



Towards Sustainable Management of River-Sea Systems: Enhancing Process and System Understanding in the Elbe-North Sea System

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The Elbe River and the adjacent North Sea are of great ecological, economical and societal importance not only for the metropolitan region of Hamburg. The Elbe is more than 1000 km long, its catchment comprises about 150,000 km² and harbours about 25 Mio. people in the Czech Republic and Germany. However, human activities such as agriculture and fisheries, shipping and energy generation, as well as industrialisation, urbanisation and tourism, have been and still are changing the process and system dynamics of Elbe and North Sea. Climate change and extreme events are additionally affecting this already heavily impacted River-Sea System. Consequently, eutrophication, hypoxia, hyperturbidity, pollution and species loss are for instance threatening ecosystem functioning and services. For a sustainable management, interdisciplinary knowledge about processes and dynamics along the River-Sea Continuum, as well as the interacting effects of human activities, climate change and extreme events is urgently needed.

That is why Elbe and North Sea have been chosen as a case study (“Supersite”) within DANUBIUS-RI, the “International Centre for Advanced Studies on River-Sea Systems”. DANUBIUS-RI is set-up as a pan-European, distributed Research Infrastructure (RI) to study rivers and their catchments, transitional waters and coastal seas in order to better understand the functioning of River-Sea Systems and to develop guidelines for their sustainable management. This European initiative brings together about 30 partners from more than 15 countries, coordinated by the research institute GeoEcoMar in Romania. Currently, eight Supersites are being investigated across Europe. DANUBIUS-RI aims to become operational from 2022 onwards for about 30 years.

The Helmholtz-Zentrum Geesthacht, Institute of Coastal Research, is coordinating the Elbe-North Sea Supersite, which encompasses the tidal part of the Elbe and the German Bight at the moment. A further extension upstream is foreseen for the future. Overarching research questions for the Elbe-North Sea Supersite are for example: How are climate change and extreme events (e.g. floods, draughts, storms) influencing nutrient, suspended particulate matter and pollutant dynamics? What is the effect of diking, deepening, dredging and disposal of dredged material on hydro- and morphodynamics, as well as the cycling of organic matter, nutrients and pollutants? What is the impact of off-shore windparks on the benthic and pelagic ecosystem of the German Bight? How can we distinguish between natural variability and anthropogenic changes? For the implementation of the Elbe-North Sea Supersite, we aim to bring together different stakeholders, research infrastructures and respective data, to complement already existing infrastructures and activities in order to enhance process and system understanding in Elbe and North Sea. For instance, we will work closely together with COSYNA (Coastal Observation System for Northern and Arctic Seas) and MOSES (Modular Observation Solutions for Earth Systems), which focusses on the effects of extreme events. An integrated observation and modelling network for the Elbe-North Sea Supersite is currently being developed to enhance the understanding of matter fluxes including particle, nutrient and oxygen as well as pollutant dynamics along the River-Sea Continuum.