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Internal Wave Breaking in Stratified Flow over Topography

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In both atmosphere and oceans, internal waves generated by stratified flow over topography "break" when a critical Froude number is exceeded. In the oceans, the global field of such waves forced by the flow of the barotropic tide over bottom topography constitutes an "internal tide", the turbulent dissipation of which contributes significantly to the diapycnal diffusivity of mass in the abyss. In the atmosphere, the vertical flux of horizontal momentum in the wave field plays an important role in mediating the strength of the mid-latitude jet streams in the troposphere through the "gravity wave drag" that is applied to the mean zonal flow when the waves break. Early work on the atmospheric problem based upon the application of LES methods demonstrated that, in the restricted case of topographically forces 2-D flows, wave breaking aloft led to the development of an intense low level jet in the lee of the topographic maximum, in which an intense secondary instability of Kelvin-Helmholtz type developed which became intensely turbulent. The same methods were later applied to the oceans, initially to develop an understanding of the tidally induced breaking wave mechanics in the Knight Inlet "flume". Similar dynamical interactions, to those observed in the atmosphere in connection with severe downslope windstorm formation, have been observed to occur in the deep ocean in the lee of ocean bottom topographic extrema. Current work is underway to determine the extent to which DNS methods applied to the oceanographic context are able to recover the phenomenology revealed by the atmospheric LES analyses.