



# AIRS UPDATE

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09/18/02

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# TOPICS

- NRT Processing Status
- Principal Component Analysis
- First Look Regression Retrievals

# NRT Processing Update



- See Walter Wolf' presentation



# Level 3 Products

- Gridded datasets at 0.5 Lon. X 2.0 Lat.
- 2378 radiances ~ 602 mb per file  
(includes AMSU/HSB , two cloud tests,  
ancillary information)
- Principal component scores
- NCEP and ECMWF analysis
- Retrievals
- Cloud clear radiances



# Principal component analysis

- PC scores is a NRT product.
- 200 PCs are kept
- Only 60 – 100 are needed.
- Advantages – Data Compression, Noise Filtering and Noise Estimation

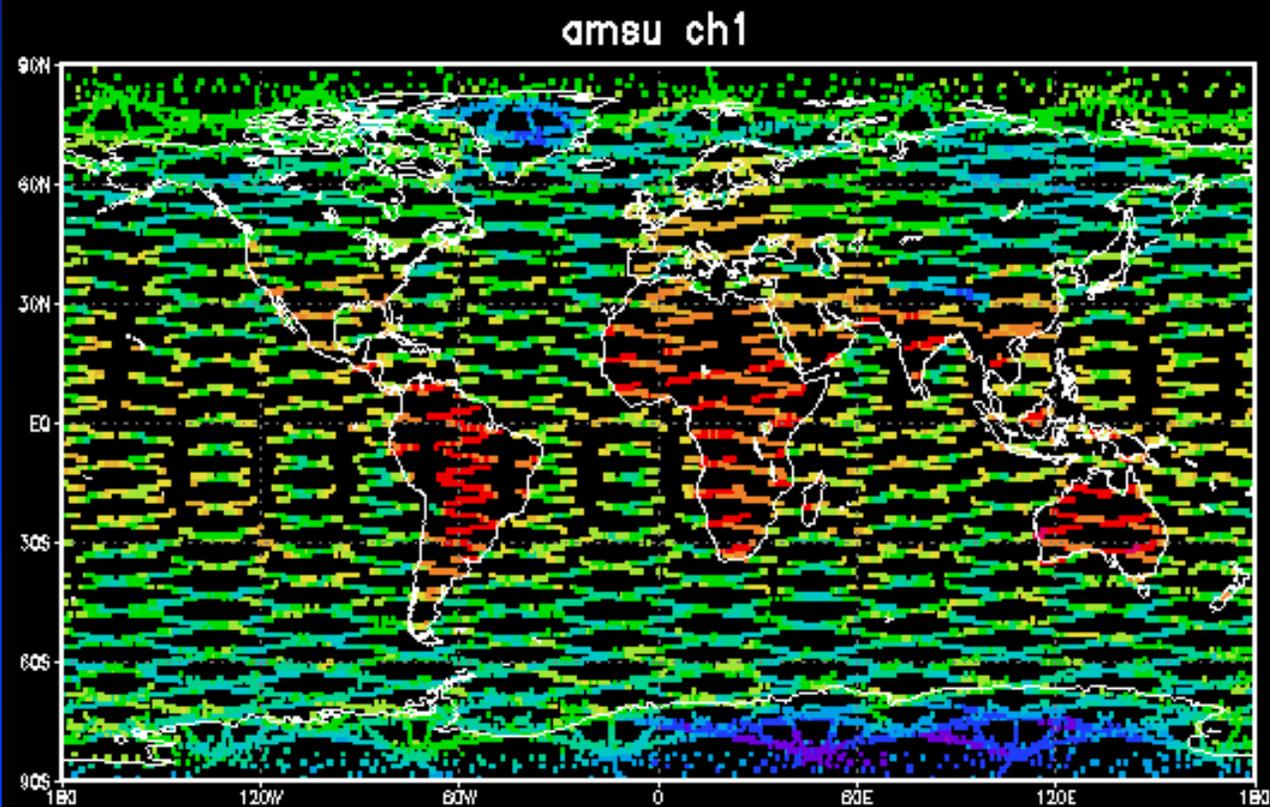


# AIRS applications

- Each day a spatial subset of AIRS data is produced (200 mbytes vs 30 GB full data)
- Eigenvectors are generated daily.
- A static set of eigenvectors is used, but the ensemble is occasionally updated with new structures.
- When the ensemble is updated a new set of eigenvectors is also updated.



# Locations used in generating eigenvectors



# Generating AIRS eigenvectors

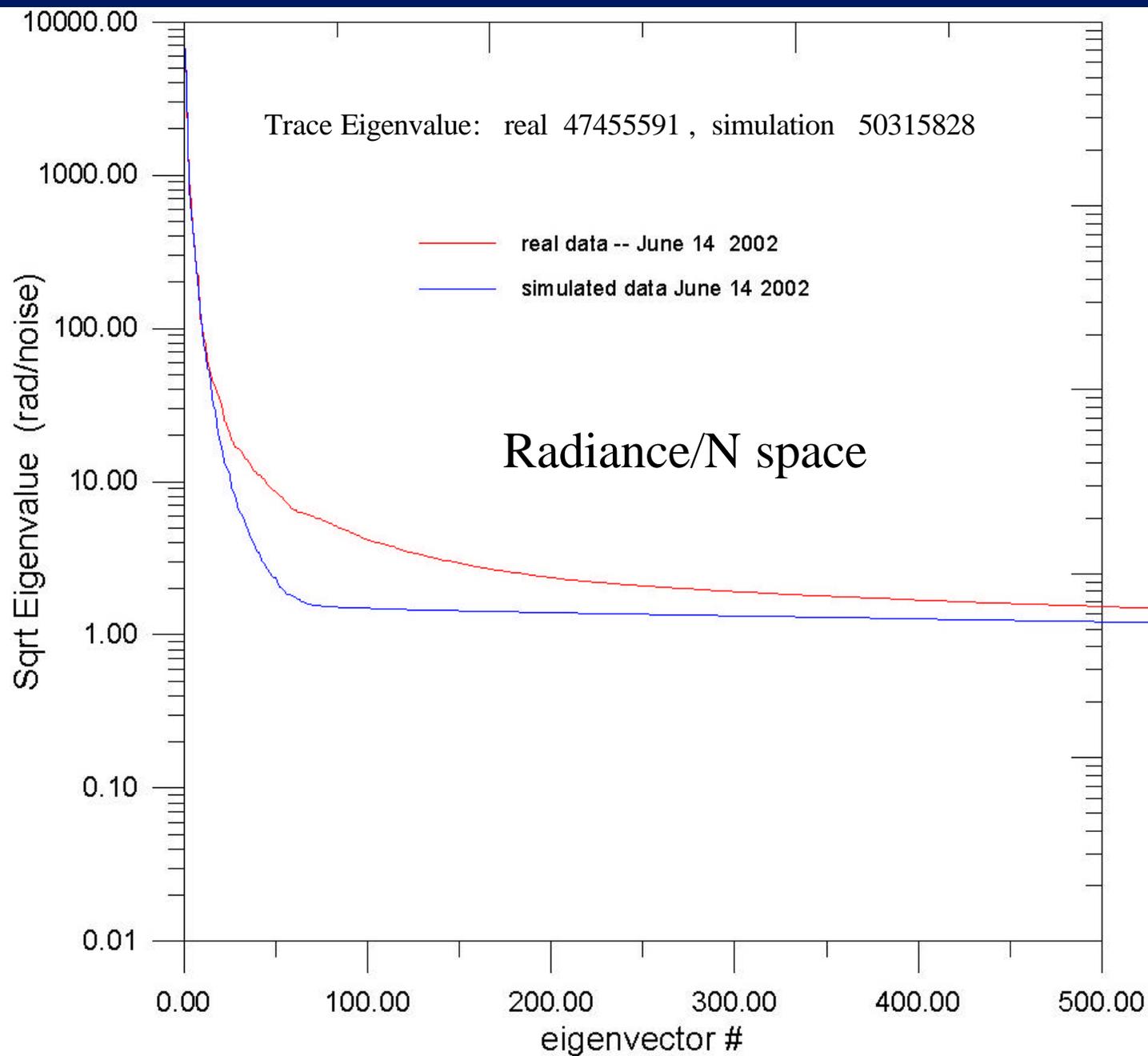


- The radiances are normalized by expected instrumental noise (signal to noise)
- Compute the covariance matrix  $S$
- Compute the eigenvectors  $E$  and eigenvalues  $\Lambda$   
$$S = E \Lambda E^T$$
- $E$  = matrix of orthonormal eigenvectors (2103x2103)  
 $\Lambda$  = vector of eigenvalues (explained variance)

# Applying AIRS eigenvectors



- On independent data – compute principal component scores.
- $P = E^T R$  ; elements of  $R = (r_i - \bar{r}_i) / n_i$
- Invert equation and compute reconstructed radiances  $R^*$ .
- $R^* = E P$
- Reconstructed radiances are used for quality control.
- Reconstruction score =  $[ 1/N \sum_{i=1}^N (R_i^* - R_i)^2 ]^{1/2}$   
i = 1 ....N channels



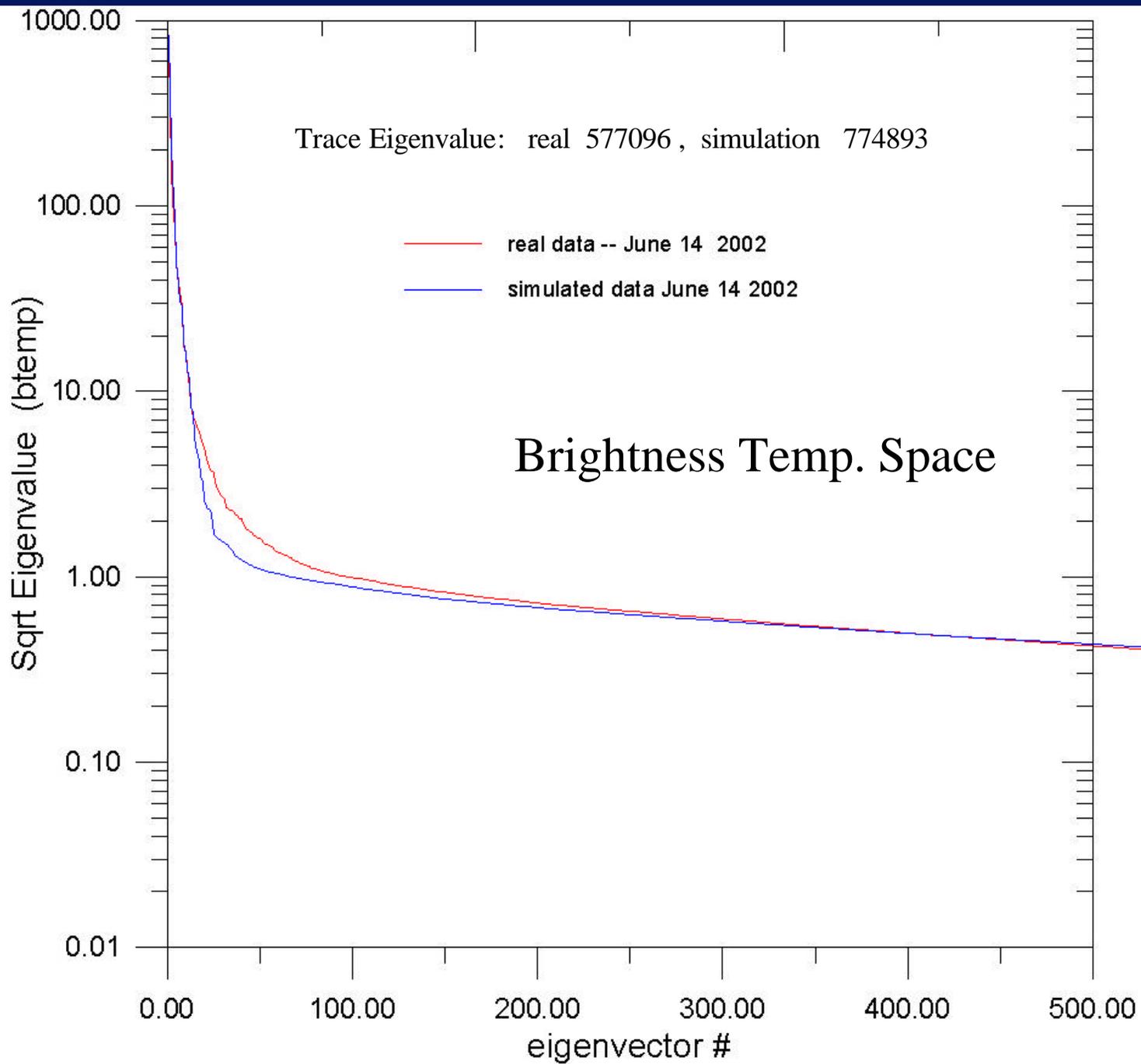


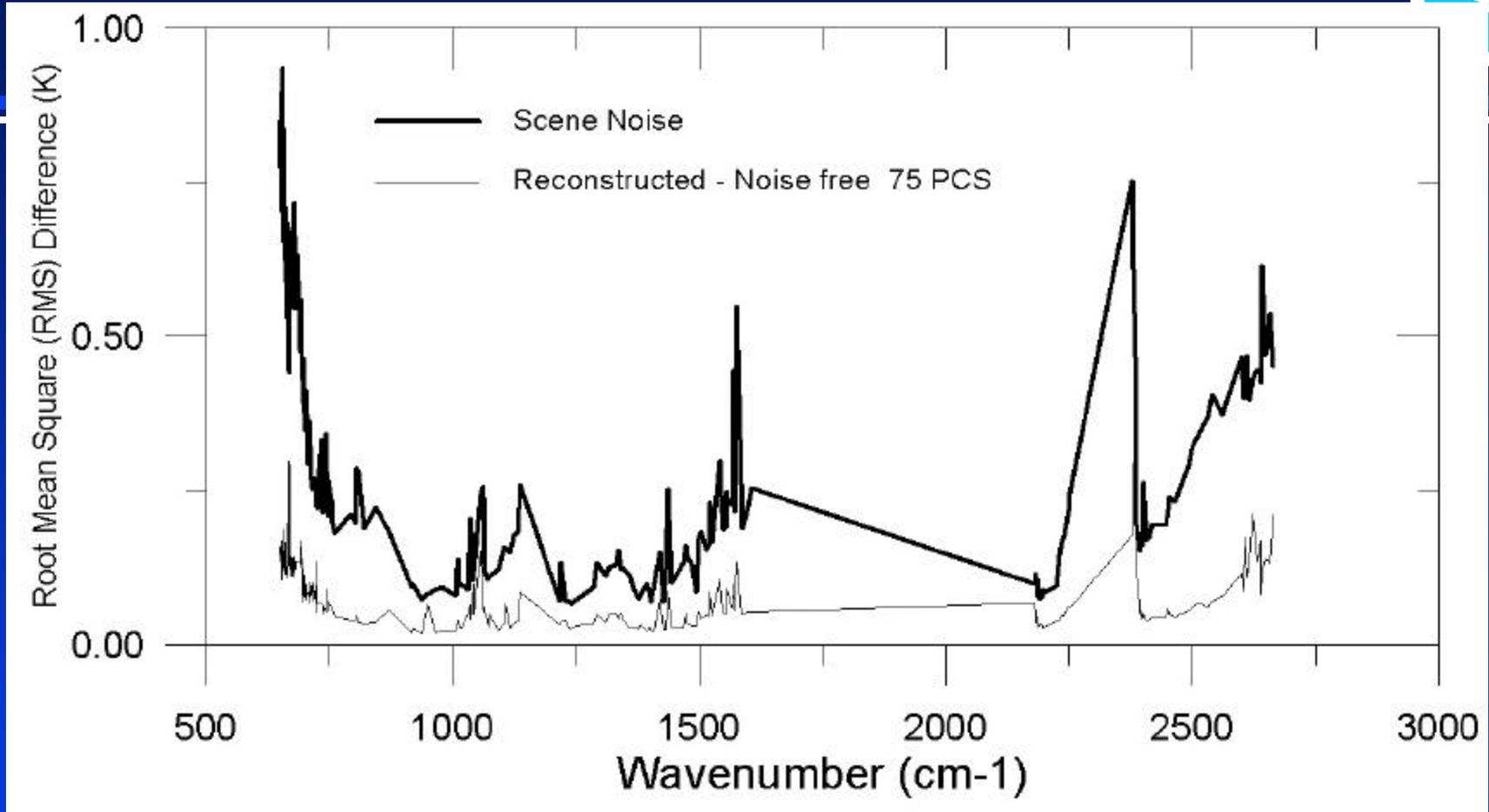
Trace Eigenvalue: real 577096 , simulation 774893

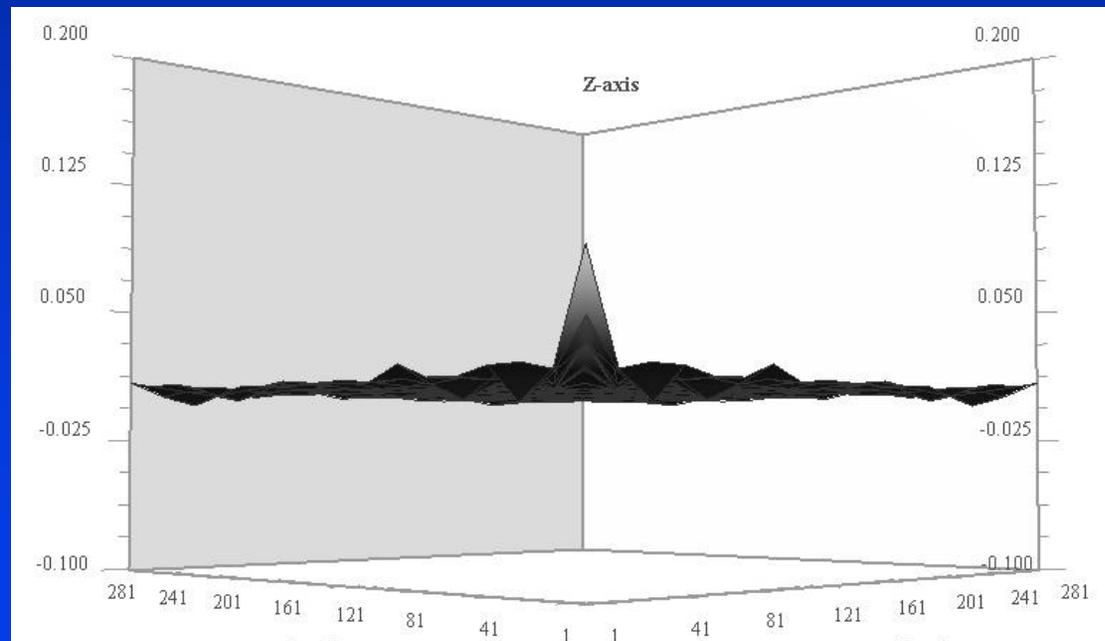
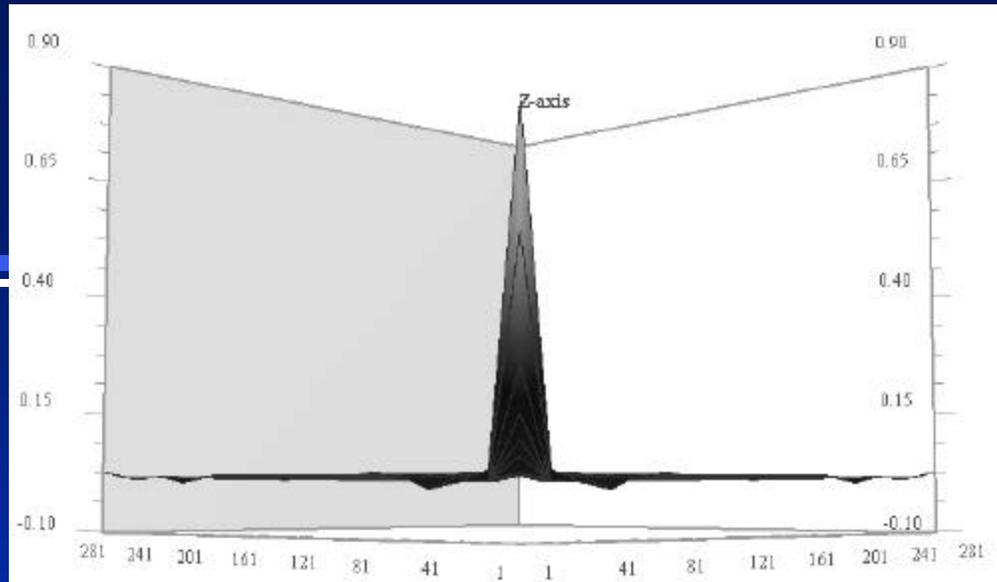
— real data -- June 14 2002  
— simulated data June 14 2002

### Brightness Temp. Space

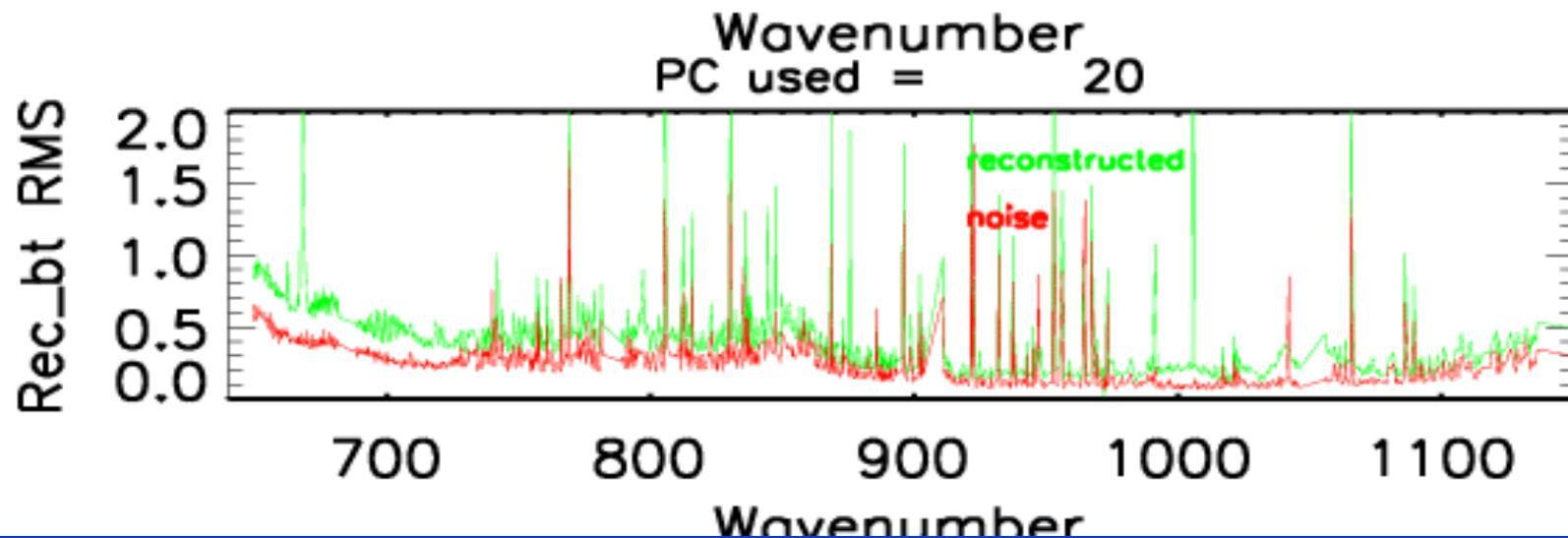
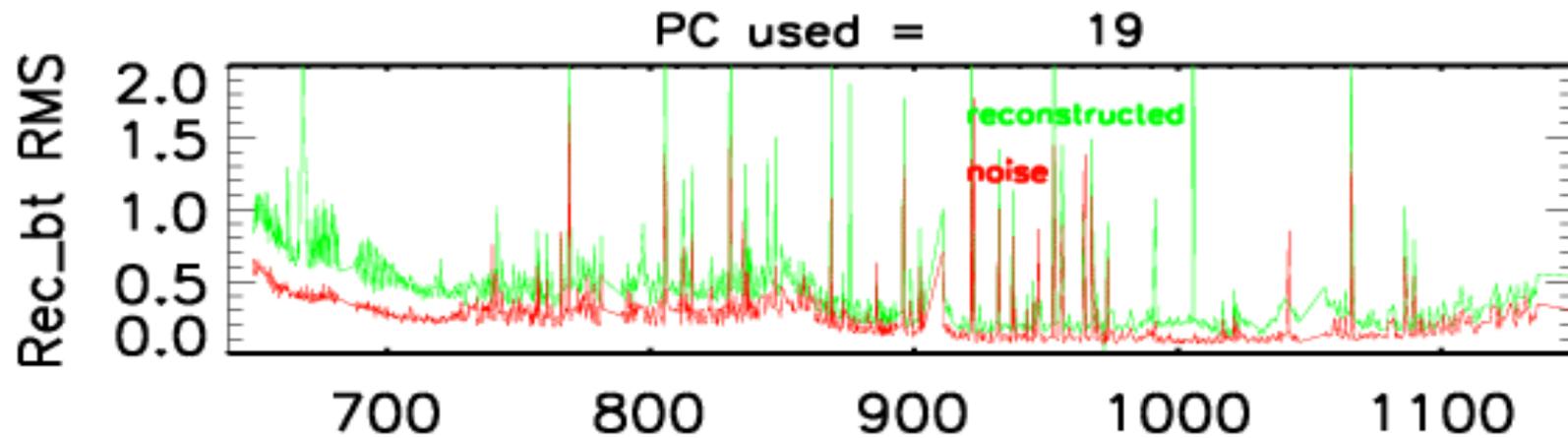
LOG



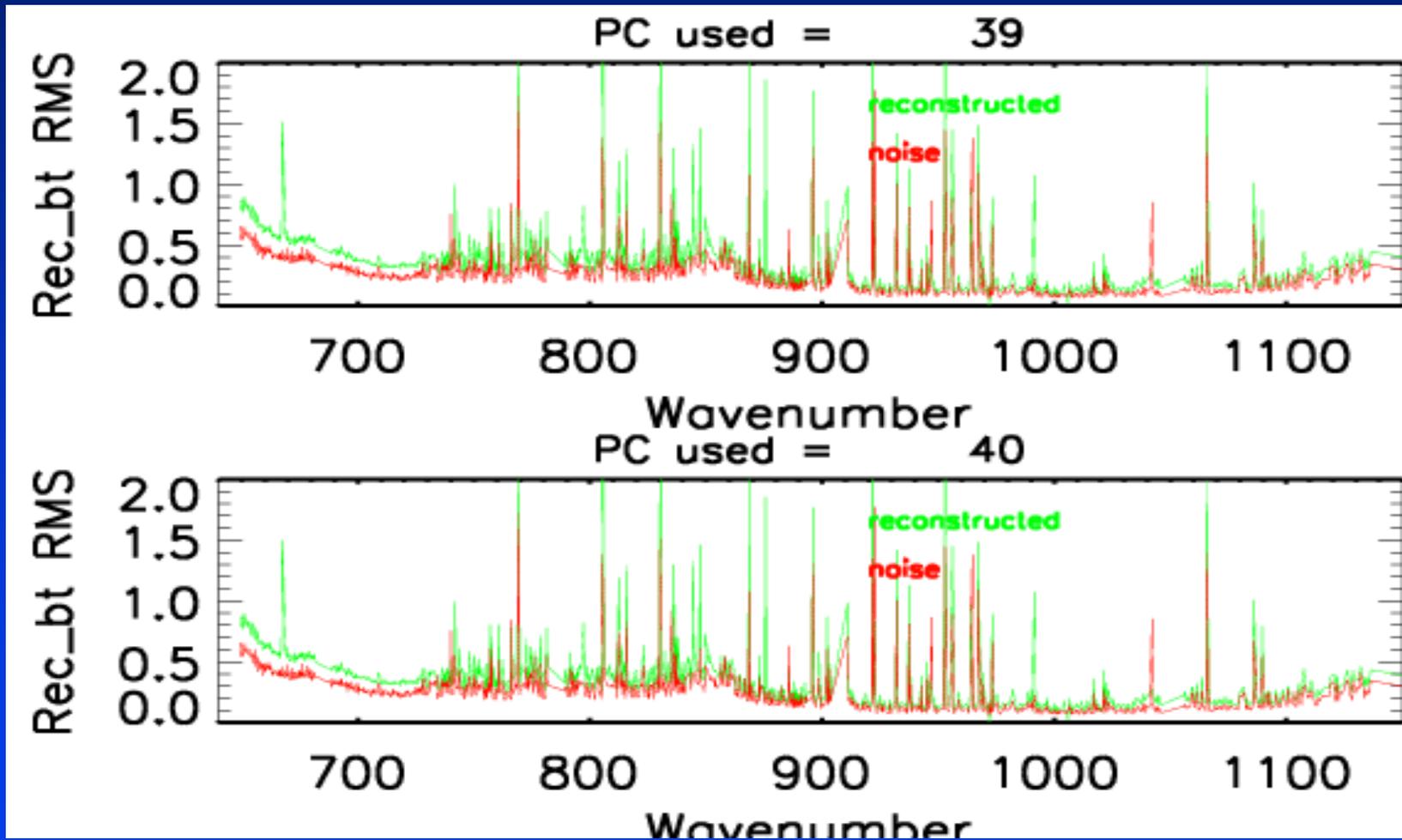




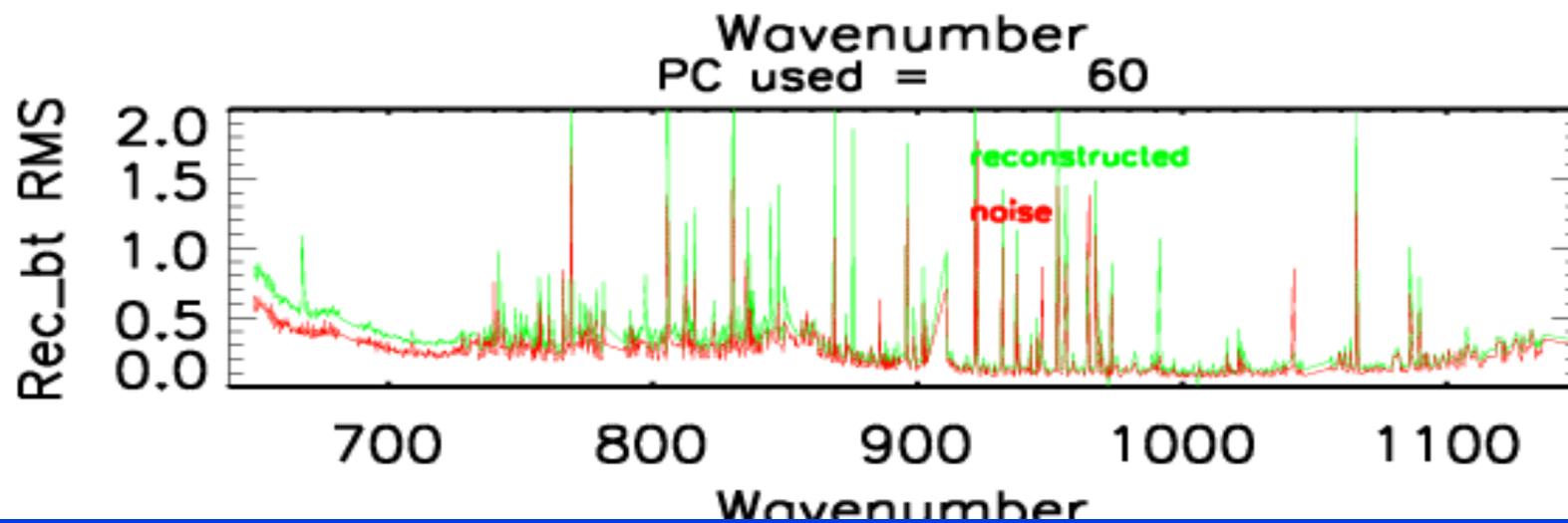
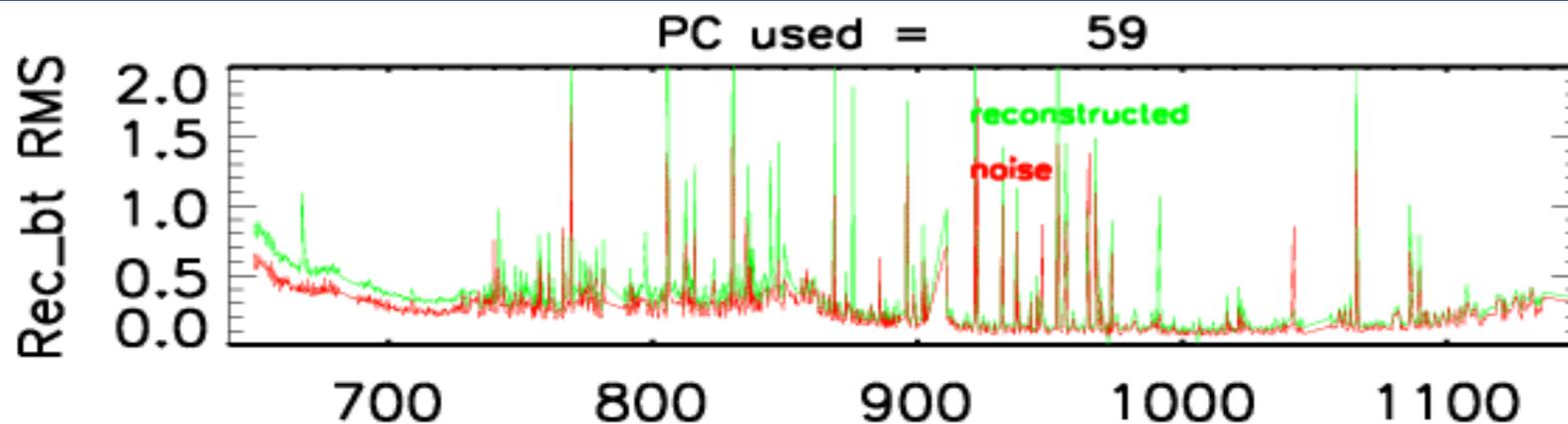
# RMS of Reconstructed BT (20pc, B1)



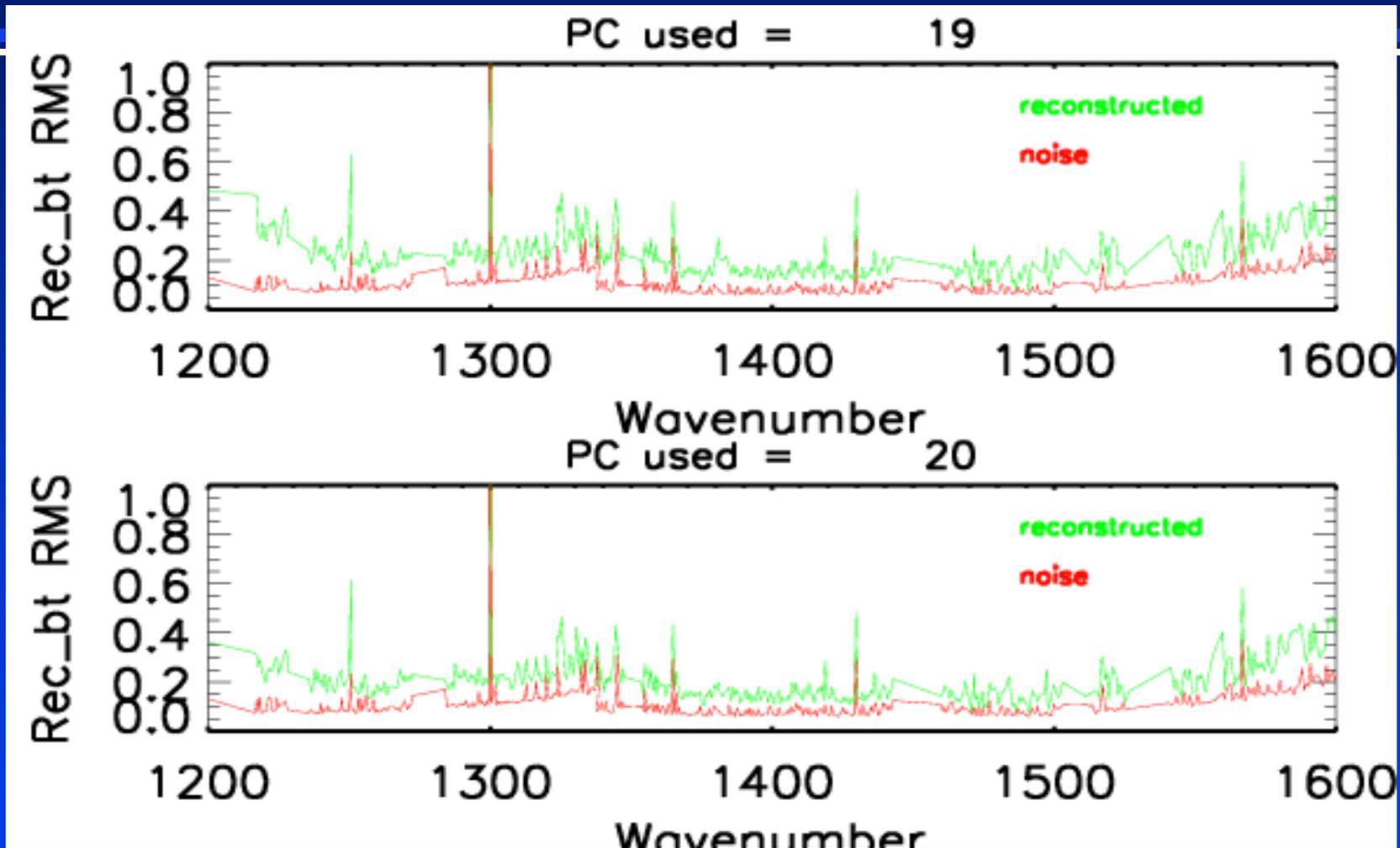
# RMS of Reconstructed BT (40pc, B1)



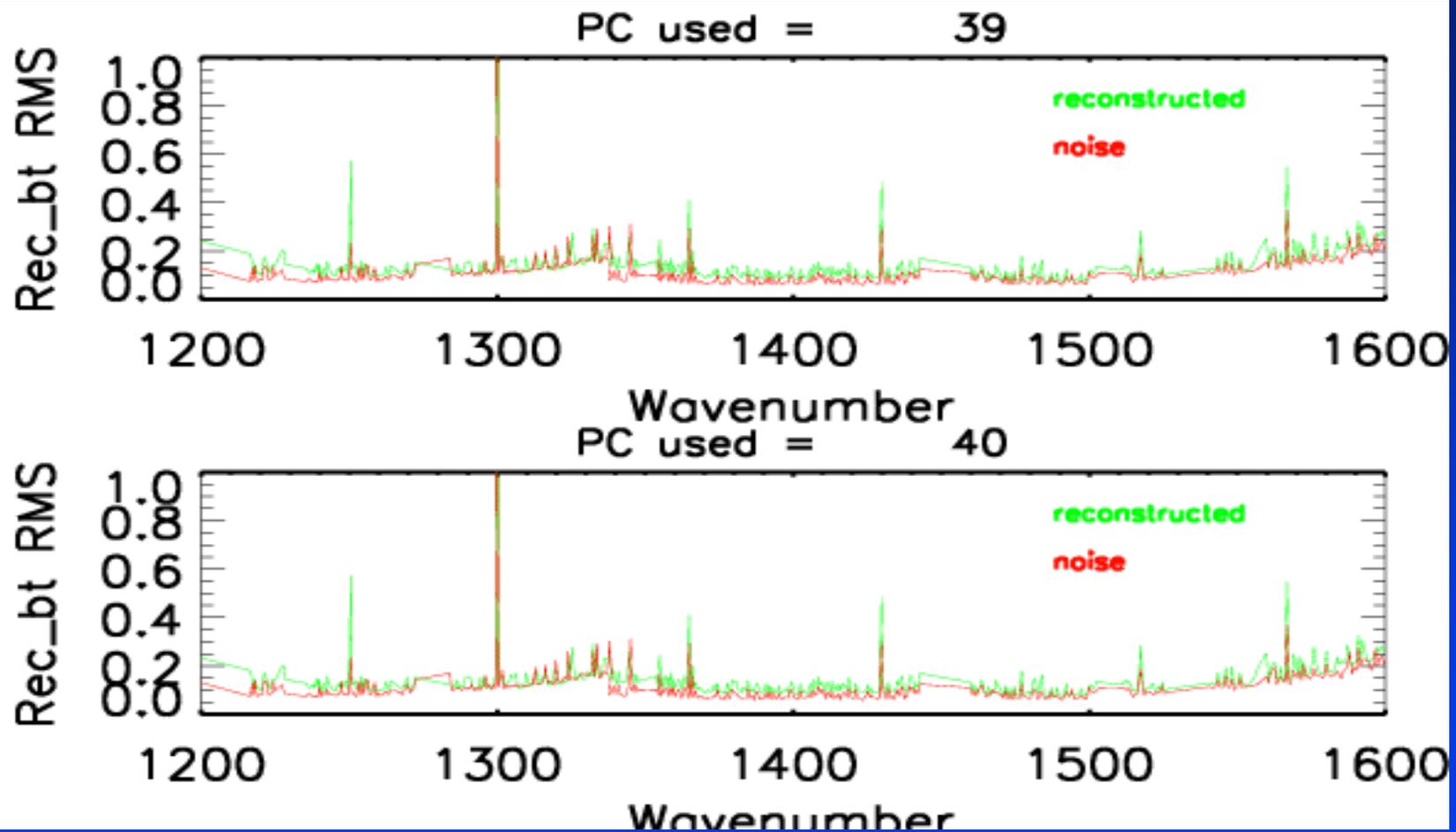
# RMS of Reconstructed BT (60pc, B1)



# RMS of Reconstructed BT (20pc, B2)

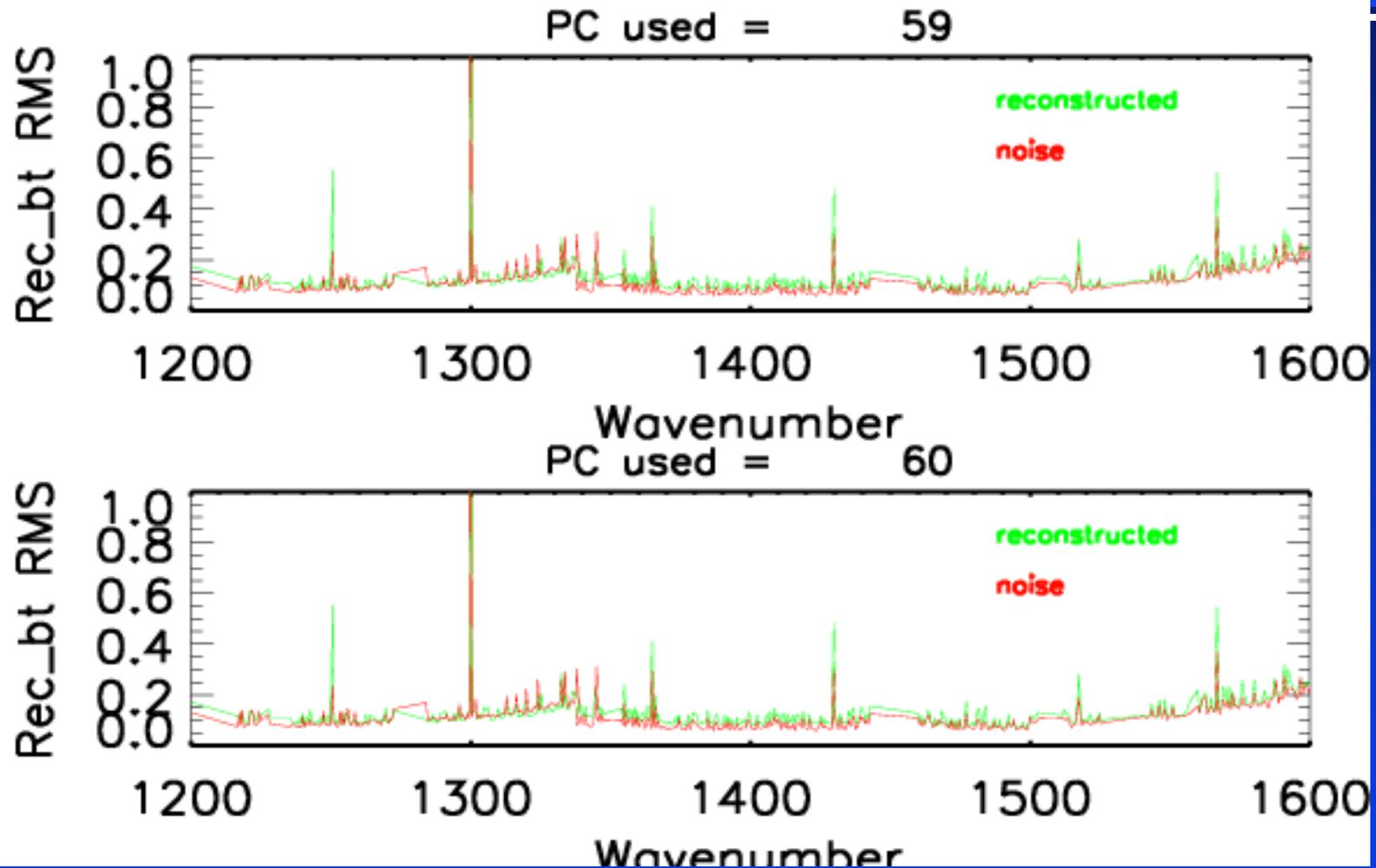


# RMS of Reconstructed BT (40pc, B2)

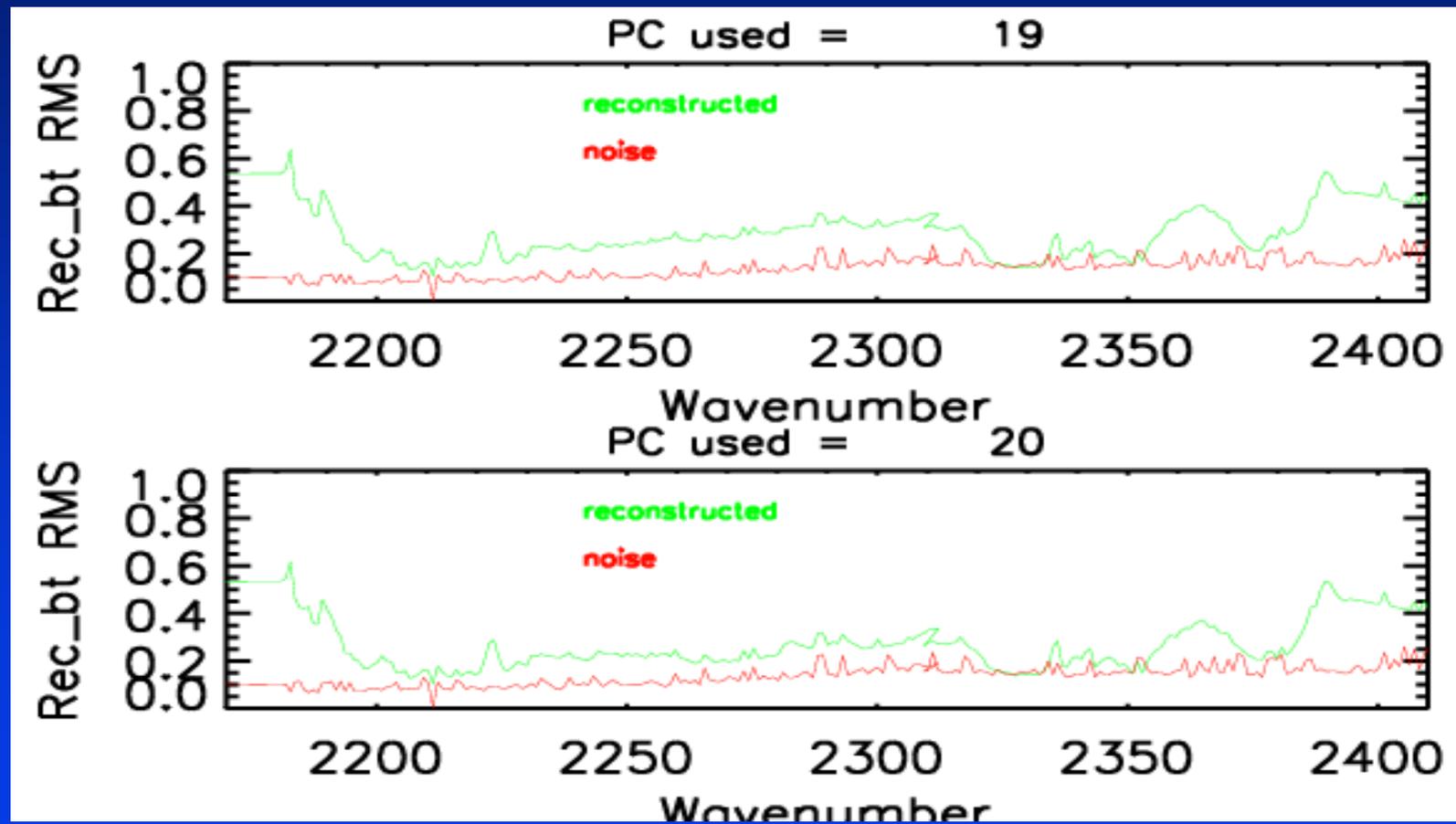




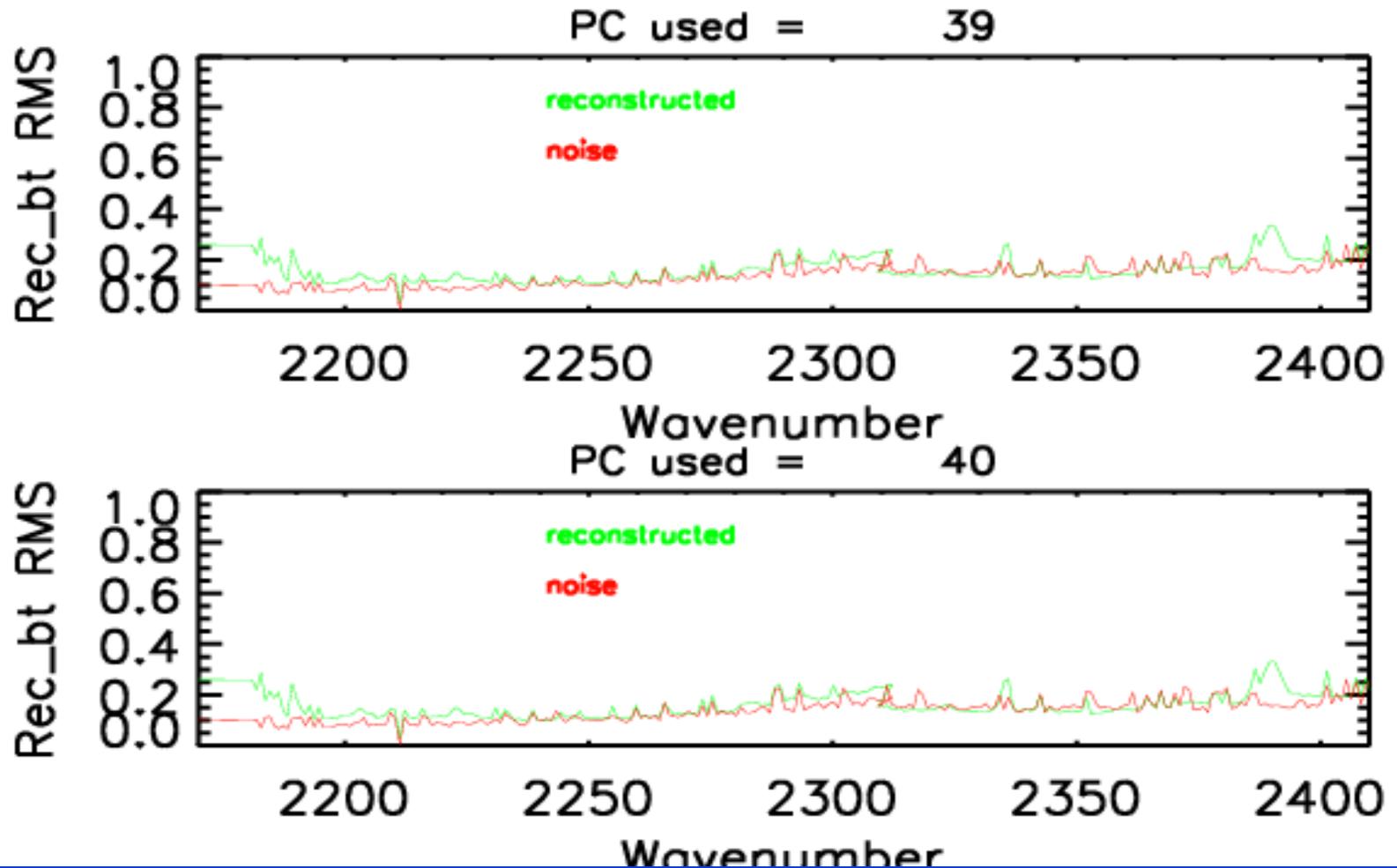
# RMS of Reconstructed BT (60pc, B2)



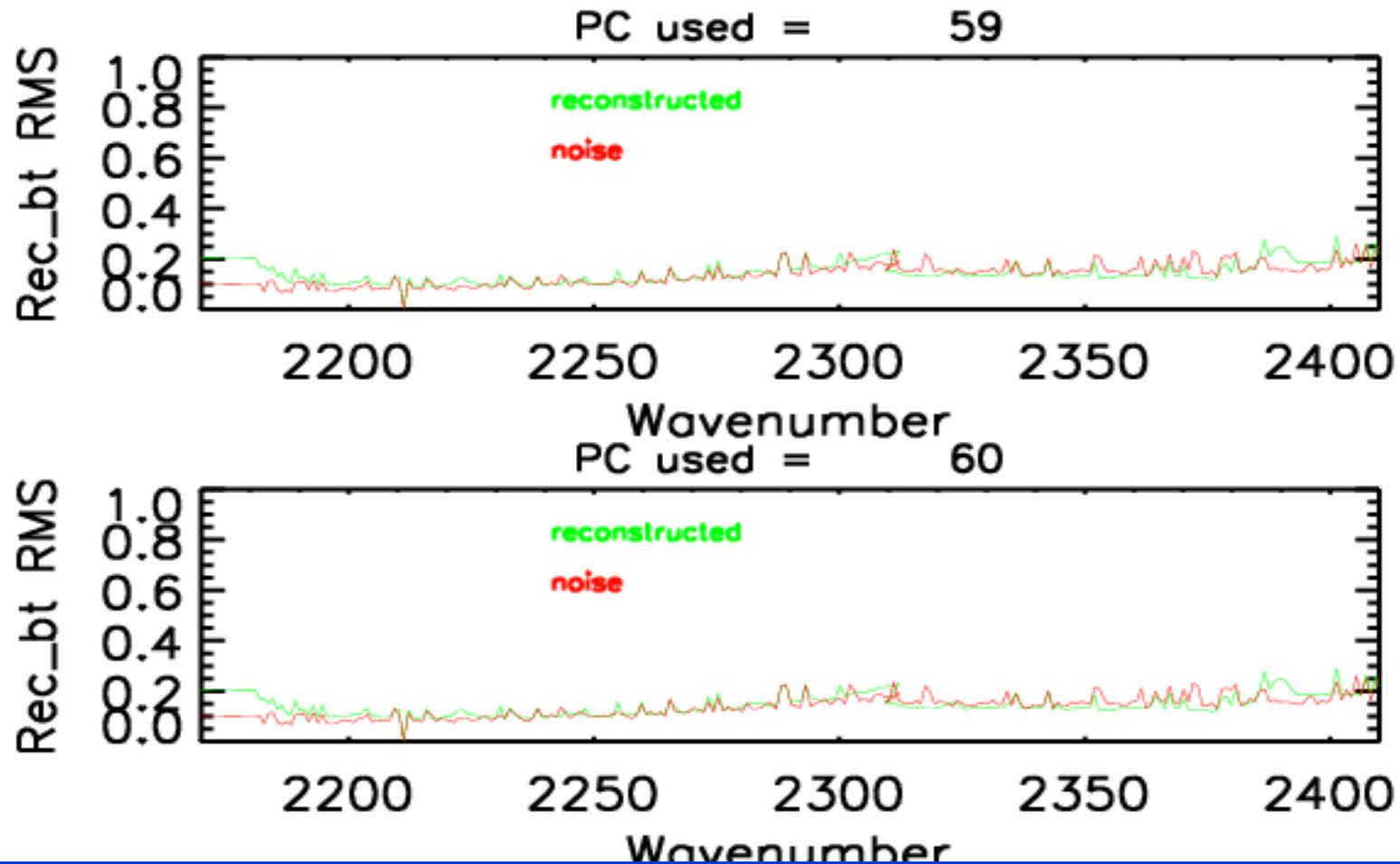
# RMS of Reconstructed BT (20pc, B3)



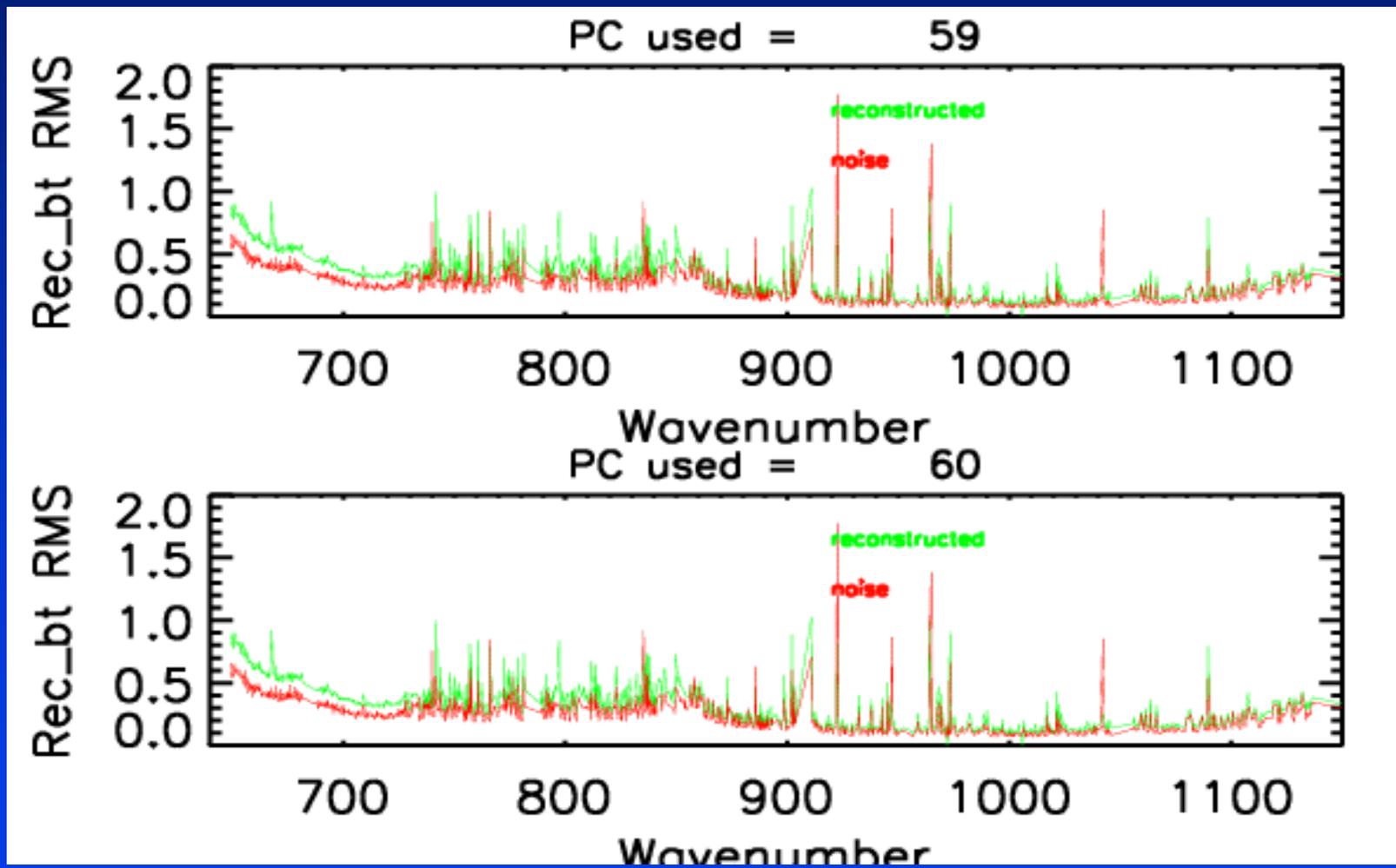
# RMS of Reconstructed BT (40pc, B3)



# RMS of Reconstructed BT (60pc, B3)

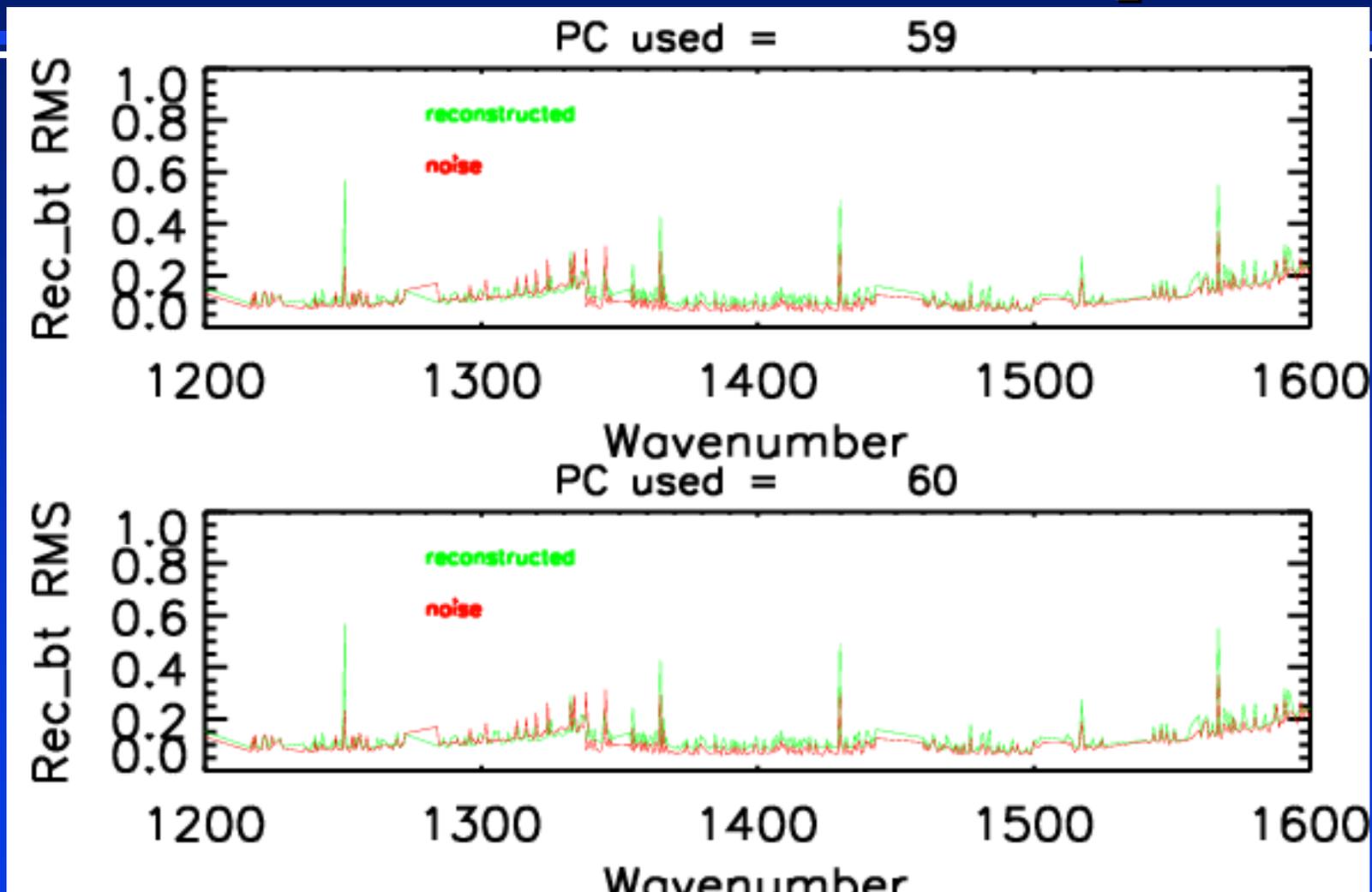


# RMS of Reconstructed BT (60pc, B1)



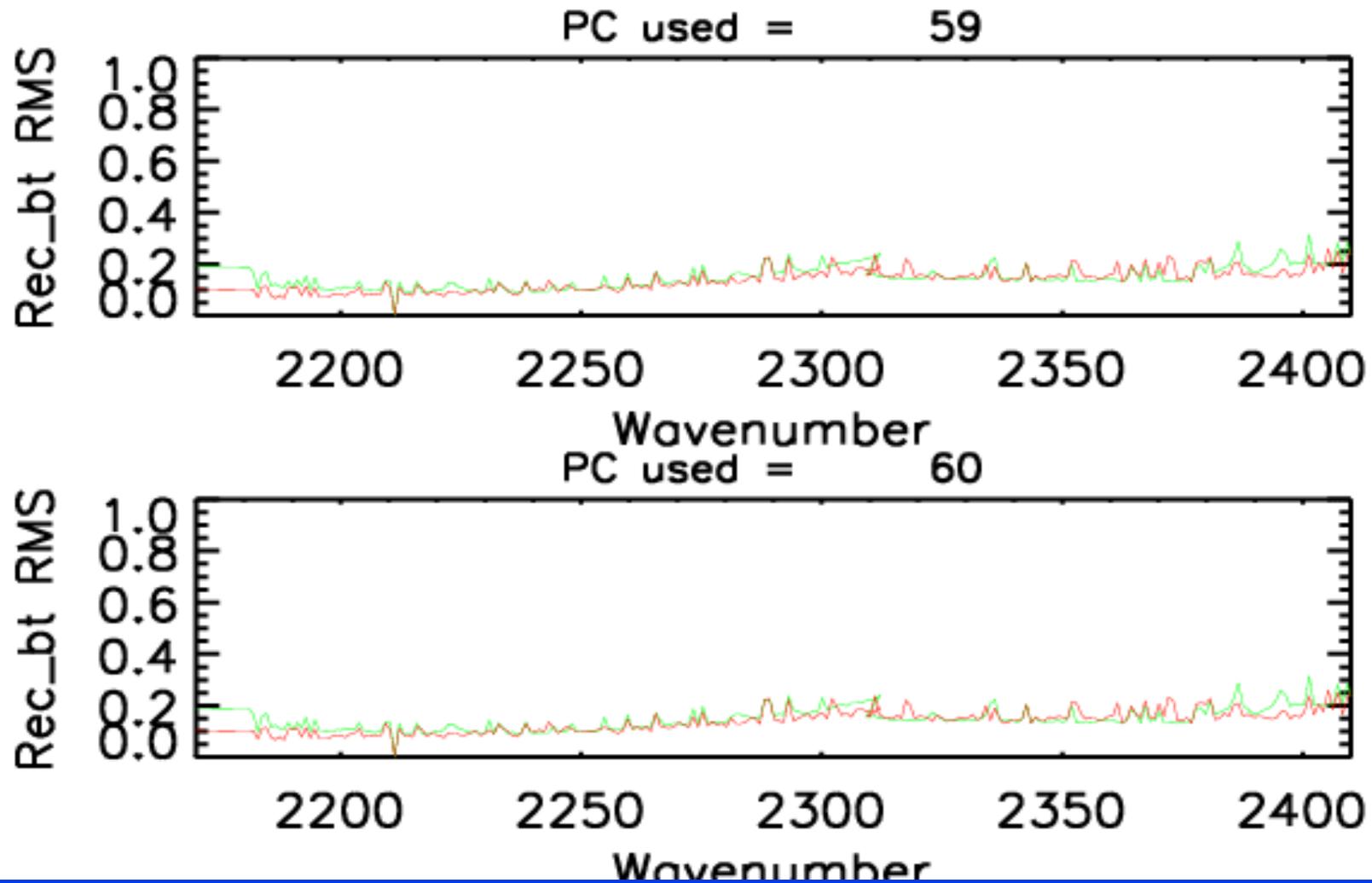


# RMS of Reconstructed BT (60pc, B2)





# RMS of Reconstructed BT (60pc, B3)

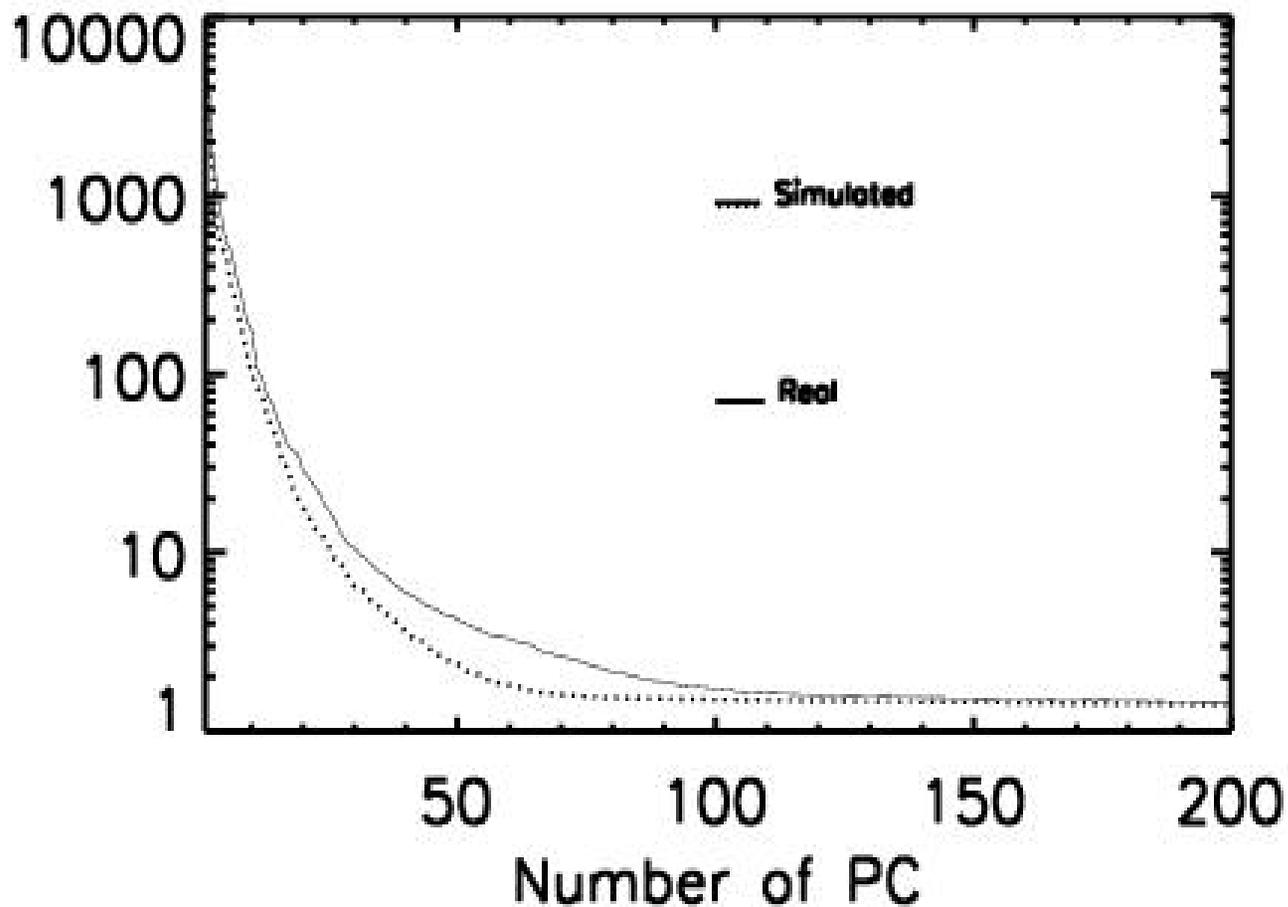


# Square root of eigenvalue (new noise)

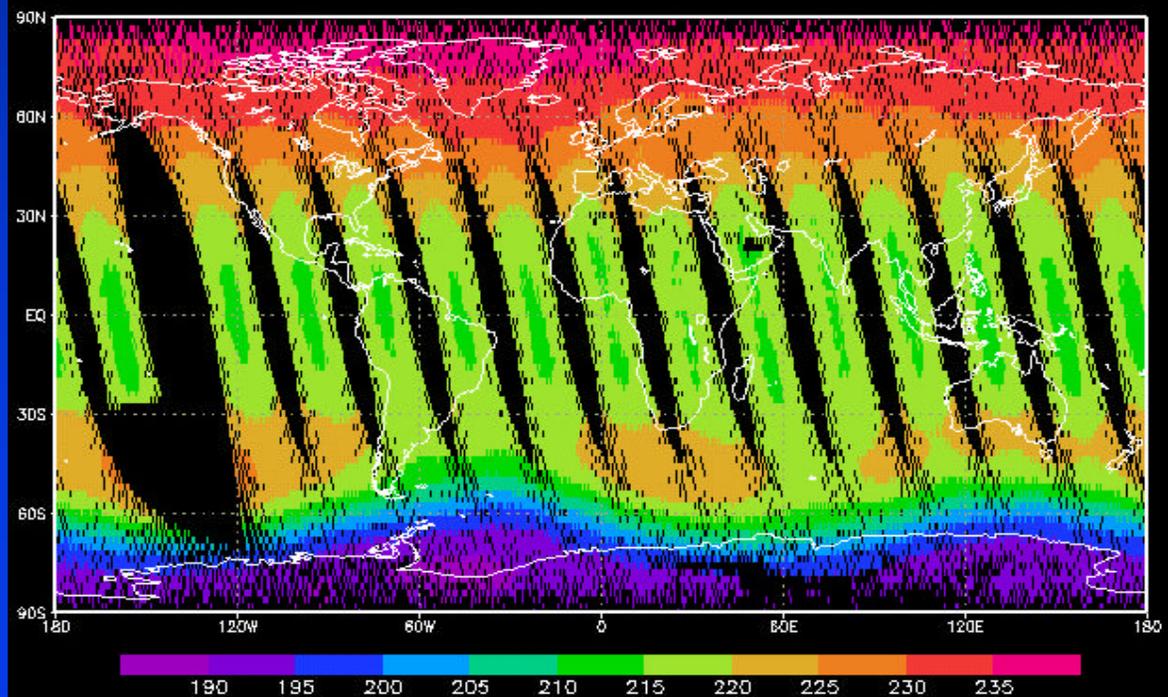
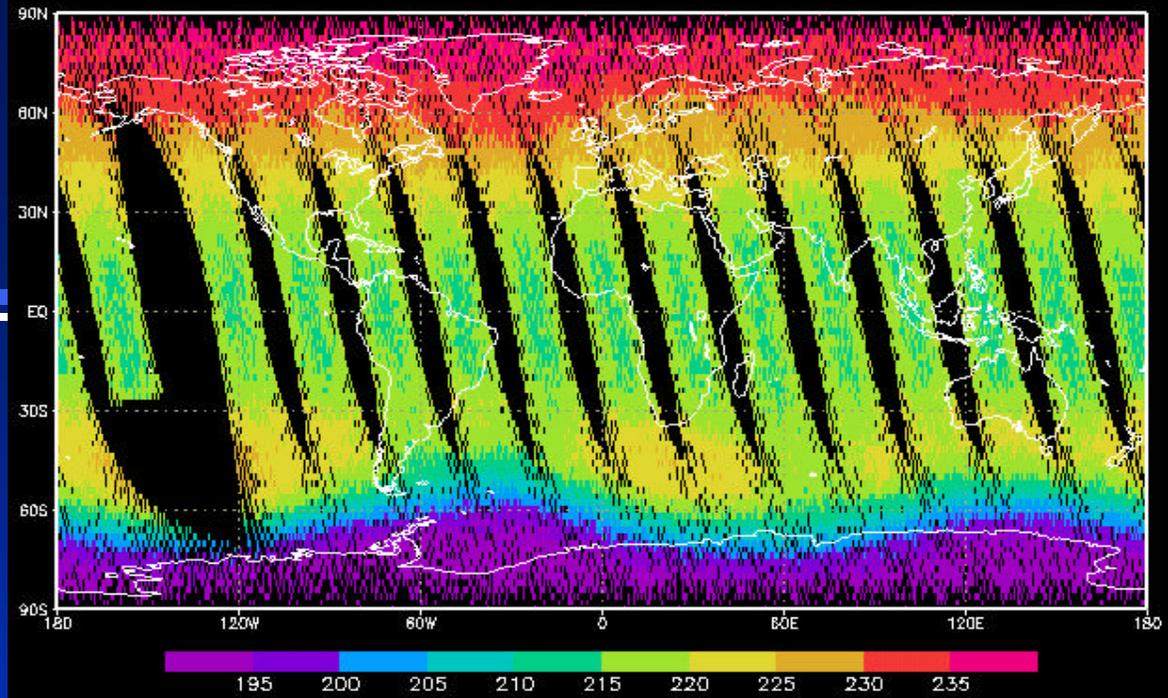


Sqrt of Eigenvalue (07/20/02)

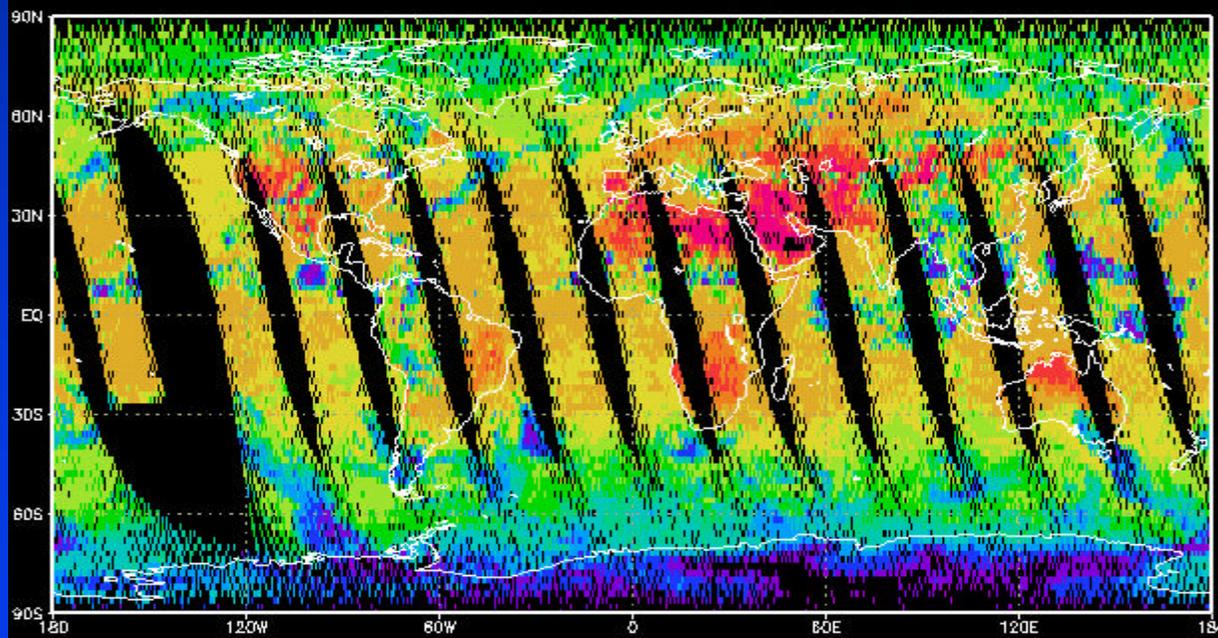
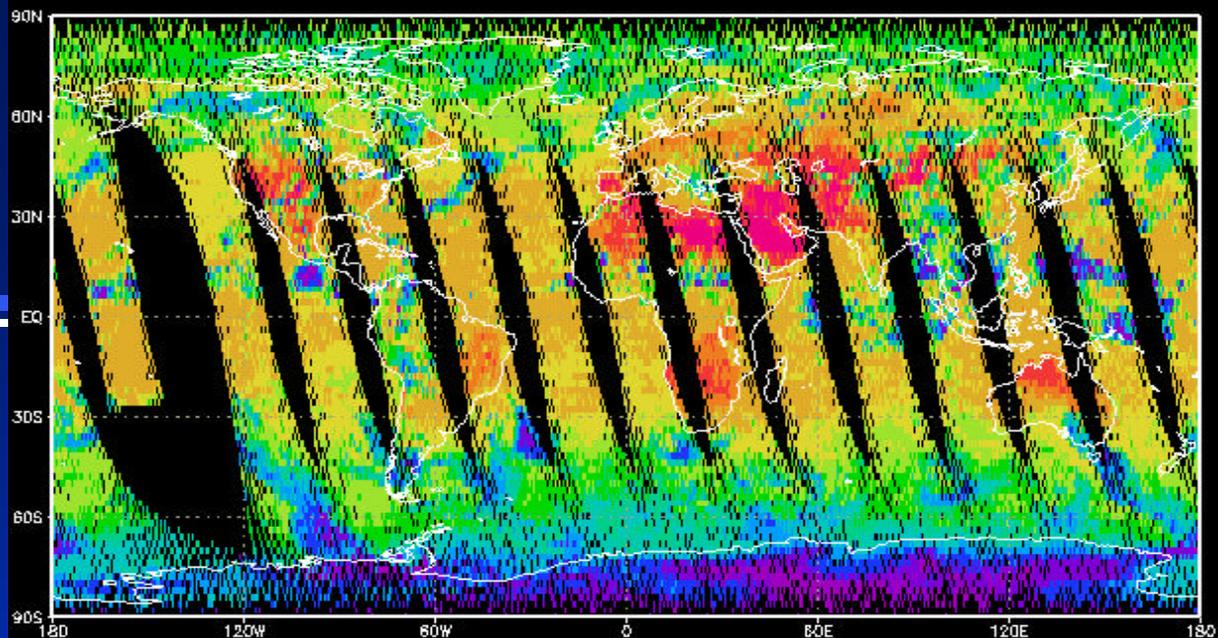
2085 Channels with new noise



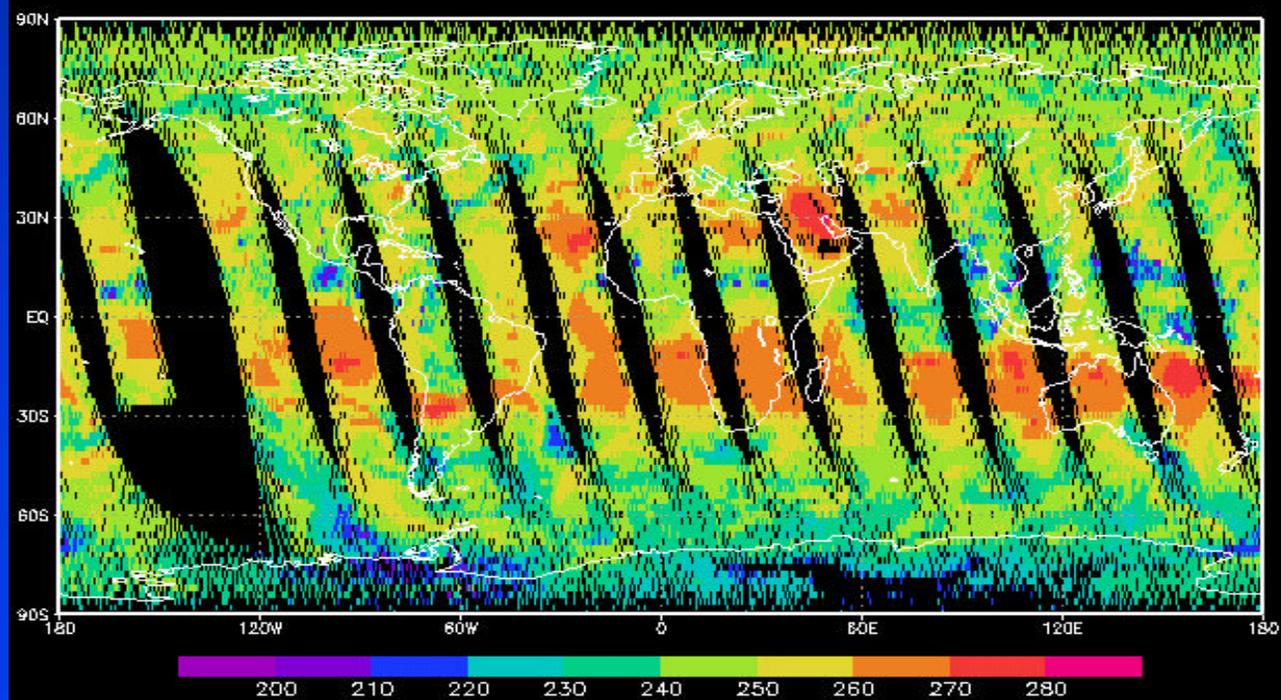
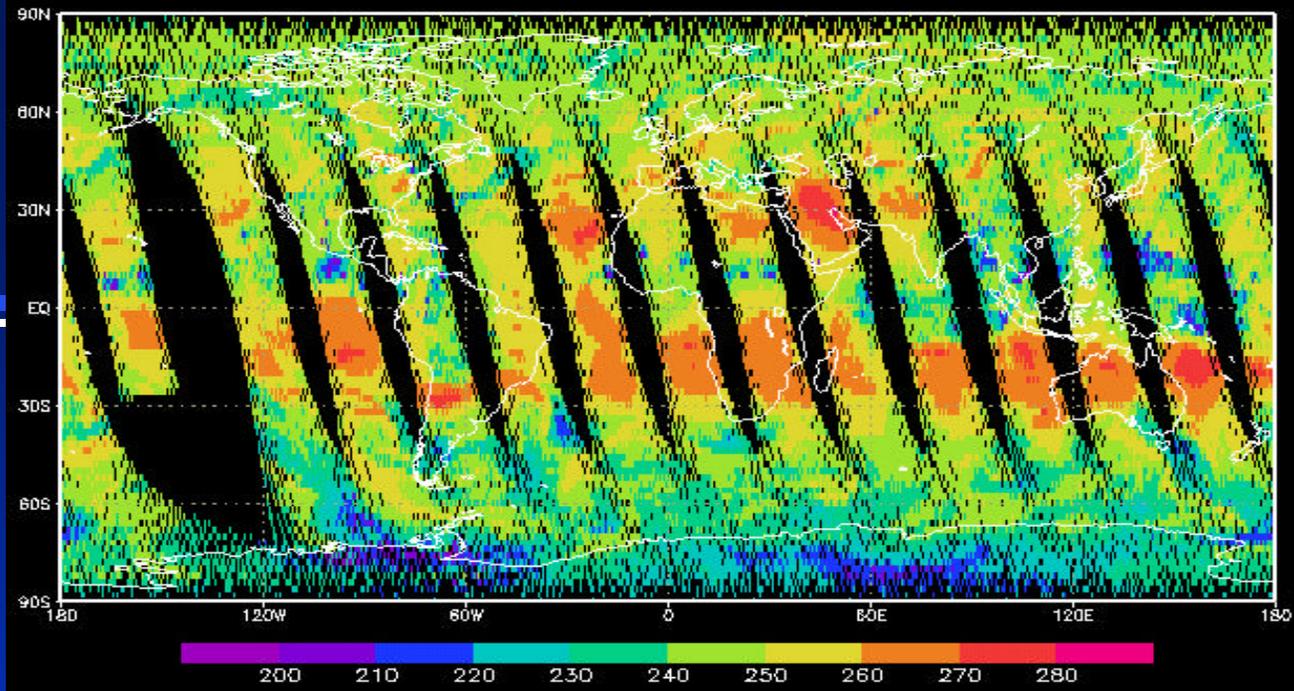
# Channel 1



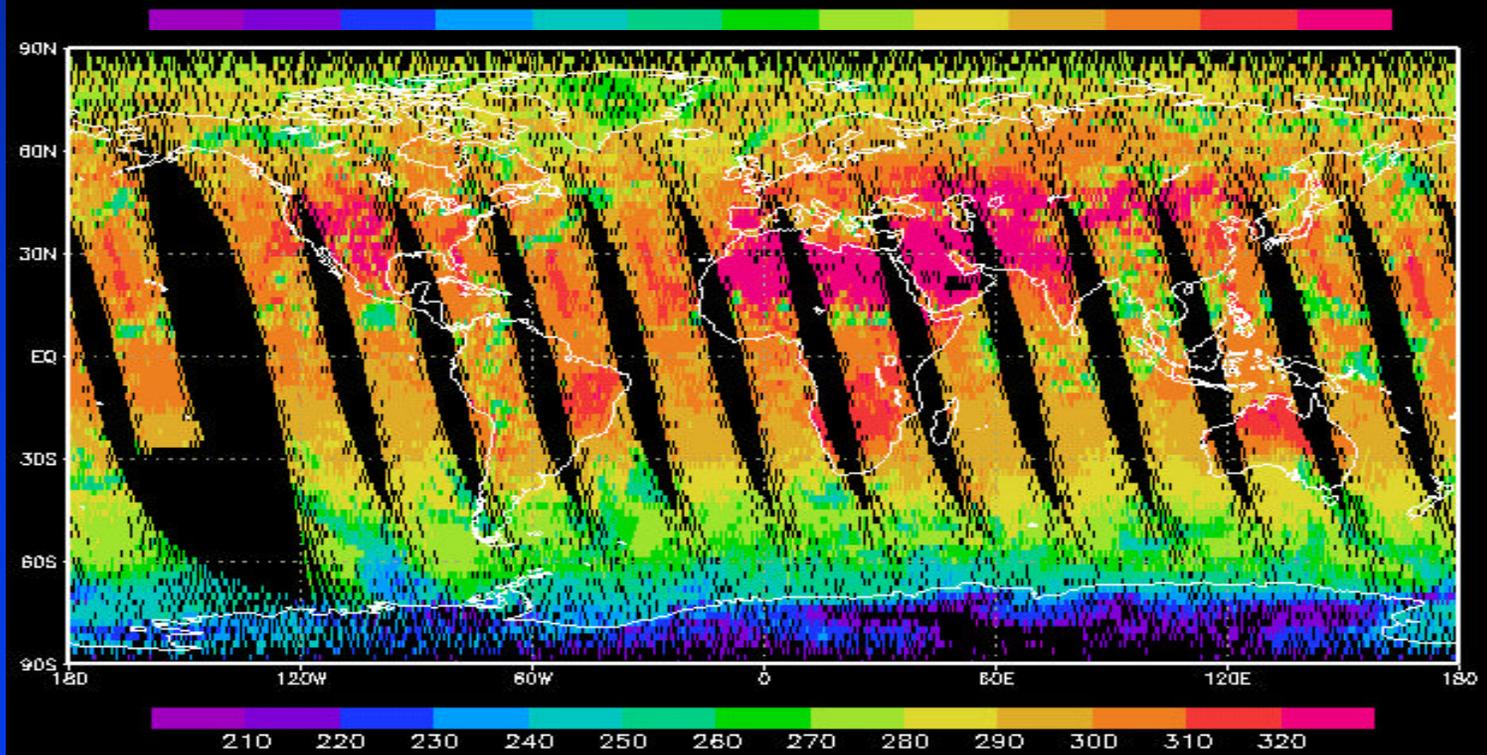
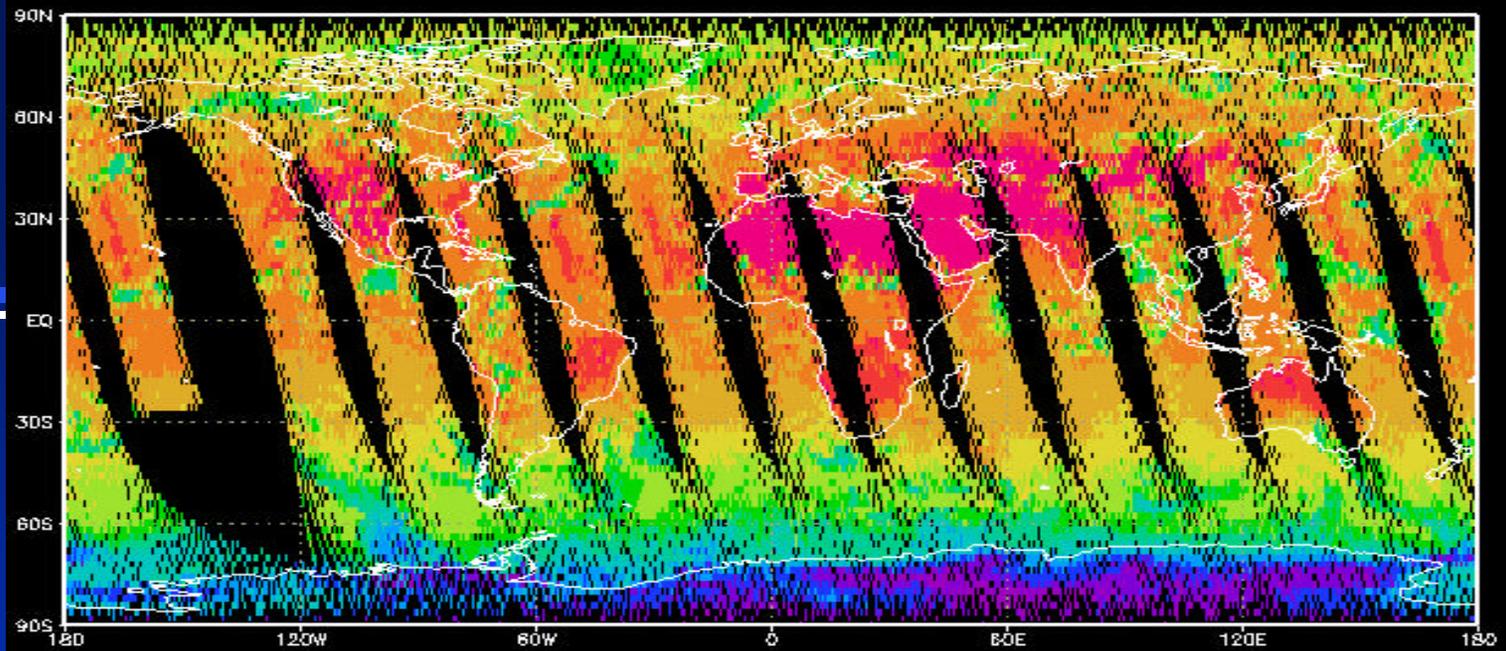
965 cm<sup>-1</sup>

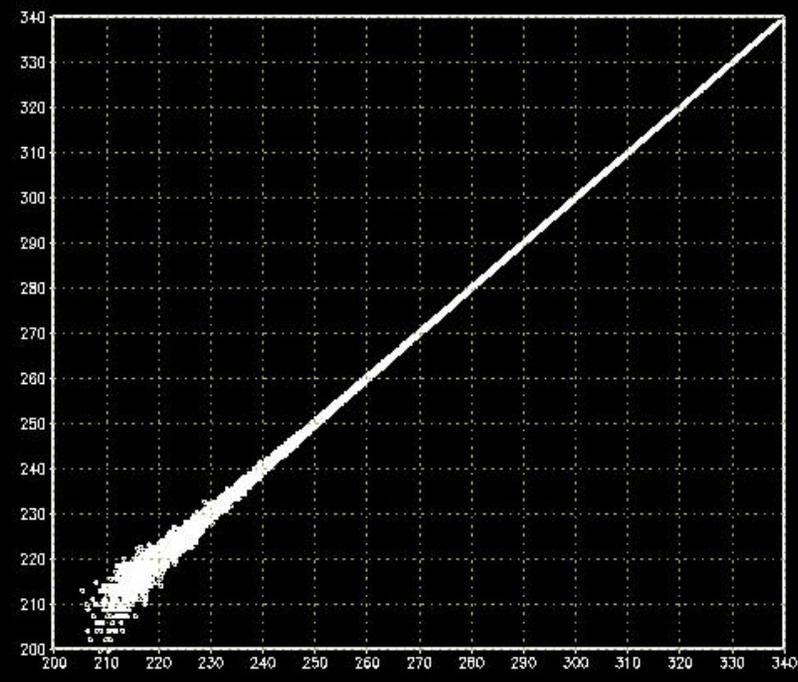
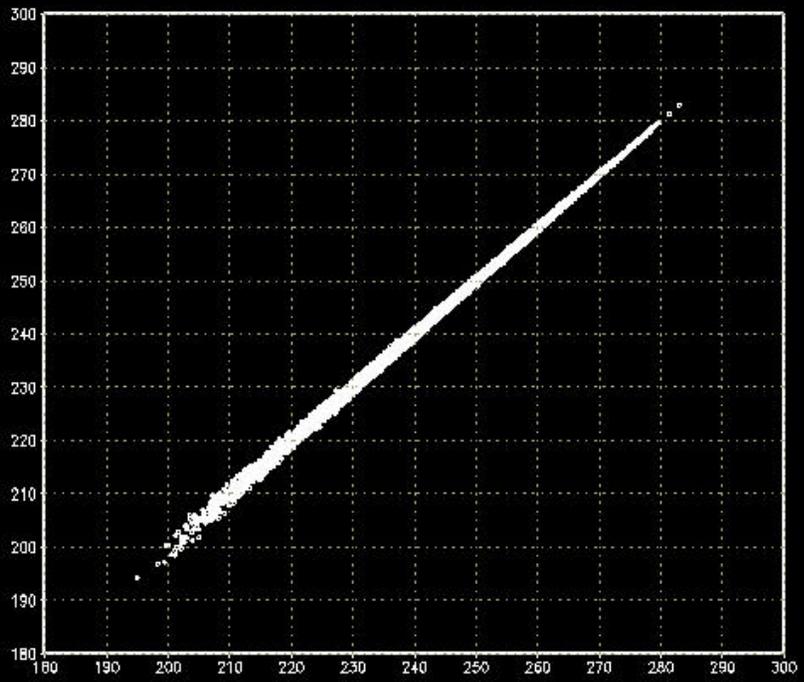
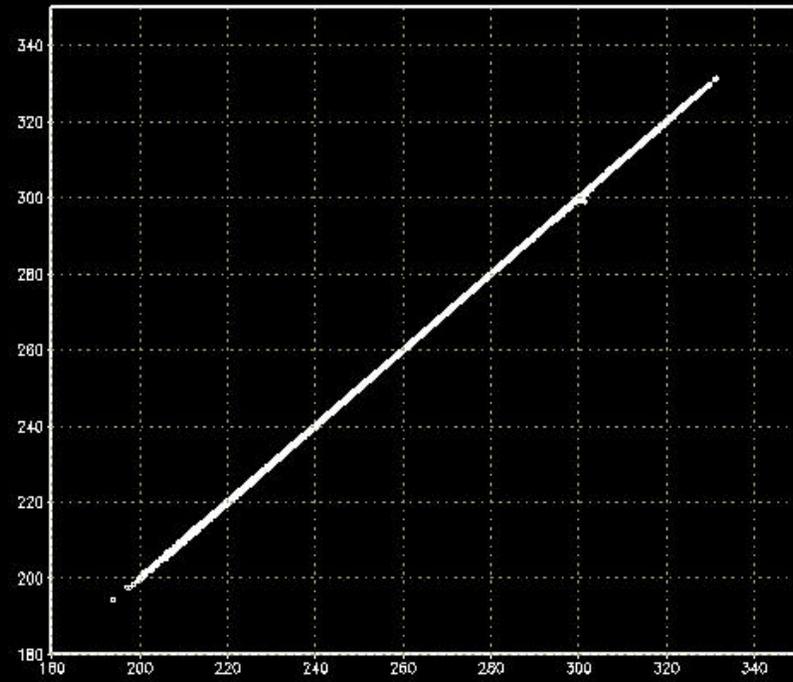
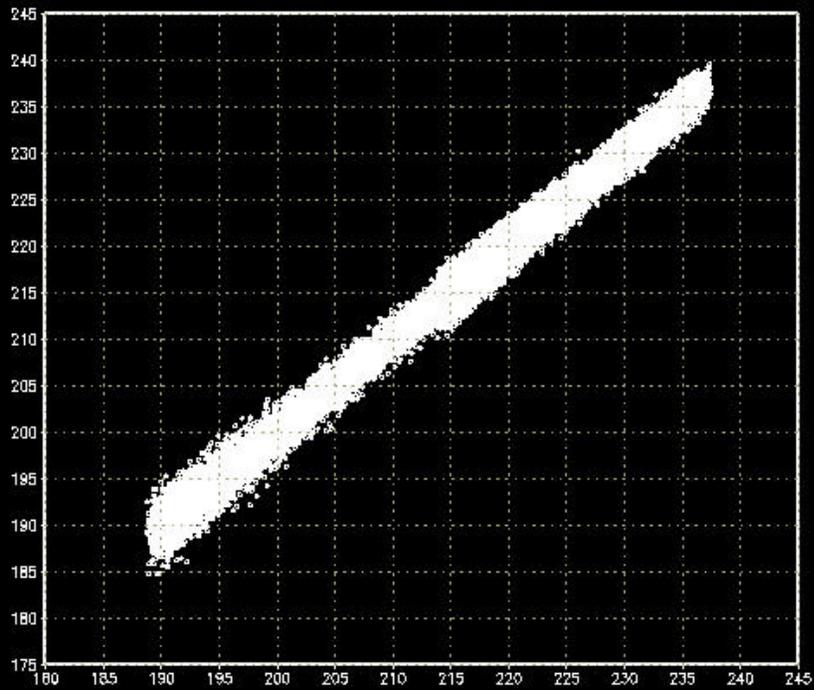


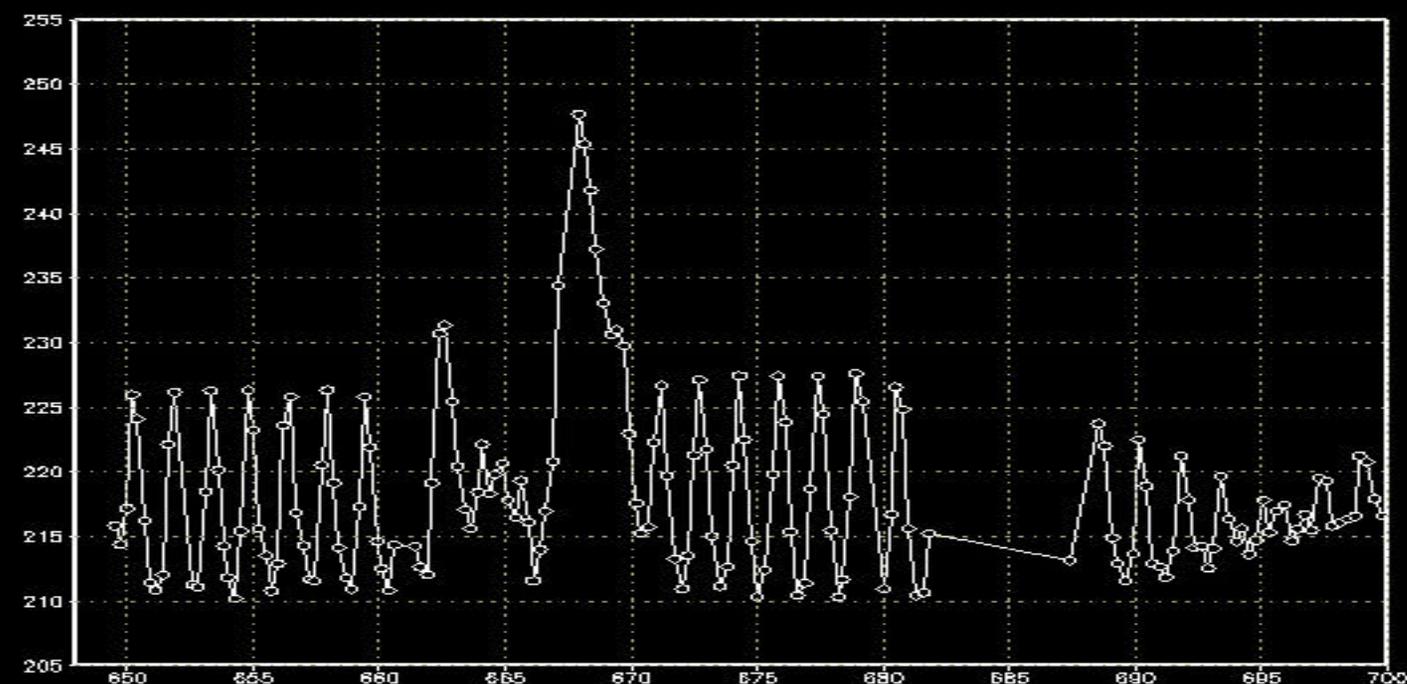
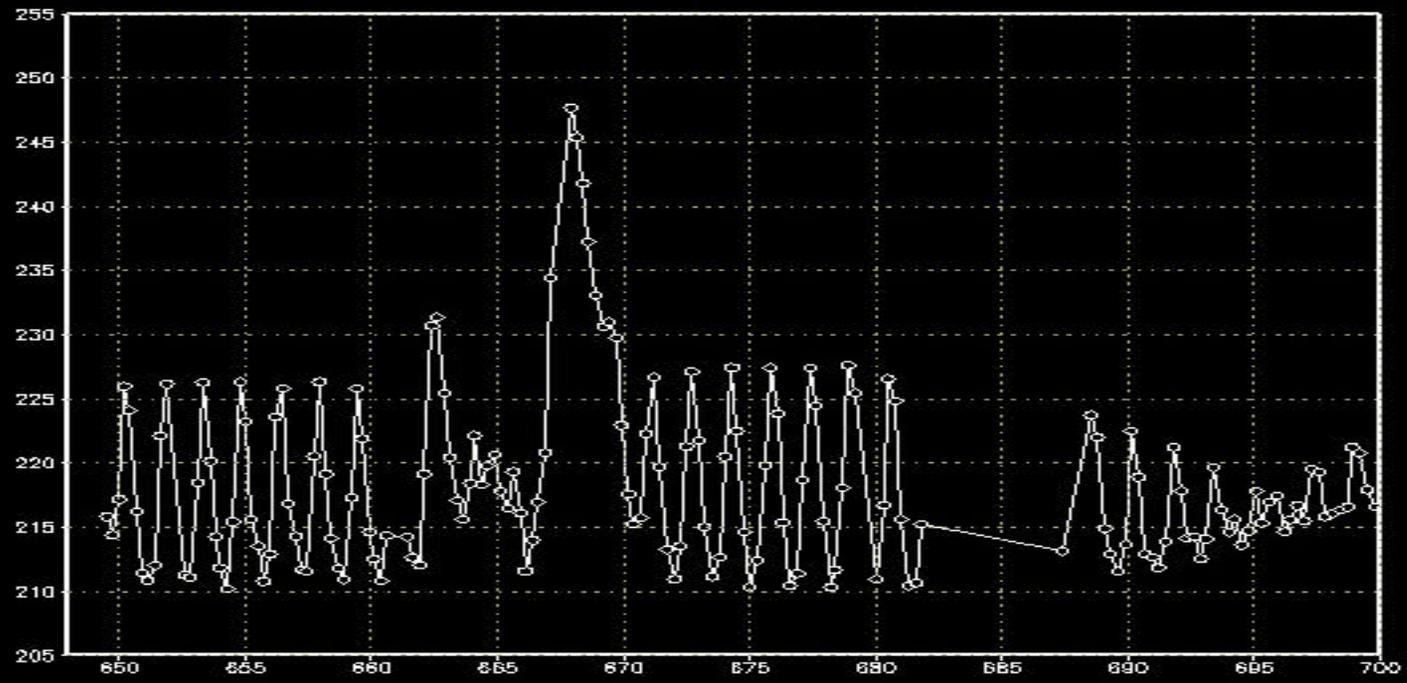
1580 cm-1

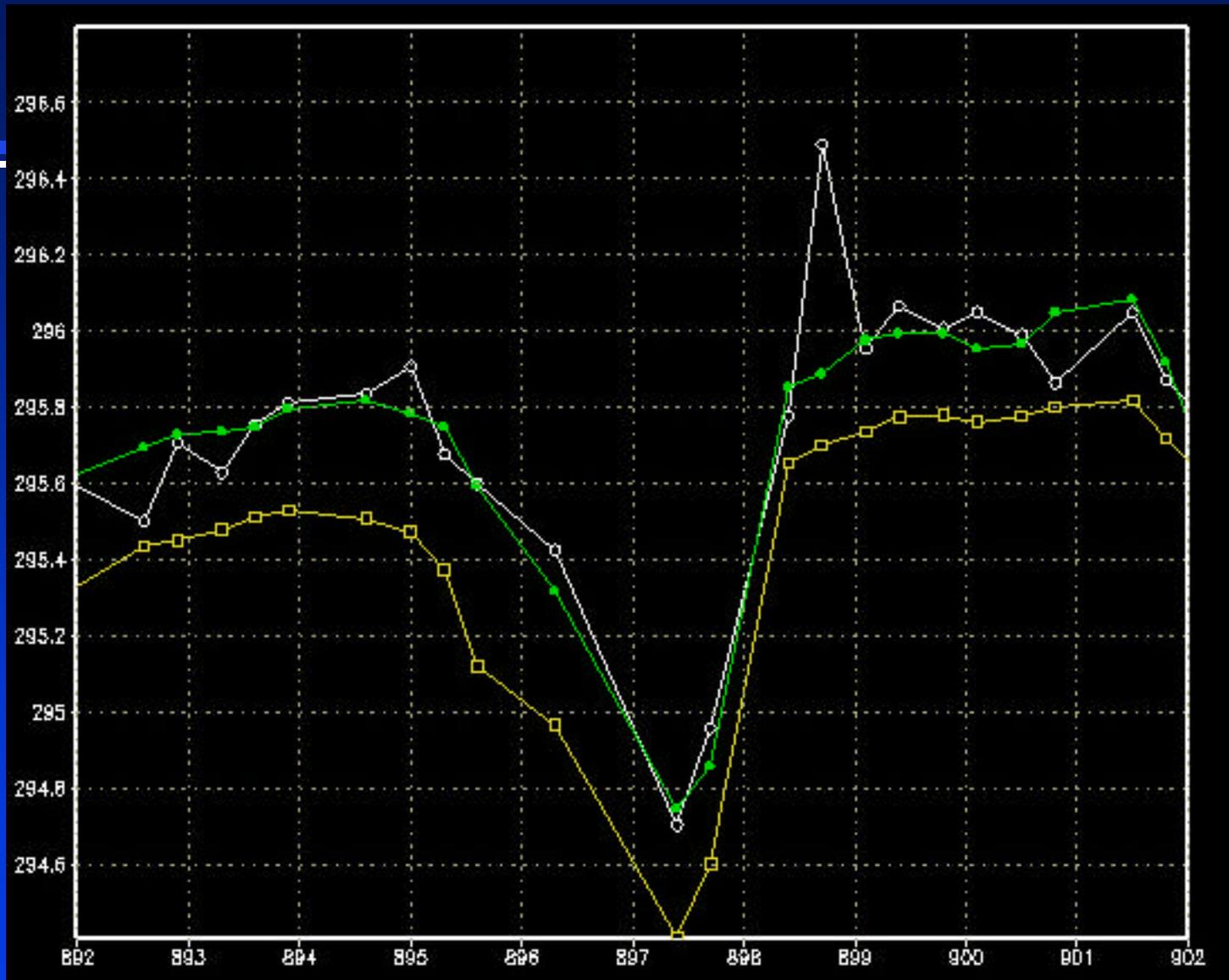


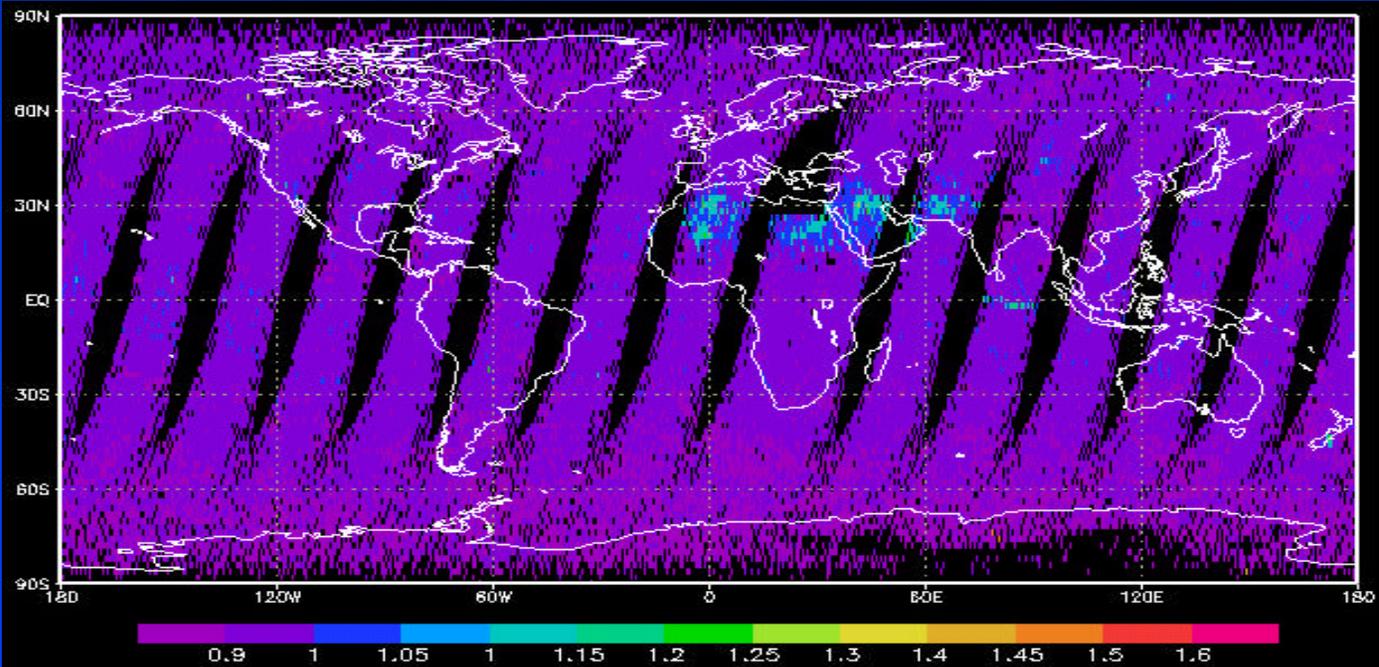
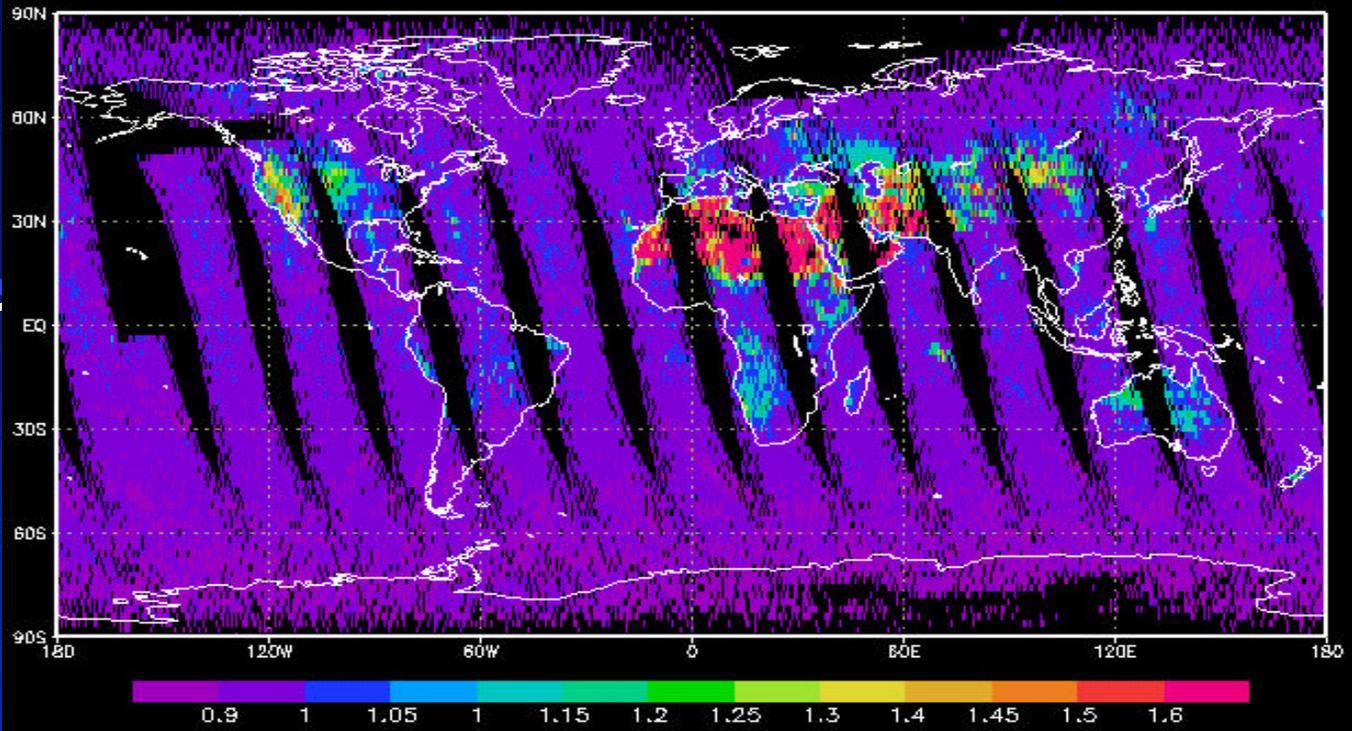
2616 cm-1

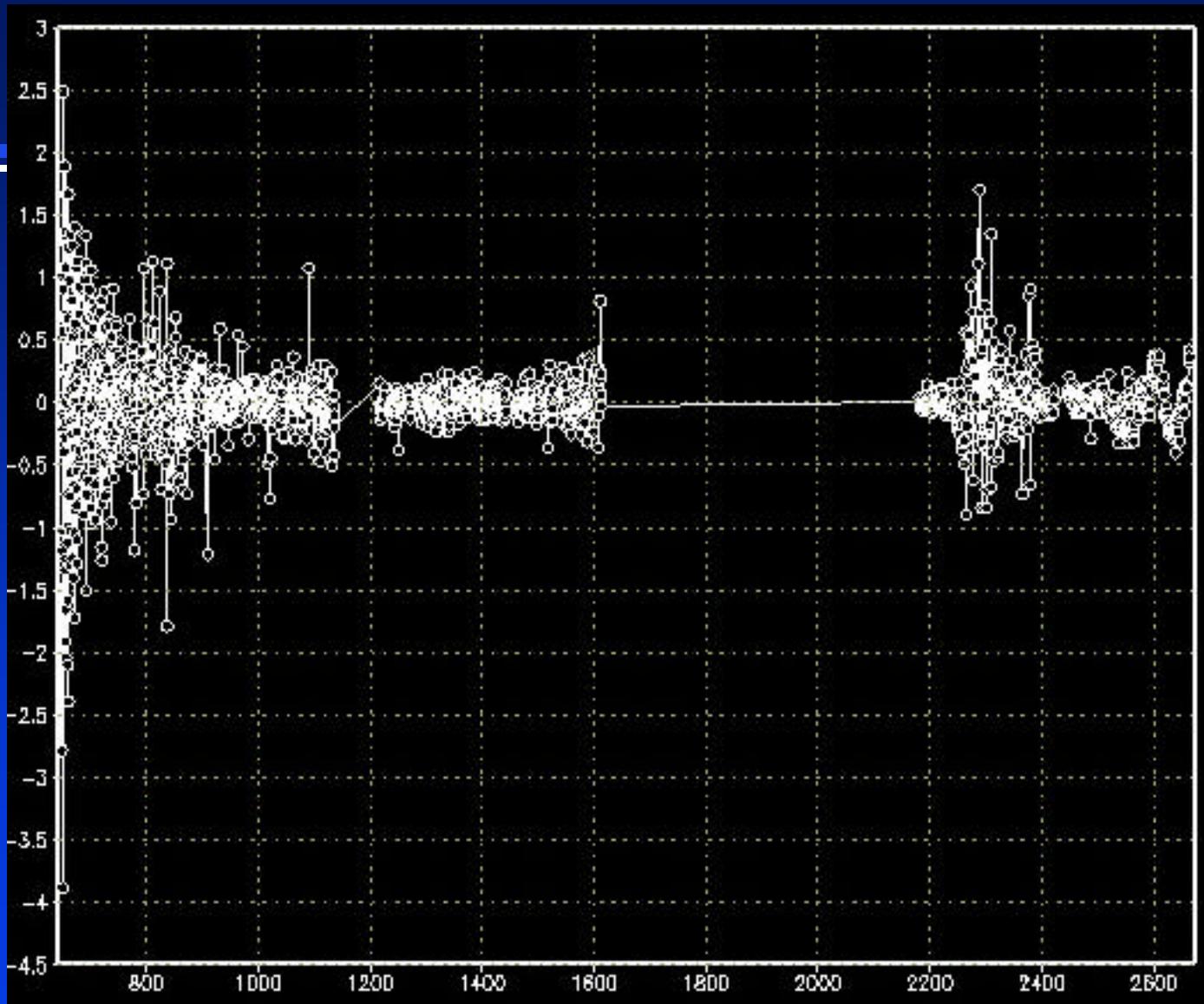


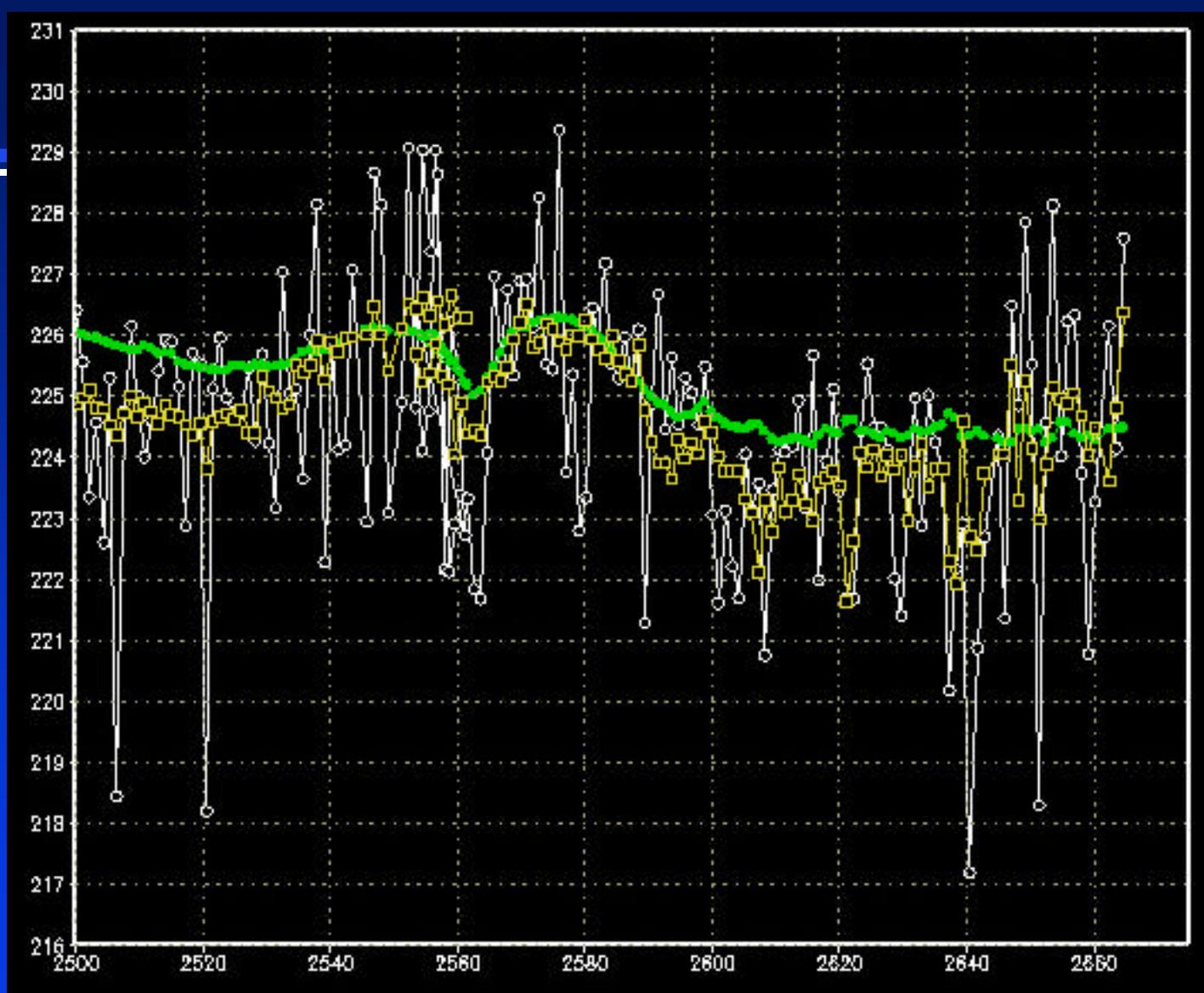






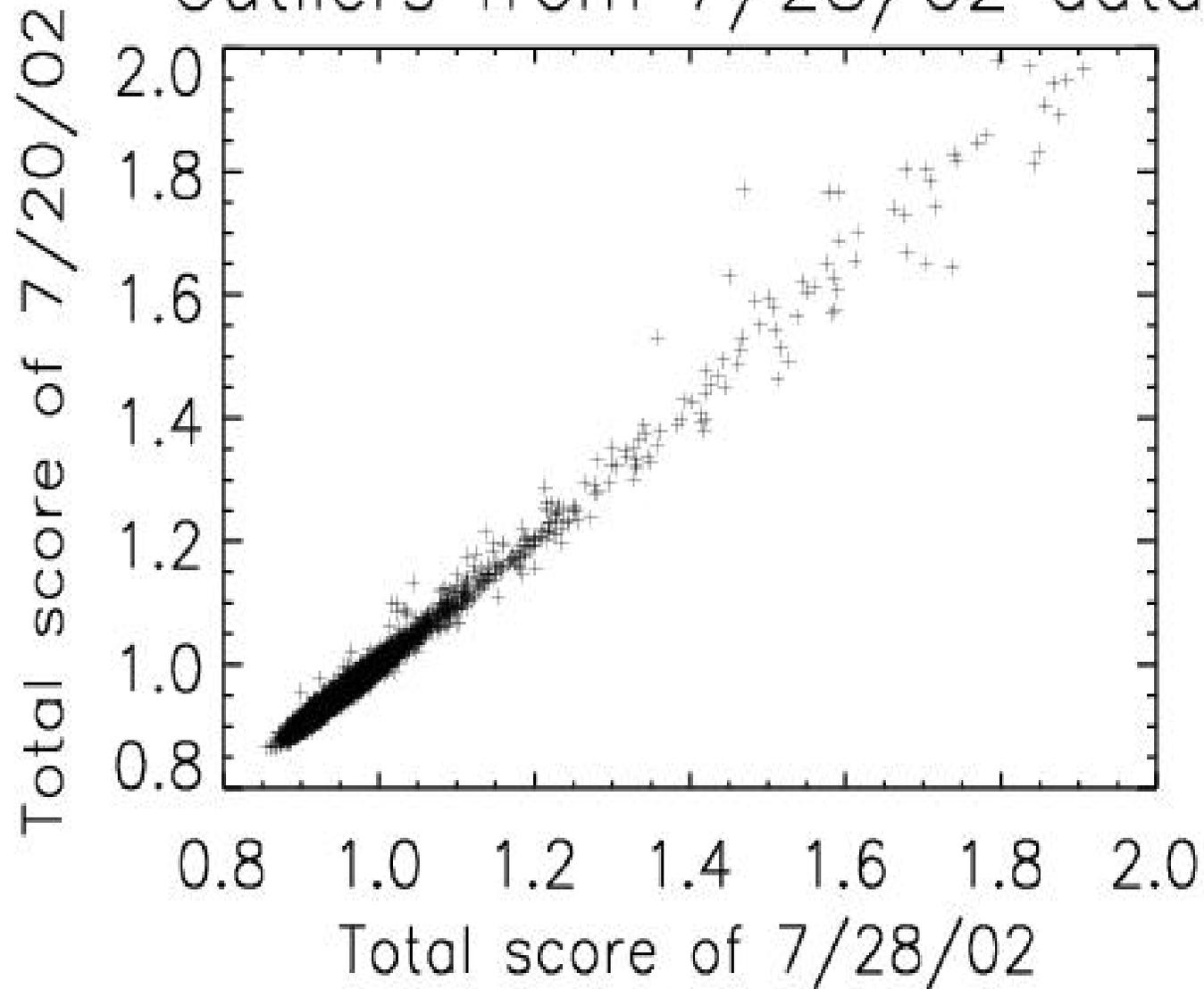








## Outliers from 7/28/02 data





# PC Summary

- Noise reduction feature is very promising
- Provide reconstructed brightness temperatures to NWP centers for evaluation.

# AQUA AMSU Activities

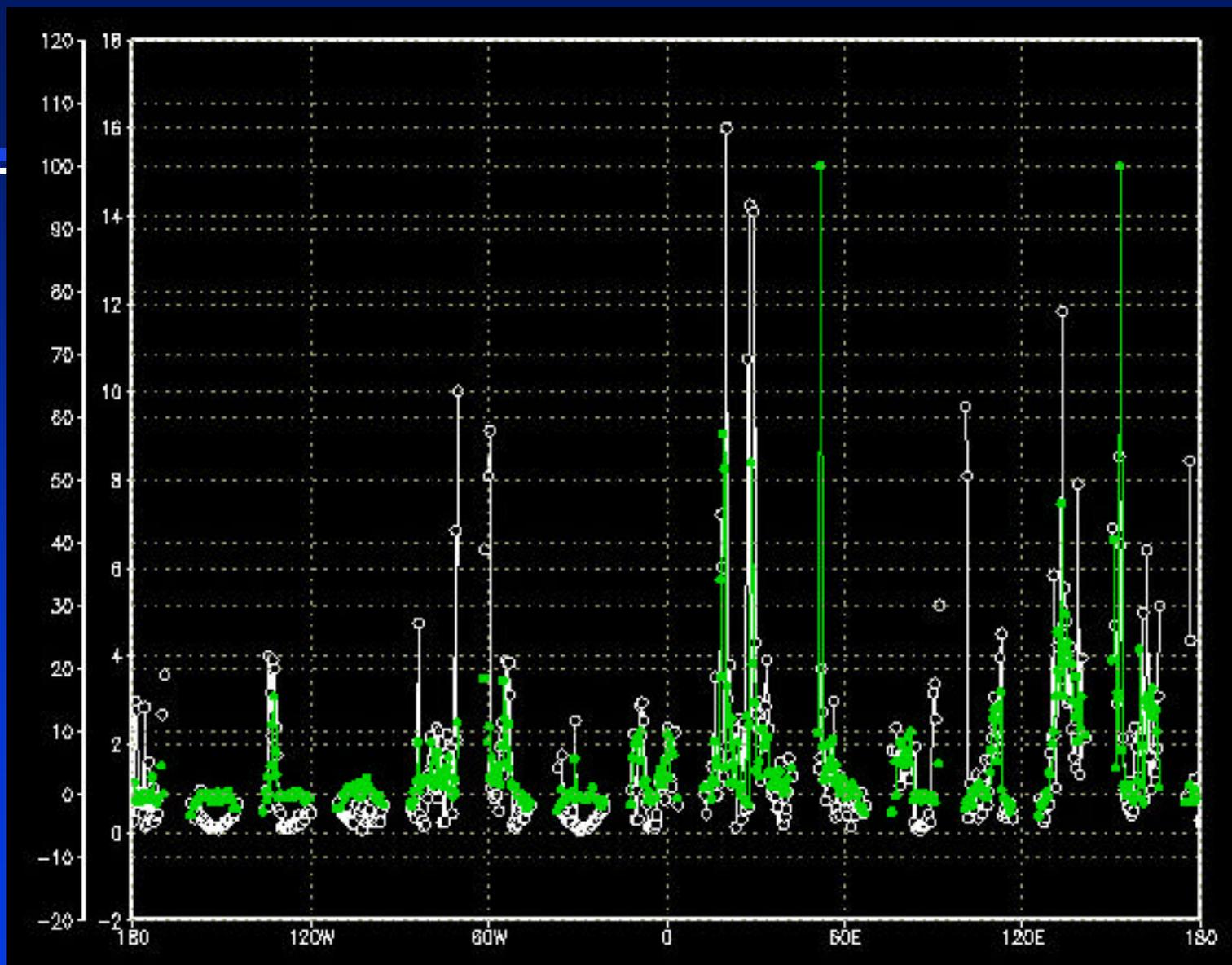


- Generated Limb Adjustment Coefficients
- Deriving retrievals from AMSU-A based using same methodology that is used for NOAA-15, NOAA-16 and NOAA-17
- Study differences between AQUA AMSU-A and NOAA-16 AMSU-A

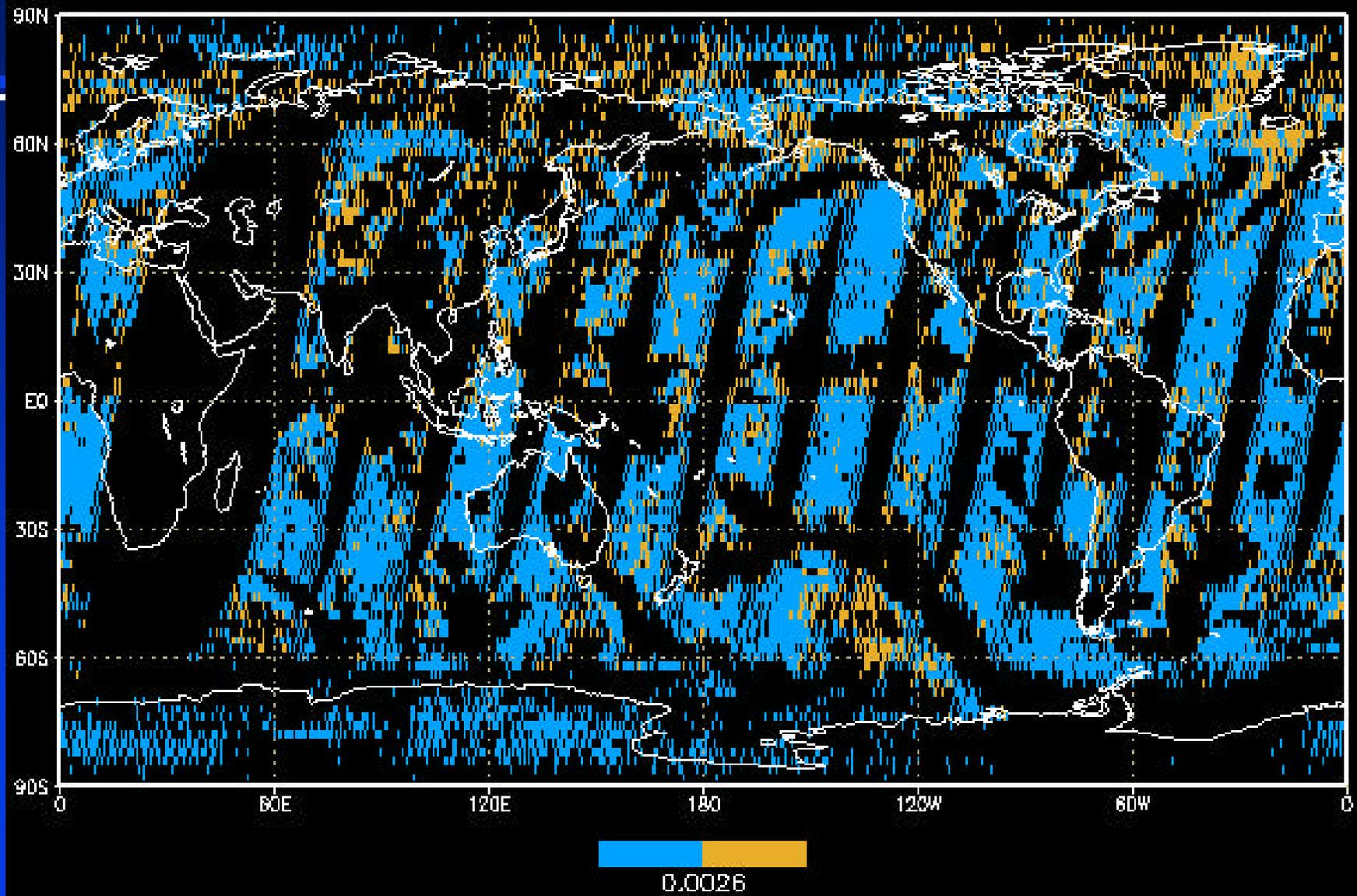


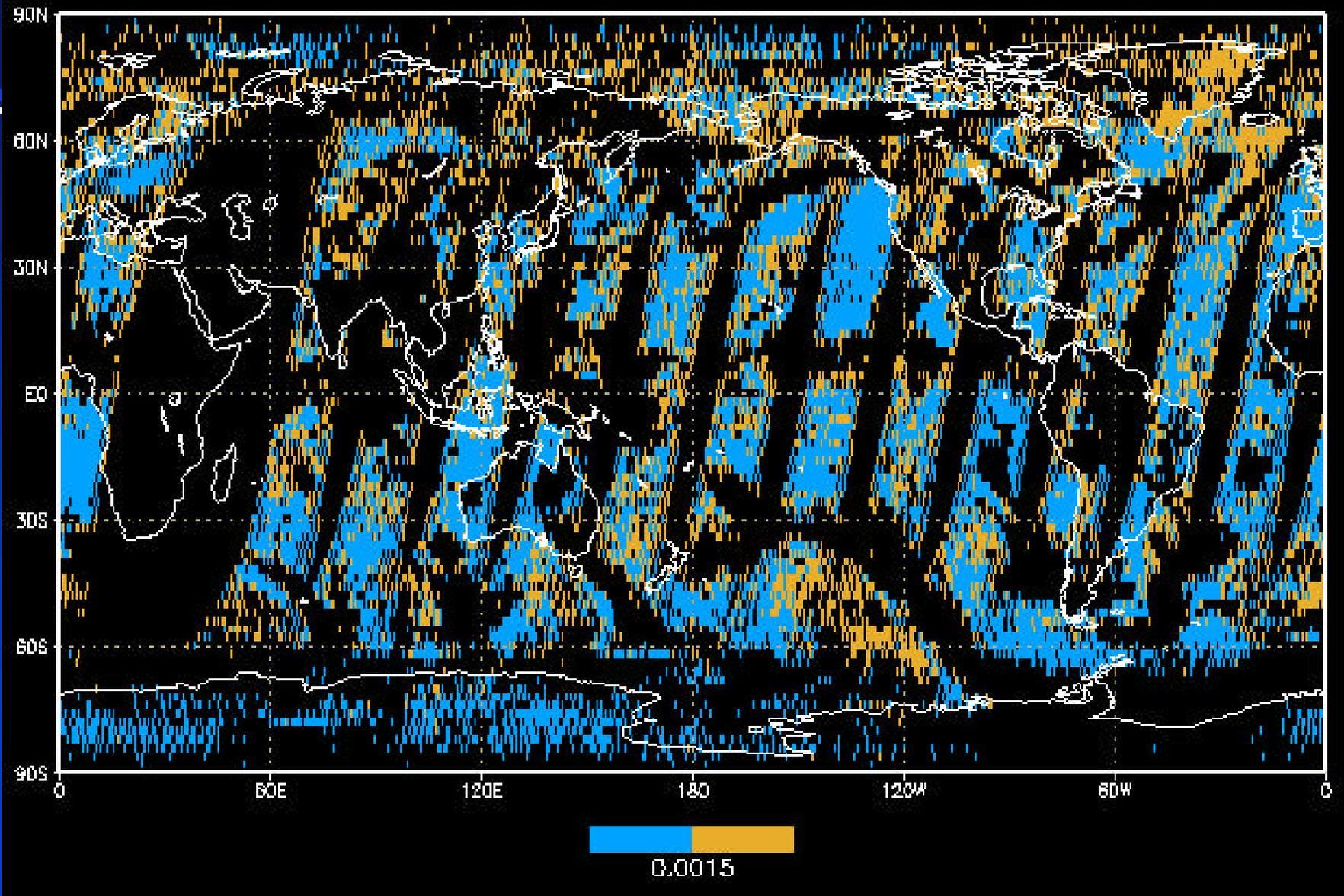
# Cloud Detection

- Predict 2390 cm<sup>-1</sup> from AMSU channels 4,5 and 6.
- SW LW IR window test is successful:  
[ch(2558.224)-CH(900.562)] < 10 K
- Compute spatial variability of 2390 cm<sup>-1</sup> over 3x3
- Predict skin temperature from 4 “window” channels (918,965,1228 1236) ~ 0.2 K accuracy over ocean (simulations)









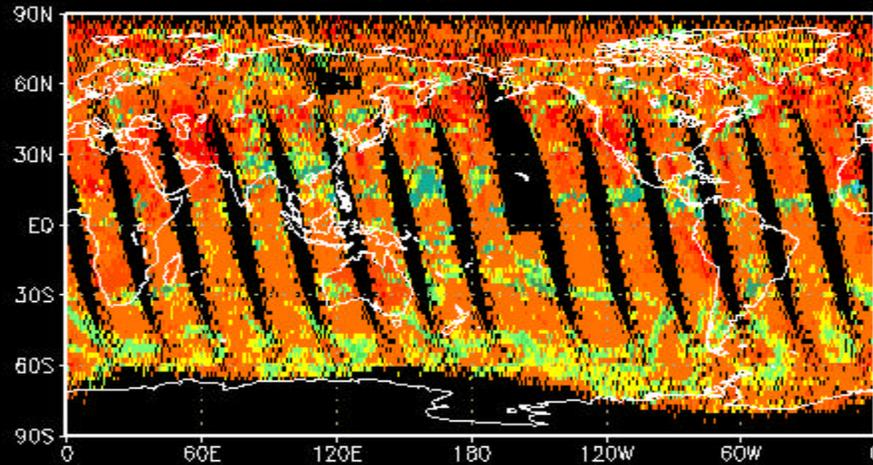
AIRS  
NESDIS  
NOAA

GG-GGEC 140 airs latlon 20JUL2002 lowres grfill rainbow  
315



- No cloud
- Max Error
- all cases
- score on
- coh on
- bt965 on
- bt2616 on
- 8mu on
- 12mu on
- sst on
- bt2445 on
- sfct on
- swlw on
- pairs on
- lat / lon
- nps
- sps
- robinson
- mollweide
- ortho
- print c
- print b/w
- Zero off
- logz on
- statistics
- Title
- Min/Max
- scale on
- diffpar on
- difflev on
- difflev1 on
- animate

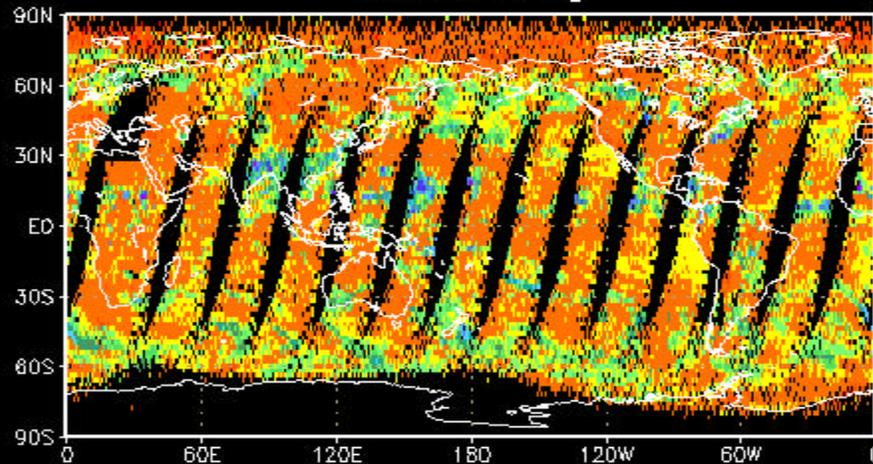
### level 1b



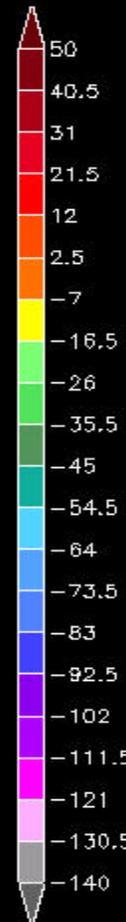
2615.77 cm-1

bias=-3.59991, rms=12.1265, sample=41585 (100%)

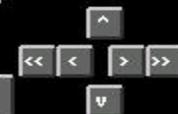
### Descending



bias=-9.49509, rms=16.008, sample=42138 (99.99%)



QUIT land/ocean LAND OCEAN UNZOOM ZOOM DISPLAY



AIRS  
NESDIS  
NOAA

GG-GGEC

140

airs

latlon

20JUL2002

lowres

grfill

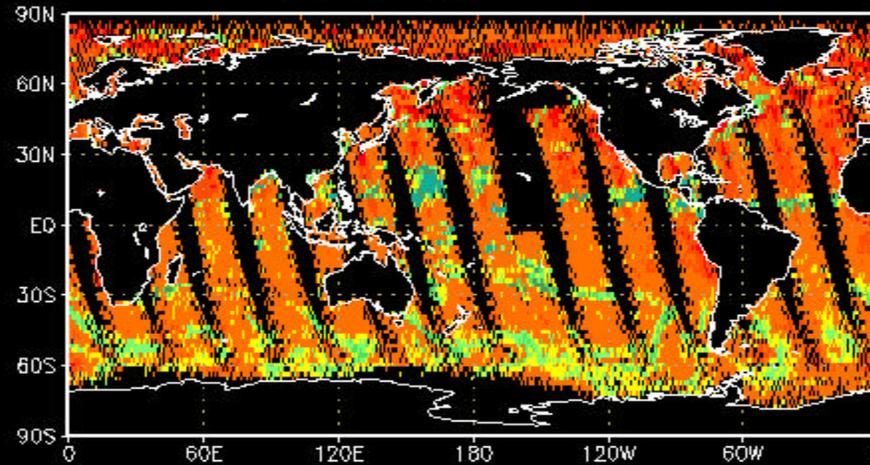
rainbow

315



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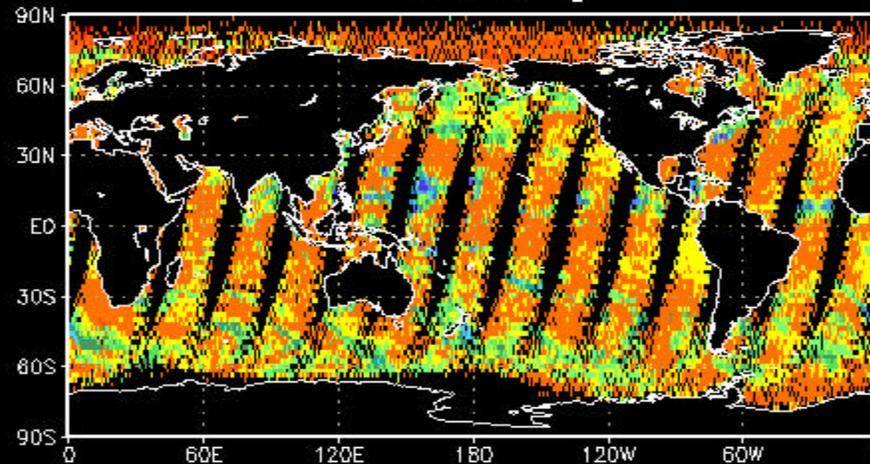
level 1b



2615.77 cm-1

bias=-4.00788, rms=11.7775, sample=26520 (63.77%)

Descending



bias=-9.98261, rms=16.075, sample=26844 (63.7%)



QUIT

land/ocean

LAND

OCEAN

UNZOOM

ZOOM

DISPLAY

AIRS  
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statistics

Title

Min/Max

scale on

diffpar on

difflev on

difflev1 on

animate

QUIT

land/ocean

LAND

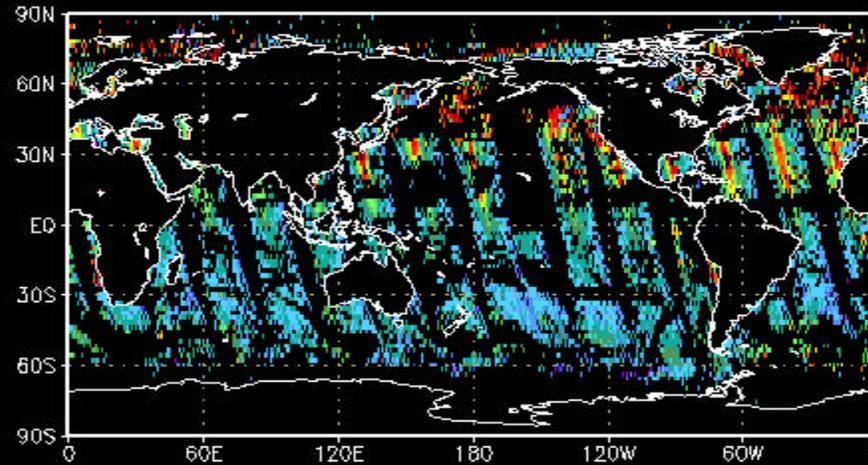
OCEAN

UNZOOM

ZOOM

DISPLAY

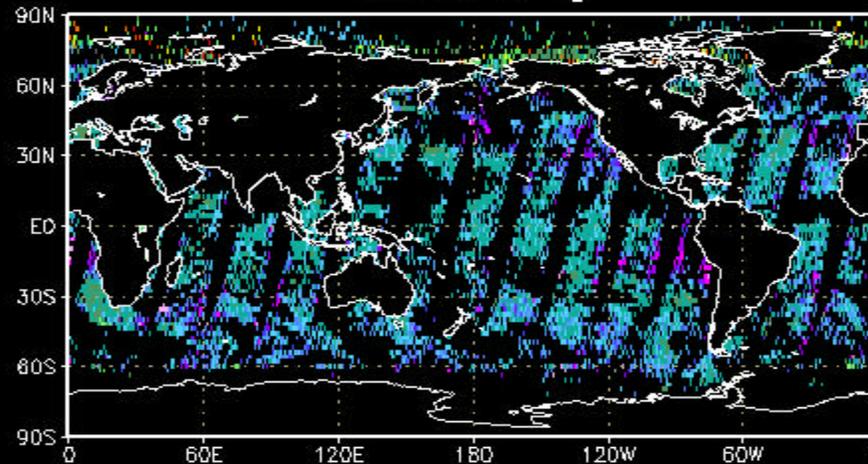
level 1b



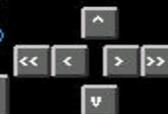
2615.77 cm-1

bias=0.209287, rms=5.22961, sample=12269 (29.5%)

Descending



bias=-3.04577, rms=4.85237, sample=11769 (27.92%)



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QUIT

land/ocean

LAND

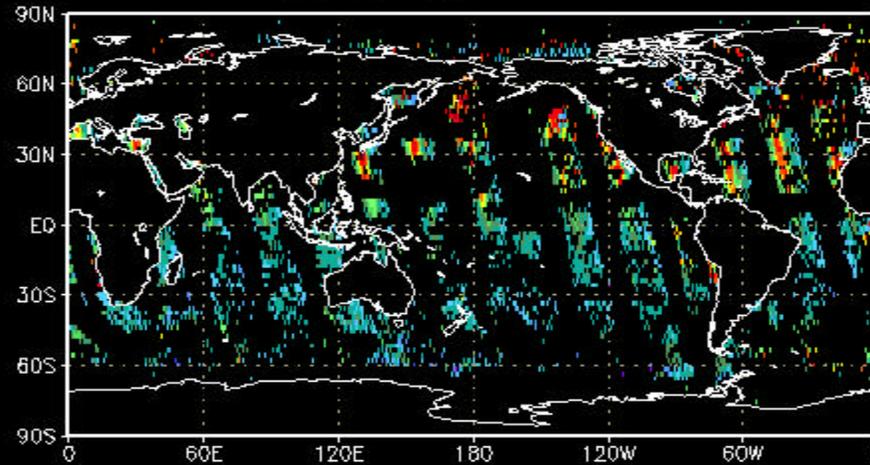
OCEAN

UNZOOM

ZOOM

DISPLAY

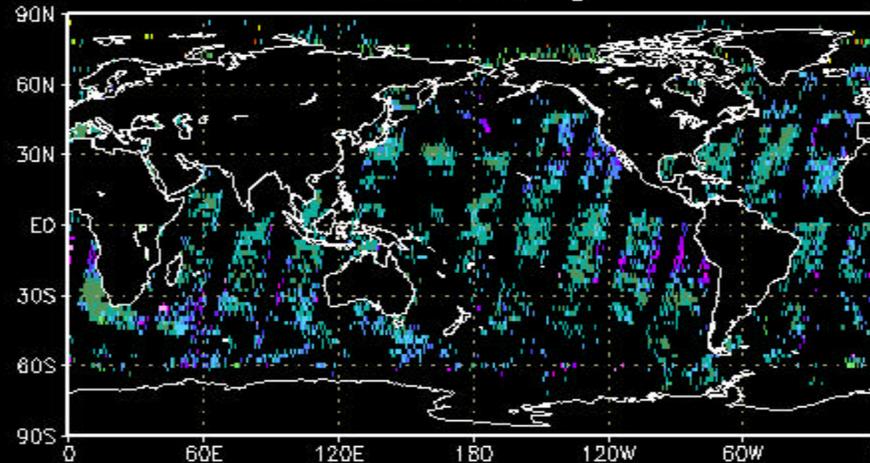
level 1b



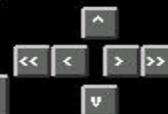
2615.77 cm-1

bias=0.662349, rms=4.9914, sample=6034 (14.51%)

Descending



bias=-2.92136, rms=4.71411, sample=6971 (16.54%)



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QUIT

land/ocean

LAND

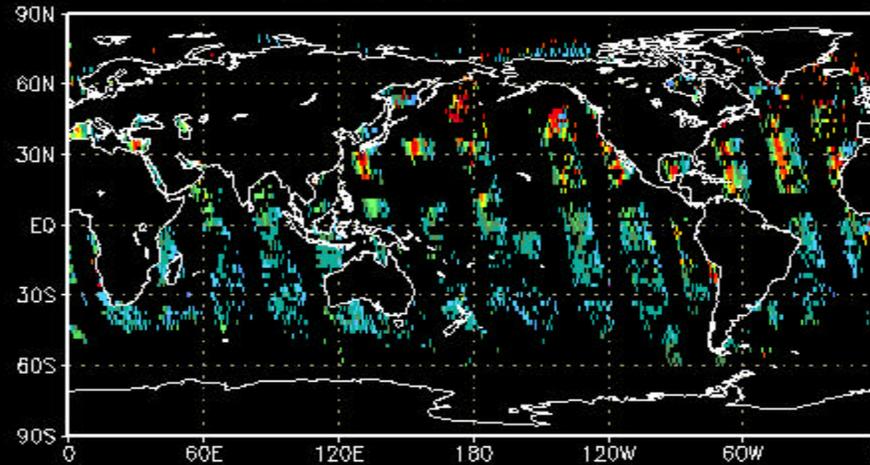
OCEAN

UNZOOM

ZOOM

DISPLAY

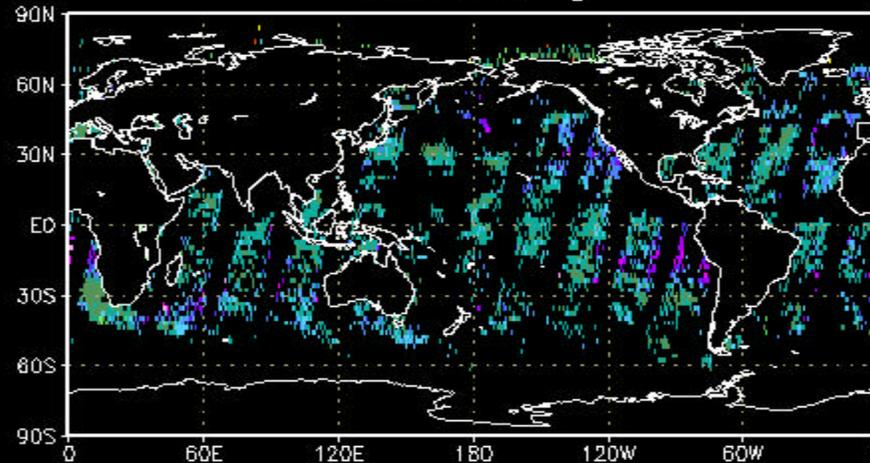
level 1b



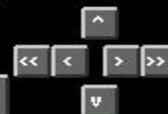
2615.77 cm-1

bias=0.7596, rms=4.96142, sample=5418 (13.02%)

Descending



bias=-2.77892, rms=4.49886, sample=6232 (14.78%)



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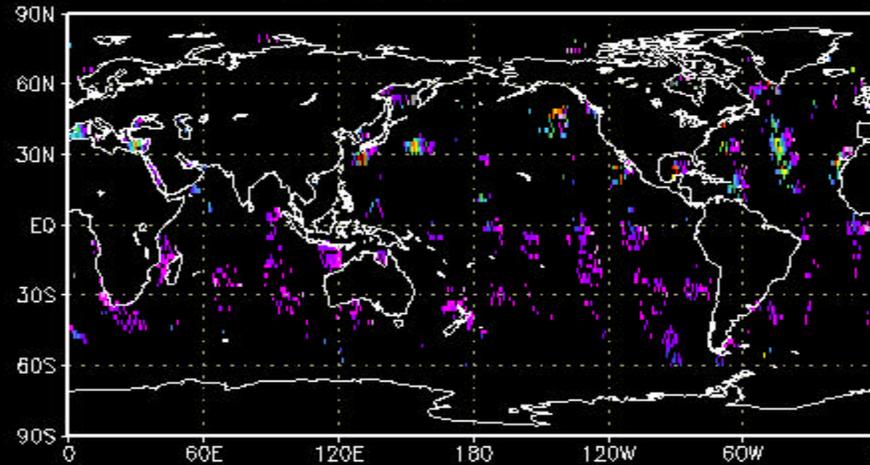
rainbow

315



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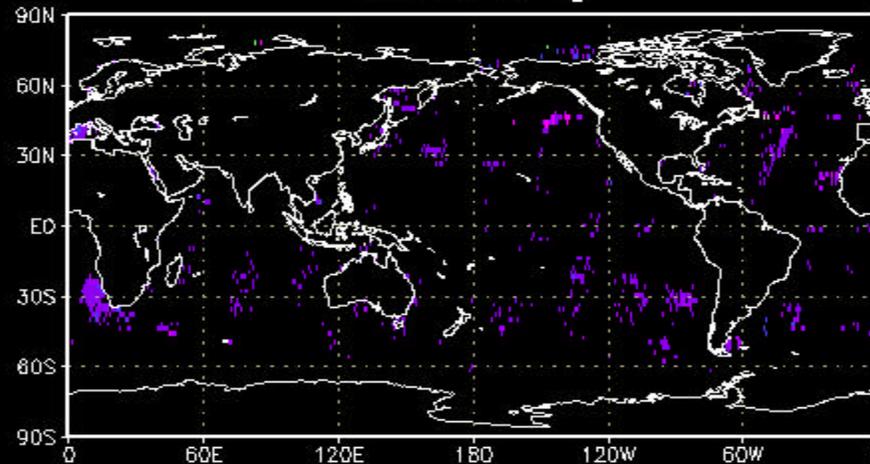
level 1b



2615.77 cm-1

bias=0.578719, rms=4.79988, sample=2098 (5.04%)

Descending



bias=-0.306437, rms=1.00488, sample=1328 (3.15%)

QUIT

land/ocean

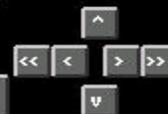
LAND

OCEAN

UNZOOM

ZOOM

DISPLAY



AIRS  
NESDIS  
NOAA

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140

airs

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lowres

grfill

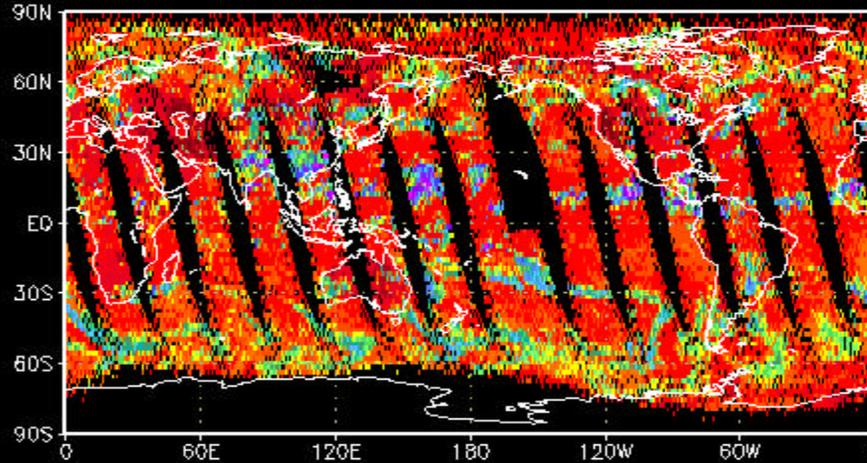
rainbow

201



- No cloud
- Max Error
- all cases
- score on
- coh on
- bt965 on
- bt2616 on
- 8mu on
- 12mu on
- sst on
- bt2445 on
- sfct on
- swlw on
- pairs on
- lat / lon
- nps
- sps
- robinson
- mollweide
- ortho
- print c
- print b/w
- Zero off
- logz on
- statistics
- Title
- Min/Max
- scale on
- diffpar on
- difflev on
- difflev1 on
- animate

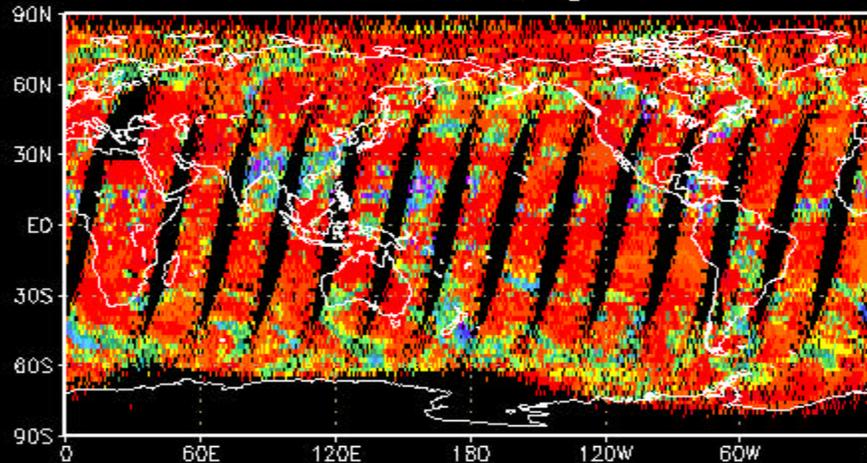
level 1b



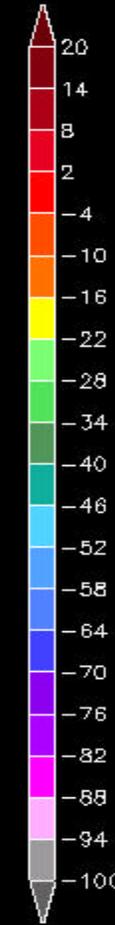
965.203 cm<sup>-1</sup>

bias=-10.6334, rms=18.9512, sample=41585 (100%)

Descending



bias=-11.1165, rms=18.114, sample=42140 (100%)



QUIT

land/ocean

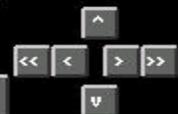
LAND

OCEAN

UNZOOM

ZOOM

DISPLAY



AIRS  
NESDIS  
NOAA

GG-GGEC

140

airs

latlon

20JUL2002

lowres

grfill

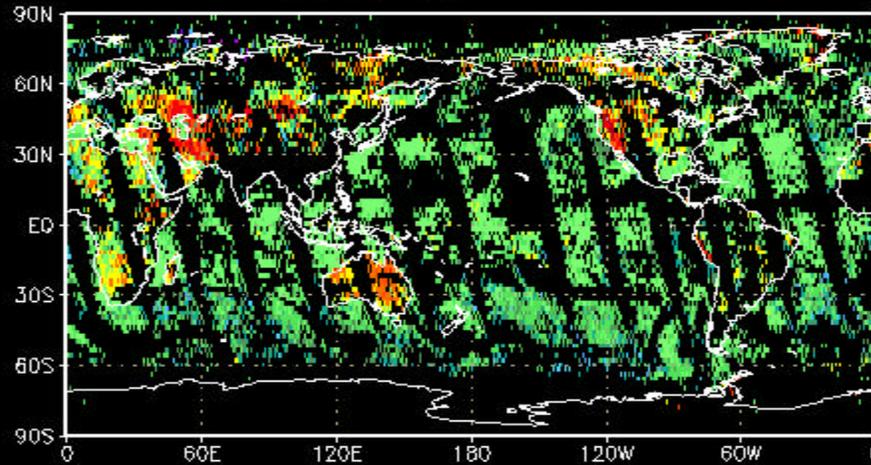
rainbow

201



- No cloud
- Max Error
- all cases
- score on
- coh on
- bt965 on
- bt2616 on
- 8mu on
- 12mu on
- sst on
- bt2445 on
- sfct on
- swlw on
- pairs off
- lat / lon
- nps
- sps
- robinson
- mollweide
- ortho
- print c
- print b/w
- Zero off
- logz on
- statistics
- Title
- Min/Max
- scale on
- diffpar on
- difflev on
- difflev1 on
- animate

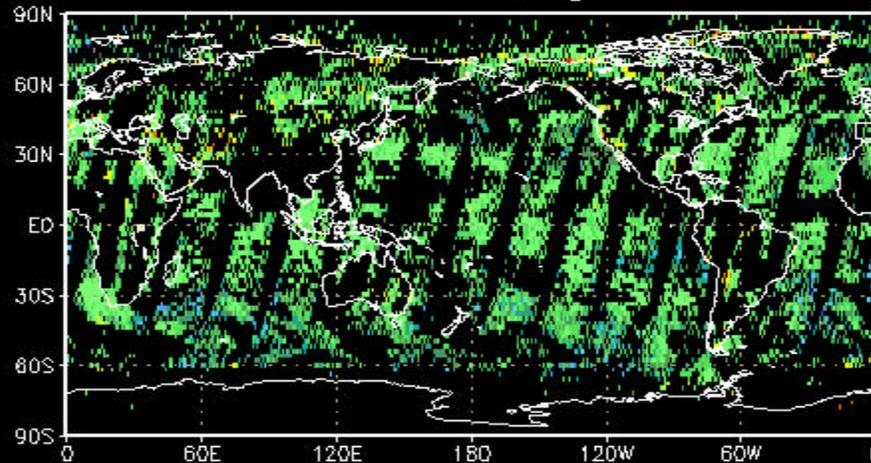
### level 1b



965.203 cm-1

bias=-0.892586, rms=5.06298, sample=17825 (42.86%)

### Descending



bias=-2.27045, rms=4.0662, sample=15830 (37.56%)



QUIT

land/ocean

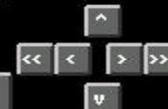
LAND

OCEAN

UNZOOM

ZOOM

DISPLAY



AIRS  
NESDIS  
NOAA

GG-GGEC

140

airs

latlon

20JUL2002

lowres

grfill

rainbow

201



No cloud

Max Error

all cases

score on

coh off

bt965 on

bt2616 on

8mu on

12mu on

sst on

bt2445 on

sfct on

swlw on

pairs off

lat / lon

nps

sps

robinson

mollweide

ortho

print c

print b/w

Zero off

logz on

statistics

Title

Min/Max

scale on

diffpar on

difflev on

difflev1 on

animate

QUIT

land/ocean

LAND

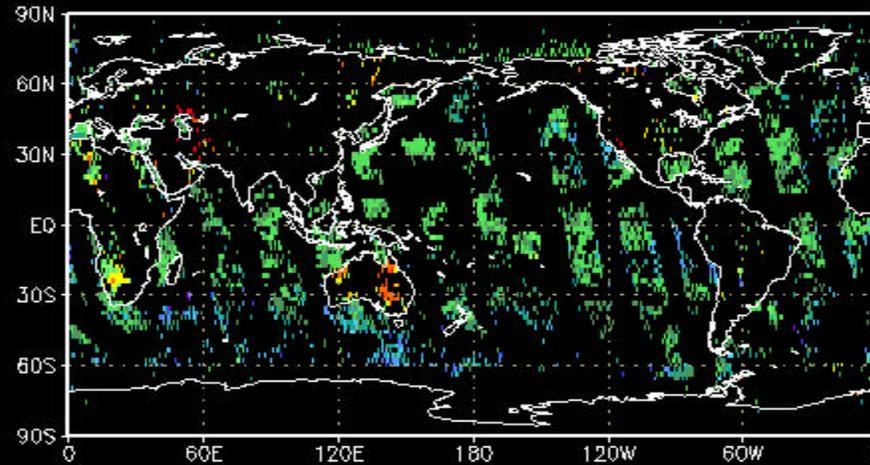
OCEAN

UNZOOM

ZOOM

DISPLAY

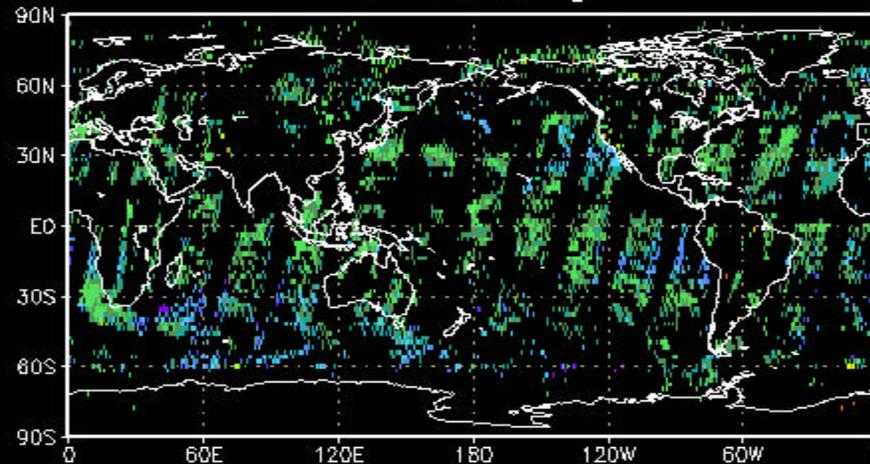
level 1b



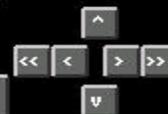
965.203 cm-1

bias=-0.858432, rms=3.48442, sample=6943 (16.69%)

Descending



bias=-1.93956, rms=3.60498, sample=8770 (20.81%)



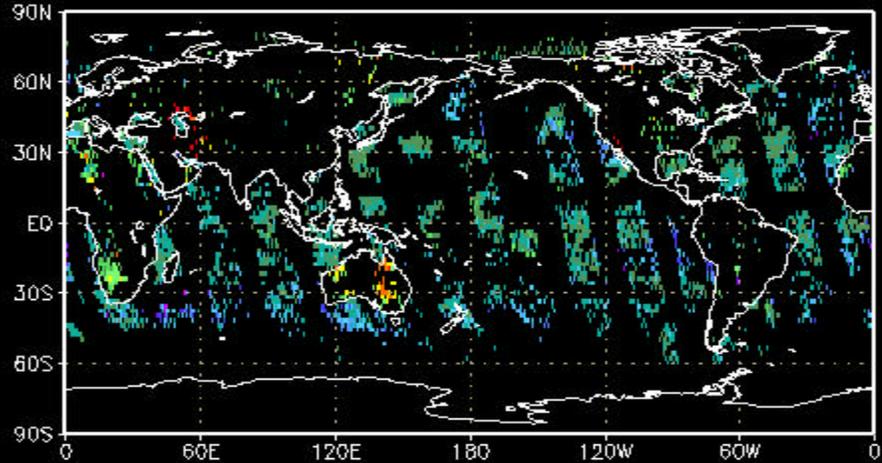
AIRS  
NEDDIS  
NOAA

GG-GGEC 140 airs latlon 20JUL2002 lowres grfill rainbow  
201



- No cloud
- Max Error
- all cases
- score on
- coh off
- bt965 off
- bt2616 on
- 8mu on
- 12mu on
- sst on
- bt2445 on
- sfct on
- swlw on
- pairs off
- lat / lon
- nps
- sps
- robinson
- mollweide
- ortho
- print c
- print b/w
- Zero off
- logz on
- statistics
- Title
- Min/Max
- scale on
- diffpar on
- difflev on
- difflev1 on
- animate

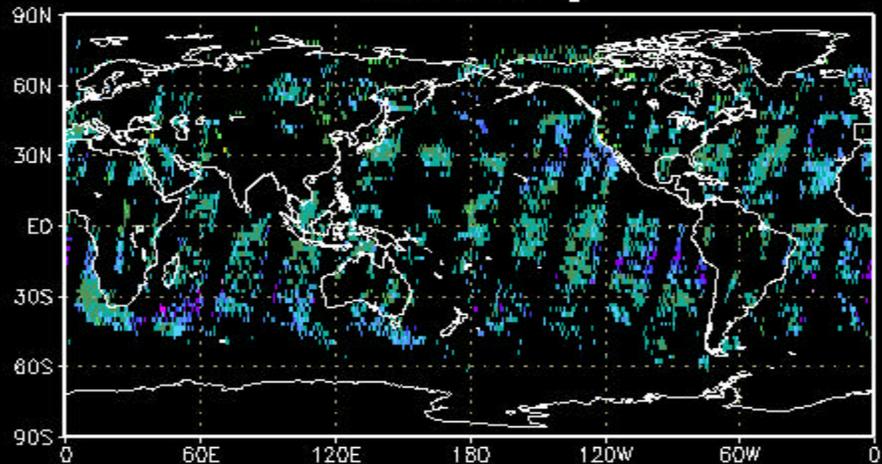
### level 1b



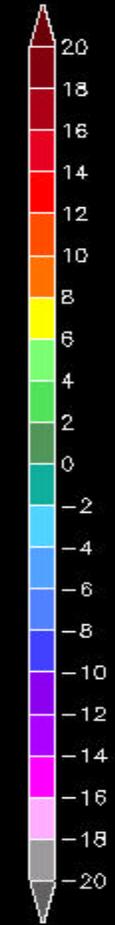
965.203 cm-1

bias=-0.520021, rms=3.14561, sample=6254 (15.03%)

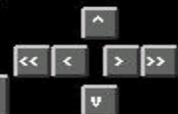
### Descending



bias=-1.7167, rms=3.26463, sample=7925 (18.8%)



QUIT land/ocean LAND OCEAN UNZOOM ZOOM DISPLAY



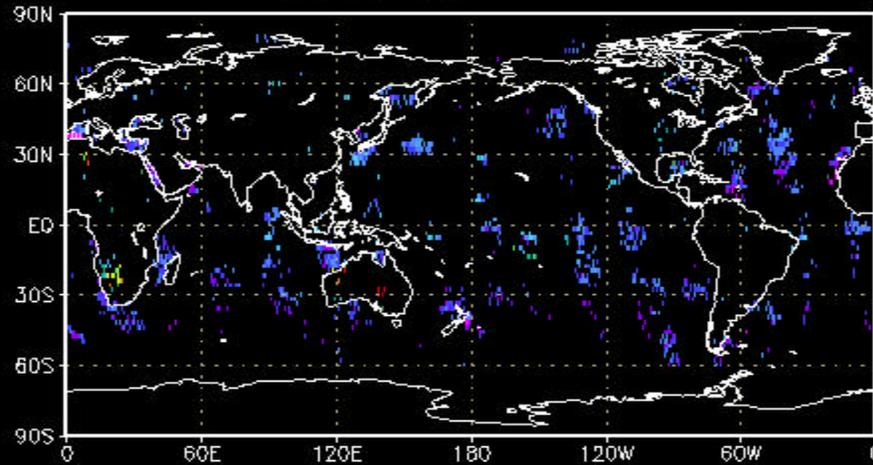
AIRS  
NESDIS  
NOAA

GG-GGEC 140 airs latlon 20JUL2002 lowres grfill rainbow  
201



- No cloud
- Max Error
- all cases
- score on
- coh off
- bt965 off
- bt2616 on
- 8mu on
- 12mu on
- sst off
- bt2445 on
- sfct on
- swlw on
- pairs off
- lat / lon
- nps
- sps
- robinson
- mollweide
- ortho
- print c
- print b/w
- Zero off
- logz on
- statistics
- Title
- Min/Max
- scale on
- diffpar on
- difflev on
- difflev1 on
- animate

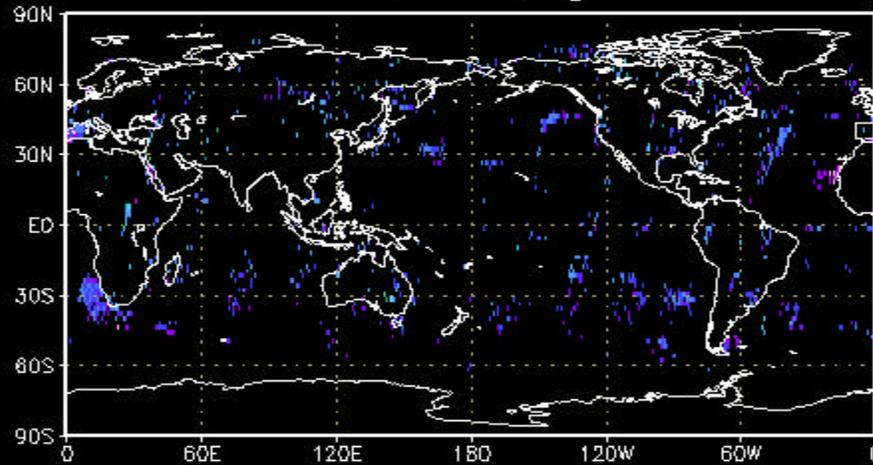
### level 1b



965.203 cm-1

bias=0.355802, rms=1.28612, sample=2285 (5.49%)

### Descending



bias=0.137438, rms=0.844345, sample=1824 (4.32%)

QUIT land/ocean LAND OCEAN UNZOOM ZOOM DISPLAY ^ << < > >> v

AIRS  
NESDIS  
NOAA

GG-GGEC

140

airs

latlon

20JUL2002

lowres

grfill

rainbow

201



No cloud

Max Error

all cases

score on

coh off

bt965 off

bt2616 on

8mu on

12mu on

sst off

bt2445 on

sfct on

swlw on

pairs off

lat / lon

nps

sps

robinson

mollweide

ortho

print c

print b/w

Zero off

logz on

statistics

Title

Min/Max

scale on

diffpar on

difflev on

difflev1 on

animate

QUIT

land/ocean

LAND

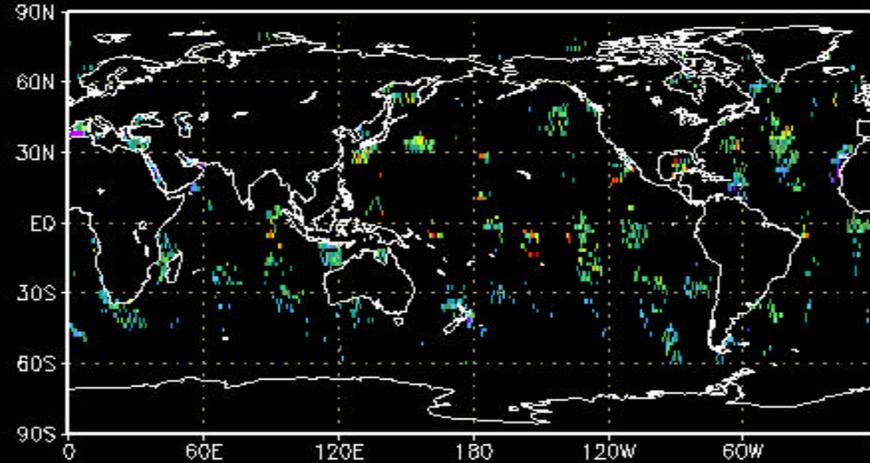
OCEAN

UNZOOM

ZOOM

DISPLAY

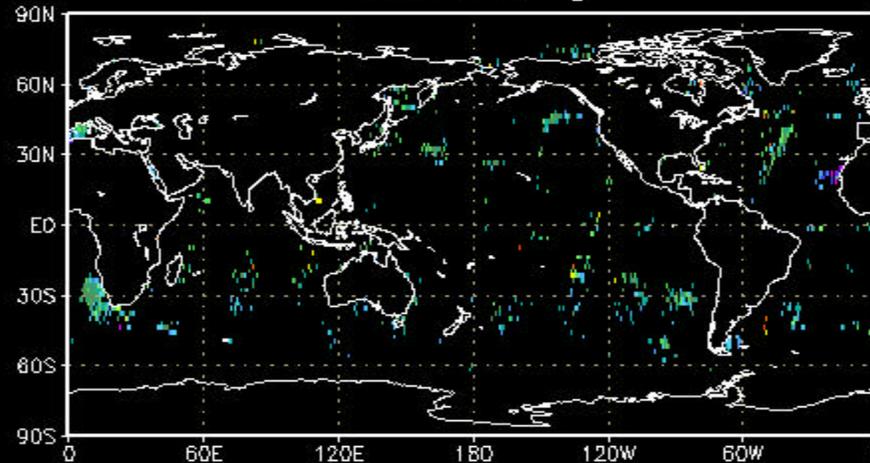
level 1b



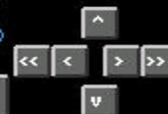
965.203 cm-1

bias=0.142914, rms=0.856364, sample=2098 (5.04%)

Descending



bias=-0.069563, rms=0.678277, sample=1328 (3.15%)

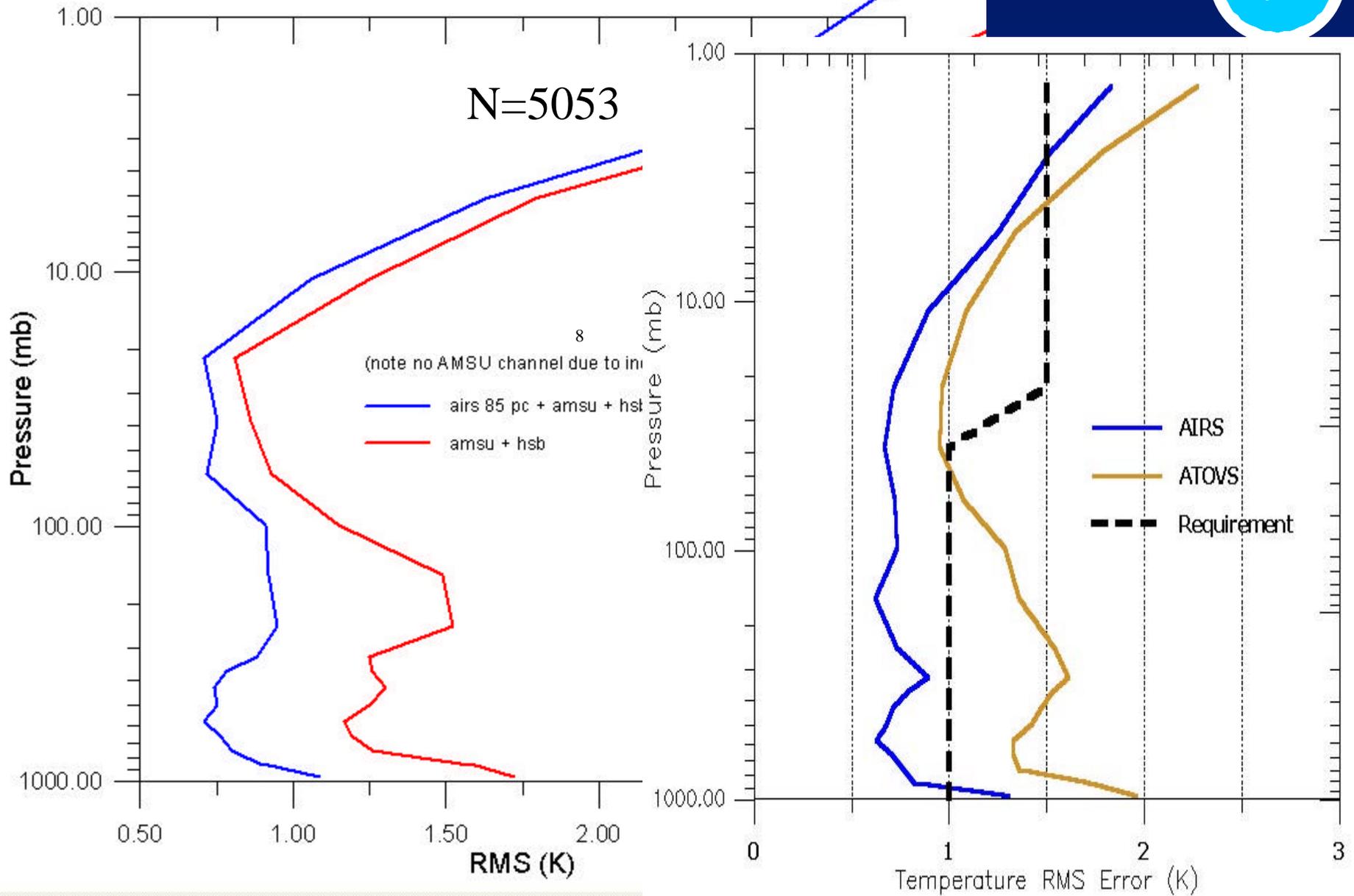




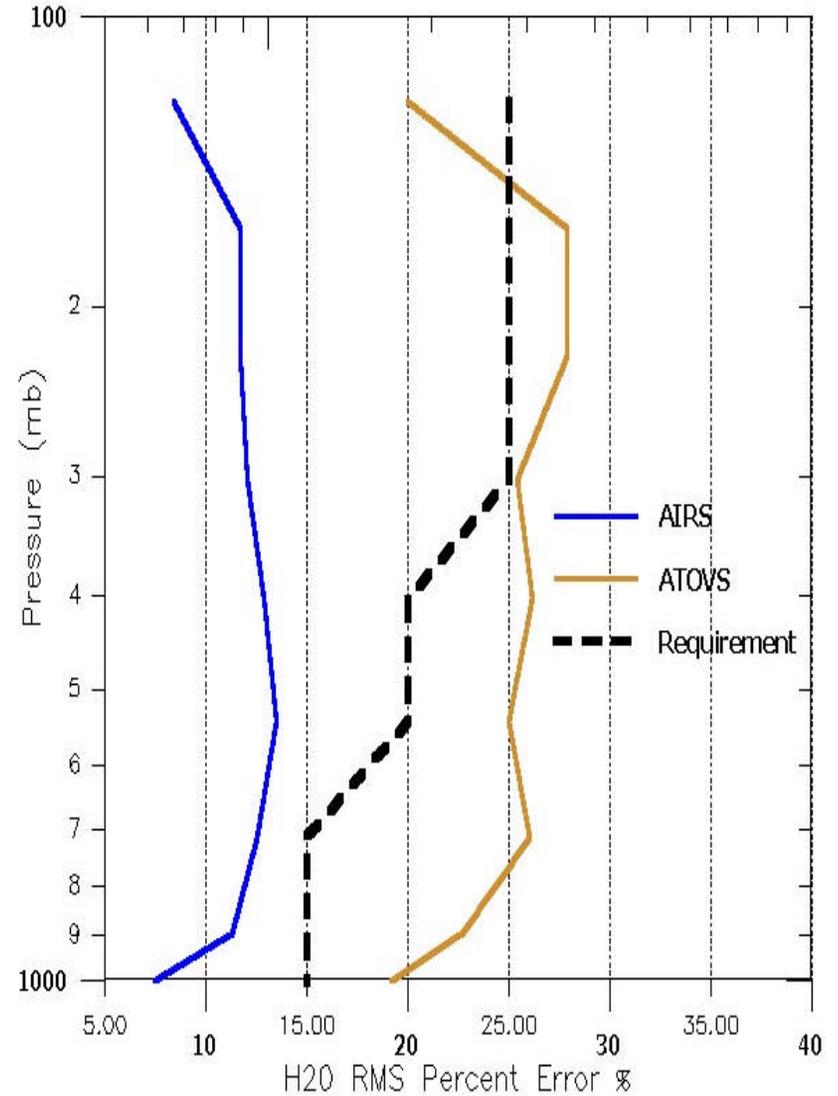
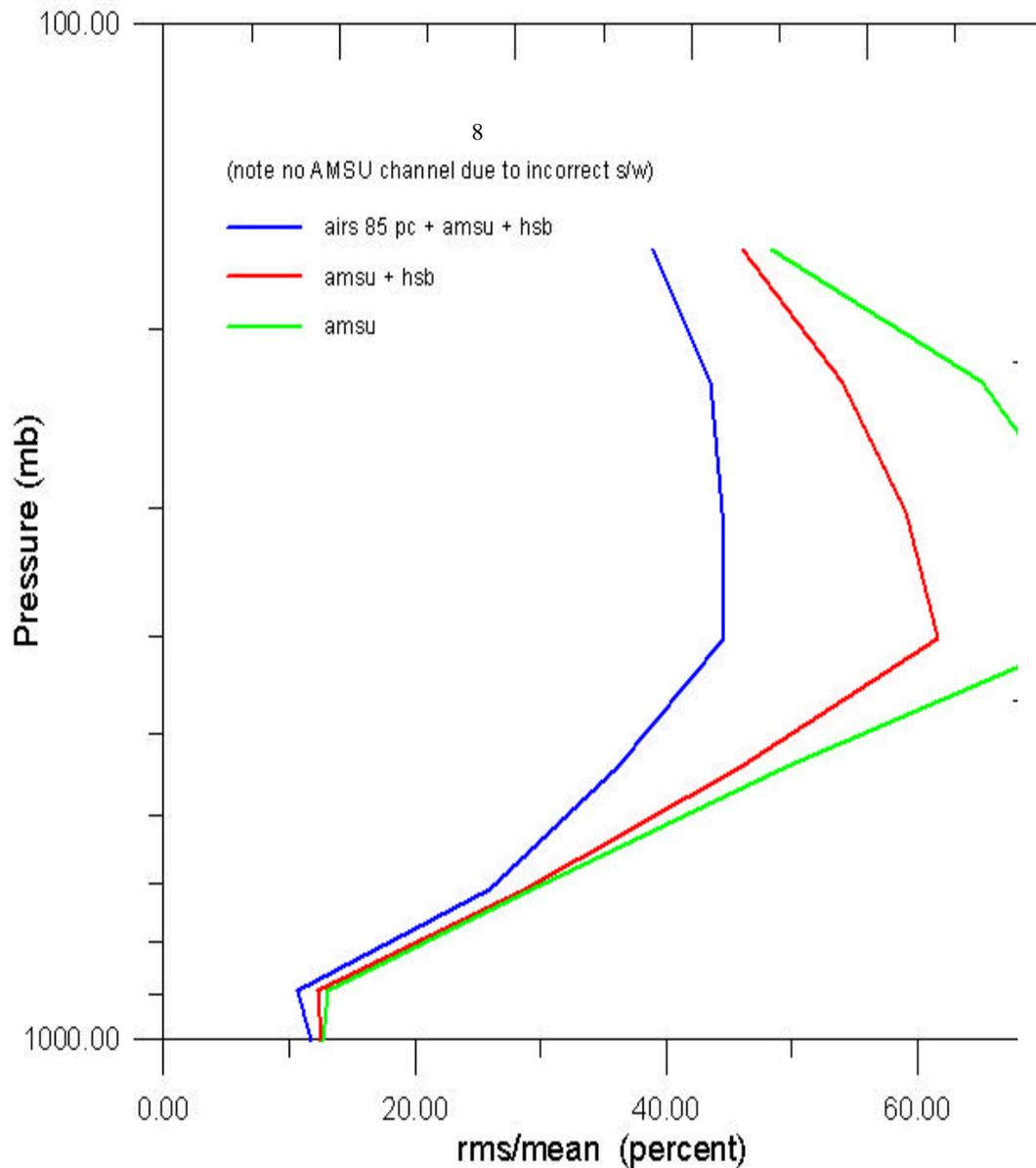
# Regression Retrievals

- Generated coefficients using ECWMF analysis fields as “truth”
- Coefficients based on July 20. Applied to both July 20 and July 28
- Independent data is about 0.1 – 0.2 K larger

# Regression prediction of ECWWMF Temperature

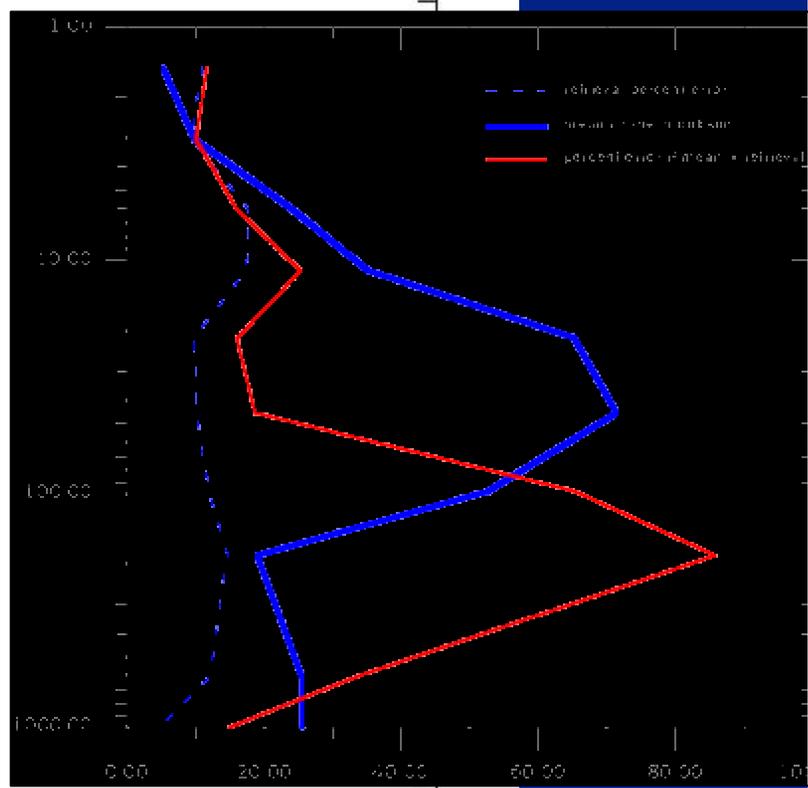
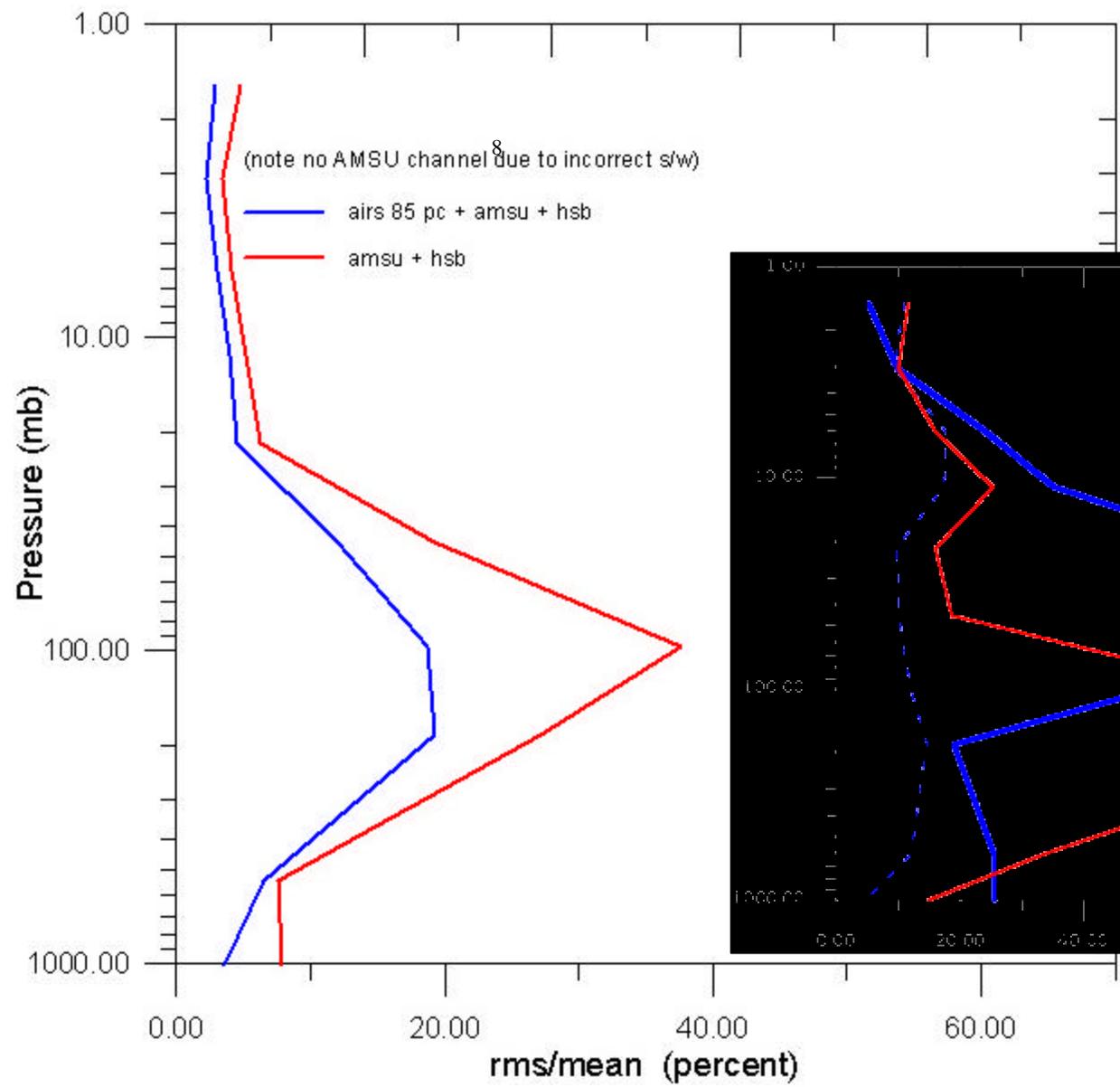


# Regression prediction of ECWMF moisture





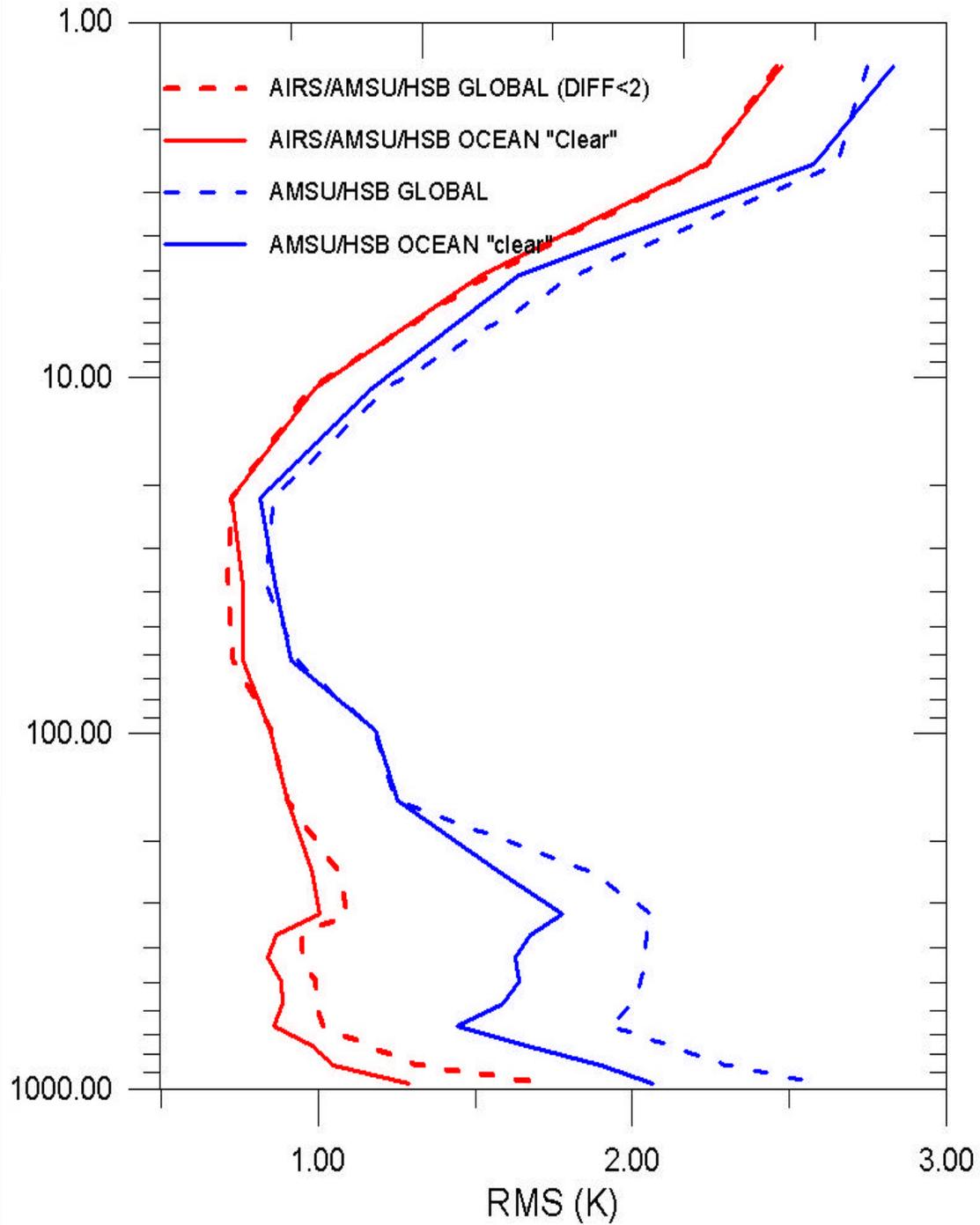
# Regression prediction of ECWFMF ozone



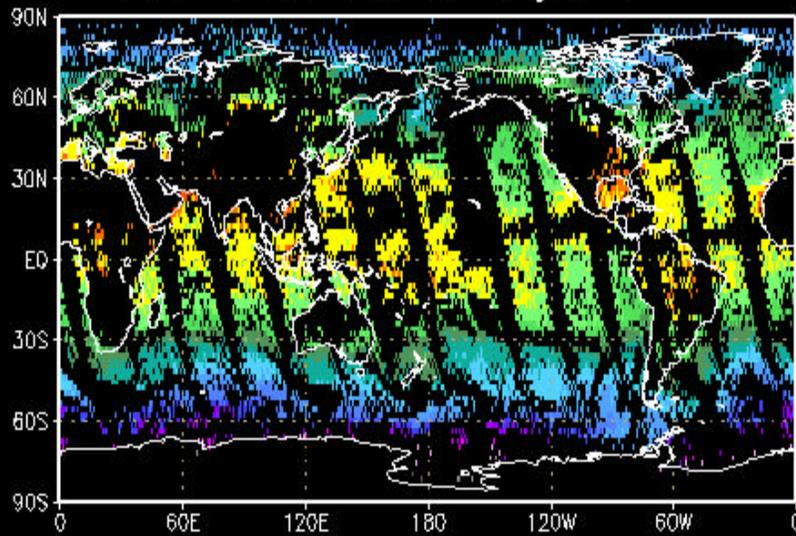
# How sensitive is the regression solution to clouds?



- Regression should be able to reduce the impact of partial clouds in AIRS fov because of the high spectral resolution of AIRS.
- Each channel has a different sensitivity due to clouds.
- Generated coefficients for all cases where the predicted AIRS from AMSU difference test is less than 2 K (~50%)



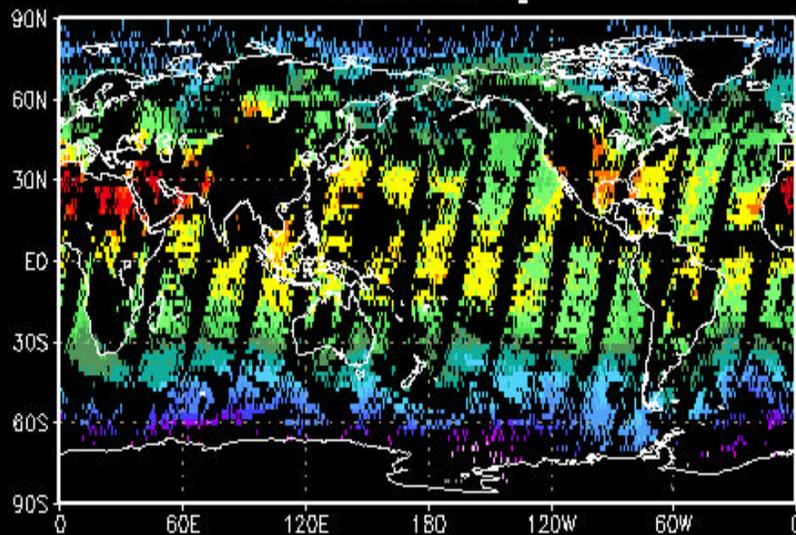
# airs retrievals at layers



904.8660 to 1013.948 mb

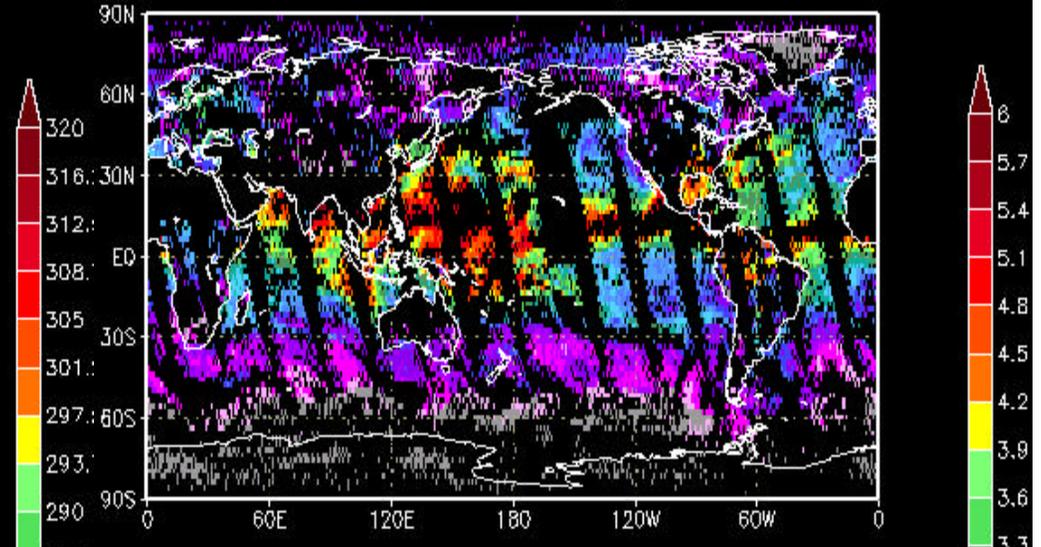
min=240.826, max=305.725, sample=18093 (49.18%)

Descending



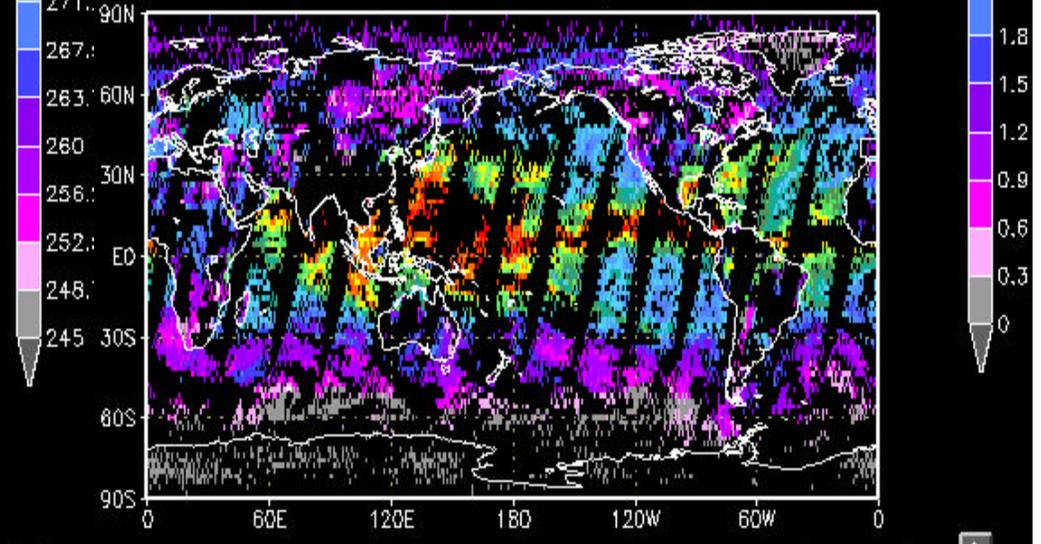
min=240.121, max=323.432, sample=18726 (50.09%)

# airs retrievals at layers



min=0, max=6.03125, sample=19823 (46.35%)

Descending

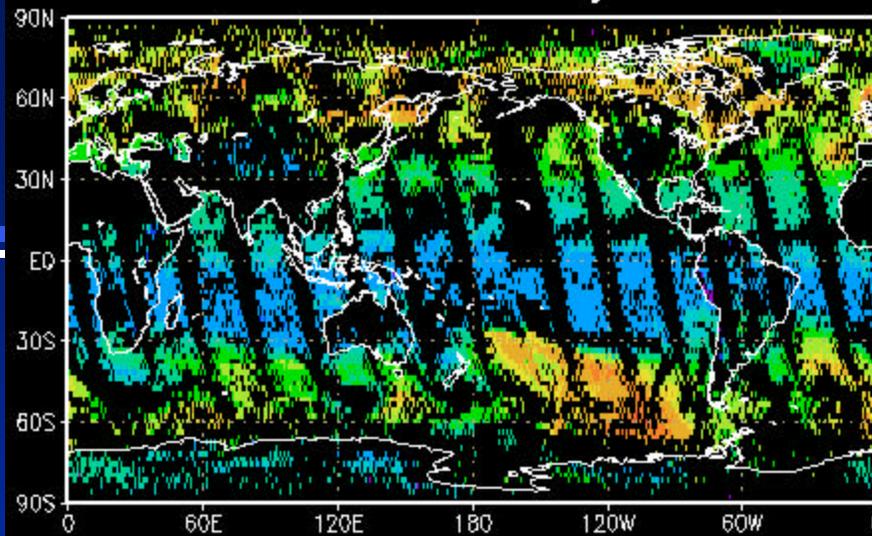


min=0.00610595, max=5.76787, sample=21072 (48.34%)

# Total ozone

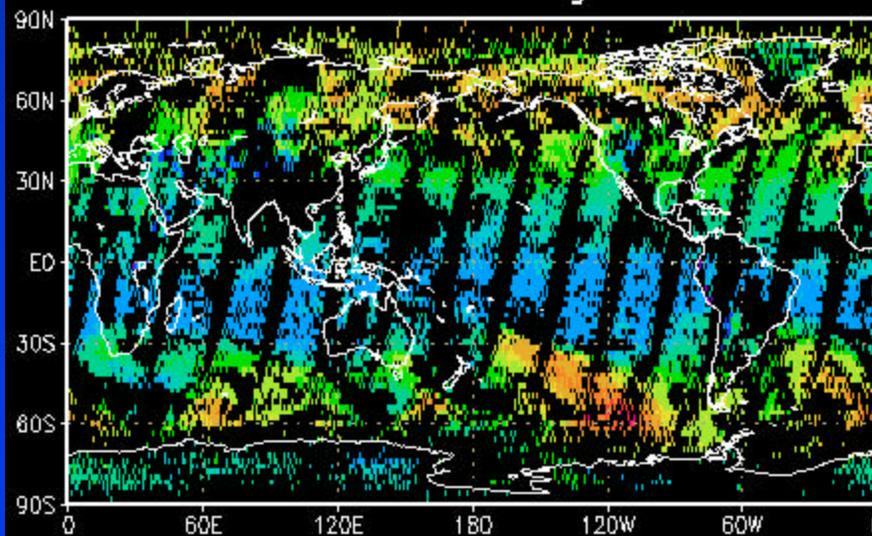


## airs retrievals at layers

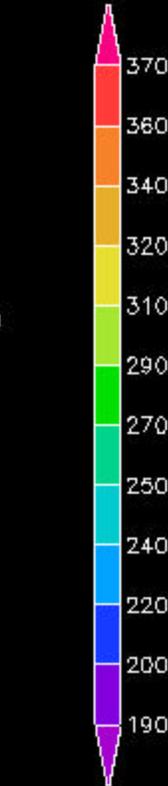


min=0, max=367.977, sample=19823 (46.35%)

## Descending



min=189.344, max=376.354, sample=21072 (48.34%)



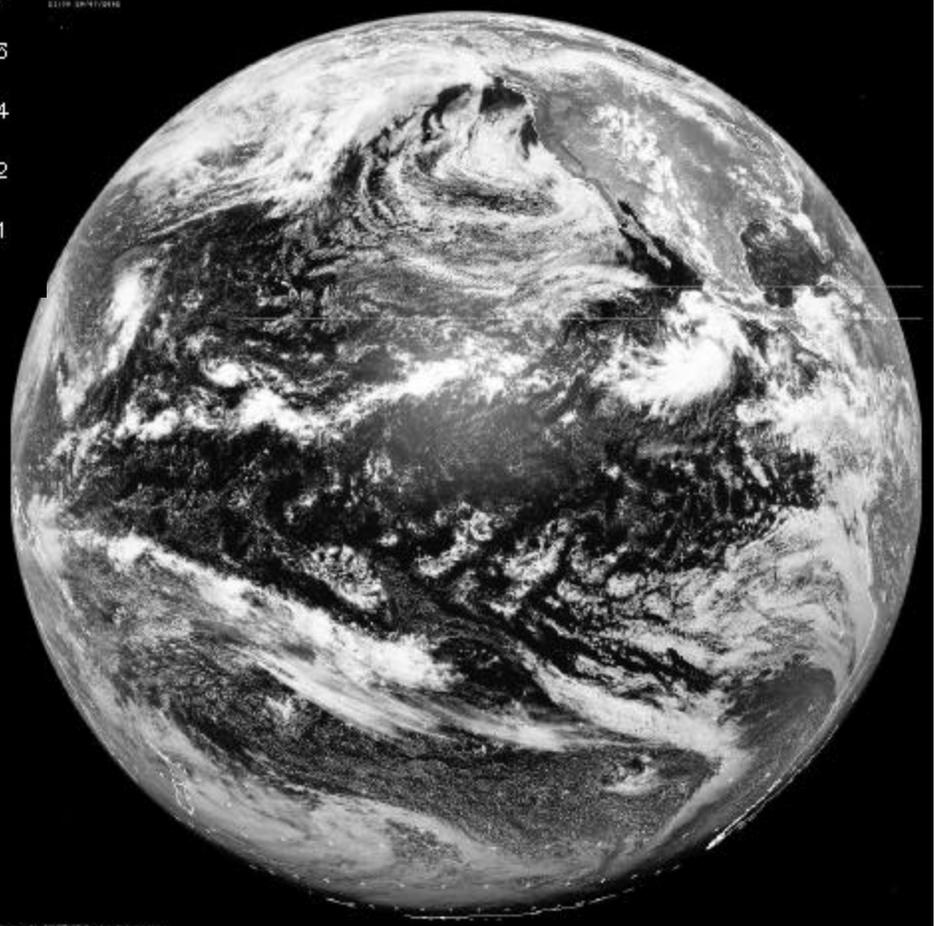
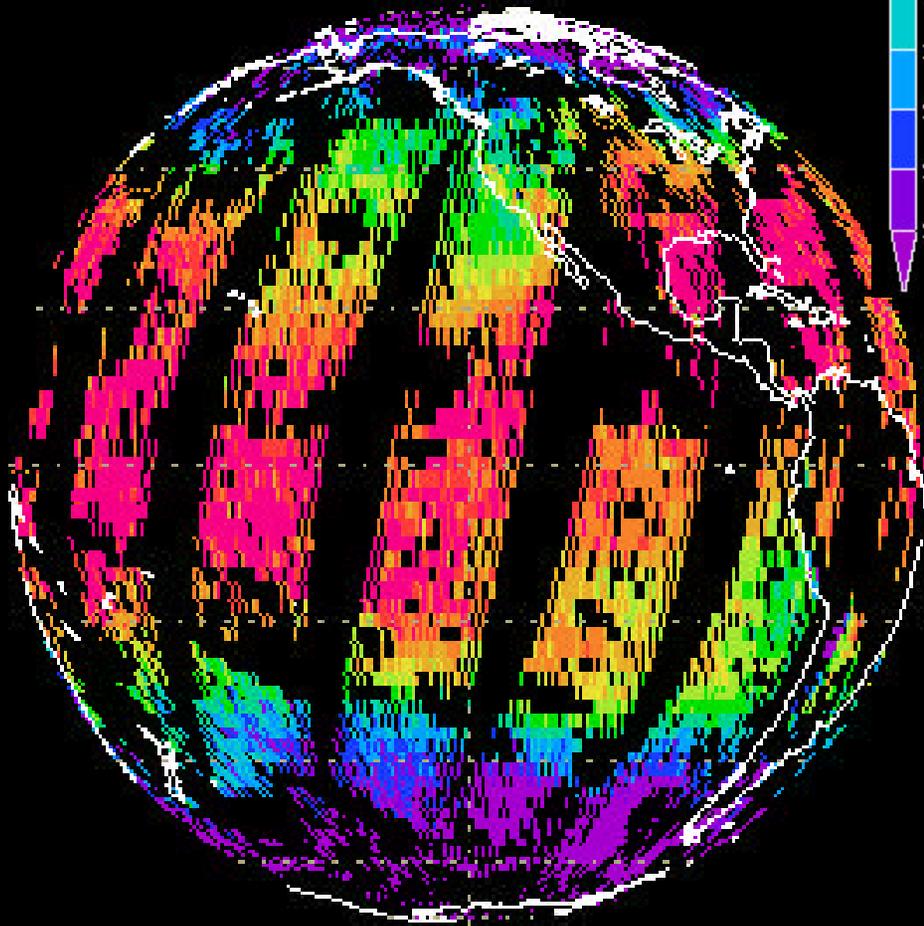
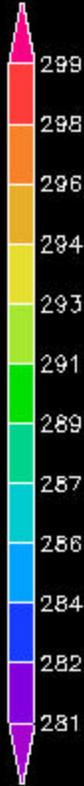
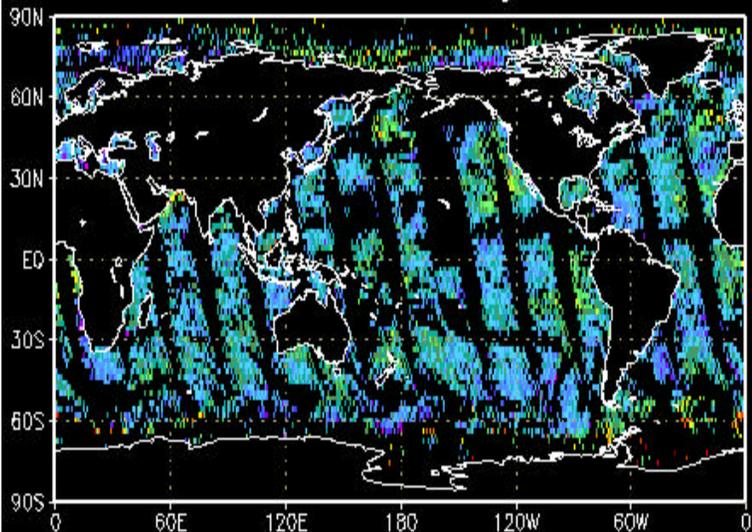


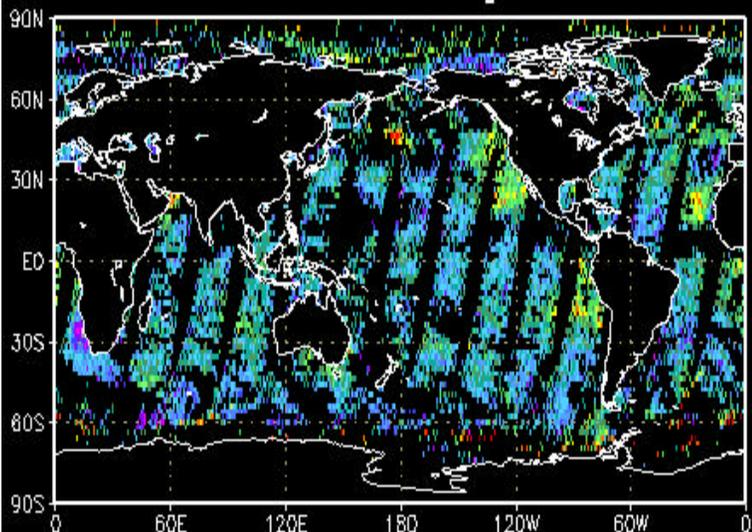
Image from NOAA/CIRES/CIRES/CIRES

### airs retrievals at layers



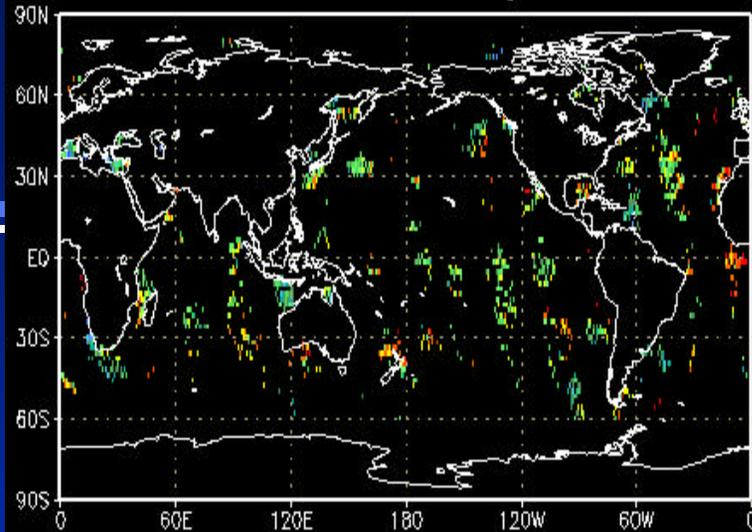
904.8660 to 1013.948 mb  
bias=0.0103873, rms=1.64228, sample=15301 (41.59%)

### Descending



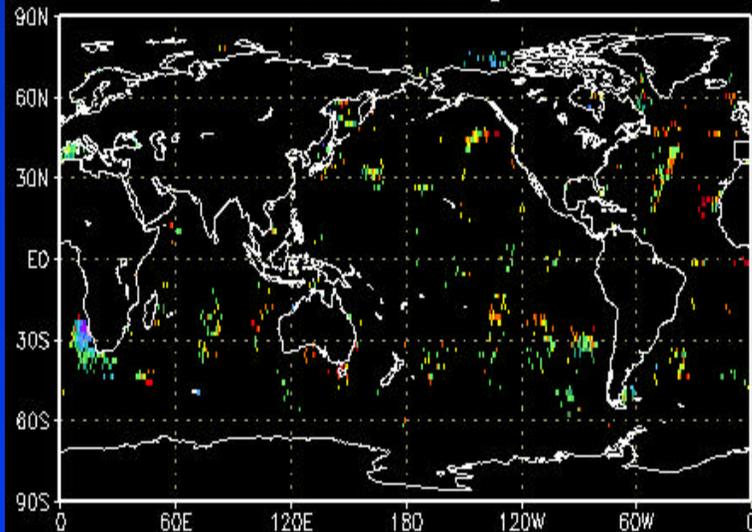
bias=0.198161, rms=1.81327, sample=14714 (39.36%)

### airs retrievals at layers



904.8660 to 1013.948 mb  
bias=-0.00818323, rms=1.3252, sample=2066 (5.81%)

### Descending



bias=0.100387, rms=1.63558, sample=1327 (3.55%)