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The role of grain size distribution and flow stratification in nearshore sediment transport

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Recently, the two-way effects of the time varying suppression of turbulence by gradients in suspend sediment concentration under waves have been investigated. The results show that, when this effect is accounted for, the wave coherent component of transport is increased relative to the mean component of transport which can even result in a change of the direction of transport. Comparisons between measured and simulated time series of near-bed sediment concentrations show great coherence (0.95 correlation) and the vertical distribution of net transport rates is more accurately reproduced by the simulations using sediment stratification. However discrepancies in both transport time series and net transport rates are still disappointing.

Investigations into the grain-size dependency of the effect indicates that it scales with the ratio of maximum orbital velocity to grain settling velocity (u_m/w_s). As the effect is therefore larger (for given flow conditions) for smaller grain sizes, it has been proposed that the model-observation mismatch may be due to the utilization of a single grain size in the simulated sediment load. A modified form of the Generalized Ocean Turbulence Model (GOTM) has been utilized to examine this question. A vertical advection-diffusion model of sediment suspension has been combined with a modified Smith & McLean relation for bottom concentration which distributes the excess bed stress among discrete sediment classes based on their concentration in the bed. The resulting simulations of sediment concentration and transport are compared to field observations as well as simulations using single grain sizes and simulations ignoring the effects of stratification.