
Atmospheric gravity waves from non-orographic sources in the extratropics

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Abstract

Jets and fronts have long been known from observations to be sources of gravity waves, both in the troposphere and into the lower stratosphere. The mechanisms responsible for these waves have remained somewhat elusive. In the past two decades, considerable progress has been made in understanding how balanced motions emit gravity waves. Several mechanisms have been identified analytically and will be reviewed: Lighthill radiation, unbalanced instabilities and transient generation by sheared disturbances. These mechanisms however do not provide an explanation for waves observed or simulated in the vicinity of jet/front systems where the flow is more complex than what is tractable by analytical treatment. Idealized numerical simulations have also been used in theoretical studies of 'spontaneous generation' of gravity waves from jets and fronts. In particular, simulations of dipoles, used as analogs to upper-tropospheric jet streaks, have provided a simple cartoon in which the generation is quantitatively explained. The background flow (including a region of strong winds, and a diffuent jet exit region) is found to play a key role in determining the characteristics of the waves that are emitted. The confrontation of these theoretical results to gravity waves in real atmospheric flows will be discussed based on observations from super-pressure balloons and on mesoscale simulations carried out in complement to the balloon campaigns. This comparison reveals some additional surprises, emphasizing for instance the role of moisture in the generation of waves from fronts.

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