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Interactive comment on "Rainfall simulation experiments in the Southwestern USA using the Walnut Gulch Rainfall Simulator" *by* Viktor Polyakov et al.

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Reviewer 1

Abstract. "Quantify" replaced with "estimated" as suggested. Introduction. Several references were added throughout the introduction to support claims on effect of erosion on rangeland functioning and compare our study to similar datasets (Lascelles et al., 2000; Nichols, 2006; Nichols et al., 2008; Parsons and Lascelles, 2000; Stavi et al., 2009; Stone et al., 2008; Yakubu and Yusop, 2017; Yisehak et al., 2013). We modified a paragraph that contained some duplicate methods information. However, we retained some key facts that help to introduce the reader to the scope and variability of

our dataset (third paragraph). In addition a paragraph on the relevance of this data and similar compilations was added. Conclusion. A paragraph (first) was added to the conclusion discussing the importance of the dataset and the current needs. Supplemental comments (markup in the text): We added requested references to the introduction (please, see above). Line 74. Soil texture was taken from the published soil survey, hence the standard deviation etc. is unknown.

Reviewer 2

Flow velocities were measured starting in 2006 as mentioned in the manuscript (Section 3.3). There is one velocity measurement for every steady state condition, i.e. typically 5 values per experimental run (please, see experimental procedure). Flow rates and sediment concentration were recorded more frequently, hence in the table there is one value of velocity per 5-7 values of flow rate. When the data was not recorded or missing due to technical or other reasons it is labeled N/A (per data repository guidelines). This should be distinguished from 0 values. Complete explanation of data fields is provided in Data Dictionary.

The values in columns are defined by units provided in the second row. Hence "Precipitation" is given as rate (mm/h). Decimal places in the rainfall simulation table were corrected in Table 2 of the manuscript. A revised version of .CSV file was submitted to the data repository (Appendix C.).

We respectfully disagree with the reviewer on changing the manuscript title. Due to the fact that this is a dataset publication and no assessment was conducted we believe that "Runoff and erosion assessment. . ." in the title will be misleading. We only conducted organization and quality control of the data for dissemination purpose.

We corrected grammatical errors in the text pointed by the reviewer. Erroneous "Table X" reference was removed.

Several references were added to the Introduction section to support the claims.

Please, see response to reviewer #1 for details. A reference to MLRA classification (USDA, 2006) was added where it is first mentioned in the text.

The plots were sized to match the existing equipment. It's a compromise between the biggest possible coverage and practicality. The WGRS was based on the Norton simulator, which was designed to be transported to hard-to-get-to places, yet use the sweep configuration and nozzles (V-Jet) that provides steady precipitation and the best possible relationship between energy and intensity of rain. Norton simulator itself was derived from Meyer's original work with the V-Jet nozzles. The variable speed motor of WGRS allowed for the plot width to be expanded to 2 m from 1 m. Other longer single pipe simulators were used in the past, but were not easy to transport and setup on site. Another limiting factor is availability of water, which has to be brought to remote sites in large quantities (1 ton or more per run for a 2x6 plot). More details are available through the citations provided in the Experimental procedure, i.e. Mayerhofer et al. (2017) on comparison of different size plots, and the Introduction. The range of ground slopes was between 4 and 40% (please, see Conclusion). Most of the sites (ranches) have been privately operated for many decades and other than few cases mentioned in the text (exclusion, etc.) grazing intensity data is not available. The spatial extent of fire covered entire plots labeled as burned, however the intensity of burn was unknown. Some idea about the fire damage can be deduced from the photographs provided.

Most rainfall in the region is indeed delivered by several high intensity storms occurring during monsoon season, and peak intensities of over 150 mm/h are not uncommon. However, the purpose of the simulations was not to replicate a natural storm or measure annual erosion (there are instrumentation and methods dedicated to do just that), but rather to look at physical processes and interactions. While the intensity of natural rainfall vary greatly and rapidly during a single event, the purpose of rainfall simulator is to offer increased control over this and other variables reducing the experimental degrees of freedom. This is important for identifying relationships between processes. The simulations include high rainfall intensities, which rarely occur naturally, to provide

information on extreme conditions and better identify trends. We provided a citation in the text (Parsons and Lascelles, 2000) relevant to the issue.

The reviewer brings a valid point whether steady-state sediment yield could be achieved or whether a different (decreasing) rainfall intensity succession could yield different result. Sediment supply is indeed limited, but seems to exceed the amount of sediment removed in a single experiment (up to 2 t/ha). A study conducted on an artificial plot using soil from one of the sites shows sediment yield slowly decreasing over prolonged, 5-6 hour simulation at 180 mm/h rainfall (Nearing et al., 2017). Rangeland sites with rocky soils are characterized by complex pattern of divergent and convergent flow where small rills rarely develop even after a heavy rain. Hence, developing new sediment sources at a plot scale is unlikely. Perhaps, "quasi-steady" is a better term to characterize sediment yield at this temporal scale. There was a small number of experiments in the dataset that used a series of increasing followed by decreasing water inputs. They show that sediment yield closely followed runoff changes, whether increasing or decreasing.

A short discussion on scaling issues with relevant references was added in the Conclusion.

Reviewer 3

We modified Table 1 to include more description of the sites and provide structure to Section 2. Due to the limited space in the body of the manuscript we included most of site information in the Appendix B (a reference added in the text). We also added a reference to Land Resources Areas classification that should help clarify site description.

Table 2 is a sub-sample of Appendix C of the dataset. All data fields, nomenclature, units, acceptable values, etc. are provided in the Data dictionary (Appendix A). This is a suggested approach of structuring and describing the data by our data repository (National Agricultural Library). We added an explanation of Table 2 content in section

4 (Experimental procedure) and referenced it in the text. N/A stands for not available. It was strongly suggested by the NAL that there are no empty cells in the .CSV format tables. All null values are labeled N/A. This should be distinguished from 0 values. Data format is further explained in the Data Dictionary (Appendix A). The measurements (rainfall, runoff, etc.) and site attributes (ID, plot conditions, etc.) are combined in one table where attributes are replicated in every line. While this is visually redundant it facilitates sorting and database query. During the study some of the plots on a given site could receive precipitation only, others run-on only, while yet another a combination of both. Moreover, the same plot could receive different type of input on different years. Hence the chosen column structure.

Comments for the figures were added in the text.

The erroneous reference (Table X) was removed.

Additional notes: We added references to the dataset tables throughout the text as following: Appendix A. Data dictionary. Appendix B. Lists of sites and general information. Appendix C. Rainfall simulations. Appendix D. Ground and vegetation cover. Appendix E. Simulation sites map. Appendix F. Site pictures. These changes (table titles) were submitted to the data repository (National Agricultural Library) for review. This takes time to process and the revisions may not be available immediately.

References: Lascelles, B., Favis-Mortlock, D. T., Parsons, A. J., and Guerra, A. J. T.: Spatial and temporal variation in two rainfall simulators: Implications for spatially explicit rainfall simulation experiments, Earth Surf. Process. Landf., 25, 709-721, 2000. Mayerhofer, C., Meissl, G., Klebinder, K., Kohl, B., and Markart, G.: Comparison of the results of a small-plot and a large-plot rainfall simulator - Effects of land use and land cover on surface runoff in Alpine catchments, Catena, 156, 184-196, 2017. Nearing, M. A., Polyakov, V. O., Nichols, M. H., Hernandez, M., Li, L., Zhao, Y., and Armendariz, G.: Slope-velocity equilibrium and evolution of surface roughness on a stony hillslope, Hydrol. Earth Syst. Sci., 21, 3221-3229, 2017. Nichols, M. H.: Measured sediment

yield rates from semiarid rangeland watersheds, Rangel. Ecol. Manag., 59, 55-62, 2006. Nichols, M. H., Stone, J. J., and Nearing, M. A.: Sediment database, Walnut Gulch Experimental Watershed, Arizona, United States, Water Resour. Res., 44, W05S06, doi:10.1029/2006WR005682, 2008. Parsons, A. J. and Lascelles, B.: Rainfall simulation in geomorphology, Earth Surf. Process. Landf., 25, 679-679, 2000. Stavi, I., Lavee, H., Ungar, E. D., and Sarah, P.: Ecogeomorphic Feedbacks in Semiarid Rangelands: A Review, Pedosphere, 19, 217-229, 2009. Stone, J. J., Nichols, M. H., Goodrich, D. C., and Buono, J.: Long-term runoff database, Walnut Gulch Experimental Watershed, Arizona, United States, Water Resour. Res., 44, 2008. USDA: Land Resource Regions and Major Land Resource Areas of the U.S., the Caribbean, and the Pacific Basin, 2006. Yakubu, M. L. and Yusop, Z.: Adaptability of rainfall simulators as a research tool on urban sealed surfaces - a review, Hydrol. Sci. J.-J. Sci. Hydrol., 62, 996-1012, 2017. Yisehak, K., Belay, D., Taye, T., and Janssens, G. P. J.: Impact of soil erosion associated factors on available feed resources for free-ranging cattle at three altitude regions: Measurements and perceptions, J. Arid. Environ., 98, 70-78, 2013.

Please also note the supplement to this comment:
https://www.earth-syst-sci-data-discuss.net/essd-2017-81/essd-2017-81-AC1-supplement.pdf

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