

Evaluation of Substation Vulnerability to Flooding in Current and Climate Change Scenarios

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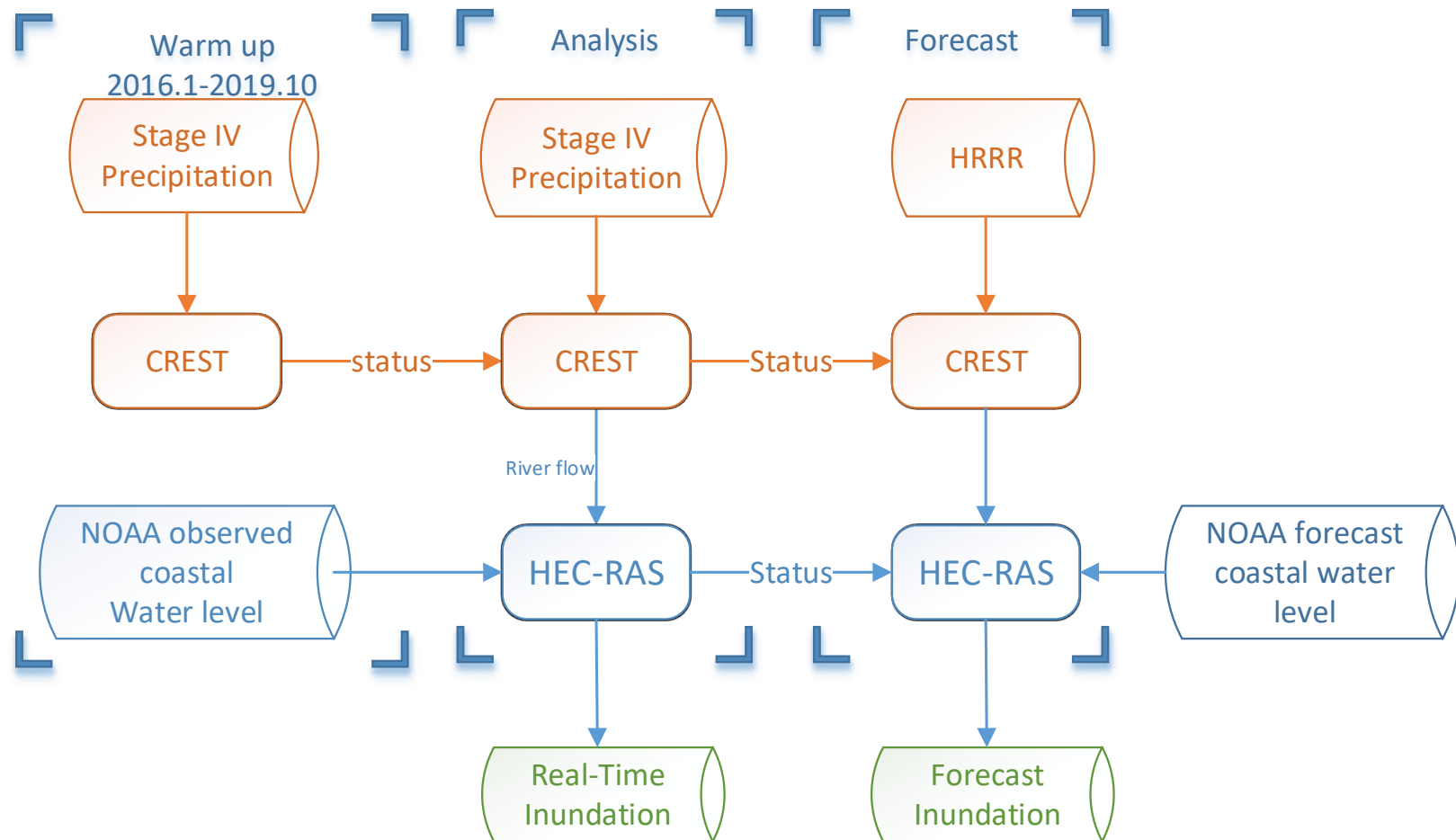
The Real Time Forecast System (Phase 3)

- Twice a day
- 36 hours forecast
- Compound Flood
 - River flow
 - Storm surge

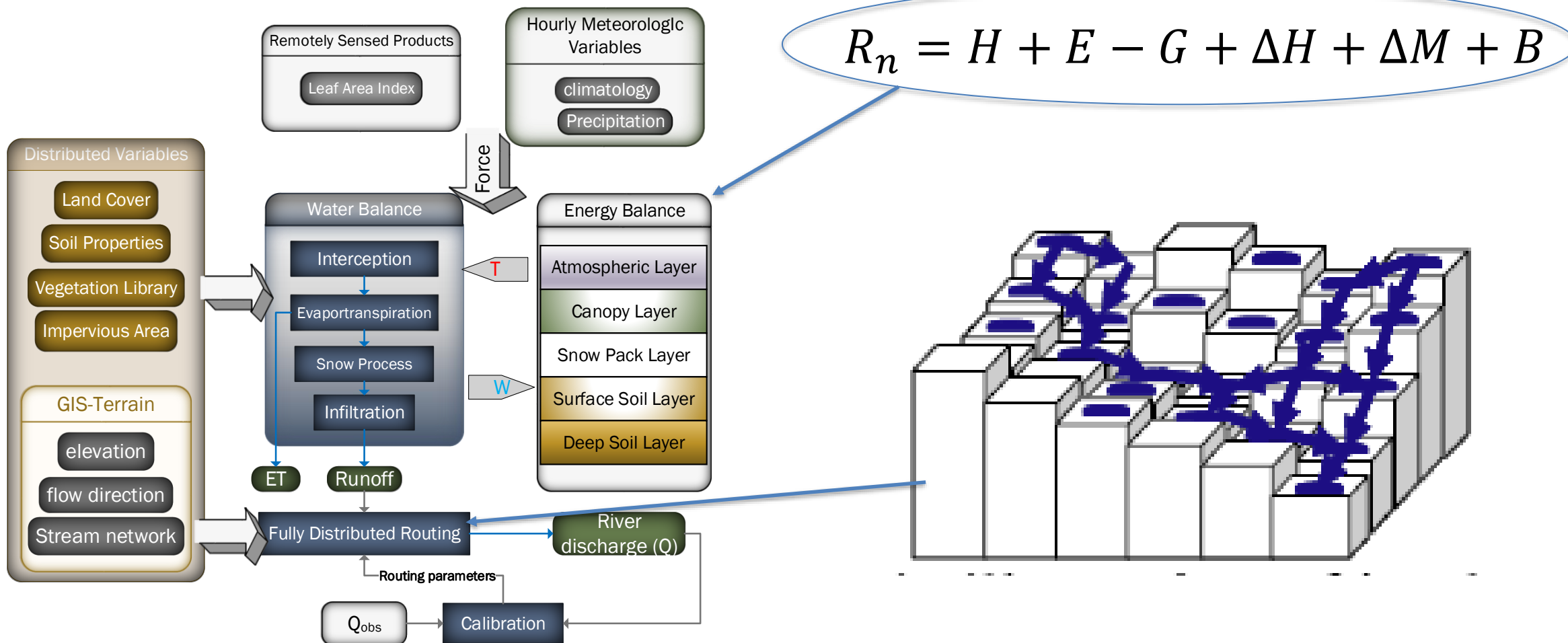
Phase 1: Evaluate flood risk using long-term historical records

Phase 2: Phase 3: Test the model in past extreme events

Phase 3: Build the forecast system



CREST-A Distributed Hydrological Model



The HEC-RAS Model

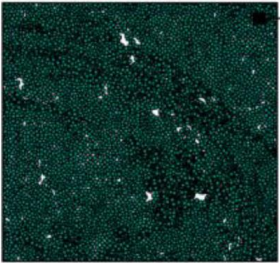
(a)

Hydrologic data from
CREST

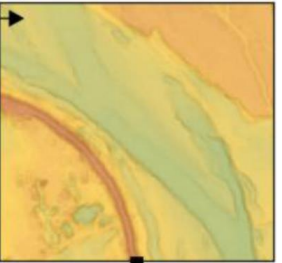


Q (m³/s)

LiDAR ground
point's elevation



LiDAR based DEM



Elev
High
Low

2D streamflow and flood modeling using HEC-RAS v.5.0.3

2D streamflow
accuracy

2d flood analysis every 12 hours, and
forecasts for 36 hours

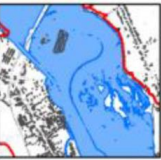
(c)



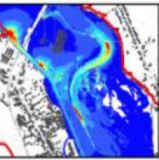
Flood pattern

Max
Min

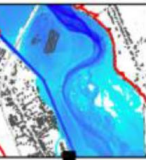
Flood extend



Flood velocity



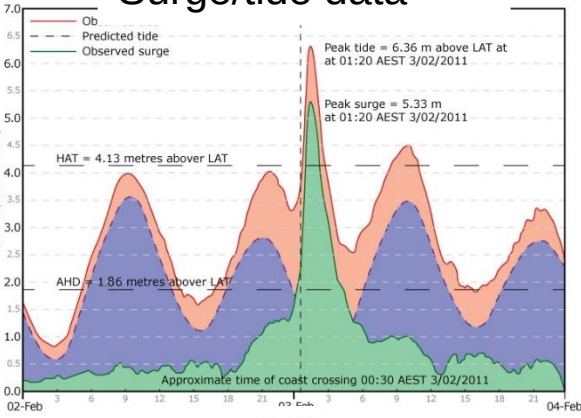
Flood depth



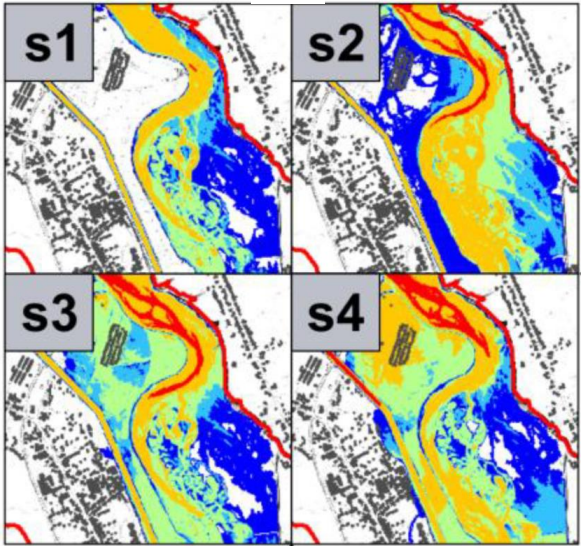
Flood hazard assessment

(b)

Surge/tide data



(d)



Depth (m)
High
Low

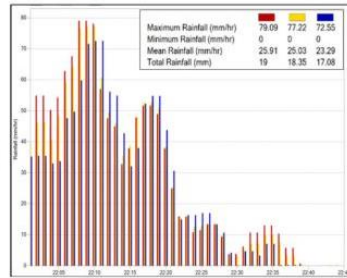
S1: forecast 36 h ago
S2: forecast 24 h ago
S3: forecast 12 h ago
S4: analysis

Dissemination of results

Local environment



Hydrologic model produces discharges for each stream

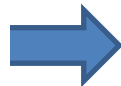


Hyetographs are fed into 1D/2D model.

Discharge is fed to the 2d flood model

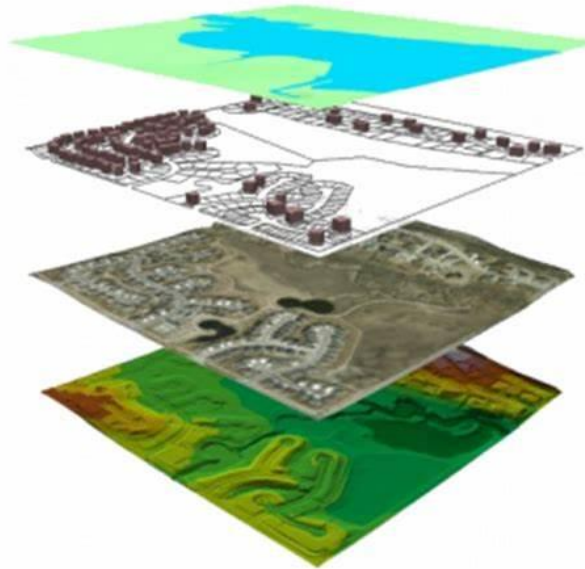


Depth maps are produced for each simulation



WEB-Gis

The results are imported in a Web-GIS architecture



User

Users visualize the most recent results on their preferred browser

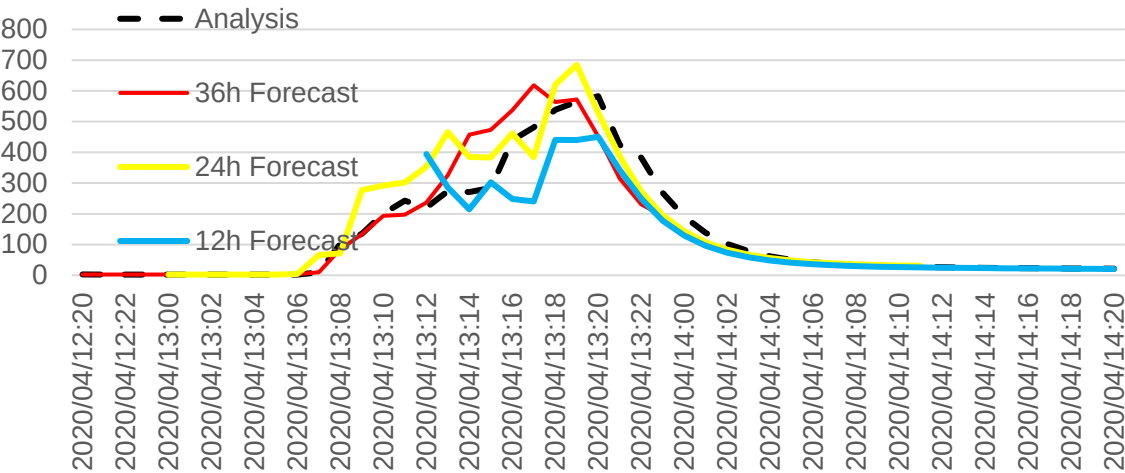
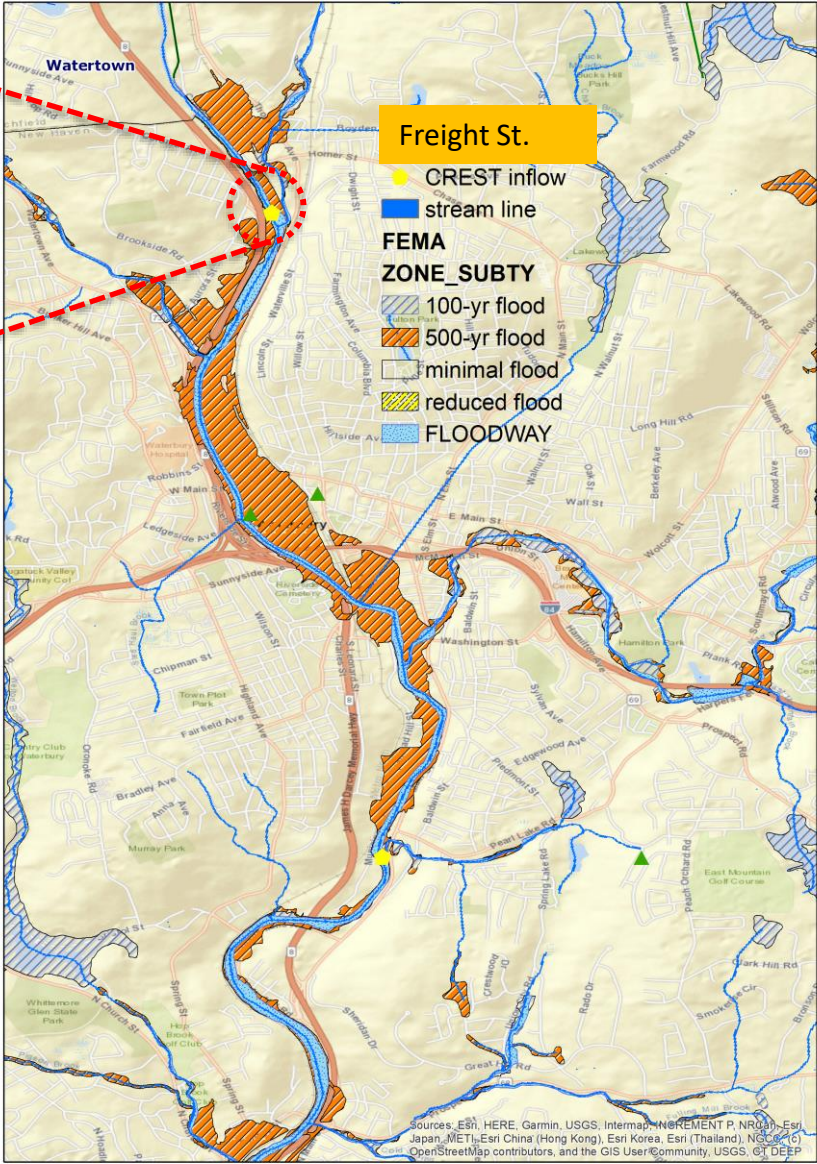
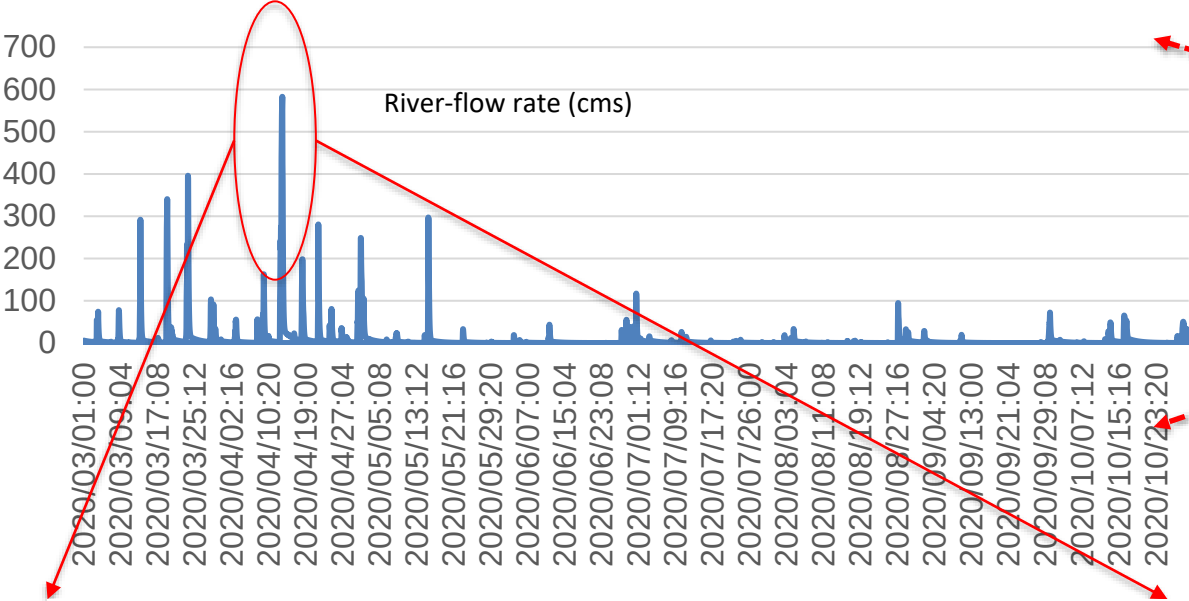


Web-gis

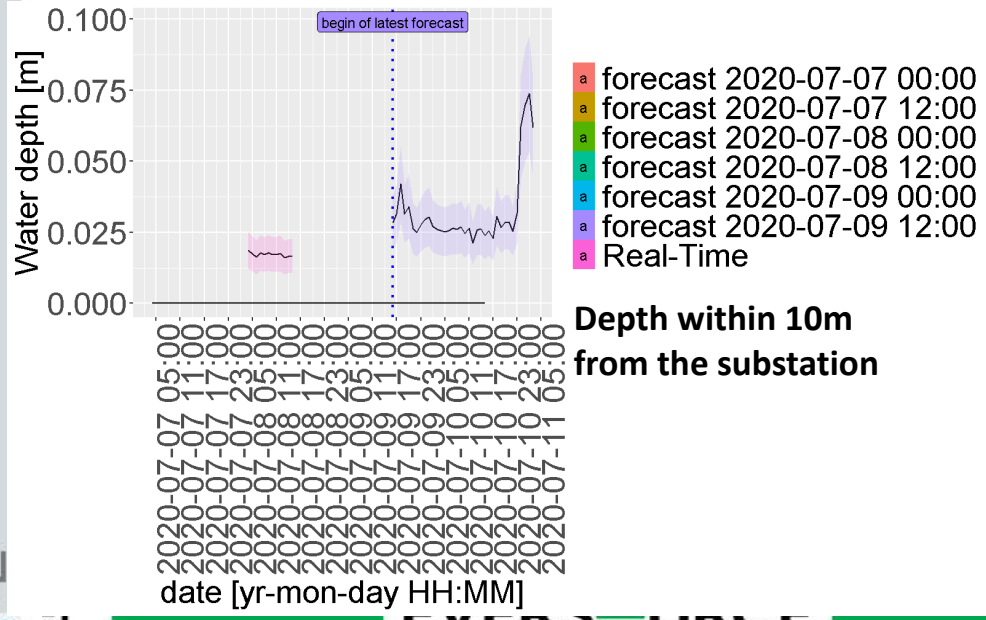
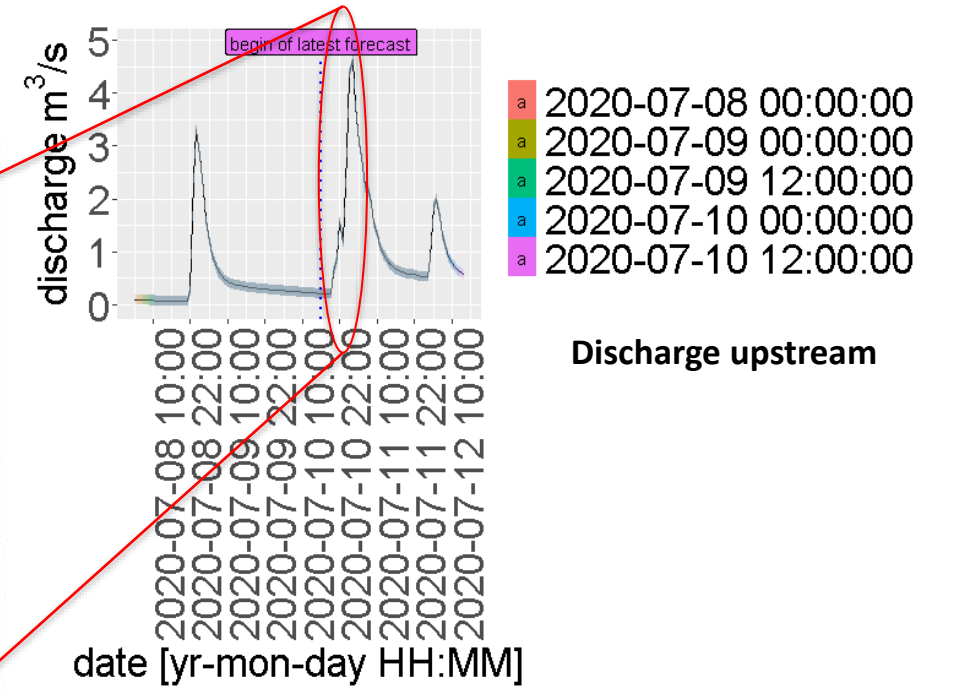
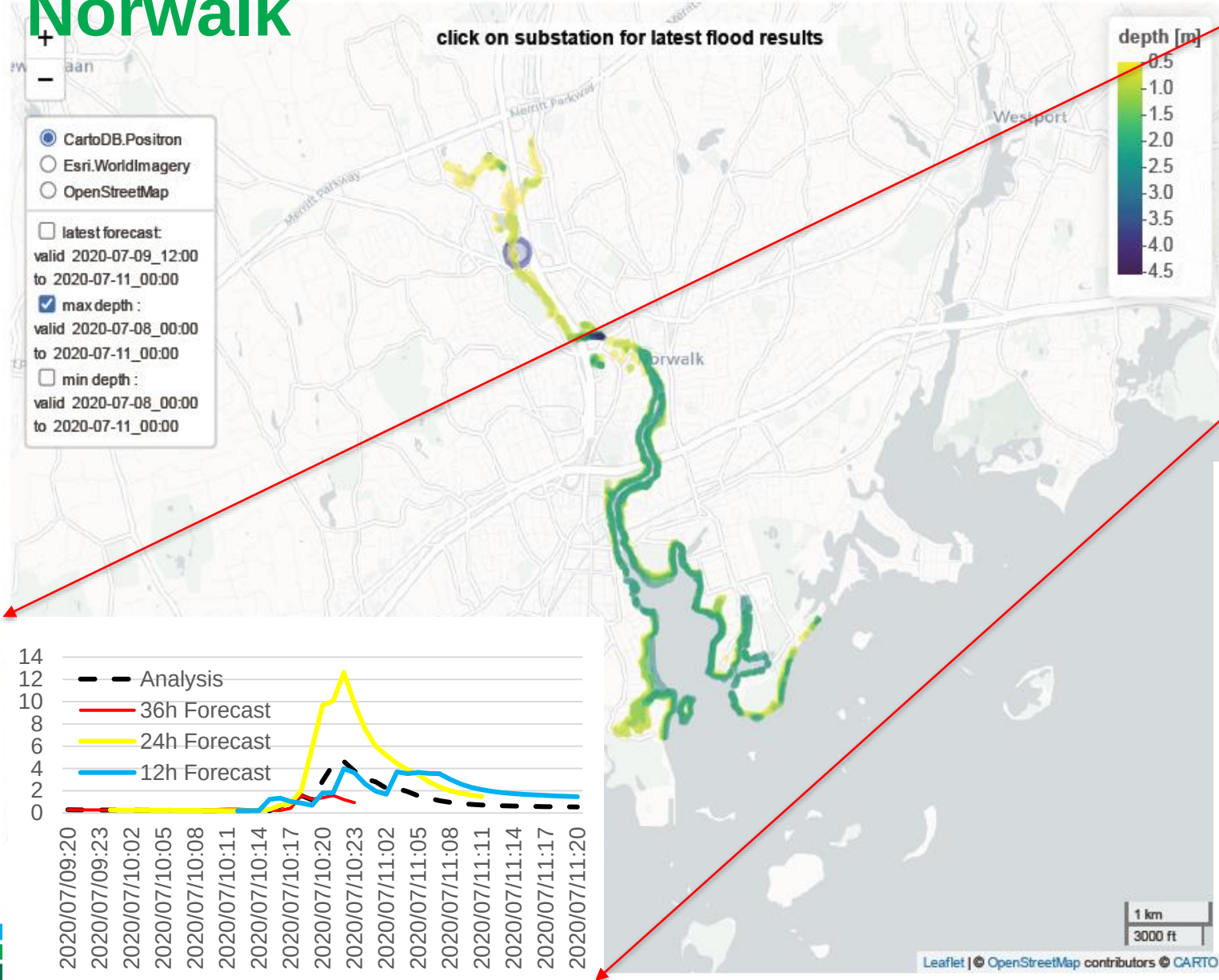
General map with all the critical locations, with quick access to latest results



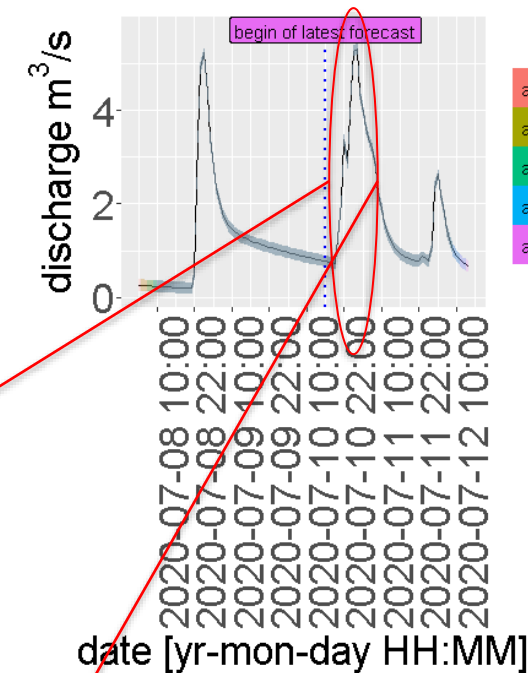
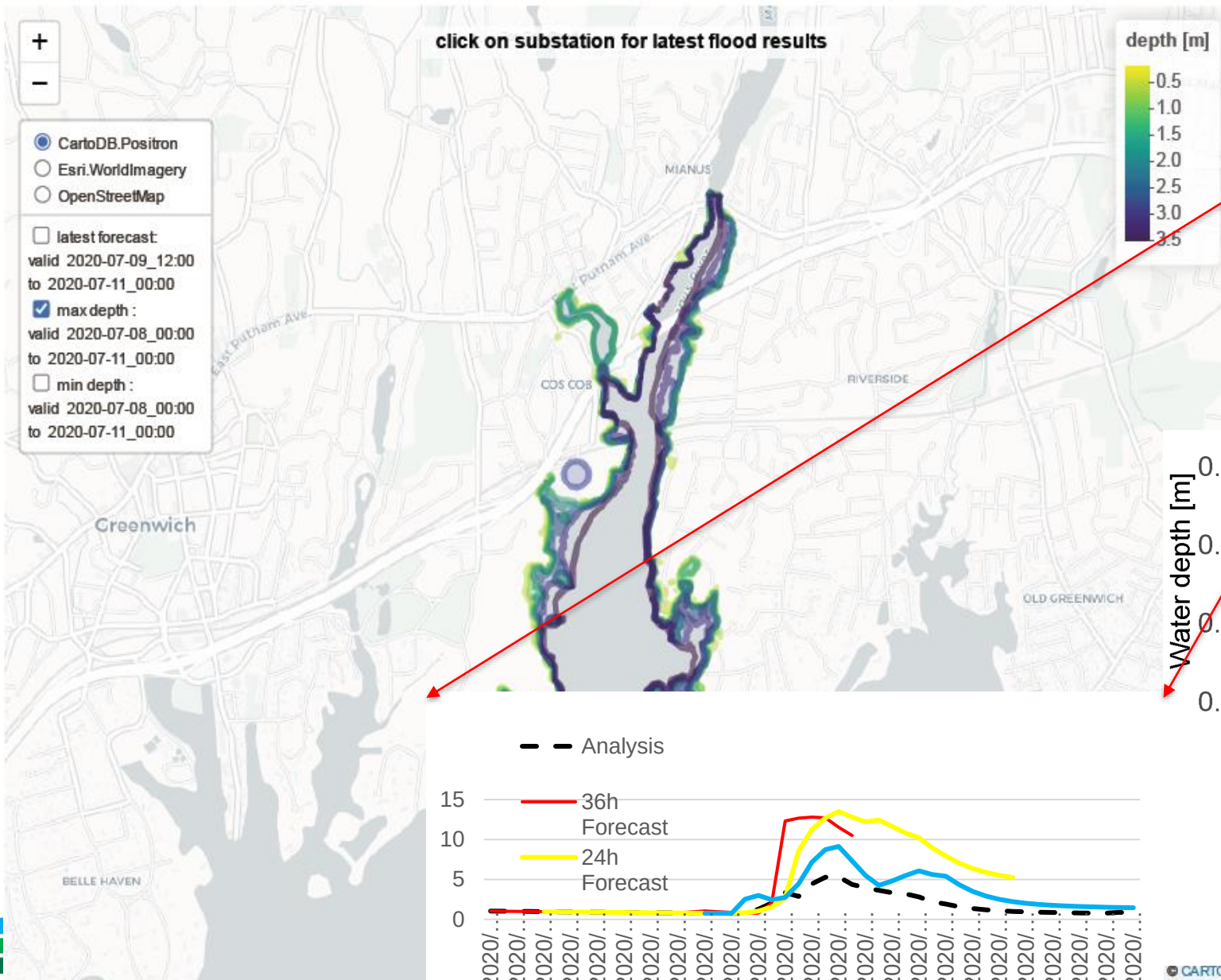
River Flow Forecast vs. Analysis- Freight St.



Example from July 7th-10th 2020: Norwalk



Example from July 7th-10th 2020: Coscob



a 2020-07-08 00:00:00

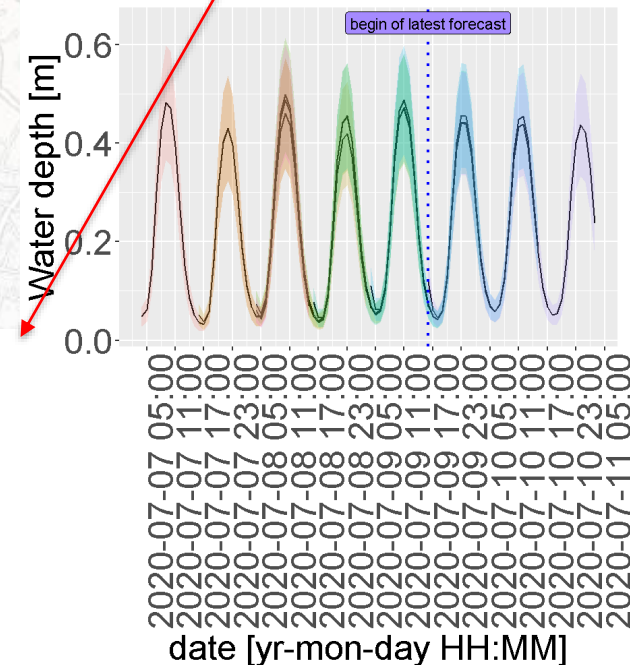
a 2020-07-09 00:00:00

a 2020-07-09 12:00:00

a 2020-07-10 00:00:00

a 2020-07-10 12:00:00

Discharge upstream



a forecast 2020-07-07 00:00

a forecast 2020-07-07 12:00

a forecast 2020-07-08 00:00

a forecast 2020-07-08 12:00

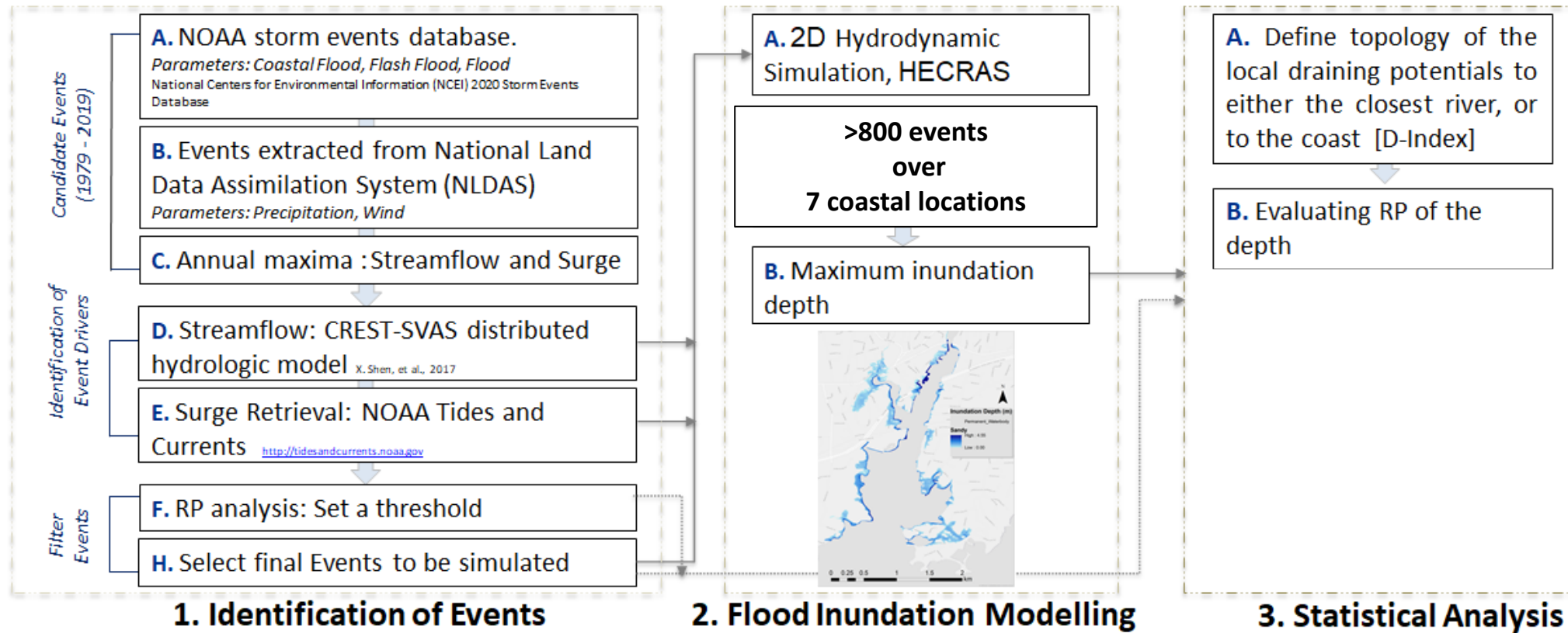
a forecast 2020-07-09 00:00

a forecast 2020-07-09 12:00

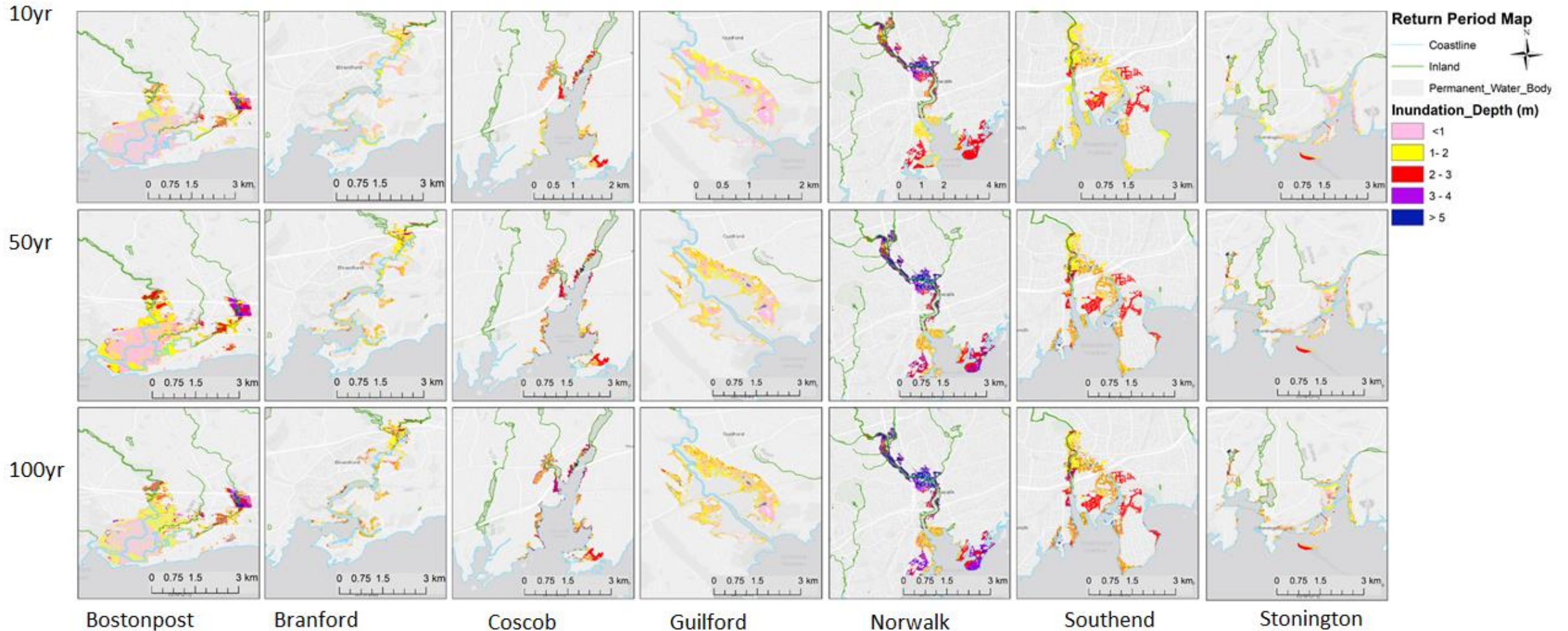
a Real-Time

Depth within 10m
from the substation

Compound Inundation Risk: Storm Surge and River High Flow



The Frequency of Inundation Depth-Estimation from past records



Predict the property insurance claims for the next flood event (iClaim)

Flood Event Locator

- USGS Water watch
- NOAA/NCEP Stage IV precipitation
- NOAA tidal/surge water level

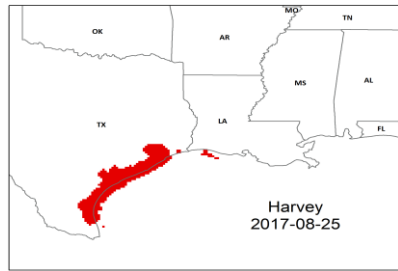
Event-wise Insurance Claim Modeling

- Hydrometeorological predictors
- Remotely sensed inundation maps (RAPID)
- Topographic distribution of buildings
- Land use/geomorphology
- FEMA/NFIP transactions as reference

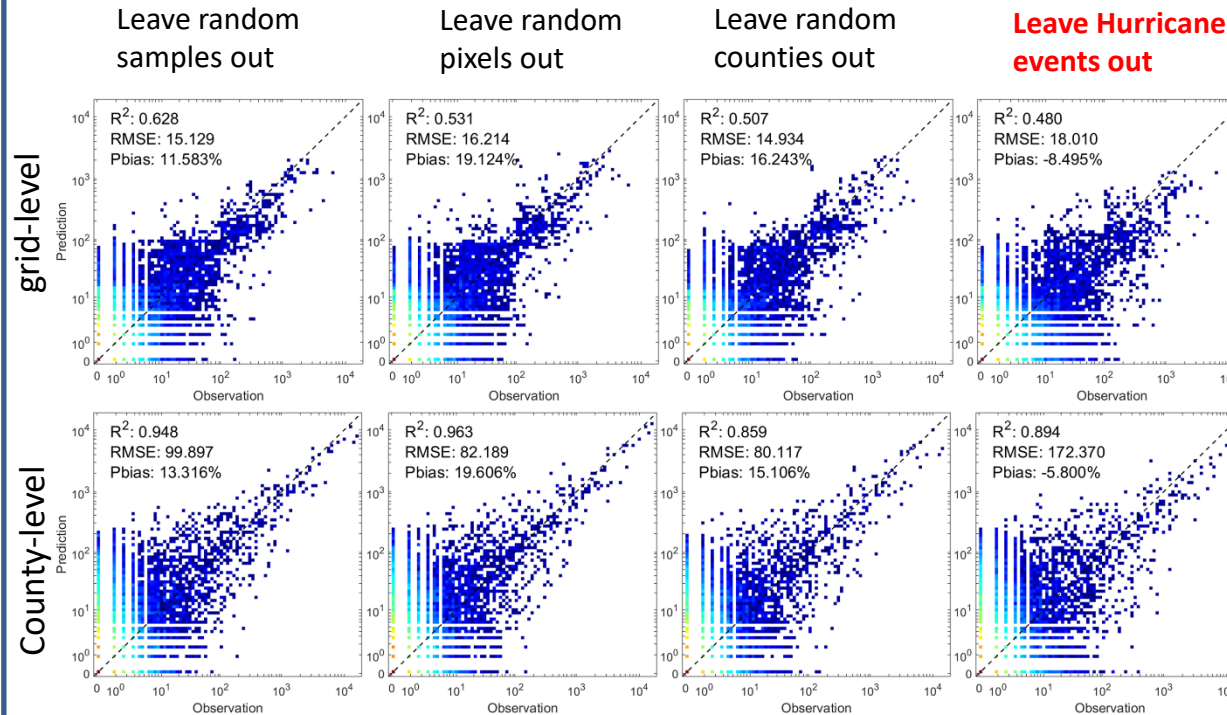
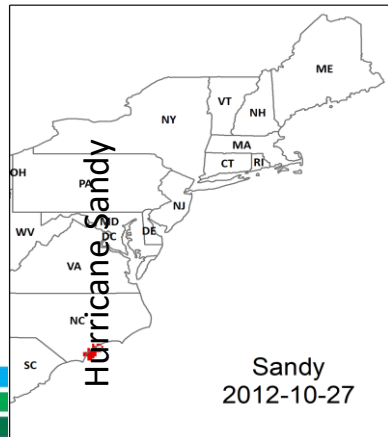
Prediction Validation (Leave One Out, LOO)

- (a) Leave random samples out
- (b) Leave random grids out
- (c) Leave random counties out
- (d) Leave events out

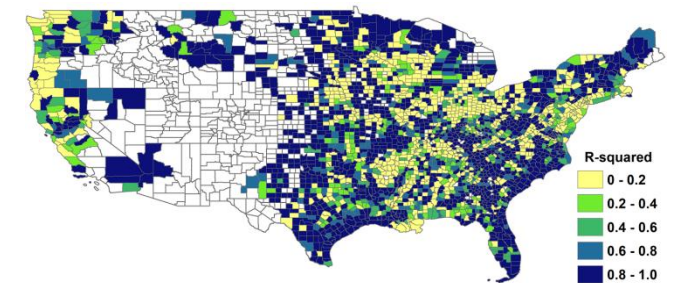
Identified potential flood zone (PFZ) for prediction



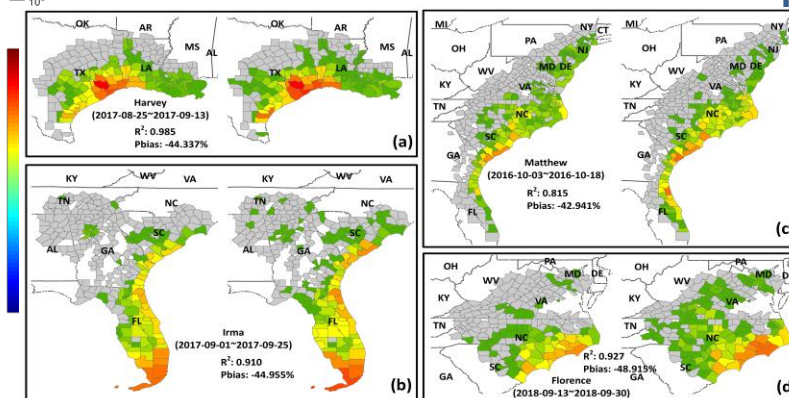
Hurricane Harvey



R^2 distribution of the CONUS



Predicting the unseen extreme Hurricanes



Eversource Energy Center

