Poster presented at Forum Skagerrak conference
in Kristiansand, Norway, 11-12 May, 2005

FORUM SKAGERRAK II

2003-2007

LINKED FOR A LIVING SEA AND COASTLANDS

Oceanographic mooring Måseskär West - real time monitoring of oceanographic state and HAB:s

Bengt Karlson & Henrik Lindh
the Swedish Meteorological and Hydrological Institute, Göteborg and Norrköping, contacts: bengt.karlson@smhi.se and henrik.kindh@smhi.se

Background

The Skagerrak is an area influenced by water from the Baltic and the North Sea. Harmful algal blooms (HAB:s) are a major concern in the area for aquaculture and the whole marine ecosystem. The water is mostly stratified and HAB:s sometimes occur in thin layers in the water column. To monitor the development and advection of blooms higher temporal resolution than regular ship monitoring is necessary. Satellites only "see" the uppermost part of the sea and FerryBox systems also only sample the upper 3-4 meters. A mooring with a profiling multi-parameter device is deployed at ca 50 m depth close to the Swedish coast

Aim of system

- To provide high quality real time data for assessment of environmental state, warnings of HAB:s and data assimilations into models etc.
- The platform should be part of a network for early warnings of hamful algal blooms etc.
- High temporal resolution - 3 hours
- High vertical resolution - ca 20 cm
  - Important in stratified waters
- Longterm monitoring necessary
  - Biofouling must be under control
- Low cost for maintenance
  - Only two sets of sensors (profiler + surface buoy)
  - Small ships for service (ca 15 m)
  - Relatively long intervals between service
    - Summer ca 45-60 days
    - Rest of the year ca 3-4 months
  - Compact system can be transported easily

Limitations

- Only high biomass blooms are monitored using automatic techniques. Low biomass species causing e.g. shellfish poisoning still require frequent sampling and microscopy.

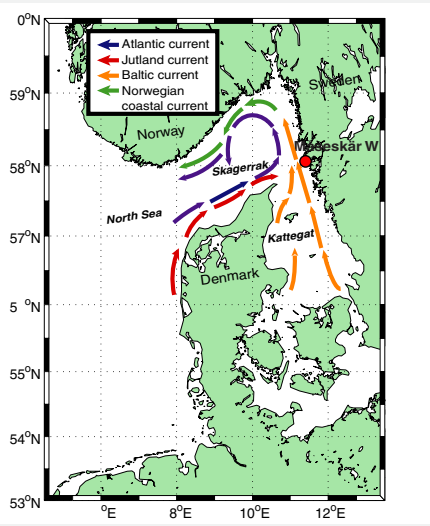


Fig. 1. The mooring will be deployed in a strategic position in the Skagerrak close to the Swedish coast. The Baltic current as well as the Jutland current passes by and deep water from the Skagerrak is also present.

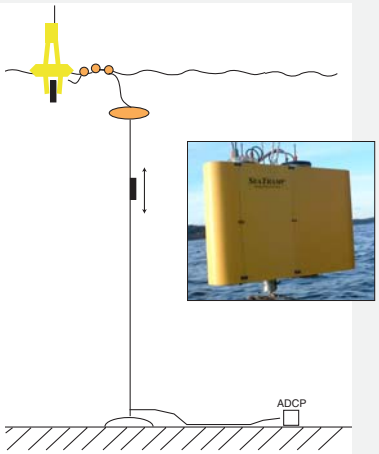


Fig. 2. The system consists of a surface buoy with meteorological sensors in air and sensors for salinity, temperature, chlorophyll a fluorescence and turbidity at 1 m dept. The heart of the system is a profiling device with the sensors shown at right.

Fig. 6. The system is designed for transport on euro pallets for easy transport to new locations or to service. Part of the bottom weight is shown.

Fig. 7. Current speed and direction as well as wave height and direction is measured using a sea floor mounted ADCP (left). ADCP = Accoustic Doppler Current Profiler. An under water data processor (right) delivers processed data in near real time. The unit in the middle contains batteries.

Fig. 3. A combined sensor for pressure (depth), oxygen concentation, temperature and conductivity. Salinity is calculated from conductivity and temperature.

Fig. 4. A combined sensor for chlorophyll *a* and turbidity. The optical window is covered with a copper shutter when the instrument is idle.

Fig. 5. Nitrate is measured using a method without chemicals. The absorbtion in UV-light is used for quantification. A copper cage is used to reduce biofouling problems. Detection limit is higher and accuracy lower compared to wet chemical techniques.

Poster presented at Forum Skagerrak conference
in Kristiansand, Norway, 11-12 May, 2005

FORUM SKAGERRAK II

2003-2007

LINKED FOR A LIVING SEA AND COASTLANDS

Monitoring the pelagic system in the Skagerrak - a report in preparation

Bengt Karlson
the Swedish Meteorological and Hydrological Insitute, Göteborg, contact: bengt.karlson@smhi.se

The report, which is in preparation, was commissioned by the workpackage on co-ordinated monitoring. The Swedish Meteorological and Hydrological Insitute, Oceanographic services, in Göteborg is preparing the report to be finalised in summet 2005.

Examples of illustrations below

Figure 2. The Skagerrak and Kattegat can get a slight turquoise colouring of the ocean water in May-June. This is caused by a harmless coccolithophoride called *Emiliania huxleyi*. Data from NASA, TERRA MODIS, 2004-05-31, processed by SMHI.

SCOPE OF REPORT

Bengt Karlson, SMHI

The Skagerrak is influenced by input from the air, the surrounding land and currents bringing water from the German bight, the North Sea and the Kattegat to the area. Several different monitoring programs exist to detect short and long term environmental change. The scope of this report is to describe the current monitoring situation of the pelagic system and to suggest a co-ordinated strategy for a cost-effective future monitoring system. To demarcate the scope of the report the benthic system, fish, mammals and oil spills are left out. However, where obvious connections exist, e.g. benthic-pelagic coupling, oxygen deficiency, satellite monitoring and modelling, these topics may be covered but not in detail.

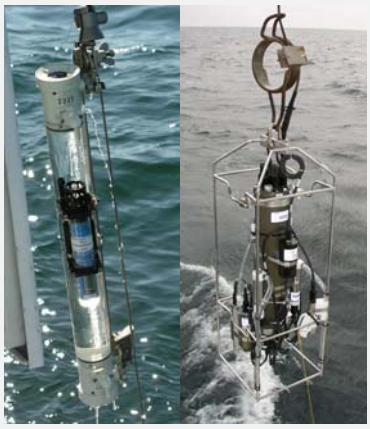


Figure XX. Left: Watersamples are taken from discreate depth. Right: CTD-sonds are used for measurements of vertical profiles of temperature, salinity and flouroscense. Photo by Bengt Karlson and Martin Hansson.

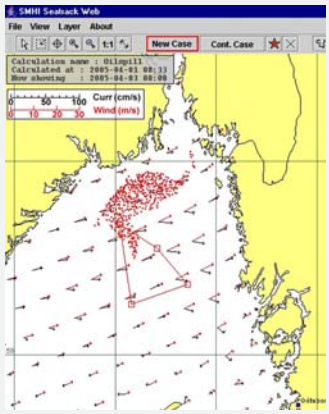


Figure 1. Forecasting the drift and spreading of oil in the Skagerrak. Oil spill is detected at 08.00 on March 21st 2005 within the area indicated by lines. Solid dots indicate a forecast of spots where oil may be detected at 00.00 on April 3rd 2005. Arrows indicate direction and strength of wind and currents. Example extracted from Seatrack Web (Ambjörn, SMHI).

Poster presented at Forum Skagerrak conference
in Kristiansand, Norway, 11-12 May, 2005

FORUM SKAGERRAK II

2003-2007

LINKED FOR A LIVING SEA AND COASTLANDS

Phytoplankton Workshop

Kristineberg Marine Research Station 14 - 17 March 2005

Background

Phytoplankton constitute the base of the food web in the sea. Monitoring of phytoplankton is performed in several locations in the Skagerrak area. The purpose is e.g. warnings for harmful algal blooms and monitoring of changes in the environment.

Purpose of workshop

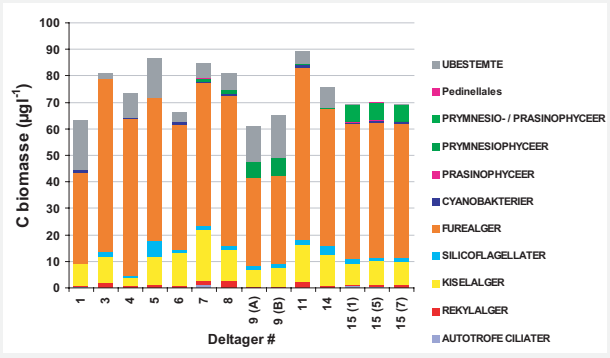
1) Co-ordination of methods for sampling and analysis
2) To identify cost effective metods for monitoring of:
   a) Biodiversity and phytoplankton biomass for detecting environmental change
   b) Species causing shellfish poisoning
   c) Species causing fish kills
   d) Method for describing status of waters according to the EU Water Framework Directive.
2) Follow up of inter-calibration study performed in 2004
3) To propose a co-ordinated harmful algal bloom warning system in the Skagerrak area
4) The EU Water Framework directive – describing water quality using phytoplankton - presentations of the strategies proposed in Norway, Sweden, Denmark and Germany.

Top: A view of Kristineberg Marine Research Station
Participants: Sweden: Mats Kuylenstierna, Bengt Karlson, Ann-Turi Skjevik and Malin Mohlin.
Norway: Torbjørn Johnsen, Einar Dahl, Tonje Castberg and Evy Lømsland.
Denmark: Maria Pécseli and Jesper Andersen (not in image).
Germany: Jeanette Göbel and Alexandra Kraberg.

Some conclusions

- Although phytoplankton is sampled in several locations results are often not available fast enough to be usable for harmful algal bloom warnings.
- The status regarding implementing the Water Framework Directive is very different in the countries around the Skagerrak.
- Warning systems of HAB:s must include frequent sampling in water entering the Skagerrak through currents. Strategic locations include the German Bight, The Jutland current and the Baltic current.
- A combination of methods is necessary for cost effective monitoring of phytoplankton and harmful algal blooms in the area. Methods include: Sampling from research vessels, helicopters and land, sampling from ferries, *in situ* observations using moorings (buoys) and monitoring using satellites. Microscopy is necessary for species identification and cell counts. Molecular biological techniques may be useful for some species. The frequency of sampling is essential, at least once a week is necessary for warning purposes.

Top: Microscopy is used for quantitative analysis of phytoplankton. Bottom: left: The diatom *Skeletonema costatum*, right the dinoflagellate *Dinophysis acuta.*



Results from intercalibration of quantitative phytoplankton analyses. Source: Peter Henriksen, Torkel Gissel Nielsen og Jesper Andersen, Interkalibrering af planktonundersøgelser i marine områder 2004, Danmarks Miljøundersøgelser.

Left: CTD with sampling bottles, and *in situ* chlorophyll fluorometer. Top right: A helicopter is used for water sampling in Schleswig-Holstein. Right: Tube sampling is often used in Sweden.

The workshop was initiated by the workpackage (5) on co-ordinated environmental monitoring. This poster was compiled by Bengt Karlson, the Swedish Meteorological and Hydrological Insitute, Oceanographic services, Göteborg, and Maria Pécseli, the County of North Jutland, Aalborg. Contacts: bengt.karlson@smhi.se and amt.mape@nja.dk