NOAA/AOML – CARICOOS Hurricane Underwater Glider Operations

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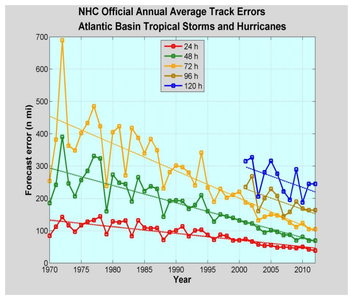
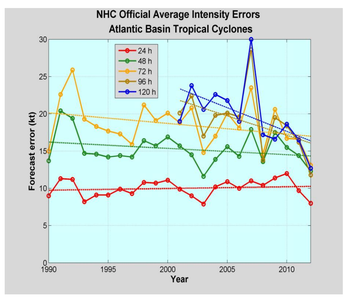
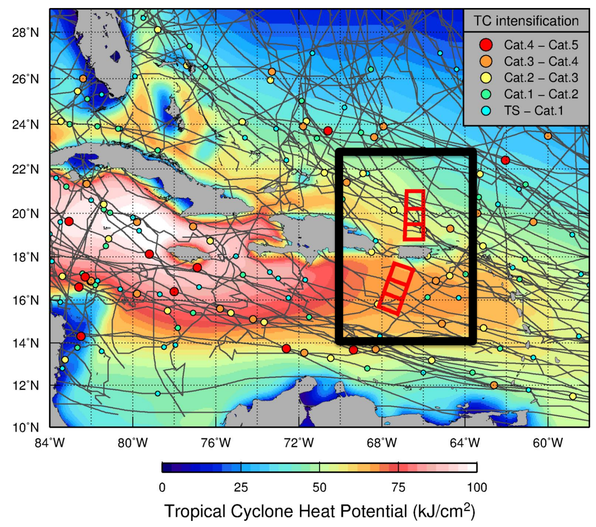
NOAA's First Emerging Technologies Workshop, Silver Spring, MD, July 2016

1. Motivation





- Tropical Cyclone (TC) track forecast error has decreased over the last two decades, while the intensity forecast error has approximately remain the same.



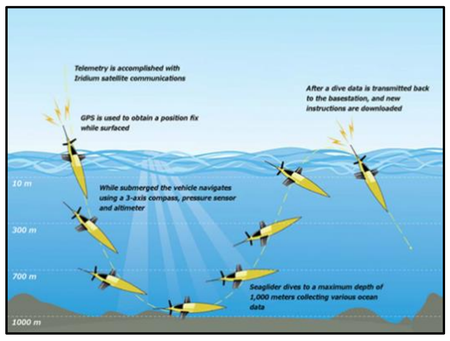
- In the tropical North Atlantic Ocean and Caribbean Sea, there is not a sustained ocean observing system in place in support of TC intensity forecasts.
- These areas are characterized by large ocean heat content, which under appropriate atmospheric conditions, may play a role in TC intensification. Therefore, a network of gliders was implemented to monitor in real time the upper ocean density (temperature, salinity) conditions.

2. Goal and Objectives

The goal of this work is to enhance our understanding of air-sea interaction processes during hurricane force wind events. In order to accomplish this goal, the network of hurricane underwater gliders was implemented to:

- Assess the impact of hurricane force winds on upper ocean density structure, and
- Assess the impact of ocean profile data from underwater gliders in hurricane intensity forecasts

3. Underwater Gliders



Underwater gliders are autonomous underwater vehicles (AUVs) that can be remotely operated under TC wind conditions. They can be configured with different oceanographic sensors, such as sensors to measure temperature, salinity, and dissolved oxygen.

4. Operations timeline

★ First paper published, Domingues et al., (2015)

☆ Second paper submitted, Dong et al., (under review)

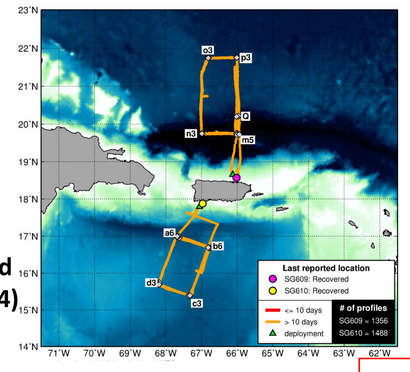
Proposal (October 2013) Disaster Relief Appropriations Act of 2013, "Sandy Supplemental"

Funded (December 2013)

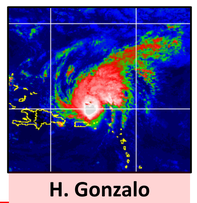
Purchase of Gliders (March 2014)

Training (June 2014)

Gliders Delivered (July 2014)

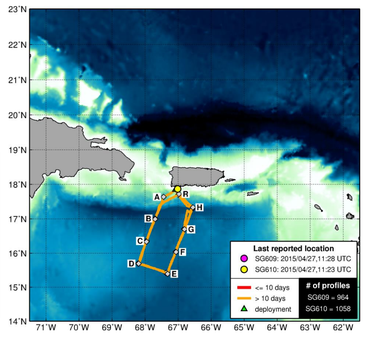


TS Bertha (Aug, 2014)

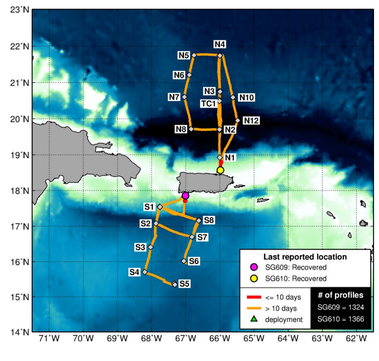


H. Gonzalo (Oct, 2014)

Mission 01 July – November 2014

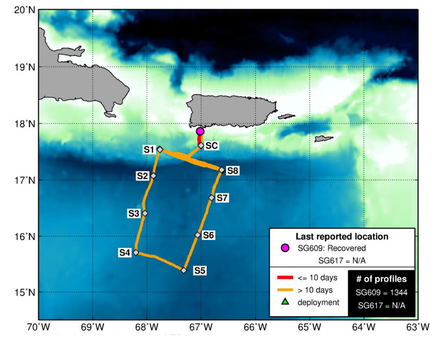


Mission 02 February – April, 2015



Mission 03 July – November, 2015

TS Erika (Aug, 2015)

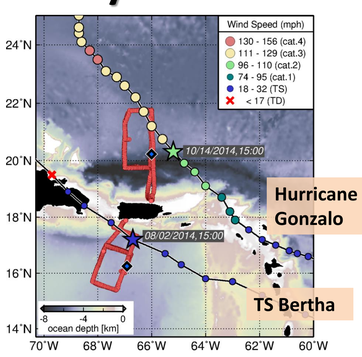


Mission 04 March– June, 2016

Mission 05 start

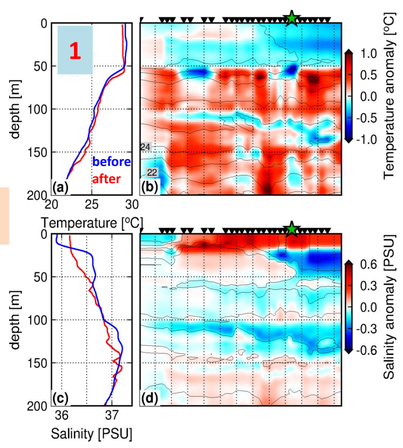
2013 | 2014 | 2015 | 2016

5. Key results



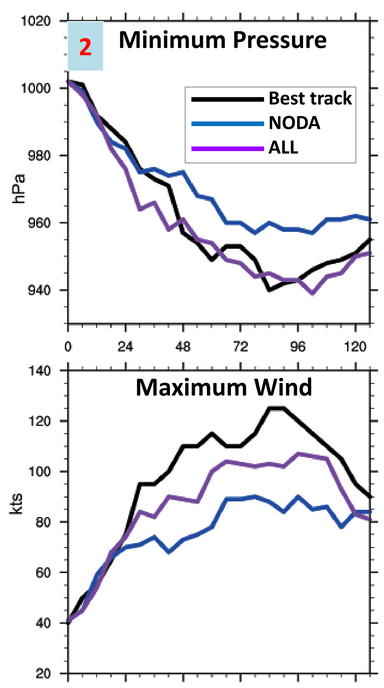
1. During Hurricane Gonzalo, glider observations revealed that upper-ocean cooling was partially suppressed by a near-surface barrier layer, that was characterized by enhanced stratification due to low salinity conditions.

Ocean Observations



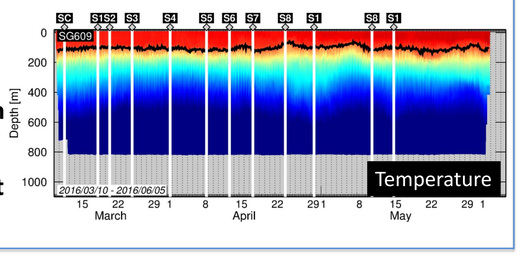
2. Assimilation of underwater glider data along with other ocean observations had a positive impact on Hurricane Gonzalo intensity forecast using the next generation ocean-atmosphere coupled HYCOM – HWRF model.

Coupled Hurricane Forecast



6. Data Distribution

- Data are transmitted in real-time into the Global Telecommunication Systems (GTS), and distributed through NOAA-AOML webpages, and through NOAA Integrated Ocean Observing System (IOOS) Data Assembly Center (DAC)
- These data are also used to initialize Tropical Cyclone forecast models



7. Operation Highlights

- ✓ Four underwater glider missions were successfully completed during 2014-2016. The fifth mission implemented during the 2016 North Atlantic Hurricane Season is currently underway with four gliders in the field.
- ✓ Approximately 10,000 profiles of each measured parameter (temperature, salinity, and dissolved oxygen) were collected during the first two years of operations, including unique datasets under TC wind conditions.

Publications

Domingues et al., (2015), Upper ocean response to Hurricane Gonzalo (2015): Salinity effects revealed by targeted and sustained underwater glider observations, Geophys. Res. Lett., 42.

Dong et al., (under review) Impact of underwater glider on Hurricane Gonzalo (2014) forecast. Manuscript currently under review at Weather Forecasting.

Acknowledgments

This work was originally funded by the Disaster Relief Appropriations Act of 2013 known as the Sandy Supplemental. This project is currently funded by NOAA/OAR, NOAA/AOML, and CARICOOS, and supported by UPRM, UM/CIMAS, NOAA/NDBC, NOAA/IOOS, NOAA/EMC, and ANAMAR.

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Gliders Live Monitoring

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