Extending the Lead Time of Tropical Cyclogenesis Prediction

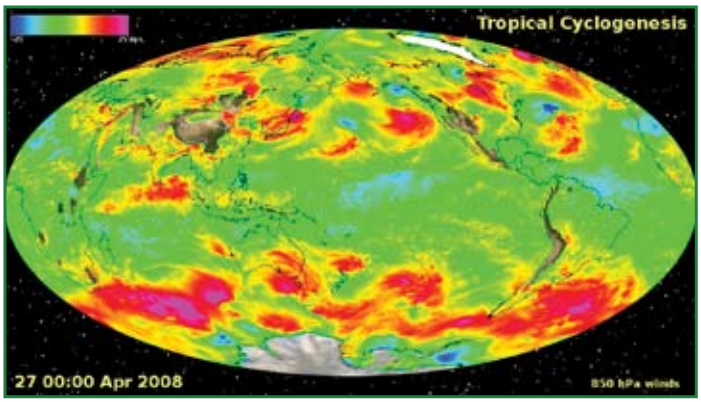
Extending the lead time and reliability of hurricane forecasts is important for saving lives and reducing economic damage. NASA scientists are using computer models to address this central issue in hurricane research.

Using the Coupled NASA Advanced Multi-scale Modeling and Concurrent Visualization Systems (CAMVis) on the Columbia and Pleiades supercomputers at Ames Research Center, they are improving multi-scale hierarchical interactions during the tropical cyclogenesis associated with large-scale flows such as a Madden-Julian Oscillation (top figure) or African Easterly Wave (AEW), taking into account the modulation and feedback between larger-scale forcing and smaller-scale flows, specifically.

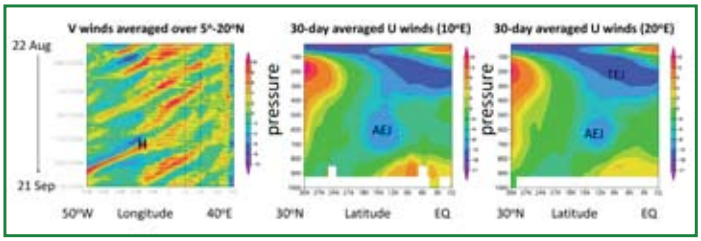
This new approach has been applied to obtain realistic simulations of the large-scale African Easterly Jet (AEJ) and six AEWs in 30-days runs initialized at 0000 UTC 22 August 2006; and of their modulation on the formation of a mesoscale vortex at Day 22 (middle figure).

Compared to observations, the simulated mesoscale vortex resembles Hurricane Helene (2006), with respect to its genesis location and timing. The subsequent movement and intensification of Helene were also simulated realistically (bottom figure). This follow-up work is supported by: NASA's Earth Science Technology Office; Advanced Information Systems Technology Program; Modeling, Analysis, and Prediction Program, the NASA Energy and Water Cycle Study, and the NASA Advanced Supercomputing facility at Ames.

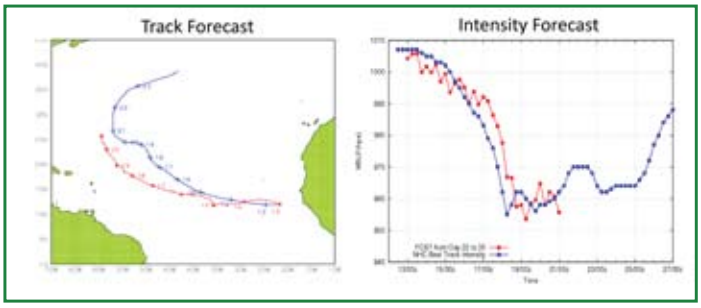
Each high-resolution simulation requires hundreds or thousands of processors and hundreds or thousands of megabytes of disk space (up to 4 terabytes per run). To examine the sensitivities of models' initial conditions and configurations on these simulations, more than forty 30-day experiments have been performed, producing more than 40-terabytes of data.



Realistic genesis prediction of the very severe cyclonic storm Nargis (2008) in the Indian Ocean from a five-day simulation. Improved representations of Nargis' environmental conditions and their hierarchical multiscale interactions were the key to achieving this lead time. (Bryan Green, NASA).



Thirty-day simulations of six African Easterly Waves and Jet (AEWs and AEJ). In the left panel, orange lines represent westward-propagating AEWs, and 'H' indicates a hurricane at Day 22 (Sep. 13). In the right panels, realistic simulations of the AEJ along longitude 10E and 20E are displayed.



Remarkable track and intensity forecasts for Hurricane Helene (2006) from Day 22 to Day 30, which formed after the 4th AEW in the middle figure above developed into a mesoscale vortex. Blue and red lines indicate best tracks and model predictions, respectively.

http://atmospheres.gsfc.nasa.gov/cloud_modeling/Shen.html

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