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Least-squares wavelet analysis and its applications in geodetic and geophysical time series analyses

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We propose a new method of analyzing a time series as well a method to compute the coherency between two (or more) time series. These methods, namely, the least-squares wavelet analysis (LSWA) and the least-squares cross wavelet analysis (LSCWA), respectively, can analyze any time series that exhibit non-stationarity, while they may be unequally spaced, and unequally weighted, exhibiting gaps and offsets without the need of editing them. The least-squares spectrograms and the least-squares cross spectrograms, respectively have associated probability distribution functions that allow the rigorous determination of stochastic surfaces above which spectral peaks are significant at a specified confidence level (usually 95% or 99%). Both methods exhibit outstanding performance when compared to the state-of-the-art methods; we exemplify this with several examples. In this presentation, we will show how the LSCWA is used effectively to study the disturbances in the gravitational gradients observed by GOCE satellite that arise from plasma flow in the ionosphere that is represented by the Poynting electromagnetic energy flux. The LSCWA is also used to study the coherency between the Westford-Wettzell VLBI baseline length and the temperature series at both stations, showing significant thermal effects on the baseline length.