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Regional climate change study requires new temperature datasets

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Analyses of global mean air temperature (Ta), i. e., NCDC GHCN, GISS, and CRUTEM4, are the fundamental datasets for climate change study and provide key evidence for global warming. All of the global temperature analyses over land are primarily based on meteorological observations of the daily maximum and minimum temperatures (Tmax and Tmin) and their averages (T2) because in most weather stations, the measurements of Tmax and Tmin may be the only choice for a homogenous century-long analysis of mean temperature. Our studies show that these datasets are suitable for long-term global warming studies. However, they may have substantial biases in quantifying local and regional warming rates, i.e. with a root mean square error of more than 25% at 5 degree grids. From 1973 to 1997, the current datasets tend to significantly underestimate the warming rate over the central U.S. and overestimate the warming rate over the northern high latitudes. Similar results revealed during the period 1998-2013, the warming hiatus period, indicate the use of T2 enlarges the spatial contrast of temperature trends. This is because T2 over land only samples air temperature twice daily and cannot accurately reflect land-atmosphere and incoming radiation variations in the temperature diurnal cycle. For better regional climate change detection and attribution, we suggest creating new global mean air temperature datasets based on the recently available high spatiotemporal resolution meteorological observations, i.e. daily four observations weather station since 1960s. These datasets will not only help investigate dynamical processes on temperature variances but also help better evaluate the reanalyzed and modeled simulations of temperature and make some substantial improvements for other related climate variables in models, especially over regional and seasonal aspects.