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The role of return-to-isotropy in wall-bounded flows with buoyancy[1] ELIE BOU-ZEID, XIANG GAO, Princeton University, GABRIEL KATUL, Duke University — The workings of how buoyancy modifies turbulence in wall-bounded flows continues to be a topic with various open fundamental questions and multiple pressing applied needs. Horizontal velocity variance is produced by shear, while buoyancy generates vertical variance. These components then interact through the energy redistribution terms that work to return turbulence to an isotropic state. It is thus reasonable to hypothesize that any changes induced by buoyancy must be communicated by these terms to the horizontal directions. In this talk, a model that connects the budgets of the three velocity variance components and captures how the redistribution terms vary with the flux Richardson number is proposed. The results of this model are first validated against large eddy simulations. The model is then used to inquire about how turbulence transitions between different regimes as the Richardson number varies. By employing a Rotta-type closure for the redistribution terms, the model further predicts the velocity anisotropy tensor. Comparisons to LES using only the slow part of the linear Rotta closure are less convincing. However, the framework explains the self-preservation of turbulence even for very large gradient Richardson number in stably stratified flows.

[1]Princeton Environmental Institute Grand Challenges Program

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