

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



Photo: Örjan Bäck, SMHI

Survey period:	2022-11-08 to 2022-11-14
Principals:	Swedish Meteorological and Hydrological Institute (SMHI), Swedish Agency for Marine and Water Management (SwAM)
Cooperation partners:	Swedish University of Agricultural Sciences (SLU), Swedish Maritime Administration (SMA)

SUMMARY

The Skagerrak, the Kattegat, The Sound and the Baltic Proper was visited during this cruise, which is part of the national marine monitoring programme of Sweden.

The temperature in the surface water was above normal and varied between 10 and 12 degrees in all visited areas. At several stations in the Skagerrak and Kattegat, the temperature was above normal throughout the water column and in the Baltic Proper it was warmer than normal down to the halocline. The surface salinity was normal and varied between 34 psu in Skagerrak to 7 psu in the Baltic Proper.

The nutrient concentration in the surface water had not increased as much as it usually does between October and November and were lower than normal at several areas. The concentration of DIN and DIP was below normal in the outer regions of Skagerrak and the Western and Northern Gotland Basin. The silicate concentrations were below normal in the Western Gotland Basin. Higher levels than normal were observed in the Gotland Basins below 100 metres.

The oxygen condition in the Skagerrak and the Kattegat was good, the oxygen levels had increased in the Kattegat bottom water since October. In the Arkona Basin lower oxygen concentrations than in October were observed near the bottom, they were below normal around 2 ml/l. No hydrogen sulphide was observed in the Hanö Bight or the Bornholm Basin. In the rest of the Baltic Proper the oxygen condition is very poor, with hydrogen sulphide concentrations closest to the bottom at, or close to, record high values.

SMHI's next cruise with R/V Svea is planned for 5th to 16th of November, starting in Kalmar and ending in Lysekil.

RESULTS

The cruise was performed onboard R/V Svea and began in Falkenberg late on November 8th and ended in Kalmar the evening of November 14th.

The ocean buoy at Huvudskär in the Northern Baltic Proper was retrieved during the cruise.

The weather was cloudy with mainly moderate wind from south west to west. On the November 11th the wind increased and the sea state was relatively rough. When the ocean buoy was retrieved on the 13th, the wind decreased and the sun was shining. The air temperature was around 10 degrees Celsius.

All of the 24 planned stations were visited. In addition to the regular sampling we also took extra phytoplankton samples for Stockholm University at three stations on the west coast.

Measurements with Svea's MVP (Moving Vessel Profiler) which is used to measure temperature, salinity and oxygen profiles underway, was operating daytime where circumstances allowed. Also, the ADCP (current measurement) and Ferrybox were running during the expedition.

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 SHARKweb here: <https://www.smhi.se/en/services/open-data/national-archive-for-oceanographic-data/download-data-1.153150>

The Skagerrak

The temperature in the surface water was around 12 °C which is above normal. It was only a minor decrease in temperature since October and at station Å13 the temperature had in fact increased. At the stations Å15, Å13 and P2 the temperature was above normal not only in the surface water but in the entire water column. The surface salinity varied from 27 psu at Släggö in Gullmarsfjorden up to 34 psu at Å13. At the station Å13 the surface salinity was above normal, at the other stations it was normal. At the outer parts of Skagerrak, the surface water was well mixed down to 20 m. Below 20 m, it was another 20 m deep layer with warmer water that had not yet been cooled, then again, the temperature decreased towards the bottom. Closer to the coast, the water was warmer in the entire water column and the surface salinity was higher which together resulted in a less sharp stratification. At Släggö, the stratification was at 25 m.

The concentration of inorganic nutrients, nitrogen (DIN¹), phosphate (DIP²) and silicate, in the surface water was still low but had increased some since the previous month except in the outer parts of Skagerrak where it had decreased. The level of DIN in the surface water varied between 0.5 µmol/l in the outer parts of Skagerrak where it was below normal to the normal level of 3.2 µmol/l at station P2. The concentration of DIP was also below normal in the outer parts of Skagerrak where it was 0.1 µmol/l, the other stations had normal levels and the highest was observed at station P2 where it was 0.4 µmol/l. The silicate levels were normal at all stations and varied between 1.2 – 3.8 µmol/l.

The oxygen conditions at the bottom were good along the Å transect and at P2 with concentrations between 4.9 to 5.8 ml/l. The lowest dissolved oxygen concentration was observed at Släggö; 2.9 ml/l. All stations had normal values for the season.

Chlorophyll fluorescence is a measure of plankton activity measured with a sensor mounted on the CTD³. No large peaks in chlorophyll fluorescence was observed but at station Å17 it was higher chlorophyll fluorescence down to the pycnocline compared with the other stations. The Secchi depth at Å17 was 9 metres.

The Kattegat and the Sound

In the Kattegat and the Sound, the temperature in the surface water was also above normal and around 12 °C. At all stations except from W Landskrona the temperature was above normal in the entire water column. The surface salinity was normal in Kattegat and varied between 26 psu in the northern part to 24 psu in the southern part. At the station W Landskrona in the Sound the surface salinity was 23 psu which is above normal. The surface layer in Kattegat was well mixed down to 20 m. In the Sound, only the top 5 metres were well mixed, below 5 m temperature increased and salinity decreased continuously to the stratification at 15 m.

The concentrations of nutrients in the Kattegat surface water were normal for this time of year and DIP and silicate had increased since October while DIN still was very low. DIP varied around 0.2 µmol/l, DIN 0.2 – 0.4 µmol/ and silicate 1.4 – 1.7 µmol/l. The levels of nutrients were higher in the Sound: DIP 0.7 µmol/l, DIN 4.0 µmol/l and silicate 14 µmol/l.

¹ DIN - dissolved inorganic nitrogen, the sum of nitrate, nitrite and ammonium.

² DIP – dissolved inorganic phosphorus, only appears in the form of phosphate.

³ CTD is a profiling instrument and is an abbreviation of Conductivity, Temperature and Depth. SMHI's CTD is also equipped with sensors that measure dissolved oxygen and fluorescence among others.

The dissolved oxygen concentration in the bottom water was good and varied between 4.1 – 4.7 ml/l, which is an increase from the previous month. In the Sound the dissolved oxygen concentration had decreased in the bottom water and was 2.6 ml/l. The oxygen level in the surface layer was lower than normal in the Sound.

In Kattegat, specially at station Fladen, the chlorophyll fluorescens was high in the top layer down to the pycnocline. The Secchi depth at Anholt E was 11 metres.

The Baltic Proper

The temperature in the surface layer in the Baltic Proper was, like at the west coast, above normal for the season, and around 12 °C in the Arkona and Bornholm Basin and 11 °C in the Gotland Basins. The coldest spot was observed at the station BY39 at the southern tip of Öland where it was 10 °C. The surface salinity at Bornholm was around 8 psu which is above normal. In the Eastern Gotland Basin, the surface salinity was 7 psu and in the Western Gotland Basin around 6.6 psu, all of these stations had normal salinity levels.

In the Arkona Basin, the surface water was well mixed down to 30 – 40 metres. At the station BY5 in the Bornholm Basin, a thermocline was observed at 25 m. Below this thermocline, the water was colder than normal down to 60 m where a second thermocline coincided with the halocline. In the Eastern Gotland Basin, the surface water was well mixed down to 30 m where thermocline and halocline coincided. Below this stratification, the temperature dropped to 4 degrees and the salinity increased down to the permanent stratification at 60 m. Below the stratification, the water became warmer, around 7 degrees at the bottom, while the salinity continued to increase to 13 psu. In the Western Gotland Basin, the halocline was observed around 50 m.

The concentration of DIN and DIP in the surface water was below normal values in the Western and Northern Gotland Basins, in Hanö Bight and at the coastal station REF M1V1, other areas had normal values. The silicate concentration was below normal in the Western Gotland Basin and at the station REF M1V1. The levels of DIN varied between 0.3 – 1 µmol/l, DIP 0.15 – 0.6 µmol/l and silicate 6 – 12 µmol/l. In general, the normal increase in nutrients between October and November was less than usual. Below the halocline all nutrients increased. In both the Eastern and Western Gotland Basin higher values than normal of DIN and silicate was observed below 100 metres. The level of DIP was above normal below 100 metres in the Eastern Gotland Basin. In the Bornholm Basin normal values of DIN, DIP and silicate were observed except at 80 m where it was higher values than normal. Normal values of DIN, DIP and silicate were observed in the deep water in the Arkona Basin.

Dissolved oxygen concentration near bottom in the Arkona Basin was lower than in October and below normal, just above 2 ml/l. Hanö Bight and Bornholm Basin had acute oxygen deficiency from 60 m but hydrogen sulphide was only observed at 80 m at BY5. No hydrogen sulphide was observed at the stations REF M1V1 or BY39. For all other areas, the oxygen situation was very serious with concentrations of hydrogen sulphide near the bottom at or near record high levels. In the Eastern and Northern Gotland Basin acute oxygen deficiency started from 75 m and hydrogen sulphide was observed from 80 – 100 m. In the Western Gotland Basin at BY31 acute oxygen deficiency started from 60 m and hydrogen sulphide was noted from 80 m. At the station BY38, also in the Western Gotland Basin, acute oxygen deficiency started from 50 m and hydrogen sulphide from 60 m.

Fluorescence measurements with the CTD showed plankton activity in the surface layer above the thermocline at all stations, low values were measured below the thermocline. No major peaks in chlorophyll fluorescence were observed. The Secchi depth in the Baltic Proper was 7 – 9 metres.

More information about the algal situation can be found in the Algaware report for November:
<https://www.smhi.se/publikationer/publikationer/algrapporter> (only available in Swedish).

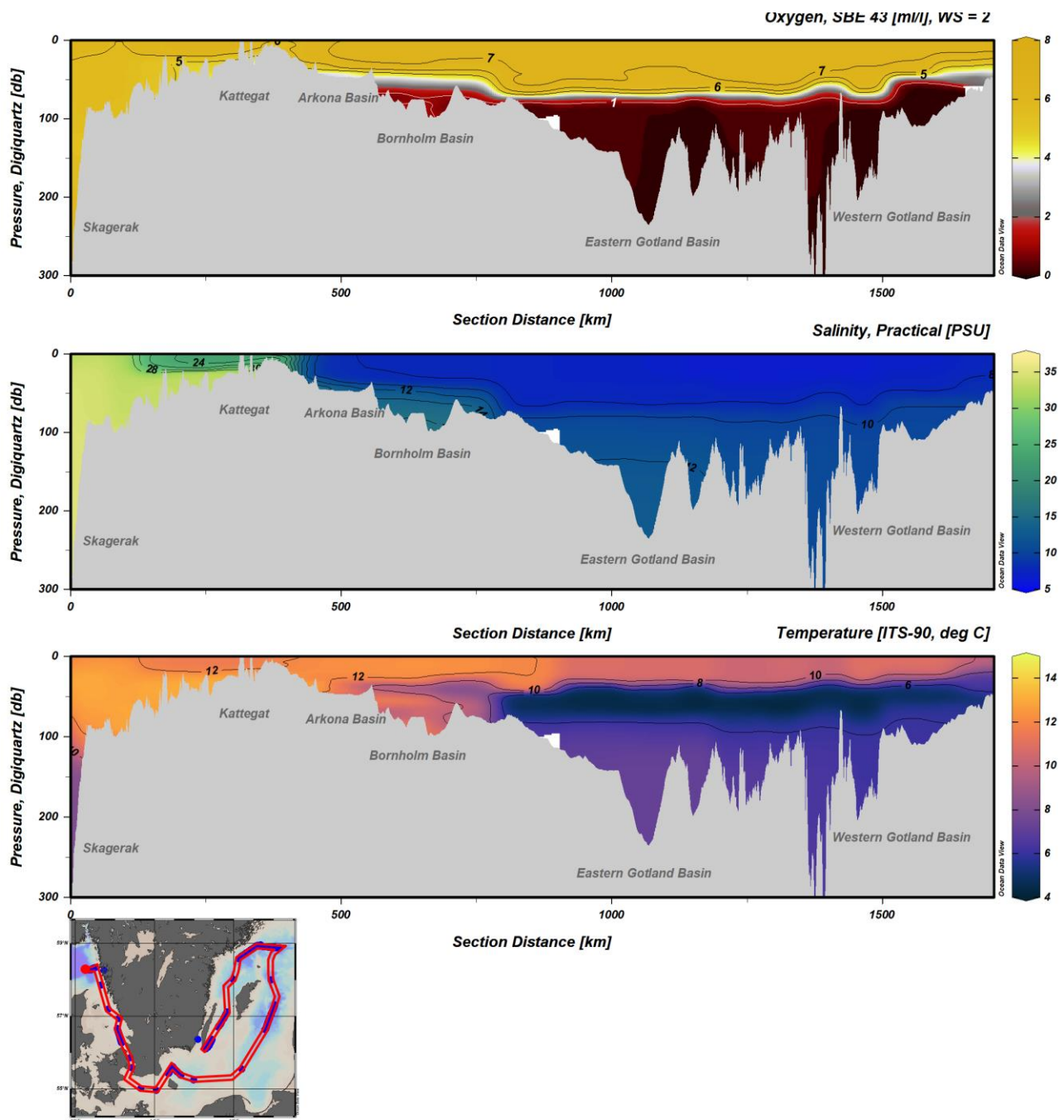


Figure 1. Transect showing CTD measurements of dissolved oxygen, salinity and temperature from Skagerrak, Kattegat, the Sound, further into the Baltic Proper, ending in the Western Gotland Basin. Vertical lines show the positions where data is collected, also shown in the map.

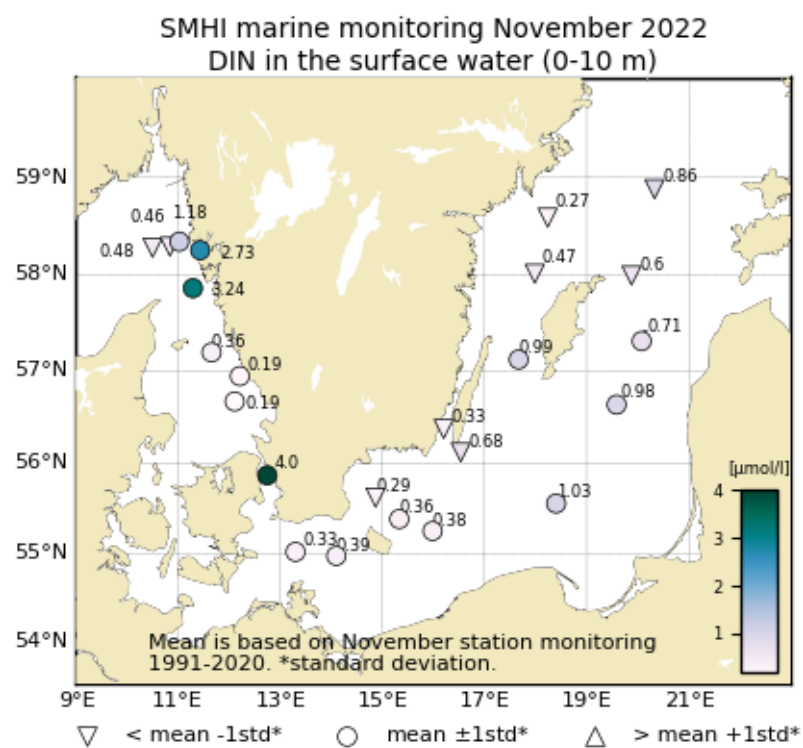


Figure 2. Concentration ($\mu\text{mol/l}$) of dissolved inorganic nitrogen in the surface water (0-10m).

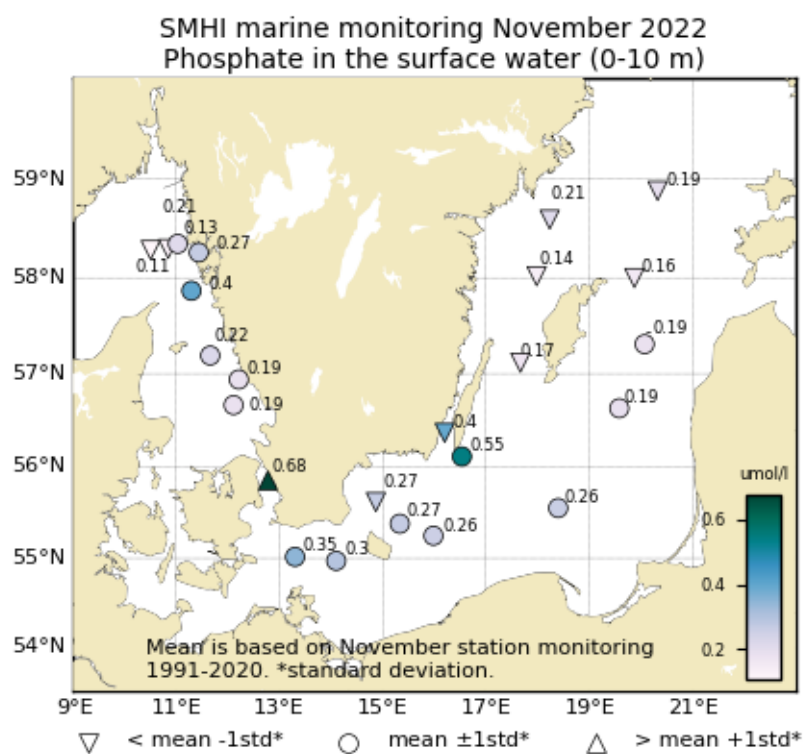


Figure 3. Concentration ($\mu\text{mol/l}$) of phosphate in the surface water (0-10m).

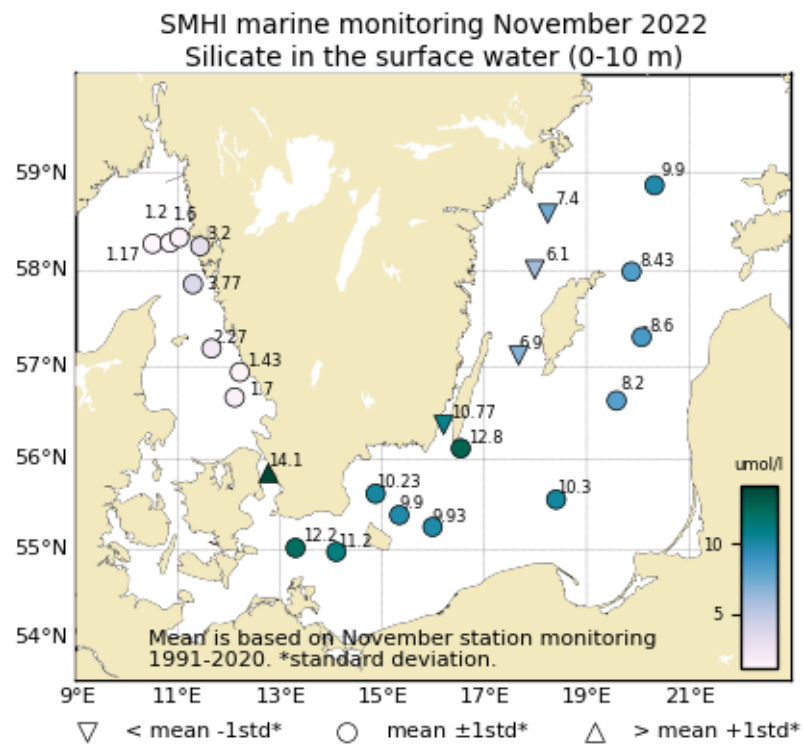


Figure 4. Concentration ($\mu\text{mol/l}$) of silicate in the surface water (0-10m).

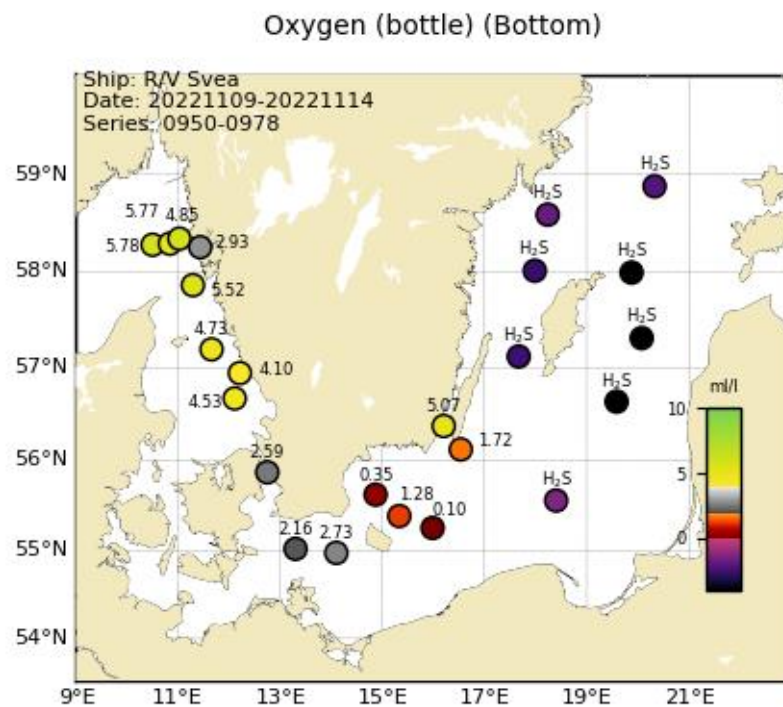


Figure 5. Oxygen concentration (ml/l) in the bottom water.

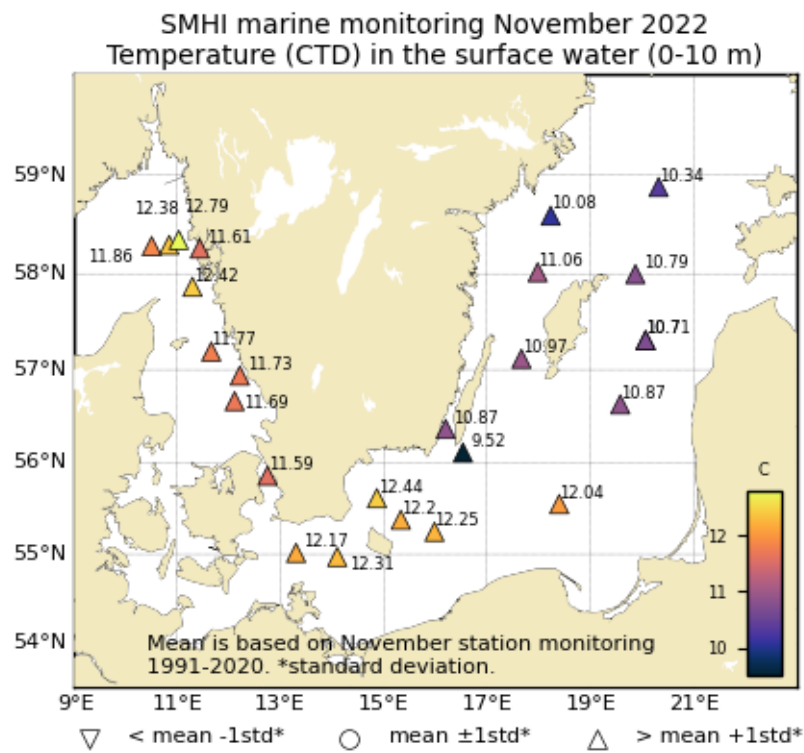
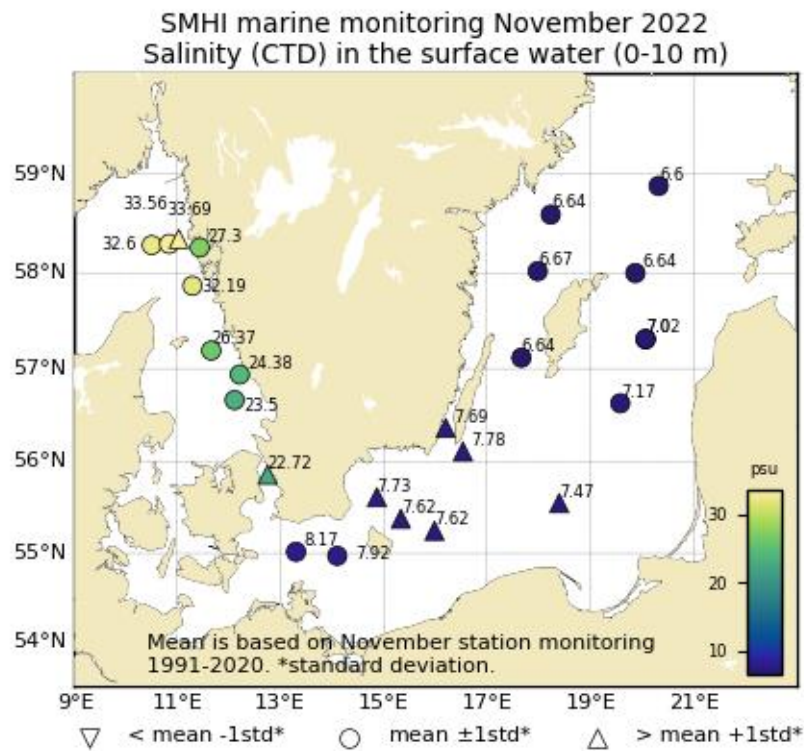


Figure 6. Temperature in the surface water (0-10m).



PARTICIPANTS

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APPENDICES

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