

Identification of suspended resilient pellets in particles tracked by a Particle Image Camera System (PICS) in a muddy estuary

Cartwright Grace M., Kelsey A. Fall and Carl T. Friedrichs

College of William and Mary, Virginia Institute of Marine Science, Gloucester Pt., VA 23062, USA
E-mail: gracec@vims.edu, kafall@vims.edu, carl.friedrichs@vims.edu

The Particle Imaging Camera System (PICS) was designed to allow for the measurement of the settling velocity of individual particles *in situ* by using the smaller particles (<30 microns) to remove the effects of water velocity due to boat/water motion (Smith, 2010). Smith and Friedrichs (2011) took advantage of this system to identify the *in situ* size and settling velocities of cohesive flocs and suspended sediment aggregates in a trailing suction hopper dredge plume. They characterized the particles of each 30s video into three groups: flocs (density $\leq 1150\text{kg/m}^3$), primary mineral particles (density $\geq 1800\text{kg/m}^3$) and bed aggregates ($1150\text{mg/m}^3 < \text{density} < 1800\text{kg/m}^3$). This classification system, while adequate for suspended dredge plumes, needs to be revisited when the PICS is used in a muddy estuary, such as the York River Estuary, Virginia. Fig. 1B shows the settling velocities of particles tracked within a video captured 2.5m from the surface in the Clay Bank region of the York River, plotted against their equivalent spherical diameters. While most of the particles are classified as flocs, as indicated by the blue dots in Fig. 1C and the peak in the relative number of particles in Fig. 1E, there is still a large number of particles classified as “bed aggregates” (red dots). This number of higher density particles may be unexpected, as this video was captured 4.25m over a “muddy bed” in a natural system with a flood current of 40cm/s. However, biologically compacted mud in the form of resilient pellets (see Fig. 2) may be the answer. Bed sediments from five sediment cruises during this study period (Aug. 2012 – Nov. 2014) were found to be comprised of 86-96% mud (Fig. 3A). However, 9-14% of the mud was packaged as resilient pellets (Fig. 3B). Sediment captured 38cm above the bed by traps deployed on tripods were found to have 92-98% mud, with 4-14% of the mud packaged as resilient pellets (Fig. 3A and B). Pellets isolated from the Apr. to Jul. 2014 trap were sampled with the PICS to determine the distribution of settling velocities (W_s), particle densities, and the ratio of the long and short axis of the particles. This will be used to identify the pellets in PICS videos captured during the five 6h anchor stations (black lines in Fig. 3) where three depths were sampled each hour.

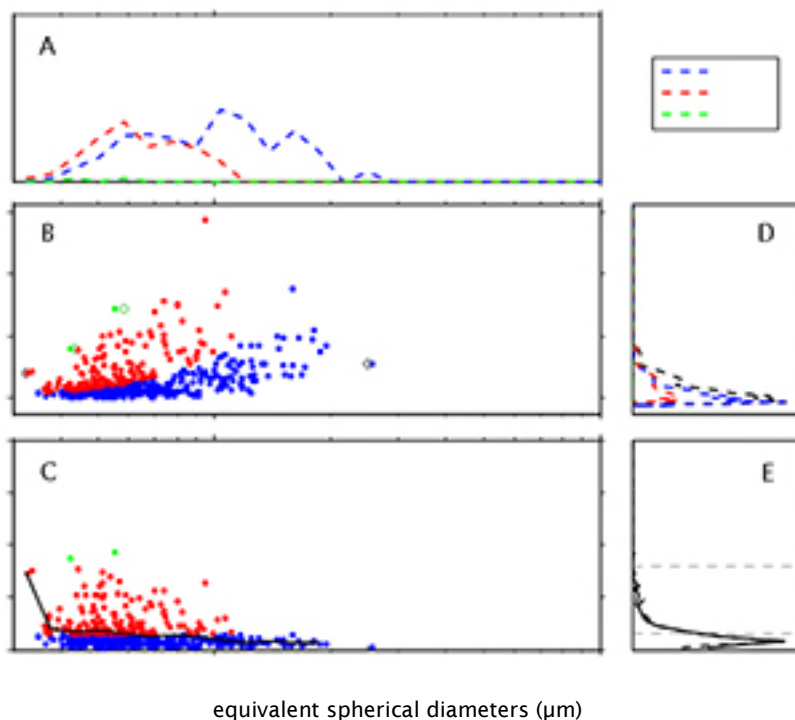


Fig. 1. 489 particles tracked from video captured *in situ* at 2.5m (4.25mab) during a flood tide (40cm/s) at Clay Bank, York River, VA using a PICS settling camera.

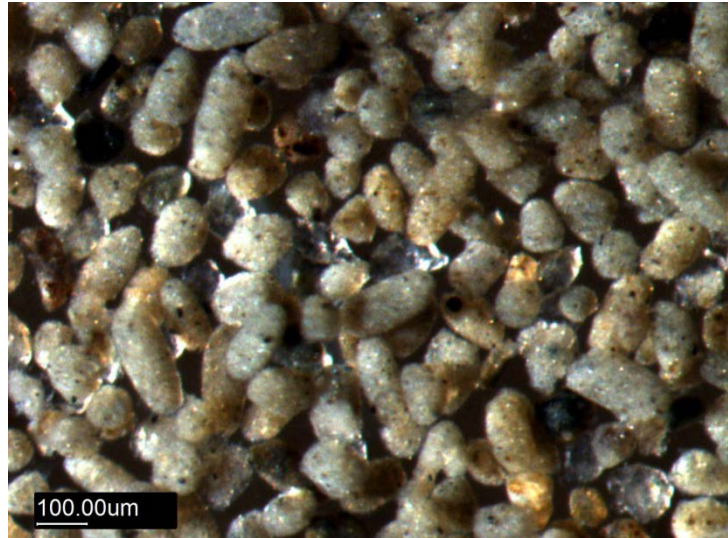


Fig. 2. Pellets, sand and debris captured on 63-micron mesh from sediment trap deployed April 2 – July 21, 2014.

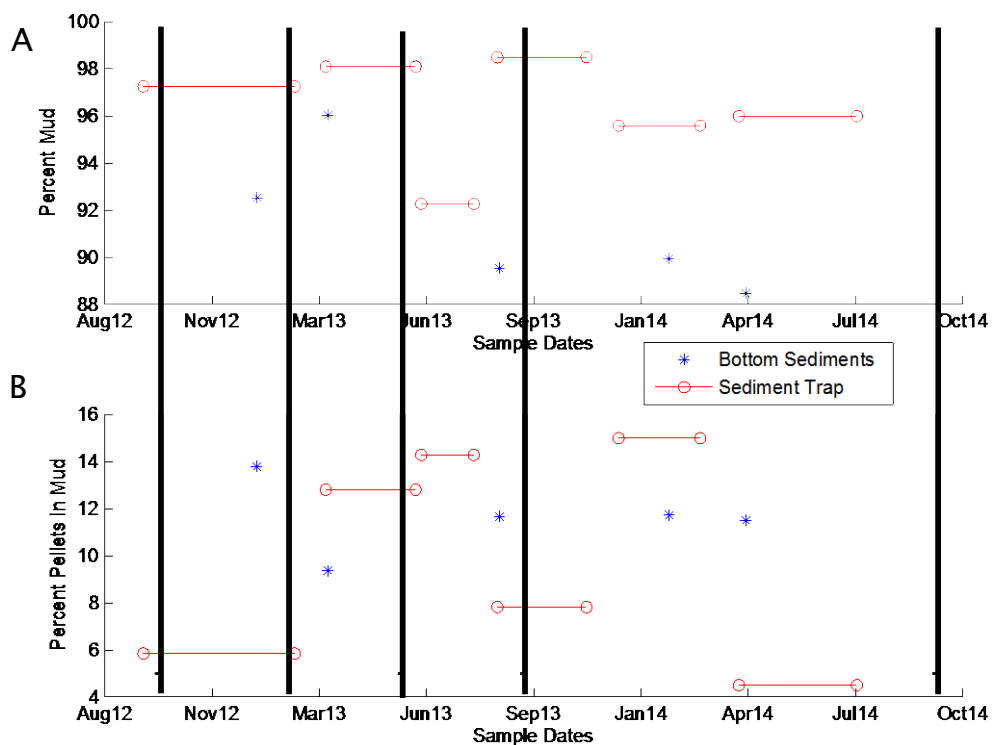


Fig. 3. A) Percent mud analysed from bottom sediment (blue stars) and sediment traps deployed on tripods in Clay Bank region of the York River Estuary, VA. B) Percent pellets in mud fraction in bottom sediment and sediment traps. Black lines indicate PICS 6-hr anchor station periods.

References

- Smith S.J. 2010. Fine sediment dynamics in dredge plumes. PhD Thesis. School of Marine Science, College of William & Mary. Gloucester Point, VA.
- Smith S.J. and C.T. Friedrichs. 2011. Size and settling velocities of cohesive flocs and suspended sediment aggregates in a trailing suction hopper dredge plume. *Continental Shelf Research* 31(10S):S50-S63.