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Large-eddy simulation of large-scale convection cells in unstably stratified open channel flow ANDRES TEJADA-MARTINEZ, Universty of South Florida, GUILLAUME MARTINAT, Old Dominion University, RACHEL WALKER, University of South Florida, CHESTER GROSCH, Old Dominion University — Results are presented from large-eddy simulation 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 Couette cells in plane Couette flow. Surface cooling leads to stronger full-depth convection cells of larger spanwise scale. Surface cooling increases vertical and spanwise velocity fluctuations in the upper half of the channel, while increasing mixing throughout the water column. Similarities and differences between the flow with full-depth convection cells and a second flow with full-depth Langmuir cells generated via surface wave-current interaction will be highlighted. Comparison between flows is based on visualizations and diagnostics including (i) profiles of mean velocity, (ii) profiles of resolved Reynolds stress components, (iii) invariants of the resolved Reynolds stress anisotropy tensor and (v) balances of the transport equations for mean resolved turbulent kinetic energy.

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