A New 3D Descriptor for Irregularly Shaped Suspended Sediment Aggregates

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Within coastal and estuarine environments suspended cohesive sediments that are often closely associated with carbon, nutrients, pathogens and pollutants form aggregates commonly known as ‘flocs’. Understanding the settling dynamics and eventual fate of flocculated sediment is therefore a major issue for the management of aquatic environments. Several factors have been reported to influence the hydrodynamic behaviour of flocs, including size, shape, density and porosity. Recent evidence suggests that of these shape exerts the greatest influence on settling rates. Yet means of characterising shape have been limited to easy to measure quantities such as fractal dimension and circularity measured in 2-dimensions (2D) that fail to capture the highly complex, irregular geometries of sediment flocs. However, recent improvements in sampling methods, 3D imaging capabilities and data processing software enable for the first time the characterisation of flocs based on their 3D morphology.

This study compares the morphologies of natural and artificial flocs generated under different environmental conditions. By employing a novel apparatus for the capture, immobilisation and handling of delicate floc samples, 3D X-ray micro-computed tomography (X-ray µCT) scans are successfully obtained and used to derive accurate volumetric reconstructions of tens of thousands of individual flocs. Using these datasets we compare different methods for describing shape, and test these for their ability to predict floc settling behaviours.