# MJO modulation of tropical cyclogenesis in E3SMv1

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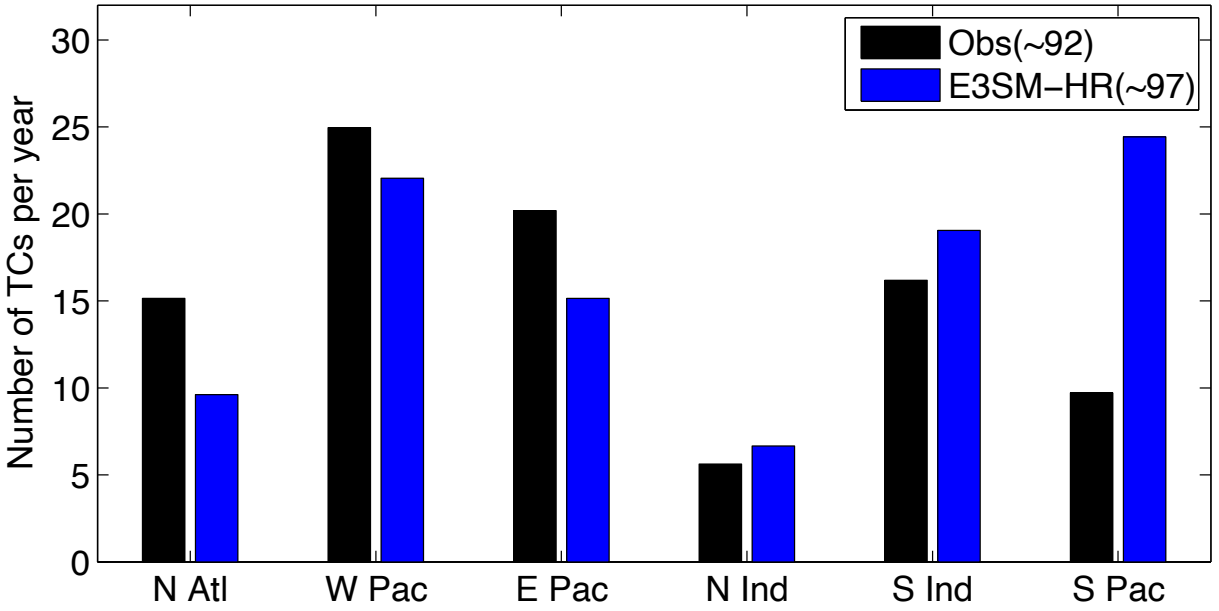
October 13, 2020 RGMA PI Meeting

E3SM Energy Exascale Earth System Model

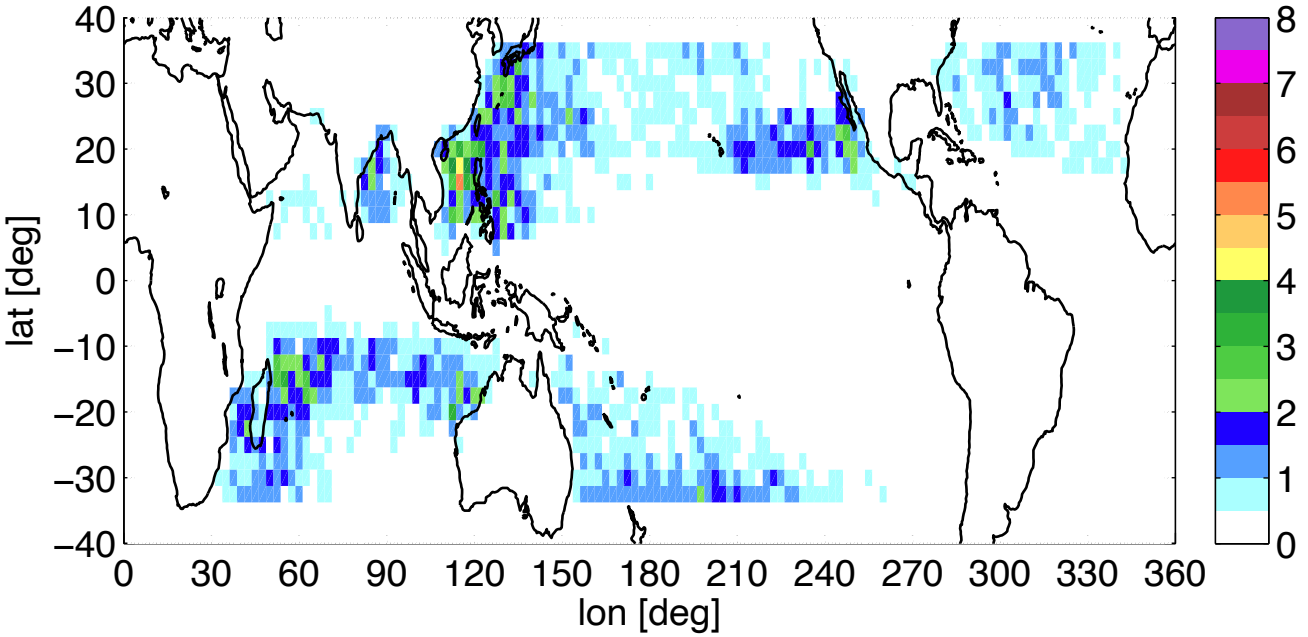
Supported by the DOE RGMA project:
"Madden-Julian Oscillation, Tropical Cyclones, and Precipitation Extremes in E3SM

# Tropical cyclone (TC) in the E3SMv1 HR simulation

**# of TCs per year**



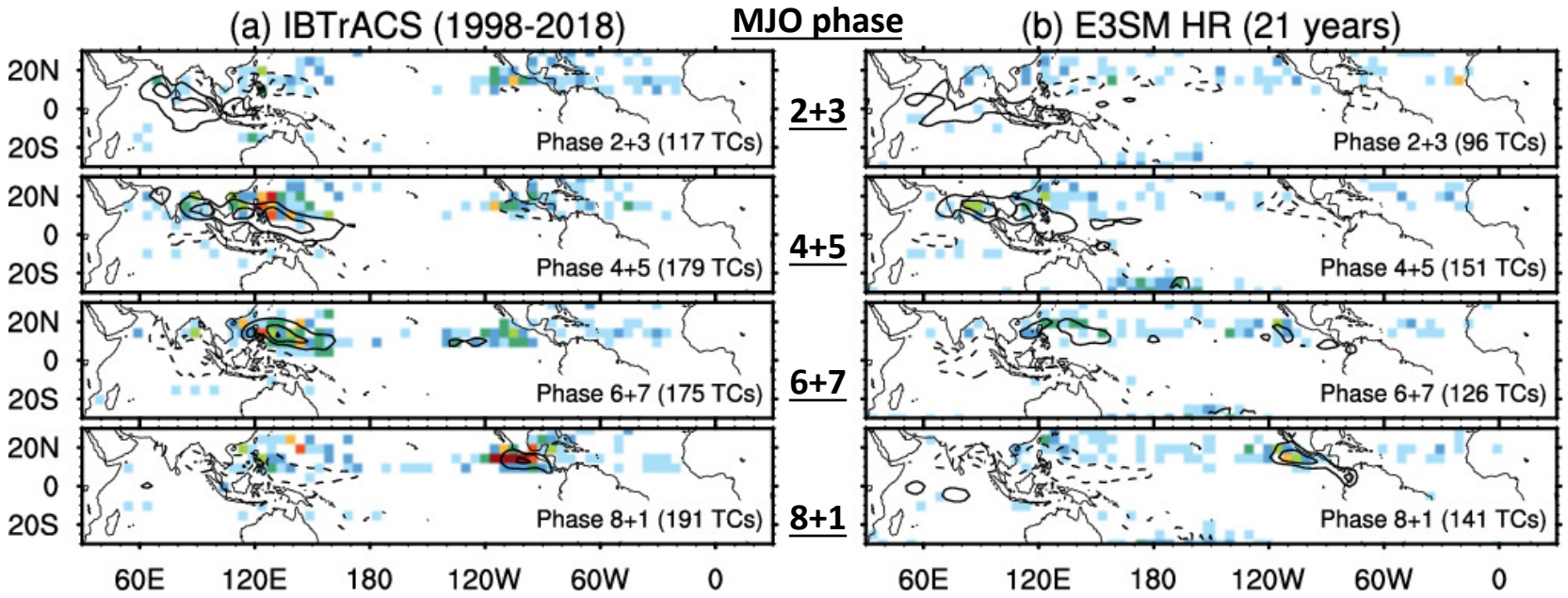

**E3SMv1 TC track density (2.5˚ x 2.5˚)**




- **TempestExtremes** (Ullrich and Zarzycki 2017; Zarzycki and Ullrich 2017) is used for TC tracking using sea-level pressure and 500-hPa temperature.
- The E3SMv1 HR (0.25˚) simulation simulates the global TC activity reasonably well, in terms of the total global number of TCs and track density.
- TC activity is underestimated in the North Atlantic but overestimated in the South Pacific.

# Modulation of TC genesis by MJO

**RMM composite (amplitude > 1) and TC genesis in 5˚ x 5˚ grid (MJJASO)**

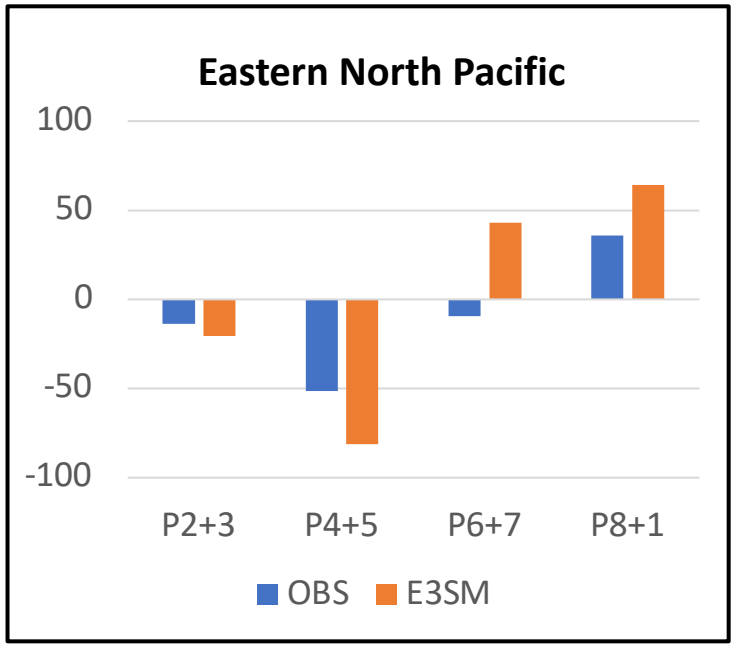



*Contour (interval: 2 mm/day)*
*TRMM precipitation anomalies*

**precipitation anomalies**

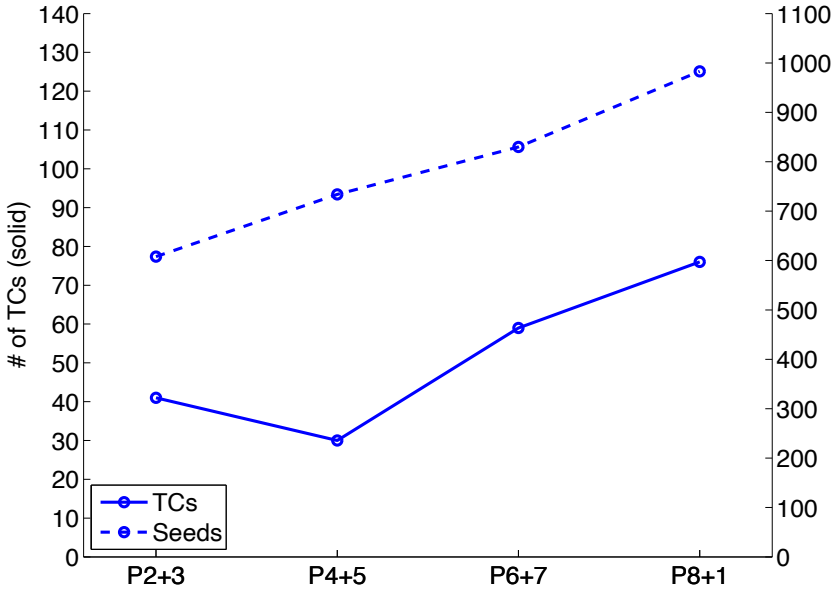
*Contour (interval: 1 mm/day)*
*E3SM precipitation anomalies*

**% changes in TC genesis frequency**

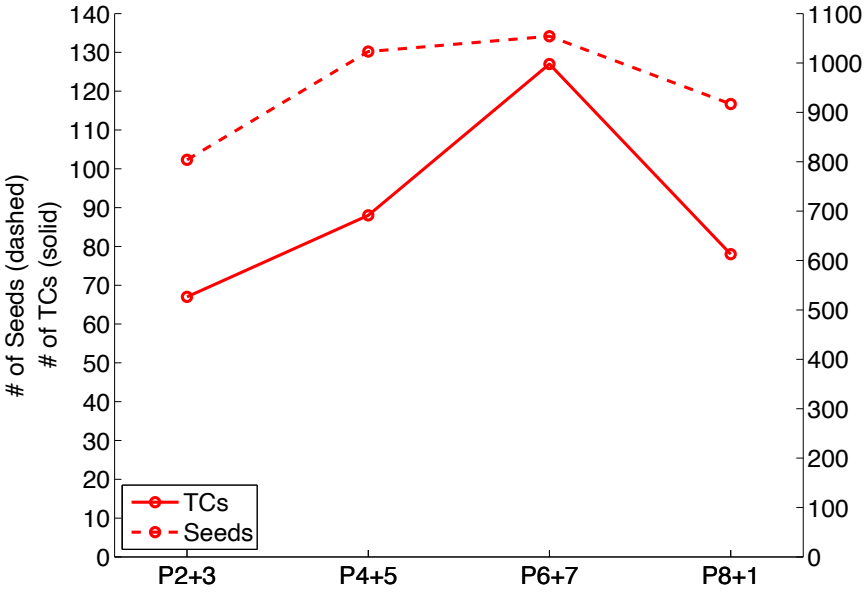



- Since the E3SM can simulate both MJO and TCs reasonably, it is a good tool to further elucidate physical processes responsible for the MJO-TC modulation.
- MJO modulation of TCs is reasonably represented, especially in the Eastern North Pacific
- When the MJO reaches EPac (Phase 8+1), TC genesis rate is greatly enhanced as in observations

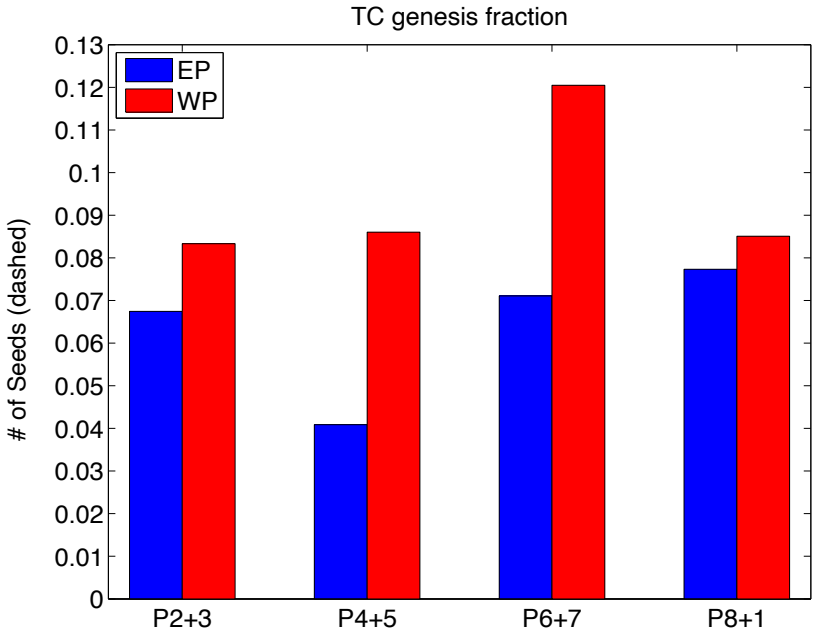
# Role of ‘seed’ disturbances on the MJO-TC relationship




EP: # TCs (solid) and # seeds (dashed)




WP: # TCs (solid) and # seeds (dashed)




Fraction of seeds developing into TCs

- In **EP (blue)**, TC genesis is enhanced during MJO phases 8 and 1 by increasing the number of seed disturbances generated and by a greater fraction of them developing into TCs.
- In **WP (red)**, TC genesis is also modulated by different phases of MJO (e.g., 6+7 vs. 4+5) by the greater number of seed disturbances and greater fraction of them developing into TCs.
- MJO affects TC genesis in two ways: the population of seed disturbances and the fraction of them developing into TCs.