

# Scale Interactions of Tropical Waves and Tropical Cyclone Formation in a Global Mesoscale Model

Bo-Wen Shen (UMCP/ESSIC and NASA/GSFC); bo-wen.shen-1@nasa.gov

Over the past several decades, tropical cyclone (TC) track forecasts have been steadily improving, but intensity and genesis forecasts have lagged behind. One of the major challenges in TC genesis prediction is the accurate simulation of complex interactions across a wide range of scales, from the large-scale environment (deterministic), to mesoscale flows, down to convective-scale motions (stochastic). General circulation models (GCMs) have been used to study TC genesis statistics and inter-annual variability, but their insufficient grid spacing and poor physics parameterizations are known limiting factors. Recent advances in high-resolution global modeling and supercomputing have made it possible to mitigate some of the aforementioned issues. One of the important questions to be answered is: if and how the lead time for predicted TC formation can be extended?

In a series of recent papers by Shen et al. (2010a,b,c,d), we have shown that accurate simulations of multiscale interactions associated with large-scale tropical waves can achieve the above goal, including

- sophisticated multiscale interactions during the formation of Nargis (2008) associated with the equatorial Rossby wave in 7-day simulations;
- remarkable simulations for the formation of multiple African Easterly waves and their association with hurricane formation (e.g., Helene, 2006) in 30-day experiments;
- simulations of twin tropical cyclones associated with a large-scale tropical system Madden-Julian Oscillation and mixed Rossby gravity wave.

In this talk, a brief summary on the aforementioned studies will be given. In addition, quasi-3D visualizations with the NASA CAMVis will be used to illustrate the multiscale interactions of a hurricane and its environmental flows.

## **References:**

**Shen, B.-W et al., 2010a:** Predicting Tropical Cyclogenesis with a Global Mesoscale Model: Hierarchical Multiscale Interactions During the Formation of Tropical Cyclone Nargis (2008) . J. Geophys. Res., 115, D14102, doi:10.1029/2009JD013140.

**Shen, B.-W. et al., 2010b:** African Easterly Waves in 30-day High-resolution Global Simulations: A Case Study during the 2006 NAMMA Period. Geophys. Res. Lett., L18803, doi:10.1029/2010GL044355.

**Shen, B.-W. et al., 2010c:** Coupling NASA Advanced Multi-Scale Modeling and Concurrent Visualization Systems for Improving Predictions of Tropical High-Impact Weather (CAMVis). Computing in Science and Engineering, 23 Nov. 2010. IEEE computer Society Digital Library. IEEE Computer Society, <http://doi.ieeecomputersociety.org/10.1109/MCSE.2010.141>

**Shen, B.-W. et al., 2010d:** Genesis of Twin Tropical Cyclones Simulated by a Global Mesoscale Model: the Role of Mixed Rossby Gravity Wave (to be submitted)