Delving Deeper:

What underlies the 100-year floodplain?

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OUTLINE

- Floodplain Mapping
  - How is the floodplain modeled?
  - How are the models validated?
- Challenges
  - All models are bad, some are useful
  - Scalability and cost
- Overview of the project objectives

HOW IS THE FLOODPLAIN MODELED?

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Historical Gauge Rainfall

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Statistical Analysis

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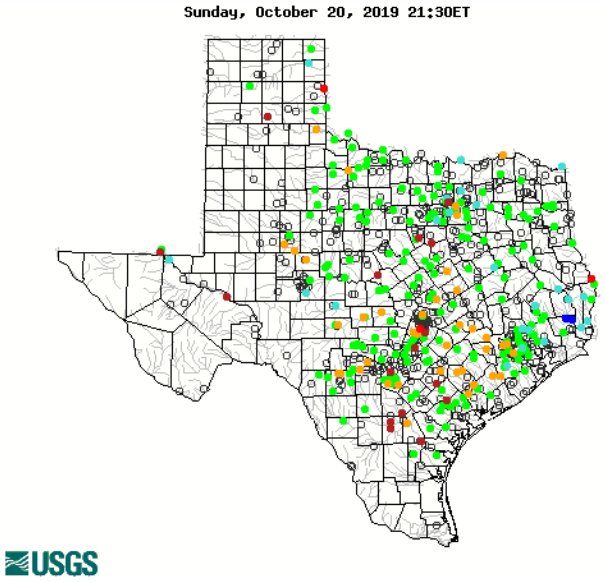
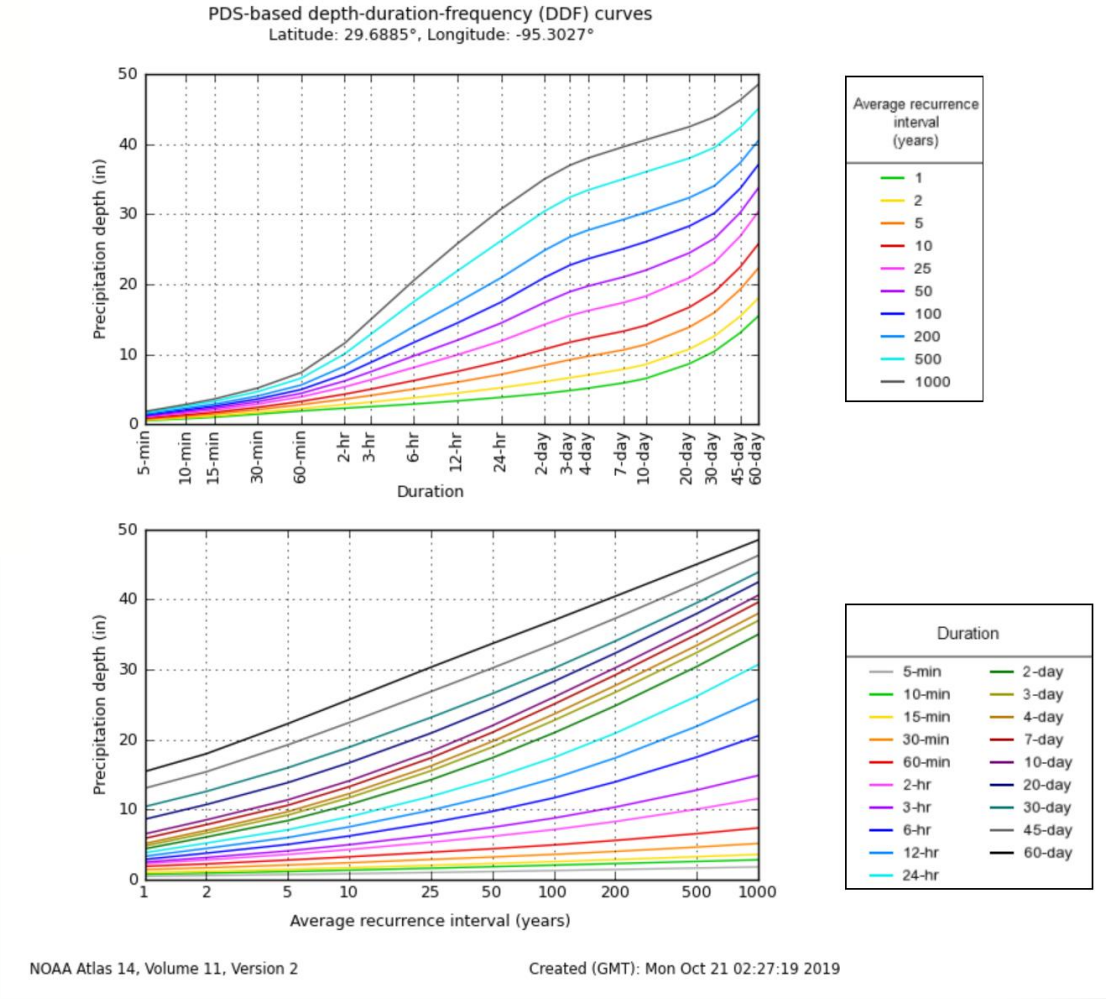
Rainfall with a given probability and distribution





HOW IS THE FLOODPLAIN MODELED?

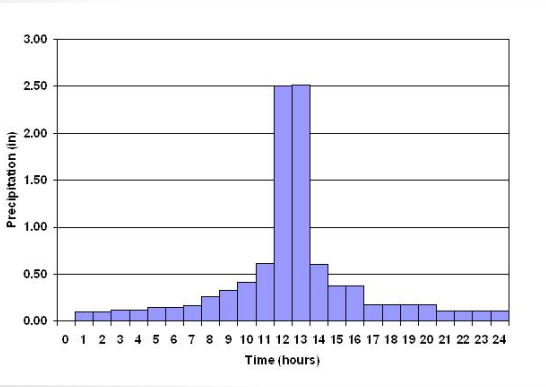
Watershed Topography,
Land Cover & Soil

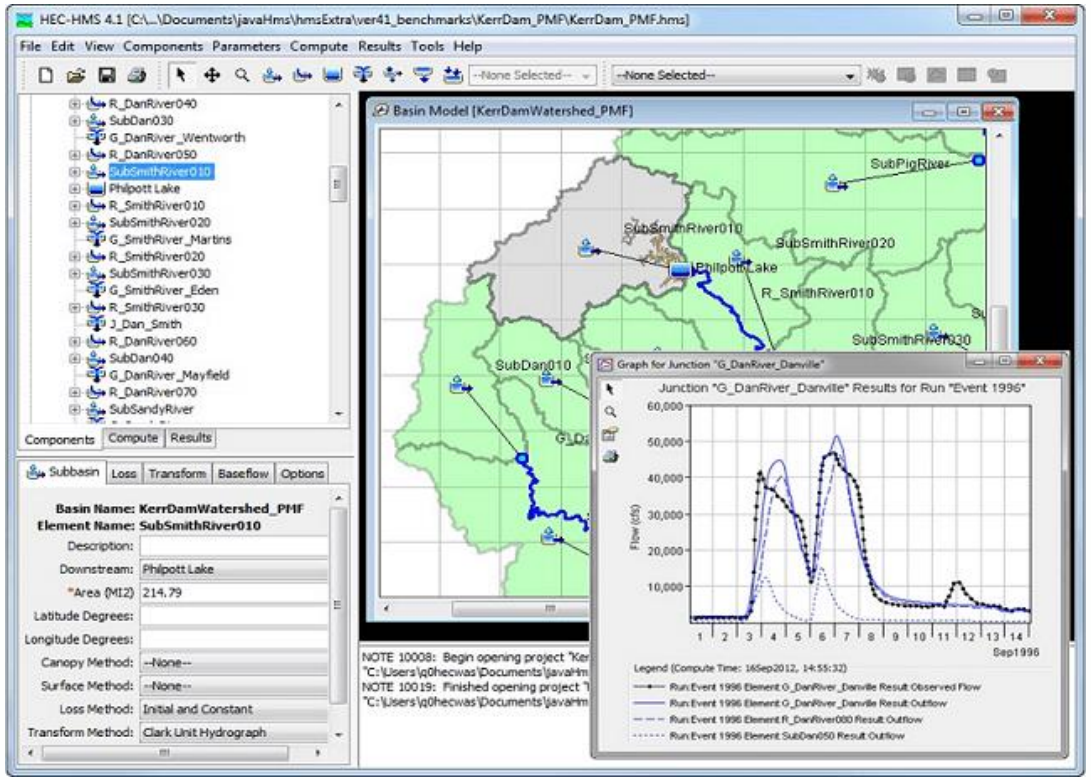
Statistical Analysis

Rainfall with a given probability and distribution

Hydrologic Model

Flows at critical locations in the watershed





HOW IS THE FLOODPLAIN MODELED?

Statistical Analysis

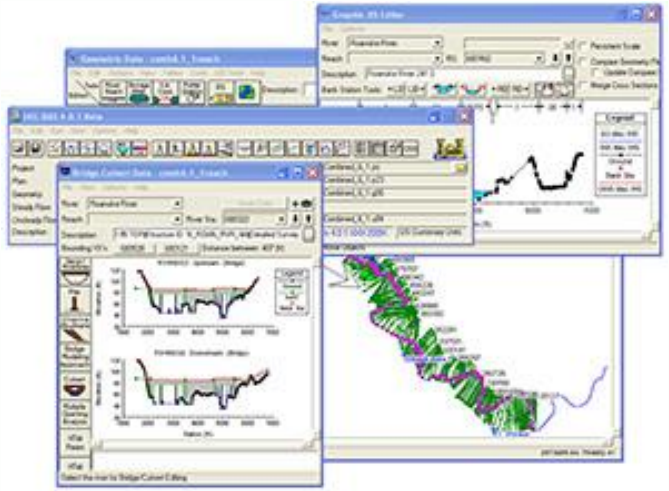
Hydrologic Model

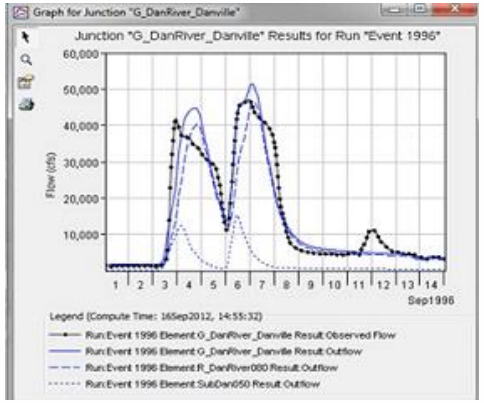
Flows at critical locations in the watershed

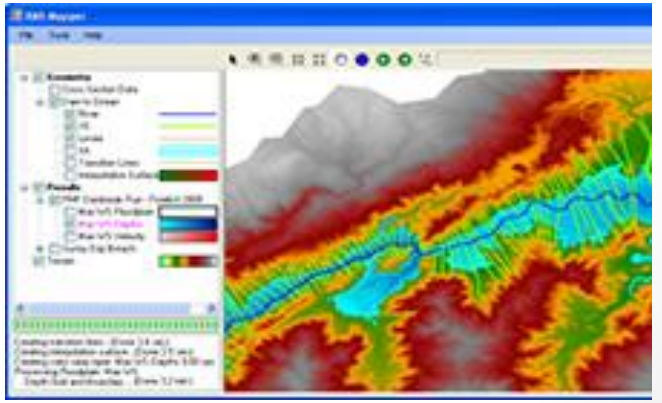
Channel Bathymetry

Hydraulic Model

Depth of Water







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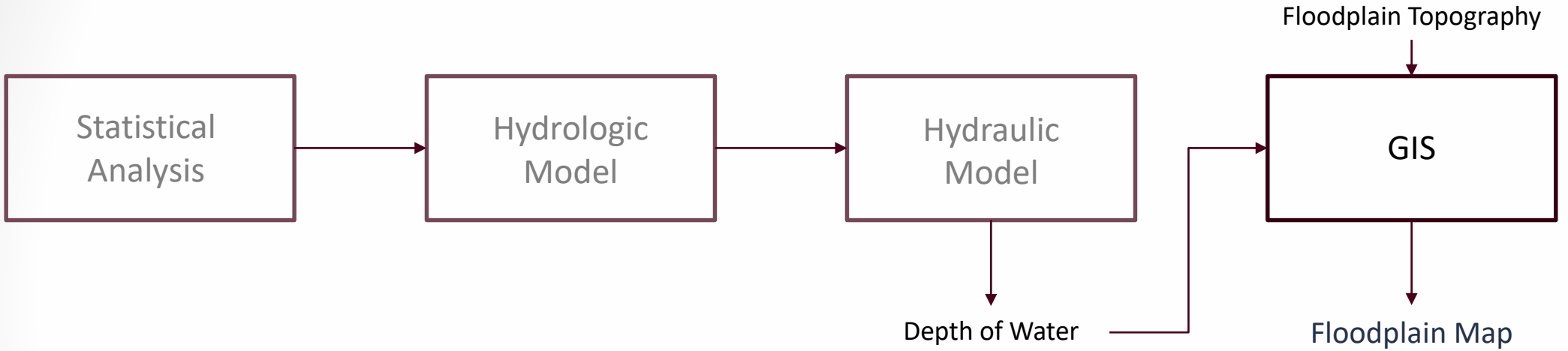
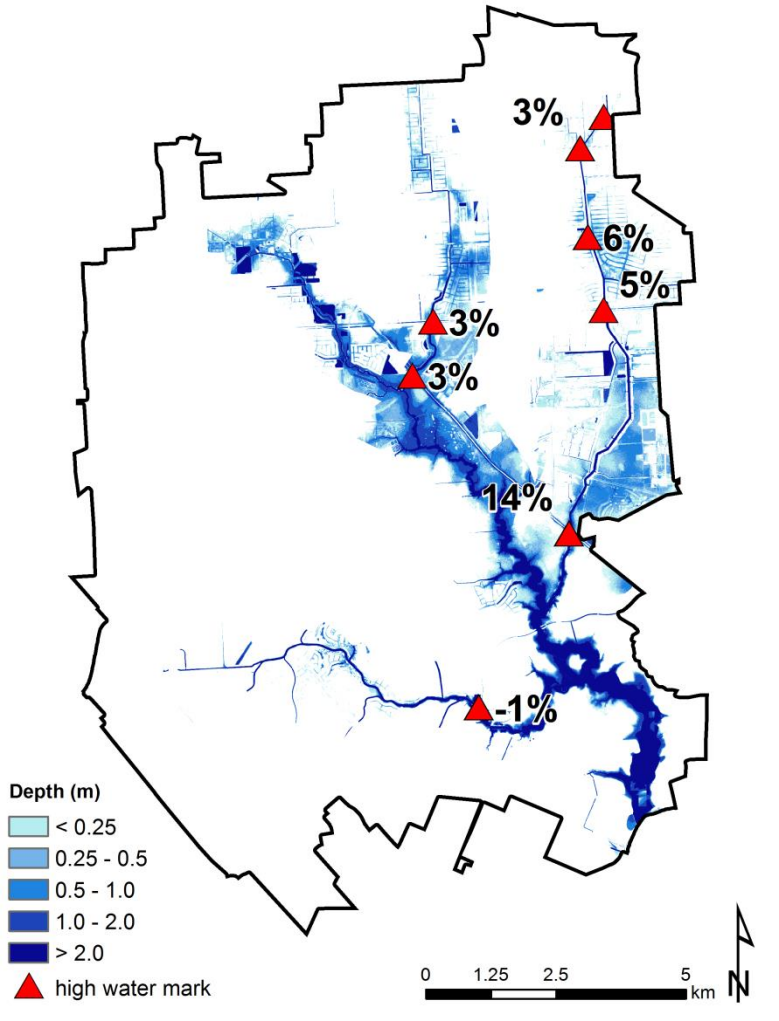


HOW DO WE VALIDATE A MODEL?

- Run the model for historical rainfall events
  - e.g., Memorial Day (2015), Tax Day (2016), and Harvey (2017)
  - Choose storms of different sizes (small, medium, large)
- Compare the hydrologic model against observed flow hydrographs
  - Compare timing, volume, and peaks
- Compare the hydraulic model results against high water marks
- If the model fits well (+/-10%) then good-to-go!

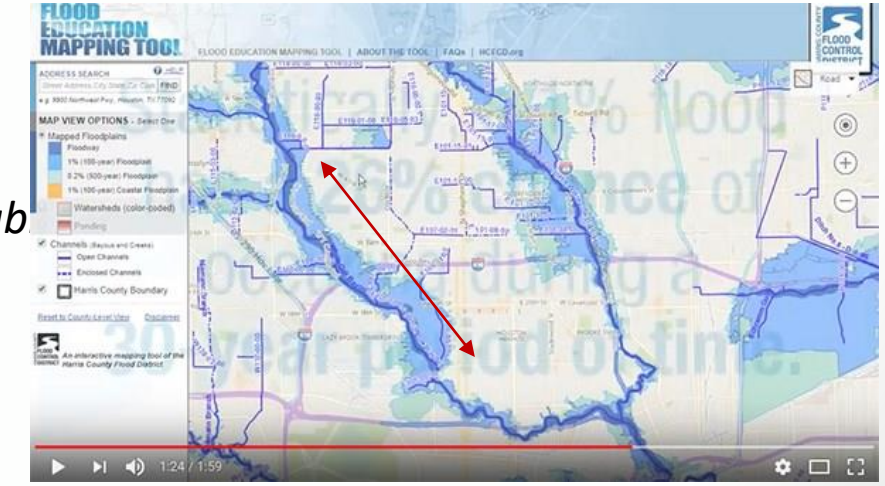


ALL MODELS ARE BAD, SOME ARE USEFUL.

- Let's assume that the model does a great job capturing historical events… then, what's the problem? Why is everyone complaining?!
  - Assume environmental conditions are stationary
    - Rainfall
    - Land Use
    - Topography
  - Assume a given rainfall event produces a given floodplain event (i.e., deterministic)
  - Assume any flooding is caused by the river overtopping its banks

    AND that the water ONLY flows in one dimension

There are more, but these are the most applicab

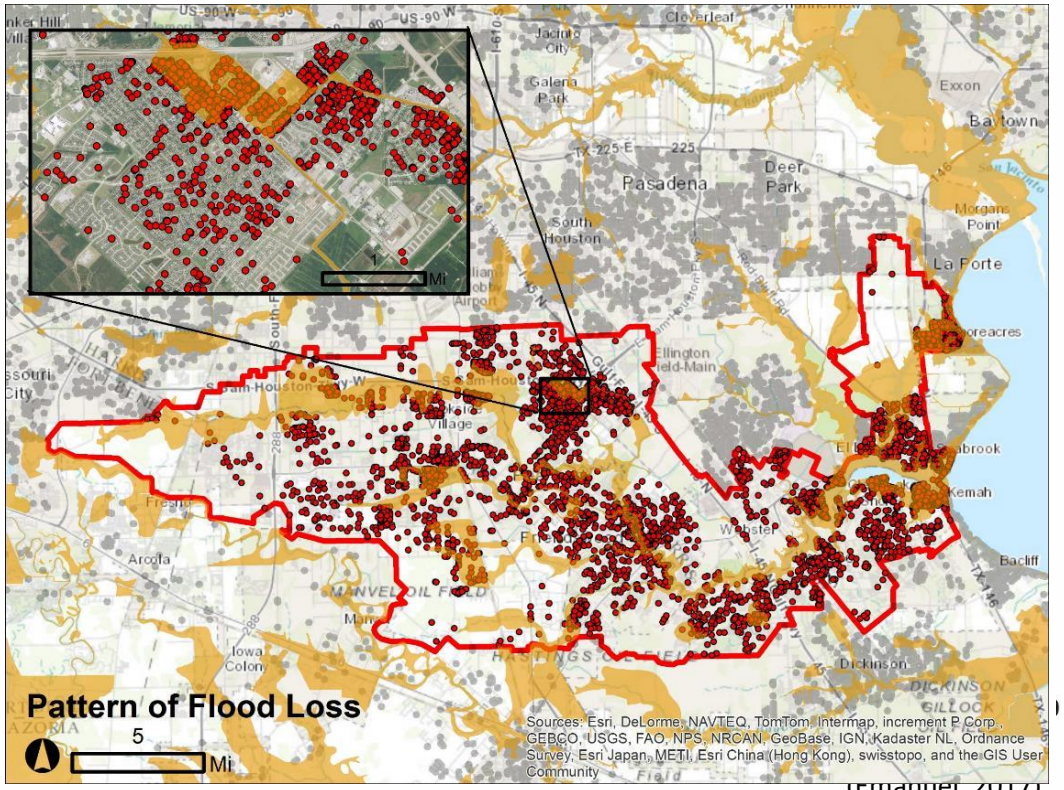


IN REALITY…

- Variables change with time
  - Rainfall is non-stationary
  - Land use is non-stationary
  - Topography is non-stationary
- Not all hazard-drivers are included
  - Pluvial events
  - Compound events

Note:

1. This is the *standard approach* to mapping a floodplain; there are communities that take a more robust modeling approach!
2. Coastal floodplains "VE Zone" were recently updated; these limitations are not applicable to surge-induced coastal floodplains.



(Emanuel, 2017)

early 2000s during TSARP.

Living 1/4-mile outside the floodplain still generates an expected loss of $13,000 (Brody et al. 2015).

SCALABILITY & COST

CHALLENGE #2

- Resource Intensive
  - Standardized process, however difficult to scale the studies to the state/nation
  - Requires significant financial resources to support the floodplain mapping process
  - GUI interface
- Majority of U.S. floodplains are 10-15 years old *(Birkland et al. 2003)*
  - Harris County
    - Tropical Storm Allison (TSARP) $19 million (2001-2007)
- FEMA Flood Map Modernization (MapMod) Initiative (FMMI)
  - $1.4 billion (2003-2009)
  - 92% of the US pop. w/ digital FIRMs
  - Improved data quality and models
  - Countywide map format

THIS PROJECT…

- Does not attempt to replace the NFIP SFHA, but to complement it
- Provide supplemental flood risk information to pilot communities in SE Texas

Hazard-Driven Analysis: Standard Engineering Risk Assessment

$$Probability \cap Exposure \cap Vulnerability \rightarrow Impact$$

How likely is it to flood?	Where will it flood and what is located there?	How susceptible is it to being damaged?	How much damage will there be?

Impact-Driven Analysis: novel planning approach based on FEMA flood claims to back out the probability of flooding…