USING LETKF WITH THE ORIGINAL RELO FORECASTING SYSTEM

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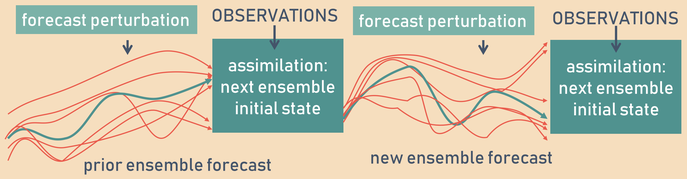
ABSTRACT

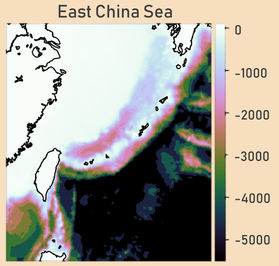
The aim of my project this year was to get the code for the Local Ensemble Transform Kalman Filter (LETKF) up and running with the Relocatable NCOM (Navy Coastal Ocean Model) Ocean Forecast System (RELO). I was assigned to set up the East China Sea domain, run the experiments, and create graphics using Python to visualize the results. I ran five experiments with different settings for the LETKF to find a base configuration for future testing. In the future we hope to implement LETKF in the global ocean model.

BACKGROUND



An **ensemble** forecast is a group of **several variations of a forecast** running at the same time. A single one of these many forecasts is called an ensemble member. By using multiple forecasts rather than one, the level of forecast **uncertainty**, the most likely forecast outcomes, and the probability of those outcomes can be determined. **This information can give the Navy more confidence in decisions that depend on ocean conditions.** The Naval Research Laboratory is just beginning testing of the LETKF data assimilation approach for regional ocean models. In this project, **I ran the first successful NCOM-LETKF forecast** and four additional experiments using the LETKF to explore how this brand new code works.

MODEL CONFIGURATION

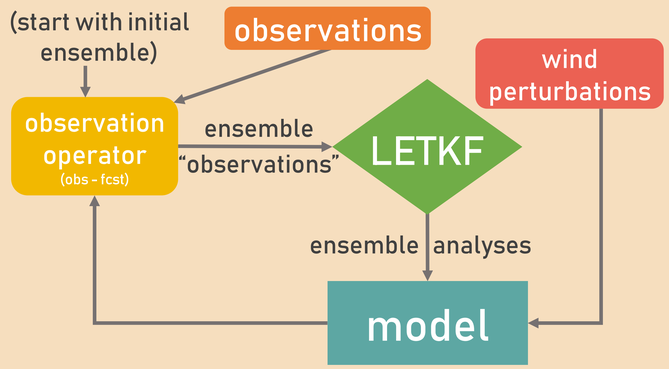


Bathymetry (in meters) of the NCOM configuration used in these experiments

- 6 kilometer^2 horizontal resolution
- 49 temperature levels
- HYCOM* boundary conditions
- COAMPS** surface forcing
- 24 hour update cycle
- 36 hour forecasts
- Assimilated all routine observations
- 32 ensemble members

* Hybrid Coordinate Ocean Model
** Coupled Ocean/Atmosphere Mesoscale Prediction Systems

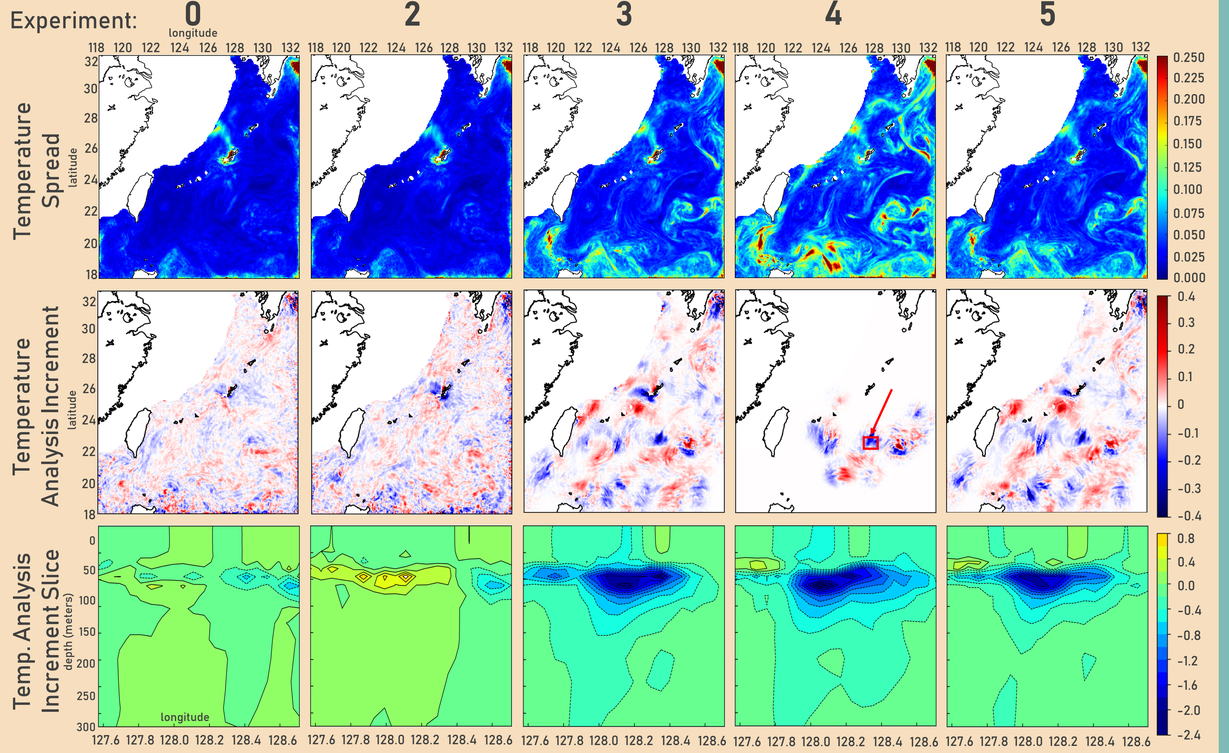
METHODS



To the left, you can see the flow of how LETKF fits into the RELO system. To the right is the table of the changes made for each LETKF experiment. Each of these changes were intended to **inflate the ensemble spread** in some way. The ensemble's spread is its **standard deviation** about the mean, and it represents **forecast uncertainty.**

experiment	MLD*-based vertical localization (*mixed-layer depth)	small horizontal localization	in-situ profiles only
0	✗	✗	✗
2	✓	✗	✗
3	✗	✓	✗
4	✗	✓	✓
5	✓	✓	✗

RESULTS



Top row: Temperature spread at 150 meters depth at 00z on 2018070200 after running the forecast for 30 days
Middle row: Temperature correction field for member 1 at 150 meters depth, same time as above
Bottom row: Vertical section of the temperature correction field for member 1 at 22.86 N (shown as the black box on Row 2, col. 3.
You can see that experiment #4 gives the highest spreads, but the in situ profiles only made it have an analysis increment in only a small region, making the spread too high in some places. From the visual results, either experiment 3 or 5 will be used for future testing as they give the most realistic results.

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