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Deng, Zhirui; He, Q; Chassagne, Claire; Winterwerp, Han

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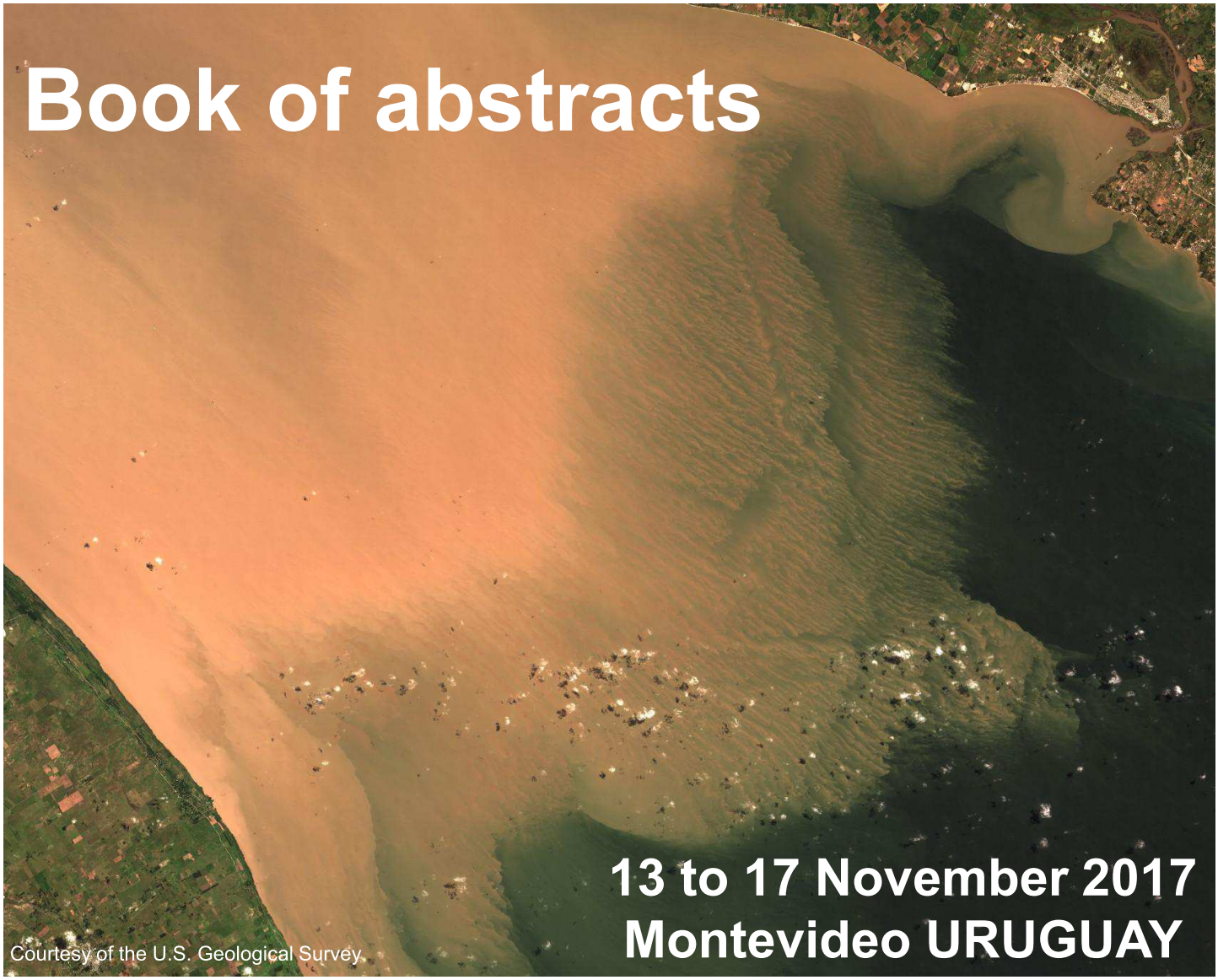

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Seasonal variation of sediment flocculation and the modeling thereof as function of biochemical factors

Zhirui Deng[1], Qing He[1], Claire Chassagne[2], Johan C. Winterwerp[2]

[1] State Key Laboratory of Estuarine and Coastal Research, East China Normal University, Zhongshan N. Road 3663, Shanghai 200062, China
E-mail: Z.Deng-1@tudelft.nl

[2] Delft University of Technology, Department of Geosciences and Engineering, 2628 CN Delft, NL, P.O. box 5048, the Netherland

Abstract

The flocculation process and modelling of suspended sediment transport in estuarine regions is a hot topic in estuarine science[*Winterwerp*, 1999]. The flocculation is greatly influenced by biochemical parameters[*De Lucas Pardo*, 2014]. In this paper, we analyse the impact of algae on the processes of flocculation in the Yangtze Estuary, and we identify the mechanisms which are responsible for their changes. The amount of algae (phytoplankton biomass) is linked to the chlorophyll α concentration which we measured[*Uncles et al.*, 1998]. The measurements were performed in the maximum turbidity zone. The seasonal variations of phytoplankton lead to changes in the flocculation dynamics and the composition of suspended particle matter. We recorded the floc size changes in the Yangtze Estuary and we found that: (1) the flocs are significantly influenced by tidal dynamics, as the floc size during slack water is larger than ebb tide and flood tide, (2) there is a correlation between the Chlorophyll concentration and sediment concentration, (3) the floc size is correlated to the algae-sediment mass ratio, (4) in winter, with high salinity and small river discharge, the region has a significant stratification and the floc size was smaller than the one in summer (fig.1).

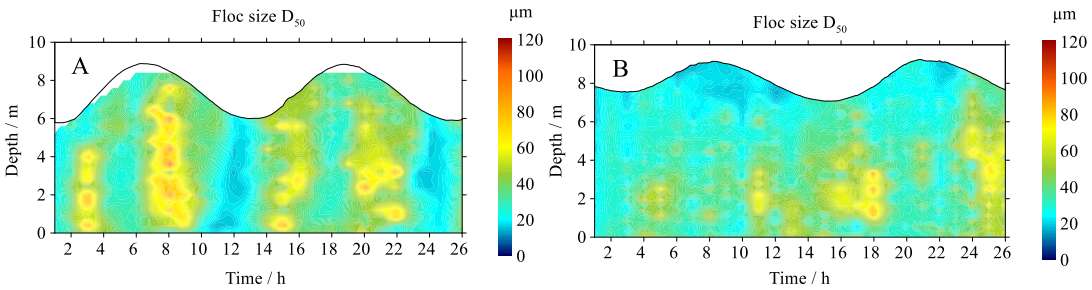

Fig. 1. The floc size distribution for different seasons ((A) summer (B) winter).

In order to better identify the parameters that influence most the flocculation and try to model it, a series of laboratory experiments were performed. Parameters such as salinity, shear rate, phytoplankton (and EPS (extracellular polymeric substances) produced by this phytoplankton) and sediment concentration were systematically varied[*Mietta*, 2010]. The floc size as function of time was modelled according to:

$$N_i(t) = \frac{a_1}{1+a_2 \exp\left(-\frac{t}{t_a}\right)}\left[a_3 + \exp\left(-\frac{t}{t_b}\right)\right] \quad (1)$$

where Ni(t) represents the number of flocs of size i as function of time and the parameters of a_1, a_2, a_3, t_a, t_b are fitted to the data. The dependence of these parameters on the environmental conditions will be discussed. the full particle size distribution (PSD) obtained from fitting each class is given in fig.2.

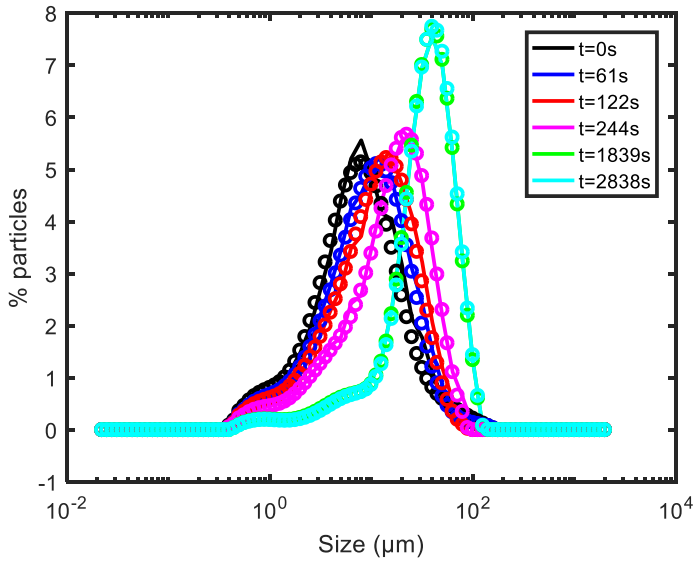

Fig. 2. The time dependent PSD of a suspension composed of 0.7g/l Yangtze sediment and 2mg/g EPS and 0.3mol/l NaCl.

We will show by comparing the lab experiments and in-situ data, that more insight can be given in the flocculation process by phytoplankton. The ultimate goal is to apply the model to in-situ flocculation data and hereby improve large scale sediment transport models.

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