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Himalayan sediment fluxes and the floodplain transfer function

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Erosion produces sediments and thereby redistributes mass at the Earth surface. A better understanding of these erosion processes can be gained by studying the products of erosion, i.e. the nature, magnitude and variability of sediment fluxes. On continents, rivers are the main conveyer belts that transport these sediments from source to sink. Owing to the integrative nature of river networks, a downstream river reach can be used to infer erosion processes that occur in upstream catchments. However on large spatial scales, sediment transport processes may affect the sedimentary signal so that the quantification of upstream erosion may not be straightforward. This is especially the case for continental scale basins: sediment sources are separated from sedimentary basins by large alluvial floodplains, where sediments are transported over hundreds to thousands of kilometers. The floodplain transfer function needs to be understood whenever modern river sediments or sedimentary archives are used to reconstruct present and past erosion processes.

In this contribution we discuss the magnitude of sediment fluxes from the Himalayan system using sediment gauging and cosmogenic nuclide data and address to what extent sediment transport may bias these estimates. The central part of the Himalayan range is drained by two major rivers, the Ganga and Brahmaputra that convey the products of Himalayan erosion over an extensive floodplain and ultimately to the Indian Ocean. This transfer may bias erosion rates derived from gauged sediment fluxes as part of the sediment flux is trapped in the subsiding foreland basin. This storage term remains however limited and can be quantified using a geochemical budget approach [1]. Floodplain transfer may also affect cosmogenic nuclide derived sediment budgets as sediments may accumulate nuclides during transport which will increase the overall nuclide concentration and hence lead to under-estimate denudation rates. By comparing cosmogenic nuclide data throughout the floodplain combined with mass balance modeling of the sediment flux we show that this effect is limited in the Ganga basin [2]. Gauged and cosmogenic nuclide derived sediment fluxes determined at the outlet of the Himalayan system are therefore reliable estimates of Himalayan denudation and are in reasonable agreement with each other. However erosion and weathering intensities in the Himalayan range are most probably variable over time due to Quaternary climate oscillations for instance, leading to a variable sediment input to the floodplain. To better understand how these variation are transferred and transcribed at the floodplain outlet and ultimately within the sedimentary record, it is crucial to constrain the transfer time and the buffering effects through such a system. Using geochemical tracers to constrain changes in sediment sources along with mass balance considerations, we discuss the transfer time of sediments in the Indo Gangetic floodplain.

[1] Lupker et al., 2011 - JGR 116, F04012
[2] Lupker et al., 2012 - EPSL 333-334, p146-156