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Feedbacks between eddies and the zonal-mean flow in the simplified configuration of GCM

Ara Arakelian and Francis Codron
Université Pierre et Marie Curie, Laboratoire de Météorologie Dynamique, France (ara.arakelian@lmd.jussieu.fr)

The feedbacks between eddies and the zonal-mean flow are studied using the LMDZ GCM in the simplified configuration of an aquaplanet with no seasonal cycle. Thereby simulations have a complete zonal symmetry but produce a reasonable atmosphere variability.

The low-frequency variability in the mid-latitudes is dominated by annular-mode like latitude shifts of the jet that seem supported by a strong positive feedback by high-frequency eddies. A statistical study based on the autocorrelation of surface pressure onto the annular mode and the crosscorrelation between eddy forcing and wind anomalies involve positive feebacks, i.e. zonal wind anomalies leads the eddy forcing.

In order to isolate the response of the eddies to zonal-mean flow changes, a series of experiments is carried out in which the zonal-mean wind is strongly nudged towards either its climatological value, or the positive or negative phase of the annular mode. The eddies are left unconstrained, and eddy statistics are essentially unchanged when the mean wind is nudged towards the climatology.

Results show that eddy fluxes change in a way that would yield a positive feedback on the zonal jet movements, combined with a tendency for poleward propagation of anomalies.There is little change in eddy heat fluxes - or upward EP fluxes - in the mid-troposphere, and most of the response in eddy momentum fluxes comes from a change in the wave propagation, with an increase in equatorward propagation and anticyclonic breaking in the positive phase (poleward jet), and the opposite during the negative phase.
In addition, there is an impact of phase speed changes apparent in the subtropics, with faster waves in the positive phase penetrating less deeply in the Tropics.