

***Interactive comment on* “Trends in rainfall erosivity in NE Spain at annual, seasonal and daily scales, 1955–2006” by M. Angulo-Martínez and S. Beguería**

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Answers to Reviewer 1

Reviewer: *Global context. The results of this paper stand in contrast to studies in other parts of the world that have shown an increase in rainfall intensities in the past few decades. There should be some discussion of this paper and its reported results relative to a broader geographical context. For example see Groisman et al's 2005 manuscript “Trends in Intense Precipitation in the Climate Record”.*

Authors: While it is true that increases in extreme rainfall events have been reported in

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other regions of the World, and more specifically in the Mediterranean region (Brunetti et al., 2001; Norrant and Douguédroit, 2006; Goodess and Jones), this is not the case of the Iberian Peninsula, as several authors have pointed out. In our article we review these studies, including those of Martínez et al. (2007), Rodrigo and Trigo (2007), López-Moreno et al. (2010), de Luis et al. (2010), Beguería et al. (2011), and Acero et al. (2012). Meteorological explanation of the observed decreasing trends in rainfall extremes can be related to prevailing positive phases of teleconnection indices such as the NAO and the MO, as studied in Angulo-Martínez and Beguería (2012). In a revised version of the manuscript we have enriched the manuscript by adding further references, and we have elaborated on the relationship between erosivity trends and teleconnections.

Reviewer: *I would like to suggest that the authors improve their statements regarding the interactions between rainfall erosivity and soil erosion. Specifically: A) Abstract: The authors write: “The impact of raindrops on the soil surface by rainsplash represents a major mechanism of particle detachment and modifies the surficial properties of the soil. If the surface is not flat rainsplash generates a preferential transport of soil particles in the downslope direction, constituting a soil erosion process. Both processes are included in rainfall erosivity or the ability of precipitation to erode soil. Despite its importance very few studies addressed the climatology of rainfall erosivity.” This introductory statement is really not explanatory, and is in fact somewhat misleading, regarding the concept of rainfall erosivity. B) Introduction: “and involves mainly two mechanisms: i) rain splash as the detachment and movement of soil particles due to raindrops kinetic energy, and ii) runoff erosion of soil particles transport by the shear stress exerted by surface runoff.” Again, I disagree with this generalization of the erosion process. Kinetic energy of raindrops cause particles of soil to be detached from the soil surface. In most cases there is quite a lot more soil being splashed around than transported downslope. We know that from numerous laboratory experiments (e.g. Bradford et al). Splash does enhance transport by thin sheet flow, but the splash itself is NOT the primary driver of soil particles downslope. With regard to runoff erosion transport is im-*

portant, but in cases where erosion rates are high it is the detaching and transporting action of runoff, particularly in rills, that is acting to cause the erosion.

Authors: We are in total agreement with the reviewer's point of view: *'Kinetic energy of raindrops causes particles of soil to be detached from the soil surface. In most cases there is quite a lot more soil being splashed around than transported downslope. [...] Splash does enhance transport by thin sheet flow, but splash itself is NOT the primary driver of soil particles downslope'*. In fact, we believe that our abstract and introduction are fully compatible with this description. We believe that there must have been some misunderstanding, since the phrases cited by the reviewer do not belong to our article. On the abstract we simply stated that *'rainfall erosivity refers to the ability of precipitation to erode soil, and depends on the characteristics of the raindrops—size and velocity—and on the rainfall intensity and duration'*. Then, on the introduction, we defined rainfall erosivity as *'the potential of a rainfall event to erode soil'*, and then we detailed that *'raindrop impacts are able to detach the soil aggregates and strike them up into the air—rainsplash—, causing a diffusive displacement of particles down the slope if the surface is not perfectly flat'*, but also that *'rainsplash is also able to disrupt the soil aggregates, and the redistribution of soil particles blocks the soil pores causes crusting and reducing infiltration'*. We then made clear that *'on addition, other processes such as sheetwash can further transport the detached particles'*.

It is true that there is still room for improving the description of the processes involved in rainfall erosivity, so we have decided to modify the introductory paragraph, which now reads as follows: *'Rainfall erosivity can be defined as the potential of a rainfall event to erode soil, and is a consequence of the interaction of several precipitation characteristics at the event scale. Rainfall erosivity models take account of the continuous and discrete characters of precipitation by considering precipitation amounts and intensities together with the energy released by raindrops when they hit the soil surface. Individual raindrop impacts are able to detach the soil aggregates and strike them up into the air—rainsplash—, preparing them for being transported by sheet wash*

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or other processes and causing a diffusive displacement of particles down the slope if the topography is not perfectly flat. Rainsplash is also able to disrupt the soil aggregates, and the redistribution of soil particles blocks the soil pores causing crusting and reduced infiltration. Infiltration and saturation excess overland flow may occur as a consequence of the amount and intensity of precipitation over short time periods, causing sheet and concentrated flow with high potential for detaching and transporting soil particles'.

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