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The energy cycle in climate models

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The energy cycle characterizes basic aspects of the physical behaviour of the climate system. Terms in the energy cycle involve first and second order climate statistics (means, variances, covariances) and the intercomparison of energetic quantities offers a physically motivated "second order" insight into model and system behaviour. The energy cycles of 14 models participating in AMIP2 are calculated, intercompared and compared with results based on NCEP reanalysis.

In general models simulate a modestly too vigorous energy cycle and the contributions to and reasons for this are investigated. The results 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".

One of the results of the study is 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 Lambert and Boer (2001) but also for the higher order climate quantities entering the energy cycle.