
Top-down control of climate on long-term interactions between fires, tree-cover and soil erosion in a Mediterranean mountain, Corsica

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Résumé

Fire is a potential significant driver of soil erosion in Mediterranean areas, as it results in the partial removal of vegetation and the alteration of organic matter, affecting soil structure and stability. The erosion of particle sizes is influenced by the intensity and duration of rainfall, regulated by disturbance regimes and vegetation cover. We hypothesise that, during the Holocene, high fire frequency and intensity under precipitation control may have contributed to soil erosion, while plant cover and composition could have mitigated it. This plant cover, in turn, might have been influenced by biomass burning. To test this hypothesis, we conducted a detailed analysis of sediments spanning the last 11,500 years from a small mountain lake, Corsica, situated in the black pine forest belt. The high temporal resolution analysis (~10 years per sample), used granulometry and loss-on-ignition as proxies for erosion and ecosystem productivity in both the lake and watershed, and fire and plant macroremains as fire and tree cover proxies, respectively. The correlation between particle size and the contents of organic or mineral matter with mean fire intervals revealed significant patterns. Long fire intervals were associated with more fine and coarse sands, whereas short MFIs correlated positively with clay and, fine and coarse silt, along with higher total mineral and organic matter contents. These findings suggest that fires were more frequent when rain duration was sustained but runoff intensity was lower. Conversely, wildfires were less frequent during intense runoff periods (wetter climate). Unlike fire frequency, fire severity did not correlate with erosion, and tree cover and plant richness had minimal to no effect. The 8.2 kyr event was characterized by runoff transporting primarily coarse sands, i.e. a dry period with very intense rains. This suggests that the system is primarily top-down controlled by climate. Multimillennial erosion trends are influenced by fire frequency and precipitation regimes, whereas vegetation does not seem to have a mitigating effect on this process.

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Mots-Clés: Sediment, Granulometry, Biomass burning, Soil, Precipitation, Mediterranean.