Grand research challenges #1: Models and validation

- Compounding, sequential and multivariate extreme events near the coast (e. g. sea-level rise, flooding etc.) require a more integrated approach to modeling their impacts.

- Model resolution must continue to increase to better represent small-scale processes associated with surface-atmosphere interactions at both the air-sea and land-atmosphere interfaces, identify critical resolution for the coastal problem.

- Coastal zone characterized by larger uncertainties, and models demonstrate less degree of confidence in simulating coastal processes/impacts.

- Use of hybrid approaches to model rare events (e.g. development of statistical dynamical/ML models that leverage observations).

- Improvement in model physics (investigate atmospheric boundary layer parametrization's role in modeling coupled processes, role of LES).

- Novel (specific science questions-driven) observational datasets and novel usages, to better understand the systems and validate them.

Grand research challenges #2: Metrics

- Current widely-used metrics are inadequate to coastal impacts from TCs/Precipitation extremes, unable to quantify model ability to simulate coastal storms.

- While there are many land-atmosphere coupling metrics, very fewer for atmosphere-ocean/lake coupling and land-ocean/lake coupling.

- New metrics, which are interpretable, encapsulate physical processes and better capture effects of complex large-scale processes on storm characteristics, must be developed.

- Two types of metrics are needed: Diagnostic (Tell us what is wrong with the model) and Process-based (Tell us why its wrong)

Grand challenge question

How do persistent and extreme ocean, lake, land, atmospheric, and human drivers individually and compoundingly influence coastal dynamics that control coastal erosion, flooding, deltaic dynamics, and land use changes that in turn feedback on atmospheric, terrestrial, and ocean/lake processes and determine the resilience of coastal ecosystems, infrastructure, and communities?