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Towards a complete contemporary sediment budget of a major Himalayan river: Kali Gandaki, Nepal

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The tectonic evolution of mountain ranges is always accompanied by enhanced denudation. In the Himalayas these denudation rates are among the highest in the world, where high topography and prominent relief ensure supply of sediment to the drainage network mainly by mass wasting processes. These processes take place almost exclusively during the summer monsoon season, but remain poorly quantified in terms of resulting sediment flux. Here we study short-term variations in contemporary sediment flux of the Kali Gandaki River, one of the large rivers traversing the Himalayas from the Tibetan Plateau in the north to the Ganges foreland in the south. We analysed seven years of continuous daily suspended sediment and river discharge measurements at a hydropower facility in the lesser part of the Mahambra range. This new dataset is unique for the whole Himalayan range in terms of temporal resolution. We used these data to derive a preliminary sediment budget for the Kali Gandaki River for the years 2006-2012, based on continuous river discharge, suspended sediment load, bed material and dissolved load measurements. First results show that the Kali Gandaki River has transported 1.5-2.7 x 10^7 m^3 of sediment per year. This equals around 4.0-7.0 x 10^7t/yr, out of which 25-45% is transported as bed-load. Inferred rates of upstream erosion range between 2-3.5 mm/yr, in good agreement with complementary estimates integrating much longer timespans for example derived by low temperature thermochronometry. Our results include one of the first calculations of bed-load transport for a large Himalayan river. Such temporally highly resolved constraints on contemporary sediment transport and erosion in the Himalayan Range not only provide field-based benchmark data for erosion studies across multiple timescales, but also yield valuable data for optimizing hydropower schemes, and the planning of flood control measures in major Himalayan rivers.