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Influence of climatic change on hydrological processes on coastal areas, a model study

T. Graeff (1), G. Baroni (1), A. Bronstert (1), A. Hohlbein (2), and S. Oswald (1)

(1) University of Potsdam, Institute of Earth & Environmental Sciences -Geoecology-, Potsdam, Germany (graeff@uni-potsdam.de), (2) University of Rostock , Faculty for Agricultural and Environmental Science,Rostock, Germany

Coastal areas will more strongly suffer from the influence of climatic change than other areas. In addition to sea level rise itself, the probability of occurrence of storm tides, heavy rains and possibly drought events will increase. Therefore, rising salt input via saltwater intrusion and by overtopping of coastal defences can be expected. These changing conditions will have a large effect on natural vegetation and agriculture. The land use management in those regions has to react to the new situation either by adapting the coastal protection (e.g. expanding the system of dikes, ditches and pumping stations), by a conversion of existing landuse (e.g. changing to an extensive usage) or by a mix of the two mentioned actions.

To understand the development of coastal areas in respect to discharge behaviour, salinisation, water balance, and feedbacks between hydrology and vegetation, two representative study sites at the German North Sea (Leybucht/Greetsiel) and Baltic Sea (Hüttelmoor/Heiliger See) were selected. The area at the North Sea is laying to 75% below sea level with an intensive agricultural land use and has a typical geological structure. The Baltic Sea area with a long investigation record has been undergoing a change from an intensively used grassland site to an inundated extensively usage and is about to be returned to a natural development, including salinisation and vegetation change, by locally discontinuing coastal protection measures.

We apply the physically based model HydroGeosphere to simulate the two areas, while focusing on the North Sea area. Down scaled time series from the ECHAM5 model of different climatic emission scenarios (A1B, A2, B1) were used to outline the change in the hydrological system. Hereby the following landuse scenarios were established: holding the status quo with an adapted coastal defence and drainage network; extensivication of landuse to wetland management and carbon sequestration; and conversion of landuse to bio fuel production of reed grass. By the model these scenarios now can be the basis for long term prediction of the hydrological system including meteorological differences, saltwater transport and inundations, which may be forced by floods from the sea or the hinterland.