CAM5 Dynamical Core Impact on Tropical Cyclones

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• National Center for Atmospheric Research and Dept. of Energy supported CAM 5 has shown some “skill” in simulating extreme weather events, especially at higher horizontal resolutions (~25 km).

• This is particularly true for the simulation of Tropical Cyclones (TCs).

• However, there is still much room for improvement as there exist biases in intensity, track duration, regions of formation, etc.

• In addition, there is uncertainty in the tuning of the model at these high horizontal resolutions and its impact on extremes.
CAM5-FV 0.9° by 1.25°
Storm Tracks - AMIP
CAM5-FV 0.23° by 0.31°
Storm Tracks - AMIP

CAM5-FV 1980-2005

Feb. 19, 2015
[Wehner et al. 2014, JAMES]
Observations
Community Atmosphere Model version 5.3 (CAM 5.3).

The default Spectral Element SE dynamical core with 30 vertical levels is used at the horizontal resolution of ne120 (~25 km) – comparable to previous CAM5-FV 0.23°x0.31° run.

This is an update of results discussed at the 2014 CESM Workshop.

Full CAM 5 physics with Atmospheric Model Intercomparison Project (AMIP) protocols for 1980-200[0,5].

Prescribed observed SSTs, ozone, CO₂, solar forcing, etc.

GFDL tracking code is used for calculating all tracks.
Recap from CESM Workshop

IBTrACS
CAM5-FV
CAM5-SE
Recap from CESM Workshop
Recap from CESM Workshop

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This initial study was not a perfect comparison as there were additional known and unknown differences between the simulations.

Treatment of aerosols:
- CAM5-FV used a prescribed BAM configuration
- CAM5-SE used the default MAM configuration

Ocean grid:
- CAM5-FV was coupled to an equivalent ~0.25 deg. grid
- CAM5-SE was coupled to a coarser ~1.0 deg. grid

We now have runs that are more directly comparable (of at least 20 years):
- CAM5-FV using the default MAM configuration
- CAM5-SE coupled to equivalent ~0.25 deg. grid
Impact of Aerosols

The aerosol treatment explained much of difference in the environment
Impact of Aerosols

But not necessarily at the cost of intensity.

With BAM set up producing slight more intense storms.

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There is a more noticeable impact on intensity from the data ocean coupling.

The coarser grid allows for large intensities (in terms of wind maximum).

The new grid has a slight increase in the total number of TCs.
Impact of Dynamical Core

Feb. 19, 2015

[Reed et al. 2015, in prep.]
Impact of Dynamical Core

Feb. 19, 2015

[Reed et al. 2015, in prep.]
Impact of Dynamical Core

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North Atlantic Basin

IBTrACS

CAM5-FV

CAM5-SE

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0.69

0.74
North Atlantic Basin

This is an improvement over previous simulations.
East Pacific Basin

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Final Thoughts

• The impact of the dynamical core on tropical cyclone statistics for the decadal experiments is significant. Is continuing to be explored!

• The high-resolution CAM5-SE produces more tropical storms and hurricanes per year than that seen in the CAM5-FV AMIP simulation.

• Need to focus on understanding some of the regional differences that exist between CAM5-FV and CAM5-SE.

Side Thoughts:

• While the treatment of aerosols certainly impacts the environment, there seems to be only a slight impact on TCs (intensity and count), at least from a global perspective.

• N. Atlantic TC variability is improved in new simulations (with MAM).
Thanks!

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