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Uncertainty of Linear Trend in Global SST Due to Multi-Scale Internal Variation

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In most parts of the global ocean, the amplitude of multi-scale internal variation of local sea surface temperature (SST) is much larger than that of its long-term linear trend. 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.

In this study, we first investigate the theoretical expression of the coefficient derived by the ordinary least-square method when the residual term in the linear regression model is regarded as a set of oscillations. It is found that the sign of the resulting linear trend will not depend on the phase of the oscillations only when its magnitude is greater than a theoretical threshold. An improved smoothed least-square method is proposed to decrease the theoretical threshold. When applying these two methods to a global reconstruction from 1881 to 2013, we find that in most of global oceanic regions including the Pacific, southern Indian Ocean and North Atlantic, it is impossible to exclude the influence of multi-scale internal variation on the sign of the long-term linear trend in local SST. Therefore, the resulting linear trend can not be fully attributed to the long-term changing SST in these regions.