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Short-range aeolian transport in high mountain environments: an overlooked phenomenon

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Abstract

Wind action in mountain environments is a topic seldom investigated from geomorphological and geopedological standpoints. Mountainous environments are known as a loess source during glacial phases and as a potential sink for long-range (hundreds to thousands of km) contribution of dust and volcanic ashes (e.g., Saharan dust to the Alps and Pleistocene tephras over European mountains). However, the short-range (tens to hundreds of km) transport of aeolian materials within mountain environments during cool and dry phases is poorly understood and in general downplayed in the larger system of wind deposition dynamics. When climatic conditions shift towards increasing aridity, the potential for aeolian activity in these environments greatly increases. Moreover, the complexity of topography in these regions offers ideal conditions for development of intense localised air fluxes. As a result, systems of micro-sources and micro-sinks take form, changing in intensity and shifting in space with the variation of local air circulation patterns, often climate induced. Processes of denudation and loss of vegetation cover as a consequence of cool and dry periods strongly contribute to the mobilization of aeolian material and its redeposition over short distances.

We investigated the geomorphological setting of a mountain ridge in the high Northern Apennines (Cusna Ridge, Italy) characterised by strong constant winds perpendicular to the direction of the ridge itself. A detailed field geomorphological and soil survey allowed to find evidence for aeolian sources and deposits. On the summit of the ridge, we found multiple deflation areas tens of meters wide, which signal the action of intense wind erosion. Evidences of dust deposition were found in the adjacent soils: a discontinuous and distinct layer of recently deposited fine sand and silt covers the ridge top itself. We relate this layer to a combination of low-energy colluvial activity and short-range wind transport from lower elevations. In one soil sequence, analytical data from sedimentological and micromorphological analyses allowed to observe four different phases of deposition with possible aeolian contributions. These phases potentially correspond to short-timed Holocene periods of denudation and deflation triggered by enhanced wind strength.