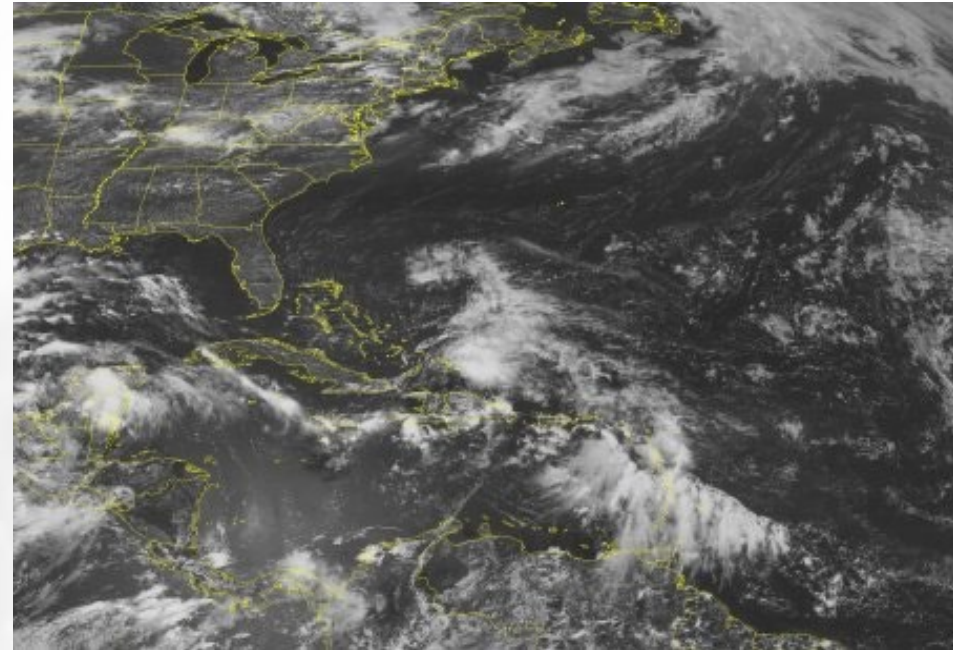
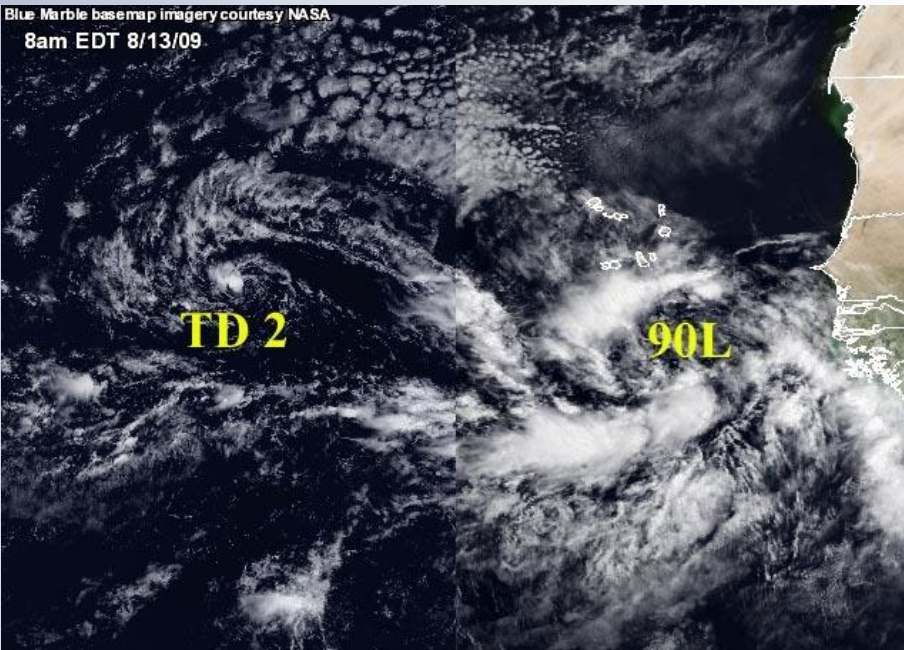


# Tropical Waves and Tropical Analysis



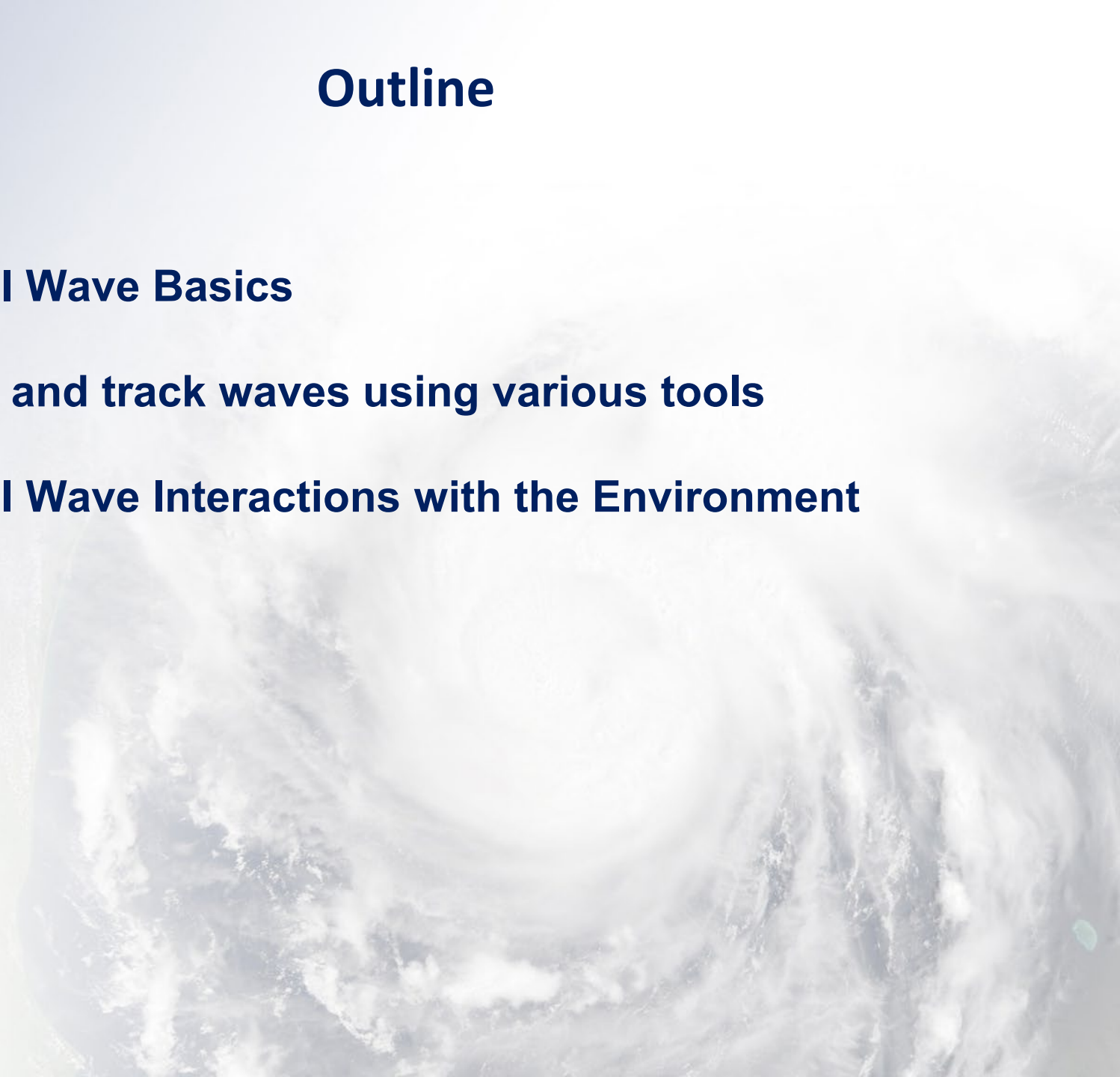
Andrew Hagen & John Cangialosi  
National Hurricane Center

WMO Region IV  
Tropical Cyclone Workshop

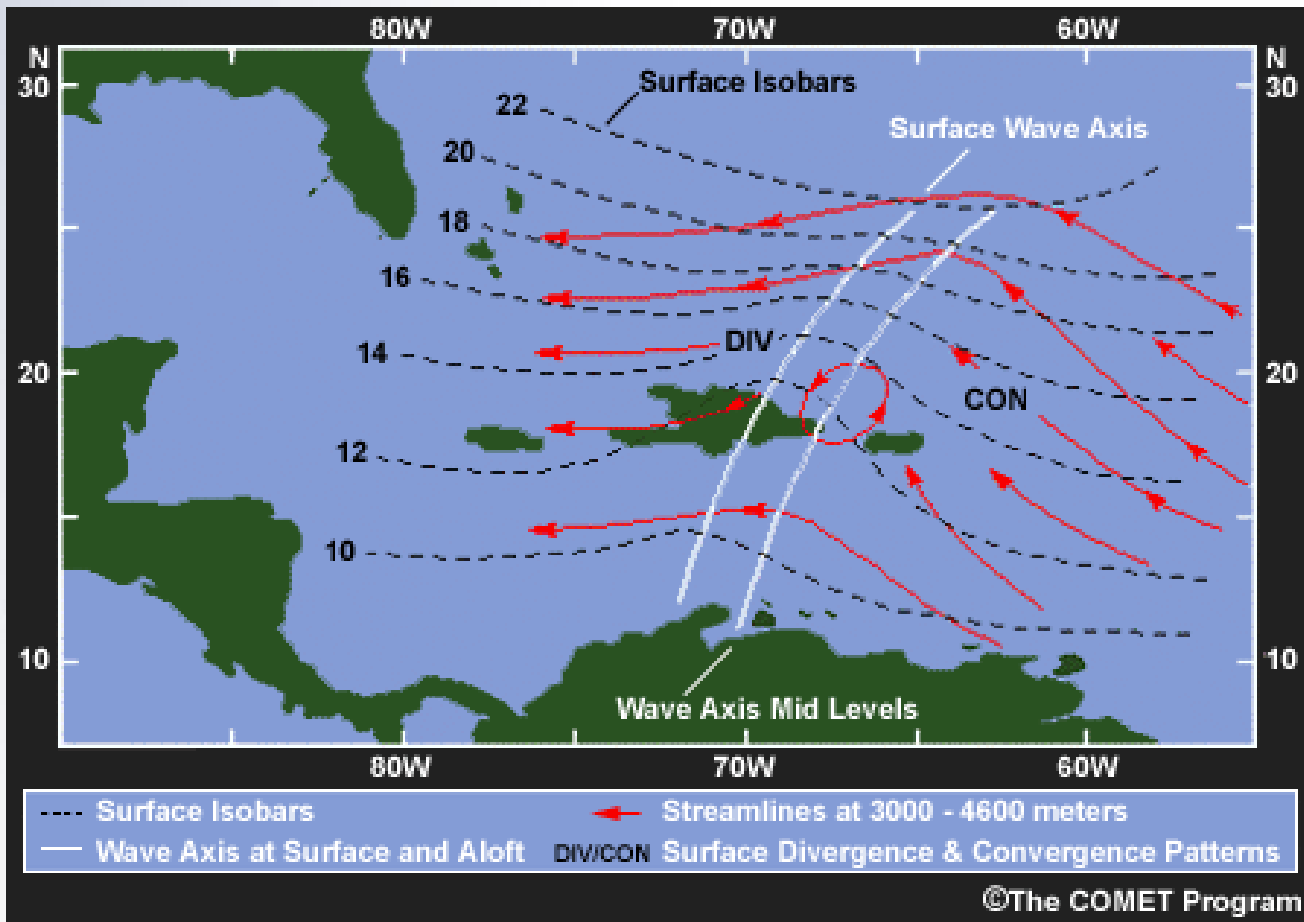


# Outline

- **Tropical Wave Basics**
- **Identify and track waves using various tools**
- **Tropical Wave Interactions with the Environment**

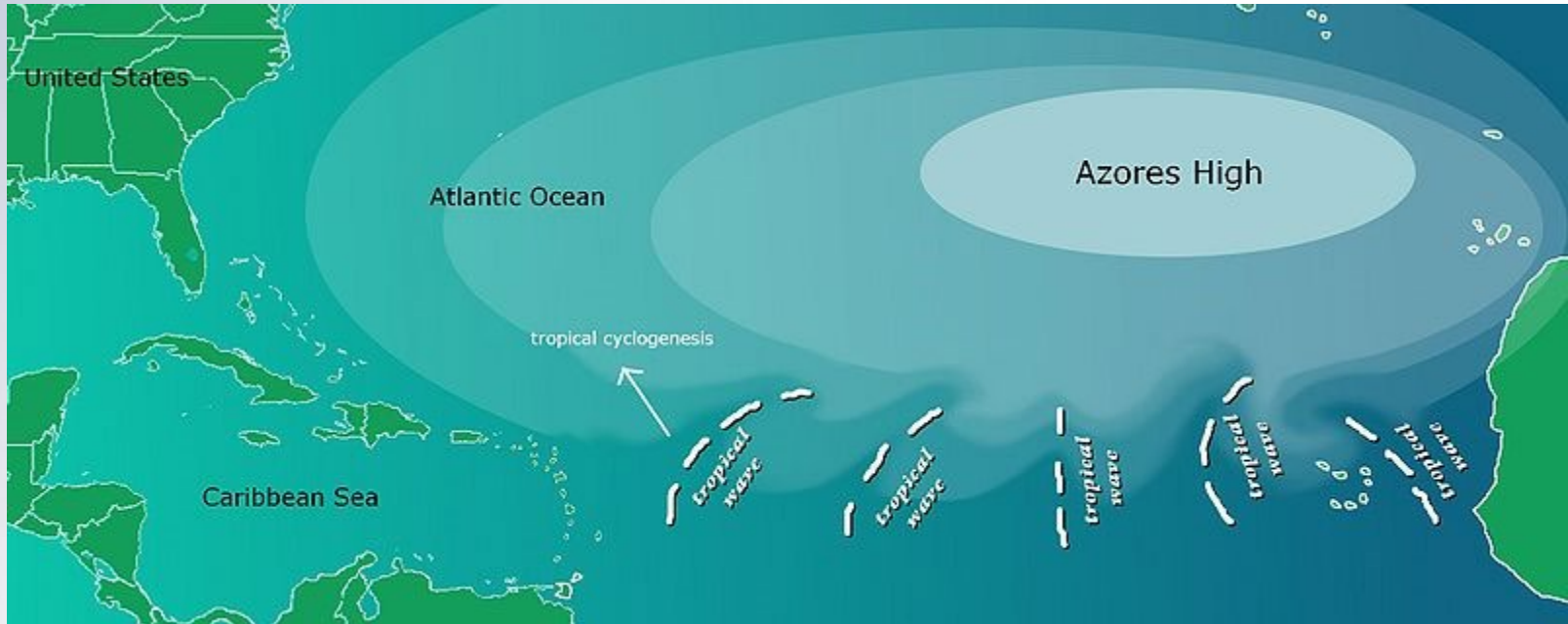


# Schematic diagram

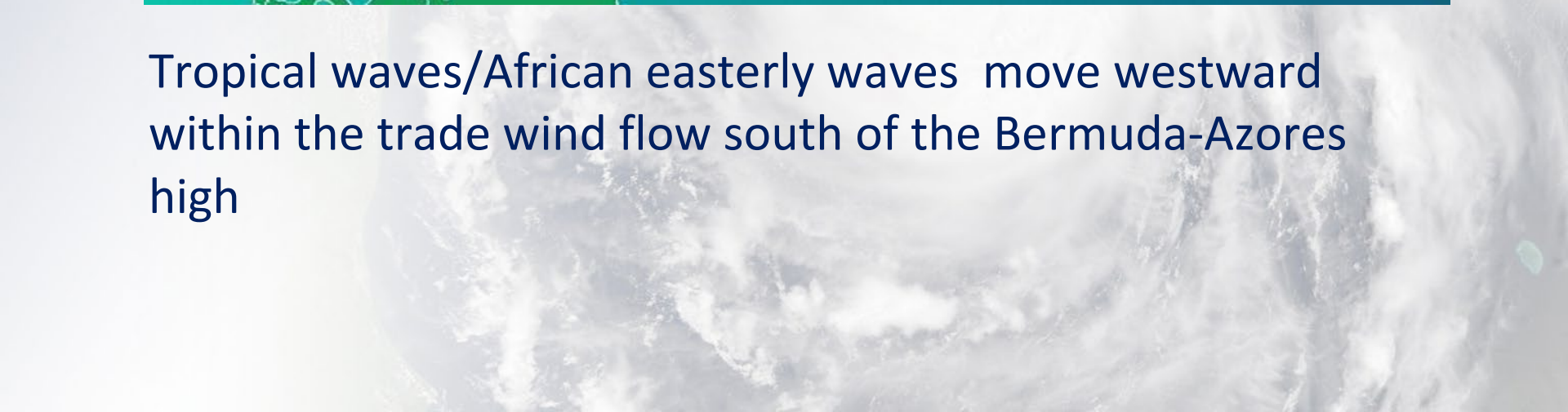


- Notice eastward slope with height
- Maximum amplitude is around 700 mb

# Typical Synoptic Setup



Tropical waves/African easterly waves move westward within the trade wind flow south of the Bermuda-Azores high



Q1: Why should you be aware of Tropical Waves? Check all that apply.



A. They could turn into a tropical cyclone at any time.

0%

B. The wave disturbance will always produce impacts when they pass over a populated area.

0%

C. A tropical cyclone may form from the wave when environmental conditions are conducive.

0%

D. If a tropical cyclone does not form from them, I do not need to be aware of them.

0%

E. A wave can often produce impacts of its own.

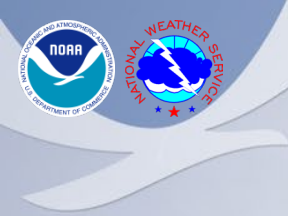
0%

A satellite image of a tropical wave, showing a large, circular cloud system with a distinct eye-like center, surrounded by spiral cloud bands. The image is centered on the tropical wave, with the text overlaid in the middle. In the top left corner, there is a partial blue and white logo.

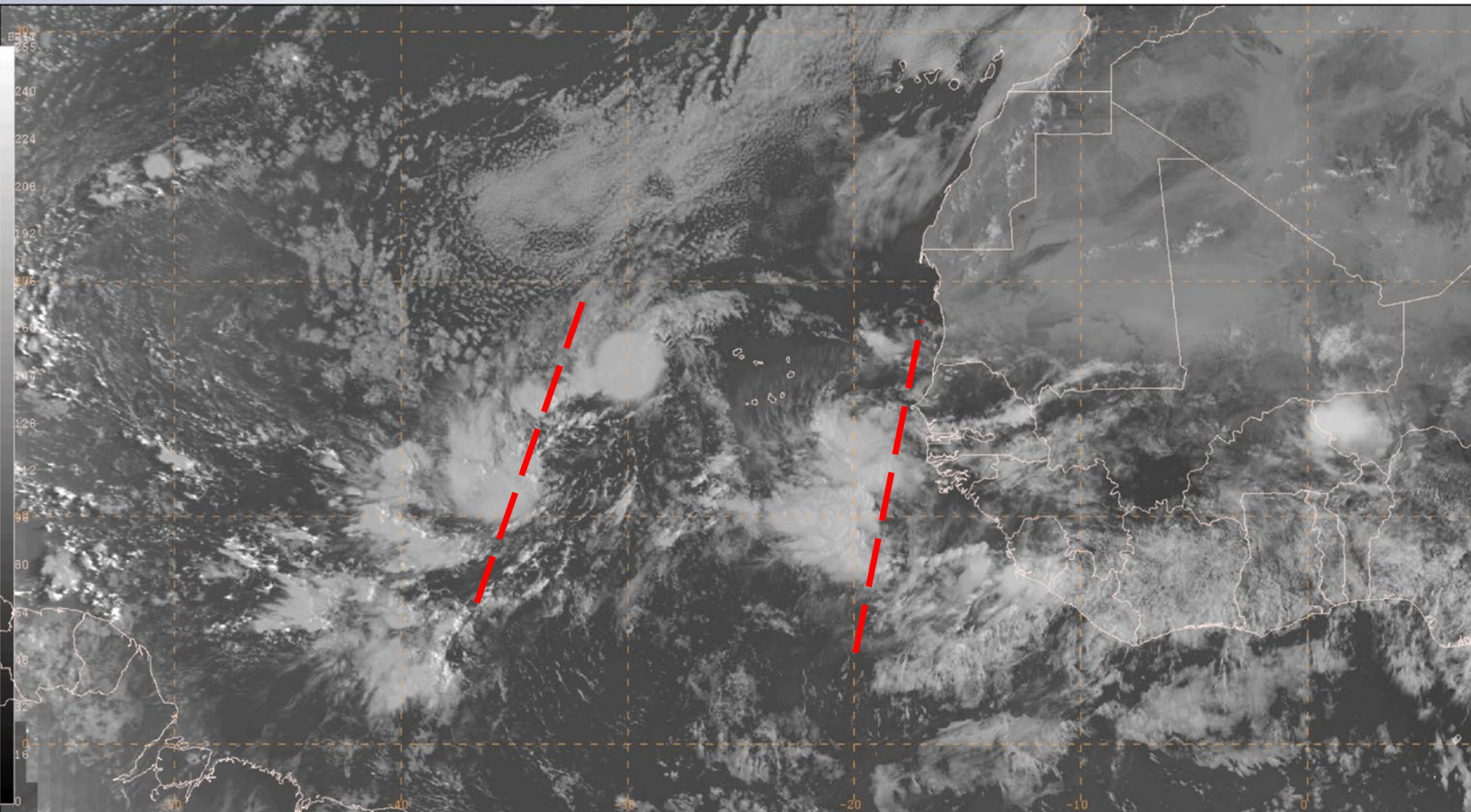
# **Tropical Wave Basics and Identification**

Q2: Add pins where you think there is a tropical wave axis. You may add more than one.





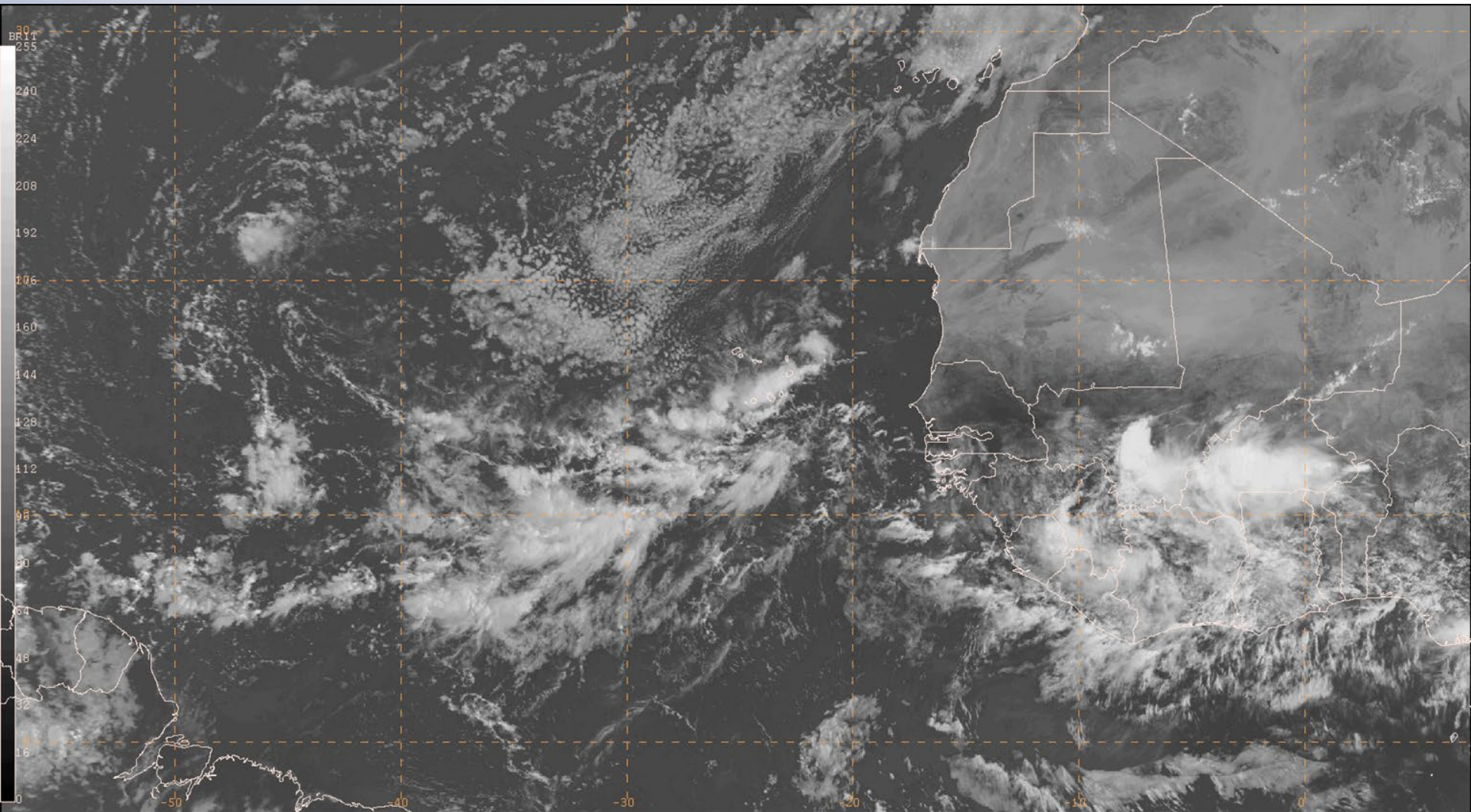
# Geostationary Satellite Imagery







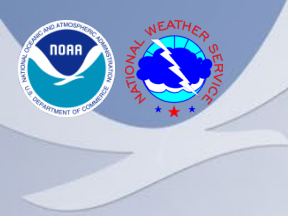
# Satellite Imagery



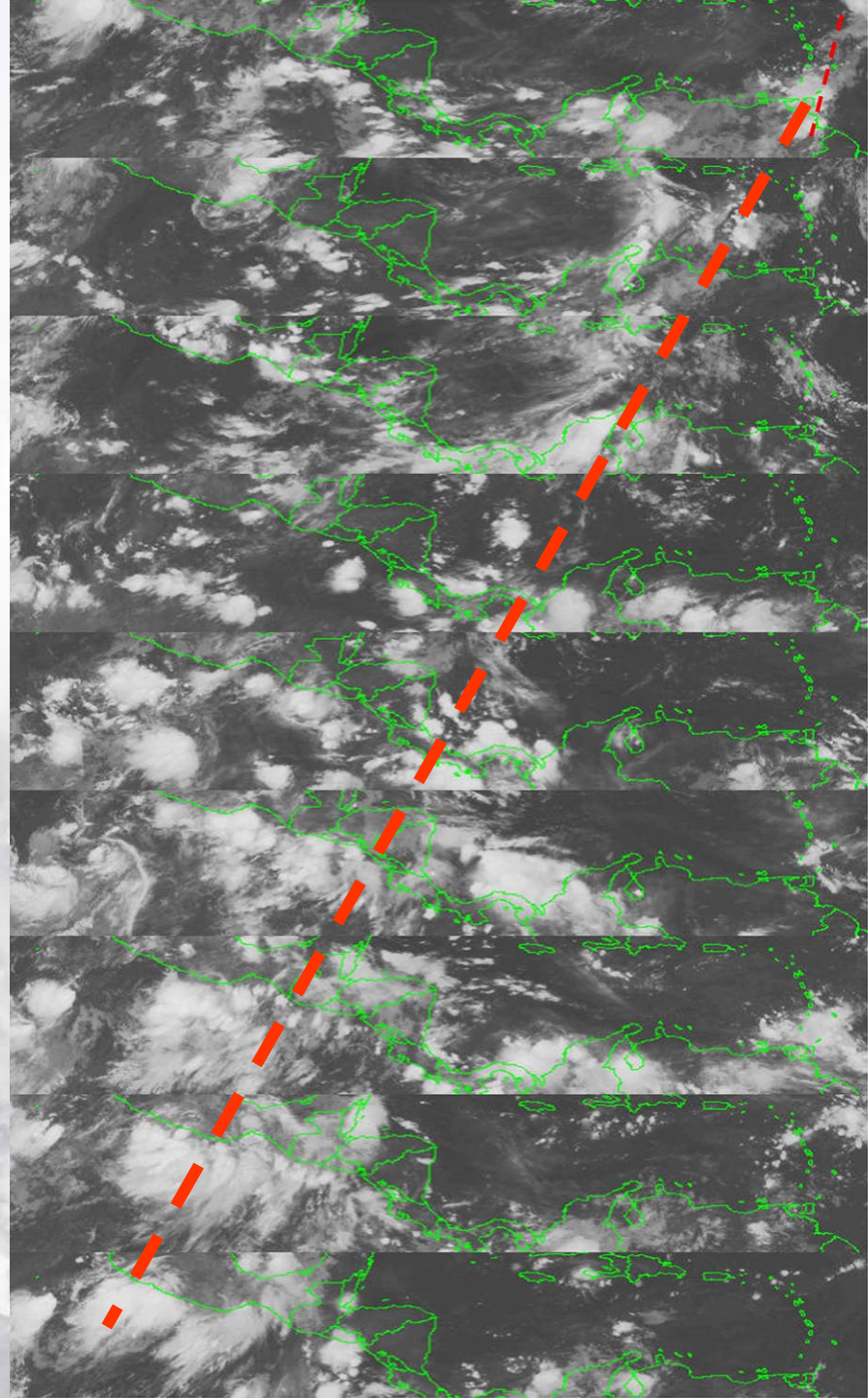
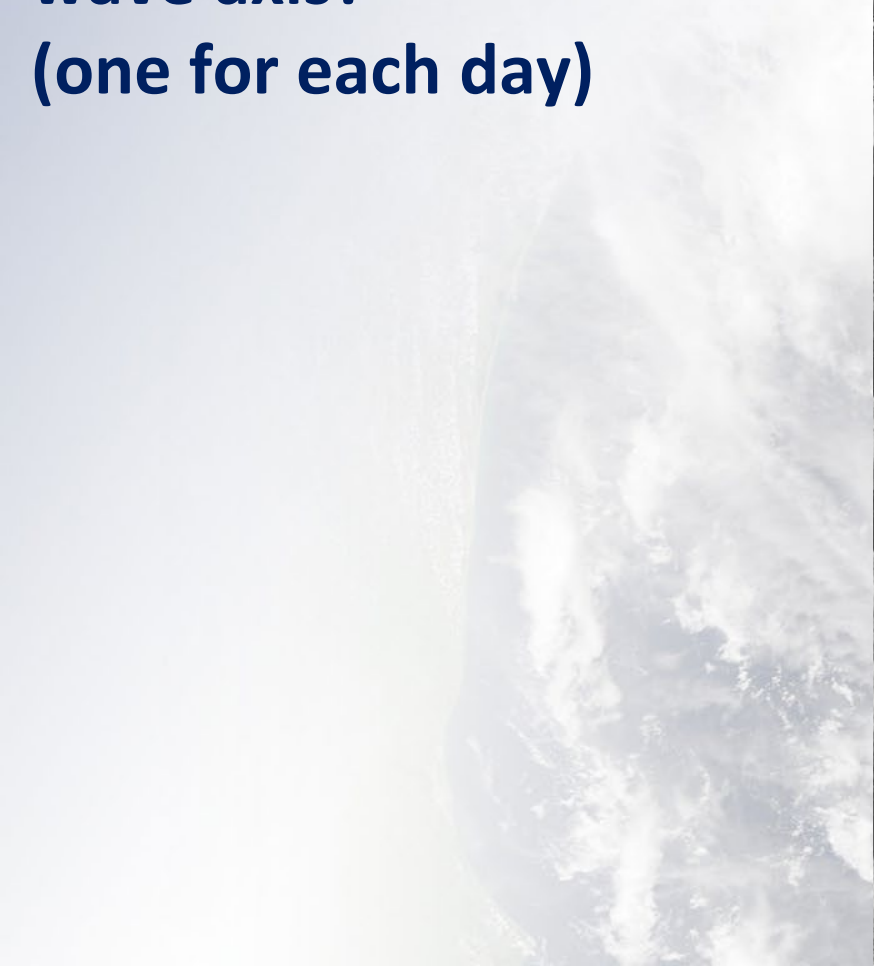
Q3: Drop a pin to identify the tropical wave axis on each day (one for each day).



0



**Hovmoller: Drop a pin  
where there is tropical  
wave axis?  
(one for each day)**

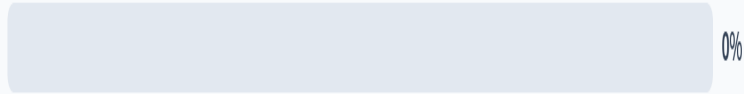


Date  
27  
28  
29  
30  
31  
1  
2  
3  
4

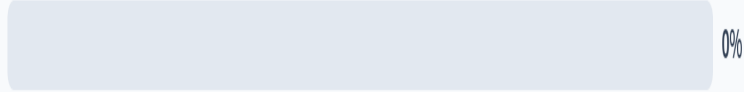
Q4: Estimate the speed of the tropical wave? ( $10^\circ \approx 675$  miles)



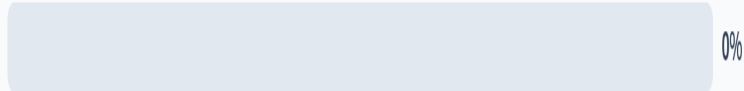
A. 5 mph



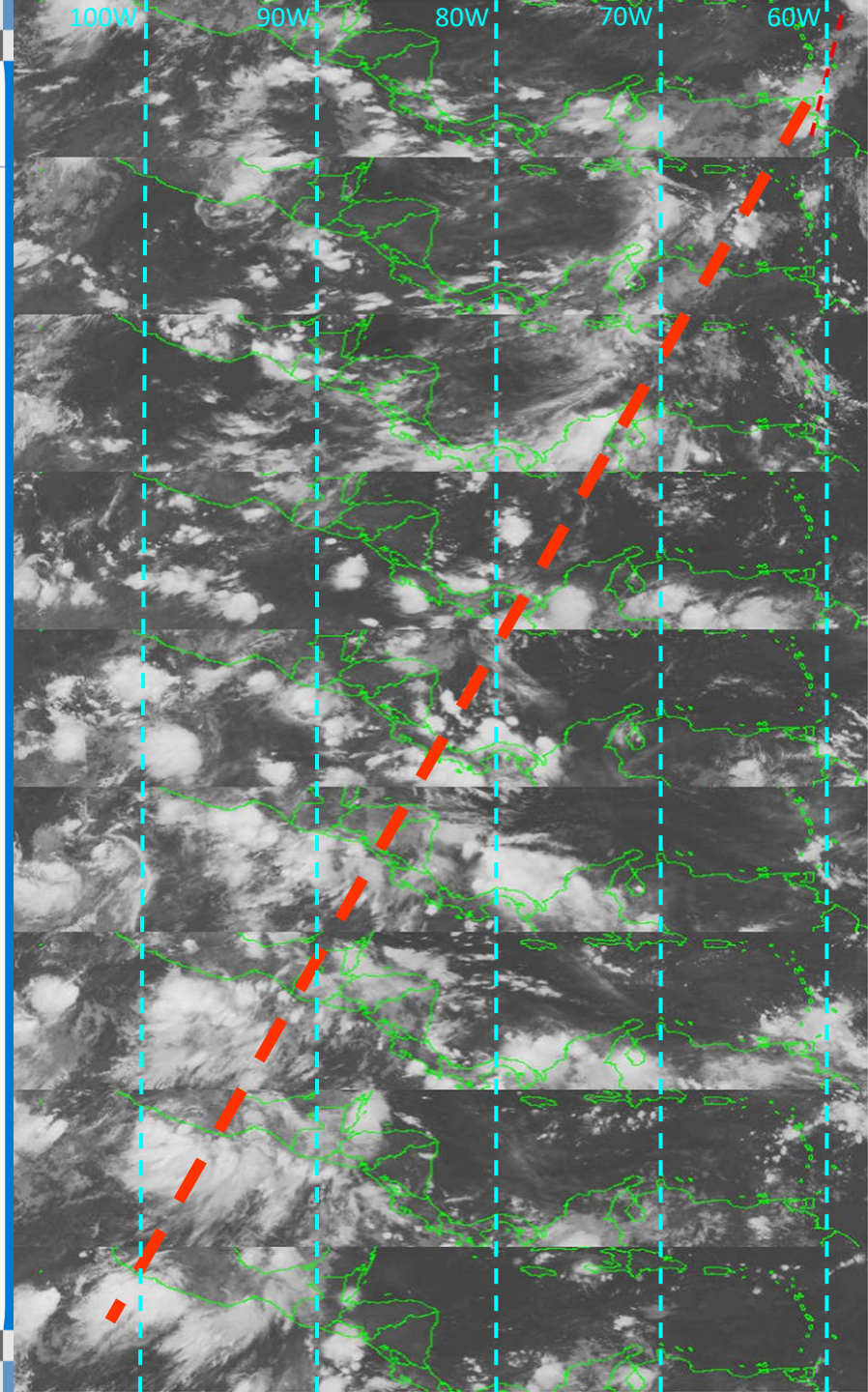
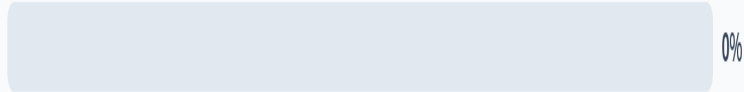
B. 15 mph



C. 25 mph



D. 35 mph



Date

27

28

29

30

31

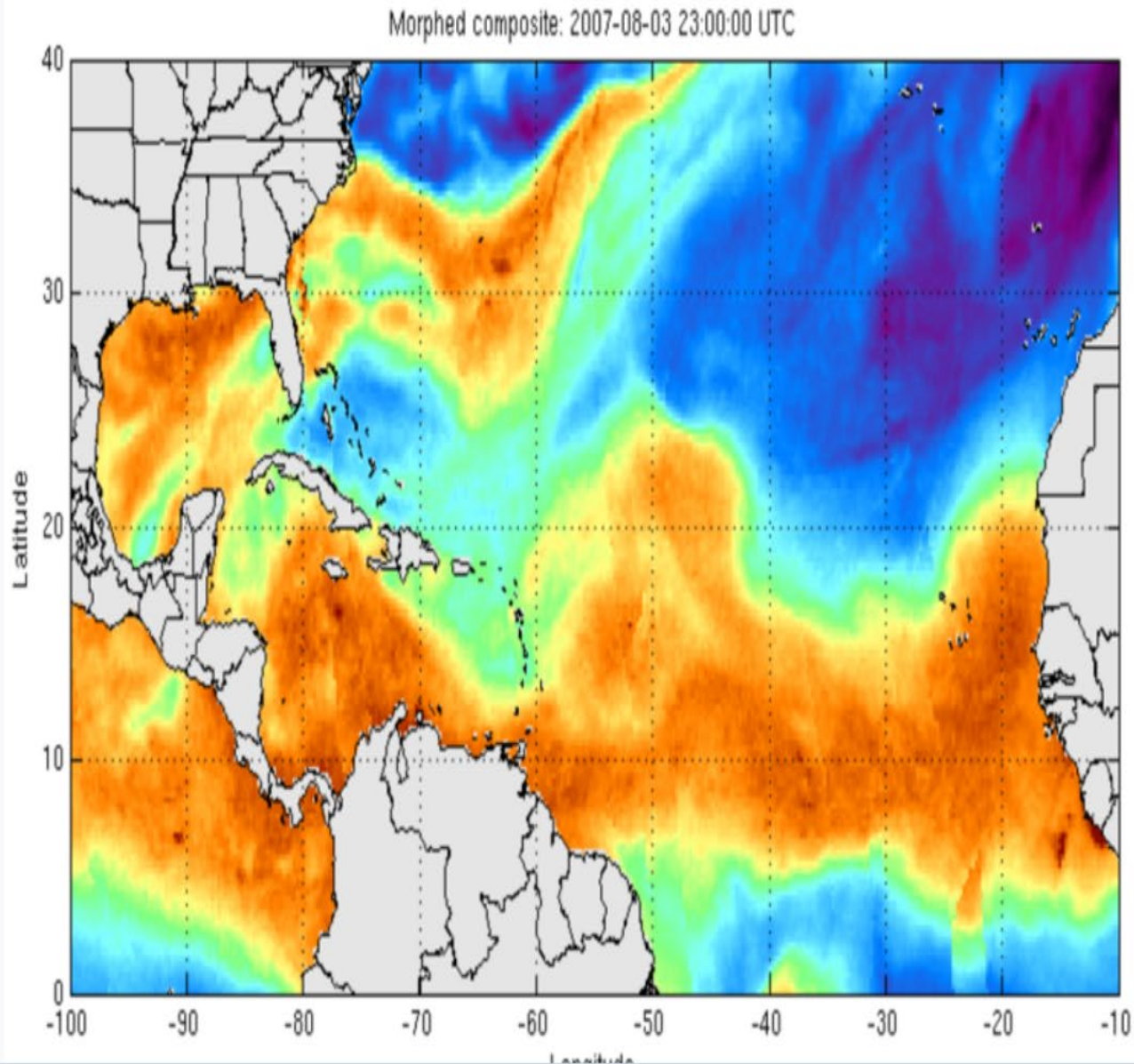
1

2

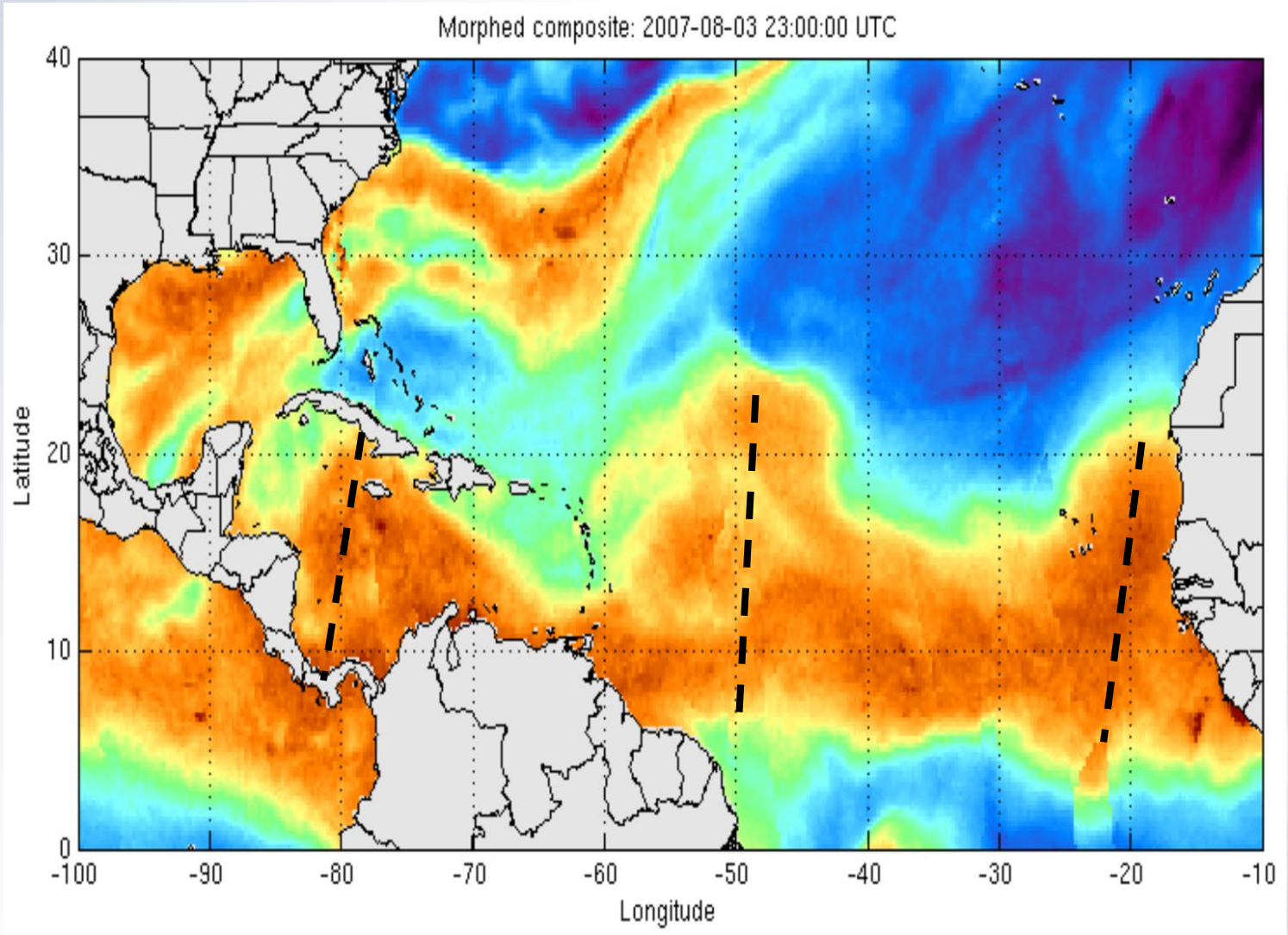
3

4

Q5: Add pins where you think there is a tropical wave axis. You may add more than one.



# Total Precipitable Water: Add pins where you think there is a tropical wave axis?



Q6: Estimate the wavelength of the tropical waves? ( $10^\circ \approx 675$  miles)



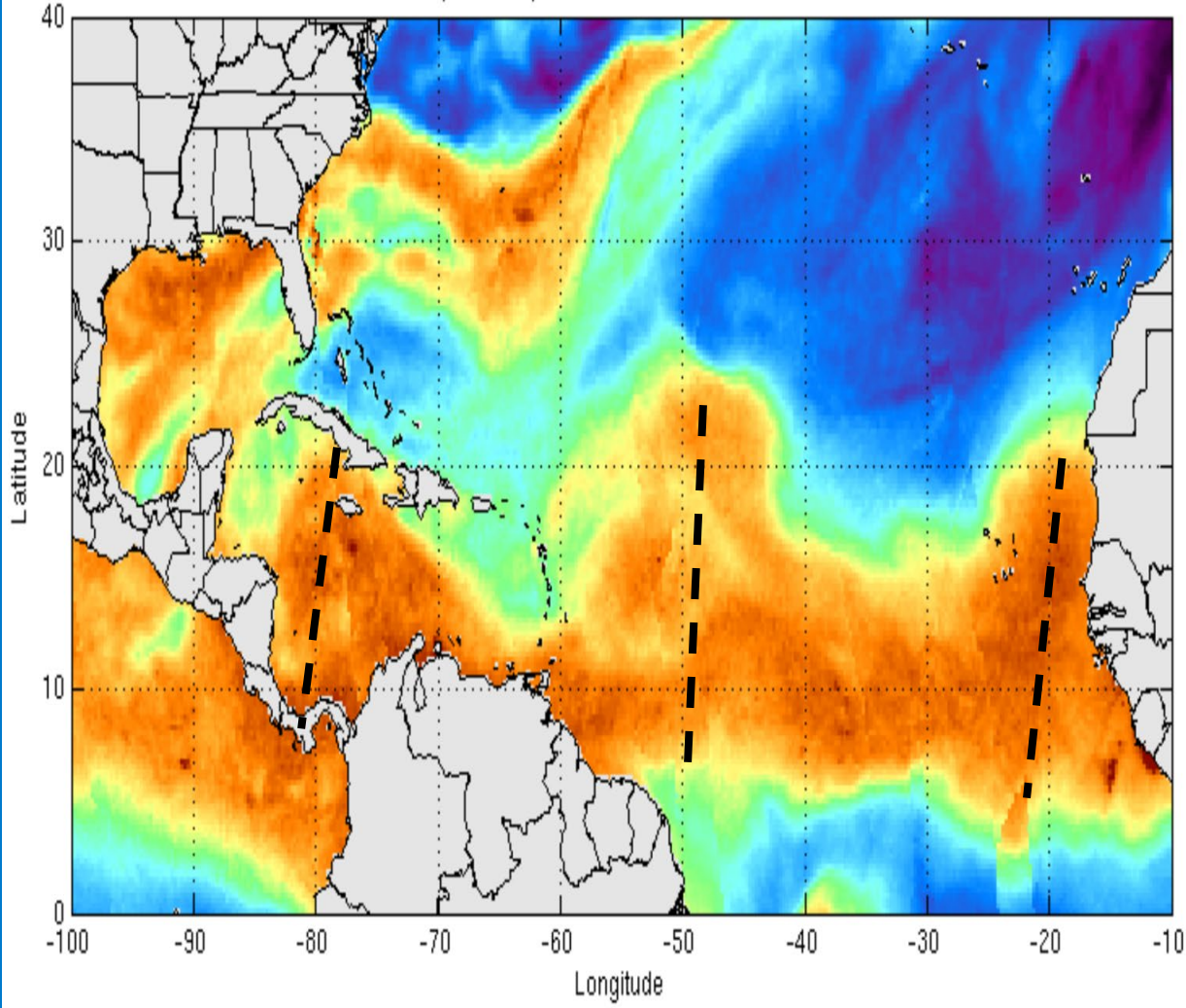
A. 1000 miles  
0%

B. 2000 miles  
0%

C. 3000 miles  
0%

D. 4000 miles  
0%

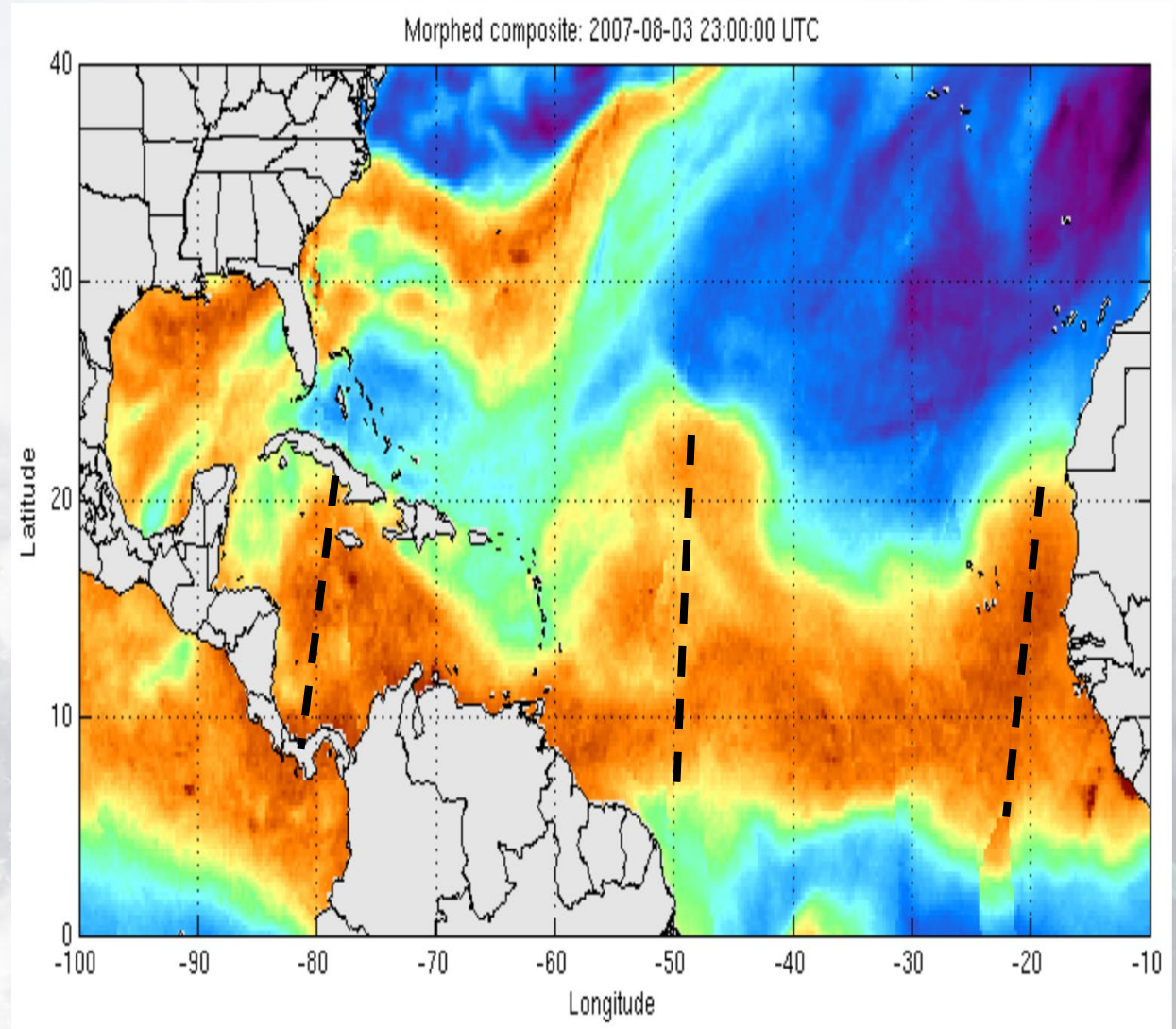
Morphed composite: 2007-08-03 23:00:00 UTC



# Estimate the wavelength of the tropical wave?

( $10^\circ \approx 675$  miles)

- a. 1000 miles
- b. 2000 miles**
- c. 3000 miles
- d. 4000 miles



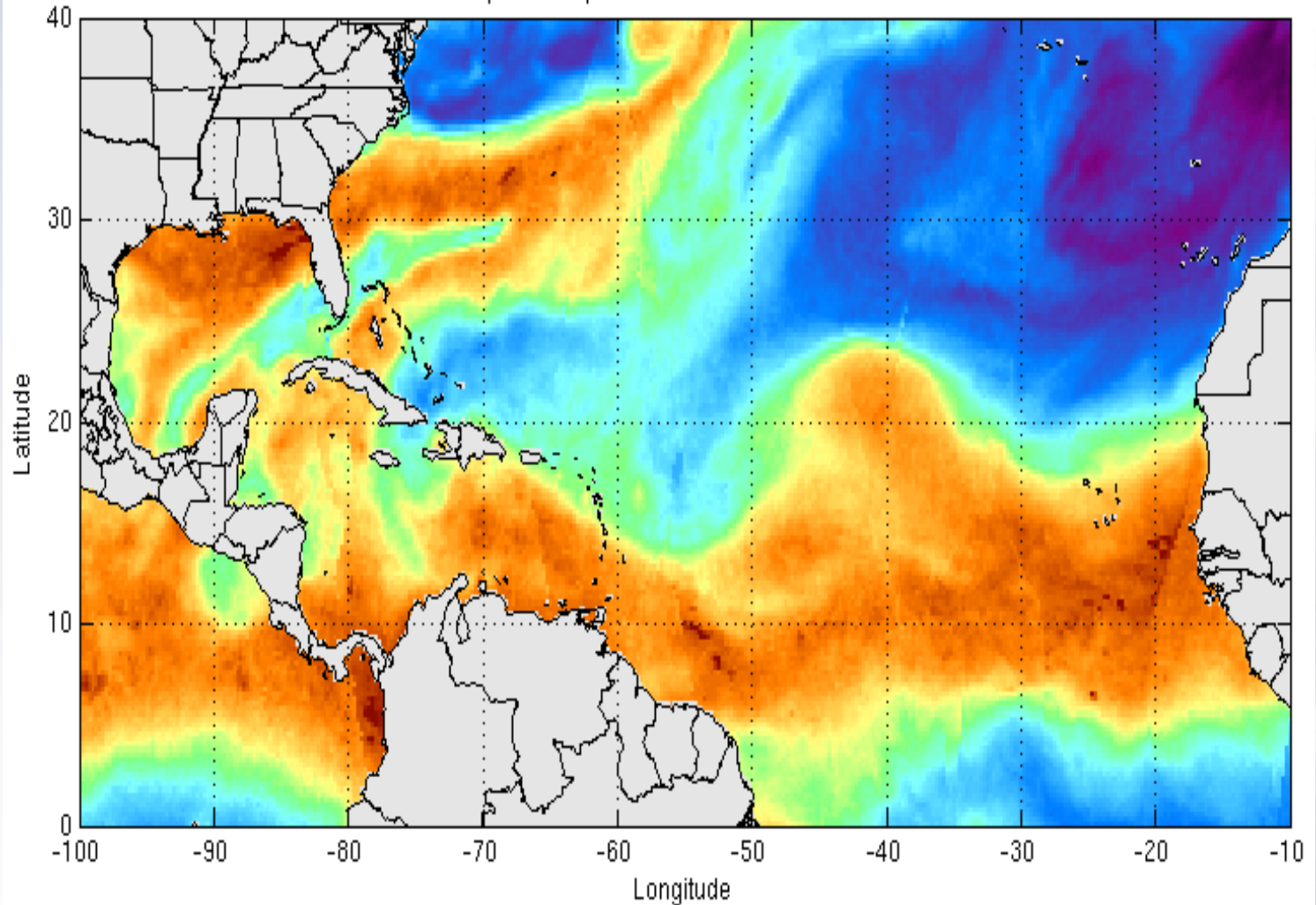




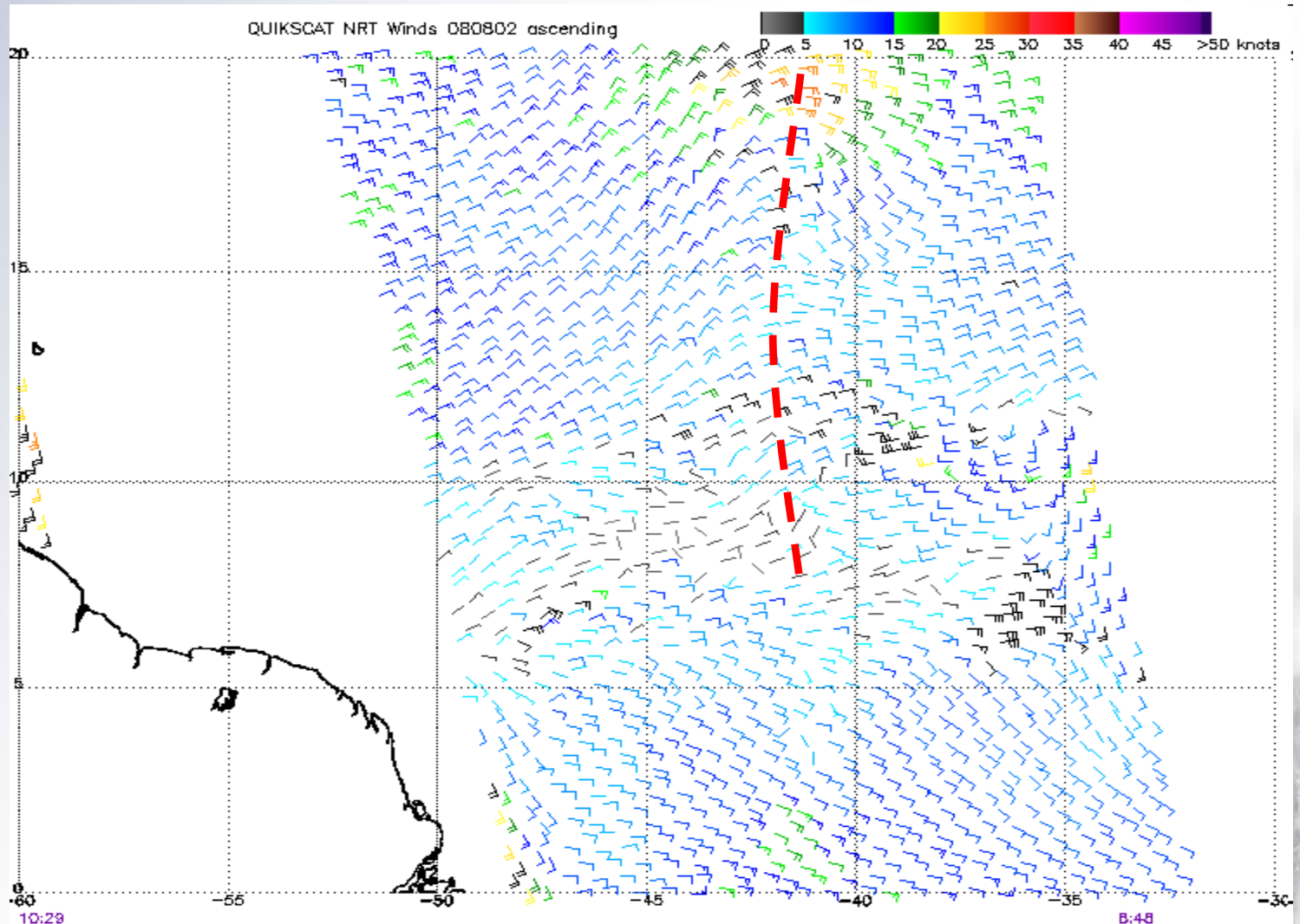
# Total Precipitable Water



Morphed composite: 2007-08-03 00:00:00 UTC

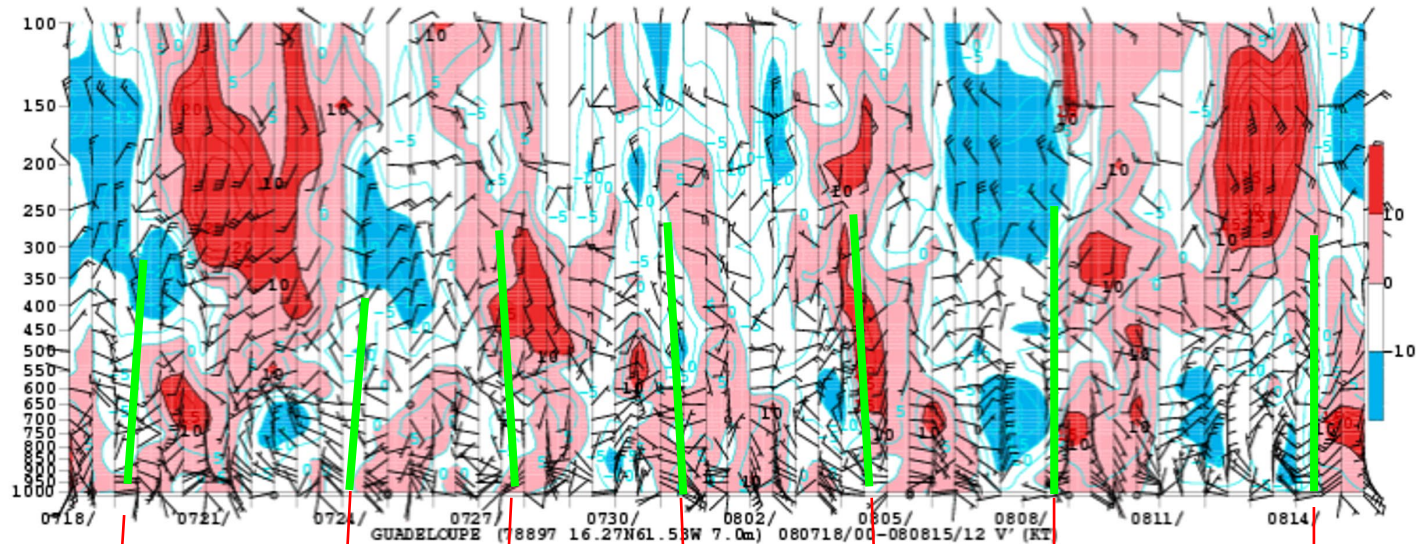


# Another Tool: Scatterometry

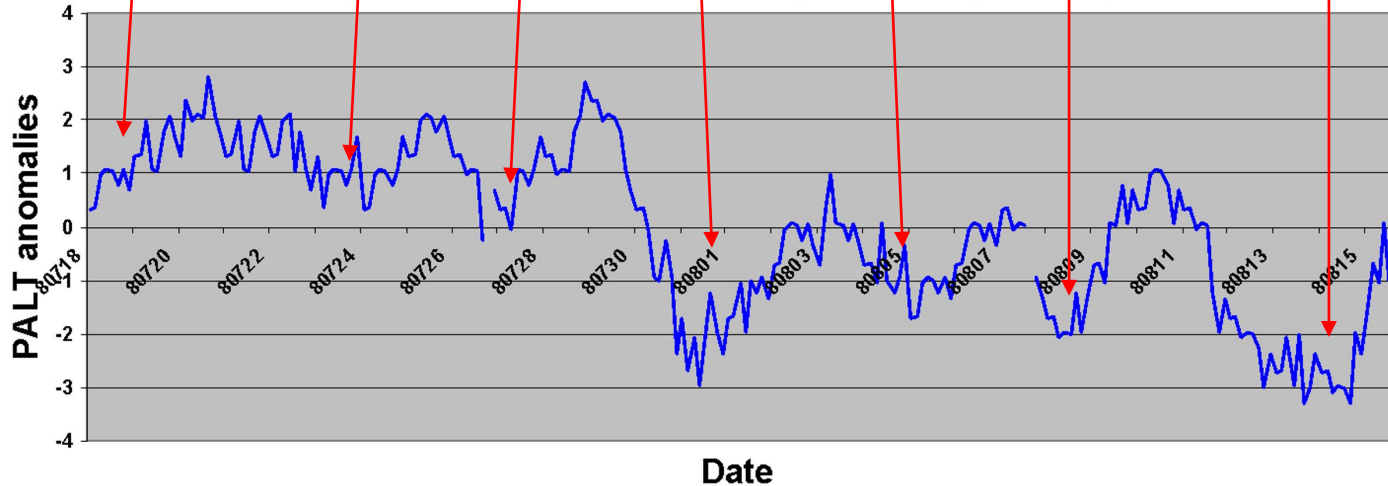


Note: 1) Times are GMT 2) Times correspond to 10N at right swath edge - time is right swath for overlapping swaths at 10N  
 3) Data buffer is 24 hrs for D80802 4) Black barbs indicate possible rain contamination  
 NOAA/NESDIS/Office of Research and Applications

# Another Tool: Soundings/Surface Obs



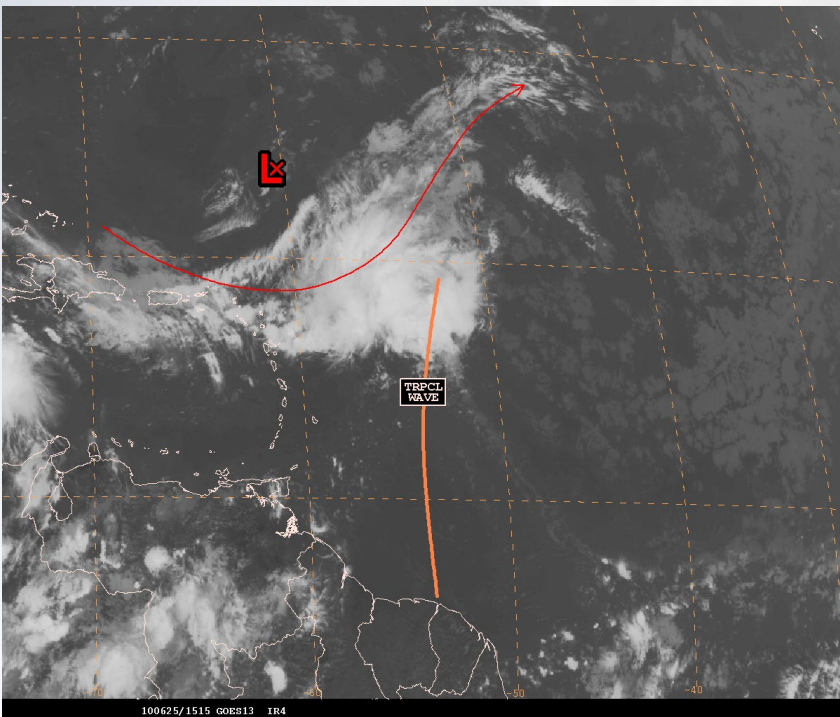
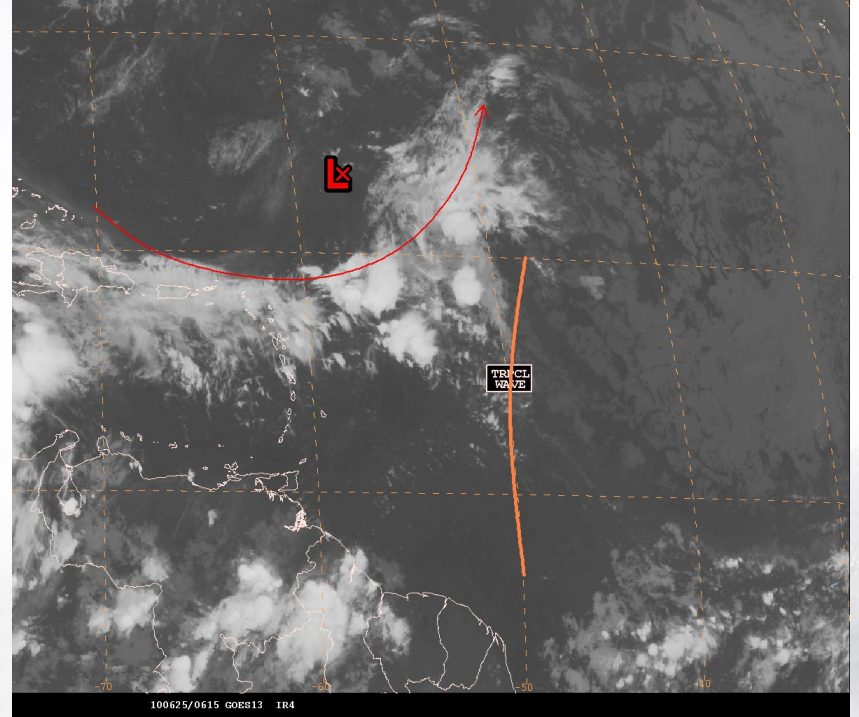
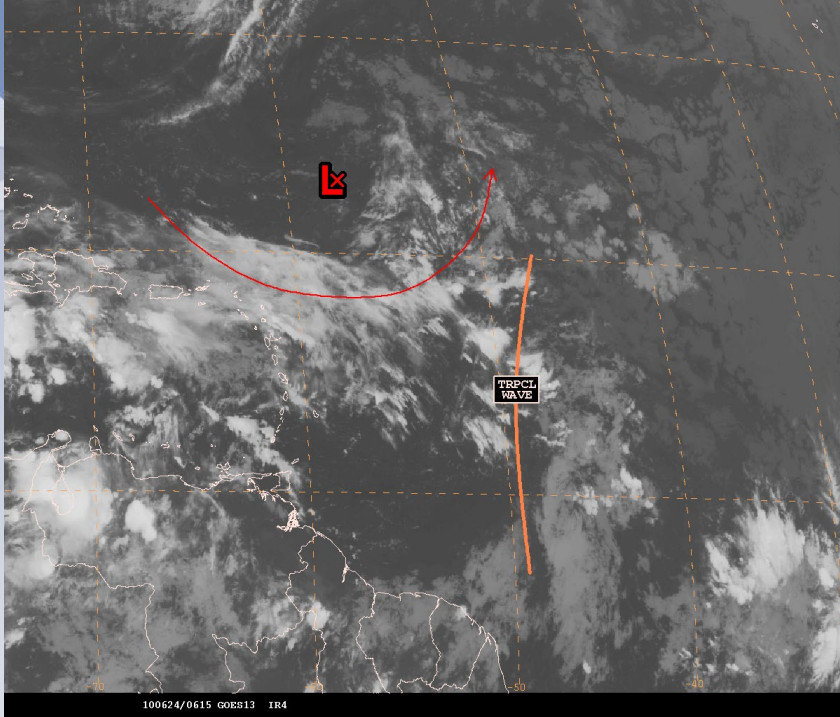
**Guadeloupe PALT anomalies July 18 - August 15, 2008**



Surface pressure with mean and diurnal and semi-diurnal tide removed



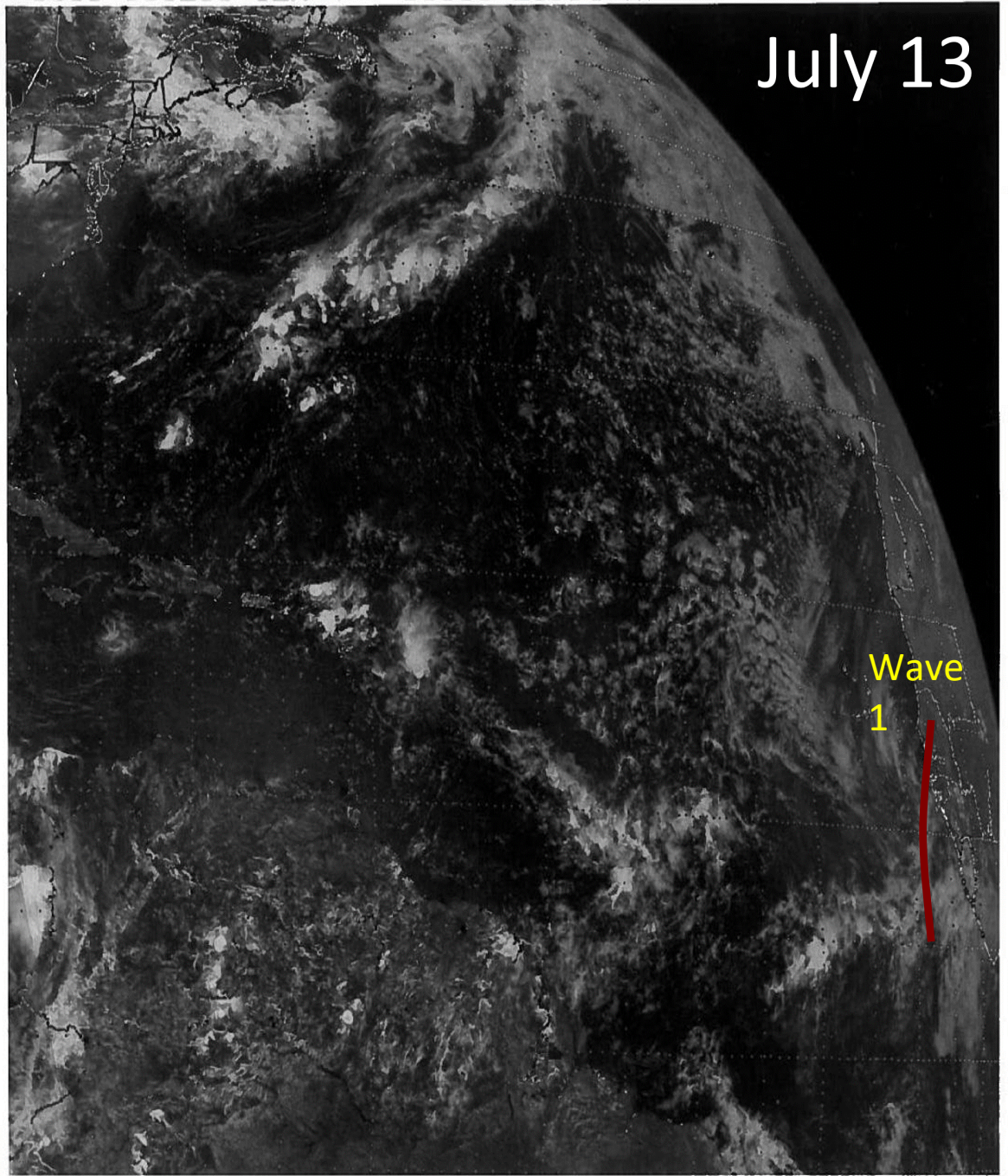
# ***Tropical Wave Interactions***



*Although interaction with upper-level lows are unfavorable for tropical cyclogenesis, it can often induce heavy rainfall.*

A satellite image of a tropical wave, showing a large, swirling cloud system over the ocean. The wave is characterized by a dense, white cloud core surrounded by a spiral of smaller clouds. The background is a light blue sky with some wispy clouds.

***Tropical Wave  
Interactions:  
Exercise***



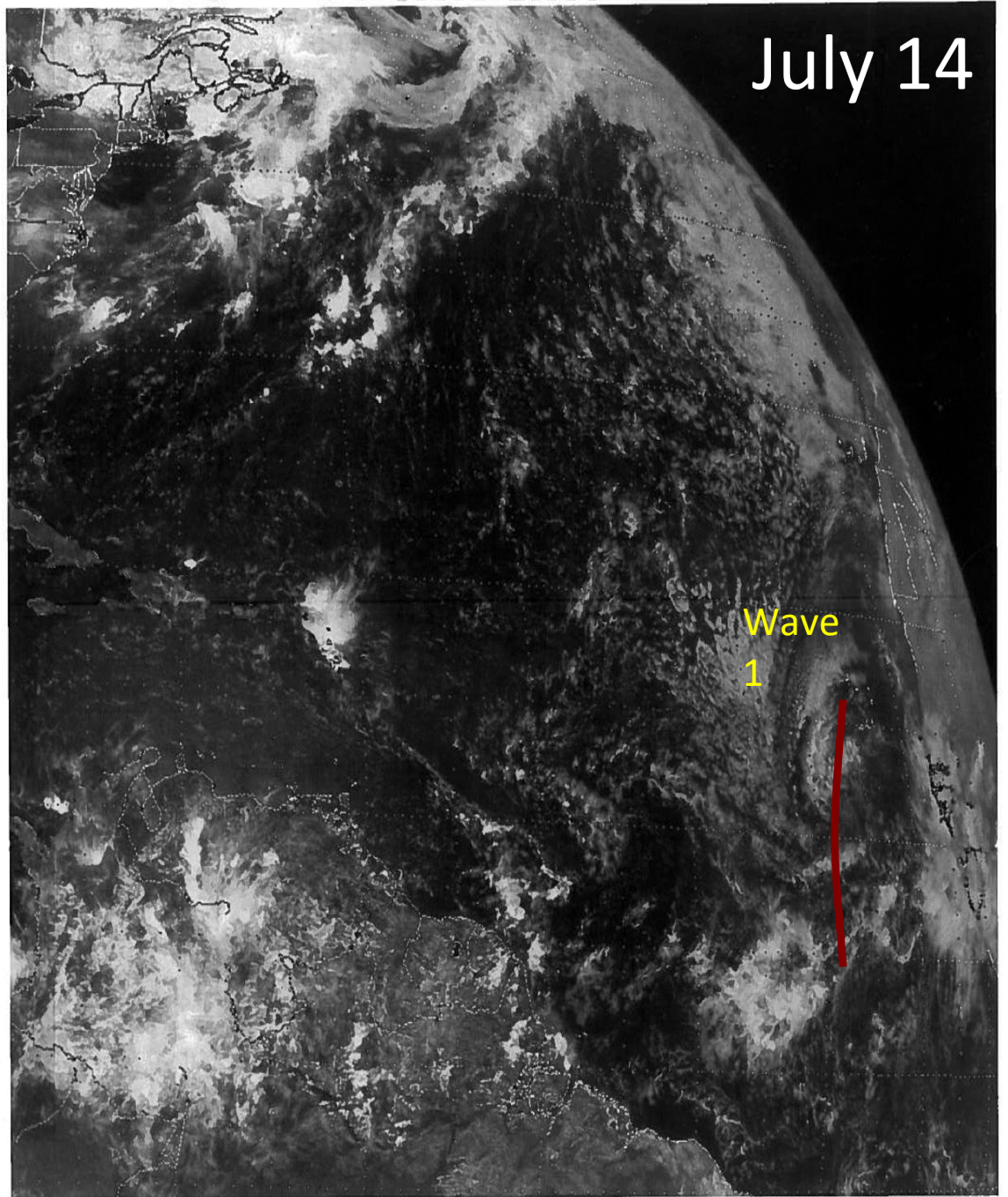
July 13

Wave  
1

July 14: Drop a pin to identify where the tropical wave axis is now?





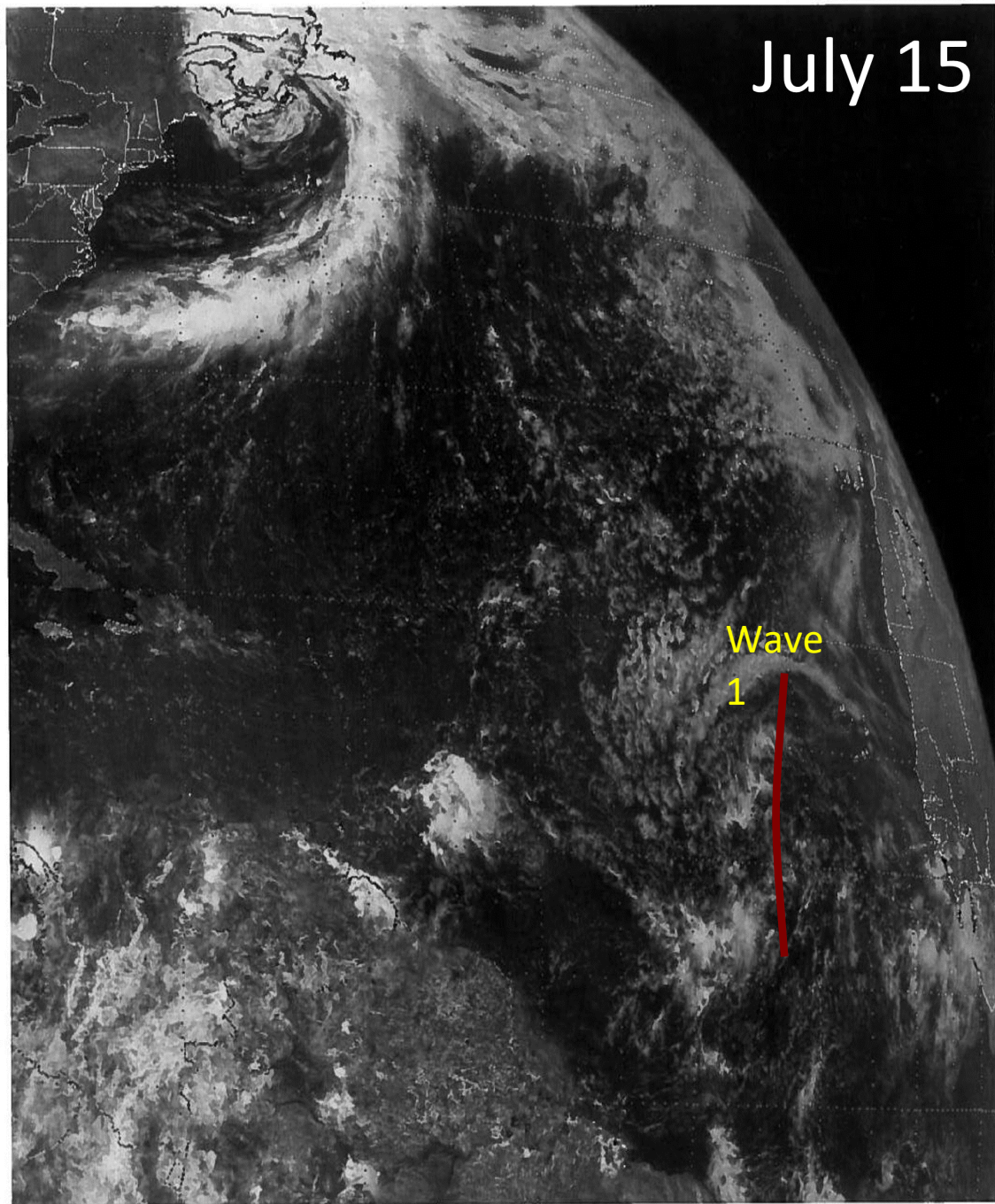


July 14

Wave  
1

July 15: Drop a pin to identify where the tropical wave axis is now?



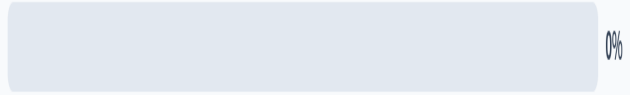


July 15

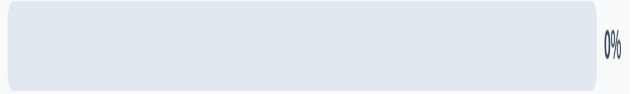
Wave  
1

You are a meteorologist in Dominica. What are you communicating to your island's Emergency Management department?

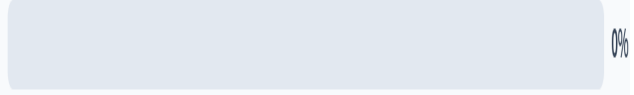
A. We are tracking a tropical wave across the Atlantic in visible satellite imagery. Please watch the satell...



B. A tropical wave could impact the island in a few days with strong winds and rain.



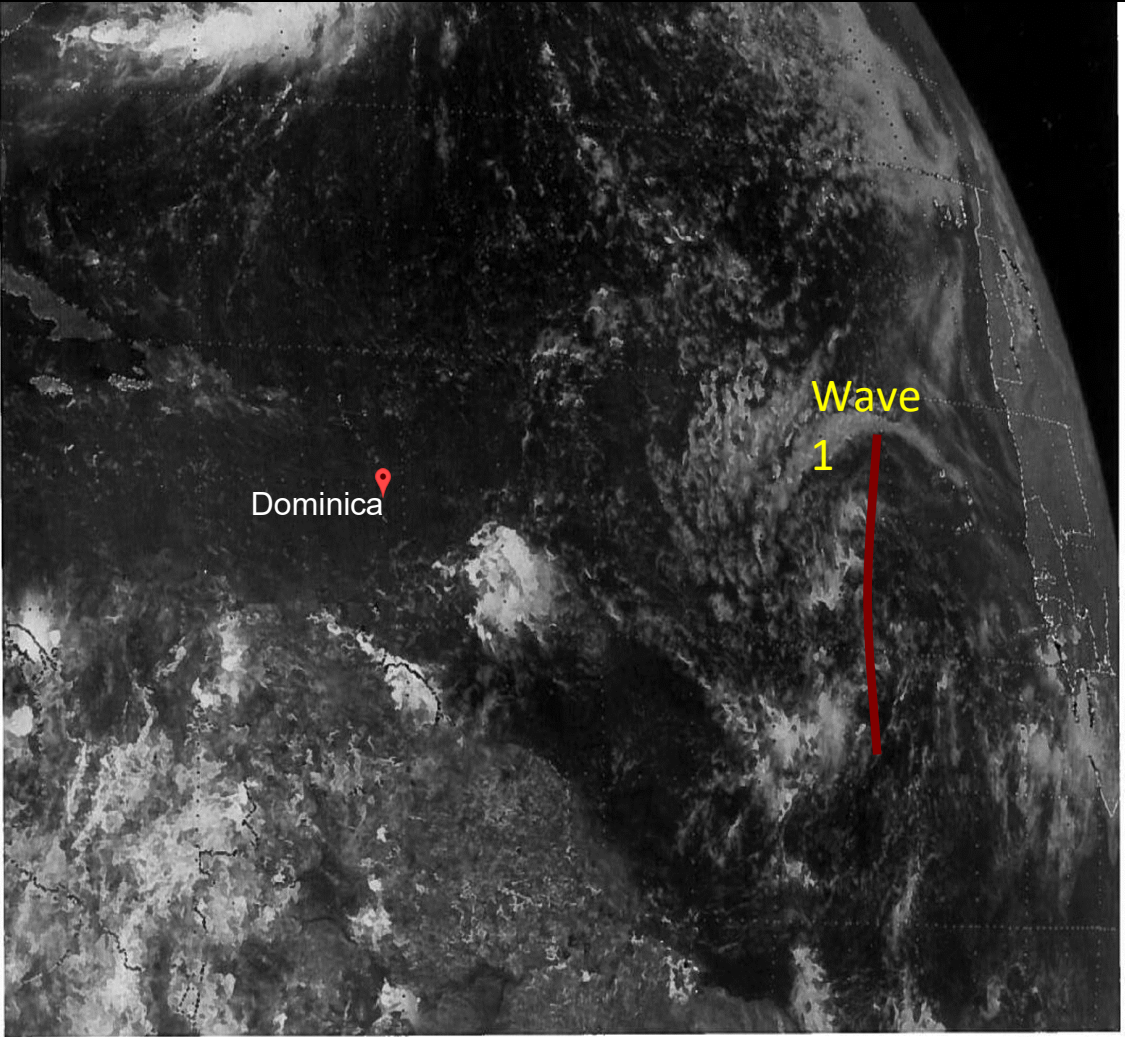
C. There is no need to communicate with them at this time. Tropical waves are regular occurrences. They...

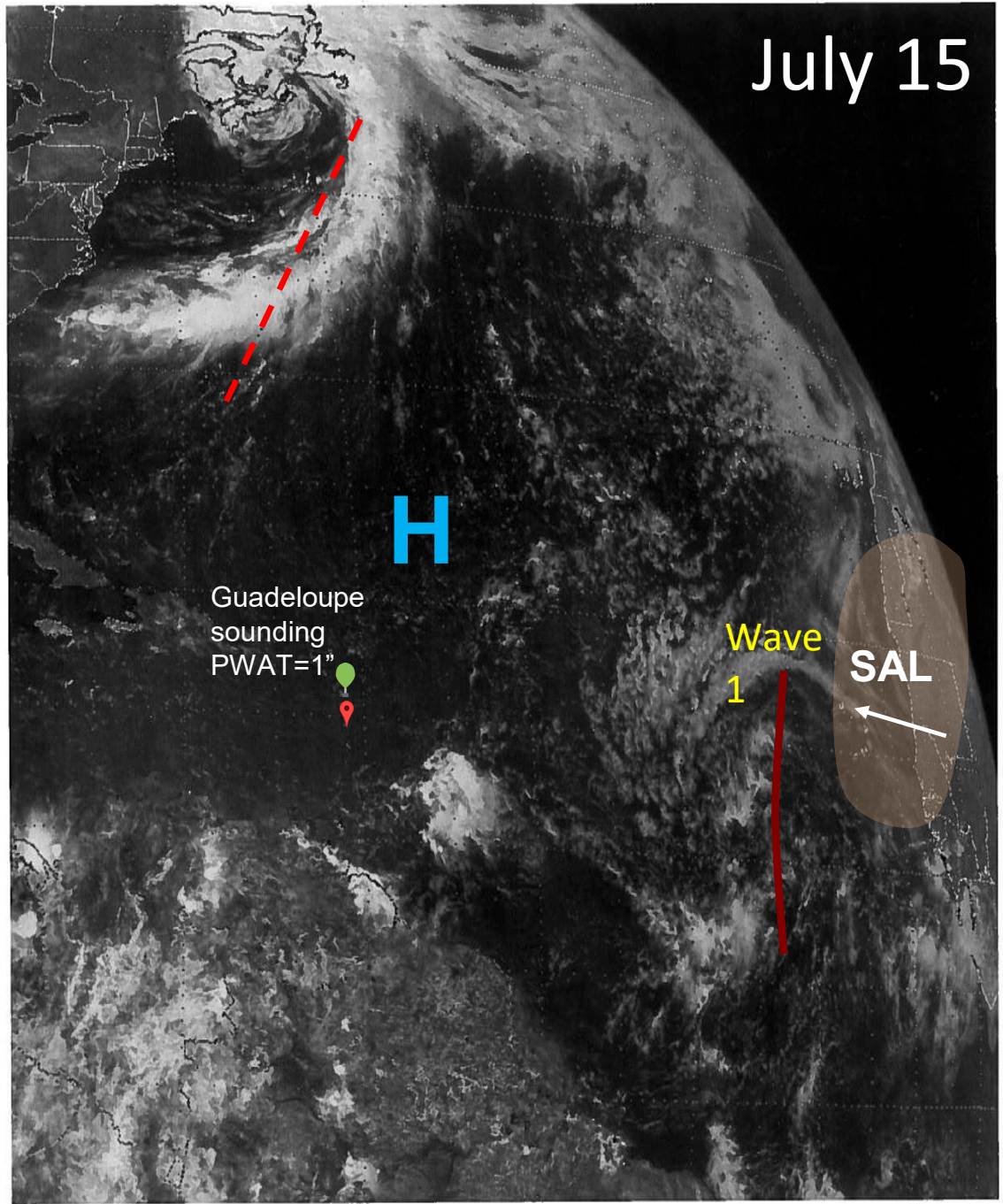


A. We are tracking a tropical wave across the Atlantic in visible satellite imagery. Please watch the satellite carefully.

B. A tropical wave could impact the island in a few days with strong winds and rain.

C. There is no need to communicate with them at this time. Tropical waves are regular occurrences. They are aware of potential impacts.





July 15

H

Guadeloupe sounding  
PWAT=1"

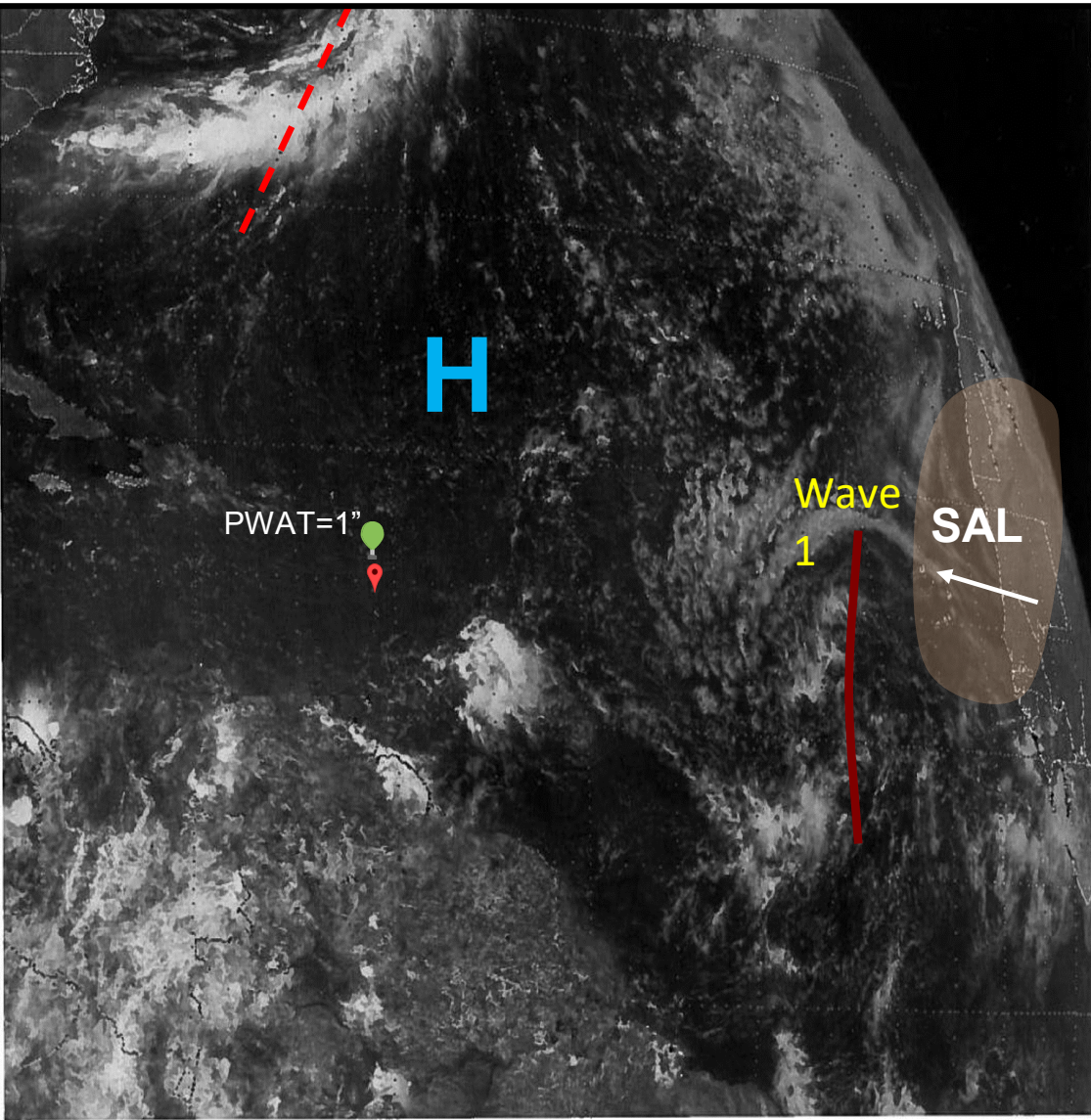
Wave  
1

SAL

A. The SAL may limit convection in the wave.

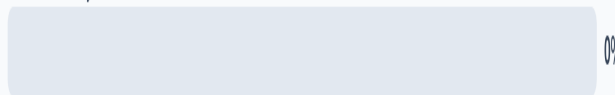
B. The SAL may cause the wave to move faster.

C. The SAL will have no influence on the wave.

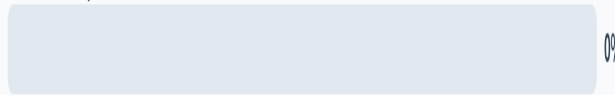


How might the Saharan Air Layer influence the wave?

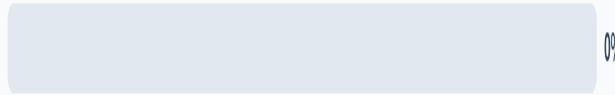
A. The SAL may limit convection in the wave.



B. The SAL may cause the wave to move faster.



C. The SAL will have no influence on the wave.



July 16: Drop a pin to identify where the tropical wave axis is now?

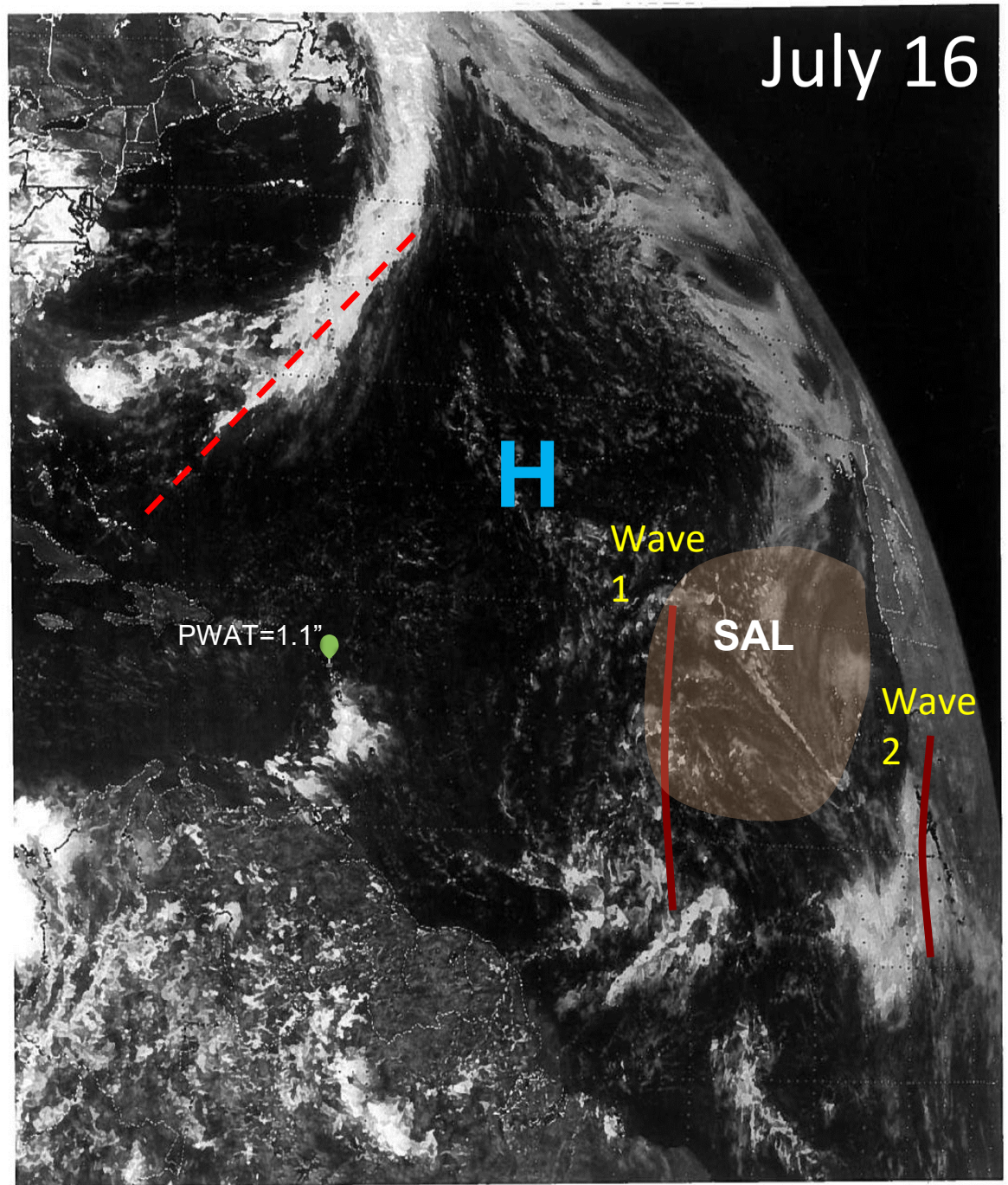


# Tropical Wave Interactions: Saharan Air Layer (SAL)

SAL is an indication of very dry/stable air in the low-mid levels of the atmosphere.

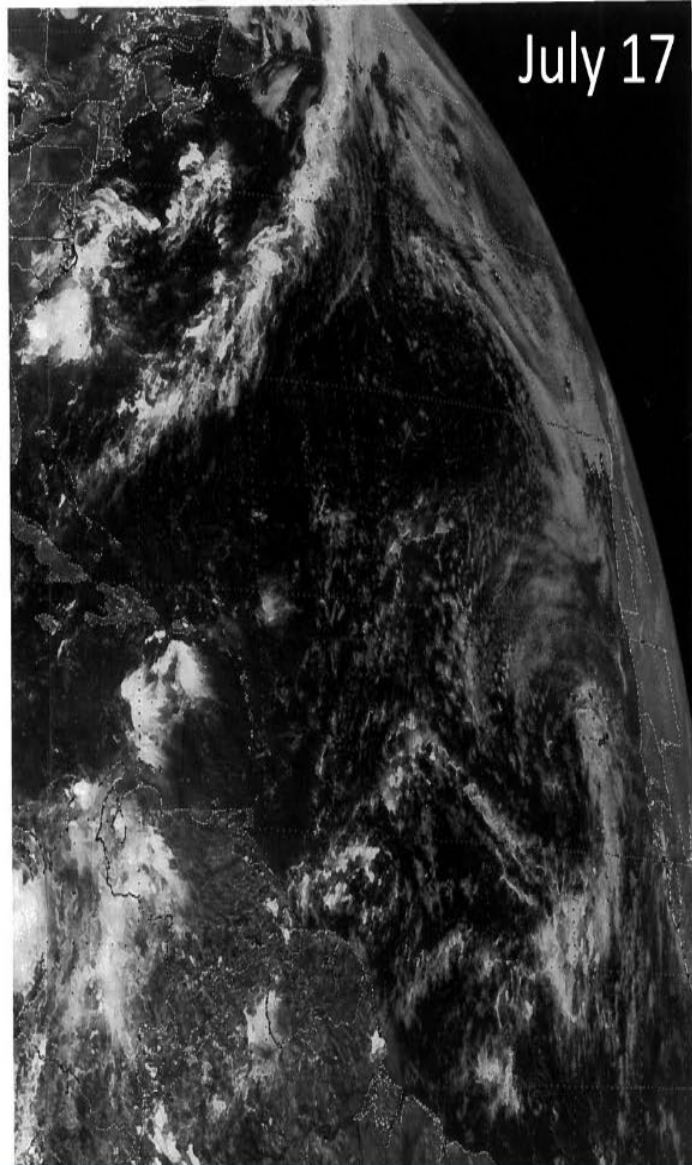
This limits convection.

Note minimal convection in the region with the SAL.



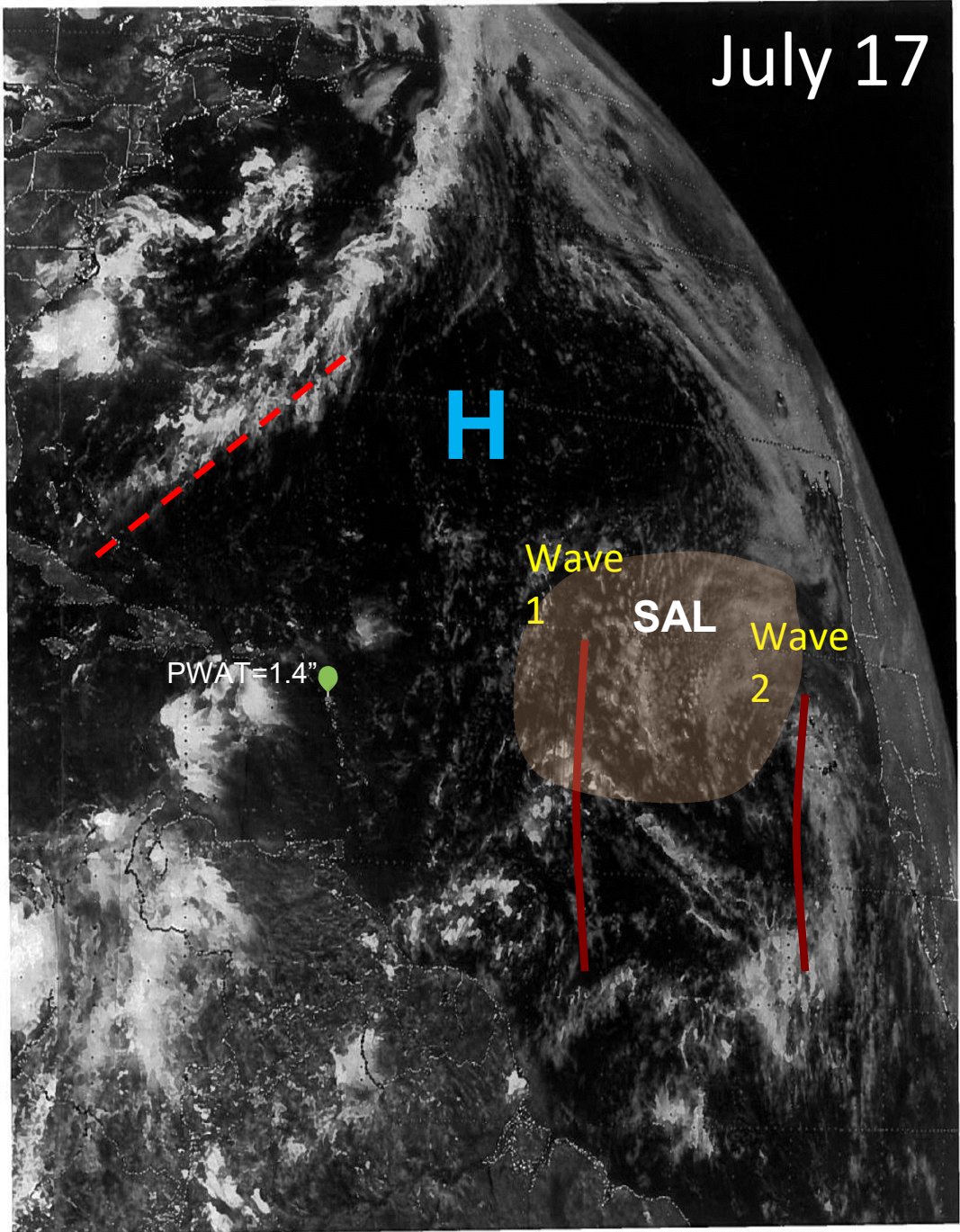


July 17: Drop a pin to identify where the tropical wave axis is now?





July 17

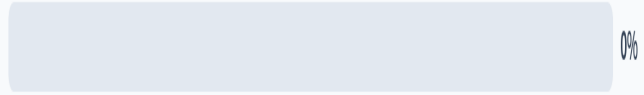


You are a meteorologist in Dominica. What are you communicating to your island's Emergency Management department?

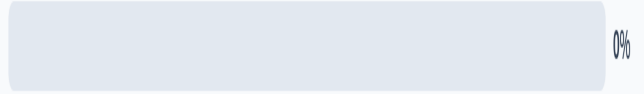


- A. There is no need to communicate with them. Tropical waves are regular occurrences so they are aware of potential impacts.
- B. A dry tropical wave is approaching the island. Impacts could include strong winds and dusty skies.
- C. A tropical wave is approaching the island. It could bring heavy rain and strong winds.

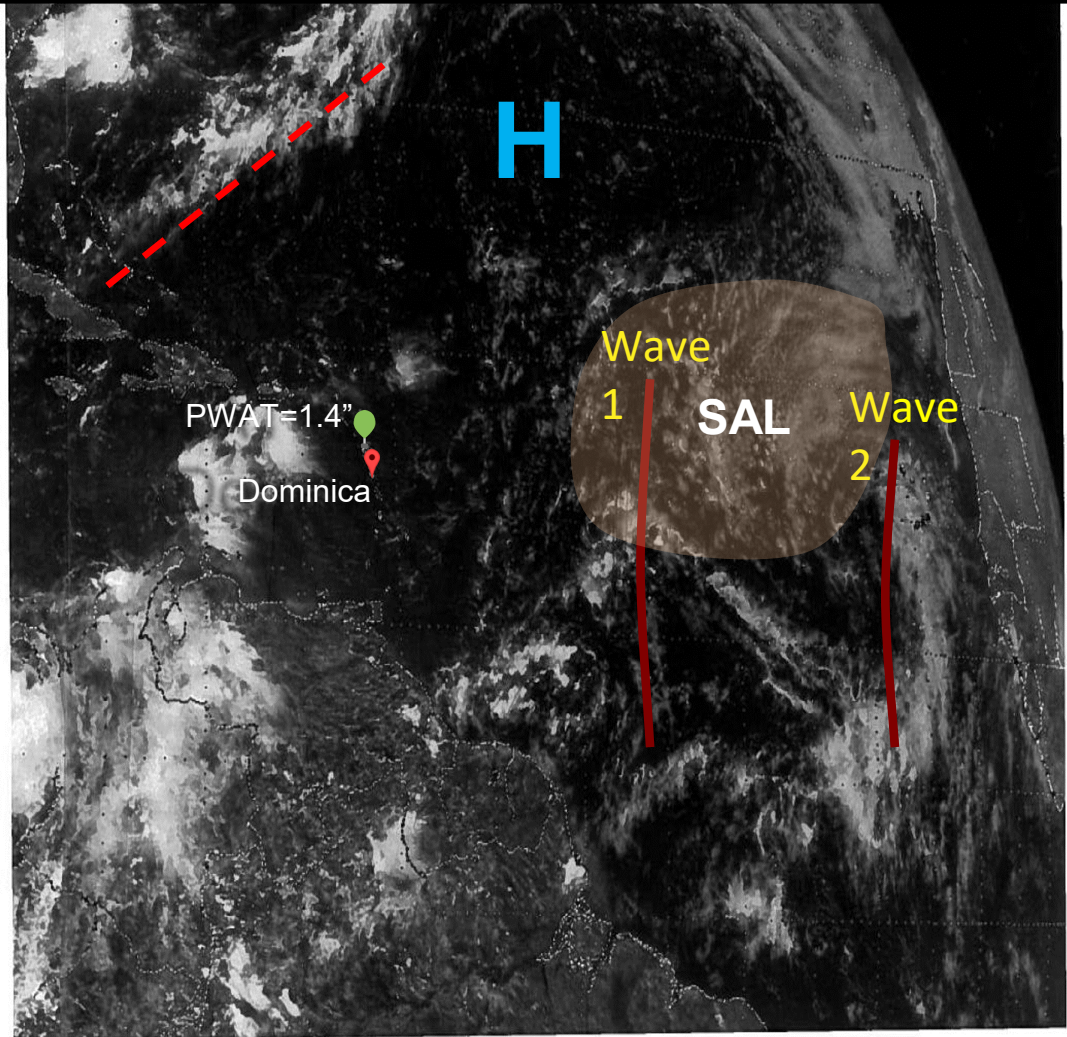
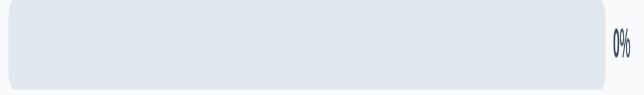
A. There is no need to communicate with them. Tropical waves are regular occurrences so they are aware...



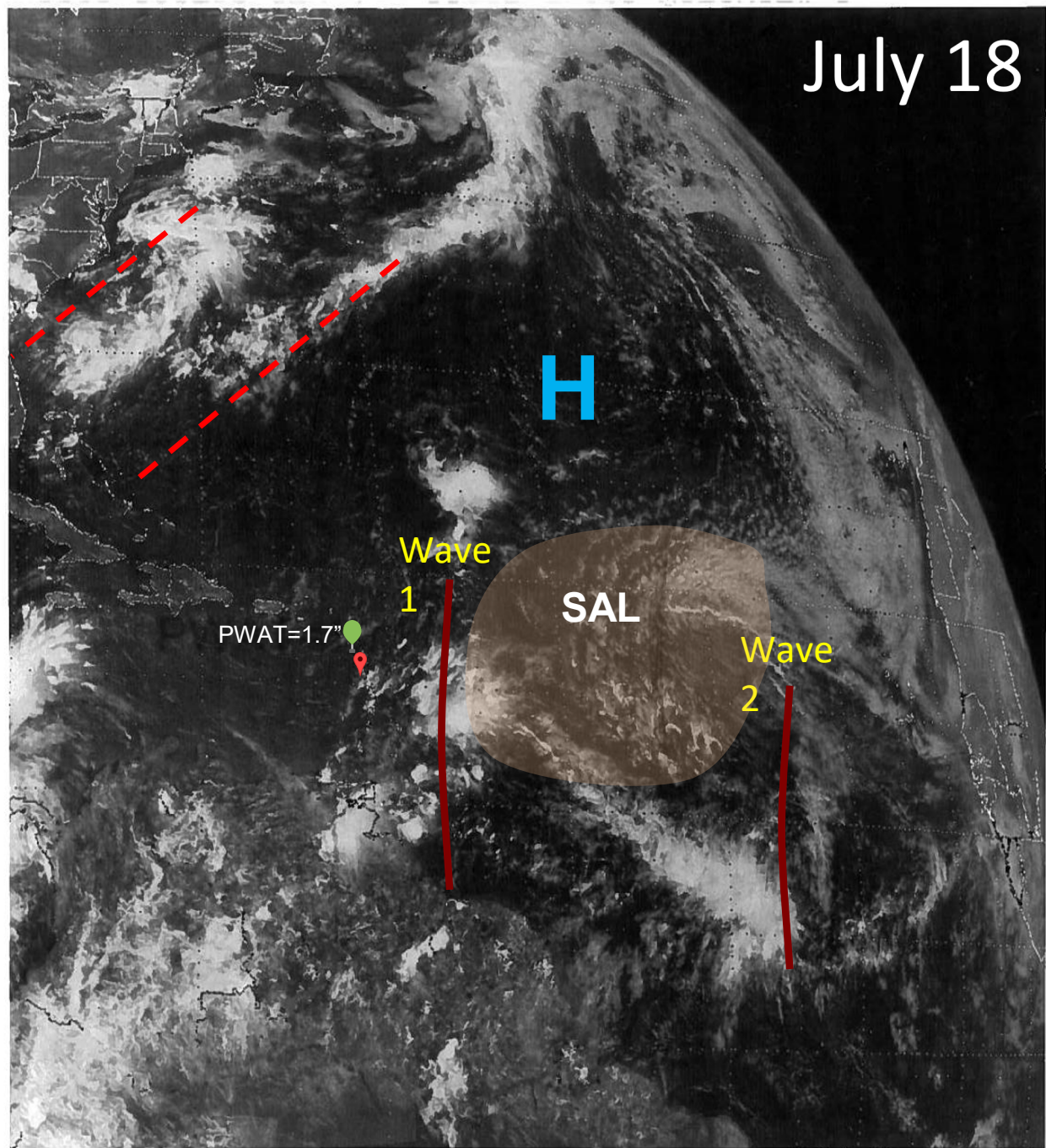
B. A dry tropical wave is approaching the island. Impacts could include strong winds and dusty skies.



C. A tropical wave is approaching the island. It could bring heavy rain and strong winds.



July 18



July 19

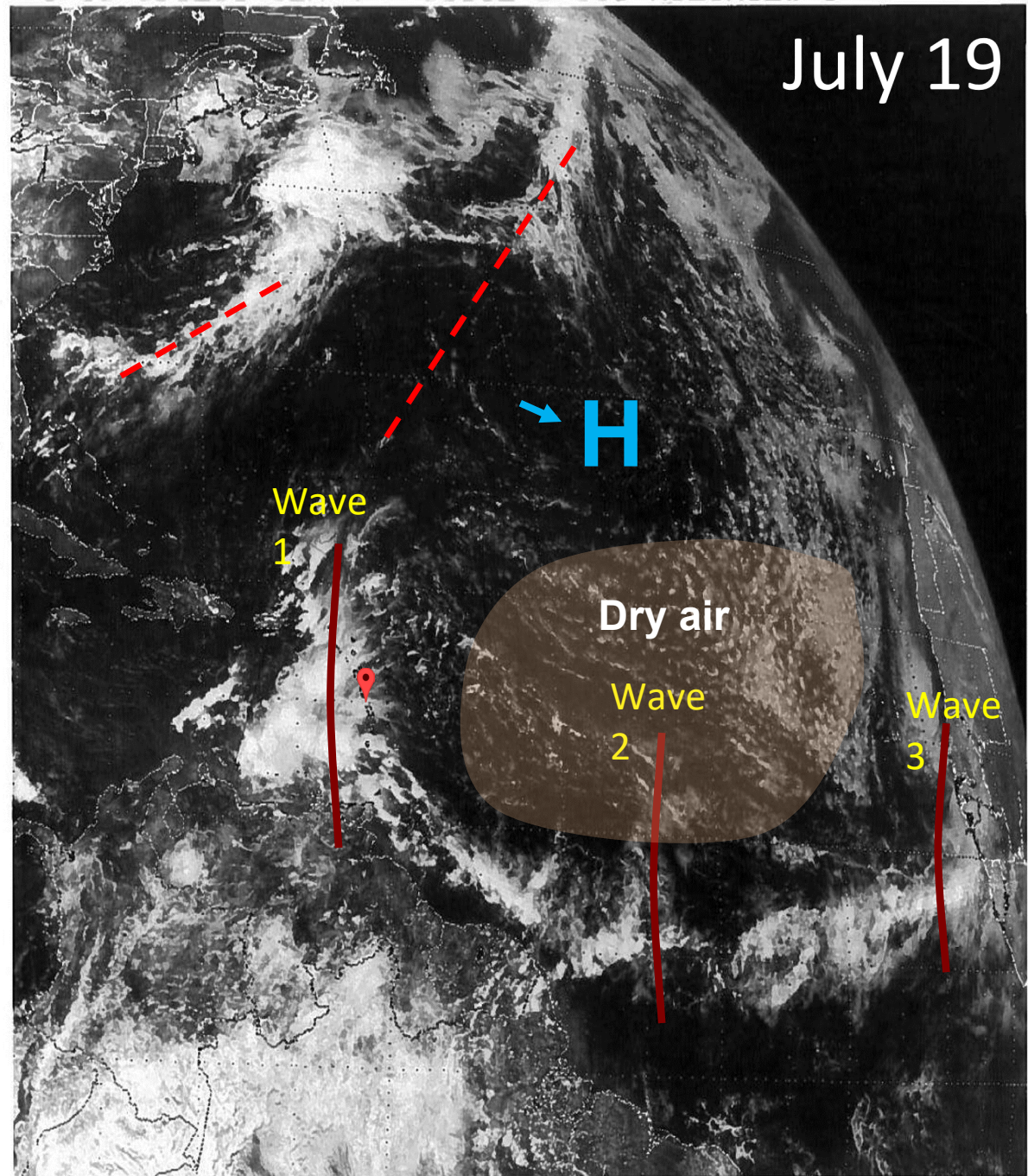
## Poll Question Answer

You are a meteorologist in Dominica. What are you communicating to your island's Emergency Management department?

A. There is no need to communicate with them. Tropical waves are regular occurrences, so they are aware of potential impacts.

B. A dry tropical wave is approaching the island. Impacts could include strong winds and dusty skies.

**C. A tropical wave is approaching the island. It could bring heavy rain and strong winds.**

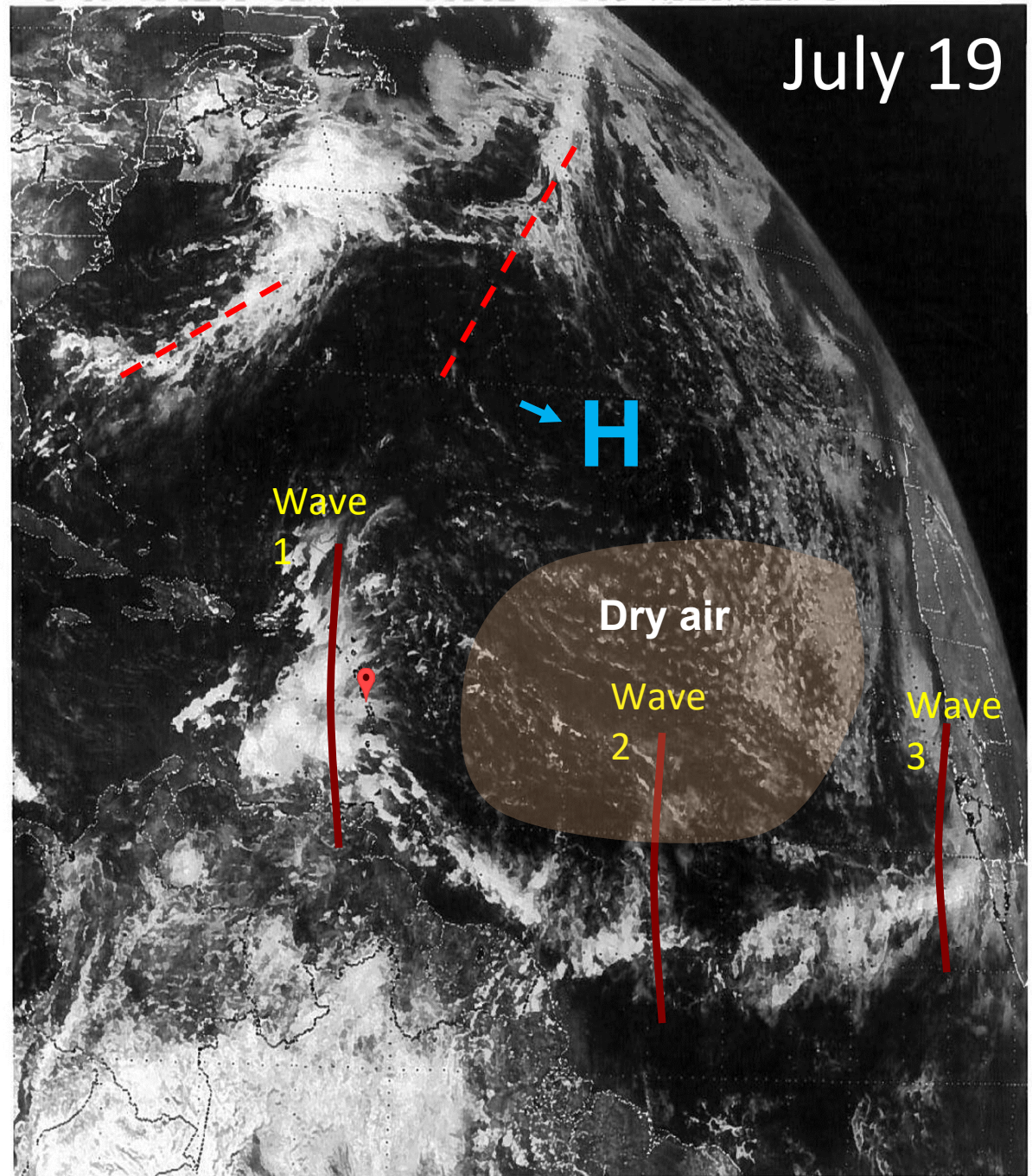


# Tropical Wave Interactions: Moisture/Trough

The wave produced significant rainfall and strong winds over the Lesser Antilles including Dominica.

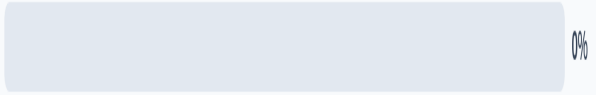
PWAT in the Guadeloupe sounding increased from 1" to 1.7" over the past 4 days. The wave interacted with increased moisture associated with the remnants of the trough to the north and the shift of the anticyclone east. Convection associated with the tropical wave increased significantly after the wave exited the SAL and entered this more moist airmass.

Waves can transition from dormant to active in a short period of time.

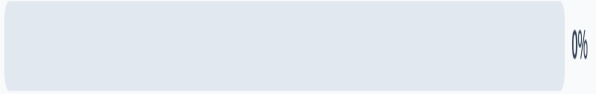


You are a meteorologist in the Bahamas. What are you communicating to your island's Emergency Management department?

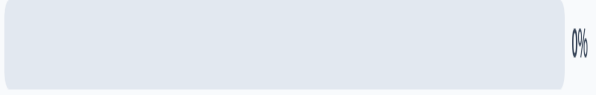
A. Most of the convection associated with the wave should pass south of the Bahamas. There is no need t...



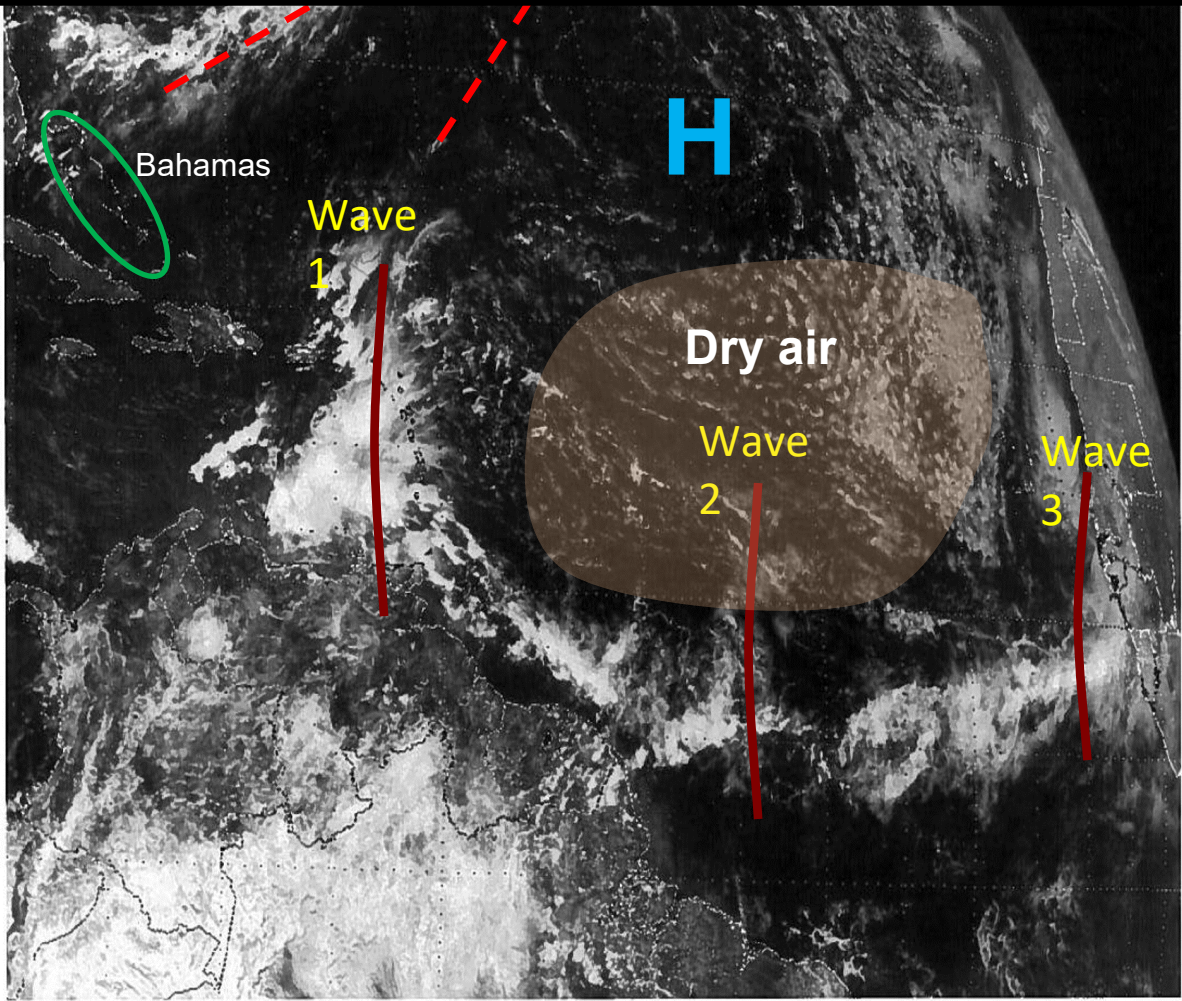
B. Heavy rains and strong winds are expected with the passage of the tropical wave that brought floo...



C. There is a strong tropical wave approaching as is clear from satellite. The trough is currently moving o...



- A. Most of the convection associated with the wave should pass south of the Bahamas. There is no need to communicate with them.
- B. The tropical wave that brought flooding and landslides to the Lesser Antilles could reach the Bahamas in a few days, bringing the possibility for heavy rain and flooding.
- C. There is a strong tropical wave approaching as is clear from satellite. The trough is currently moving over the Lesser Antilles.

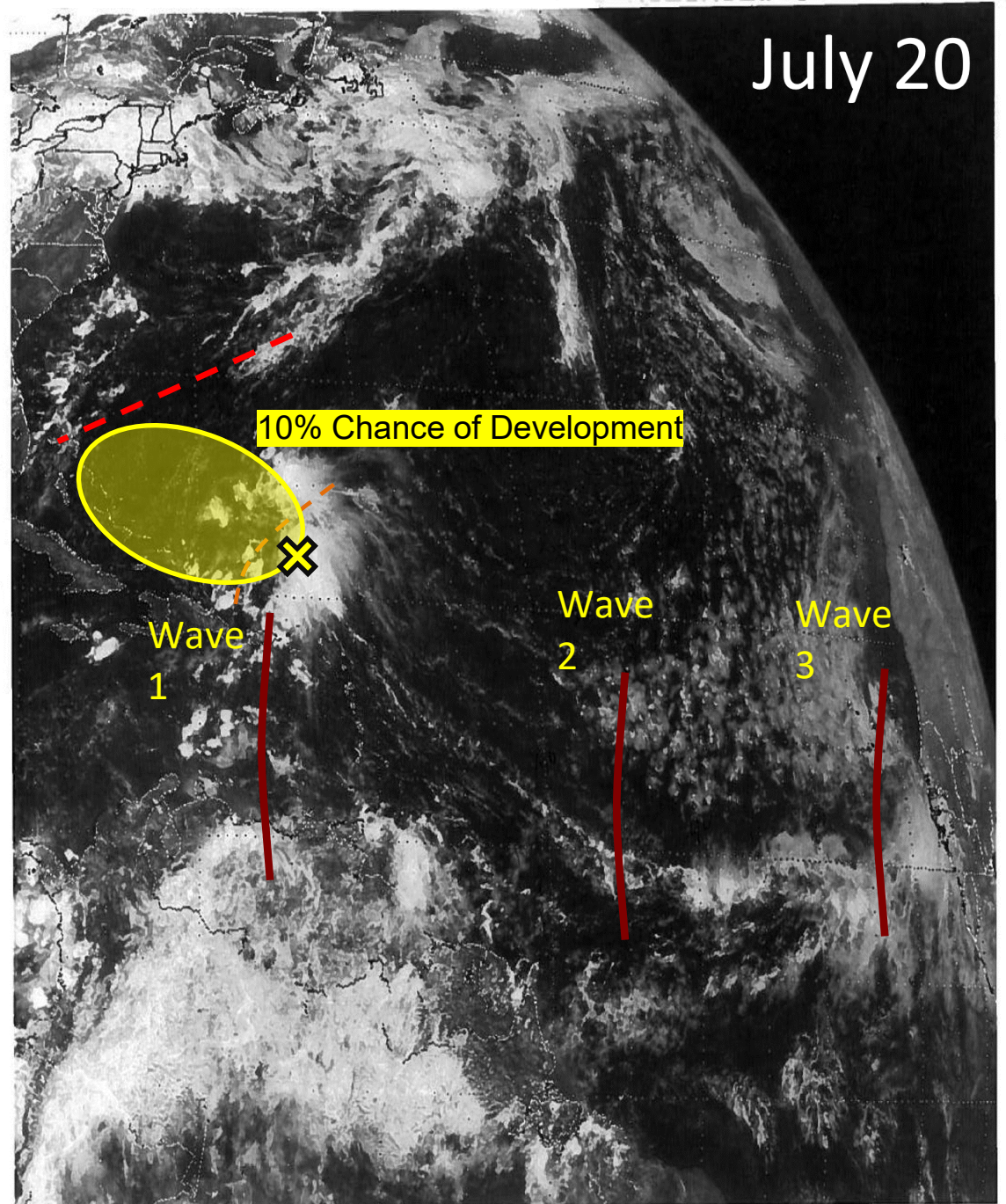


# July 20: Drop a pin to identify where the tropical wave axis is now?





July 20



You are a meteorologist in the Bahamas. What are you communicating to your island's Emergency Management department?



A. A surface trough is approaching with a chance TC development. Regardless of its status, heavy rains an...

0%

B. There is a chance the surface trough could develop into a tropical cyclone. If it does, this could bring h...

0%

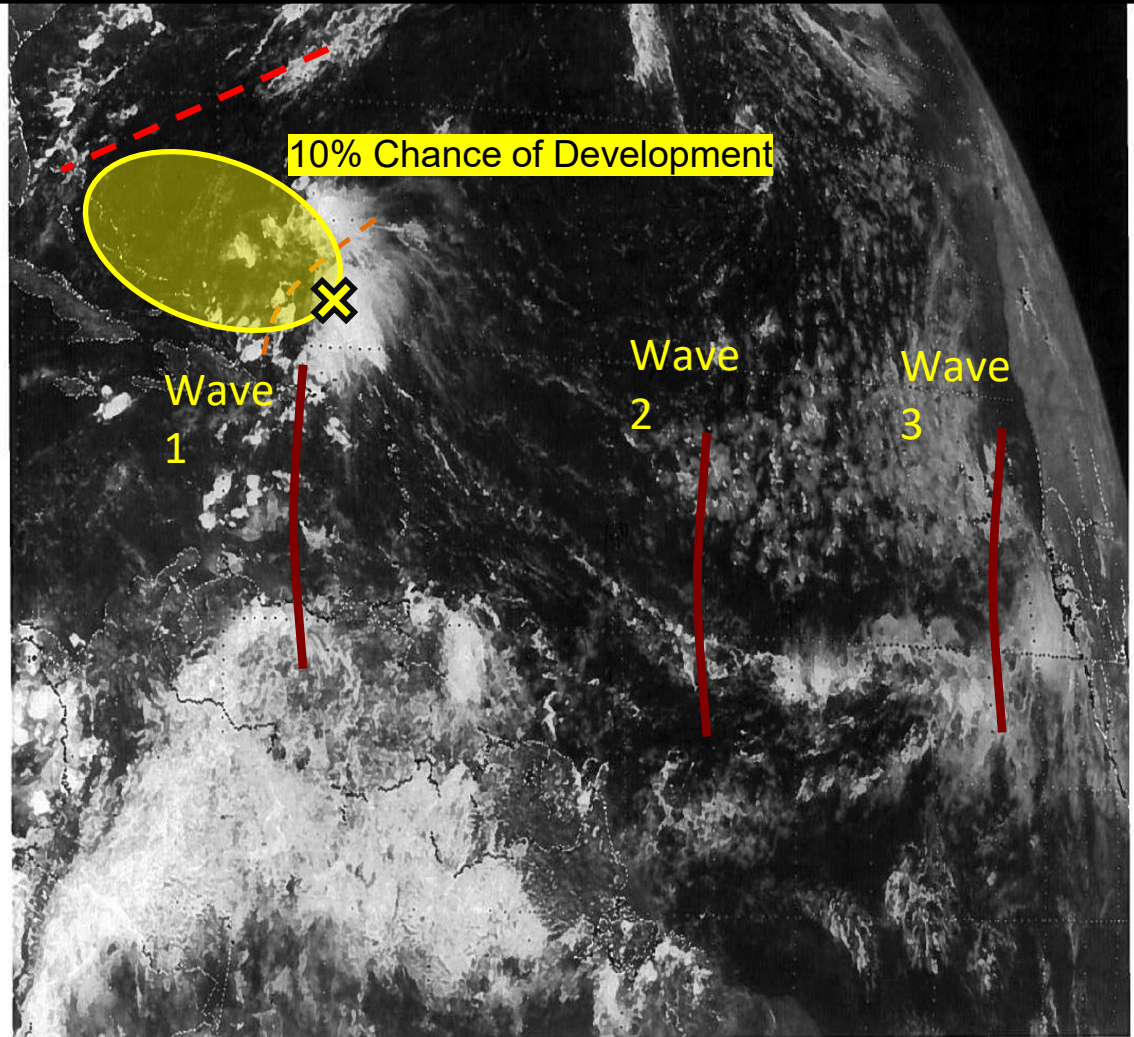
C. A surface trough will move through the Bahamas. There is a 10% chance it becomes a tropical depres...

0%

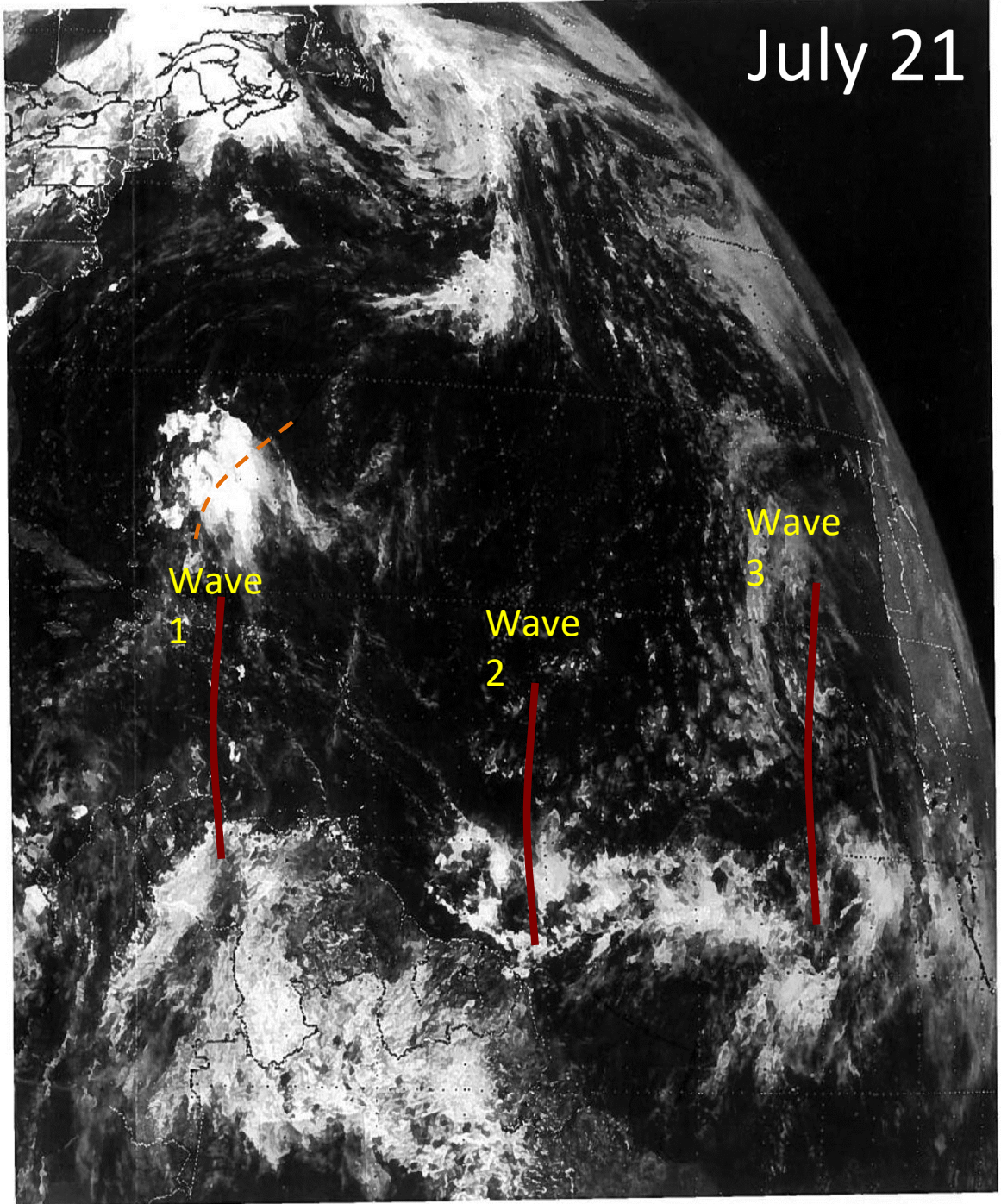
A. A surface trough is approaching with a chance TC development. Regardless of its status, heavy rains and strong winds are expected.

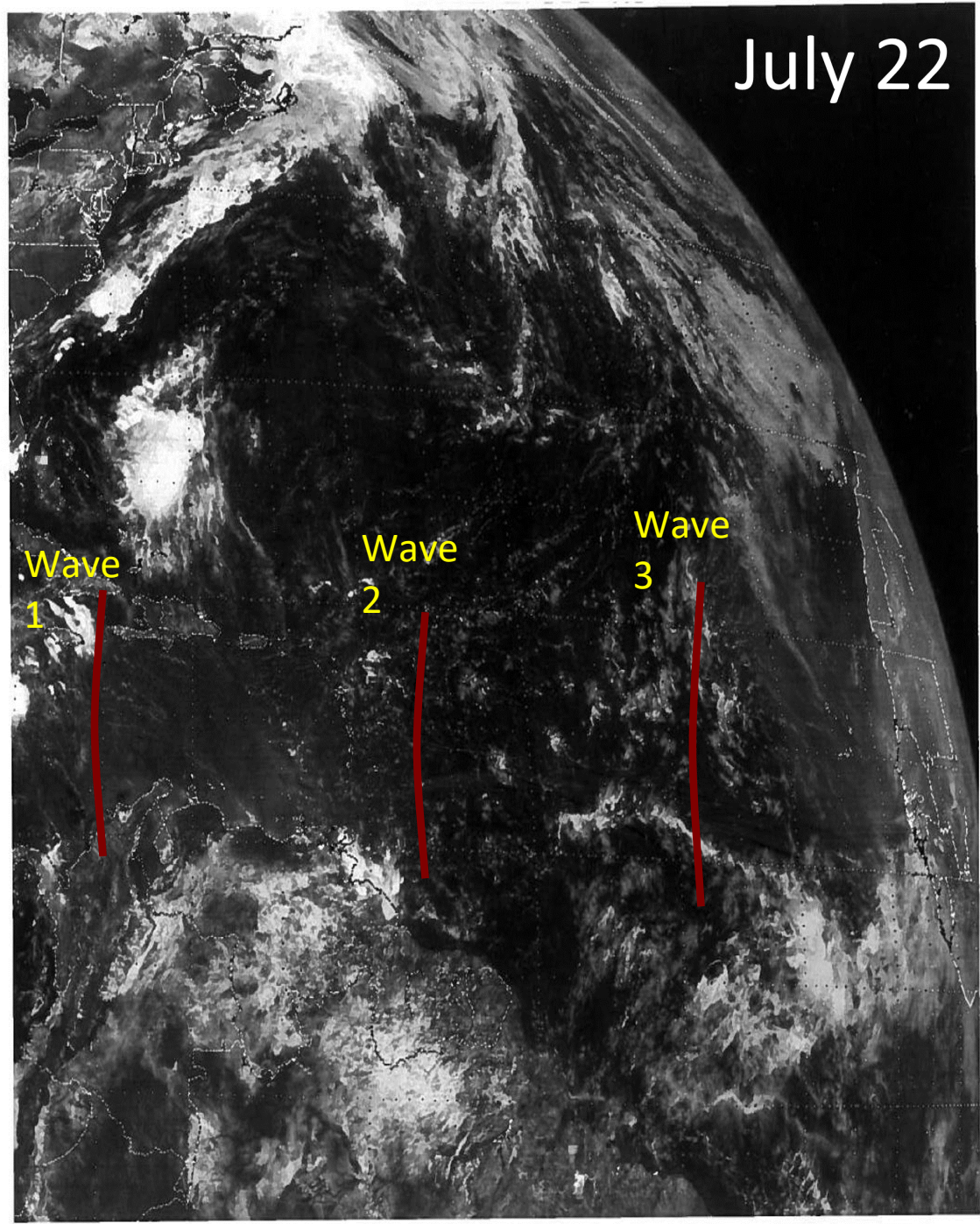
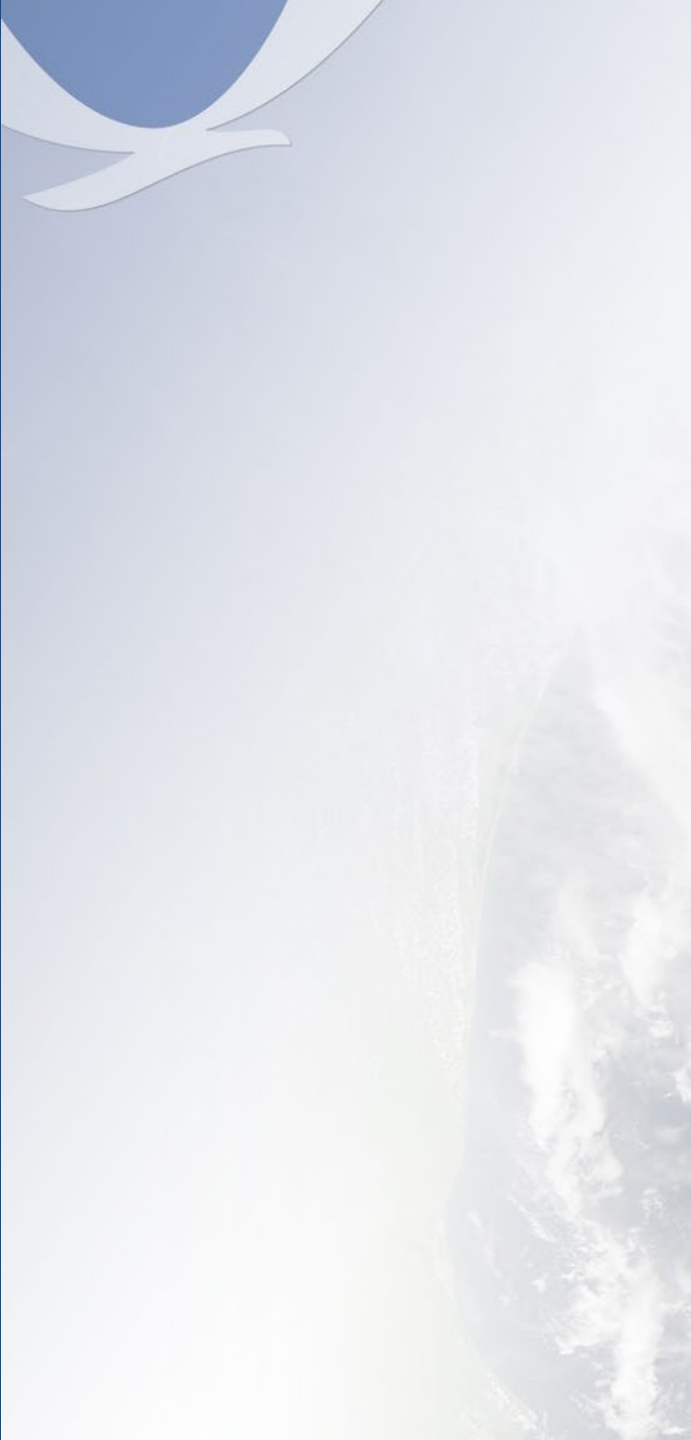
B. There is a chance the surface trough could develop into a tropical cyclone. If it does, this could bring heavy rain and strong winds.

C. A surface trough will move through the Bahamas. There is a 10% chance it becomes a tropical depression.



July 21





July 22

Wave  
1

Wave  
2

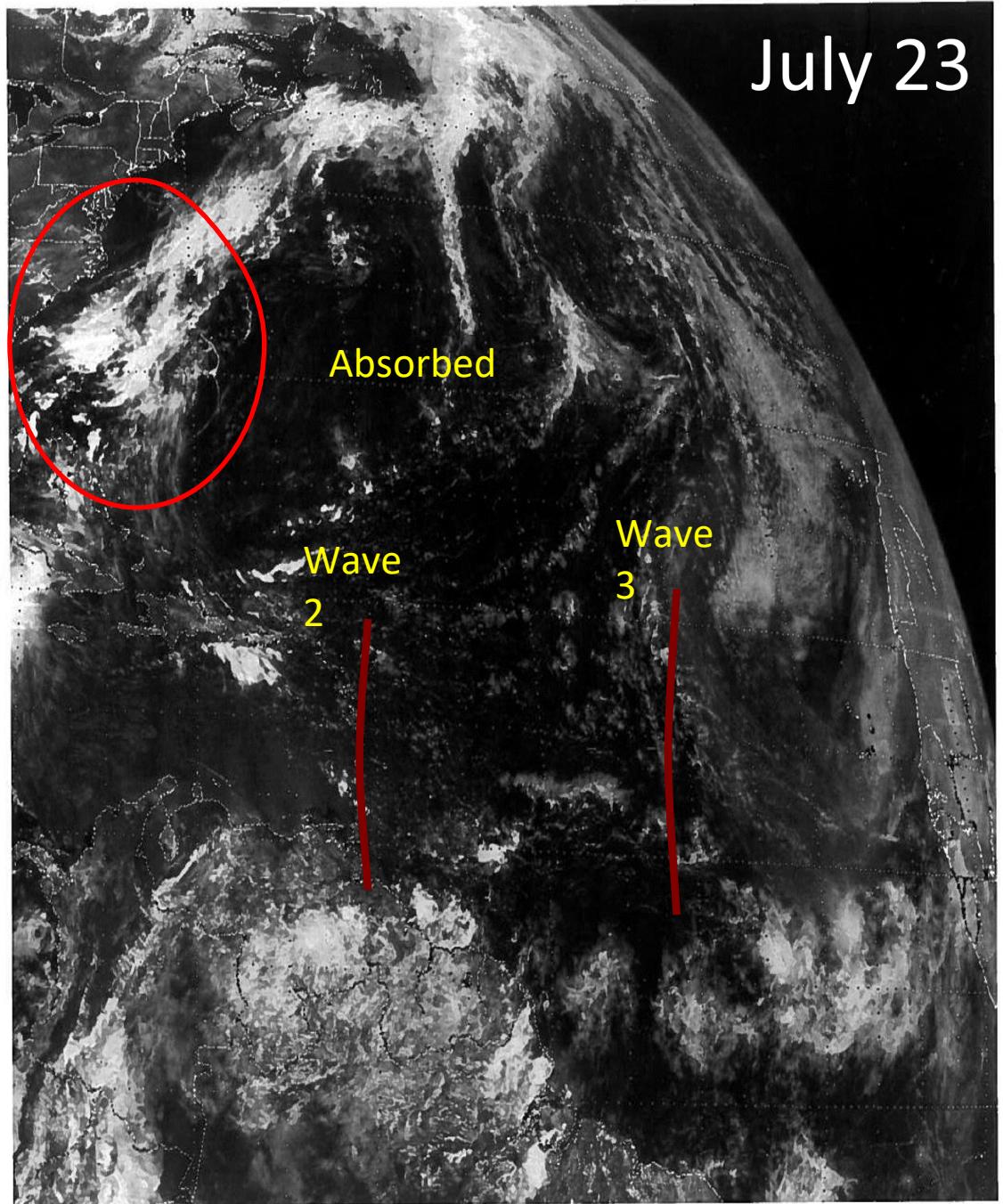
Wave  
3

# Tropical Wave Interactions: TC Formation/Trough

A TC did not form. But heavy rainfall did fall across the islands.

Interactions with upper-level lows are unfavorable for tropical cyclogenesis.

However, the tropical wave/trough interaction often leads to enhanced rainfall.



# Summary

- The environment around the tropical wave is the most important factor in determining whether it will develop as well as impacts
- Local influences (terrain, time of day) can have a significant affect on convection
- Although computer models are generally better than they were a couple decades ago, it is still important to assess the background environment that the tropical wave will be moving in to.

