



Coldest Temperature Extreme Monotonically Increased and Hottest Extreme Oscillated over Northern Hemisphere Land during Last 114 Years

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Most studies on global warming rely on global mean surface temperature, whose change is jointly determined by anthropogenic greenhouse gases (GHGs) and natural variability. This introduces a heated debate on whether there is a recent warming hiatus and what caused the hiatus. Here, we presented a novel method and applied it to a $5^{\circ} \times 5^{\circ}$ grid of Northern Hemisphere land for the period 1900 to 2013. Our results show that the coldest 5% minimum temperature anomalies (the coldest deviation) have increased monotonically by $0.22^{\circ}\text{C}/\text{decade}$, which reflects well the elevated anthropogenic GHG effect. The warmest 5% maximum temperature anomalies (the warmest deviation), however, display a significant oscillation following the Atlantic Multidecadal Oscillation (AMO), with a warming rate of $0.07^{\circ}\text{C}/\text{decade}$ from 1900 to 2013. The warmest ($0.34^{\circ}\text{C}/\text{decade}$) and coldest deviations ($0.25^{\circ}\text{C}/\text{decade}$) increased at much higher rates over the most recent decade than last century mean values, indicating the hiatus should not be interpreted as a general slowing of climate change. The significant oscillation of the warmest deviation provides an extension of previous study reporting no pause in the hottest temperature extremes since 1979, and first uncovers its increase from 1900 to 1939 and decrease from 1940 to 1969.