Geophysical Research Abstracts
Vol. 18, EGU2016-11640, 2016
EGU General Assembly 2016

Drop size distributions and kinetic energy rates in variable intensity rainfall

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Temporal variability in rainfall intensity reflects on the drop size distribution (DSD), and affects the rainfall kinetic energy during the event. Smith et al. (2009) reported on 1-min interval rainfall intensity and corresponding DSD variability during a storm on the 22/7/06 at Princeton, NJ. They reported also on DSDs characteristics of heavy convective rainfall events during the whole summer. Applying the DSD model of Assouline and Mualem (1997), it is shown that: (a) a similar relationship between the mean drop size and the rainfall intensity characterized the local rainfall at both the seasonal and the single storm scale; (b) using the mean drop size as a scaling factor of the DSD removes the rainfall intensity dependence at the intrastorm scale, providing a powerful tool to deal with temporal variability of rainfall rates during rainfall events. For a storm characterized by a given temporal variability of intensities, three different ways of evaluating kinetic energy per unit mass or time were applied. By comparison to estimates accounting for rainfall temporal variability and related full DSDs, representing the storm by mean intensity and drop diameter tends to overestimate kinetic energy for low intensities and underestimate it for the higher ones. The relative error for the kinetic energy per unit of mass is $\pm$45% and shifts from negative to positive sign for I>25 mm/h. For the kinetic energy per unit of time, the relative error ranges from -100% to +210% and changes sign for I>45 mm/h. When temporal variation of intensity is accounted for but drops are characterized by their mean values instead of the full DSD, kinetic energy is underestimated by 20% on average. Consequently, accounting for temporal variability in rainfall intensity during a storm has a notable impact on the erosive power of the rainfall.