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Temperature and Lapse Rate Changes Over the IPCC Regions and Over Large-Scale Zonal Bands

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Abstract Wegener Center for Climate and Global Change (WegCenter) and Institute for Geophysics, Astrophysics, and Meteorology (IGAM), University of Graz, Graz, Austria

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Global warming will likely cause inhomogeneous tropospheric temperature changes at different altitude levels and can thus affect atmospheric stability and cloud formation processes. Therefore, projected temperature lapse rate changes are of major interest.
In this study temperature changes and variability are investigated for the 30 IPCC regions and 7 large scale zonal bands, together referred to as IPCC$^+$ regions. For the analysis two global climate models of the IPCC fourth assessment report are employed, ECHAM5 and HadCM3. A combination of the 20th century run and the A2 scenario is used for the period 1980 to 2060. Since three ECHAM5 simulations have been available, an ensemble mean was used in the analysis. Here we present the evolution of temperature and lapse rate at different altitudes. The temperature changes considered are surface temperature and the temperature at 8 km geopotential height (gpkm). Lapse rates are based on the one hand on differences between surface and 8 gpkm and on the other hand on the difference between two upper tropospheric altitude levels, which vary with the latitude of the regions. For better comparison with radio occultation science, which is an accurate measurement method between 8 and 30, for the 8 gpkm temperature evolution and the upper tropospheric lapse rates, 'dry' and physical atmospheric states were considered. Dry temperature is a parameter commonly utilized in radio occultation science and it is calculated from refractivity assuming that atmospheric water vapor content is very small and its contribution to refractivity can be neglected. It turns out that in most IPCC regions a steepening of the physical lapse rate occurs, while in some high latitude regions a lapse rate flattening takes place. This indicates on average higher atmospheric stability in most regions, while few change towards higher atmospheric instability. According to this projections the average cloud building processes through convection could become somewhat weaker.

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