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Critical latitude parametric resonance of the semi-diurnal internal tide

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Recent progress in large-scale modelling of the low-mode internal tide is discussed in light of dynamics affecting internal gravity waves at their critical latitude. Previous research (e.g., Hibiya et al., 1996, 1998, 2002 and MacKinnon and Winters, 2004) found that internal gravity waves are subject to a parametric resonance where diurnal-band propagating internal waves undergo period doubling to the local inertial frequency at the latitude where $1/2\ \omega = f$. It is shown that, in the context of a realistic geometry global baroclinic tidal model, the M_2 internal tide is indeed subject to a parametric resonance at $\pm 28.9^\circ$ latitude. As the semi-diurnal internal tide transfers its energy to the non-propagating inertial band, shear is greatly enhanced, and poleward energy flux diminishes. The 60 meter bulk Richardson number in the upper few hundred meters becomes smaller than 1, and even smaller than 1/4, in distinct latitudinal bands across all of the world oceans. Sixty meter bulk Richardson numbers this small are not expected to arise in the real ocean because dissipation at scales neglected in the model would likely remove energy before such large-scale shears could develop. It is further evidence that an increase in shear-driven turbulent mixing in the upper ocean is predicted at critical latitudes.