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Trends and Drivers of Bedload and Suspended Sediment Fluxes in Global Rivers

Sagy Cohen[1], Jaia Syvtski[2], Thomas Ashley[3], Roderick Lammers[4], Balazs Fekete[5], and Hong-Yi Li[6]
[1]University of Alabama, Tuscaloosa, AL, USA
[2]University of Colorado at Boulder, Boulder, CO, USA
[3]Virginia Polytechnic Institute and State University, Blacksburg, VA, USA
[4]Central Michigan University, Mt. Pleasant, MI, USA
[5]CUNY City College, New York, NY, United States
[6]University of Houston, Houston, Texas, USA

Bedload flux is notoriously challenging to measure and model. The dynamics of bedload, therefore, remains largely unknown in most fluvial systems worldwide. We present a global scale bedload flux model as part of the WBMsed modeling framework. Our results show that the model can very well predict the distribution of water discharge and suspended sediment and well predict bedload. We analyze the model's bedload predictions sensitivity to river slope, particle size, discharge, river width, and suspended sediment. We found that the model is most responsive to spatial dynamics in river discharge and slope. We analyze the relationship between bedload and total sediment flux globally and in representative longitudinal river profiles (Amazon, Mississippi, and Lena Rivers). We show that while, as expected, the proportion of bedload is decreasing from headwater to the coasts, there is considerable variability between basins and along river corridors. The latter is largely responsive to changes in suspended sediment and river slope due to dams and reservoirs. We provide a new estimate of water and sediment fluxes to global oceans from 2,067 largest river outlets (draining 67% of the global continental mass). Estimated water discharge (30,579 km3/y) corresponds well to past estimates however sediment flux is considerably higher. Of the total 22 Gt/y estimated average sediment flux to global oceans, 19 Gt/y is transported as washload, 1 Gt/y as bedload, and 2 Gt/y as suspended bed material. The largest 25 rivers are predicted to transport over 55% of total sediment flux to global oceans.