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Gravity Wave Tunneling through a Stratospheric Jet

This study presents a numerical analysis of the ship wave gravity wave (GW) event observed over Auckland Island during the 2014 DEEPWAVE Campaign, as reported in Fritts et al., 2016, Pautet et al., 2016, and Eckermann et al., 2016. The event is simulated using the 3D, compressible EULAG model to evaluate 1. the stratospheric conditions that enable deep orographic GW propagation up to the mesopause with lower-than-expected (“linear”) amplitudes; and 2. the resulting instability characteristics and momentum deposition.

The linear Fourier model solutions presented in Eckermann et al., 2016 employed steady state solutions that omit GW contributions from vertical reflections, resonant modes, and evanescent tunneling. When modeled in a compressible environment that includes these dynamics, dominant GW modes tunnel through a large stratopause jet to reach the mesosphere, while localized regions of reflection and ducting reduce GW amplitudes farther downstream. The resulting GW characteristics compare favorably with the DEEPWAVE observations and Fourier solutions in the mesosphere, suggesting that stratospheric GW tunneling is a viable source for this and other deep propagation events. Further analyses of the GW energy/momentum deposition shed light on the types of dynamics driving GW transport phenomena which are not addressed in current mesoscale models.

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