

Climate Change and the Baltic Basin – Late Quaternary history and future projection.-

Jan Harff^{1,2}

¹Szczecin University, Mickiewicza 18, 70-383 Szczecin, Poland

²Leibniz-Institute for Baltic Sea Research, Seestr. 15, 18119 Rostock, Germany

The Baltic Sea Basin serves as a natural laboratory for the investigation of a changing climate interfering with geological processes. One factor that makes the Baltic Sea especially suitable as a natural laboratory is that it spans the area from the centre of the glacio-isostatic uplift in the Gulf of Bothnia out into the subsiding periphery in the southern Baltic area. The second important factor of the Baltic Sea is the influence of external forcing on the coastal and basin morphogenesis. Sea level change and variation in meteorological and hydrographic forces are mirrored by the Baltic Sea sediments. Their unique high resolution record of environmental change allows us to reconstruct and to model the erosion, transport and accumulation of sediments from local up to basin scale. The variability of sediment proxies from the Baltic Proper mirror secularly changing depositional conditions determined by climatically-driven changes in salinity, oxygenation, and glacio-isostatic adjustment which controls the coupling of the Baltic Sea's hydrographical regime with the world ocean. During the late Holocene when the Baltic basin was permanently connected with the Atlantic Ocean the dynamics of the atmospheric circulation of the North Atlantic, but also its modification due to the variation of Eurasian anticyclones is reflected in the facies of sediments in the Baltic Sea varying on the centennial scale. Variations in the salinity of the brackish Baltic Basin are attributed to changes in the North Atlantic Oscillation (NAO) ascribing the wind forces driving the inflow of marine water into the Baltic basin. Time series analysis of facies variation reveals distinct periodicities of 900 and 1500 years. These periods can be compared with data from North Atlantic marine sediments and Greenland ice cores identifying global climate change effects in Baltic Basin sediments. These periods can be compared to transgression phases in the Gulf of Gdansk as expression of climatically controlled coastal history of the southern Baltic Sea. We have developed transgression/regression models including climatically controlled sea level change and neotectonical vertical crustal displacement mirroring appropriately the regional paleogeographic pattern of coastal advance at the Fennoscandian Shield and coastal retreat at the Quaternary southern lowlands since the Littorina transgression onset. For local studies, sediment dynamics have been incorporated into the model design. The PRD-LTMM model which was successfully applied for the study of the Holocene evolution of Pearl River Delta, South China Sea, has been adjusted to the Baltic conditions. First results from the German coast indicate that the model is capable of simulating the long-term morphological evolution of the southern Baltic coast. We have used our models for future scenarios of coastal processes including climate models superimposed with extreme sea level data measured during the storm surge in November 1872. A new project, "Coastline Changes of the Southern Baltic Sea - Past and Future Projection" (CoPaF), was launched in 2010 to extend the coastal studies to the entire southern Baltic coast.