Geophysical Research Abstracts
Vol. 18, EGU2016-6628-1, 2016
EGU General Assembly 2016

Spectral analysis of sealevel during the altimetry era, and evidence for GIA and glacial melting fingerprints

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We study the spatial patterns of the mass and steric components of sea-level change during the "altimetry era" (1992-today), and we characterize them at different scales by the orthonormal functions method. The spectrum of the altimetry-derived rate of sea-level rise is red and decays with increasing wavenumber nearly following a power law with exponent ≈ 10. By analyzing the degree correlation and the admittance function, we find that the altimetric rate of sea-level change is coherent with the total steric field in the whole range of wavelengths considered (down to 1000 km), but particularly for wavelengths exceeding 2000 km. Thermosteric and halosteric components are moderately anti-correlated within the range of wavelengths 1000-4000 km. Their power spectrum varies significantly with the wavelength and, for 2000 km, it is equally partitioned between the two components. The power of regional sea-level variations driven by Glacial Isostatic Adjustment (GIA) and the melting of continental ice sheets is small compared to that held by the steric component, which explains most of the regional variability shown by the altimetry record. This causes the elusiveness of the "static" sea-level fingerprints, which at present are hidden in the pattern of the residual sea-level (*i.e.,* the altimetry-derived sea-level minus the steric component). However, we find that at harmonic degree 2, mainly associated with rotational variations, the power of glacial melting is significant and it will progressively increase during next century in response to global warming. We also estimate that at the end of the Mid-Holocene the strength of the GIA fingerprints was ≈ 10 times larger than today, well above the long-wavelength component of residual sea-level.