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Lagrangian particle statistics of numerically simulated shear waves

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The properties of numerical solutions of various circulation models (Boussinesq-type and wave-averaged NLSWE) have been investigated on the basis of the induced horizontal flow mixing, for the case of shear waves. The mixing properties of the flow have been investigated using particle statistics, following the approach of LaCasce (2001) and Piattella et al. (2006). Both an idealized barred beach bathymetry and a test case taken from SANDYDUCK 97 have been considered. Random seeding patterns of passive tracer particles are used. The flow exhibits features similar to those discussed in literature. Differences are also evident due both to the physics (intense longshore shear shoreward of the bar) and the procedure used to obtain the statistics (lateral conditions limit the time/space window for the longshore flow). Within the Boussinesq framework, different formulations of Boussinesq type equations have been used and the results compared (Wei et al. 1995, Chen et al. (2003), Chen et al. (2006)). Analysis based on the Eulerian velocity fields suggests a close similarity between Wei et al (1995) and Chen et. al (2006), while examination of particle displacements and implied mixing suggests a closer behaviour between Chen et al. (2003) and Chen et al. (2006). Two distinct stages of mixing are evident in all simulations: i) the first stage ends at t¡t1 when a large fraction of the particles has approached the shoreline, ii) the second is essentially characterized by dispersion in the longshore in the trough of the barred beach. In this particular cases the numerical computations confirm a dependency of the relative dispersion from the particles separation with an exponent 4/3. Different models give different transitions to this stage. The main difference between the wave averaged approach appears to be the description of the cross-shore dynamics and the order of magnitude of the longshore dispersion/diffusion.

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