



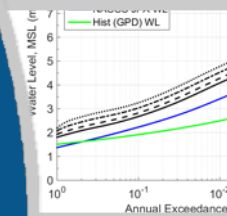
Drivers of Uncertainty in External Flood Probabilistic Risk Assessment

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Introduction

Norberto C. Caraballo-Nadal, PhD



■ Position:

- Lead, Coastal Hazards Group
- (Research Civil Engineer)

■ Experience:

- U.S. Army Engineer R&D Center, Coastal and Hydraulics Laboratory (ERDC-CHL) (2007-present)

■ Education:

- PhD in Civil Engineering, University of Puerto Rico – Mayagüez (2007)

■ Research Interests:

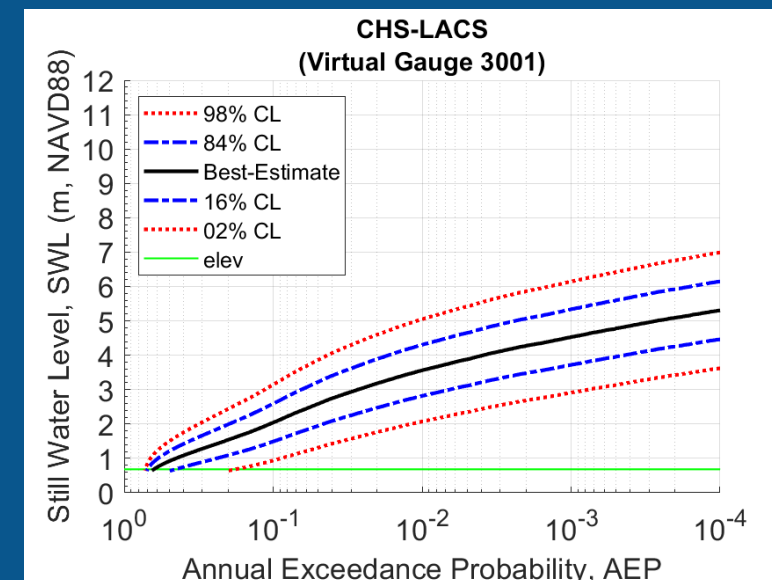
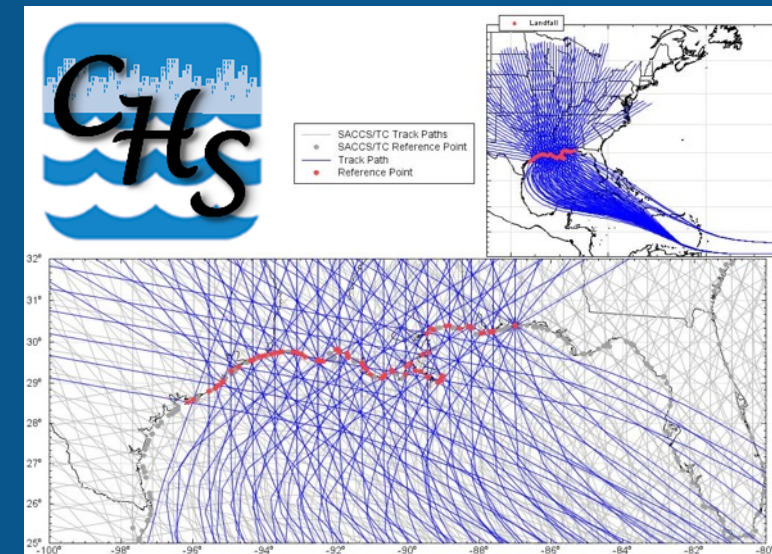
- Coastal storm hazards – storm surge, waves, wind, rainfall, flooding
- Probabilistic hazard analysis
 - ▶ Joint probability models
 - ▶ Multivariate correlation (copulas)
 - ▶ Uncertainty quantification
- Extreme storm climatology and coastal hydrodynamics
- Metamodeling (surrogate modeling)
- Compound flooding
- Risk assessment (consequences)



Coastal Hazards System (CHS)

A Probabilistic Coastal Hazard Analysis (PCHA) framework

- **Products:** storm hazard and uncertainty
- **Applications:** planning, economics, engineering design
- **Regional studies:**
 - North Atlantic Coast Comprehensive Study (NACCS)
 - Coastal Texas Protection and Restoration Study
 - South Atlantic Coast Study (SACS)
 - ▶ Phase I: Puerto Rico & U.S. Virgin Islands
 - ▶ Phase II: North Carolina to South Florida
 - ▶ Phase III: South Florida to Mississippi
 - Louisiana Coastal Protection and Restoration (LACPR 2020)
- **Use of CHS data in Coastal Storm Risk Management (CSRM) projects:**
 - CSRM systems currently under construction or in review are expected to return +\$280B in prevented damages.



Thoughts on Uncertainty

- **Different definitions:**
 - Epistemic Uncertainty vs. Aleatory Uncertainty/Variability
- **Major contributors to uncertainty:**
 - Atmospheric and hydrodynamic modeling – per storm and localized uncertainty
 - Storm climatology – unreliable data prior to 1940s; storm size (R_{max})
 - Probabilistic analysis – relatively small storm suites; parameter correlations
- **Most critical source of uncertainty:**
 - Numerical modeling – lack of validation data; unreliable measurements
- **Overcoming challenges associated with uncertainty:**
 - Metamodeling (surrogate) of atmospheric and hydrodynamic responses
 - Spatially-varying estimation of bias and uncertainty



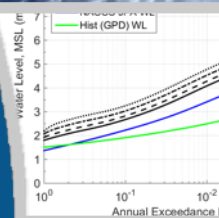
Thank you!

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