AGU FALL MEETING
San Francisco | 12–16 December 2016

EP33A-0976: Including Flocculation in a Numerical Sediment Transport Model for a Partially-Mixed Estuary

Wednesday, 14 December 2016
13:40 - 18:00
Moscone South - Poster Hall

Particle settling velocity impacts the transport of suspended sediment to the first order but fine-grained material like muds tend to form loosely bound aggregates (flocs) whose settling velocity can vary widely. Properties of flocculated sediment such as settling velocity and particle density are difficult to predict because they change in response to several factors including salinity, suspended sediment concentration, turbulent mixing, and organic content. Knowledge of the mechanisms governing flocculation of cohesive sediment is rapidly expanding; especially in response to recent technical advances. As the understanding of particle dynamics progresses, numerical models describing flocculation and break-up are being developed with varying degrees of complexity. While complex models capture the dynamics of the system, their computational costs may prohibit their incorporation into larger model domains. It is important to determine if the computational costs of intricate floc models are justifiable compared to simpler formulations.

For this study, we implement an idealized two-dimensional model designed to represent a longitudinal section of a partially mixed estuary that neglects across-channel variation but exhibits salinity driven estuarine circulation. The idealized domain is designed to mimic the primary features of the York River, VA. Suspended load, erosion and deposition are calculated within the sediment transport routines of the COAWST modeling system. We compare different methods for prescribing settling velocity of fine-grained material. The simplest, standard model neglects flocculation dynamics while the complex treatment is a size-class-based flocculation model (FLOCMOD). Differences in tidal and daily averages of suspended load, bulk settling velocity and bed deposition are compared between the standard and FLOCMOD runs, to examine the relative impact of flocculation on sediment transport patterns. We expect FLOCMOD to have greater variability and elevated suspended load during increased shear stress but minimal impact on depositional patterns near the ETM. This model also incorporates bed consolidation and sediment-induced stratification; allowing the evaluation of the relative roles of various cohesive sediment processes in limiting sediment distribution.

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