Geophysical Research Abstracts
Vol. 20, EGU2018-12103, 2018
EGU General Assembly 2018

Maintenance of Baroclinicity: Global Climatology of the Slope of Isentropic Surfaces and their Tendencies

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The positioning and maintenance of mid- and high-latitude baroclinicity and associated storm tracks is still not fully understood. In particular, the relative role of surface inhomogeneities, such as land-sea contrasts and fronts in sea surface temperature versus the role of diabatic and adiabatic processes in the free troposphere, are still debated. A seminal paper pointed to the self-maintenance of storm tracks via diabatic heating of the storms themselves, which would imply that the storms not only live off the baroclinicity, feeding from its available potential energy, but would actually also act to resupply baroclinicity for subsequent development. Recent studies emphasise the importance of sea surface temperature fronts on positioning storm tracks. Using a recently introduced diagnostic analysing the slope of isentropic surfaces and its tendency, we assess the relative roles of diabatic and adiabatic effects in maintaining baroclinicity in the lower and upper troposphere.

We present a global climatology of baroclinicity for summer and winter, measured by the slope of isentropic surfaces. As expected, the storm tracks are clearly visible in the mean baroclinicity, as well as their seasonal progression. Furthermore, the previously claimed self-maintenance of storm tracks is confirmed, with the diabatic tendencies balancing the adiabatic tendencies in the time mean, where the diabatic tendencies are mostly associated with extratropical cyclones and act to increase baroclinicity. In addition, we highlight certain differences between the Atlantic and Pacific storm tracks in terms of their maintenance by the aforementioned processes. We also contrast the two main storm tracks in the Northern Hemisphere to the storm track in the Southern Hemisphere. We will also shed light on the potential role of sea surface temperature and land-sea contrasts in this framework for baroclinicity.