UGOS Argo Float Fleet Update

Heather Furey, Anna Pinckney, Andrée Ramsey, Pelle Robbins & Amy Bower
Wood Hole Oceanographic Institution, Woods Hole, MA, USA

UGOS Annual Meeting
College Station, Texas
September 30-October 2, 2024

Overview:

NASEM GRP UGOS observations are critical to understanding and forecasting the evolution of the Loop Current and Loop Current Eddies. Since the initial release of 20 UGOS-funded temperature-salinity (T-S) profiling (Argo-equivalent) floats in 2019, we have maintained a fleet of these floats in the eastern Gulf of Mexico by periodically re-seeding floats to replace those that escape from the eastern Gulf, ground on shallow bathymetry, or reach end of life.

A total of 53 UGOS-funded floats have been deployed in the eastern Gulf (east of 90W) since June 2019. As of September 2024, 8,790 vertical profiles of salinity and temperature from 0-2000dbar have been collected (**Figures 1, 2**). Profile density is highest in the deep eastern Gulf, but some floats have escaped into the western Gulf. Others have exited through Florida Straits or grounded themselves on the continental slope (where they still continue to profile). **Figure 3** shows the number of profiles per month since 2019.

The UGOS-funded floats are the overwhelmingly dominant source of deep (>1000 m) T-S profiles in the Gulf of Mexico (International Argo does not sample marginal seas). The profile data are publicly accessible in near-real-time from global Argo data assembly centers, and delayed-mode, quality-controlled (DMQC) data are made available about 6-12 months after collection. The float data are being utilized in numerous UGOS and other research and operational applications, e.g., to refine vertical projection of remotely sensed surface observations, to improve estimates of upper-ocean heat content for hurricane forecasting, to develop methods for assimilating deep velocity observations, and to correct salinity biases in some operational ocean models.

The floats drift at 1500 m for five days between profiles, resulting in more than 8000 deep velocity measurements so far. Preliminary maps of mean velocity and eddy kinetic energy (EKE) derived from the profiling float velocity observations show similar patterns to equivalent maps constructed with 2011-2015 RAFOS float data (**Figure 4, 5**). For example, narrow deep boundary currents over the Sigsbee Escarpment and West Florida slope, and a tripole structure in the deep eastern Gulf, are evident for both time periods. The pattern of EKE is similar in both, but the magnitude is two times higher in the earlier time period because RAFOS float trajectories are much higher resolution (8-hour positions versus 5-day for profiling floats).

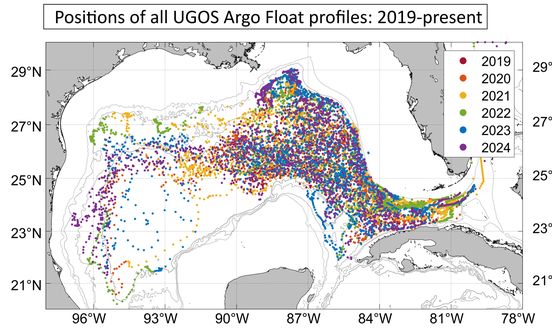

Figure 1: Map of T/S profile positions collected by UGOS-funded Argo floats from June 2019 – September 2024, color coded by year. The gray lines are bathymetry contours [500m, 1000m, 2000m, 3000m].

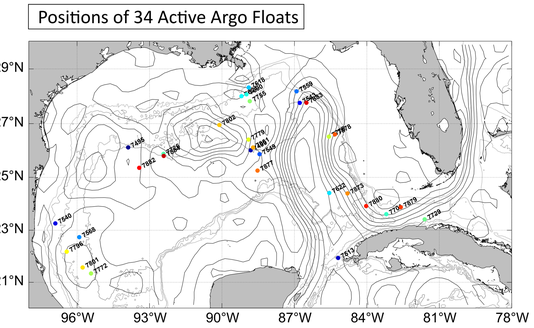

Figure 2: Map of Argo Float Positions as of September 10, 2024, with Absolute Dynamic Topography. The gray lines are bathymetry contours [500m, 1000m, 2000m, 3000m].

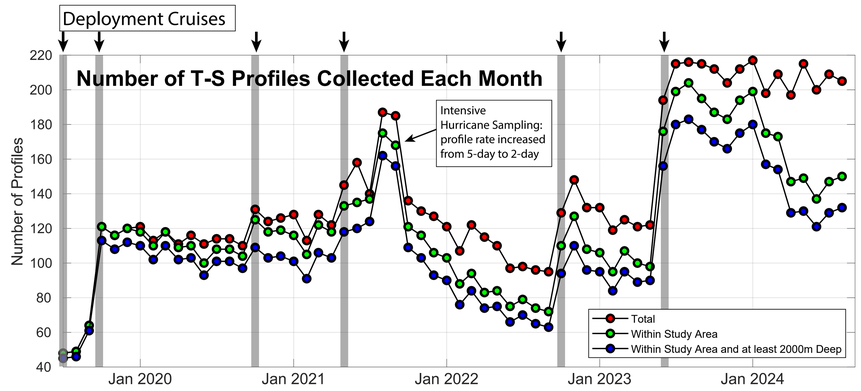

Figure 3: Time series of number of profiles collected by UGOS-funded Argo floats in the Gulf of Mexico from July 2019-August 2024. The red dots represent total profiles collected throughout the Gulf, the green dots represent number of profiles collected within the eastern Gulf only (between 93W and 81W), and the blue dots represent number of profiles collected within the eastern Gulf in water deeper than 2000 m.

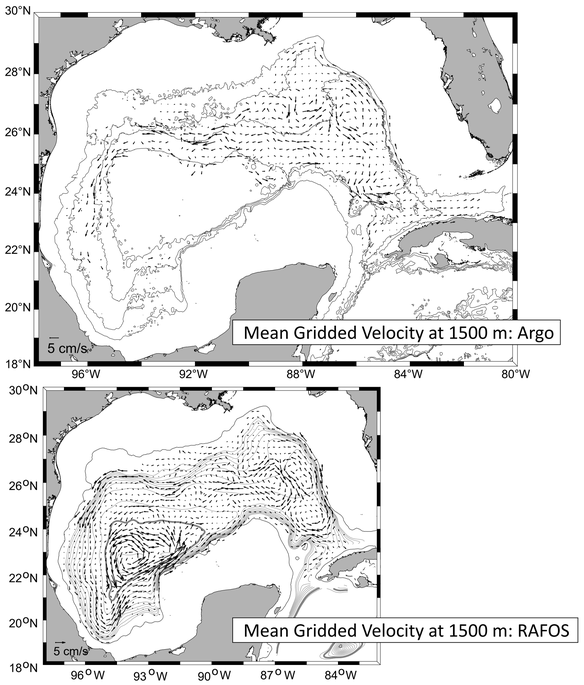

Figure 4: (upper) Preliminary results for mean June 2019 – present velocity derived from 5-day, 1500-dbar drift depth UGOS profiling float displacements. Velocity was binned on a regular grid of 0.5 x 0.5 degree overlapping boxes, centered on a 0.25 x 0.25 degree grid. Black contours show the 1000-, 2000-, 3000-, 3500-m isobaths. (lower) The same, but for 8-hourly, 1500-dbar RAFOS floats (adapted from Perez-Brunius et al., 2018). Planetary potential vorticity (f/H) contours in gray ([1.52:0.2:3.5] x 10^8 m-1 s-1), where f is the local Coriolis parameter and H is the bottom depth. Closed f/H contour 1.61 x 10-8 m-1 s-1 shown with a thick gray line.

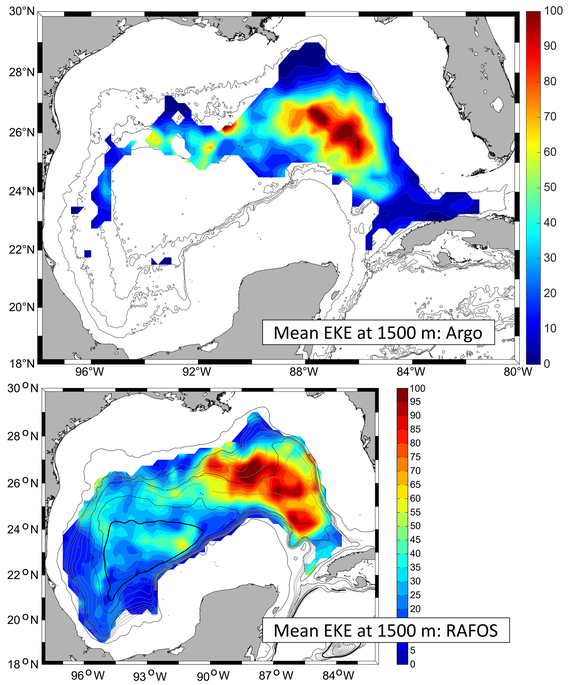

Figure 5: (upper) Preliminary EKE results from the mean June 2019 – present velocity derived from 5-day,1500-dbar drift depth profiling float displacements. Velocity was binned on a regular grid of 0.5 x 0.5 degree overlapping boxes, centered on a 0.25 x 0.25 degree grid. Black contours shows the 1000-, 2000-, 3000-, 3500-m isobaths. (lower) The same, but for 8-hourly, 1500-dbar RAFOS floats (adapted from Perez-Brunius et al., 2018). Planetary vorticity (f/H) contours as in Figure 4.

Pérez Brunius, P, H. Furey, A. Bower, P. Hamilton, J. Candela, P. Garcia-Carrilo, and R. Leben, 2018. Dominant circulation patterns of the deep Gulf of Mexico. Journal of Physical Oceanography, https://doi.org/10.1175/JPO-D-17-0140.1

The profiling floats are used in the following UGOS 2024 presentations:

> Empirical methods to vertically project surface information to produce 3D thermohaline fields
by Paula Pérez-Brunius, Paula García, Nathalí Cordero, José Miranda, Olmo Zavala, Bruce Cornuelle, Amy Bower

> Neural Synthetic Profiles from Remote Sensing and Observations (NeSPReSO)
by Jose R. Miranda, Olmo Zavala-Romero, Luna Hiron, Eric P. Chassignet, Bulusu Subrahmanyam, Thomas Meunier, Robert W. Helber, Enric Pallas-Sanz, Miguel J. C. A. Tenreiro

> Sensitivity of the satGEM technique to the selection of surface information parameters to project 3D thermohaline structure in the Loop Current region
by Nathalí Cordero Quirós, Paula Pérez Brunius, Bruce Cornuelle, Paula Garcia, Amy Bower

> Idealized eddy modeling and assimilation experiments to understand the vertical projection of surface information through MITgcm model dynamics.
by Ganesh Gopalakrishnan, Bruce Cornuelle, Alexandra Bozec, Eric Chassignet

> Observations and Forecasts of Hurricane Interactions with the Loop Current: Hurricane Idalia
by NASEM GRP UGOS WG-C, NOAA/Navy Hurricane Glider Team, IOOS Hurricane Model/Data Comparison Team

> Ocean and Coupled Observing System Experiments for Tropical Cyclone Applications (Uses RTOFS)
by Matthieu Le Hénaff, Hyun-Sook Kim, HeeSook Kang, Lew Gramer

NATIONAL ACADEMIES Sciences Engineering Medicine
GULF RESEARCH PROGRAM

This work was funded by the National Academy of Science Grant 2000013145.

WOODS HOLE OCEANOGRAPHIC INSTITUTION