Coastal System Land-Atmosphere-Ocean Interactions

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Photo: Ben Jones

Coupling was central message of breakout

- ”Everything is coupled to everything”
- Resistance to being divided into Atmosphere, Land, Ocean subgroups
- Any other divisions: biogeochemistry, flooding, multi-sectors, however, has the same challenge
- Coupling has a huge range of scales:
  - Meter to submeter with high gradients right at the land-ocean interface
  - Teleconnections and global scale ocean dynamics propagating to coastal regions

Grand Challenge: What to leave out?

~~*How do persistent and extreme ocean, lake, land, atmospheric, and human drivers individually and compoundingly influence coastal dynamics that control 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?*~~

Why not? Rivers, sea ice, precipitation, groundwater, multiscaling, biogeochemistry, predictability, wave energy, adaptation…

Grand challenge by word cloud.

Grand Challenge: Is simpler better?

How should models be coupled at the coastal interface and how do these couplings affect predictions of the dynamics and feedbacks of the Earth and Human system components?

Feedback and reactions wanted: Google Drive, Slack, email (jrowland@lanl.gov)

Focused Questions (a few of many):

How do rivers control coastal BGC and ocean dynamics?

How do economics and land use interact with natural systems in coastal regions?

How does atmospheric – ocean coupling control coastal dynamics and change?

What is the role and importance of groundwater in coastal systems?

How do coastal systems vary regionally?

How do we quantify multiscale processes to inform both up- and downscaling of processes and feedbacks?

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)