How much of GPS noise refers to hydrology loading? An insight from GRACE-assimilating hydrological modeling

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RESEARCH DESCRIPTION

Research question:
Does GPS (Global Positioning System) detect the short-term hydrology-related deformations?

Data:
GPS vertical displacements from a set of 221 European EPN (EUREF Permanent GNSS Network) stations.

Methods:
To separate deterministic part from the short-term changes:
(1) We use predictions of vertical deformations from a GRACE (Gravity Recovery and Climate Experiment)-assimilating land surface model (CLM-DA).
(2) We use conventional harmonic functions approach with pre-defined annual and semi-annual periods.

For the stochastic parts associated with two methods, the noise parameters (spectral indices and amplitudes of power-law noise) are estimated using the Maximum Likelihood Estimation (MLE).

Results:
(1) Annual and semi-annual frequencies are significantly explained by the hydrological model, resulting 60% reduction on average in amplitudes.
(2) The GRACE-assimilated model can remove the effect of high-frequency hydrological deformations, producing residuals with spectrum closer to the white noise process.
(3) Many oscillations at periods between 15 and 90 days are well-explained by GRACE-assimilating deformation model.
(4) Using GRACE-assimilated model as a deterministic part of GPS displacement time series, we provide a totally new estimates of uncertainty of GPS velocity for European sites.

This research has been published as:

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