**Abstract**

Data assimilation under global coupled Earth System Prediction Capability (ESPC) presents significantly greater challenges than data assimilation in forecast models of a single earth system like the ocean and atmosphere. In forecasts of a single component, data assimilation has broad flexibility in adjusting boundary conditions to reduce forecast errors; coupled ESPC requires consistent simultaneous adjustment of multiple components within the earth system: air, ocean, ice, and others. Data assimilation uses error covariances to express how to consistently adjust model conditions in response to differences between forecasts and observations. In coupled ESPC, these covariances must extend from air to ice to ocean such that changes within one fluid are appropriately balanced with corresponding adjustments in the other components. We show several algorithmic solutions that allow us to resolve these challenges. Specifically, we introduce the interface solver method that augments existing stand-alone systems for ocean and atmosphere by allowing them to be influenced by relevant measurements from the coupled fluid. Plans are outlined for implementing coupled data assimilation within ESPC for the Navy’s global coupled model. Preliminary results show the impact of assimilating SST-sensitive radiances in the atmospheric model and first results of hybrid DA in 1/12 degree model of the global ocean.

**Results**

- SST increments are similar between all three experiments
- Positive impact of SST increments on the low atmosphere is clear along the coast of Israel and Portugal
- Using hybrid covariances ocean DA in the Pacific reduces RMS 24-hour forecast errors relative to in situ temperature and salinity observations

**Impact of interface coupling on atmosphere DA**

- **Sensor**: OAS, CRSS, CRSS, BHR, ATMS
- **Channels**: water vapor, temperature, salinity
- **% State Reduction in the first 24 hours**
  - OAS: 42.0
  - CRSS: 1.3
  - BHR: 24.3
  - ATMS: 22.2
  - OAS: 19.3
- **Interface error**

**Impact of hybrid covariance on ocean DA**

- **Sensor**: OAS, CRSS, BHR
- **Channels**: water vapor, temperature, salinity
- **% State Reduction in the first 72 hours**
  - OAS: 42.0
  - CRSS: 1.3
  - BHR: 24.3
- **Interface error**

**Conclusions**

- Need to find right balance in coupled DA (e.g., outer loop coupling, interface solver)

**Planned activities in the next year**

- Specific work plans:
  - Completing work on SST-sensitive channels
  - Tuning the performance of the ocean Hybrid-EnVAR
  - Implementing impact of ice velocities and temperatures on the atmosphere
  - Implementing impact of scatterometer winds, surface temperature, and humidity retrievals on the ocean