Regional Assessment of Observed Rainfall-Runoff Relations in Maricopa County and its Hydrologic Modeling for Selected Areas

Lei Fang, Enrique R. Vivoni and Giuseppe Mascaro
School of Sustainable Engineering and the Built Environment

1. INTRODUCTION

The U.S. Geological Survey and the Flood Control District of Maricopa County have been collecting long-term, high-resolution rainfall and runoff data for the purposes of emergency alerts and flood hazard assessments.

Our object are to

- Conduct an assessment of the regional rainfall-runoff relations obtained from a large set of urban and rural watershed in Maricopa County, illustrating the variations in the watershed responses according to season and urbanization extent.
- Develop hydrology modeling for selected watershed.

2. METHODOLOGY

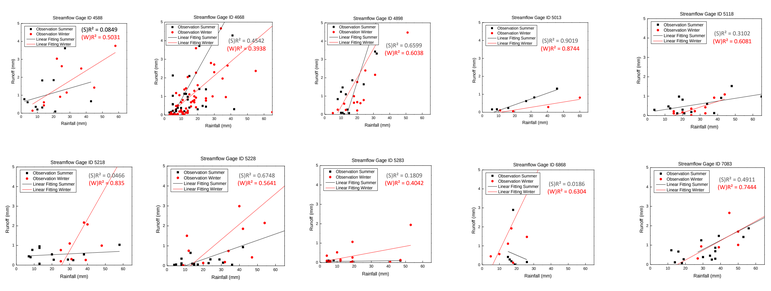
2.1 STREAMFLOW GAGE SELECTION

Fig 2.1 streamflow gage map

Requirements:

- surface flow only response to rainfall instead of human activity (water transporting like CAP), avoid nearby large river, water body or downstream of dam
- sufficient rainfall events recording

2.2 BUILDING RUNOFF-RAINFALL VOLUME CORRELATION BASED ON THE SEANAILITY



The scatter diagram for each watershed doesn't indicate a strong linear relationship, normally the runoff volume that same amount of rainfall generated varies with the hyetograph and soil moisture content. Also the numbers of the samples would also impact the regression result.

2.3 WATERSHED MODELING

Table 2.3 streamflow gage watershed modeling summary

Streamflow gage ID	Land cover type	Record since	Runoff events	Area(mi^2) from website	Area(mi^2) from modeling	Area(mi^2) After modeling calibration
4588	Natural	2002	25	7.9	8.67	7.9
4668	Urban	1998	124	14.1	253.93	16.73
4898	Natural	2006	42	1	0.95	0.95
5013	Natural	2003	18	25.4	28.65	28.65
5118	Natural	2000	35	27.8	5.54	Fail
5218	Natural	2001	41	120	143.49	143.49
5228	Urban	1994	49	711	713.1	713.1
5283	Natural	1995	33	1450	1356.862	1356.862
6868	Urban	2006	35	14.6	219.85	Fail
7083	Natural	1994	34	8.5	8.8	8.8

Raw DEM data was obtained from the USGS TNM, the highest resolution available is 10 meters, which is coarse for the modeling.

The discord of the two watershed area generated from the ArcGIS and Maricopa County flood control website indicate that modification of the DEM data and real situation should be considered for the watershed modeling due to the low resolution of the DEM.

Fig 2.3.2 shows the upper boundary was manual set because of the barrier of the CAP canal, and the catchment, drainage line delineation with sub-basin merge processing.

Fig 2.3.3 is the soil data from USDA soil survey for loss parameter setting, and fig 2.3.4 is land cover data from USGS for impervious area parameter setting in HEC-HMS.

Fig 2.3.1 watershed map

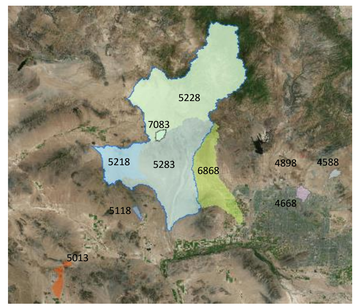


Fig 2.3.2 watershed 4668 delineation

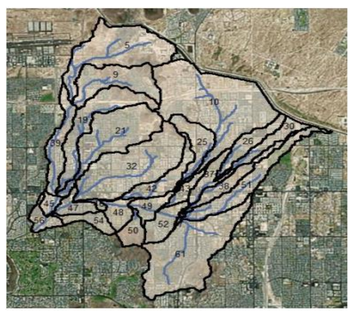
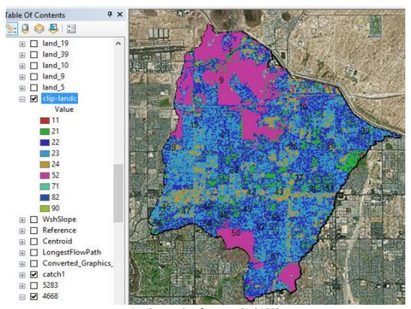


Fig 2.3.3 soil data for watershed 4668

Fig 2.3.4 land cover data for watershed 4668



3.RESULTS

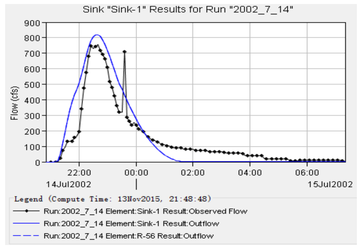


Fig 3.2 Simulation runoff hydrograph for watershed 4688

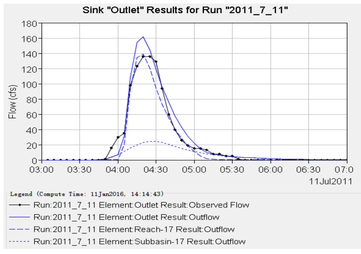


Fig 3.1 Simulation runoff hydrograph for watershed 4898

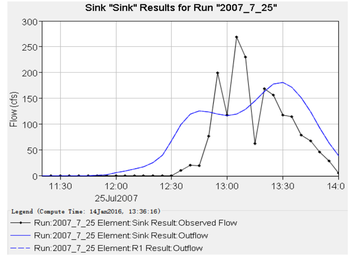


Fig 3.2 Simulation runoff hydrograph for watershed 5013

4.SUMMARY & CONCLUSION

- The preliminary conjecture for developing linear correlation of runoff and rainfall volume is unpromising, as well as the prominent feature difference expected between natural and urban watershed (e.g. runoff ratio).
- The modeling method from the Maricopa County hydrology manual didn't applied well for large watershed.
- For further investigation,

a. the modeling method need to be further optimized as well as parameter setting.

b. higher resolution DEM data (e.g. 3.3 or even 1 meter) is required for better simulation result, especially for urban watershed.

5.ACKNOWLEDGEMENT AND REFERENCE

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Hydrology manual Maricopa county, 2013
HEC-GeoHMS users' manual, 2013