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Spatial patterns of variability from wavelet analysis of variance of sea level time series

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Sea level is an important parameter in the context of climate variability. The height of the sea surface is being measured from space through radar altimetry, yielding a large space-time dataset of absolute sea level measurements. Sea level exhibits variability over a wide range of spatial and temporal scales. A general issue is the relative importance of each scale and the associated spatial dependence. Wavelet analysis of variance is a useful approach to obtain a scale-based description of variability from an observed space-time dataset.

In this work the contribution of each scale to the overall variability is assessed by wavelet analysis of variance of satellite altimetry observations. Wavelet analysis of variance is carried out for a large dataset of sea level time series on a regular spatial grid over the North Atlantic. The contribution of each scale to the overall variability is expressed as the percentage of the wavelet variance at a given scale relative to the sum for all scales. Spatial patterns reflecting the contribution of each scale to the overall sea level variability are obtained. The contribution from high-frequency variability is larger in the Caribbean area and in the northernmost Labrador Sea, due to the proximity to complex land features, affecting the satellite measurements. In dynamically-enhanced areas, including the Gulf Stream, North Brazil Current and Guinea Current, sea level variability is dominated by high-frequency and semi-annual contributions. The annual signal is the main contributor to the observed sea level variability on the eastern boundary and near the equator, where almost 80% of the overall variability is explained by the annual cycle. In the northern Atlantic and north of the Intertropical convergence zone sea level variability is dominated by low-frequency signals.