



# Bermuda 1-2 Race Preparations METOC Considerations

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Preparation is Everything !!!

*Races are lost on the water*

*Anon...*

# What is Weather ?

**Weather... n** .....

: the state of the atmosphere with respect to heat or cold, wetness or dryness, calm or storm, clearness or cloudiness

..... Webster

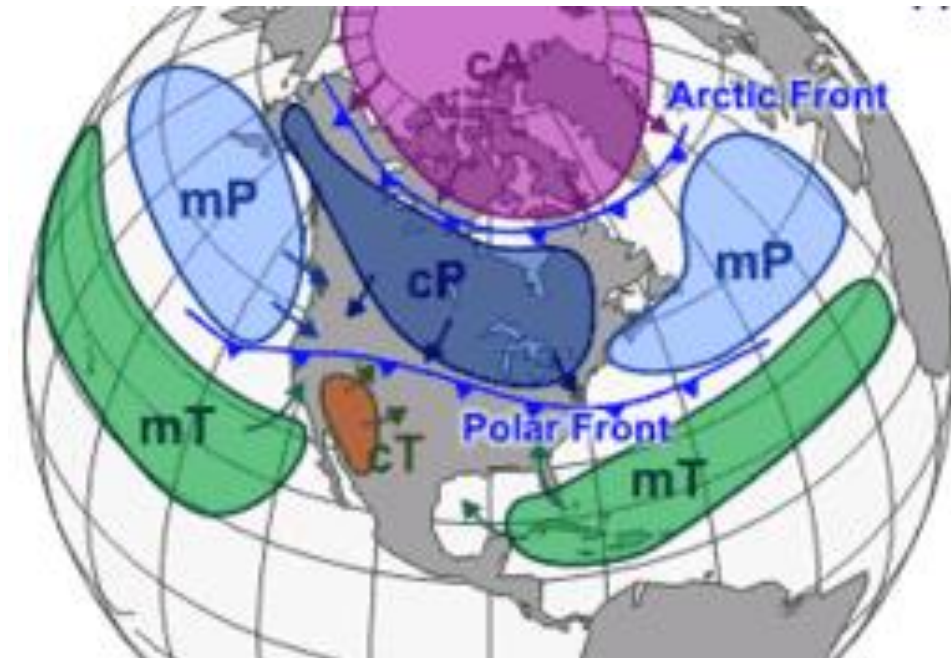
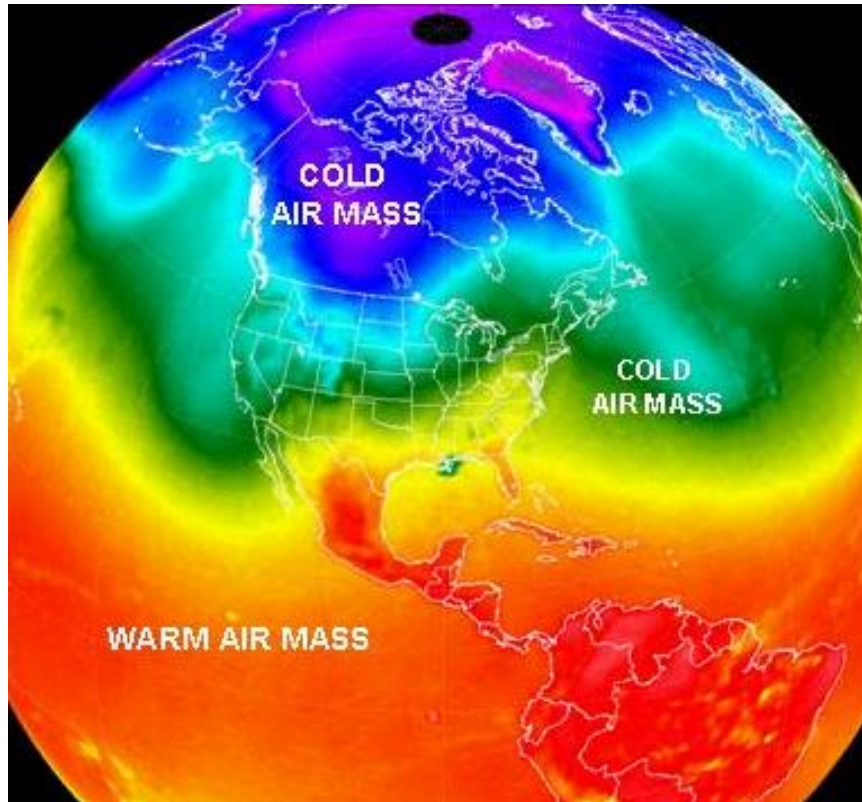
or Alternatively ..... **A Collision of Air Masses**

**Air mass .... n** .....

a body of air extending hundreds or thousands of miles horizontally and sometimes as high as the stratosphere and maintaining as it travels nearly uniform conditions of temperature and humidity at any given level

..... Webster

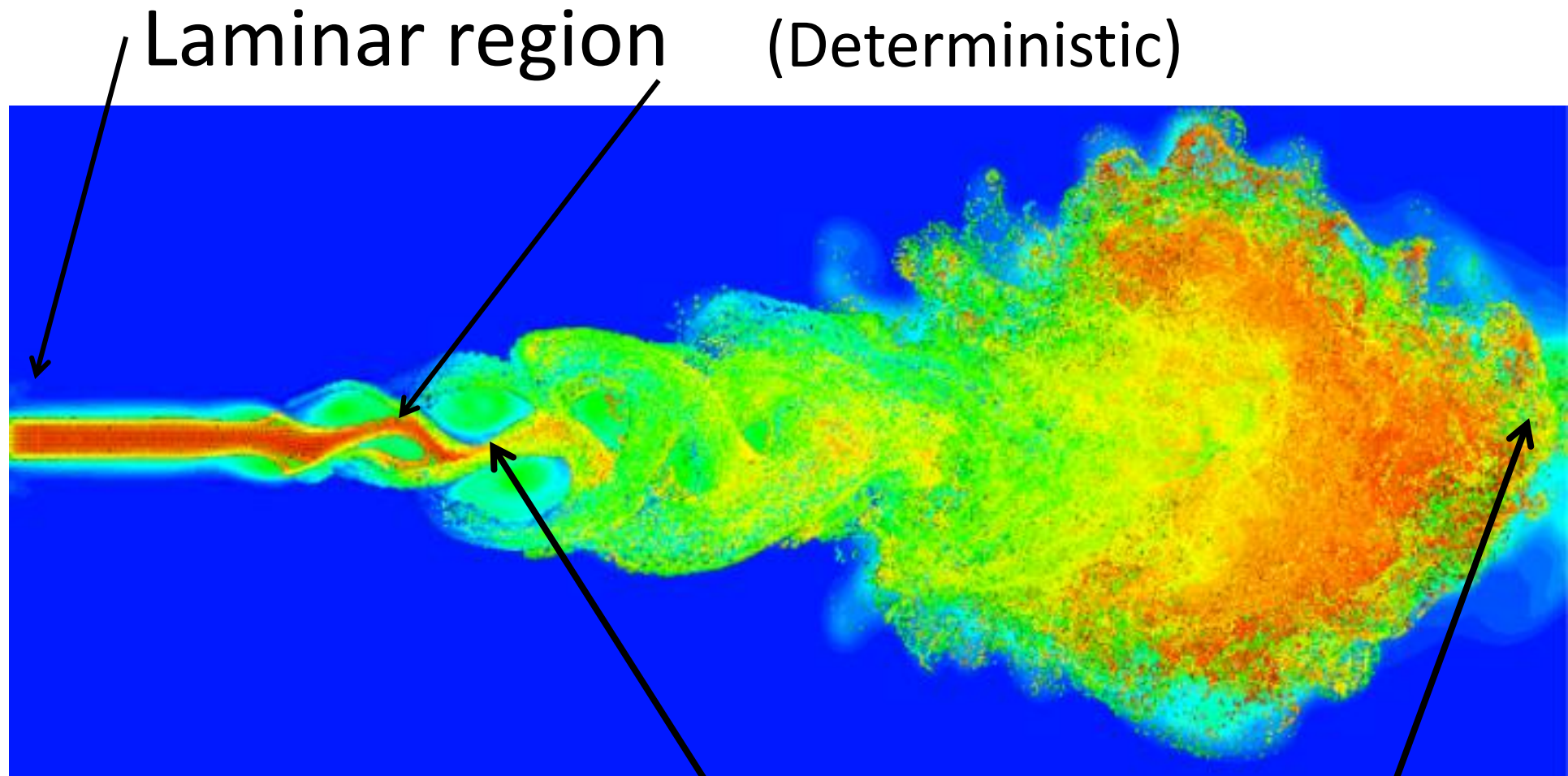
# Air Masses



*Characteristics Determined by Air Temperature and Humidity*



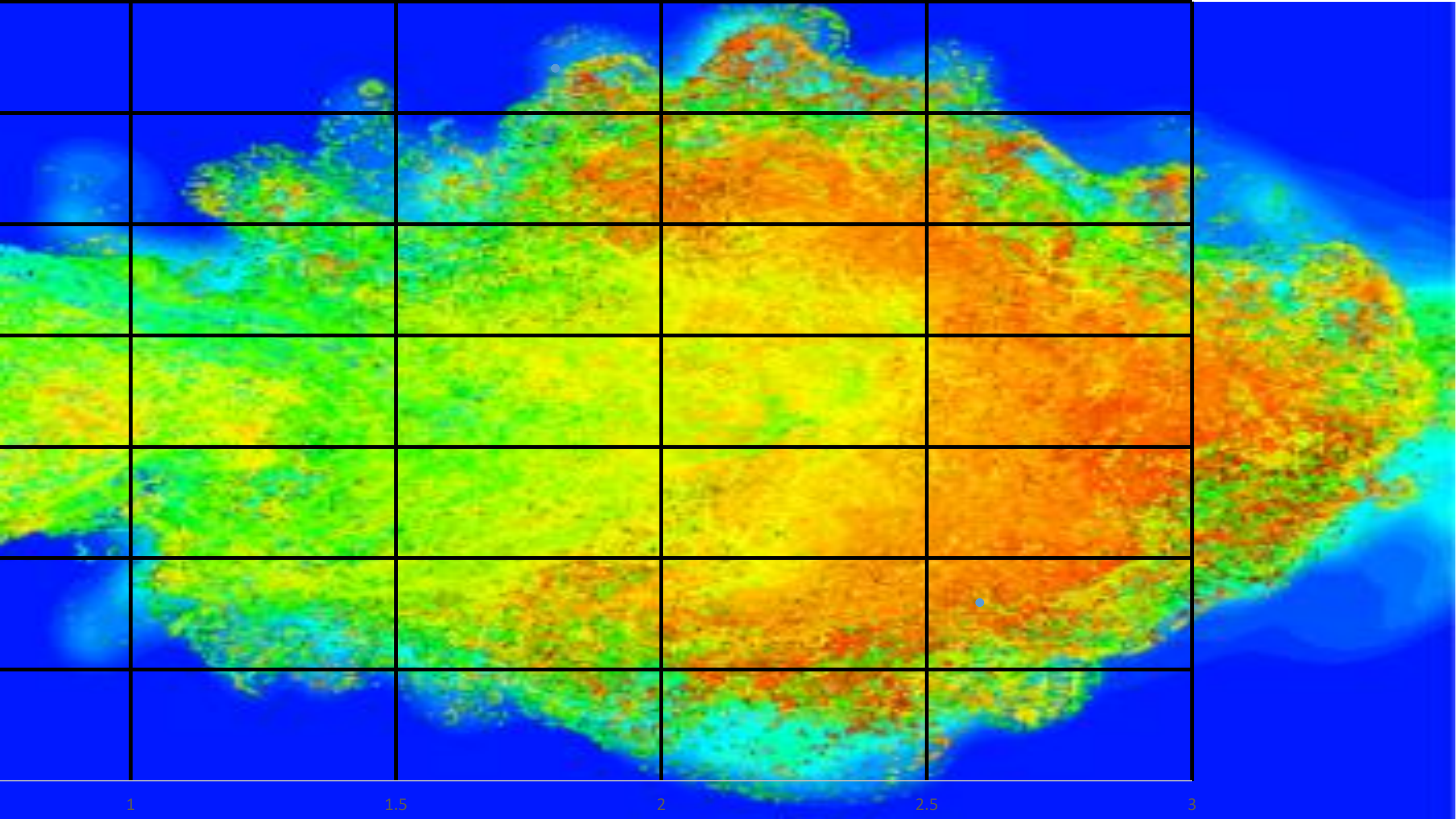




Laminar region (Deterministic)

*"Big whirls have little whirls,  
That feed on their velocity;  
And little whirls have lesser whirls,  
And so on to viscosity."  
Richardson....*

Turbulent Region (Probabilistic)

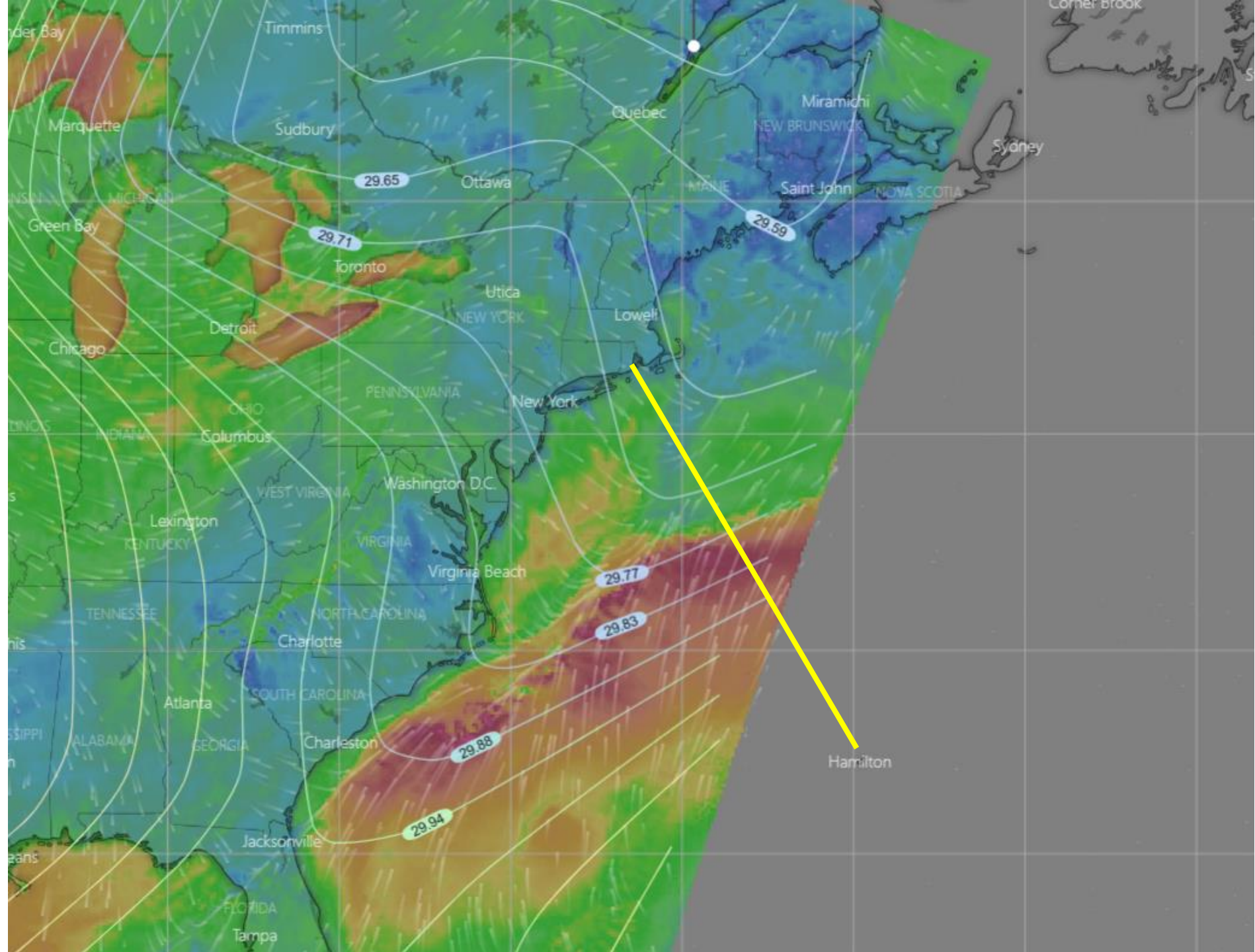




# Meteorological Forecast Models

- **Global Forecast System (GFS)** (<https://www.ncei.noaa.gov/products/weather-climate-models/global-forecast>)  
The GFS model is a coupled, hydrostatic, global weather forecast model run four times a day on a horizontal resolution of **13 km** reported at **25km**
- **Global Ensemble Forecast System (GEFS)**  
The GFS model run 31 times to produce an ensemble of forecasts to quantify uncertainty. **GEFS runs four times each day with forecast going out to 35 days** with a **25km** horizontal resolution
- **Integrated Forecast System (IFS)** ([Forecasts | ECMWF](#))  
IFS is a global, non hydrostatic, forecast model referred to as the ECMWF or “Euro” model.  
**The Hi-Res version runs every 6 hours out to 10 days providing 9km resolution.**  
**A 51 member ensemble is run every 12hrs out to 15 days with a 18km resolution.**
- **Unified Model (UKMET)**  
An operational model system run in a number of configurations. The global version provides forecasts out to 7 days on a resolution of 16 km for the ensemble
- **High Resolution Rapid refresh (HRRR)** (<https://www.spc.noaa.gov/exper/hrrr/>) is an hourly updated updated assimilation and model forecast system, based on the WRF (Weather Research and Forecasting) model which provides **3 km** resolution out to approximately 31 hours





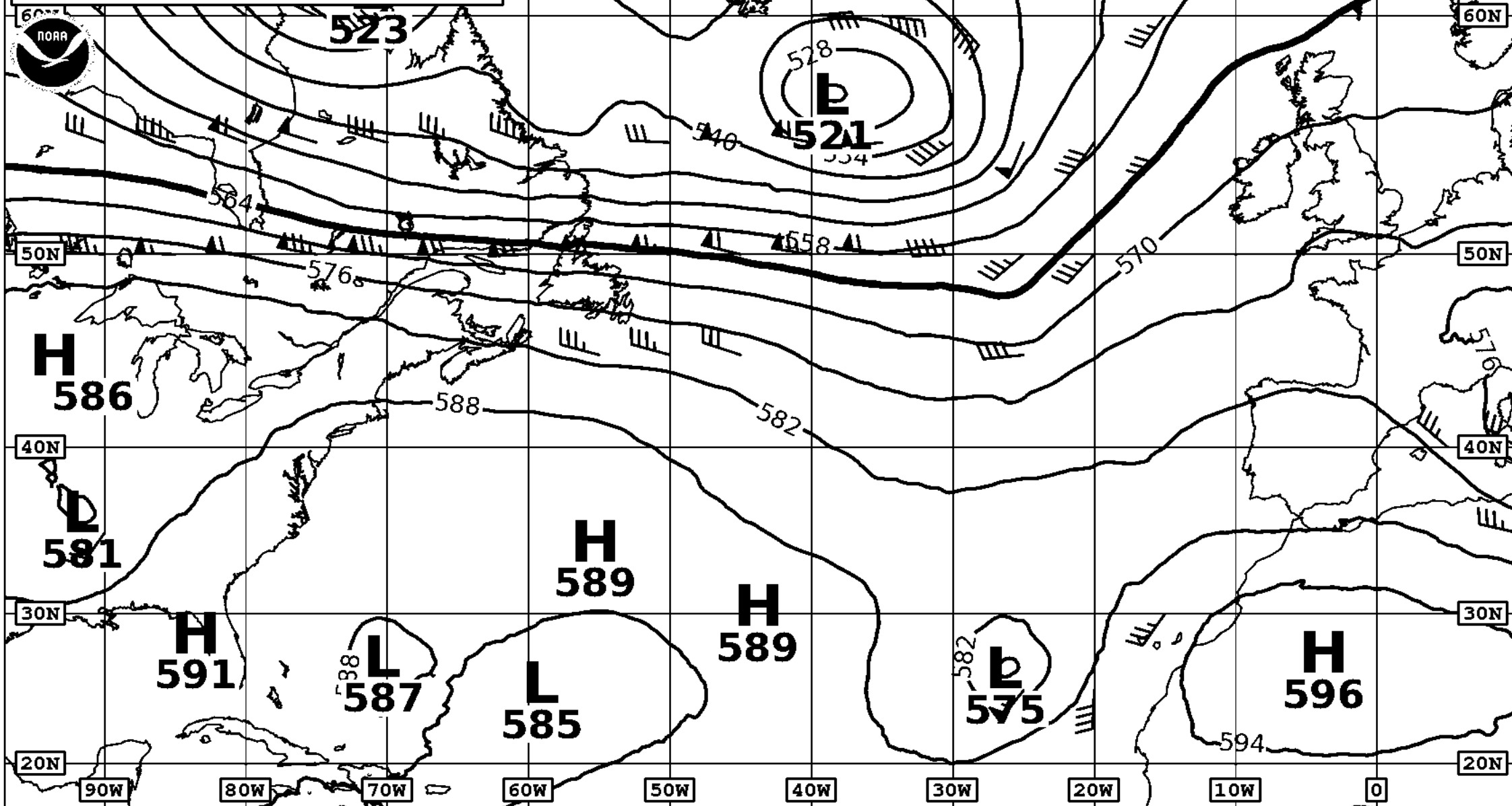
**ATLANTIC SURFACE ANALYSIS**  
ISSUED: 15:07 UTC 08 JUN 2021  
VALID: 12:00 UTC 08 JUN 2021  
FCSTR: JOSEPH  
SOURCES: OPC NHC WPC

FORECAST TRACKS ARE FOR VALID TIME + 24 HOURS.  
WARNING LABELS ARE FOR HIGHEST CONDITIONS FROM  
VALID TIME THROUGH 24 HOURS.

NWS/NCEP - Ocean Prediction Center  
ocean.weather.gov

NWS/NCEP – Ocean Prediction Center  
ocean.weather.gov

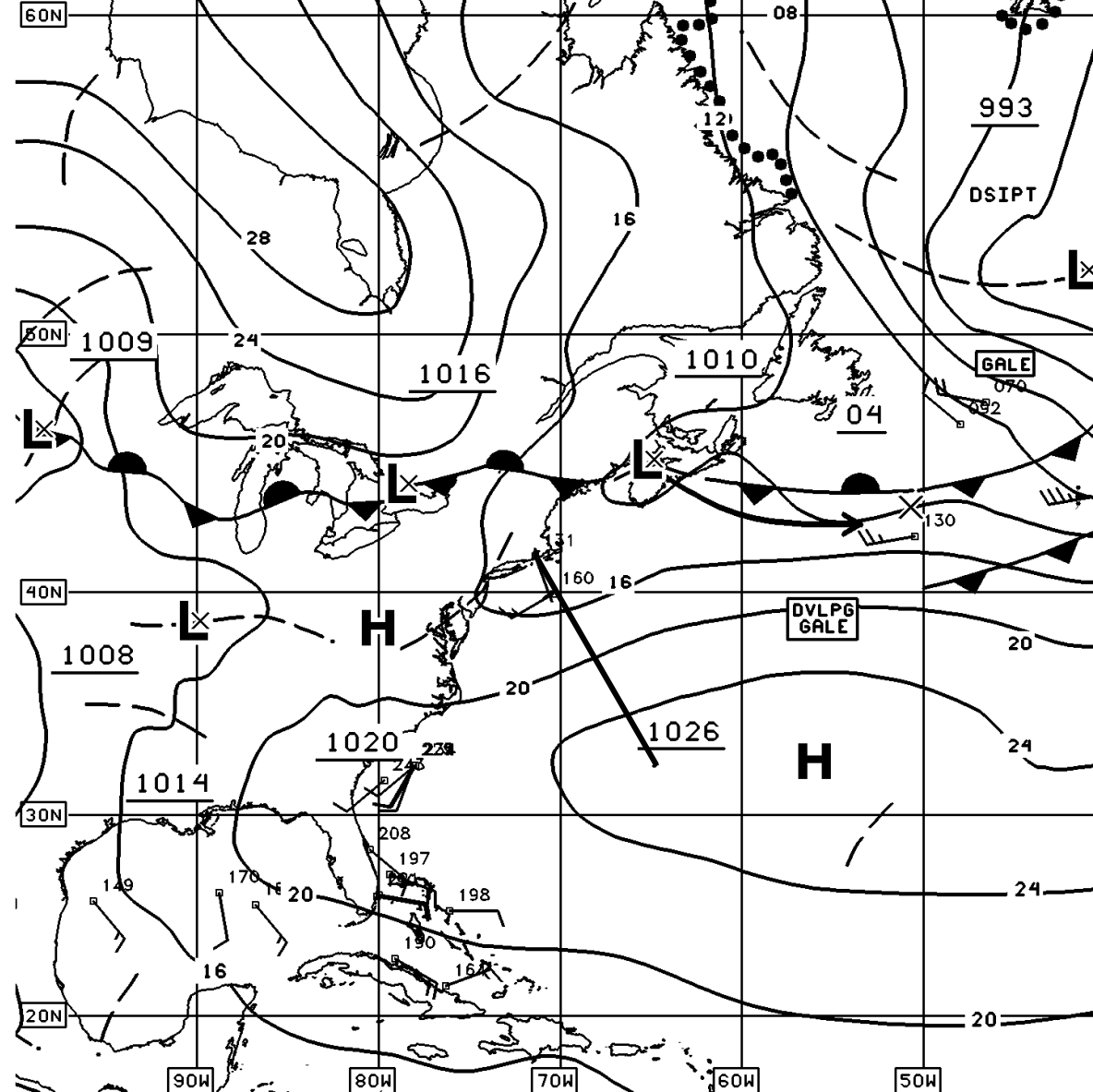
00-HOUR 500 MB FORECAST  
ISSUED: 17:19 UTC 08 JUN 2021  
VALID: 12:00 UTC 08 JUN 2021  
DATA: GFS 12 UTC 08 JUN 2021



ATLANTIC SURFACE ANALYSIS  
ISSUED: 14:53 UTC 09 JUN 2021  
VALID: 12:00 UTC 09 JUN 2021  
FCSTR: HOLLEY  
SOURCES: OPC NHC WPC



FORECAST TRACKS ARE FOR VALID TIME + 24 HOURS.  
WARNING LABELS ARE FOR HIGHEST CONDITIONS FROM  
VALID TIME THROUGH 24 HOURS.

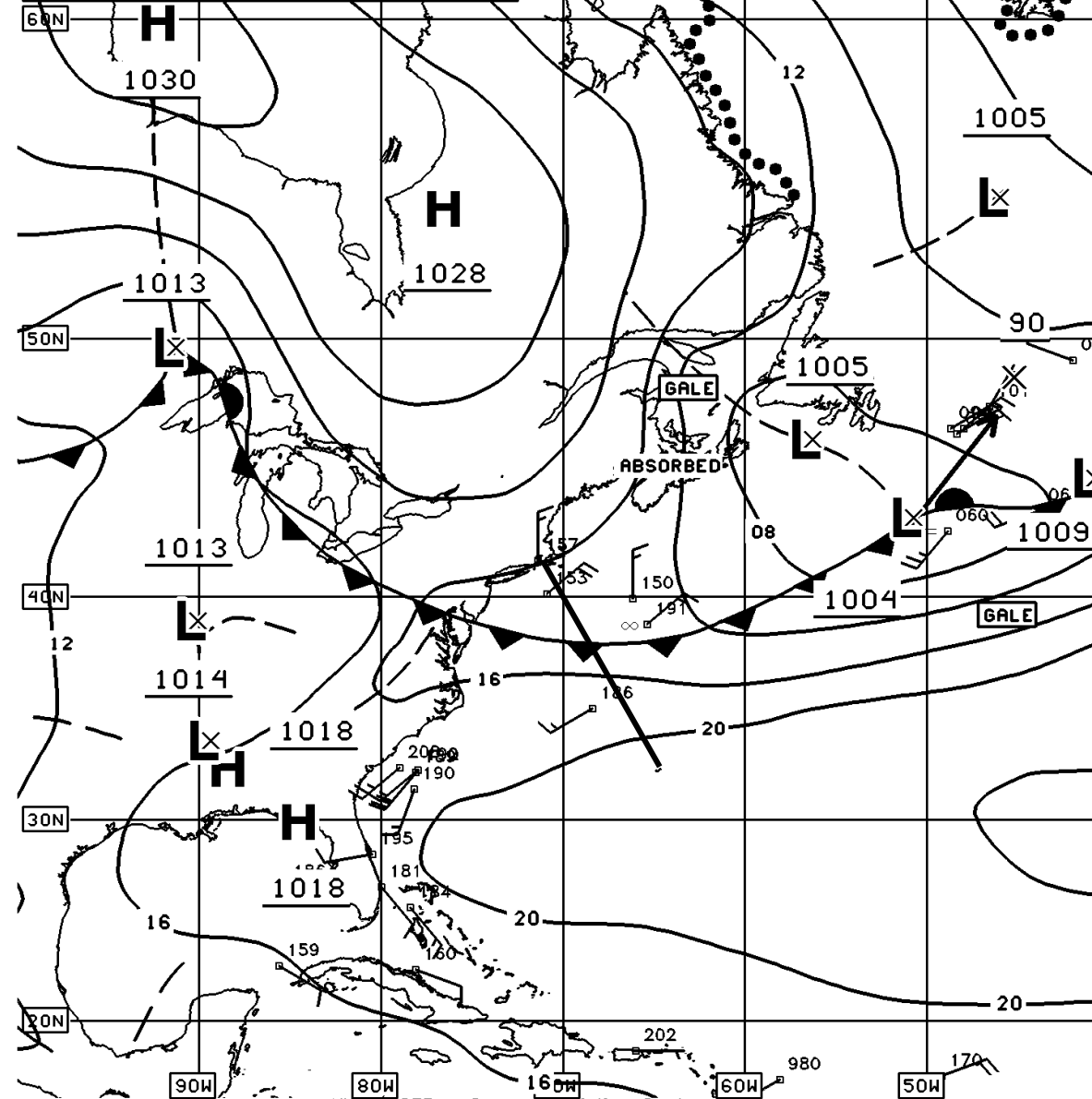




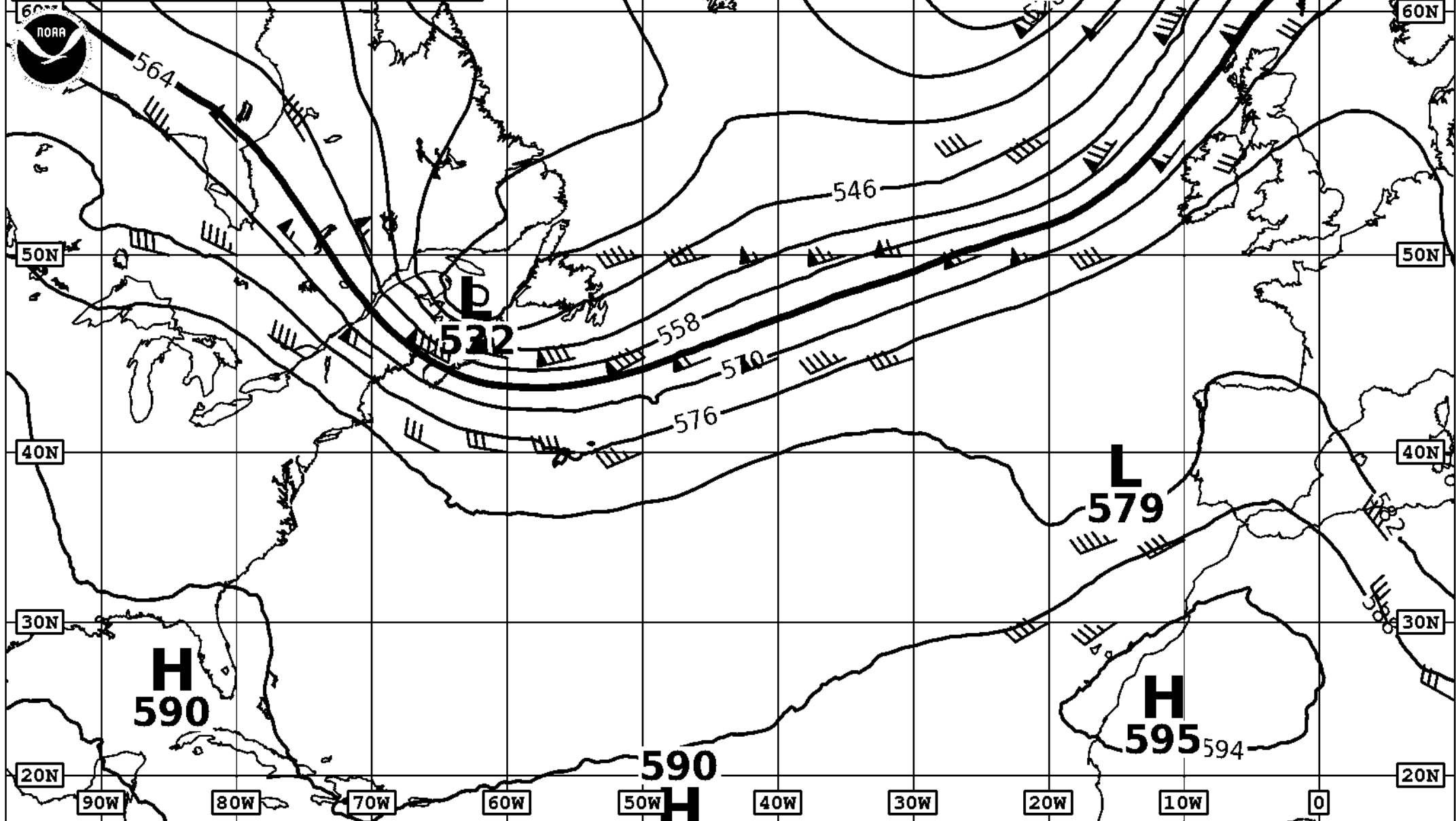
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VALID: 12:00 UTC 10 JUN 2021  
FCSTR: COLLINS  
SOURCES: OPC NHC WPC



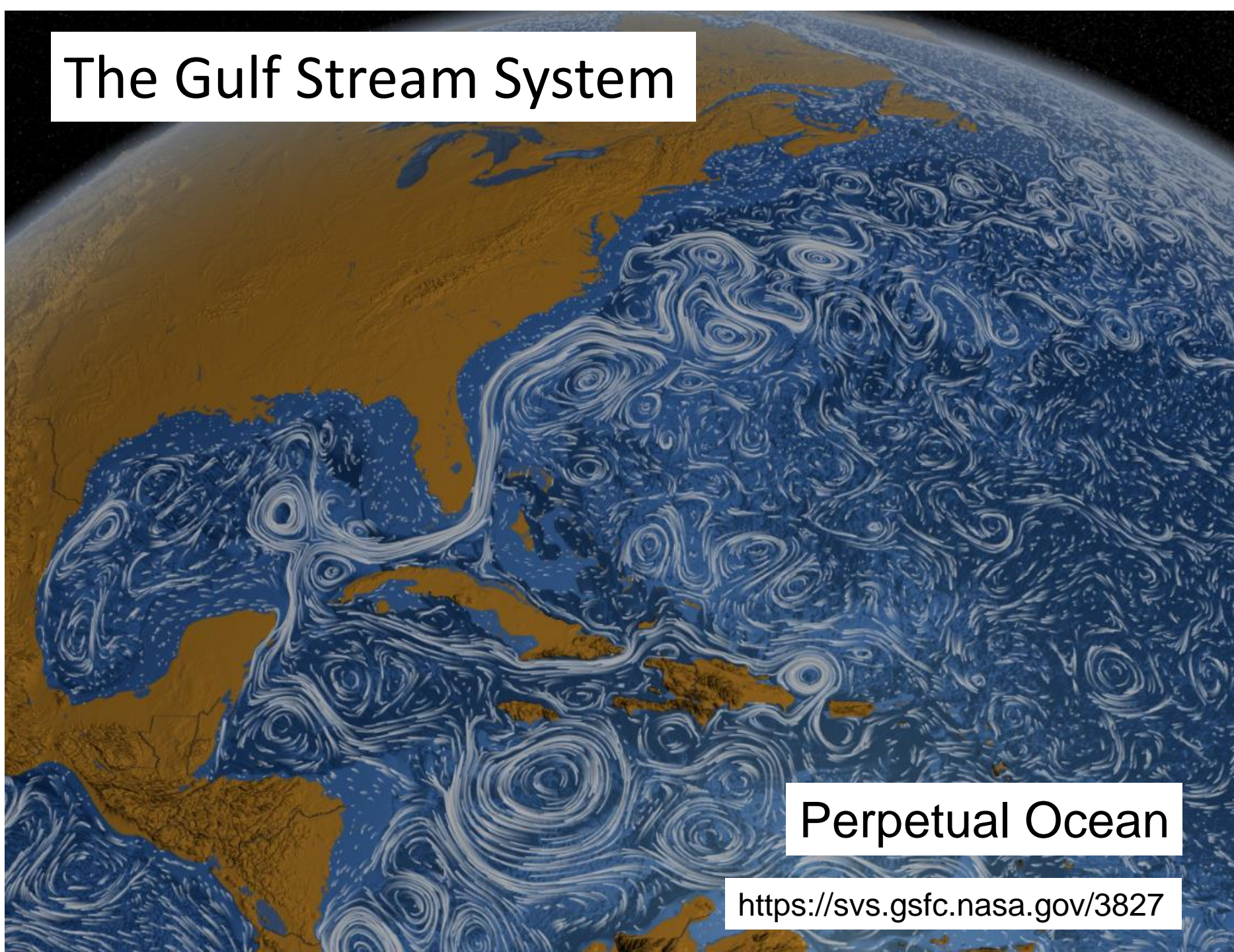
FORECAST TRACKS ARE FOR VALID TIME + 24 HOURS.  
WARNING LABELS ARE FOR HIGHEST CONDITIONS FROM  
VALID TIME THROUGH 24 HOURS.



00-HOUR 500 MB FORECAST  
ISSUED: 17:19 UTC 10 JUN 2021  
VALID: 12:00 UTC 10 JUN 2021  
DATA: GFS 12 UTC 10 JUN 2021



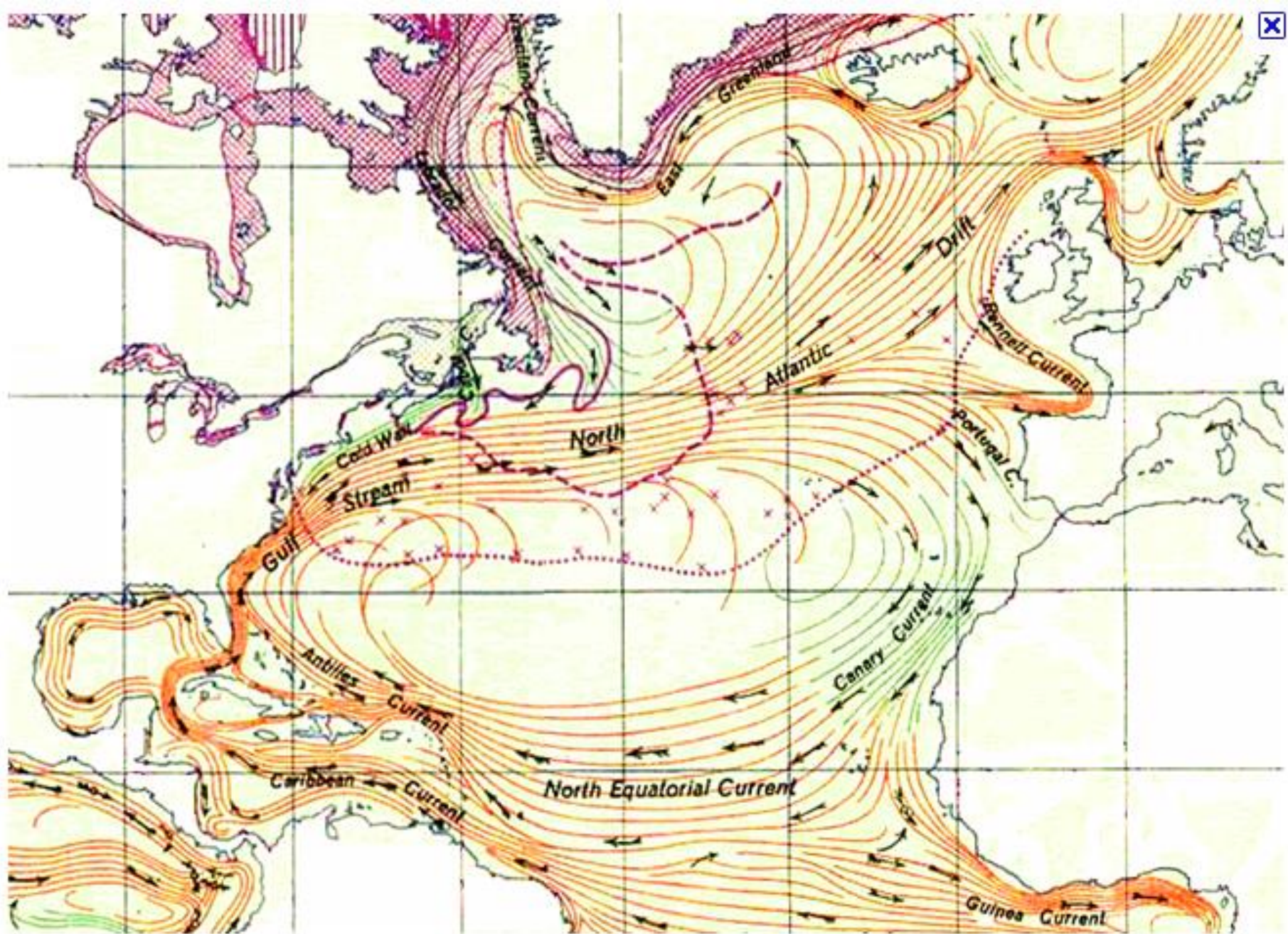
# The Gulf Stream System



Perpetual Ocean

<https://svs.gsfc.nasa.gov/3827>

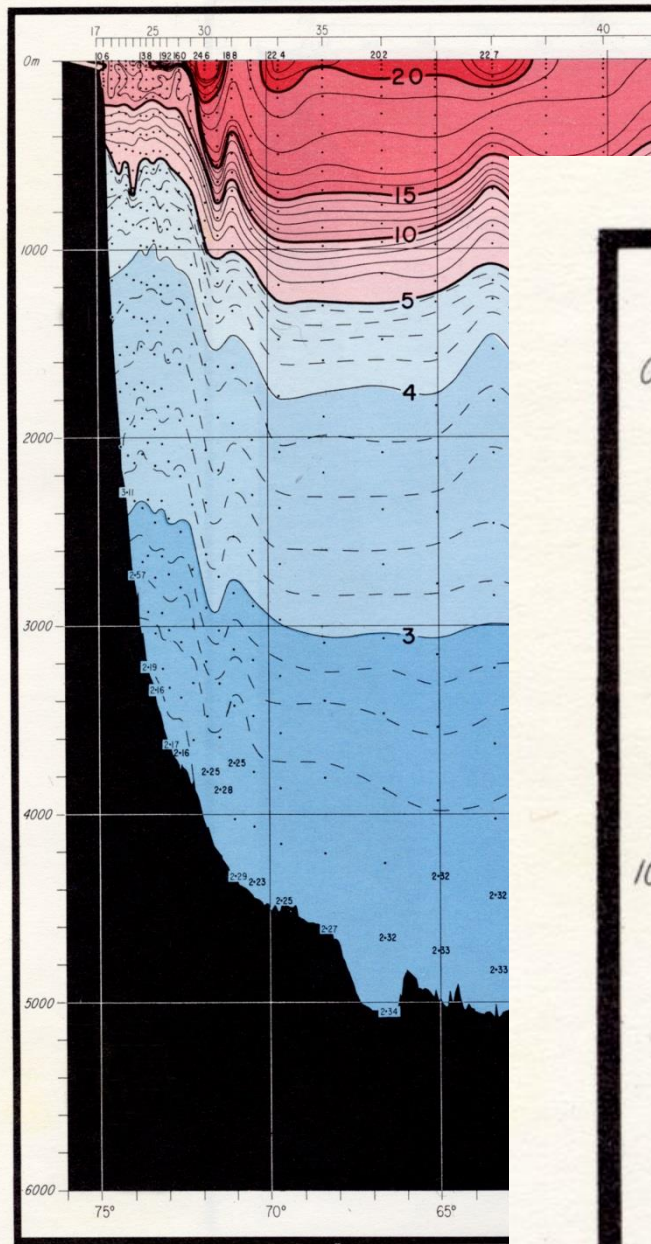




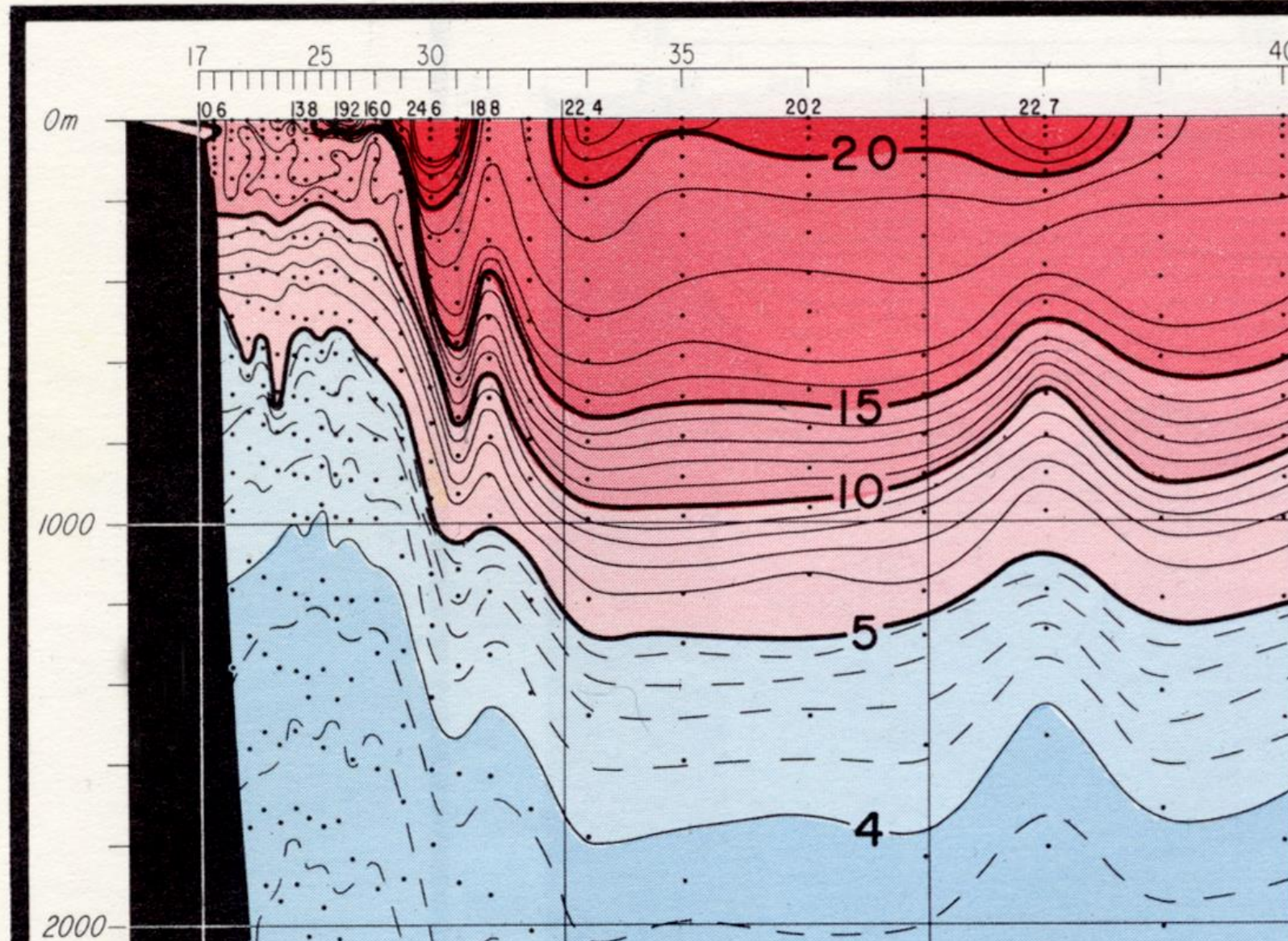
North Atlantic Gyre – Largely Wind Driven



## Water Temperatures ... **IMPORTANT!!**

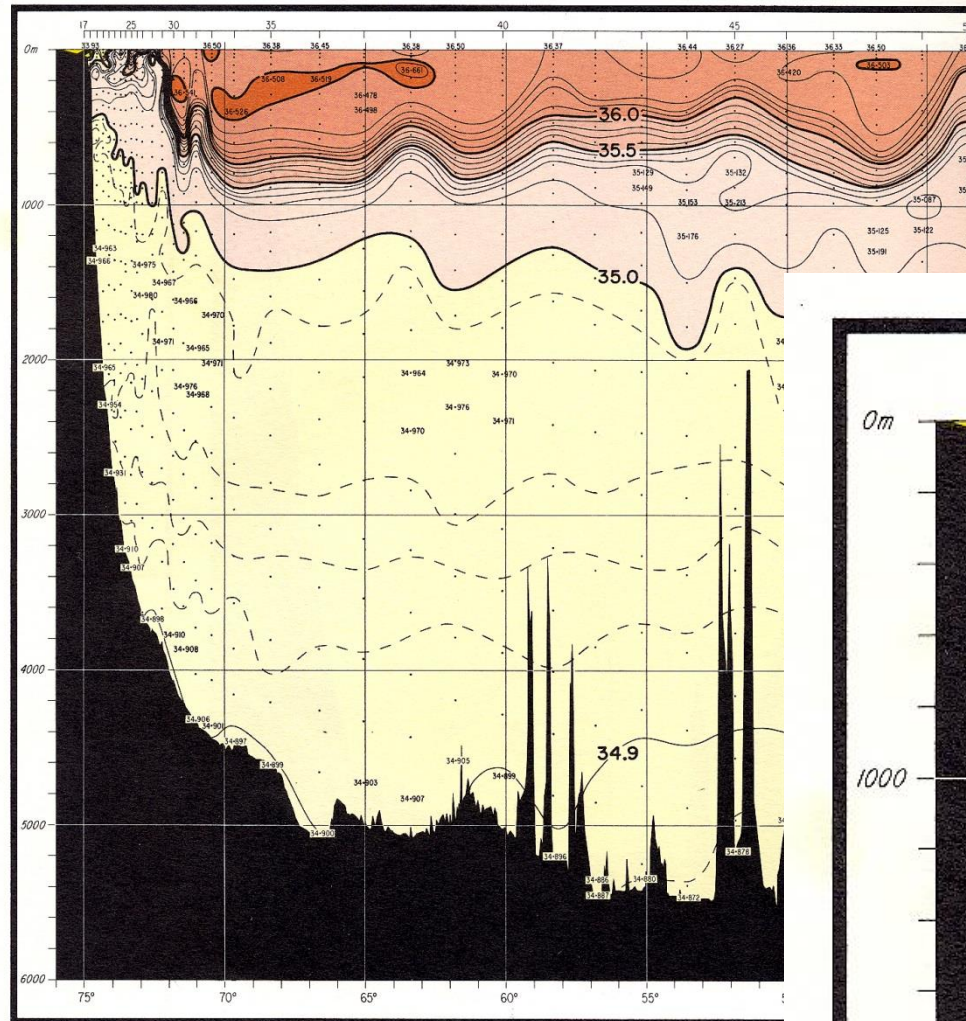


36° N.

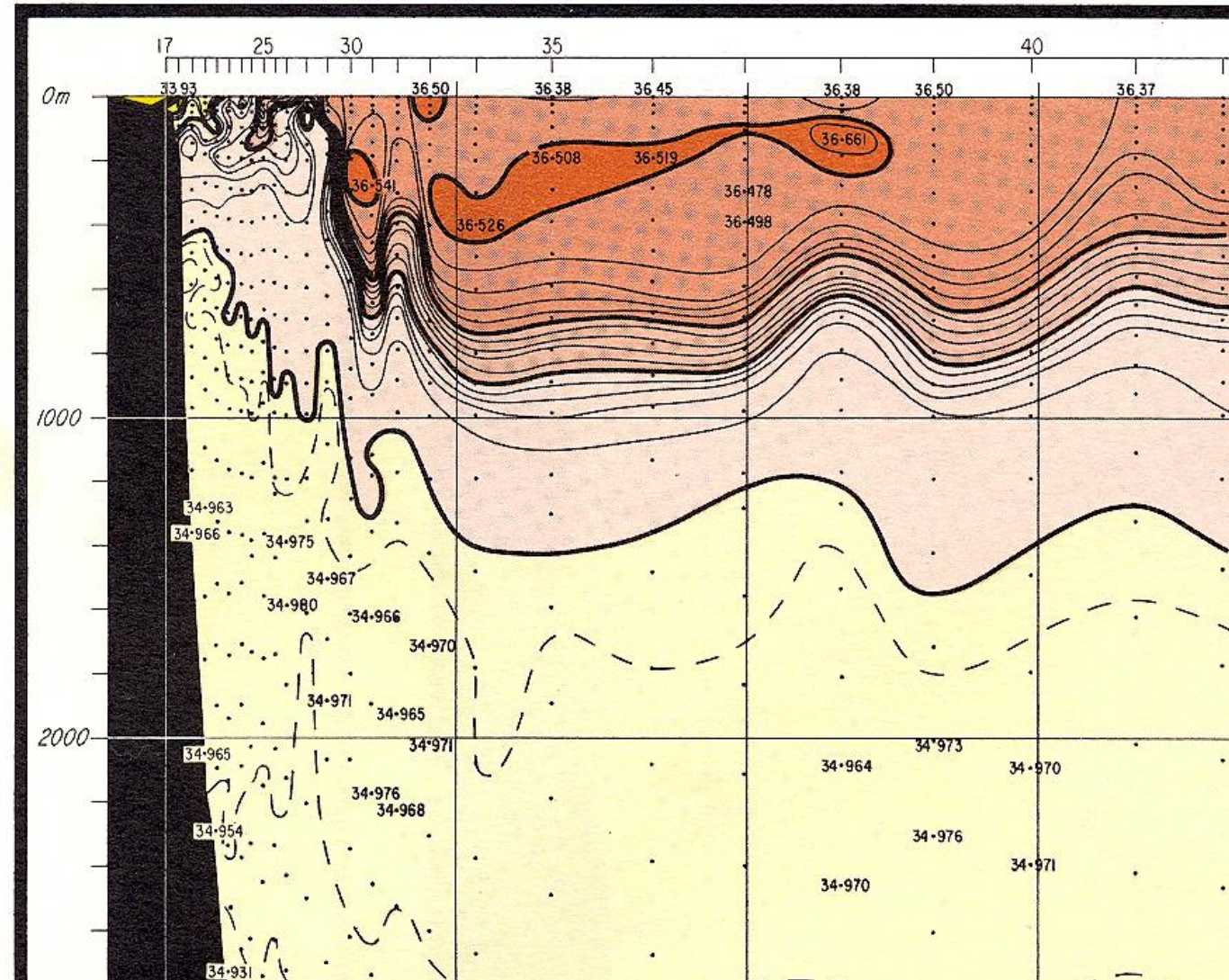




***and Salinity Gradients !***

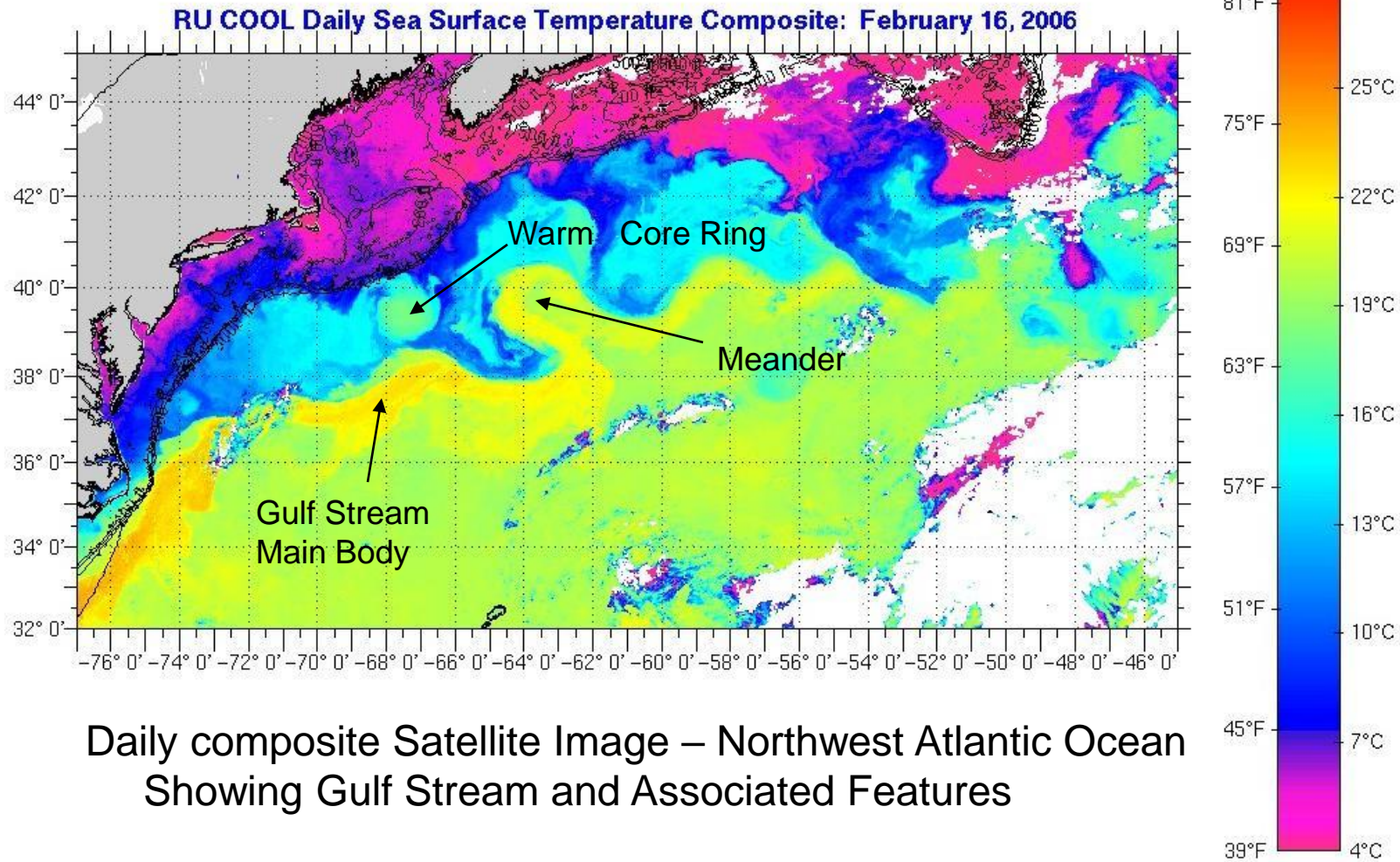


**36°N.**

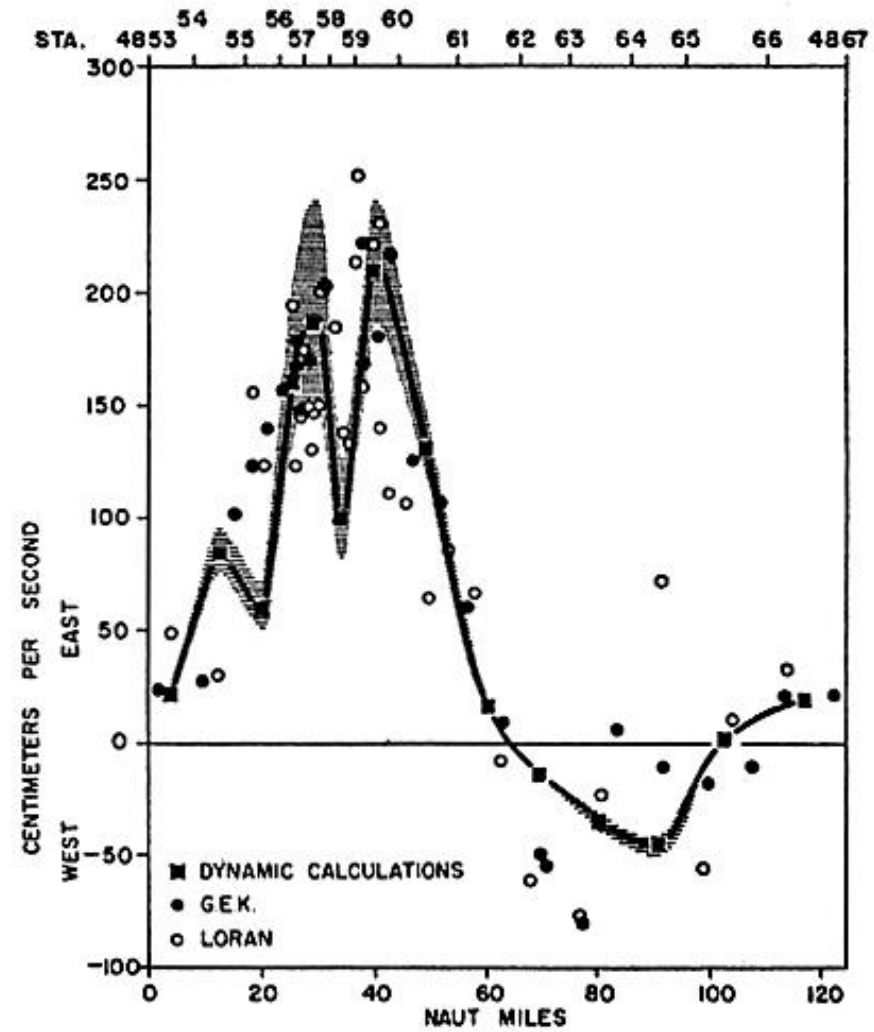




# SST



## Typical Main Body Structure

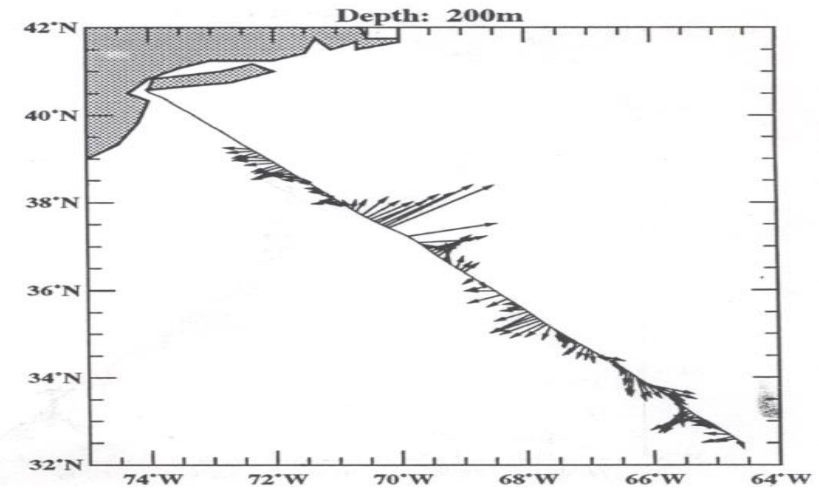
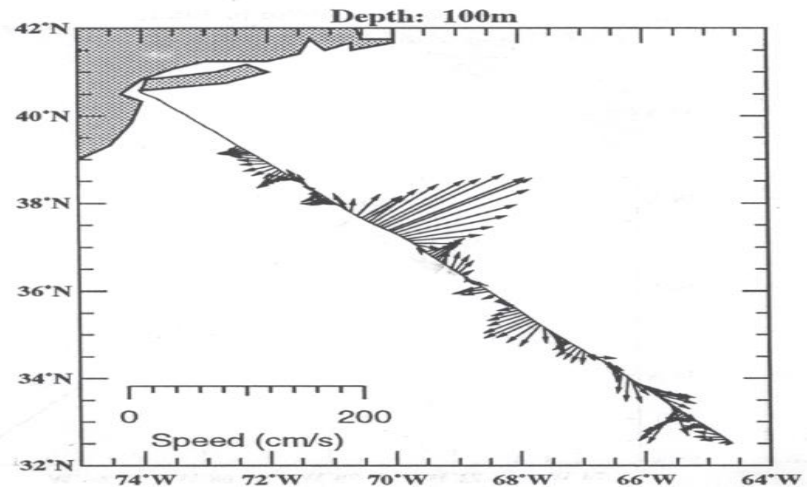
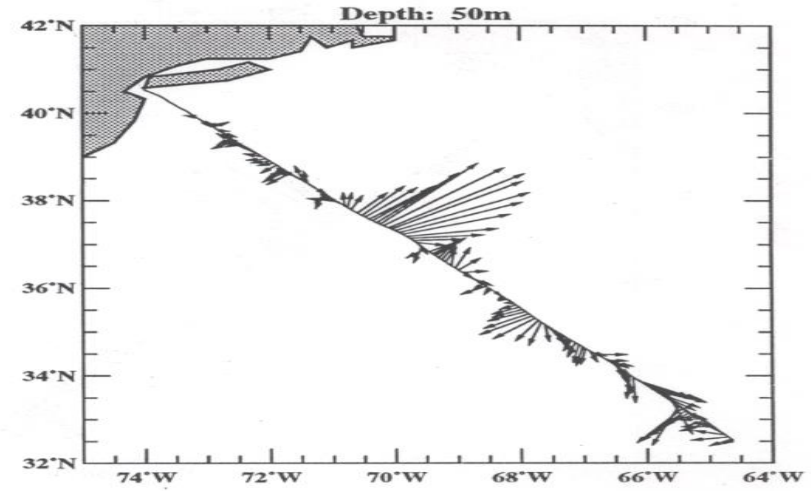
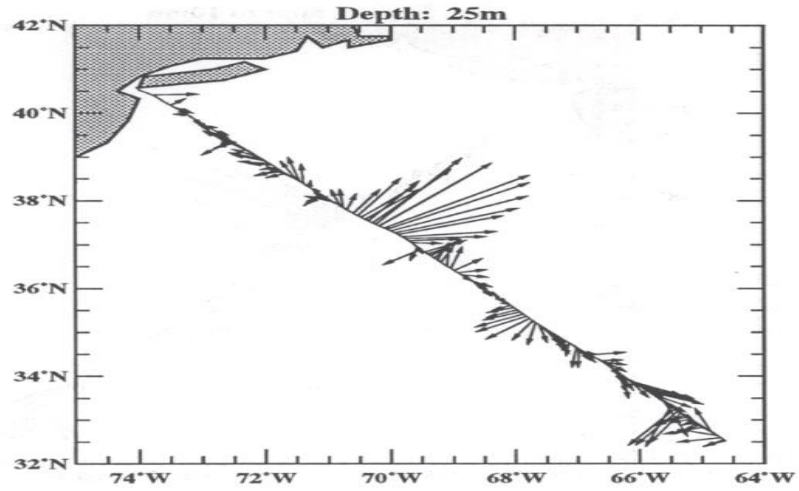


From: Stommel, , *The Gulf Stream* , 1965



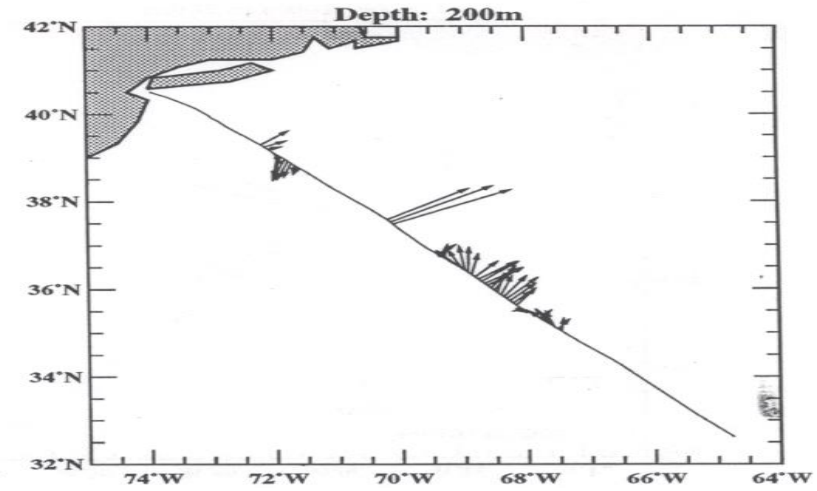
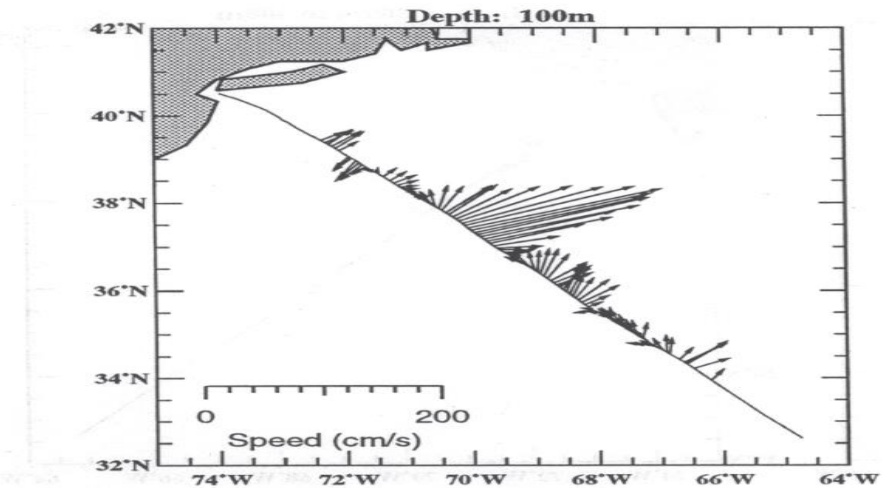
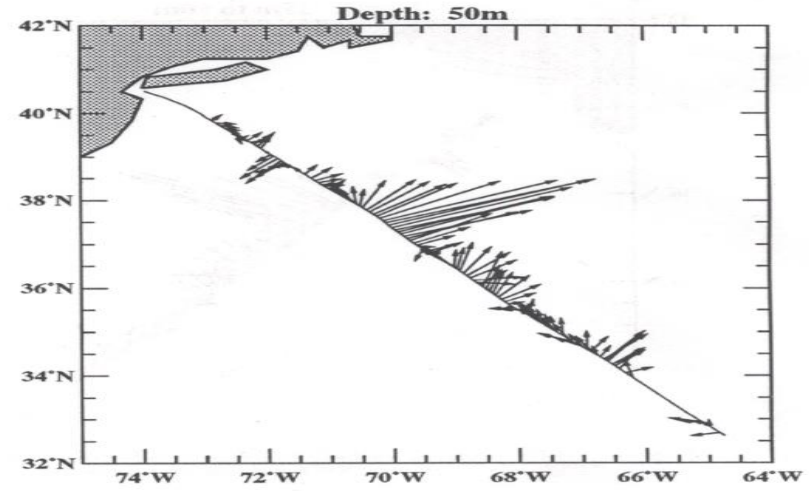
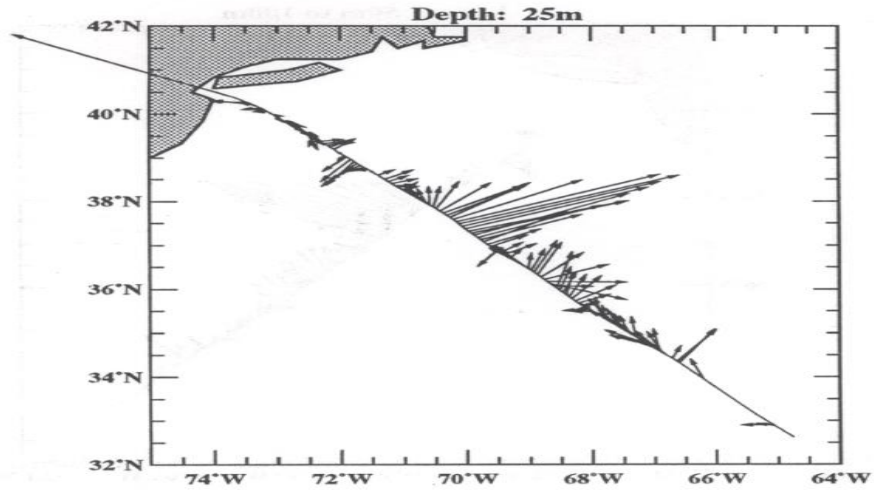
## Oleander ADCP Velocities

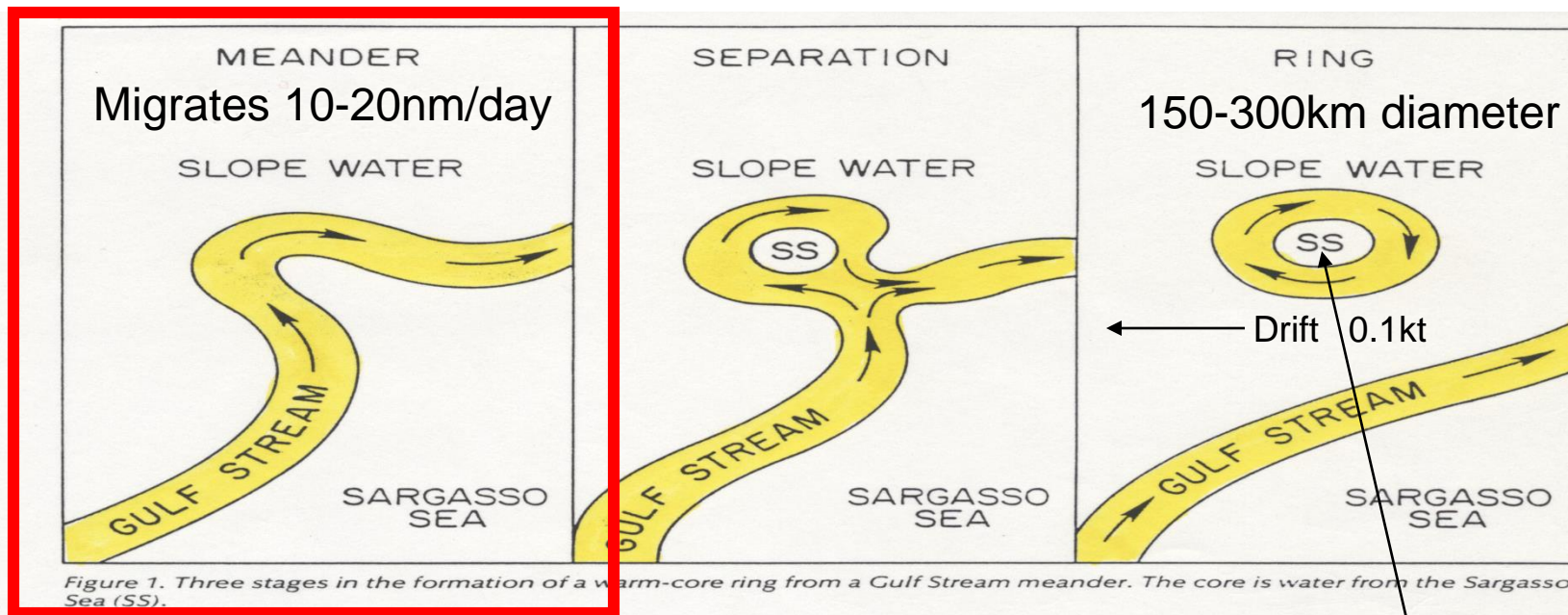
Cruise # 059-061 (98/03/13 08:22:59 to 98/03/16 14:50:05 Outbound)



# Oleander ADCP Velocities

Cruise # 062-064 (98/03/16 14:55:06 to 98/03/19 17:21:32 Inbound)





Warm Core

Cold Core

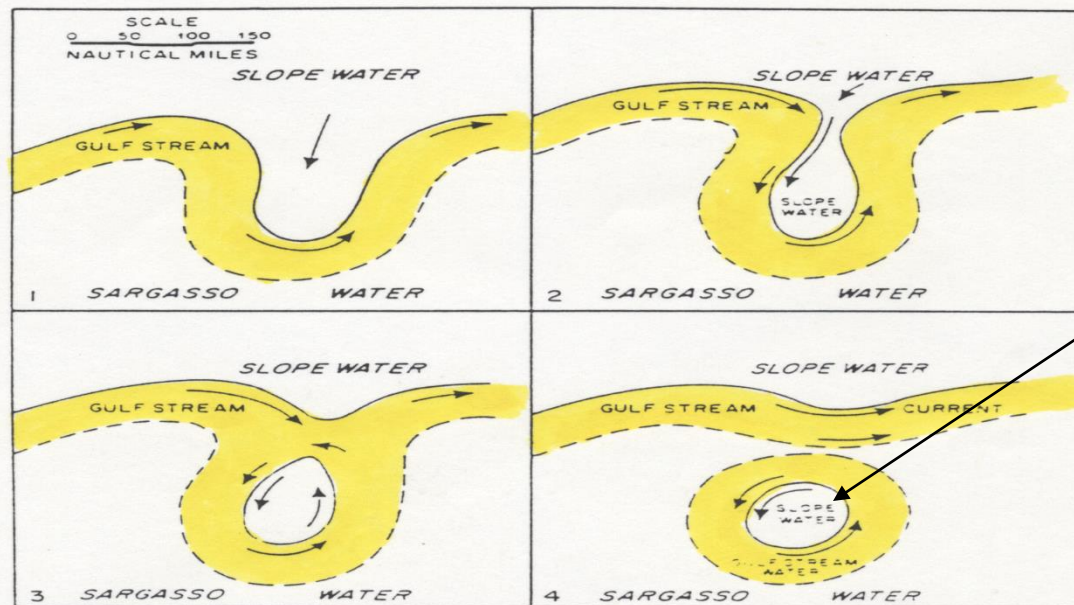
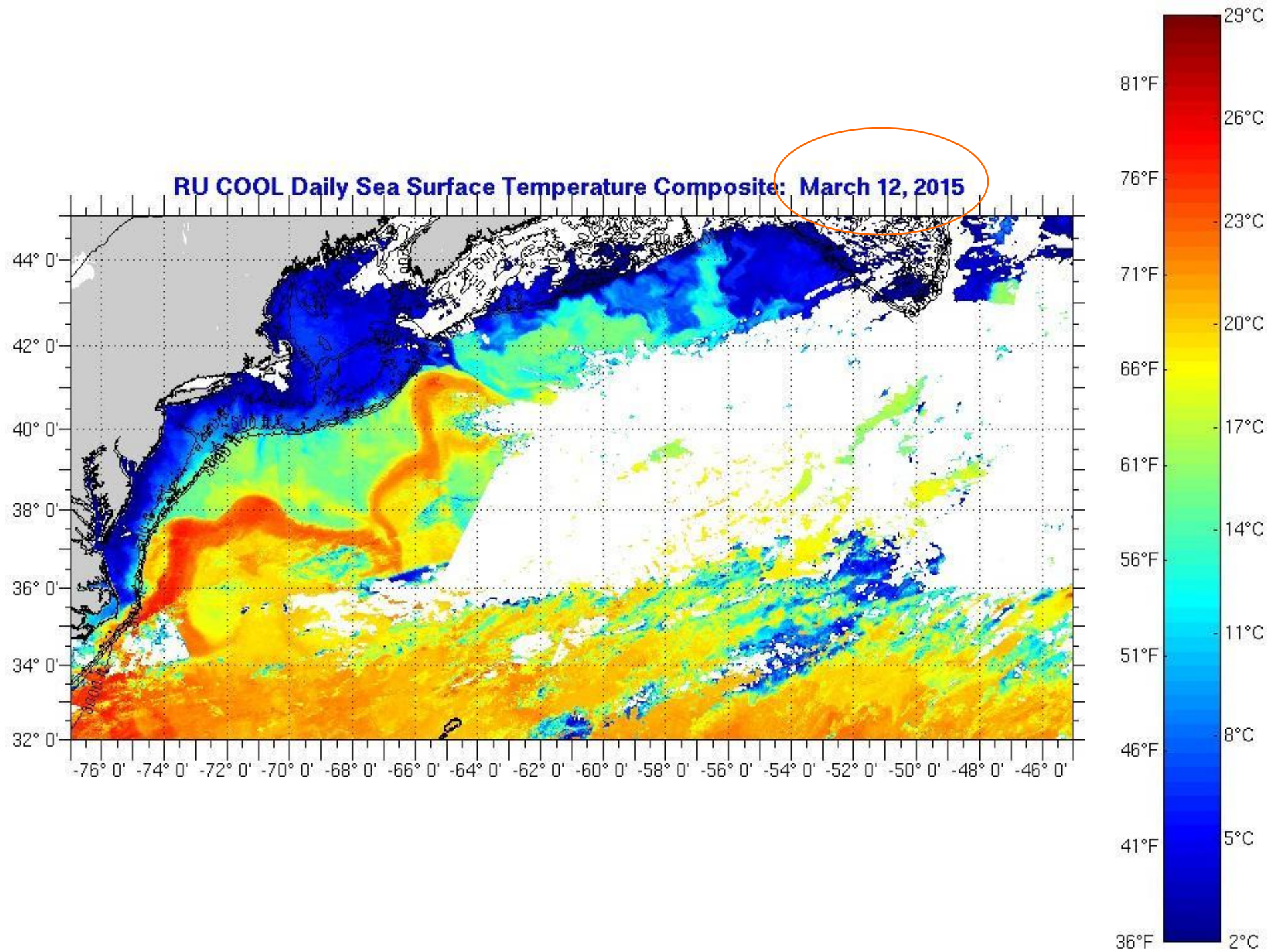
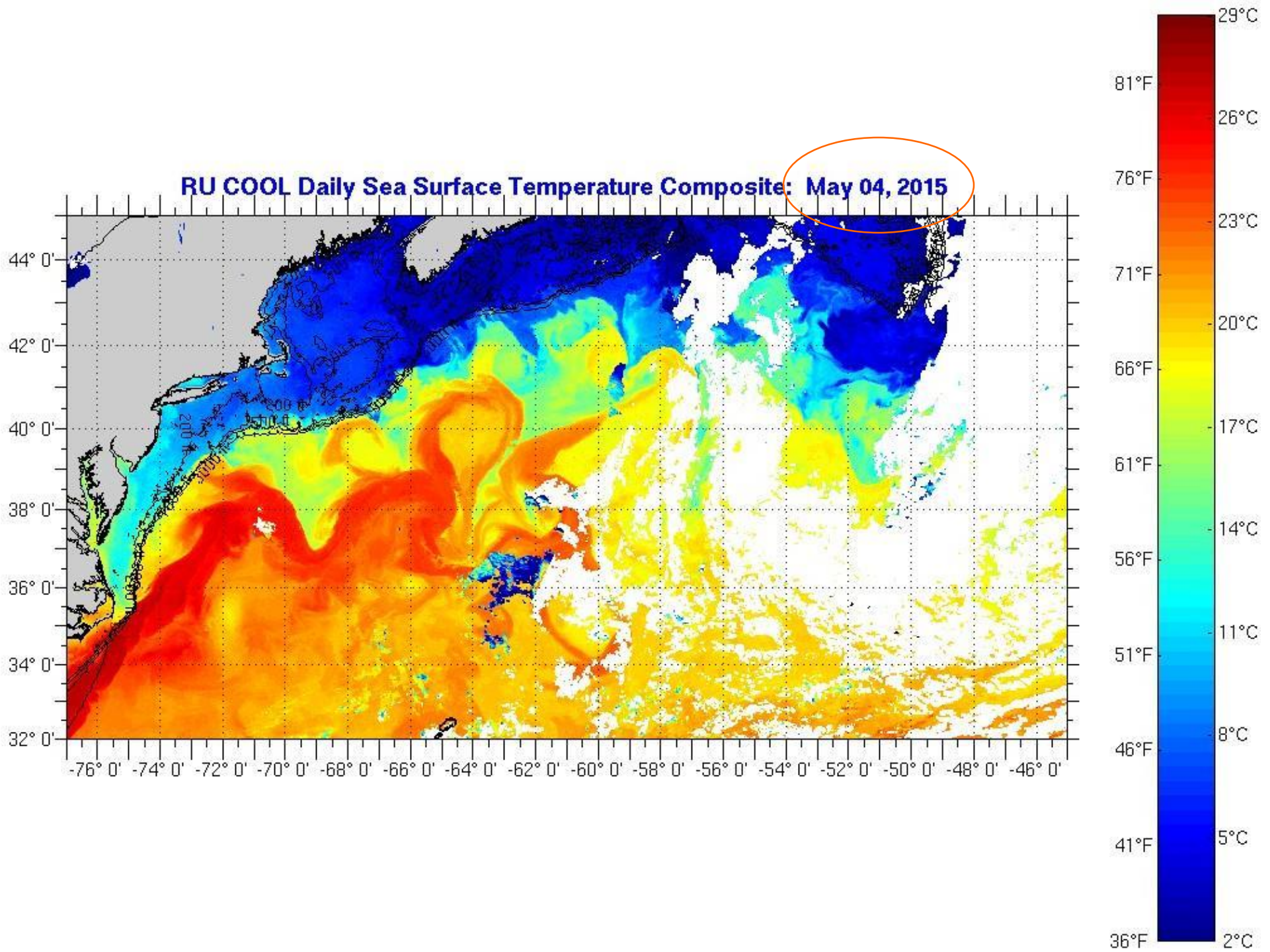


Figure 4.8 Diagram of Gulf Stream ring generation from meander formation to separation. (Parker, 1971.)









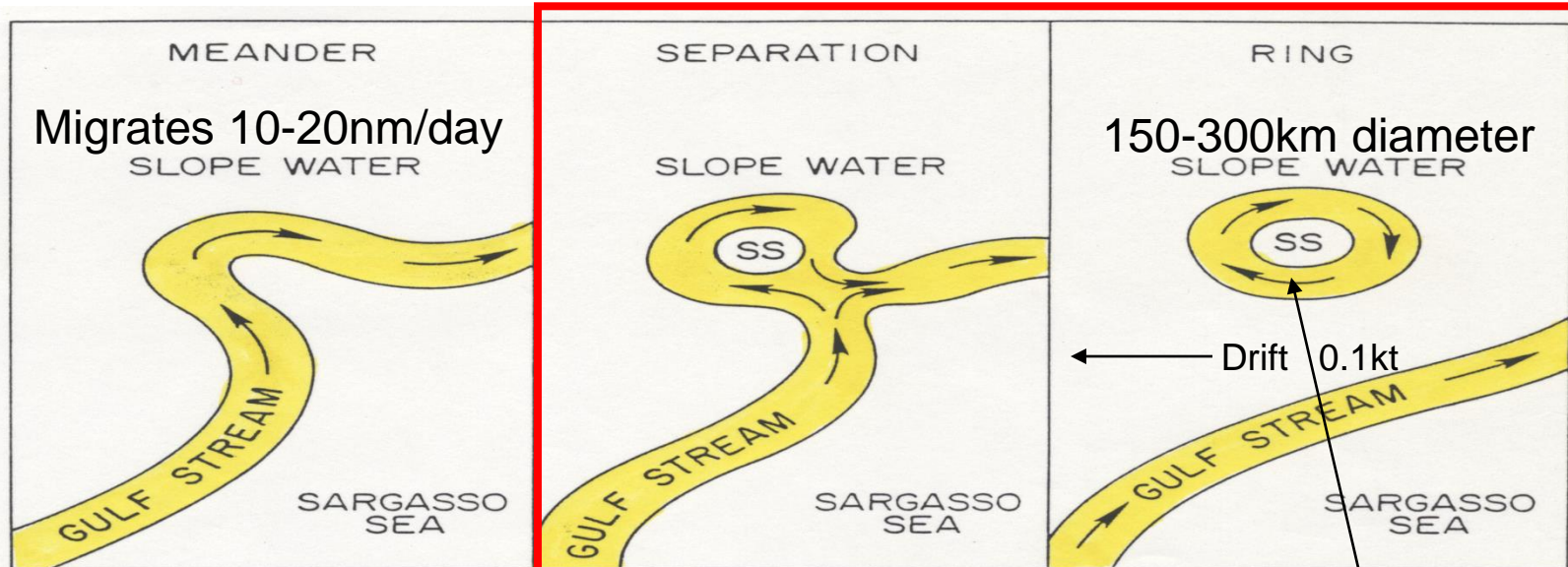


Figure 1. Three stages in the formation of a warm-core ring from a Gulf Stream meander. The core is water from the Sargasso Sea (SS).

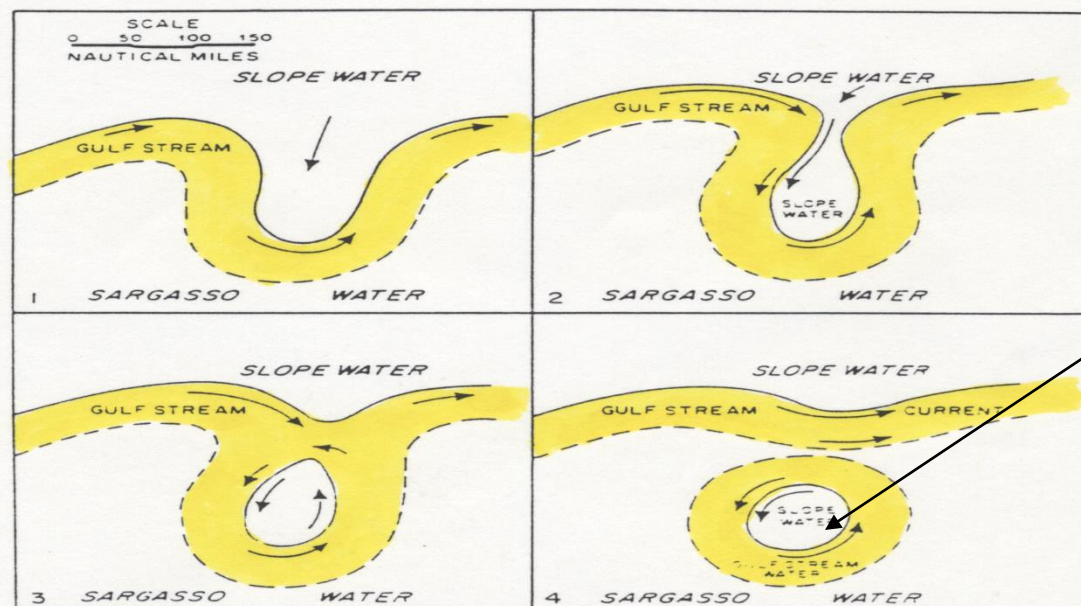
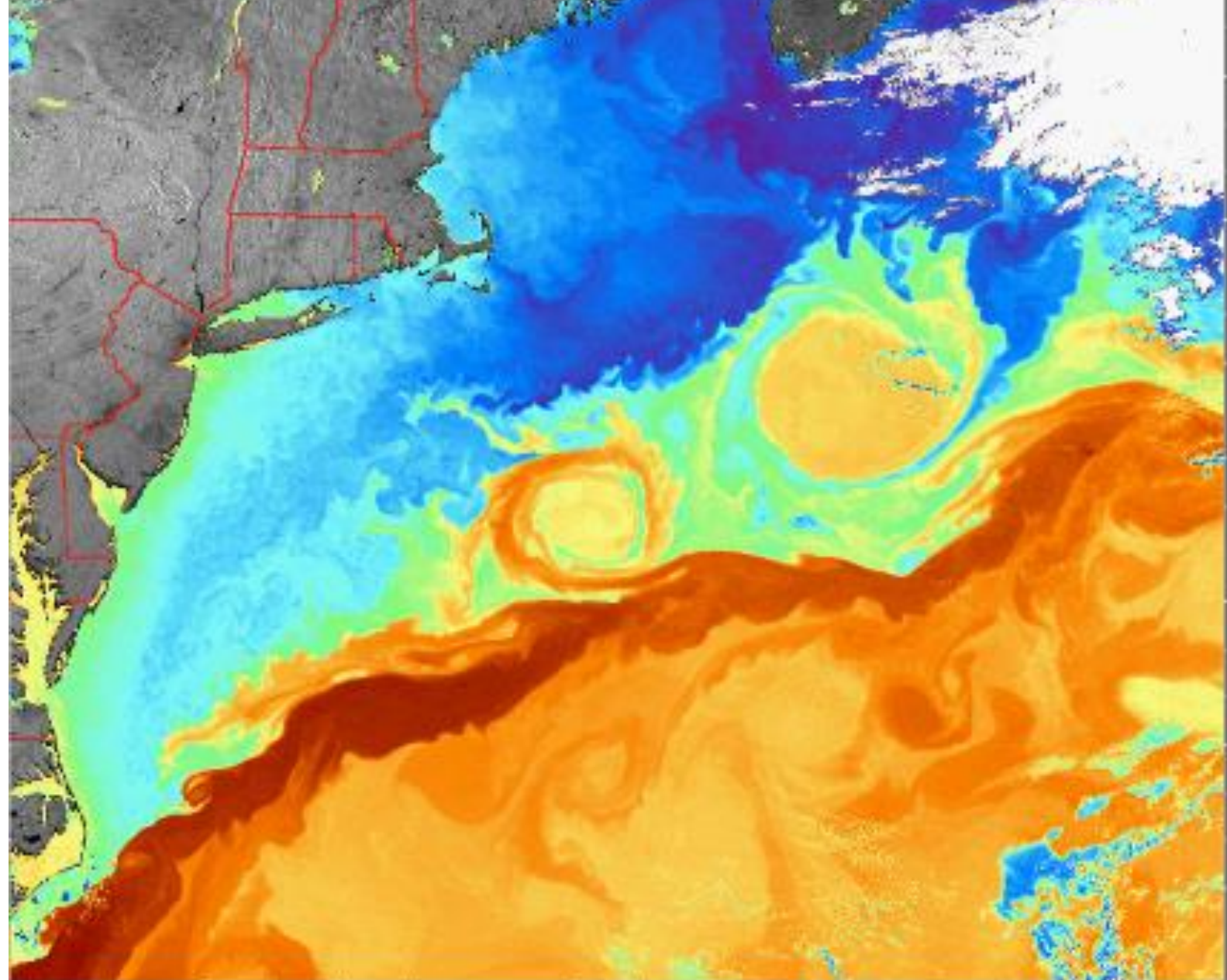


Figure 4.8 Diagram of Gulf Stream ring generation from meander formation to separation. (Parker, 1971.)

Warm Core

Cold Core





-75

-70

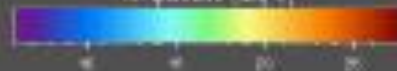
-65

-60

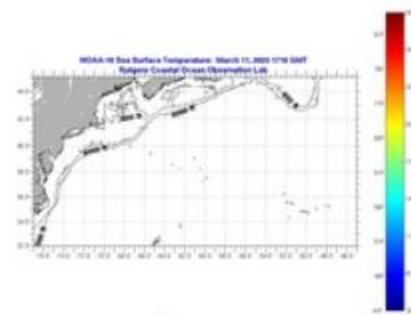
Longitude

WIND SPEED TRANSMISSION  
Level: 1000 hPa  
1000-12 km/s, 1000 km/h, 1000 km/h

Temperature (deg C)



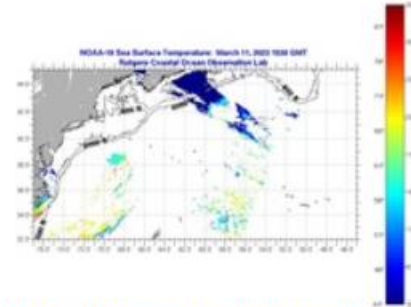
© 1997 by the National Aeronautics and Space Administration. All rights reserved.



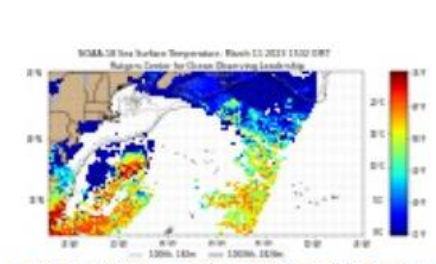
NOAA-18 March 11, 2023 17:18 144kb



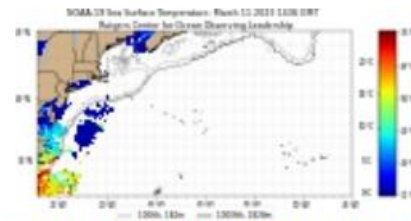
NOAA-18 March 11, 2023 17:14 603kb



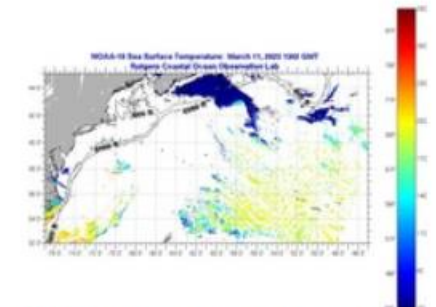
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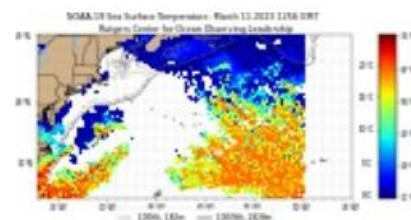
NOAA-18 March 11, 2023 15:32 935kb



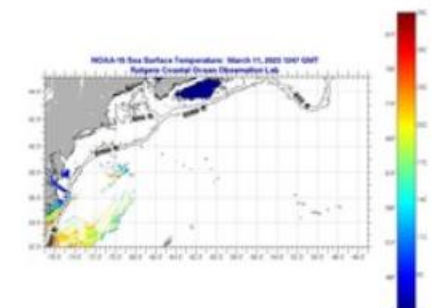
NOAA-19 March 11, 2023 14:36 660kb



NOAA-19 March 11, 2023 13:02 215kb



NOAA-19 March 11, 2023 12:56 1104kb



A look over the past few days  
and what do we see... ?

CLOUDS !!

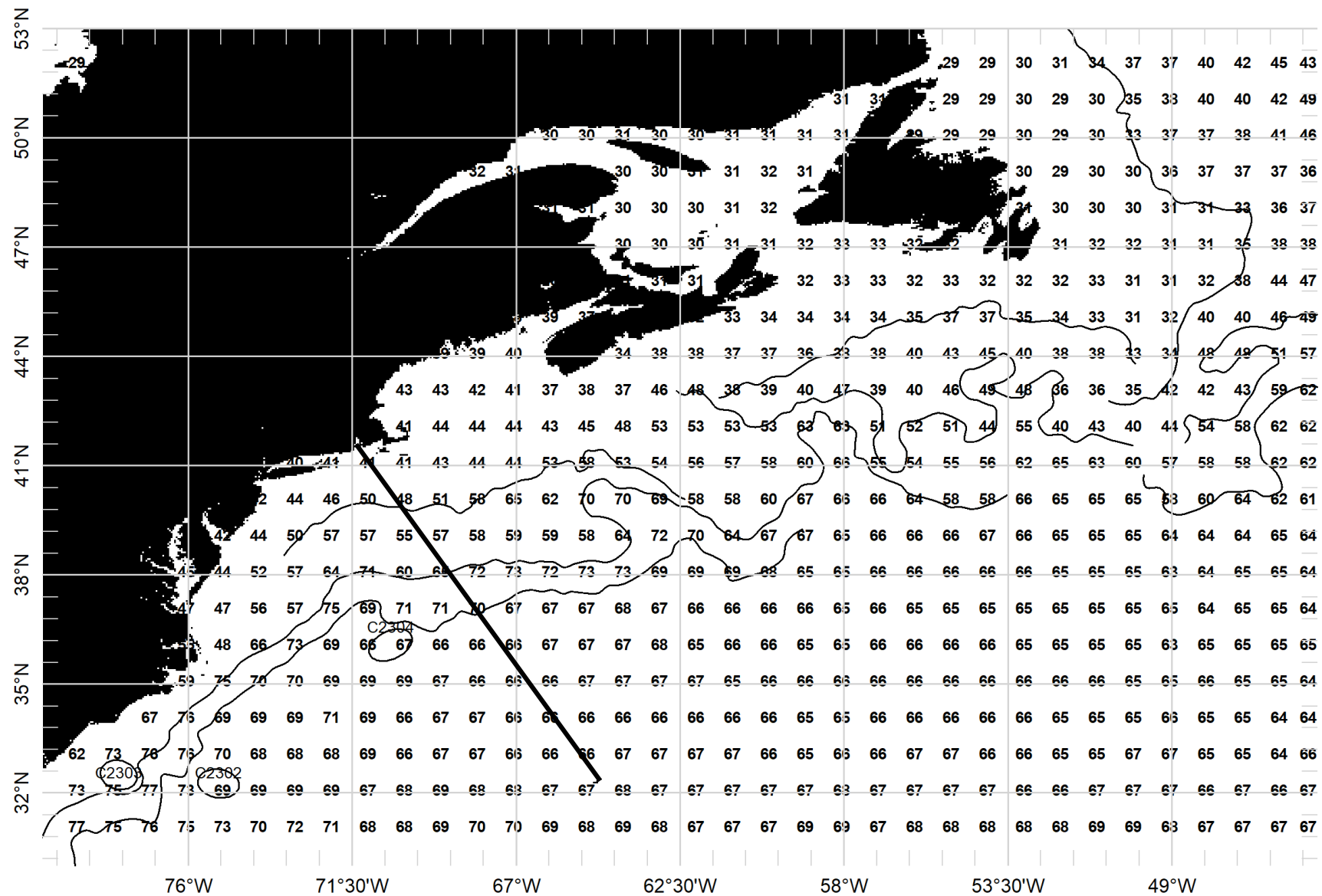
Start Study Early !



# Using a Variety of Resources

Keeping in mind.....

- Scales of Variability
- Needed/Desired Accuracy
- Reception Limitations
- Sensory Overload



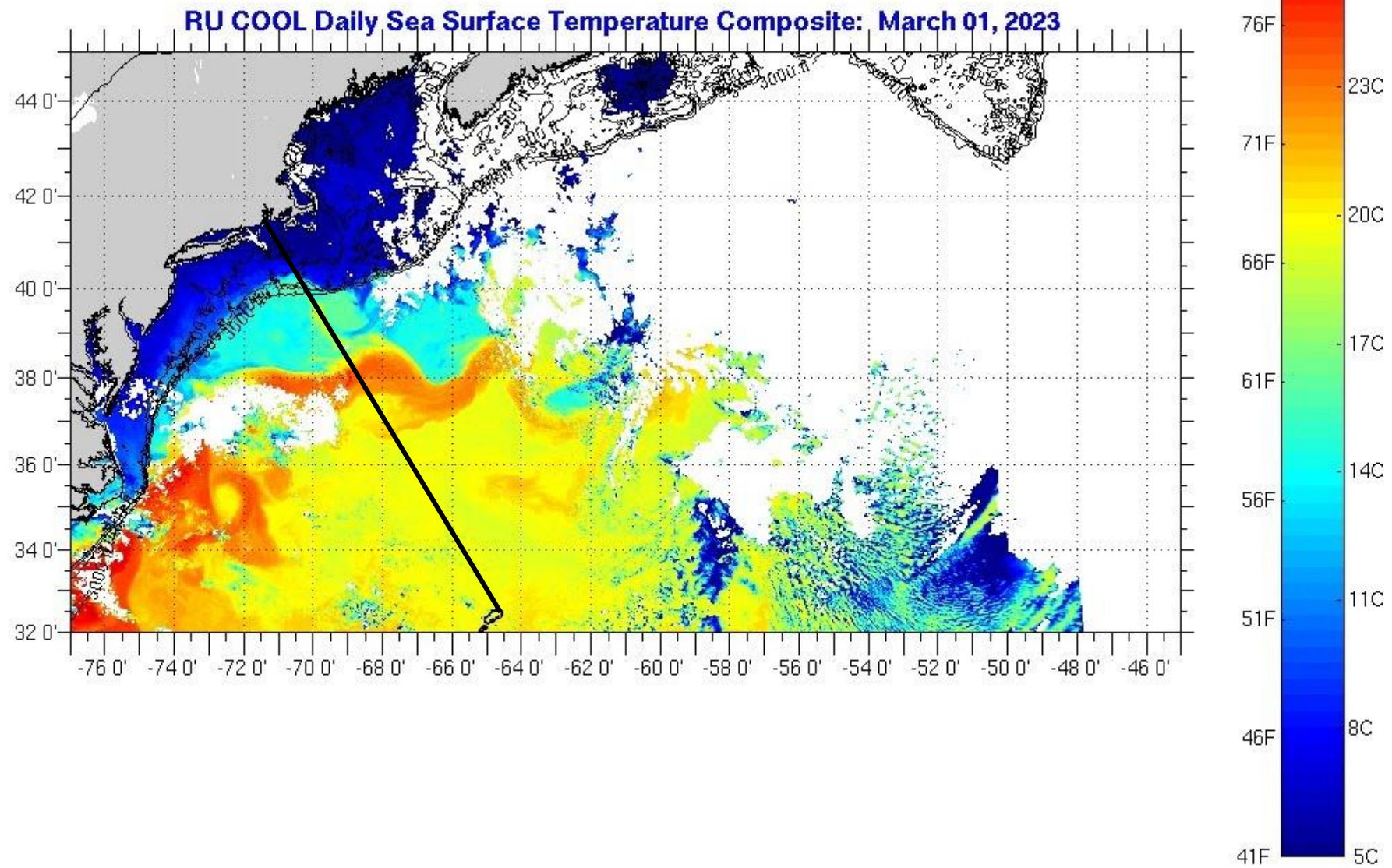
Approved for Public Release: Distribution Unlimited

Date: 3-18-2023

North Atlantic B&W

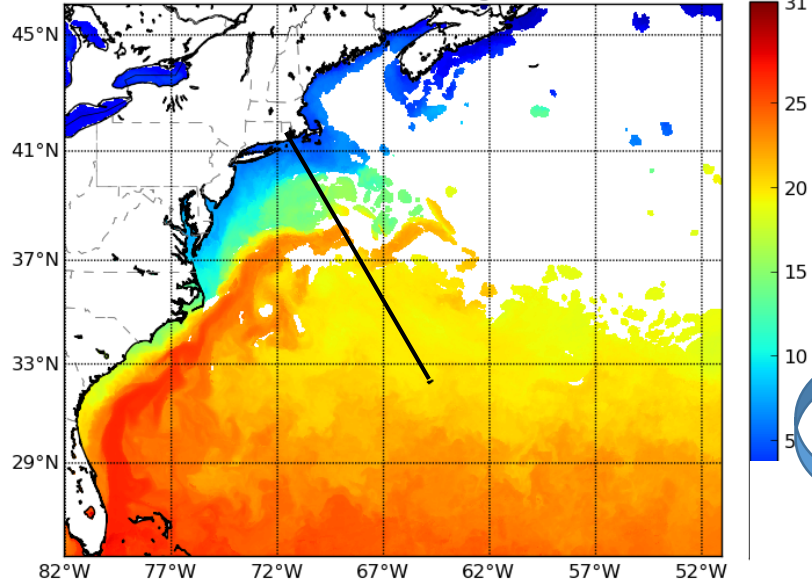


[https://www.ncei.noaa.gov/jag/navy/data/satellite\\_analysis/gsnofa.gif?id=768](https://www.ncei.noaa.gov/jag/navy/data/satellite_analysis/gsnofa.gif?id=768)

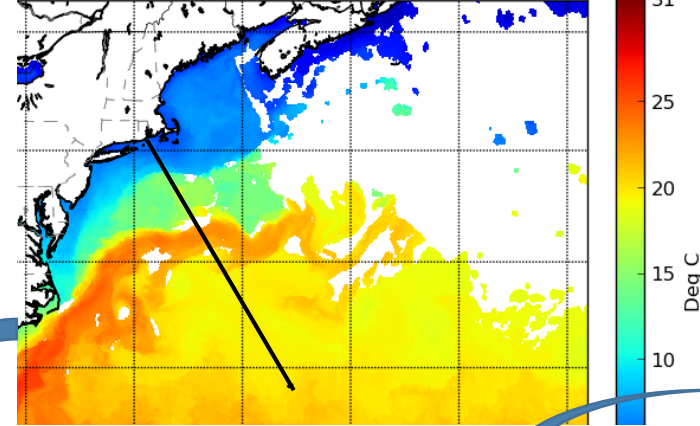




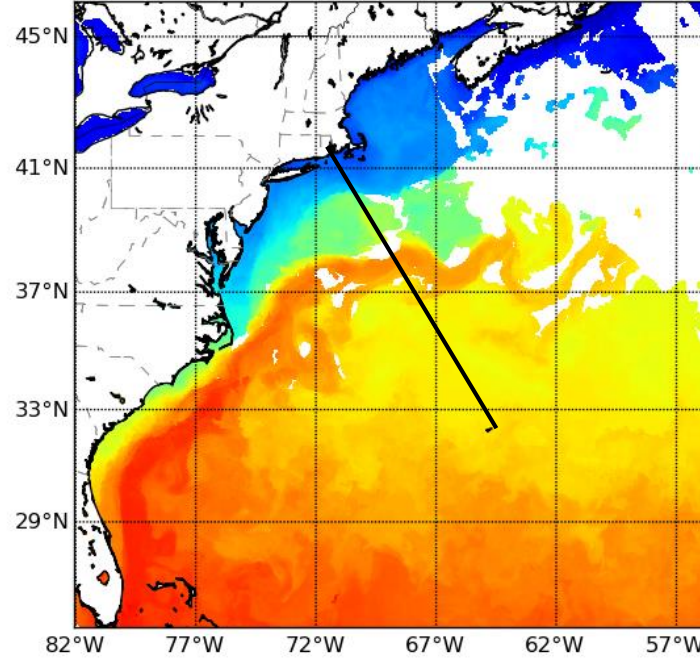
GOES SST 4 Day Most Recent Composite  
in the West Atlantic ending 20230301



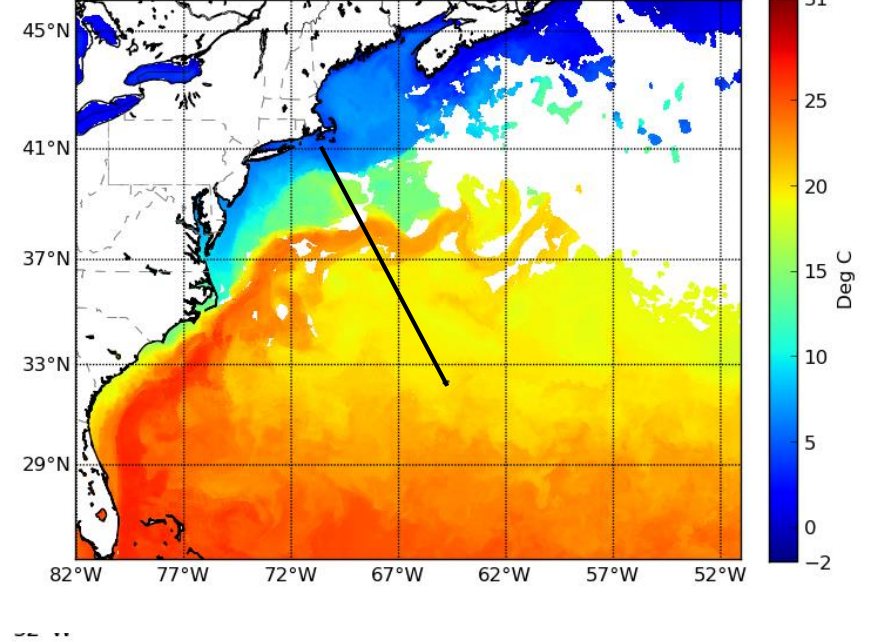
GOES SST 4 Day Most Recent Composite  
in the West Atlantic ending 20230302



GOES SST 4 Day Most Recent Composite  
in the West Atlantic ending 20230303



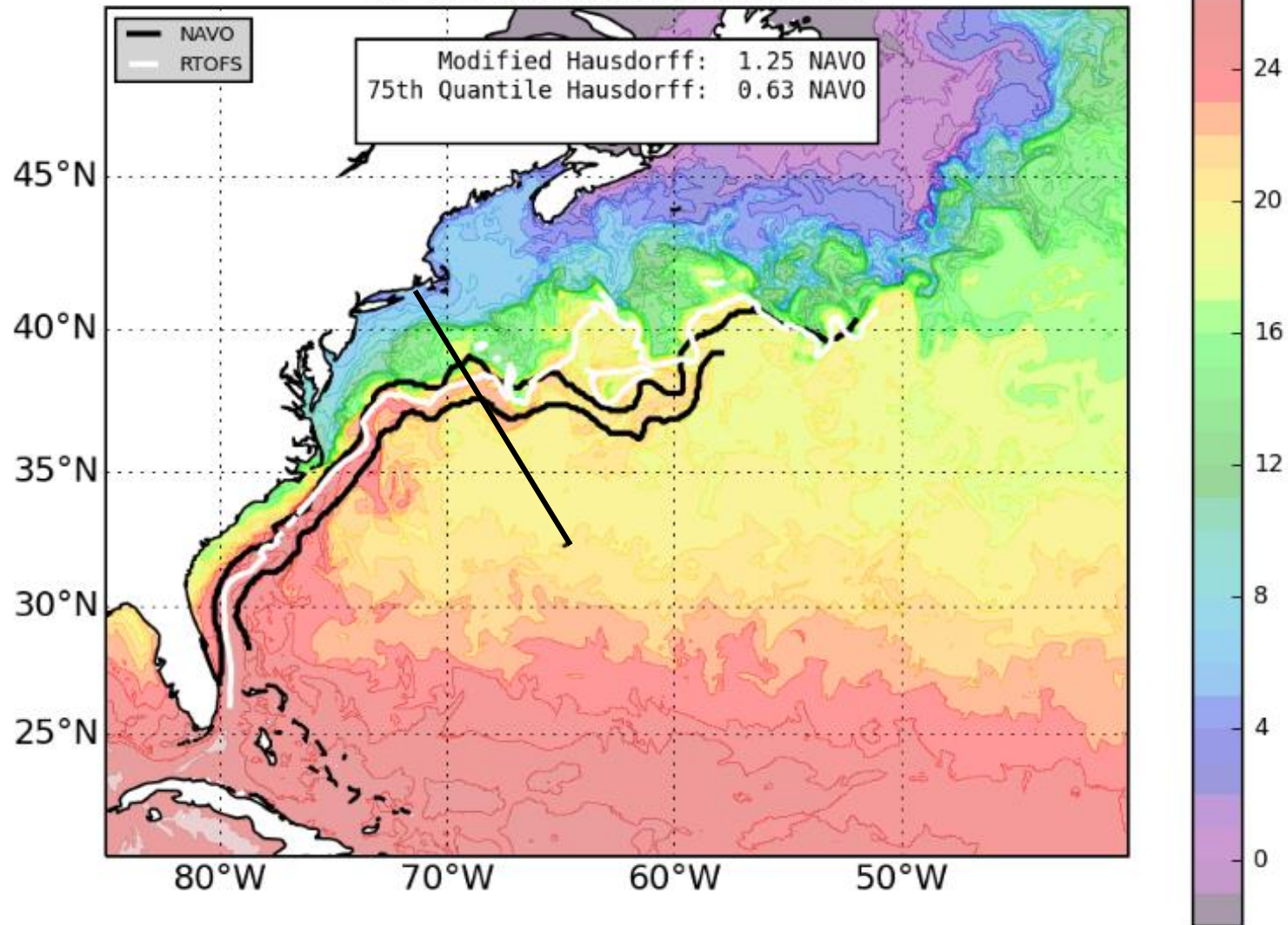
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in the West Atlantic ending 20230304



## OPC 4 – Day Composite Time Series

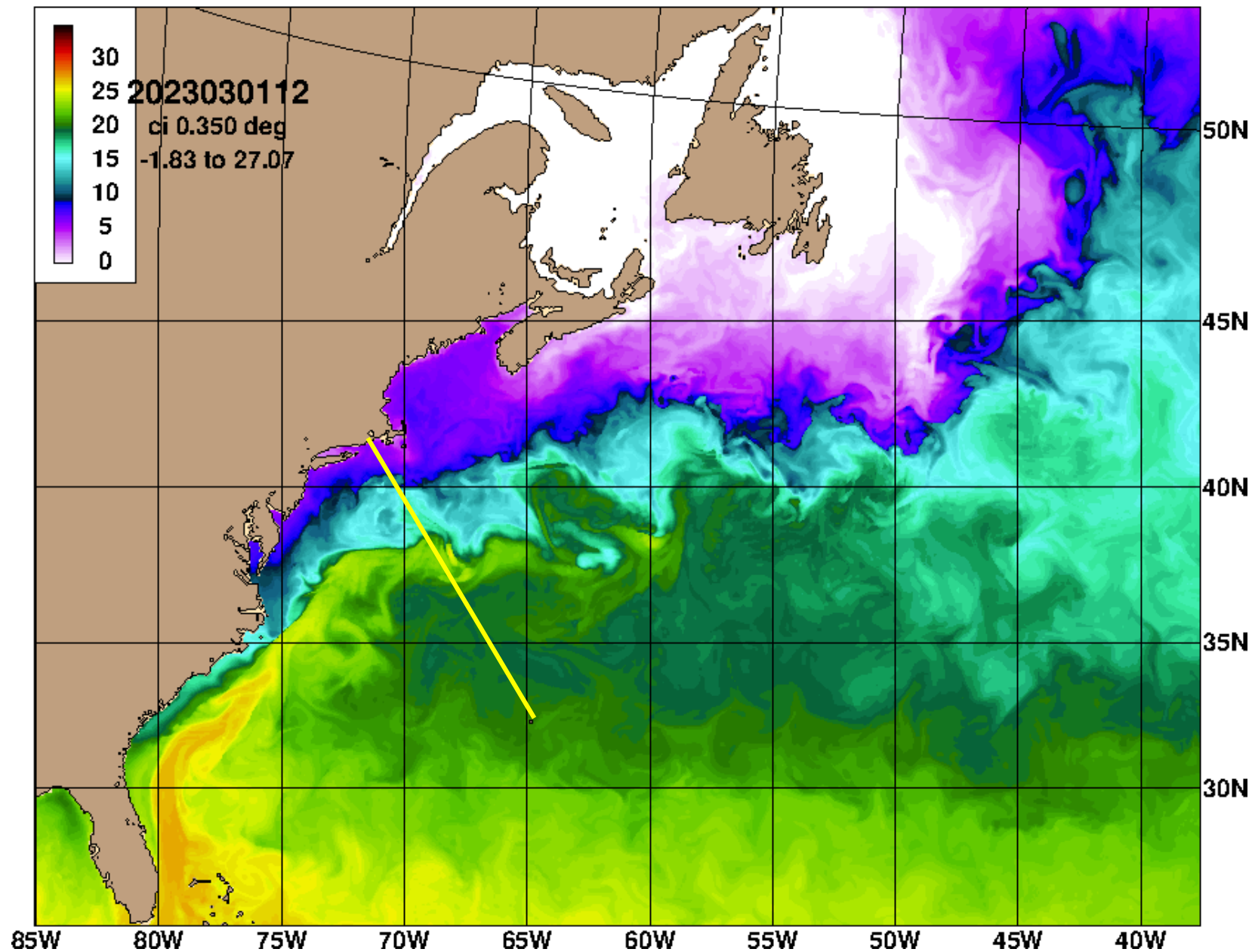


Global RTOFS Gulf Stream North Wall Location  
000H fcst valid March 01, 2023 model run date March 01, 2023  
12 °C Isotherm and 400 m with SST



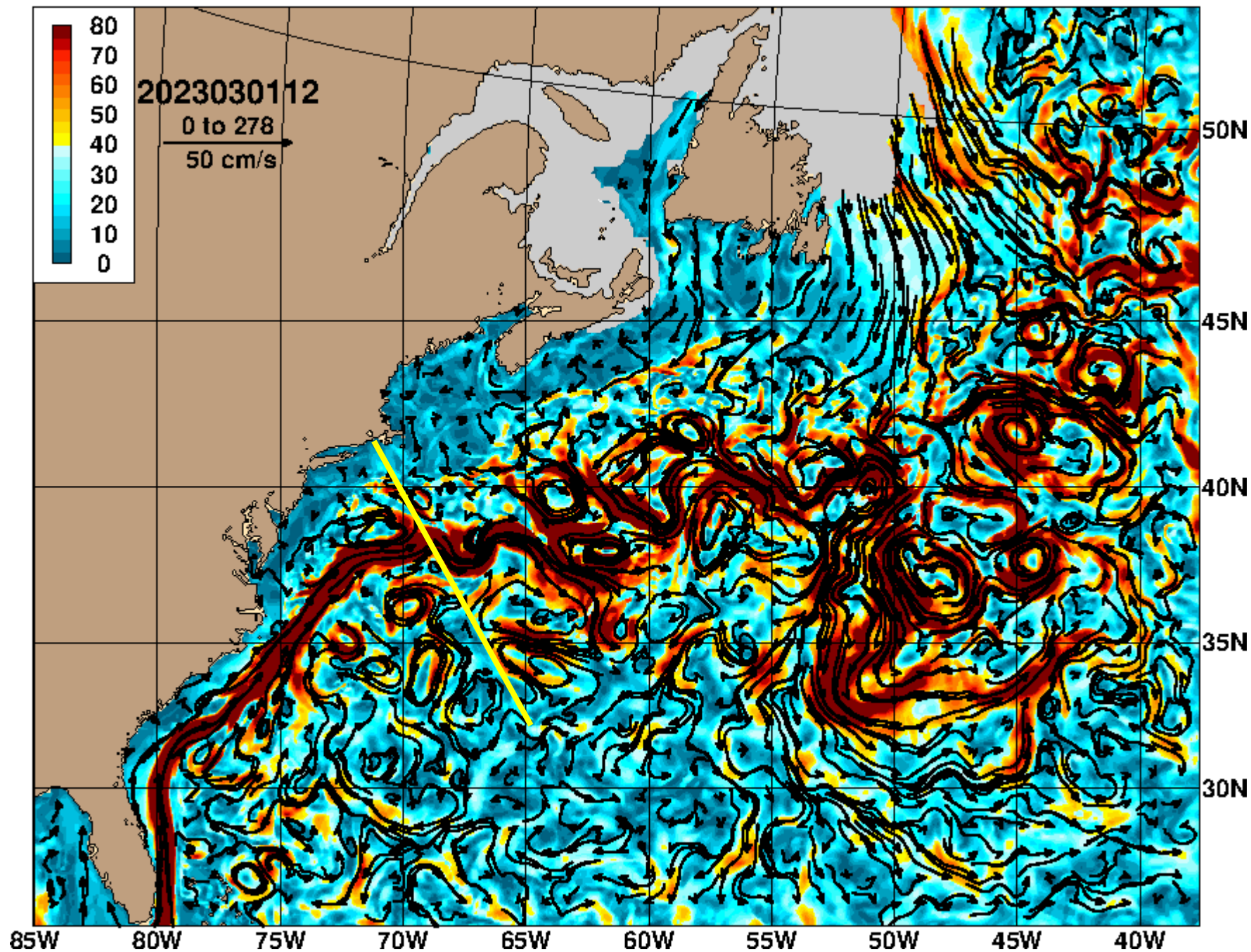


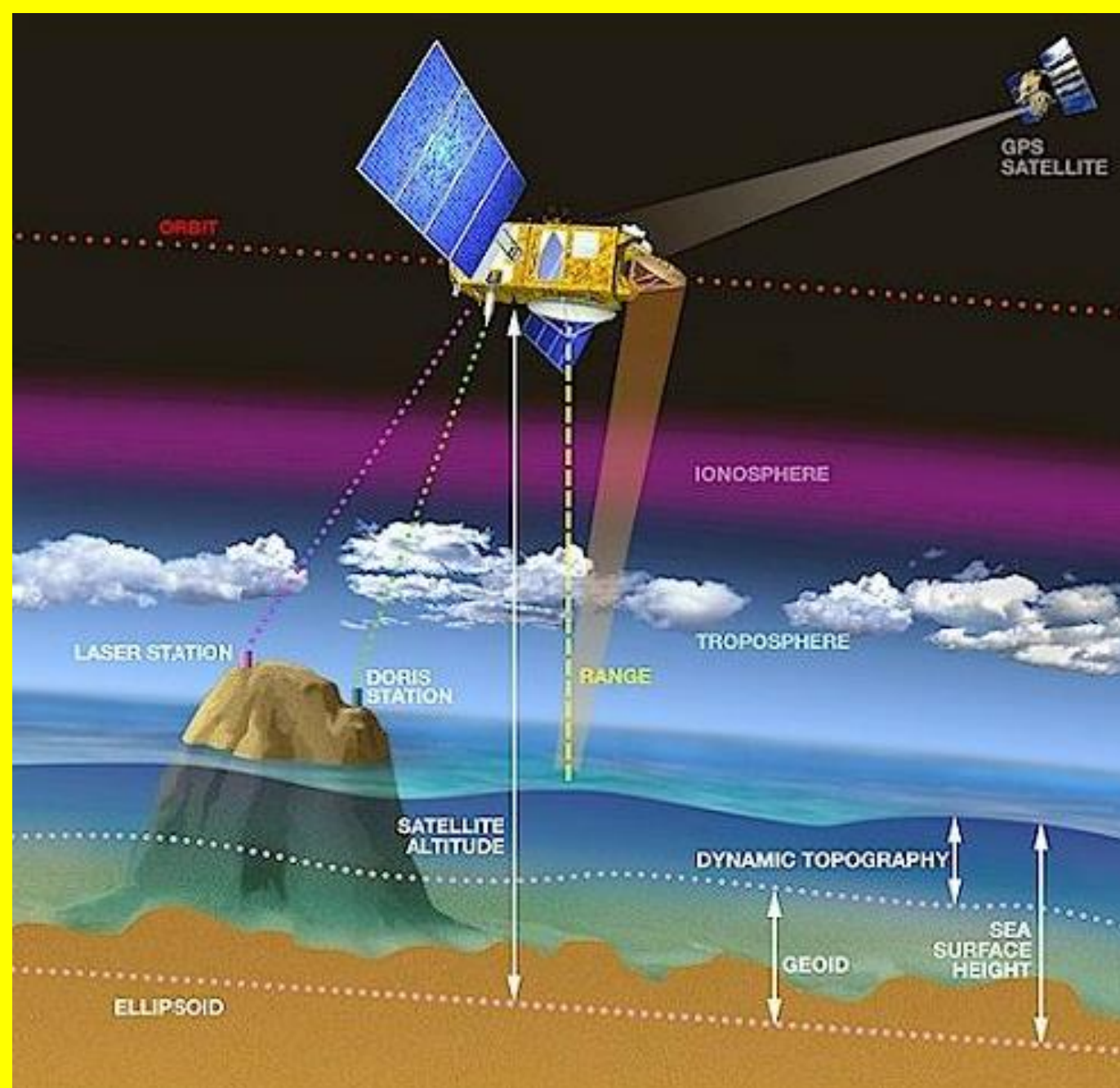
layer=01 temp Mar 02, 2023 00Z [93.0H]



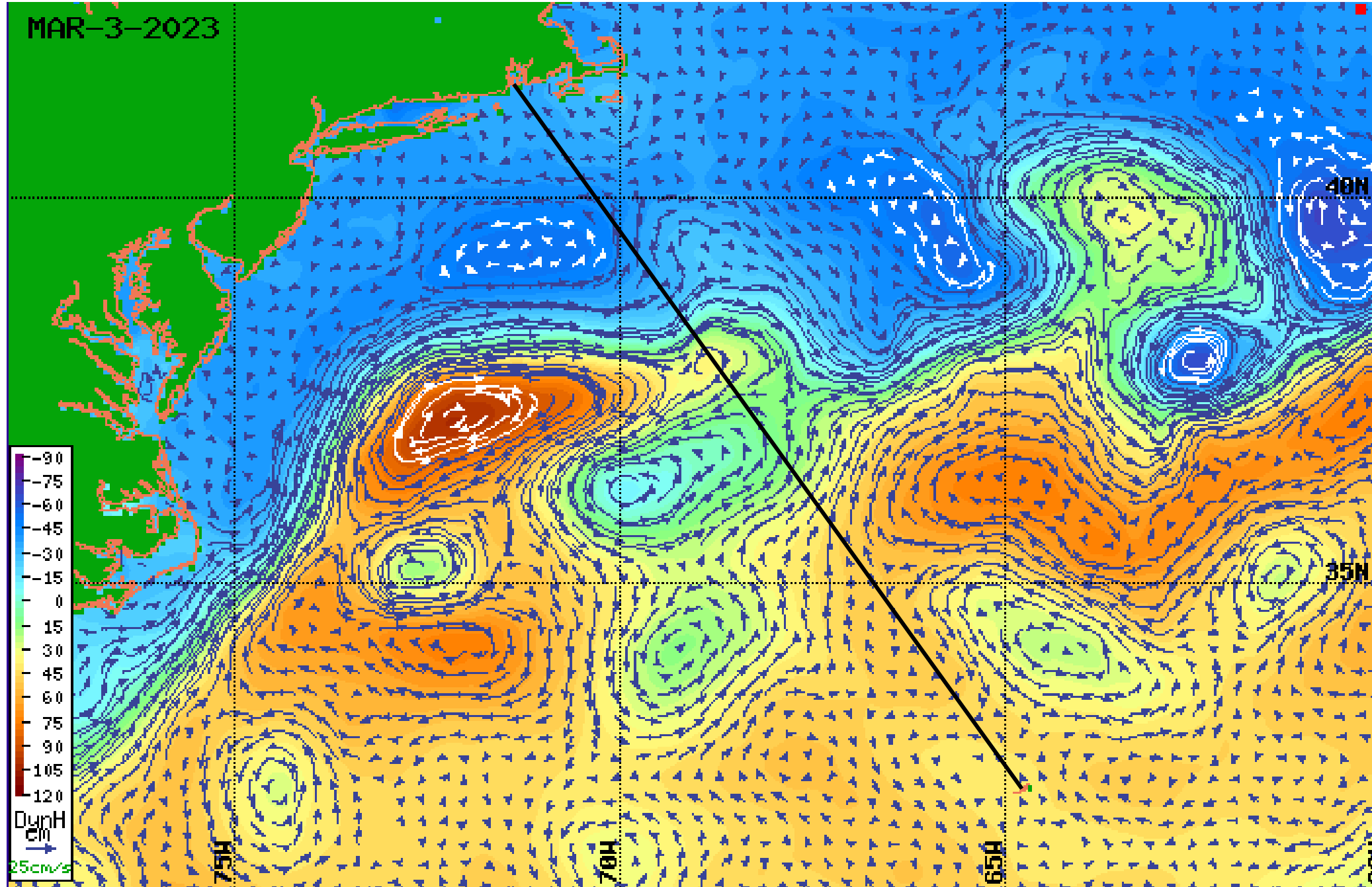


# Speed/currents layer 1 Mar 02, 2023 00Z 93.0



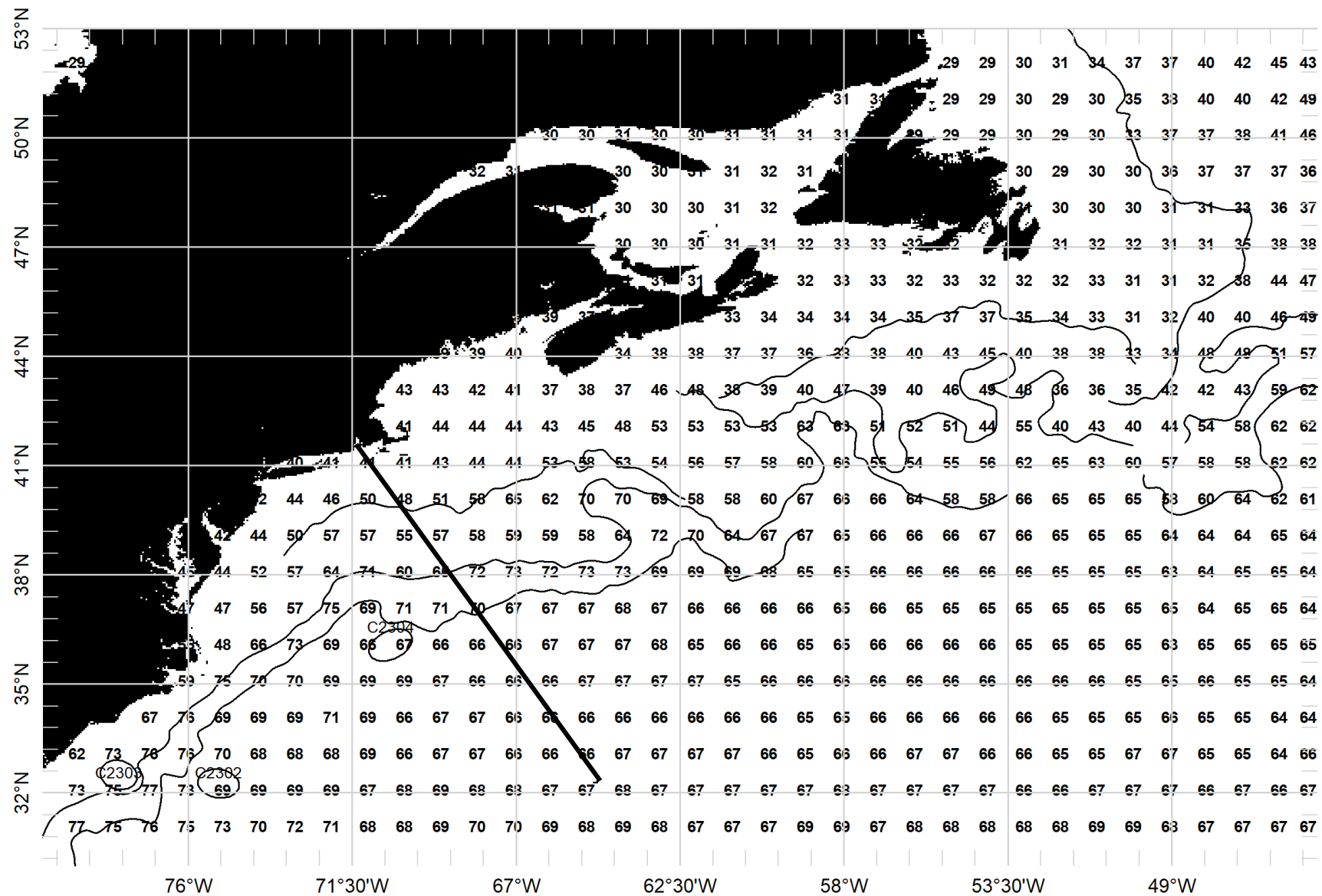


Satellite Altimetry (Geodesy)



<https://cwcaribbean.aoml.noaa.gov/CURRENTS/index.html>





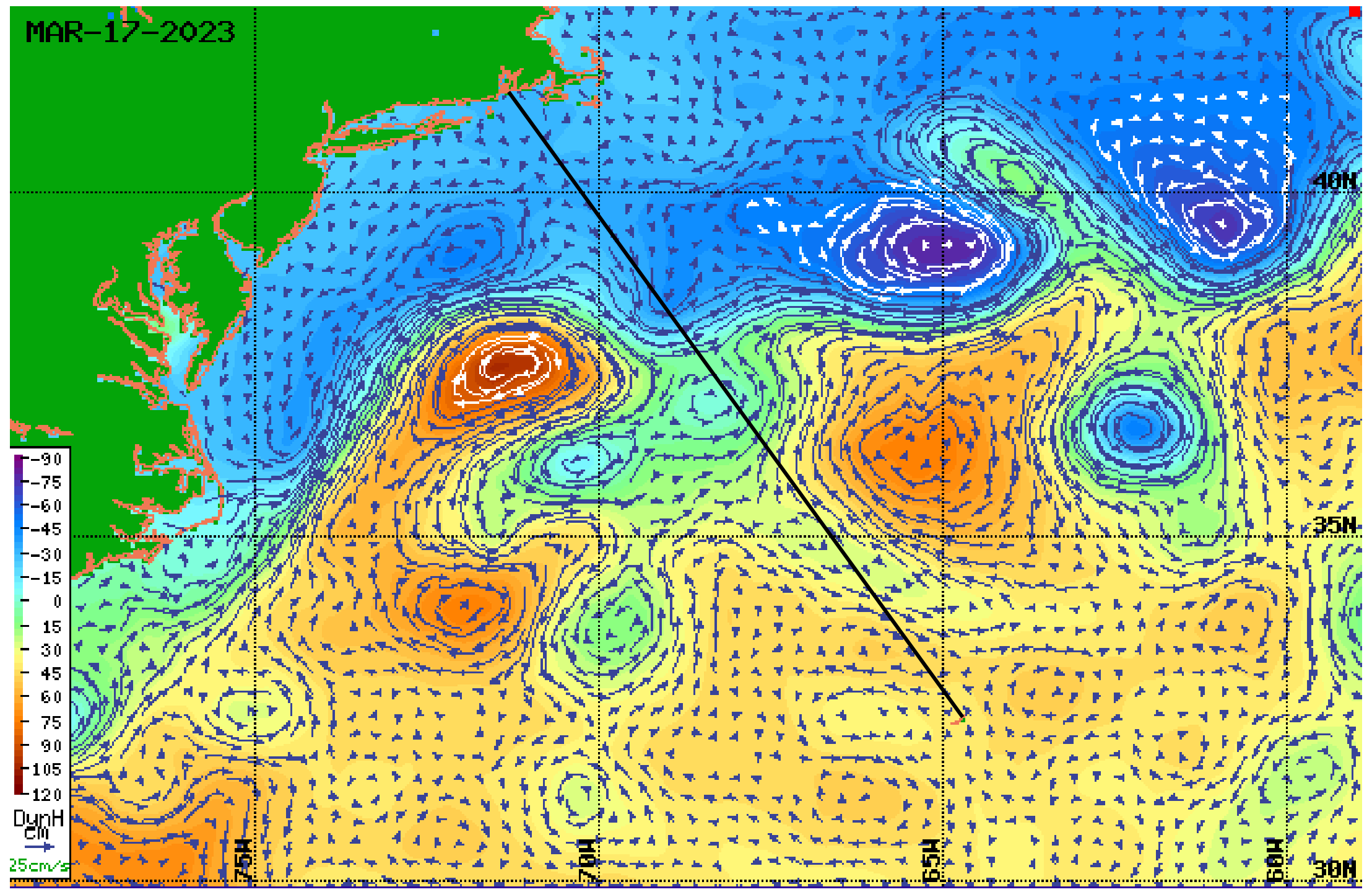
Approved for Public Release: Distribution Unlimited

Date: 3-18-2023

North Atlantic B&W



[https://www.ncei.noaa.gov/jag/navy/data/satellite\\_analysis/gsnofa.gif?id=768](https://www.ncei.noaa.gov/jag/navy/data/satellite_analysis/gsnofa.gif?id=768)



# Things to be remembered.....

- Start Study well before the start of the Race  
Navigator/Skipper/Watch Captains  
Communicate in Plain language - “No Riddles”  
Consider - <https://sas.cruisingclub.org/weather/online>
- Weather is the result of Air Mass collisions
- Geophysical flows (i.e. winds and currents) are turbulent  
characterized by significant spatial and temporal variability
- Model resolution is limited – Both Spatial and Temporal
- System is thoroughly 3-dimensional ...at least



