Innocent Souopgui³, William J. Teague² RESEARCH **12 February 2018**

1. ABSTRACT

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LABORATORY

Temperature and salinity profiles from 6 gliders within a roughly 40 km by 40 km region are assimilated into a Relocatable Navy Coastal Ocean Model (RELO NCOM) with a "multi-scale" four-dimensional variational (4DVAR) approach. Gliders were deployed north of Cape Hatteras (US East Coast) and inshore of the Gulf Stream in a field experiment from 17 May until 4 June 2017. Gliders were divided into two teams, generally two or three gliders per team. One team was tasked with station keeping and the other with moving and sampling regions of high variability in temperature and salinity. Data from gliders, in combination with multi-scale 4DVAR assimilation methods, have the potential to significantly improve model forecasts.

2. RELOCATABLE NAVY COASTAL OCEAN MODEL

- Baroclinic, Boussinesq, freesurface, hydrostatic forward model
- 3 km horizontal resolution (74 x 53 grid points) • σ -*z* vertical coordinate
- (25 σ -levels above 125 m)
- Tidal forcing $(M_2, S_2, K_2, N_2, K_1, O_1, C_2)$ P_1, Q_1 ; OSU Tidal Inversion Software)
- COAMPS atmospheric forcing
- Boundary conditions from a 3 km model nested in a global $1/12^{\circ}$ HYCOM model (experiment 92.8)





3. NCOM-4DVAR MULTI-SCALE ASSIMILATION

Weak-constraint indirect representer approach

- Sea surface temperature
- Sea surface height (SSH) via synthetic temperature and salinity profiles generated by the Modular Ocean Data Assimilation System
- Glider temperature and salinity profiles

Multi-Scale 4DVAR Experiment

Data

- 2 outer loops for observations with different spatial decorrelation length scales (20 km & 6 km)
- Loop 1: Surface data and spatially-averaged glider profiles (20 km binning/decorrelation length scale)
- Loop 2: Glider profiles only, 6 km decorrelation length scale

4. EXPERIMENTS

Spin up: 1 March – 17 April (3DVAR) and 18 April – 17 May (4DVAR) **CONTROL EXPERIMENTS**



Assimilation of Glider Profile Data in a Shelf Ocean via Multi-Scale 4DVAR (OM14B-2048) John J. Osborne¹, Matthew J. Carrier², Jeffery W. Book², Charlie N. Barron², Ana E. Rice², Clark D. Rowley², Lucy F. Smedstad²,

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5. GLIDER PROFILE LOCATIONS



- 1-6 gliders deployed each day, usually 5 or 6
- assimilate multiple profiles at one time







Top Row: Observed temperature and experiment results (analysis state, save for Free Run) at Glider A locations (red dots, map at top center). Bottom Row: Observed temperature and experiment results (analysis state, save for Free Run) at Glider D locations (orange dots, map at top center). Glider observations (left column) show thermal inversions (e.g., 20 May, 26 May through 1 June) from two selected gliders. Inversions are between roughly 20 m and 40 m depth and are hot, salty Gulf Stream water below cool, fresh shelf waters. The Free Run does not show inversion at the glider location. The Surface-Only experiment shows some inversion but is warmer than observed. The Multi-Scale 4DVAR experiment resolves the inversions and has similar temperature to observations throughout the water column.



(top) and adjusted in analysis (bottom).

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SST Composite (4 June 2017 0Z) and



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4DVAR experiment, temperatures are similar to observations. The inversion is present in both the forecast (top) and analysis (bottom).