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## **Spatiotemporal Trend and Variability of Precipitation in Taiwan Based on Multi-dimensional Ensemble Empirical Mode Decomposition (MEEMD)**

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### Abstract

Most of the time series in nature are nonlinear and nonstationary affected by climate change particularly. It is inevitable that Taiwan has also experienced frequent drought events in recent years. However, drought events are natural disasters with no clear warnings and their influences are cumulative. The difficulty of detecting and analyzing the drought phenomenon remains. To deal with the above-mentioned problem, Multi-dimensional Ensemble Empirical Mode Decomposition (MEEMD) is introduced to analyze the temperature and rainfall data from 1975~2018 in this study, which is a powerful method developed for the time-frequency analysis of nonlinear, nonstationary time series. This method can not only analyze the spatial locality and temporal locality of signals but also decompose the multiple-dimensional time series into several Intrinsic Mode Functions (IMFs). By the set of IMFs, the meaningful instantaneous frequency and the trend of the signals can be observed. Considering stochastic and deterministic influences, to enhance the accuracy this study also reconstruct IMFs into two components, stochastic and deterministic, by the coefficient of auto-correlation.

In this study, the influences of temperature and precipitation on the drought events will be discussed. Furthermore, to decrease the significant impact of drought events, this study also attempts to forecast the occurrences of drought events in the short-term via the Artificial Neural Network technique. And, based on the CMIP5 model, this study also investigates the trend and variability of drought events and warming in different climatic scenarios.

**Keywords:** Multi-dimensional Ensemble Empirical Mode Decomposition (MEEMD), Intrinsic Mode Function(IMF), Drought