NCAR & UCAR 50th Anniversary Lecture

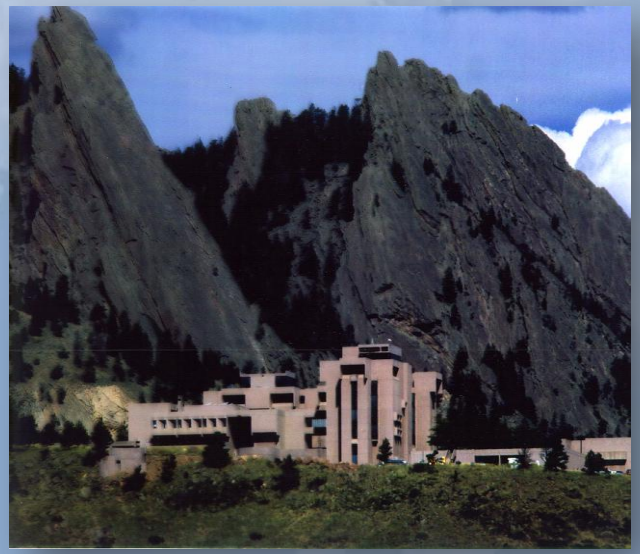
UCAR • NCAR
50 Years
2010
Science Serving Society

Turbulence, Wind Shear, Toxin Attacks, and Other Things That Go Bump In the Night: Applied Research for Real-Life Problems

Bill Mahoney
National Center for Atmospheric Research (NCAR)
Research Applications Laboratory
Boulder, Colorado USA

What is the National Center for Atmospheric Research (NCAR)?

- NCAR is a Federally funded research and development center sponsored by the National Science Foundation (NSF). About 60% of NCAR funds come from NSF.
- NCAR is operated by the University Corporation for Atmospheric Research (UCAR), a non-profit 501(c)(3) corporation formed in 1959.
- UCAR has approximately 1400 employees.



NCAR, Boulder, CO

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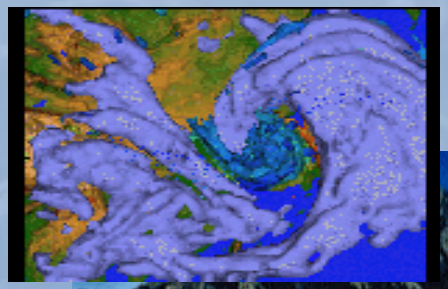
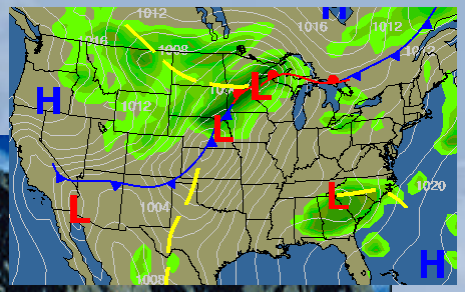
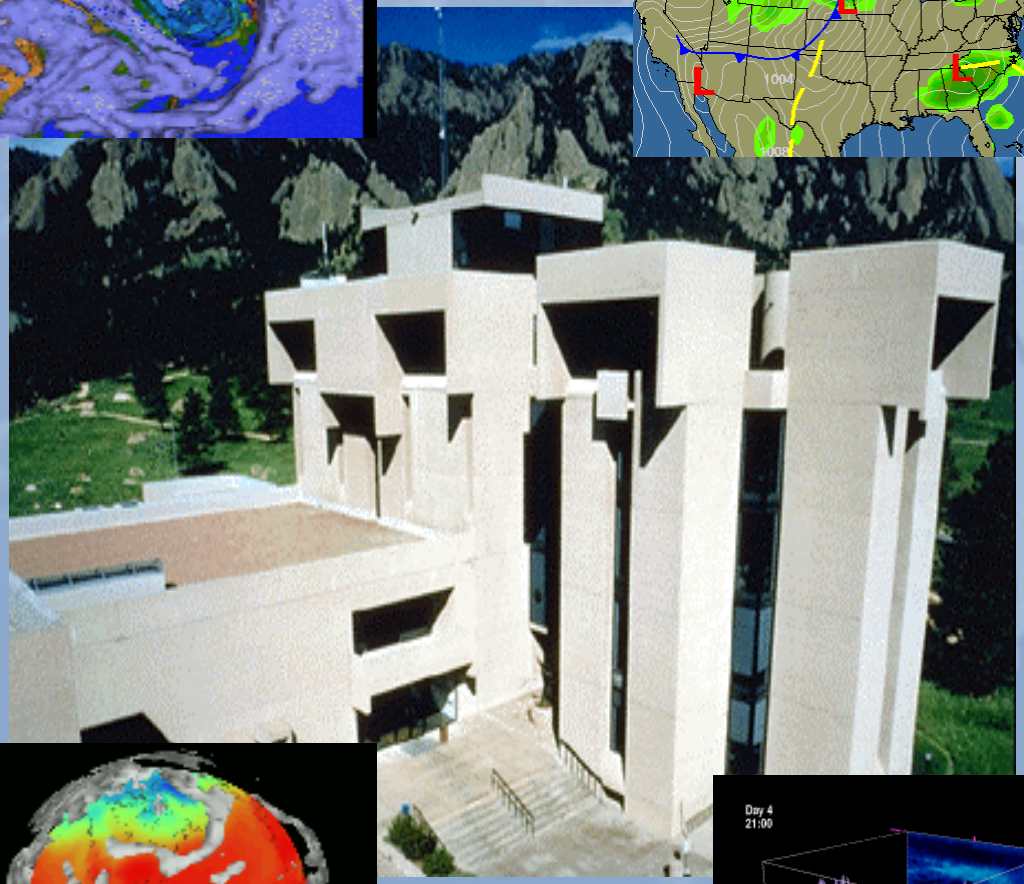
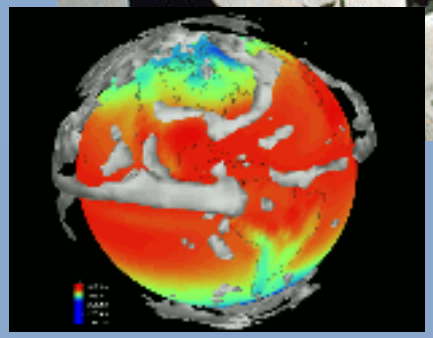
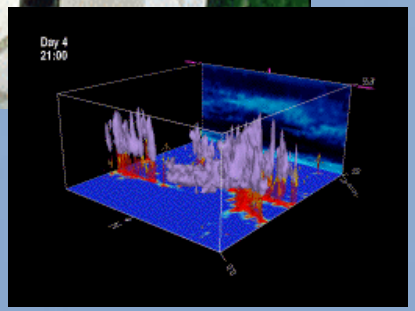










Research Topics

Climate Science
Air Chemistry
Solar Physics
Weather Research
- boundary layer
- thunderstorms
- weather models
- hurricanes
- land surface
- coupled models

Social Sciences
Supercomputing
Technology Transfer

National Center for Atmospheric Research (NCAR)

Research Applications Laboratory

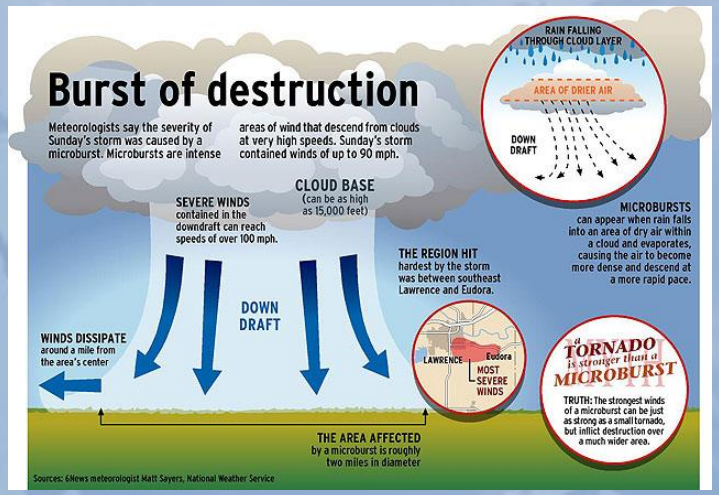
- Mission
  - Perform applied R&D geared toward weather related decision support systems
  - Transfer knowledge and technology to U.S. government agencies, the private sector, and foreign governments

Nature of Work in RAL

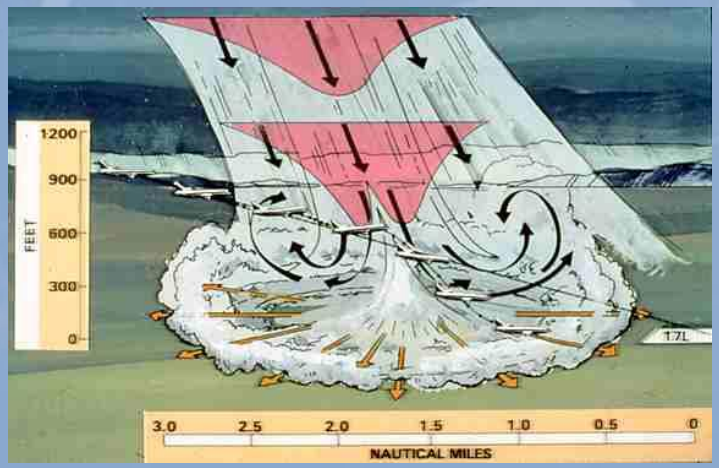
- Atmospheric research (basic & applied)
- Engineering research & development
- Demonstration, testing, and evaluation of capability
- Decision support system development
- Technology & knowledge transfer, including the deployment of turn-key systems
- Education and training

How Did We Get Started?

In the 1970s and 1980s, there were several aircraft accidents caused by mysterious wind conditions.



In 1981, NCAR was funded by the Federal Aviation Administration (FAA) to investigate.



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Microburst Wind Shear Impacts

Several planes crashed during the wind shear research program.

Two wind shear detection systems were developed as part of this program.

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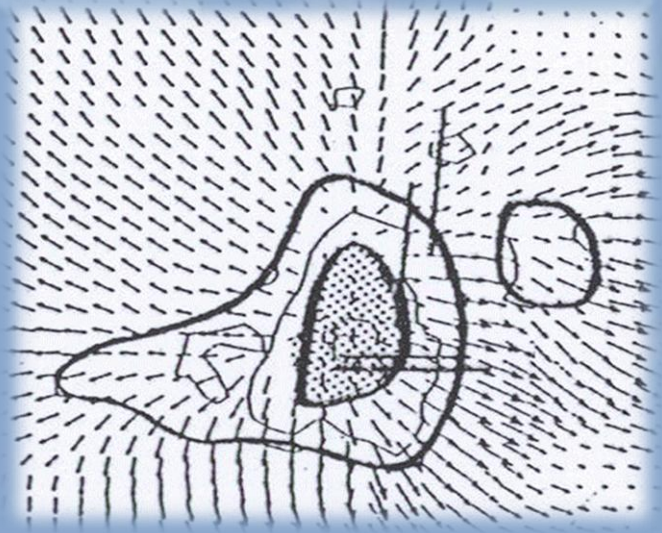
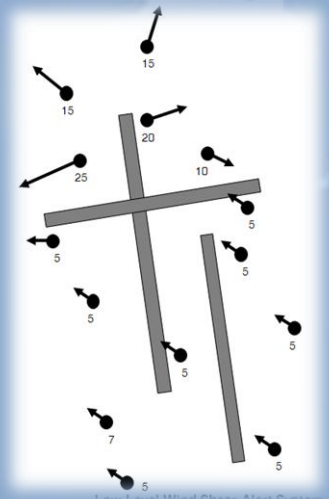
Microbursts Detection

- Terminal Doppler Weather Radar (TDWR)
- Low-Level Wind Shear Alert System (LLWAS)

Terminal Doppler Weather Radar



Microburst at Stapleton Airport



Low-Level Wind Shear Alert System

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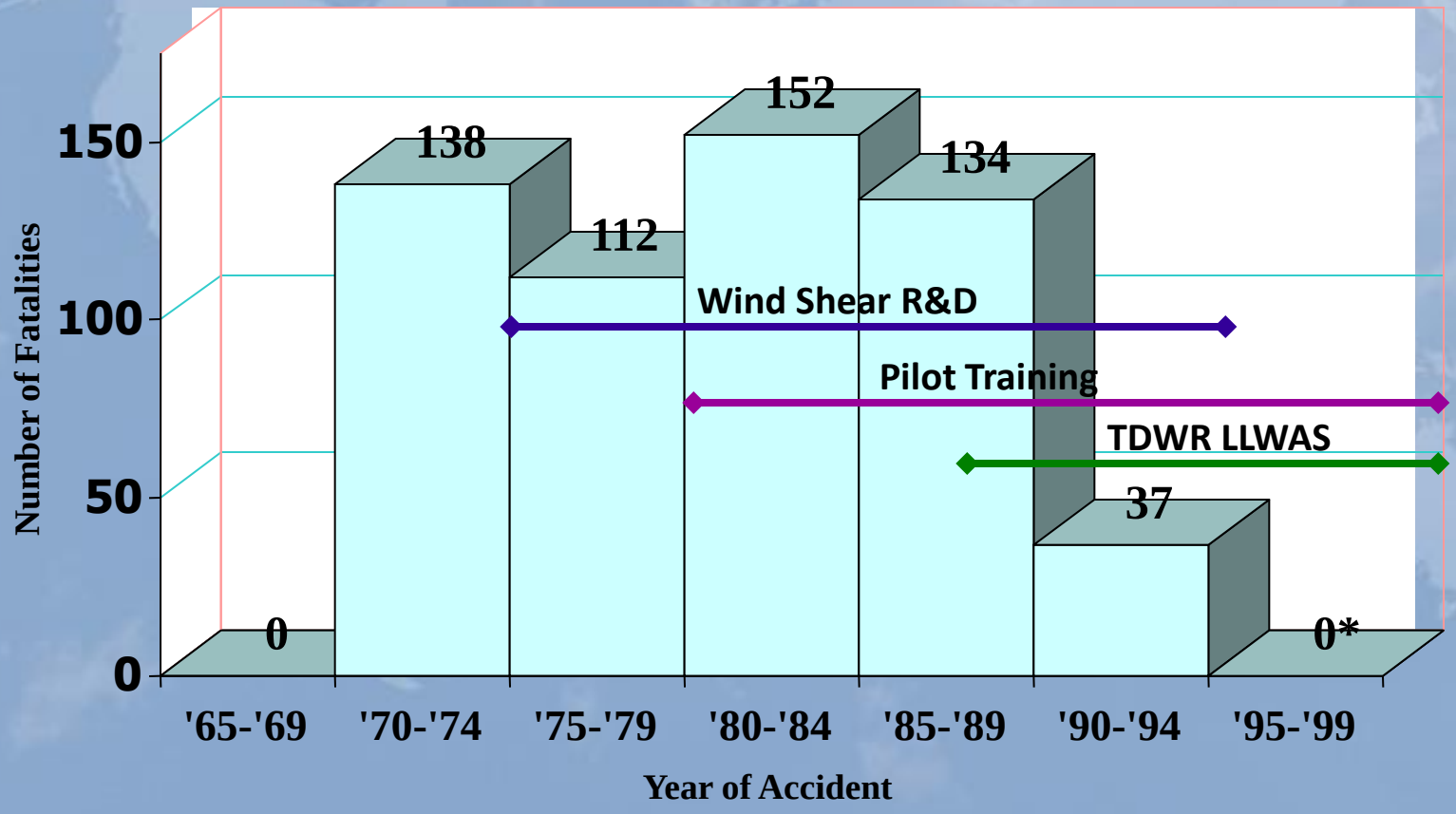
Research Success Story!



US Crashes Decreased Significantly

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Applied Research Agenda Expands

- Since the 1990s, NCAR's applied research has expanded quickly. Topics now include:
  - Turbulence
  - Aircraft Icing
  - Thunderstorms
  - Ceiling & Visibility
  - Hazardous Plumes
  - Water Resources
  - Weather/Climate & Health
  - Agricultural Pests
  - Road Snow & Ice Control
  - Wind Energy
  - Fire Behavior
  - Flooding
  - Hurricanes

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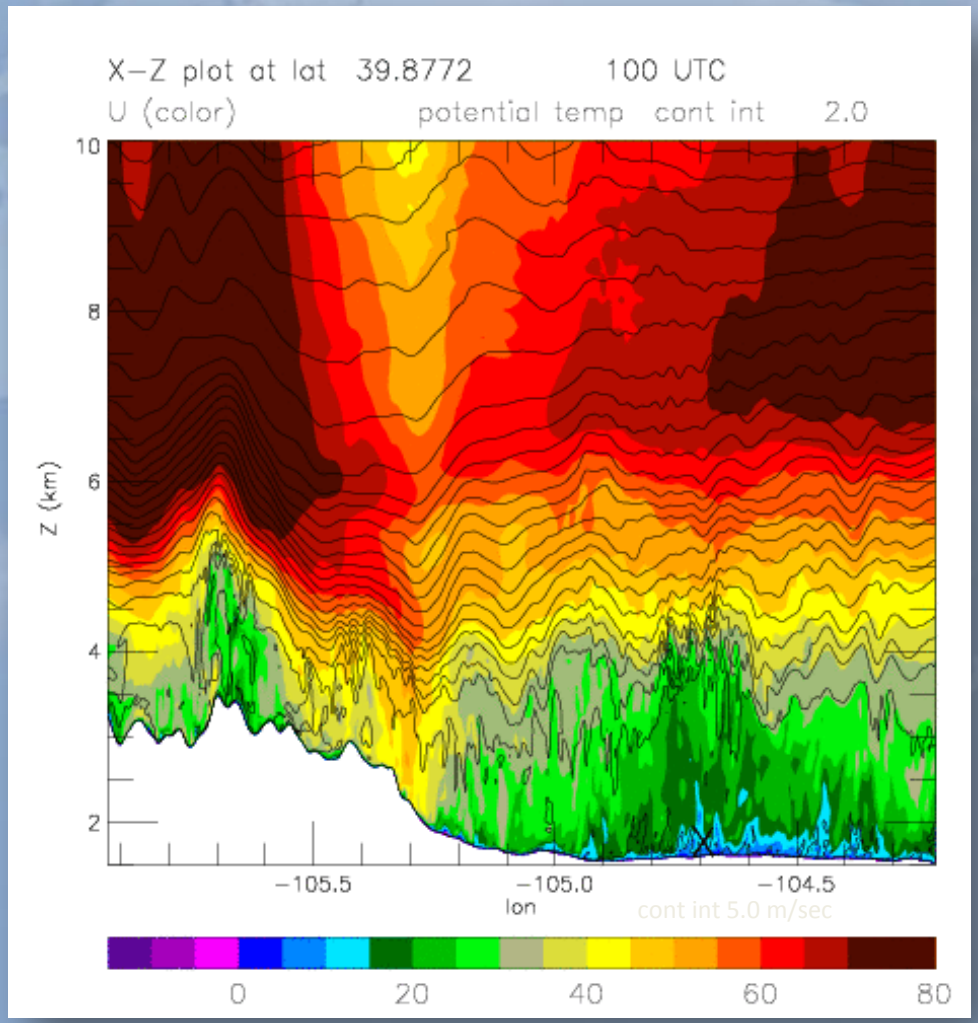
Turbulence – Down Slope Winds

Both on-board and ground based turbulence products have been developed for the FAA and NWS.

21 Dec 2008 -0118 UTC
Boeing 737-500



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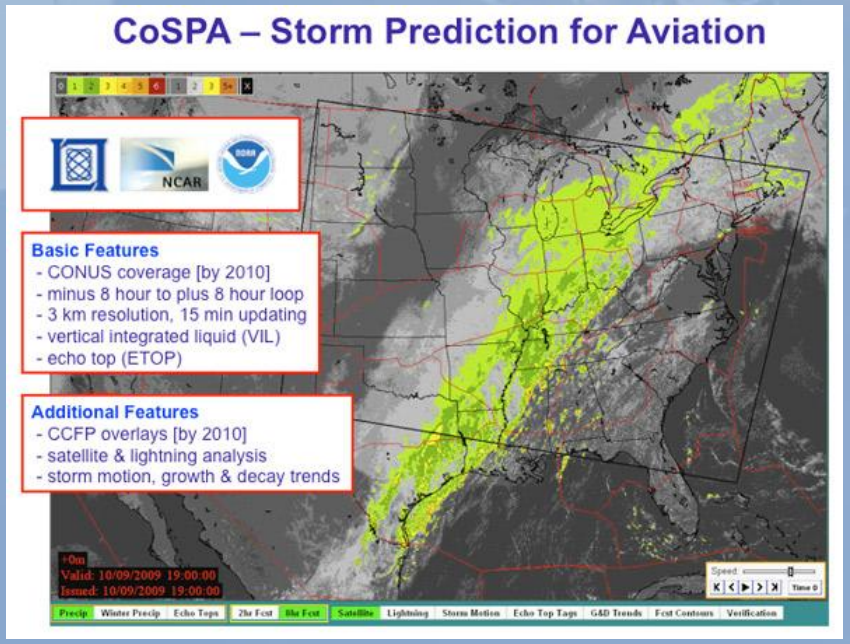
Thunderstorm Prediction for Aviation

Thunderstorms are the #1 cause of flight delays in the U.S. NCAR is working closely with the FAA, airlines and other researchers to improve short-term storm predictions.

Photo: Tim Rotz, Northwest Airlines



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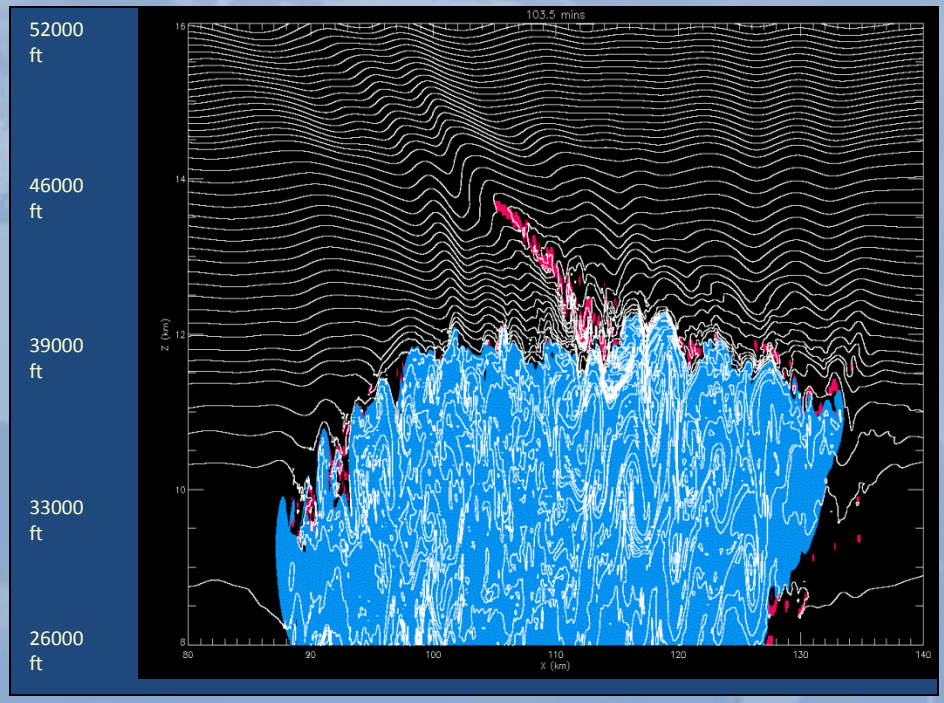
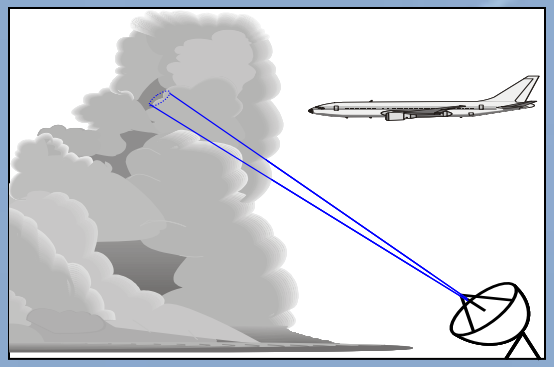
Thunderstorm Induced Turbulence

Strong vertical air motions associated with thunderstorms can cause severe turbulence. NCAR has developede a national storm related turbulence product for the FAA and aviators.



United Airlines Turbulence Incident
21 July 2010



NEXRAD Turbulence Detection Algorithm

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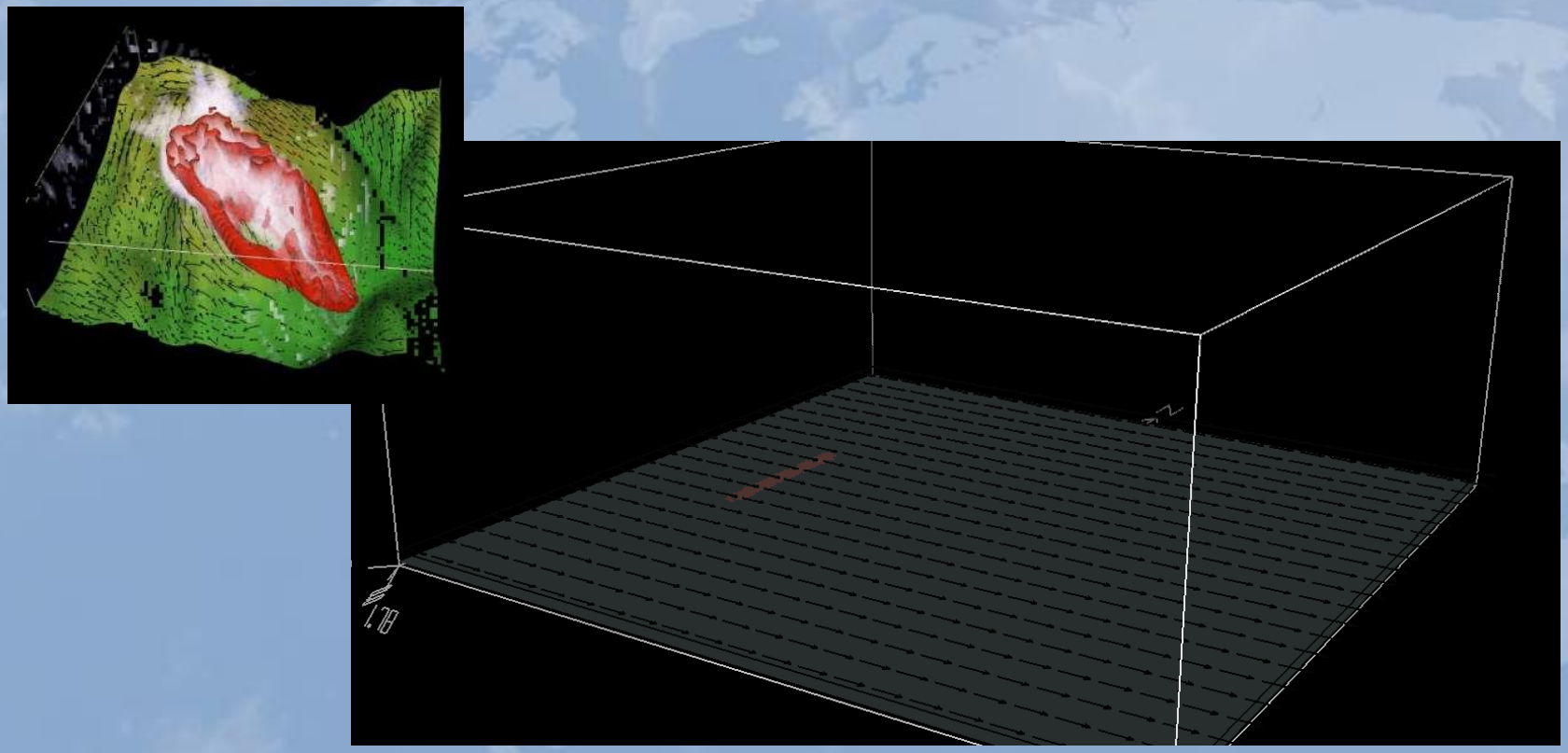
Fire Behavior Modeling



Fire Behavior Animation

Courtesy – Janice Coen

Goal – To provide decision support to wild land fire managers and fire fighters

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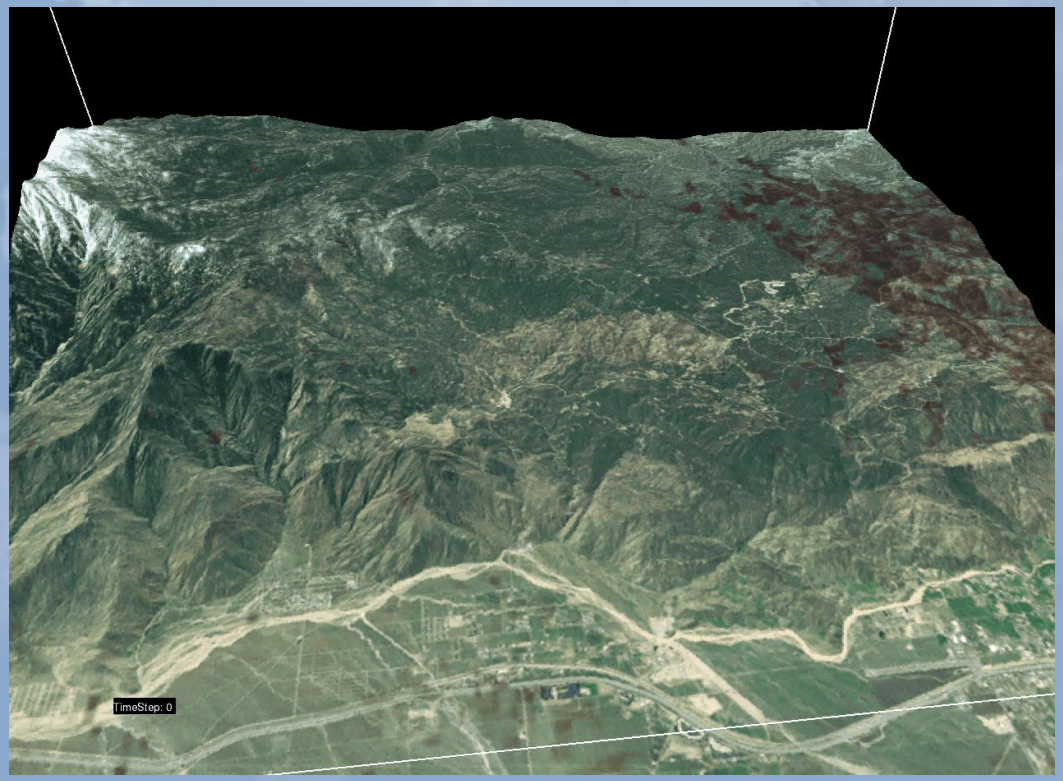
Fire Behavior Modeling

Espiranza Fire, CA

Simulation of fire Line behavior



Fire Line Animation

Courtesy – Janice Coen

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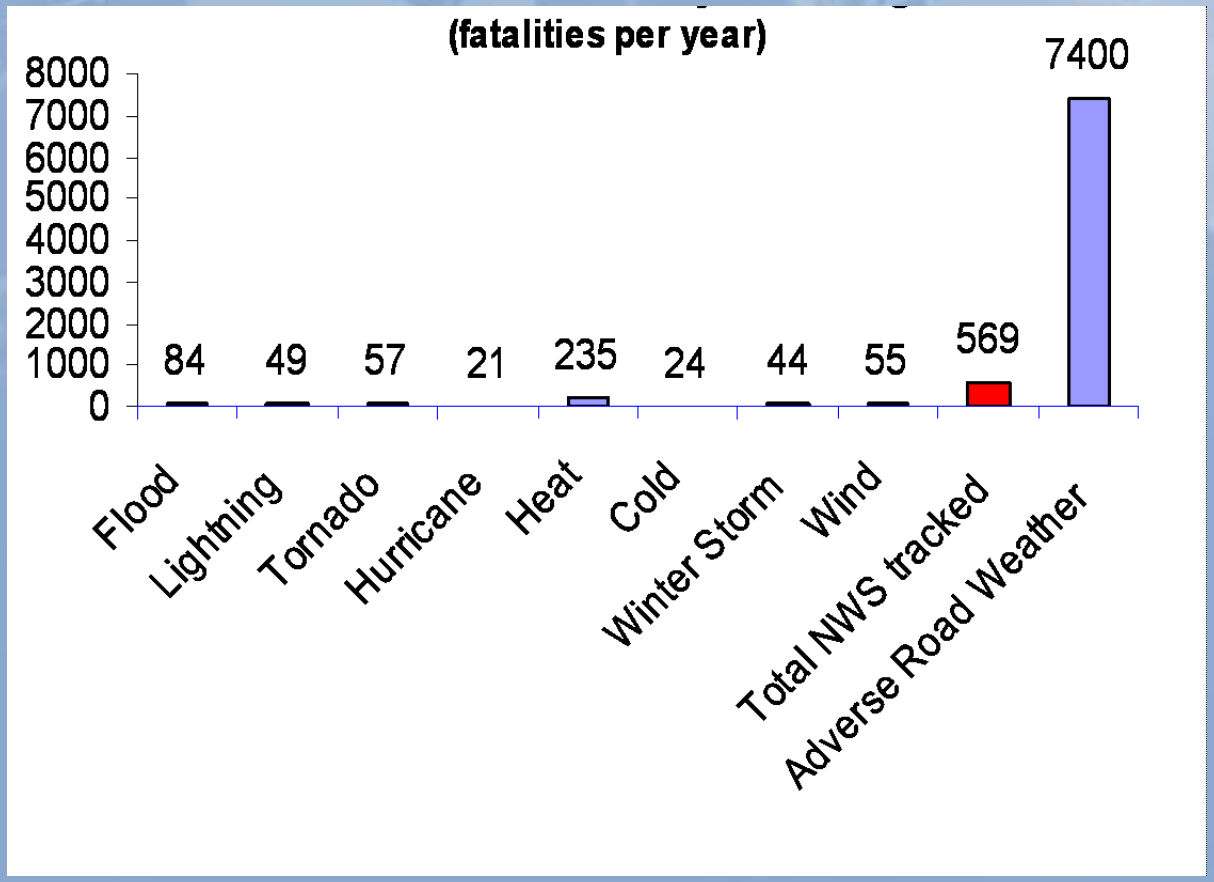
Road Weather



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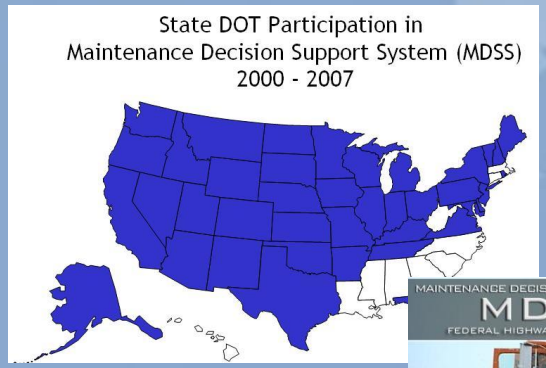
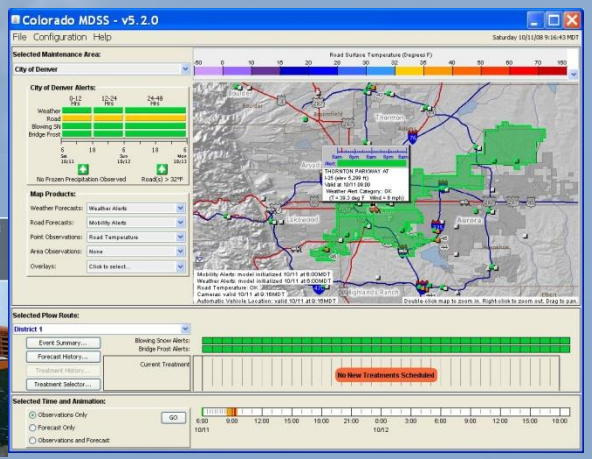
Road Weather
Snow & Ice Control Decision Support

The winter Maintenance Decision Support System (MDSS) predicts road conditions and recommends treatments (sand, NaCl, MgCl, plow, etc.)





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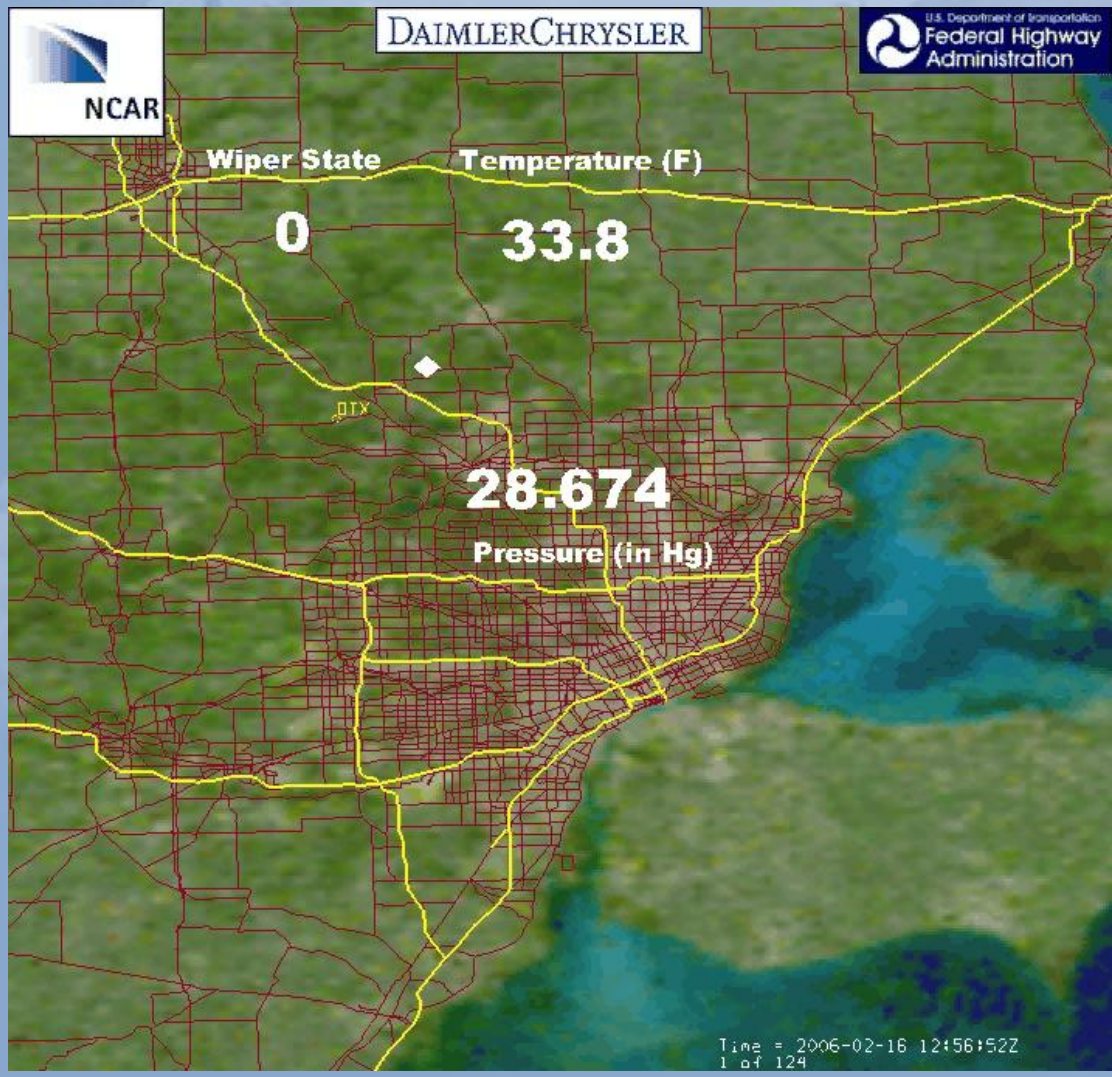
Road Weather IntelliDrive^{SM} Program

NCAR is developing techniques to diagnose and predict road conditions using vehicle data from regular passenger cars and trucks



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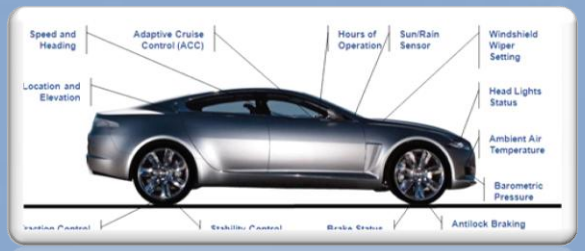

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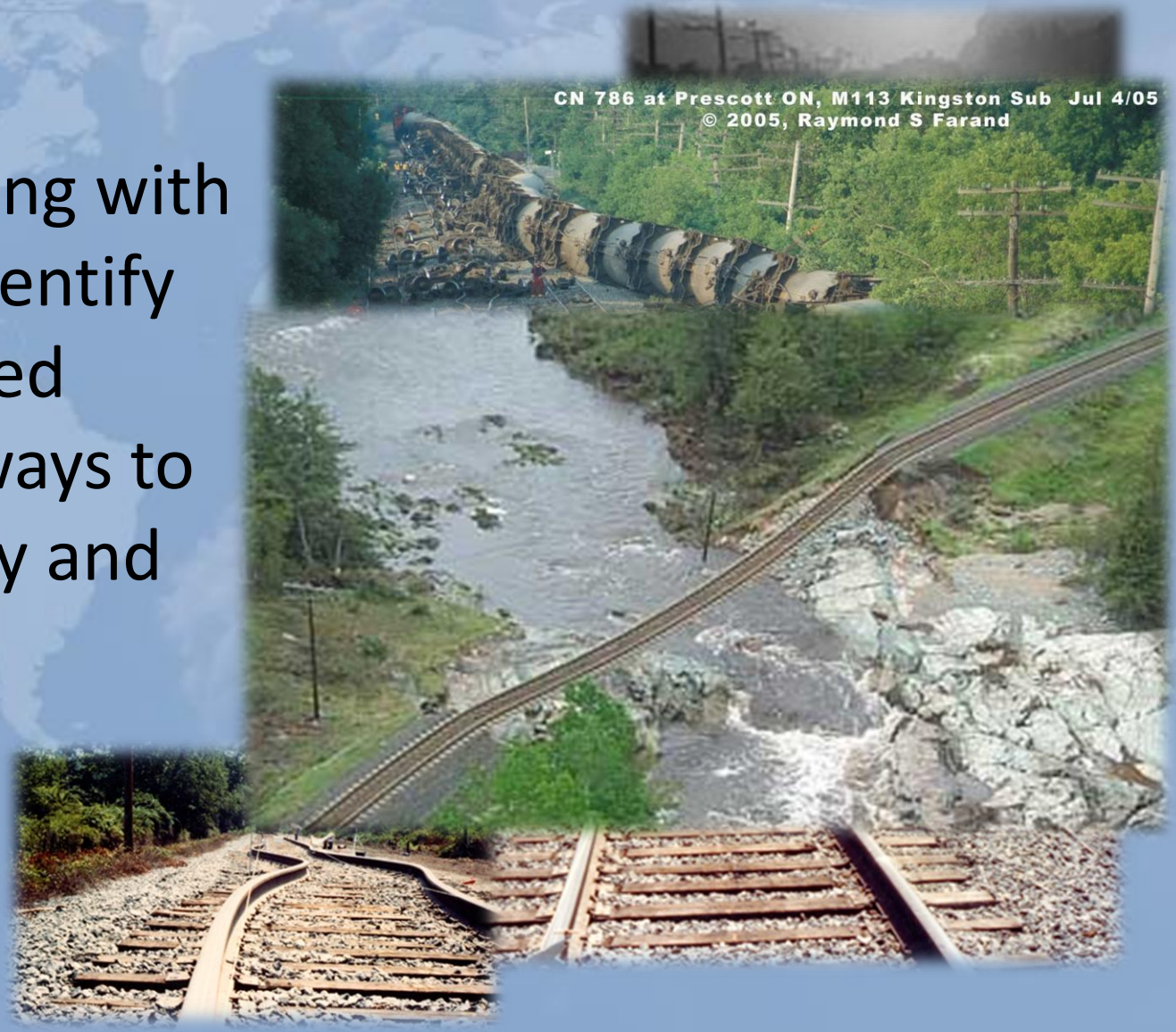
Rail Road Weather

NCAR is working with railroads to identify weather related hazards and ways to improve safety and operations.



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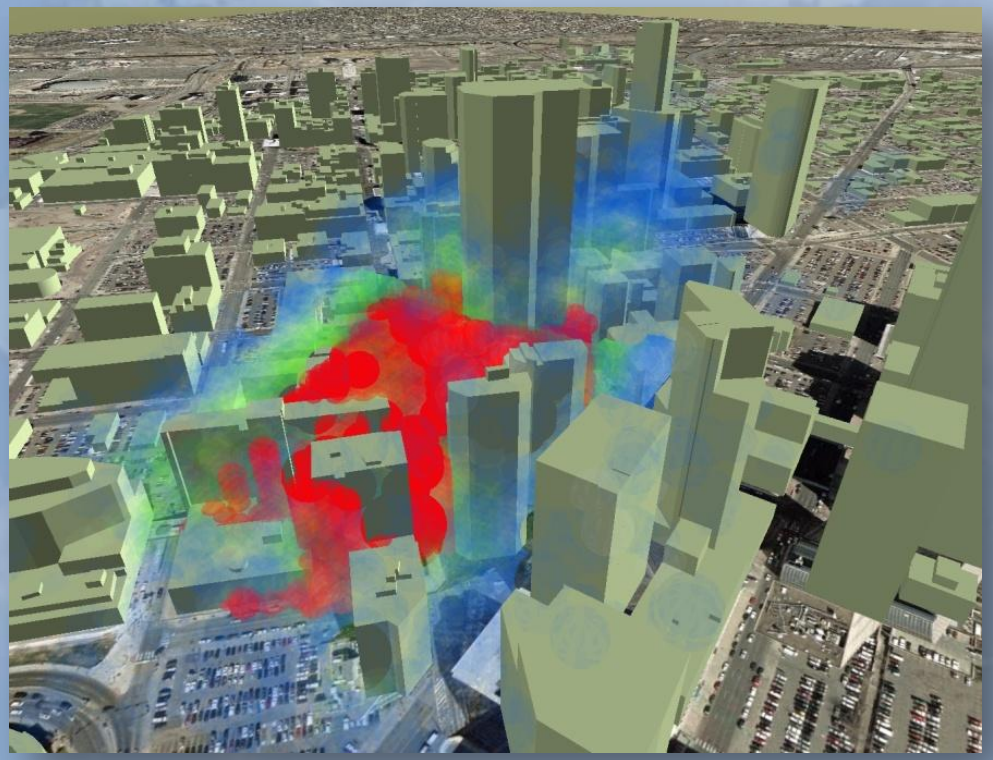
Homeland Security

NCAR works with Department of Homeland Security and DoD to develop hazardous plumes detection and tracking systems



Simulation
Pentagon City – Washington D.C. Region

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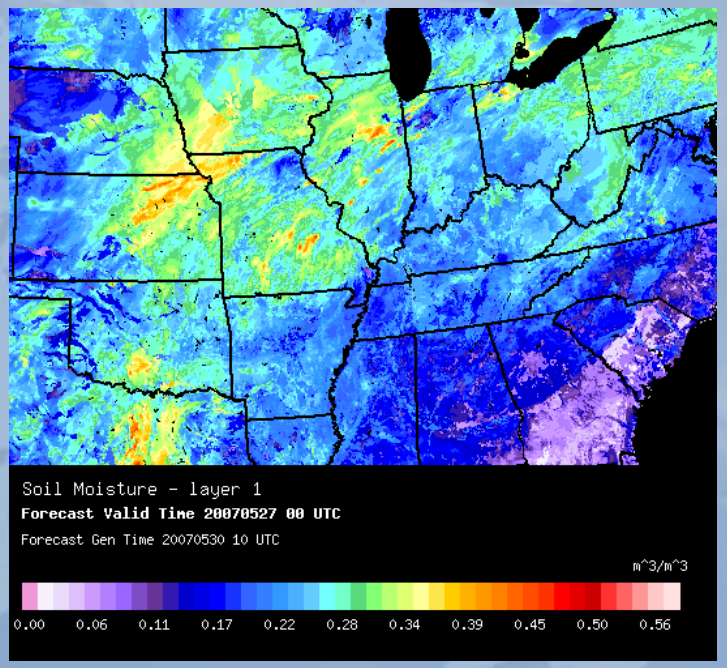
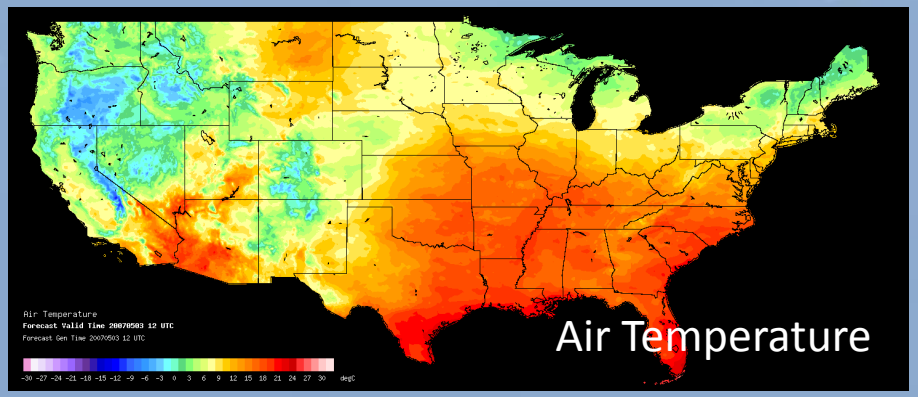
Advanced Forecasting Systems

NCAR has developed advanced technologies for weather companies such as The Weather Channel, Televent/Meteorlogix, WSI, and others



Soil Moisture



Air Temperature

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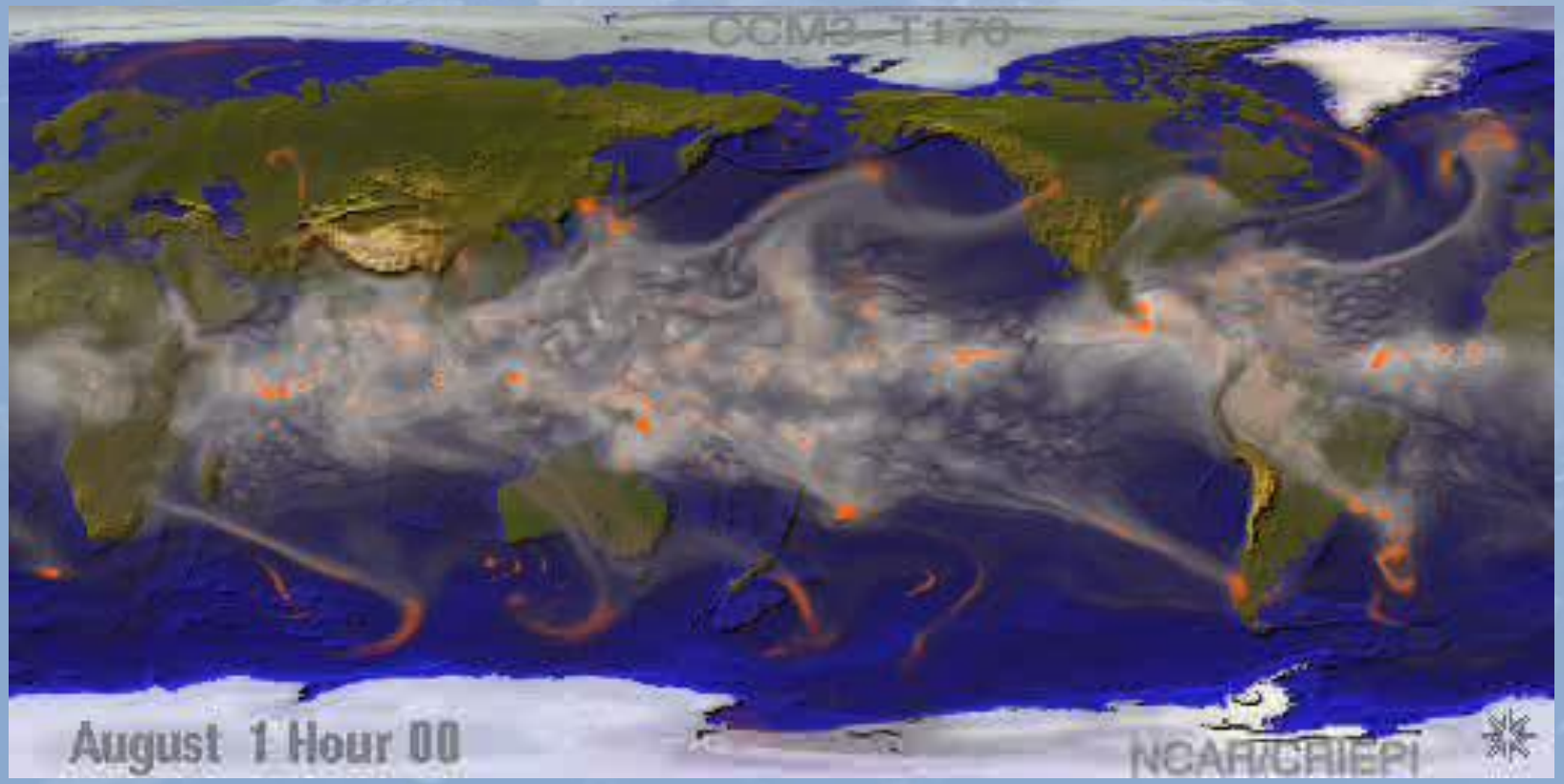
Climate Science Applications Program



NCAR is working with end users to communicate climate change issues and impacts to help with adaptation and mitigation decision making.

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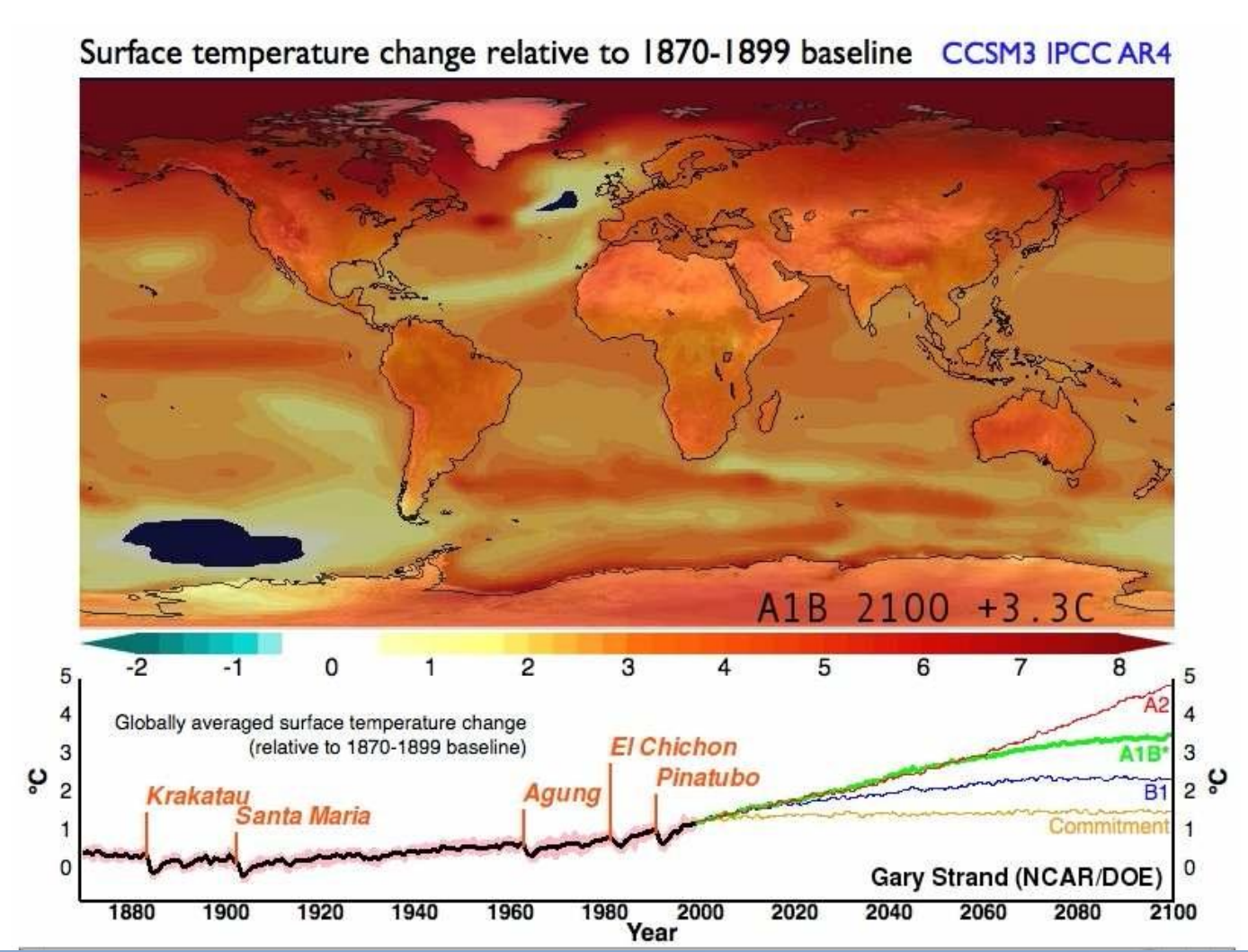
Climate Modeling – Global Temperature



Source NCAR CCMS3

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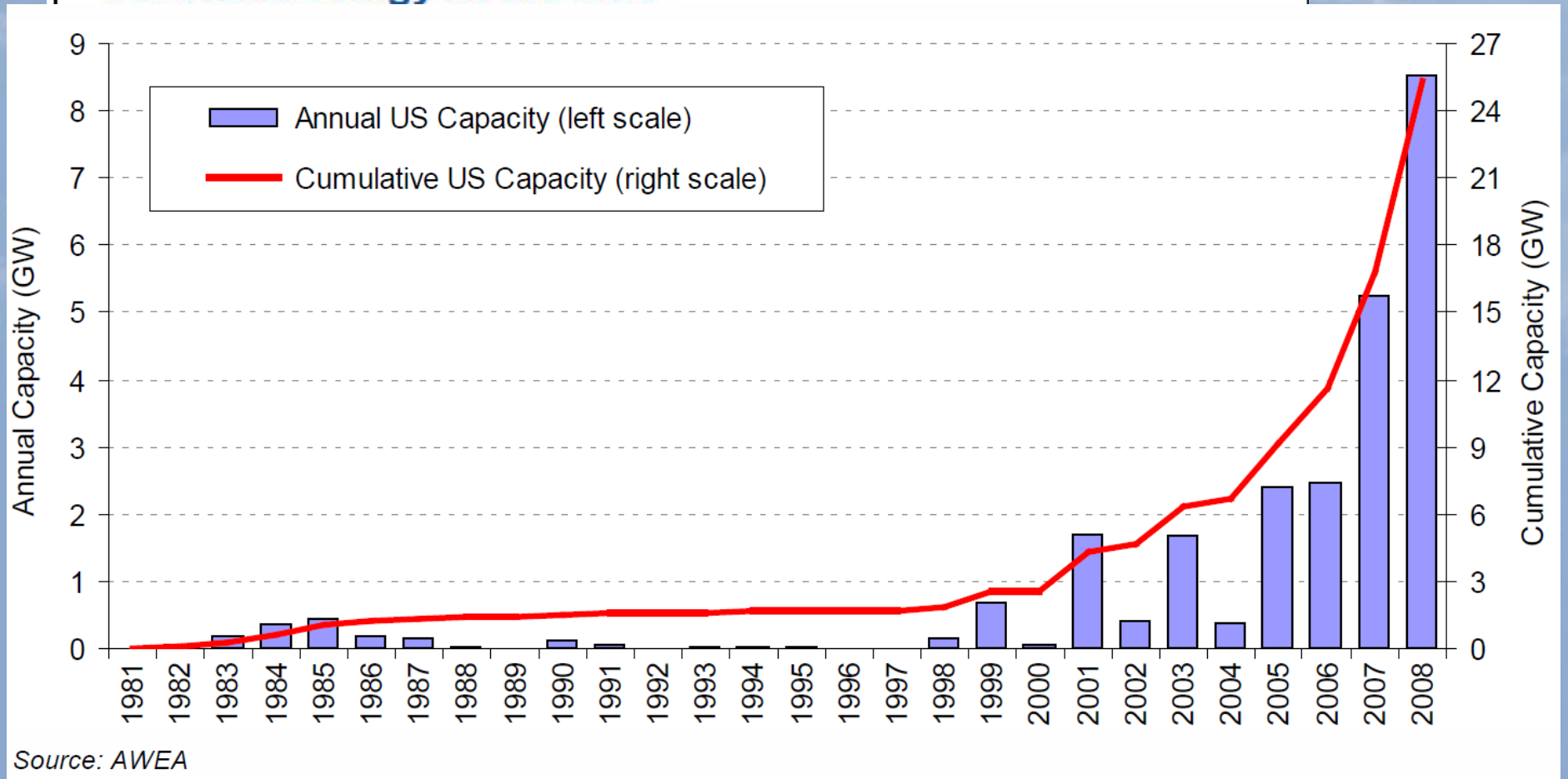
Wind Energy – The Big Push

A New Vision
For Wind Energy in the U.S.



Source: AWEA

Figure 1. Annual and Cumulative Growth in U.S. Wind Power Capacity

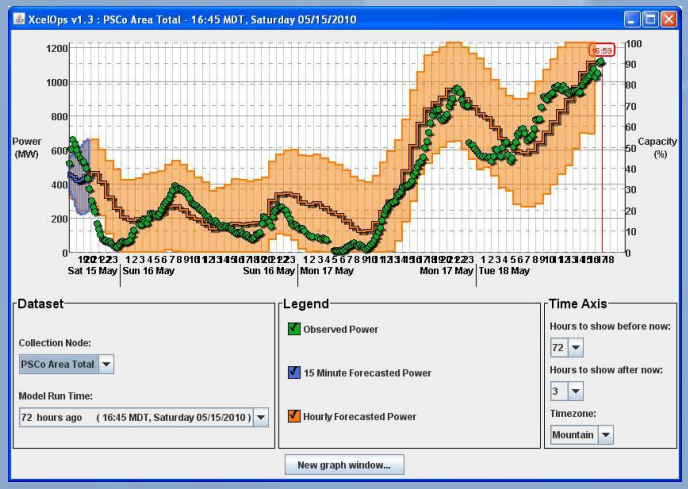
National Renewable Energy Laboratory — Innovation for Our Energy Future

NCAR

Wind Energy Prediction

NCAR partnered with Xcel Energy to develop an advanced wind energy prediction system.

Improved prediction capabilities are required to move toward 25% renewable by 2020



Wind energy prediction system display

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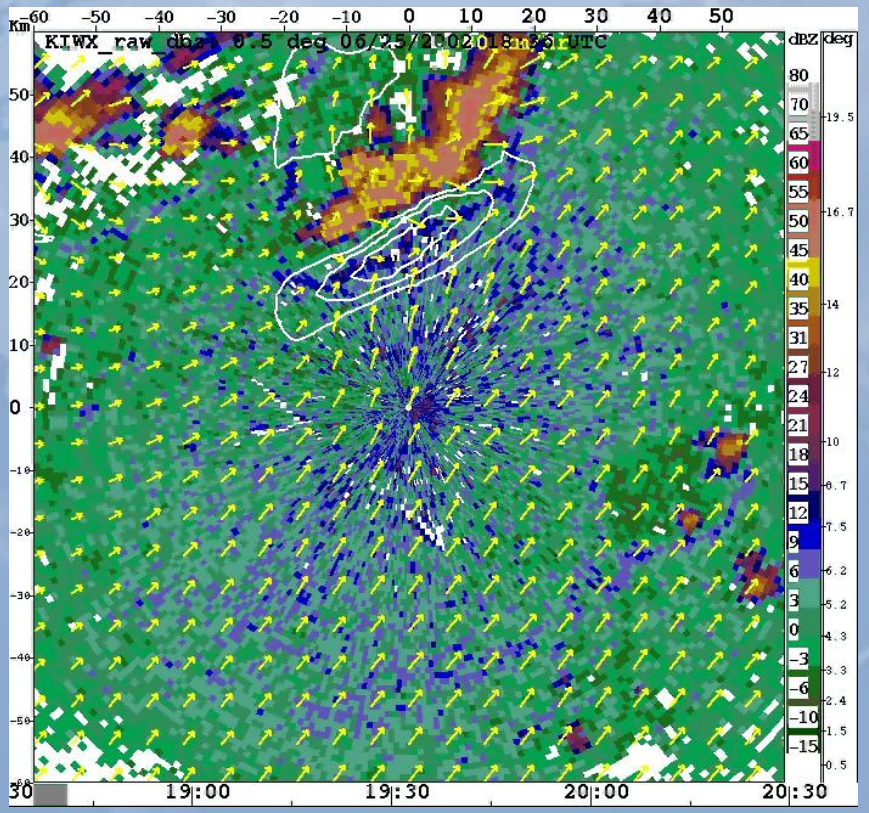
Wind Energy Prediction

Rapid increases or ramps in wind energy are difficult for utilities to manage. NCAR is working with industry to improve wind energy ramp prediction.



Wind Energy Ramp Event
NCAR Auto-Nowcaster

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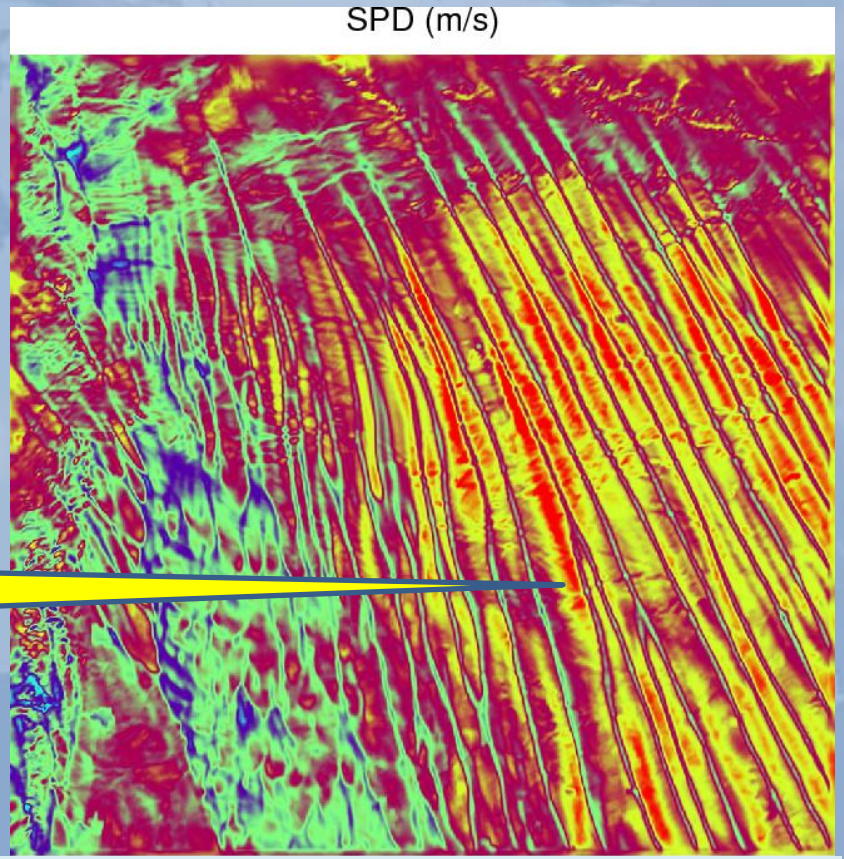
Wind Energy Prediction

Understanding complex wind flows near wind farms helps us predict wind energy.

Wind vary greatly across a single wind farm.



Wind Speed Variability

Northern Colorado Wind Farm

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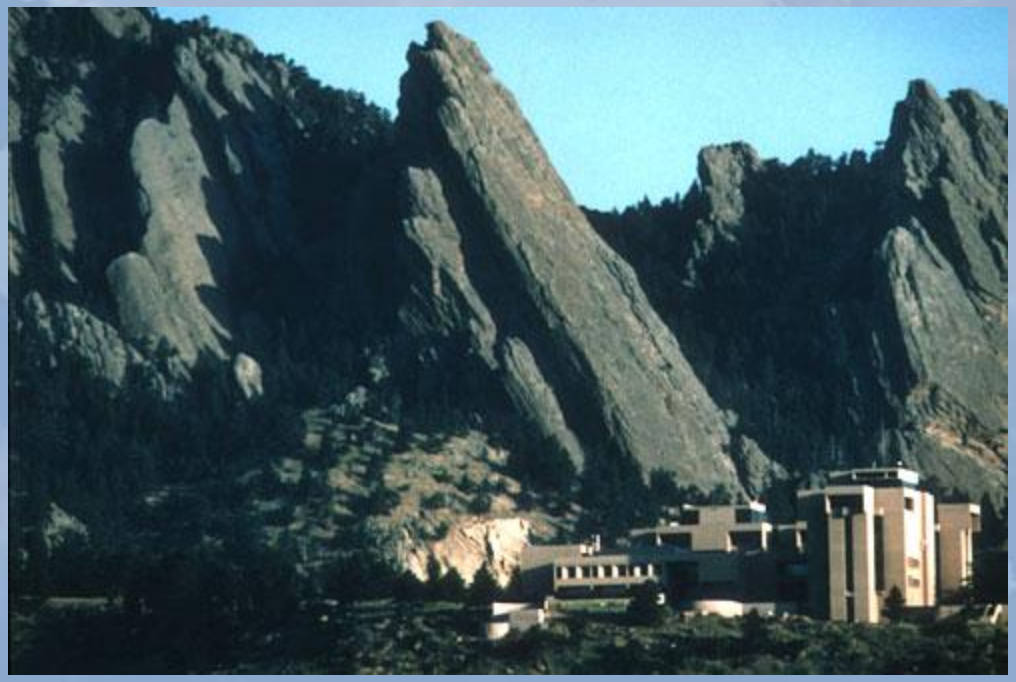
In Closing

NCAR's research and development are being applied to solve everyday problems so that we can meet our founding Director's vision of "Science in Service to Society"



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Boulder, Colorado

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THANK YOU