

NCAR & UCAR 50th Anniversary Lecture





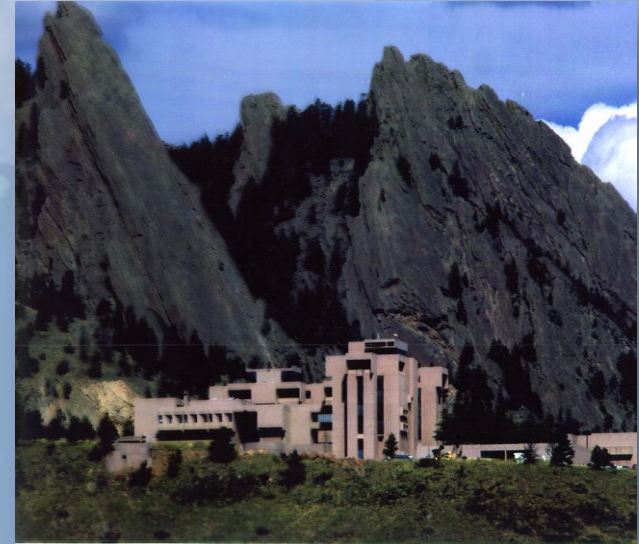
Turbulence, Wind Shear, Toxin Attacks, and Other Things That Go Bump In the Night: Applied Research for Real-Life Problems

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Research Applications Laboratory
Boulder, Colorado USA



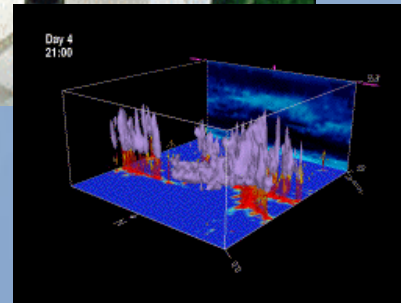
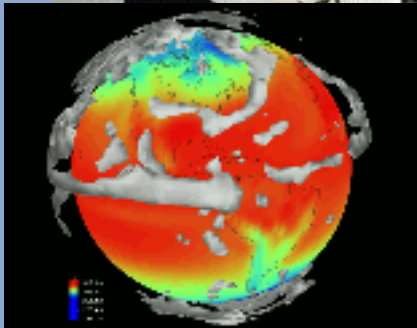
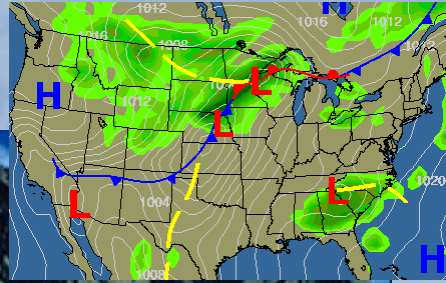
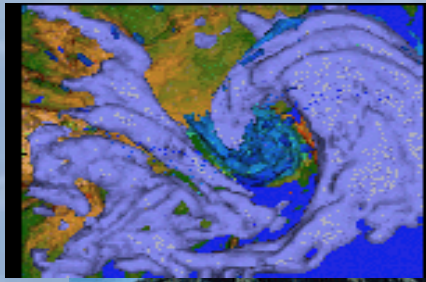
What is the National Center for Atmospheric Research (NCAR)?

- 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





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

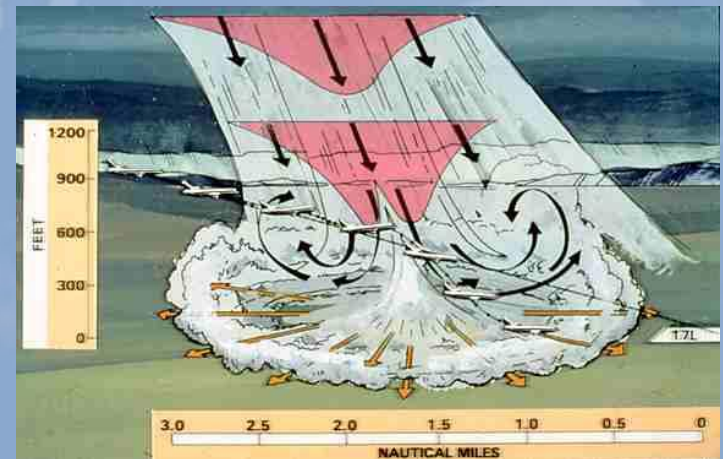
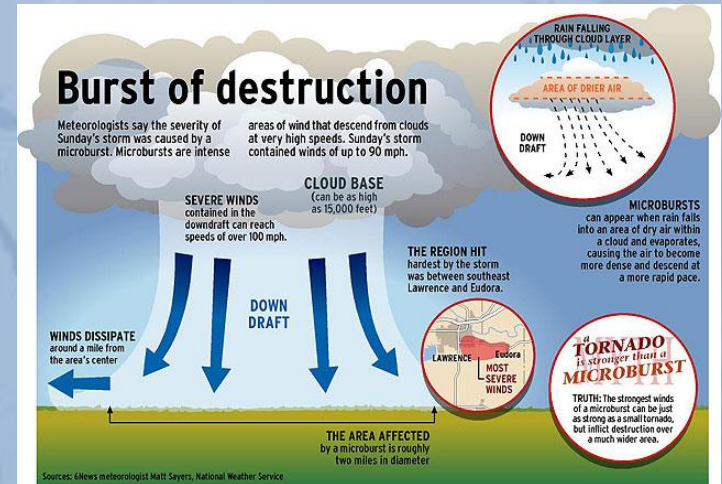
- Atmospheric research (basic & applied)
- Engineering research & development
- Demonstration, testing, and evaluation of capability
- Decision support system development
- Technology & knowledge transfer, including the deployment of turn-key systems
- Education and training



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.



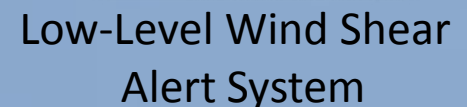
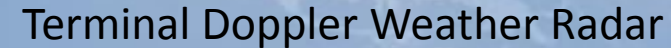
Microburst Wind Shear Impacts

Several planes crashed during the wind shear research program.

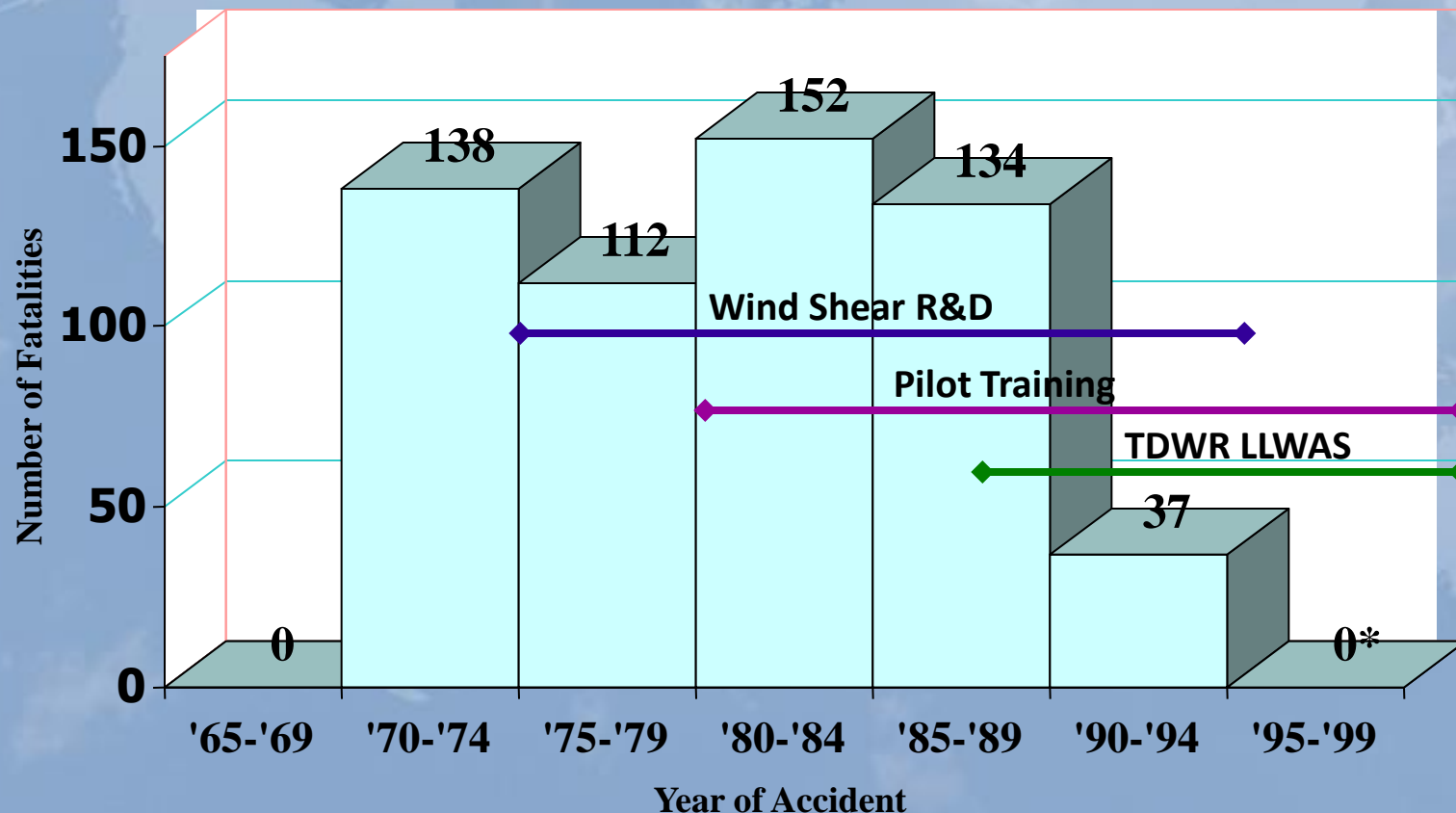
Two wind shear detection systems were developed as part of this program.



- NCAR



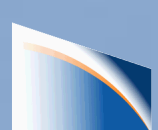
Research Success Story!



US Crashes Decreased Significantly

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

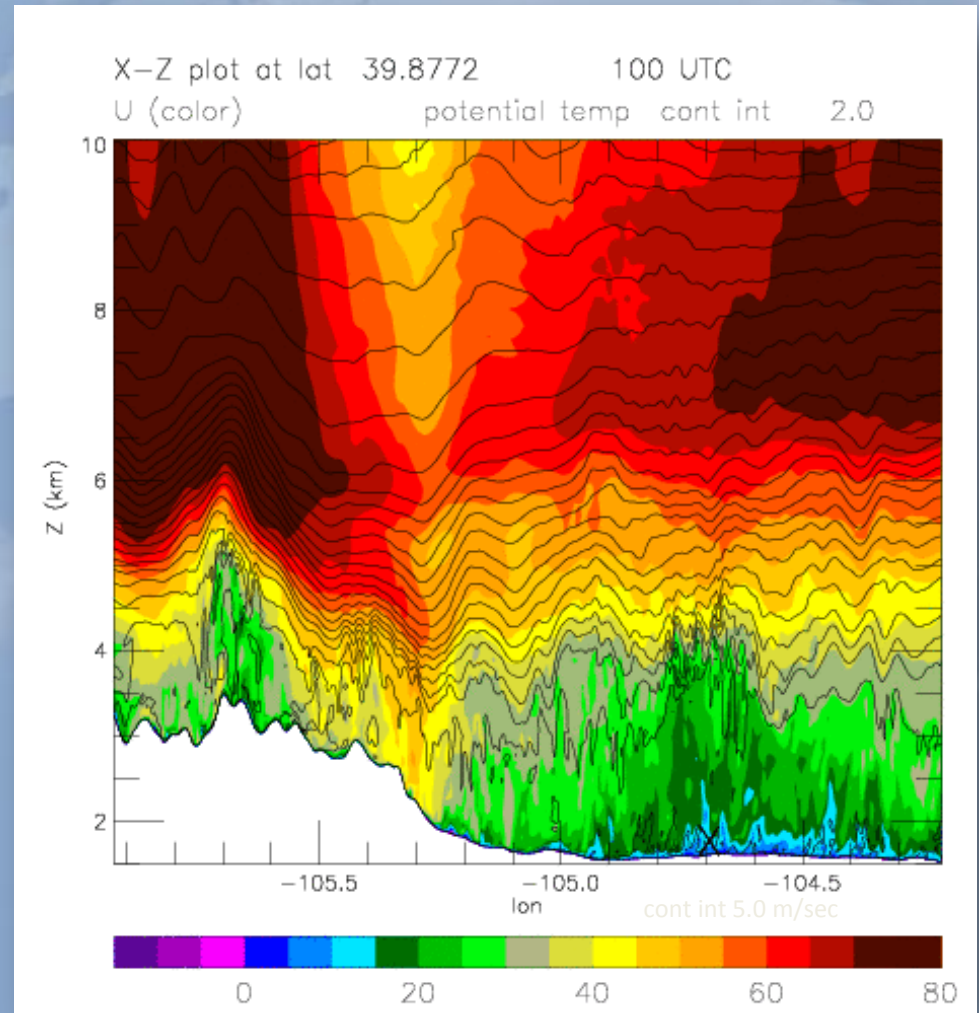


Turbulence – Down Slope Winds

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



21 Dec 2008 -0118 UTC
Boeing 737-500

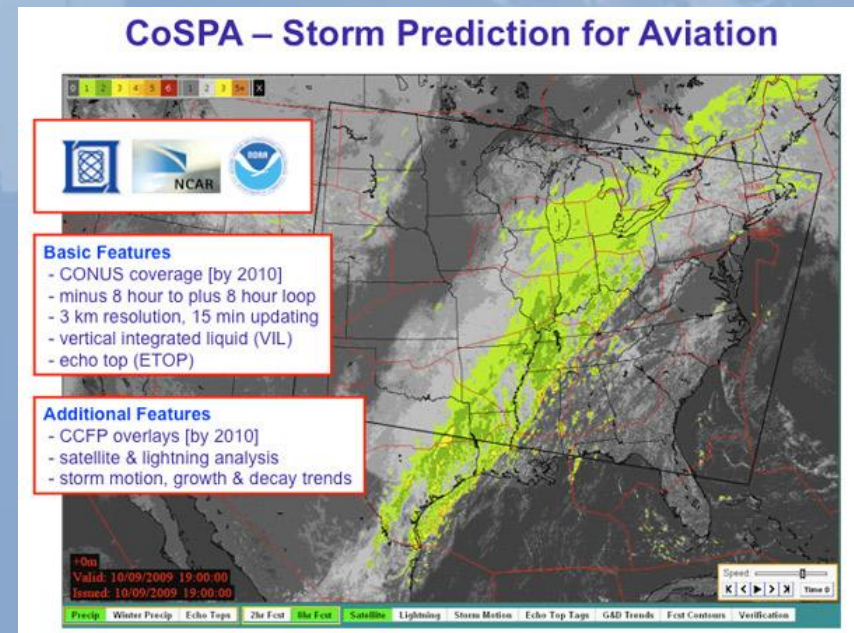


Thunderstorm Prediction for Aviation

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.

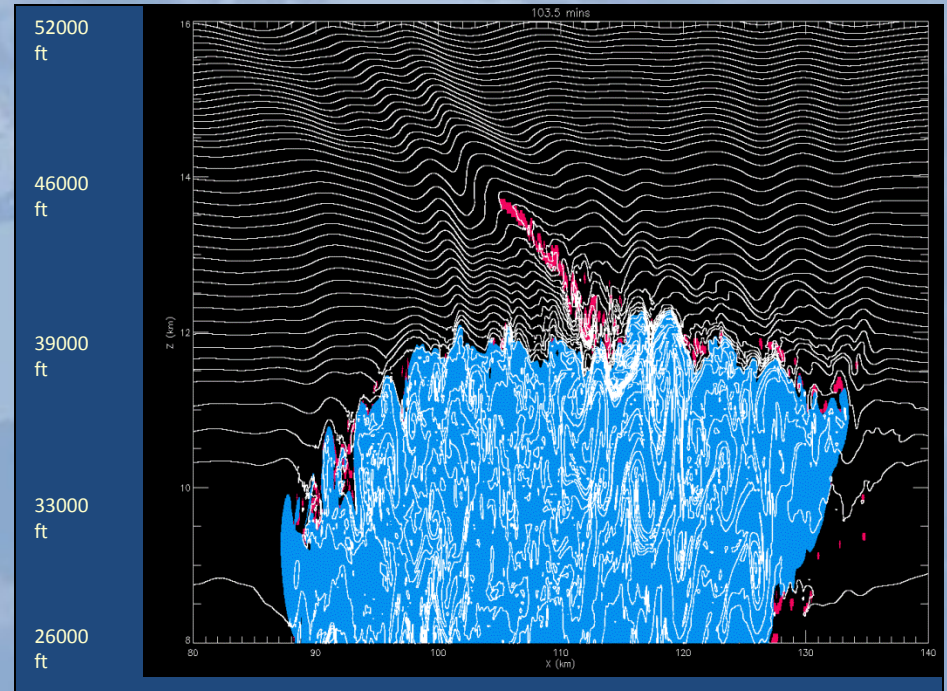


Photo: Tim Rotz, Northwest Airlines

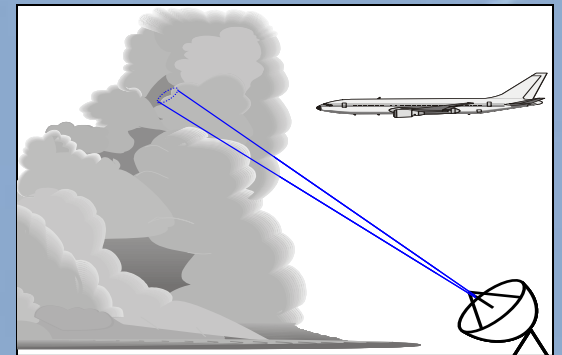


Thunderstorm Induced Turbulence

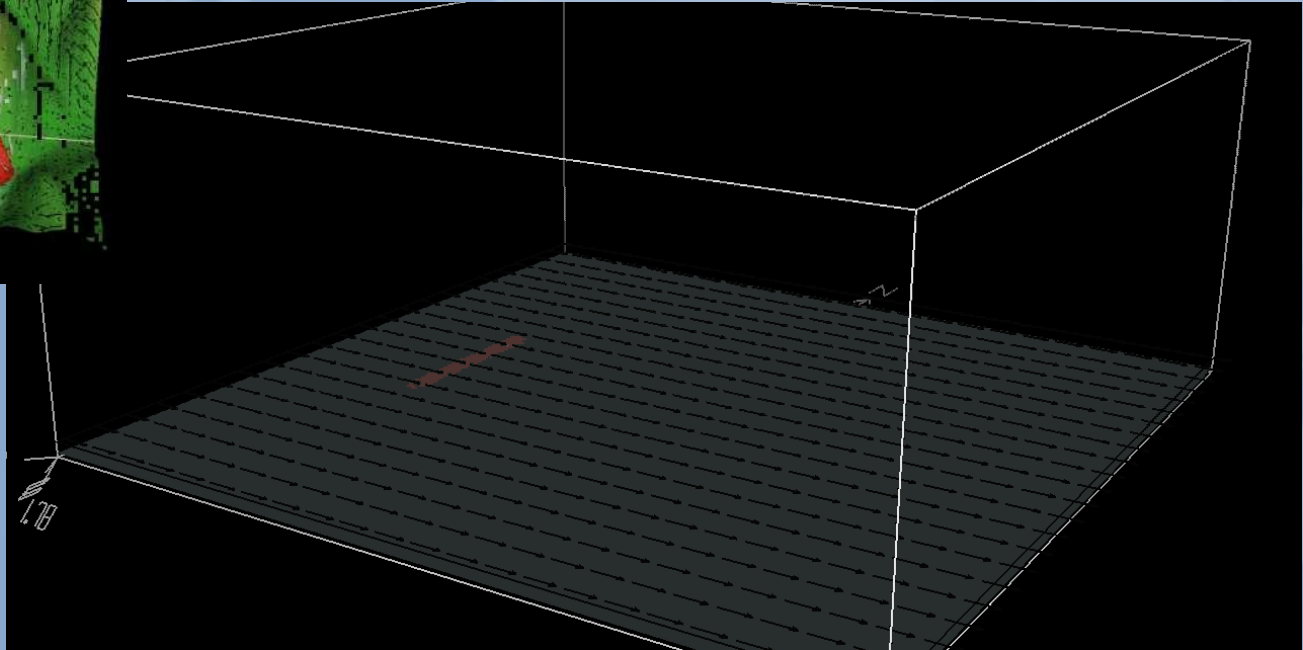
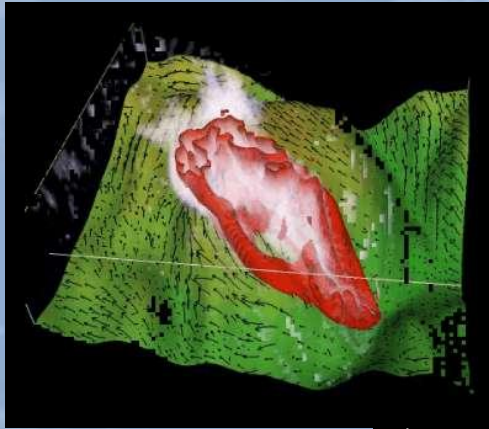
Strong vertical air motions associated with thunderstorms can cause severe turbulence. NCAR has developed a national storm related turbulence product for the FAA and aviators.



United Airlines Turbulence Incident
21 July 2010



Fire Behavior Modeling



Fire Behavior Animation

Courtesy – Janice Coen

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

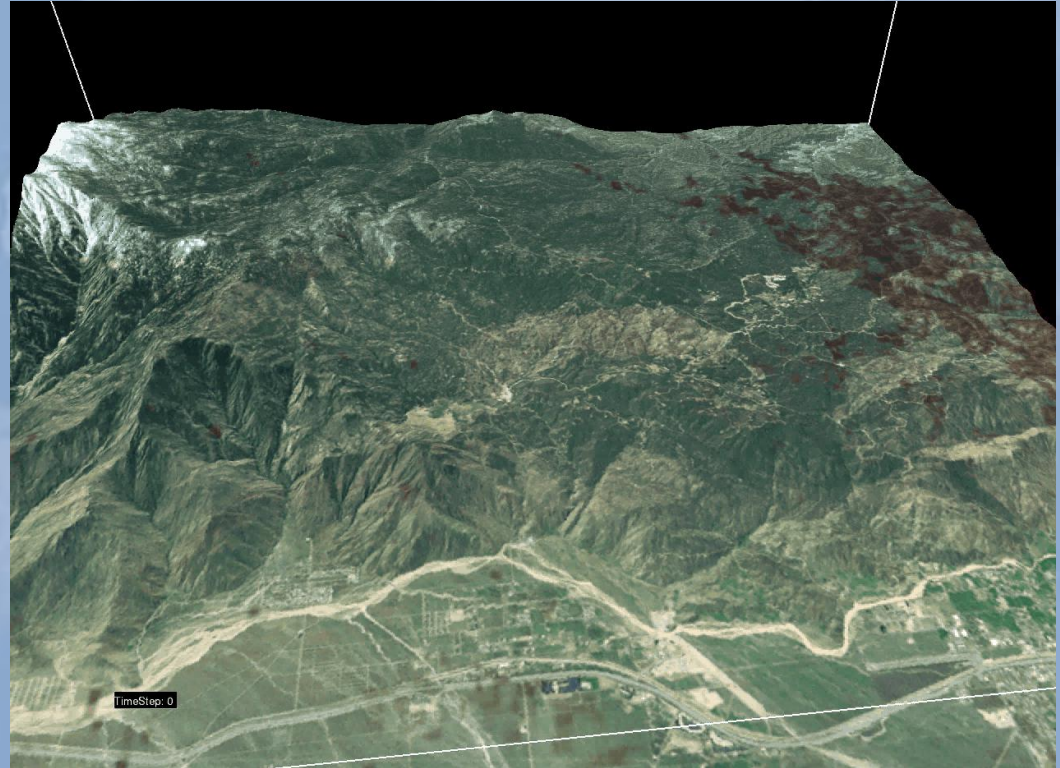


NCAR

Fire Behavior Modeling

Espiranza Fire, CA

Simulation of fire
Line behavior



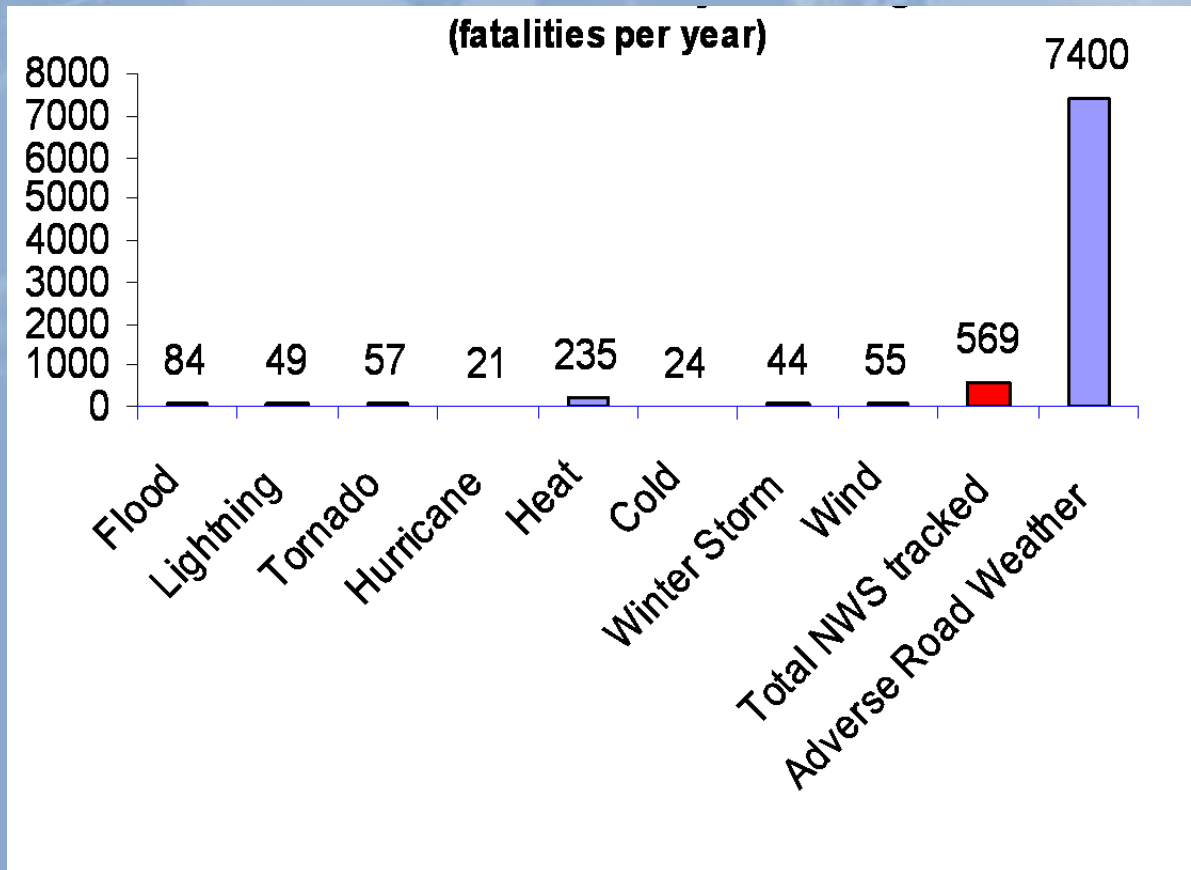
Fire Line Animation

Courtesy – Janice Coen



NCAR

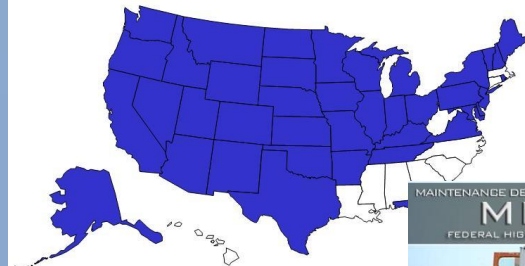
Road Weather



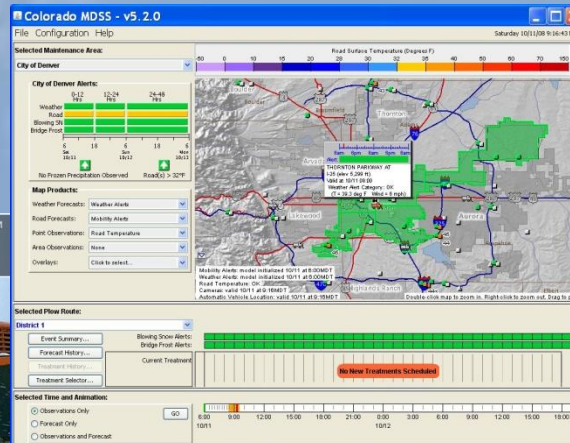
Road Weather Snow & Ice Control Decision Support

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

State DOT Participation in
Maintenance Decision Support System (MDSS)
2000 - 2007



MAINTENANCE DECISION SUPPORT SYSTEM
MDSS
FEDERAL HIGHWAY ADMINISTRATION



Fighting snow and ice with technology

Knowing when to treat the roads before a snowstorm used to be partly guesswork — sometimes a radio forecast or even an achy joint. But this winter the Colorado Department of Transportation is using a new system that rivals battlefield technology. The key to the Maintenance Decision Support System is a computer program that sorts through weather forecasts, radar and temperature readings and combines that information with real-time observations from snowplow drivers and maintenance shops. Ultimately, that leads to one plan of attack.

Key pieces of system

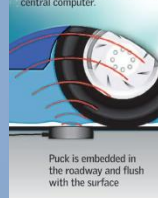


Weather information

Weather stations: Hundreds of sites across the state send readings for temperature, wind, dew point, hourly precipitation and snowfall to a central computer. That and satellite information is combined with 15 forecasts. Once real-time information from snowplow drivers is added, the most accurate weather prediction is selected. Selected roads: The MDSS was successfully tested in the Greeley area last year. It has expanded this year, but because of limited equipment, it is designated for highways that often see difficult weather conditions.

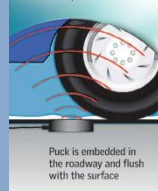
High-tech trucks

Snowplows are equipped with infrared sensors that determine the temperature of the road. They also have onboard computers linked to the central computer, and a touch-screen control panel records plowing and treatment information.



Road surfaces

Weather stations alongside roadways are connected to "pucks" embedded in the road surface. Their sensors tell if roads are wet or frozen and how much chemical has been applied. All information is sent to the central computer.



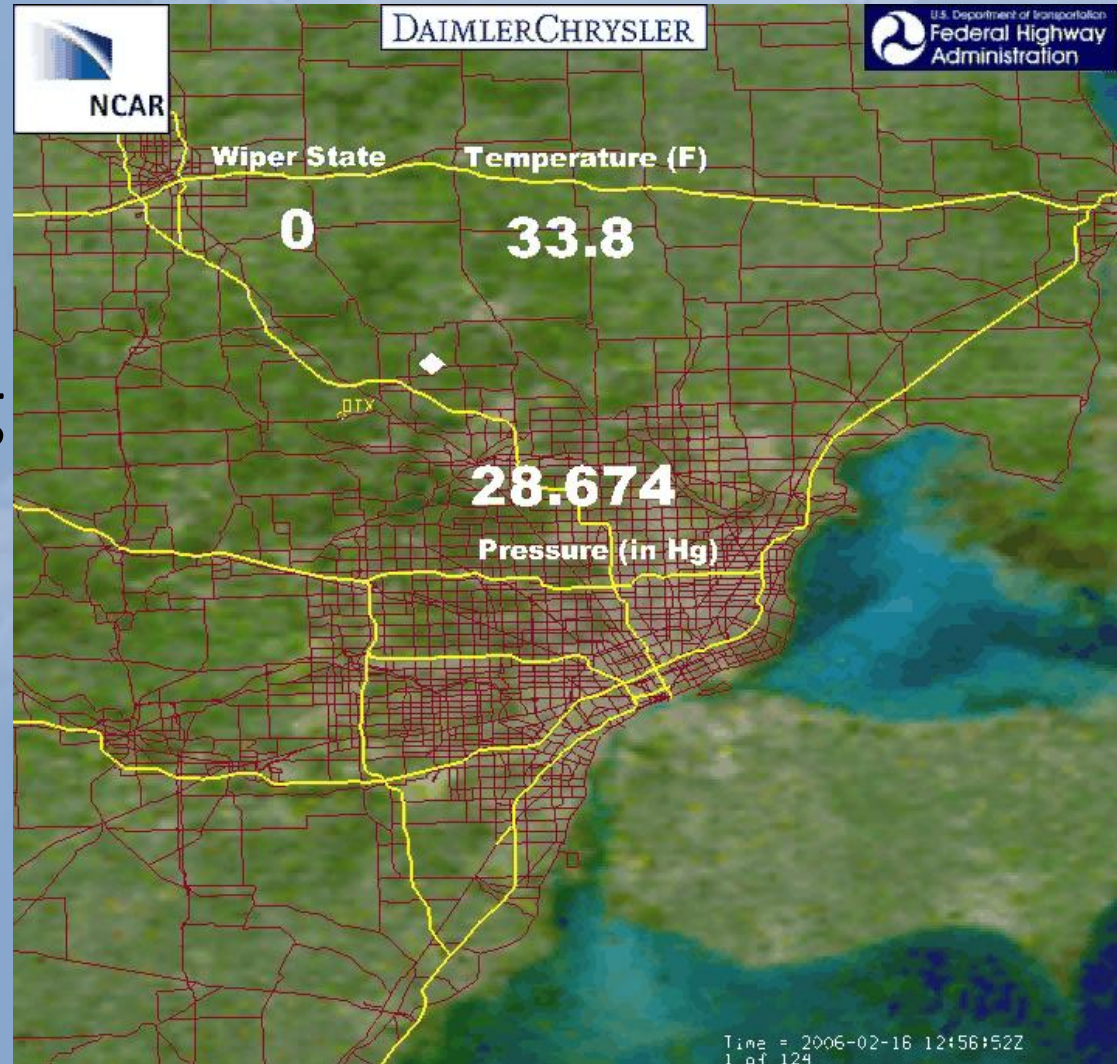
Melting snow and ice

Before a storm hits, many highway department trucks can spray anti-icer across three lanes. After snow and ice have built up, de-icer is directed over one lane in a more powerful stream to the pavement below. Snowplows carry about 1,600 gallons of anti-icer/de-icer.

Source: Roy Smith and Alan Martinez, Colorado Department of Transportation | Jon Moreno, Joe Watt and Jeff Goertzen | The Denver Post

Road Weather IntelliDriveSM Program

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



Road Weather IntelliDriveSM Program

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

Road/Weather
Hazard
Information

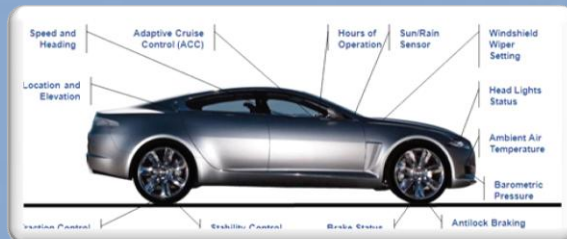


REINVENTING TODAY'S FORECAST.

The new Lexus RX now adds weather prediction to its many talents. Its available XM IntelliDriveSM is an advanced warning system with detailed maps and continuous forecasts, enabling you to detect and take weather-changing conditions. And since weather is the only obstacle you'll face, the RX offers real-time XM IntelliDriveSM to help keep you informed of conditions on major roads, and intelligent alertness to help you handle them. By making you a more prepared driver, the RX is reinventing the way you drive.

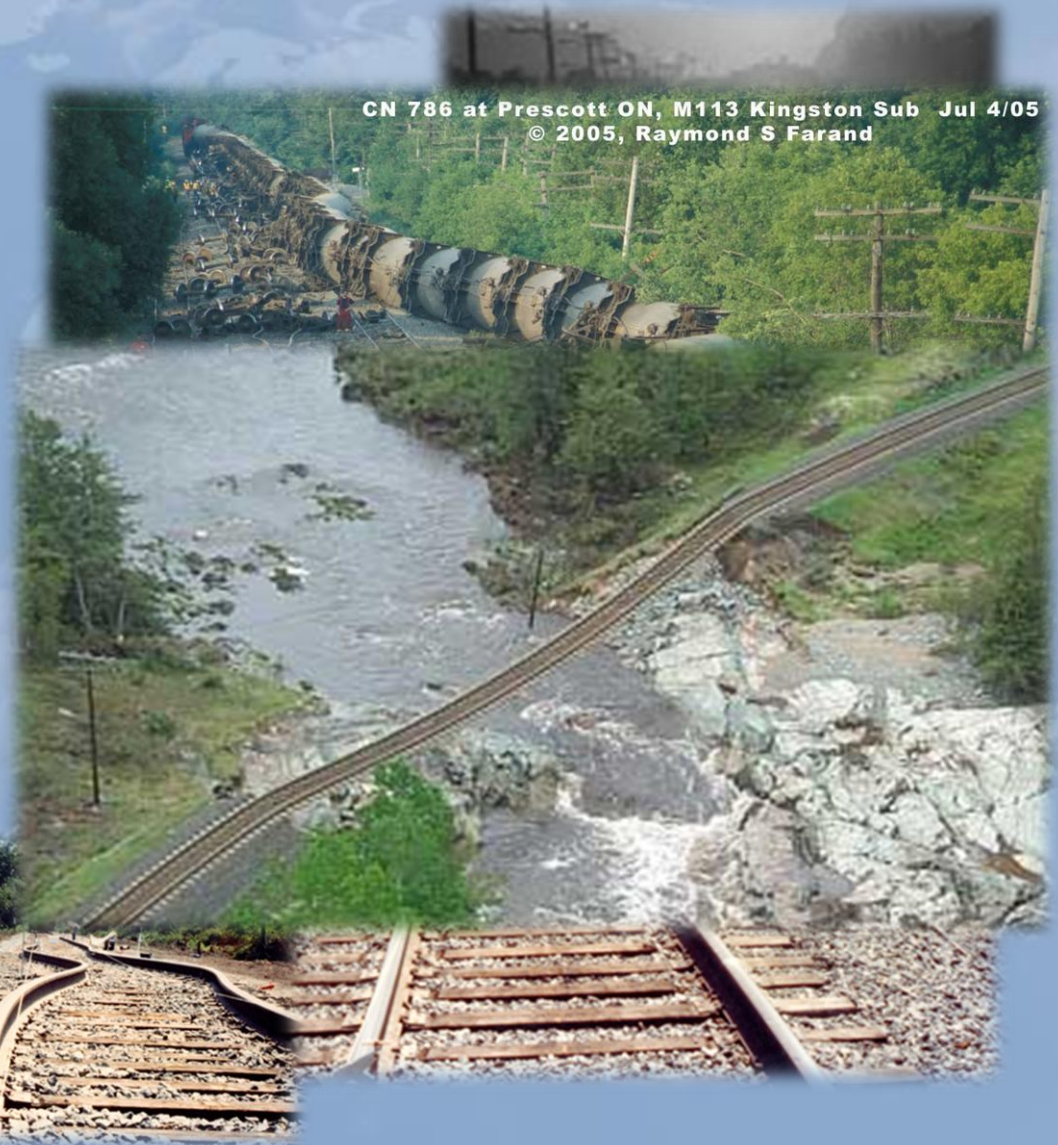
REINVENTING THE VEHICLE THAT INVENTED IT ALL.

((XMI))
Intelligence & Innovation



Rail Road Weather

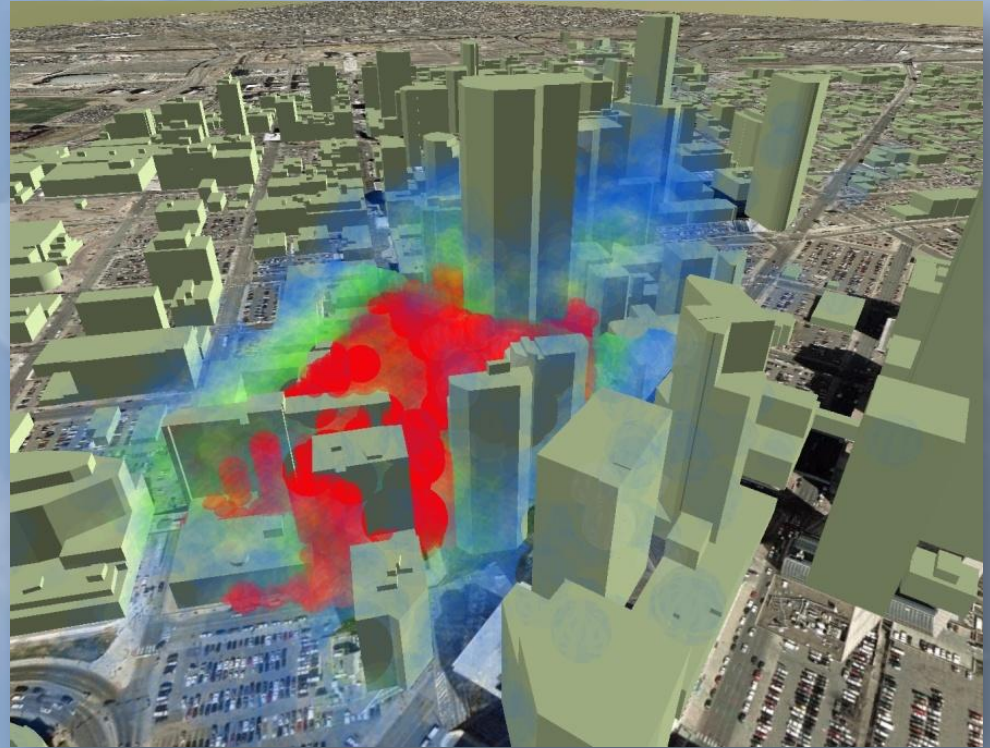
NCAR is working with railroads to identify weather related hazards and ways to improve safety and operations.



CN 786 at Prescott ON, M113 Kingston Sub Jul 4/05
© 2005, Raymond S Farand

Homeland Security

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



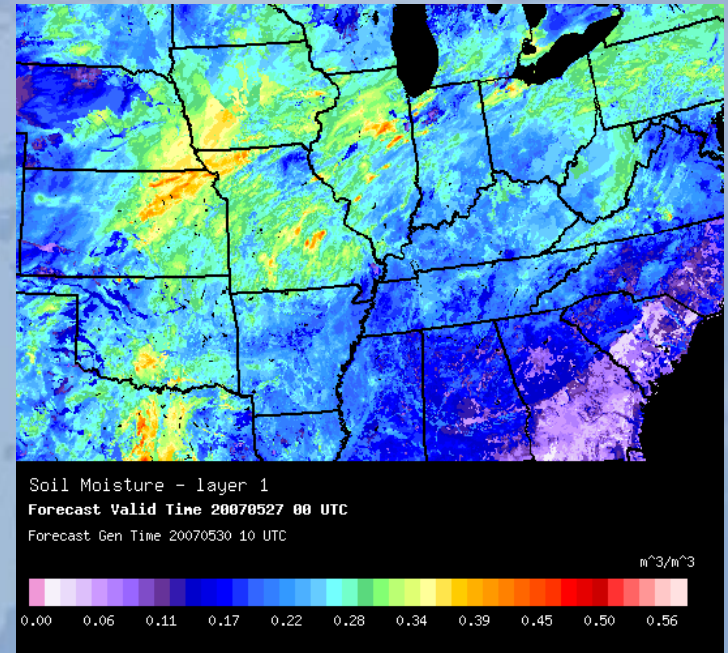
Simulation

Pentagon City – Washington D.C. Region

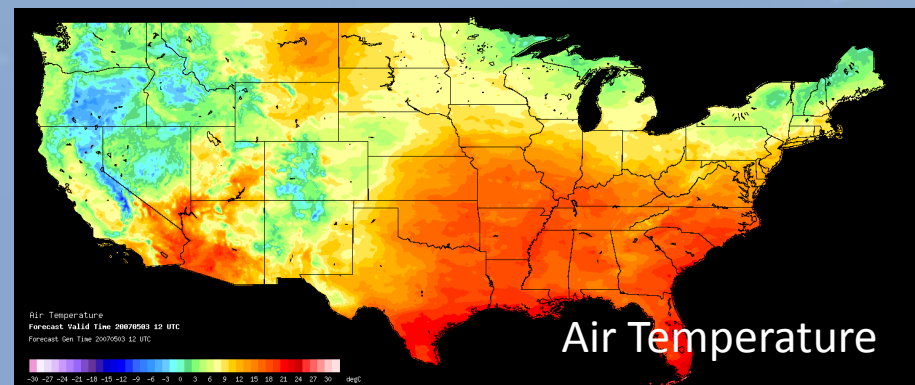


Advanced Forecasting Systems

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

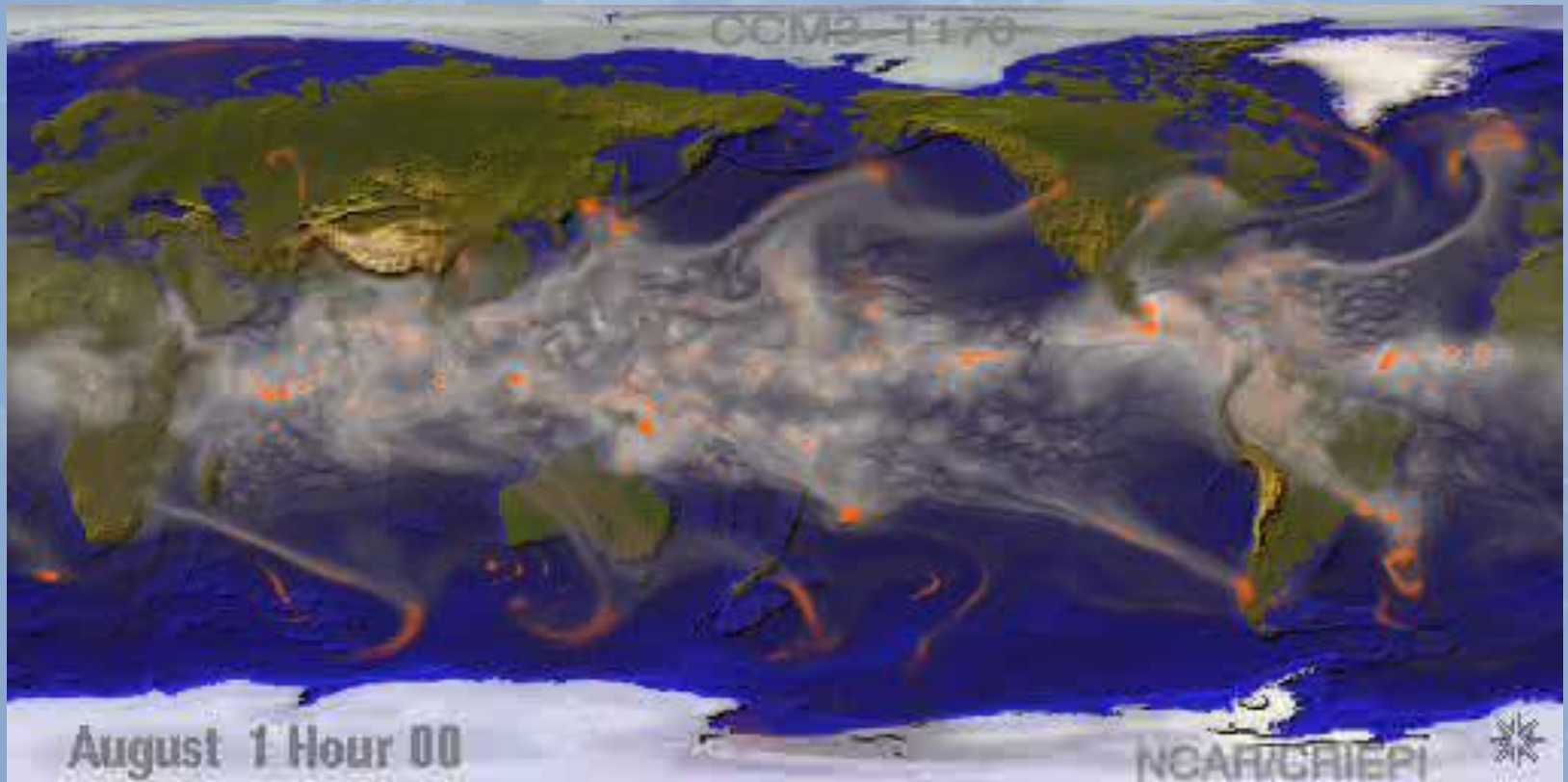


Soil Moisture



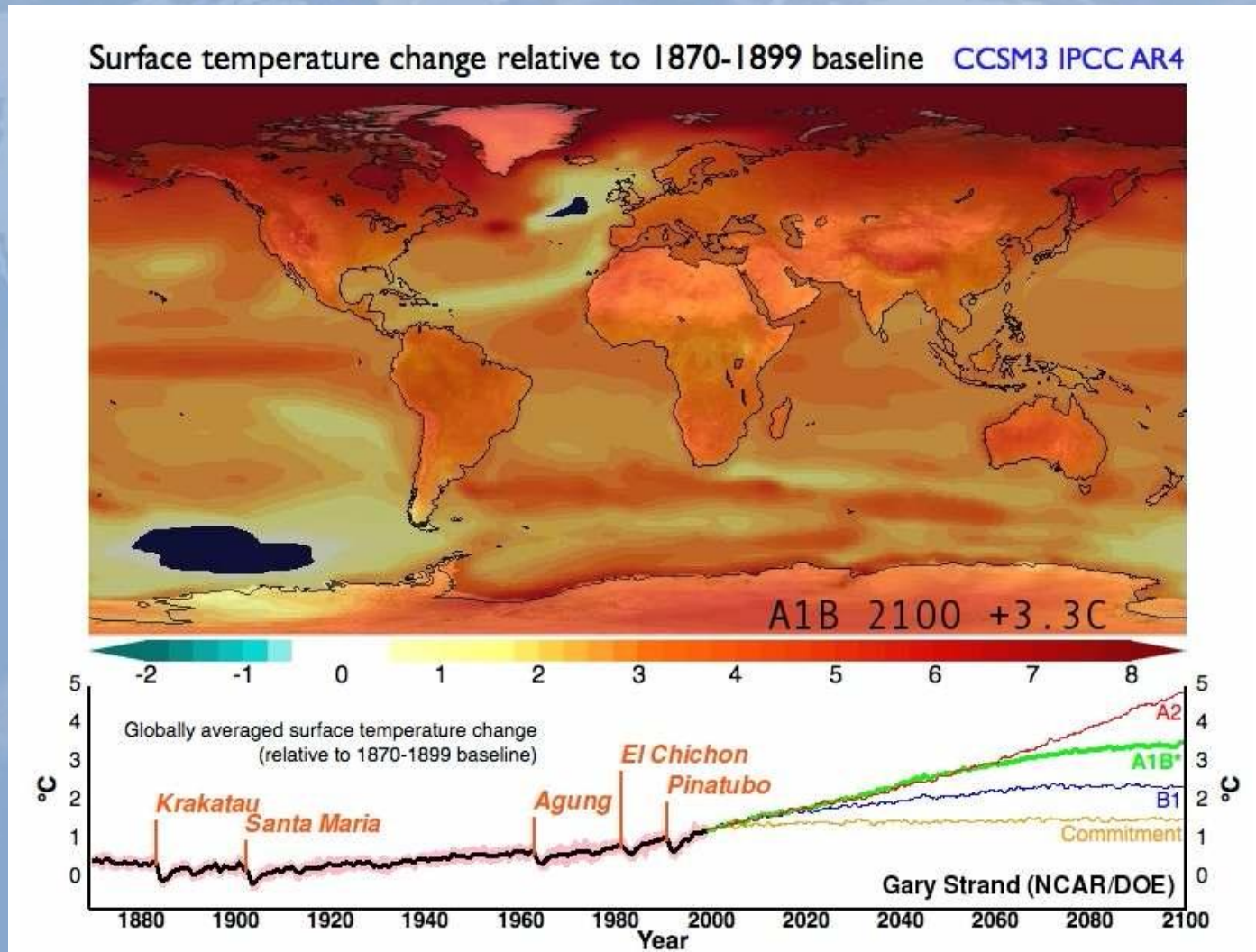
Air Temperature

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.

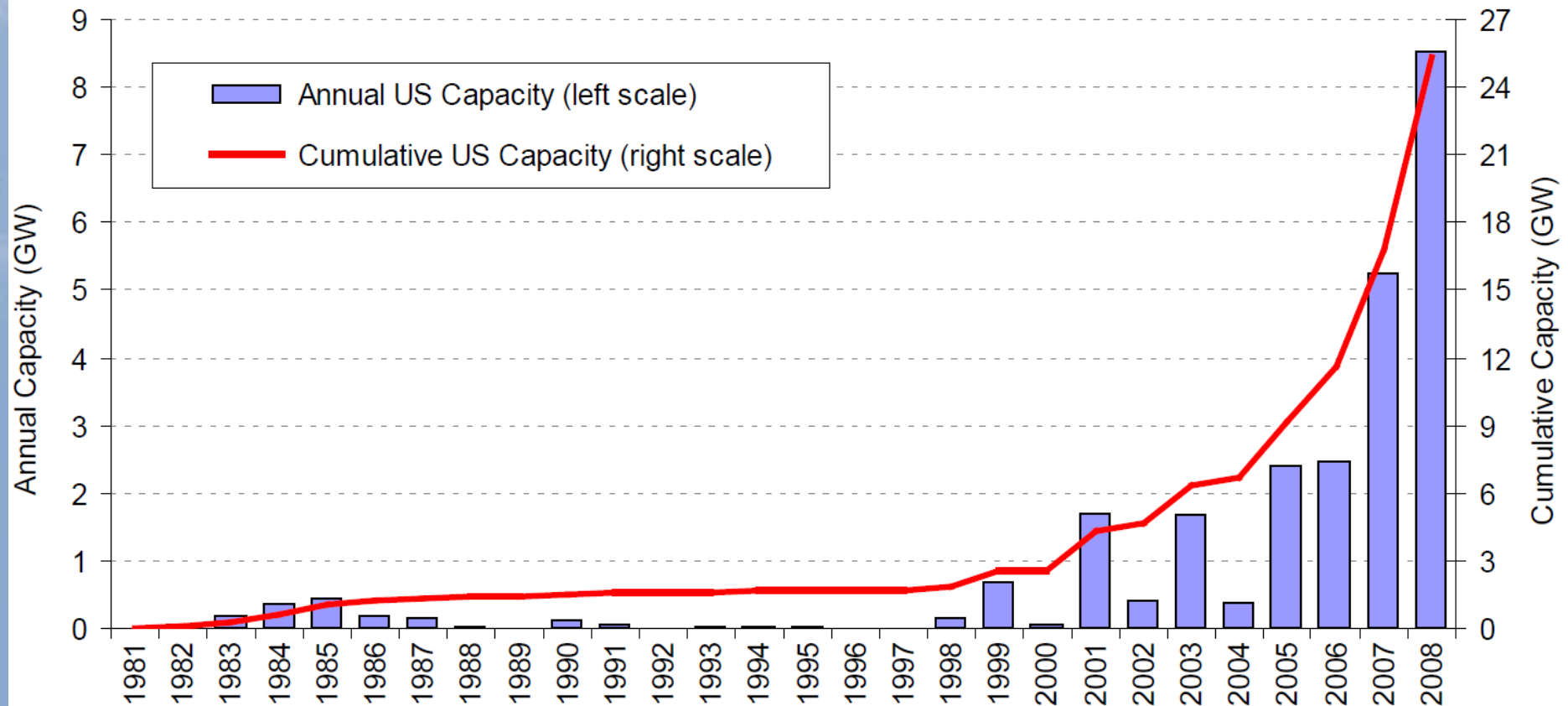
Climate Modeling – Global Temperature



Source NCAR CCMS3

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

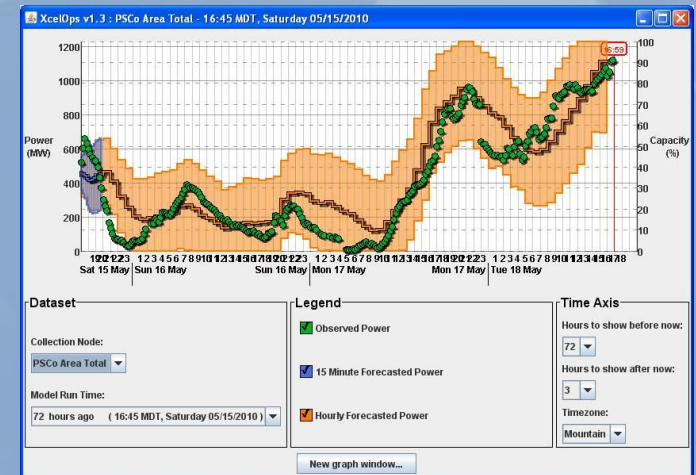
Wind Energy Prediction

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



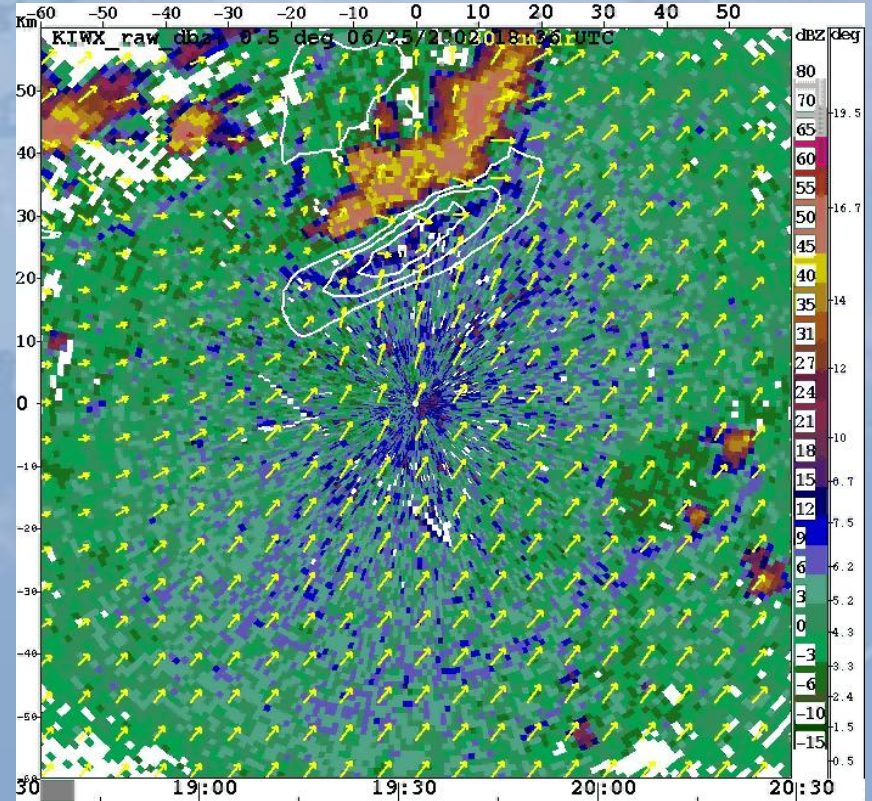
Photo by Bob Henson (UCAR)



Wind energy prediction system display

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

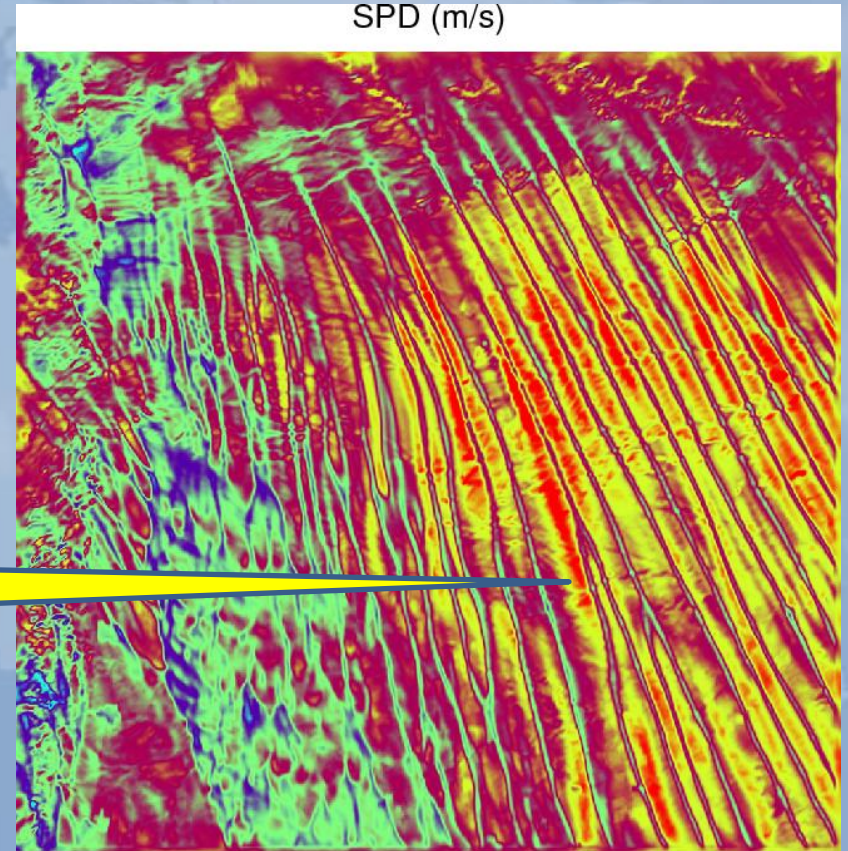


Wind Energy Prediction

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

**Wind Farm
Location**

Wind vary greatly across a single wind farm.



Wind Speed Variability

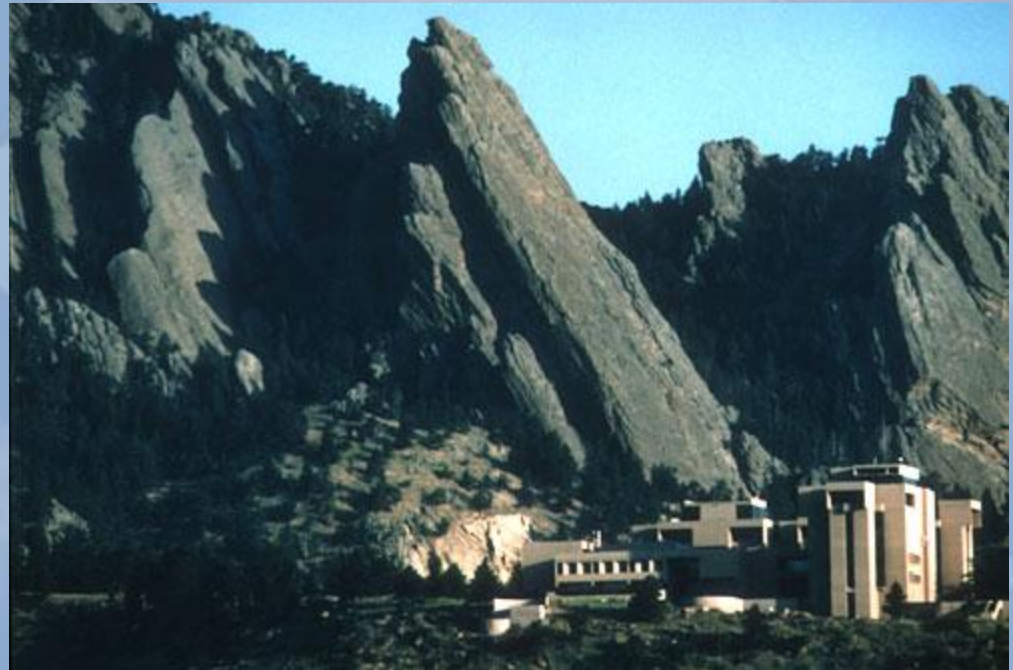
Northern Colorado Wind Farm



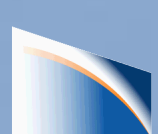
In Closing



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"



National Center for Atmospheric Research (NCAR)
Boulder, Colorado



NCAR



THANK YOU