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Improving hydrological loading by relocation of modeled surface water to geo-referenced river channels

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Variations in terrestrial surface water storage cause elastic crustal displacements of several millimeters in the vertical direction on daily to seasonal time scales. Locally, strong signals with exceptionally high amplitudes can be observed along the major river channels. Modelling such crustal deformations for geodetic applications is very sensitive to the resolution of the applied mass load. The spatial resolution of hydrological models for global distributions of terrestrial water storage is typically limited to 0.5° x 0.5°, mass loads derived from satellite observations, e.g. GRACE, have even much lower resolutions. In consequence, the locally concentrated surface water of rivers appears spread out on the coarse model or observation grid which leads to substantially underestimated surface displacements. In addition, the generalized model drainage network leads to apparent river-mass distributions that are not collocated with the real courses of the rivers.
Here, we present a relocation procedure for improving such hydrological loading estimates. The separated water masses stored in the modeled river network are relocated to a geo-referenced river map with higher resolution. Applying the relocation procedure, deformation amplitudes increase by 0.2 to 5 mm, along the Amazon even up to 15 mm. The horizontal displacement field is also strongly affected in the directions. For GPS stations in close proximity to larger rivers, the correlation of modeled hydrologically-induced surface displacement time series with GPS observations show a significant improvement.