OAK RIDGE National Laboratory

Simulating Estuarine Wetland Function:
Nitrogen removal, carbon sequestration, and greenhouse gas fluxes at the river-land-ocean interface

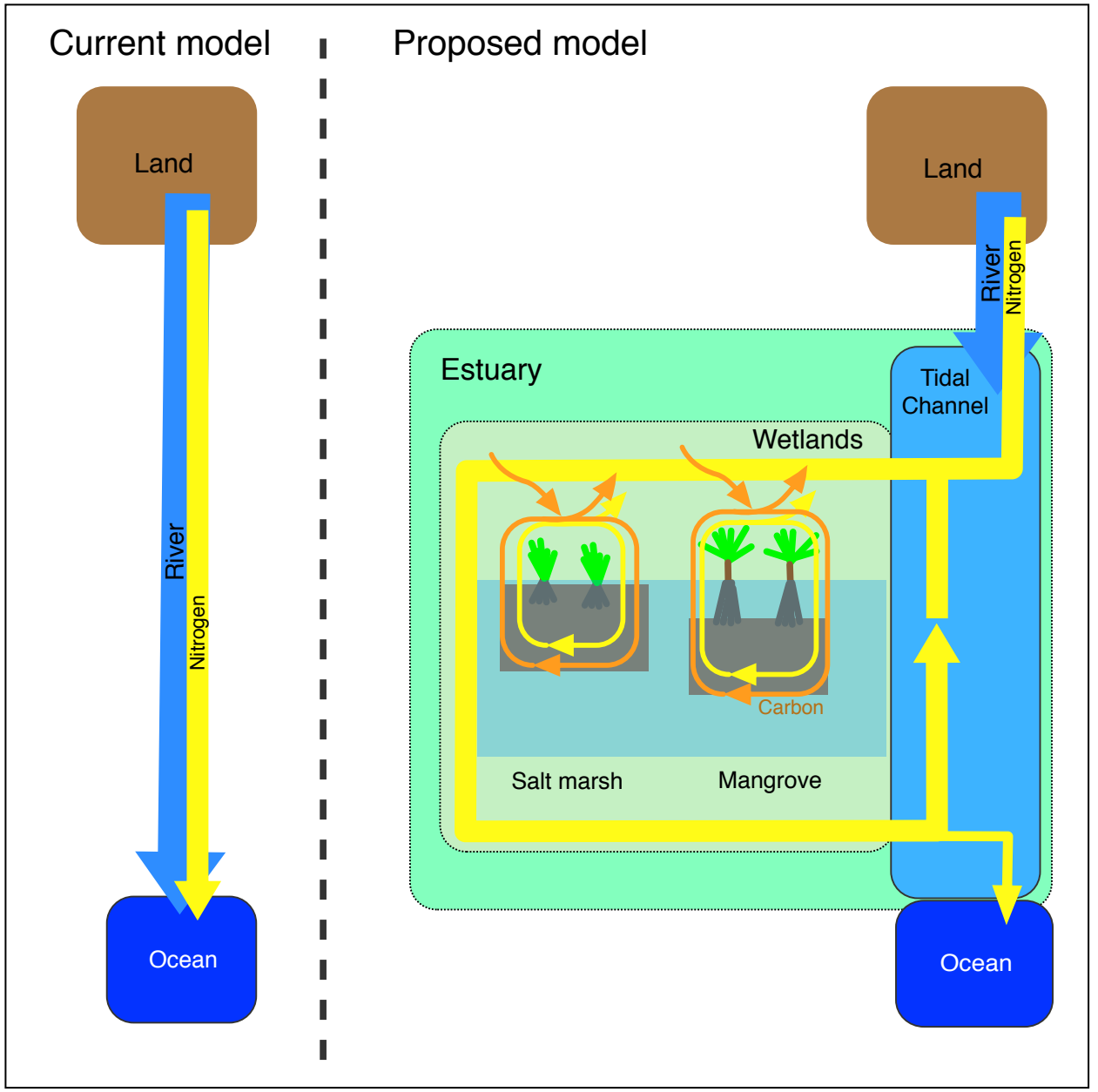
Early Career Award, Benjamin N. Sulman

ORNL is managed by UT-Battelle, LLC for the US Department of Energy

U.S. DEPARTMENT OF ENERGY

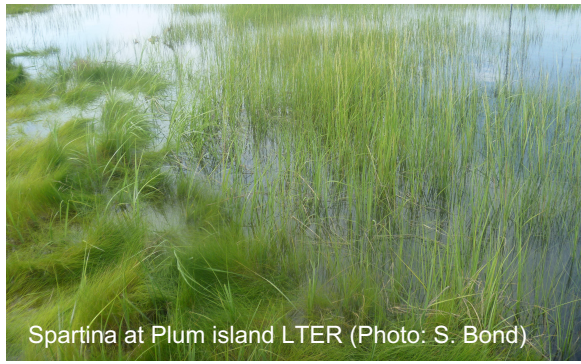
Rationale:

- Estuarine wetlands are hot spots of biogeochemical cycling due to high nutrient inputs and rapid redox fluctuations
- Waterlogged sediments drive high **carbon** sequestration but also produce greenhouse gases under anoxic conditions (CH_4, N_2O)
- Estuary **nitrogen** sequestration and emission as N_2O can remove up to 76% of river N flows before they reach the ocean
- E3SM currently simulates river flows as a pipe from land to the ocean, omitting these processes

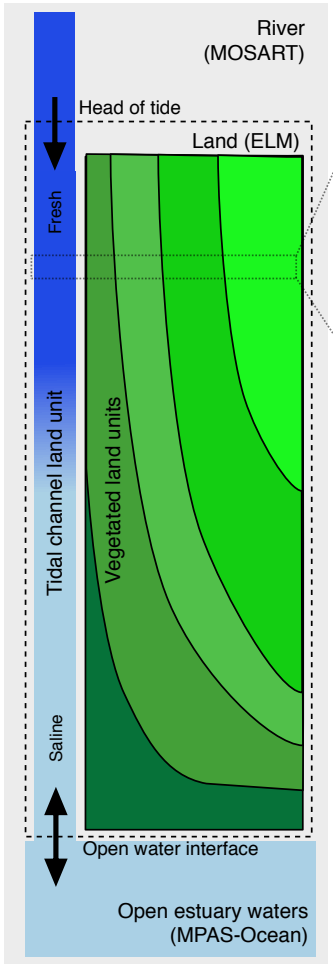


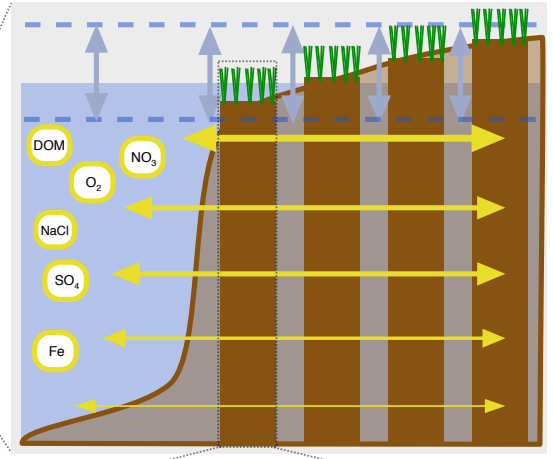
Process developments

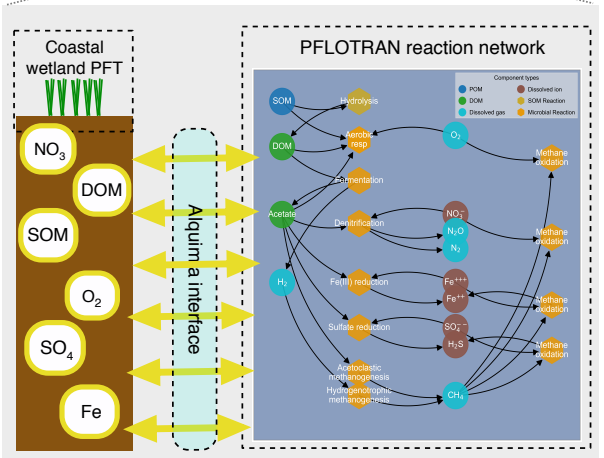
- Vegetation:
  - Develop salt marsh and mangrove plant functional types within ELM
  - Salt tolerance, inundation tolerance, and plant-mediated gas transport parameterizations
- Biogeochemistry:
  - Simulate redox transitions and other biogeochemistry in PFLOTRAN
  - Couple PFLOTRAN to ELM via Alquimia interface and ELM External Model Interface (EMI)
- Wetland-river-ocean coupling
  - Connect new ELM capabilities to river model (MOSART) and open ocean (MPAS-O) using new tidal channel land unit in ELM
  - Based on existing lake land unit, but with boundary conditions for river and open estuary water/ocean


Spartina at Plum island LTER (Photo: S. Bond)


Mangroves at Florida Coastal Everglades LTER (Photo: Franco Tobias)







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Scaling

- Begin with plot-scale parameterization and testing at selected well-studied sites
- Expand to estuary scale using wetland area inventories
- Expand to continental scale using MOSART coupling by end of 5-year project