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Separating Contributions from Anthropogenic Warming and from Natural Oscillations to Global Warming

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During the past five decades, global air temperatures have been warming at a rather high rate (IPCC-2013) resulting in scientific and social concern. This warming trend is observed in field data sampling and model simulations and affects both air temperatures over land and over the ocean. However, the warming rate changes with time and this has led to question the causes underlying the observed trends. Here, we analyze recent measured and modeled data on global mean surface air temperature anomalies (GMTA) covering the last 160 years using spectral techniques. The spectral analysis of the measured data does show a strong secular trend (ST) and a clear multidecadal sinusoidal oscillation (MDV) that resembles the Atlantic Multidecadal Oscillation (AMO).
The observed acceleration of the warming during the period from 1970 to 2000 therefore appears to be caused by a superimposition of anthropogenic-induced warming ($\sim$60%) with the positive phase of a multidecadal oscillation ($\sim$40%), while the recent slowdown (hiatus) of this tendency is likely due to a shift in the MDV phase. It has been proposed that this change in the MDV phase could mask the effect of global warming in the forthcoming decades and our analysis indicates that this is quite likely, the current hiatus being already a manifestation of this phenomenon. Most current generation global circulation models (CMIP5) do not reproduce this MDV and are missing the actual temperature hiatus. Therefore, it is less likely that such models could correctly forecast the temperature evolution during the coming decades. We propose here to use the climate dynamics that is inherent in the GMTA data to forecast temperatures until 2100. These forecasts, based on the analyzed secular trend and the multidecadal oscillations are indeed capable of reproducing the actual hiatus and generally result, in comparison to CMIP5 forecasts, in much lower temperature increases for 2100 of only about 1oC. Global mean air temperatures could be even decreasing for the next 2-3 decades. Henceforth, for a correct assessment of the anthropogenic-induced warming of the global air temperatures in the future natural multidecadal temperature oscillations should be taken into account.