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Assessing the terrestrial water balance in South America using multi-satellite remote sensing data

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The hydrological cycle components of the terrestrial water cycle have been estimated with increasingly accuracy through remotely-sensed data, from regional to continental scales and in different time intervals. In this paper, we evaluated the water balance closure using remote sensing data in 28 large basins in South America for the period from 2003 to 2014. We used observed discharge (Q) data, precipitation (P) data from the TRMM Multi-satellite Precipitation Analysis (TMPA 3B43 version 7) with spatial resolution 0.25°, evapotranspiration (ET) data from MOD16, with spatial resolution of 0.05° and terrestrial water storage (TWS) estimations from the Gravity Recovery and climate Experiment (GRACE), with spatial resolution of 300 km. To evaluate the water budget closure, we used the simplified continuity equation (dS/dt=P-ET-Q) at monthly time-scales to analyse the water storage change in time (dS/dt), comparing the results to the TWS change from GRACE. Our results indicate that the water storage change dS/dt computed from remote sensing products showed significant correlations with the terrestrial water storage from GRACE. We found correlations higher than 0.70 in 14 basins, mostly in large basins located in the north of South America (with tropical wet and tropical dry climates), whilst lower correlations were found in Southern Brazil and in smaller basins (usually with subtropical climates). Lastly, we computed the correlation between dS/dt from GRACE and P, ET and Q. Precipitation was the hydrological component that showed better correlations, with 19 basins yielding a correlation higher than 0.70, suggesting that precipitation has a strong influence of the terrestrial water storage in those basins. Discharge measurements also yielded a very good agreement, with correlations higher than 0.63 in almost all basins. Despite the water balance closure based on remote sensing data still remains a challenge due to large biases and uncertainties in the precipitation, evapotranspiration and terrestrial water storage data, our results showed a great potential to mapping the terrestrial water cycle dynamics over large areas and with limited ground measurements.