

# A filtered analytical model of tropical waves associated with the Madden- Julian Oscillation



Alex O. Gonzalez

Advisor: Wayne Schubert, CSU Atmos.

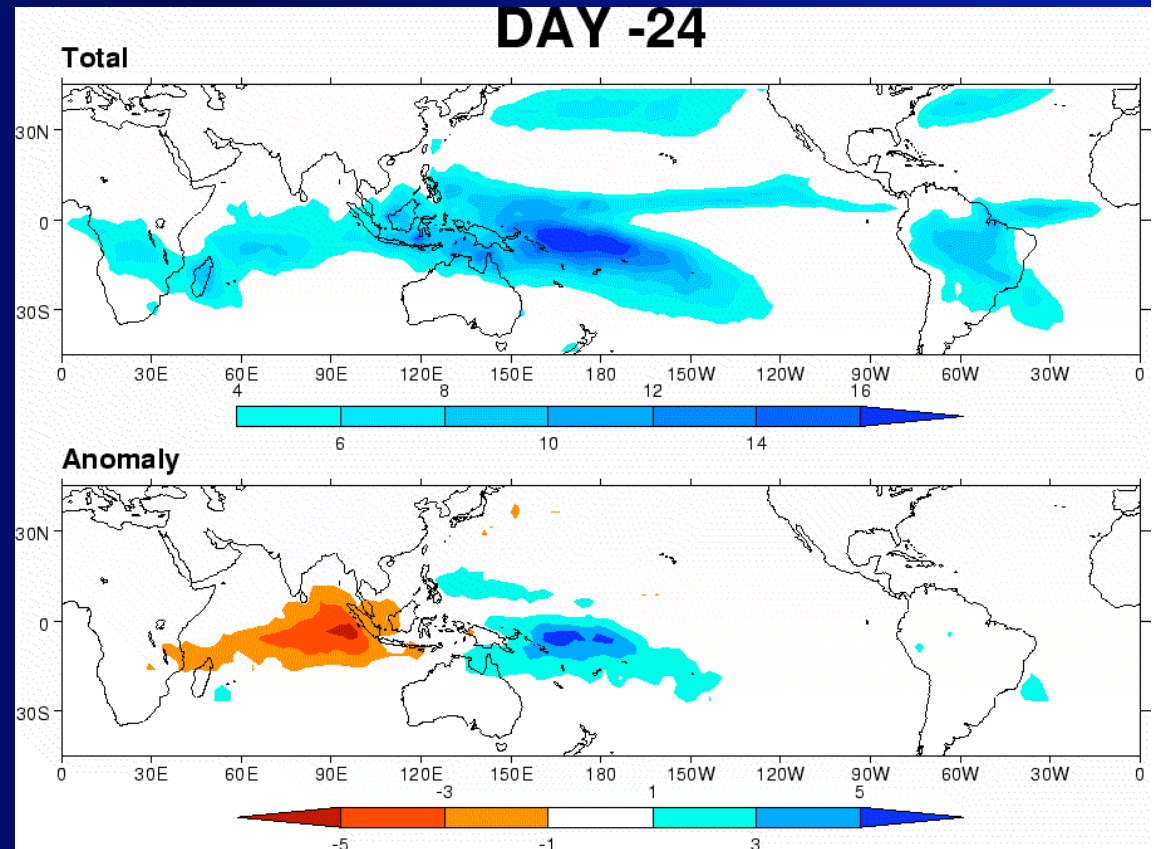
Co-Advisor: Brian Mapes, RSMAS UMiami

# More about me

- 2<sup>nd</sup> semester M.S. student in CSU Atmos.
- 3<sup>rd</sup> year SOARS intern at NCAR
- Passions include:
- Lifting weights, running, biking, basketball
- Cooking, eating healthy
- Singing, playing the piano, composing music
- Salsa and hip-hop/break dancing

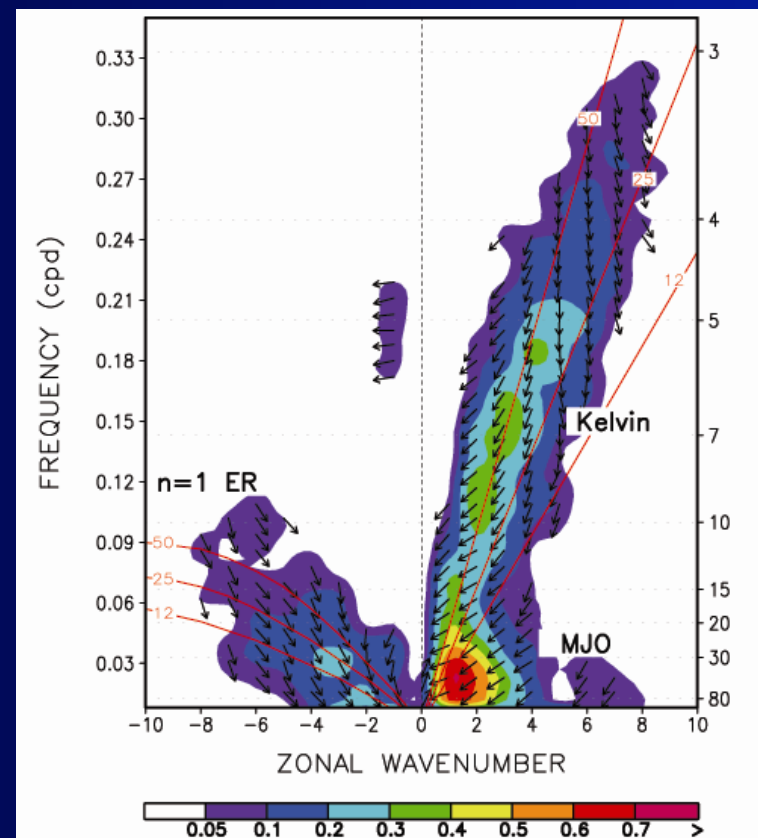
# Background on the MJO

- Main intraseasonal oscillation in tropical weather (30-60 days)
- Eastward propagating area of clouds/precipitation,  $5 \text{ ms}^{-1}$
- Affects local agriculture, transportation, water resource management
- GCMs do not simulate it well due in part to lack of simple theory
- MJO dynamics can be modeled prescribing a heat source, a.k.a. radiation and cloud processes
- Wind circulations develop, in the form of atmospheric equatorial waves



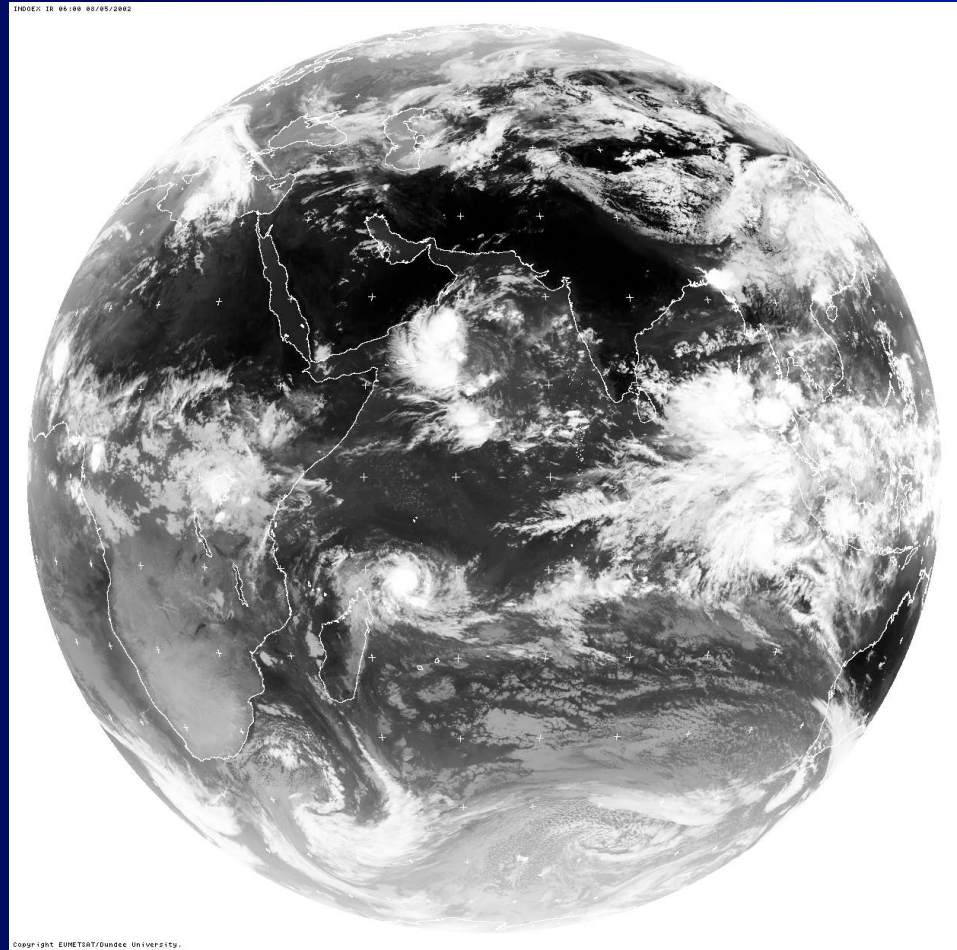
# Atmospheric equatorial waves

- Waves attempt to re-stabilize the atmosphere
- "Birds ride the waves"
- 4 types of EQ waves: ER, Kelvin, IG, and MRG waves
- **GOAL: Filtered out IG and MRG waves, keep all ER and Kelvin waves**
- Gill (1980) filtered IG, and small-scale ER waves using "longwave approximation"
- Gill (1980) great theory of tropical dynamics, e.g. monsoon
- Need to improve representation of small-scale ER waves (Schubert et al. 2009)



# New Filtered Model

- Simulate the MJO, with ER waves west of prescribed heat source and Kelvin waves to the east
- We use a linear, shallow-water model (2D) with earth approximated on the beta plane following methods of Ripa (1994)
- Impose the 3<sup>rd</sup> dimension with a vertical structure similar to Mapes (2000)
- Convective and stratiform clouds/heating
- **GOAL: Improve dynamical theory of MJO, could be used to better understand GCMs and weather forecasts for tropics**



# Questions? Comments?

Thanks to SOARS, CMMAP,  
CSU, UMiami students and staff!

# References

- Gill, A. E. 1980. Some simple solutions for heat-induced tropical circulation. *Quart. J. Roy. Meteor. Soc.*, 447-462.
- Mapes, B. E. 2000: Convective inhibition, subgrid-scale triggering energy, and stratiform instability in a toy tropical wave model. *J. Atmos. Sci.*, **57**, 1515–1535.
- Ripa, P. 1994: Horizontal wave propagation in the equatorial waveguide. *J. Fluid Mech.*, **271**, 267-284.
- Schubert, W. H., L. G. Silvers, M. T. Masarik, and A. O. Gonzalez, 2009: A filtered model of tropical wave motions. *J. Adv. Model. Earth Syst.*, in press.