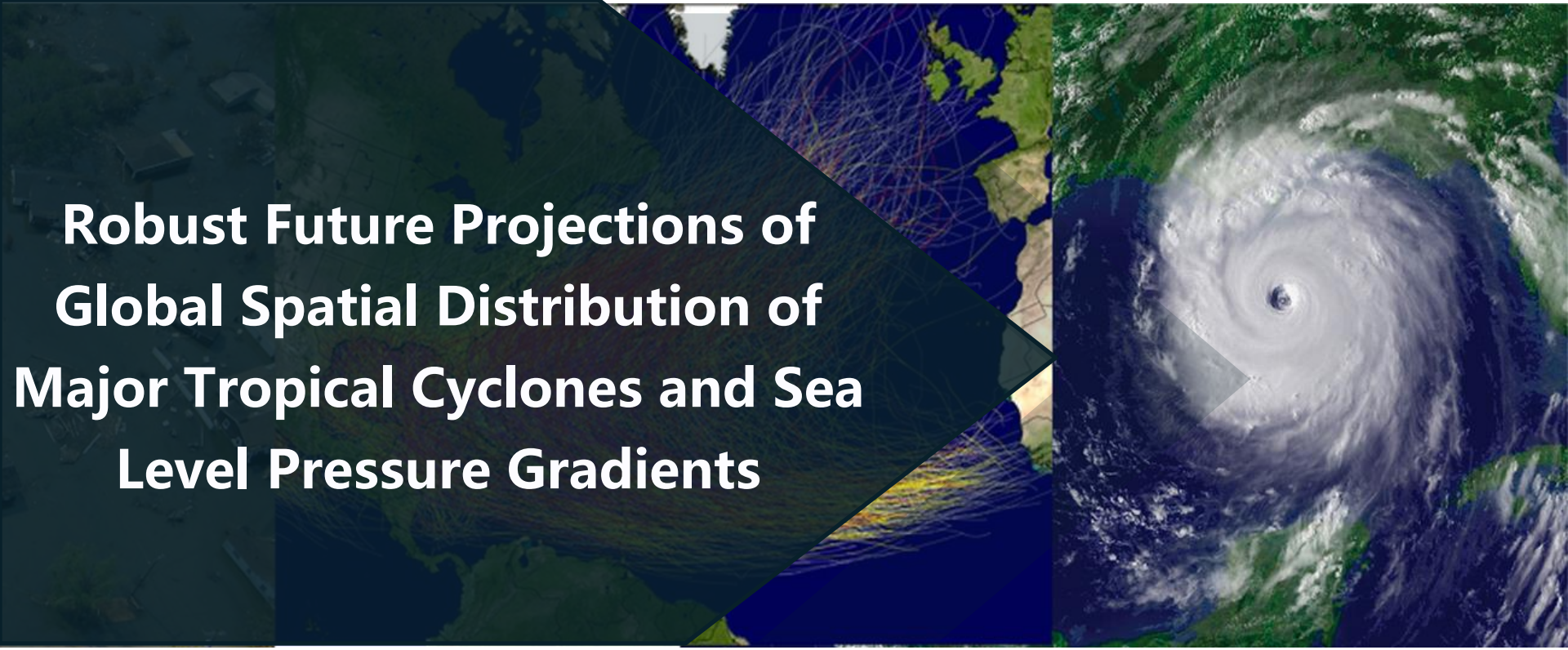

Robust Future Projections of Global Spatial Distribution of Major Tropical Cyclones and Sea Level Pressure Gradients

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The Aim of This Study

1. To determine if there are robust future changes in spatial distribution of major TCs (≥50m s^{-1}).
2. To identify storm hazards associated with changes in major TCs.

Models Used:

SPEAR_HI (High-resolution coupled model developed at GFDL)

25-km atmosphere and land-surface coupled with 100-km ocean and ice components

MRI-AGCM3.2S (20-km mesh Atmosphere model developed at MRI)

20-km atmosphere (Mizuta et al. 2012; Murakami et al. 2012)

OBS (1981-2022) SPEAR_HI (1981-2022) MRI-AGCM3.2S (1981-2021)

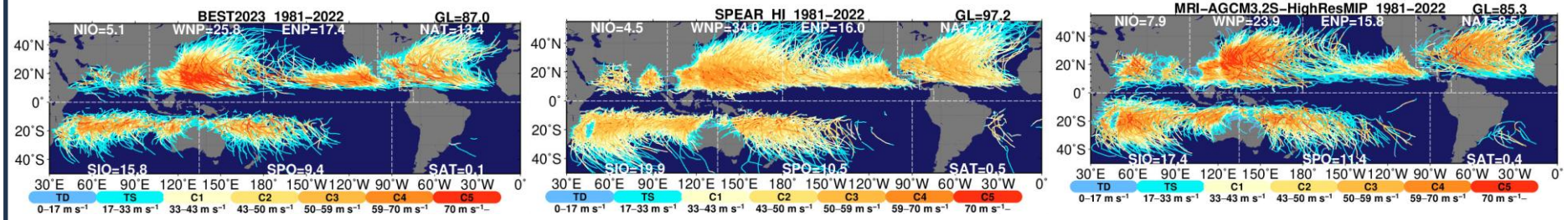
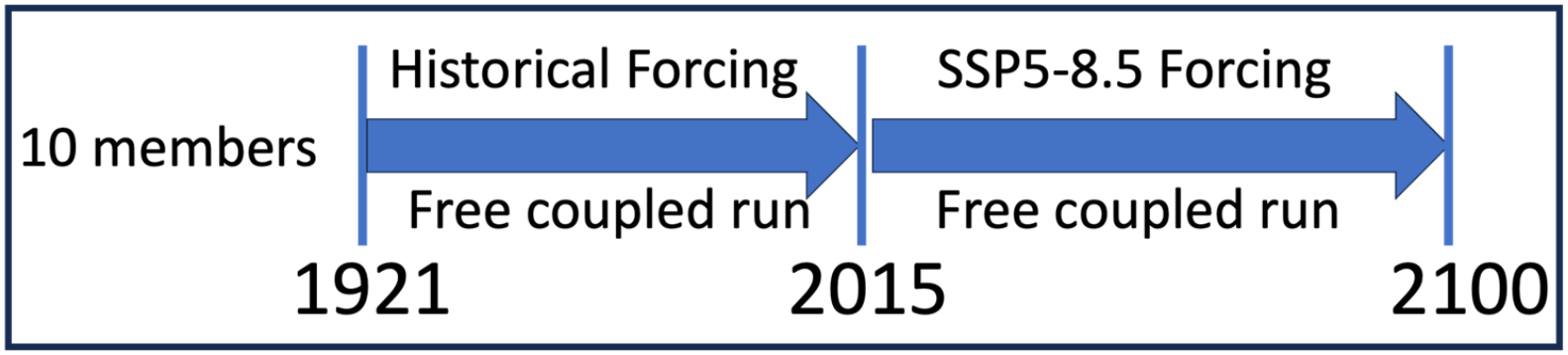


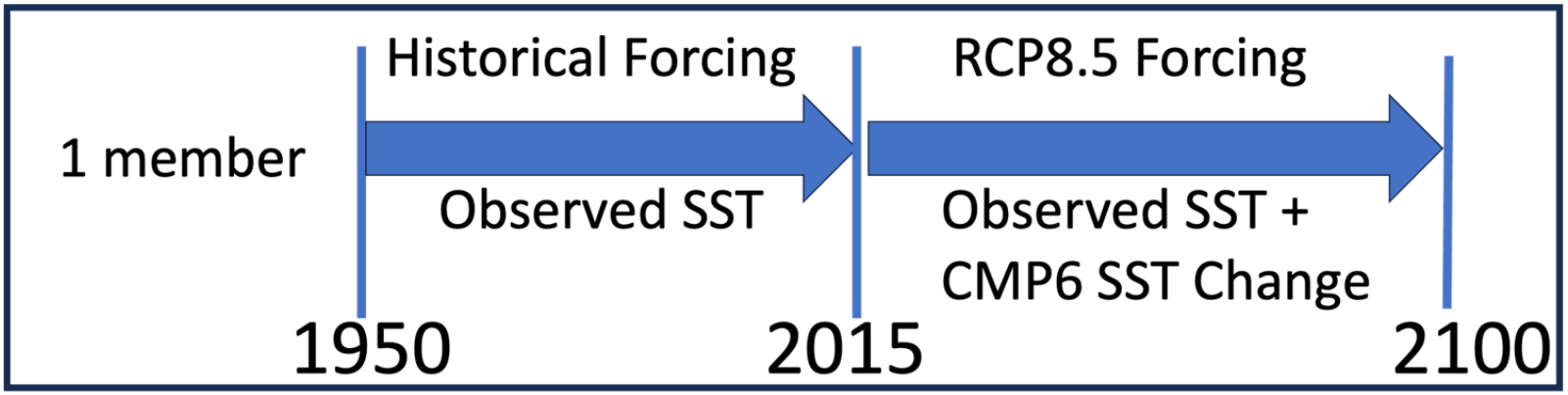
Fig. TC Tracks with TC intensity

Climate Experiments

SPEAR_HI (25-km mesh coupled model developed at GFDL)



MRI-AGCM3.2S (20-km mesh Atmosphere model developed at MRI)

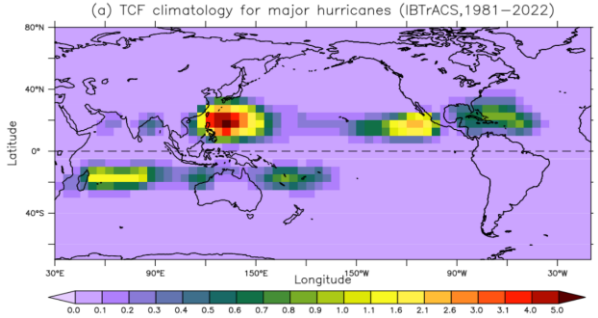


Future Change = 2061-2099 minus 1981-2020 mean

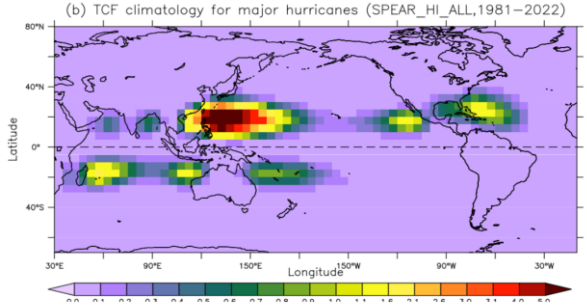
Projected Future Changes in Major TC Density

Major TC density (Maximum Wind Speeds, ≥50m s^{-1})

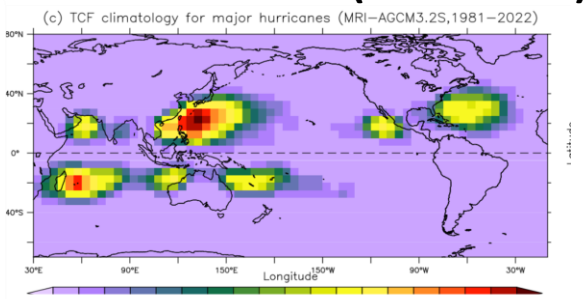
Observations (1981-2022)



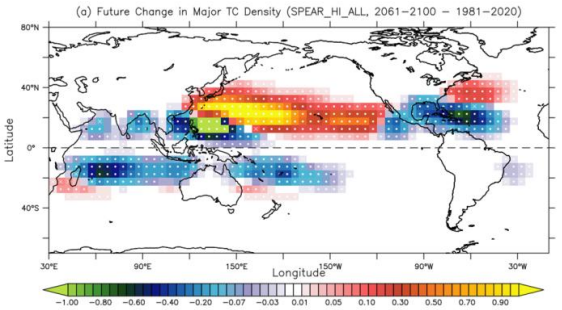
SPEAR_HI (1981-2022)



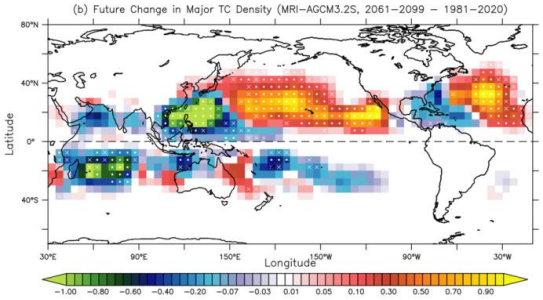
MRI-AGCM3.2S (1981-2022)



Future Change



Future Change

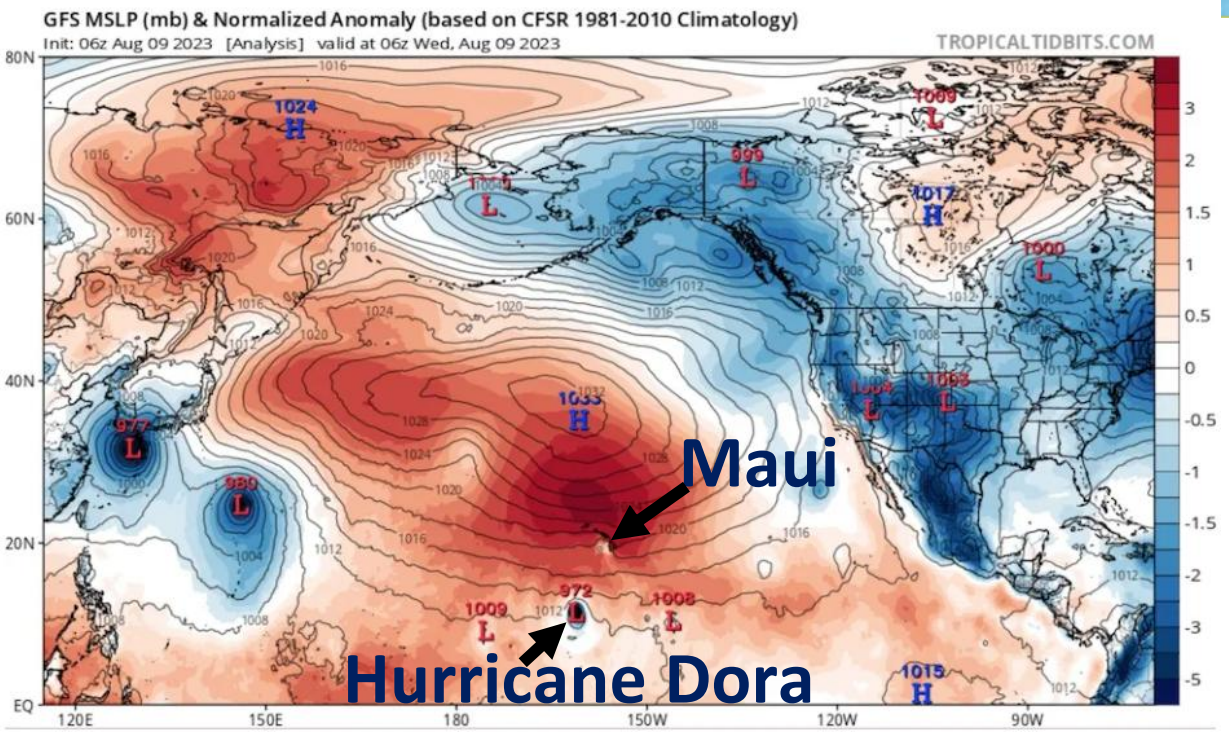


Future Change = 2061-2099 minus 1981-2020 mean

Both models project similar spatial patterns of changes in major TC density

Hurricane Dora and Wildfire in Maui (2023)

Aug. 8-9, 2023.
At least 36 deaths in Lahaina

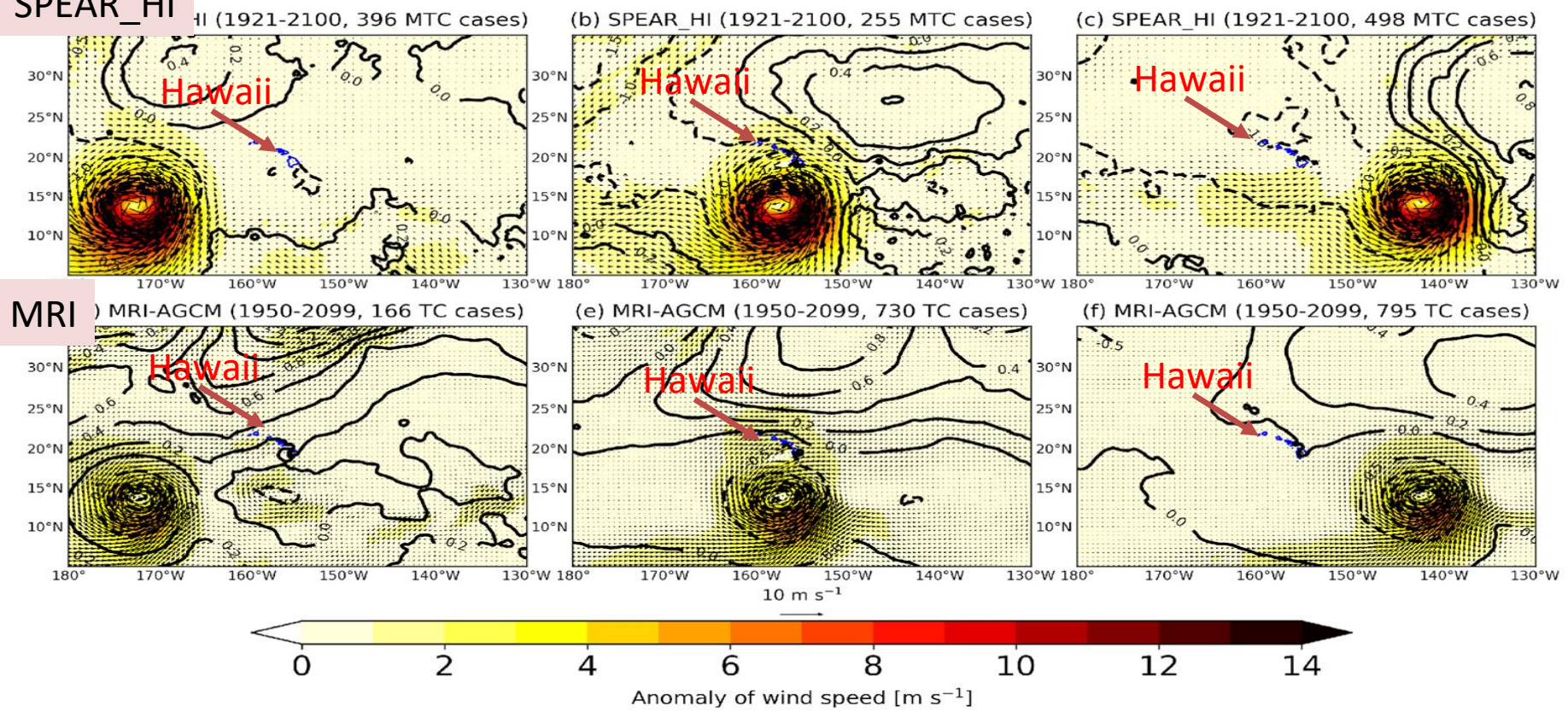


Influence of Major TCs on Remote Sea Level Pressure

Contours: SLP Anomaly (2 hPa interval for negative and 0.2 hPa interval for positive values)
Shadings: Wind Speed Anomaly

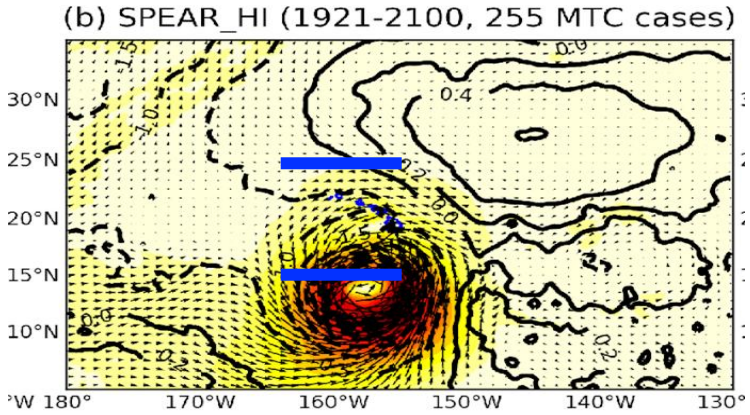
SPEAR_HI

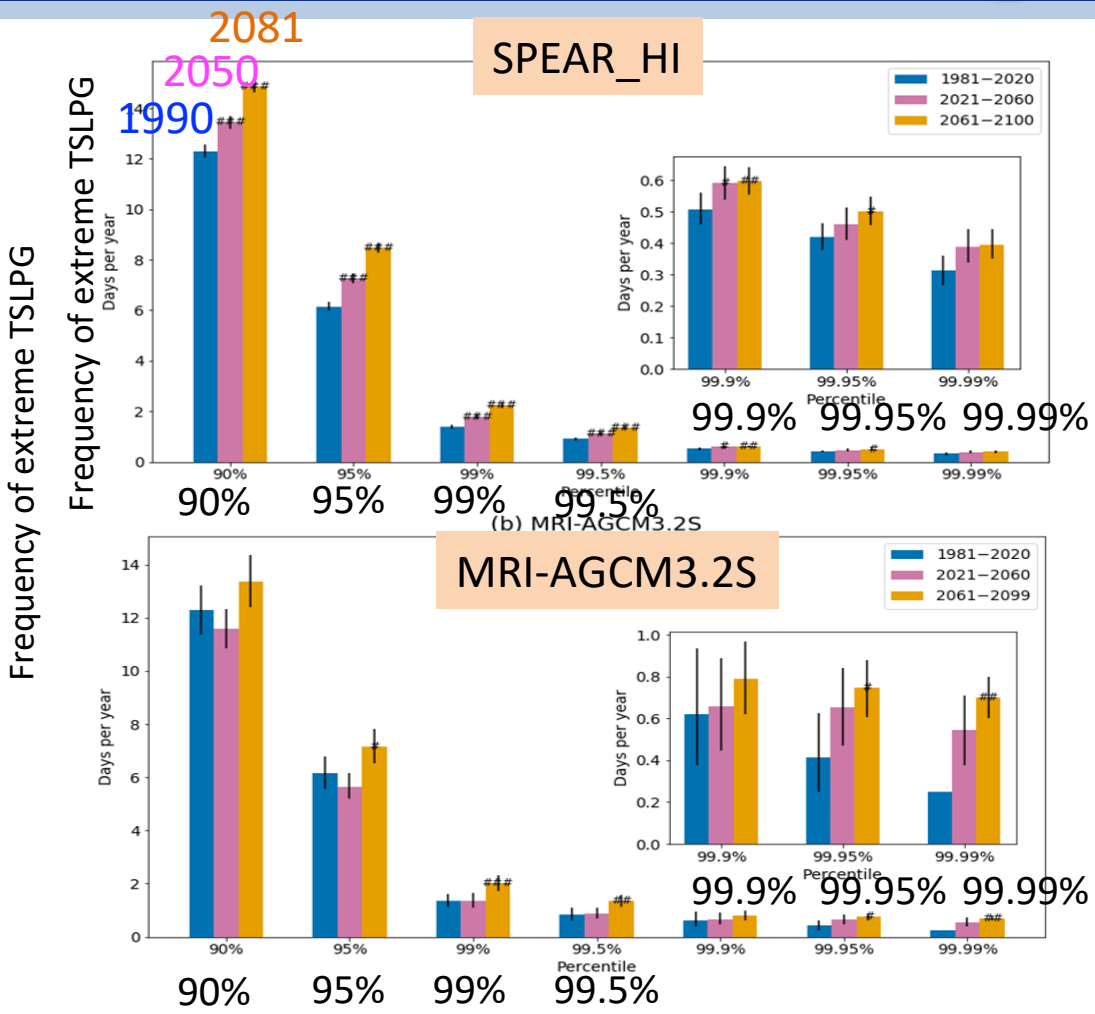
MRI



A Major TC transfers low PV at lower latitudes to higher latitudes, generating positive SLP anomaly to the Northeast, resulting in a strong meridional SLP gradient

Simulated frequency of extreme events of abrupt increases in SLP gradient near Hawaii

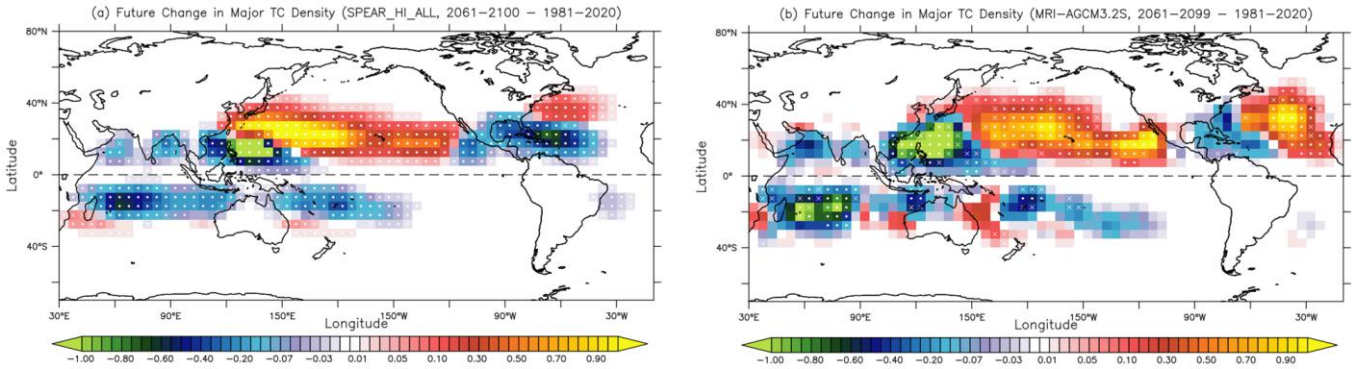




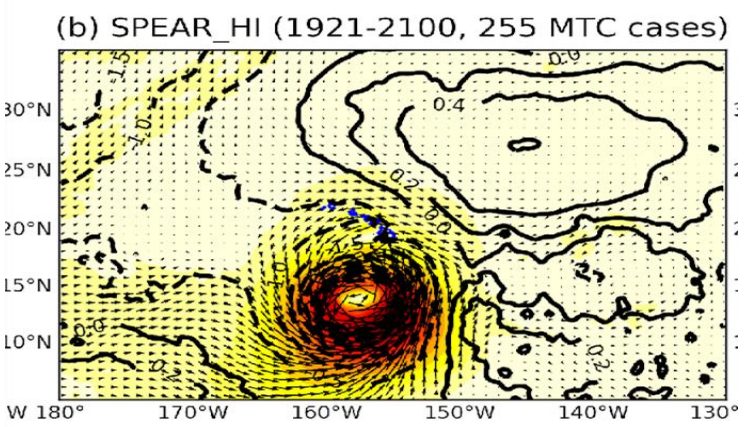
Significant increases in extreme sea level pressure change events near Hawaii in the future –> Increase the occurrence of wildfire events like Hurricane Dola in 2023.

Takeaway

1. Robust future changes in the spatial pattern of major TC density



2. The hazard risk exists even when a major hurricane is positioned far away



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