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Assessment of an improved hydrological loading model from space geodesy: case study in South America

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Loading effects are crustal deformations induced by ocean, atmosphere and continental water mass redistributions. In this study we focus on hydrological loading effect monitored by space geodesy and in particular by GNSS and GRACE. Classically, hydrological loading models take into account snow and soil-moisture but don't consider surface waters (rivers, lakes...). As a result, huge discrepancies between GPS observations and those models arise around large rivers such as the Amazon where nearly half of the vertical signal cannot be explained by the combination of atmospheric, oceanic and hydrological loading models. To better resolve the hydrological signal, we improve the continental water storage models computed from soil-moisture and snow GLDAS/Noah or MERRA data sets by including surface water runoff.

We investigate how continental water storage model improvements are supported by GNSS and GRACE observations in South America main river basins: Amazon, Orinoco and Parana. In this area the hydrological effects are among the largest in the world mainly due to the river level variations. We present the results of time series analyses with spectral and principal component analysis (PCA) methods. We extract the dominant spatio-temporal annual mode. We also identify and characterize the spatio-temporal changes in the annual hydrology signal, which is the key to a better understanding of the water cycle variations of those major rivers. We demonstrate that it is crucial to take into account the river contribution in fluid signatures before investigating high-frequency variability and episodic events.