Geophysical Research Abstracts,
Vol. 11, EGU2009-4101, 2009
EGU General Assembly 2009

Uncertainties of estimates of inertio-gravity energy in the atmosphere

N. Zagar (1), J. Tribbia (2), J. Anderson (2), and K. Raeder (2)

(1) University of Ljubljana, Ljubljana, Slovenia (nedjeljka.zagar@fmf.uni-lj.si), (2) National Center for Atmospheric Research, Boulder, Colorado (tribbia@ucar.edu)

The normal-mode functions are applied to diagnose the atmospheric energy spectra in terms of balanced and inertio-gravity (IG) contributions. A set of three-dimensional orthogonal normal modes is applied to four analysis datasets: the operational analysis systems of NCEP and ECMWF, the NCEP/NCAR reanalysis and DART/CAM, an ensemble analysis system developed at NCAR. The selected truncation parameters of the expansion (zonal, meridional and vertical truncation) ensure that the projection provides the most good fit to the input data on model levels. The differences between the datasets can be considered as a measure of uncertainty of the IG contribution to the global energetics.

The results show that the percentage of IG motion in the present NCEP, ECMWF and DART/CAM analysis systems is between 1% and 2% of the total energy field. In the wave part of the flow (zonal wavenumber k>0), the IG energy contribution is between 9% and 15%. On the contrary, the NCEP/NCAR reanalyses contain more IG motion, especially in the Southern Hemisphere extratropics. Each analysis contains more energy in the eastward IG motion than in its westward counterpart. The difference is about 2% to 3% of the total wave energy and it is associated with the motions projected onto the Kelvin wave (KW) in the tropics.The contribution of the Kelvin wave energy to the total IG wave energy in the four datasets varies between 7% and 25%. The mixed Rossby-gravity (MRG) mode comprises between 4% and 15% of the IG wave energy.

The transient structure of the KW and MRG modes is studied in the space of normal modes. The difference in the depth of the model domain in DART/CAM and NCEP/NCAR on one hand and ECMWF and NCEP on the other appears to be one reason for different wave propagation properties. In the latter case the vertical energy propagation is diagnosed by filtering the propagating KW modes back to physical space. The results agree with the linear theory of vertically propagating equatorially waves.

The inverse projection shows that the bulk of the IG motion is confined to the tropics. The average tropical IG circulation in the studied period is characterized by reverse flows in the upper and lower troposphere consistent with the ideas behind simple tropical models. For the successful reproduction of this circulation by the normal modes it is important that the expansion includes many vertical modes based on realistic temperature and stability profiles.