

Hurricane Threats to Hawaii

Climate Change Informational Briefing – January 11, 2024

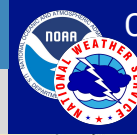
John Bravender, Warning Coordination Meteorologist

NOAA/NWS Central Pacific Hurricane Center

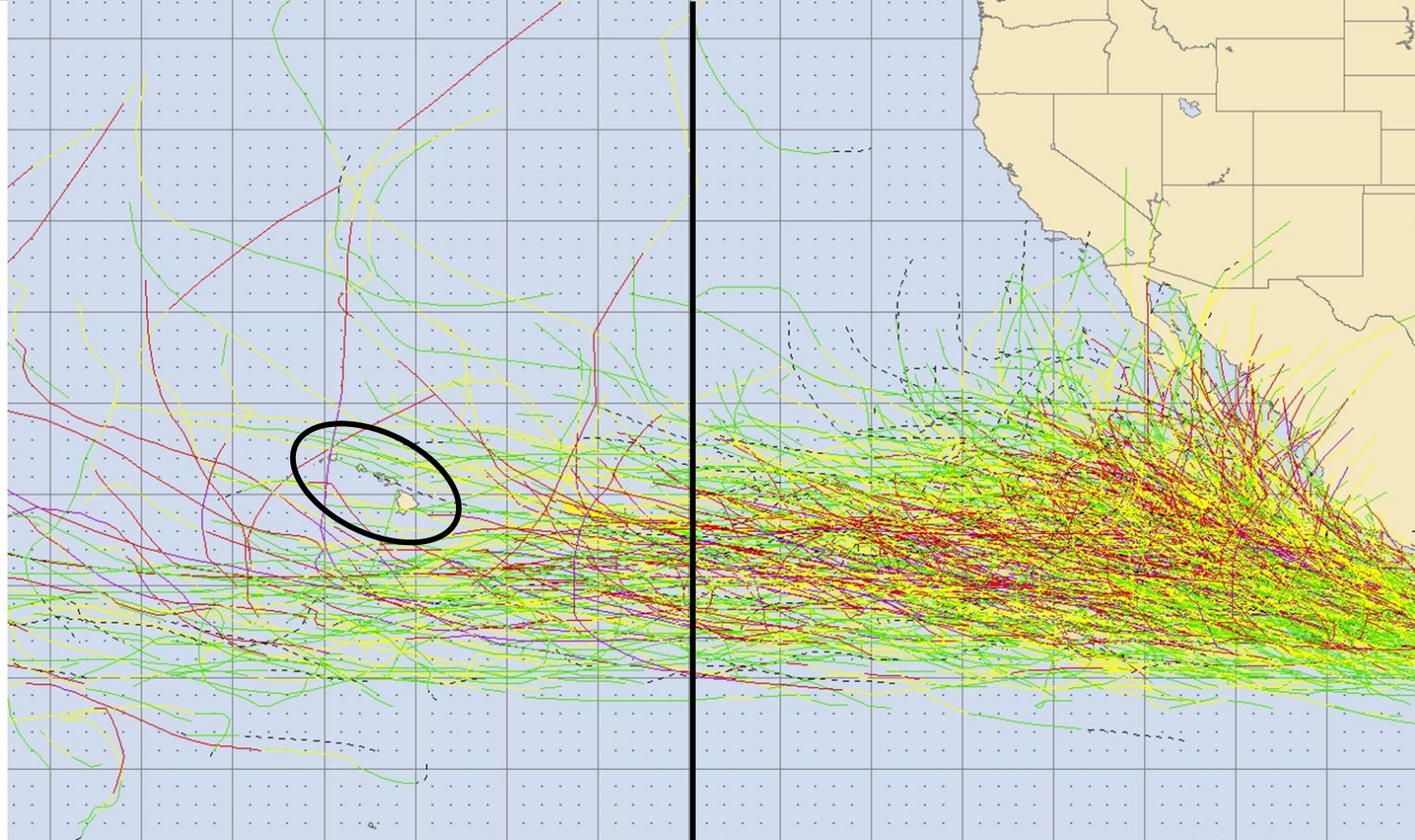
john.bravender@noaa.gov

Tropical Cyclone Climatology

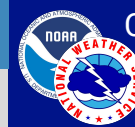
All tropical cyclone tracks from 1970-2016



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Honolulu, HI

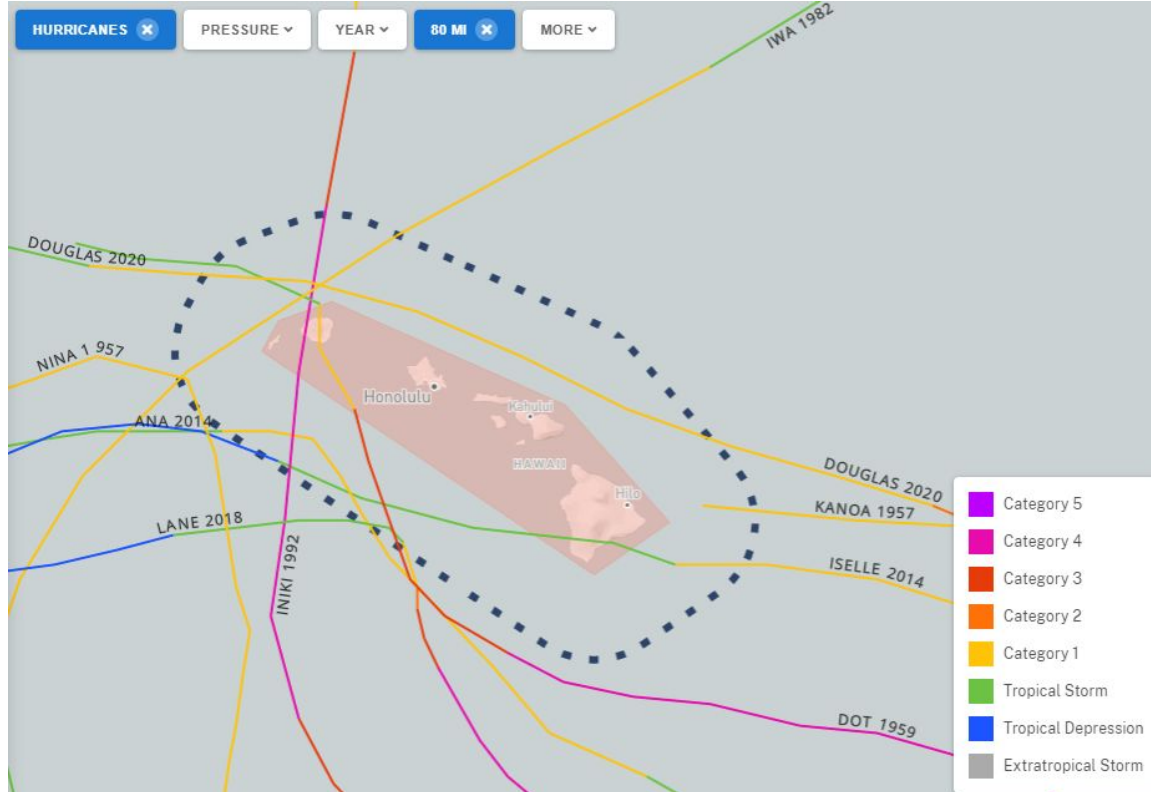


Tropical Cyclone Fatalities and Damage in Hawaii



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Hurricanes near Hawaii (1950-2022)



Source: <https://coast.noaa.gov/hurricanes/>

Sample searches: [all East Pacific](#), [hurricanes near Hawaii](#) (above)

Damaging tropical cyclones:

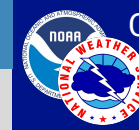
- Lane 2018: 1 fatality, \$250 million
- Iselle 2014: 1 fatality, \$148 million
- Iniki 1992: 7 fatalities, \$3.1 billion
- Iwa 1982: 2 fatalities, \$312 million
- Dot 1959: \$6 million

26 fatalities since 1950:

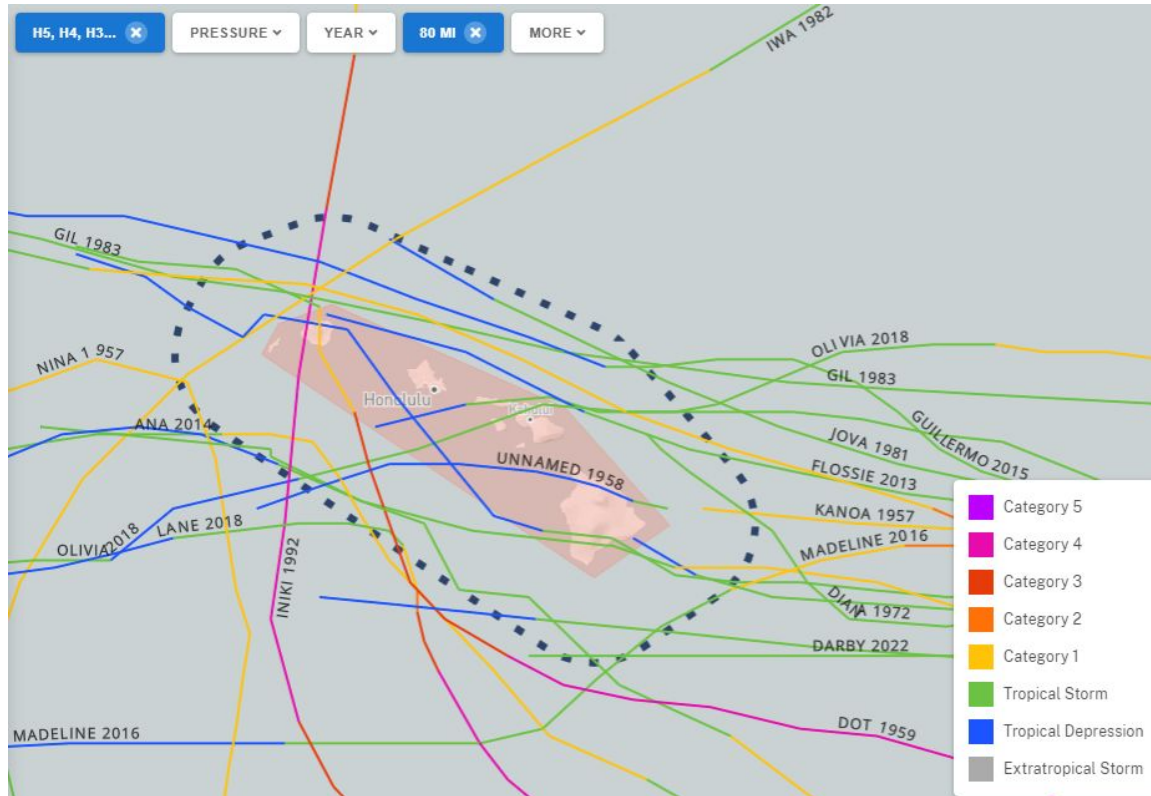
- 9 lost at sea
- 6 drown due to rough surf
- 2 drown in freshwater

Tropical Cyclone Fatalities and Damage in Hawaii

Hurricanes/Tropical Storms near Hawaii (1950-2022)



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Source: <https://coast.noaa.gov/hurricanes/>

Sample searches: [all East Pacific](#), [hurricane/T.S. near Hawaii](#) (above)

Damaging tropical cyclones:

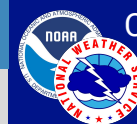
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26 fatalities since 1950:

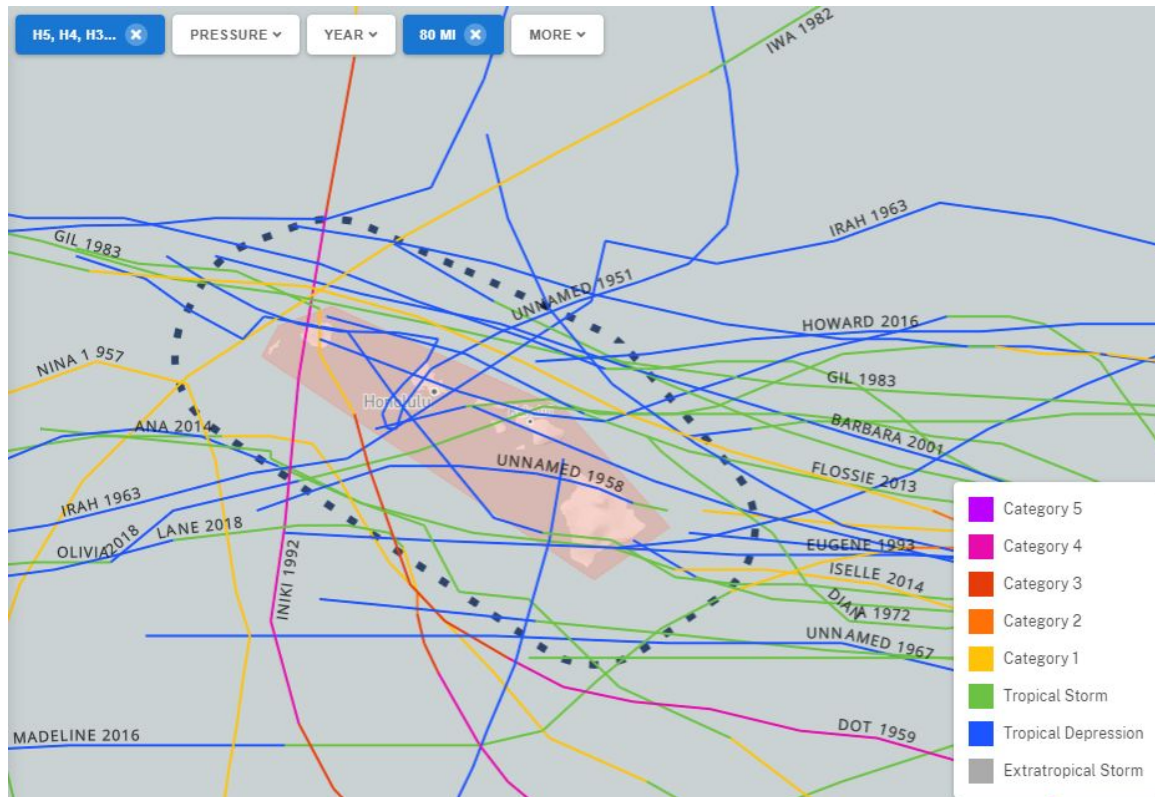
- 9 lost at sea
- 6 drown due to rough surf
- 2 drown in freshwater

Tropical Cyclone Fatalities and Damage in Hawaii

Hurricane/Tropical Storm/Depression near Hawaii (1950-2022)



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Damaging tropical cyclones:

- Lane 2018: 1 fatality, \$250 million
- Iselle 2014: 1 fatality, \$148 million
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26 fatalities since 1950:

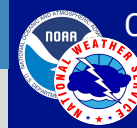
- 9 lost at sea
- 6 drown due to rough surf
- 2 drown in freshwater

Source: <https://coast.noaa.gov/hurricanes/>

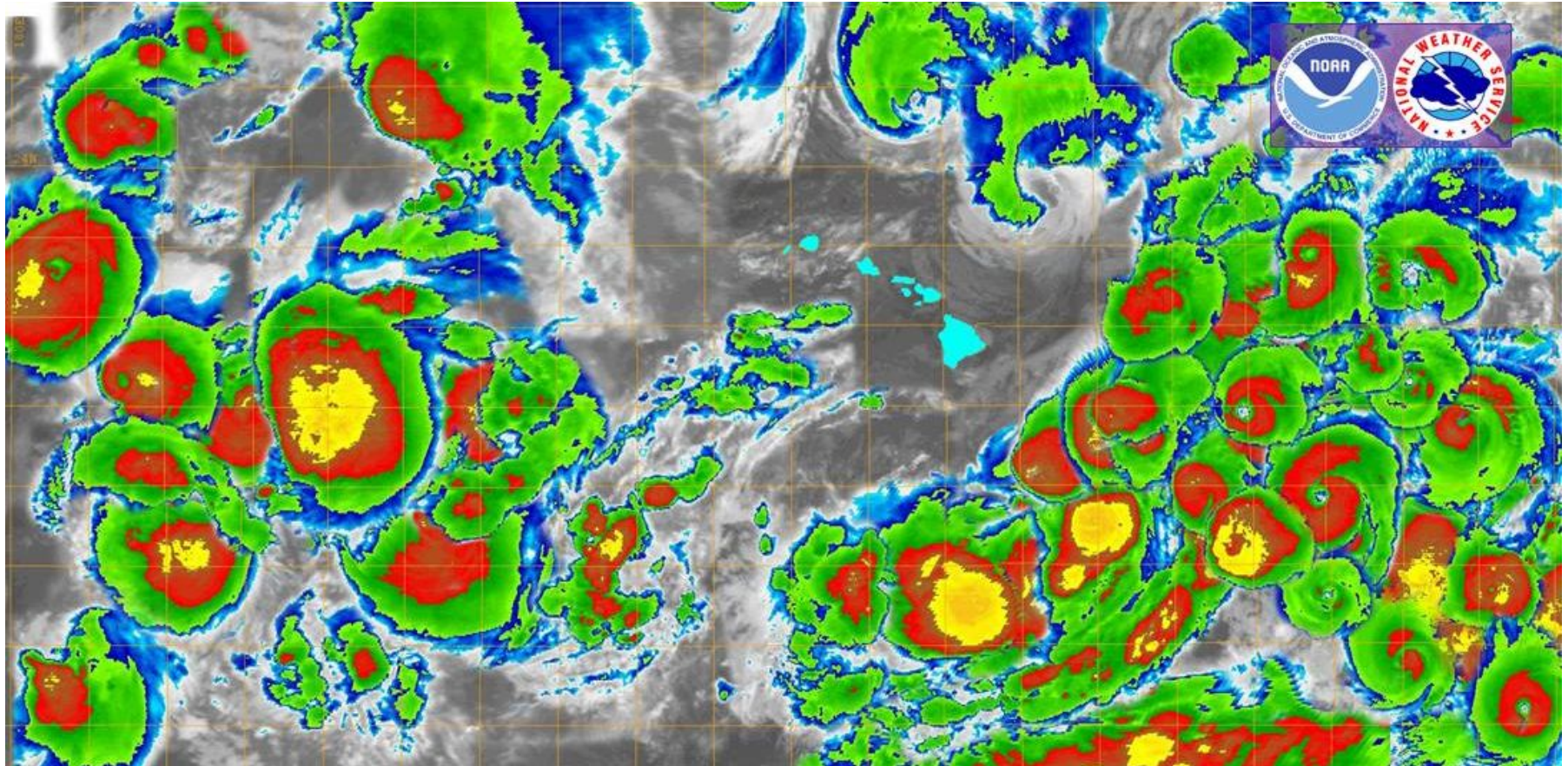
Sample searches: [all East Pacific](#), [tropical cyclones near Hawaii](#) (above)

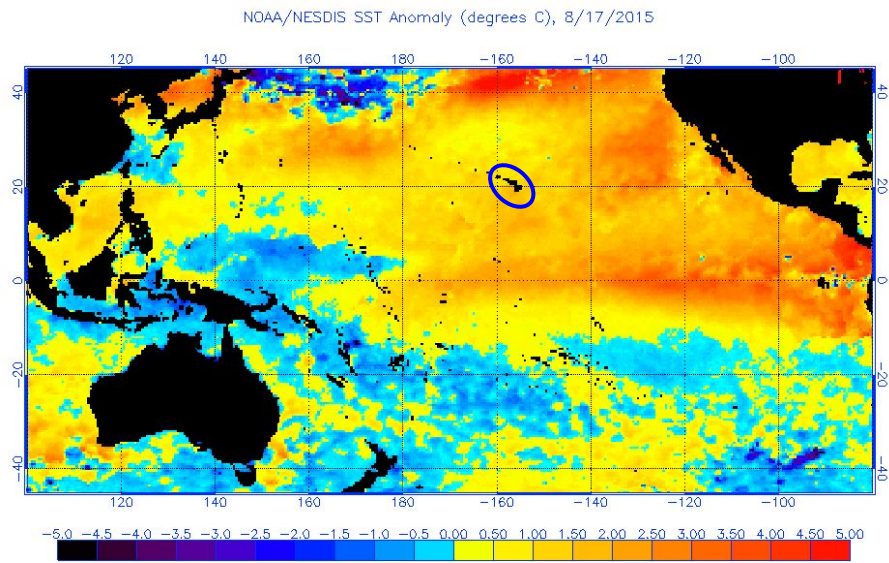
2015: 16 Tropical Cyclones in the Central Pacific

Record-setting hurricane season (average 4-5 TCs per year)

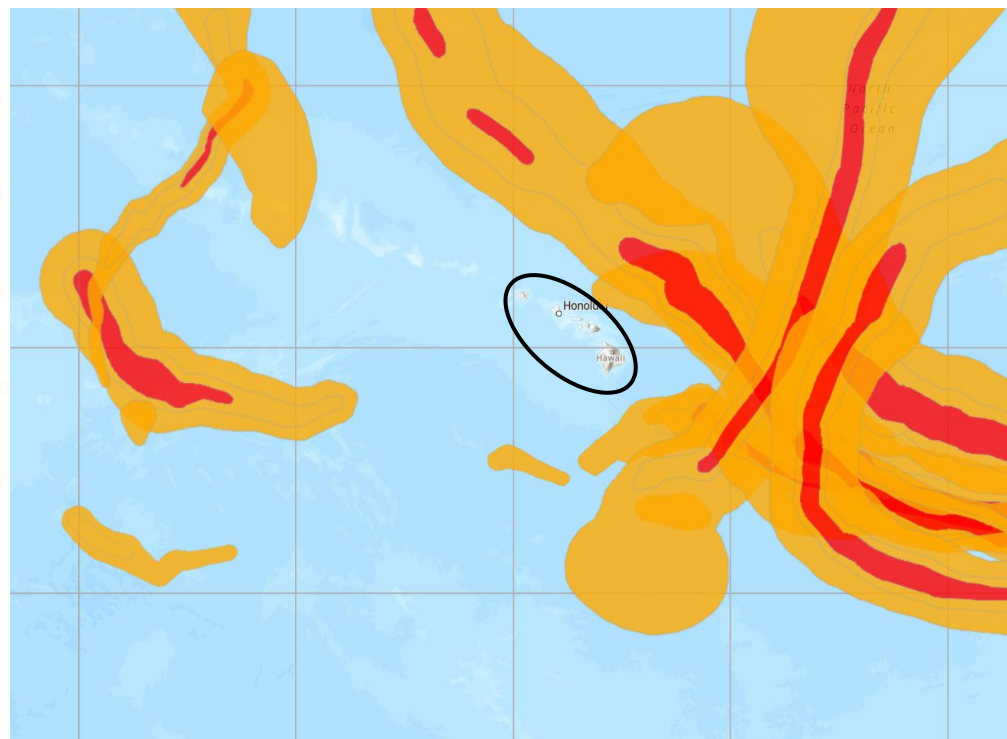


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- Strong El Niño event
- Also warmer than normal through much of the northeast Pacific

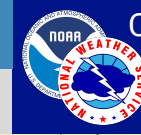


Composite wind field of all 16 tropical cyclones from 2015

- Orange: tropical storm (≥ 39 mph)
- Red: hurricane (≥ 74 mph)

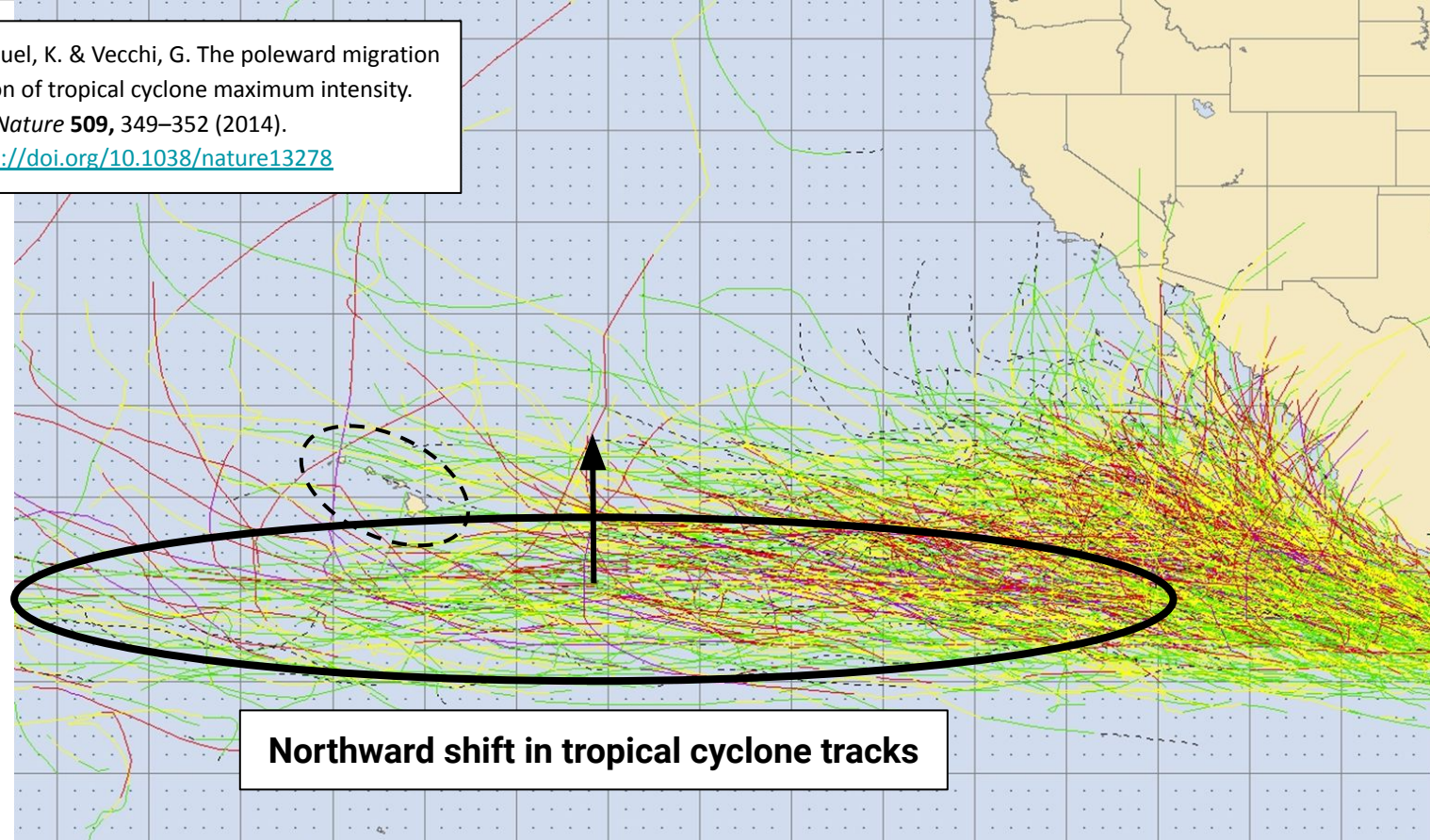
Impacts of a Warming Ocean

Observed: covering the 31 year period 1982-2012



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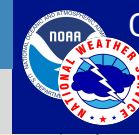
Kossin, J., Emanuel, K. & Vecchi, G. The poleward migration of the location of tropical cyclone maximum intensity. *Nature* **509**, 349–352 (2014).
<https://doi.org/10.1038/nature13278>



Northward shift in tropical cyclone tracks

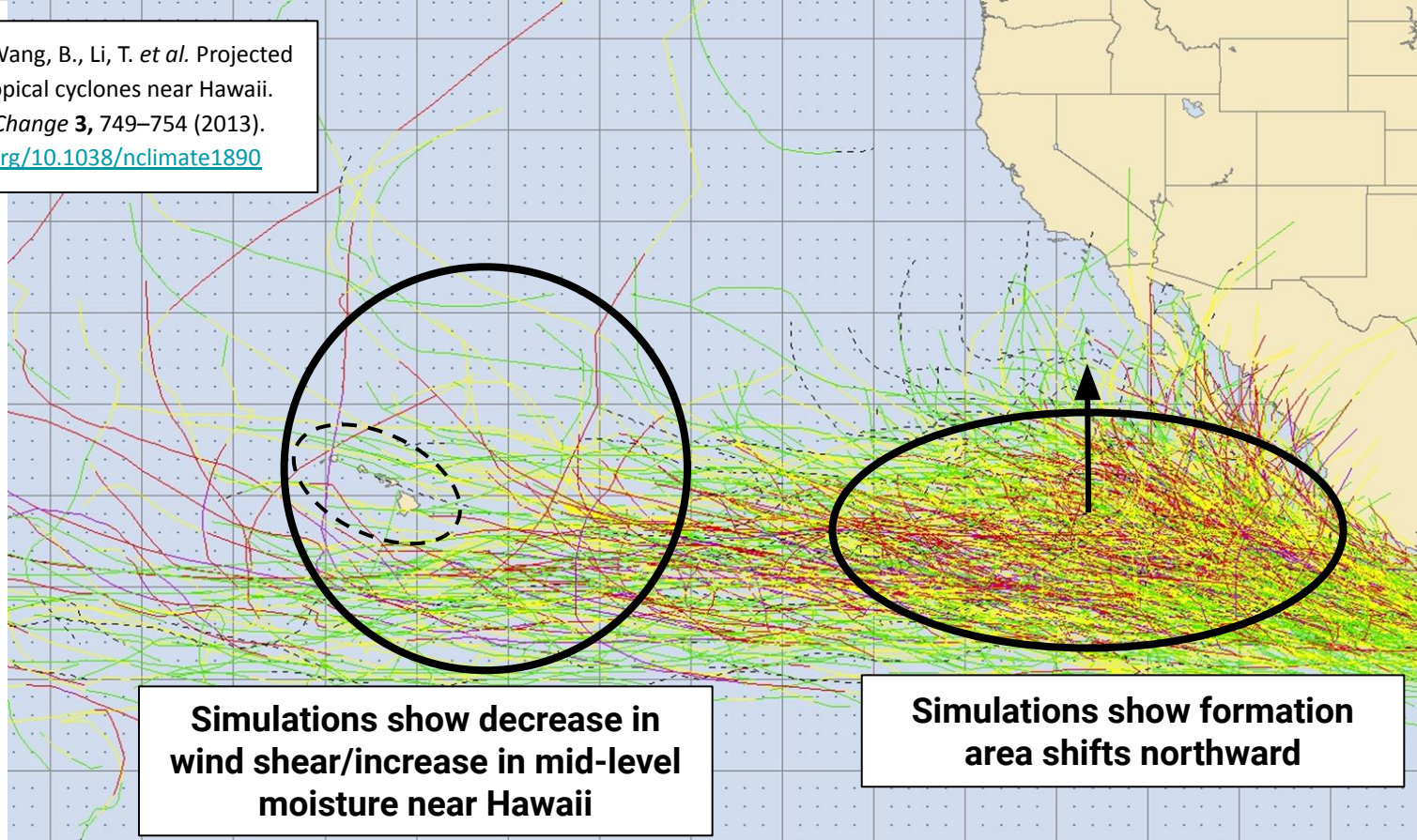
Impacts of a Warming Ocean

Computer simulation: modeled for the future period 2075-2099



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Murakami, H., Wang, B., Li, T. *et al.* Projected increase in tropical cyclones near Hawaii.
Nature Clim Change **3**, 749–754 (2013).
<https://doi.org/10.1038/nclimate1890>

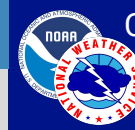


Simulations show decrease in wind shear/increase in mid-level moisture near Hawaii

Simulations show formation area shifts northward

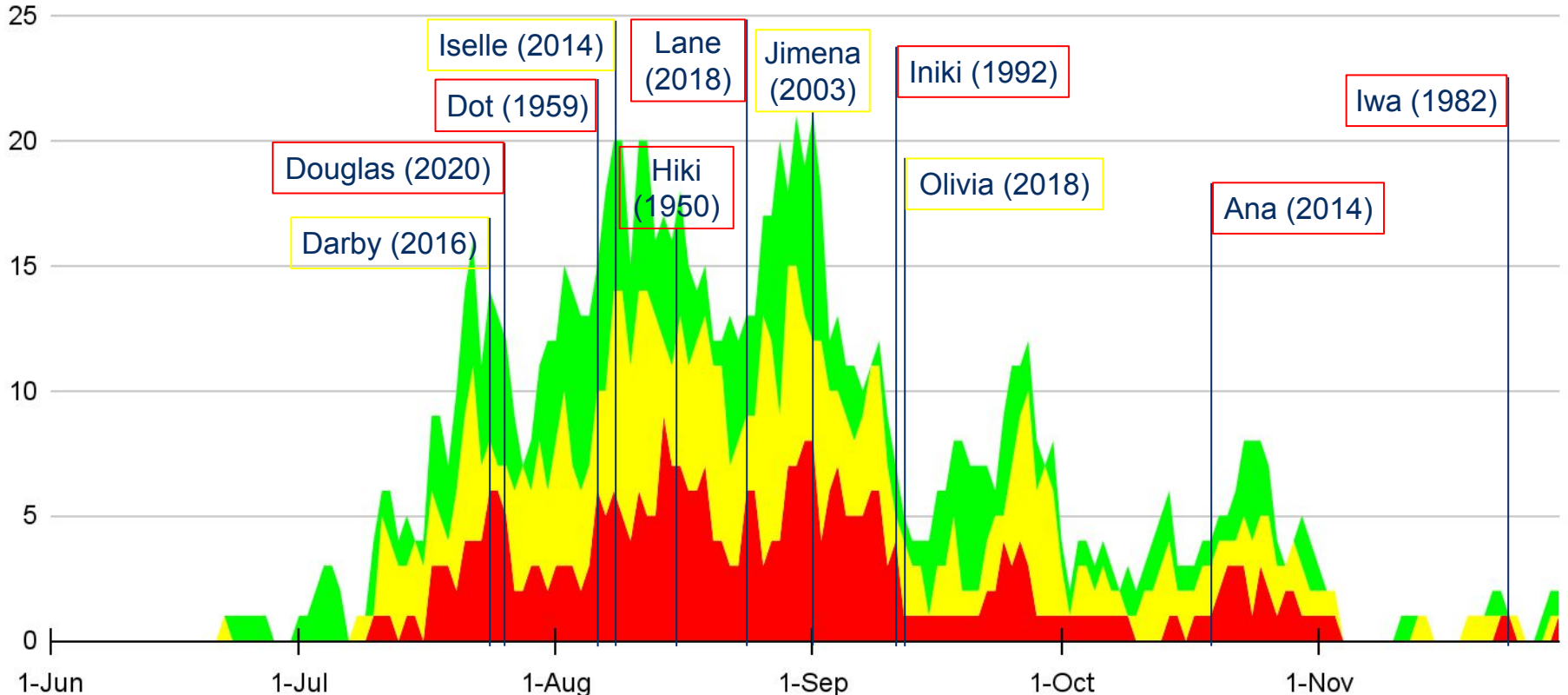
Tropical Cyclone Activity By Day – Central Pacific

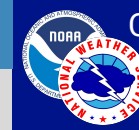
Hurricanes/Tropical Storms/Tropical Depressions, 1950-2022

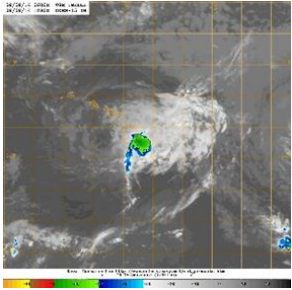
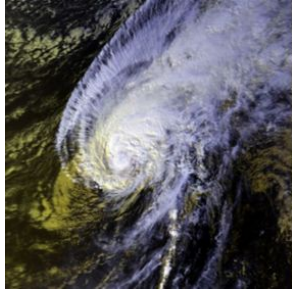
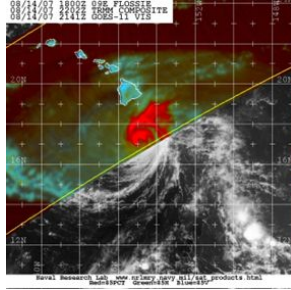
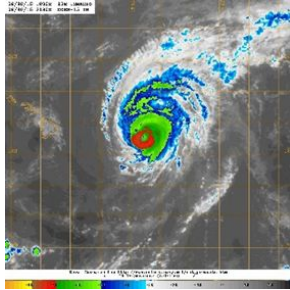
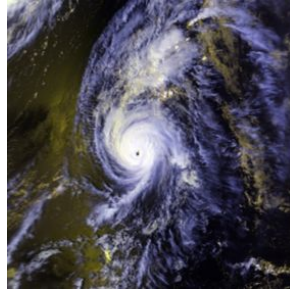



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● Tropical Depressions + Tropical Storms + Hurricanes ● Tropical Storms + Hurricanes ● Hurricanes



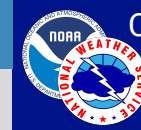


Major Hurricanes					
Tropical Storm Winds: 39-73 mph (34-63 kt)	Category 1 Winds: 74-95 mph (64-82 kt)	Category 2 Winds: 96-110 mph (83-95 kt)	Category 3 Winds: 111-129 mph (96-112 kt)	Category 4 Winds: 130-156 mph (113-136 kt)	Category 5 Winds: 157+ mph (> 137 kt)
Iselle (2014) 	Iwa (1982) 	Flossie (2007) 	Ignacio (2015) 	Iniki (1992) 	Lane (2018) 






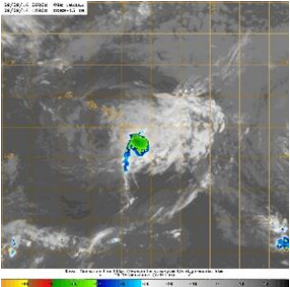
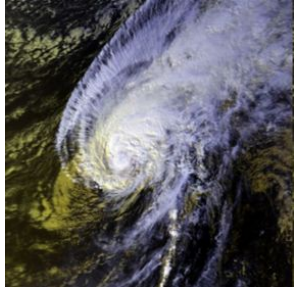
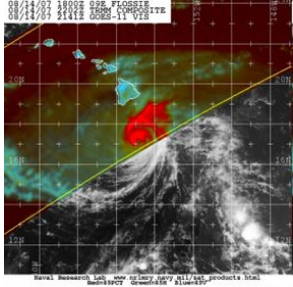
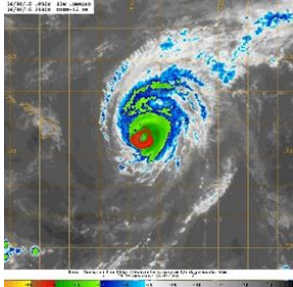
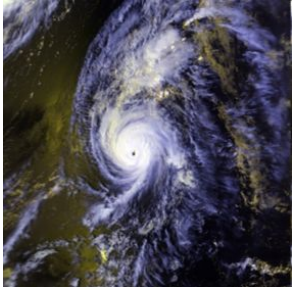
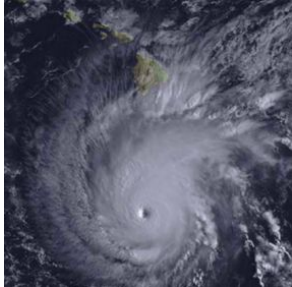
- Storm surge is not tied to the Saffir-Simpson Scale
- Storm surge values can vary dramatically by wind speed and category

Saffir-Simpson Hurricane Wind Scale

Central Pacific Tropical Cyclone Examples

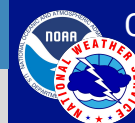


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Saffir-Simpson Hurricane Wind Scale

Central Pacific Tropical Cyclone Examples

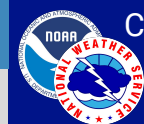


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Shingles, awnings removed from houses and carports incur minor damage. More significant damage to old/weak structures. Tree limbs break and shallow rooted trees may be toppled. Damage to power lines and poles likely will result in power outages that could last several days.	Well-constructed frame homes could have damage to roof, shingles, vinyl siding and gutters. Large branches of trees will snap and shallowly rooted trees may be toppled. Extensive damage to power lines and poles likely will result in power outages that could last several days.	Well-constructed frame homes could sustain major roof and siding damage. Many shallowly rooted trees will be snapped or uprooted and block numerous roads. Near-total power loss is expected with outages that could last from several days to weeks.	Well-built framed homes may incur major damage or removal of roof decking and gable ends. Many trees will be snapped or uprooted, blocking numerous roads. Electricity and water will be unavailable for several days to weeks after the storm passes.	Well-built framed homes can sustain severe damage with loss of most of the roof structure and/or some exterior walls. Most trees will be snapped or uprooted and power poles downed. Fallen trees and power poles will isolate residential areas. Power outages will last weeks to months.	Well-built framed homes can sustain severe damage with loss of most of the roof structure and/or some exterior walls. Most trees will be snapped or uprooted and power poles downed. Fallen trees and power poles will isolate residential areas. Power outages will last weeks to months.

Saffir-Simpson Hurricane Wind Scale

Damage increases exponentially as wind speed increases



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Iselle (2014)	Iwa (1982)	Flossie (2007)	Ignacio (2015)	Iniki (1992)	Lane (2018)
Wind damage multiplier compared to a 75 mph hurricane:	75 mph: 1x 80 mph: 1.6x 85 mph: 2.9x 90 mph: 4.3x 95 mph: 6.6x	100 mph: 10x 105 mph: 15x 110 mph: 21x	115 mph: 30x 120 mph: 43x 125 mph: 60x	130 mph: 82x 135 mph: 110x 140 mph: 147x 145 mph: 195x 150 mph: 256x 155 mph: 333x	160 mph: 429x 165 mph: 549x 170 mph: 697x 175 mph: 879x 180 mph: 1101x 185 mph: 1371x



Image source: <https://www.noaa.gov/jetstream/tc-potential>

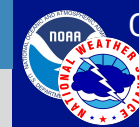
“Good structure, a little luck

Warren Adams insists that there is nothing special about the way the home was constructed. It was built to Galveston County code, he said, which anticipates 130-mile-per-hour winds on the seaward side of the county.

But the elevation may have helped. Adams said he built high, in part, to get a break on flood insurance. The home sits 15 feet above ground.”

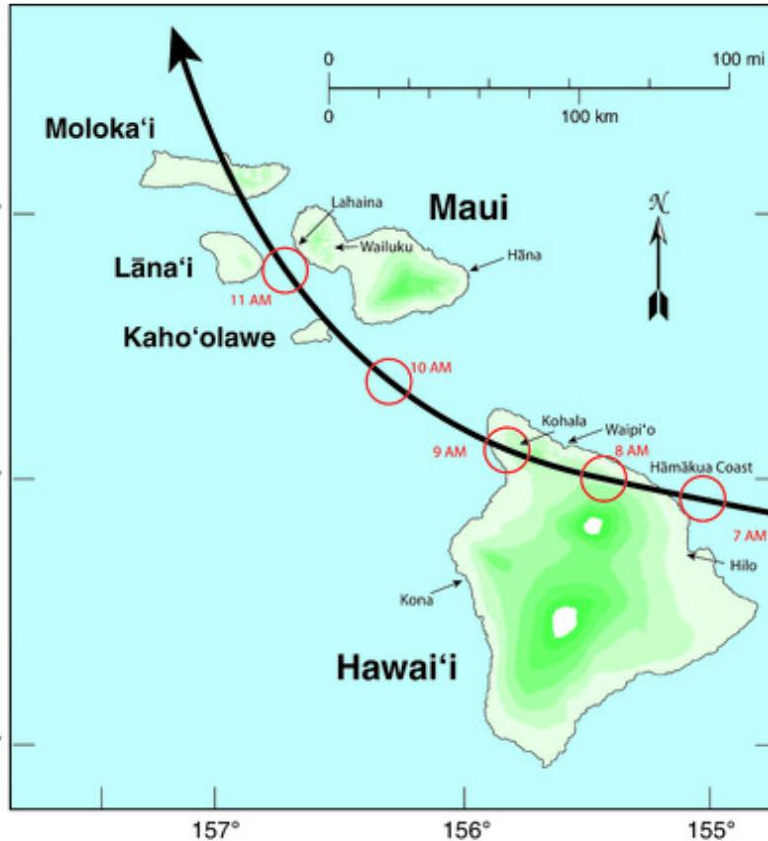
Source: [Houston Chronicle, Sep 26, 2008](#)

Kohala Cyclone – August 9, 1871



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Track and intensity reconstructed from newspaper accounts



Category 3 intensity (111 to 129 mph) based on newspaper damage reports, such as:

Waipi'o:

- “There were 28 houses blown clean away and many more partially destroyed. There is hardly a tree or bush of any kind standing in the valley.”

Kohala:

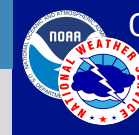
- “About 150 houses were blown down. A mango tree was snapped as a pipe stem, just above the surface of the ground. Old solid Kukui trees, which had stood the storms of a score of years were torn up and pitched about like chaff.”

*“Hurricane with a History: Hawaiian Newspapers
Illuminate an 1871 Storm”*

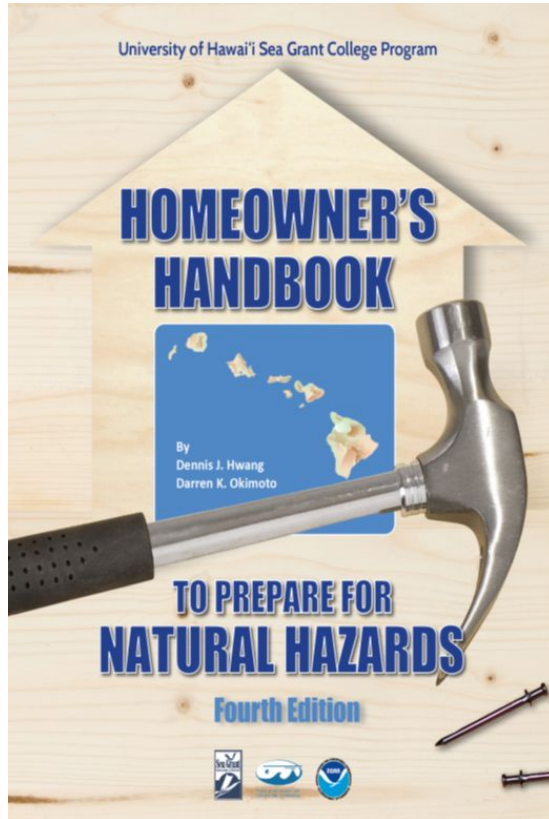
<https://doi.org/10.1175/BAMS-D-16-0333.1>

Where Can You Start?

Free publication from UH Sea Grant College Program



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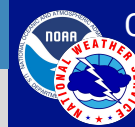


ABILITY TO SHELTER IN PLACE DURING A HURRICANE					
PLEASE READ INSTRUCTIONS BEFORE USING THIS TABLE					
	FEMA or Hawai'i Residential Safe Room				
Safe room					
Concrete or CMU wall house	Concrete CMU wall house in poor condition	→	Concrete CMU wall house in good condition	→	Concrete CMU wall house with hurricane clips
				→	Concrete CMU wall house with hurricane clips & window protection
Double wall house	Double wall house in poor condition	→	Double wall house in good condition	→	Double wall house with hurricane clips & window protection
				→	Double wall house with hurricane clips, window protection, garage & roof reinforced
Single wall house	Single wall house in poor condition	→	Single wall house in good condition	→	Single wall house with hurricane clips
				→	Single wall house with hurricane clips & window protection
Suggested Action	Single wall house with complete load path	→	Double wall with complete load path	→	Double wall with complete load path, window protection, garage & roof reinforced
	Single wall house with clips, window protection and foundation upgrades	→	Single wall house with complete load path, window protection, garage & roof reinforced	→	Double wall with complete load path, window protection, garage & roof reinforced
	Unsafe Evacuate! Do Not Shelter in place		Marginal Shelter in place up to a Tropical Storm		Good Shelter in place up to Category 1 hurricane
					Better Shelter in place up to Category 2 hurricane
					Best Shelter in place up to Category 3 hurricane

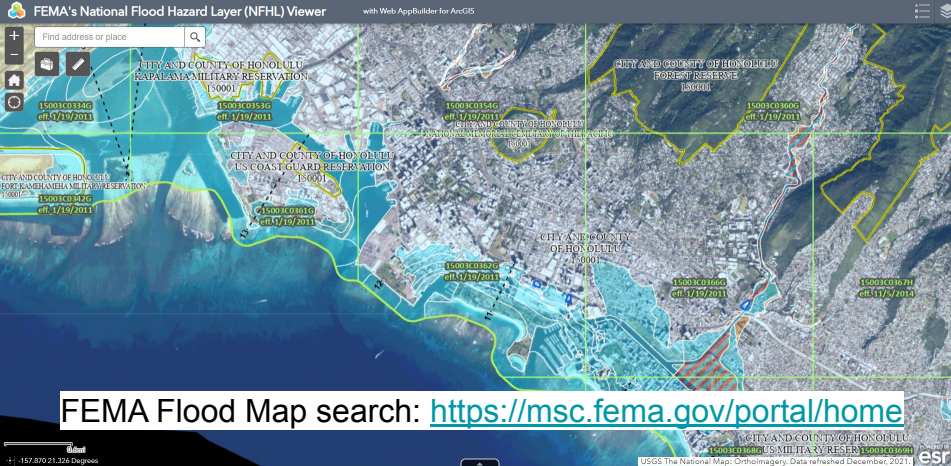
<https://seagrant.soest.hawaii.edu/homeowners-handbook-to-prepare-for-natural-hazards/>

Preparedness Information

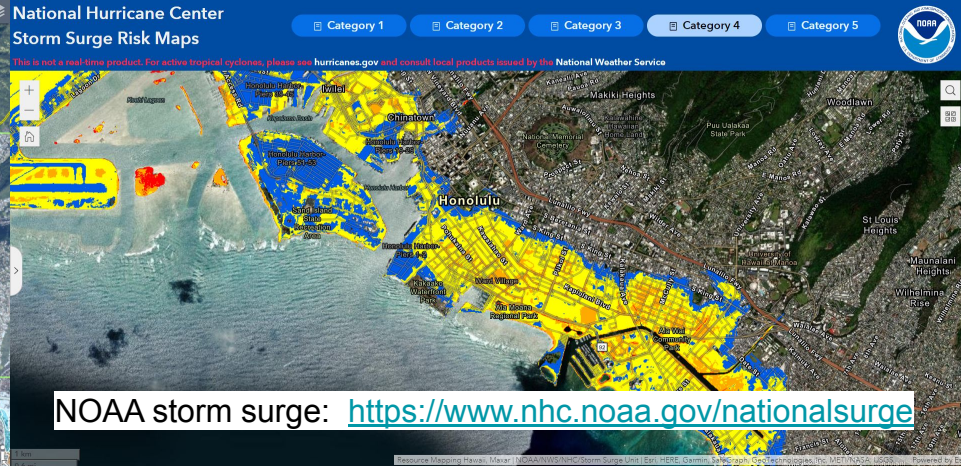
Flooding: freshwater or saltwater



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FEMA Flood Map search: <https://msc.fema.gov/portal/home>



NOAA storm surge: <https://www.nhc.noaa.gov/nationalsurge>



Tsunami inundation: <https://tsunami.coast.noaa.gov/>

Any questions?

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Central Pacific Hurricane Center
john.bravender@noaa.gov

A QUICK REFERENCE FOR HURRICANE CATEGORIES

