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2020-03-16
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Cruise Report

March, R/V Svea
Swedish National Marine Monitoring Programme

Survey period:	2020-03-12 - 2020-03-17
Survey area:	Skagerrak, Kattegat, the Sound and the Baltic Proper
Principal:	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 national marine monitoring programme, Skagerrak, Kattegat, the Sound and the Baltic Proper were visited.

The surface water temperature was well above normal and ranged between 4 - 6°C which is about 2 - 3°C above normal for the season. The deep waters in the Baltic Proper were also warmer than normal. In the Baltic Proper, the salinity was higher than usual.

The concentrations of dissolved inorganic nitrogen were elevated in parts of the Skagerrak as well as in the Western Gotland Basin. Phosphate and silicate concentrations were elevated in large parts of the Baltic Proper.

The oxygen situation in the Arkona Basin was good with concentrations above 6 ml/l. In Hanö Bight, the Bornholm Basin and in the southeastern Baltic Proper oxygen levels in the bottom water had decreased since the last measurement in February and was now just over 2 ml/l, which is the limit for acute oxygen deficiency. Acute oxygen deficiency was observed from 55-70 meters depth in these areas. In the southern and central parts of the Eastern Gotland Basin, acute oxygen deficiency was noted from 55-65 meters, in the northern parts from 70 meters depth. In the Western Gotland Basin a little deeper, from 70-80 meters depth.

Anoxic waters, oxygen-free conditions where toxic hydrogen sulphide is formed, were found in the Eastern Gotland Basin at depths exceeding 125 meters. In the Western Gotland Basin from 90 meters depth.

The next cruise is scheduled for April 14-20 with R/V Svea.

Front: R/V Svea in Lysekil harbour after completed cruise.

RESULTS

The cruise was performed onboard the research vessel Svea and started in Karlskrona on March 12 and ended in Lysekil's harbour on March 17.

The same day as the cruise started, the storm "Laura" ravaged the southern Baltic Sea. Therefore, the route was changed so that the first station was taken in Kalmar Stait. To avoid the storm, the route continued up through Kalmar Stait and then the storm had subsided so that the cruise could continue as normal. In the Eastern Gotland Basin the wind gained strength again but then from the north. Also in the Bornholm and Arkona basins, the wind increased to about gale force, then the wind subsided. At the Å-transect in central Skagerrak, the wind increased again in strength.

Two nutrient mapping stations (BY9 and BY36) that were not visited during the February cruise due to bad weather and lack of time were sampled during this cruise. A computer failure at BY32 lead to that the entire profile could not be sampled; however water samples and samples for plankton were taken from the surface (0-10m) and from the bottom.

During the cruise, extra sampling of phytoplankton for DNA barcoding was carried out within a project for the development of the monitoring program and eDNA (environmental DNA) for researchers at the University of Turku. Samples were also taken from water and plankton samples for measuring selenium for EAWAG in Switzerland (Swiss Federal Institute of Aquatic Science and Technology).
Water samples were also taken to researchers at Uppsala University in order to find living cells of a species called *Meringosphaera mediterranea* that they will try to grow or obtain DNA from and do research on, morphologically and molecular biologically.

In addition to the regular sampling program, tests were also made with Svea's new instruments during transit, with, the so-called. Moving Vessel Profiler (MVP). The instrument was operated between monitoring stations when the weather allowed. Results indicate that the measurements can be a good complement to the regular program and give an understanding of the variation between stations. Work remains to establish routines for data flow, quality checks and determination of the accuracy of the measurements from the sensors on the instrument. Just over 200 profiles were collected with the MVP on five different transects; BY9 - BCSIII-10, BCSIII-10 - BY5, BY4 - Hanö Bight, Hanö Bight - BY2 and between Fladen - P2. Svea's ferrybox and ADCPs were also tested during the trip.

This report is based on data that has undergone an initial quality control. After further quality controls, certain values or quality flags may have changed. Data from this cruise is published as soon as possible on the data host's website; normally this is done within a week after the cruise. Some analyses are done after the expedition and will be published later.

Data and reports can be downloaded here:
https://www.smhi.se/en/theme/marine-environment-2-885

The Skagerrak

The surface water temperature was higher than normal, just below 6 °C. The salinity in the surface water was normal for the season, 31-33 psu, at the coast slightly lower, around 26 psu. The stratification was weakly developed, only at Å17 in central Skagerrak and at the coastal station Släggö there was a marked stratification at about 20 meters depth. In open Skagerrak, it was basically well-mixed throughout the water column with roughly the same salinity and temperature conditions from the surface down to the bottom.

The concentration of nutrients in the surface water was generally normal or above normal. The phosphate content varied between 0.30-0.35 µmol/l. Higher than normal at Å15 and Å13. The content of dissolved inorganic nitrogen ranged from 4 to 10 µmol/l. Much higher than normal (10 µmol/l) at Å13, the easternmost station in the Å-transect. The silicate content varied between 2.0-6.6 µmol/l, also here the concentrations were highest at Å13 and P2. The stations closest to the Swedish coast (Å13 and P2) were clearly influenced by outflowing nutrient-rich water from the Baltic Sea, the so-called Baltic current, which normally flows along the Swedish west coast northwards. In central Skagerrak deep water, nutrient levels were generally lower than normal.

At the coastal station Släggö, in the entrance to the Gullmarsfjord, nutrient levels were normal for the season, phosphate; 0.2 µmol/l, inorganic nitrogen; 4.2 µmol/l and silicate; 5.5 µmol/l. The levels were slightly lower here compared to the offshore stations, probably due to the early spring bloom of phytoplankton that consumes nutrients. CTD fluorescence showed slightly higher plankton activity at Släggö compared to the Skagerrak offshore stations.

The oxygen situation was good at all stations in the Skagerrak.

The Kattegat and the Sound

The surface water temperature was higher than normal, just above 5°C. The salinity in the surface water was higher than normal in central Kattegat at Anholt E; 25 psu, and lower than normal at the coastal station N14; 16 psu. In the central and northern parts, a primary halocline was found at a depth of 5 meters and a secondary halocline at a depth of 20 meters. At N14 and in the Sound, the halocline was found at 10-15 meters depth. The thermocline was weakly developed.

Phosphate levels in the surface water were normal throughout Kattegat and the Sound and varied between 0.1-0.5 µmol/l, highest in the Sound. Dissolved inorganic nitrogen levels were also normal but varied more than phosphate levels with concentrations between 0.8-3.4 µmol/l, higher than normal in the Sound. The levels of silicate were normal in both Kattegat and in the Sound and varied between 3-11 µmol/l, also here highest in the Sound. In the Kattegat's deep water, nutrients were normal or slightly lower than normal. In the deep waters of the Sound; oxygen levels were much higher than normal, salinity lower than normal and all nutrients lower than normal.

The oxygen situation in the bottom water throughout the studied area was good. Oxygen levels above 6 ml/l were observed at all stations.

In the northern Kattegat at station P2, a fluorescence peak at about 5 meters depth was noted. In other areas, there was some activity in the surface layer. At Station N14, the water was turbid, secchi depth was measured to only 2 meters, probably due to large runoff from land after the heavy rainfall during the winter.

The Baltic Proper

Throughout the Baltic Proper, the surface water temperature was well above normal for the season and varied between 4.5 and 5°C. In the deep water, much higher temperatures than normal were also observed in the entire area. The salinity was also above normal in the entire area, probably due to vertical wind mixing and upwelling along the Swedish east coast due to strong westerly / southwesterly winds during recent months. In the surface water, salinity ranged from 7.1 psu in the north to 9.0 psu in the southwest. The salinity was higher than normal down to the halocline but in the deep water the salinity was generally normal, except in the Gotland basins where the deep water also had elevated levels of salinity. The halocline and thermocline coincided and were found at about 35 meters depth in Arkona Basin, at 50-60 meters depth in Hanö Bight and Bornholm Basin and at 60-70 meters depth in the deeper Gotland Basins.

Phosphate levels in the surface water were higher than normal in the eastern part of the Bornholm Basin, the southeastern Baltic Sea and in the Eastern Gotland Basin. Also in Kalmar Strait, at the station RefM1V1, higher phosphate levels were measured than normal. The levels varied between 0.5-0.9 µmol/l. The concentration of dissolved inorganic nitrogen was higher than normal in the Western Gotland Basin but generally normal in other basins and ranged between 1.1-4.8 µmol/l. The silicate content was elevated above normal throughout the entire Baltic Proper; 18-20 µmol/l except in the Arkona Basin where normal levels were noted. Highest values were found at the coastal station RefM1V1 in Kalmar strait, phosphate; 1.0 µmol/l, inorganic nitrogen; 5.0 µmol/l, silicate; 23 µmol/l. In the offshore deep waters, concentrations of nutrients were generally normal except in the Western Gotland Basin where dissolved inorganic nitrogen and silicate concentrations were higher than normal.

The oxygen situation in the Arkona basin was good with concentrations above 6 ml/l. In the Hanö Bight, the Bornholm Basin and in the southeastern Baltic Sea (BCSIII-10), oxygen levels in the bottom water had decreased since the previous visit in February and were now just over 2 ml/l, which is the limit for acute oxygen deficiency. Acute oxygen deficiency was observed from 55-70 meters depth in these areas. In the southern and central parts of the Eastern Gotland Basin, acute oxygen deficiency was noted from 55-65 meters depth, in the northern parts from 70 meters depth. In the Western Gotland Basin a little deeper, from 70-80 meters depth.

Anoxic waters, oxygen-free conditions, where toxic hydrogen sulphide is formed, were found in the Eastern Gotland Basin at depths exceeding 125 meters. In the Western Gotland Basin from 90 meters depth.

The plankton activity, estimated from the chlorophyll fluorescence given by the CTD probe, was low throughout the studied area.

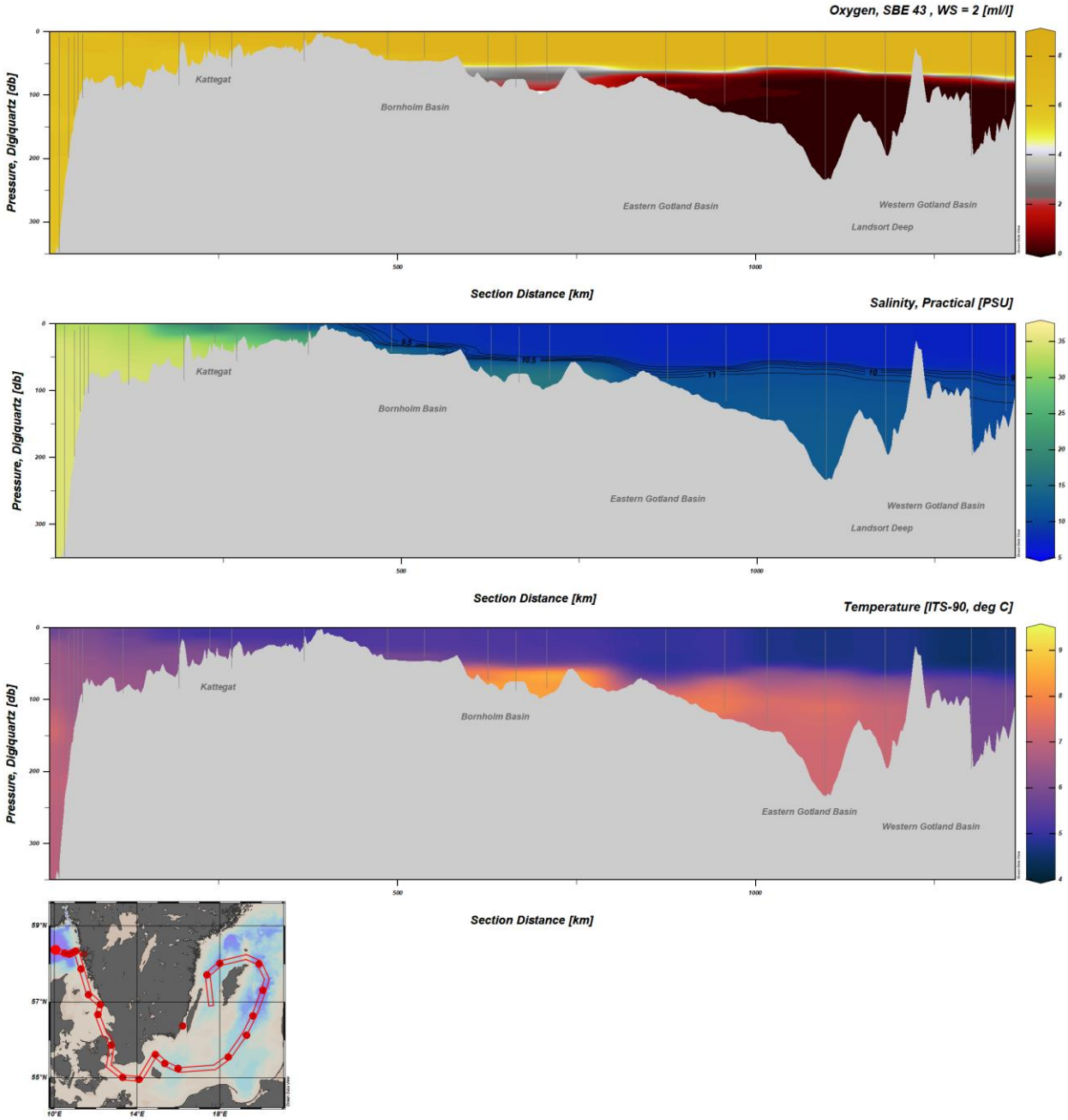

Figure 1. Transect showing dissolved oxygen, salinity and temperature from the Skagerrak, Kattegat, the Sound, through the Baltic Proper, to the Western Gotland Basin.

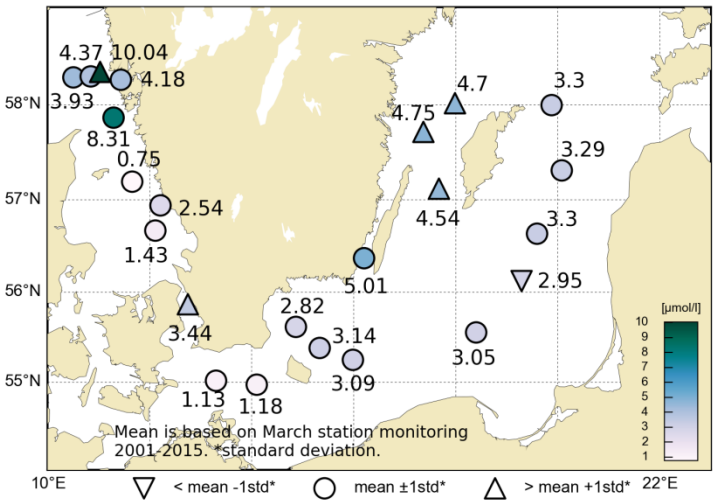

Figure 2: Concentration of dissolved inorganic nitrogen in the surface water (0-10m).

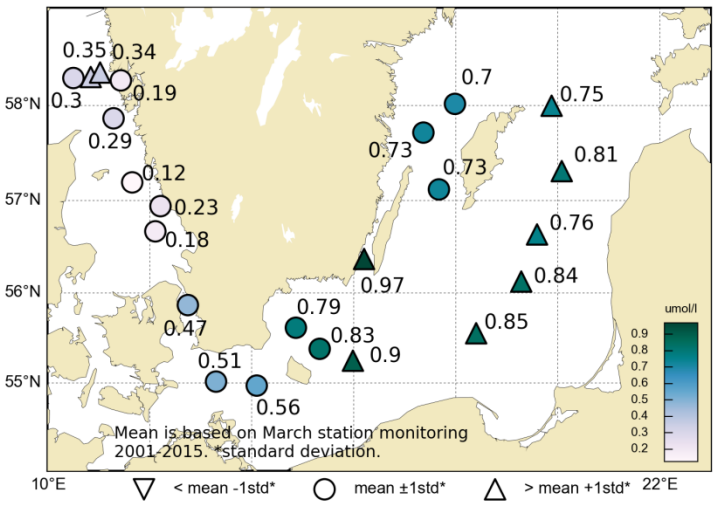

Figure 3: Concentration of phosphate in the surface water (0-10m).

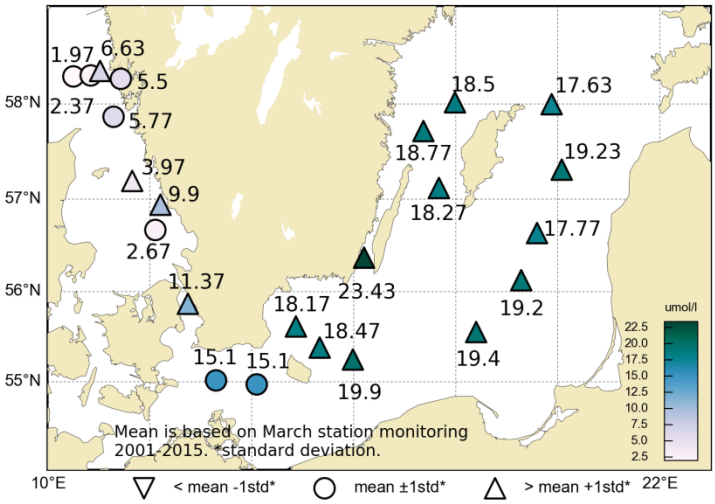

Figure 4: Concentration of silicate in the surface water (0-10m).

PARTICIPANTS

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APPENDICES

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

SMHI
Havs och Vatten myndigheten

TRACKCHART
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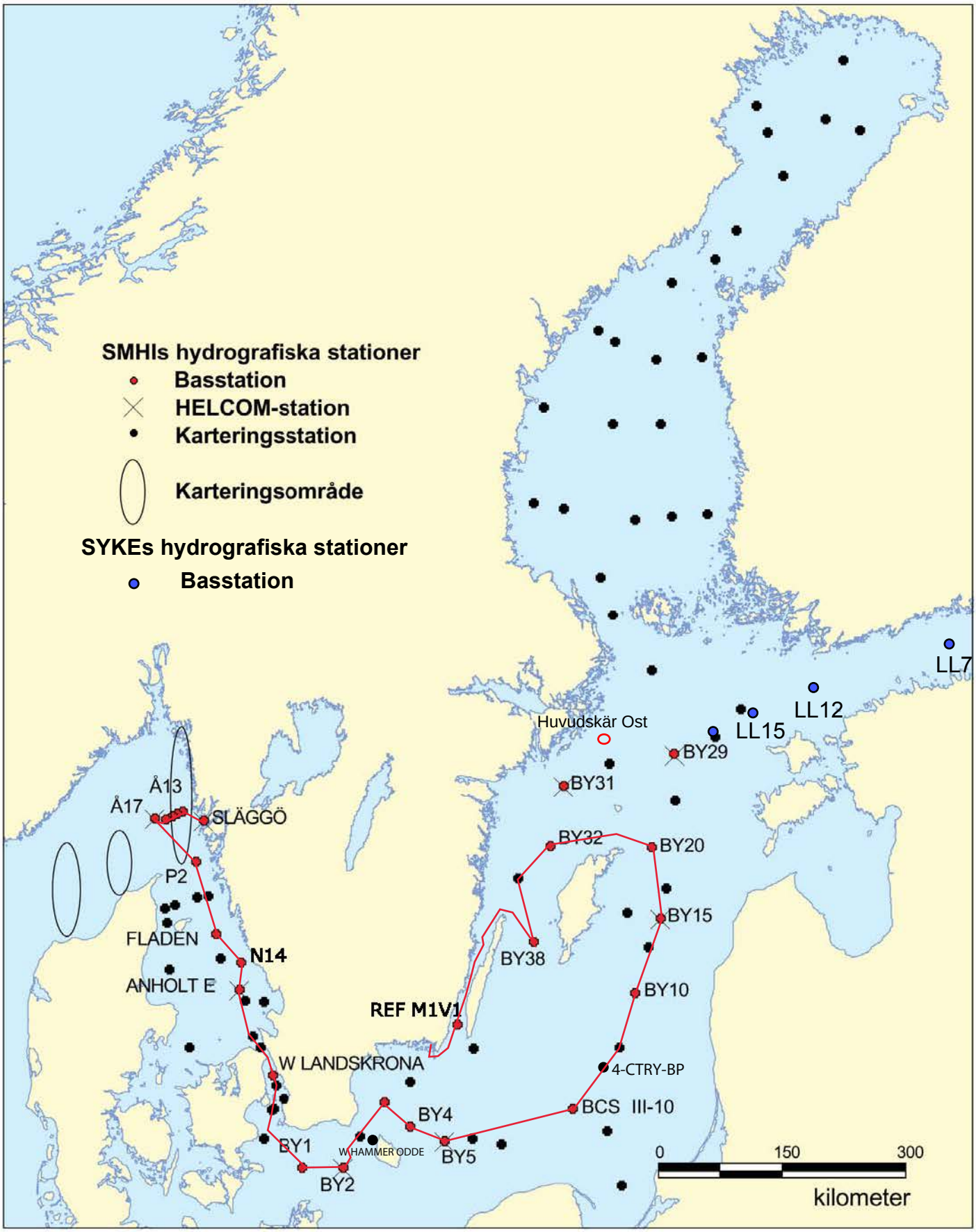
Ship: R/V Svea
Date: 20200312-20200317
Series: 0209-0233



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Time: 14:24

Ship: SE
Year: 2020

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 elac aove tueo hdsb	CZPP hohp loy apt o p	No de	No btl	Temp_bttl	Temp_ctd	Sal_btl	Sal_ctd	Phos_btl	Phos_ctd	DOxy_btl	DOxy_ctd	H2S	Phos	Nitr_oxr	Nitr_tri	Nitr_azn	Amm_rot	Ant_ook	Alk_ty	Sil_3-si	Humus_si	Cond_vis	Cond_sal	Cond_temp
0209	5	BPWK01	BAS...	REF M1V1	5622.22	01612.17	20200312	1200	21		22	18	5.9	981	2840	x---	5	5	x	x	x	x	x	x	-	x	x	x	x	x	x	x	-	x	-
0210	5	BPWX45	BAS...	BY38 KARLSÖDJ	5707.07	01740.20	20200313	0200	114		23	12	4.8	992	9990	x---	14	14	x	-	x	-	-	x	-	x	x	x	x	x	x	x	-	x	x	x	-
0211	5	BPWX42	BAS...	BY36	5743.06	01721.95	20200313	0715	140		22	8	4.7	994	1430	----	15	15	x	x	x	x	-	x	x	x	x	x	x	x	x	x	-	x	-	x	-
0212	5	BPWX38	BAS...	BY32 NORRKÖPINGSDJ	5801.02	01759.08	20200313	1040	205	11	36	6	2.9	996	7830	x---	17	17	x	x	-	x	-	x	x	x	x	x	x	x	x	x	-	x	-	-	-
0213	5	BPEX26	BAS...	BY20 FÅRÖDJ	5759.84	01952.75	20200313	1900	203		35	13	2.2	1000	9999	x---	17	17	x	x	-	x	-	x	x	x	x	x	x	x	x	x	-	x	-	-	-
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0215	5	BPEX13	BAS...	BY10	5638.13	01935.61	20200314	0730	147		31	12	0.3	1015	1350	x---	15	15	x	x	x	x	-	x	x	x	x	x	x	x	x	x	-	x	-	-	-
0216	5	BPSE12	BAS...	BY9 KLAIPEDA	5607.46	01917.04	20200314	1220	127	9	35	8	0.8	1021	1150	x--x	14	14	x	x	x	x	x	x	x	x	x	x	x	x	x	x	-	x	-	x	-
0217	5	BPSE11	BAS...	BCS III-10	5533.32	01824	20200314	1833	90		25	5	1.4	1024	9990	x---	12	12	x	x	x	x	-	x	x	-	x	x	x	x	x	x	-	x	x	-	x
0218	5	BPSB07	BAS...	BY5 BORNHOLMSDJ	5514.99	01559.04	20200315	0420	91		16	12	3.6	1020	1140	x-x-	12	12	x	x	x	x	x	x	x	-	x	x	x	x	x	x	x	x	x	-
0219	5	BPSB06	BAS...	BY4 CHRISTIANSÖ	5522.96	01519.98	20200315	0857	94		16	15	4.6	1017	1140	x---	12	12	x	x	x	x	-	x	x	-	x	x	x	x	x	x	-	x	-	x	-
0220	5	BPSH05	BAS...	HANÖBUKTEN	5537.01	01451.99	20200315	1115	80		16	10	5.8	1014	2740	x--x	11	11	x	x	x	x	x	x	x	-	x	x	x	x	x	x	-	x	-	x	-
0221	5	BPSA03	BAS...	BY2 ARKONA	5458.26	01405.92	20200315	1740	47		16	11	7.8	1012	9990	x-x-	8	8	x	x	x	x	-	x	x	-	x	x	x	x	x	x	-	x	x	x	-
0222	5	BPSA02	BAS...	BY1	5500.95	01318.04	20200315	2110	47		16	10	7.1	1010	9999	x---	8	8	x	x	x	x	-	x	x	-	x	x	x	x	x	x	-	x	-	-	-
0223	5	SOCX39	BAS...	W LANDSKRONA	5552	01244.92	20200316	0415	50		21	10	7.5	1008	9990	x---	9	9	x	x	x	x	-	x	x	-	x	x	x	x	x	x	-	x	-	-	-
0224	5	KAEX29	BAS...	ANHOLT E	5640.14	01206.69	20200316	1010	62	7	23	6	6.0	1012	1120	xxxx	10	10	x	x	x	x	x	x	x	-	x	x	x	x	x	x	x	x	-	-
0225	5	KANX50	BAS...	N14 FALKENBERG	5656.37	01212.71	20200316	1300	30	2	22	3	6.4	1014	1620	xxx-	7	7	x	x	x	x	x	x	x	-	x	x	x	x	x	x	x	x	-	-	-
0226	5	KANX25	BAS...	FLADEN	5711.56	01139.45	20200316	1630	84		22	4	6.5	1016	1120	x---	12	12	x	x	x	x	-	x	x	-	x	x	x	x	x	x	-	x	-	-	-
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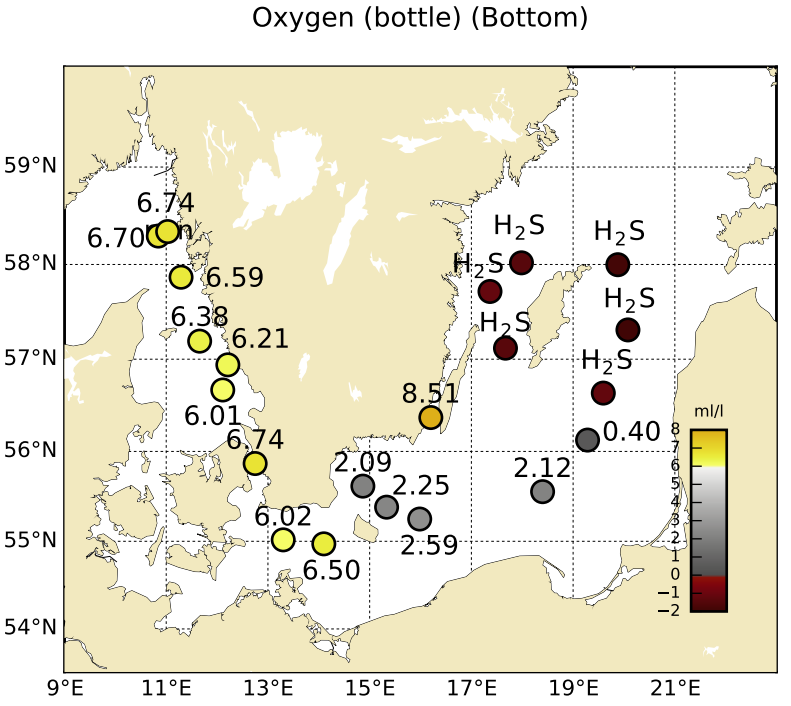
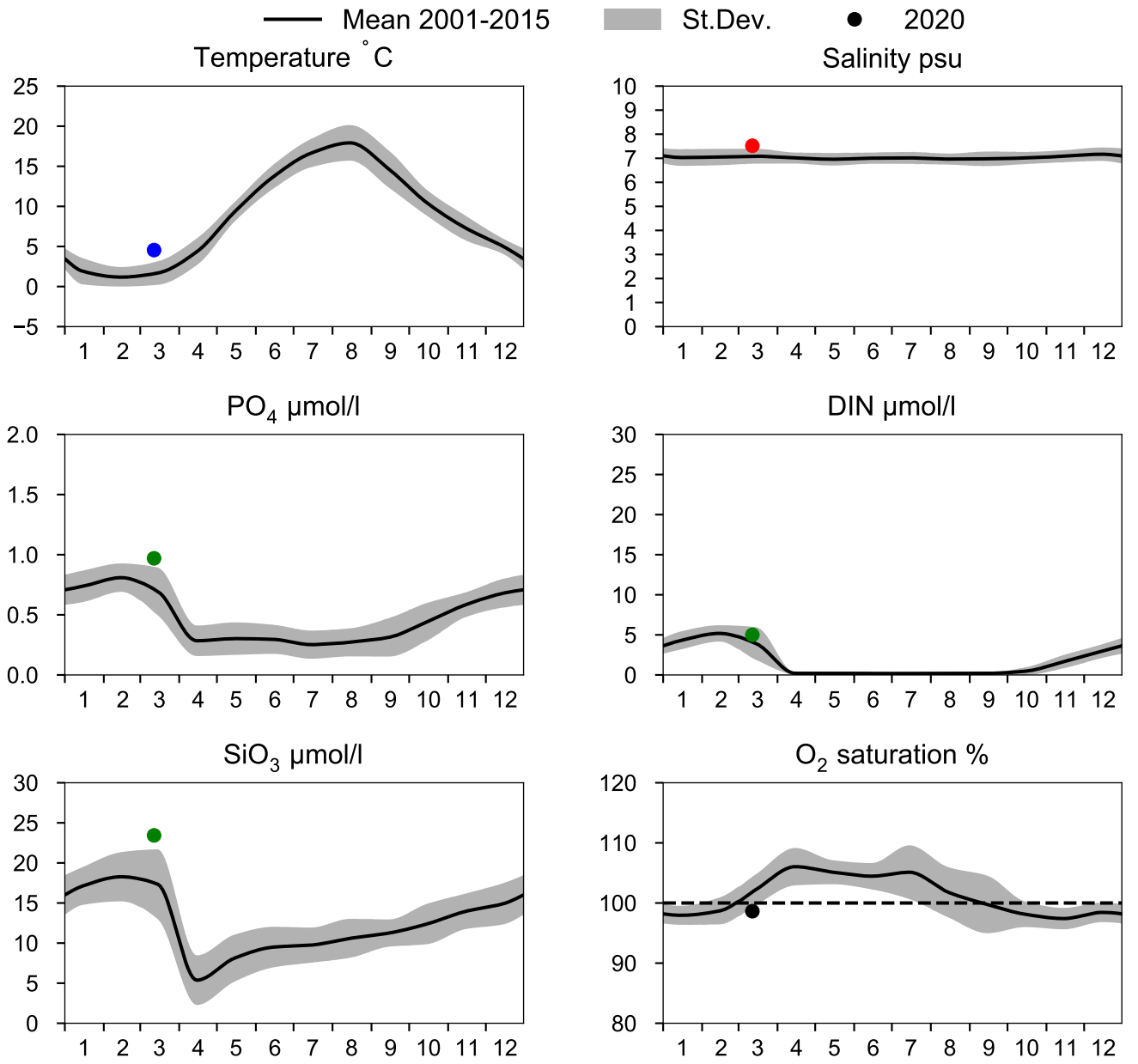
0229	5	SKEX17	BAS...	Å16	5816.04	01043.46	20200317	0450	202		19	12	5.5	1014	9990	----	14	0	-	x	-	x	-	-	x	-	-	-	-	-	-	-	-	-	-	-	-
0230	5	SKEX16	BAS...	Å15	5817.67	01050.67	20200317	0620	135		19	13	5.9	1013	2850	x---	12	12	x	x	x	x	-	x	x	-	x	x	x	x	x	x	-	x	-	-	-
0231	5	SKEX15	BAS...	Å14	5818.97	01056.3	20200317	0745	110		19	12	5.3	1013	2840	----	11	0	-	x	-	x	-	-	x	-	-	-	-	-	-	-	-	-	-	-	-
0232	5	SKEX14	BAS...	Å13	5820.45	01101.7	20200317	0845	90		20	10	60	1013	2840	x---	10	10	x	x	x	x	-	x	x	-	x	x	x	x	x	x	-	x	-	-	-
0233	5	FIBG27	BAS...	SLÄGGÖ	5815.58	01126.13	20200317	1315	74	4	19	10	6.7	1014	2630	xxx-	9	9	x	x	x	x	-	x	x	-	x	x	x	x	x	x	-	x	-	x	-

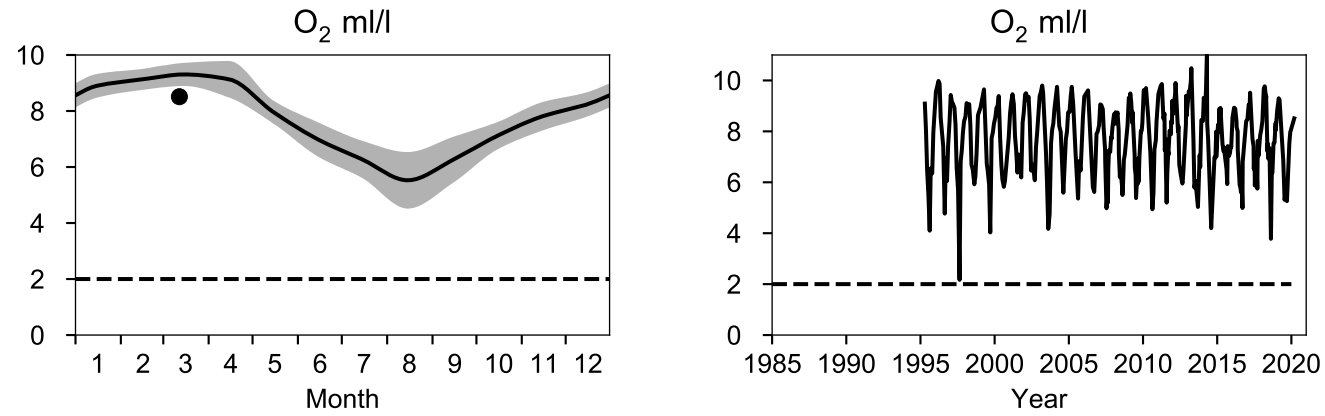

Oxygen (bottle) (Bottom)
59°N
58°N
57°N
56°N
55°N
54°N
9°E
11°E
13°E
15°E
17°E
19°E
21°E
6.74
6.70
6.59
6.38
6.21
6.01
6.74
6.02
6.50
8.51
2.09
2.25
2.59
2.12
0.40
H2S
ml/l
8
7
6
5
4
3
2
1
0
−1
−2

STATION REF M1V1 SURFACE WATER (0-10 m)

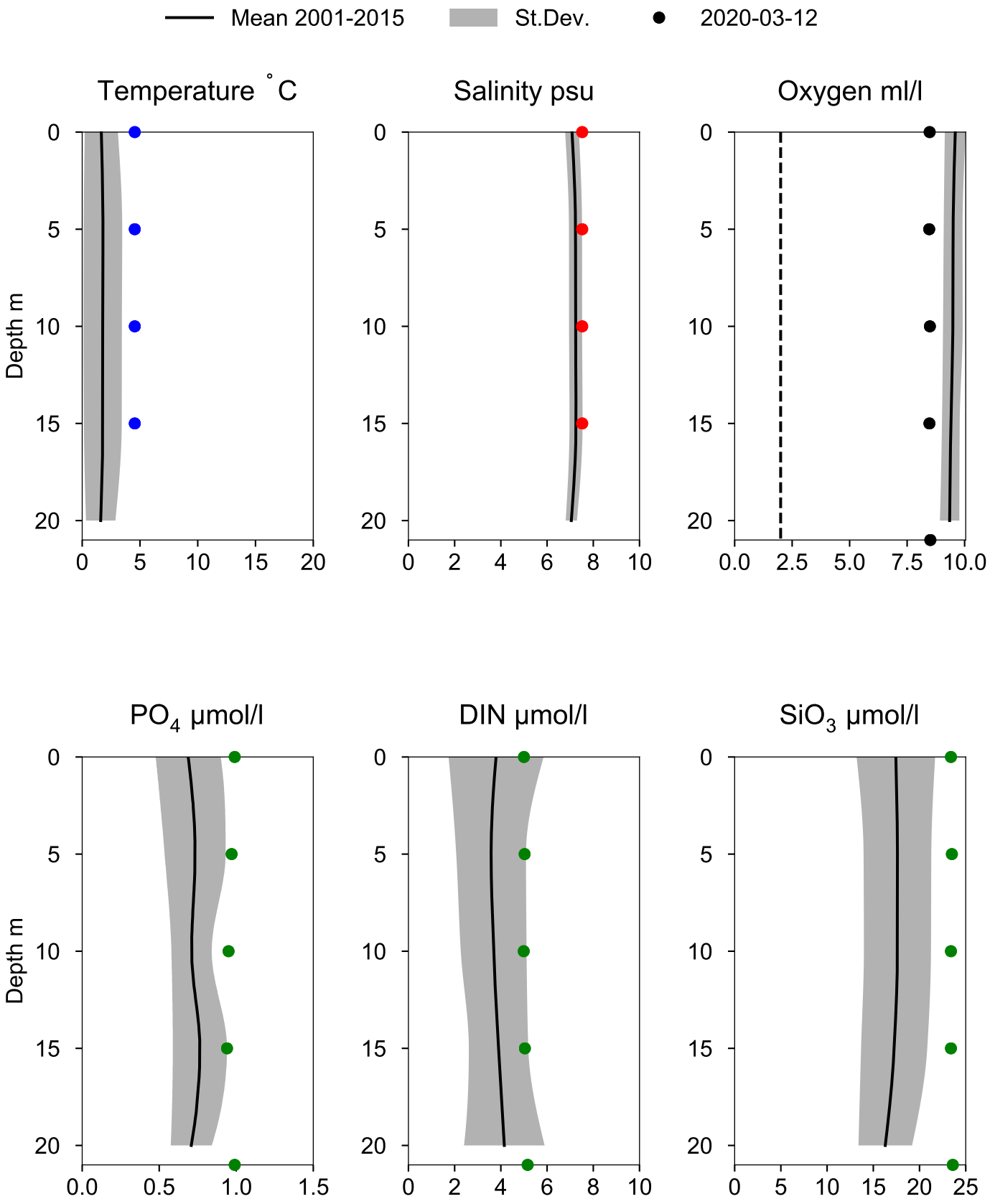
Annual Cycles



OXYGEN IN BOTTOM WATER (depth >= 15 m)

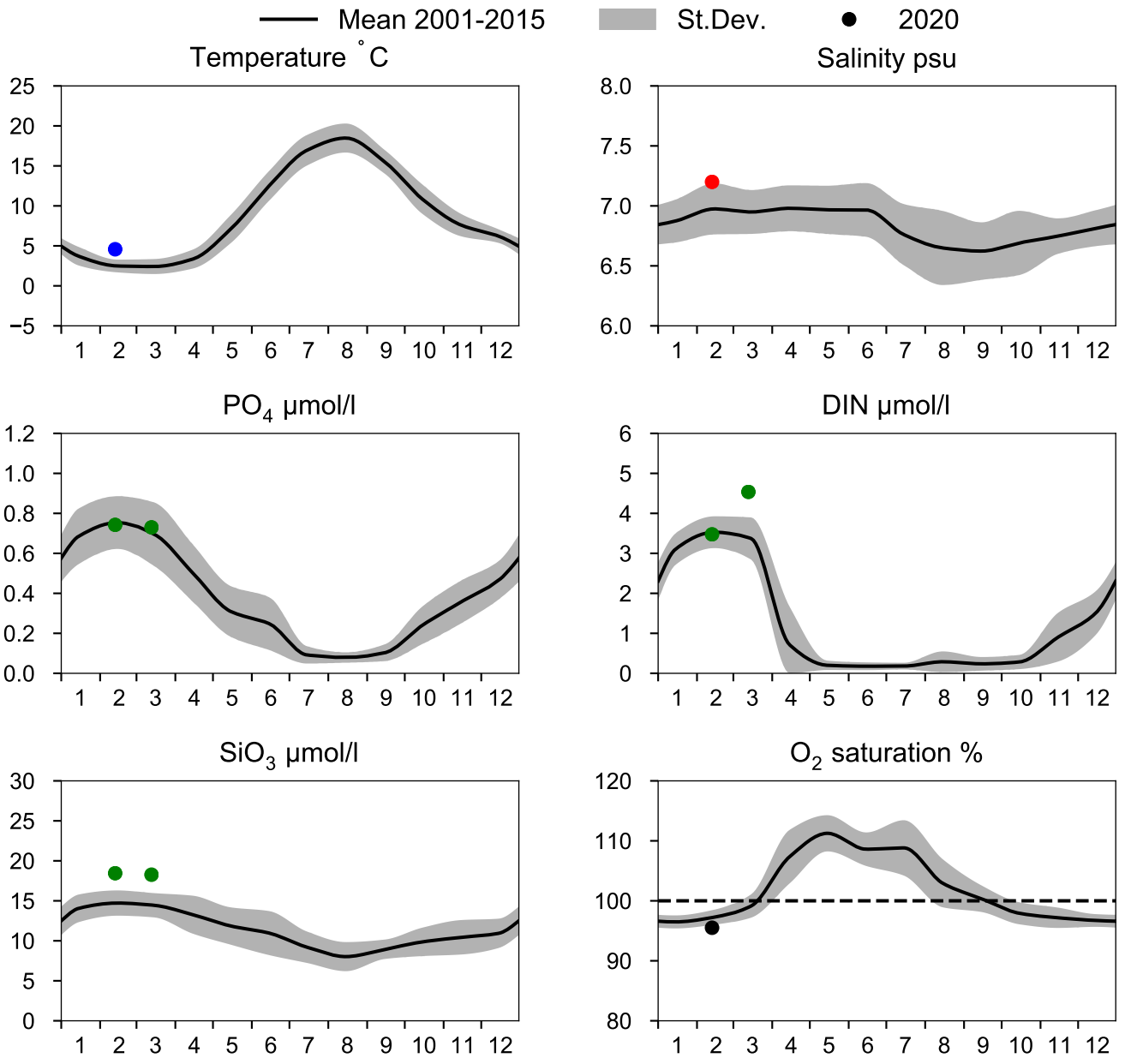


Vertical profiles REF M1V1
March

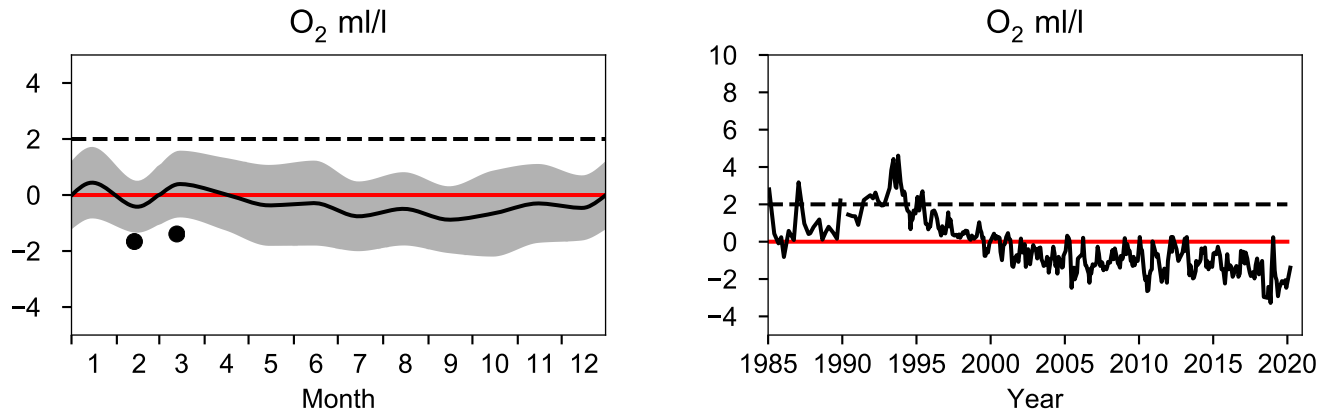


STATION BY38 KARLSÖDJ SURFACE WATER (0-10 m)

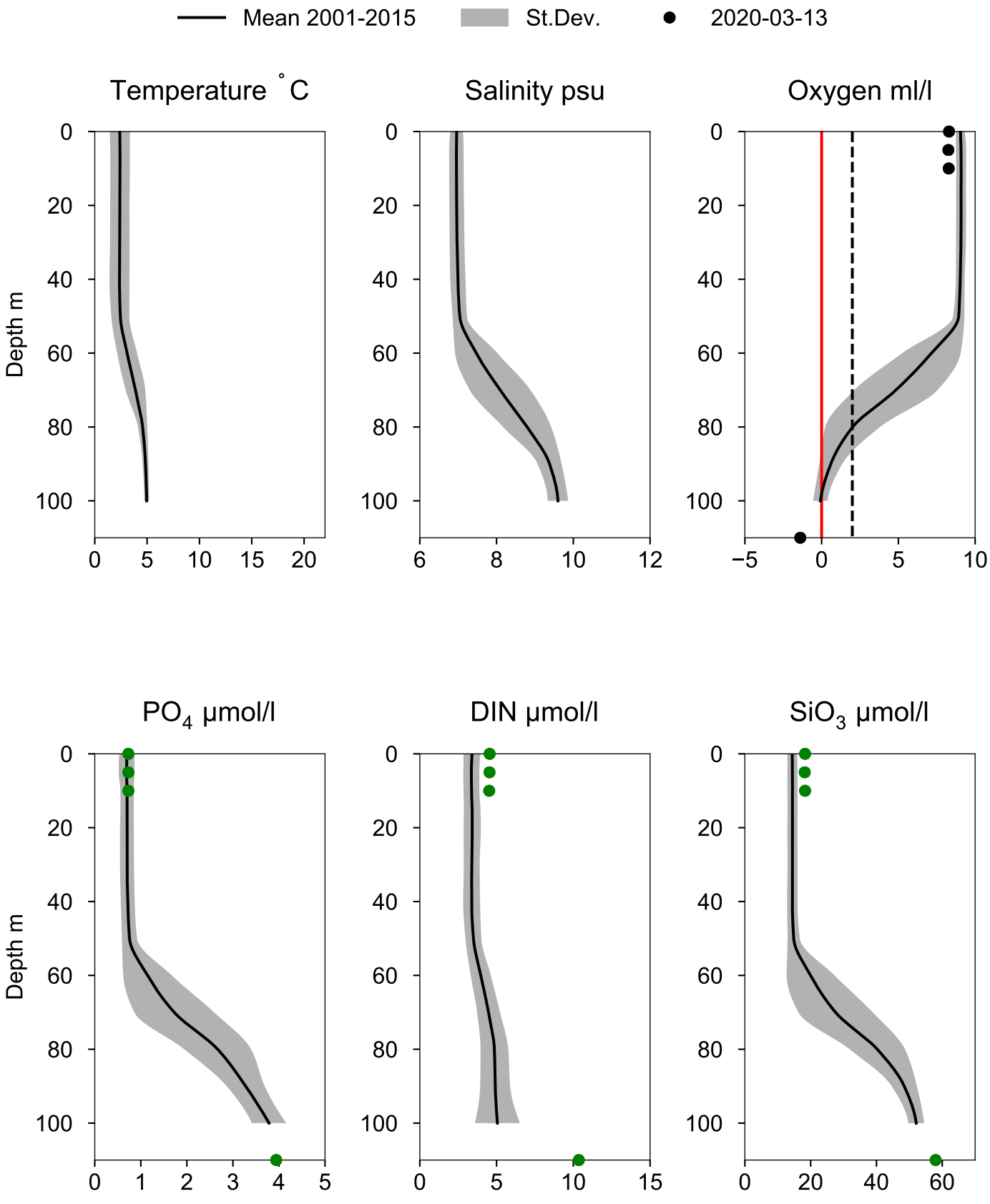
Annual Cycles



OXYGEN IN BOTTOM WATER (depth >= 100 m)

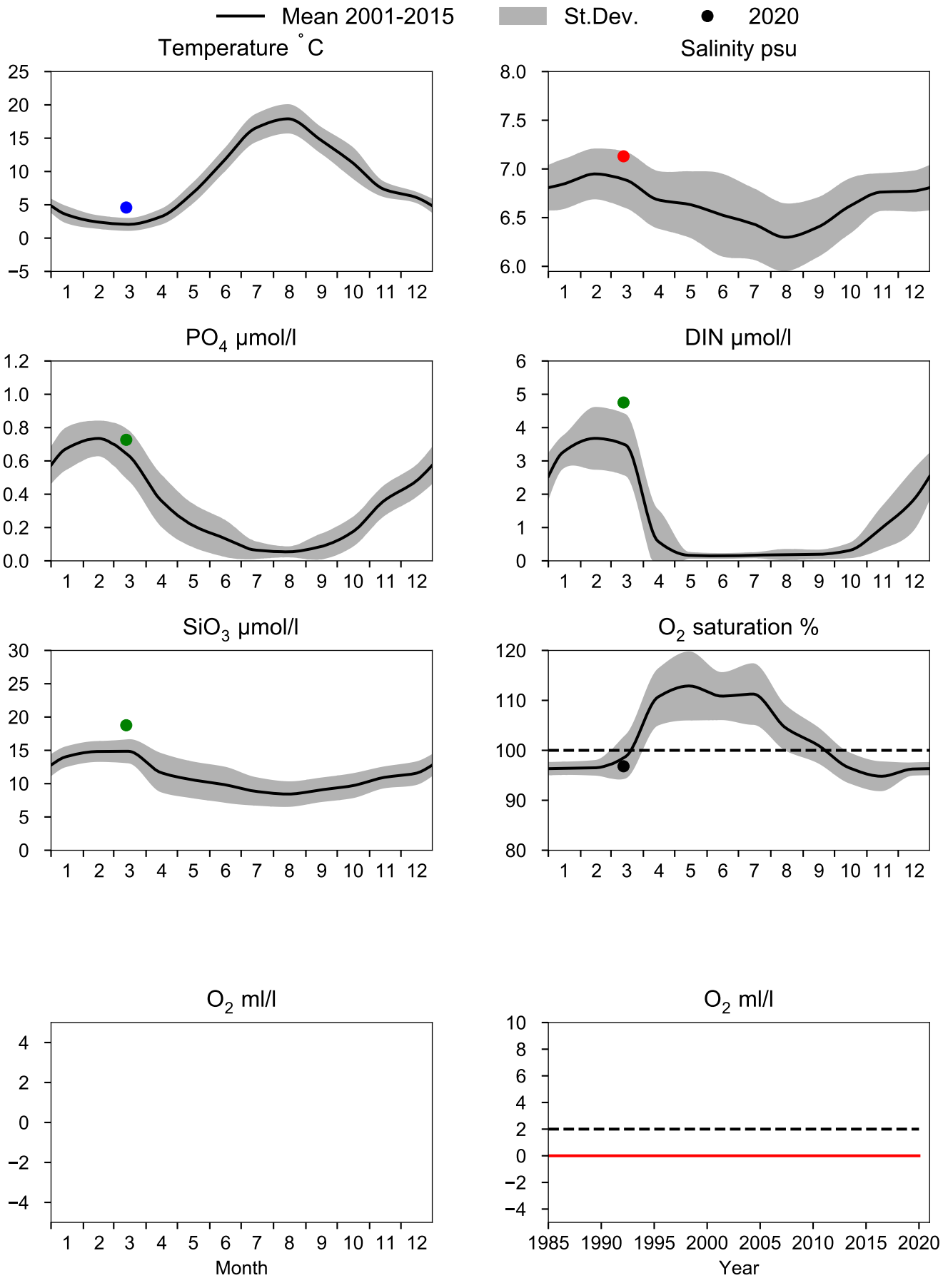


Vertical profiles BY38 KARLSÖDJ
March

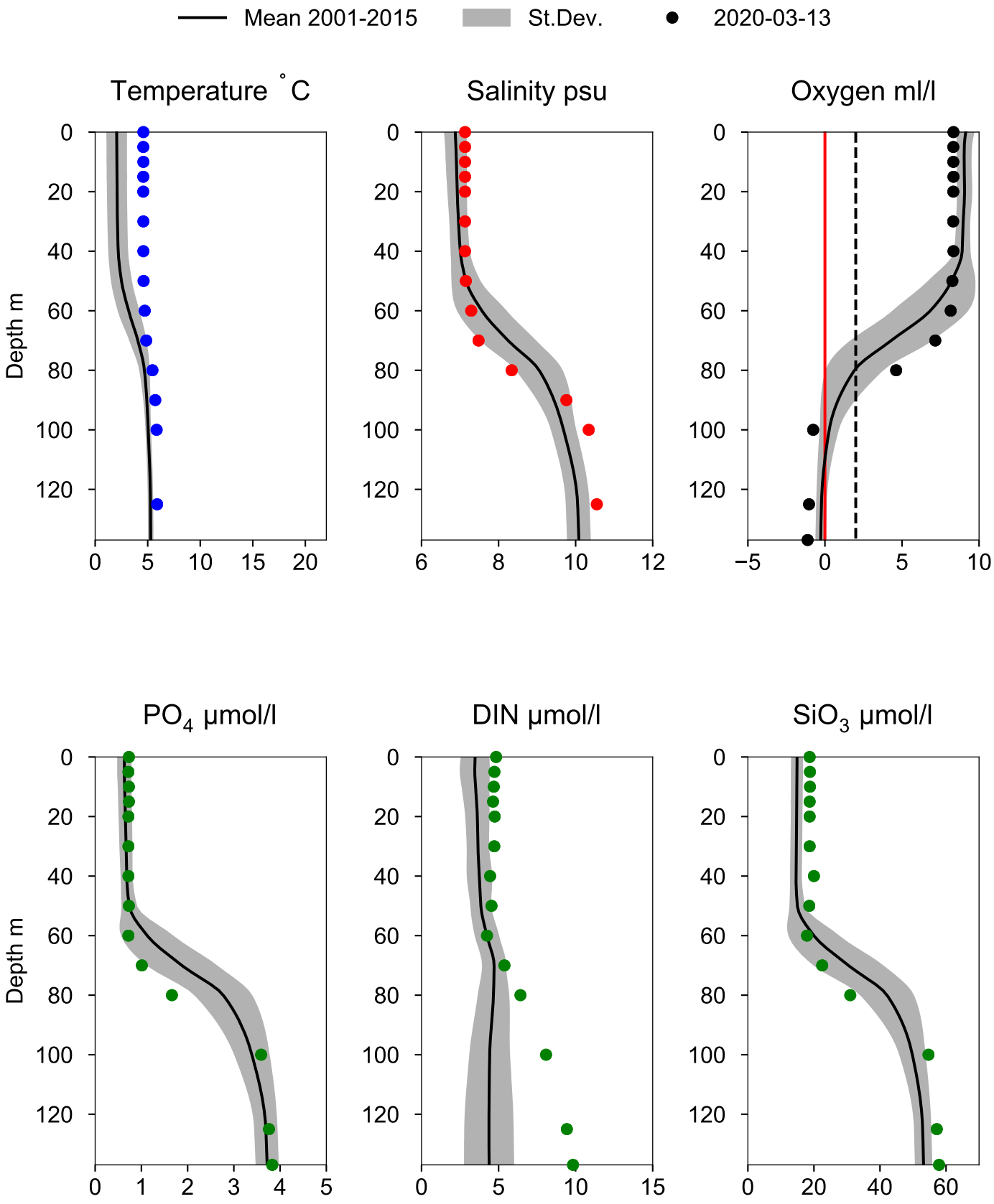


STATION BY36 SURFACE WATER (0-10 m)

Annual Cycles

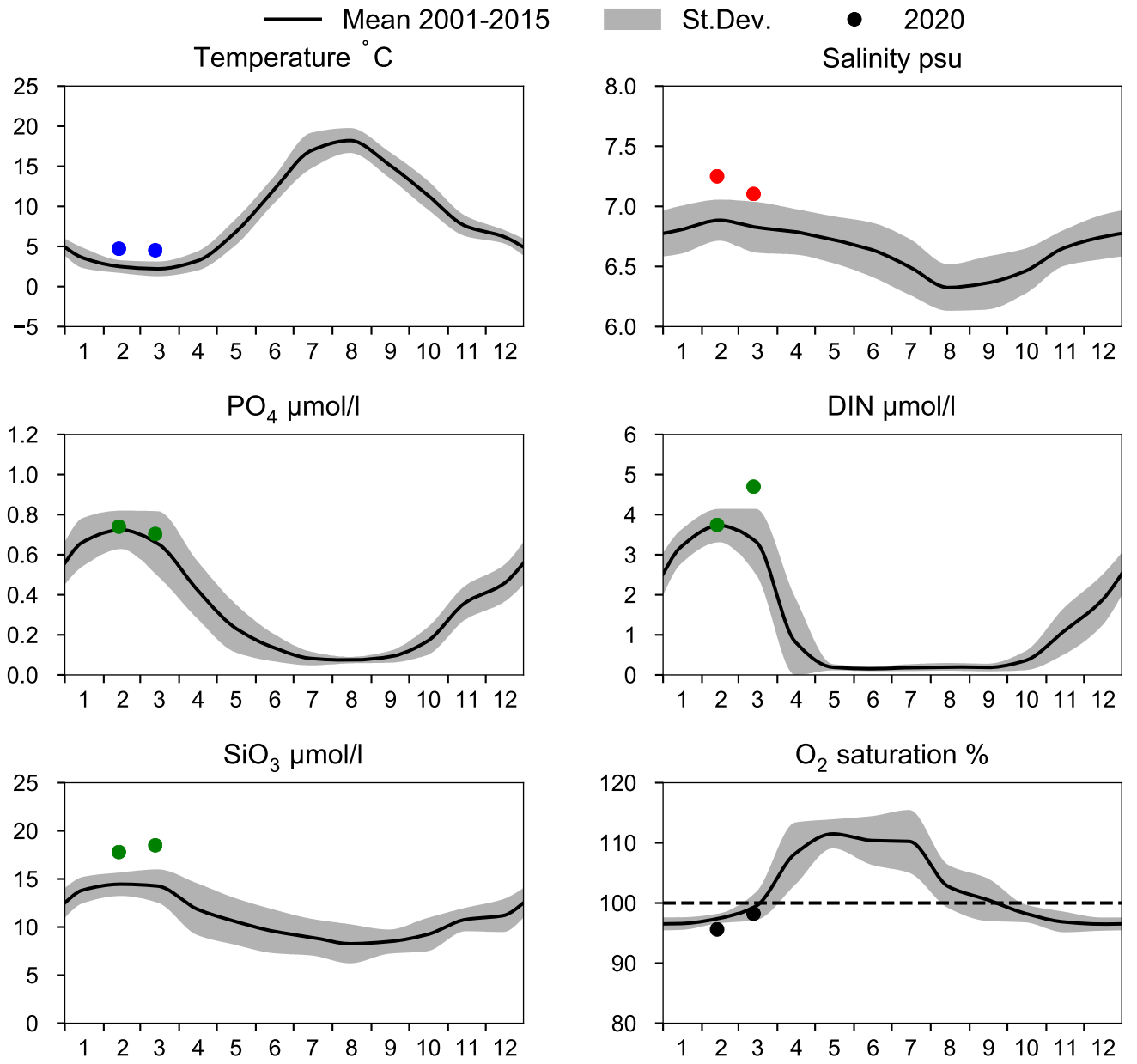


Vertical profiles BY36
March

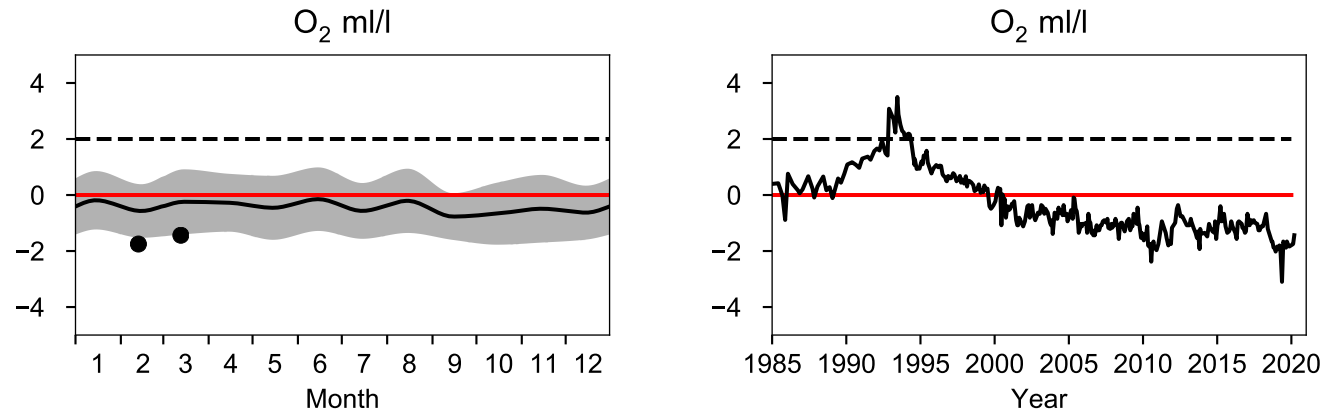


STATION BY32 NORRKÖPINGSDJ SURFACE WATER (0-10 m)

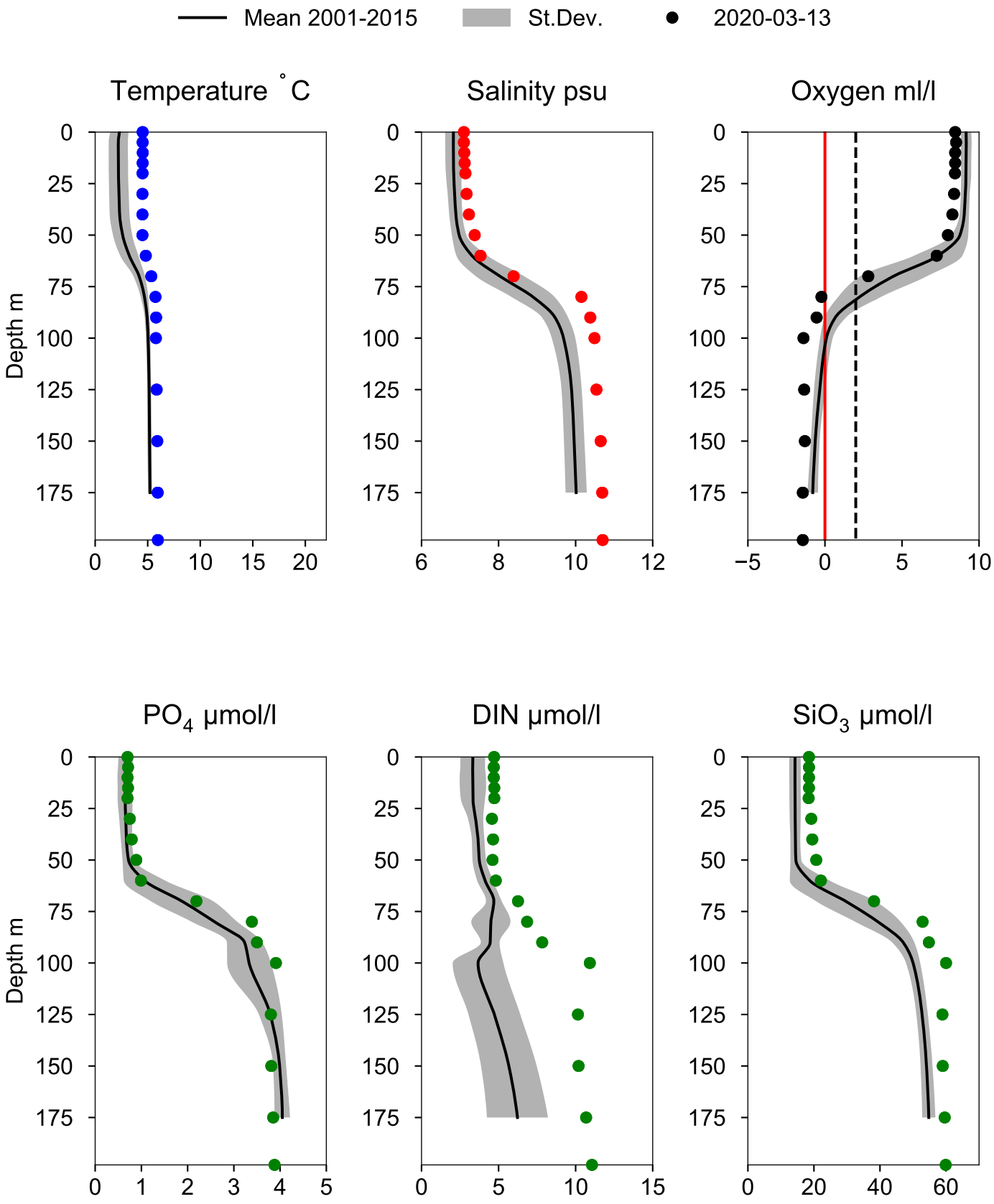
Annual Cycles



OXYGEN IN BOTTOM WATER (depth >= 175 m)

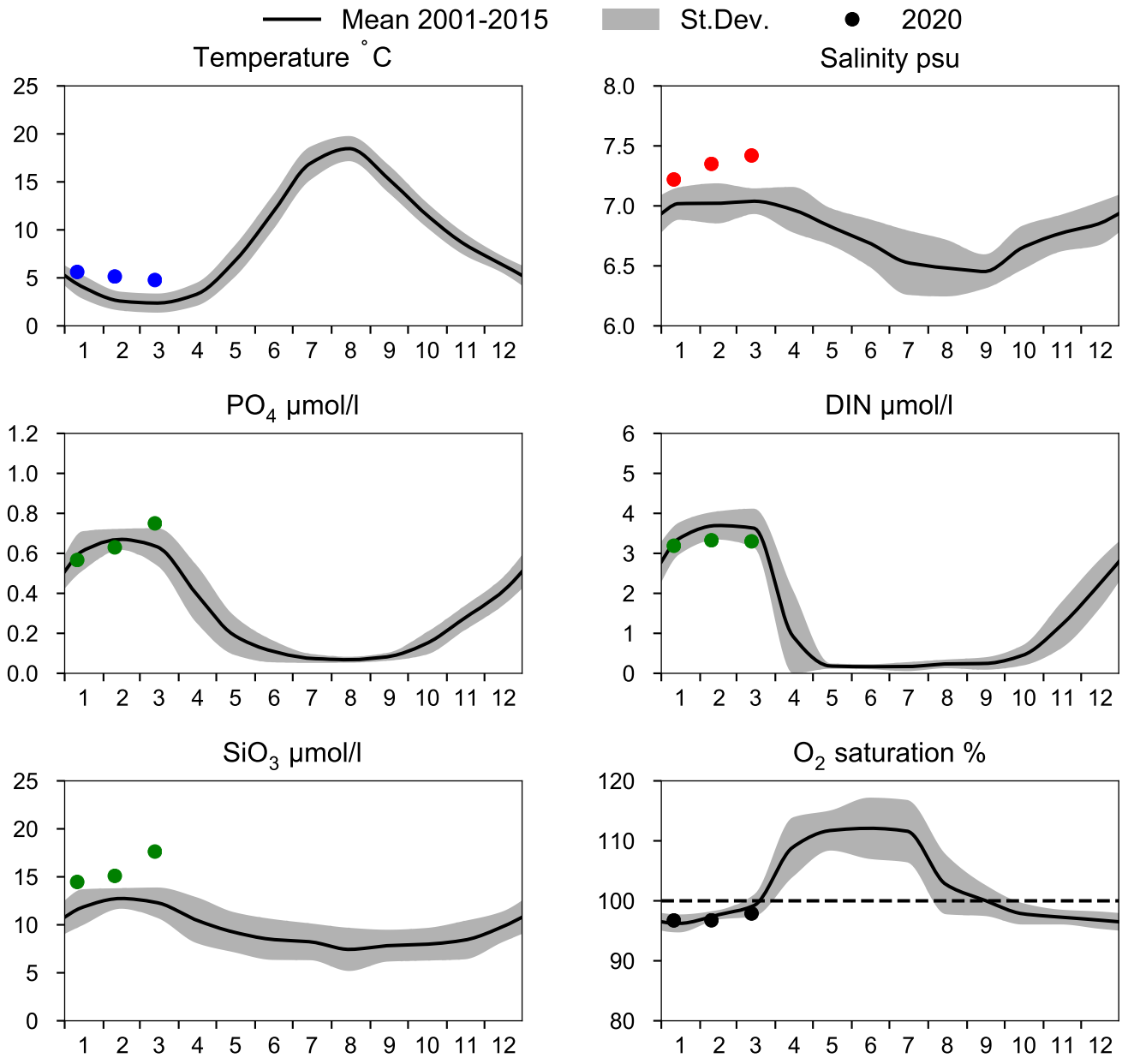


Vertical profiles BY32 NORRKÖPINGSDJ
March

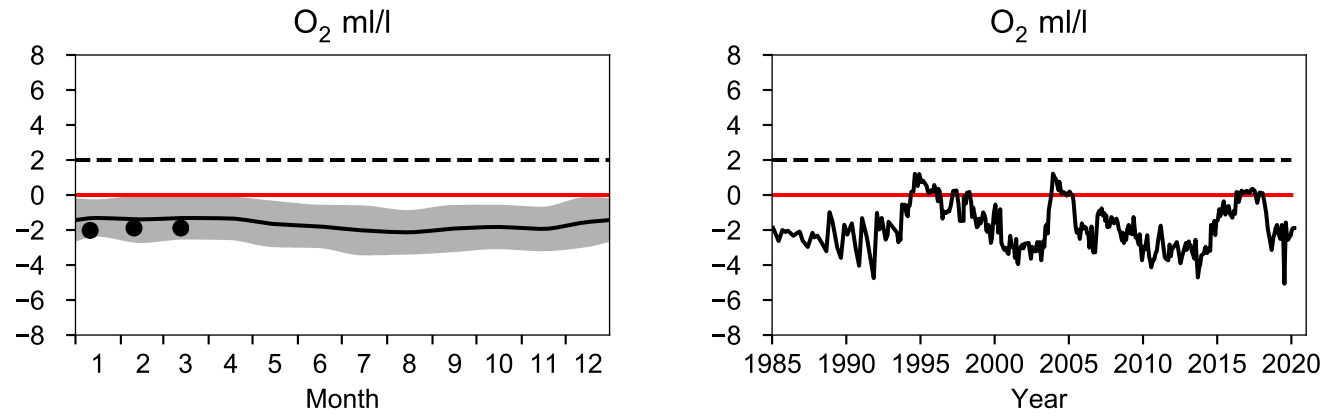


STATION BY20 FÅRÖDJ SURFACE WATER (0-10 m)

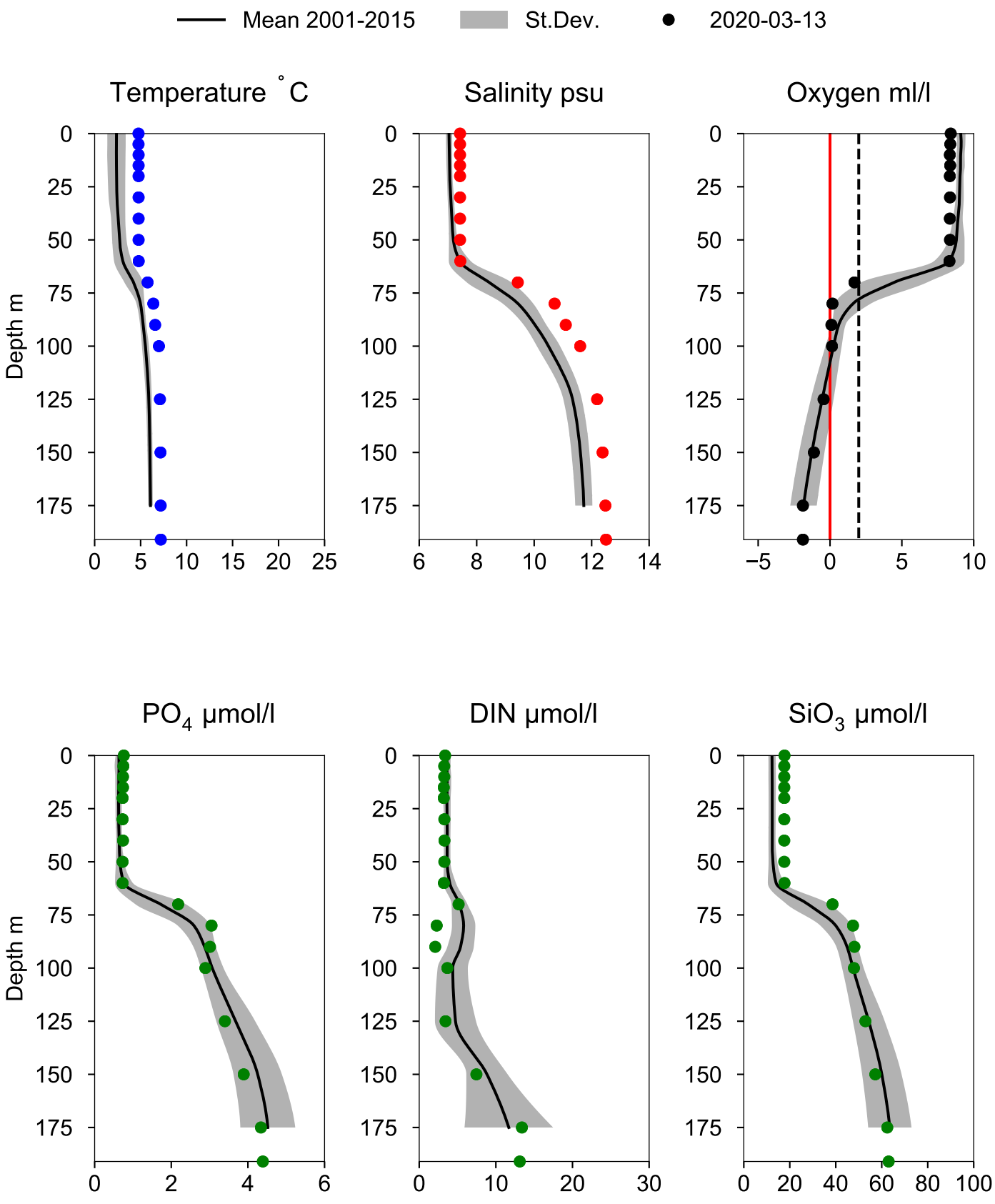
Annual Cycles



OXYGEN IN BOTTOM WATER (depth >= 175 m)

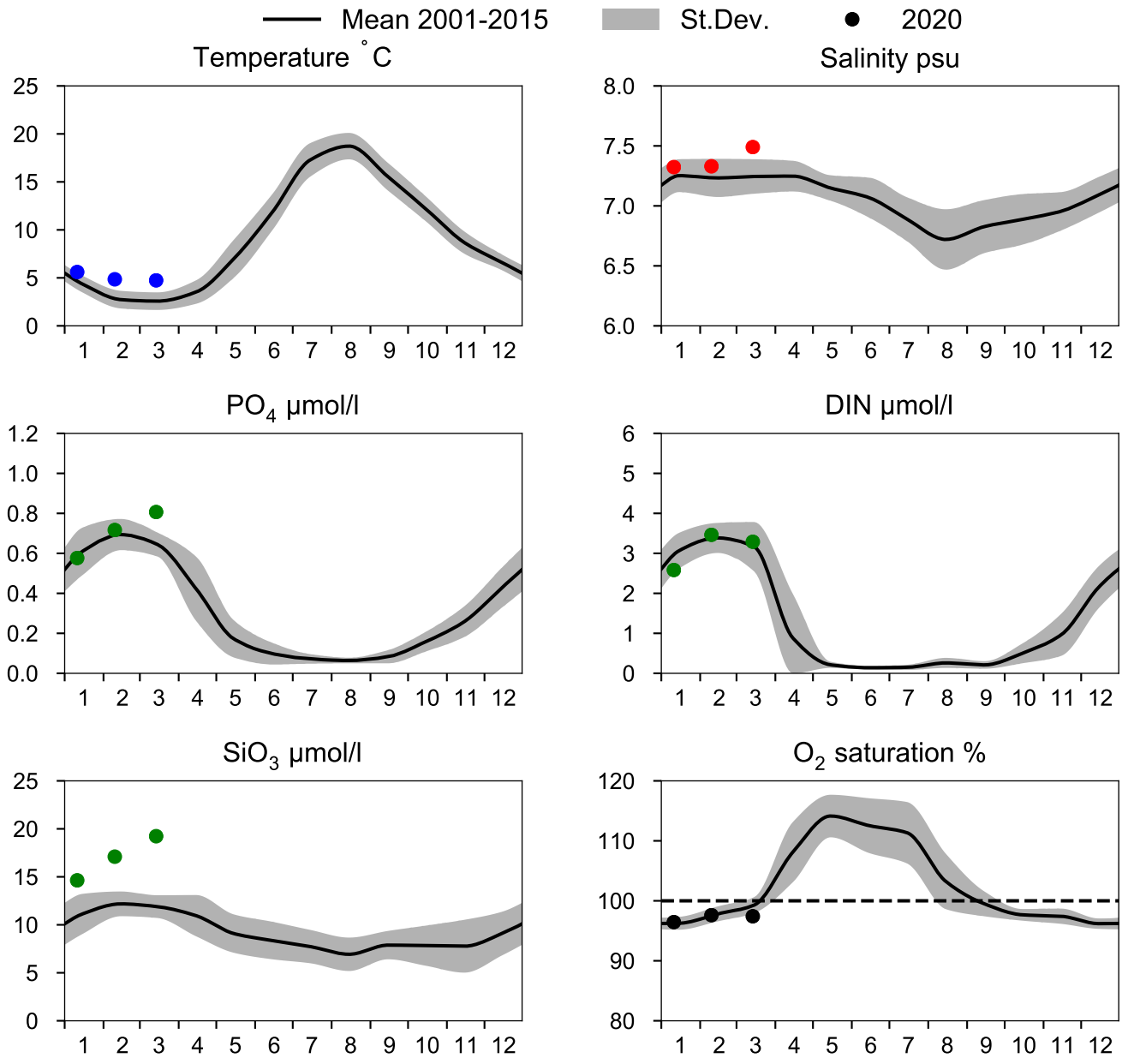


Vertical profiles BY20 FÅRÖDJ
March

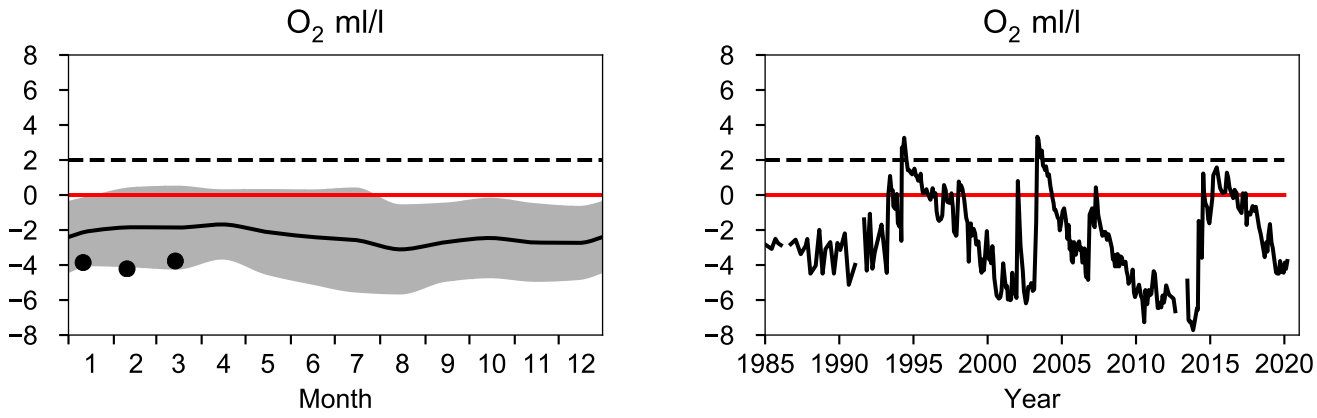


STATION BY15 GOTLANDSDJ SURFACE WATER (0-10 m)

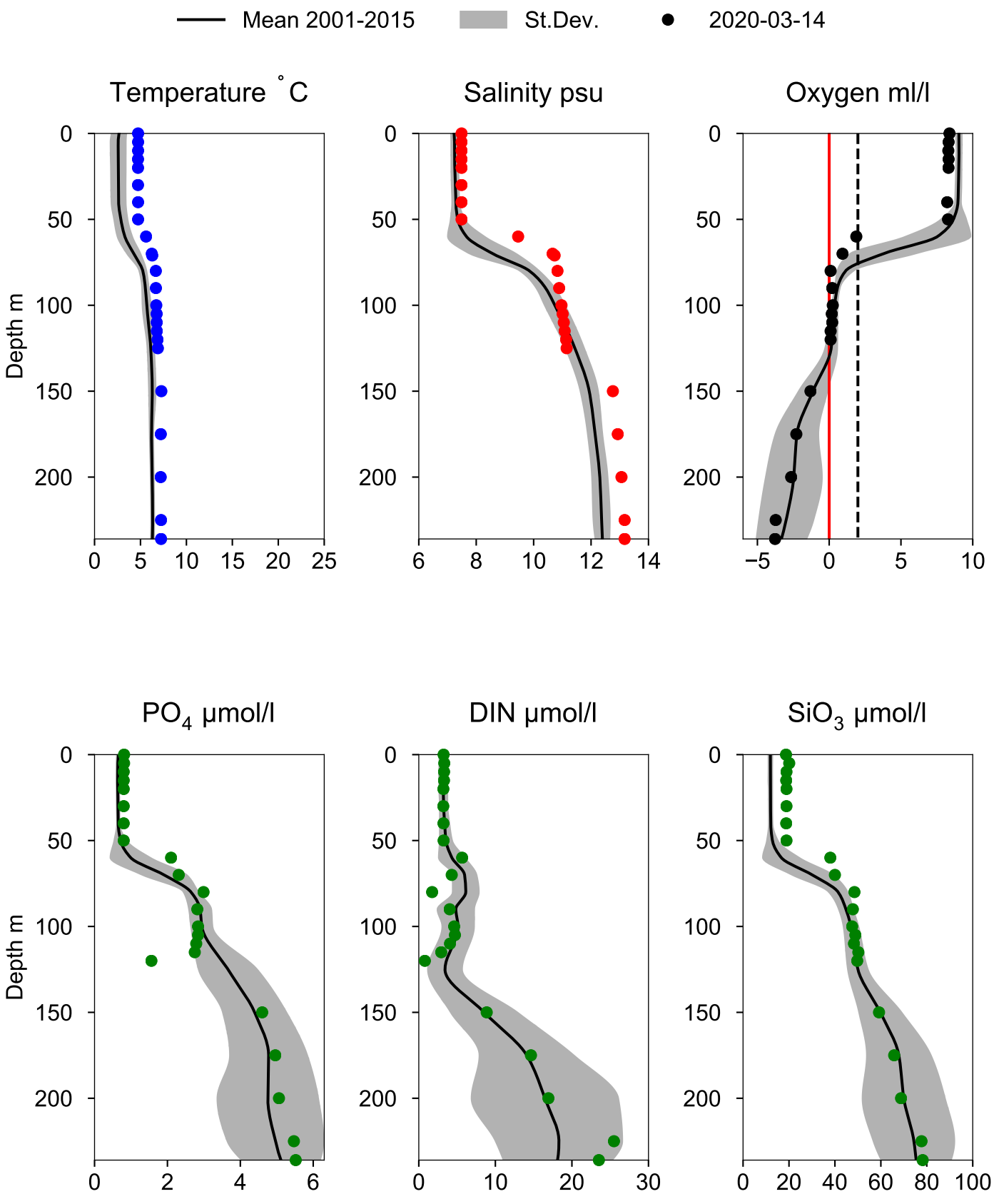
Annual Cycles



OXYGEN IN BOTTOM WATER (depth >= 225 m)

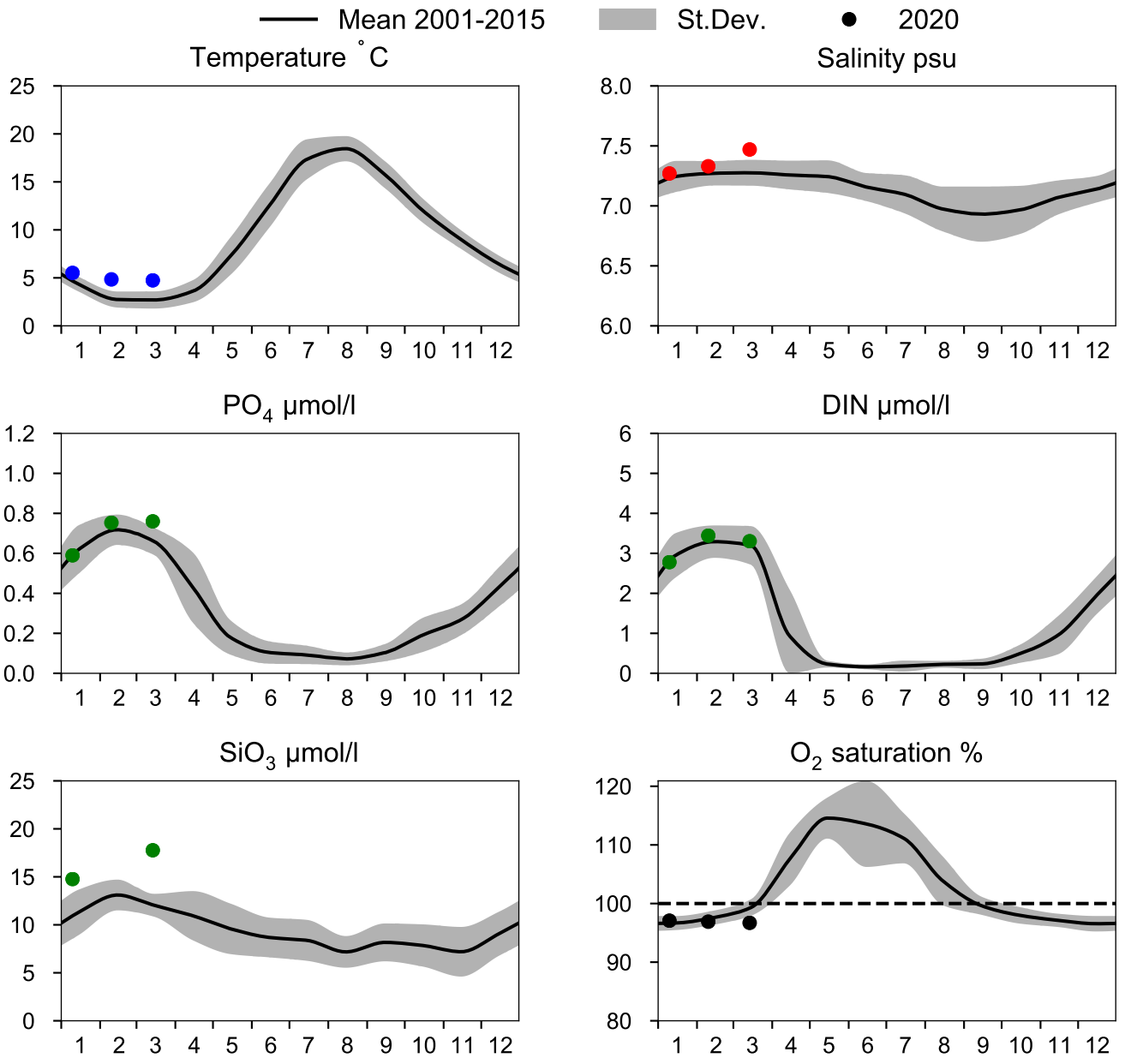


Vertical profiles BY15 GOTLANDSDJ
March

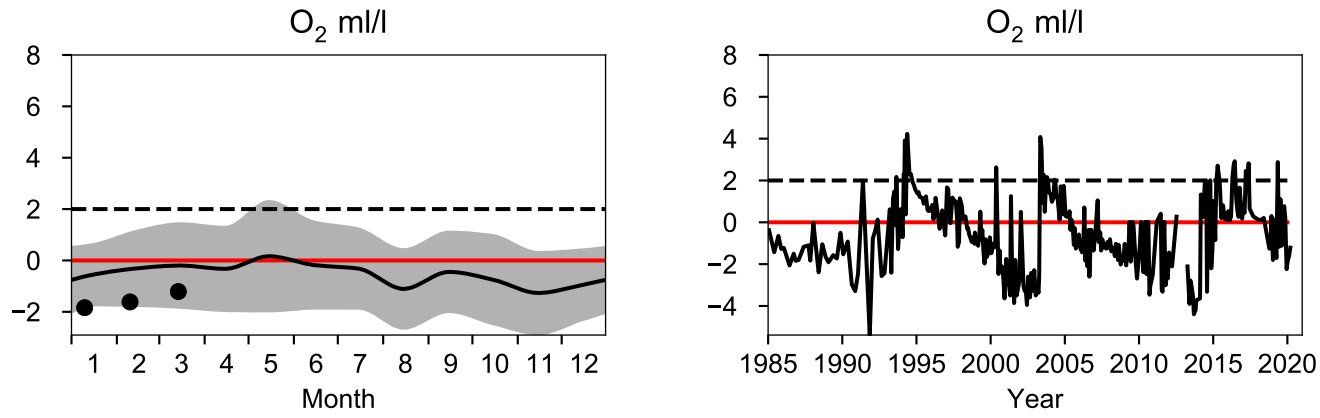


STATION BY10 SURFACE WATER (0-10 m)

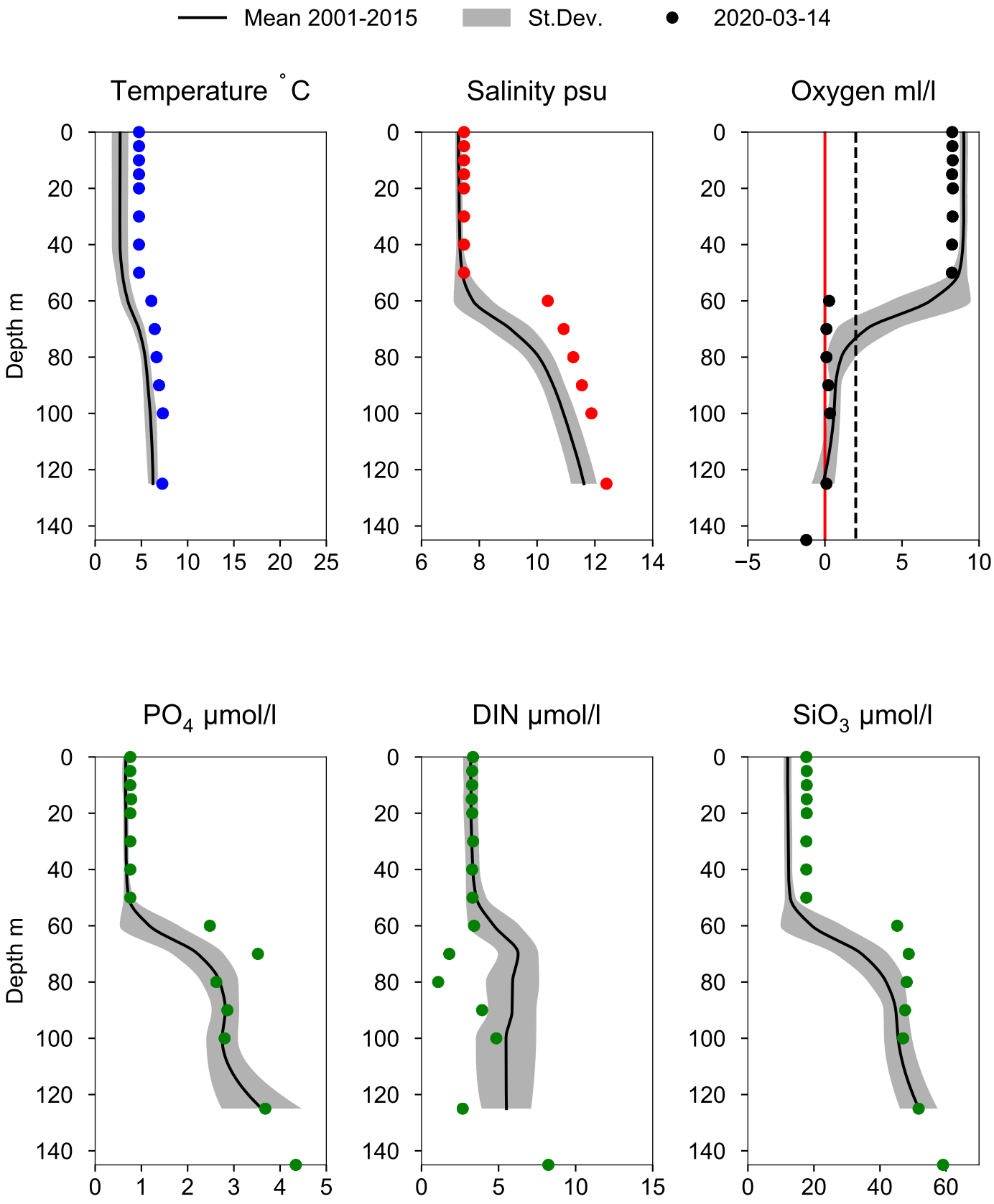
Annual Cycles



OXYGEN IN BOTTOM WATER (depth >= 125 m)

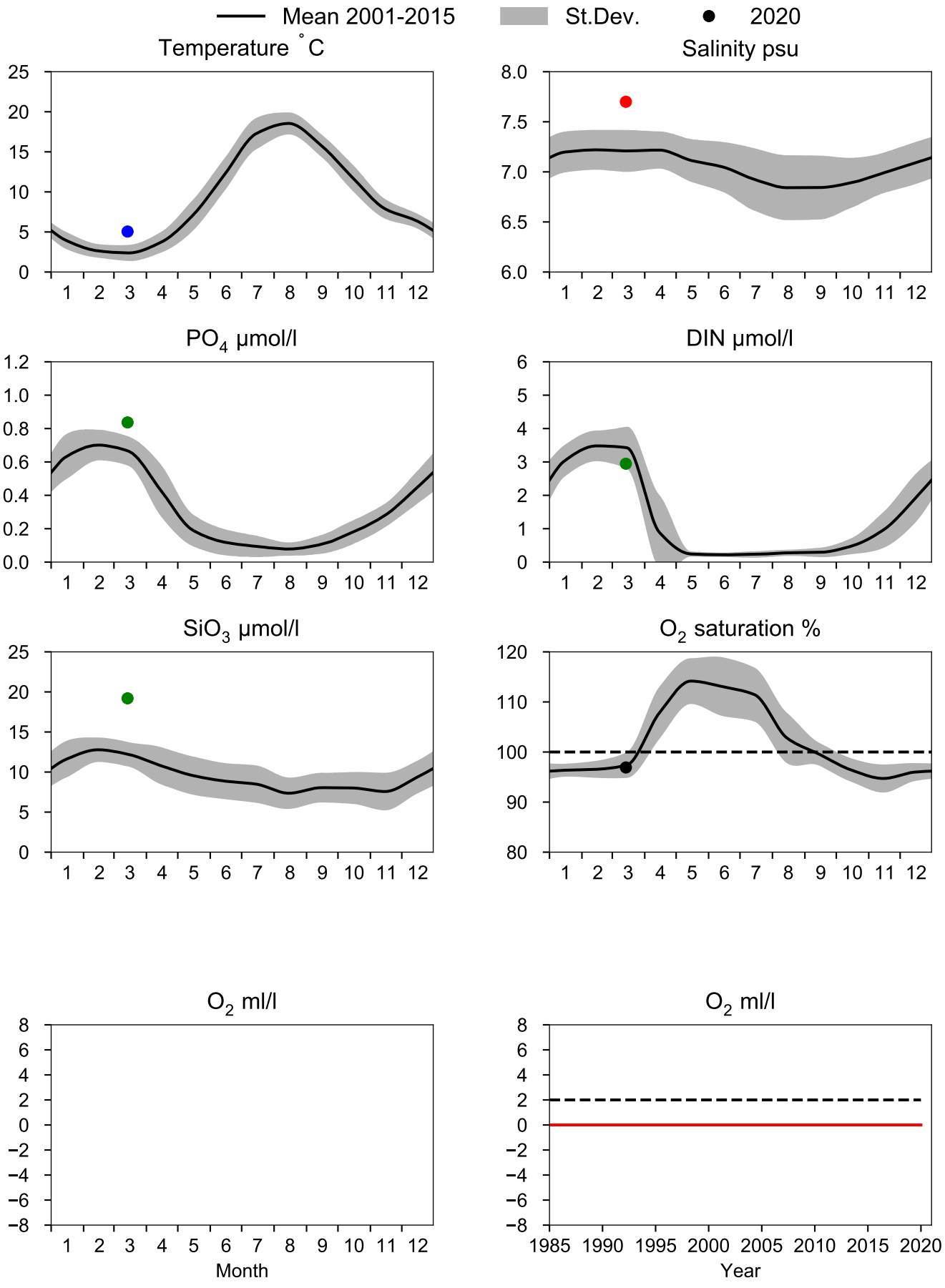


Vertical profiles BY10
March

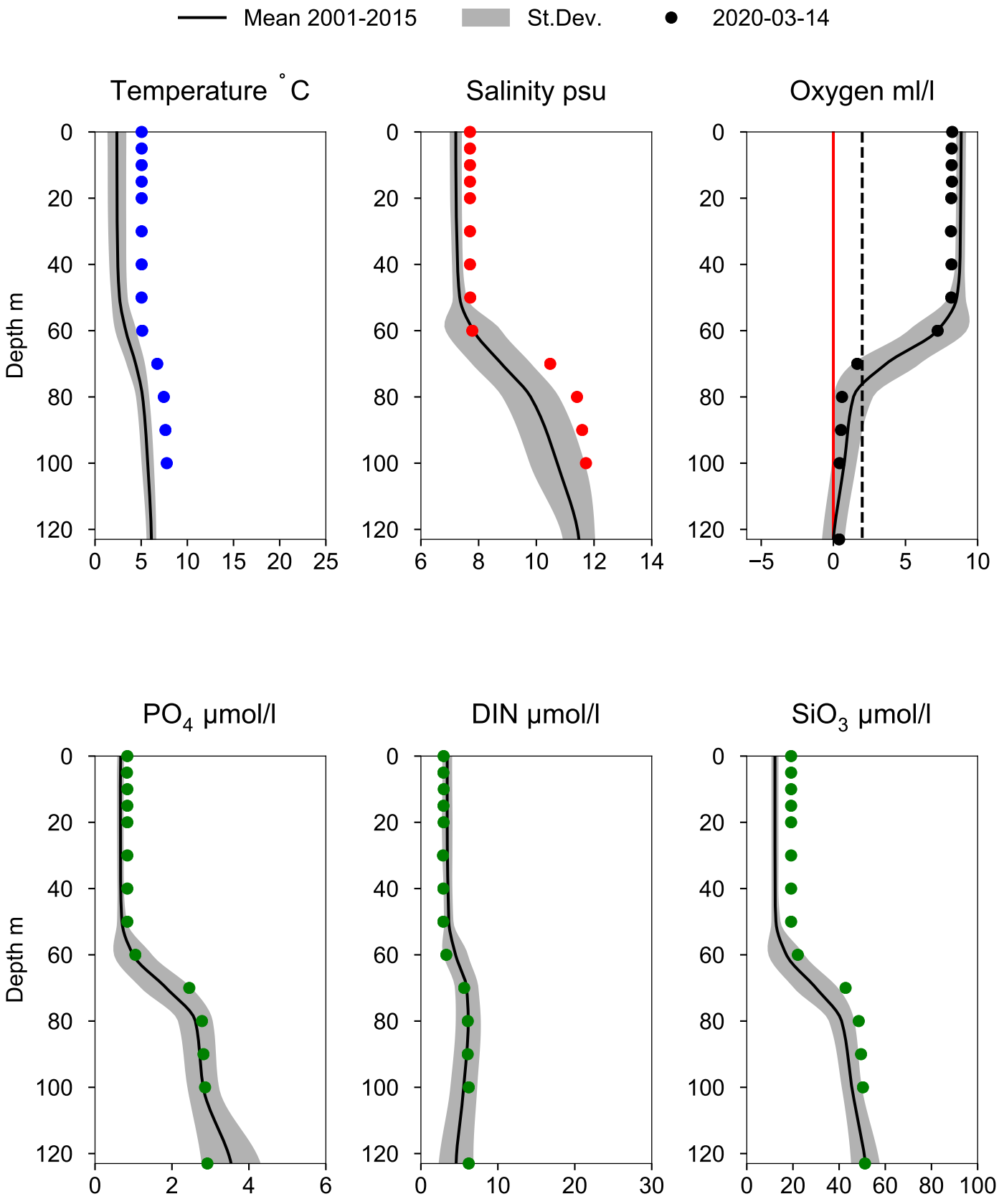


STATION BY9 KLAIPEDA SURFACE WATER (0-10 m)

Annual Cycles

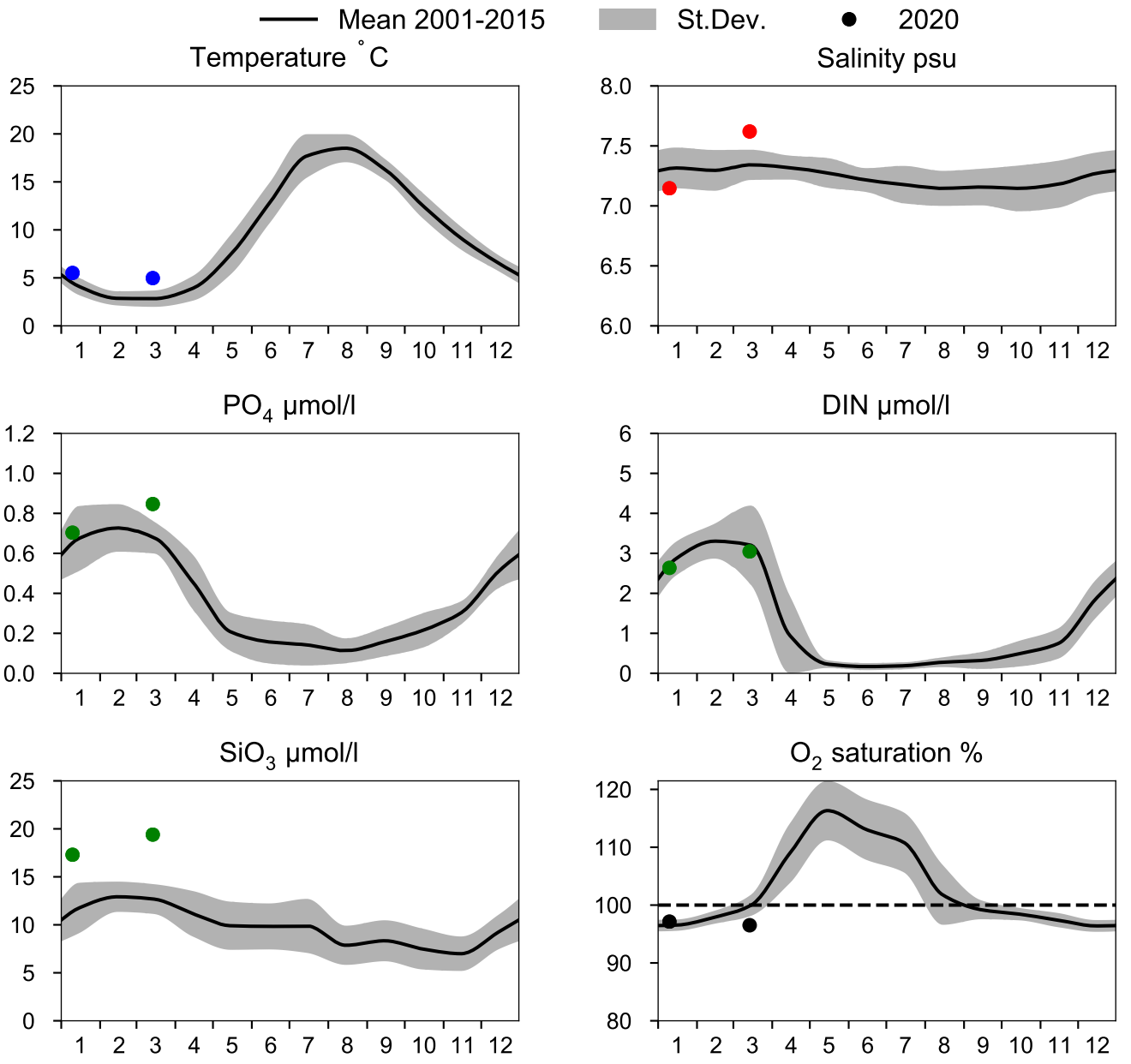


Vertical profiles BY9 KLAIPEDA
March

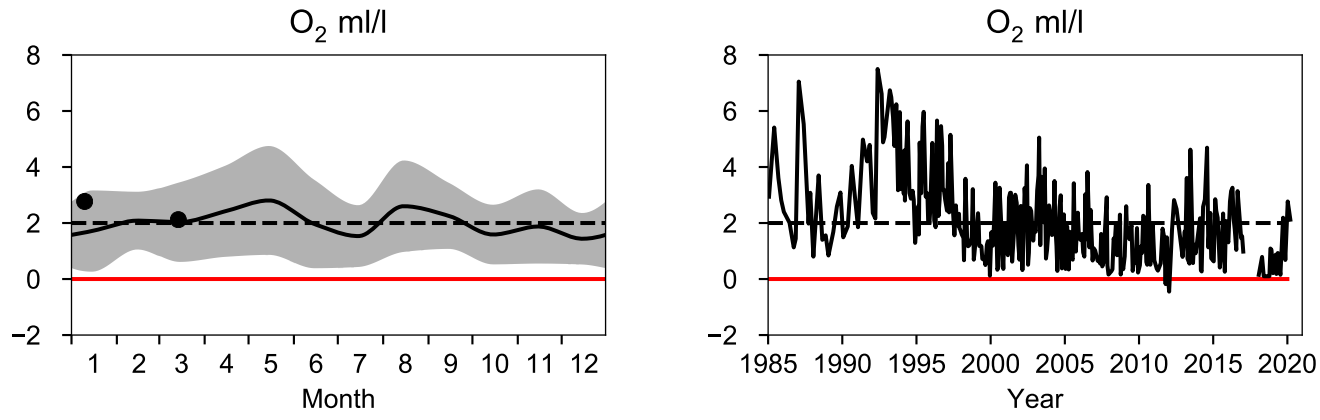


STATION BCS III-10 SURFACE WATER (0-10 m)

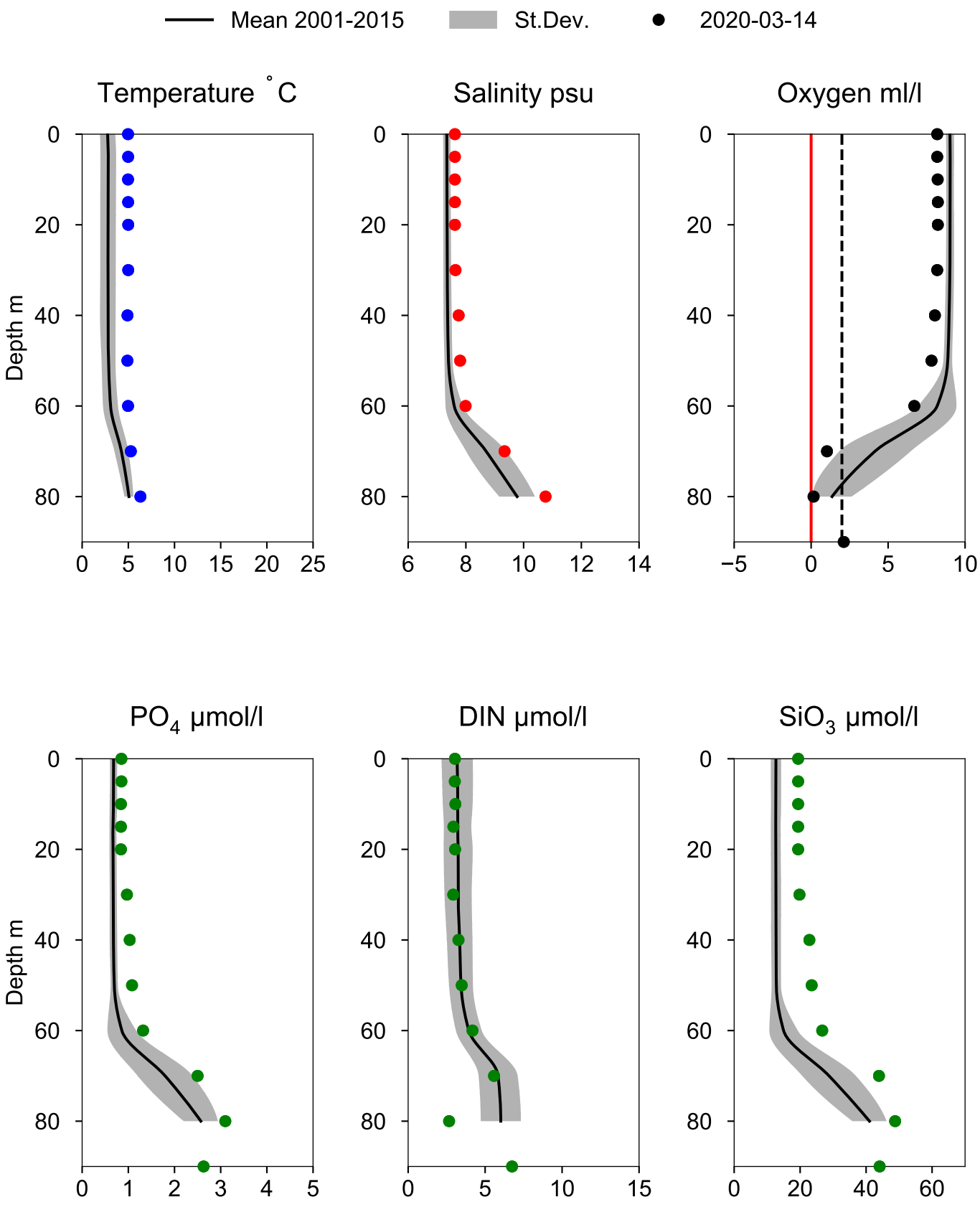
Annual Cycles



OXYGEN IN BOTTOM WATER (depth >= 80 m)

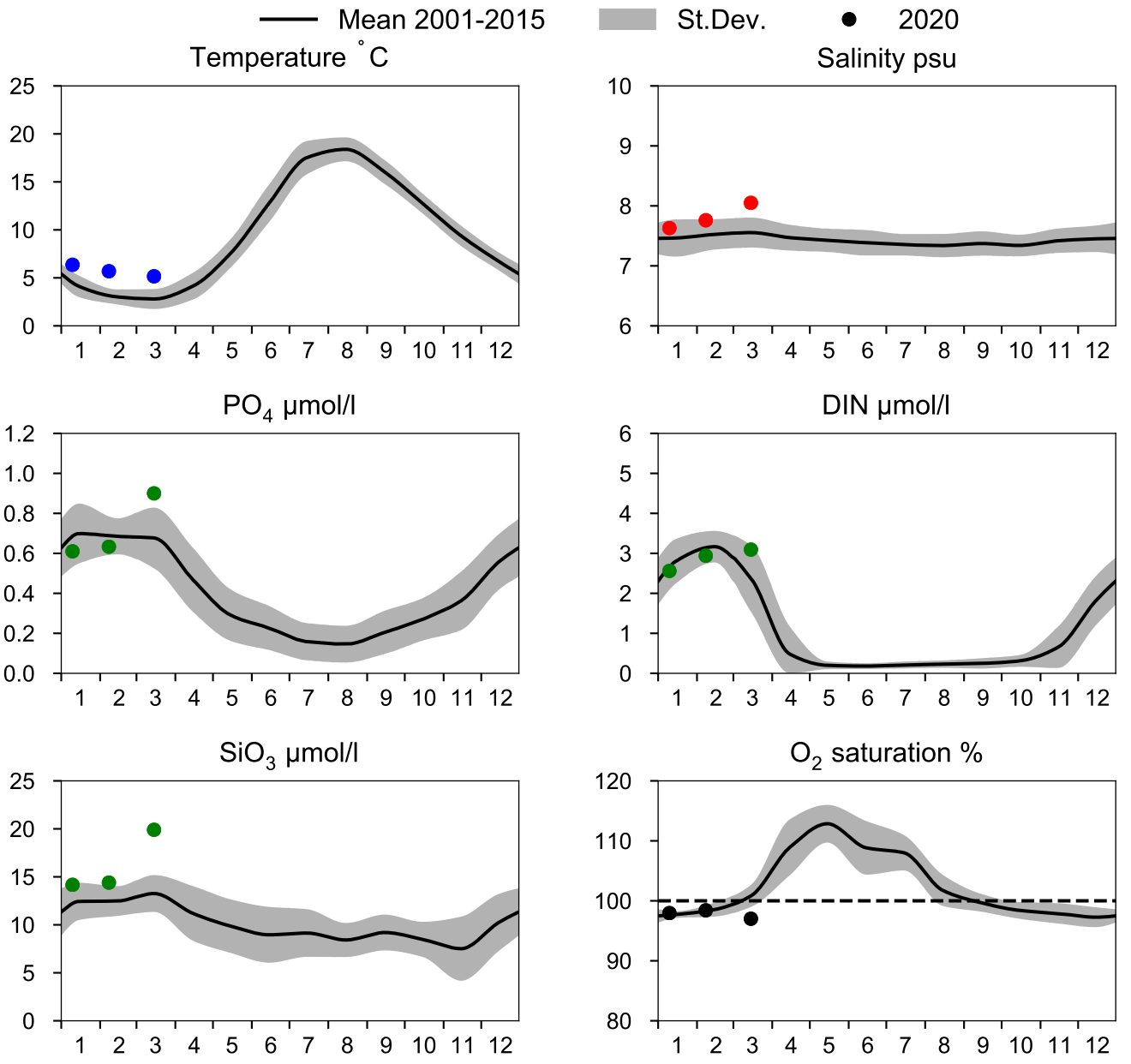


Vertical profiles BCS III-10
March

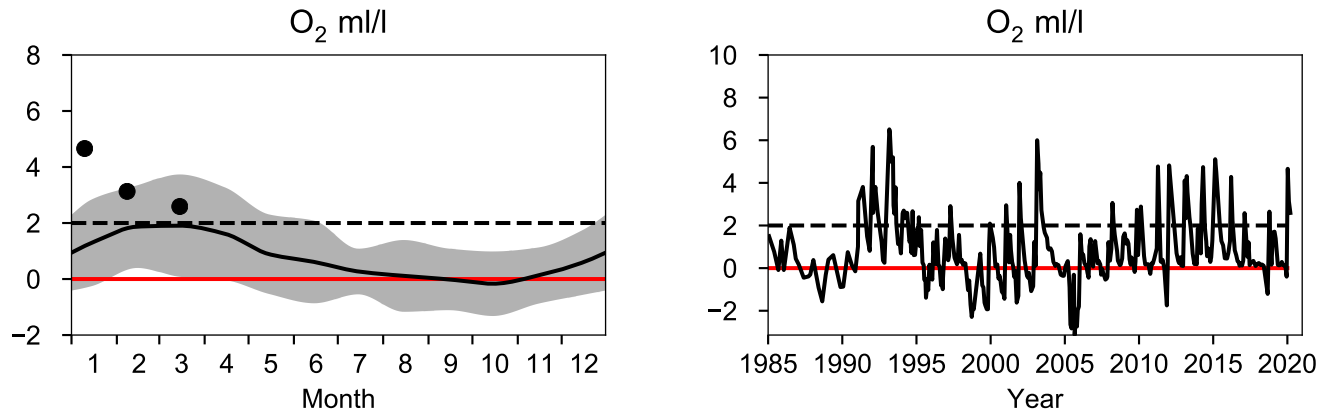


STATION BY5 BORNHOLMSDJ SURFACE WATER (0-10 m)

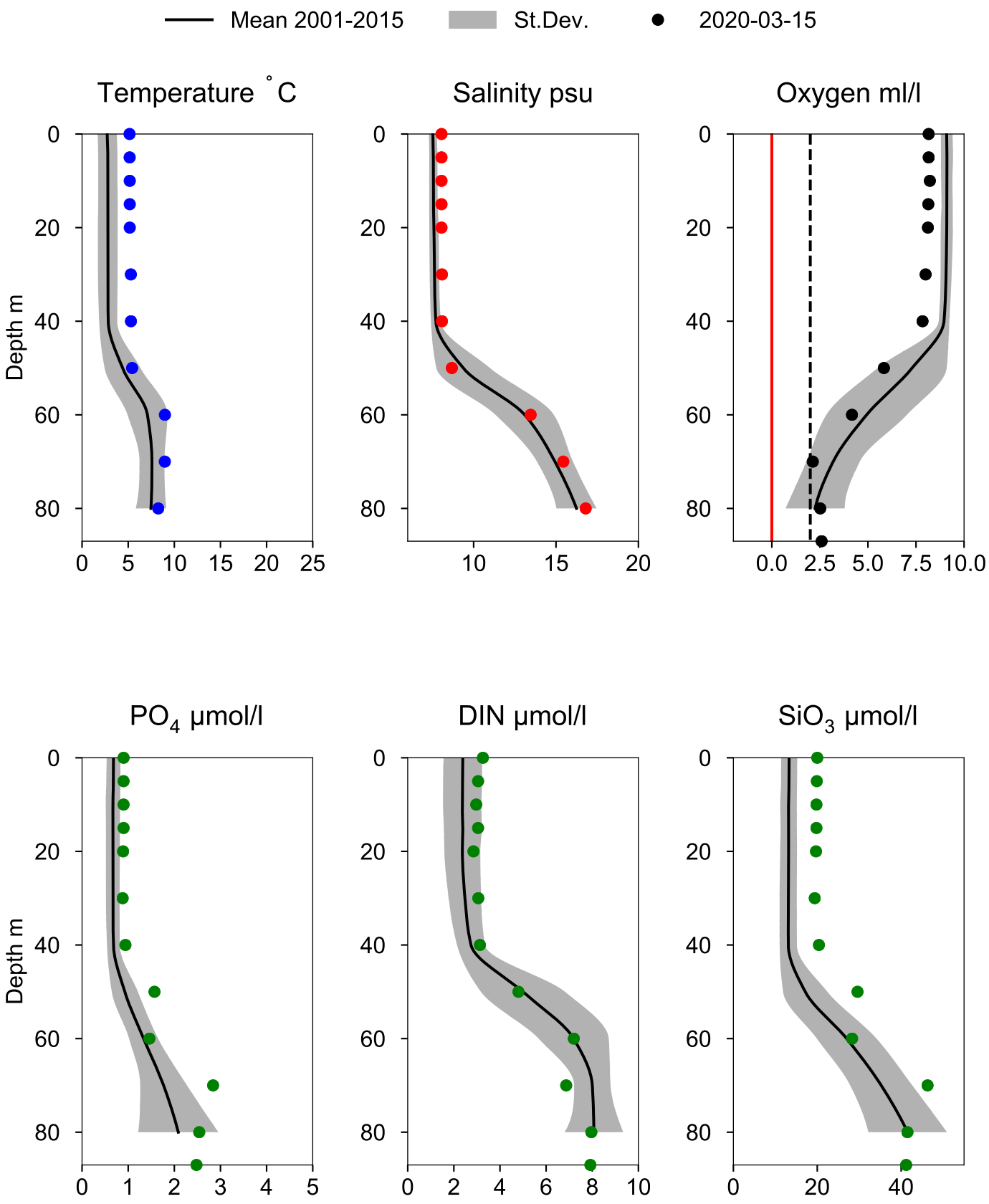
Annual Cycles



OXYGEN IN BOTTOM WATER (depth >= 80 m)

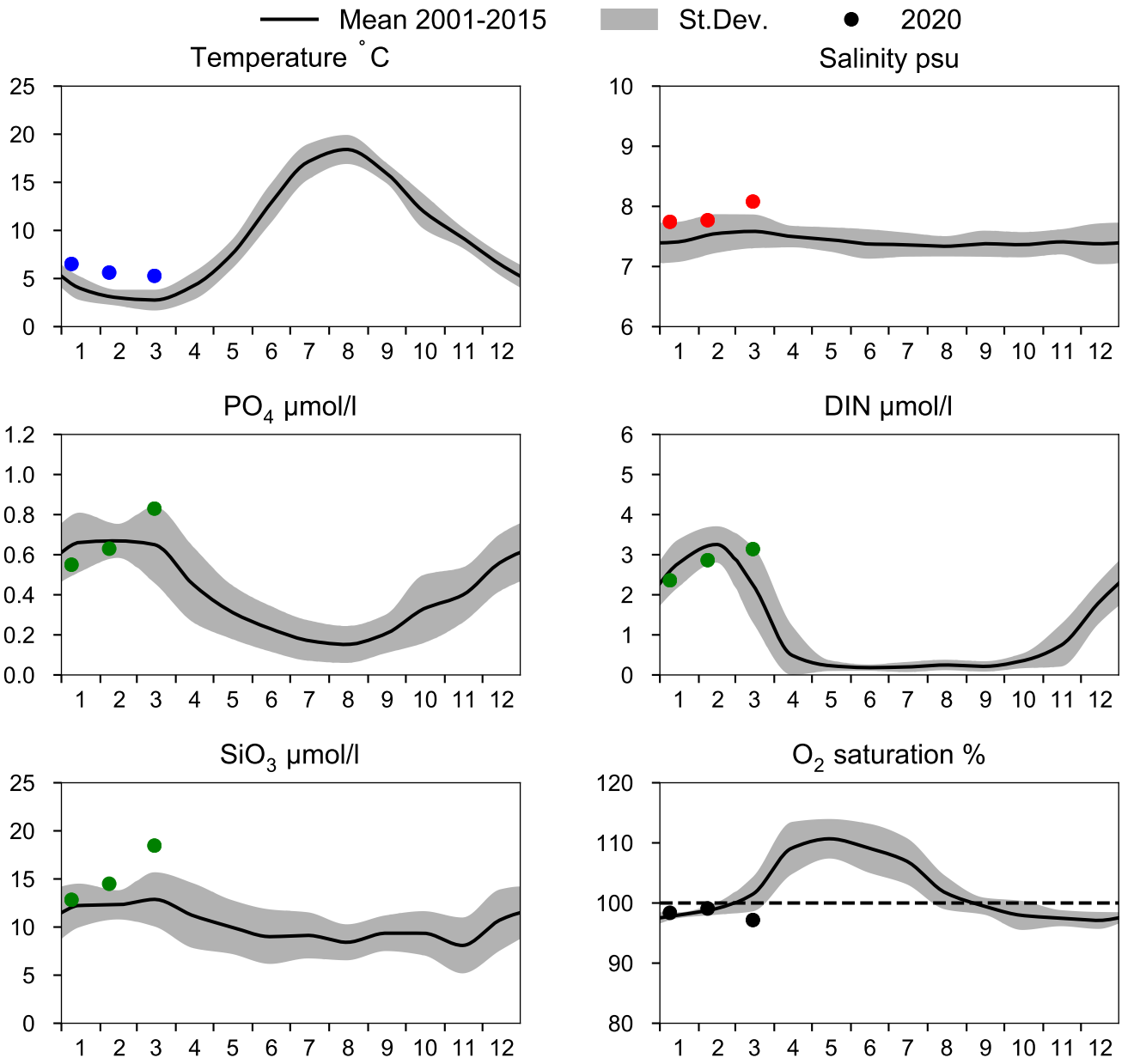


Vertical profiles BY5 BORNHOLMSDJ
March

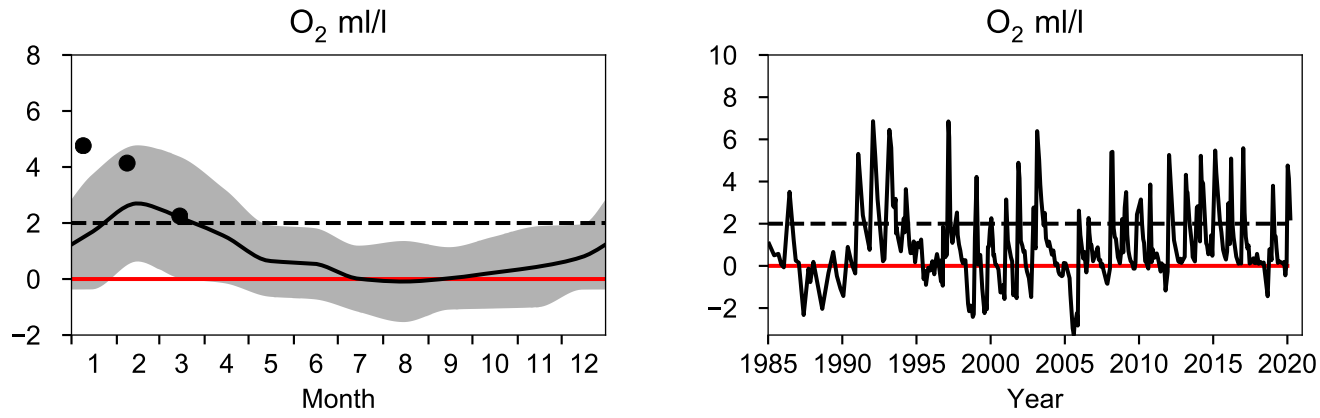


STATION BY4 CHRISTIANSÖ SURFACE WATER (0-10 m)

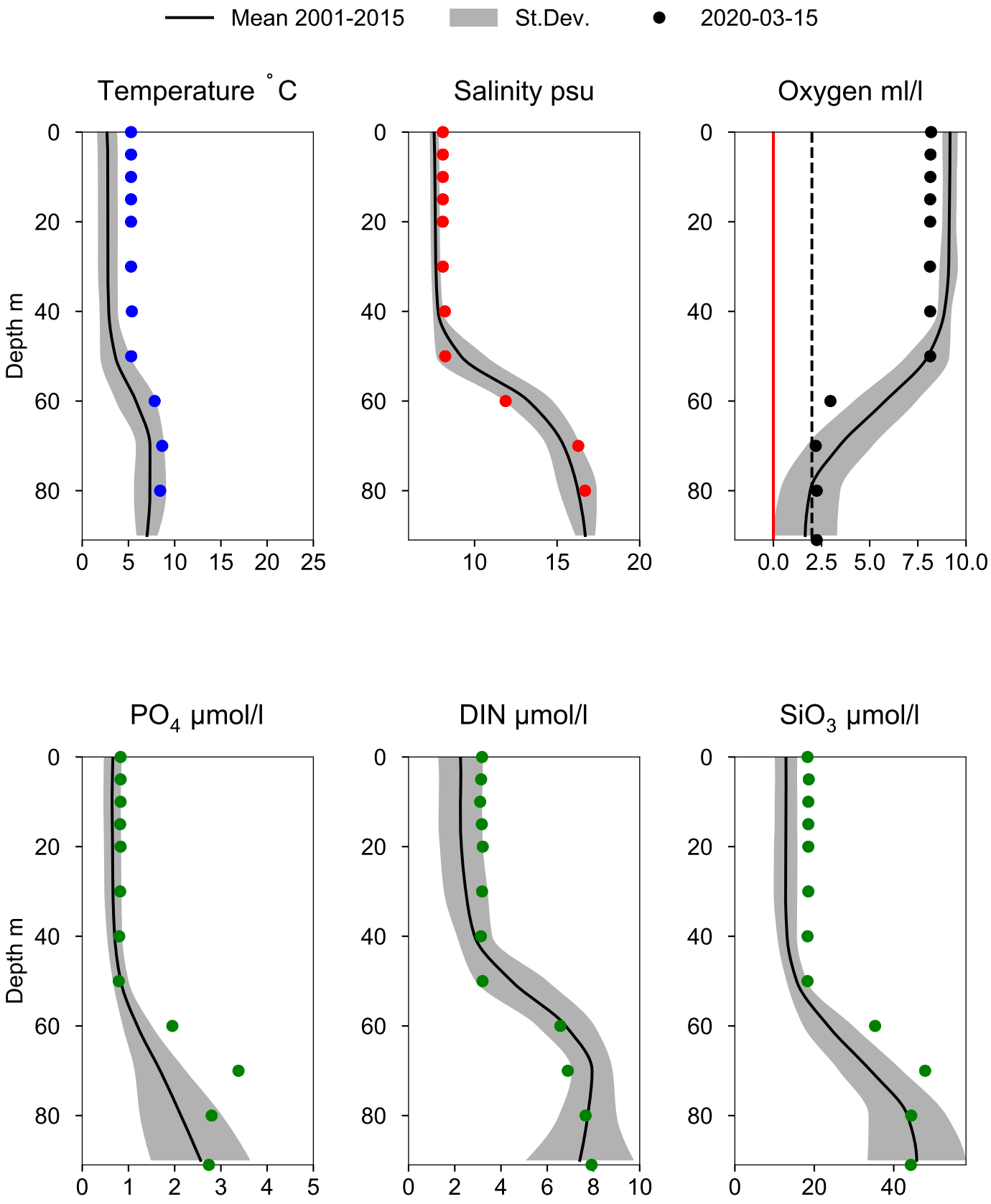
Annual Cycles



OXYGEN IN BOTTOM WATER (depth >= 80 m)

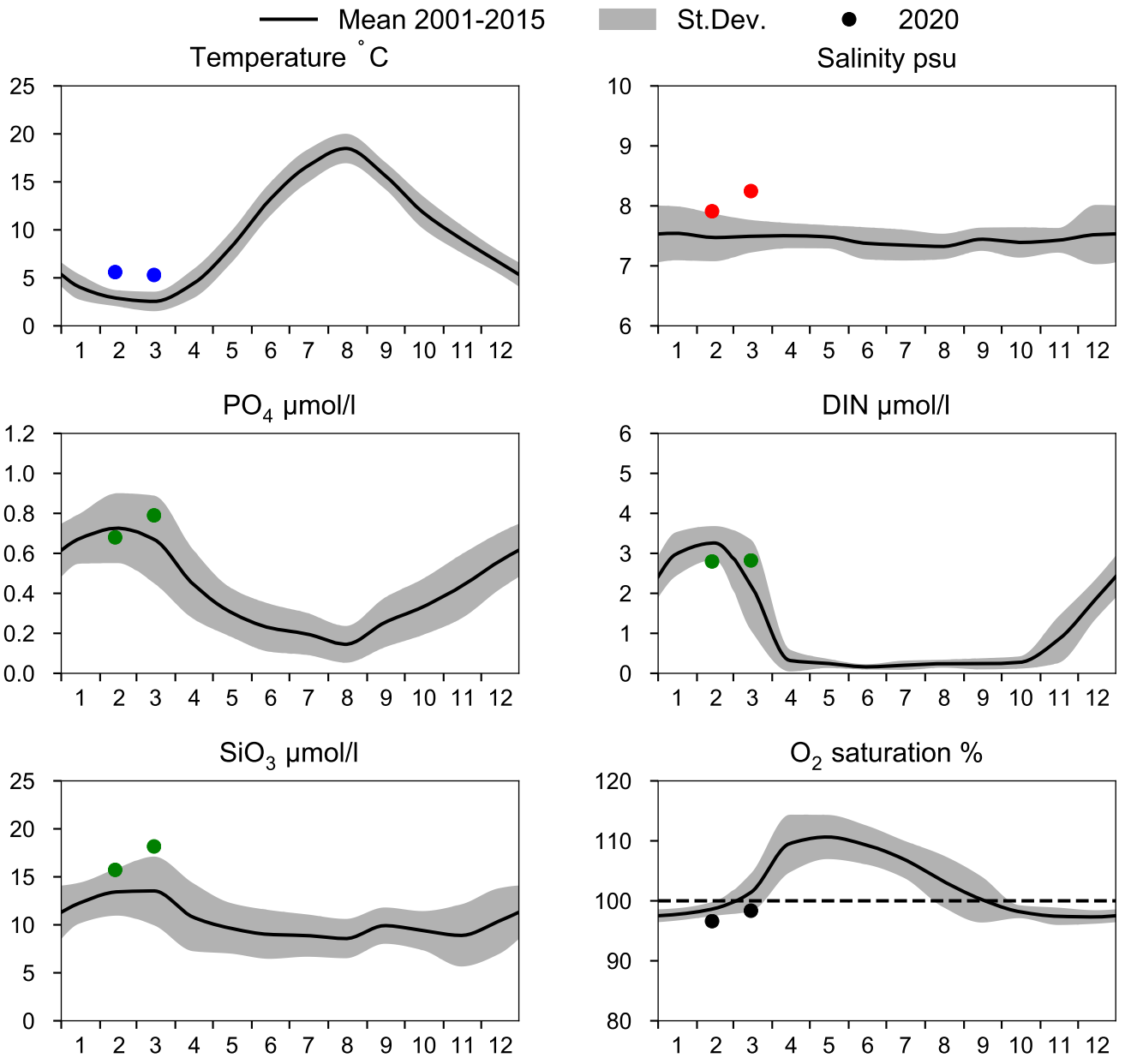


Vertical profiles BY4 CHRISTIANSÖ
March

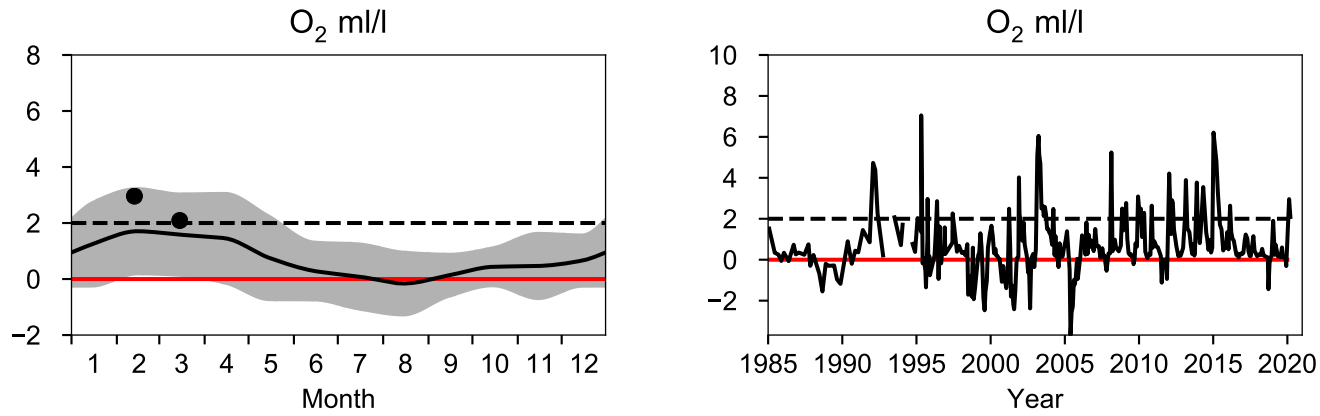


STATION HANÖBUKTEN SURFACE WATER (0-10 m)

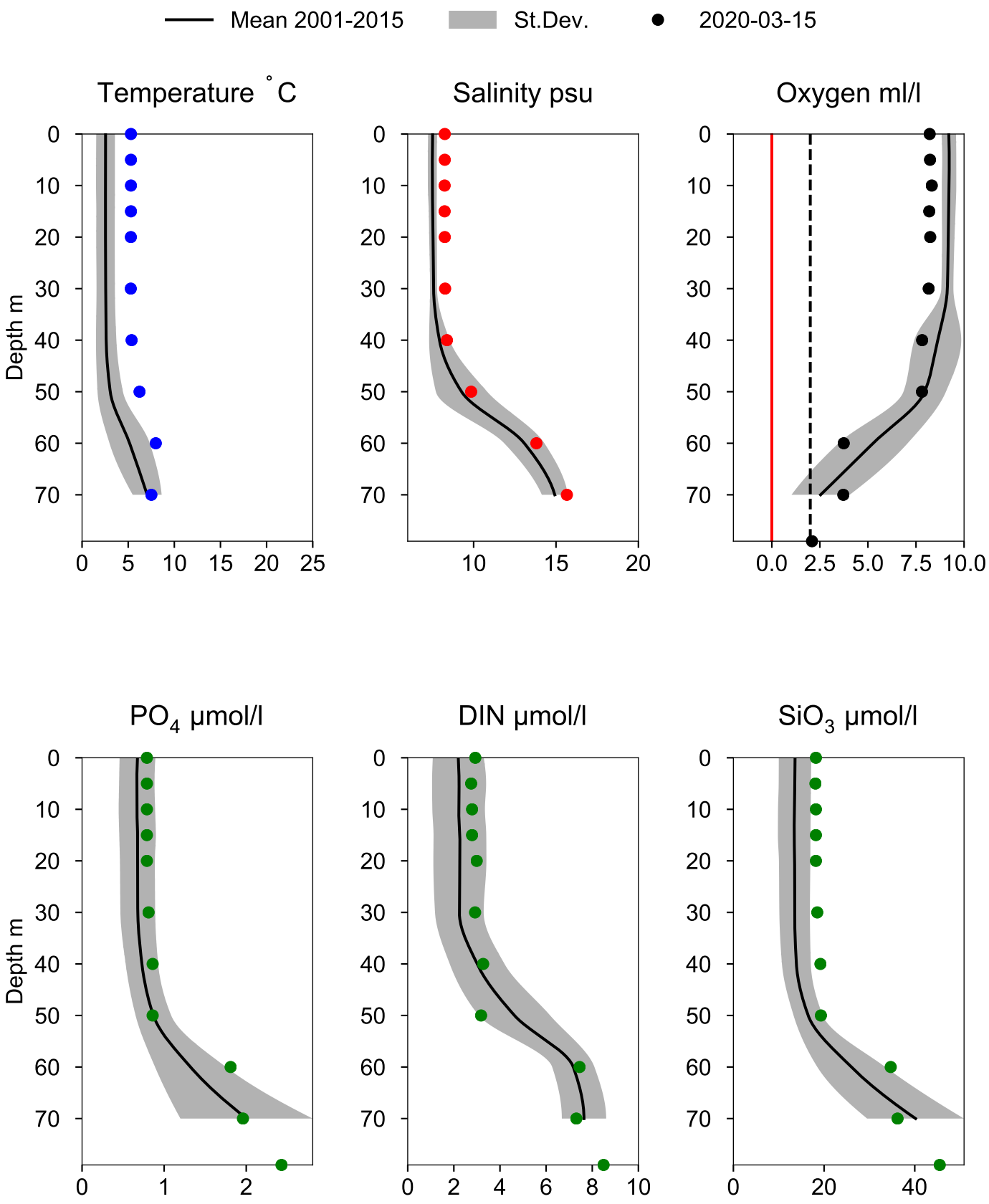
Annual Cycles



OXYGEN IN BOTTOM WATER (depth >= 70 m)

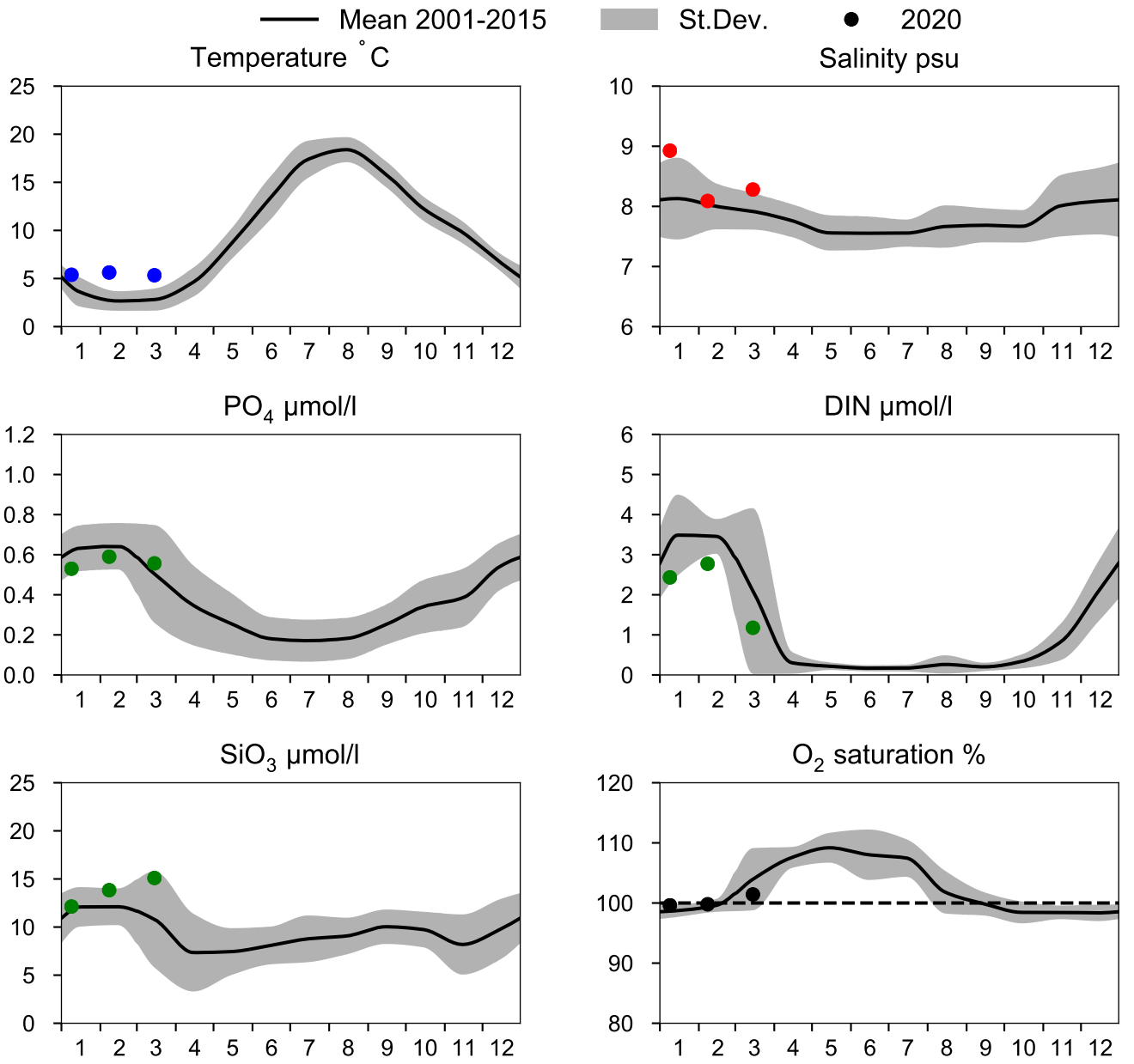


Vertical profiles HANÖBUKTEN
March

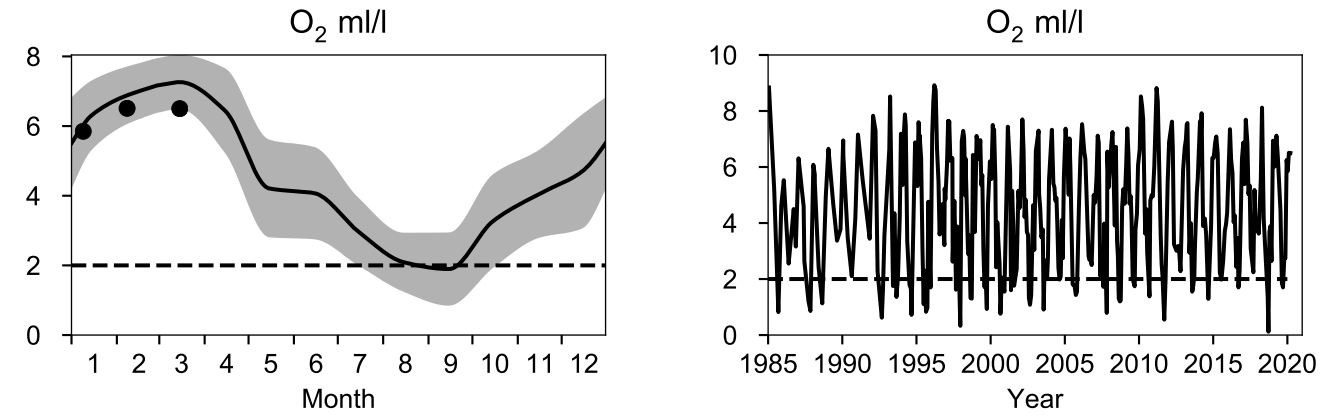


STATION BY2 ARKONA SURFACE WATER (0-10 m)

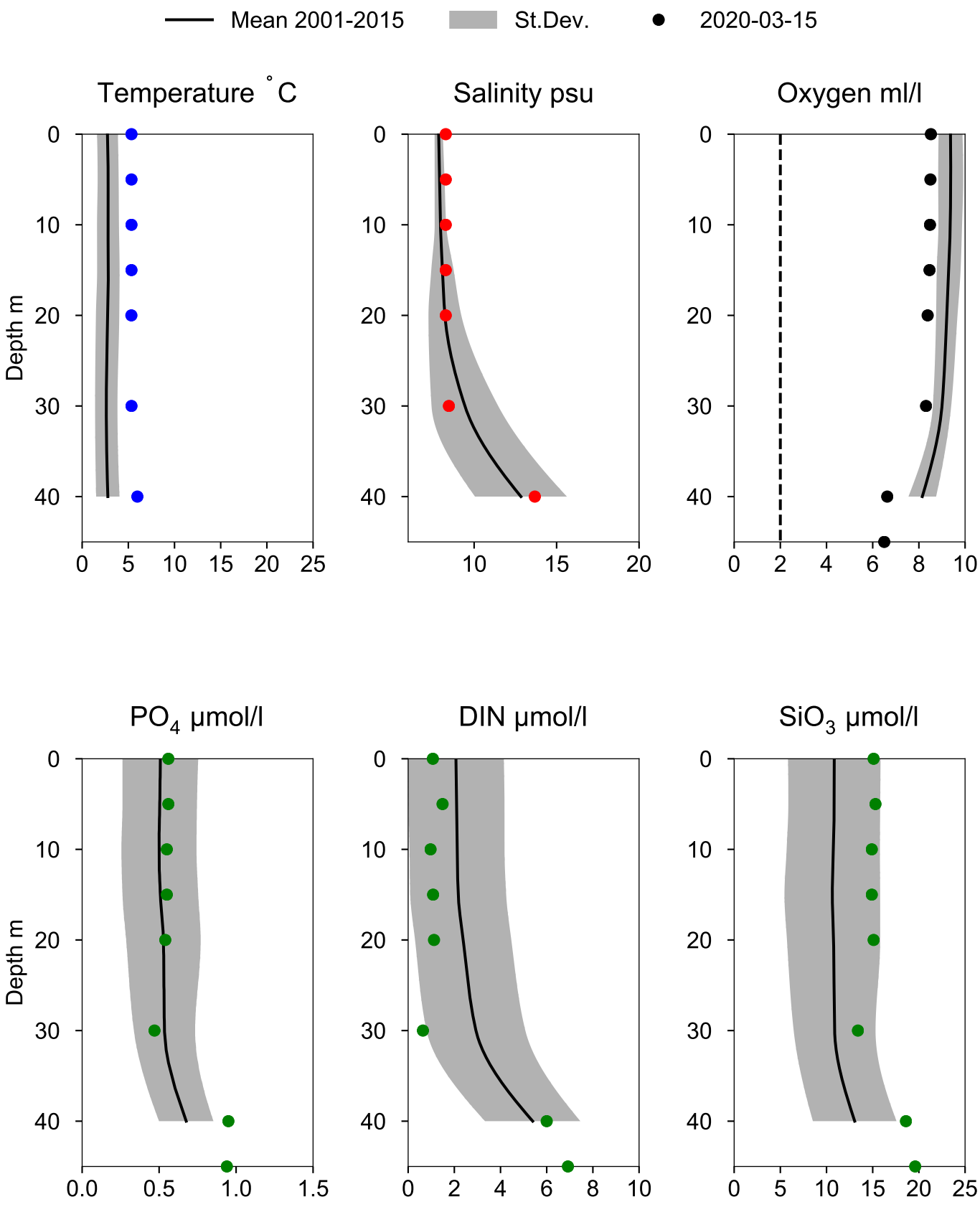
Annual Cycles



OXYGEN IN BOTTOM WATER (depth >= 40 m)

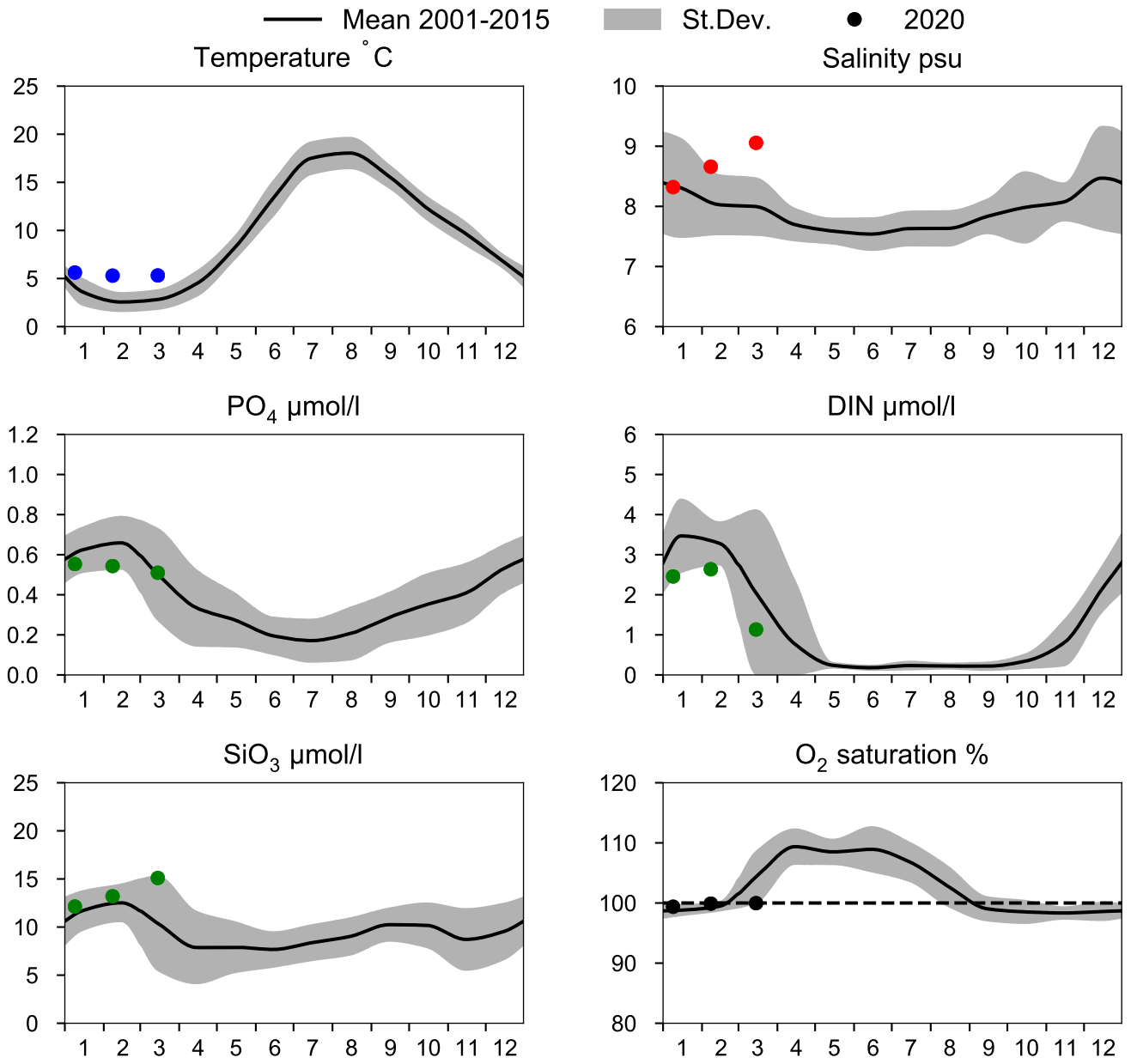


Vertical profiles BY2 ARKONA
March

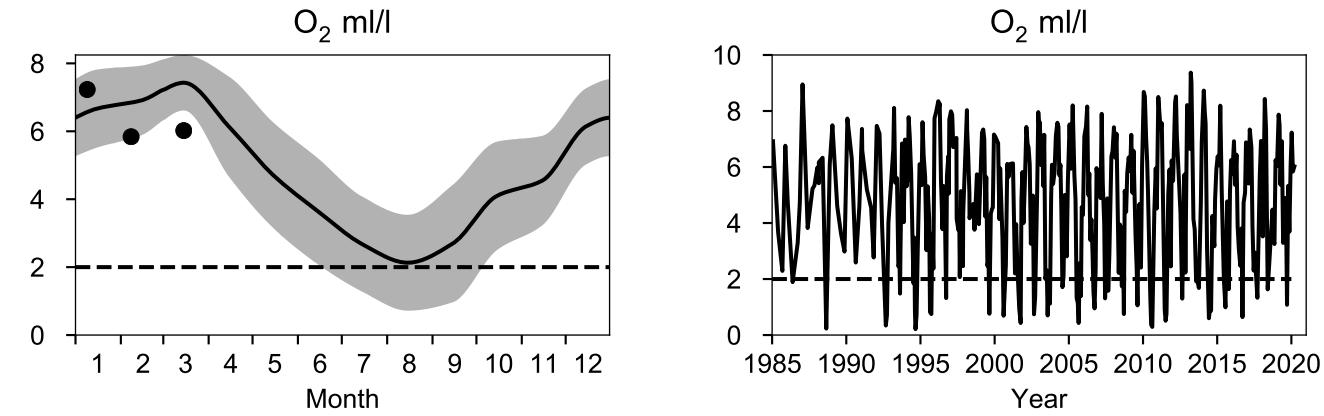


STATION BY1 SURFACE WATER (0-10 m)

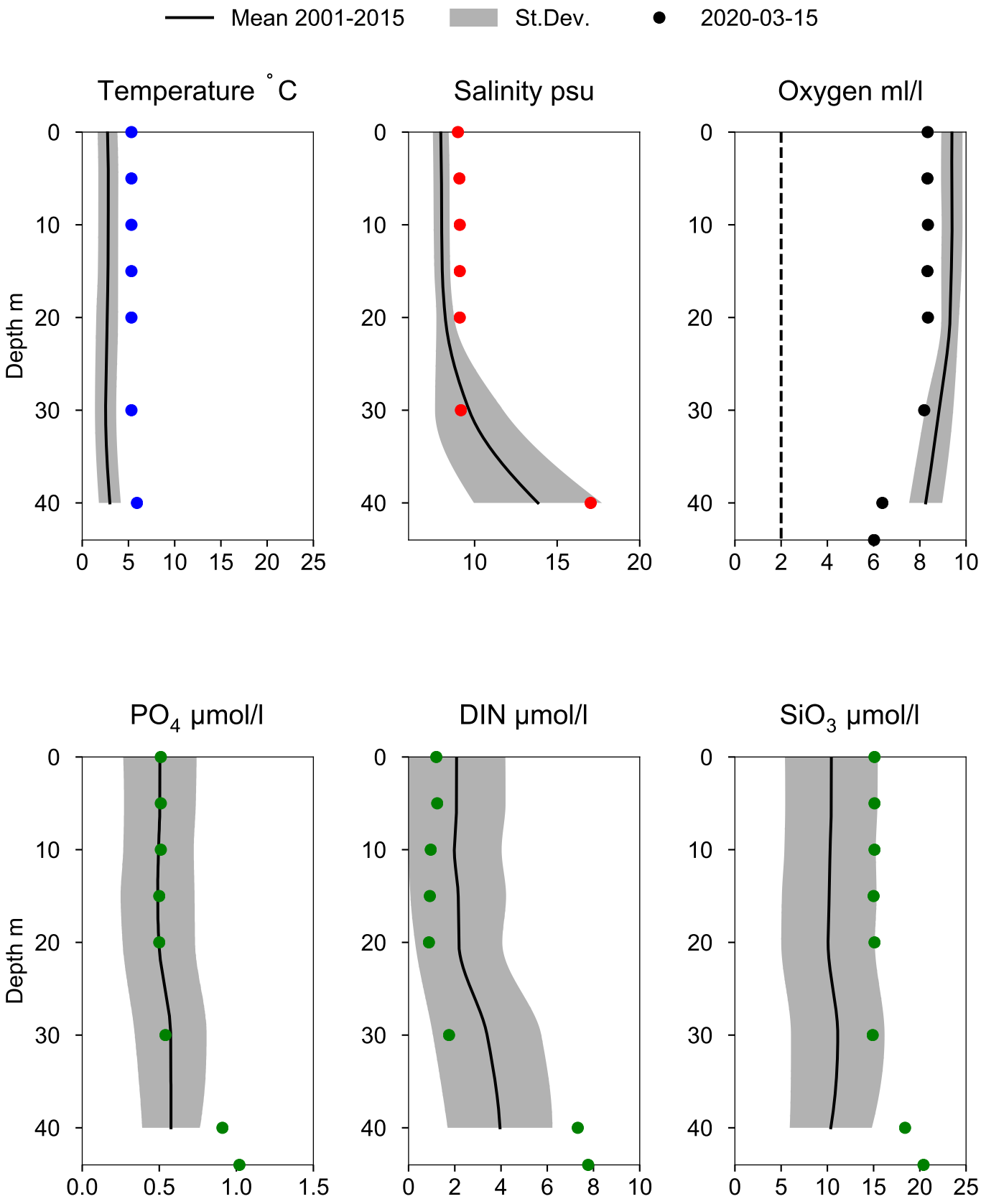
Annual Cycles



OXYGEN IN BOTTOM WATER (depth >= 40 m)

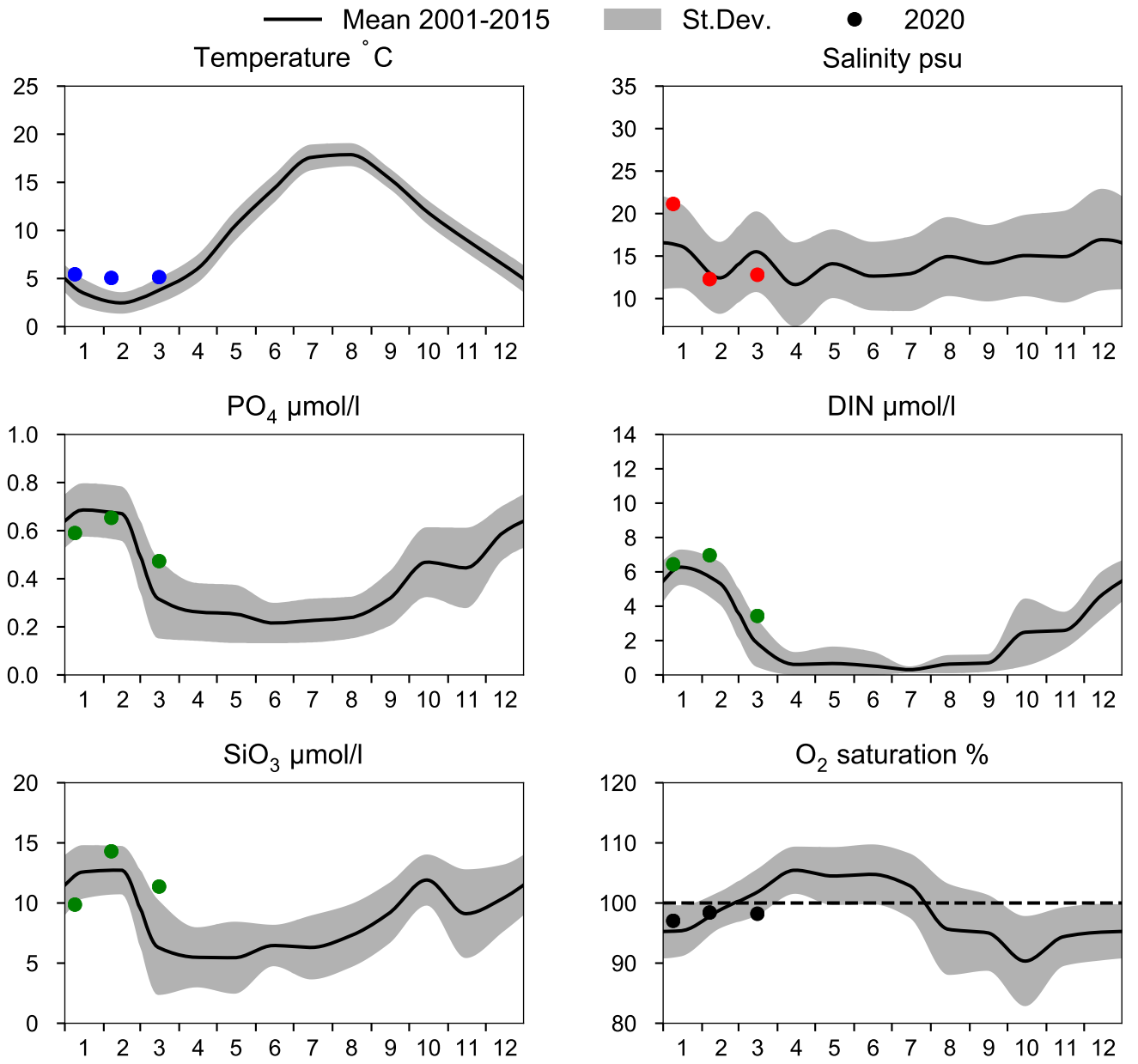


Vertical profiles BY1
March

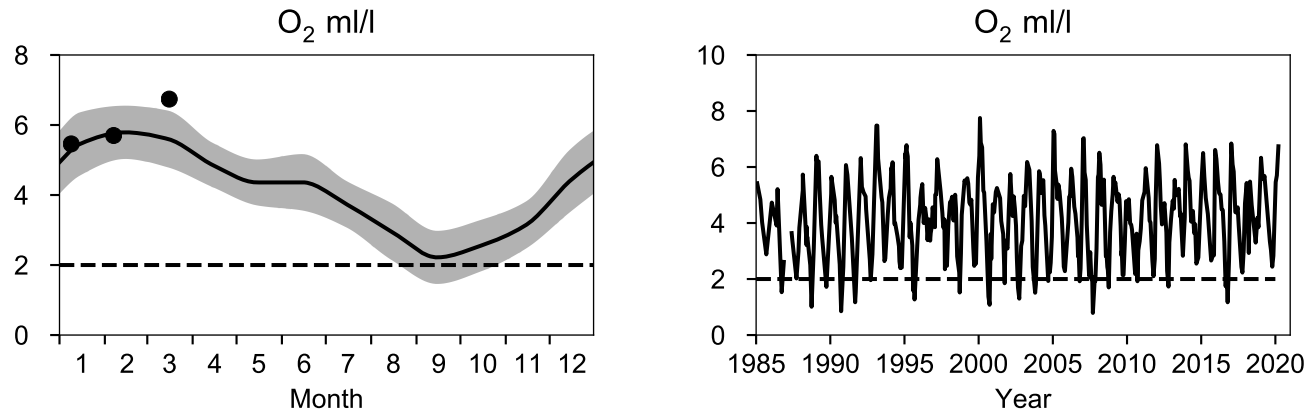


STATION W LANDSKRONA SURFACE WATER (0-10 m)

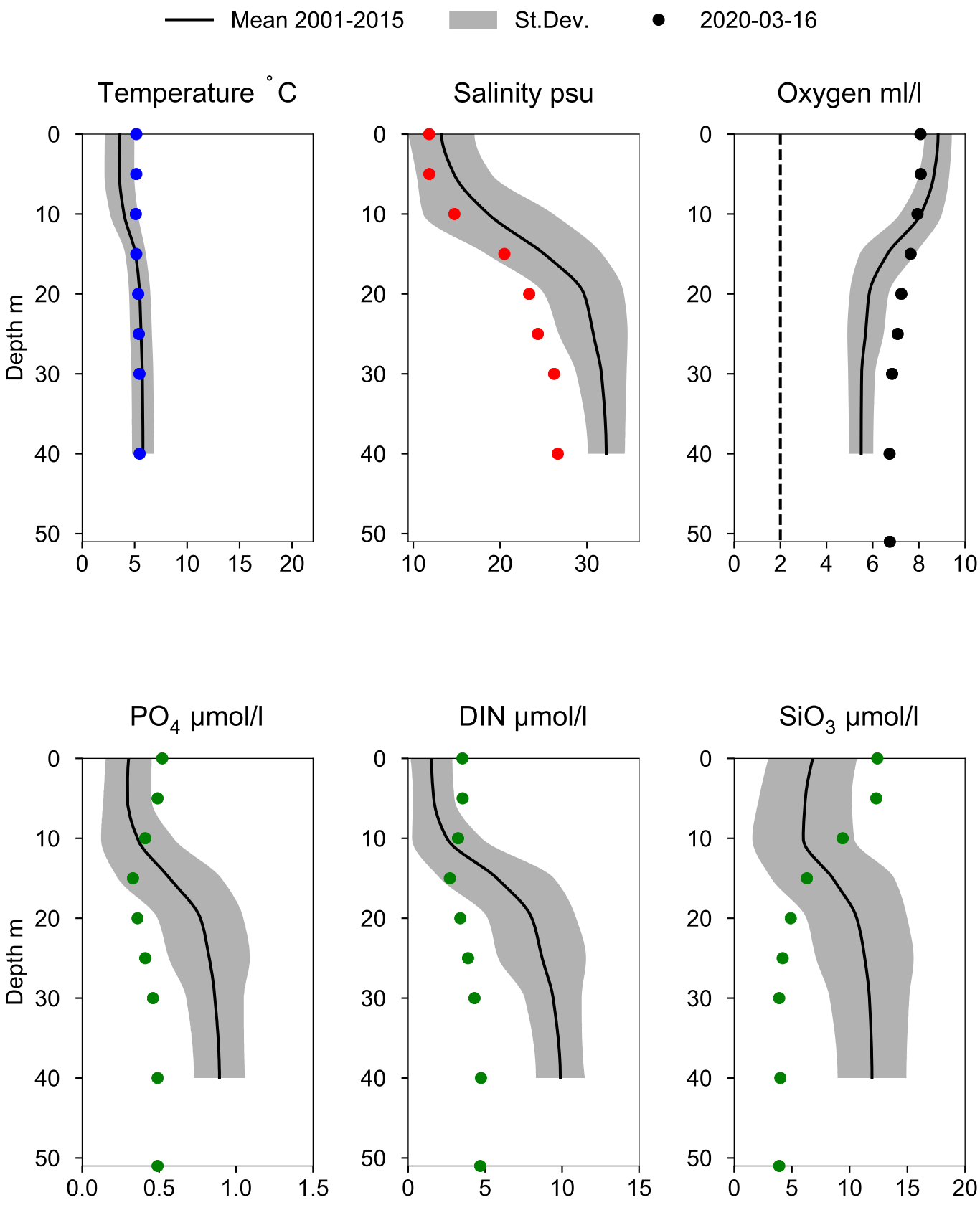
Annual Cycles



OXYGEN IN BOTTOM WATER (depth >= 40 m)

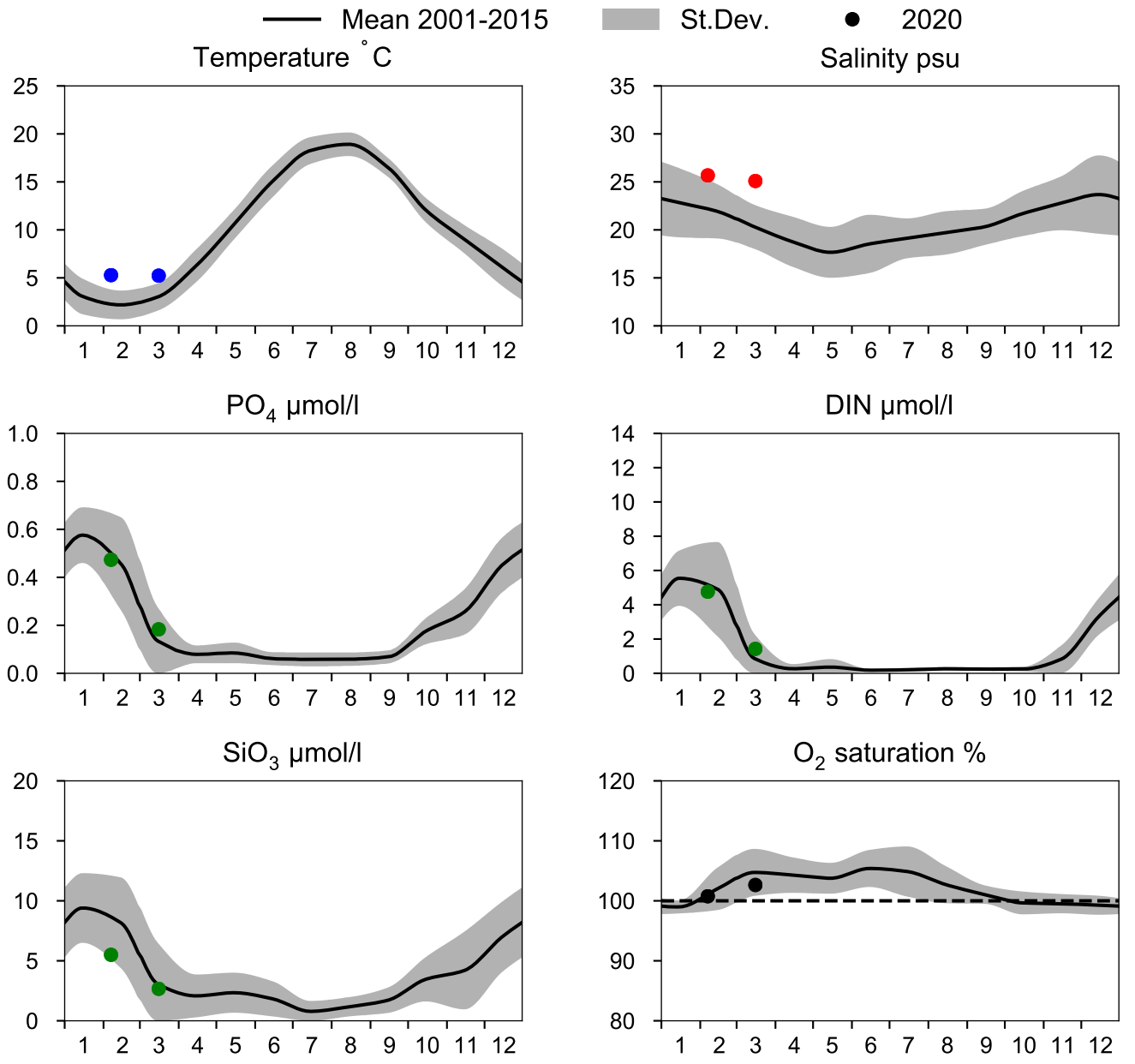


Vertical profiles W LANDSKRONA
March

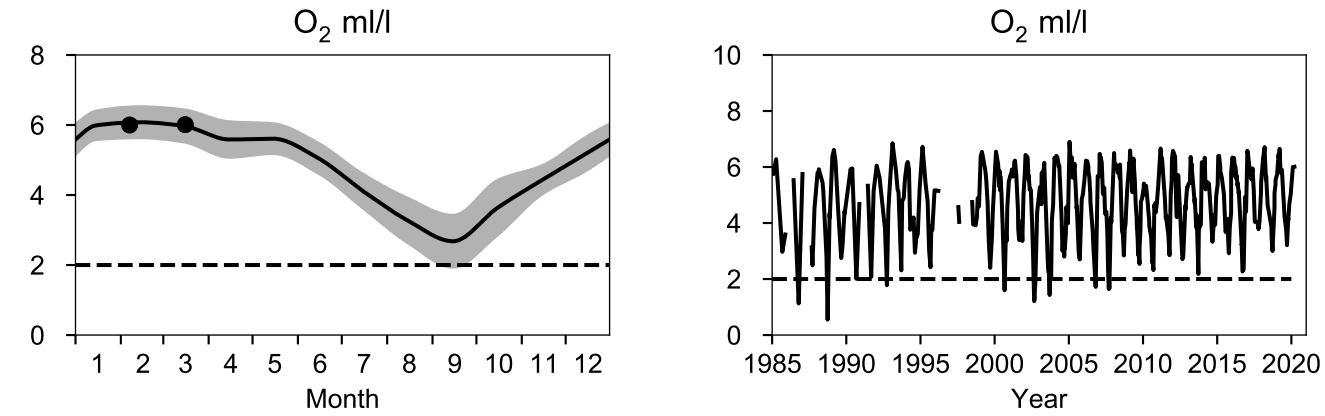


STATION ANHOLT E SURFACE WATER (0-10 m)

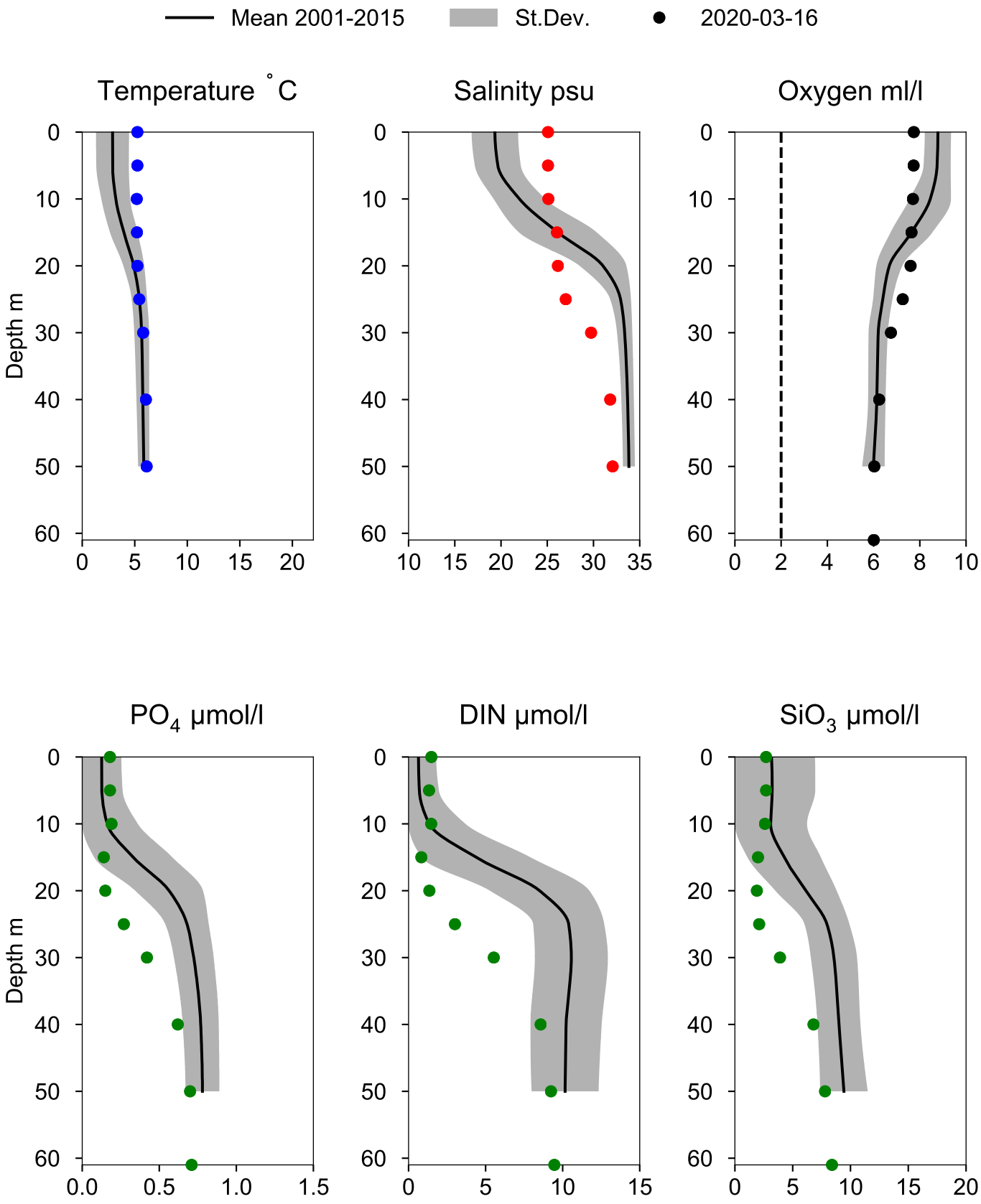
Annual Cycles



OXYGEN IN BOTTOM WATER (depth >= 52 m)

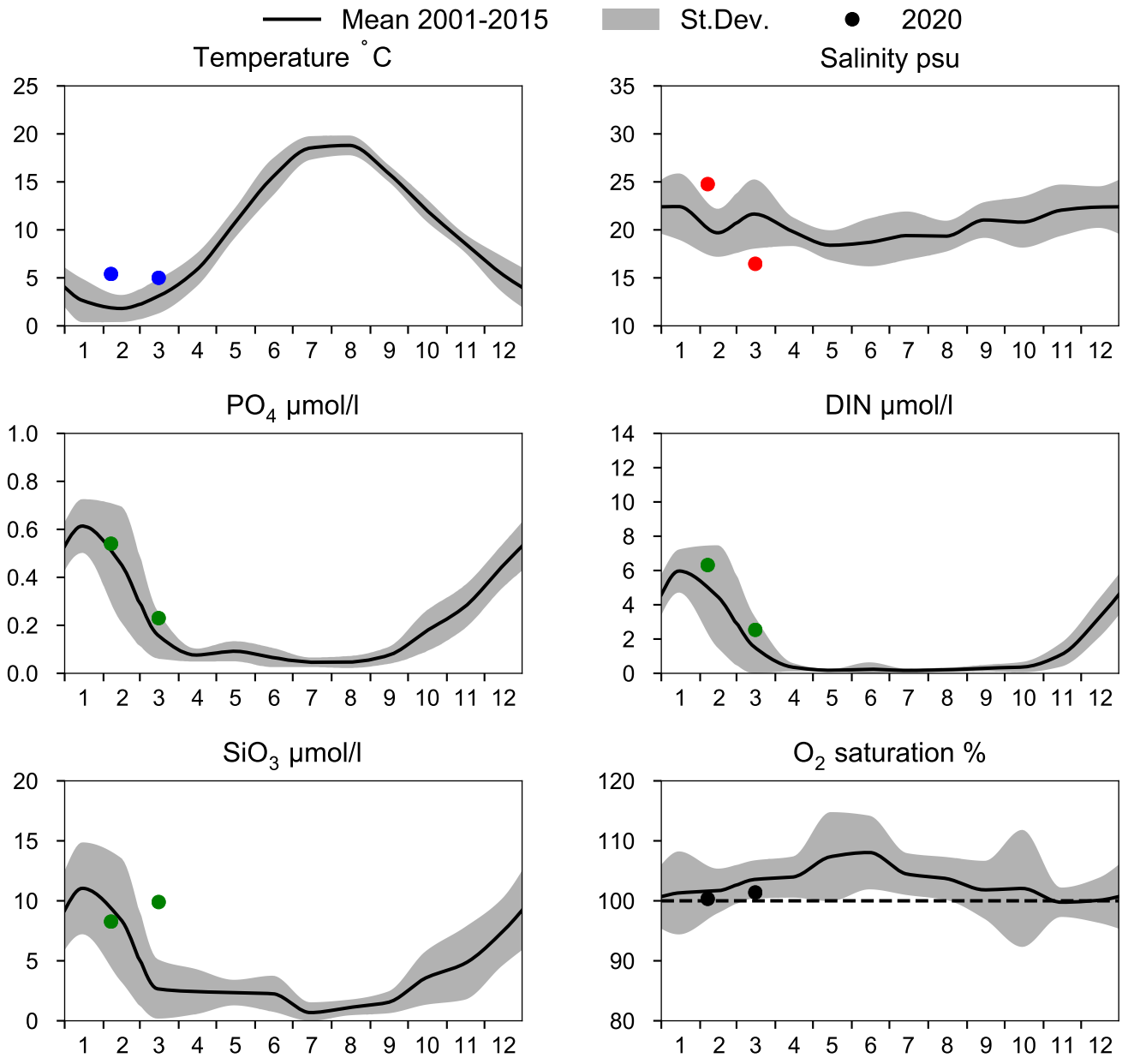


Vertical profiles ANHOLT E
March

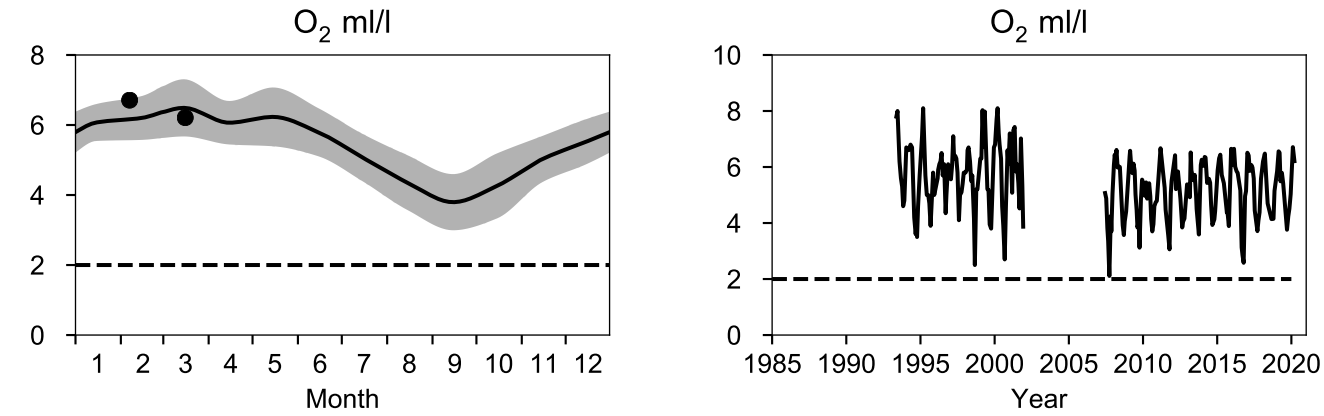


STATION N14 FALKENBERG SURFACE WATER (0-10 m)

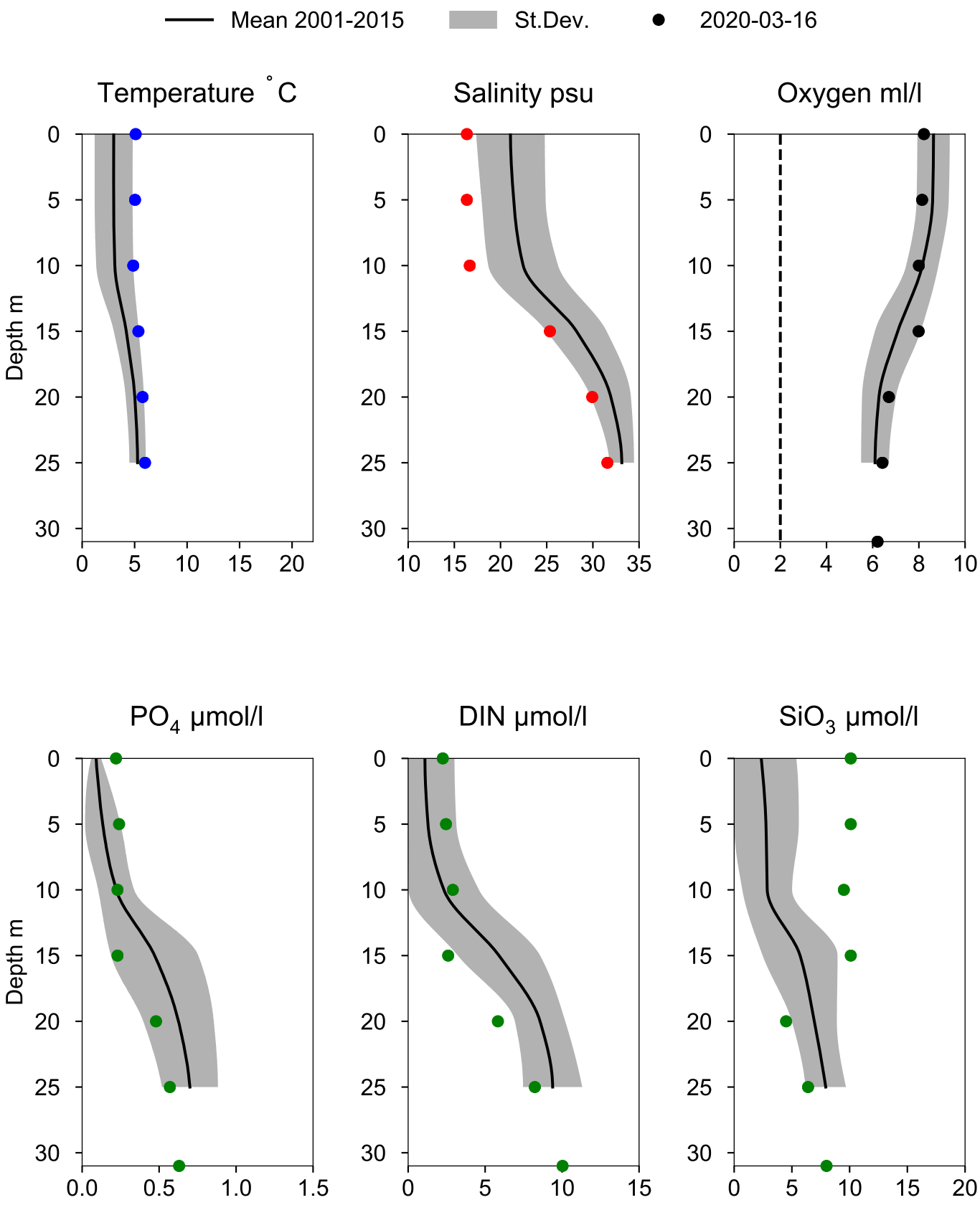
Annual Cycles



OXYGEN IN BOTTOM WATER (depth >= 20 m)

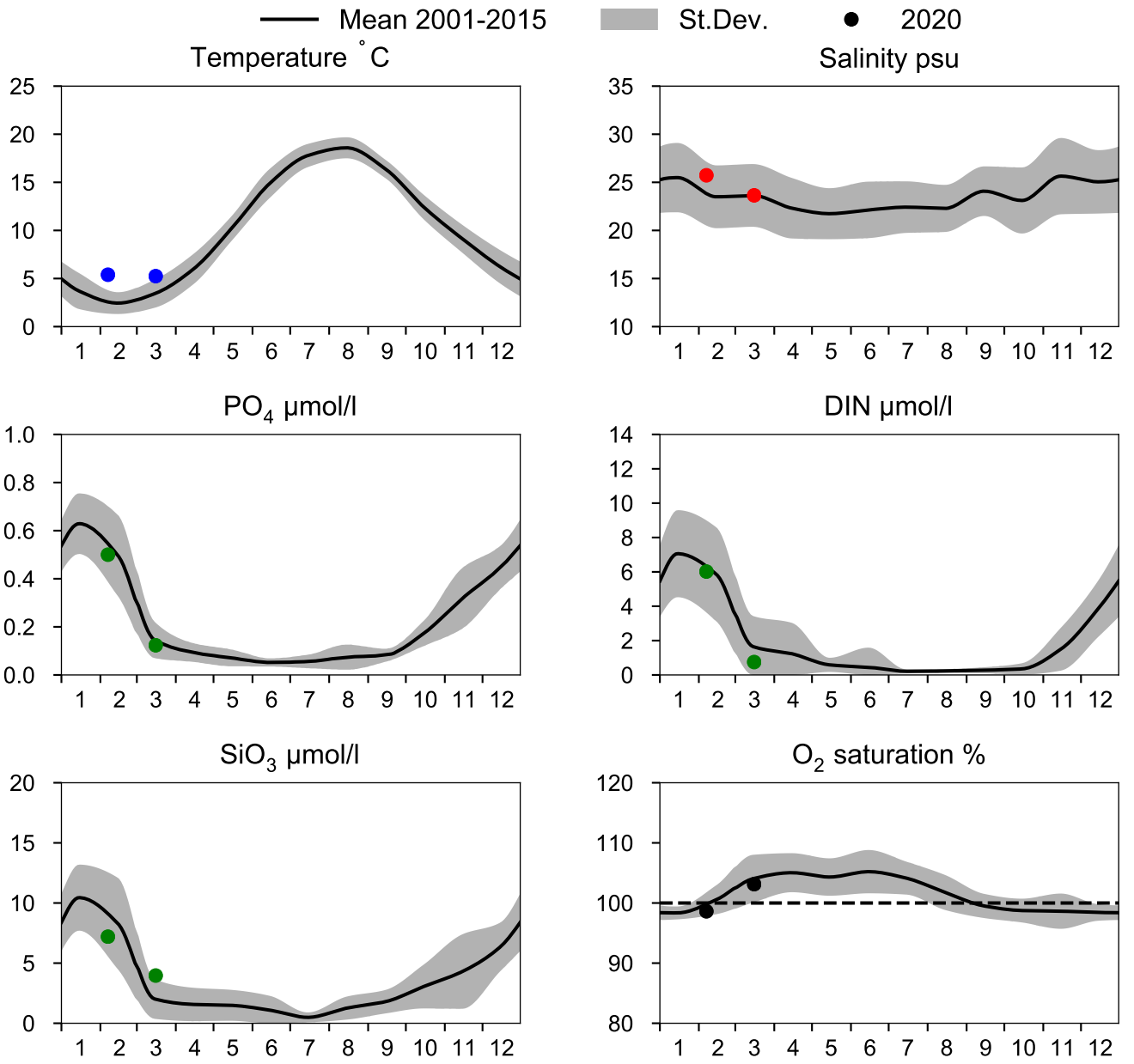


Vertical profiles N14 FALKENBERG
March

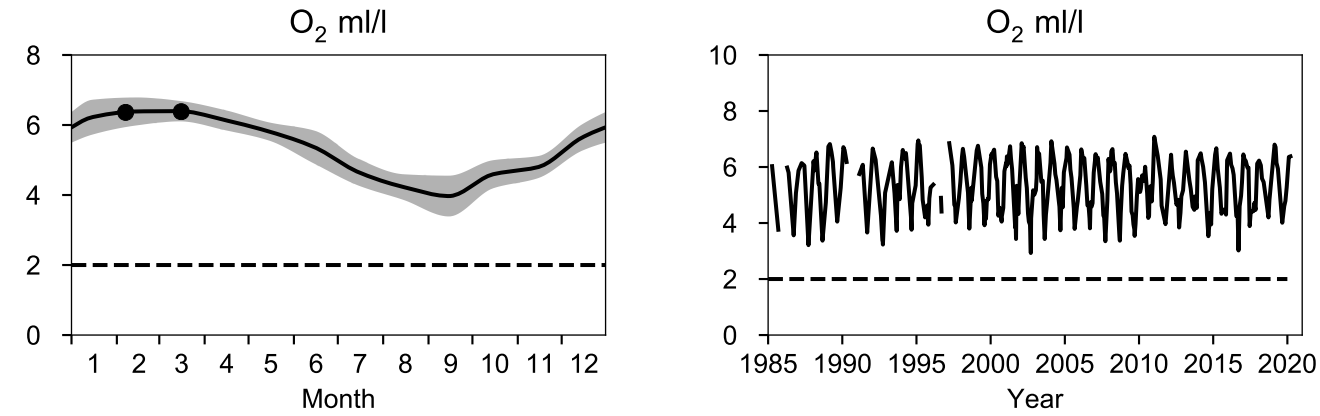


STATION FLADEN SURFACE WATER (0-10 m)

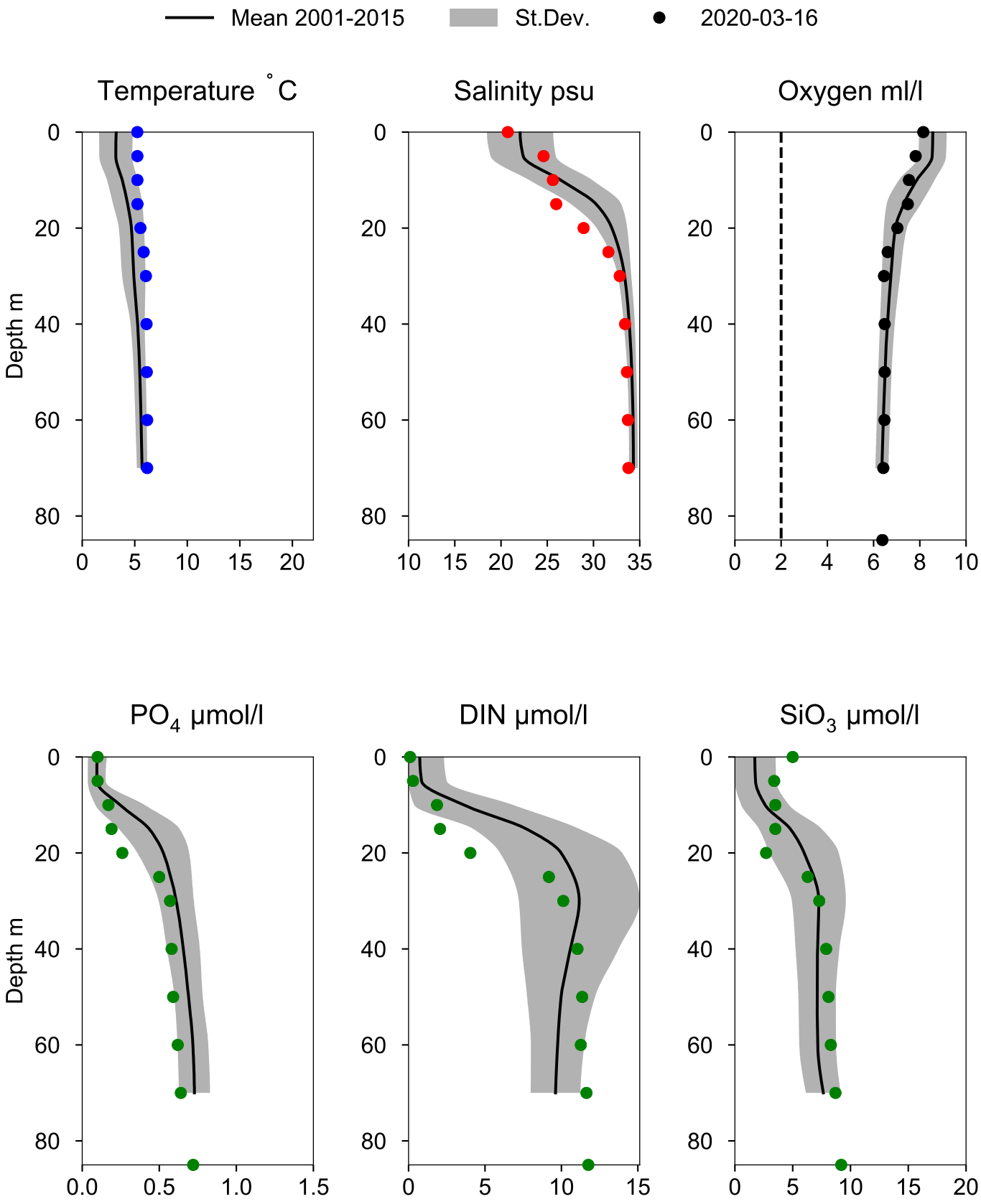
Annual Cycles



OXYGEN IN BOTTOM WATER (depth >= 74 m)

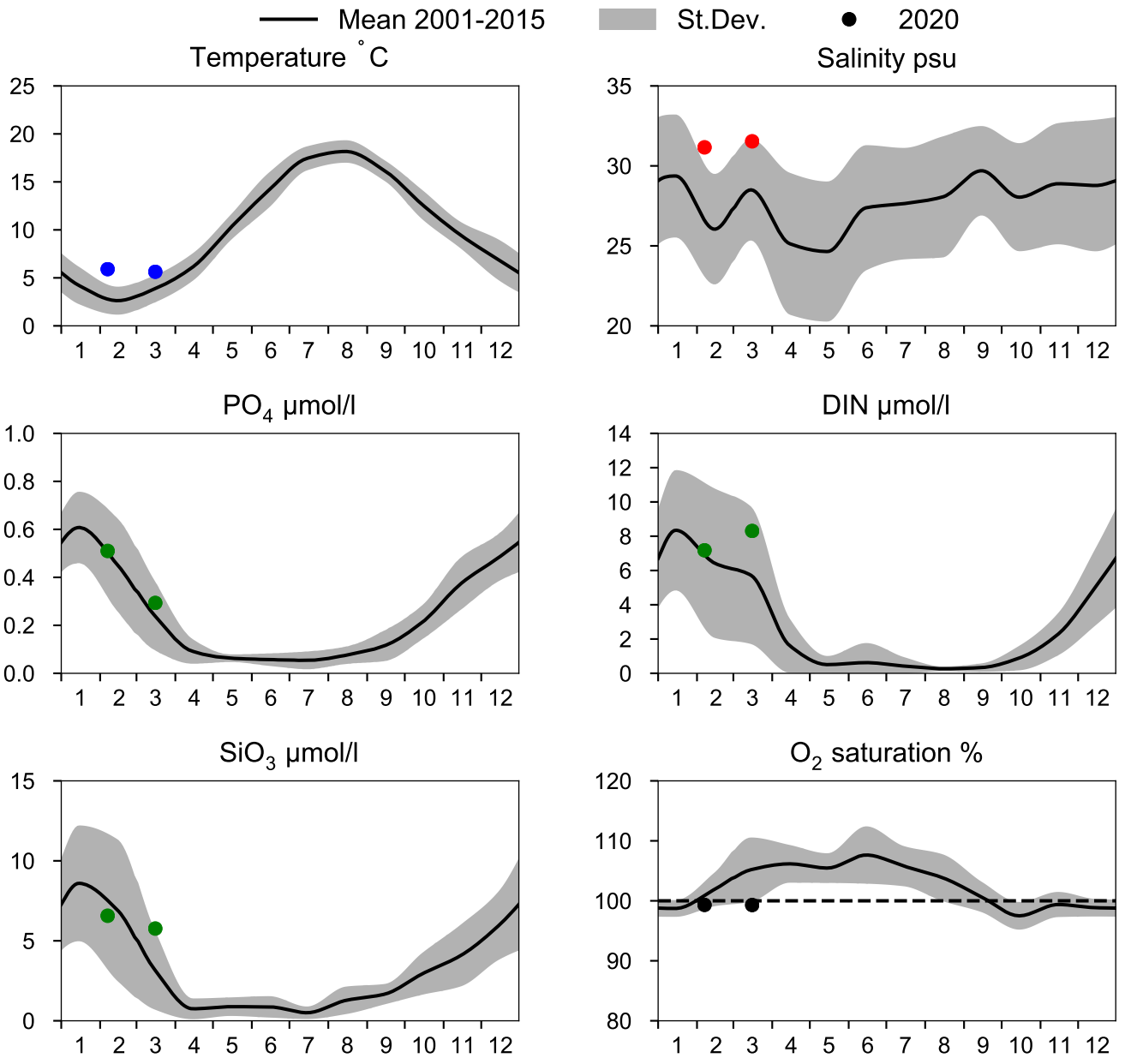


Vertical profiles FLADEN
March

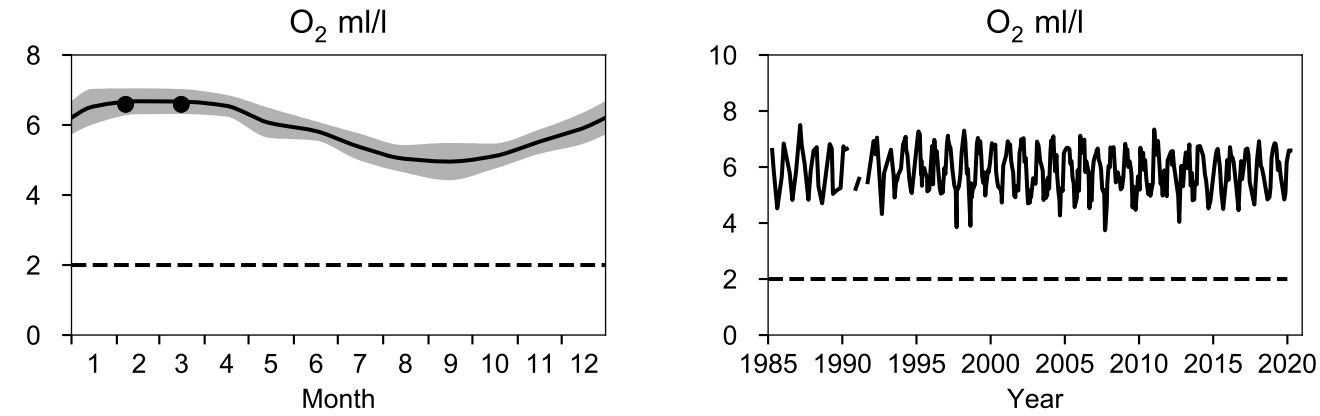


STATION P2 SURFACE WATER (0-10 m)

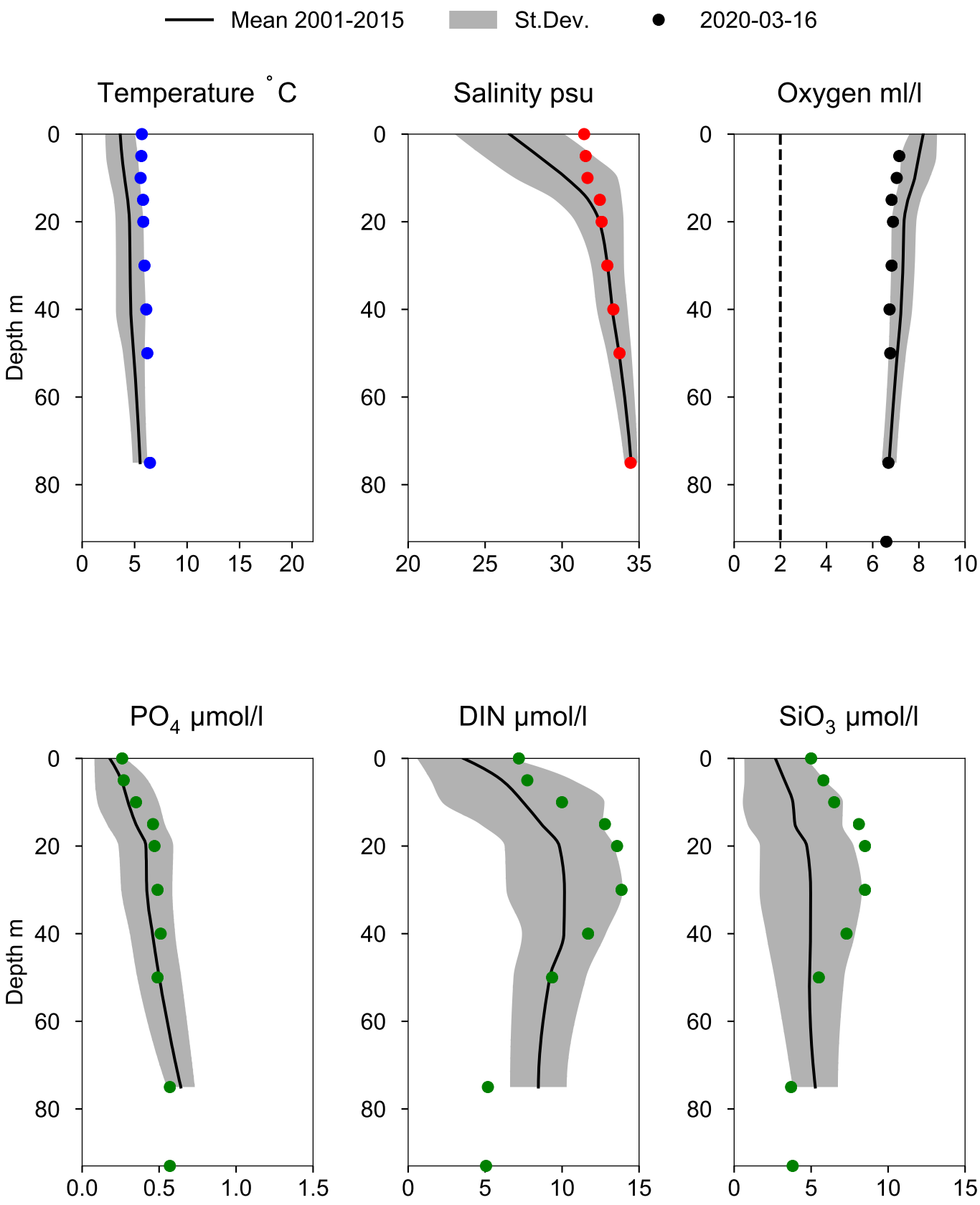
Annual Cycles



OXYGEN IN BOTTOM WATER (depth >= 75 m)

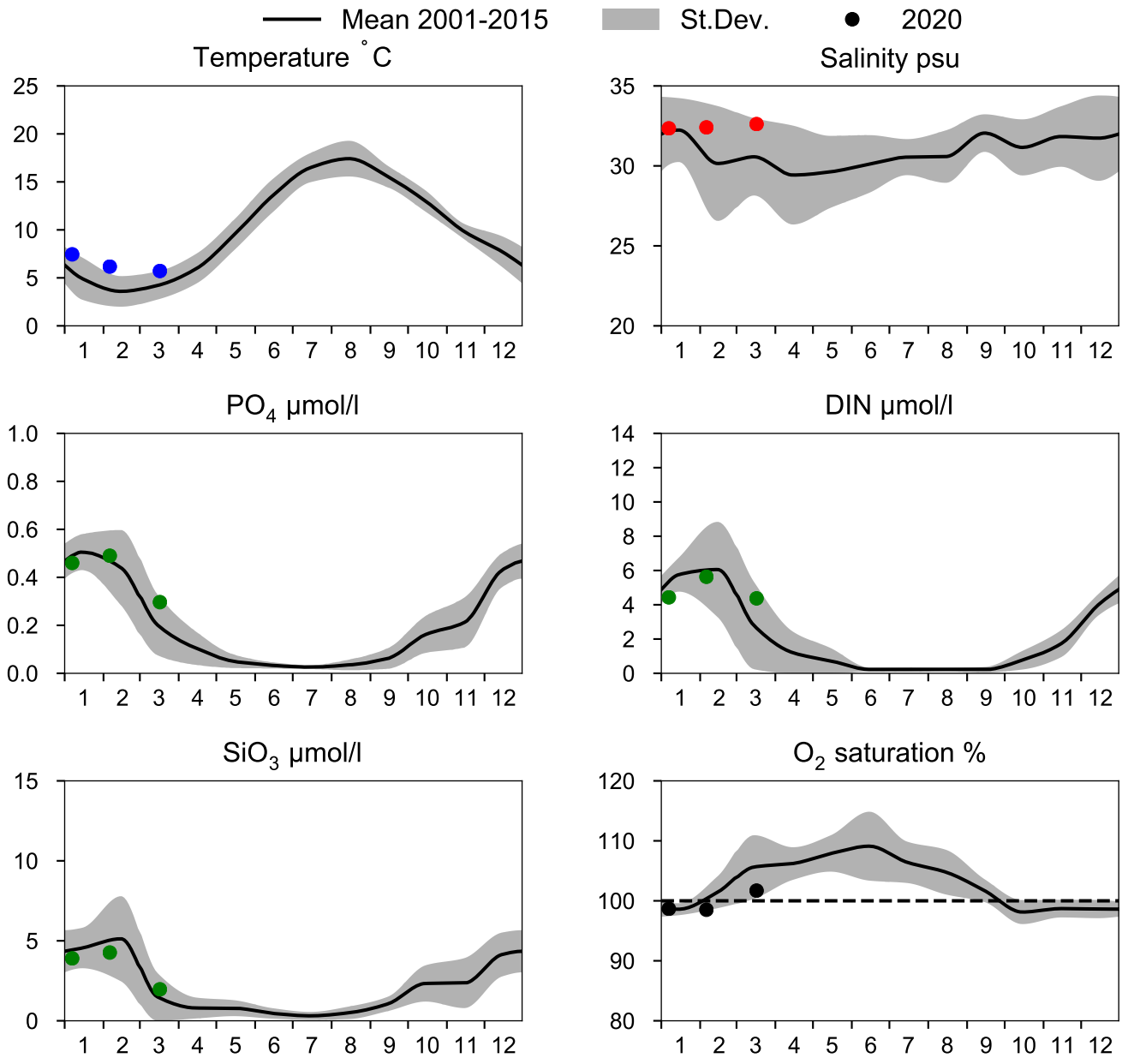


Vertical profiles P2
March

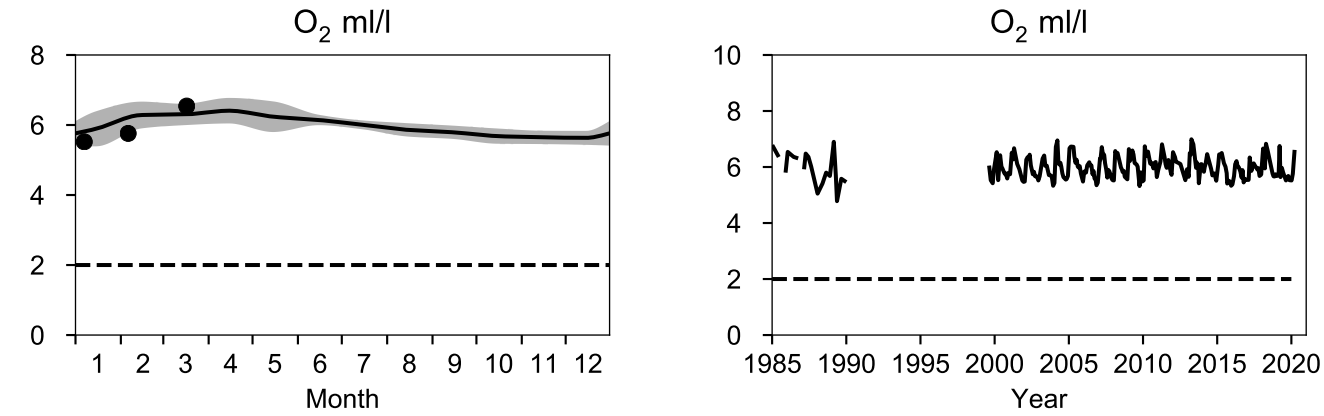


STATION Å17 SURFACE WATER (0-10 m)

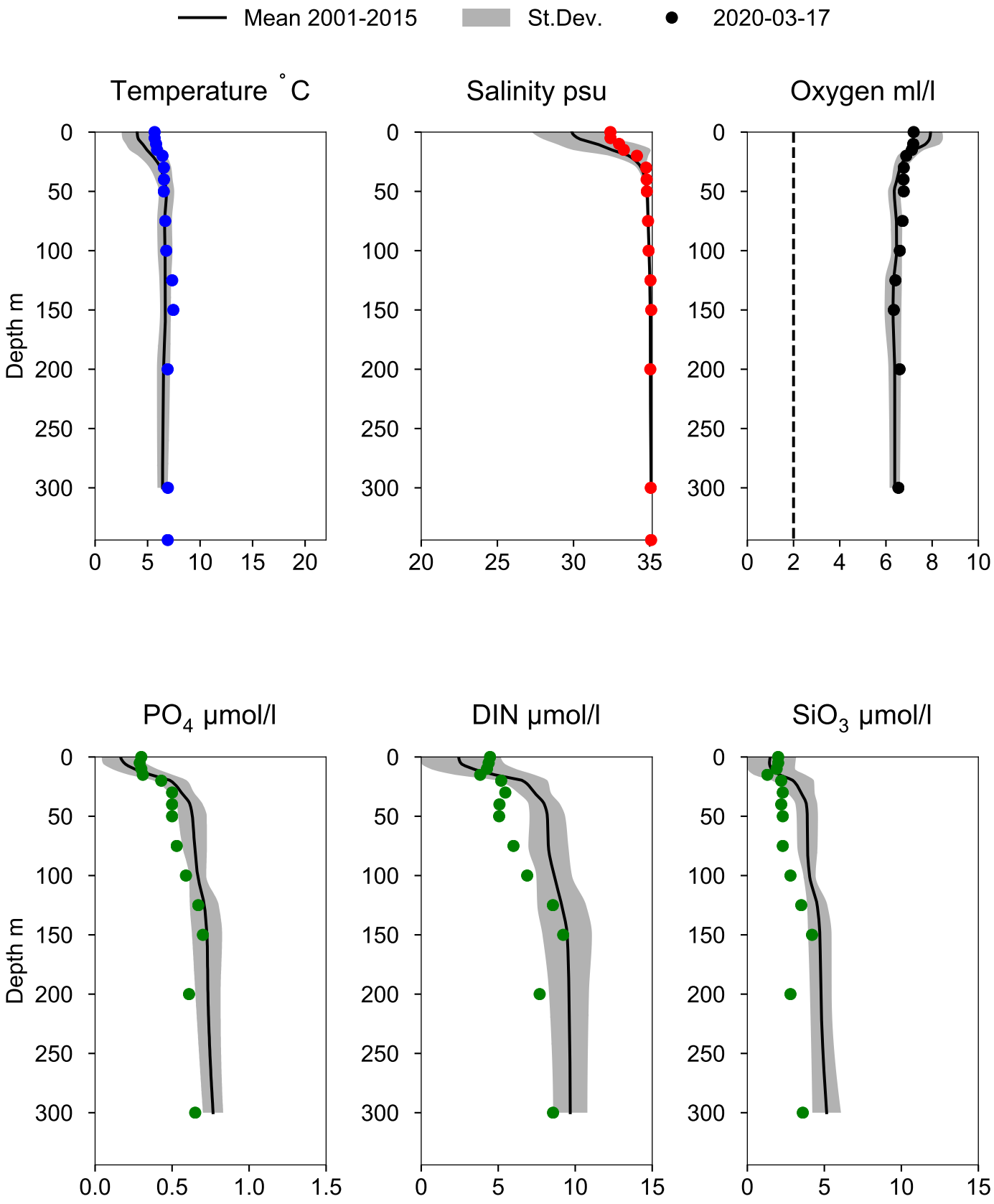
Annual Cycles



OXYGEN IN BOTTOM WATER (depth >= 300 m)

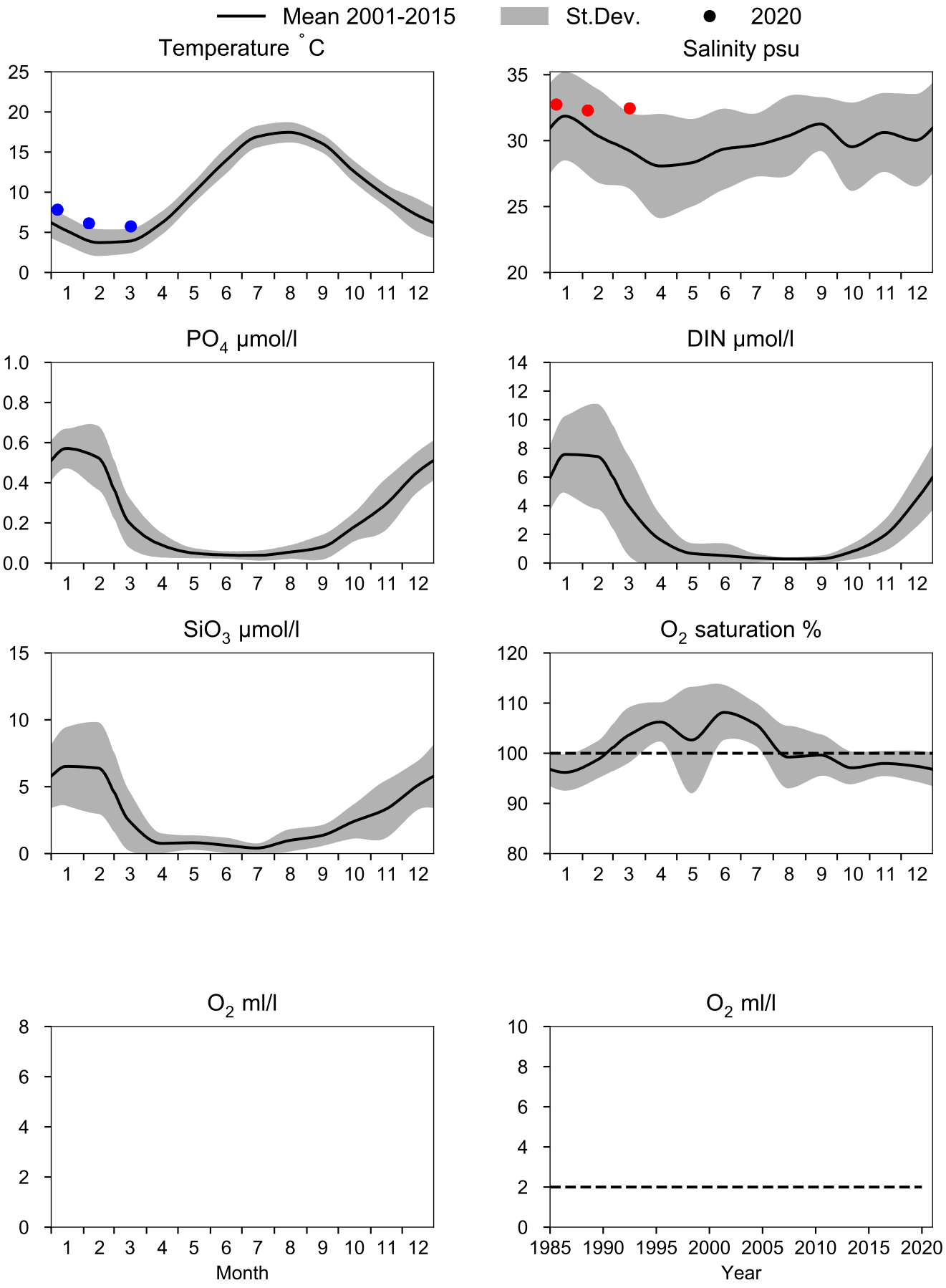


Vertical profiles Å17
March

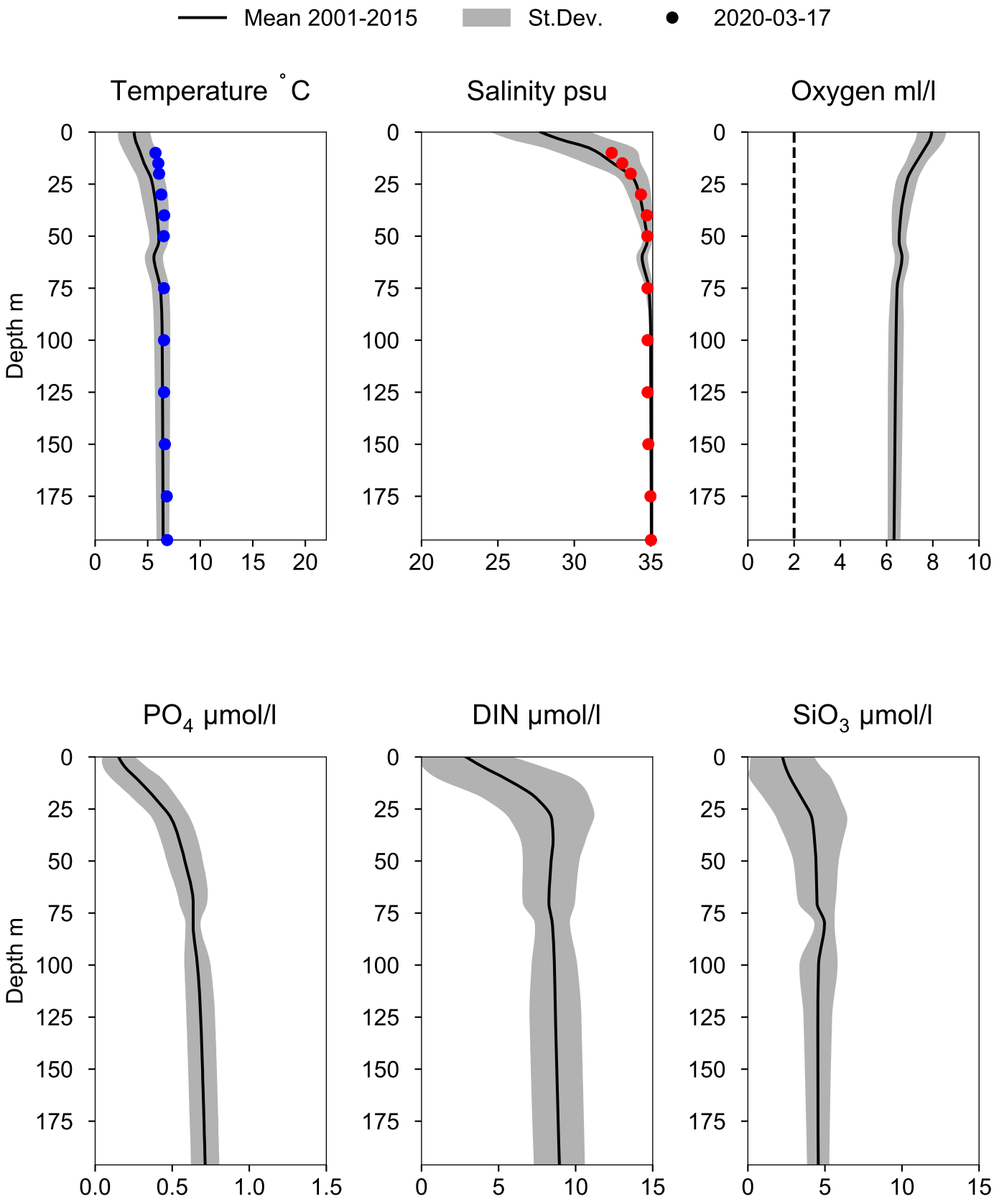


STATION Å16 SURFACE WATER (0-10 m)

Annual Cycles

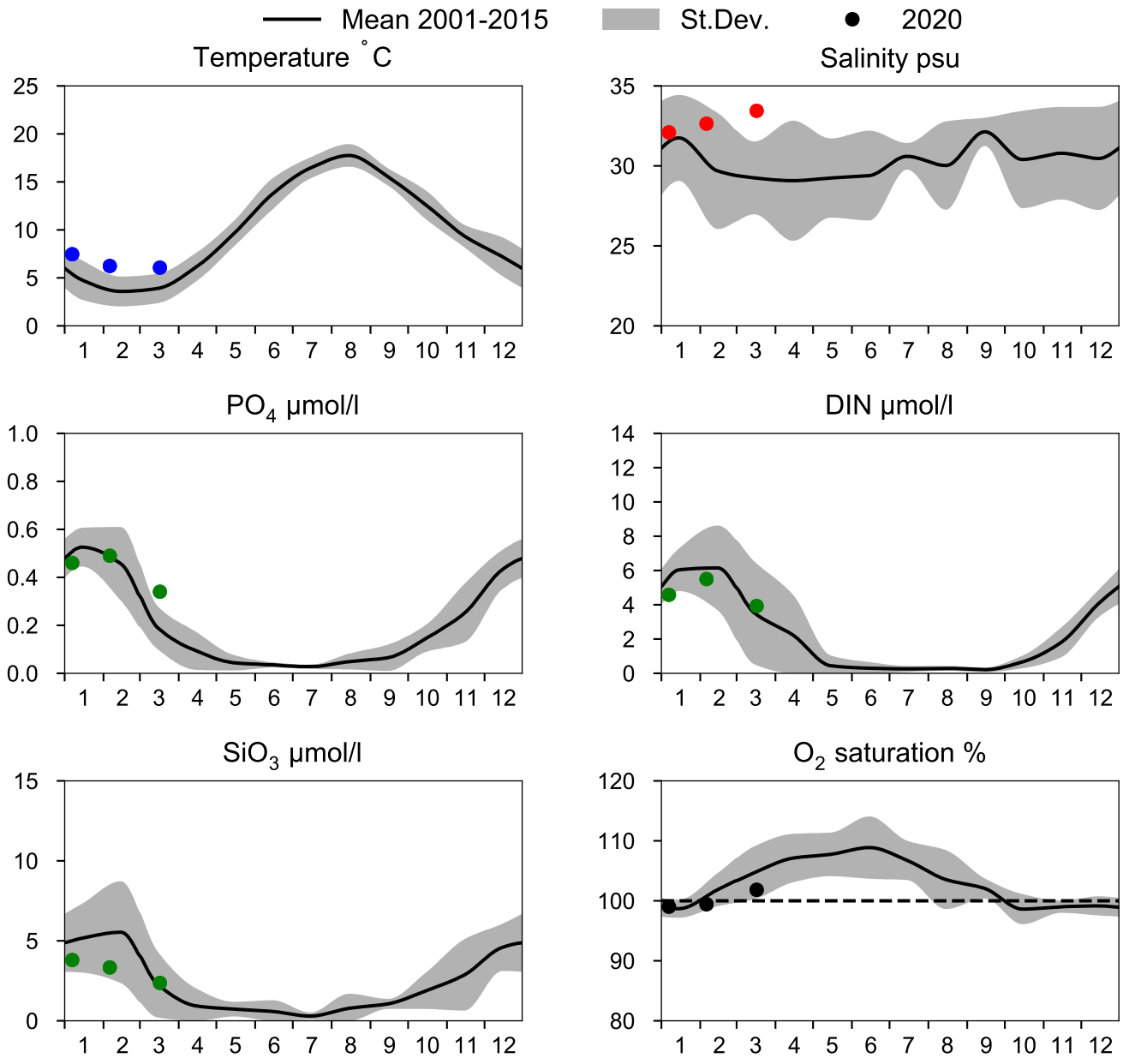


Vertical profiles Å16
March

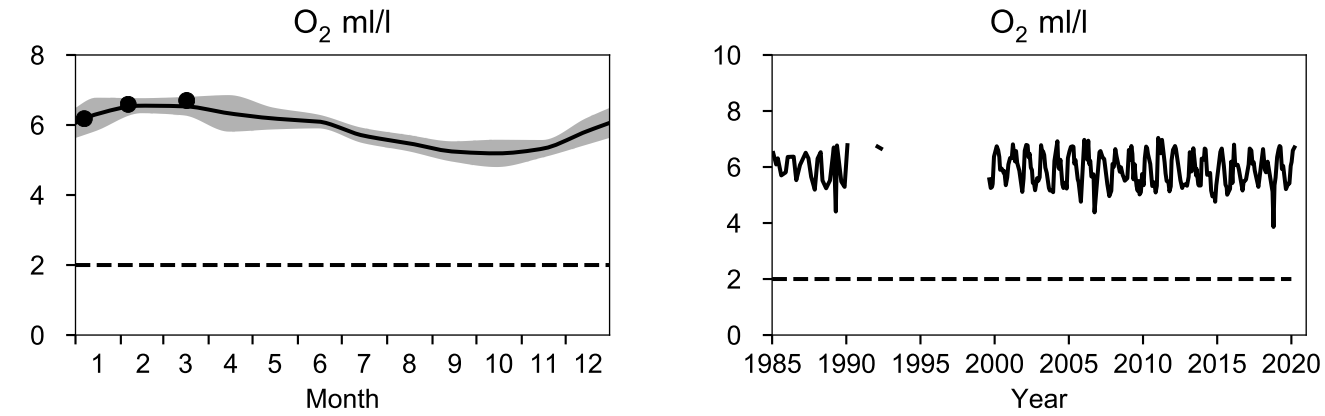


STATION Å15 SURFACE WATER (0-10 m)

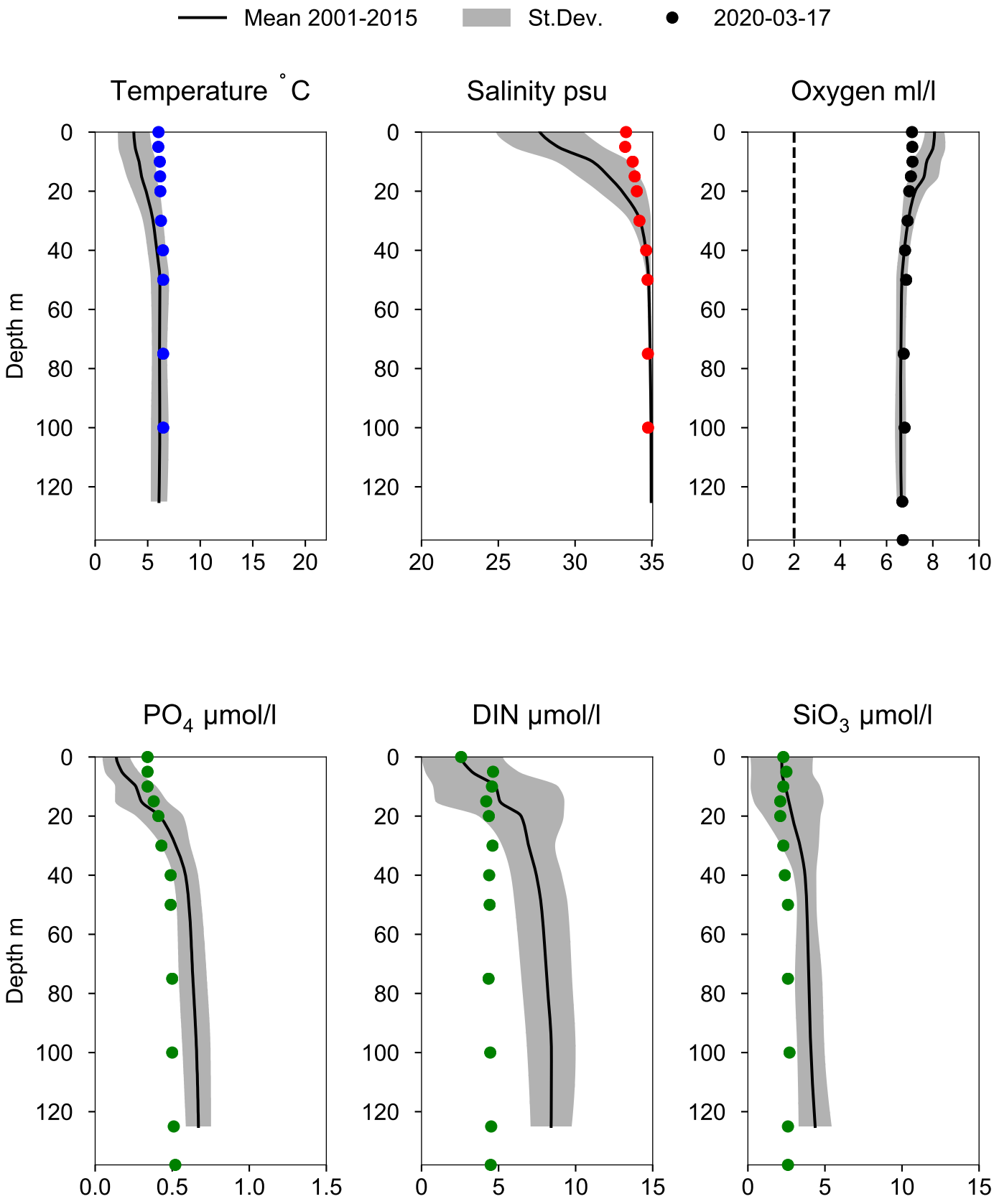
Annual Cycles



OXYGEN IN BOTTOM WATER (depth >= 125 m)

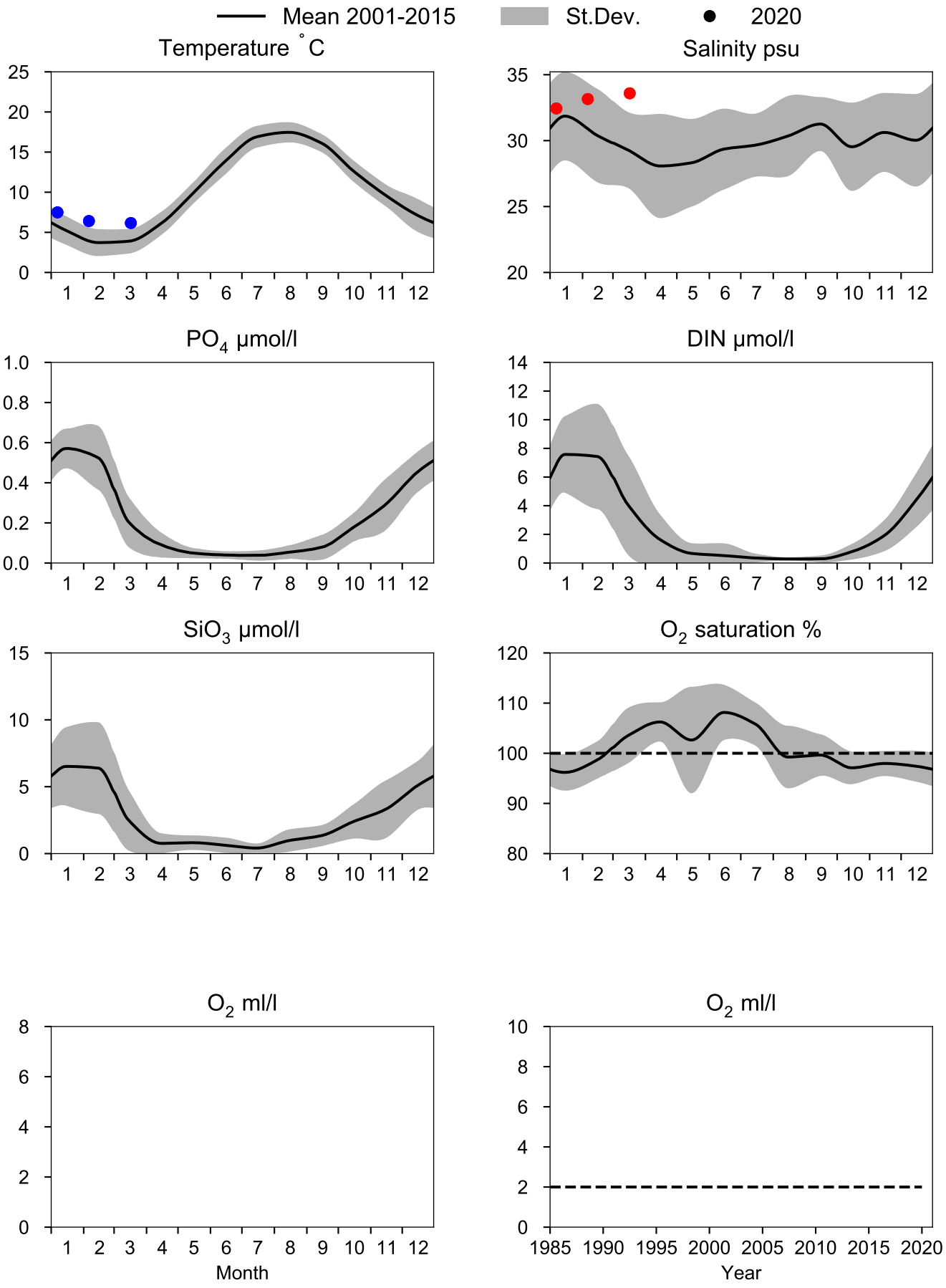


Vertical profiles Å15
March

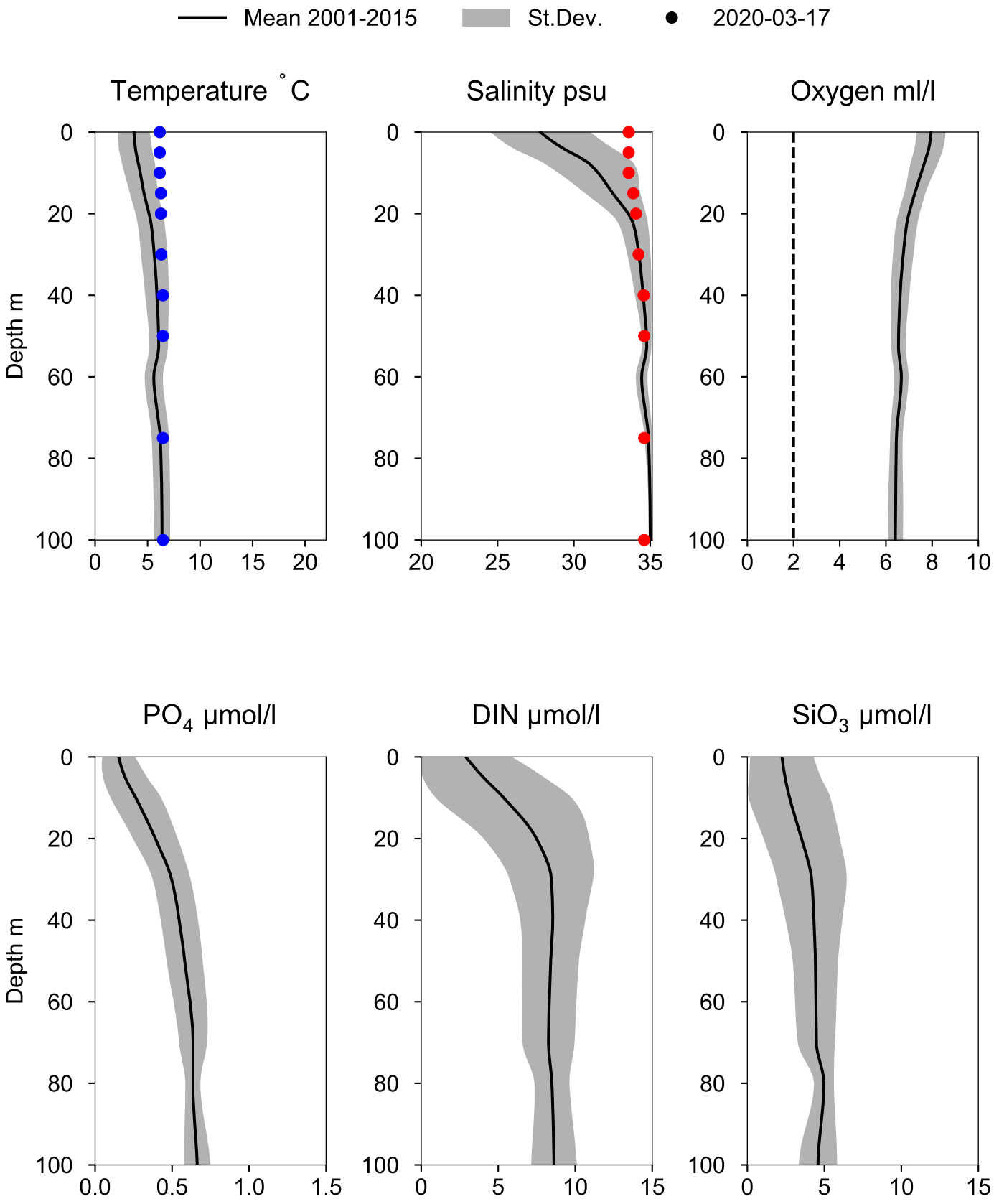


STATION Å14 SURFACE WATER (0-10 m)

Annual Cycles

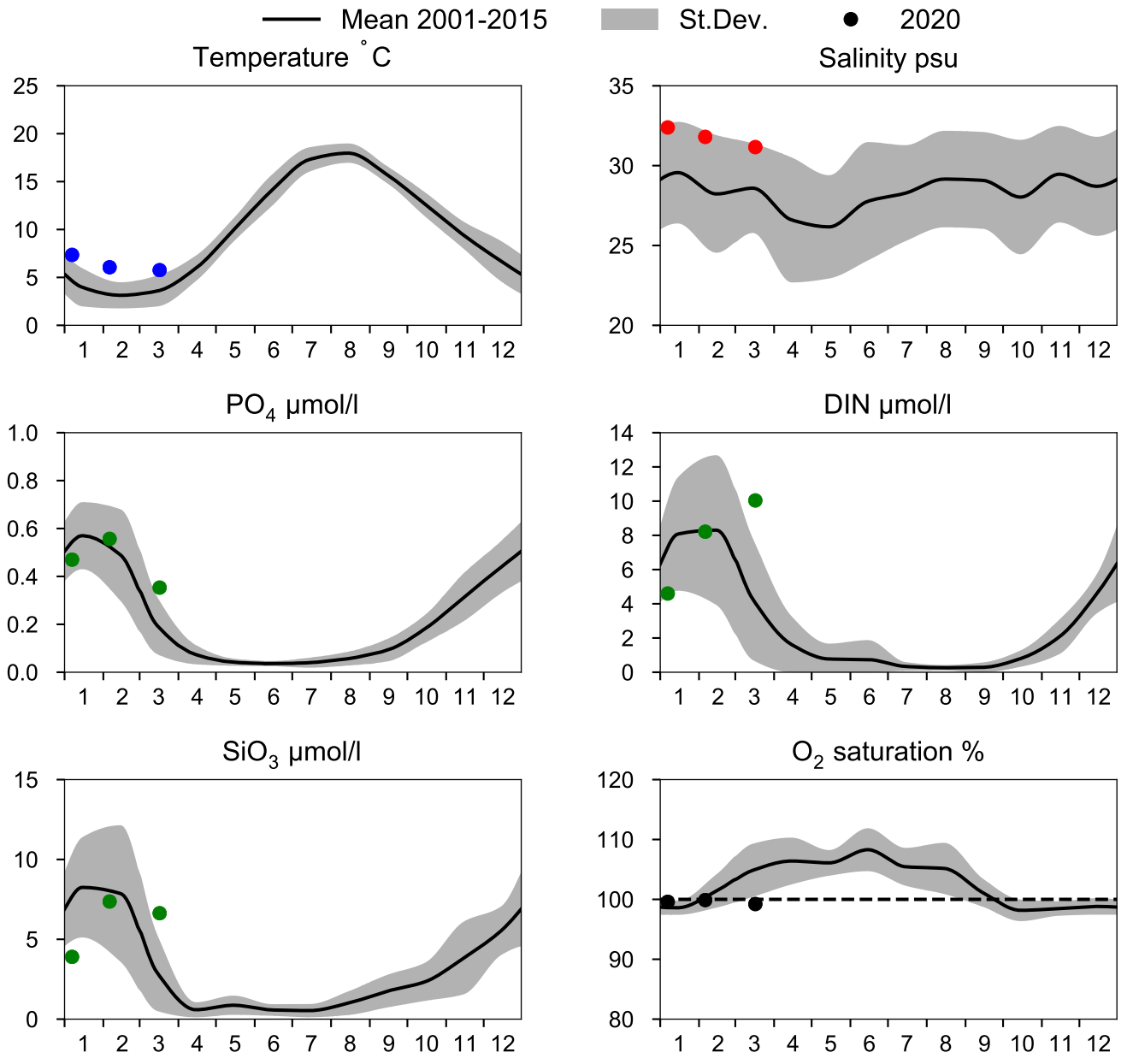


Vertical profiles Å14
March

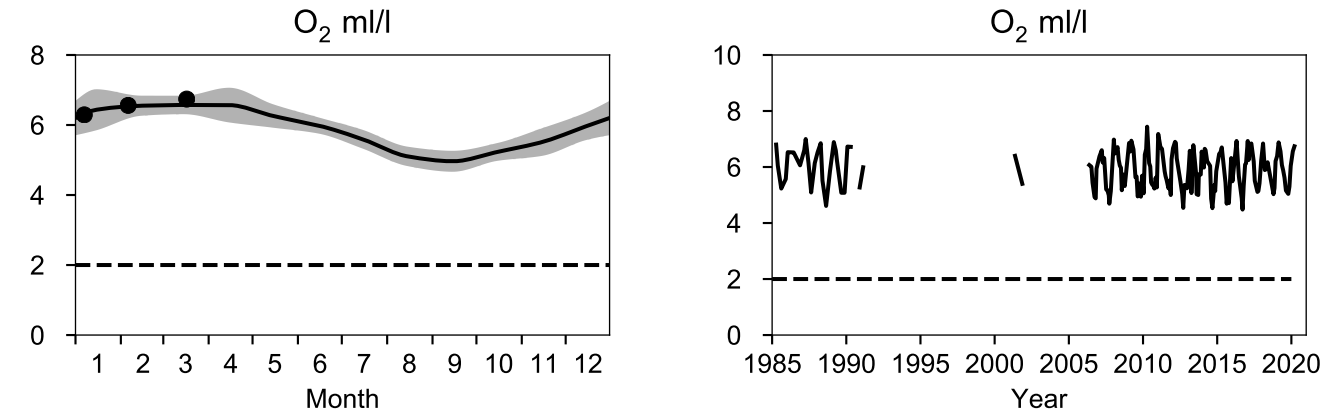


STATION Å13 SURFACE WATER (0-10 m)

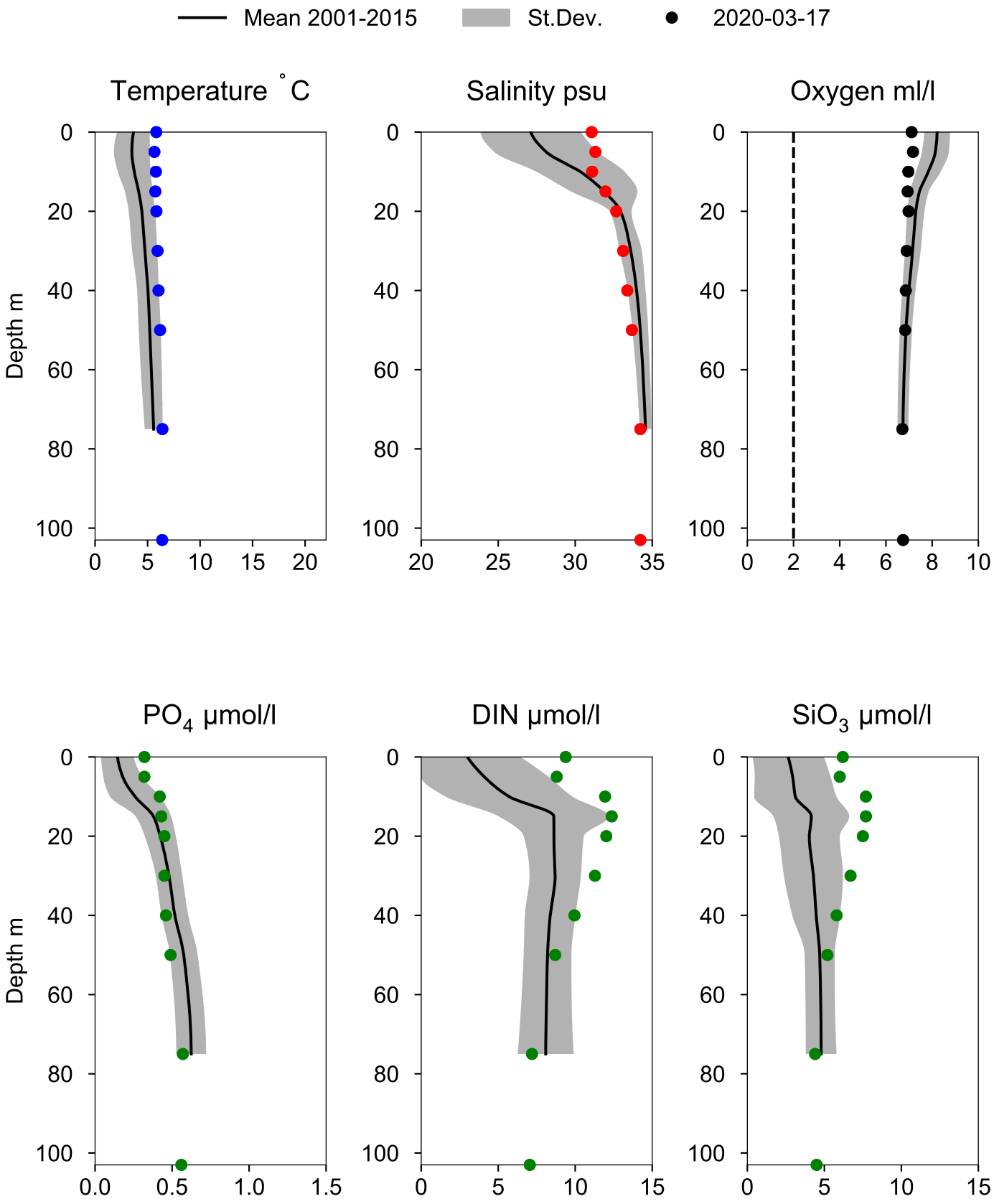
Annual Cycles



OXYGEN IN BOTTOM WATER (depth >= 80 m)

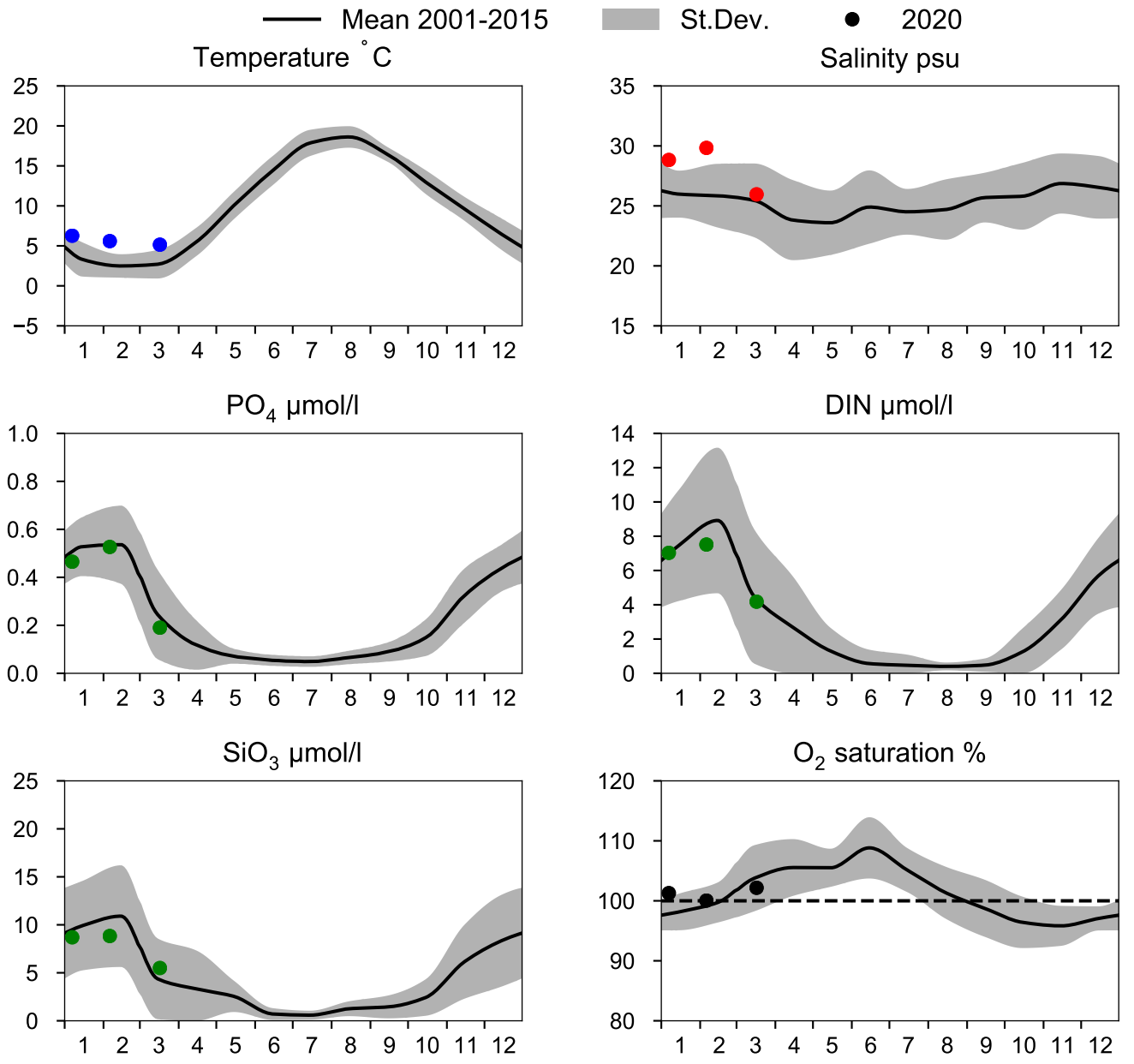


Vertical profiles Å13
March

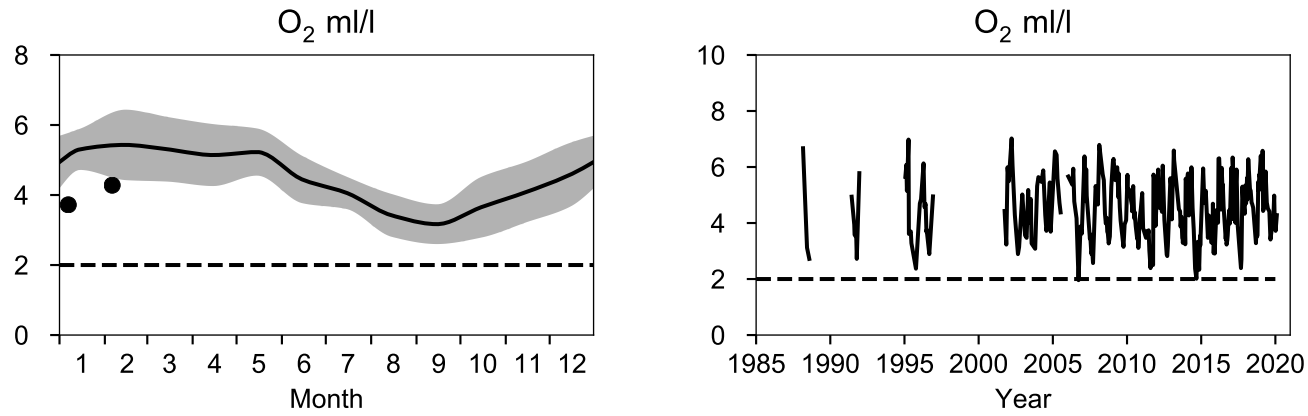


STATION SLÄGGÖ SURFACE WATER (0-10 m)

Annual Cycles



OXYGEN IN BOTTOM WATER (depth >= 64 m)



Vertical profiles SLÄGGÖ
March