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Form, Process and Evolution of Carbonate Hillslopes in Semi-Arid to Sub-Humid Mediterranean Climate

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Convex soil-mantled hillslopes evolve in highly diverse tectonic and climatic settings. The magnitude of convexity (curvature) is controlled by the rates of soil production and transport. The vast majority of previous studies focused on sites with silicate substrate, limiting their application to extensive carbonate regions on Earth. The goal of this work is to decipher key controls on the evolution of carbonate hillslopes in semi-arid to sub-humid climate including the influence of climate (mean annual precipitation), micro climate (aspect), and dust flux. Our study sites are located in the Eastern Mediterranean across a prominent north-to-south gradient in both precipitation (300 to 1000 mm yr^{-1}) and dust flux (150 to 40 g m^{-2} yr^{-1}). The relatively high solubility of carbonates and the high fluxes of dust in the region encourage us to quantify the influence of dust and chemical weathering on soil production and hillslope morphology. To quantify soil production and transport processes, we combine topographic analysis of high-resolution LiDAR data with extensive regolith characterization (depth, composition, granulometry, geochemistry of immobile elements). Our results delineate distinctive and unique trends in the in the semi-arid (dryer) and the sub-humid (wetter) regions. In the semi-arid sites, hilltop curvature decreases with mean annual precipitation reaching a minimum at 400-500 mm yr^{-1}, while in the sub-humid sites hilltop curvature increases with precipitation. The fraction of dust in the soil is positively correlated with the present-day dust flux and decreases with mean annual precipitation from >50