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Insights from the past millennium climate simulations into the recent temperature hiatus

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The trend in the global temperature over the last two decades is only marginally compatible with the ensemble of climate simulations participating in the CMIP3 and CMIP5 projects. The causes for the lower-than-predicted global temperature rise may be external with either misspecified external forcings or overestimated climate sensitivity. They can be internal, with internal variability at decadal and multidecadal time scales being larger than the one generated by climate models. A possible way to disentangle these two possibilities is to identify the large-scale spatial patterns where the ratio between external to total temperature variability (SNR) is largest. If the marginal disagreement between observations and models over the last two decades is caused by external causes, the temperature trends averaged only over those regions with high signal-to-noise ratio.
The spatial pattern of SNR in the global mean temperature can be identified from ensemble of simulations over the past millennium conducted with the same model and with (nearly) the same external forcing. Their length - 1200 years - and the fact that they have been driven my a mixture of different external forcings, make this estimation more robust than by using RCP future scenario simulations that are essentially driven by greenhouse gas forcing. Within the CMIP5 project and previous simulations, two models provide an ensemble of at least two simulations: the ECHAM5-OM model of the Manx-Planck-Institute for Meteorology and the GISS-E2-R model of the Goddard Institute for Space Studies.
Both models yield similar global patterns of high SNR in the annual mean temperature, focused on the tropical regions and the Arctic, with a band of low SNR along mid-latitudes in both hemispheres. The corporation of internal variability is lower in the ECHAM5-OM model than in the GISS-E2-R model, even though the amplitude of solar forcing was larger in the former. Antarctica appears essentially disconnected from the external forcing in both models, which agrees with the recent temperature reconstructions provided by the Pages 2k consortium.
The observed annual mean temperature trend over the last 15 and 20 years are compared against the backdrop of the distribution of trends in 15-year and 20-year segments in the annual mean temperature simulated in 55 CMIP5 simulations in the RCP4.5 scenario simulations until the year 2060. Two cases are considered: the spatially unfiltered trends and the trends calculated after filtering the spatial temperature fields by the patterns of high SNR. In the first case, the observed temperatures are marginally consistent with the model ensemble, a result already known from previous studies. In the second case, the filtered temperature trends are more clearly outside the range spanned by the model ensemble
These results suggest that the recent temperature hiatus is more strongly due to external causes: either to a misspecification of the external forcing or to an overestimation of the climate sensitivity by the model ensemble.