International Conference 2007 and 97th Annual Meeting of the Geologische Vereinigung e.V., Bremen, October 1-5, 2007

Session C5 Talk

Floc characteristics in a coastal turbidity maximum: calibration of a sediment transport model using in situ measurements

Michael Fettweis, Dries van den Eynde and Frederic Francken
Management Unit of the North Sea Mathematical Model (MUMM), Royal Belgian Institute of Natural Sciences, Gulledelle 100, 1200 Brussels, Belgium, Email: m.fettweis@mumm.ac.be

The fall velocity (w_s) of flocs is a crucial parameter in cohesive sediment transport modelling and varies between approximately 0.01 and 10 mm/s. The variation of fall velocity during a tidal cycle or a neap-spring cycle is important in areas with high tidal energy. Fall velocity can be directly measured using *e.g.* video cameras or a LISST-ST, but these instruments have the drawback that high-frequency information is difficult to obtain over longer time periods. However, with the LISST-100C, long-term measurements of floc size, volume concentration and mass concentration can easily be carried out. The fall velocity can be derived from the empirical relation between effective density ($\Delta\rho$) and floc size (D): $\Delta\rho \propto D^{nf-3}$ with nf representing the fractal dimension (Kranenburg, 1994). It can be further simplified to $\rho \propto D^{nf-3}$ with ρ as the floc density, if one assumes that the primary particle size, the density of the water, and the primary particle is independent of D. From Stokes' law it follows that $w_s \propto D^{nf-1}$ (Winterwerp, 1998).
Long-term measurements (0.5 up to 51 days) of hydrodynamics, SPM mass and volume concentration, and floc size carried out at different locations in the Belgian nearshore area, are presented together with analyses characterising the suspended particulate matter (primary particle size, organic matter, mineral and $CaCO_3$ content, density of flocs). The Belgian nearshore area is a trap for fine-grained cohesive sediments. Most of these suspended sediments are transported into the North Sea through the Strait of Dover. The measurements show that the size of the flocs is significantly smaller in the coastal turbidity maximum area. This has been explained by the higher turbulence; the shorter time available to reach equilibrium floc size; the higher deposition of mud resulting in a break-up of the flocs, and the lower ratio between organic matter and SPM concentration, which may limit the floc size.
An engineering floc model is presented (see the approach of Van der Lee, 2000) which relates the fall velocity to the SPM concentration, and which takes into account variations during tidal and neap-spring tidal cycles. The impact of the introduction of this flocculation model on the results of a 2D cohesive sediment transport model is discussed. The model results are compared with the measurements.

References

Kranenburg, C. (1994) On the fractal structure of cohesive sediment aggregates. *Estuarine, Coastal and Shelf Science*, 39, 451-460.

van der Lee, W. T. B. (2000) The settling of mud flocs in the Dollard estuary, The Netherlands. *PhD thesis*, Universiteit Utrecht, 133pp.

Winterwerp, J. (1998) A simple model for turbulence induced flocculation of cohesive sediments. *Journal of Hydraulic Research*, 36 (3), 309-326.