The impact of grazing regimes on event-scale rainfall-runoff relationships: A case study at Santa Rita Experimental Range, Arizona

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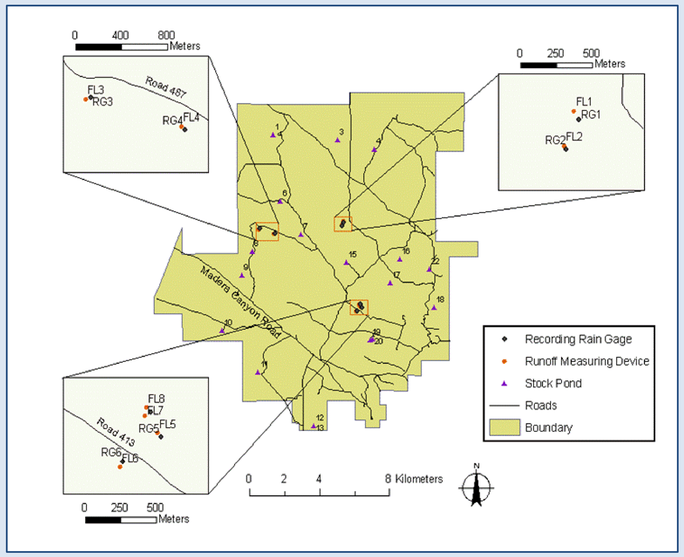
1. Introduction

Semi-arid systems account for 40% of terrestrial biomes and are especially vulnerable to degradation resulting from anthropogenic disturbances[1]. For example, rangeland activities such as grazing can lead to land degradation (e.g. excess erosion, compaction, devegetation); to minimize the effects of grazing on land health, range managers adjust grazing practices. In November 2007, a new grazing regime was implemented at the Santa Rita Experimental Range in southern Arizona. To evaluate hydrologic impacts such as runoff and peak discharge associated with grazing changes, event-scale precipitation and associated runoff data were collected at 8 watersheds from 1975-2013. The 8 watersheds fell into 4 possible 2007 management shifts, from: (1) year-long grazing to grazing rotation; (2) grazing rotation to grazing rotation; (3) rotation to ungrazed; (4) year-long grazing to ungrazed[2].



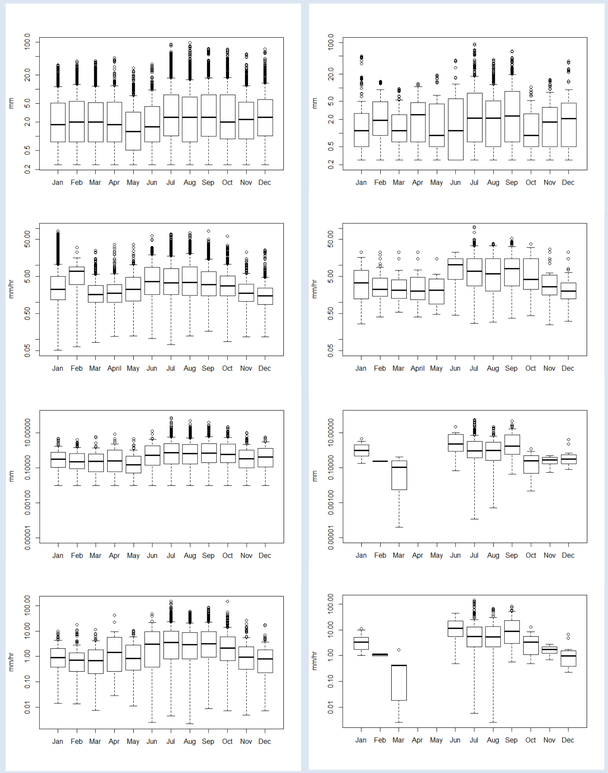
Rain gage and runoff flume locations on 8 small watersheds within Santa Rita Experimental Range, Tucson, AZ. Map courtesy of the Southwest Watershed Research Center[3].

2. Methods

- Gather the data from 8 ongoing rain and discharge monitoring sites[4]
- Separate data into pre- and post- November 2007 data sets
- Create box plots and calculate regressions to view trends in data & verify significance of relationship

3. Research Questions and Results

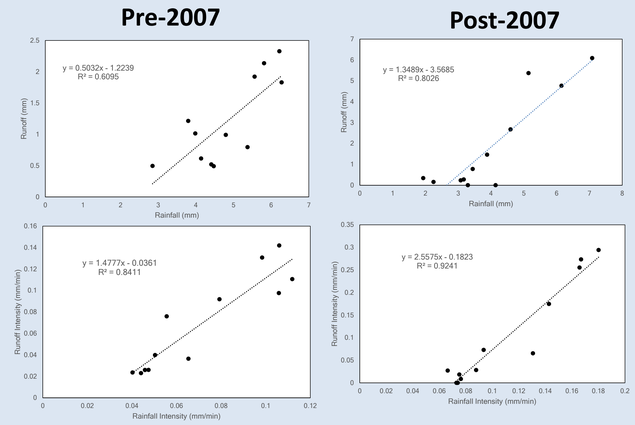
3.1. In examining event-scale rainfall amount and intensity and runoff amount and intensity:
-Is there month-to-month variation?
-Is there a difference before and after the 2007 grazing regime change?



Important findings:

- Post-2007 data is much more variable than pre-2007 data
- Rainfall volume tends to be lowest in May and June
- Rainfall and runoff intensity tend to be high June-Sep.
- Average Feb. rainfall intensity is much higher pre-2007
- There have been no event-scale runoff observations in April and May since 2007

3.2. Does the difference in pre- and post-2007 precipitation explain the difference in pre- and post-2007 runoff?



Important findings:

- Runoff volume and intensity is strongly correlated to rainfall volume and intensity
- R^2 values suggest a stronger rainfall-runoff relationship post-2007 (R^2 =0.80, 0.92) than pre-2007 (R^2 =0.60, 0.82)
- Changes in rainfall volume and intensity after 2007 explain most of the changes in runoff volume and intensity

4. Considerations

- There were far fewer years of rainfall and runoff data in the post-2007 data set compared to the pre-2007 data set
- Grazing regime specific analysis was not possible because current grazing regime data of the 8 watersheds was unavailable

5. Take home points

- There is a difference in the pre- and post-2007 event scale runoff that is not explained by changes in precipitation
- Land management changes may impact rainfall/runoff relationships
- Changes identified in event runoff (overland flow) can affect nutrient and sediment transport, with ecohydrological consequences for the region

References

1. Jenerette, G. Darrel, et al. "Organization of complexity in water limited ecohydrology." *Ecohydrology* 5.2 (2012): 184-199.
2. Martin, S. Clark, and Howard L. Morton. "Mesquite control increases grass density and reduces soil loss in southern Arizona." *Journal of Range management* (1993): 170-175.
3. http://www.tucson.ars.ag.gov/dap/images/SR_overview_2.gif
4. http://www.tucson.ars.ag.gov/dap/DataCatalogueOld.htm

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