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Revised sediment transport model for estimation of suspended sediment flux and chemical composition of the Irrawaddy and Salween rivers

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A large portion of freshwater and sediment is exported to the ocean by just several of the world's major rivers. Many of these mega-rivers are under significant anthropogenic pressures, such as damming and sand mining, which are having a significant impact on water and sediment delivery to deltaic ecosystems. However, accurately measuring the total sediment flux and its mean physicochemical composition is difficult in large rivers due to hydrodynamic sorting of sediments. To account for this, we developed an updated semi-empirical Rouse modeling framework, which synoptically predicts sediment concentration, grain size distribution, and mean chemical composition (organic carbon wt%, Al/Si ratio) with depth and across the river channel.

We applied this model to derive new sediment flux estimates for the Irrawaddy and the Salween, the last two free-flowing mega-rivers in Southeast Asia, using a newly collected set of suspended sediment depth samples, coupled to ADCP-measured flow velocity data. Constructing sediment-discharge rating curves, we calculated an annual sediment flux of 326 (68% confidence interval of 256-417) Mt/yr for the Irrawaddy and 159 (109-237) Mt/yr for the Salween, together accounting for 2-3% of total global riverine sediment discharge. The mean flux-weighted sediment exported by the Irrawaddy is significantly coarser (D_{84} = 193 ± 13 μm) and OC-poorer (0.29 ± 0.08 wt%) compared to the Salween (112 ± 27 μm and 0.59 ± 0.16 wt%, respectively). Both rivers export similar amounts of particulate organic carbon, with a total of 1.9 (1.0-3.3) Mt C/yr, contributing ~1% of the total riverine POC export to the ocean. These results underline the global significance of the Irrawaddy and Salween rivers and warrant continued monitoring of their sediment fluxes, given the increasing anthropogenic pressures on these river basins.