Geophysical Research Abstracts
Vol. 17, EGU2015-4737, 2015
EGU General Assembly 2015

A stochastic parameterization of the gravity waves emitted by jets and fronts for general circulation models

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Internal gravity waves (GWs) propagating vertically from their tropospheric sources impact the circulation of the middle atmosphere, and are crucial for the reversal of the mesospheric jet and the maintenance of the quasi-biennial oscillation. Their spatial scales being too small to be represented in current Earth System models, they need to be parameterized. Nevertheless, mechanisms for GW emission by fronts and jets remain elusive nowadays. As a result, non-orographic GW parameterizations usually assume an arbitrarily uniform source of waves, which makes them insensitive to the annual cycle or to a changing climate.
In this study we take advantage of recent theoretical results on the emission of GWs by potential vorticity (PV) anomalies in vertically sheared flows, where GWs are emitted during the evolution of a near balanced flow (i.e. spontaneous adjustment). We then construct a stochastic GW parameterization linked to their frontal sources via PV anomalies. We will show that the scheme produces realistic GW drag, realistic GW intermittency and that it performs as well as classical schemes that have been thouroughly tuned the last 20 years. We will also present preliminary indications that the annual cycle in the GW forcing (which is related to the annual cycle of the sources) as well as the GW intermittency help the Laboratoire de Météorologie Dynamique Zoom (LMDz) general circulation model to have a final warming date of the southern polar vortex close to that shown by reanalyses products.