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Wavelet based time-frequency comparison of centre of mass time series determined by DORIS, SLR and GNSS techniques

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Wavelet analyzes were applied to determine wide-band dominant oscillations in center of mass time series data obtained by DORIS, GNSS and SLR space geodetic techniques. The time frequency wavelet spectra computed for complex-valued time series reveal seasonal and subseasonal oscillations in these data. Oscillations in these time series usually have variable amplitudes and phases which entail change in the flattening and polarization of the elliptic oscillations in their projections onto XY, XZ and ZY planes of the terrestrial reference frame. The comparison of these center of mass time series using the corresponding Morlet wavelet transform coefficients enabled detection of common variations in the flattening and polarization of the relevant elliptic oscillations.

Next, these time series were transformed into time-scale domain using the discrete wavelet transform based on the Shannon wavelet functions. Such a transformation enables computation of the semblance functions between the wavelet transform coefficients of the considered time series determined by different techniques. Assuming a fixed semblance threshold, e.g. 0.1, zero values were assigned to discrete wavelet transform coefficients for which the semblance was below this threshold. The common signals in the compared center of mass time series were then computed using the inverse discrete wavelet transform of the coefficients exceeding the assumed threshold level.