Geophysical Research Abstracts
Vol. 15, EGU2013-3929, 2013
EGU General Assembly 2013

Temperature Dependent Climate Projection Deficiencies in CMIP5 Models

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Monthly mean temperatures for 34 GCMs available from the CMIP5 project are compared with observations from CRU for 26 different land regions covering all major land areas in the world for the period 1961-2000 by means of quantile-quantile (q-q) diagrams. A significant warm period positive temperature dependent bias is identified for many of the models within a majority of the chosen climate regions. However, the exact temperature dependence varies considerably between the models. We analyse the role of this difference as a contributing factor for some models to project stronger regional warming than others by looking at the entire ensemble rather than individual models. RCP4.5 temperature projections from all GCMs for two time periods (2021-2050 and 2071-2100) are compared against a linear fit to the 50% warmest months from the respective q-q plot for each model and region. Taken together, we find that in general models with a positive temperature dependent bias tend to have a large projected temperature change. In some regions, there is no such dependency and in a few, the dependency is the opposite, although not statistically significant. Moreover, where positively identified these tendencies increase with increased global warming. We argue that this appears to be linked with the ability of models to capture complex feedbacks accurately. In particular land-surface atmosphere interactions are treated differently and with different degree of realism between models.