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Causes and implications of the growing divergence between climate model simulations and observations

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For the past 15+ years, there has been no increase in global average surface temperature, which has been referred to as a 'hiatus' in global warming. By contrast, estimates of expected warming in the first several decades of 21st century made by the IPCC AR4 were 0.2C/decade. This talk summarizes the recent CMIP5 climate model simulation results and comparisons with observational data. The most recent climate model simulations used in the AR5 indicate that the warming stagnation since 1998 is no longer consistent with model projections even at the 2% confidence level. Potential causes for the model-observation discrepancies are discussed. A particular focus of the talk is the role of multi-decadal natural internal variability on the climate variability of the 20th and early 21st centuries. The "stadium wave" climate signal is described, which propagates across the Northern Hemisphere through a network of ocean, ice, and atmospheric circulation regimes that self-organize into a collective tempo. The stadium wave hypothesis provides a plausible explanation for the hiatus in warming and helps explain why climate models did not predict this hiatus. Further, the new hypothesis suggests how long the hiatus might last. Implications of the hiatus are discussed in context of climate model sensitivity to CO2 forcing and attribution of the warming that was observed in the last quarter of the 20th century.