



PACIFIC ISLANDS CLIMATE OUTLOOK FORUM - 13

23 - 27 OCTOBER, 2023
NADI, FIJI



Looking Forward – Tropical Cyclones and Surface Winds

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Some record-breaking TCs in recent years...

Hurricane Harvey (August 2017)

- Hurricane Harvey in 2017 was the costliest hurricane in the history of North Atlantic hurricane (tied with Hurricane *Katarina* in 2005)

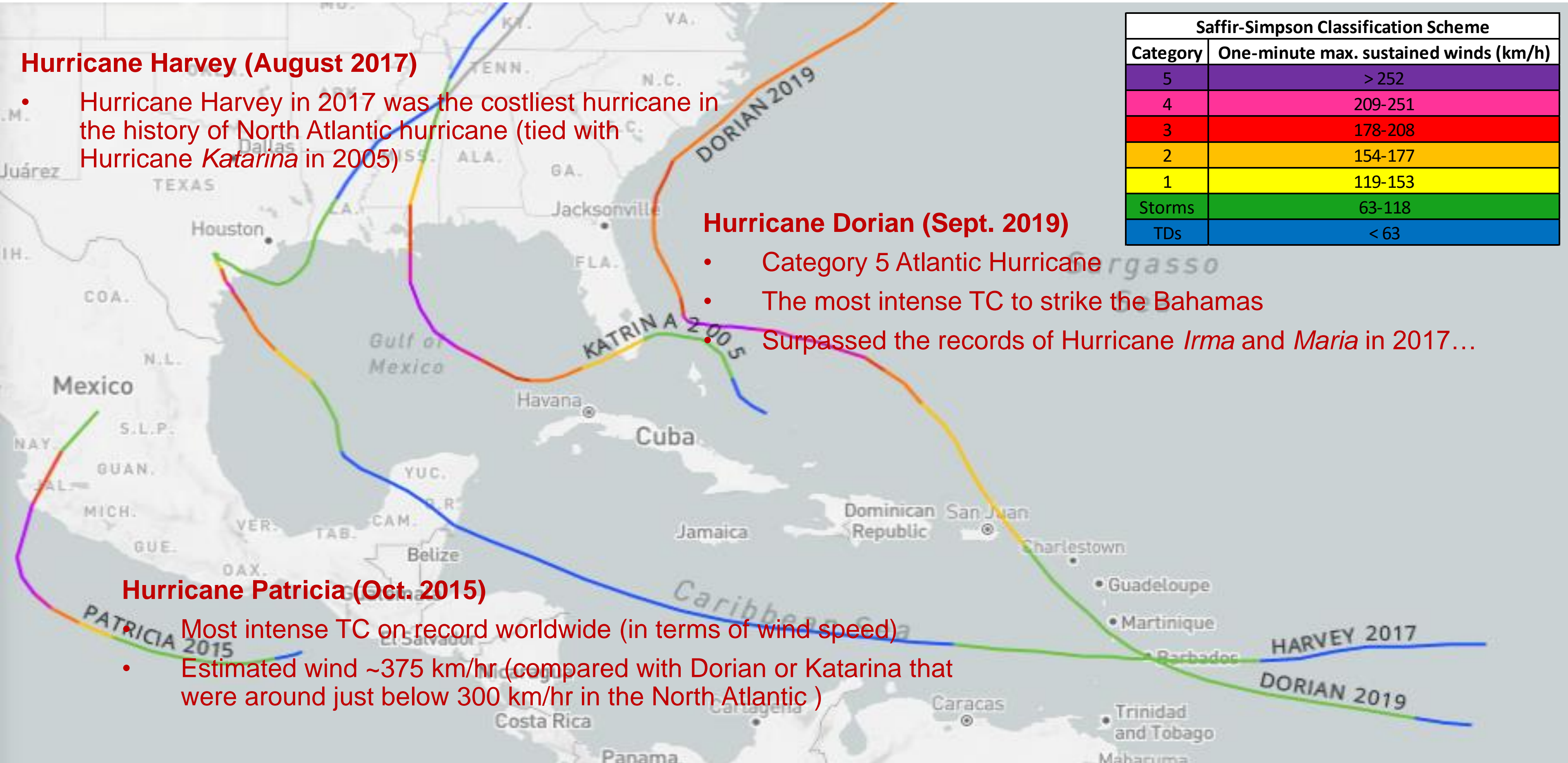
Hurricane Dorian (Sept. 2019)

- Category 5 Atlantic Hurricane
- The most intense TC to strike the Bahamas
- Surpassed the records of Hurricane *Irma* and *Maria* in 2017...

Saffir-Simpson Classification Scheme	
Category	One-minute max. sustained winds (km/h)
5	> 252
4	209-251
3	178-208
2	154-177
1	119-153
Storms	63-118
TDs	< 63

Hurricane Patricia (Oct. 2015)

- Most intense TC on record worldwide (in terms of wind speed)
- Estimated wind ~375 km/hr (compared with Dorian or Katarina that were around just below 300 km/hr in the North Atlantic)



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Typhoon Meranti (Sept. 2016)

- Second-strongest TC on record

Typhoon Haiyan (Sept. 2013)

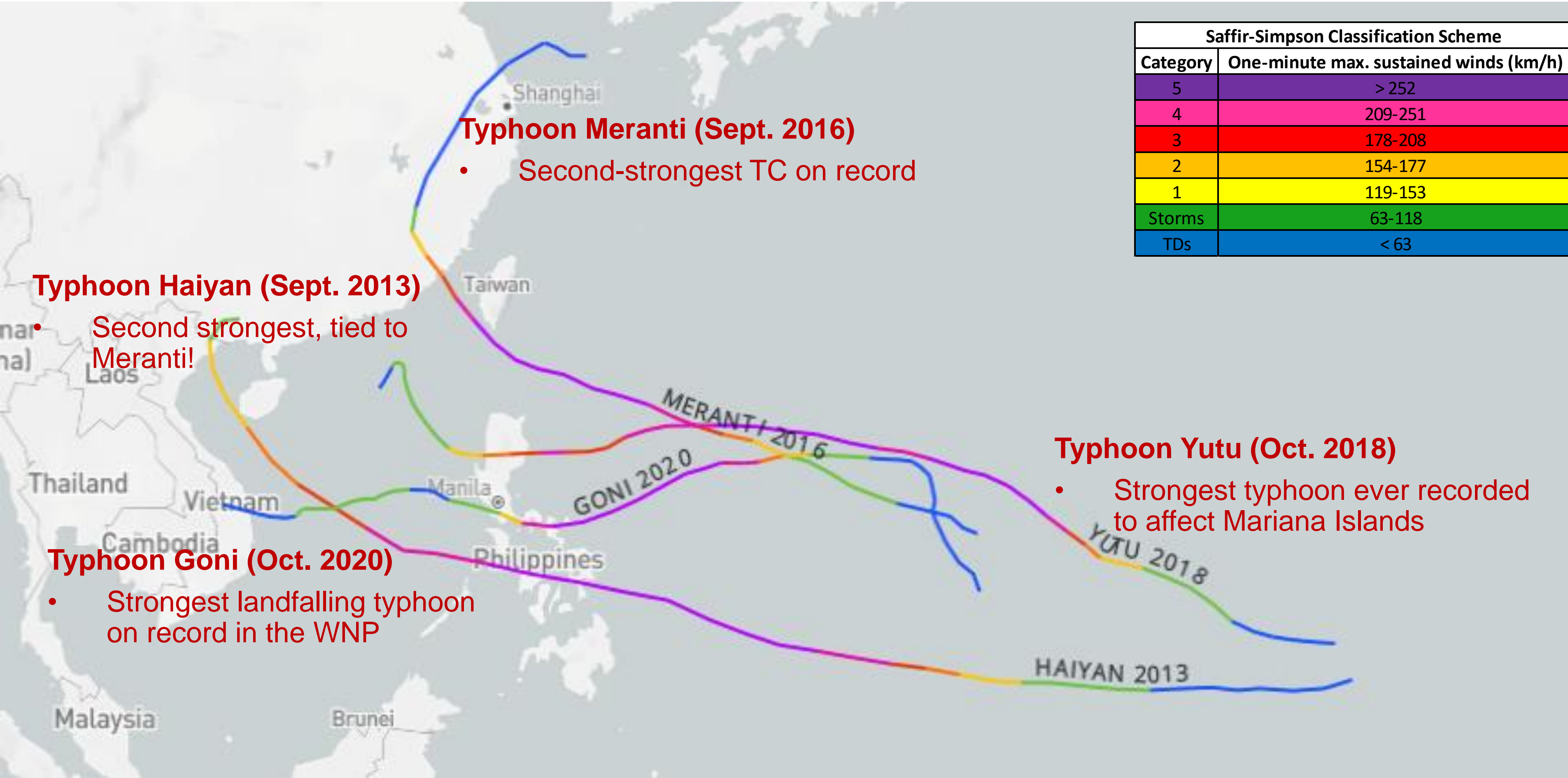
- Second strongest, tied to Meranti!

Typhoon Goni (Oct. 2020)

- Strongest landfalling typhoon on record in the WNP

Typhoon Yutu (Oct. 2018)

- Strongest typhoon ever recorded to affect Mariana Islands



Some record-breaking TCs in recent years...

Australian/Fiji Classification Scheme

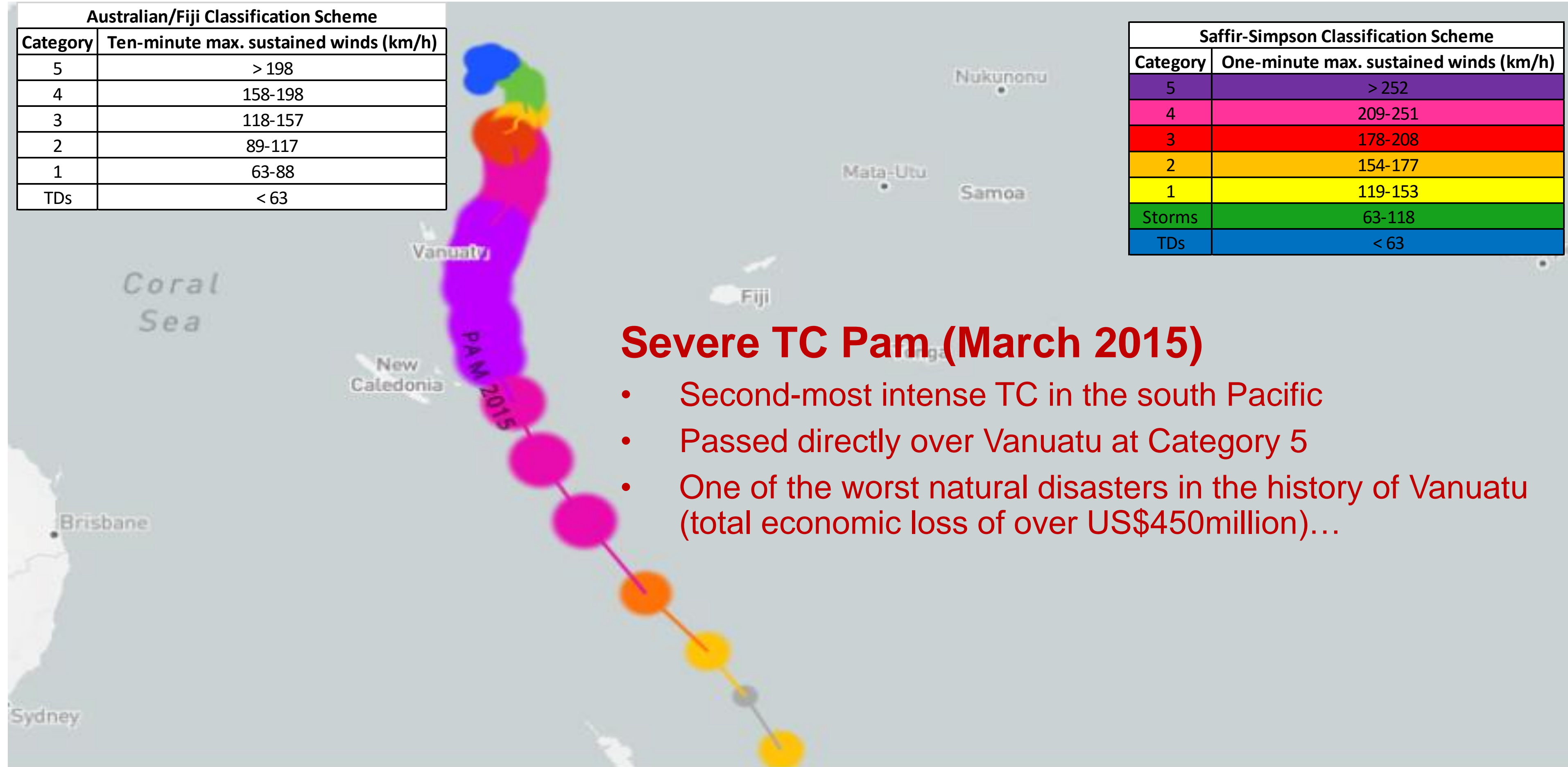
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Severe TC Pam (March 2015)

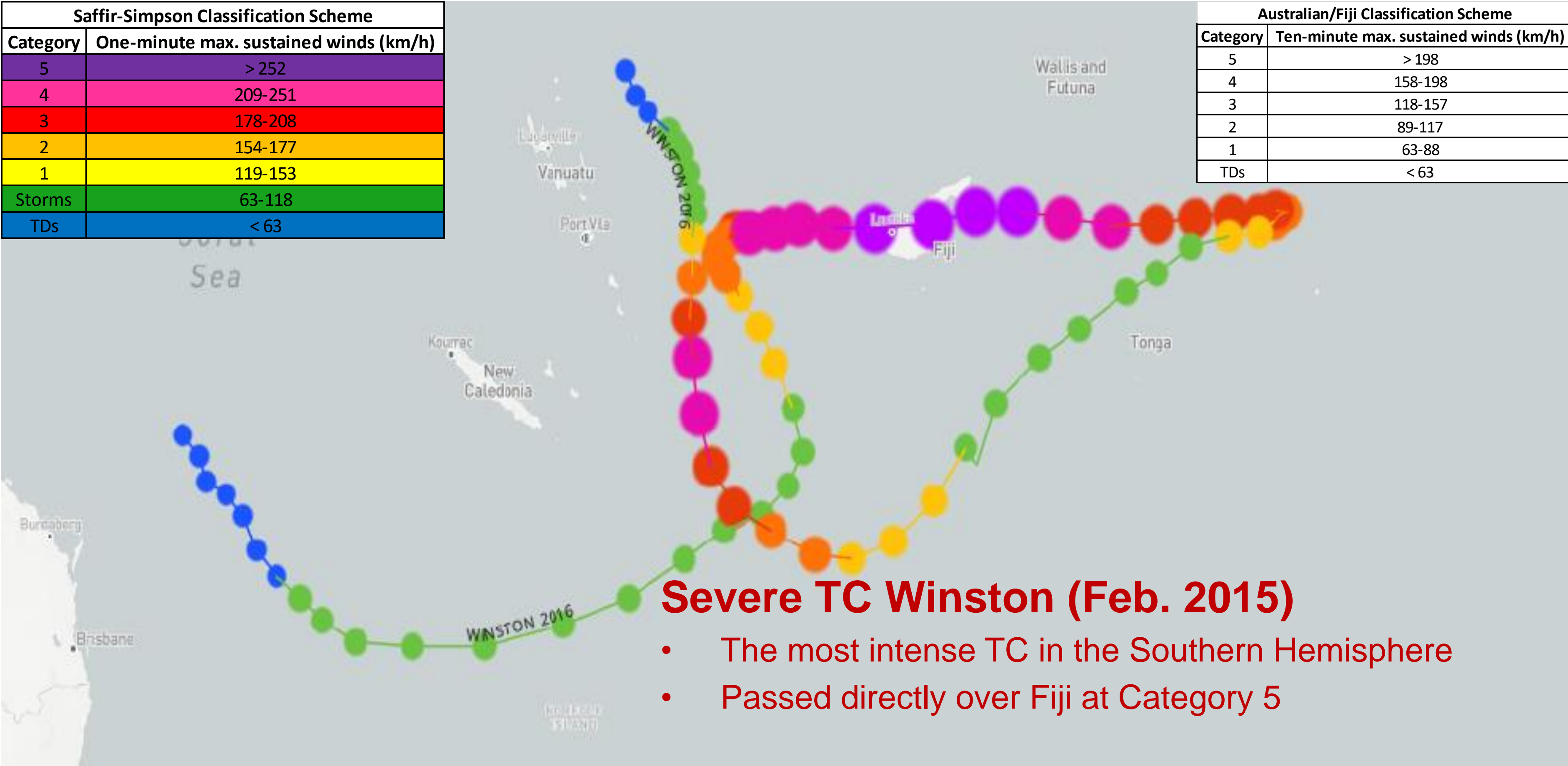
- Second-most intense TC in the south Pacific
- Passed directly over Vanuatu at Category 5
- One of the worst natural disasters in the history of Vanuatu (total economic loss of over US\$450million)...



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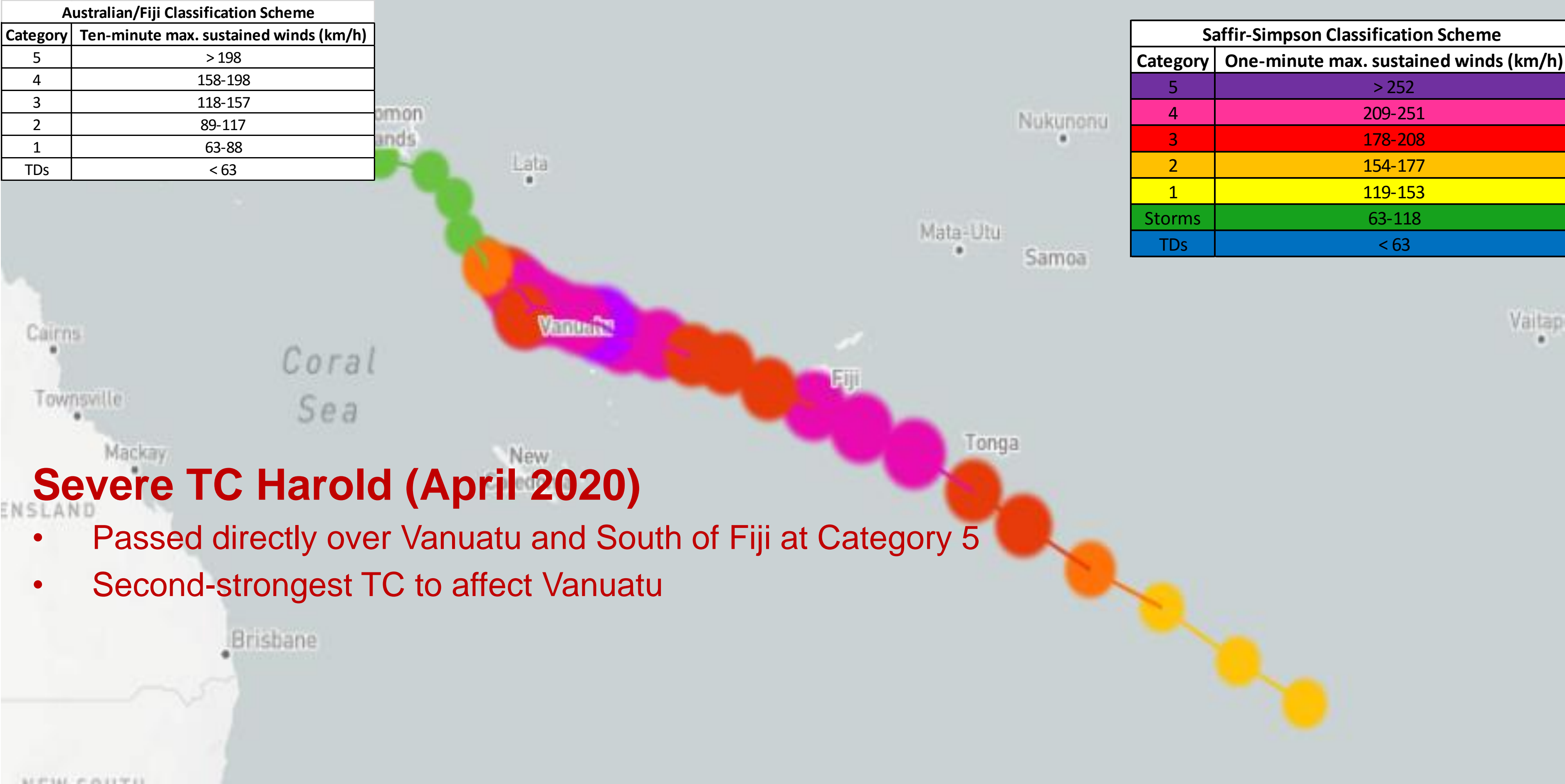
Severe TC Winston (Feb. 2015)

- The most intense TC in the Southern Hemisphere
- Passed directly over Fiji at Category 5

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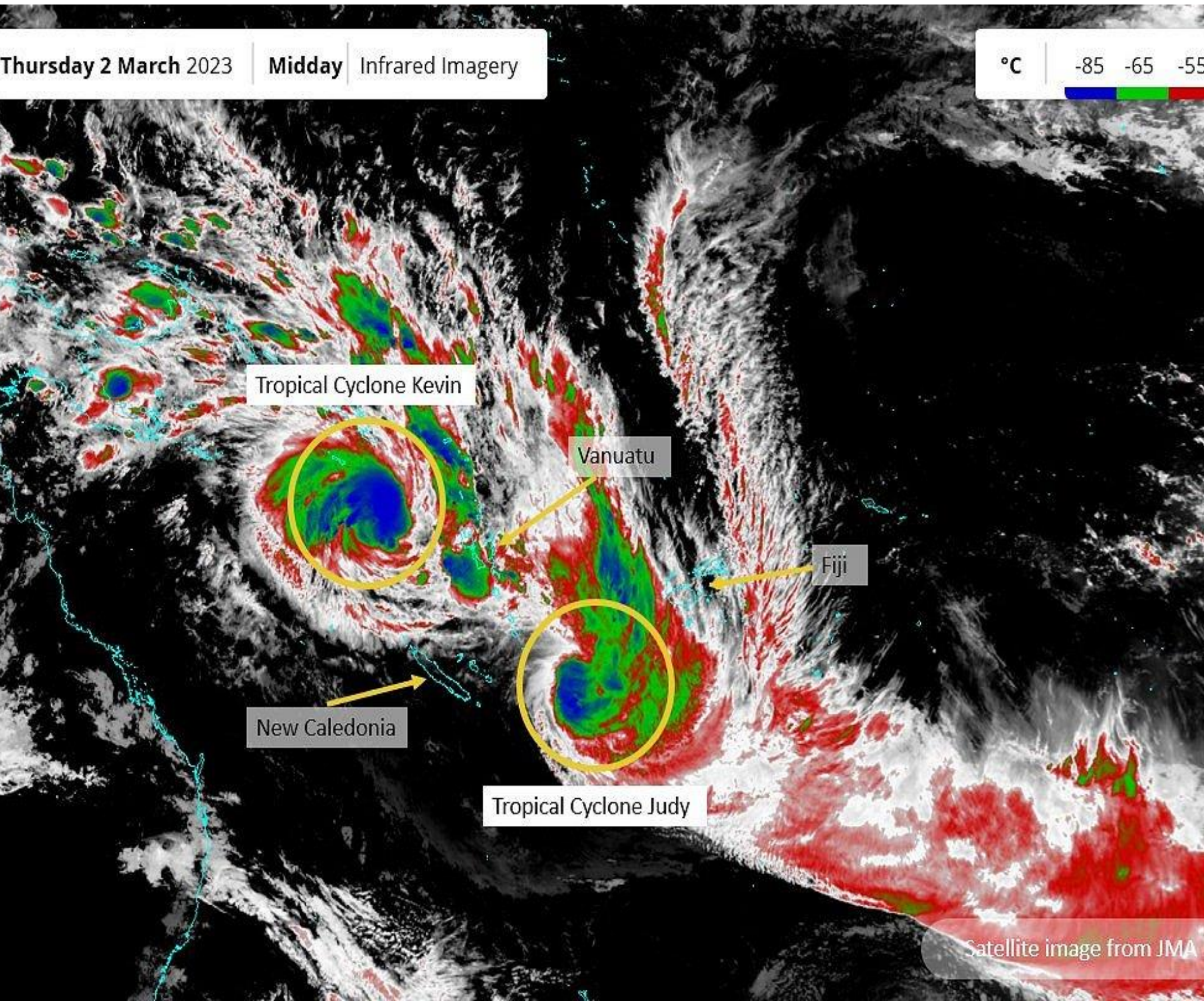
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Severe TC Harold (April 2020)

- Passed directly over Vanuatu and South of Fiji at Category 5
- Second-strongest TC to affect Vanuatu

Severe cyclones Judy and Kevin, March 2023



A pair of intense tropical cyclones that made landfall over Vanuatu within 48 hours of each other in March 2023.

Severe Tropical Cyclone Freddy, March 2023



Freddy is both the longest-lasting and highest ACE-producing tropical cyclone ever recorded worldwide, traveling across the southern Indian Ocean, Mozambique, and Madagascar for 37 days.

How tropical cyclone characteristics are likely to change in future due to global warming?

TC Frequency?

Intensity?

Propagation speed?

Size?

Poleward migration?

Sequential events?

Widespread impact from cyclone *Winston* in Fiji

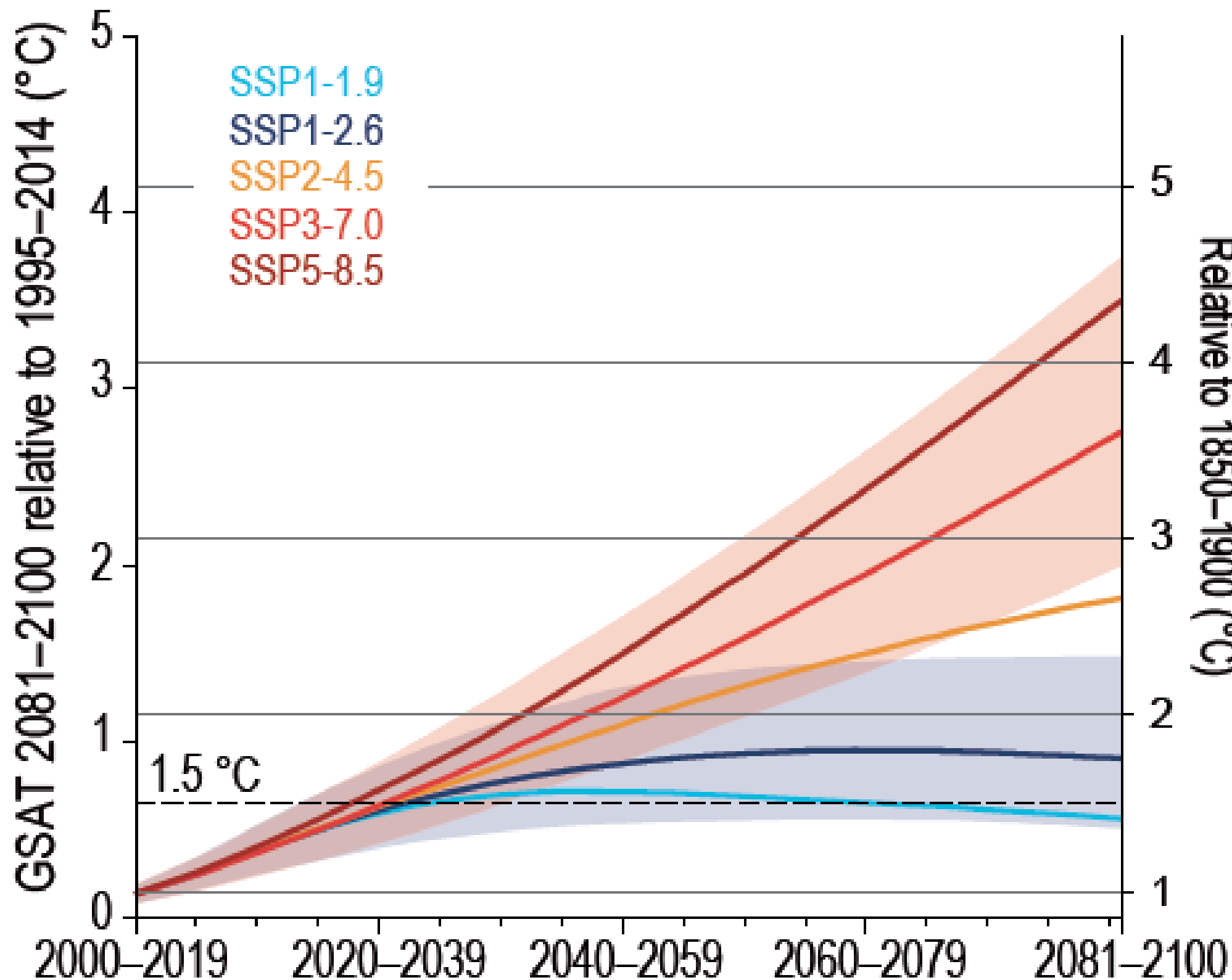


Source: FBC news

There is no doubt that cyclones are the costliest natural disaster affecting communities in the Pacific island countries.

We also know that majority of population and infrastructure in the Pacific are in the vicinity of coastlines... coastal infrastructure and population are also likely to grow in future (plans to expand tourism sector etc.)!

Anthropogenic Global Warming

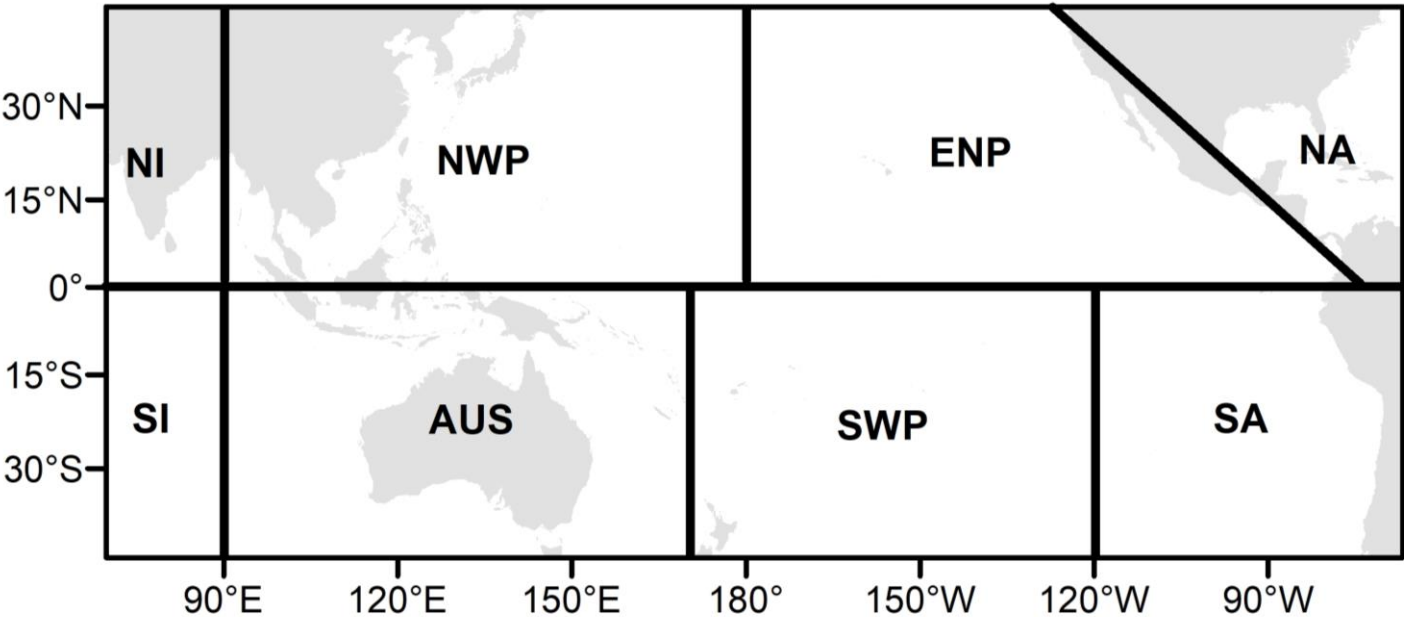


Category in WGIII	Category description	GHG emissions scenarios (SSPx-y*) in WGI & WGI	RCPy** in WGI & WGI
C1	limit warming to 1.5°C (>50%) with no or limited overshoot	Very low (SSP1-1.9)	
C2	return warming to 1.5°C (>50%) after a high overshoot		
C3	limit warming to 2°C (>67%)	Low (SSP1-2.6)	RCP2.6
C4	limit warming to 2°C (>50%)		
C5	limit warming to 2.5°C (>50%)		
C6	limit warming to 3°C (>50%)	Intermediate (SSP2-4.5)	RCP 4.5
C7	limit warming to 4°C (>50%)	High (SSP3-7.0)	
C8	exceed warming of 4°C (>50%)	Very high (SSP5-8.5)	RCP 8.5

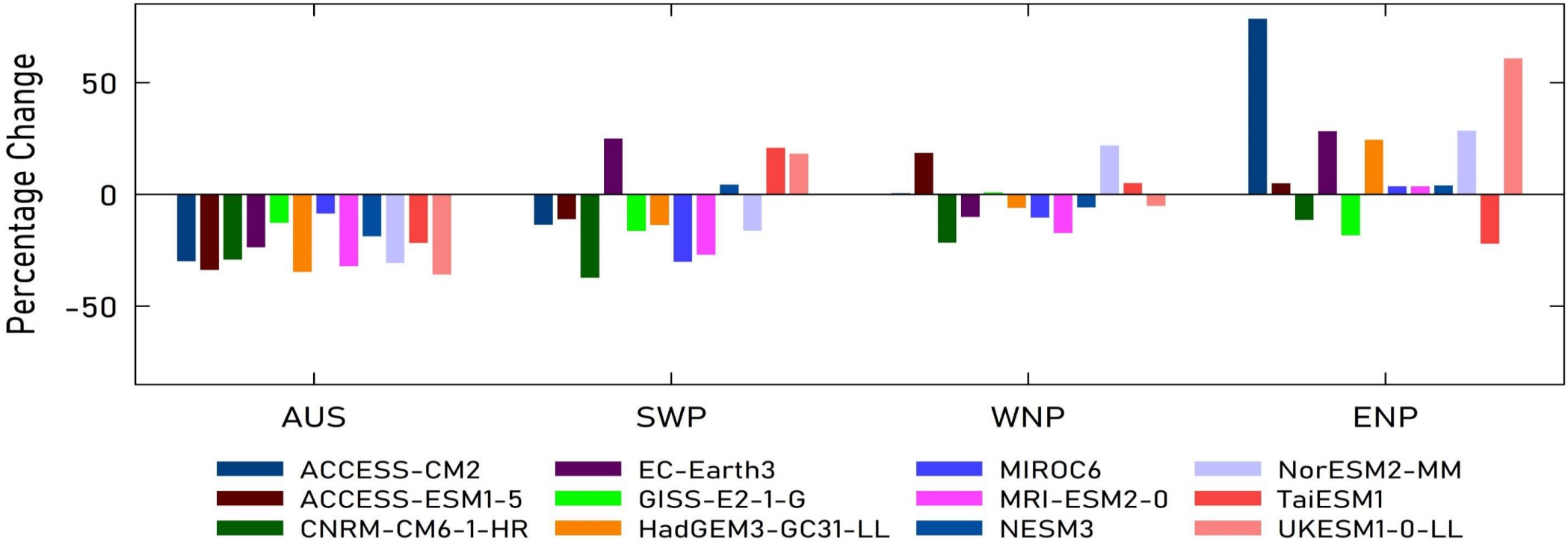
Future changes in TC frequency: Results from CMIP6 Projections

Historical period: 1984-2014

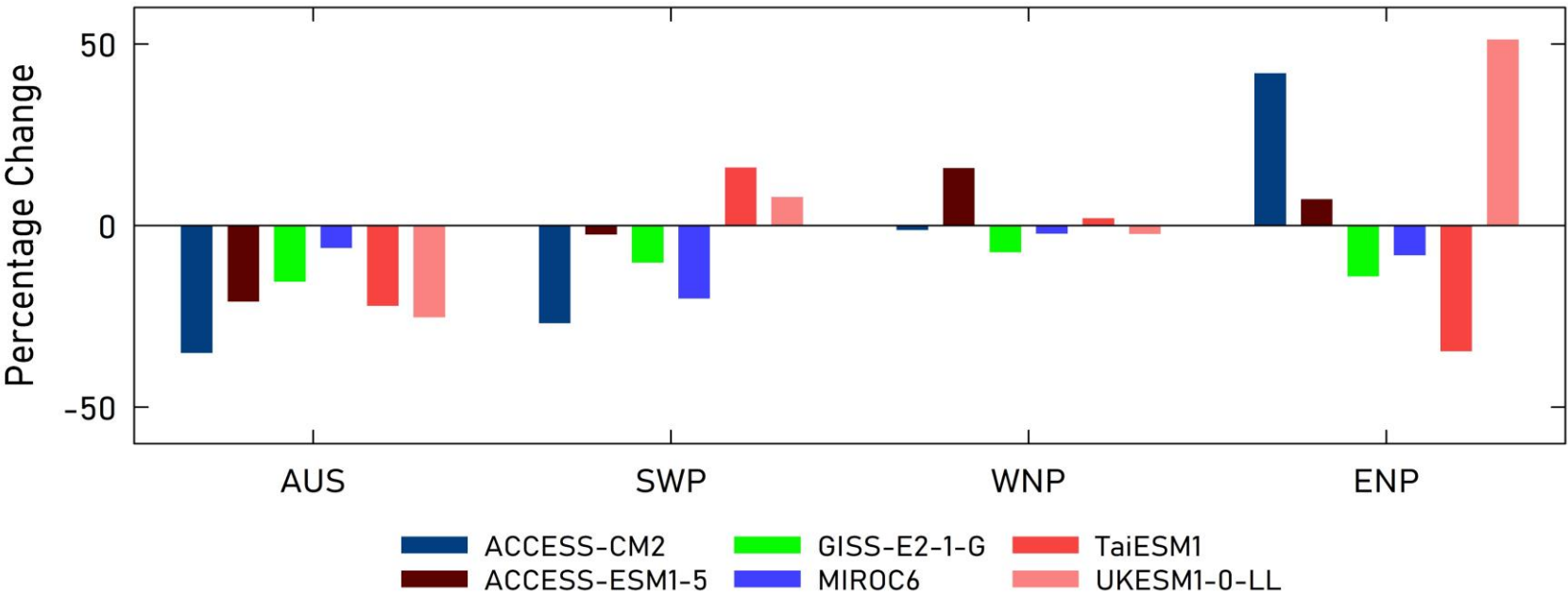
Future period: 2070-2100



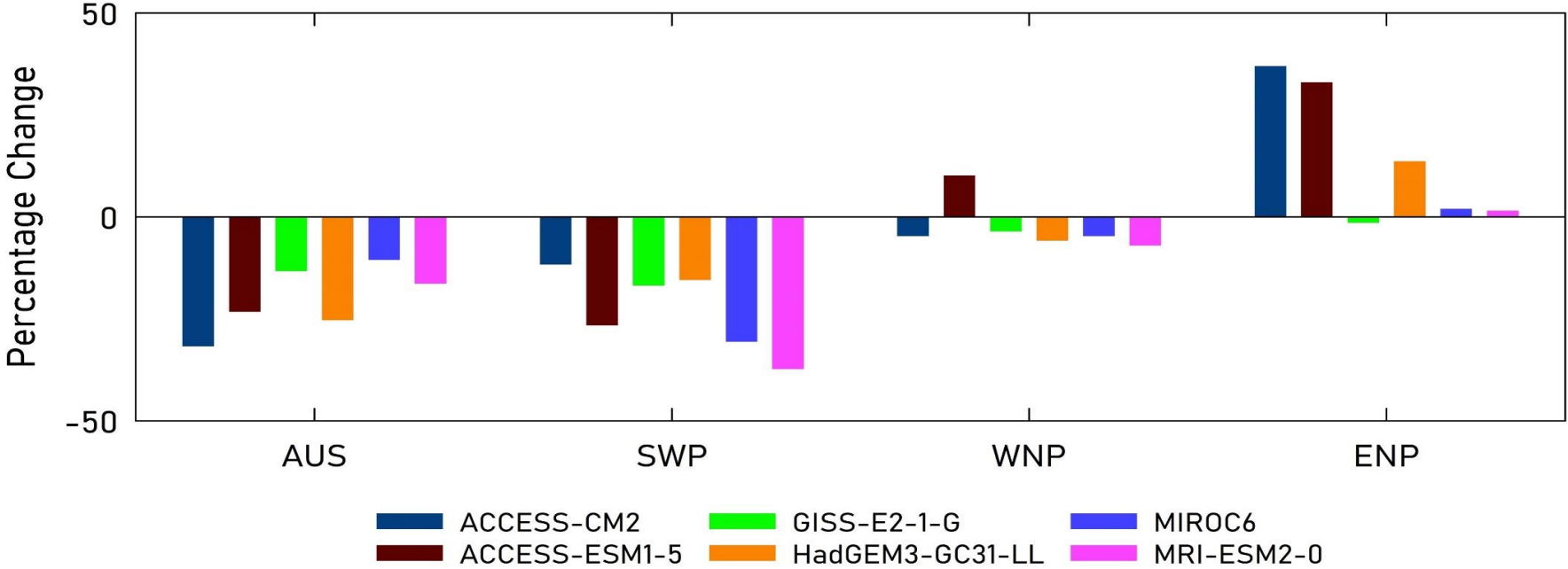
TC Frequency projections under SSP585 scenario



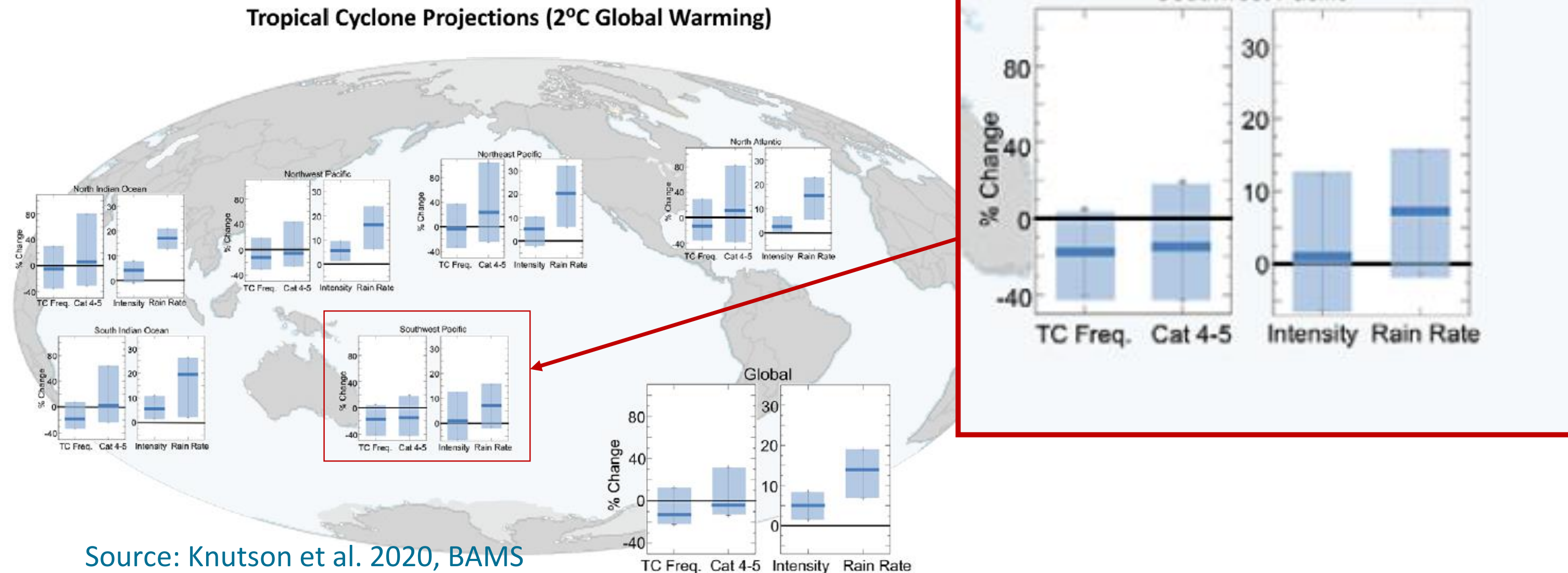
TC Frequency projections under SSP370 scenario



TC Frequency projections under SSP126 scenario



Future changes in tropical cyclone activity



There is a general consensus from theory and climate modeling that the strongest TCs will get stronger in the future, and will at least become a larger fraction of total TC frequency (Camargo et al. 2023)

Changes in other characteristics of TCs?

- ***Translational Speed***: Changes in translational speed is uncertain as different modelling studies reported contradictory results.
- ***TC Size***: TC size is an important determinant of storm surge risk and is correlated—along with TC intensity—to TC-related economic damages. The median TC size (based on radius of 12 m s^{-1} winds) will remain approximately unchanged globally.
- ***TC-induced Storm Surge***: Expectation is that projected increases in sea level, average TC intensity, and TC rainfall rates will each generally act to elevate future storm surge risk.
- ***TC tracks and areas of occurrence***. Projected changes in TC tracks or areas of occurrence in climate warming scenarios are challenging. However, if such TC track changes were to emerge due to anthropogenic climate change, they could be very important for societal impacts. While contradictor results are for the NH basins, in the SH, most climate models suggest a likely poleward shift in TC activity.
- ***Sequential TC events (The U.S. context)***: Chances of sequential TC hazards has been increasing over the past several decades at many US locations. Under the high (moderate) emission scenario, the chance of hazards from two TCs impacting the same location within 15days may substantially increase. How sequential events may change for the Pacific is not clear.

Key Points

- Tropical cyclones (TCs) pose major risks to livelihood in the Pacific.
- TC frequency is one of the most debated issues of future TC projections, since our knowledge of the potential mechanisms associated with TC frequency is not as robust as those associated with intensity of rainfall. There is general agreement in modeling studies that TC frequency in the SH will decline and/or shift poleward.
- There is a consensus from theory and climate modeling that the strongest TCs will get stronger globally in the future and will at least become a larger fraction of total TC frequency. However, basin-wide projections are more uncertain.
- TC size and translational speed are an important determinant of storm surge risk and wind damages. There is no consensus between studies on how these characteristics may change in future, under enhanced warming climate.
- TC-induced storm surge is projected to increase in warming climate. Increases in sea level, average TC intensity, and TC rainfall rates will each generally act to elevate future storm surge risk.

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Thank You

