



Western Research Mesonets and Applications

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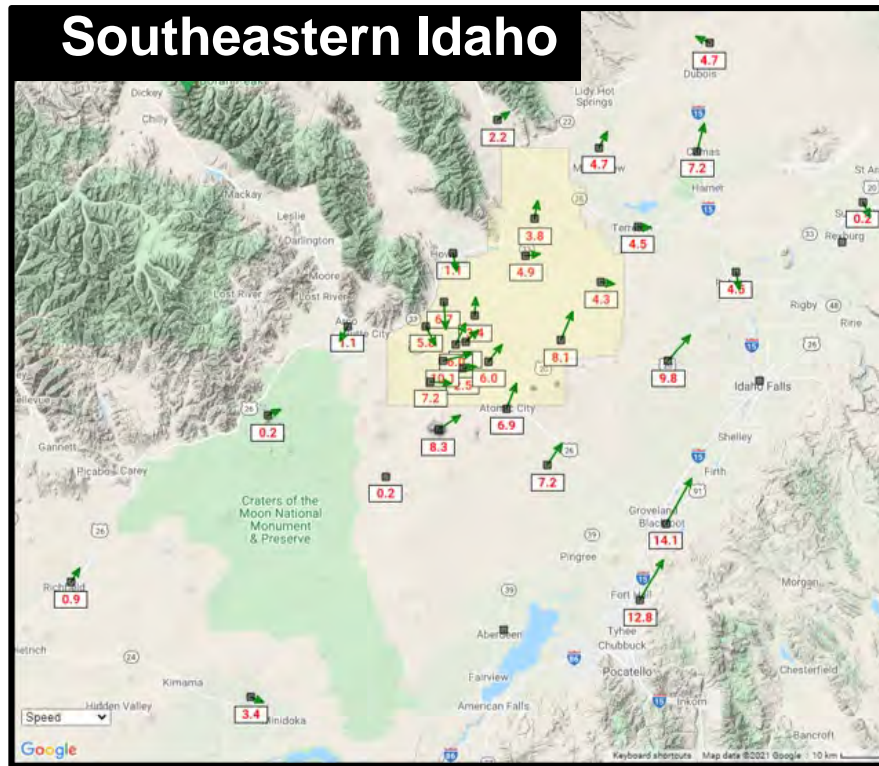
March 24, 2022



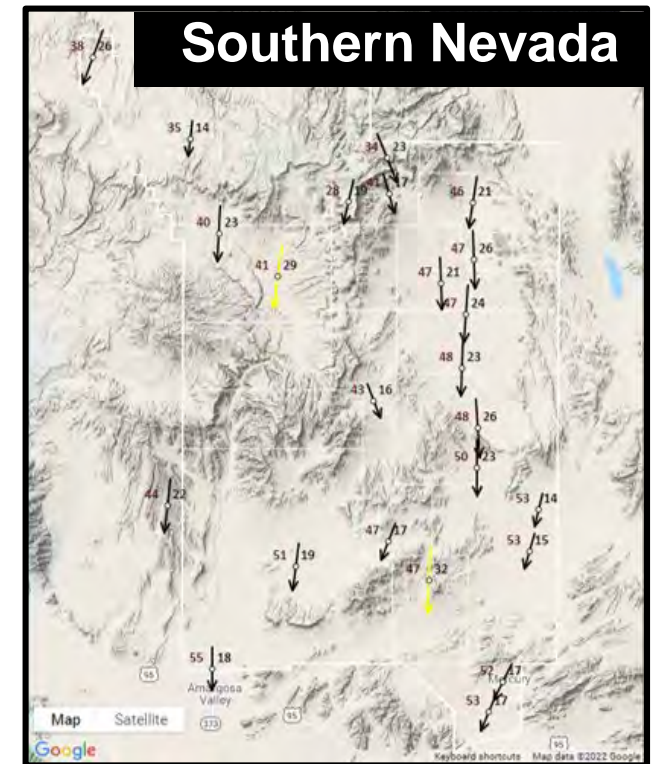
The Mesonets



ARL operates and maintains two research mesonets in the western U.S.



- 34 Station Network
- Covers a 6,200 sq. mi. area
- High desert of the eastern Snake River Plain



The instrumentation includes:

- Surface Weather Tower Networks
 - Wind Speed,
 - Wind Direction,
 - Temperature,
 - Relative Humidity,
 - Pressure,
 - Precipitation,
 - Solar Radiation,
 - GPS time
- SODARs
- Mobile Radiosonde Systems

- 24 Station Network
- Covers a 1,350 sq. mi. area
- Southern Great Basin Desert
- Lightning Detection System



The ARL Research to Applications Loop



Air Resources Laboratory

NOAA Missions: To understand and predict changes in climate, weather, oceans, and coasts.
To share that knowledge and information with others.

These mesonets provide ARL the “**Feedback to Research**” and internal “**Research to Application**” in data, experience, and lessons learned to improve models and tools through increased knowledge and expertise, and by expanding applications



OAR Strategy:

Strengthen Internal And External Collaboration

OAR Goal 2.1

Sustain and Optimize Observation System Management and Use

OAR Goal 3

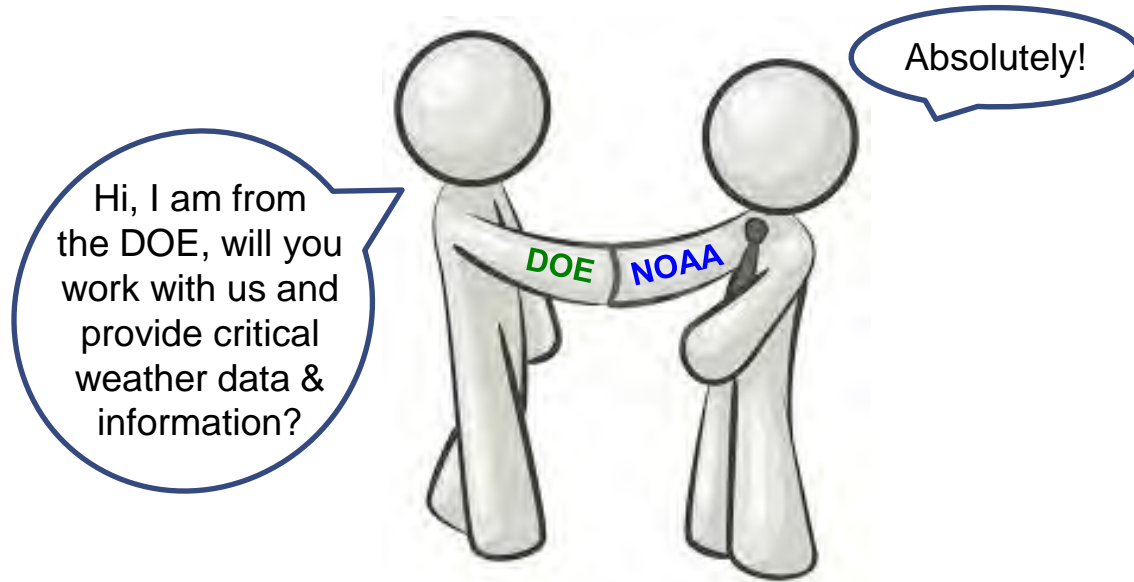
Make Forecasts Better

OAR Strategy:

Leverage New Technology



Collaboration / Preeminence



- Atomic Energy Commission (predecessor to the Department of Energy) initiated a collaboration with the Weather Bureau (predecessor to NOAA).
- Decadal collaboration, since
 - 1949 for Idaho, and
 - 1954 for Nevada,
- Originally supported nuclear energy research and national security testing and development,
- Today, supports nuclear materials research, environmental restoration, and national security missions and experiments,

- The Nevada National Security Site (NNSS) is a 1,350 square mile DOE/NNSA reservation
- The Idaho National Laboratory (INL) is an 890 square mile DOE site,
- Activities are funded and supported through Inter-Agency Agreements between DOE and DOE/NNSA and ARL.



Investigation



Data are Collected

Collaboration with
DOE and DOE/NNSA

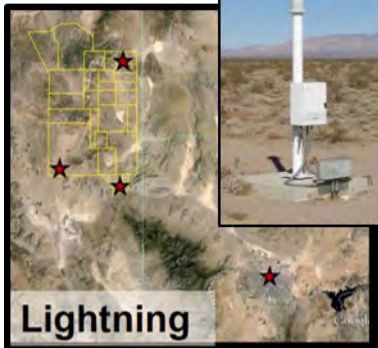
Archived

Research

- > Support Services
 - Near Real-time Display of Data
 - Daily Site Operations Forecasts
 - Weather Surveillance
 - Weather Safety Alerts and Warnings
- > Emergency Response
 - Consequence Assessment
 - Wildland Fire Support
- > Special Operations and Experiments
 - Additional data collection with "micronets"
 - Specialized, detailed, location-specific forecasts

- > Climatology
- > Annual Site Compliance Reports
- > Annual Environmental Reports
- > Site, Project, & Experiment Planning
- > Air-Quality Permitting
- > Data Analysis

- > Dispersion and Boundary Layer
- > Mesoscale Modeling (WRF)
 - Test Bed
 - Model Verification
 - Ingest Data into Model
 - Parameterization Testing
 - New Instrument Applications



Western WRF Modeling Project



What? An operational WRF modeling system to provide forecasts for daily operations, special experimental support, and emergency response components of the ARL Western Division missions.

Why? A coupling of modeling and measurements provide a platform to increase understanding of PBL dynamics, with attention to particular aspects of atmospheric fluid flow that impact the transport and dispersion of pollutants.

How? The system will be a testbed for ARL research projects such as general PBL parameterizations, direct mesonet data inclusion, and desert climate studies.

- Platform: 112 vCPU, 48TB storage Dell Servers + backup
- WRF running since May 2021 with
 - 3 Domains:
 - one Common 16 km resolution grid
 - two 6 km resolution grid one each for ID and NV
 - two 2 km resolution grid one each for ID and NV
 - 34 vertical layers
 - Producing forecasts out to 102 hours (4+ days)
 - Four cycles per day (00z, 06z, 12z, and 18z)
 - Output can be linked to HYSPLIT for a dispersion product



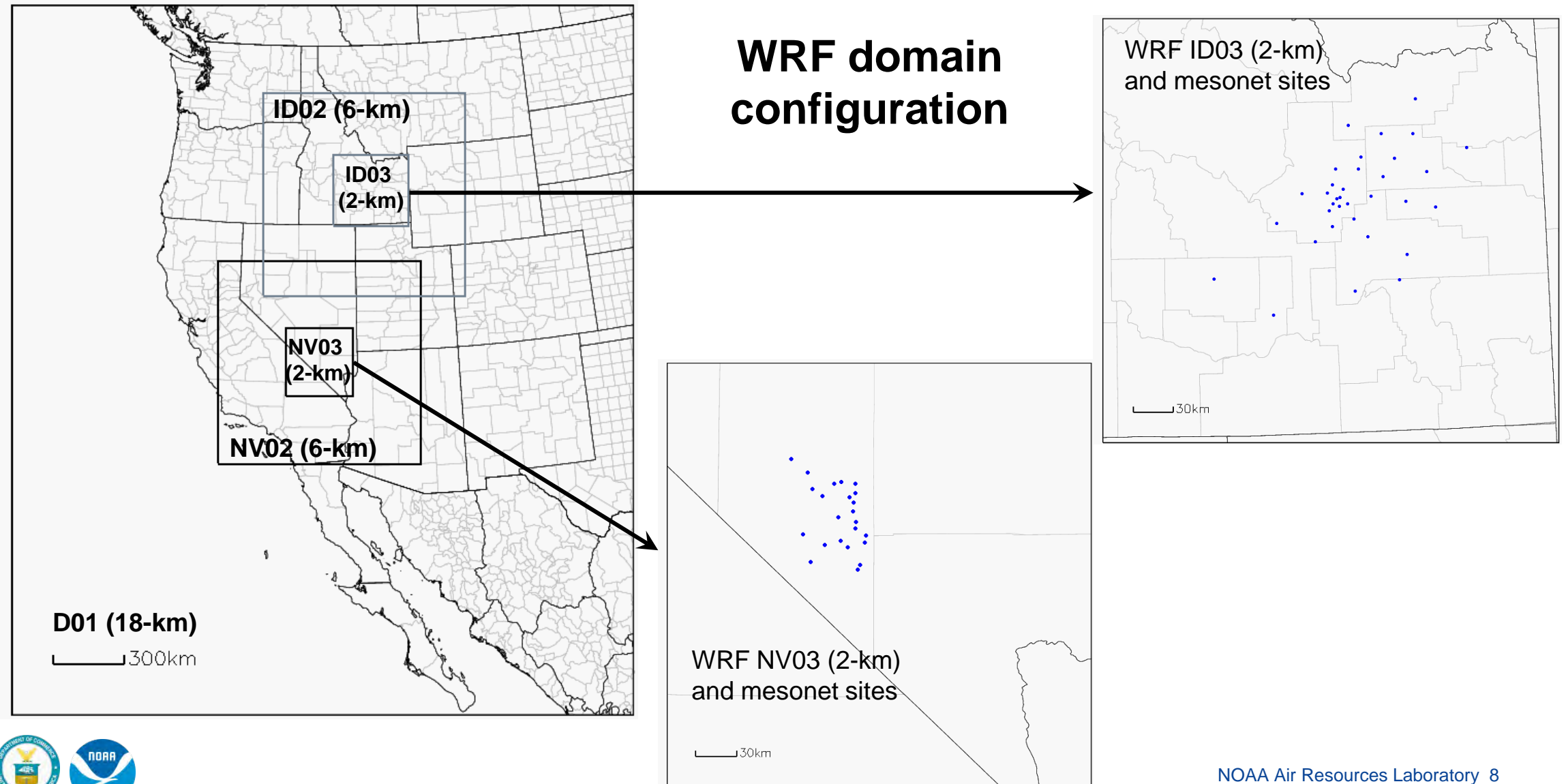
Western WRF Modeling Project



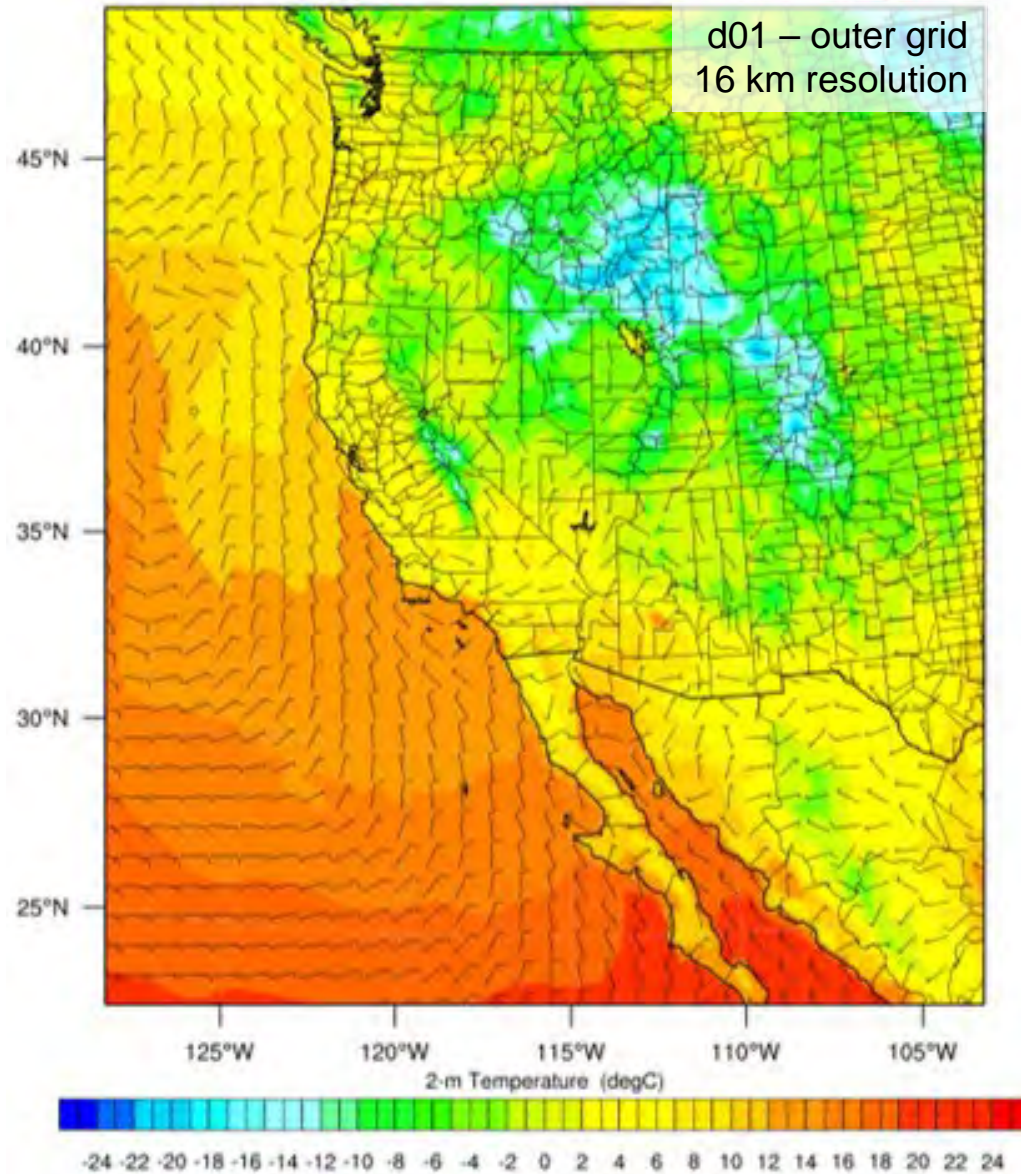
	D01	D02	D03
Grid Spacing (km)	18	6	2
Initial Conditions / Boundary Conditions	GFS0P5	Nestdown from D01	Nestdown from D02
Nesting	One-way nesting		
Microphysics	WSM6 (WRF Single-Moment 6-class scheme with graupel)		
Cloud Physics	Grell-3D ensemble scheme sub-grid scale convective processes		
Radiation Model	RRTMG (Rapid Radiative Transfer Model for General Circulation Models)		
PBL scheme	MYNN (Mellor-Yamada-Nakanishi-Niino) 2.5 level		
Surface scheme	MYNN		
Land Surface Model	Noah (NCEP, OSU, AF, HSL) Land Surface Model		
Nudging	Analysis Nudging		Analysis Nudging (no PBL wind)
Output Frequency	hourly		
Time Step (sec)	60	30	10
Run Time (min) [using 24 CPUs]	30	50	100-140



Western WRF Modeling Project



Western WRF Modeling Project



Details:

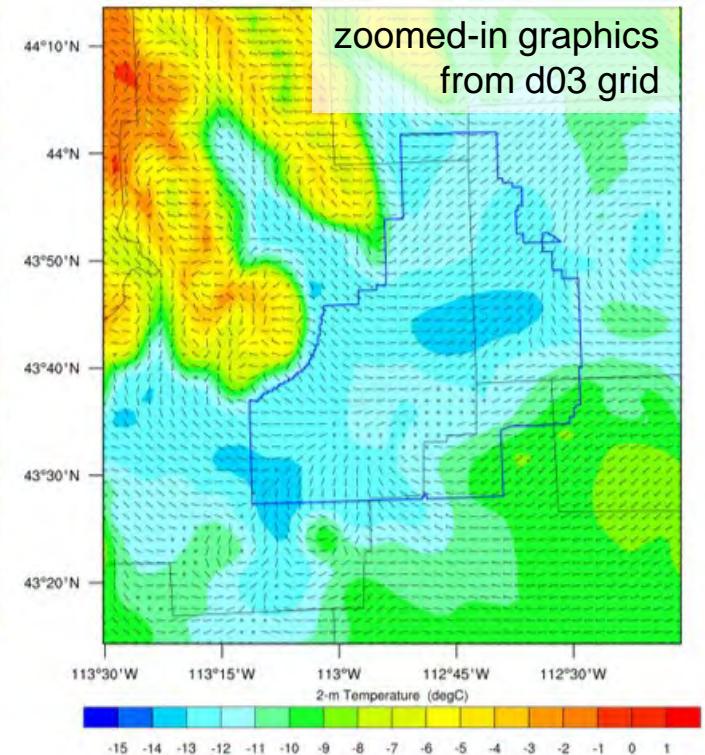
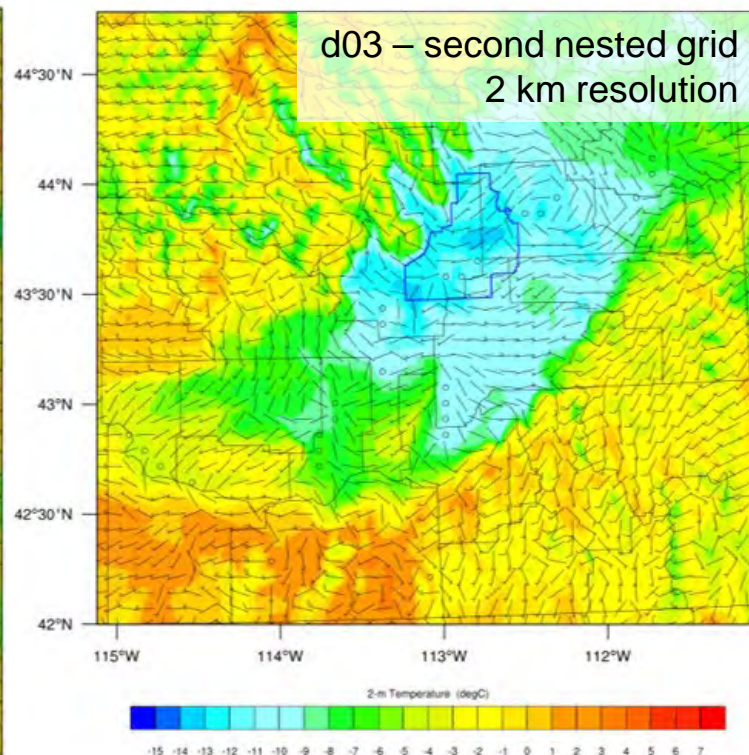
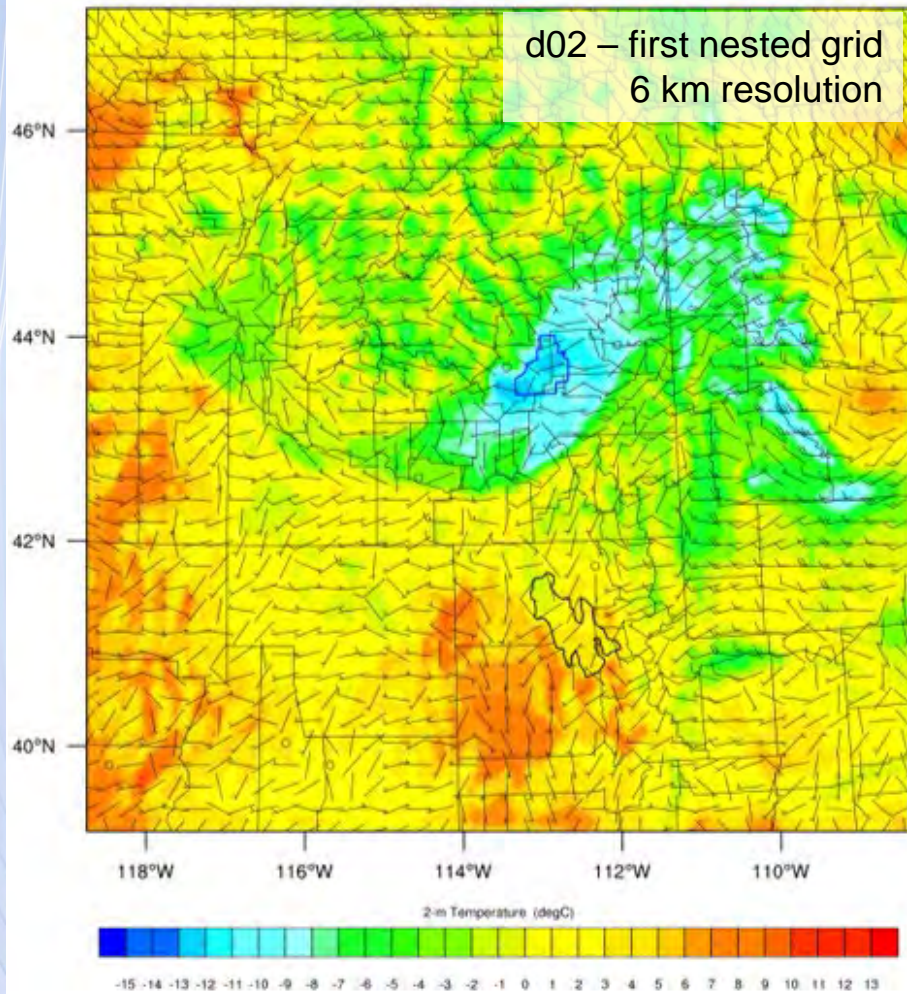
- Large domain to provide appropriate area for model initialization and spin up
- One large outer domain used for both specialized sub-domains
- Synoptic Scale
- Only a couple of wind barbs represent our operational areas

2 meter temperatures and 10 meter wind barbs shown



Western WRF Modeling Project

Idaho



- **Mesoscale**, see how systems move through the area
- ~10 wind barbs represent area

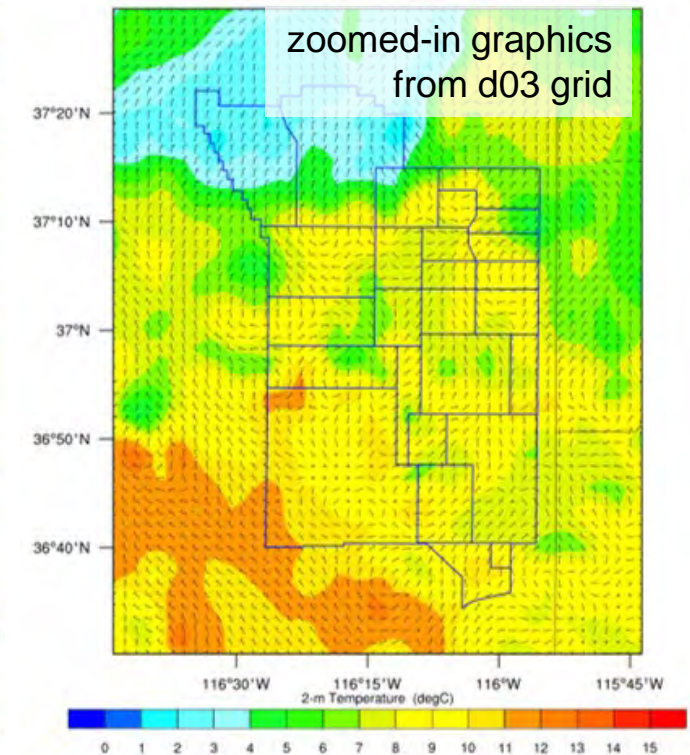
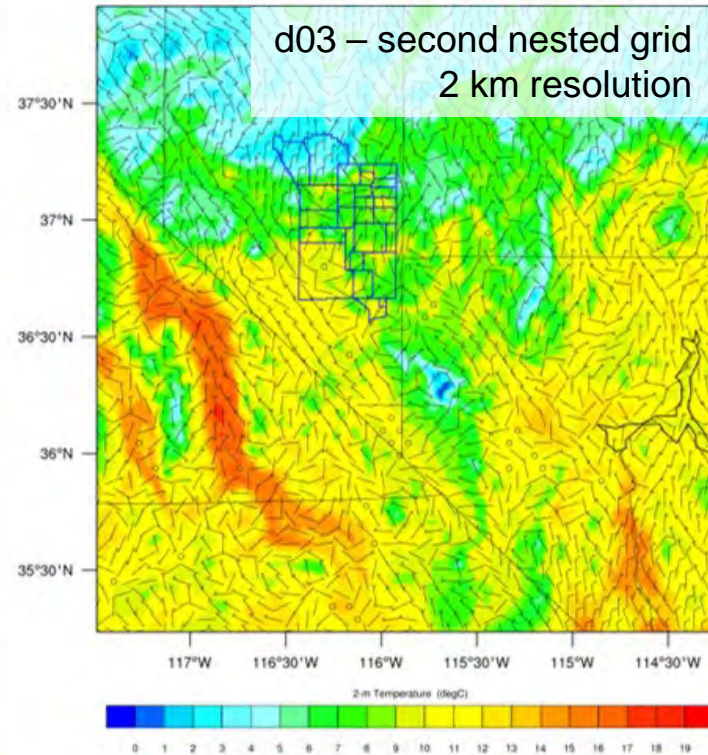
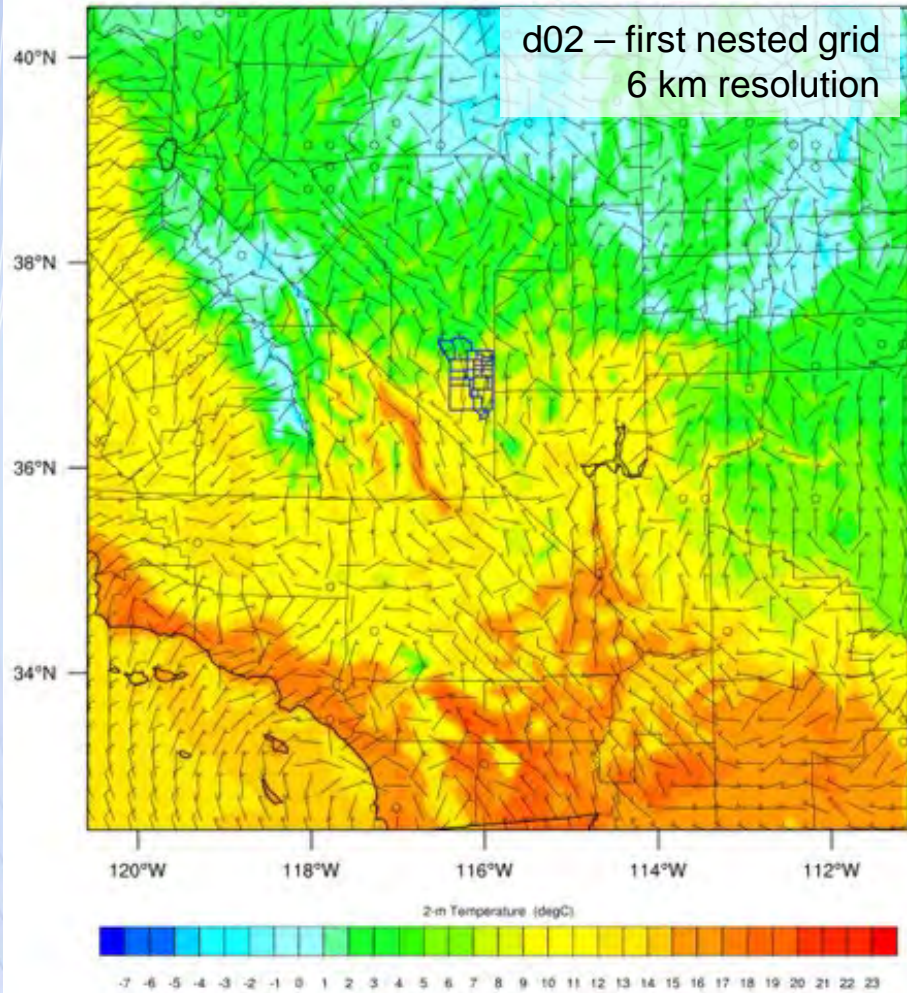
- **Regional Scale**, see effects of systems moving through the area
- ~50 wind barbs represent area
- Increasing resolution is critically important in resolving the terrain influences of the forecast area.
- Fine detail in the wind is essential for providing specialized forecasts for specific experiment/activity locations.

- **Local Scale**, see details of systems moving through the area
- ~1,000 wind barbs represent area

Western WRF Modeling Project



Nevada



- **Mesoscale**, see how systems move through the area
- ~12 wind barbs represent area

- **Regional Scale**, see effects of systems moving through the area
- ~170 wind barbs represent area
- Increasing resolution is critically important in resolving the terrain influences of the forecast area.
- Fine detail in the wind is essential for providing specialized forecasts for specific experiment/activity locations.

- **Local Scale**, see details of systems moving through the area
- ~1,350 wind barbs represent area

The Numbers and the Ribbons



- NWS Service Award
- DOE/NNSA, NA-22 Award
- Participated in over 50 Emergency Response Drills, Exercises, and Events
- Supported over 20 Wildland Fires on the INL and NNS
- Fulfilled over 100 mesonet data requests, including 10 meteorological data reports for the annual National Emission Standards for Hazardous Air Pollutants (NESHAPS)
- 10 Annual Site Environmental Report, Meteorology Chapter/Appendix
- DOE Meteorological Sub-Committee (DMSC), DOE/NNSA, NA-41
 - Chairman (since 1994)
 - Sub-Committee of the Year 2021
 - Primary Author of the DOE Meteorology Program Guide, 2021 supporting DOE Order 151.1d
- Contributor and Reviewer to the ANS/ANSI-3.11-2015 Voluntary Consensus Standard, “Determining Meteorological Information at Nuclear Facilities”
- Whiting, Jericho, Bill Doering, Ken Aho, Jason Rich, 2021: Long-term patterns of cave-exiting activity of hibernating bats in western North America. *Scientific Reports*. <https://doi.org/10.1038/s41598-021-87605-0> (Accepted March 2021)
- Tour Guide to NOAA Administrator, Dr. Spinrad and NWS DAA Mary Erickson



A Bright Future



- Continue to maintain and improve the mesonets in Idaho and Nevada.
 - Update aging infrastructure,
 - Add new instrumentation as appropriate,
 - Explore upgrade opportunities,
 - Expand services provided to DOE-ID and DOE/NNSA/NFO,
 - Explore new/additional “research to application” opportunities.
 - Maintain databases and work to modernize
- Western WRF Modeling Project
 - Tweak operations (i.e., forecast length, products generated),
 - Automate routine mesonet data transfer to research server,
 - Run Model vs. Data comparisons to learn biases,
 - Collaborate with other ARL Divisions,
 - Ingest mesonet data during model run,



Closing



Remember... it all started with a big bang!

We continue to partner with DOE and NNSA and to provide high quality mesonet data.

We will apply these data to improve models and our understanding of the boundary layer.

Thank you for your time.

