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Trends in suspended sediment fluxes and sediment budgets across the river Rhine basin (1990-present)

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Suspended sediment transport is a vital process in healthy river systems as it provides a source of nutrients in the soils of riverbanks and floodplains that eventually forms the principal building material of downstream river deltas. Deltas require sufficient sediment supply from the upstream river basin to sustain area and elevation on the long-term. Recent decades, the delivery of suspended sediment to many deltas in the world has decreased, which, together with sediment extraction through dredging, resulted in negative sediment budgets of these deltas. To design strategies to attenuate or reverse the decreased sediment delivery, a quantitative understanding of the sources, fluxes, and budget of suspended sediment in river basins is essential.

The aim of this study is to quantify the contribution of different tributaries to the suspended sediment budget in the Rhine river basin between 1995 and 2015. For this, we used fortnightly to monthly measurements of suspended sediment concentrations and daily discharge measurements at 34 stations along the main branch of the Rhine river and its four major tributaries Aare, Neckar, Main, Mosel. Annual suspended sediment loads were estimated by means of the sediment rating curve method, which allowed establishing the annual sediment budgets for 28 river sections.

For the first time we were able to show the relative contribution of different tributaries to the overall decreasing suspended sediment load of the upper Rhine river (between 1995 and 2015). A decline of 70% percent in suspended sediment at Lobith between 1950 and 2016 and an observed consistent decline further upstream suggests an overall decline of sediment delivered to the lower lying delta. The causes must be sought in basin wide changes such as land-use, land management, hydrology, or climate. This is a trend that is observed in many river basins in recent decades.