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# Structural Time Series Model for El Niño Prediction

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ENSO is a dominant feature of climate variability on inter-annual time scales destabilizing weather patterns throughout the globe, and having far-reaching socio-economic consequences. It does not only lead to extensive rainfall and flooding in some regions of the world, and anomalous droughts in others, thus ruining local agriculture, but also substantially affects the marine ecosystems and the sustained exploitation of marine resources in particular coastal zones, especially the Pacific South American coast. As a result, forecasting of ENSO and especially of the warm phase of the oscillation (El Niño/EN) has long been a subject of intense research and improvement. Thus, the present study explores a novel method for the prediction of the Niño 3.4 index. In the state-of-the-art the advantageous statistical modeling approach of Structural Time Series Analysis has not been applied. Therefore, we have developed such a model using a State Space approach for the unobserved components of the time series. Its distinguishing feature is that observations consist of various components - level, seasonality, cycle, disturbance, and regression variables incorporated as explanatory covariates. These components are aimed at capturing the various modes of variability of the N3.4 time series. They are modeled separately, then combined in a single model for analysis and forecasting. Customary statistical ENSO prediction models essentially use SST, SLP and wind stress in the equatorial Pacific. We introduce new regression variables – subsurface ocean temperature in the western equatorial Pacific, motivated by recent (Ramesh and Murtugudde, 2012) and classical research (Jin, 1997), (Wyrtki, 1985), showing that subsurface processes and heat accumulation there are fundamental for initiation of an El Niño event; and a southern Pacific temperature-difference tracer, the Rossbell dipole, leading EN by about nine months (Ballester, 2011).