Gus in the Gulf Stream: A model for sustained observing of western boundary currents

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Overview:
The Gulf Stream is a key part of the climate system, carrying warm waters poleward as part of the Atlantic Meridional Overturning Circulation. As it flows along the US East Coast from the Florida Strait to the open North Atlantic, the Gulf Stream triples its volume transport and separates from the continental margin; meandering and eddy shedding increase downstream. To fill a 1500-km-long gap in sustained, high-resolution monitoring of the Gulf Stream’s sub-surface structure and variability along the US East Coast, autonomous underwater gliders are routinely surveying the Gulf Stream.

Spray Glider Observations in the Gulf Stream:
- Spray gliders steer across observed currents while being advected downstream in the Gulf Stream from Miami, FL to New England.
- New missions lasting about 110 days start about every 2 months.
- Instrumentation sampling during all ascents (box 1):
  - Pumped Sea-Bird 41C PCTD
  - 1-MHz Nortek AD2CP Doppler current profiler
  - Seapoint chlorophyll fluorometer
  - Sea-Bird 63 dissolved oxygen sensor
- Near-real time temperature and salinity observations are distributed via NOAA ERDDAP, the IOOS Glider DAC, GTS, and email for operational usage.
- Post-processed data are publicly available for research purposes.

Summary of Findings:
Spray glider observations in the Gulf Stream have been used to:
- Investigate the time-mean, three-dimensional structure in the western boundary current including eddy kinetic energy (box 2).
- Characterize the along-stream evolution of Gulf Stream transport (box 2).
- Identify multiple phenomena associated with strong flow over relatively shallow bathymetry (box 3).
- Constraining numerical simulations (box 4).
- Examine the impact of hurricanes on the Gulf Stream (Todd et al., 2018).

Future Outlook:
The goal is to sustain glider observations in the Gulf Stream for years to come, building a dataset that captures seasonal to interannual variability along the US East Coast.
- This work serves as a model for sustained, glider-based surveillance of other western boundary currents (e.g., Kuroshio, Agulhas, East Australian Current, Brazil Current).
- The OceanGliders Boundary Ocean Observing Network (BOON) is working to build a global network of glider-based observatories along ocean boundaries.

References:

Acknowledgments:
- O.D. Todd, R. Graham, J. Heitkall, L. Dierker, K. Kusko, J. Sherman, D. Redden, and the Instrument Development Group at Scripps have been key to the success of glider operations. Spray glider observations in the Gulf Stream have been supported by funding from the National Science Foundation, NOAA’s Global Ocean Monitoring and Observing program, the Office of Naval Research, Examine Chemical Co., and WHOI.

Constrain numerical simulations (box 4).
- Characterize the along-stream evolution of Gulf Stream transport (box 2).
- Post-processed data are publicly available for research purposes.
- Submesoscale coherent vortices formed due to bottom friction and mixing that transport water from the boundary into the basin (Sulak et al., 2016).

References:

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