NASA's Climate in a Box: Desktop Supercomputing for Open Scientific Model Development

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Vision

Climate in a Box seeks to:

- Open climate/Earth science model development and validation to a community beyond traditional domain scientists
- Develop/improve models through a more efficient "open" model development and validation

Motivation

Two obstacles to "open" model development and validation:

- Climate/Earth science models are difficult to use, even for domain experts
- Supercomputing resources are not readily accessible
  - Wait times in job queues can be extensive
  - Arduous supercomputing account application process, especially for foreign nationals

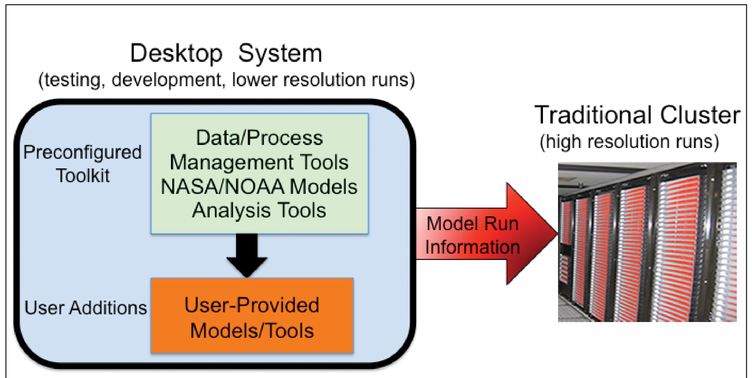

Figure 1 – Climate in a Box Pre-configured Toolkit. A user will be able to seamlessly transition model run information from the desktop system to a more powerful system as needed.

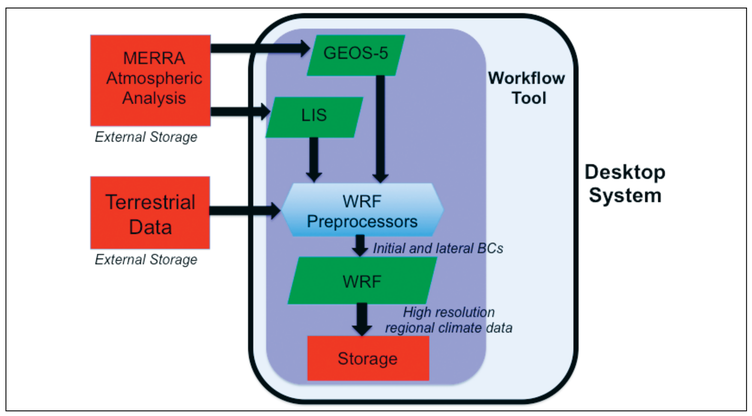

Figure 2 – Climate in a Box Use Case. Run GEOS-5, LIS-6, and WRF sequentially for downscaling purposes to a 4km resolution WRF simulation of Hurricane Isabel's landfall September 18-20, 2003.

Goals

Four major goals of Climate in a Box:

- Make NASA/NOAA climate/Earth science models easier to use by developing a complete ready-to-use modeling toolkit containing:
  - Models (ModelE, GEOS-5, WRF, GFS, LIS-6)
  - Analysis tools
  - Social networking/collaboration capabilities (NASA's Modeling Guru: http://modelingguru.nasa.gov)
  - Process management tools
- Explore desktop supercomputing architecture, ***not as a replacement for, but as a complement to, traditional supercomputing clusters,*** to help users tap into this arena where we expect continued growth
  - Cray CX1
    - Linux and Microsoft Windows HPC Server 2008
    - 8 compute nodes, 64 cores
  - SGI Octane3 (configuration to be determined)
  - Other architectures
- Package the toolkit with desktop supercomputers as a turnkey system for investigators
  - Include capability to capture and archive the science workflow (Figure 1)
  - Demonstrate the feasibility of this package with a Hurricane Isabel downscaling simulation as run on a larger system (Figures 2, 3 and 4)
- Explore use of this system as a testbed for "open" model development and validation through the social networking/collaboration features

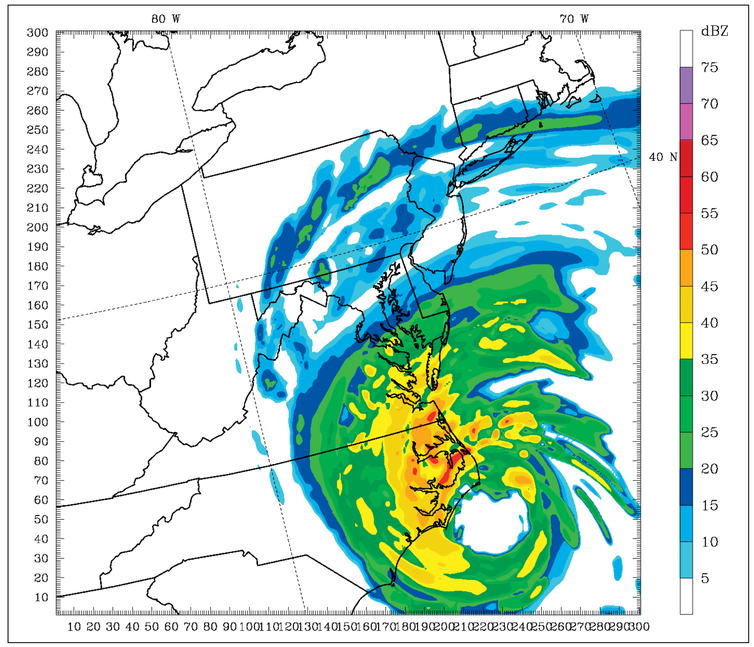

Figure 3 – Climate in a Box Use Case. 4km WRF radar reflectivity at 15Z, September 18, 2003, just before Hurricane Isabel's landfall.

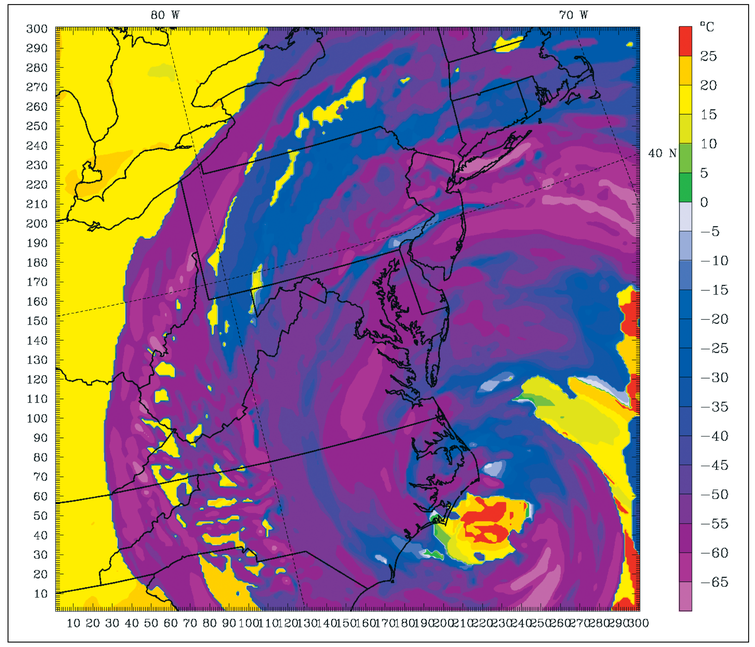

Figure 4 – Climate in a Box Use Case. 4km WRF cloud top temperatures at 15Z, September 18, 2003, just before Hurricane Isabel's landfall.

Project Status

- Ported ModelE, WRF, and GEOS-5 to Cray CX1 with no change in science results
- Model timing tests on CX1 show comparable performance to a traditional supercomputer system at equivalent CPU counts
- Porting WRF to Microsoft Windows HPC Server 2008 using the Visual Studio 2008 IDE
- Porting GFS and LIS-6 to the Linux Cray CX1
- Enabling GEOS-5 to WRF downscaling capability on the Linux Cray CX1

Acknowledgments

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[3] Northrop Grumman Corporation, [4] Advanced Management Technology Incorporated