Assimilation of data from AIRS for improved numerical weather prediction

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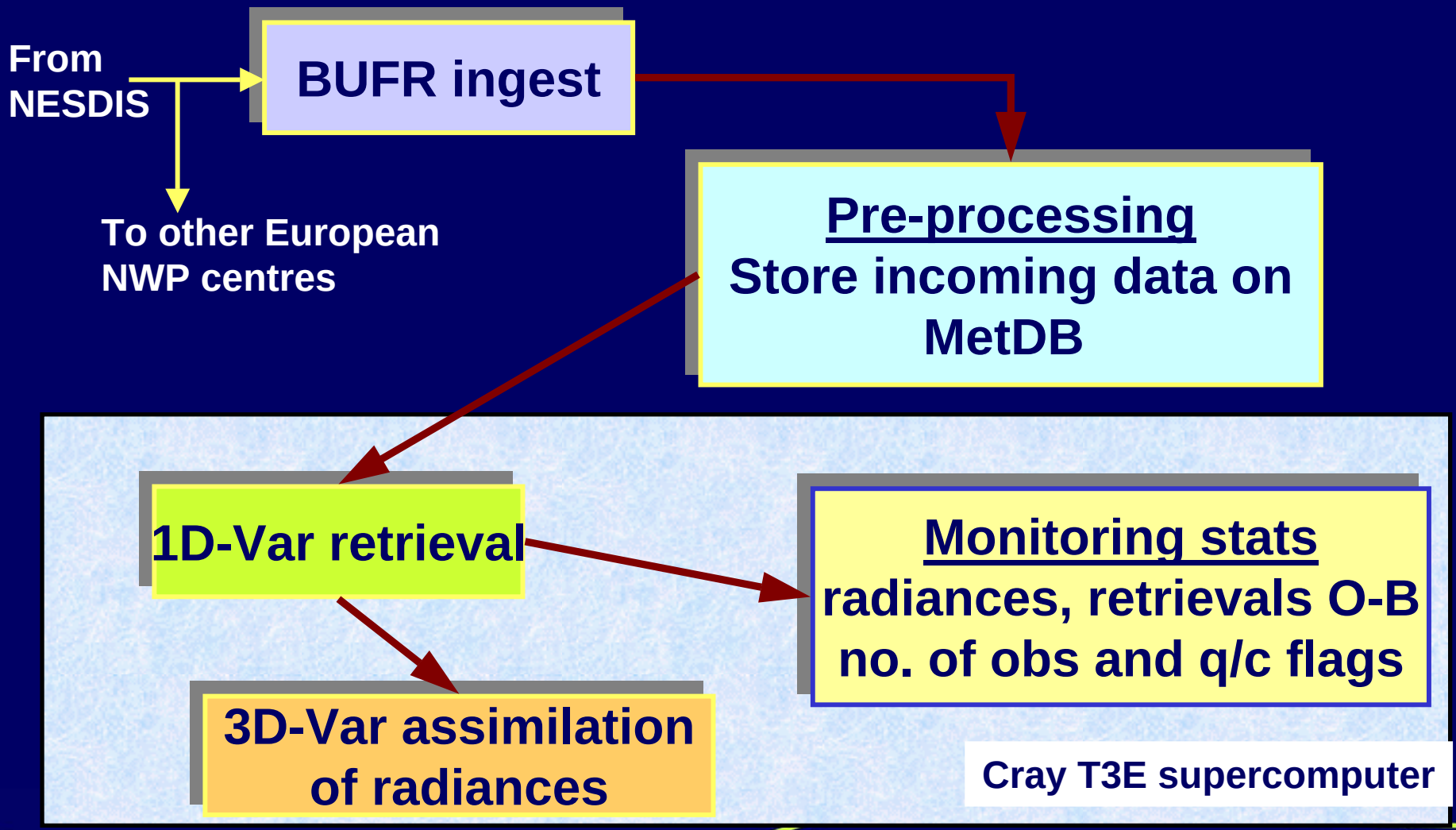
AIRS data processing at the Met Office



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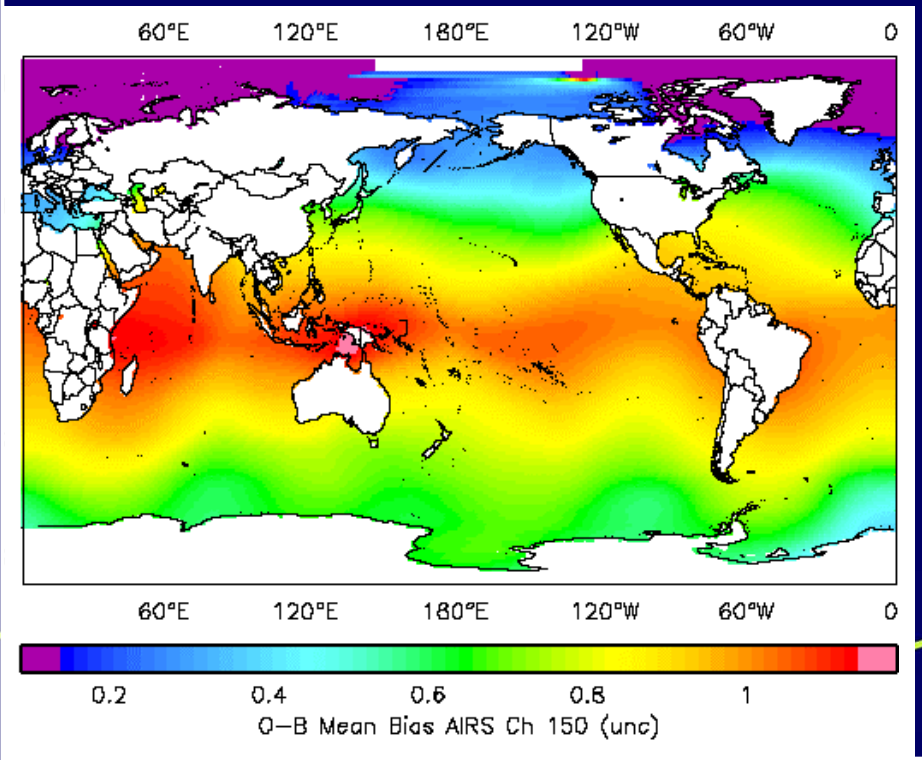
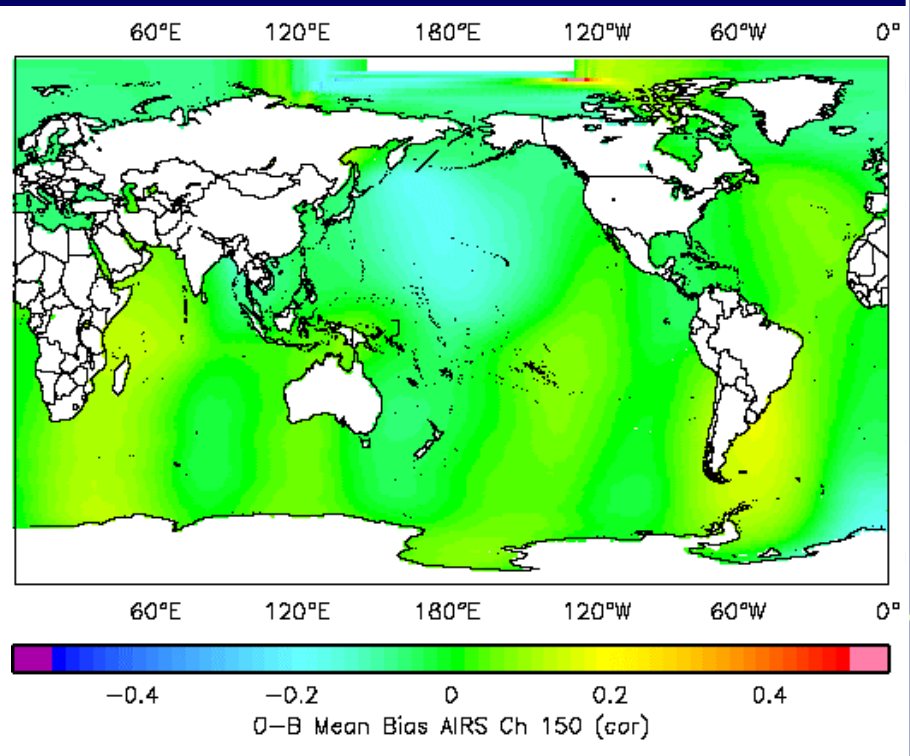
Bias Correction

- Biases vary with scan angle
- Biases vary with “air-mass”
- Biases are channel dependent

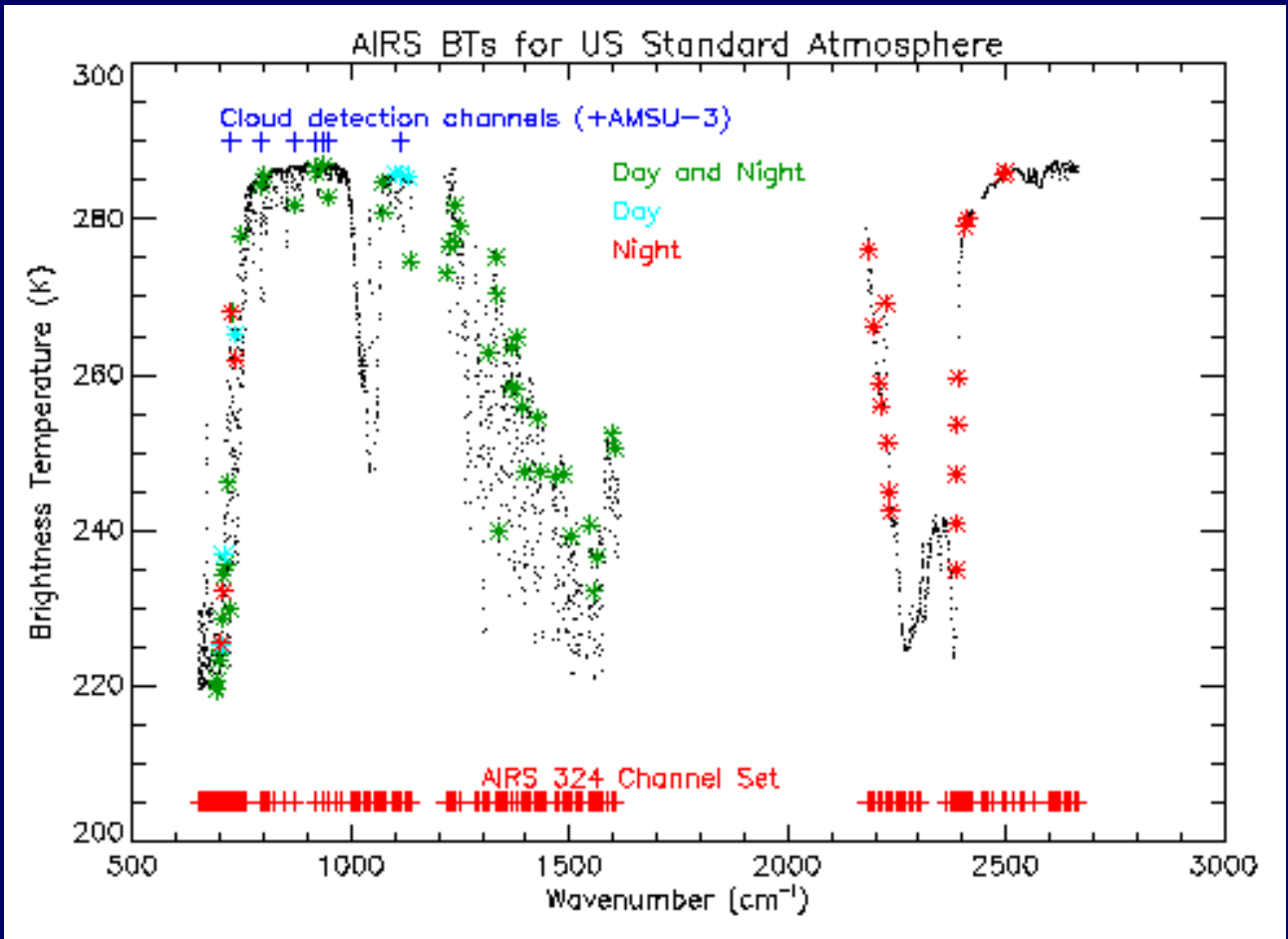
- Air-mass bias predictors
  - brightness temperature
  - 200-50 hPa thickness
  - 850-300 hPa thickness

16 January - 15 February 2003, AIRS channel 150 (692.8 cm^{-1} / 14.4 μm)





Channel Selection



- 324 AIRS channels supplied
- Assimilate a subset of 71 (day) or 86 (night)
- Choose those with highest impact on degrees of freedom for signal (Rodgers, 1996)

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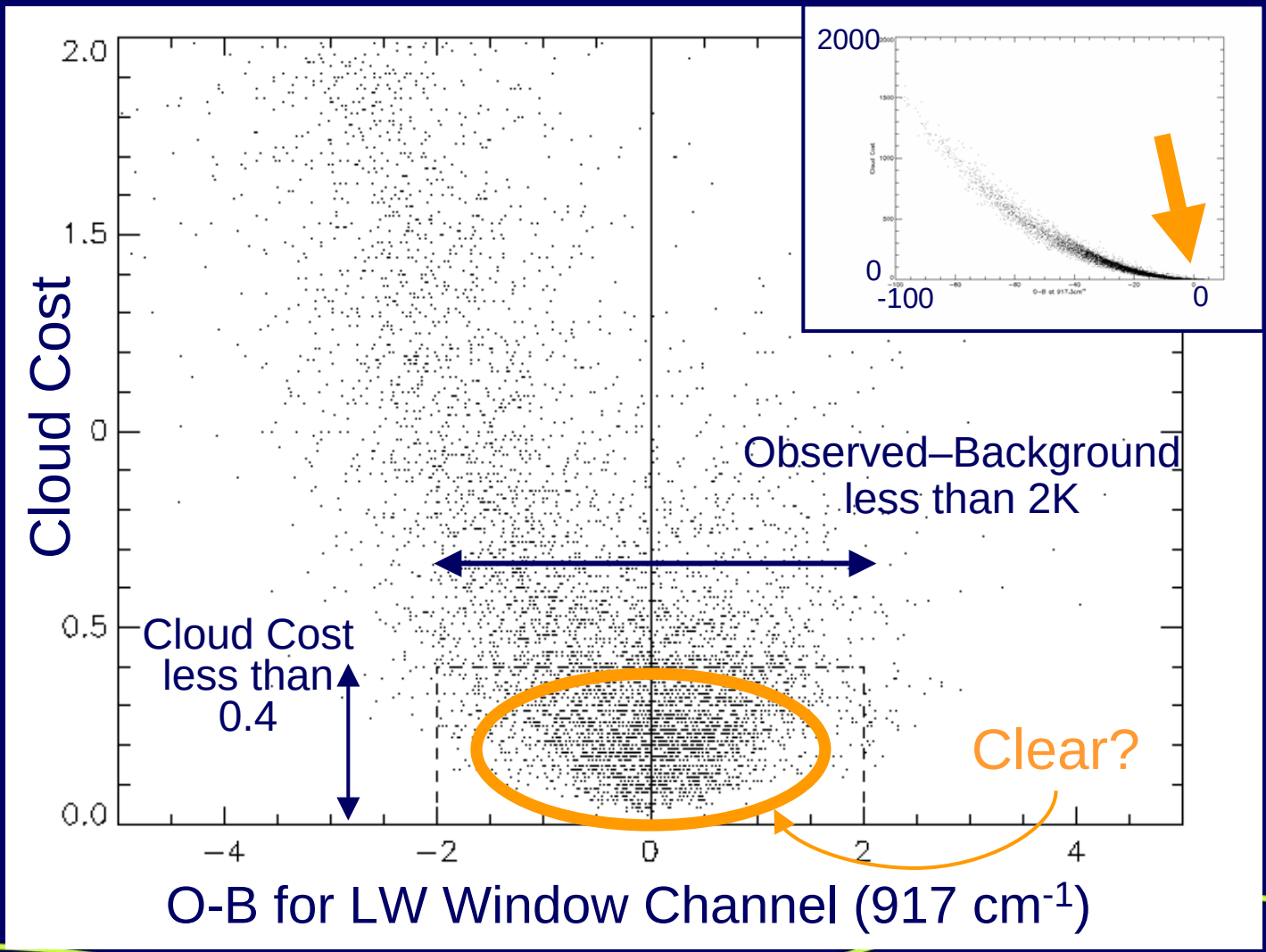
Variational Cloud Detection



Cloud Cost: Attempt to determine the probability of having cloud in the field of view, given the observed radiances and the NWP background profile (English, Eyre and Smith, 1999)

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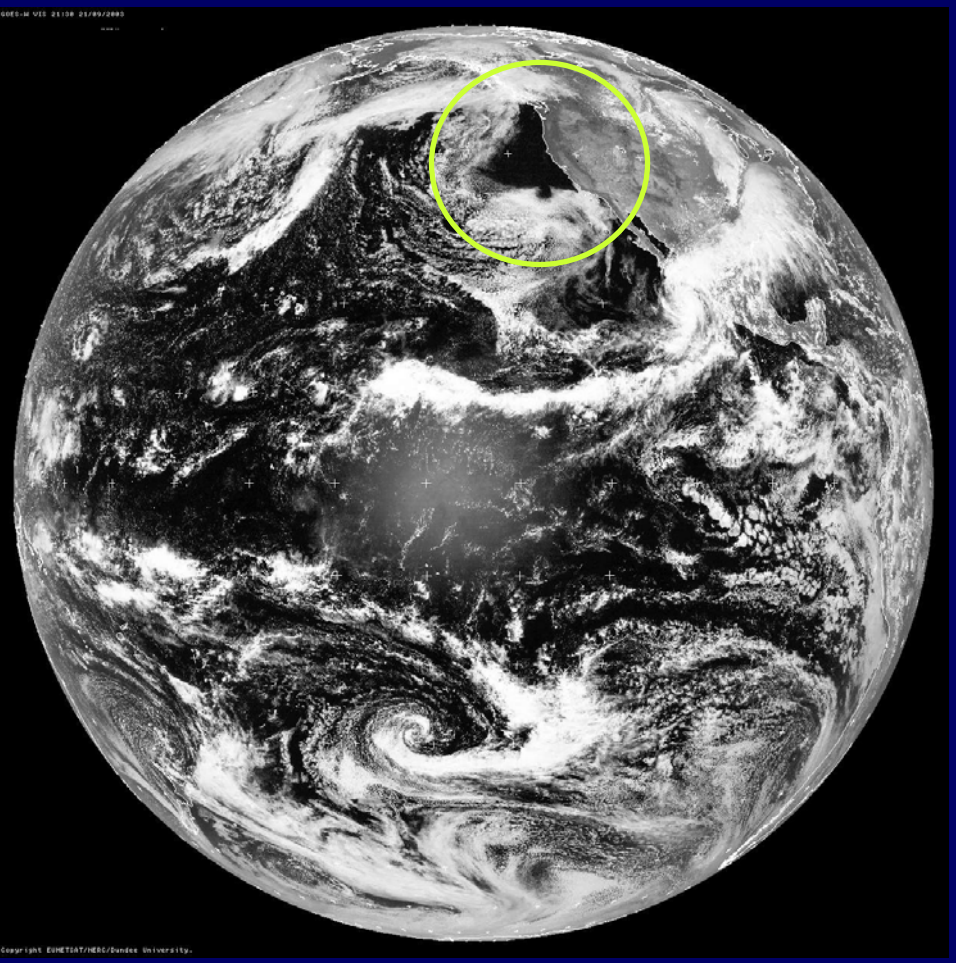
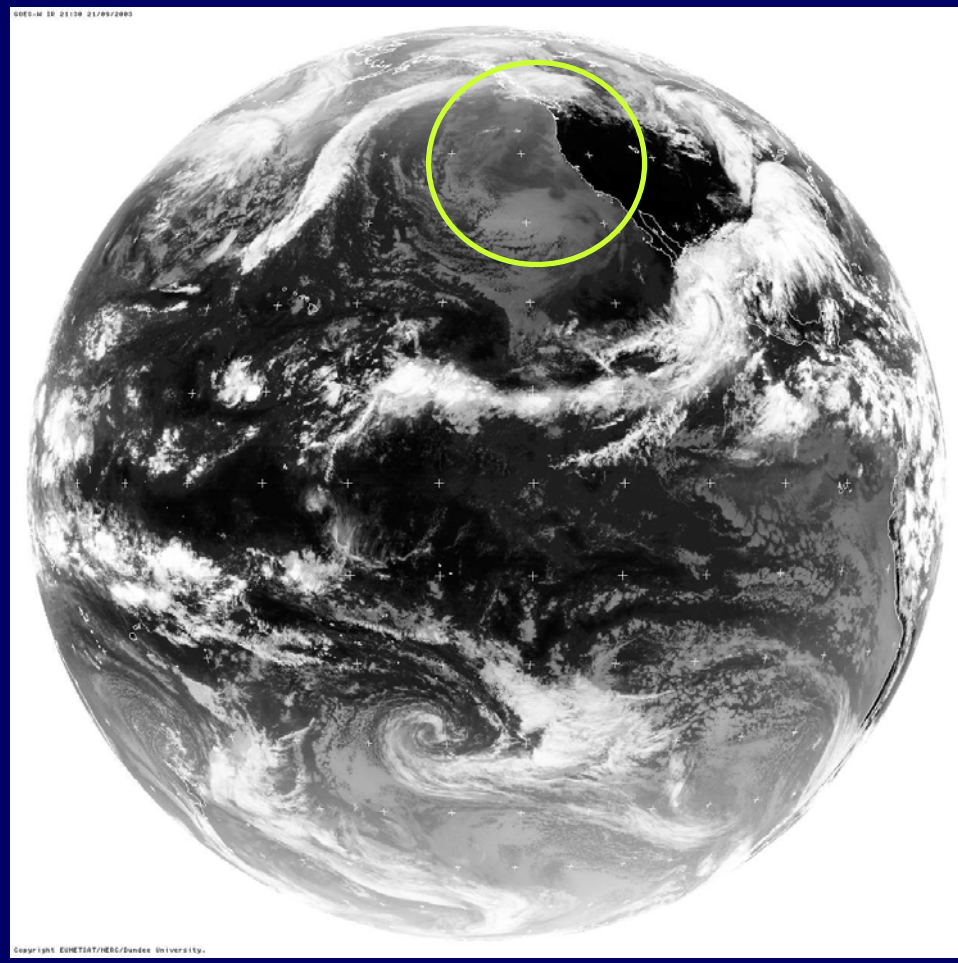
Cloud Detection Verification (1/4):

GOES-W Images. 21/9/03 21.30Z





Focus on region of low thin cloud off western USA.

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Cloud Detection Verification (2/4): AIRS Visible Imager

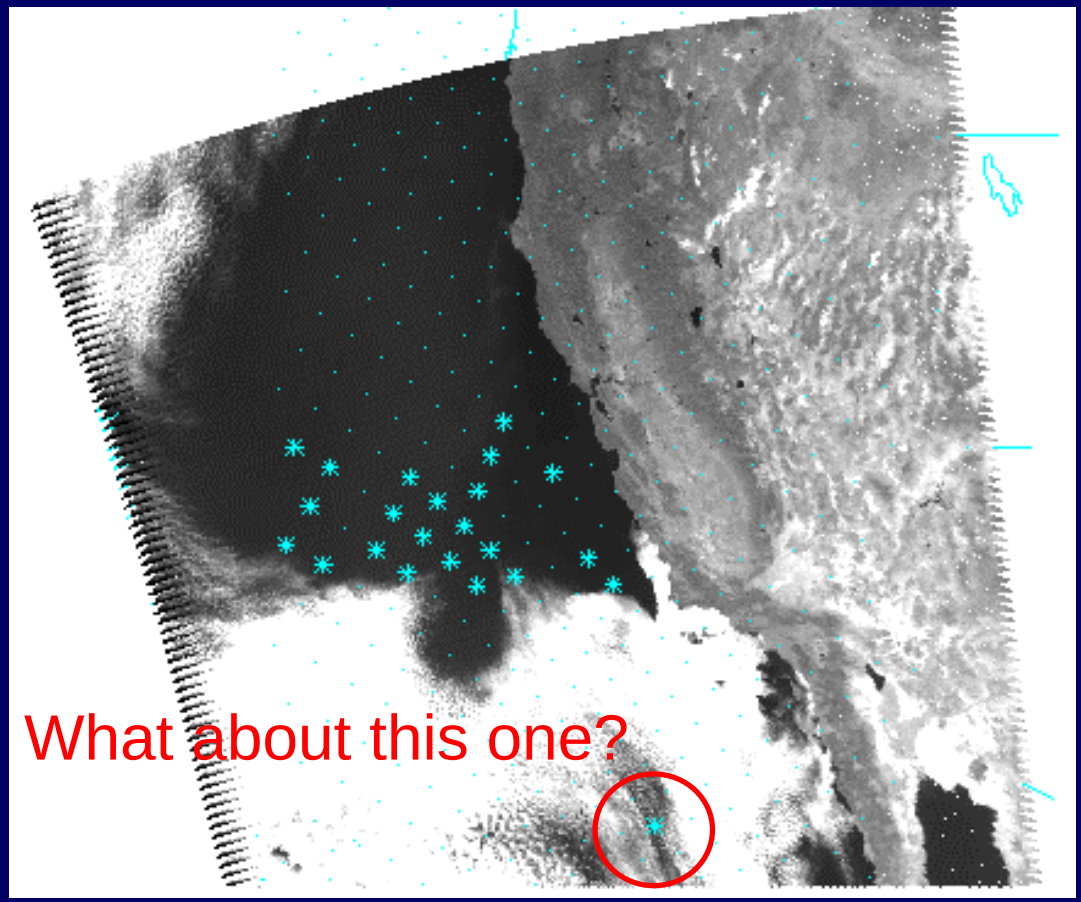

Image is AIRS Visible Imager Channel 4.
21st Sept. 2003 ~21.30Z

*=AIRS “Clear” FOV
. =AIRS “Cloudy” FOV

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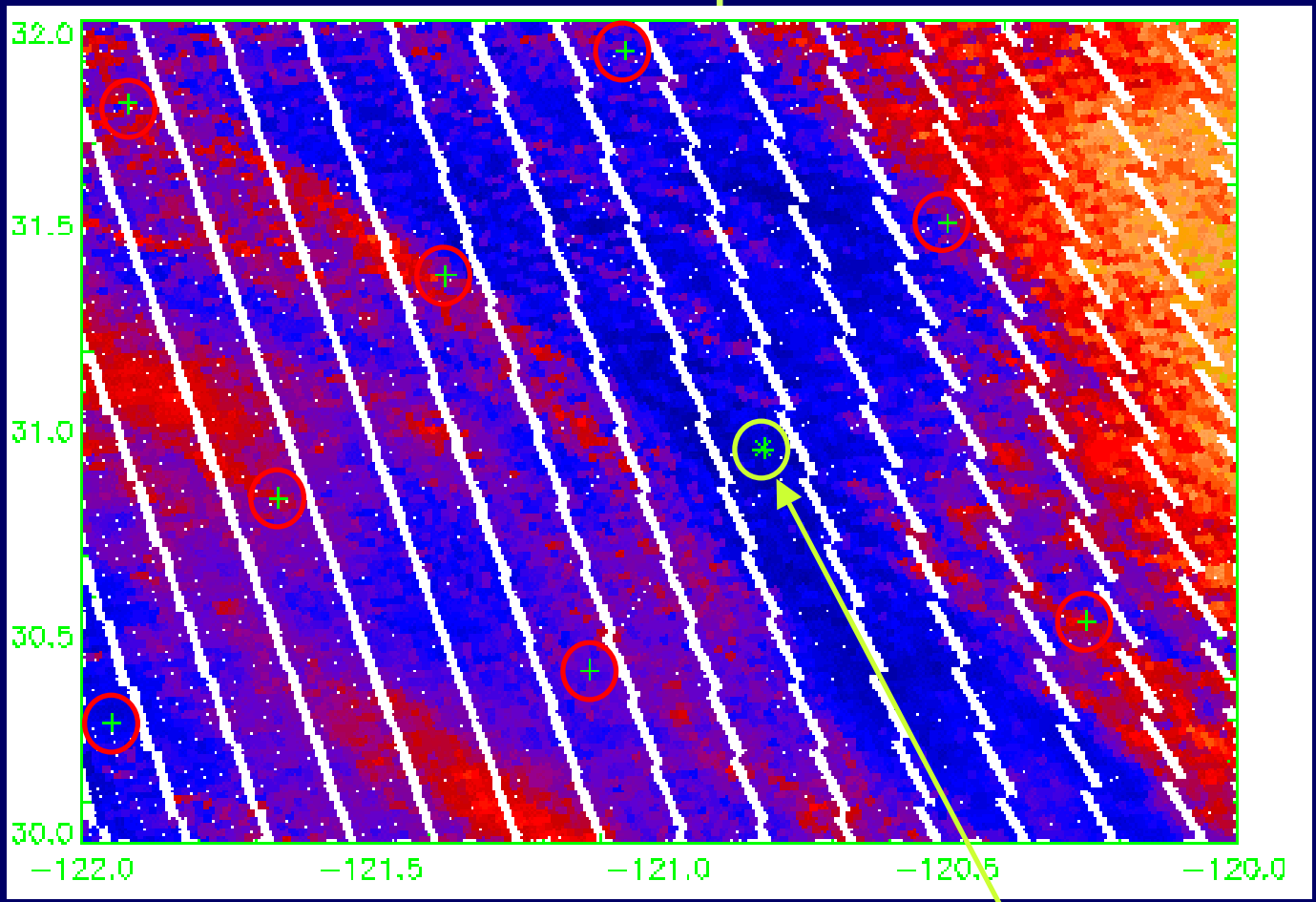
Cloud Detection Verification (3/4): Detail from previous slide



Blue :
Low Albedo

Orange:
High Albedo

Cloudy?

Clear?

Point from previous page seems to be clear

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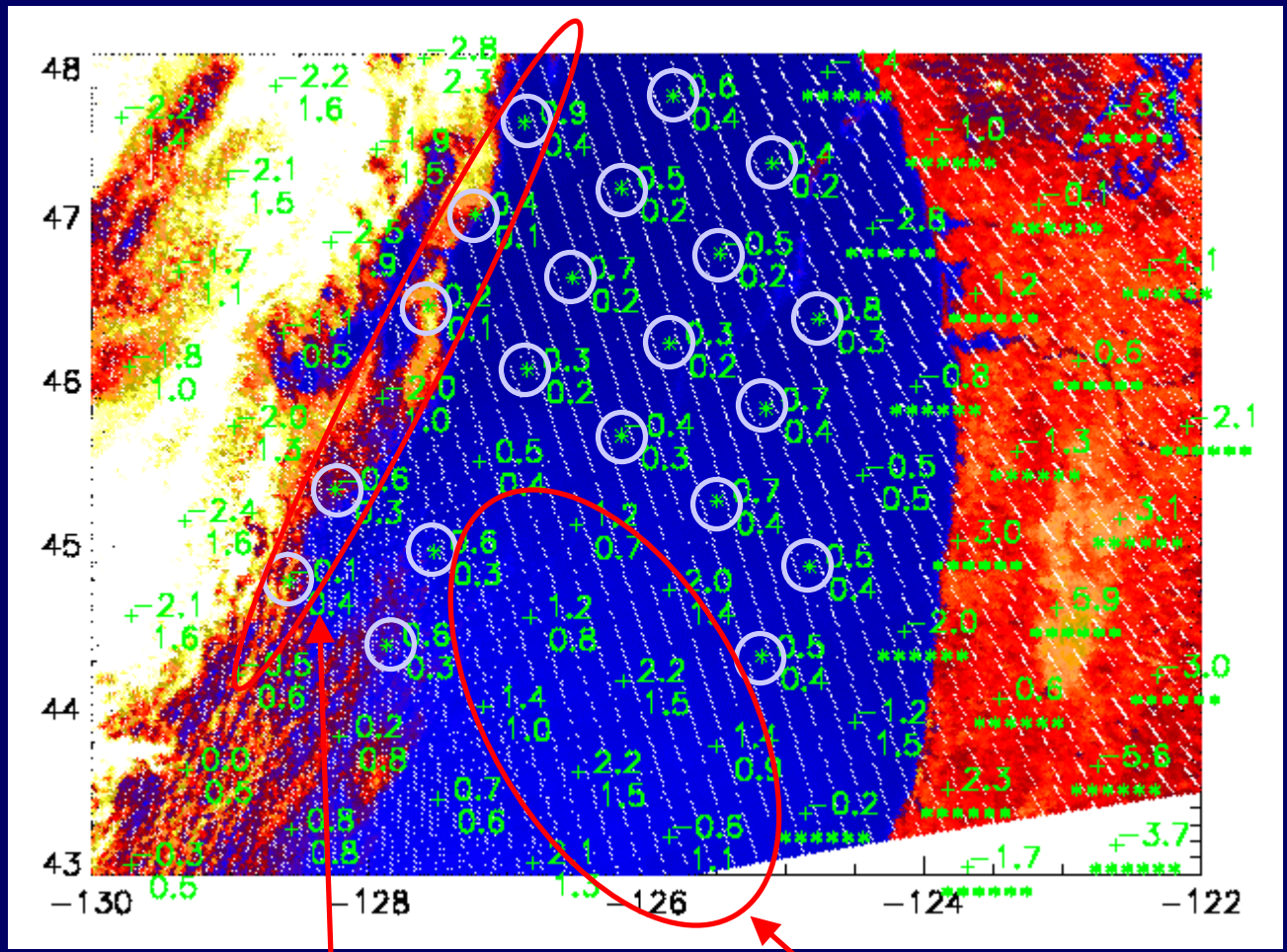
Cloud Detection Verification (4/4):
AIRS Imager, Off the coast of Washington



Top number is O-B in LW Window

Bottom number is Cloud Cost

Circled obs are designated clear

Here there are some erroneous clears on edge of thin, low cloud.

This region has high O-B: Almost certainly real SST error

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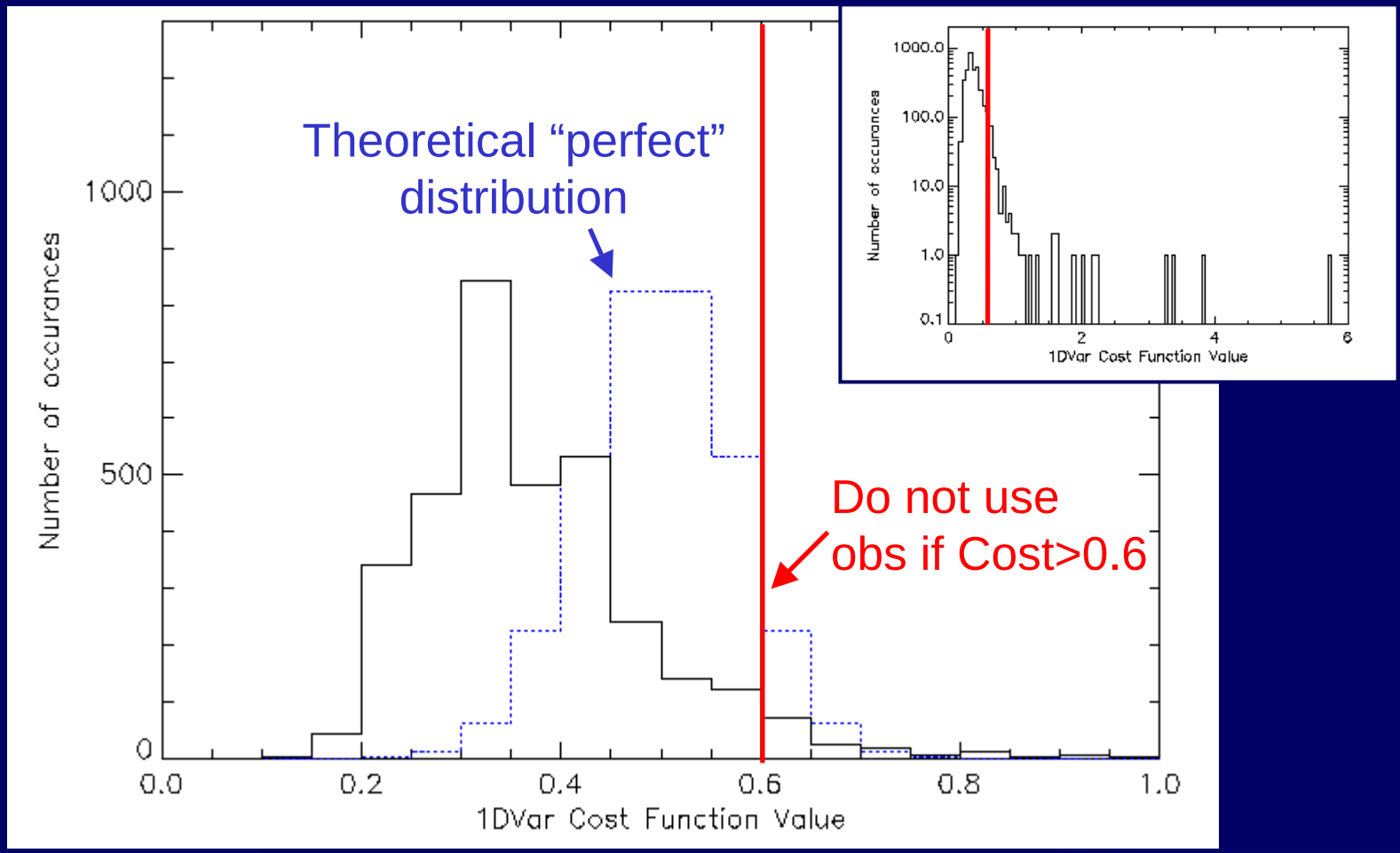
1D-Var Cost Distribution



No. of occurrences

1D-Var Cost Function Value

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Initial AIRS Assimilation Trial

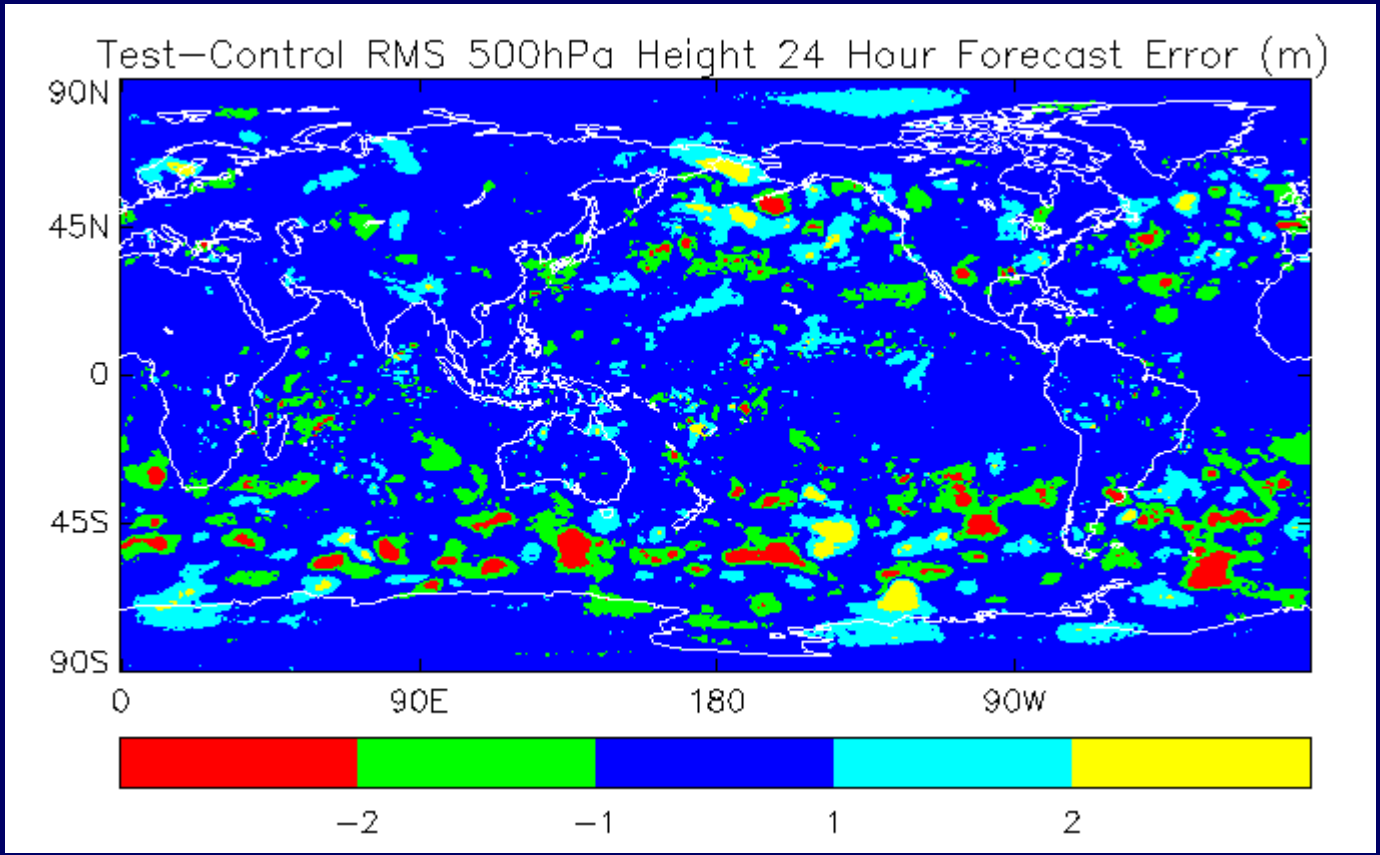
- 16th December 2002 - 13th January 2003
- Main AIRS trial run started in August 2003
  - Currently we have reached 5th January
- Headline verification score is NWP index
  - We are currently seeing improvements of 0.5% when verified versus sondes and surface obs.; 0.7% versus analysis fields.
- Here we present rms forecast errors for the 500hPa height.

Change in Forecast Errors: 500hPa Height at 24 hours

-0.2%

-0.6%

-1.8%



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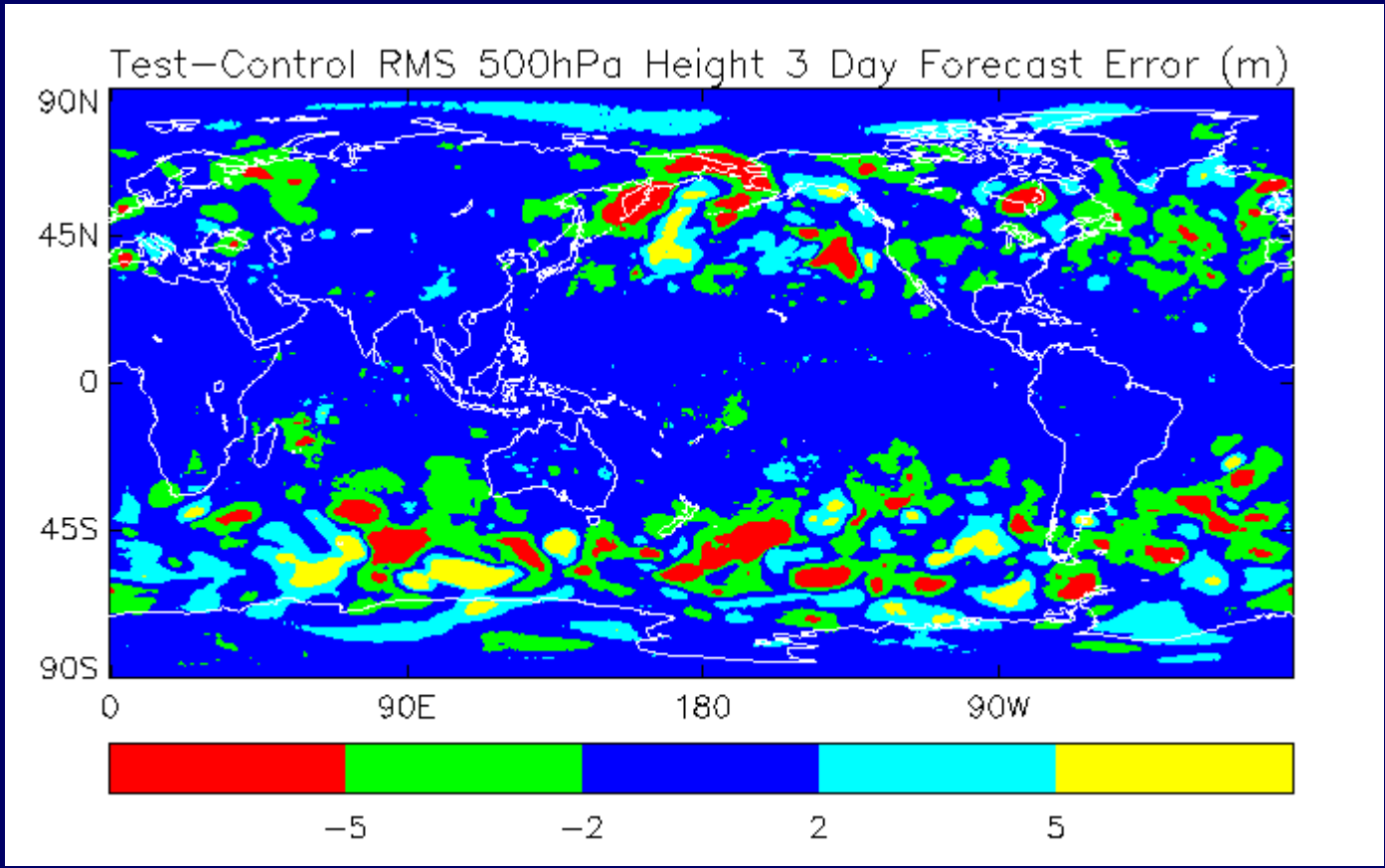
Change in Forecast Errors: 500hPa Height at 72 hours

-2.0%

-1.0%

+0.3%



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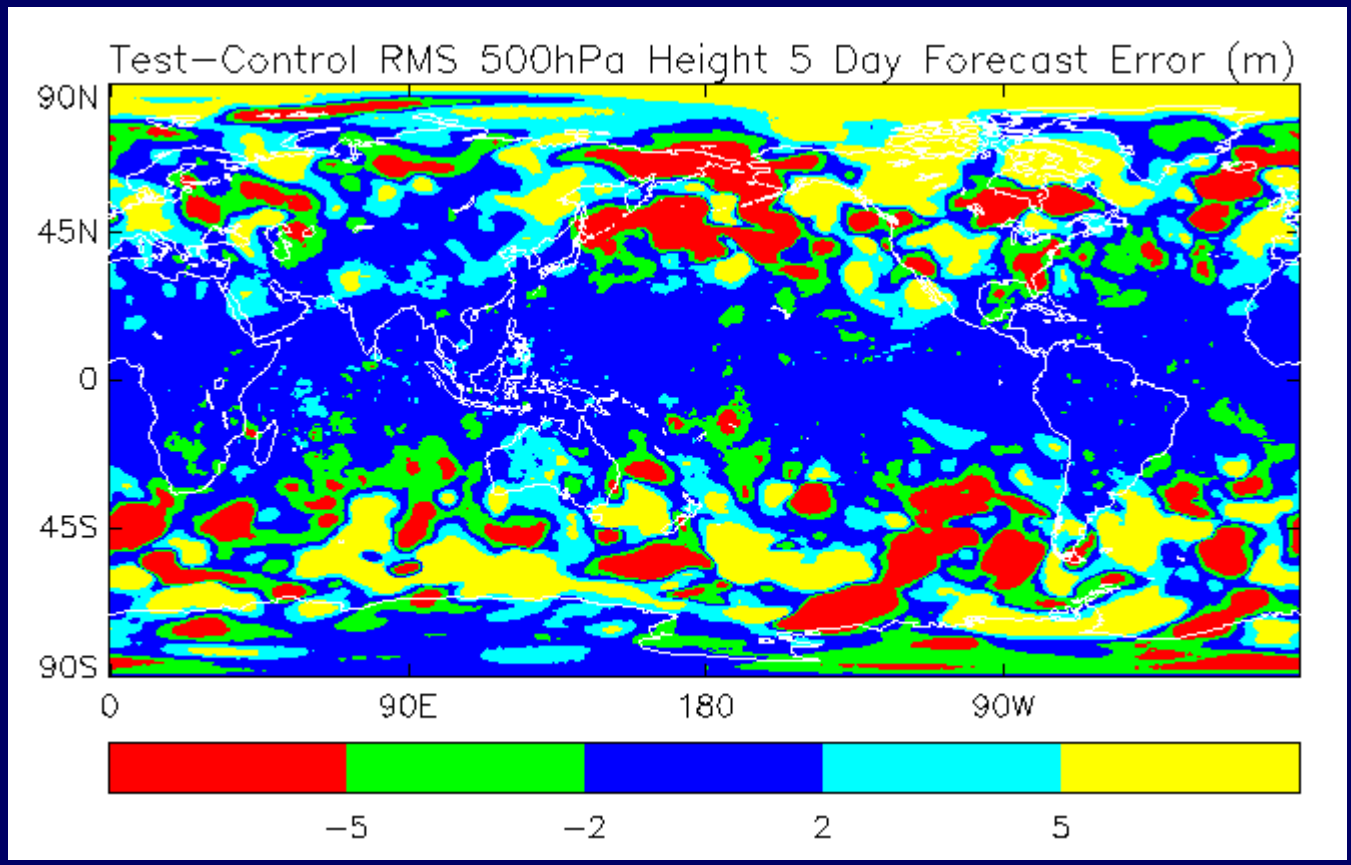
Change in Forecast Errors: 500hPa Height at 120 hours

0.0%

-1.1%

-1.1%



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Future Work

- Improve cloud detection
  - Revisit channel choice for cloud detection
  - Look into implementing PCA approach
  - AIRS visible imager data (during daytime)
- Continue investigation of bias correction
- Use of advanced sounder data over land
  - Start by using channels that do not see the surface
- Assimilation of cloudy infrared data
  - Use 1DVar step to try to infer cloud optical properties before assimilation

Conclusions

- Day-1 processing system in place
  - System is designed to be very conservative.
- Cloud detection system being investigated
  - Some tuning may be required
- Initial trial results show neutral to positive impact.
- We will run a second trial for July 2003 on our new NEC SX-6 supercomputer
  - should be much faster!
  - If also neutral or positive AIRS should be operational by March 2004.