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Modeling the sediment transport induced by deep sea mining in the Pacific Ocean

Kaveh Purkiani (1), André Paul (1), Michael Schulz (1), Annemiek Vink (2), and Maren Walter (3)

(1) Center for Marine Environmental Sciences and Faculty of Geosciences, University of Bremen, Bremen, Germany, (2) Federal Institute for Geosciences and Natural Resources, Hannover, Germany, (3) Institute for Environmental Physics, University of Bremen, Bremen, Germany

A numerical modeling study is conducted in the German license area in northeastern Pacific Ocean to investigate the sediment dispersal of mining exploitation. A sediment transport module is implemented in a hydrodynamic model. All differently sized particles can aggregate and break up until equilibrium floc sizes are obtained. A nested model approach using the MITgcm (Massachusetts Institute of Technology general circulation model) is applied and validated against hydrographic and hydrodynamic measurements obtained in this region.

Two different sediment discharge scenarios have been examined to investigate the effect of flocculation on sediment transport distribution in the deep ocean. The suspended sediment is mainly influenced by a dominant SW current far away from the sediment discharge location. Independent of initial particle size all initial particles larger than 30 μm attain similar floc size equilibrium. In contrast to coastal seas and estuaries where floc size equilibrium can be obtained in a few hours, due to low shear rate (G) the flocculation process at deep ocean is completed within 1$\sim$2 days.

Considering temporal evolution of the floc size in the model, an increase in floc sinking velocity consequently enhances the sediment deposition at seafloor. The analysis of different sediment concentration scenarios suggests that floc sinking velocity increases at higher suspended sediment concentration (SSC). The presence of a dominant current in this region induces a fine sediment plume in SW direction. The dispersed SSC plume at 20 km downstream the discharge location is able to form the flocculation process and induces a spatial variation of floc size and floc sinking velocity.