



Assessing modern rates of river sediment discharge to the ocean using satellite gravimetry

Maxime Mouyen (1), Laurent Longuevergne (1), Philippe Steer (1), Alain Crave (1), Jean-Michel Lemoine (2), Himanshu Save (3), and Cécile Robin (1)

(1) Géosciences Rennes, UMR 6118 - OSUR, Université de Rennes 1, Rennes, France, (2) CNES/GRGS, 18 Avenue E. Belin, 31401 Toulouse Cedex, France, (3) Center for Space Research, The University of Texas at Austin, Austin, Texas, USA

Worldwide rivers annually export about 19 Gigatons of sediments to the ocean that mostly accumulate in the coastal zones and on the continental shelves. This sediment discharge testifies of the intensity of continental erosion and records changes in climate, tectonics and human activity. However, natural and instrumental uncertainties inherent to the in-situ measurements of sediment discharge prevent from conclusive estimates to better understand these linkages. Here we develop a new method, using the Gravity Recovery and Climate Experiment (GRACE) satellite data, to infer mass-integrative estimates of sediment discharge of large rivers to the ocean. GRACE satellite provides global gravity time series that have proven useful for quantifying mass transport, including continental water redistribution at the Earth surface (ice sheets and glaciers melting, groundwater storage variations) but has been seldom used for monitoring sediment mass transfers so far. Here we pair the analysis of regularized GRACE solutions at high spatial resolution corrected from all known contributions (hydrology, ocean, atmosphere) to a particle tracking model that predicts the location of the sediment sinks for 13 rivers with the highest sediments loads in the world. We find that the resulting GRACE-derived sediment discharges off the mouth of the Amazon, Ganges-Brahmaputra, Changjiang (Yangtze), Indus, Magdalena, Godavari and Mekong rivers are consistent with in-situ measurements. Our results suggest that the lack of time continuity and of global coverage in terrestrial sediment discharge measurements could be reduced by using GRACE, which provides global and continuous data since 2002. GRACE solutions are regularly improved and new satellite gravity missions are being prepared hence making our approach even more relevant in a near future. The accumulation of sediments over time will keep increasing the signal to noise ratio of the gravity time series, which will improve the precision of the GRACE-derived sediment discharges values.