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Momentum fluxes and intermittency of gravity waves: balloon observations and mesoscale numerical simulations

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Gravity waves in the lower stratosphere above Antarctica and the Southern Ocean are investigated using two complementary approaches: superpressure balloons from the Vorcore campaign (2005) and mesoscale simulations. Stratospheric balloons from the Vorcore campaign have provided a unique description of the gravity-wave field in the lower stratosphere above Antarctica and the Southern Ocean, during the austral spring of 2005 (Hertzog et al 2008). Mesoscale simulations with the WRF (Weather Research and Forecast Model) are carried out to analyze further the gravity-wave field. The present comparison allows to assess the realism of the simulations, and to revisit certain limitations of the observations.

First, the realism of the simulated waves is assessed by comparison to the observations. A satisfactory overall agreement is found, but different behaviour is noted for orographic waves (overestimation in the simulations relative to the observations) and non-orographic waves (underestimation). Sensitivity to resolution is quite small regarding the spatial structure of the gravity-wave field, but is significant for the amplitudes. The momentum flux values increase by ~ 2 when the horizontal resolution is doubled, and possible biases of both simulations and observations are discussed. Nonetheless, the good agreement between observations and simulations and the complementary information on the biases of each dataset promises that in the future these different estimates of gravity-wavemomentum fluxesmay converge.

Second, the gravity-wave field is analyzed in more detail than was possible from observations alone. It is necessary to distinguish and quantify orographic and non-orographic waves separately. Orographic waves are larger and more intermittent, yet affect only a limited geographical region. Hence, although orographic sources stand out as 'hot spots' for gravity waves, their contribution to momentum fluxes entering the stratosphere is comparable to or smaller than the contribution of non-orographic sources. A diagnostic for intermittency, the Gini coefficient, is proposed. It clearly marks the distinction between orographic and non-orographic sources (intermittencies of~ 0.8 and~ 0.5 respectively).