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Large-scale assessment of soil erosion in Africa: satellites help to jointly account for dynamic rainfall and vegetation cover

Anton Vrieling (1), Joost C.B. Hoedjes (2), and Marijn van der Velde (3)

(1) University of Twente, Faculty ITC, Enschede, Netherlands (a.vrieling@utwente.nl), (2) Applied Hydromet, PO Box 1896, 20117, Naivasha, Kenya (joosthoedjes@hotmail.com), (3) Joint Research Centre of the European Commission (JRC), MARS Unit, Via Fermi 2749, 21027 Ispra (VA), Italy (marijn.van-der-velde@jrc.ec.europa.eu)

Efforts to map and monitor soil erosion need to account for the erratic nature of the soil erosion process. Soil erosion by water occurs on sloped terrain when erosive rainfall and consequent surface runoff impact soils that are not well-protected by vegetation or other soil protective measures. Both rainfall erosivity and vegetation cover are highly variable through space and time. Due to data paucity and the relative ease of spatially overlaying geographical data layers into existing models like USLE (Universal Soil Loss Equation), many studies and mapping efforts merely use average annual values for erosivity and vegetation cover as input. We first show that rainfall erosivity can be estimated from satellite precipitation data. We obtained average annual erosivity estimates from 15 yr of 3-hourly TRMM Multi-satellite Precipitation Analysis (TMPA) data (1998–2012) using intensity–erosivity relationships. Our estimates showed a positive correlation (r = 0.84) with long-term annual erosivity values of 37 stations obtained from literature. Using these TMPA erosivity retrievals, we demonstrate the large interannual variability, with maximum annual erosivity often exceeding two to three times the mean value, especially in semi-arid areas. We then calculate erosivity at a 10-daily time-step and combine this with vegetation cover development for selected locations in Africa using NDVI – normalized difference vegetation index – time series from SPOT VEGETATION. Although we do not integrate the data at this point, the joint analysis of both variables stresses the need for joint accounting for erosivity and vegetation cover for large-scale erosion assessment and monitoring.