

Late Holocene denudation rates and sediment fluxes in the Po basin from source to sink based on in situ cosmogenic ^{10}Be

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We constrain the long-term sediment delivery within the Po basin from source to lowland sink using sediment fluxes from in situ ^{10}Be -derived denudation rates and compare these to published short-term estimates from gauging. We measured in situ ^{10}Be concentrations in nearly all Alpine and Apennine upstream catchments draining to the Po River and in the Po lowlands down to the Po delta, respectively. In the upstream reaches of the Po basin, short-term sediment interception in dams and reservoirs and long-term sediment trapping in periglacial lakes may modify ^{10}Be concentrations, whereas in lowland reaches, sediment burial and storage may affect nuclide concentrations. From the comparison of ^{10}Be nuclide data measured upstream of dam influence to those measured downstream of major dams, we find that the average ^{10}Be signal is not significantly modified. In the lowland reaches, we find that the average ^{10}Be concentration is only marginally modified by floodplain processes, as $^{26}\text{Al}/^{10}\text{Be}$ ratios do not show differential decay due to burial and ^{21}Ne concentrations change only slightly along the floodplain reach. Thus we interpret the average ^{10}Be concentration of lowland samples to reflect the average ^{10}Be concentration of all upstream catchments in terms of a preservation of the source area erosion signal. The close similarity in ^{10}Be concentrations from the sources to the Po lowland sink suggests that LGM denudation rates prior to sediment trapping in periglacial lakes were similar to today's, as the sediment now contained in the Po lowlands must have been eroded from the orogen and deposited in the lowlands prior to lake formation. This source-sink assessment shows the robustness of cosmogenic ^{10}Be as erosion rate tracer.

From these in situ ^{10}Be -derived denudation rates integrating over the last few thousand years, we constrain the sediment contributions of the Alpine and Apennine source areas arriving at the Po delta. In total, ca. 60 Mt/yr of sediment are exported to the Adriatic Sea, with an Apenninic contribution to this total value of ca. 5 Mt/yr. Published present-day estimates of sediment export by gauging are notably lower, adding up to ca. 10 Mt/yr at the delta. This mismatch includes the sediment trapped in the subsiding Po plain, and short-term fluctuations in sediment yield also including anthropogenic disturbance. The construction of reservoirs and dams, and the use of water for irrigation purposes have decreased the sediment outflux of the Po River in modern times in the source areas and in the lowlands, respectively, but sediment fluxes derived from ^{10}Be nuclide concentrations have remained essentially unaffected.