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Oceanographic Laboratory

2024-08-26

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

Photo: Anna-Kerstin Thell, SMHI

Survey period:	2024-08-10 - 2024-08-16
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)

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SUMMARY

During the cruise, which is part of the Swedish pelagic monitoring program, the Skagerrak, the Kattegat, the Sound, and the Baltic Proper were visited.

Surface water temperatures in all sea areas were around normal, between 16–19°C, except at BY39, south of Öland, where it was 9°C, which is below normal.

Dissolved inorganic nitrogen was around the detection limit, 0.1 µmol/l, down to the thermocline, which is normal for this time of year. The surface concentration of phosphate was low and at most stations, it was normal for the season. Silica levels in surface water were above normal at most stations in the Gotland basins, while in the Arkona and Bornholm basins, as well as in the Sound, they were below normal.

In the Arkona Basin, the oxygen concentration in the bottom water had decreased since July and was now just over 2 ml/l. In the Bornholm Basin, the concentration had increased slightly and was now 0.5–0.8 ml/l. At station BCS III-10, the oxygen concentration near the bottom had increased to 1.2 ml/l. In the rest of the Baltic Proper, there was no oxygen in the bottom water.

Acute oxygen deficiency, i.e., oxygen levels less than 2 ml/l, was observed from 70 meters in the Bornholm Basin and in the Eastern Gotland Basin, and in the Western Gotland Basin already from 50 meters. Hydrogen sulfide was measured from 90 meters in the Eastern Gotland Basin and from 60 meters depth in the Western Gotland Basin.

The next regular cruise is scheduled to start on September 14th in Lysekil.

RESULTS

The cruise was carried out on board the R/V Svea and started in Lysekil on August 10th and ended in Lysekil on August 16th. At the start of the cruise, it was relatively windy with westerly winds between 12–15 m/s, but by the second day, the weather improved, and throughout the passage in the Baltic Sea, it was warm and relatively calm.

Svea's instrument for continuous measurements of surface water, Ferrybox, was in operation throughout the cruise, however, the instrument for pH measurements had run out of indicator solution, and unfortunately, no pH measurements were recorded from the Ferrybox. In the Arkona Basin over Kriegers Flak and in the Western Gotland Basin before station BY38, Svea's MVP (Moving Vessel Profiler) was in use underway and provided profiles with temperature, salinity, oxygen and chlorophyll fluorescence. After this, the ship's technicians onboard began replacing the cable/wire for the MVP. One of Svea's two ADCPs (Acoustic Doppler Current Profilers) could be restarted after servicing and reinstallation on the hull during the shipyard visit. During the cruise, a calibration of the ADCP (angle test) was also successfully conducted.

At all stations, surface water was sampled for a project investigating and analysing algal toxins produced by cyanobacteria. The project is a collaboration between SMHI, SLU and the Swedish Food Agency, and sampling is planned to be carried out during the cruises in June, July, August and September

At two stations in the Baltic Sea, BY38 and BY2, extra samples were taken in collaboration with VOTO. Water samples from the standard depth from the surface down to 30 meters were sampled to investigate the presence of cyanobacteria in the water column and the aim is to investigate whether it is possible to predict future blooms of cyanobacteria. These measurements will be taken during the June, July and August cruises.

Samples were also taken within the AMIME project where water samples were taken from the Ferrybox and pictures were taken with the IFCBn. Measurements within the project will be made during the cruises in June-October.

Extra phytoplankton samples from the surface water were taken at stations Anholt E and Å17 for Uppsala University. At Anholt E, extra samples of microzooplankton were also taken for Gothenburg University.

During the first day of the cruise, a journalist and a photographer from Nordic Eye Productions participated to create educational material for UR (Swedish Educational Broadcasting Company). The program's focus was on source criticism, facts, and climate change.

The results from plankton analyses will be presented in the AlgAware report:

https://www.smhi.se/publikationer/publikationer/algrapporter.

Daily algae monitoring via satellite is carried out by SMHI during the summer and is available at:

https://www.smhi.se/vader/observationer/algsituationen/alger

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 cruise 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.

Data can be downloaded here: https://www.smhi.se/en/services/open-data/national-archive-for-oceanographic-data/download-data-1.153150

The Skagerrak

Surface water temperatures ranged between 18–19°C, which is normal for the season. The salinity in the surface water was also normal, varying between 24–31 psu, with the lowest levels recorded closest to the coast.

Near the coast at station Släggö, a halocline and thermocline coincided around 15 meters. Below this depth, the salinity increased to 34 psu, and the temperature dropped to 7°C. Along the Å-section, stratification varied; at the innermost station Å13, there was shallow stratification at 5 meters and deeper stratification around 35 meters. At the outermost station Å17, stratification was again primarily around 15 meters. In the deep water at 300 meters, the temperature was 7°C, and the salinity was 35 psu. At station P2, located furthest south in Skagerrak, the thermocline and halocline were deeper, around 26 meters.

The levels of dissolved inorganic nitrogen (DIN) in the surface water were typically low, around the detection limit (0.1 µmol/l) at all stations except Å15, where it was higher than normal (0.4 µmol/l). Phosphate levels varied between 0.04–0.12 µmol/l, and silica levels ranged between 0.45–2.63 µmol/l. Both phosphate and silica were normal at Släggö and Å17, below normal at P2, and above normal at Å13 and Å15.

The lowest oxygen concentration in the bottom water was measured at Släggö, 2.9 ml/l, which is normal. Offshore, levels in the deep water ranged between 4.4–5.8 ml/l, which is also normal.

Chlorophyll fluorescence measurements with the CTD, which indicate phytoplankton activity, showed activity from the surface down to 50 meters in the area. At station Å13, there was also a chlorophyll peak at 65 meters.

The Kattegat and the Öresund

The surface water temperature had slightly increased since July and was now around 19°C, which is normal for the season. The salinity in the surface water of the Kattegat was normal, ranging between 20–23 psu. In the Sound, the surface salinity was 19 psu, which is higher than normal. In the Kattegat and the Sound, the thermocline and halocline were found between 10 and 20 meters.

In the surface water of the Kattegat, the concentration of nutrients was normal. The concentration of phosphate was around 0.7 µmol/l, silicate 0.4–1.0 µmol/l, and DIN was around the detection limit of 0.1 µmol/l. In the Sound, the levels of DIN were normal (0.2 µmol/l), while phosphate (0.09 µmol/l) and silicate (1.97 µmol/l) were lower than normal.

Oxygen measurements in the bottom water showed lower levels than last month: 3.3–3.8 ml/l in the Kattegat and 3.2 ml/l in the Sound. At the Fladen and N14 Falkenberg stations, oxygen levels were lower than normal.

In the Kattegat, chlorophyll fluorescence measurements with the CTD indicated chlorophyll peaks at 15–20 meters. In the Sound, biological activity was observed at 0–10 meters.

The Baltic Proper

The surface water temperature in the Baltic Proper was around the normal range, with temperatures between 16.1–19.5°C. However, at BY39 near Öland's southern part, the surface temperature was 8.7°C, which is lower than normal. The surface salinity ranged from 6.2 to 7.6 psu and was generally normal, except in the Eastern Gotland Basin where it was above normal.

In the Arkona Basin, the halocline was at 30 meters, where the thermocline was also observed. Near the bottom, there was a layer of warmer water. In the Bornholm Basin, the halocline was slightly deeper, around 40–50 meters, while the thermocline was around 20 meters. In the Gotland basins, there were two haloclines, one around 20 meters and a deeper one at 50–70 meters. The thermocline was around 20 meters. The salinity in the deep water was highest in the Gotland Deep at 12.6 psu. Below the thermocline, the temperature was lowest at 3.6°C, and below the halocline at depths greater than 100 meters, the temperature was relatively stable around 6–7°C.

The levels of dissolved inorganic nitrogen (DIN) in the surface water were below the detection limit of 0.1 µmol/l down to 20 meters at almost all stations. The exception was station BY29, where levels were above normal due to high ammonium concentrations.

The phosphate levels in the offshore surface water varied between 0.04–0.1 µmol/l, which was mostly normal for the season. However, in the Bornholm Basin, levels were slightly lower than normal, and in the northernmost parts of the Baltic Proper, they were slightly above normal.

The silicate concentration in the offshore surface water ranged from as low as 5.2 µmol/l in the Arkona Basin to 12.9 µmol/l in the Western Gotland Basin. This was below normal in the Arkona and Bornholm Basins and above normal at most other stations.

At station BY39, which is near the coast and often experiences upwelling, the concentrations of phosphate (0.4 µmol/l) and silicate (13.5 µmol/l) were above normal.

In the Arkona Basin, the oxygen concentration in the bottom water had decreased since July and was now just over 2 ml/l. In the Bornholm Basin, the concentration had increased slightly and was now 0.5–0.8 ml/l. At station BCS III-10, the oxygen concentration near the bottom had increased to 1.2 ml/l. In the rest of the Baltic Proper, there was no oxygen in the bottom water.

Acute oxygen deficiency, i.e., oxygen levels less than 2 ml/l, was observed from 70 meters in the Bornholm Basin and in the Eastern Gotland Basin, and in the Western Gotland Basin already from 50 meters. Hydrogen sulfide was measured from 90 meters in the Eastern Gotland Basin and from 60 meters depth in the Western Gotland Basin.

Chlorophyll fluorescence measurements with the CTD, which is an indicator of phytoplankton activity, showed activity from the surface down to the thermocline. The highest activity was observed in the Arkona and Bornholm Basins, as well as at station BY29. More information about the algae situation can be found in the Algaware report; https://www.smhi.se/publikationer/publikationer/algrapporter.

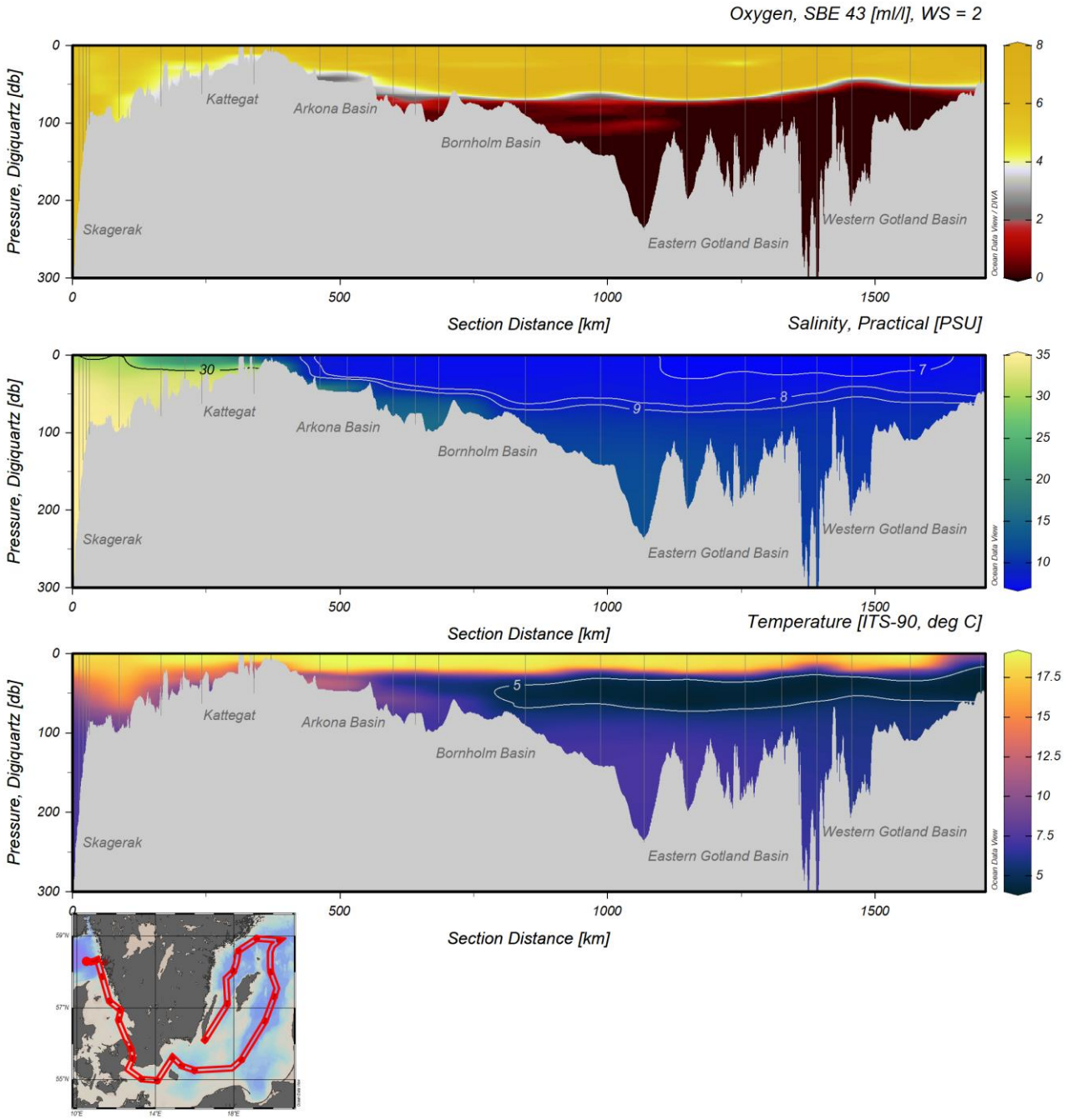

Figure 1. Transects ranging from the Skagerrak, through the Kattegat and The Sounds, further into the Baltic Proper, ending in the Western Gotland Basin shows the oxygen, salinity and temperature. Grey vertical lines indicate the positions where data is collected, also shown in the map.

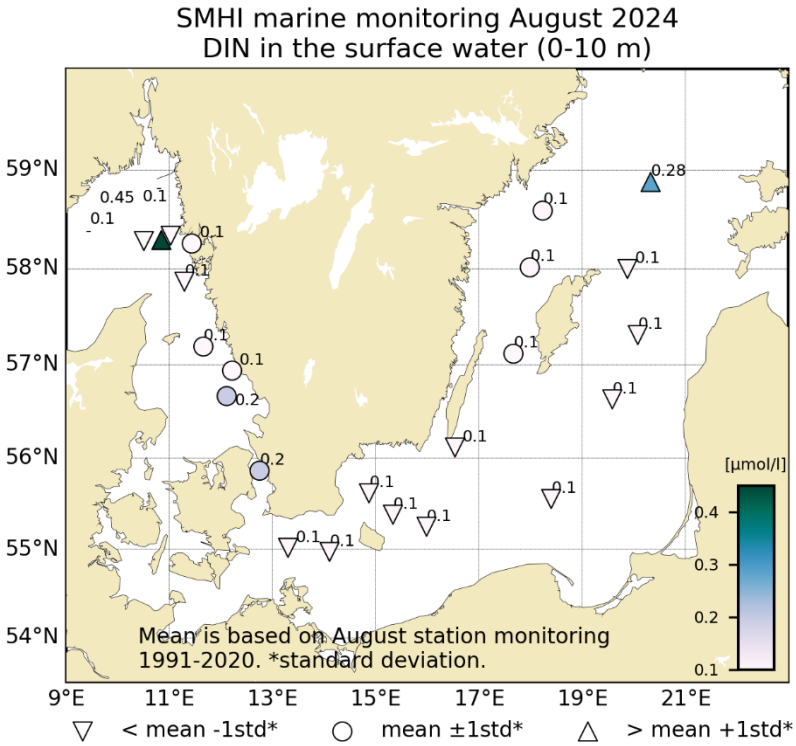

Figure 2. Concentration of dissolved inorganic nitrogen in the surface water (0-10m).

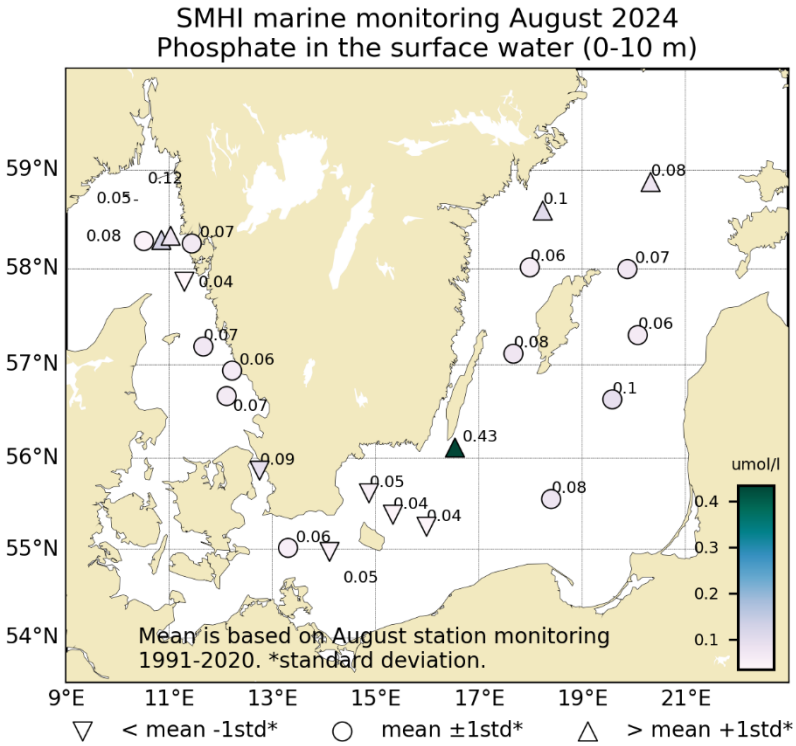

Figure 3. Concentration of phosphate in the surface water (0-10m).

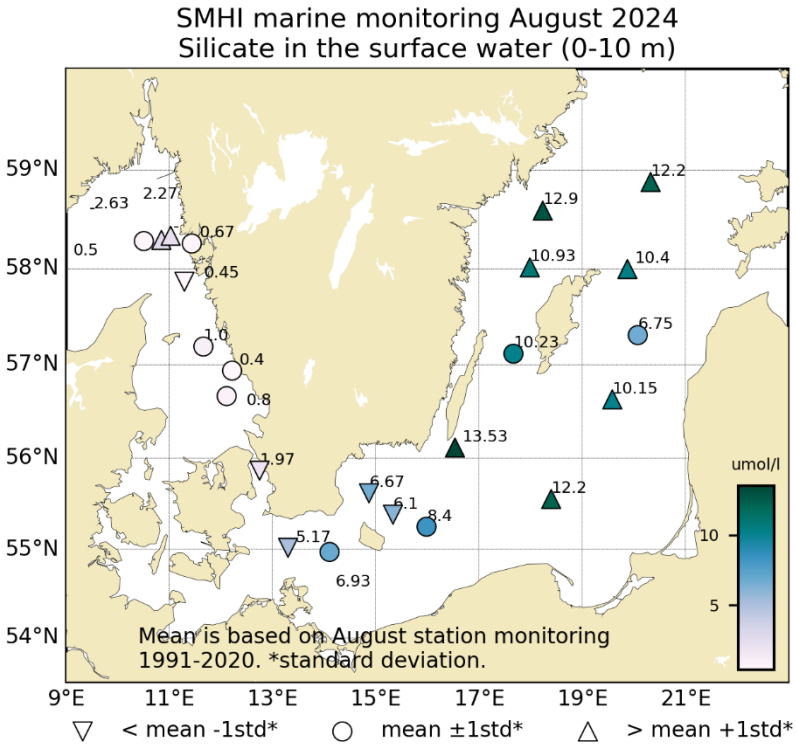

Figure 4. Concentration of silicate in the surface water (0-10m).

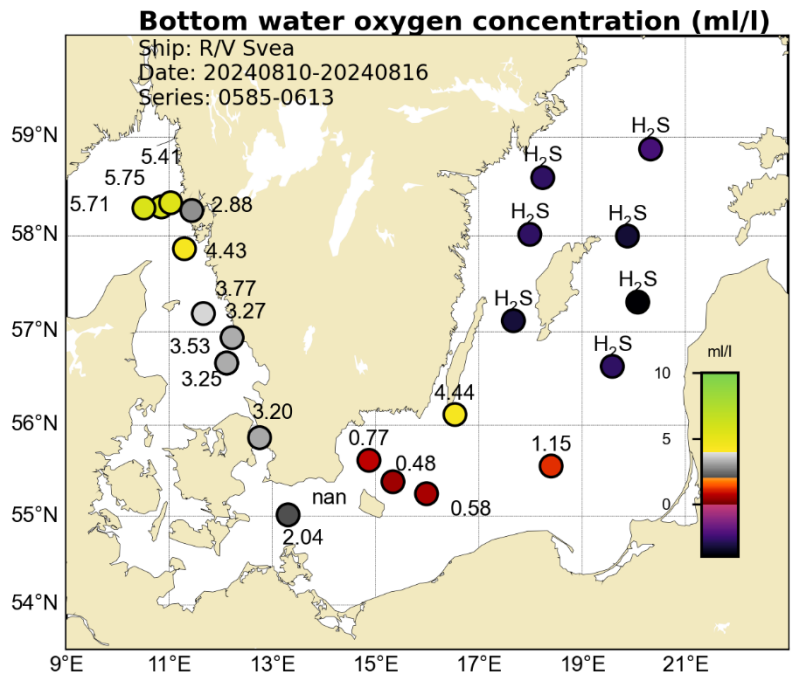

Figure 5. Oxygen concentration in the bottom water.

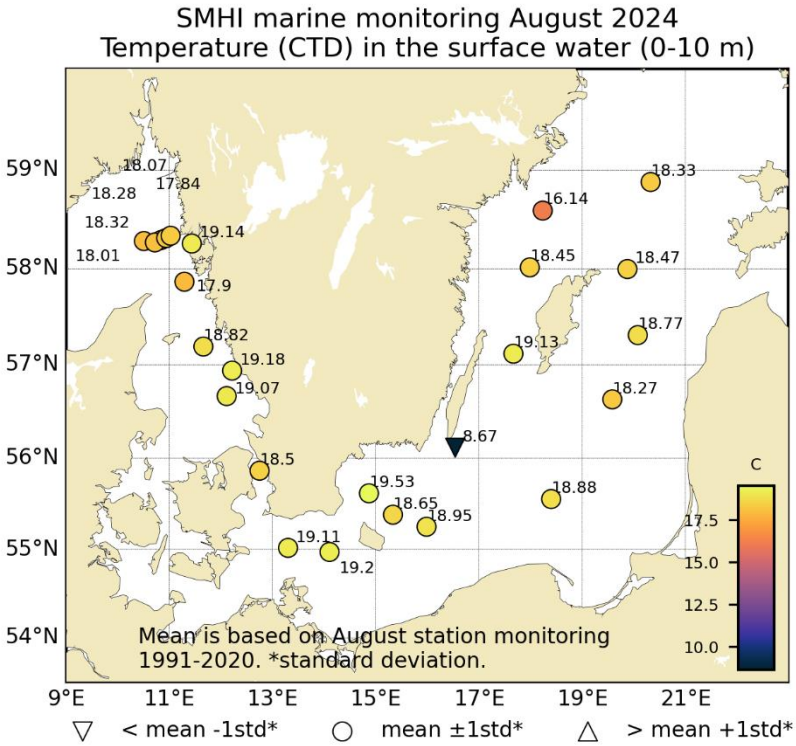

Figure 6. Temperature in the surface water (0-10m).

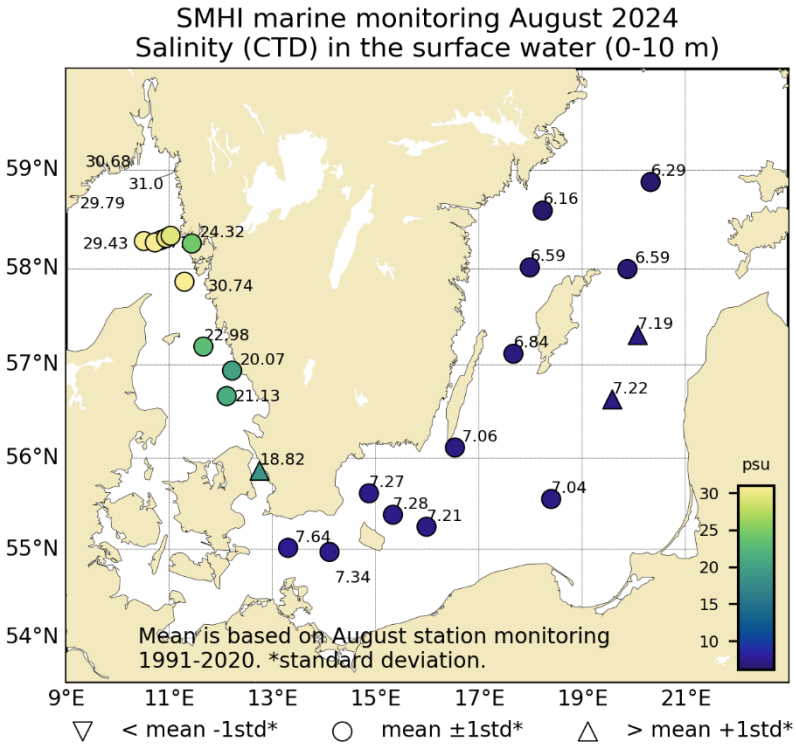

Figure 7. Salinity in the surface water (0-10m).

PARTICIPANTS

Namn	Roll	Från
Lena Viktorsson Lena Viktorsson	Chief scientist, Oceanographer	SMHI
Ola Kalén	Oceanographer	SMHI
Helena Björnberg	Marine chemist	SMHI
Sari Sipilä	Marine chemist	SMHI
Monica Lindner	Marine chemist	SMHI
Bengt Karlson	Marin biologist	SMHI

APPENDICES

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

SMHI

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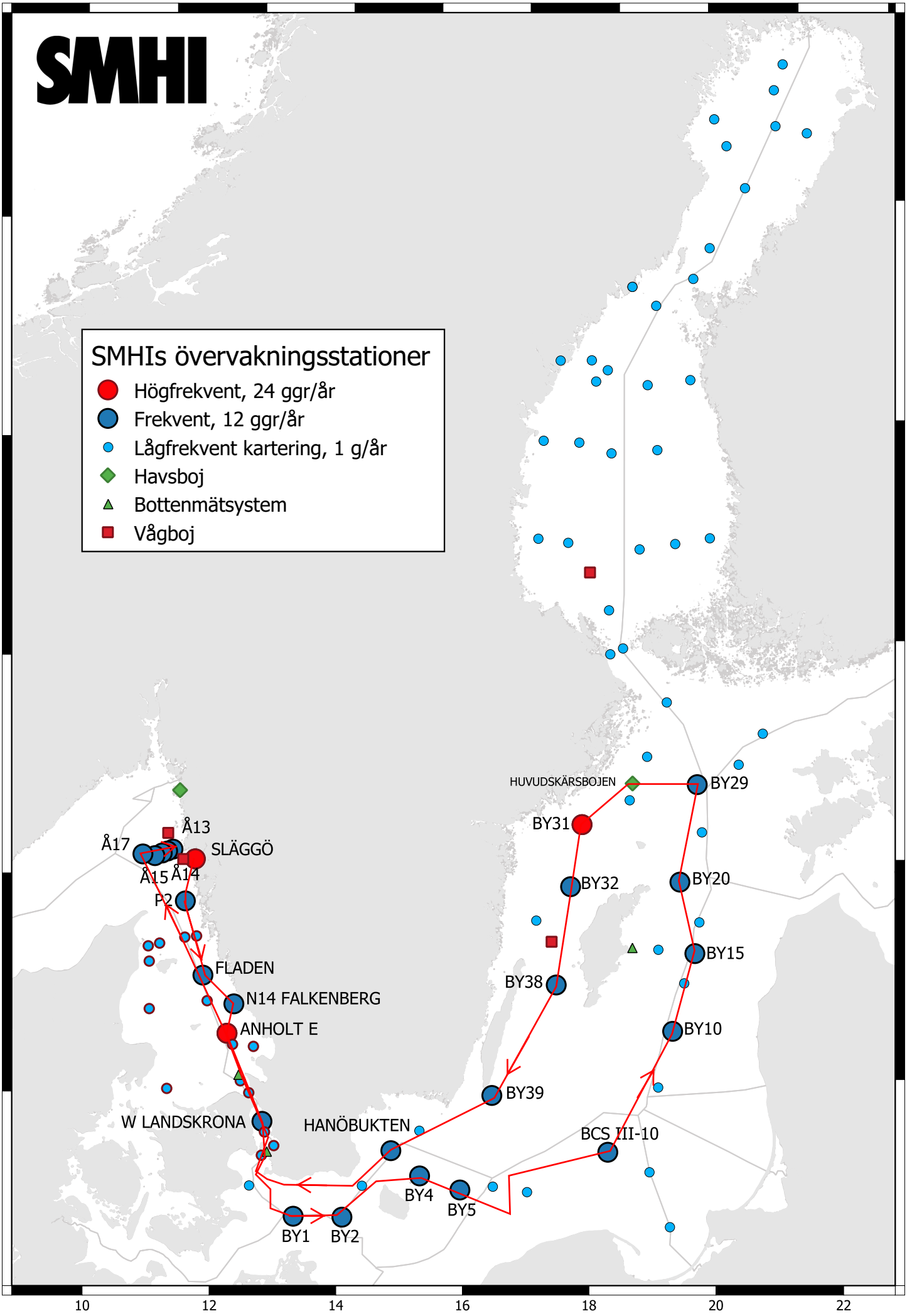
SMHI
SMHIs övervakningsstationer
Högfrekvent, 24 ggr/år
Frekvent, 12 ggr/år
Lågfrekvent kartering, 1 g/år
Havsboj
Bottenmätsystem
Vågboj
HUVUDSKÄRSBOJEN
BY29
BY31
BY32
BY20
BY15
BY38
BY10
BY39
BCS III-10
HANÖBUKTEN
BY4
BY5
BY1
BY2
W LANDSKRONA
ANHOLT E
N14 FALKENBERG
FLADEN
P2
Å17
Å13
SLÄGGÖ
Å15
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64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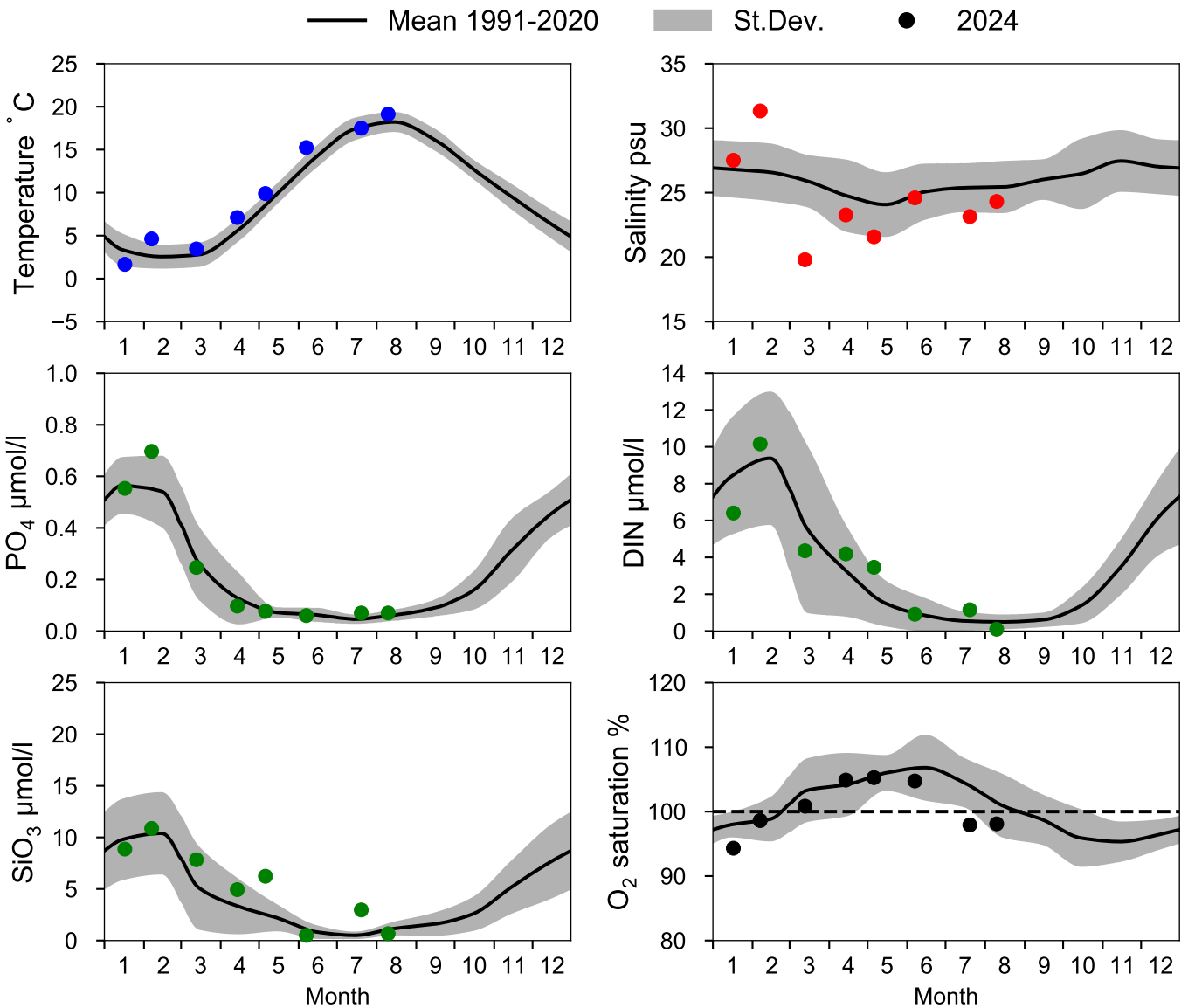
22

August 2024
Ship: 77SE

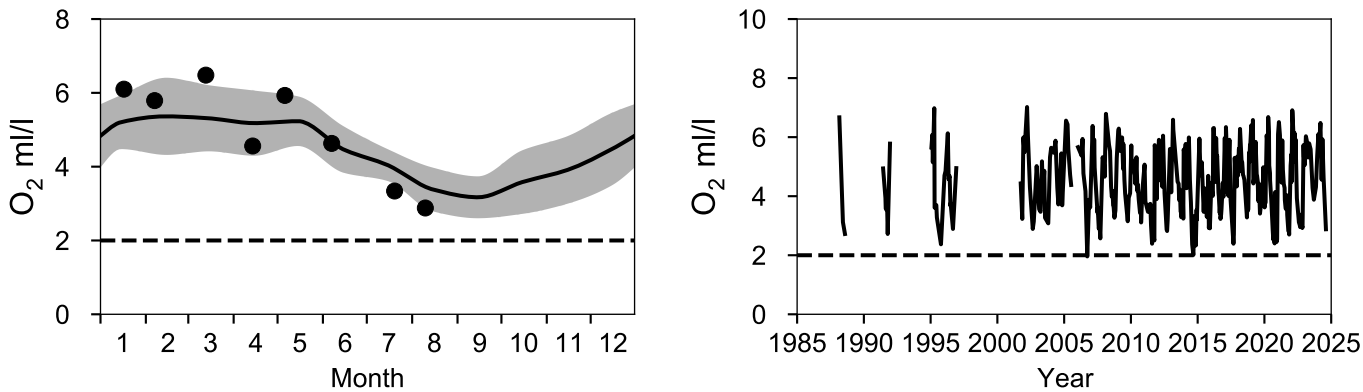
Serno	Cruise no	Station code	Proj	Station name	Lat	Lon	Date (yyyymmdd)	Start time (hhmm)	Bottom depth (m)	Secchi (m)	Wind direction	Wind velocity (m/s)	Air temp	Air pressure (kPa)	Weather codes	No depths	CTD	Bottom water (BW)	Watersample parameters								Zoopl. net	Phytopl. net	Hose 0-10 m						0-20m	
																			Salinity & Temp (BW)	O2/H2S	Nutrients	pH-electrode	pHT & Alkanity	pH / pHT / ALK sample depth	Humic substances	Chl - no. smaples	WP2-net, 90µm formalin	10µm net, acid lug	Chlorophyll	Picopl., formalin	Phytopl. acid lug	Phytopl basic lug	Primary production	Mikrozoopl. acid lug	Phytopln acid lug	Chlorophyll
585	17	FIBG27	BAS...	SLÄGGÖ	5815.58	01126.14	20240810	0554	74	6	18	4		1019	1220	9	X	X	X	X	X	-	X	0, 5, 10, 20, 30, 50, BW		10		20-0	X	X	X	X				
586	17	SKEX23	BAS...	P2	5752.05	01117.56	20240810	1043	94		26	13,4		1006	1250	10	X	X	X	X	X					9										
587	17	KANX25	BAS...	FLADEN	5711.57	01139.61	20240810	1620	79		25	12		1010	1440	12	X	X	X	X	X	-	X	0, 5, 10, 20, 30, 50, BW		10										
588	17	KANX50	BAS...	N14 FALKENBERG	5656.34	01212.99	20240810	2000	31		27	15			9990	7	X	X	X	X	X					8		20-0	X	X	X	X				
589	17	KAEX29	BAS...	ANHOLT E	5640.11	01206.71	20240810	2223	62		26	11		1011	9990	10	*X*	*X*	*X*	*X*	*X*	*X*	*X*	0, 5, 10, 20, 30, 50, BW	*X*	*11*		20-0	X	X	X	X		X		
590	17	SOCX39	BAS...	W LANDSKRONA	5551.89	01244.95	20240811	0407	52		28	11		1013	1130	9	X	X	X	X	X					9										
591	17	BPSA02	BAS...	BY1	5500.96	01318.08	20240811	1359	45	7	31	6		1018	1230	8	X	X	X	X	X					8										
592	17	BPSA03	BAS...	BY2 ARKONA	5458.22	01406.29	20240811	1732	46		28	9		1016	1130	7	X	X	X	X	X	-	X	0, 5, 10, 40, BW	X	9	btn-30, 30-0	20-0	X	X	X	X				
593	17	BPSB06	BAS...	BY4 CHRISTIANSÖ	5522.97	01520.06	20240812	0015	91		30	10		1015	9990	12	X	X	X	X	X					9										
594	17	BPSB07	BAS...	BY5 BORNHOLMSDJ	5515.01	01559.12	20240812	0340	90		29	9		1014	9990	12	X	X	X	X	X	X	X	0, 5, 10, 40, 60, 80, BW	X	10	60-30, 30-0	20-0	X	X	X	X				
595	17	BPSE11	BAS...	BCS III-10	5533.31	01824.00	20240812	1241	90	8	30	7		1012	1140	12	X	X	X	X	X				X	10			X			X				
596	17	BPEX13	BAS...	BY10	5638.02	01935.1	20240812	2110	144		29	7		1012	9990	15	X	X	X	X	X					9										
597	17	BPEX21	BAS...	BY15 GOTLANDSDJ	5718.76	02004.73	20240813	0208	241		30	8		1012	9990	23	X			X[2]	X	X	X	0, 5, 10, 40, 60, 80, 125, 200, BW	X	10	60-30, 30-0	20-0	X	X	X	X				
598	17	BPEX26	BAS...	BY20 FÅRÖDJ	5759.9	01952.68	20240813	0805	197	9	36	4		1015	1220	17	X			X	X		X			9			X				X			
599	17	BPNX35	BAS...	BY29/LL19	5852.90	02019.66	20240813	1357	176	6	26	1		1016	0020	16	X			X	X					10			X			X				
600	17	BPNX00	EXT...	HUVUDSKÄR	5856.00	01910.09	20240813	1838	96		22	4		1016	1420	12	X																			
601	17	BPNX37	BAS...	BY31 LANDSORTSDJ	5835.63	01814.21	20240813	2230	448		22	3		1017	9990	22	X			X	X	X	X	0, 5, 10, 40, 60, 80, 125, 200, BW	X	12	60-30, 30-0	20-0	X	X	X	X			X	X
602	17	BPWX38	BAS...	BY32 NORRKÖPINGSDJ	5800.93	01759.22	20240814	0358	202		20	3		1017	1420	17	X			X	X					9										
604	17	BPWX45	BAS...	BY38 KARLSÖDJ	5707.04	01740.12	20240814	1230	109	8	15	7		1016	1120	14	X	X	X	X	X		X		X	10			X			X	X			
605	17	BPSE49	BAS...	BY39 ÖLANDS S UDDE	5606.98	01632.16	20240814	2135	51		12	8		1014	9990	8	X	X	X	X	X	-	X	0, 5, 10, 40, BW		9	btn-30, 30-0	20-0	X	X	X	X				
606	17	BPSH05	BAS...	HANÖBUKTEN	5537.08	01452.15	20240815	0429	78		15	8		1010	1430	11	X	X	X	X	X		X			9			X				X			
607	17	SOSX00	EXT...	FLINTEN-7	5534.58	01249.85	20240815	1449	9		21	6		1011	1630	3	X																			
608	17	KAEX29	BAS...	ANHOLT E	5640.11	01206.71	20240815	2230	63		20	8		1009	9990	10	X	X	X	X	X	X	X	0, 5, 10, 20, 30, 50, BW	X	11	25-0	20-0	X	X	X	X		X		
609	17	SKEX16	BAS...	Å15	5817.78	01050.79	20240816	0930	130		10	28	7	1007	0040	12	X	X	X	X	X					9										
610	17	SKEX18	BAS...	Å17	5817.08	01030.43	20240816	1135	339		10	29	6	1008	0040	15	X			X	X	X	X	0, 5, 10, 20, 30, 50, 200, BW		10	25-0	20-0	X	X	X	X				
611	17	SKEX17	BAS...	Å16	5816.26	01043.24	20240816	1400	195		25	6		1008	0040	13	X																			
612	17	SKEX15	BAS...	Å14	5818.92	01056.43	20240816	1510	107		26	7		1008	0040	11	X																			
613	17	SKEX14	BAS...	Å13	5820.33	01101.55	20240816	1610	103	9	26	9		1008	0040	10	X	X	X	X	X	-	X	0, 5, 10, 20, 30, 50, BW		9										

STATION SLÄGGÖ SURFACE WATER (0-10 m)

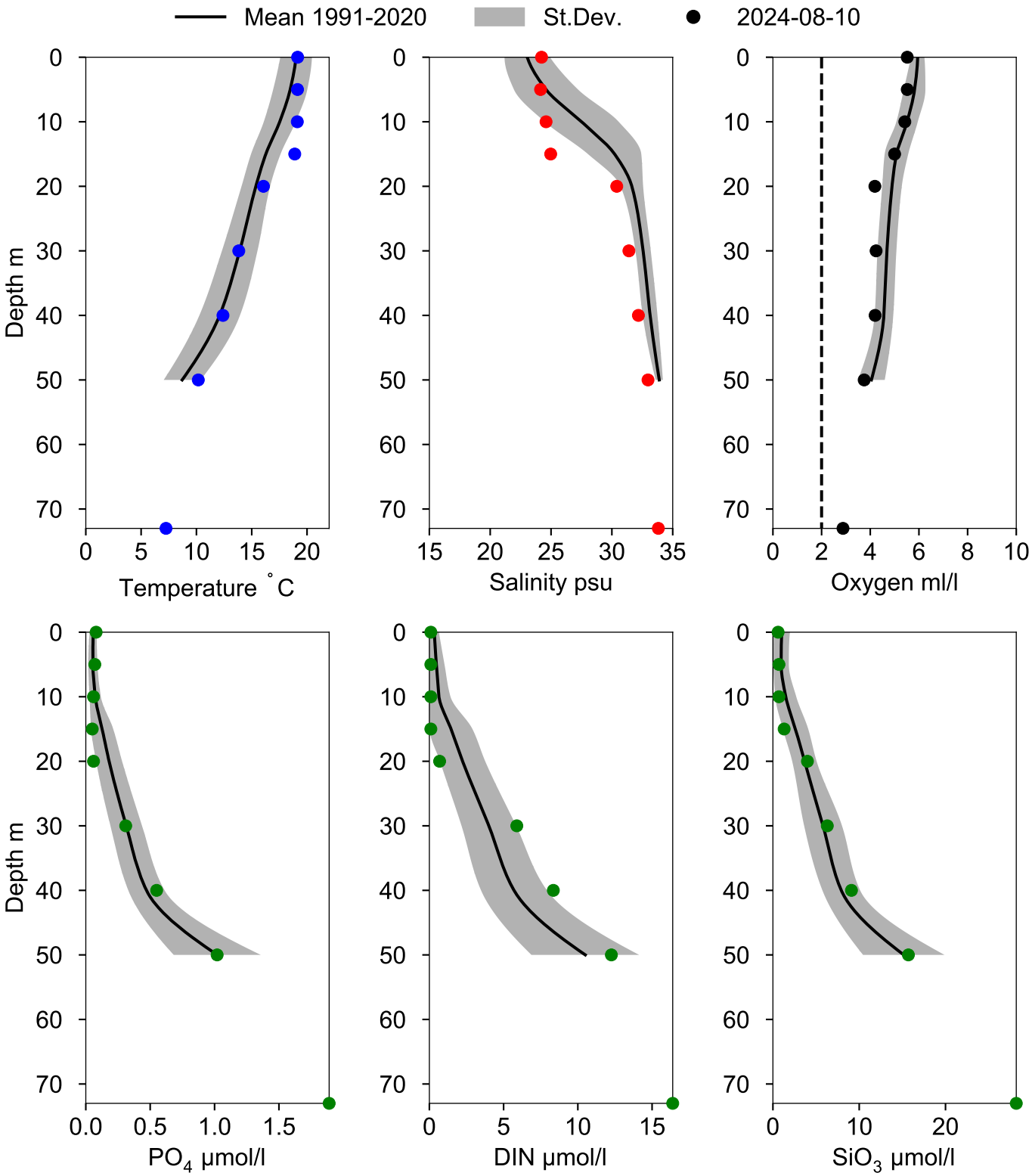
Annual Cycles



OXYGEN IN BOTTOM WATER (depth >= 64 m)

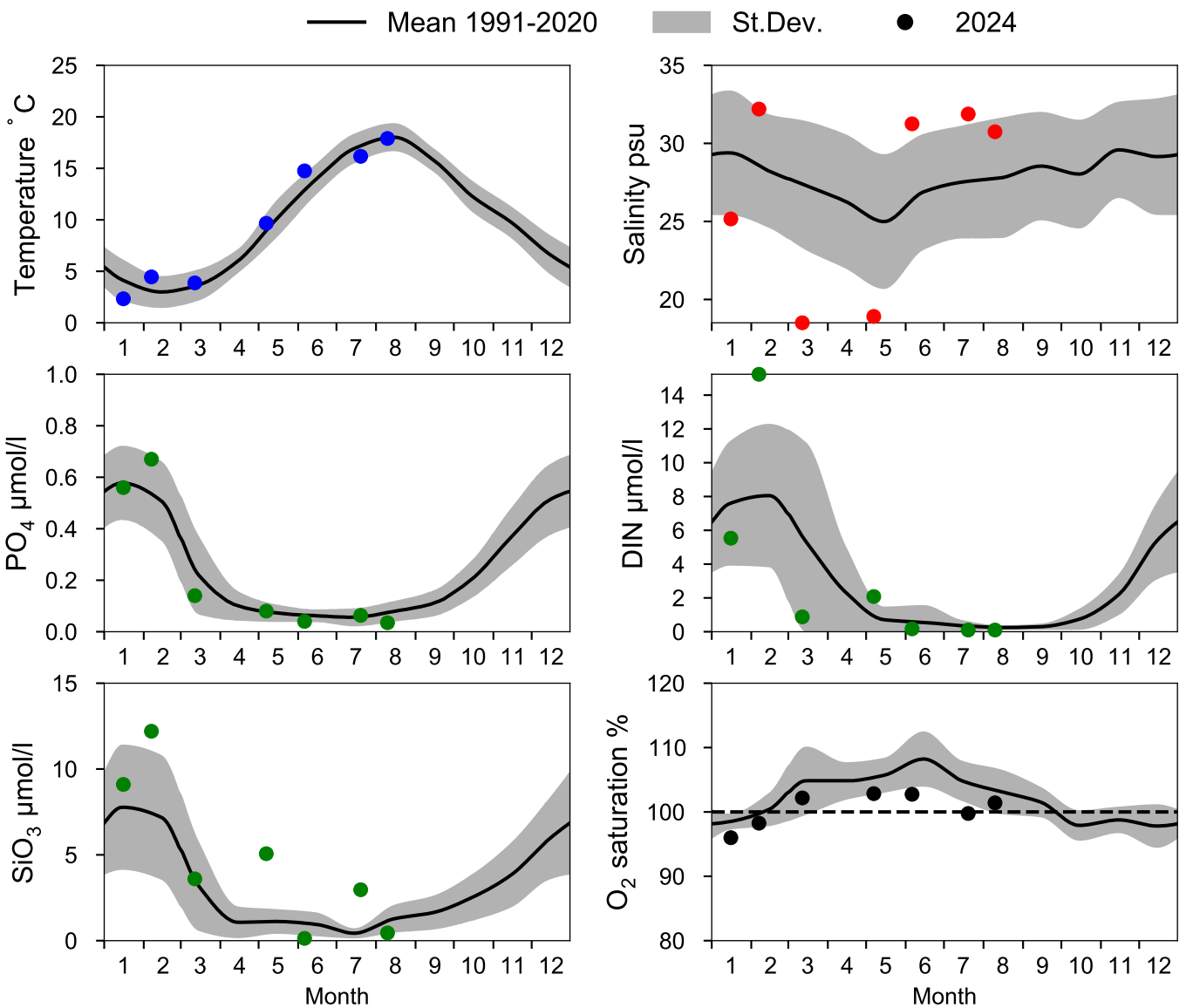


Vertical profiles SLÄGGÖ
August

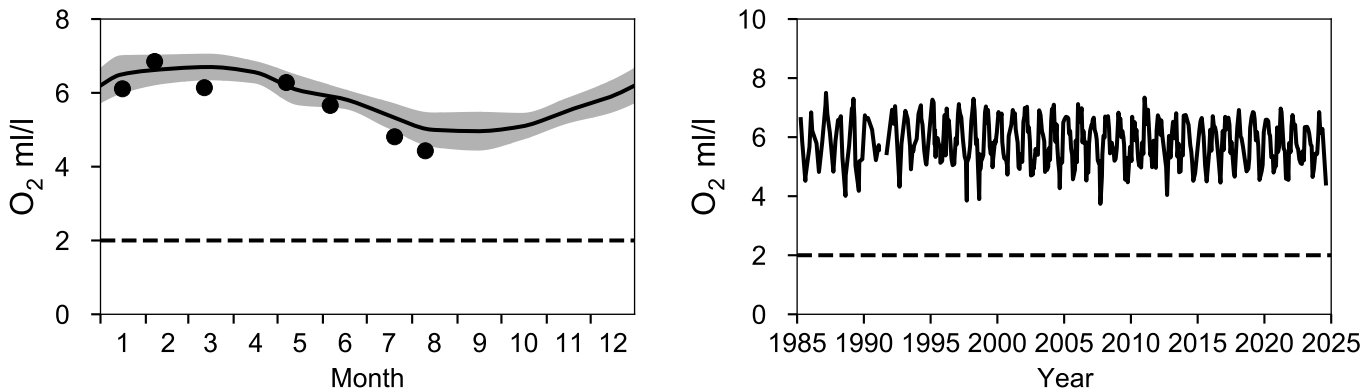


STATION P2 SURFACE WATER (0-10 m)

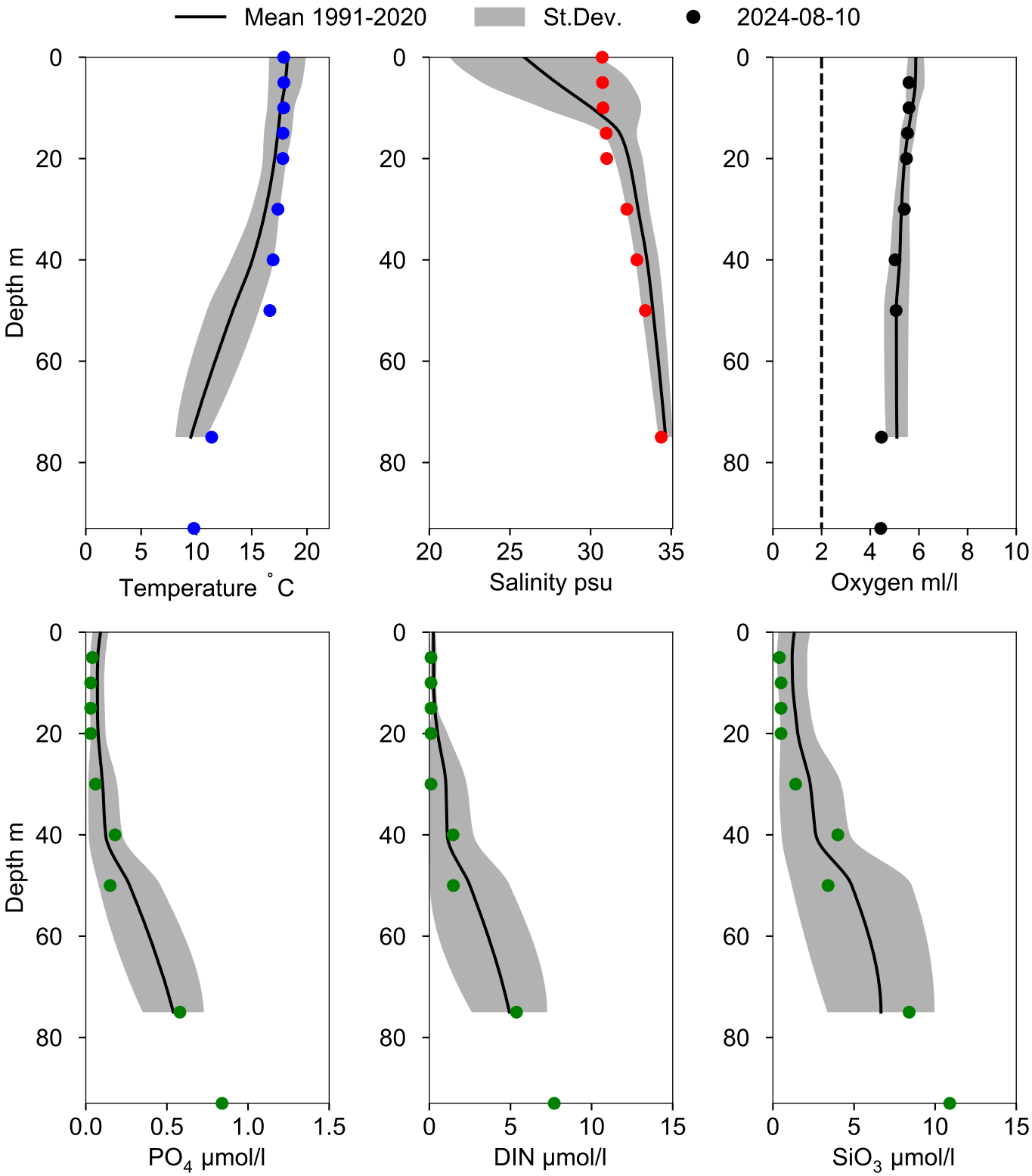
Annual Cycles



OXYGEN IN BOTTOM WATER (depth >= 75 m)

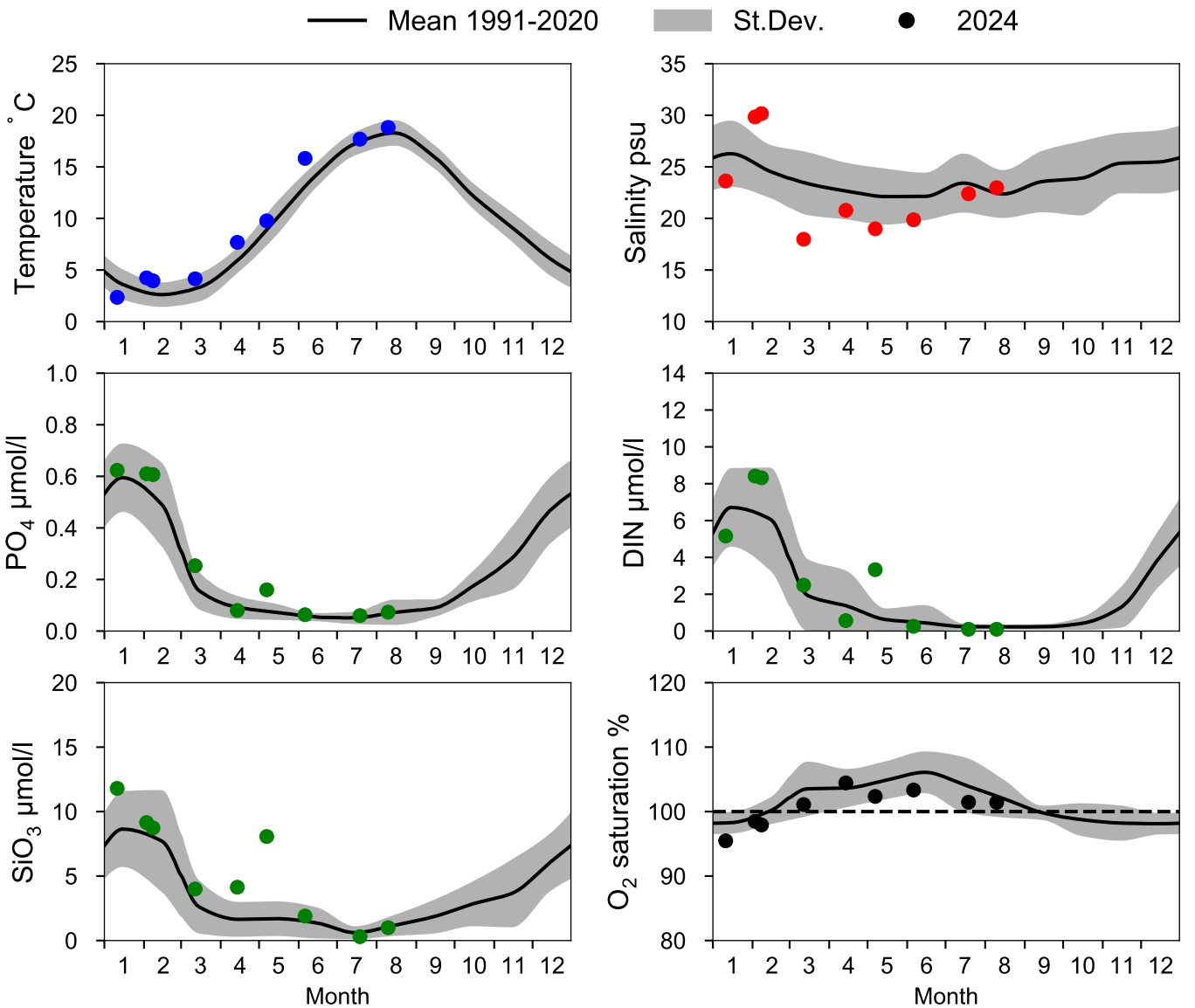


Vertical profiles P2
August

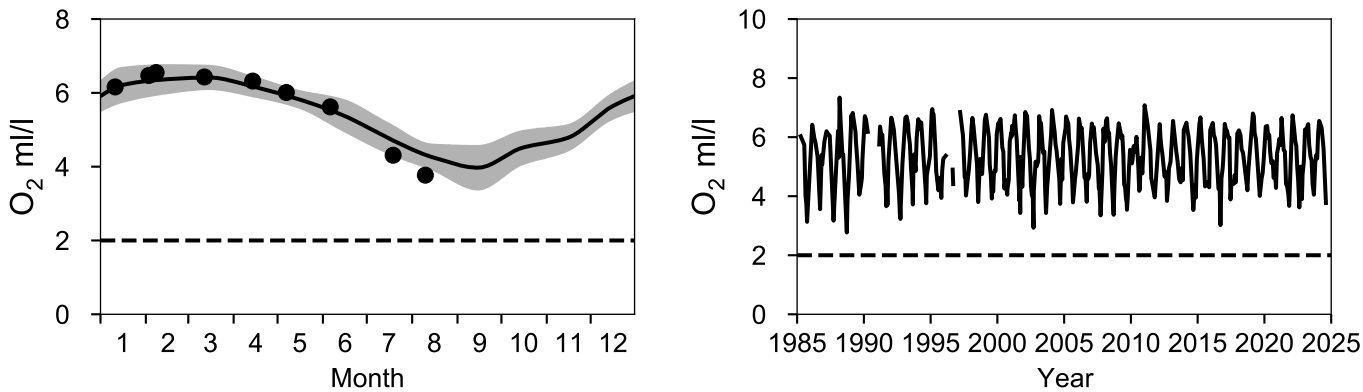


STATION FLADEN SURFACE WATER (0-10 m)

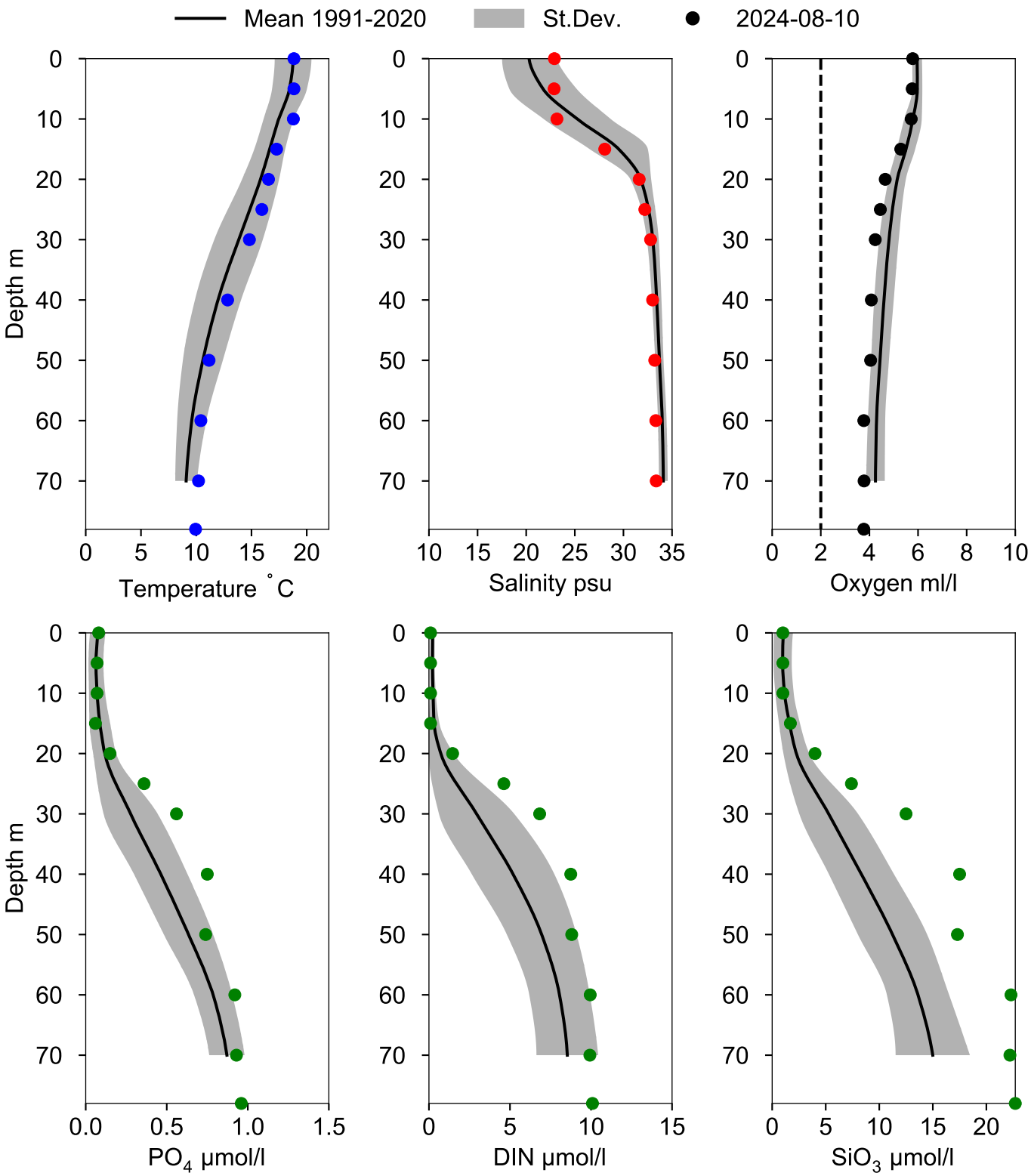
Annual Cycles



OXYGEN IN BOTTOM WATER (depth >= 74 m)

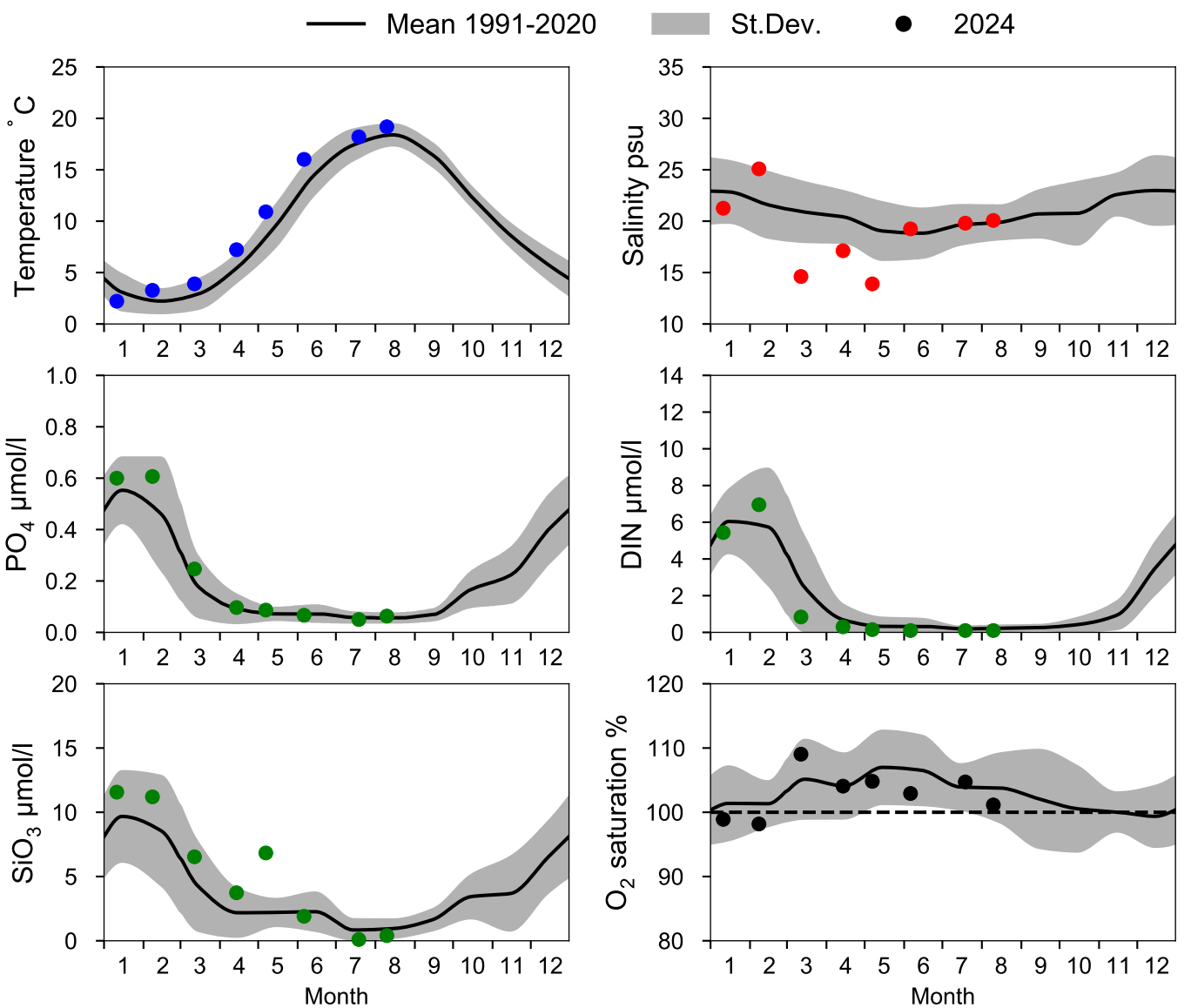


Vertical profiles FLADEN
August

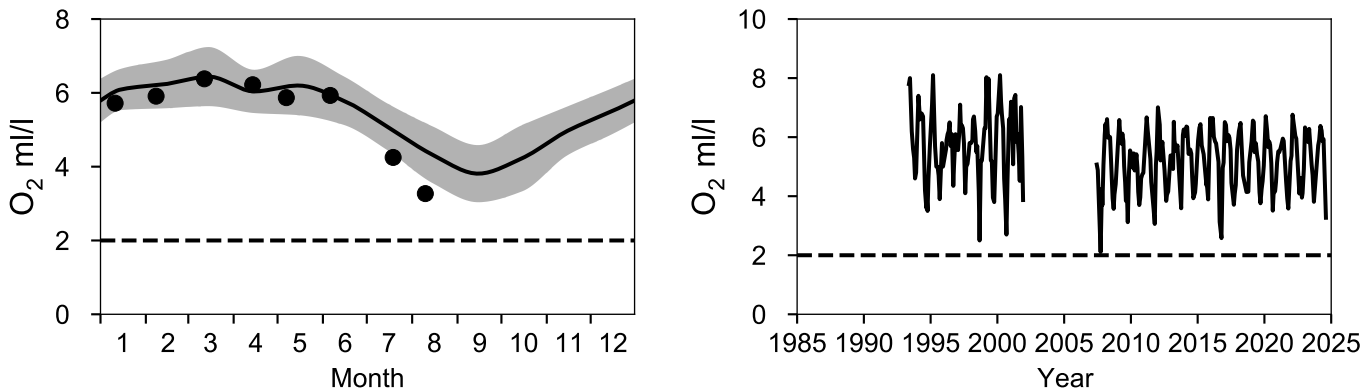


STATION N14 FALKENBERG SURFACE WATER (0-10 m)

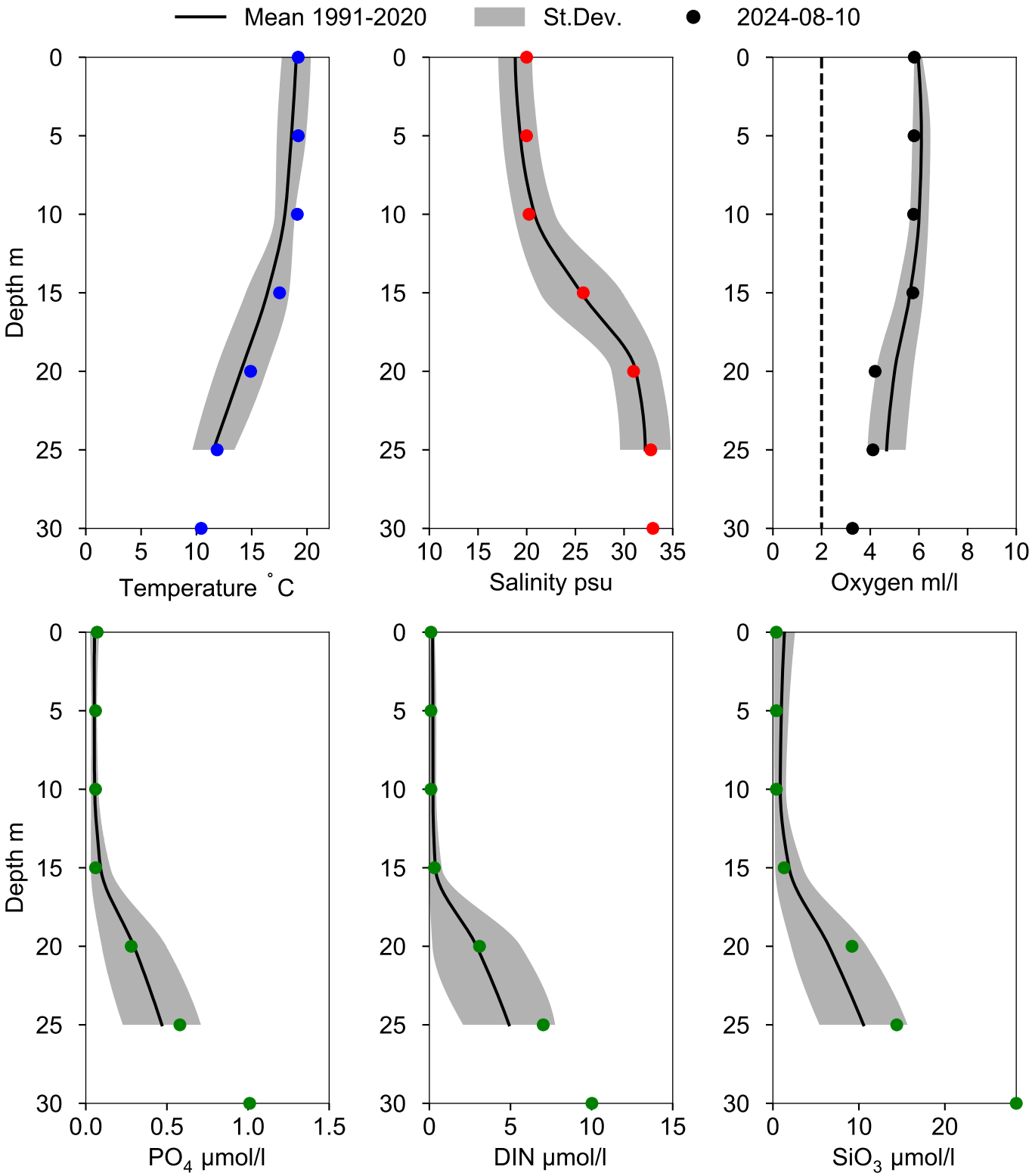
Annual Cycles



OXYGEN IN BOTTOM WATER (depth >= 25 m)

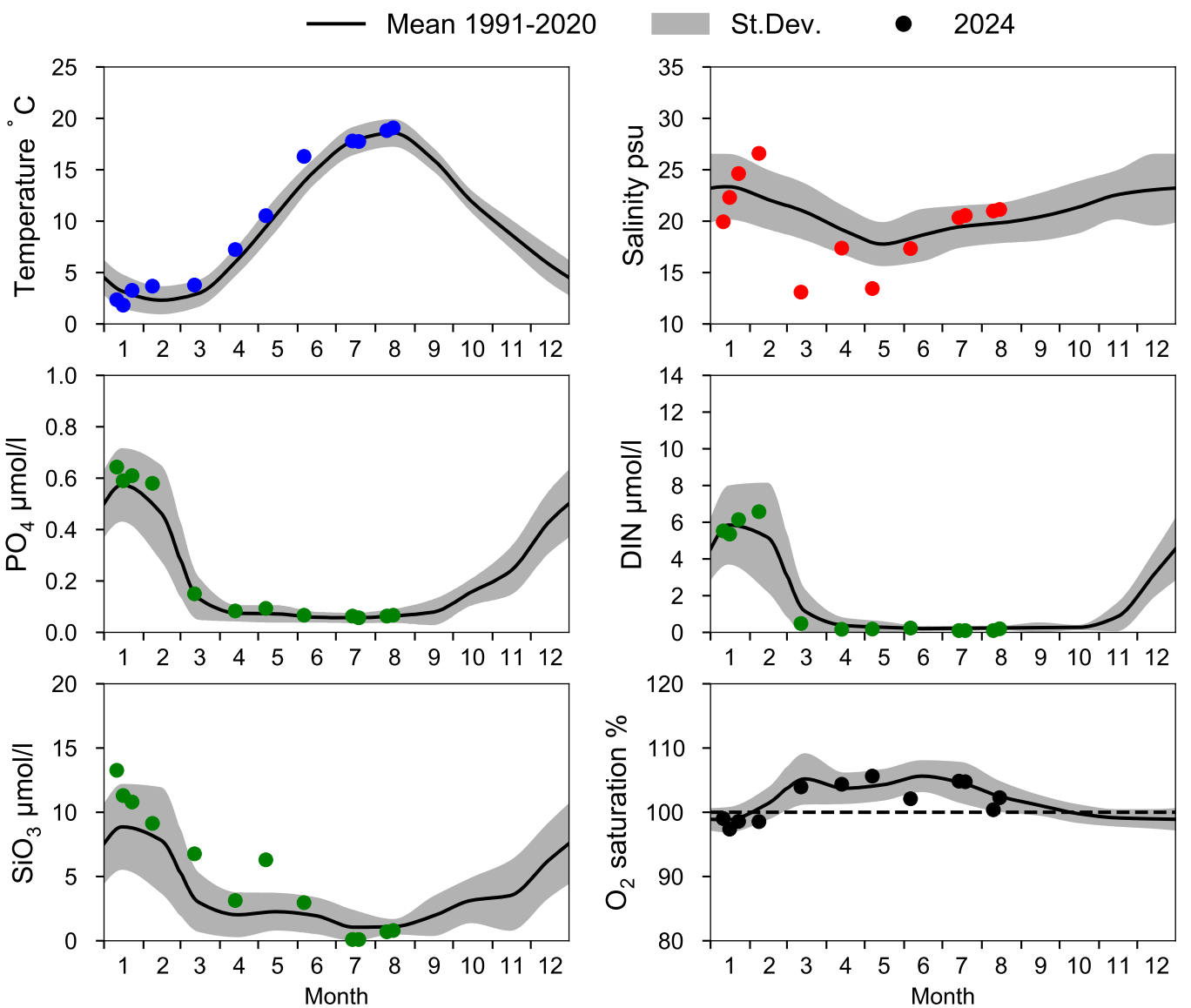


Vertical profiles N14 FALKENBERG
August

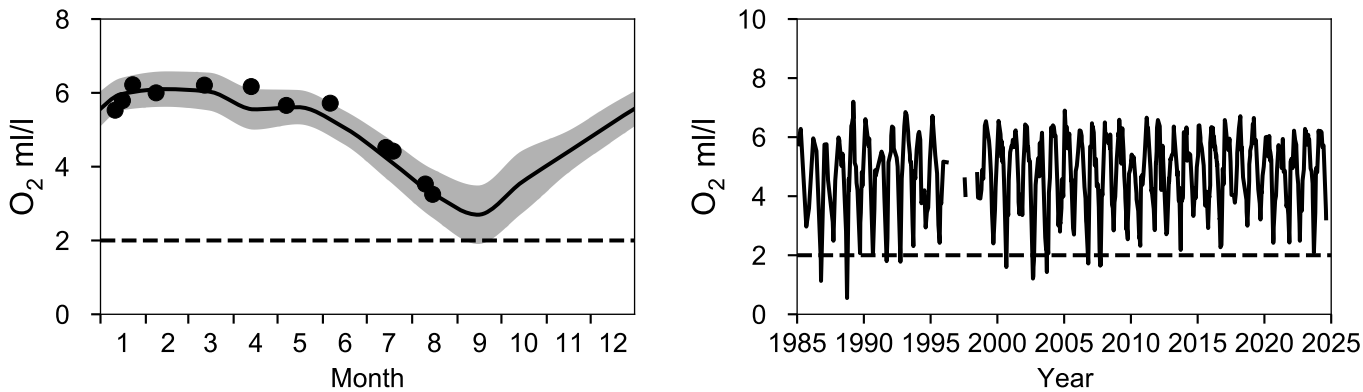


STATION ANHOLT E SURFACE WATER (0-10 m)

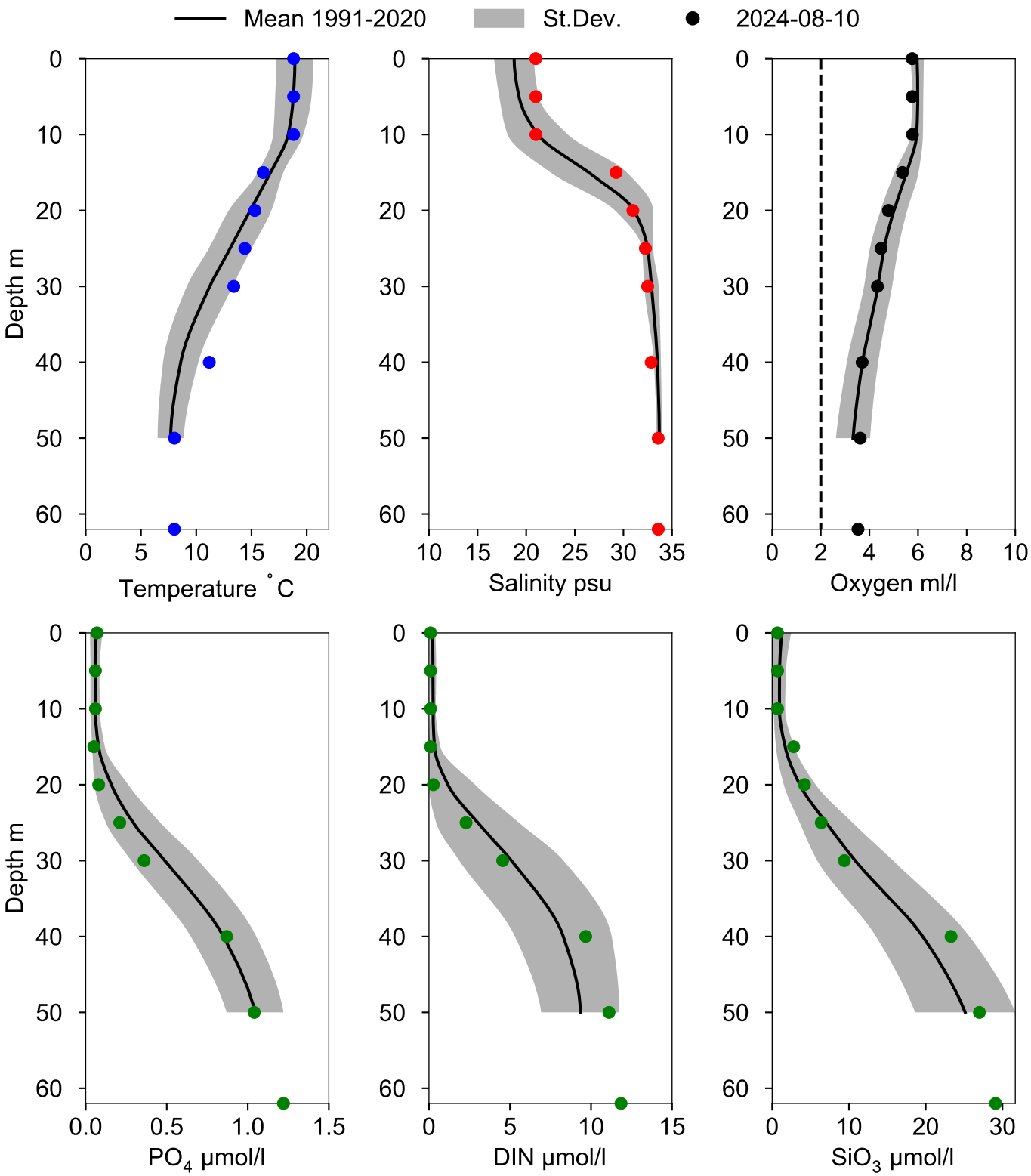
Annual Cycles



OXYGEN IN BOTTOM WATER (depth >= 52 m)

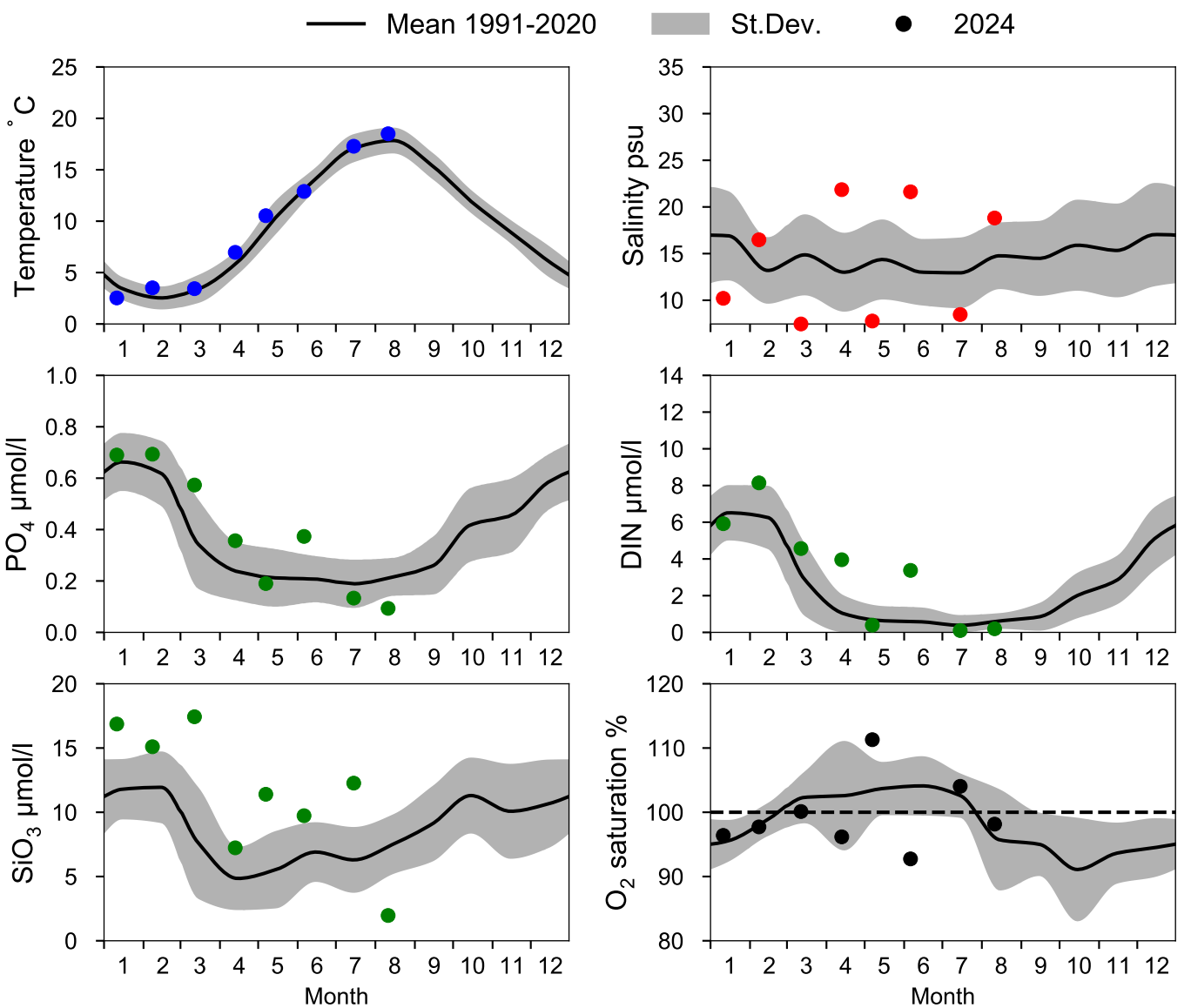


Vertical profiles ANHOLT E
August

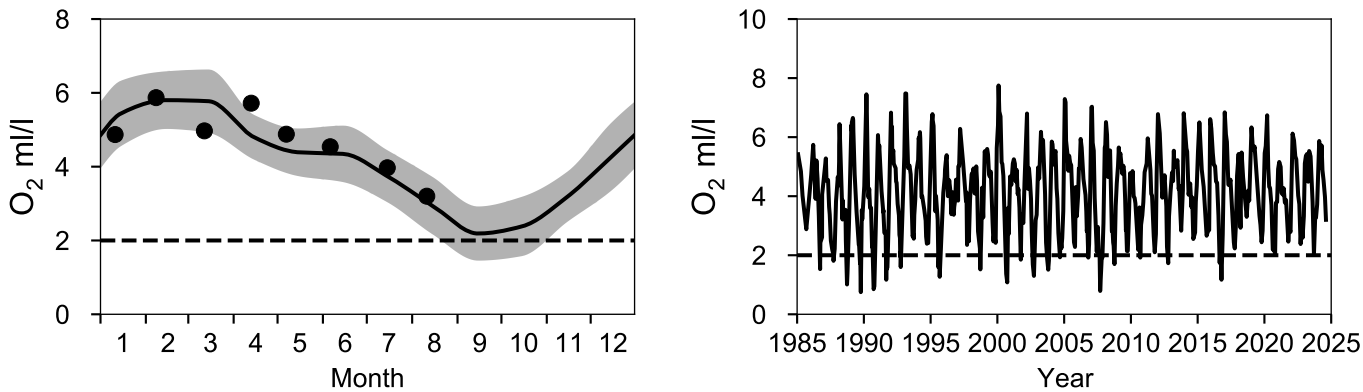


STATION W LANDSKRONA SURFACE WATER (0-10 m)

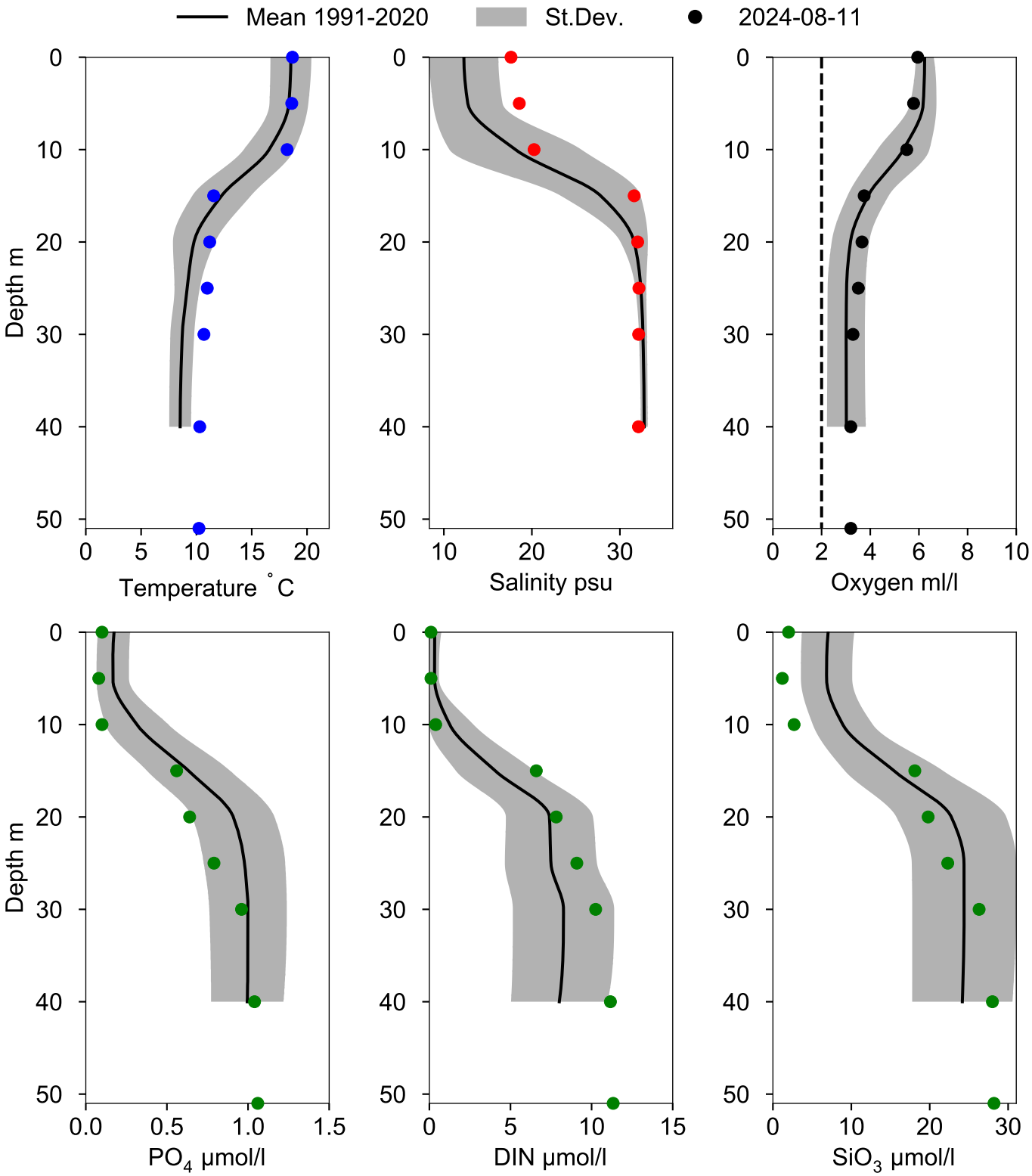
Annual Cycles



OXYGEN IN BOTTOM WATER (depth >= 40 m)

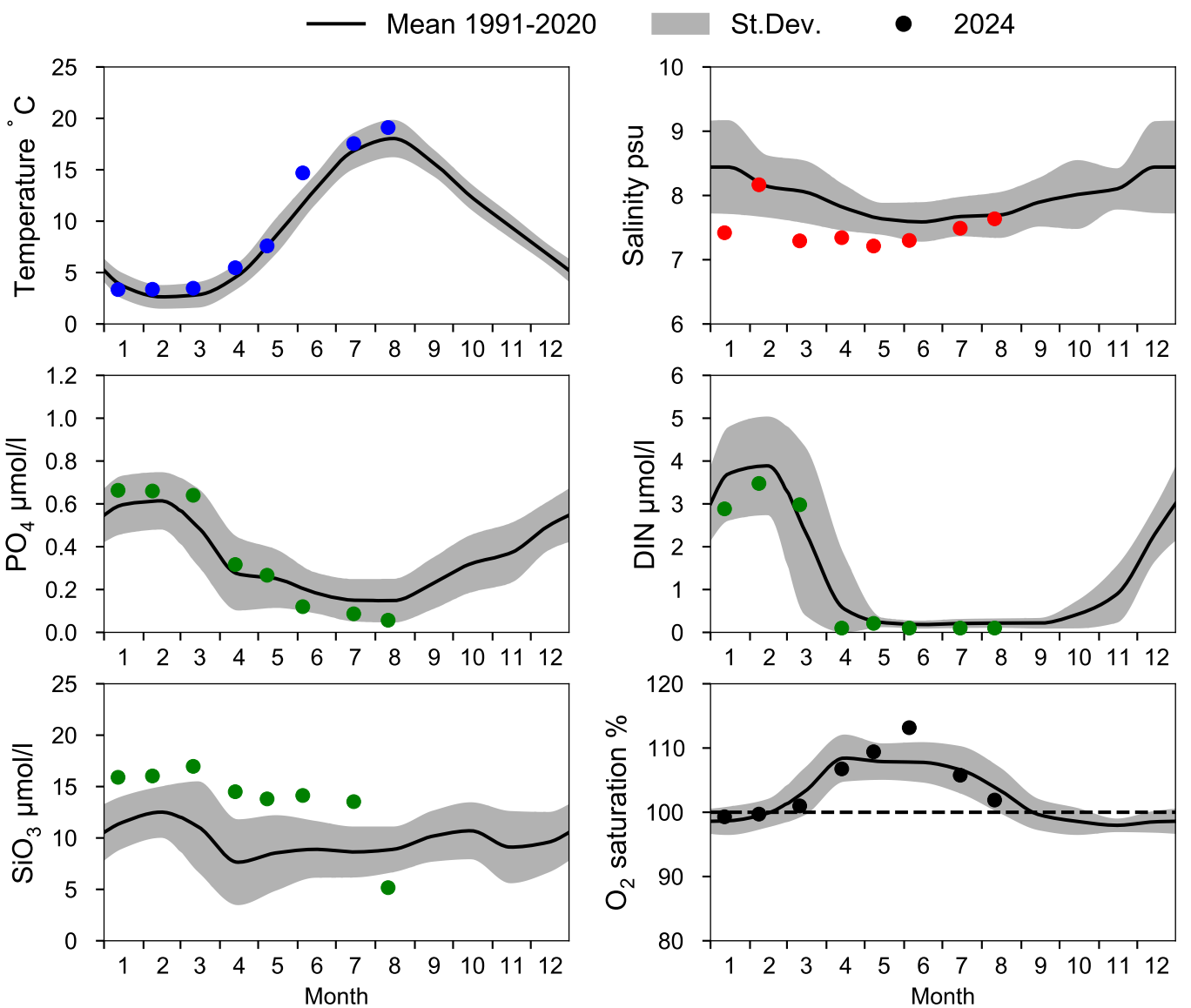


Vertical profiles W LANDSKRONA
August

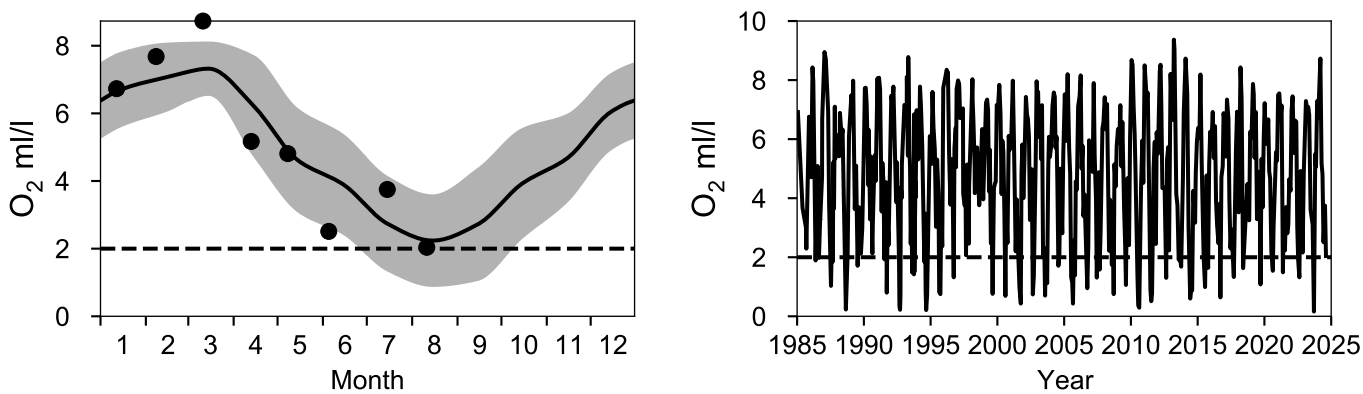


STATION BY1 SURFACE WATER (0-10 m)

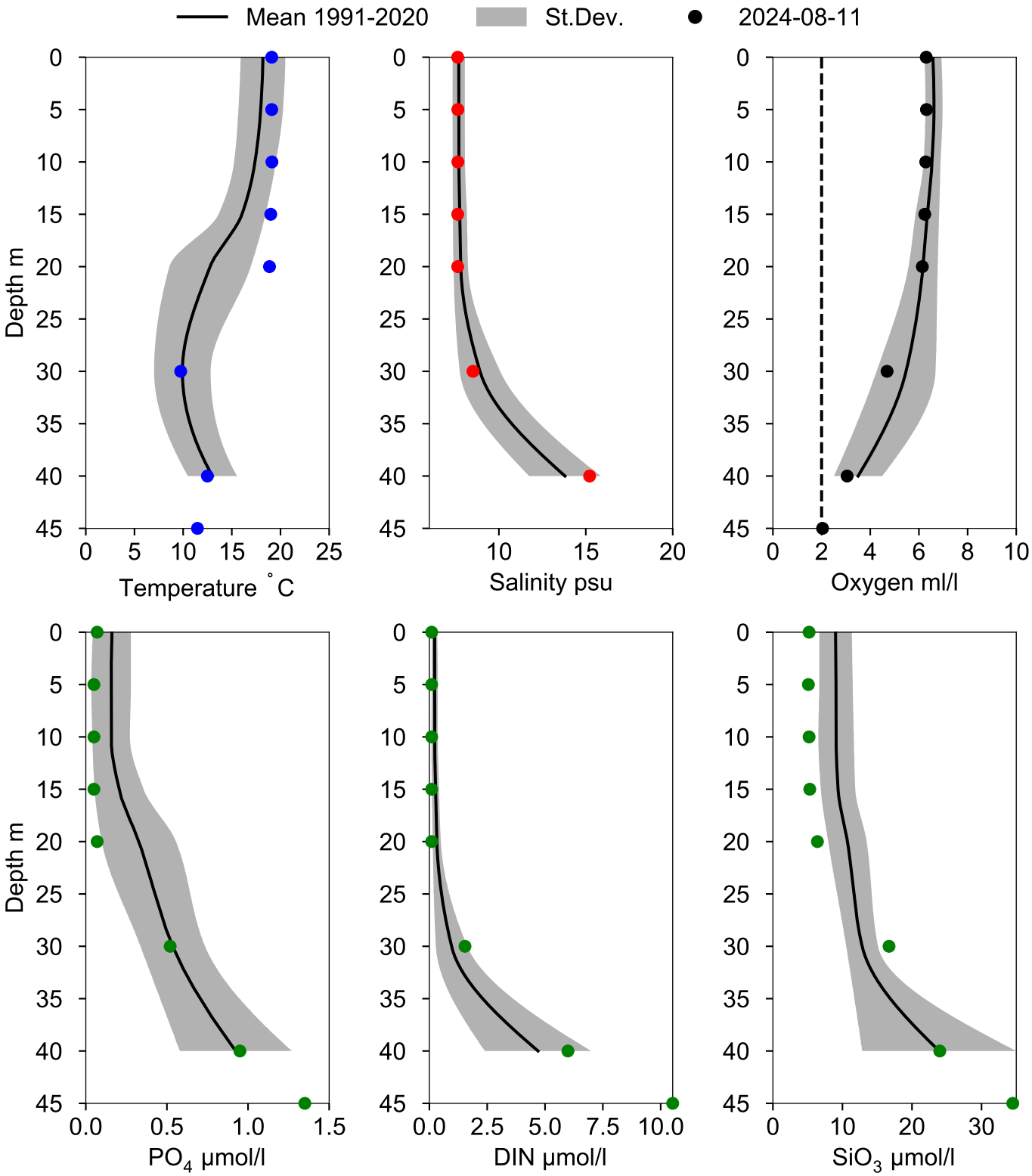
Annual Cycles



OXYGEN IN BOTTOM WATER (depth >= 39 m)

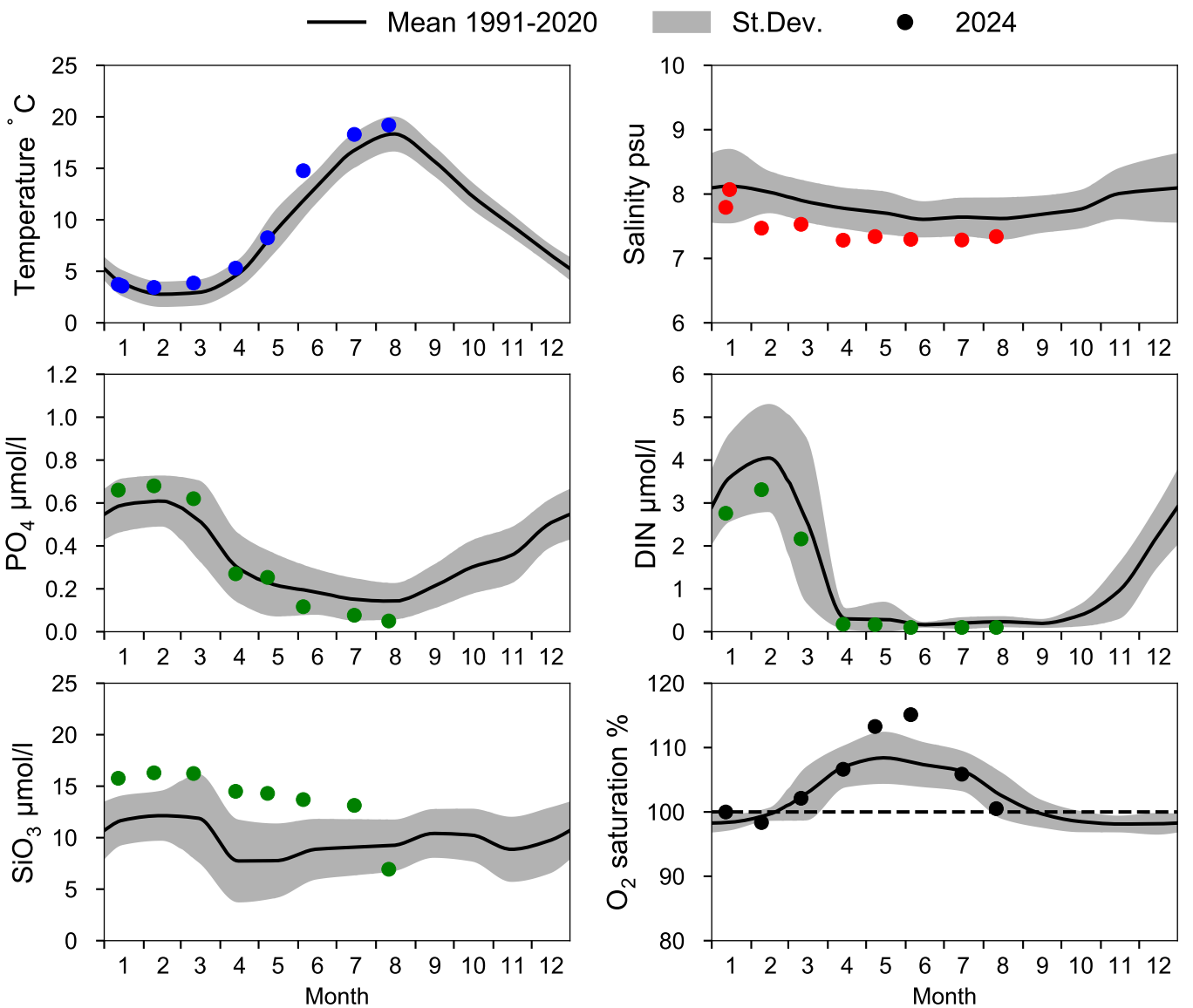


Vertical profiles BY1
August

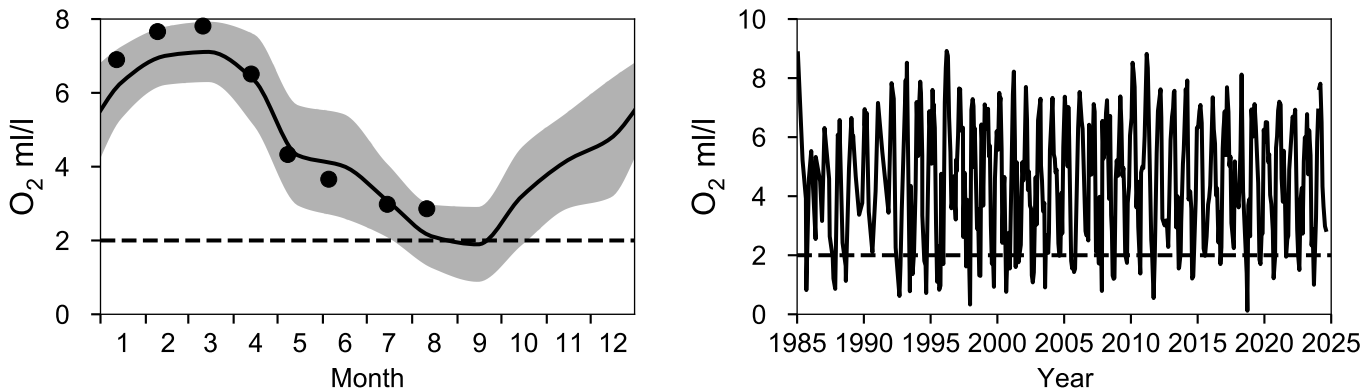


STATION BY2 ARKONA SURFACE WATER (0-10 m)

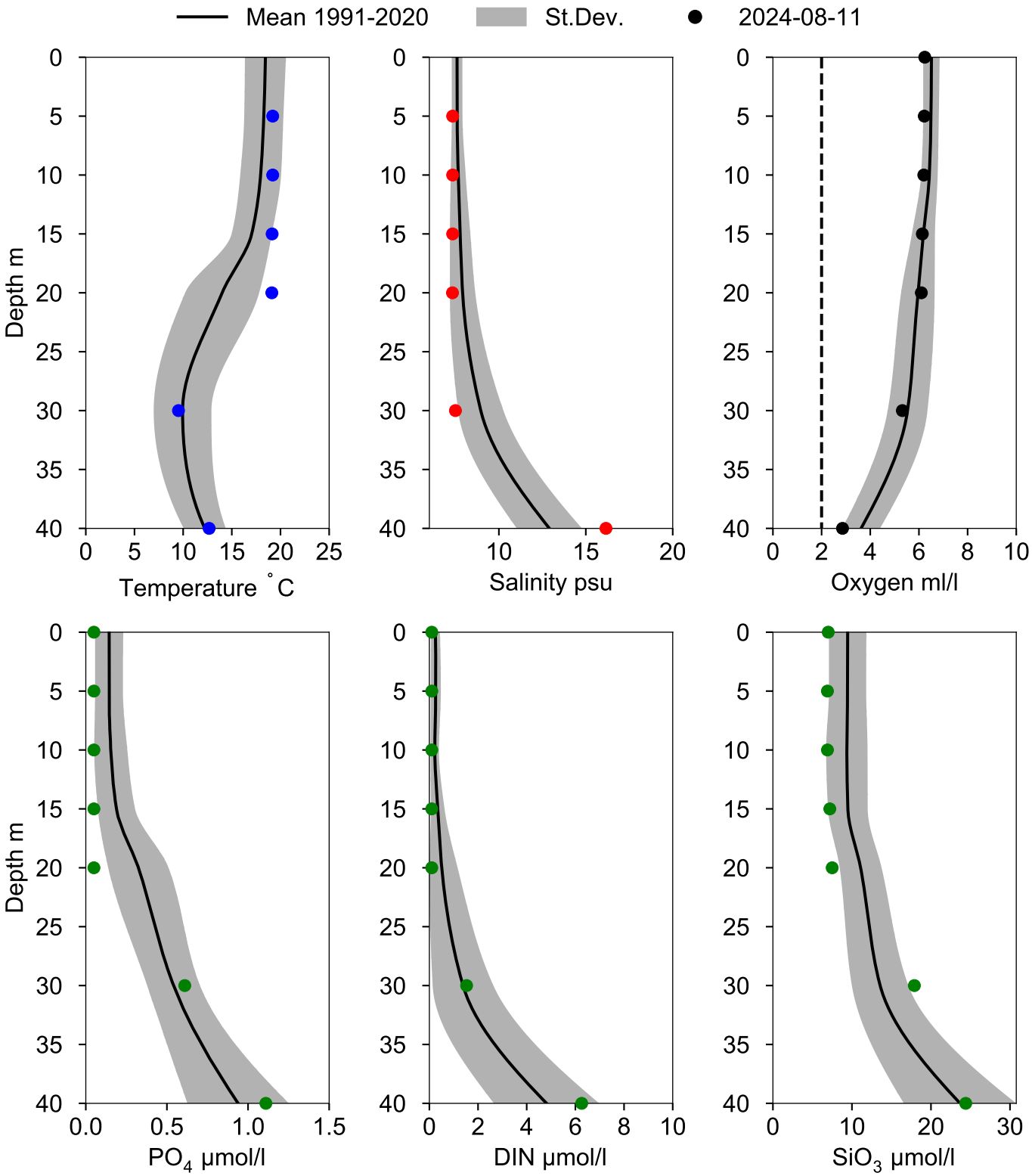
Annual Cycles



OXYGEN IN BOTTOM WATER (depth >= 40 m)

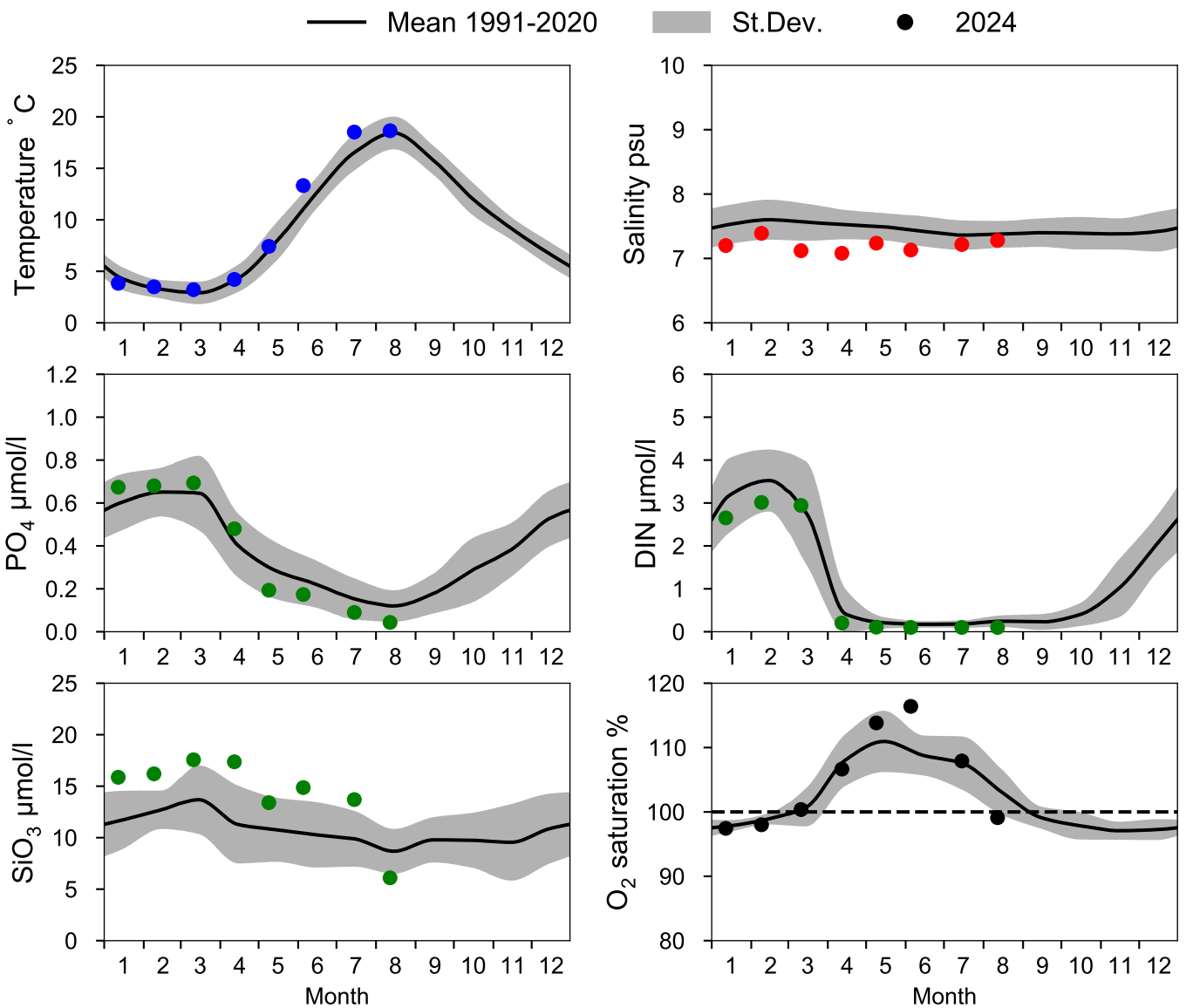


Vertical profiles BY2 ARKONA
August

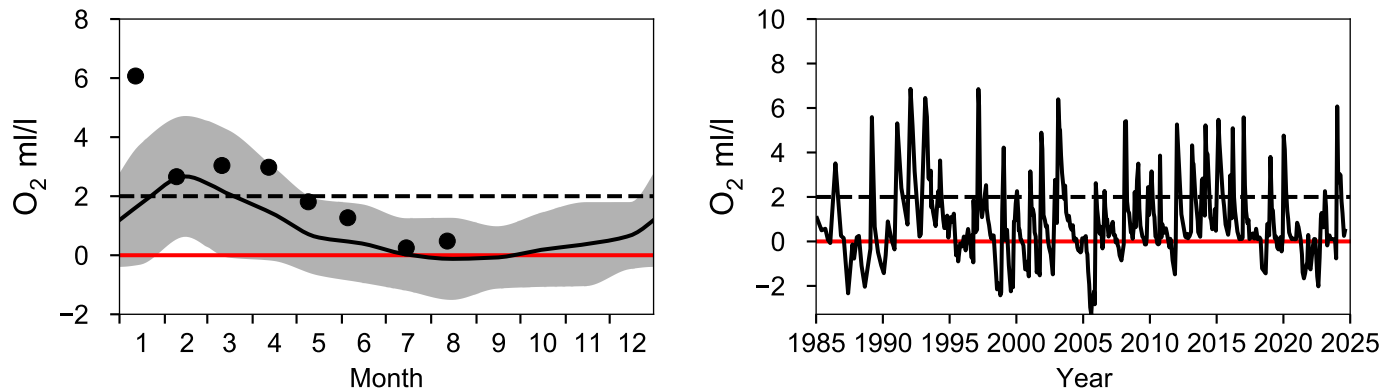


STATION BY4 CHRISTIANSÖ SURFACE WATER (0-10 m)

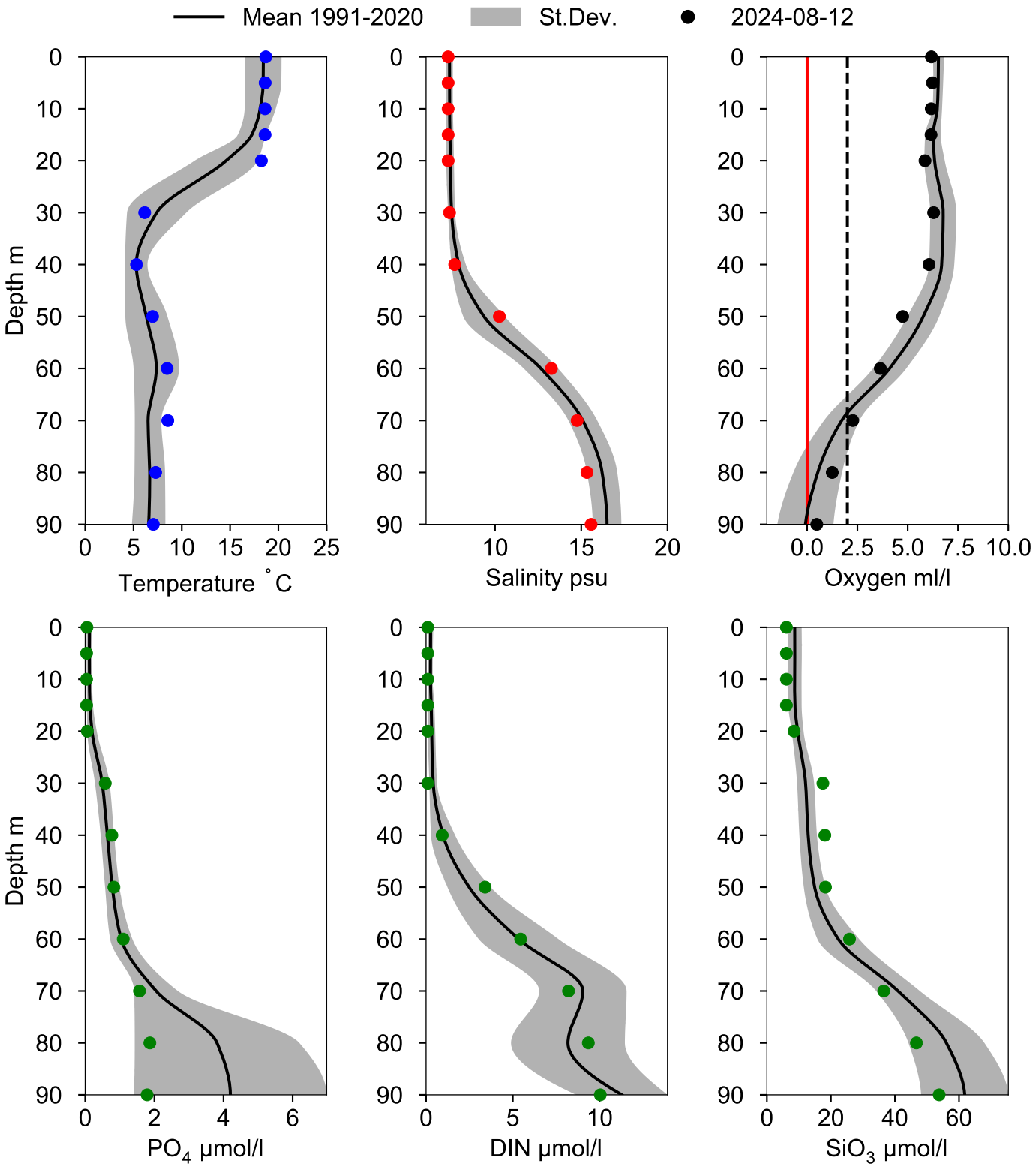
Annual Cycles



OXYGEN IN BOTTOM WATER (depth >= 80 m)

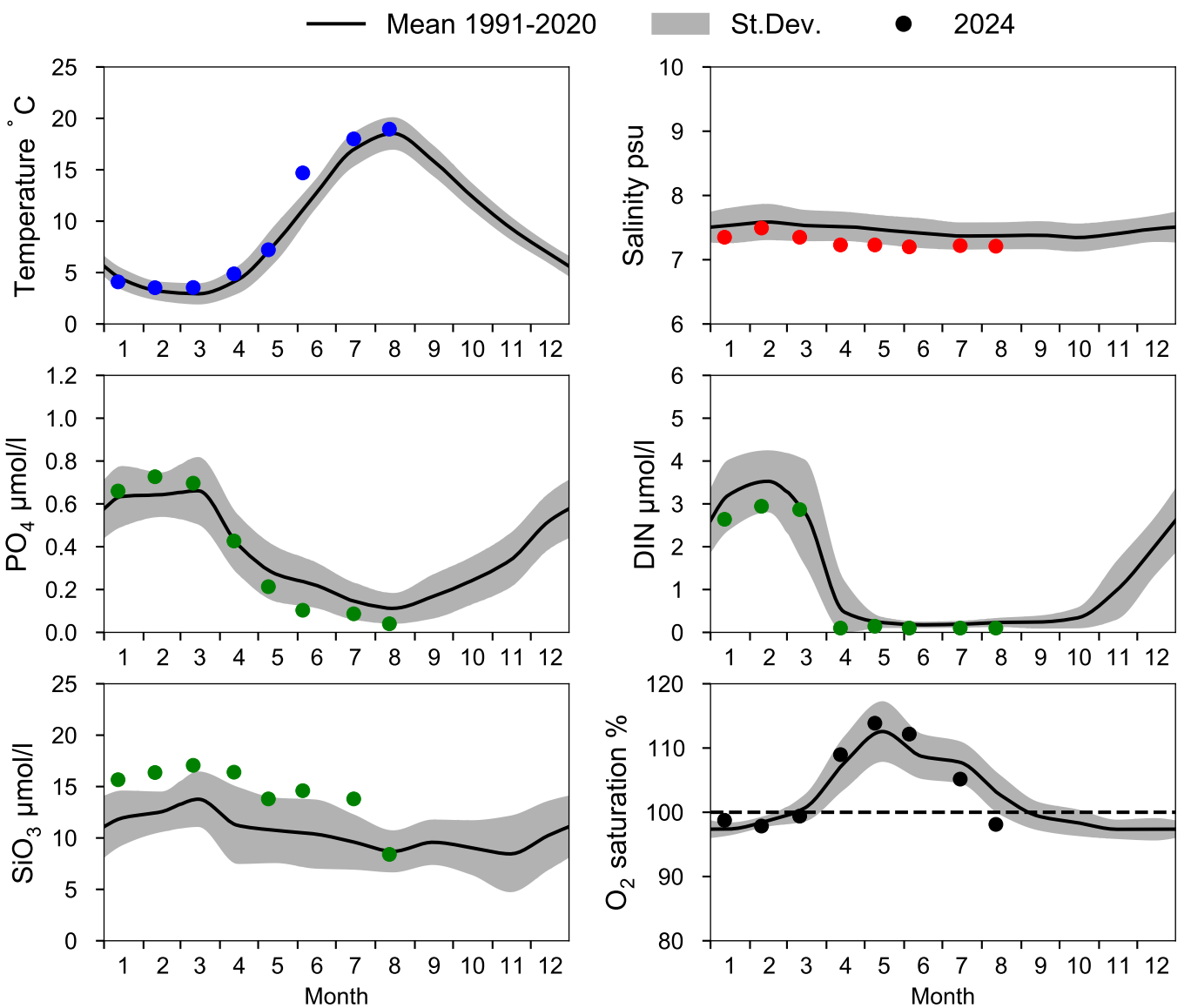


Vertical profiles BY4 CHRISTIANSÖ
August

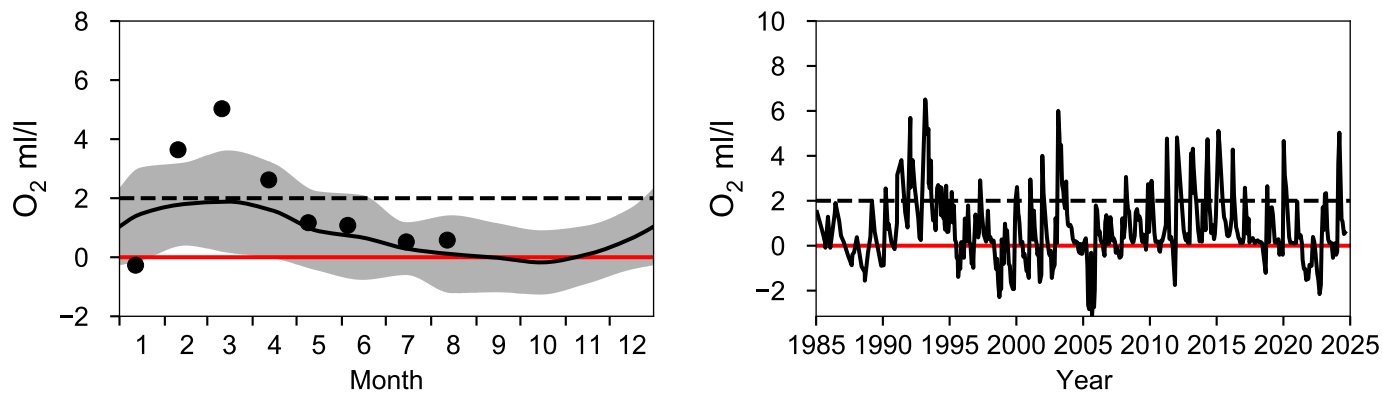


STATION BY5 BORNHOLMSDJ SURFACE WATER (0-10 m)

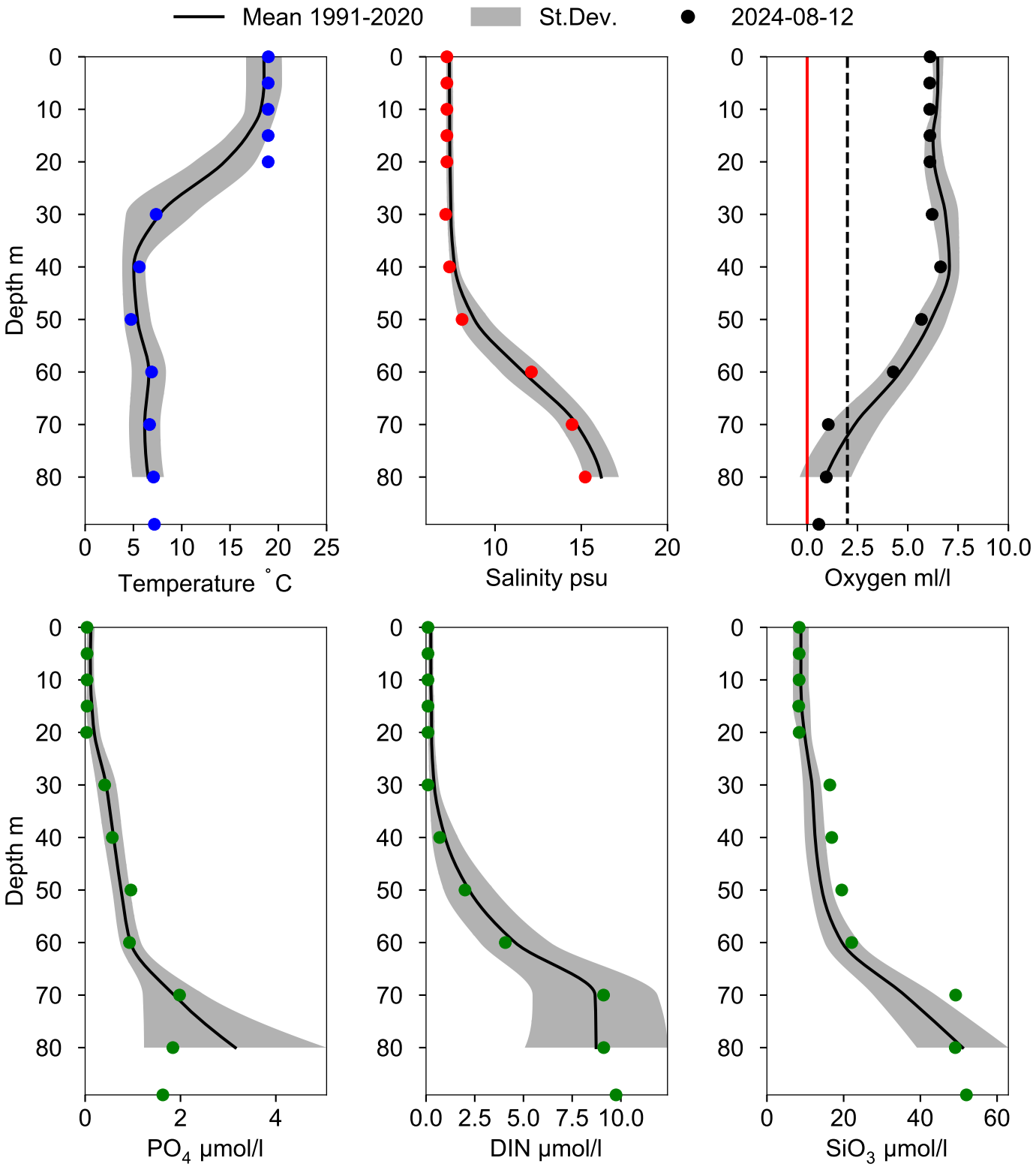
Annual Cycles



OXYGEN IN BOTTOM WATER (depth >= 80 m)

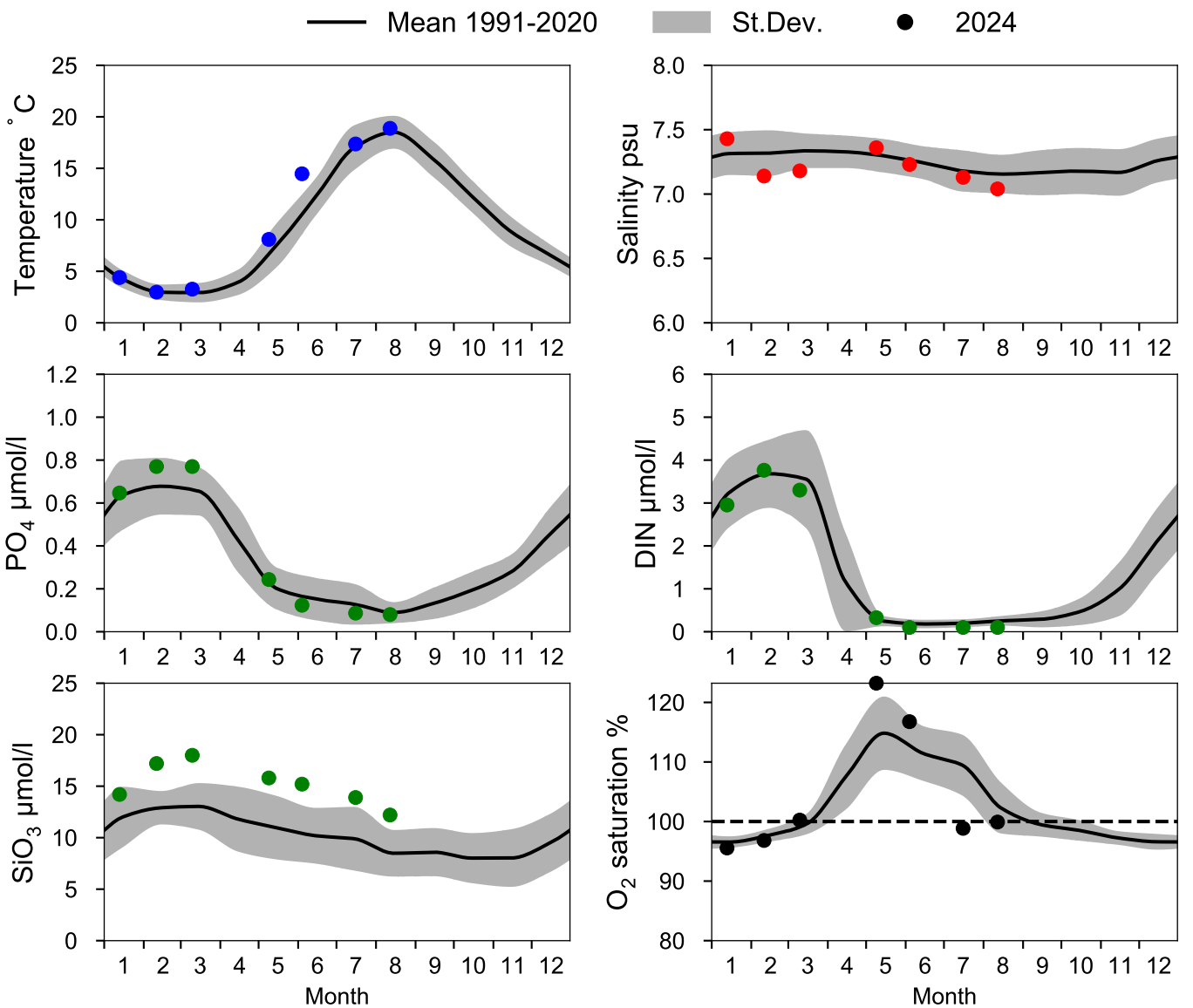


Vertical profiles BY5 BORNHOLMSDJ
August

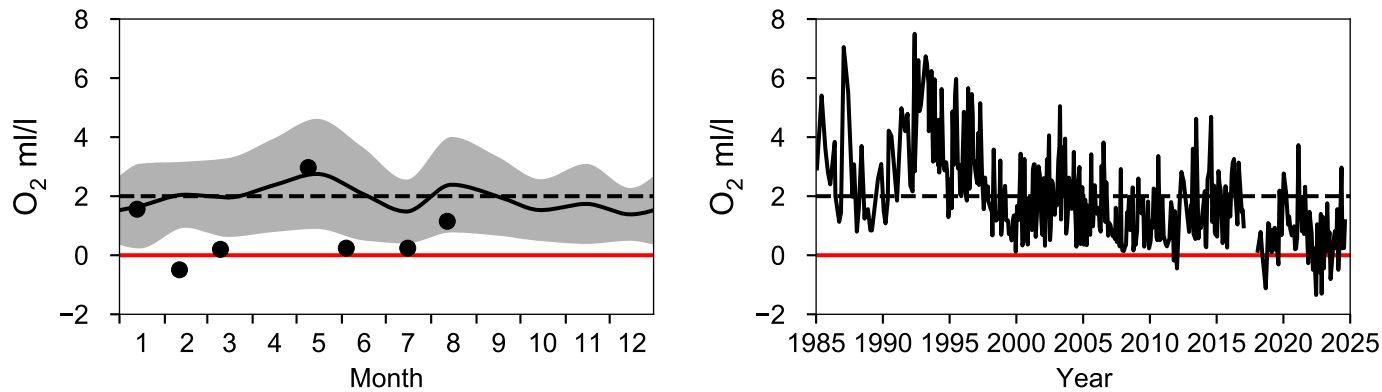


STATION BCS III-10 SURFACE WATER (0-10 m)

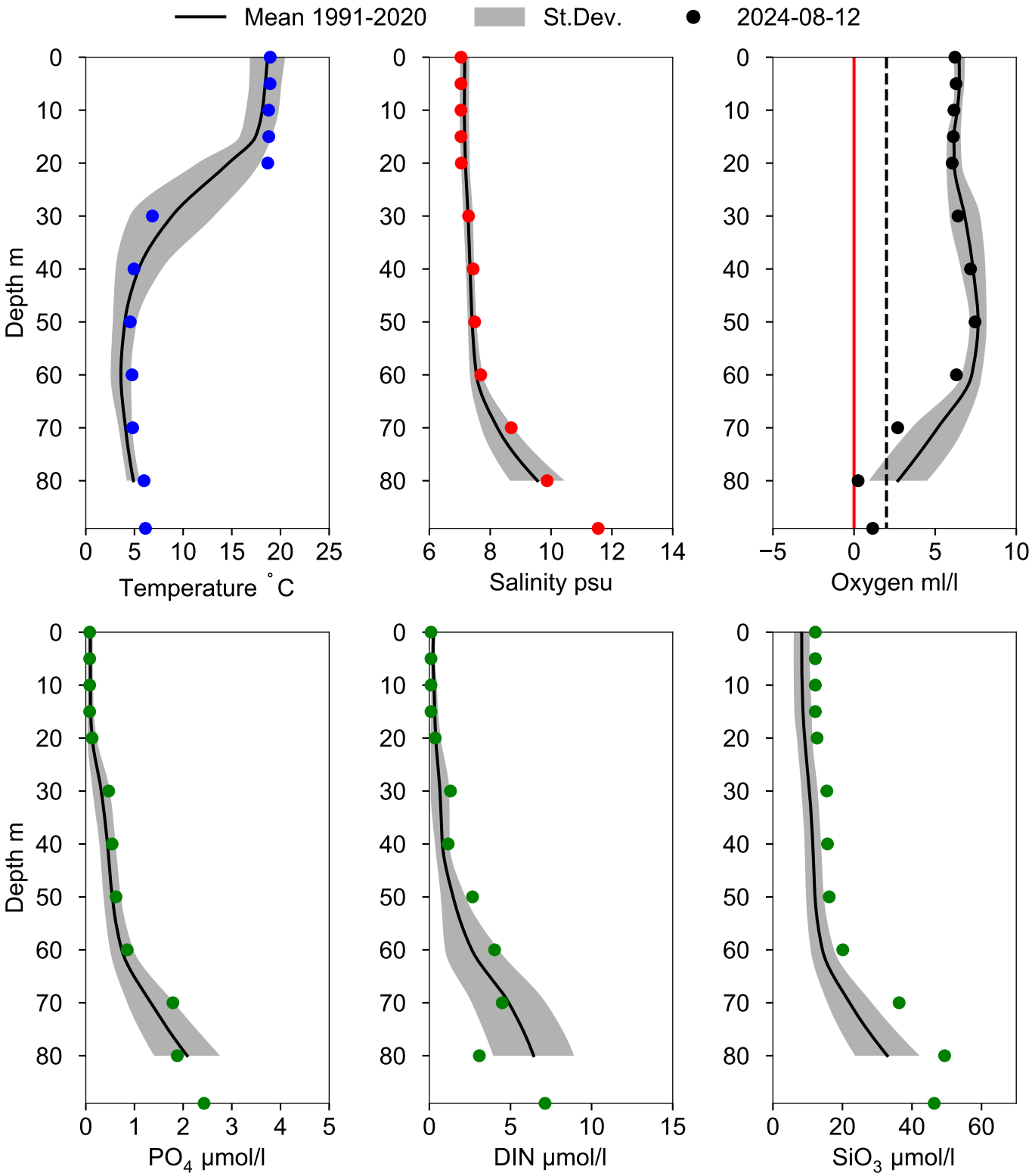
Annual Cycles



OXYGEN IN BOTTOM WATER (depth >= 80 m)

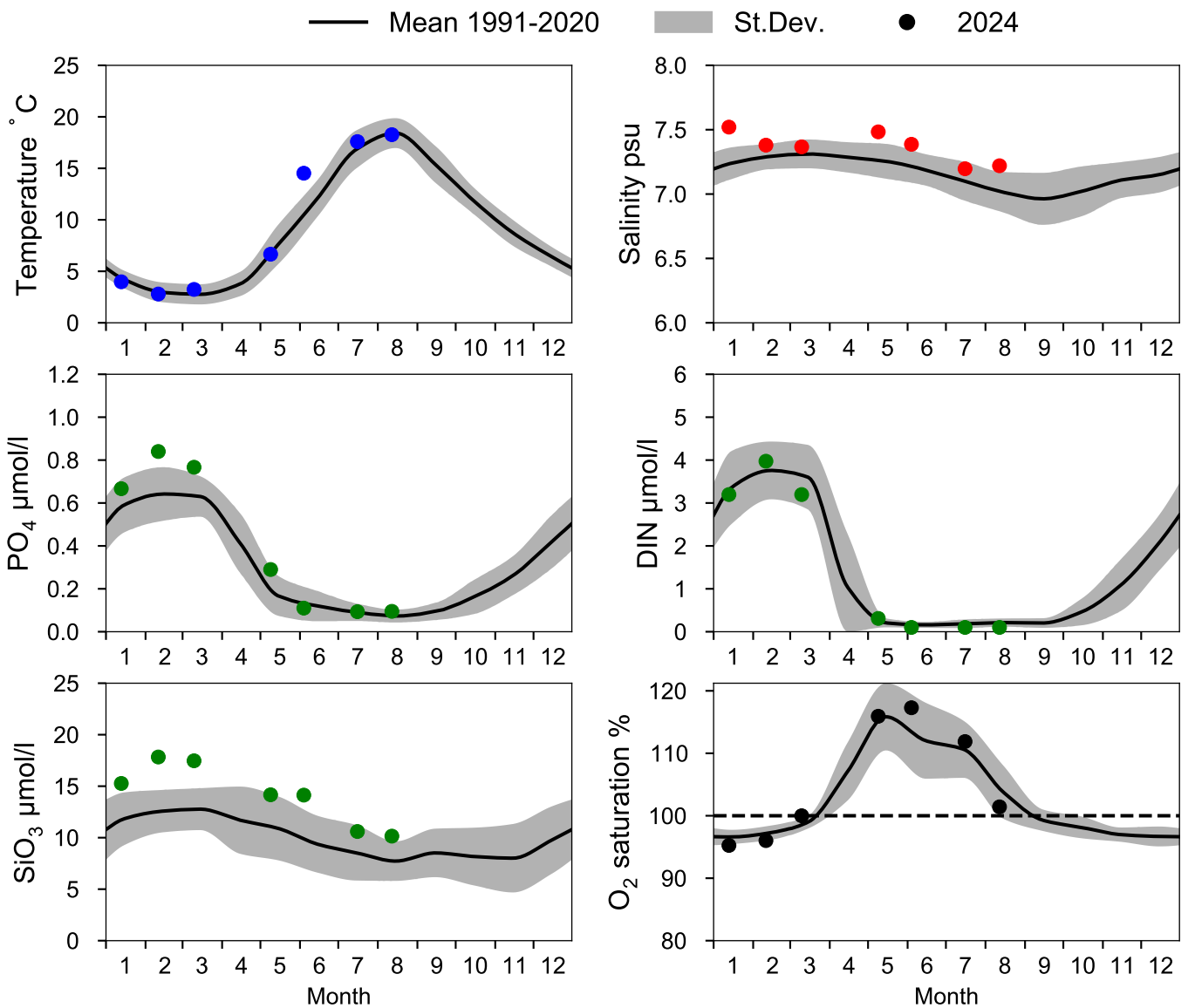


Vertical profiles BCS III-10
August

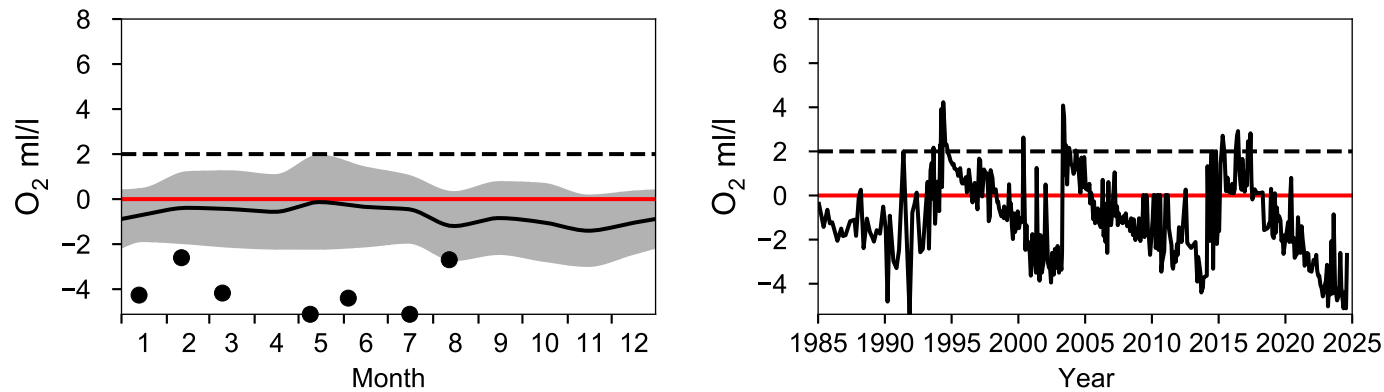


STATION BY10 SURFACE WATER (0-10 m)

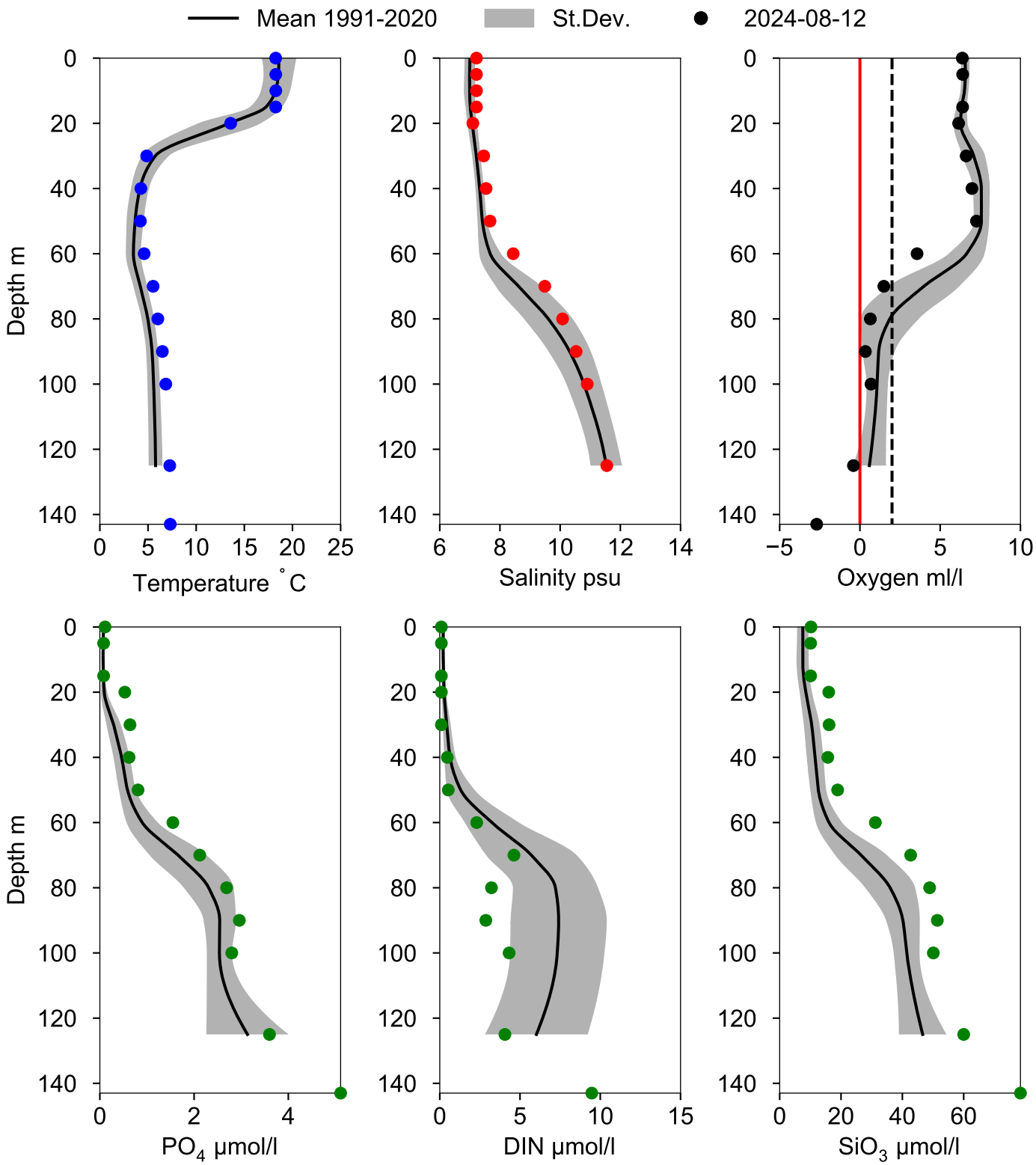
Annual Cycles



OXYGEN IN BOTTOM WATER (depth >= 125 m)

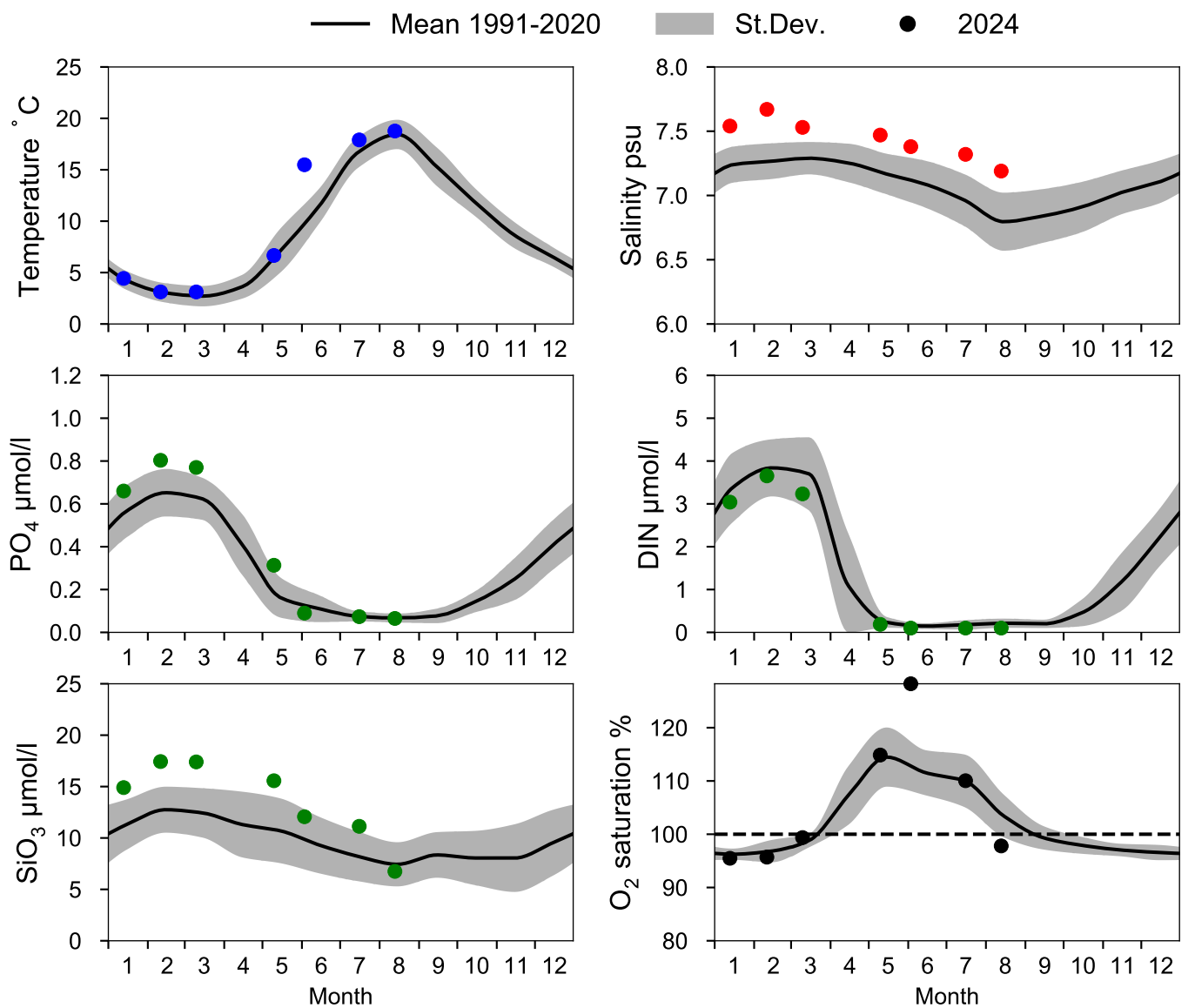


Vertical profiles BY10
August

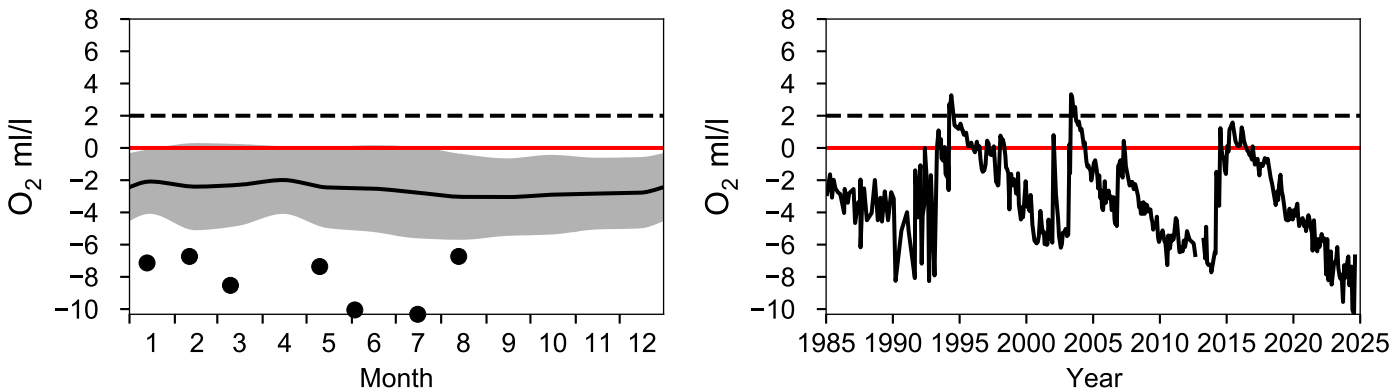


STATION BY15 GOTLANDSDJ SURFACE WATER (0-10 m)

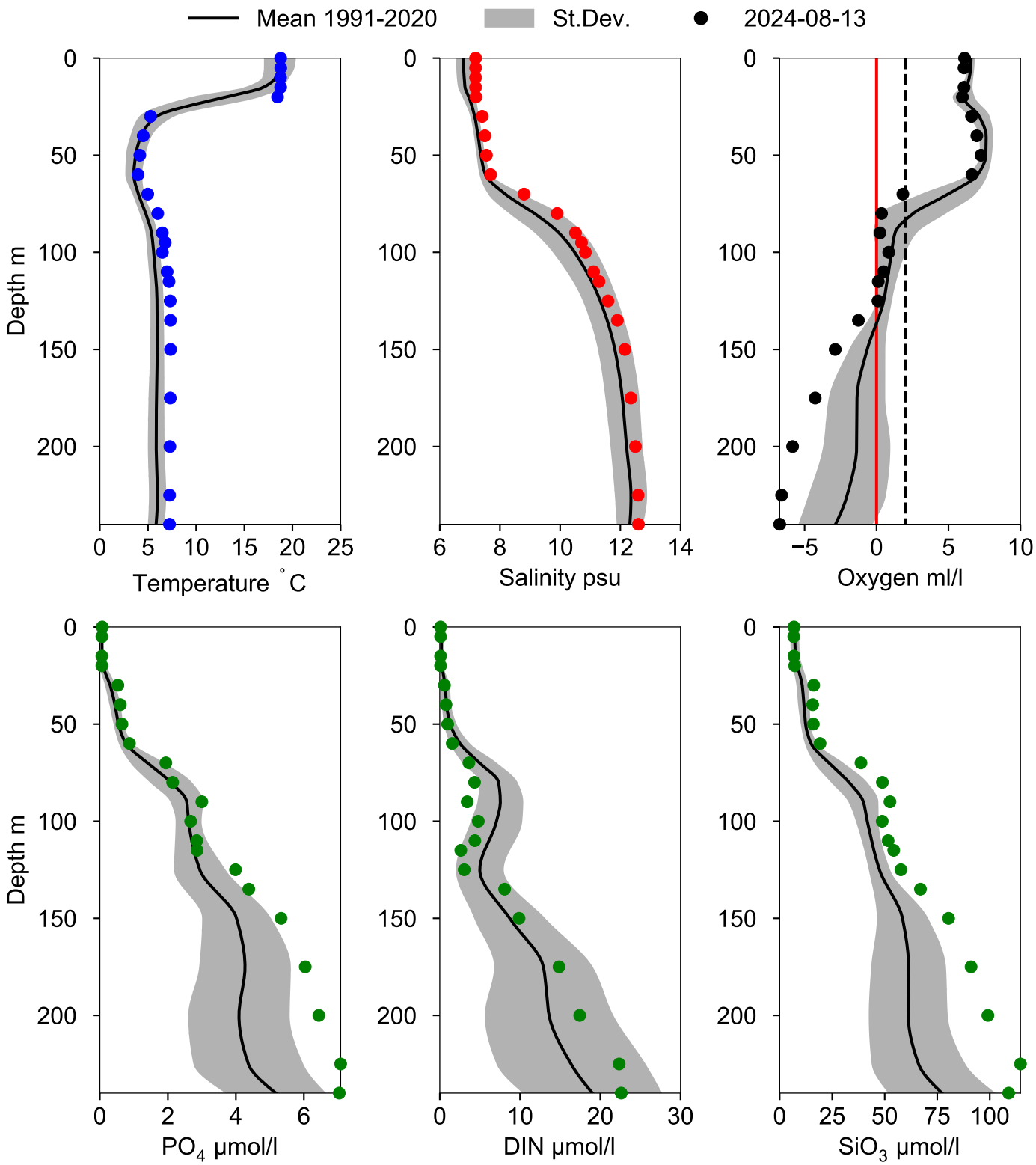
Annual Cycles



OXYGEN IN BOTTOM WATER (depth >= 225 m)

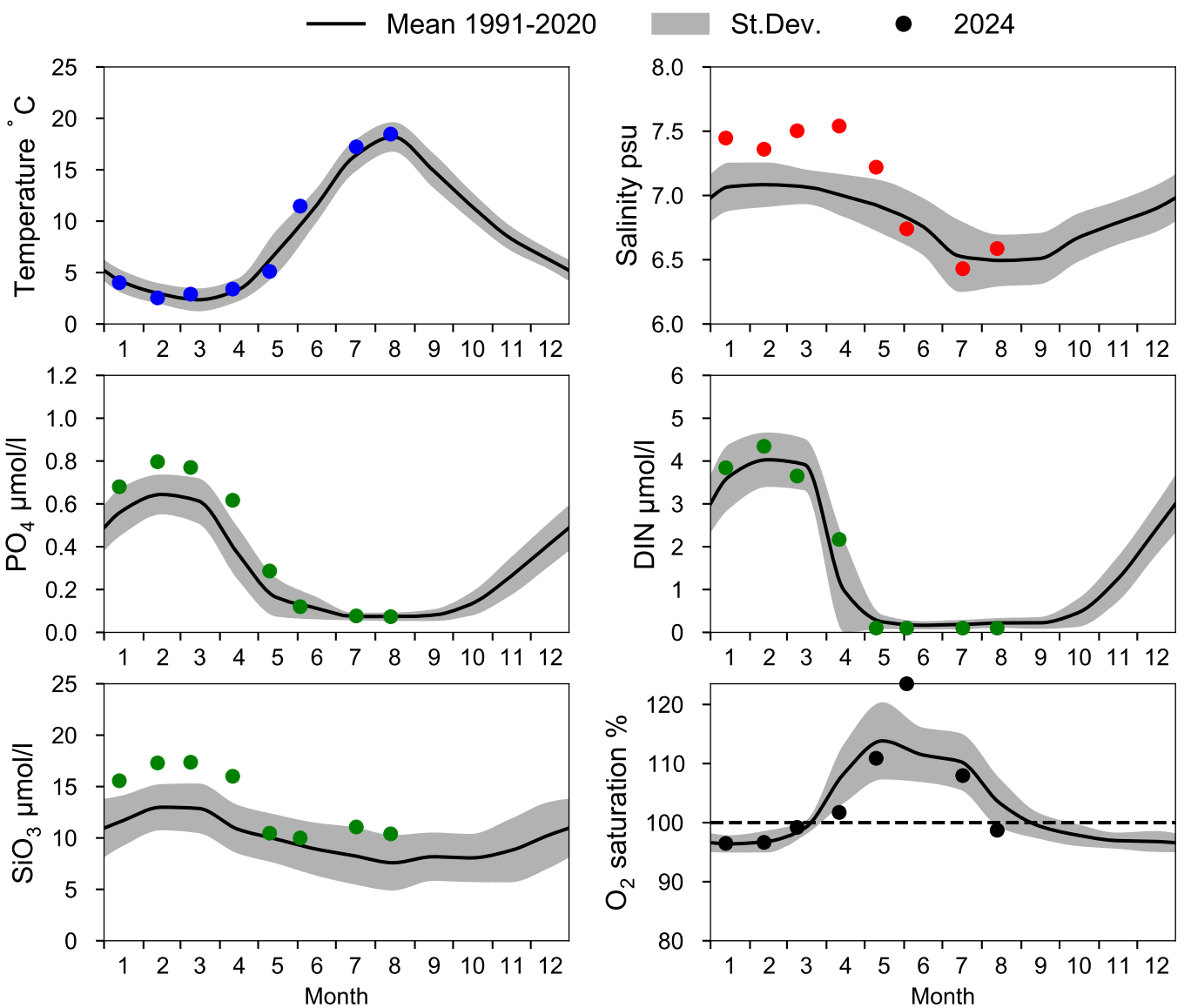


Vertical profiles BY15 GOTLANDSDJ
August

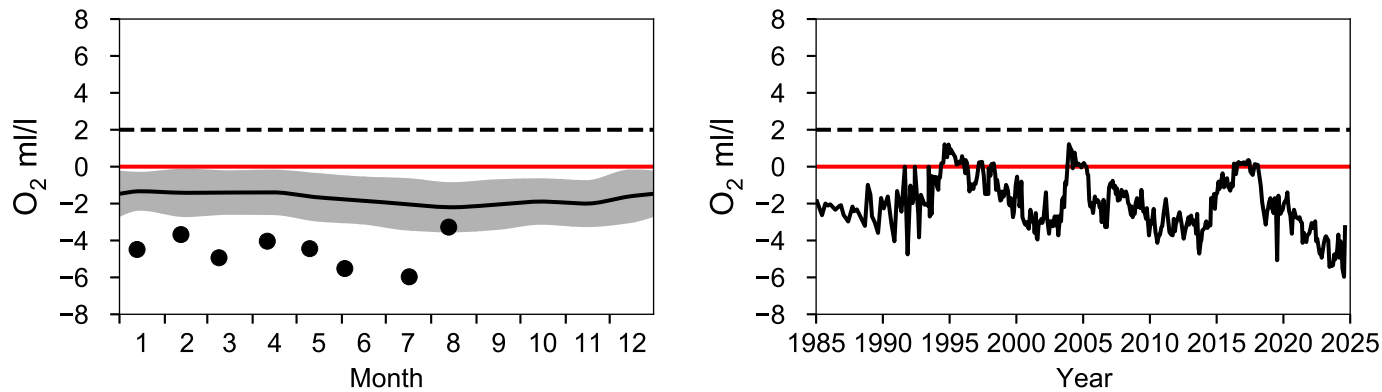


STATION BY20 FÅRÖDJ SURFACE WATER (0-10 m)

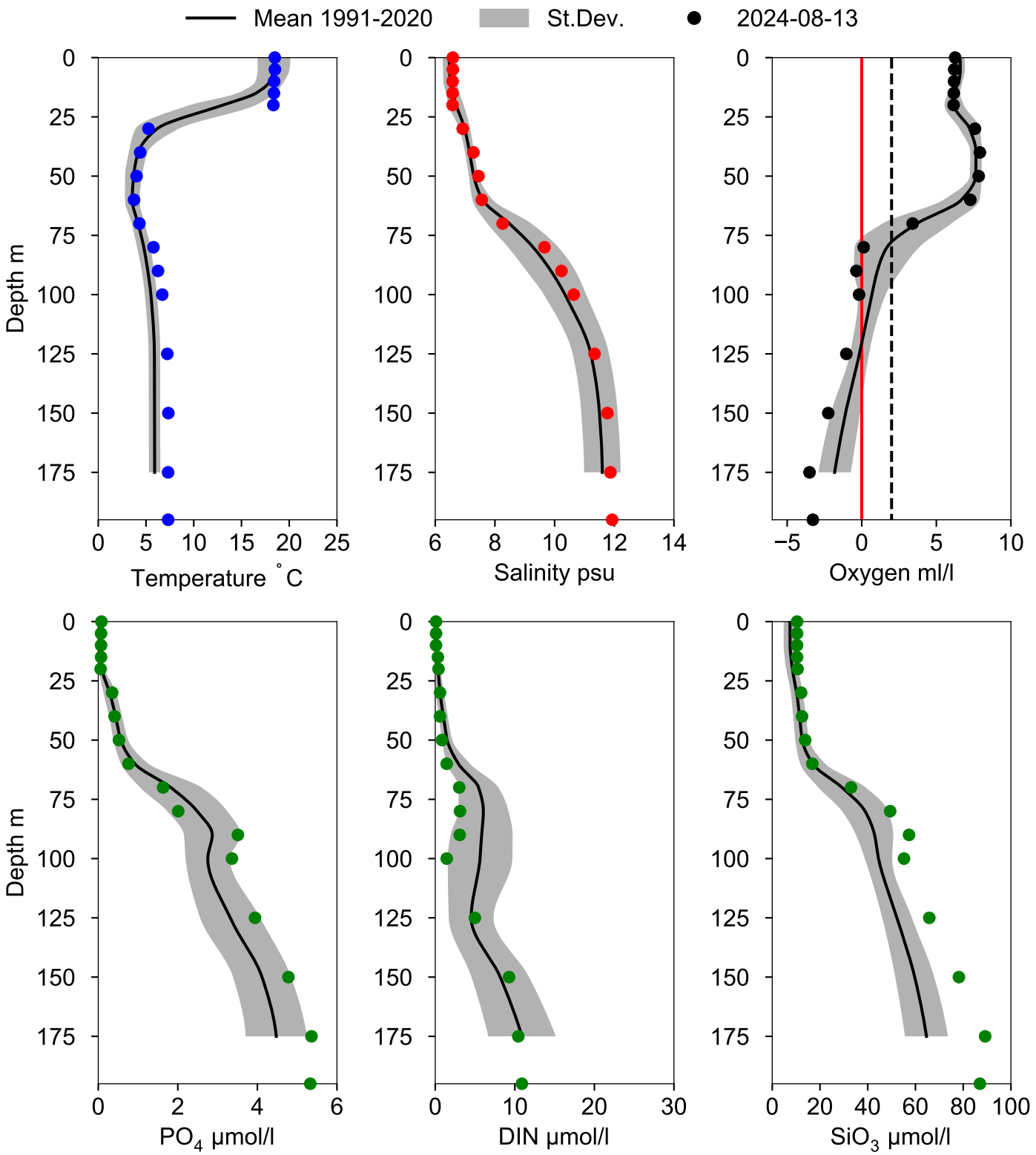
Annual Cycles



OXYGEN IN BOTTOM WATER (depth >= 175 m)

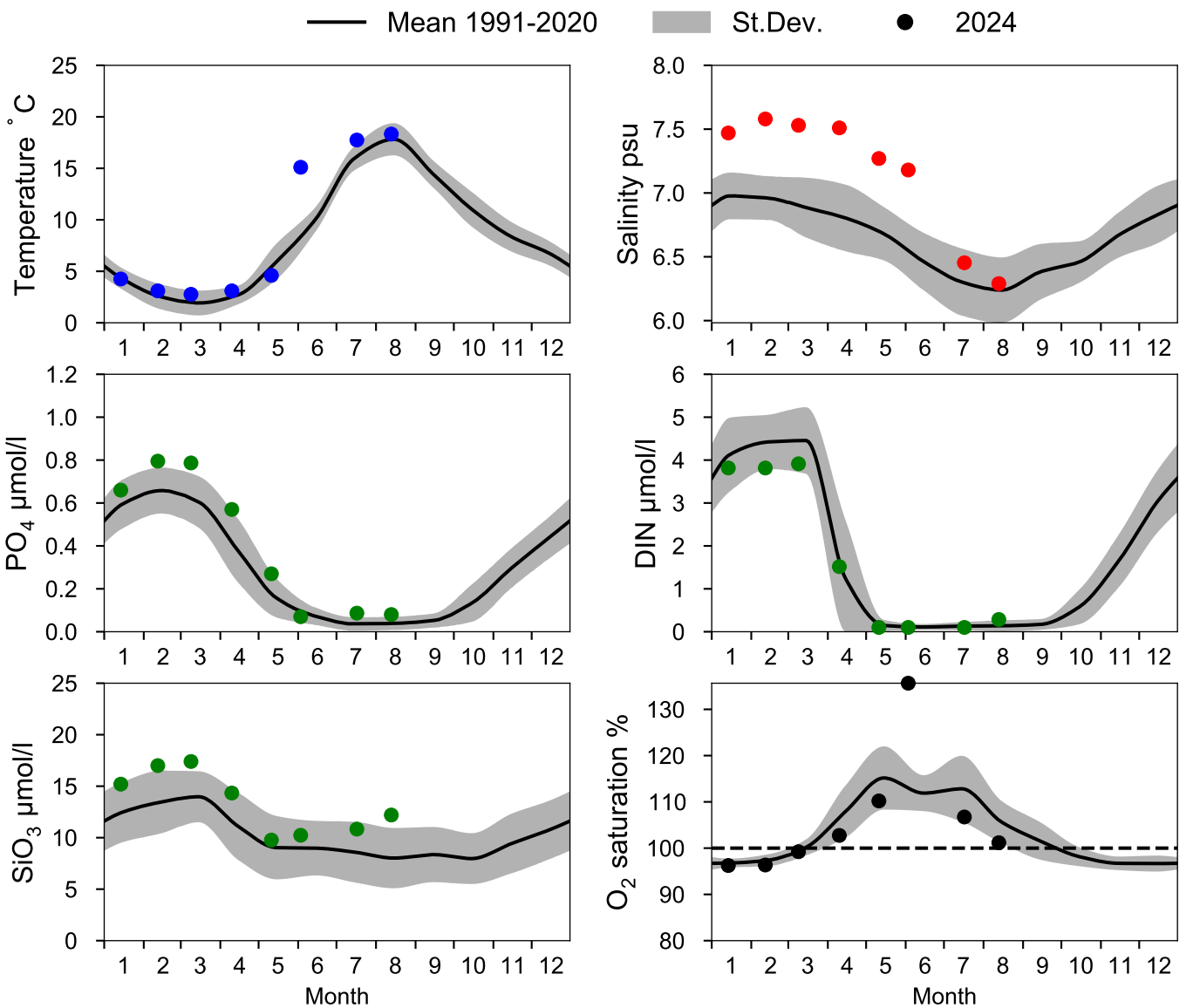


Vertical profiles BY20 FÅRÖDJ
August

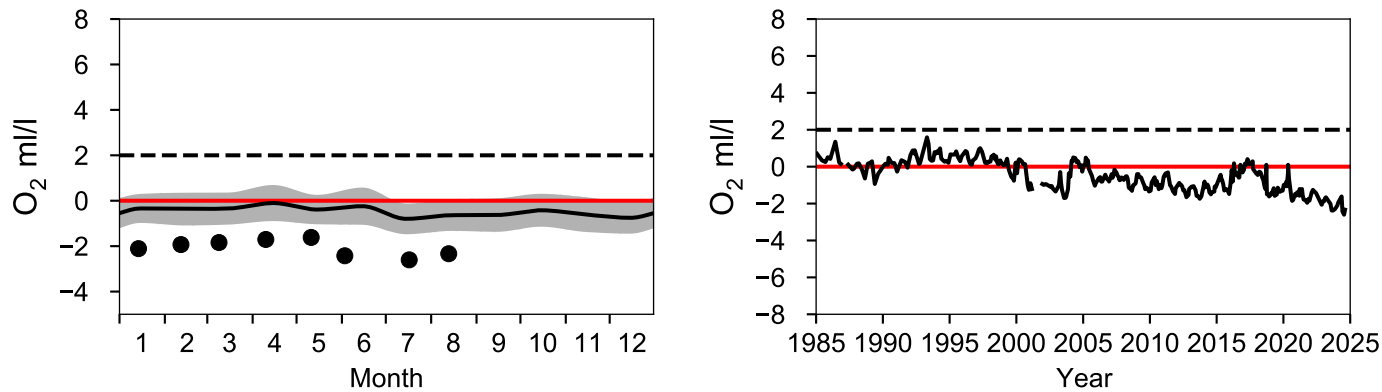


STATION BY29 / LL19 SURFACE WATER (0-10 m)

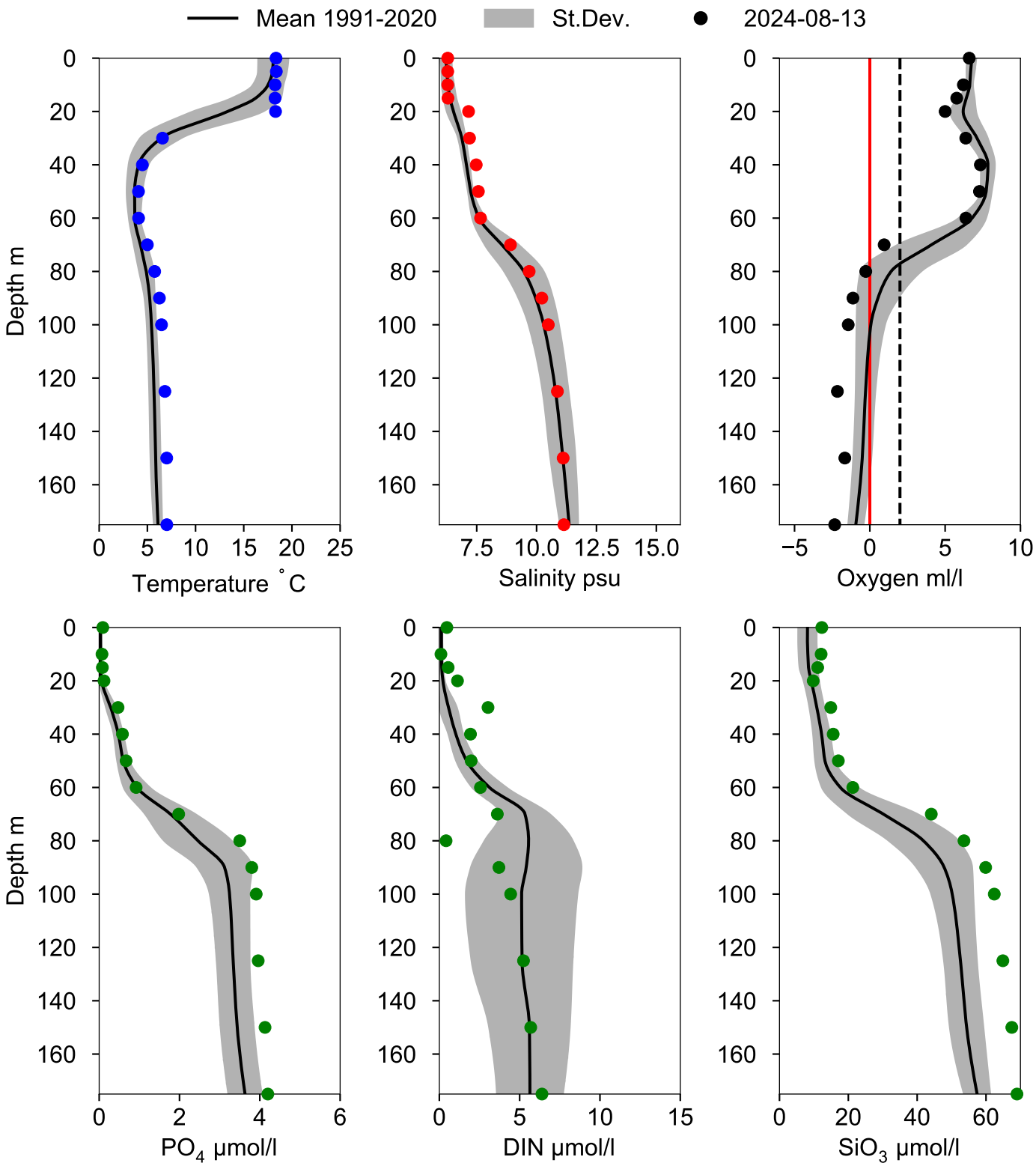
Annual Cycles



OXYGEN IN BOTTOM WATER (depth >= 150 m)

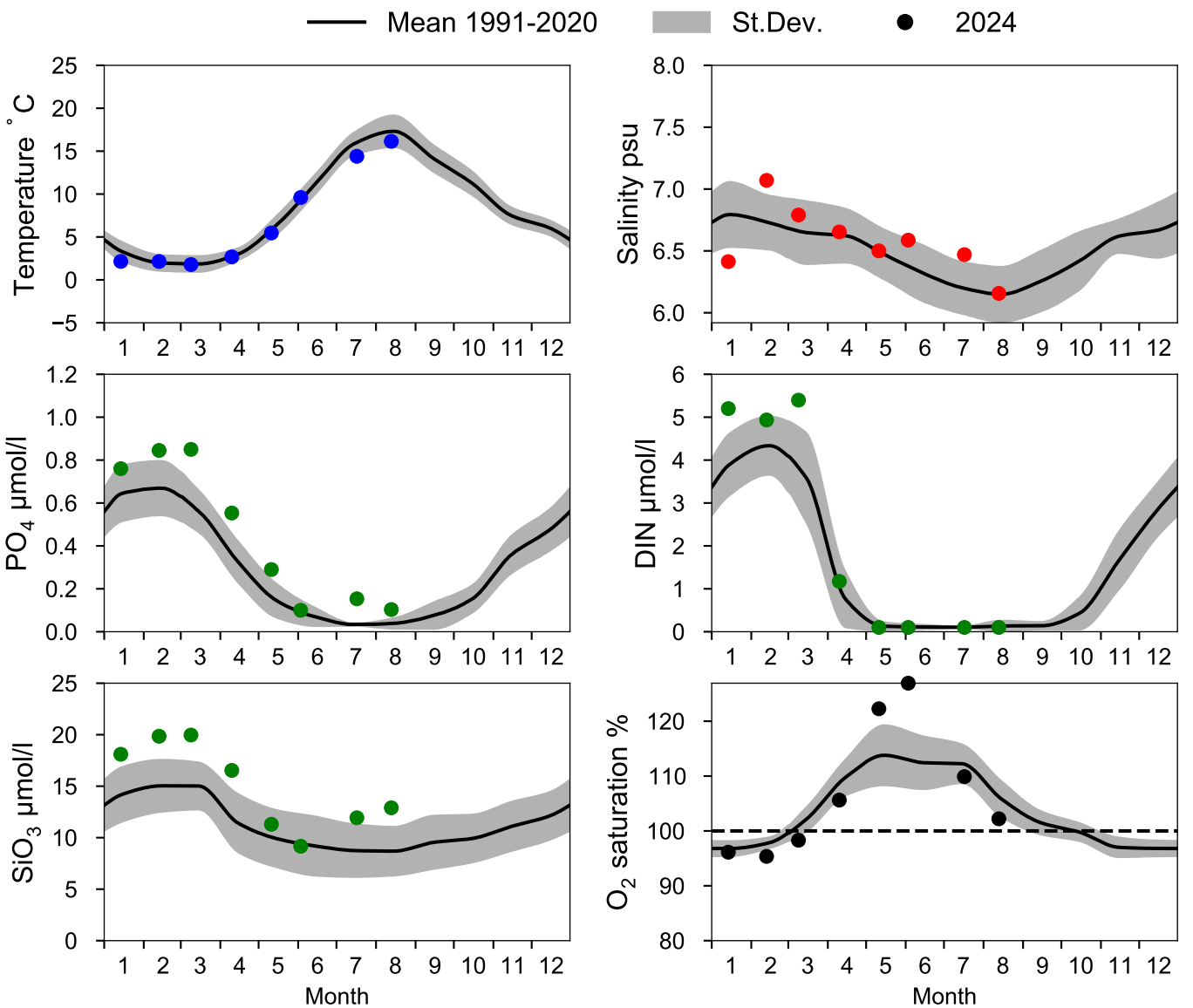


Vertical profiles BY29 / LL19
August

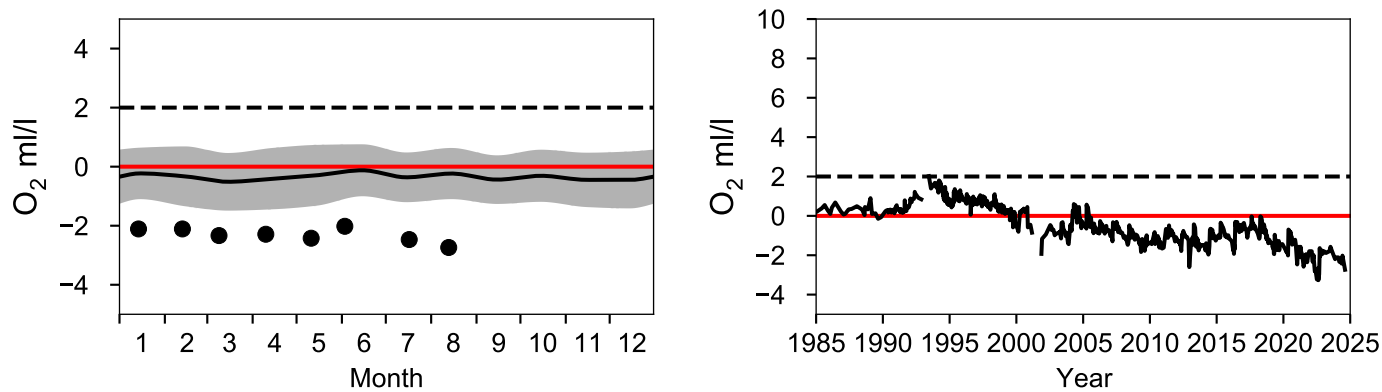


STATION BY31 LANDSORTSDJ SURFACE WATER (0-10 m)

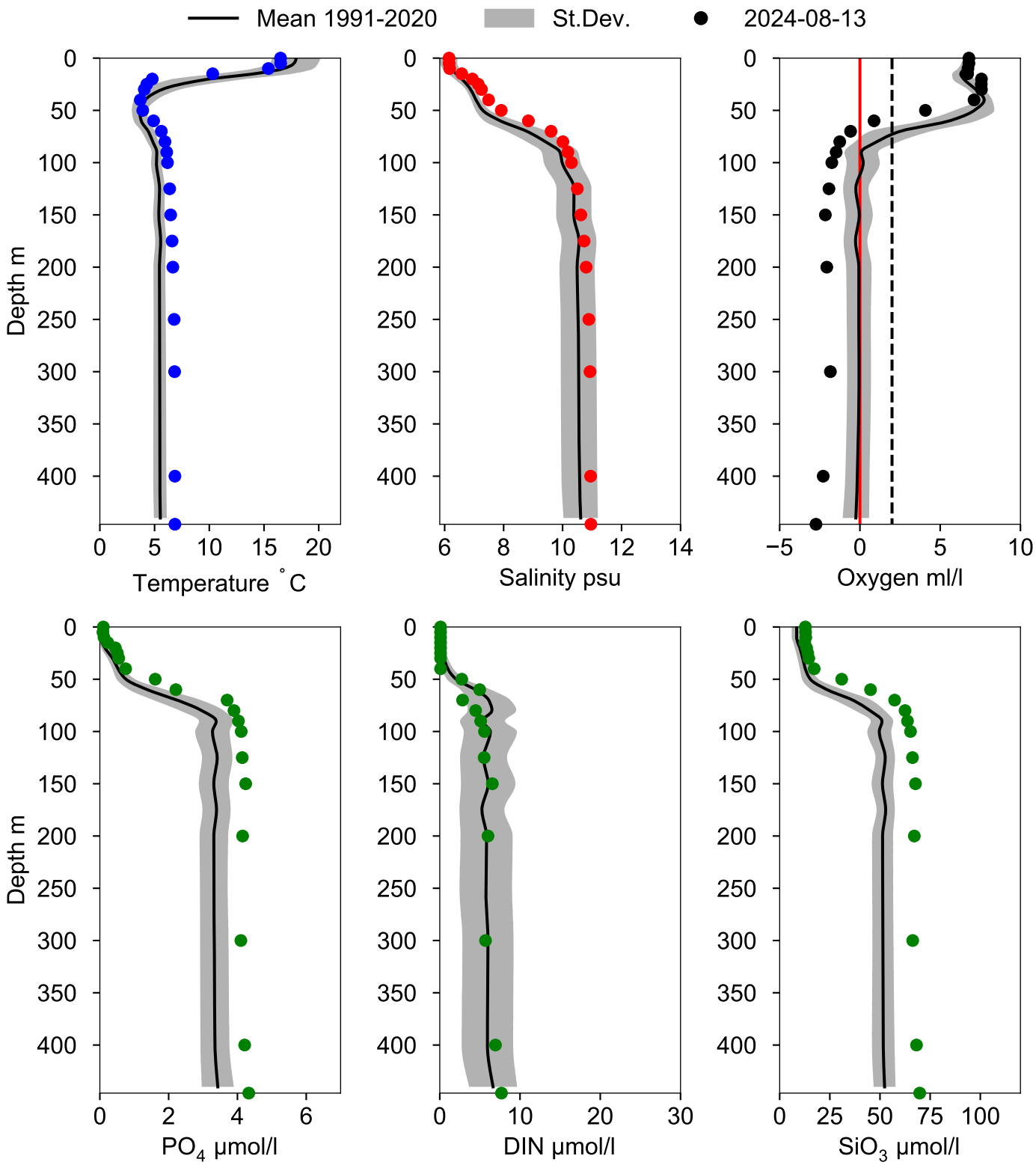
Annual Cycles



OXYGEN IN BOTTOM WATER (depth >= 419 m)

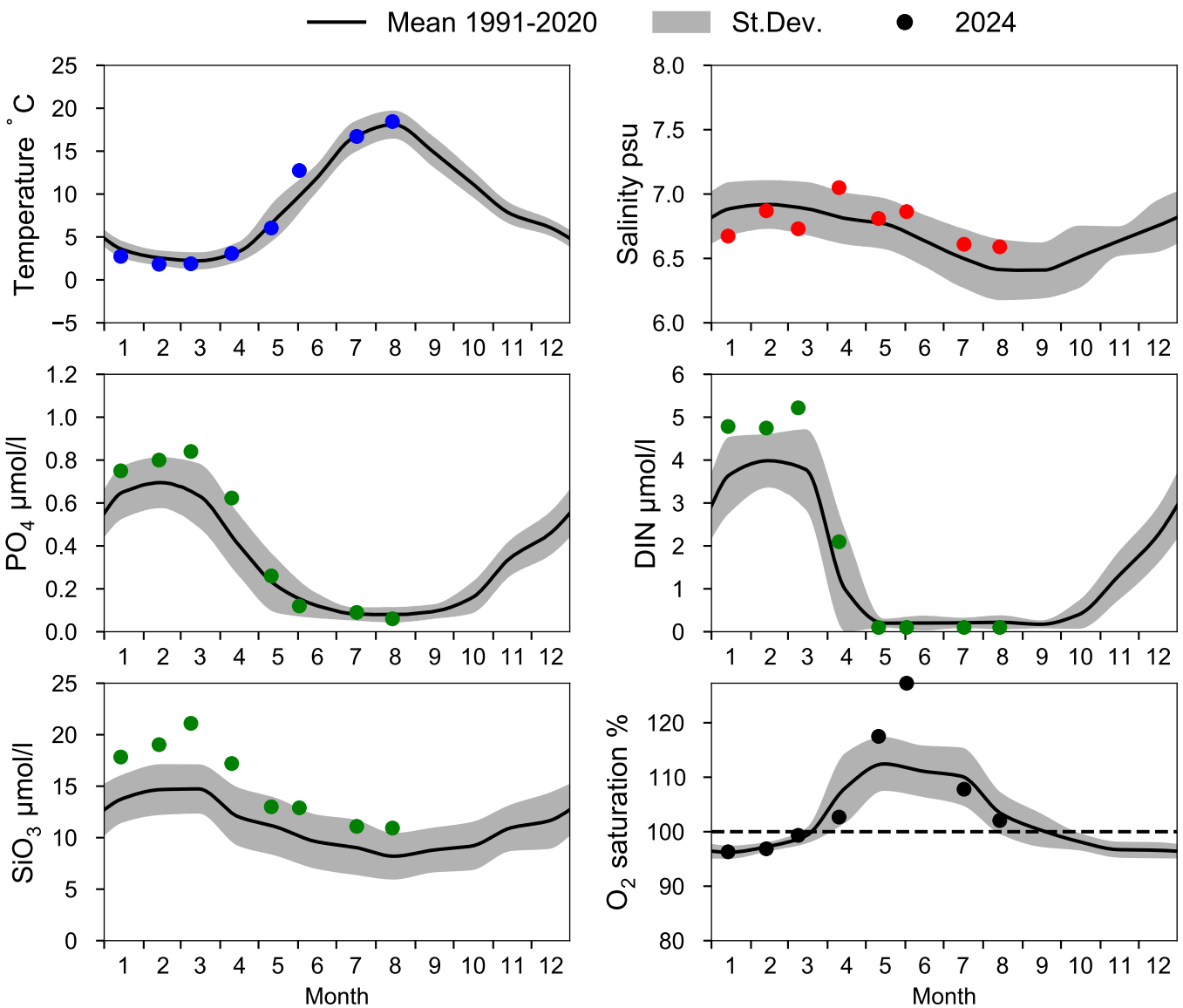


Vertical profiles BY31 LANDSORTSDJ
August

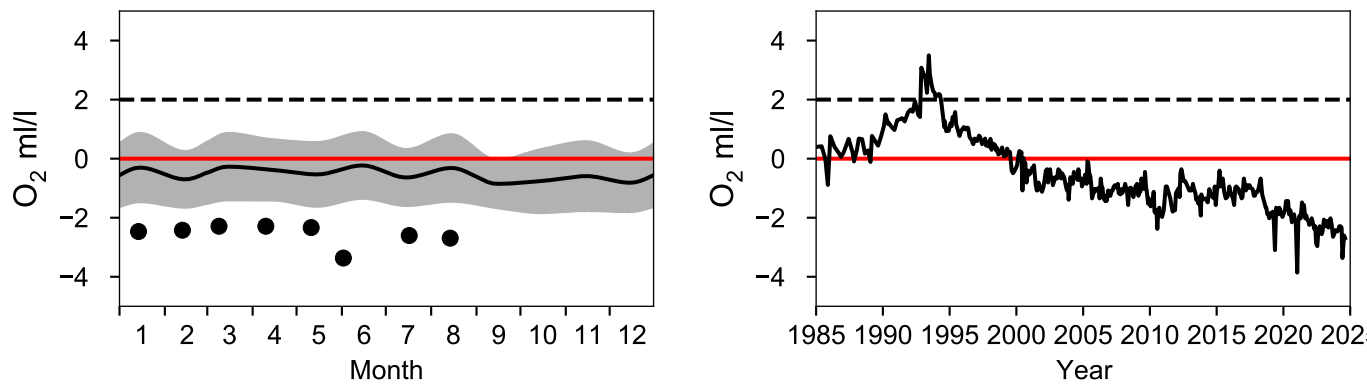


STATION BY32 NORRKÖPINGSDJ SURFACE WATER (0-10 m)

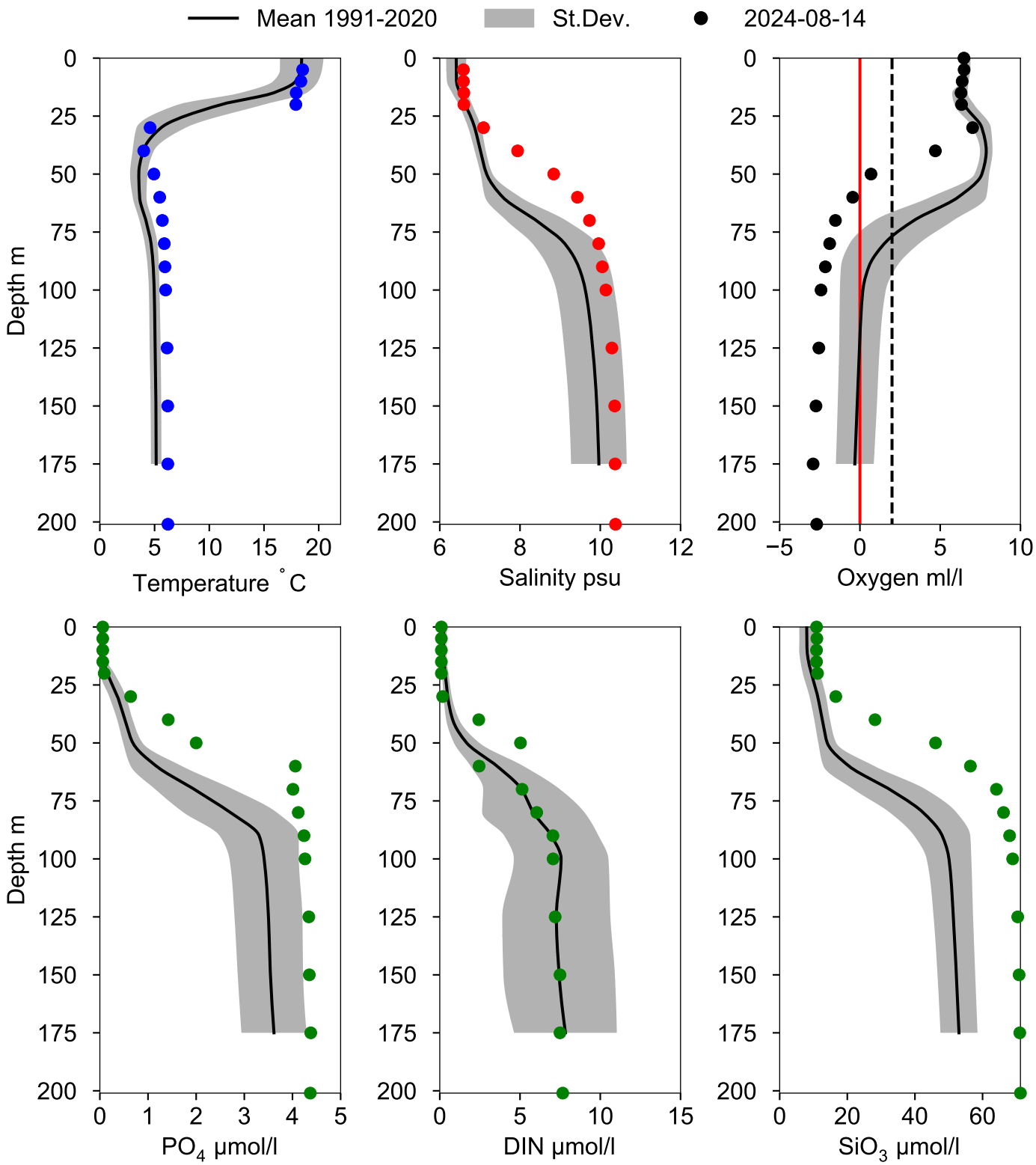
Annual Cycles



OXYGEN IN BOTTOM WATER (depth >= 175 m)

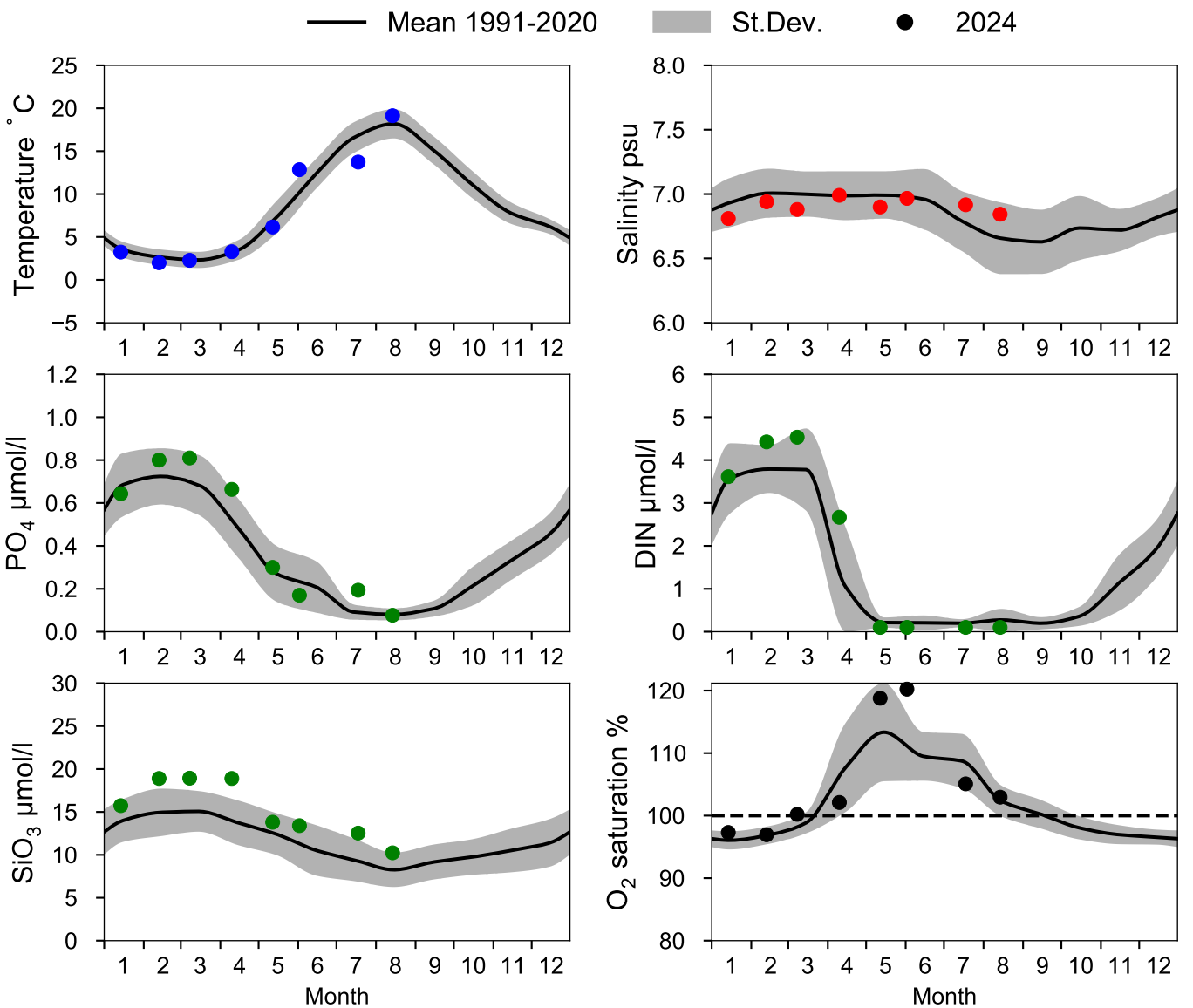


Vertical profiles BY32 NORRKÖPINGSDJ
August

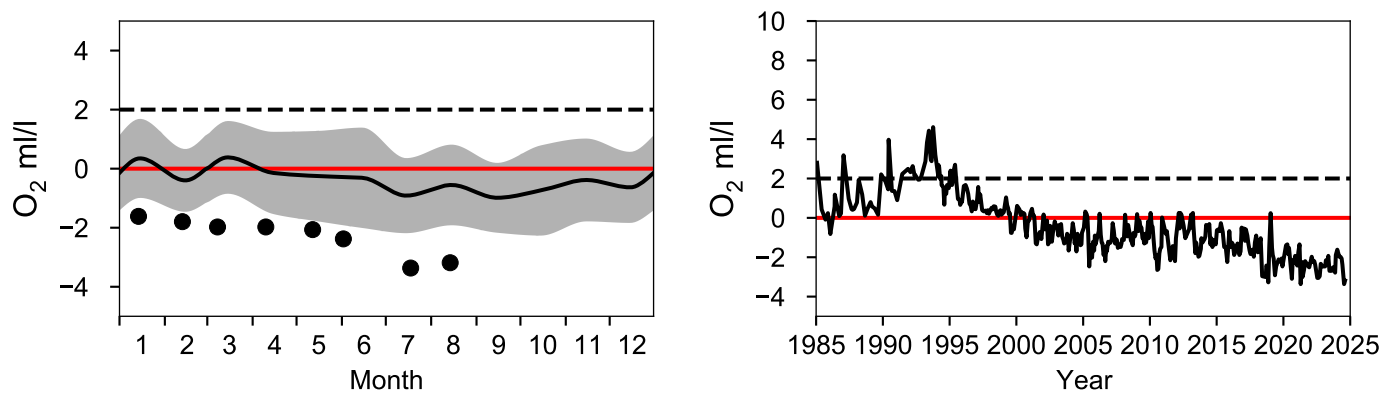


STATION BY38 KARLSÖDJ SURFACE WATER (0-10 m)

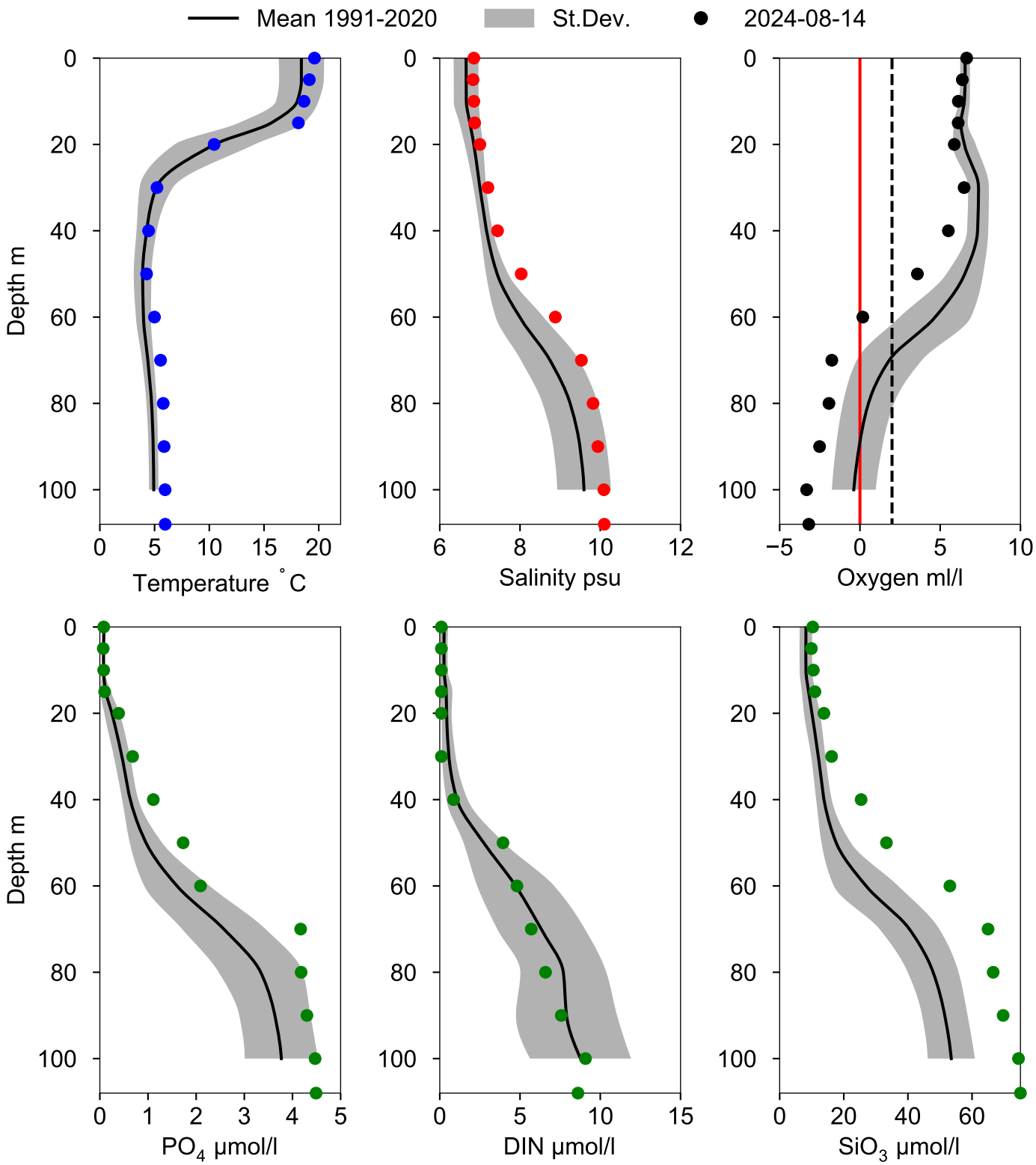
Annual Cycles



OXYGEN IN BOTTOM WATER (depth >= 100 m)

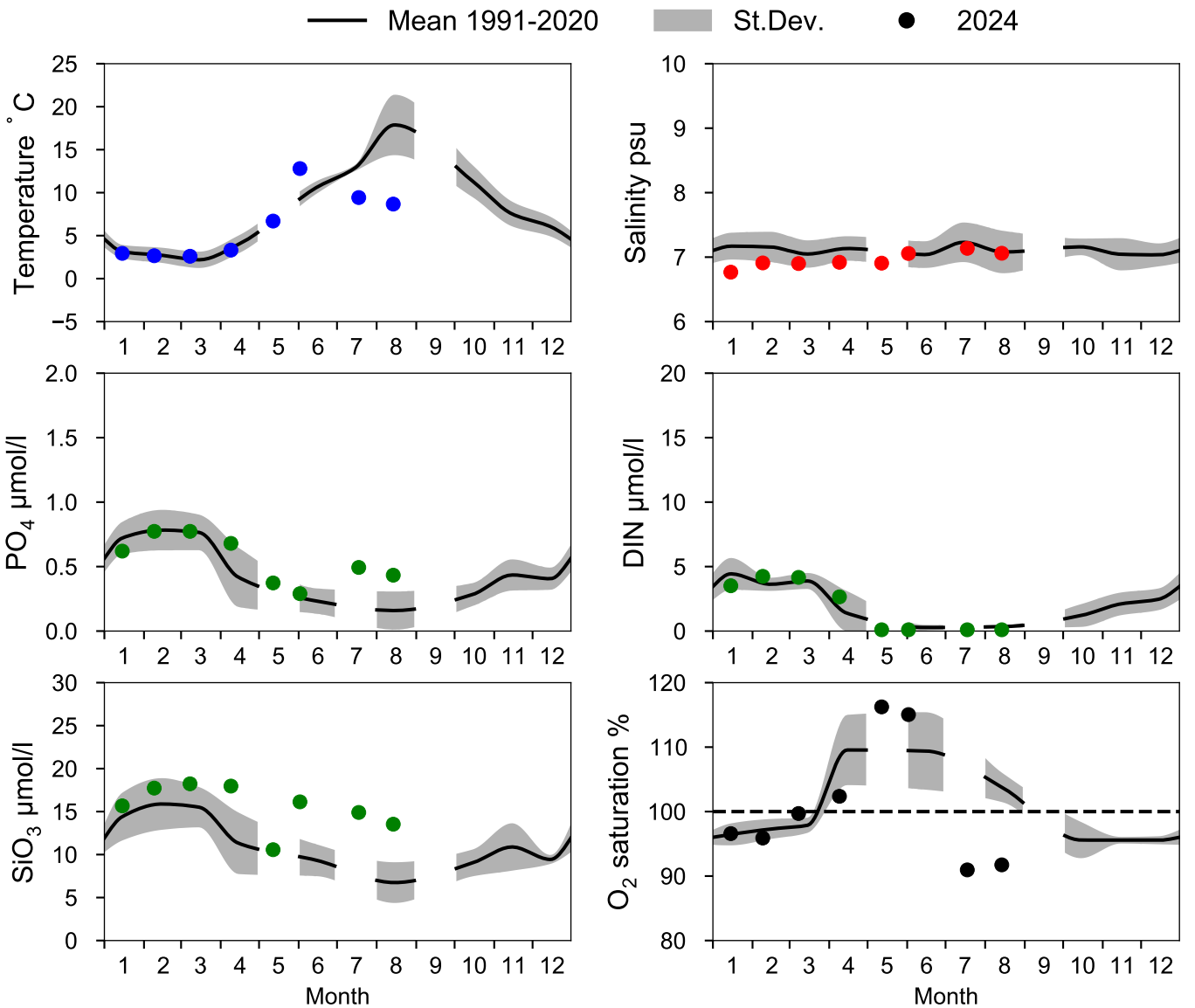


Vertical profiles BY38 KARLSÖDJ
August

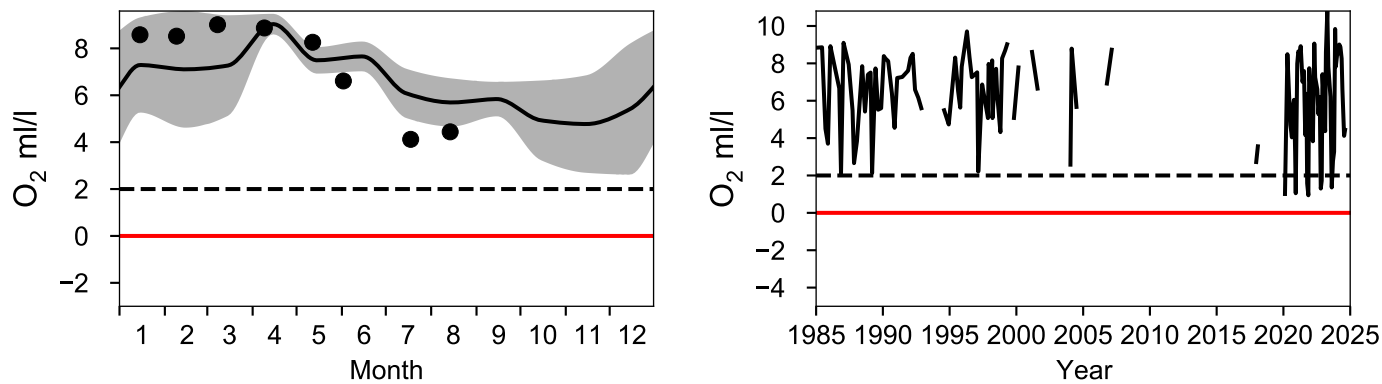


STATION BY39 ÖLANDS S UDDE SURFACE WATER (0-10 m)

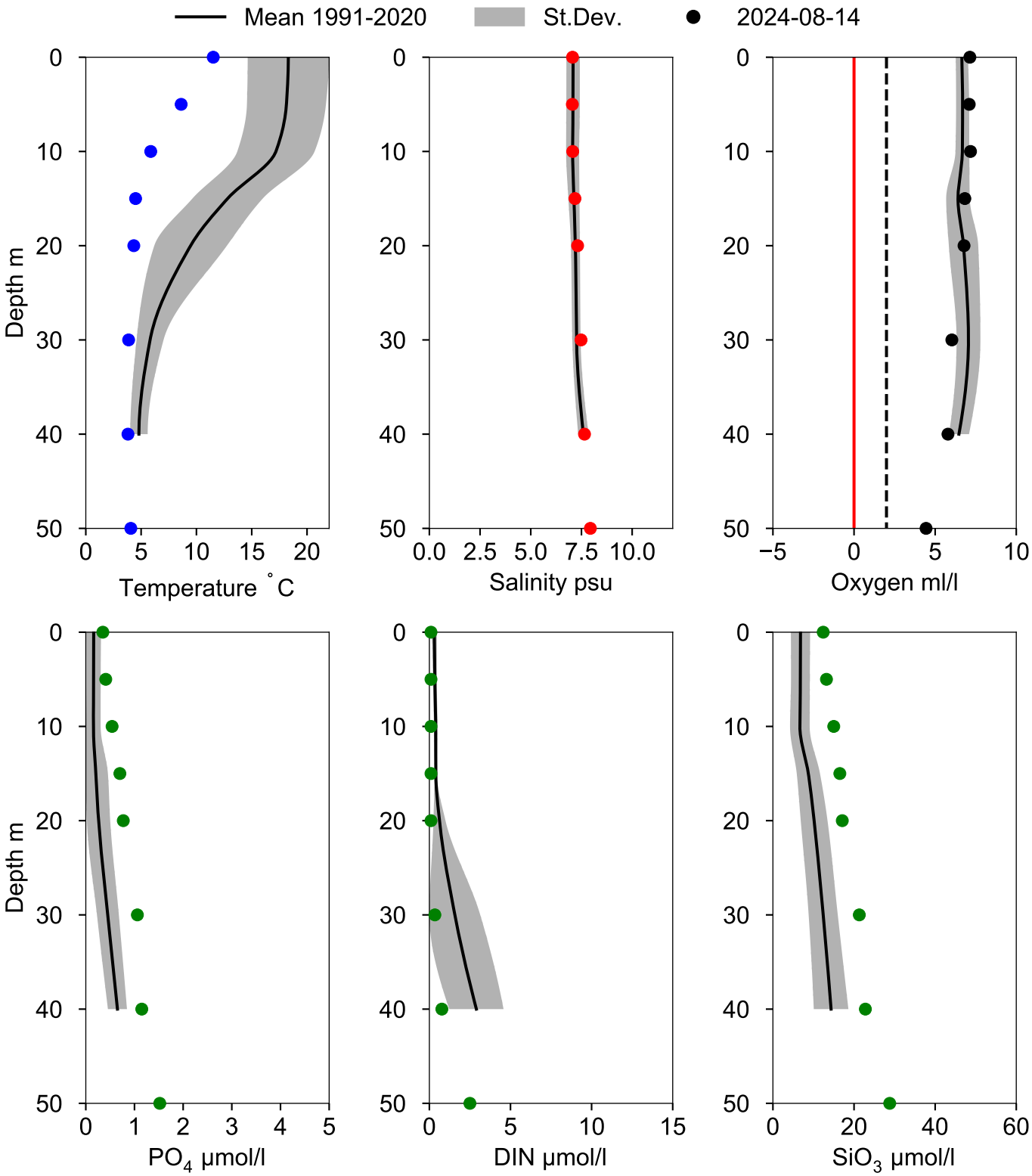
Annual Cycles



OXYGEN IN BOTTOM WATER (depth >= 40 m)

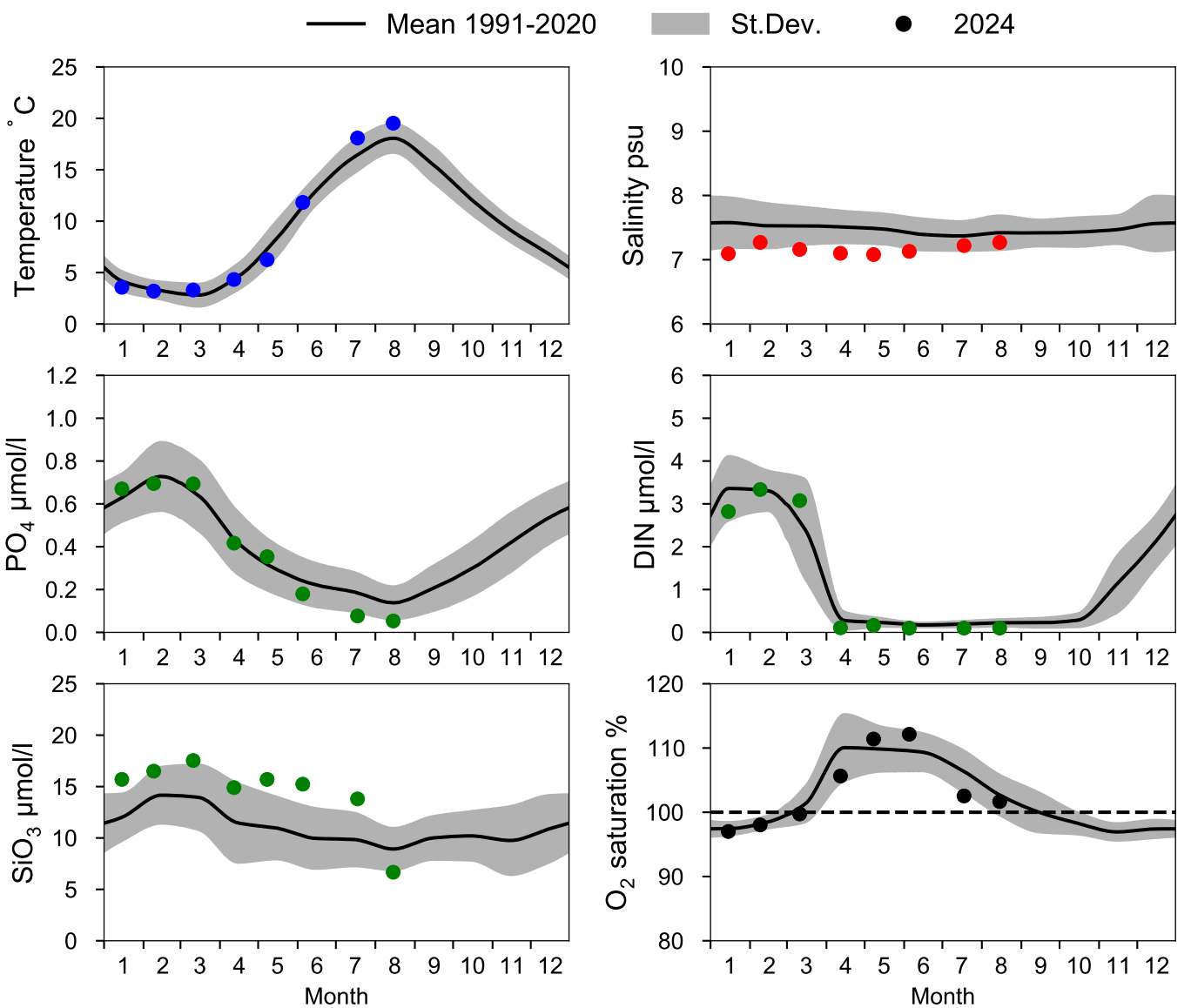


Vertical profiles BY39 ÖLANDS S UDDE
August

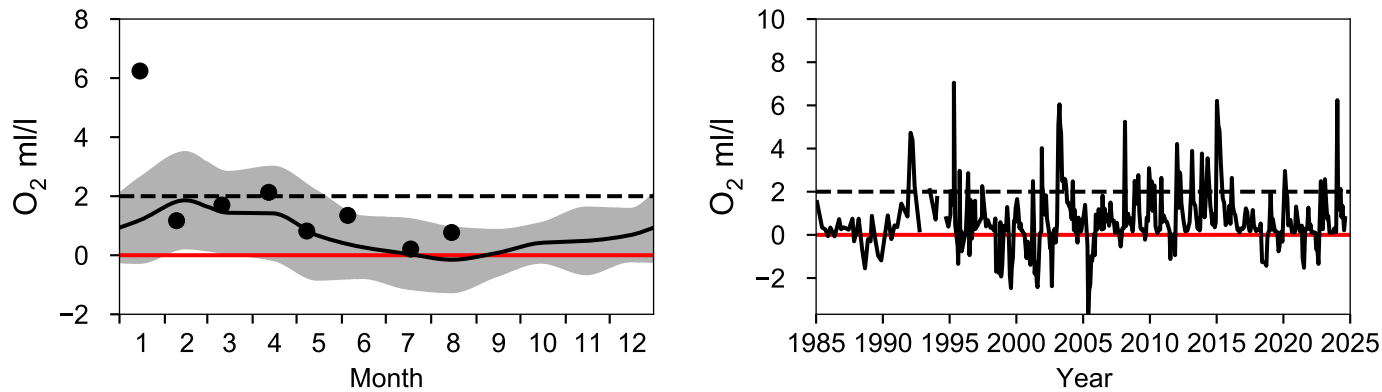


STATION HANÖBUKTEN SURFACE WATER (0-10 m)

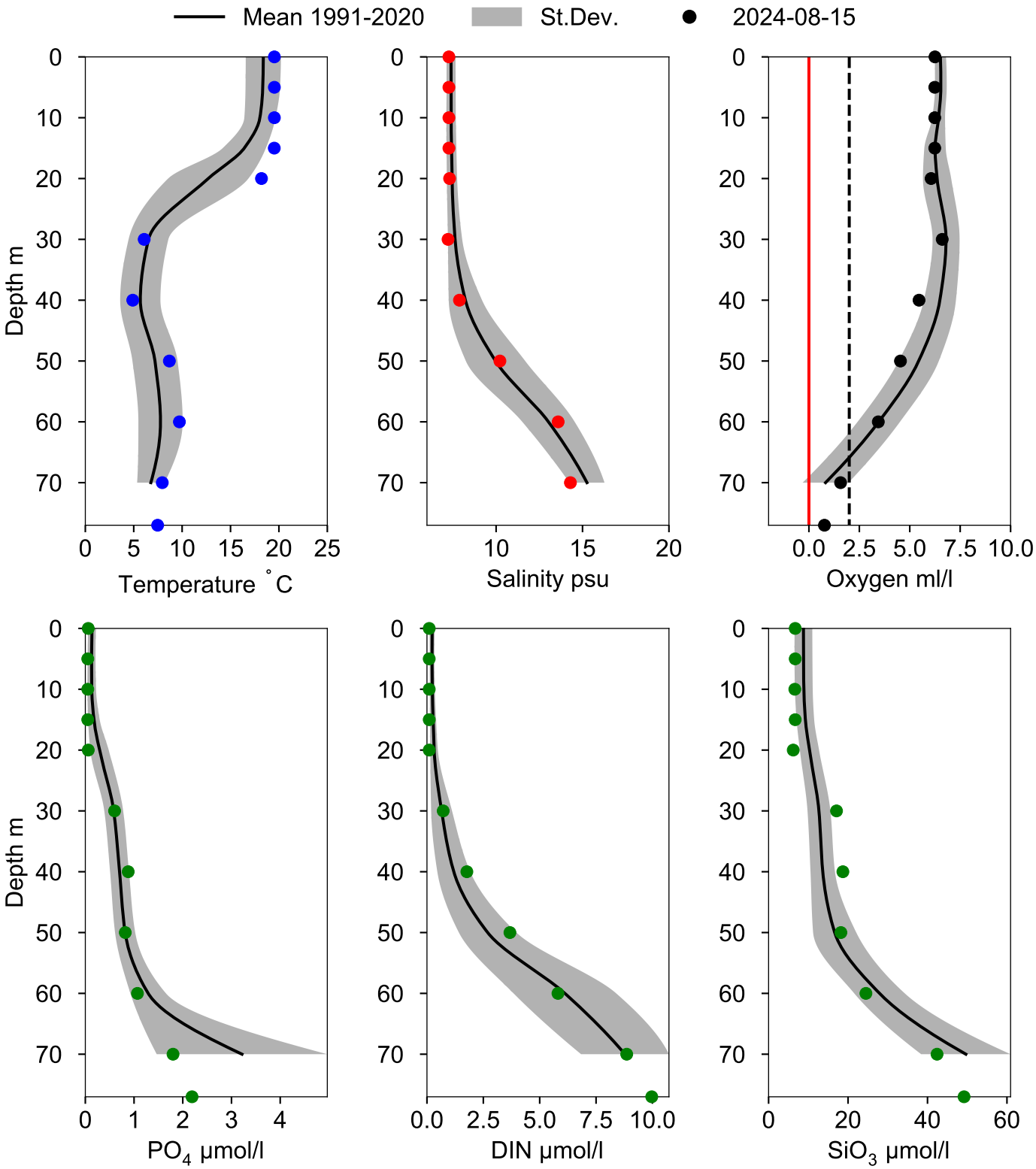
Annual Cycles



OXYGEN IN BOTTOM WATER (depth >= 70 m)

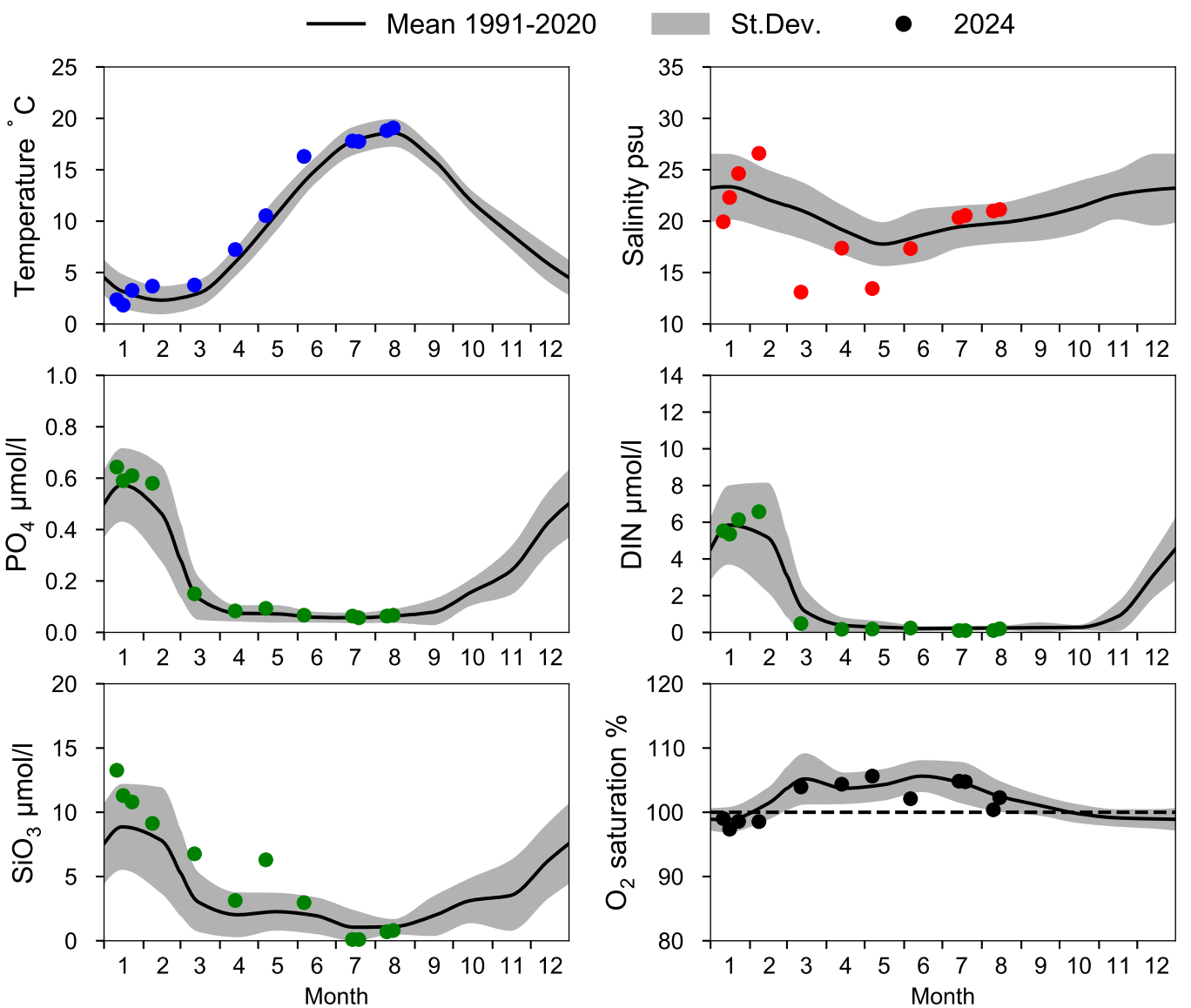


Vertical profiles HANÖBUKTEN
August

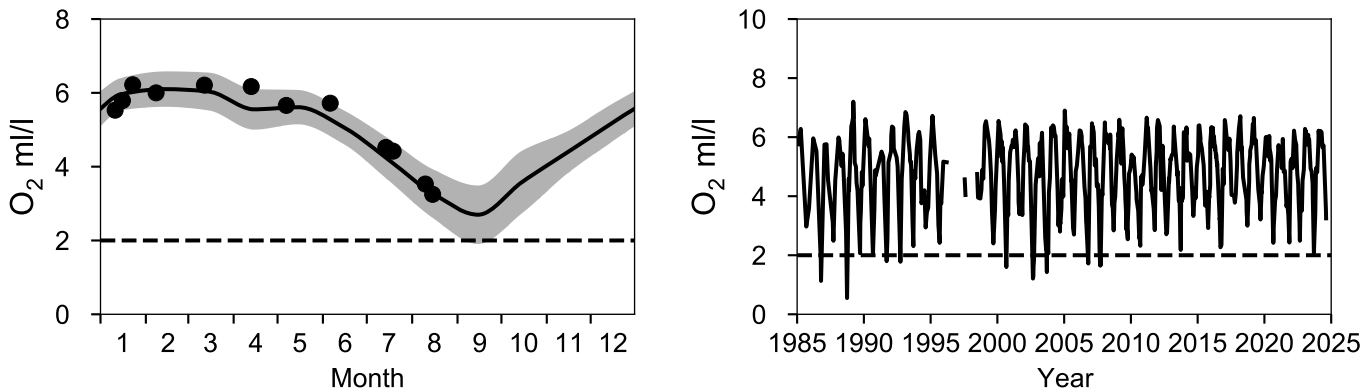


STATION ANHOLT E SURFACE WATER (0-10 m)

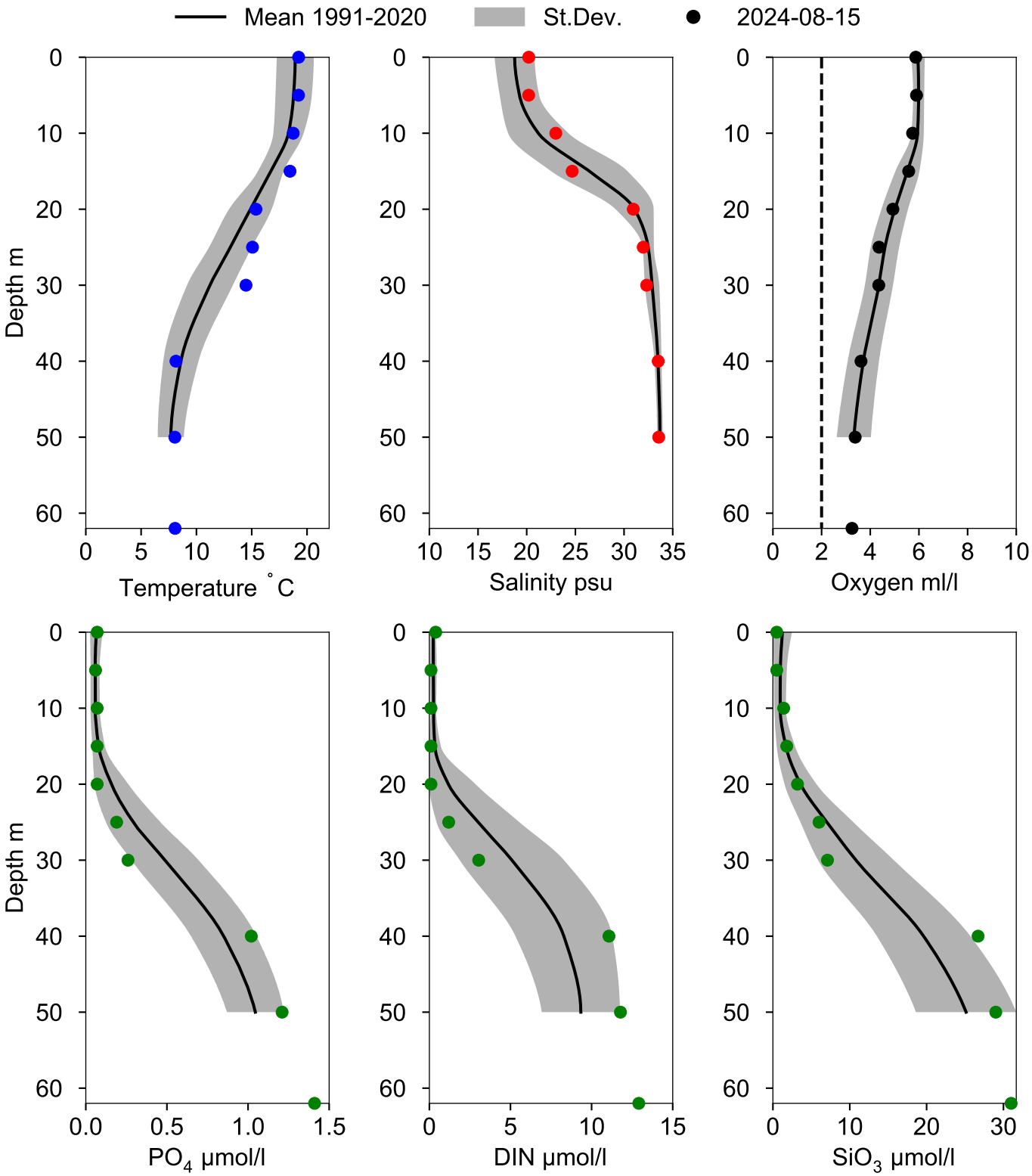
Annual Cycles



OXYGEN IN BOTTOM WATER (depth >= 52 m)

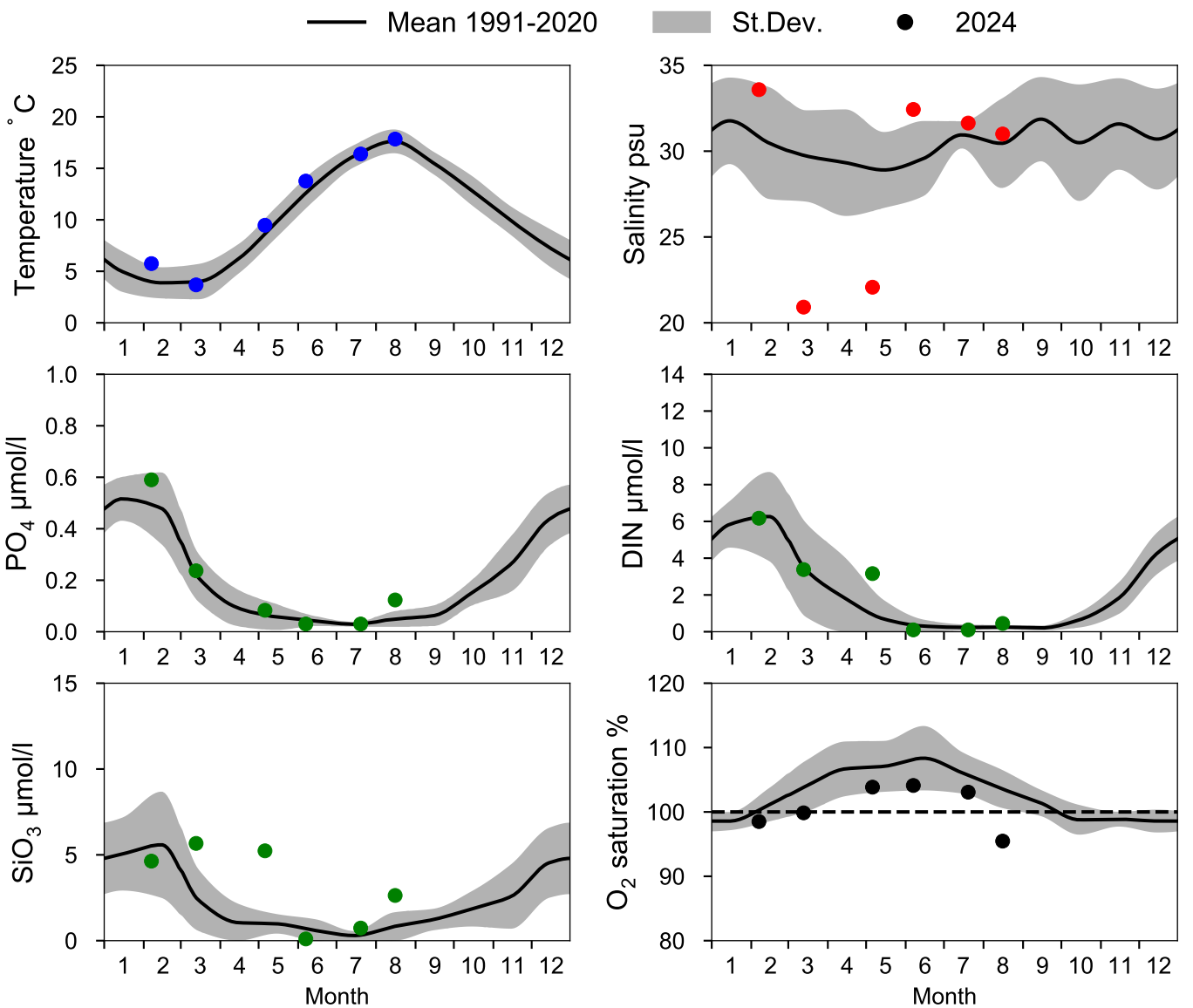


Vertical profiles ANHOLT E
August

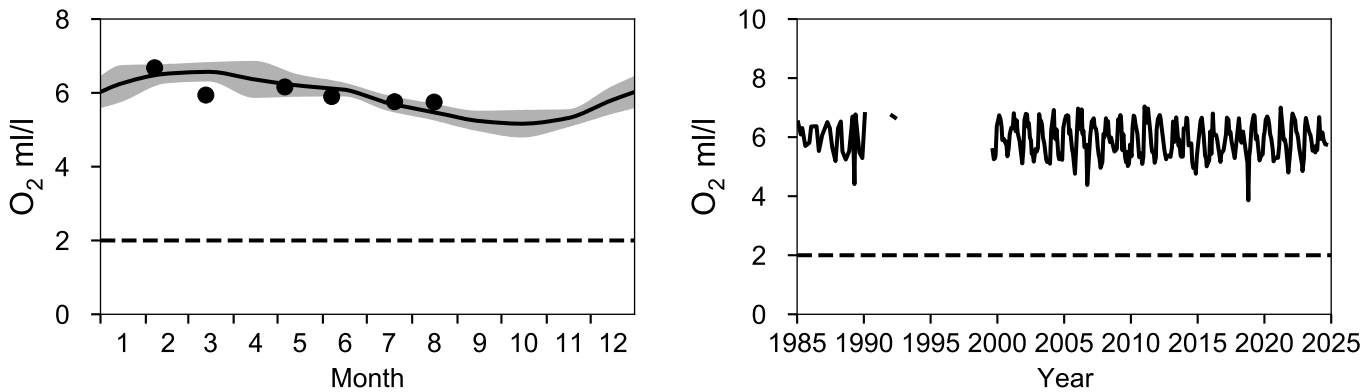


STATION Å15 SURFACE WATER (0-10 m)

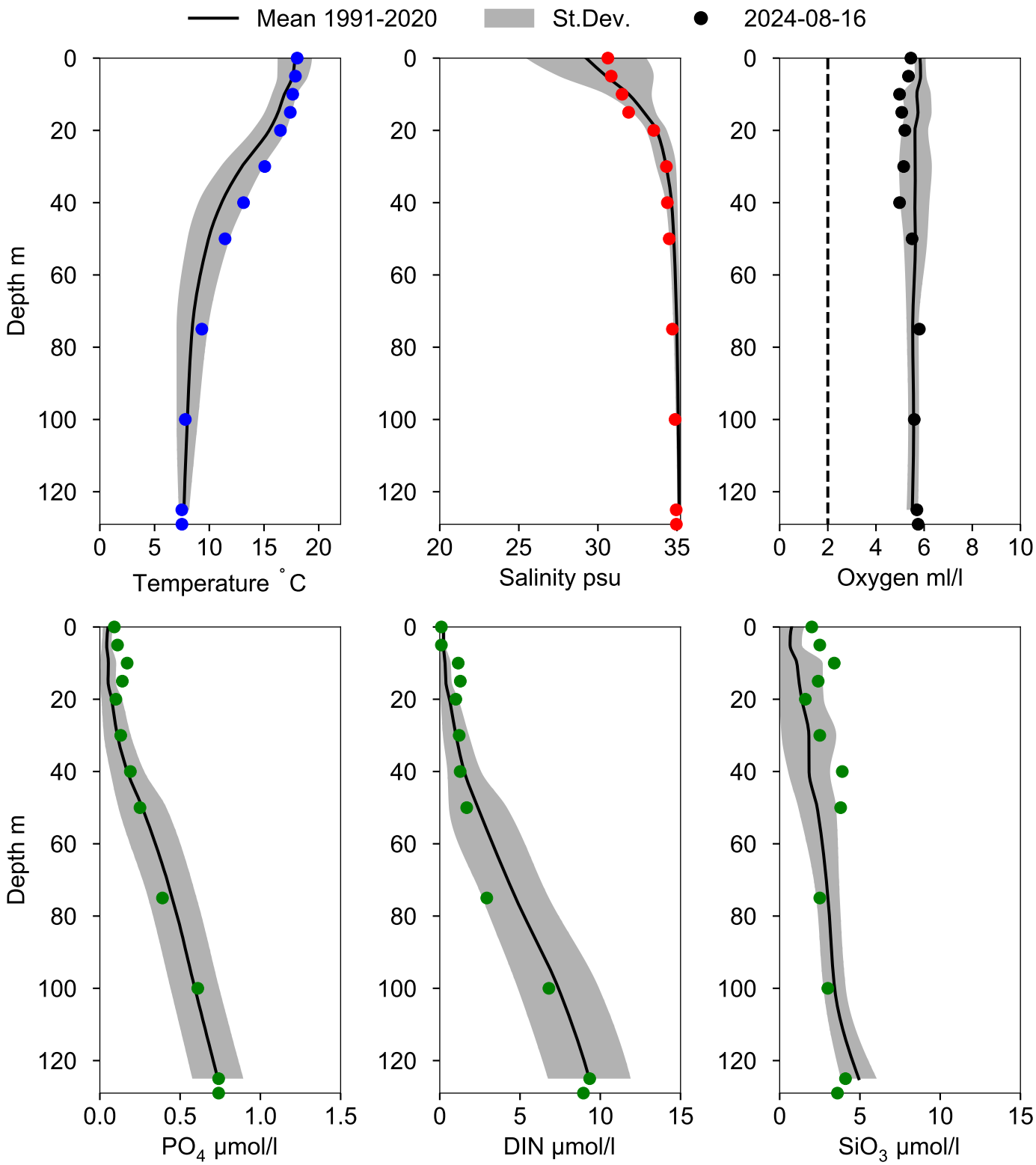
Annual Cycles



OXYGEN IN BOTTOM WATER (depth >= 125 m)

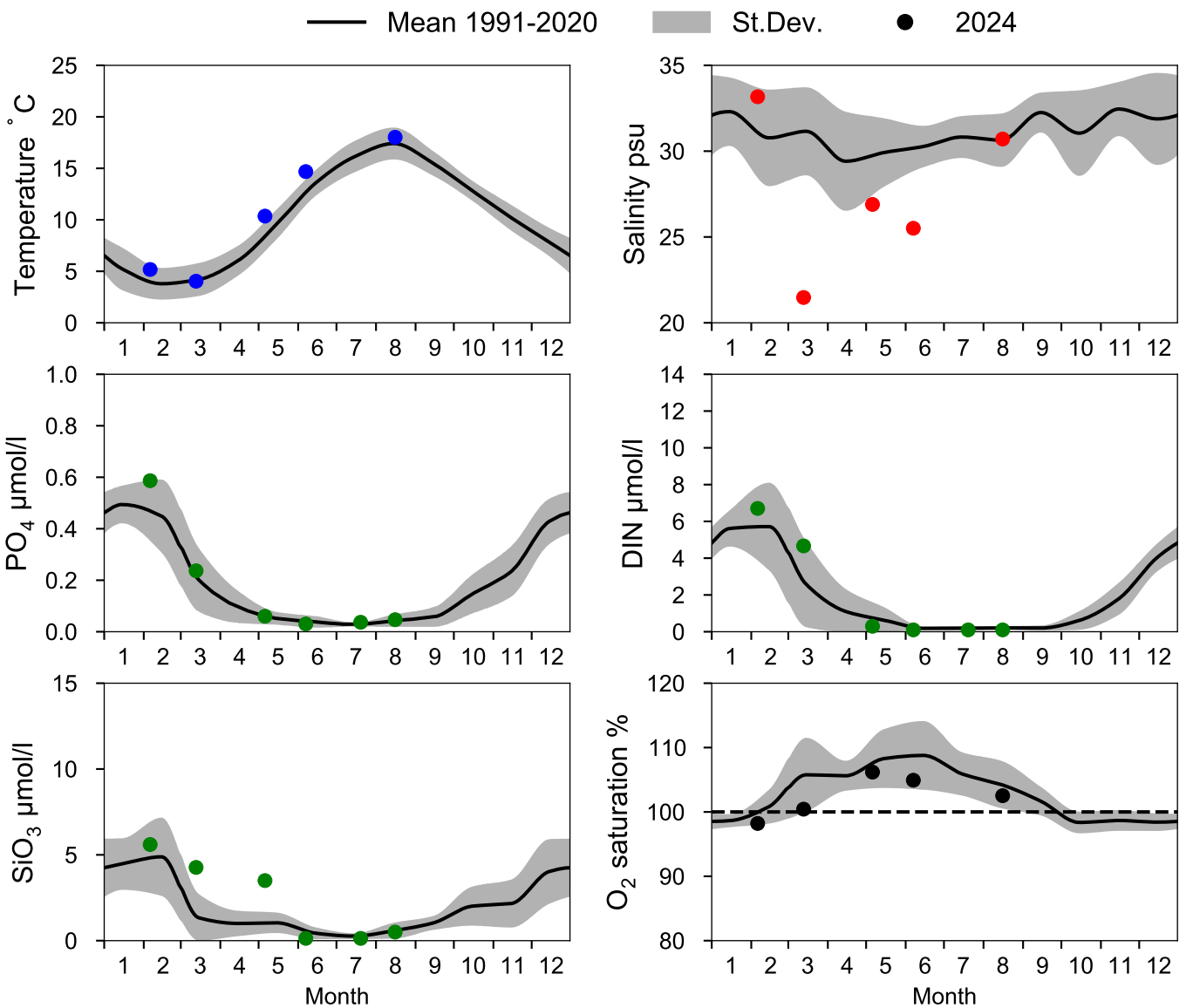


Vertical profiles Å15
August

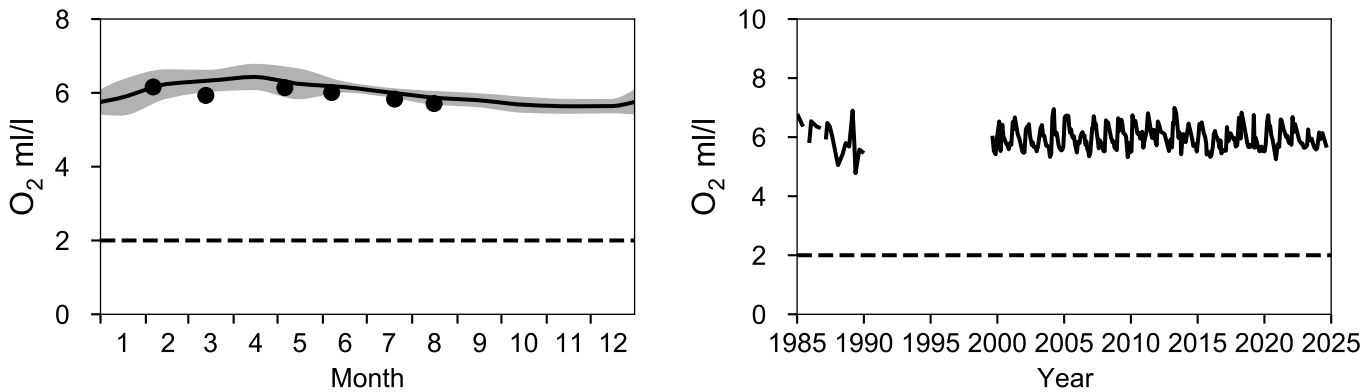


STATION Å17 SURFACE WATER (0-10 m)

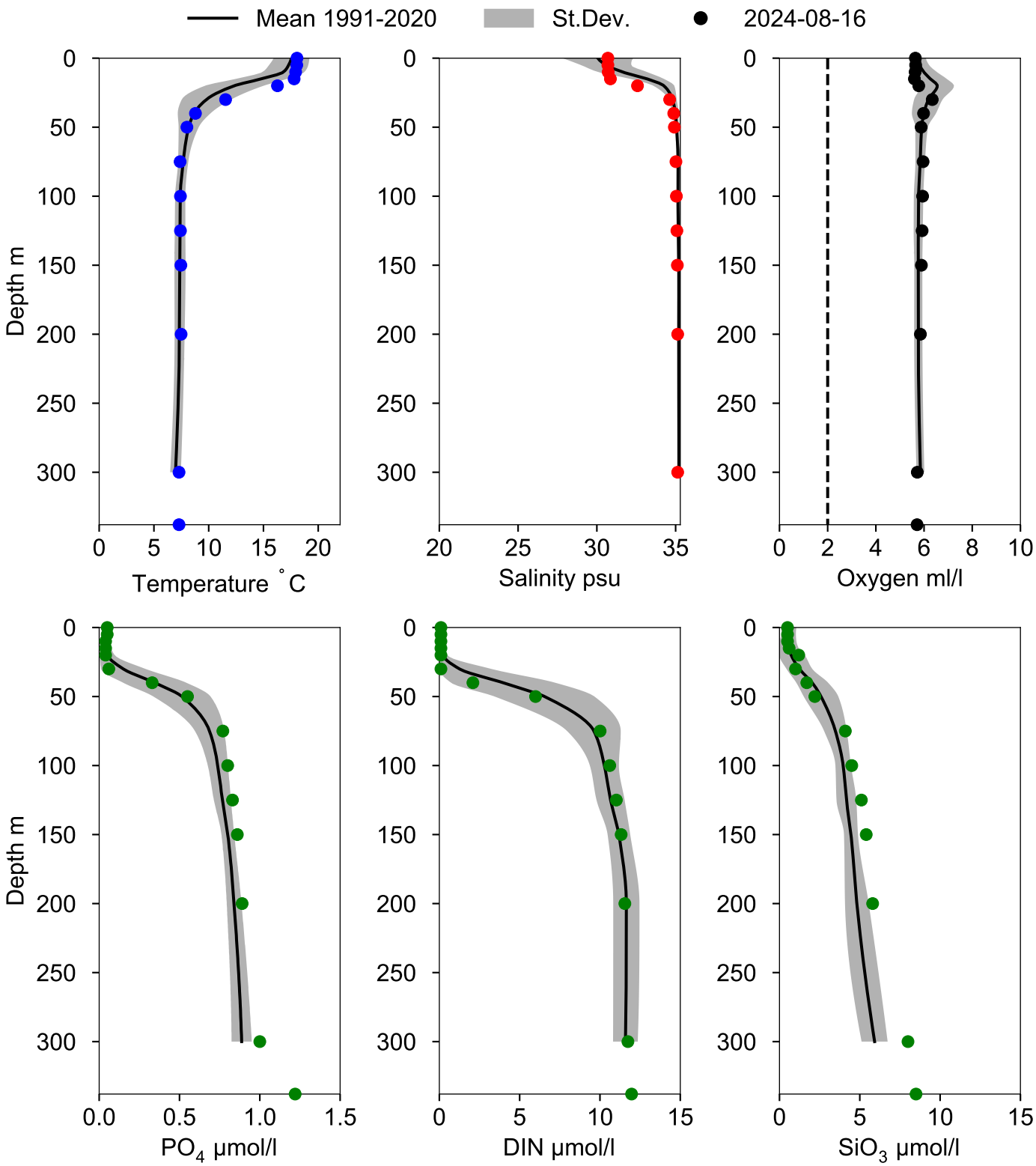
Annual Cycles



OXYGEN IN BOTTOM WATER (depth >= 300 m)

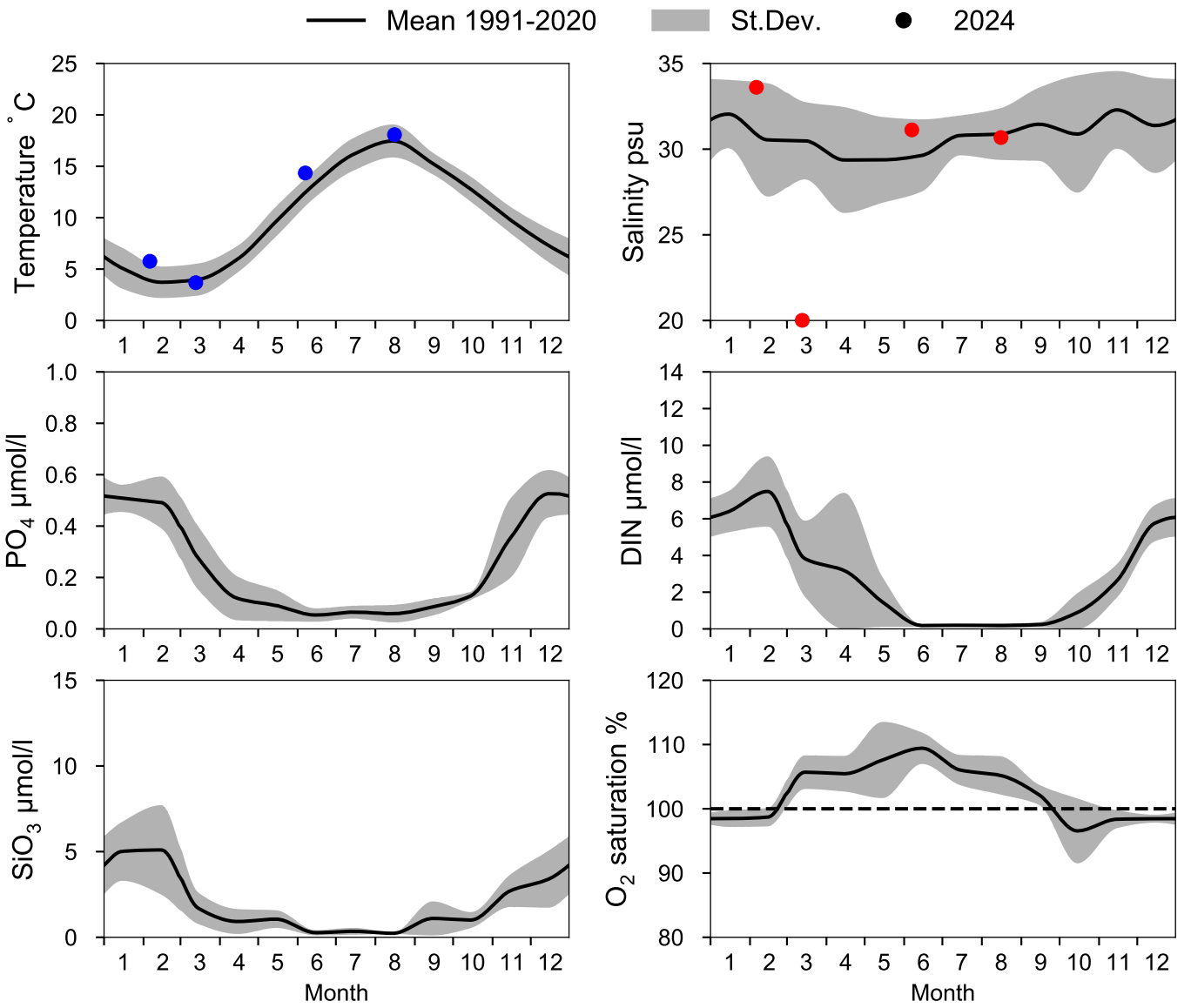


Vertical profiles Å17
August

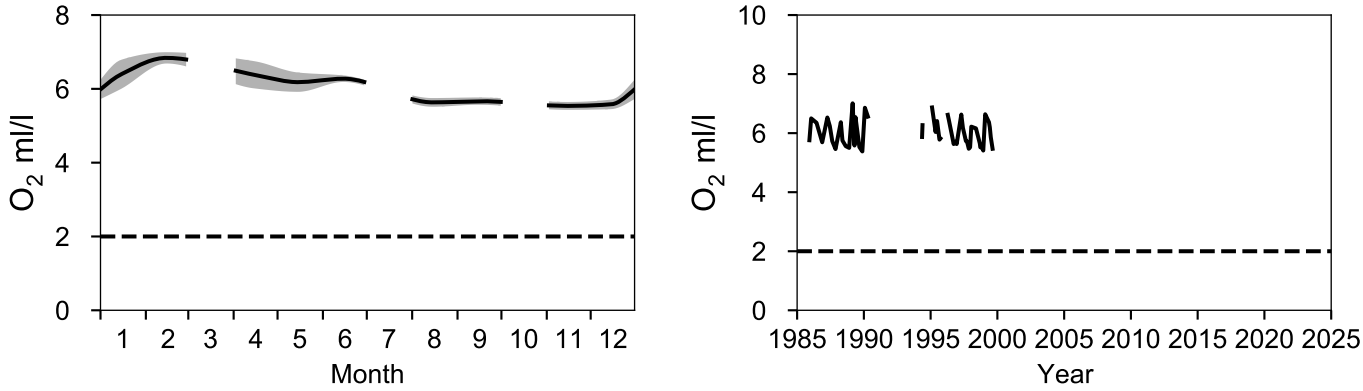


STATION Å16 SURFACE WATER (0-10 m)

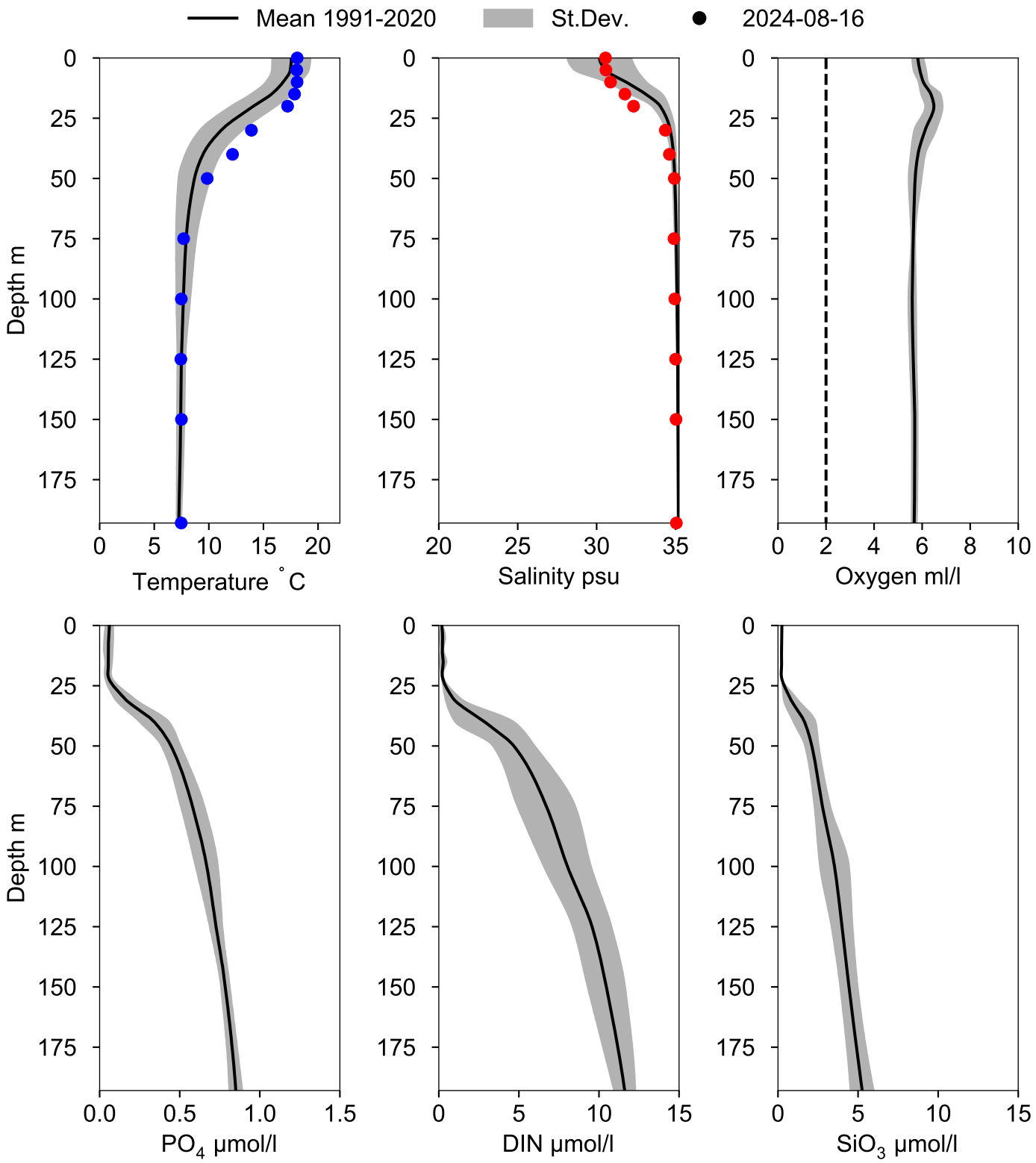
Annual Cycles



OXYGEN IN BOTTOM WATER (depth >= 193 m)

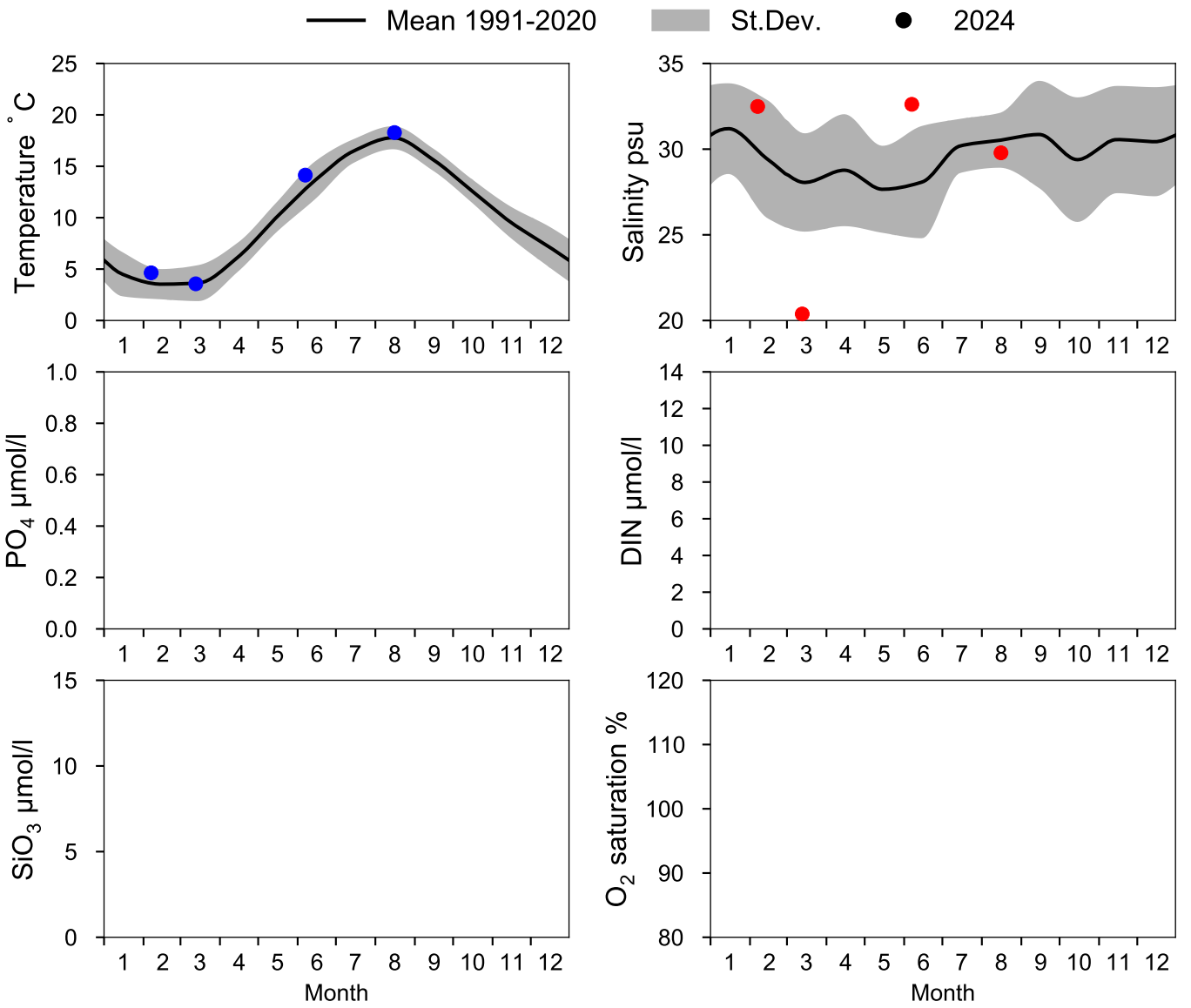


Vertical profiles Å16
August

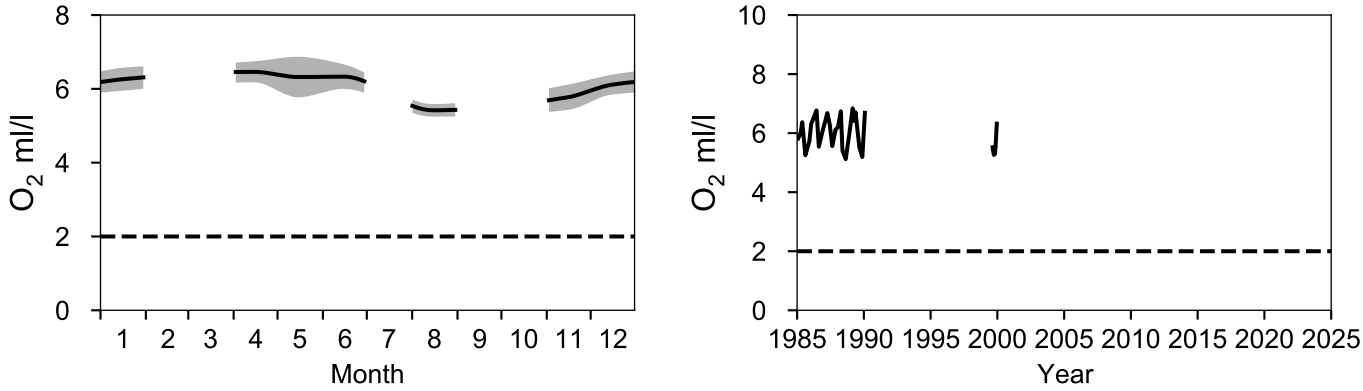


STATION Å14 SURFACE WATER (0-10 m)

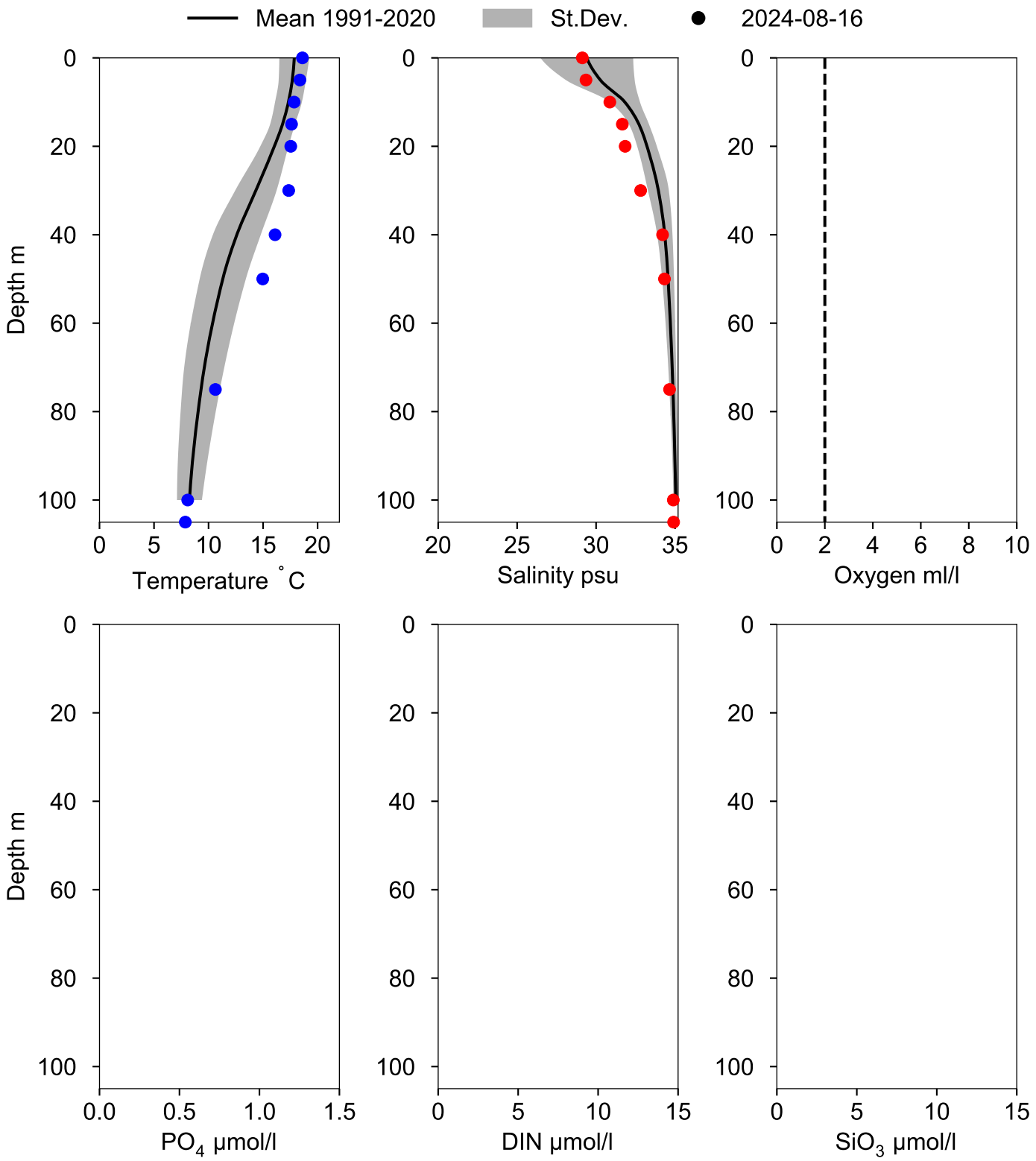
Annual Cycles



OXYGEN IN BOTTOM WATER (depth >= 100 m)

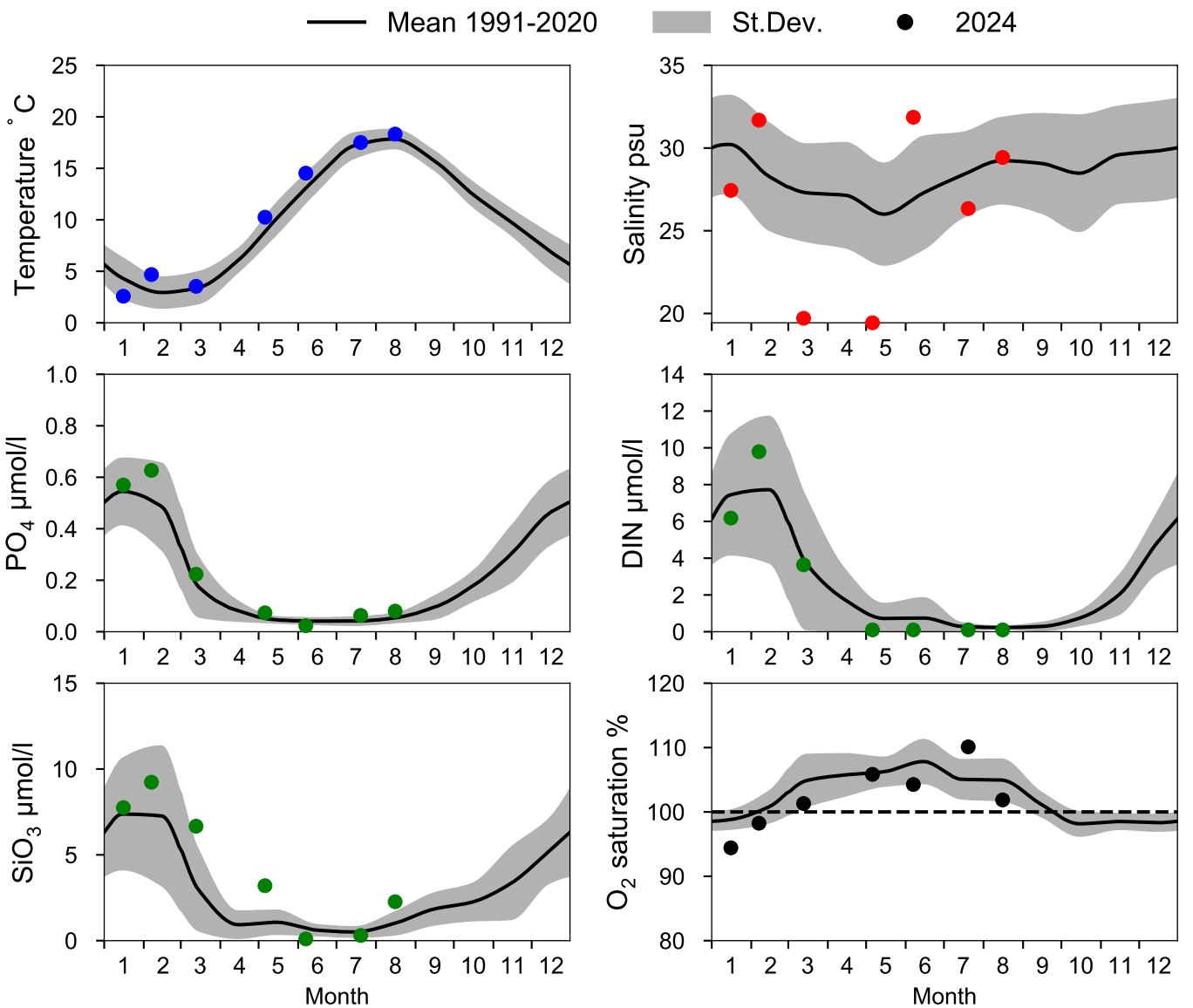


Vertical profiles Å14
August

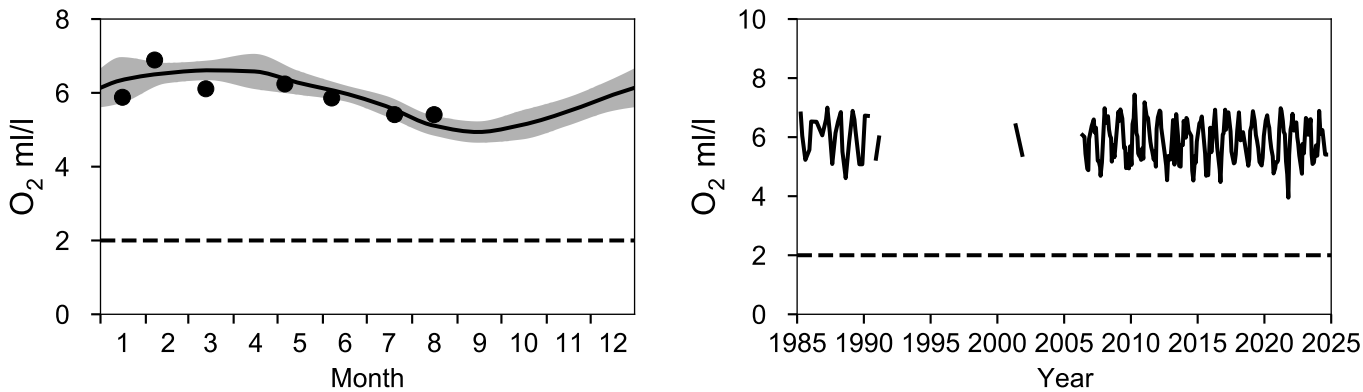
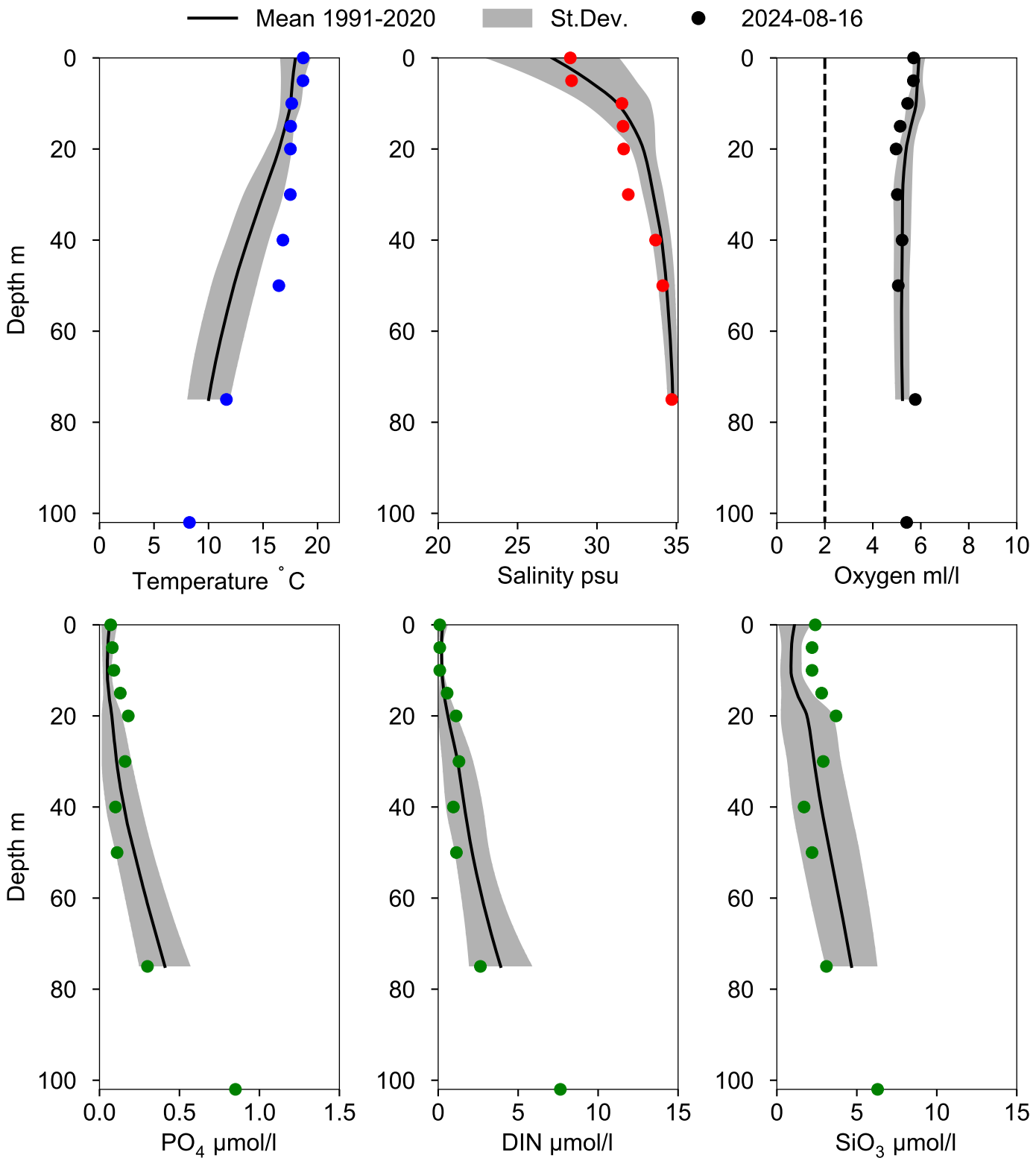


STATION Å13 SURFACE WATER (0-10 m)

Annual Cycles



OXYGEN IN BOTTOM WATER (depth >= 82 m)



Vertical profiles Å13
August