SPICOSA

The Oder/Odra estuary case study (SSA 3)

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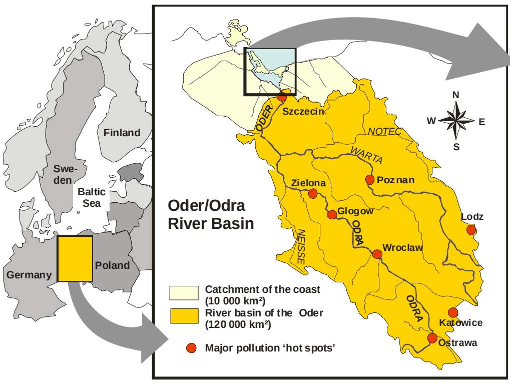
SIXTH FRAMEWORK PROGRAMME



Map of the Ode/Odra river basin and the estuary

Policy Issue:

Water quality improvement & eutrophication abatement

Background & ecological dysfunctions: Already for centuries, the river basin is under strong human influence. Agricultural land covers 70% of the upper river basin and 58 % of the middle basin. However the contribution of agriculture to the gross product is only 3.9 %. Several larger cities and many industries are located in the river basin (total population 15.4 millions). The nitrogen (N) and phosphorus (P) loads in the early 1960's were already high (N: 50,000 t/a; P: 6,000 t/a), increased further and reached its maximum during the 1980's (N: 116,000 t/a; P: 16,000 t/a). Due to economic changes, warm and dry years as well as improved sewage treatment a significant decrease of nutrient loads took place until the late 1990's (N: 94,000 t/a; P: 8,500 t/a). The Odra river flows through Szczecin and enters the large, shallow Szczecin (Oder) Lagoon. The river and its loads are responsible for the poor water quality in the lagoon and its highly eutrophic state. Temporary anoxia, fish kills, algae bloom and poor water transparency reflect the poor water quality state.

Process: A systematic and comprehensive analysis of existing regional documents ended in a list of most important regional policy issues. The availability of a political commitment with pre-defined focus issues (German-Polish Regional Agenda 21), discussions with Federal State (Land Mecklenburg-Vorpommern) ministries and authorities (what would they support) as well as the competence of the (project) consortium were finally responsible for the choice. This choice does not reflect the priority setting in the region itself but political reasons, a lack of competence, a lack of a critical financial mass etc. did not allow to tackle other issues.

CATWOE

Customers:

Beneficiaries: The coastal community and coastal tourism

(Victims): Farmers, industries and communities in the river basin

Actors:

European Union (through the Water Framework Directive), the Oder/Odra Commission and regional authorities

Transformation:

Changes in land use & farming practice, reduced fertilizer application & improved sewage treatment

Worldview:

The majority of the society perceives eutrophication as a major coastal ecological problem (with strong economical and social implications)

Owners:

Farmers, industries and communities in the river basin

Environment:

Regulatory laws, administrative structure, biological carrying capacity, morphometric and hydrodynamic situation

DPSIR

Driver:

Intensive human activities in the river basin

Pressure:

High input of N and P into the coastal system

State:

Concentrations of N, P, Chl.a; water transparency

Impact:

Ecological: Eutrophication, algae blooms, fish kills

Social & economic: hampered bathing tourism

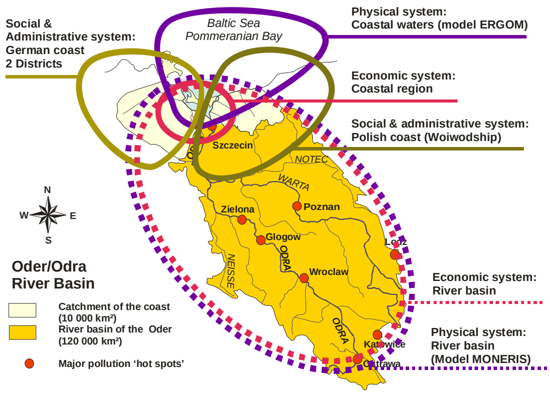
Response:

Improved nutrient management in the river basin

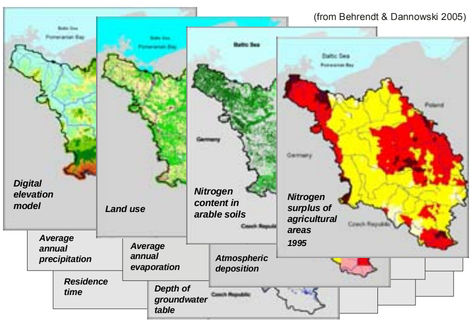
Major Questions:

- How do different stakeholders perceive water quality?
- What are their demands with respect to water quality?
- Would a "good" water quality (according to the Water Framework Directive) satisfy all stakeholders?
- Can a "good" water quality be reached in the entire estuary? If no, what would be the alternatives?
- Which measures in the river basin are necessary?
- Which nutrient sources have to be tackled preferably?
- On which nutrient (nitrogen or phosphorus) should the focus be?
- What are the costs for reaching a good water quality status?
- How would a cost-efficient approach look like?
- Which measures in the estuary would support a water quality improvement and how efficient will they be?
- How long would it take to reach a good status?

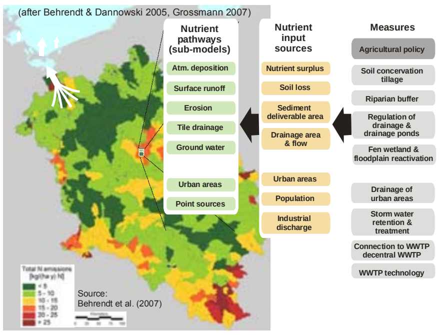
System definition:



Conceptual models



Data requirement for the river basin model MONERIS



Links between Economic and agricultural measures, nutrient input sources and the nutrient pathways in the river basin

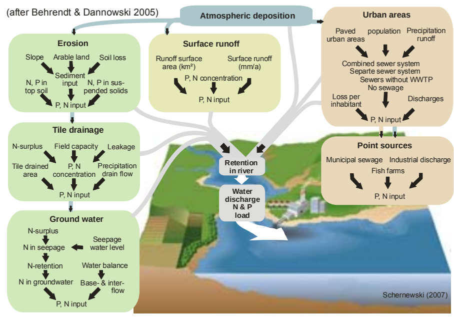
The models MONERIS and ERGOM will be used. Both models are documented, calibrated and validated

MONERIS is applied to calculate the nutrient inputs and loads in the entire Oder River basin. The model calculates the annual nutrient load into the coastal waters, resulting from point and various diffuse sources. MONERIS is based on a geographical information system (GIS), which includes various digital maps and extensive statistical information. The use of a GIS allows a regional differentiated quantification of nutrient emissions into river systems.

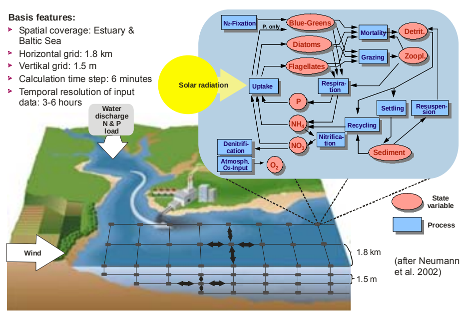
To be able to run the model, large amounts of spatial information had to be compiled and transferred into the GIS: The river system, catchment and administrative borders, land use classifications, soil maps, topographical information, ground water tables, hydro-geological and hydro-meteorological information as well as data on atmospheric deposition, river flow and water quality. Details about sources and data quality are given in Behrendt & Dannowski (2005). Point discharges from waste water treatment plants and industrial entering the river system directly, but diffuse emissions into surface waters have very different pathways and have to be modelled separately.

Altogether six diffuse pathways are considered in MONERIS: point sources, atmospheric deposition, erosion, surface runoff, groundwater, tile drainage and paved urban areas. Along the pathway from the emission source into the river many transformation, retention and loss processes have to be taken into account.

The ecosystem model ERGOM is an integrated biogeochemical model linked to a 3D circulation model covering the entire Baltic Sea. The biogeochemical model consists of nine state variables. The nutrient state variables are dissolved ammonium, nitrate, and phosphate. Primary production is provided by three functional phytoplankton groups: diatoms, flagellates and cyanobacteria (blue-green algae). Diatoms represent larger cells which grow fast in nutrient-rich conditions. Flagellates represent smaller cells with an advantage at lower nutrients concentrations especially during summer conditions. The cyanobacteria are able to fix and utilize atmospheric nitrogen, and therefore, the model assumes phosphate to be the only limiting nutrient for cyanobacteria. Due to the ability of nitrogen fixation, cyanobacteria are a nitrogen source for the system.



Conceptual model of the river basin model MONERIS and the nutrient loads towrds the coast



Conceptual model of the coastal water and Baltic Sea model ERGOM