Geophysical Research Abstracts,
Vol. 10, EGU2008-A-09268, 2008
SRef-ID: 1607-7962/gra/EGU2008-A-09268
EGU General Assembly 2008

Energetics in Atmospheric Climate Models

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The energy cycle characterizes basic aspects of the physical climate of the atmosphere. Terms in the Lorenz energy budget involve first and second order climate statistics of atmospheric quantities (means, variances, covariances) and for that reason are not often calculated or intercompared. The intercomparison of energetic quantities offers physically motivated "second order" insight into model and system behaviour. The energy cycle components of 14 models participating in AMIP2 are calculated, intercompared and assessed against results based on NCEP and ECMWF reanalyses.

In general, models simulate a modestly too vigorous energy cycle and the contributions to and reasons for this are investigated. Comparing differences across the models suggest that excessive generation of zonal available potential energy is an important driver of the overactive energy cycle through "generation push" while excessive dissipation of eddy kinetic energy in models is implicated through "dissipation pull". The study also shows that "ensemble model" results are best or among the best in the comparison of energy cycle quantities with reanalysis-based values. Thus ensemble approaches are apparently "best" not only for the simulation of 1st order climate statistics as in earlier studies but also for the higher order climate quantities entering the energy cycle.