DATA BASED MODELING OF SEDIMENT AND WATER VOLUMES TRANSPORT DURING THE LATE QUATERNARY OF THE NORTH ATLANTIC

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An Ocean General Circulation Model (OGCM) and two three–dimensional large–scale models, an ocean sediment transport (SENNA) and a semi–lagrangian trajectory–tracing model (PATRINNA) are used for a better understanding of the North Atlantic ocean circulation and complex interactions in the ocean–sediment system since the last glacial maximum (LGM).

1

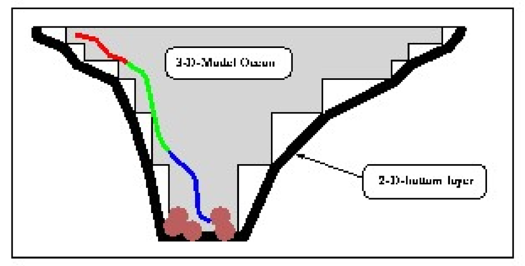

Figure 1: Integration scheme

Integration scheme and information flow from the OGCM to the SENNA and PATRINNA.

2

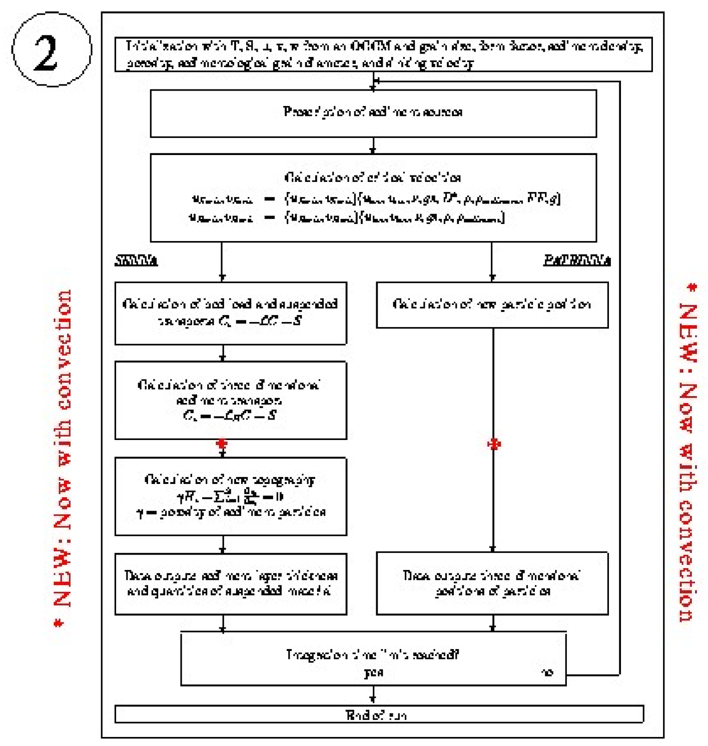

Figure 2: Coupling of the sub–components in SENNA / PATRINNA

The transport of sediment before it reaches the ocean floor is simulated using a 3–D sub–model of SENNA and PATRINNA. Sediment transport in the near–bottom boundary layer, which follows the bottom topography, further is computed using a 2–D sub–model. Combination of the 3–D and 2–D components of the two models provides continuous simulation of sediment transport both within the main body of the ocean and in the near–bottom boundary layer.

Figure 3a–c: Diagrams of convection

The heights of the bars are equal to the convection depth.

a) During the LGM the North Atlantic Deep Water production dropped by 30% from its present intensity. Only in the upper 500 m of the glacial Norwegian–Greenland Seas (NGS) were ventilated. Compared to their present locations, the deep ventilation zones south of Greenland were shifted 10 degrees to the south–west; **b)** During the Meltwater Event (MWE) deepwater formation stopped completely; **c)** Today's convection ventilates the deep ocean and even reaches the bottom at some sites in the NGS and northern North Atlantic.

Figure 4a–c: Trajectories without convection

A cloud of neutrally–buoyant particles (36 particles in the cloud) deployed at a depth of 50 m south–east of Greenland. The trajectories are calculated using the velocity field from the OGCM, without the impact of convection, and traced during the first 100 years after deployment. Particle depth are indicated by colors from the color palette; as particle descends or upwells the color of its trajectory changes.

Figure 5a–c: Trajectories with convection

Similar to Figure 5a–c, but also including the direct impact of convection on the motion of the particles. When a particle enters the convection zone, it may either be transported downward or upward in the convection chimney. Both the velocity and the convection depths are taken as an output from the OGCM simulations. In addition to the color palette, the convection depths are shown by different shades of gray.

Figure 6a–c:

Sedimentation rate varies according to the different ocean circulation patters. This rate also differs depending on whether it is calculated with or without the influence of convection on the sediment transport by 3–D flows. The models give a higher glacial sedimentation rate in the vicinity of Iceland in the Irminger Basin, along the Reykjanes Ridge at both the south and the north sides of Iceland, at the Rockall Plateau and in the NGS. The radical changes of the ocean circulation during the MWE led to further changes of the sedimentation rates in the northern and eastern North Atlantic.