Projected Applications of a "Weather in a Box" Computing System at the NASA Short-term Prediction Research and Transition (SPoRT) Center

[1]Gary J. Jedlovec, [1]Andrew L. Molthan, [1]Bradley T. Zavodsky, [2]Jonathan L. Case, [3]Frank J. LaFontaine, and [4]Jayanthi Srikishen

[1]NASA Short-term Prediction Research and Transition (SPoRT) Center, Marshall Space Flight Center, Huntsville, AL

[2]NASA SPoRT/ENSCO, Inc., [3]NASA SPoRT/Raytheon, and [4]NASA SPoRT/Universities Space Research Association, Huntsville, AL

andrew.molthan@nasa.gov

IN13A-1099

What is the NASA SPoRT Center?

❖ The NASA Short-term Prediction Research and Transition (SPoRT) Center partners with several universities and government agencies to:

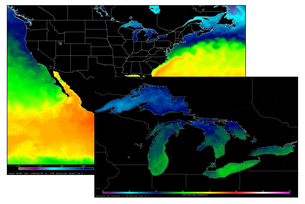
- Improve short-term (0-48 hr) weather forecasts
- Facilitate and promote the use of Earth Observing System satellite data for weather analysis and forecasting
- Promote the use of unique, advanced NASA modeling and data assimilation techniques applicable to regional forecasting

Mission Statement

❖ Serve as a focal point and facilitator for the transfer of NASA Earth Science technologies to the operational weather community, emphasizing short-term forecasting.

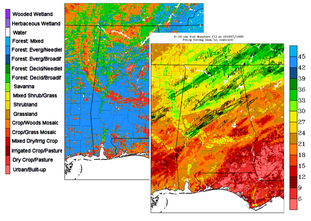
SPoRT Contributions to the Weather Research and Forecasting (WRF) Model

❖ SPoRT has developed several techniques and unique data products to support high resolution, short-term weather forecasts:



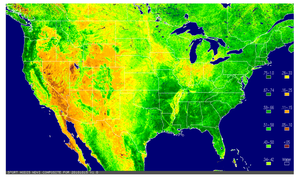
Sea and Lake Surface Temperature Composites

❖ Produced four times per day at one 1km spatial resolution, derived from MODIS/AMSR-E data and available ice cover data sets.
❖ 1 km spatial resolution
❖ Derived from MODIS/AMSR-E



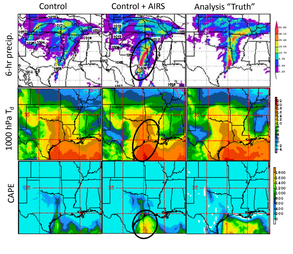
NASA Land Information System

❖ Unique NASA research tool
❖ 3 km spatial resolution
❖ Receives inputs of radar estimated precipitation and satellite vegetation composites.
❖ Outputs high resolution soil moisture, soil type, and vegetation characteristics.



Normalized Difference Vegetation Index (NDVI) Composites

❖ Daily composites at 1 km resolution, derived from MODIS, to serve as a proxy for vegetation cover and greenness fraction.
❖ Replaces coarse climatology fields in model forecasts.



Advanced Infrared Sounder (AIRS) Profile Assimilation

❖ Provides vertical profiles of temperature and moisture with horizontal resolution of 50 km.
❖ Supplements rawinsonde network with observations at atypical hours.
❖ Used in variational assimilation techniques to improve the three-dimensional atmospheric analysis.

SPoRT "Weather in a Box" Systems

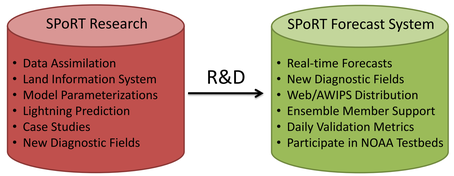
❖ SPoRT is acquiring two new modeling systems to support weather forecasting experiments utilizing unique NASA research tools and products:

Research and Development

- CRAY CX1 Chassis
- 8 Compute Nodes
- Each node contains:
  - 8 Intel Xeon X5550 Cores
  - 2.67 GHz
  - 24 GB RAM
  - 320 GB 7.2k HDD
  - Infiniband connectivity

Real-Time Forecasting

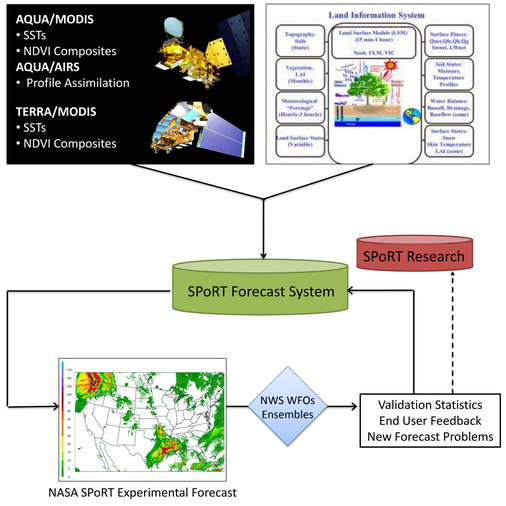
- CRAY CX1 Chassis
- 8 Compute Nodes
- Each node contains:
  - 8 Intel Xeon X5472 Cores
  - 3.00 GHz
  - 32 GB RAM
  - 320 GB 7.2k HDD
  - Infiniband connectivity



SPoRT "Weather in a Box" Software

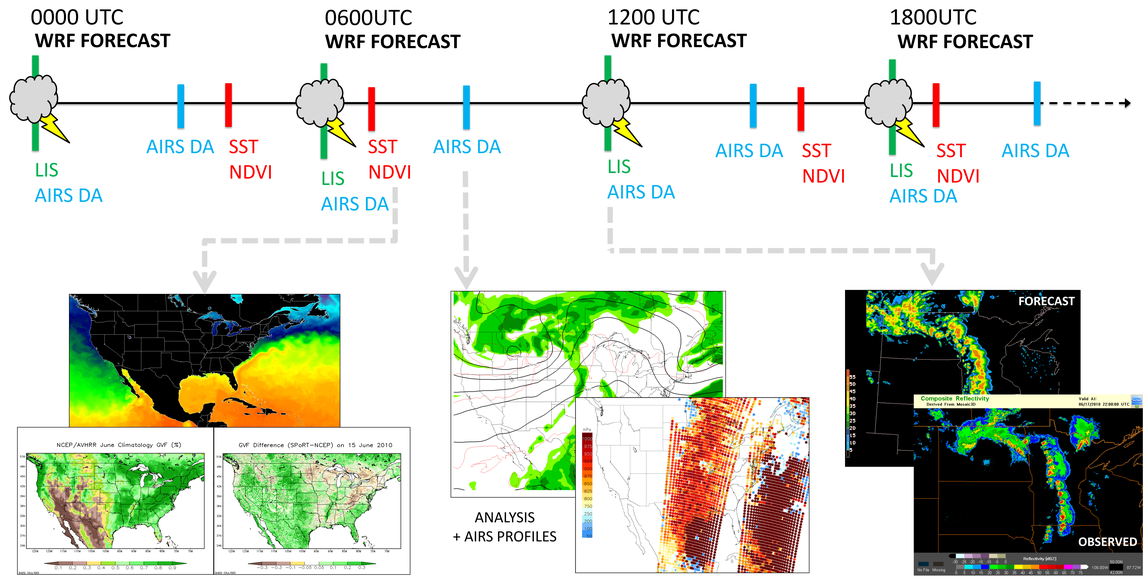
❖ High resolution forecasts will be generated using the NASA Unified Weather Research and Forecasting (NU-WRF) modeling suite, which includes:

- Advanced Research WRF (WRF-ARW)
- NASA Land Information System (LIS) with internal coupling
- NCAR Model Evaluation Tools (MET) Package
- Goddard Chemistry Aerosol Radiation and Transport (GOCART)
- Goddard Satellite Data Simulator Unit (SDSU)
- Unique diagnostic fields for severe weather forecasting
- Lightning forecasting capabilities based upon cloud microphysics
- WRF Pre- and Post-Processors



NASA SPoRT Experimental Forecast

Hypothetical Forecast Cycle
Example: June 17, 2010



SSTs, Soil Moisture, and GVF

❖ High resolution, accurate surface water temperatures for coastal processes and moisture return.
❖ Soil moisture and greenness vegetation fractions derived from the NDVI to improve evapotranspiration and land contributions to low level moisture sources.

AIRS Profile Assimilation

❖ AIRS profiles contribute moisture and temperature data above cloud top to adjust model initial conditions.
❖ Above: Warm colors represent widespread, contribution of AIRS data in cloud-free conditions.
❖ Available on orbital times between the 00/12 UTC rawinsonde network.

NU-WRF Model Forecast

❖ Goal: Generate high resolution (4 km) forecasts that simulate precipitation and storm structure.
❖ Determine improvements gained through use of NASA data sets.
❖ Contribute our unique, NASA-driven forecast to ensemble efforts characterizing forecast uncertainty.

Summary

❖ SPoRT's new "Weather in a Box" resources will provide weather research and forecast modeling capabilities for real-time application.
❖ Model output will provide additional forecast guidance and research into the impacts of new NASA satellite data sets and software capabilities.
❖ By combining several research tools and satellite products, SPoRT can generate model guidance that is strongly influenced by unique NASA contributions.

Acknowledgements

❖ SPoRT modeling clusters were provided by Dr. Tsengdar Lee, High End Computing Program Manager at NASA Headquarters.
❖ Software installation and configuration was performed by NASA Goddard Space Flight Center under the guidance of Tom Clune.
❖ Local software and installation support at NASA Marshall Space Flight Center was performed and managed by Rita Edwards and David Cross.