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Splash erosion in recently-burnt area in North-West Spain

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I. Introduction

The study of erosion by water requires a very detailed knowledge of a number of precipitation parameters, such as raindrop size, precipitation volume, intensity, and above all, the kinetic energy of the raindrops hitting the ground, removing and dragging soil aggregates (Angulo et al, 2012).
Splash erosion is generally acknowledged as the main erosive agent, because it represents the first step in water erosion (Ellison, 1944, Sempere Torres et al., 1994). The impact of raindrops not only modifies the structure of the earth's surface, (Moss, 1991) but also breaks down and emits soil fragments which are later transported over long distances in the case of additional surface runoff processes (Moss and Green, 1983).
In the whole process we need to take into account not only the specific kinetic energy associated to each rain event, but also the type of soil and the size of the particles released (Sharma et al 1991), as well as the characteristics of the layer of water formed on the surface (Moss and Green, 1983, Kinnell, 1991, Leguédois et al., 2005). The erosion process is more obvious when it affects vulnerable areas that have recently been devastated by a wildfire.
This study has computed the raindrop size, its volume, the fall velocity, and its kinetic energy by means of an optical disdrometer. The data have subsequently been compared with the mass of soil that was splashed and collected in a particular area devastated by an important wildfire on the 17th of May 2012. The splash erosion produced in 6 months has been analyzed.

2. Study Site

The data were gathered in the period between the 29th May and the 30th November 2012, in the area of Congosto, in the province of León, Spain.
The study zone is part of a transition area between the plain and the mountainous regions. The dominant climate is the continentalized Mediterranean climate, although with more moderate temperatures.
In general, in this area we find a wide temperature range (from 12 to 20°C), long and cold winters, short springs and autumns, and short and warm summers. Precipitation is irregularly scattered along the year, and may reach, depending on the area, up to 1,500 mm per year. Intense precipitation events may occur.
The area presents a coarse-grained siliceous lithology, that is, quartzite with sandstone and slate, with a soil cover of inceptisol of franc-sandy texture. The vegetation, which is the first defense line against erosion in the area, is limited to holm oaks and pine trees, all of which were virtually eliminated by the virulence of the wildfire in May 2012.

3. Materials and Methods

Precipitation was measured using a Thies optical disdrometer which registers raindrop size spectra every minute. This device is described in detail in Bloemink and Lanzinger (2005).
The instruments used to carry out this study on splash erosion have been the funnels described in Fernández-Raga 2010. The area affected by the wildfire was divided into 2 sections, one former pine tree area, and another former scrubland area. Five sampling points were installed in each area. Similar control areas were established in the part

of land not affected by the fire, with the same type of vegetation, and with another 5 sampling points in each case. In addition, control devices were installed to collect airborne soil.

4. The kinetic energy of rain

The kinetic energy of rain was assessed using data obtained by the disdrometer: raindrop size distribution (DSD). This information enables us to compute the mass of the raindrop and its fall velocity (Ryzhkov et al 1999). To compute the mass, we need to know the shape of the drop.
The shape of raindrops has been the object of many previous studies (Brandes, 2002, Sansom, 2004). The main conclusion is that drops smaller than 1 mm are spherical, but raindrops with diameters larger than 1 mm take on a shape that resembles more an ellipsoid. Considering that size, we adopt a polynomial equation of degree 12 (Fernández-Raga 2010).

5. Evolution of splash erosion

The study has assessed the amount of splash erosion as well as its composition. In addition, the erosion caused has been compared with the regeneration of the vegetation in the area. The results reveal a very slow recovery of the vegetation in the study zone, and a halt in the amount of soil affected by splash erosion until now.

5. Results and Conclusions

It was found that the precipitation in Congosto has a nearly exponential drop size distribution (DSD), except for large sizes. It can also be noted that drops between the sizes of 2 and 2.5 mm are the ones that contribute more to the kinetic energy hitting the ground.

The comparison between the splash erosion registered and the total kinetic energy in each rain event has led to the following conclusions:

• The DSD of precipitation in Congosto follows an exponential or gamma distribution. The energy distribution, on the other hand, is a gamma distribution.
• Splash erosion has been found to be very important in the area devastated by the wildfire in the 2 months immediately after the fire. Later, splash erosion decreases, though it remains relatively high despite fewer rain events during the summer.
• The vegetation has not recovered at all in the 6 months that followed the wildfire.
• The soil analysis reveals a high degree of degradation caused by the wildfire.

6. References

Angulo-Martínez, M., Beguería, S., Navas, A. Machín, J. 2012. Splash erosion under natural rainfall on three soil types in NE Spain Geomorphology, 175–176, 38–44.
Bloemink, HI and Lanzinger, E., 2005.precipitation type from the thies disdrometer. Wmo technical conference on meteorological and environmental instruments and methods of observations (teco-2005) Bucharest, Romania, 4-7 may, 3.
Brandes, e. A., g. Zhang, and j. Vivekanandan, 2002: experiments in rainfall estimation with a polarimetric radar in a subtropical environment. J. Appl. Meteor., 41, 674–685.
Ellison, W.D. 1944. Studies of raindrop erosion. Agric. Eng. 25:131 136, 181–182.
Fernandez-Raga, M., Fraile, R., Keizer, J.J., Teijeiro, M.E.V., Castro, A., Palencia, C., Calvo, A.I., Koenders, J. and Marques, R.L.D., 2010. The kinetic energy of rain measured with an optical disdrometer: An application to splash erosion. Atmos. Res. 96, 225-240.
Kinnell, P.I.A. 1991. The effect of flow depth on sediment transport induced by raindrops impacting shallow flows. Trans. ASAE. 34: 161–168.
Leguedois C., S., Malam-Issa O., and Bissonnais Y. Le. 2005. Splash distance and size distributions for various soils. Geoderma, 124, 3-4, 279-292
Moss, A.J., and Green, P.. 1983. Movement of solids in air and water- by raindrop impact. Effects of drop-size and water-depth variations. Austr. J. Soil Res. 21:257–269.
Moss, Aj. 1991. Rain impact soil crust.I. Formation on a granite derived soil.Austr. J. Soil Res 29:271-289.

Ryzhkov A., Schuur, T., Zrnic, D. and Schönhuber M. 1999, Comparison of radar polarimetric measurements of rainfall with 2D-video disdrometer observations. Preprints, National Radio Science Meeting, 1999, Boulder, CO, USA.
Sansom, J. 2004 Rainfall as breakpoints: observations and physically based Markov models. International Precipitation Conference, Quantifying Uncertainties in Precipitation Measurements, Estimates, and Forecasts, Vancouver, Canada.
Sempere Torres, D., Porrà, J.M., Creutin, J.D., 1994. A general formulation for raindrop size distribution. Journal of Applied Meteorology 33, 1494–1502.
Sharma, P.P., Gupta, S.C. and Rawls. W.J. 1991. Soil detachment by single raindrops of varying kinetic energy. Soil Sci. Soc. Am. J. 55:301–307.