

# QBO-MJO Connection in CMIP6 Models

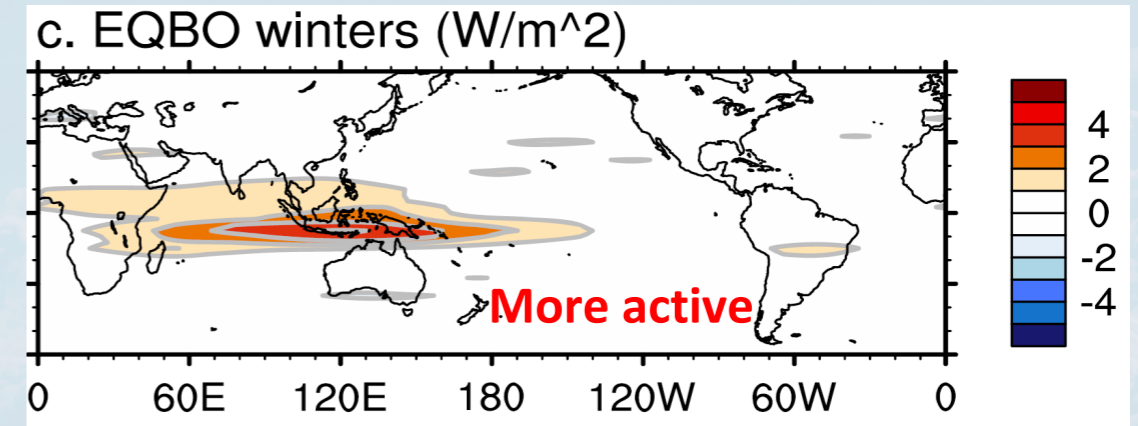
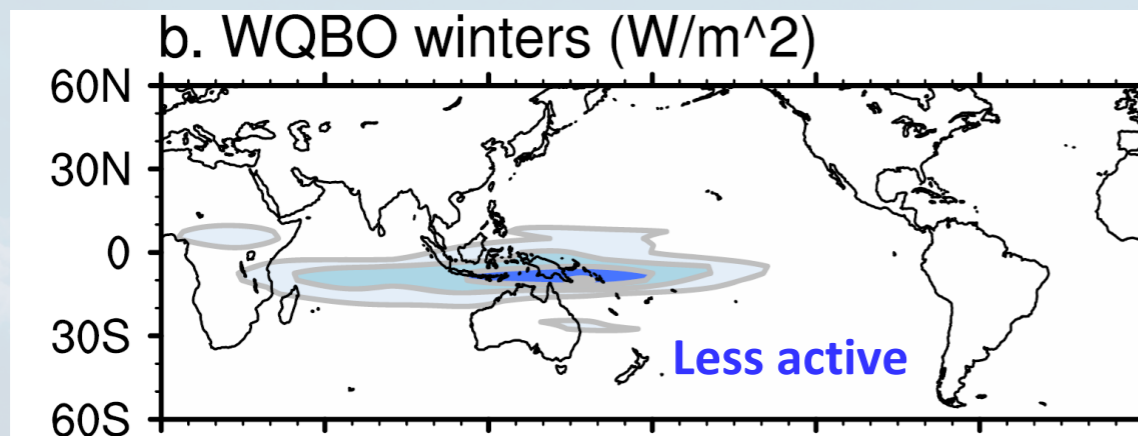
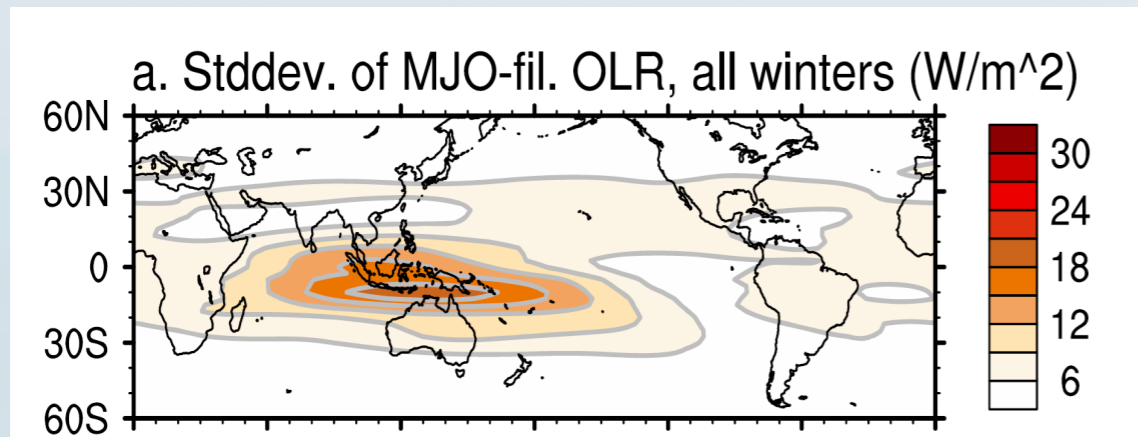
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# catalyst

Cooperative agreement to analyze variability, change and predictability in the earth system

## Observed QBO-MJO connection



## MJO activity (DJF)

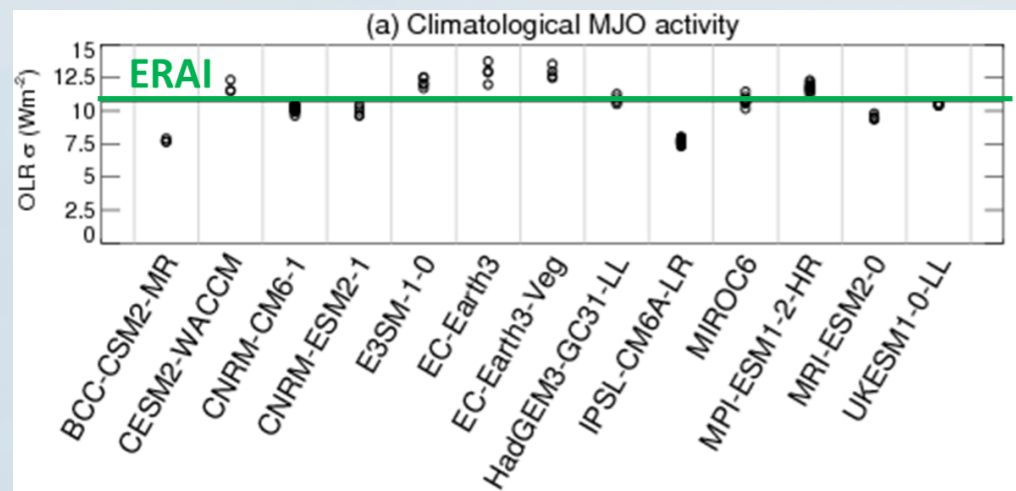
**MJO is more active during EQBO**

(MJO convection is stronger, more organized, propagates further east)

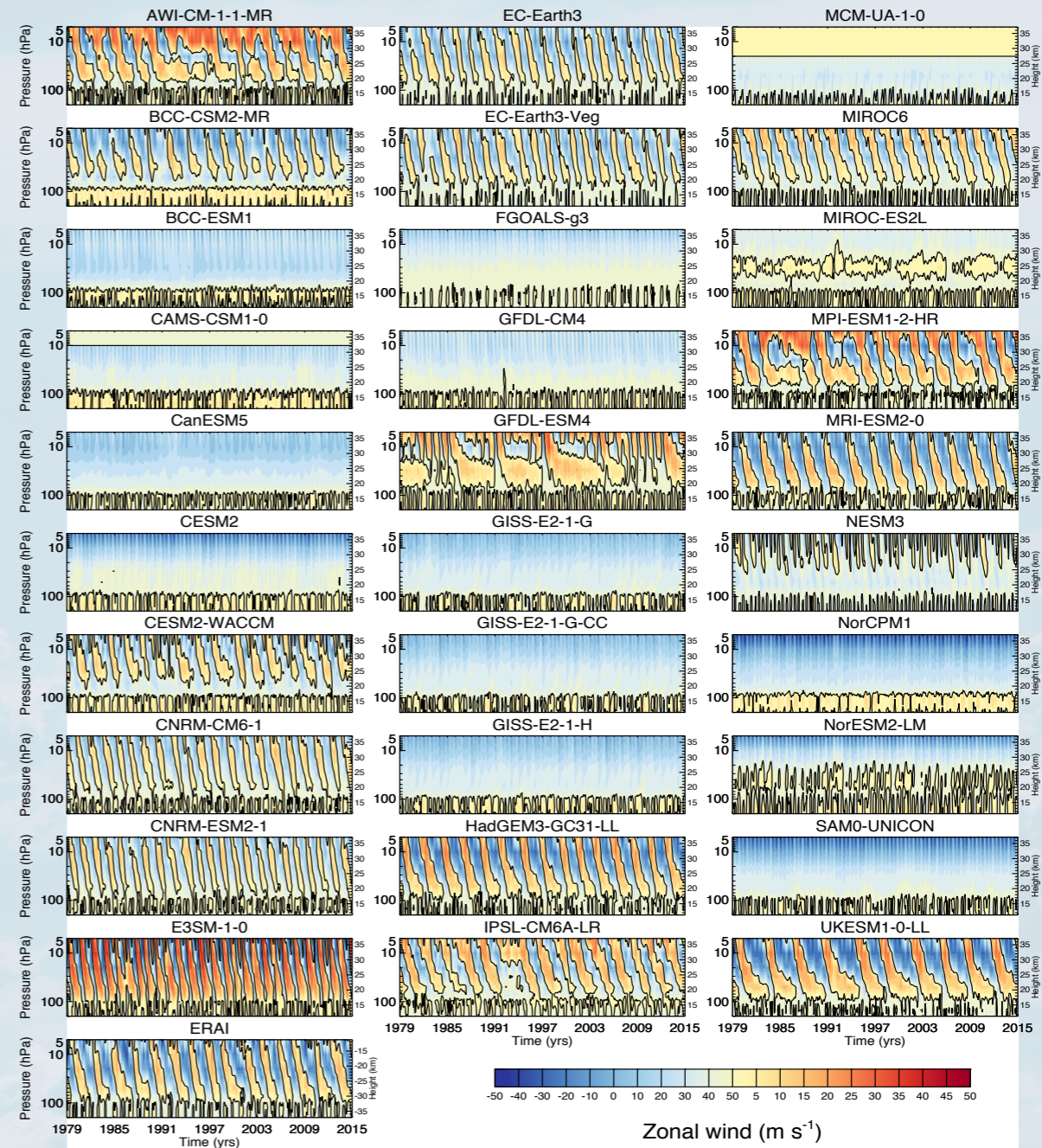
\* Yoo and Son (2016), Son et al. (2017), Nishimoto and Yoden (2017), Zhang and Zhang (2018), Hendon and Abhik (2018), Martin et al. (2019), Abhik and Hendon (2019)

# QBO-MJO Connection in CMIP6 Models

## MJO and QBO in CMIP6 Models



- MJO activity: STD of MJO-filtered OLR (DJF, 1979-2014) over Indo Pacific region is reasonably well simulated by CMIP6 models
- QBO: alternating easterlies and westerlies on about 28 month time scale in 10S-10N averaged zonal wind anomaly is well represented in 15 out of the 30 CMIP6 models.

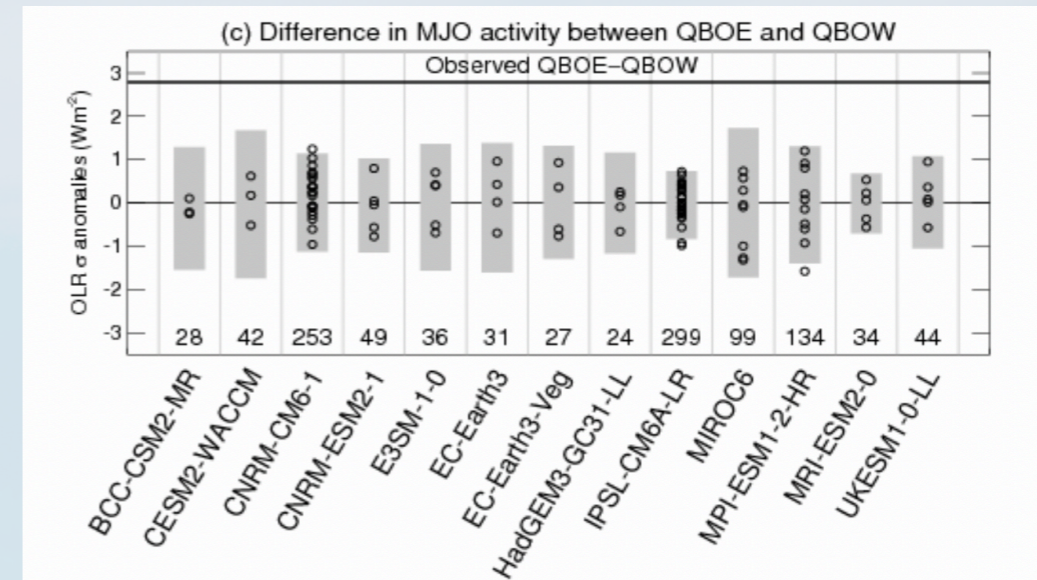
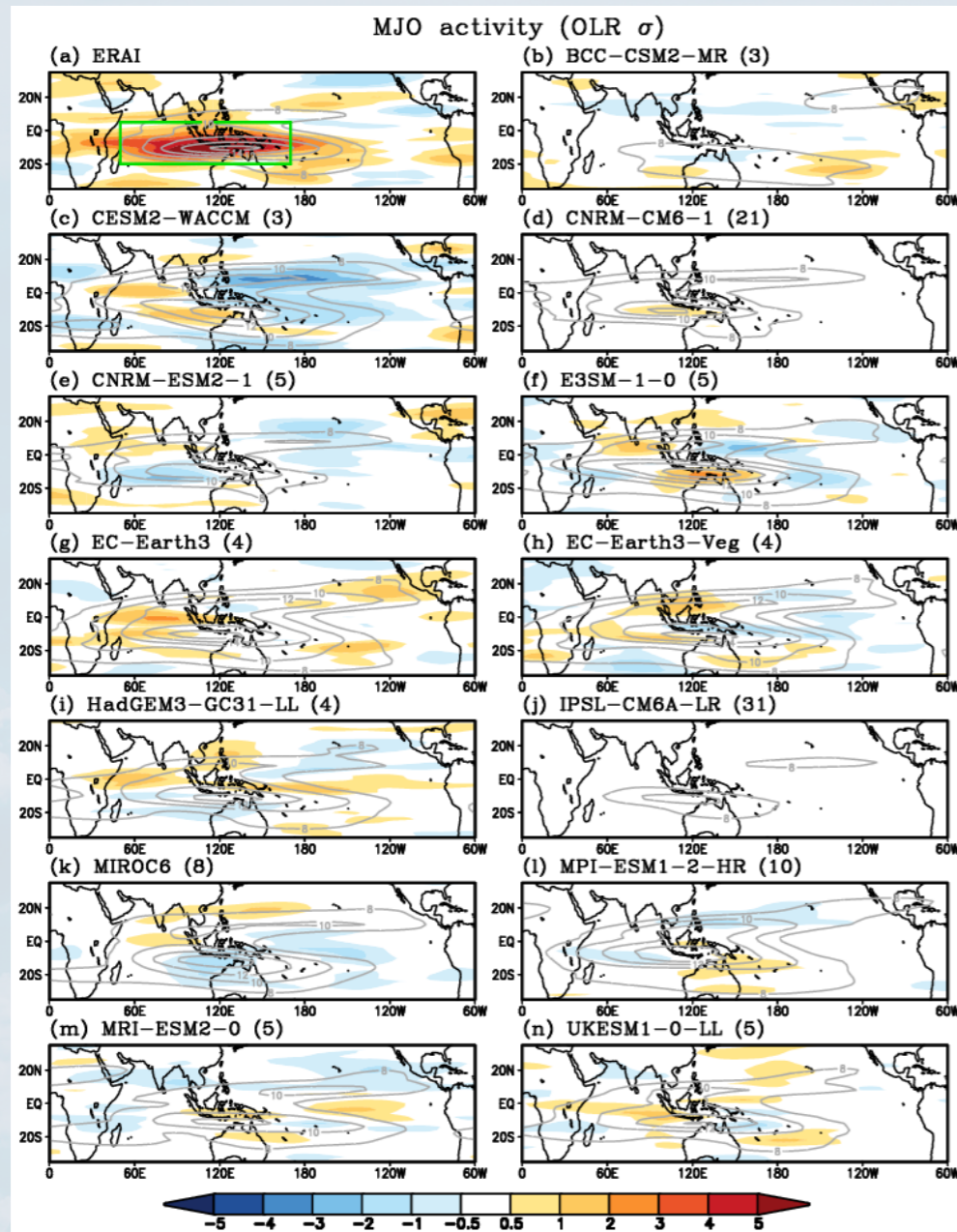


Kim, Caron, Richter, & Simpson (2020), GRL

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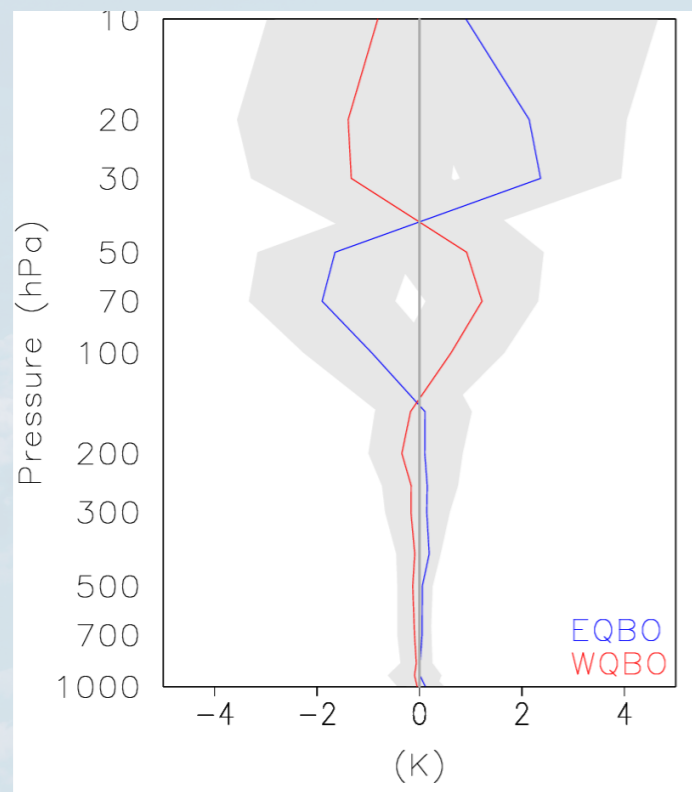
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- None of the CMIP6 models capture the MJO-QBO relationship.
- In fact, even with reasonable simulations of QBO and MJO none of the models capture a difference in MJO activity between easterly and westerly QBO phases that is larger than random sampling of internal variability.

## Potential Reasons for lack of QBO-MJO Connection in CMIP6 Models

**T anomaly profile  
(Maritime Continent, 10S-10N)**



### Plausible mechanism

#### During EQBO:

- Cold anomalies around 50-100mb
  - Reduced static stability (& reduced wind shear)
  - Allowing deeper convection
- (Enhanced tropical cirrus causing more longwave heating)

### Model deficiencies

- QBO amplitude (T & U) are weak compared to observations.
- Insufficient vertical resolution to simulate the QBO and assoc. wave-mean interactions.
- Biases in simulating the 3D structure of MJO, such as convection reaching high enough to be impacted by QBO.