CE394K-GIS in Water Resources **Cesar N. Yahia**
project-update 10-26-18

A Probabilistic Model for Predicting Road Network Disruption

Objective:
In this project, we aim to predict the impact of storm events on the road network disruption state. We propose a framework that integrates large-scale discharge forecasts from the national water model (NWM) with local topographic and road information. The framework relies on a probabilistic model that predicts the likelihood of road network disruption from NWM-HAND inundation maps and observed road disruptions from past storms. Thus, by assimilating observed road data and NWM-HAND predicted inundation impact, we aim to improve predictions on the anticipated road network disruption state for a particular flood.

Outline:
The national water model (NWM) provides large-scale discharge forecasts for streams extracted from the national hydrography dataset (NHDplus). In particular, the NWM uses a weather research and forecasting hydrological model (WRF-Hydro) to perform Muskingum-Cunge channel routing and to assimilate forcing data from multiple sources (precipitation data, USGS gage data, etc.). Therefore, the NWM is a powerful tool for predicting the impact of storm events.

However, the stream discharge NWM output can not be easily translated to road network disruption state. Specifically, the NWM is limited in that it relies on trapezoidal NHDplus streams, its forecasts have a latency period, and it does not assimilate local data (such as sensors deployed by the city or road network observations from past flood events).

Therefore, we propose a probabilistic model that assimilates local road network data with NWM-HAND inundation maps to provide disruption predictions that account for approximations used in the NWM. In particular, we use HAND generated rating curves and compute HAND values for road segments to translate discharge observations (NWM forecasts) into road network disruption observations. In addition, we assimilate observations on the road network to improve the resulting predictions.

Steps:
(1) Extract NWM data and map watershed to corresponding road network links
(2) Calibrate model using maximum likelihood estimation
(3) Test different scenarios with simulated road network sensor data to evaluate the impact of additional local information

Data:
In terms of data:
(1) NWM data from past hurricane events will be extracted for a testbed region (e.g. Onion Creek Watershed).
(2) The road network will be extracted from https://extract.bbbike.org/. This website allows us to generate shape files for the road network in any region.
(3) For road network local disruption data, we will calibrate the model assuming this data is not available, and then simulate data to evaluate the performance of the model when local road network disruption data is available (e.g. simulate data by assuming that if discharge at the

outlet is above a certain level then the road network sensors would indicate a set of links are disrupted regardless of NWM predictions). To simulate time series disruption data, we will rely on a road closure dataset reported by the Texas Department of Transportation (TxDOT).
(4) Other data for calculating HAND include a digital elevation model from the National Elevation Dataset as well as NHDplus watershed and stream network data.

Base Map:
In the base map below, you will find the testbed area (Onion Creek Watershed) on which we aim to calibrate and test the probabilistic model. This base map includes (1) the road network from https://extract.bbbike.org/ clipped to the Onion Creek region, (2) Road closures as red dots indicating TxDOT reported road network disruptions from past flood events, (3) USGS stream gages, (4) the Onion Creek watershed boundary, catchments, and NHDplus flow lines.

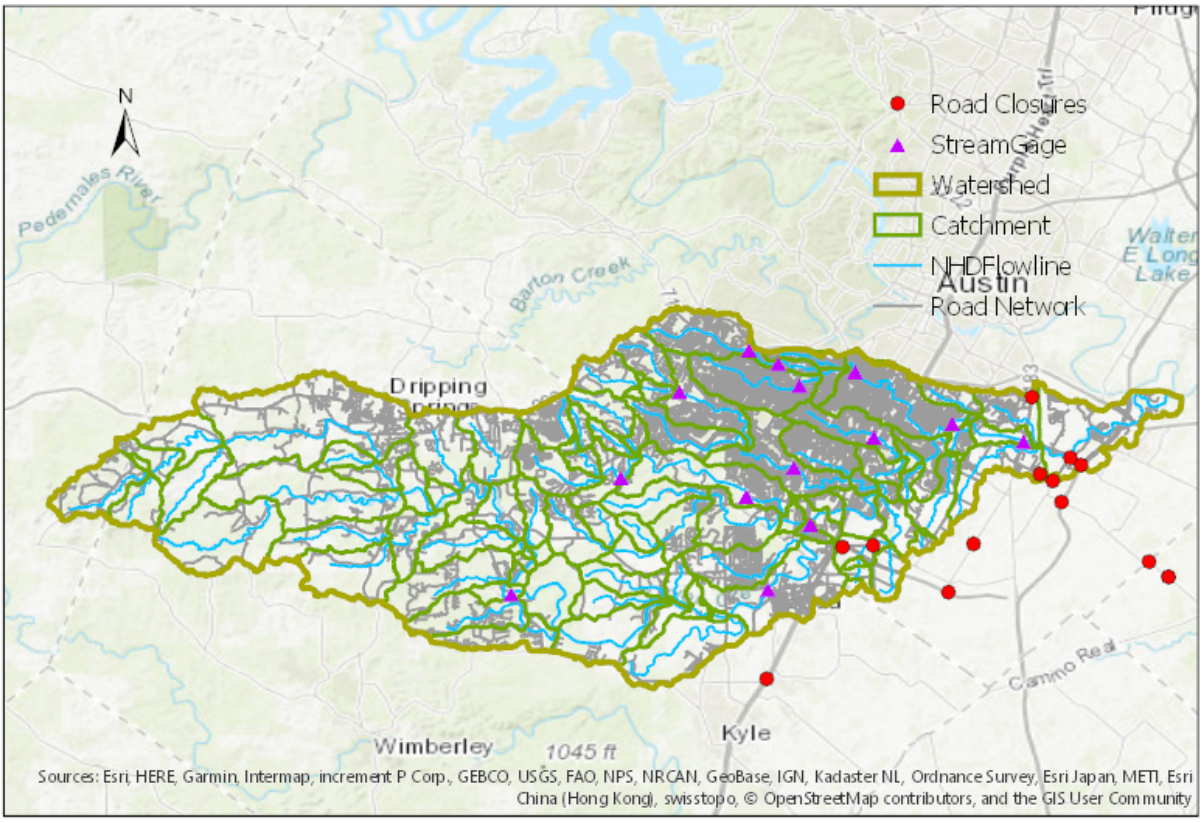

Figure 1: Base map for testbed area