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Combining radar and rain gauges to capture the space-time variability of monsoon rainfall during an extreme flood event

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Monsoon rainfall events are typified by high spatial and temporal variability in both rainfall amount and intensity. Monsoon rainfall events occurring in Tucson, AZ, USA over seven consecutive days in July, 2006 led to the highest ever recorded stream flows in Sabino Canyon Creek and resulted in flash flooding that caused large-scale property damage. Concurrent to these monsoon events, a network of 40 tipping bucket rain gauges were in place throughout the Sabino Canyon Creek watershed. In addition to this rain gauge network, radar data (NEXRAD) was collected during this monsoon period and used to derive rainfall accumulation maps with a 15-minute temporal resolution and 1 km^2 spatial resolution. An event based, kinematic-wave overland flow runoff model (KINEROS2) was used to model stream flow in Sabino Canyon Creek for the largest of the flooding events using rainfall data from both rain gauge observations and radar estimation. While the modeling results based solely on rain gauge observations agreed well with observed flow, the results were highly reliant on the extent of the spatial coverage of the rain gauge network. To overcome the reliance, geostatistics (kriging with external drift) were used to combine the rain gauge data with the radar data. By combining these two datasets, we could compensate for restricted

spatial coverage in the rain gauge network. This allowed for high quality modeling of the flood event even with a great reduction in the spatial extent of the observational rain gauge network. Techniques to combine data from rain gauge networks and radar estimates are quite valuable as the development of real-time rain gauge network with good spatial extent and high spatial density is difficult and costly.