THORPEX

THORPEX

A GLOBAL ATMOSPHERIC RESEARCH PROGRAMME

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NCAR/EOL/MMM
Co-chair, North American Regional Committee
US Lead

A photographic collage depicting the societal, economic and ecological impacts of severe weather associated with four Rossby wave-trains that encircled the globe during November 2002.

WMO
OMM

What is THORPEX?

THORPEX: **a Global Atmospheric Research Programme** is an international research programme to accelerate improvements in the accuracy of 1 to 14-day high-impact weather forecasts for the benefit of society, the environment and the economy. THORPEX seeks to enhance international collaboration between the research and operational-forecasting communities and with users of forecast products.

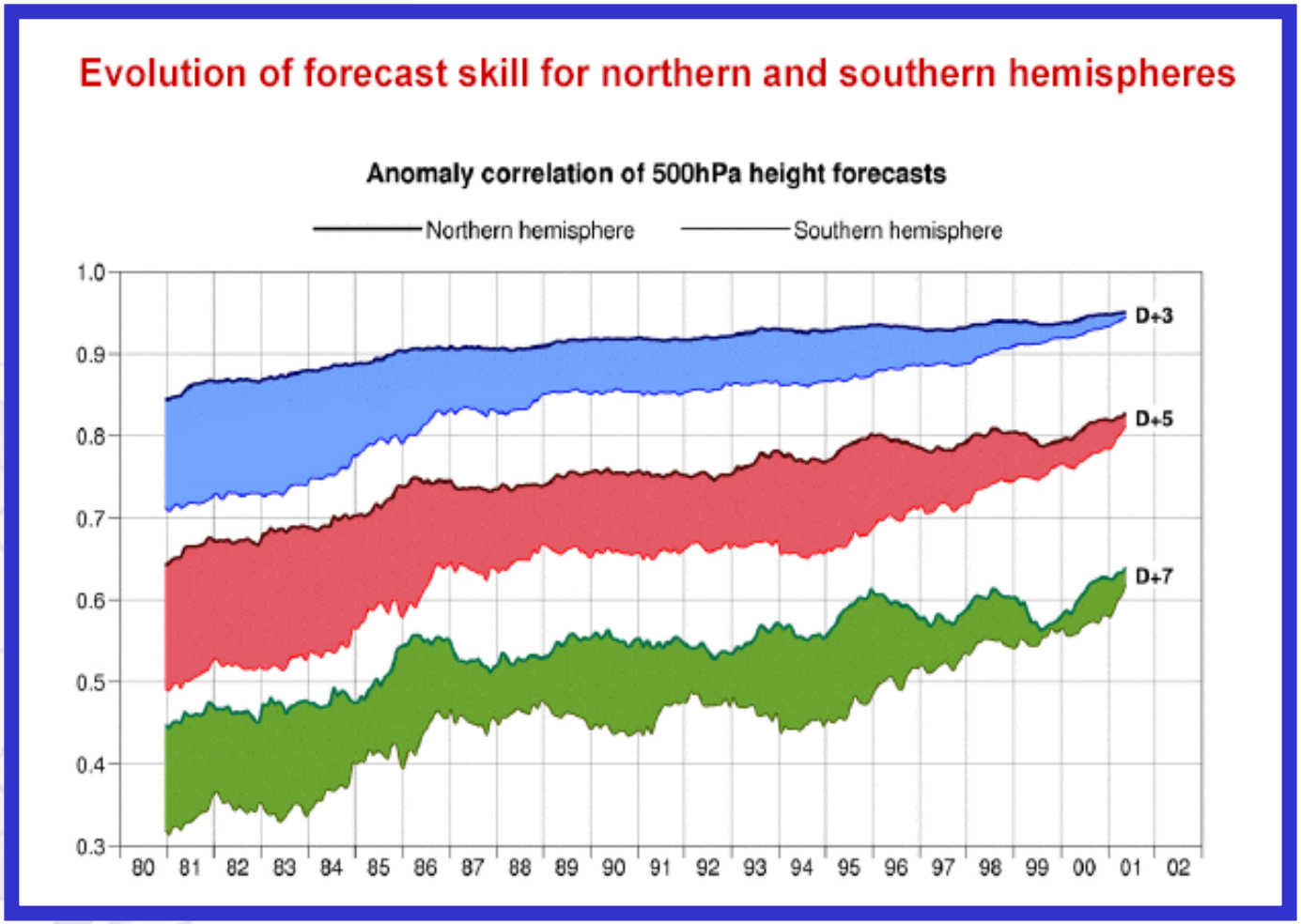
THORPEX is coordinated within the World Meteorological Organization and approved by the ~180 nations of the WMO Congress. Sixteen countries (Australia, Canada, China, France, Germany, Japan, Iceland, India, Korea, Morocco, Norway, Russia, South Africa, Spain, UK, US) and the European Commission are leading the THORPEX effort. Participation includes developing (the 54 countries of African for example) and developed world. Thirty countries were represented at the 1st Intl Science Symposium.

The THORPEX web site is http://www.wmo.int/thorpex

The THORPEX implementation phase begins 1 January 2005.

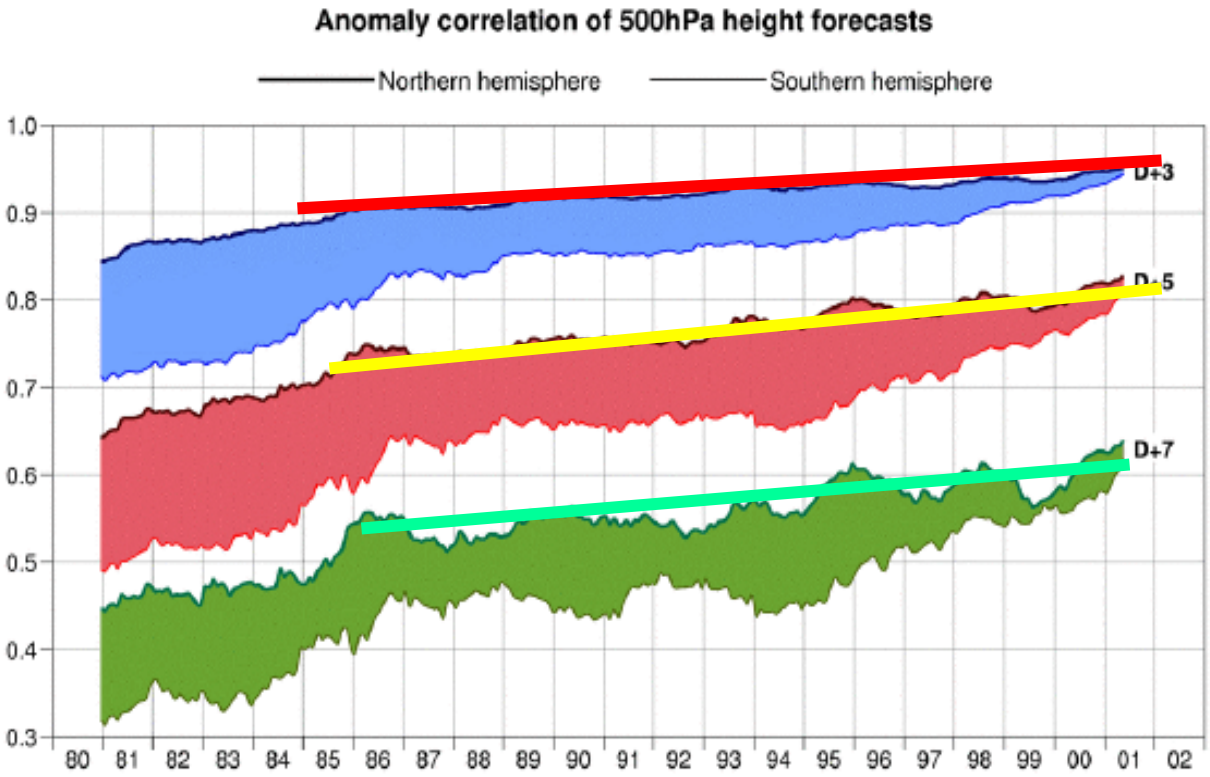
Four Interrelated and Coordinated THORPEX Sub-programmes

- *Observing Systems*
- *Observing Strategies and Data Assimilation*
- *Predictability and Dynamical Processes*
- *Societal and Economic Impacts*.
- *Combine efforts to work on grand challenges*
- *Science plan available at http://www.wmo.int/thorpex (led by Mel Shapiro and Alan Thorpe)*



Evolution of forecast skill for the northern and southern hemispheres: 1980-2001. Anomaly correlation coefficients of 3, 5, and 7-day ECMWF 500-mb height forecasts for the extratropical northern and southern hemispheres, plotted in the form of running means for the period of January 1980-August 2001. Shading shows differences in scores between hemispheres at the forecast ranges indicated (from Holingsworth, et al. 2002).

Evolution of forecast skill for northern and southern hemispheres



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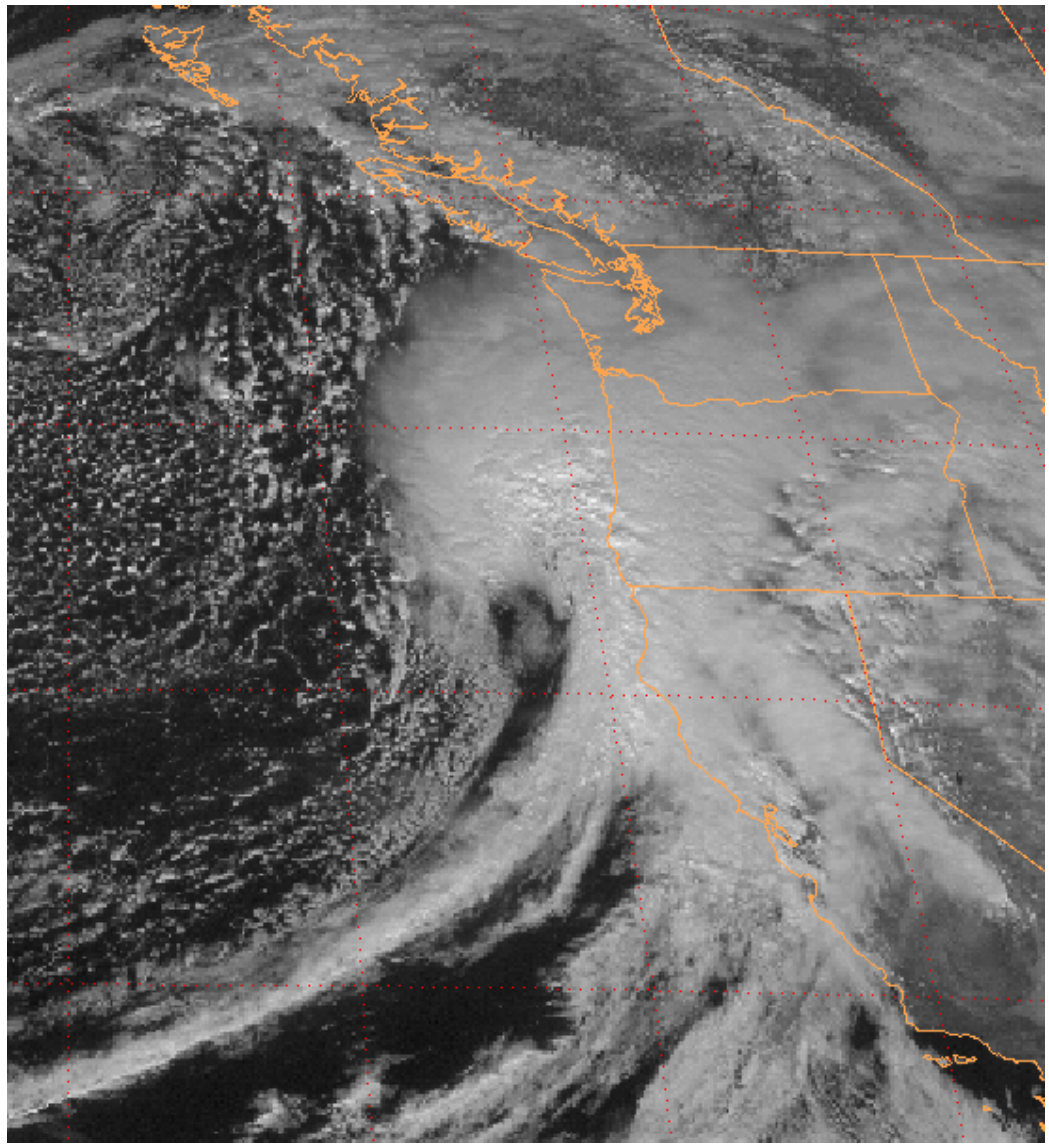
February 7, 2002

- On the morning of 7 February 2002 an intense low center moved into the central Oregon coast, with absolutely no warnings by the National Weather Service.
- Produced strong winds with gusts exceeding 70 mph
- NW slides from Cliff Mass (UW)



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The result: massive tree falls and damage

The Register-Guard

STORMY WEATHER

Winds land sneak punch

Surprise storm packing 70 mph gusts downs trees, damages property

Three men freed after tree flattens their pickup truck

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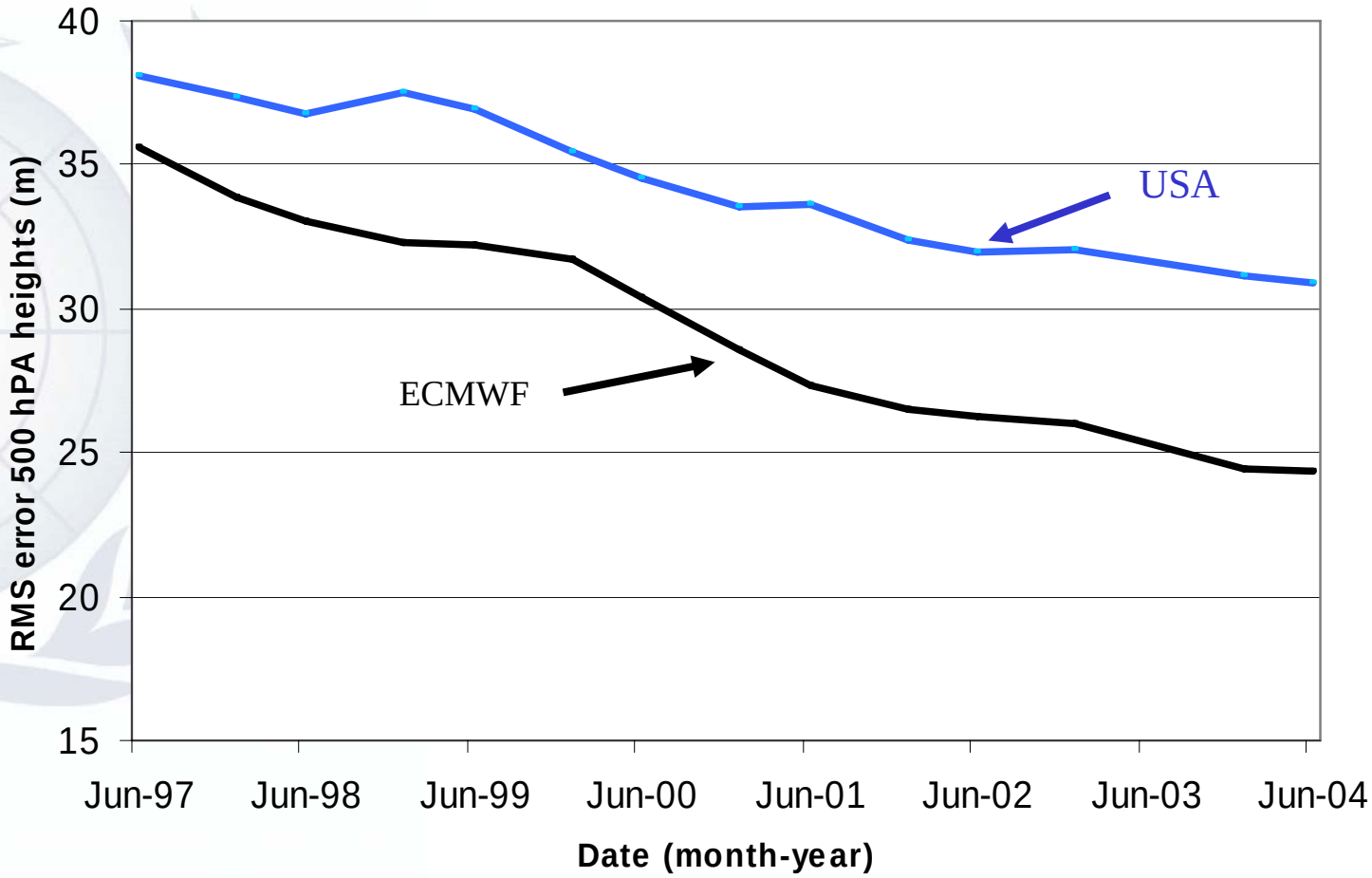
Verification of 72 h Forecast vs. Analyses for the Northern Hemisphere

12 Month Running Mean



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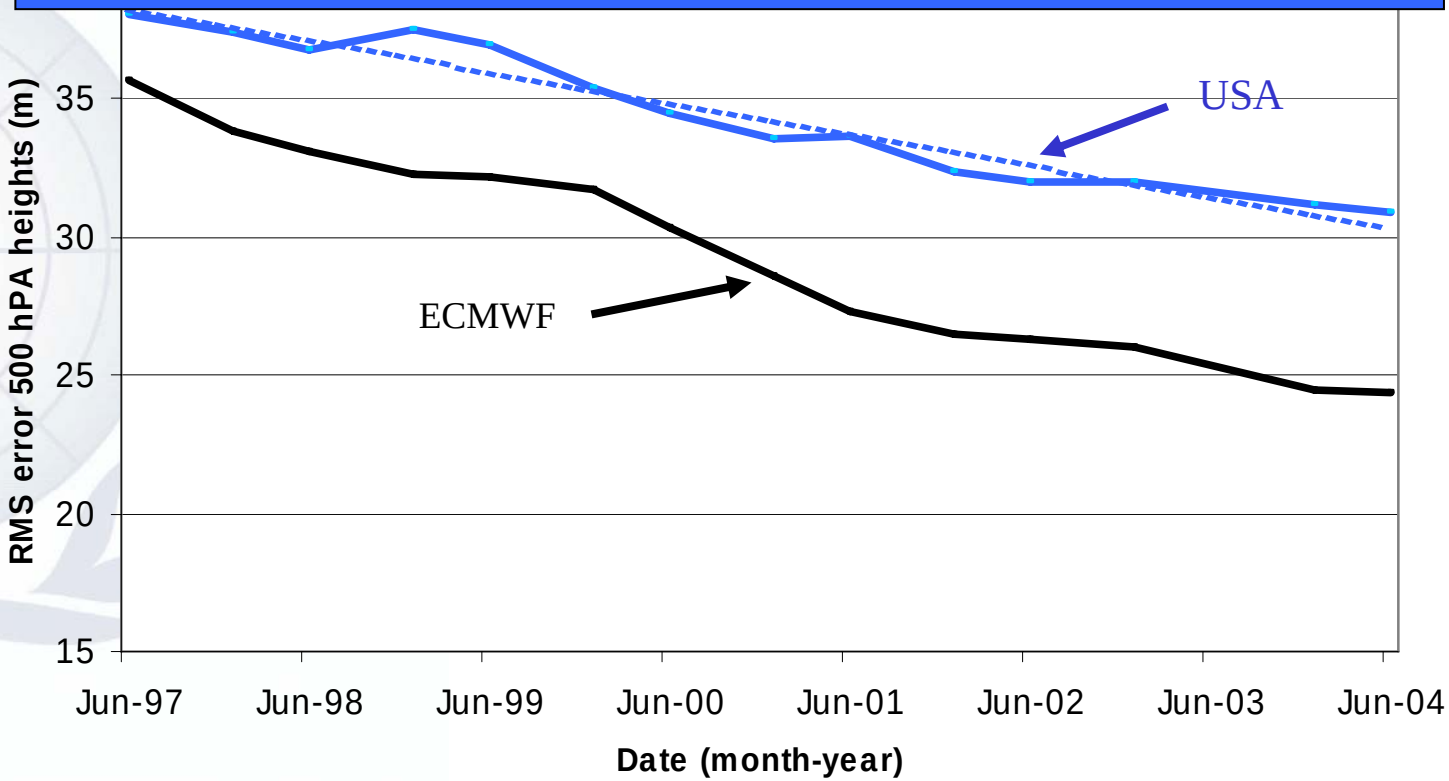
Verification of 72 h Forecast vs. Analyses for the Northern Hemisphere

12 Month Running Mean

If ECMWF freezes their system it will take ~5.5 years for the US to reach this level of skill at 72 h!!



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Weather Impacts in the US

~1/4 of the US economy is sensitive to weather – Dutton (2002) growing in the age of the global economy and increasing populations

"An estimated 70% of all businesses are impacted by some form of weather risk – earnings volatility" (*AON, 2001)*.

Improvements in forecast skill will be cost effective for the NWP time-scale. Estimates of savings range up to $300 billion (NOAA/OAR briefing materials).

57 billion dollar weather-related disasters between years 1980 and 2003. Seven occurred during 1998 alone and the 48 during the 1988-2003 period totaled unadjusted damages/costs of nearly $215 billion.

In a typical year, between 300 and 400 people in the US die each from hazardous weather (peak years ~1000-10,000)

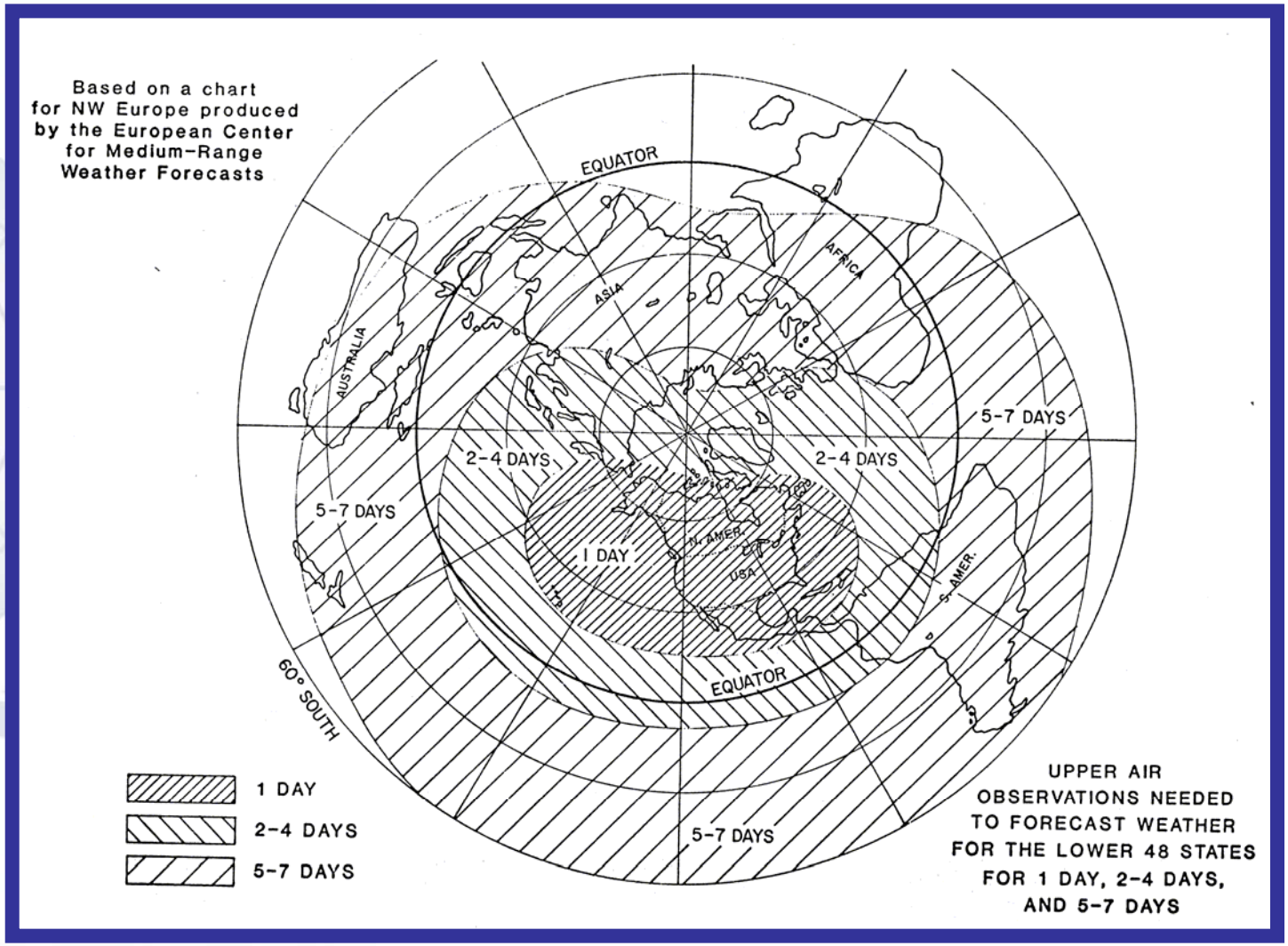
In an average year, the US spends ~$18 billion on weather damage

In response, the US has the world's best system for short-term weather warning. However, improvements on the NWP time-scale will help improve our response to hazardous weather by planning for high-impact weather rather than simply reacting.

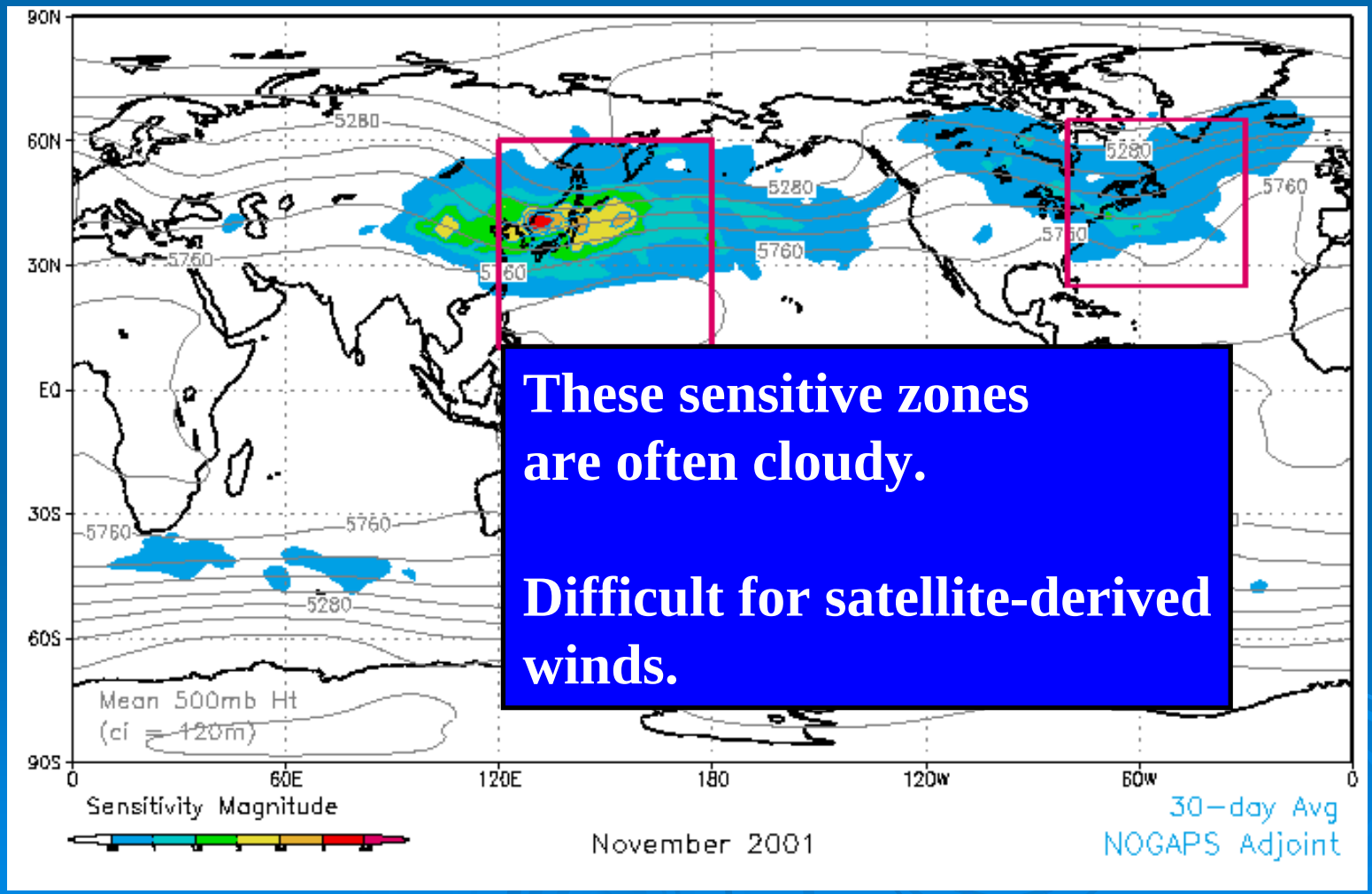
A Proposal from THORPEX

- We propose that one of the major priority areas for THORPEX is a Pacific Regional Field Campaign
  - Goals include examining dynamical processes and predictability, the sources of forecast uncertainty and strategies for forecast improvement (1 to 5 day forecasts)
  - Build upon the work done by this NW weather group
  - Not just researchers, but also include the forecaster, international NWP centers and user communities
  - Propose that it take place during the International Polar Year (Jan – March 2007 and/or Jan – March 2008) allowing investigations of the impacts of both Arctic and Pacific circulations
  - Complementary regional modeling efforts over Arctic (Canadian effort), NW, (and Alaska or elsewhere?)

Observational Requirements for US Weather

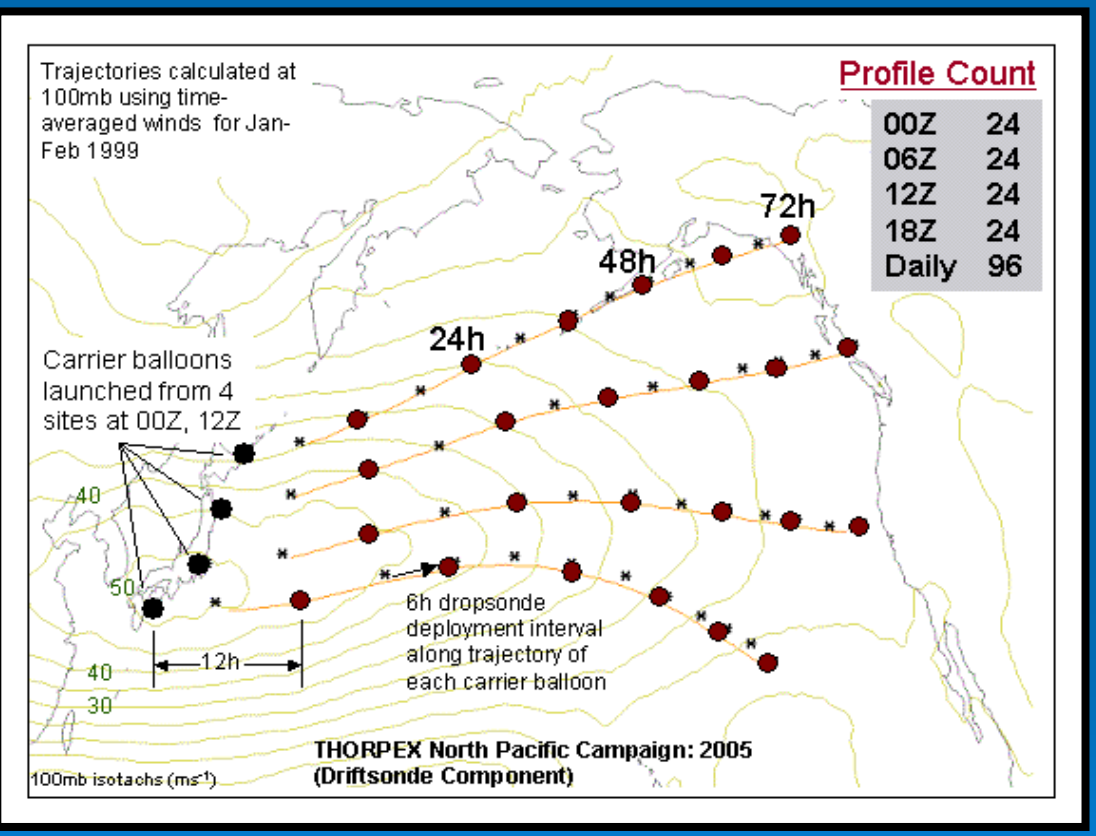


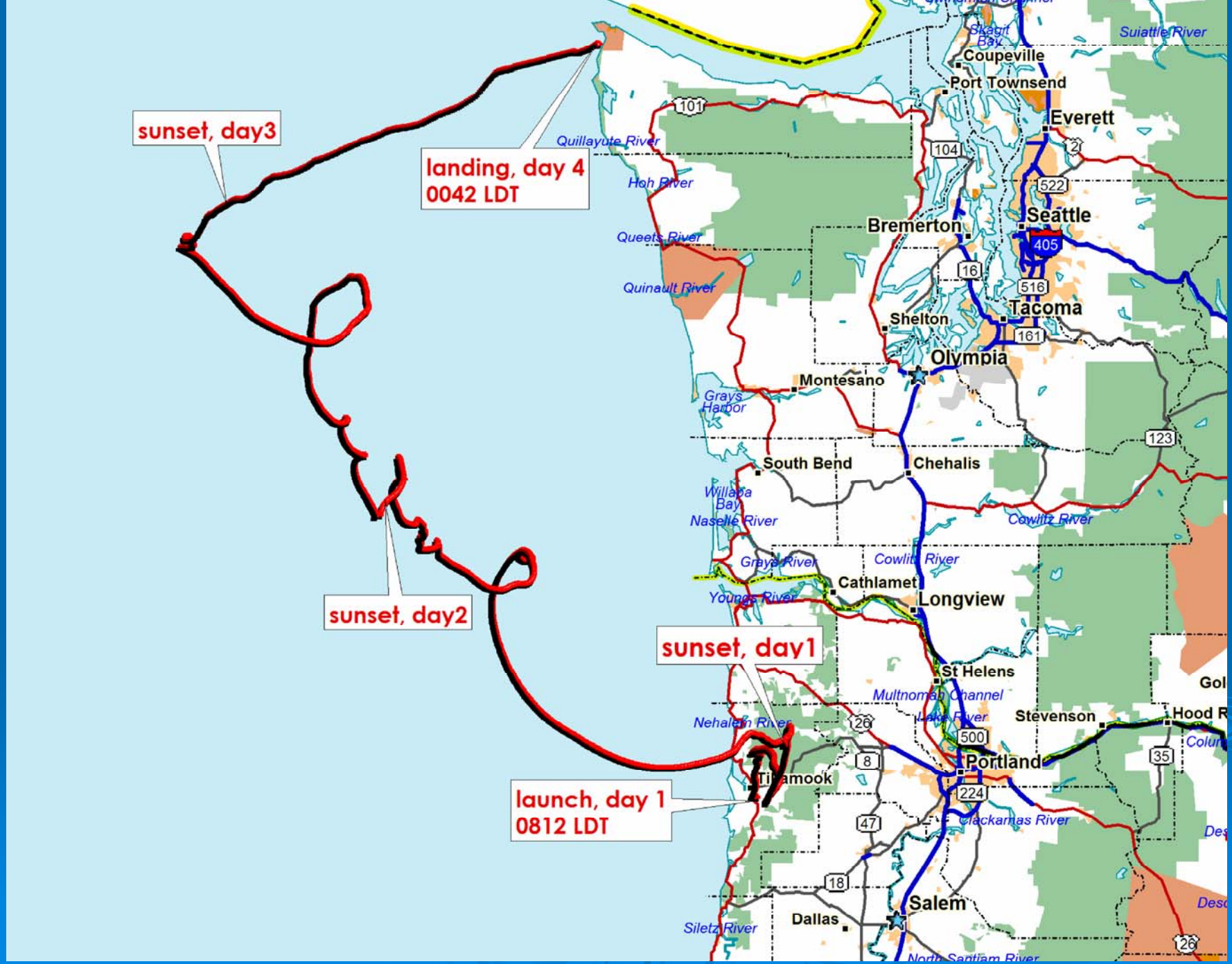
Prediction of global sensitive regions for November 2001



Courtesy of Shapiro and Thorpe

In-Situ Sensing Advances Driftsonde




sunset, day3
landing, day 4
0042 LDT
sunset, day2
sunset, day1
launch, day 1
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Port Townsend
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Bremerton
Tacoma
Shelton
Olympia
Montesano
South Bend
Chehalis
Cathlamet
Longview
St Helens
Stevenson
Portland
Tillamook
Salem
Dallas
Quillayute River
Hoh River
Queets River
Quinault River
Grays Harbor
Willapa Bay
Naselle River
Grays River
Cowlitz River
Nehalem River
Multnomah Channel
Lake River
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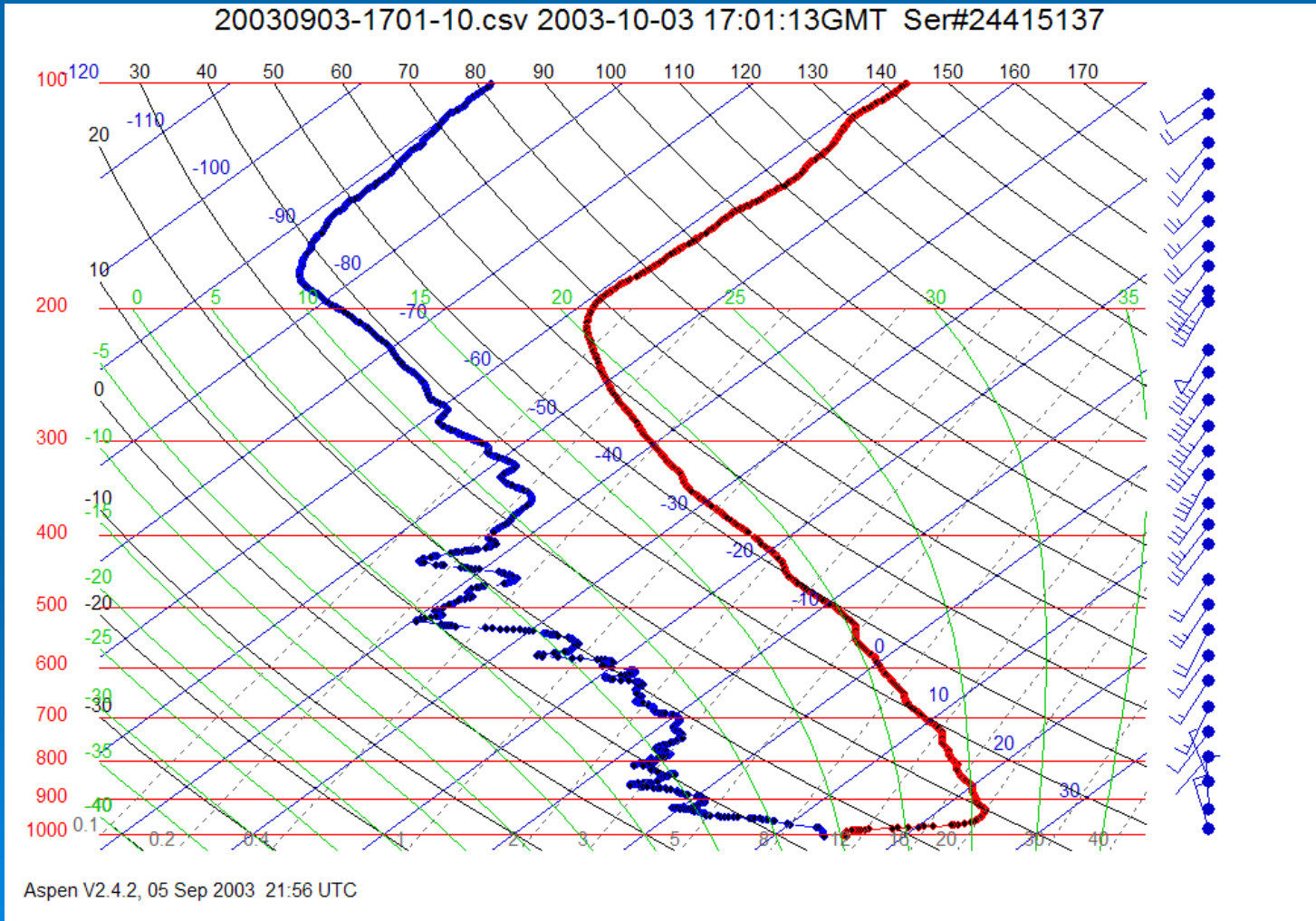
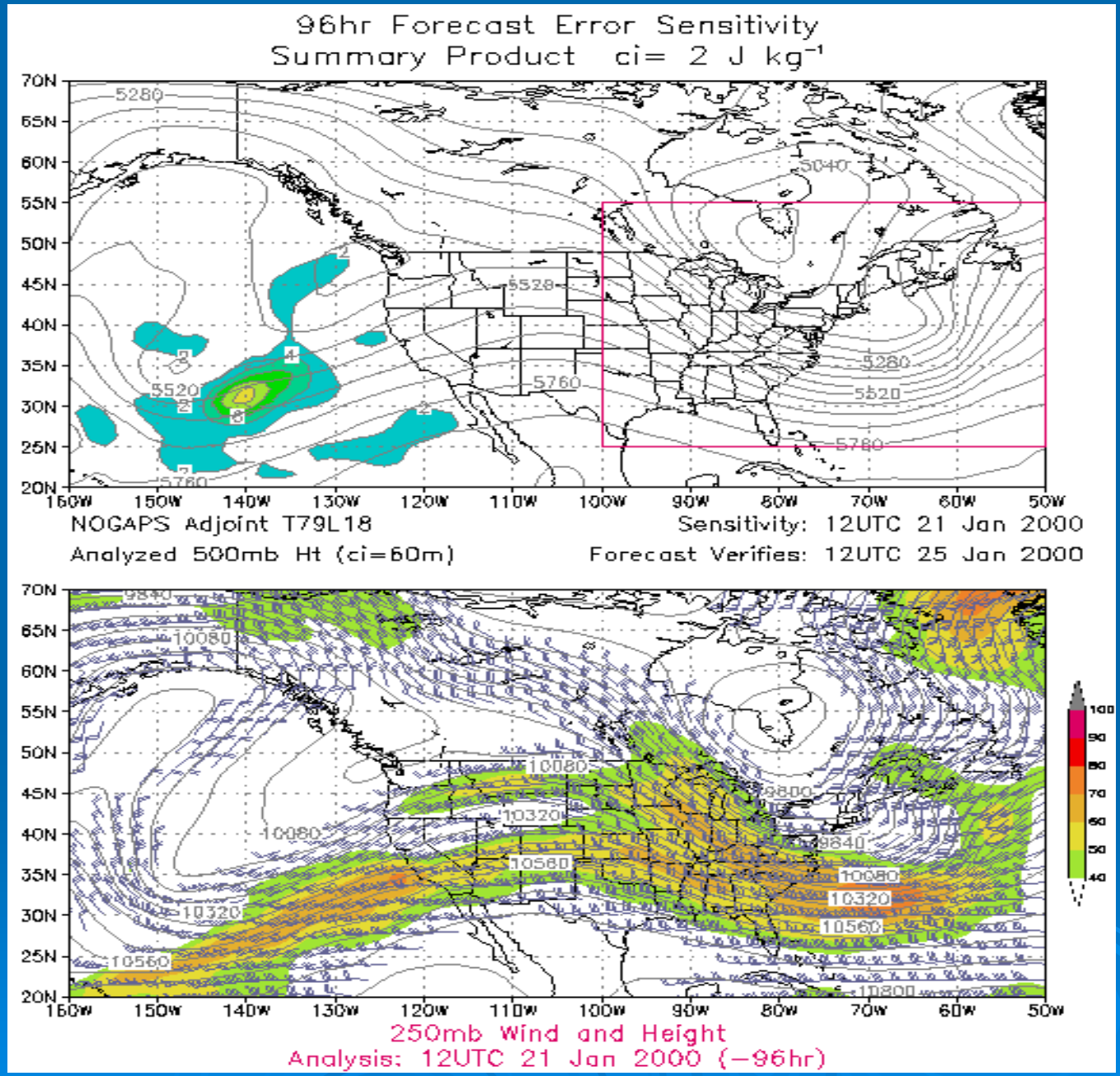
Driftsonde Deployed Dropsonde



Targeted sensitivity

Washington snowstorm



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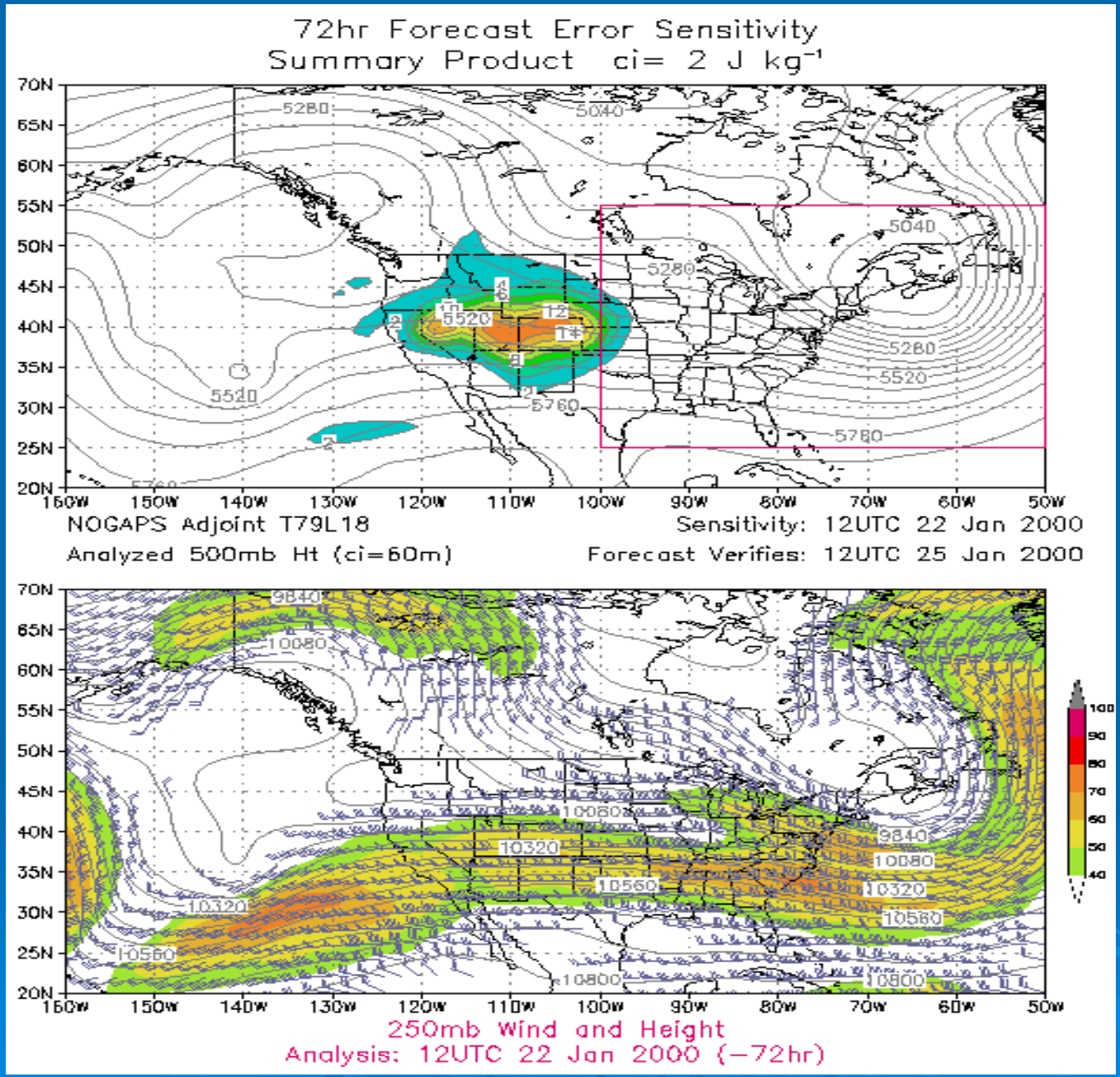

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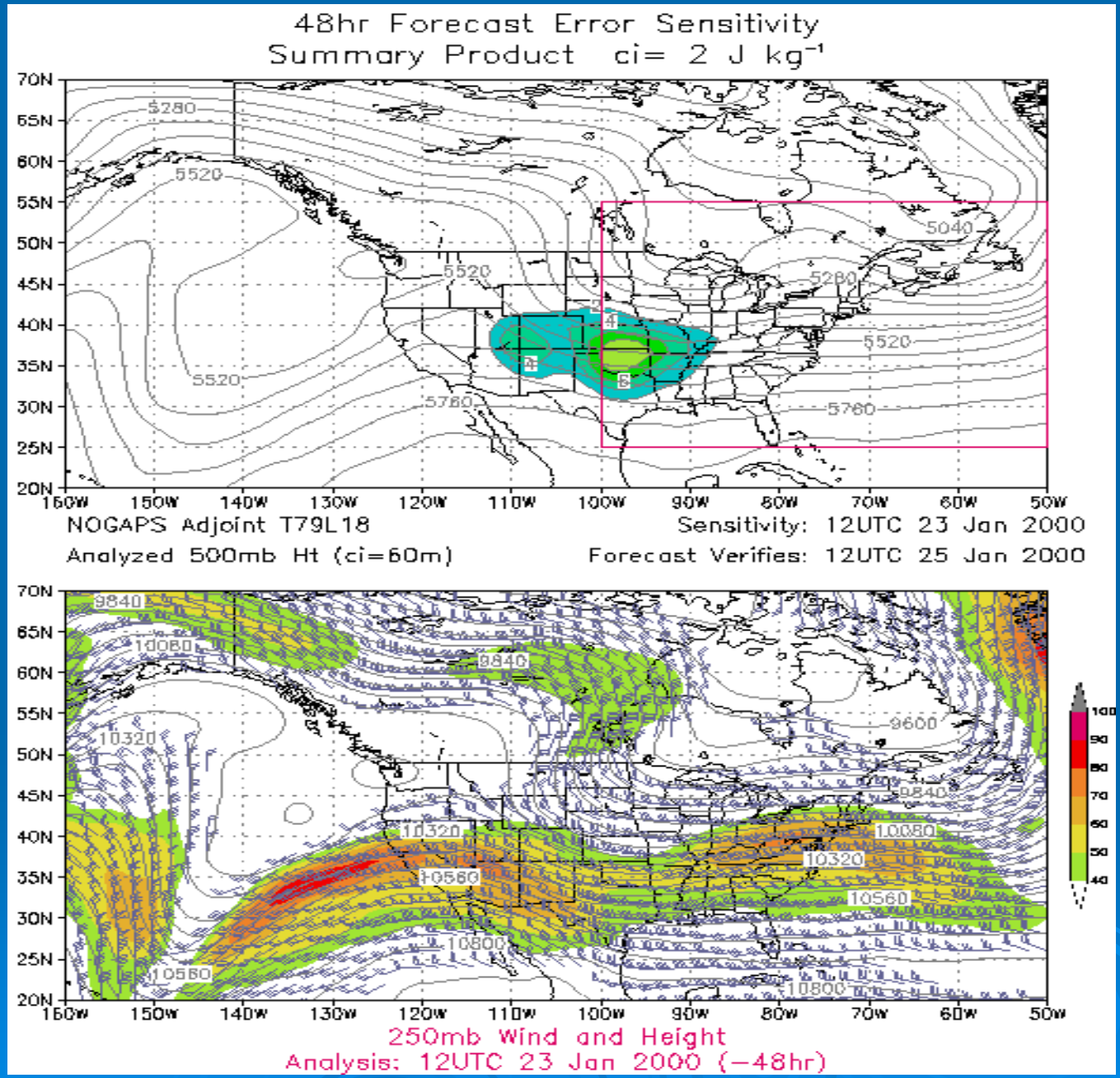

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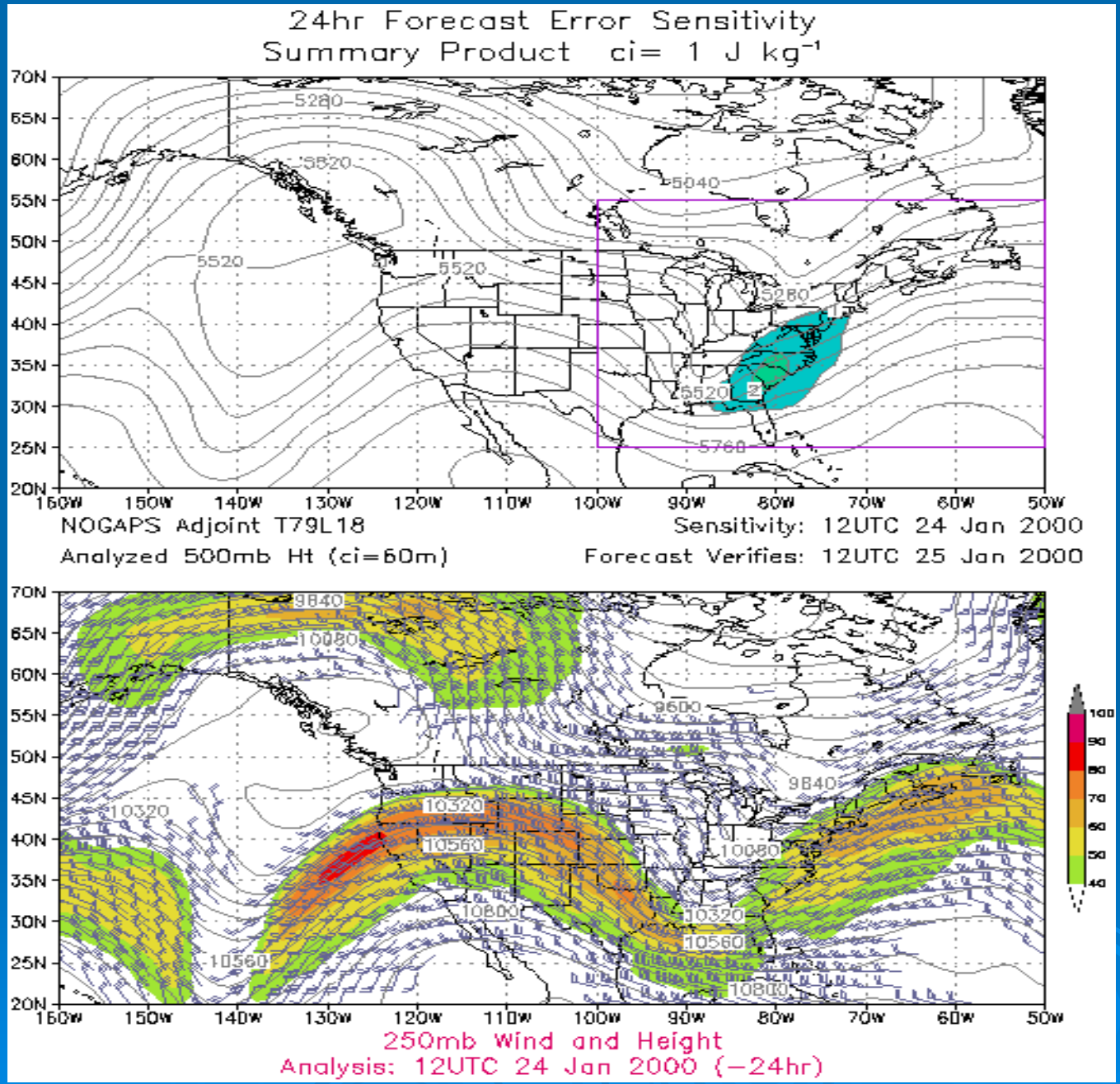
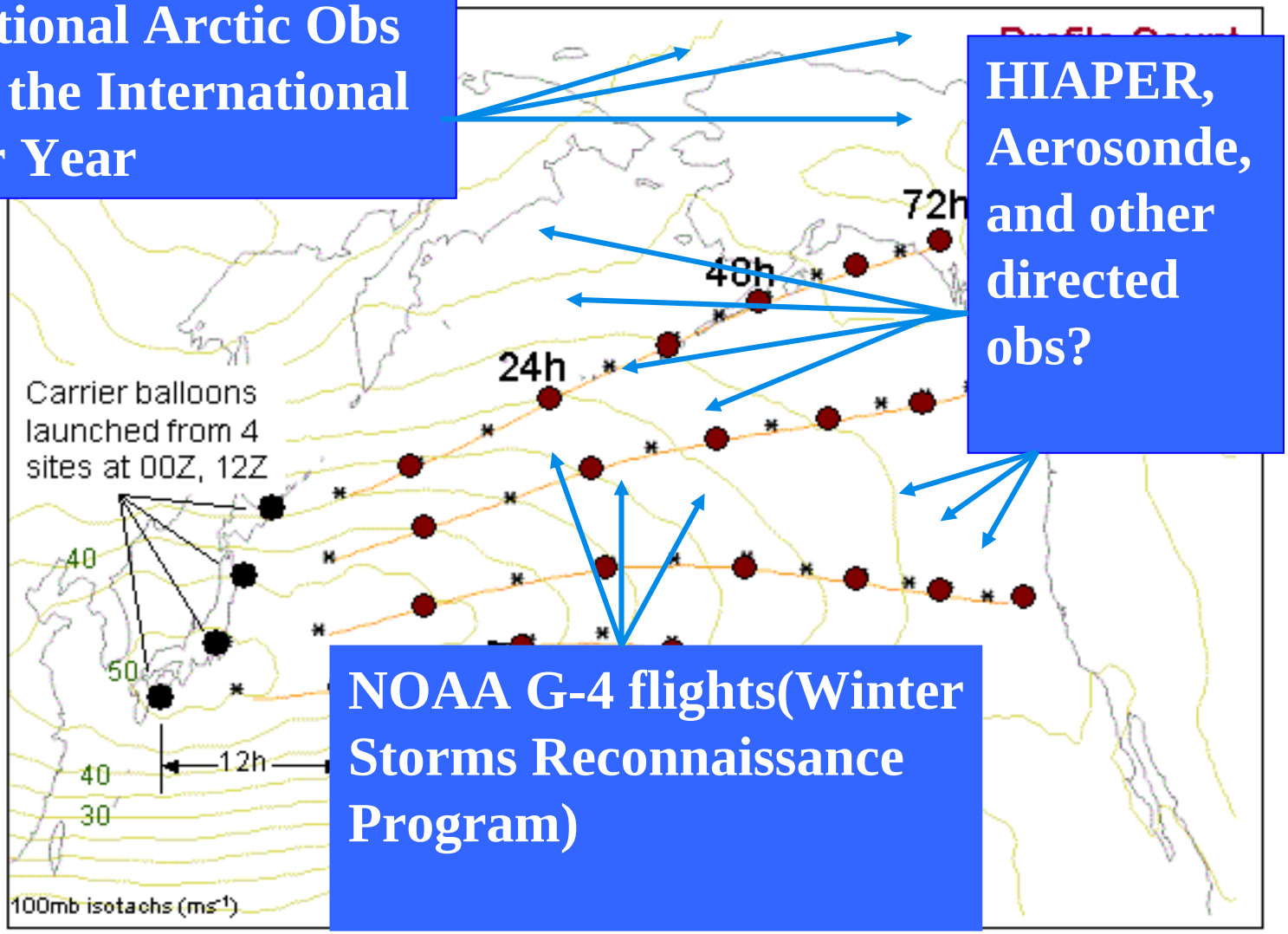


Observational Strategies

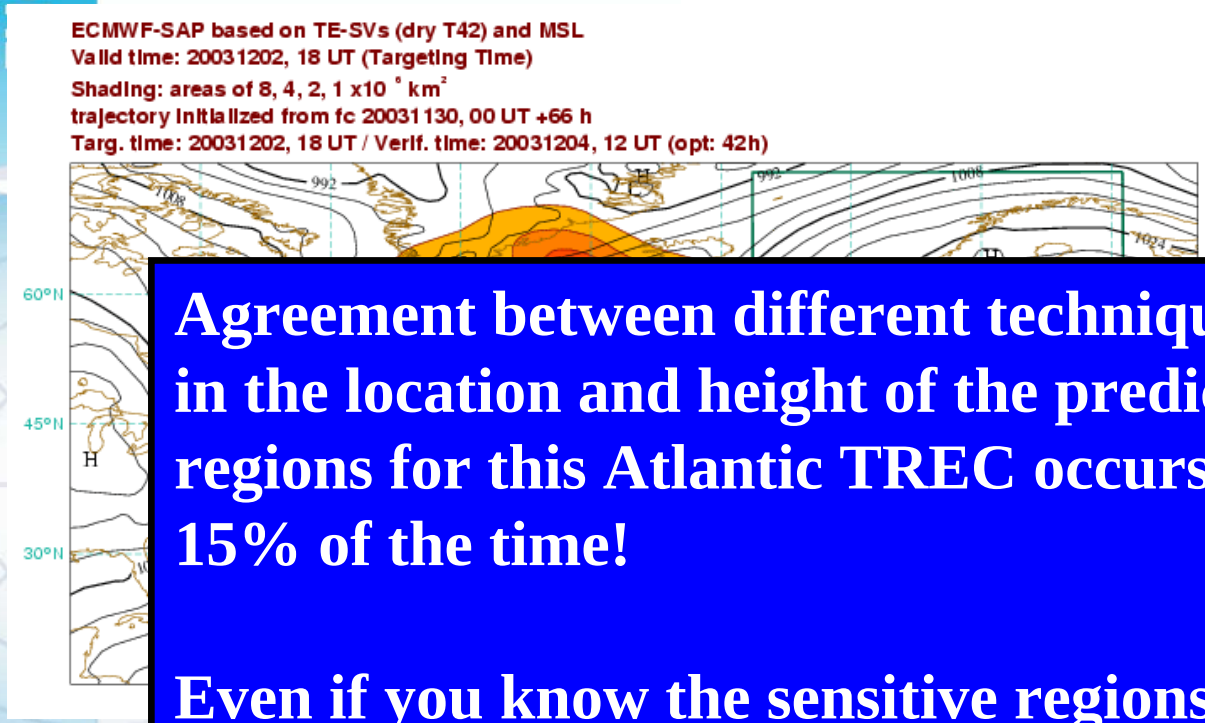
Additional Arctic Obs from the International Polar Year



HIAPER, Aerosonde, and other directed obs?

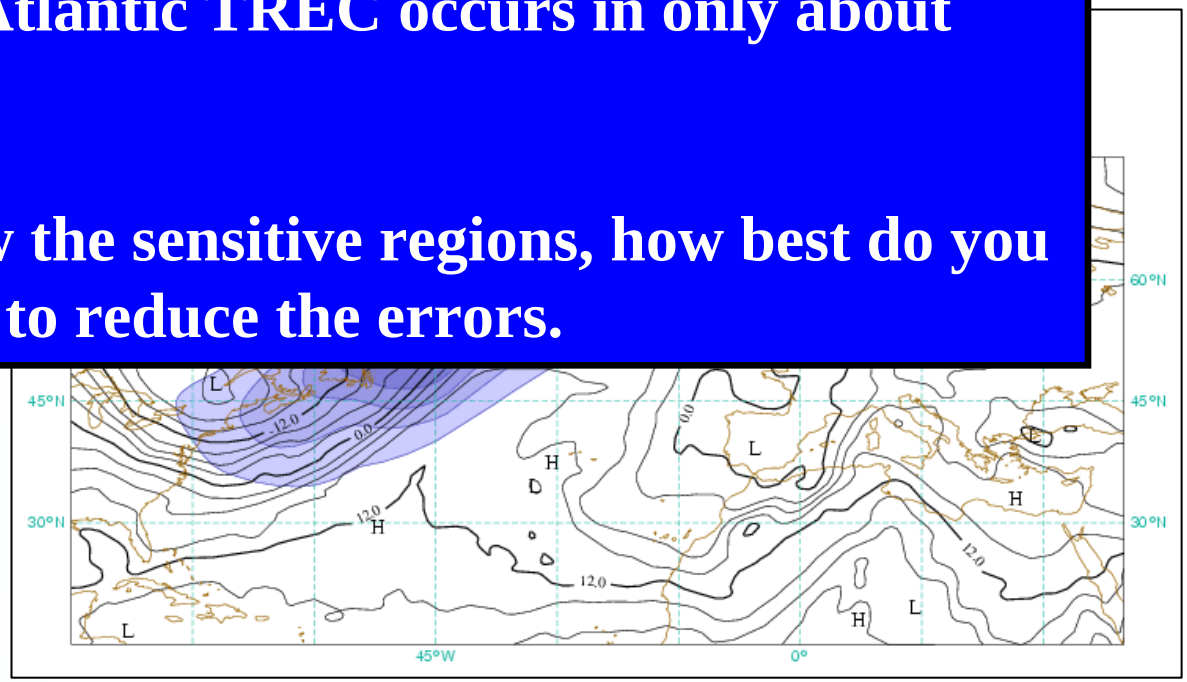
NOAA G-4 flights(Winter Storms Reconnaissance Program)

Observations in sensitive areas
(TReC_024)

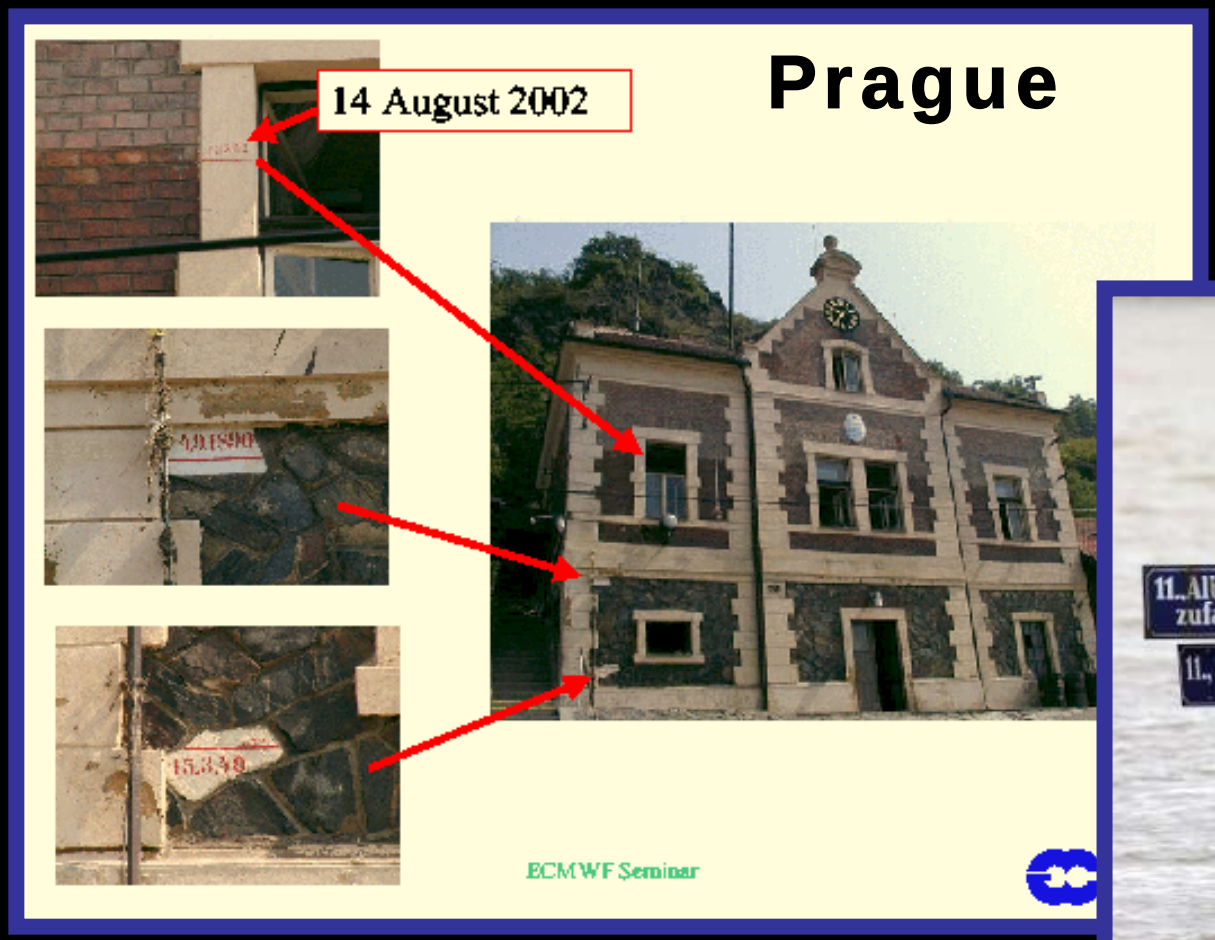


Agreement between different techniques and models in the location and height of the prediction of sensitive regions for this Atlantic TREC occurs in only about 15% of the time!

Even if you know the sensitive regions, how best do you use observations to reduce the errors.



1st Example: Central European Floods



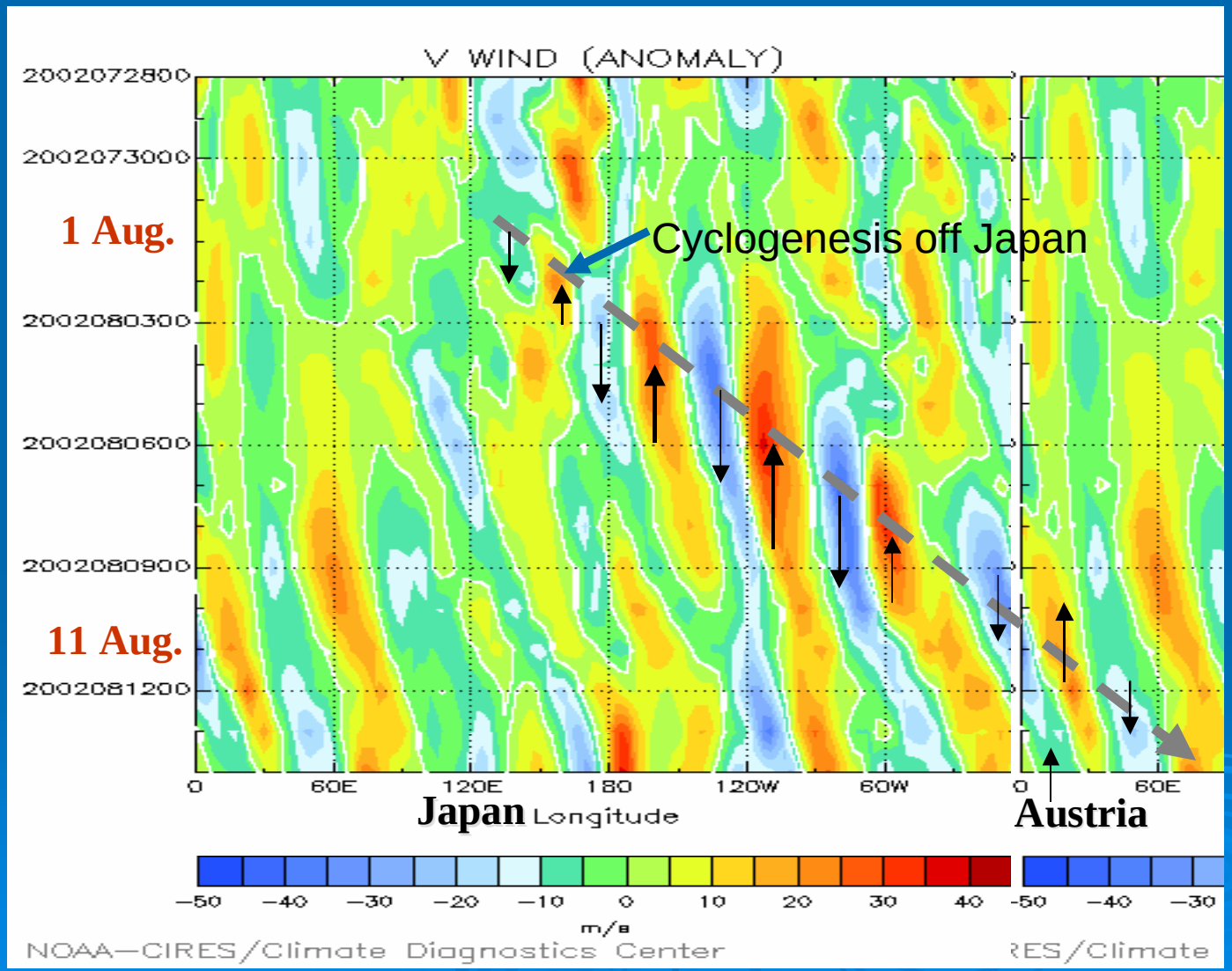
August 2002

Courtesy of Mel Shapiro

Dresden Germany

Courtesy of Mel Shapiro

Central European Floods



Courtesy of Shapiro and Thorpe

2nd Example: Minnesota Flood: 9-11 June 2002

Moderate drought on 1 June

Widespread rainfall in excess of 5 inches.

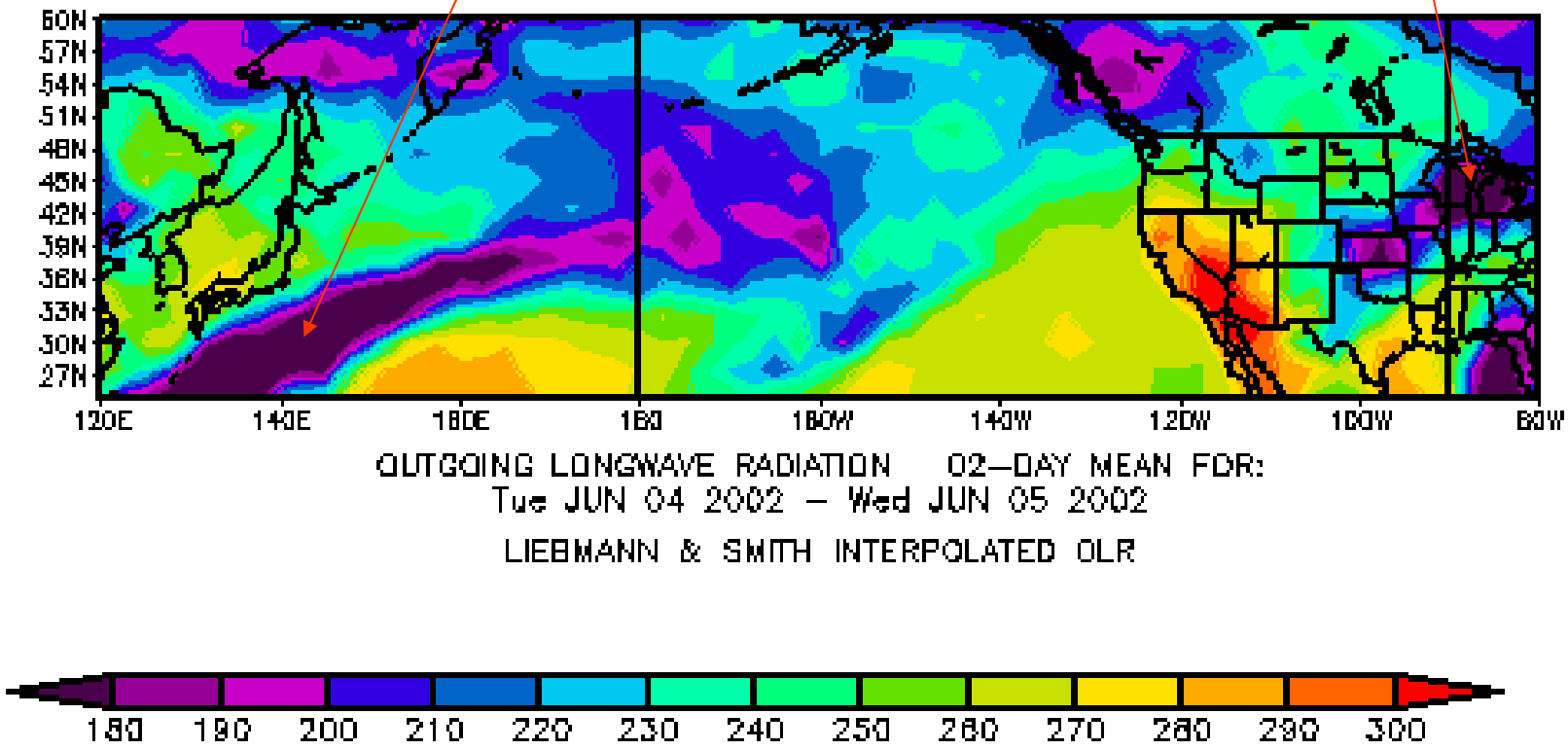
Flood with >$340 million in federal disaster aid.

80% of homes and businesses damaged in Roseau, MN

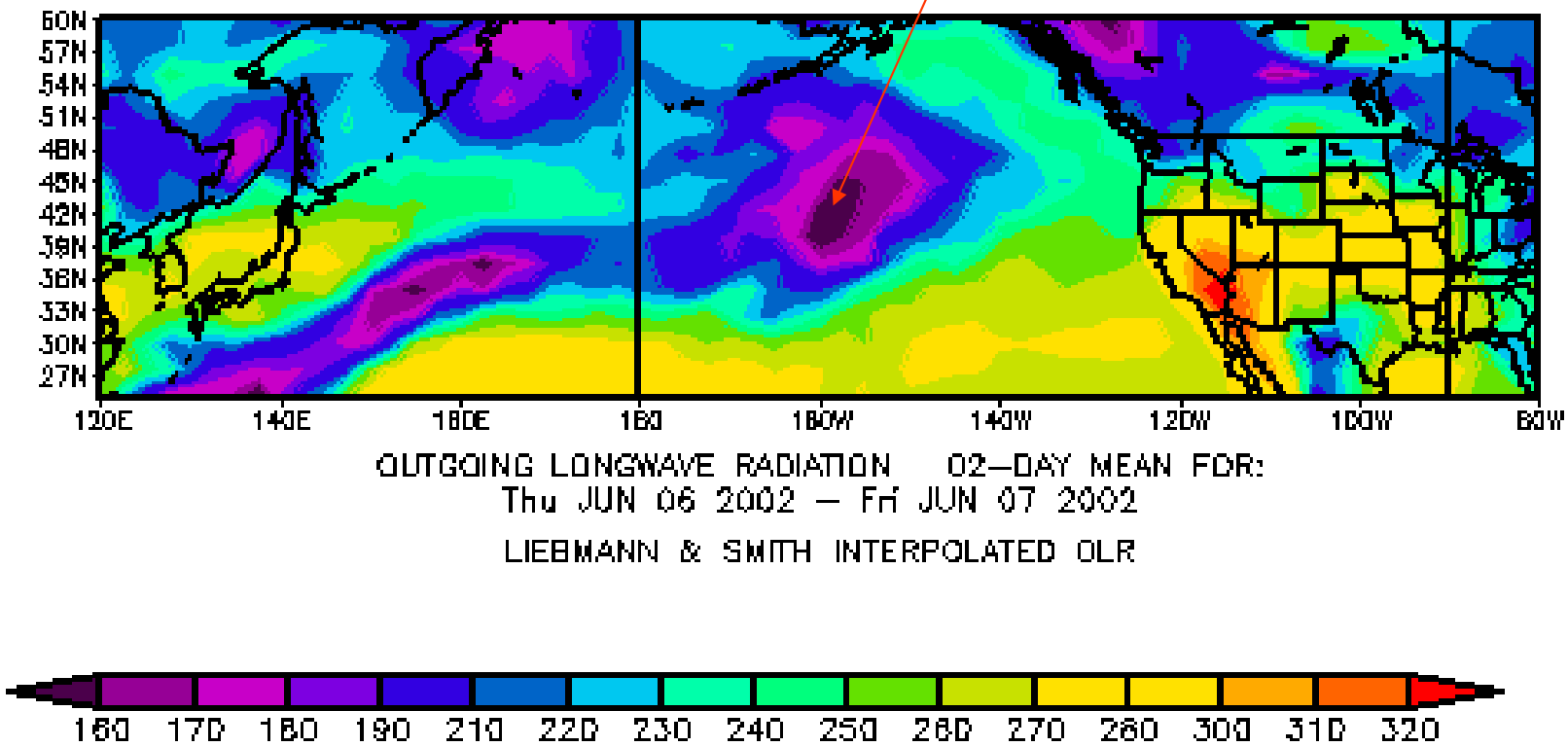
Locally most significant flood on record.

Wisc. flood, previous wave packet

Convection along Mei-Yu Front

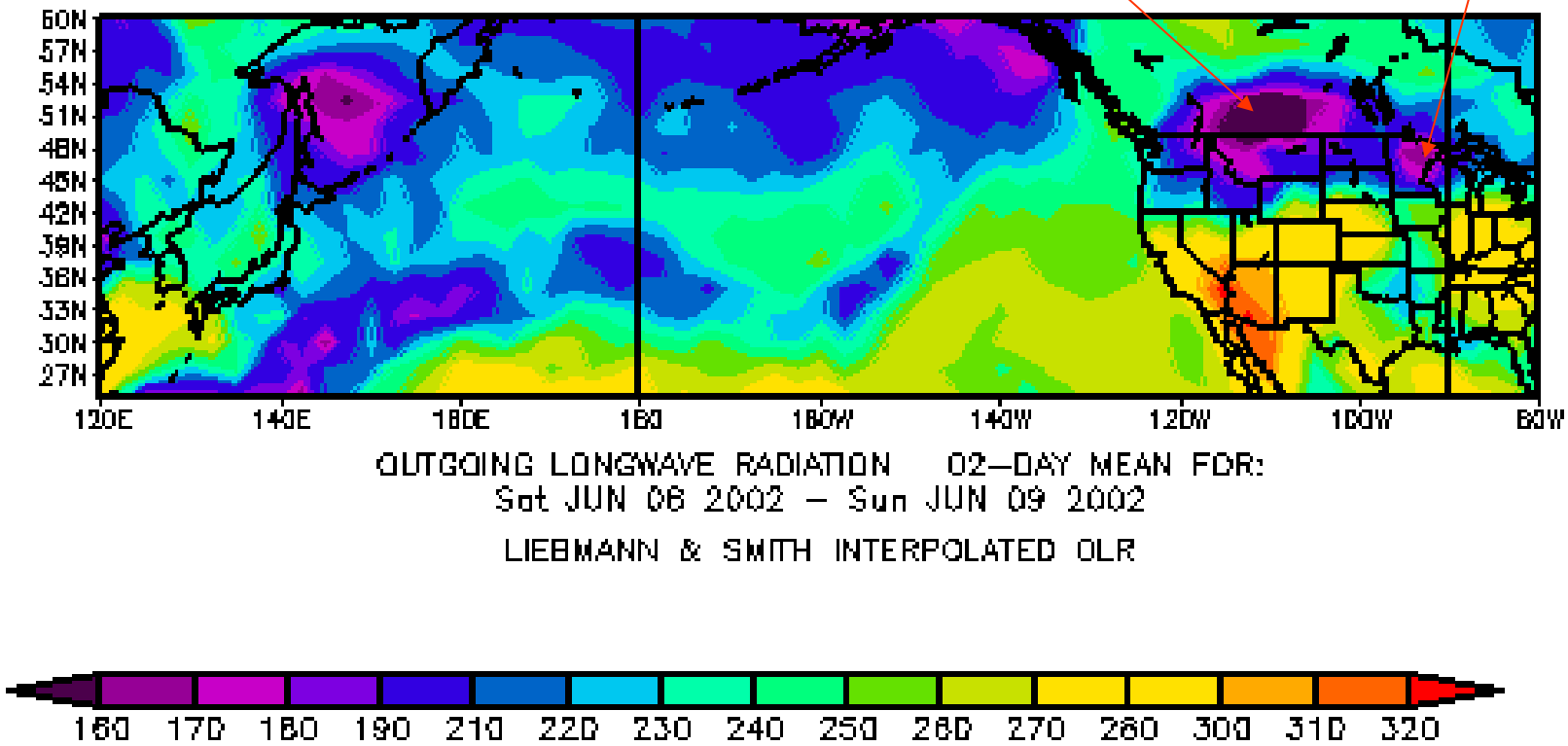


1st Downstream Cyclogenesis



2nd Downstream cyclogenesis

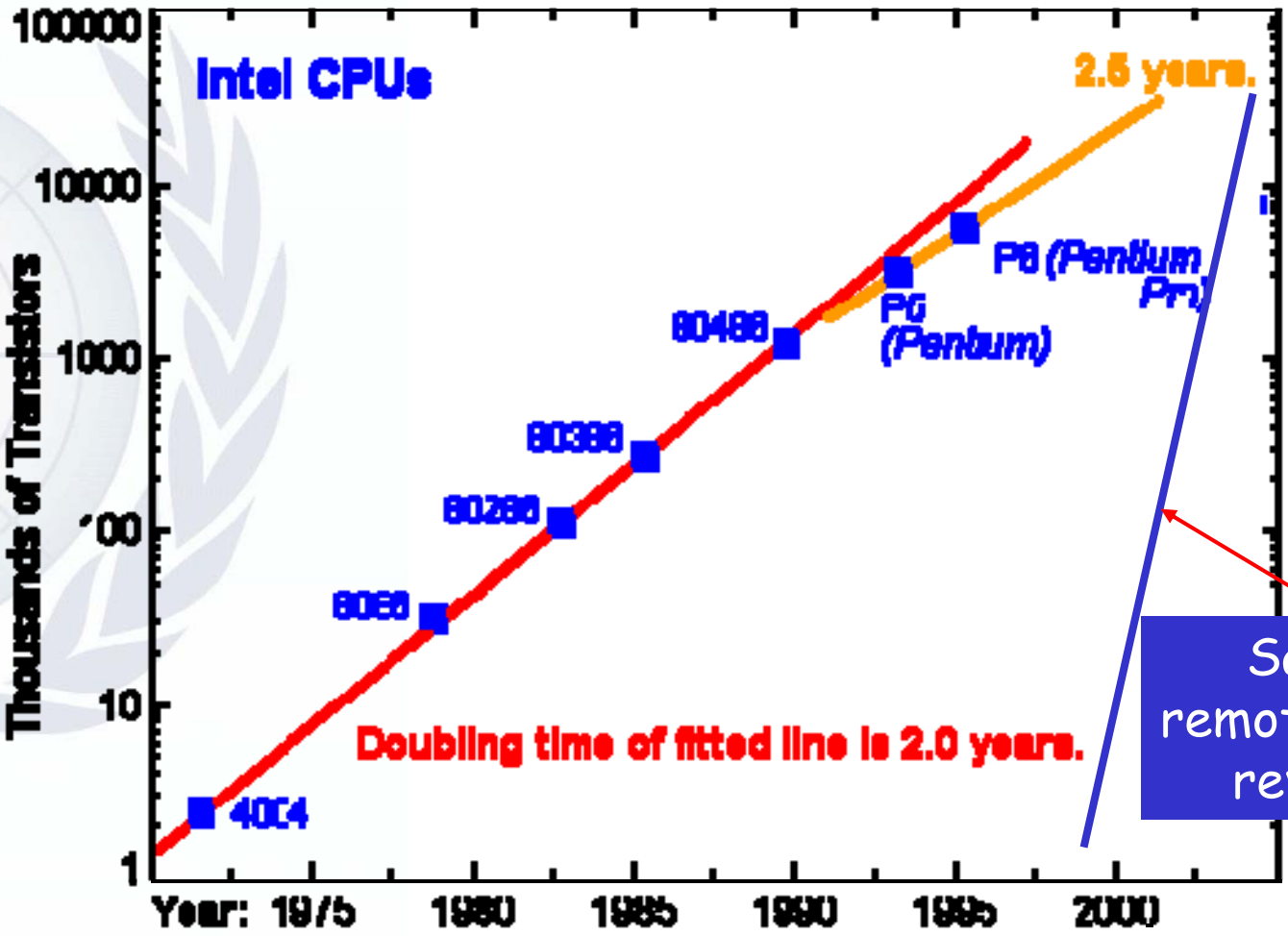
Mn flood from frontal overrunning



Our Next Steps?

- Field project planning meeting in late April or early May to gauge interest and begin the planning process (THORPEX Project Office/NSF will cover costs)
- Meeting location(s) in Seattle (or Alaska)
- Coordinate with IPY
- NSF field planning document needs to be complete by Jan 2006 and NSF has become (in my opinion) quite receptive to THORPEX
- NOAA is aware of this THORPEX effort and has included it in their budget planning
- Place this field effort in the next draft of the US THORPEX Plan (next draft completed in ~ 1 week) and THORPEX IPY plans?
- THORPEX will bring an international flavor (parallel runs at other global centers?, other observing systems?, Canadian polar modeling effort, links to IPY, international collaborators on research and logistics), Asian participation?

Moore's Law for Intel



Satellite remote-sensing revolution