

Future nutrient emissions and loads to the Oder River Basin – How to reach a Good Ecological Status?

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1. Introduction

In 2009 the EU-Project AMBER (Assessment and Modelling Baltic Ecosystem Response) was established under the framework of BONUS (Science for a better future of the Baltic Sea region). Eutrophication is one of the major problems in the Baltic Sea. The main part of nutrients originates from a variety of human activities in the Baltic Sea Catchment and the direct atmospheric deposition on the water surface area [5].

For this the HELCOM Baltic Sea Action Plan (BSAP) was adopted in 2007 to achieve a Good Ecological Status until 2021. A Baltic Sea unaffected by eutrophication is the appointed goal of the BSAP [4]. To reach BSAP reduction goals (- 65% Phosphorus and - 29% Nitrogen) for nutrient emissions from the Oder River Basin, different scenarios were considered in the MONERIS (Modelling Of Nutrient Emissions in River Systems) [6] calculations to find the most effective measures for nutrient reduction. For studying the functional relationship between nutrient emissions in the river basin, the transformation and retention processes in the limnic system and the resulting loads to the coastal waters, the Oder River Basin has been chosen.

By linking the climate models ECHAM4 and HadAM3H with the nutrient emission goals (BSAP), future developments in nutrient emissions and loads to the Baltic Sea can be estimated.

2. Materials and Methods

2.1 Site description

The Oder River basin is located south of the Baltic Sea (Fig.1) and covers an area of 118,611 km² [2] with an maximum dimension between latitudes 49°30' N to 53°50' N and longitudes 13°00' E to 20°00' E. After a course of 912 km the Oder flows with a mean discharge of 550 m³/s into the Szczecin lagoon. Thus the Oder River Basin is part of the Baltic Proper Catchment. Concerning the Baltic Sea, the study site is one of the main emitters of nutrients, due to an intensive agricultural use (Fig.1) and 15.5 millions inhabitants [3].

2.2 Data Source

Input data was derived from digital maps and statistical information with a spatial distribution to the catchment by using a geographical information system (GIS). For precipitation information global data by GPCC (Global Precipitation Climatology Centre) were used. In addition to this, precipitation data for the future scenarios were provided by the climate models ECHAM4 and HadAM3H. Data sets for the atmospheric deposition by EMEP (European Monitoring and Evaluation Programme) were utilized.

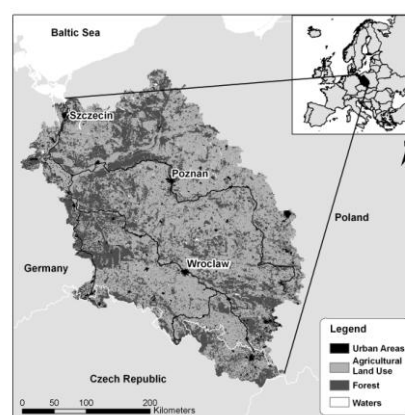


Fig 1: Oder River Basin land use

2.3 Method

MONERIS has been developed at the IGB to calculate nutrient emissions into surface waters by diffuse and point sources, in-stream retention and resulting loads for Nitrogen (N) and phosphorus (P) on a river catchment scale (www.moneris.igb-berlin.de) [6]. The calculations were performed on basis of 493 sub-catchments with a mean size of 240 km². Due to the 'Scenario Manager' implemented in MONERIS different options of measures for the reduction of nutrient emissions can be taken into account. For the time periods of 1983/2005 and 2070/2100 calculations were conducted.

3. Results

Following the goals of HELCOM BSAP, a significant reduction of nutrient emissions in the Baltic Sea River Basins has to occur, to attain a Baltic Sea unaffected by eutrophication [1]. Especially for the Oder River Basin a phosphorus emission reduction is determined to 65 %, and nitrogen emissions had to be reduced by

Table 1: modelled mean nutrient emissions in reference period and under future climate

		TN in t/yr	TP in t/yr
	1997/2003	99146	7610
2070/2100	ECHAM_A2	93782	5955
	ECHAM_B2	94076	5995
	HADAM_A2	93191	5921
	HADAM_B2	93400	5930

29 % [4]. Starting point for this consideration is the situation of mean nutrient emissions in the period from 1997 to 2003 (Tab.1). Considering the BSAP reduction goals, 70400 t/yr TN and 2660 t/yr TP had to be reached in the Oder River Basin. The mean values of nutrient emissions in the period 2070/2100 (Tab.1) by exclusive use of the future climate are modelled to 93610 t/yr TN and 5950 t/yr TP (Tab.1). So it is not

to be due that the BSAP goals can be reached under future climate situation. By the application of different measures in agriculture and wastewater treatment it is feasible to reach the goals of the BSAP. Hereby the most effective measures and measure combinations could be found.

3. Conclusion

By identifying appropriate nutrient reduction measures it is reasonable to achieve a good ecological status of the Oder River Basin and the Baltic Sea Ecosystem as well. Due to the modelling process in MONERIS, emission hot spots and contributing sources can be identified precisely in future situations to deliver helpful arguments for the implementation of management plans.

Acknowledgments

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