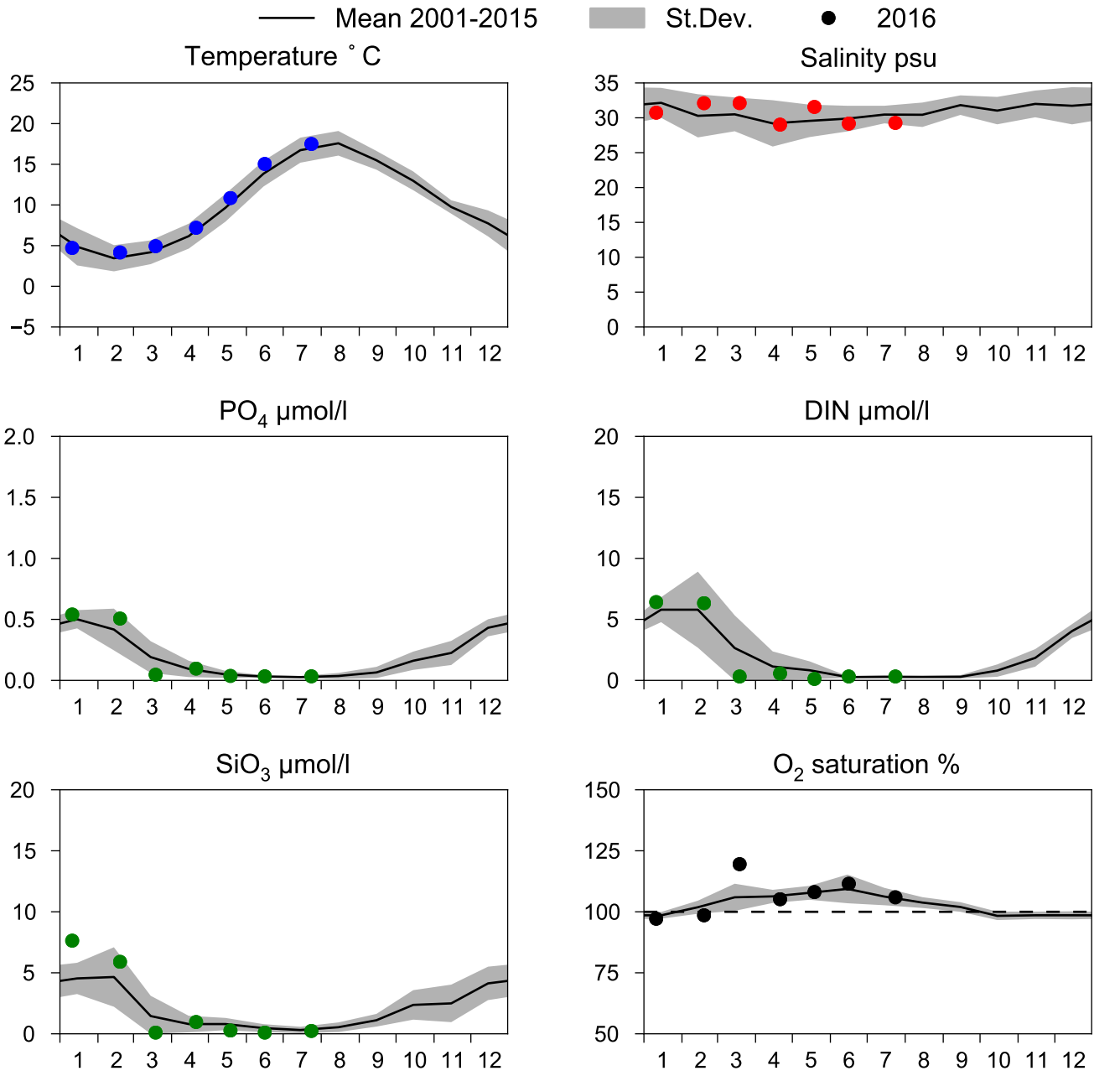


Vertical profiles FLADEN
July

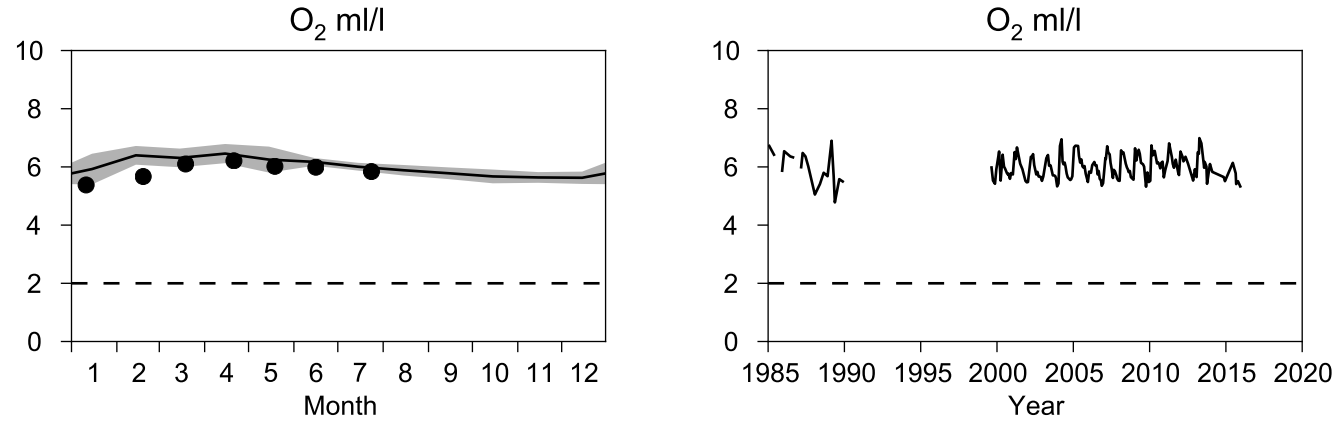


STATION Å17 SURFACE WATER

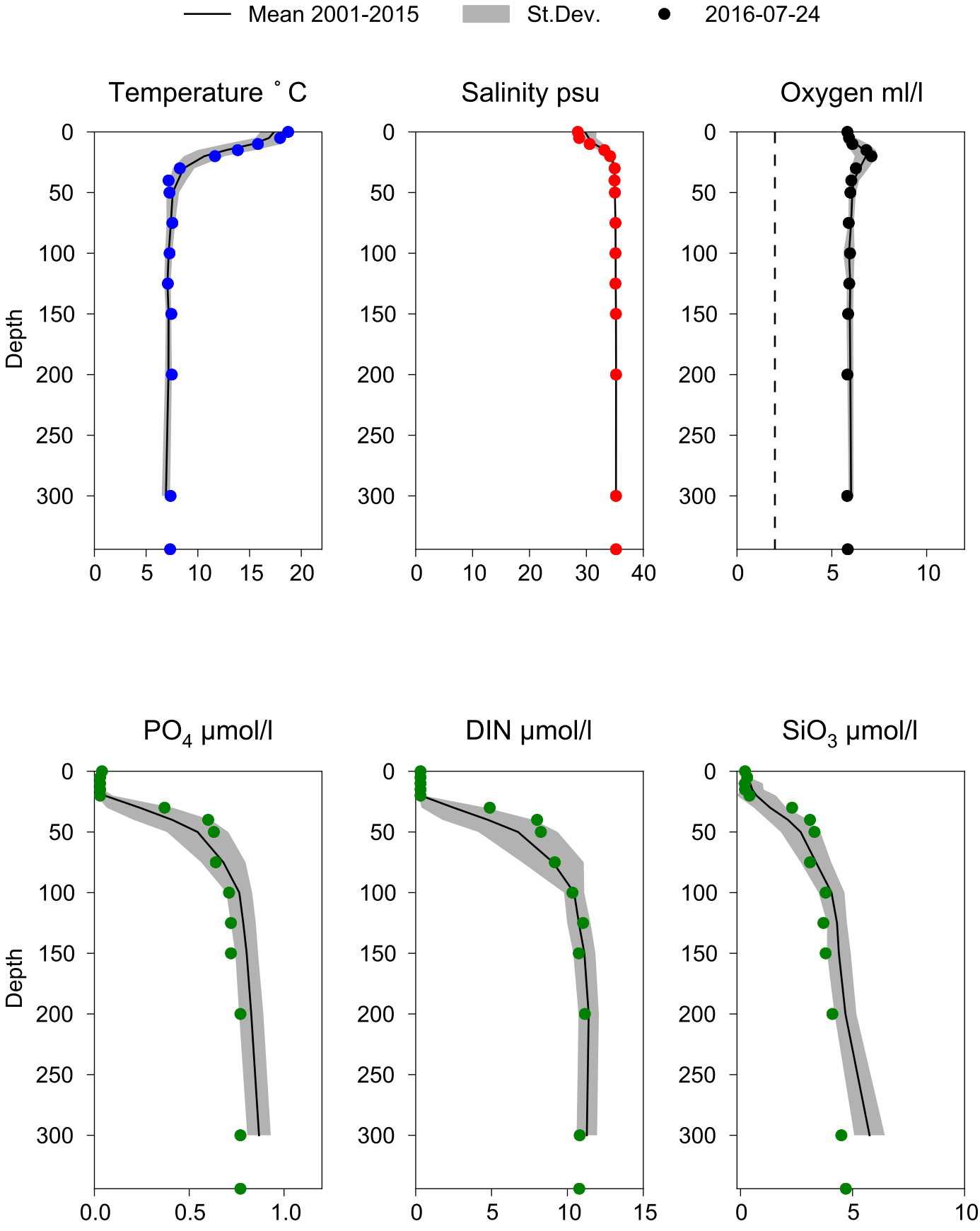
Annual Cycles



OXYGEN IN BOTTOM WATER (depth >= 300 m)

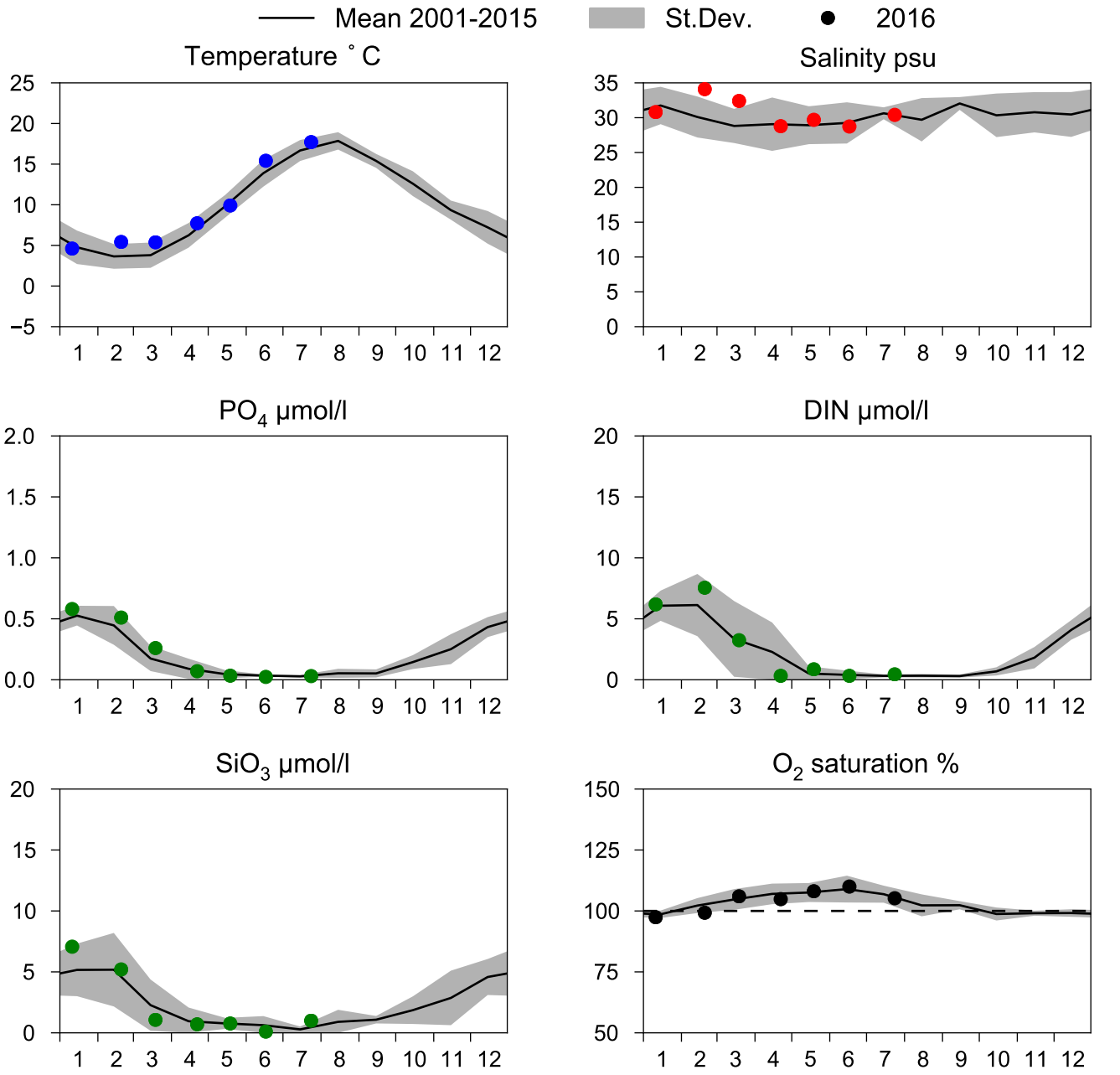


Vertical profiles Å17
July

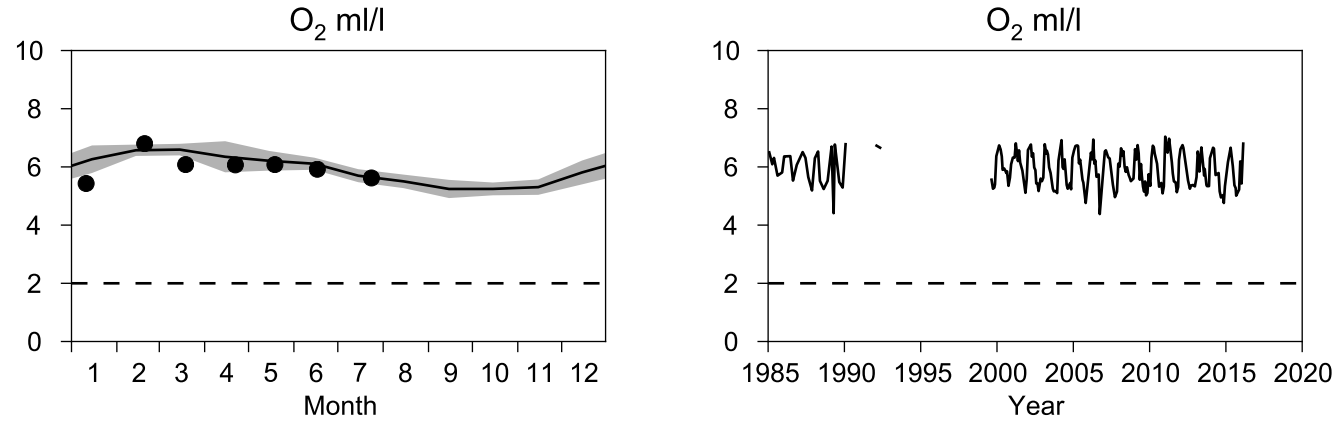


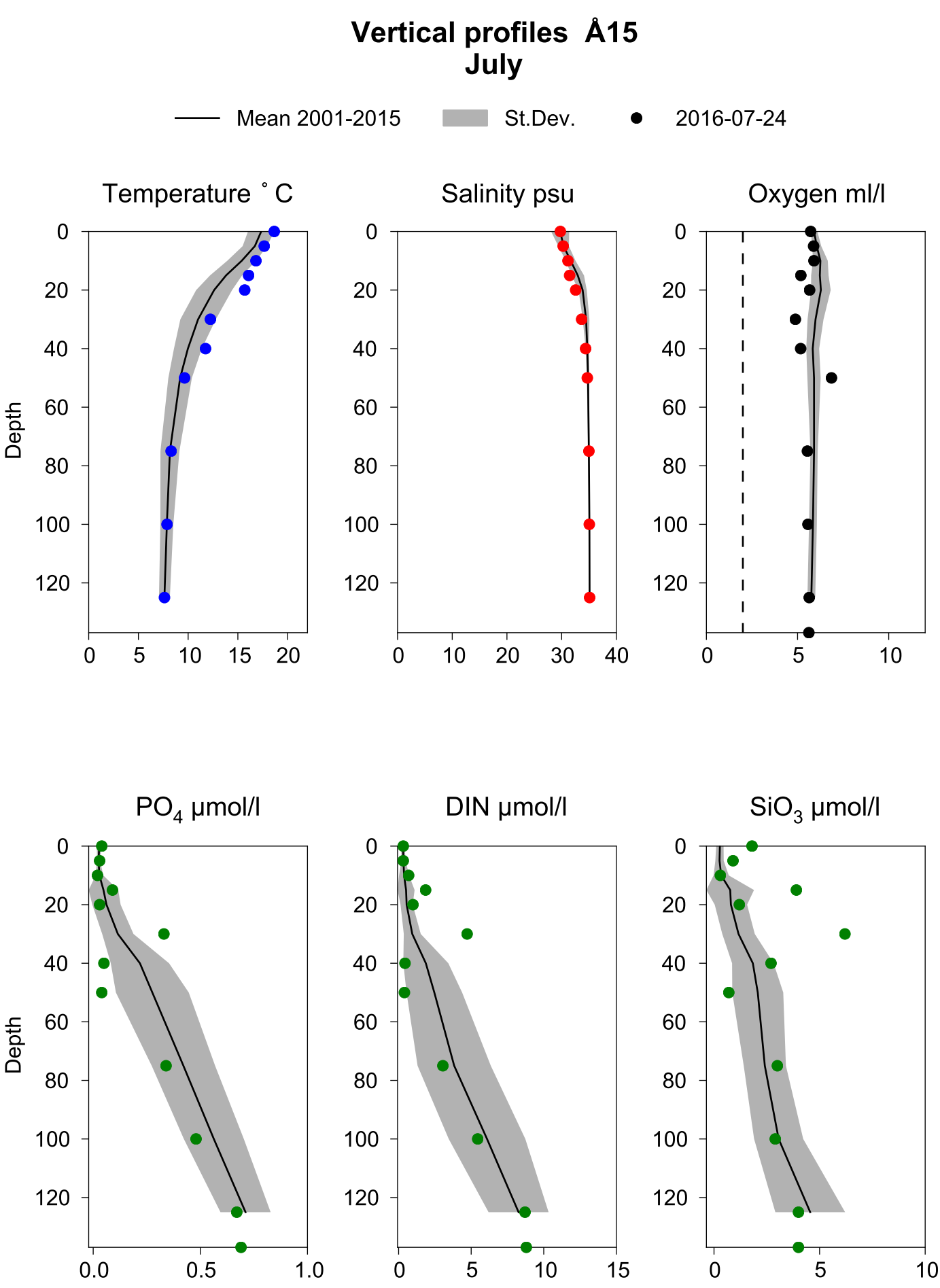
STATION Å15 SURFACE WATER

Annual Cycles



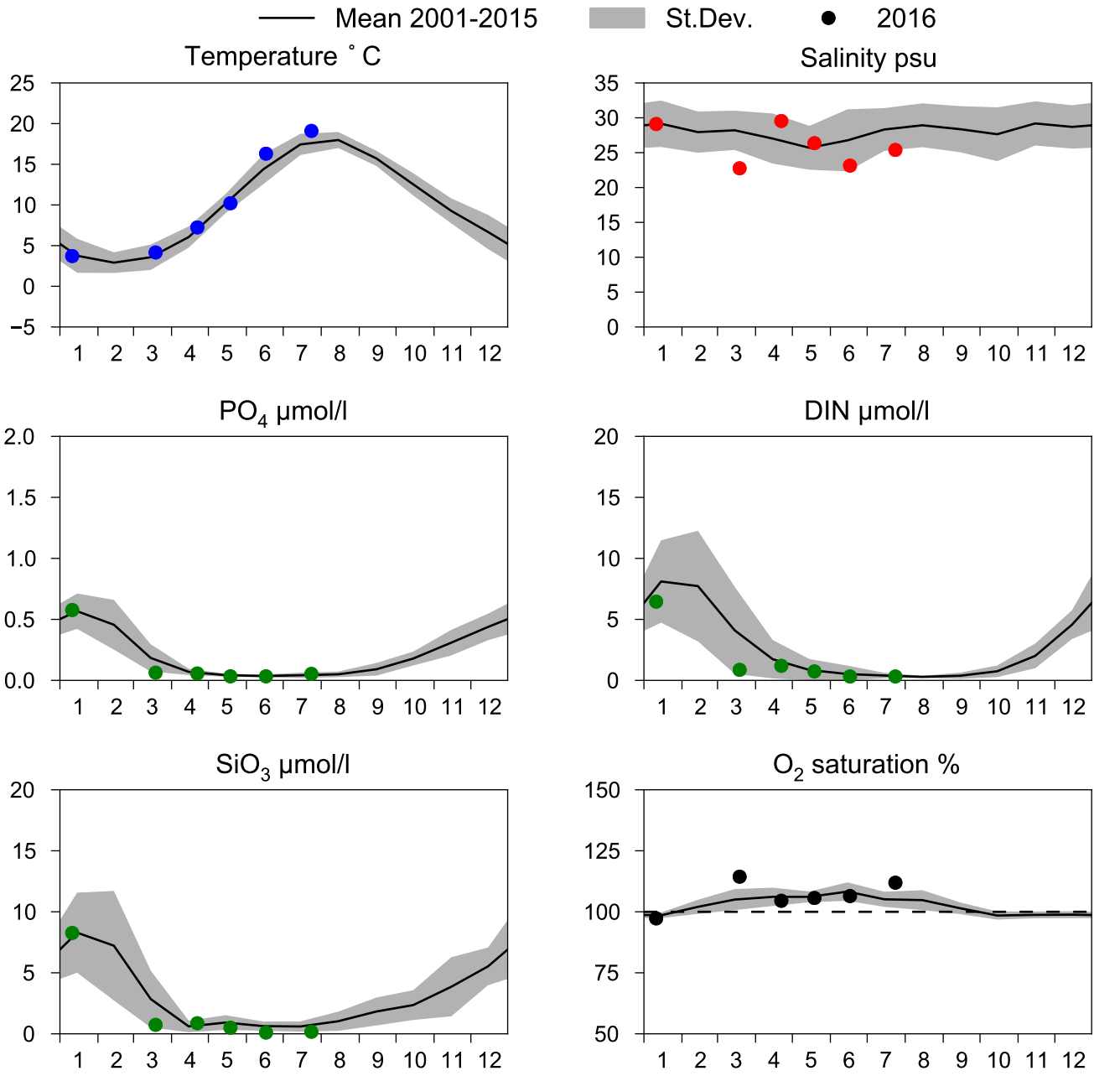
OXYGEN IN BOTTOM WATER (depth >= 125 m)



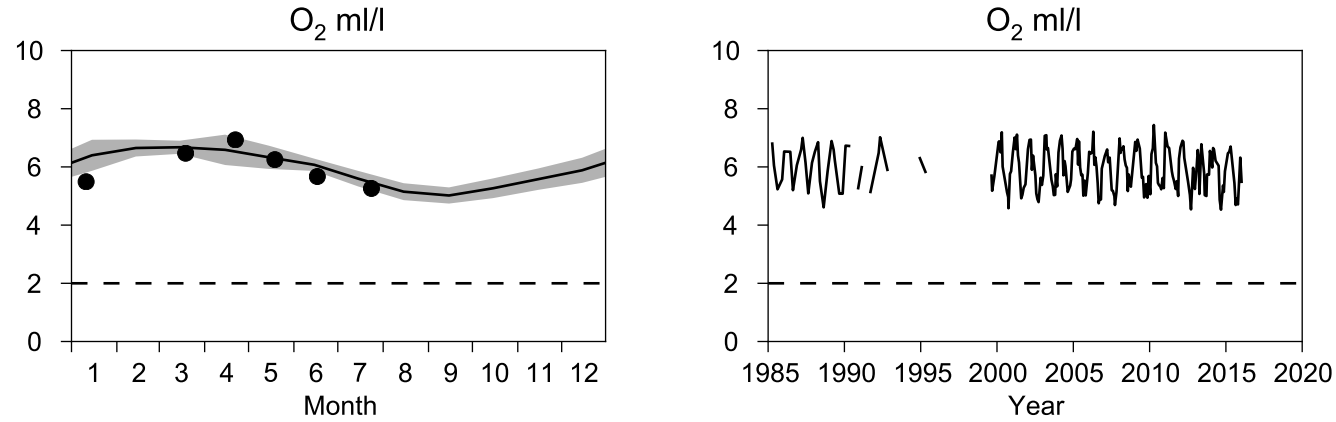

Vertical profiles Å15
July
Mean 2001-2015
St.Dev.
2016-07-24
Temperature ˚C
Salinity psu
Oxygen ml/l
Depth
PO4 µmol/l
DIN µmol/l
SiO3 µmol/l

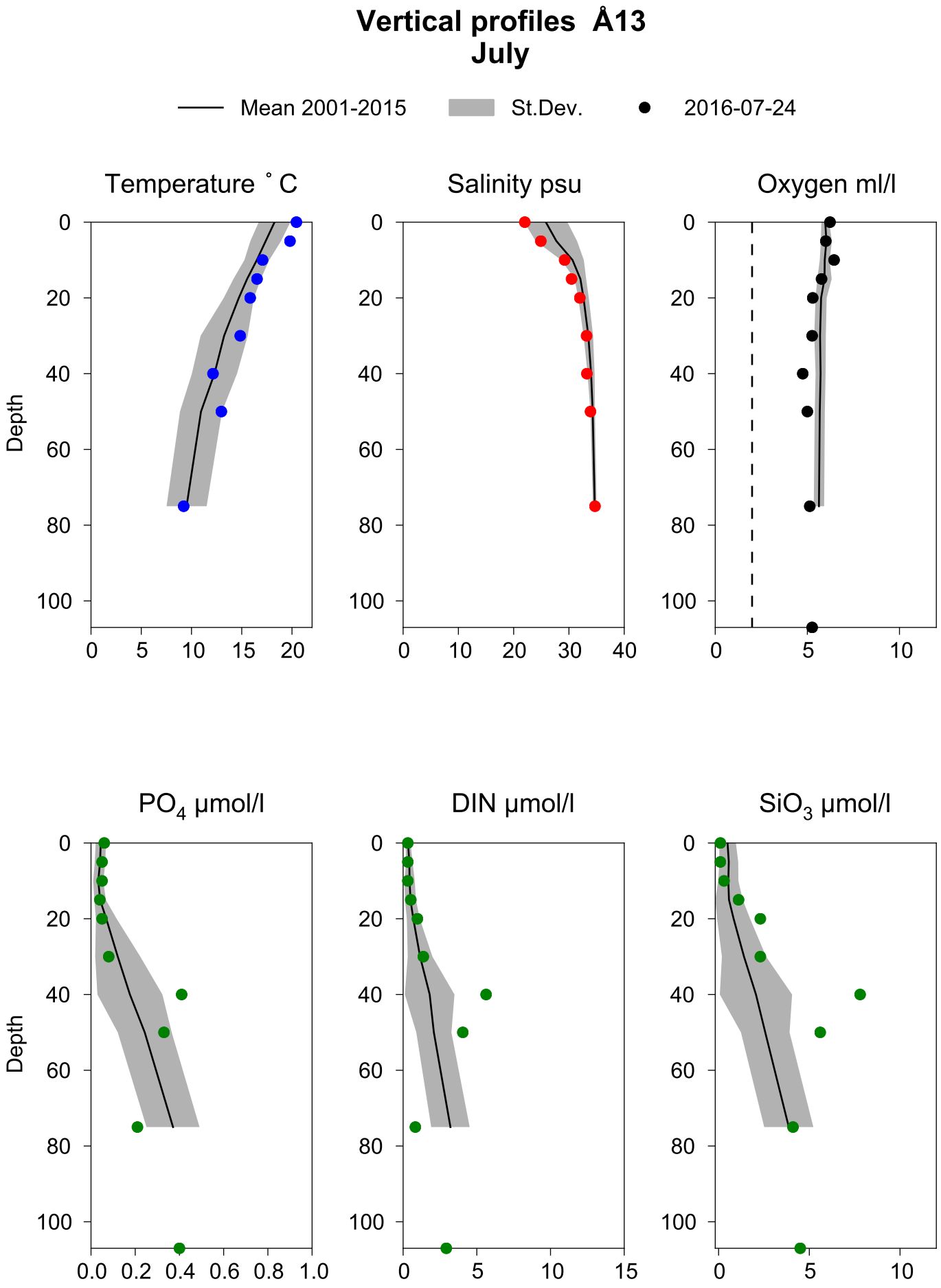
STATION Å13 SURFACE WATER

Annual Cycles



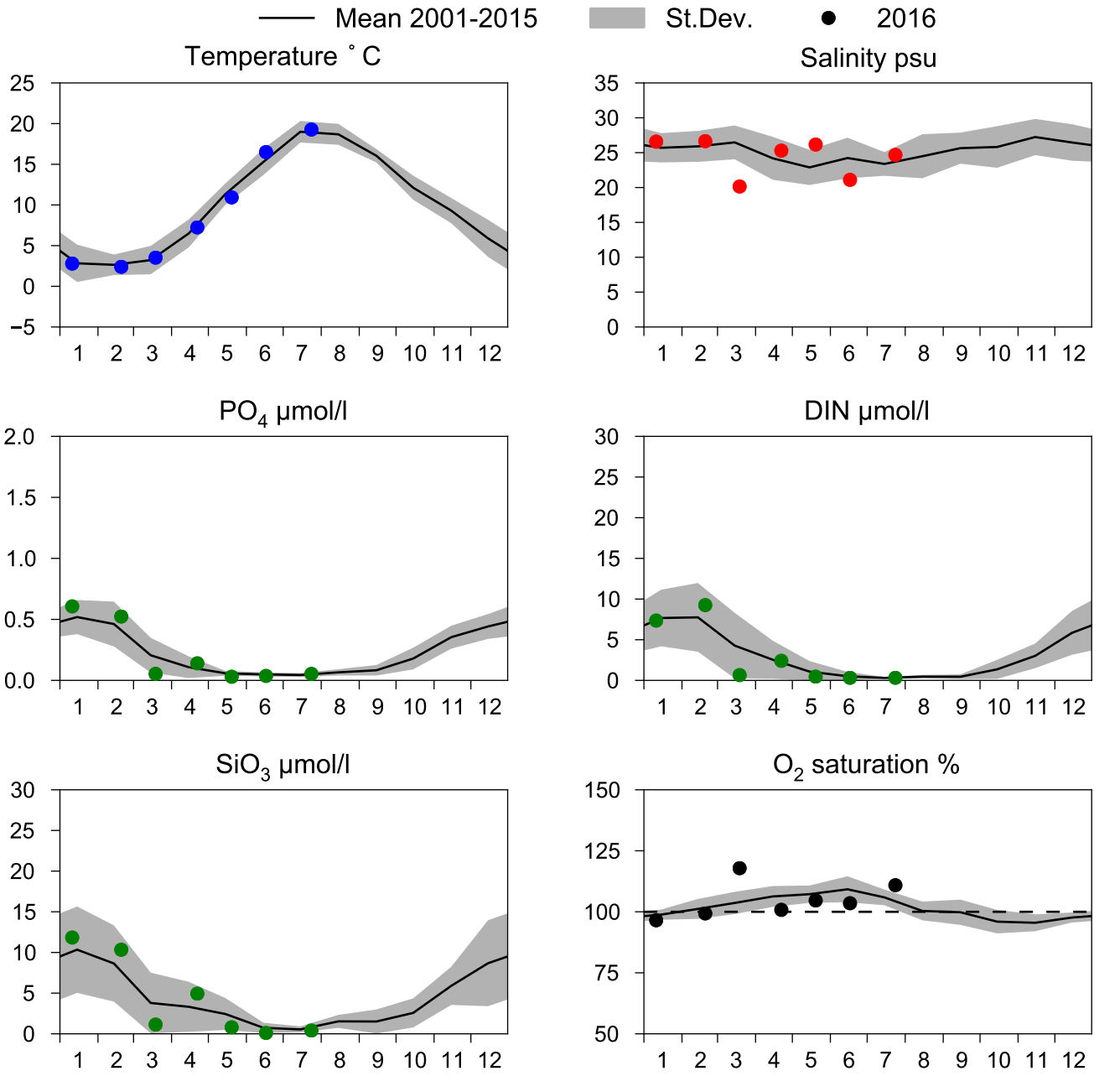
OXYGEN IN BOTTOM WATER (depth >= 75 m)



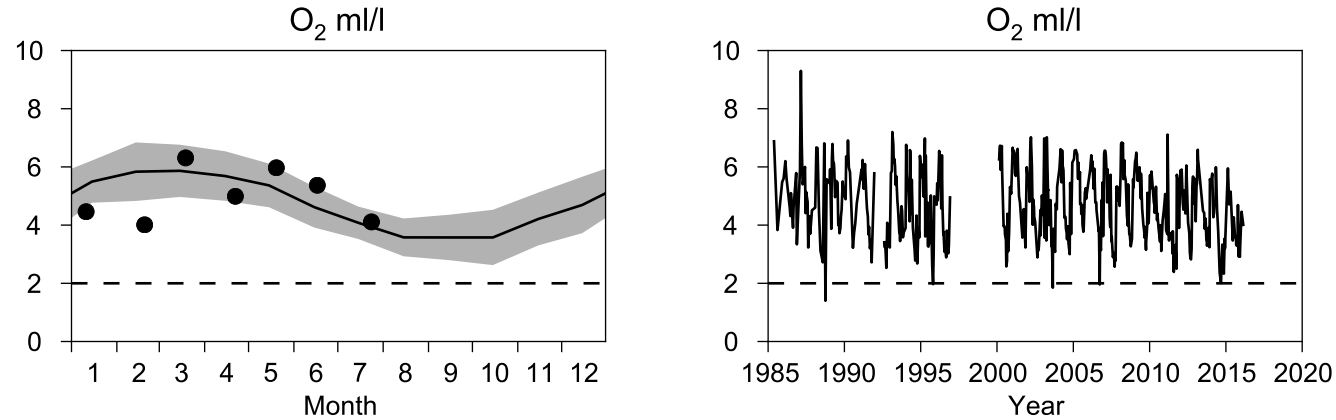

Vertical profiles Å13
July
Mean 2001-2015
St.Dev.
2016-07-24
Temperature ˚C
Salinity psu
Oxygen ml/l
PO4 µmol/l
DIN µmol/l
SiO3 µmol/l
Depth
0
20
40
60
80
100
0 5 10 15 20
0 10 20 30 40
0 5 10
0.0 0.2 0.4 0.6 0.8 1.0
0 5 10 15

STATION SLÄGGÖ SURFACE WATER

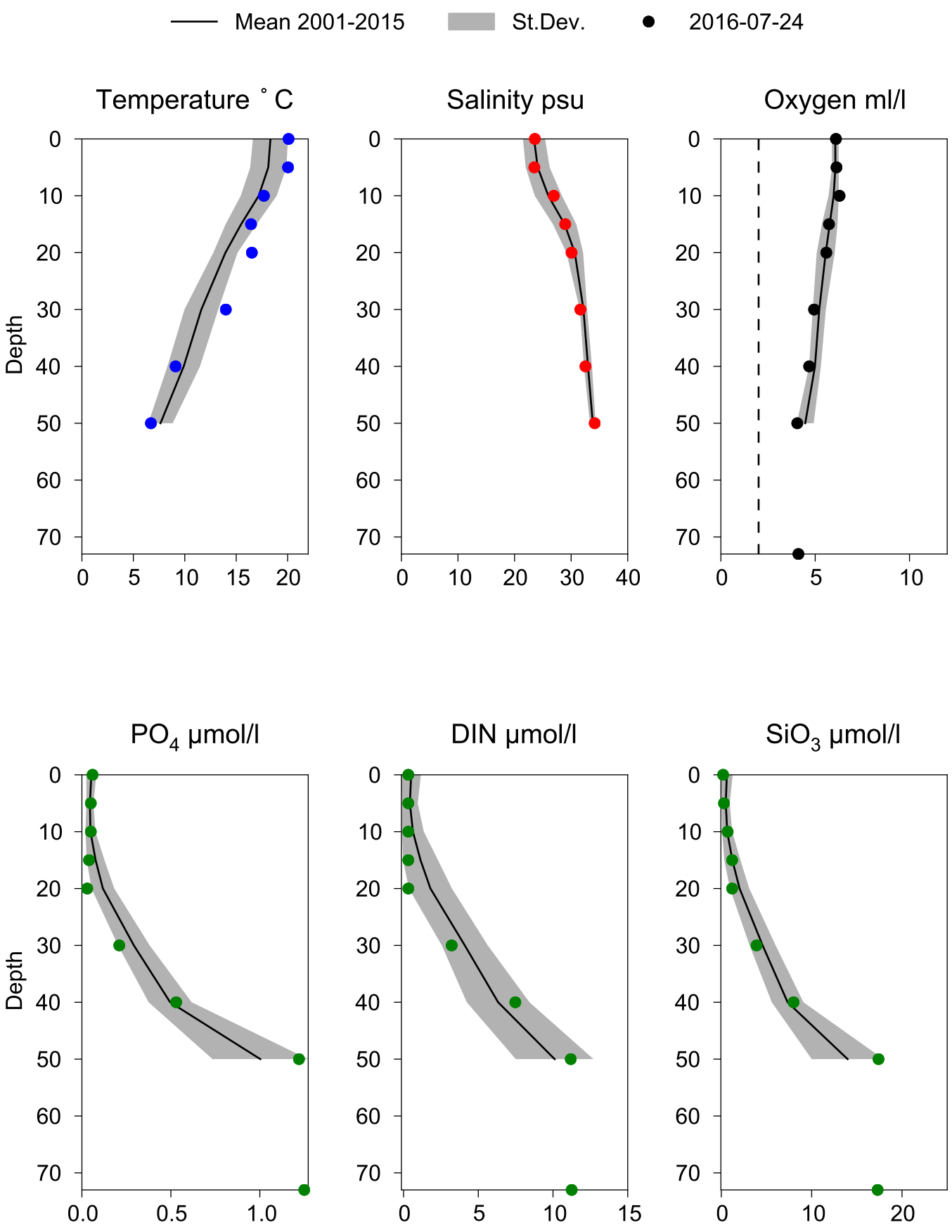
Annual Cycles



OXYGEN IN BOTTOM WATER (depth >= 50 m)

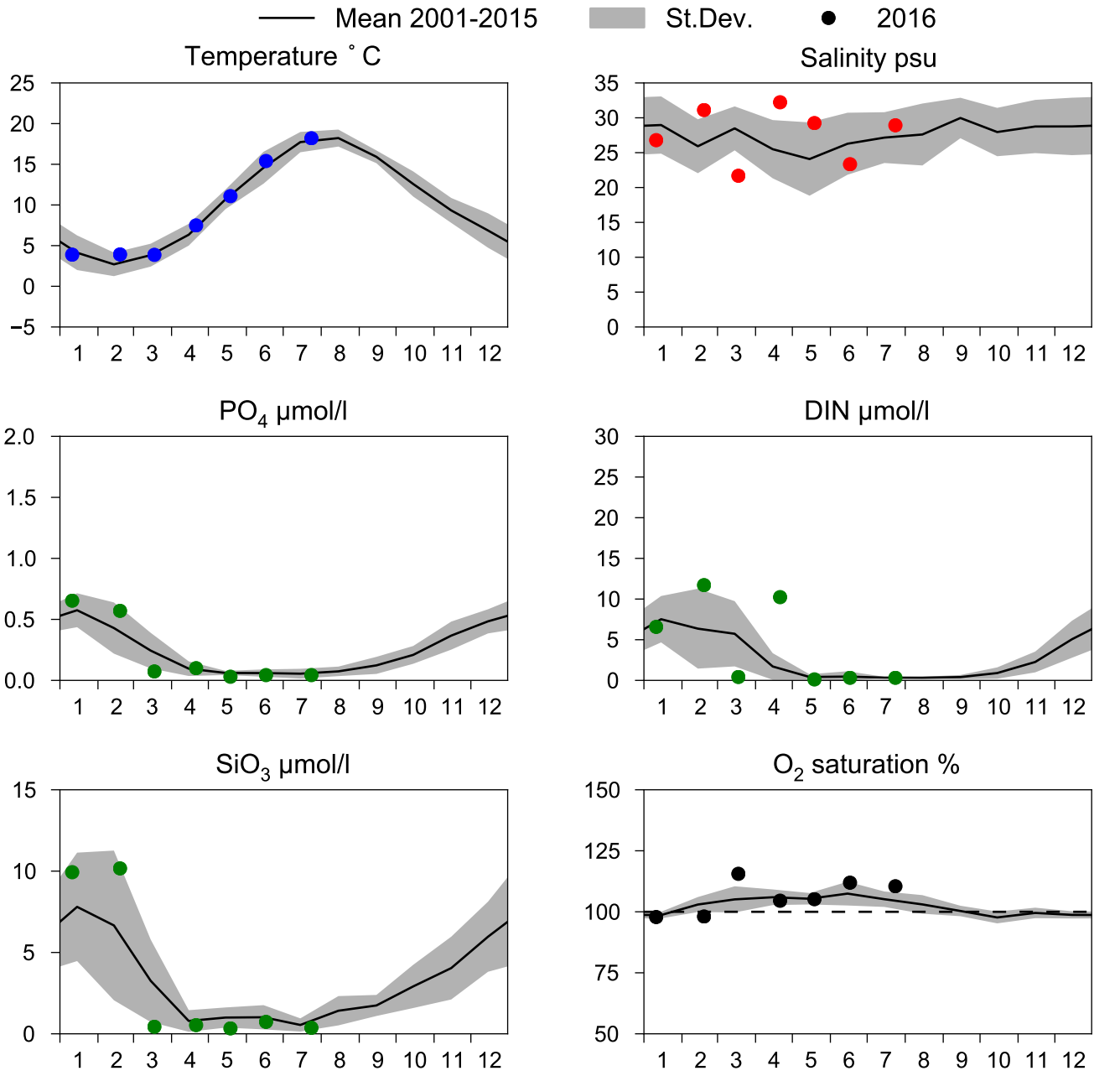


Vertical profiles SLÄGGÖ
July

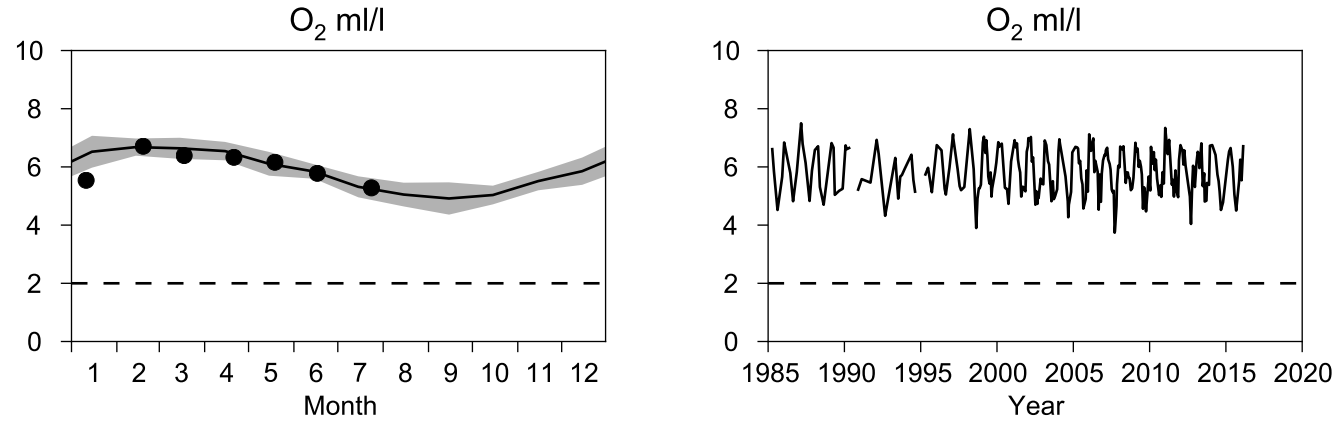


STATION P2 SURFACE WATER

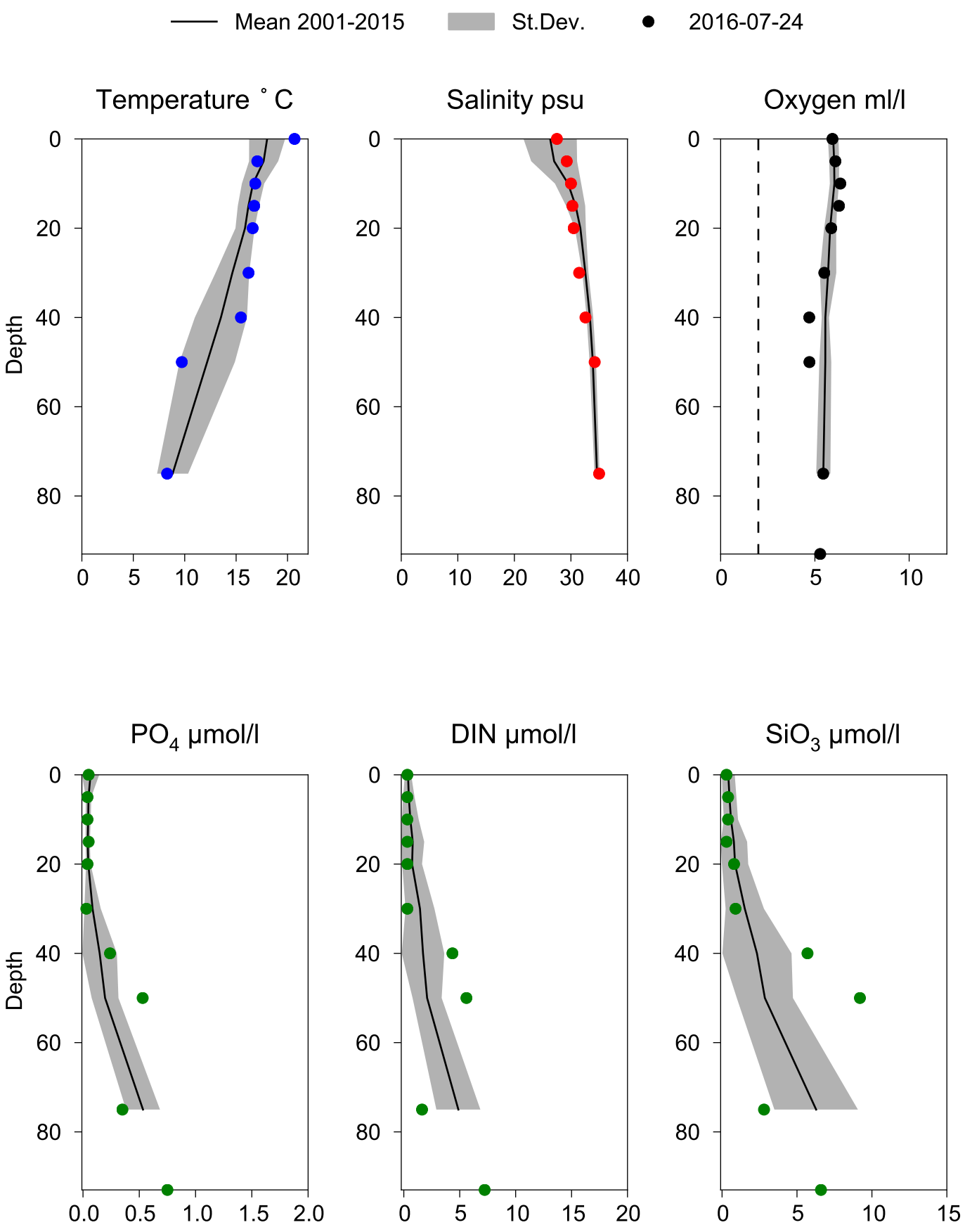
Annual Cycles



OXYGEN IN BOTTOM WATER (depth >= 80 m)

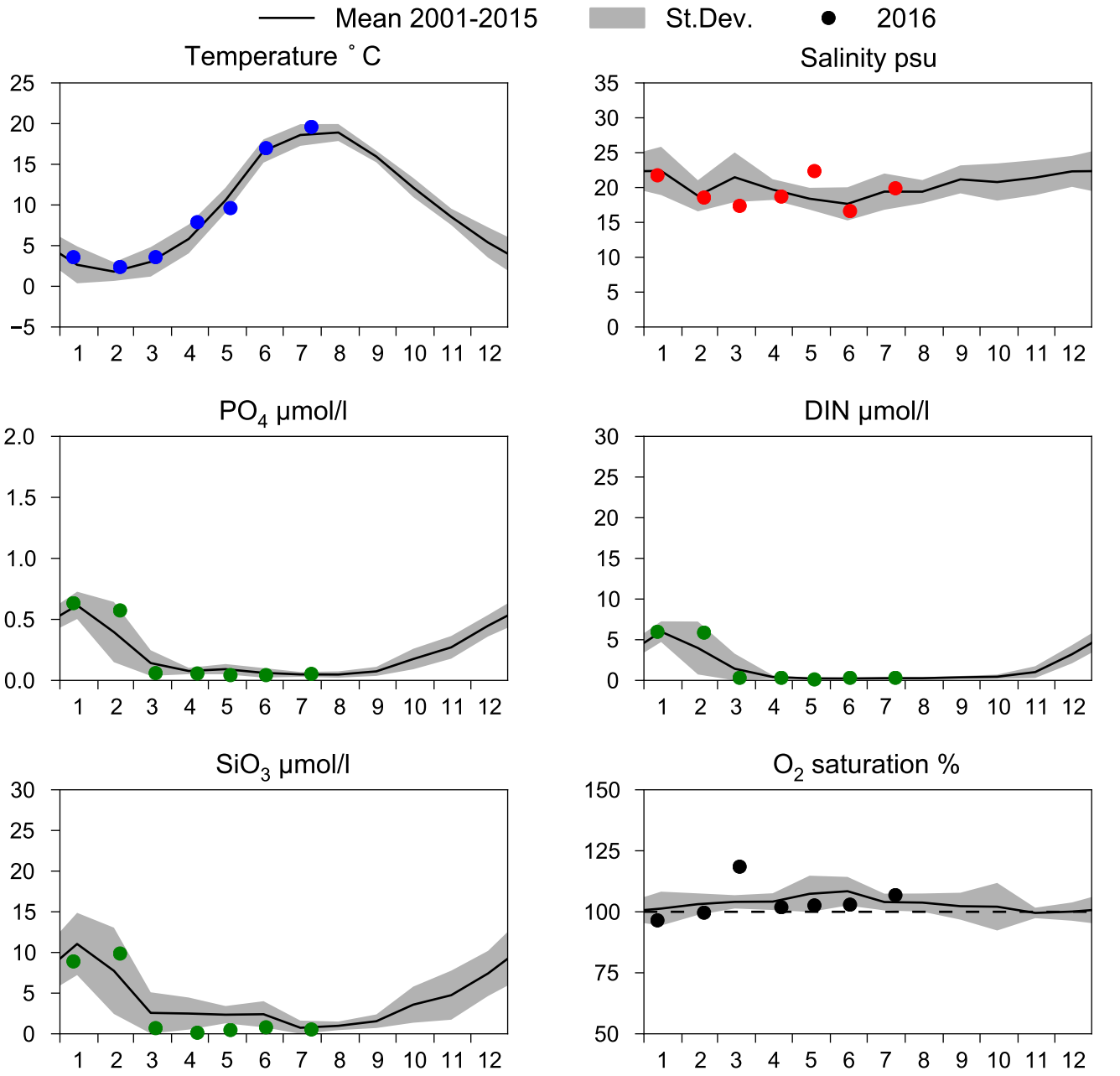


Vertical profiles P2
July

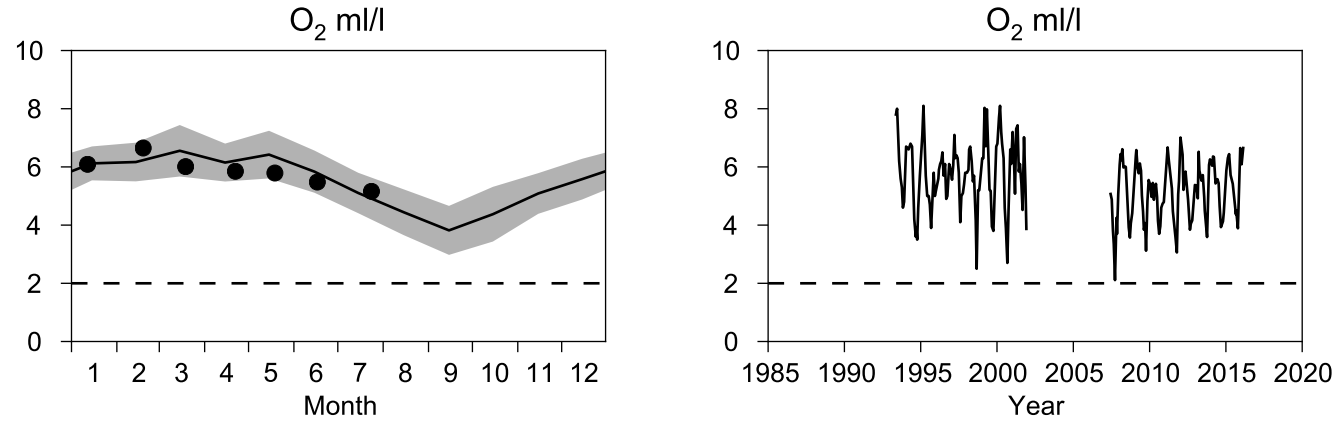


STATION N14 FALKENBERG SURFACE WATER

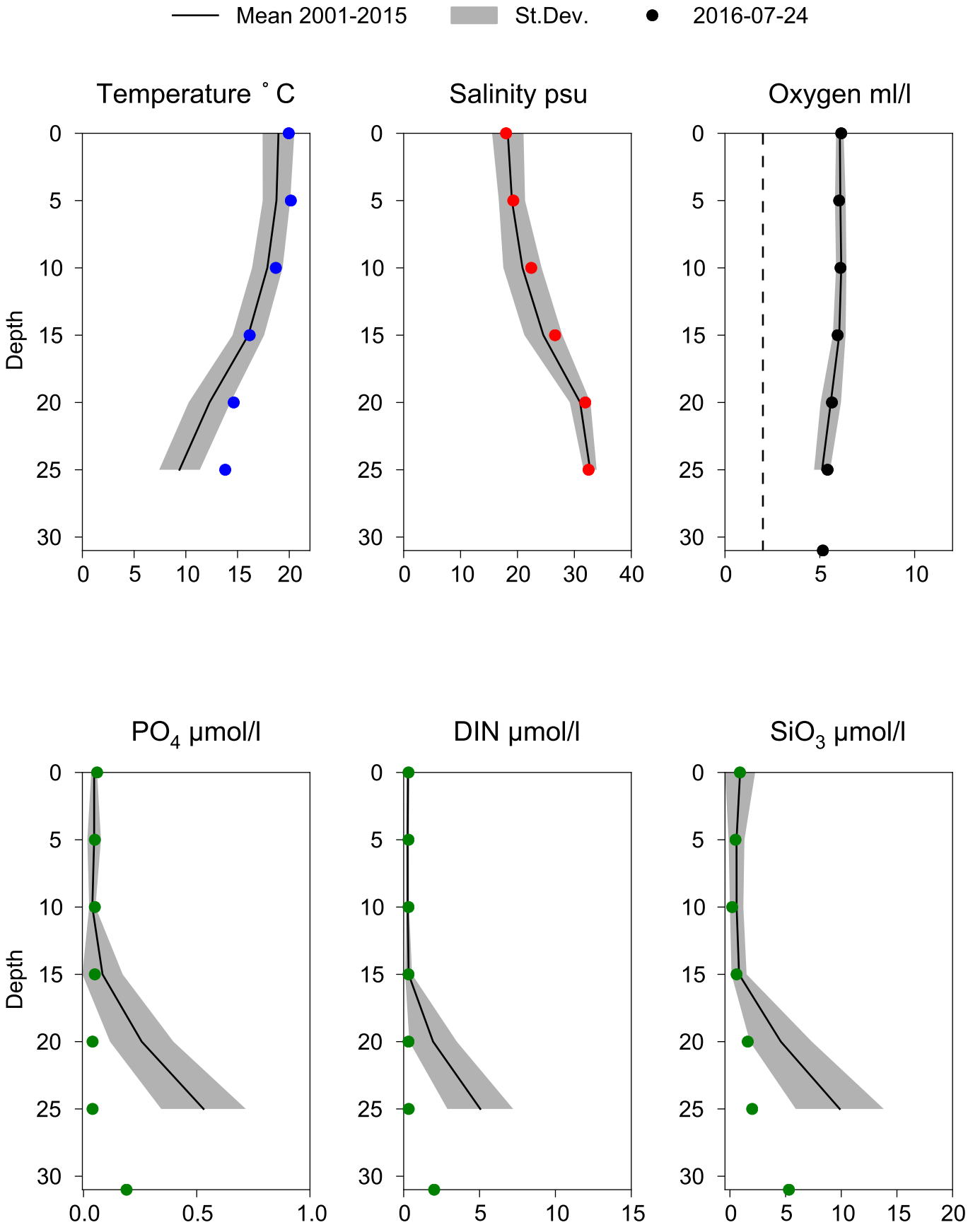
Annual Cycles



OXYGEN IN BOTTOM WATER (depth >= 25 m)

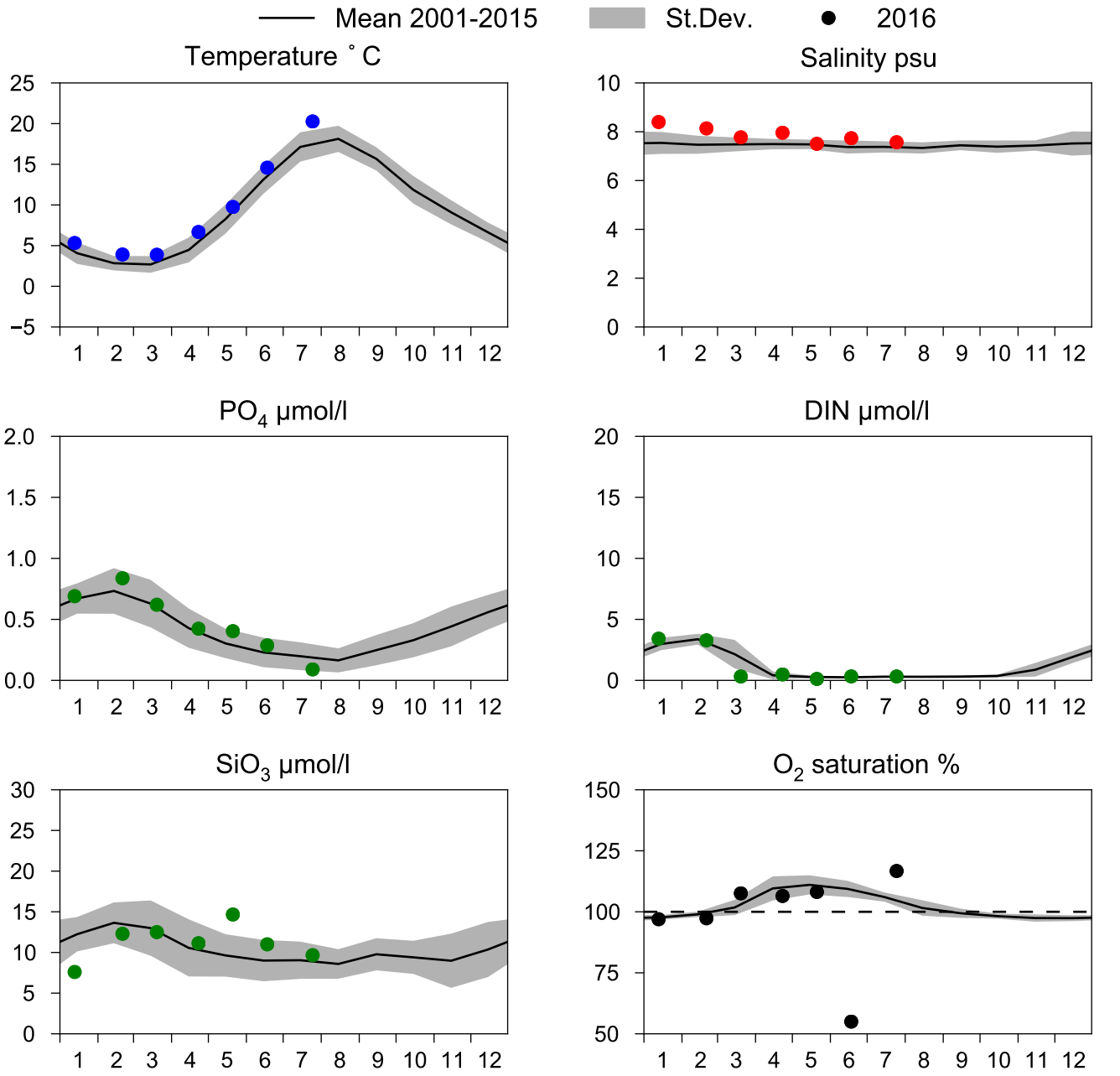


Vertical profiles N14 FALKENBERG
July

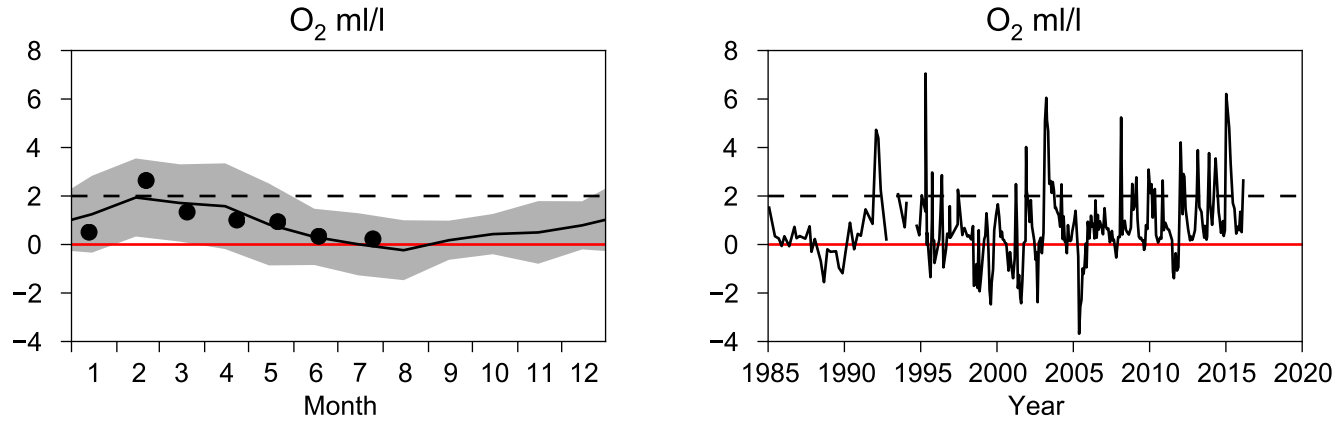


STATION HANÖBUKTEN SURFACE WATER

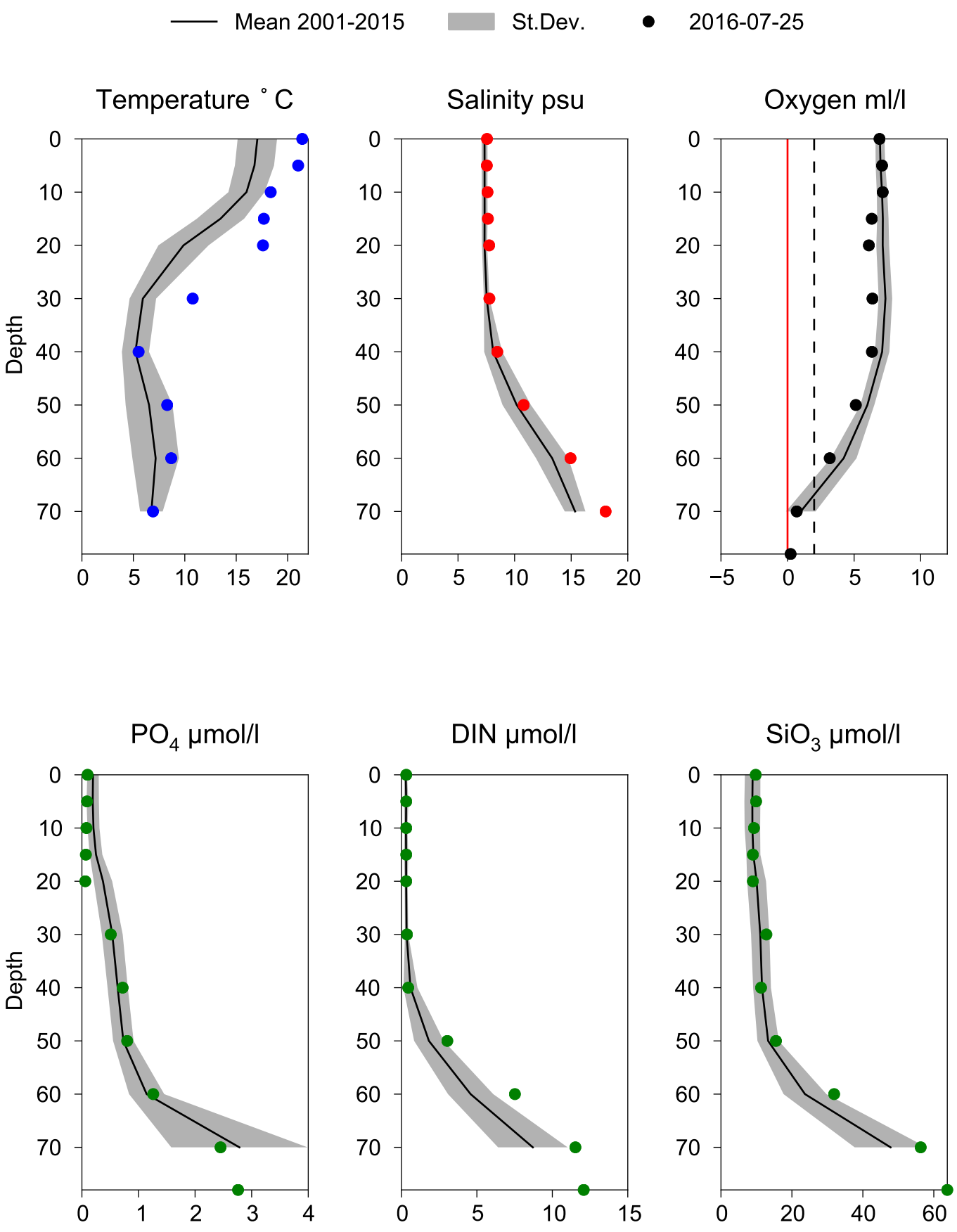
Annual Cycles



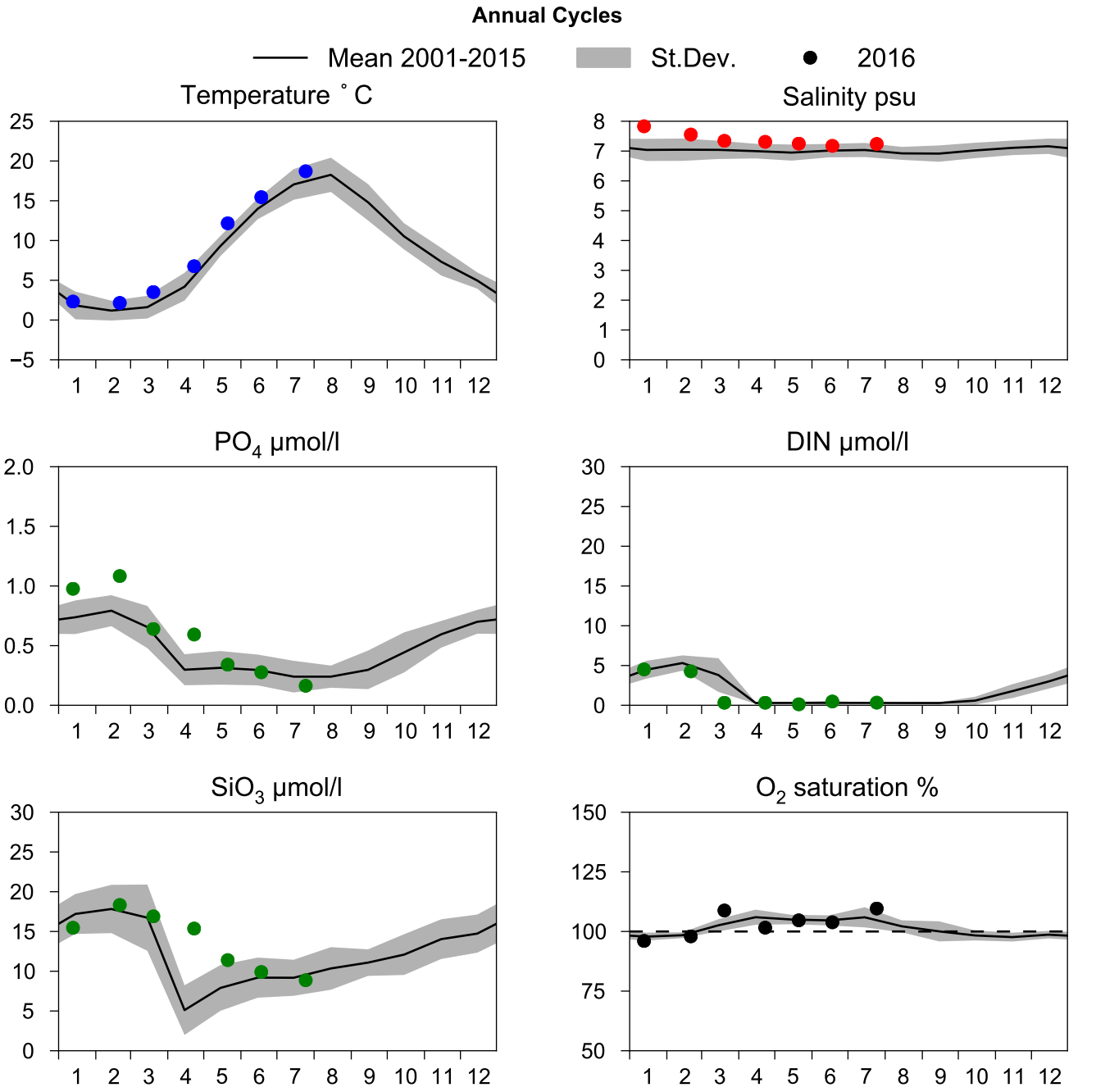
OXYGEN IN BOTTOM WATER (depth >= 70 m)



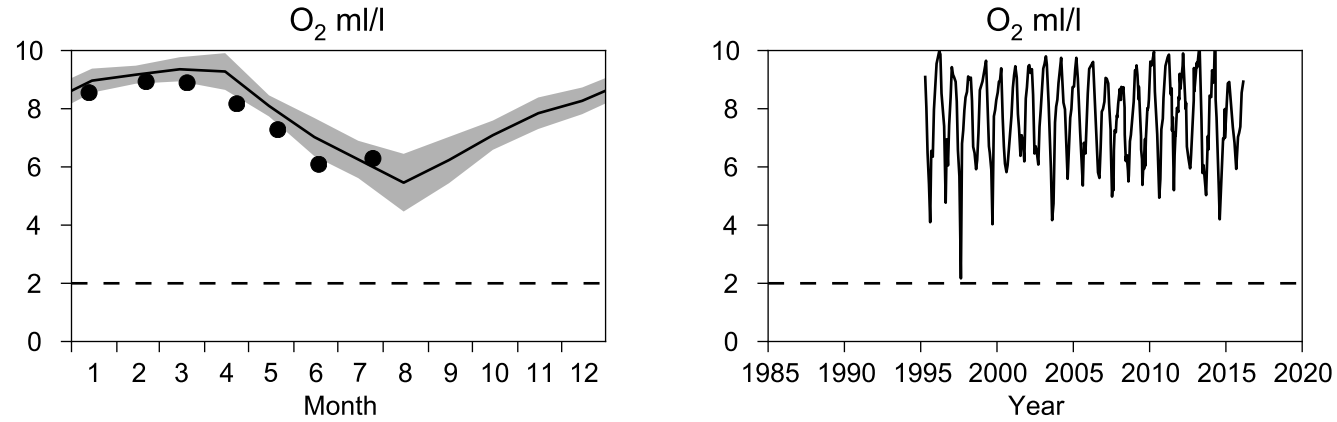
Vertical profiles HANÖBUKTEN
July



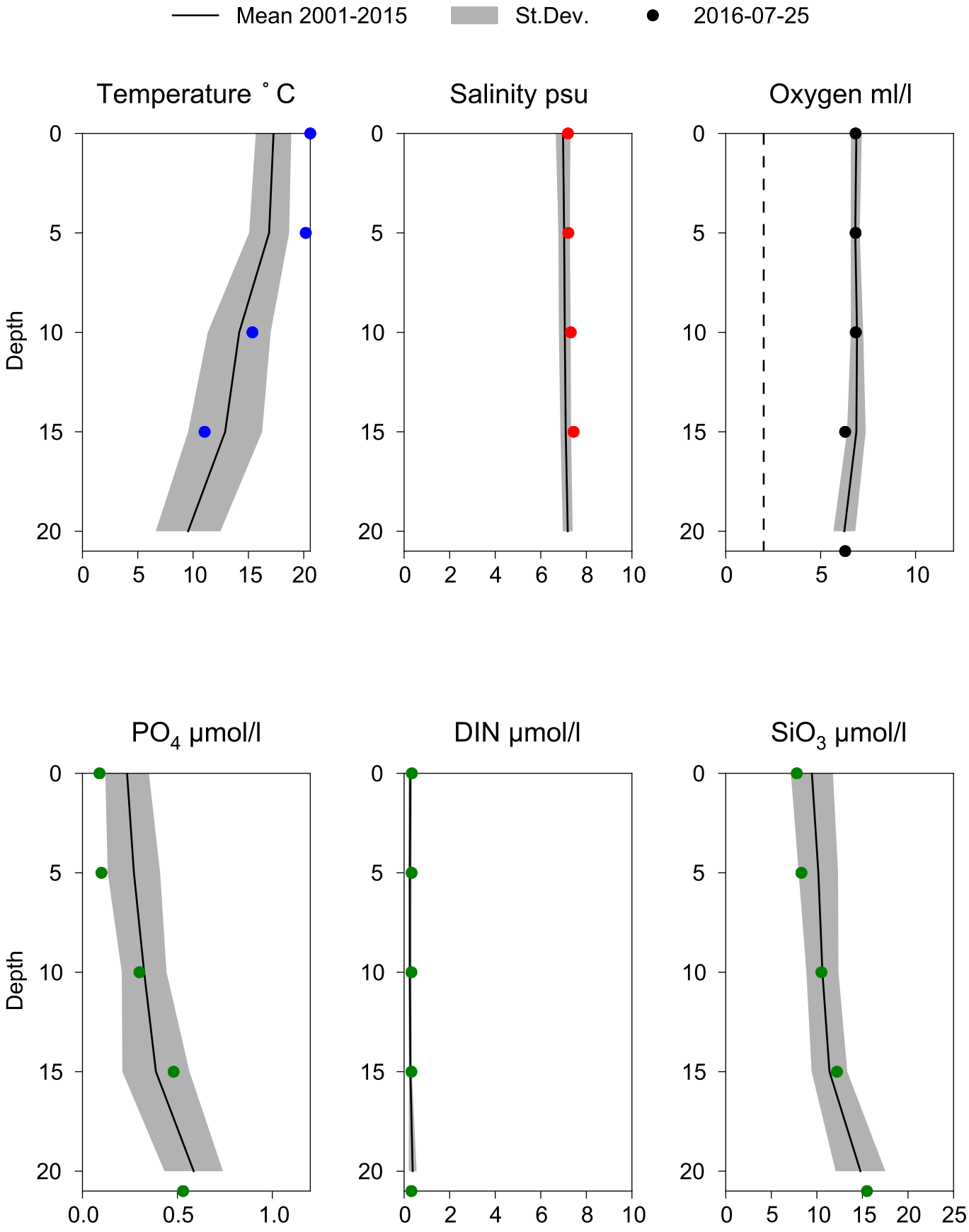
STATION REF M1V1 SURFACE WATER



OXYGEN IN BOTTOM WATER (depth >= 17 m)

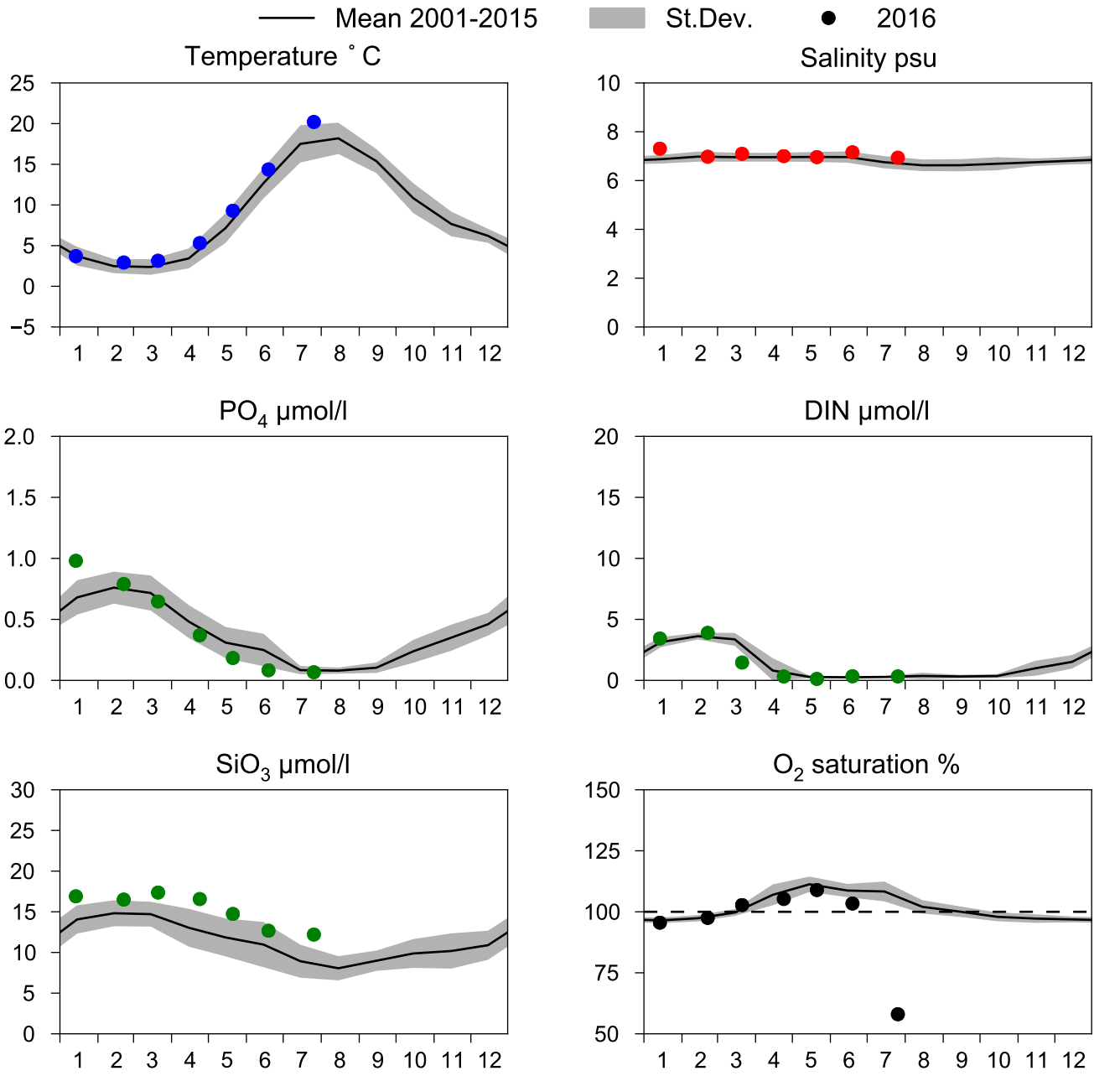


Vertical profiles REF M1V1
July

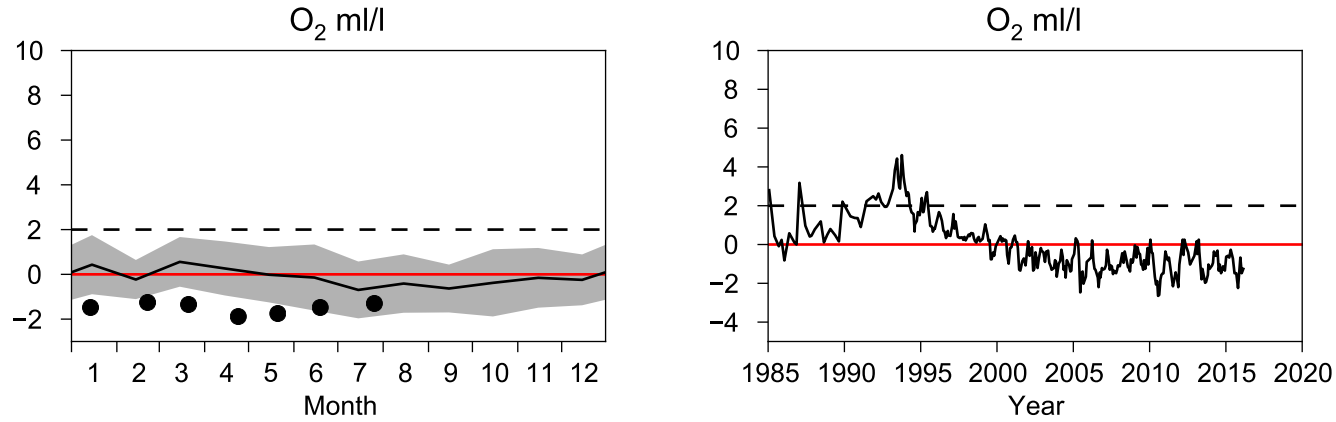


STATION BY38 KARLSÖDJ SURFACE WATER

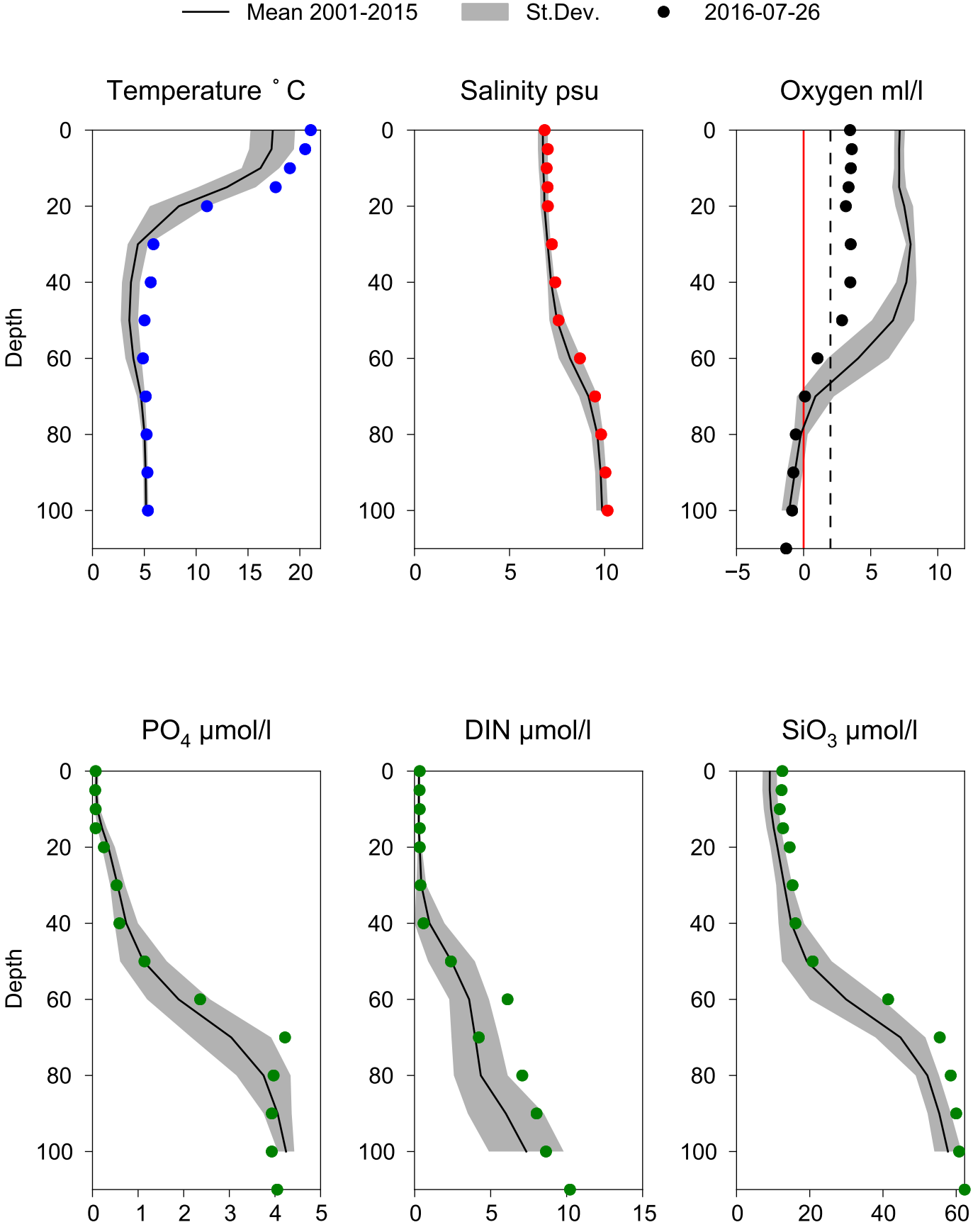
Annual Cycles



OXYGEN IN BOTTOM WATER (depth >= 100 m)

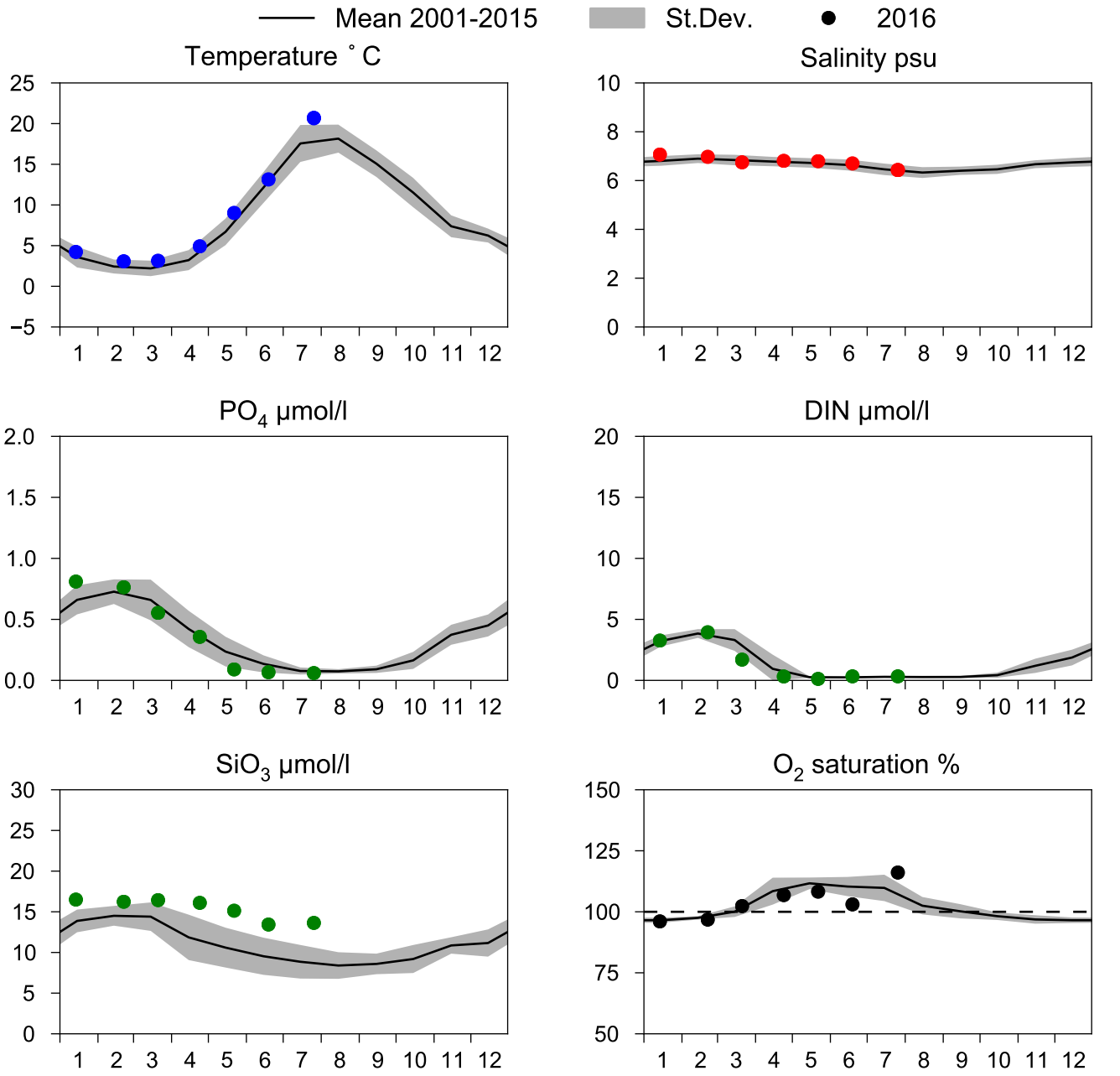


Vertical profiles BY38 KARLSÖDJ
July

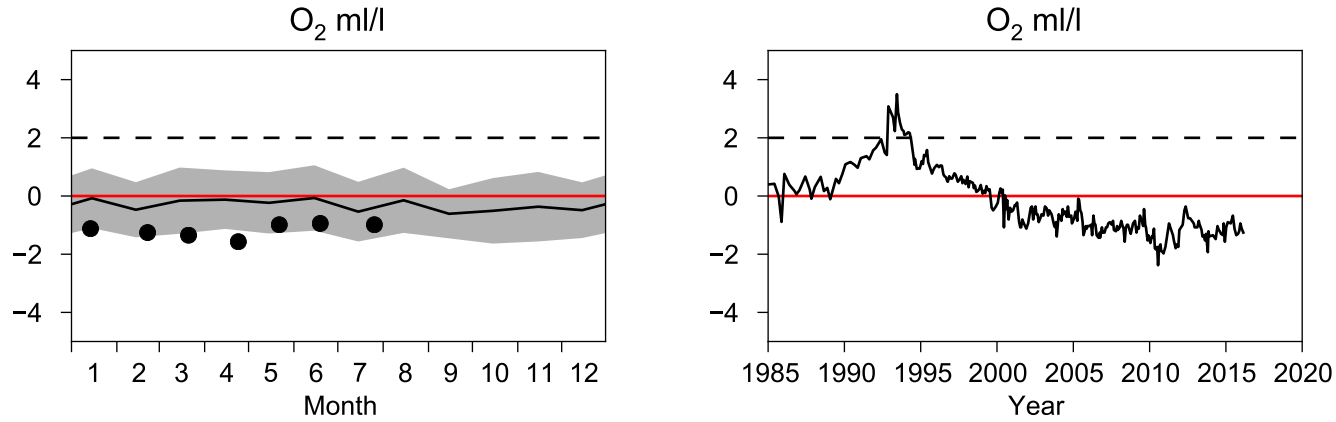


STATION BY32 NORRKÖPINGSDJ SURFACE WATER

Annual Cycles



OXYGEN IN BOTTOM WATER (depth >= 175 m)



Vertical profiles BY32 NORRKÖPINGSDJ
July