Geophysical Research Abstracts
Vol. 13, EGU2011-1522, 2011
EGU General Assembly 2011

A dynamical interpretation of the poleward shift of the jet streams in global warming scenarios

Gwendal Rivière
CNRM/GAME, Météo-France/CNRS, Toulouse, France (gwendal.riviere@meteo.fr)

Future climate IPCC (Intergovernmental Panel on Climate Change) scenarios exhibit a robust poleward shift of the jet streams, that is, a positive trend in both the Arctic and Antarctic Oscillations. These changes are accompanied by an increase in intensity and poleward shift of the storm tracks, a strengthening of the upper-tropospheric baroclinicity (due to stronger warming in the tropical upper troposphere) and an increase in the eddy length scale. All these properties are more obvious in the Southern Hemisphere and are briefly recalled using two coupled climate model outputs. The purpose of our study is more precisely to examine the role played by enhanced upper-tropospheric baroclinicity in the poleward shift of the jet streams using comprehensive and idealized models.

An analytical study of the baroclinic instability in the three-level quasigeostrophic model offers a simple explanation for the increased eddy spatial scale. It is shown that long and small wavelengths become respectively more and less unstable when the upper-tropospheric baroclinicity is increased.

A simple dry atmospheric general circulation model (GCM) is then used to confirm the key role played by the upper-level baroclinicity by employing a normal-mode approach and long-term simulations forced by a temperature relaxation. The eddy length scale is shown to largely determine the nature of wave breaking: long (small) wavelengths break more anticyclonically (cyclonically). When the upper-tropospheric baroclinicity is reinforced, long wavelengths become more unstable, break more strongly anticyclonically and push the jet more poleward. Small wavelengths being less unstable, they are less efficient in pushing the jet equatorward. This provides an interpretation for the increased poleward eddy momentum fluxes and thus the poleward shift of the eddy-driven jets diagnosed in global warming scenarios.