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North Atlantic sea level variability from T/P altimetry and tide gauges: a wavelet covariance analysis

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Satellite altimetry provides high quality global observations of absolute sea level in a precise geocentric reference frame, but has inconveniences in coastal areas due to corruption of altimeter measurements by land surfaces and less reliable geophysical corrections. Continuous altimetry records are still short, spanning approximately 12 years, and on sparse time intervals. Long records of relative sea level measurements with respect to a local reference frame are available at high temporal samplings from tide gauges, but these are confined to coastal locations. The two datasets of altimetry and tide gauge sea level observations are therefore complementary rather than redundant.

This work focuses on the comparison of sea level observations in the North-East Atlantic from tide gauges and Topex/Poseidon altimetry, in order to investigate the relationships between sea level variability in open sea and near the coast and the different physical processes influencing sea level at coastal locations and offshore. The discrete wavelet transform is used to decompose sea level time series locally both in frequency and time. The relation between altimetry and tide gauge sea level series for different time scales is obtained through a wavelet analysis of covariance, which decomposes the covariance for the two processes on a scale-by-scale basis. The correlation between sea level observations and forcing variables is also examined using reanalysis data, and a statistical empirical model relating the two types of sea level measurements and forcing covariates is put forward.