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A Younger Dryas sediment wave and enhanced erosion at millennial time scales in a non-glacierized catchment, Northern Apennines, Italy

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The Younger Dryas (YD), the last Lateglacial cold period in the Greenland – Europe area, allows us to test the effects of millennial scale climate deterioration and associated vegetation changes on the erosion of mountain catchments prior to the advent of any anthropic perturbation.
Sub-fossil P. sylvestris trunks, found at the base of a terrace fill in the lower intramountain reach of the Senio river, document the occurrence of a riparian wood near a single/multi-thread river between 13.5 and 12.8 kyr cal 14C BP. This wood was destroyed and covered by the aggradation of a 3.5 m thick, approximately 1 km wide braided river plain, and topped by a 11.5 ky incipient soil.
Thanks to a dense network of dated cores in the adjacent plain, we reconstructed the total volume of the Senio YD fan - (0.87 $\pm$0.15) km3 including terraces - embedded between buried soils and pinching out downstream. The lower fan bears ages of c. 15.2 to 13.5 kyr, and the upper one is between c. 9.7 to 8.1 kyr cal 14C BP. The fan formed in a time span of 1.3 to 3.8 kyr.
Corrected for measured porosity, this volume is transformed into paleoerosion rates of 0.68 – 1.98 mm/yr. From the literature, 10Be catchment-wide denudation rates for modern sediment from the Senio River are 0.35 mm/yr, 2 to 5 times less than the YD.
Data from the Senio YD terrace document the very rapid destabilization of the forest cover in the hillslopes from 12.8 ky, and its recovery since 11.5 kyr. A positive feedback between increased sediment transfer toward the trunk channel (bedload), and lateral erosion of the braided plain in the middle-lower reaches of the intramountain catchment, enhanced the connectivity and the efficiency of the conveyor belt by 2 to 5 times during the YD.
Two other cycles of terrace/fan deposition are recorded in the Holocene of the Senio and neighboring rivers, around 6 to 3.8 and 1.6 to 0.1 kyr BP, but their climatic meaning is perturbed by anthropic influences, namely forest clearing and agriculture.
Pulsating waves of sediments created various cycles from Lateglacial to Holocene in the studied fans at the foothills of the northern Apennines. The buried soils formed during decreased sedimentation, and they mark a time period of decreased erosion rates in the mountain catchment. Pollen data show increasing forest cover during these periods. In the uplifting mountain catchment, oscillating river behavior between braided and single-thread geometries created flights of terraces, whose ages correlate with the fan sedimentary cycles. The timing of incision and terrace abandonment, creating a new local base-level for subsequent hillslope failures, correlate with the development of soils in the fans.