Destroying A Hurricane and Simulating Downslope Flow with WRF: Lessons from the 2023 Maui Wildfire Event

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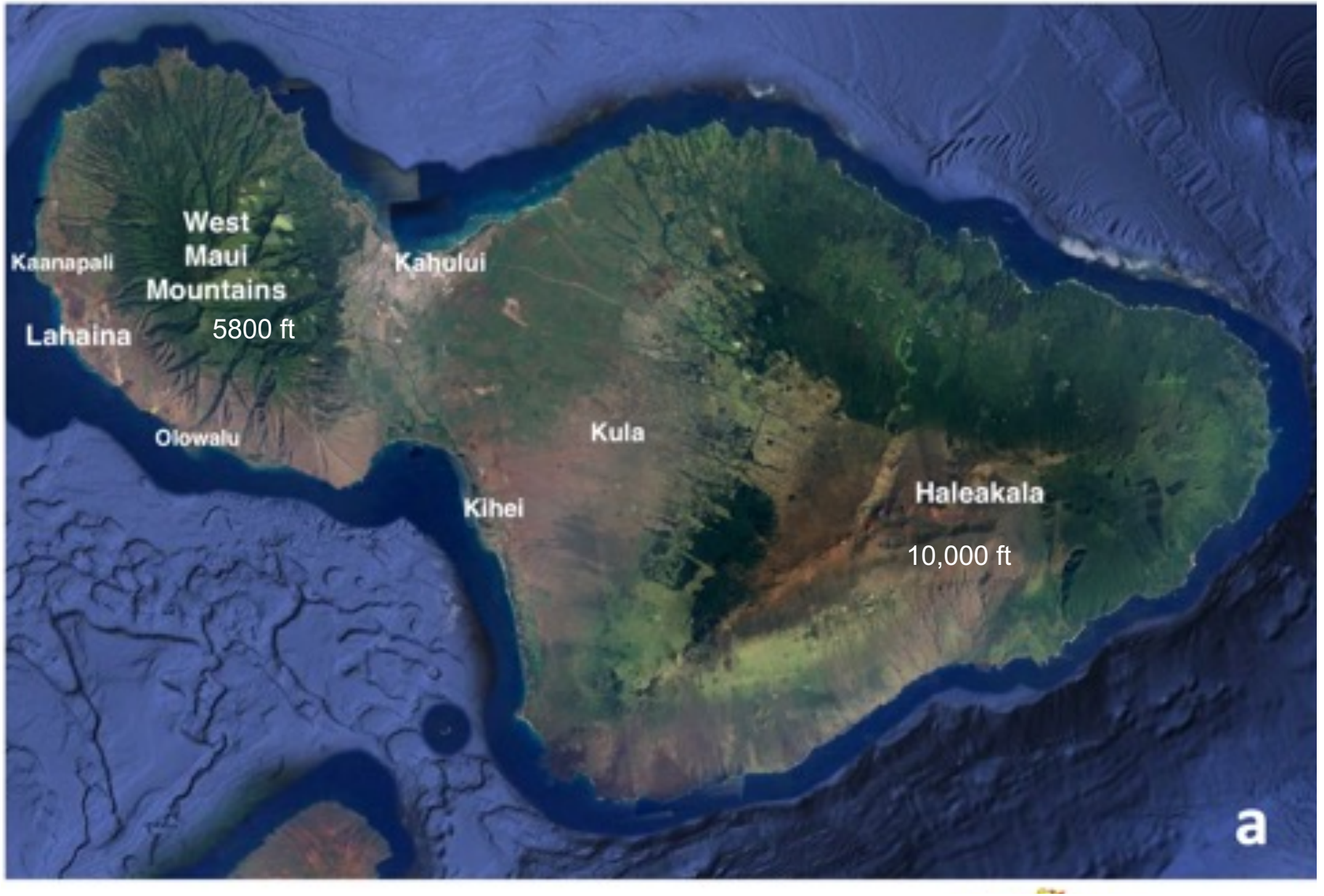
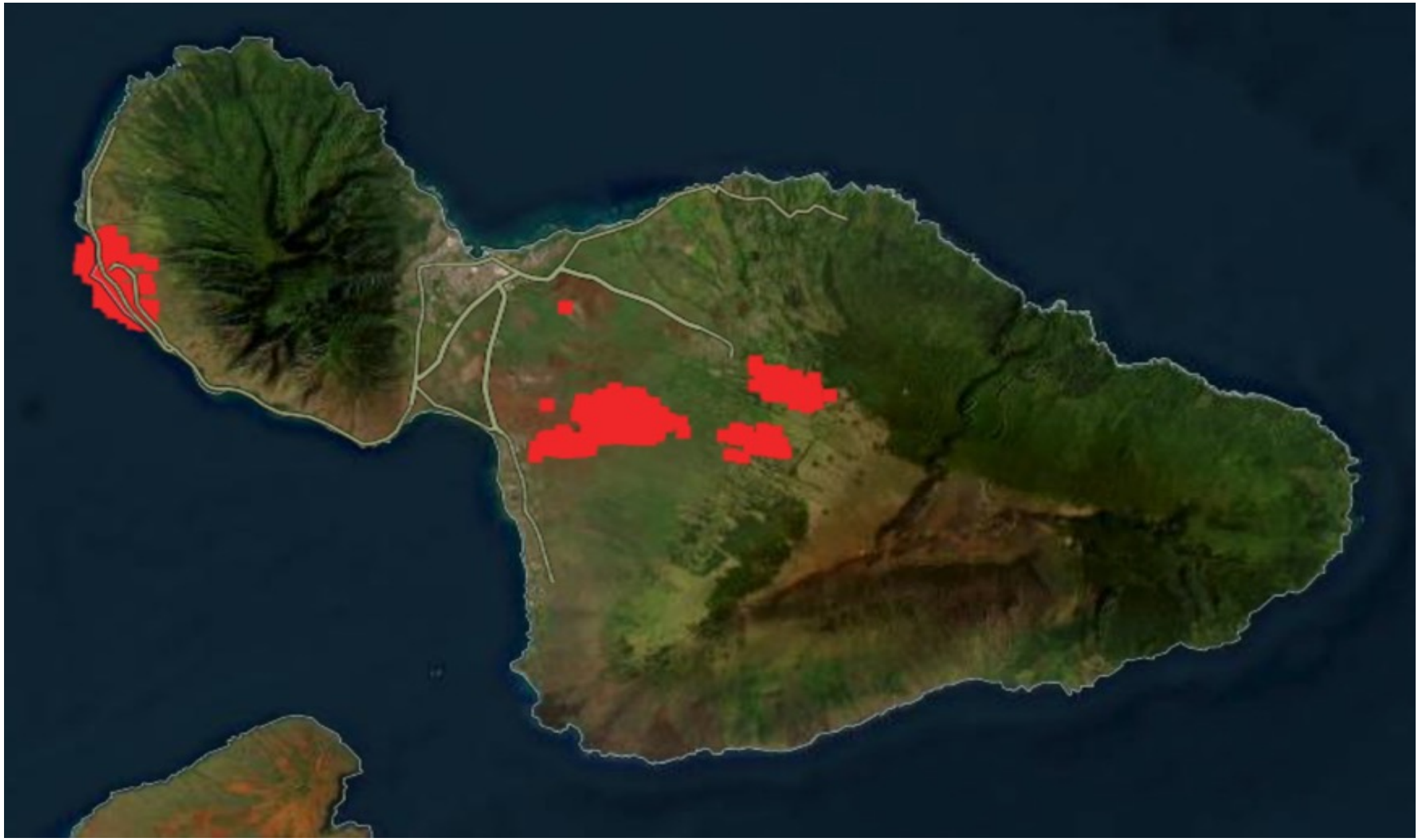
On August 8, 2023, large wildfires hit western and central Maui, killing at least 100 people and resulting in 3-6 billion dollars of damage.

The historic town of Lahaina was destroyed

Maui Introduction

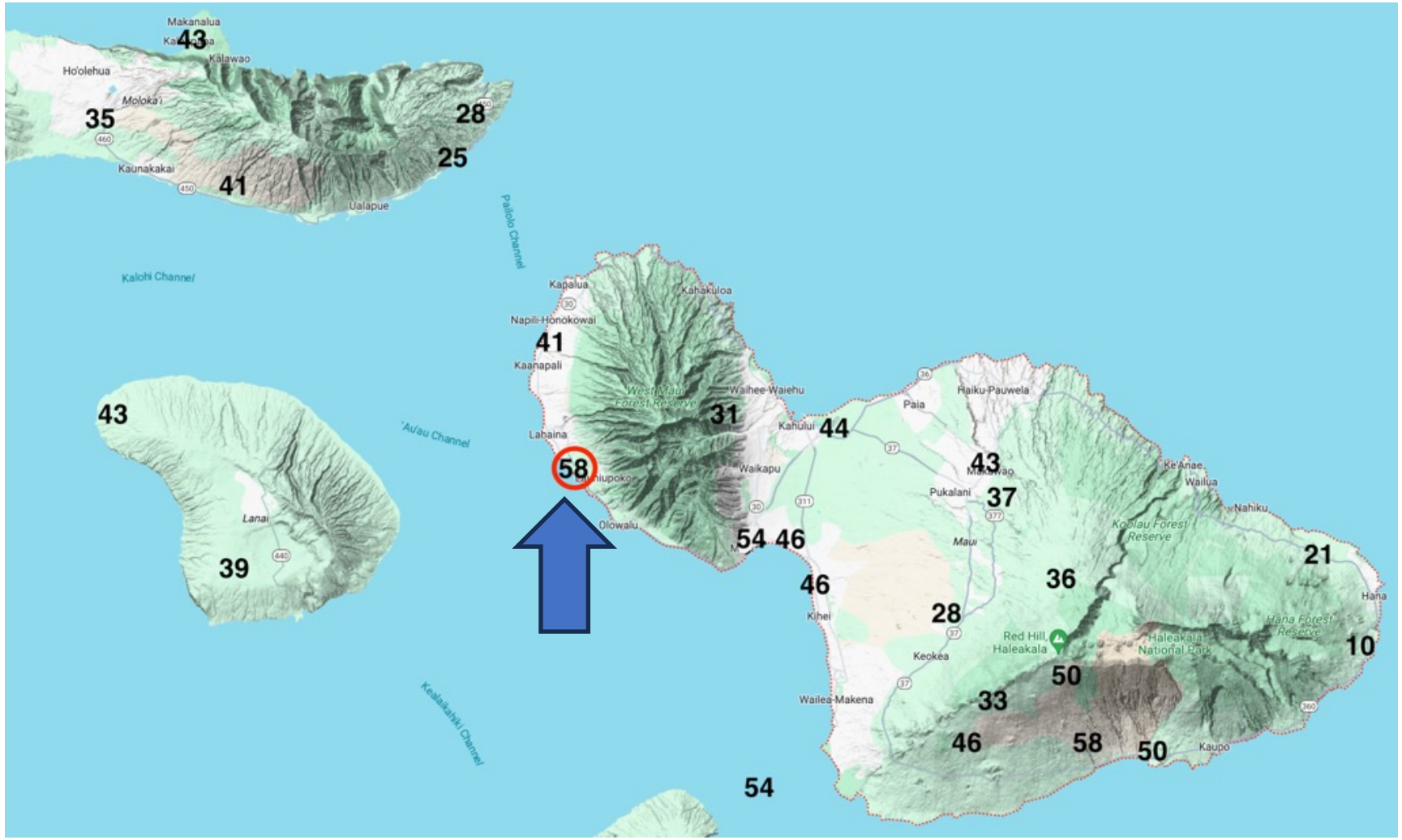


Fire Areas



The Maui Wildfire Even Was Associated with Very Strong Northeasterly Winds

Based on damage, qualitative estimates, and very limited wind observation data, **winds gusted to 60-80 kt in and east of Lahaina**

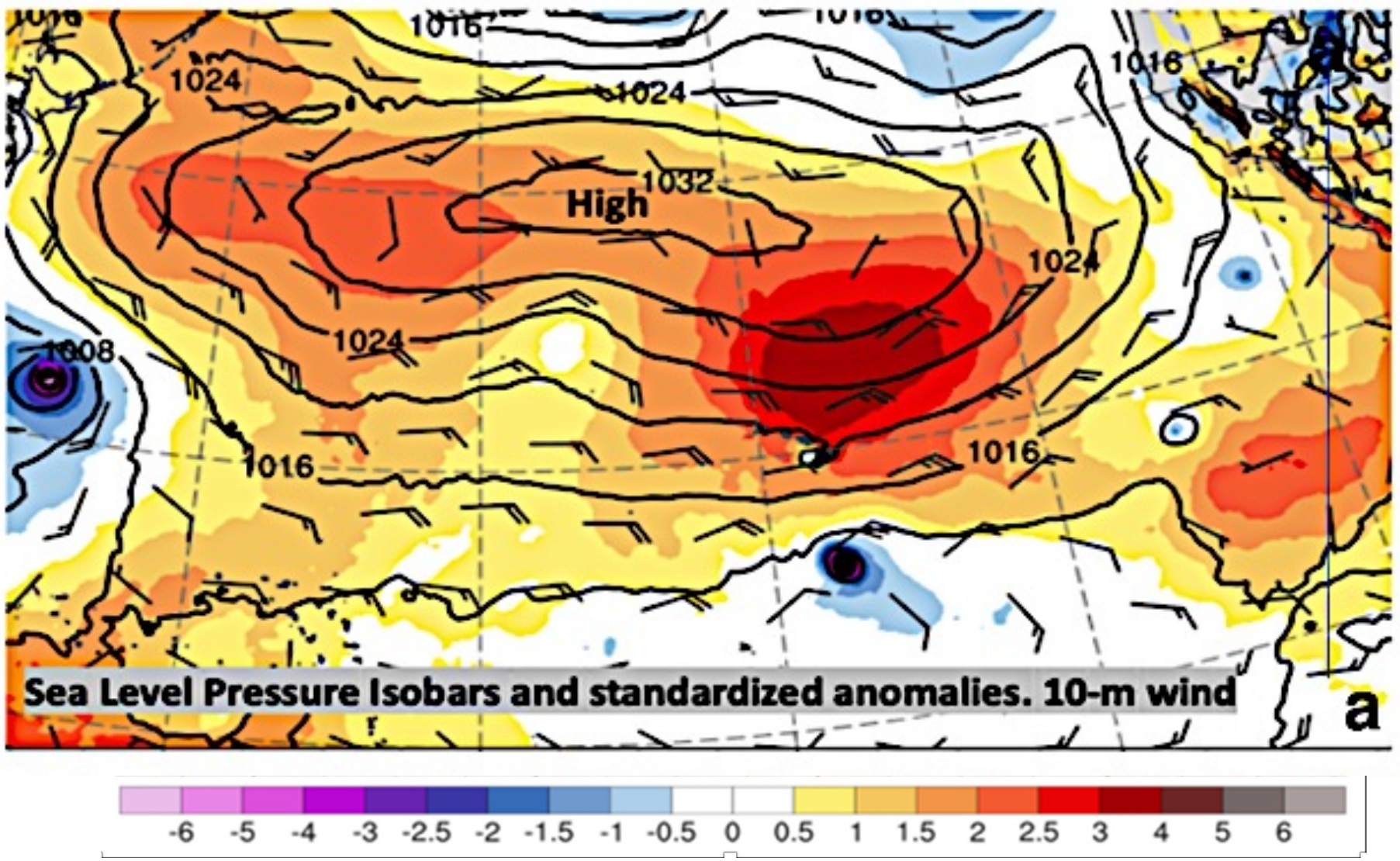


Powerlines Snapped and Roofs were Pealed Off

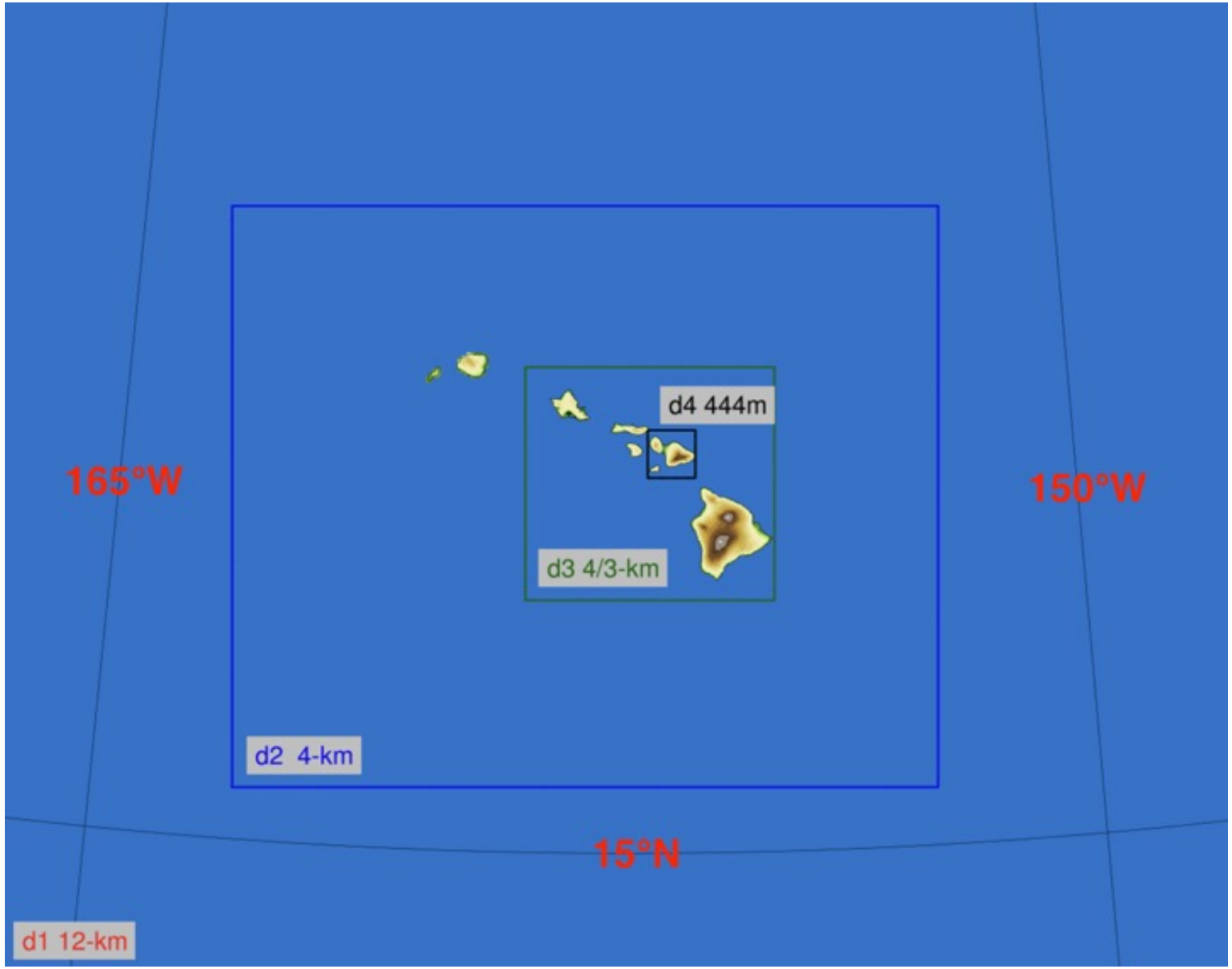
Sea Level Pressure and Its Standardized Anomalies

Unusual high pressure to the north of the islands

Hurricane Dora to the South



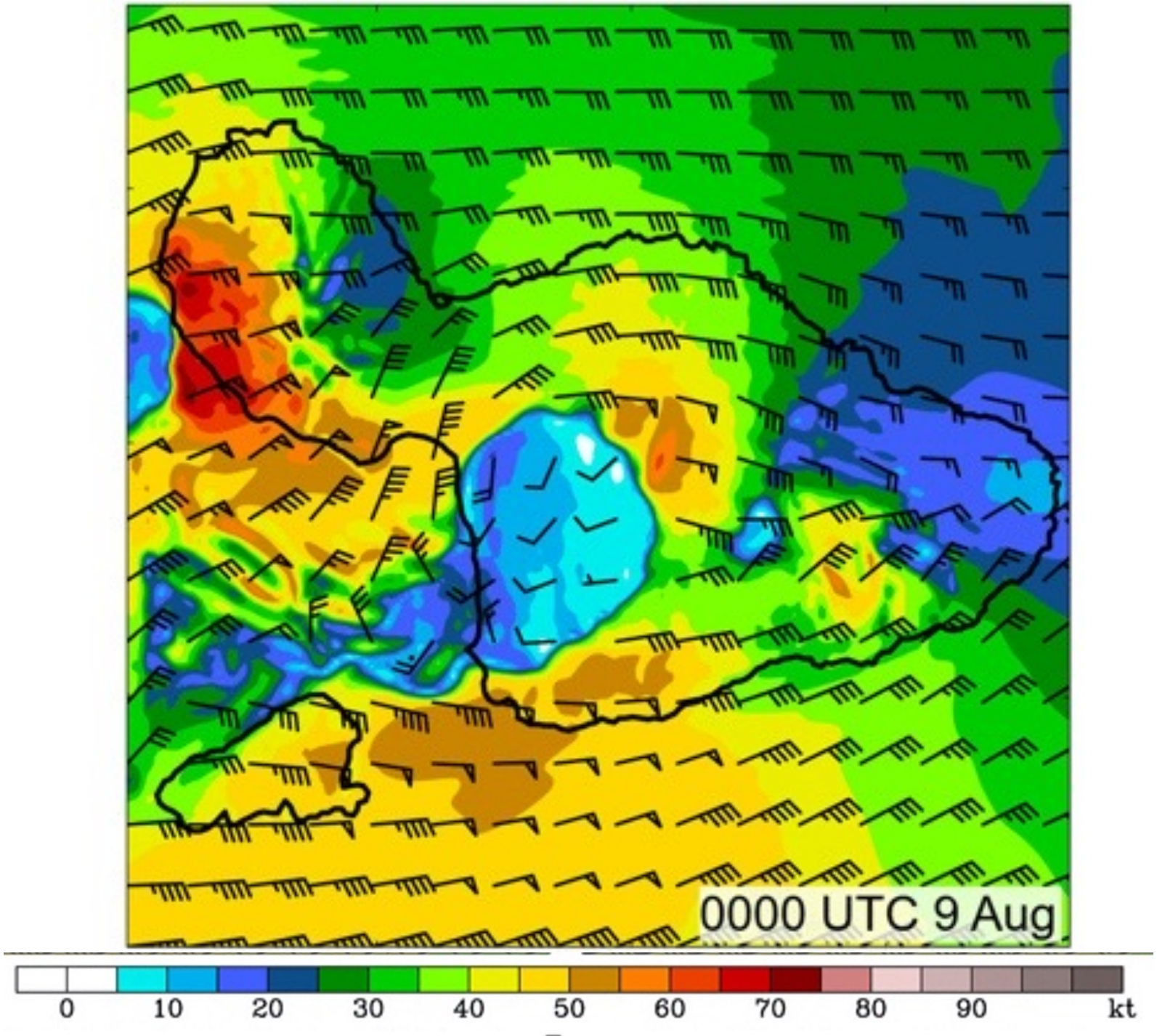
High Resolution WRF Simulations

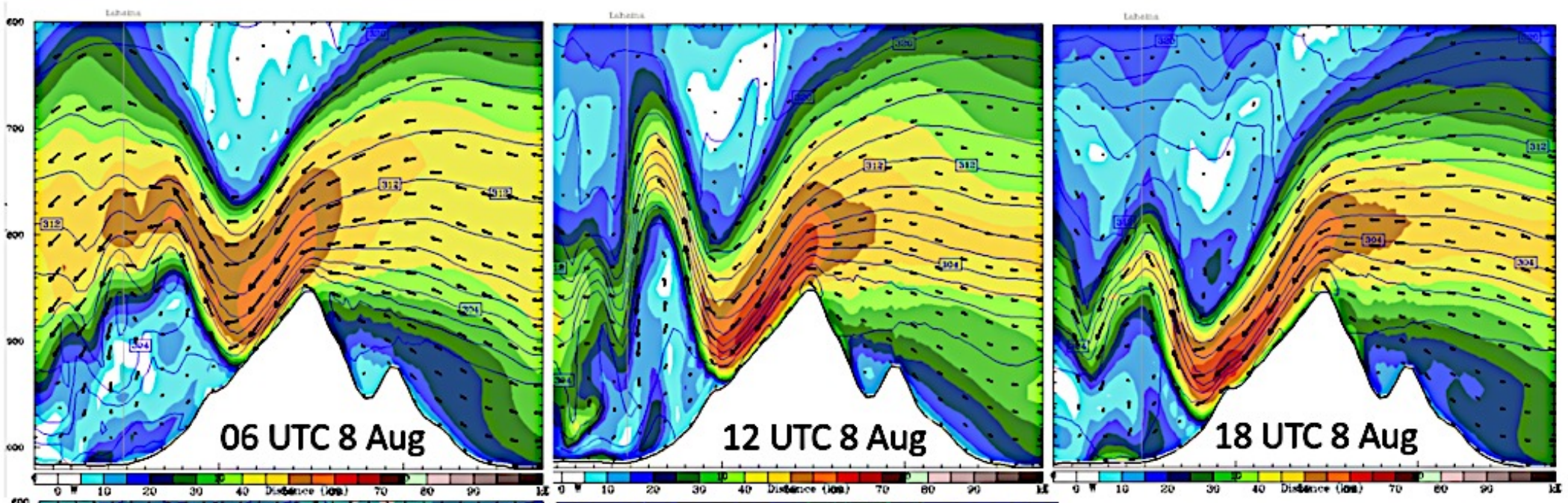


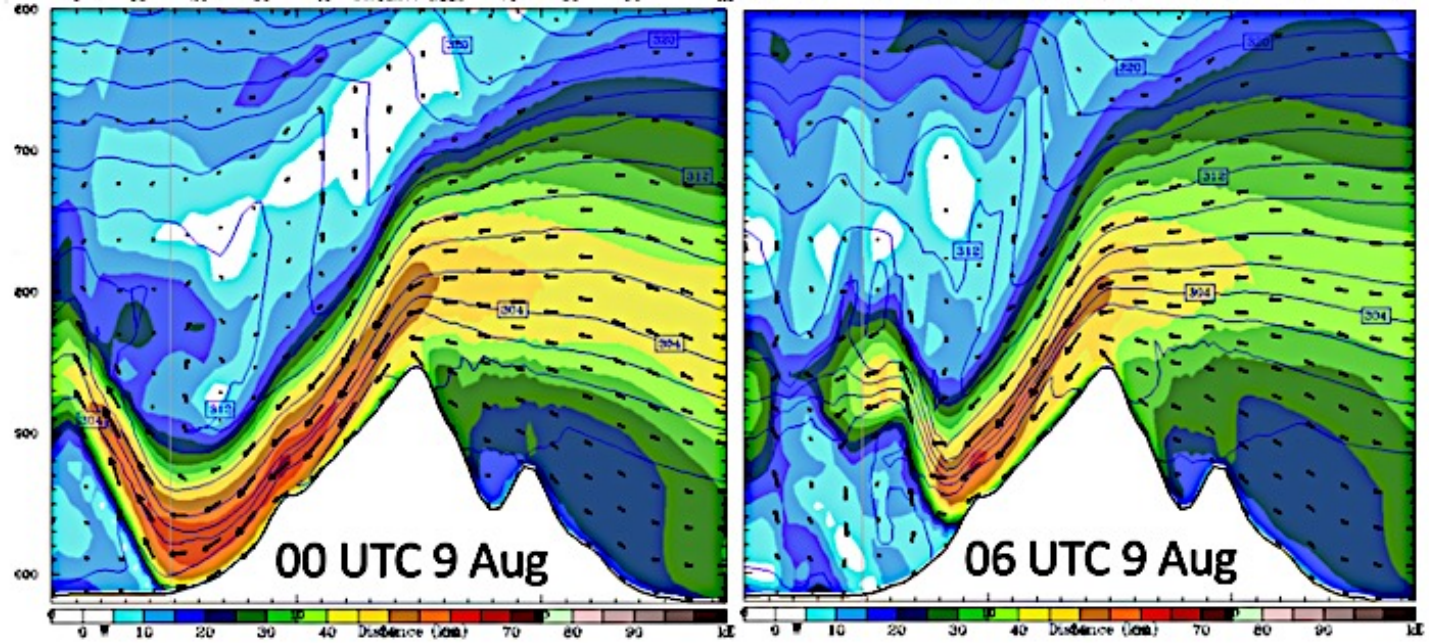
24-h forecast was excellent

Forecast
Wind
Gusts (kt)

Initialized 0000 UTC
8 August







Potential Temperature
Wind Speed (shaded)
Wind Vector in Cross Section

High Amplitude Mountain Wave and Downslope Windstorm

Photos Suggested the Amplified Mountain Wave

Many claimed Hurricane Dora was essential

npr

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The wildfires in Maui are unusually destructive due to Hurricane Dora's winds

USA Today

How Hawaii wildfires are fueled by Hurricane Dora winds, low humidity

Hurricane Dora, which was a Category 4 storm at 5 a.m. HST Aug. 9, passed roughly 800 miles south-southwest of Hawaii, spinning off powerful...

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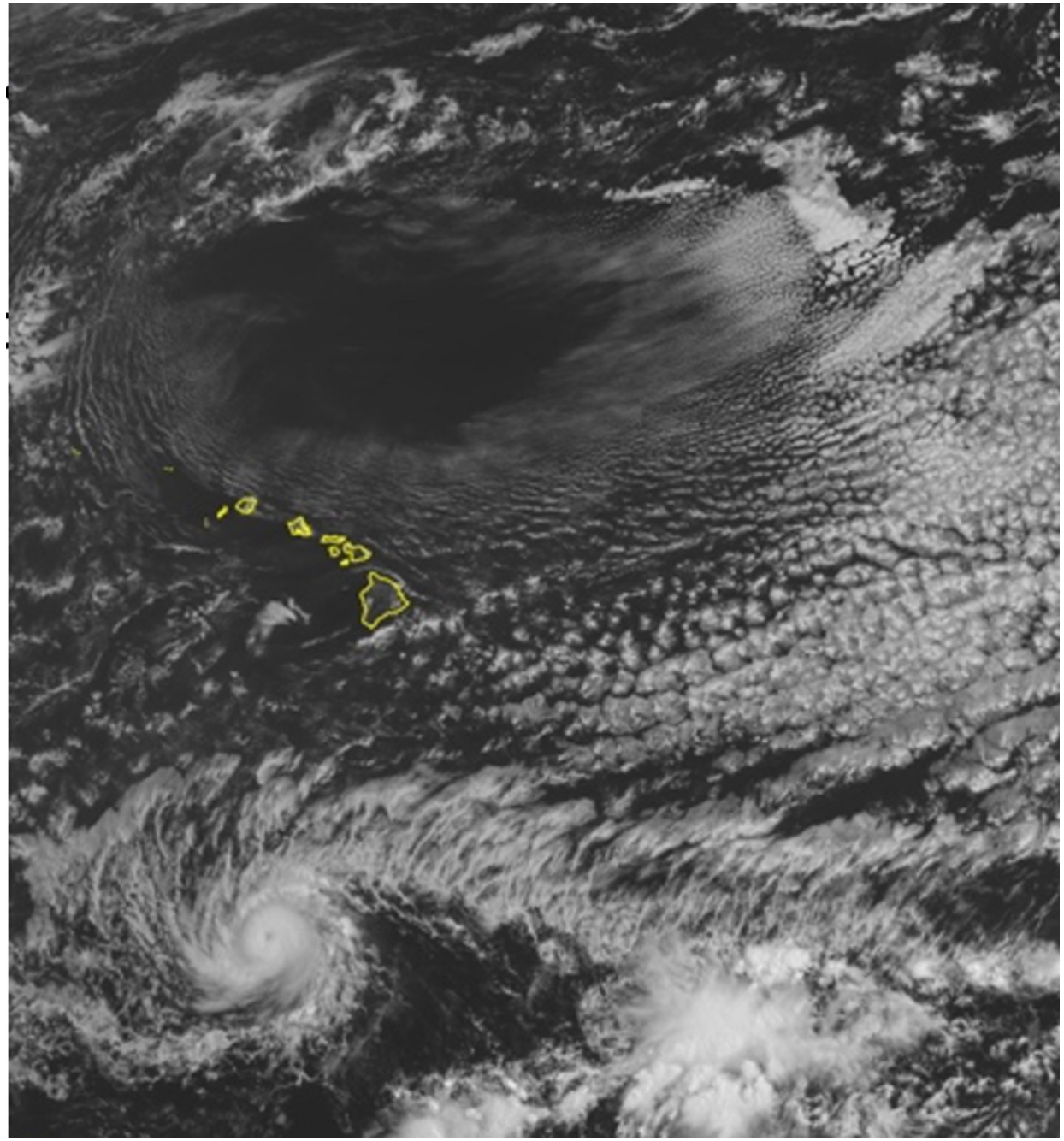
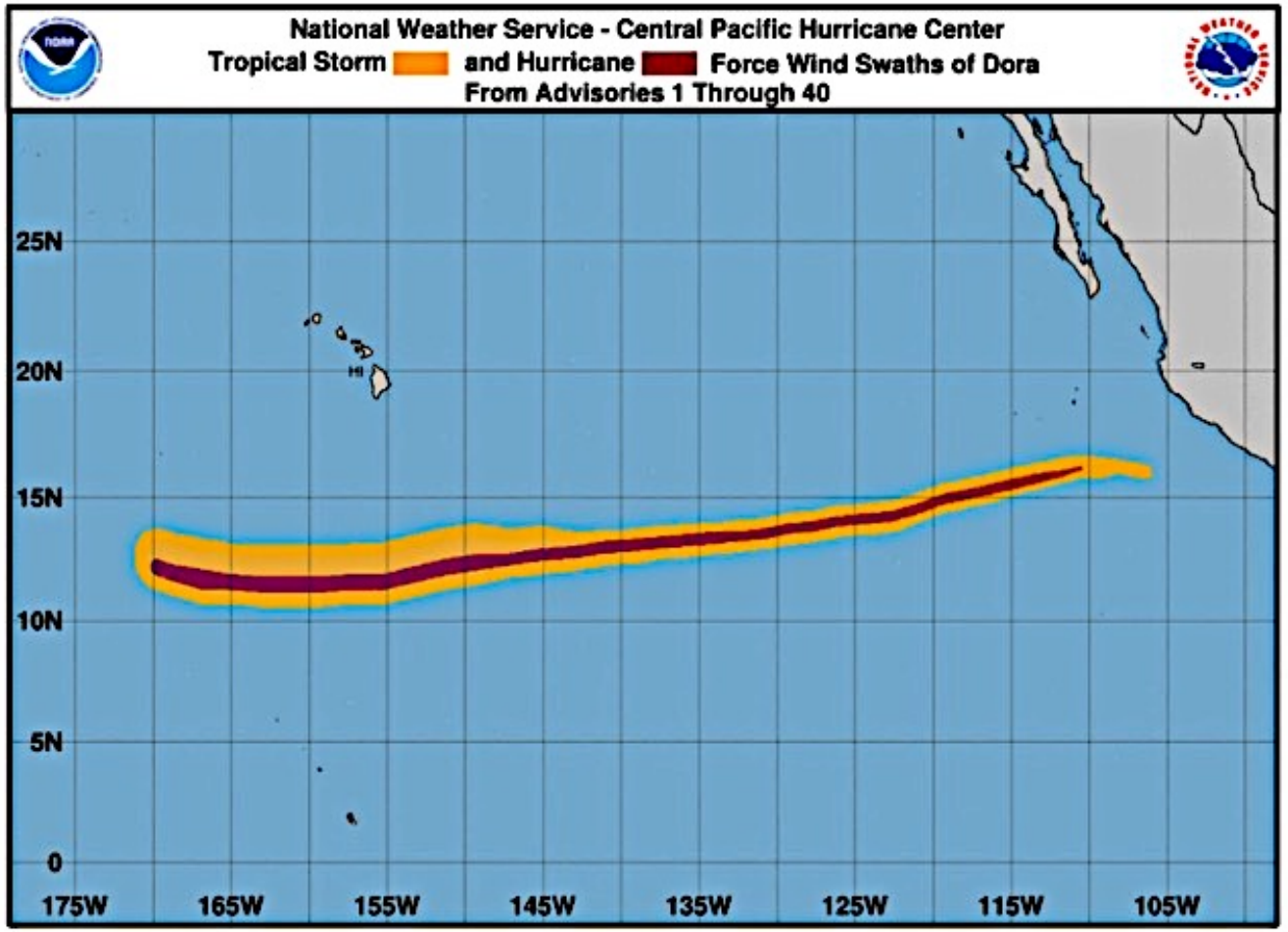
Hurricane Dora is fuelling Hawaii wildfires. Here's how



Hurricane Dora passed around 800 miles south of Maui

Was a category 4 storm as it passed south of Hawaii



Can we eliminate the storm in the simulation WITHOUT harming other fields?

Can we surgically remove the storm?

Tropical Cyclone Vulnerability: They Require SST's of at least 26°C

Ran Two Parallel WRF Extended Experiments (138-h)

(1) Using **observed sea surface temperatures (SSTs)**, forced onboundaries with operational NOAA/NWS GFS forecasts.

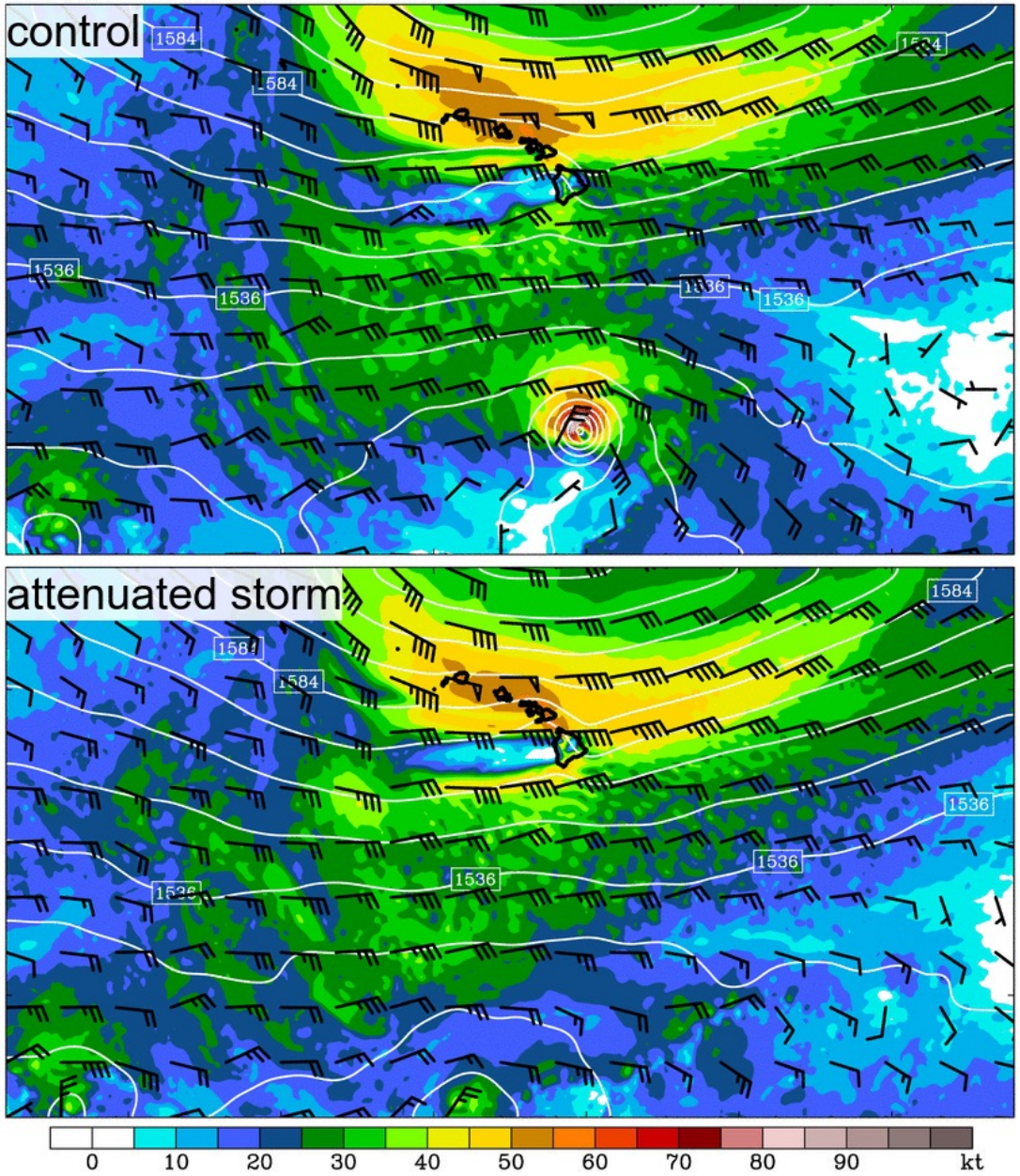
(2) SSTs in a 2-degree box following the storm were cooled to 75F (24C). **Goal: to weaken and destroy the hurricane.**

It Worked!

850-hPa heights/winds 1800 UTC 8 August 2023, 138-hr forecast

Control

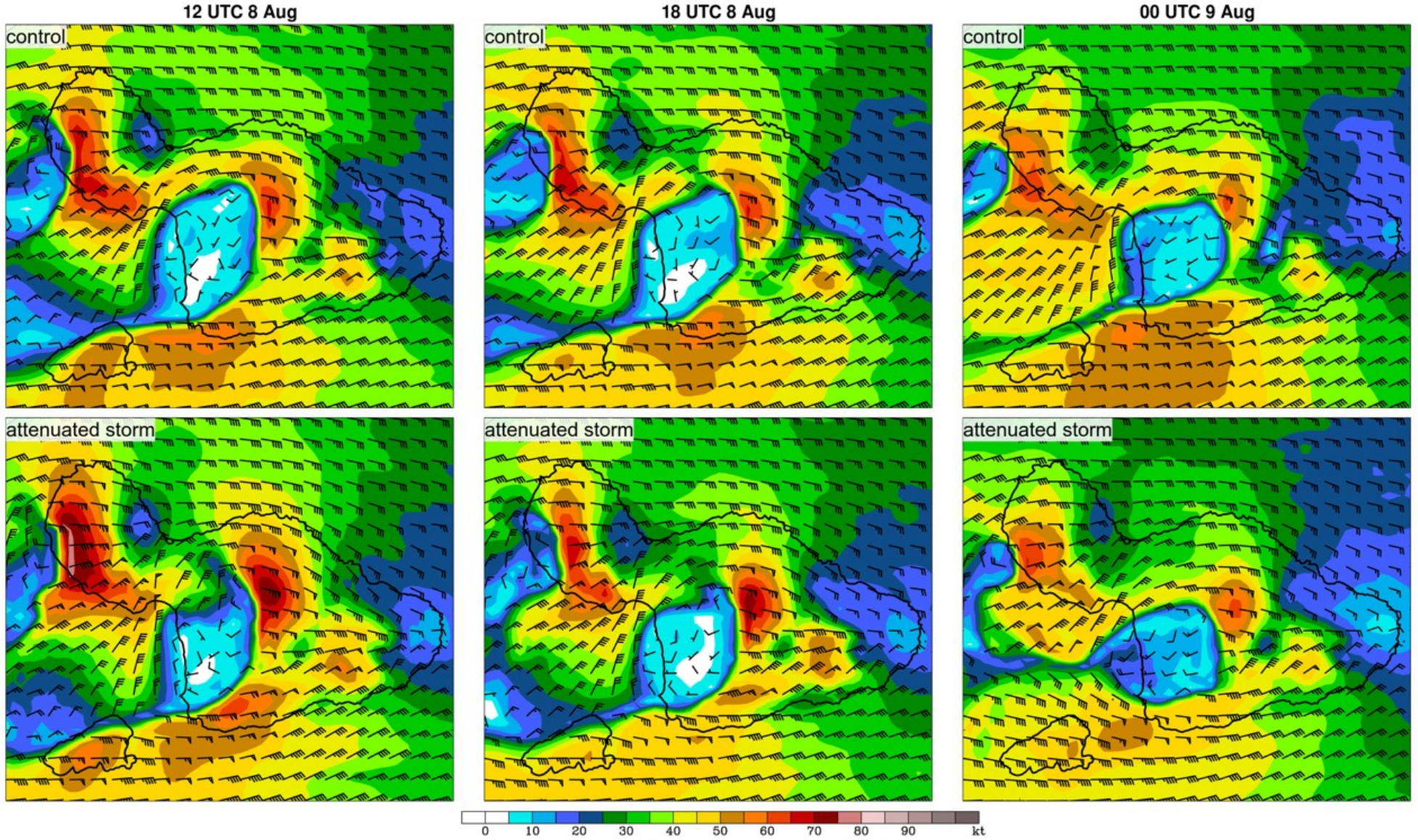
Weakened Storm



Strong Winds Remained over Lahaina with Killed Hurricane

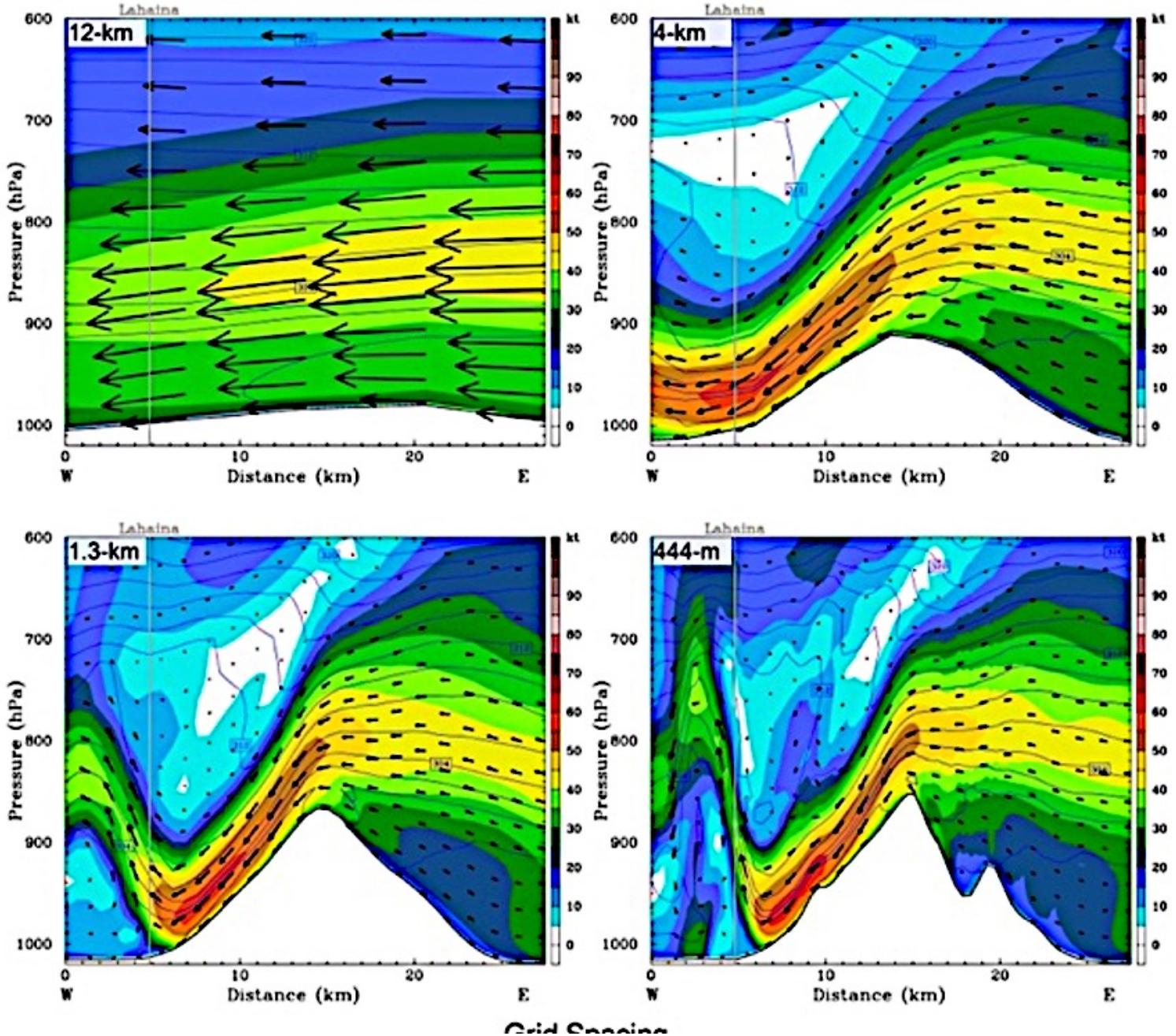
Control

Killed Hurricane

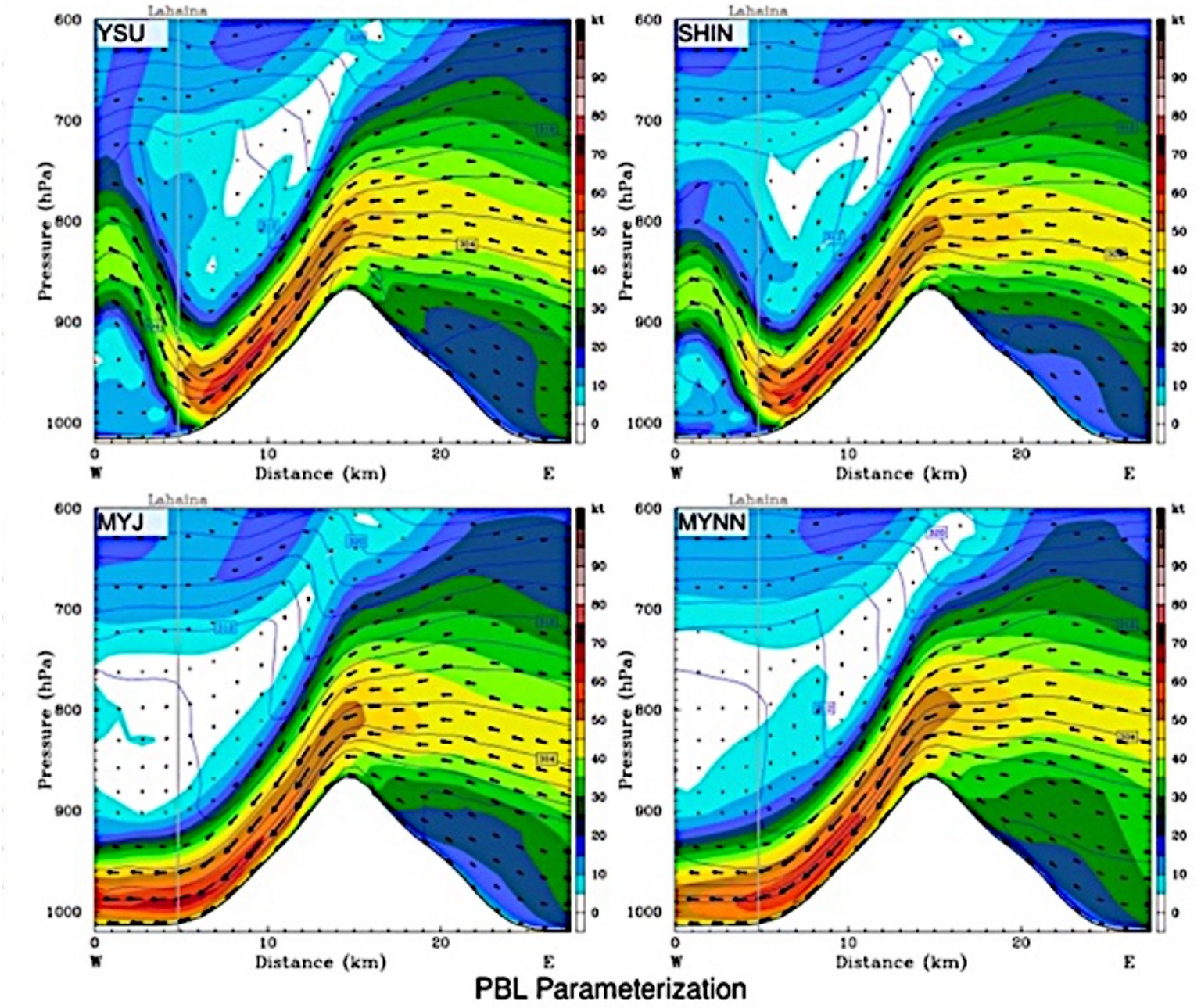


The Downslope Winds Were Sensitive to Grid Spacing and PBL Parameterization

Grid Spacing



PBL Scheme


Lahaina
YSU
SHIN
MYJ
MYNN
Pressure (hPa)
Distance (km)
W
E
kt
PBL Parameterization

Conclusions

- **High-resolution forecasts were excellent at all time scales**
- **We can surgically remove a hurricane by cooling the waters just around the storm.**
- **Hurricane Dora had little impact on the event**
- **Substantial sensitivity to grid spacing and PBL scheme.**