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Non-hydrostatic Flows Past 3D Obstacles

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Three-dimensional isolated mountains may excite high-amplitude internal waves that modify the atmospheric flow in their vicinity. In the case of circular mountains, or whenever their cross-stream extension is small, the establishment of those high-amplitude waves is only possible for a small range of flow parameters, corresponding to a range of values for Nh/U. That behaviour has been previously studied for hydrostatic non-rotating flow. This work studies the changes that occur when non-hydrostatic effects are taken into account. These effects tend to increase horizontal dispersion reducing the amplitude of standing internal waves. However, when appropriately scaled by the corresponding linear solutions, non-hydrostatic flows allow for the establishment of high-drag regimes, qualitatively similar to those of hydrostatic non-rotating solutions. In non-hydrostatic flow over bell-shaped mountains wave breaking occurs for higher values of Nh/U and for strongly non-hydrostatic flows (Na/U$\sim$2) stagnation on the upslope occurs even when no wave breaking is observed aloft.

The effects of vertically changing static stability are also being investigated.