

A satellite image of the Pacific Ocean showing several large, swirling hurricane-like storm systems. The storms are characterized by dense, white cloud spirals with distinct eyes. The background is a dark blue, textured view of the ocean from space.

# **ATMO 102 Pacific Climates and Cultures**

**Lecture: Pacific Hurricanes**



Advertiser photo by Richard Ambo

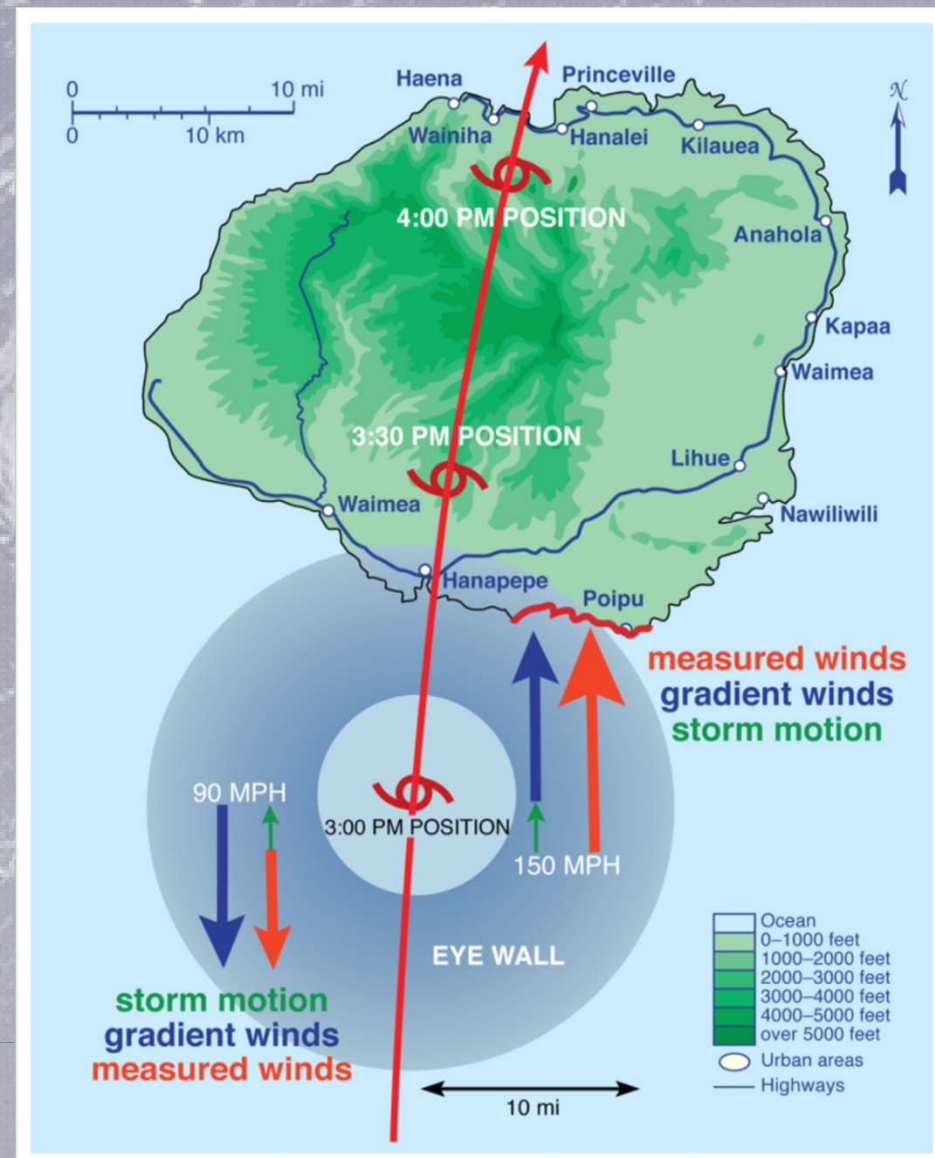
A house on Kauai stands open to the elements after its roof was torn away by a gust from Hurricane Iniki. No area of the island escaped devastation by the storm, officials said.



# Hurricane Hazards in Hawaii

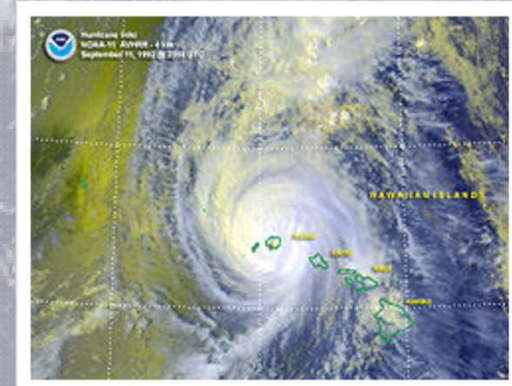
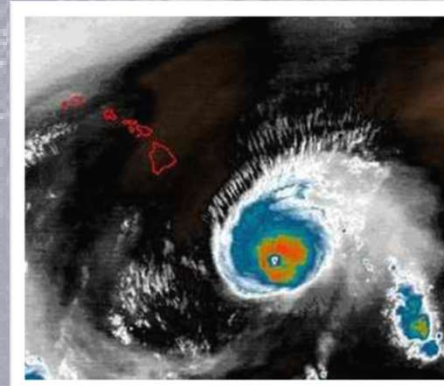
The winds, storm surge, and storm waves are all greatest just to the right of the storm track. Why?

- The storm surge and storm waves are greatest just to the right of the storm track.
- Wind hazard is greatest on exposed ridges and mountain slopes.
- Flash flood hazard is greatest near stream beds.



# Hawaiian Hurricanes

- So far no hurricane has made landfall on Oahu.
- Recently only Kauai has been hit
  - The Big Island and Maui were struck by a hurricane in 1871
  - Dot 1959, Iwa 1982, and Iniki 1992 all impacted Kauai
- There is no Hawaiian word for hurricane
  - No “Hawaiian Term” actually is not a surprise, since words such as Hurricane and Typhoon arise from local words for the winds observed.
  - David Malo (1843) defined five different Kona Winds but none for hurricanes.





# Eastern Pacific Hurricane Climatology

Simulation showing the number of times a hurricane passes within 75 nautical miles per 10 years in the Eastern and Central Pacific.

30

20

10



Red is more likely and blue is less likely.

Hawaii is on the edges of the blue area, meaning hurricanes are not likely to hit.

-170

-160

-150

-140

-130

-120

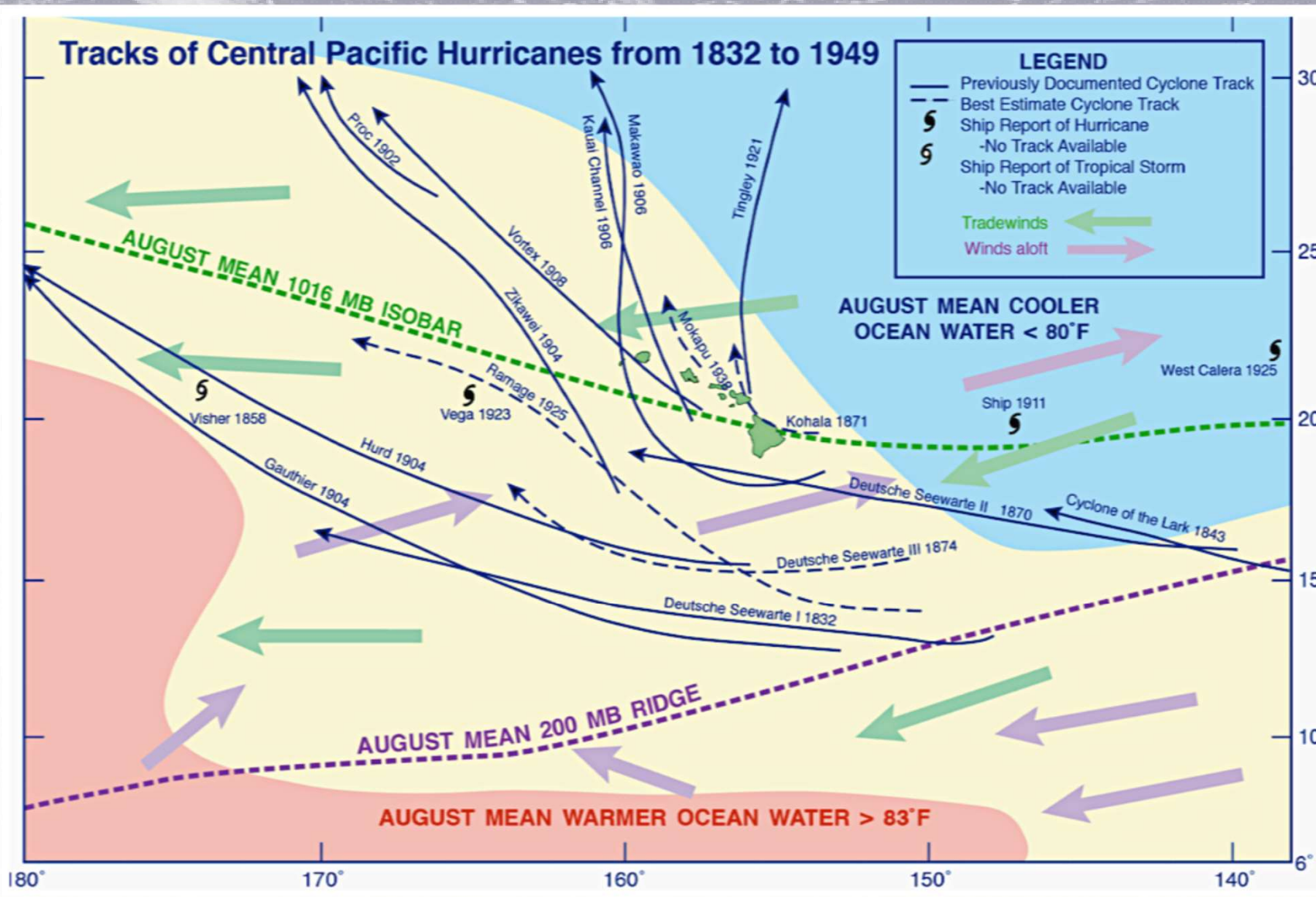
-110

-100

# Hawaii Hurricane Climatology

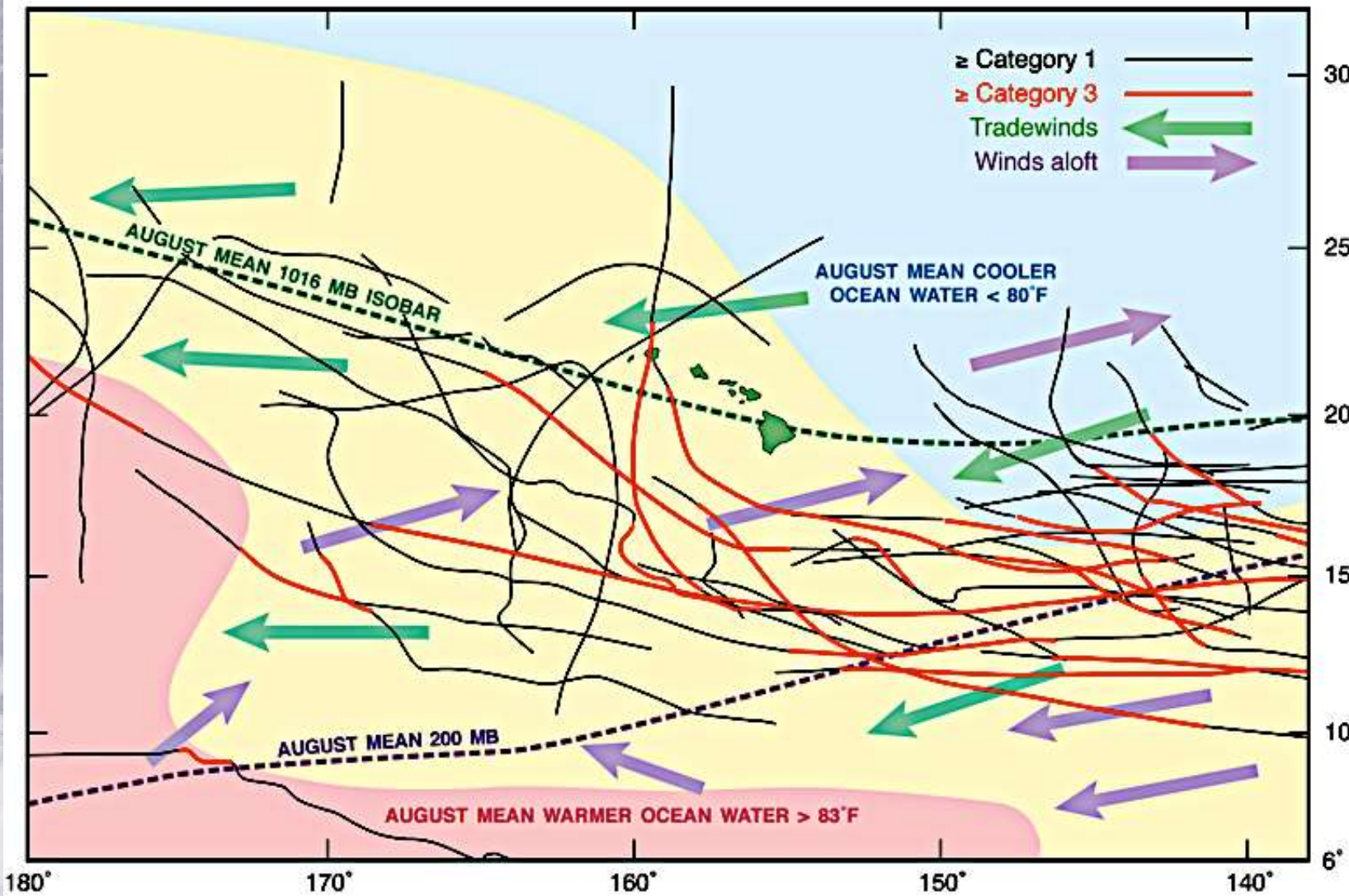
Hurricane tracks in the central Pacific from 1832 to 1949

- Notice the Wind Shear!
- Tradewinds and Winds Aloft go in **OPPOSITE** directions





## Tracks of Central Pacific Hurricanes from 1949 to 1998



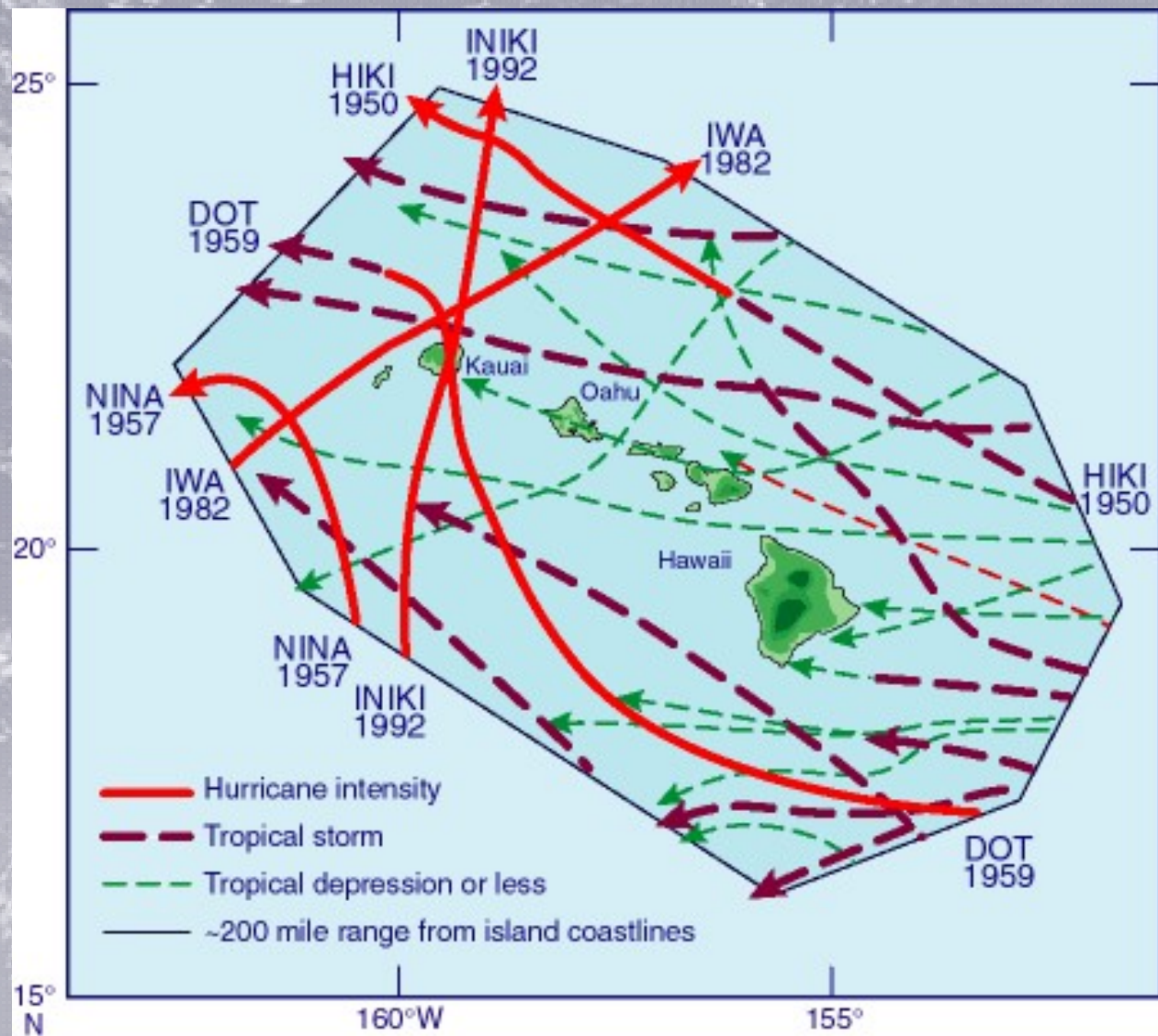
## Hawaii Hurricane Climatology

Hurricane tracks in the central Pacific from **1949-1998**

- Notice the Wind Shear!
- Tradewinds and Winds Aloft go in **OPPOSITE** directions

# Hawaii Hurricane Climatology

- **Tropical Cyclone** tracks within 200 miles of the Hawaiian Islands since 1949.
- **Kauai** is the only island to be hit directly with storms that reached Hurricane intensity.





# Impacts on Hawaii



**BEFORE INIKI**



**AFTER INIKI**



A DECADE AFTER THE DISASTER

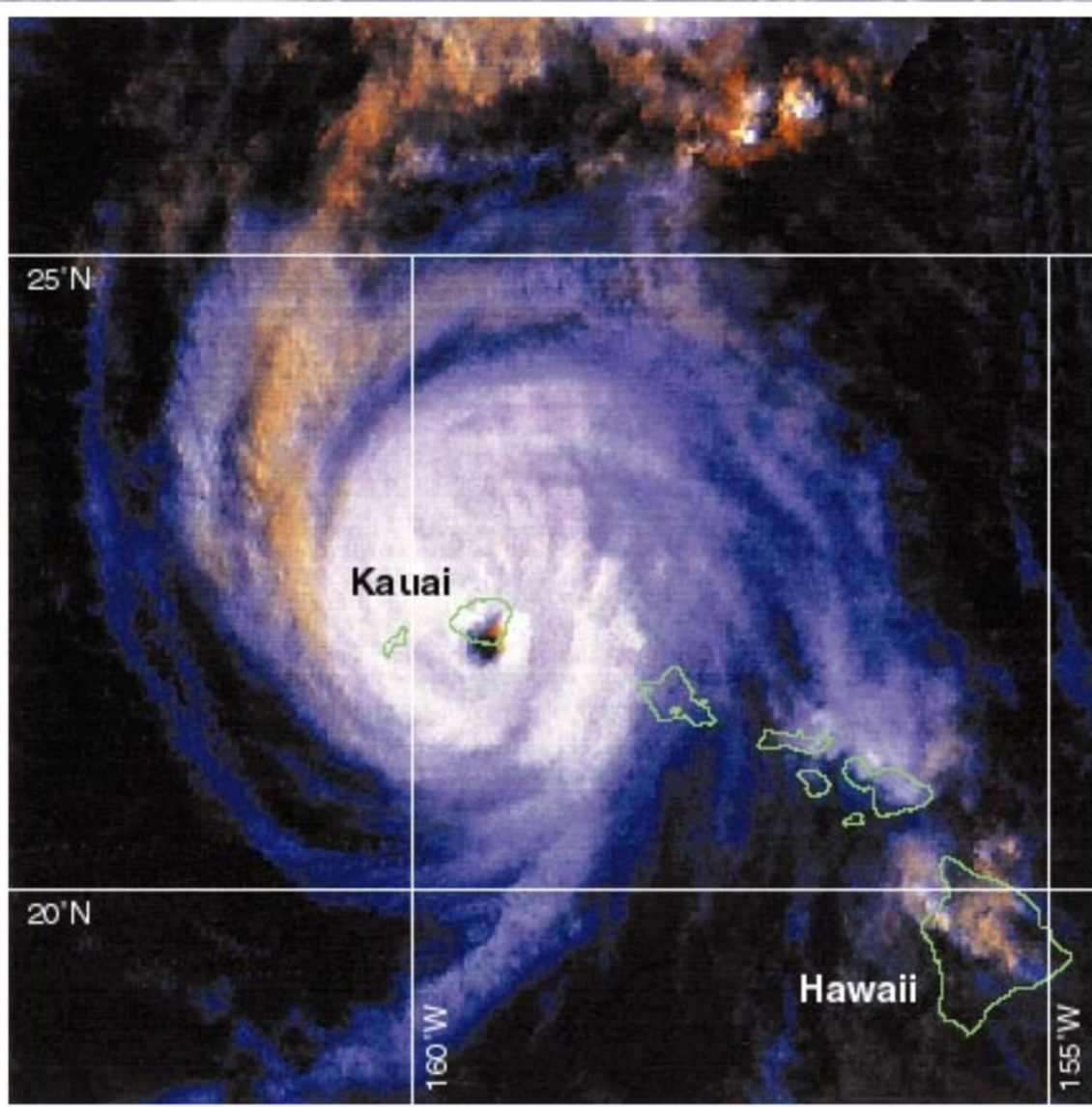
**INIKI**

<http://helzhalfacre.com/iniki/>



# Iniki Impacts

- **90% of structures** on Kauai affected
- **14,118 damaged or destroyed**
- **30%** telephone poles down
- 3 years later unemployment **12%**
- **Social fabric altered**
  - 10% moved away to other islands or to the mainland





# Super Typhoon Yolanda a.k.a Haiyan

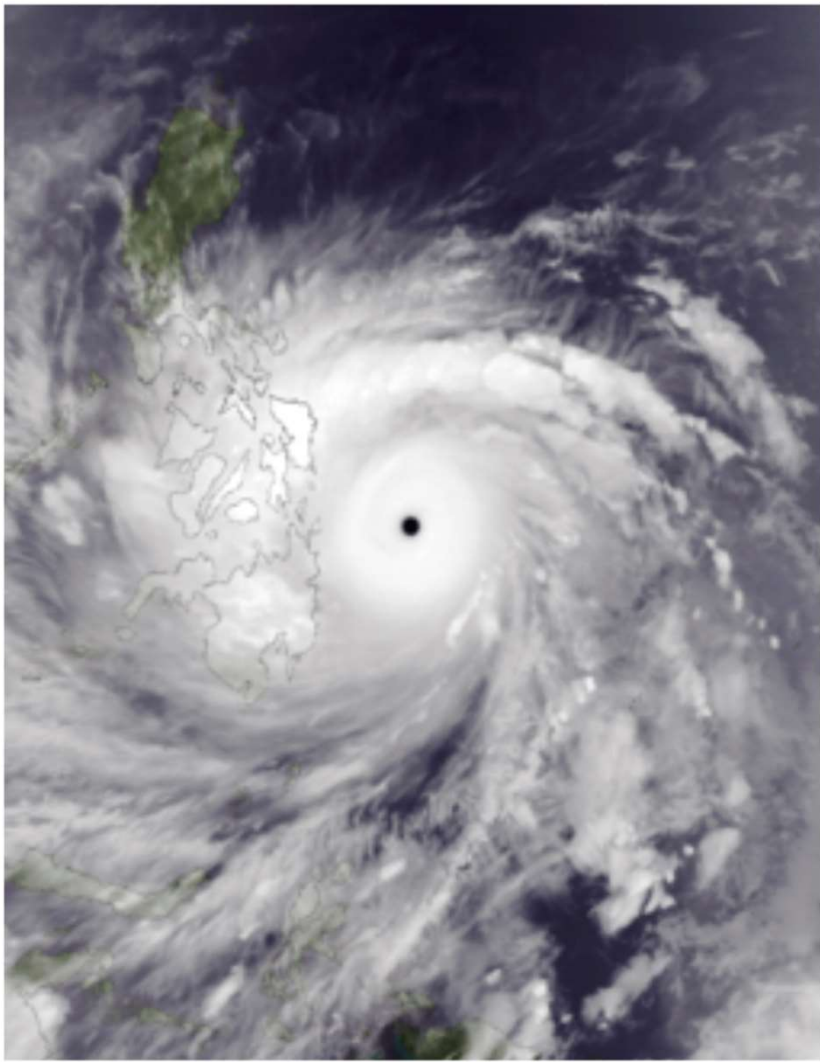
A satellite map of the Philippines showing the path and intensity of Super Typhoon Yolanda (Haiyan). The typhoon is depicted as a large, circular storm system with a central eye, surrounded by concentric rings of clouds. The storm is shown in shades of red and green, indicating its intensity. The map includes a grid of latitude and longitude lines. The text "#YolandaPH" is overlaid on the bottom left of the map.

**#YolandaPH**

International Code Name: Haiyan

# Super Typhoon Haiyan

- **Formed:** November 3, 2013
- **Dissipated:** November 11, 2013
- **Highest Winds:**
  - 10-minute sustained: 145 mph (230 km/h)
  - 1-minute sustained: 195 mph (315 km/h)
- **Lowest Pressure:** 895 mb (26.43 inHg)
- **Fatalities:** 6,340 confirmed, 1,061 missing
- **Damage:** \$2.86 billion (US 2013 dollars)
- **Areas Affected:**
  - Micronesia
  - Philippines
  - Southern China
  - Vietnam

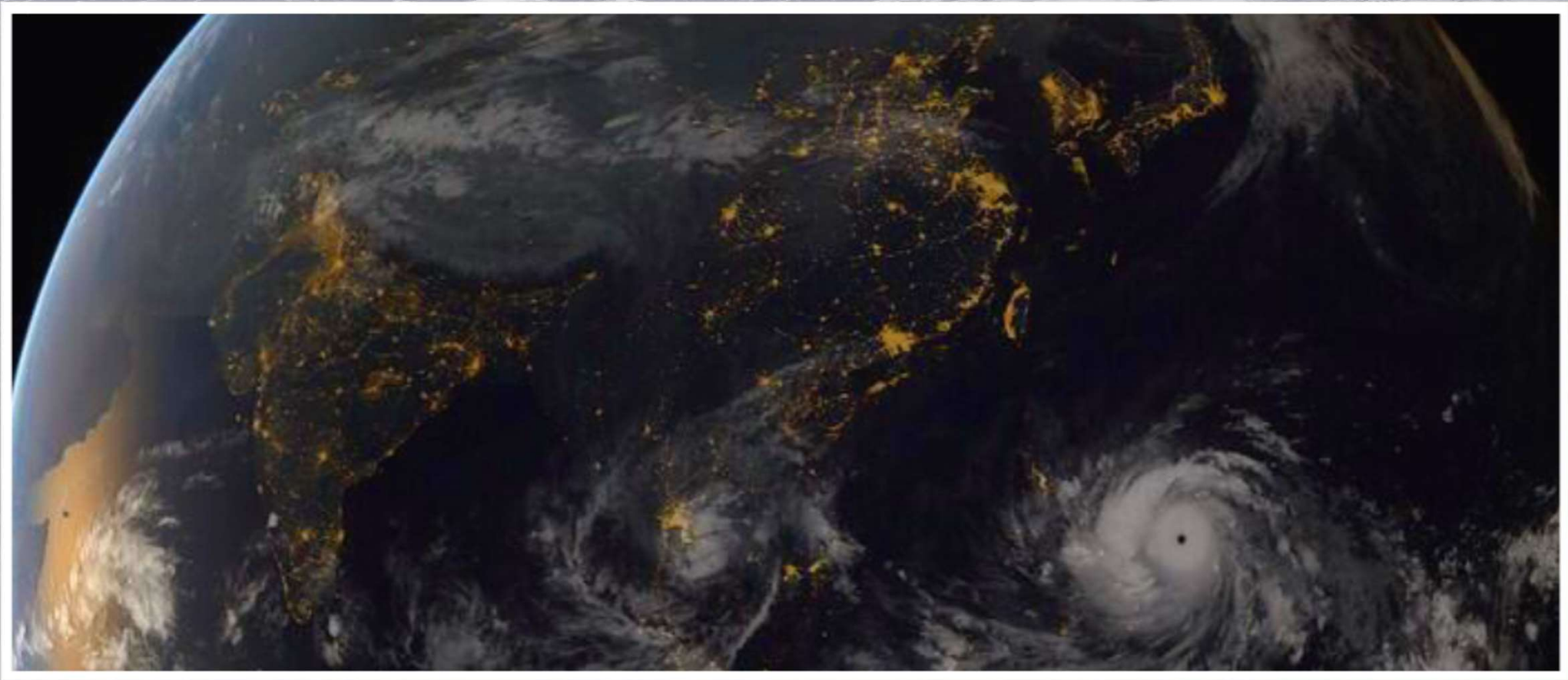


Typhoon Haiyan at peak intensity on November 7





# **Yolanda (Haiyan) From Space**



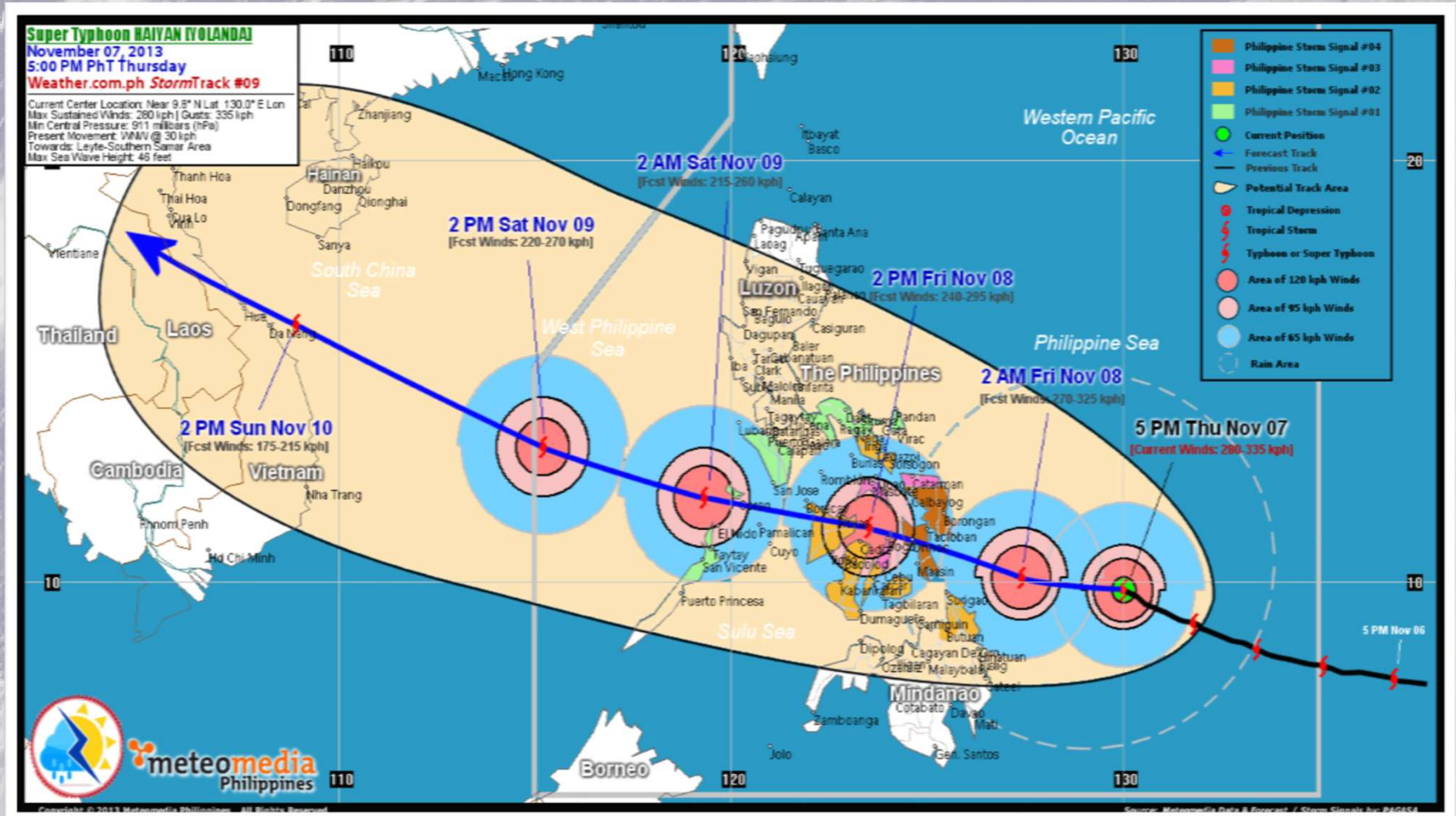
# Super Typhoon Haiyan Track



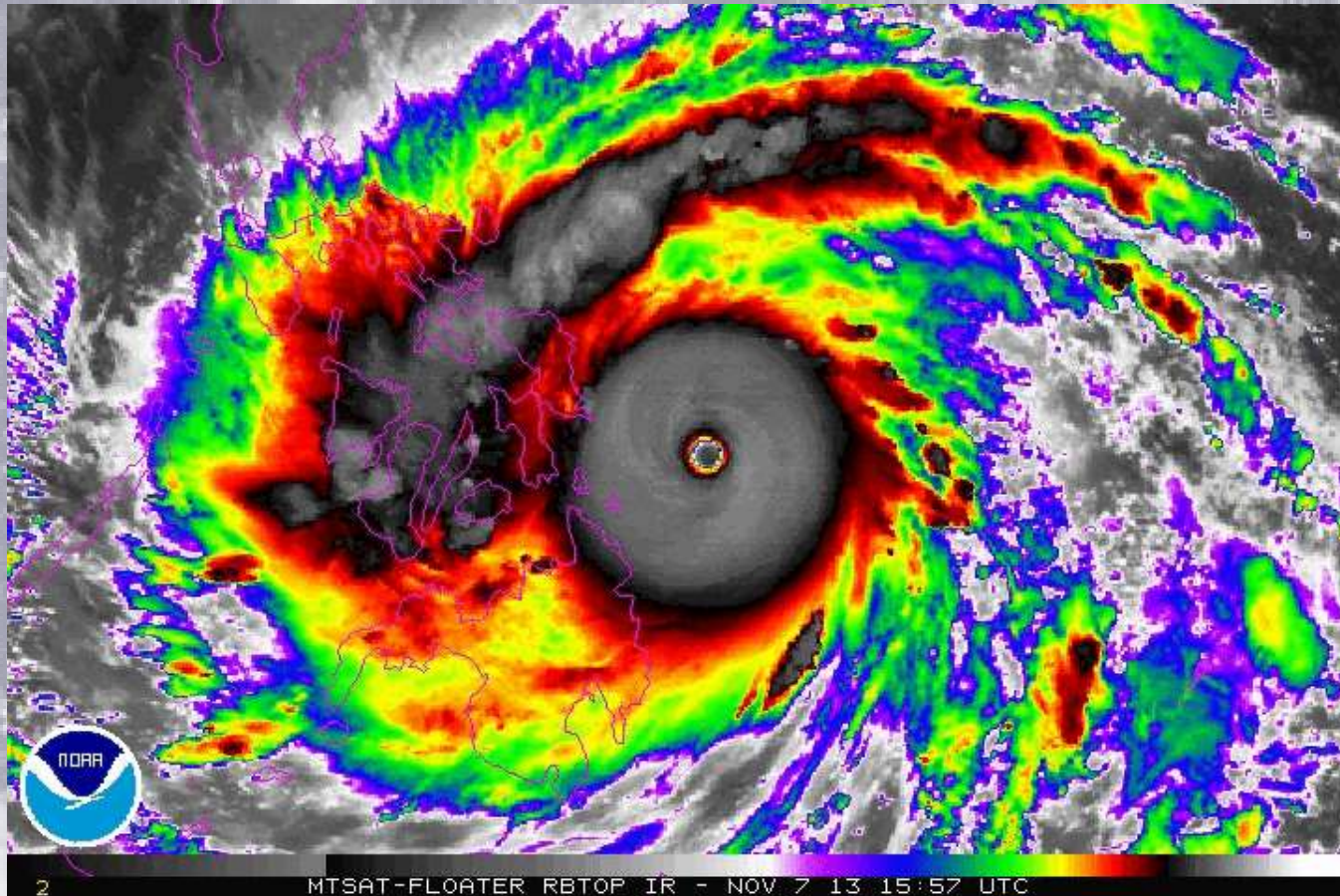
- The 13<sup>th</sup> named storm of the 2013 Pacific typhoon season
- Haiyan originated from an area of low pressure several hundred kilometers east-southeast of **Pohnpei in the Federated States of Micronesia** on November 2, 2013.



# Super Typhoon Haiyan



# Haiyan (Yolanda) Hitting the Philippines

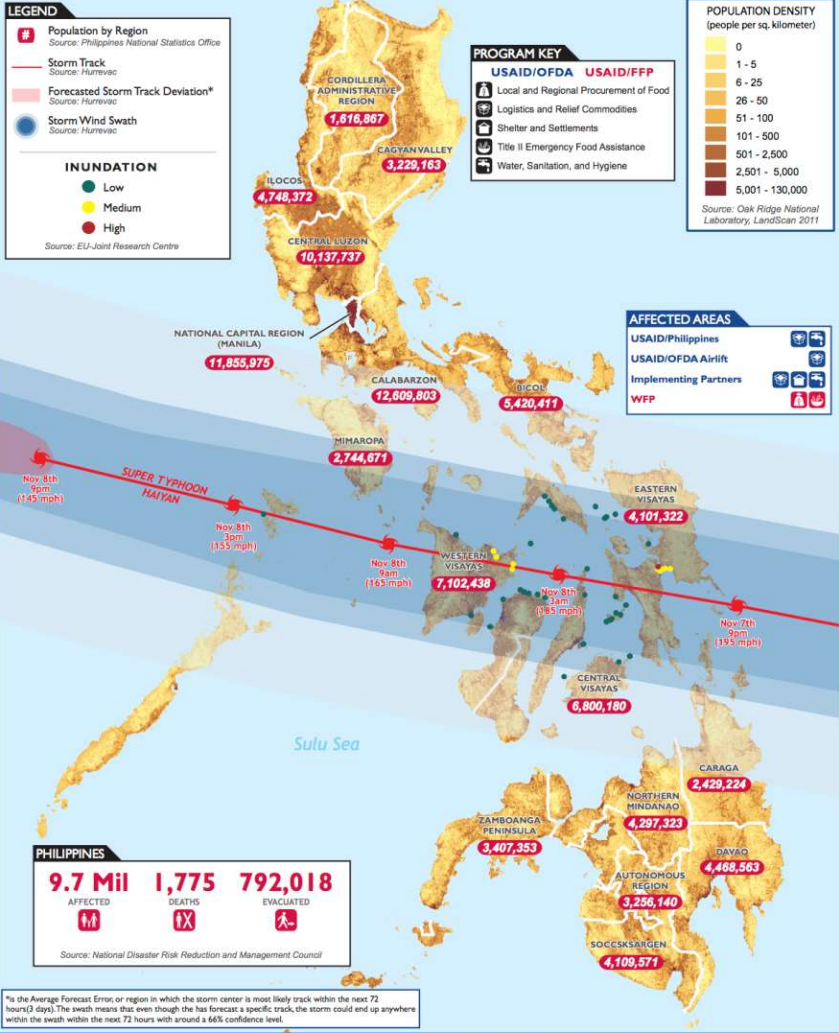




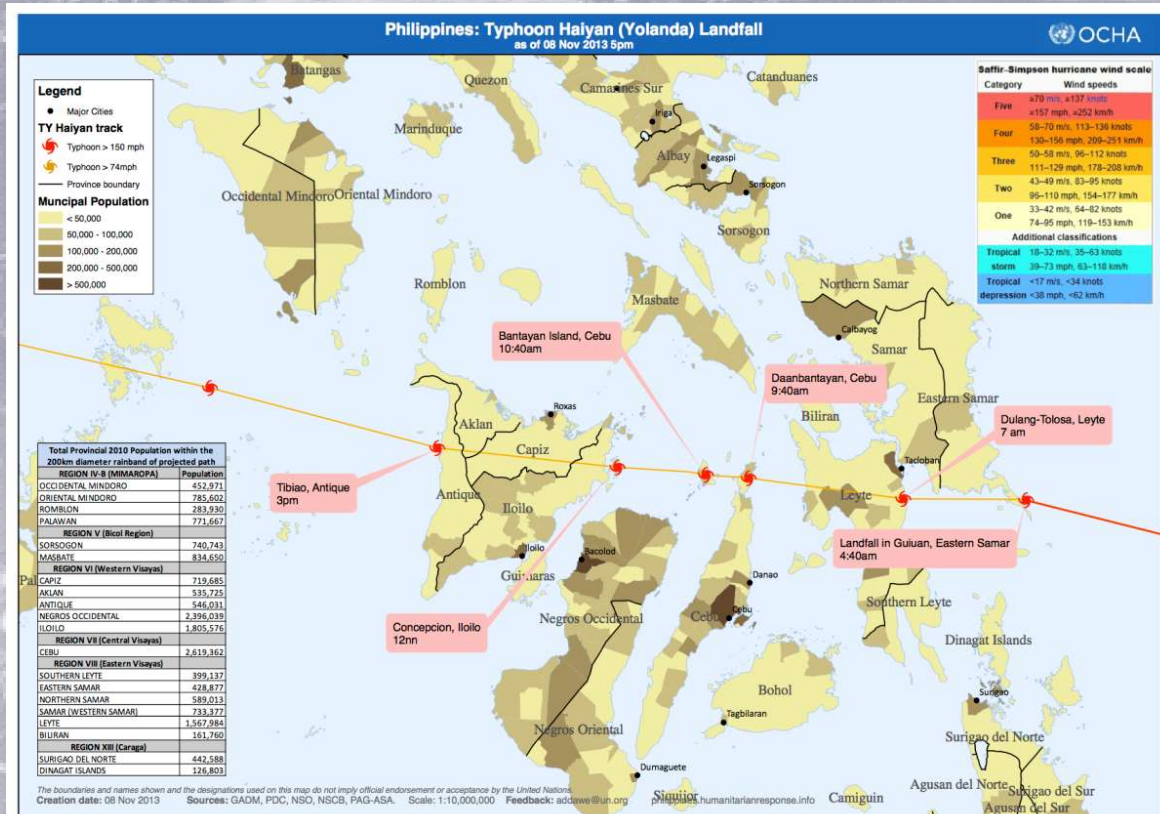


# SUPER TYPHOON YOLANDA/HAIYAN

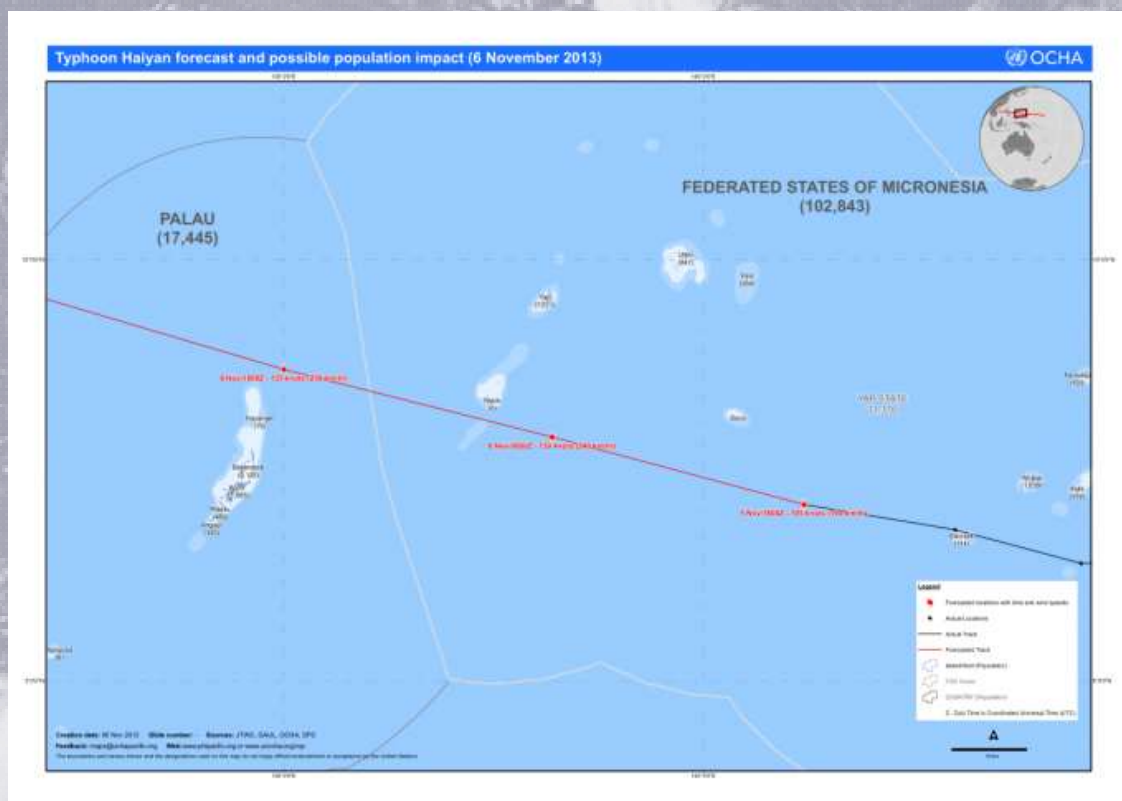
Last Updated 11/11/13



# Yolanda (Haiyan) Damage in Philippines



# Haiyan impacts on Micronesia and Palau



- **Palau**

- the strongest tropical cyclone that struck Palau since reliable records.
- **Kayangel was flooded in its entirety, and all homes were destroyed.**
- On Kayangel in Palau, a high **storm surge** damaged several houses, while **strong winds** downed trees.
- Despite residents' refusal to evacuate, **no fatalities or major injuries** took place on the island, 69 people were displaced by the storm.



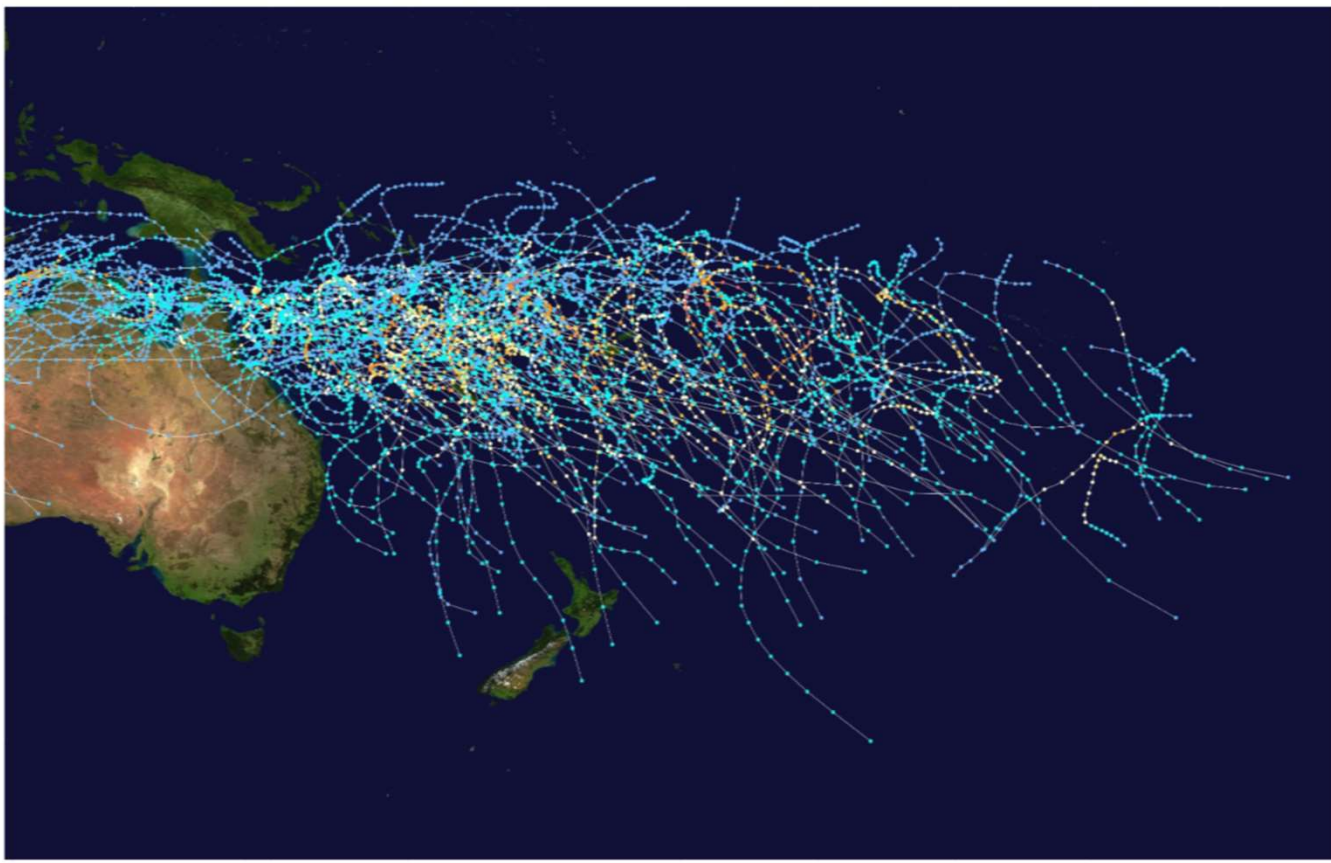
# Haiyan impacts on Micronesia and Palau

- **Koror, Babeldaob and Kayangel each lost access to water and power.**
  - In Koror, winds reaching as high as 120 km/h (75 mph) blew out rooftops and downed trees and power lines.
  - A causeway linking an offshore hospital to the main island was temporarily shut down after being inundated by water.
  - On the northern end of Babeldaob, Haiyan damaged schools and buildings.



# Cyclones in the South Pacific

- Tropical cyclone season:  
November 1-April 30.

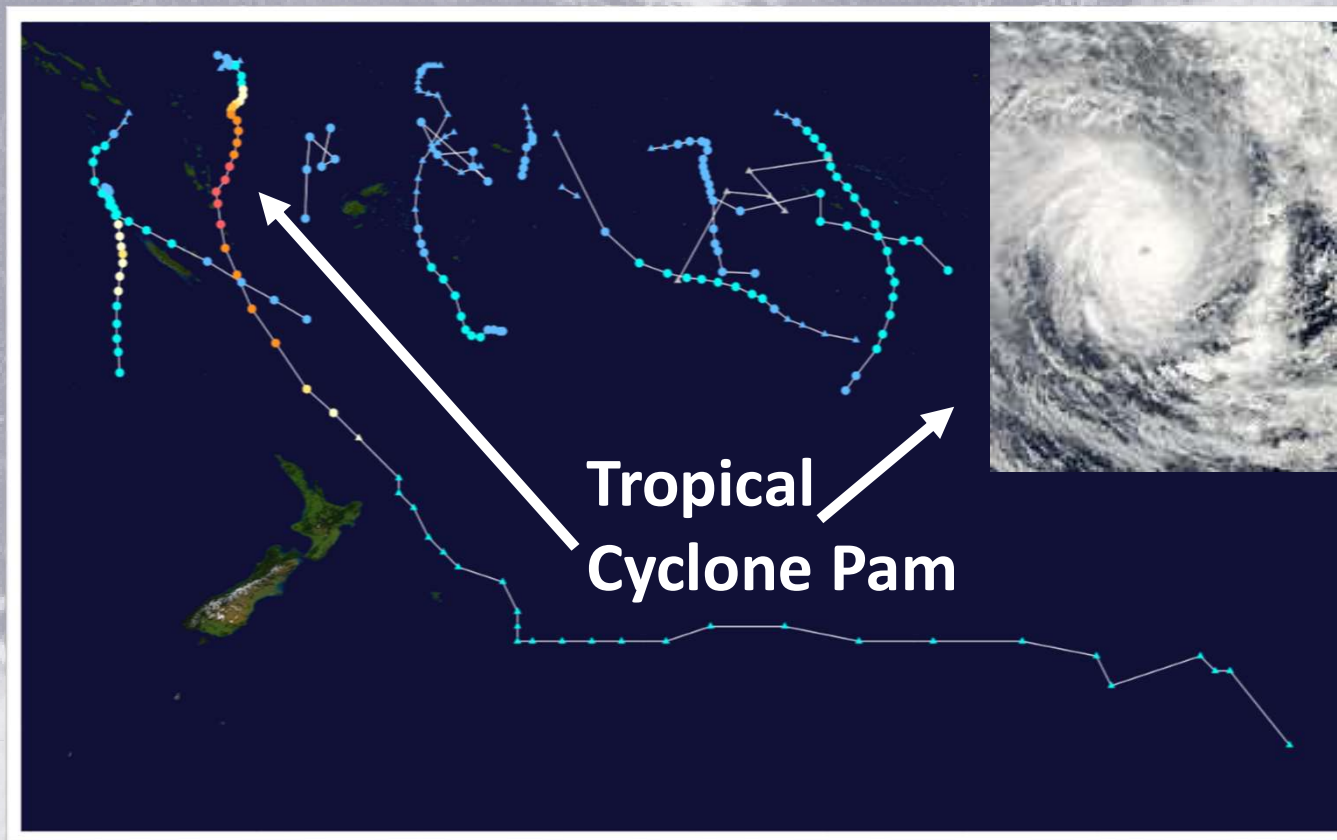


- Most tropical cyclones have their origins within **the South Pacific Convergence Zone** or within the **Northern Australian monsoon trough**.
  - both of which form an extensive area of cloudiness and are dominant features of the season.



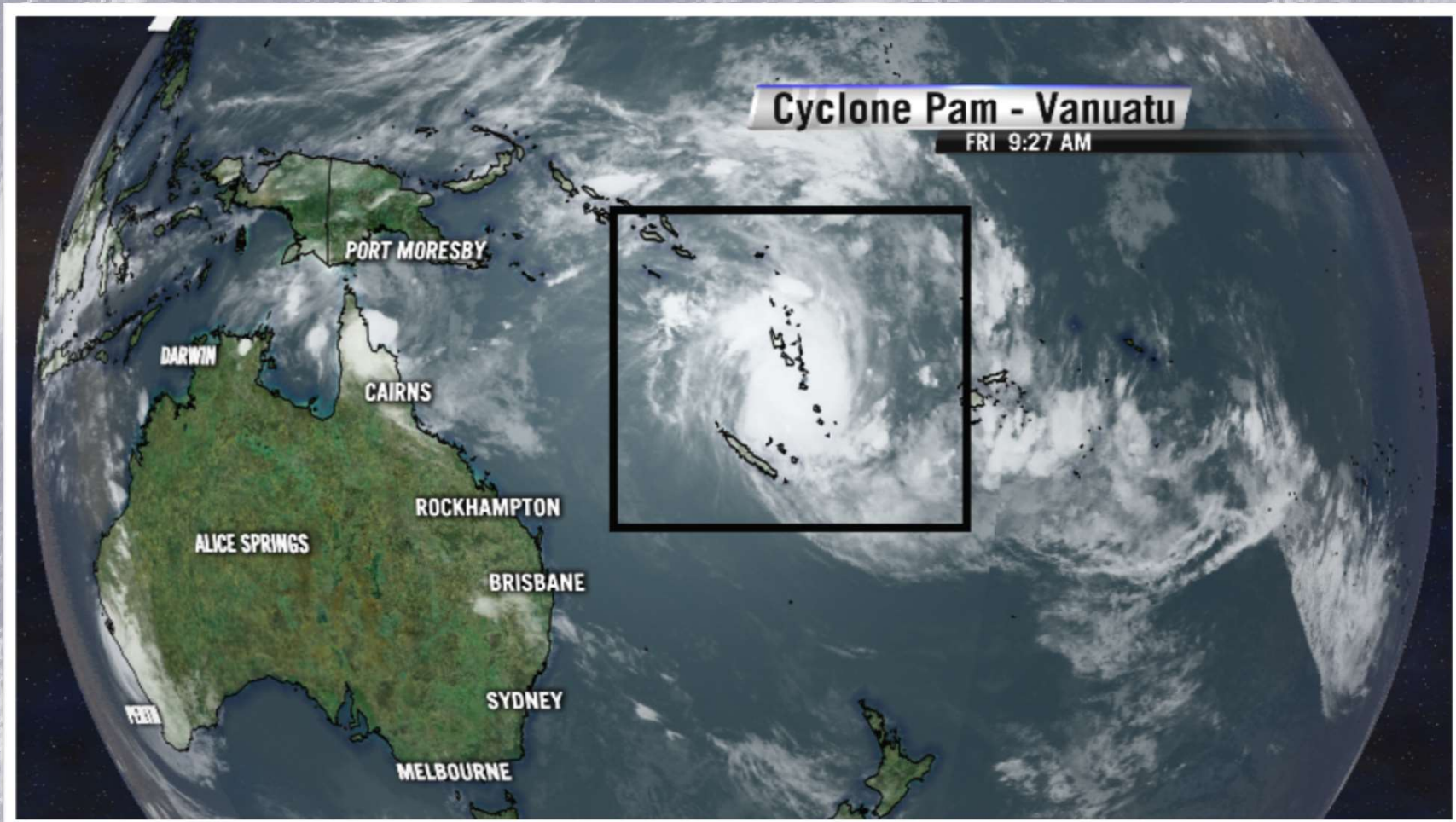
# Cyclones in the South Pacific

- Tropical cyclone season:  
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- **Tropical Disturbance:** 10-minute sustained wind speeds of more than 65 km/h (35 mph), that wrap halfway around the low level circulation center.
- **Severe Tropical Cyclone:** maximum 10-minute sustained wind speeds are greater than 120 km/h (75 mph).

# Tropical Cyclone Pam - South Pacific



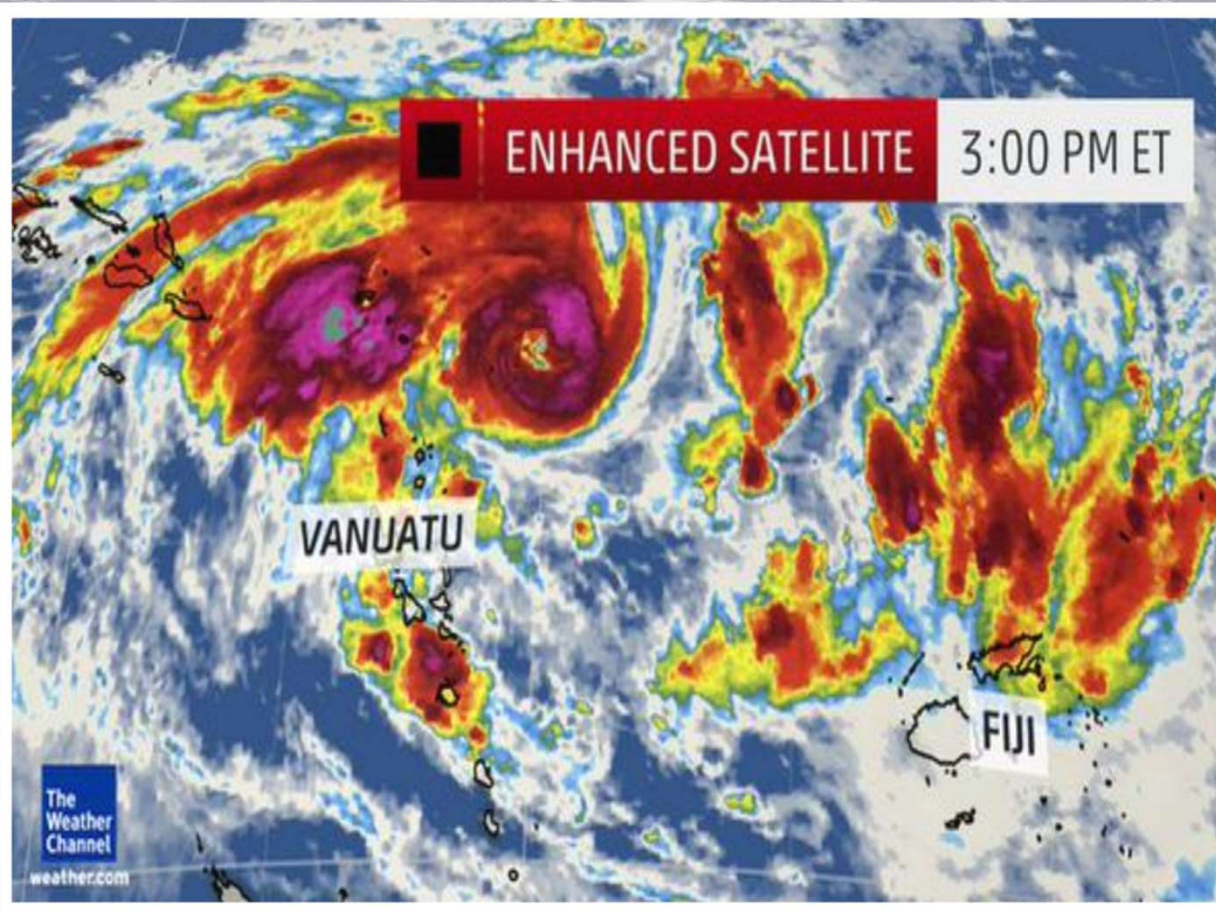


# Cyclone Pam – South Pacific

- Pam gradually intensified into a powerful, **category 5 severe tropical cyclone** by March 12.
- Pam's ten-minute maximum sustained winds **peaked at 250 km/h (155 mph)**
- **Minimum pressure of 896 mb**, making Pam the most intense tropical cyclone in the basin.



# Cyclone Pam – South Pacific



- **Vanuatu devastation**
  - Pam passed just east of Efate.
  - It is the single worst natural disaster in the history of Vanuatu.
  - Vanuatu's infrastructure was crippled: ~90 % of the nation's buildings were impacted by the storm's effects, telecommunications were paralyzed, and there were water shortages