Uncertainty in Detecting Trend: A New Criterion and Its Applications to Global SST

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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 multi-scale internal variation. One can thus use a specific period in a much longer record to arbitrarily determine the sign of long-term trend, which is statistically significant, in regional SST. This could lead to a controversial conclusion on how global SST responded to the anthropogenic forcing in the recent history.
In this study, the uncertainty in the linear trend due to multi-scale internal variation is theoretically investigated. It is found that the “estimated” trend will not change its sign only when its magnitude is greater than a theoretical threshold that scales the influence from the multi-scale internal variation. Otherwise, the sign of the “estimated” trend may depend on the period used. The new criterion is found to be superior over the existing methods when the de-trended time series is dominated by the oscillatory term. Applying this new criterion to a global SST reconstruction from 1881 to 2013 reveals that the influences from multi-scale internal variation on the sign of “estimated” linear trend cannot be excluded in most parts of the Pacific, the southern Indian Ocean and the northern Atlantic; therefore, the warming or/and cooling trends found in these regions cannot be interpreted as the consequences of anthropogenic forcing. It’s also suggested that the recent hiatus can be explained by combined uncertainty from internal variations at the interannual and decadal time scales.

Keywords: ordinary least-square, linear trend, internal variation

