Title: **Multiscale Data Synthesis and Analysis for Understanding Coastal Ecosystems**

Ben Bond-Lamberty[1*], Ben Brown[2], Nathan Conroy[3], Léa Enguehard[2], Nicola Falco[2], Jim Holmquist[4], Nate McDowell[1], Kendalynn Morris[1], Allison Myers-Pigg[1], Stephanie Pennington[1], Peter Regier[1], Nicholas Ward[1], Jianqiu Zheng[1], and Vanessa Bailey[1]

[1]Pacific Northwest National Laboratory, Richland, WA
[2]Lawrence Berkeley National Laboratory, Berkeley, CA
[3]Los Alamos National Laboratory, Los Alamos, NM
[4]Smithsonian Environmental Research Center, Edgewater, MD

Contact: (bondlamberty@pnnl.gov)
Project Lead Principal Investigator (PI): Vanessa Bailey
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Project Abstract: This multipronged data synthesis effort involved five key areas clearly and traceably linked with the main COMPASS-FME hypotheses and/or goals, and highly relevant for the project's modeling and/or experimental goals. These areas are to (i) assemble and synthesize disparate coastal datasets relevant to the project; (ii) use a meta-analysis to understand how top-of-column root- and/or microbe-generated greenhouse gas fluxes are affected by changes in water availability, experimental length, and ecosystem type; (iii) examine how inundation changes alter vegetation dynamics and lead to the formation of 'ghost forests' worldwide, and the mechanisms driving these changes; (iv) use machine learning to probe how estuarine and lacustrine water biogeochemistry and quality vary through time and space, and the effects of press and pulse disturbances; and (v) understand the degree to which coastal marsh plant production is driven by growing season phenology, tidal flooding, and species-specific effects. Finally (vi), a 'functional zonation' task focusing on spatial synthesis and inference is being used to scale results and models within COMPASS-FME as well as to the larger-scale companion project COMPASS-GLM.

We summarize progress in these areas, including initial results, the manuscripts submitted and published to date, and how this work links with other project MODEX efforts. Key results include the construction of a meta-analysis statistical pipeline for (ii), and ingestion of over 100 studies reporting soil water manipulation experiments; a completed literature review in (iii) that provides the foundation for a testable framework regarding ghost forest formation under changing inundation levels; extensive dataset assembly and analysis in (iv) working to identify linkages between water quality, ephemeral ecosystem control points, and disturbances; and an ongoing belowground traits meta-analysis (v) focusing on how these factors control coastal marsh productivity in the Chesapeake Bay (CB) region. Finally, the functional zonation team has assembled and co-registered spatial datasets across the CB and Lake Erie regions (vi), constructed maps of the functional zones in which the project's synoptic sites sit, and finalized regression models predicting peak plant productivity.