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DNS of stably stratified open channel flow OSCAR FLORES, JAMES RILEY, University of Washington — The surface layer of the atmospheric boundary layer under stable conditions (i.e., night time) is approximated here by a DNS of a stably stratified open channel, with buoyancy effects included using the Boussinesq approximation. The Reynolds number is $Re_\tau = u_* h/\nu = 560$, where u_* is the friction velocity and h is the height of the channel. Night time cooling is simulated by a negative heat flux at the ground, which imposes a stable density profile in the flow. The simulations are initialized with velocity fields obtained from a non-stratified case, and they are run until a quasi- steady state is achieved. As a result of the ground-cooling, the Reynolds stresses and the turbulent fluctuations decay in times of the order of L/u_*, where L is the Obukov length-scale. For relatively weak cooling, the turbulence survives, and the flow evolves towards a quasi-steady state. If the cooling is too strong, the flow becomes laminar. Our results indicate that parameter controlling that behavior is Lu_*/ν, rather than L/h as proposed before. Interestingly, for the turbulent cases, the flow in the near-wall region is very similar to the non-stratified case, except for the longest scales of the streamwise velocity. In the outer region the profiles of velocity fluctuations are also similar, but the turbulence structure and the energy balance are drastically changed by the stable stratification. Funded by ARO Grant No. W911NF-08-1-0155.

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