U.S. Army Corps of Engineers H&H Research Activities

2nd Annual PFHA Research Workshop

Christopher Dunn, P.E., D.WRE
Hydrologic Engineering Center
Institute for Water Resources

John England, Ph.D, P.E., P.H., D. WRE
Risk Management Center
Institute for Water Resources

Norberto Nadal-Caraballo, Ph.D
Coastal Hydraulics Laboratory
Engineer Research and Development Center

January 25, 2017

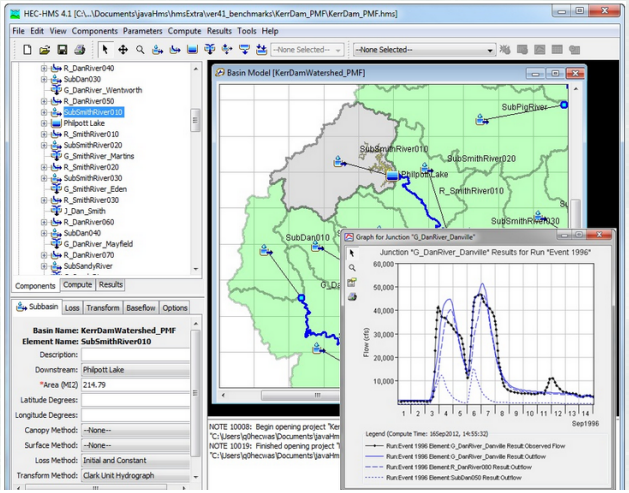
US Army Corps of Engineers
BUILDING STRONG®
www.hec.usace.army.mil

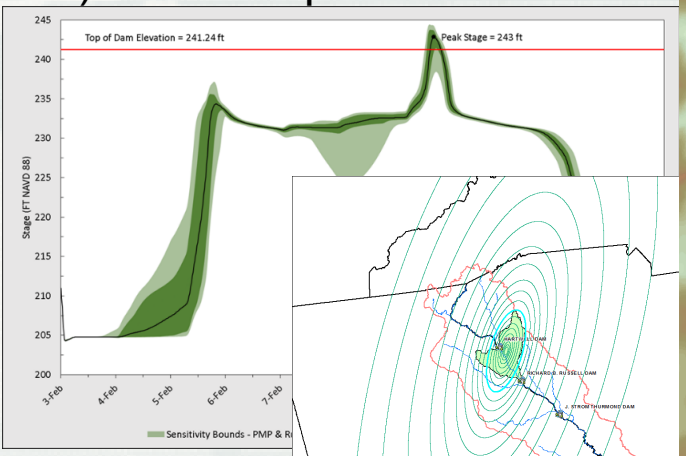
Hydrologic Modeling System

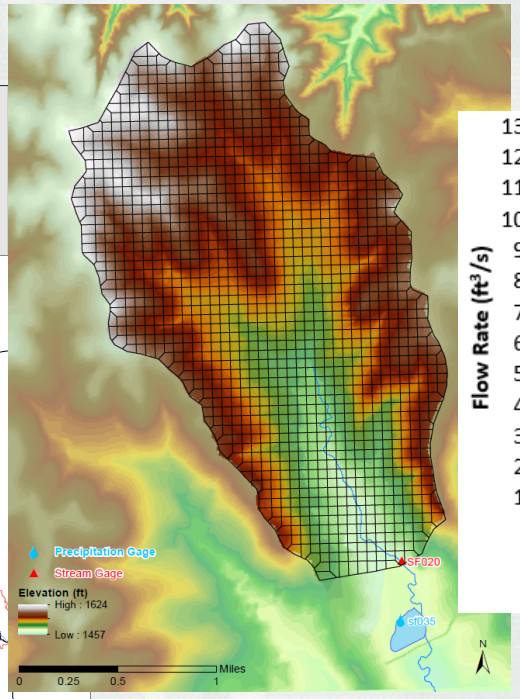
HEC-HMS R&D Efforts

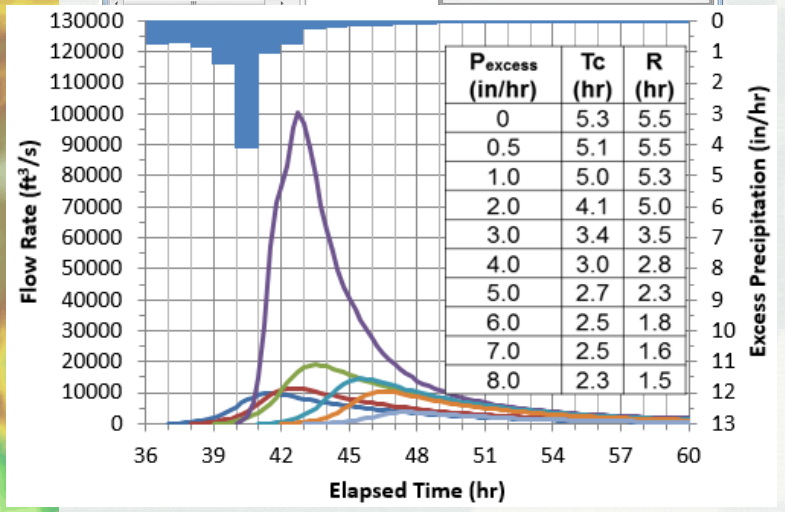
a) Energy Balance Snowmelt
b) Sampling Starting Snow Water Equivalent (meteorologic variables)
c) Classical MC and New MCMC Optimization and Uncertainty
d) Variable Clark UH
e) 2D Overland Flow and 2D sediment Transport
f) Flood Forecasting
g) HMR 52 Storm Tool
h) GIS Capabilities

Computes streamflow throughout a river basin given precipitation and watershed characteristics









IWR INSTITUTE FOR WATER RESOURCES

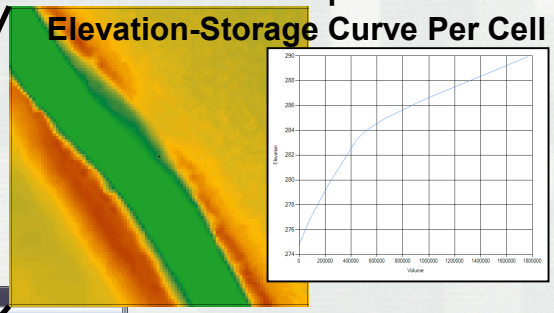
BUILDING STRONG®

River Analysis System

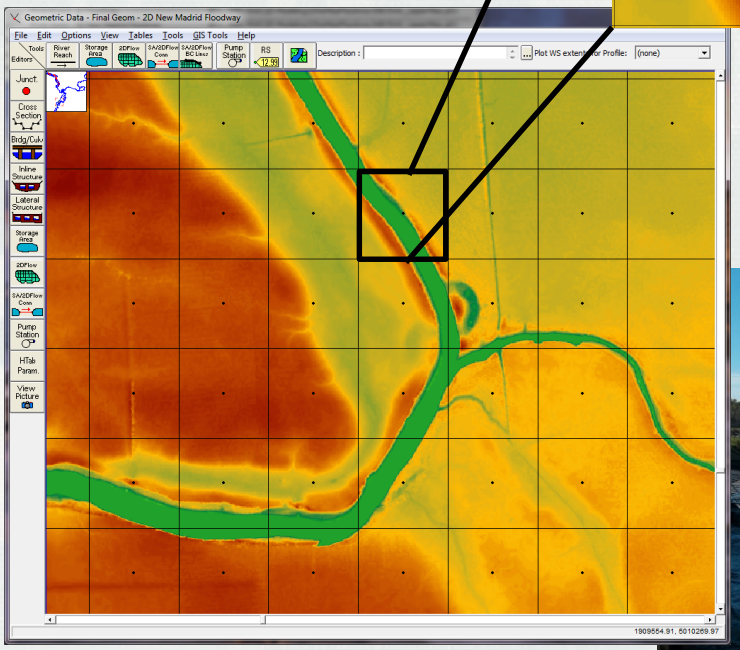
HEC-RAS R&D Efforts

a) 2D Hydraulics
b) Uncertainty Analysis
c) Unsteady Flow and 2D Sediment Transport
d) GIS and Mapping
e) Physical Breaching
f) Wind Forces
g) Water Quality

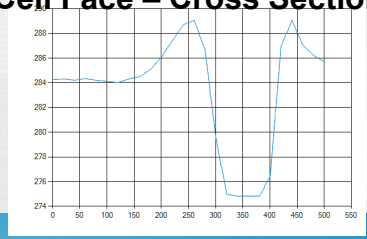
Computes river velocities, stages, profiles, and inundated areas given stream flow and geometry

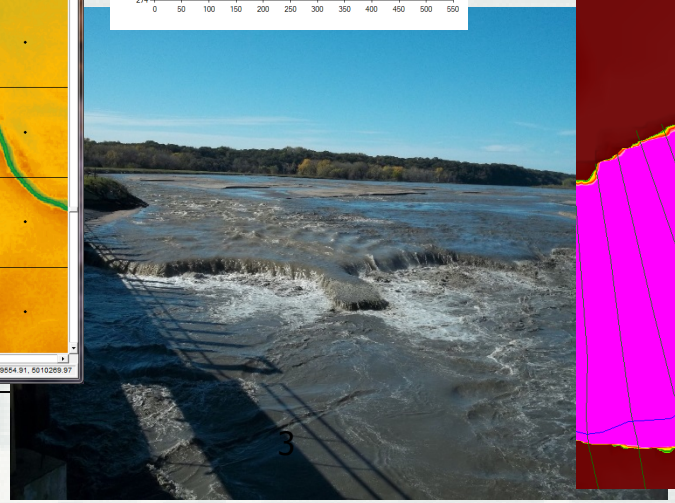


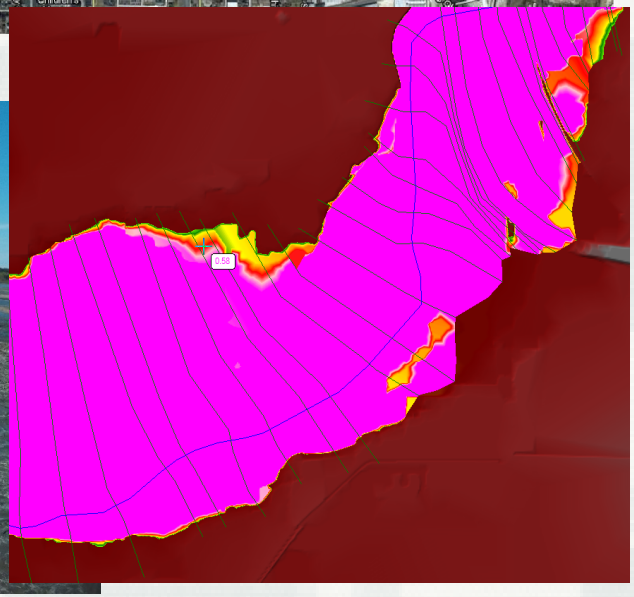
Elevation-Storage Curve Per Cell



Cell Face – Cross Section





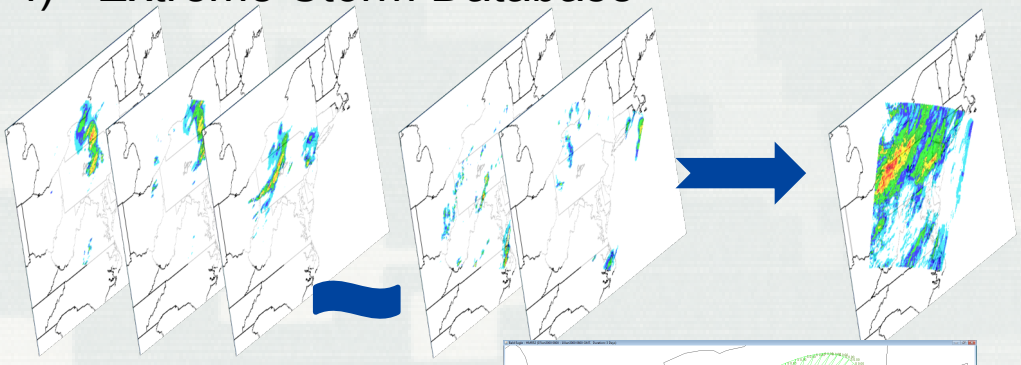


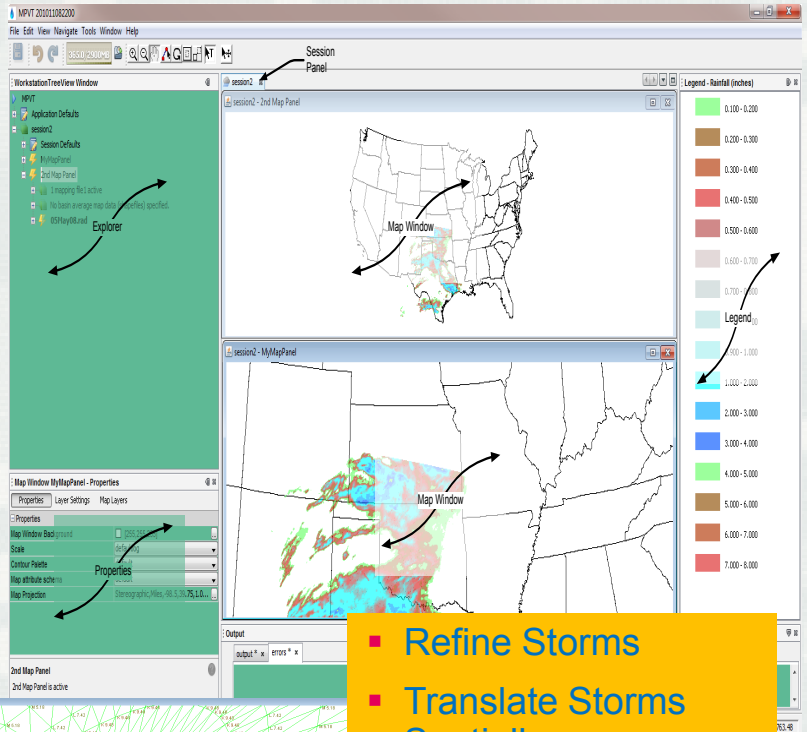
Meteorologic Visualization Utility Engine

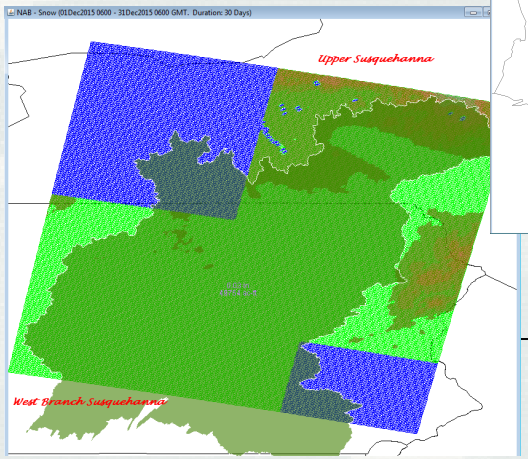
HEC-MetVue R&D Efforts

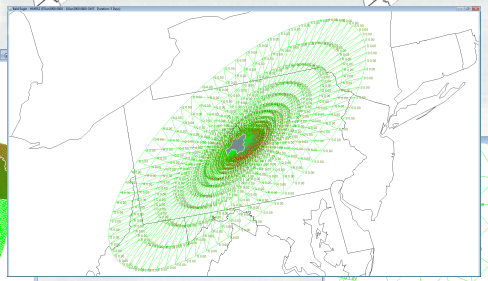
a) Data Manipulation to Create Modified Storms
b) Temporal Disaggregation/Aggregation
c) Spatial Aggregation
d) Hypothetical Storm Design
e) CWMS Enhancements
f) Extreme Storm Database

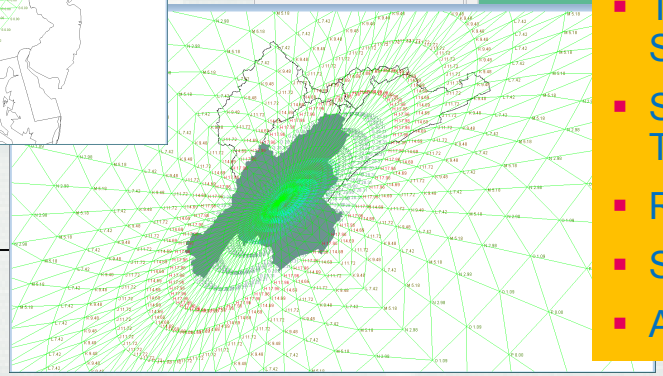
Visualize storm events and computes optimal/standardized design storms given historic events







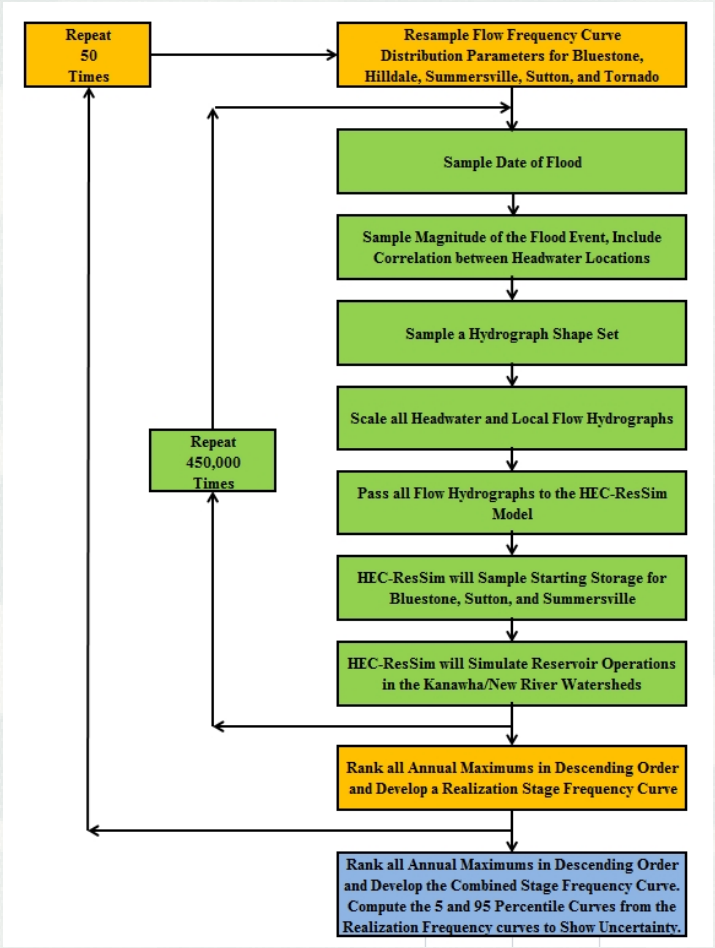


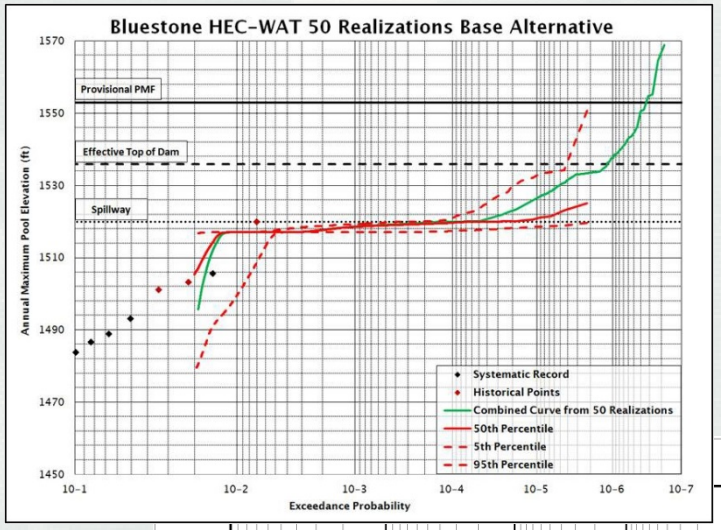


- Refine Storms
- Translate Storms Spatially
- Shift Storms Temporally
- Rotate Storms
- Scale Storms
- Animate Storms

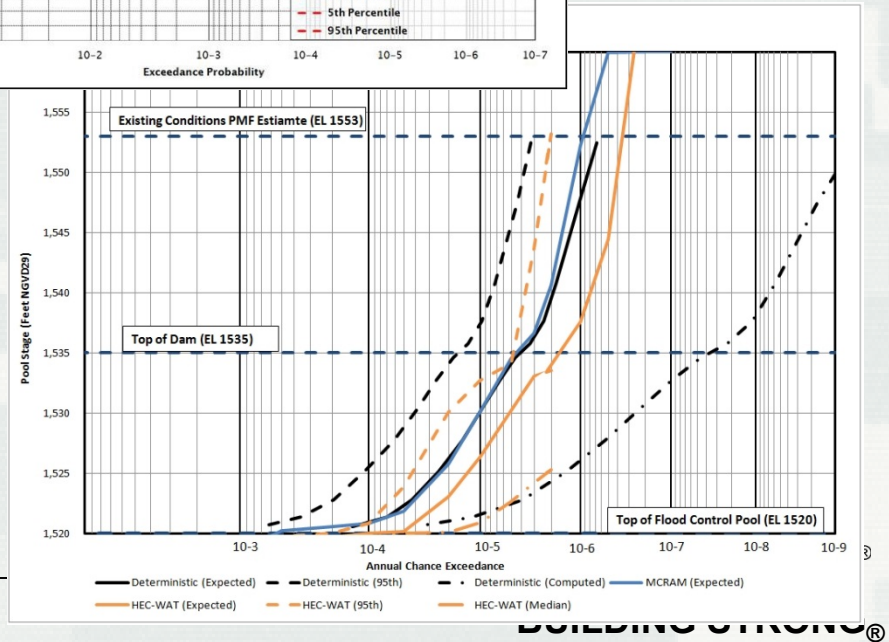
Hydrologic Hazard Team
Bluestone Dam, WV Example DSMS

Flow and Reservoir Pool Frequency (HEC-WAT), subsequent MCRAM runs





Key inputs for risk analysis – assess spillway failure and overtopping



Willamette Dams, OR
Hydrologic Hazards

Willamette Dams Hydrologic Hazard-

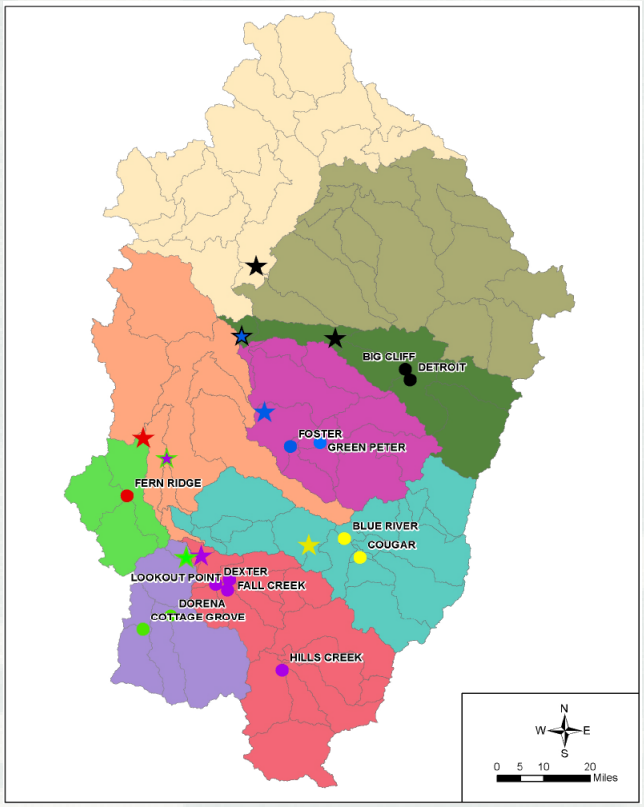
Major Subbasin Modeling

15 Calibration/3 Validation

Provides Dam-Specific Loading Curves

Consequences flows less than PMF

- Regional precipitation frequency curve for each major watershed
- Unit hydrograph sampling for each major watershed
- Soil loss, baseflow sampling for each major watershed
- Starting elevation sampling
- Debris loading for each major watershed
- Gate Failure Scenarios
- Top 5-10 synthetic temporal and spatial storm pattern sampling
- Critical precipitation duration analysis
- SWE deterministic analysis



Hydrologic risk estimates – 7 key dams
HEC-WAT (HMS, ResSim, sampler)
System operations

U.S. Army Engineer R&D Center

Coastal and Hydraulics Laboratory

Probabilistic Coastal Hazard Assessment (PCHA) Products

- StormSim – stochastic storm simulation system
  - Used for joint probability analysis of coastal storm hazards.
  - GUI in development for select statistical tools.
- CSTORM modeling system
  - Standardizes application of high-resolution, highly skilled numerical models.
  - Consists of WAM for deep water waves, and tightly two-way coupled ADCIRC and STWAVE for storm surge and nearshore waves.
- Coastal Hazards System (CHS)
  - National coastal storm hazard data resource, spanning practical probability and forcing-parameter spaces.
  - Contains numerical and probabilistic modeling results including storm surge, astronomical tide, waves, currents, and wind.

U.S. Army Engineer R&D Center

Coastal and Hydraulics Laboratory

Probabilistic Coastal Hazard Assessment (PCHA) Studies

- North Atlantic Coast Comprehensive Study (NACCS)
  - Virginia to Maine
  - Statistical reanalysis (v.2) to be completed in 2017
- Coastal Texas Study
  - To be completed in summer of 2017
- South Atlantic Comprehensive Study
  - Phase I (2018), Phase II (2019)
  - South Florida to North Carolina
    - including Puerto Rico and USVI
  - Mississippi to South Florida