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Correlation study between the annual signal in GPS and DORIS station positions and the atmospheric and hydrological loading effects

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In this paper, the origin of the annual signal observed in the position time series of GPS (Global Positioning System) and DORIS (Global Positioning System-Doppler Orbitography and Radiopositioning Integrated by Satellite) co-located stations is investigated, by studying its correlation with atmospheric and hydrological pressure loading signals.

The data used in this study are the residual position time series of 11 well observed GPS-DORIS co-located stations, expressed in the local (North, East and Up) reference frame and referred to ITRF2014. For the time series of displacements (North, East and Up) of the analyzed stations due to atmospheric and hydrological loading, we used those estimated from the atmospheric models ERA interim, ECMWF-IB and ECMWF-TUGO-m barotropic, and from the hydrological models ERA interim, GLDAS/Noah and MERRA2.

The annual signal in the analyzed position time series is determined by means of the wavelet multi-resolution analysis. The results show that the amplitudes of the GPS annual signals are much lower than those of the DORIS annual signals for the three components (North, East and Up). Indeed, the average annual amplitudes for GPS positions in the North, East and Up components are about 0.55, 0.54 and 1.70 mm respectively, while those for DORIS positions are about 4.39, 4.56 and 4.06 mm, respectively. The correlations computed between the extracted annual signal and the three atmospheric loading models are low for most GPS and DORIS stations. However, for the three hydrological loading models, the correlations are weak for most GPS stations and significant (more than 0.6) for only a few components of some DORIS stations, especially in the Up component.