

Gu, Chuan, Wheatland, Jonathan, Botto, Lorenzo, Bushby, Andy, Carr, Simon
ORCID: <https://orcid.org/0000-0003-4487-3551> , Manning, Andy and Spencer,
Kate (2019) Investigation of the dynamics of 3-D flocs with complex morphology
via Stokesian dynamics simulations. Geophysical Research Abstracts, 21 . p. 1.

Downloaded from: <http://insight.cumbria.ac.uk/id/eprint/7209/>

Usage of any items from the University of Cumbria's institutional repository 'Insight' must conform to the following fair usage guidelines.

Any item and its associated metadata held in the University of Cumbria's institutional repository Insight (unless stated otherwise on the metadata record) may be copied, displayed or performed, and stored in line with the JISC fair dealing guidelines (available [here](#)) for educational and not-for-profit activities

provided that

- the authors, title and full bibliographic details of the item are cited clearly when any part of the work is referred to verbally or in the written form
 - a hyperlink/URL to the original Insight record of that item is included in any citations of the work
- the content is not changed in any way
- all files required for usage of the item are kept together with the main item file.

You may not

- sell any part of an item
- refer to any part of an item without citation
- amend any item or contextualise it in a way that will impugn the creator's reputation
- remove or alter the copyright statement on an item.

The full policy can be found [here](#).

Alternatively contact the University of Cumbria Repository Editor by emailing insight@cumbria.ac.uk.



Investigation of the Dynamics of 3-D Flocs with Complex Morphology via Stokesian Dynamics Simulations

Chuan Gu (1), Jonathan A. T. Wheatland (2), Lorenzo Botto (1), Andy J. Bushby (1,3), Simon J. Carr (4), Andy J. Manning (5), and Kate L. Spencer (2)

(1) Queen Mary University of London, School of Engineering and Materials Science, United Kingdom (c.gu@qmul.ac.uk), (2) School of Geography, Queen Mary University of London, London, United Kingdom, (3) The NanoVision Centre, Queen Mary University of London, London, UK, (4) Department of Science, Natural Resources and Outdoor Studies, University of Cumbria, Cumbria, United Kingdom, (5) HR Wallingford, Estuaries and Dredging Group, Wallingford, United Kingdom

Understanding the transport behaviors of suspended particulate matter (SPM) is crucial for analyzing the impact and the flux of sediment in natural aquatic environment. SPM usually exists in form of flocs which are fragile and loosely bound aggregates characterized by highly irregular 3D shape, low effective densities and high porosity [1]. Previous studies of the physical characteristics of flocs are often based on simplified 2-D geometries of complex 3-D shapes. With the availability of 3-D sampling data of flocs, we employ Stokesian dynamics simulations to investigate the vertical or horizontal transport behaviors of flocs, e.g. settling under gravity or movement under shear flows. The correlations between the floc shapes, the transport behaviors and the floc internal stresses imposed by surrounding fluid are investigated.

3-D voxel-based datasets of the flocs are generated by conducting non-destructive 3-D X-ray computed tomography imaging on the stabilized floc samples, following the preparation protocol described in Wheatland et al. [2]. Based on the resulting voxel-based images of the flocs, the structure of each individual floc is modelled as an assembly of identical solid spheres and the velocity of the assembly is solved via Stokesian dynamics [3,4].

An automated process of predicting the dynamics of a floc in liquid environment from its voxel image is established. The entire modelling approach can serve as a powerful tool for analyzing the parameters determining the flocs transport behaviors and possibly provide inputs for modelling sediment bed growth rate at macro scales.

Acknowledgements: The funding support from NERC project NE/N011678/1 has been acknowledged.

References:

- [1] Droppo (2001) *Hydrol. Process.* 15:1551-1564;
- [2] Wheatland et al. (2017) *Environ. Sci. Technol.* 51:8917-8925;
- [3] Bossis et al. (1991) *J. Chem. Phys.* 94:5064-5070;
- [4] Swan et al. (2011) *Phys. Fluids* 23:071901.
- [5] Brady et al. (1988) *Annu. Rev. Fluid Mech.* 20.1:111-157.