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Patterns and Pathways of Evolving Catchment Response in a Medium-Sized Mediterranean Catchment on a Millennium Scale

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The meso-scale landscape dynamics model, CALEROS, has been developed to simulate the interactions between climate, soil production and erosion, vegetation and land use on geomorphological to human time scales in Mediterranean environments. Starting from an initial landscape consisting of a DTM, soil distribution and underlying lithology, the landscape is free to develop in response to the imposed climate variability and seismicity. In addition to changes in soil distribution and bedrock lowering, this includes the establishment of vegetation as conditioned by a selection of plant functional types and, optionally, population and land use dynamics as conditioned by land use scenarios specifying technological and dietary constraints for different periods. As such CALEROS is well-suited to investigate the relative impacts of climate, land cover and human activities on the hydrological catchment response and the associated sediment fluxes due to soil erosion and mass movements.
Here we use CALEROS to i) investigate the redistribution of water and sediment across the landscape in a medium-sized Mediterranean catchment (Contrada Maddalena; $\sim$14km2, Calabria, Italy) and ii) to establish patterns of co-evolution in soil properties and vegetation under pristine and anthropogenically impacted conditions on a millennium-scale.
Using summary statistics to describe the emergent properties and to verify them against observations, we then delineate areas of uniform morphology and describe the various pathways of development. This information allows us to identify elements of consistent hydrological response and the associated transfer of material across different scales. It also provides essential information on essential feedbacks and the resulting convergence or divergence in landscape development under the impact of climatic or seismic events or human intervention. Although the results are evidently conditioned by the physiographic setting of the study area and by the interactions included in the model, they can help us to understand the organization of medium-sized catchments and their resilience in light of ongoing changes.