

Spectral Detection of Erosion Phase Transitions in Large Watersheds

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Abstract

New methods are needed to monitor soil erosion processes and their environmental impacts in large watersheds. We developed an approach for rapid, non-destructive screening of eroded and depositional phases of soils using laboratory diffuse reflectance (350–2500 nm) spectroscopy (DRS). DRS measurements of a diverse set of soil samples originating from a 3,590 sq. km watershed in western Kenya were benchmarked to a principal components model of DRS measurements of sediment samples recovered at the outlet of the watershed in Lake Victoria. We established the diagnostic characteristics of the resulting spectral erosion/deposition index (EDI) relative to a suite of independently measured observational, radioisotope and physicochemical soil properties.

Strong power law relationships between EDI, Cesium-137 ($R^2 = 0.73$) and Lead-210 ($R^2 = 0.62$) radionuclide inventories of topsoils were observed. Similarly, relationships between EDI, particle size distributions, extractable nutrients, soil organic carbon and field infiltration capacity were consistent with erosion induced physicochemical depletion/accretion processes. We also calibrated EDI to Landsat ETM satellite observations and showed it to be capable of bridging methodological gaps in interpreting erosion phenomena from remotely-sensed information. Further research should test this method for calculating sediment budgets, erosion monitoring and risk assessment in prospective studies

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