



Vertical structure of 20th century temperature trends in an ensemble of all-forcing transient GCM runs

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The vertical structure of atmospheric temperature trends plays an important role for the detection and attribution of the anthropogenic influence on the global climate via increased levels of greenhouse gases in the atmosphere. Atmospheric models as well as theoretical considerations predict an amplification of global warming close to the surface in the Arctic (polar amplification) and in the upper troposphere in the Tropics and Subtropics. The latter is caused by (a) enhanced convective latent heat release in the Inner Tropics and (b) increased static stability due to increased specific humidity in the Subtropics in a warmer climate (although the picture might look different in continental environments where evaporation is limited by water supply). Over the last years there has been an active debate whether observations already show evidence for this characteristic or not. Notably the upper tropospheric amplified warming in the Tropics has been contested in a number of studies. Using radiosonde and satellite data many analyses did not find this amplification or even showed a weaker warming than at the surface level. Yet, one study used upper tropospheric winds, which are much less affected by observational biases, to deduce the temperature distribution via the thermal wind relation and found a broad agreement with an enhanced warming trend in the tropical upper troposphere. Meanwhile it seems to have become clear that the temperature data used in the former studies had not been sufficiently corrected for measurement errors.

Here, we take a look at these trends in the global chemistry-climate model (CCM) SOCOL as well as in various observation based datasets (Comprehensive Historical Upper Air Network (CHUAN), statistical reconstructions (REC2), Twentieth Century Reanalysis (20CR)). We present vertical profiles of zonally and seasonally averaged temperature trends over 20-year periods during the whole 20th century for latitude bins of 10° from a 100-year transient all-forcings 9-member ensemble run of the CCM SOCOL. The uncertainty of the trends, represented by internal atmospheric variability in the model, is sampled by the spread of the ensemble members. Diagrams of time-height cross-sections will be compared to other model-based and observational studies, focusing on the Arctic (60°N - 90°N) and the tropical and subtropical (30°S - 30°N) region.