

SESSION: (B6) Frontiers in earth system prediction

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Seasonal to multi-annual marine biogeochemical prediction using GFDL's Earth System Model

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While physical ocean prediction systems routinely assimilate observations and produce seasonal to decadal forecasts, ocean biogeochemical (BGC) prediction systems are less mature due to additional challenges. A first impediment is the high BGC sensitivity to transient momentum imbalances that arise during physical data assimilation. In this study, we develop a strategy to robustly integrate the GFDL's ocean BGC model with the ensemble coupled-climate data assimilation (ECDA) system used for GFDL's seasonal to decadal global climate predictions. The ocean and atmosphere data constraints in the assimilation system are optimally modified to reduce BGC biases caused by momentum imbalances while retaining the information of observed physical states. We then performed retrospective prediction runs by initializing the model with the output from our ECDA run coupled with BGC model and investigated seasonal to multi-annual prediction skills of BGC variables over 1991 to 2016. We found that our earth system prediction system can provide skillful global marine biogeochemistry predictions about one year in advance in many ocean basins although forecast skill varied by region and initialization month. We further investigated potential utility of our earth system prediction system for marine resource management and found that reported temporal variability of annual fish catch in the Large Marine Ecosystem around the United States is well explained by predicted fish catch estimated from predicted BGC variables.