Karin Wesslander

Swedish Meteorological and Hydrological Institute
Oceanographic Laboratory

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Report of SMHI's marine monitoring cruise with R/V Svea

Survey period:	2023-08-10 - 2023-08-17
Principals:	Swedish Meteorological and Hydrological Institute (SMHI), Swedish Agency for Marine and Water Management (SwAM)
Cooperation partners:	Swedish University of Agricultural Sciences (SLU), Swedish Maritime Administration (SMA)

Address:
Sven Källfelts Gata 15
426 71 Västra Frölunda

Phone:
011-495 80 00

E-mail:
karin.wesslanderberg@smhi.se
WWW:
http://www.smhi.se/

SUMMARY

During the expedition, which is part of the Swedish national marine monitoring programme, the Skagerrak, the Kattegat, the Sound and the Baltic Proper were visited.

The water temperature in the surface water varied between 10 – 17°C which is low for the season and at several stations it had decreased from last month.

Levels of dissolved inorganic nitrogen in the surface water were around the detection limit in all basins. The phosphate concentration was also low, which is normal this time of year, but in some places, it was above normal, such as in the Bornholm Basin and the Kattegat. The concentration of silicate was normal except in the Bornholm Basin and the Kattegat where it was above normal.

The oxygen situation in the Arkona Basin was normal and as low as 2.9 ml/l in the bottom water, no hydrogen sulphide was measured. In the Bornholm Basin and Hanö Bay, acute oxygen deficiency (<2 ml/l) was noted from 70 m with low oxygen levels around 0.1 ml/l in the bottom water, but no hydrogen sulphide. In the Eastern Gotland Basin, the acute oxygen deficiency began at a depth of 70 meters and hydrogen sulphide was noted from 80 m. In the Western Gotland Basin, acute oxygen deficiency and also hydrogen sulphide were measured already from 60 m. At the southern tip of Öland, there was an acute oxygen deficiency from 50 meters, which is a deterioration from last month.

The next regular monitoring cruise carried out by SMHI on board R/V Svea is planned to begin the 15th September from Gothenburg.

RESULTS

The cruise was carried out onboard R/V Svea. SMHI embarked in Lysekil August 10th, and the cruise terminated in Lysekil August 17th. The weather was calm with winds varying from southeast to west. Air temperatures varied between 13.5 – 18.4°C.

The Ferrybox (continuous measurements at 4 metres depth) and one ADCP were running throughout the whole cruise.

Throughout the trip, water samples were taken which were filtered for later analysis of DNA, algal toxins and phytoplankton composition for two different research projects; a new forecasting system for harmful algal blooms for safer future water supply and development of tourism on Gotland (Formas) and establishment of a Center for environmental monitoring of algal toxins - from sampling to communication with the public (The Swedish Board of Agriculture and the marine, fisheries and aquaculture program 2021-2027). Extra microzooplankton samples from the surface water were taken at stations Släggö, Å17, Anholt E, BY5, BY15 and BY39 for a project being carried out at the University of Gothenburg.

Doris Björling from the PhD-project HYDROINS (Hydrozoa in Sweden), University of Gothenburg, took zooplankton samples from 25–0 m using a WP3 net at 6 stations: Å17, Falkenberg, Landskrona, BY4, BY39 and Anholt. The project explores and resolves the diversity of Hydrozoa (Cnidaria) in Sweden using integrative morphological and molecular taxonomical methods. Onboard R/V Svea hydromedusae were sorted out of the plankton samples, documented and fixed in ethanol (96%) for future DNA extraction.

Neea Hanström from Stockholm University joined the cruise to take samples of zooplankton to investigate the role of zooplankton parasite and how they shape marine food webs.

This report is based on data that has undergone an initial quality control. When additional quality review has been performed, certain values may change. Data from the expedition is published as soon as possible on the data host, SMHI's website. This usually takes place within one to two weeks after the cruise has ended. Some analyses are made after the cruise and are published later.

SHARKweb: https://sharkweb.smhi.se/hamta-data/

The Skagerrak

The surface water temperature varied between 15°C in the outer parts and 17°C closest to the coast, which is below normal for the season. From 20 meters and deeper, the temperature was within normal range. The surface salinity varied between 27.4 psu closest to the coast and 33 psu in the outer parts where it was slightly saltier than normal. At the stations at the westernmost end of the Å-transect, the surface salinity was above normal. A stratification caused by lower salinity and higher temperature was observed around 10 meters at all stations. Closest to the coast at Släggö station, there was also a clear stratification at 50 meters.

All nutrients in the surface water were lower in the outer parts of the Skagerrak and increased towards the coast. Near the coast, at station Släggö, the content of phosphate, 0.1 µmol/l, and silicate, 2.5 µmol/l, was above normal, while the content of dissolved inorganic nitrogen (DIN) was normal, 0.34 µmol/l. Along the Å-transect, normal levels of phosphate and silicate were observed while DIN was below normal. Phosphate and DIN were largely consumed down to 20 m. In southern Skagerrak at station P2, the phosphate content was above normal with 0.12 µmol/l, so was DIN with 0.54 µmol/l, while the silicate content was normal with 1.4 µmol/l. The level of silicate had increased in Skagerrak since July.

The oxygen situation was good at all stations in Skagerrak, with values normal for the season. The lowest concentration in the bottom water was observed at Släggö, 4.3 ml/l.

Chlorophyll fluorescence, which is a measure of plankton activity measured from the CTD probe, showed higher activity in the top 50 meters.

The Kattegat and the Sound

The surface temperature in the Kattegat and the Sound was 16 degrees which is low for the season and it had become colder since last month. The surface salinity was above normal and varied from 20 psu in the Sound to 26 psu in the Kattegatt. Temperature and salinity stratifications were found around 5 and 30 meters.

The concentration of phosphate in the surface water was normal or higher than normal in the area and varied between 0.1 - 0.2 µmol/l. In the Kattegat there were low levels of DIN, around 0.1 µmol/l, which is normal for the time of year. The silicate concentration in the Kattegat was above normal and around 2.5 µmol/l. In the Sound, the level of DIN was normal at 0.8 µmol/l and silicate was below normal with 4.8 µmol/l.

The oxygen levels were normal for the season and in the bottom water the lowest was measured at 4.0 ml/l in the Kattegat and 3.8 ml/l in the Sound.

The chlorophyll fluorescence showed plankton activity in the surface water and was at its highest in the Sound.

The Baltic Proper

The temperature in the surface water had dropped since the visit in July and was in most places below normal for the season and varied between 10 – 17°C. It was coldest at the southern tip of Öland, only 10 degrees, a place often affected by upwelling. Surface salinity varied from 6.4 psu in the northernmost parts to 9 psu in the Arkona Basin and ranged from normal to slightly above

normal. The deep water below the halocline in the eastern and western Gotland Basin was warmer than normal.

There were two general stratifications in the Baltic Proper. One closest to the surface around 15 – 20 meters which was caused by the warmer surface water. Deeper down, a salinity stratification, halocline, was observed, which was shallowest in the Arkona and Bornholm basins, where the halocline lies around 30 - 40 meters. In the Eastern Gotland Basin, the halocline was observed around 60 meters and in the Western Gotland Basin around 50 meters.

The concentration of phosphate in the surface water was above normal in the Arkona and Bornholm basin where it was around 0.25 µmol/l, in the Western and Eastern Gotland Basin the levels were low, around 0.1 µmol/l, which is normal. The content of dissolved inorganic nitrogen (DIN) was normal to below normal and around the detection limit, 0.1 µmol/l, in the entire Baltic Proper, except at BY15 where it was 0.34 µmol/l, which is above normal. The concentration of silicate was slightly above normal in the Arkona and Bornholm basins, around 11 µmol/l. Silicate levels were otherwise normal, 9 – 11 µmol/l, except at the southern tip of Öland where it was above normal with 14 µmol/l. At the southern tip of Öland, the phosphate level was also above normal, 0.6 µmol/l. In the deep water below the halocline, the levels of phosphate and silicate were above normal.

The oxygen situation in the Arkona Basin was normal and as low as 2.9 ml/l in the bottom water, no hydrogen sulphide was measured. In the Bornholm Basin and Hanö Bay, acute oxygen deficiency (<2 ml/l) was noted from 70 m with low oxygen levels around 0.1 ml/l in the bottom water, but no hydrogen sulphide.

In the Eastern Gotland Basin, the acute oxygen deficiency began at a depth of 70 meters and hydrogen sulphide was noted from 80 m. In the Western Gotland Basin, acute oxygen deficiency and also hydrogen sulphide were measured already from 60 m. At the southern tip of Öland, there was an acute oxygen deficiency from 50 meters, which is a deterioration from last month.

The fluorescence measurement from the CTD probe showed plankton activity in the surface water at all stations.

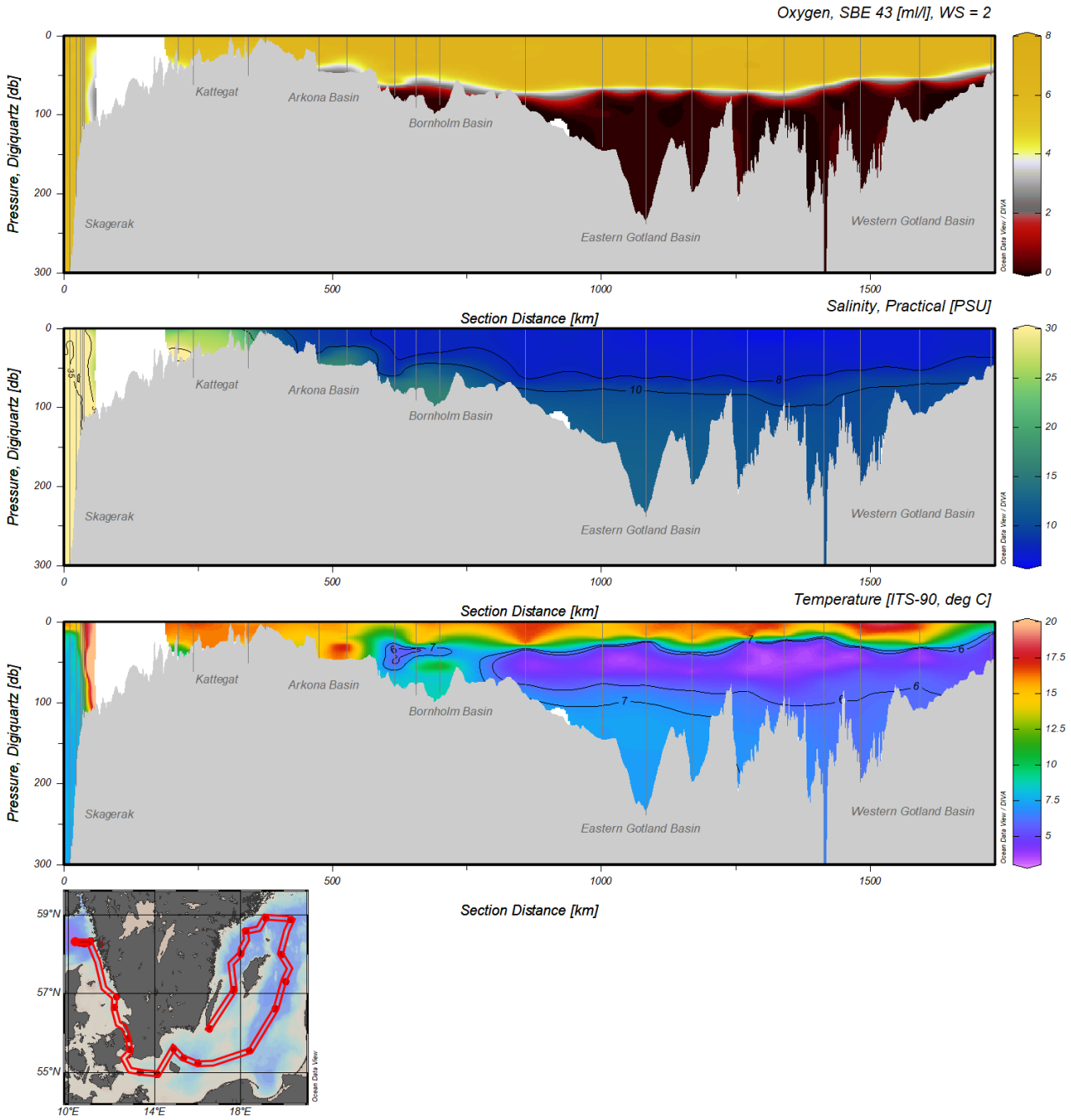


Figure 1. Transect showing CTD and MVP measurements of dissolved oxygen, salinity and temperature from Kattegat, the Sound through the Eastern Gotland Basin to the Western Gotland Basin.

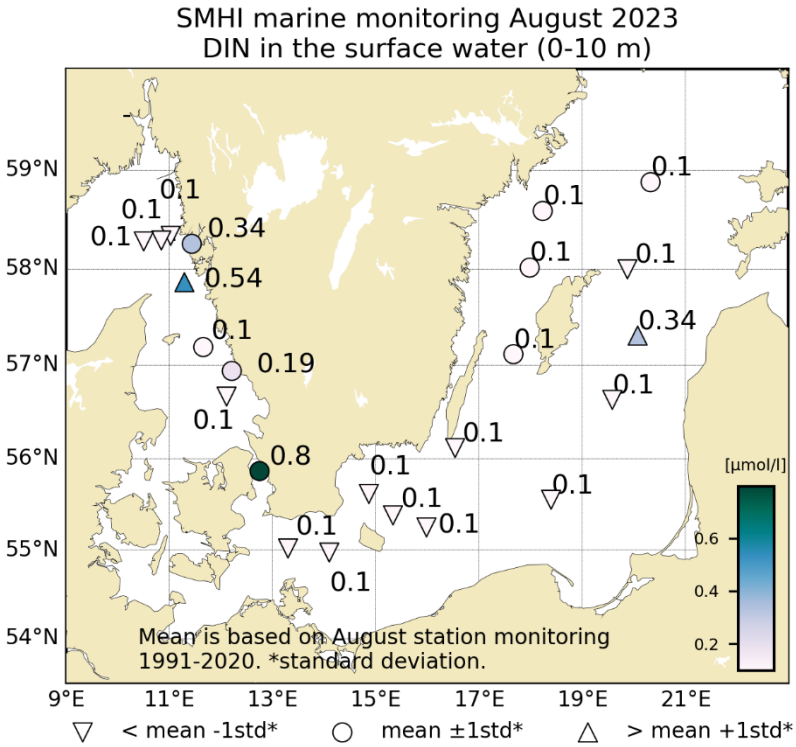


Figure 2. Concentration of dissolved inorganic nitrogen in the surface water (0-10m).

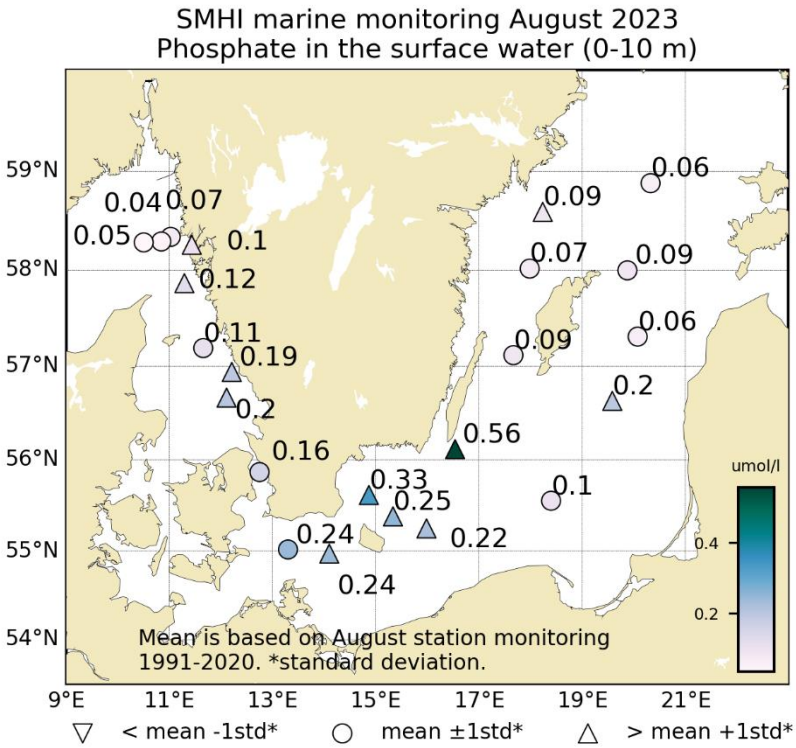


Figure 3. Concentration of phosphate in the surface water (0-10m).

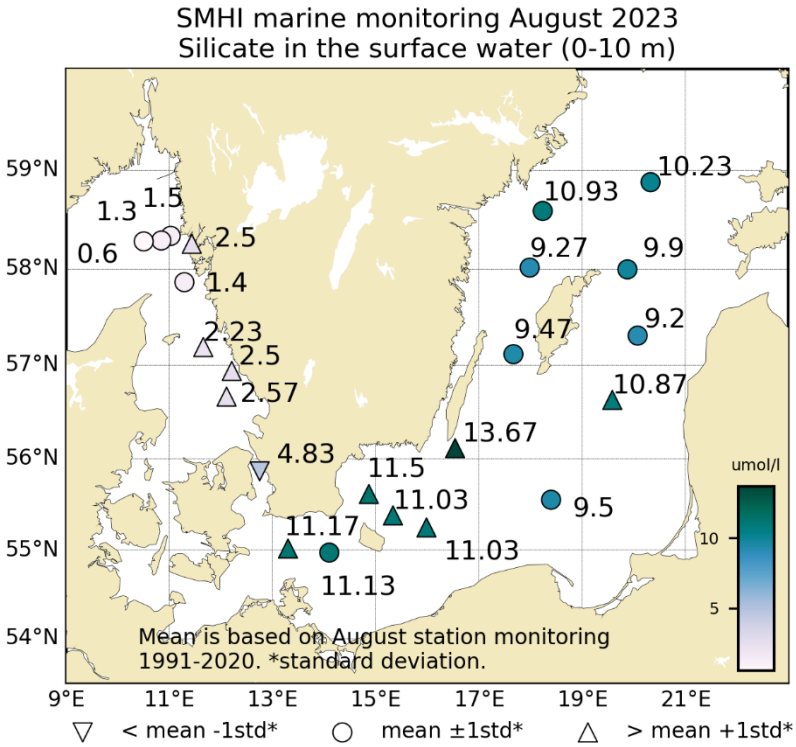


Figure 4. Concentration of silicate in the surface water (0-10m).

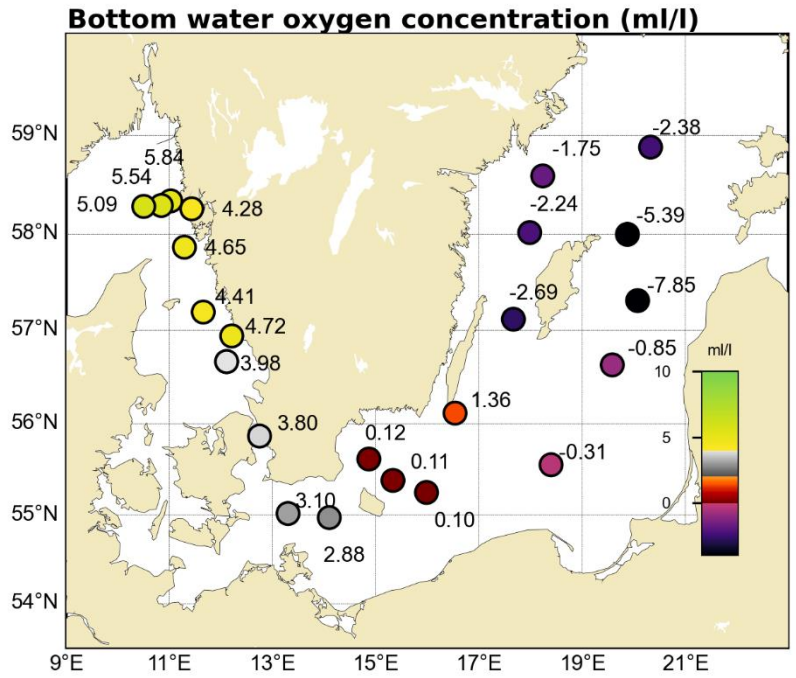


Figure 5. Oxygen concentration in the bottom water. Hydrogen sulphide is expressed as negative oxygen.

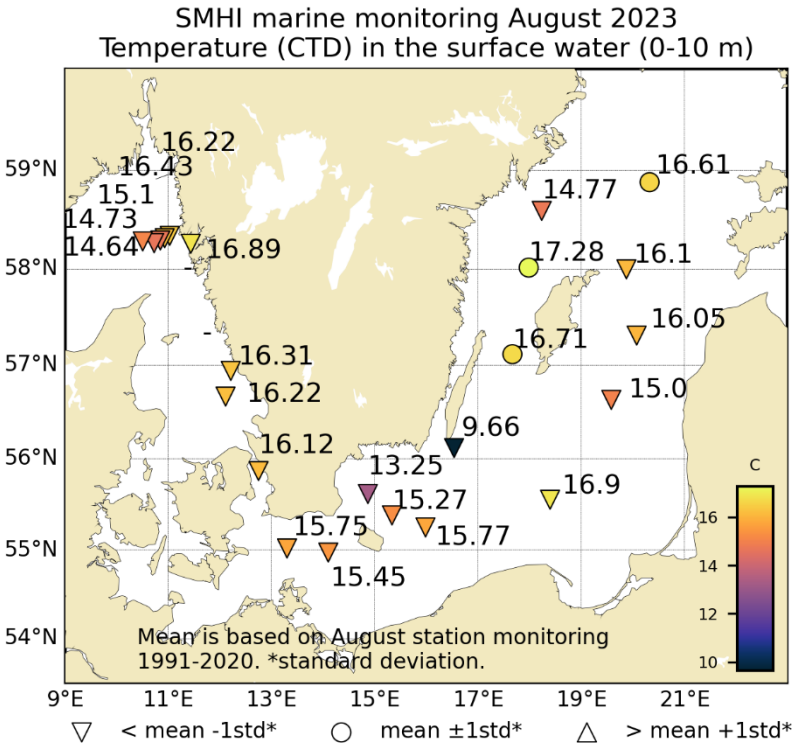


Figure 6. Temperature in the surface water (0-10m).

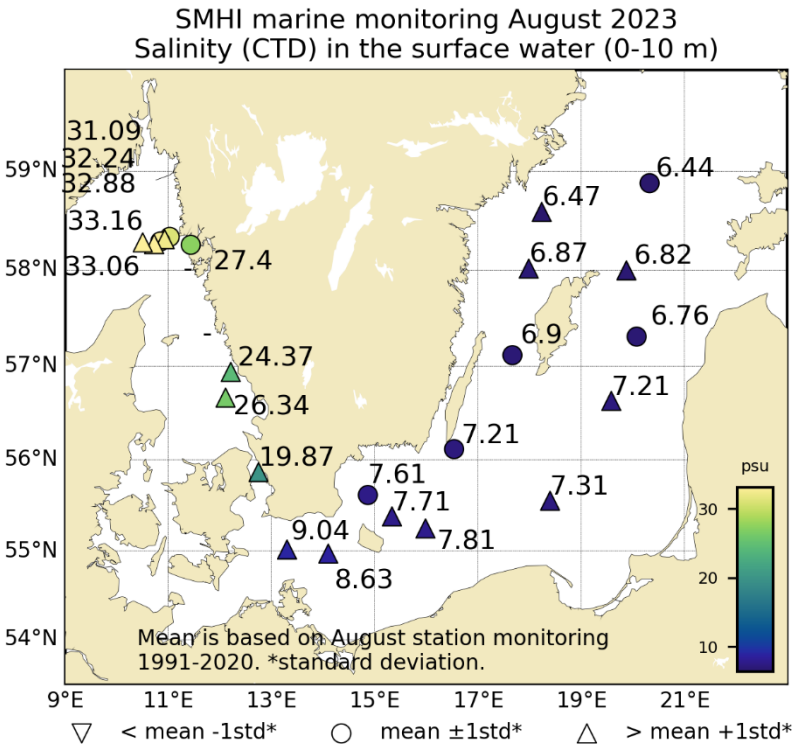


Figure 7. Salinity in the surface water (0-10m).

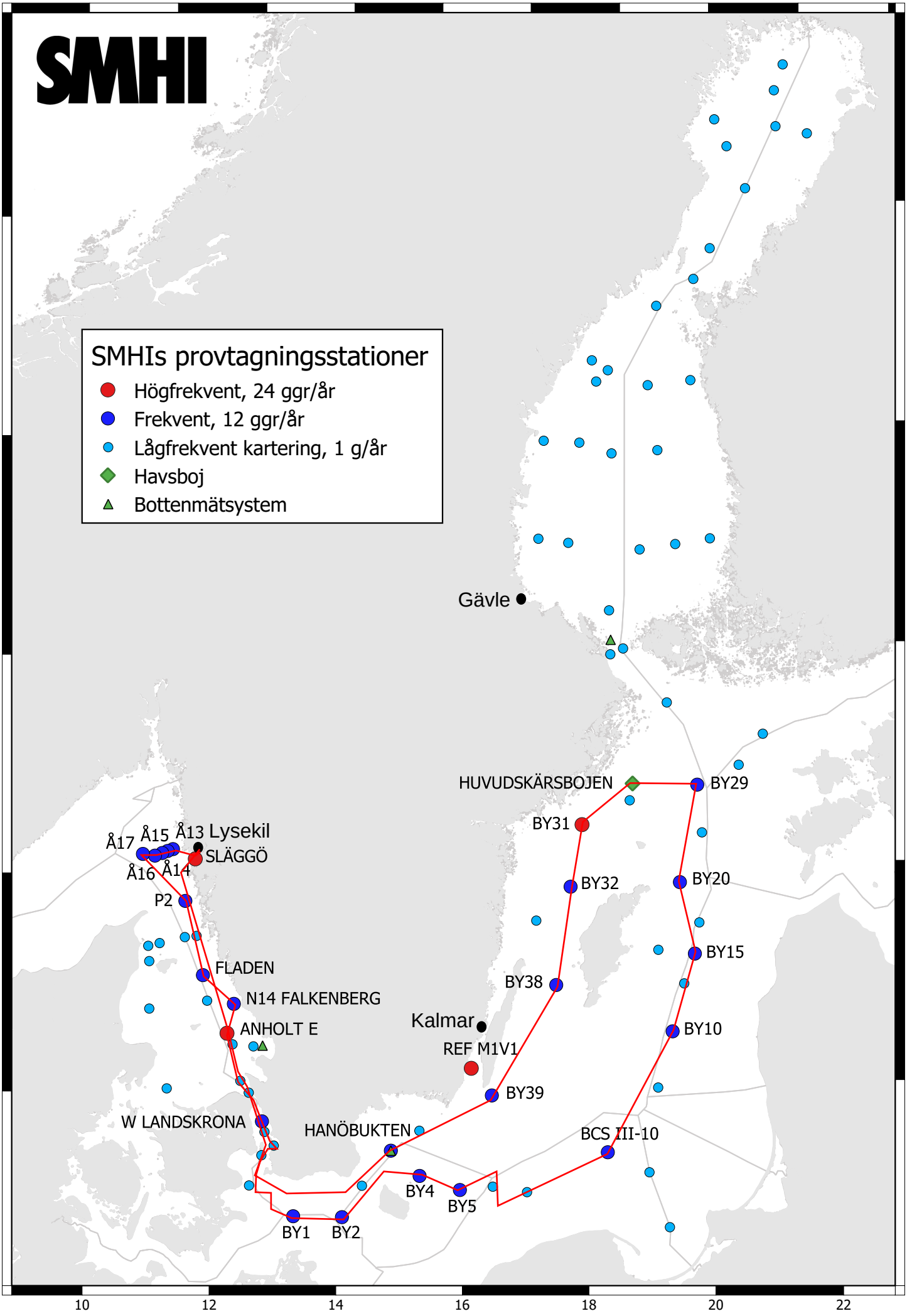
DELTAGARE

Namn	Roll	Från
Anna-Kerstin Thell	Chief scientist	SMHI
Sari Sipilä	Marine chemist	SMHI
Ola Kalén	Oceanographer	SMHI
Johanna Linders	Oceanographer	SMHI
Ann-Turi Skjevik	Marine bilogist	SMHI
Daniel Bergman-Sjöstrand	Oceanographer	SMHI
Doris Björling	Guest scientist	GU
Neea Hanström	Guest scientist	SU

APPENDICES

- Track chart
- Table over stations, sampled parameters and number of sampling depths
- Vertical profiles for regular monitoring stations
- Monthly average surface water plots for regular monitoring stations

SMHI
Havs
och Vatten
myndigheten


SMHI
SMHIs provtagningsstationer
Högfrekvent, 24 ggr/år
Frekvent, 12 ggr/år
Lågfrekvent kartering, 1 g/år
Havsboj
Bottenmätsystem
Gävle
HUVUDSKÄRSBOJEN
BY29
BY31
BY32
BY20
BY15
BY38
BY10
Å17
Å15
Å13
Lysekil
SLÄGGÖ
Å16
Å14
P2
FLADEN
N14 FALKENBERG
ANHOLT E
Kalmar
REF M1V1
BY39
W LANDSKRONA
HANÖBUKTEN
BCS III-10
BY4
BY5
BY1
BY2
64
62
60
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16
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22

Date: 2023-08-20
Time: 15:24

Ship: SE
Year: 2023

Ser no	Cru no	Stat code	Proj	Stat name	Lat	Lon	Start date yyyymmdd	Start time hhmm	Bottom depth m	Secchi depth m	Wind dir	Wind vel	Air temp C	Air pres hPa	WCWI elacaoveTueohdsb	CZPP hohp loyapto p	No de	No btl	Temp_bottle	Temp_cast	Salt_bottle	Salt_cast	Phos_bottle	Doxy_bottle	Doxy_cast	H2S	Phosphate	Nitrite	Nitrate	Nitrite	Ammonia	Alkalinity	Silicate	Shipmen-s	Comment_visit	Comment_sample
0587	13	FIBG27	BAS...	SLÄGGÖ	5815.59	01126.12	20230810	1000	75	5	29	6	15.8	1013	2410	xxx-	9		x	x	x	-	x	x	-	x	x	x	x	x	x	-	x	-	x	x
0588	13	SKEX14	BAS...	Å13	5820.44	01101.62	20230810	1330	116	6	27	5	16.0	1014	1230	x---	10		x	x	x	-	x	x	-	x	x	x	x	x	x	-	x	-	x	x
0589	13	SKEX15	BAS...	Å14	5819.01	01055.78	20230810	1500	117		25	7	15.5	1015	2230	----	11		-	x	-	x	-	-	x	-	-	-	-	-	-	-	-	-	-	-
0590	13	SKEX16	BAS...	Å15	5817.63	01050.70	20230810	1615	138		26	7	15.3	1015	1230	x---	12		x	x	x	x	-	x	x	-	x	x	x	x	x	x	-	x	-	x	-
0591	13	SKEX17	BAS...	Å16	5816.02	01043.51	20230810	1800	204		26	7	15.5	1015	1230	----	13		-	x	-	x	-	-	x	-	-	-	-	-	-	-	-	-	-	-
0592	13	SKEX18	BAS...	Å17	5817.06	01030.25	20230810	1920	352		25	7	15.4	1015	1230	xxx-	15		x	x	-	x	x	x	x	-	x	x	x	x	x	x	x	-	x	-
0593	13	SKEX23	BAS...	P2	5752	01117.54	20230811	0310	93		24	6	15.0	1017	9990	x---	10		x	-	x	-	-	x	-	-	x	x	x	x	x	x	-	x	-	x	-
0594	13	KANX25	BAS...	FLADEN	5711.52	01139.47	20230811	0630	85	7	26	7	13.5	1019	1430	x---	13		x	-	x	-	-	x	-	-	x	x	x	x	x	x	-	x	-	x	-
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0596	13	KAEX29	BAS...	ANHOLT E	5640.11	01206.59	20230811	1300	62	4	22	8	16.4	1021	2430	xxxx	10		x	x	x	x	x	x	-	x	x	x	x	x	x	x	x	x	x	-
0597	13	SOCX39	BAS...	W LANDSKRONA	5552.04	01244.92	20230811	1900	50		18	7	16.8	1021	2410	x---	9		x	x	x	x	-	x	x	-	x	x	x	x	x	x	-	x	-	x	-
0598	13	SOSX00	EXT...	FLINTEN 7	5535.34	01250.81	20230811	2145	10		15	6	15.8	1021	9990	----	3		-	x	-	x	-	-	x	-	-	-	-	-	-	-	-	-	-	-
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0601	13	BPSB06	BAS...	BY4 CHRISTIANSÖ	5522.97	01520.08	20230812	1310	91	8	12	5	17.2	1018	2620	x---	12		x	x	x	x	-	x	x	-	x	x	x	x	x	x	-	x	-	x	x
0602	13	BPSB07	BAS...	BY5 BORNHOLMSDJ	5515.00	01559.05	20230812	1645	90		10	7	18.1	1017	1720	xxxx	12		x	x	x	x	x	x	-	x	x	x	x	x	x	x	x	x	x	-
0603	13	BPSE11	BAS...	BCS III-10	5533.26	01823.9	20230813	0210	90		19	5	18.4	1012	9990	x-x-	12		x	x	x	x	-	x	x	x	x	x	x	x	x	x	-	x	x	x	-
0604	13	BPEX13	BAS...	BY10	5638.00	01935.09	20230813	0945	144	6	24	7	17.0	1016	4920	x---	15		x	x	x	x	-	x	x	x	x	x	x	x	x	x	-	x	-	x	-
0605	13	BPEX21	BAS...	BY15 GOTLANDSDJ	5718.72	02004.58	20230813	1550	243	7	26	6	18.2	1017	2620	xxxx	24		x	x	-	x	x	x	x	x	x	x	x	x	x	x	x	x	-	x	-
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0608	13	BPNX00	EXT...	HUVUDSKÄR	5855.99	01909.61	20230814	0830	92		23	7	16.6	1019	2420	----	6		-	x	-	x	-	-	x	-	-	-	-	-	-	-	-	-	-	-
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0610	13	BPWX38	BAS...	BY32 NORRKÖPINGSDJ	5801.01	01759.09	20230814	1850	203		17	7	17.6	1020	2420	x---	17		x	x	-	x	-	x	x	x	x	x	x	x	x	-	x	-	x	-
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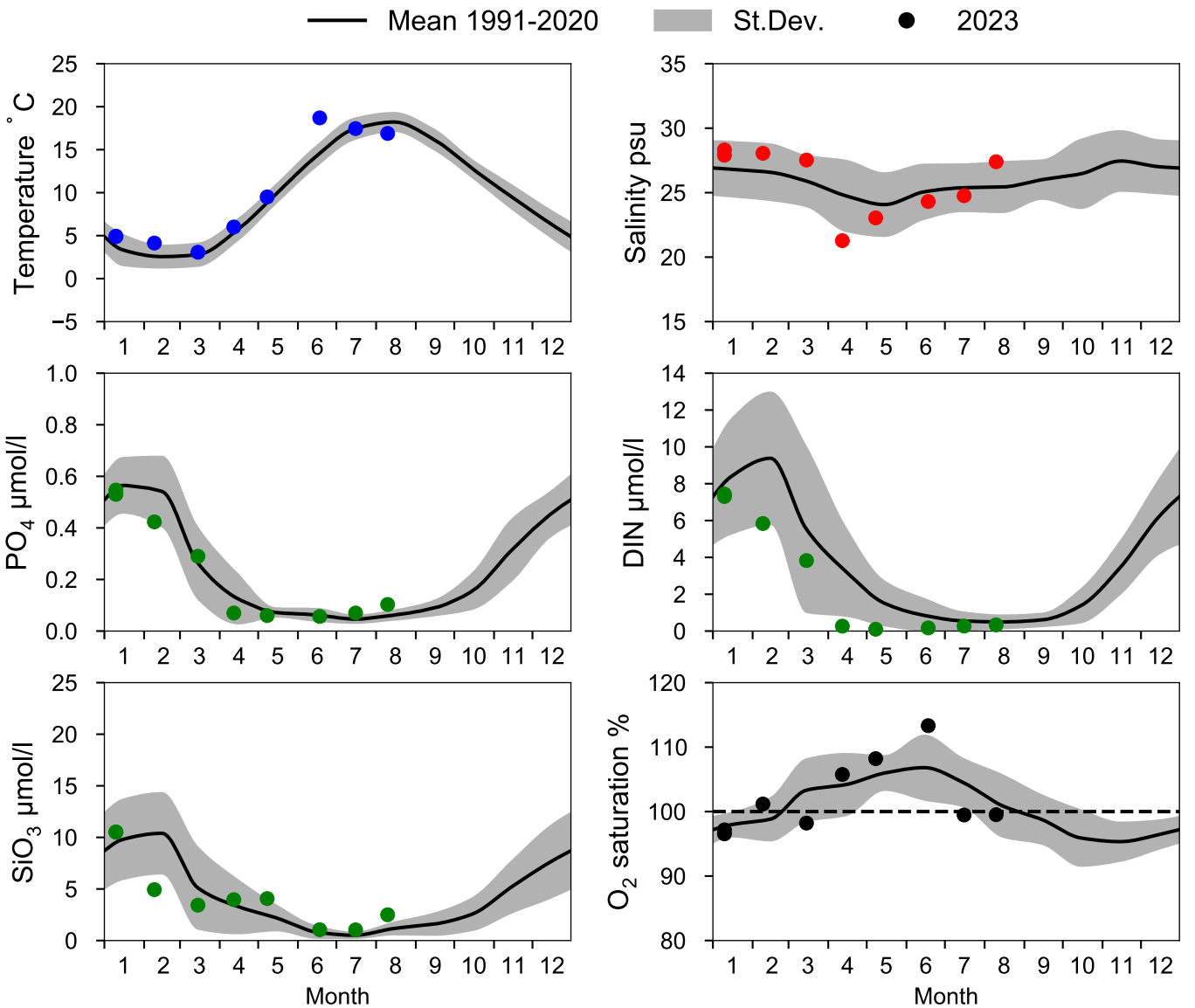
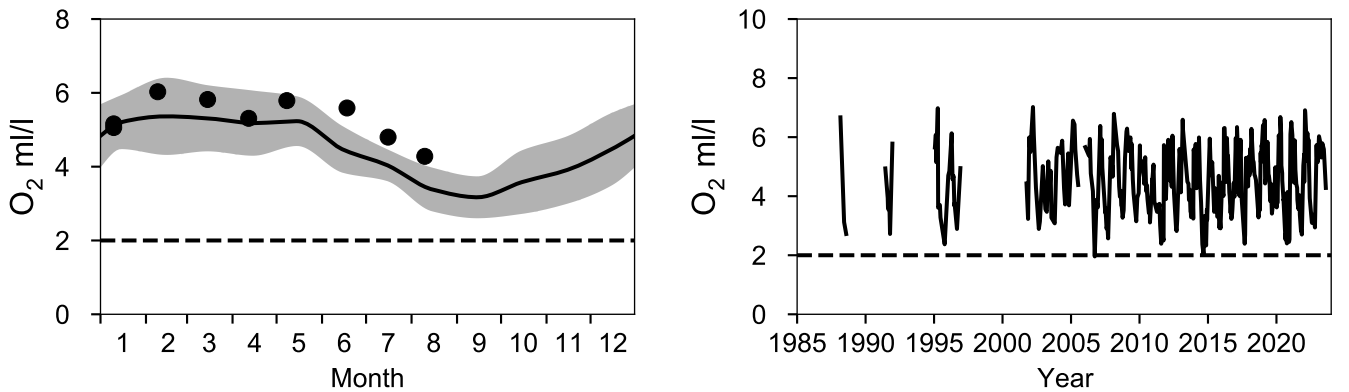
0613	13	BPSH05	BAS...	HANÖBUKTEN	5537.04	01452.05	20230815	2000	79		21	7	17.0	1018	9990	x---	11		x	x	x	x	-	x	x	-	x	x	x	x	x	x	-	x	-	x	-
0614	13	KAEX29	BAS...	ANHOLT E	5640.11	01206.68	20230816	1700	63		23	6	17.6	1022	1720	xxx-	10		x	x	x	x	x	x	-	x	x	x	x	x	x	x	x	x	-	

STATION SLÄGGÖ SURFACE WATER (0-10 m)

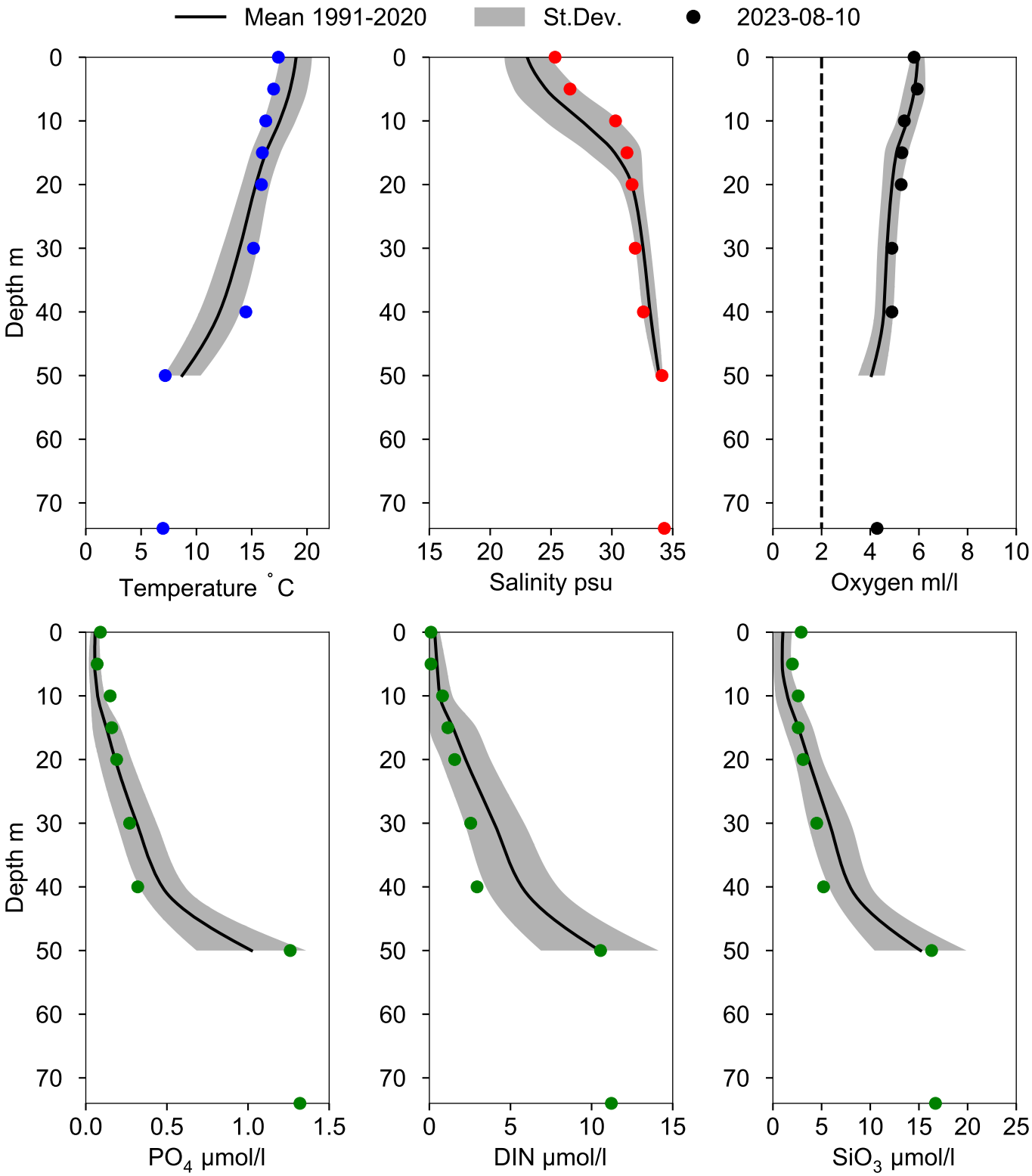
Annual Cycles



OXYGEN IN BOTTOM WATER (depth >= 64 m)

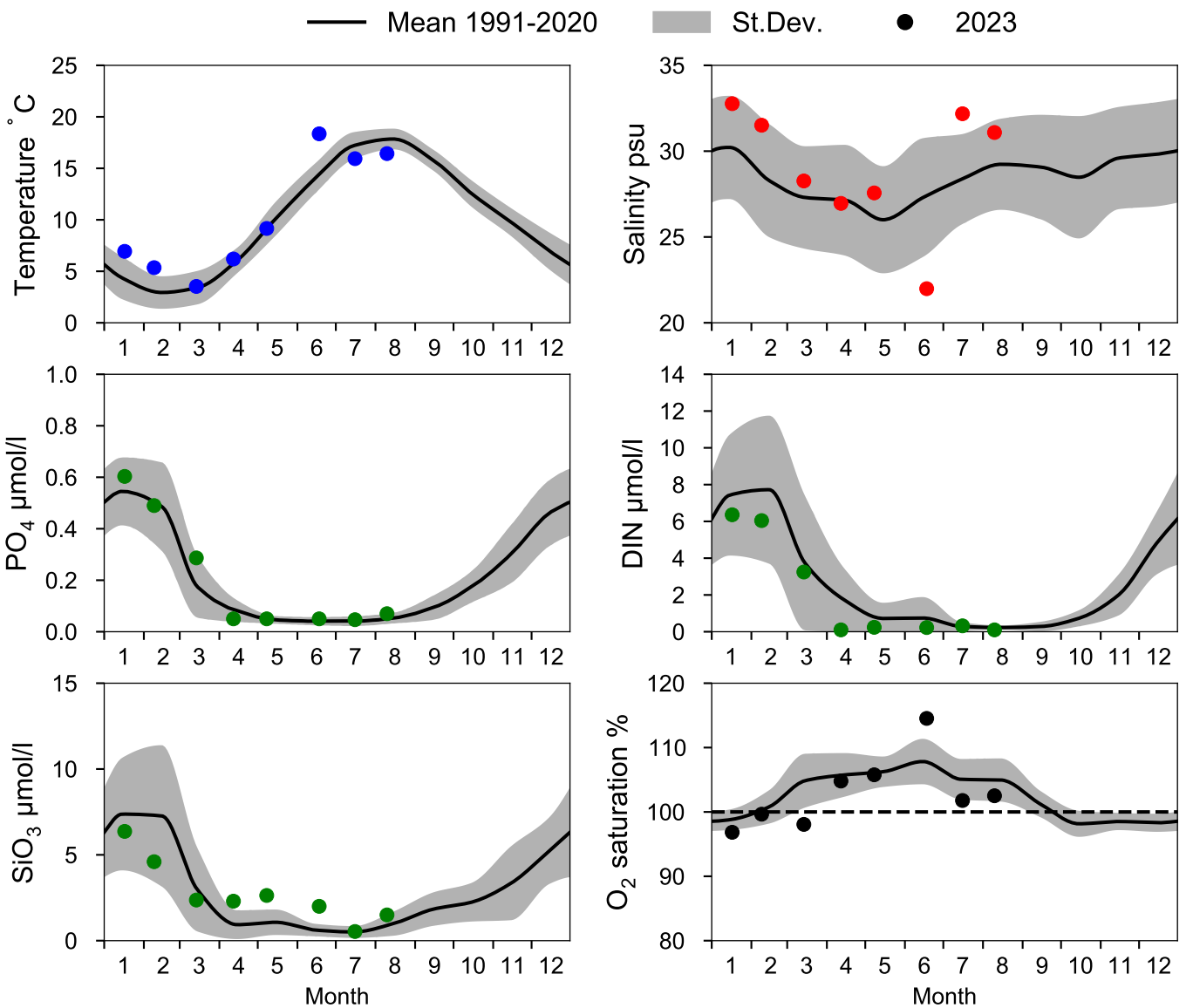


Vertical profiles SLÄGGÖ
August

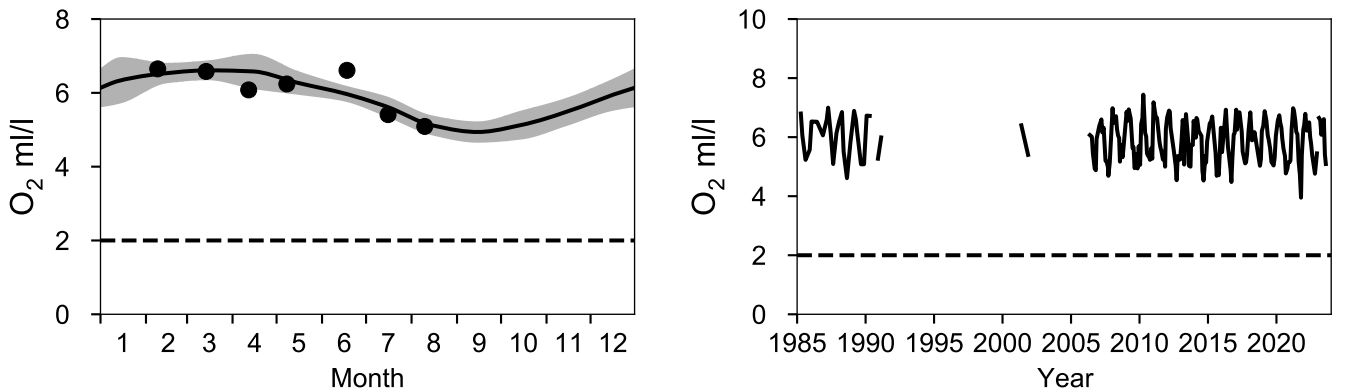


STATION Å13 SURFACE WATER (0-10 m)

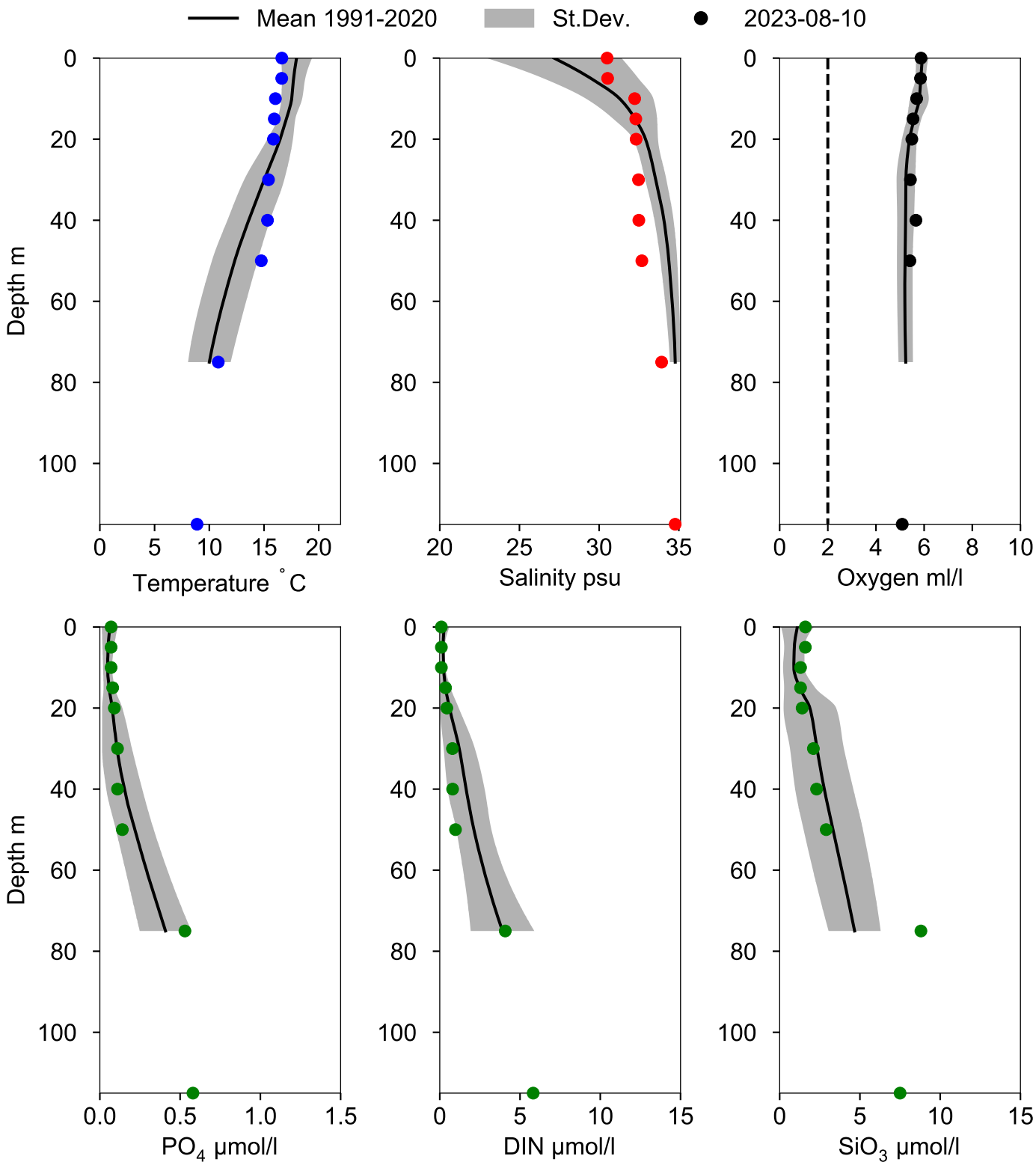
Annual Cycles



OXYGEN IN BOTTOM WATER (depth >= 82 m)

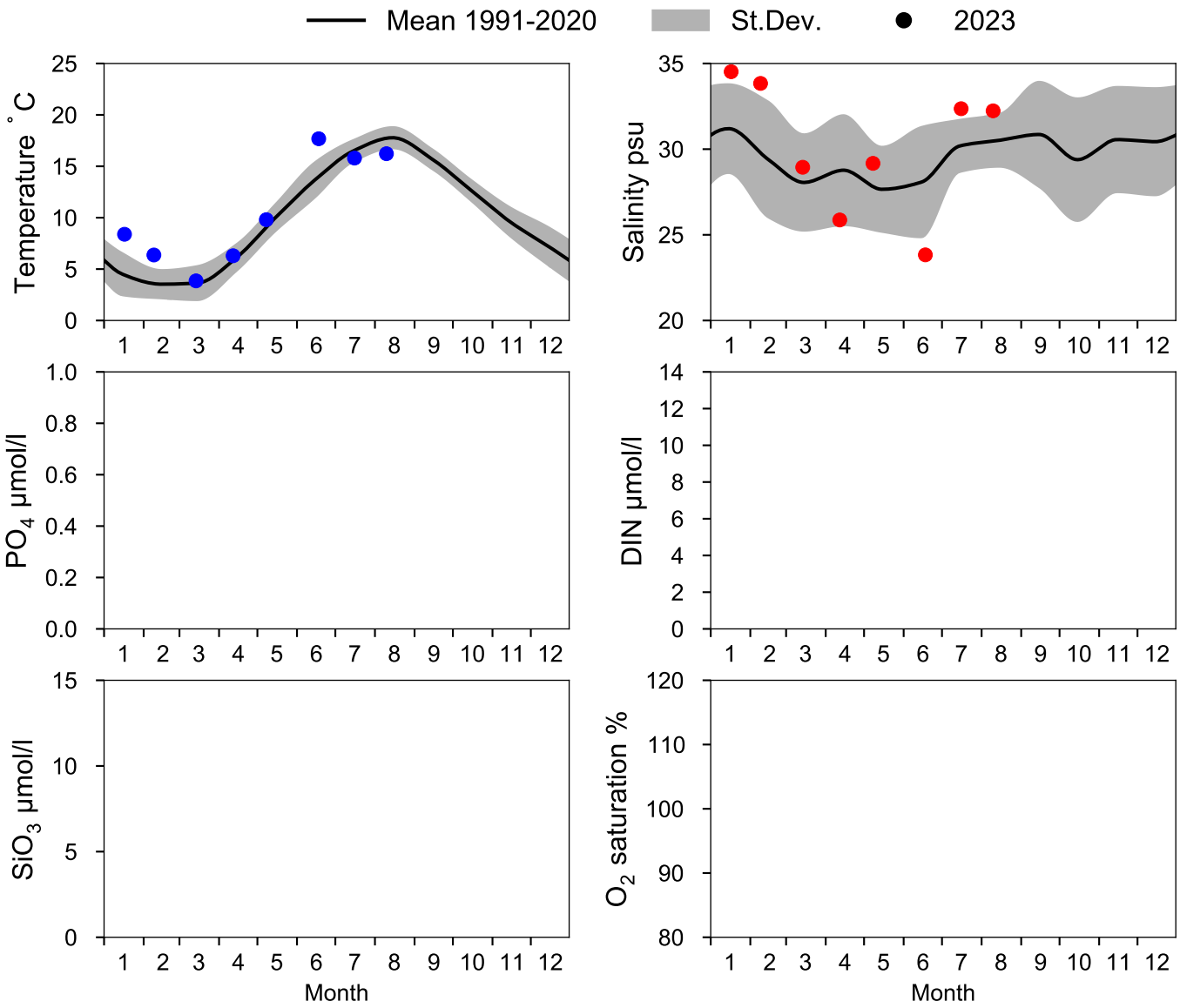


Vertical profiles Å13
August

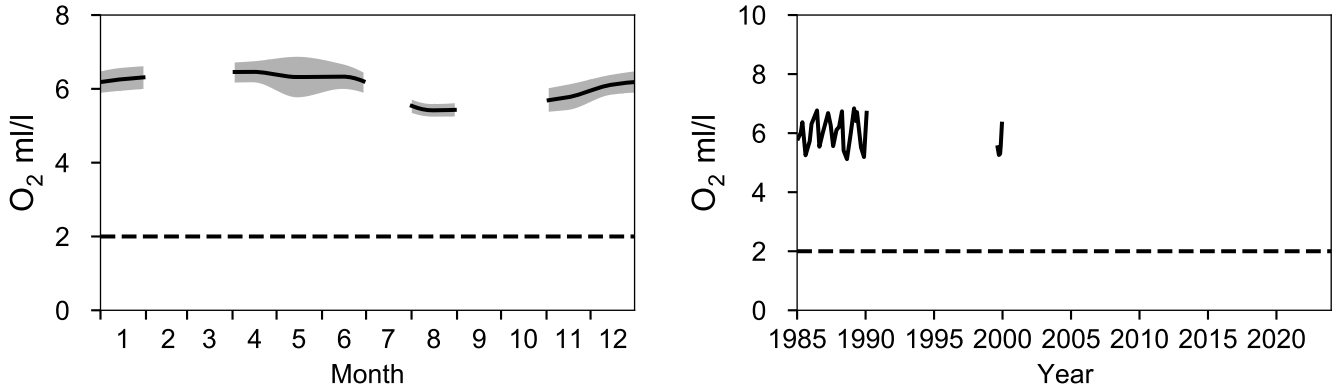


STATION Å14 SURFACE WATER (0-10 m)

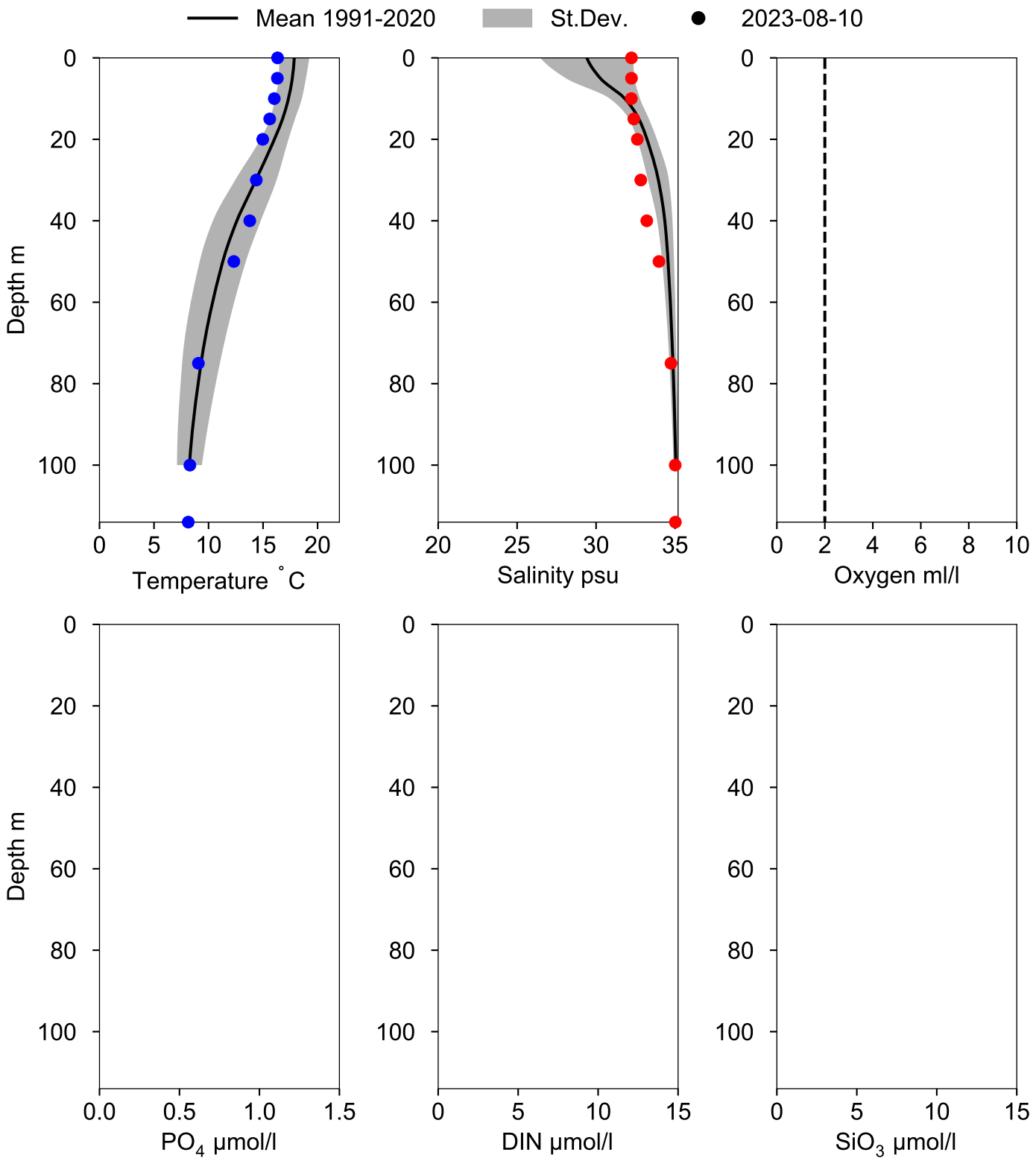
Annual Cycles



OXYGEN IN BOTTOM WATER (depth >= 100 m)

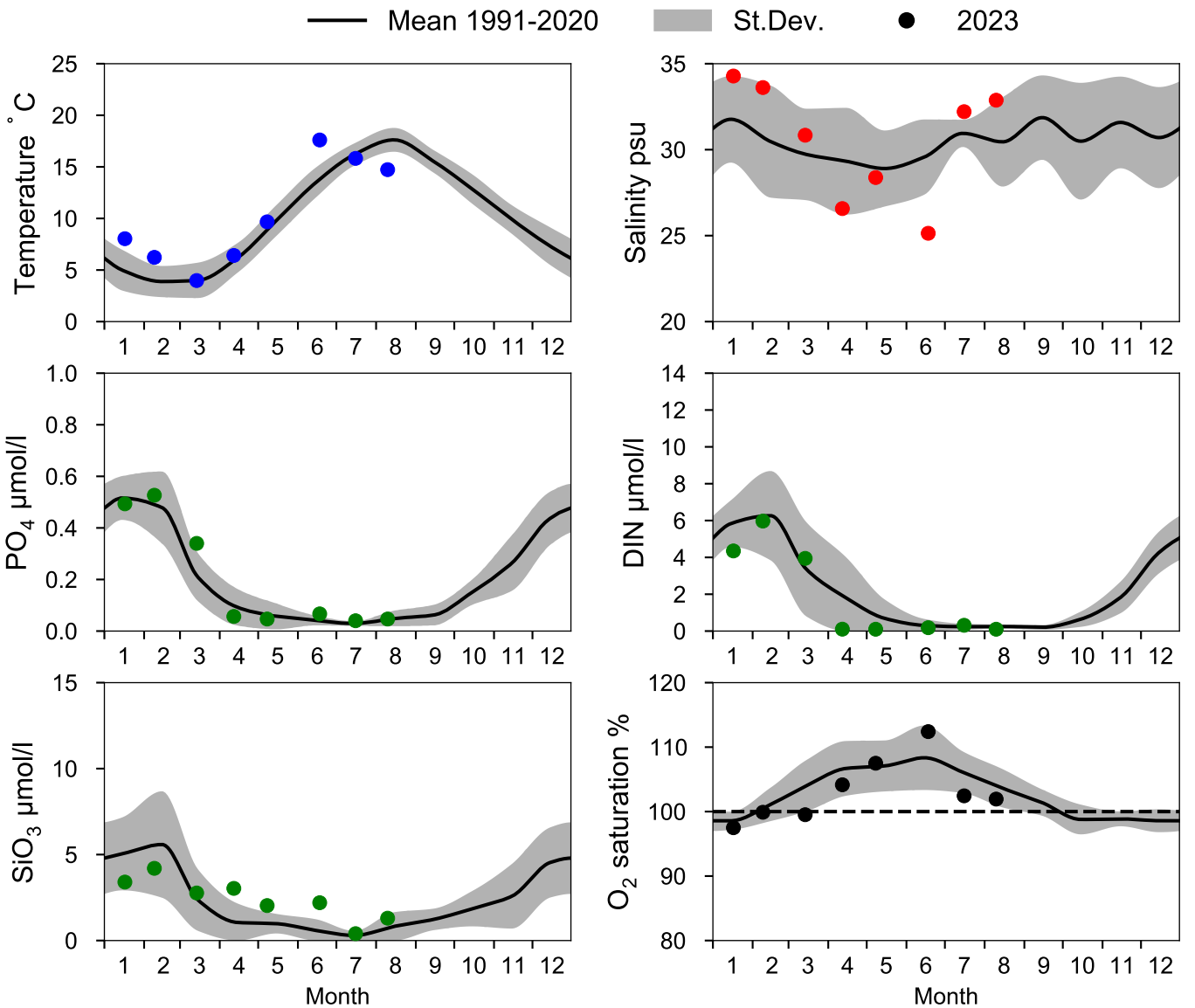


Vertical profiles Å14
August

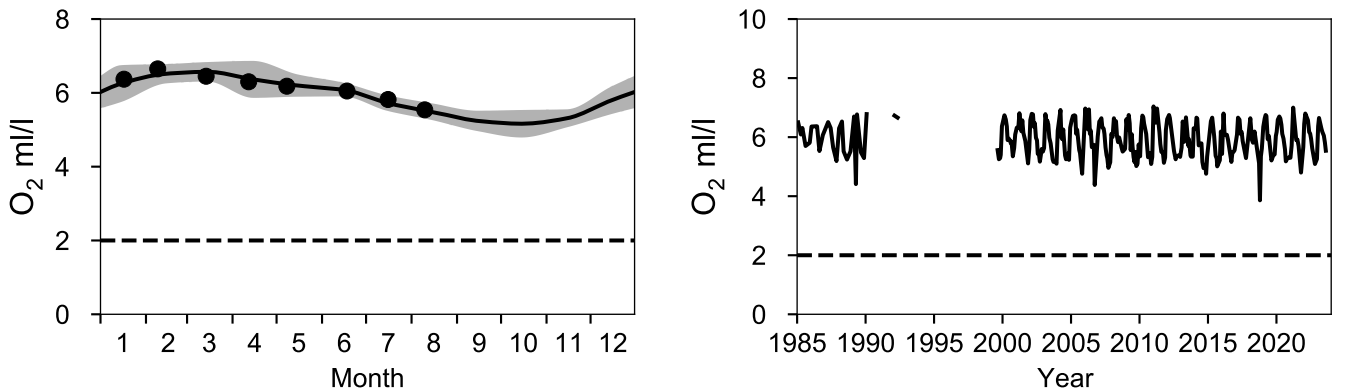


STATION Å15 SURFACE WATER (0-10 m)

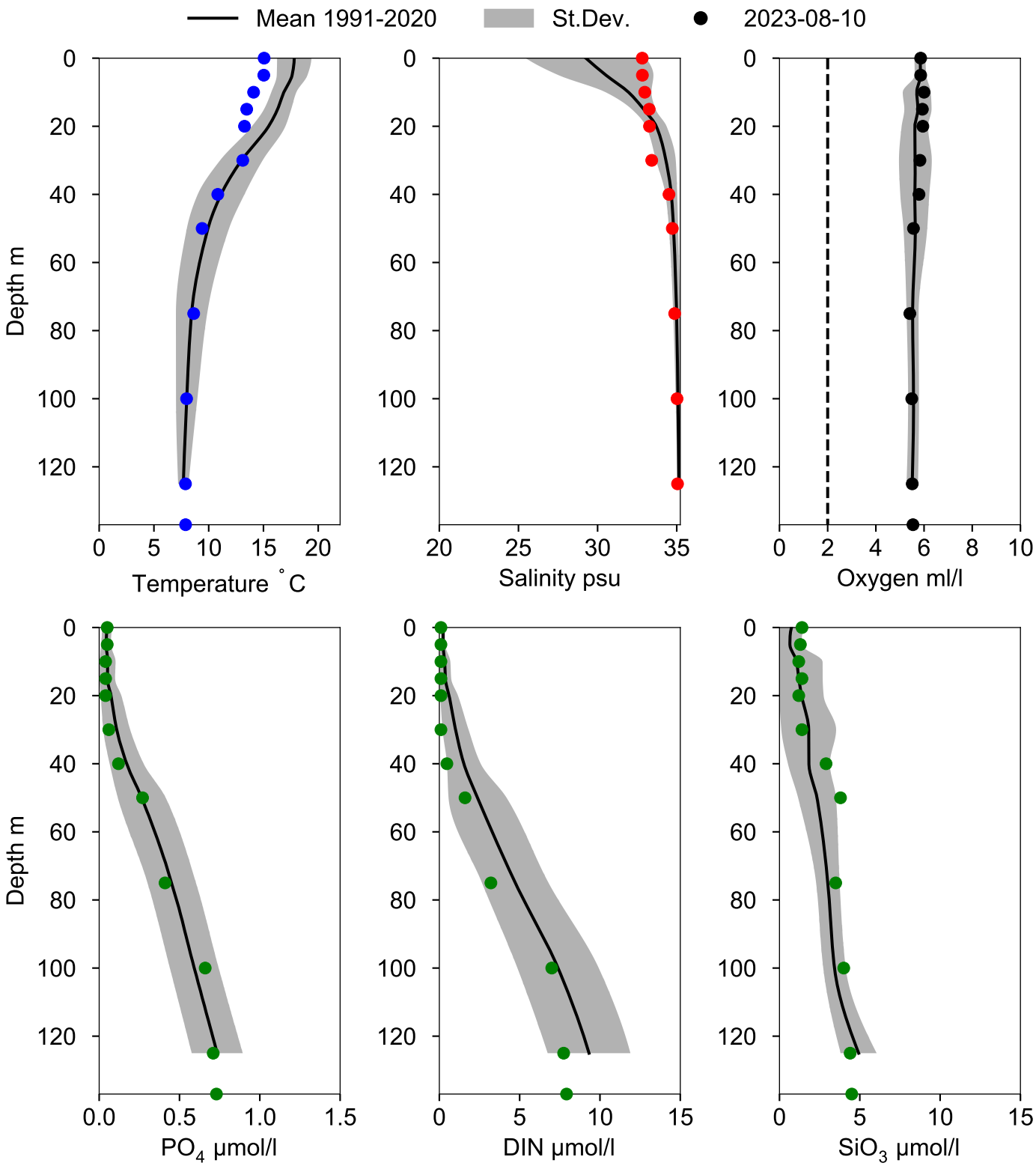
Annual Cycles



OXYGEN IN BOTTOM WATER (depth >= 125 m)

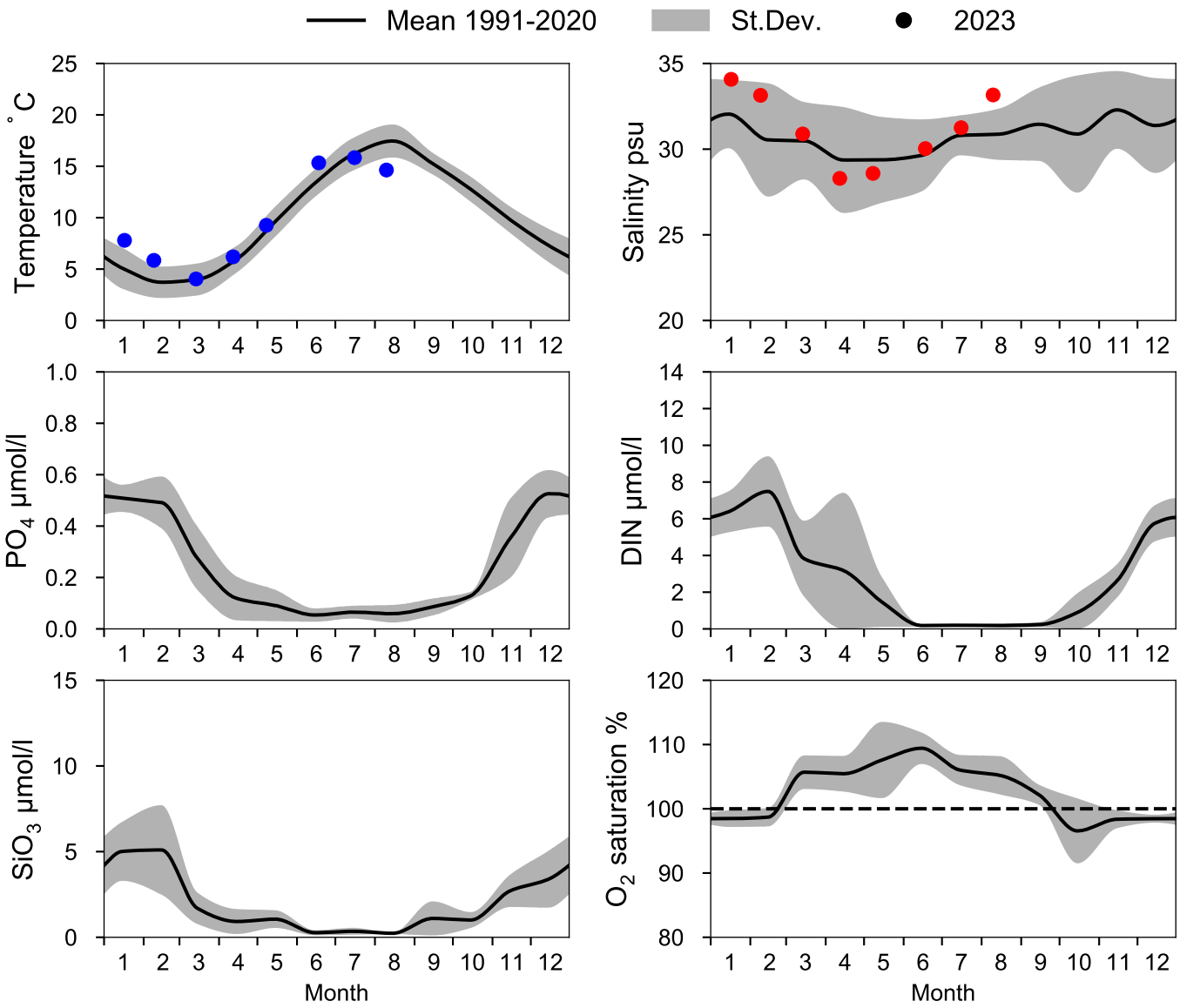


Vertical profiles Å15
August

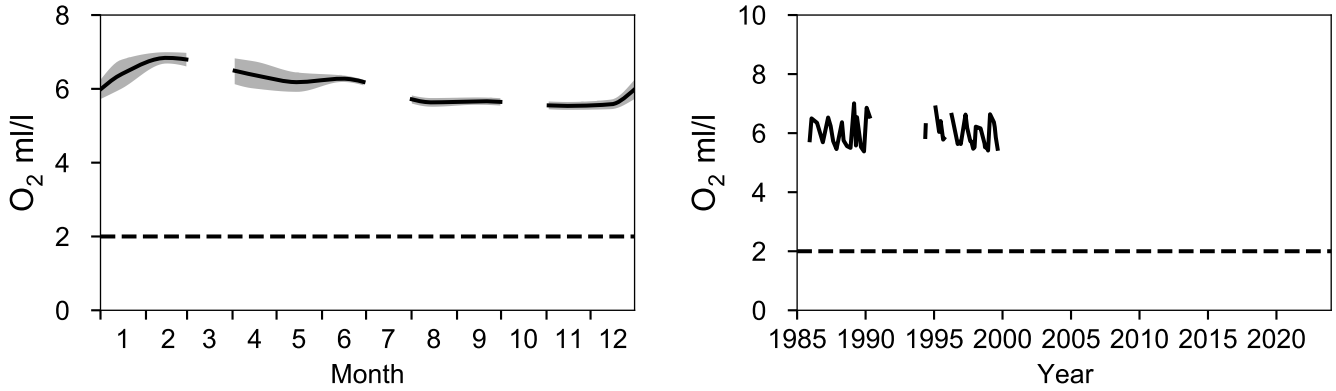


STATION Å16 SURFACE WATER (0-10 m)

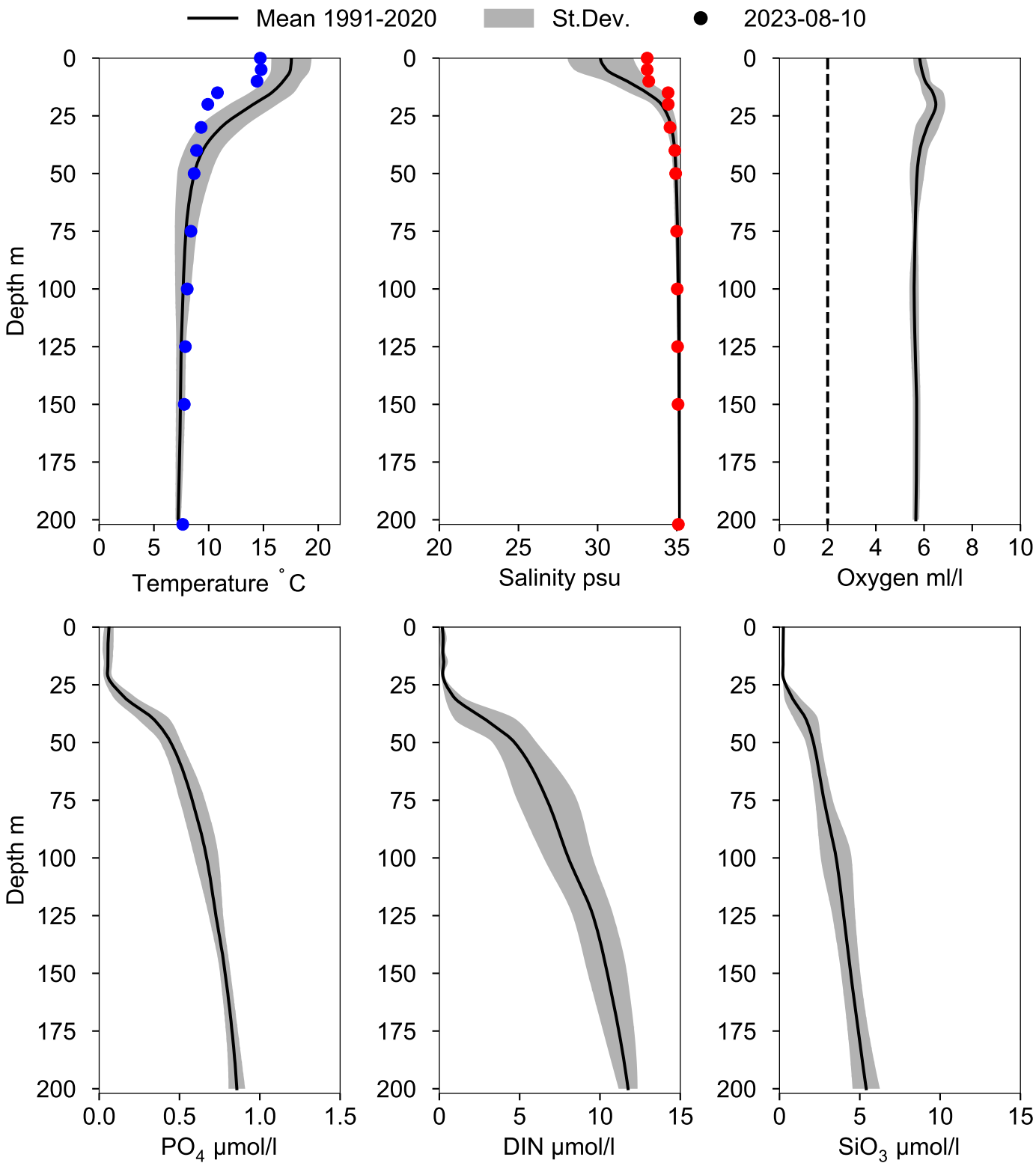
Annual Cycles



OXYGEN IN BOTTOM WATER (depth >= 193 m)

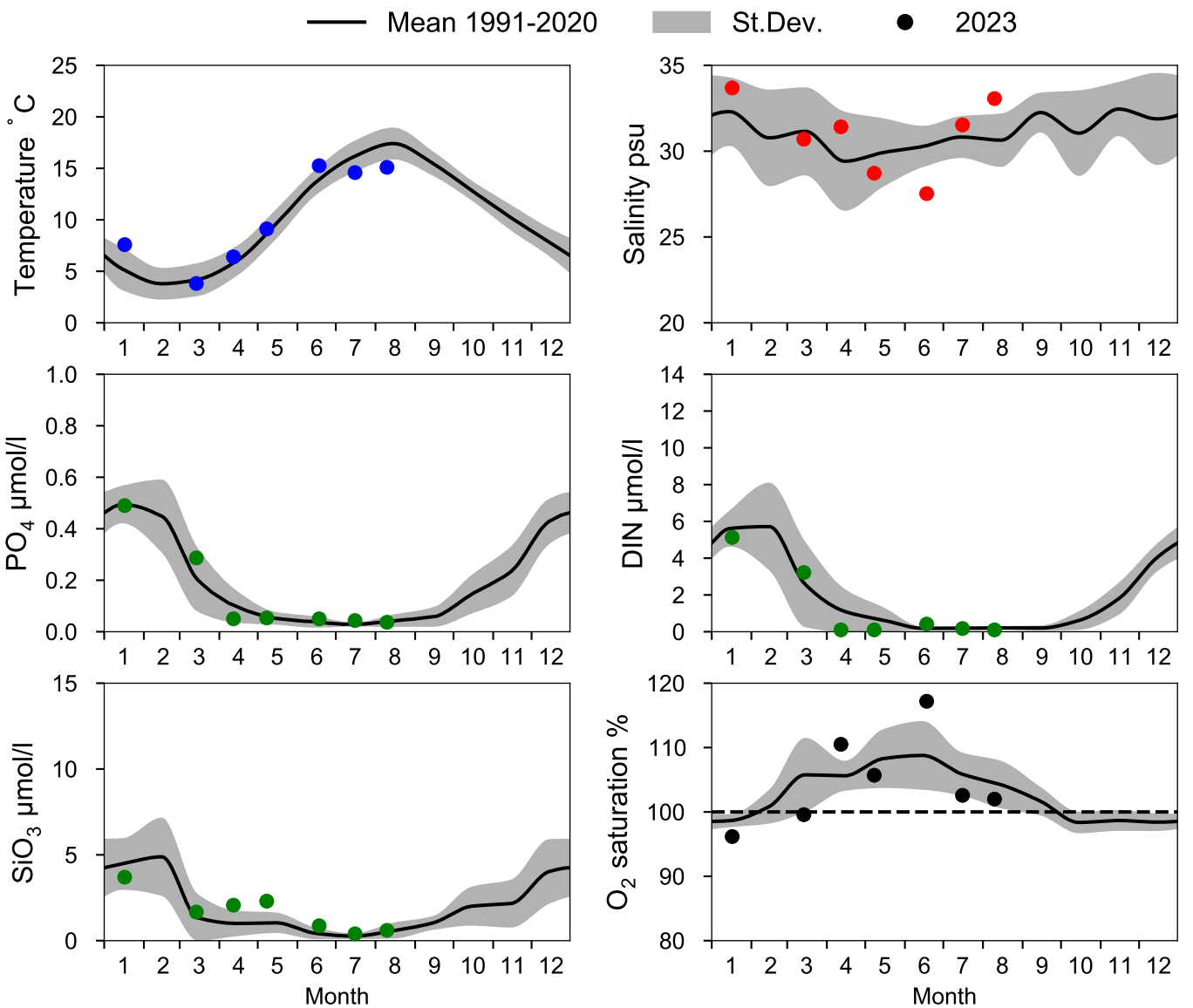


Vertical profiles Å16
August

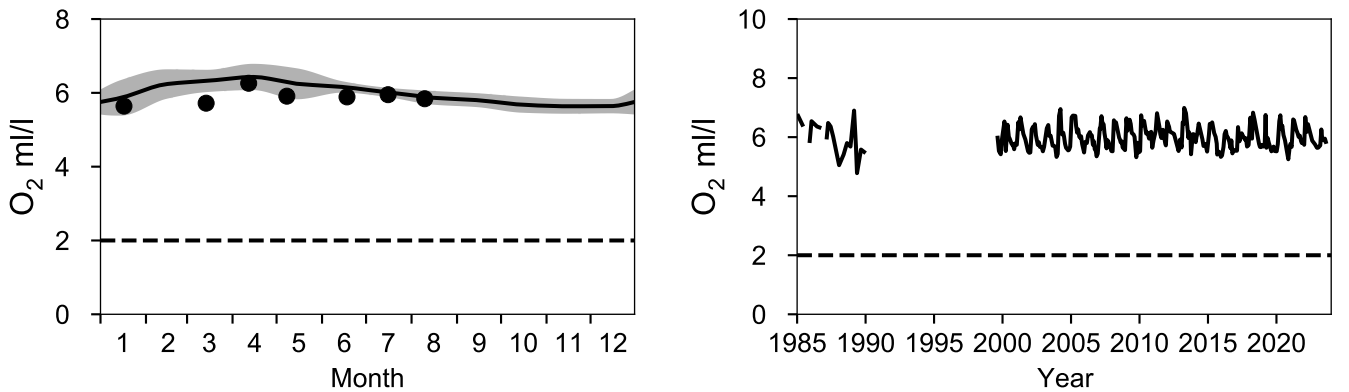


STATION Å17 SURFACE WATER (0-10 m)

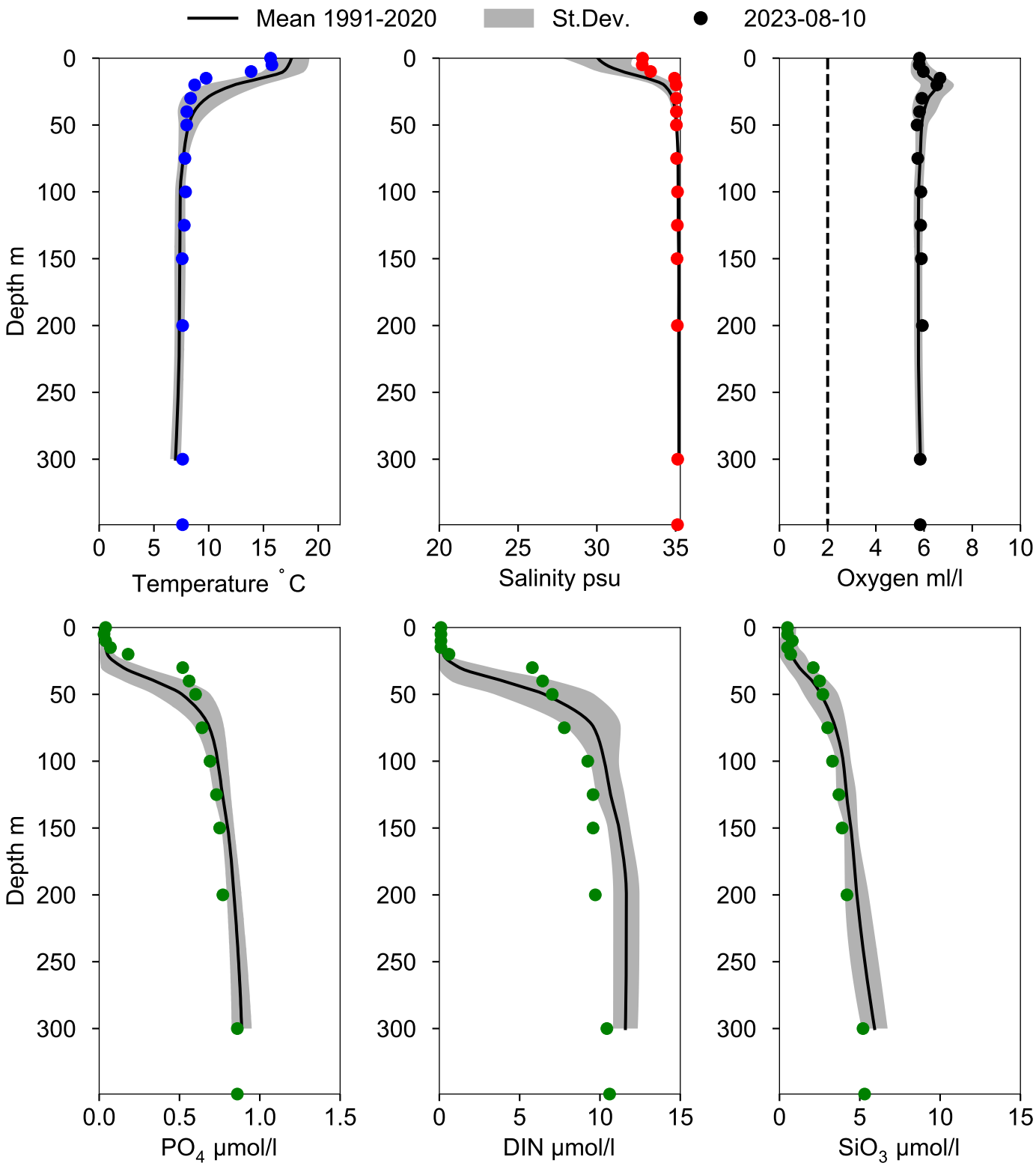
Annual Cycles



OXYGEN IN BOTTOM WATER (depth >= 300 m)

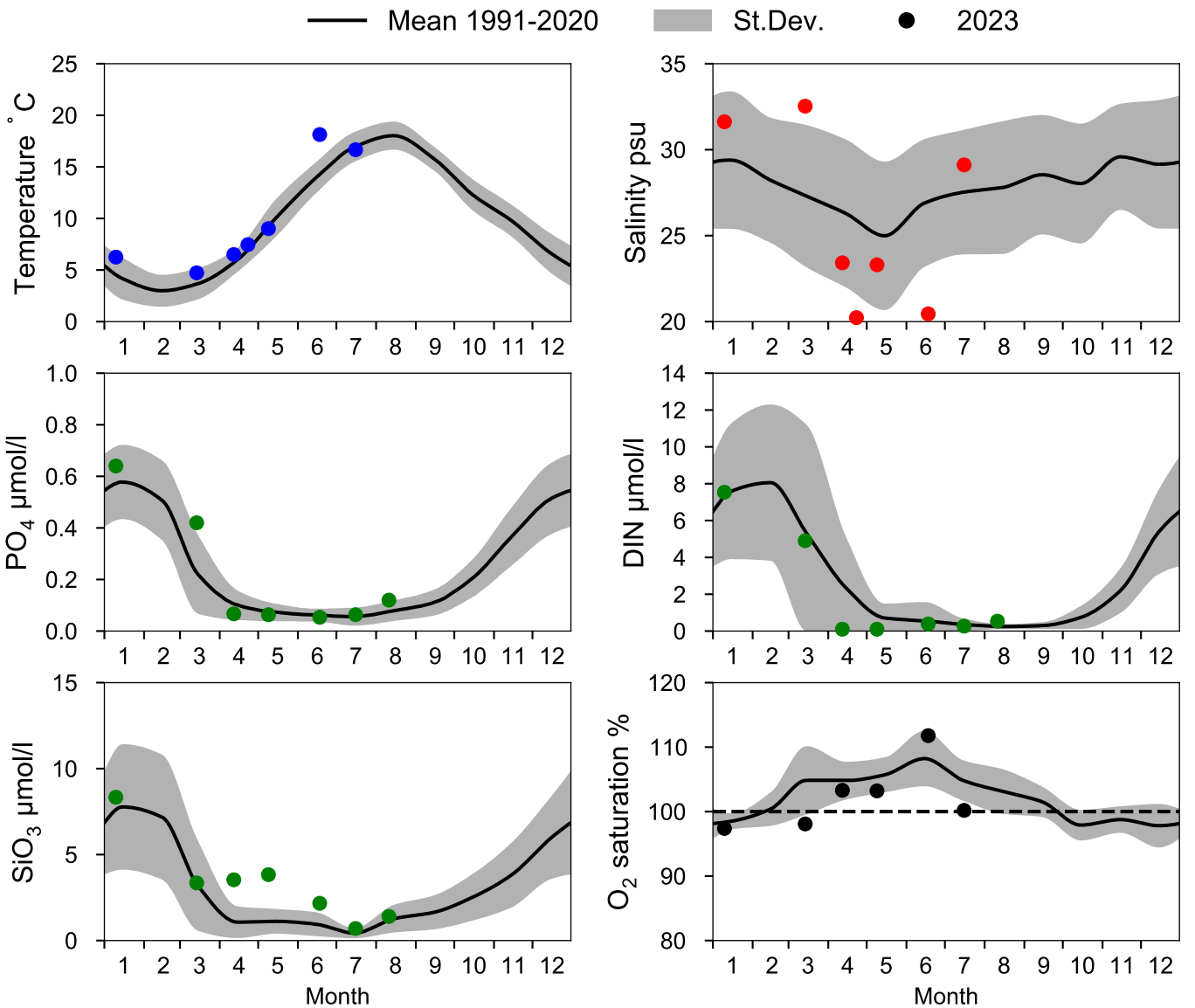


Vertical profiles Å17
August

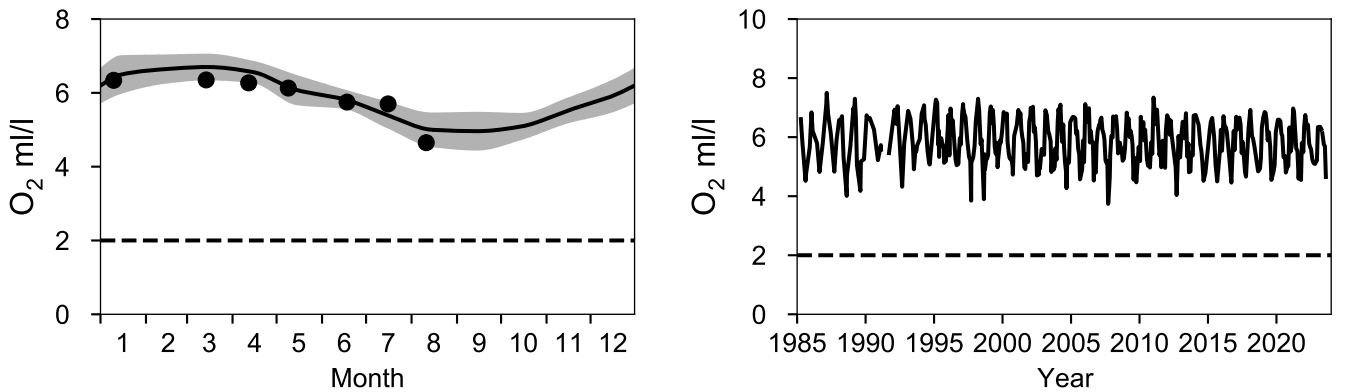


STATION P2 SURFACE WATER (0-10 m)

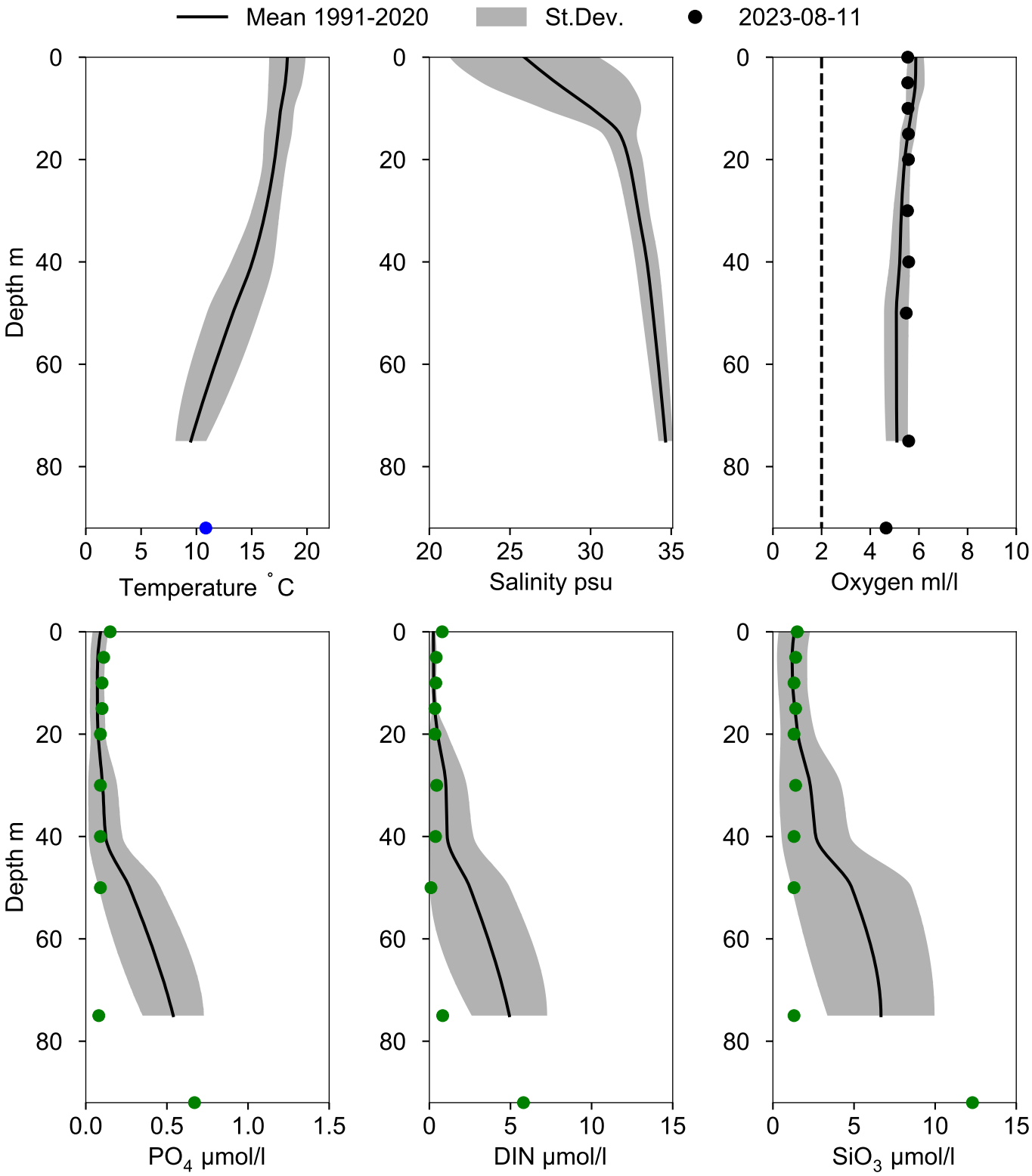
Annual Cycles



OXYGEN IN BOTTOM WATER (depth >= 75 m)

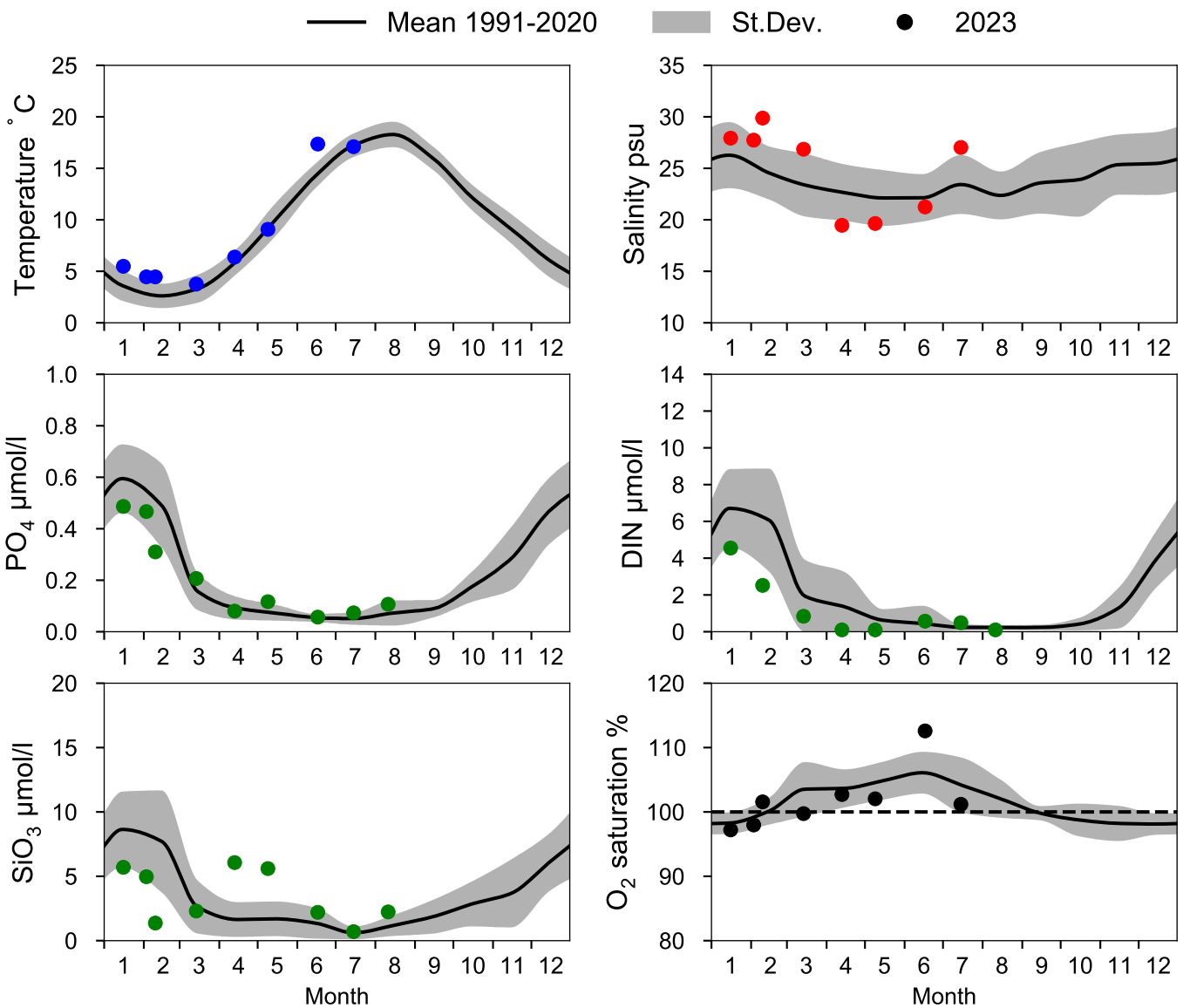


Vertical profiles P2
August

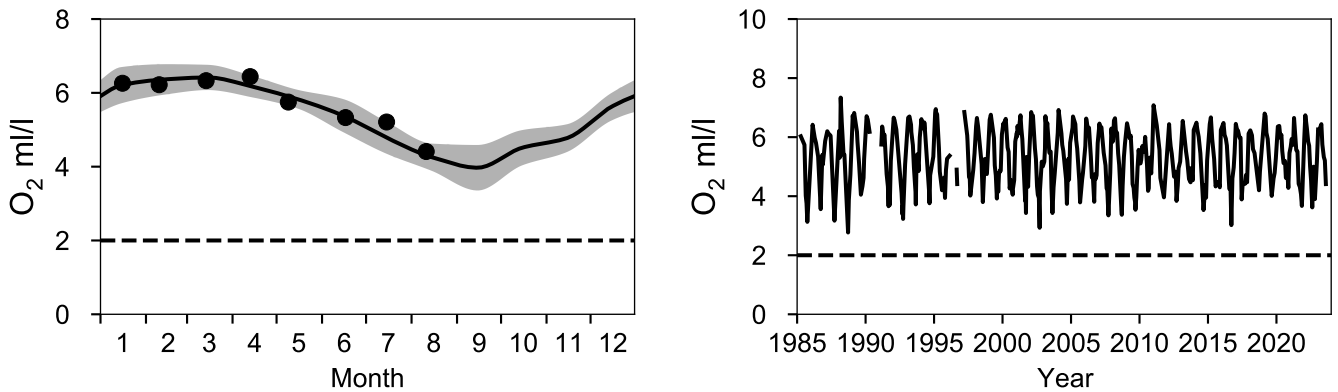


STATION FLADEN SURFACE WATER (0-10 m)

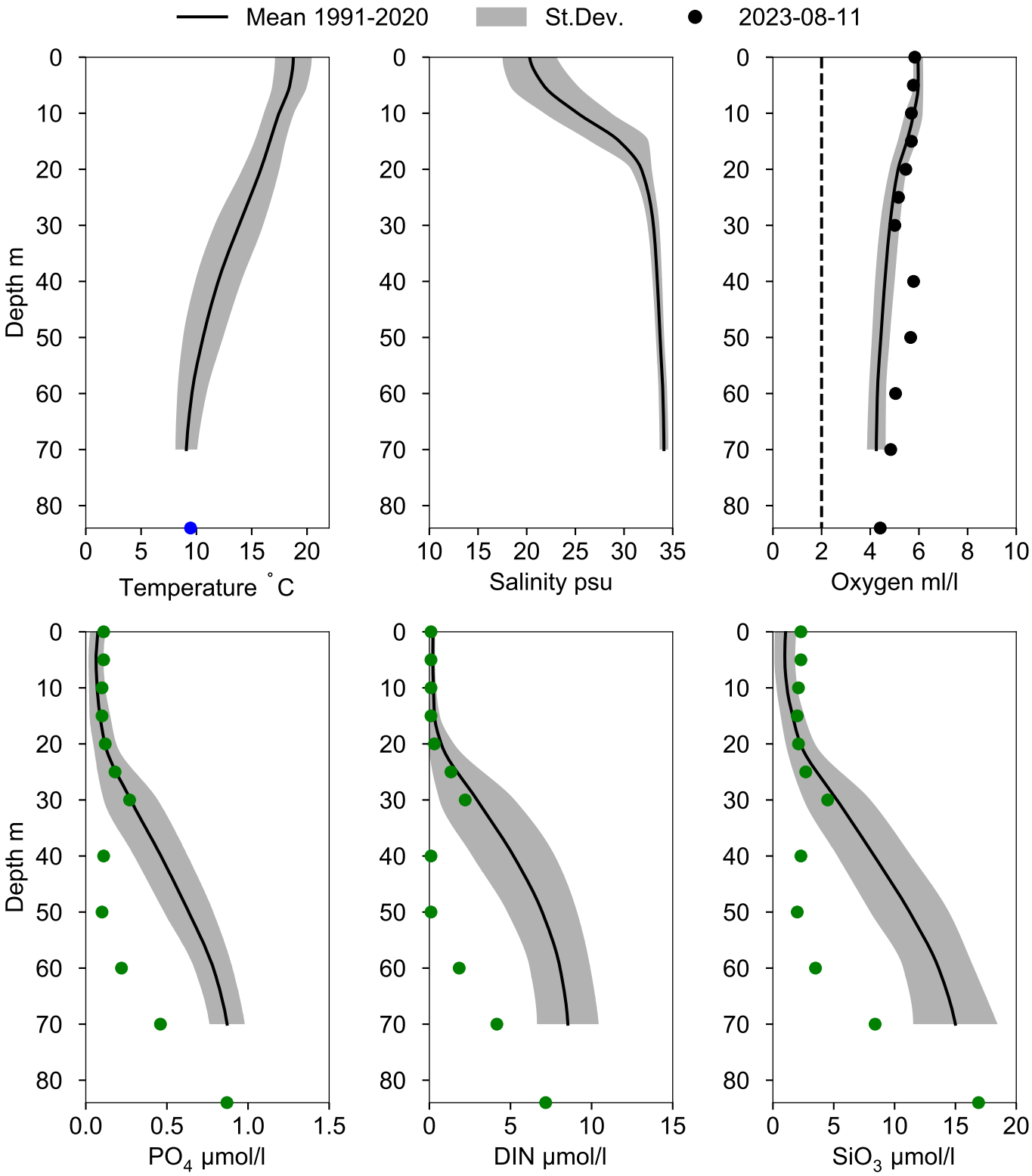
Annual Cycles



OXYGEN IN BOTTOM WATER (depth >= 74 m)

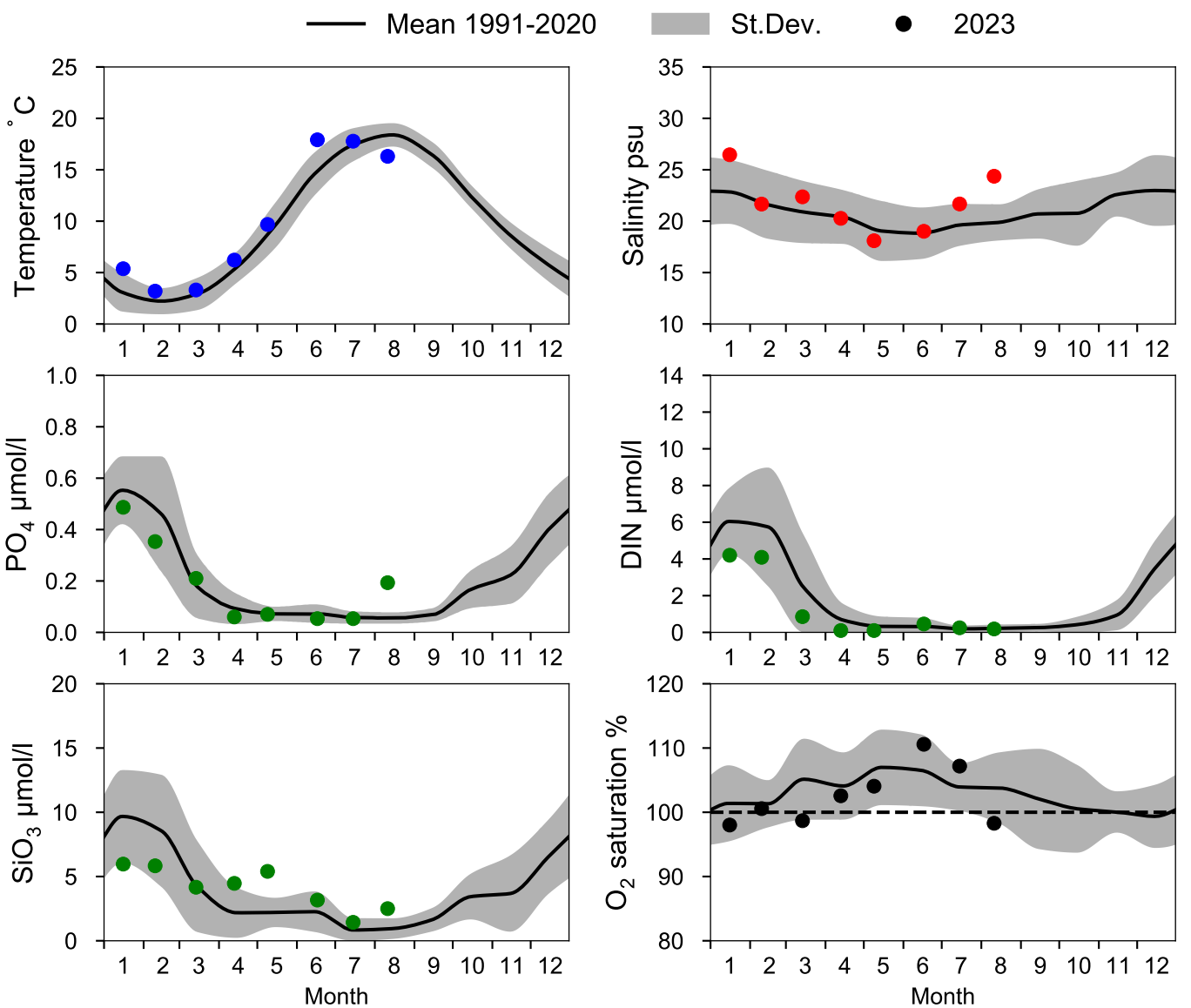


Vertical profiles FLADEN
August

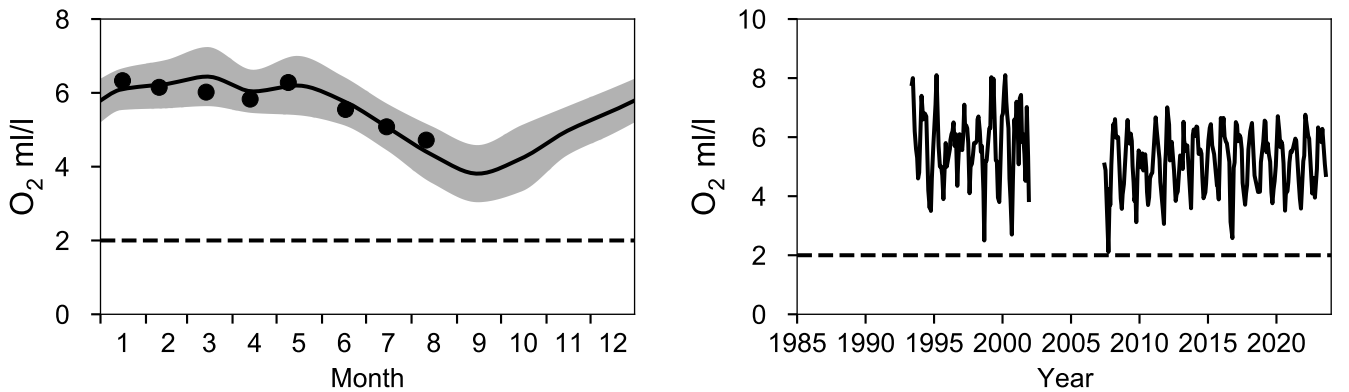


STATION N14 FALKENBERG SURFACE WATER (0-10 m)

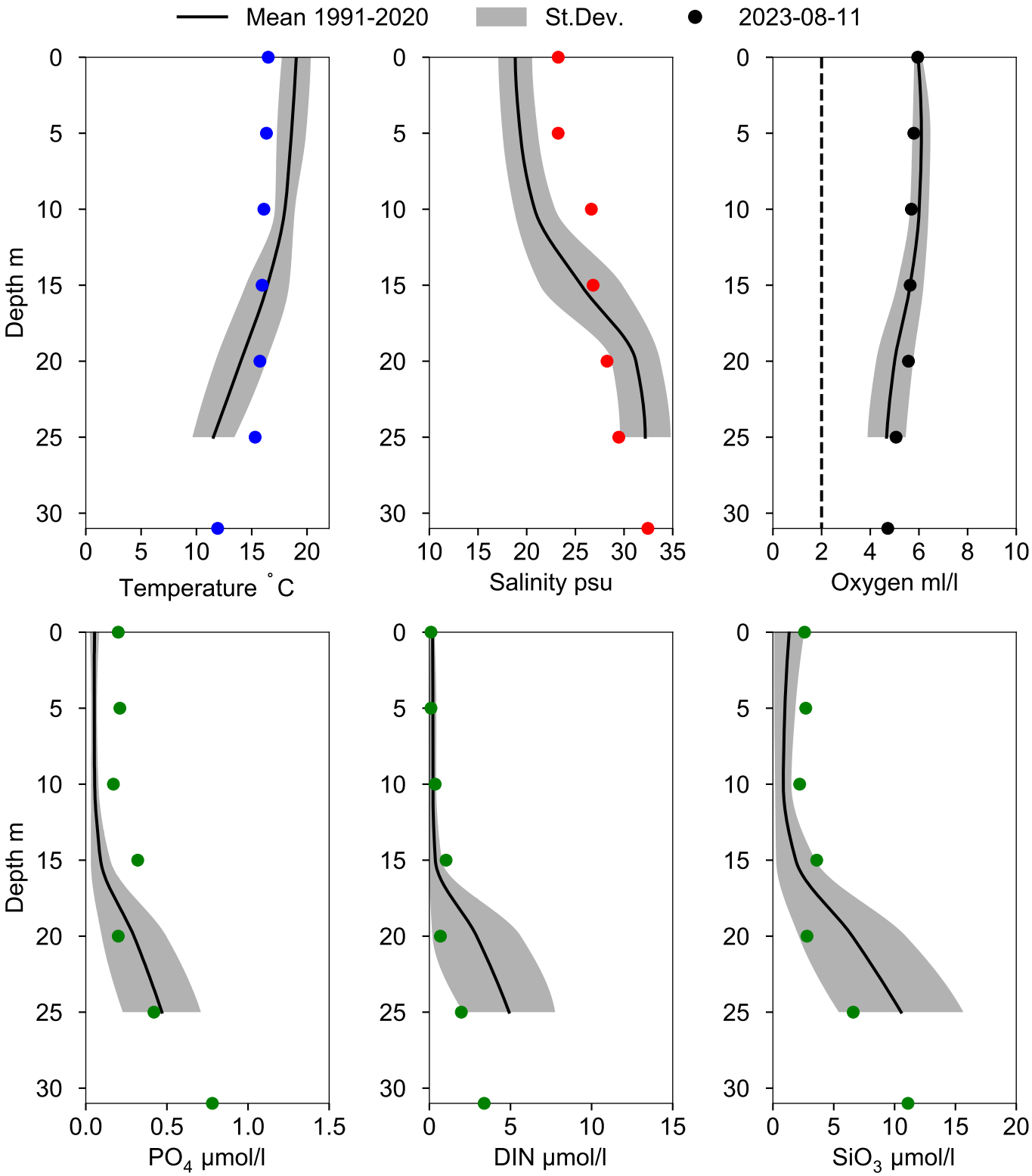
Annual Cycles



OXYGEN IN BOTTOM WATER (depth >= 25 m)

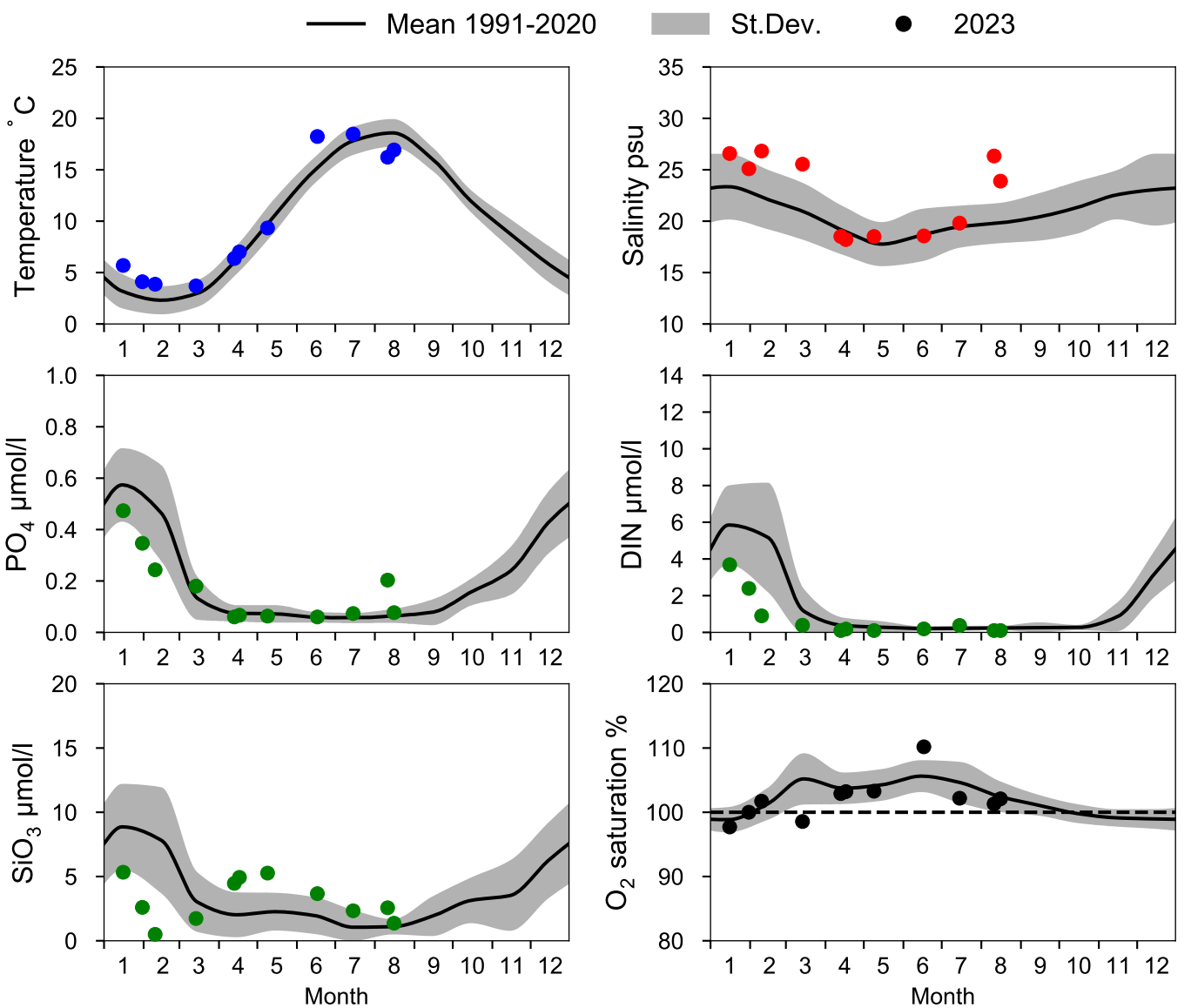


Vertical profiles N14 FALKENBERG
August

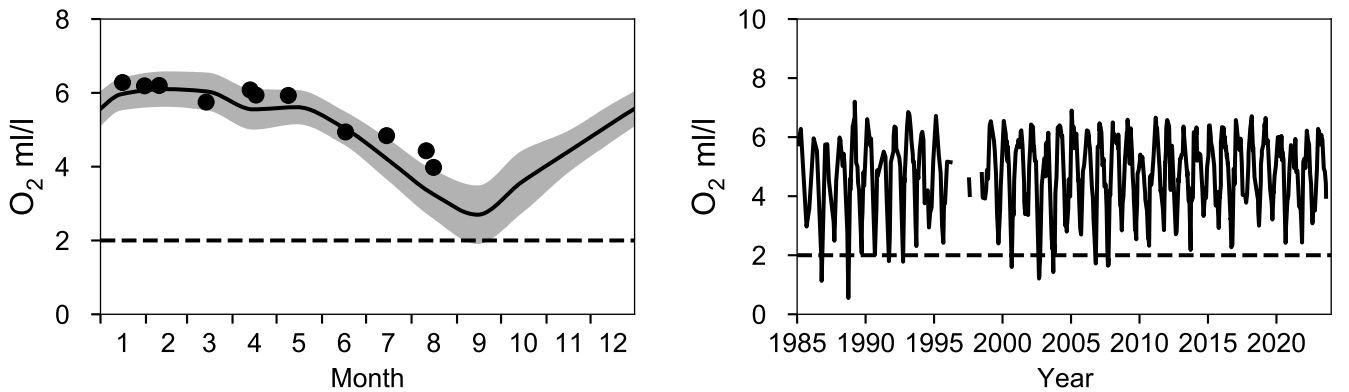


STATION ANHOLT E SURFACE WATER (0-10 m)

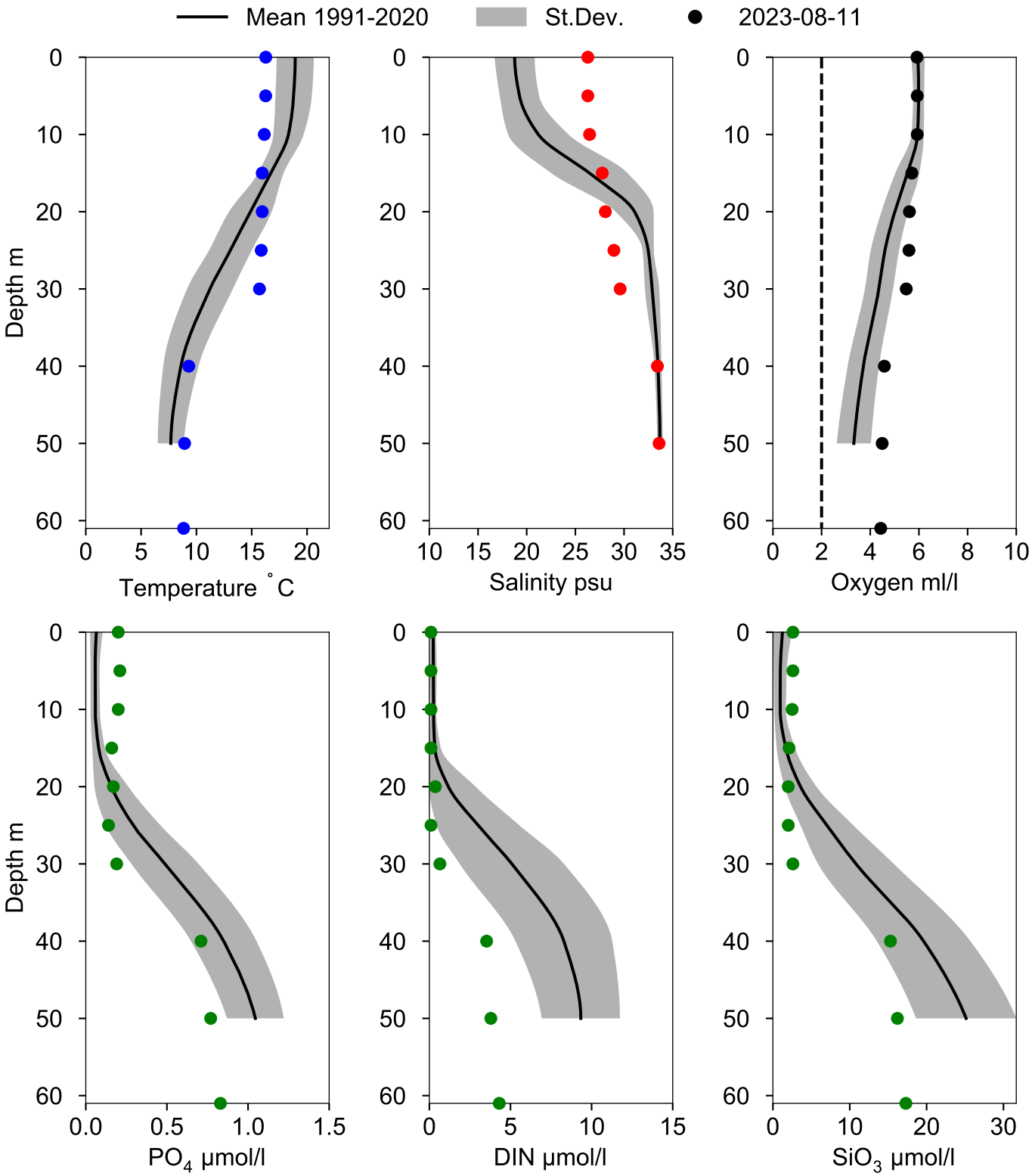
Annual Cycles



OXYGEN IN BOTTOM WATER (depth >= 52 m)

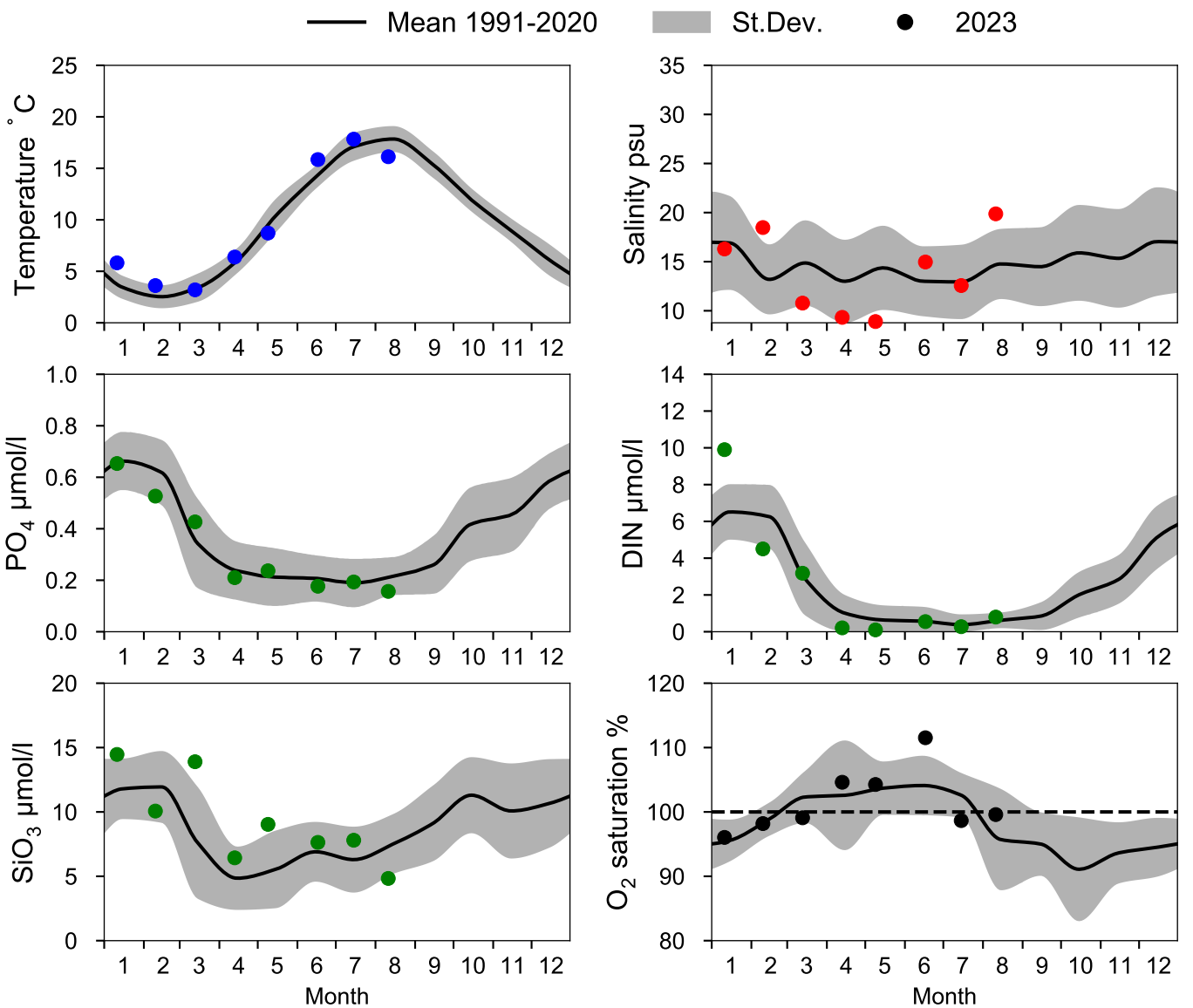


Vertical profiles ANHOLT E
August

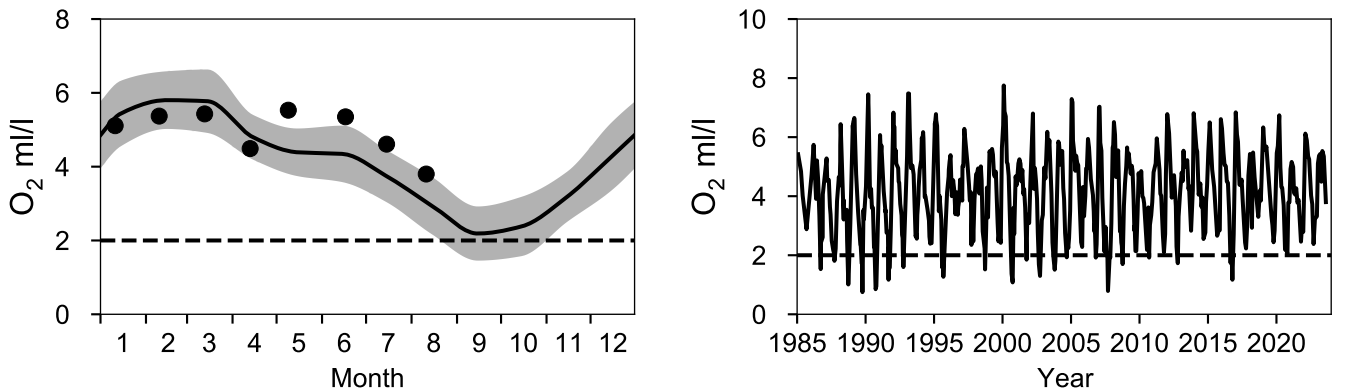


STATION W LANDSKRONA SURFACE WATER (0-10 m)

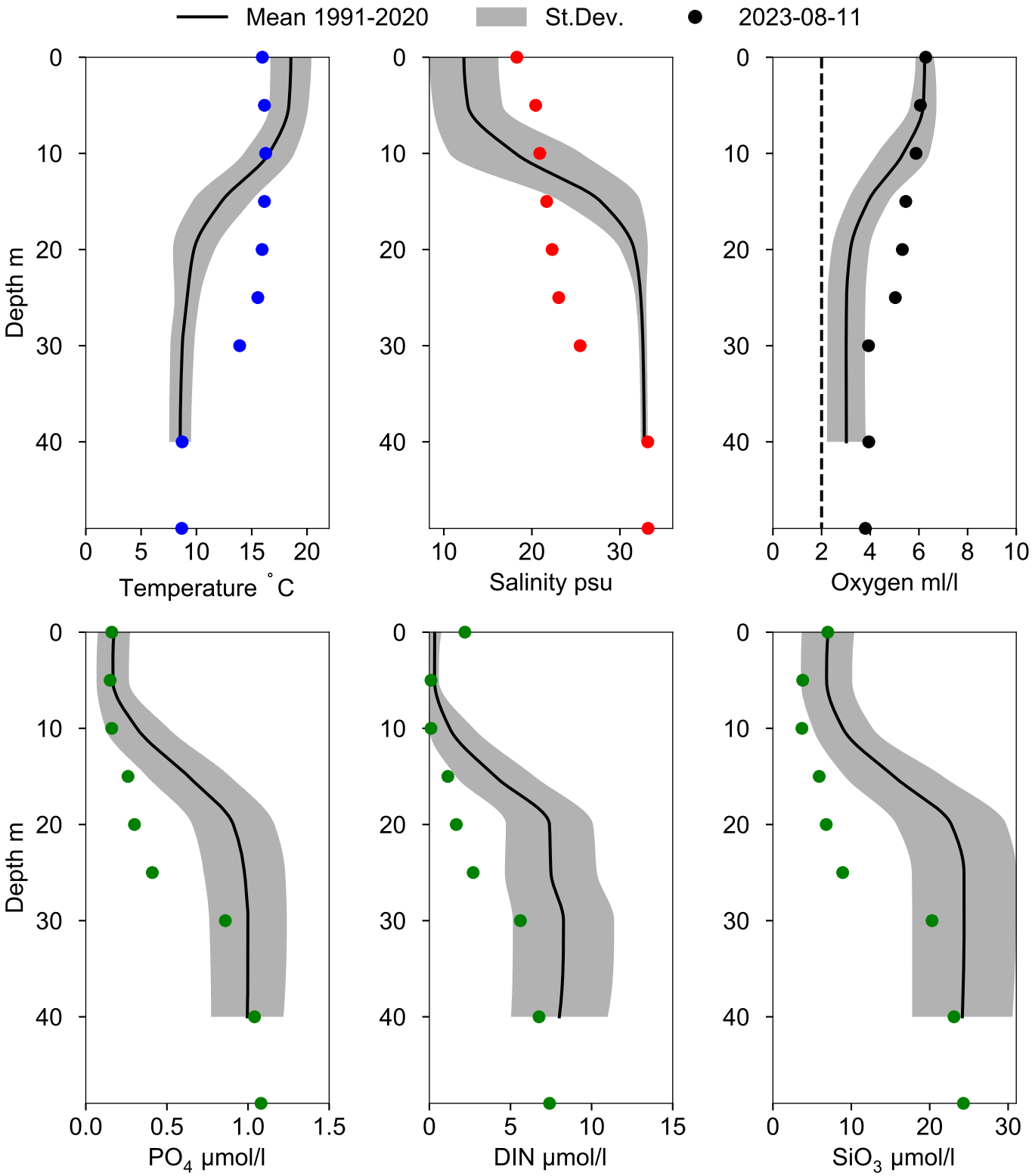
Annual Cycles



OXYGEN IN BOTTOM WATER (depth >= 40 m)

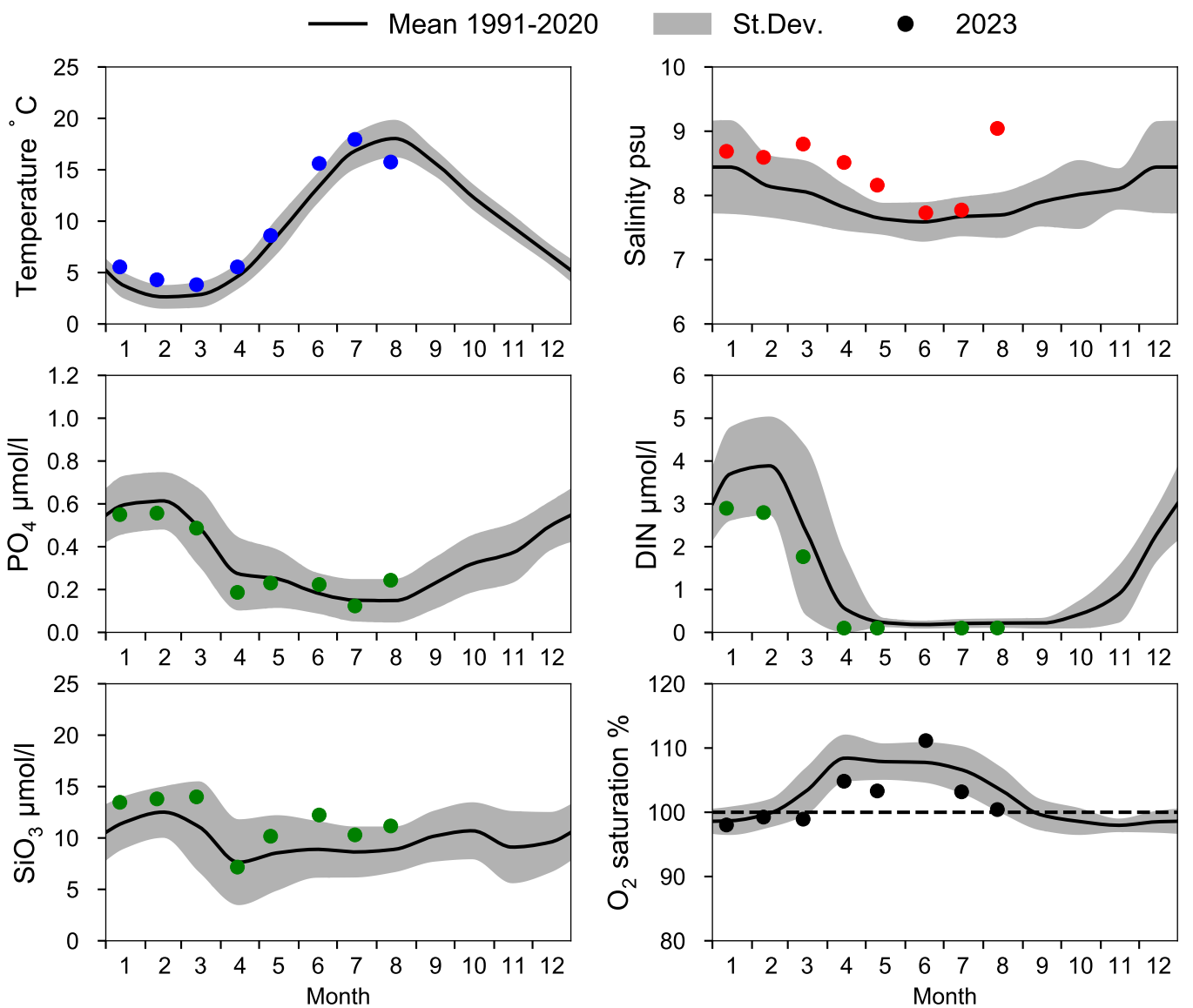


Vertical profiles W LANDSKRONA
August

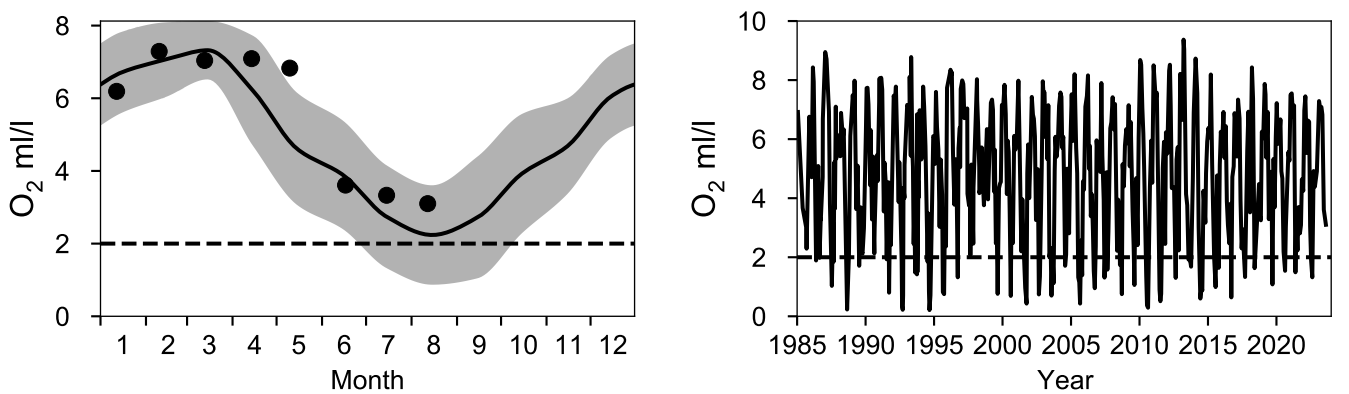


STATION BY1 SURFACE WATER (0-10 m)

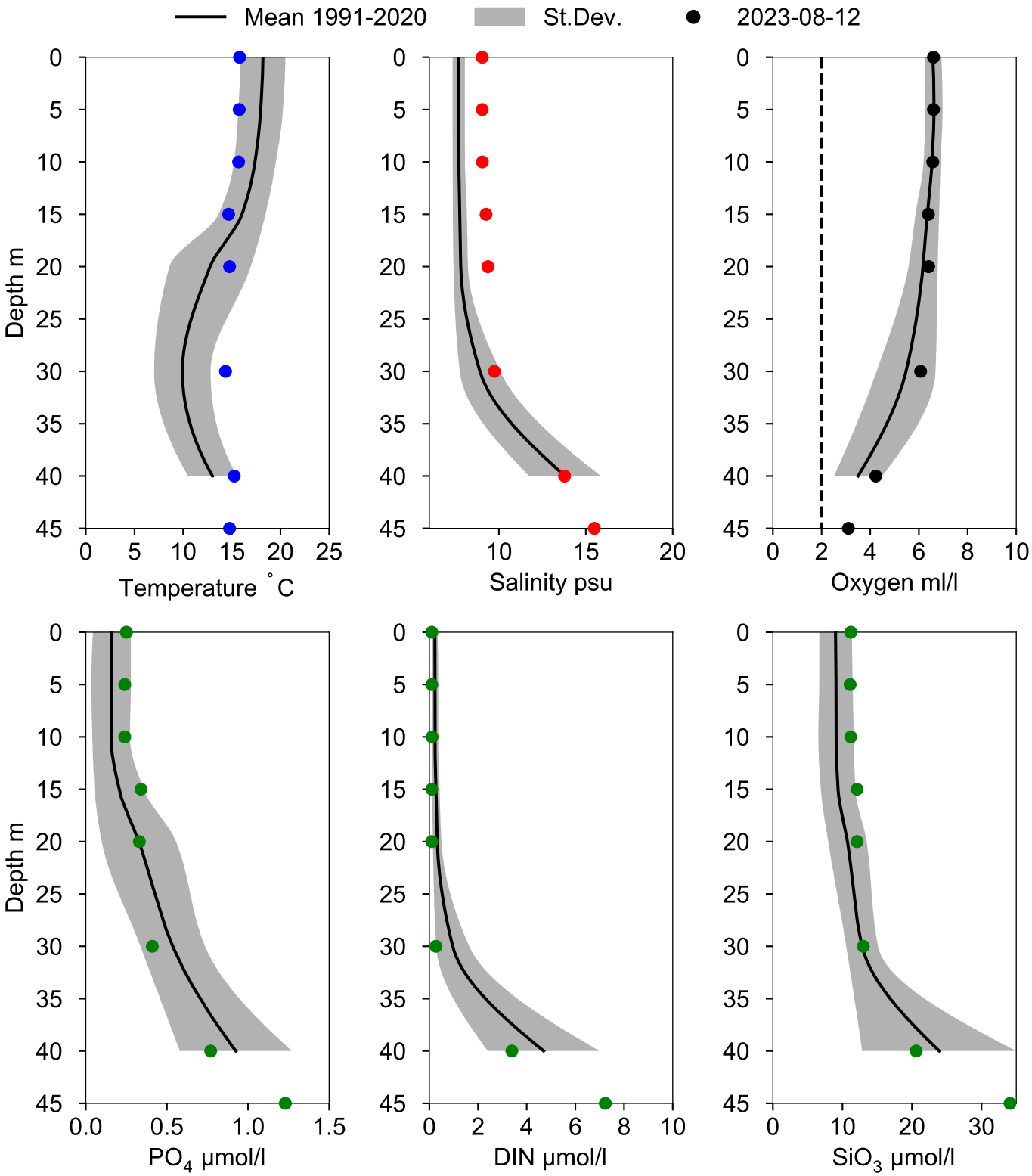
Annual Cycles



OXYGEN IN BOTTOM WATER (depth >= 39 m)

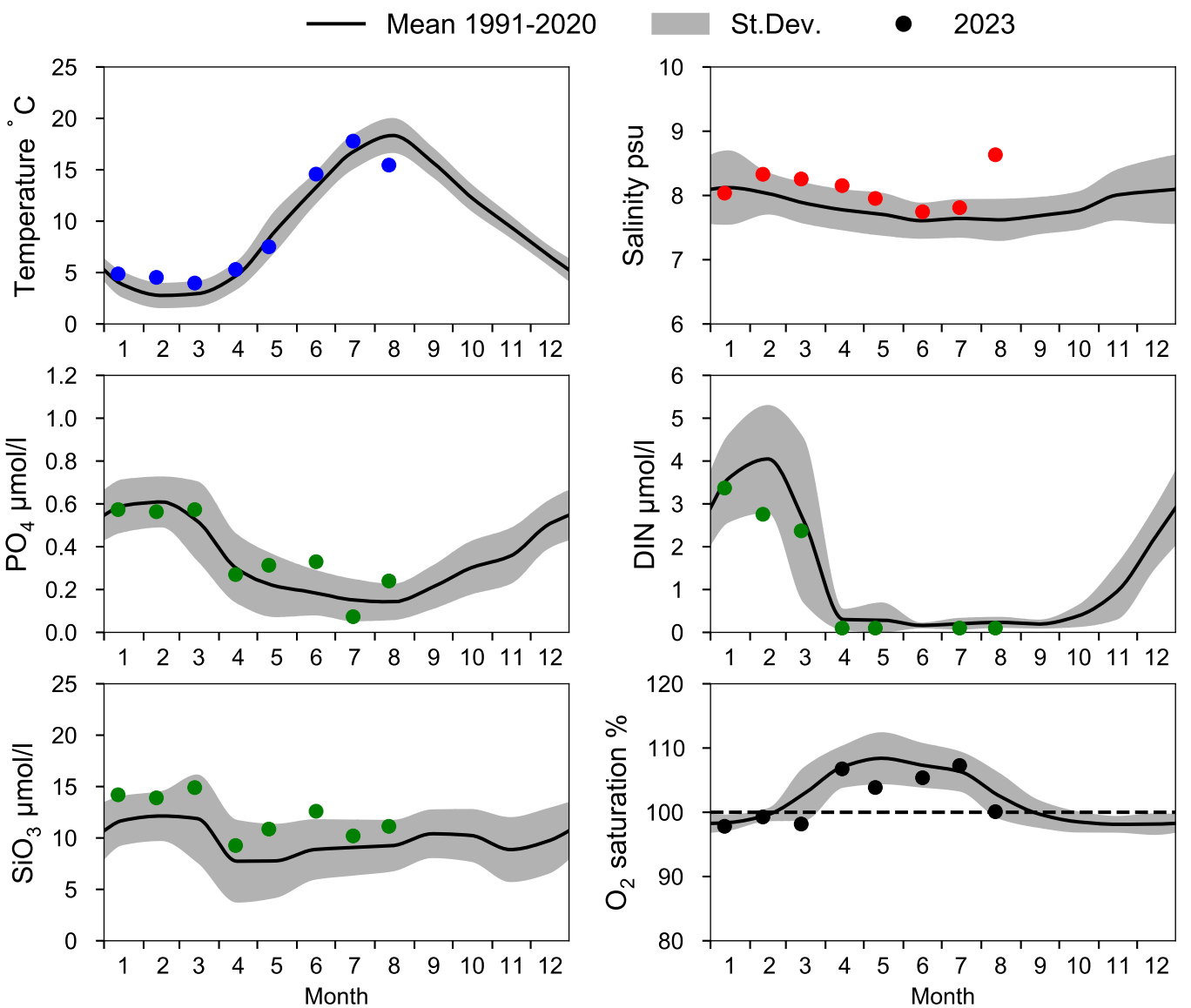


Vertical profiles BY1
August

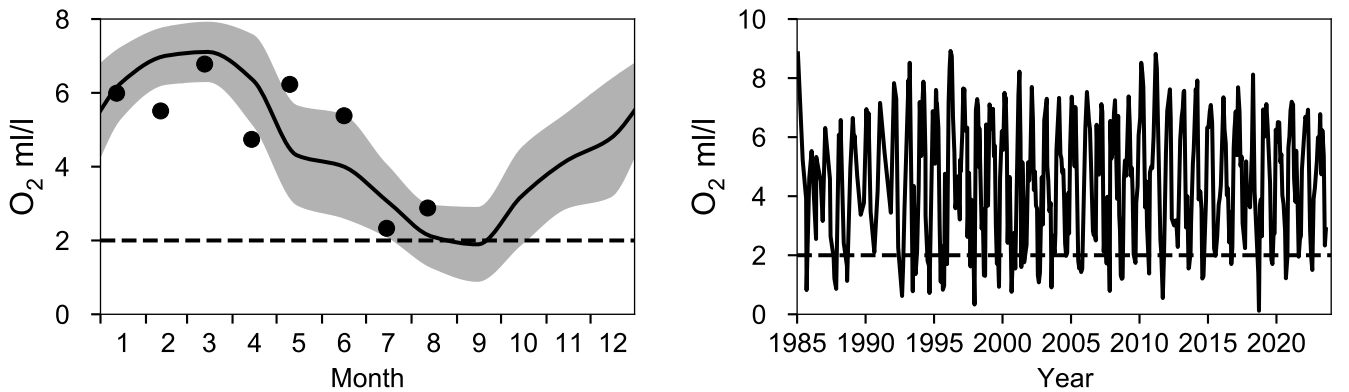


STATION BY2 ARKONA SURFACE WATER (0-10 m)

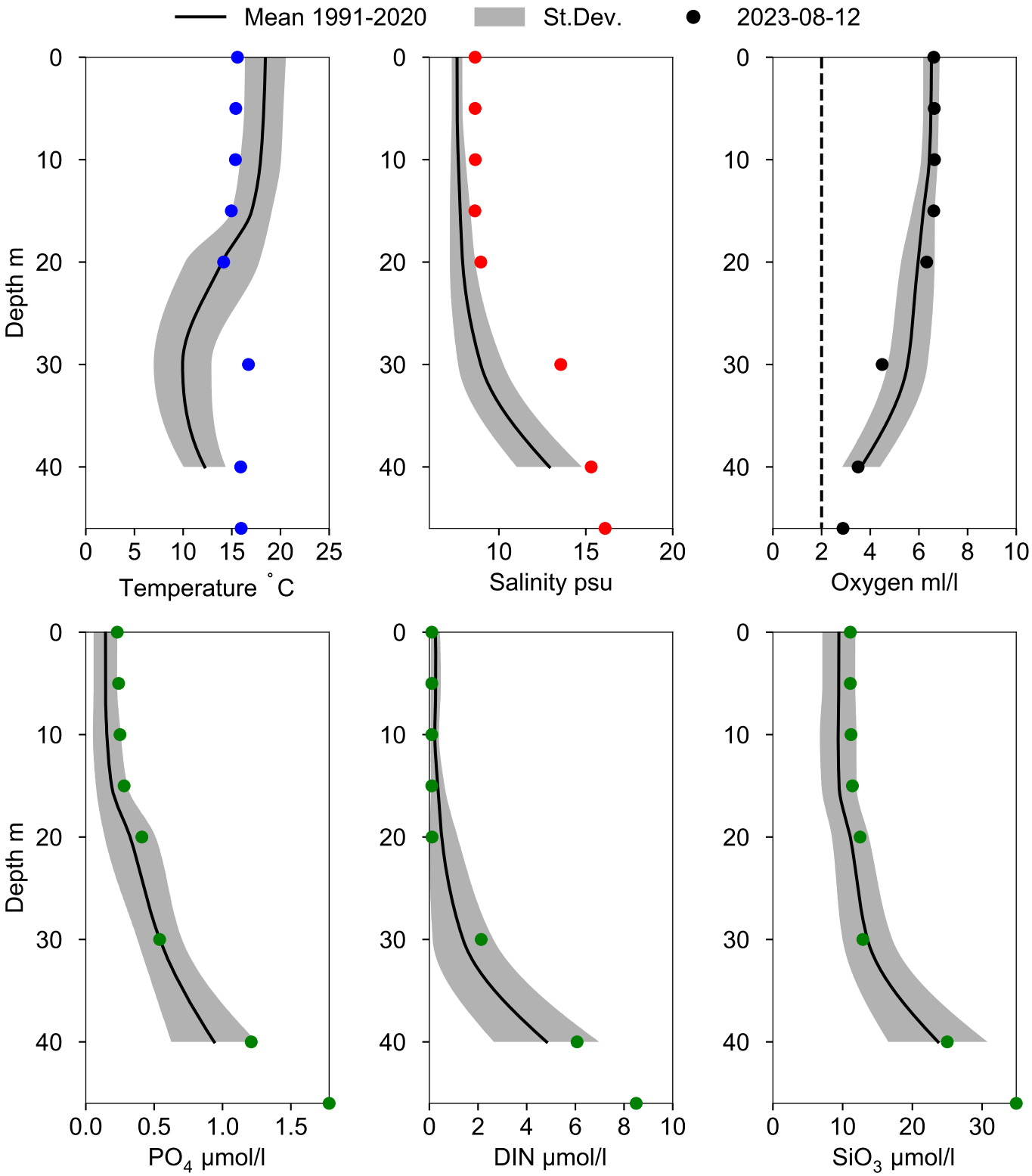
Annual Cycles



OXYGEN IN BOTTOM WATER (depth >= 40 m)

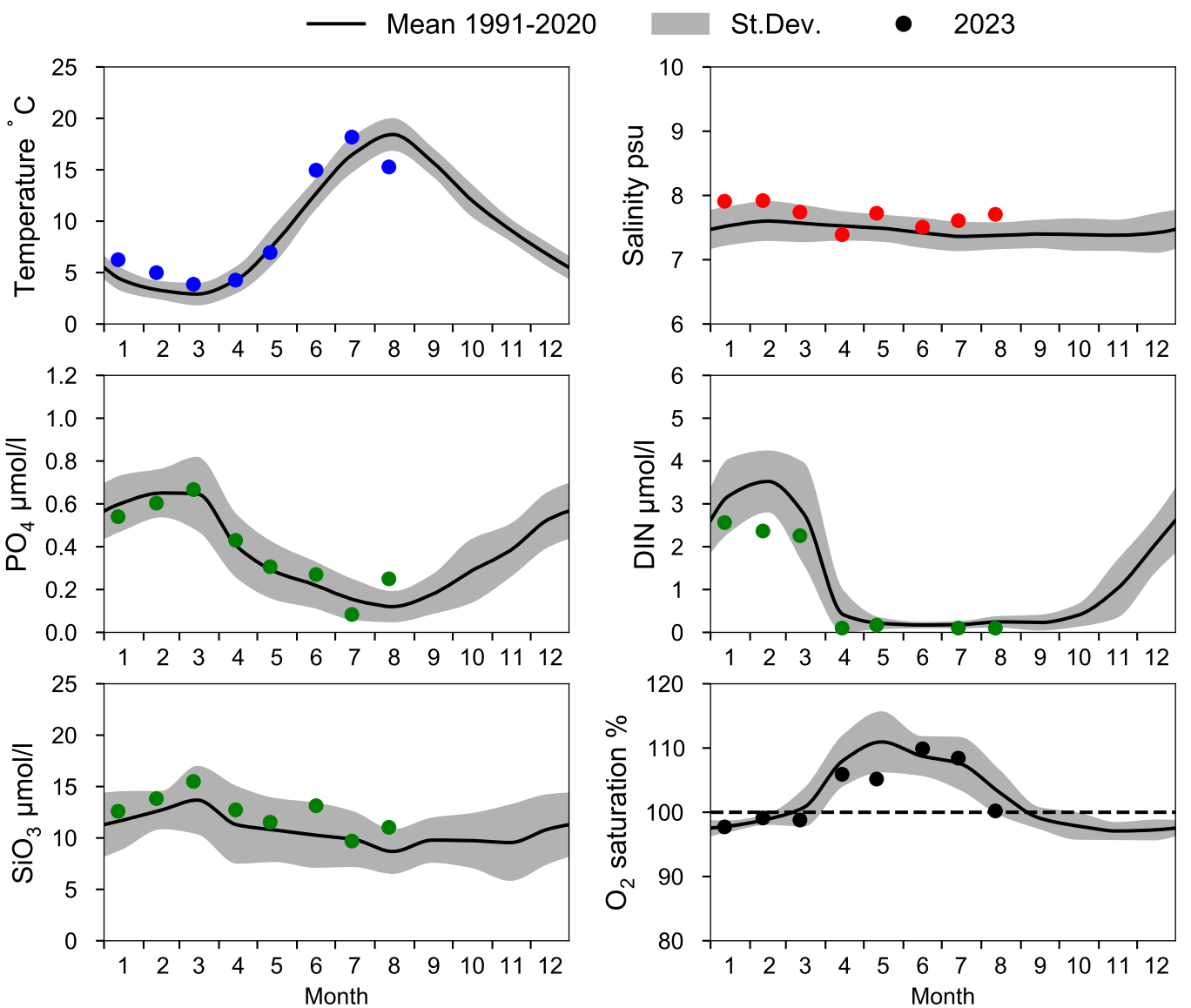


Vertical profiles BY2 ARKONA
August

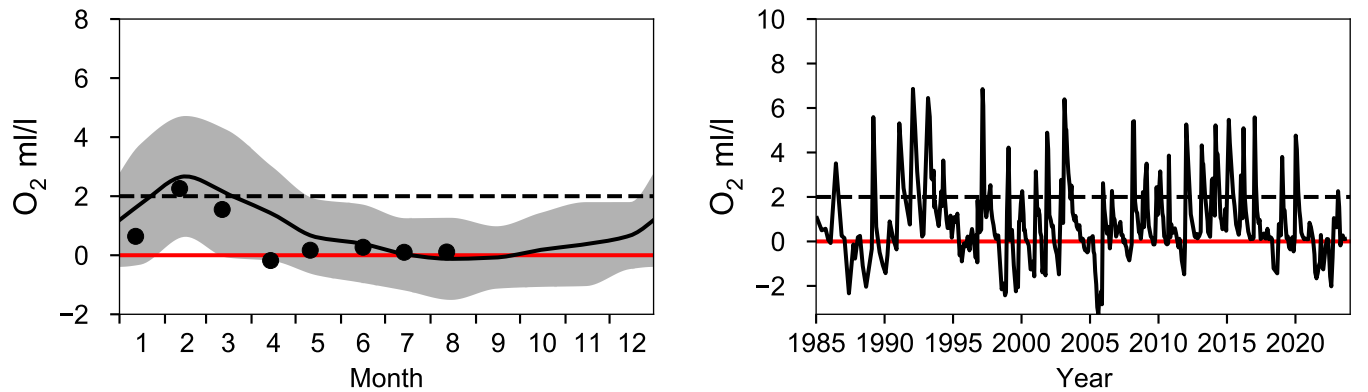


STATION BY4 CHRISTIANSÖ SURFACE WATER (0-10 m)

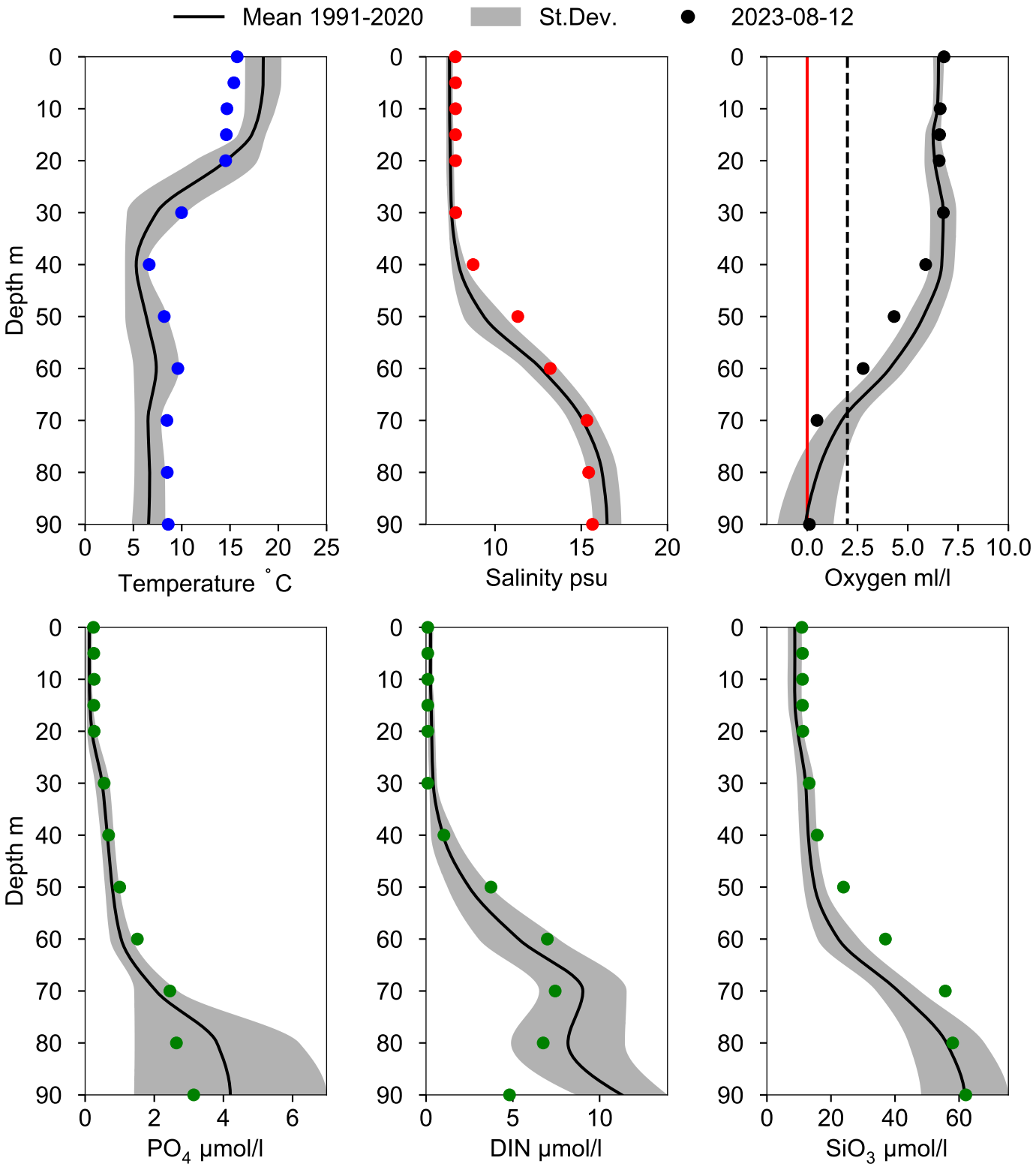
Annual Cycles



OXYGEN IN BOTTOM WATER (depth >= 80 m)

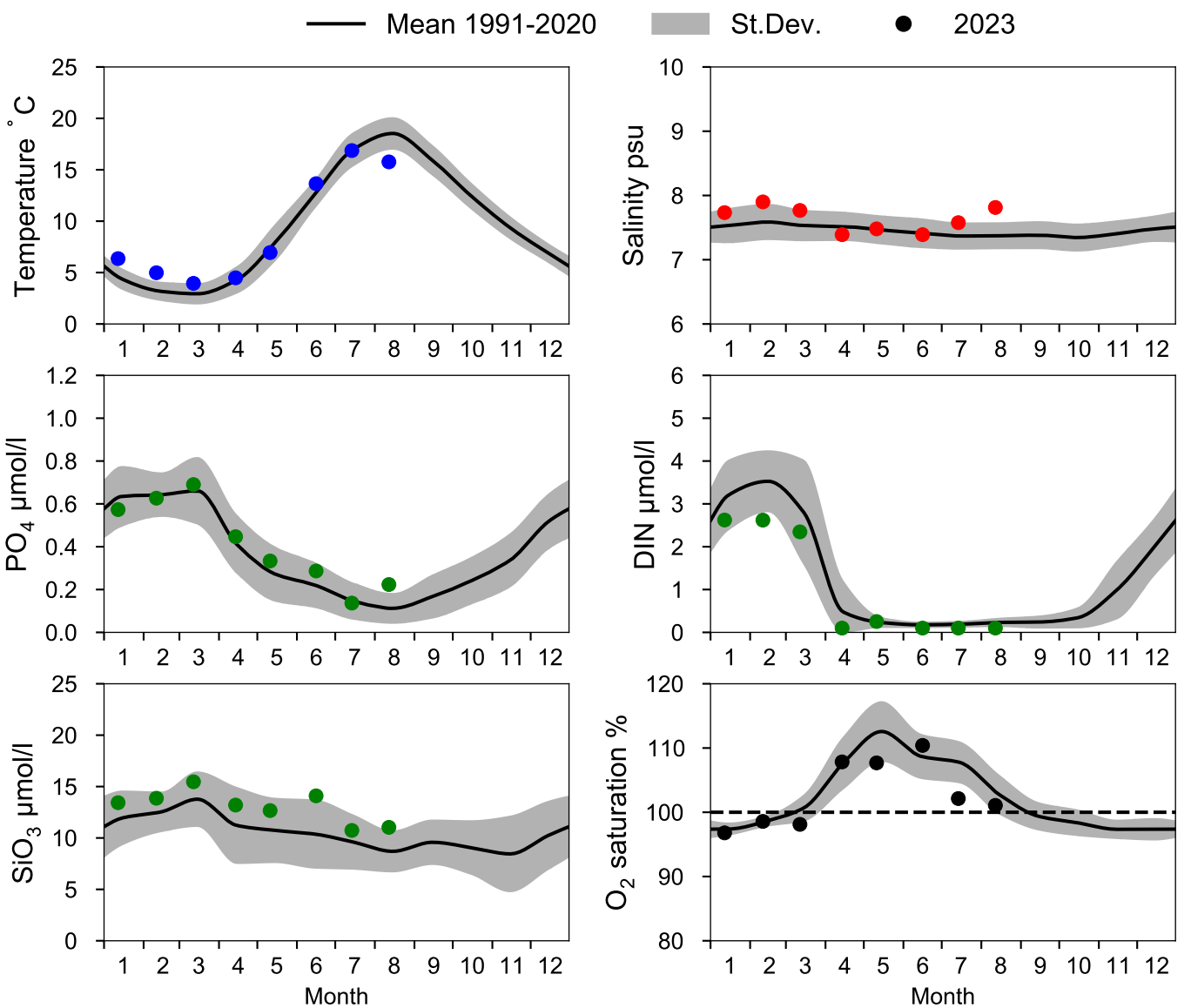


Vertical profiles BY4 CHRISTIANSÖ
August

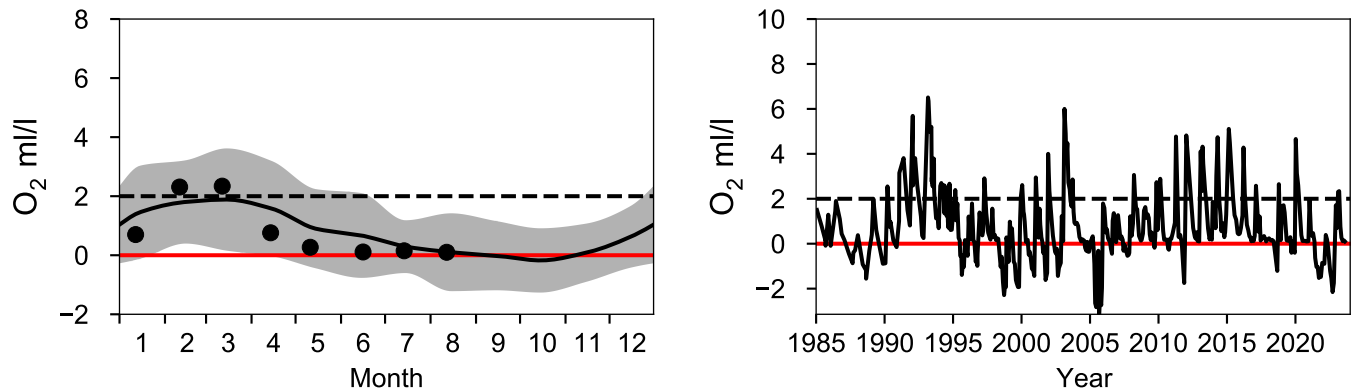


STATION BY5 BORNHOLMSDJ SURFACE WATER (0-10 m)

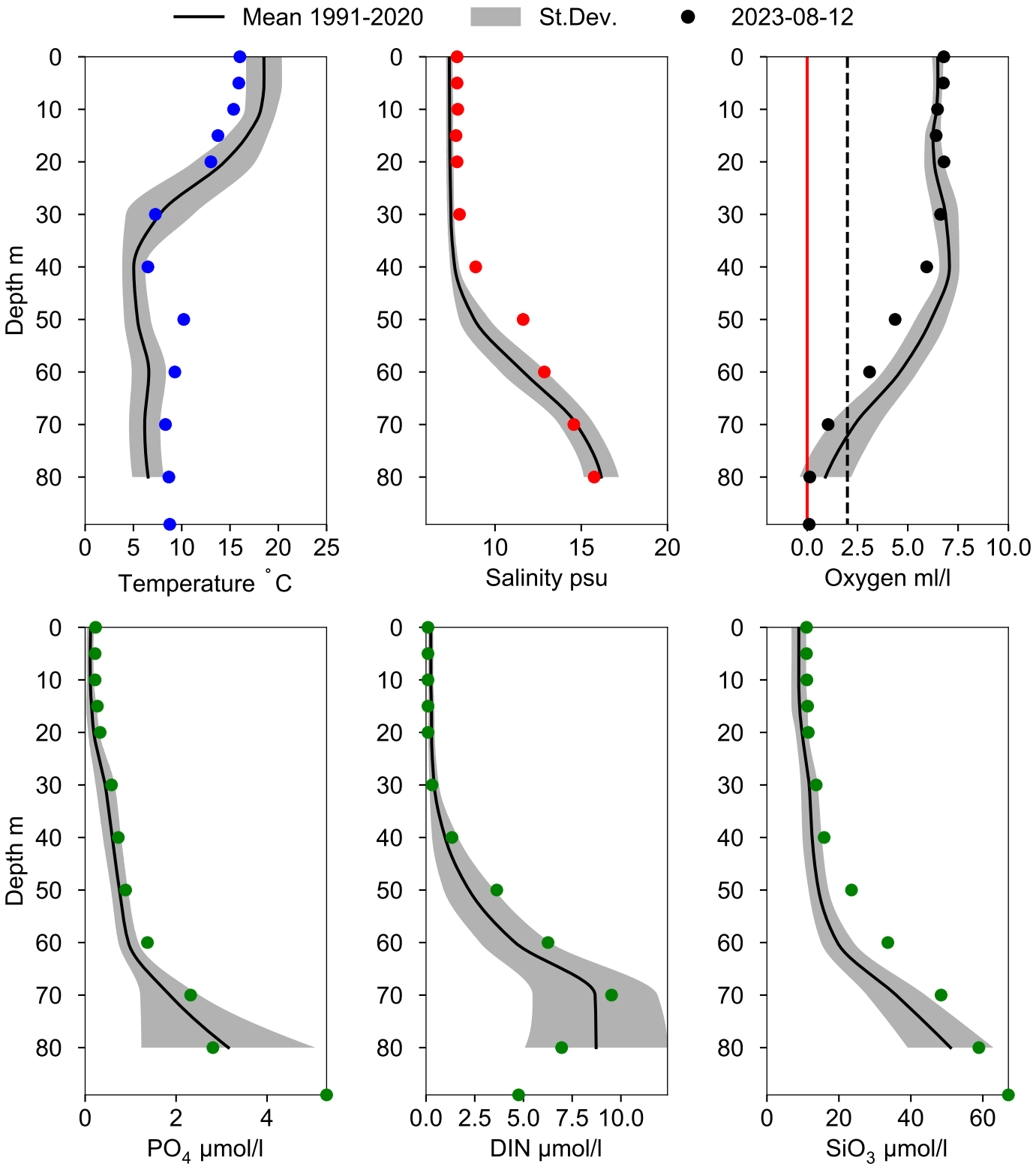
Annual Cycles



OXYGEN IN BOTTOM WATER (depth >= 80 m)

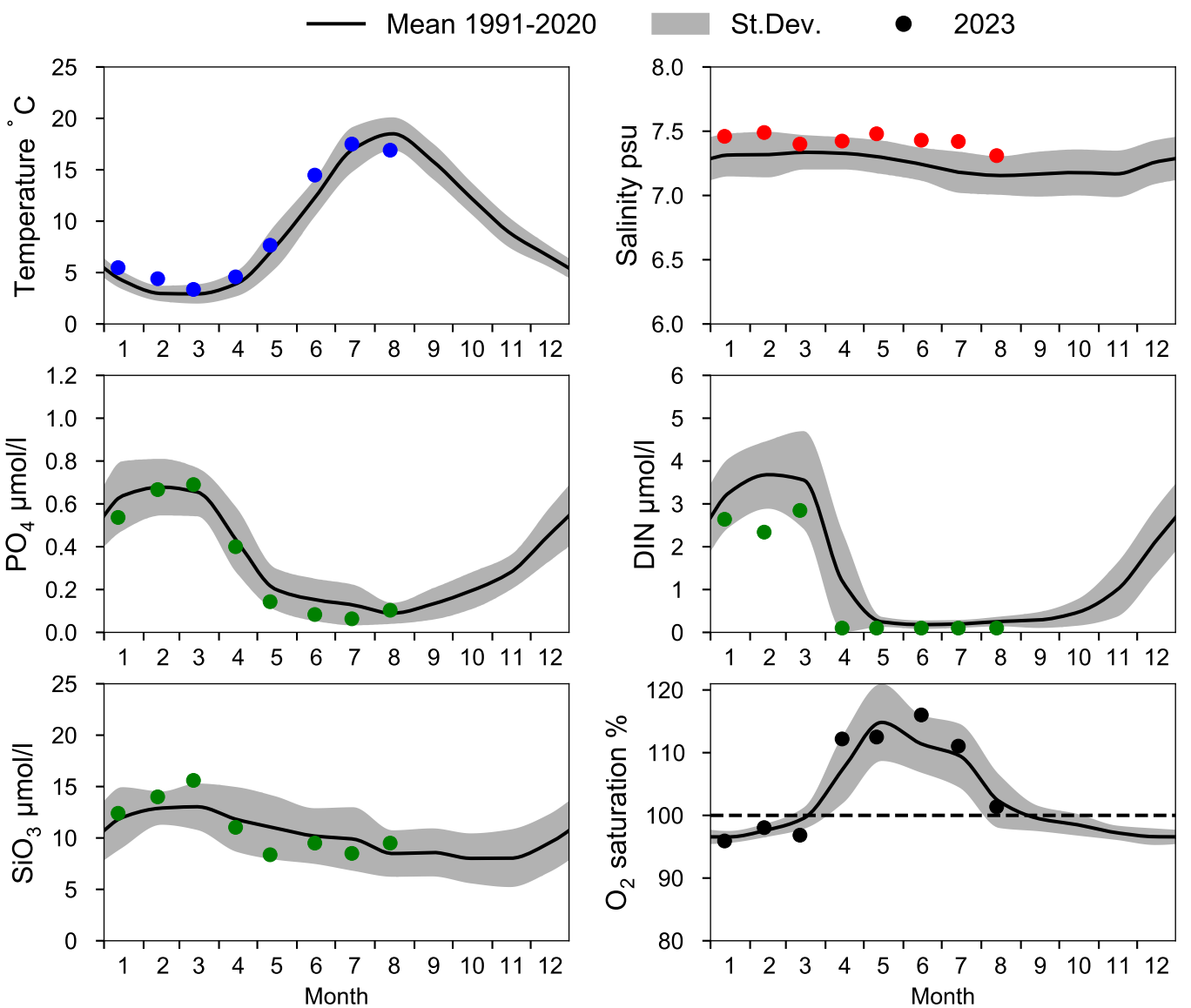


Vertical profiles BY5 BORNHOLMSDJ
August

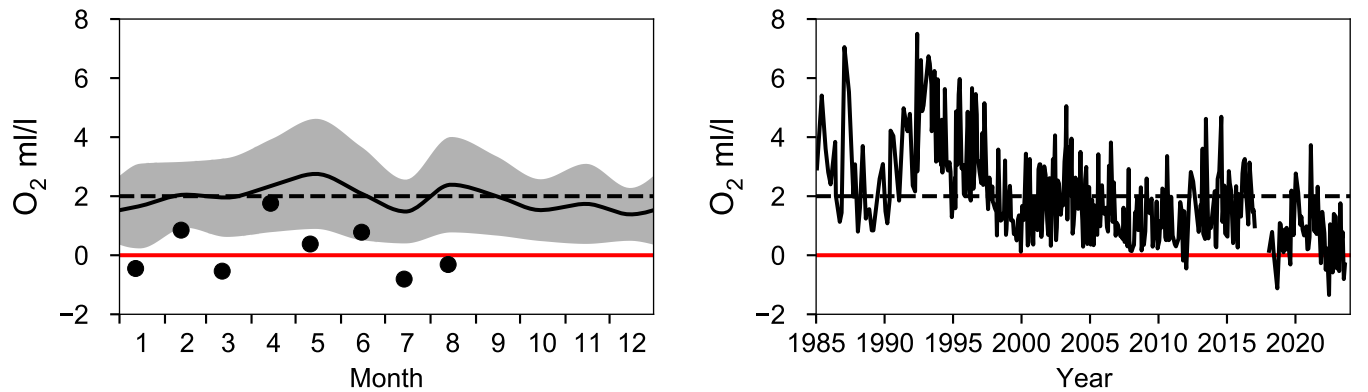


STATION BCS III-10 SURFACE WATER (0-10 m)

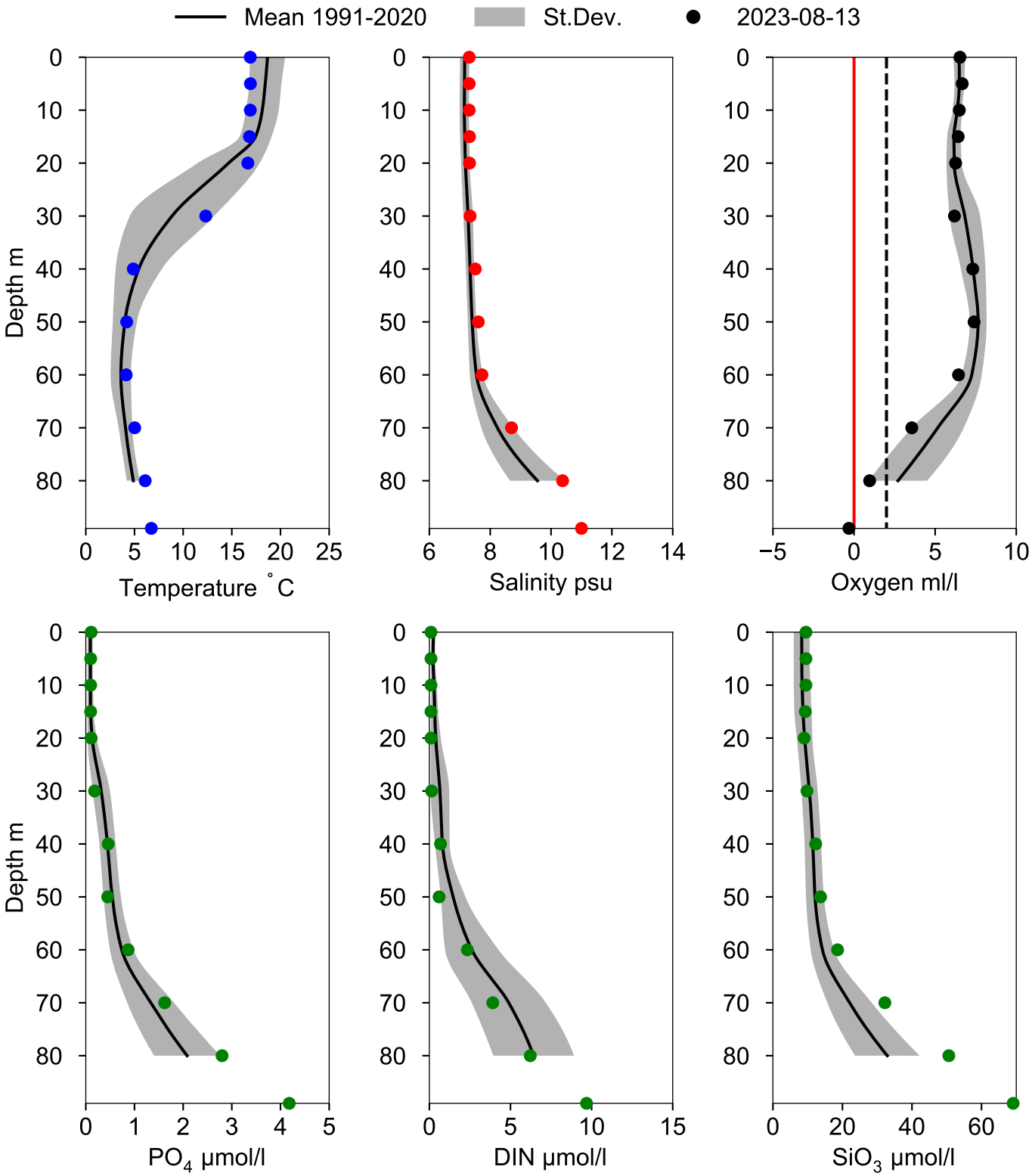
Annual Cycles



OXYGEN IN BOTTOM WATER (depth >= 80 m)

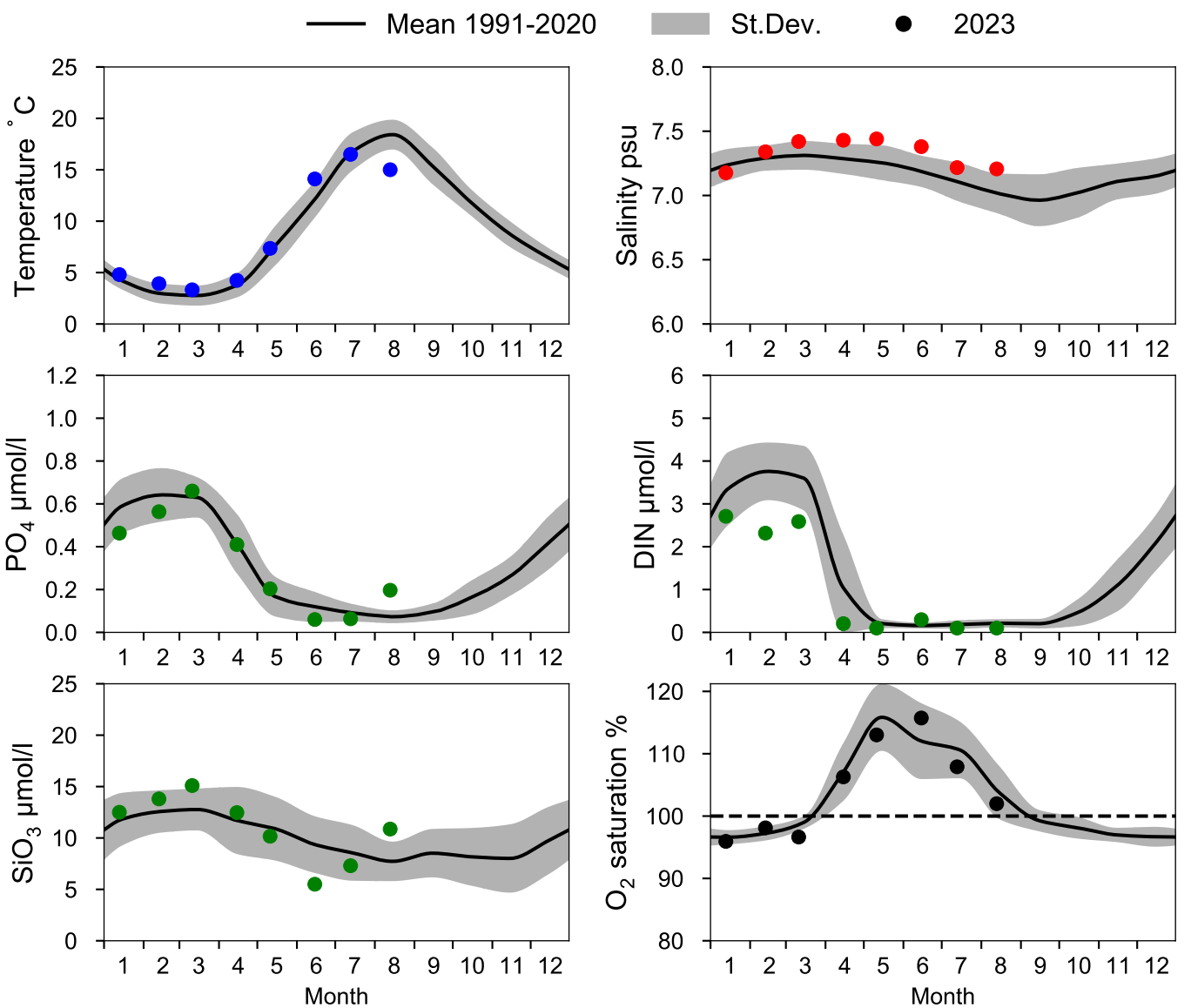


Vertical profiles BCS III-10
August

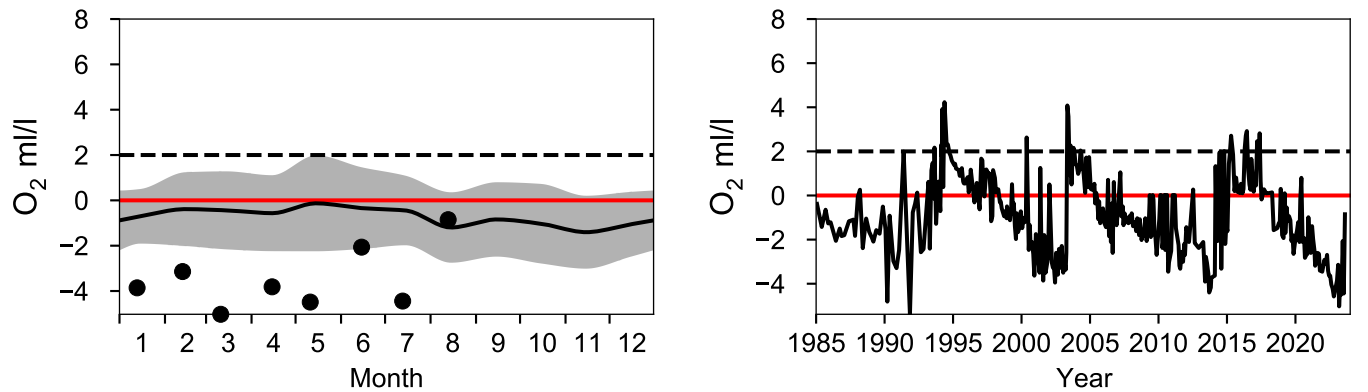


STATION BY10 SURFACE WATER (0-10 m)

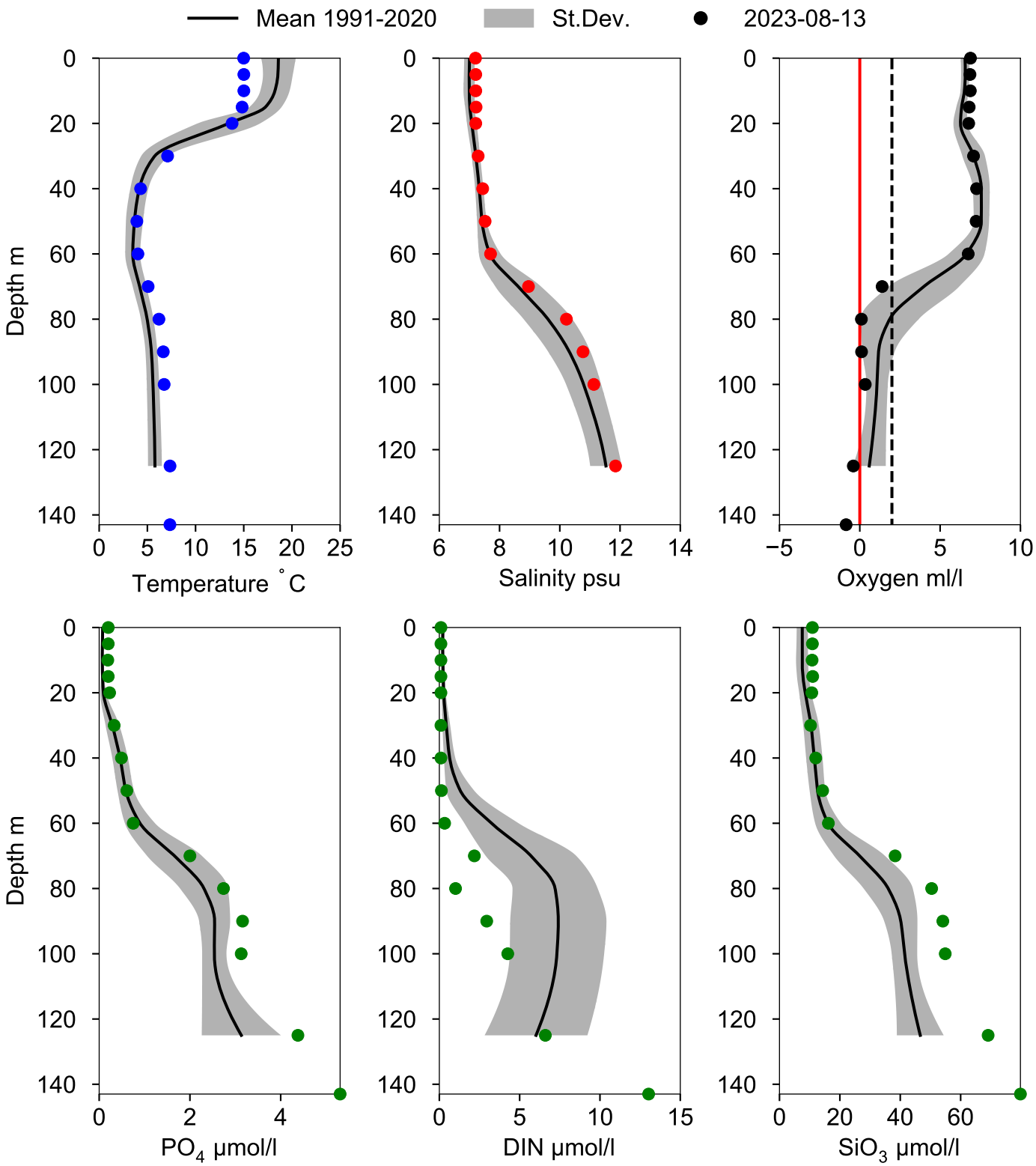
Annual Cycles



OXYGEN IN BOTTOM WATER (depth >= 125 m)

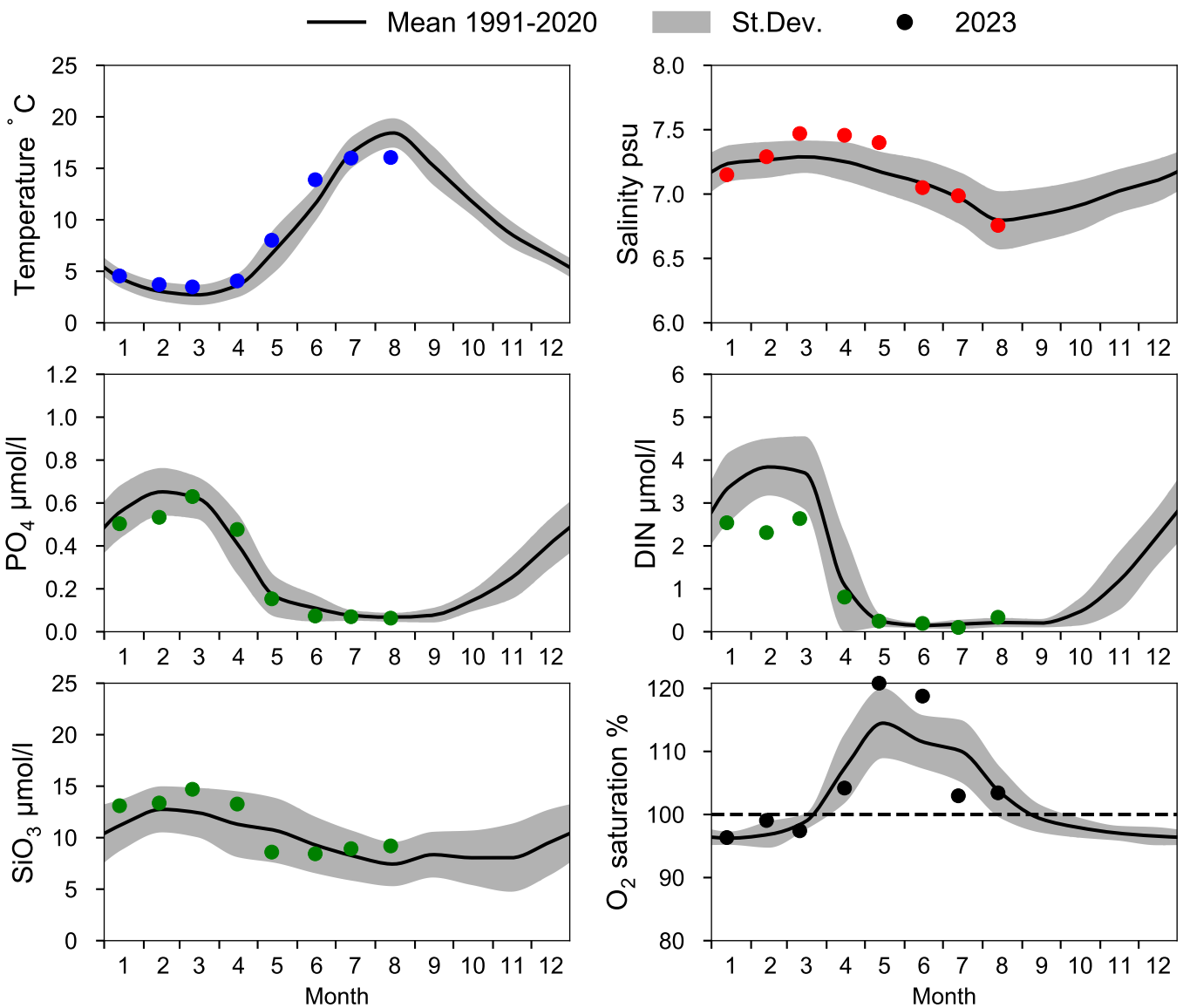


Vertical profiles BY10
August

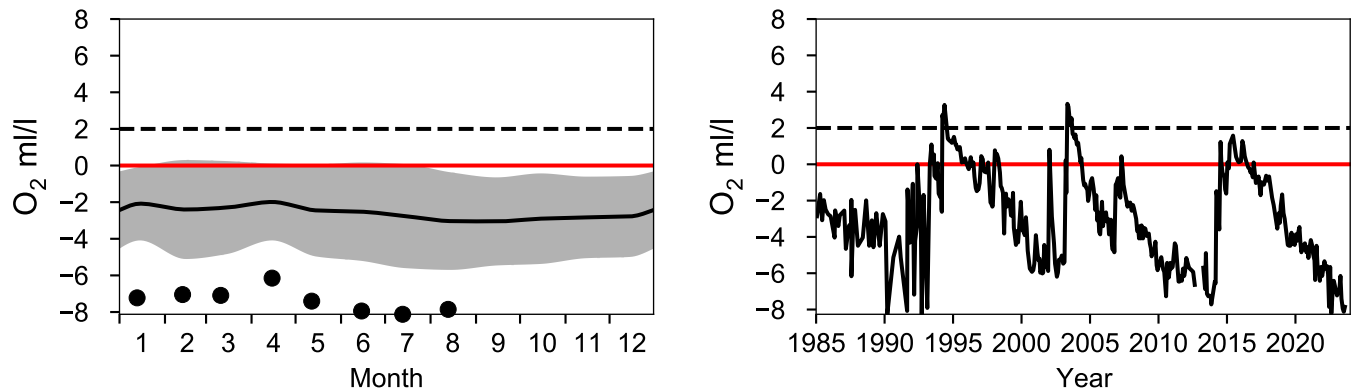


STATION BY15 GOTLANDSDJ SURFACE WATER (0-10 m)

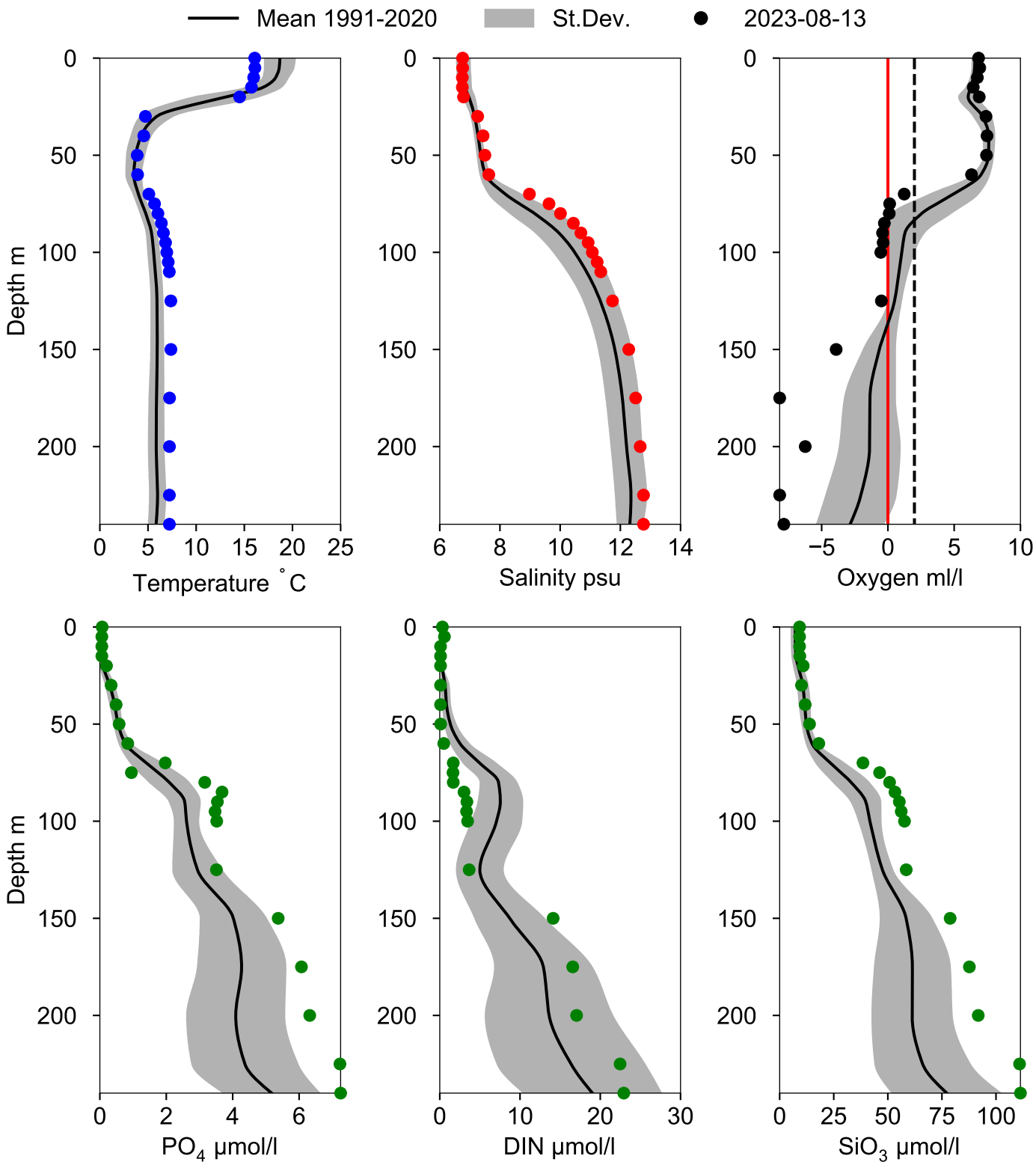
Annual Cycles



OXYGEN IN BOTTOM WATER (depth >= 225 m)

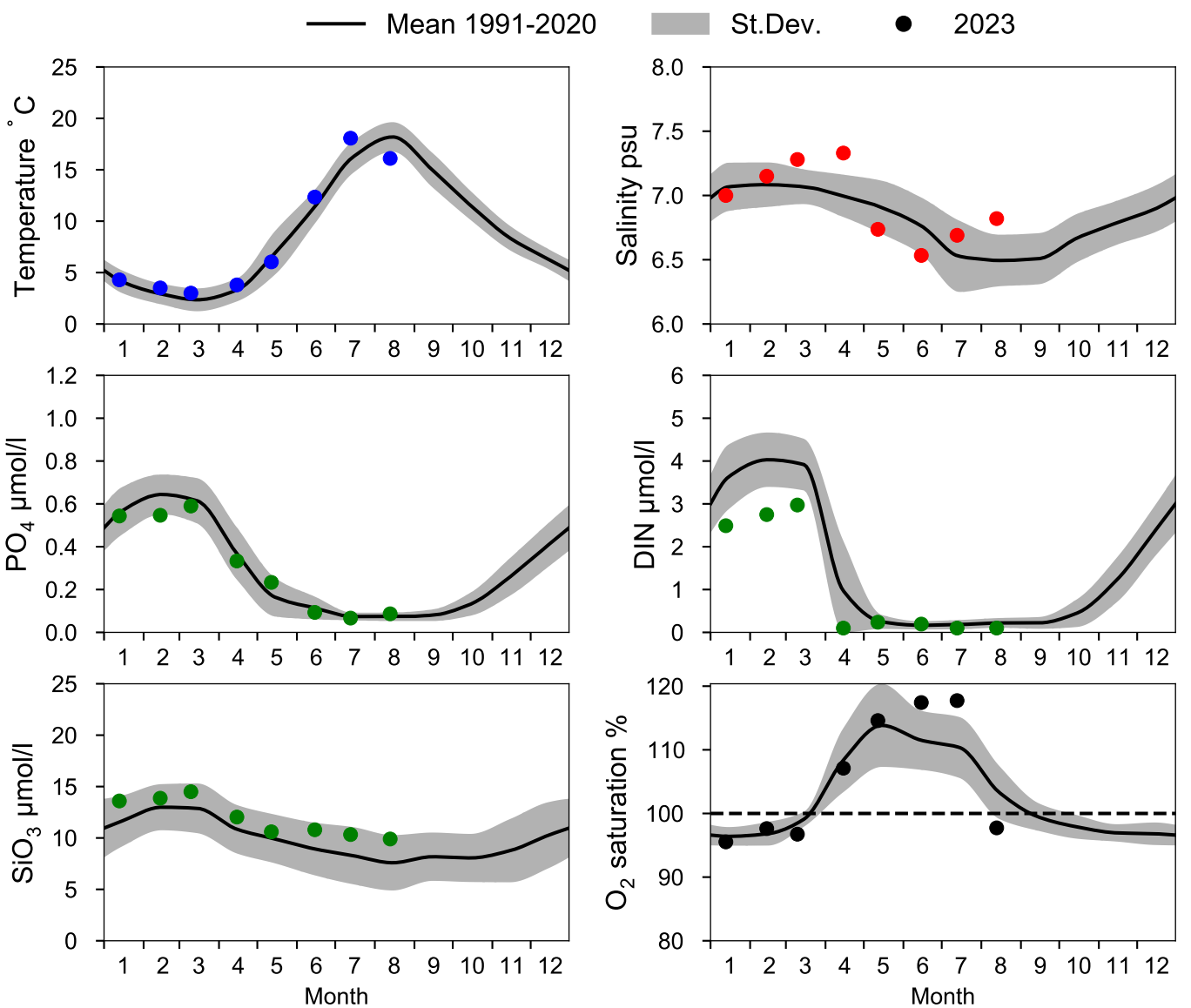


Vertical profiles BY15 GOTLANDSDJ
August

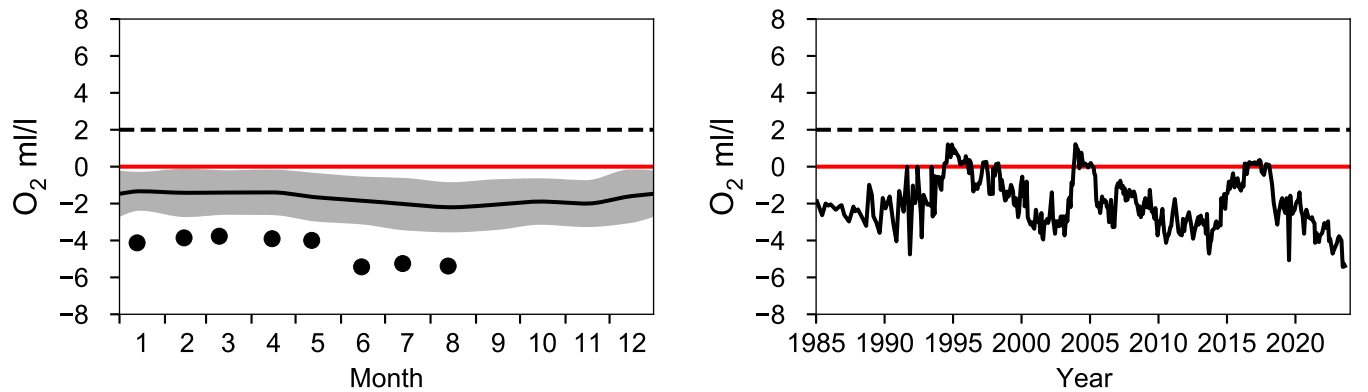


STATION BY20 FÅRÖDJ SURFACE WATER (0-10 m)

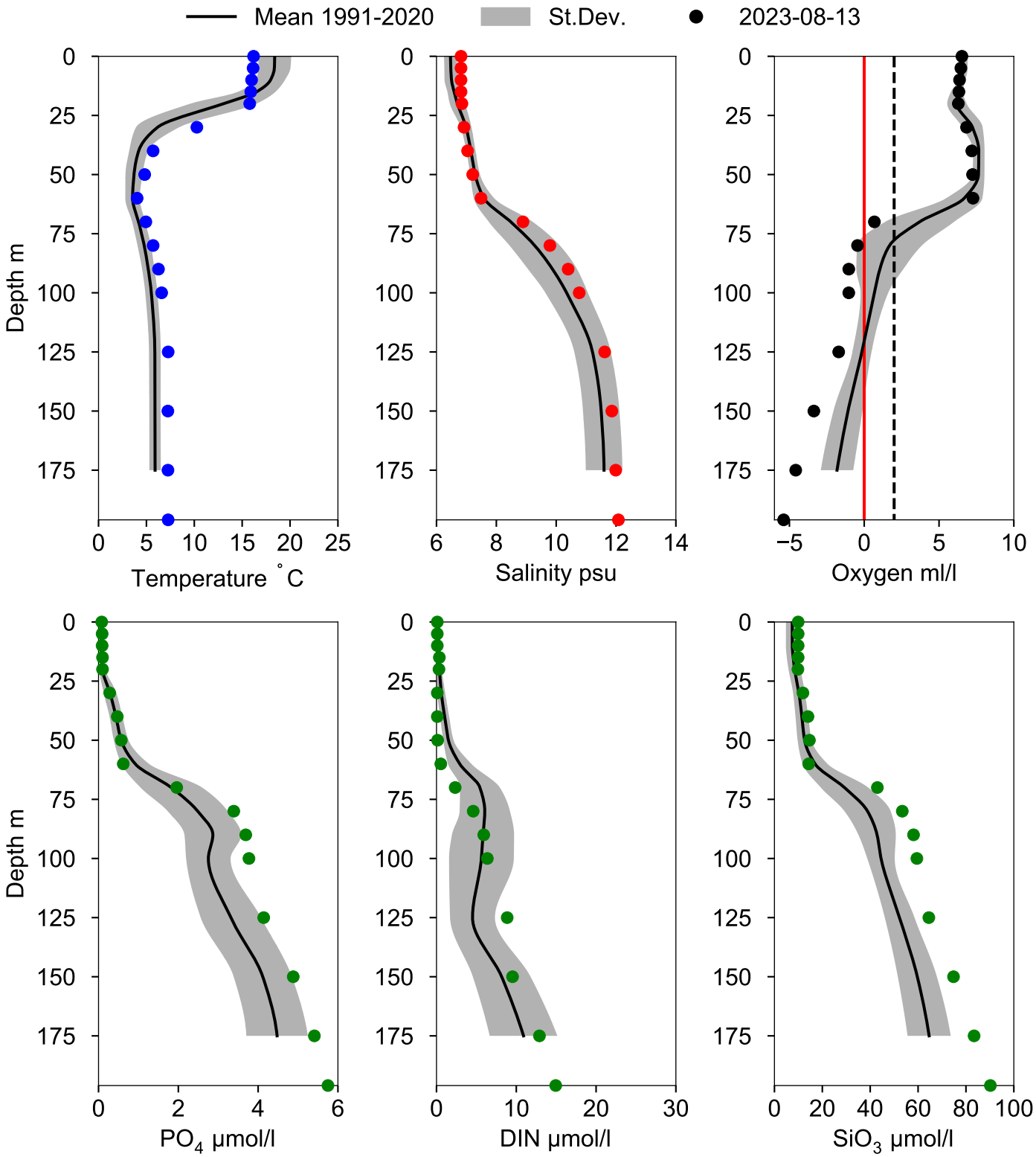
Annual Cycles



OXYGEN IN BOTTOM WATER (depth >= 175 m)

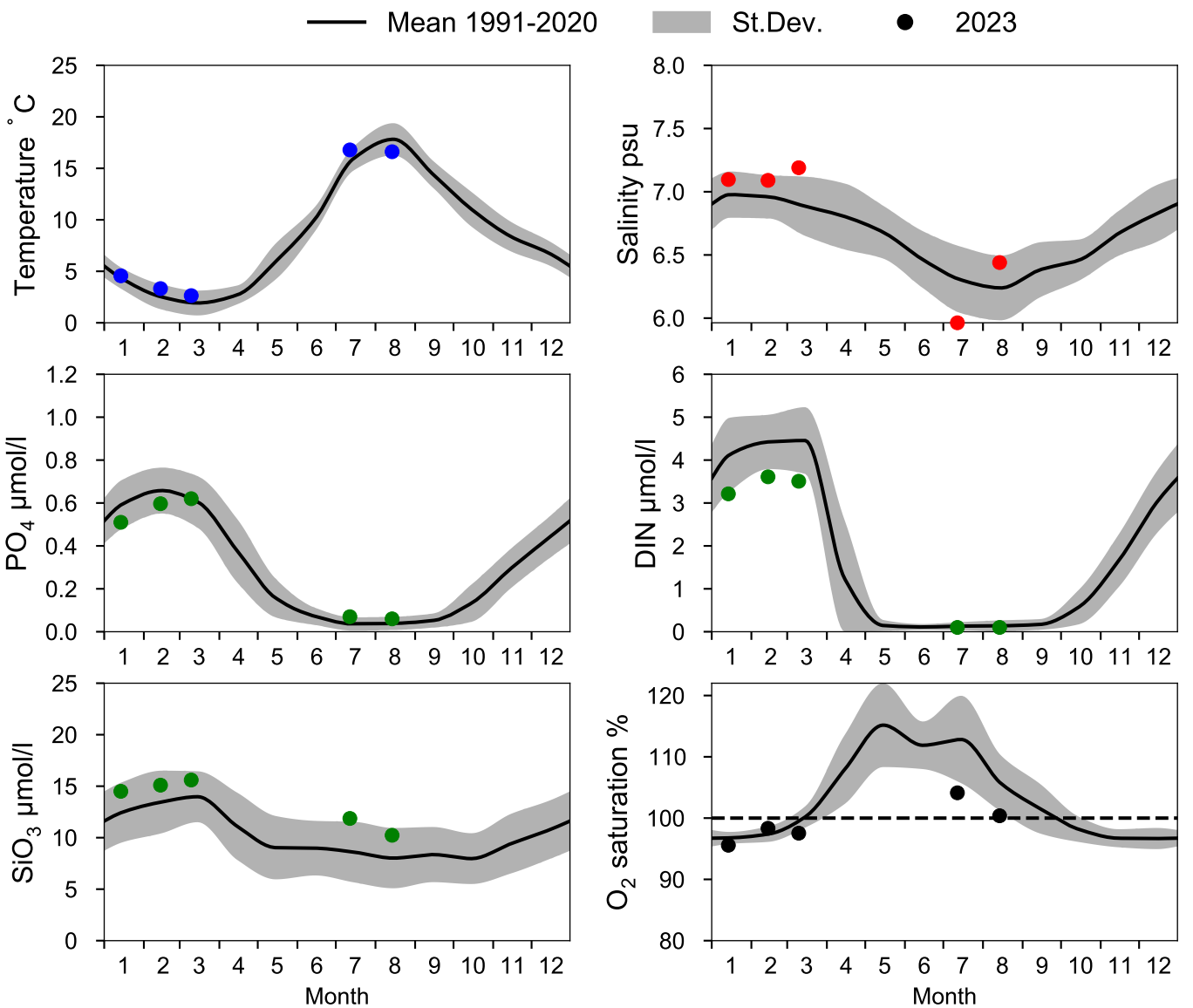


Vertical profiles BY20 FÅRÖDJ
August

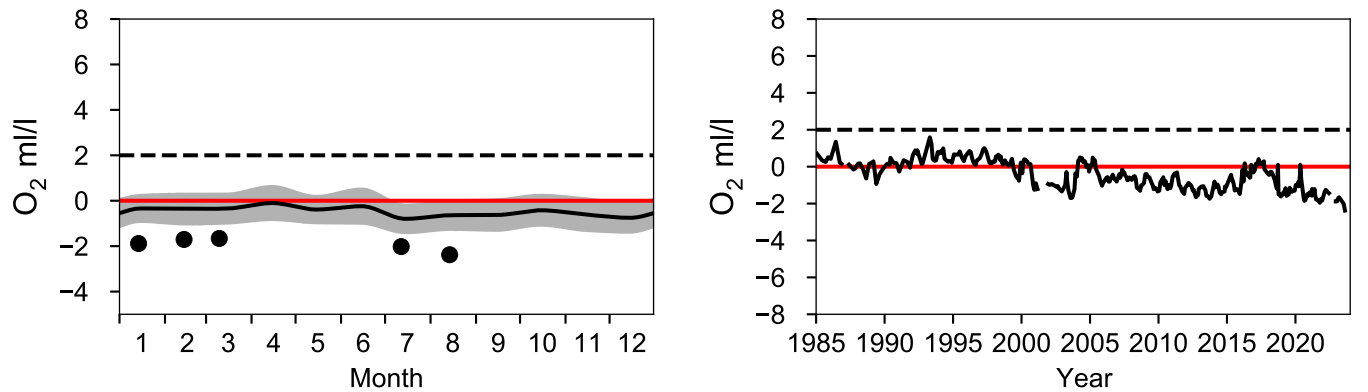


STATION BY29 / LL19 SURFACE WATER (0-10 m)

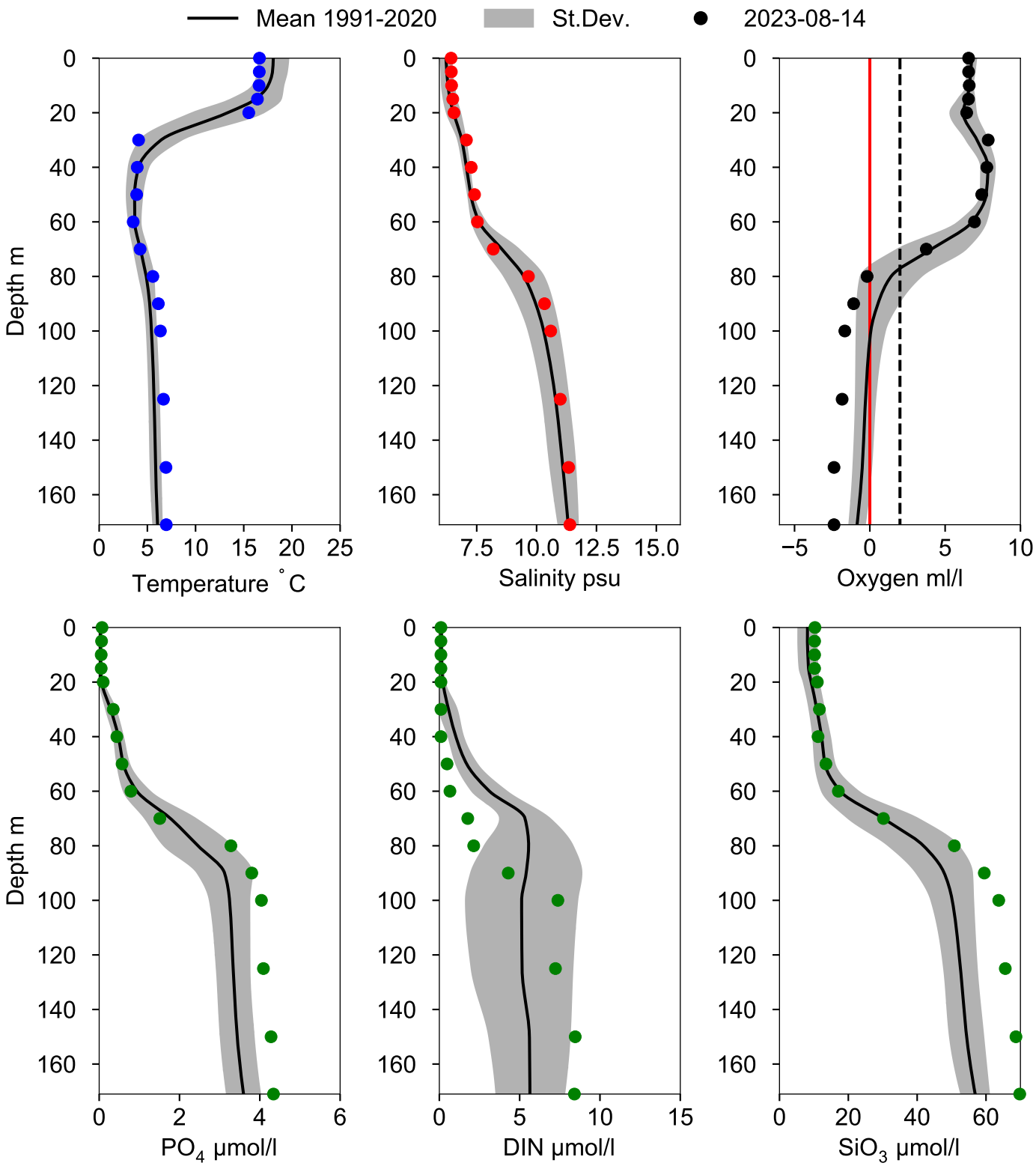
Annual Cycles



OXYGEN IN BOTTOM WATER (depth >= 150 m)

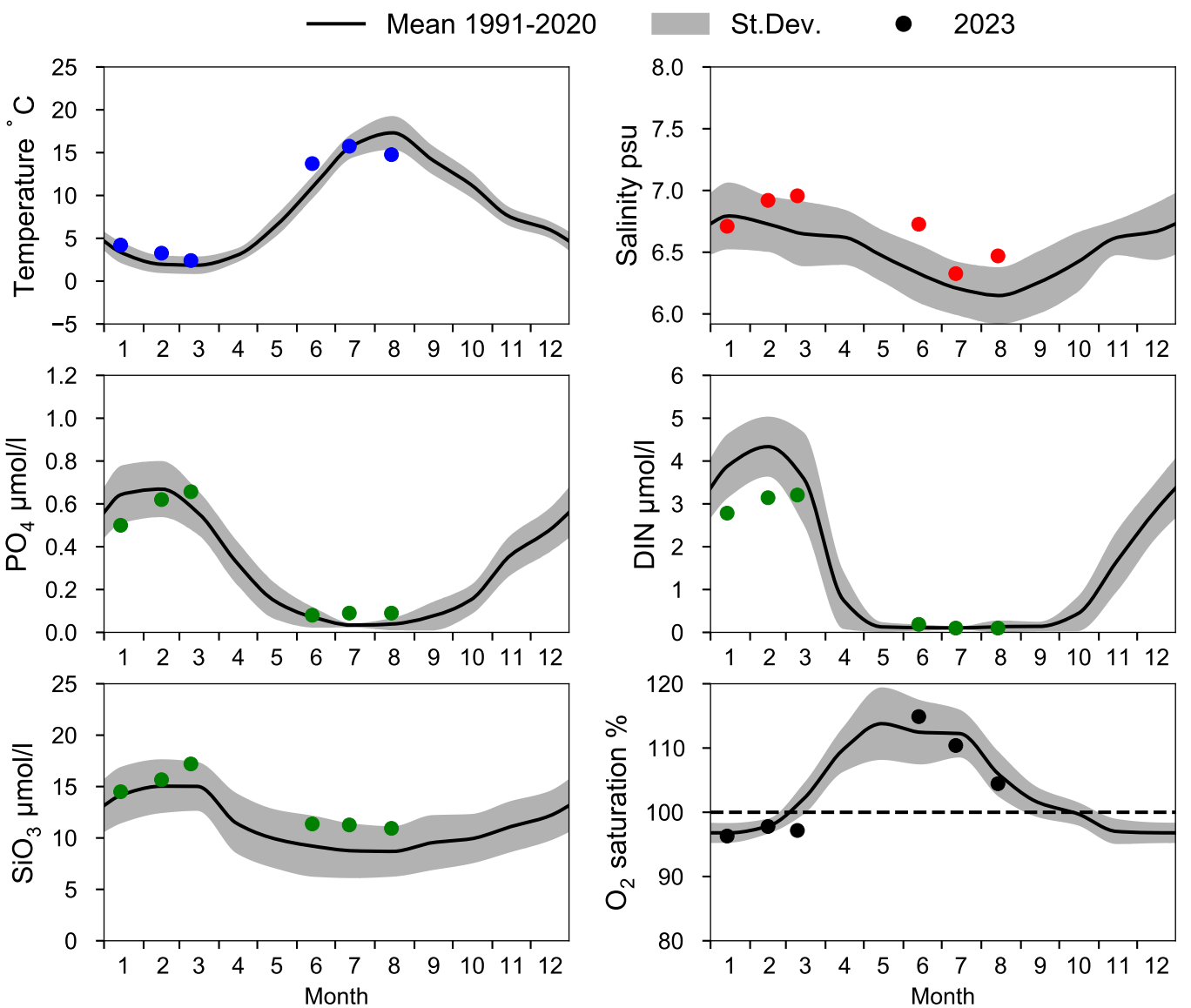


Vertical profiles BY29 / LL19
August

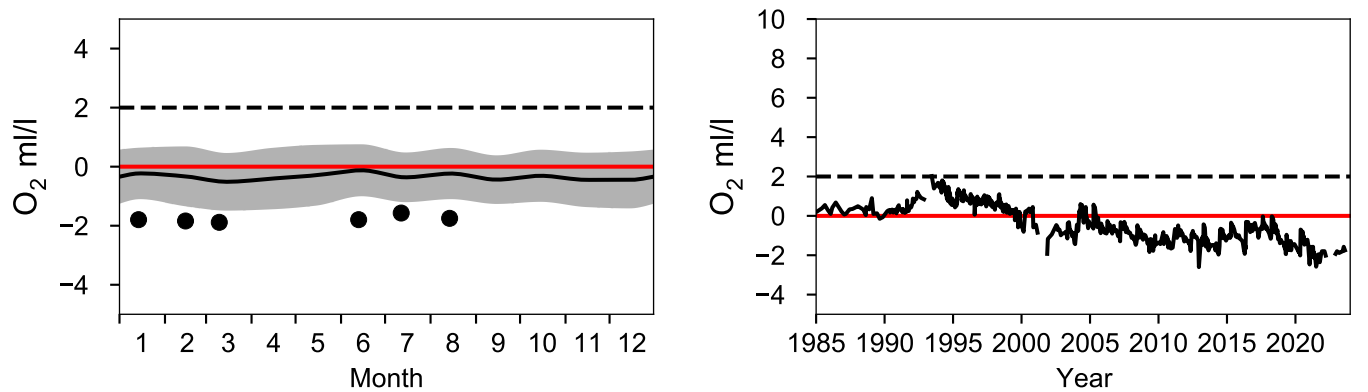


STATION BY31 LANDSORTSDJ SURFACE WATER (0-10 m)

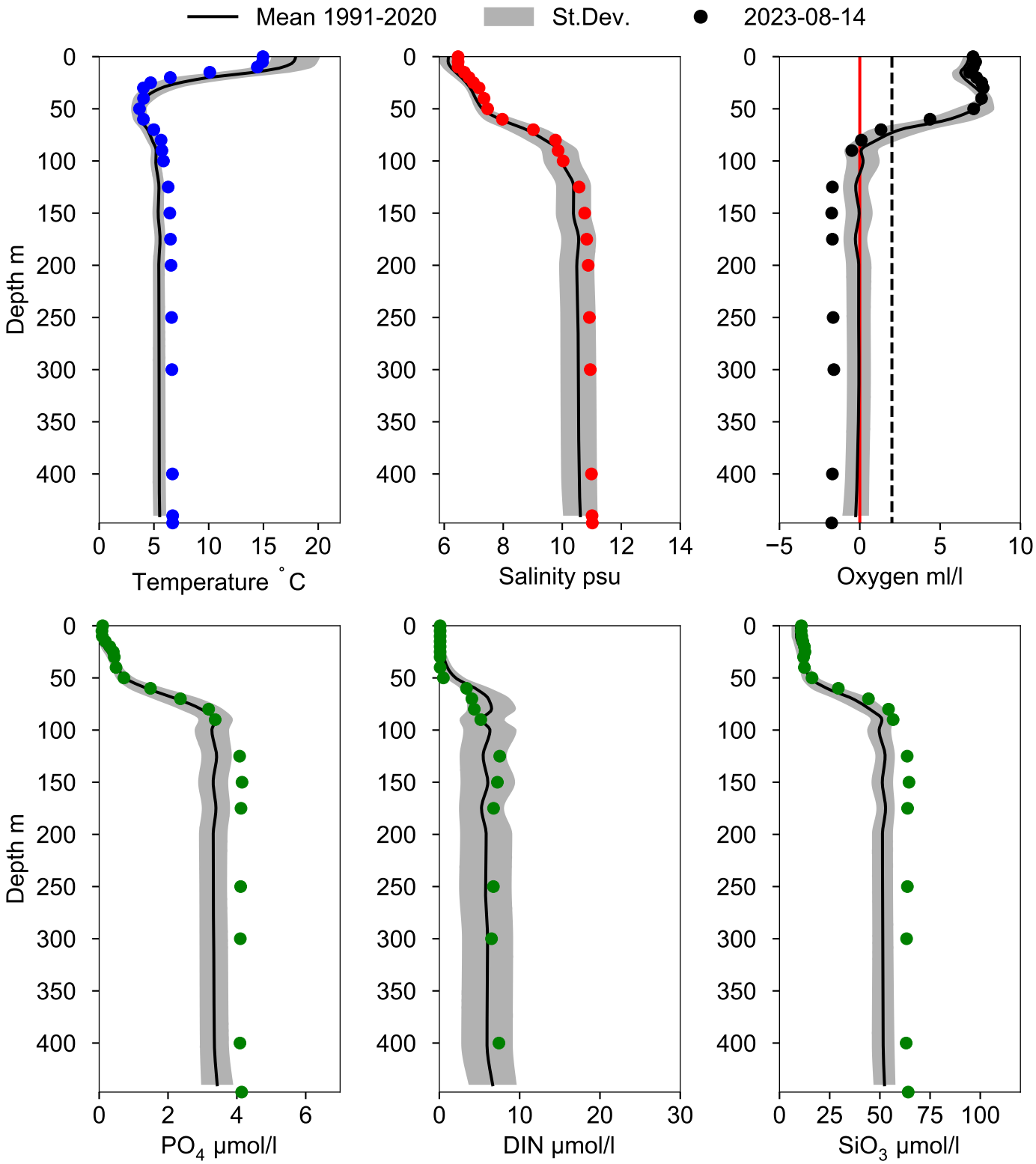
Annual Cycles



OXYGEN IN BOTTOM WATER (depth >= 419 m)

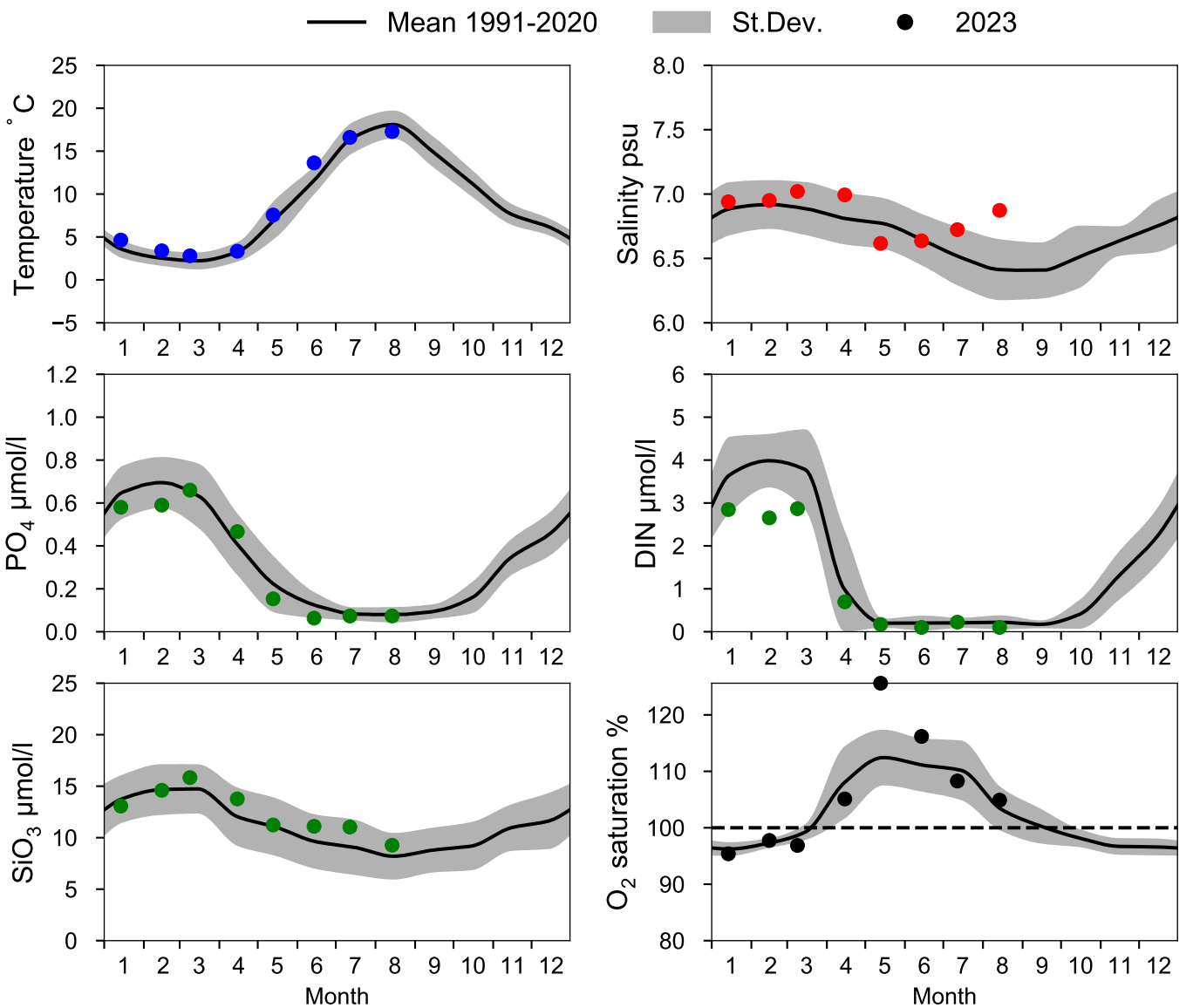


Vertical profiles BY31 LANDSORTSDJ
August

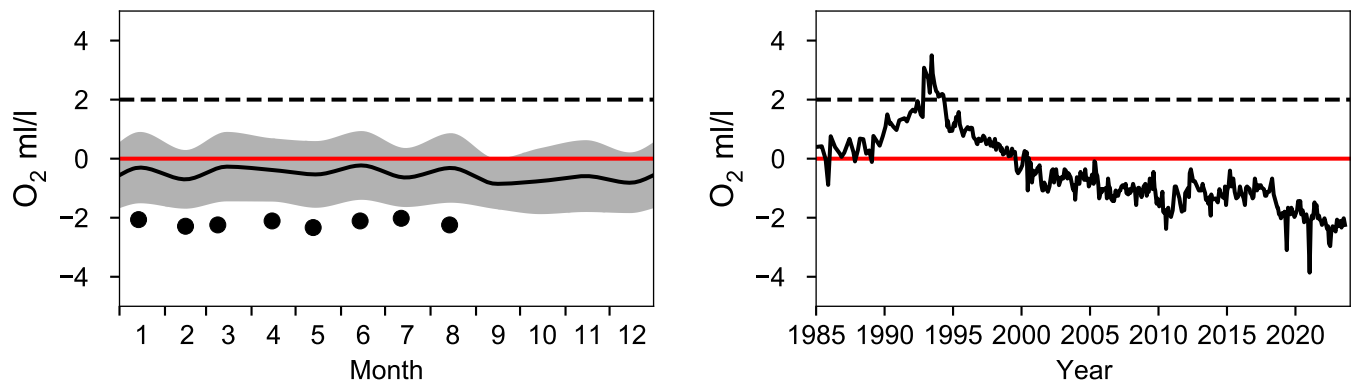


STATION BY32 NORRKÖPINGSDJ SURFACE WATER (0-10 m)

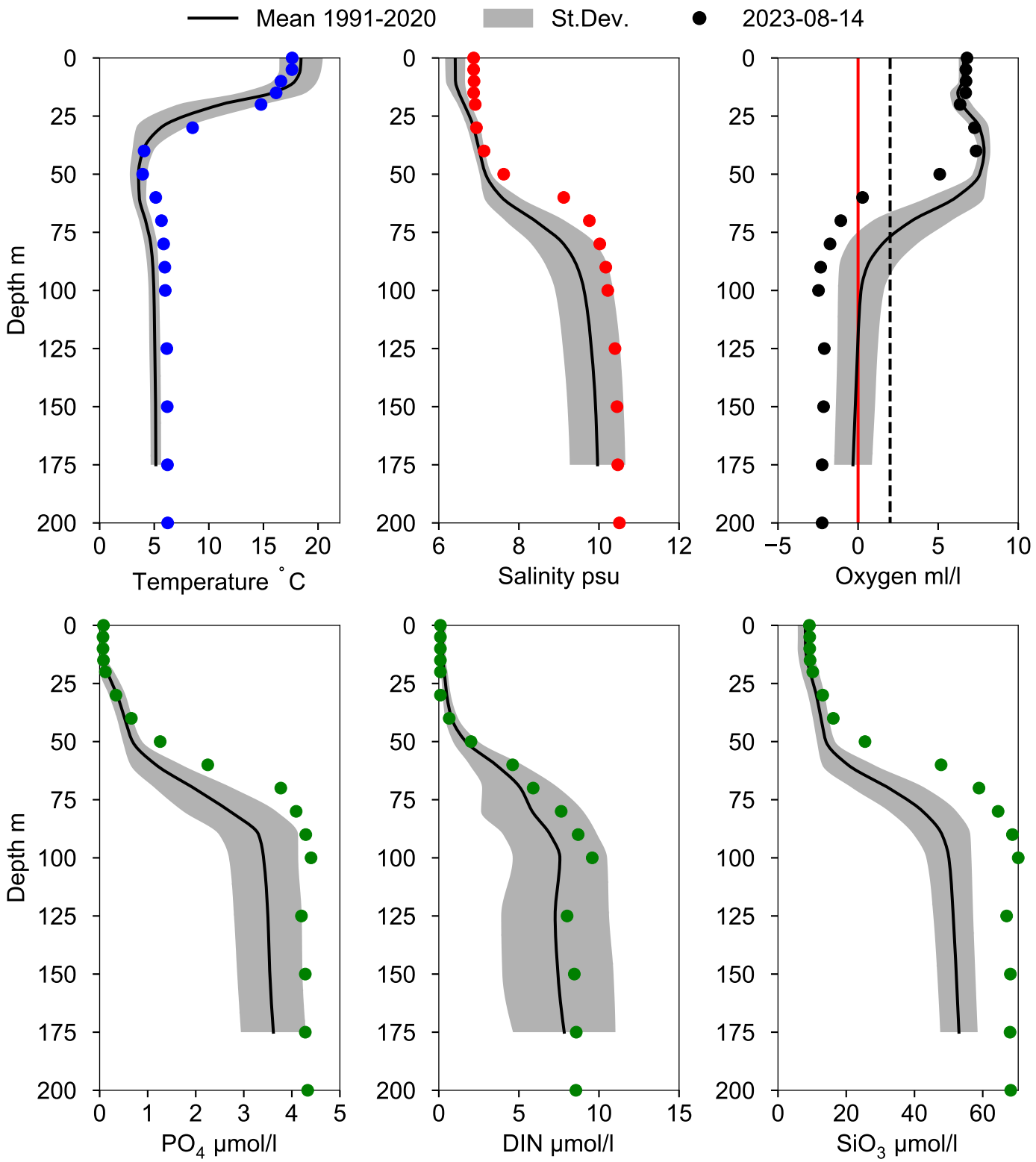
Annual Cycles



OXYGEN IN BOTTOM WATER (depth >= 175 m)

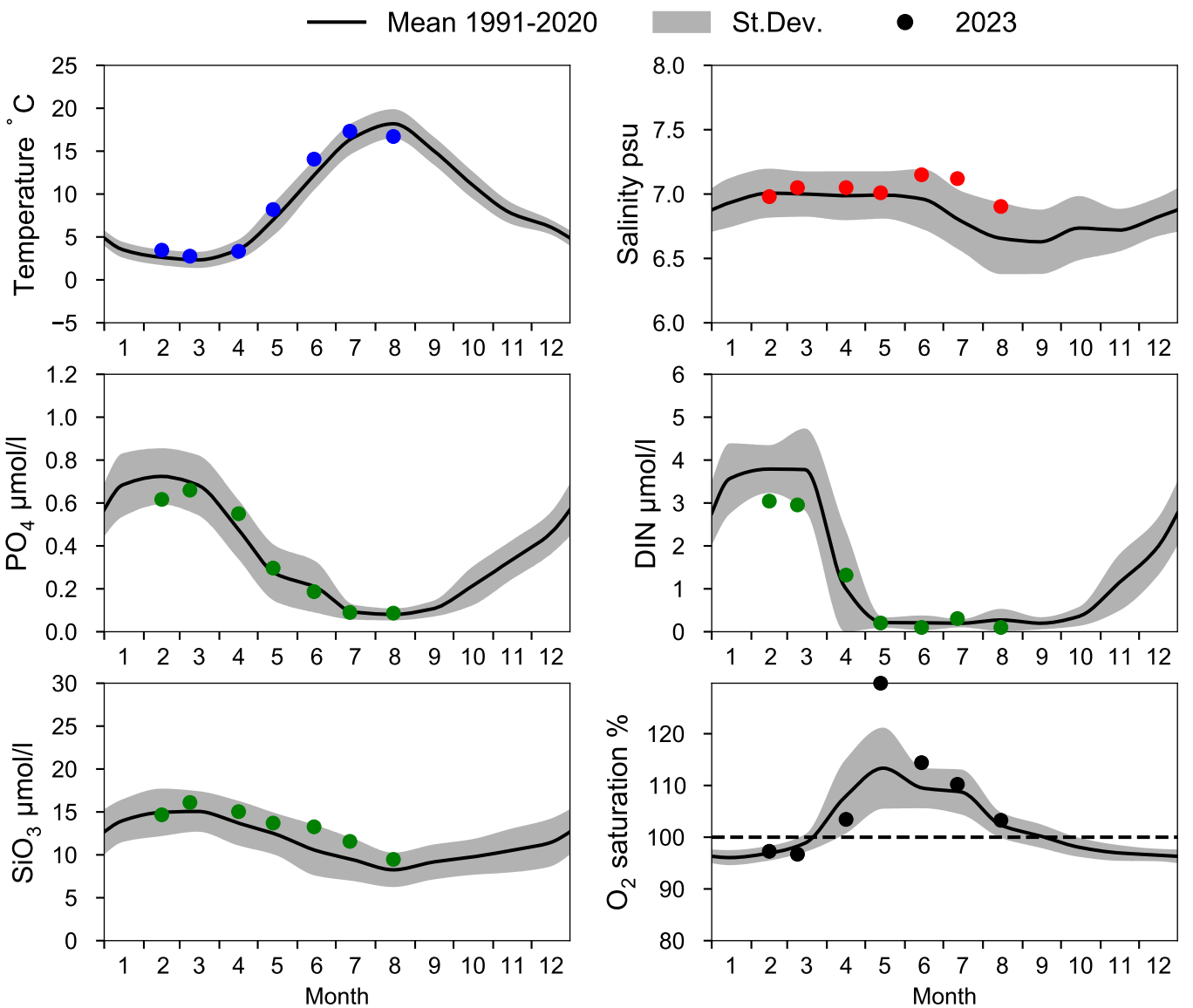


Vertical profiles BY32 NORRKÖPINGSDJ
August

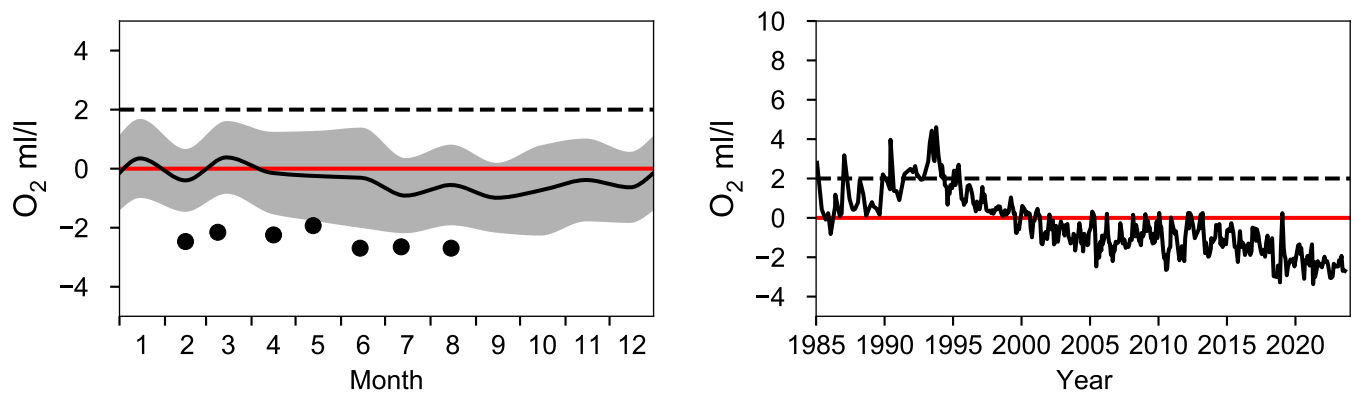


STATION BY38 KARLSÖDJ SURFACE WATER (0-10 m)

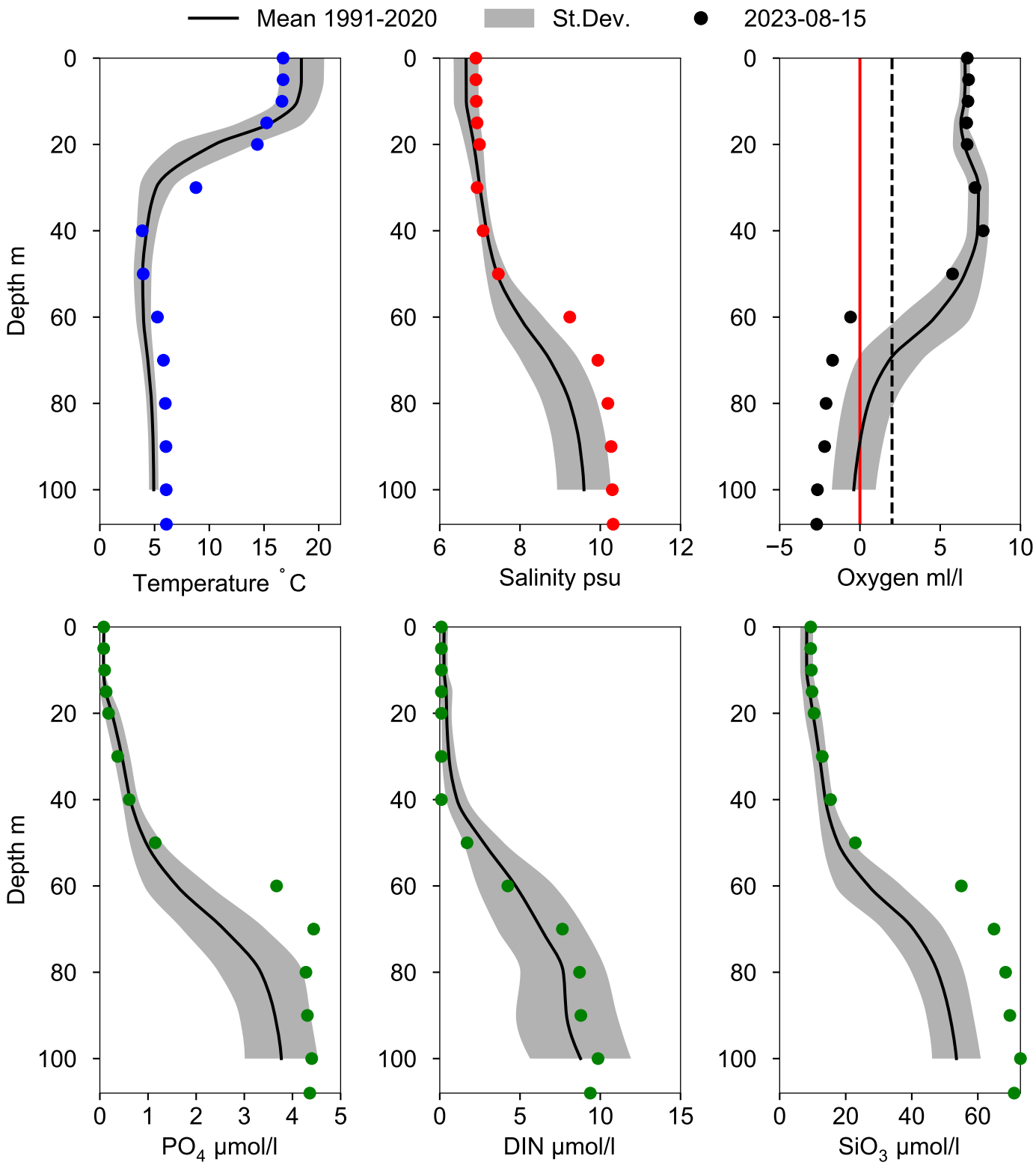
Annual Cycles



OXYGEN IN BOTTOM WATER (depth >= 100 m)

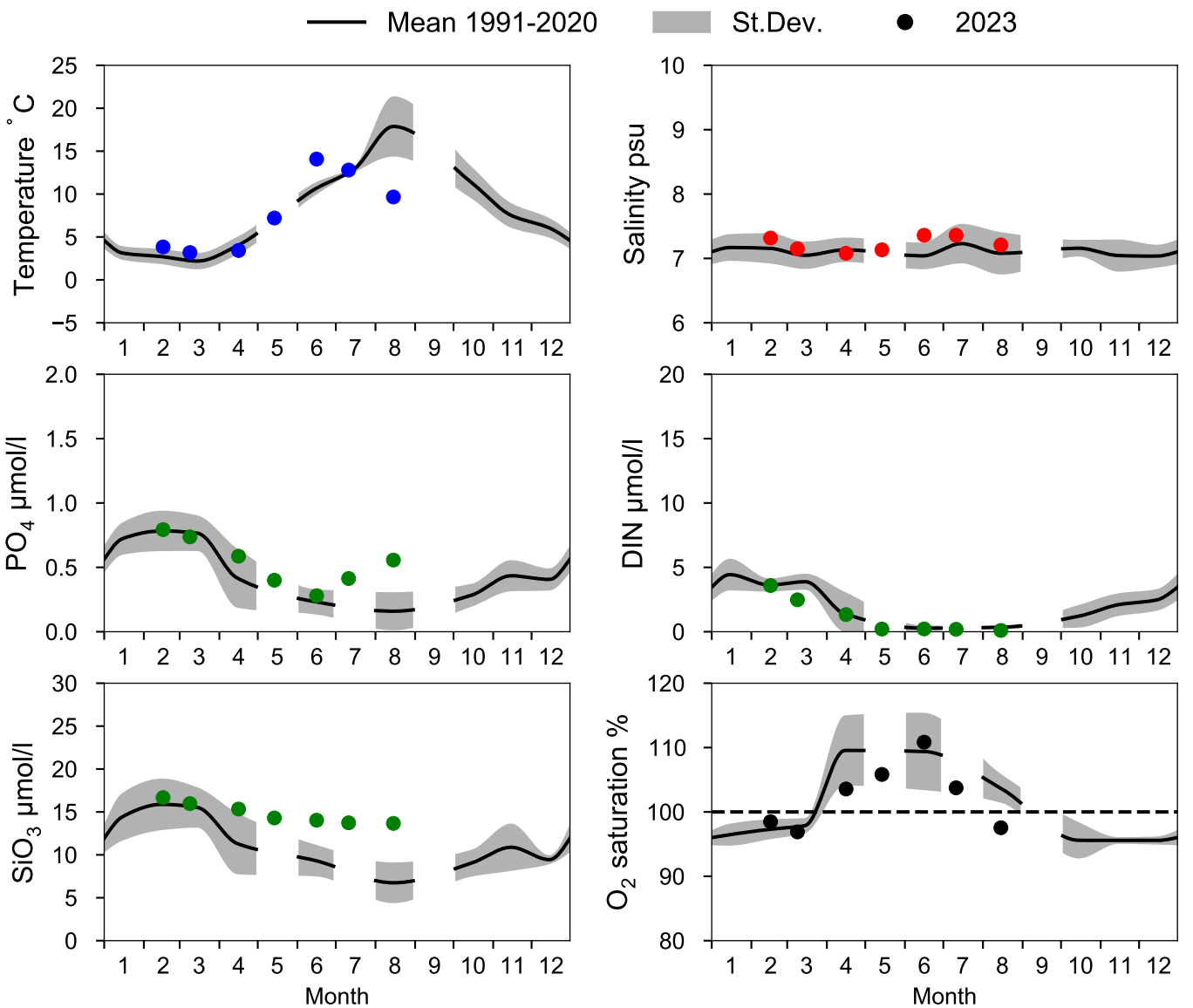


Vertical profiles BY38 KARLSÖDJ
August

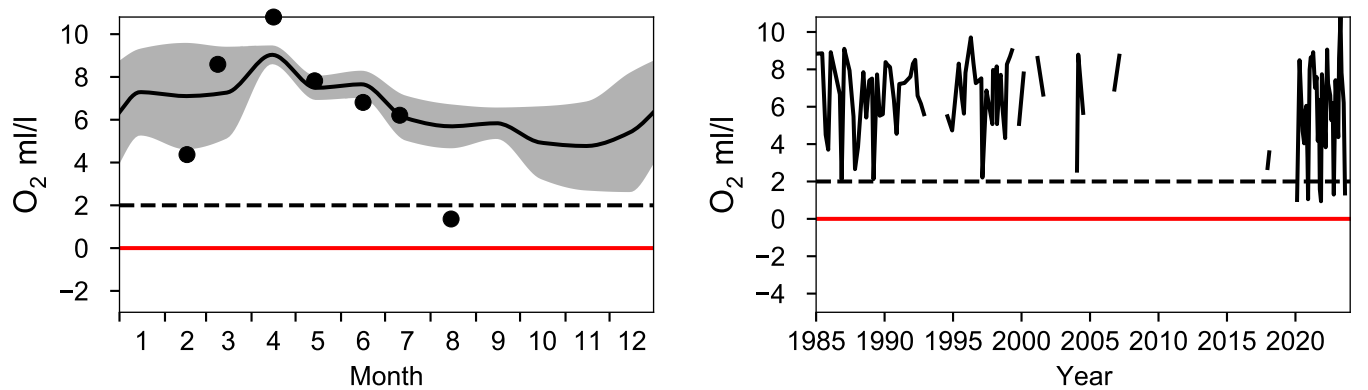


STATION BY39 ÖLANDS S UDDE SURFACE WATER (0-10 m)

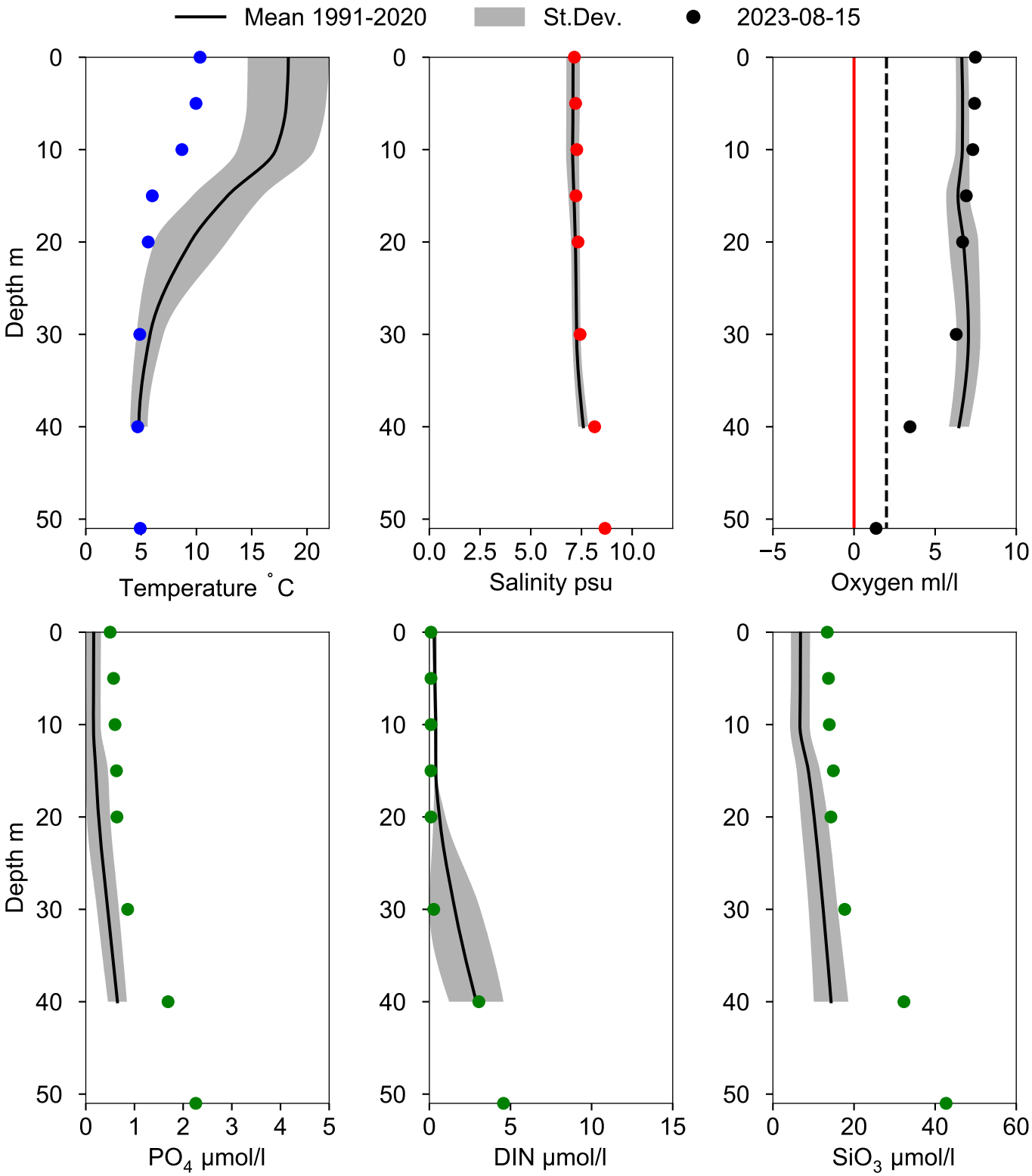
Annual Cycles



OXYGEN IN BOTTOM WATER (depth >= 40 m)

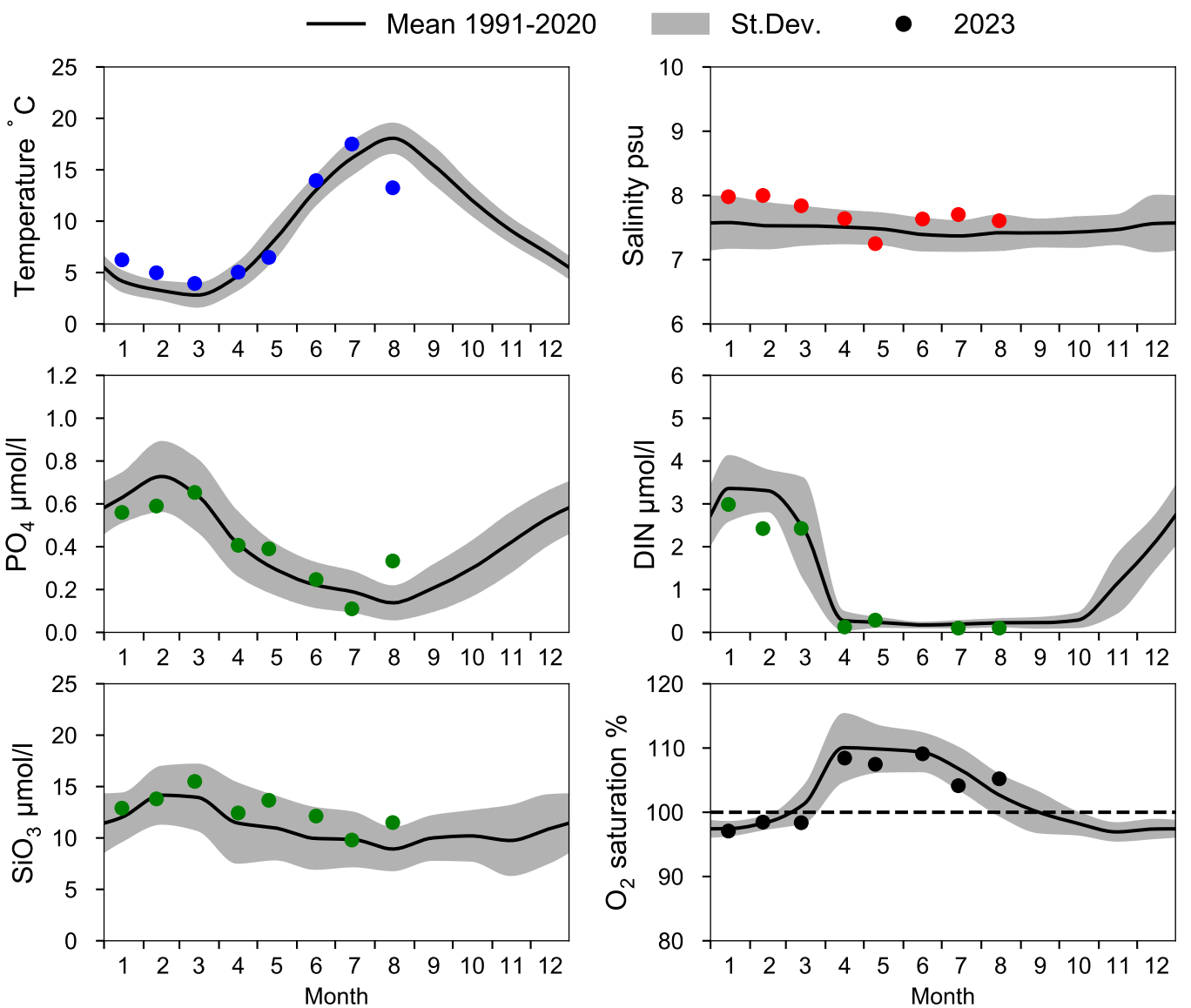


Vertical profiles BY39 ÖLANDS S UDDE
August

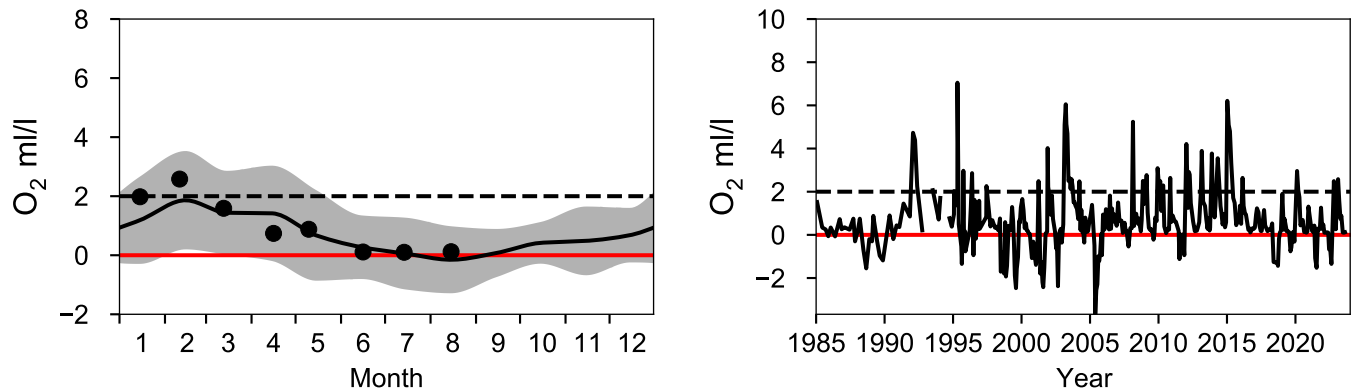


STATION HANÖBUKTEN SURFACE WATER (0-10 m)

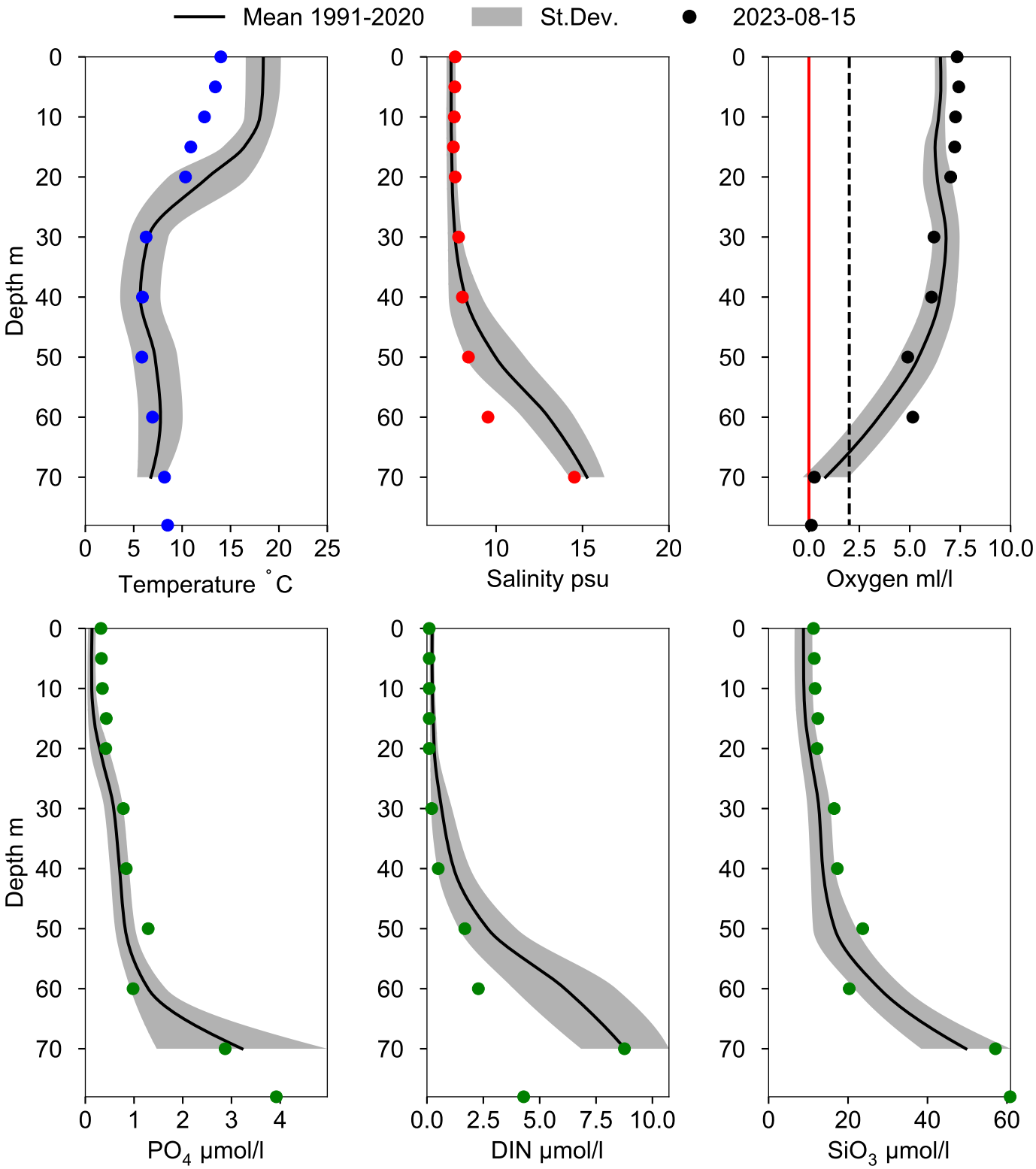
Annual Cycles



OXYGEN IN BOTTOM WATER (depth >= 70 m)

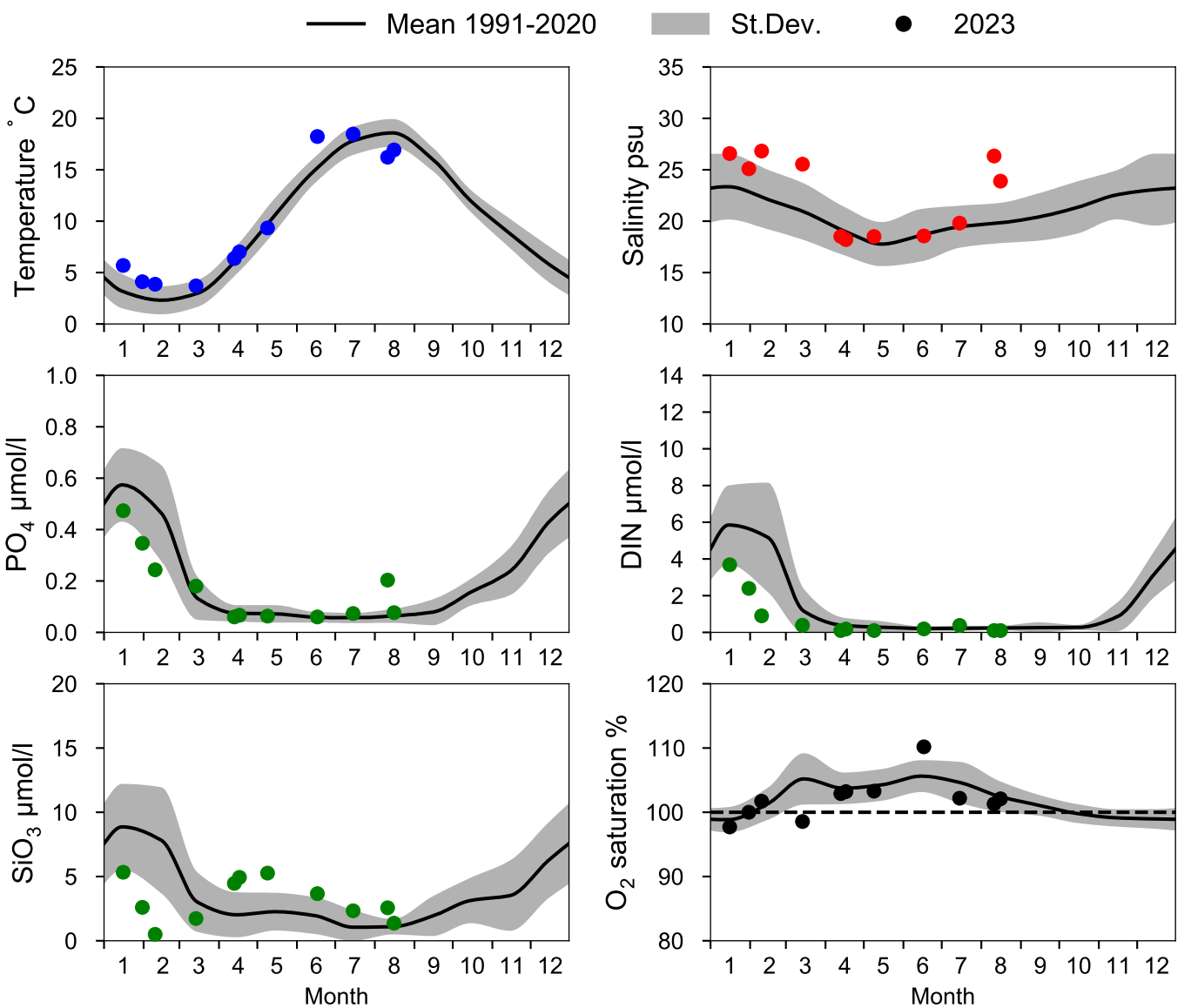


Vertical profiles HANÖBUKTEN
August

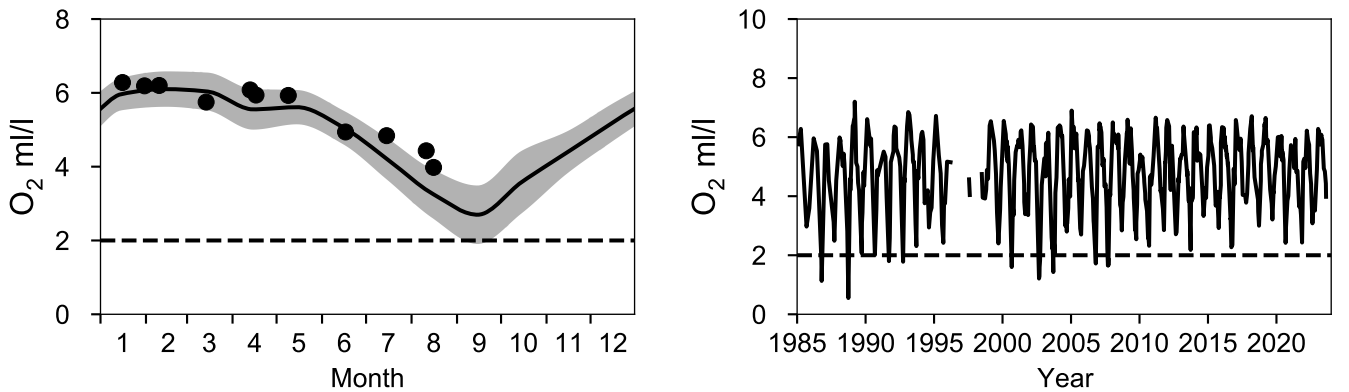


STATION ANHOLT E SURFACE WATER (0-10 m)

Annual Cycles



OXYGEN IN BOTTOM WATER (depth >= 52 m)



Vertical profiles ANHOLT E
August