Geophysical Research Abstracts
Vol. 20, EGU2018-12977, 2018
EGU General Assembly 2018

A statistical significance test for sea-level variability

Daniele Castellana (1), Henk A. Dijkstra (2), and Fred W. Wubs (3)

(1) Utrecht University, IMAU, Physics, Utrecht, The Netherlands (d.castellana@uu.nl), (2) Utrecht University, IMAU, Physics, Utrecht, The Netherlands, (3) University of Groningen, Department of Mathematics and Computer Science, Groningen, The Netherlands

Sea level varies on many temporal and spatial scales. This study is motivated by the problem of attributing sea surface height (SSH) variations to specific mesoscale ocean features, such as eddies or rings. This is problematic, as much of the sea-level variability is due to other processes, for example, due to high-frequency wind-stress fluctuations and Rossby waves.

For sea surface temperature (SST) variability, a similar problem occurs of distinguishing SST changes due to specific large-scale phenomena (e.g. El Niño) from those caused by high-frequency fluctuations in atmospheric temperature and the associated heat fluxes. This problem was addressed over 40 years ago by Hasselmann, who introduced a stochastic model of the ocean mixed layer. In this model, the SST anomalies can be modeled by an Ornstein-Uhlenbeck process with a Gaussian probability density function (PDF). The discrete variant of this process is the AR(1) or red noise process, which is serving as a null hypothesis for SST variability. Indeed, when applied to SST variability in the Eastern Tropical Pacific, the El Niño variations are such that this null hypothesis can be rejected.

In a series of studies, extensive statistical analyses of daily observed SST and SSH variations were performed. Whereas SST statistics was proven to be Gaussian or nearly Gaussian, at least at midlatitudes, much larger deviations from Gaussian distributions are found in SSH anomaly time series.

To explain the non-Gaussian behaviour of SSH variability, the stochastic Hasselmann model is extended to include (in addition to the additive noise due to the wind stress) a multiplicative noise term (due to the dependence of the wind stress noise on the SSH anomaly). The resulting model of Correlated Additive and Multiplicative (CAM) noise can be analysed through its equilibrium probability density function (PDF) by solving the corresponding Fokker-Planck equation.

The main purpose of this study is to develop a statistical test for wind-stress driven sea-level variability, based on a stochastic model, for which the parameters can be estimated from the altimetry (or tide gauge) time series (like the lag-1 autocorrelation in the AR(1) process).