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Topographic gravity waves: theory and numerical simulations in heterogeneous flows

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Gravity waves generated by mesoscale topography are an important globe-atmosphere coupling process, being a major element of the global angular momentum cycle. Parametrization of that process in large scale models has been mostly based on linear theory of homogeneous (constant U and N) flow past idealized bell-shaped isolated topography, with empirical corrections for non-linear effects, validated by numerical experiments with mesoscale models (e.g. Lott and Miller 1997). Heterogeneity of the background flow, as well as rotating and non-hydrostatic effects, are generally not considered, due to the lack of simple formulas able to deal with those effects.

Recent theoretical and numerical results (Teixeira and Miranda 2004, 2006), however, have shown the possibility of obtaining approximate analytical expressions for gravity wave drag produced by non-rotating sheared flow past isolated mountains, usable for parametrization purposes. Although not directly usable as a parametrization tool, due to its numerical cost, it is also possible to directly assess the importance of rotation, non-hydrostatic and anisotropic topographic effects in linear GWD estimation, using close numerical formulas (Miranda and James, 1992).

In the present study we review those recent developments of GWD theory and perform a numerical estimation of the impact of different neglected terms in GWD computation, using reanalysis data and GTOPO30 topography.