

On the dynamical impact of the warming pattern

Jin-Song von Storch[†]; Daniel Daniel Hernandez-Deckers

[†] Max-Planck Institute for Meteorology, Germany

Leading author: jin-song.von.storch@zmaw.de

It is well established that an increase in greenhouse gas concentration does not lead to a homogeneous tropospheric warming, but a warming pattern characterized by a stronger warming in the upper tropical troposphere and near the surface at the northern high-latitudes than elsewhere in the troposphere (Fig.10.7 in Meehl et al. 2007). We investigated the impact of this warming pattern for the Lorenz energy cycle and addressed the question of how the warming pattern alters the energetics of the atmosphere, including the storm activity. The question is difficult to answer, mainly because the warming pattern reveals various counteracting effects. Held (1993) pointed out a pair of competing effects involving the increase in meridional temperature gradient in the upper troposphere due to the upper tropical warming and the decrease in temperature gradient near the surface due to the high-latitude surface warming. In general, the effect of temperature-gradient change has been perceived as being more important than that of the static-stability change. In the present paper, we present results from specially designed nudging experiments, in which effects of different elements of the warming pattern are isolated. We found that it is the changes in static stability, not those in temperature gradient, that control the energetics responses.