

Geophysical Fluid Dynamics Laboratory Review

June 30 - July 2, 2009



Simulation of Global Hurricane Climatology, Variability and Response to Global Warming

Presented by
Ming Zhao

Geophysical Fluid Dynamics Laboratory Review

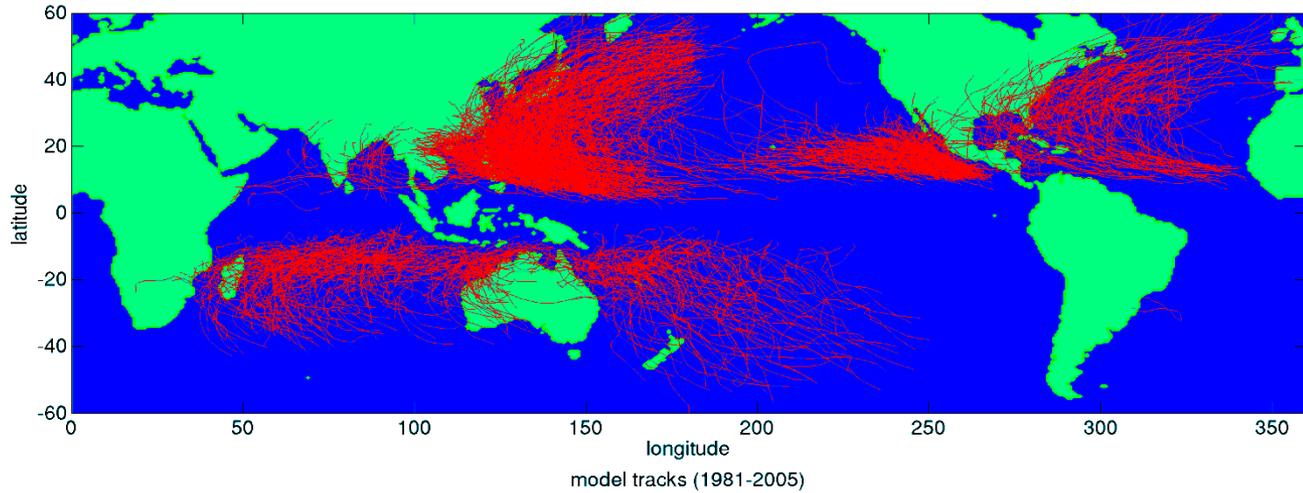
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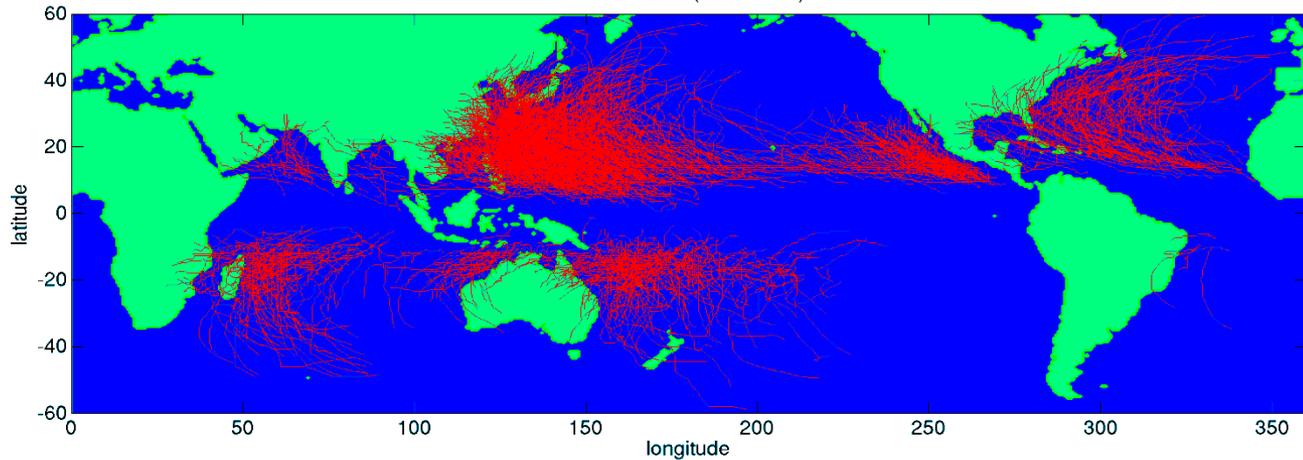
Simulation of global hurricane climatology, variability and response to global warming in a new global High Resolution Atmospheric Model (HiRAM)

Observation

Hurricane Tracks (1981-2005)



50 km
resolution
HiRAM
simulation



Ming Zhao, Isaac Held, Shian-Jian Lin, Gabe Vecchi

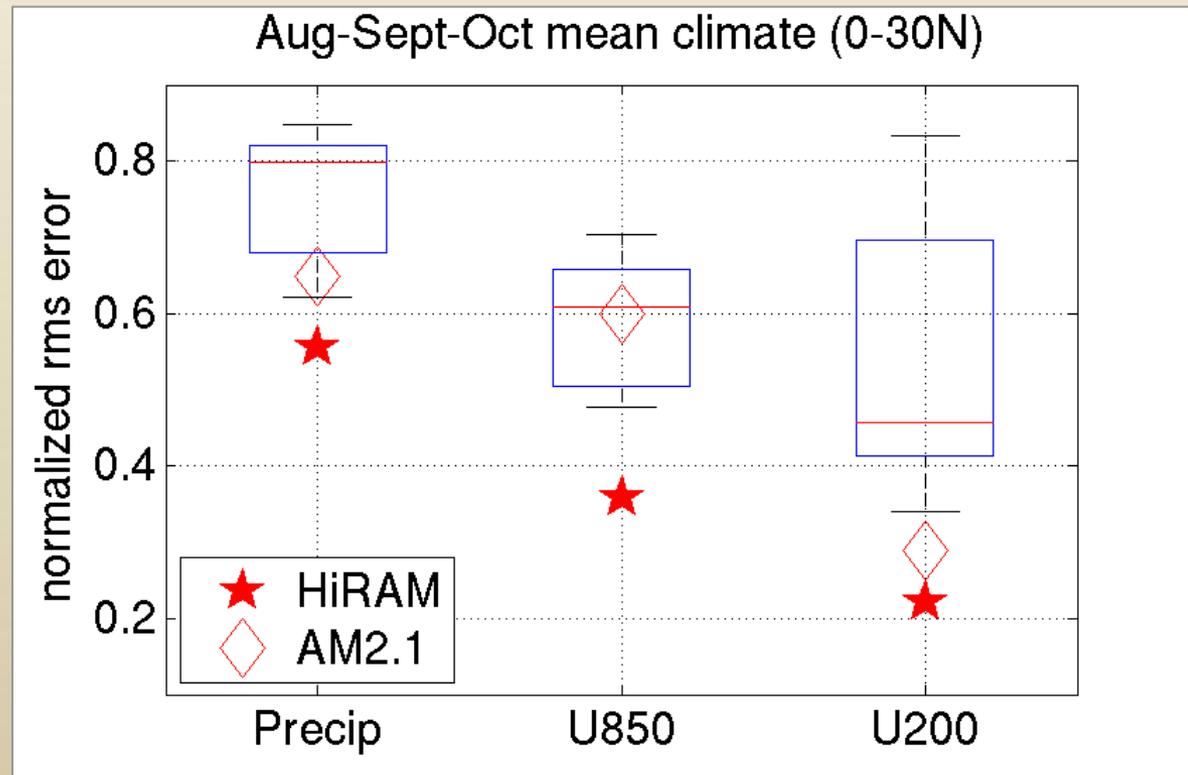
A high-quality global high resolution atmospheric model is necessary for hurricane-climate research and hurricane seasonal forecasting

Two key changes were made based on AM2 to achieve success:

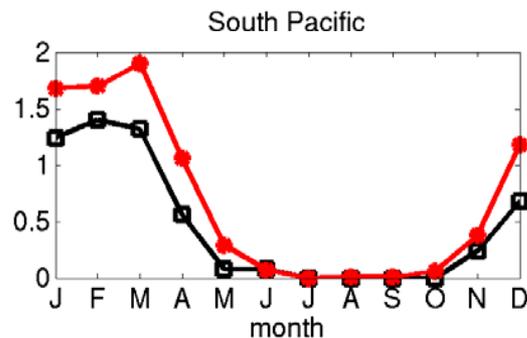
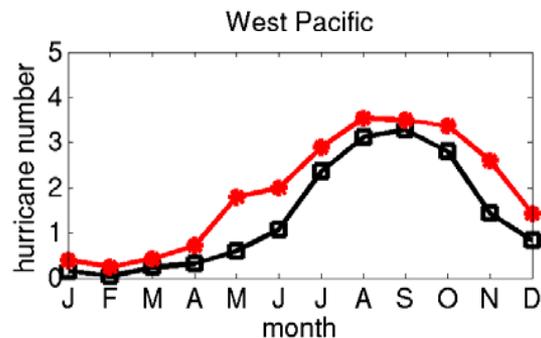
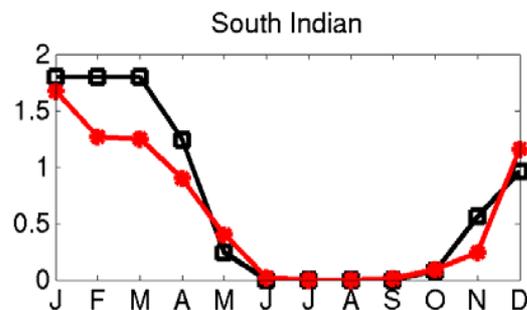
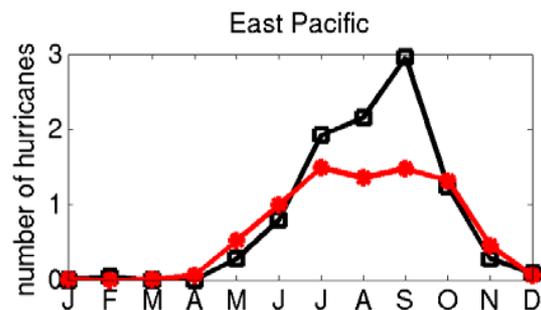
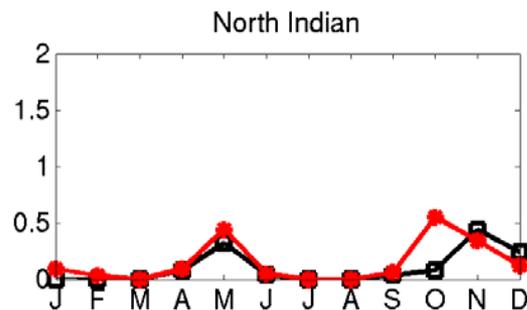
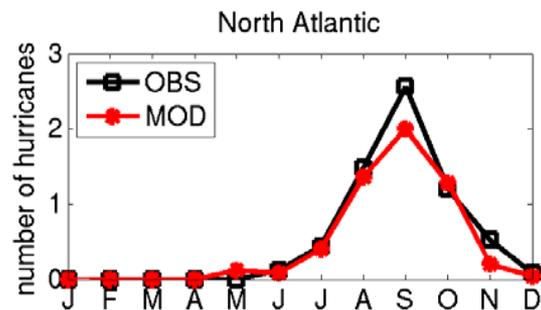
1. The new cubed-sphere dynamic core improves computational efficiency
2. An optimization of convection scheme for high resolution model improves tropical cyclone genesis

Using prescribed SST, four-member ensemble of 1981-2005 integrations were generated at 50km resolution

Mean climate is superior in many respects to those from the IPCC AR4 models including AM2

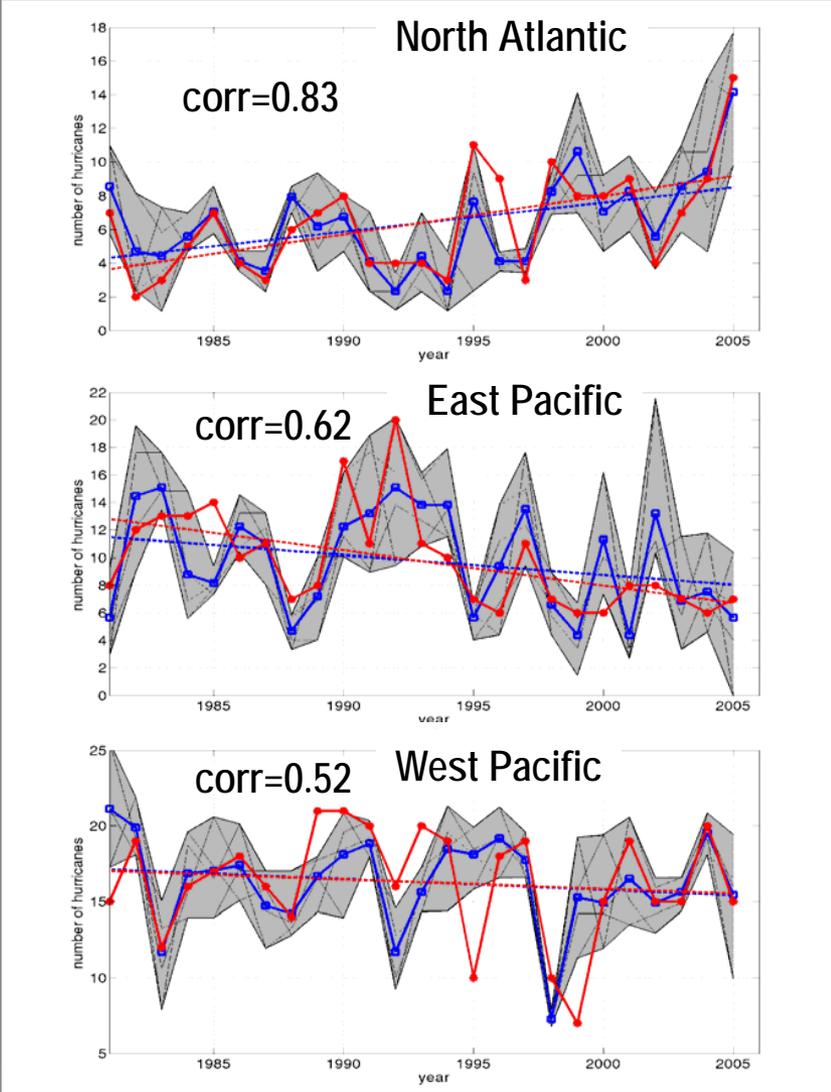


HiRAM captures the seasonal cycle of hurricane frequency over various ocean basins



HiRAM captures both the inter-annual variability and decadal trend over the N. Atlantic, the E. and W. Pacific

Red: observations
Blue: HiRAM ensemble mean
Shading: model spread

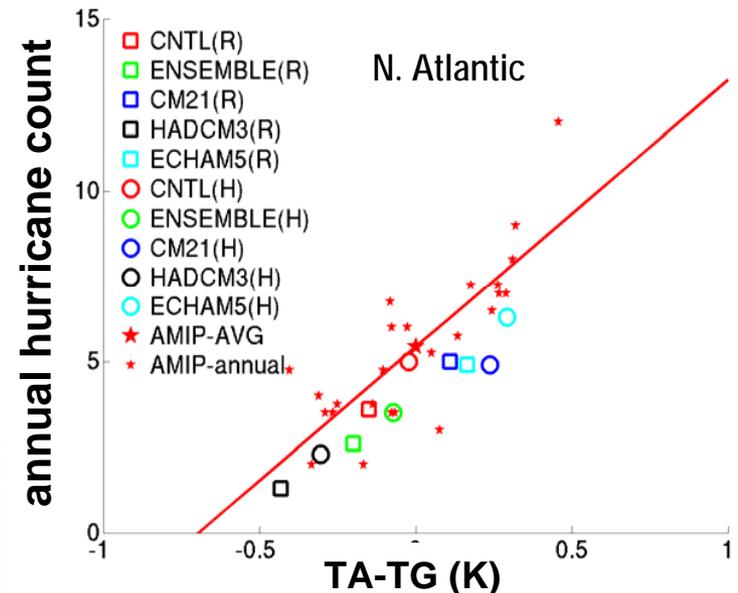
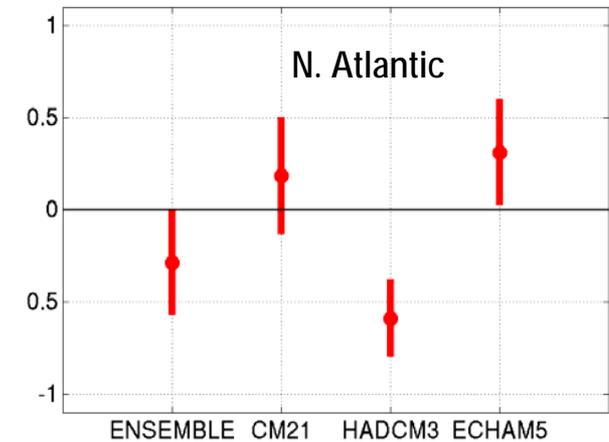
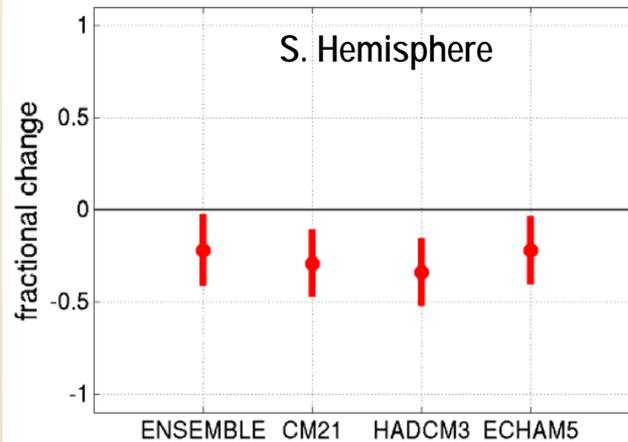


HiRAM hurricane frequency response to 21st century warming in individual basins differs among IPCC models, but a reduction in SH storms is a robust projection

21st century warming anomalies are generated by coupled models for the IPCC AR4

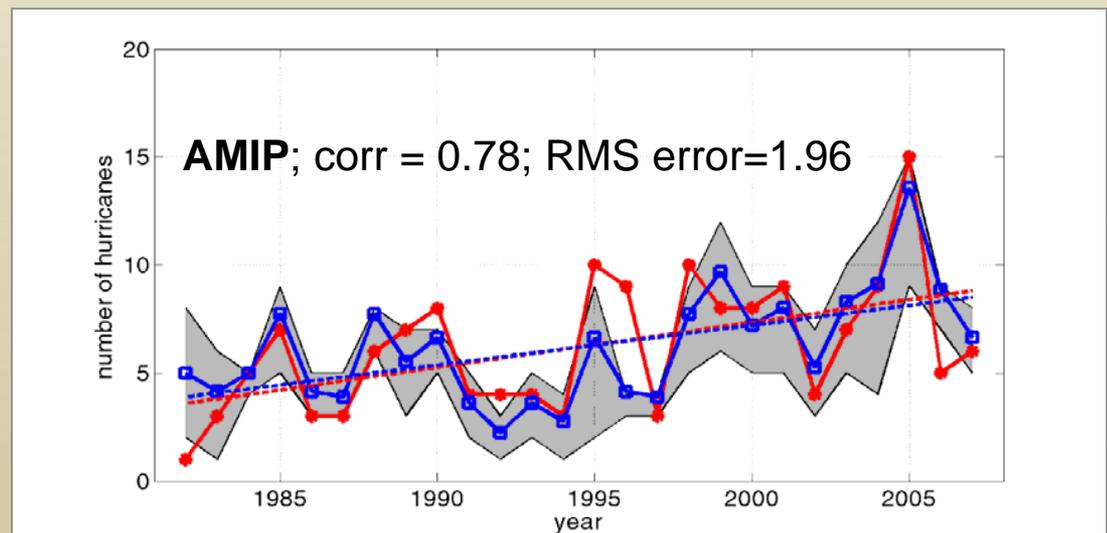
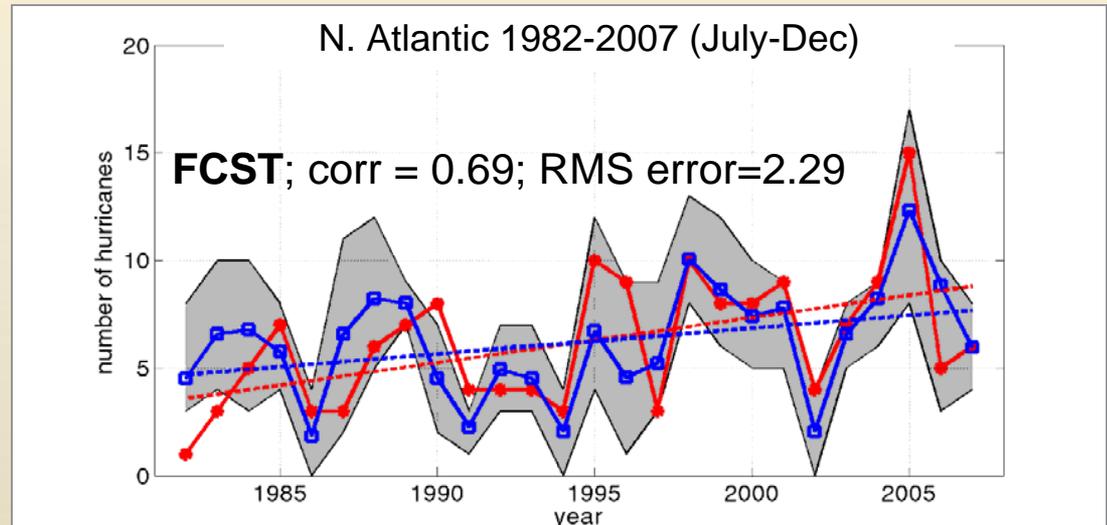
The modeled Atlantic hurricane changes and inter-annual variability can be well explained by the changes in tropical Atlantic SST minus global tropical SST (TA-TG).

Vecchi et al. 2008, Science



Simply persisting SST anomalies from June, the model retains skill for its forecast of the Atlantic hurricane season

Add June SST anomalies to a seasonally varying climatological SST for each year and carried out 5-member ensemble hindcast runs for the period 1982-2007



Summary

- We have developed a global high resolution atmospheric model (HIRAM) that provides high quality simulations of the global hurricane climatology, the inter-annual variability and decadal trend over the N. Atlantic, the E. and W. Pacific.
- Atlantic hurricane frequency response to 21st century warming depends on the changes in tropical Atlantic SST minus global tropical SST. A reduction in SH storms is a robust projection.
- Tests of seasonal hurricane hindcasts with persistent SST anomalies promise to provide information on what features of the SSTs are most important for forecasting the hurricane season.

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