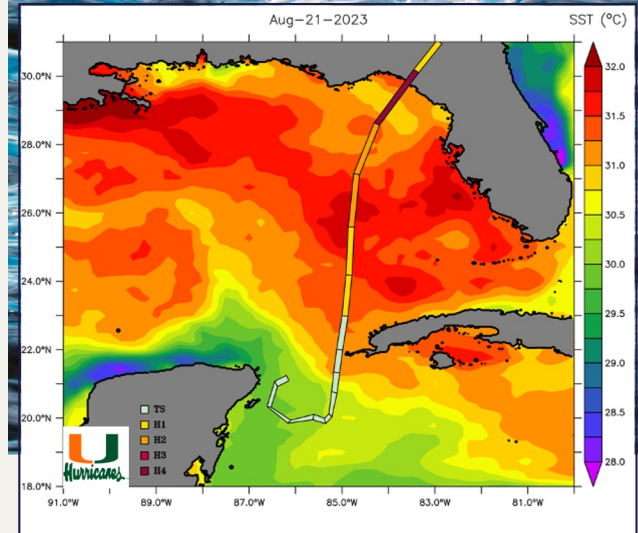
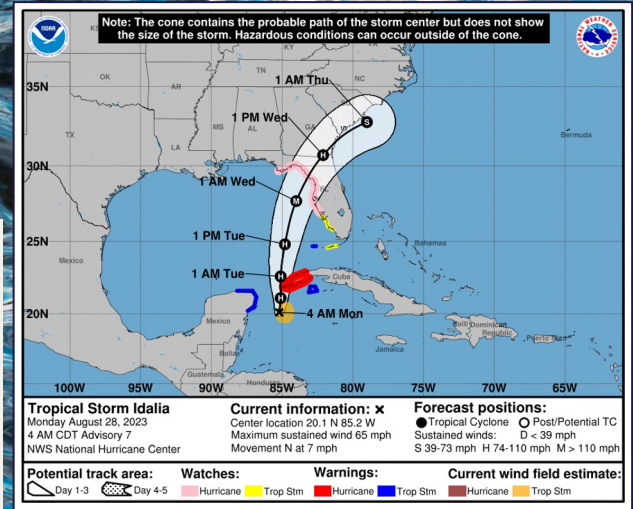




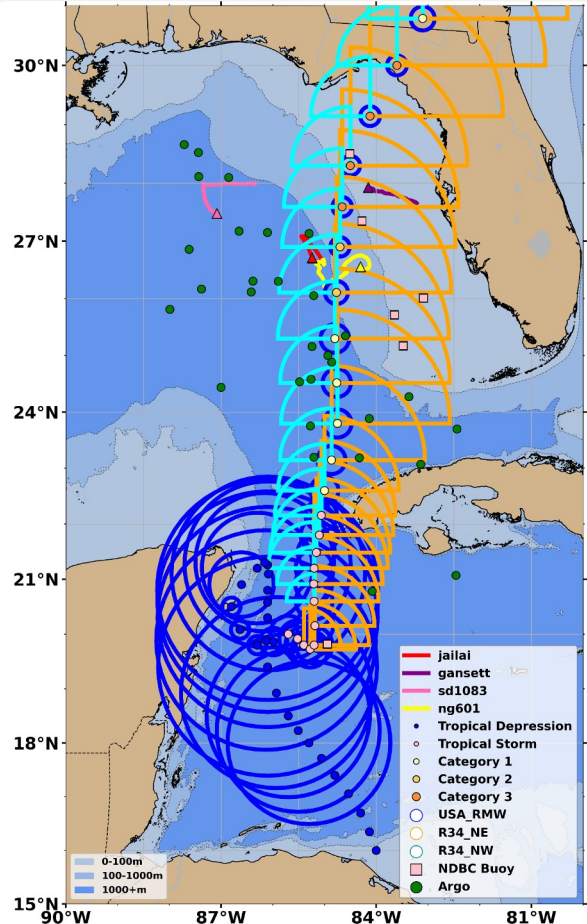
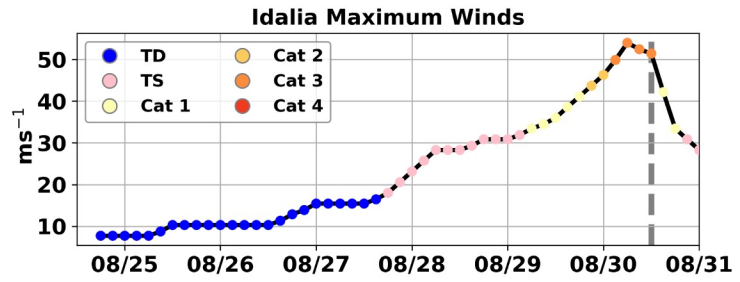
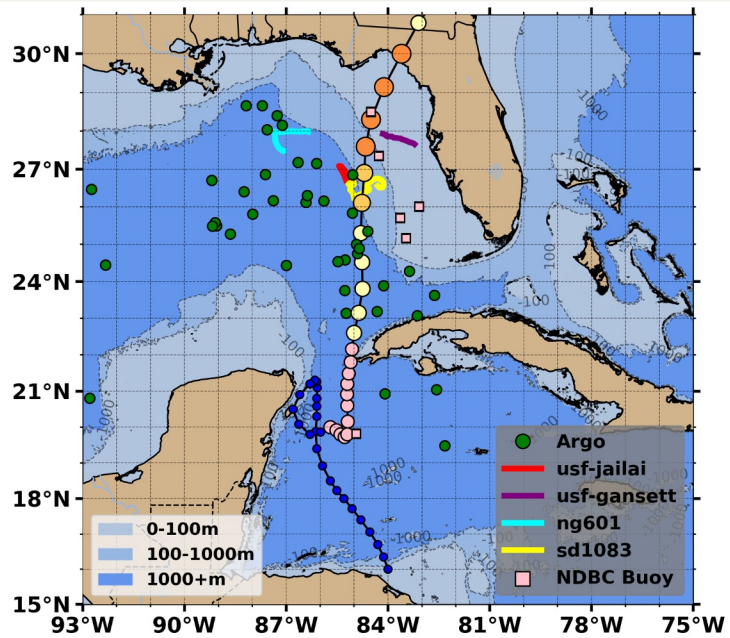
# Heat Content and Hurricanes: *Hurricane Idalia*

- NASEM GRP UGOS WG-C
- NOAA/Navy Hurricane Glider Team
- IOOS Hurricane Model/Data Comparison Team

*Scott Glenn, Travis Miles, Michael Smith, Julia Engdahl, Tim Stolarz, Tony Knap, Steve DiMarco, Andy Dancer, Sakib Mahmud, Uchenna Nwankwo, David Salas de Leon, Rosalinda Monreal Jimenez, Edgar Escalante Mancera, Miguel Angel Gomez Reali, Pelle Robbins, Heather Furey, Amy Bower, Miguel Tenreiro, Enric Pallas Sanz, Rafael Ramos, Bruce Magnell, Jill Storie, Samantha Longridge, Anneliese Schmidt, Ben Jaimes de la Cruz, Nick Shay, Pierre Lermusiaux, Patrick Haley, Chris Marabito, Paula Perez Brunius, Nathali Cordero Quiros, Bruce Cornelle, Stephan Howden, Alexandra Bozec, Ganesh Gopal, Matthieu LeHenaff, Hyun-Sook Kim, Pat Hogan, Jan van Smirren, Kathy Bailey, Bill Lingsh, Corbin Brooks, Doug Wilson, Catherine Edwards, Julio Morell, Jorge Brenner, Kevin Martin, Chad Lembke, Natalia Sidorovskaia, Cliff Merz, Yonggang Liu, Bob Weisberg, Bob Currier, Dawn Petraitus, Kevin O'Brien, Avichal Mehra, Zulema Garraffo, Dmitry Dukhovskoy, Maria Aristizabal, Dan Iredell, Jim Cummings (>60)*



# Hurricane Idalia - Cat 1 off Cuba to Cat 3 Landfall in 2 Days



**Stage 3:** Rapid Intensification to Cat 3 along the West Florida Shelf - *Hurricane Gliders, Sairdrone, IOOS (USF) HF Radar*

**Stage 2:** Intensification to Cat 2 Hurricane between the Loop Current and the west Florida Shelf - *UGOS Argo floats*

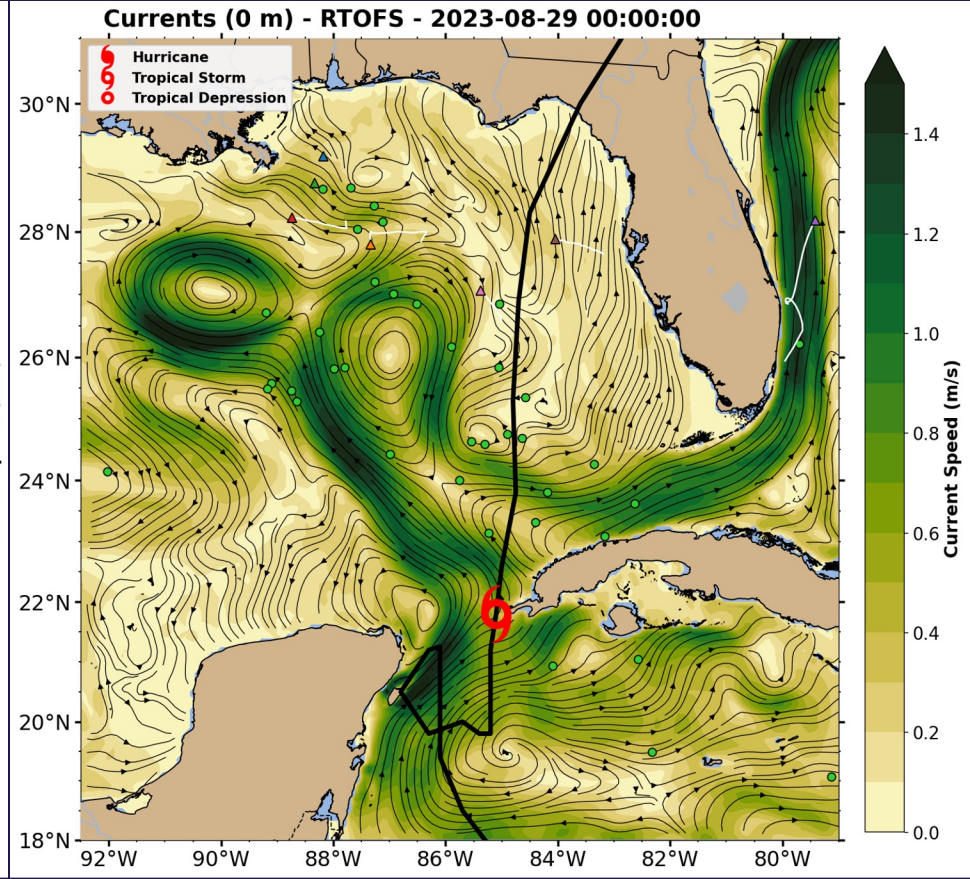
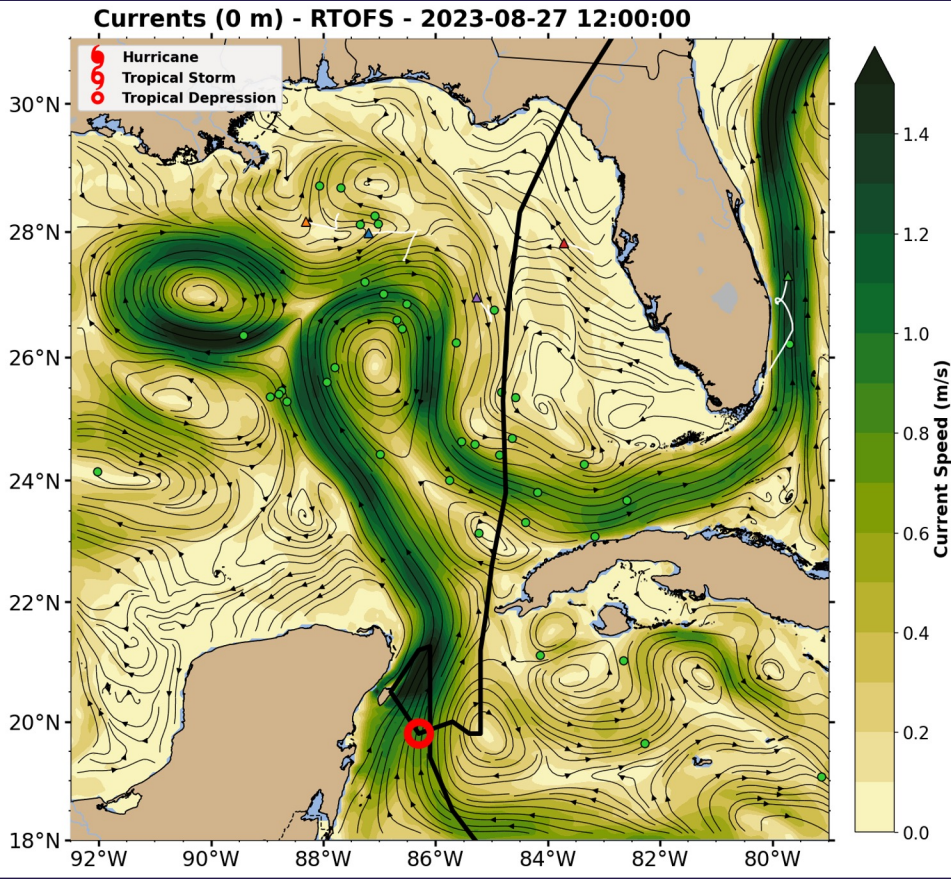
**Stage 1:** Intensification to Cat 1 Hurricane over the Loop Current - *UGOS Argo floats*

**Stage 0:** Formation over the Yucatan Strait - *UGOS HF Radar*



# Tropical Storm Idalia - Stage 0 - Formation

Surface Currents - NOAA global Real Time Ocean Forecast System (RTOFS)

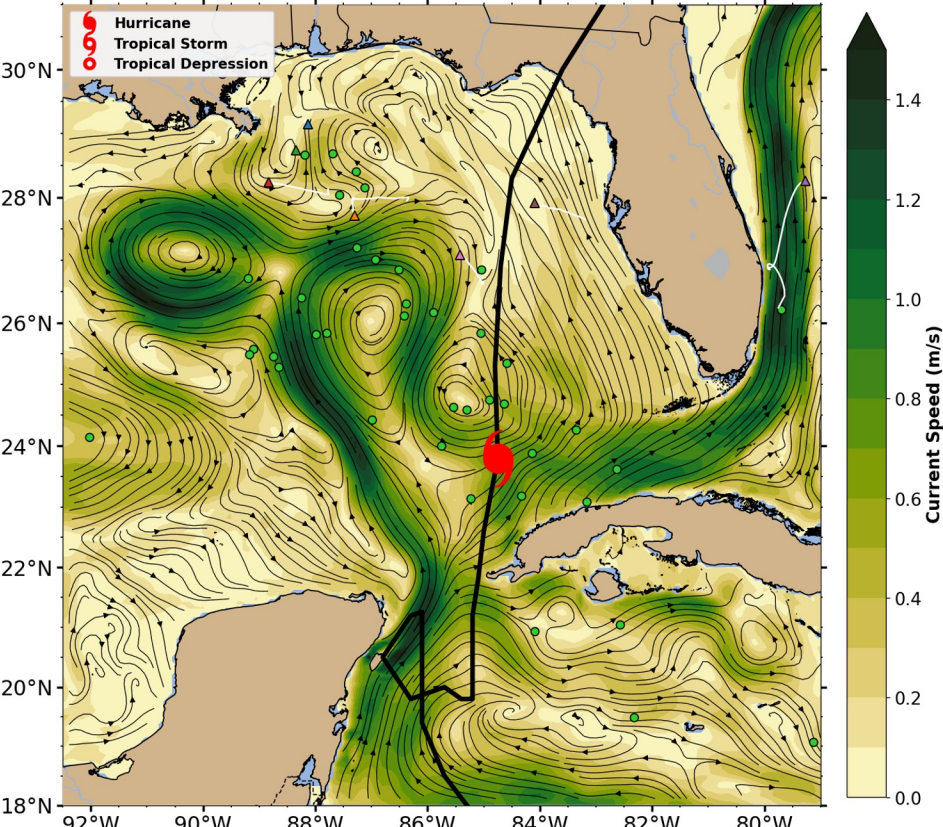




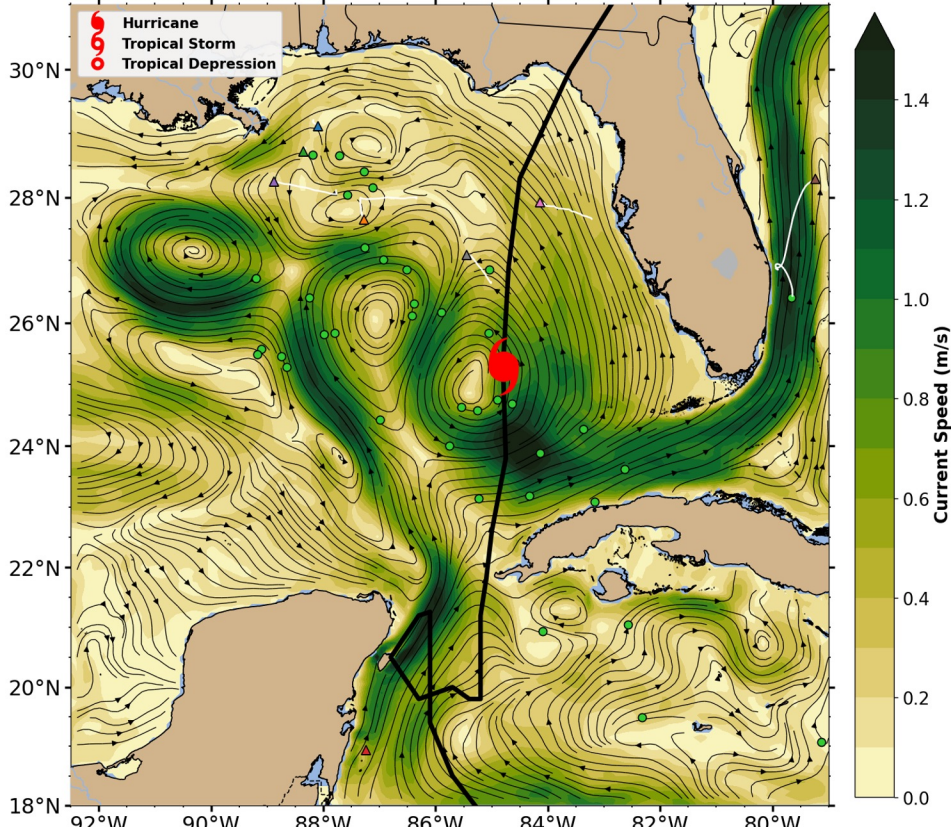
# Hurricane Idalia - Stage 1 & 2 - Intensification to Cat 1 & 2

## Surface Currents - NOAA global Real Time Ocean Forecast System (RTOFS)

Currents (0 m) - RTOFS - 2023-08-29 12:00:00



Currents (0 m) - RTOFS - 2023-08-29 18:00:00

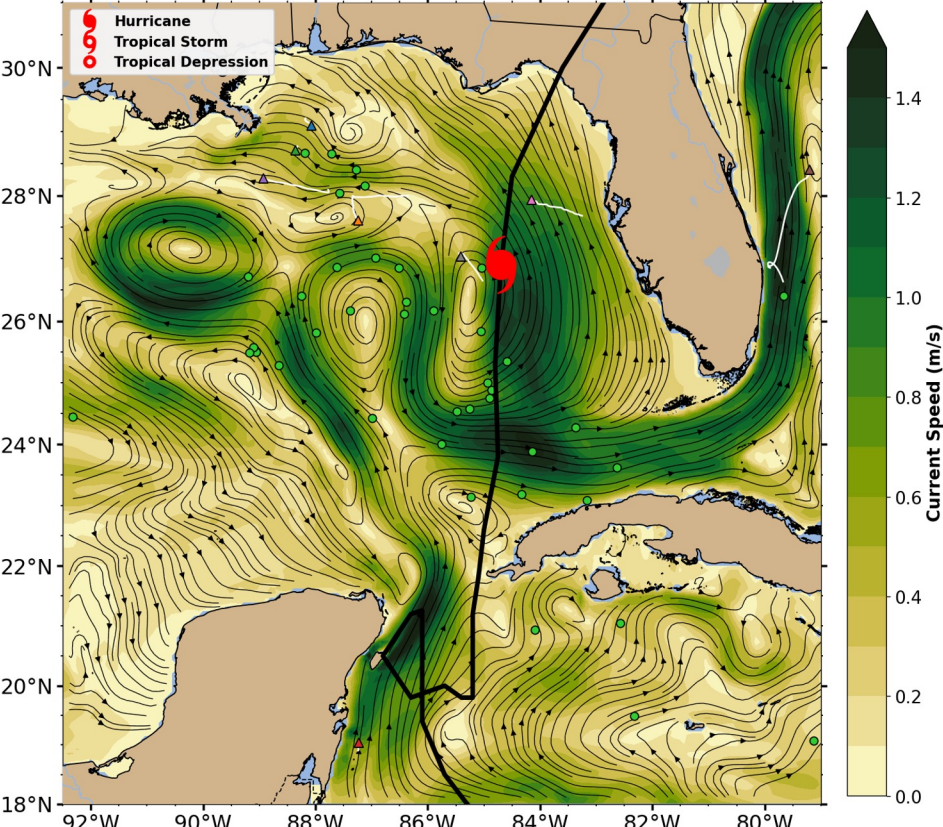




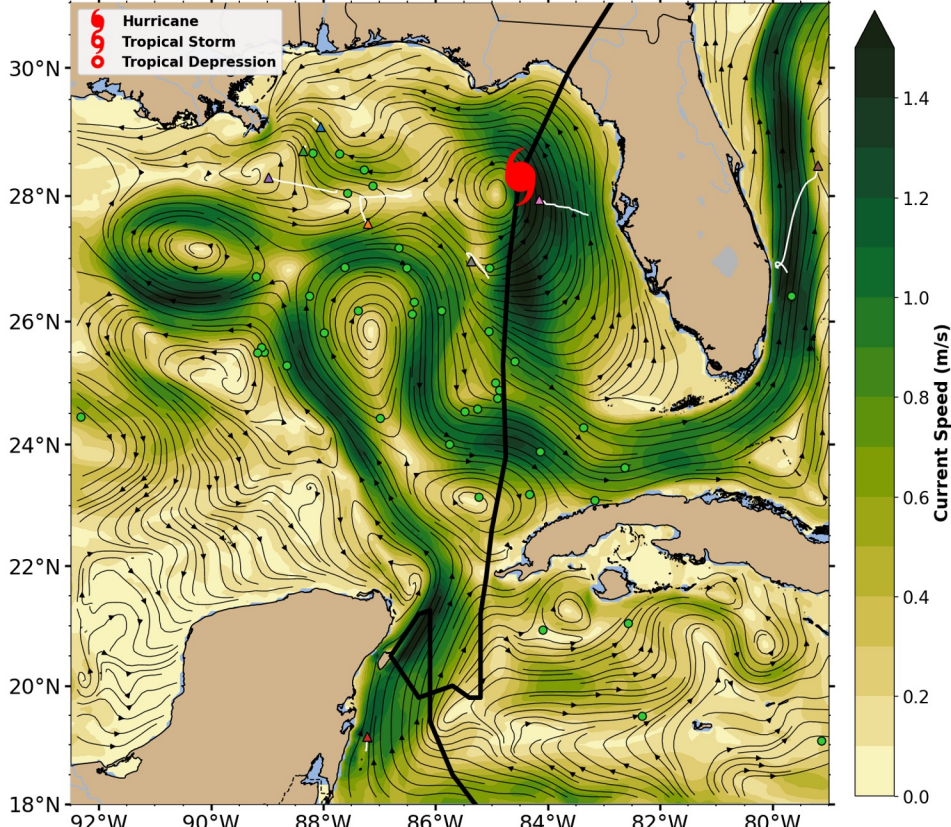
# Hurricane Idalia - Stage 3 - Intensification to Cat 3 & Landfall

## Surface Currents - NOAA global Real Time Ocean Forecast System (RTOFS)

Currents (0 m) - RTOFS - 2023-08-30 00:00:00

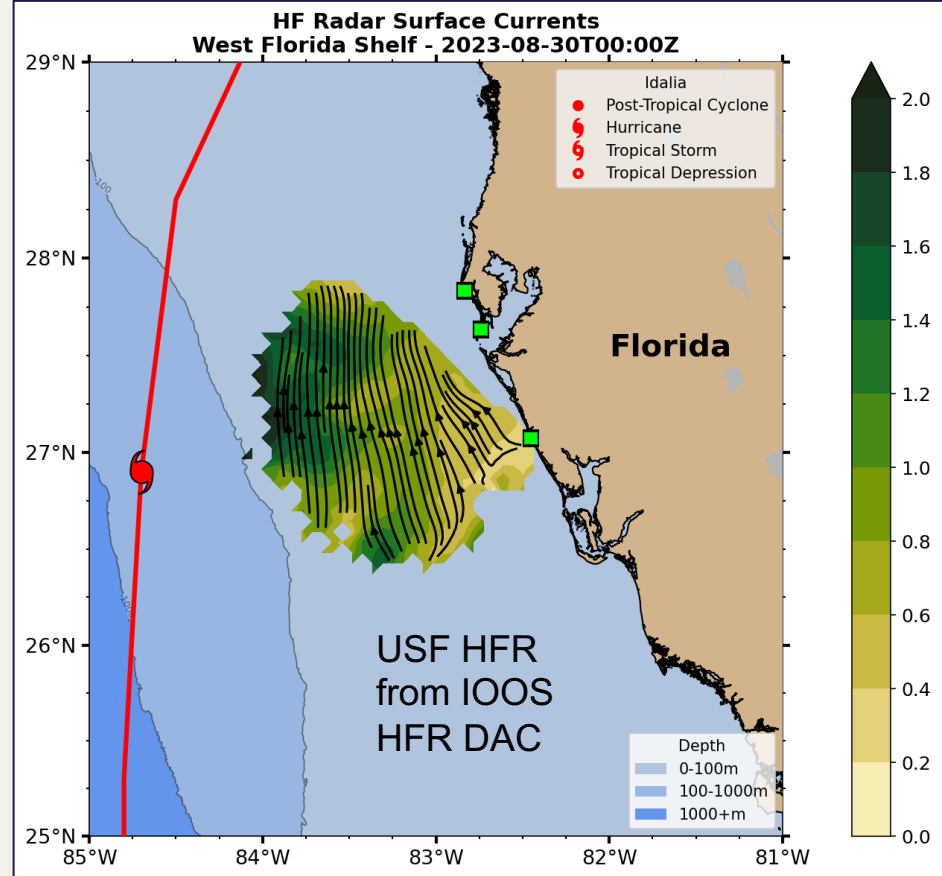
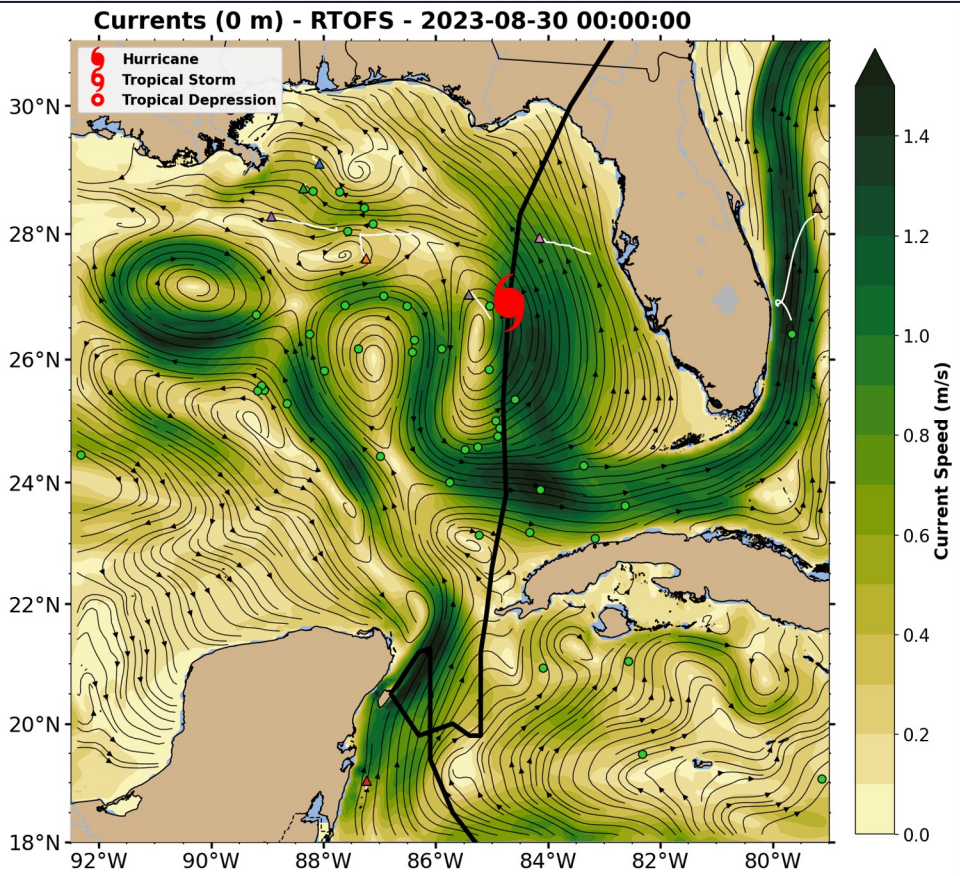


Currents (0 m) - RTOFS - 2023-08-30 06:00:00



# Hurricane Idalia - Stage 3 - Intensification to Cat 3 & Landfall

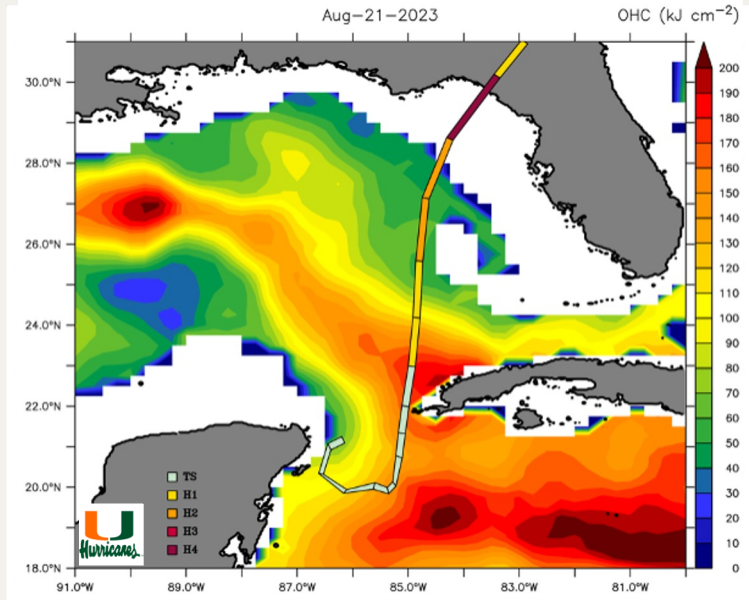
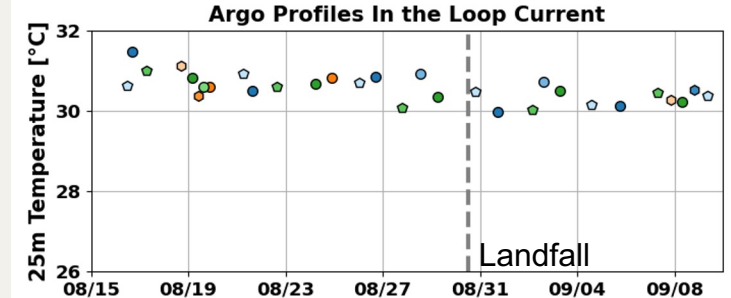
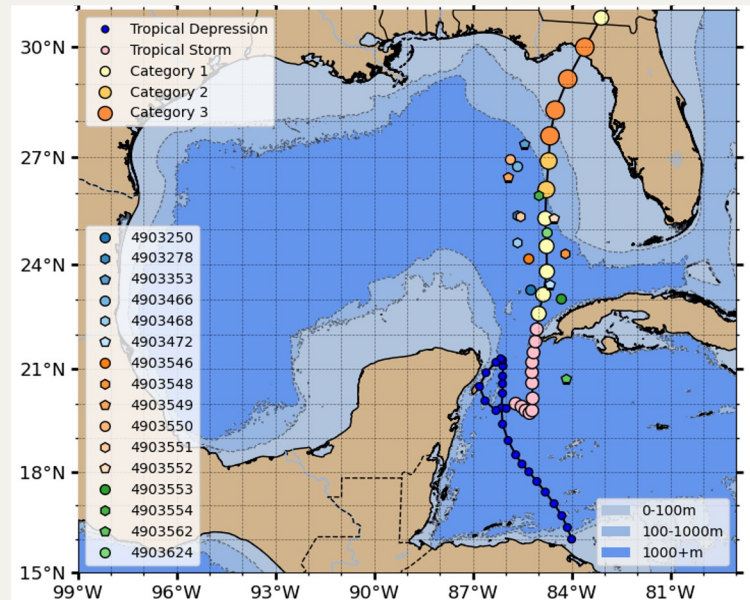
Surface Currents - NOAA global Real Time Ocean Forecast System (RTOFS)



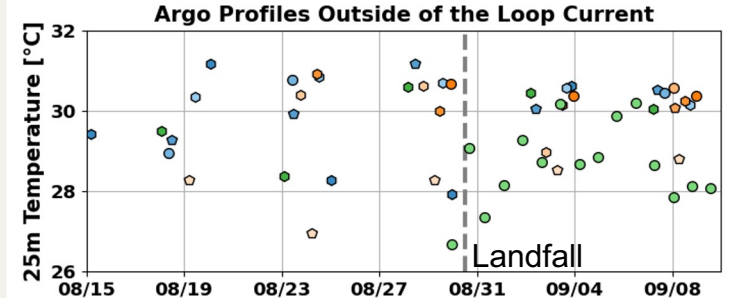


# Hurricane Idalia - Stage 1 & 2

## Argo Float Near-Surface Temperature - In (bottom left) & Out (bottom right) Loop Current

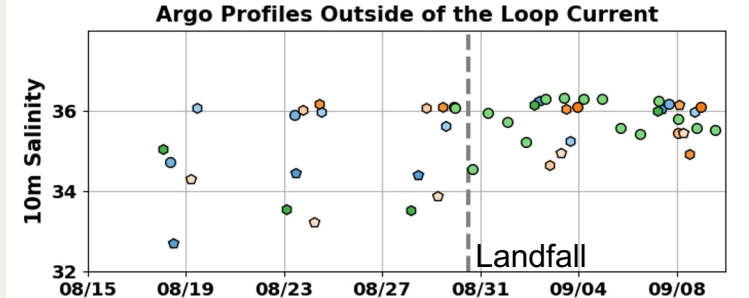
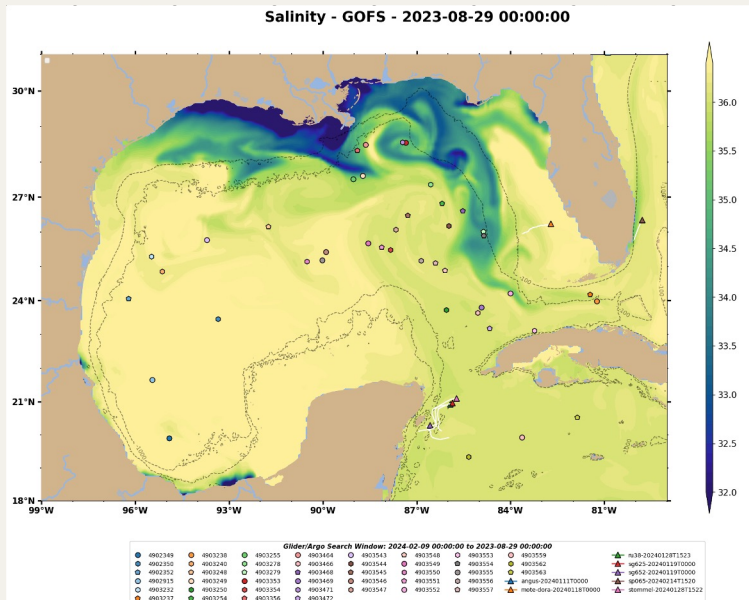
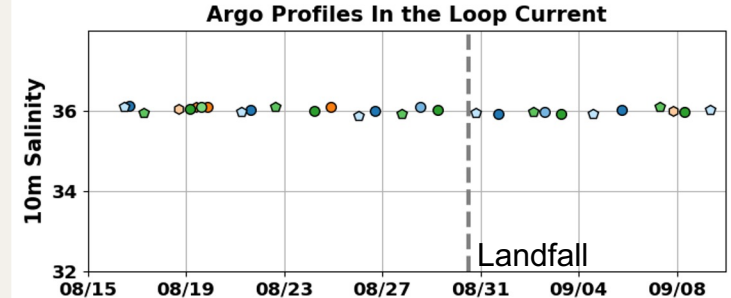
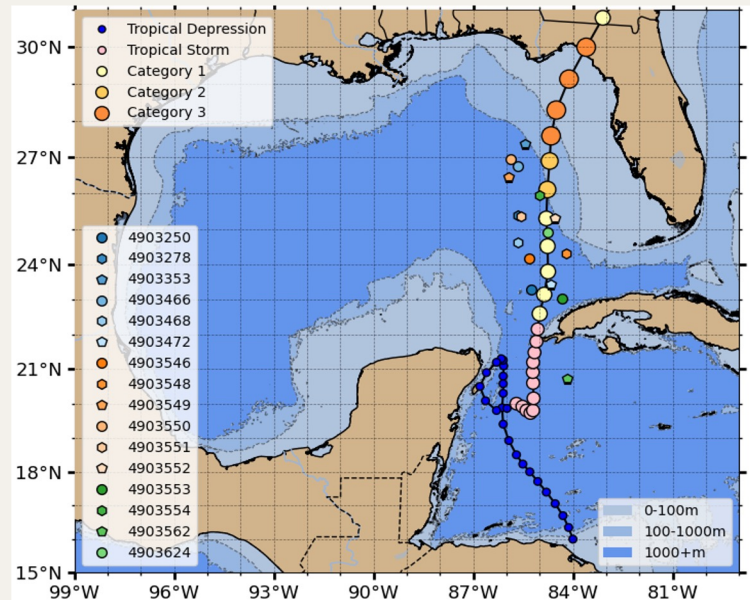


UMiami /  
NOAA  
NESDIS  
Ocean  
Heat  
Content  
product



# Hurricane Idalia - Stage 1 & 2

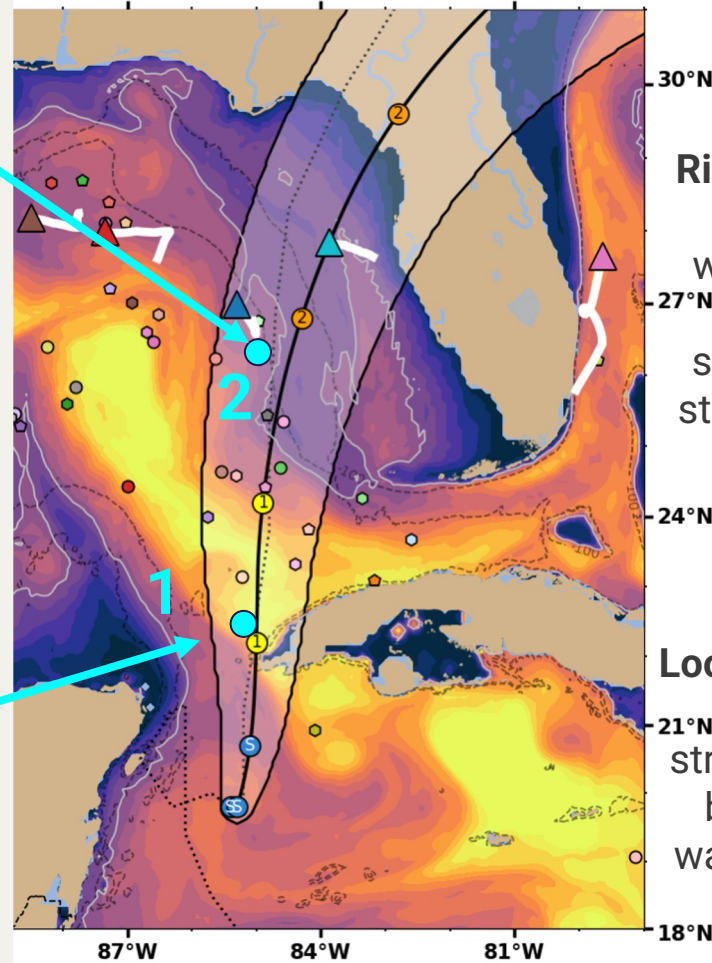
Argo Float Near-Surface Salinity - In (bottom left) & Out (bottom right) Loop Current



Navy  
Global  
Ocean  
Forecast  
System  
(GOF5)  
Surface  
Salinity

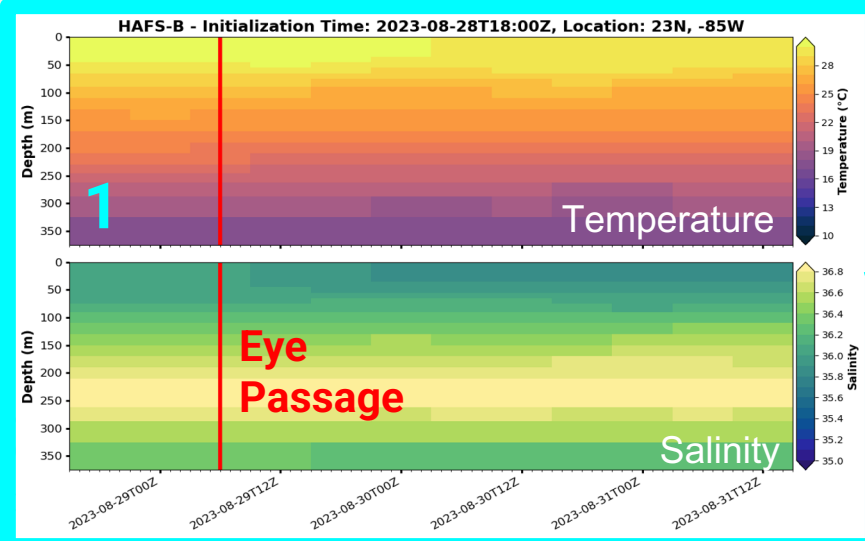
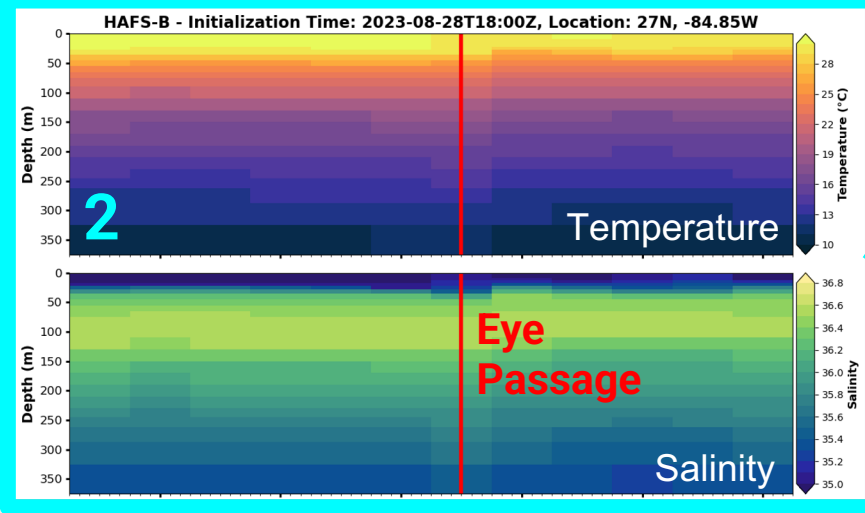


# HAFS Time Series under Idalia



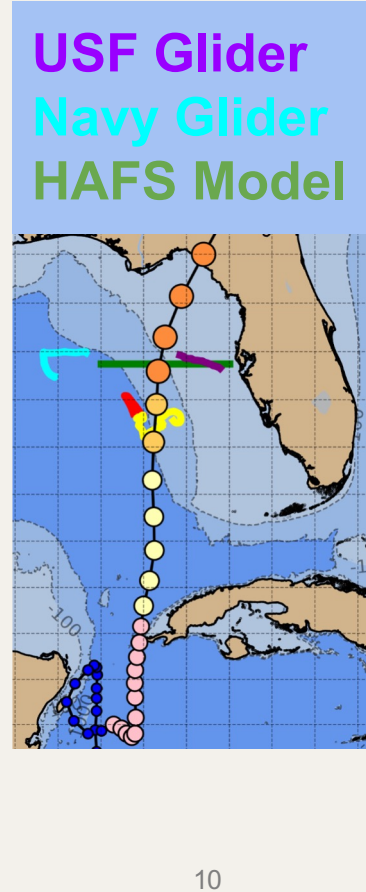
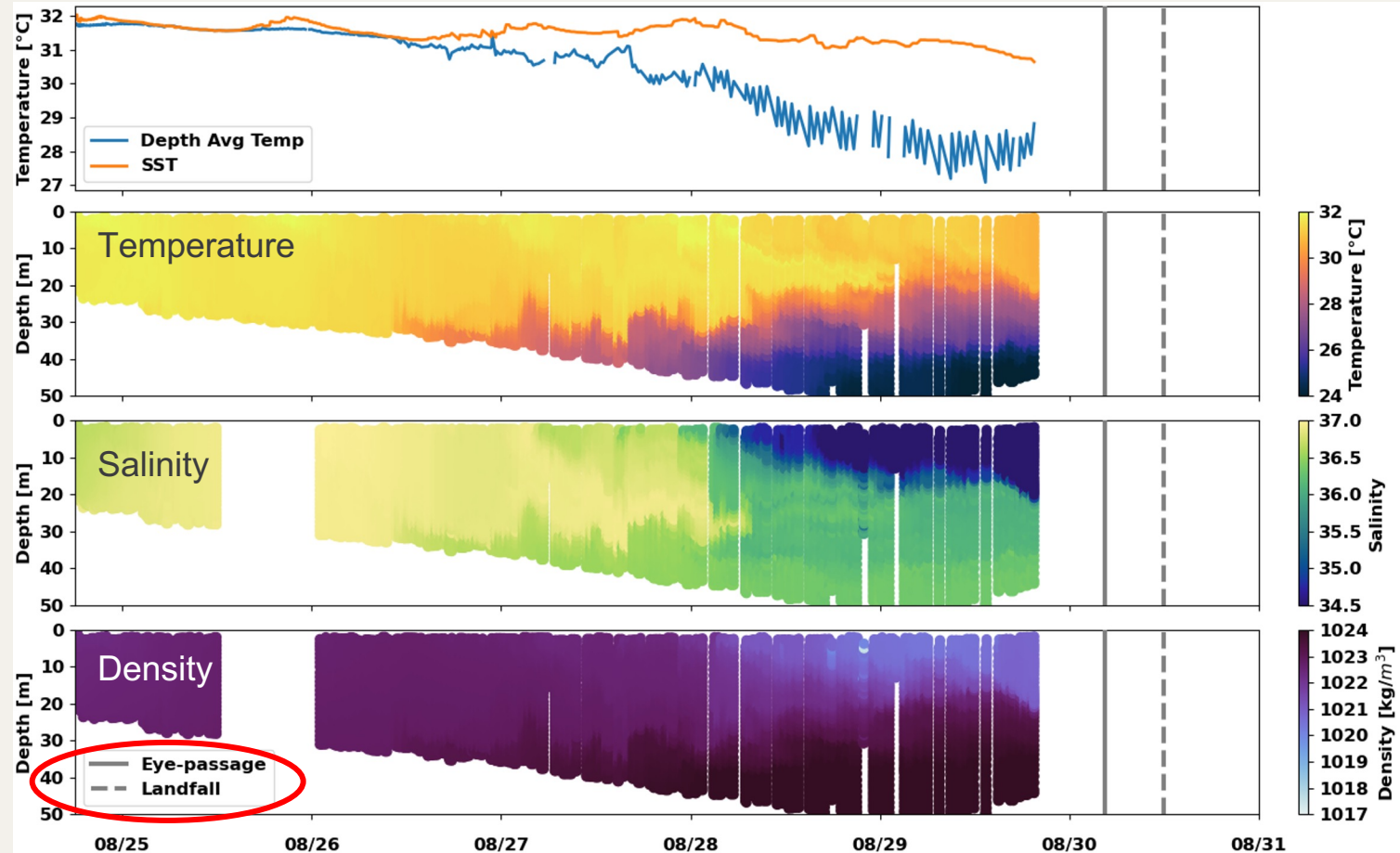
**Stage 2**  
**River Plume:**  
Shallow  
warm layer  
but  
strong T&S  
stratification

**Stage 1**  
**Loop Current:**  
Weak  
stratification  
but deep  
warm layers

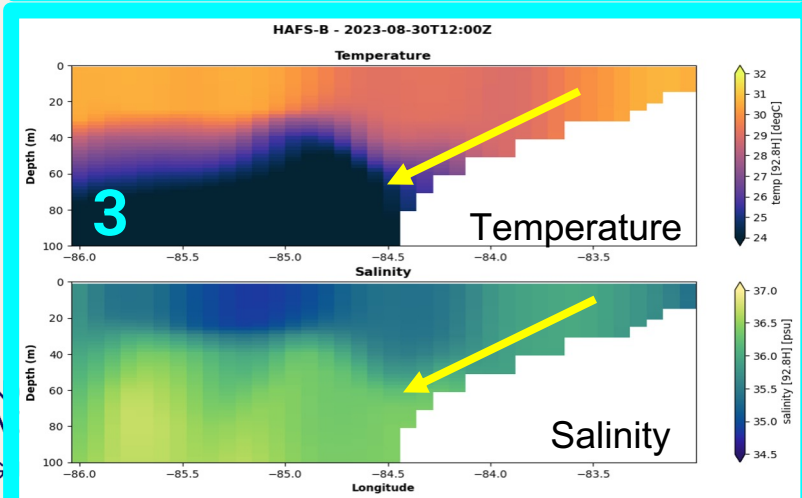
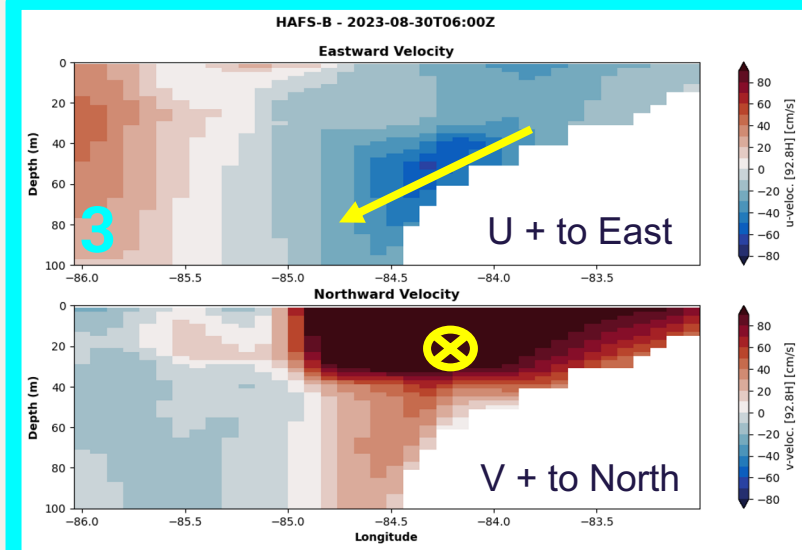


# Hurricane Idalia - Stage 3

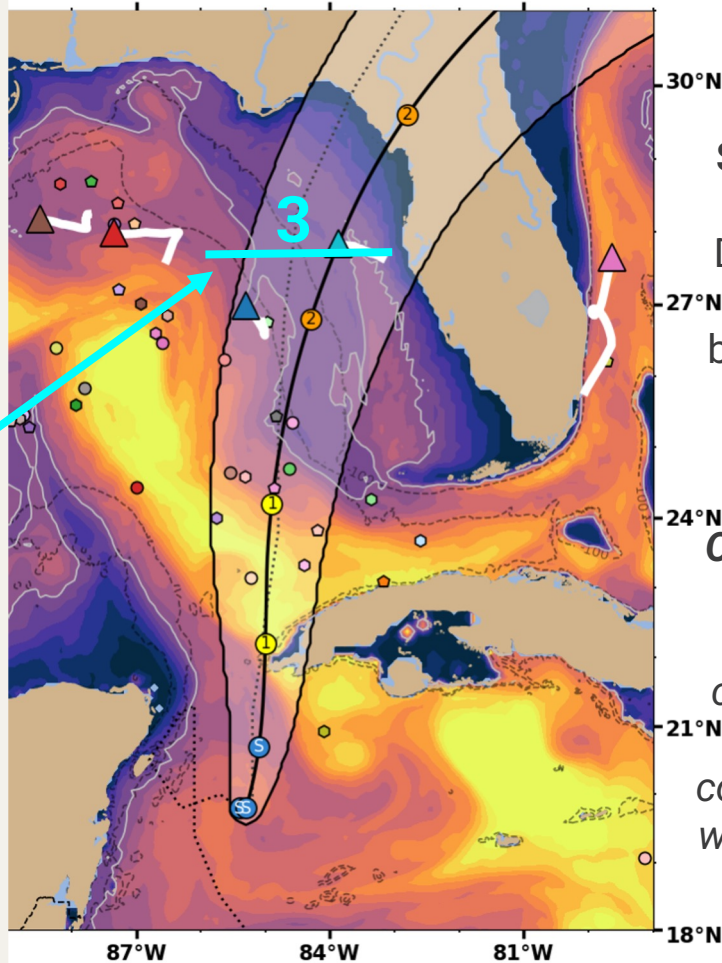
## USF Slocum Glider Gansett on the West Florida Shelf







# HAFS Cross-Section under Idalia

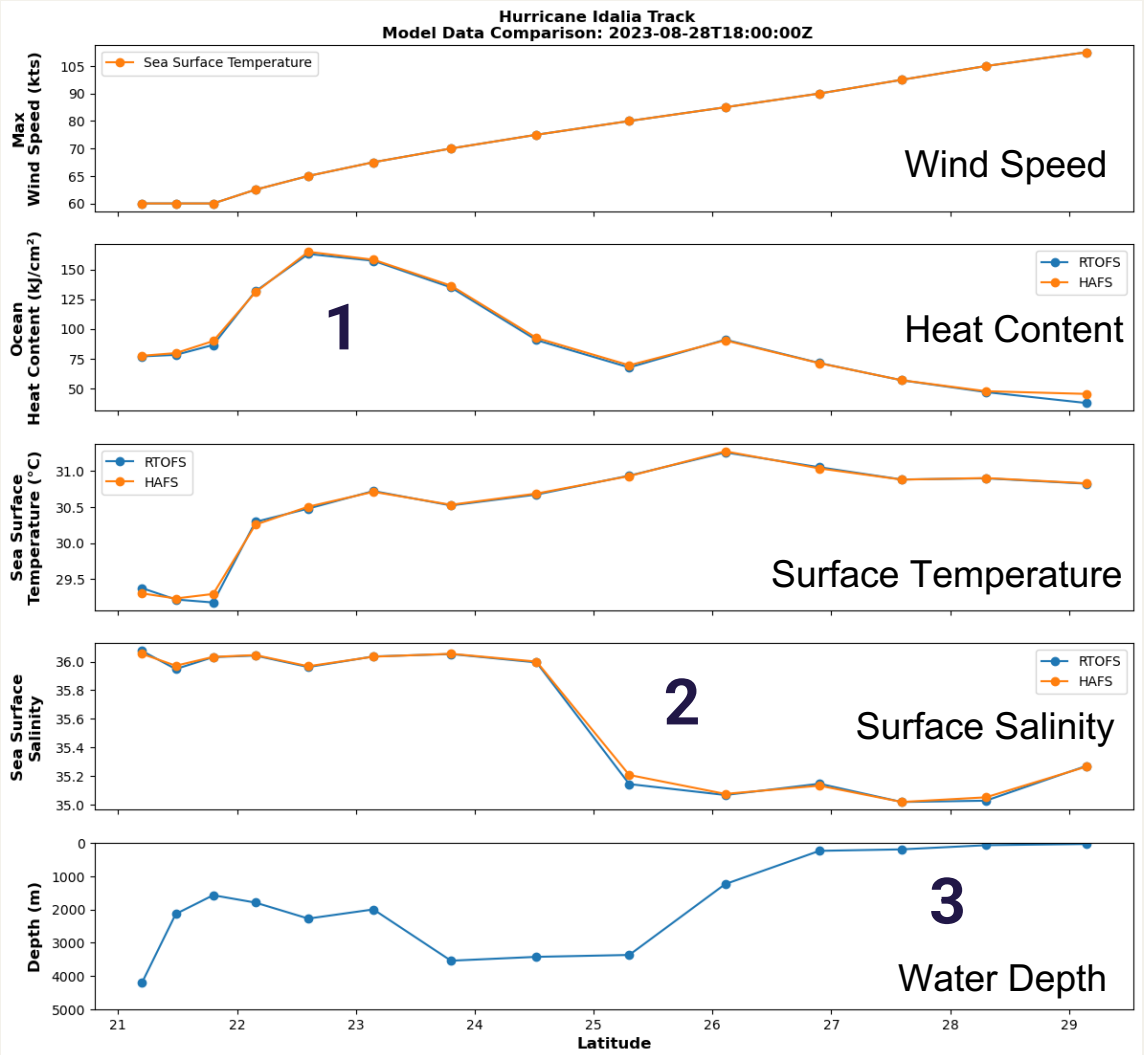
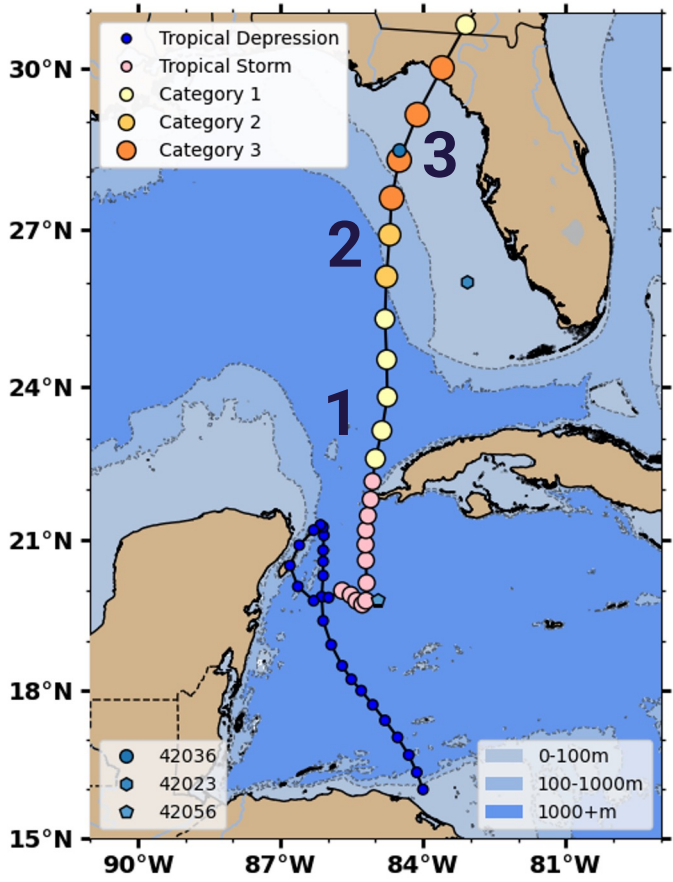


**Stage 3**  
**Two Layer**  
**Shelf Water:**  
Coastal  
Downwelling  
moves cold  
bottom water  
offshore

**O2R Science**  
**Result:**  
3 different  
co-evolution  
processes  
contributed to  
warm surface  
water

# Hurricane Idalia

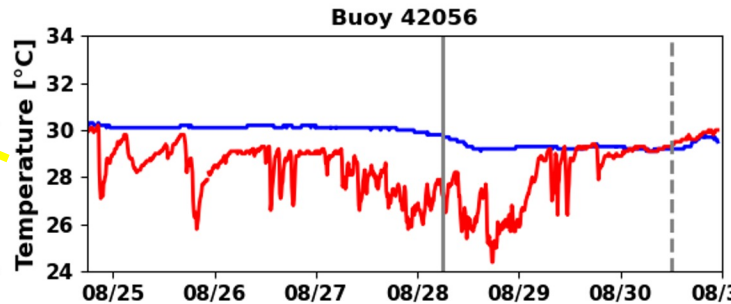
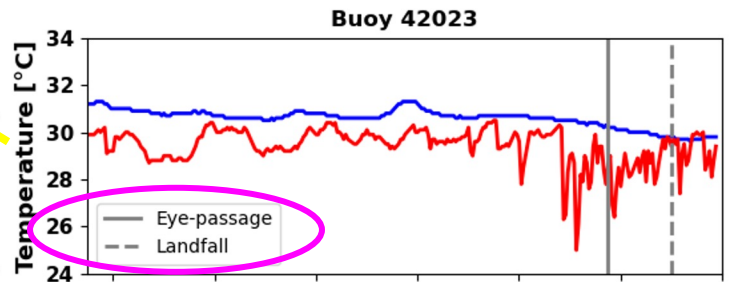
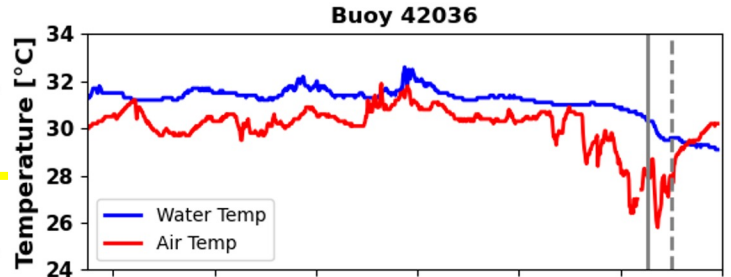
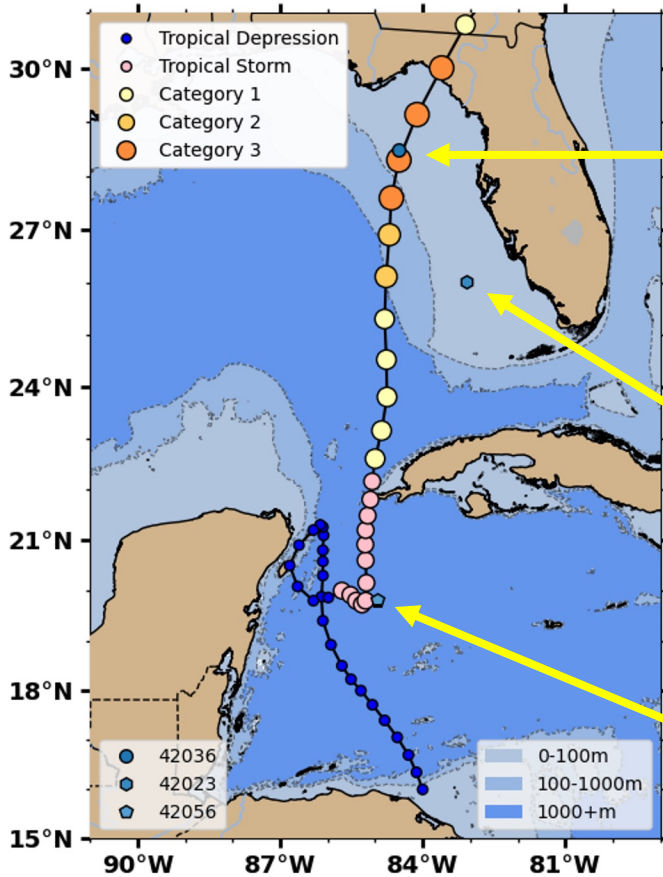
## 3 Processes Maintain Warm SST





# Hurricane Idalia - Stages 1-3

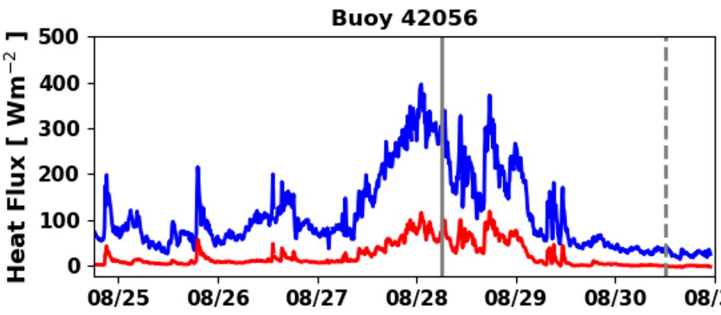
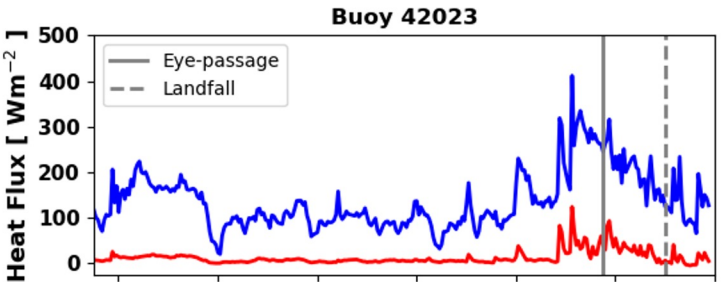
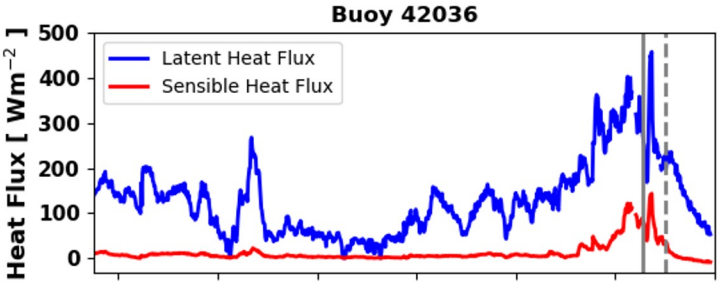
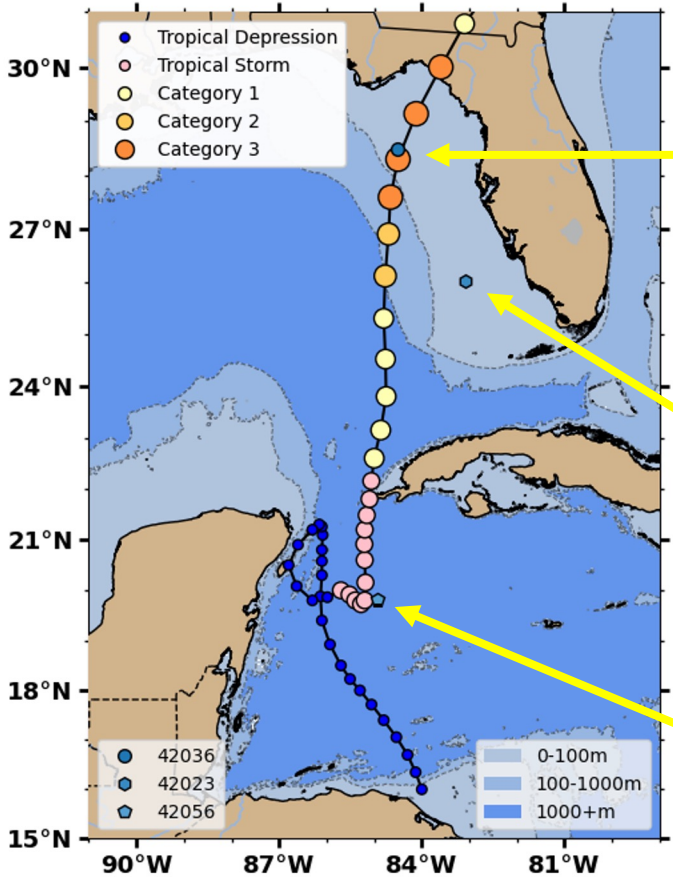
## Water & Air Temperatures - NOAA NDBC & USF COMPS Buoys



**Water** surface temperatures consistently warmer than the **air** temperatures along the entire track

# Hurricane Idalia - Stages 1-3

## Latent & Sensible Heat Fluxes - NOAA NDBC & USF COMPS Buoys



**Latent & Sensible**  
Heat Fluxes large during the strong storm winds along the entire track

Fairall 1996 Bulk Parameterization  
<https://agupubs.onlinelibrary.wiley.com/doi/10.1029/95JC03205>



NATIONAL ACADEMIES  
Sciences  
Engineering  
Medicine

GULF RESEARCH PROGRAM



## Idalia Conclusions:

- The Ocean is 3-D – *Subsurface T&S structure of Essential Ocean Features defined by our community*
- The Ocean & Hurricanes can co-evolve - *Essential Ocean Processes affecting hurricane intensity again identified*
- Success is a broad team effort - *We need the IOOS community*

