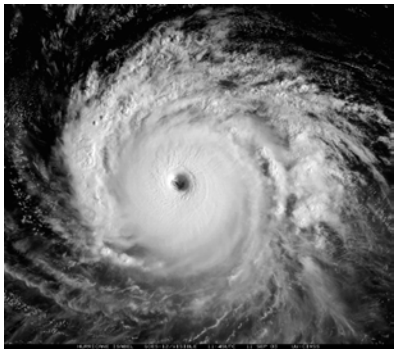

# CAM5 Dynamical Core Impact on Tropical Cyclones


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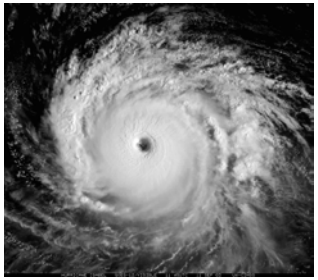
Julio Bacmeister, Nan Rosenbloom, Cecile Hannay,
Peter Lauritzen, John Truesdale & Many Others.

*NCAR*

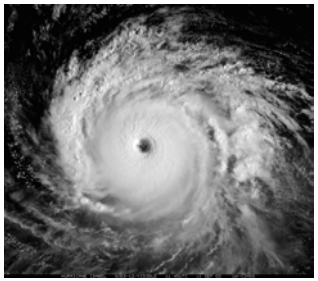
Michael Wehner

*LBNL*

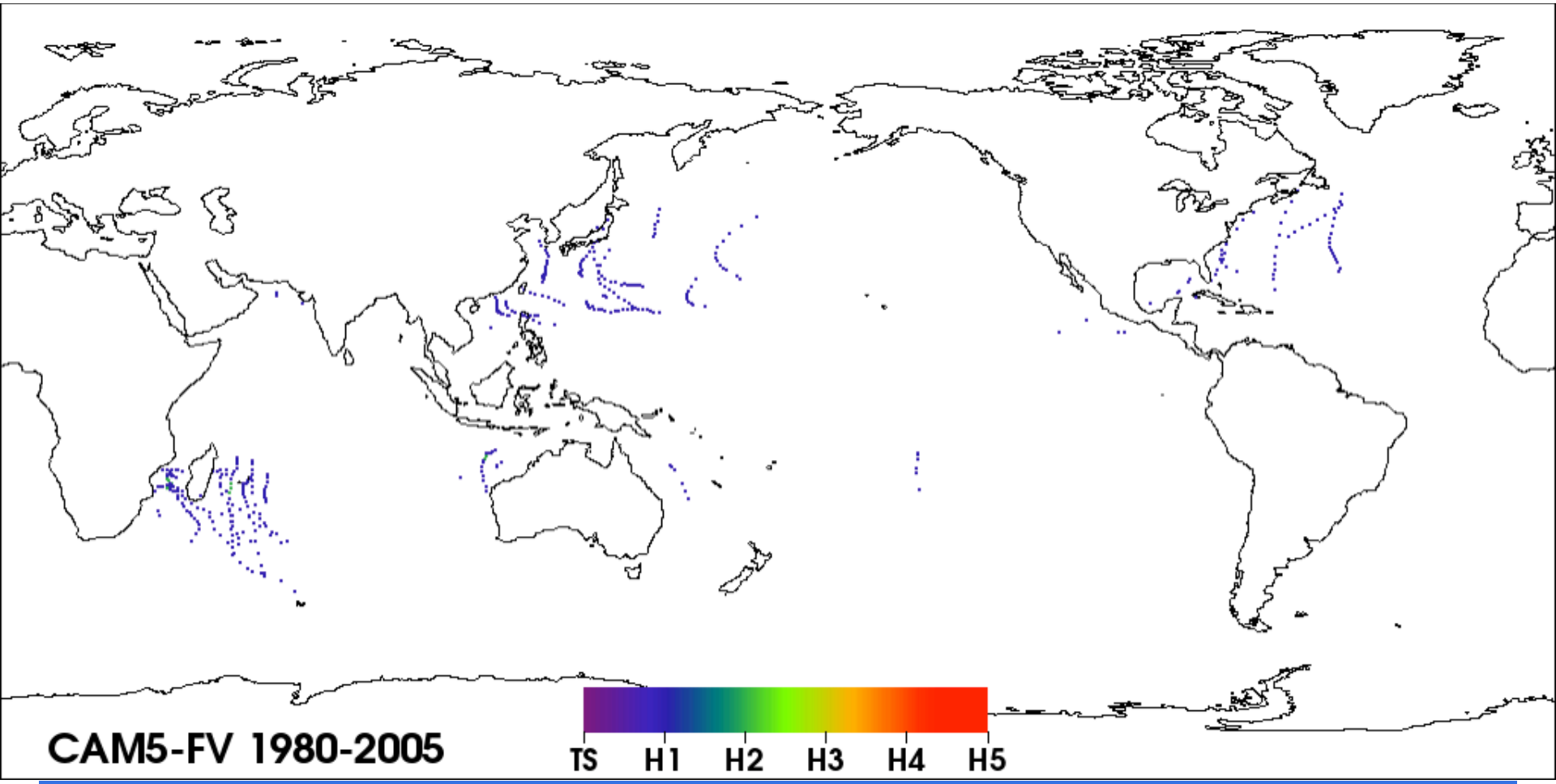


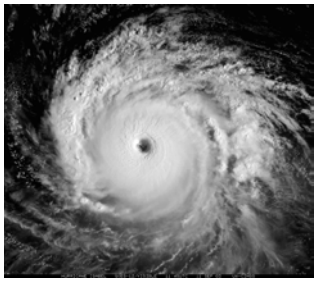
# Background

- 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.

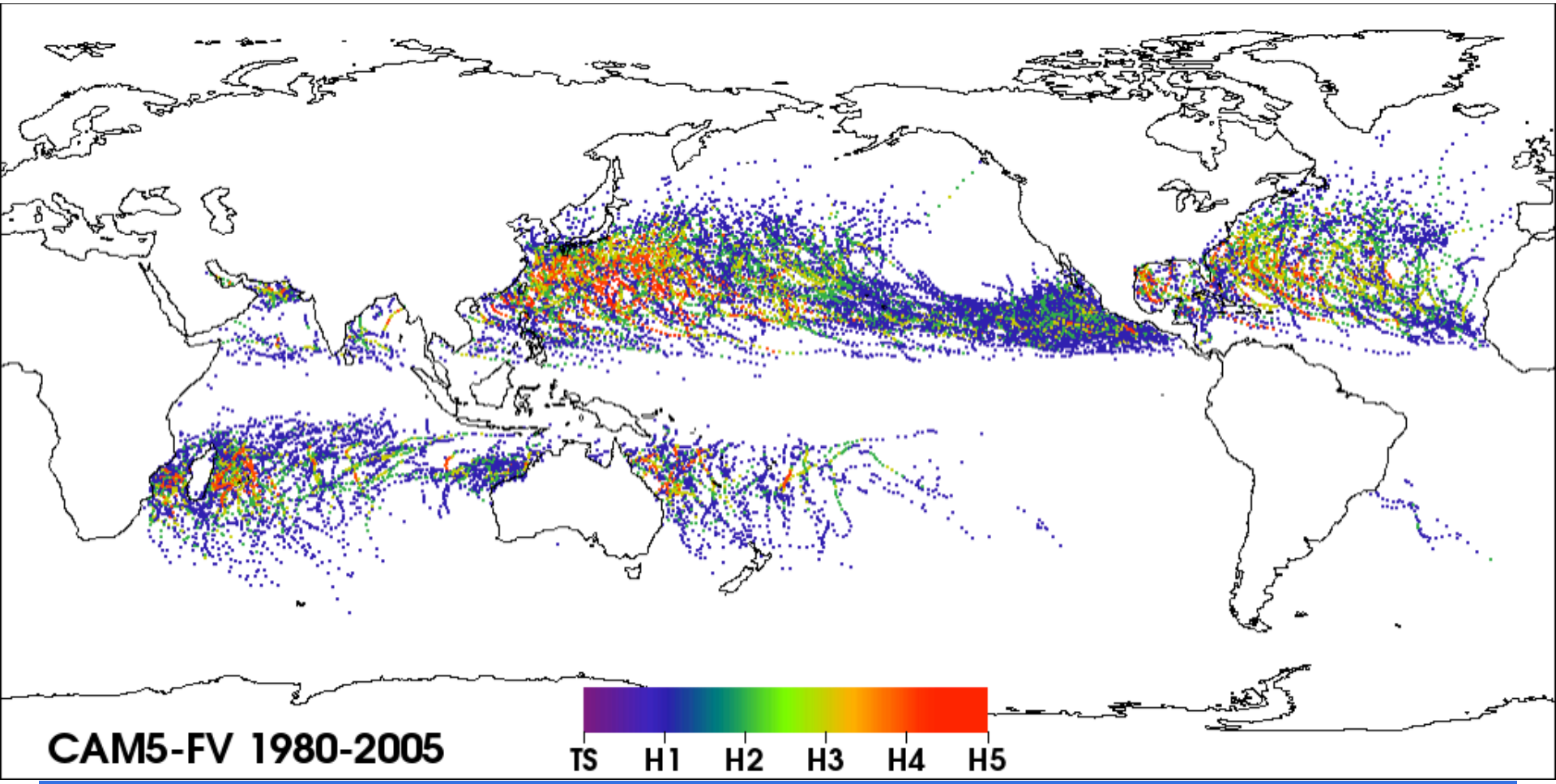


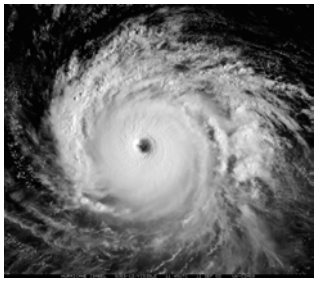
# CAM5-FV 0.9º by 1.25º Storm Tracks - AMIP



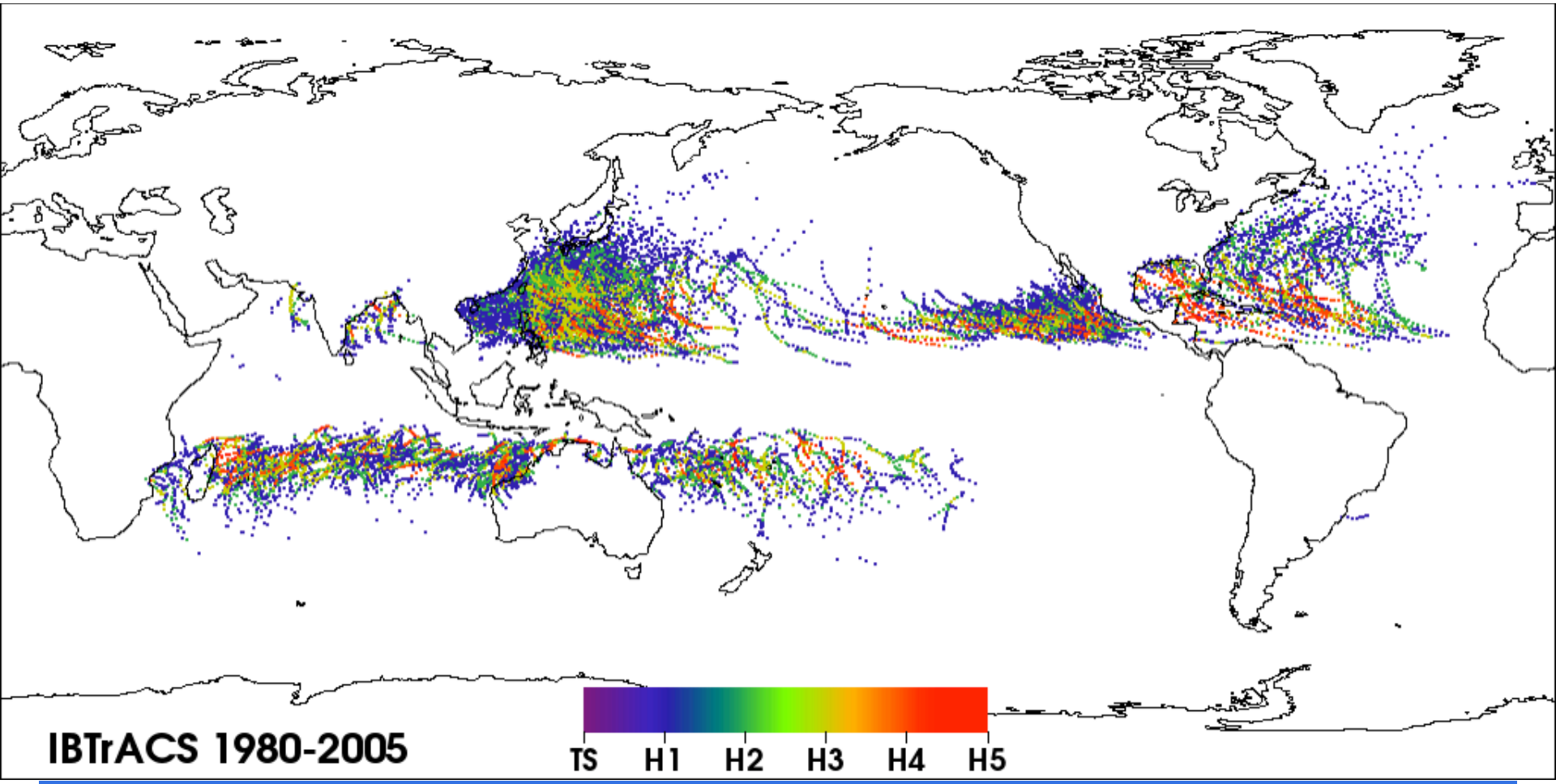


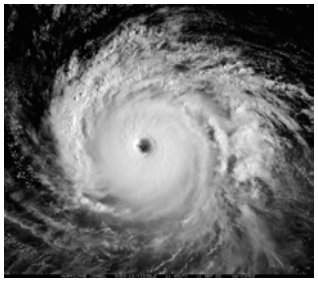
# CAM5-FV 0.23º by 0.31º Storm Tracks - AMIP





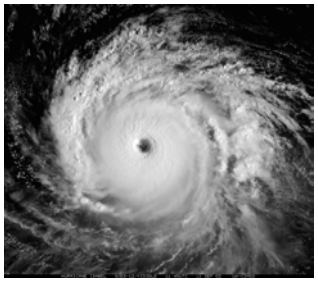
# Observations



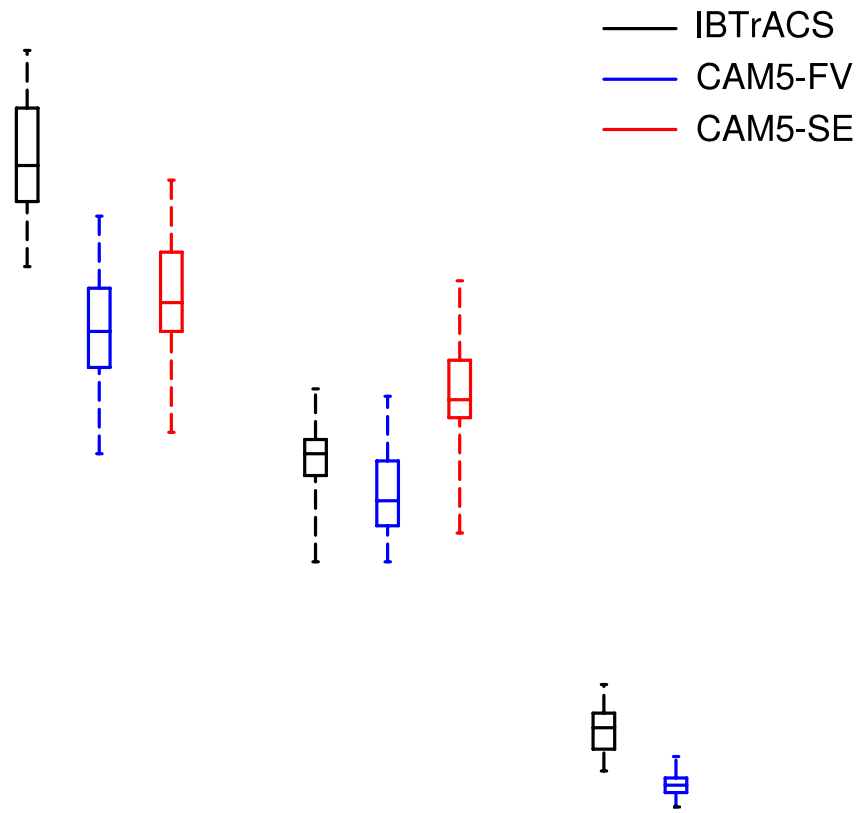


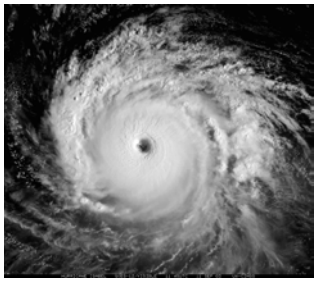
# Design of Experiments

- 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 $0.23^{o}$x$0.31^{o}$ 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, $CO_2$, solar forcing, etc.
- GFDL tracking code is used for calculating all tracks.

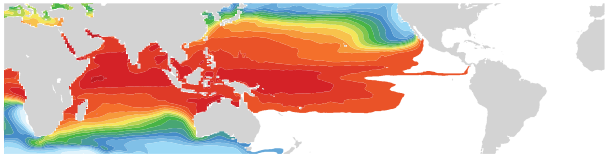


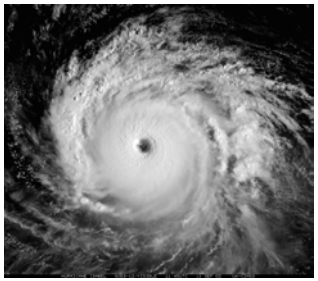
# Recap from CESM Workshop



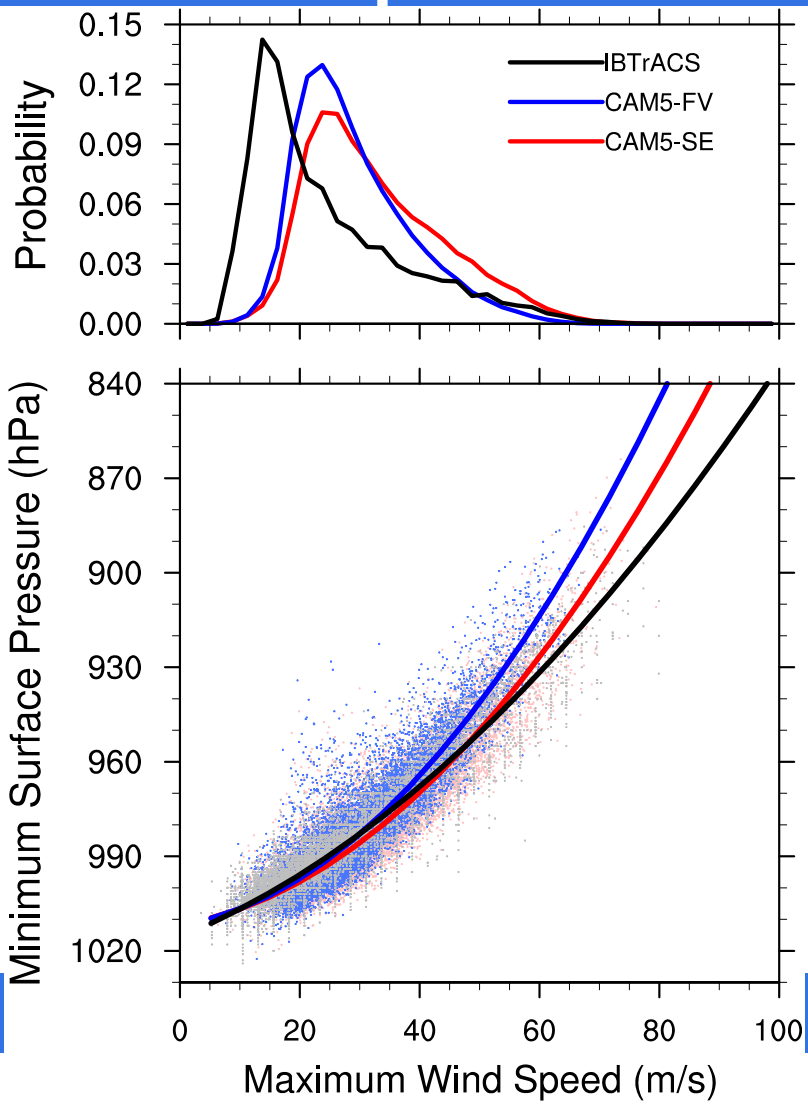


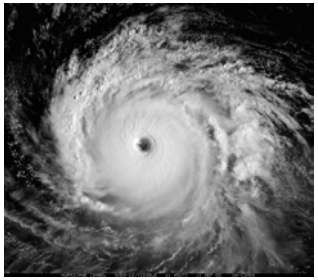
# Recap from CESM Workshop





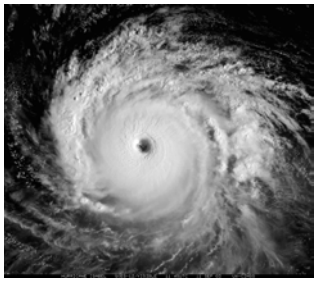
# Recap from CESM Workshop





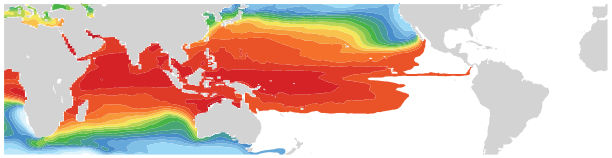
# Design of Experiments

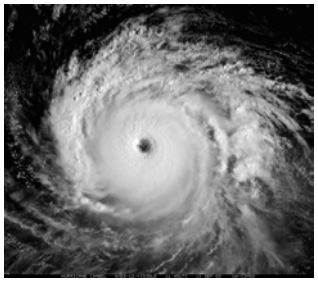
- This initial study was not a *perfect* comparison as there where additional known and unknown differences between the simulations.
- Treatment of aerosols:
  - CAM5-FV used a prescribed BAM configuration
  - CAM5-SE used the default MAM configuration
- Ocean grid:
  - CAM5-FV was coupled to an equivalent ~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

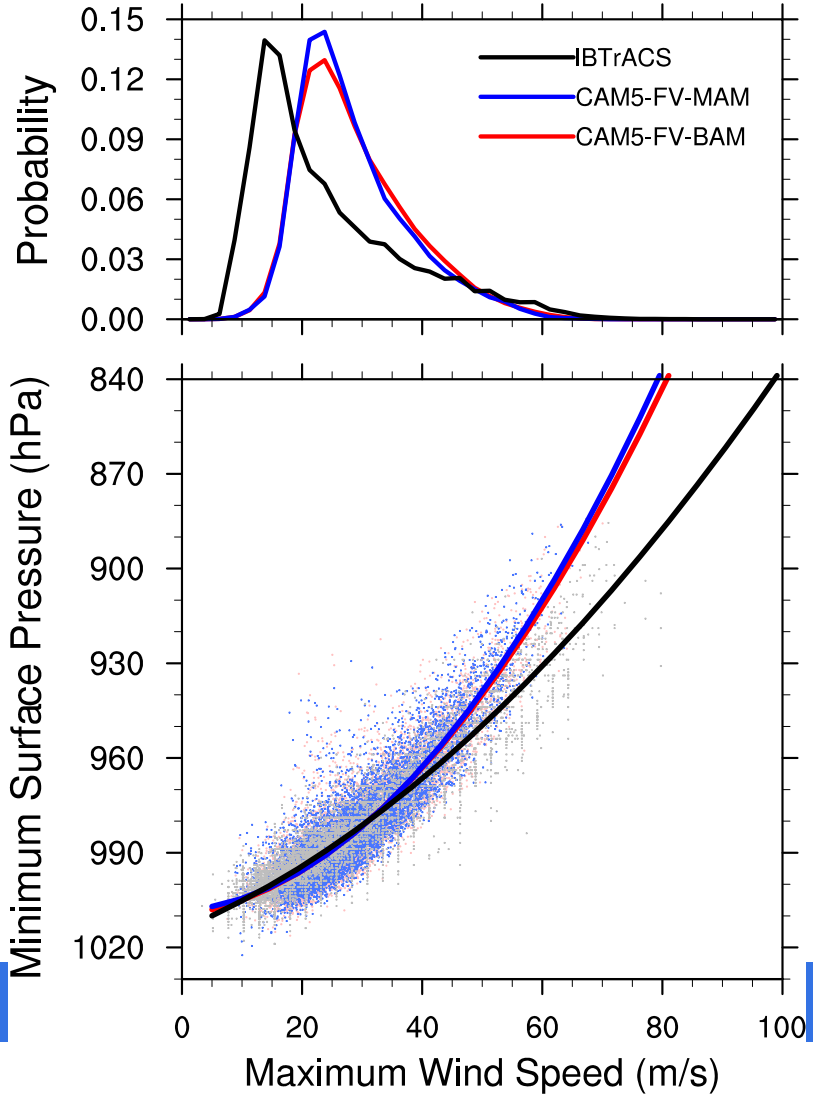


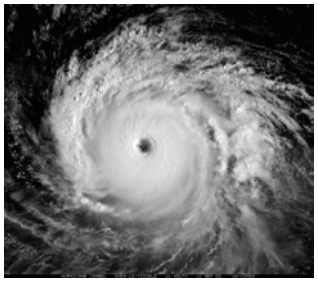


# Impact of Aerosols

But not necessarily at the cost of intensity.

With BAM set up producing slight more intense storms.



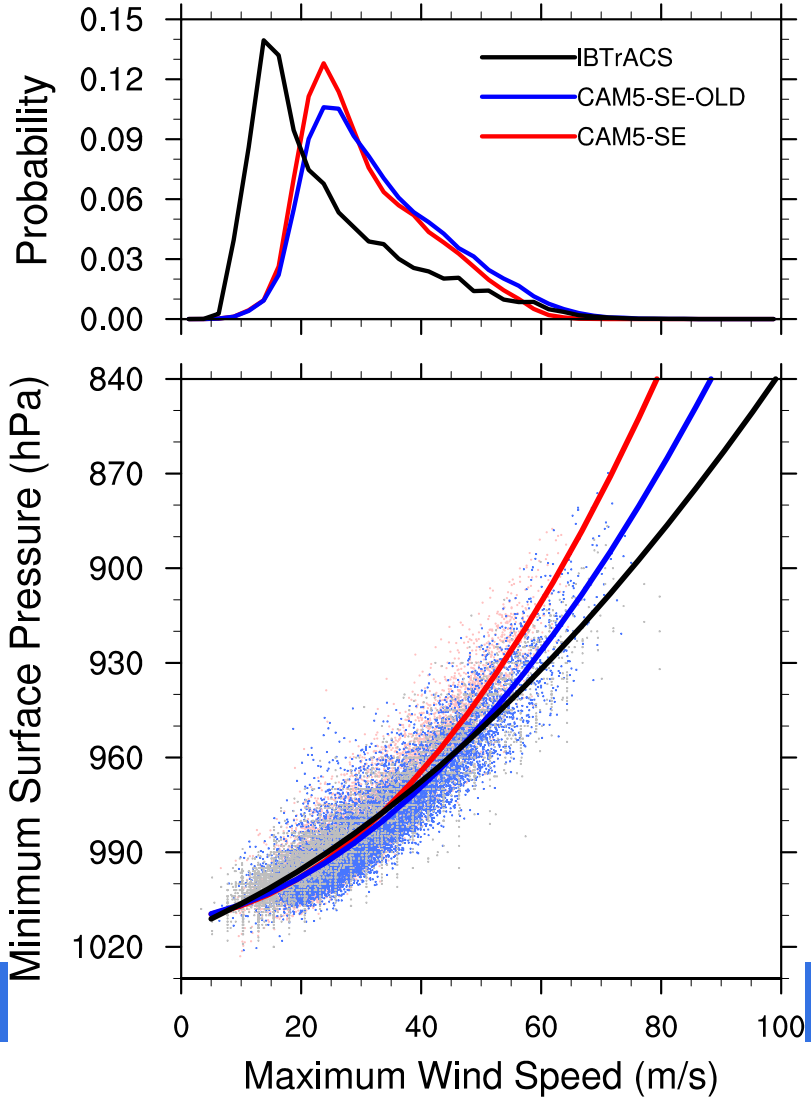


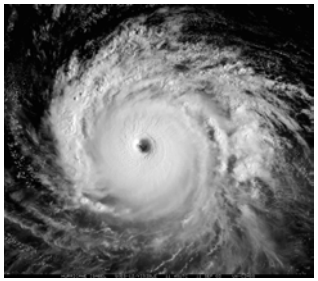
# Impact of Ocean Grid

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

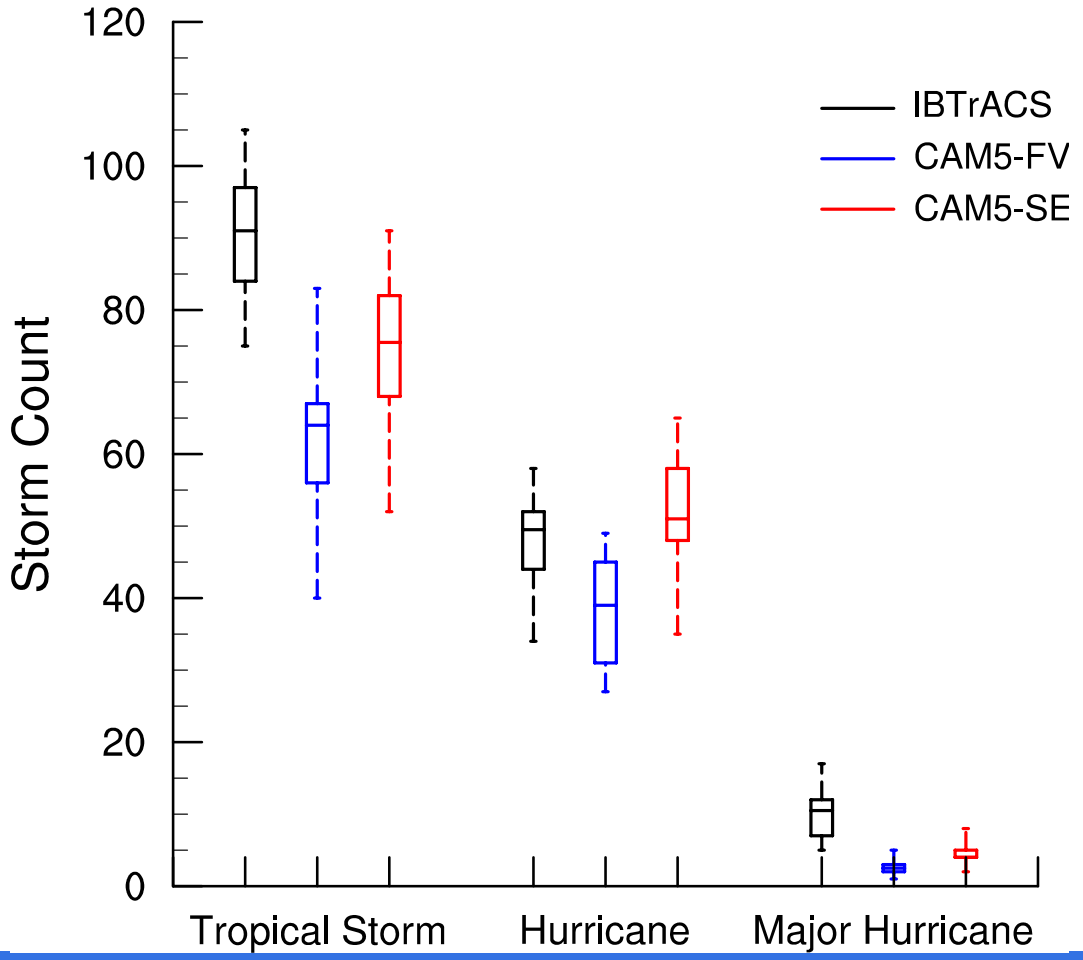
The coarser grid allows for large intensities (in terms of wind maximum).

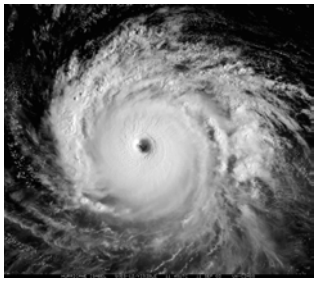
The new grid has a slight increase in the total number of TCs



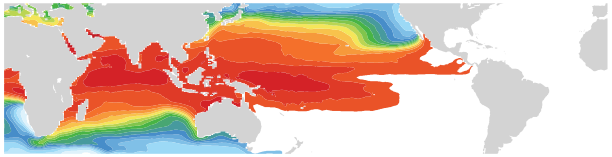


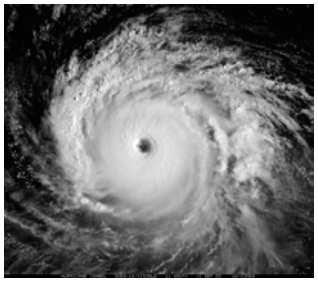
# Impact of Dynamical Core



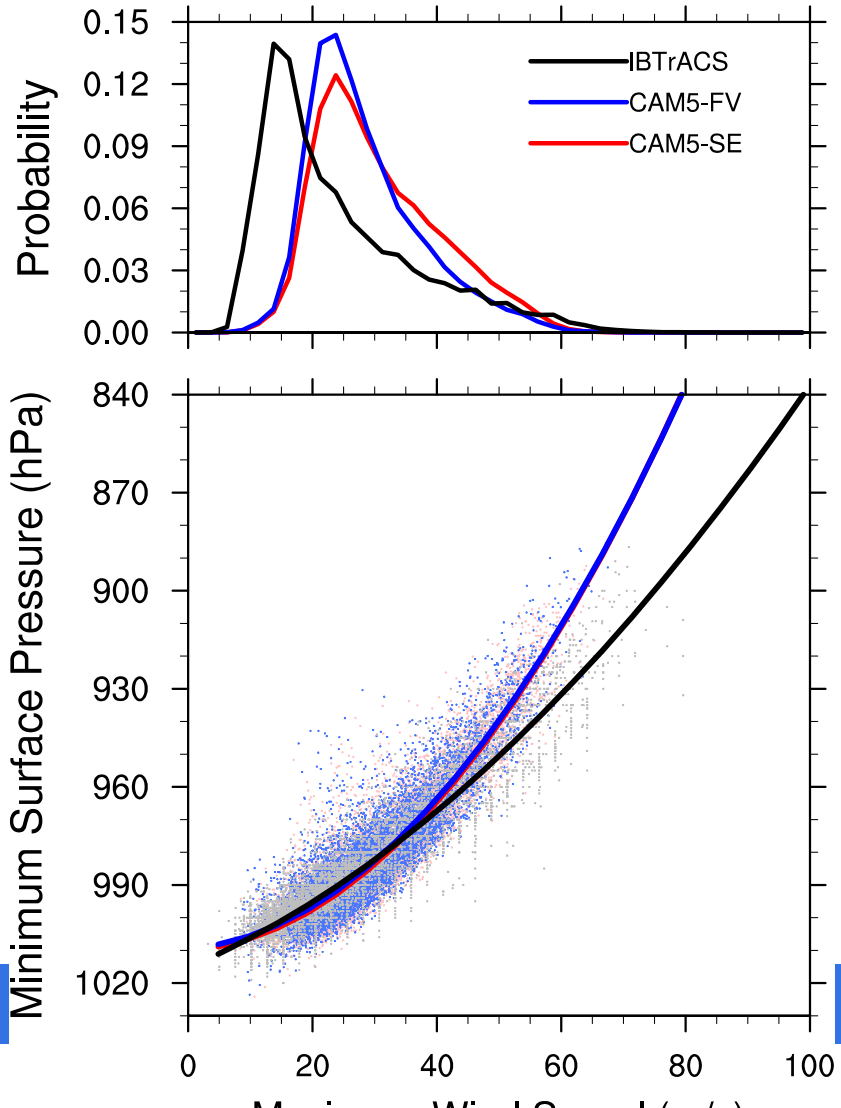


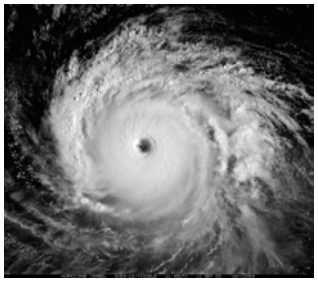
# Impact of Dynamical Core



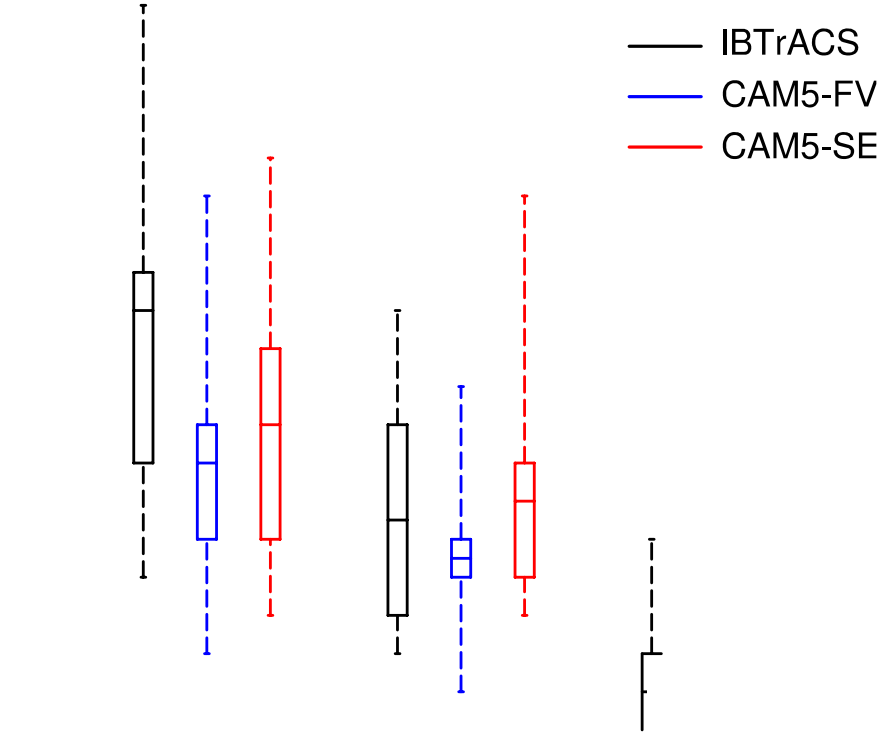


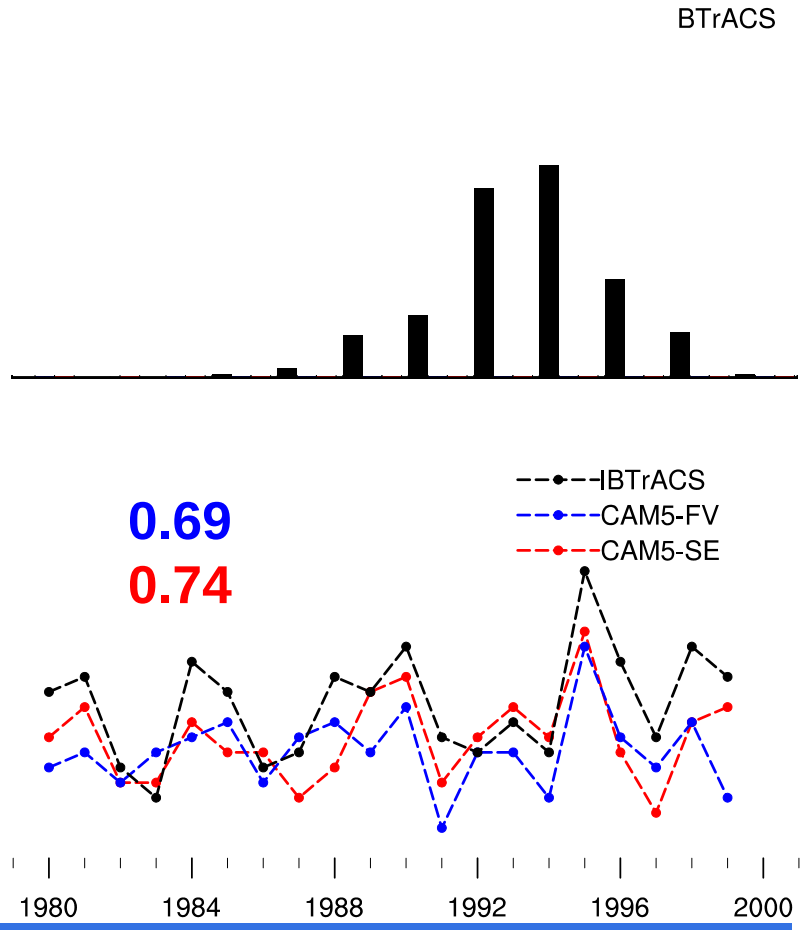
# Impact of Dynamical Core

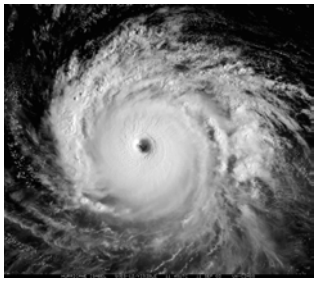




# North Atlantic Basin

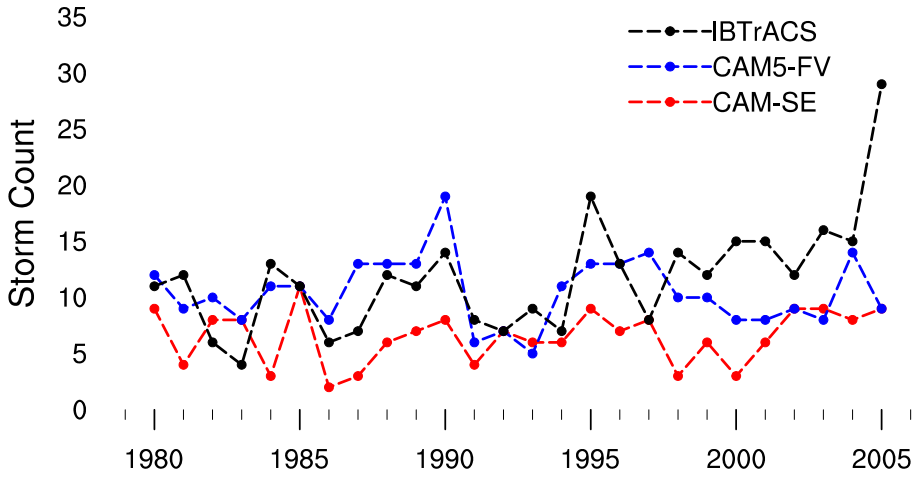


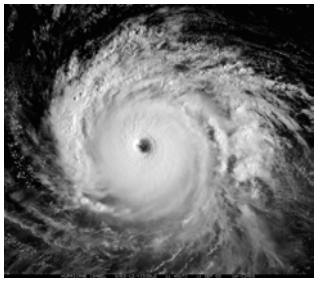





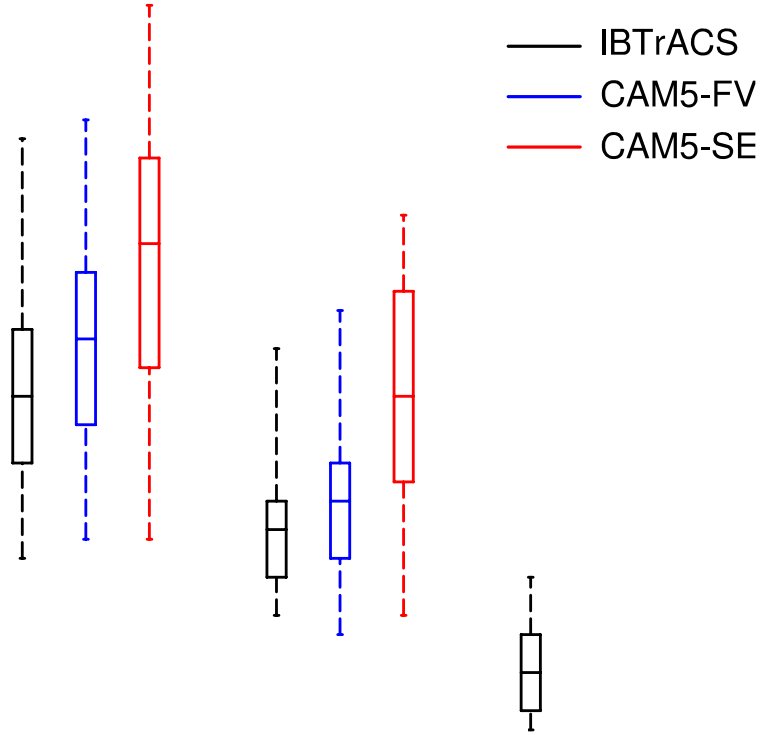
# North Atlantic Basin

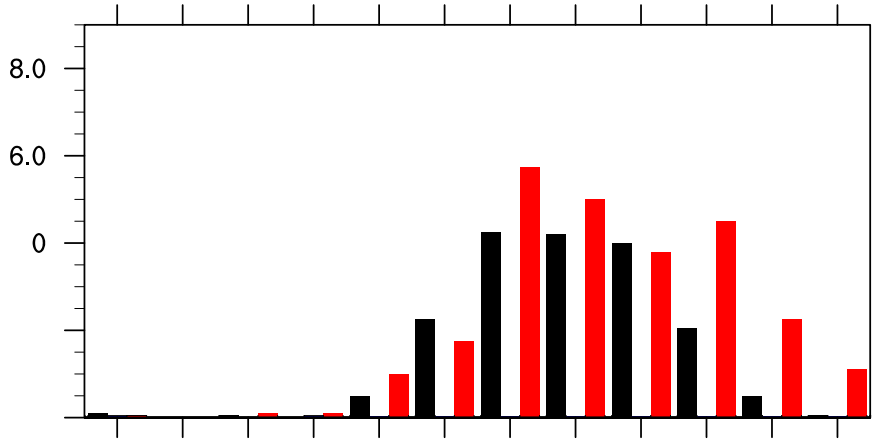
This is an improvement over previous simulations.

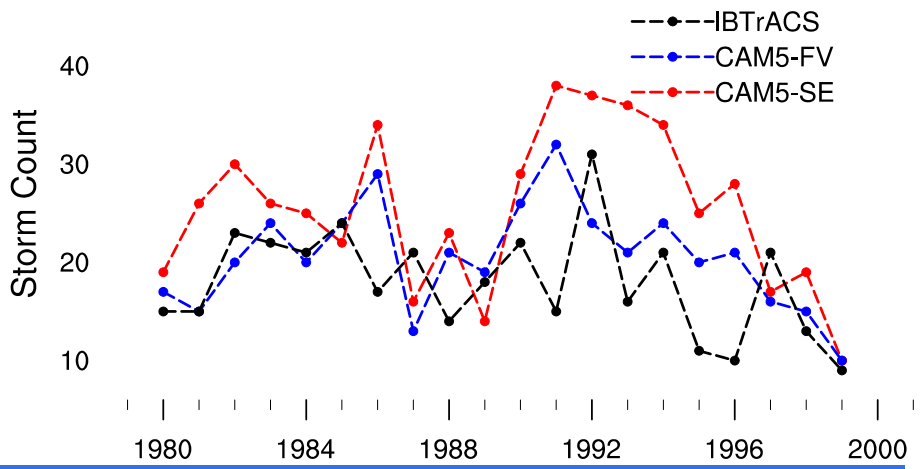


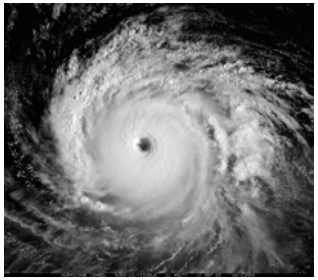


# East Pacific Basin



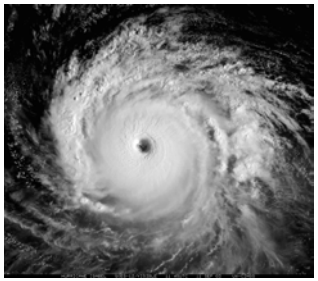


# Final Thoughts

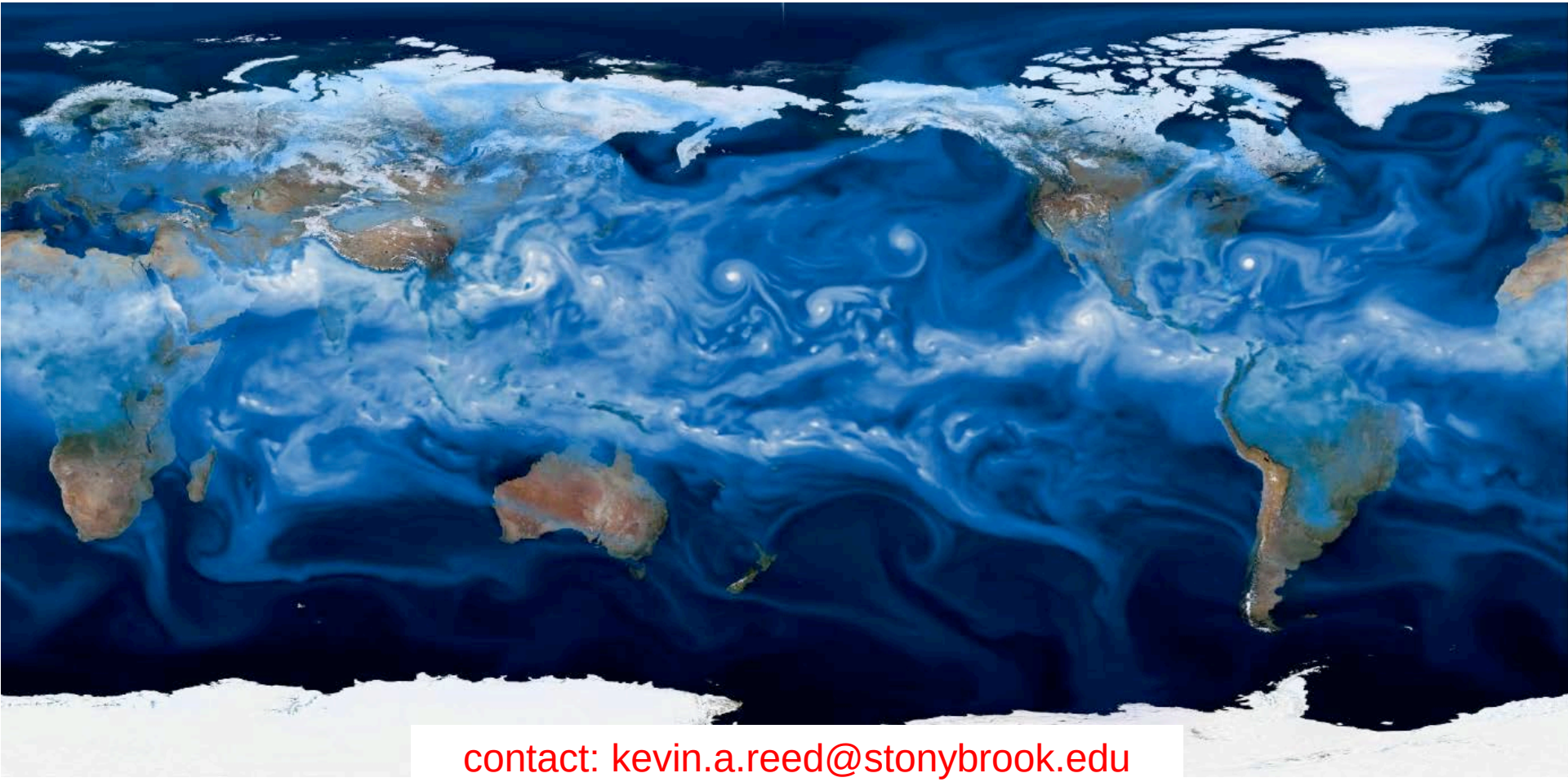
- The impact of the dynamical core on tropical cyclone statistics for the decadal experiments is significant. Is continuing to be explored!
- The high-resolution CAM5-SE produces ***more*** tropical storms and hurricanes per year than that seen in the CAM5-FV AMIP simulation.
- Need to focus on understanding some of the regional differences that exist between CAM5-FV and CAM5-SE.

Side Thoughts:

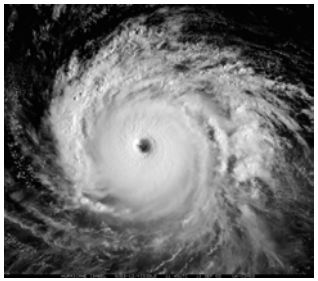
- While the treatment of aerosols certainly impacts the environment, there seems to be only a slight impact on TCs (intensity and count), at least from a global perspective.
- N. Atlantic TC variability is improved in new simulations (with MAM).



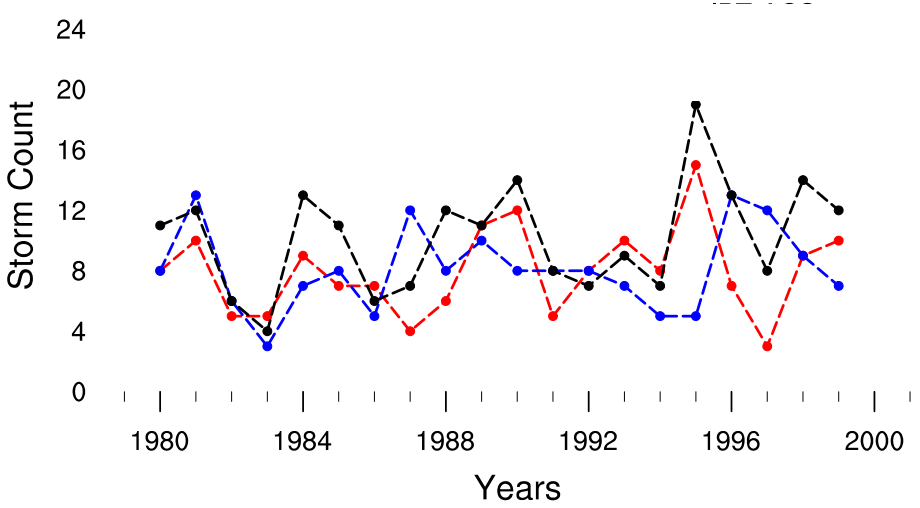
# Thanks!

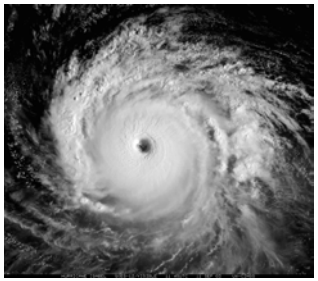


contact: kevin.a.reed@stonybrook.edu



# CAM5-SE Ensemble Comparison





# Aerosol Comparison