

Research&Innovation
Center for Advanced Computing



I-WRF: Containerized Framework for Weather Modeling, Verification, and Visualization

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dg.o 2024

Annual Meeting - NTU

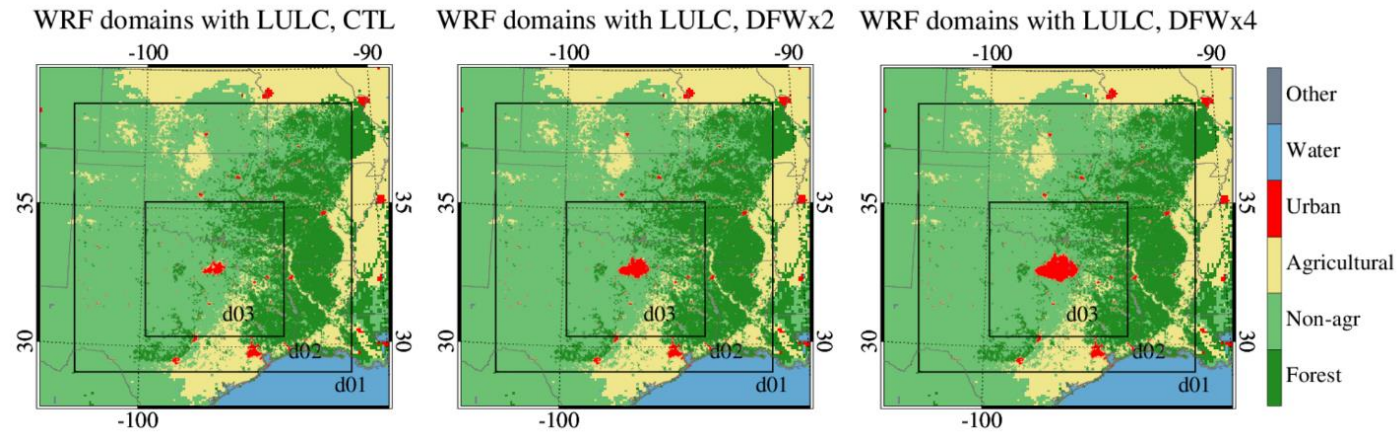
June 13, 2024

Increasing Flexibility for Weather Research, Building a Pipeline to Recruit New Atmospheric Scientists

- Weather prediction is a vital part of national capacity to support trade and shipping, transportation, agriculture and public safety
- Modeling and simulation is critical to the development of both daily and long-term weather analysis and prediction
- Atmospheric scientists are in short supply, require a lot of training in both theoretic and technical domains



WRF Software



- WRF is weather modeling software with a broad range of applications
 - Weather prediction, climate modeling
 - Simulation of events based on characteristics such as land use or cover
 - Chemistry, wildfire, renewable energy generation
 - Validation and visualization tools for verifying and seeing results
- In development since 2000, with a user base of more than 30,000
- Deployment across a wide range of HPC systems, so much as to be included in benchmark suites

WRF Challenges



Stanczyk, Jan Matejko, 1862. Wikimedia commons

- Despite this, around *50% of users* attending tutorials at NCAR report difficulty configuring the software for use
- Compiling WRF software requires understanding multiple compiler frameworks, a wide range of WRF configuration options
- Output from WRF is not immediate ingestible by verification and visualization tools
- These technical barriers mean that potential researchers and scholars run into hurdles before they can even get to the weather and climate stuff

Application Containerization

Application is put into a *container* with all associated libraries and support.

The containerized application is smaller than a virtual machine image, and portable to a number of systems

I-WRF puts the application, data, and configurations into a portable package



I-WRF Goals

Application containers support simplicity, portability, and scalability

Run on a wide range of systems without installation/configuration issues

Include data management and interoperability with validation and visualization tools

Allow for large-scale problems with multi-node processing

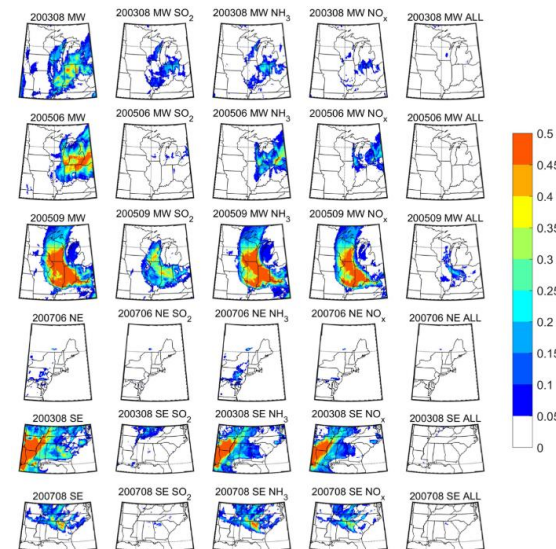
Another goal is to bring more researchers into Atmospheric Science

I-WRF allows a user to try WRF without dealing with installing and compiling software

Model weather on your laptop, in the cloud, or on an HPC resource

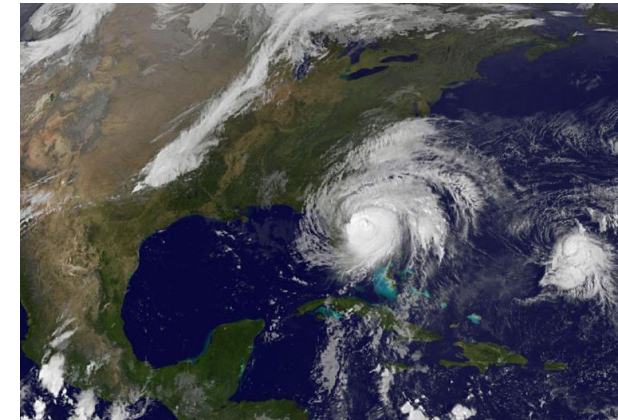
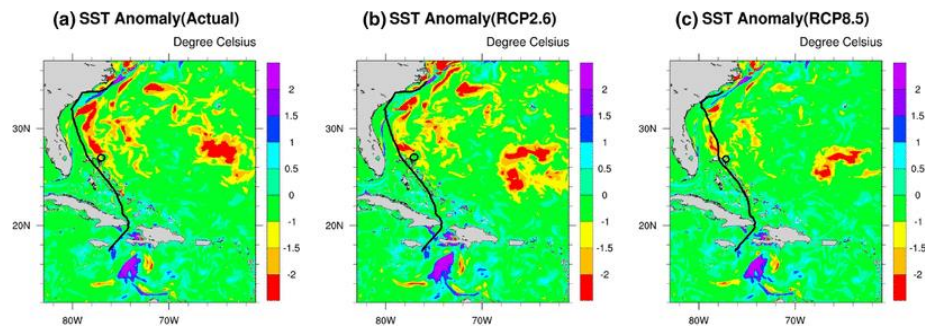
I-WRF Science Cases - running at scale to answer research questions

1. Land Use/Land Cover (LULC) Change in the U.S. Northeast and Feedbacks to Extreme Weather Events and Societal Impacts
2. Climate Change Impacts on Wind and Solar Resources
3. Air Quality in the Northeast Urban Corridor



Supporting broader engagement in Atmospheric Science

- Users can run sample WRF simulations on a laptop or free cloud resource
- Sample simulation is an event used for NCAR tutorials:
2016 Hurricane Matthew event

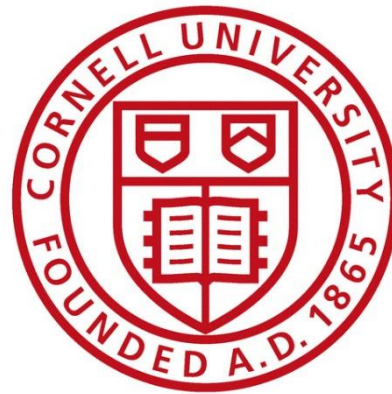


- Making the WRF software easier to run - and relevant to
- Increasing recruitment into Atmospheric Sciences
- Building a **pipeline** of researchers into the discipline
- Bridging the diversity gap in weather and climate research

I-WRF details

- Run it yourself on Jetstream: <https://bit.ly/iwrf-matthew>
- Overview website: <https://i-wrf.org>
- User guide: https://i-wrf.readthedocs.io/en/latest/Users_Guide/index.html
- Github site: <https://github.com/NCAR/i-wrf>
- Help through help@cac.cornell.edu





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