APPLIED MATHEMATICS/GEOLOGY/ENGINEERING SEMINAR

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MacMillan, Room 115
324 Brook Street
4pm

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Separation and Entrainment Effects in Stratified Flow Past Topography

Abstract

Stratified flow past topography has applications that include the forecasting of severe downslope winds, clear air turbulence and drag induced by mountain ranges which accounts for about 50% of the resistance felt by atmospheric circulation. Topographic effects are also thought to be a significant source of mixing in the abyssal ocean. For nearly half a century Long's model, along with related numerical simulations provided the framework for interpreting these phenomena. Validation of theoretical predictions has been limited by the great difficulty of acquiring comprehensive measurements of geophysical flows at high Reynolds numbers. Direct comparison has recently become possible with the advent of new technical approaches, which are providing insights on small scale mechanisms neglected in prior studies.

Measurements of tidally forced stratified flow over a sill are used to illustrate the importance of mixing, entrainment and boundary layer separation and the influence these processes have on the time dependent response. Separation of the accelerated current at the sill crest forms a jet which inhibits development of the downslope flow. Instability and small scale mixing above the jet then create a nearly stationary layer which generates an asymmetric response and favorable pressure gradient, suppressing separation and leading to development of the high drag state. A different mechanism associated with separation from irregular lateral boundaries is also observed. Following separation the shear zone may start as a nearly vertical vortex sheet, but the presence of horizontal density gradients leads to progressive tilting and consequent vortex stretching, creating a region of convective overturning, turbulence, whirlpools and rapid air entrainment.