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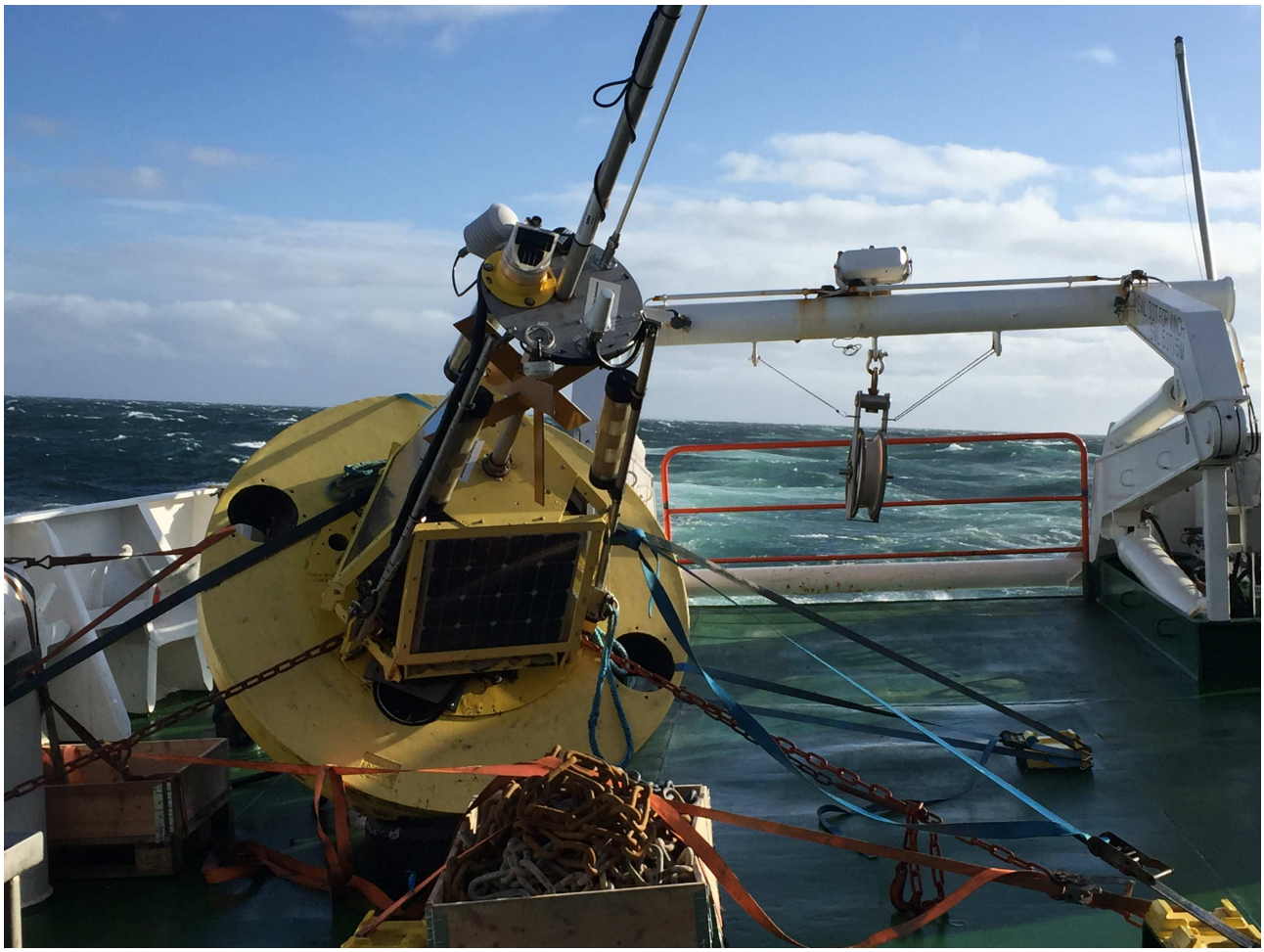
Report from the SMHI monitoring cruise with R/V Aranda



Survey period: 2019-03-14 - 2019-03-20
Principal: Swedish Meteorological and Hydrological Institute (SMHI), Swedish Agency for Marine and Water Management (SwAM).
Cooperation partners: Finnish Environment Institute (SYKE)

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SUMMARY

The March cruise, which is part of the Swedish national marine monitoring programme, covered the Skagerrak, the Kattegat, The Sound and the Baltic Proper.

The entire water column was generally well mixed in the Skagerrak area, which resulted in higher than normal salinity and temperature in the surface waters. At Å17 a weak stratification could be seen at around 30 meters, with somewhat colder and less salty water in the surface layer. The nutrient concentrations were, similar to temperature and salinity, well distributed over the entire water column. Compared to normal this meant lower or much lower concentrations in the deep waters. Also in the Kattegat nutrient concentrations below normal could be seen below the halocline.

In the Baltic Proper, both in the Eastern and Western Gotland Basin, temperature and salinity values higher than normal were found below the stratification.

No hypoxia (<2 ml O_2/l) was found in the Arkona Basin, however in the Bight of Hanö and in the Bornholm Basin hypoxia appeared from 70 meters and below, no samples with hydrogen sulphide (formed in anoxic conditions) were found in this area. Also further east, in the Eastern and Western Gotland Basin, hypoxia started from 70 meters depth. Hydrogen sulphide was first observed at BY10 closest to the bottom at 144 meters depth and at BY15 from 150 meters and below. Even though no hydrogen sulphide was found until around 150 meters the oxygen concentrations between 80 and 150 meters were very low, close to 0 ml/l. Further north at BY20, and west into the Western Gotland Basin at BY32 and BY38, hydrogen sulphide was observed from 80 meters depth and below.

Next regular cruise is scheduled to start the 5th of April.

RESULTS

The expedition was conducted aboard the Finnish vessel Aranda, it started in Helsinki the 14th of March and ended in Nynäshamn on the evening of the 20th. The winds were initially gentle to moderate from south or southwest. On the west coast of Sweden increasing to around 20 m/s, which was evident in the Skagerrak where the wave record at Väderöarna for March was exceeded. Highest significant wave height of 6.6 meters was measured during the afternoon the 17th. Aranda reached the area a couple of hours later during the night, however the sampling at Å13, Å14 and Å16 still had to be cancelled due to the rough sea which made it impossible to keep the ship steady at the station. At Å15 and Å17 measurements with the CTD and rosette could be performed, however all biological sampling from the aft deck was cancelled due to the rough sea and safety of personnel. The storm was followed by clear weather with northerly winds through the Kattegat until the Bornholm Basin. In the Eastern Gotland Basin the wind turned southwest and started out gentle, then increasing.

22 stations were sampled in total, 20 out of 23 scheduled monitoring stations and 2 extra CTD stations.

The ocean buoy at Huvudskär was safely salvaged early morning the 15th with good help from the Aranda crew. This work was planned since the buoy had stopped sending data in real time and needed service, maintenance and change of batteries. Even if the real time data transmission had stopped working in the middle of November, data was stored locally on a memory card and was downloaded after the buoy was recovered. This data will eventually be available for download at SMHI open data site:
https://www.smhi.se/klimatdata/oceanografi/ladda-ner-oceanografiska-observationer (only available in Swedish)

In addition to our regular sampling we also performed sampling for determination of DNA within the project “DNA barcoding of marine phytoplankton”, financed by the Swedish Agency for Marine and Water Management. The project includes all national monitoring stations where phytoplankton is sampled and will continue during 2019. Extra samples of phytoplankton were also sampled for Uppsala University as the last samples in a series that started last year. A new cooperation with Swiss EAWAG, Swiss Federal Institute of Aquatic Science and Technology, started in March. Ocean water is sampled to investigate the concentrations of selenium in phytoplankton. This sampling will continue until November. Next year scientists from this project will likely join a cruise for further studies.

Biological data has normally not been analysed at the time this report is written, but eventually there will be an algae report available from the current month where more information about phytoplankton is available:
https://www.smhi.se/publikationer/publikationer/algrapporter (only available in Swedish)

This report is based on data that have passed a first quality control. When data are published at the national oceanographic data centre some values might have changed due to further quality controls. Data from this cruise will be published as soon as possible on the data centre’s webpage, normally within a week after the cruise.

Data can be downloaded here: http://www.smhi.se/klimatdata/oceanografi/havsmiljodata (only available in Swedish)

The Skagerrak

The entire water column was generally well mixed in the Skagerrak area, which resulted in higher than normal salinity and temperature in the surface waters. At Å17 a weak stratification could be seen at around 30 meters, with somewhat colder and less salty water in the surface layer. The temperature varied in the surface waters between 5.5-6 ºC and deeper down between 6-7 ºC. The salinity only increased slightly with depth and was around 33-34 psu in the surface and 34-35 psu at the bottom.

The absence of strong stratification resulted in a nutrient distribution that differed compared to normal distribution for the time of the year. Normally the concentrations are low in the upper water layer because of biological production, consumption by phytoplankton, and high below the stratification due to mineralisation. Since the water column was mixed there were no large differences in concentrations for either nitrogen (DIN, dissolved inorganic nitrogen) or phosphorus (DIP, dissolved inorganic phosphorus) between the surface and bottom waters. This resulted in normal or higher than normal concentrations of DIN and DIP in the surface layer, similar values were found in the deep water which is lower or much lower than normal for the season. Similar conditions were also observed in February. Concentrations of DIN were around 3-4 µmol/l in the surface waters at Å17 down to around 30 meters, at the bottom at P2 and in the entire water column at Å15. Somewhat higher values, around 6 µmol/l, were found at Å17 between 30-150 meters and at P2 from the surface down to 50 meters. Concentrations of DIP varied between 0.3-0.4 µmol/l except at Å17 in intermediate waters, 30-150 meters, where concentrations were just over 0.5 µmol/l. Silicate concentrations followed a similar pattern with generally low values in the deep waters, 1.5-2.0 µmol/l. Somewhat more normal values were found at Å15 in the entire water column, between 2.4-3.3 µmol/l, and at Å17 above 40 meters with values around 2.7 µmol/l.

Oxygen concentrations were normal except for in the surface waters where they were somewhat below normal. This was because of the slightly higher than normal temperature. Warmer water has less capacity to hold oxygen because molecules move faster at higher temperatures and take up more space.

No clear peaks in the fluorescence measurements were found at the sampling stations in the Skagerrak, however some higher values were observed above 30 meters at Å17, above 20 meters at Å15 and in the entire water column at P2, which indicates phytoplankton presence. Since the nutrient concentrations are relatively high in the surface waters, the conditions for further phytoplankton production are good. If the weather becomes calmer and a thermocline[1] forms, with a warmer surface layer where phytoplankton can stay and get good access of sun light, a large phytoplankton production is likely.

[1] Stratification due to temperature differences with depth

The Kattegat and the Sound

Temperature and salinity were at normal levels for the month in the entire area, except at Anholt E where salinities just above normal were observed in the surface layer. Surface temperatures were around 4.5 ºC and marginally warmer in deeper water, up to 5.7 ºC. Salinity in the surface varied between 22 and 25 psu in the Kattegat, with a halocline[2] around 10-20 meters. Underlying waters had a salinity of just over 33 psu. As opposed to the Kattegat, there was no clear halocline with a well mixed surface layer in the Sound at station W Landskrona. The surface salinity was just above 12 psu and continuously increasing down to 16 meters. Below that, the salinity was around 33 psu all the way to the bottom.

Nutrient concentrations in the surface above the halocline were on normal levels, only DIN at W Landskrona deviated with higher than normal values, up to just above 7 µmol/l in the surface. DIN varied from 0.2 µmol/l in the surface water at Anholt E to just above 2 µmol/l closest to the coast at N14 Falkenberg. DIP concentrations were around 0.10-0.15 µmol/l in the Kattegat surface water and around 0.3 µmol/l in the Sound. Concentrations of silicon in the form of silicate were at 2-3 µmol/l in the Kattegat and around 10 µmol/l in the Sound. Deeper down in the water column, below the halocline in the Kattegat, there were nutrient concentrations which were lower than normal for March. Values were at normal levels in the Sound. Concentrations of DIN were around 6 µmol/l in the Kattegat and in the Sound somewhat higher, around 7.5 µmol/l. DIP concentrations varied between 0.5-0.6 µmol/l in the Kattegat and around 0.8 µmol/l in the Sound. Silicate concentrations below the halocline in the Kattegat were between 5-7 µmol/l and in the Sound just over 12 µmol/l in the deeper water.

Fluorescence measurements with the CTD indicated some presence of phytoplankton in the surface layer above the halocline but no peaks were observed.

There were no low oxygen concentrations observed at any of the visited stations.

The Baltic Proper

In the southwestern part of the Baltic Proper, Arkona Basin, Bight of Hanö and Bornholm Basin, were well mixed upper layers with temperature at 4 ºC, which is in the upper limit for what is normal for March, and salinity at 8 psu. Below this layer was a halocline and everywhere except in the Arkona Basin also a thermocline which was followed by increasing salinity and temperature towards the bottom. The stratification was located at 40 meters in the western Arkona Basin at BY1 and at 30 meters in the eastern part at BY2. In the Bight of Hanö the stratification started at 50 meters and in the Bornholm Basin at BY4 and BY5 at 45 and 40 meters respectively.

Further east, at station BCS III-10, and north, in both Eastern and Western Gotland Basin, the conditions were similar with a well mixed upper layer followed by a halocline and thermocline at the same depth, then increasing temperature and salinity with depth towards the bottom. Both salinity and temperature in the surface water decreased somewhat northward, eventually down to 2.5 ºC and 7 psu at BY20 and BY32 furthest north. The stratification was located at 50-70 meters depth, shallowest in the north. The water beneath the stratification in this part of the Baltic had temperature and salinity which were slightly above what is normal for March, temperature 5-6 ºC, in the Eastern

[2] Stratification due to salinity differences with depth

Gotland Basin up to 7.5 ºC beneath 100 meters depth. Salinity increased rapidly at the halocline to over 10 psu, then slowly increasing towards the bottom, 13.3 psu as highest closest to the bottom at BY15, in the Western Gotland Basin up to 10.7 psu at BY32.

Nutrient concentrations in southwestern Baltic Proper, from BY1 to BY5, were at normal levels. In the surface layer, above the stratification, concentrations of DIP were around 0.5 µmol/l, DIN between 0.8-1.8 µmol/l and silicate at around 14 µmol/l, then increasing towards the bottom.

In the Eastern Gotland Basin normal levels for the season of DIN and DIP were measured, the deep water at BY10 deviated somewhat with DIN values just below normal. In the Western Gotland Basin DIN values below the stratification were below normal, otherwise normal concentrations were observed. Values of DIN above the stratification were between 2.4-3.1 µmol/l and increasing towards the bottom, mostly at the four northernmost stations where concentrations passed 10 µmol/l, BY15, BY20, BY32 and BY38, where also hydrogen sulphide was observed. Highest concentration was found closest to the bottom at BY15, 17.5 µmol/l. Concentration of DIP were stable at around 0.6-0.7 µmol/l in the upper water mass, then increasing with depth below the stratification to over 3 µmol/l, at most up to 4.5 µmol/l, also that closest to the bottom at BY15.

Concentrations of silicon, in the form of silicate, were somewhat higher than normal in the surface layer in the Eastern Gotland Basin and in the southeast at BCS III-10, a bit over normal in the entire water column in the Western Gotland Basin. Concentrations in the surface layer were just above 15 µmol/l in the southeast at BCS III-10, BY10 and BY15. Over 18 µmol/l were measured at the stations in the northwest at BY20, BY32 and BY38. Values increased below the stratification towards the bottom to reach over 60 µmol/l as highest.

At the coastal station Ref M1V1 lower concentrations than normal of DIN and DIP were measured and the silicate concentration was much lower than normal. Nitrogen in the form of DIN was completely consumed and only phosphorus was available for biological production. This is one of the conditions that favour cyanobacteria that can fix nitrogen gas instead of using DIN in the water.

Oxygen conditions in the southwestern part of the Baltic were normal. No acute hypoxia (<2 ml O_2/l) was found in the Arkona Basin, however in the Bight of Hanö and the Bornholm Basin acute hypoxia was observed from 70 meters depth, no hydrogen sulphide was found in this area. Further east, in the Eastern Gotland Basin, acute hypoxia was observed from 70 meters depth, as well in the Western Gotland Basin. Hydrogen sulphide, formed at anoxic conditions, was found first at BY10 closest to the bottom at 144 meters depth, also at BY15 hydrogen sulphide wasn't observed until 150 meters depth and beneath. Even though no hydrogen sulphide was found until 150 meters the oxygen concentration between 80 and 150 meters was very low, around 0 ml/l. Northward at BY20, and west into the Western Gotland Basin at BY32 and BY38, hydrogen sulphide was observed from 80 meters depth and below. Values were somewhat higher than normal, at least at the stations in the Western Gotland Basin. Oxygen conditions in the bottom water at BY32 has slowly deteriorated since the spring 2018, at BY38 however there was an oxygen increase in the bottom water in January this year. This could be caused by water from the south flowing over the sill east of Öland. Another possibility is that overlaying waters have mixed down and oxygenated the bottom water. A temporary decrease in salinity in the bottom water supports this theory that overlaying, less salty water, has mixed with the saltier bottom water. This is possibly caused by internal waves in the stratification layer at the same time as this layer moved from about 60 meters in December to around 80 meters in January.

Fluorescence measurements with the CTD indicated larger concentrations of phytoplankton at the coastal station Ref M1V1 and the spring bloom has probably started there, also the low concentrations of nutrients at this station is a sign that phytoplankton blooms have consumed all available nitrogen. Otherwise the measurements showed low activity above the stratification in the entire Baltic Proper, somewhat higher in the north at station BY32 and at the stations in the southwestern Baltic east and west of Bornholm, BY1, BY2 and BY5. More information about phytoplankton is available in the AlgAware report (only available in Swedish).

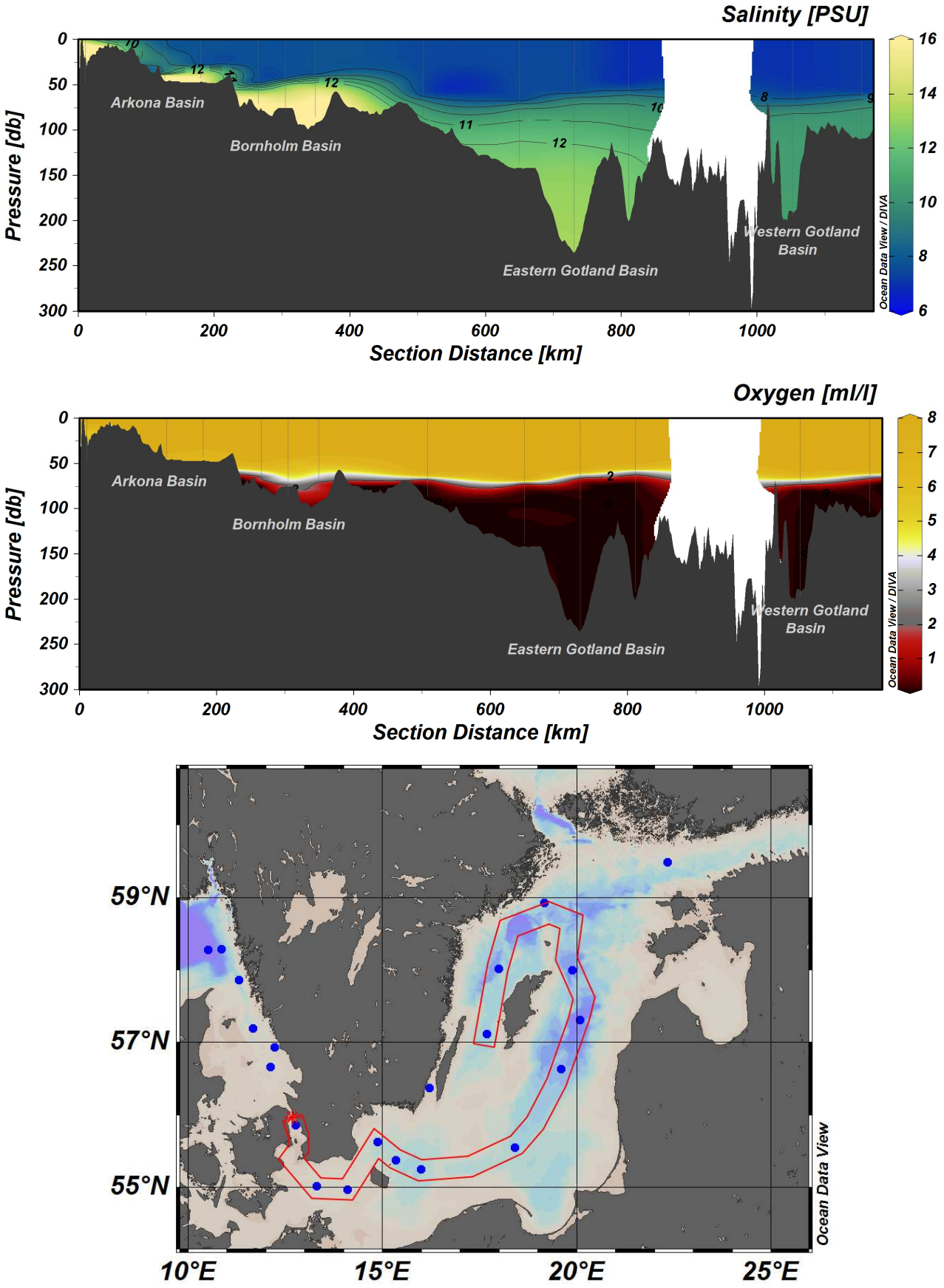

Figure 1. Transect showing dissolved oxygen and salinity from the Sound, through the Baltic Proper, to the Western Gotland Basin.

PARTICIPANTS

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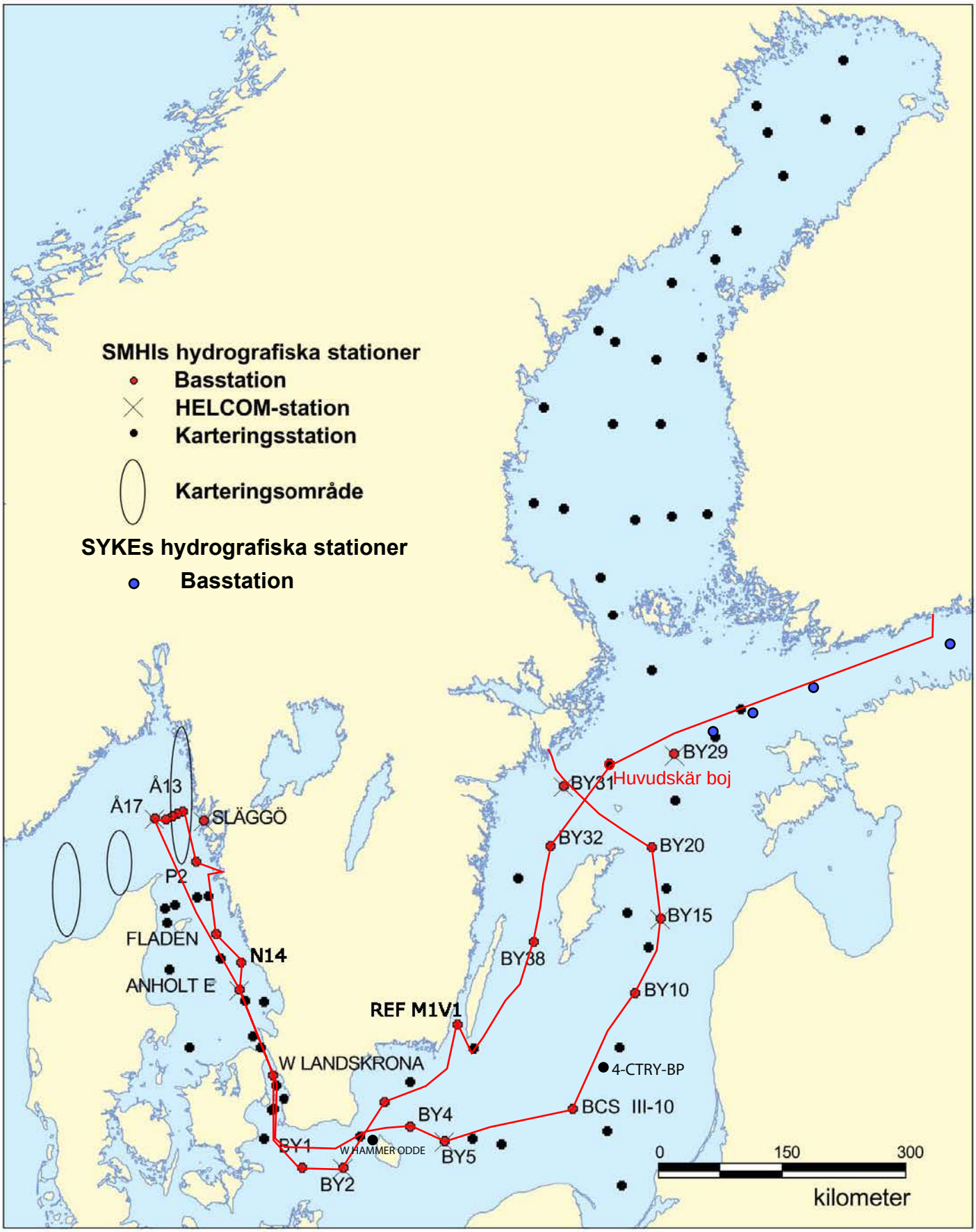
Kristin Andreasson		SMHI
Jenny Lycken	Quality manager	SMHI

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

SMHI
Havs och Vatten myndigheten


SMHIs hydrografiska stationer
Basstation
HELCOM-station
Karteringsstation
Karteringsområde
SYKEs hydrografiska stationer
Basstation
Å13
Å17
SLÄGGÖ
P2
FLADEN
N14
ANHOLT E
REF M1V1
W LANDSKRONA
BY1
W HAMMER ODDE
BY2
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BY15
BY38
BY10
4-CTRY-BP
BCS III-10
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150
300
kilometer

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Ship: AR
Year: 2019

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	Tsal _ btl	Tsal _ btl	Spar _ btl	Doxy _ btl	Doxy _ btl	H2S	Phos	Ptot	Ntra	Ntri	Nnit	Namm	Ntot	Nook	Asil 3-si	Hum	Cond _ sal	Cond _ sal
0166	5	BPNX00	EXT...	17W LL12	5929.57	02219.89	20190314	1830	55		15	9	2.1		9990	----	8	0	-	x	-	x	-	x	-	-	-	-	-	-	-	-	-	x	-
0167	5	BPNX00	EXT...	HUVUDSKÄR	5856.04	01909.73	20190315	0325	95		19	4.8	0.7		9990	----	12	0	-	x	-	x	-	-	x	-	-	-	-	-	-	-	-	x	-
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0173	5	BPSA02	BAS...	BY1	5500.04	01318.04	20190316	2000	47		19	11.2	4.7	995	9990	x---	8	8	x	x	x	x	-	x	x	-	x	x	x	x	x	x	-	x	-	-	-
0174	5	SOCX39	BAS...	W LANDSKRONA	5552.00	01244.90	20190317	0150	50		20	11	6.4	987	9999	x---	9	9	x	x	x	x	-	x	x	-	x	x	x	x	x	x	-	x	-	-	-
0175	5	KAEX29	BAS...	ANHOLT E	5640.12	01206.69	20190317	0650	62	7	22	13	5.5	984	2840	xxxx	10	10	x	x	x	x	x	x	-	x	x	x	x	x	x	x	x	x	-
0176	5	KANX50	BAS...	N14 FALKENBERG	5656.40	01212.72	20190317	0930	30	7	21	14	5.2	984	1240	xxx-	7	7	x	x	x	x	x	x	-	x	x	x	x	x	x	x	x	-	-	-
0177	5	KANX25	BAS...	FLADEN	5711.59	01139.49	20190317	1300	84		21	20	5.3	981	1550	x---	12	12	x	x	x	x	-	x	x	-	x	x	x	x	x	x	-	x	-	-	-
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0180	5	SKEX18	BAS...	Å17	5817.04	01030.21	20190318	0429	340		36	18	3.3	983	9990	x---	15	12	x	x	-	x	x	x	x	-	x	x	x	x	x	x	x	-	x	-
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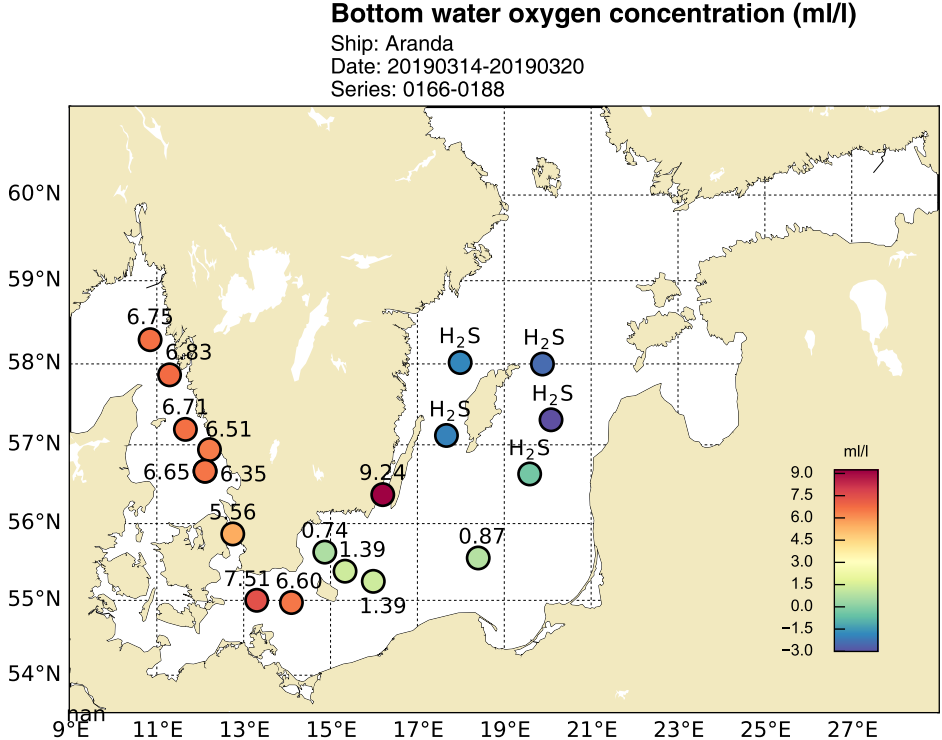
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23°E
25°E
27°E
6.75
6.83
6.71
6.51
6.65
6.35
5.56
7.51
6.60
0.74
1.39
1.39
9.24
H2S
H2S
H2S
H2S
H2S
0.87
ml/l
9.0
7.5
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1.5
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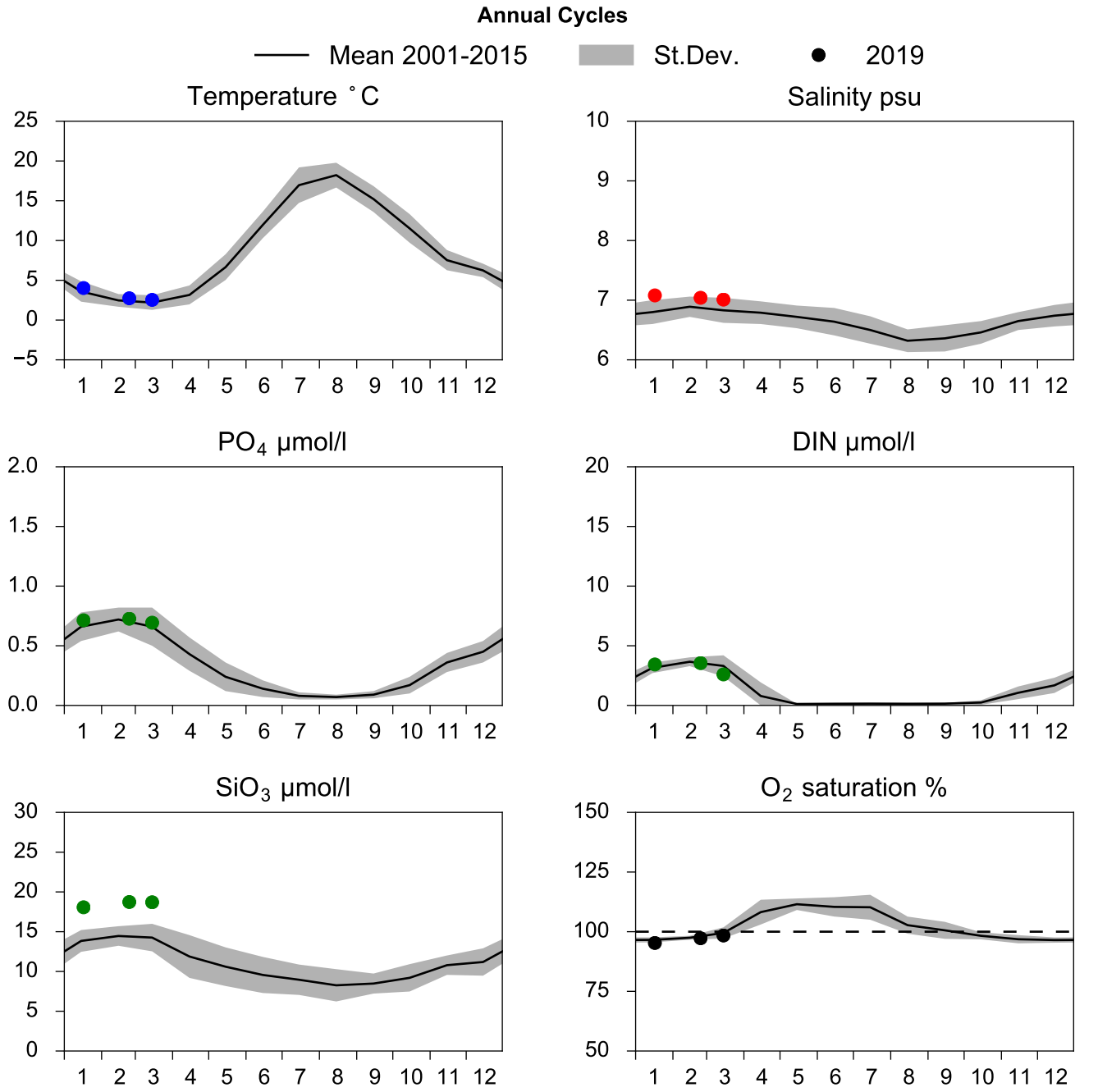
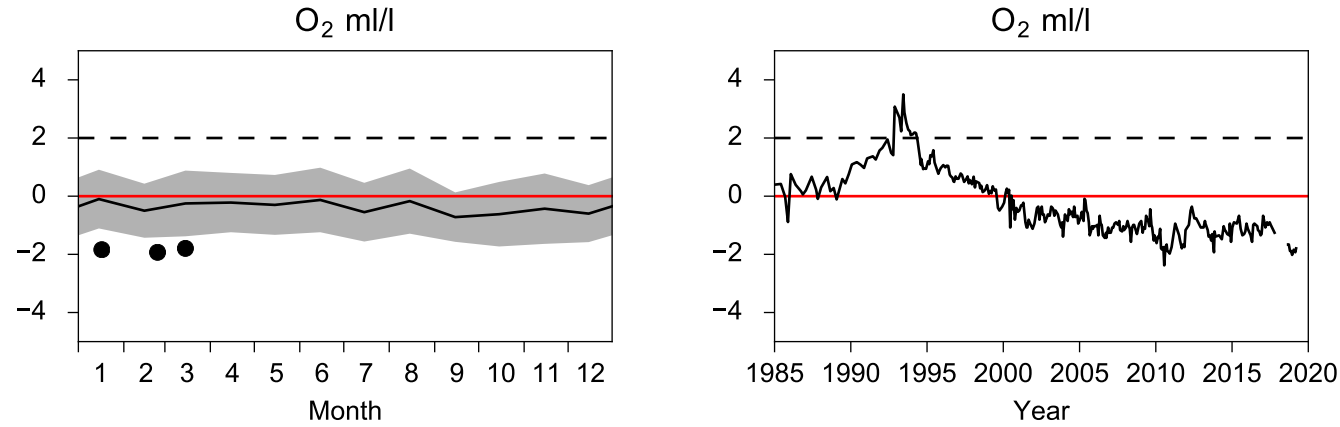
−3.0

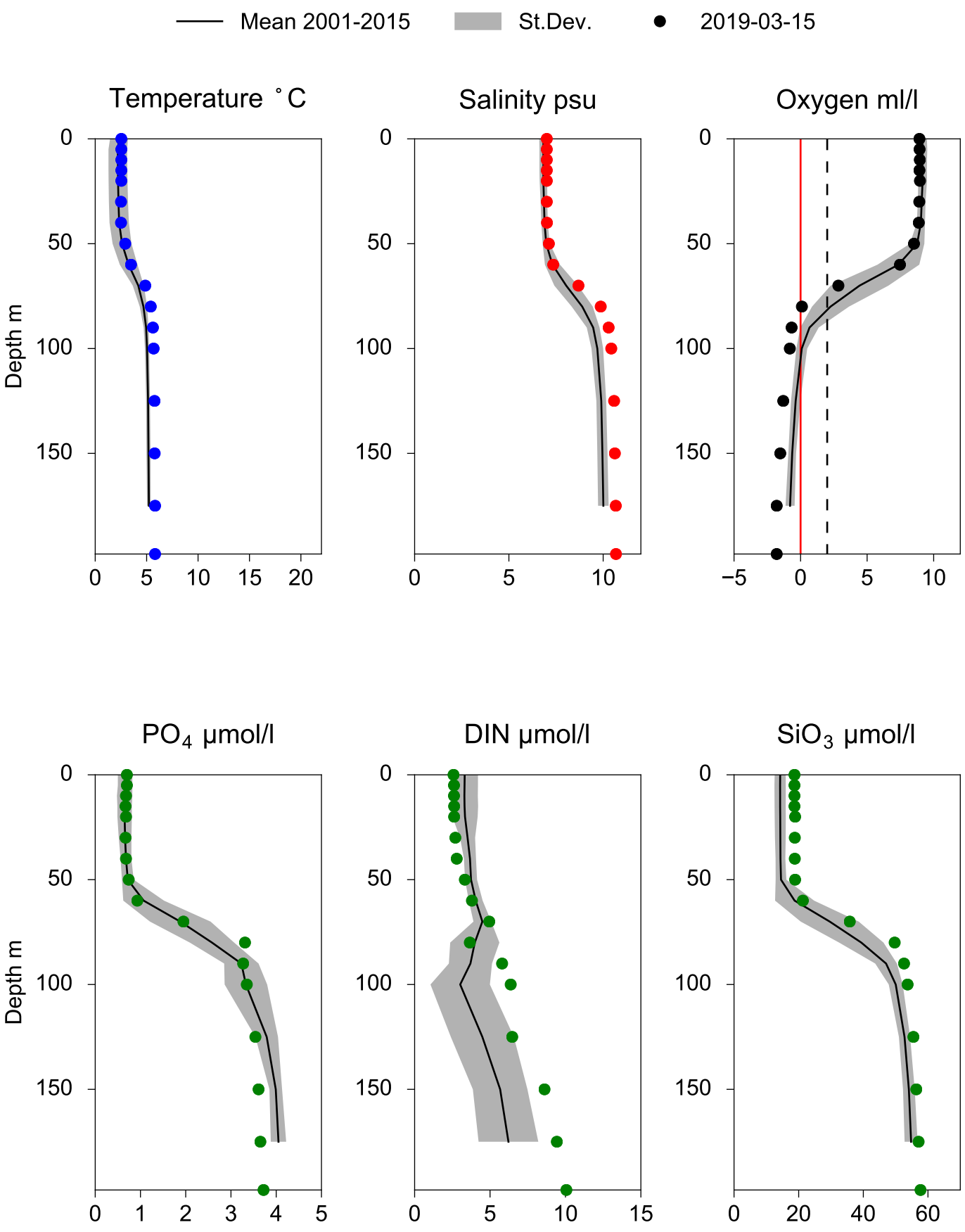
STATION BY32 NORRKÖPINGSDJ SURFACE WATER (0-10 m)



OXYGEN IN BOTTOM WATER (depth >= 175 m)

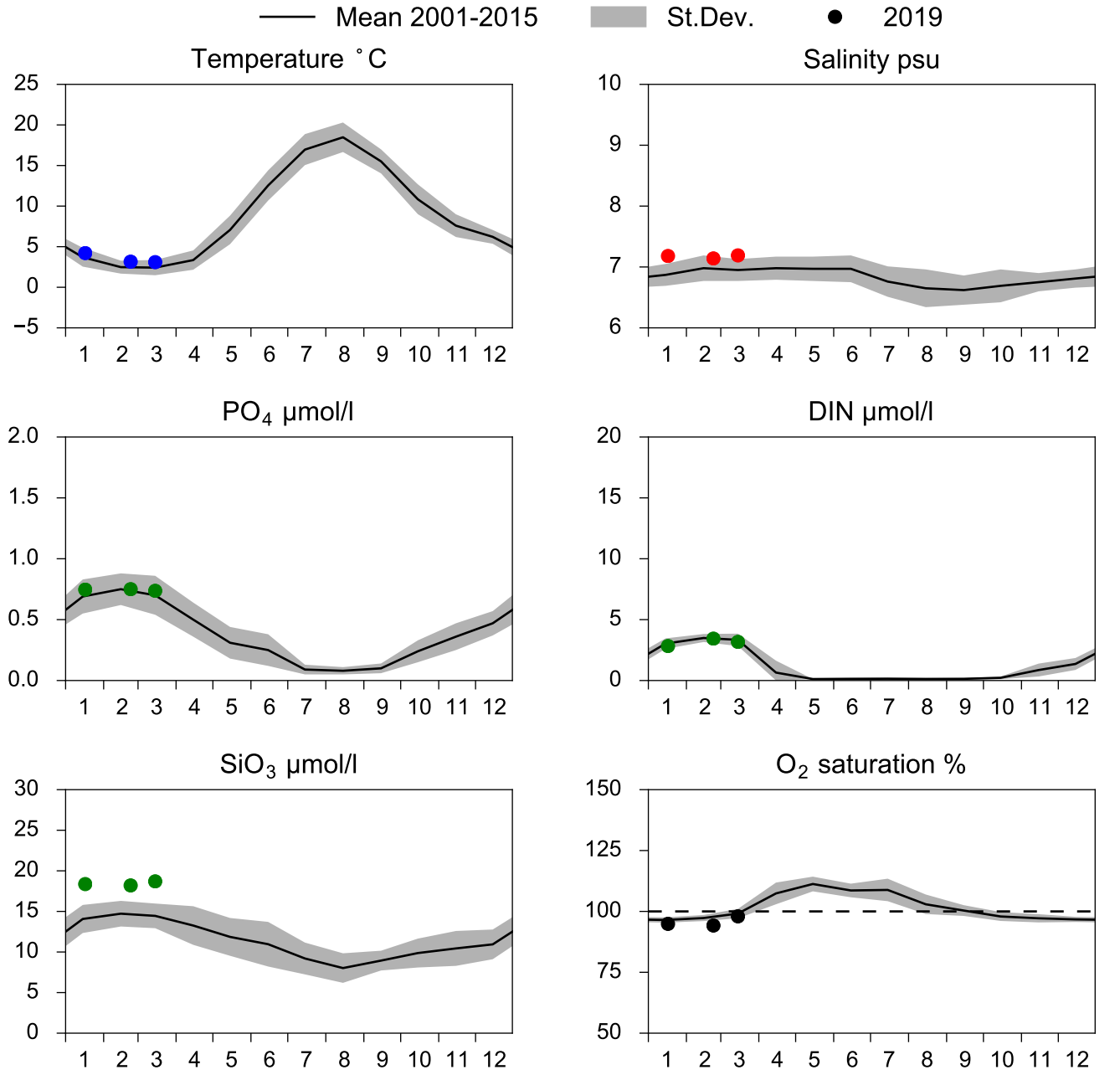


Vertical profiles BY32 NORRKÖPINGSDJ
March

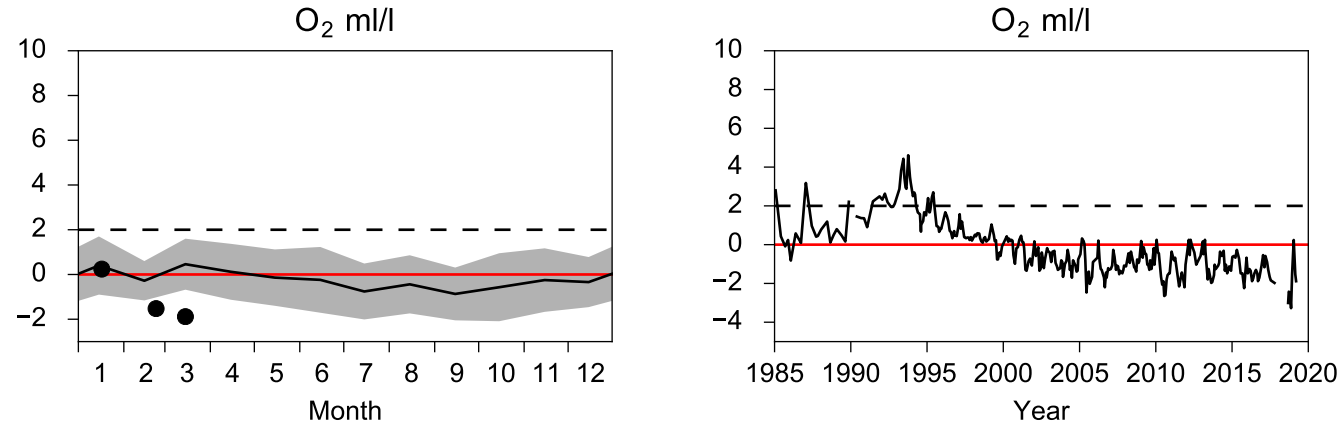


STATION BY38 KARLSÖDJ SURFACE WATER (0-10 m)

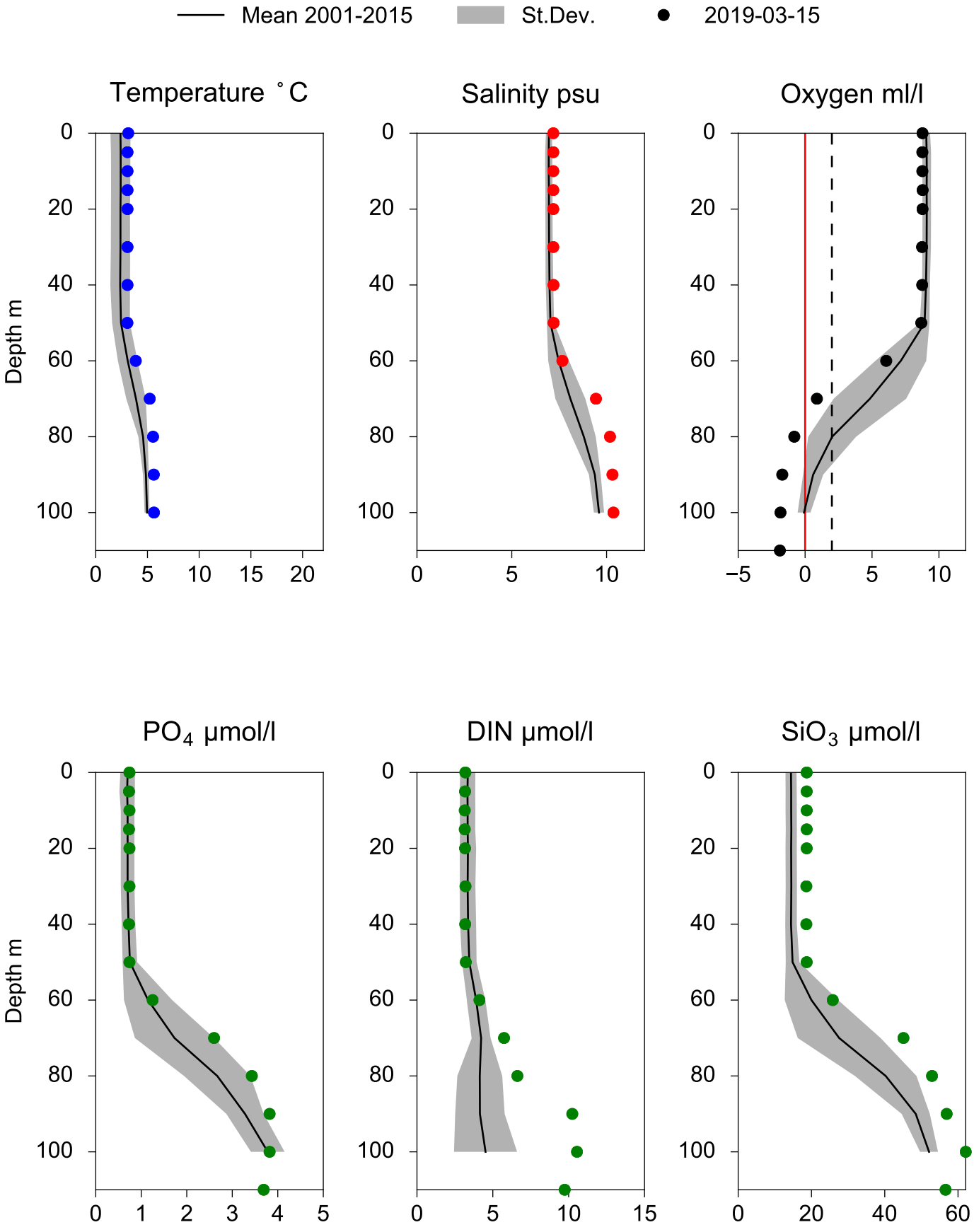
Annual Cycles



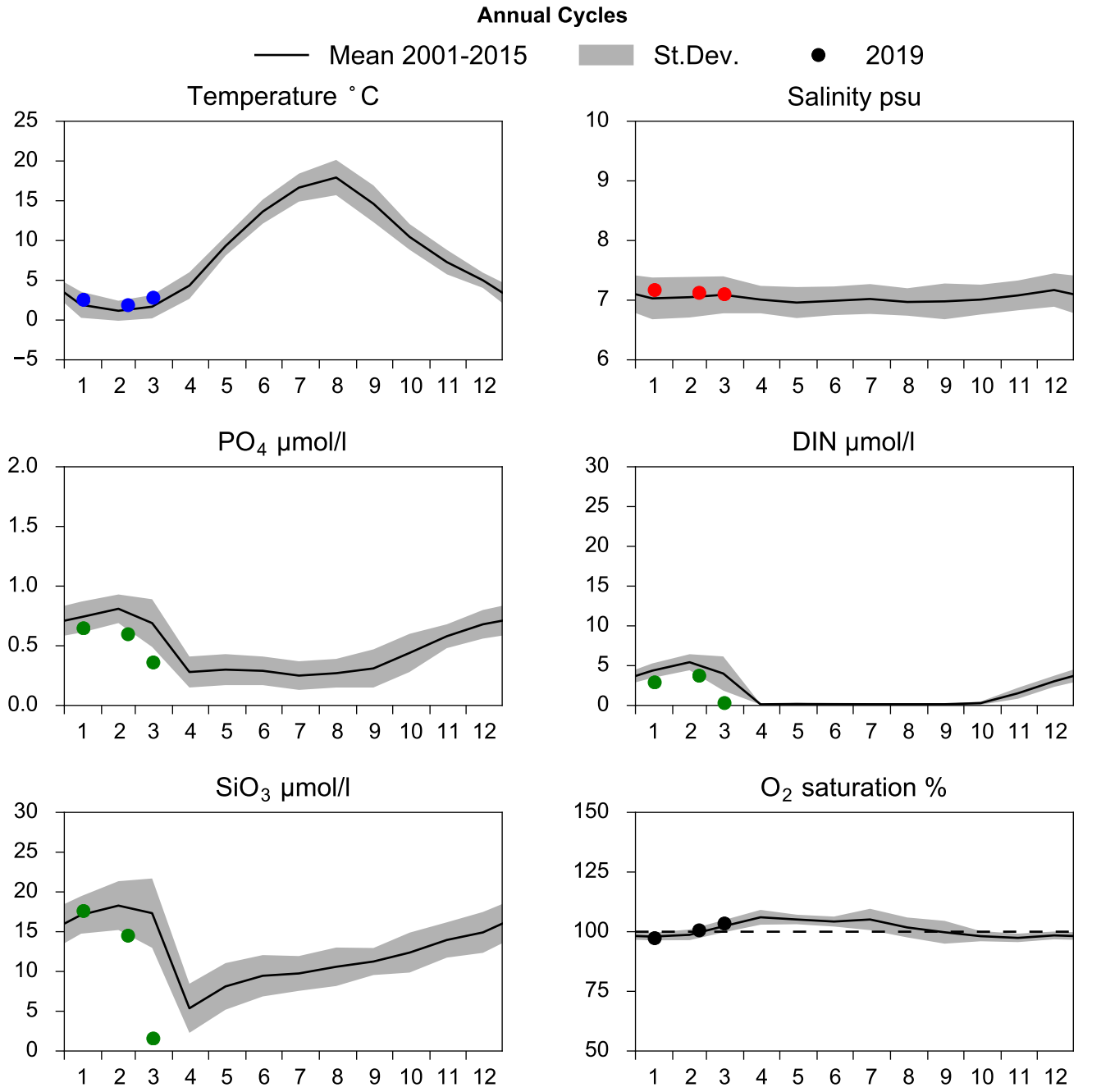
OXYGEN IN BOTTOM WATER (depth >= 100 m)



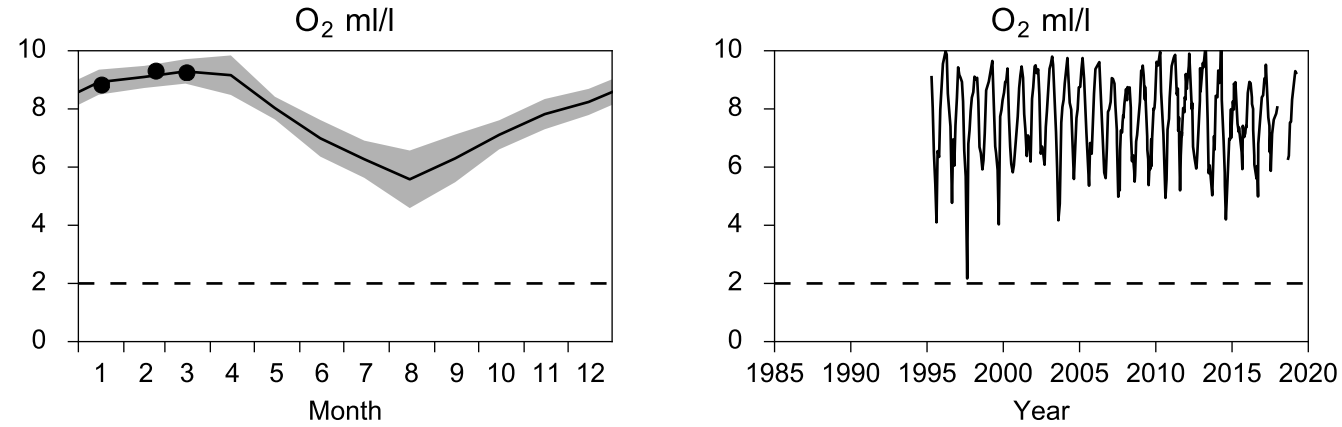
Vertical profiles BY38 KARLSÖDJ
March



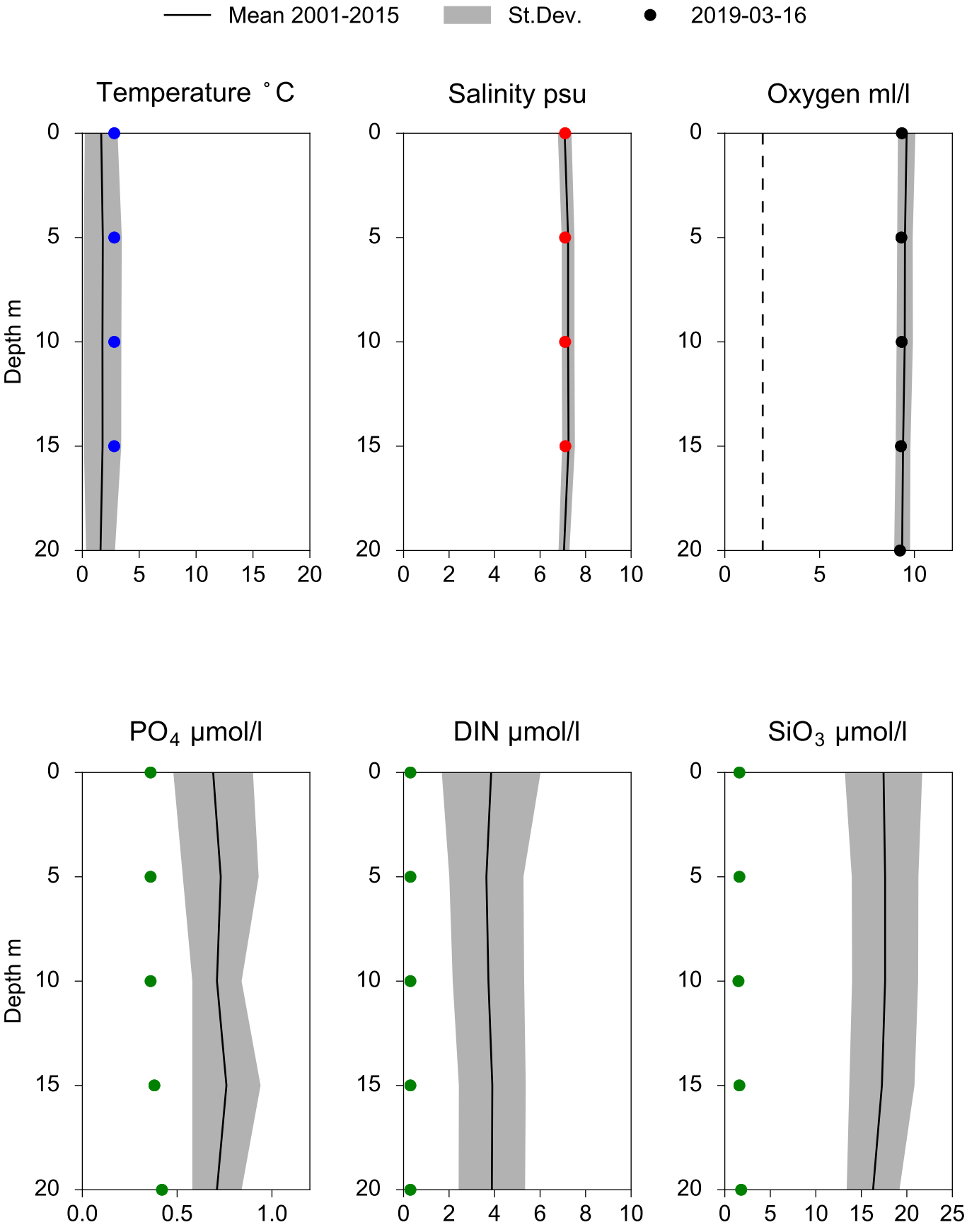
STATION REF M1V1 SURFACE WATER (0-10 m)



OXYGEN IN BOTTOM WATER (depth >= 17 m)

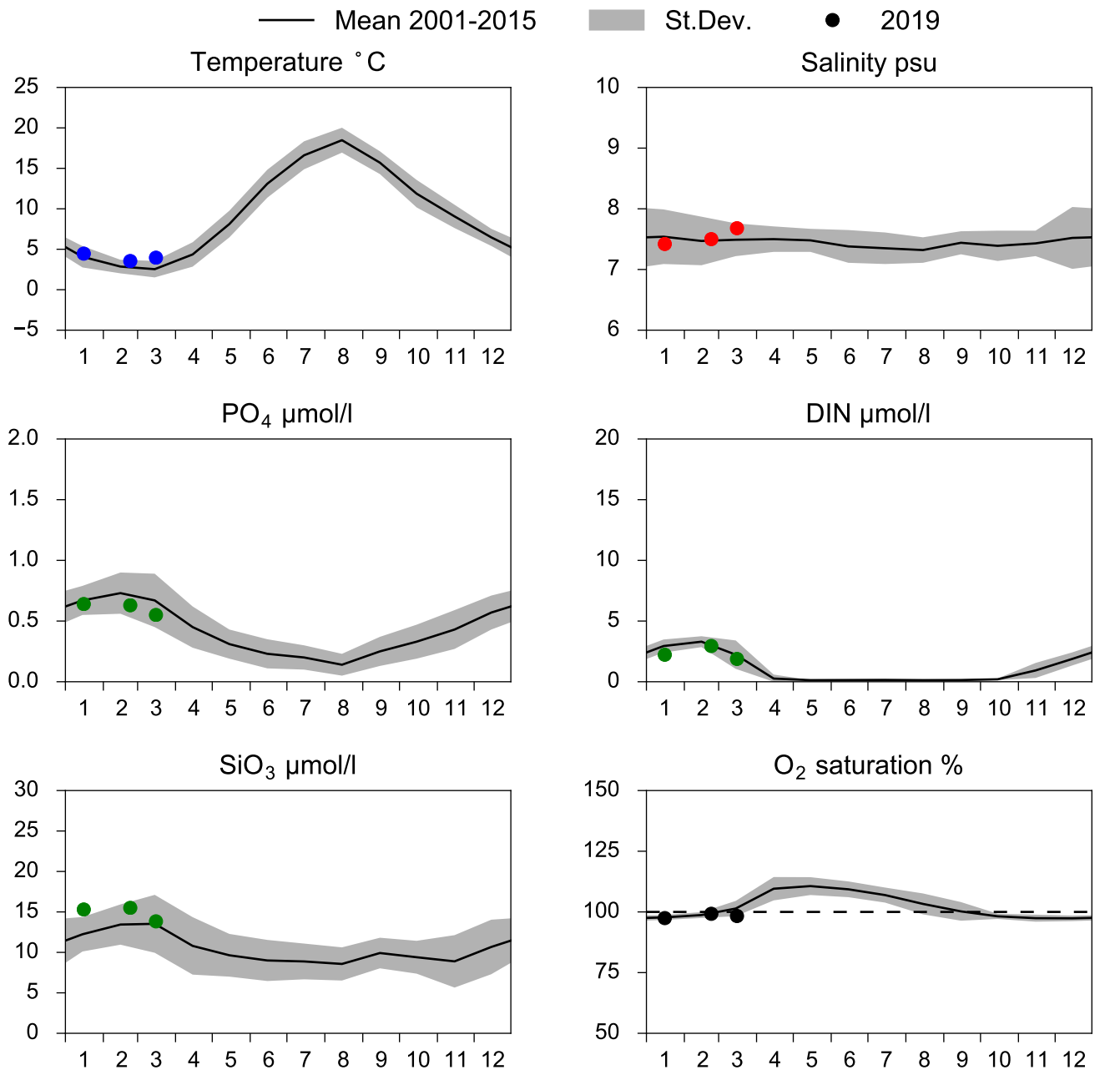


Vertical profiles REF M1V1
March

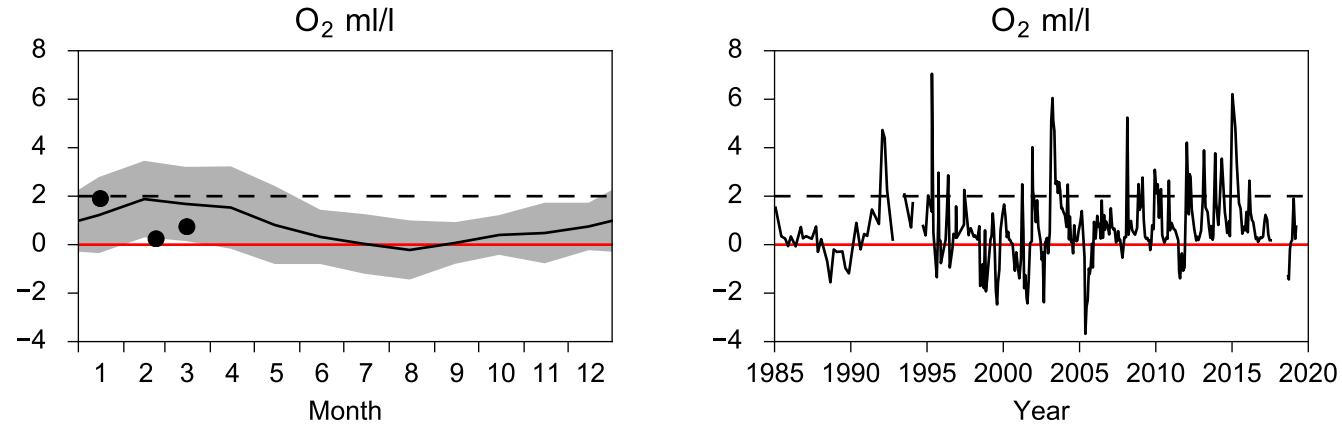


STATION HANÖBUKTEN SURFACE WATER (0-10 m)

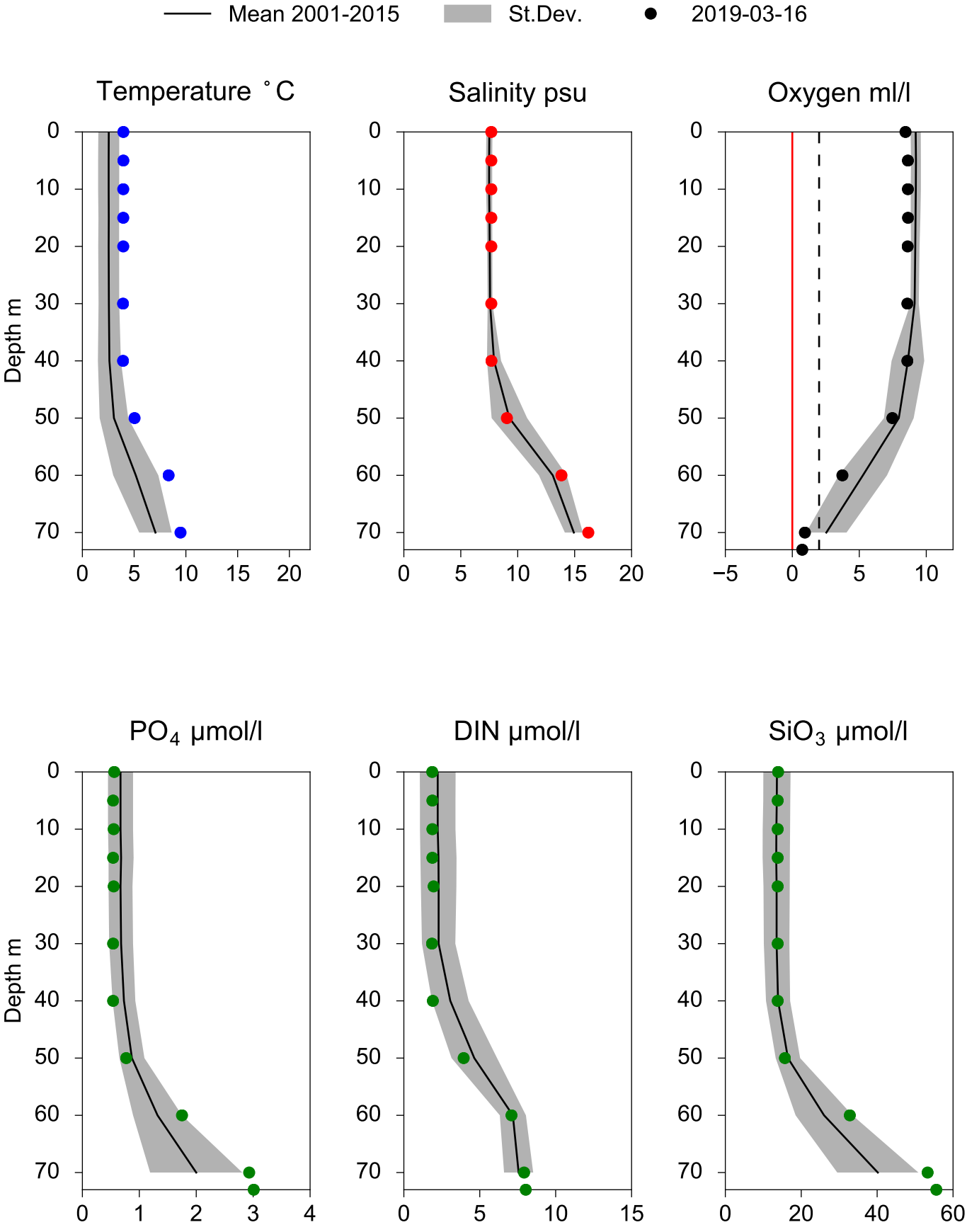
Annual Cycles



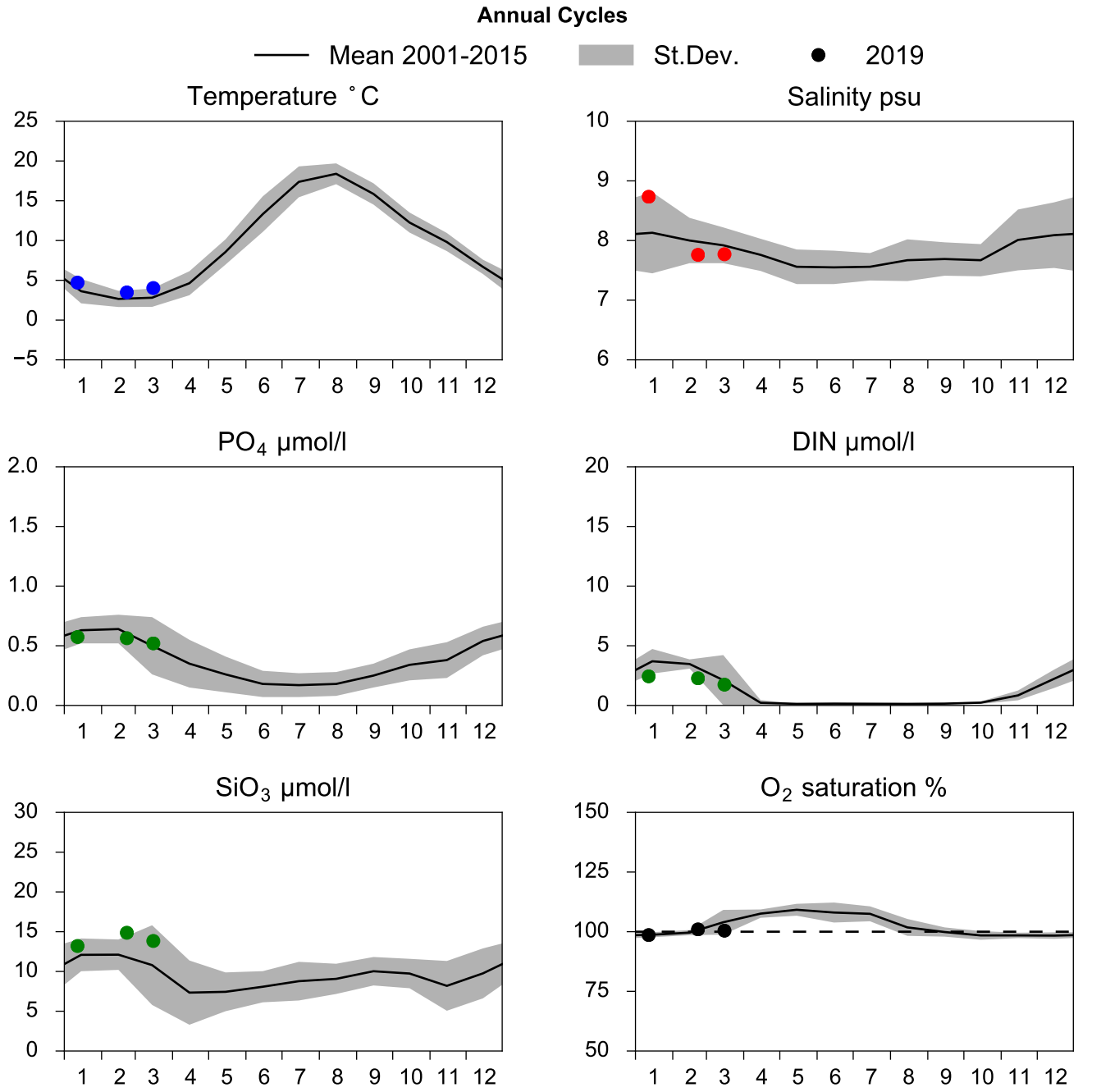
OXYGEN IN BOTTOM WATER (depth >= 70 m)



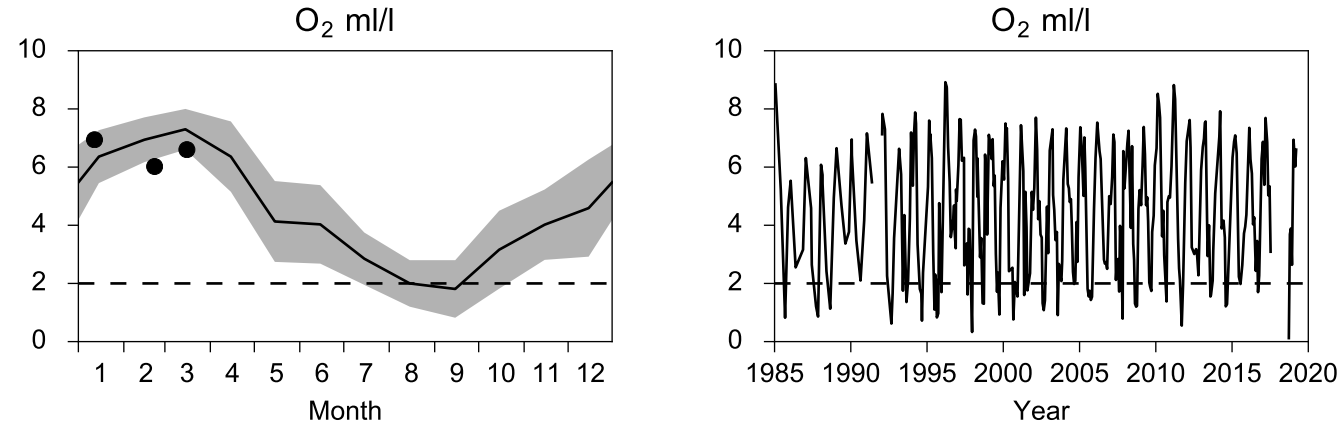
Vertical profiles HANÖBUKTEN
March



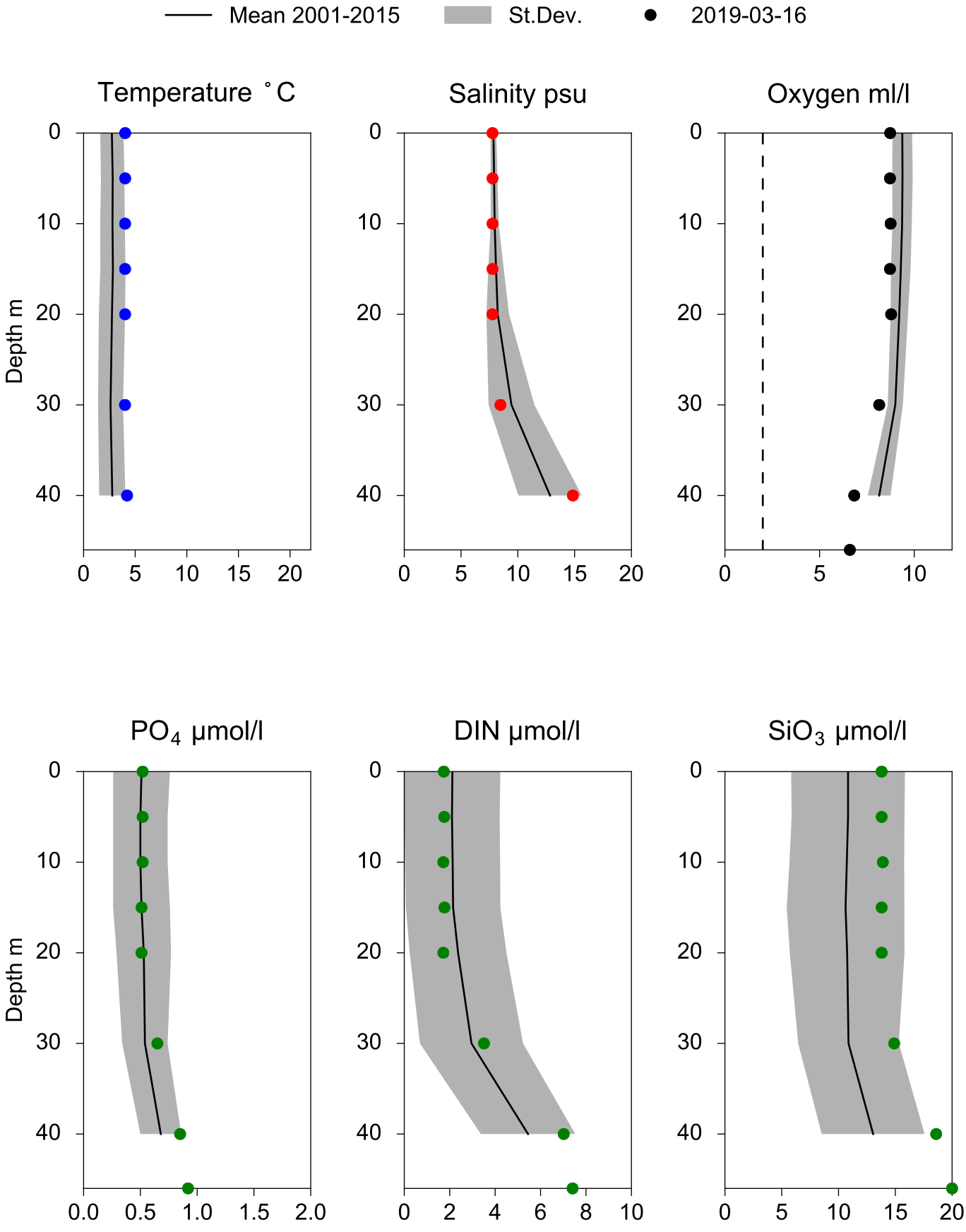
STATION BY2 ARKONA SURFACE WATER (0-10 m)



OXYGEN IN BOTTOM WATER (depth >= 40 m)

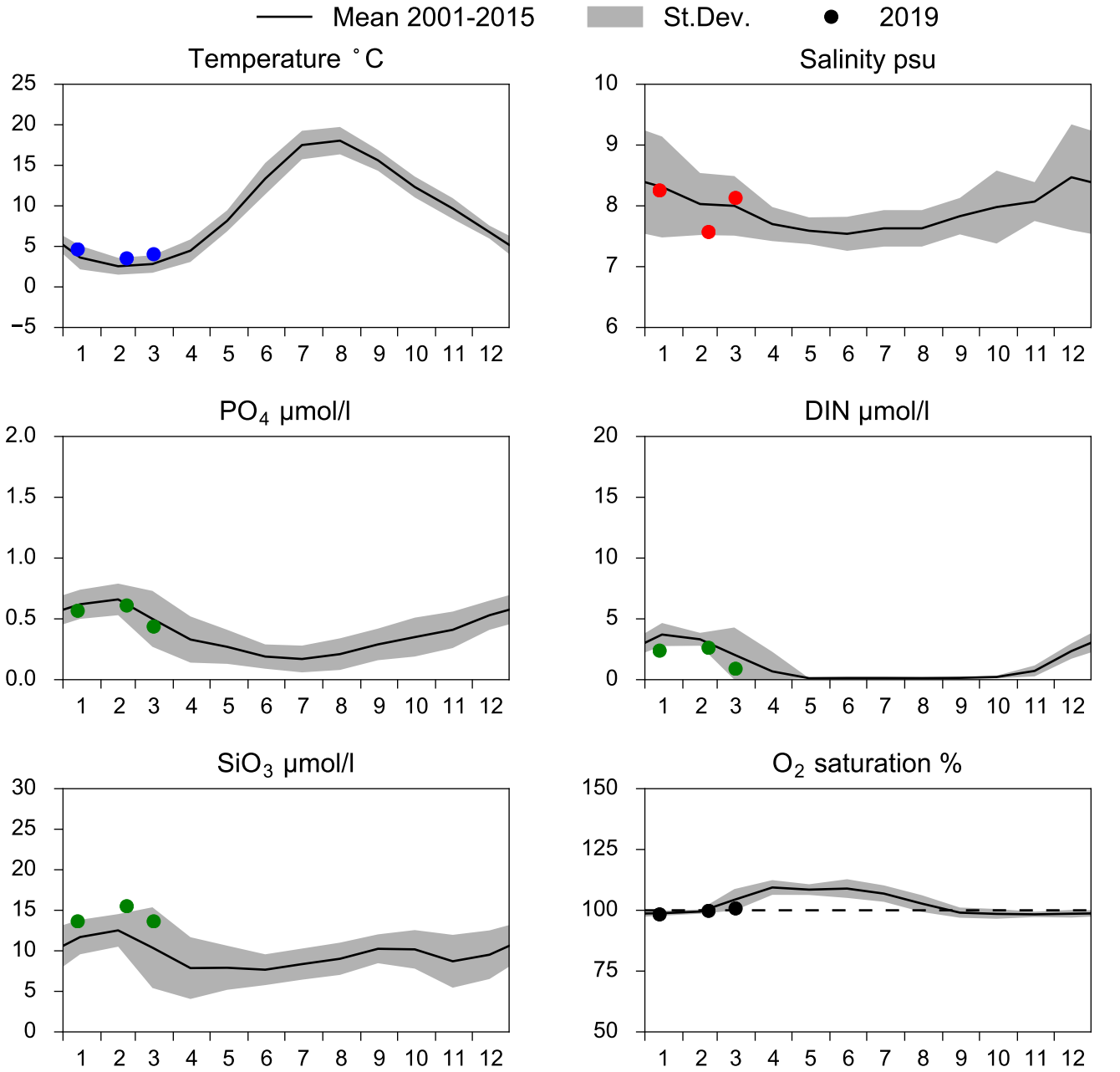


Vertical profiles BY2 ARKONA
March

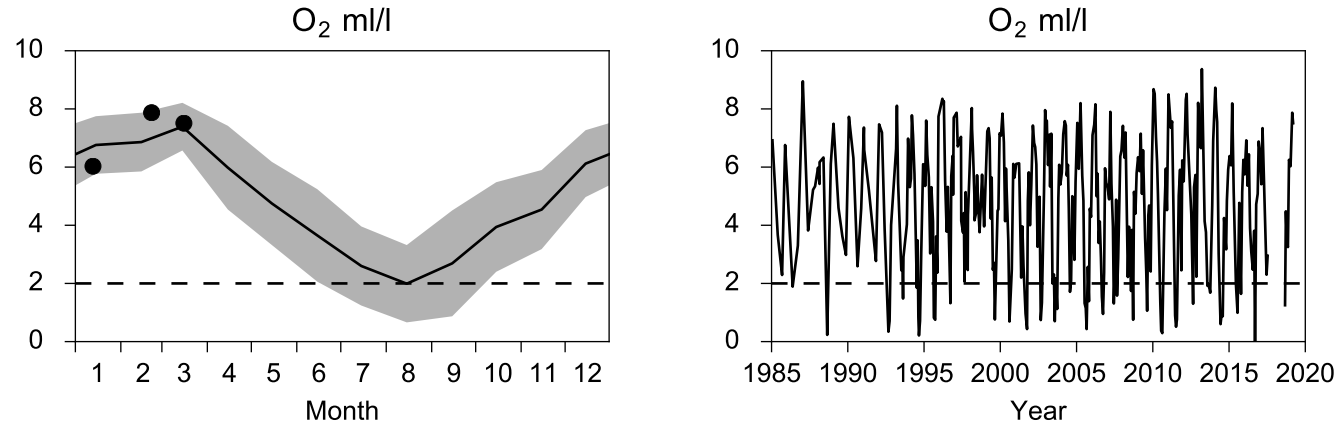


STATION BY1 SURFACE WATER (0-10 m)

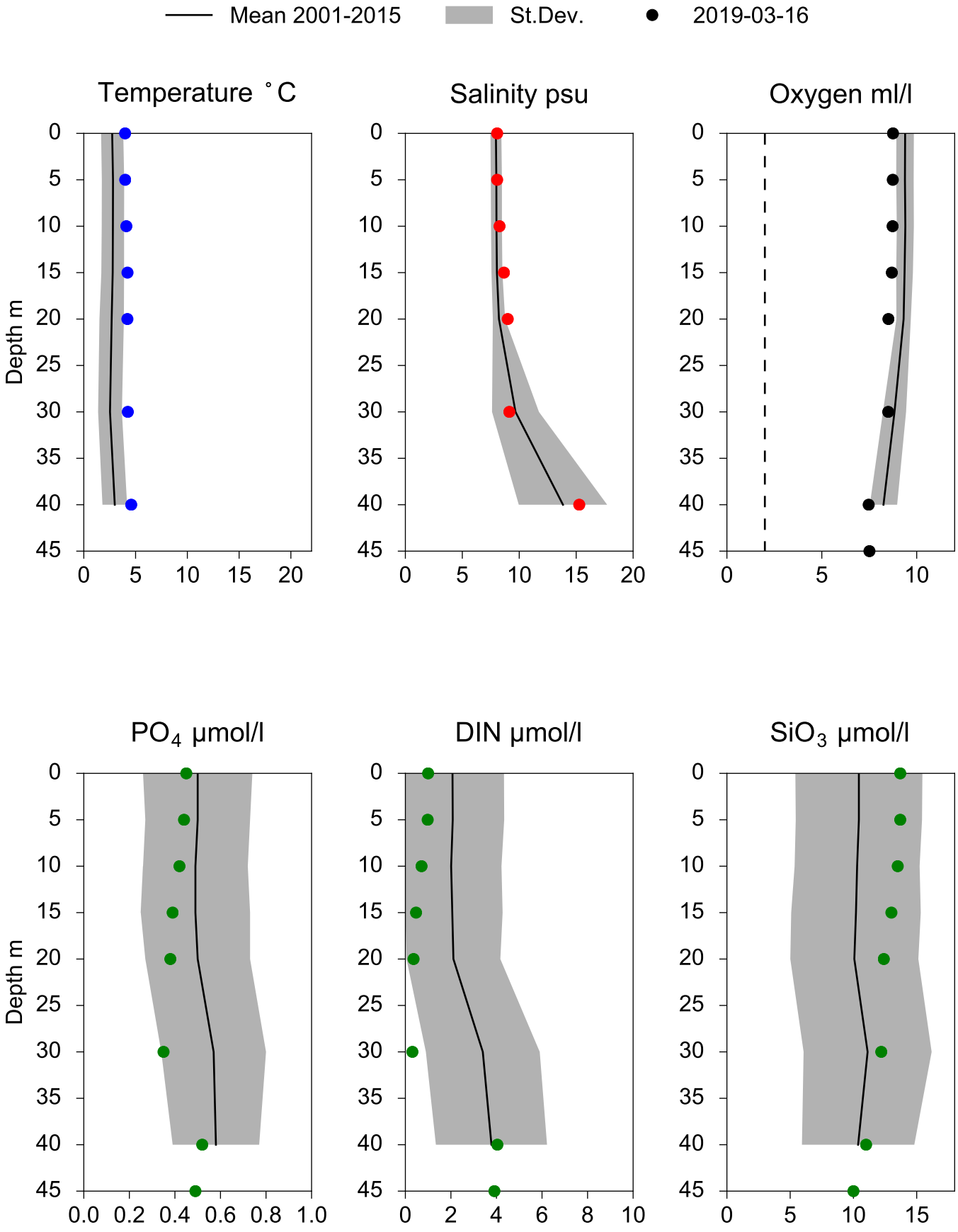
Annual Cycles



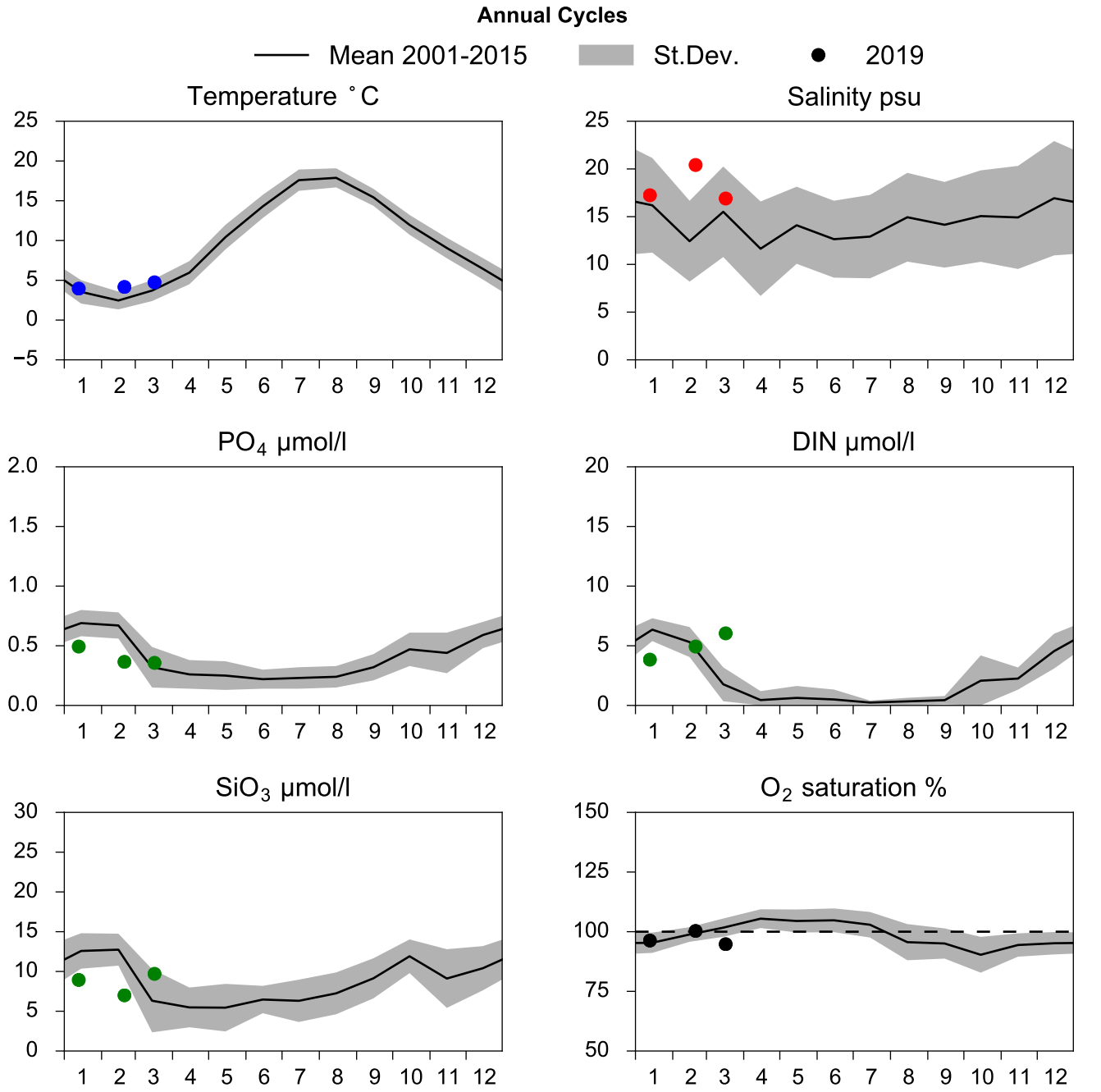
OXYGEN IN BOTTOM WATER (depth >= 40 m)



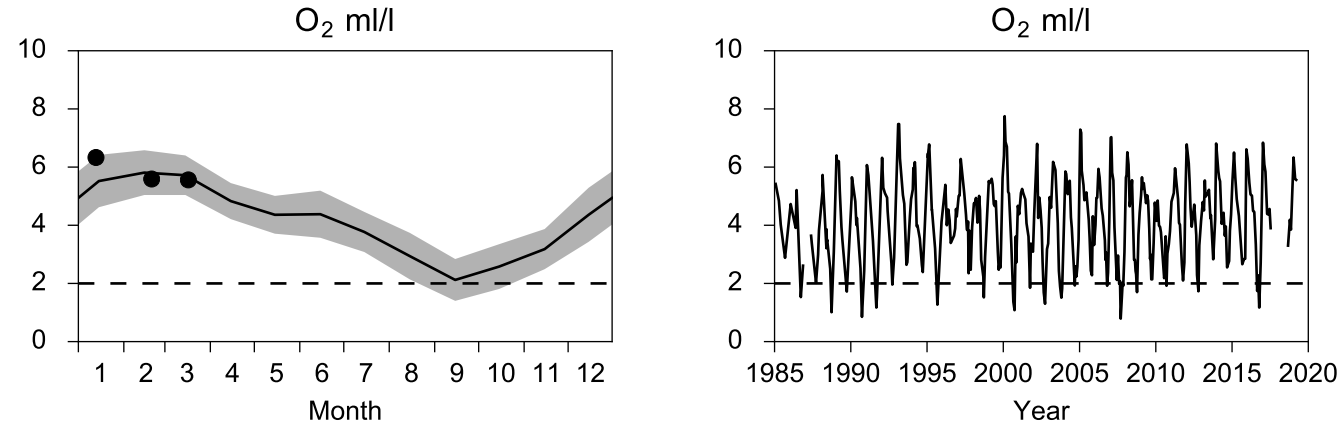
Vertical profiles BY1
March



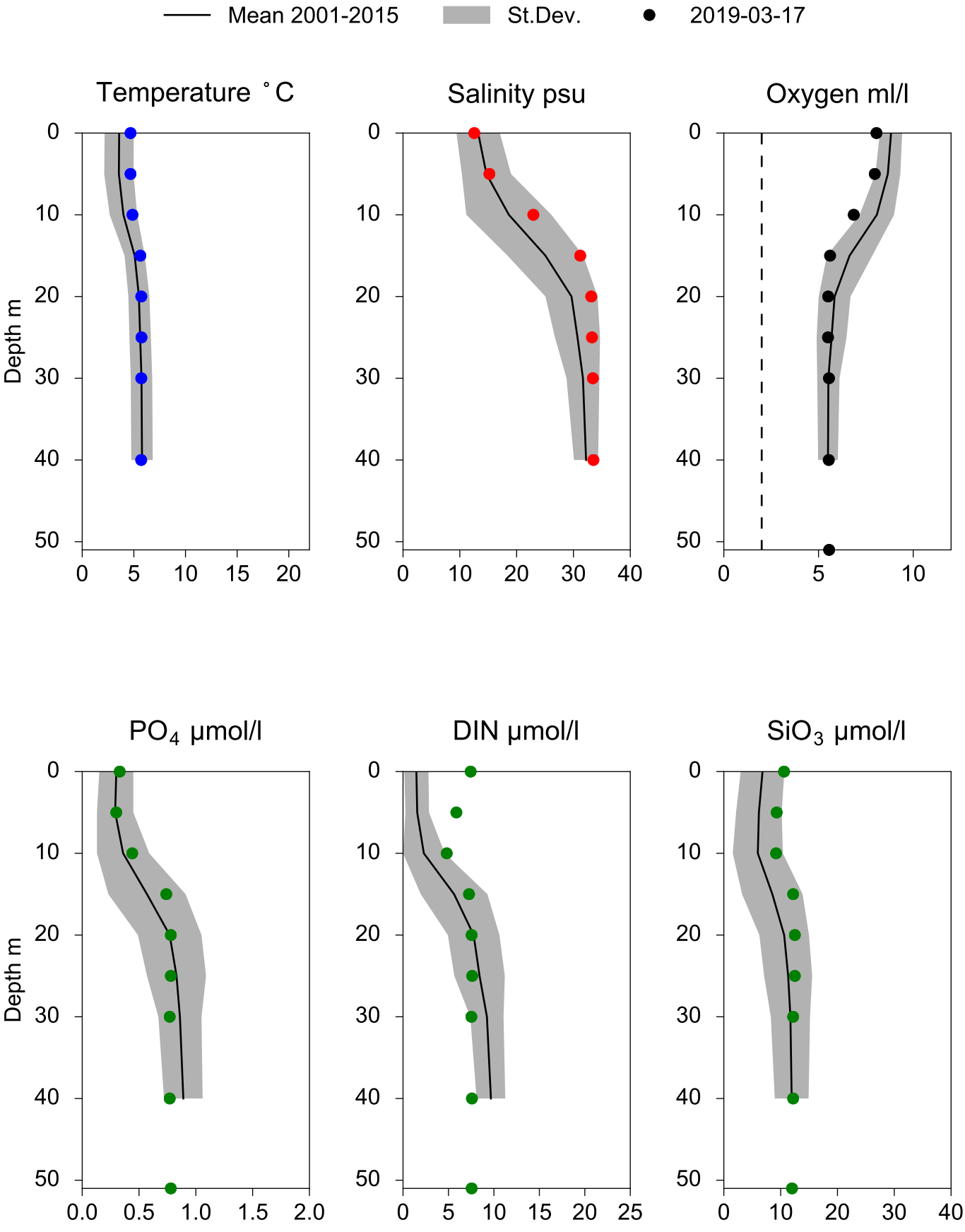
STATION W LANDSKRONA SURFACE WATER (0-10 m)



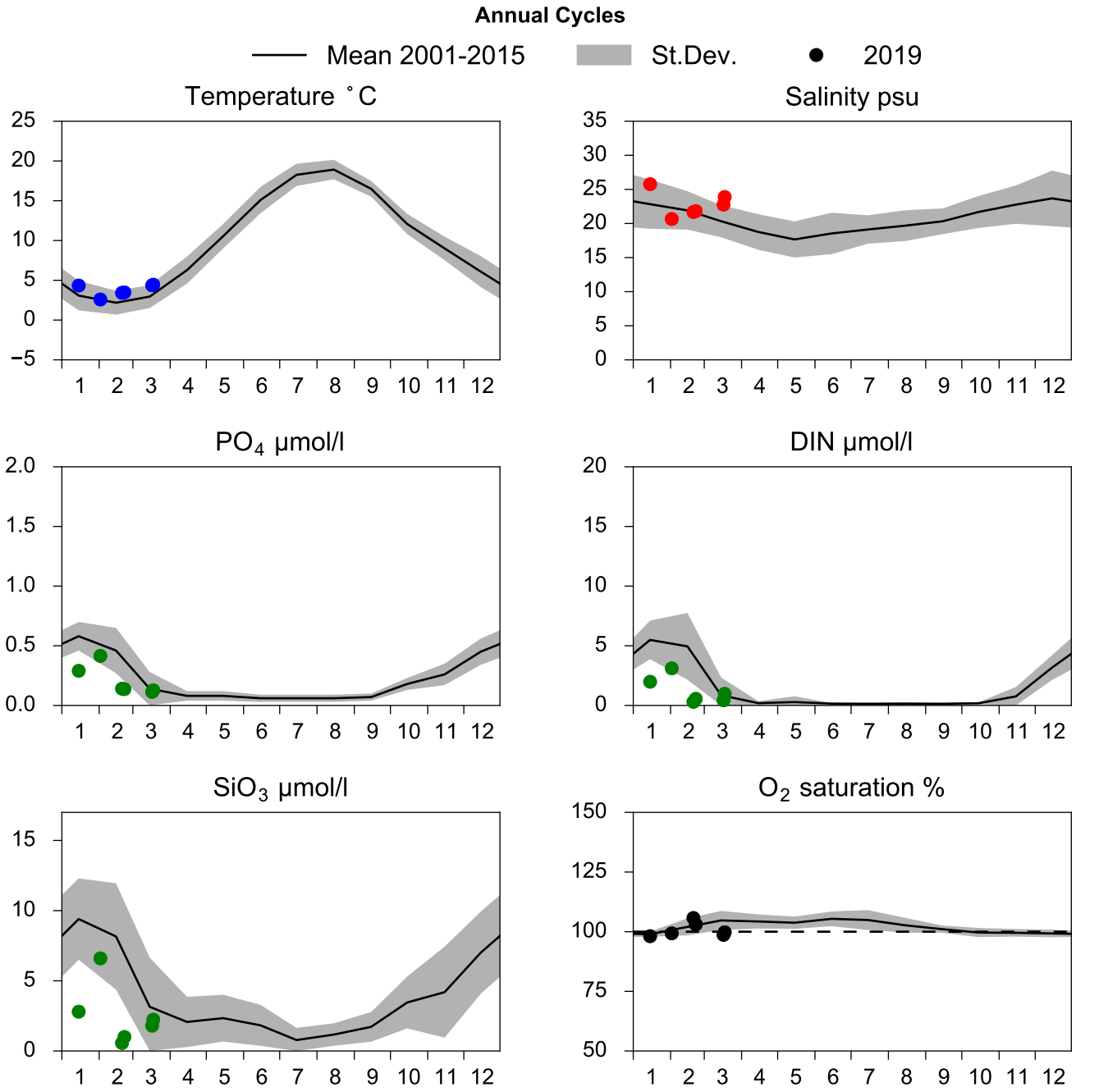
OXYGEN IN BOTTOM WATER (depth >= 40 m)



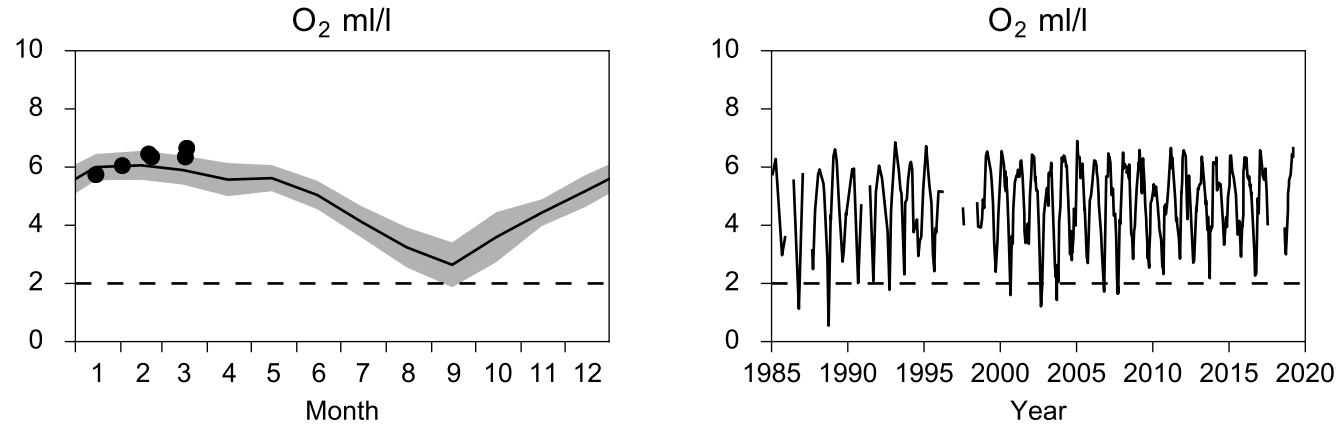
Vertical profiles W LANDSKRONA
March



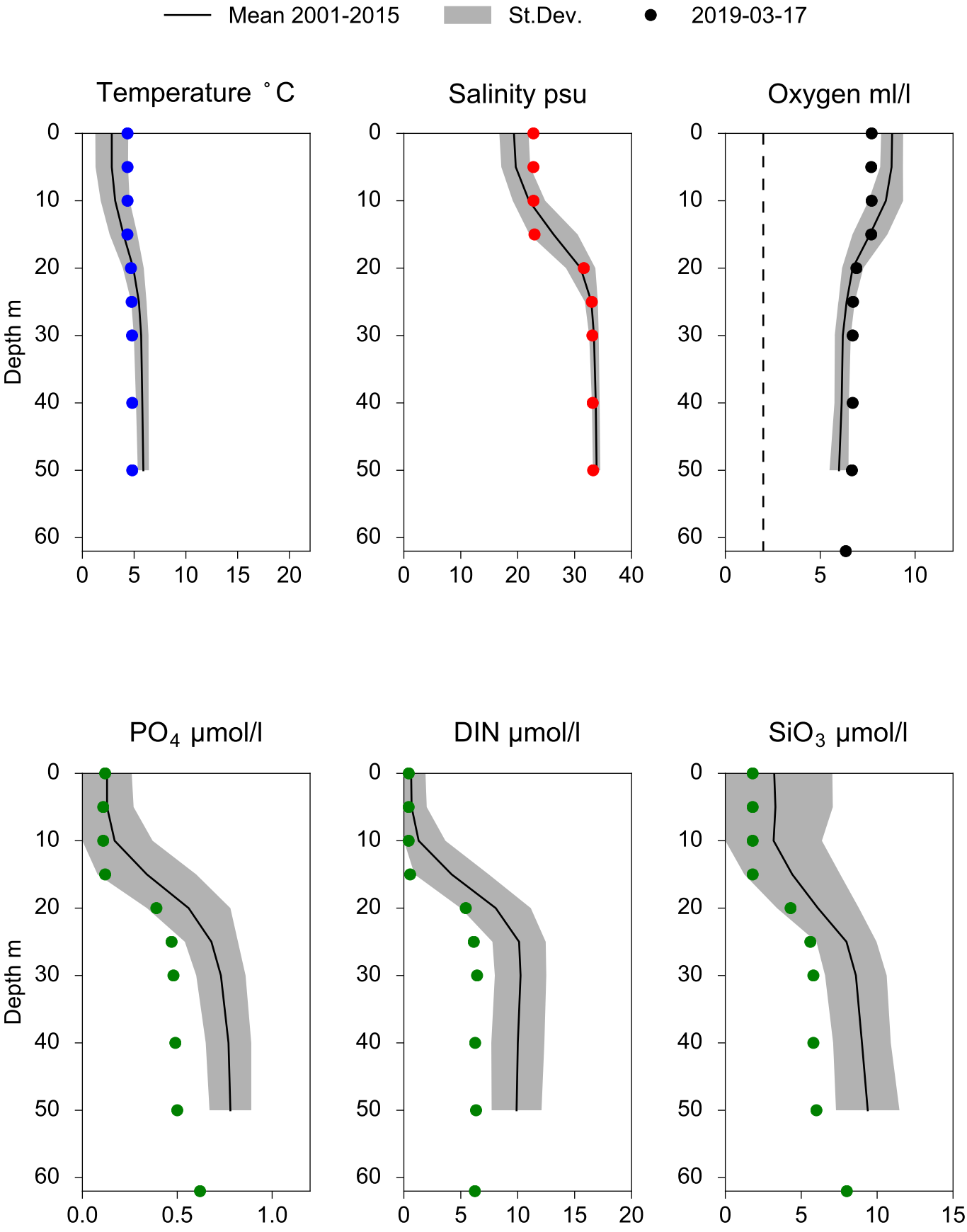
STATION ANHOLT E SURFACE WATER (0-10 m)



OXYGEN IN BOTTOM WATER (depth >= 52 m)

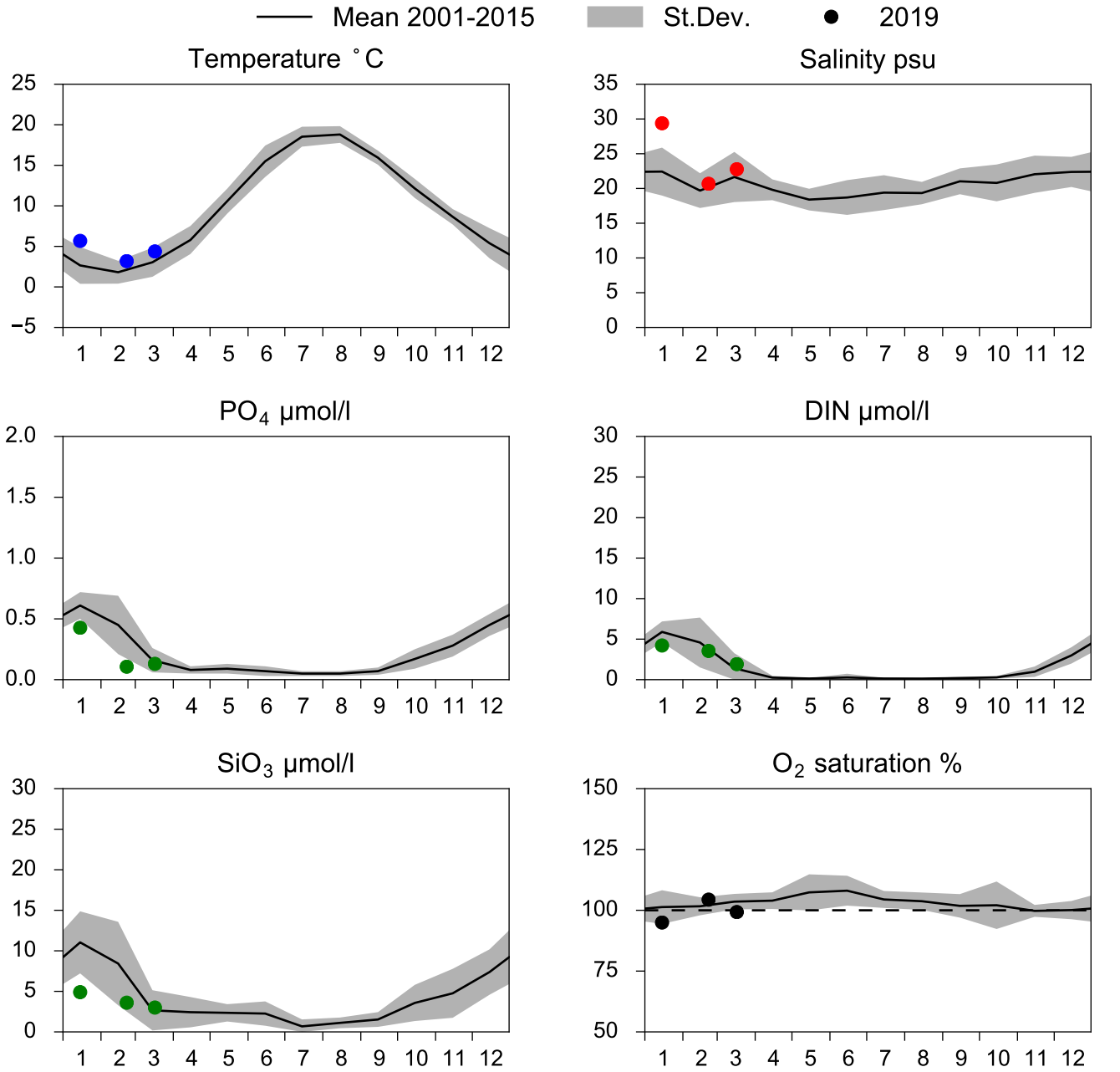


Vertical profiles ANHOLT E
March

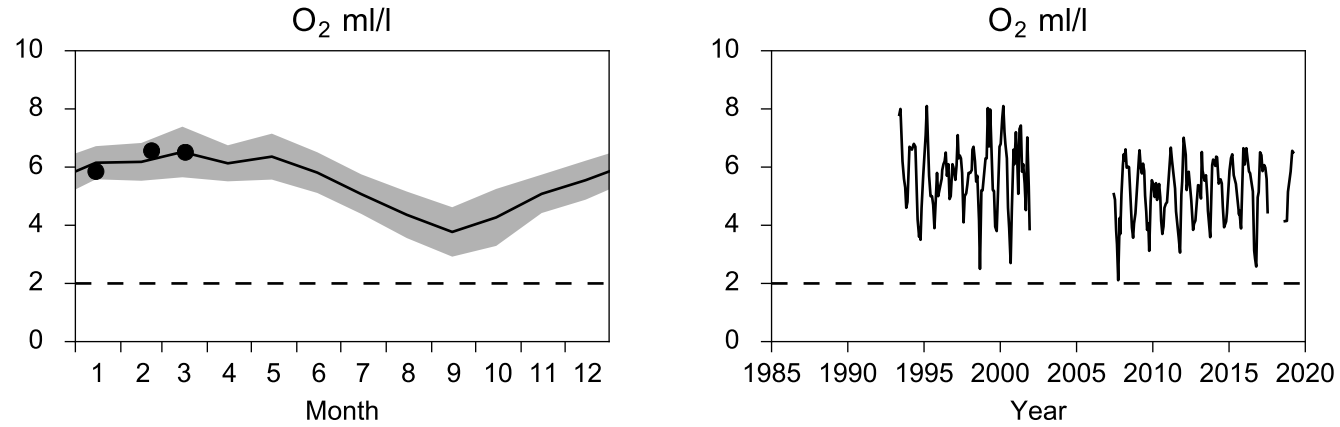


STATION N14 FALKENBERG SURFACE WATER (0-10 m)

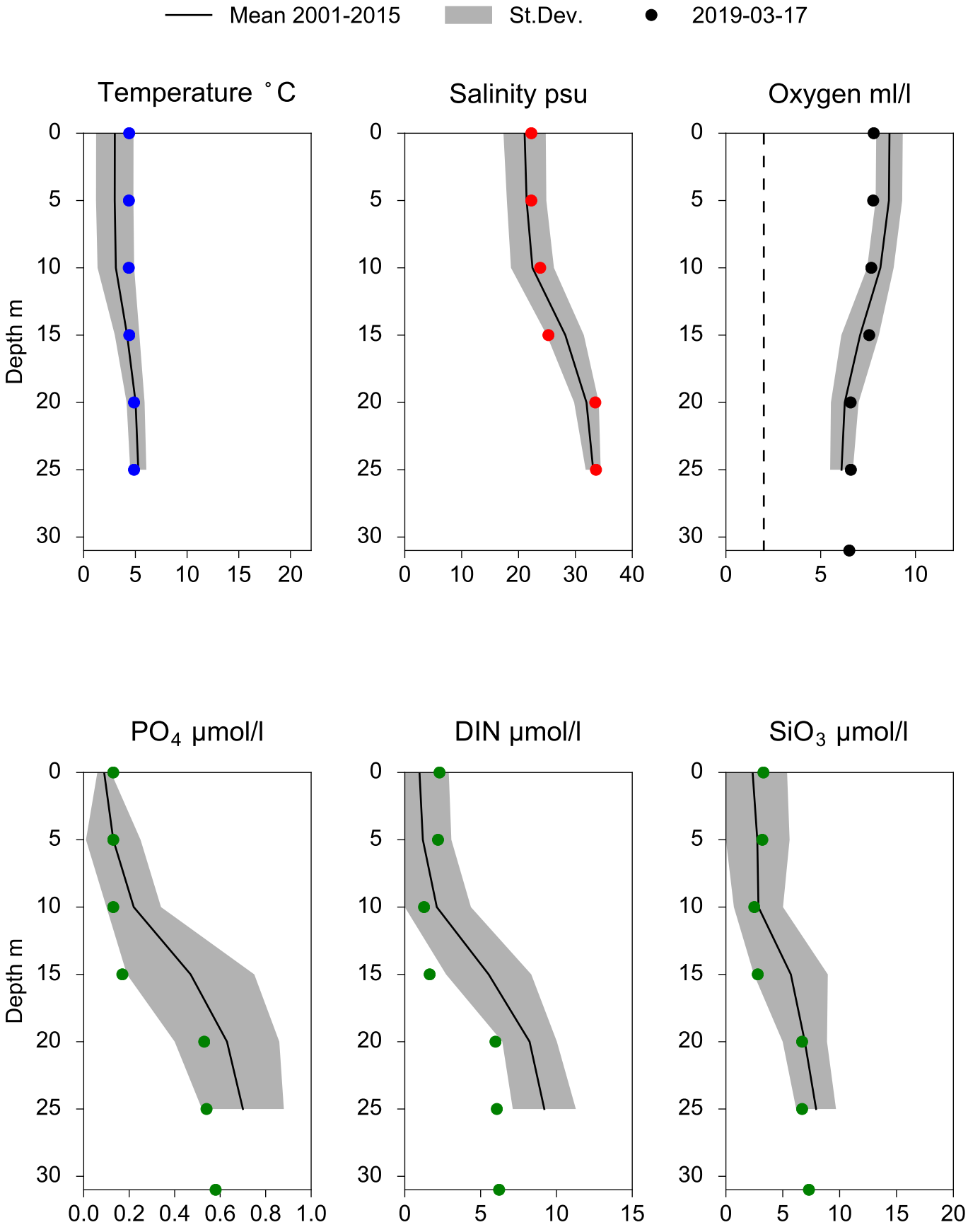
Annual Cycles



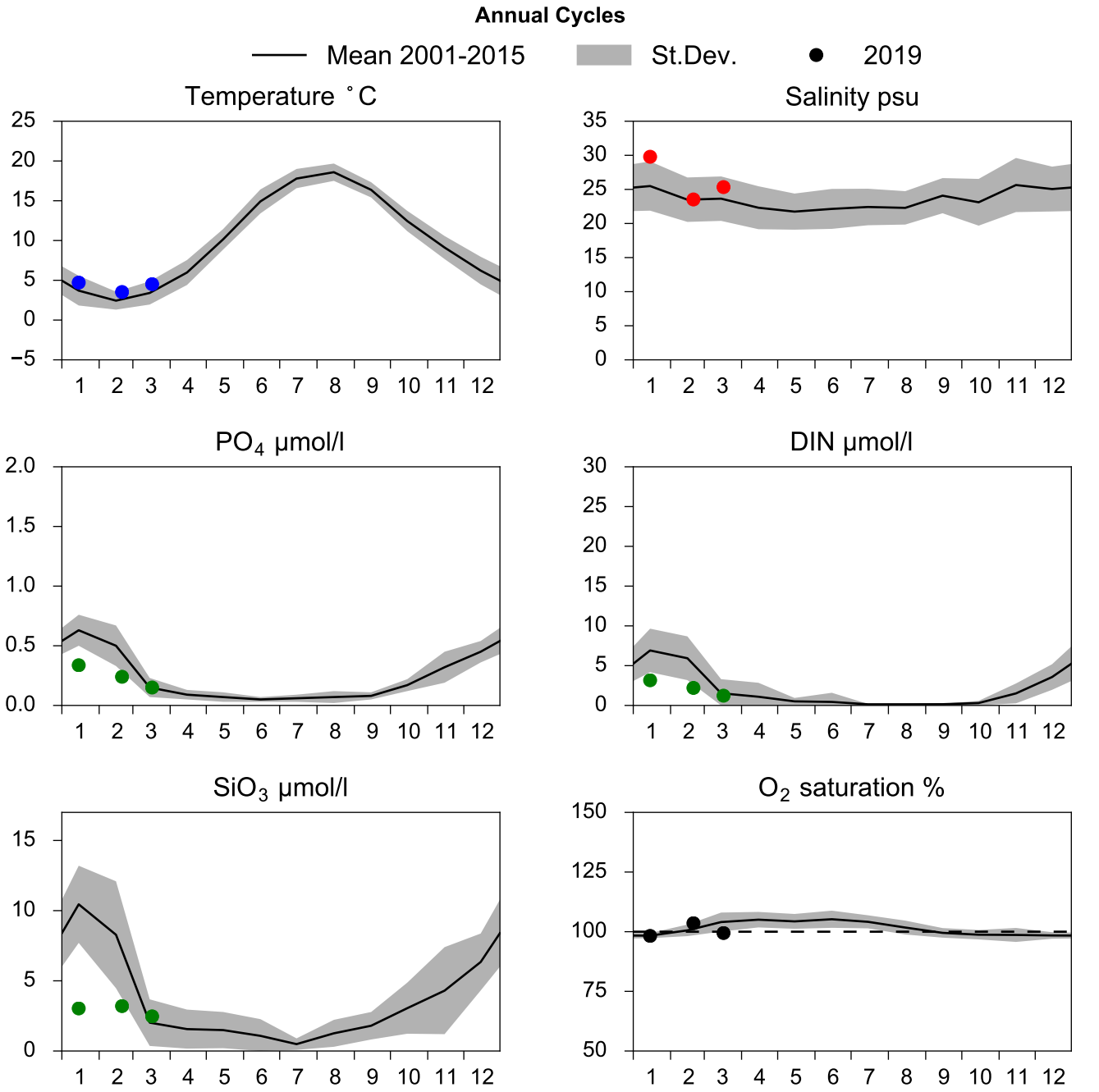
OXYGEN IN BOTTOM WATER (depth >= 25 m)



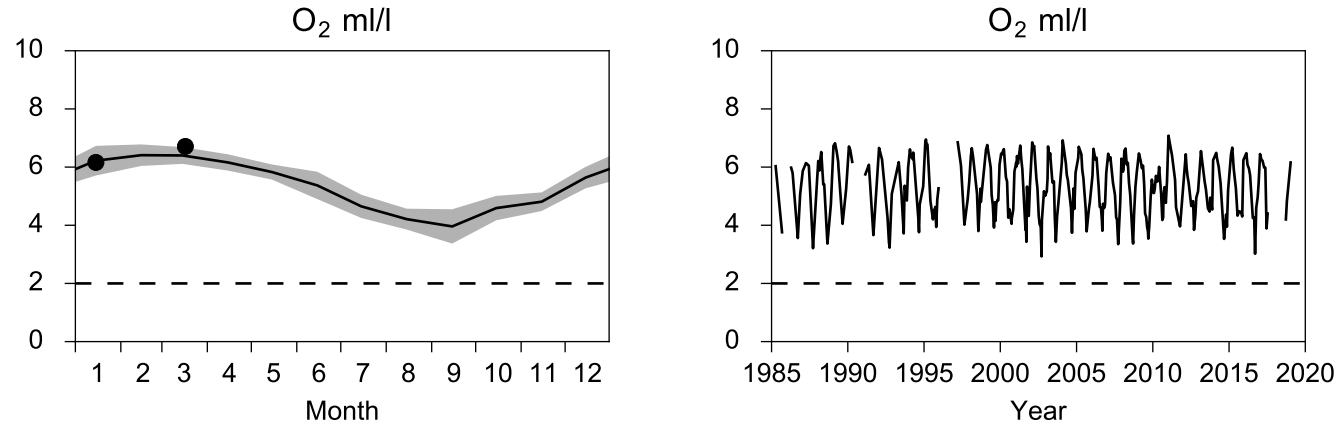
Vertical profiles N14 FALKENBERG
March



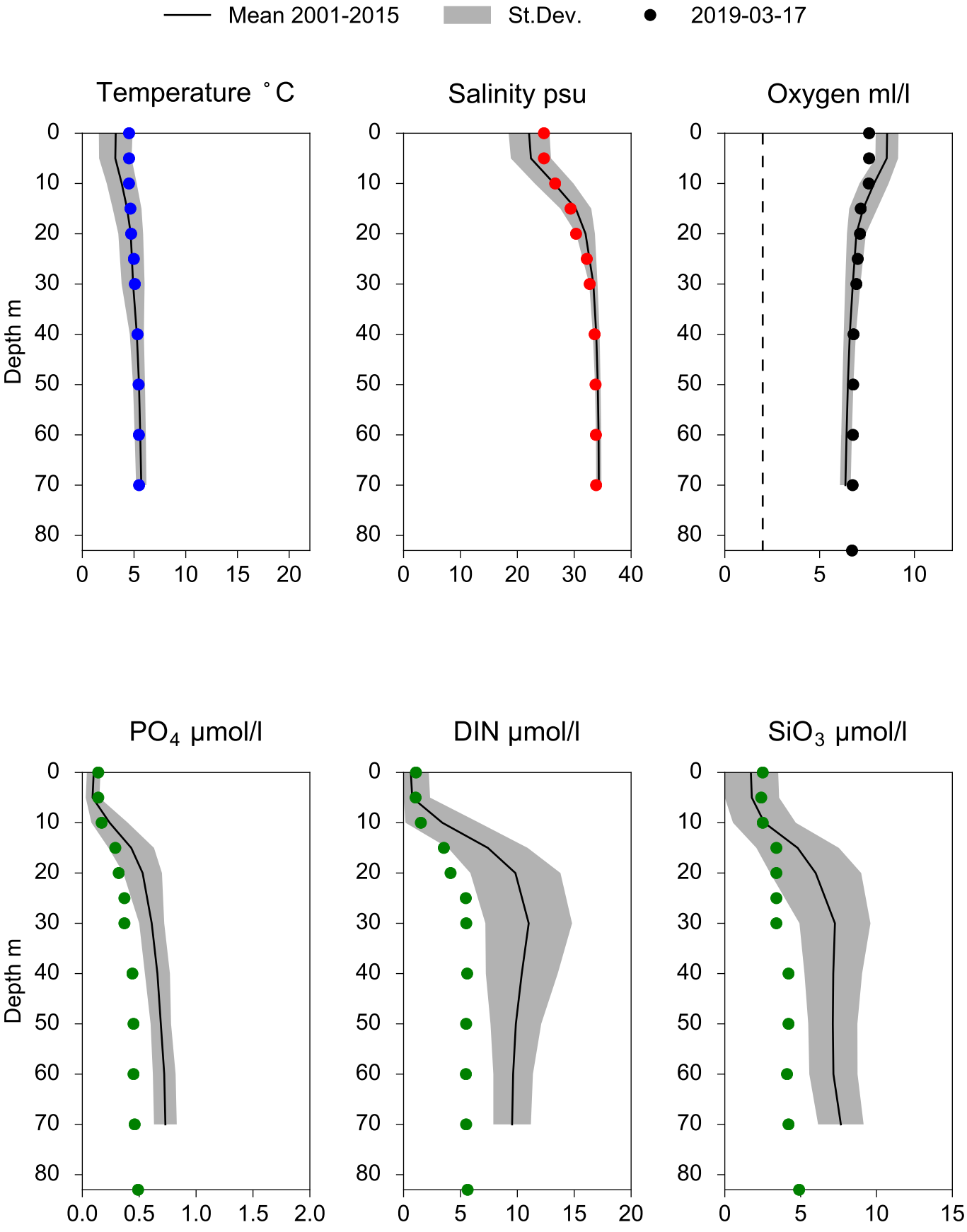
STATION FLADEN SURFACE WATER (0-10 m)



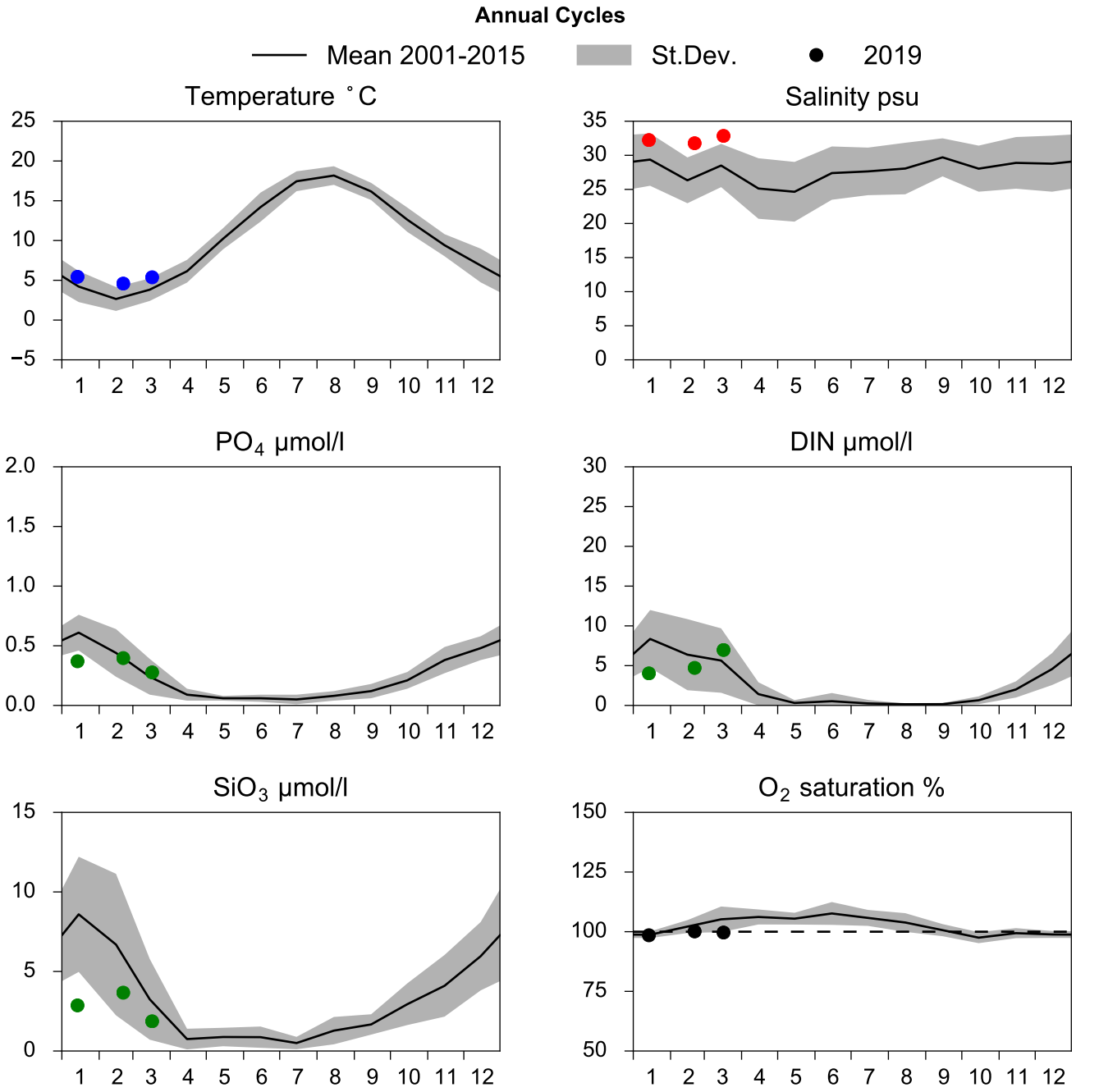
OXYGEN IN BOTTOM WATER (depth >= 74 m)



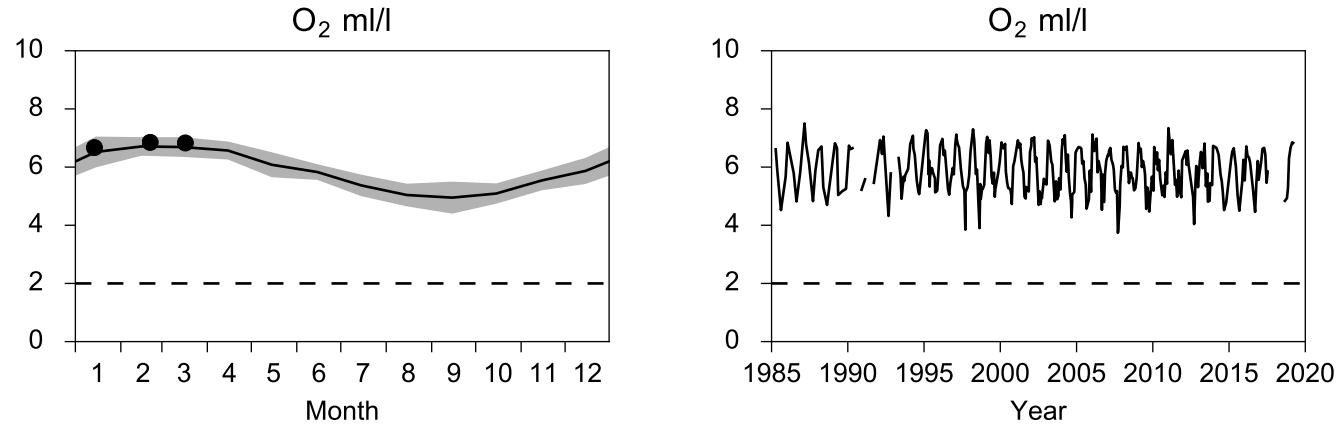
Vertical profiles FLADEN
March

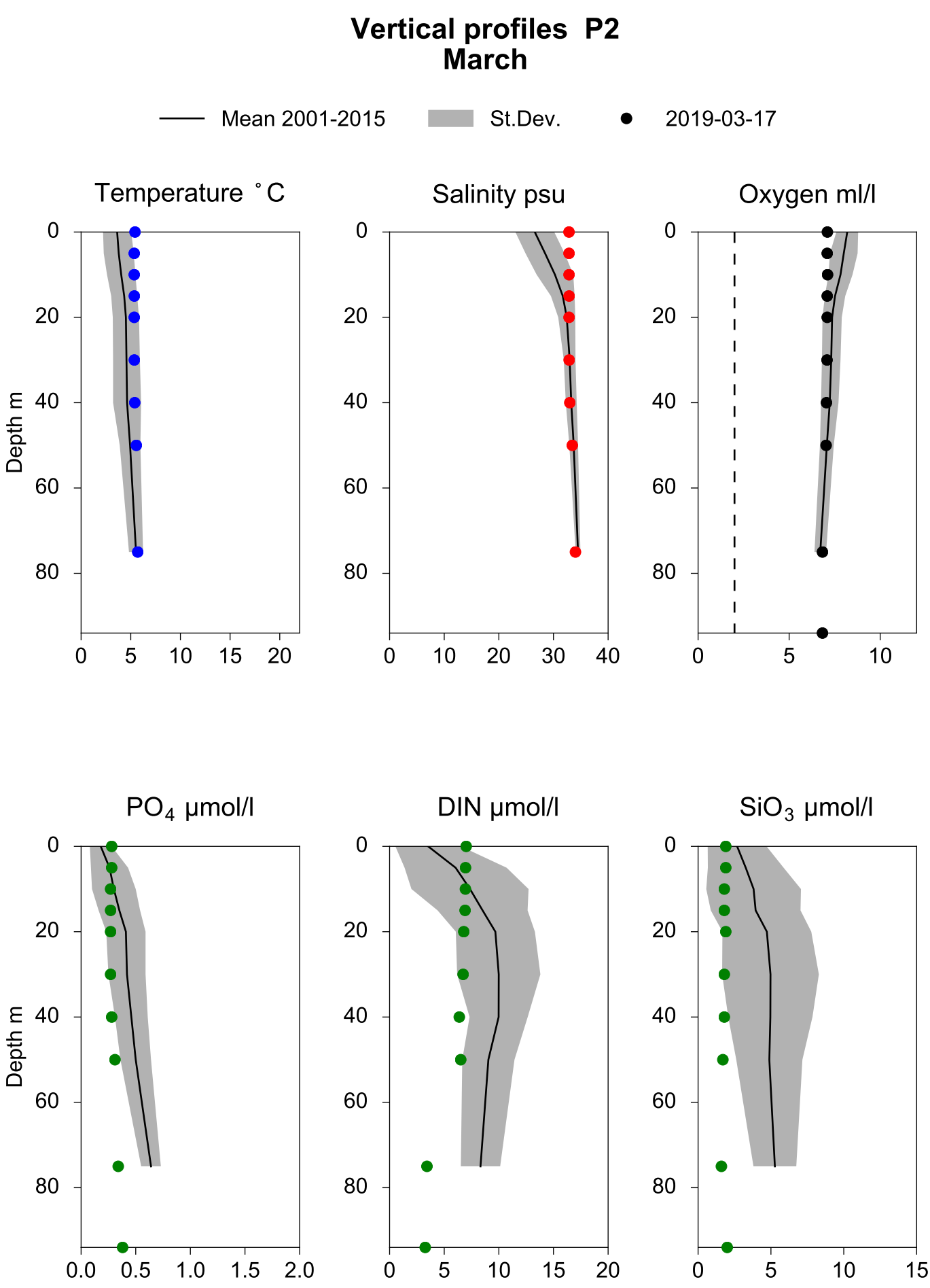


STATION P2 SURFACE WATER (0-10 m)



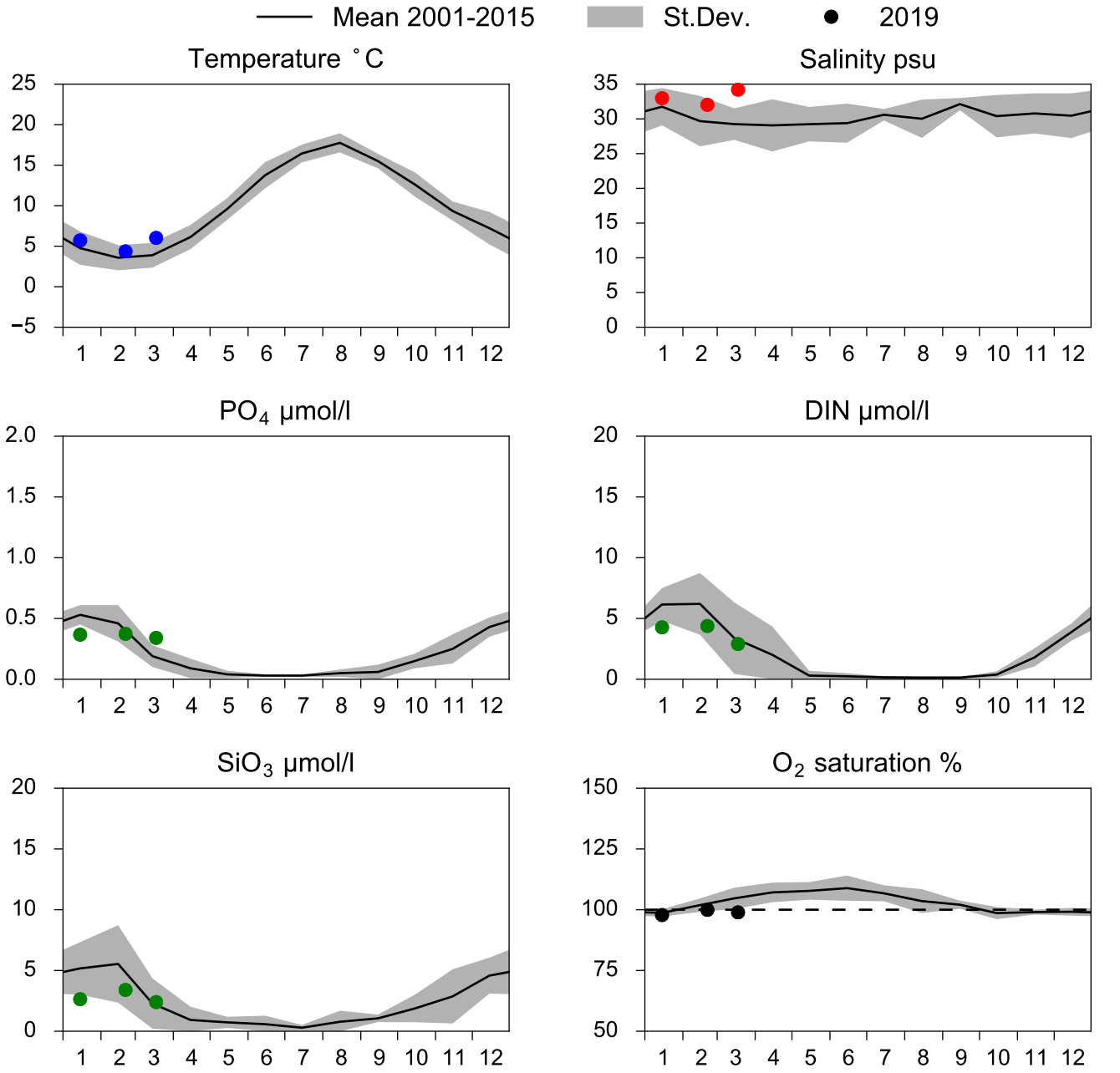
OXYGEN IN BOTTOM WATER (depth >= 75 m)



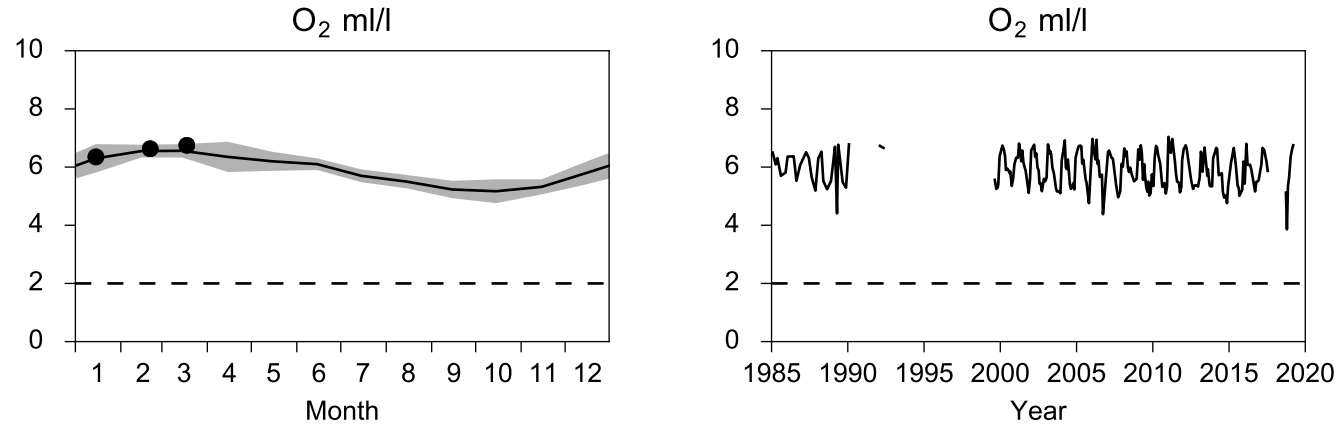

Vertical profiles P2
March
Mean 2001-2015
St.Dev.
2019-03-17
Temperature ˚C
Salinity psu
Oxygen ml/l
Depth m
PO4 µmol/l
DIN µmol/l
SiO3 µmol/l

STATION Å15 SURFACE WATER (0-10 m)

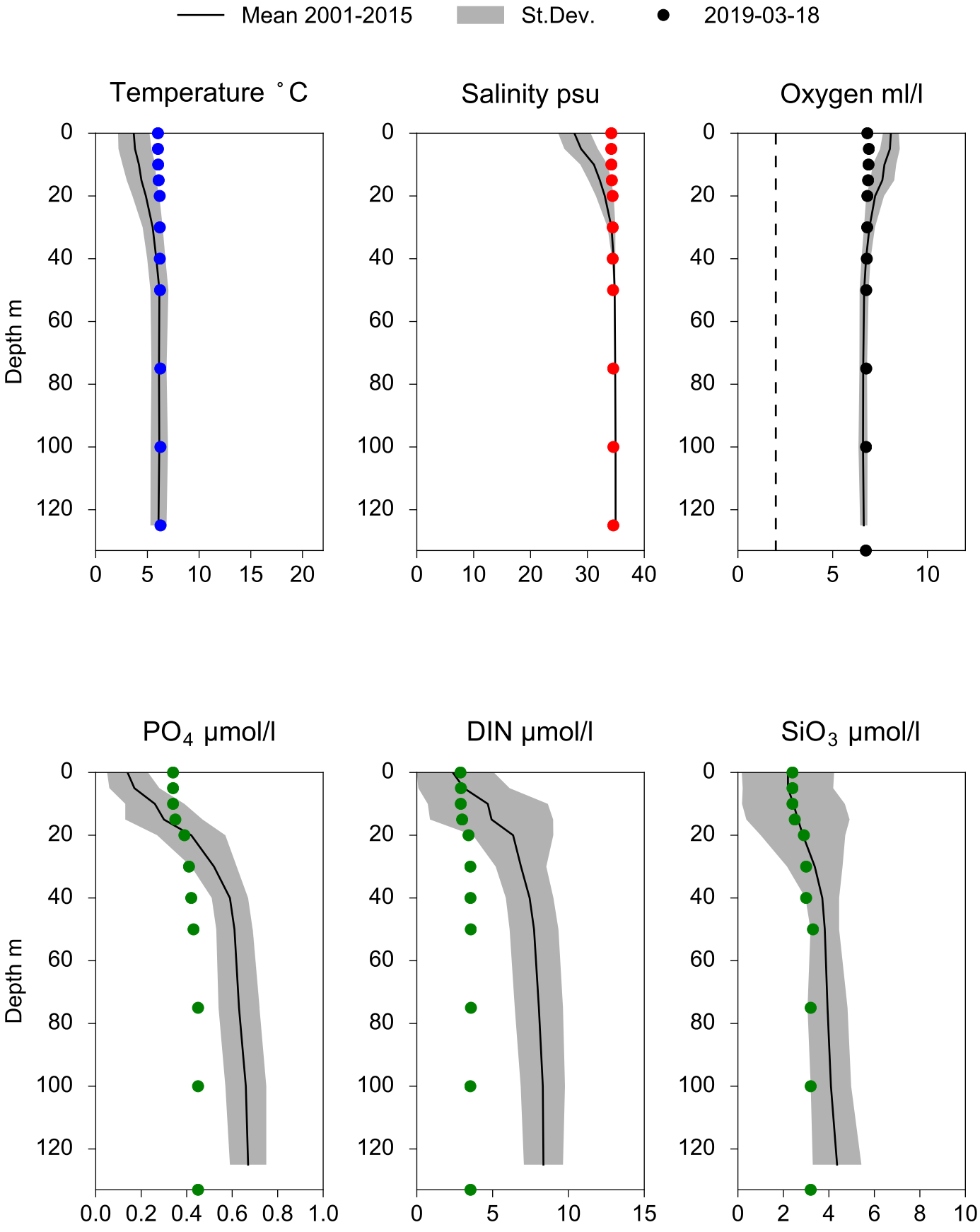
Annual Cycles



OXYGEN IN BOTTOM WATER (depth >= 125 m)



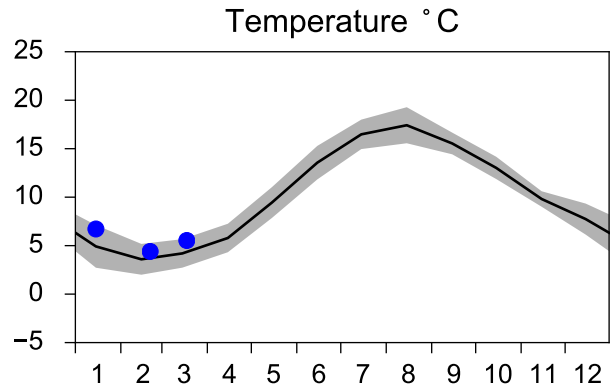
Vertical profiles Å15
March

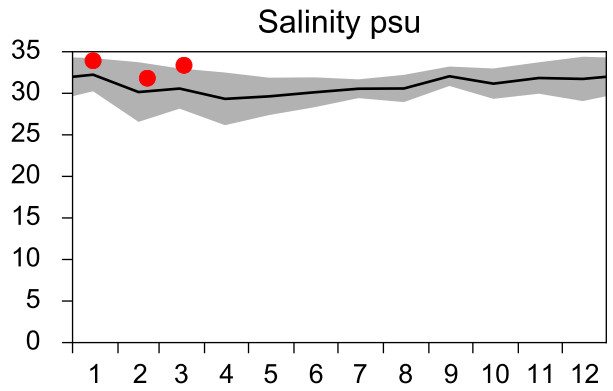


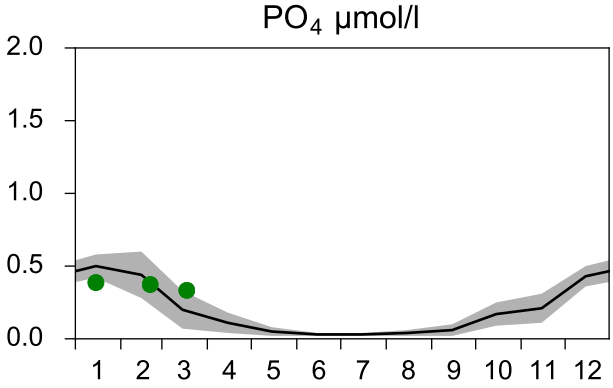
STATION Å17 SURFACE WATER (0-10 m)

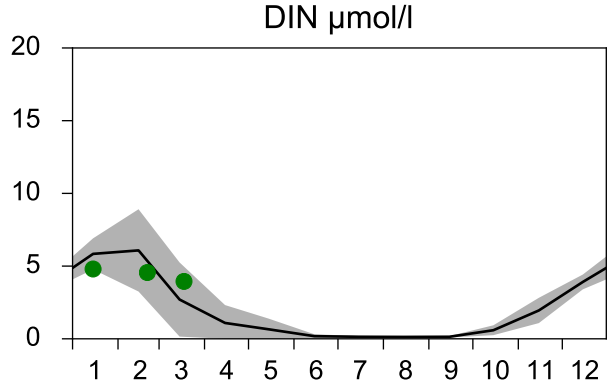
Annual Cycles

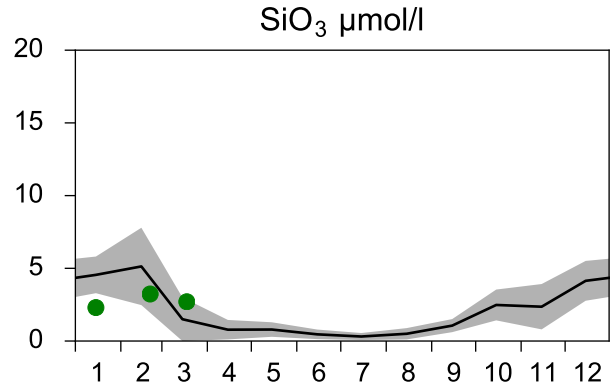
Mean 2001-2015 St.Dev. 2019

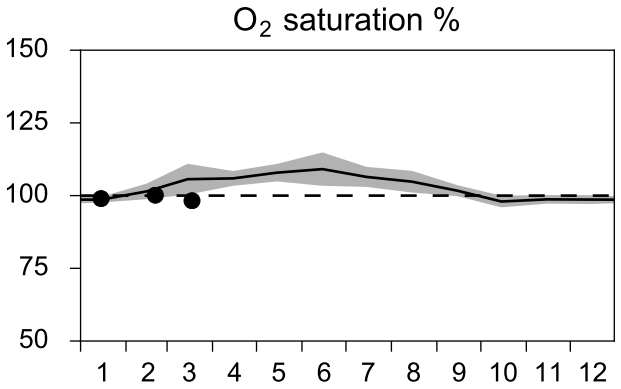




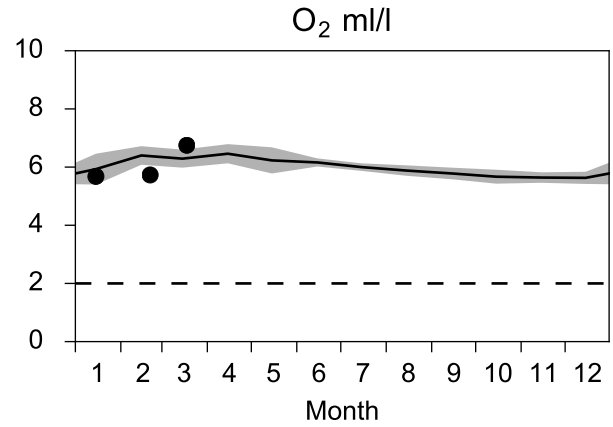


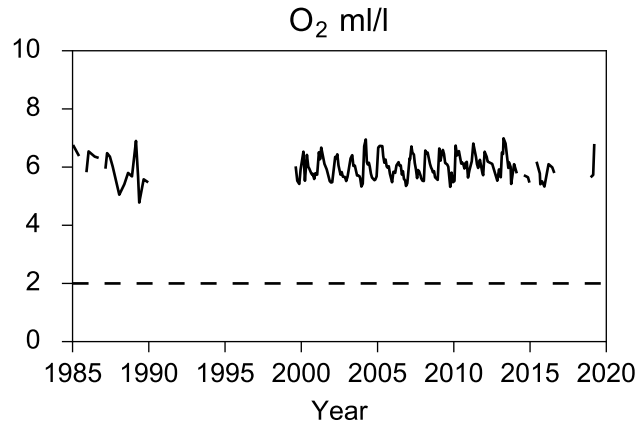




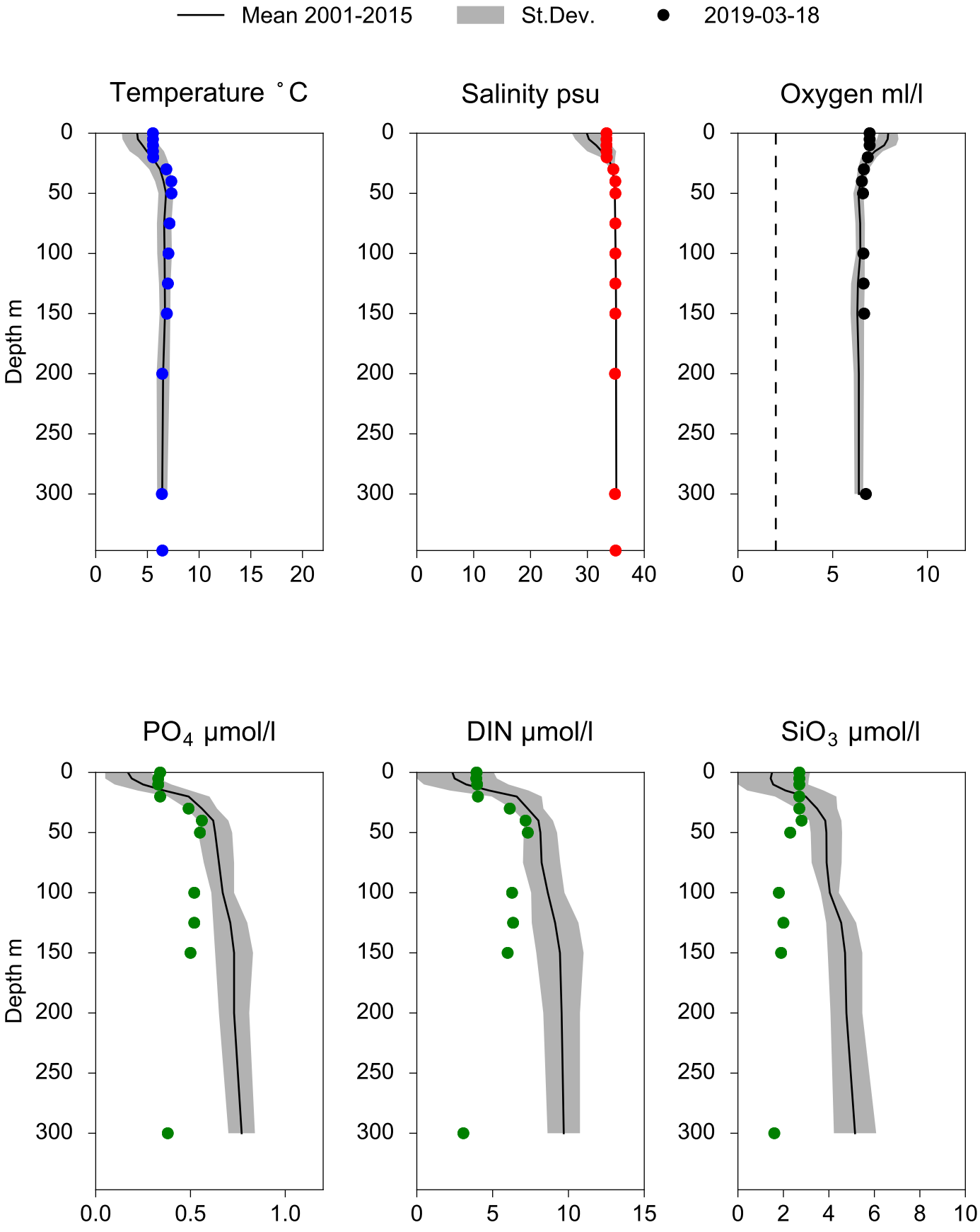


OXYGEN IN BOTTOM WATER (depth >= 300 m)

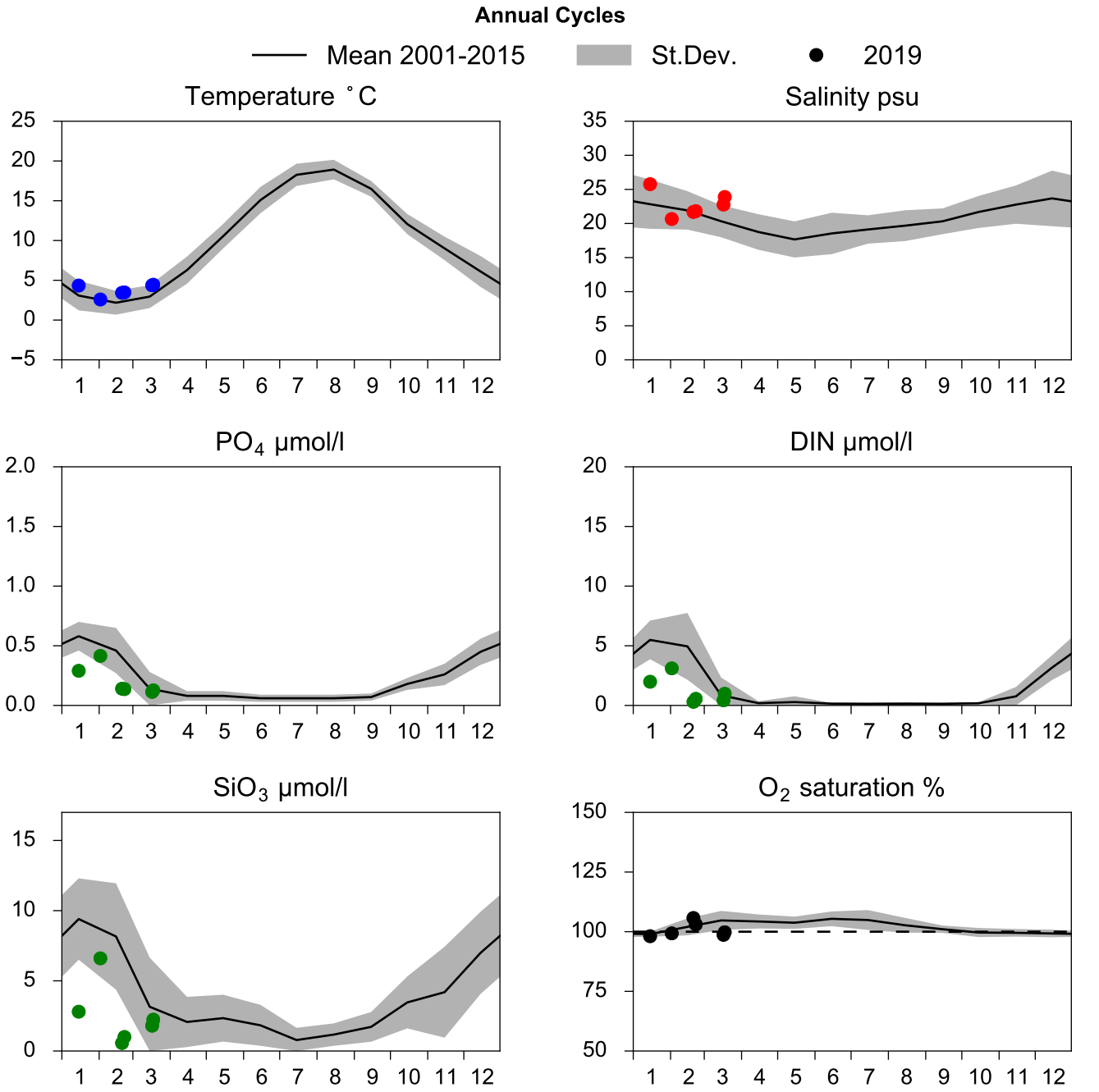




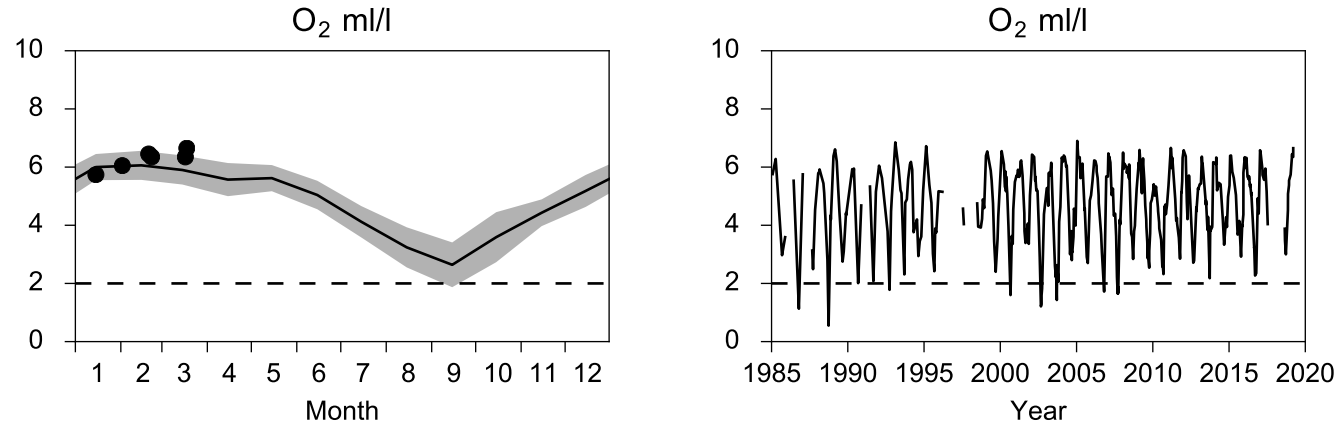
Vertical profiles Å17
March



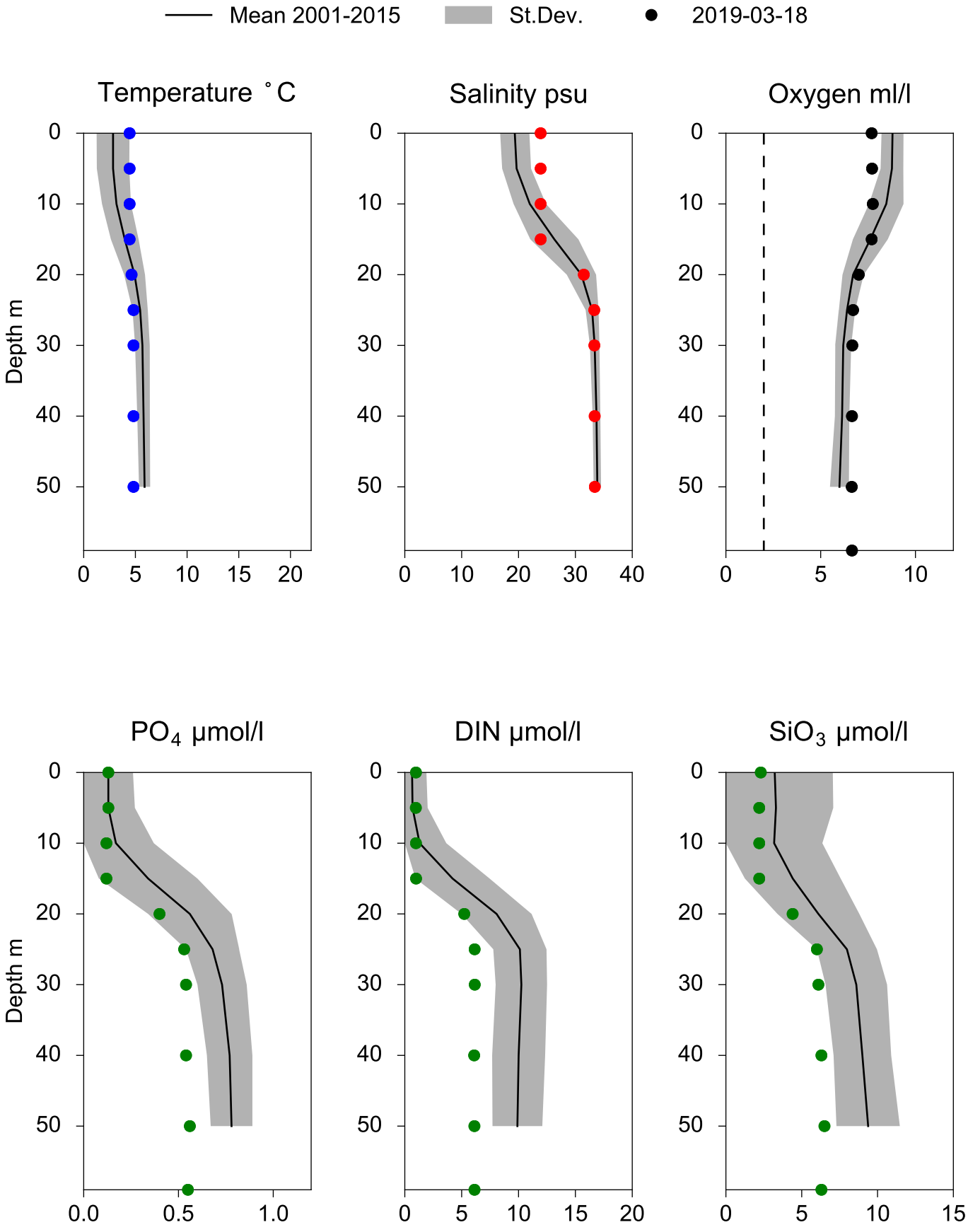
STATION ANHOLT E SURFACE WATER (0-10 m)



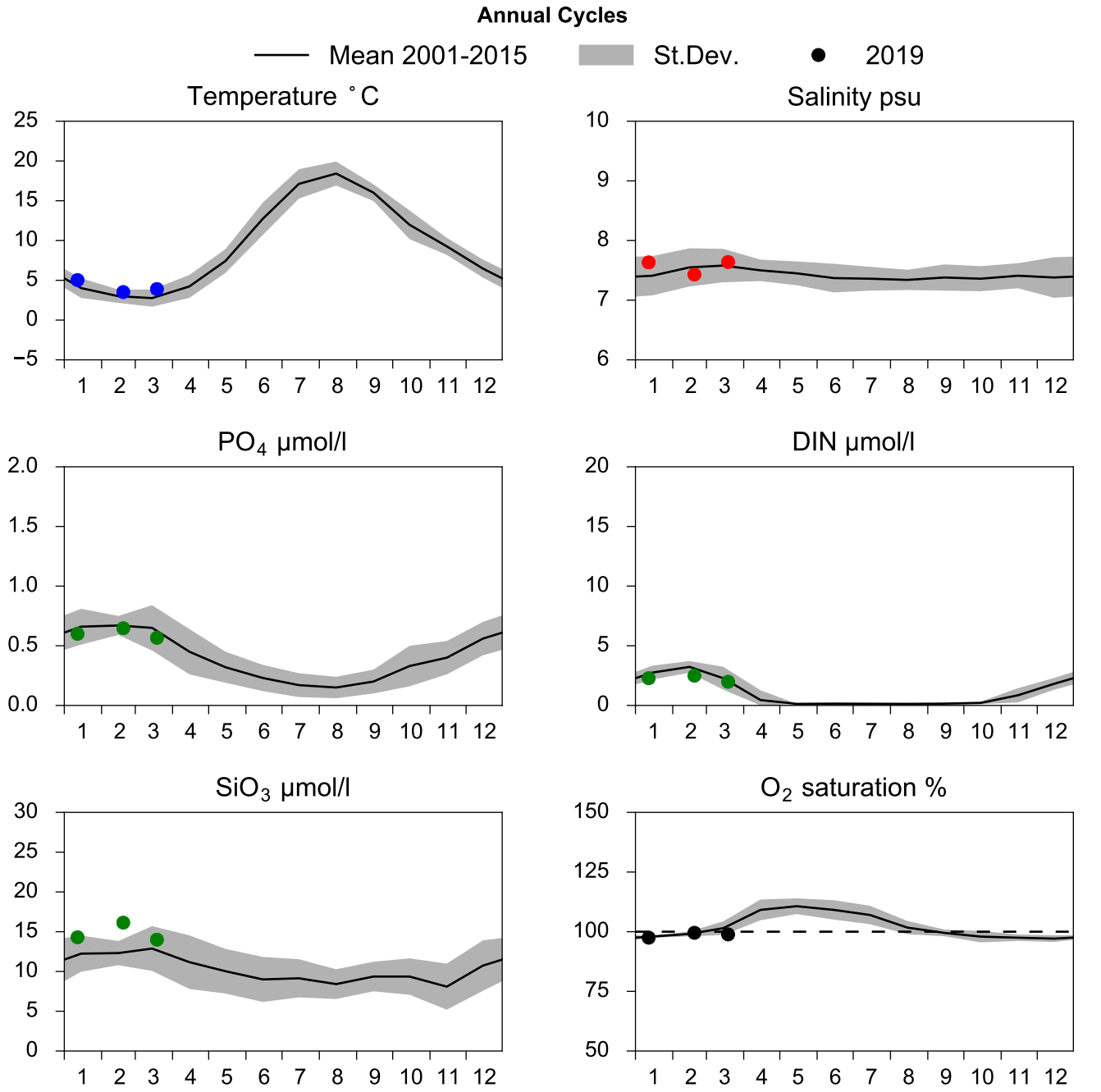
OXYGEN IN BOTTOM WATER (depth >= 52 m)



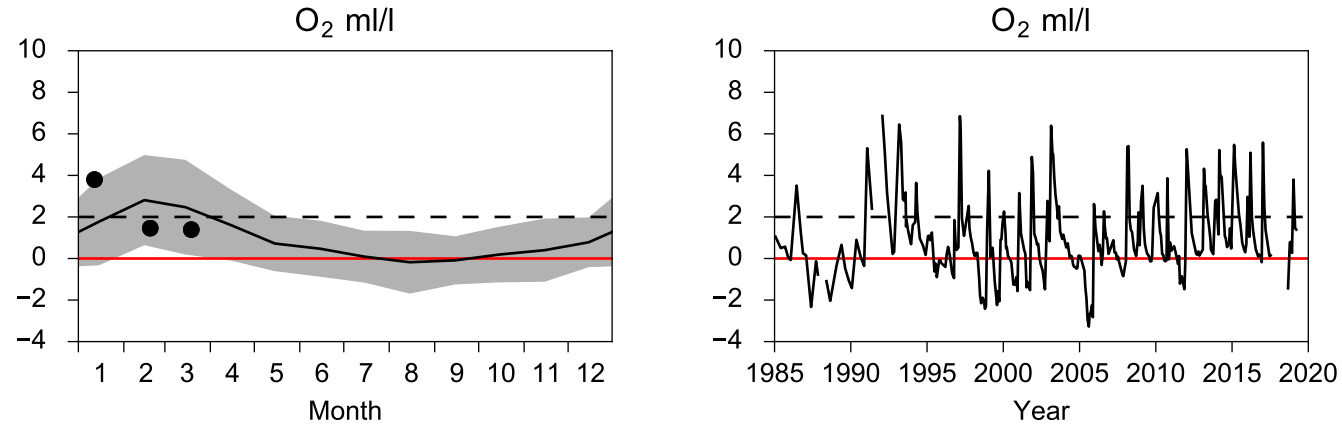
Vertical profiles ANHOLT E
March



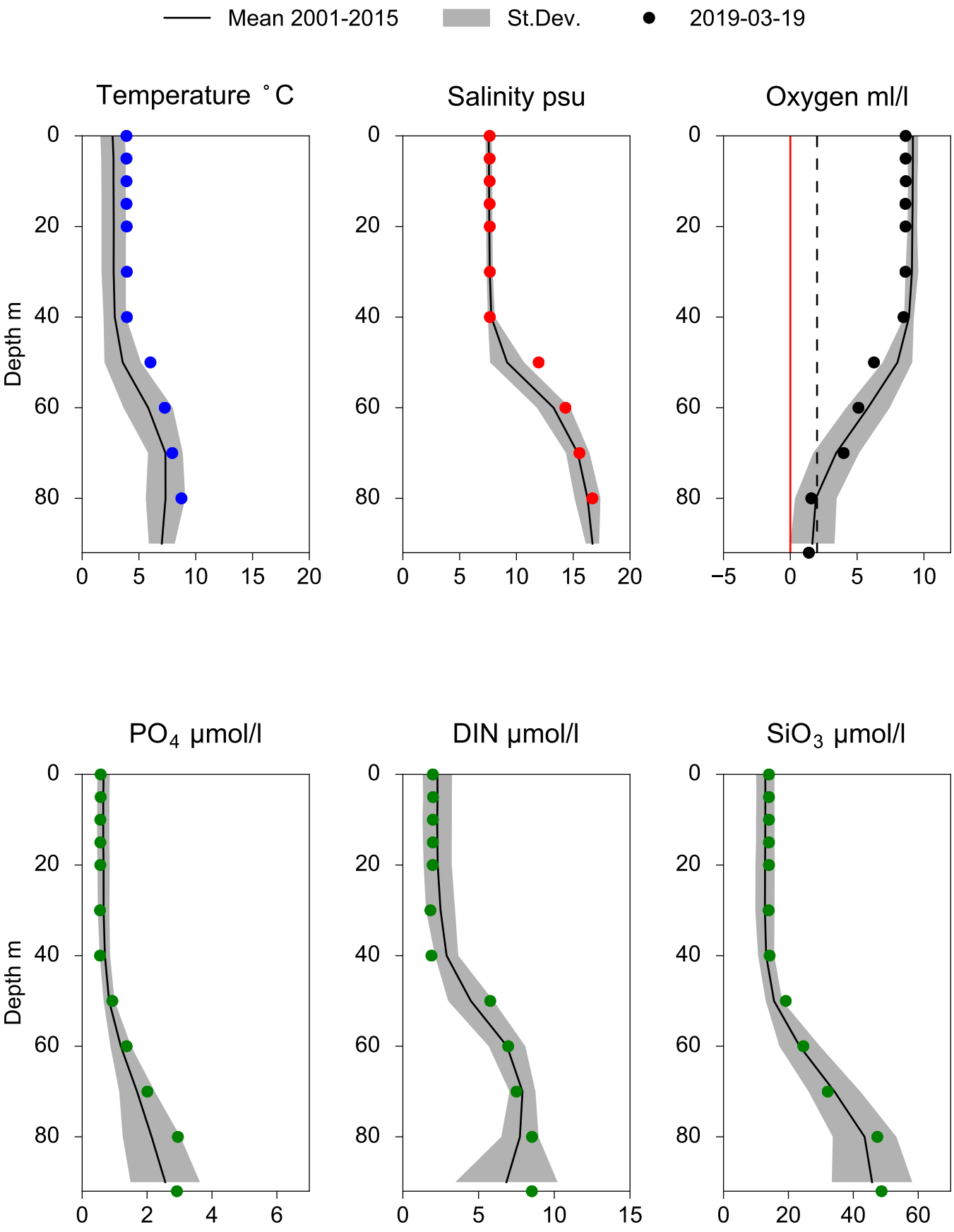
STATION BY4 CHRISTIANSÖ SURFACE WATER (0-10 m)



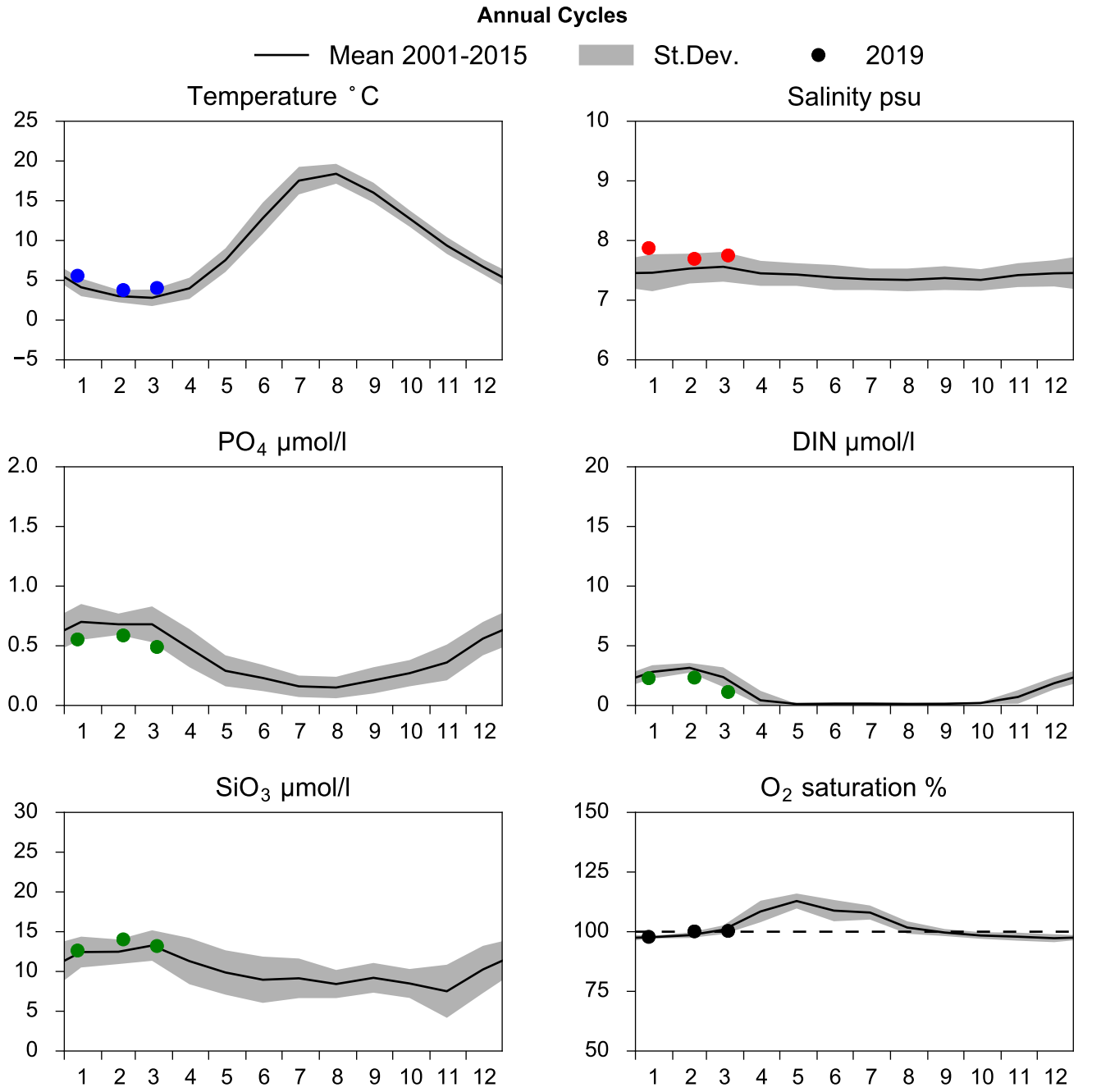
OXYGEN IN BOTTOM WATER (depth >= 80 m)



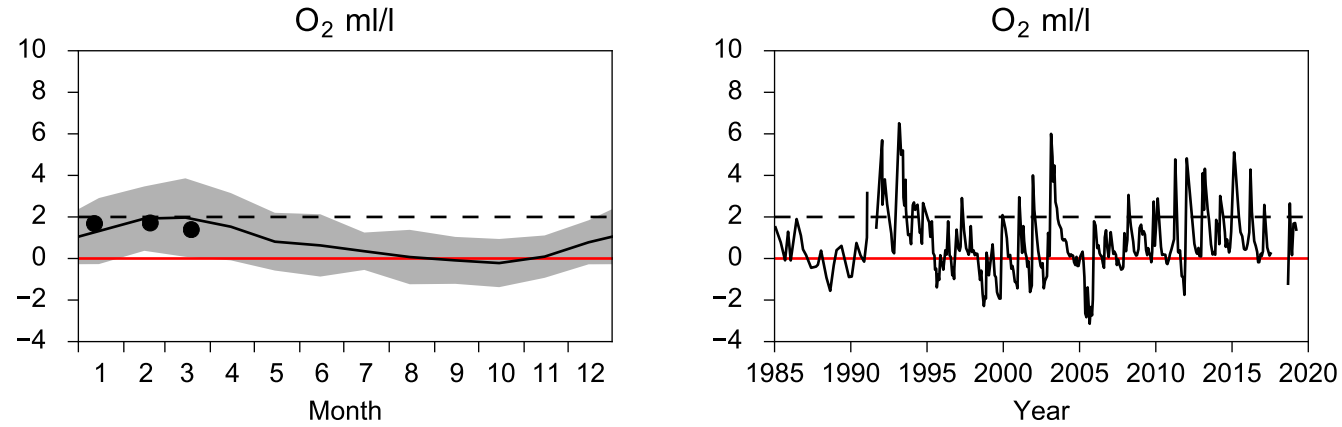
Vertical profiles BY4 CHRISTIANSÖ
March



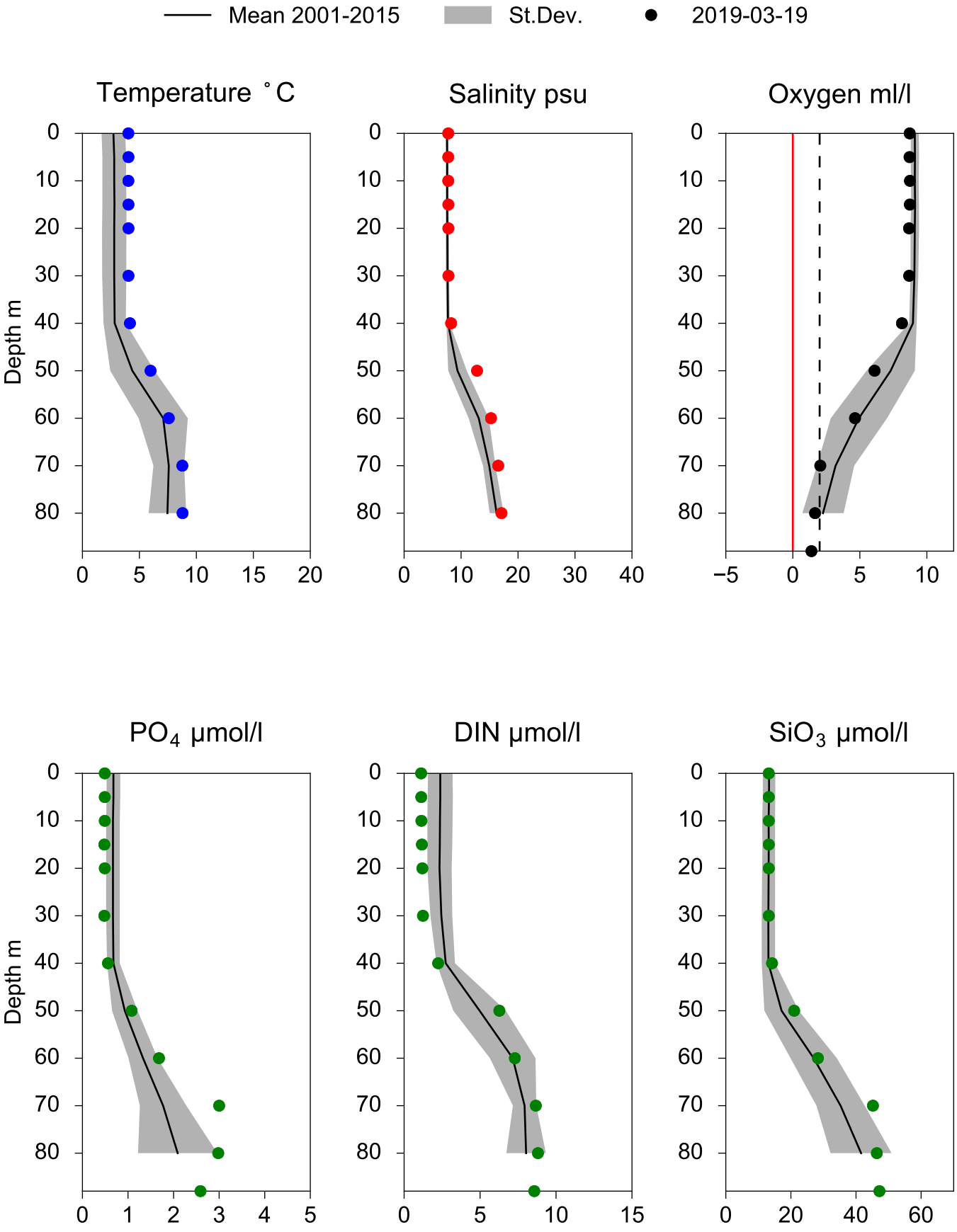
STATION BY5 BORNHOLMSDJ SURFACE WATER (0-10 m)



OXYGEN IN BOTTOM WATER (depth >= 80 m)



Vertical profiles BY5 BORNHOLMSDJ
March

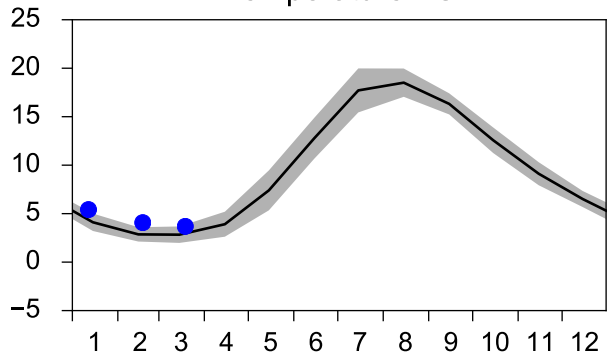


STATION BCS III-10 SURFACE WATER (0-10 m)

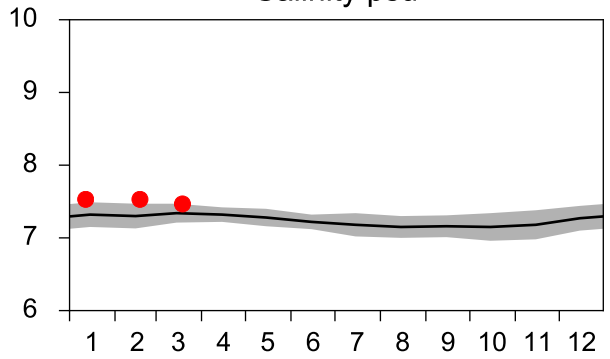
Annual Cycles

Mean 2001-2015 St.Dev. 2019

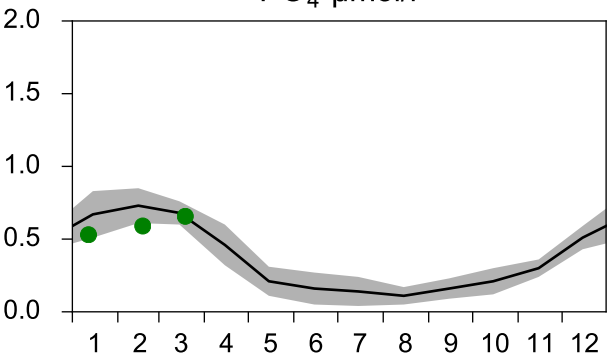
Temperature ˚C



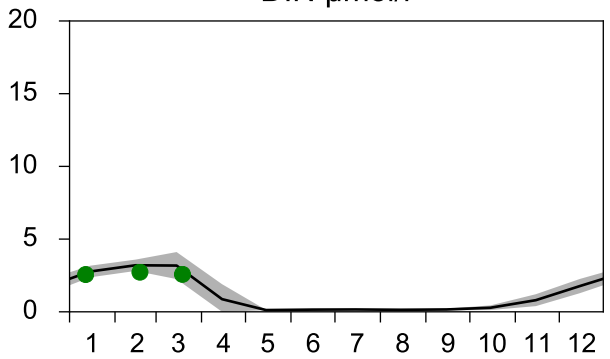
Salinity psu



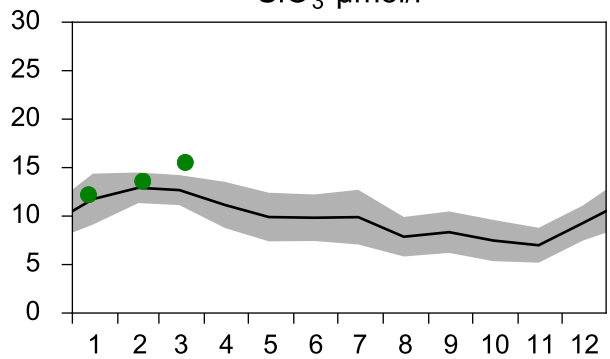
PO_4 µmol/l



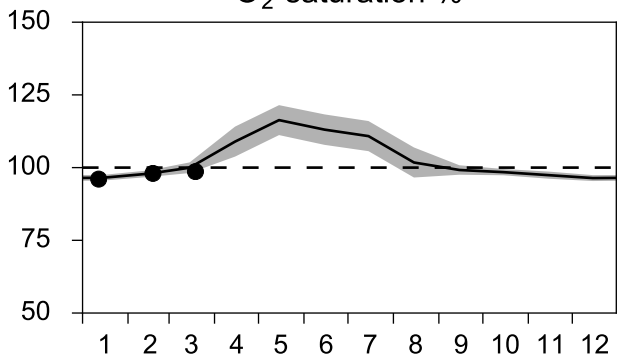
DIN µmol/l



SiO_3 µmol/l

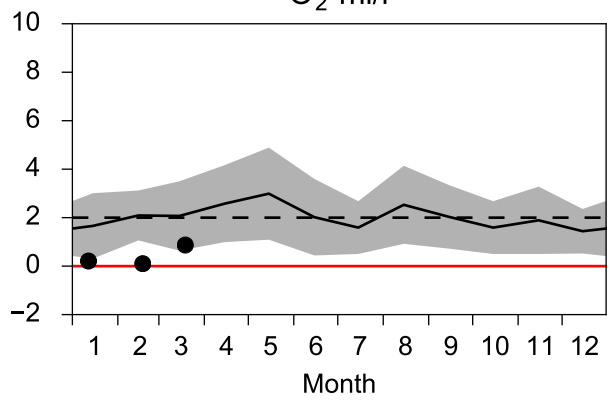


O_2 saturation %

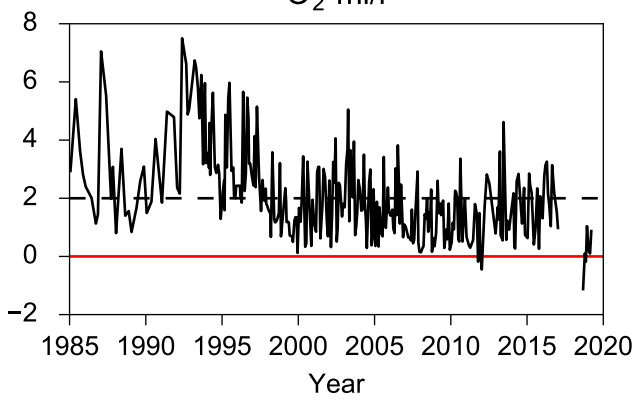


OXYGEN IN BOTTOM WATER (depth >= 80 m)

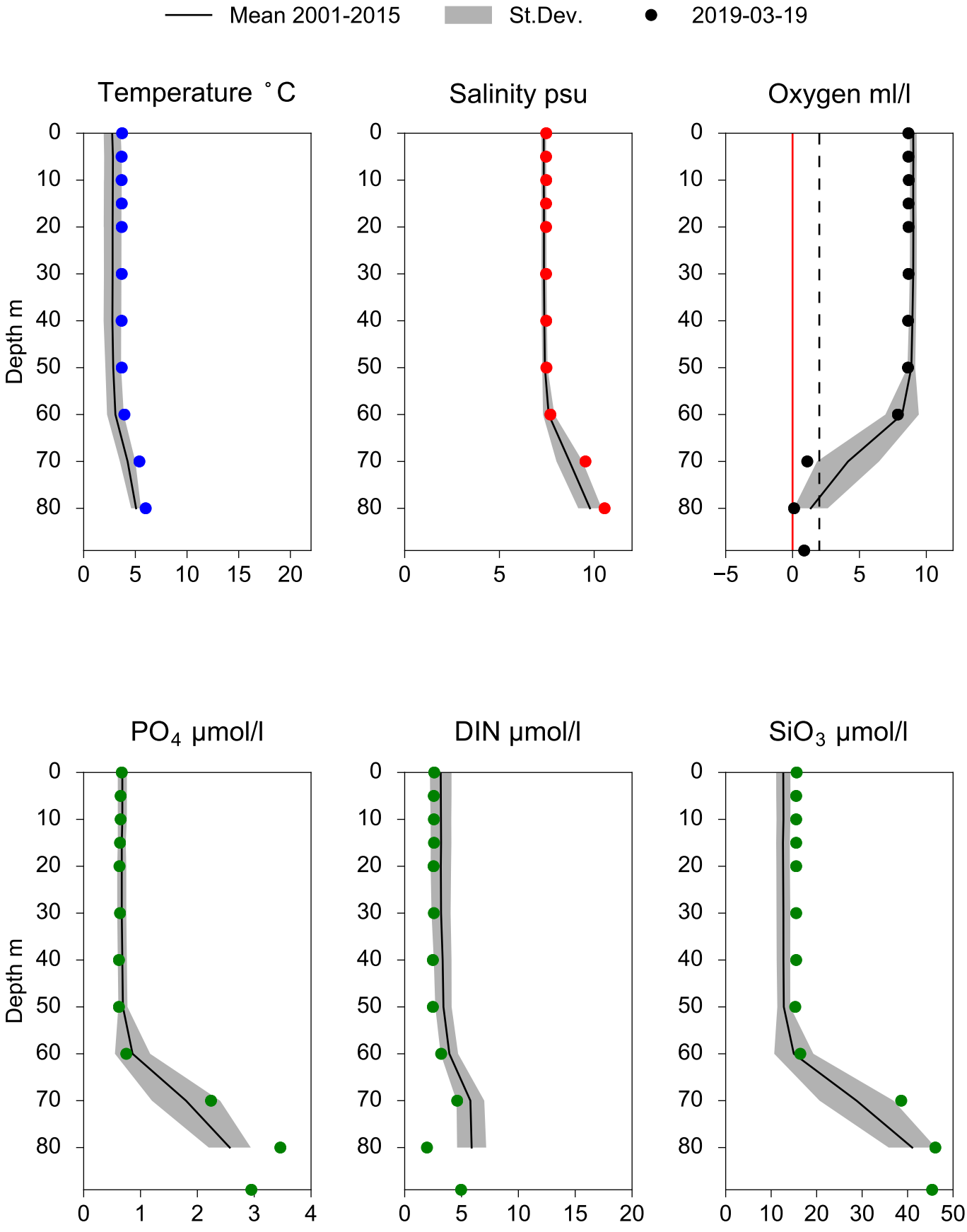
O_2 ml/l



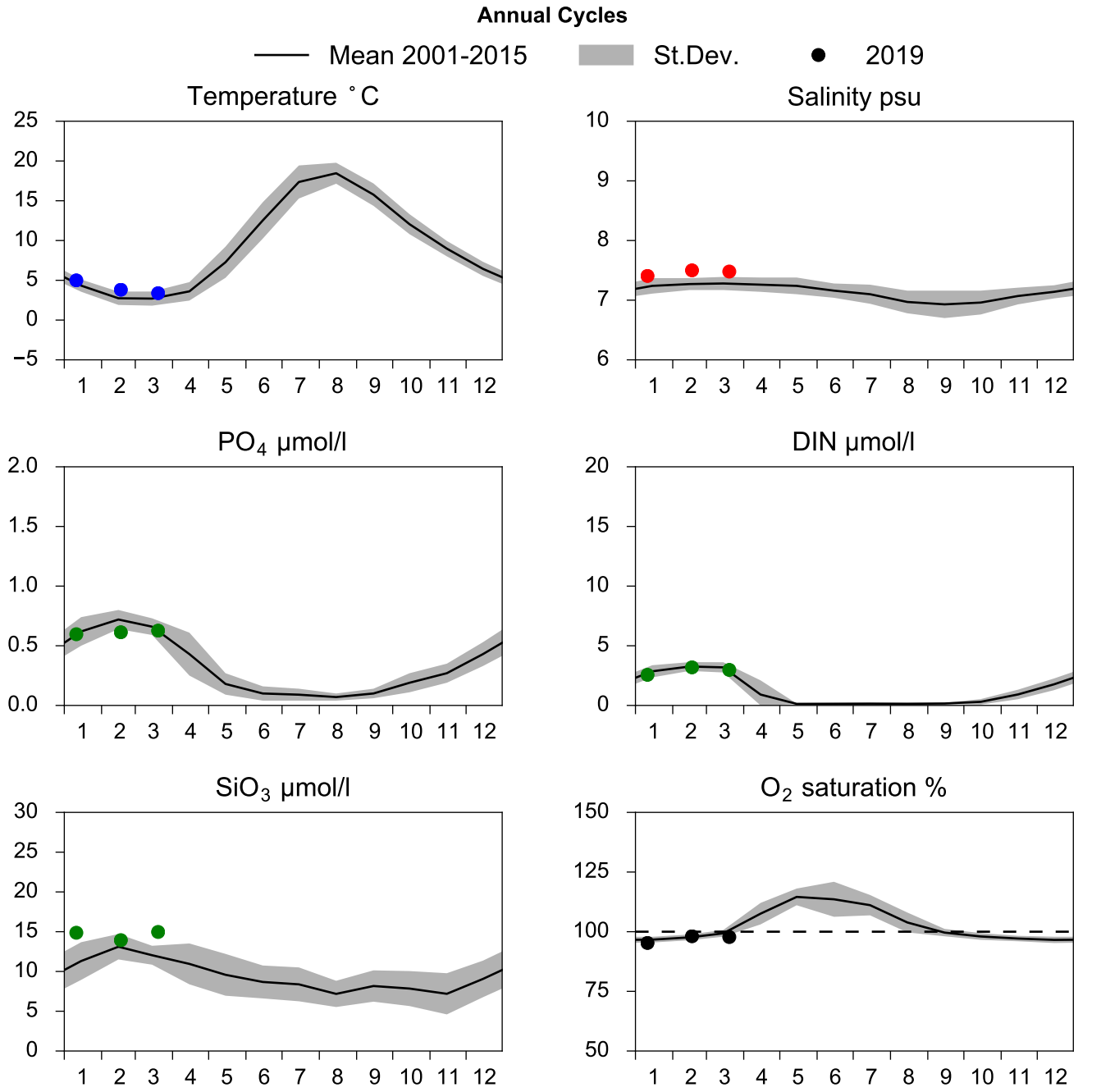
O_2 ml/l



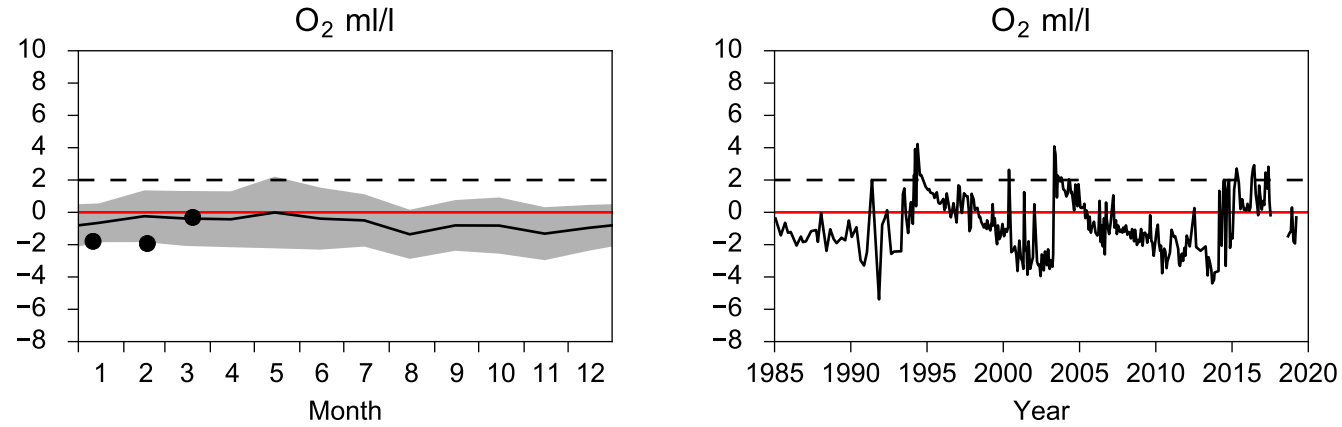
Vertical profiles BCS III-10
March



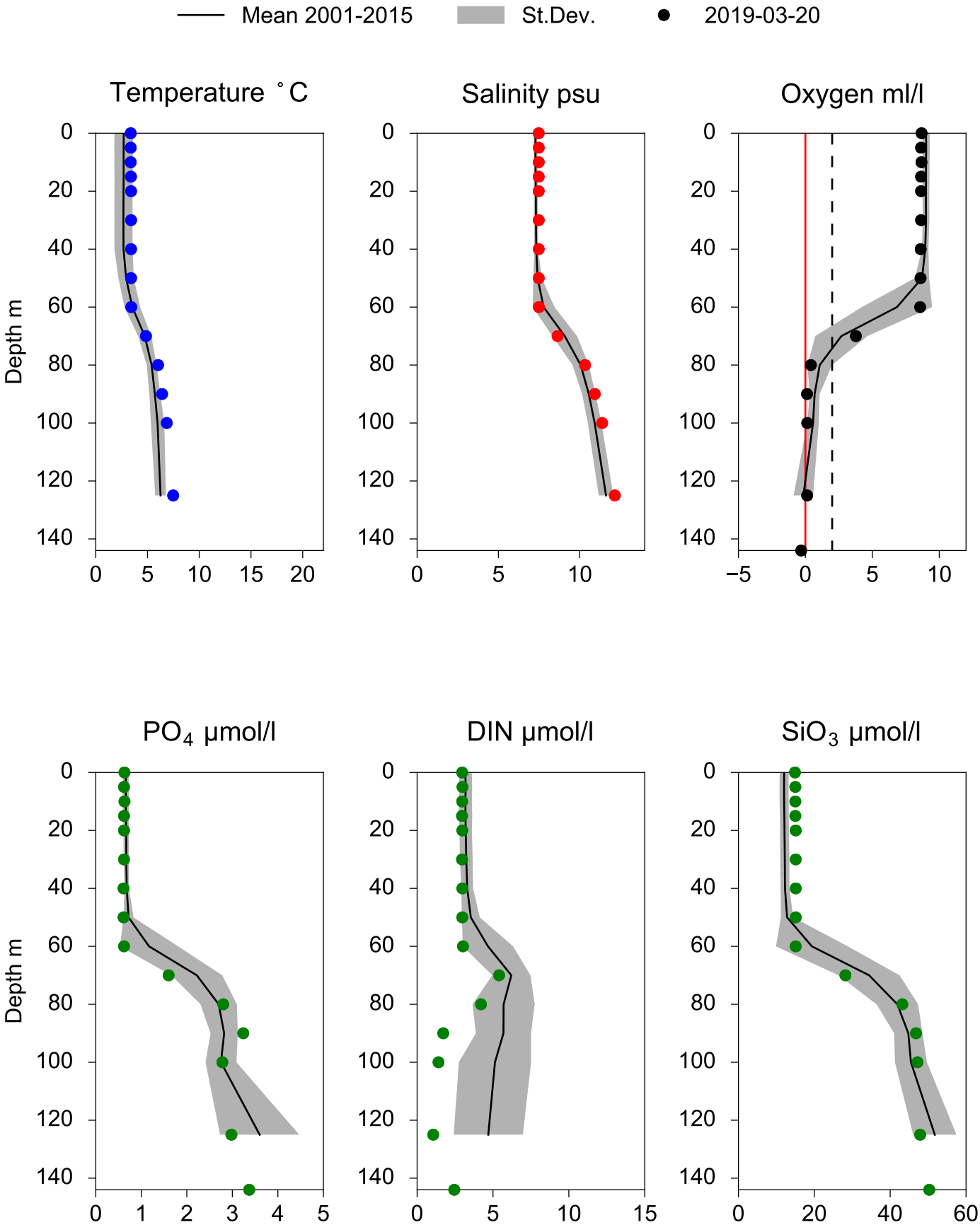
STATION BY10 SURFACE WATER (0-10 m)



OXYGEN IN BOTTOM WATER (depth >= 125 m)



Vertical profiles BY10
March

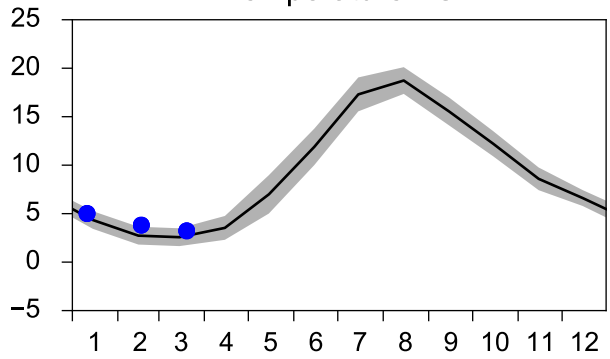


STATION BY15 GOTLANDSDJ SURFACE WATER (0-10 m)

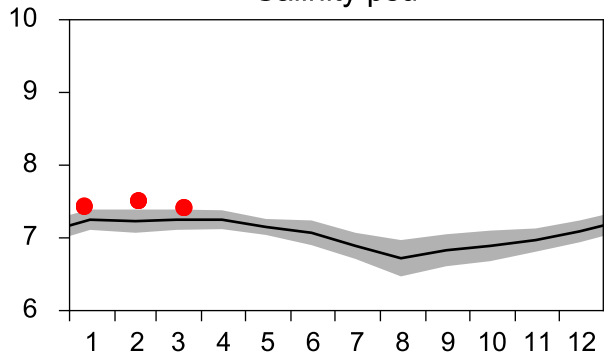
Annual Cycles

Mean 2001-2015 St.Dev. 2019

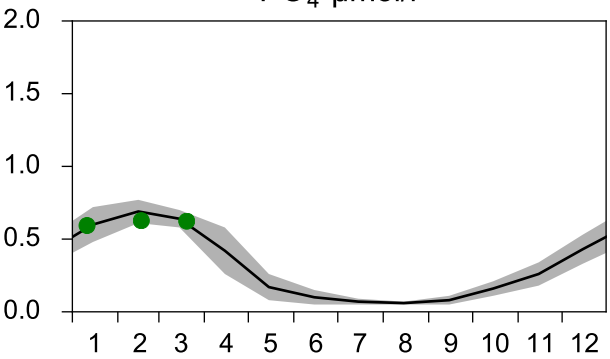
Temperature ˚C



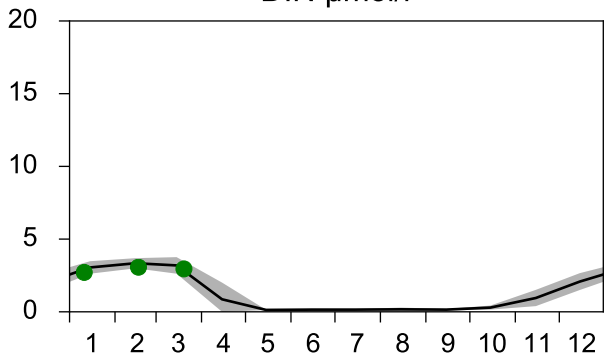
Salinity psu



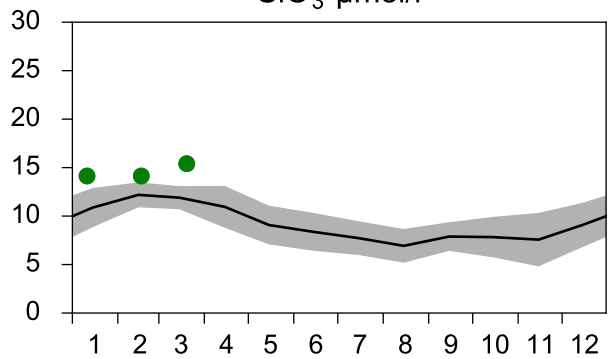
PO_4 µmol/l



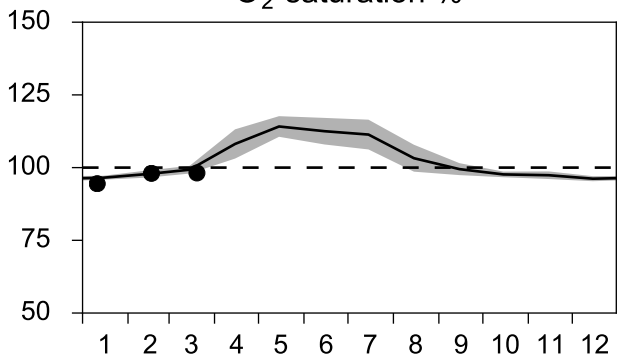
DIN µmol/l



SiO_3 µmol/l

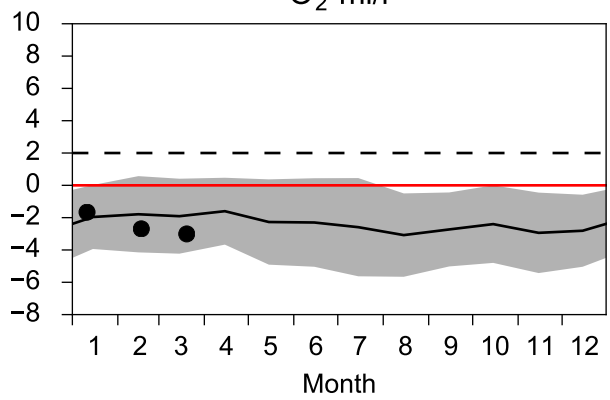


O_2 saturation %

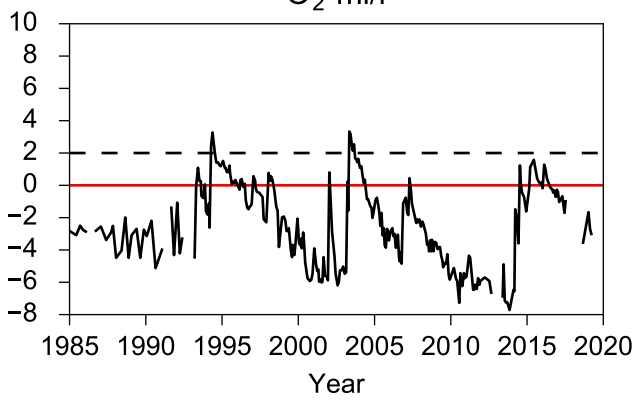


OXYGEN IN BOTTOM WATER (depth >= 225 m)

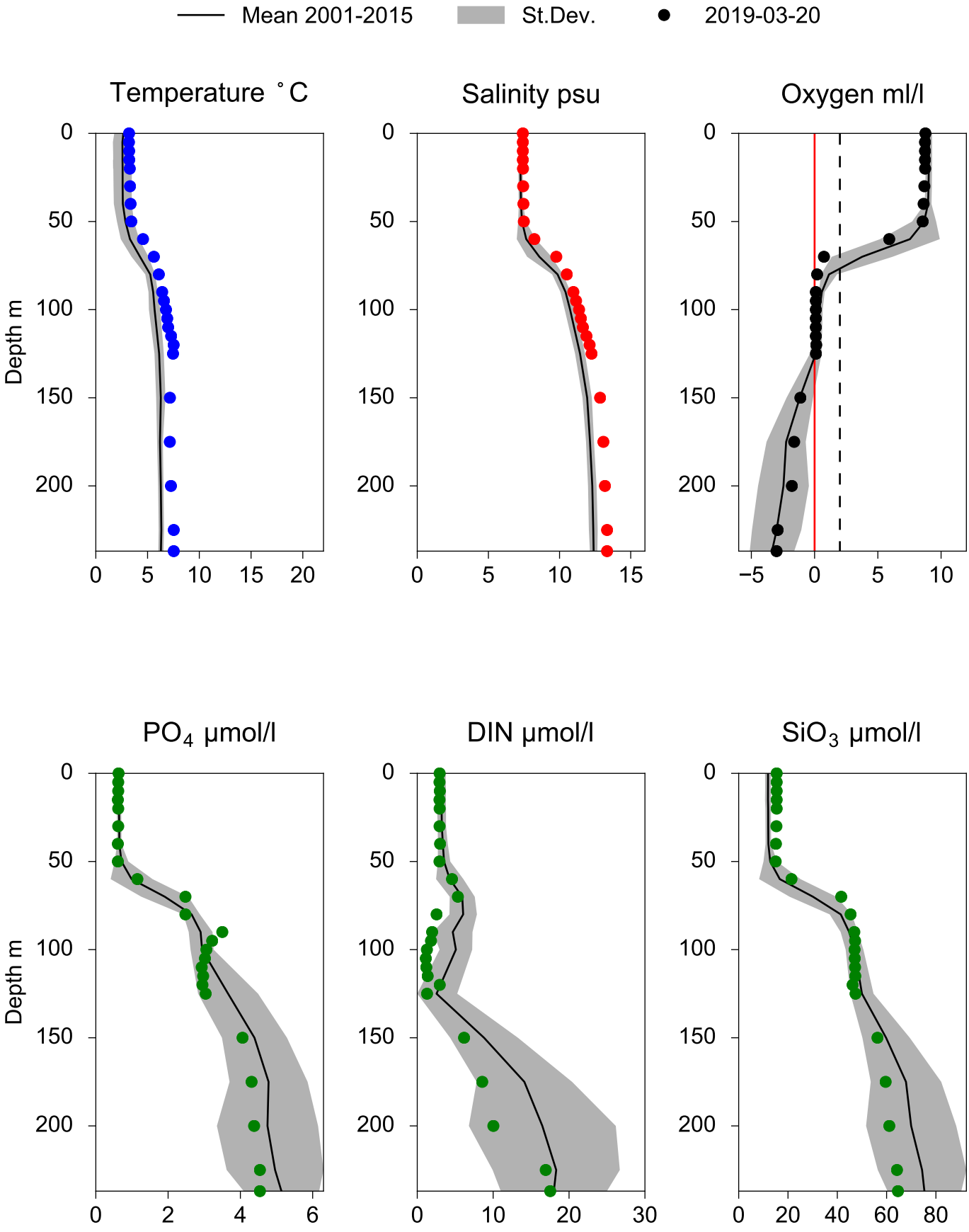
O_2 ml/l



O_2 ml/l



Vertical profiles BY15 GOTLANDSDJ
March

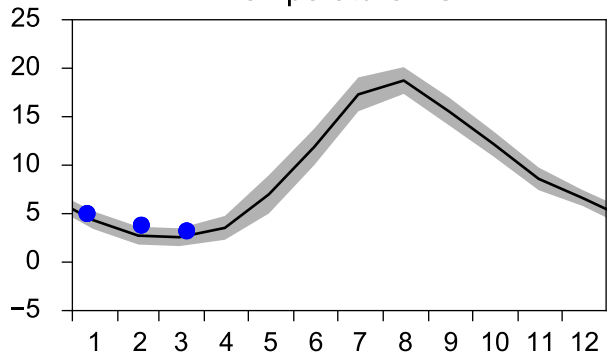


STATION BY15 GOTLANDSDJ SURFACE WATER (0-10 m)

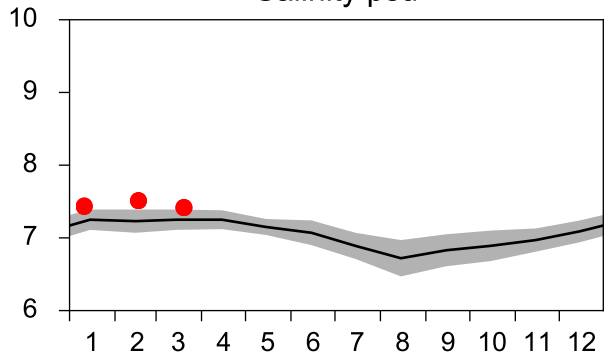
Annual Cycles

Mean 2001-2015 St.Dev. 2019

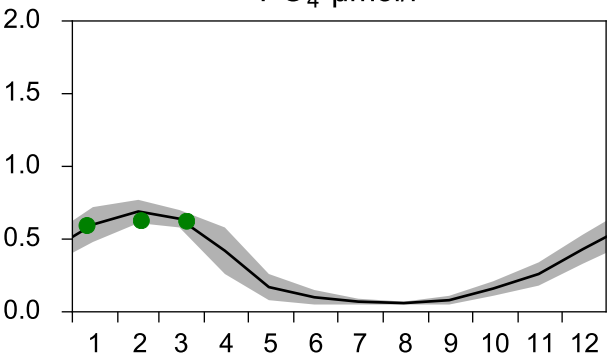
Temperature ˚C



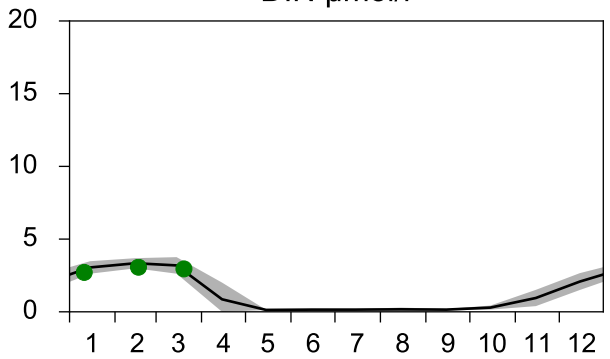
Salinity psu



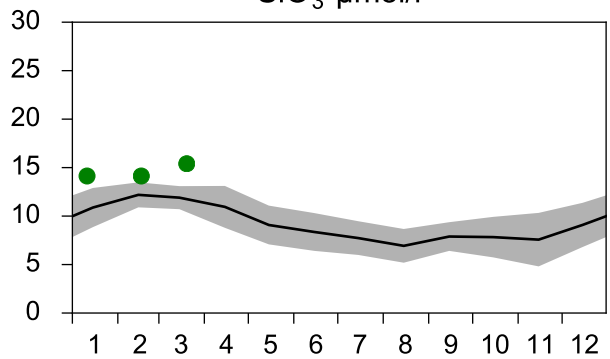
PO_4 µmol/l



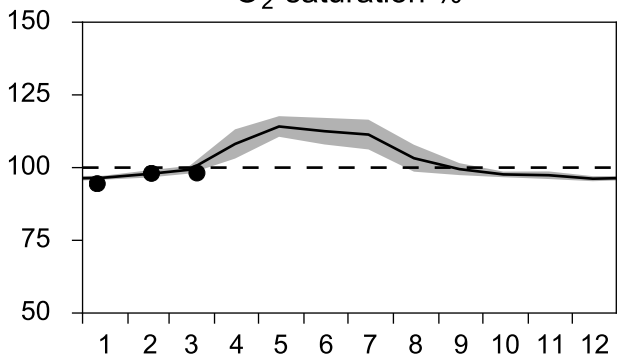
DIN µmol/l



SiO_3 µmol/l

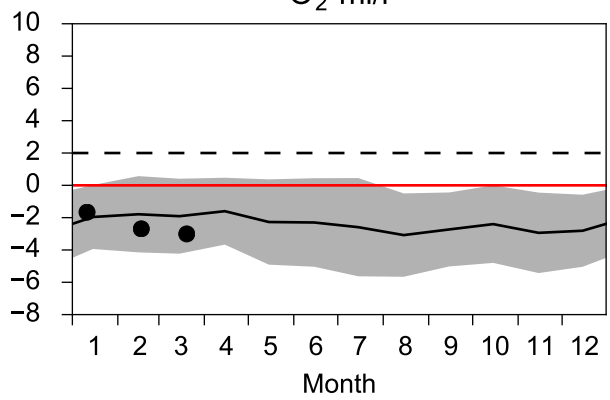


O_2 saturation %

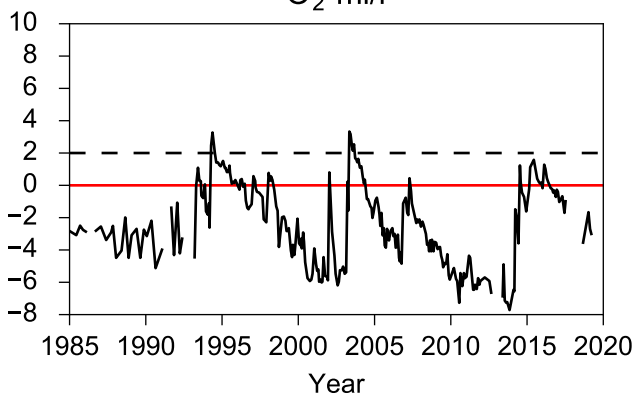


OXYGEN IN BOTTOM WATER (depth >= 225 m)

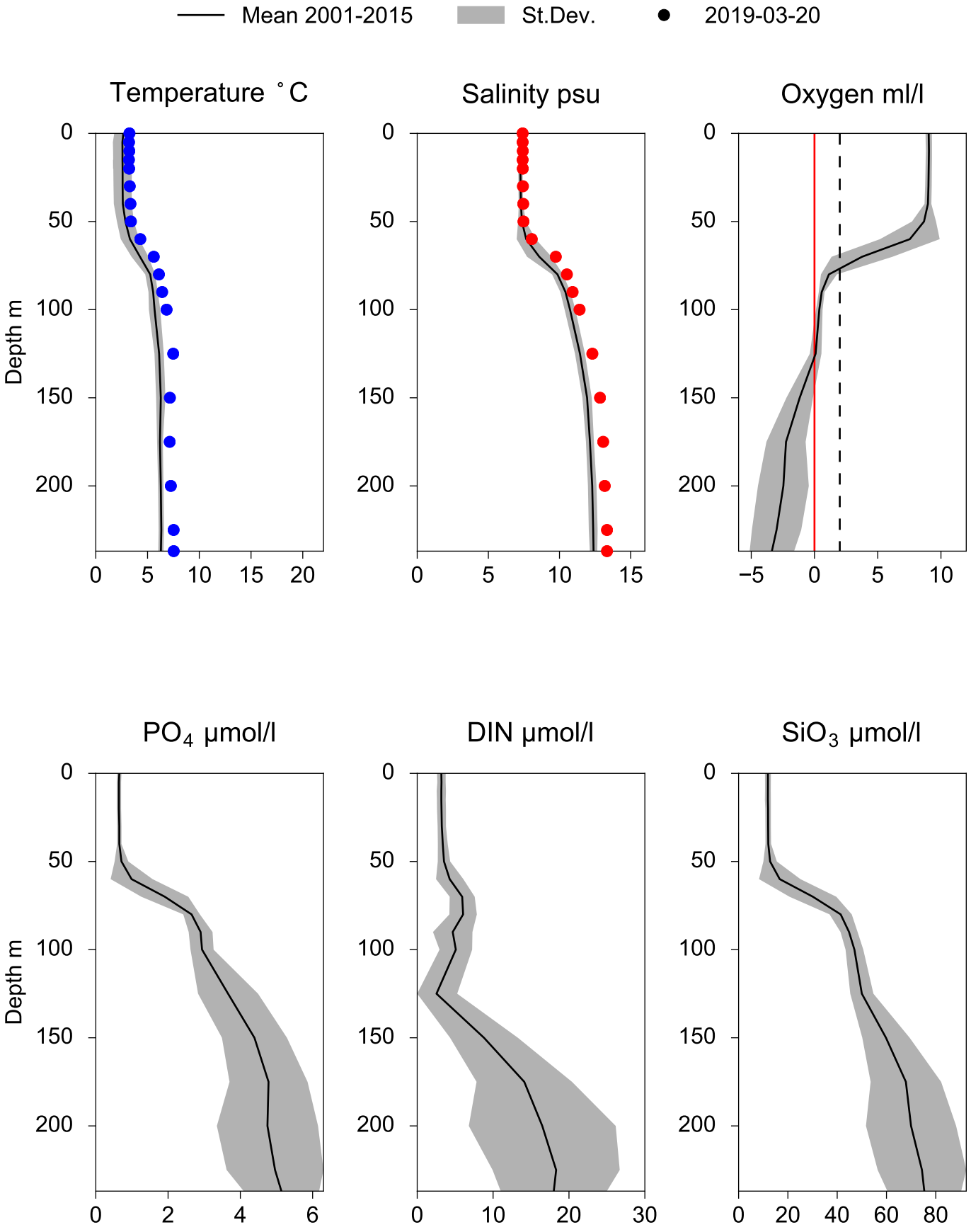
O_2 ml/l



O_2 ml/l



Vertical profiles BY15 GOTLANDSDJ
March

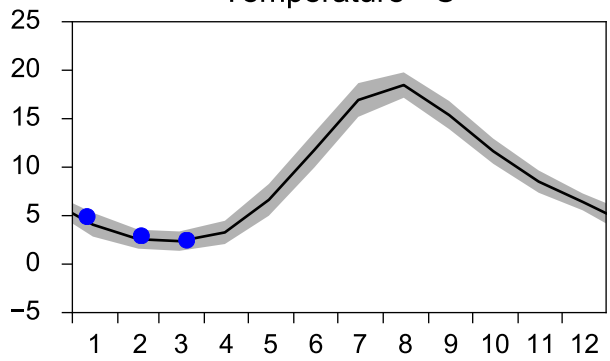


STATION BY20 FÅRÖDJ SURFACE WATER (0-10 m)

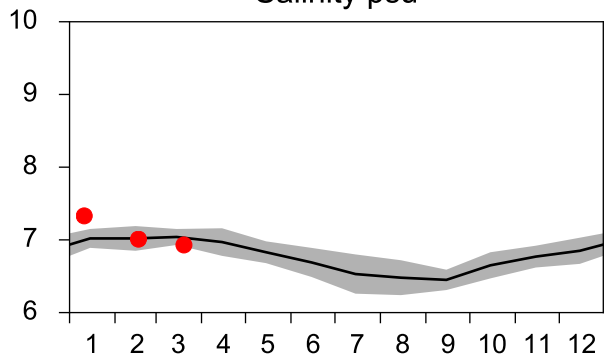
Annual Cycles

Mean 2001-2015 St.Dev. 2019

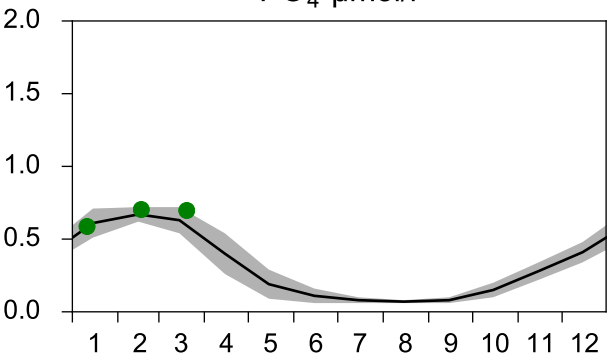
Temperature ˚C



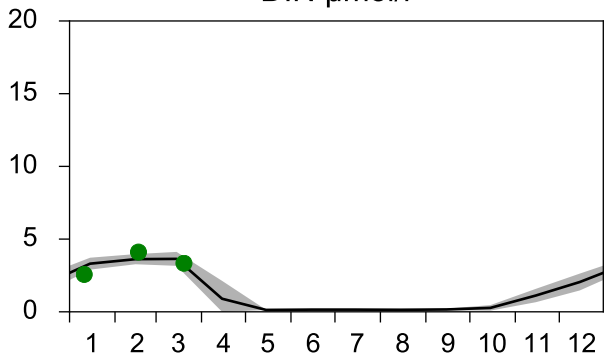
Salinity psu



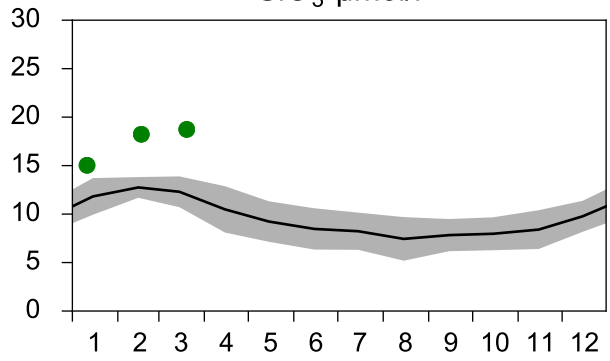
PO_4 µmol/l



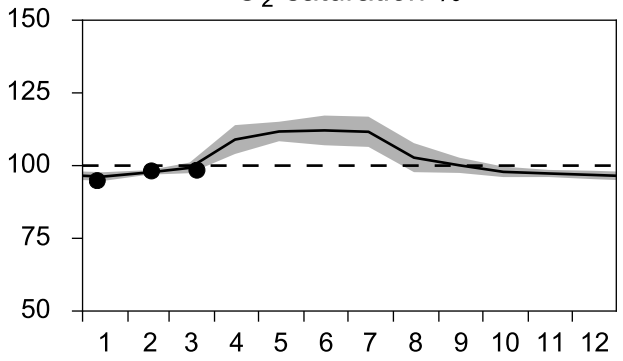
DIN µmol/l



SiO_3 µmol/l

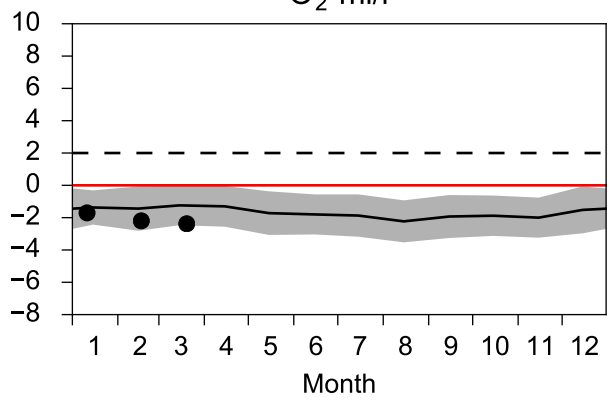


O_2 saturation %

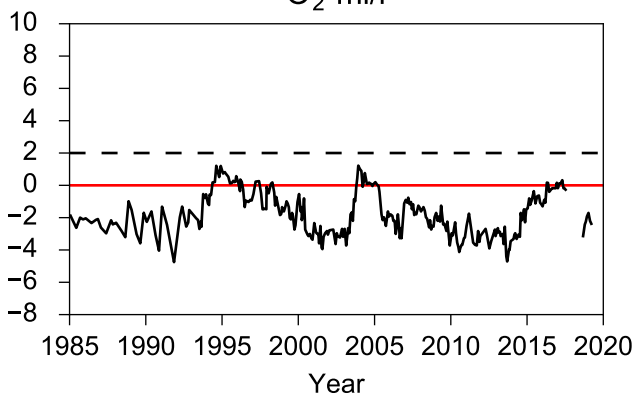


OXYGEN IN BOTTOM WATER (depth >= 175 m)

O_2 ml/l



O_2 ml/l



Vertical profiles BY20 FÅRÖDJ
March