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Statistical analysis of climate-driven spatio-temporal variations of GRACE Total Water Storage in the Amazon River basin

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The hydrology of the Amazon River basin is characterized by a strong annual cycle due to the annual oscillation of the Inter Tropical Convergence Zone about the equator. However, this strong annual cycle shows significant inter-annual variations. For example, during the GRACE period, two severe drought periods occurred in 2005 and 2010 as well as strong floods in 2009. With now more than 9 years of GRACE data, investigation of such non-linear, long-period oscillations is possible. The Amazon River basin is strongly coupled with the climate system. Therefore, we investigate the possible relationships between total water storage variations from GRACE and different climate oscillations originating in the tropical Pacific and Atlantic Oceans (such as ENSO and AMO). Based on purely statistical methods (Rotated Empirical Orthogonal Functions and lead/lag correlation) we show that different sub-regions of the basin have different connections with different climate indices. In particular, we show the sensitivity of GRACE data to different types of El Niño. Finally, by means of a Multichannel Singular Spectrum Analysis we analyze and then compare the quasi-periodic constituents of GRACE total water storage and climate indices.