OSSE Instrument Simulation of Advanced Sounders

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Progress as of last review

TOVS radiances simulation had been completed.

Due to gaps in funding, support contractor lost.

Work came to a halt until 1 Jan 2002.

Progress Since Last Review

- Exceptionally well qualified contractor on the job
- AIRS community simulation package acquired and modified for OSSE
- Additional funding from IPO will continue work at least through July 2003
- Awaiting next funding increment from IPO

Simulated Advanced Sounders

Instruments to be simulated:

TIROS Operational Vertical Sounder (TOVS)-done

Atmospheric InfraRed Sounder (AIRS) –almost done

Cross track Infrared Sounder (CrIS) –in progress

Advanced Technology Microwave Sounder (ATMS) – in progress

Conically scanning Microwave Imager/Sounder (CMIS)

Radiative Transfer Model

•AIRS community radiative transfer model

• UMBC Developed

• PFAAST / OPTRAN hybrid

•OPTRAN for H2O (home grown, 1995)

Geolocation Generator

• Instrument observation location

    •EOS Science Data Processing (ESDP) Toolkit Geolocation Package

Surface Properties Generator: Surface radiative properties

- **Surface skin temperature and surface pressure are from the "Nature run". Topography, land fraction is from Digital Elevation Model**

- **The radiative properties are obtained based on the surface material properties. Eight materials are used to describe surface composition. The contribution of each material is determined by land fraction, the amount of vegetation, the types of vegetation defined by the International Geosphere-Biosphere Program (IGBP) land use surface classification, vegetation and water amounts are determined from AVHRR NDVI (Normalized Difference Vegetation Index) imagery and the sampled DEM**

Surface Properties Generator: Surface radiative properties

- **IR Land Emissivity: interpolated from CERES emissivities, which are derived from the Johns Hopkins spectral library**

- **IR Ocean Emissivity: Masuda et al, 1988.**

- **MW Land Emissivity: surface type and random noise**

- **MW Ice Emissivity: first-year sea ice, multi-year sea ice, glacial ice and dry snow**

- **MW Ocean Emissivity:** Guillou et al. at 23.8 and 31.4 GHz) (Radio Science v.33, pp. 649-667 , 1998) Lamkaouchi, Balana & Ellison. (draft ESA report (1997) for 50.3, 89, 52.8, 150., 183.3 GHz.)

Cloud effects

- **Cloud Fraction:**
  - **Clear Sky Radiance + Cloud Fraction*Cloud Radiance, two layers**
  - **Maximum overlap**

- **IR: Opaque, Lambertian reflector**
  - **Randomly assigned, normal variate, $\mu=0.99$, $\sigma = 0.01$, range 0.5=0.99**

- **MW: Non reflective**
  - **Cloud Liquid Water attenuation**
  - **No precipitation scattering**

Instrument Noise

- **AIRS/AMSU/HSB**
  - **Normal distribution, $\mu=0$, σ from pre-launch NEDR**

- **CrIS**
  - **NEDR model from ITT, 3 parameter model for each channel**
  - **Normal distribution, $\mu = 0$, $\sigma = $ NEDR**

- **ATMS**
  - **TBD**
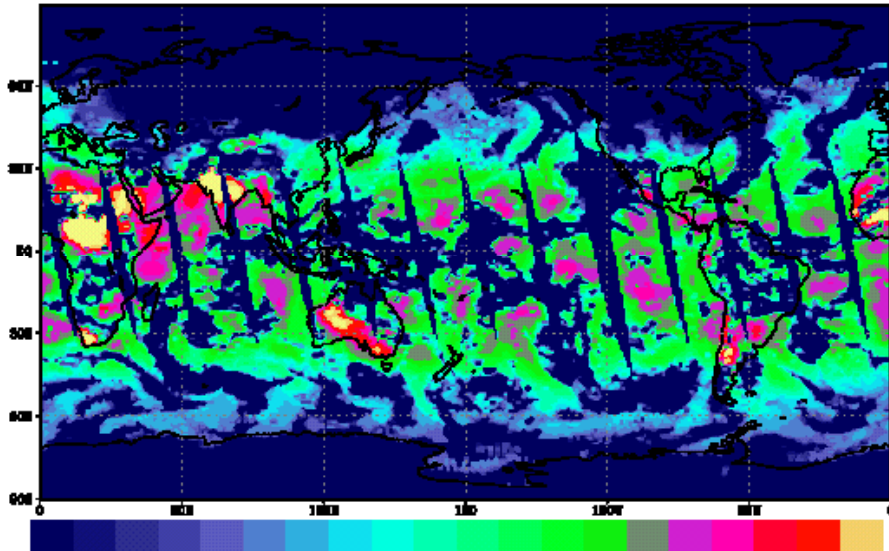
Simulated AIRS Aqua Observation Result
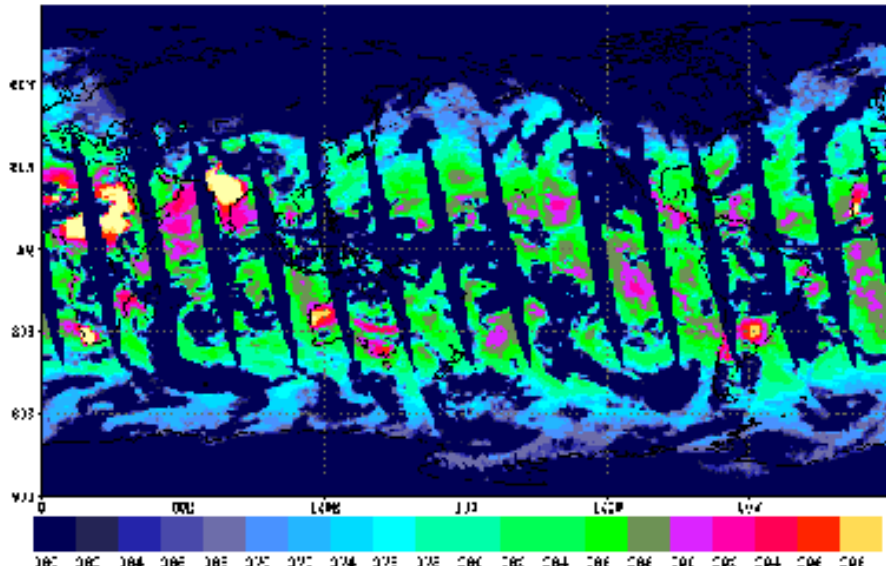
AIRS on Aqua
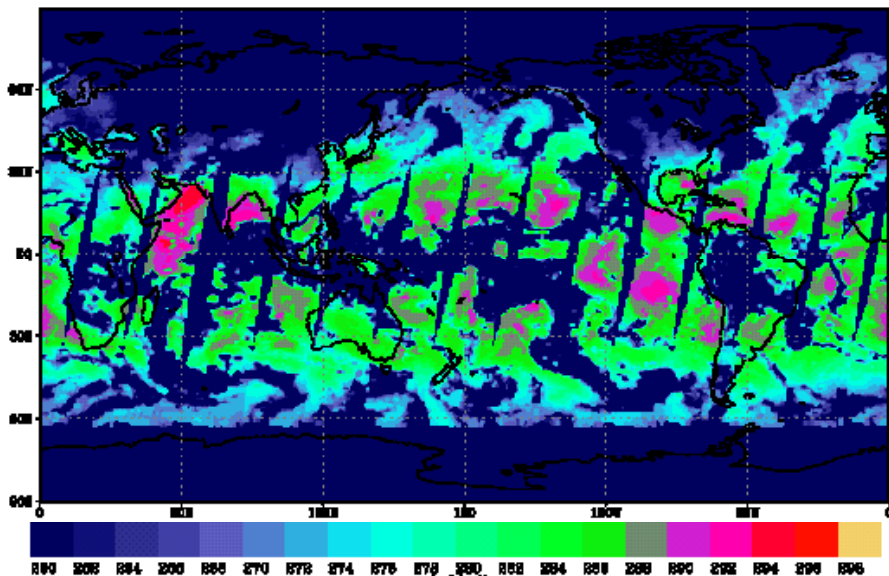
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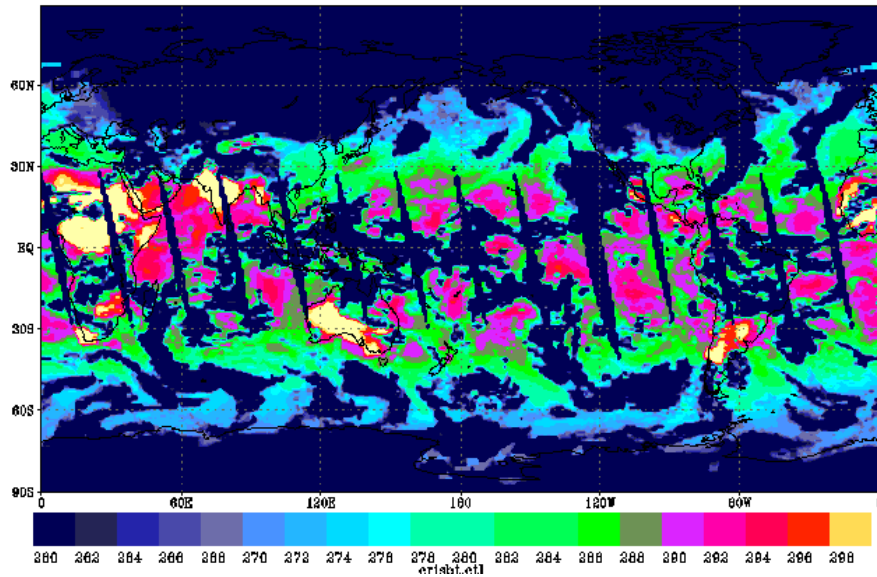
871.202 cm-1
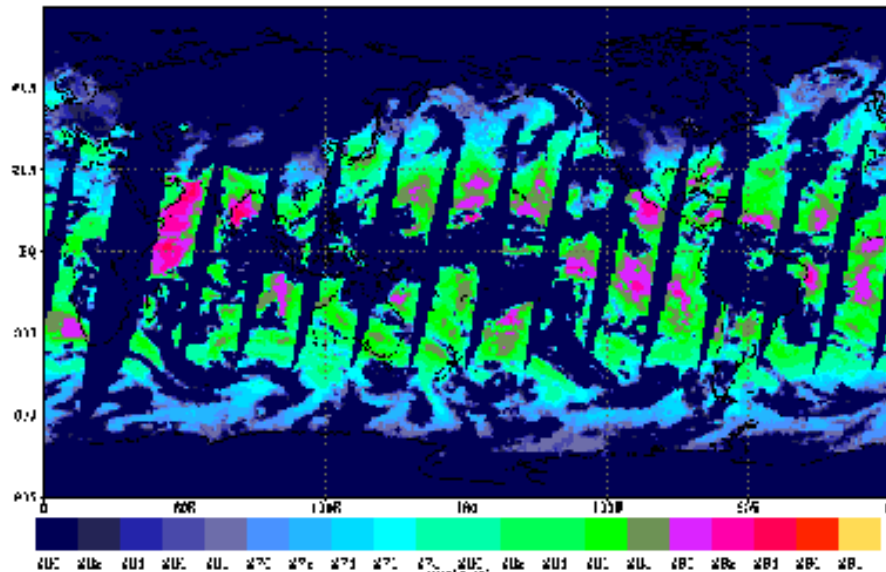
Simulated AIRS NPOESS Observation Result
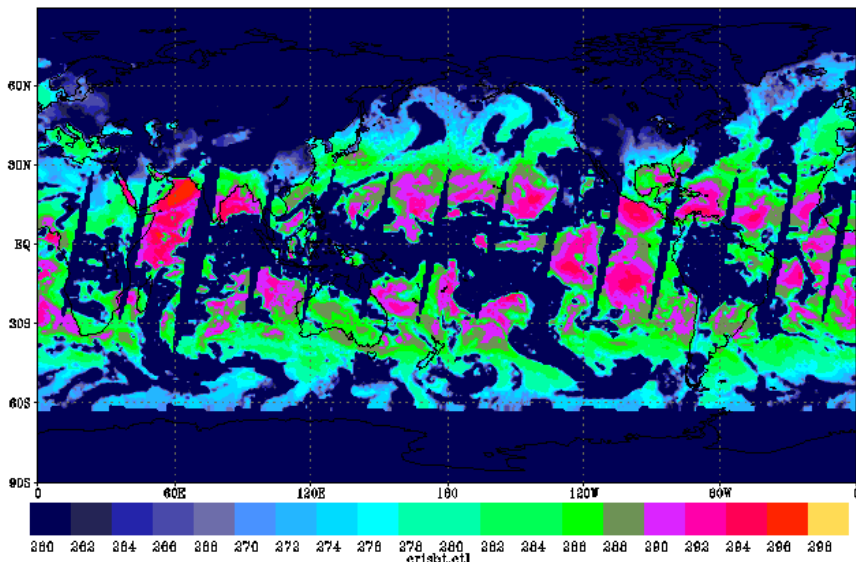

AIRS on NPOESS

Time:1993/02/13

871.202 cm-1

Simulated CrIS Observation Result

CrIS on NPOESS
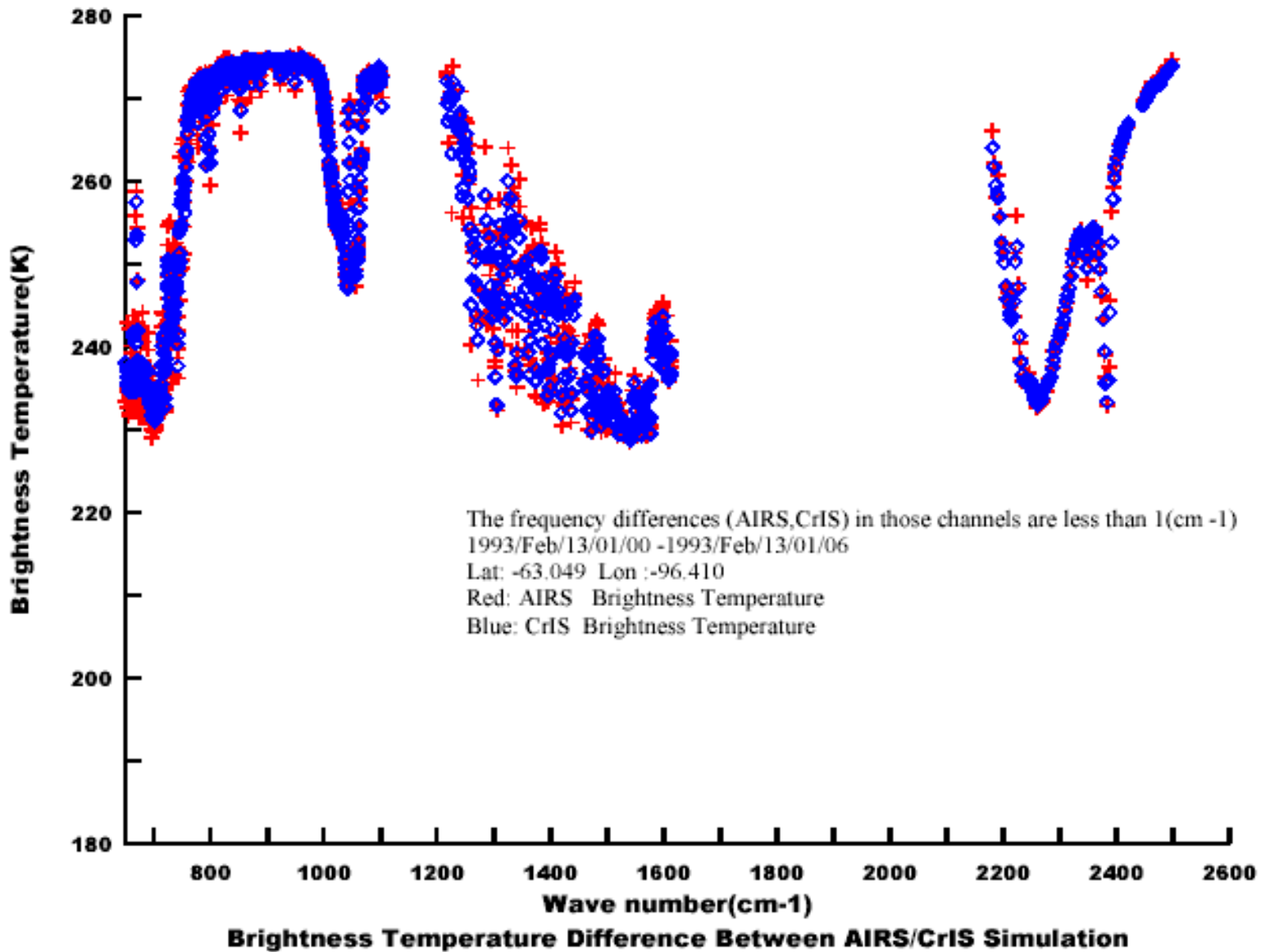
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871.3131 cm-1

Observation simulation CrIS/AIRS

The frequency differences (AIRS,CrIS) in those channels are less than 1(cm -1)
1993/Feb/13/01/00 -1993/Feb/13/01/06
Lat: -63.049 Lon :-96.410
Red: AIRS   Brightness Temperature
Blue: CrIS Brightness Temperature

Brightness Temperature Difference Between AIRS/CrIS Simulation

Radiance difference of AIRS/CrIS

The frequency difference AIRS/CrIS in those channels are less than 1(cm -1)
1993/Feb/13/01/00 -1993/Feb/13/01/06
Lat: -63.049 Lon :-96.410

Green: Brightness Temperature Difference

Brightness Temperature Difference Between AIRS/CrIS Simulation
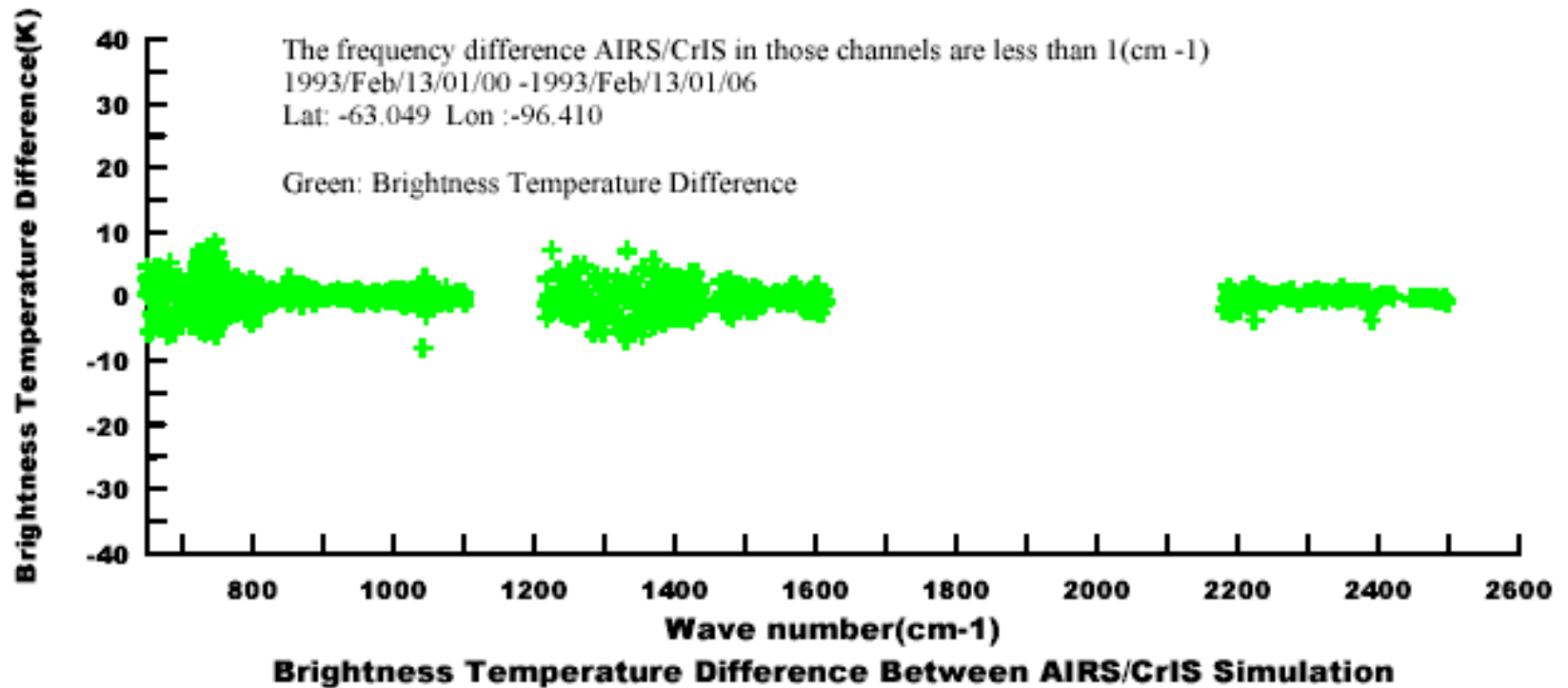
Radiative Transfer for Assimilation

- Polynomial version of community model (POPTRAN), VanDelst, Tahara
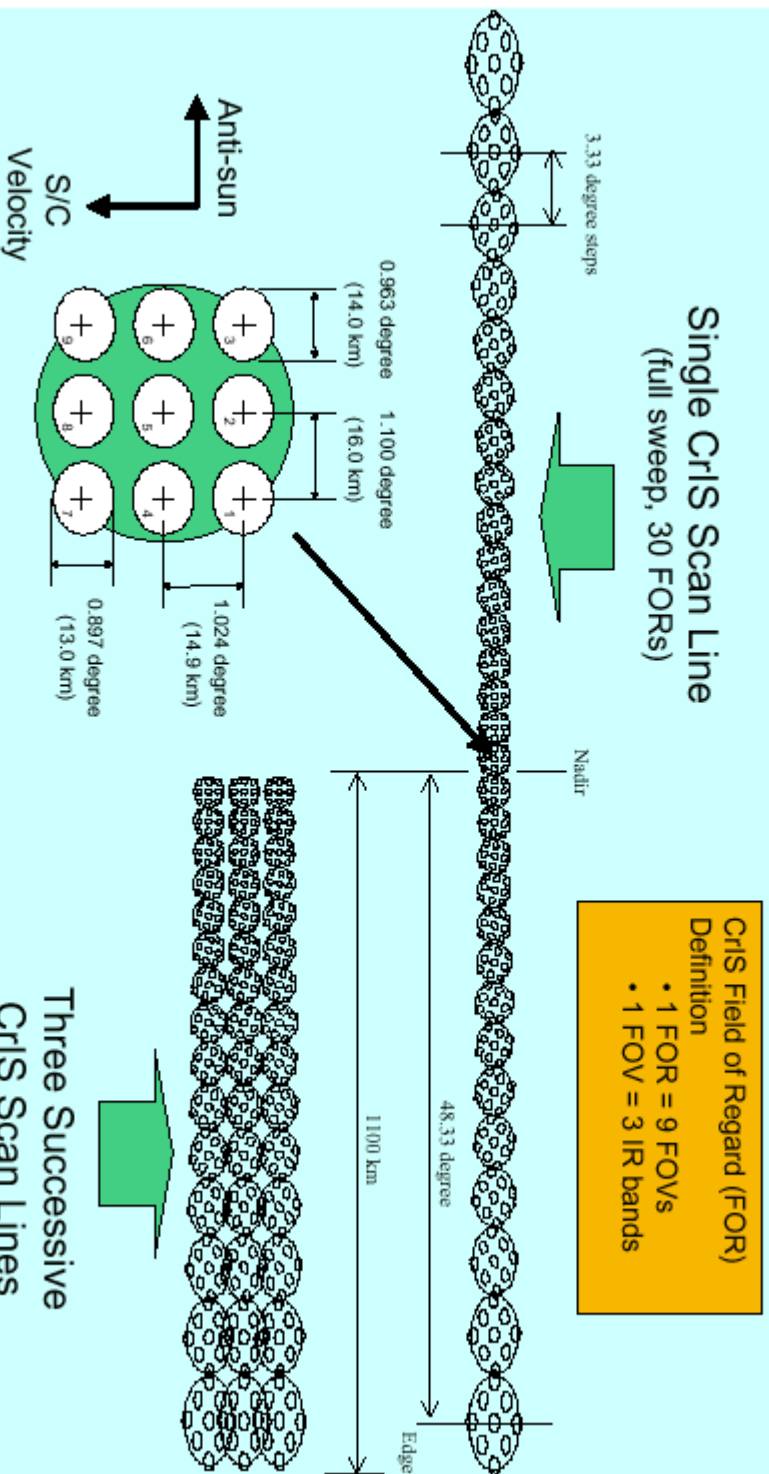- Includes reflected downward thermal, CBR, direct solar

Issues

1) Cloud simulation not consistent with DWL (Emmitt)

- Low level clouds not climatologically adjusted

- High level clouds always opaque

- These will be addressed in the near future

2) CrIS field of regard rotation

- ITT and Northrup-Grumman to work out details of geolocation this summer

Optical Signal Flow: Earth Scene Interrogated with 3x3 FOV Array

Single CrIS Scan Line
(full sweep, 30 FORs)

3.33 degree steps

Anti-sun

S/C Velocity

0.963 degree (14.0 km)

1.100 degree (16.0 km)

0.897 degree (13.0 km)

1.024 degree (14.9 km)

Nadir

1100 km

48.33 degree

Edge

CrIS Field of Regard (FOR) Definition
- 1 FOR = 9 FOVs
- 1 FOV = 3 IR bands

Three Successive CrIS Scan Lines
(nadir to edge sweep)

Summary

- Radiance simulation back on track
- AIRS simulation basically completed
- CrIS tests look good
- Working on ATMS

Simulated AIRS Observation Result:
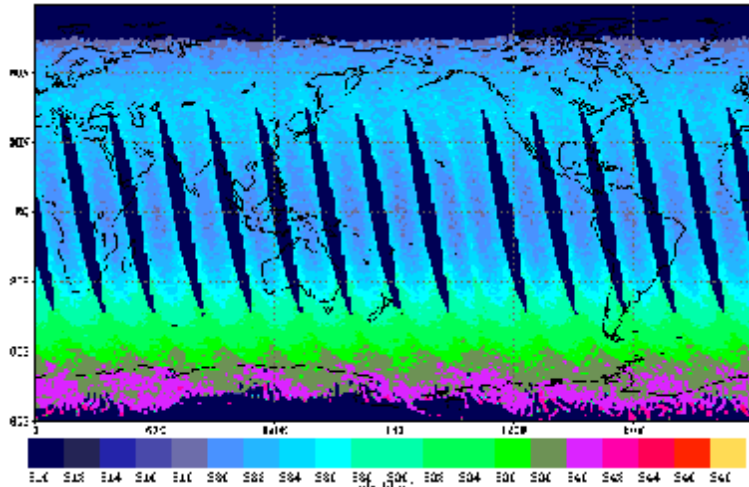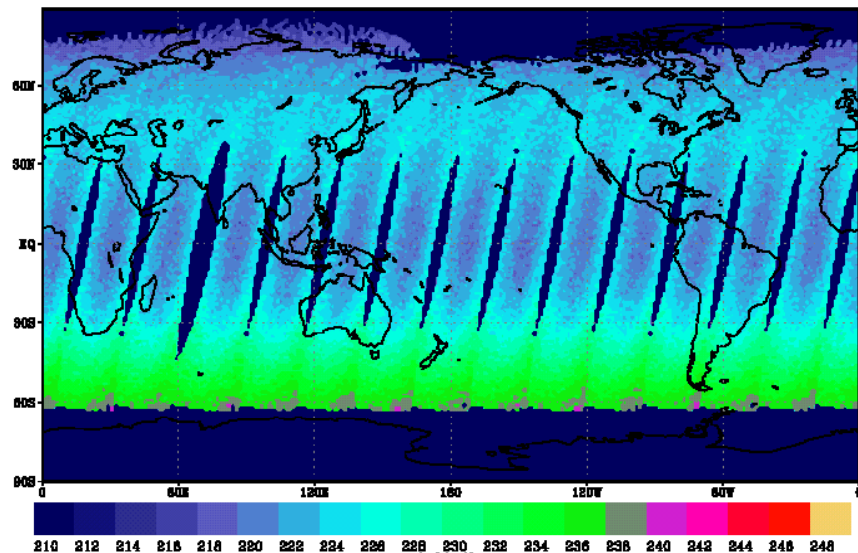

AIRS on Aqua

Time:1993/02/13

650.742 cm-1
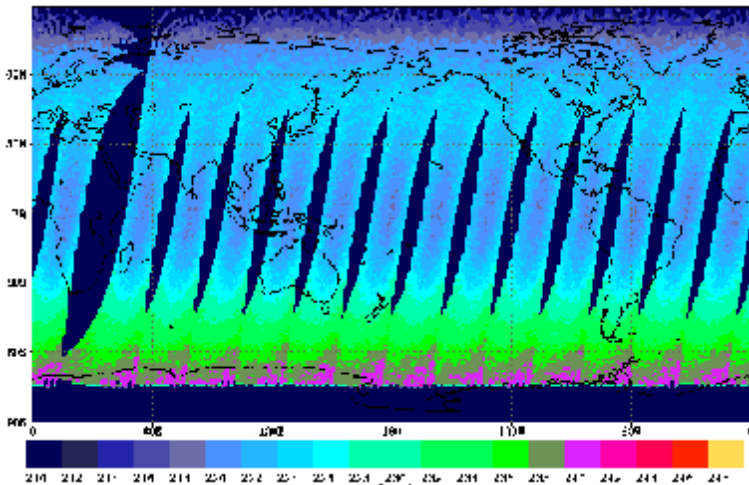
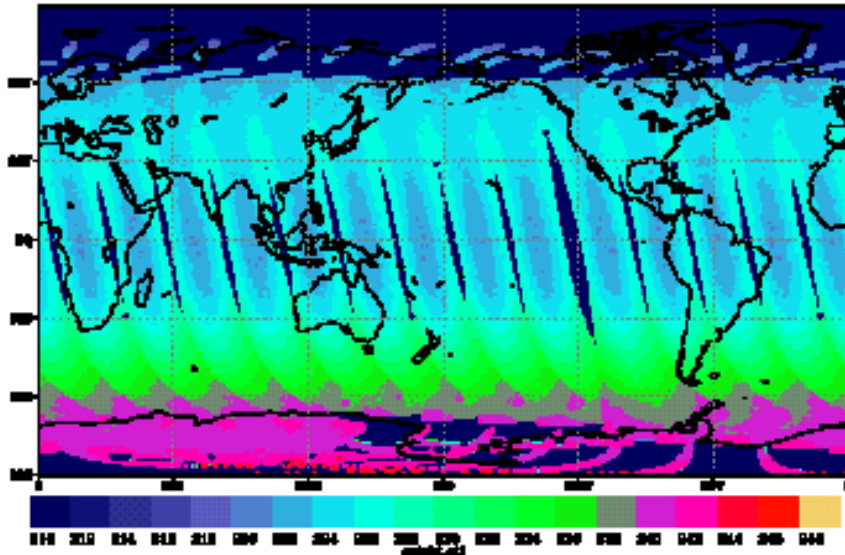# Simulated AIRS Observation Result
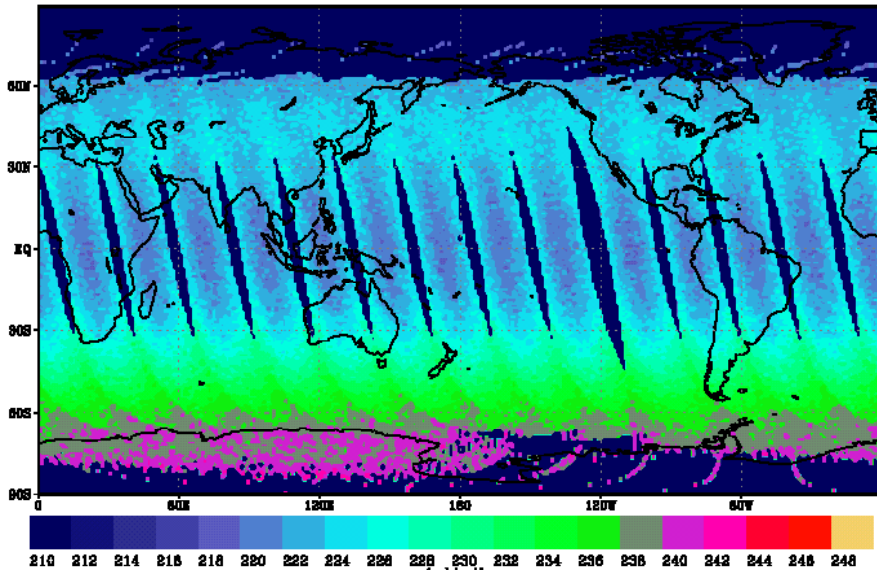
AIRS on NPOESS

Time:1993/02/13
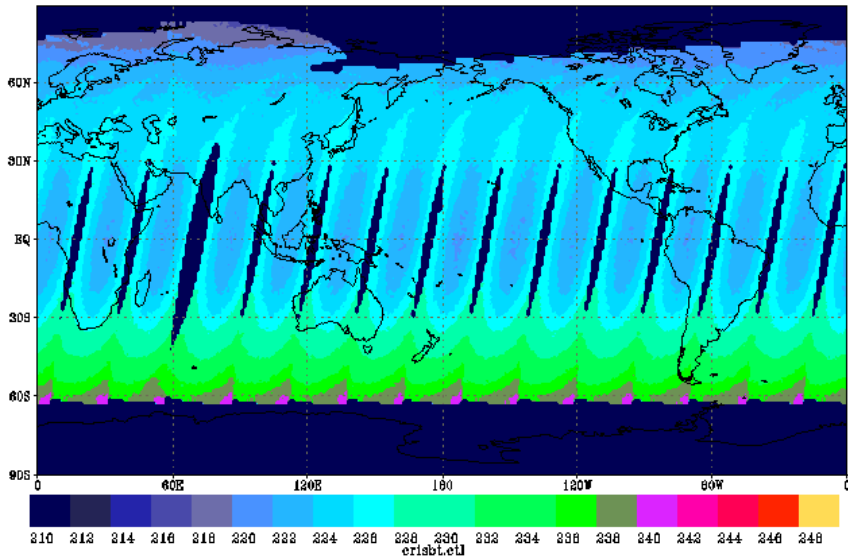
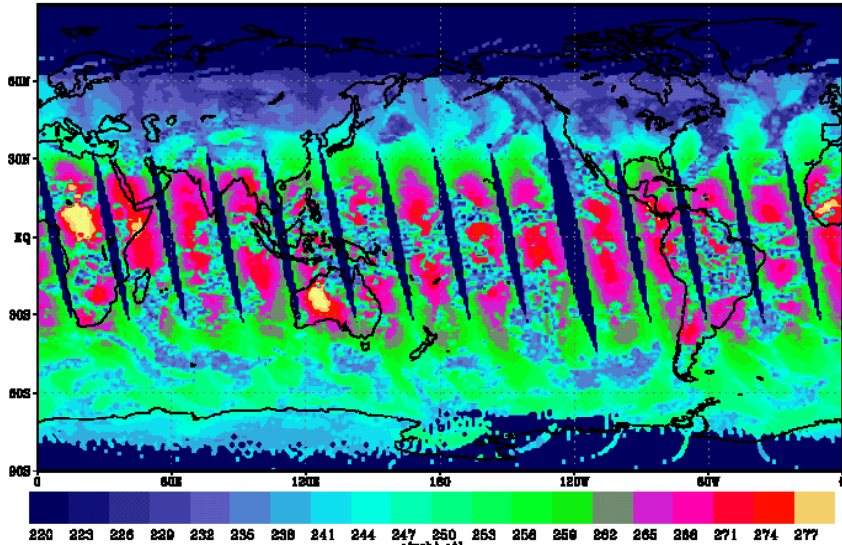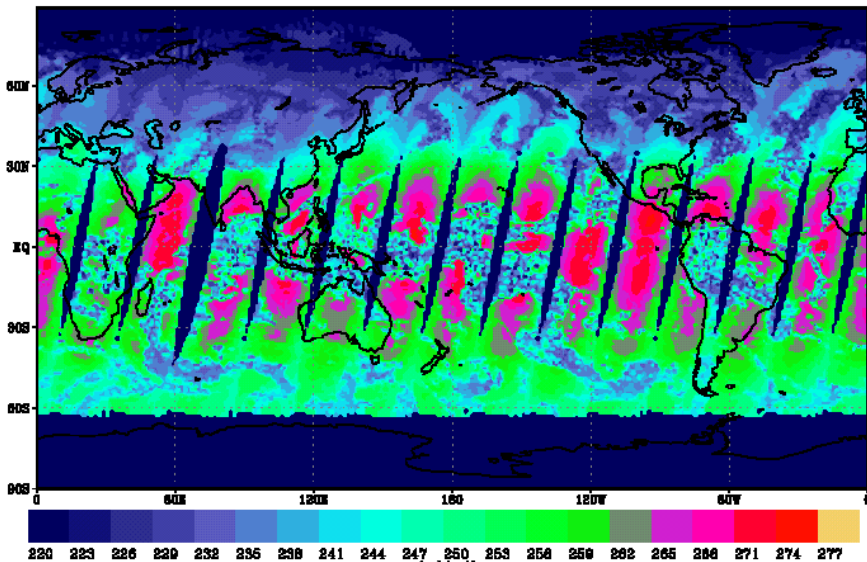650.742 cm-1

Simulated CrIS Observation Result

CrIS on NPOESS

Time:1993/02/13

650.047 cm-1

Simulated AIRS Observation Result

AIRS on Aqua

Time:1993/02/13

1040.259 cm-1
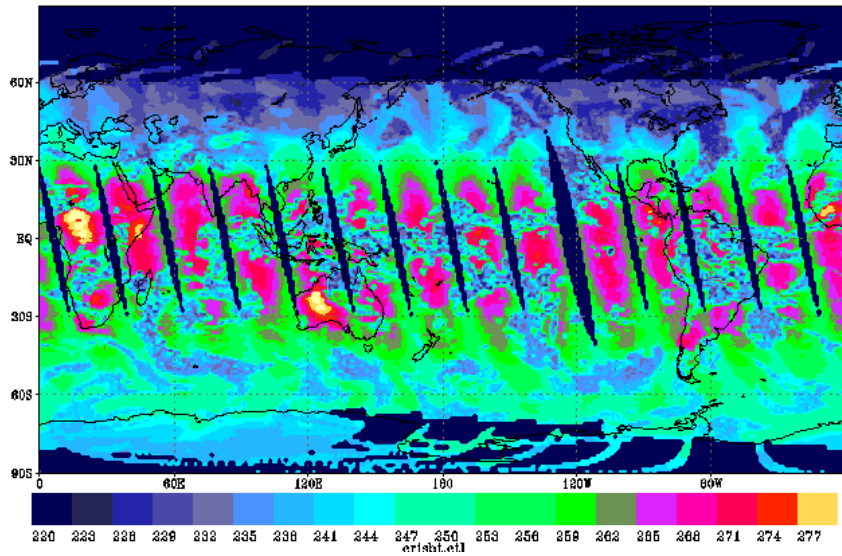
Simulated AIRS Observation Result

AIRS on NPOESS

Time:1993/02/13

1040.259 cm-1

Simulated CrIS Observation Result

CrIS on NPOESS

Time:1993/02/13

1040.075cm-1