HYDROMETEOROLOGICAL ANALYSIS OF FLOODING EVENTS IN SAN ANTONIO, TX

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Abstract The United States suffers an annual average of 100 deaths and over $2 billion in damage from flood events in every year. South Central Texas is particularly vulnerable to floods due to: (1) proximity to a moist air source (the Gulf of Mexico); (2) the Balcones Escarpment, which concentrates rainfall runoff; (3) a tendency for synoptic scale features to become cut-off and stall over the area; and (4) decaying tropical cyclones stalling over the area. The San Antonio Metropolitan Area is the 7th largest city in the nation, one of the most flash-flood prone regions in North America, and has experienced a number of flooding events in the last decade (2002, 2004, and 2007). Research is being conducted to (1) characterize the meteorological conditions that lead to these events; (2) verify and adjust radar-rainfall estimates from WSR-88D radars located at New Braunfels and Laughlin AFB, TX, using surface recorded rainfall accumulations; and (3) apply the rainfall and watershed characteristics data to recreate the runoff events using a two-dimensional, physically-based, distributed-parameter hydrologic model. The physically based, distributed–parameter Gridded Surface Subsurface Hydrologic Analysis (GSSHA) hydrological model was used for simulating the watershed response to these storm events. Finally observed discharges were compared to GSSHA model discharges for these storm events. Analysis of the some of these events will be presented.

GSSHA Model The Gridded Surface Subsurface Hydrologic Analysis (GSSHA) is a physically distributed hydrologic model. The GSSHA model is a significant reformulation and enhancement of the CASC2D model (Ogden and Julien 2002). GSSHA is a physically based, distributed, structured grid hydrologic parameter model that simulates the hydrologic response of a watershed from cell to cell under given hydrologic inputs. The main components of the GSSHA model include temporally and spatially varying precipitation, snow fall accumulation and melting, precipitation interception, infiltration, evapotranspiration, routing, unsaturated soil moisture accounting, overland sediment erosion, saturated ground water flow, transport and deposition and in stream sediment transport.

Watersheds Data For all watersheds, the resolution of the DEM is 150 m. DEM was first converted from geographic coordinates into UTM NAD 83, which is the preferred coordinate system for *GSSHA* models. All three watersheds and stream arcs were delineated from the DEMs using WMS (Watershed Modeling System) processing tools (Figure 1).

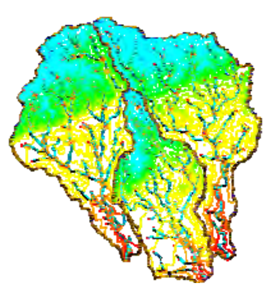

Figure -1: Delineated watershed boundaries and stream networks of Leon Creek, Upper San Antonio and Salado Creek watersheds.

Results and Conclusion For the 2002 event, the highest simulated peak discharge occurred in Leon Creek followed by Upper San Antonio River and Salado Creek, respectively. Leon Creek simulated peak discharge was 0.5% higher than the observed peak discharge (Figure 2). For Upper San Antonio River watershed, model peak discharge was 1.08% less than the observed peak discharge. The MPE resolution (4x4 km at hourly time step) is certainly not adequate for distributed modeling. The main reason for that can be the lack of data regarding the storage and infiltration volume at the sites of 14 dams that were built to enhance recharge. The model has certainly underestimated recharge at these dams. If a grid size smaller than 150-meter was used, simulation results may have improved as a result of better representation of topography of the watershed and more accurate allocation of impervious areas. A smaller grid size, however, will lead to an increase in the number of cells and thus increase the model running time. Finally, the results from the three watersheds demonstrated that GSSHA model can be used to predict the storm runoff for single or multiple events on the three watersheds discussed in this study.

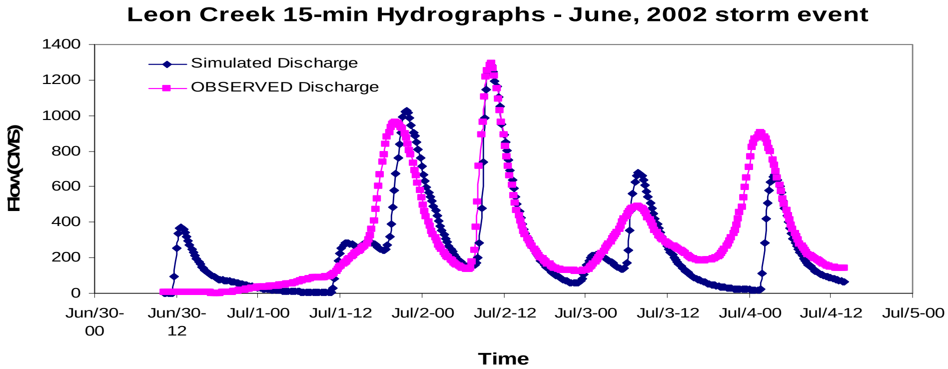

Figure 2: Comparison of model generated 15-min hydrographs with USGS observed flow data for Leon Creek.

REFERENCES

Ogden, F. L. and P.Y. Julien, (2002). Distributed model CASC2D, in Mathematical Models of Small Watershed Hydrology, Vol 2, V.P. Singh, R. Frevert, and D. Meyers eds., Water Resources Publications, ISBN 1-887201-35-1, 972 pp.

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