A NOAA plan to enhance underwater glider observations during the 2019 Atlantic hurricane season

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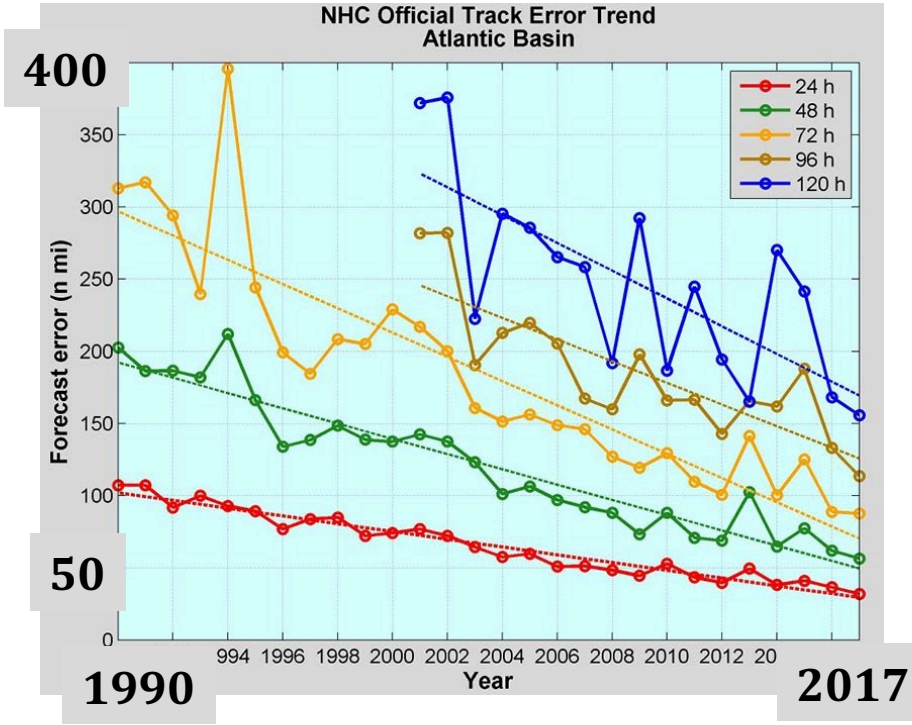
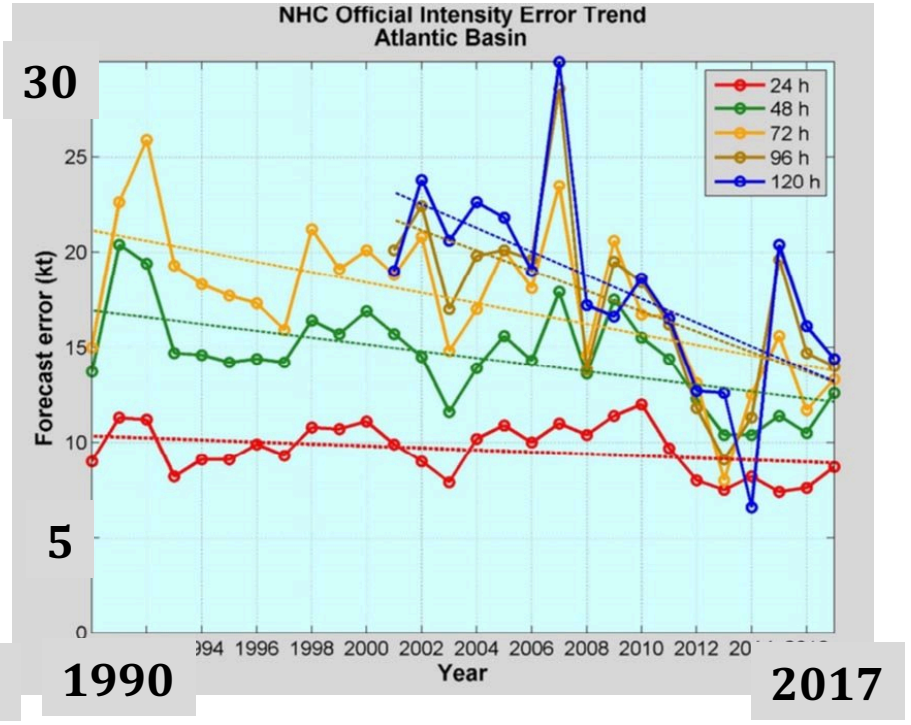
2. Rutgers University
3. Univ. of Puerto Rico
4. CARICOOS
5. SECOORA
6. IOOS
7. University of Miami, CIMAS
8. MARACOOS
9. Univ. of Georgia

8th EGO Meeting and International Glider Workshop.
21-23 May, 2019, Rutgers University, NJ

Reduction of errors in track and intensity forecasts

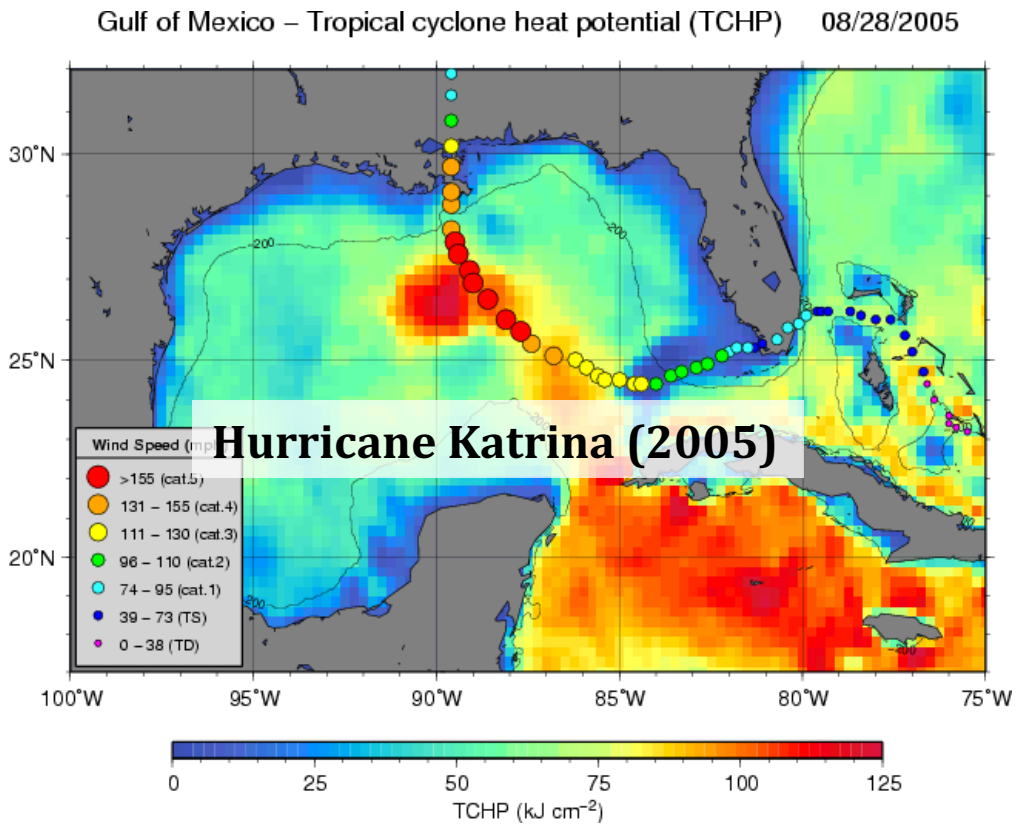




In average, error in intensity forecast has remained almost unchanged (for 48hs or less forecasts) and larger than 15 knots (for 72hs or more forecasts) during last 25 years.

In average, these errors may represent <u>one category above or below</u> the actual hurricane intensity.

Role of the ocean in tropical cyclone intensification



The upper ocean heat content matters.

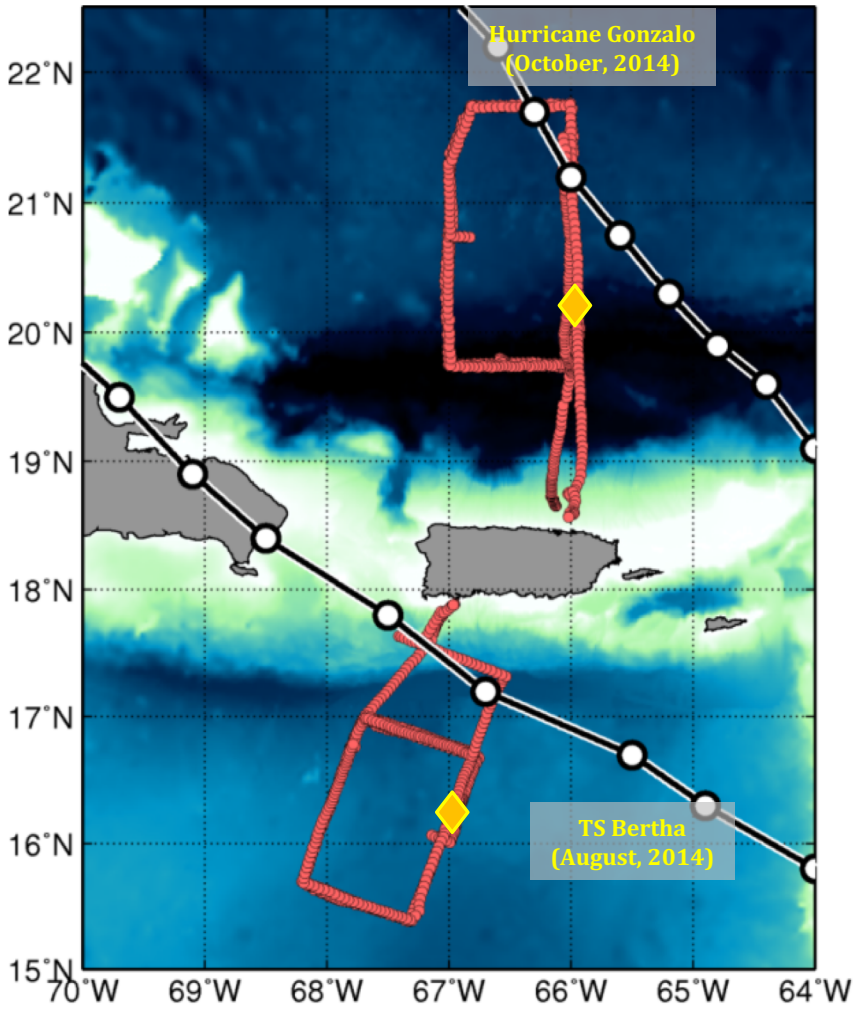
The upper ocean temperature, salinity, density matters.

Ocean numerical models that represent the ocean conditions assimilate T(z) and S(z).

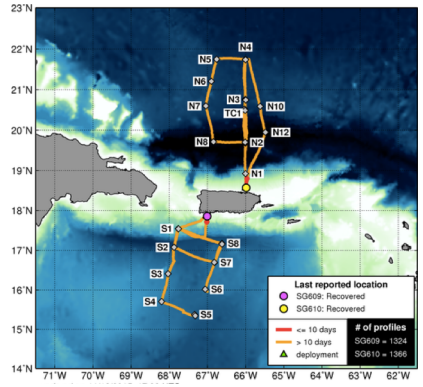
Ocean observations allow to correctly represent the ocean conditions within a numerical model.

NOAA-CARICOOS Hurricane Glider operations since 2014

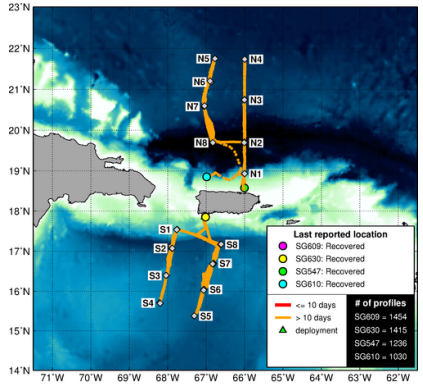
2014 hurricane season



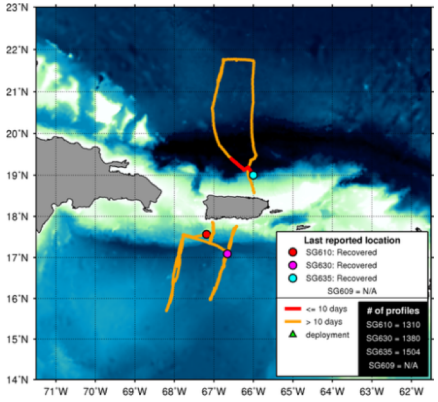
2015



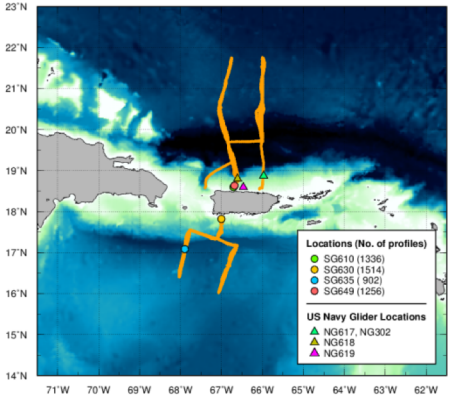
2016



2017

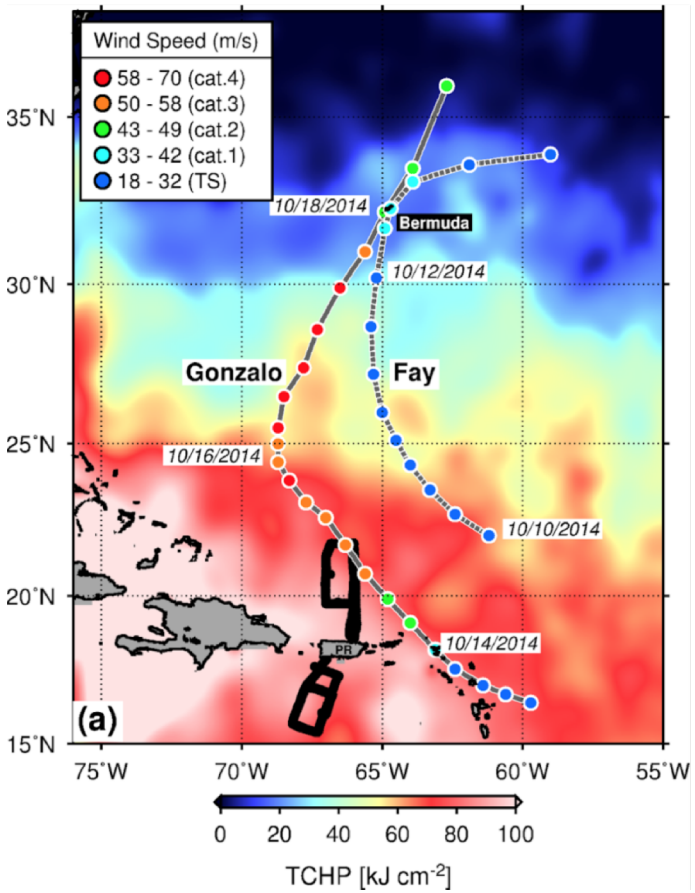


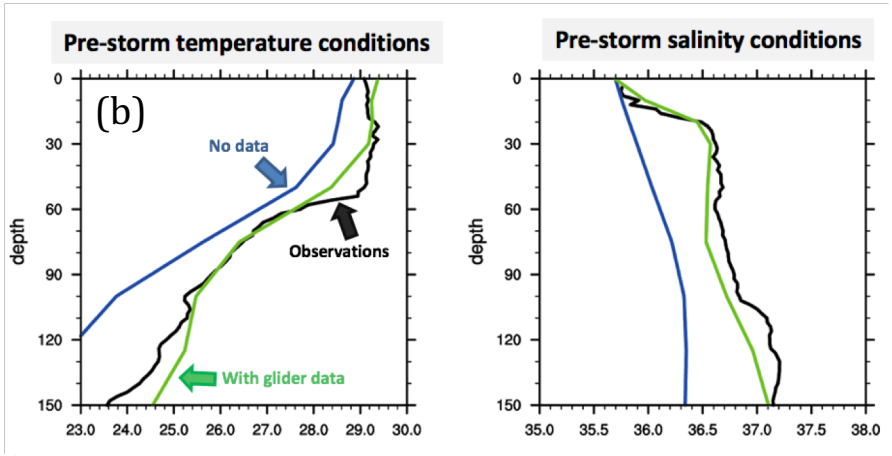
2018

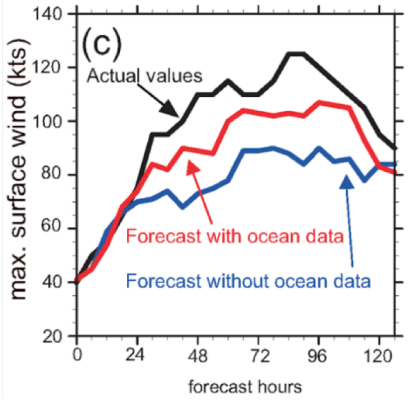


21 missions, 1,852 glider days, 23,000 temperature and salinity profiles

Impact Study: Hurricane Gonzalo (2014)





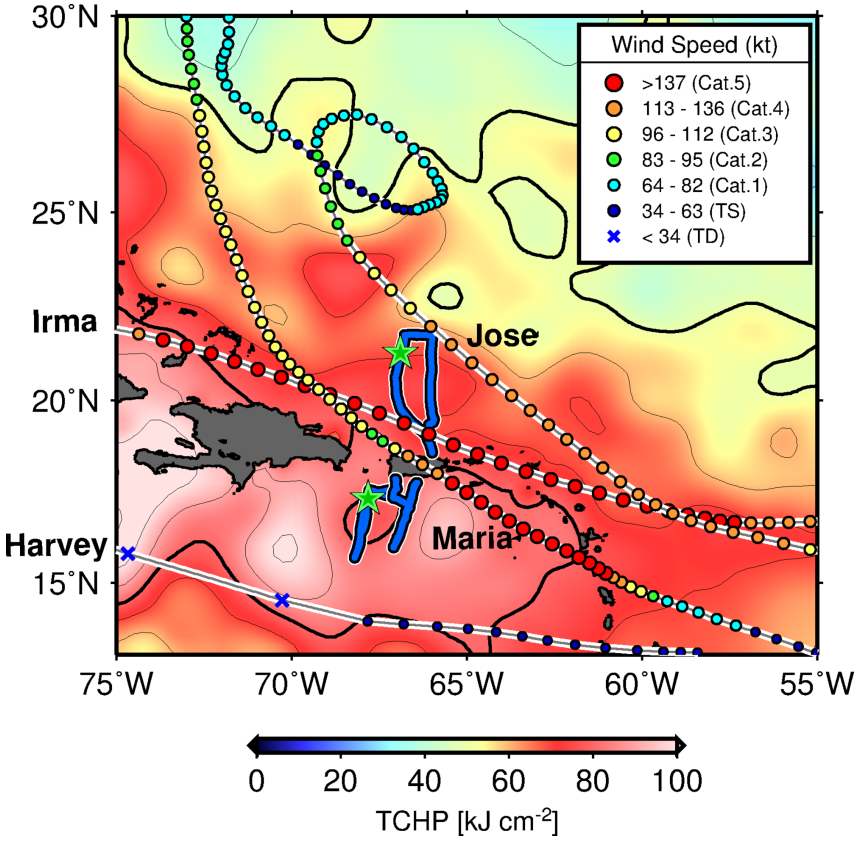


The barrier layer* is only represented in numerical model fields when glider data are assimilated.

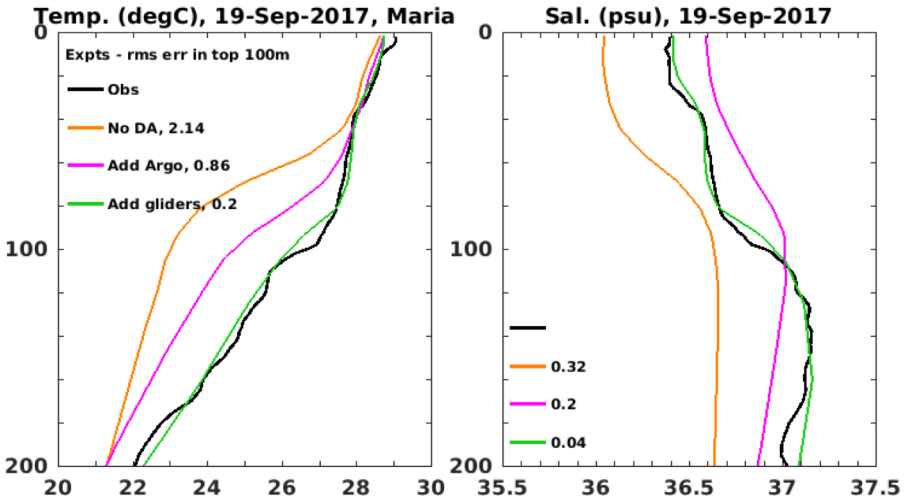
*=low salinity warm layer, very difficult to mix with colder subsurface waters, allows for intensification

Assimilation of underwater glider data along with other ocean observations reduced the error on Hurricane Gonzalo intensity forecast by approximately 50% using the next generation ocean-atmosphere coupled HYCOM – HWRF model.

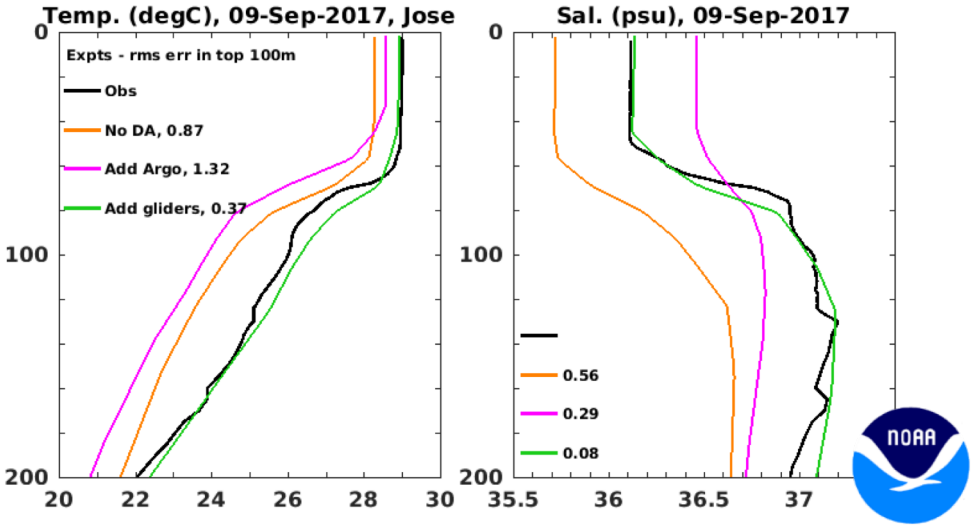
Impact Study: Hurricanes Jose and Maria (2017)



Hurricane Maria

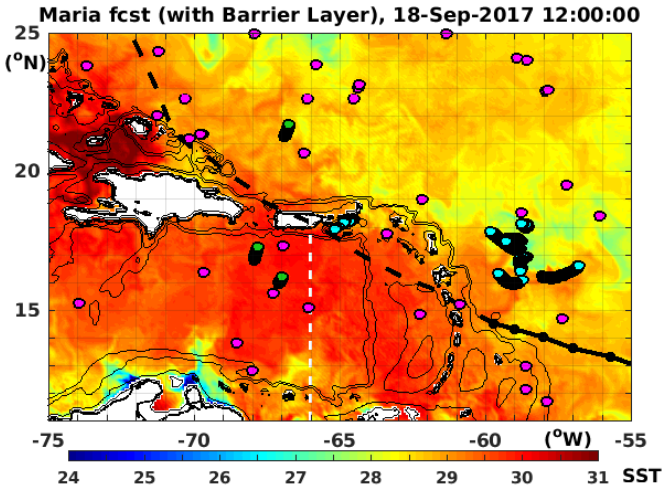


Hurricane Jose

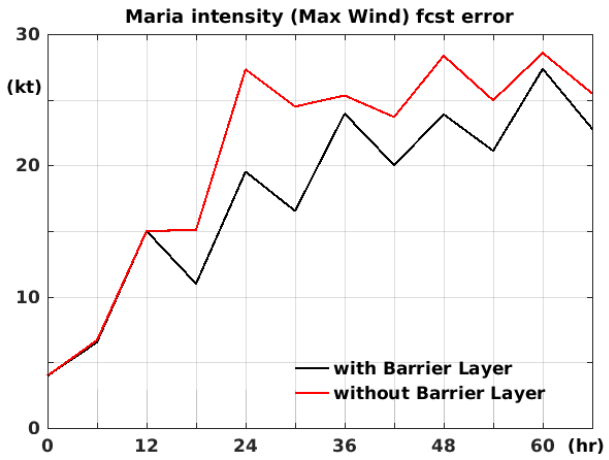


Correcting for impact of ocean barrier layers

Hurricane Maria



Error in intensity (kt) for 6 forecast cycles



In **black**. intensity when the ocean model assimilates all observations. In **red**, when the ocean model misses the barrier layer. rms intensity error for Hurricane Maria (2017) is reduced with the assimilation of the barrier layer.

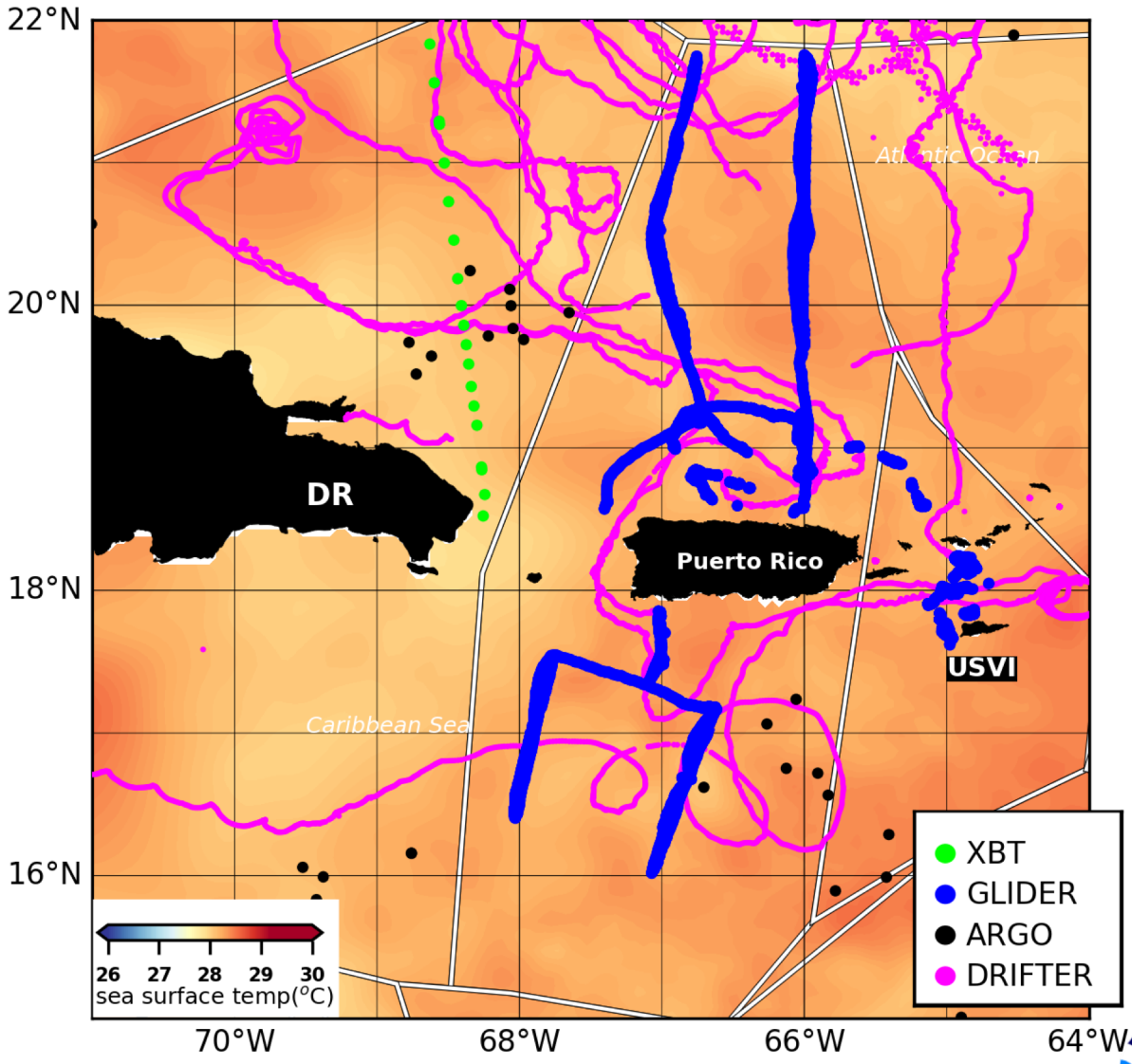
- Barrier layers are layers of low salinity waters at the surface sitting over warm but not fresh waters
- These layers are usually due to river run-off, here from the Amazon and Orinoco rivers
- They favor hurricane intensification
- During Maria, intensity predictions are degraded when barrier layers are not represented in the ocean model (by 20 to 30% at > 12 hour range)

2018 NOAA- US Navy gliders collaboration

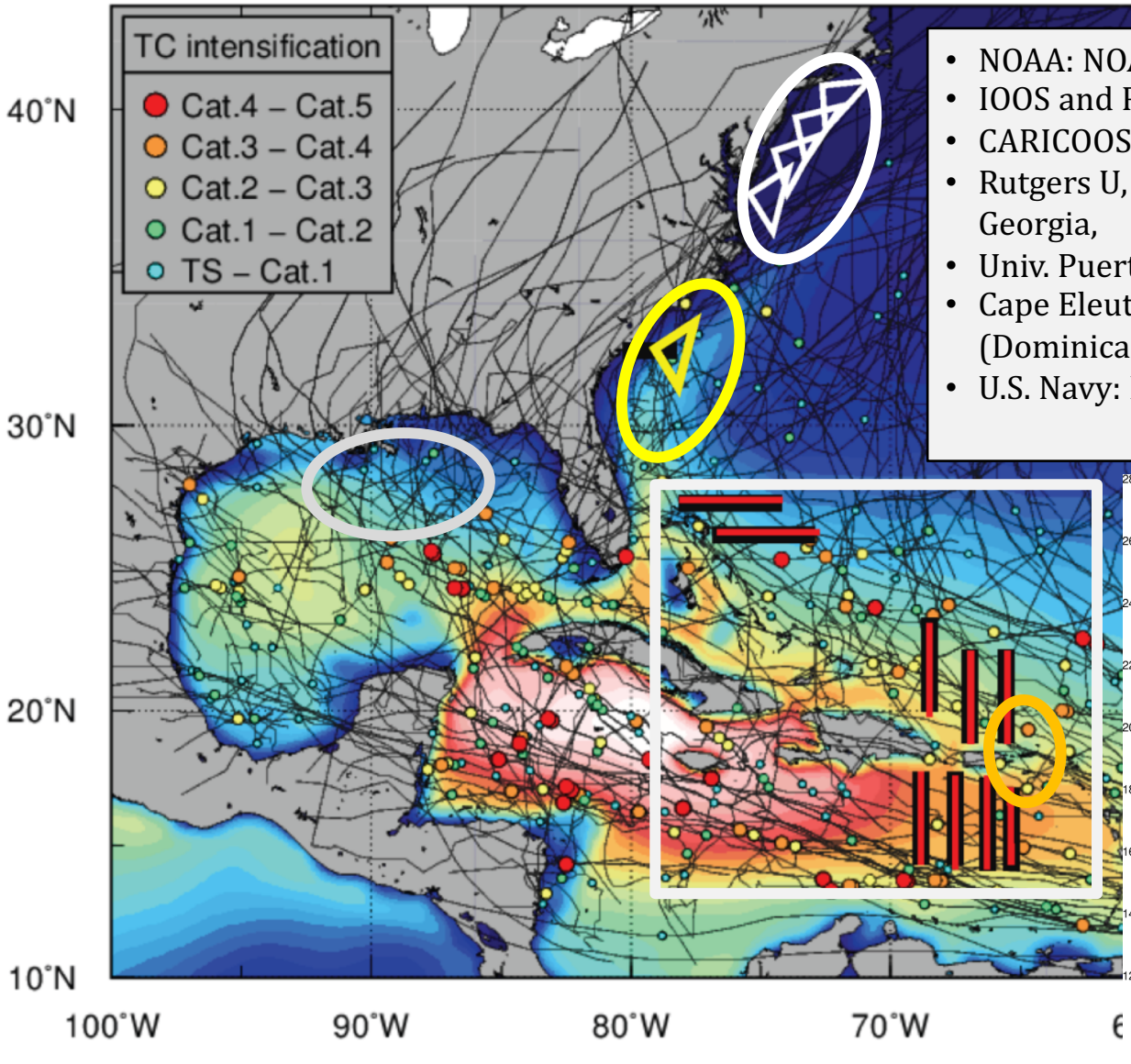
(GTS) In situ ocean observations during July 1 – September 30, 2018

Gliders provided more than 99% of profile observations.

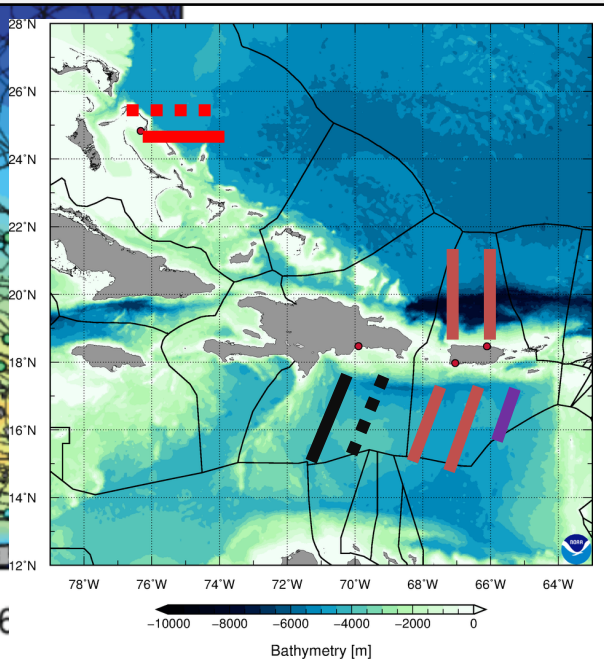
The number of non-glider observations have no impact in the representation of the ocean in the models during hurricane season.



2019 Hurricane Gliders collaborations



- NOAA: NOAA/AOML,
- IOOS and Regional Associations: MARACOOS,
- CARICOOS, OCOVI, SECORA
- Rutgers U, Univ. of Miami: CIMAS, Univ. of Georgia,
- Univ. Puerto Rico Mayaguez, U. So. Miss.
- Cape Eleuthera Institute (Bahamas), ANAMAR (Dominican Republic)
- U.S. Navy: NAVO



Summary

Appropriate ocean monitoring is key for hurricane intensity forecasts.
2019 hurricane season observations are being planned.

What type of ocean observations do we need?

1) Resolve mesoscale features
2) Collect T and S profiles in the upper 100's meters (warm rings, barrier layers, …)
3) Observations implemented beginning of hurricane season in survey regions
4) Transmission in RT for data assimilation into forecast models

Mid Plans and Needs

1) Continue impact studies of glider (and other platforms) data on hurricane forecasts
2) Model/Data comparisons
3) Strengthen interaction between observational and modeling efforts
4) Increase international collaborations/partnerships