



## **The Uncertainty of Long-term Linear Trend in Global SST Due to Internal Variation**

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In most parts of the global ocean, the magnitude of the long-term linear trend in sea surface temperature (SST) is much smaller than the amplitude of local multi-scale internal variation. One can thus use the record of a specified period to arbitrarily determine the value and the sign of the long-term linear trend in regional SST, and further leading to controversial conclusions on how global SST responds to global warming in the recent history.

Analyzing the linear trend coefficient estimated by the ordinary least-square method indicates that the linear trend consists of two parts: One related to the long-term change, and the other related to the multi-scale internal variation. The sign of the long-term change can be correctly reproduced only when the magnitude of the linear trend coefficient is greater than a theoretical threshold which scales the influence from the multi-scale internal variation. Otherwise, the sign of the linear trend coefficient will depend on the phase of the internal variation, or in the other words, the period being used. An improved least-square method is then proposed to reduce the theoretical threshold. When apply the new method to a global SST reconstruction from 1881 to 2013, we find that in a large part of Pacific, the southern Indian Ocean and North Atlantic, the influence from the multi-scale internal variation on the sign of the linear trend coefficient can-not be excluded. Therefore, the resulting warming or/and cooling linear trends in these regions can-not be fully assigned to global warming.