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A hybrid Method to model suspended Particulate Matter Concentrations in Shelf Seas

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Accurate predictions of suspended particulate matter (SPM) concentrations in shelf seas are essential for reliable predictions of the under-water light regime in three-dimensional models of nutrient transport and cycling, and plankton growth. To do this simulation of multiple grain-size fractions, ranging from sand to silt and clay, is needed to capture the main features of the temporal variability in SPM concentrations induced by combined tides and wind waves. The fine silt and clay fractions govern the variability in background concentration with a settling time scale ranging from several days to weeks. The coarser fractions govern high concentration events of shorter duration that are mainly meteorologically induced. The long response time of the fine fractions means that their concentrations are rarely in equilibrium with the local, instantaneous hydrodynamic conditions. Hence, they require solving a set of advection-diffusion equations. Solving the same equations for the coarser fractions, that are much closer to equilibrium with the forcing, leads to a high computational burden in explicit and semi-implicit numerical schemes because the high settling velocities of those fractions require a very small time step. In three-dimensional coupled hydro-biogeochemical models, such a computational burden is prohibitively expensive. To circumvent this problem, a hybrid method is presented that calculates concentrations of coarse SPM fractions using a local equilibrium parameterisation, while computing the fine fractions from the advection-diffusion equations. This method yields comparable results to solving the advection-diffusion equations for all grain sizes, and is sufficiently fast to include in three-dimensional models. Results of a one-dimensional

water-column implementation in the General Ocean Turbulence Model (GOTM) for a site in the Irish Sea will be presented and compared to observations from water samples and high-frequency (< 1 h) Optical Back Scatter (OBS) sensors covering multiple years. Extension to the three-dimensional General Estuarine Transport Model (GETM) is currently underway.