



# THORPEX

A GLOBAL ATMOSPHERIC RESEARCH PROGRAMME



David Parsons

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.

# 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 1<sup>st</sup> Intl Science Symposium.

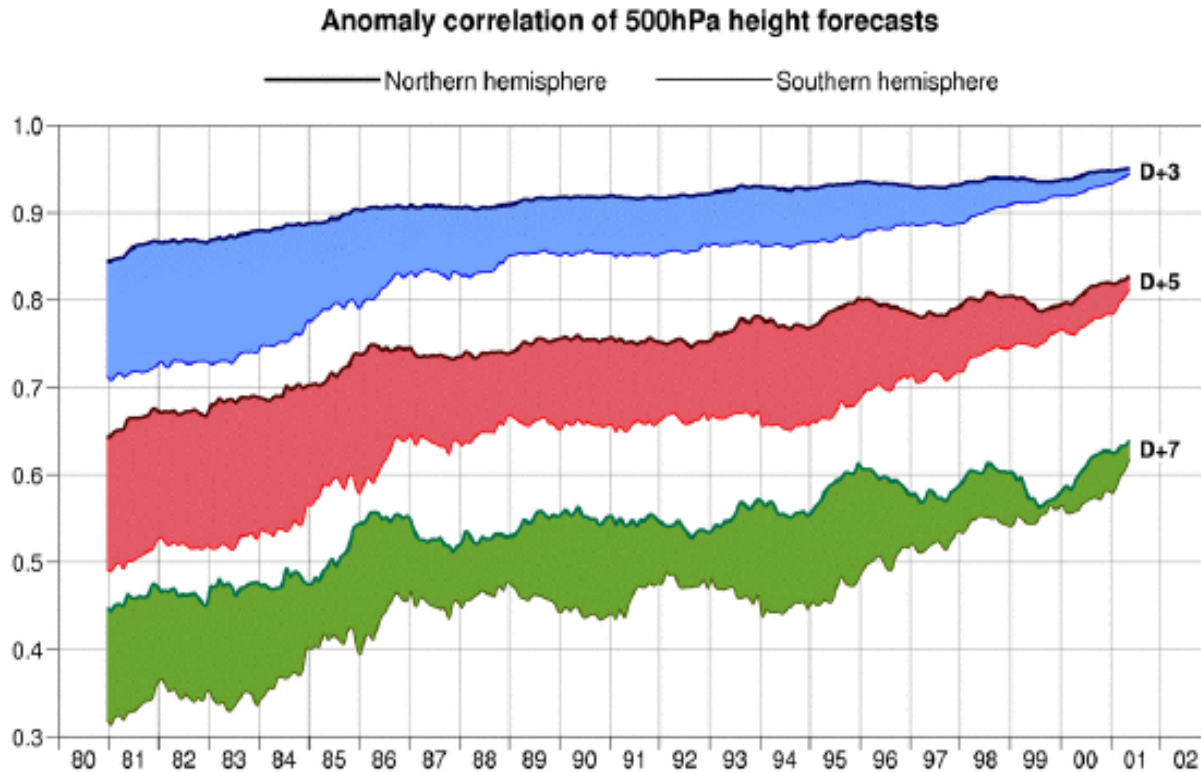
The THORPEX web site is <http://www.wmo.int/thorpex>

The THORPEX implementation phase begins 1 January 2005.

# Four Interrelated and Coordinated THORPEX Sub-programmes

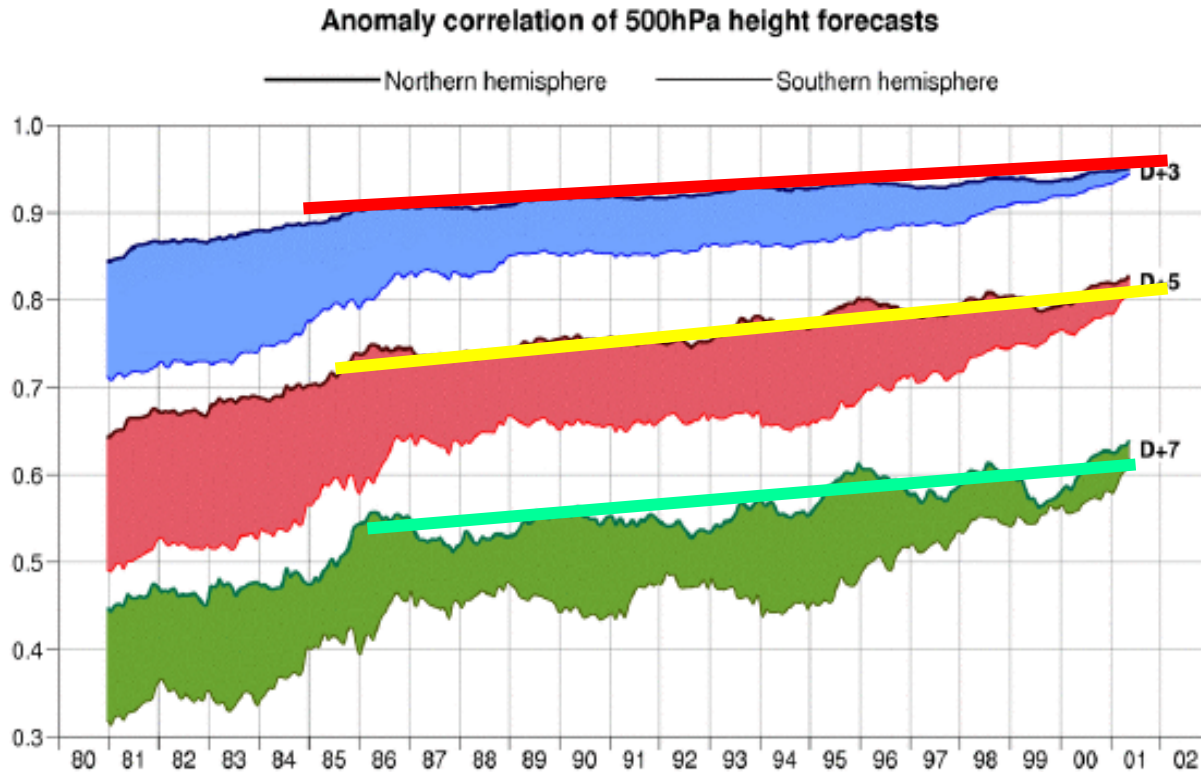
- *Observing Systems*
- *Observing Strategies and Data Assimilation*
- *Predictability and Dynamical Processes*
- *Societal and Economic Impacts.*
- *Combine efforts to work on grand challenges*
- *Science plan available at <http://www.wmo.int/thorpex> (led by Mel Shapiro and Alan Thorpe)*

## Evolution of forecast skill for northern and southern hemispheres



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).

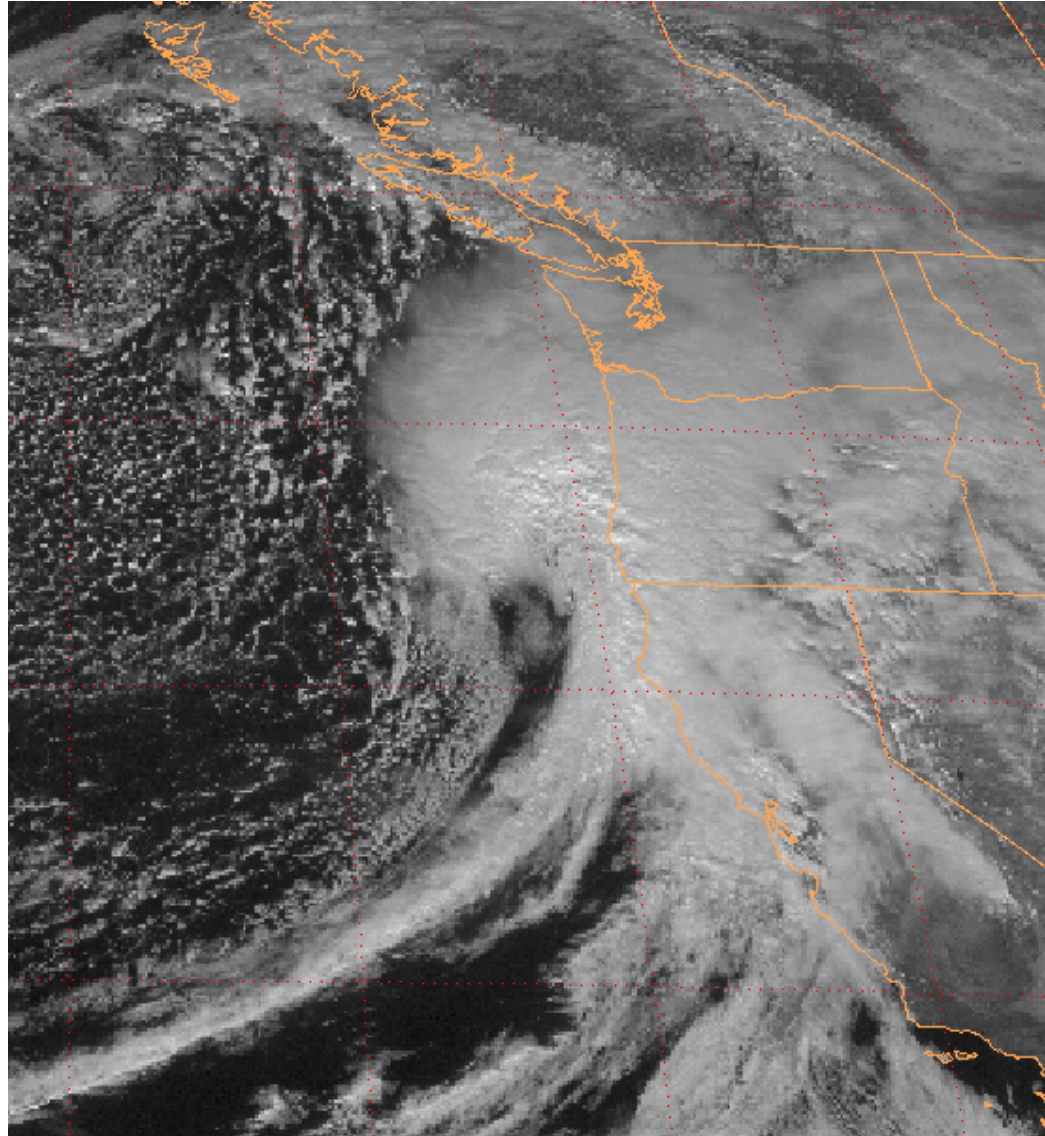
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# February 7, 2002

- 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)



# The result: massive tree falls and damage



# The Register-Guard

www.register-guard.com

STORMY WEATHER

## Winds land sneak punch



PHOTO BY JEFFREY GARDNER

Stormy weather in the form of a sneak punch by a Christmas pickup truck on the 100th anniversary of the city's founding. Two of the men, Steve Hansen and driver Matt Stevens, were rescued without incident, but firefighter John Callahan was hospitalized for facial, hand, neck and chest injuries.

## Surprise storm packing 70 mph gusts downs trees, damages property

By JEFF GARDNER

Contributed photo

A surprise winter storm packing gusts to 70 mph hit the southern Willamette Valley late Thursday afternoon, bringing a flurry of snow, damaging homes and roads, shutting traffic, downing big liquor signs and forcing the closure of Lane County courthouses for the day.

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The snow — one of the most successful in recent years — was on the north side of the valley. It may be subject to heavy rain in the valley.

### UTILITY HELP

- Eugene Plant & Electric Dept. 682-2700
- Eugene Public Works 682-6800
- Springfield Utility Dept. 542-3467
- Roseburg Peoples Utility District 762-1505
- Falls City Electric Dept. 633-3333
- Gas Electric Co. 339-1011

### TRAVEL

- Call the state Department of Transportation's toll-free number 800-437-4328
- Visit www.oregon.gov for the latest road conditions
- Transportation News 800-437-4328

### SCHOOLS

- Lane County Schools are closed today and tomorrow
- Lane Community College closed today and tomorrow
- Willamette University closed today and tomorrow



## Three men freed after tree flattens their pickup truck

By JEFF GARDNER

Contributed photo

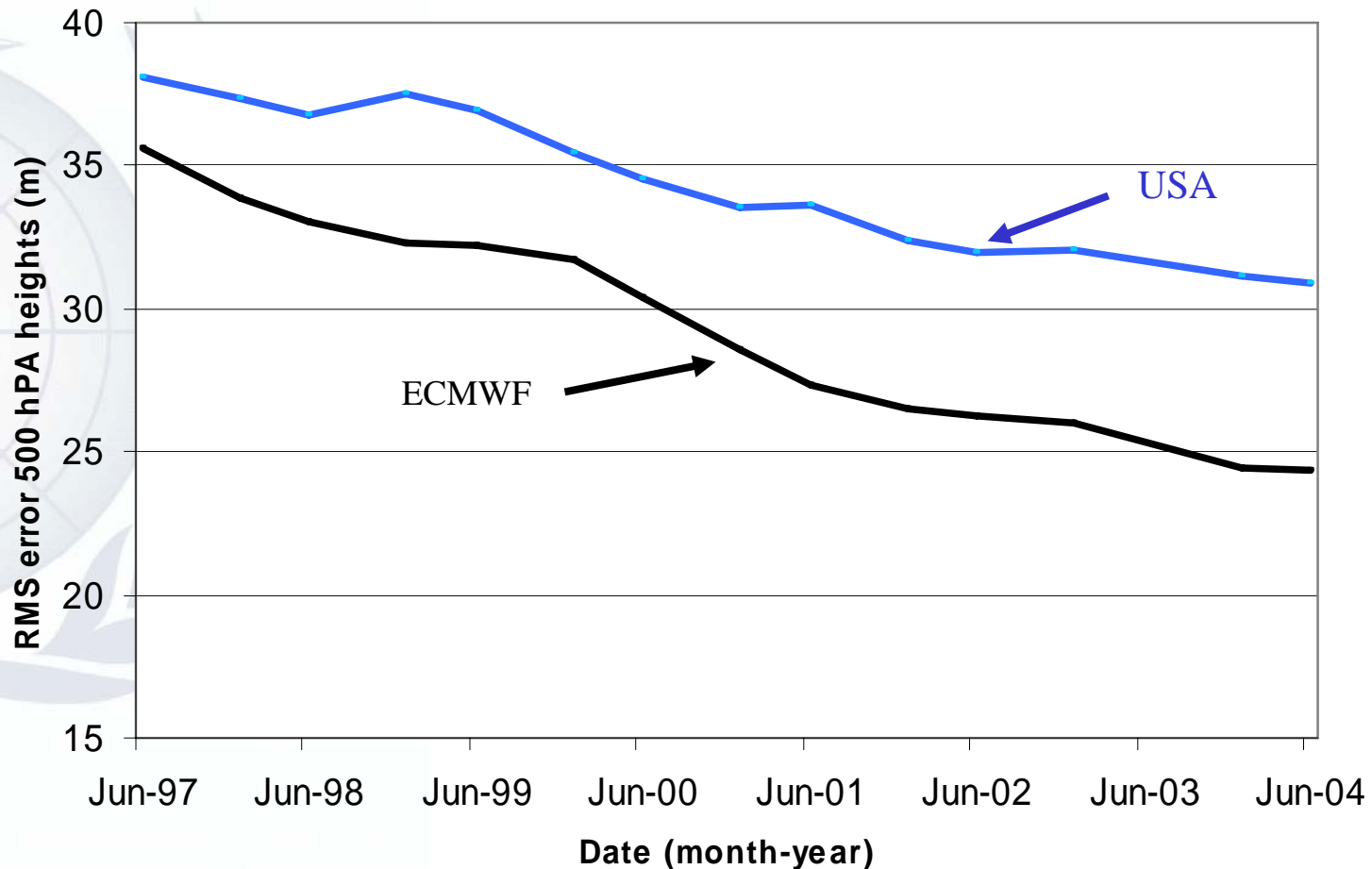
Three men were freed from the back of a four-wheeler pickup truck when "Thorpe's" hit it, causing it to be crushed by a tree trunk that landed on top of the truck, crushing the roof and most of the back.

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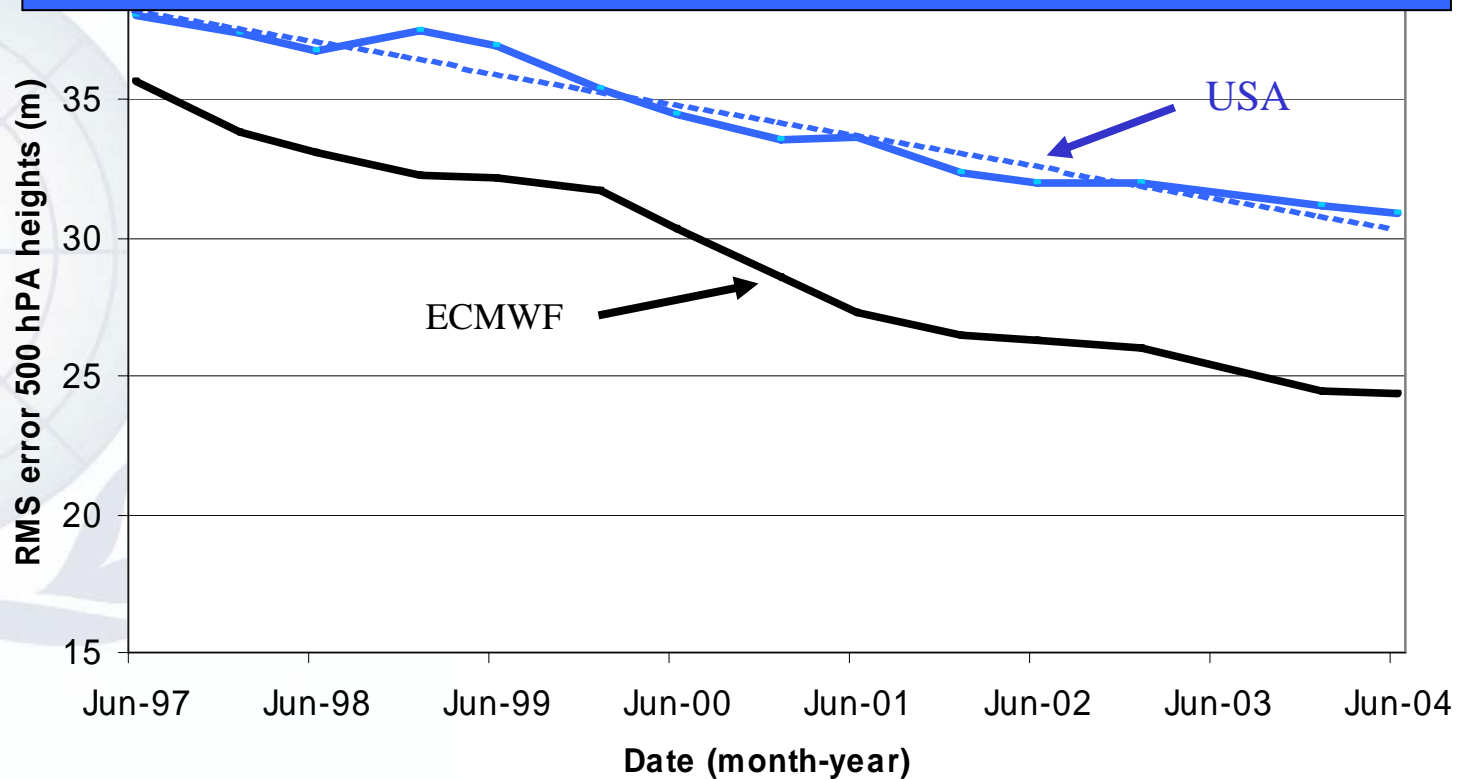
# Verification of 72 h Forecast vs. Analyses for the Northern Hemisphere 12 Month Running Mean





# 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!!



# 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)

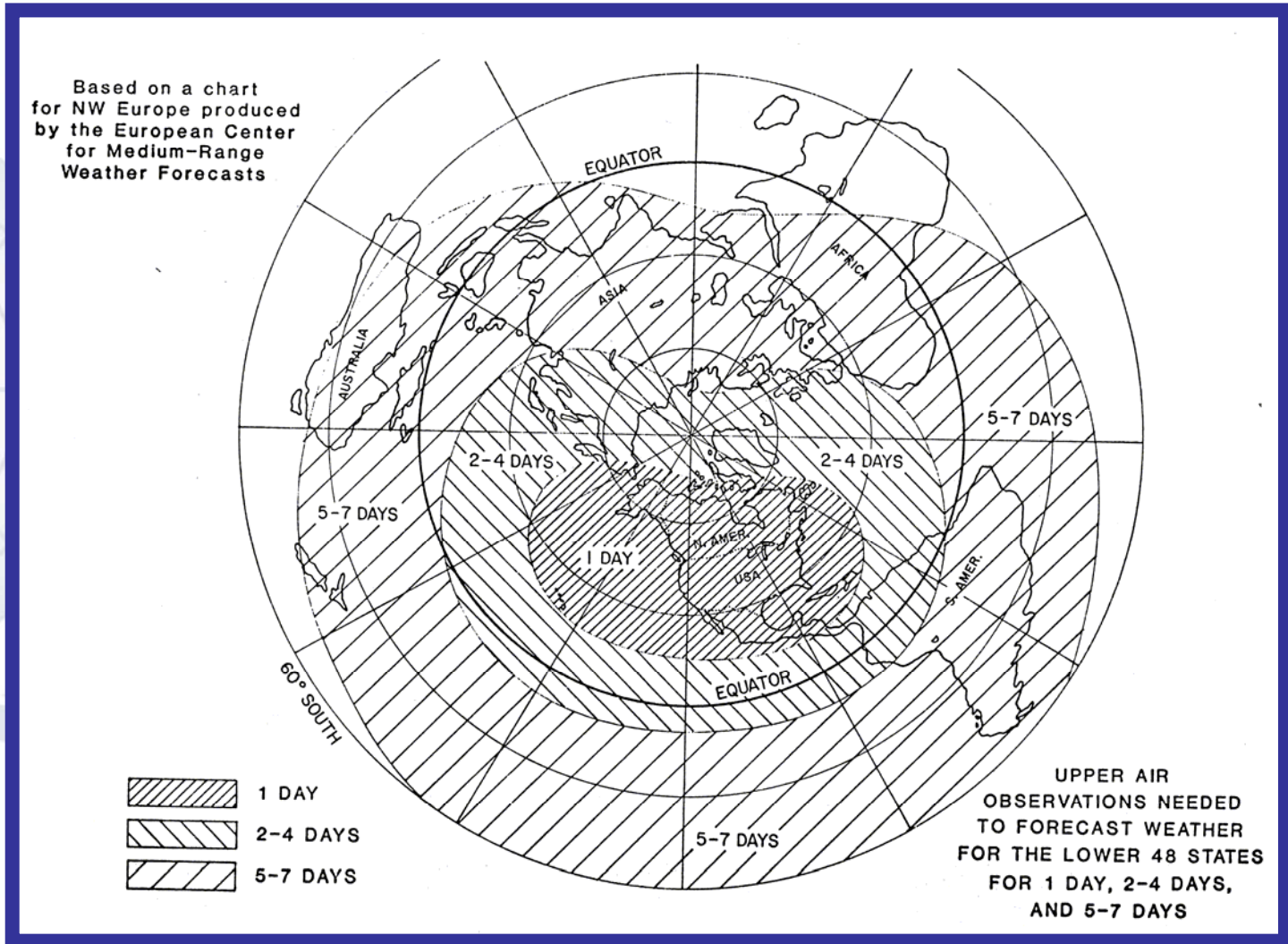
In an average year, the US spends ~\$18 billion on weather damage

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.

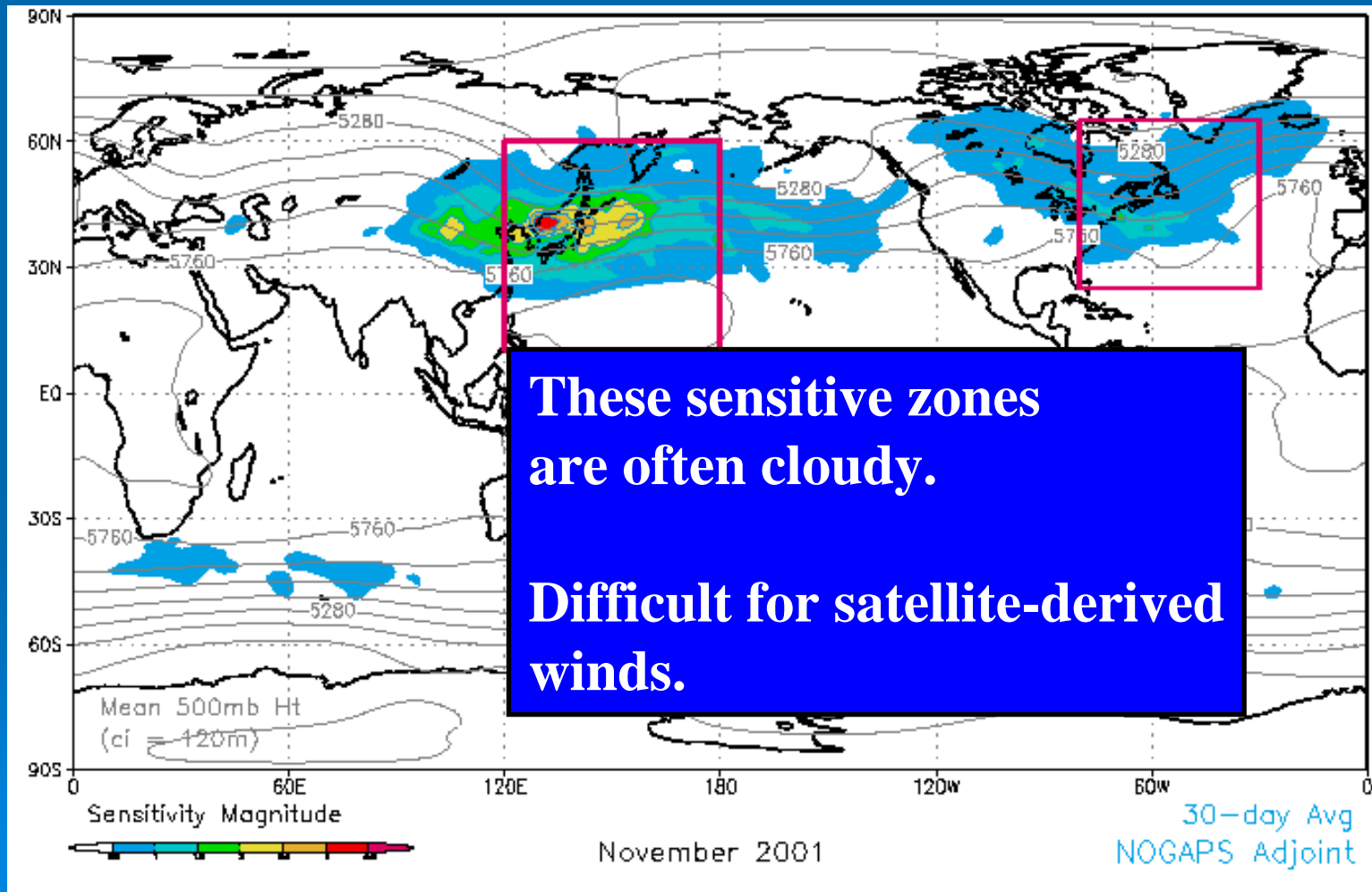
# A Proposal from THORPEX

- 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



# In-Situ Sensing Advances Driftsonde

Trajectories calculated at 100mb using time-averaged winds for Jan-Feb 1999

## Profile Count

00Z	24
06Z	24
12Z	24
18Z	24
Daily	96

Carrier balloons launched from 4 sites at 00Z, 12Z

40  
50  
40  
30

6h dropsonde deployment interval along trajectory of each carrier balloon

THORPEX North Pacific Campaign: 2005  
(Driftsonde Component)

100mb isotachs ( $\text{ms}^{-1}$ )



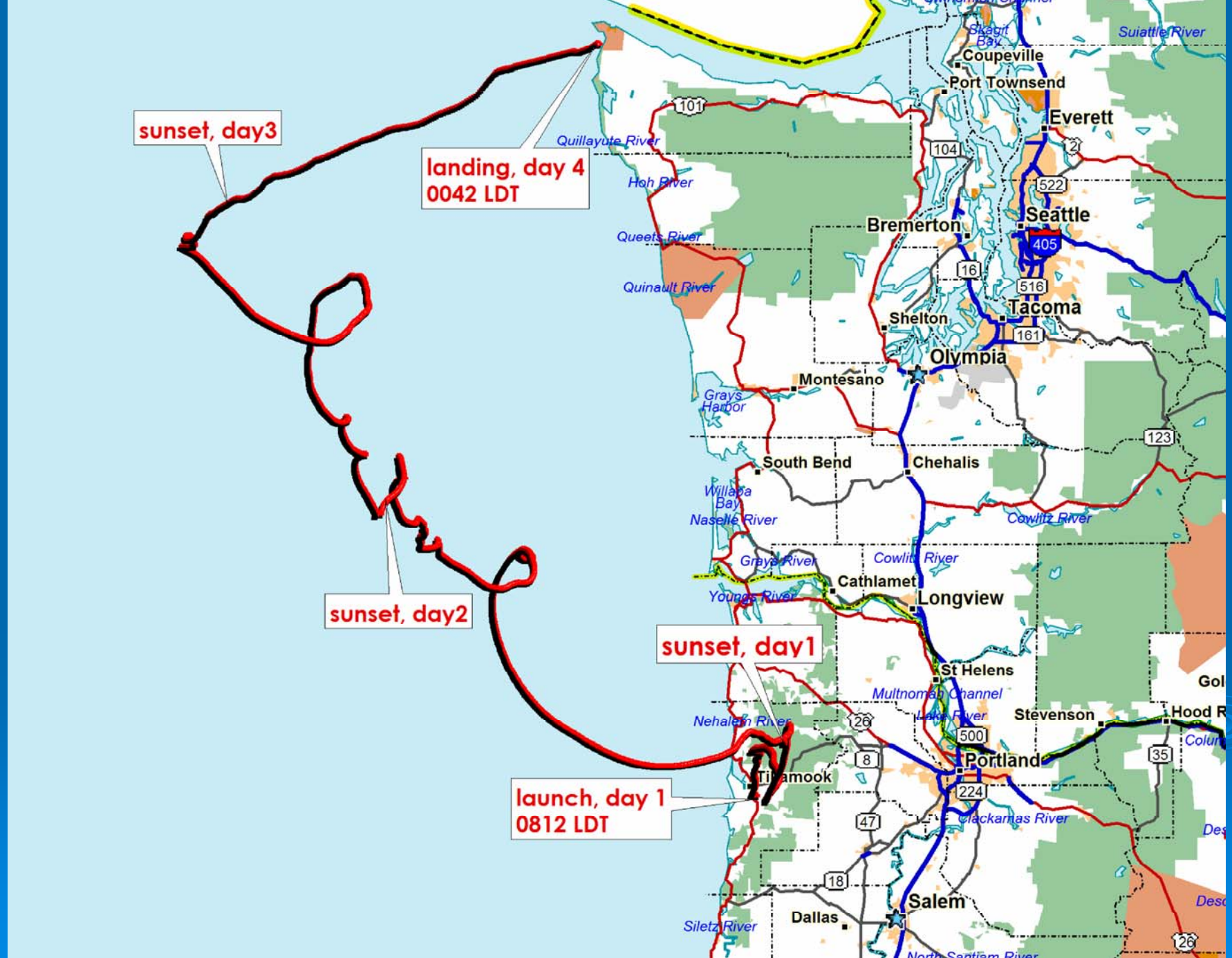
**sunset, day3**

**landing, day 4  
0042 LDT**

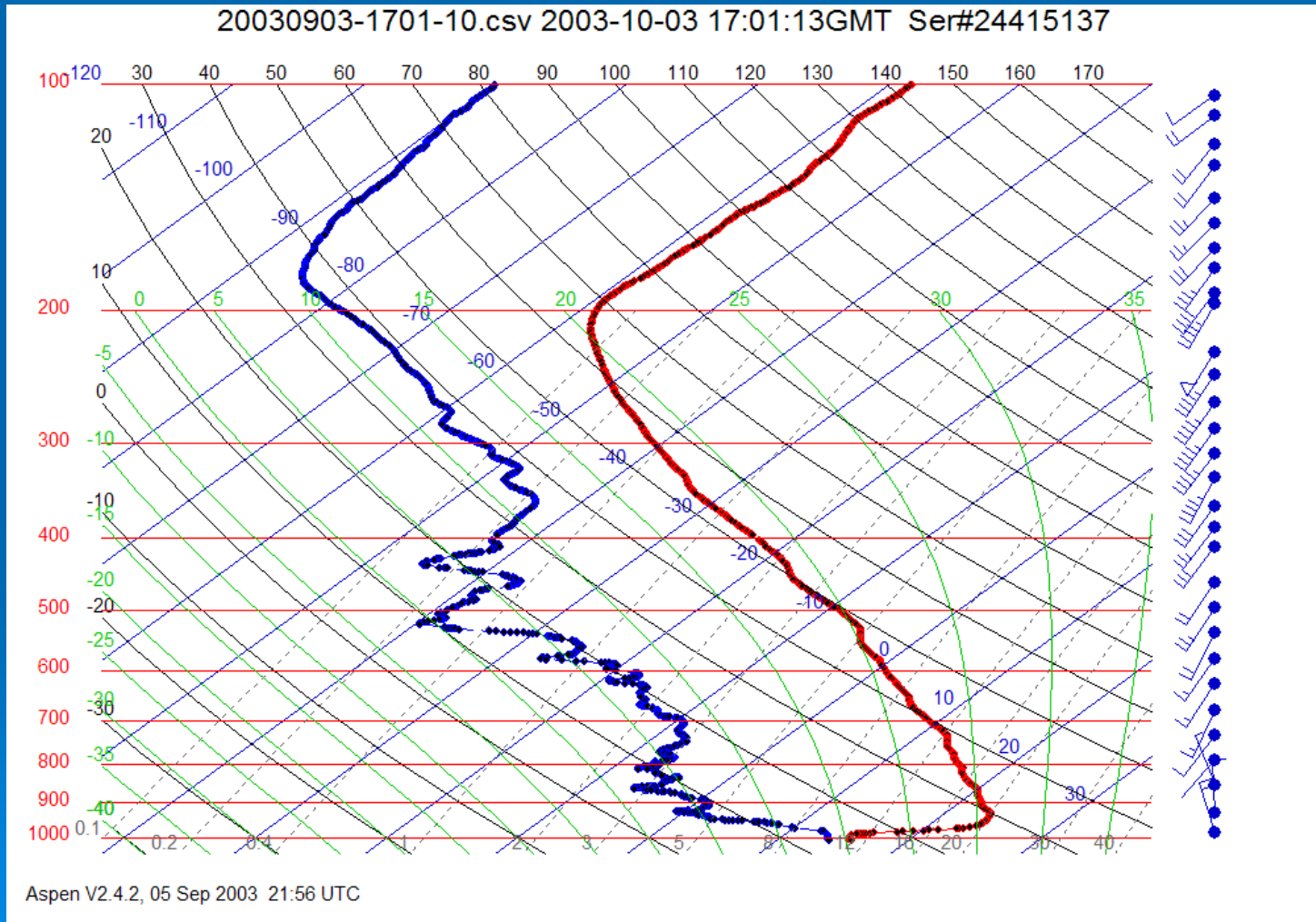
**sunset, day2**

**sunset, day1**

**launch, day 1  
0812 LDT**



# Driftsonde Deployed Dropsonde

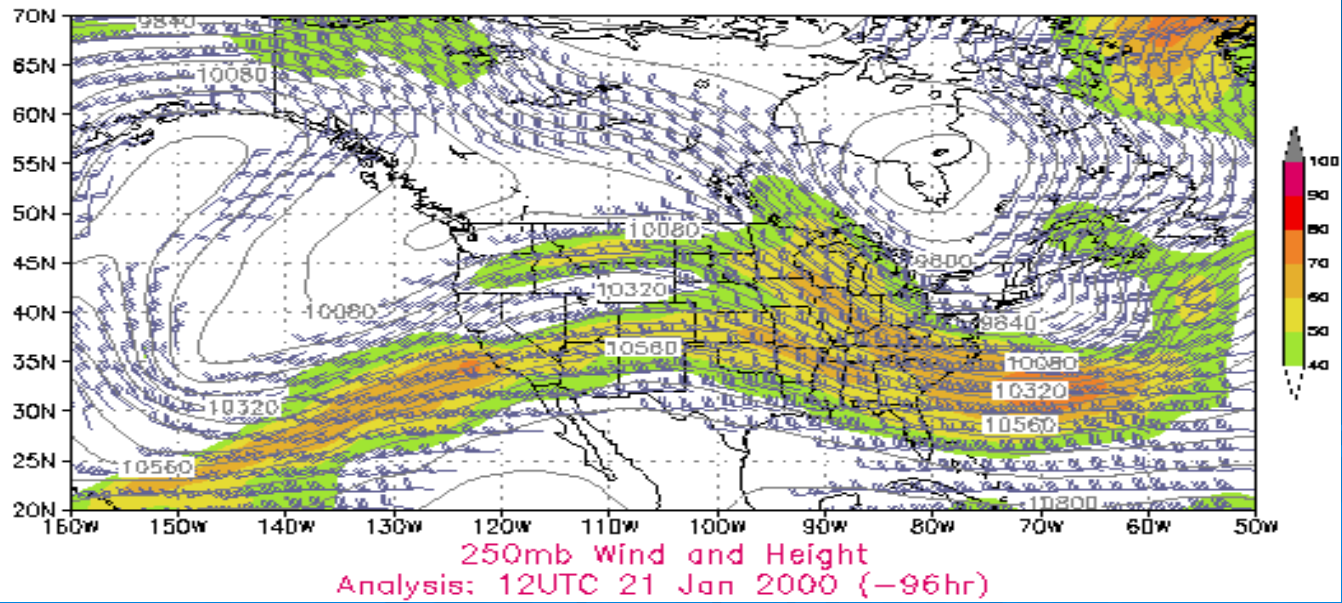
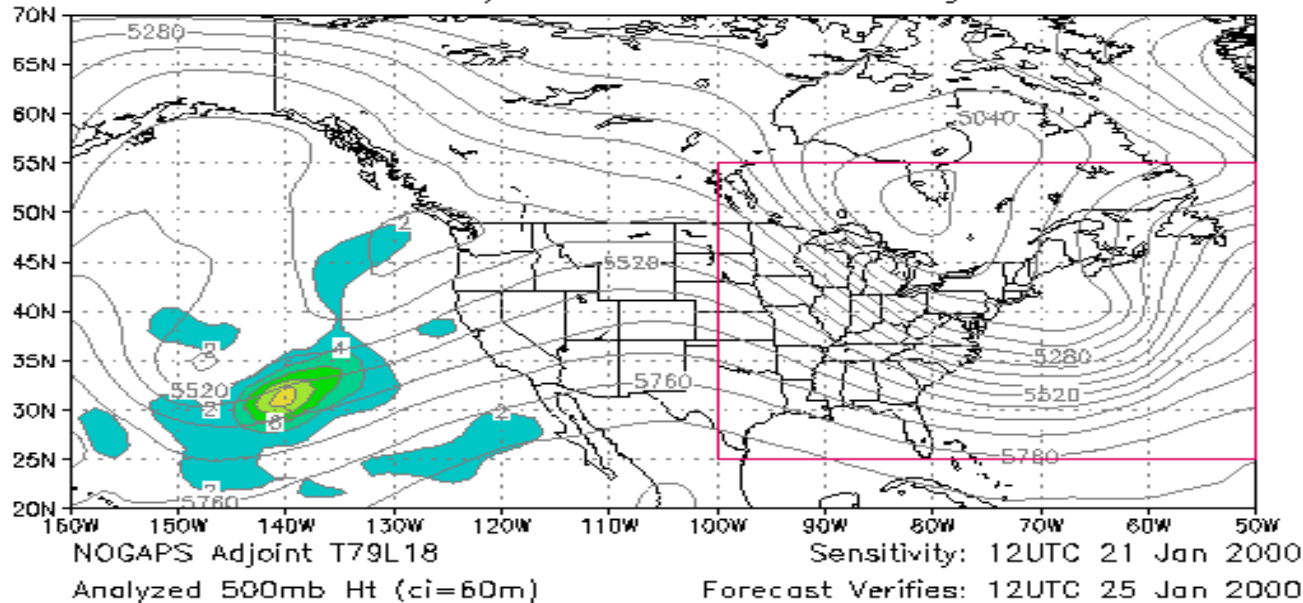




Targeted  
sensitivity

Washington  
snowstorm

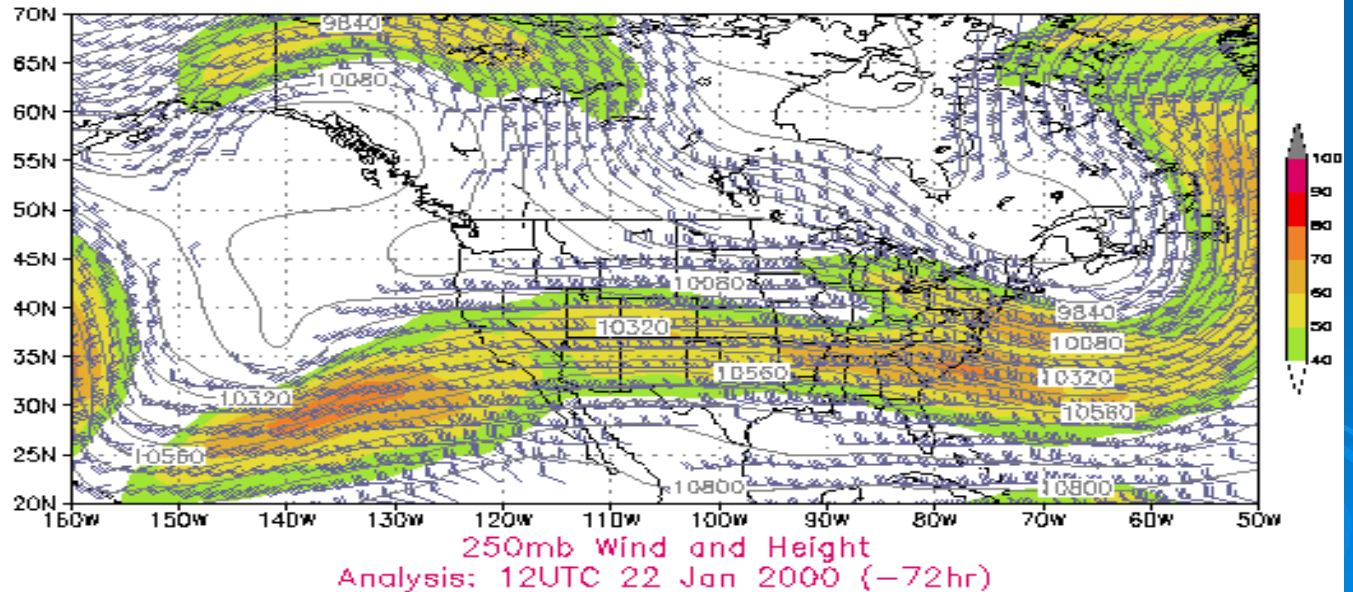
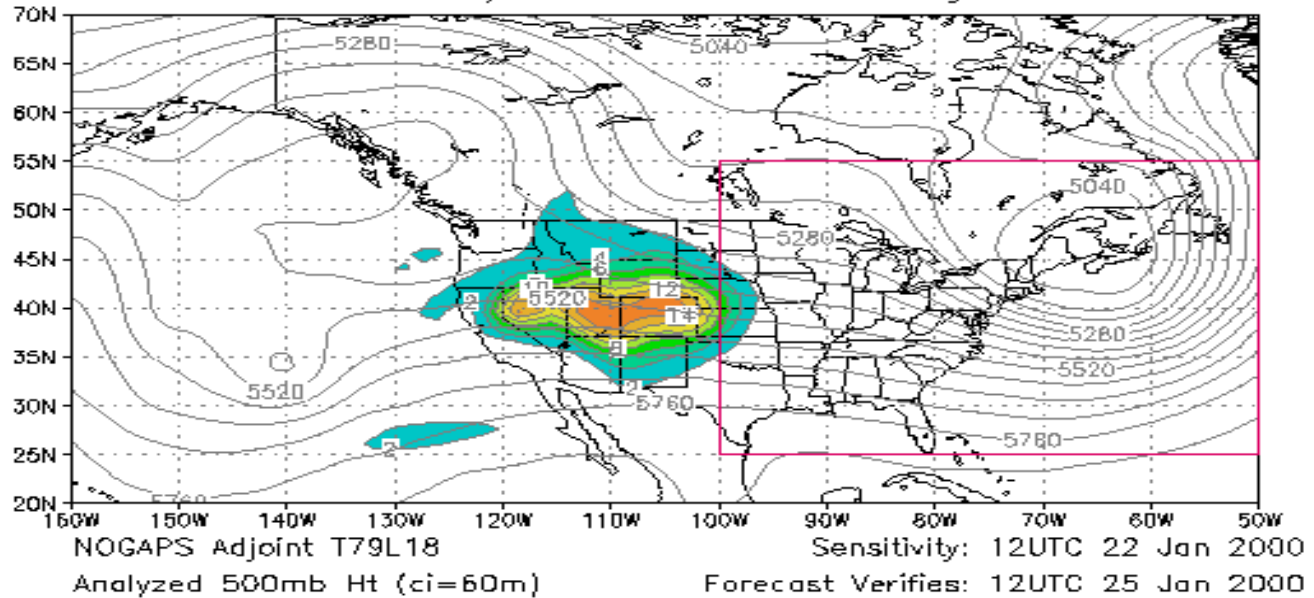
### 96hr Forecast Error Sensitivity Summary Product $ci = 2 \text{ J kg}^{-1}$



Targeted  
sensitivity

Washington  
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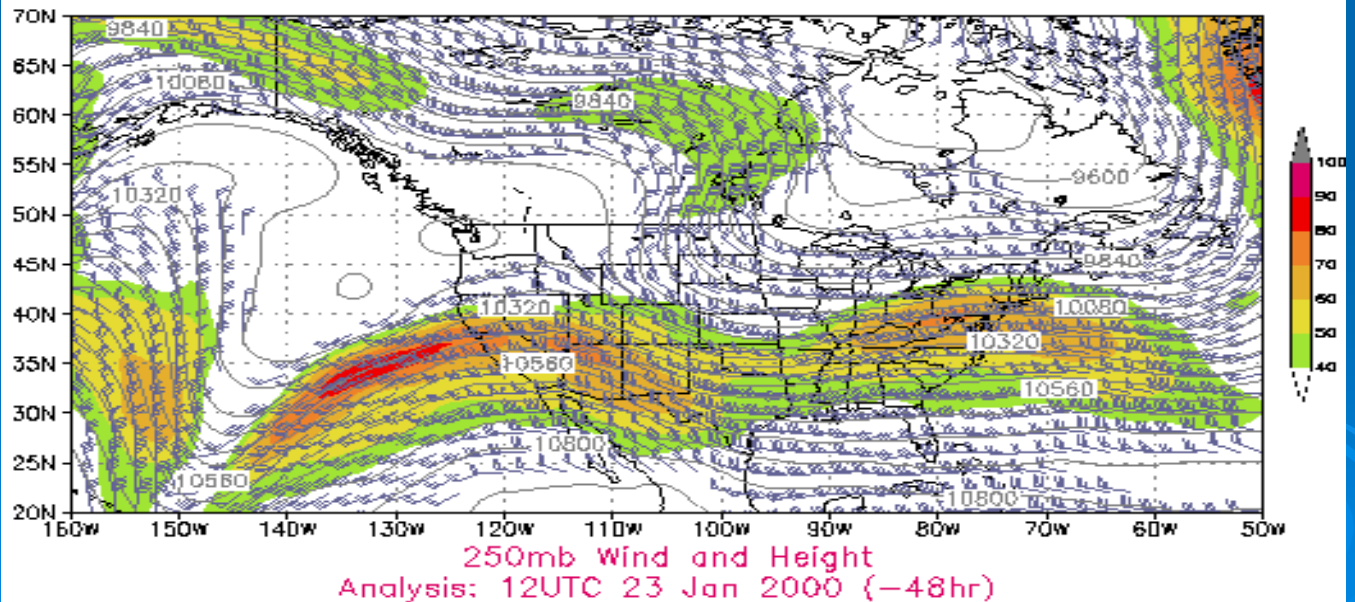
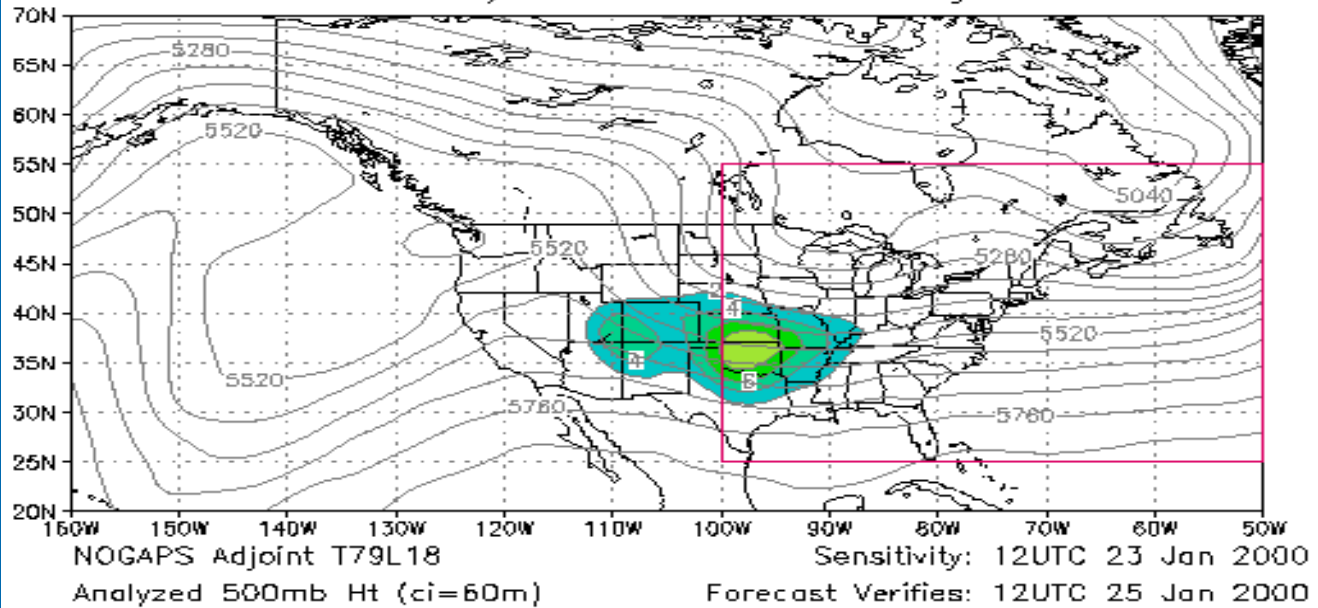
### 72hr Forecast Error Sensitivity Summary Product $ci = 2 \text{ J kg}^{-1}$



Targeted  
sensitivity

Washington  
snowstorm

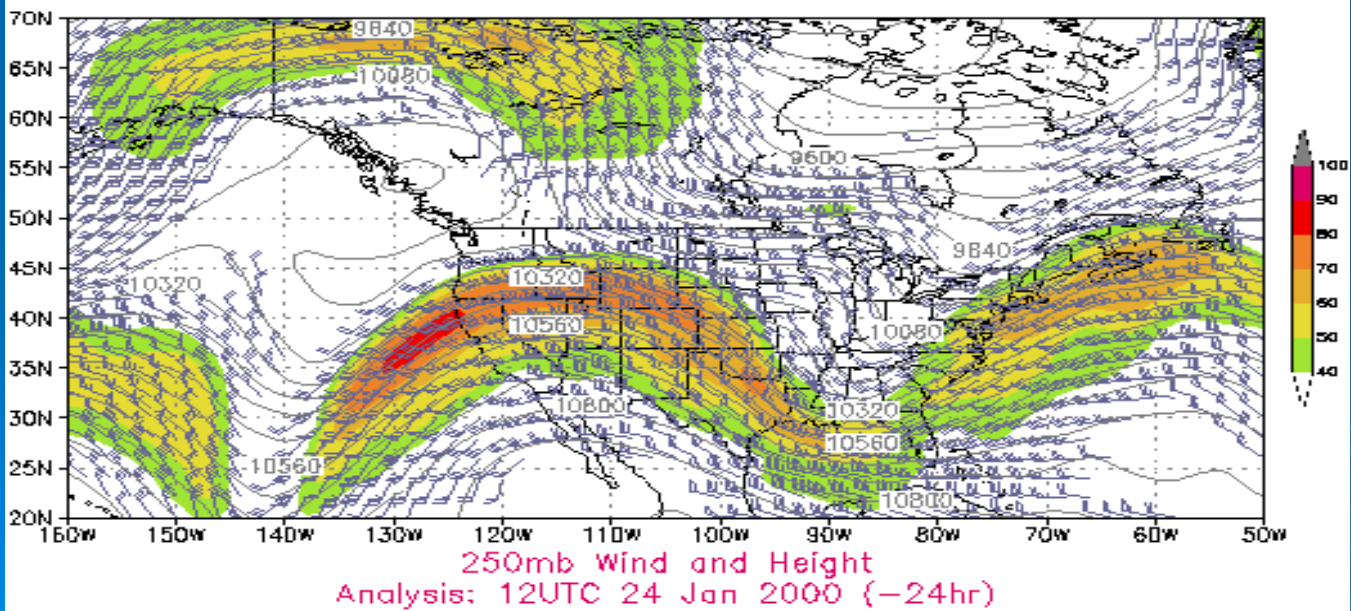
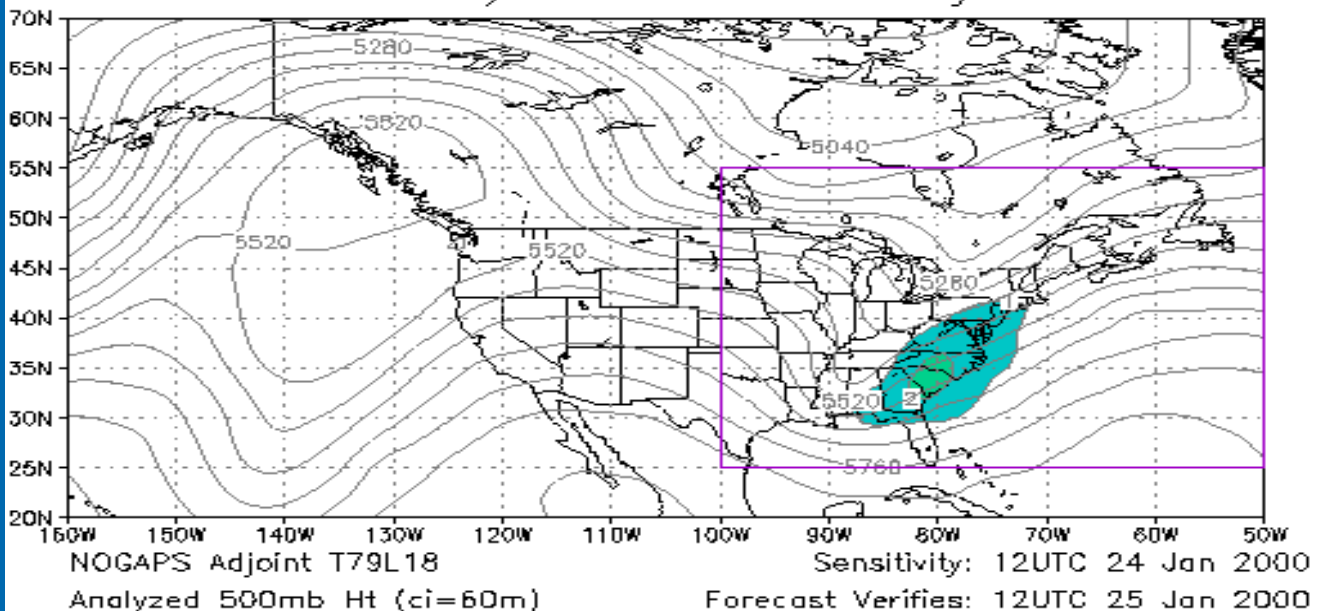
### 48hr Forecast Error Sensitivity Summary Product $ci = 2 \text{ J kg}^{-1}$



Targeted  
sensitivity

Washington  
snowstorm

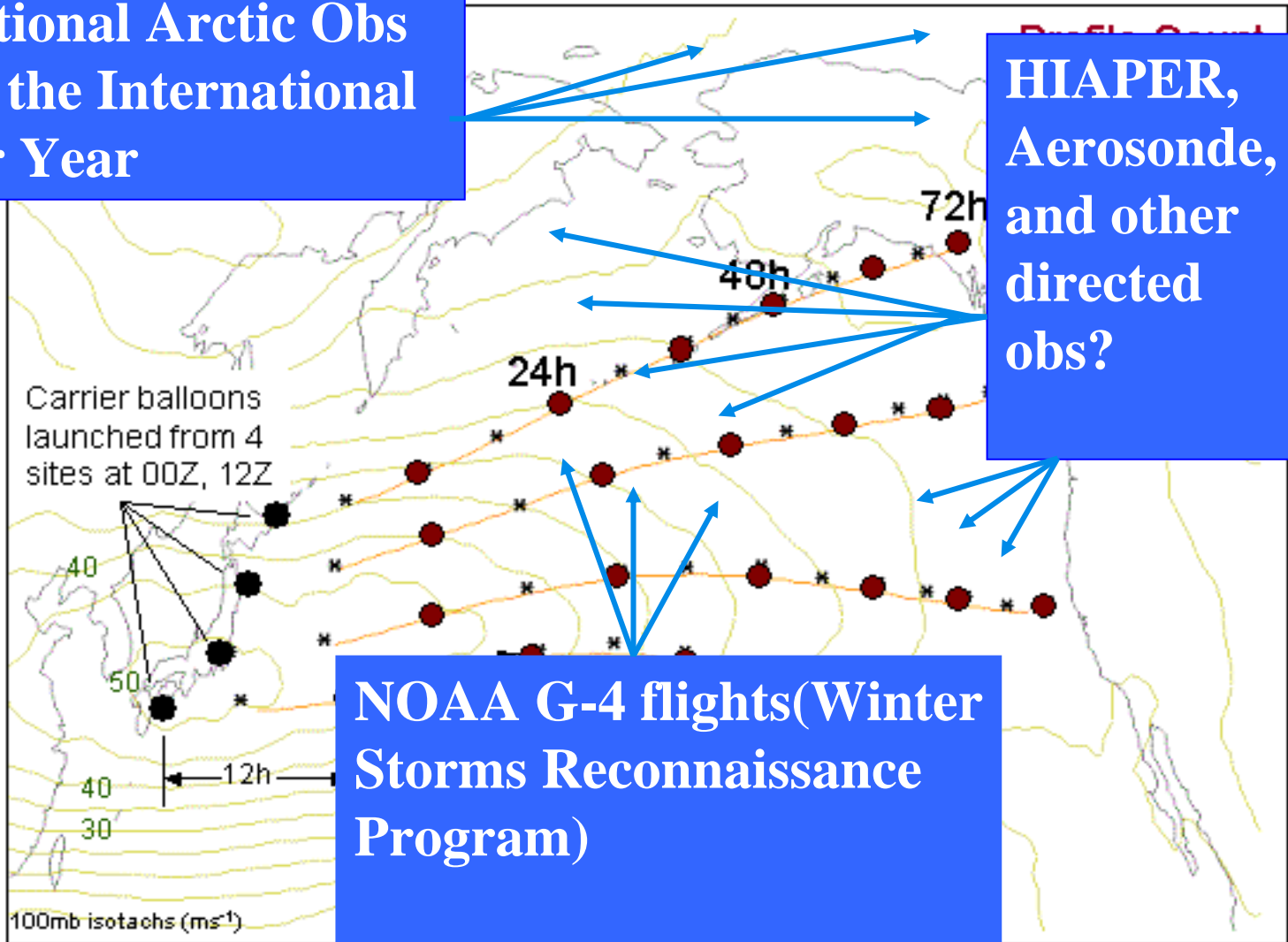
### 24hr Forecast Error Sensitivity Summary Product $ci=1 \text{ J kg}^{-1}$



# 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)

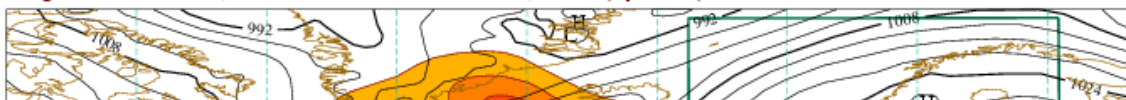
ECMWF-SAP based on TE-SVs (dry T42) and MSL

Valid time: 20031202, 18 UT (Targeting Time)

Shading: areas of 8, 4, 2, 1 x10<sup>6</sup> km<sup>2</sup>

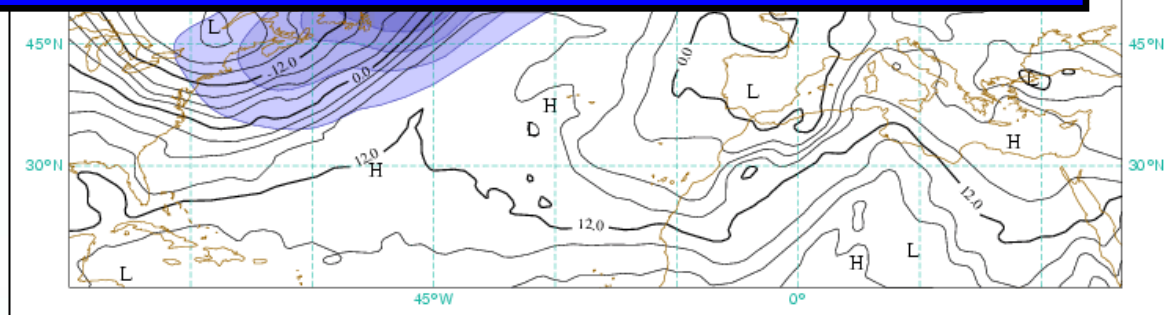
trajectory initialized from fc 20031130, 00 UT +66 h

Targ. time: 20031202, 18 UT / Verif. time: 20031204, 12 UT (opt: 42h)

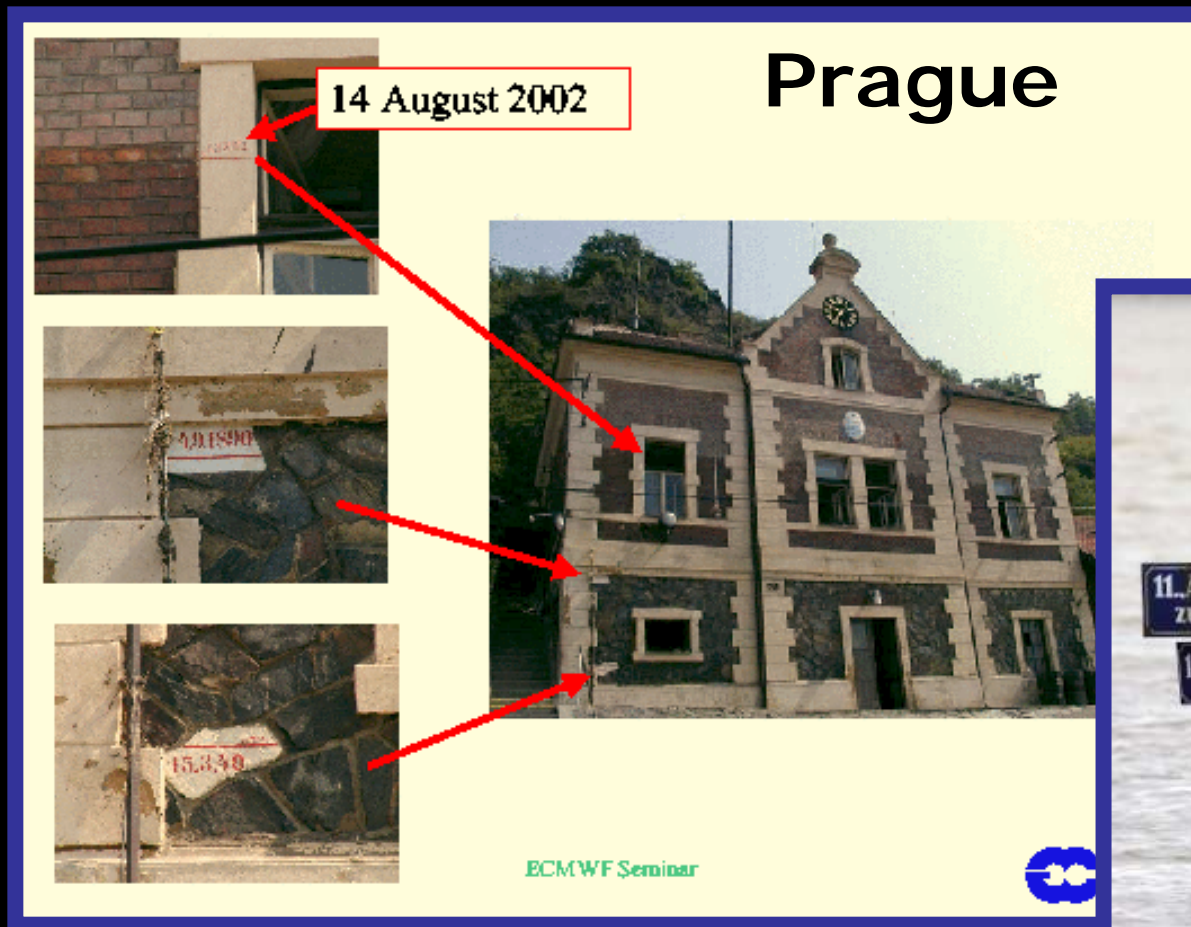


**Agreement between different techniques and models in the location and height of the prediction of sensitive regions for this Atlantic TREC occurs in only about 15% of the time!**

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



# 1<sup>st</sup> Example: Central European Floods



August 2002

Courtesy of Mel Shapiro

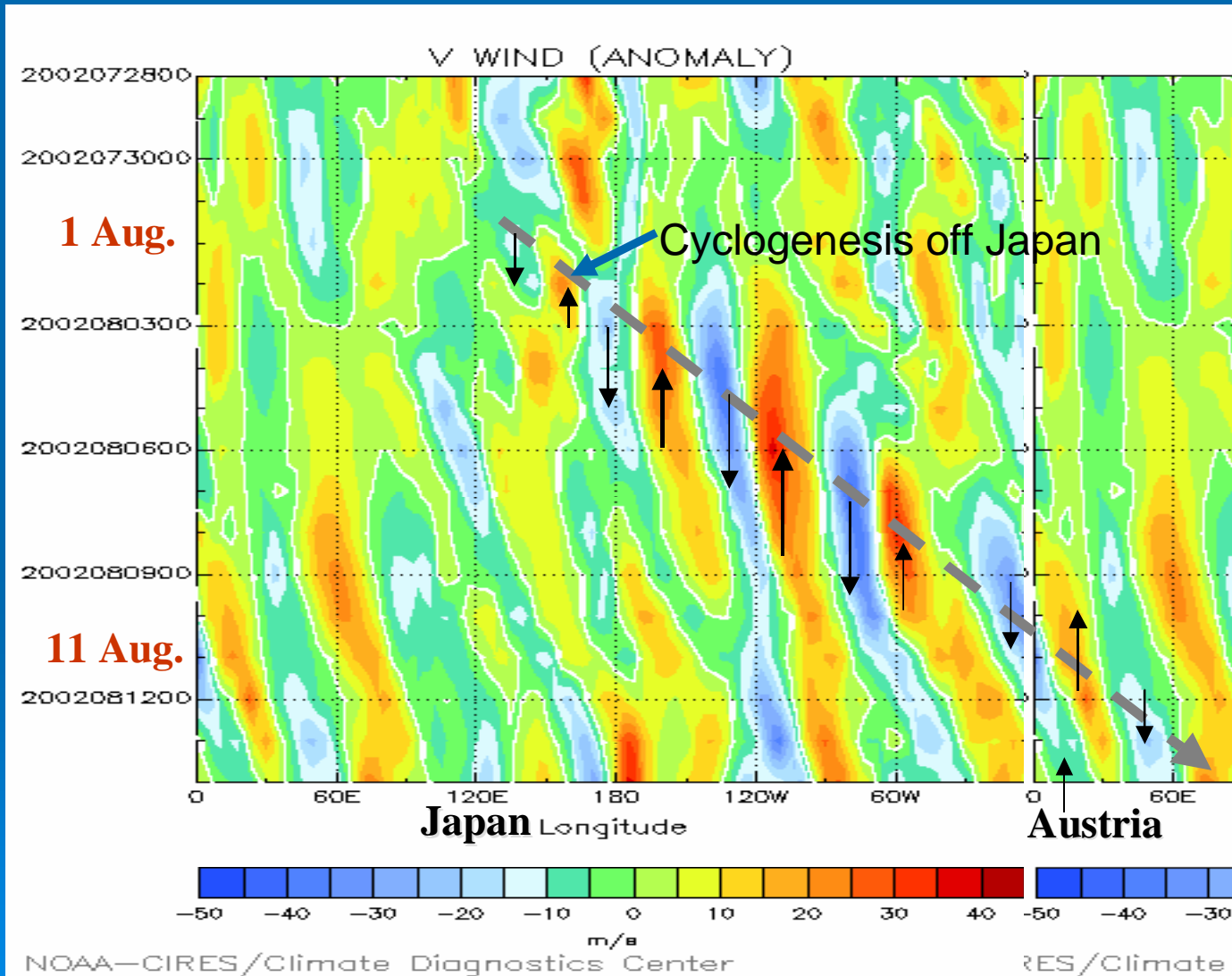
# Dresden Germany



Courtesy of Mel Shapiro



# Central European Floods



# 2<sup>nd</sup> 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.

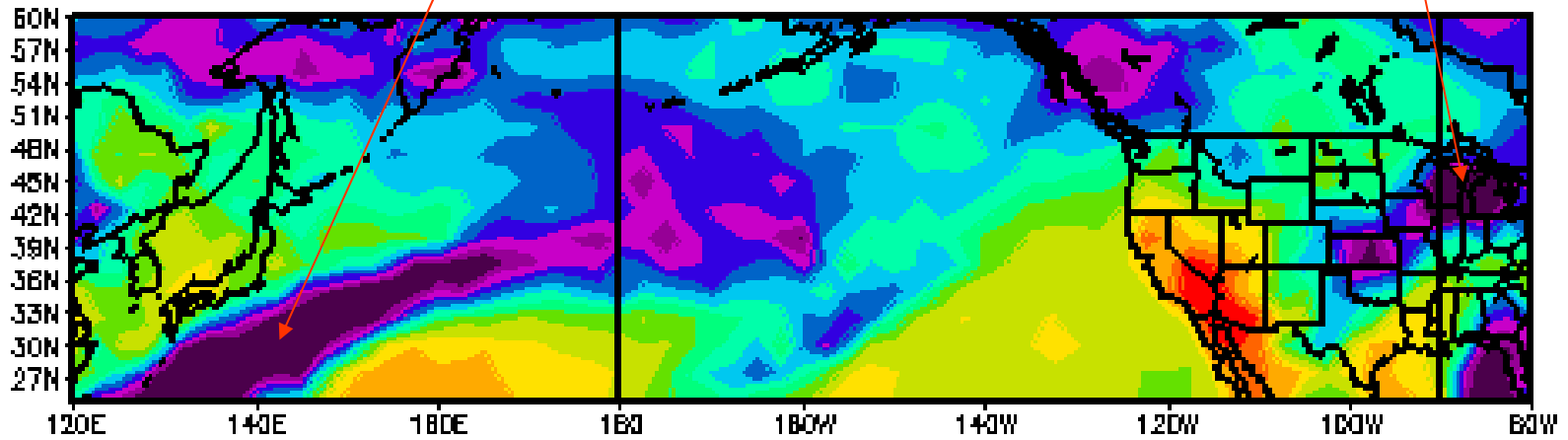
80% of homes and businesses damaged in Roseau, MN

Locally most significant flood on record.



Wisc. flood, previous wave packet

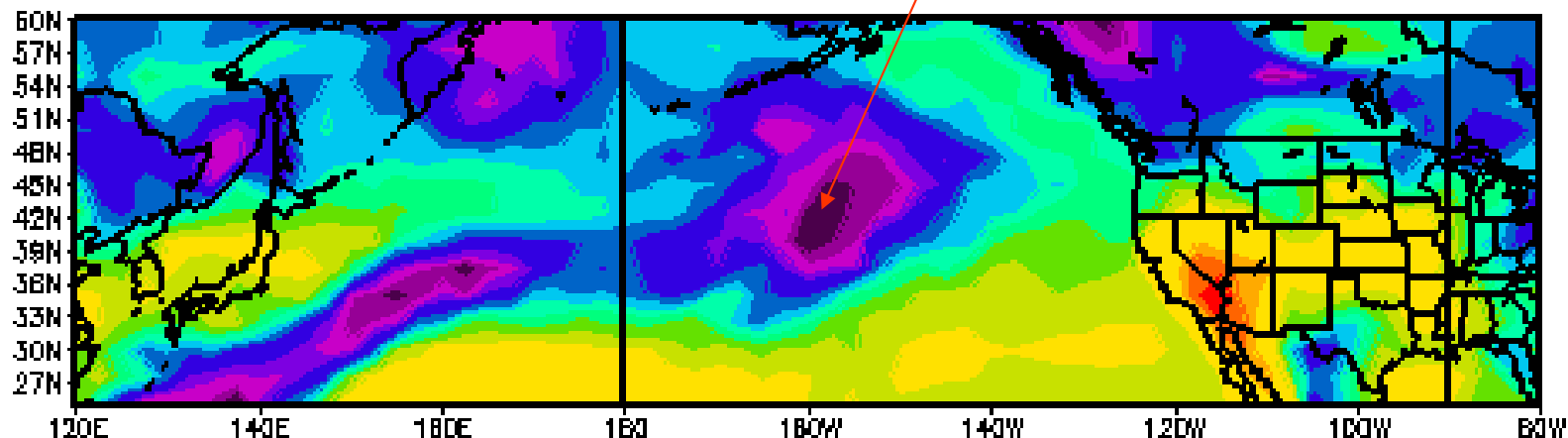
Convection along Mei-Yu Front



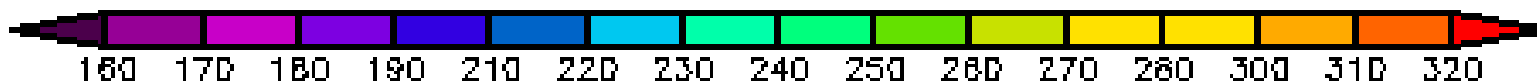
OUTGOING LONGWAVE RADIATION 02-DAY MEAN FOR:  
Tue JUN 04 2002 - Wed JUN 05 2002  
LIEBMANN & SMITH INTERPOLATED OLR



1<sup>st</sup> Downstream Cyclogenesis

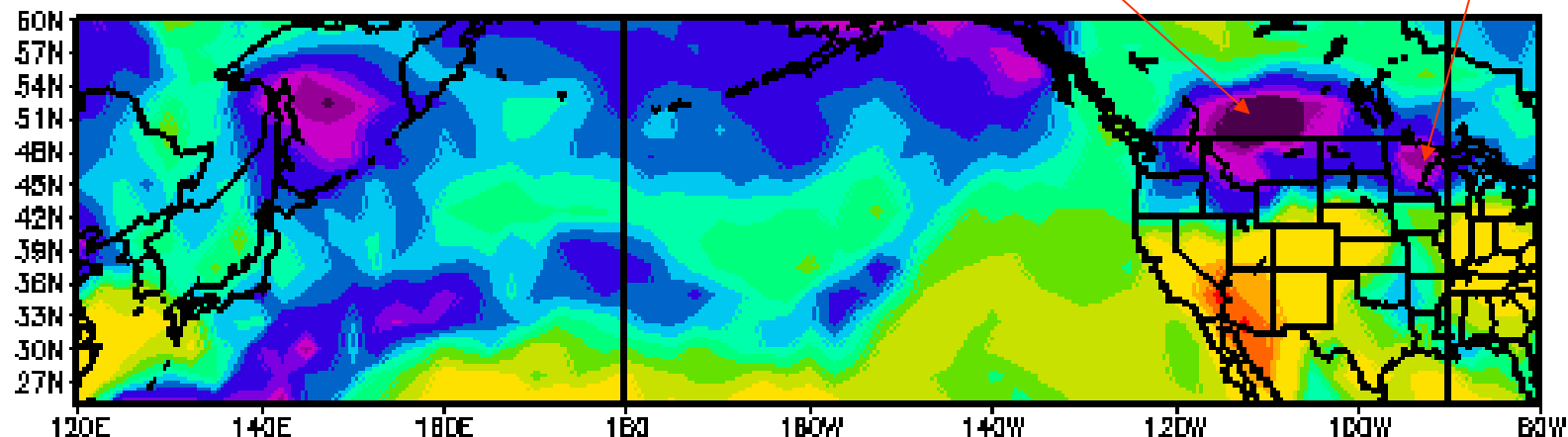


OUTGOING LONGWAVE RADIATION 02-DAY MEAN FOR:  
Thu JUN 06 2002 - Fri JUN 07 2002  
LIEBMANN & SMITH INTERPOLATED OLR

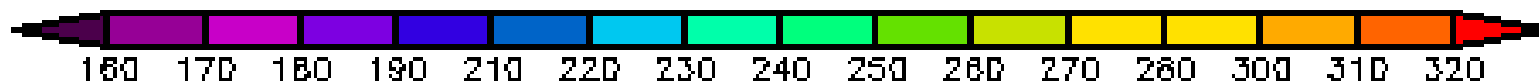


2<sup>nd</sup> Downstream  
cyclogenesis

Mn flood  
from frontal  
overrunning



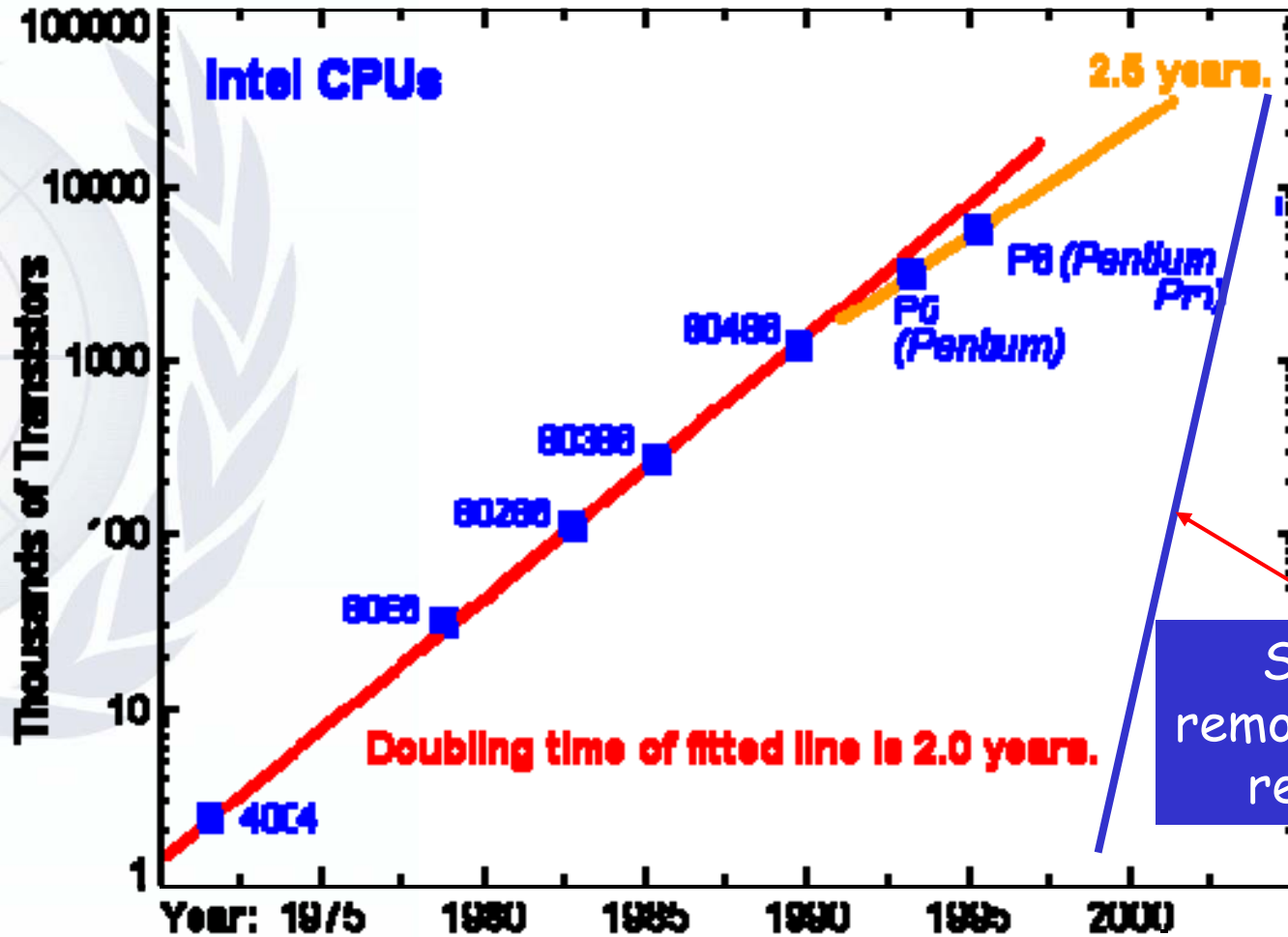
OUTGOING LONGWAVE RADIATION 02-DAY MEAN FOR:  
Sat JUN 06 2002 - Sun JUN 09 2002  
LIEBMANN & SMITH INTERPOLATED OLR



# 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