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Responsible Coastal Zone Management The Challenge of the 21st Century



Instruments for Water Quality Management and Research in Coastal Zones: Flow and Transport Simulations Across Spatial Scales

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Abstract

Summer tourism is the most important economic factor along the inner and especially outer Baltic Sea coasts of the Oder estuary at the German/Polish border. Due to heavy nutrient load of the river Oder especially the large Oder Lagoon (680 km²) suffers from severe eutrophication. Heavy cyanobacteria blooms and high water turbidity are common during summer and a problem for further tourist development. Three applications of a flexible two-dimensional flow and transport model system covering extremely different spatial scales are presented to underline the value of this simple tool for research and coastal management: a) Water flow and transport simulations in the Oder Lagoon during the extreme Oder flood of August 1997 were used to explain the large scale suspended matter and algae (*Mycrocystis*) distribution, visible on satellite images. b) Flow simulations were conducted to analyse an extreme small-scale sub-surface patchiness of *Ceratium* in a sheltered bay (0.15 km²). c) The model was applied to simulate flow in a littoral zone and inside reed stands.

Algae patchiness is visible on very different spatial scales and hydrodynamics plays a major role for its formation. The model system with its modifications, like spatial wind inhomogeneity, spatially variable bottom friction and locally increased grid density allowed to tackle problems with different spatial scales and to achieve a closer linkage between hydro-physics and biology. It is a valuable tool to predict the transport of algae and the endangerment of beaches. In this regard remote sensing is an important supporting method.

Introduction

Summer tourism is the most important economic factor along the inner and especially outer coasts of the Oder estuary at the German/Polish border. Due to its heavy nutrient load, the river Oder is one of the most important sources of eutrophication and pollution for the south-western Baltic Sea. The Oder Bight and especially the Oder lagoon therefore suffer from severe eutrophication, heavy algal blooms and high water turbidity. Water quality is an important factor for further tourist development and integrated management is needed to ensure a sustainable development. Water quality models integrated in decision support systems might become important instruments in coastal management of the Oder estuary.

We present applications of a hydrodynamic model system consisting of a flexible two-dimensional flow model with several modules that can serve as a valu-

able tool in research and is further developed for coastal zone and lake management applications. Three examples of applications cover extremely different spatial scales prove its scientific value as well as its benefit in coastal zone management:

- a) Water flow and transport simulations together with remote sensing were applied to investigate the spatial impact of the extreme Oder flood of August 1997 on suspended matter and algae distribution in the Oder Lagoon (680 km²).
- b) Flow simulations were conducted to analyse small-scale phytoplankton patchiness (*Ceratium*) in a sheltered bay (0.15 km²).
- c) The model was applied to simulate flow in a littoral zone and inside reed stands (0.01 km²).