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Large-eddy simulation of tidally driven mixing in estuaries

SENTHIL RADHAKRISHNAN, UGO PIOMELLI, University of Maryland, MING LI, University of Maryland Center for Environmental Science, W. ROCKWELL GEYER, Woods Hole Oceanographic Institution — The estuarine boundary layer is affected by the horizontal density gradient and exhibit mixing and restratification over a tidal cycle. Large Eddy Simulation(LES) is used to investigate the physics controlling the entrainment and growth of the boundary layer during the flood tide and the restratification during the ebb tide. While small-scale turbulent eddies generated by the bottom stress are the major flux-carriers in the well-mixed bottom boundary layer, relatively large spanwise vortices, dominate salt and momentum fluxes in the outer part of the bottom boundary layer between mid-flood and mid-ebb. Turbulent kinetic energy, momentum flux and bottom stress show a strong flood-ebb asymmetry. Strong bed stress during the flood tide causes the entrainment and growth of the bottom boundary layer whereas tidal straining during the ebb tide causes restratification in the water column. Additional LES runs conducted by switching off the baroclinic pressure gradient term in the momentum equation and the tidal straining term in the salinity equation show that the baroclinic pressure gradient is the main mechanism responsible for generating the flood-ebb asymmetry in turbulent mixing.

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