Baltic Marine Environment Protection Commission

Working Group on the State of the Environment and Nature Conservation
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Background

HELCOM guidelines for hydrography and hydrochemistry are currently being revised. Lead Country Sweden submits these draft guidelines for monitoring of physical oceanography in the HELCOM area as a contribution to the ongoing revision of HELCOM monitoring guidelines.

Physical oceanography is currently not included in the Manual for monitoring in the COMBINE programme in HELCOM. The variables described in the proposed guidelines are not directly linked to any indicators.

The draft has been amended based on reviews by representatives from Denmark, Estonia, Finland, Germany and Poland. Further feedback was received at HELCOM STATE & CONSERVATION 9-2018. However, the material is considered incomplete, and further input is needed.

Suggestions for further work, such as comments on the level of detail in descriptions of monitoring techniques, would be valuable for the review process.

Action requested

The Meeting is invited to

- take note of the ongoing work
- provide comments to the draft Guidelines for Monitoring of physical oceanography as needed

Guidelines for monitoring of physical oceanography

1 Background

Monitoring of physical oceanographic variables is necessary to describe natural variability, and assess permanent changes in hydrographic conditions. Data from near real-time observations are used in operational oceanographic products such as forecasts, warnings and data assimilations.

Although there are no corresponding core indicators, physical oceanographic observations provide essential supporting data for environmental monitoring and assessment, and are required for characterization of habitats.

1.1 Introduction

(Short introduction of the topic/species/substance under monitoring, what is monitored, how and by whom and relevant definitions.)

This document aims to cover

- Sea level
- Waves (significant wave height, period, and direction)
- Currents (speed and direction)

1.2 Purpose and aims

(Brief description on why the monitoring is carried out and its aims.)

There are no HELCOM core indicators specifically linked to sea level, waves or currents. Monitoring is to be carried out to fulfil assessment requirements of HELCOM ecological objectives that are specified through HELCOM core indicators. The monitored parameters are essential to support status assessment and characterize the habitats.

2 Monitoring methods

2.1 Monitoring features

(More detailed description on the monitoring in question (species/substance/target of monitoring), if relevant.)

Fundamental physical oceanographic variables such as sea level, waves and currents have a huge impact on shipping, and marine safety and infrastructure. Apart from the obvious utilitarian purpose of monitoring these variables, it also supports environmental monitoring and assessments. Factors affecting transport between water and atmosphere, and exchange between basins need to be monitored to assess both eutrophication and climate change effects.

2.2 Time and area

(Provide reference and direct links to the temporal and spatial information in the Monitoring Manual.)

2.2.1 Time and frequency

Data is collected from autonomous instruments continuously, either all year around (e.g., sea level) or during the ice-free seasons (e.g., waves measured using wave buoys). Frequency depends on the parameter and the method applied varying form 10 min to 1 hour. For instance, current speed and direction is measured every 10 minutes while the wave characteristics are usually calculated for 30 minute intervals.

2.2.2 Spatial coverage:

Sea level

Coastal sea level stations should be placed at an appropriate distance from each other in all Baltic sub-basins. Currently, approximately 200 tide gauges are distributed along Baltic coasts, and coverage is found sufficient.

Waves

1-2 devices per Baltic sub-basin would be considered sufficient.

Currents

Monitoring must include measurements in each sub-basin, and connecting straits. The information on water transport between the Baltic and the North Sea as well as between Baltic sub-basins is of great importance for the budget calculations. Therefore it is recommended to perform current measurements in the transition areas.

2.3 Monitoring procedure

2.3.1 Monitoring strategy

(A general short description of the monitoring strategy e.g. why certain methods are used)

Sea level

Sea level is measured by tide gauges on shore. Measurements are usually based upon stilling well technique and pressure measurements, but microwave or radar gauges are now available, and considered reliable. Radar gauges can be mounted in existing stilling wells, as well as over open water.

Waves

- Wave parameters (significant height, direction, and period) are traditionally measured using moored wave buoys. Measurements of wave height from buoys equipped with accelerometers have been standard method for decades, advances in sensor technique now also allow for observations of direction and period.
  Wave buoys normally need little maintenance, but are sensitive to ice and low (sub-zero) temperatures.
- HF radar has the advantages of covering a larger area, rather than the spot metering offered by buoys and other moored equipment. HF radar systems operate by transmitting electromagnetic waves of 3-30 MHz, with wavelengths of 5-10m. The signal travels along the sea surface by ground wave propagation, and thus can reach beyond line of sight. Reach and resolutions depend on power output; a reach of 200 km could be obtained.
  The reach of HF radar systems is reduced by the lower conductivity in brackish water. At a surface salinity of 7 psu, reach will typically be reduced to 50%, compared to oceanic (35 psu) conditions.
- Pressure sensors are used for the near-coast measurements. As a disadvantage of pressure sensor method is that the wave direction is not determined.

Currents

- Current speed and direction are measured using ADCPs (Acoustic Doppler Current Profiler), either from moored installations, or from ship-based instruments.
- Land-based HF radar installations can be used for measuring surface currents in coastal areas. Using the radar Doppler shift, HF radar can be used for detection of the sea surface currents.
  A temporal resolution of hourly averages in surface current is usually obtainable.

2.3.2 Data collection methods and equipment

(A description of the field sampling method(s) and equipment(s) used)

Sea level

Recommendations for installation, use, and maintenance are available in *Manual on sea level measurement and interpretation, volume V: Radar gauges* (IOC 2016).

Sea level stations have to be connected to the geodetic network. Information of the reference datum has to be identified. Sea level data will be connected to a common reference datum for the Baltic Sea in the near future.

Waves

Wave buoys and sensors (e.g., accelerometers) have to be serviced and calibrated on a regular basis. They need to be recovered every autumn/early winter and deployed early spring after floating ice is disappeared.

Currents

2.4 Data analysis

(How tentative further treatment of data and calculations are executed e.g. equations, conversion factors, statistical analysis)

Recommendations for automated real-time data checks are available in *Copernicus In Situ TAC, Real Time Quality Control for WAVES. CMEMS-INS-WAVES-RTQC* (Copernicus Marine *In Situ* Team 2017). Relevant metadata must be recorded

3 Data reporting and storage

(Format for data reporting, where the data is reported e.g. specific database)

Data from *in situ* measurements are reported to, and distributed through, the Baltic Operational Oceanographic System (BOOS).

Data and metadata are assembled by SMHI and BSH, and made accessible through the BOOS portal. *In situ* data and data products are also made available through European Marine Observation and Data Network (EMODnet), Copernicus Marine Environment System (CMEMS), and SeaDataNet.

4 Quality control

4.1 Quality control of methods

For reliable observations, instruments must be kept in good order. Manufacturers usually give detailed instructions regarding service and calibration of instruments.

Maintenance, care and calibrations of instruments and installations must be scheduled.

4.1.1 Tide gauges

Manual readings should be done continuously (at least once a month) and a more qualified levelling should be performed at least once a year.

4.2 Quality control of data and reporting

General guidelines for quality control of data and metadata are listed in *Recommendations for in-situ data Real Time Quality Control* (Pouliquen, Sylvie and the DATA-MEQ working group 2017) available from the EuroGOOS website; and in *DATA QUALITY CONTROL PROCEDURES* (SeaDataNet 2010).

QC routines for wave data are available from in *Copernicus In Situ TAC, Real Time Quality Control for WAVES. CMEMS-INS-WAVES-RTQC* (Copernicus Marine *In Situ* Team 2017).

5 Contacts and references

5.1 Contact persons

Thomas Hammarklint, Swedish Maritime Administration

Johan Håkansson. SMHI

5.2 References

Copernicus Marine *In Situ* Team 2017
Copernicus *In Situ* TAC, Real Time Quality Control for WAVES. CMEMS-INS-WAVES-RTQC.
http://doi.org/10.13155/46607

Intergovernmental Oceanographic Commission 2016
Manual on sea level measurement and interpretation, volume V: Radar gauges
JCOMM Technical Report No. 89
https://unesdoc.unesco.org/ark:/48223/pf0000246981/PDF/246981eng.pdf.multi

Pouliquen, Sylvie and the DATA-MEQ working group 2017
Recommendations for in-situ data Real Time Quality Control
http://eurogoos.eu/download/publications/rtqc.pdf

SeaDataNet 2010
DATA QUALITY CONTROL PROCEDURES Version 2.0 May 2010
https://www.seadatanet.org/Standards/Data-Quality-Control

5.3 Additional literature

BOOS Annual member reports
http://www.boos.org/documents/annual-meeting-documents/