Decrease in total water storage in the Magdalena River basin in recent years inferred from GRACE data

Silvana Bolaños Chavarría, Juan Fernando Salazar Villegas, and Teresita Betancur Vargas
Universidad de Antioquia, Medellín, Colombia

Groundwater is becoming increasingly important as a strategic water resource in many regions of the world, and particularly in Colombia where some regions are already facing surface water scarcity and drought-related problems. Global change-related decreases of terrestrial water storages can have strong effects on the sustainability of groundwater resources over continental regions. Identifying long-term trends in terrestrial water storages can have important implications for water management. Here we use remote sensing data from the Gravity Recovery and Climate Experiment (GRACE), to investigate the existence of long-term trends in the total water storage in the Magdalena river basin, the most important basin for water resources in Colombia. We use data of rainfall, evaporation and river flow from gauging stations and products such as TRMM, GPCC, MODIS and GLEAM, to evaluate the consistency of GRACE data through water balance computations. We found that the observed water balance agrees well with the storage changes observed from GRACE, thus giving confidence that the GRACE data captures storage changes in the basin and can be used to estimate trends. We found a decreasing trend in the total water storage starting around 2011, especially in the lower part of the basin, which is consistent with trends in river flow and precipitation over the whole basin. Our results provide an example of using GRACE data to investigate variations in continental water resources that affect their sustainability and, therefore, can have important implications for decision making and water management. More generally, our results provide insight into the use of GRACE data for inferring water balance variations and trends that may exacerbate droughts and water insecurity.