

Process Oriented Diagnostics of Tropical Cyclones in Reanalyses Using Moist Static Energy Budgets Caitlin A. Dirkes and Allison A. Wing (Florida State University), Suzana Camargo (LDEO), Daehyun Kim (UW), and Yumin Moon (UW) Part of NOAA MDTF, supported by NOAA MAPP Grant NA180AR4310270

Introduction

Key Questions:

- What biases do global models have in representing tropical cyclones (TCs)?
- What physical processes are involved in a "good" TC simulation in a model? How does the moist static energy (MSE) variance budget help us understand
- these biases?

Goals:

- Extend Wing et al. 2019 approach for GCMs to include reanalyses
- Develop "observation"-based reference against which models can be evaluated with respect to the processes involved in a good simulation of TCs Diagnose the physical mechanisms associated w/ TC development in
- reanalyses

	Reanalysis Data		
Reanalysis	Model	Output	Time Period
	Resolution	Resolution	Used
MERRA-2	0.5° x 0.625°	0.5° x 0.625°	1980-2016
CFSR	T382 (~0.34°)	0.5° x 0.5°	1980-2015
JRA-55	T319 (~0.5°)	1.25° x 1.25°	1980-2014
ERA5	T639 (~0.28°)	0.25° x 0.25°	1980-2016
ERA-Interim	T255 (~0.54°)	0.75° x 0.75°	1980-2016

Methodology



Composites

TC Pre-Processing Vortex relocation

Vortex relocation

TC WPR None None



- Bullseye of large h in the center where the storm is strongest \rightarrow h' > 0 in center
- Surface flux large in a ring where winds are strongest \rightarrow SEF' > 0 in ring, SEF' < 0 in center representing 'eye' \rightarrow h'SEF' > 0 in ring, h'SEF' < 0 in center
- Net longwave flux negative everywhere, less negative in center where there is cloud cover

 \rightarrow LW' > 0 in center

 \rightarrow h'LW' > 0 in center

• Net shortwave flux positive everywhere, larger in center where higher moisture content is absorbing more SW radiation \rightarrow SW' > 0 in center

 \rightarrow h'SW' > 0 in center



- ERA-Interim surface flux feedback largely negative, too large to be an 'eye'
 - Only dataset with this feature \bullet
- Surface wind composite reveals a large RMW ~ 200km, broad circulation

 \rightarrow 9 gridpoint square of SEF' < 0 \rightarrow h'SEF' < 0 at these points

Remaining datasets have similar spatial structures of feedbacks and h





mechanisms necessary for TC simulation

- Even after removing sources of inherent discrepancy, the feedbacks still have a large spread across datasets at a given intensity
- represented differently in these datasets





Box Averages

- comparison among datasets and intensities about the physical
- These physical processes involved in the feedbacks are being