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Distinguishing resuspension and advection signals in a hypertidal estuary

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Terrestrial material is supplied to an estuary system by the river, while marine material is supplied by the sea. Whether the estuary acts as a trap or a bypass zone for SPM (suspended particulate matter) depends upon the properties and dynamics of both the estuary, including the tidal and residual behaviour of the currents, and the SPM, including particle sizes and settling velocities and concentration gradients, which together control the dynamics, such as the trapping efficiency, of the estuary.

Whether an SPM signal is regarded as being one of resuspension or advection depends upon the area of interest, and therefore distinguishing between resuspension and advection can be complex. Material that is resuspended within the area of study is regarded as resuspension, while that which is resuspended outside, but passes through, the area of interest, is regarded as advection.

The results of a measurement campaign undertaken in a hypertidal UK estuary during the pre-spring bloom February-March and post-spring bloom May-June are presented utilising a combination of acoustic and optical instruments, moorings, and CTD stations.

A characteristic asymmetric “twin peak” signal is present during both time periods, implying the presence of both resuspension and advection. This is confirmed through the use of harmonic analysis. A seasonal variation in the relative importance of the resuspension and advection components is seen between the two observation periods, with the small (<122μm) and large (>122μm) particles displaying different behaviours and providing a strong indication of the presence of flocculation.

Approximate point flux calculations showed a reduction in the horizontal gradient of concentration, and subsequently the flood dominance of sediment transport, between May-June and February-March. This has been attributed to changes in biological activity and atmospheric forcing between the two observational periods.

Ebb-dominant concentrations brought about by the horizontal concentration gradient were opposed by a possible asymmetrical flocculation signal with asymmetrically larger particles occurring during low water than high water. This led to faster settling particles at low water and therefore, over time, a tidal pumping mechanism which transports material up the estuary.