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Testing for deterministic trends in global sea surface temperature

Susana Barbosa
University of Lisbon, IDL, Lisboa, Portugal (sabarbosa@fc.ul.pt)

The identification and estimation of trends is a frequent and fundamental task in the analysis of hydrometeorological records. The task is challenging because even time series generated by purely random processes can exhibit visually appealing trends that can be misleadingly taken as evidence of non-stationary behavior. Hydrometeorological time series exhibiting long range dependence can also exhibit trend-like features that can be mistakenly interpreted as a trend, leading to erroneous forecasts and interpretations of the variability structure of the series, particularly in terms of statistical uncertainty. In practice the overwhelming majority of trends in hydro-climatic records are reported as the slope from a linear regression model. It is therefore important to assess when a linear regression model is a reasonable description for a time series. One could think that if a derived slope is statistically significant, particularly if inference is performed carefully, the linear regression model would be appropriate. However, stochastic features, such as long-range dependence can produce statistically significant linear trends. Therefore, the plausibility of the linear regression model needs to be tested itself, in addition to testing if the trend slope is statistically significant. In this work parametric statistical tests are applied in order to evaluate the trend-stationary assumption in global sea surface temperature for the period from January 1900 to December 2008. The fit of a linear deterministic model to the spatially-averaged global mean SST series yields a statistically significant positive slope, suggesting an increasing linear trend. However, statistical testing rejects the hypothesis of a deterministic linear trend with a stationary stochastic noise. This is supported by the form of the temporal structure of the detrended series, which exhibits large positive values up to lags of 5 years, indicating temporal persistence.