# Amplified Madden–Julian Oscillation impacts in the Pacific–North America region in a warmer climate

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Reference:

**Zhou, W., Yang, D.**, Xie, S. et al. Amplified Madden–Julian oscillation impacts in the Pacific–North America region. ***Nat. Clim. Chang.*** 10, 654–660 (2020).

# Convection, Circulation and Climate Change

1000 km

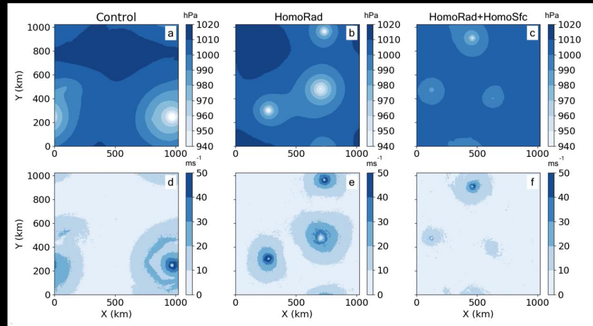
10,000 km

Global scale

Day

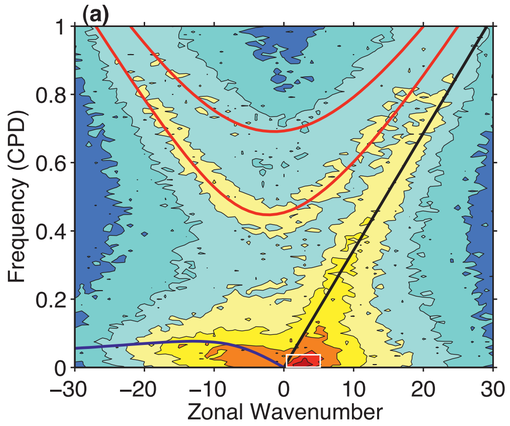
Month

Season




## Convective aggregation and Tropical cyclones

**Reyes** and **Yang**, (2020, in revision)
**Yang (2018a, b, 2019, 2020)**

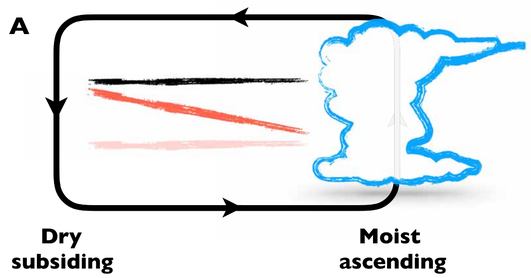



## The MJO

**Yang and Ingersoll (2011, 13, 14)**
**Yang et al. (2020)**
**Zhou, Yang, Xie et al. (2020)**

## Global scale climate change

**Seidel and Yang (2020) Science Advances**
**Yang and Seidel (2020) Journal of Climate**



# The Madden-Julian Oscillation is the most dominant intraseasonal oscillation in the tropical atmosphere.

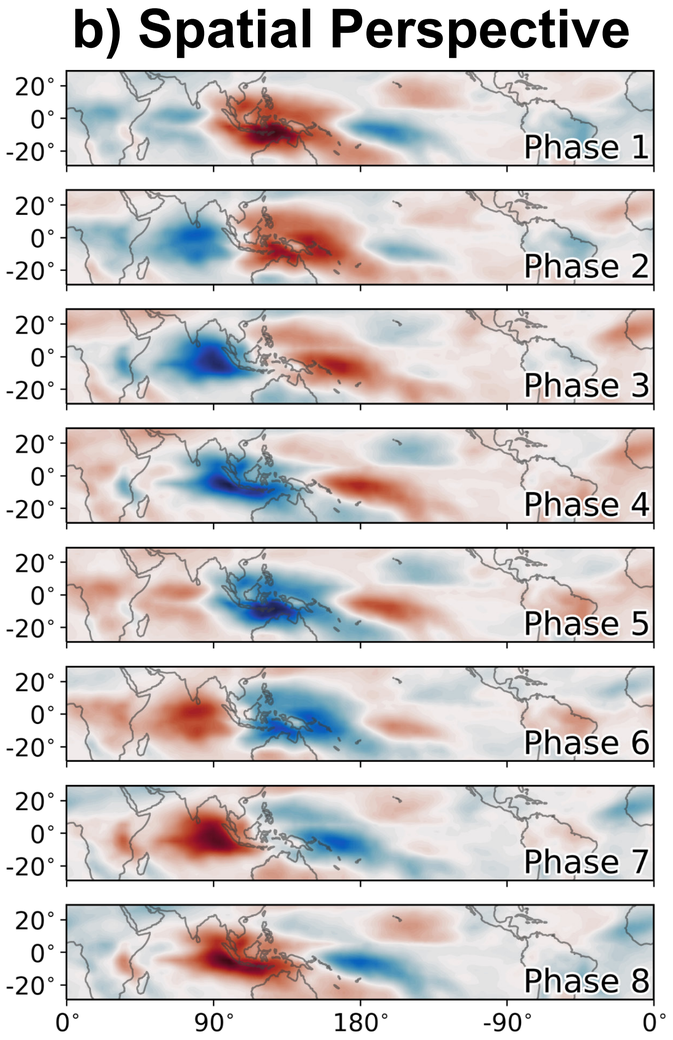
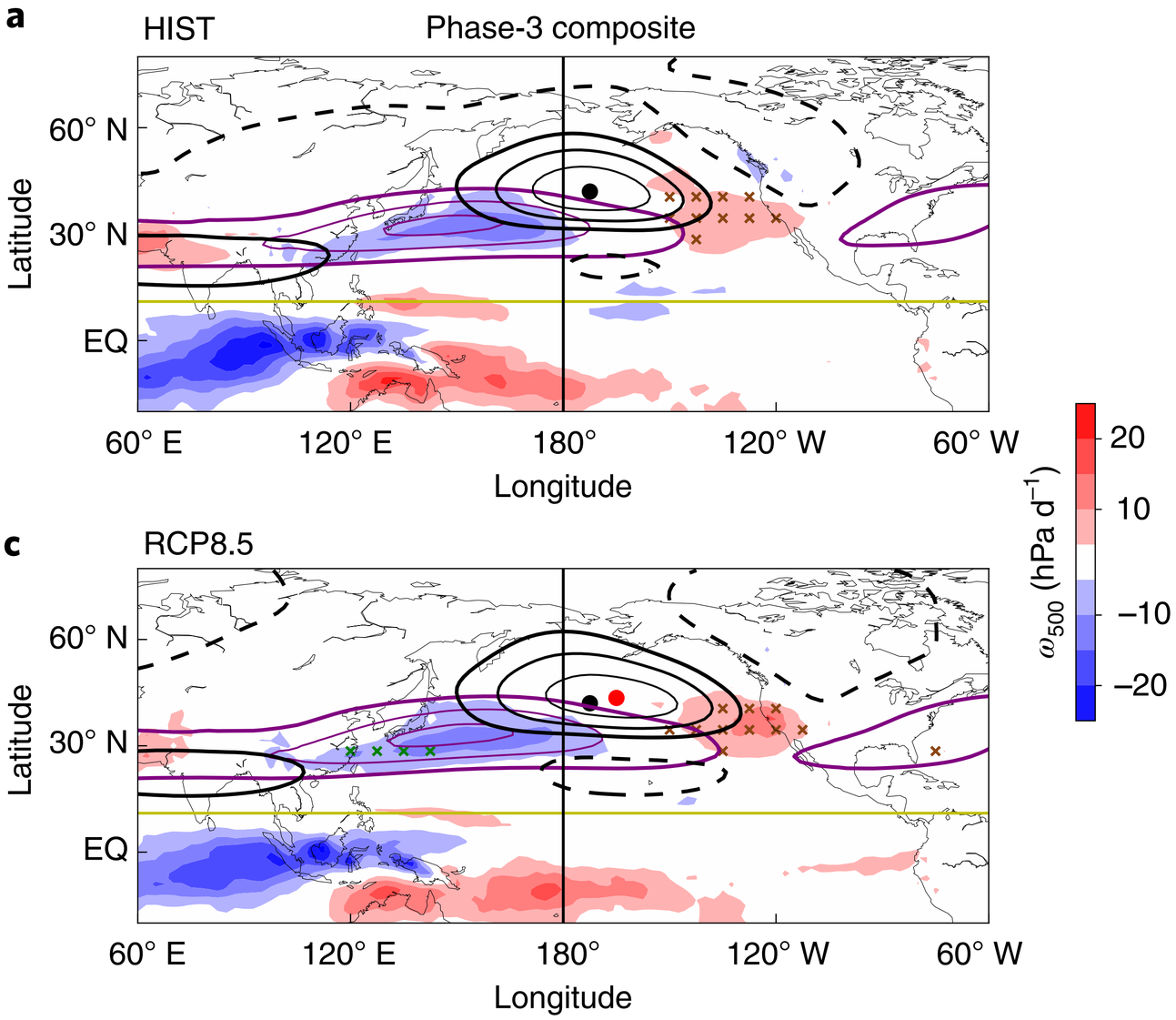
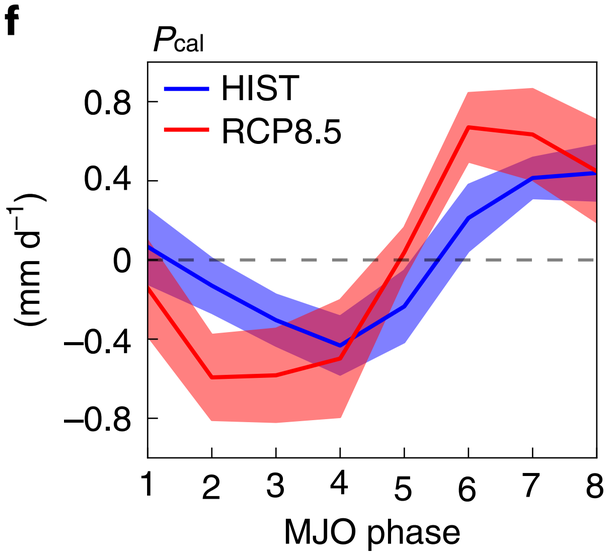



Figure from Toms, Kashinath, Prabhat, and **Yang** (2020)

Recent review papers:
Zhang, Adames, Khouider, Wang, and **Yang** (2020, Review of Geophysics)
**Yang**, Adames, Khouider, Wang, Zhang (2020, The Multi-Scale Global Monsoon System)

# The MJO-induced teleconnection pattern extends eastward in warmer climates, leading to enhanced rainfall variabilities in California by about 50%



Why does the teleconnection pattern shift eastward?

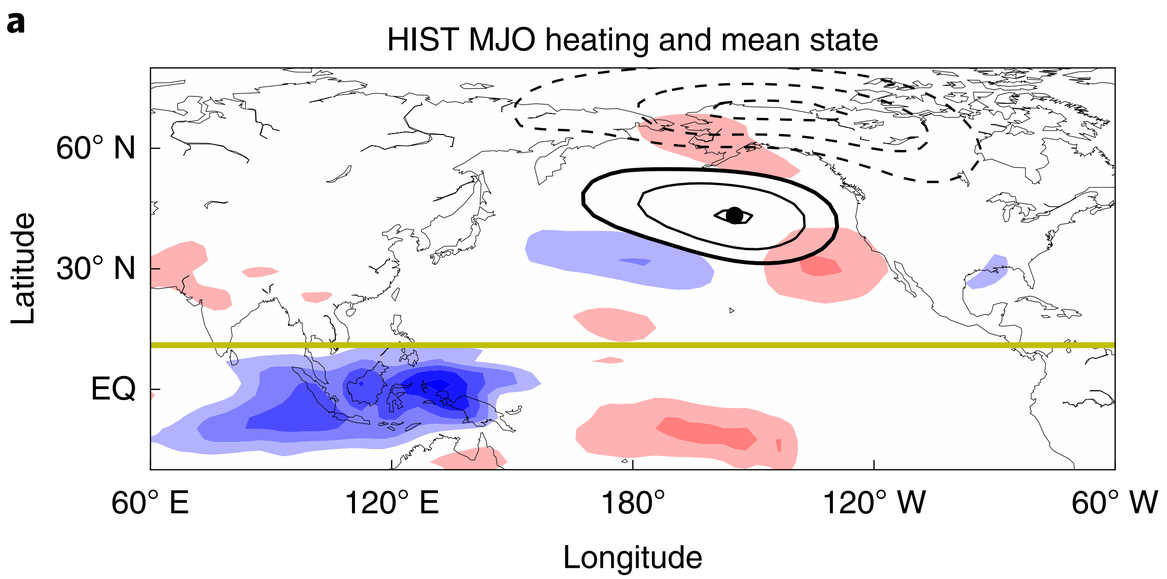
Hypothesis 1: the MJO circulation extends eastward

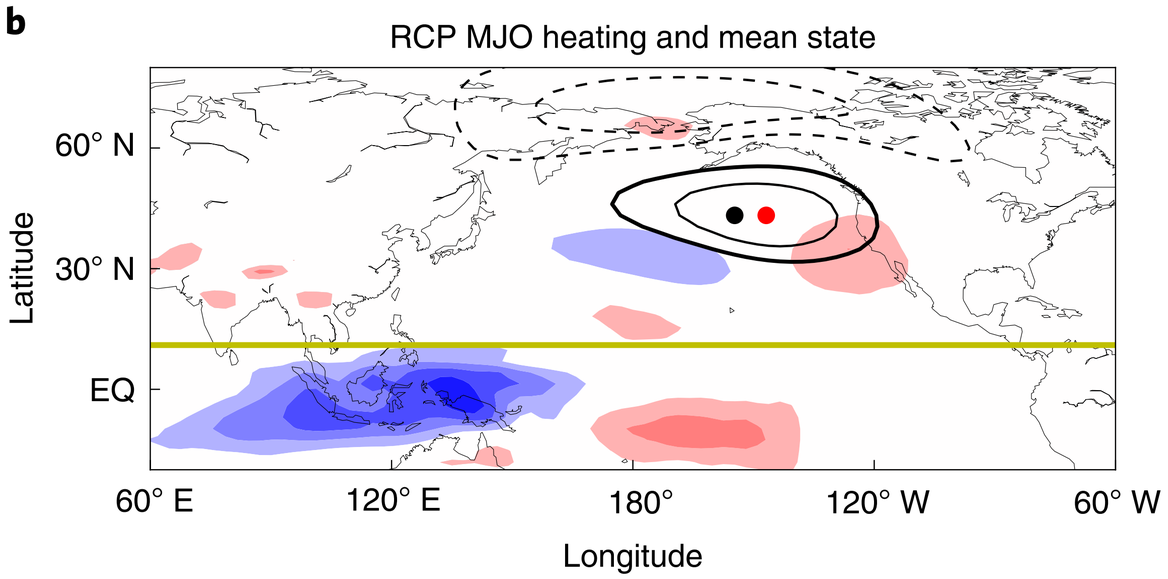
Hypothesis 2: the background jet structures shift eastward

We test the hypothesis by using a linear baroclinic model (LBM)

LBM: primitive equations linearized about a mean state

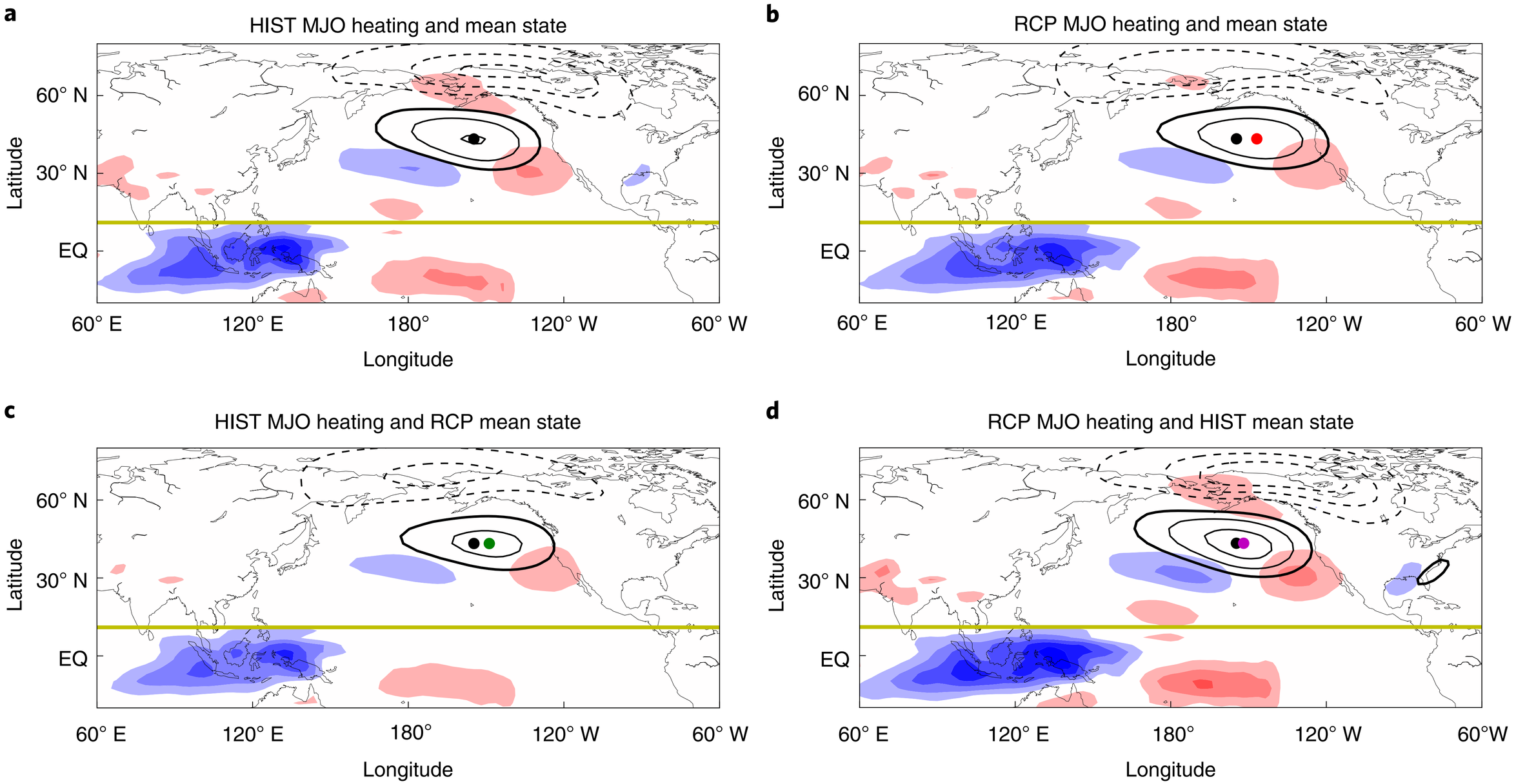
# The LBM reproduces the CMIP results with prescribed climatology and MJO



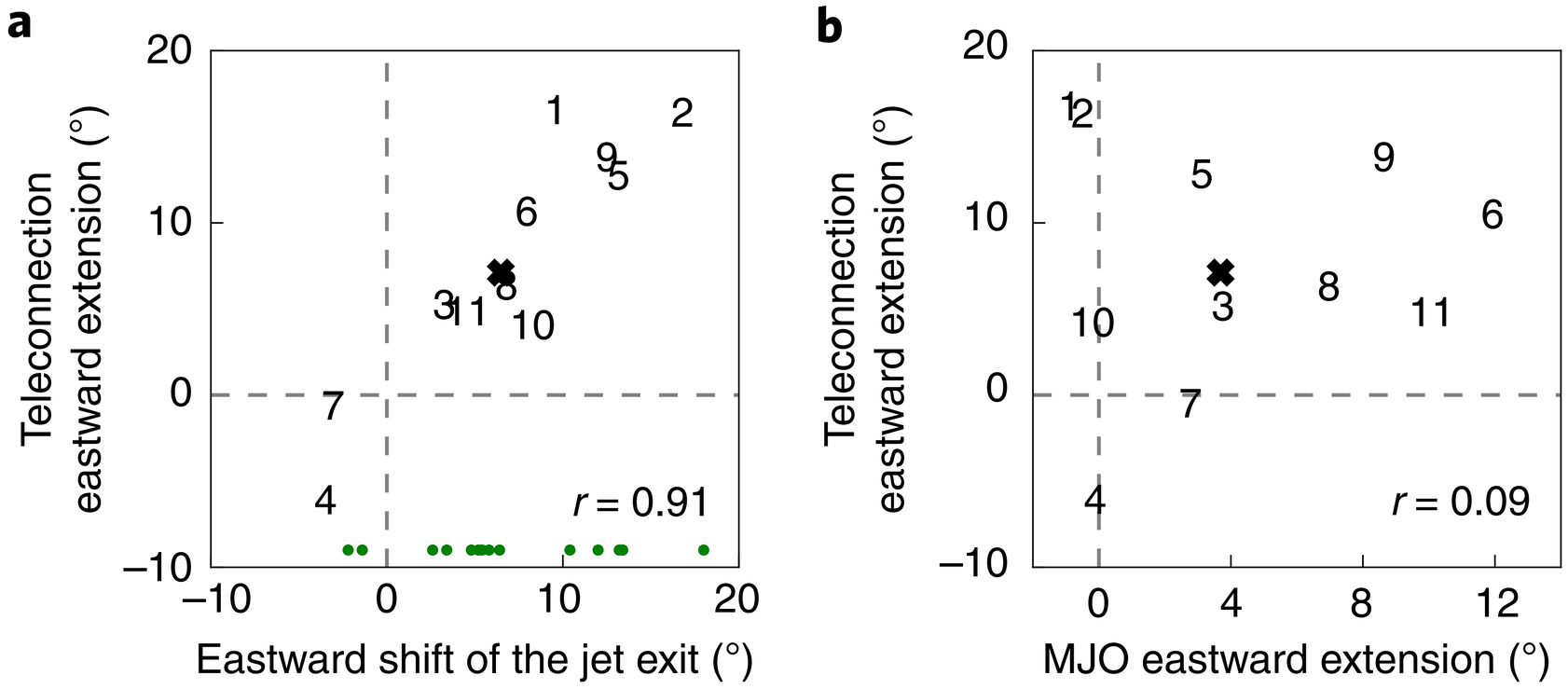




**An eastward shift is observed!**

# The mean state shift dominates the eastward extension of the teleconnection



# In CMIP simulations, the eastward extension of the teleconnection is highly correlated with the eastward shift of the jet structure (exit region)



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The changes depend on the eastward shift of jet structures (related to changes in stationary waves).

The changes do NOT depend on detailed MJO physics, which is highly uncertain.