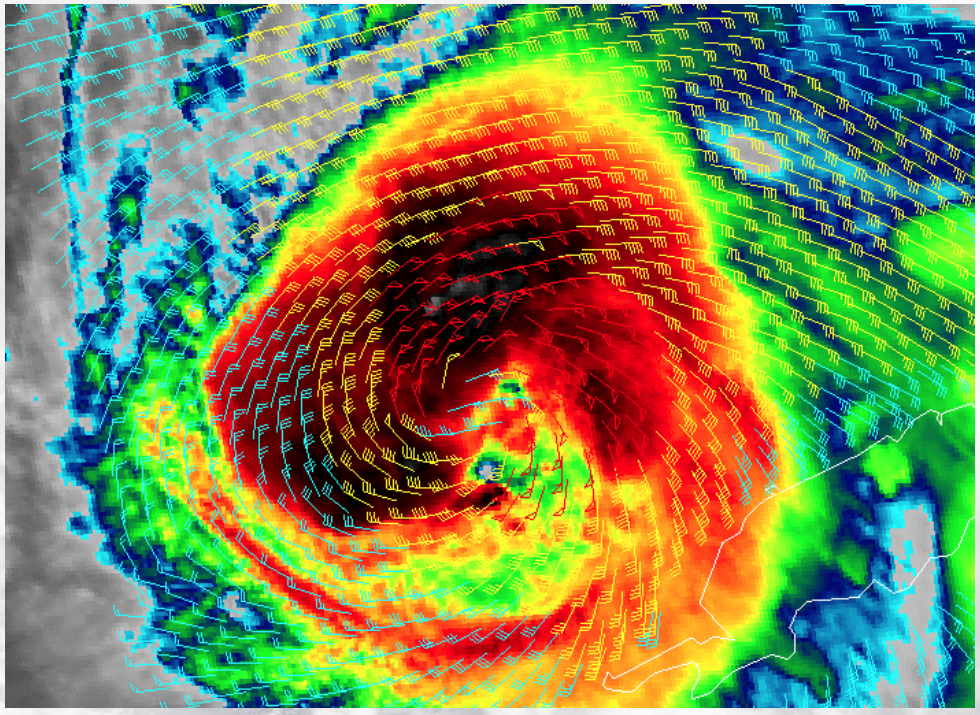
Scatterometer Data & Tropical Cyclone Applications



Scatterometry Basics

What is a scatterometer?

- Microwave radar located aboard polar-orbiting (low Earth orbit) satellites
- The instrument actively transmits energy toward the Earth's surface and measures the energy reflected back to it.
- How does this information help us as tropical cyclone forecasters?

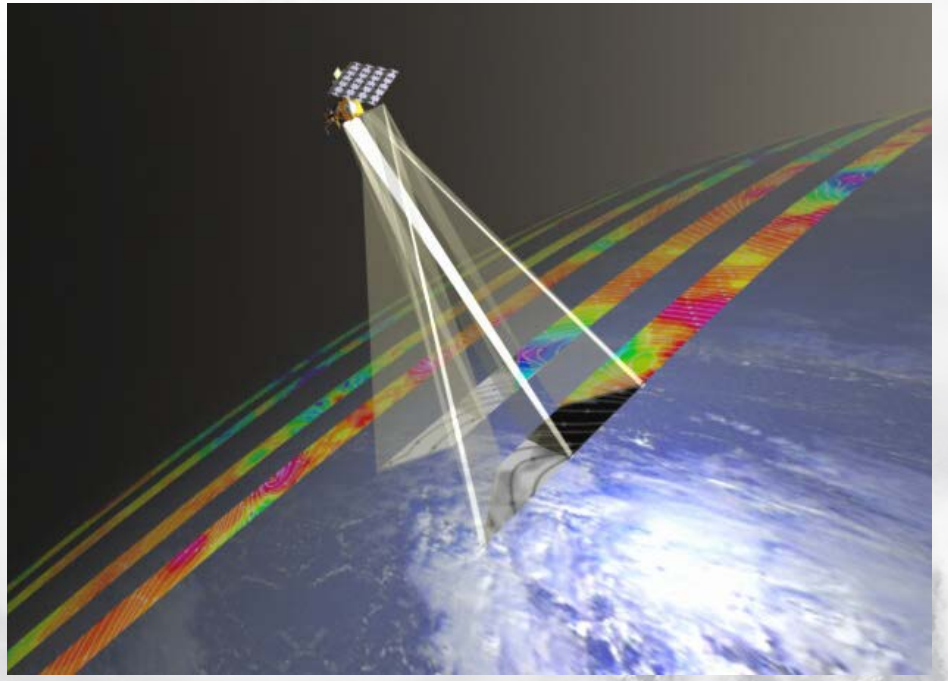


Image courtesy EUMETSAT

Scatterometry Basics

- Microwave energy is sensitive to small-scale roughness of the ocean surface that is generated by surface winds.
- By viewing the same patch of ocean from several angles, it is possible to derive wind speed and direction.

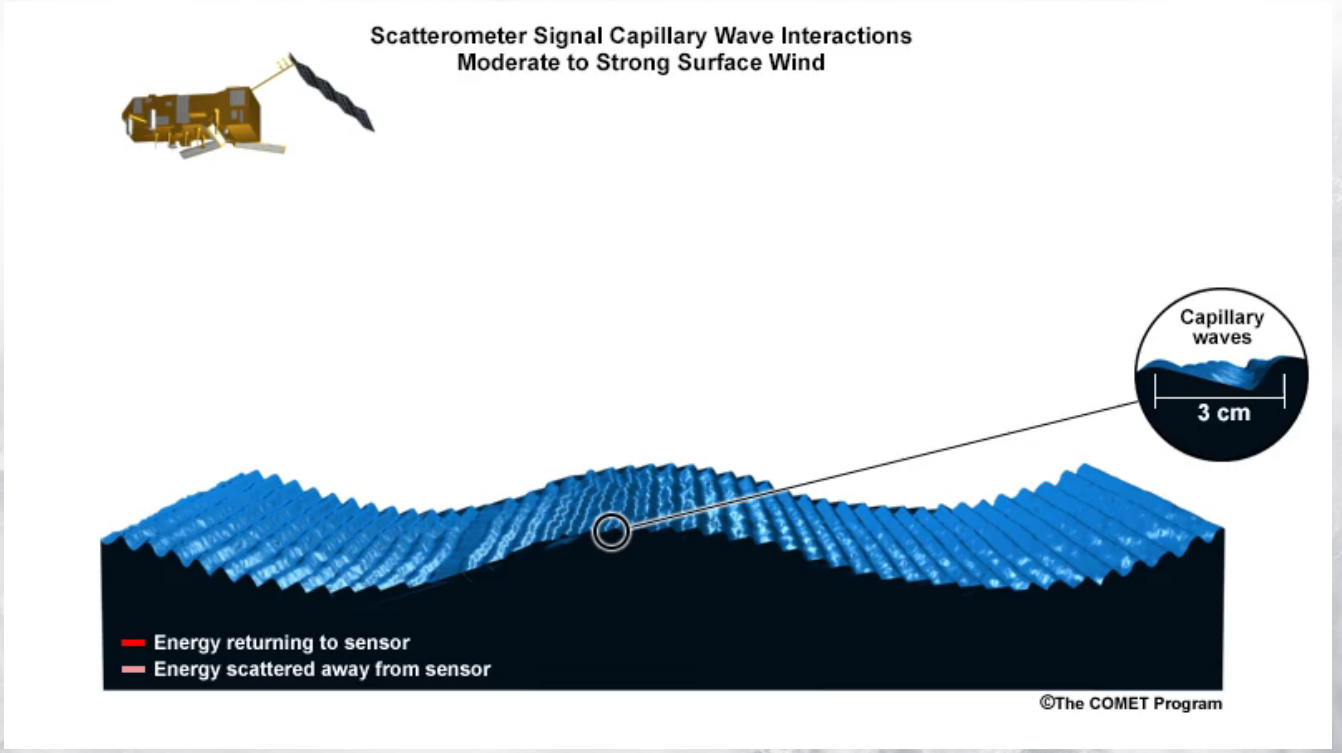


Image courtesy COMET

Advanced Scatterometer (ASCAT)

Satellites: Metop-B, -C
Launched: 2012, 2018
Operator: EUMETSAT

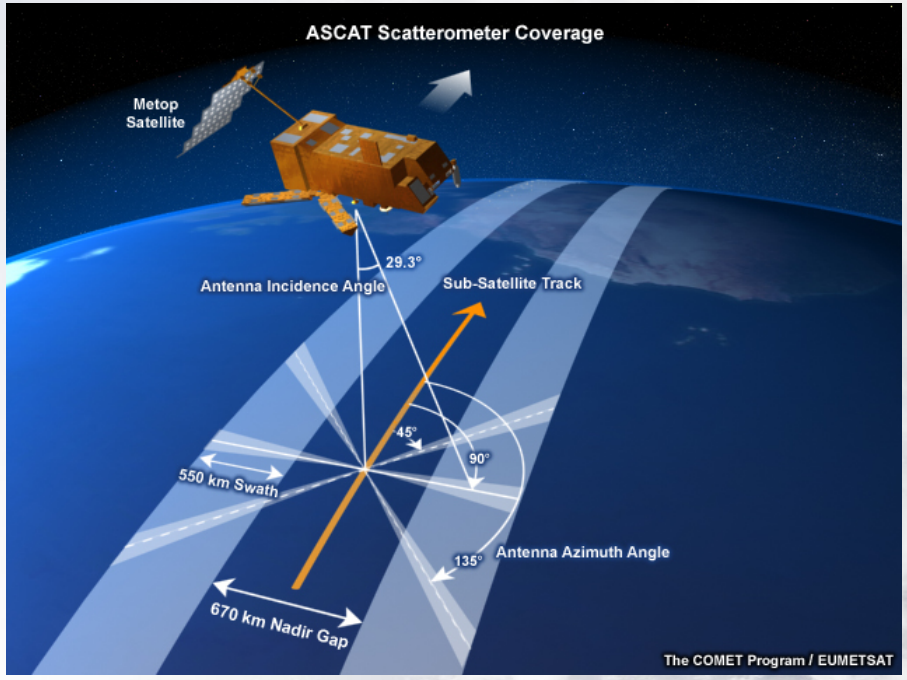


Image courtesy COMET

Image courtesy EUMETSAT

Sensor: Microwave radar
Channel: 5.25 GHz (C-band)
Swath: Two 550-km swaths; 670 km nadir gap

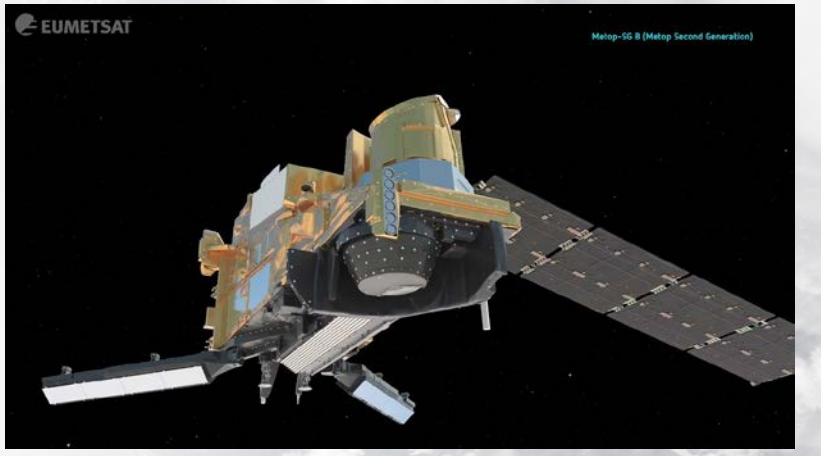
Note: C-band is less sensitive to rain contamination

ASCAT (2022 Update)

Metop-A satellite has reached its end of life

- Deorbiting completed: 1 December 2021
- Replacement: Metop-SG (Second Generation); won't be launched until July 2024 at the earliest

Impacts: We will have less scatterometer data available for real-time TC analysis and assimilation into U.S. weather models during the upcoming hurricane season.



Metop-SG Satellite
Image courtesy EUMETSAT

Other Scatterometer Data

Satellites: HY-2B, -2C, -2D*
Launched: 2018, 2020, 2021
Operator: Chinese National Satellite Ocean Application Service (NSOAS)

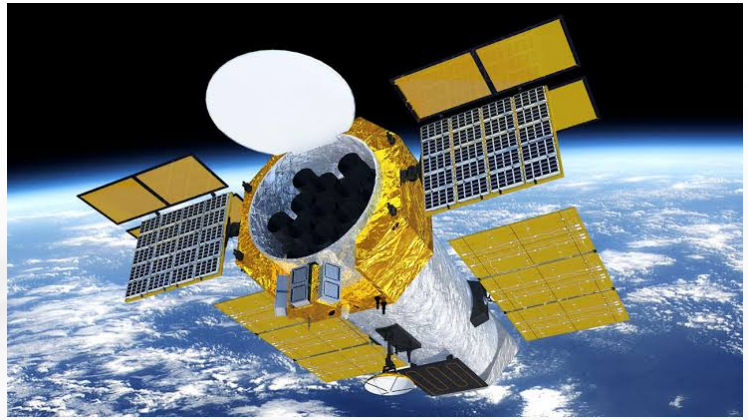
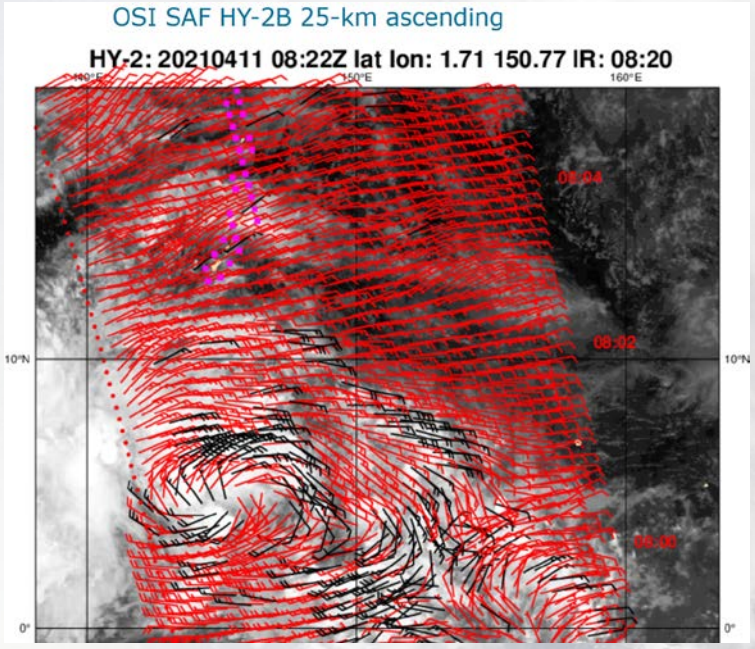


Image courtesy NSOAS



Black wind barbs = QC flagged data

Sensor: Microwave radar
Channel: 13.3 GHz (Ku-band)
Swath: 1300 km

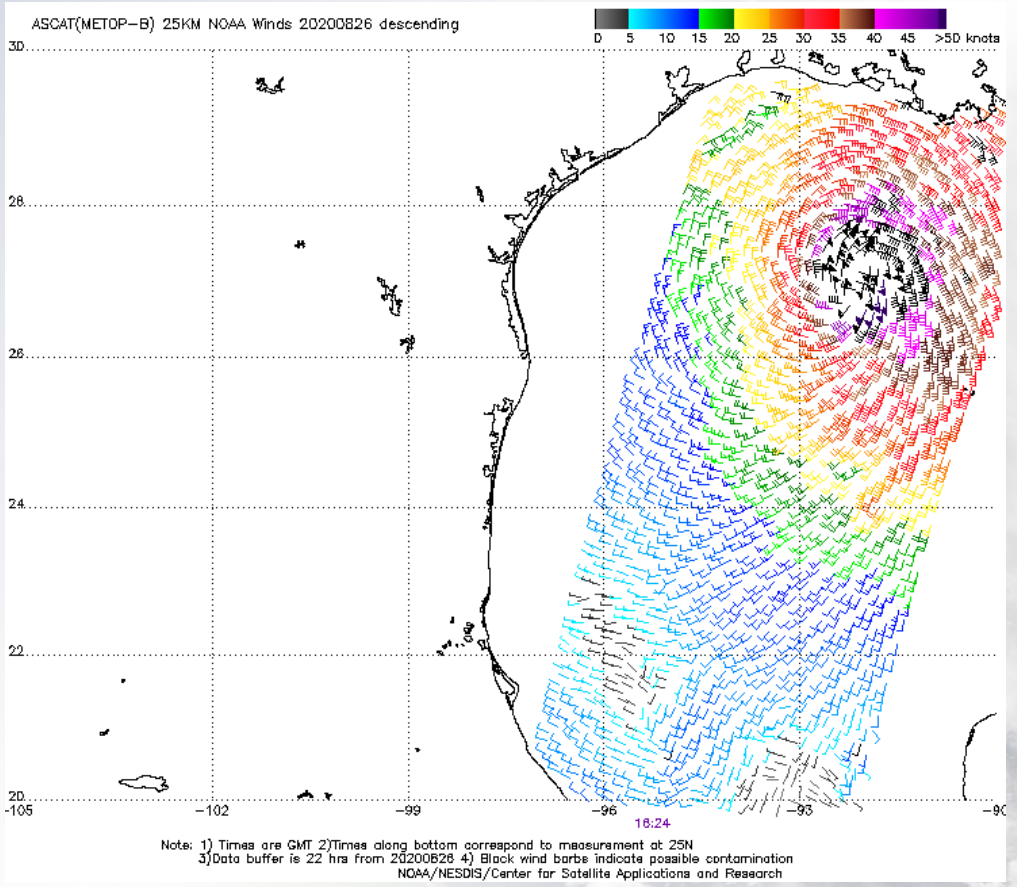
Note: Ku-band is more sensitive to rain contamination, which can lead to overestimated winds.

Scatterometer Data Access

NOAA/NESDIS

https://manati.star.nesdis.noaa.gov/

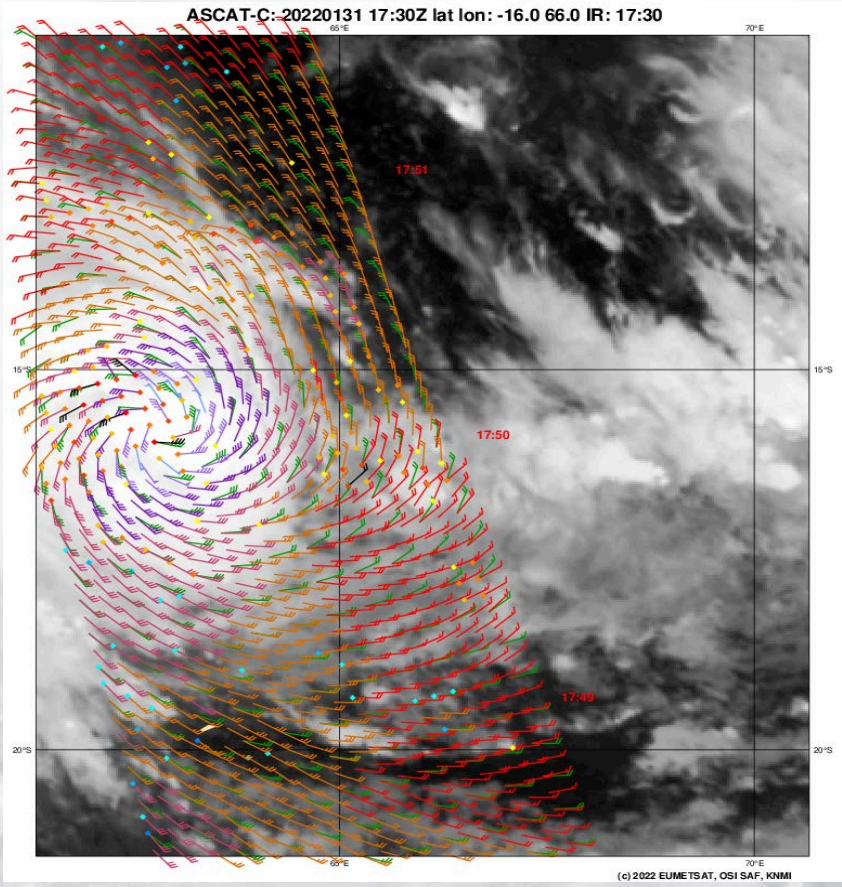
(25- and 50-km ASCAT wind vector products)



EUMETSAT

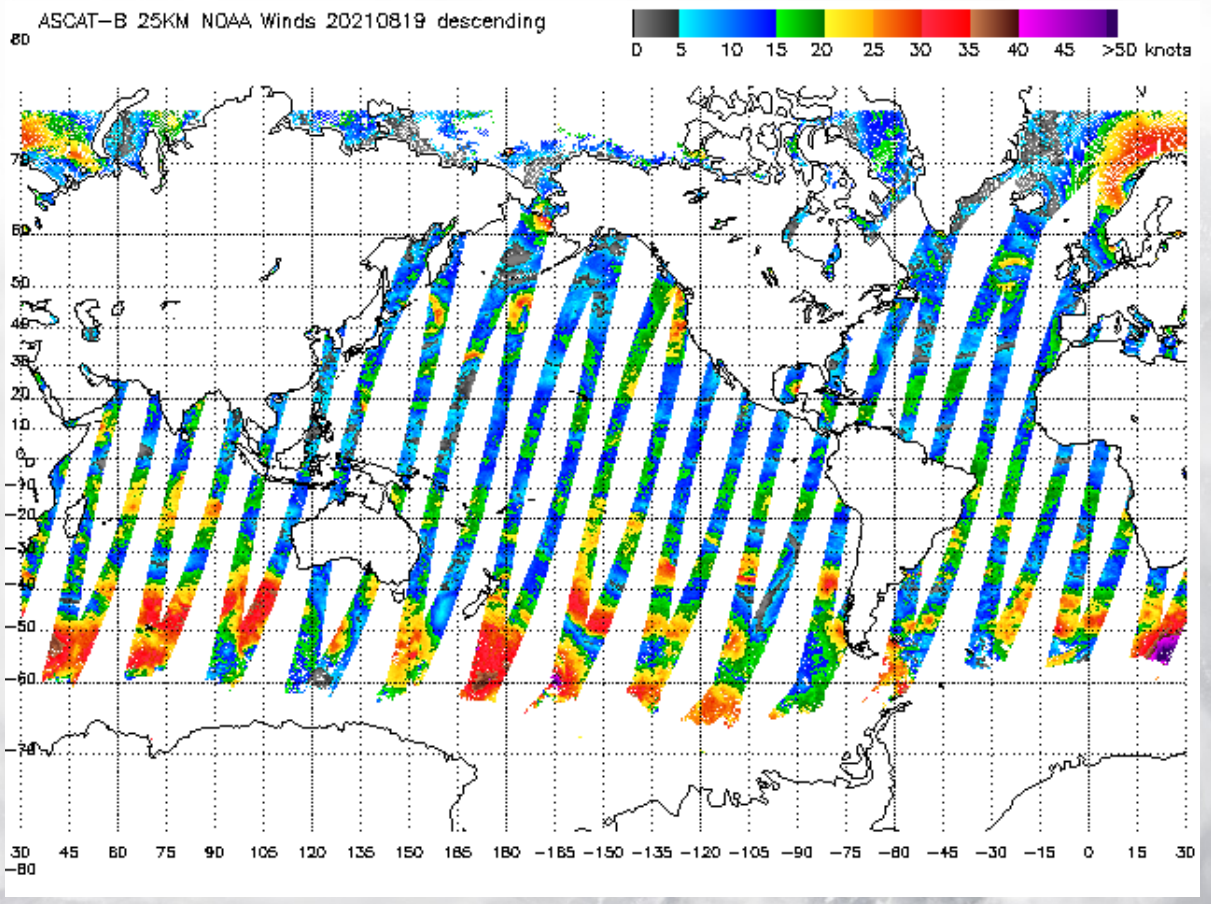
https://scatterometer.knmi.nl/tile_prod

(Public, operational HY-2B, -2C winds)



Scatterometer Limitations

- Gaps over the tropics reduce spatial data coverage, and swaths may completely miss TCs
- Spatial sampling/resolution does not allow for detection of peak winds in hurricanes or strong tropical storms
- Uncertainties in derived wind direction (directional ambiguity)



Directional Ambiguity

Wind direction is derived by determining the angle that is most likely consistent with the backscattered energy.

- The best fit *usually* matches the true wind direction
- But what if it doesn't?
  - Look at ambiguities to view other possible directions and identify the most likely solution

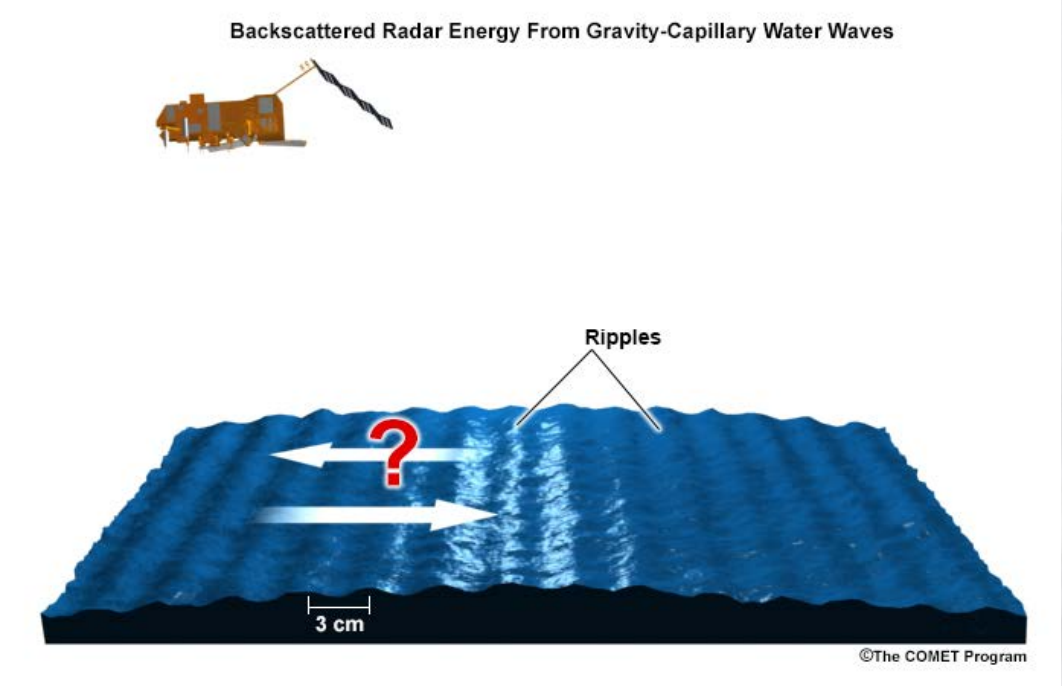
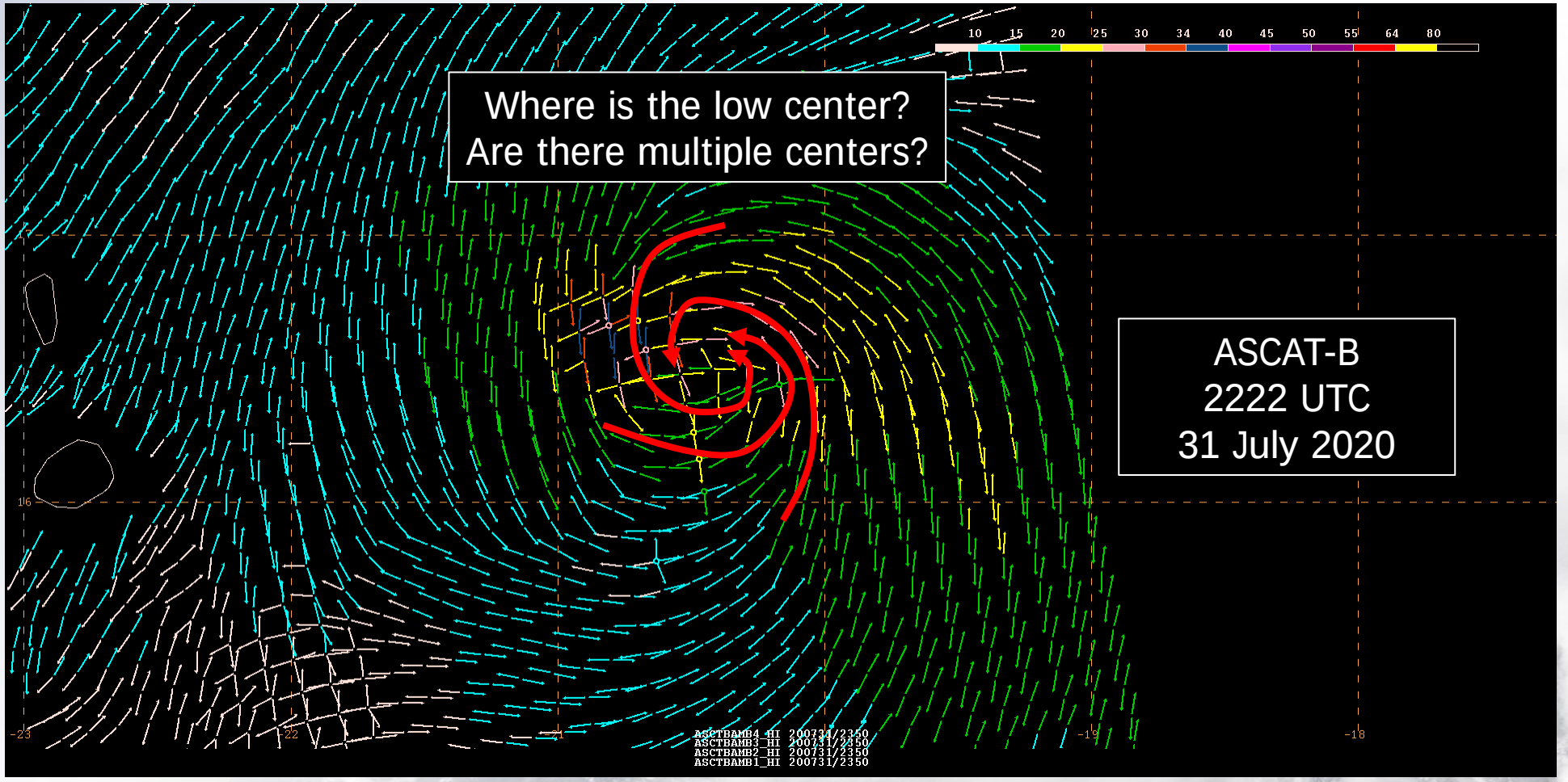


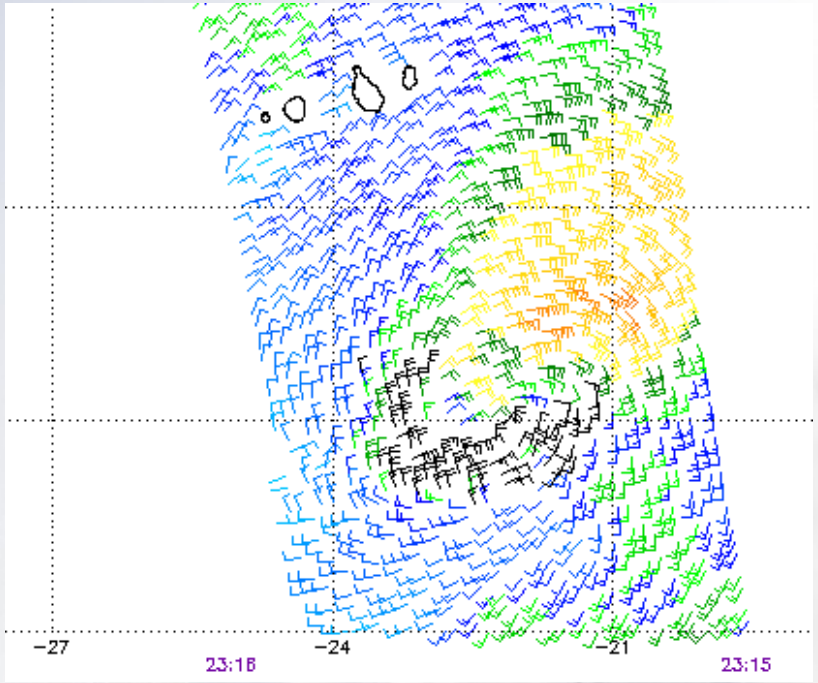
Image courtesy COMET

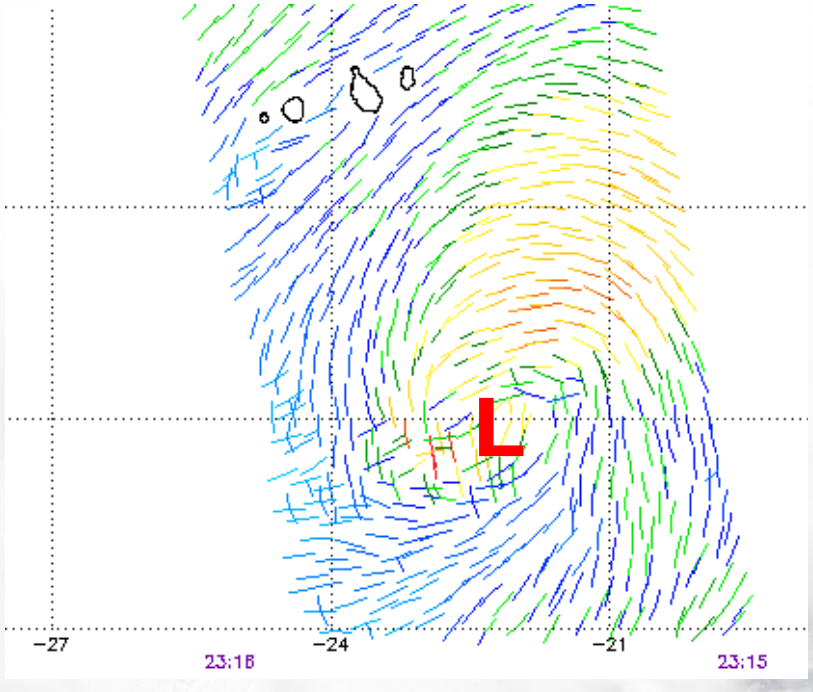
Directional Ambiguity



- ASCAT ambiguities can be used to help assess appropriate wind directions and improve the center fix for developing TCs

TC Applications: Genesis

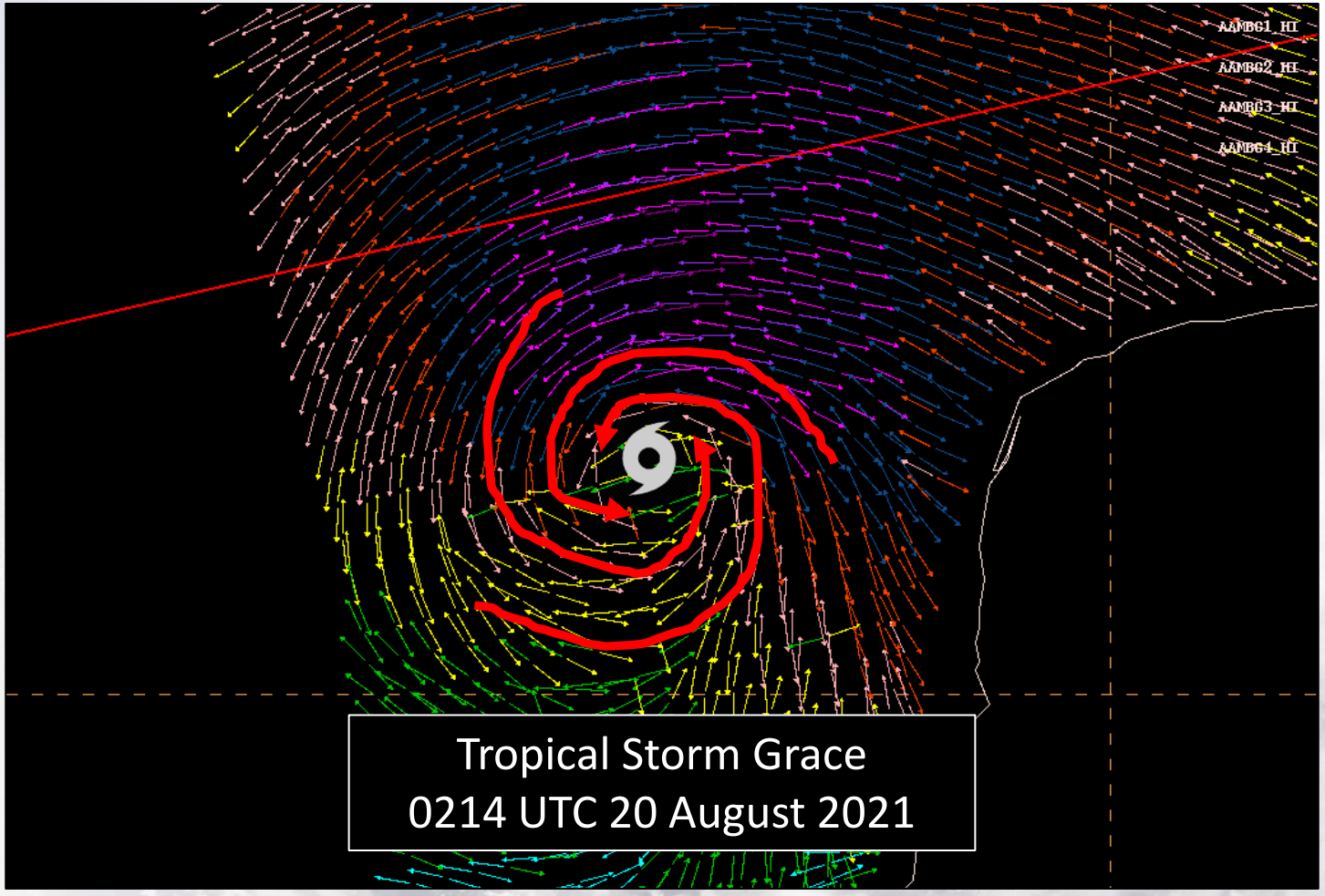




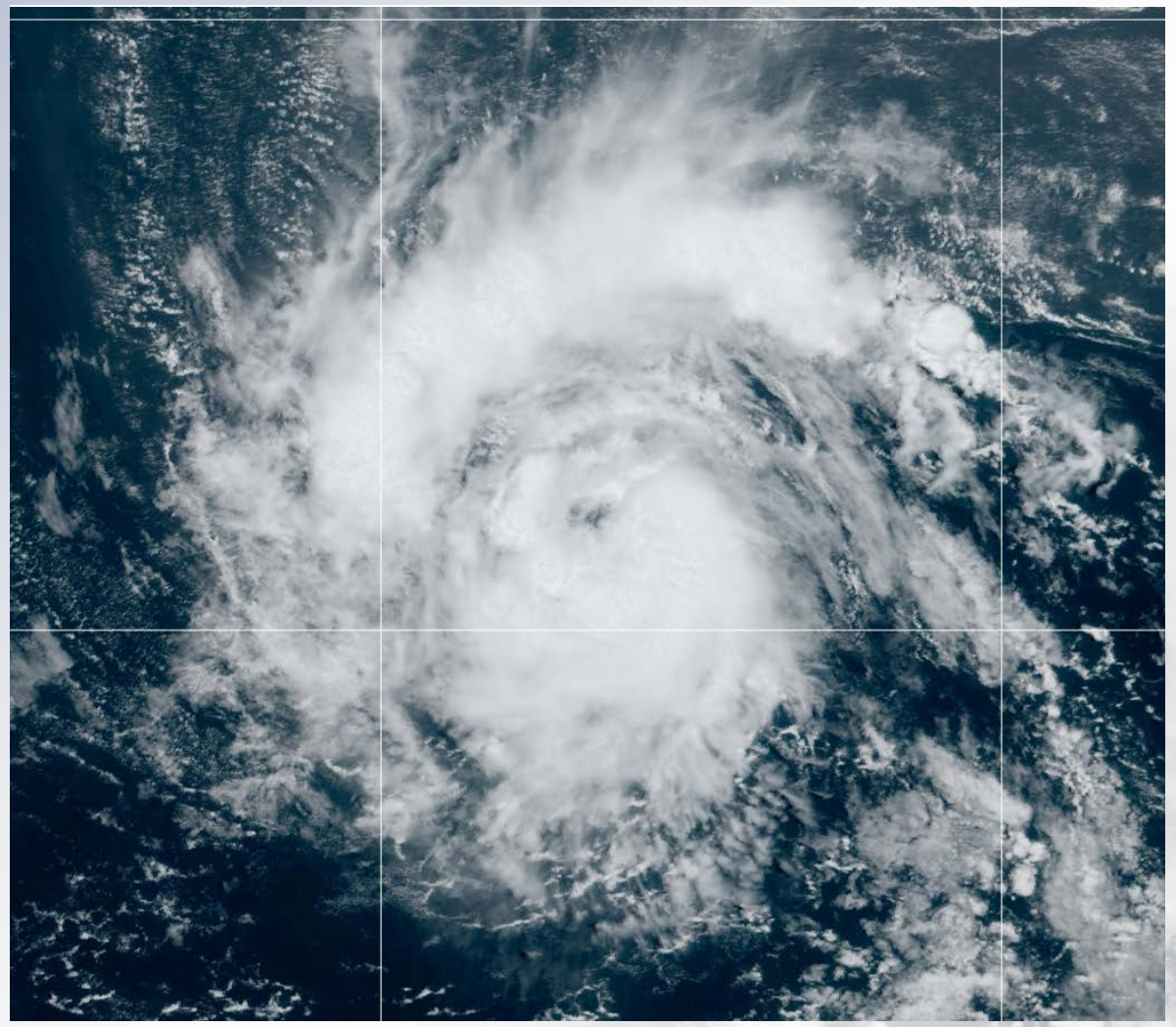
Tropical Depression Twelve Discussion Number 1
NWS National Hurricane Center Miami FL AL122021
800 PM CVT Tue Aug 31 2021

Satellite imagery, along with **earlier scatterometer data**, indicates that the low pressure area over the eastern tropical Atlantic has a well-defined circulation and sufficient organized convection to be considered a tropical depression. Thus, **advisories are being initiated on Tropical Depression Twelve**. The **initial intensity is set at 30 kt** based on satellite intensity estimates from TAFB and SAB as well as the **scatterometer data**.

TC Applications: Center Fix



TC Applications: Intensity Analysis



Tropical Storm Sam Discussion Number 4
NWS National Hurricane Center Miami FL AL182021
1100 AM AST Thu Sep 23 2021

"Subjective Dvorak satellite intensity estimates are now **T3.5/55-kt** from SAB and **T2.5/35-kt** from TAFB..."

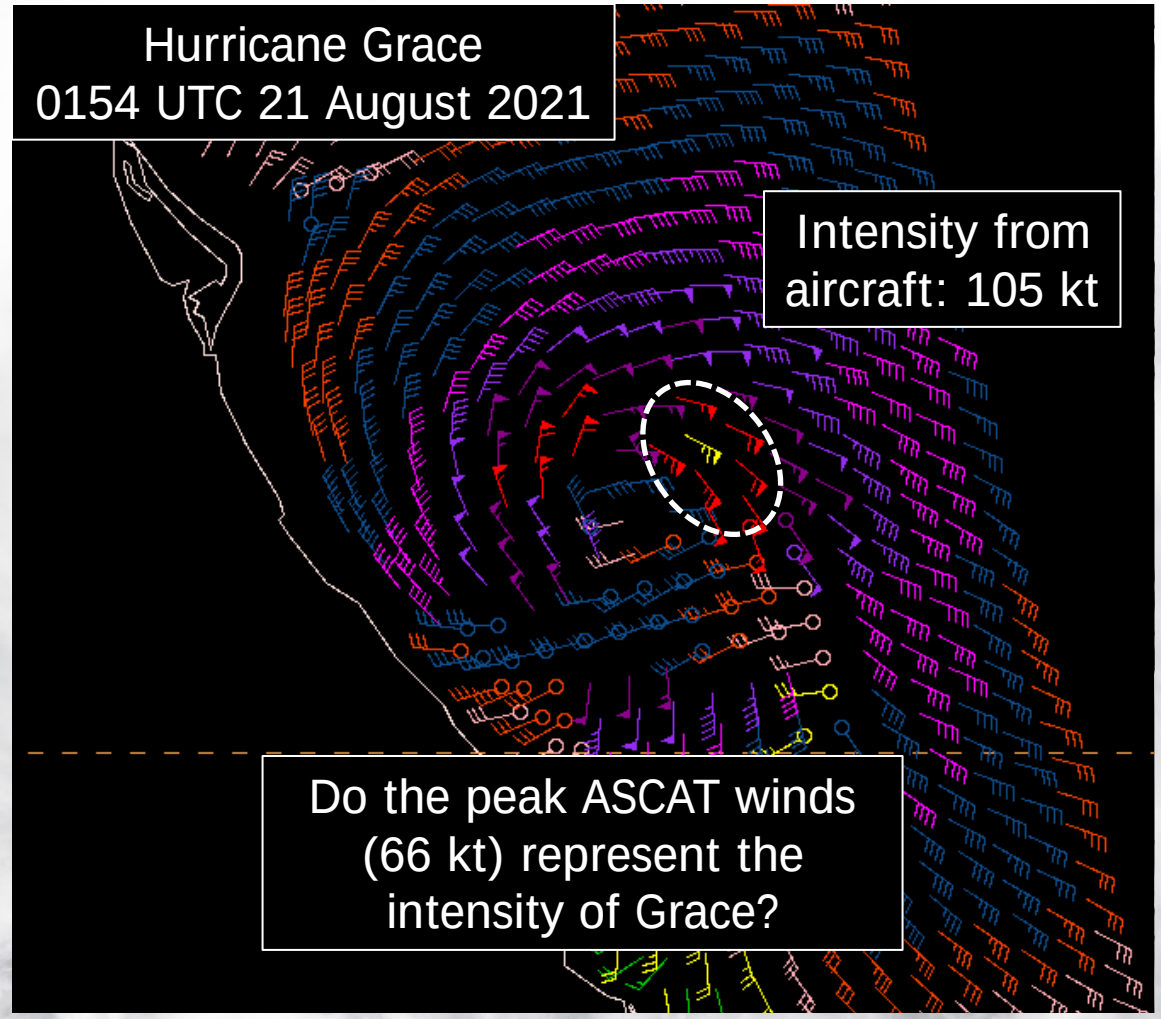
"ASCAT-B wind retrievals at 1234 UTC also indicated a tight, well-defined circulation had formed, with peak winds of 44 kt on the north side of the vortex..."

Given the recent scatterometer data, the intensity has been set to 45-kt for this advisory. Thus, Tropical Depression 18 has been upgraded to Tropical Storm Sam.

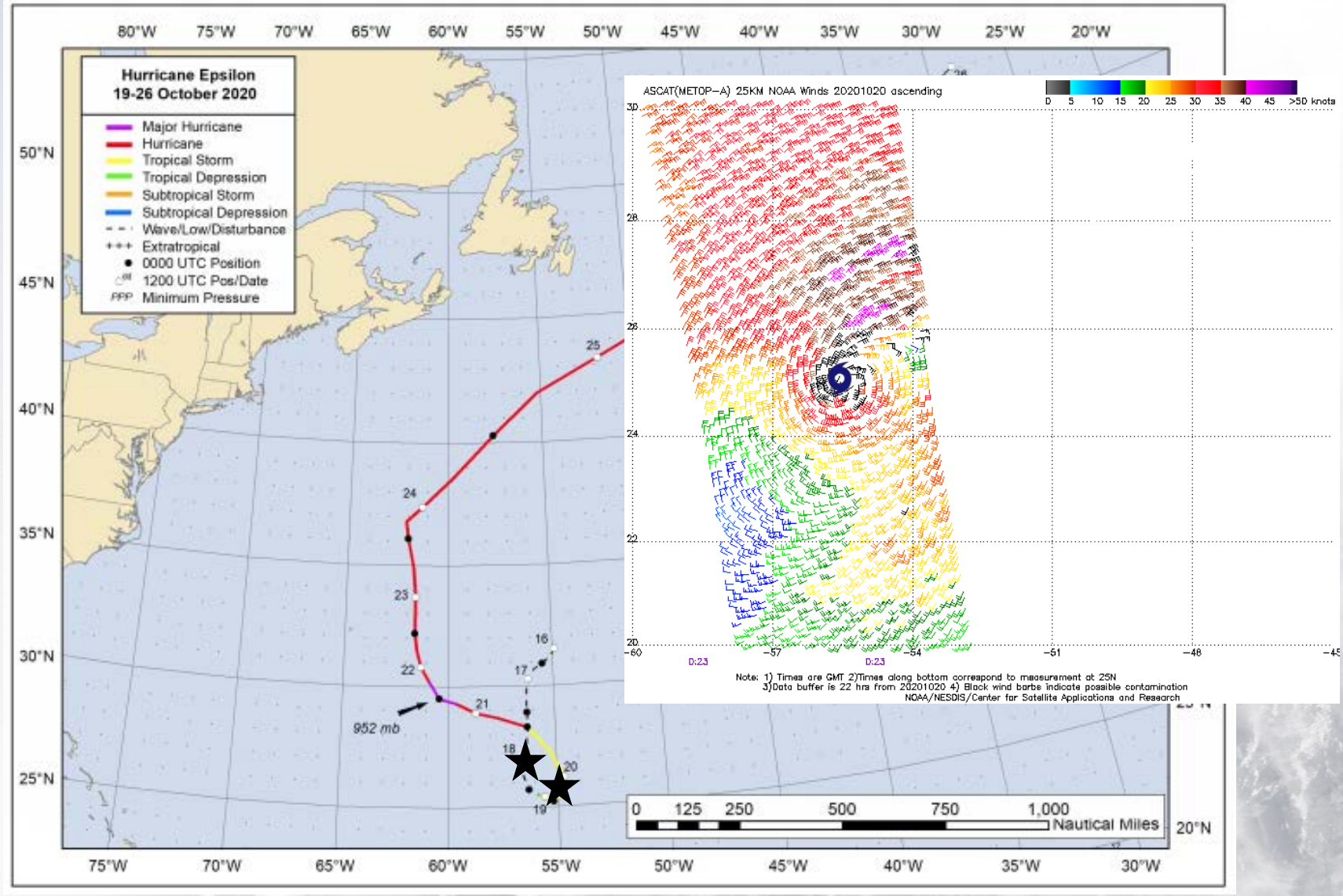
TC Applications: Intensity Analysis

- Remember: Scatterometer winds cannot be used to determine the peak intensity of hurricanes or stronger tropical storms.

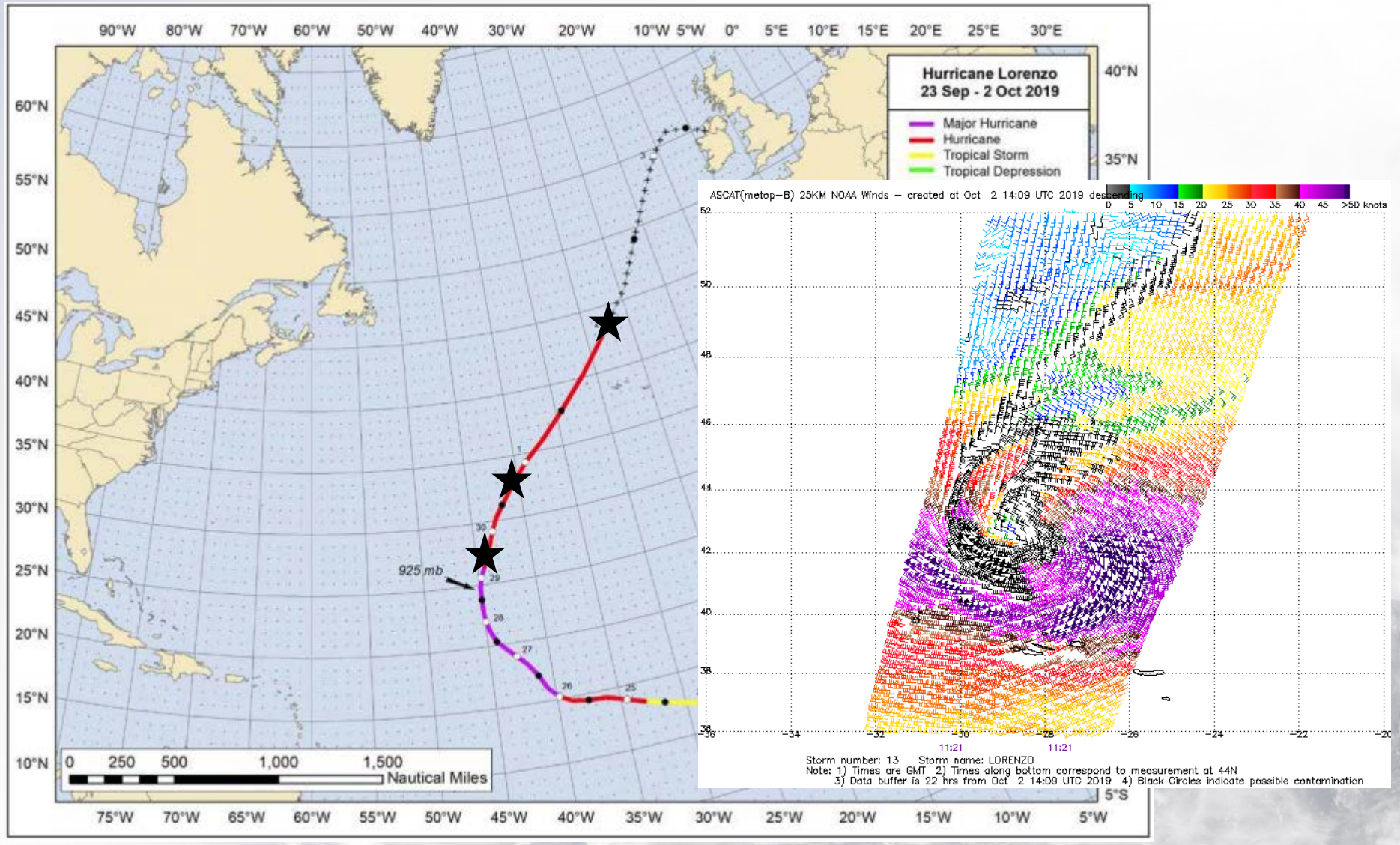
- But, the data can still provide us with valuable information.
  - Center fix (w/ambiguities)
  - Radius of maximum wind
  - 34, 50-kt wind radii



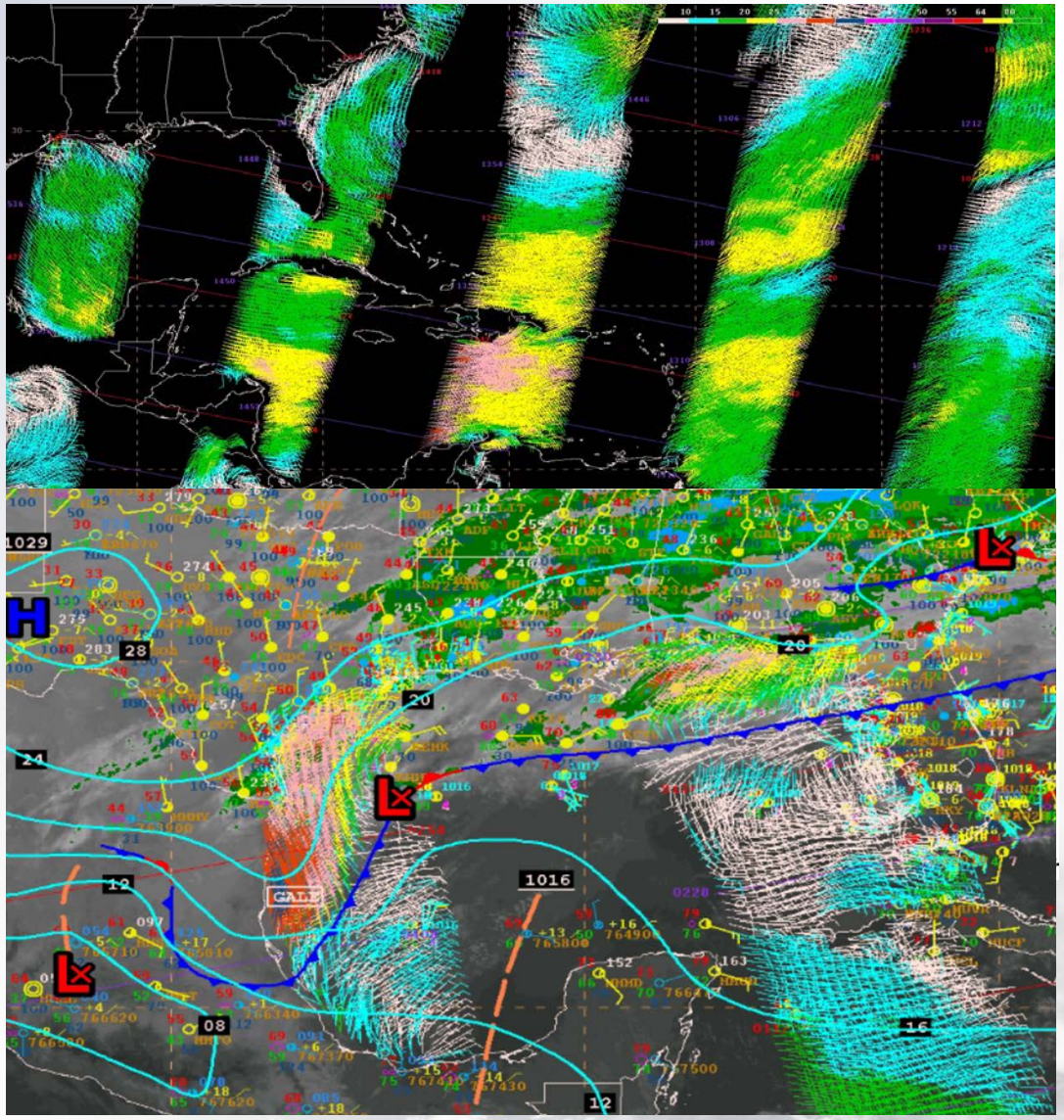
TC Applications: Cyclone Phase Transition



TC Applications: Extratropical Transition

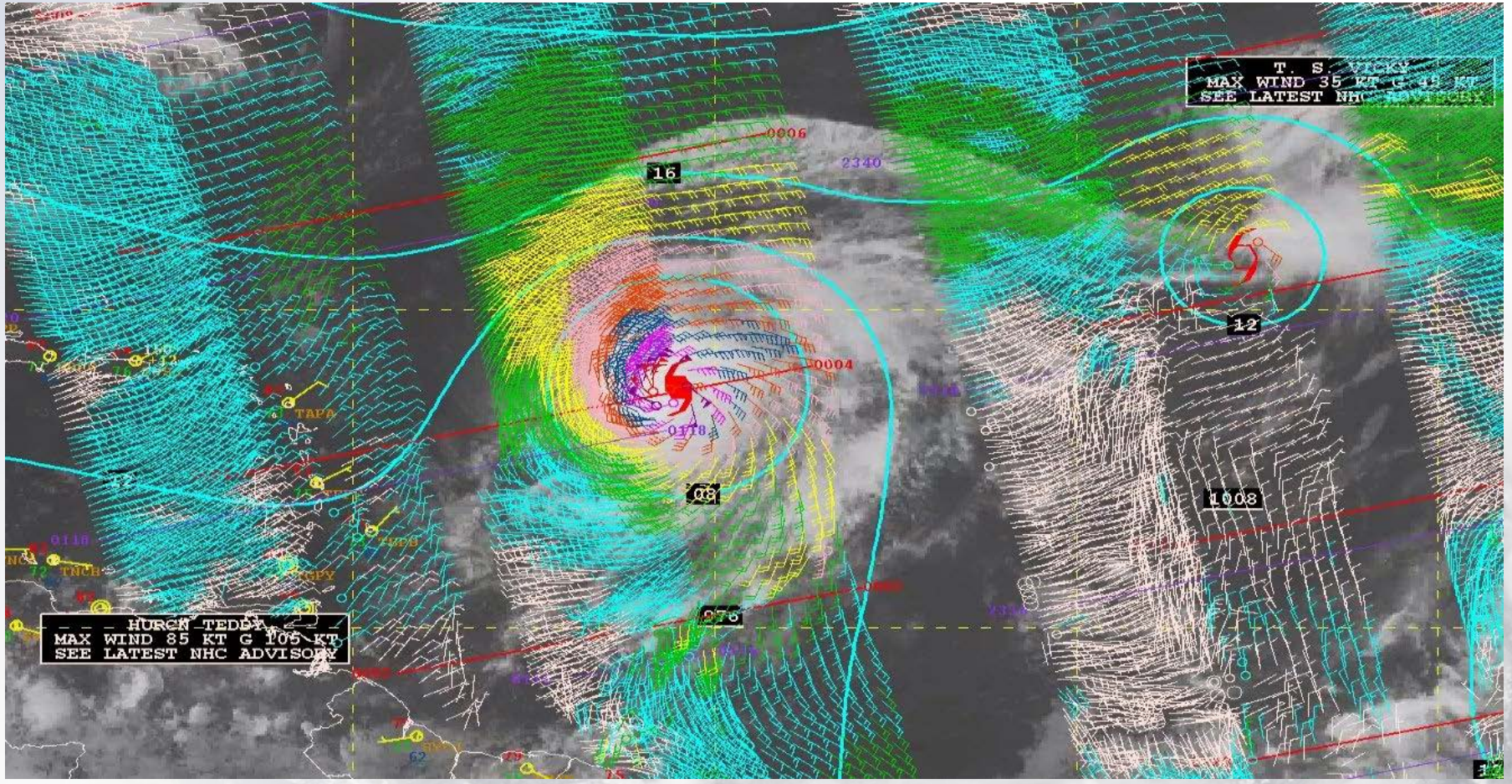


Other Applications: Marine Surface Analysis



- Tropical waves
- Orientation of the surface ridge axis
- Extratropical cyclones and fronts

Questions?


MAX WIND 85 KT G 105 KT
SEE LATEST NHC ADVISORY
MAX WIND 35 KT
SEE LATEST NHC
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