Understanding Convective Coupling in Atmospheric Tropical Waves

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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

Ref: Jaramillo, Dias and Kiladis (in prep.)
Why do models have a difficult time representing tropical waves?

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Why do we care about tropical waves?

• To better understand multiscale tropical-extratropical interactions
• To improve both weather and climate predictions

Ref: Jaramillo, Dias and Kiladis (in prep.)
(1) How sensitive are synoptic scale waves to cumulus parametrizations and the basic flow?

- 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

Ref: Dias et al., 2013 JAS/ Dias and Kiladis, 2014 GRL
(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**

![Diagram](image-url)

(a) Eastward power-spectrum
(b) Westward power-spectrum

MJO events from 1979 to 2012

Ref: Dias, Tulich and Kiladis, 2011 JAS / Dias et al., 2012 GRL
(3) What defines the MJO? Zonal wind or Convection?

- 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/](http://www.esrl.noaa.gov/psd/mjo/mjoindex/)

Ref: Kiladis et al. 2014, MWR
(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.