

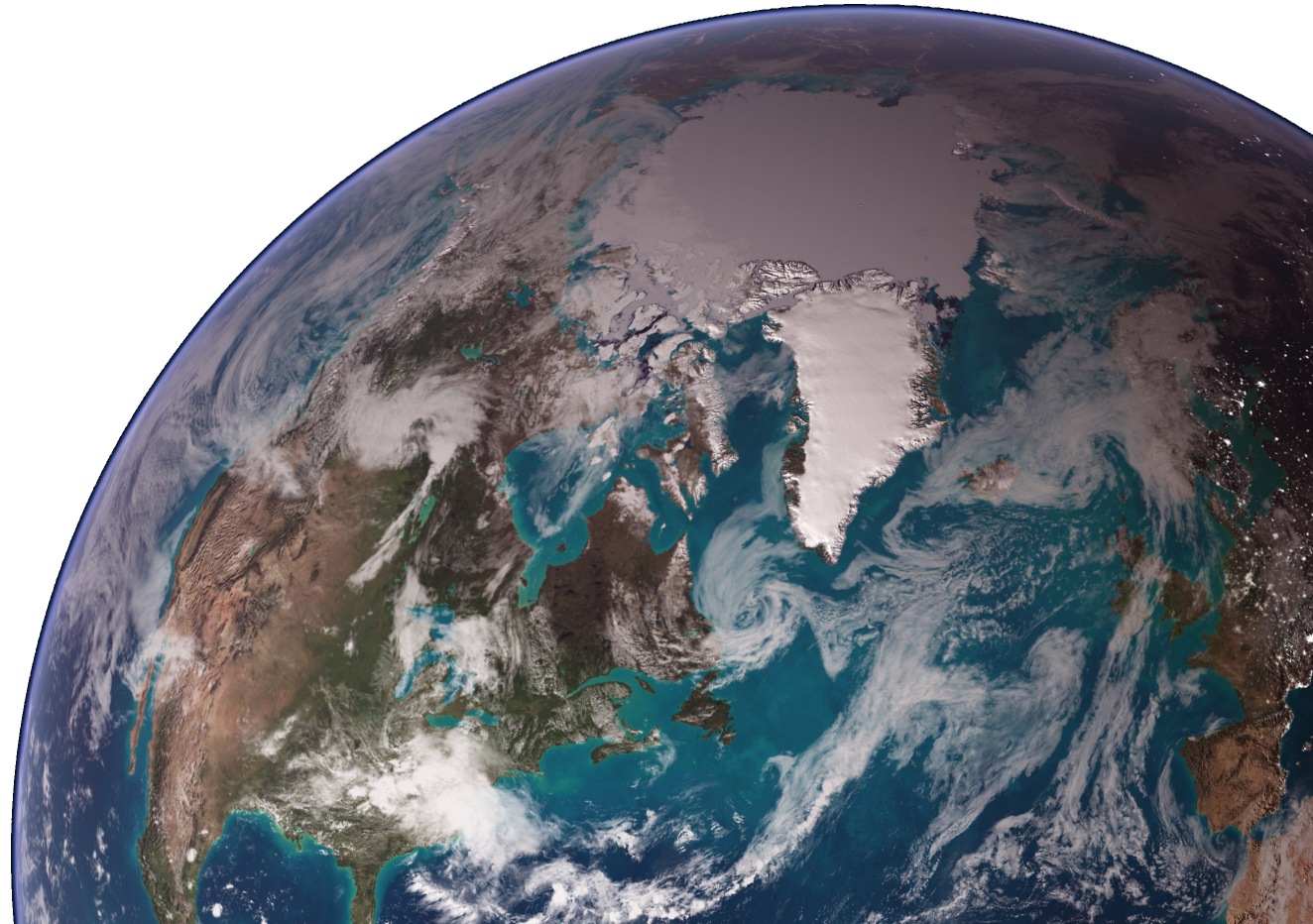


NOAA RESEARCH • ESRL • PHYSICAL SCIENCES DIVISION

Understanding Convective Coupling in Atmospheric Tropical Waves

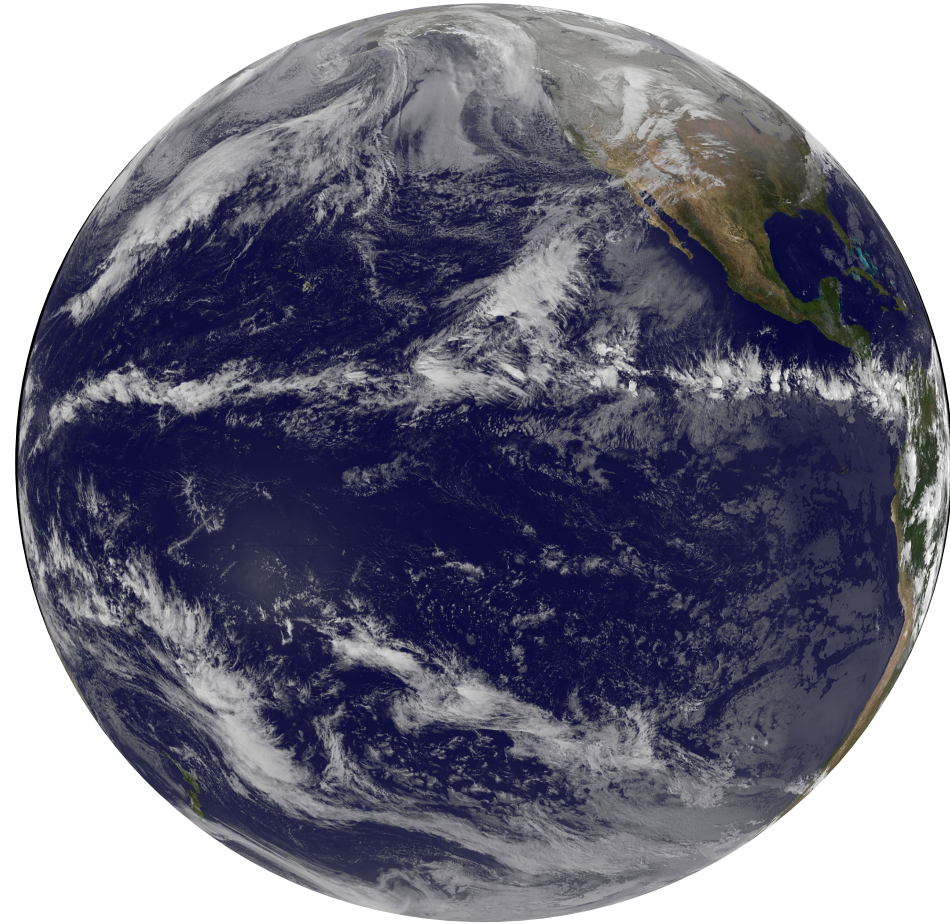
Juliana Dias

Science Review
12-14 May 2015
Boulder, Colorado

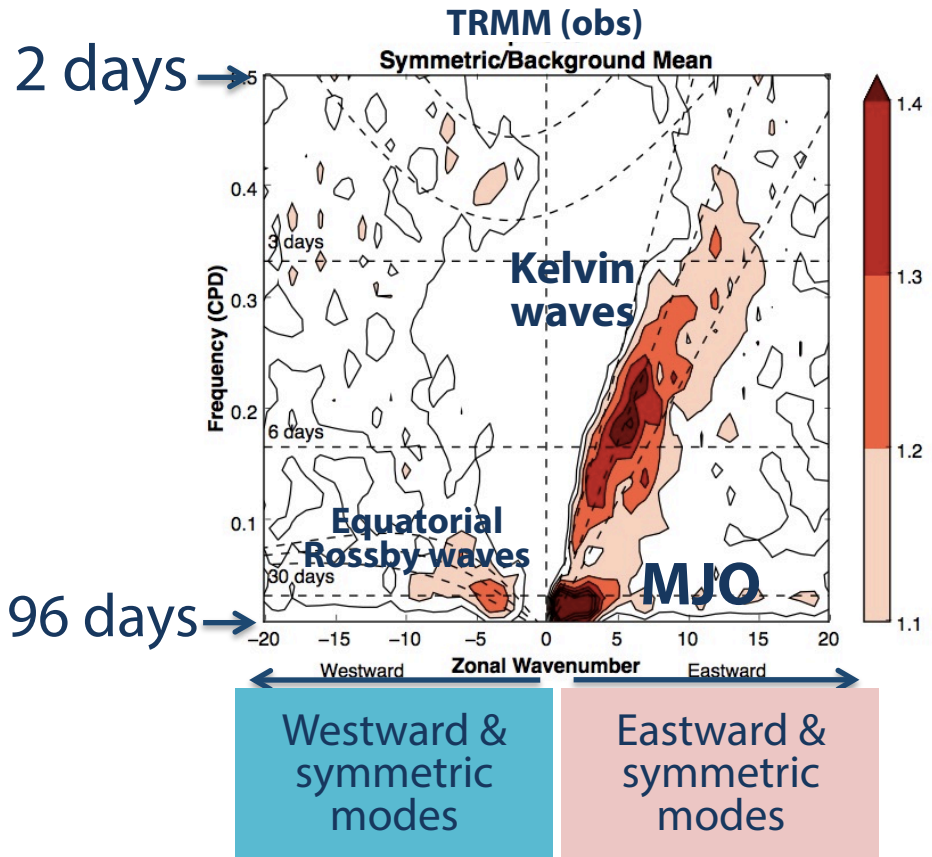


Why study convectively coupled tropical waves?

- tropical waves control local weather;
- larger scale tropical waves (such as MJO and ER) affect *higher latitude weather*;

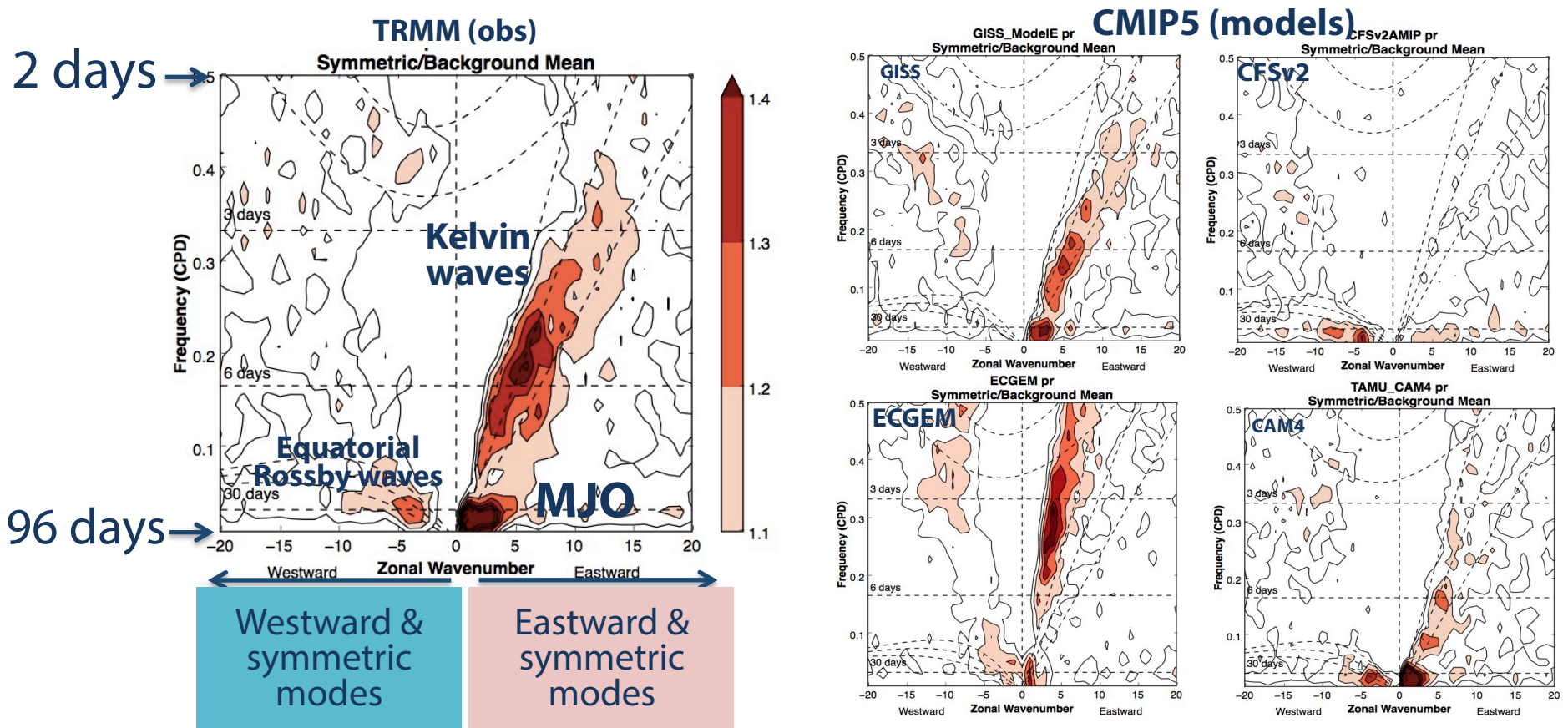


How to diagnose convectively coupled tropical waves?



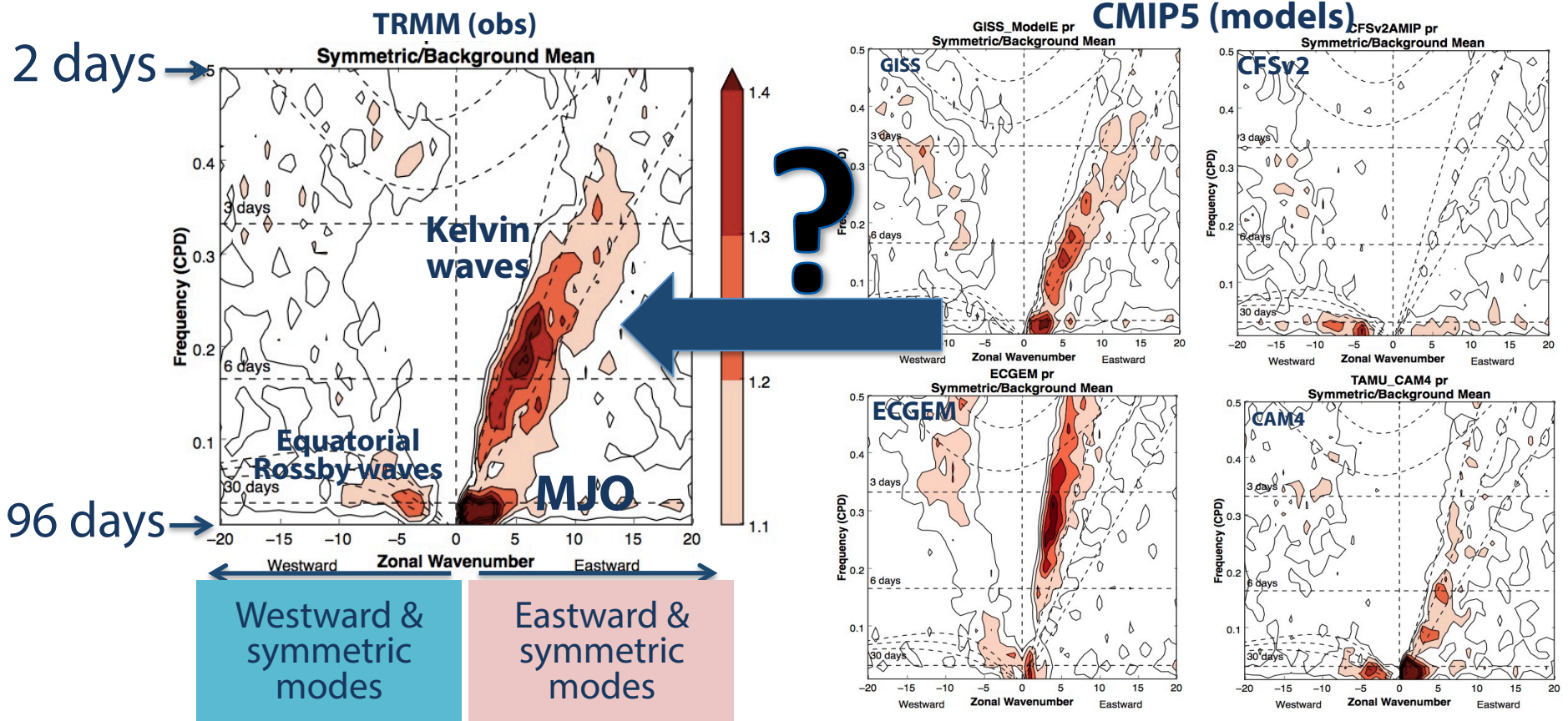
our focus is on synoptic-to-planetary waves that are coupled to rainfall

How well do models resolve tropical waves?



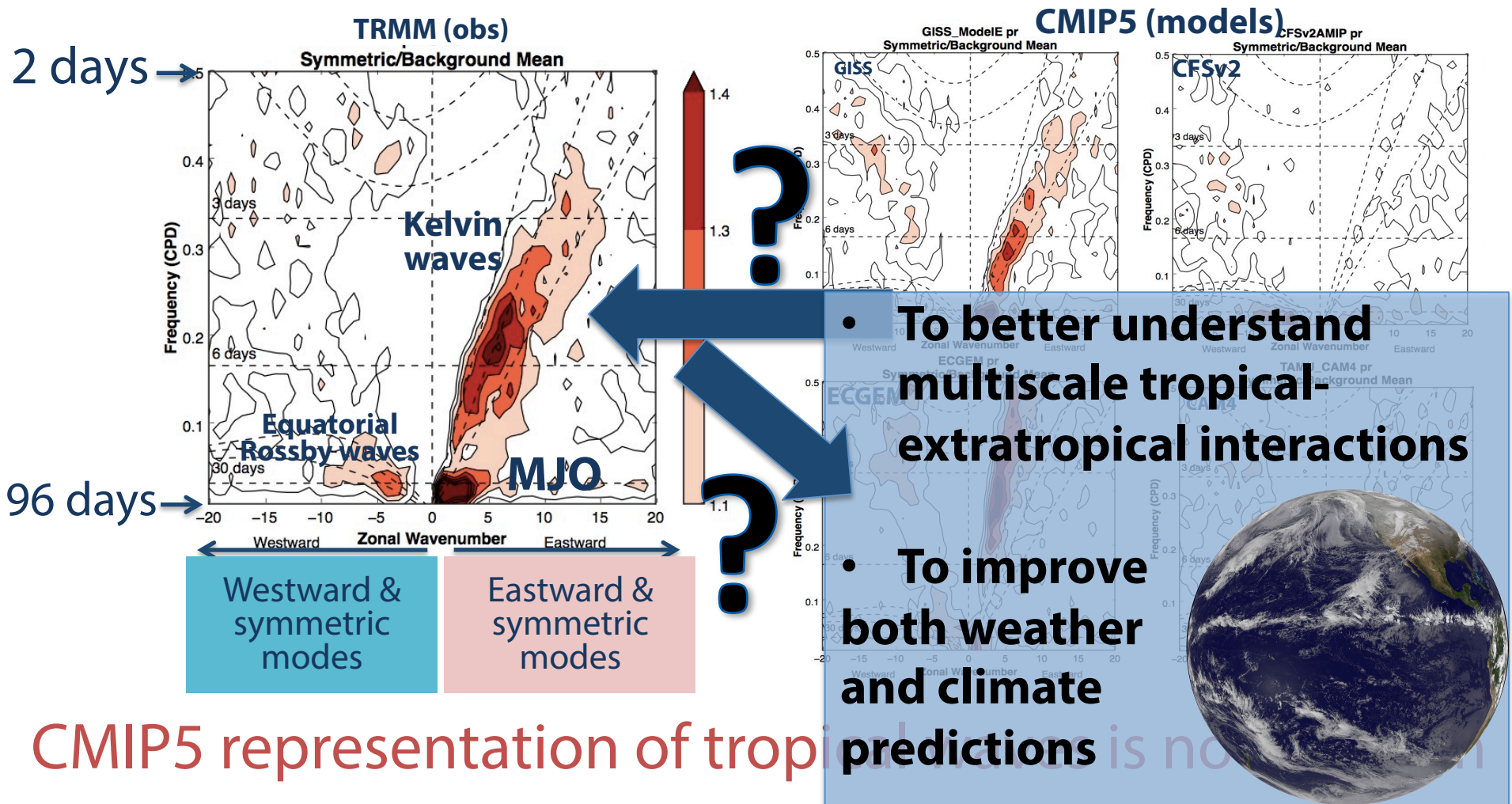
CMIP5 representation of tropical waves is not uniform

Why do models have a difficult time representing tropical waves?



CMIP5 representation of tropical waves is not uniform

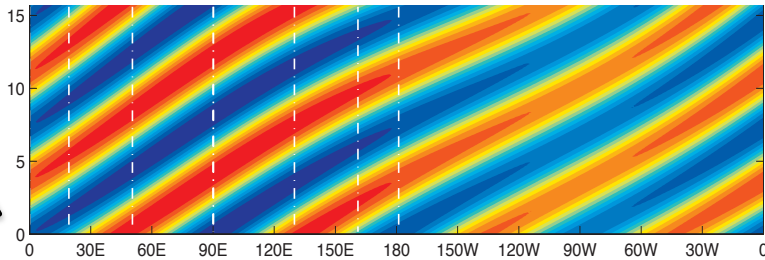
Why do we care about tropical waves?



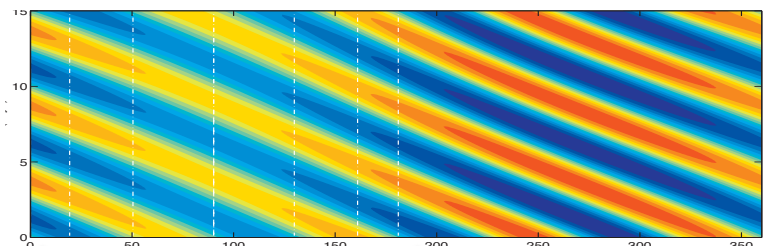
CMIP5 representation of tropical waves is not

(1) How sensitive are synoptic scale waves to cumulus parametrizations and the basic flow?

(a) KW amplitude



(b) MRG amplitude

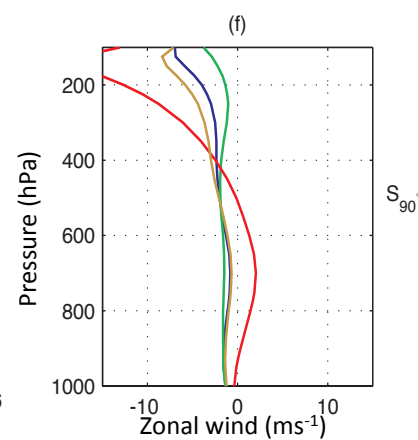
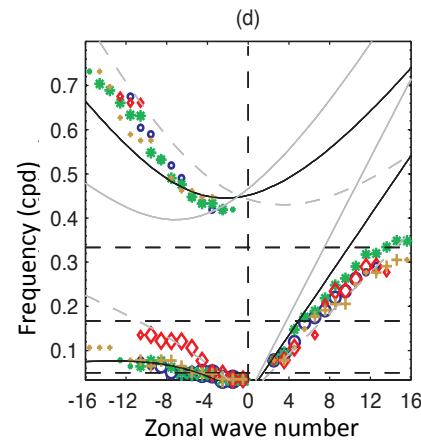
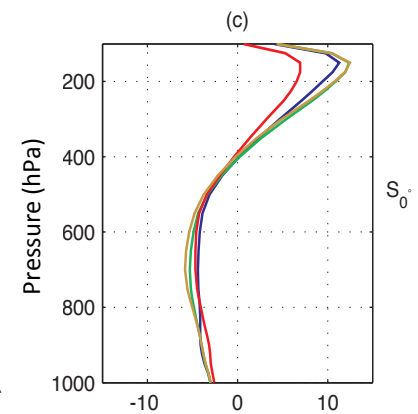
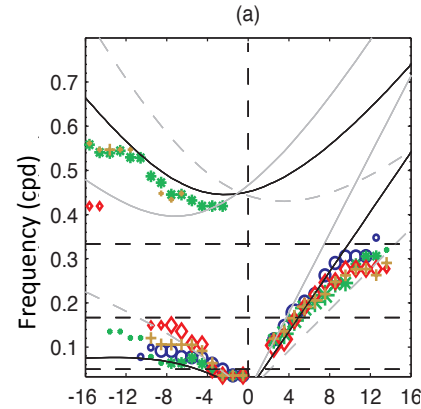


moister

longitude (deg)

drier

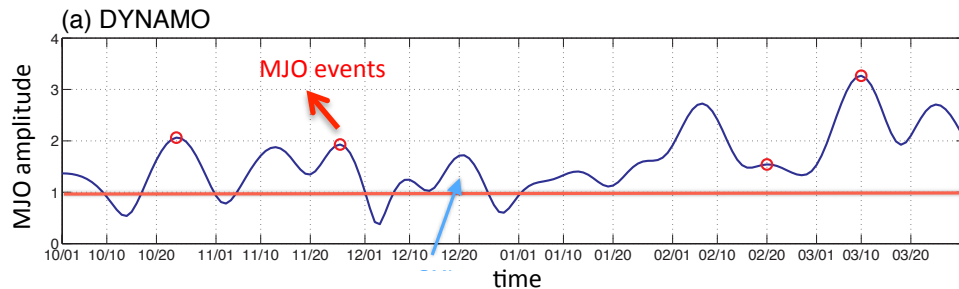
- Convective coupling induced by Betts-Miller types of cumulus parameterizations have different impacts synoptic scale tropical waves.



- Wave scales are not too sensitive to vertical shear

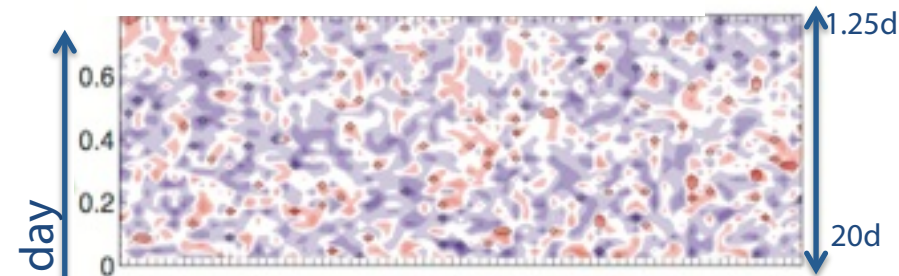
(2) Are multi-scale interactions key to the existence and propagation of the MJO?

Is there a pattern of higher frequency disturbances that is common to most MJO events?

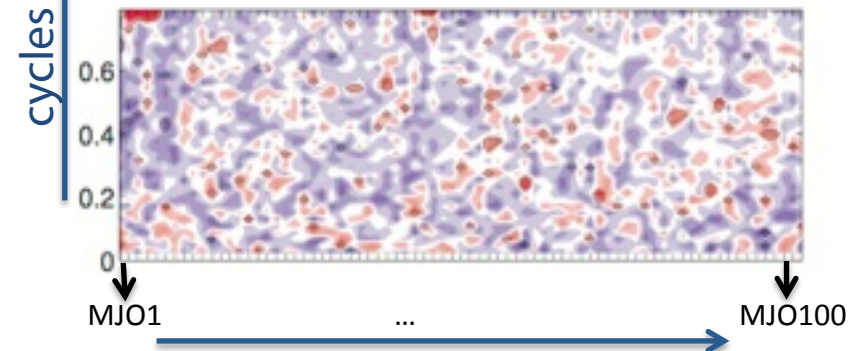


- *There is no systematic enhancement of synoptic scale variability within the MJO envelope*

(a) Eastward power-spectrum



(b) Westward power-spectrum



MJO events from 1979 to 2012

(3) What defines the MJO? Zonal wind or Convection?

RMM (zonal wind)

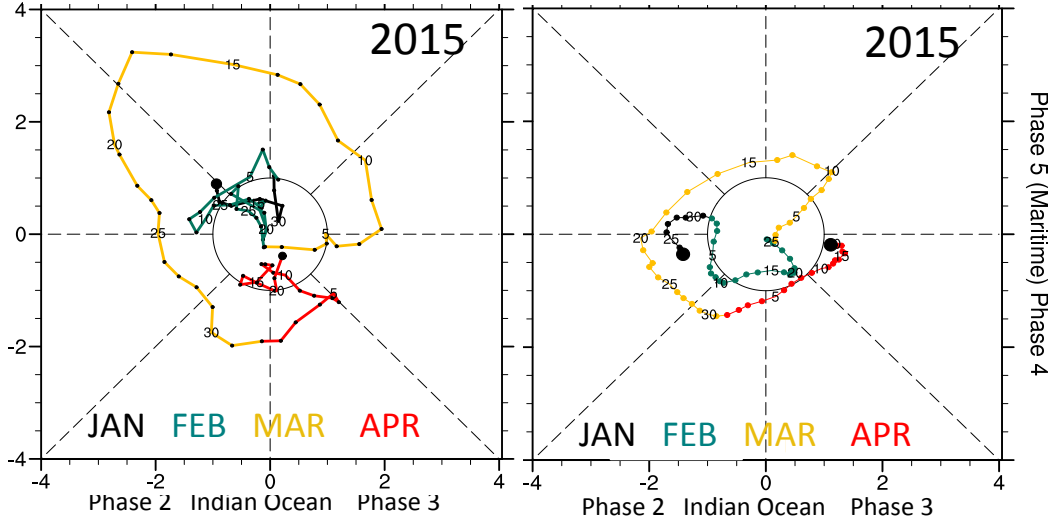
OMI (OLR)

Phase 7 Western Pacific Phase 6

Phase 7 Western Pacific Phase 6

2015

2015

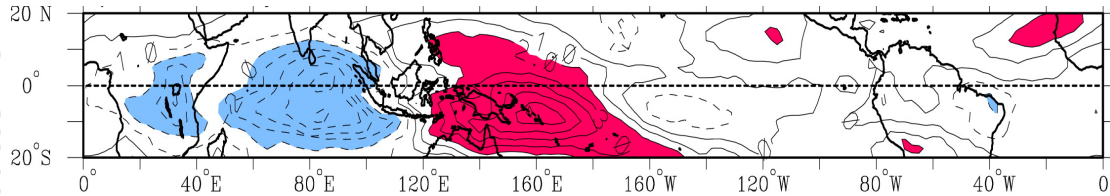


- RMM and OMI are both bivariate MJO indexes. **RMM** is primarily a **zonal wind** based index, and **OMI** is an **OLR-only** index.

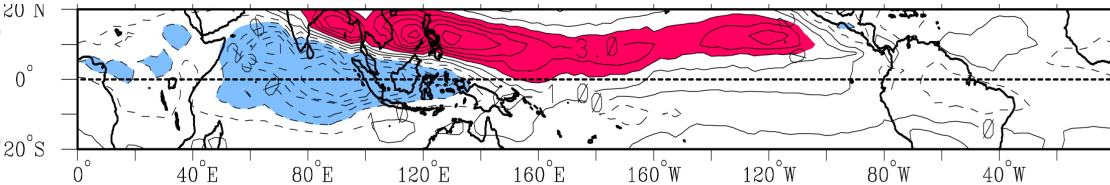
- OMI is a useful index for tracking the MJO convective envelope, including its seasonal changes;
- OMI produces robust statistics of MJO primary events; and

- OMI is available at: <http://www.esrl.noaa.gov/psd/mjo/mjoindex/>

(a) EOF1 Jan, 15



(b) EOF1 Jul, 15



Summary and Conclusions

- (1) Both cumulus parameterization and basic flow impact tropical waves in different ways, highlighting differences in the physical processes underlying their convective coupling.

Is that why it is so difficult to represent tropical waves in models?

- (2) Because the MJO does not organize higher frequency waves it is possible that model resolution is not critical to the MJO representation;

MJO representation in models might be possible in a coarse resolution global model.

- (3) OLR based indexes are an important target for model development because they better track the MJO convective envelope.

A model can have high MJO skill based on a circulation index without properly representing MJO rainfall.