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Report from the SMHI monitoring cruise with R/V Svea July

Survey period: 2022-07-12 – 2022-07-18
Principal: Swedish Meteorological and Hydrological Institute (SMHI), Swedish Agency for Marine and Water Management (SwAM)
Cooperation partners: Swedish University of Agricultural Sciences (SLU)

SUMMARY

The Skagerrak, the Kattegat, The Sounds and the Baltic Proper was visited during this cruise, which is part of the National Marine Monitoring Programme of Sweden.

Surface temperatures in July were normal for the season at almost all visited stations, except for The Bight of Hanö and Ref M1V1 where temperature was below normal. Satellite observations in the area showed upwelling earlier this week.

Dissolved inorganic nitrogen (DIN) levels were low and showed values below reporting limit in the whole investigated area, considered normal for the season. The concentrations of phosphate and silicate was normal or below normal on the Swedish west coast and slightly above normal in the Baltic Proper.

The oxygen situation in the bottom water showed levels lower or much lower than normal for this time of the year in the Baltic Proper. In the Arkona Basin, hypoxic conditions (oxygen concentration <2 ml/l) occurred in the bottom water. In the Bornholm Basin and The Bight of Hanö hypoxic conditions was observed below 70 m depth, and hydrogen sulphide was measured in the bottom water from 80 m depth. In the Eastern and the Western Gotland Basins hypoxic conditions

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occurred from 60-80 m depth. Hydrogen sulphide were present from 90 m depth in the Eastern Gotland Basin and from 70 m in the Western Gotland Basin.

The next cruise is planned to depart on August 12th from Lysekil.

RESULTS

The expedition was performed with the Swedish research vessel Svea and departed from Lysekil on the 12th of July and ended in the same harbour on the 18th. During the expedition it was mostly cloudy with light to moderate winds with varying directions from southwest to northwest. Air temperature varied from 13.6 to 22.1°C.

Measurements with Svea's MVP (Moving Vessel Profiler) which is used to measure temperature, salinity and oxygen profiles underway, was run daytime (08.00-20.00) between stations during the 14th and 17th of July. Both the Ferrybox (continuous measurements at a depth of 4 m) and Svea's two ADCPs (current measurement) were running during the expedition.

In addition to the regular sampling, extra phytoplankton samples were taken for Stockholm University at two stations in the Skagerrak and one in the Kattegat. Extra phytoplankton samples were taken for cyanobacteria research purposes at Swedish University of Agricultural Sciences (SLU), Swedish Food Agency and University of Gothenburg. During the cruise an Imaging FlowCytobot (IFCB) performed automatic phytoplankton analyses underway.

At Östergarnsholm, sensors were changed on a measurement system belonging to Uppsala University. A shorter ADCP test was also performed to compare Svea's and Uppsala's measurements.

Marie Johansen, phytoplankton expert, participated in the expedition and has summarized the algae situation below. More detailed results are presented in the AlgAware report for July:
https://www.smhi.se/en/publications/publications/algal-situation-reports-2-1056
Daily algae monitoring via satellite is performed by SMHI during the summer and is available at
https://www.smhi.se/vader/observationer/algsituationen/algae

The diatom *Proboscia alata* was found in high concentrations in the integrated hose samples taken at all stations in the Skagerrak and the Kattegat. Among the smaller cells numerous cells of *Emiliania huxleyi* were present. The species diversity was overall low. Several smaller chlorophyll fluorescence maxima were found at several depths. Stations at the transect Å-snittet presented a fluorescens maximum at 10-12 m, and closer to the coast *Dinophysis acuta* dominated the samples.

No clear surface accumulations of cyanobacteria were found in the Baltic Sea during this expedition. This was probably due to high wind speed and waves that mixed the water. The samples from the southwest stations showed only few filaments in the water. At the middle of the southern part outside Bornholm, a few more filaments were found in both the surface sample and the integrated sample. At the southeastern part, the water was well mixed with relatively high fluorescence down to 20 m. Here, both *Aphanizomenon flosaquae* and *Nodularia spumigena* were common in both surface and integrated samples. The eastern middle part of the Baltic Proper showed some more filaments at BY15 Gotland Deep, where small surface accumulations were noted slightly north of the station. At the northernmost part of the expedition, north of Gotland, slightly larger amounts of filaments were found. At both stations it was mixed down to about 12-15 m due to the wind. If the wind calms down, surface accumulations may form quickly. In this area,

satellite images have also indicated surface accumulations in recent days. At BY38 between Öland and Gotland, the wind had calmed down a bit and the waves were smaller. Here, small grains were seen in the water (which could be small aggregations of filaments) and could lead to surface accumulations with decreasing wind. The surface sample showed more filaments compared to the integrated sample, indicating that the filaments may be on their way to the surface. In the western parts, a lot of cyanobacterial filaments were found, with the genus *Dolichospermum* dominating.

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

Data can be downloaded from the SHARKweb:
https://www.smhi.se/data/oceanografi/datavardskap-oceanografi-och-marinbiologi

The Skagerrak

The temperature in the surface water varied from 17.6°C in the off-shore part to 16.3°C closer to the coast, which is considered normal for this time of the year. Surface salinity varied between 29 and 31 psu, with lowest values closer to the coast. This is normal for the off-shore area however elevated closer to the coast. A clear stratification occurred at a depth between 5-20 m at most stations. Släggö and P2 also showed a clear temperature stratification at 50 m.

Nutrient concentrations in the surface waters of the Skagerrak was depleted or low, which is normal for the season. Phosphate varied between 0.04 and 0.07 µmol/l, silicate 0.4-1.6 µmol/l and dissolved inorganic nitrogen (DIN) was below detection limit (≤0.1 µmol/l).

The oxygen condition was good at the sampling stations in the Skagerrak with concentrations normal for the season. Lowest concentration was found at the bottom at station P25.6 ml/l.

Chlorophyll fluorescence which indicate phytoplankton activity, measured using CTD, showed some activity between 10 and 30 m.

The Kattegat and The Sounds

The sea surface temperature in the Kattegat and The Sounds was normal for the season and varied between 17.5-18.1°C. The sea surface salinity varied between 19-27 psu in the Kattegat, and in The Sounds salinity was 14 psu, considered between normal and slightly above normal. In the Kattegat and The Sounds the temperature and salinity stratification was found between 10 and 20 m depth. Stratification at Anholt E occurred at 35 m depth.

The nutrient concentrations in the surface waters were considered between normal and lower than normal in the area. Phosphate concentration varied between 0.05-0.24 µmol/l and the concentration of silicate was between 0.3-3.9 µmol/l. The concentration of DIN was <0.1 µmol/l. The highest concentrations were measured in The Sounds.

Oxygen condition in the bottom water was good, the lowest concentration measured in the Kattegat and in The Sounds was 4.2 ml/l and 4.0 ml/l respectively.

Similarly, as in the Skagerrak, the chlorophyll fluorescence showed activity between 10 and 30 m.

The Baltic Proper

The sea surface temperature was normal for the season at almost all the visited stations except at The Bight of Hanö and Ref M1V1 were the temperature was lower than normal. In this area, upwelling was seen from satellite images earlier this week. The temperature varied from 13.9 to 18.4°C. The salinity in the surface water was 6.6-8.4 psu, considered between normal and above normal, throughout the investigated area. A thermocline was observed between 5 to 20 m, as well as a stratification from both temperature and salinity at between 35 and 80 m depth.

The nutrient concentrations in the surface waters were considered between normal and above normal in the area. Concentration of phosphate varied between 0.08-0.38 µmol/l, DIN between 0.10-0.38 µmol/l and silicate concentration between 8.4-12.3 µmol/l.
The oxygen situation in the bottom water showed levels considered lower or much lower compared to normal for this time of the year in the Baltic Proper. In the Arkona Basin hypoxic conditions (oxygen concentration <2 ml/l) occurred in the bottom water. In the Bornholm Basin and The Bight of Hanö hypoxic conditions were observed below 70 m depth, and hydrogen sulphide was measured in the bottom water at The Bight of Hanö and from 80 m depth in the Bornholm Basin. In the Eastern and the Western Gotland Basins hypoxic conditions began at 60-80 m depth. Hydrogen sulphide were detected from 90 m depth in the Eastern Gotland Basin and from 70 m in the Western Gotland Basin.

Fractional plankton activity was measured using CTD fluorescence, with a few stations showing a peak at 20 m depth.

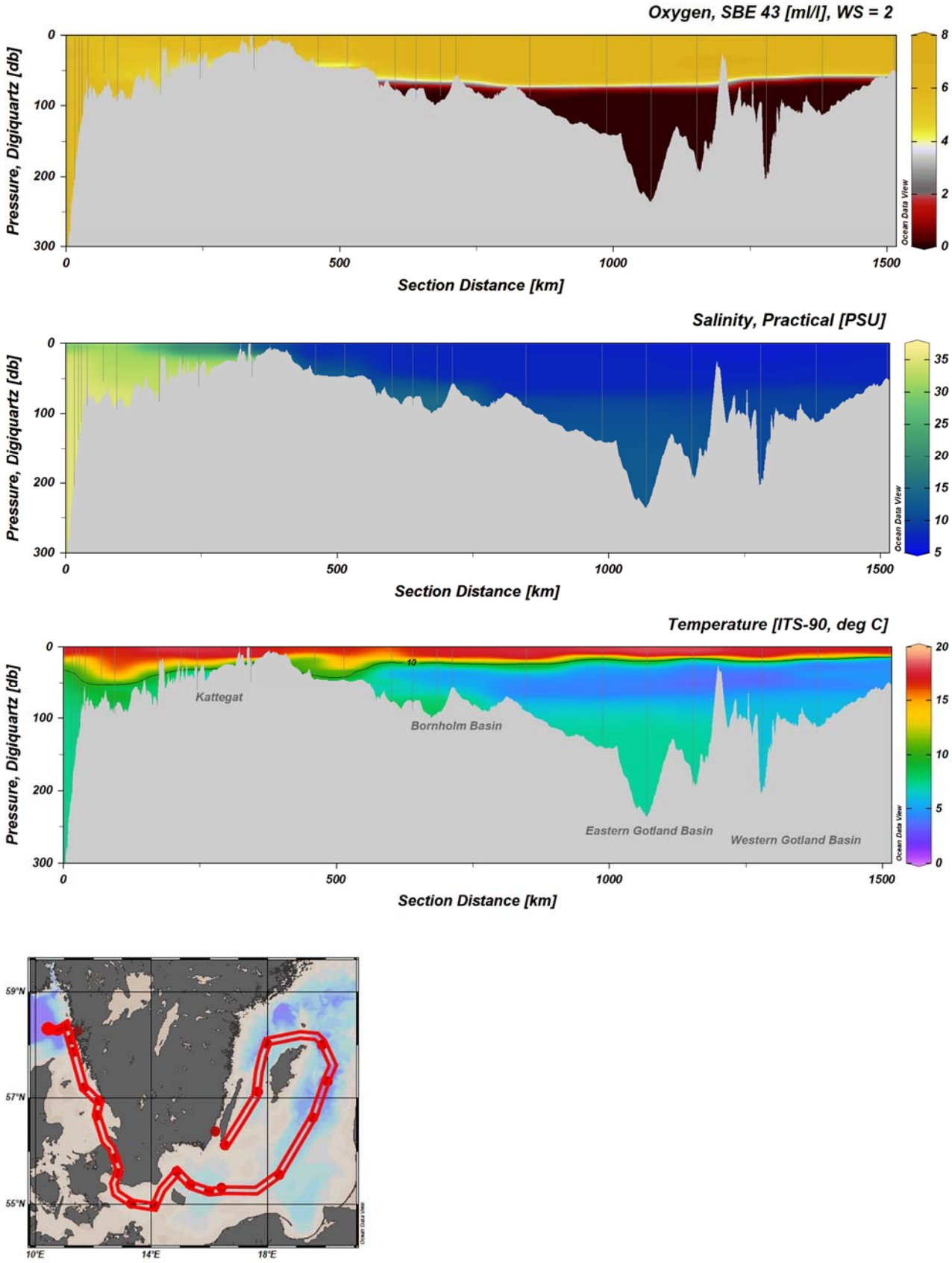

Fig 1. Transects ranging from the Skagerrak, through the Kattegat and The Sounds, further into the Baltic Proper, ending in the Western Gotland Basin shows the oxygen, salinity and temperature. Grey vertical lines indicate the positions where data is collected, also shown in the map.

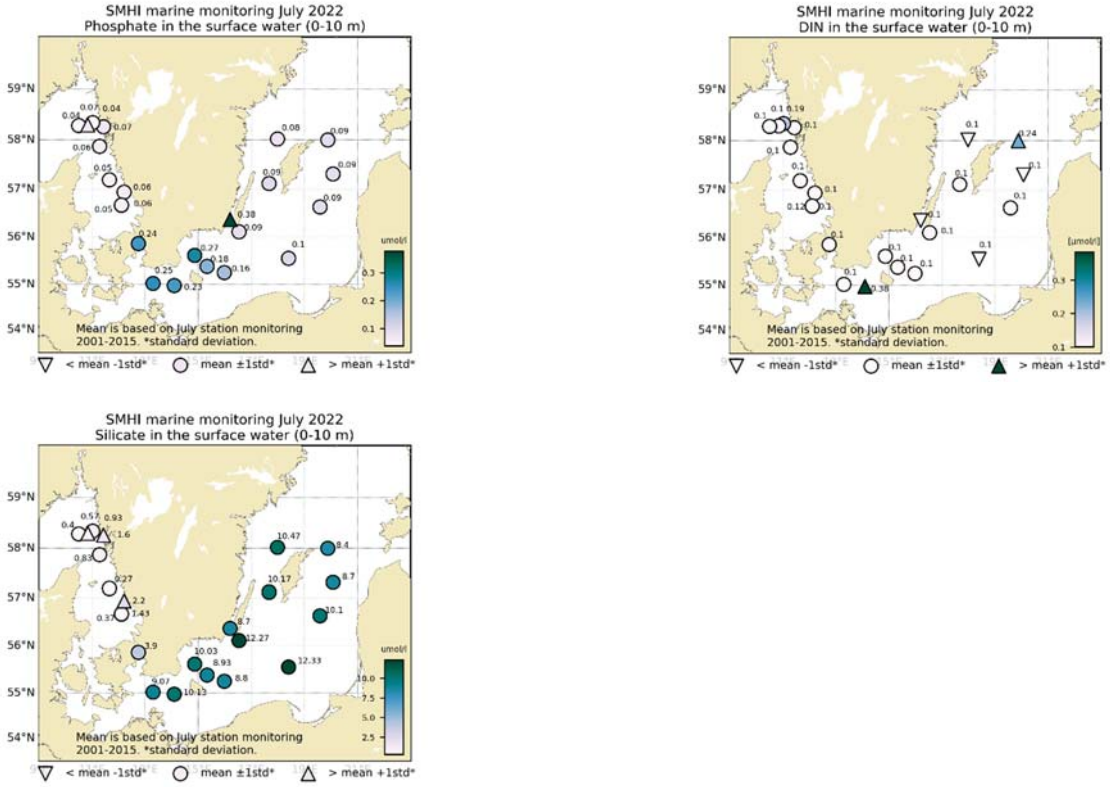

Figure 2. Surface concentrations of phosphate, dissolved inorganic nitrogen (DIN) and silicate.

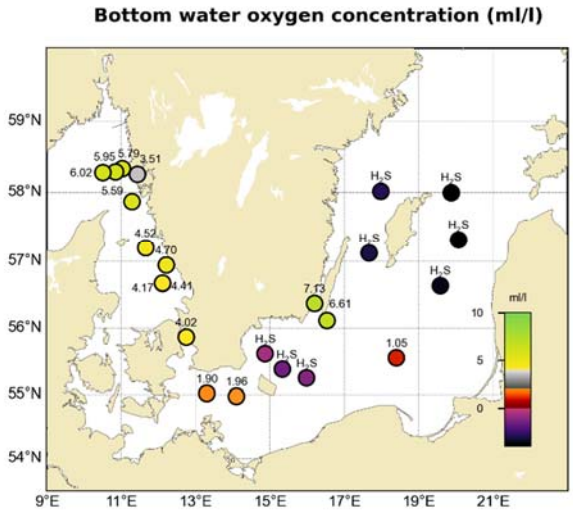

Figure 3. Oxygen concentration in the bottom water.

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APPENDICES

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

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TRACKCHART
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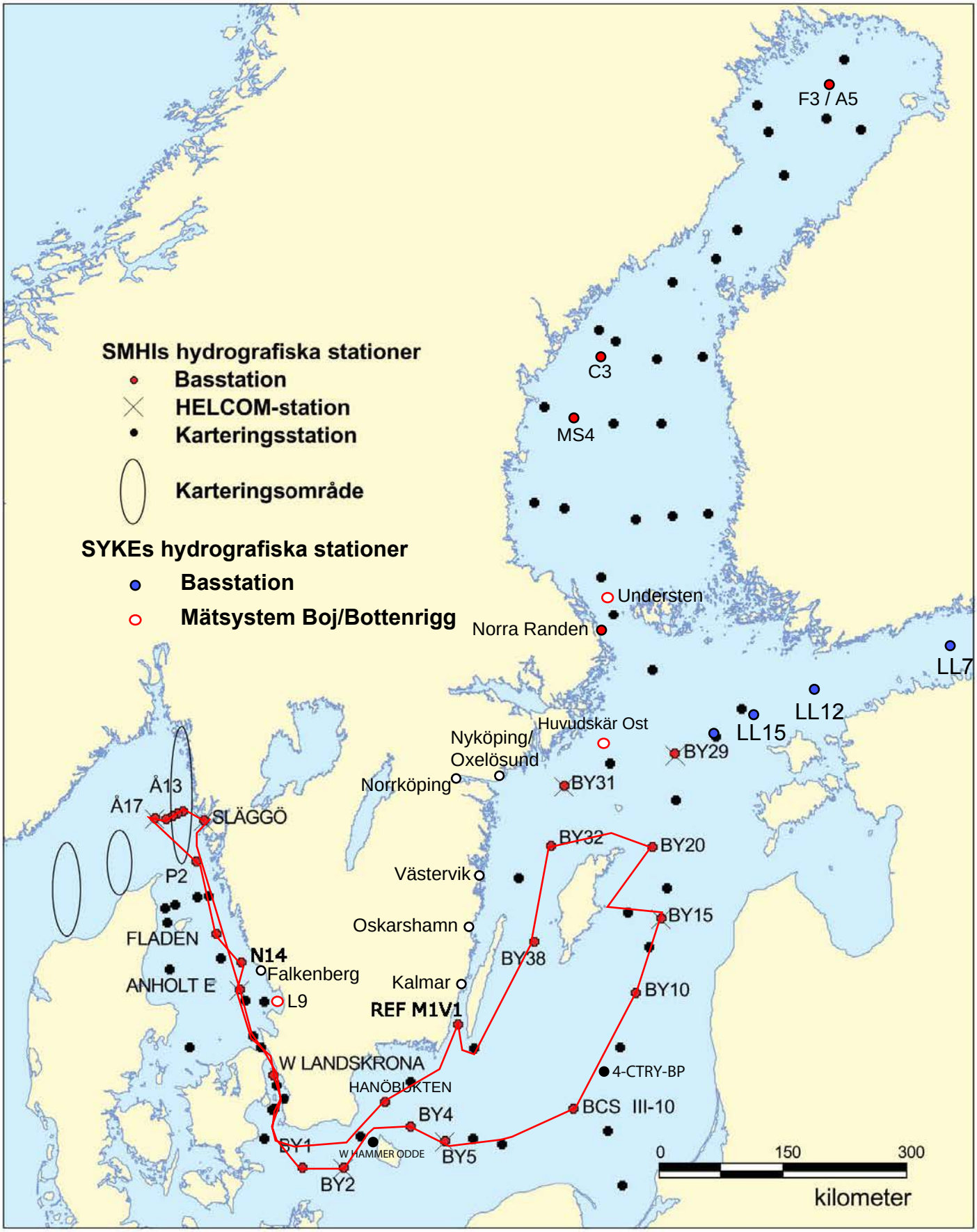
Ship: R/V Svea
Date: 20220712-18
Series: 0534-0562



Ship: SE
Year: 2022

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	Weath	Cloud	Waves	Iceob	Chla	Zoop	Phytop	Pp	No de	No btl	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	Comnt_visit	Comnt_samp
0534	12	FIBG27	BAS...	SLÄGGÖ	5815.58	01126.14	20220712	0630	75	8	22	6	16.9	1022	1	6	1	0	x	x	x	-	9		x	x	-	x	-	x	x	-	x	-	x	x	x	-	-	-	x	-	-	-
0535	12	SKEX14	BAS...	Å13	5820.43	01101.72	20220712	1115	89	13	25	5	17.1	1022	2	7	3	0	x	-	-	-	10		x	x	-	x	-	x	x	-	x	-	x	x	x	-	-	-	x	-	-	-
0536	12	SKEX15	BAS...	Å14	5818.92	01056.07	20220712	1230	110		25	7	16.9	1020	2	7	3	0	-	-	-	-	11		-	x	-	x	-	-	x	-	-	-	-	-	-	-	-	-	-	-	-	-
0537	12	SKEX16	BAS...	Å15	5817.66	01050.73	20220712	1340	137	11	25	7	17.0	1021	2	7	3	0	x	-	-	-	12		x	x	-	x	-	x	x	-	x	-	x	x	x	-	-	-	x	-	-	-
0538	12	SKEX17	BAS...	Å16	5816.02	01043.45	20220712	1515	203		24	8	17.0	1017	2	8	4	0	-	-	-	-	13		-	x	-	x	-	-	x	-	-	-	-	-	-	-	-	-	-	-	-	-
0539	12	SKEX18	BAS...	Å17	5817.06	01030.25	20220712	1650	351		22	9	16.6	1015	2	8	4	0	x	-	x	-	15		x	x	-	x	x	x	x	-	x	-	x	x	x	-	-	-	x	-	x	-
0540	12	SKEX23	BAS...	P2	5752.20	01117.37	20220712	2120	94		26	3	17.3	1015	9	9	9	0	x	-	-	-	10		x	x	-	x	-	x	x	-	x	-	x	x	x	-	-	-	x	-	-	-
0541	12	KANX25	BAS...	FLADEN	5711.56	01139.49	20220713	0220	83		26	7	17.6	1016	2	7	2	0	x	-	-	-	13		x	x	-	x	-	x	x	-	x	-	x	x	x	-	-	-	x	-	-	-
0542	12	KANX50	BAS...	N14 FALKENBERG	5656.40	01212.70	20220713	0505	31	9	29	8	17.6	1016	1	3	3	0	x	x	x	-	7		x	x	-	x	-	x	x	-	x	-	x	x	x	-	-	-	x	-	-	-
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0544	12	SOCX39	BAS...	W LANDSKRONA	5552.00	01244.96	20220713	1420	49	7	27	12	22.1	1014	1	4	3	0	x	-	-	-	9		x	x	-	x	-	x	x	-	x	-	x	x	x	x	-	-	x	-	-	-
0545	12	SOSX00	EXT...	FLINTEN-7	5535.22	01250.53	20220713	1645	8.5		30	12	21.4	1015	1	2	2	0	-	-	-	-	3		-	x	-	x	-	-	x	-	-	-	-	-	-	-	-	-	-	-	-	-
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0547	12	BPSA03	BAS...	BY2 ARKONA	5458.24	01405.87	20220714	0130	46		31	14	15.2	1017	9	9	9	0	x	x	x	-	8		x	x	-	x	-	x	x	-	x	-	x	x	x	x	-	-	x	-	x	-
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0552	12	BPEX13	BAS...	BY10	5638.04	01935.09	20220715	0710	143		29	10	15.7	1008	1	4	4	0	x	-	-	-	15		x	x	-	x	-	x	x	x	x	-	x	x	x	x	-	-	x	-	-	-
0553	12	BPEX21	BAS...	BY15 GOTLANDSDJ	5718.71	02004.51	20220715	1230	241		30	10	15.8	1010	1	5	4	0	x	x	x	-	24		x	x	-	x	x	x	x	x	x	-	x	x	x	x	-	-	x	-	x	-
0555	12	BPEX26	BAS...	BY20 FÅRÖDJ	5759.84	01952.75	20220715	2230	198		30	8	16.4	1010	9	9	9	0	x	-	-	-	17		x	x	-	x	-	x	x	x	x	-	x	x	x	x	-	-	x	-	x	-
0556	12	BPWX38	BAS...	BY32 NORRKÖPINGSDJ	5801.02	01759.07	20220716	0500	203	5	31	7	14.3	1010	1	3	3	0	x	-	-	-	17		x	x	-	x	-	x	x	x	x	-	x	x	x	x	-	-	x	-	-	-
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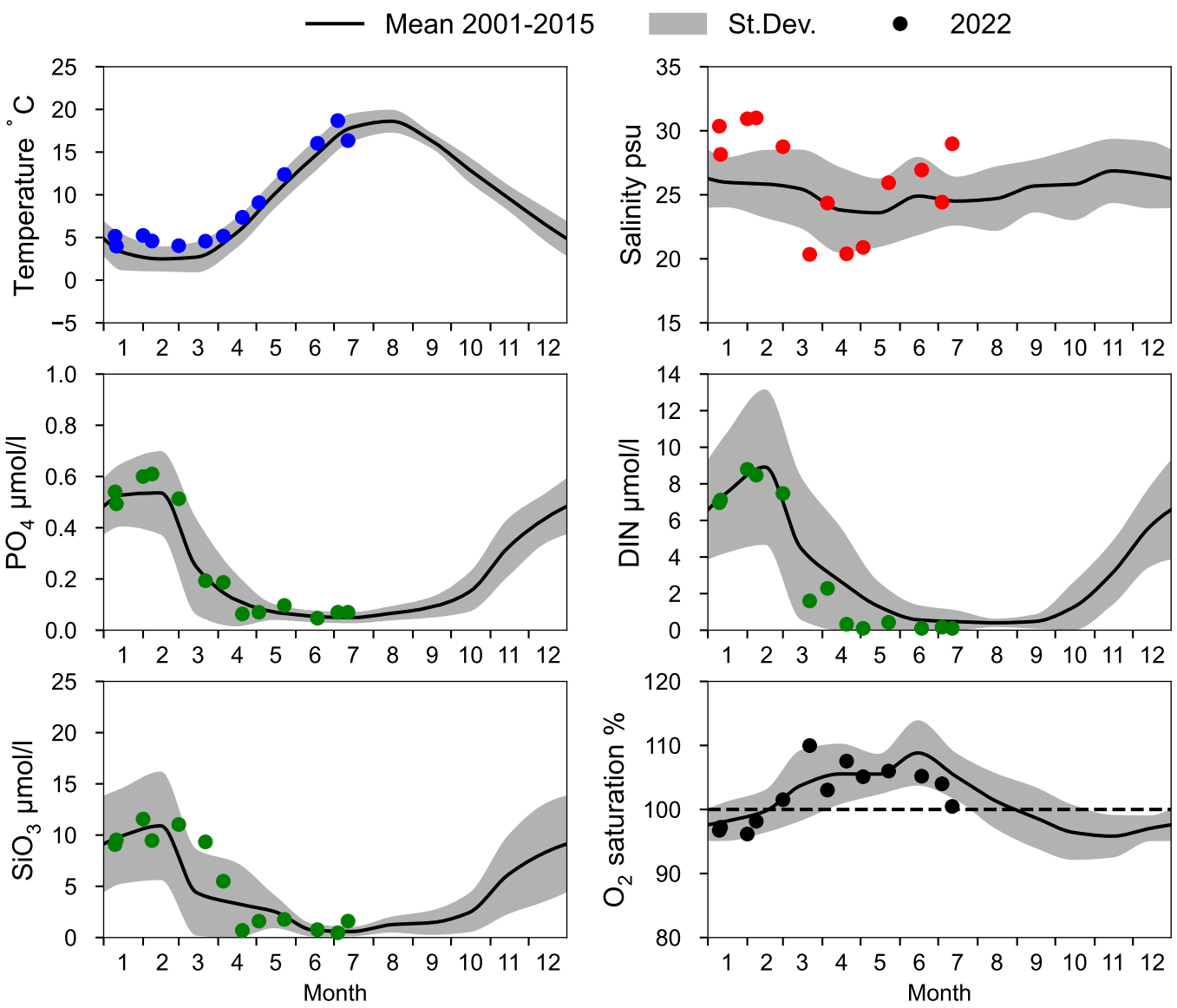
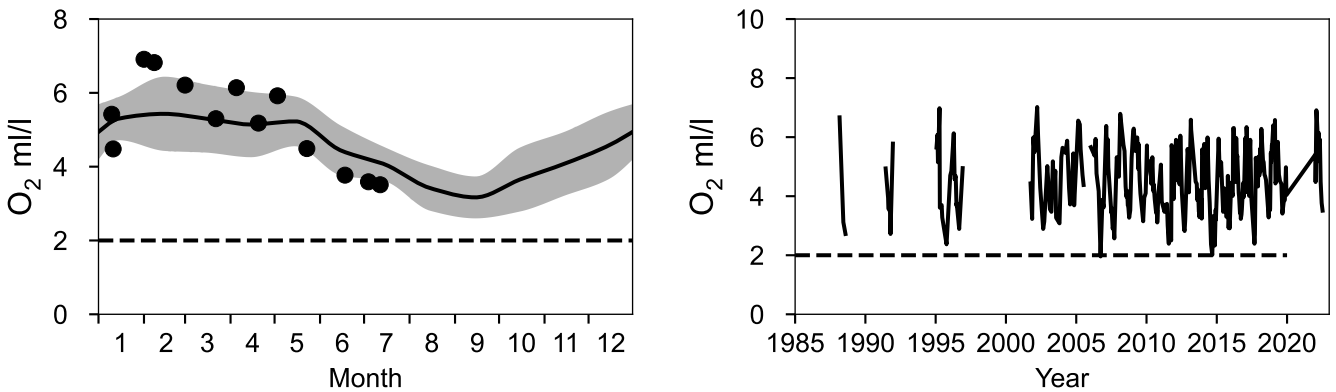
0558	12	BPSE49	BAS...	BY39 ÖLANDS S UDDE	5606.97	01632.16	20220716	1920	52		28	7	16.0	1018	1	3	2	0	x	-	-	-	8		x	x	-	x	-	x	x	-	x	-	x	x	x	x	-	-	x	-	-	-
0559	12	BPWK01	BAS...	REF M1V1	5622.25	01612.07	20220716	2200	21		30	3	15.5	1019	9	9	9	0	x	x	x	-	5		x	x	-	x	x	x	x	-	x	-	x	x	x	x	-	-	x	-	x	-
0560	12	BPSH05	BAS...	HANÖBUKTEN	5537.04	01452.05	20220717	0515	79		28	7	13.6	1023	1	4	3	0	x	-	-	-	11		x	x	-	x	-	x	x	x	x	-	x	x	x	x	-	-	x	-	-	-
0561	12	KAEX29	BAS...	ANHOLT E	5640.4	01206.67	20220717	2215	63		27	8	17.0	1023	9	9	9	0	x	x	x	-	10		x	x	-	x	x	x	x	-	x	-	x	x	x	x	-	-	x	-	-	-
0562	12	SKEX00	EXT...	AHC-TEST 2	5805.64	01113.18	20220718	1105	58		19	7	16.2	1019	2	8	3	0	-	-	-	-	9		-	x	-	x	-	-	x	-	-	-	-	-	-	-	-	-	-	-	-	-

STATION SLÄGGÖ SURFACE WATER (0-10 m)

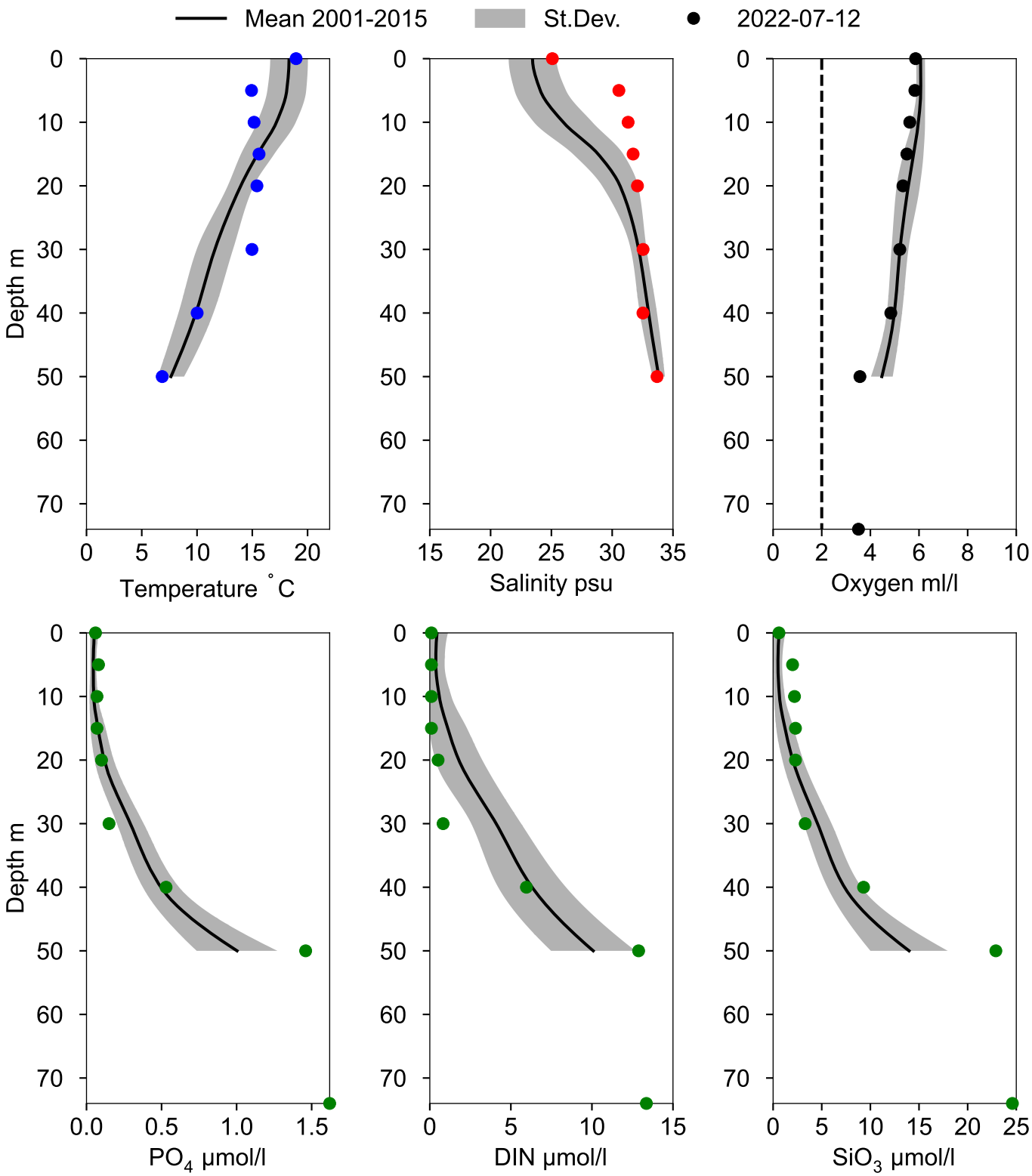
Annual Cycles



OXYGEN IN BOTTOM WATER (depth >= 64 m)

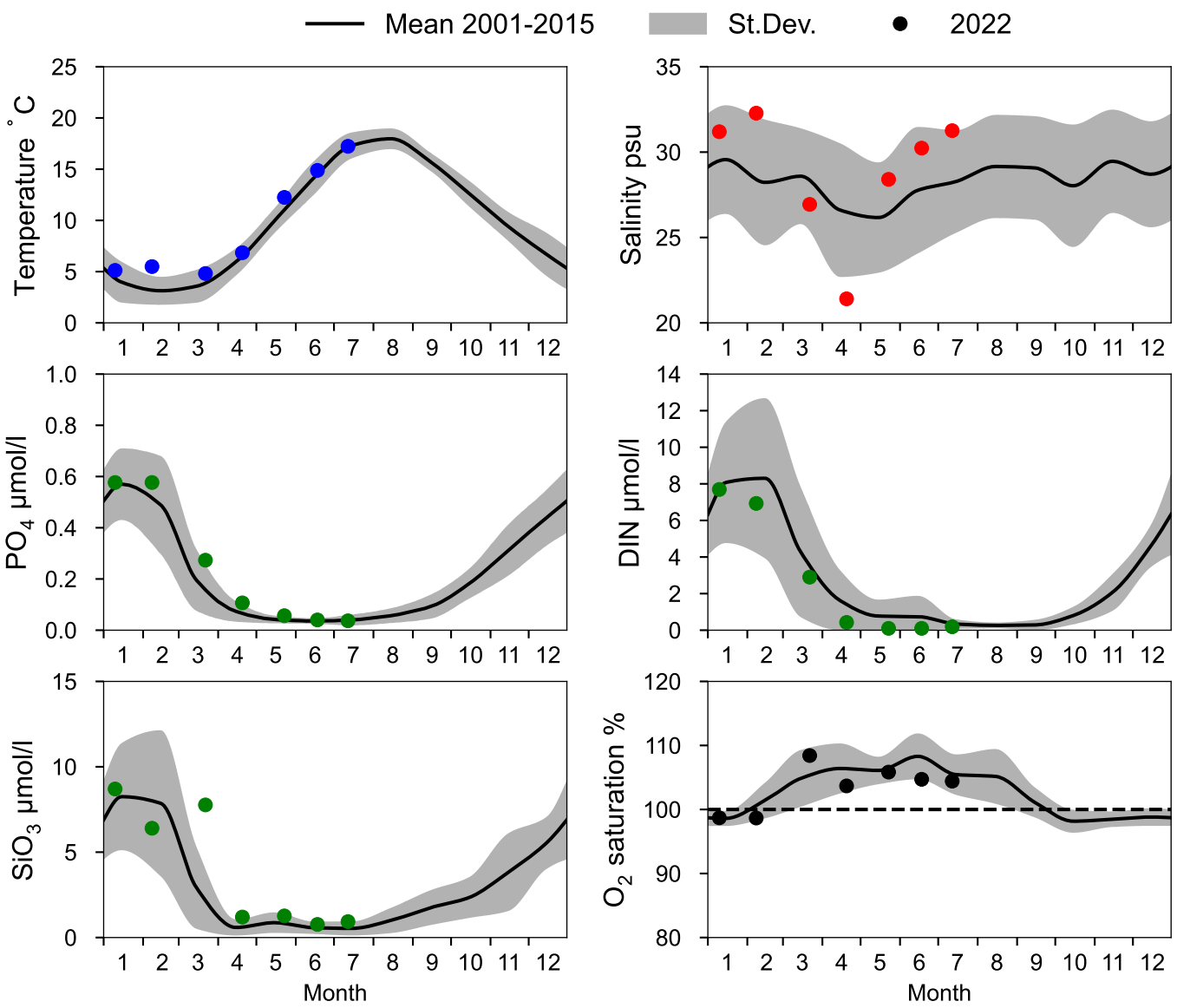


Vertical profiles SLÄGGÖ
July

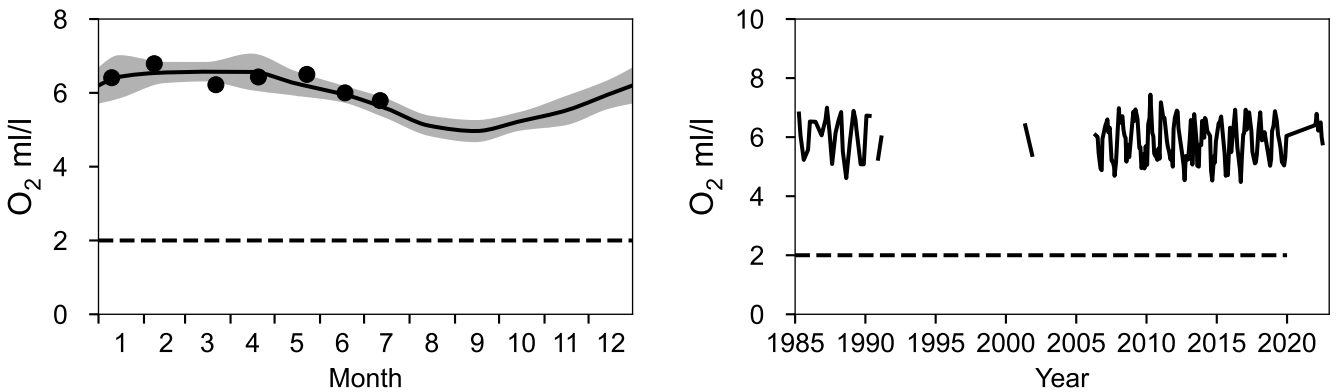


STATION Å13 SURFACE WATER (0-10 m)

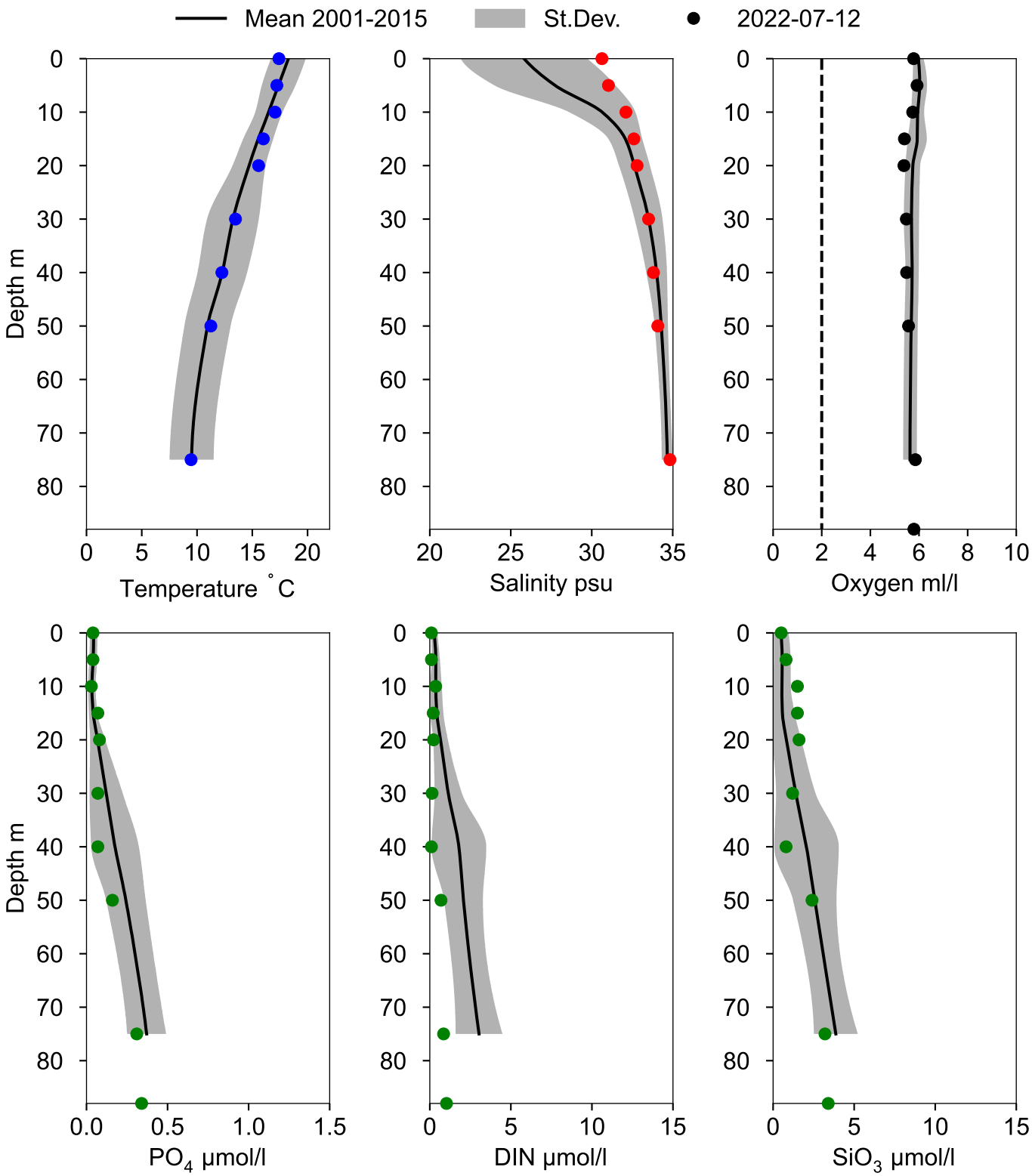
Annual Cycles



OXYGEN IN BOTTOM WATER (depth >= 80 m)

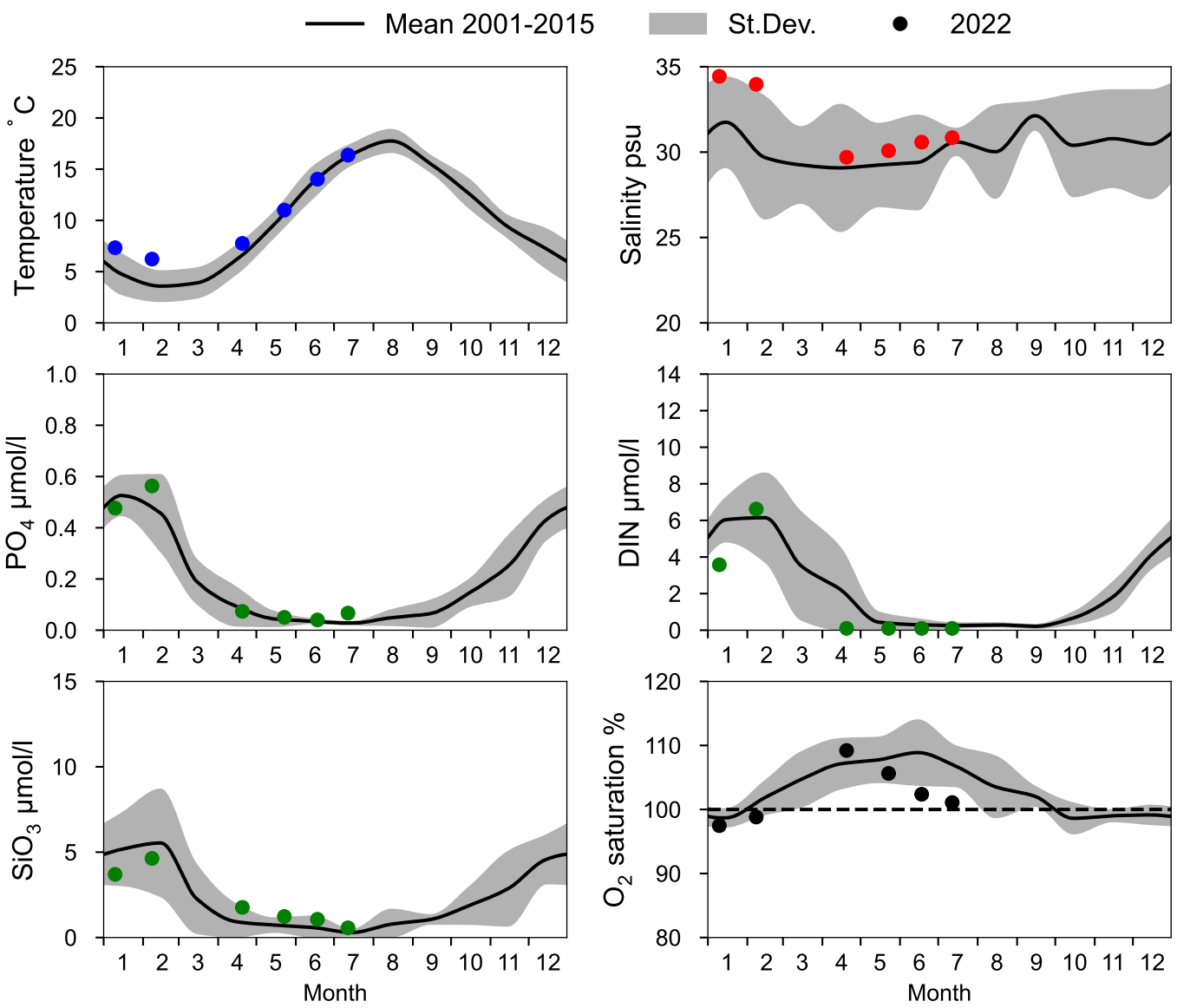


Vertical profiles Å13
July

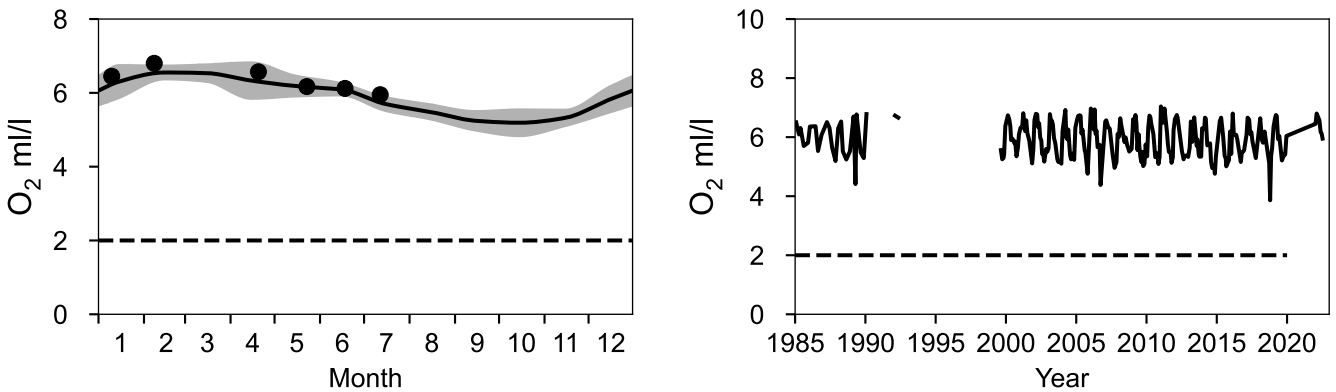


STATION Å15 SURFACE WATER (0-10 m)

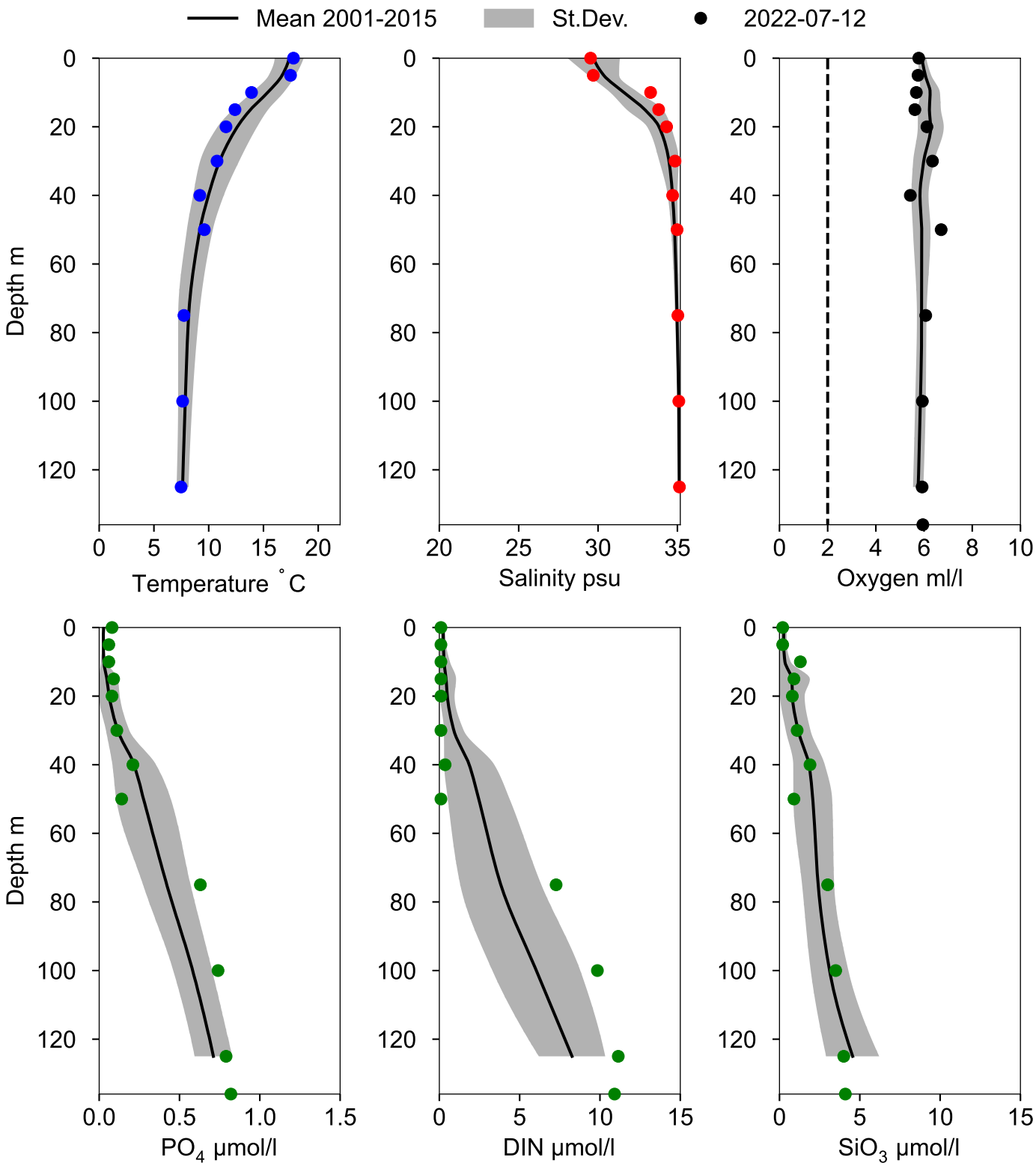
Annual Cycles



OXYGEN IN BOTTOM WATER (depth >= 125 m)

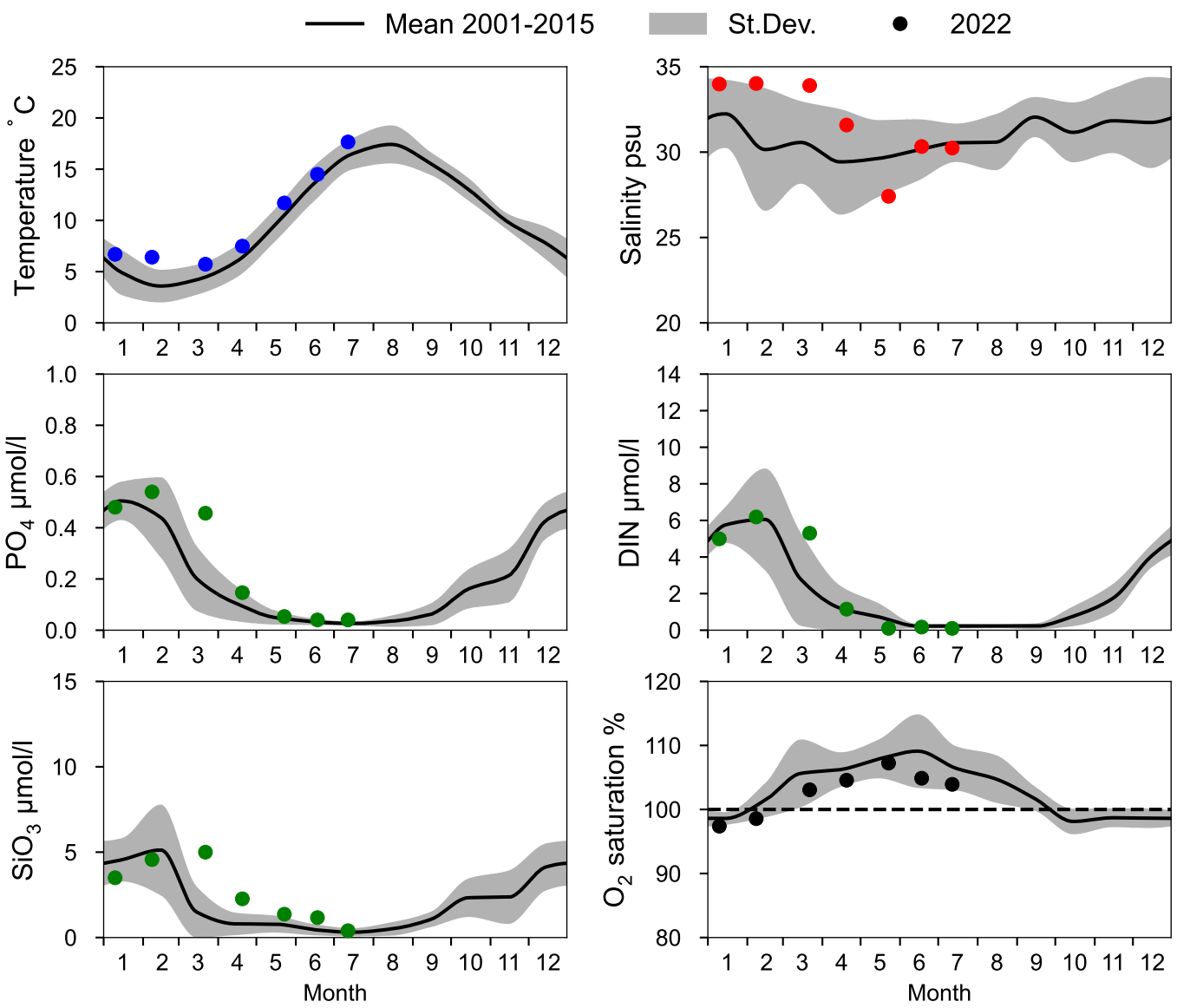


Vertical profiles Å15
July

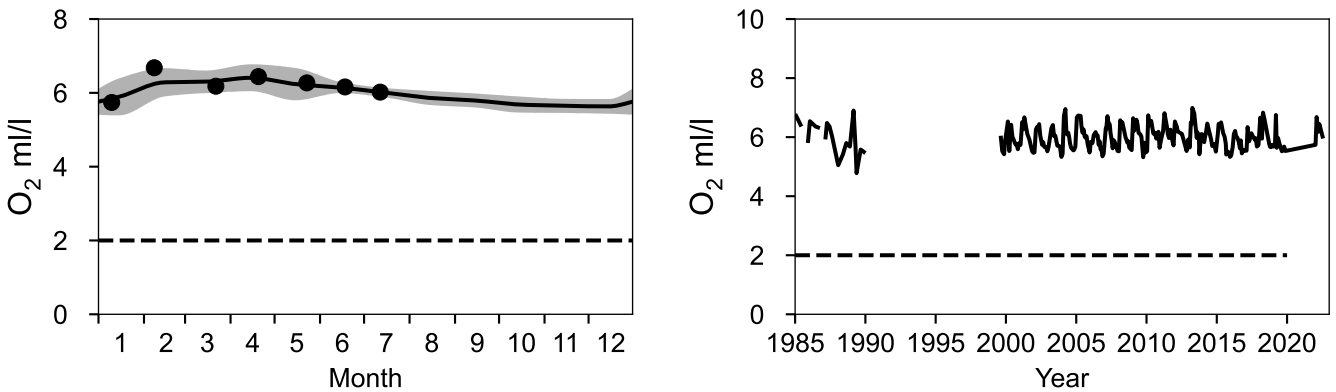


STATION Å17 SURFACE WATER (0-10 m)

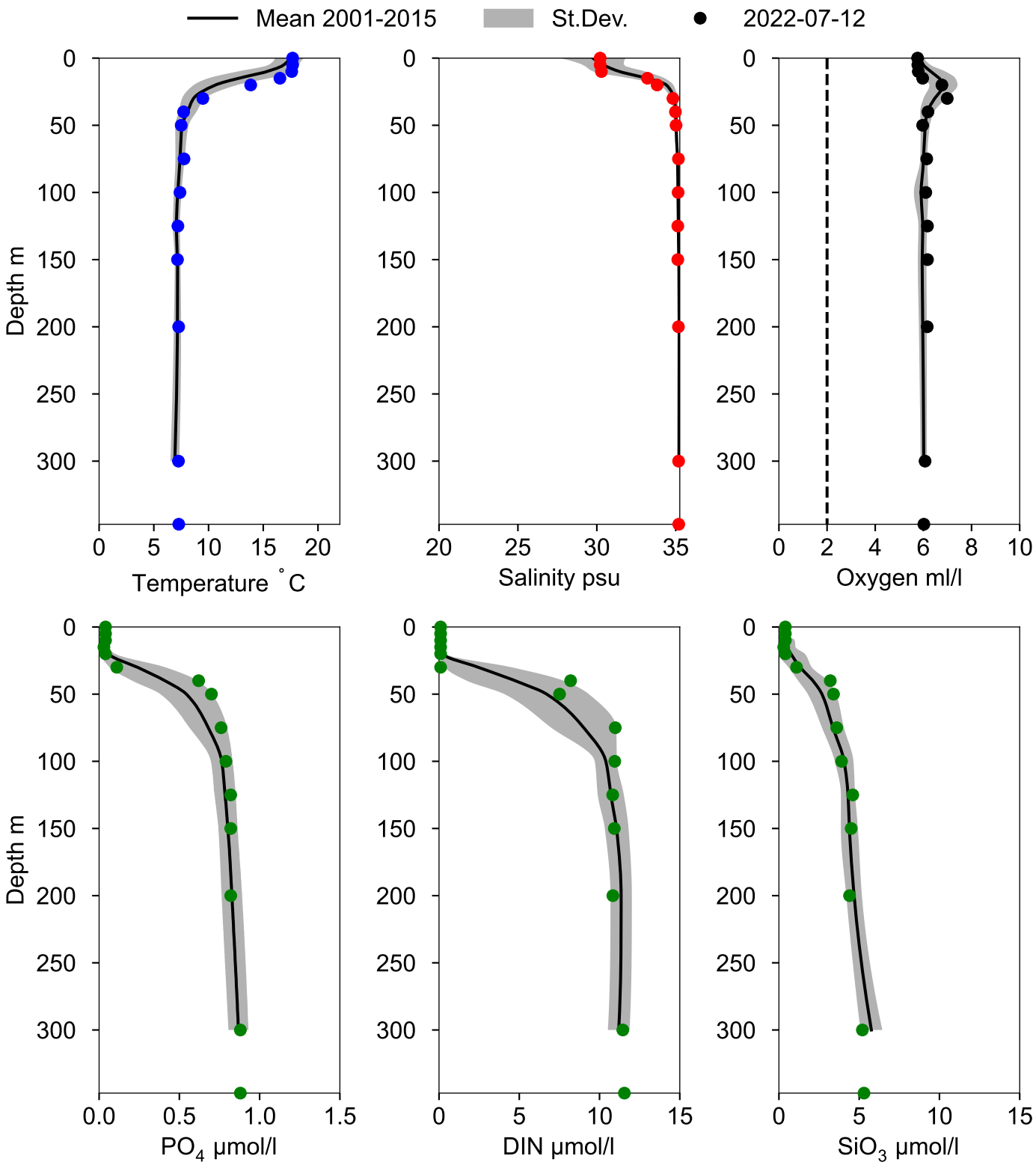
Annual Cycles



OXYGEN IN BOTTOM WATER (depth >= 300 m)

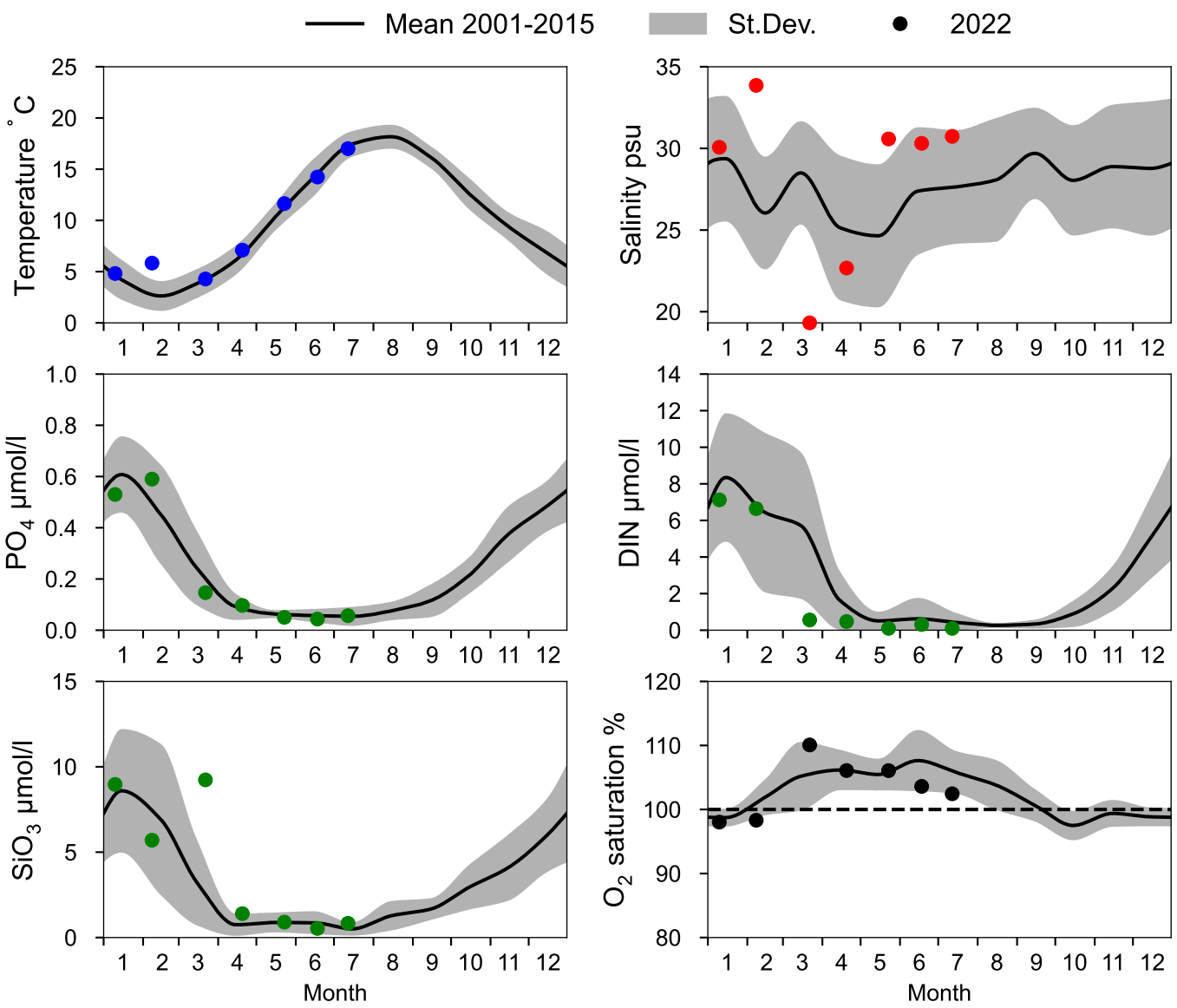


Vertical profiles Å17
July

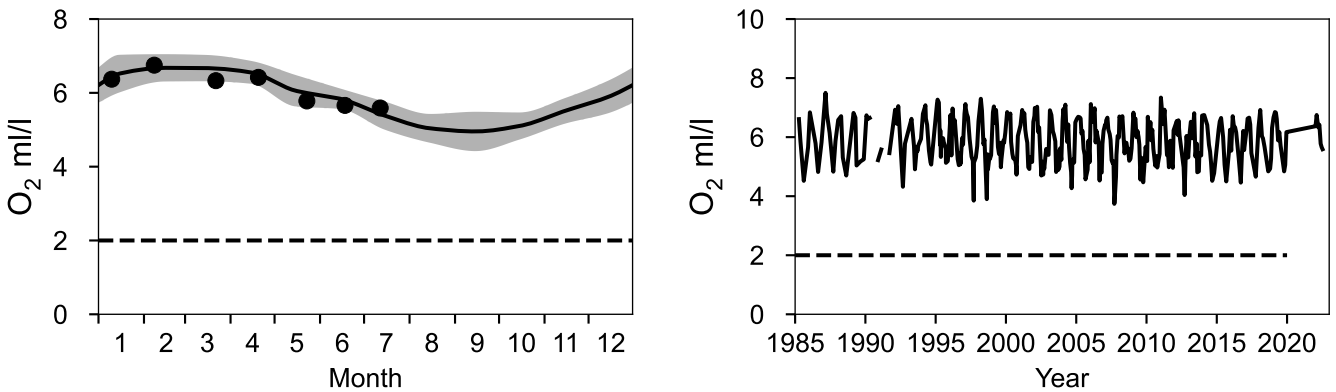


STATION P2 SURFACE WATER (0-10 m)

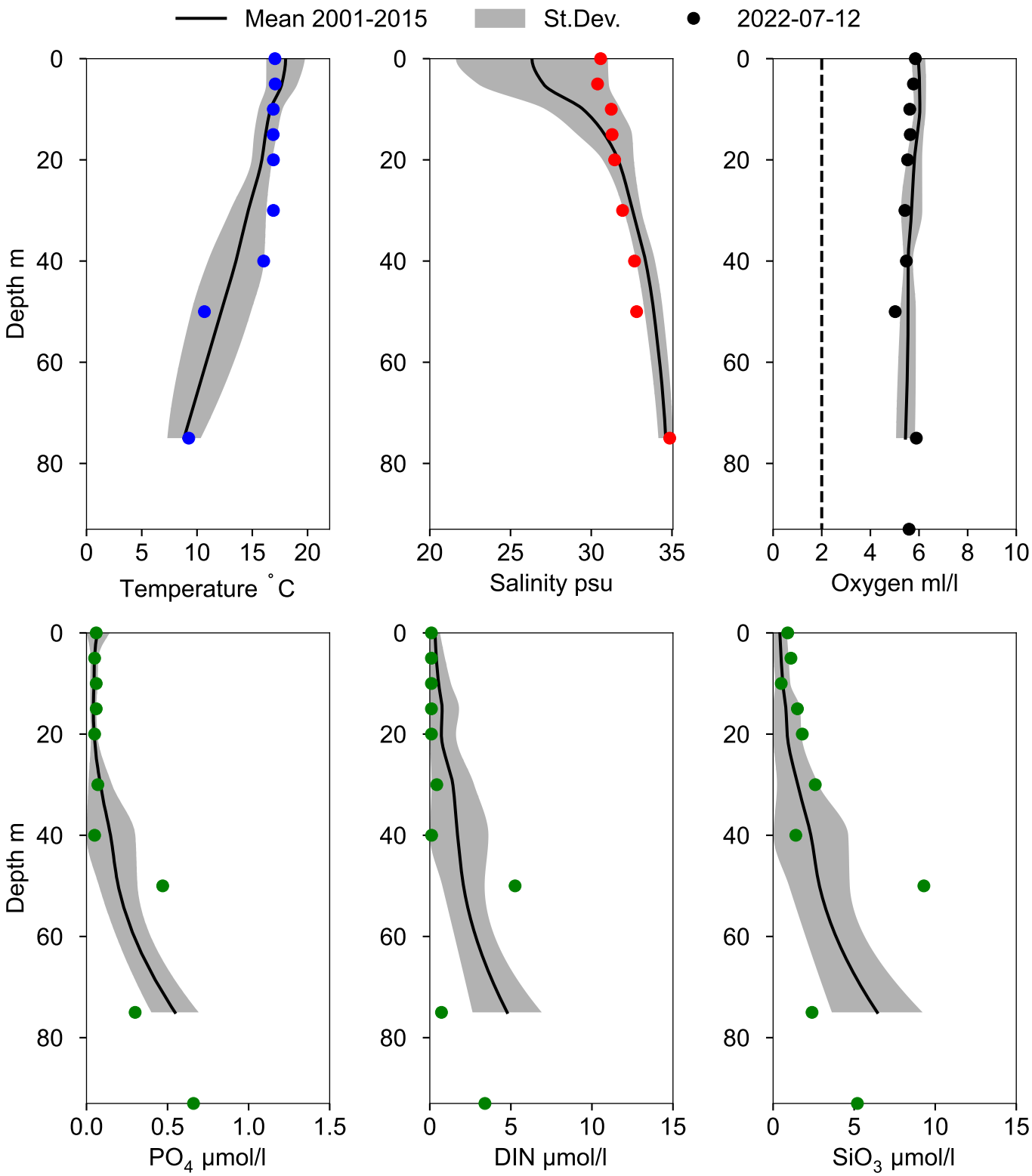
Annual Cycles



OXYGEN IN BOTTOM WATER (depth >= 75 m)

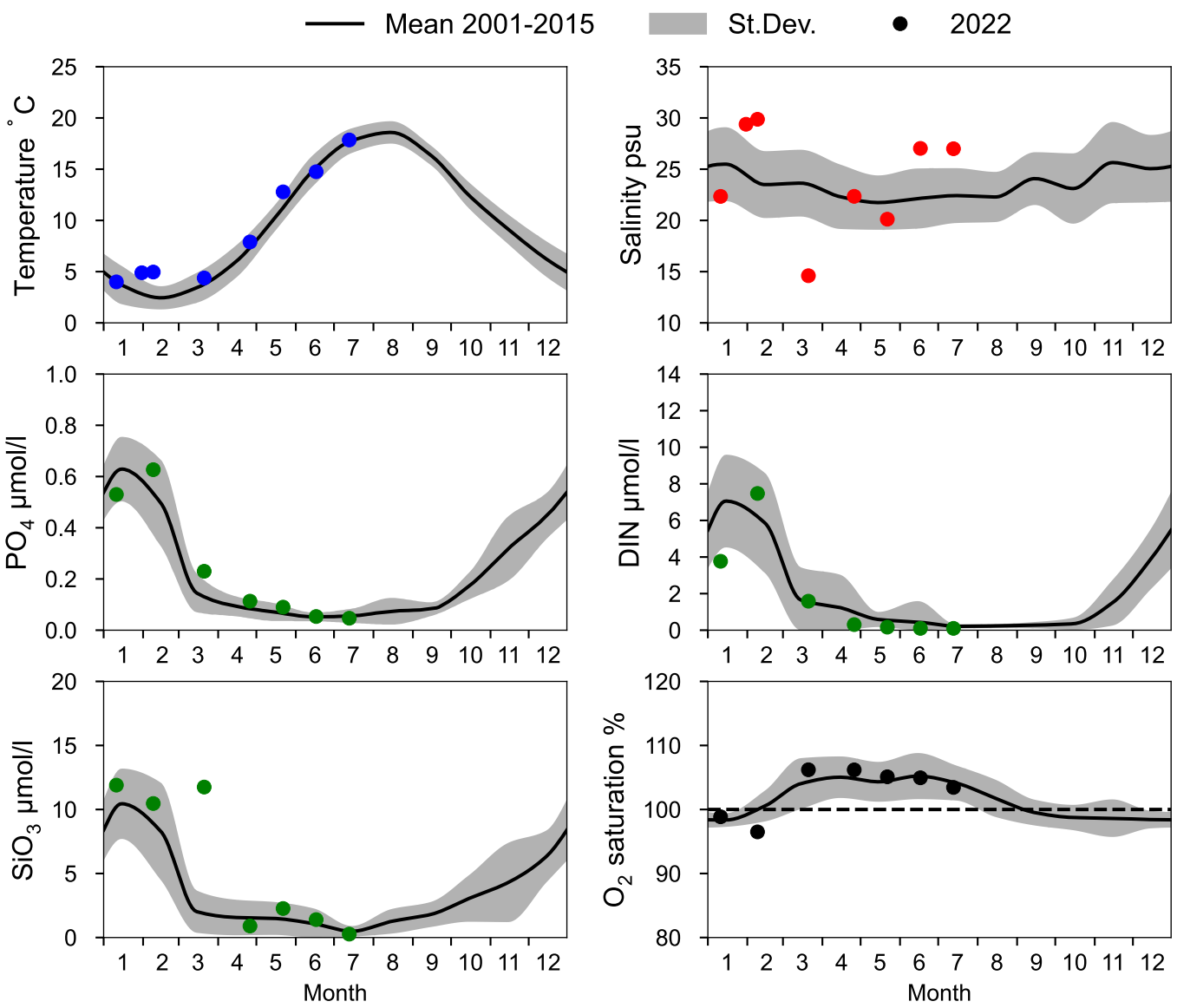


Vertical profiles P2
July

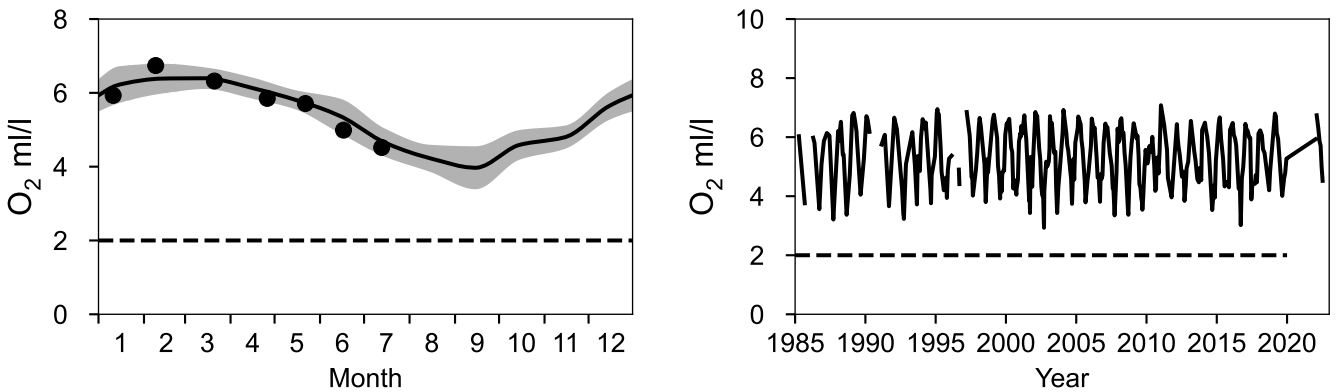


STATION FLADEN SURFACE WATER (0-10 m)

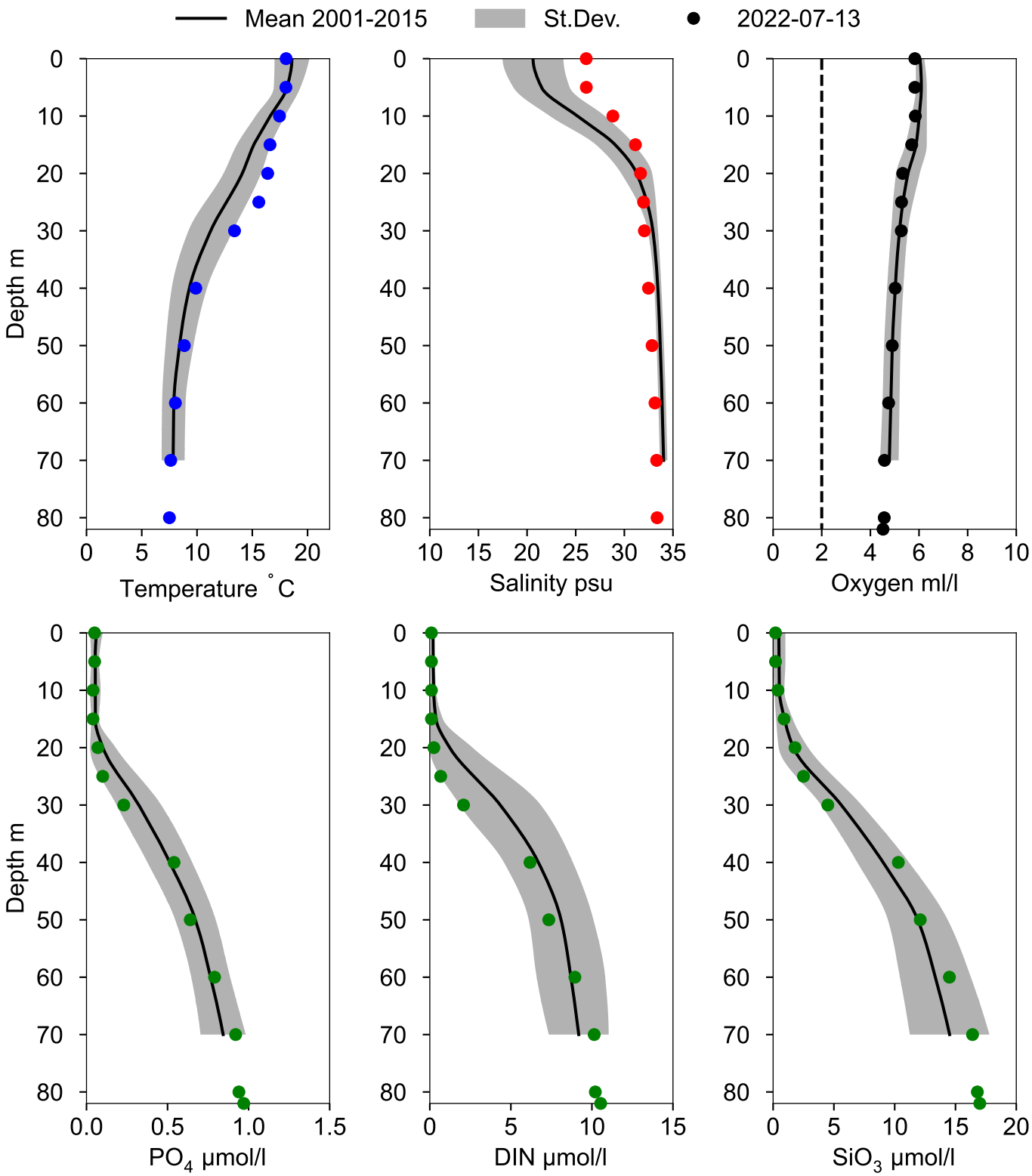
Annual Cycles



OXYGEN IN BOTTOM WATER (depth >= 74 m)

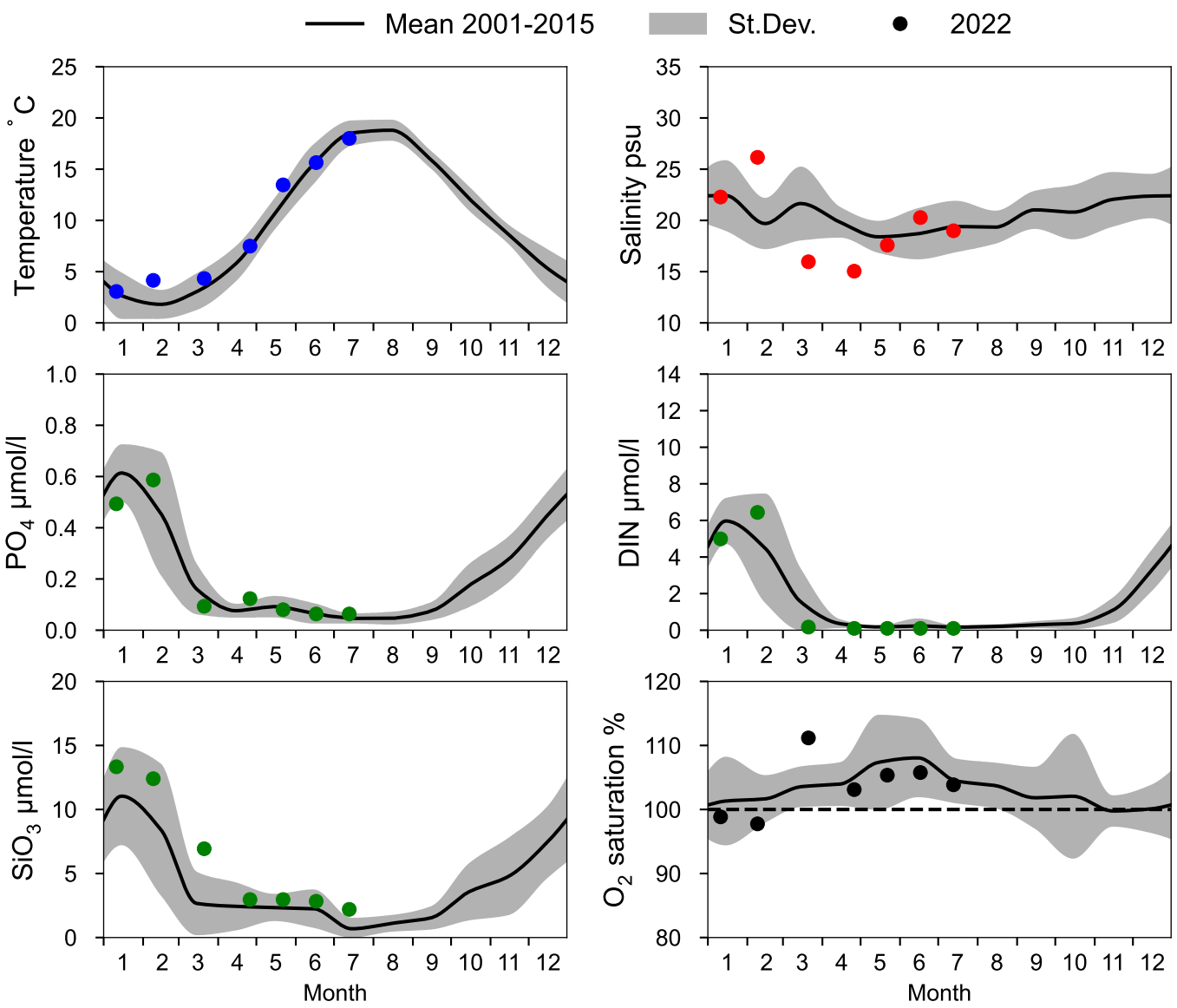


Vertical profiles FLADEN
July

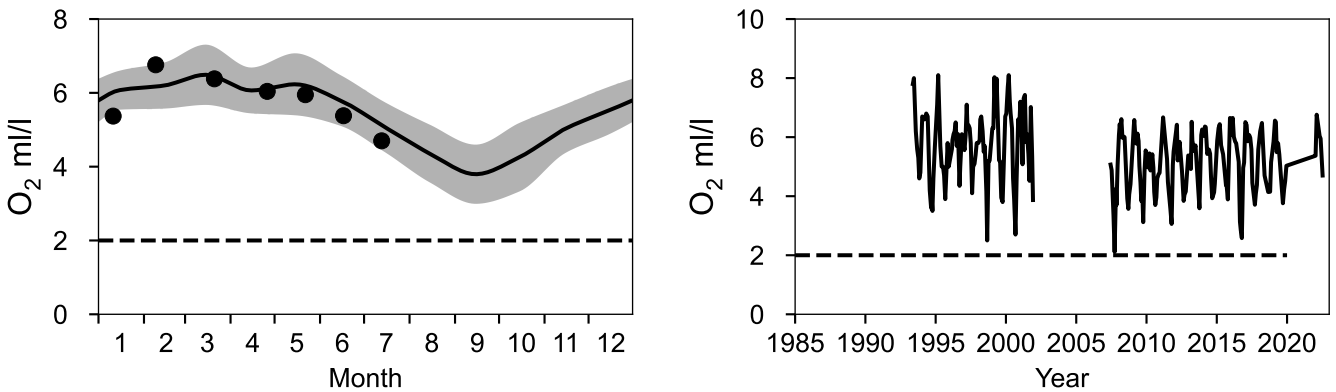


STATION N14 FALKENBERG SURFACE WATER (0-10 m)

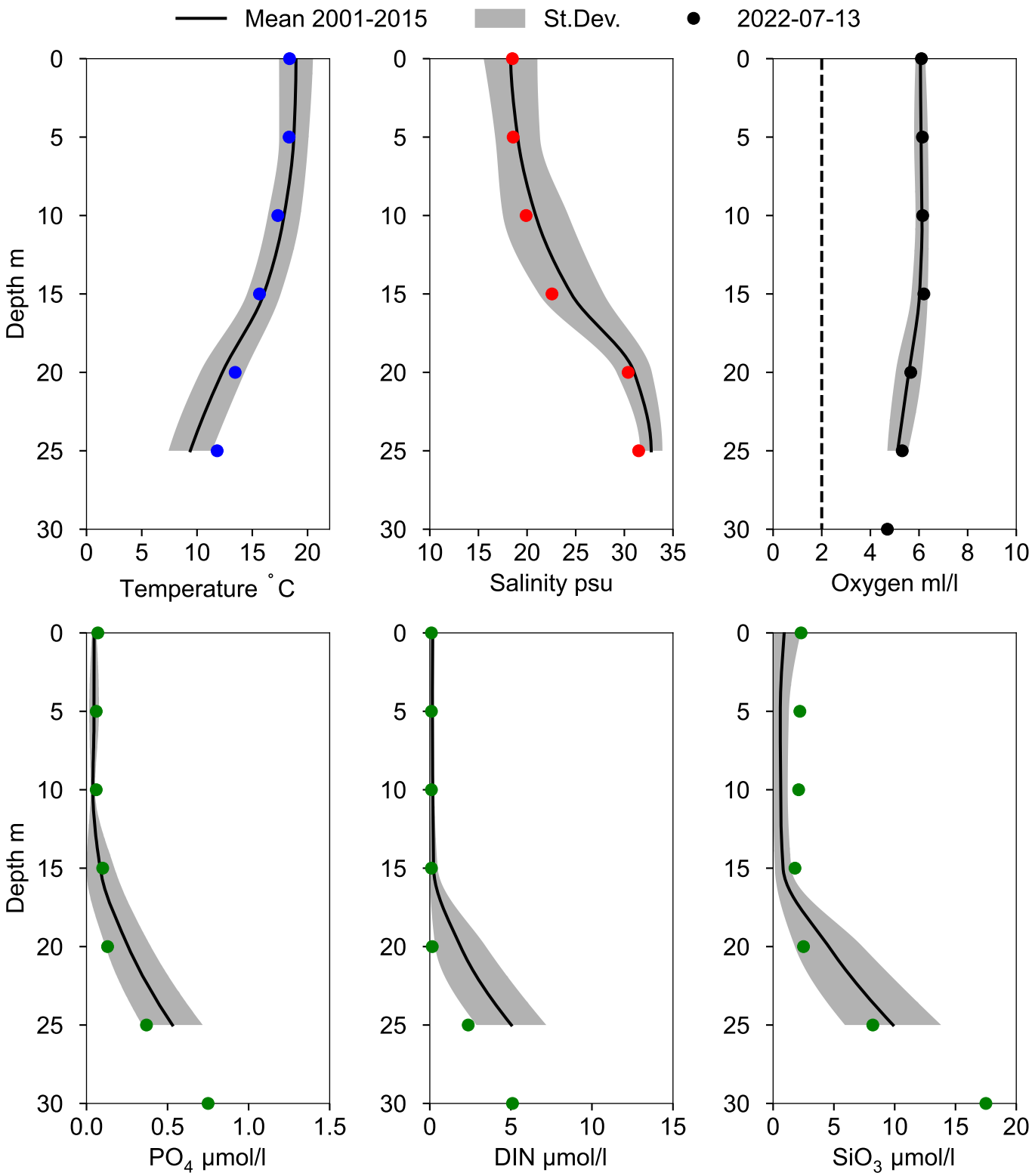
Annual Cycles



OXYGEN IN BOTTOM WATER (depth >= 20 m)

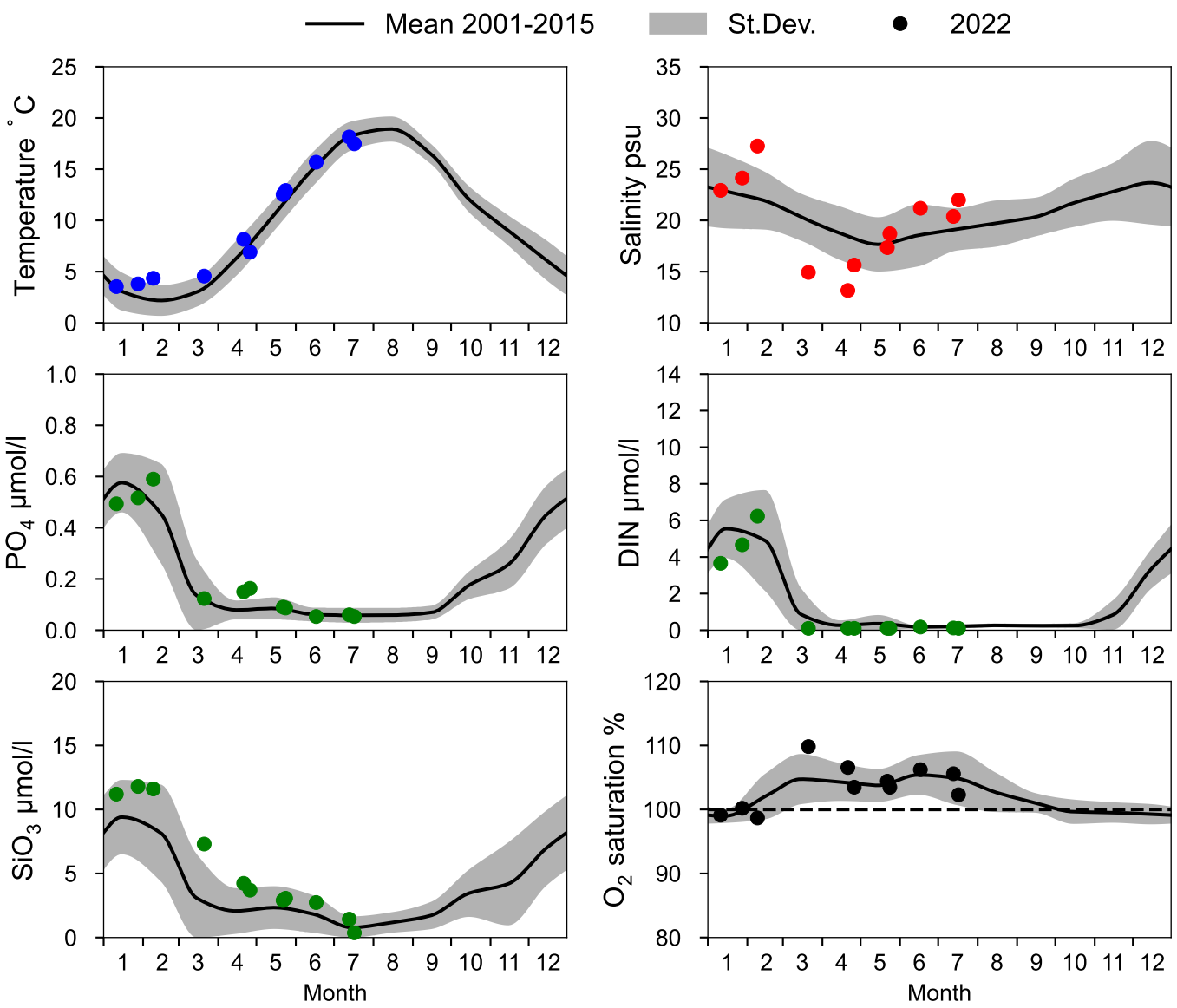


Vertical profiles N14 FALKENBERG
July

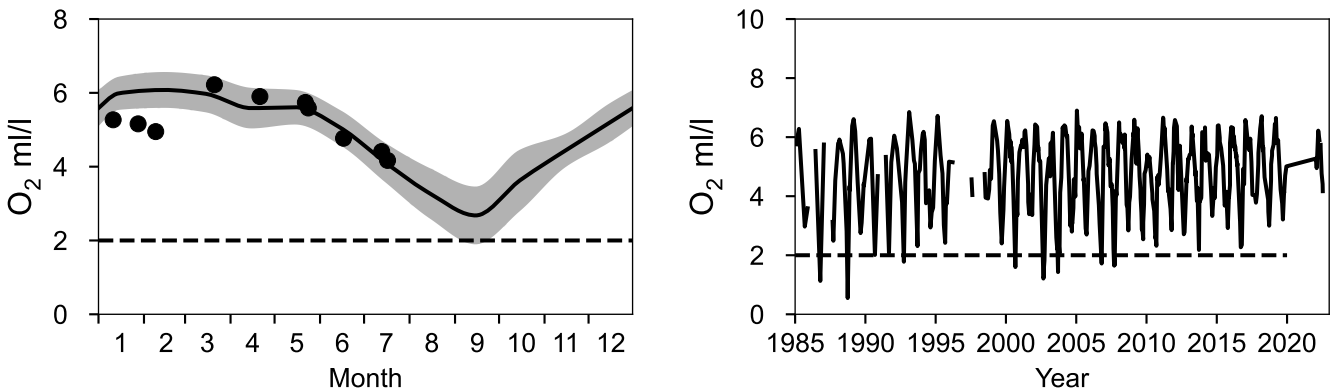


STATION ANHOLT E SURFACE WATER (0-10 m)

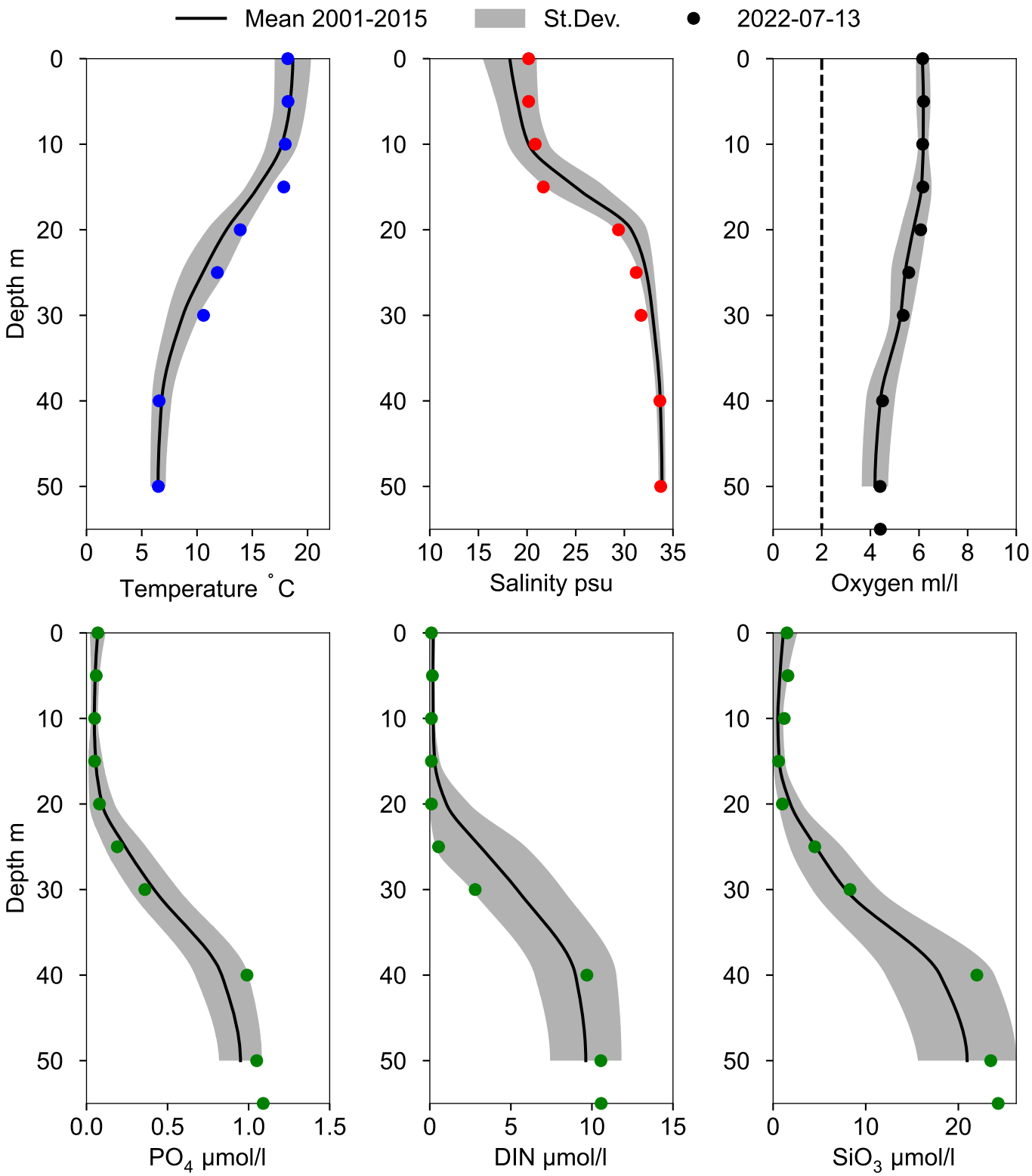
Annual Cycles



OXYGEN IN BOTTOM WATER (depth >= 52 m)

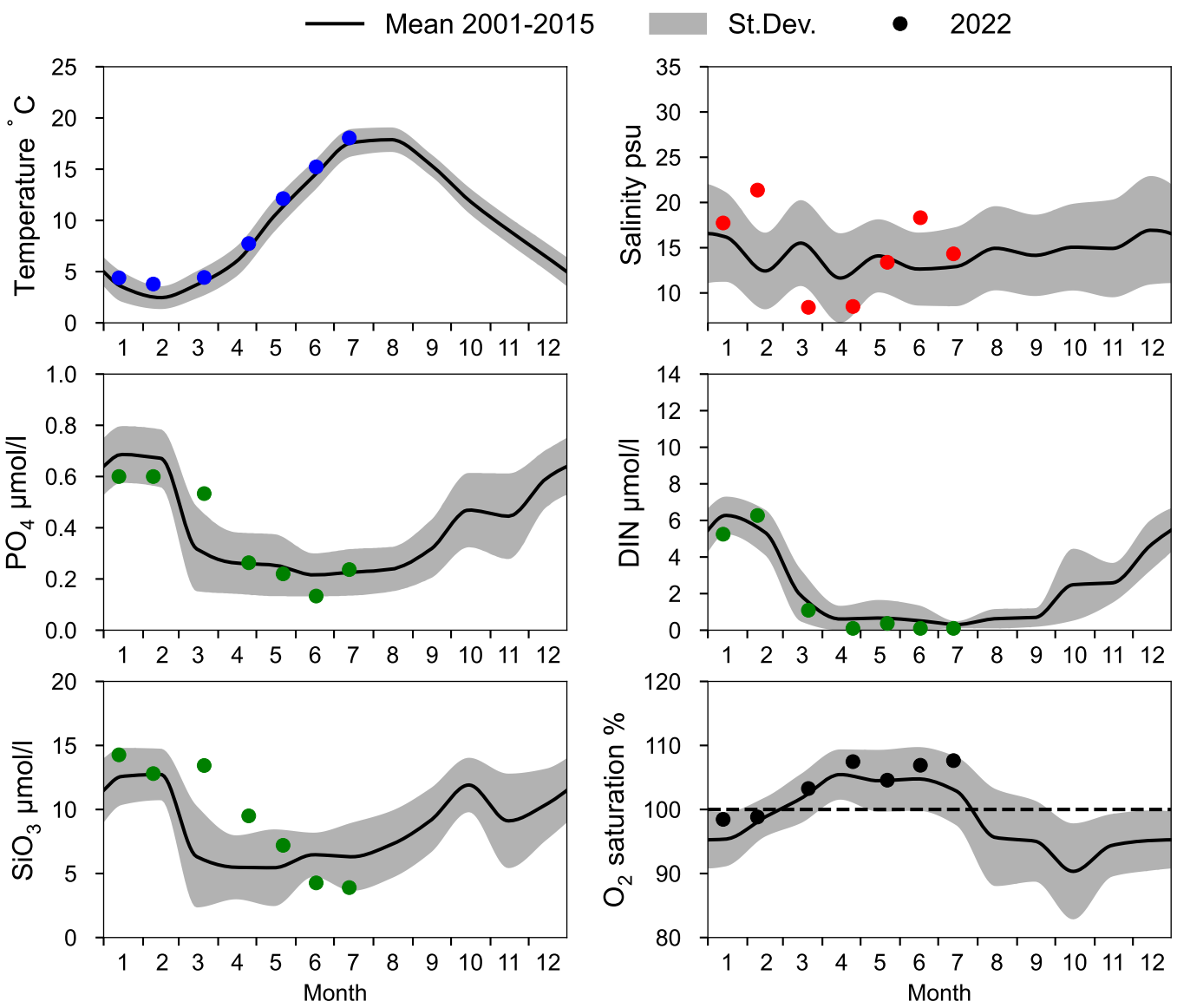


Vertical profiles ANHOLT E
July

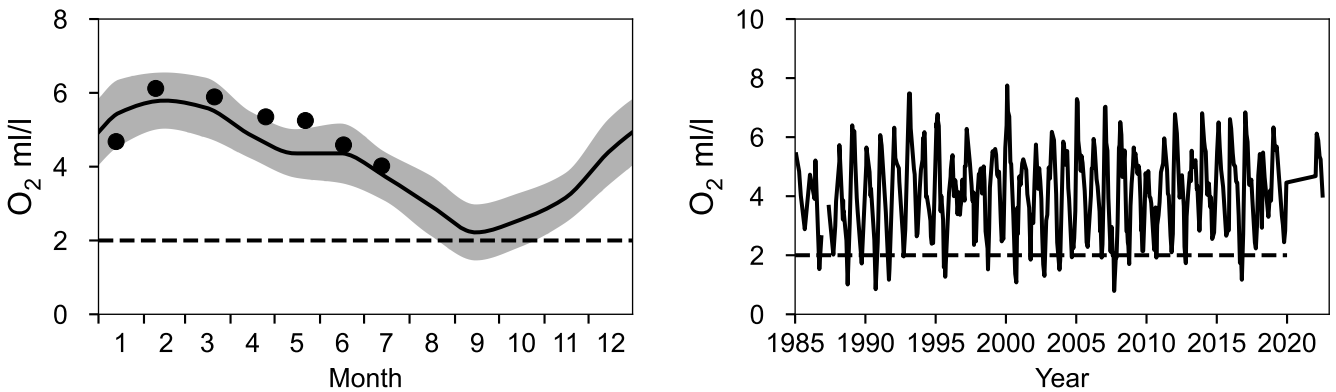


STATION W LANDSKRONA SURFACE WATER (0-10 m)

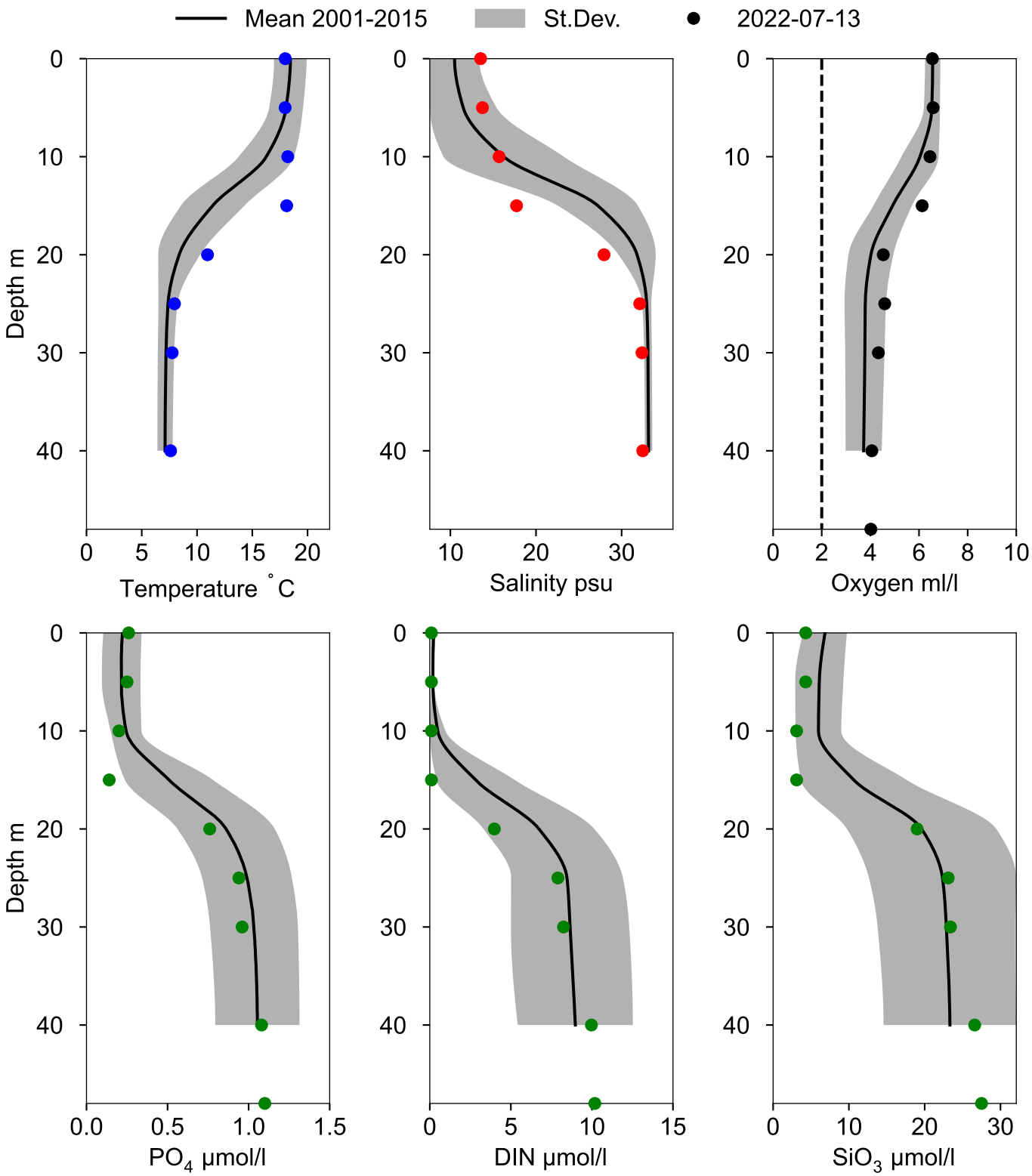
Annual Cycles



OXYGEN IN BOTTOM WATER (depth >= 40 m)

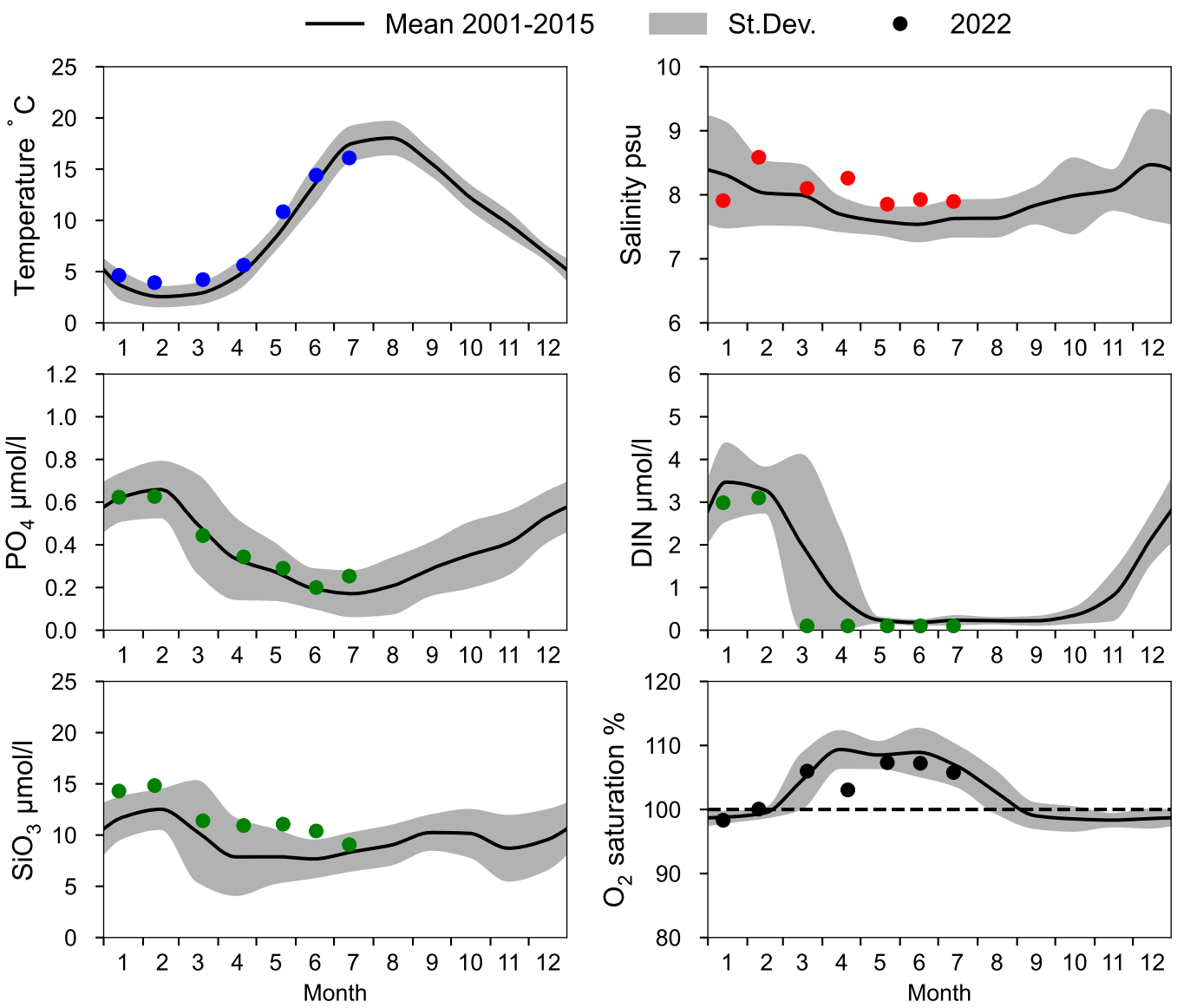


Vertical profiles W LANDSKRONA
July

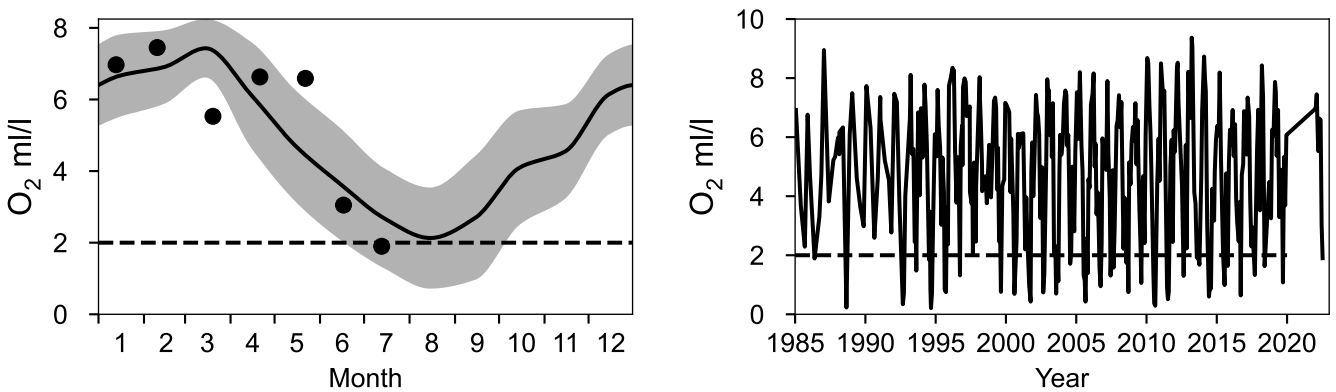


STATION BY1 SURFACE WATER (0-10 m)

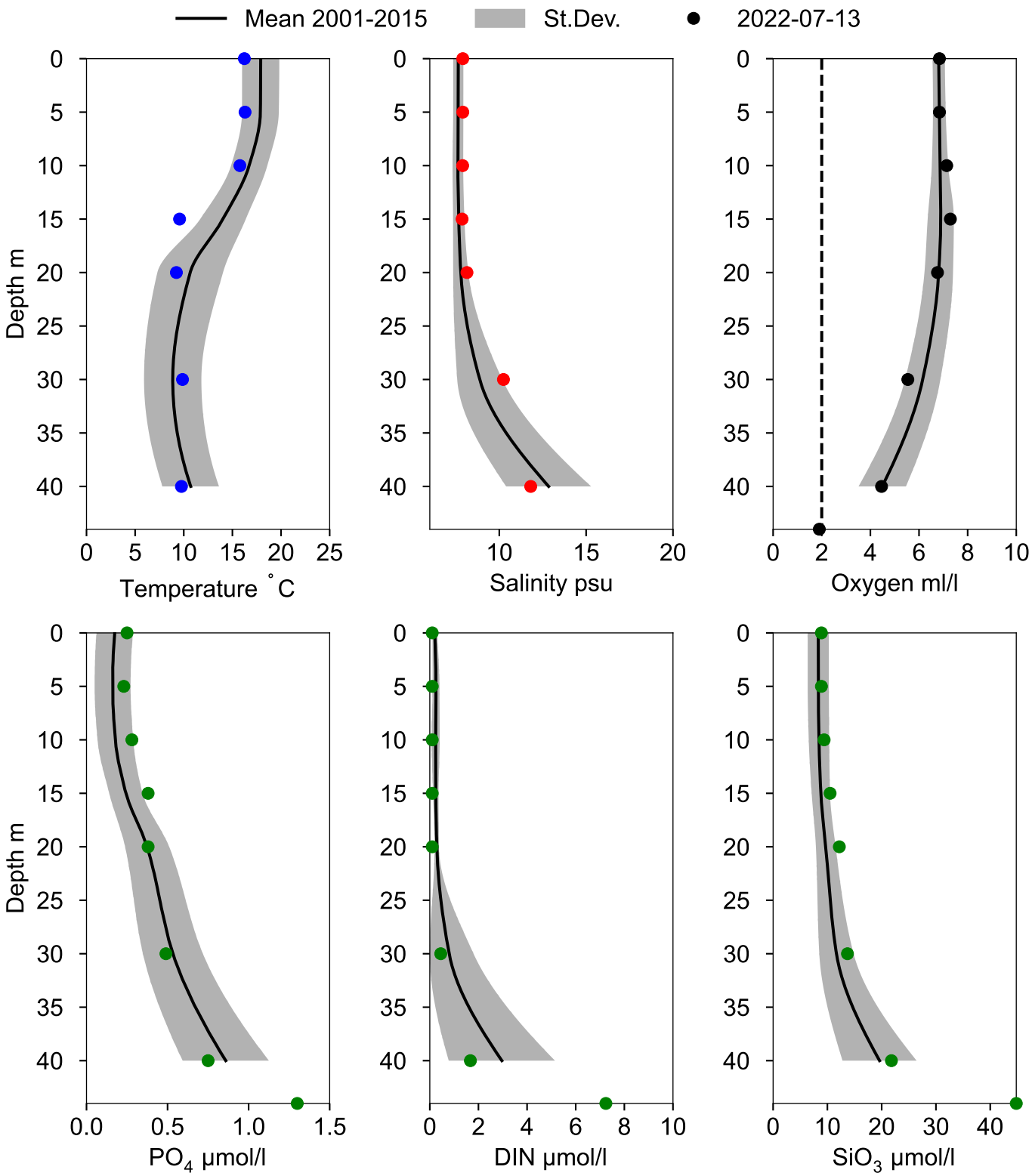
Annual Cycles



OXYGEN IN BOTTOM WATER (depth >= 40 m)

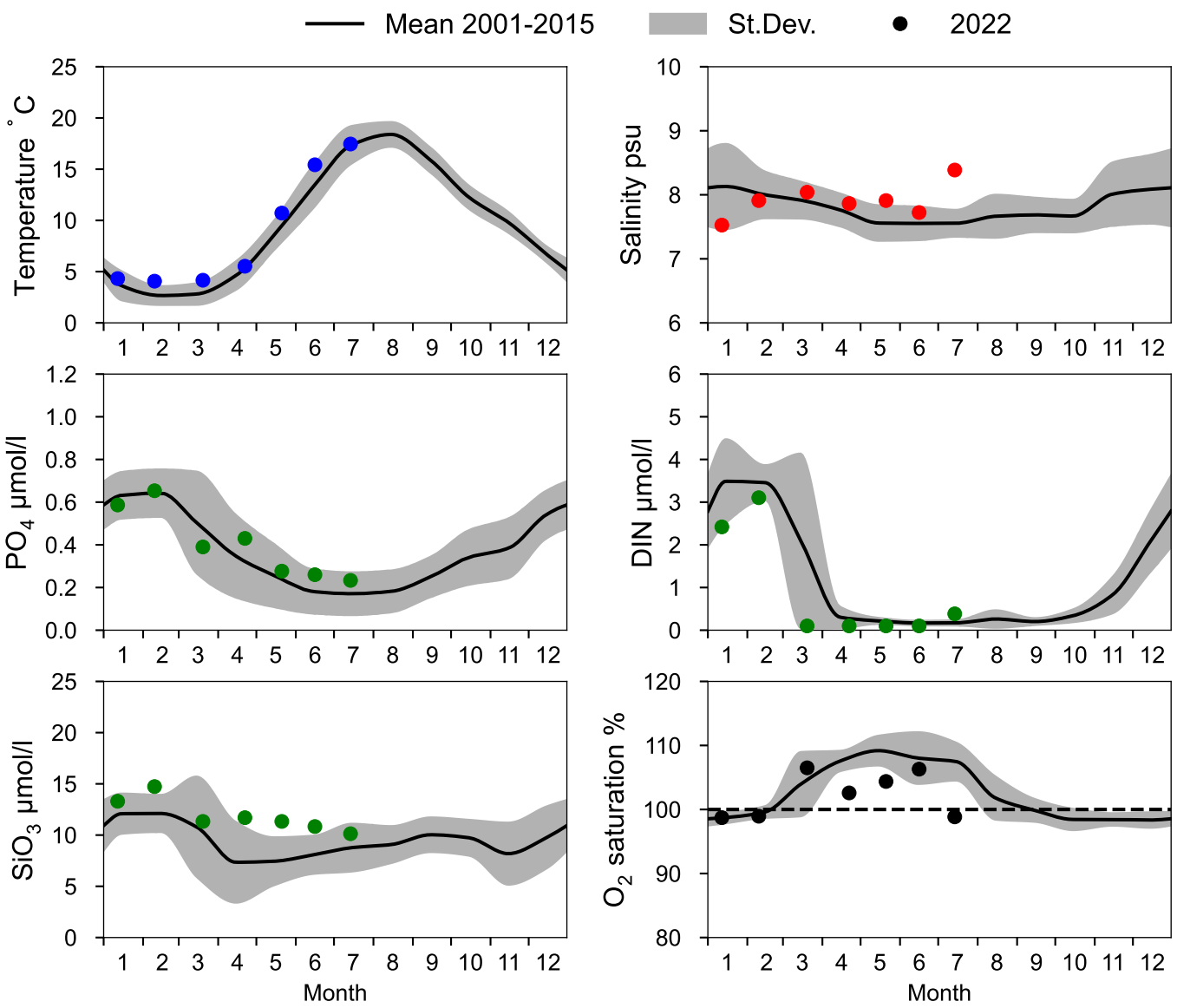


Vertical profiles BY1
July

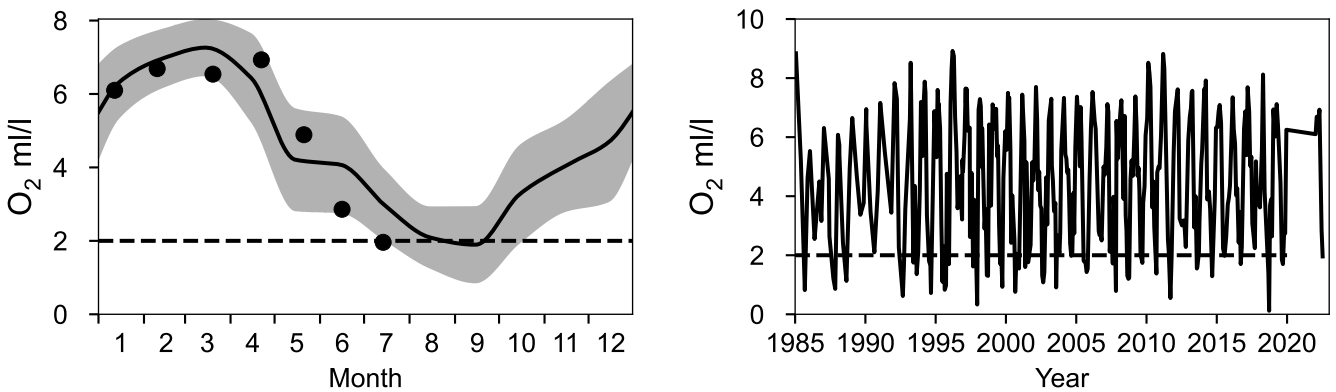


STATION BY2 ARKONA SURFACE WATER (0-10 m)

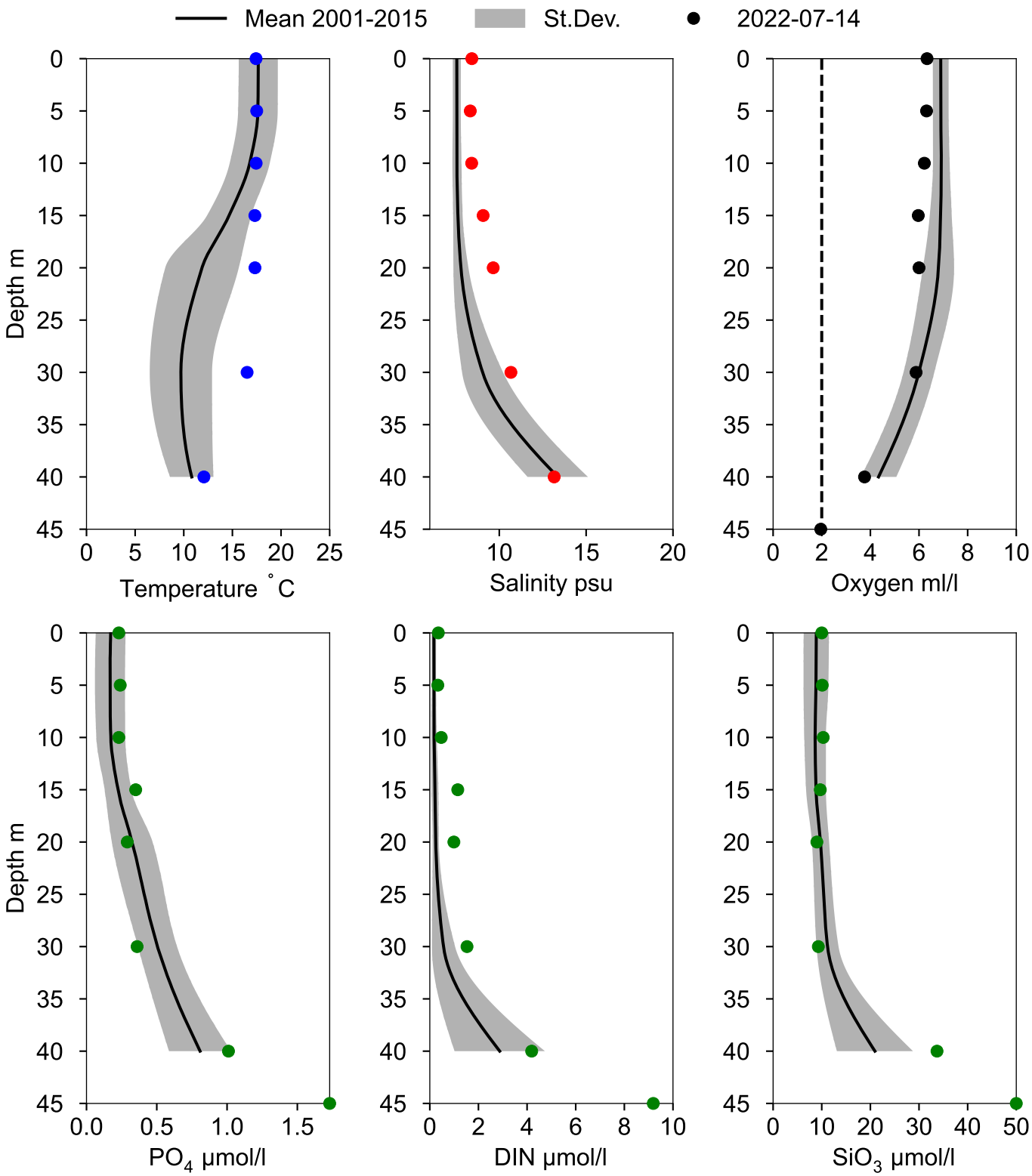
Annual Cycles



OXYGEN IN BOTTOM WATER (depth >= 40 m)

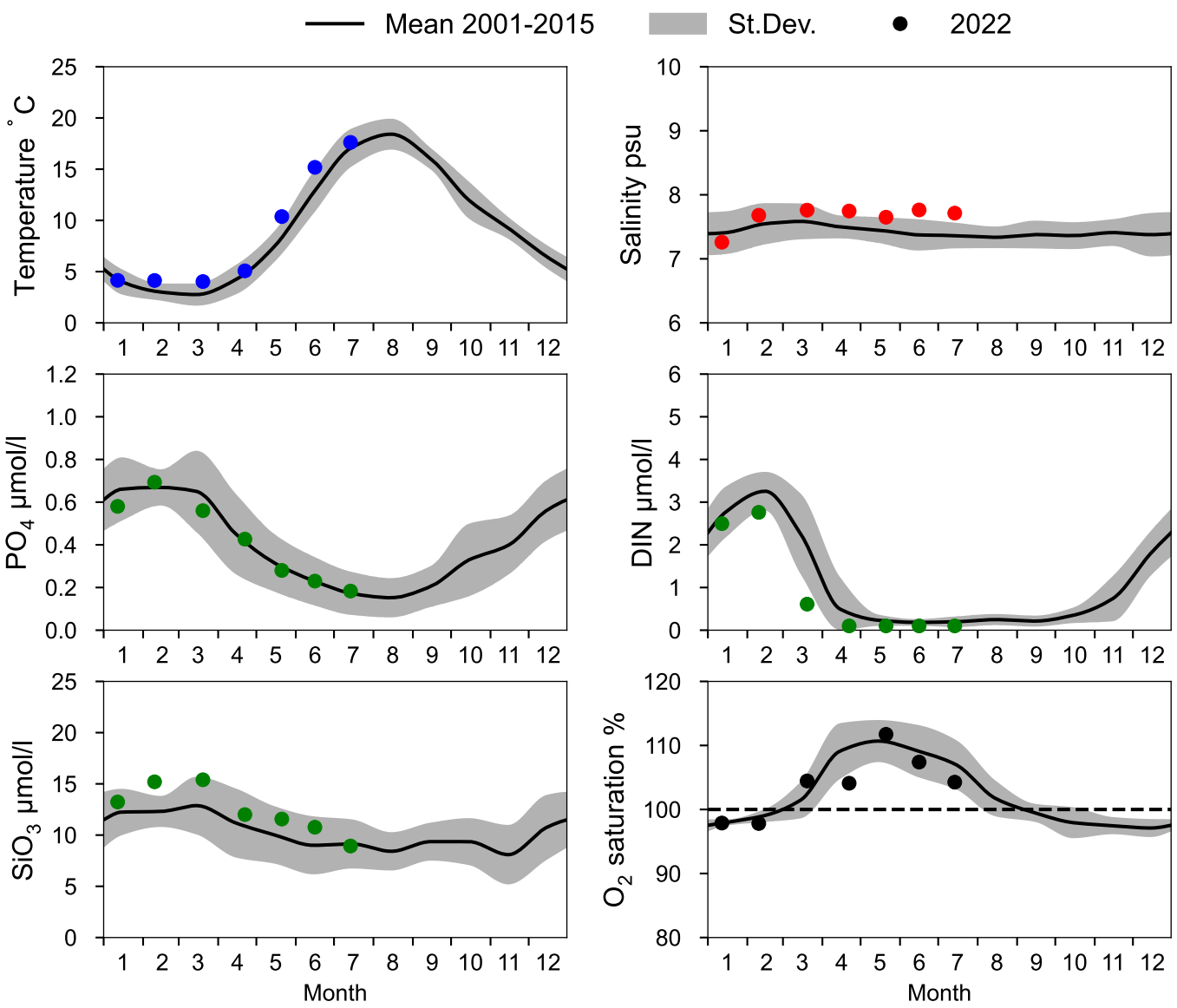


Vertical profiles BY2 ARKONA
July

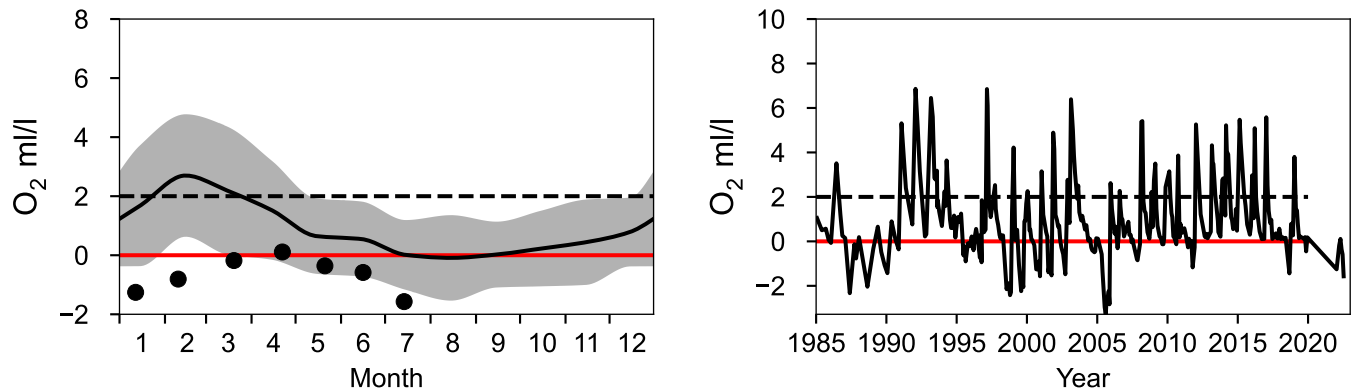


STATION BY4 CHRISTIANSÖ SURFACE WATER (0-10 m)

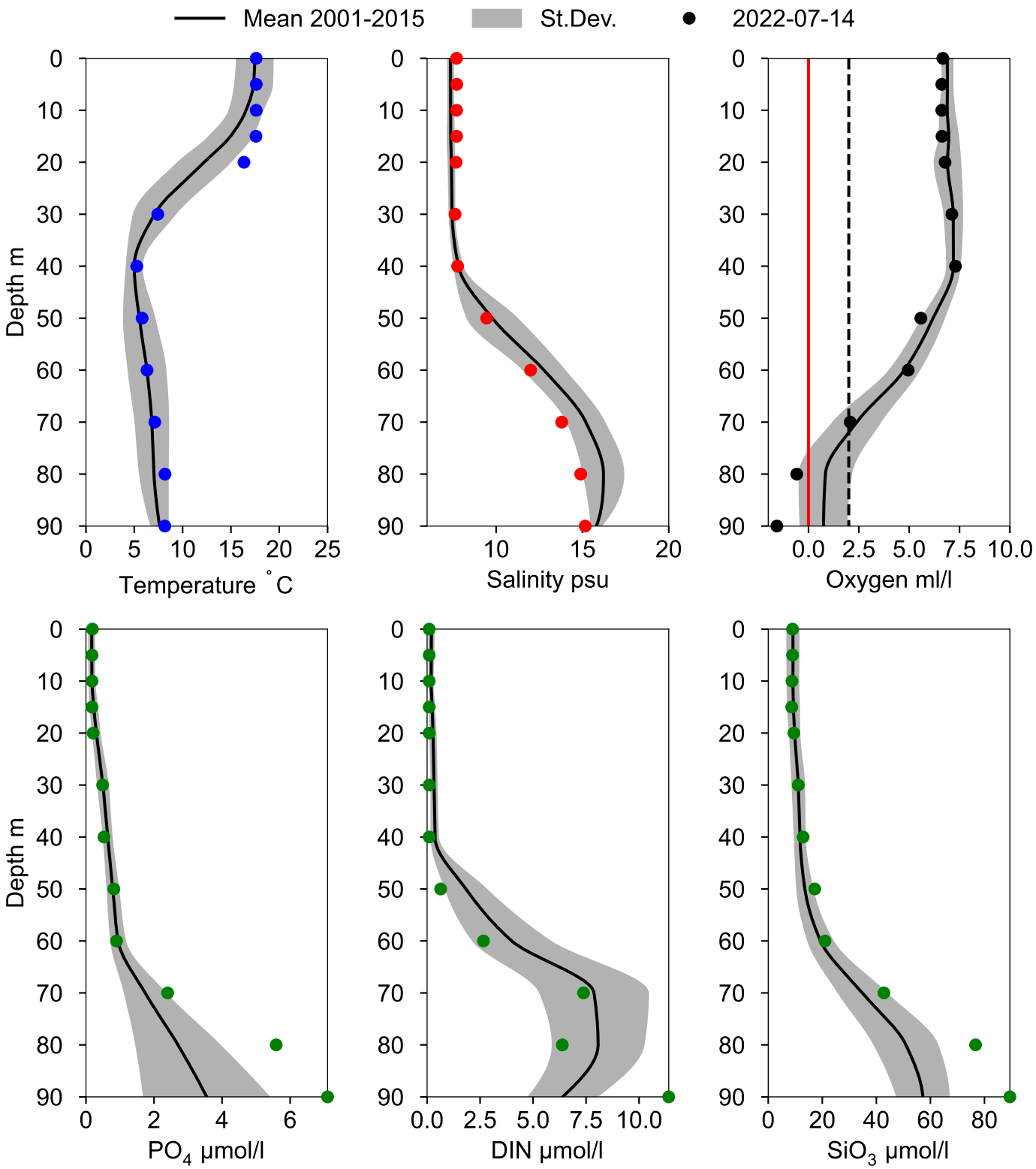
Annual Cycles



OXYGEN IN BOTTOM WATER (depth >= 80 m)

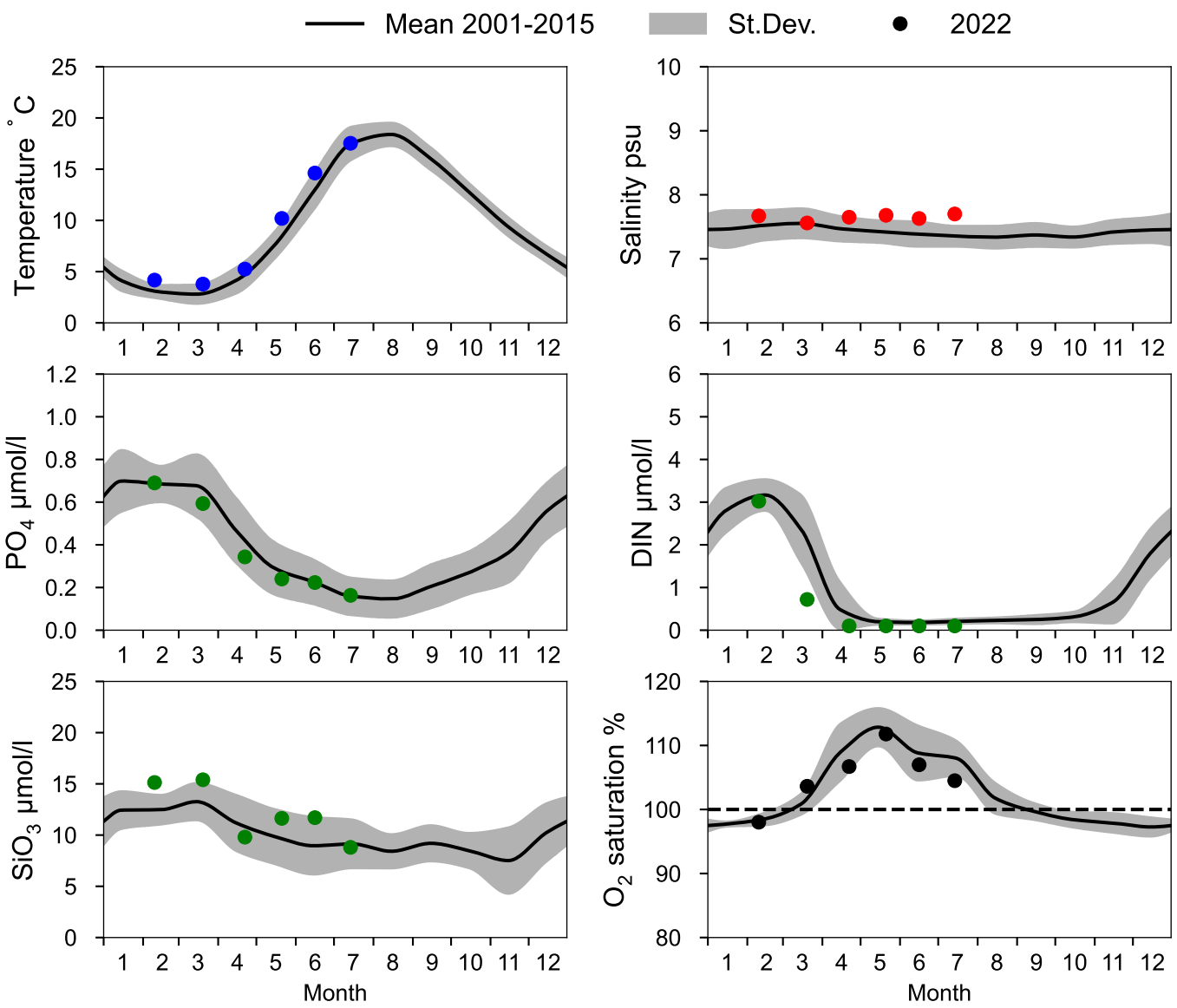


Vertical profiles BY4 CHRISTIANSÖ
July

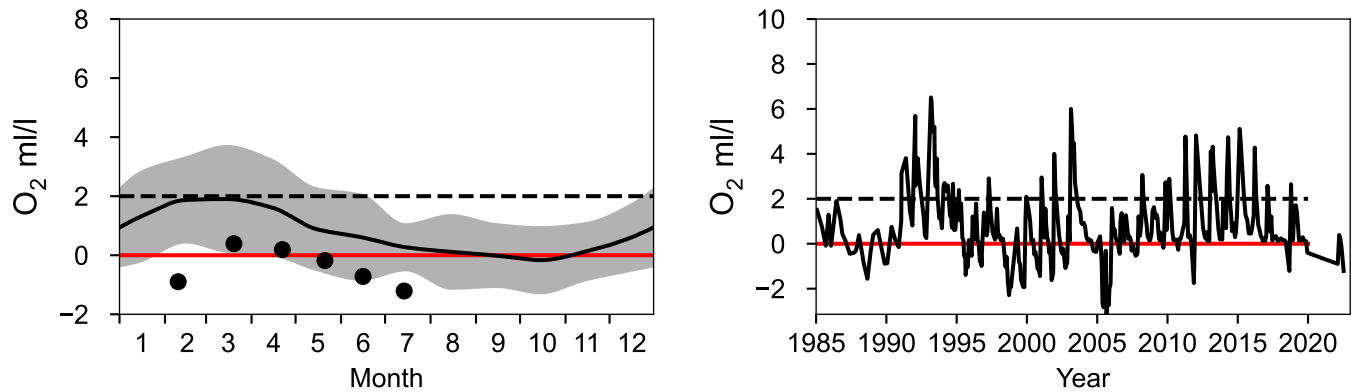


STATION BY5 BORNHOLMSDJ SURFACE WATER (0-10 m)

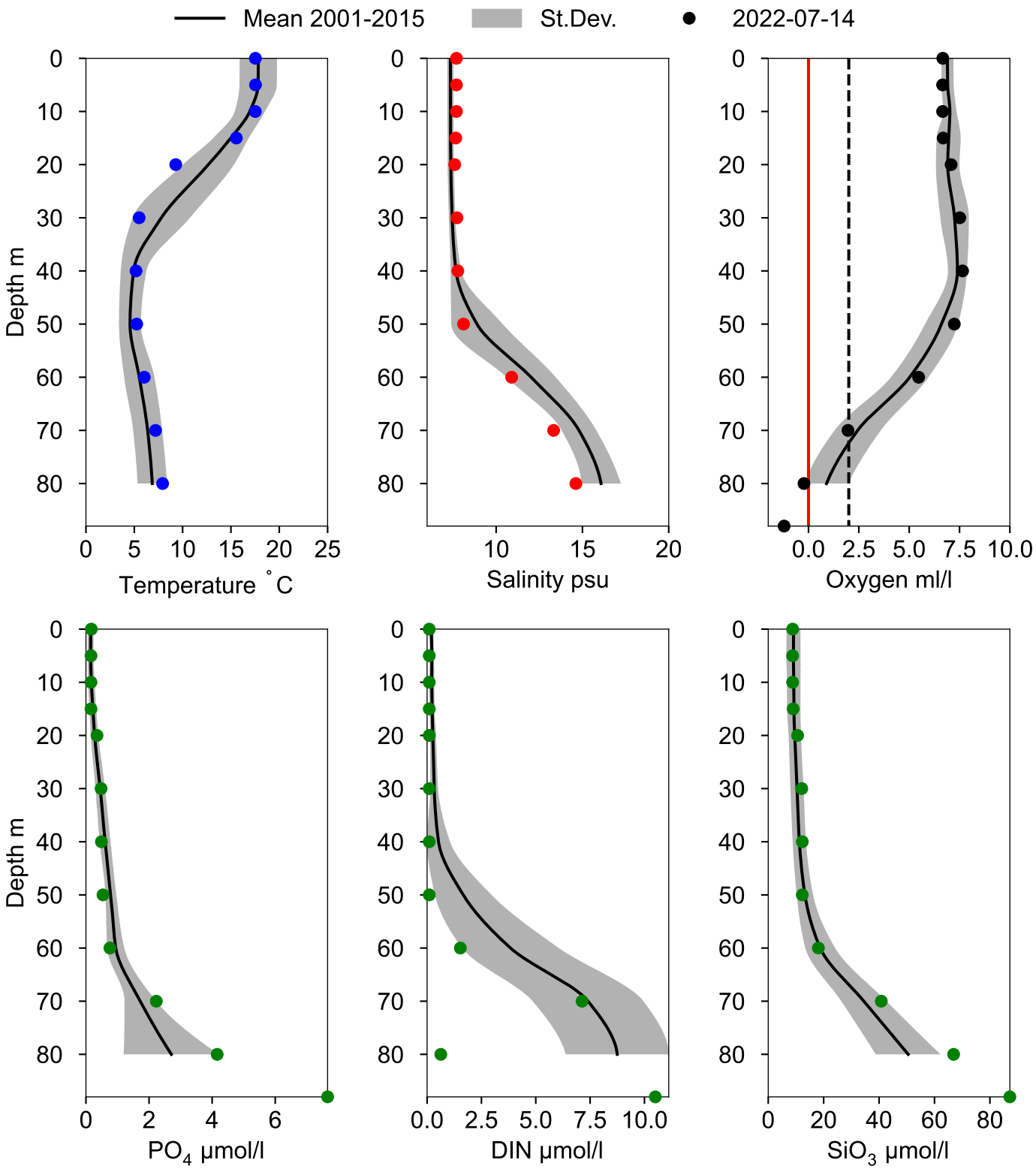
Annual Cycles



OXYGEN IN BOTTOM WATER (depth >= 80 m)

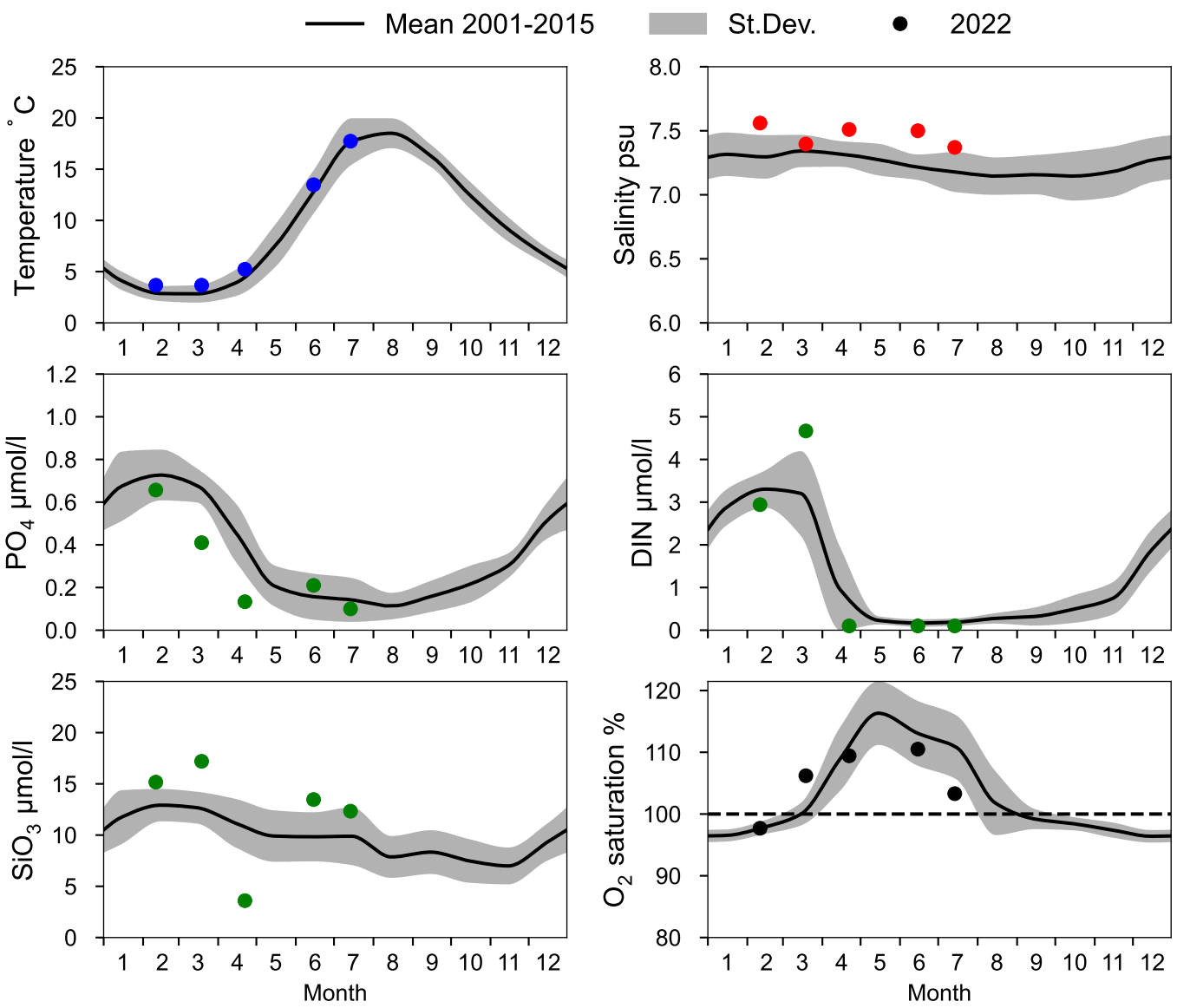


Vertical profiles BY5 BORNHOLMSDJ
July

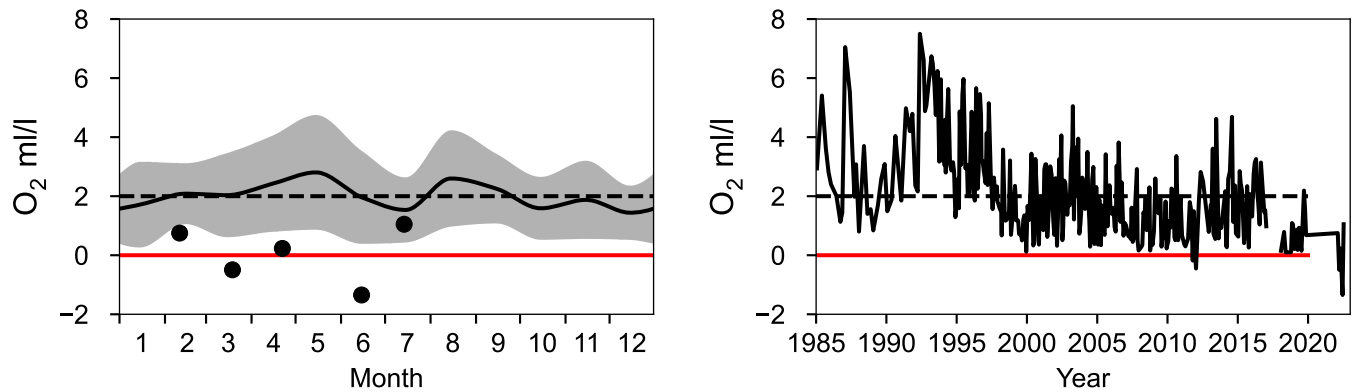


STATION BCS III-10 SURFACE WATER (0-10 m)

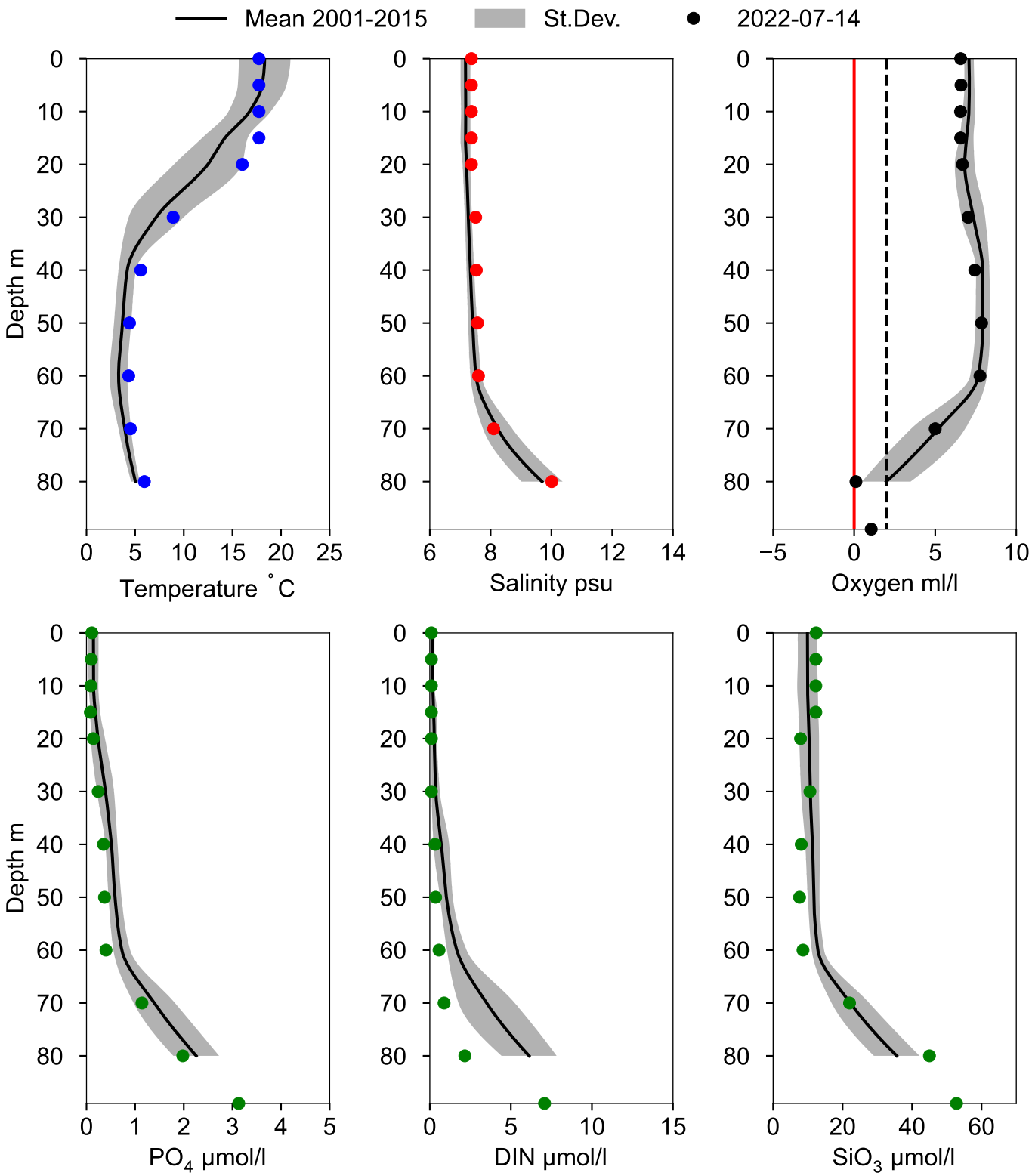
Annual Cycles



OXYGEN IN BOTTOM WATER (depth >= 80 m)

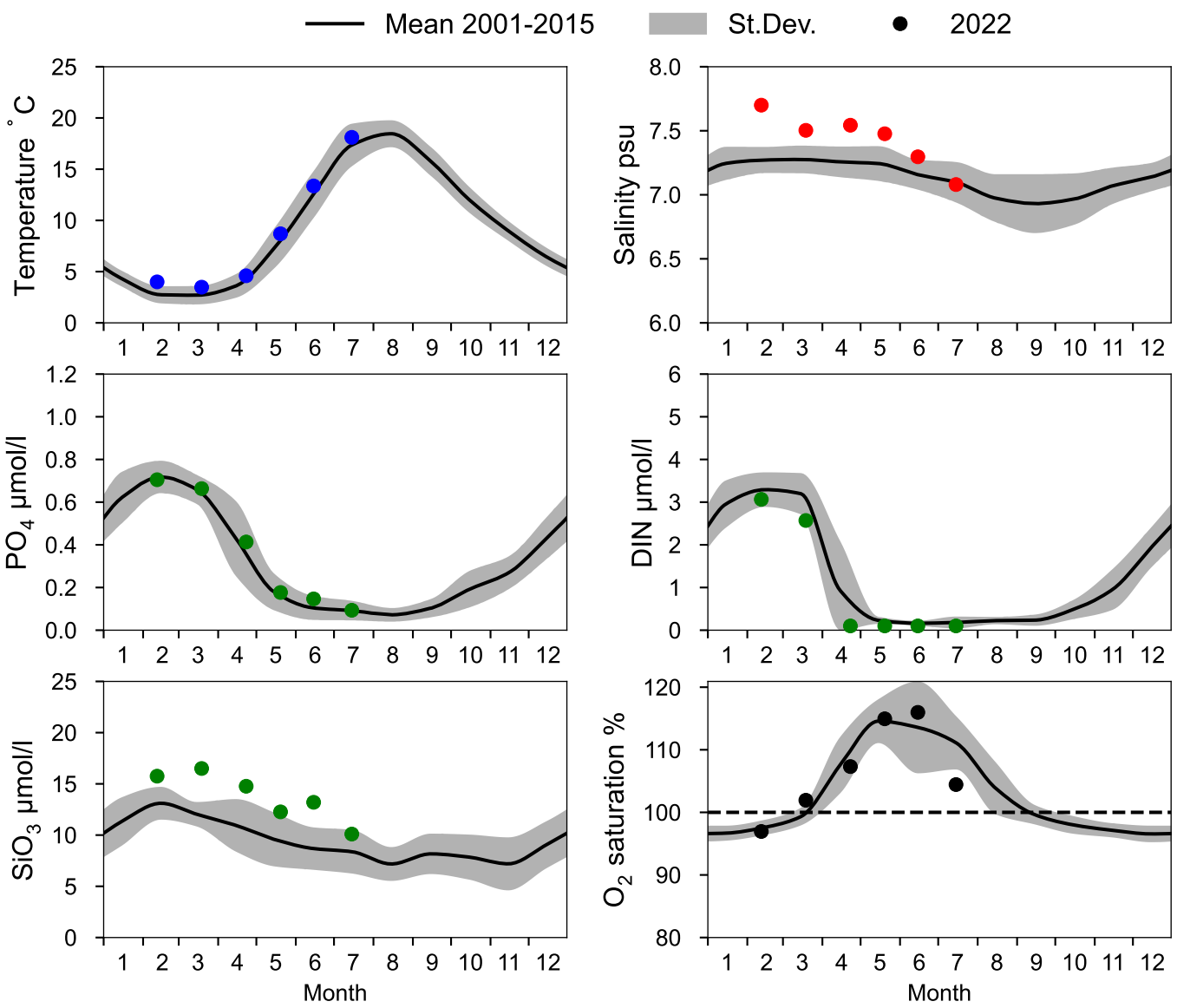


Vertical profiles BCS III-10
July

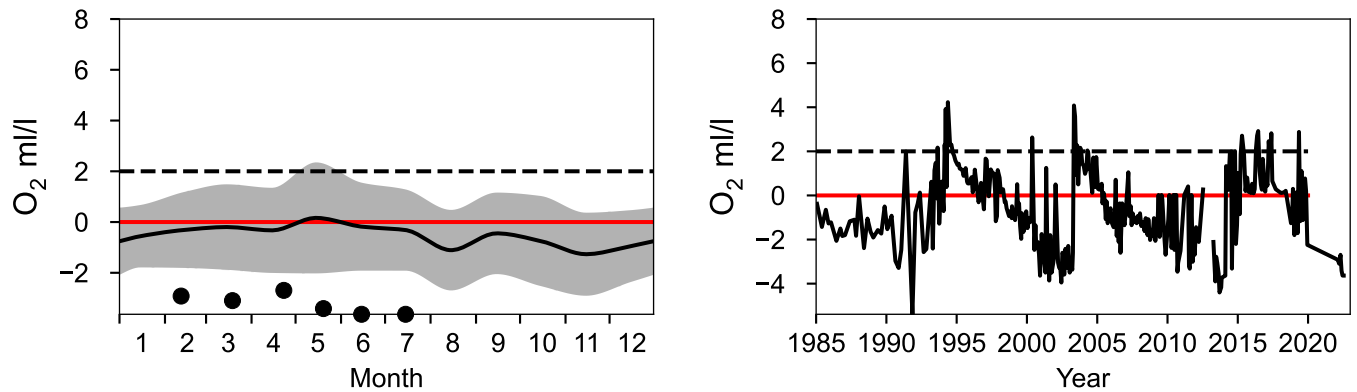


STATION BY10 SURFACE WATER (0-10 m)

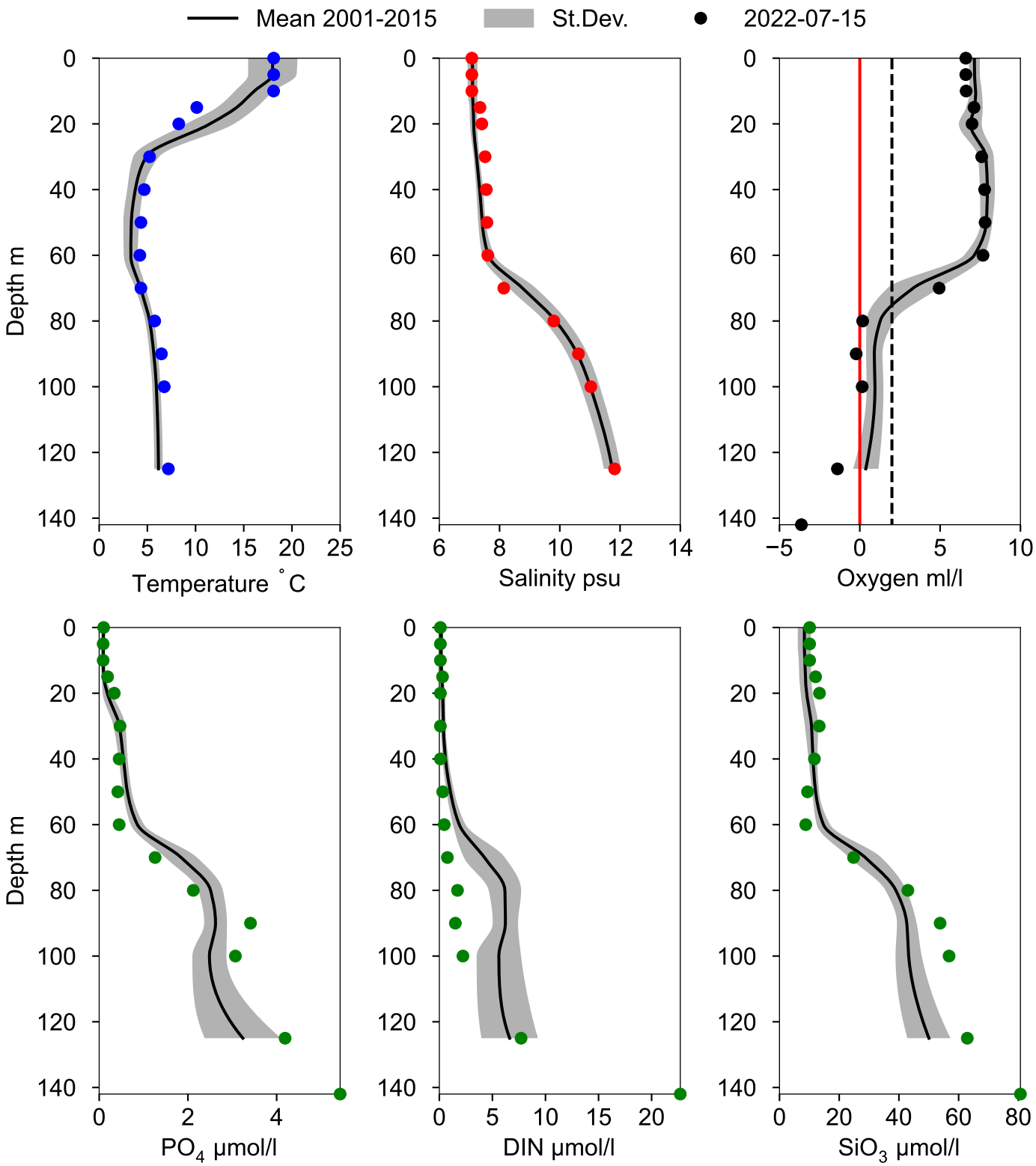
Annual Cycles



OXYGEN IN BOTTOM WATER (depth >= 125 m)

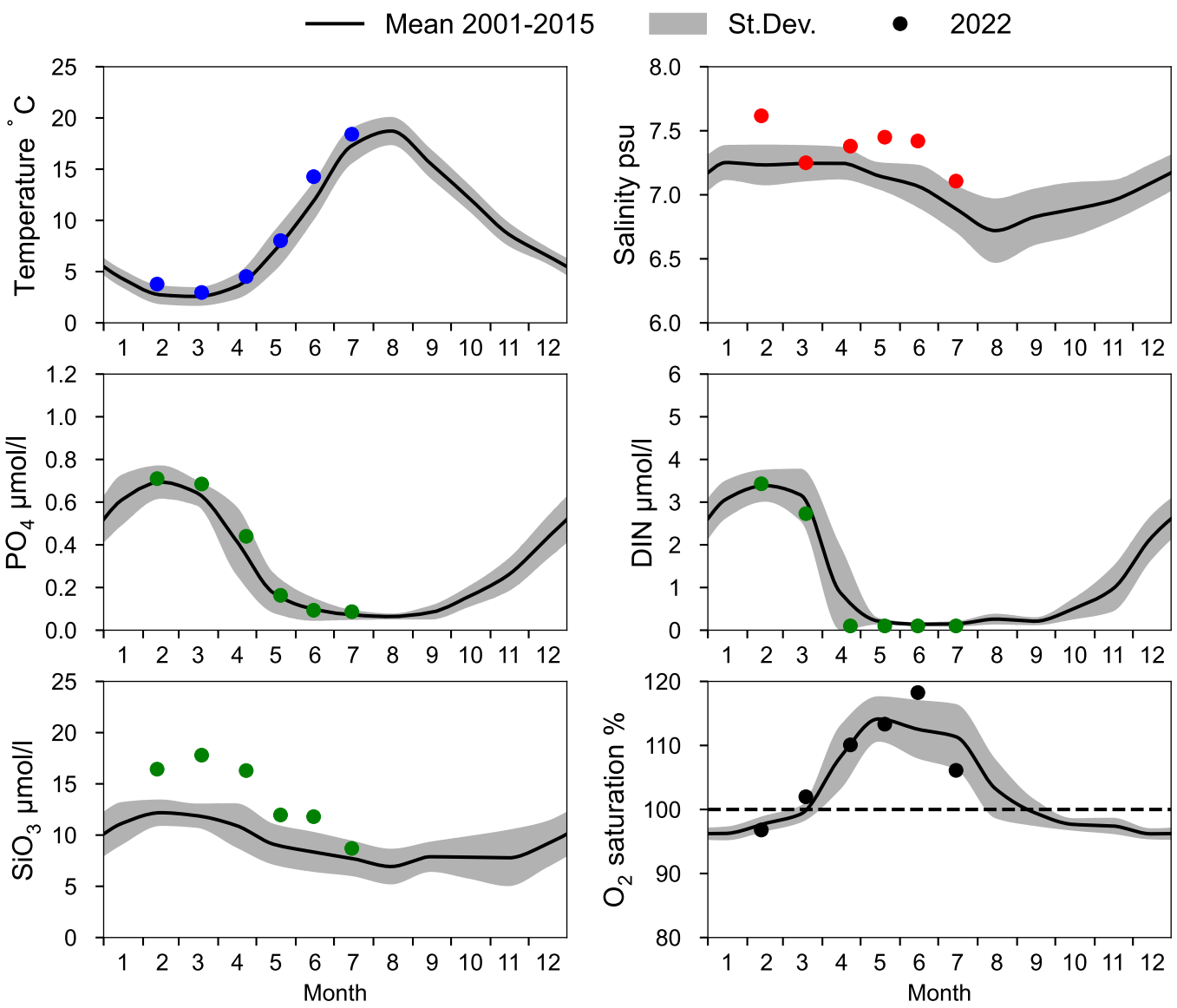


Vertical profiles BY10
July

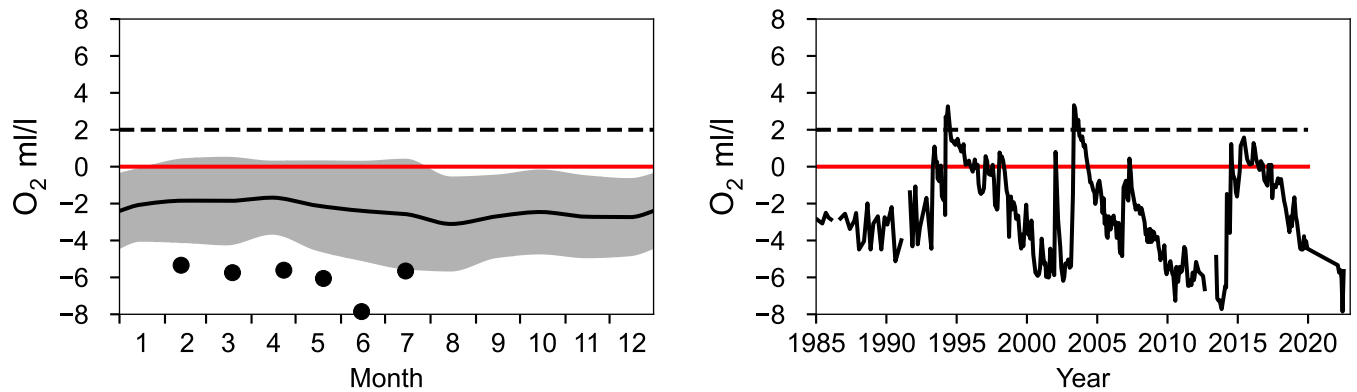


STATION BY15 GOTLANDSDJ SURFACE WATER (0-10 m)

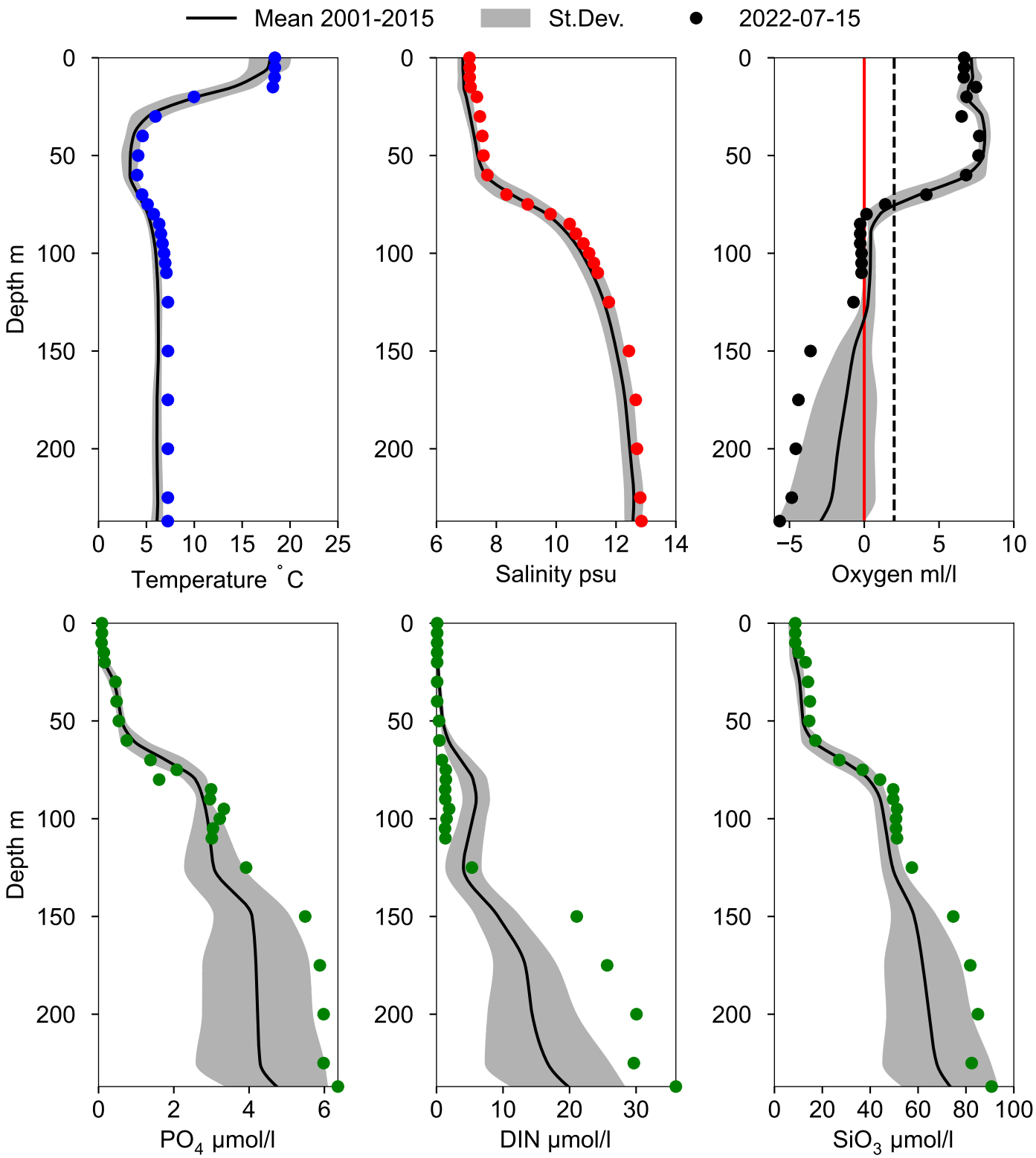
Annual Cycles



OXYGEN IN BOTTOM WATER (depth >= 225 m)

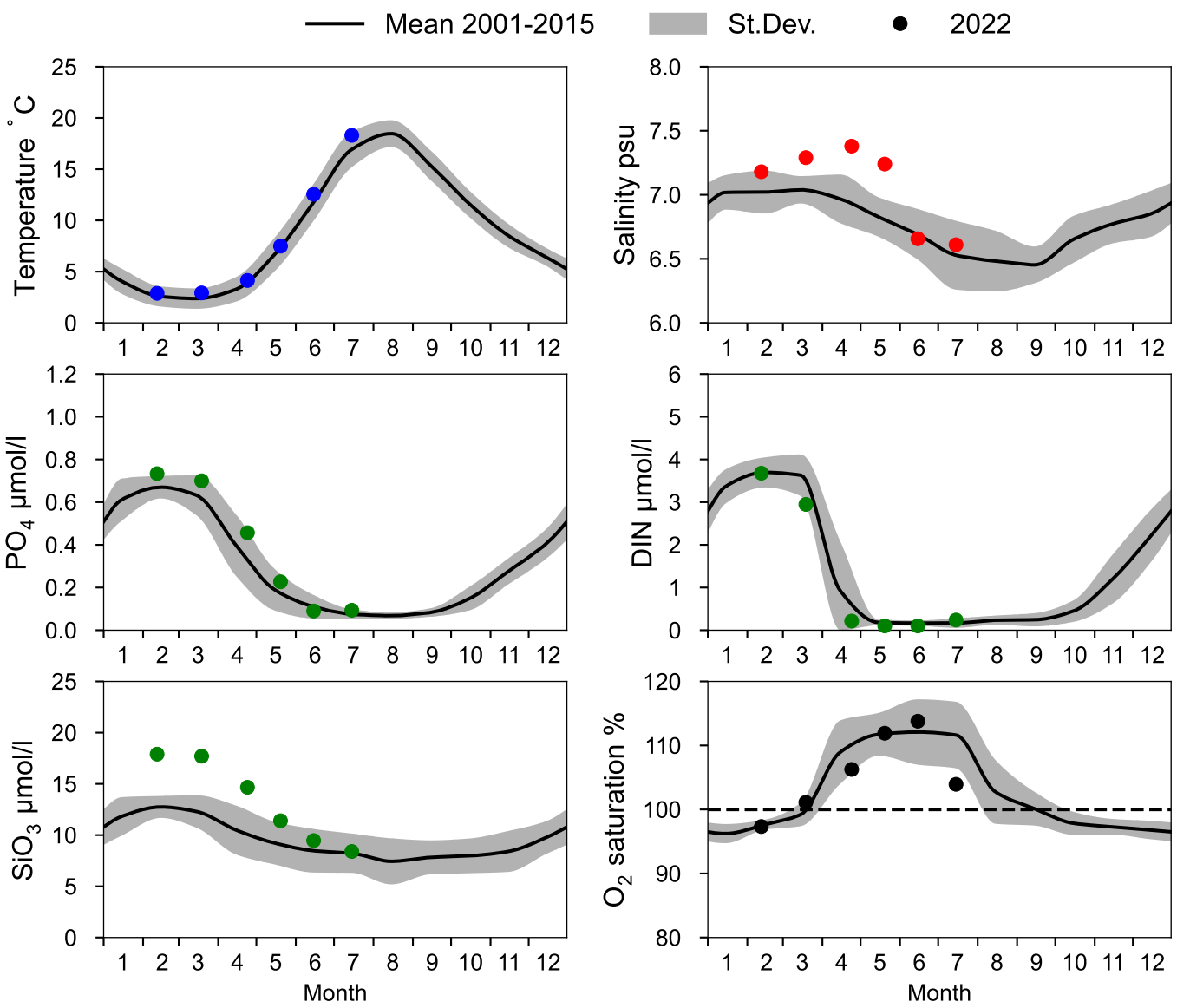


Vertical profiles BY15 GOTLANDSDJ
July

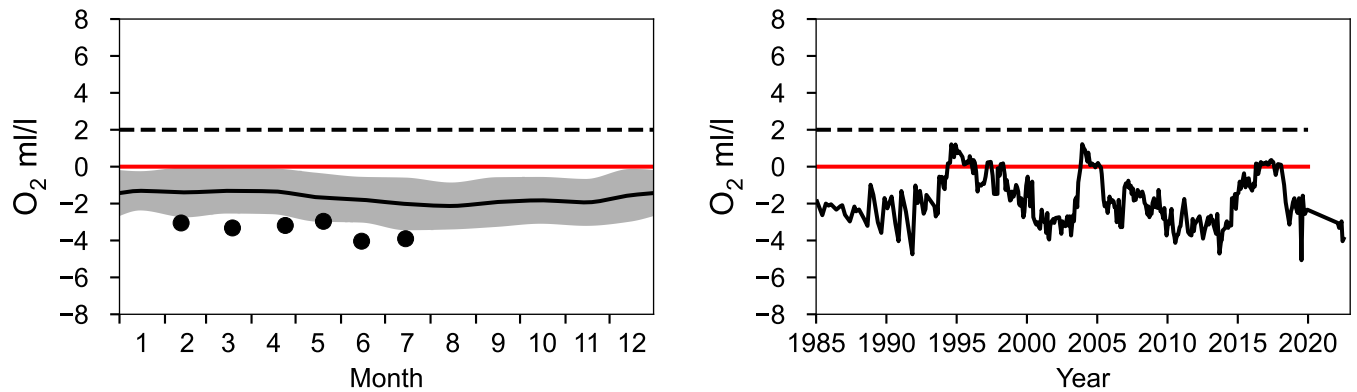


STATION BY20 FÅRÖDJ SURFACE WATER (0-10 m)

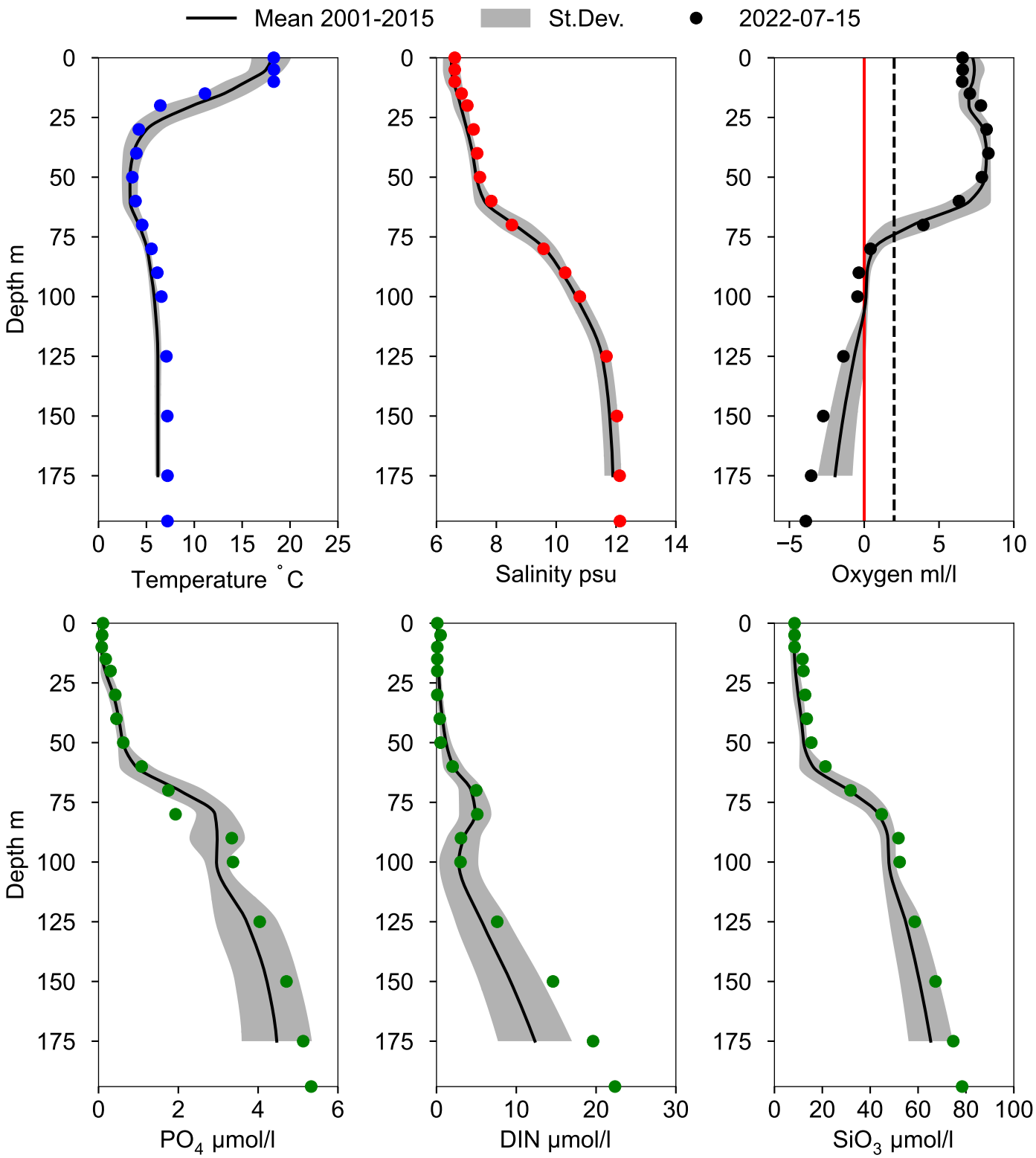
Annual Cycles



OXYGEN IN BOTTOM WATER (depth >= 175 m)

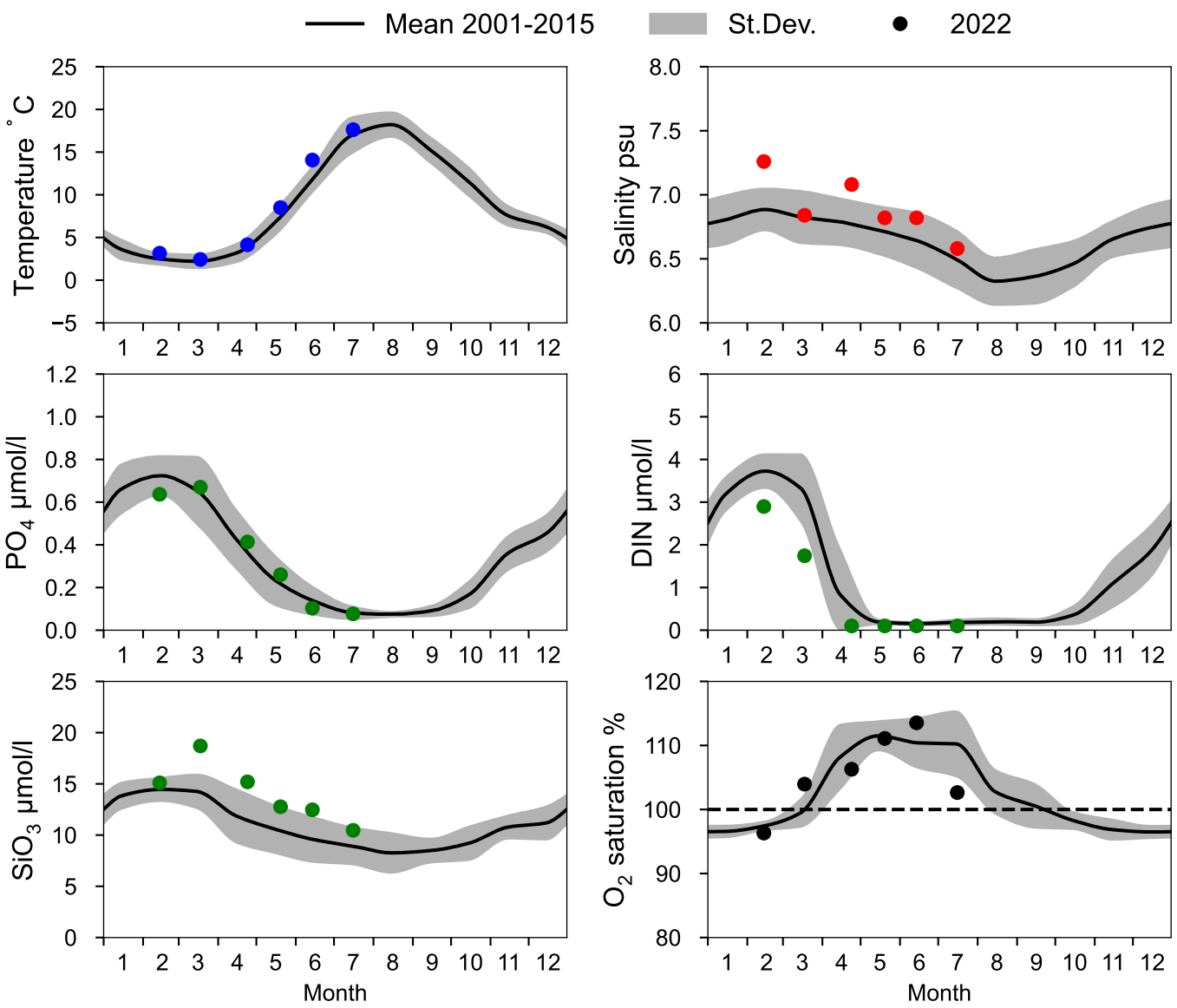


Vertical profiles BY20 FÅRÖDJ
July

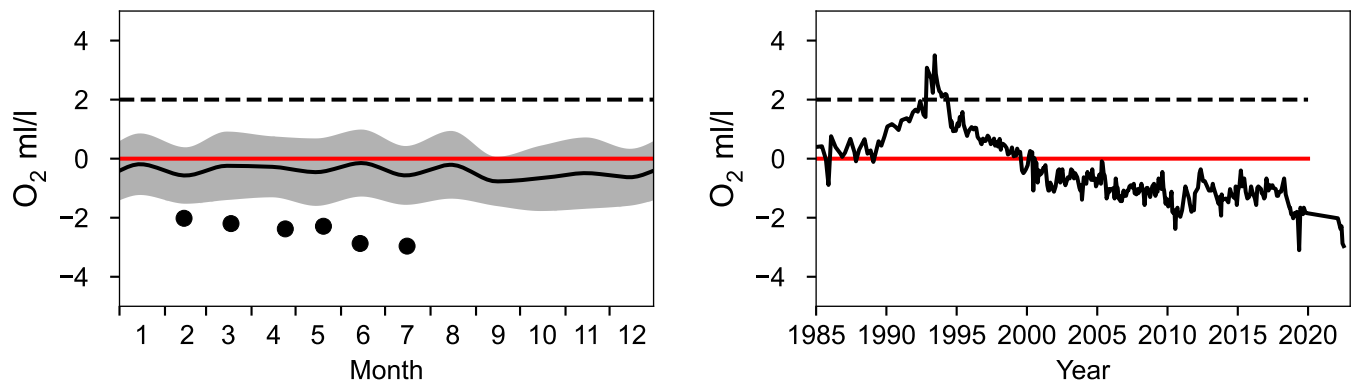


STATION BY32 NORRKÖPINGSDJ SURFACE WATER (0-10 m)

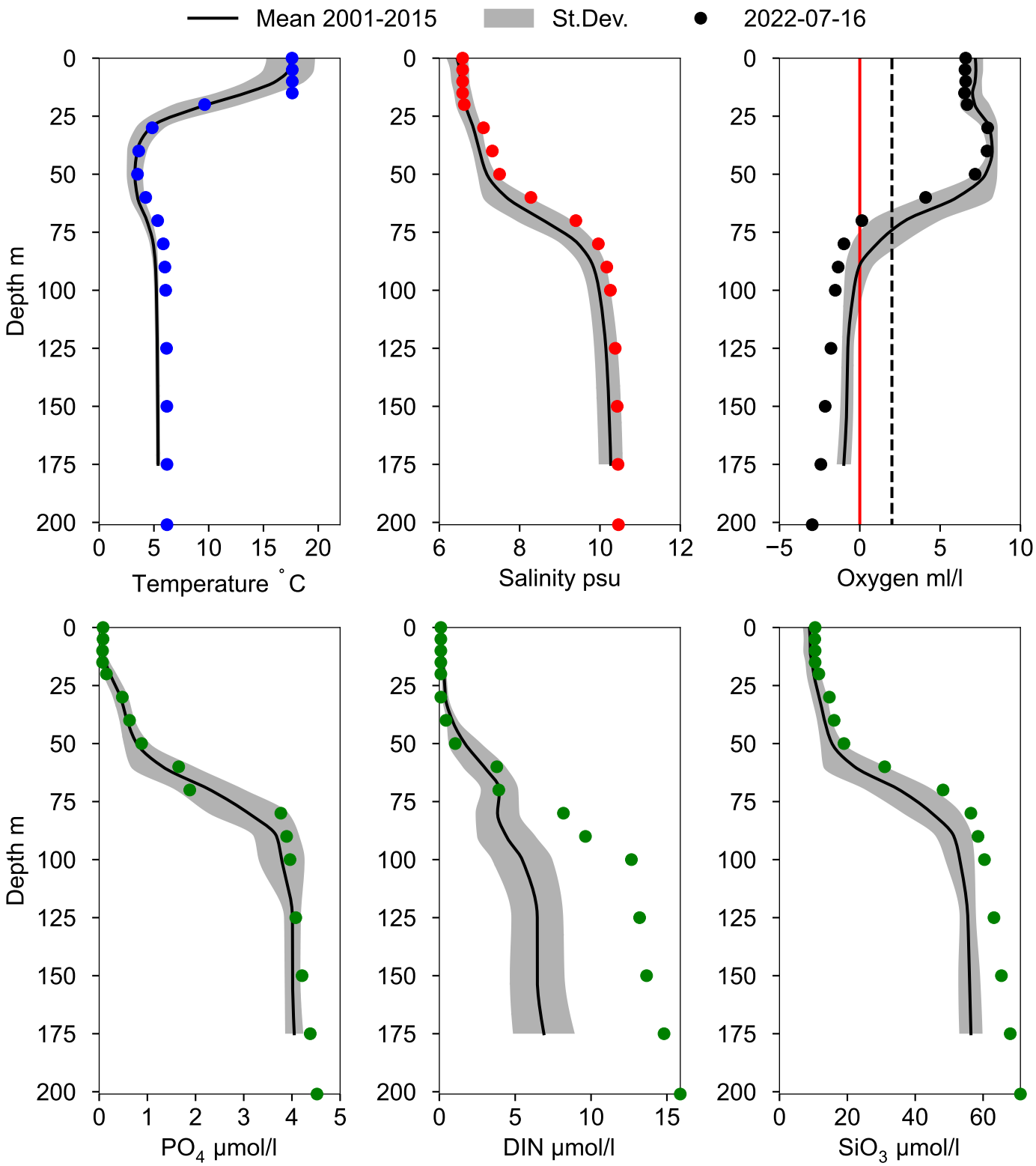
Annual Cycles



OXYGEN IN BOTTOM WATER (depth >= 175 m)

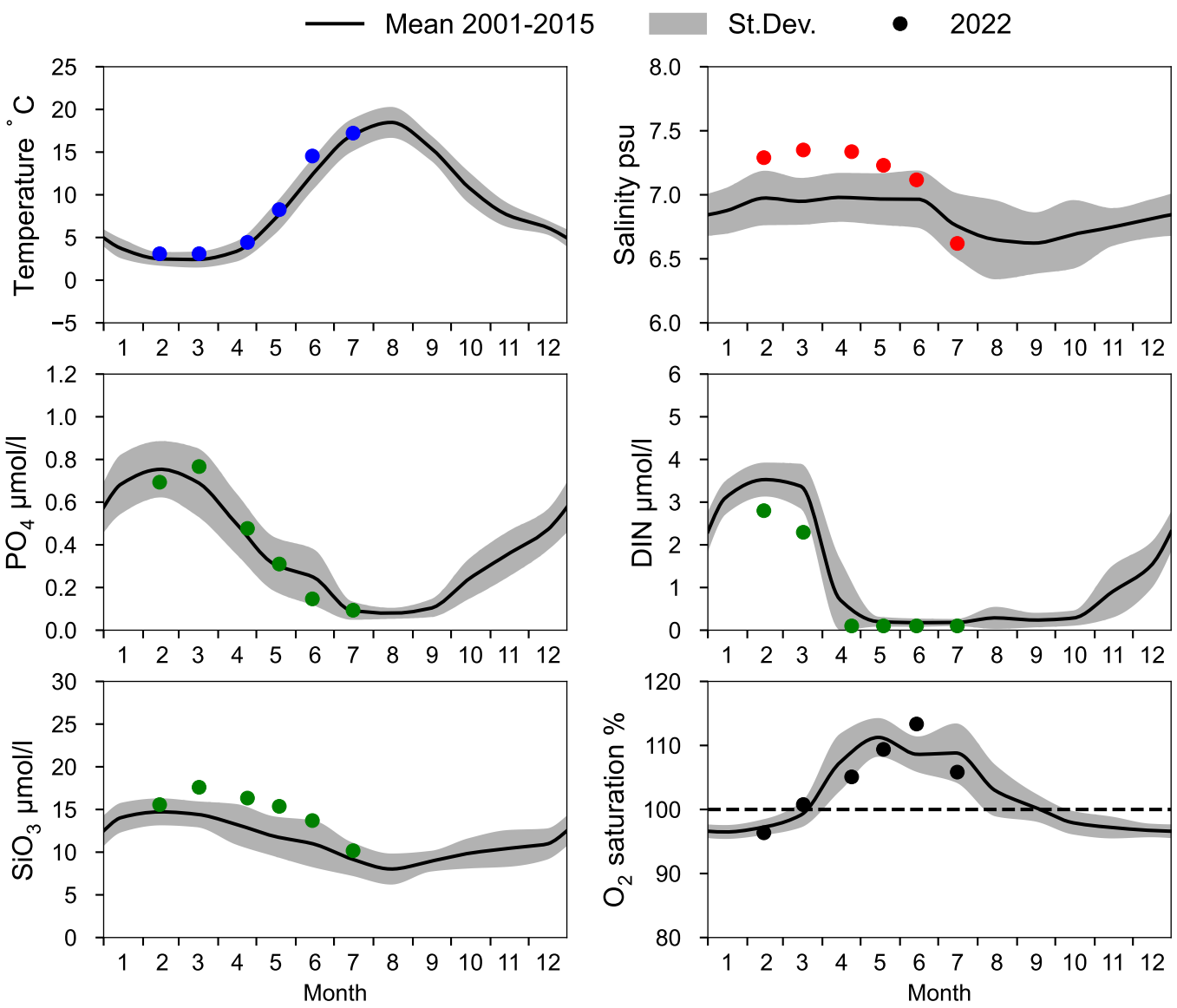


Vertical profiles BY32 NORRKÖPINGSDJ
July

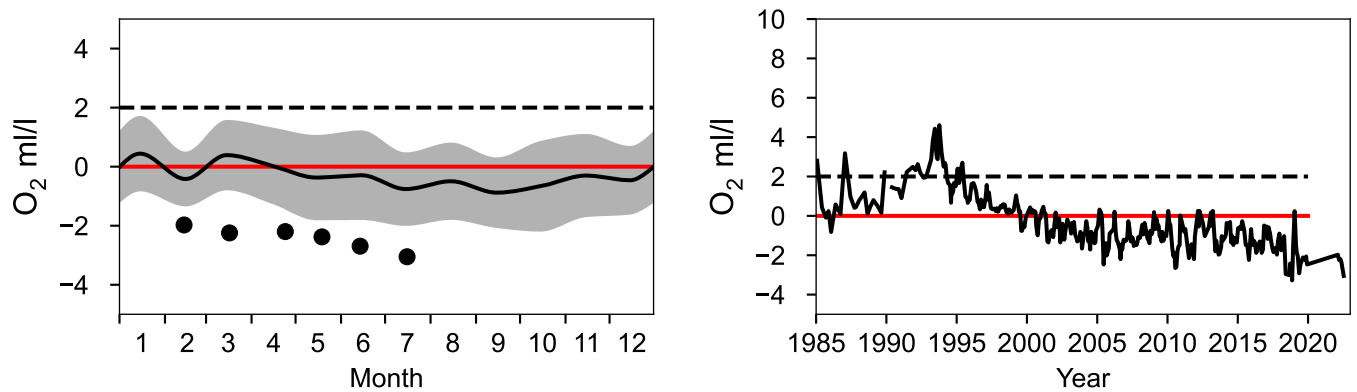


STATION BY38 KARLSÖDJ SURFACE WATER (0-10 m)

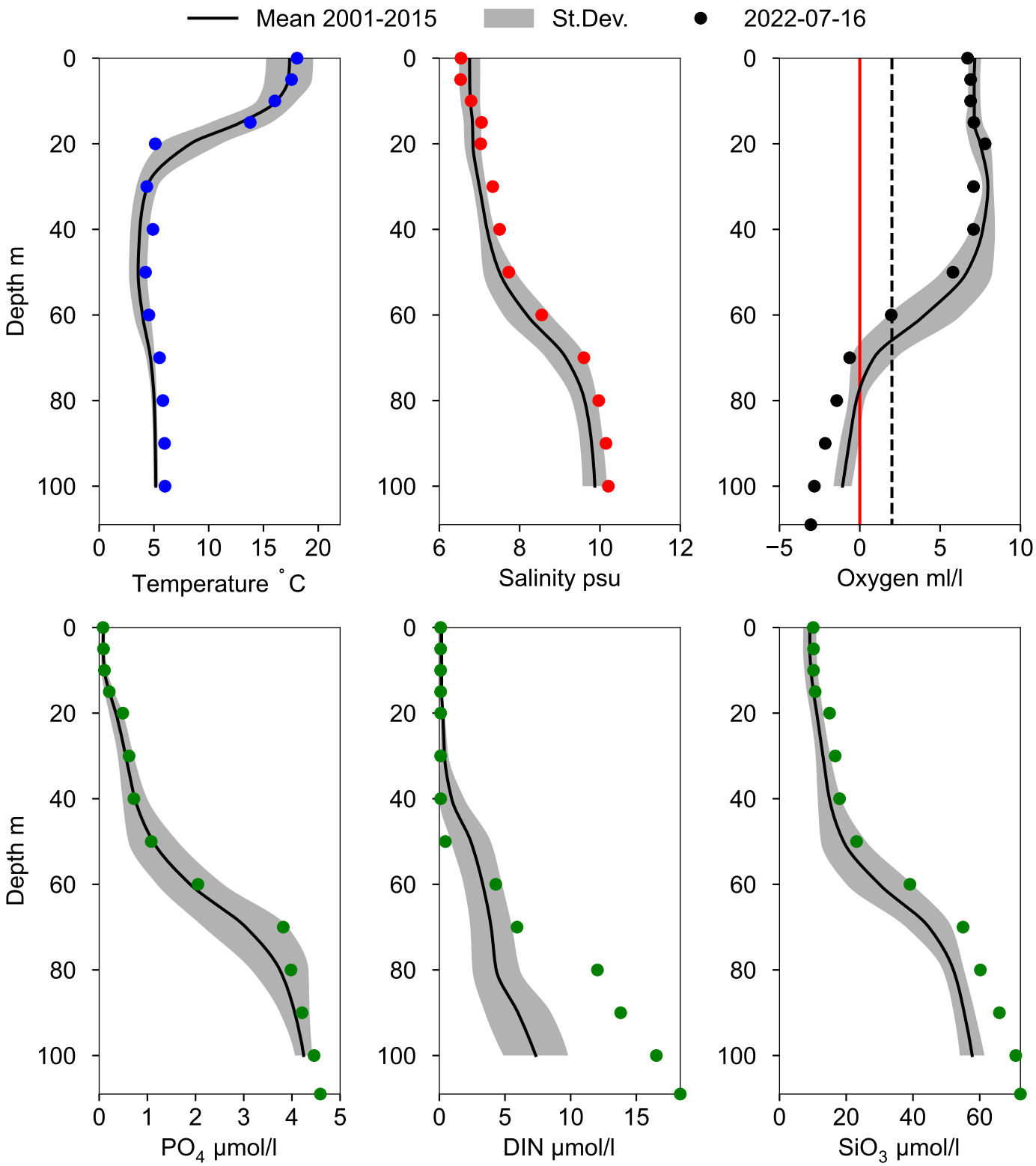
Annual Cycles



OXYGEN IN BOTTOM WATER (depth >= 100 m)

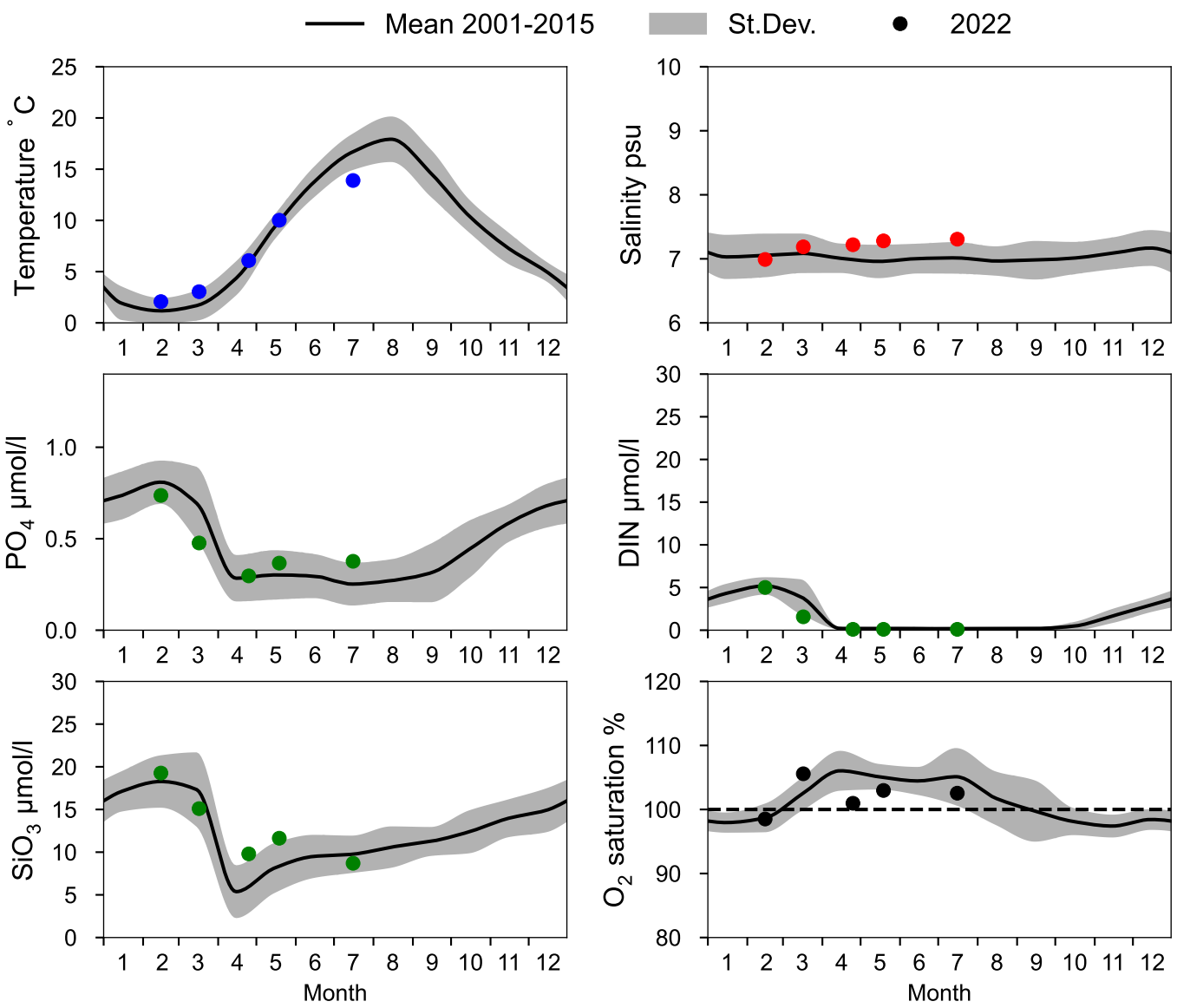


Vertical profiles BY38 KARLSÖDJ
July

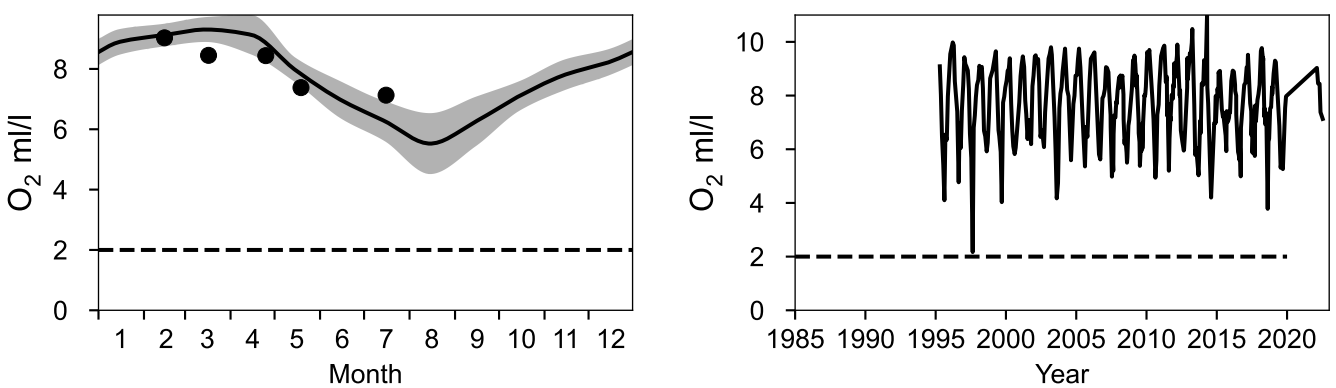


STATION REF M1V1 SURFACE WATER (0-10 m)

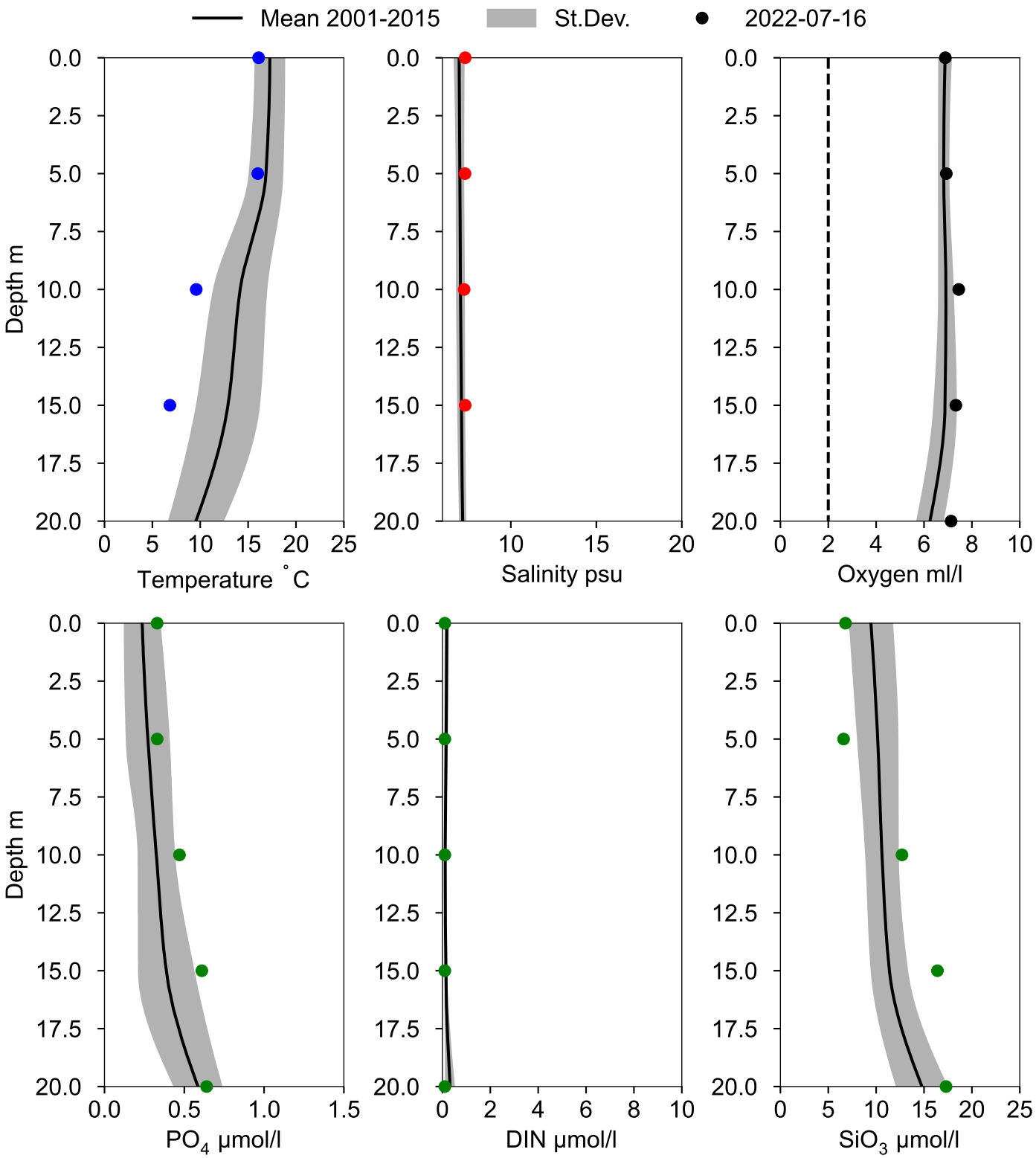
Annual Cycles



OXYGEN IN BOTTOM WATER (depth >= 15 m)

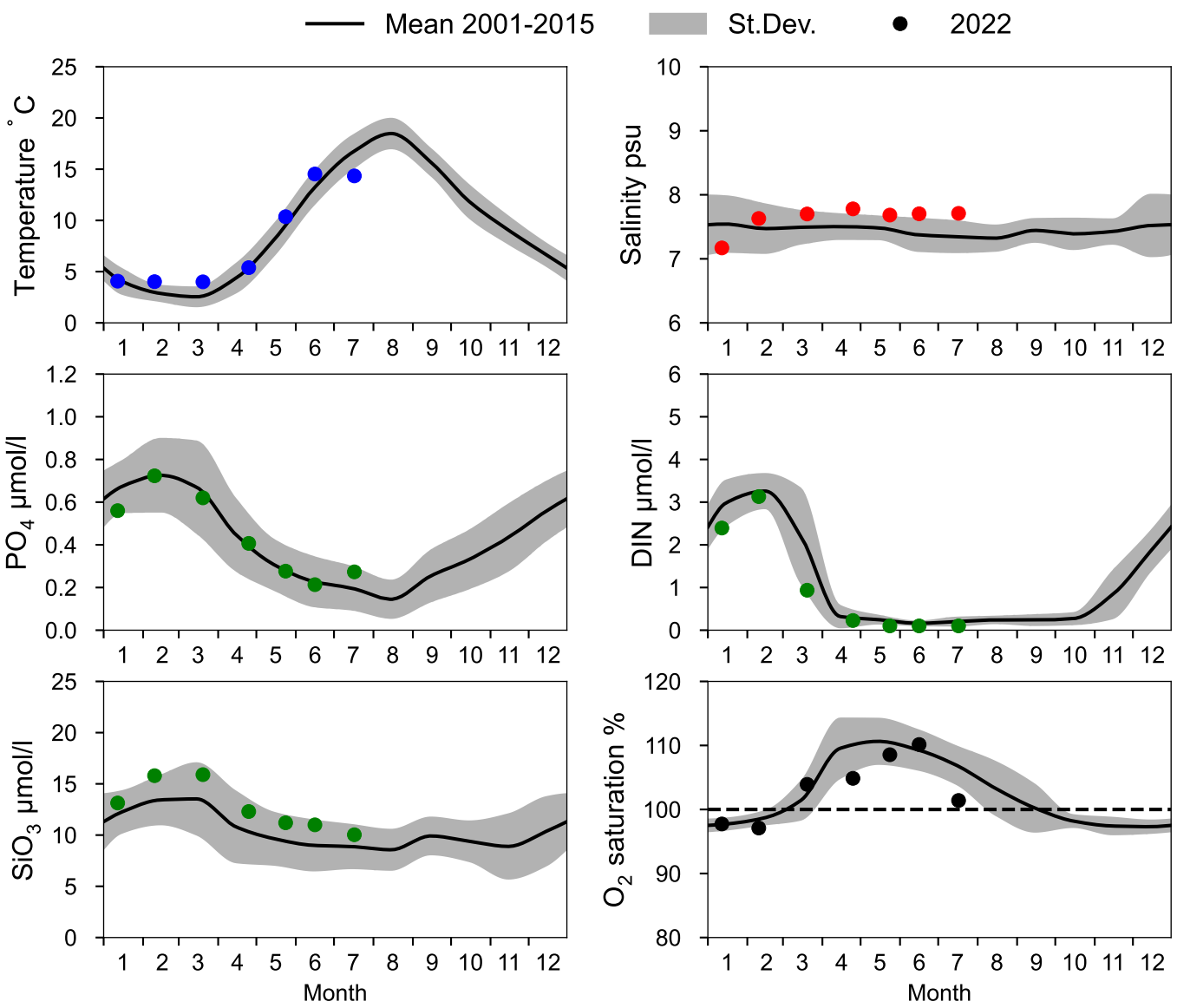


Vertical profiles REF M1V1
July

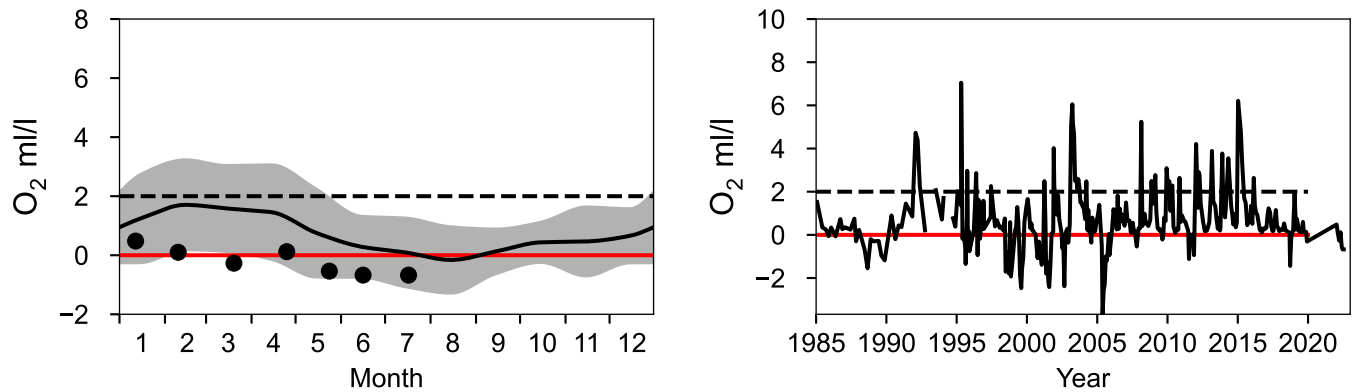


STATION HANÖBUKTEN SURFACE WATER (0-10 m)

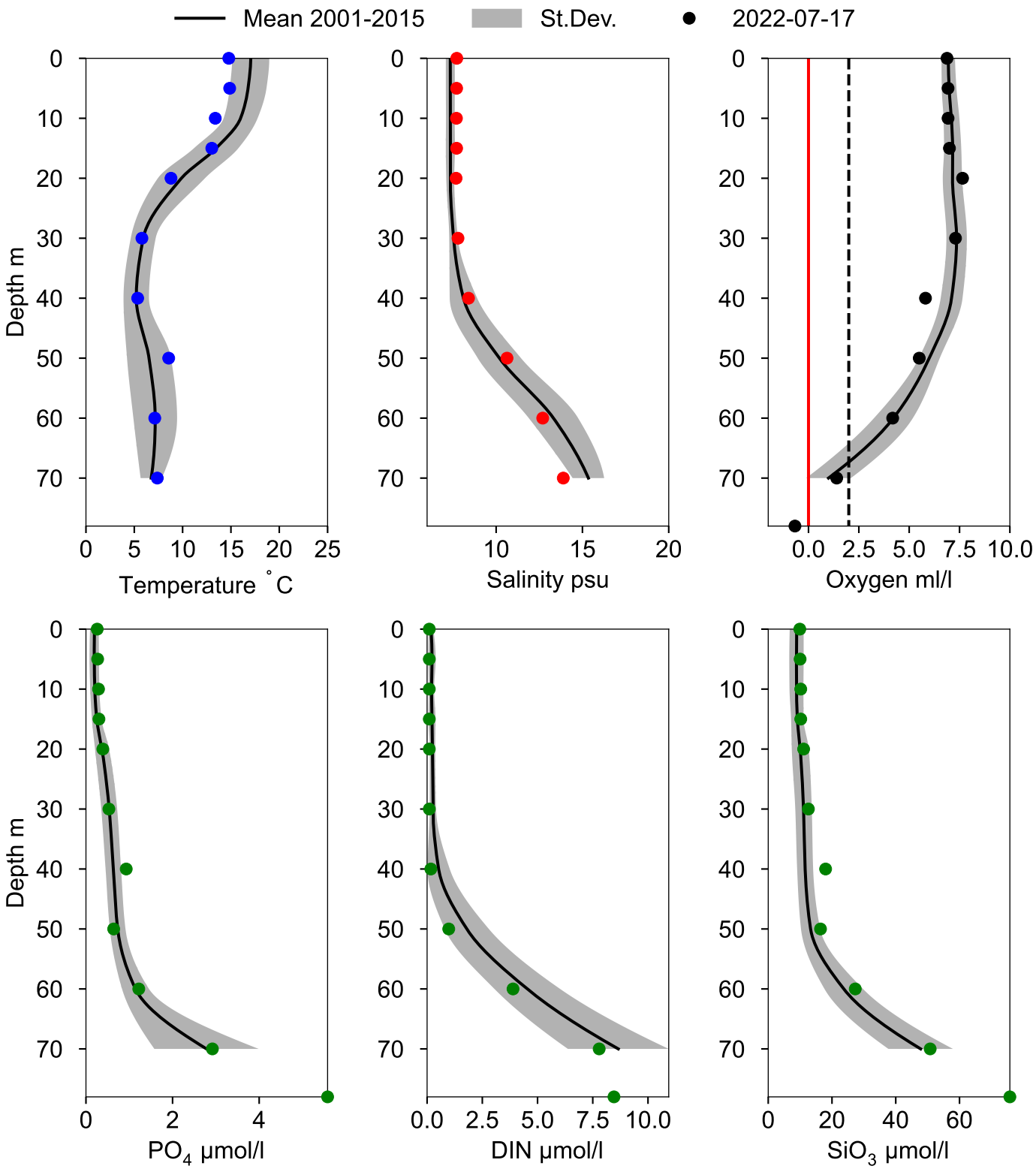
Annual Cycles



OXYGEN IN BOTTOM WATER (depth >= 70 m)

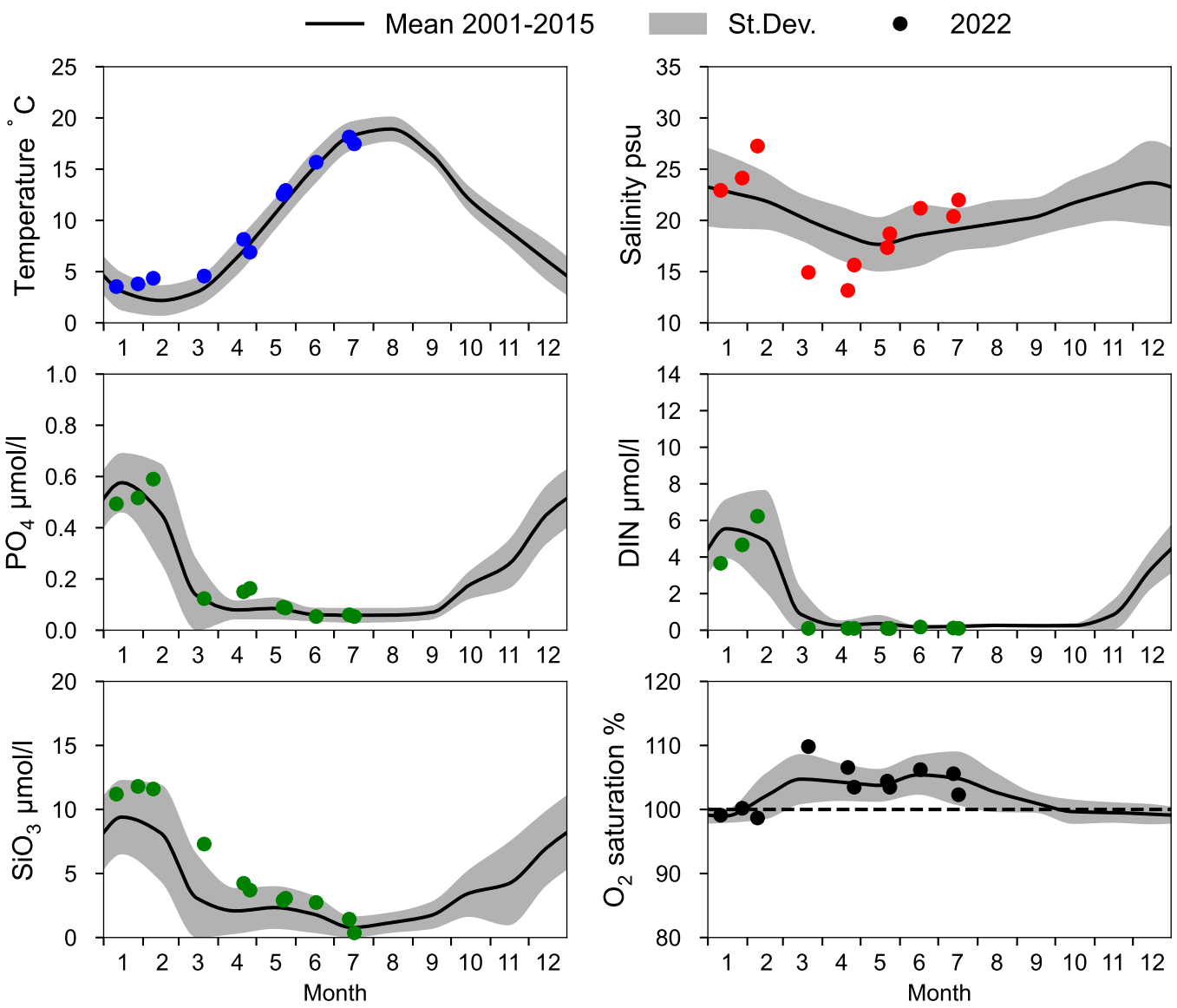


Vertical profiles HANÖBUKTEN
July

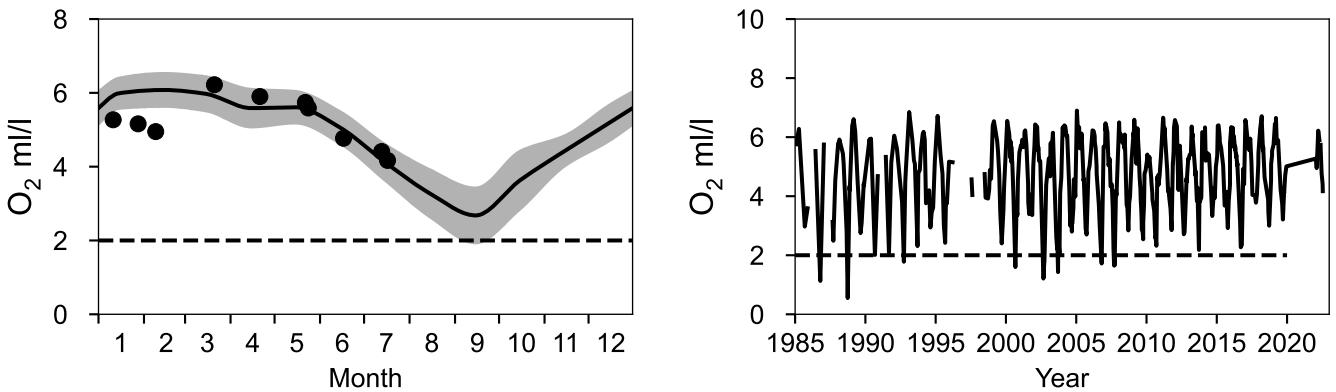


STATION ANHOLT E SURFACE WATER (0-10 m)

Annual Cycles



OXYGEN IN BOTTOM WATER (depth >= 52 m)



Vertical profiles ANHOLT E
July