NEW CLIMATE PARAMETERS FOR VERSION 5.0

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AIRS Science Team Meeting

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BACKGROUND

TOVS Pathfinder Path A data set covers 1979-present

HIRS2/MSU from TIROS-N, NOAA 6-12, NOAA 14

Monthly mean products have been used to study interannual variability and trends

Most important products have been T(p), OLR, MSU2R/MSU4, precipitation estimate (P.E.)

Level 2 and Level 3 T(p) and OLR are generated in Version 4.0

We want AIRS Level 2 and Level 3 products to overlap and extend TOVS data set

NOAA N launch date is May 11

Most likely, NOAA 14 data will no longer be transmitted

Need Level 2,3 MSU2R/MSU4 and P.E. in Version 5.0

Need to be able to post process Version 4.0 data to produce analogous products

AIRS LEVEL 3 PRODUCTS

Different geophysical parameters are gridded according to different tests

Stratospheric Temperature Test

T(p) 100 mb and above

Constituent Profile Test

q(p), O_3(p), CO(p) at all p

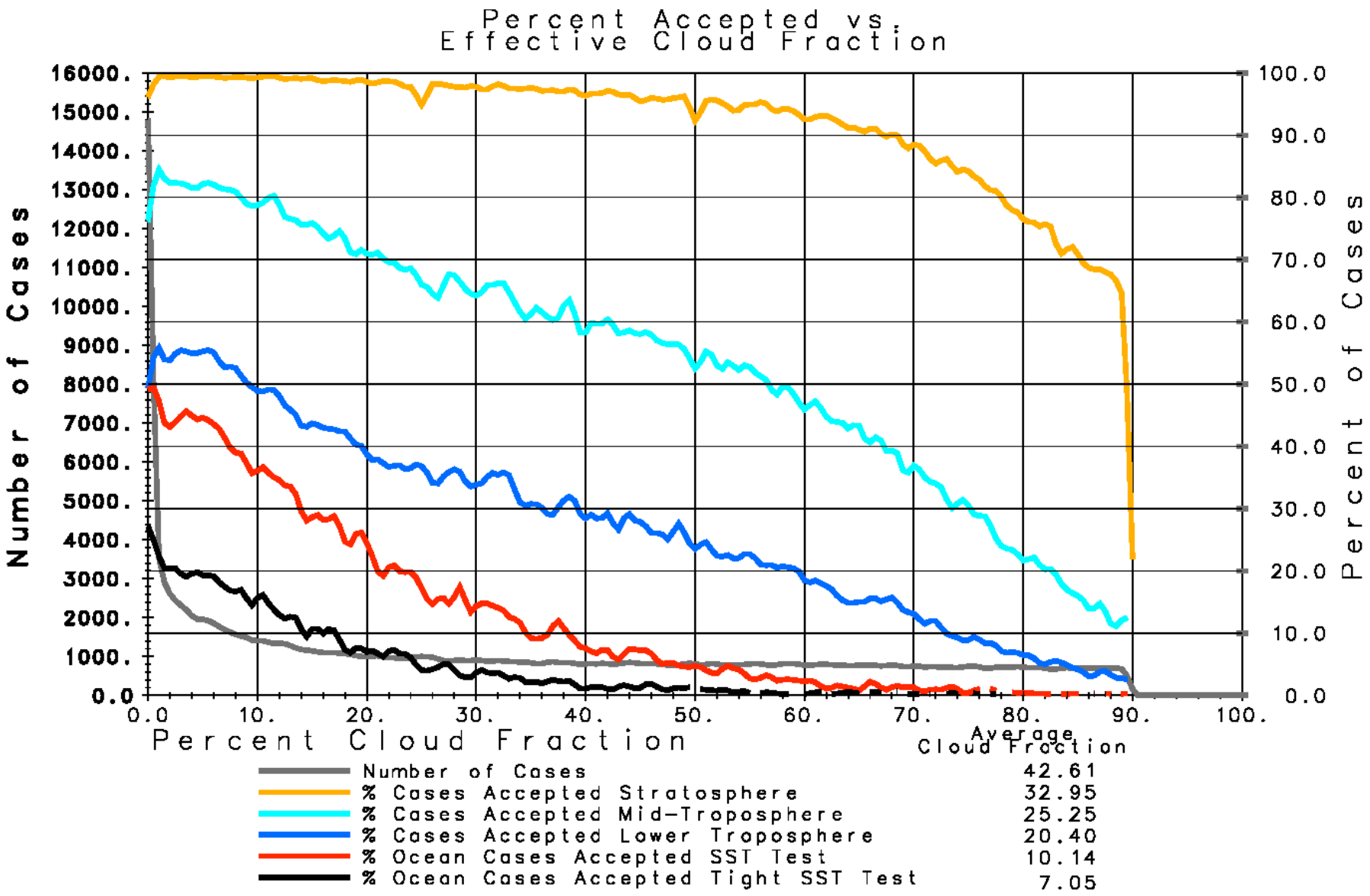
Mid-Tropospheric Temperature Test

T(p) beneath 100 mb, MSU2/MSU4, land (including ice and coasts) surface skin temperature (and emissivity)

Sea Surface Temperature Test

Non-frozen ocean surface skin temperature (and emissivity)

Cloud parameters, OLR, clear sky OLR, and P.E. use all AIRS cases


Percent Accepted vs.
Effective Cloud Fraction
Number of Cases
Percent of Cases
16000.
15000.
14000.
13000.
12000.
11000.
10000.
9000.
8000.
7000.
6000.
5000.
4000.
3000.
2000.
1000.
0.0
100.0
90.0
80.0
70.0
60.0
50.0
40.0
30.0
20.0
10.0
0.0
0.0
10.
20.
30.
40.
50.
60.
70.
80.
90.
100.
Percent Cloud Fraction
Average
Cloud Fraction
Number of Cases 42.61
% Cases Accepted Stratosphere 32.95
% Cases Accepted Mid-Troposphere 25.25
% Cases Accepted Lower Troposphere 20.40
% Ocean Cases Accepted SST Test 10.14
% Ocean Cases Accepted Tight SST Test 7.05

QUESTION ABOUT CLEAR (DRY) BIAS FOR AIRS LEVEL 3 PRODUCTS

This is a good question because

1) All non-cloud parameter retrievals see clear portion of the field of view

    Unlike microwave only retrievals

2) Gridded data totally excludes some cloudier cases

Question is particularly important with regard to interannual variability and trends

We attempt to minimize effects of 2) by including as many cloudy cases as possible

    This is why we average constituent profiles with very little quality control

Partial answer to 1) comes from comparing retrievals with colocated forecast

    Forecast includes cloudy portion of the scenes

Partial answer to 2) comes from comparison with other data sets

    Spencer and Christy MSU, CERES OLR, TOMS O_3

We will also address 2) by comparing interannual differences of gridded ECMWF forecasts colocated to

    Accepted AIRS retrievals (as done now)

    All AIRS observations

PRECIPITATION ESTIMATE

TOVS Pathfinder

Empirically relates precipitation to $\alpha\varepsilon$, P_c, T(p), q(p)

Bob Adler uses TOVS precipitation estimate in official GPCP product

Best source of precipitation in polar regions

Huffman et al., J. Hydrometeor., **2**, 36-50, 2001 daily product

Adler et al., J. Hydrometeor., **4**, 1147-1167, 2003 monthly product

We provide 1° x 1° gridded precipitation estimate daily and monthly

Bob Adler would like AIRS precipitation estimate as soon as possible (daily, monthly)

This is critical because TOVS Pathfinder will end in May 2005

Need to generate product using DAAC Version 4 data

COMPUTATION OF PRECIPITATION ESTIMATE

TOVS

Computed on a sounding by sounding basis using $\alpha\varepsilon$, P_c, T(p), q(p)

Uses retrieved T(p), q(p) if retrieval is successful

Uses forecast T(p), q(p) if retrieval is rejected

Uses $\alpha\varepsilon, P_c$ determined from retrieval, or forecast if retrieval is rejected

AIRS

Computed on a sounding by sounding basis in level 2 code

Uses final product T(p), q(p), $\alpha\varepsilon$, P_c if IR/MW retrieval is produced

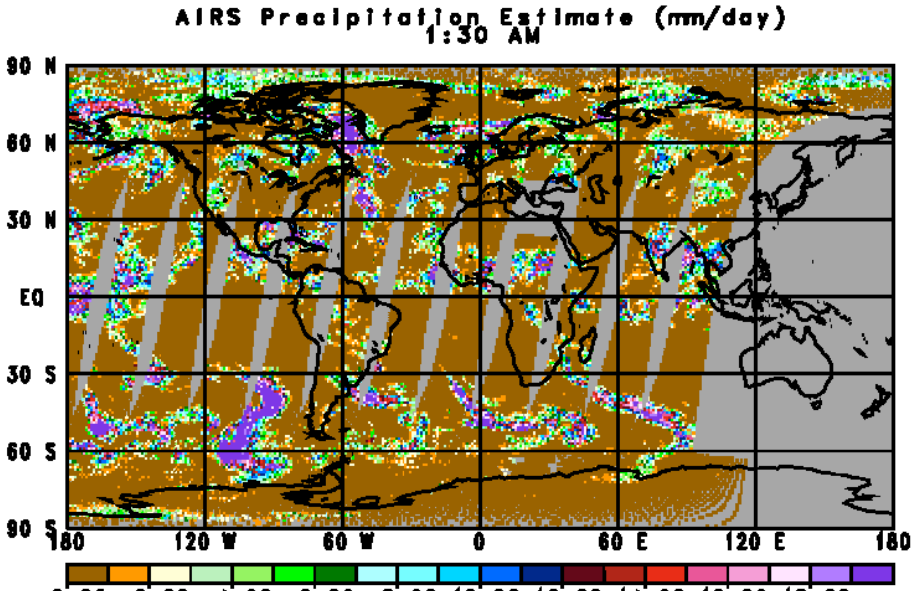
Uses microwave product T(p), q(p) and appropriate $\alpha\varepsilon$, P_c if IR/MW retrieval is not produced

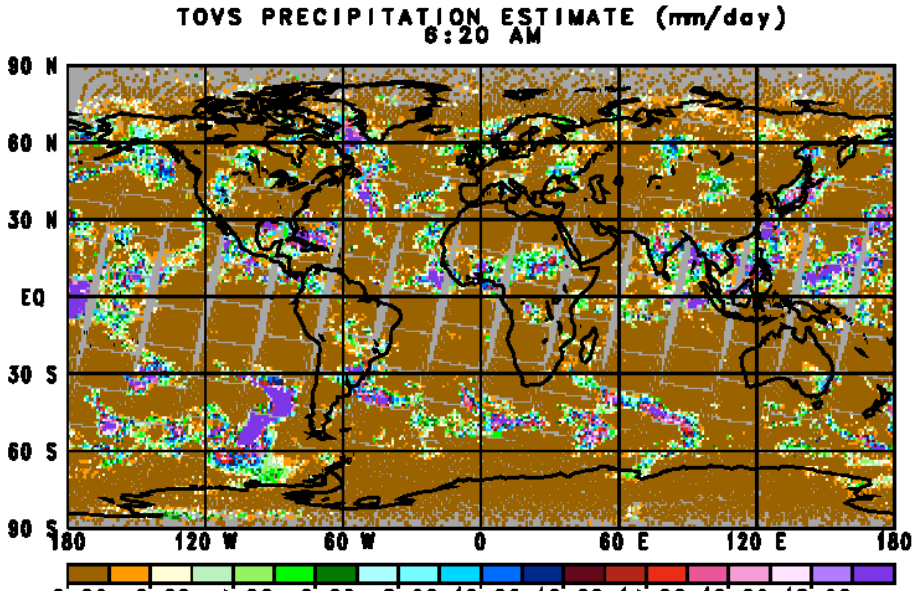
Subroutine is called as part of cloud retrieval subroutine

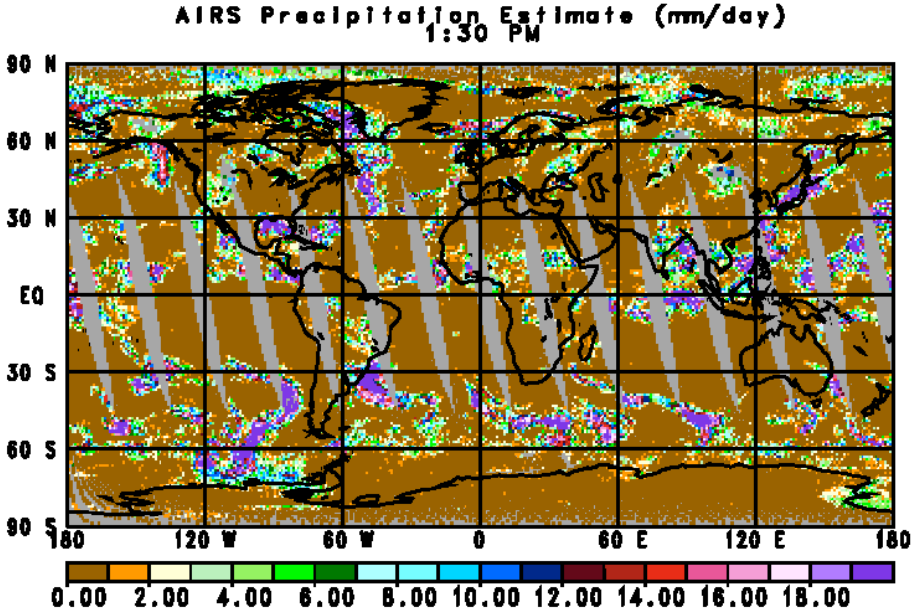
Calculation is very fast

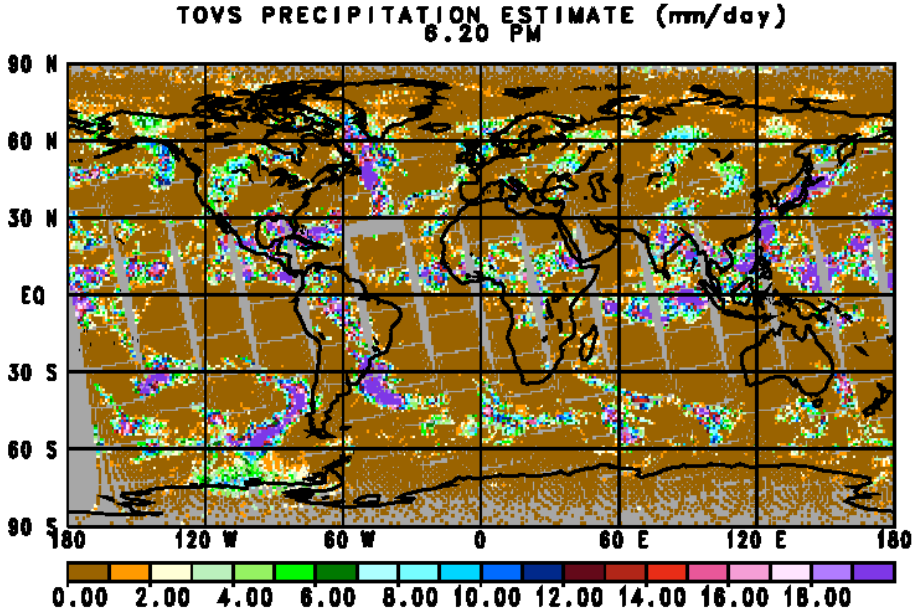
Calculation does not change any other result

PRECIPITATION ESTIMATE (mm/day)
September 6, 2002









STATUS OF AIRS PRECIPITATION ESTIMATE - VERSION 5.0

Subroutine to compute Level 2 P.E. is in JPL Version 4.2

Currently written out to support product : IR_Precip_Est

Level 3 PGE should be augmented to include P.E.

What is the best way to achieve this?

- Write P.E. in standard product and included in Level 3 processing
- Modify Level 3 processing to include support product

STATUS OF AIRS PRECIPITATION ESTIMATE – VERSION 4.0

We have developed code to post-process support product to generate P.E.

Calculation is very fast

Resources to handle the support product present a problem for us

Goddard DAAC has agreed to try to produce Level 3 P.E. using Version 4.0

Data mining approach

Input:

Preferred input is Level 2 support files

Can use Level 2 standard files but approximations are needed that degrade results

Have:

Fortran subroutine to compute off either

Need:

Driver scripts to organize input data sets, date namelists, and output file locations

Data mining procedure

MSU2R, MSU4

Spencer and Christy MSU2R and MSU4 are used widely to indicate global and regional temperature trends

Spencer and Christy uses direct observations of MSU channel 2 and MSU channel 4

Computes what MSU2 and MSU4 would have been from AMSU A observations

TOVS Pathfinder computes MSU2 and MSU4 from T_s, $\varepsilon_{50.3}$, T(p), q(p)

TOVS MSU2R and MSU4 trends are similar to Spencer and Christy trends

Relates MSU2R, MSU4 trends to T(p), T_s trends

COMPUTATION OF MSU2R, MSU4

Spencer and Christy

$MSU2R = 2\,[(MSU2^{OBS}(21.6°) + MSU^{OBS}(32.7°)] - 1.5\,[(MSU2^{OBS}(44.1°) + MSU2^{OBS}(56.5°)]$

One value per scan line

$MSU4 = MSU4^{OBS}$

TOVS

Use same formulas as Spencer and Christy but with MSU^{COMP}

MSU^{COMP} is computed based on retrieved values for all accepted retrievals

Uses monthly mean gridded T_s , $\varepsilon_{50.3}$, T(p), q(p) at mandatory levels

AIRS

Uses same formulas for MSU^{COMP} based on retrieved values passing Mid-Tropospheric Temperature Test

Can use monthly mean values

If monthly mean values are used, need gridded monthly mean ocean T_s and $\varepsilon_{50.3}$, based on Mid-Tropospheric Temperature Test

MSU^{COMP} can be done in post-processing mode

Better yet, do spot by spot MSU calculations for AIRS in level 2 code

Use 100 level profile of T(p), q(p), T_s, $\varepsilon_{50.3}$, for cases passing Mid-Tropospheric Temperature Test

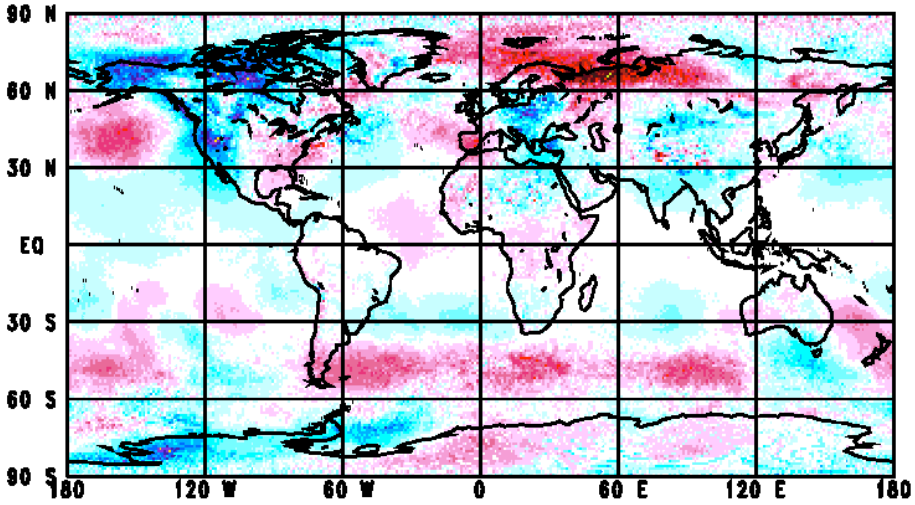
Code is very quick

It is a subroutine call at the end of the final retrieval

Will not change any other result

MSU2r
January 2004 minus January 2003

AIRS



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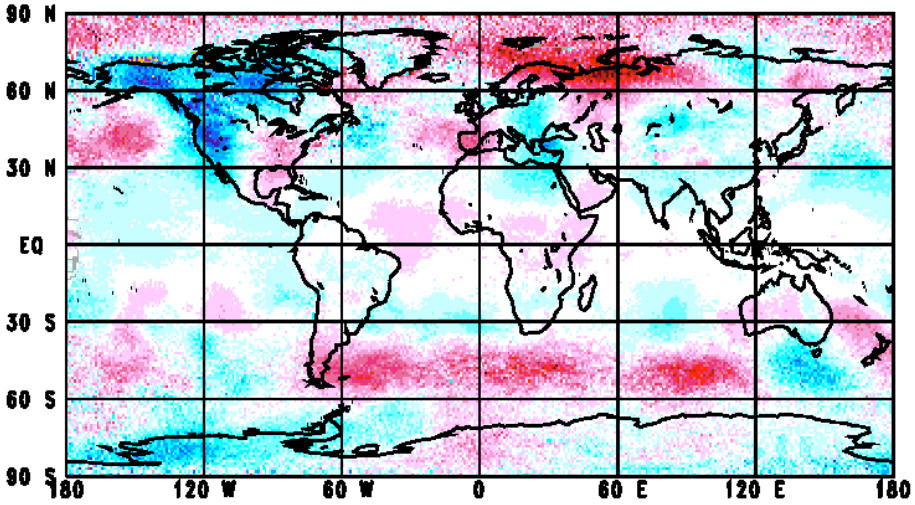
TOVS



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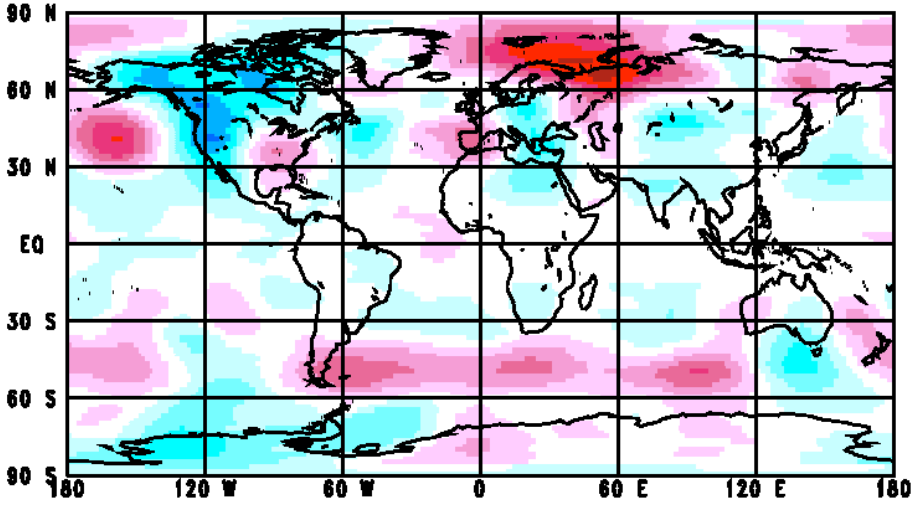
Spencer and Christy



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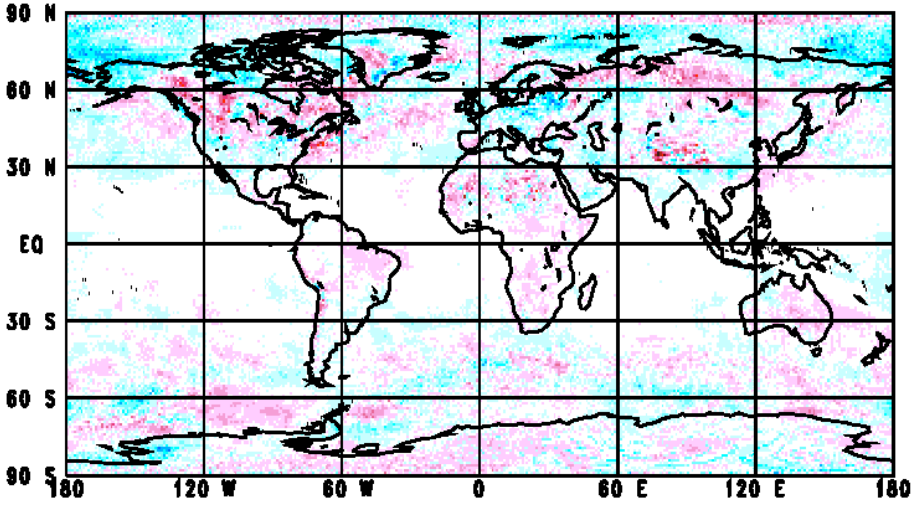
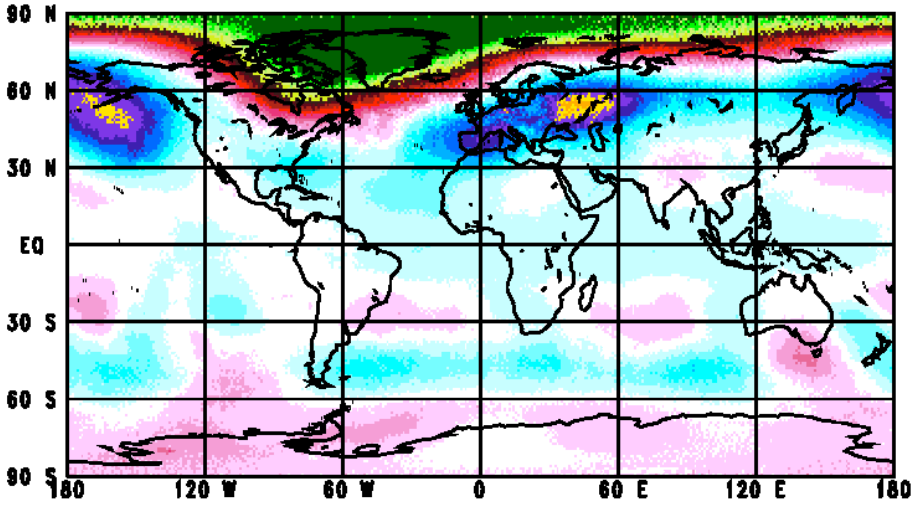
AIRS minus Spencer and Christy



GLOBAL MEAN= -0.10 STD= 0.72 CORR= 0.81

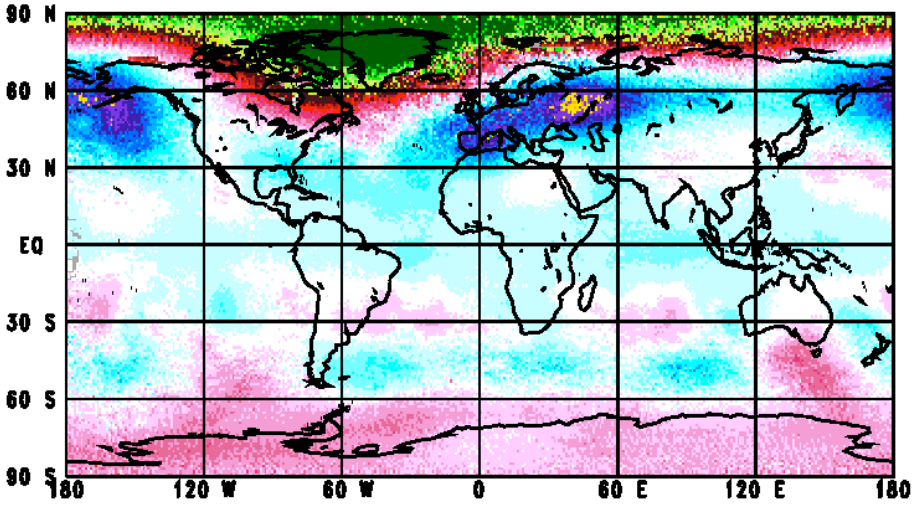
MSU4
January 2004 minus January 2003

AIRS



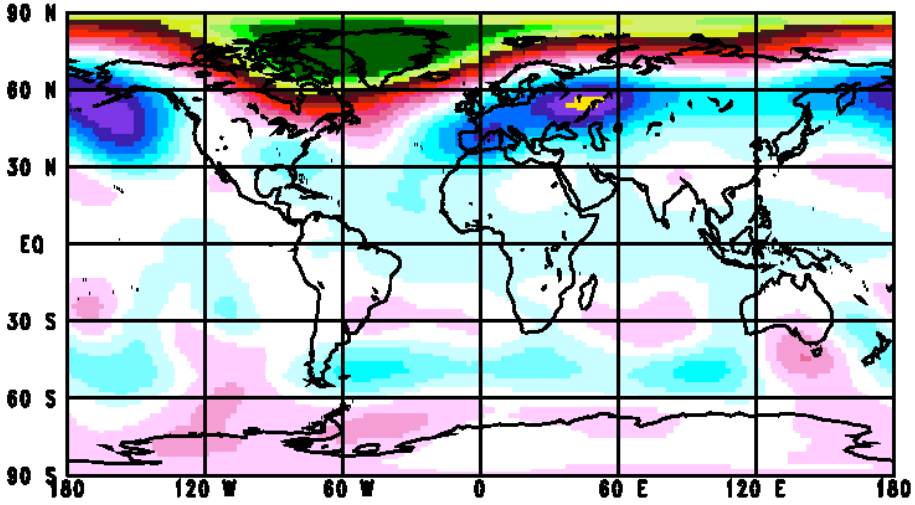
GLOBAL MEAN= -0.42 STANDARD DEV= 2.00

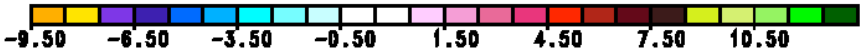
TOVS



GLOBAL MEAN= -0.39 STANDARD DEV= 1.89

Spencer and Christy





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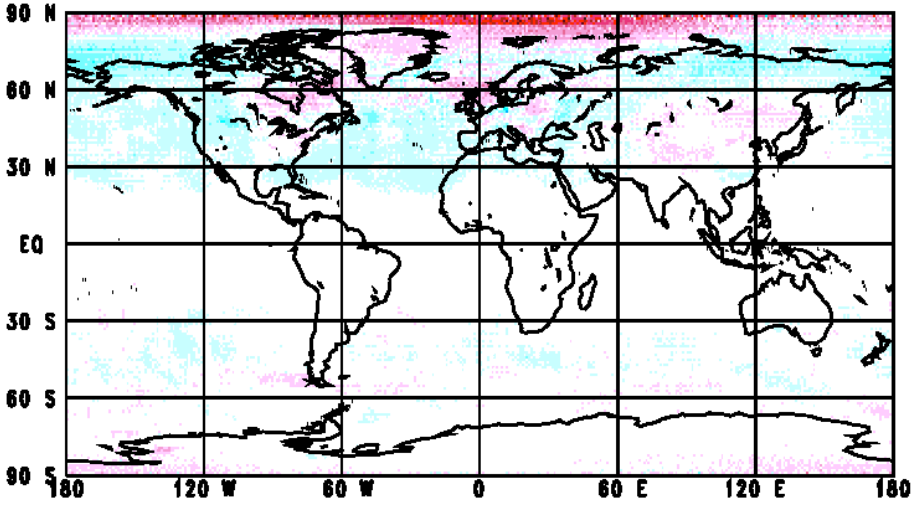
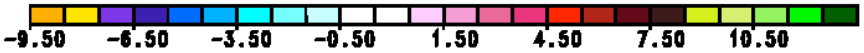
AIRS minus Spencer and Christy





GLOBAL MEAN= -0.12 STD= 0.36 CORR= 0.99

Interannual Differences of T(P)

	AIRS Jan 2004-2003		AIRS-ECMWF Jan 2004-2003			AIRS-TOVS Jan 2004-2003		
	mean	STD	mean	STD	correlation	mean	STD	correlation
1000 mb	-0.05	1.44	0.14	0.90	0.82	-0.02	1.24	0.45
850 mb	-0.09	1.69	0.04	0.71	0.93	-0.04	1.28	0.69
700 mb	-0.28	1.54	-0.05	0.45	0.97	-0.05	1.06	0.77
600 mb	-0.15	1.55	0.07	0.42	0.98			
500 mb	-0.36	1.54	-0.05	0.39	0.97	-0.19	1.02	0.75
400 mb	-0.45	1.50	-0.15	0.39	0.95	0.00	0.98	0.73
300 mb	-0.10	1.33	0.03	0.46	0.94	0.02	0.85	0.83
200 mb	-0.06	1.99	-0.13	0.53	0.99	-0.60	0.98	0.92
150 mb	0.23	2.07	0.06	0.53	0.99			
100 mb	-0.10	2.57	0.16	0.84	0.99	0.04	1.02	0.97
70 mb	-1.01	2.35	-0.21	0.81	0.99	-0.37	1.09	0.96
50 mb	-0.53	2.37	0.04	1.03	0.99	-0.29	1.12	0.95
30 mb	0.10	3.05	0.09	0.91	0.99	0.54	1.39	0.90
10 mb	-0.06	2.74	0.02	0.72	0.99	0.15	1.67	0.81
1 mb	-1.47	4.13	0.26	1.76	0.99			

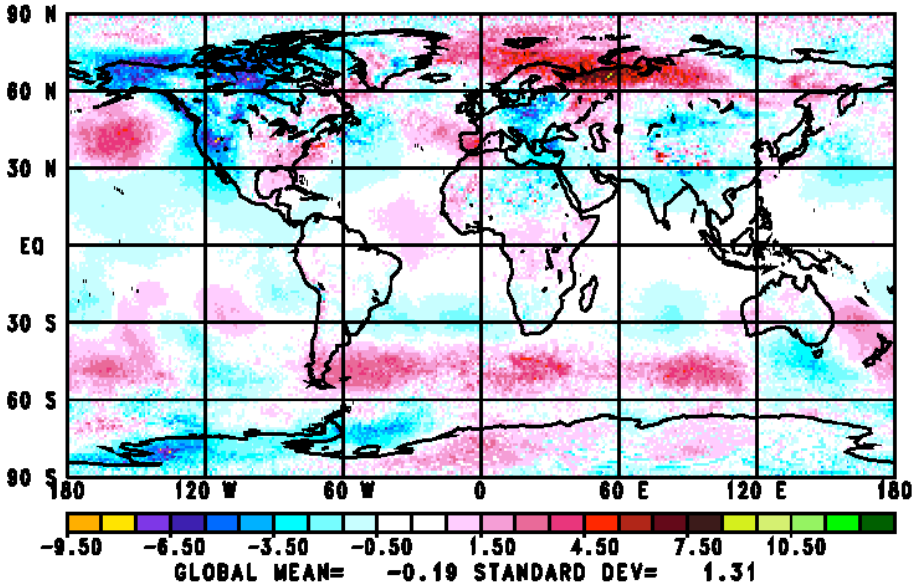
Interannual Difference of MSU2R/MSU4

	AIRS		AIRS-Spencer-Christy			AIRS-TOVS		
MSU2R	-0.19	1.31	-0.10	0.72	0.81	-.03	0.81	0.74
MSU4	-0.42	2.00	-0.12	0.36	0.99	-.04	0.66	0.97

AIRS

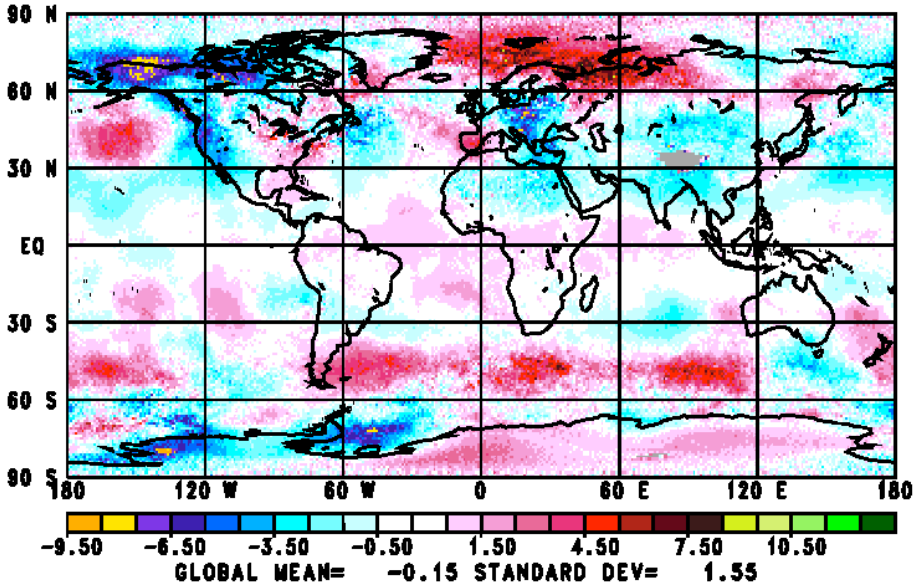
January 2004 minus January 2003

MSU2R



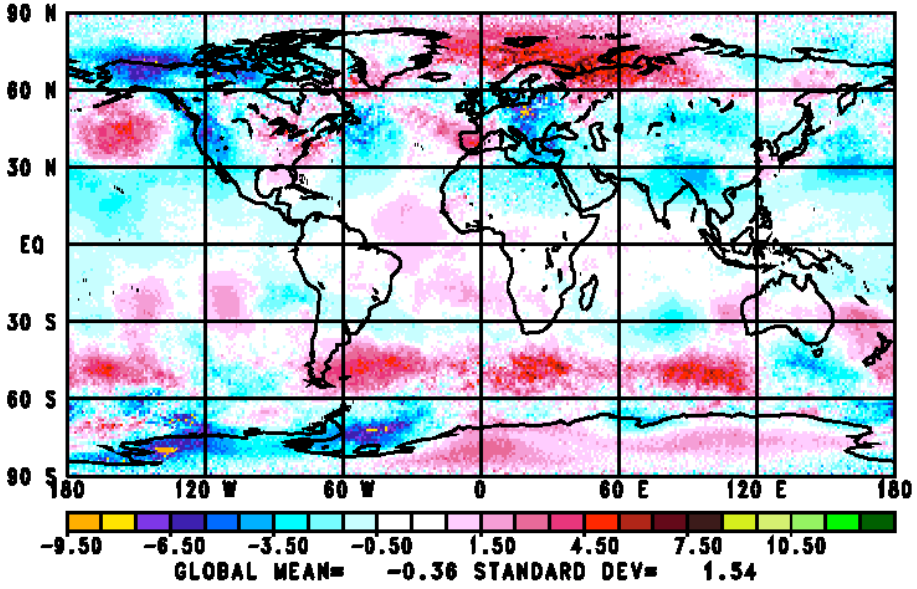
GLOBAL MEAN= -0.19 STANDARD DEV= 1.31

600 mb Temperature



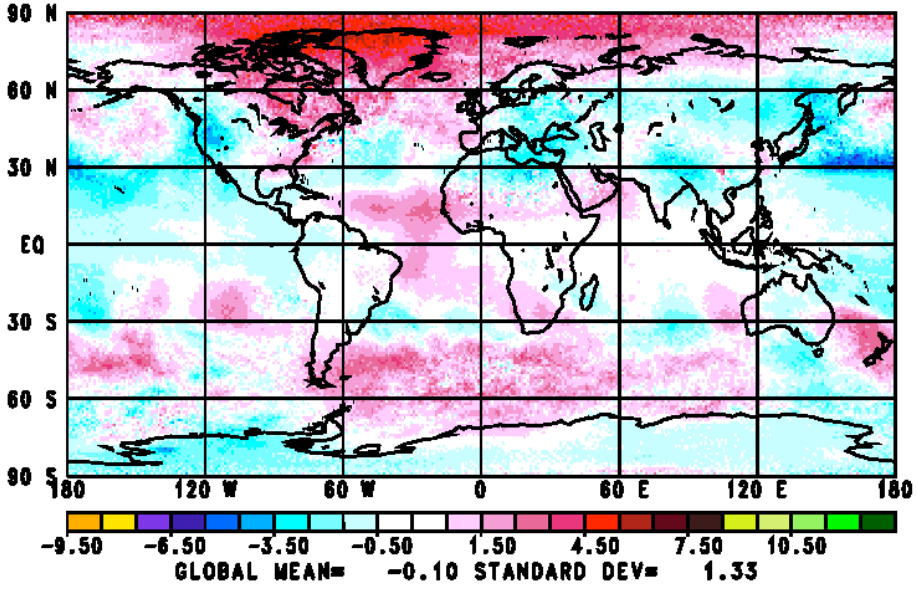
GLOBAL MEAN= -0.15 STANDARD DEV= 1.55

500 mb Temperature



GLOBAL MEAN= -0.36 STANDARD DEV= 1.54

300 mb Temperature

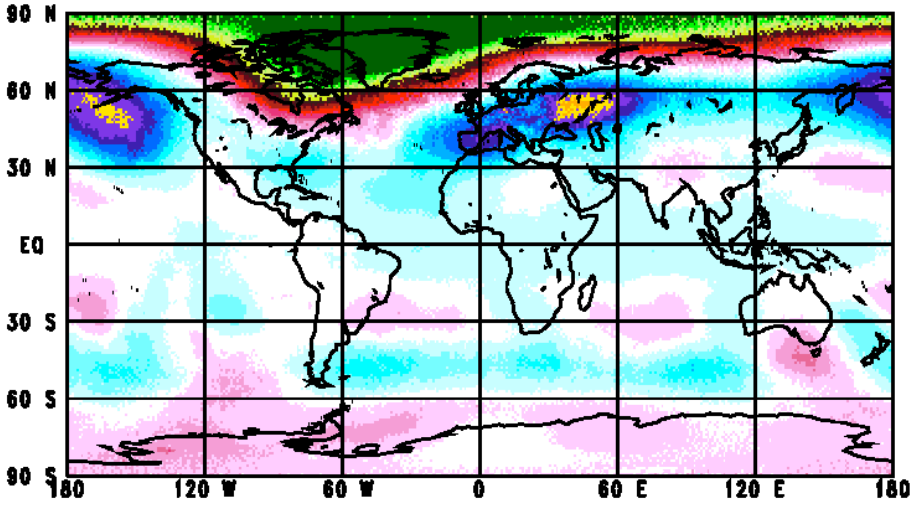


GLOBAL MEAN= -0.10 STANDARD DEV= 1.33

AIRS

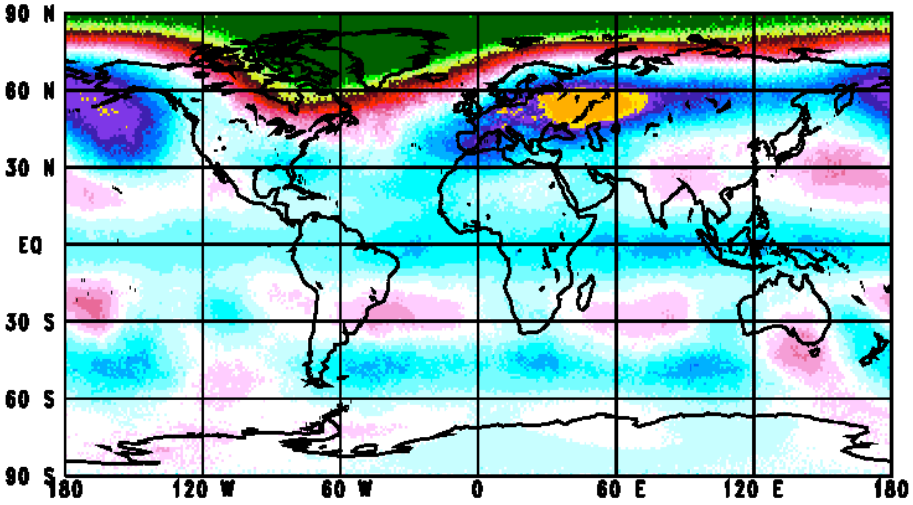
January 2004 minus January 2003

MSU4



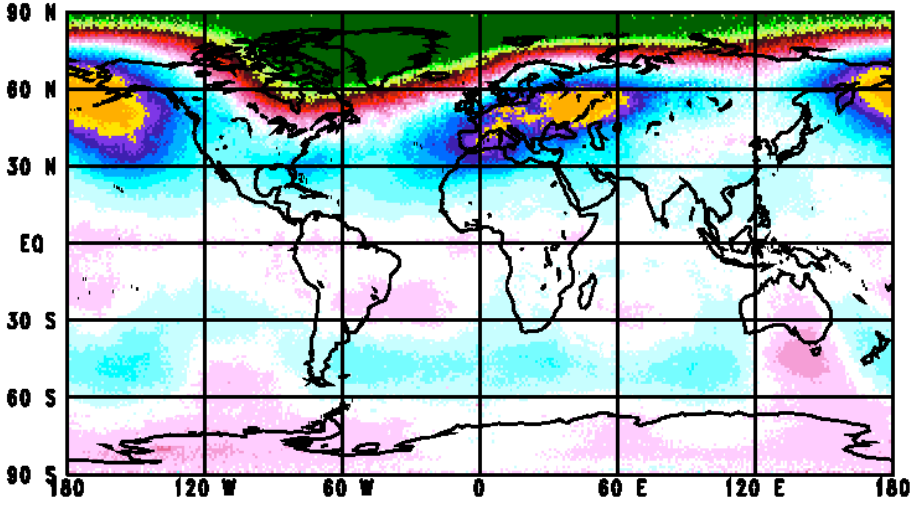
GLOBAL MEAN= -0.42 STANDARD DEV= 2.00

70 mb Temperature



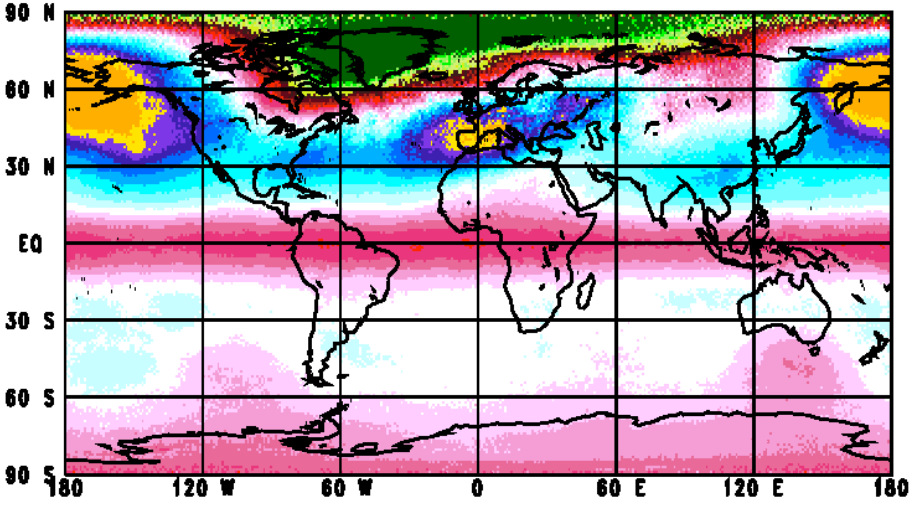
GLOBAL MEAN= -1.01 STANDARD DEV= 2.35

50 mb Temperature



GLOBAL MEAN= -0.53 STANDARD DEV= 2.37

30 mb Temperature



GLOBAL MEAN= 0.10 STANDARD DEV= 3.05

STATUS OF MSU2R/MSU4

Results shown used monthly mean gridded AIRS retrievals

- All monthly mean parameters were created for cases passing Mid-Tropospheric Temperature Test

We are testing computation of Level 2 MSU2R/MSU4 using GSFC offline output

- Contains T_s, T(p), q(p), $\varepsilon_{50.3}$

Calculation is very fast and changes no other results

Will be implemented into JPL Version 4.X when ready

Version 5 level 3 product needs to include MSU2R/MSU4

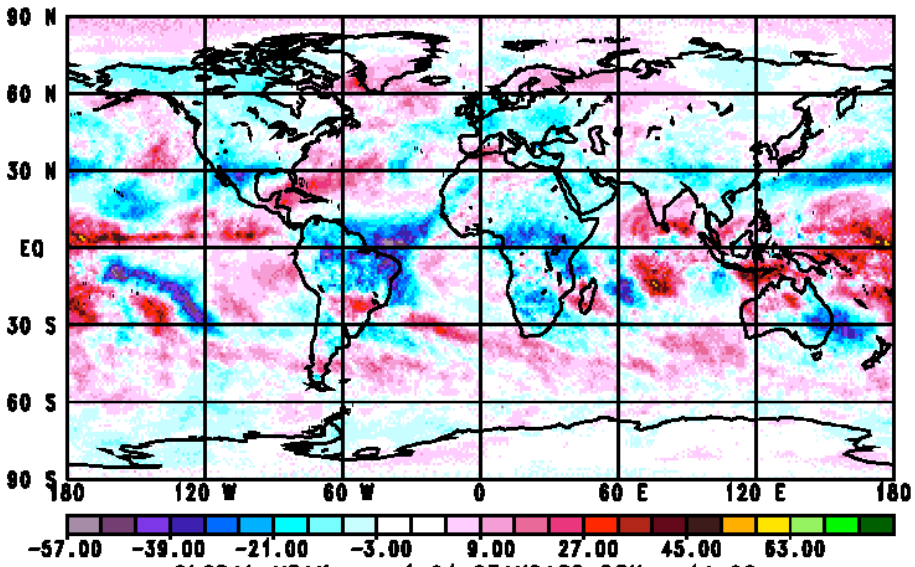
- Analogous questions as with Precipitation Product

GSFC post-processing of Version 4.0 data

- Can be done using Level 2 standard product
- Needs to be done by DAAC, as does Precipitation Estimate

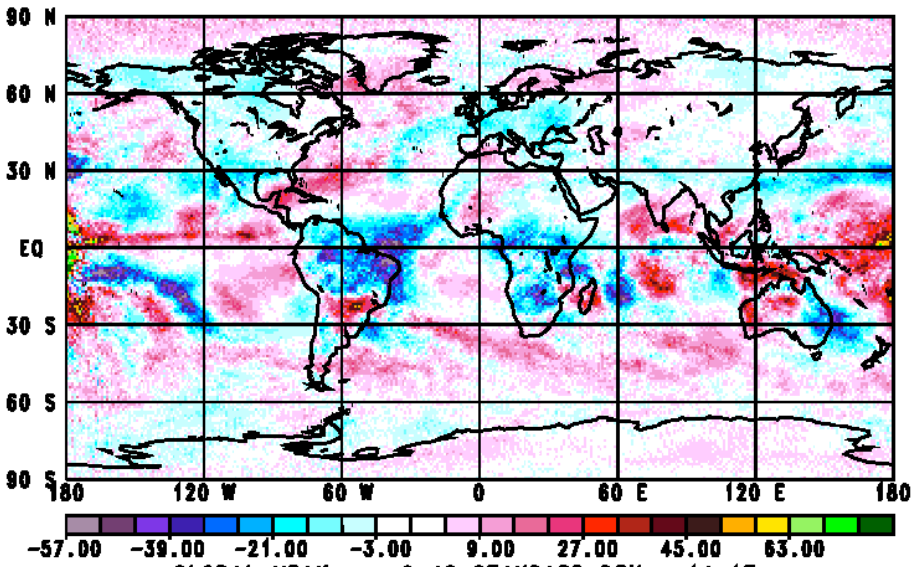
Outgoing Longwave Radiation (watts/m²)
January 2004 minus January 2003

AIRS Outgoing Longwave Radiation (watts/m²)



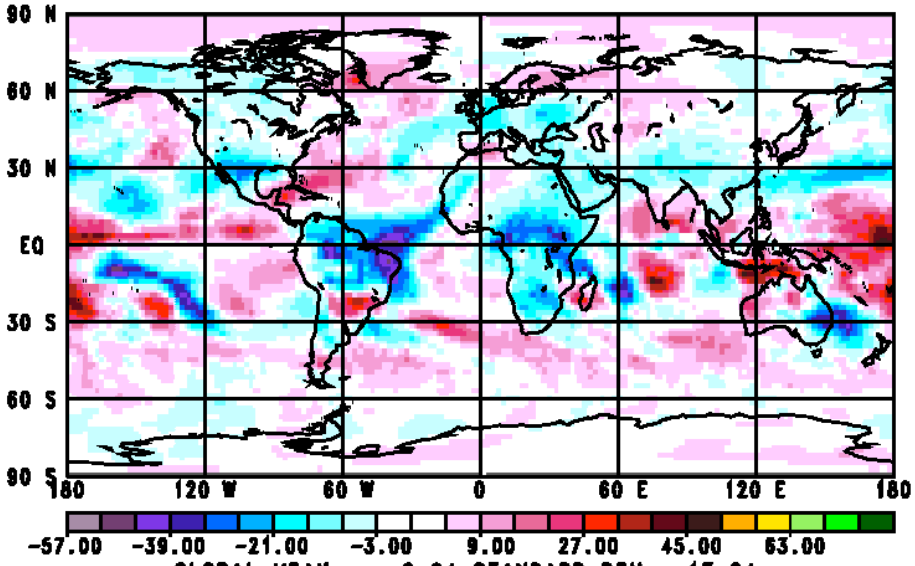
GLOBAL MEAN= -1.01 STANDARD DEV= 14.00

TOVS Outgoing Longwave Radiation (watts/m²)



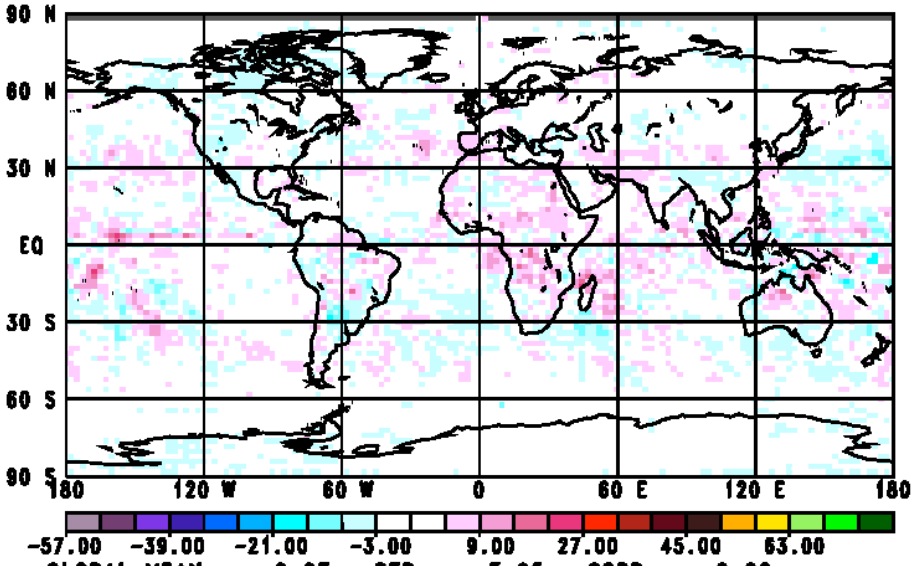
GLOBAL MEAN= -0.42 STANDARD DEV= 14.17

CERES Outgoing Longwave Radiation (watts/m²)



GLOBAL MEAN= -0.94 STANDARD DEV= 13.24

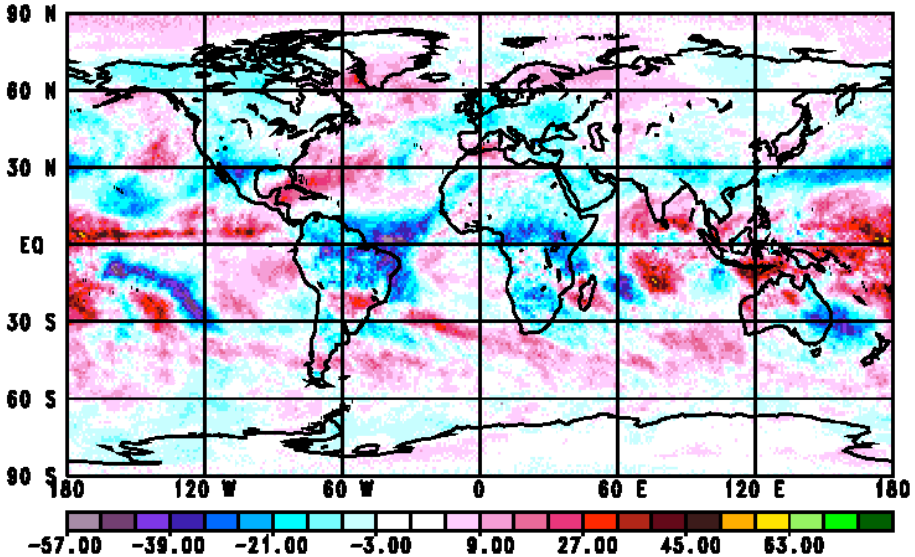
AIRS minus CERES



GLOBAL MEAN= -0.07 STD= 3.95 CORR= 0.92

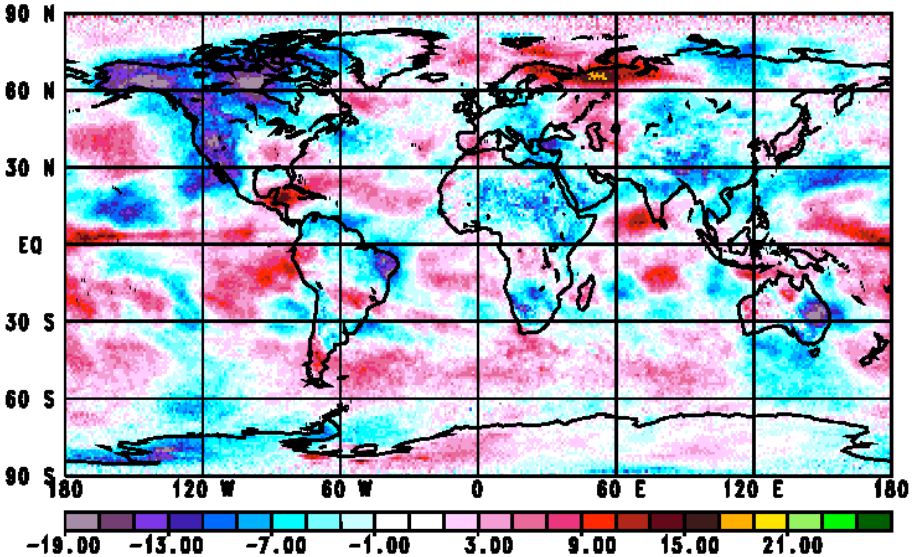
January 2004 minus January 2003

AIRS Outgoing Longwave Radiation (watts/m²)



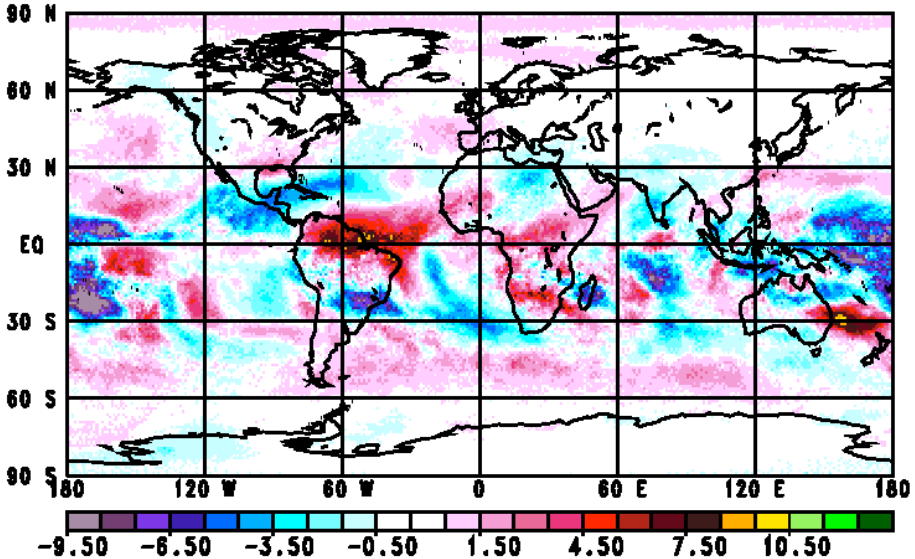
GLOBAL MEAN= -1.01 STANDARD DEV= 14.00

AIRS Clear Sky Outgoing Longwave Radiation (watts/m²)



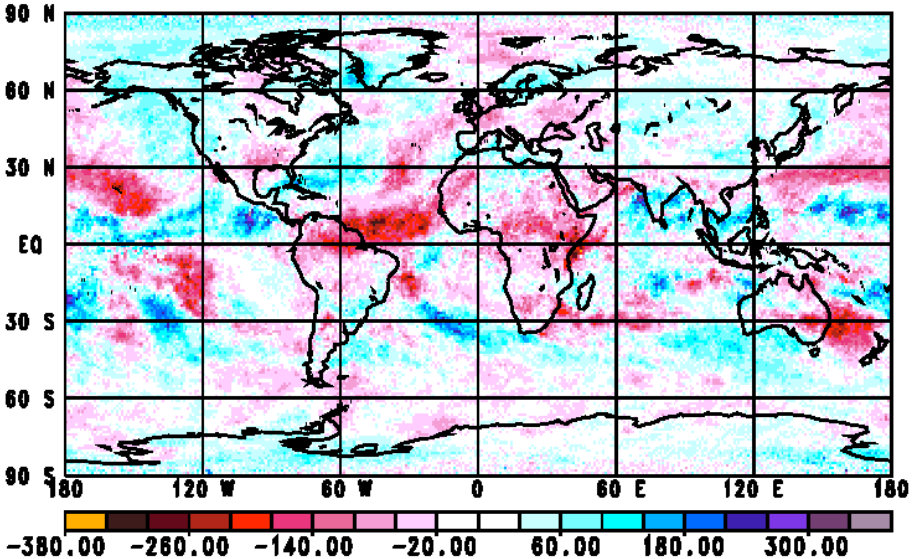
GLOBAL MEAN= -0.72 STANDARD DEV= 4.95

AIRS Precipitable Water 300 mb to top (mm*100)



GLOBAL MEAN= -0.18 STANDARD DEV= 2.39

AIRS Cloud Top Pressure (mb)



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