Geophysical Research Abstracts
Vol. 13, EGU2011-740-3, 2011
EGU General Assembly 2011

Inertia-gravity waves generated in a moist baroclinic wave simulation

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The generation of inertia–gravity waves in numerical simulation of a moist idealized baroclinic wave is investigated using the Weather Research and Forecasting Model on the f plane. The life cycle dominated by cyclonic behavior studied by Plougonven and Snyder in 2007 is extended to the moist case. To set up the moist baroclinic instability, an idealized moisture profile is added to the initial zonal jet. The role of diabatic heating in the evolution of the baroclinic wave and generation of the inertia–gravity waves is studied by comparing the life cycles of the moist and dry baroclinic waves.

Consistent with previous simulations by Zülicke and Peters in 2006, when compared to the dry case, inclusion of diabatic heating increases the growth rate of the baroclinic wave and leads to intensification of the generated inertia–gravity waves. In the dry case, two wave packets are excited by the upper-level jet similar to the wave packets described in previous studies. In the moist case, two new wave packets emerge that have not been previously identified in idealized simulations and are likely emanated from convection. One propagates into the lower stratosphere, the other moves horizontally in the troposphere.

These morphological findings are supplemented with energetic characteristics. The related budgets and fluxes are estimated for the balanced and unbalanced flow components. They show clear evidence of convective and spontaneous forcing of inertia-gravity waves in different phases of the life cycle.