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High resolution KE-maps with X-band mini weather radar

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The erosion of the terrain starts with the process of soil detachment by raindrop impact. The Kinetic Energy (KE) of a single raindrop can represent the basic and most commonly used unit of raindrop erosivity. KE is functions of the drop size, drop shape and its terminal velocity. It can be expressed as the rain kinetic energy per unit area and per unit time (KEtime, time-specific kinetic energy) or, alternatively, as the amount of rain kinetic energy per unit volume of rain (KEmm volume-specific kinetic energy).
The total KE of rainfall is evaluated by summing up the individual kinetic energies of all the raindrops. Therefore, KE can be calculated directly for any rainfall event by knowing its intensity (I) and by using one of the so-called KE–I relationships, which are present in large number in the scientific landscape, relations that in turn derive from an assumed Drop Size Distribution (DSD). Alternatively, it would be more pertinent to relate KE with data obtained by a disdrometer: however, such instruments are costly, complex (and therefore critics to use) and, consequently not generally available.
Short-range X band weather radars are a good alternative solution to estimate KE. They can provide measure of radar reflectivity factor (Z) taking into account that indeed Z is related to the drops kinetic energy than the rain intensity itself. By using the weather radar, it is possible to measure KE exploiting the KE-Z relationships.
In this work, we consider a pulsed X-band radar, non-coherent, non-Doppler, with vertical polarization, acquiring reflectivity maps each minute with radial resolution of 60 meters, up to a maximum range of 30 km.
By using the high temporal and spatial resolution radar maps it is possible to realize high-resolution KE maps exploiting one of the KE-Z relations available in the literature, in particular the one by Yu et. al. in 2012. Starting from the maps acquired by the radar in the form of digital number, the radar reflectivity maps are obtained exploiting signal processing algorithms and the consequent KE maps are evaluated. A significant correlation between a strong rain event and some landslides in the nearby hills is presented.
The high-resolution KE maps can put in evidence the spatial and temporal variability of the kinetic energy of rainfall. Used in conjunction with GIS layers concerning topography, soil properties and land use, such KE maps have a strong potential for geosciences applications.