Abstract Submitted for the DFD12 Meeting of The American Physical Society

Large-eddy simulation of open channel flow with surface cooling RACHEL WALKER, ANDRES TEJADA-MARTINEZ, University of South Florida, GUILLAUME MARTINAT, CHESTER GROSCH, Old Dominion University — Results are presented from large-eddy simulations of unstably stratified open channel flow driven by a pressure gradient with zero surface shear stress and a no-slip bottom. Unstable stratification is imposed by a constant cooling flux at the surface and an adiabatic bottom wall. Under neutrally stratified conditions, the flow is characterized by weak full-depth streamwise cells similar to, but less coherent than Couette cells in plane Couette flow. Surface cooling leads to full-depth convection cells characterized by greater coherency than Couette cells. The structure of the turbulence and turbulence statistics are analyzed with respect to the Rayleigh number (Ra) representative of the surface buoyancy relative to shear. Increased surface cooling and thus increased Ra leads to full-depth convection cells of greater spanwise size than Couette cells. Impact of the convection cells on mean velocity, root mean square of velocity, and budgets of resolved turbulent kinetic energy and Reynolds shear stress will be investigated as a function of Rayleigh number. These results motivate further studies of the effect of surface cooling on tidal boundary layers simulated via an oscillating pressure gradient.

> Rachel Walker University of South Florida

Date submitted: 09 Aug 2012

Electronic form version 1.4