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The impact of pre-historic land use on suspended sediment delivery to the floodplains in the Rhine valley and delta: catchment-scale quantifications and the nature of response

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The non-alpine Rhine catchment has a long history of human occupation and — especially from the Neolithic onwards — the landscape has been increasingly altered by human cultivation. This most likely influenced erosion and subsequently sediment delivery to the fluvial system. Increased sediment input as a result of human land use has been documented in smaller tributaries of the Rhine, but has so-far not been quantified on a catchment scale. This study quantifies the amounts of floodplain sedimentation per millennium for natural and human-impact time scales (the last 9000 years) for three large floodplain areas that have functioned as sediment sinks: the northern Upper Rhine Graben, the Lower Rhine Embayment and the Rhine-Meuse delta. New collected field data and borehole data from extensive databases, and C-14 and OSL dates allow calculating thicknesses, volumes and ages of the floodplain sediments. The results show remarkable coherent trends for different parts of the drainage basin: increased sediment delivery during the late Holocene caused raised overbank sedimentation by up to 60 % when compared to the pre-human impact time interval in all study areas.
Changes in sediment-trapping efficiency and climate change are unable to explain the encountered sedimentation trends, and the bulk of this increase seems to be the result of land use changes. A time lag of several hundreds of years may exist between the upstream and downstream sinks, but all sinks show a response to pre-Roman land use. Within a couple of millennia, human land use caused a shift from a natural controlled to a human modified fluvial system. The magnitude and scale of human impact is impressive: pre-historic agricultural practises already influenced the development of the Rhine trunk valley and delta, and should be regarded as a catchment-scale forcing factor. The results may be of major importance for a thorough understanding of the spatial scale, temporal scale and magnitude of fluvial system response to future changes in climate and land use.