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DATA BASED MODELING OF THE OCEAN–SEDIMENT SYSTEM IN LARGE BASINS

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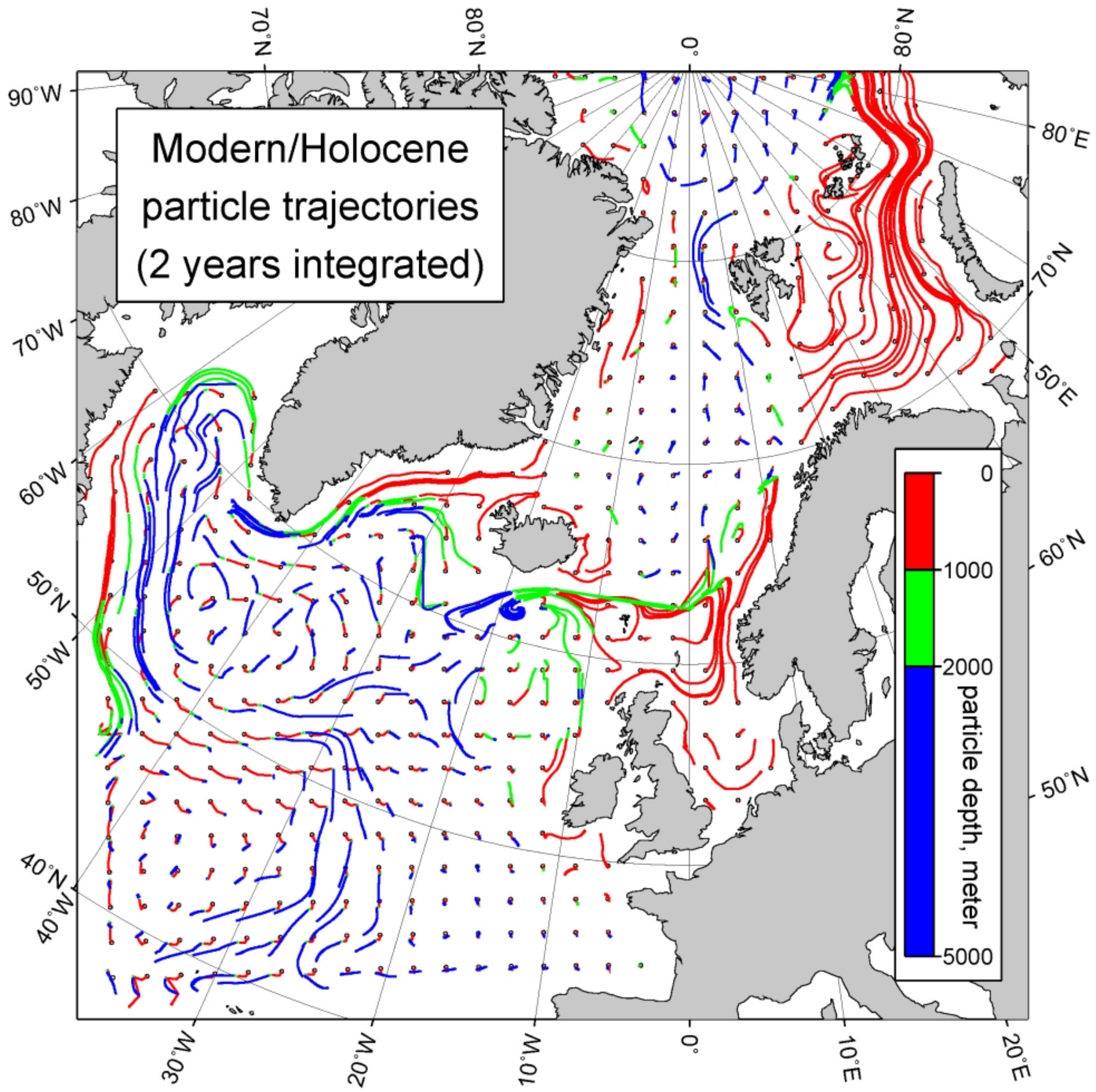
Numerical modeling of oceanic circulation and resultings sedimentary patterns provides a quantitative means for evaluating and understanding the complex interactions of the ocean–sediment system.

SCINNA (= Sensitivity and CIrculation in the Northern North Atlantic (NNA)), a three–dimensional fully prognostic ocean general circulation model (OGCM), is used for modeling the oceanography of the Greenland, Iceland, and Norwegian (GIN) Seas and their adjacent basins. The fine resolution of 55 km box length in latitude and longitude and a total of 17 vertical levels allows a realistic representation of the topography. The model is forced by prescribed sea surface temperatures and salinities, thereby introducing the effects of surface heat and freshwater fluxes.

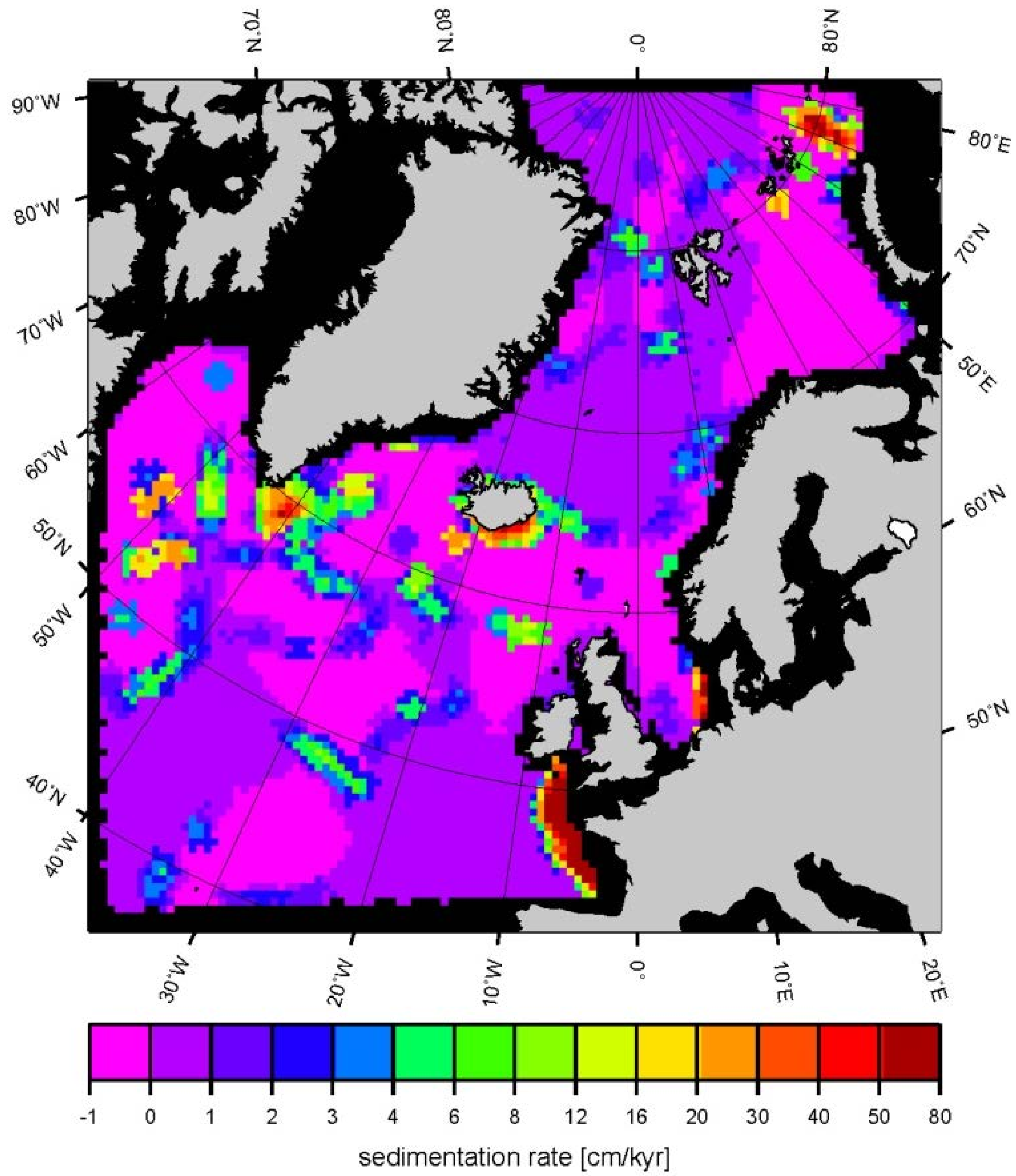
The prognostic sedimentation models SENNA (= SEdimentation – erosion, transport and deposition – in the NNA) and PATRINNA (= PArticle Tracing In the NNA) are driven by the thermohaline oceanic circulation and coupled to an OGCM. SENNA and PATRINNA combine two coupled models: the 3–D models calculate the sediment transport and the separate particle path in the water column. In SENNA the 1 centimeter thick 2–D bottom layer considers the erosion, transport and deposition of sediments; in PATRINNA single particle drifts parallel to the sea floor.

Modeling the Last Glacial Maximum on a 21600 calendar–years time slice, the most probable scenario for the glacial summer resembles very closely the modern winter with ice–free GIN Seas. Proceeding to the subsequent Meltwater Event (13500 yrs B. P.), several possibilities for meltwater discharges from the Laurentide and European ice sheets have been modeled which lead to dramatic changes in ocean circulation and deepwater formation.

The simulated sedimentation patterns and particle paths fit very well the observed sediment distributions, e. g. the large sediment drifts south of the Greenland–Scotland Ridge. The strength of these models is the predictability of tracing transport pathways for variables such as sediments, water masses, pollutants, and organic material for variable scenarios, natural or artificial.



A crucial point is the primary model initialisation which should be based on consistent observational data. To fill a small–scale grid of a large–scale basin, this data cannot be easily obtained. Even for modern state control–experiments, available data sets are not always physically consistent to drive a model in a realistic manner. Going back on the geologic record, a sound data base for modeling needs, e. g. proxies in paleoceanography, is much more difficult to find, especially if one wants to cover several distinct time slices. Although we have poor data and sophisticated models, sensitivity experiments using varying input data can help substantially evaluating realistic model scenarios, and determining the influence of single model–parameters.



Future model experiments will concentrate on climatically induced changes in oceanic circulation and its sedimentary response with special focus on (i) increasing sea surface temperatures starting a greenhouse scenario by triggering a new meltwater event and (ii) decreasing temperatures that approximate the icehouse state.