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The M_2 Internal Tide Simulated by a 1/10° OGCM

Zhuhua Li (1), Jin-Song von Storch (2), and Malte Müller (3)

(1) Max Planck Institute for Meteorology, Germany (zhuhua.li@mpimet.mpg.de), (2) Max Planck Institute for Meteorology, Germany (jin-song.von.storch@mpimet.mpg.de), (3) Norwegian Meteorological Institute, Oslo, Norway (maltem@met.no)

Using a concurrent simulation of the ocean general circulation and tides with the 1/10° STORMTIDE model, this study provides a first global quantification of the low-mode M_2 internal tides. The quantification is based on wavelengths and their global distributions obtained by applying spectral analysis to STORMTIDE velocities and on comparisons of the distributions with those derived by solving the Sturm-Liouville and the WKB-simplified eigenvalue problems.

The simulated wavelengths of mode 1 and 2 range within 100-150 km and 45-75 km, respectively. Their distributions reveal, to different degrees for both modes, a zonal asymmetry and a tendency of poleward increase. As both features are by and large reproduced by solutions of the two eigenvalue problems, the STORMTIDE internal waves are, to a first approximation, linear waves determined by local dispersion relations, with stratification N being responsible for the zonal asymmetry and the Coriolis parameter f for the poleward increase. Distributions of mode-1 wavelengths are found to be determined by both N and f, but those of mode 2 are determined by and large by N only. In the tropical and subtropical oceans, the difference between the STORMTIDE wavelengths and those of the Sturm-Liouville eigenvalue problem is small but systematic, and can be attributed to refractions of remotely generated waves by the equatorward increase of N. In high-latitude oceans and the Kuroshio and Gulf Stream and their extensions, larger differences are found. There, non-linear wave-current interactions are important and the pictures of linear waves are much less accurate.