A joint decision support system for effective water protection measures in the archipelagos of Turku, Åland, and Stockholm.

Tuula Kohonen[1], Anders Engqvist[2], Bengt Fladvad[3], Harri Helminen[4], Mikael Wennström[5] & Johanna Mattila[1]

[1] Husö Biological Station, Åbo Akademi University, Akademigatan 1, FI-20500 Turku, Finland
[2] Dept. of Systems Ecology, Stockholm University, SE-10691 Stockholm, Sweden
[3] Svealands Kustvattenvårdsförbund, Box 38145, SE-10064, Stockholm, Sweden
[4] Southwest Finland Regional Environment Centre, PB 47, FI-20801 Turku, Finland
[5] Ålands landskapsregering, PB 160, AX-22111 Mariehamn, Finland

Joint protective measures for water quality are being created in a multinational study for the three archipelago areas of Turku, Åland and Stockholm. Effective protection plans are needed to achieve a good ecological status of EU waters by year 2015 as stated by the EU Water Framework Directive. Additionally, recent ecological concerns of the present state of the Baltic Proper also generate a need for new, more effective measures to stop the deterioration of the Baltic Sea waters. The latest research results show that anthropogenic nutrient emissions and internal loading from anoxic sediments have had severe adverse effects on the Baltic Sea ecosystem in spite of a significant reduction of nutrient discharges during the past decades. The overall objective of this project is to facilitate the possibilities to evaluate in advance the consequences of different local water protection measures, ultimately making it possible to rank their cost effectiveness.

Two different 3D-models will be employed in parallel; their capacity to simulate the oceanographic features of the area will be validated against data series covering a full-year cycle since the spring of year 2004. Both of these models use the same boundary forcing provided by a 3D-model of the entire Baltic Sea with its boundary located at Kattegat. In the project "Basic studies for effective water protection measures on Åland" detailed studies in specific areas of the inner Åland archipelago have been performed, e.g. measurements of water flows (Figs. 2-4) and sediment studies (Figs. 5-7).
The project will generate a decision support system that consists of different elements. An ecological water quality model will help to estimate the effectiveness of different water protection measures. The proposals for cost-effective actions to achieve a good ecological quality of coastal waters will help to fulfil the requirements of the EU Water Framework Directive.

The proposed method to achieve this goal is to set up the area containing the three archipelagos in the form of a model domain grid delimited by the latitudes 59° 50' and 60° 46' with a resolution of one quarter of a nautical mile (Fig. 1).
An inventory of nutrient sources within this area has been made, and these data will be recorded as an emission database containing assessments of nutrient discharges from fish farms, sewage treatment plants and larger rivers. These data, together with less accurate data of atmospheric nutrient deposition and nutrient release from the bottom sediments as well as nutrients that enter into the domain through the vertical north and south borders, will be subjected to advective and diffusive processes by circulation models.

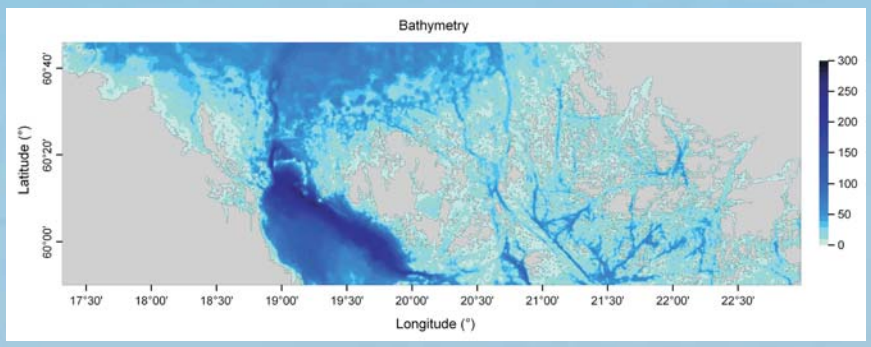

Fig. 1. The bathymetry of the study area.
gridding: Arto Inkala, EIA Ltd
map: Oleg Andrejev, Finnish Institute of Marine Research

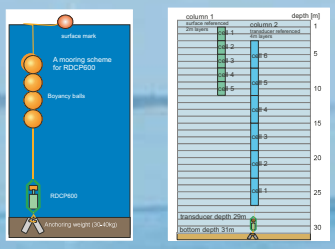

Fig. 2. Mooring scheme for the current profiler and configuration of the flow data.
(J. Forsius & P. Väänänen, SYKE)

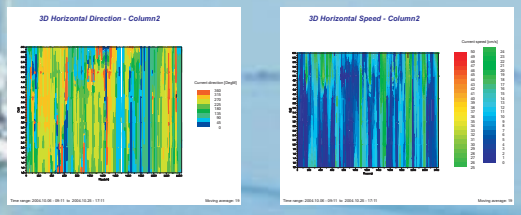

Fig. 3. Horizontal speed and direction of the column 2 flow data.
The measuring period: 6th Oct 2004 9:11 25th Oct 2004 19:01.
(J. Forsius & P. Väänänen, SYKE)

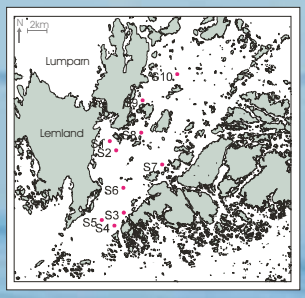

Fig. 5. Sediment sampling sites in the Åland archipelago.
(Jouni Lehtoranta *et al.*, SYKE)

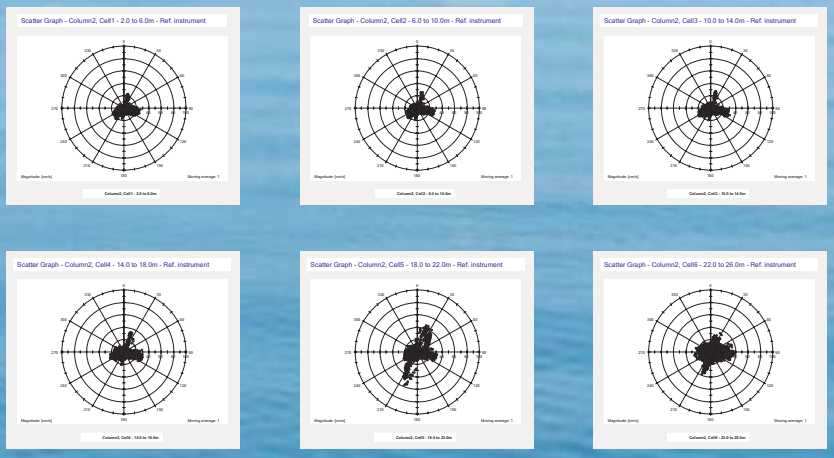

Fig. 4. Directions and magnitudes of water flows at different water depths.
The measuring period: 6th Oct 2004 9:11 25th Oct 2004 19:01.
(J. Forsius & P. Väänänen, SYKE)

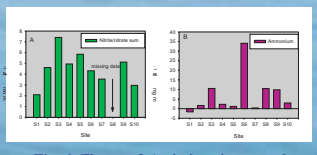

Fig. 6. Fluxes of a) nitrite-nitrate and b) ammonium from sediment to water.
(Lehtoranta *et al.*, SYKE)

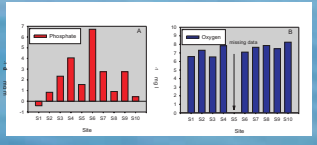

Fig. 7. A) Fluxes of phosphate from sediment to water. B) Concentrations of oxygen in the overlying water of the incubated cores at the end of incubation.
(Lehtoranta *et al.*, SYKE)

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Reference:
Lehtoranta, J., Knuuttila, S., Väänänen, P. & Nöjd, A. 2004. Sediment studies in the Archipelago of Åland. Data report to Åbo Akademi University, Husö Biological Station. 16 p. SYKE.