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Multi-model assessment of regional surface temperature trends (1900-2010)

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In this study we use climate models to help assess the causes of observed decadal to centennial scale variability in historical surface temperatures on global and regional scales over different periods during 1900 to 2010. A method for performing this assessment, as well as for assessing credibility of climate models (along with the current estimates of historical climate forcings), is to quantitatively compare simulated trends from these models with the historical climate data. Here we compare maps of the simulated and observed temperature trends, using t-tests applied for each observed grid box to assess the consistency between the modeled and observed trends (Knutson et al., J. Geophys. Res. 1999; Karoly and Wu, J. Climate 2005; Knutson et al., J. Climate, 2006). This approach is useful for highlighting regions where observed trends are highly unusual compared to the model-simulated internal variability, or where simulated trends are either consistent or inconsistent with past temperature trends for a given region. When inconsistencies are found, the reasons for these include possible errors in: i) specified forcing, ii) modeled response to the forcing, iii) observations, or iv) simulated internal variability, which is used to estimate the "allowable difference" between modeled and observed trends. Our method here is extended from our earlier work to apply to the full suite of CMIP3 models. Use of multiple models may provide an advantage in reliability over use of a single climate model. For example, the "All Forcing" response is estimated as the multi-model ensemble mean across all of the model All Forcing runs, each adjusted for any substantial control run drifts that were identified. The available control runs from all of models are combined to create a pooled estimate of internal climate variability for the comparisons. A few models are excluded from this pooled variability estimate, as we assess their internal variability as very likely unrealistic based on inspection of their global mean temperature series and variance spectra. Looking forward, we plan to apply this multi-model approach to the CMIP5 model data for comparison once this model output is available online. In addition, we plan to incorporate revised analyses of historical SST data once this becomes available. The latest results from these analyses will be reported on at the meeting.