# Adaptation and application of a Baltic Sea Ecosystem Model to a coastal ecosystem

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## Introduction

Changing land uses, socio-economic transformation processes as well as global climate change will alter the ecosystem of the Baltic Sea. In this context the coastal lagoons play an important rule since these acts as a source, sink and transformational area for riverine input of nutrients and pollutants. Thus, the coastal lagoons control the quality of coastal ecosystems and, to a certain degree, the status of the Baltic Sea.

Function and functional changes of coastal lagoons and interaction in terms of exchange processes between the lagoons and the Baltic Sea are whether not well understood nor subject of current models. Preceding and ongoing simulations with the Baltic Sea Ecosystem Model (ERGOM) developed by Neumann (2001) covers the whole Baltic Sea with a horizontal resolution of about 3 nautical miles. Therefore the model is unsuitable to address the dynamics of changing processes caused by future changes in land use and socio-economic behave in small coastal lagoons like the Odra-Lagoon. For this reason we have adapted ERGOM to run on localised areas like the Odra-Lagoon.

Here we will present the first results of application of the model compared to measurement data and show that we are now able to trace the role of water-column as well as biogeochemical processes within the lagoon and its function in terms of exchange between the river Odra, the lagoon and the Baltic Sea.

## Model Setup

The model is based on the Modular Ocean Model MOM3 (Pacanowski et al., 1991, 2000) and the bio-geochemical model (ERGOM) as described in Neumann (2001). The model domain is defined on an Arakawa B Grid whereas the X, Y coordinates are a regular lattice of unequally spaced points. The horizontal resolution range between 95 m and 270 m. The vertical coordinate comprise 15 layers with an resolution of 1 m.

Riverine fresh water and nutrient input are provided by runoff data of the river Odra. The second prominent river the Peene is included as part of the western boundary. Initializing the model were done with measurement data and modelled data provided by runs of ERGOM covering the whole Baltic Sea.

The model area covers the hole Szczecin Lagoon from about 13.868°E - 14.627°E and 53.650°N - 53.908°N with an area of about 687 km² and a total volume of 2.6 km³. The water depth ranged from 2 m to 12.5 m with an average depth of 9.95 m (Fig.1). Both, water depth, volume and area are in accordance with published data by T. Radziejewska & G. Schernewski (2008).

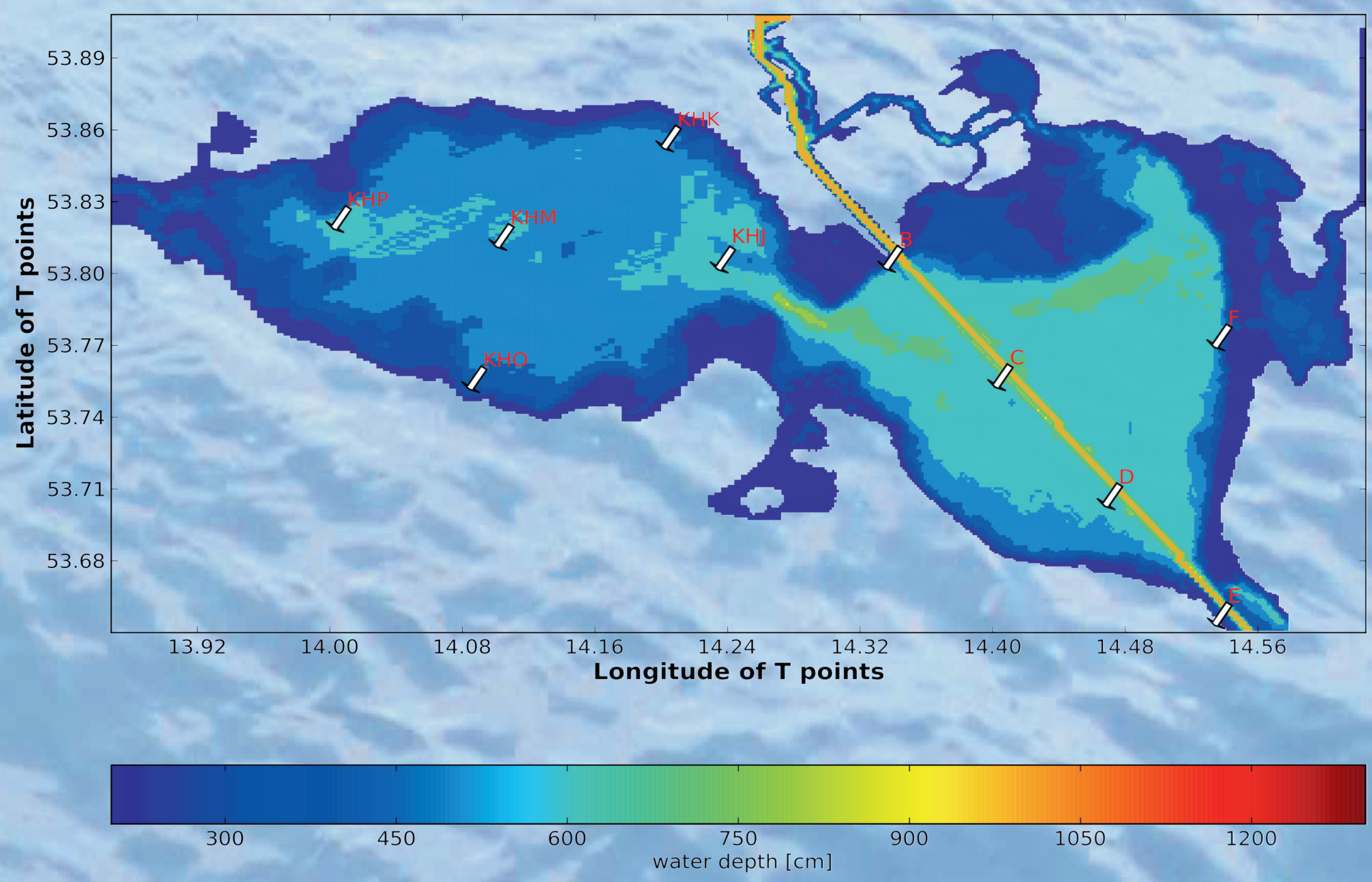


Fig. 1 Model domain and topopgraphy of the Odra Lagoon. The red marked text show the position of measurement stations. Model comparison and validation were done with data taken from this stations.

## Results

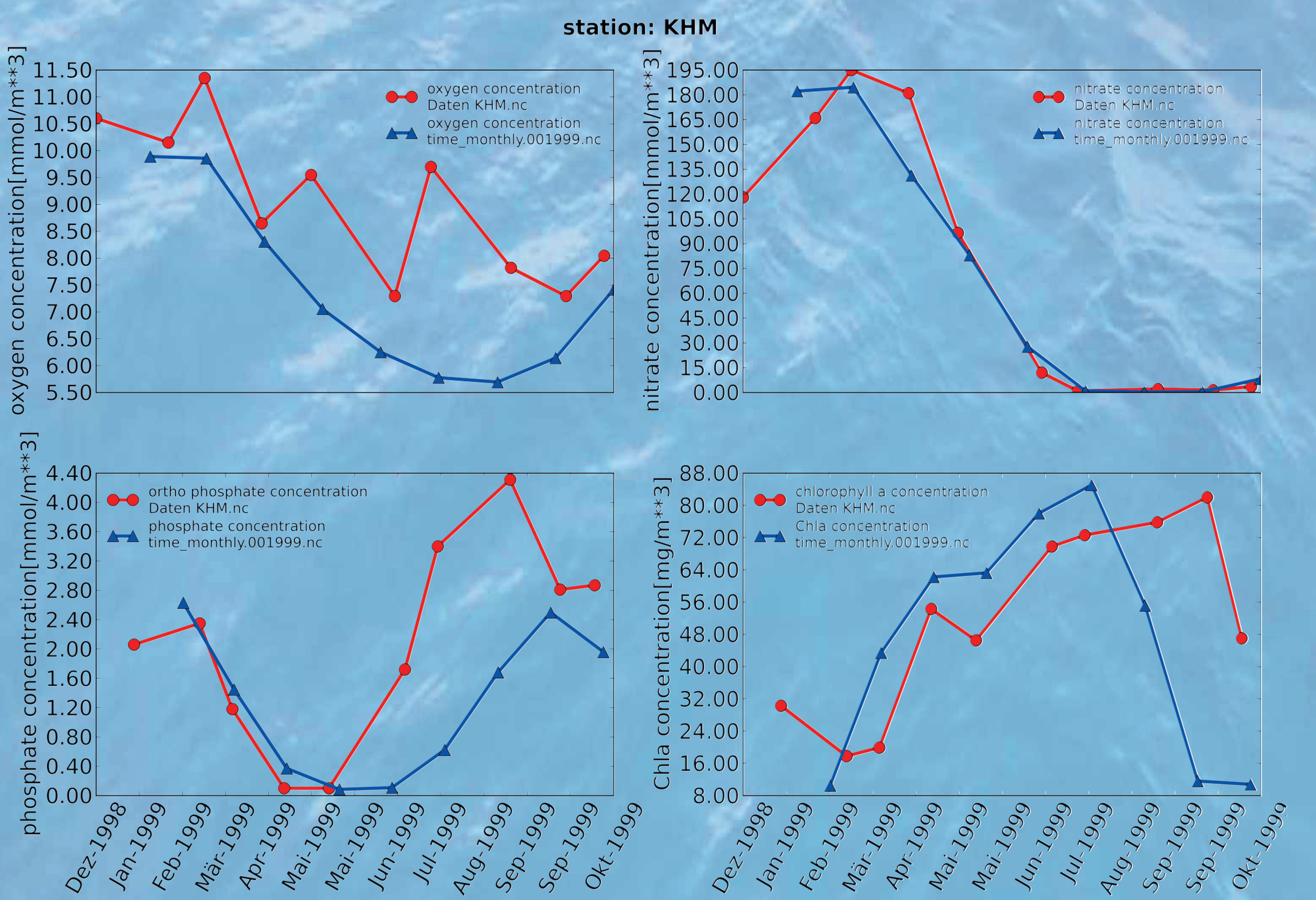


Fig. 2 Comparison of monthly means of four tracer variables with measurement data taken from the Landesamt für Naturschutz, Umwelt und Geographie, Germany (LUNG). The measurement data were taken ones a month. Therefore they are a snapshot of prevalent conditions. The red line indicate the measurement data and the blue one modelled data.
Generally, the model reflects the measurement data except slightly underestimations of oxygen concentrations (upper left panel) which may result from the 'snapshot' character of measurement data. The time-delayed development of phosphate from midyear on is currently under investigation. This may be a reason for the premature decrease in Chlorophyll a concentration.

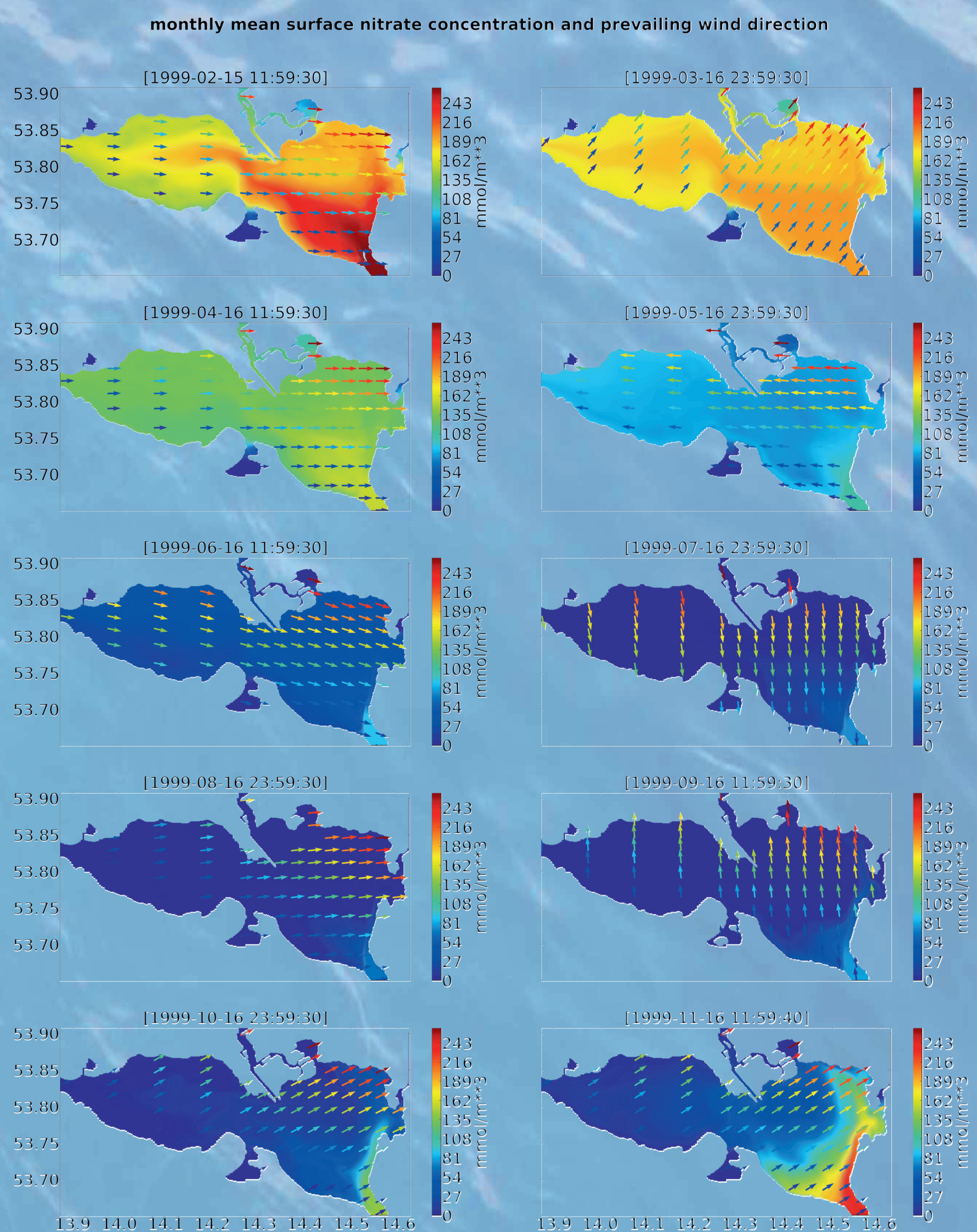


Fig. 3 Succession of the calculated monthly mean surface concentration of nitrate in 1999. The black arrows indicate the prevailing wind direction. Due to primarily wind driven currents in the Szczecin Lagoon the plume at the river mouth follows the wind direction.

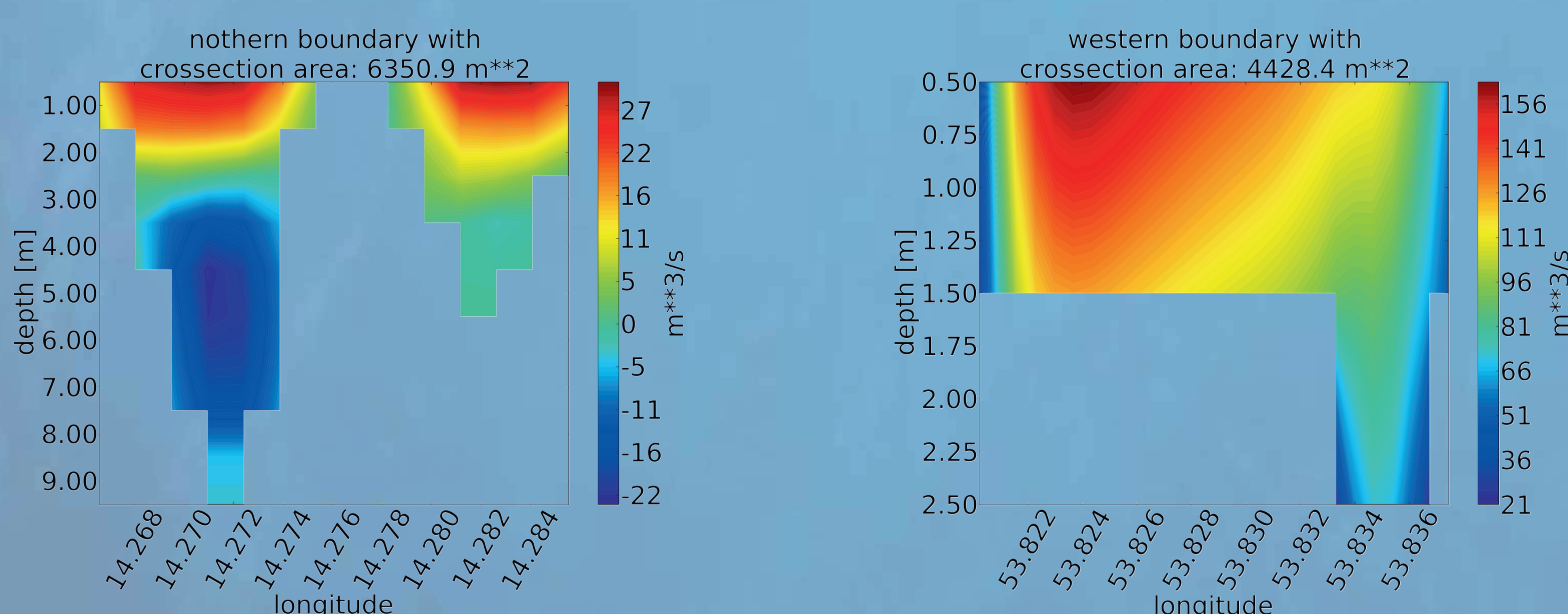


Fig. 4 time integrated volume transport of monthly mean water masses through the nothern (Baltic Sea) and western ('Achterwasser') boundary over a period of 10 month (February - October 1999). The negative values indicate inflow events and the positive values outflow events.

## Literature

Neumann, T., 2000. Towards a 3d-ecosystem model of the Baltic, Sea. J. Mar. Syst. 25 (3-4), 405 – 419.

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Pacanowski, R.C., Dixon, K., Rosati, A., 1990. The GFDL Modular Ocean Model Users Guide Version 1.0, GFDL Technical Report No. 2., Geophysical Fluid Dynamic Laboratory, NOAA,Princeton University, Princeton.