

AIRS
(Atmospheric Infrared Sounder)
Instrument Characteristics

AIRS onboard of AQUA

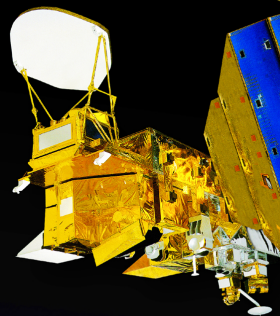
- NASA's EOS spacecraft
- Aqua launched May 4, 2002
- 705 km orbit (polar-orbiting)
- Early afternoon (1:30 PM) equator crossing time heading north
- AIRS system on Aqua:
 - AIRS (Atmospheric Infrared Sounder)
 - AMSU-A (Advanced Microwave Sounding Unit)
 - HSB (Humidity Sounder Brazil)
- Other instruments:
 - MODIS (Moderate Resolution Imaging Spectroradiometer)
 - AMSR-E (Advanced Microwave Scanning Radiometer for EOS)
 - CERES (Clouds and the Earth's Radiant Energy System)



AIRS – Monitoring Earth's Atmosphere

AIRS

Monitoring Earth's Atmosphere



AIRS on Aqua
Providing New Insights into
Weather and Climate

AIRS will:

Improve weather forecasting



**Establish the connection between
severe weather and climate change**



**Determine if the global
water cycle is accelerating**



**Detect the effects
of greenhouse gases**



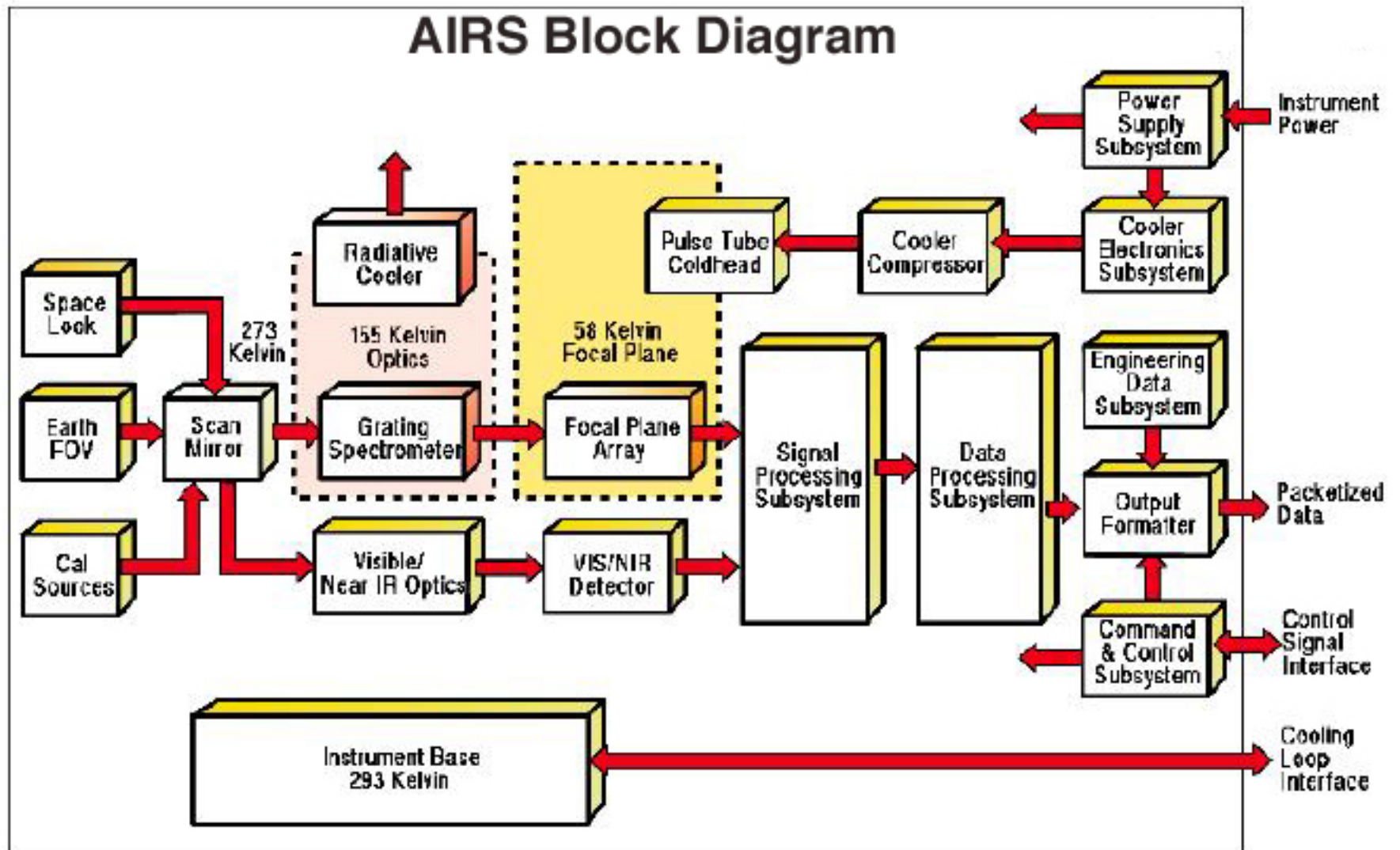
The Atmospheric Infrared Sounder, AIRS, brings climate research and weather prediction into the 21st century. From NASA's Aqua spacecraft, the AIRS instrument measures humidity, temperature, cloud properties, and the amounts of greenhouse gases. AIRS also reveals land and sea surface temperatures.

<http://www.jpl.nasa.gov/airs>



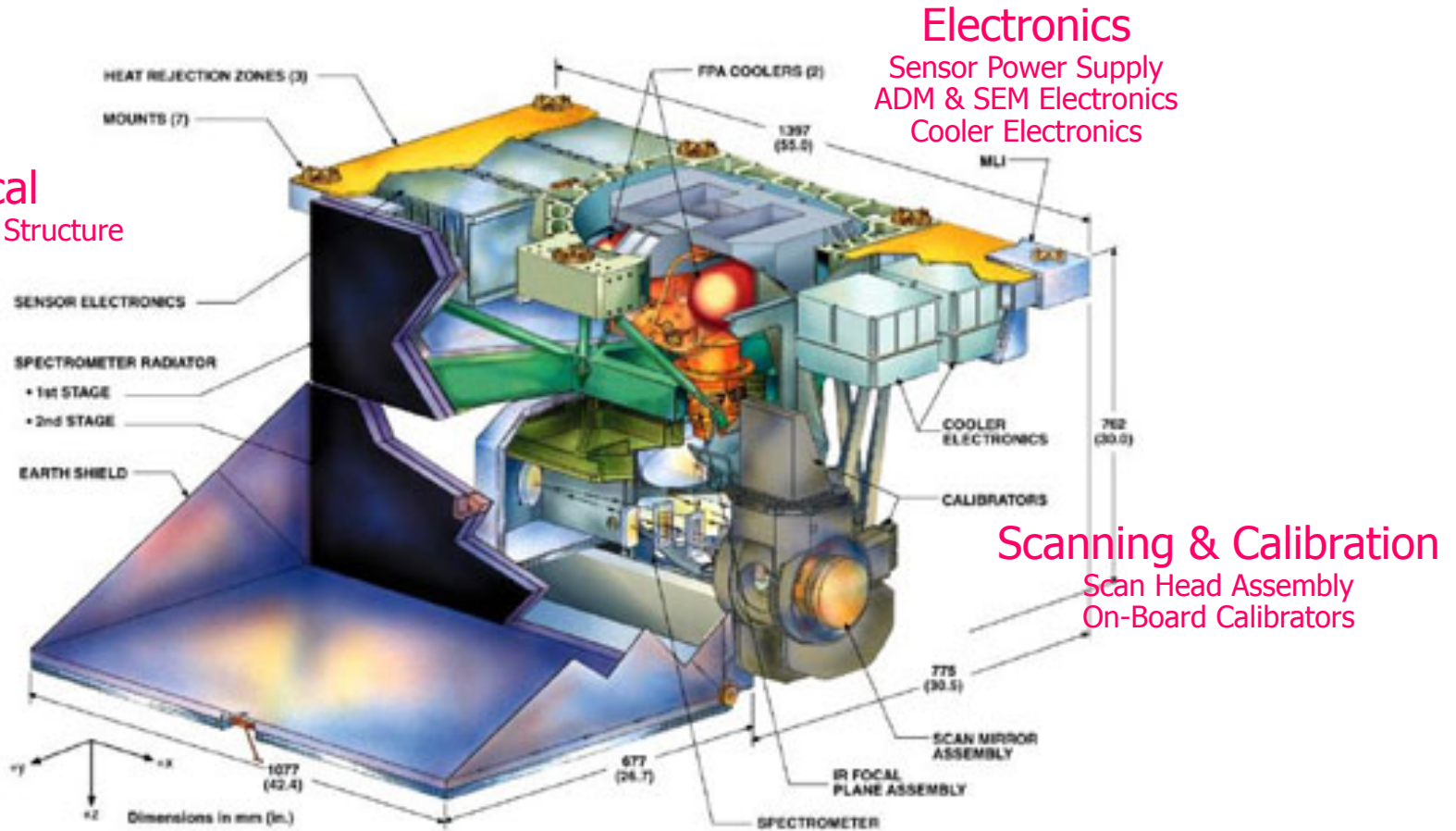
National Aeronautics and
Space Administration
JPL Propulsion Laboratory
California Institute of Technology
Pasadena, California
JPL 00-1008A 3/02

AIRS System



AIRS – Subsystems

Mechanical
Instrument Support Structure



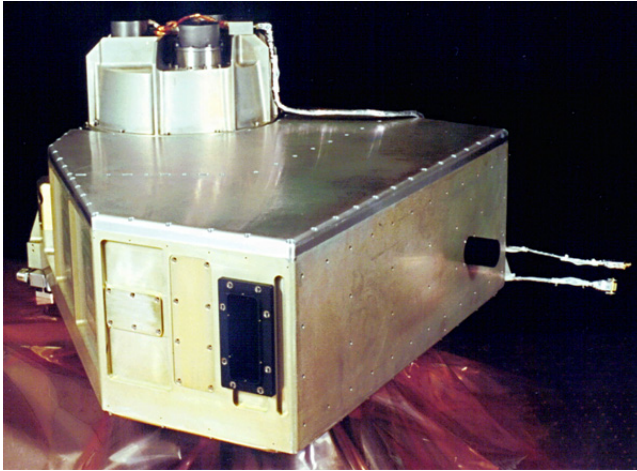
Electronics
Sensor Power Supply
ADM & SEM Electronics
Cooler Electronics

Scanning & Calibration
Scan Head Assembly
On-Board Calibrators

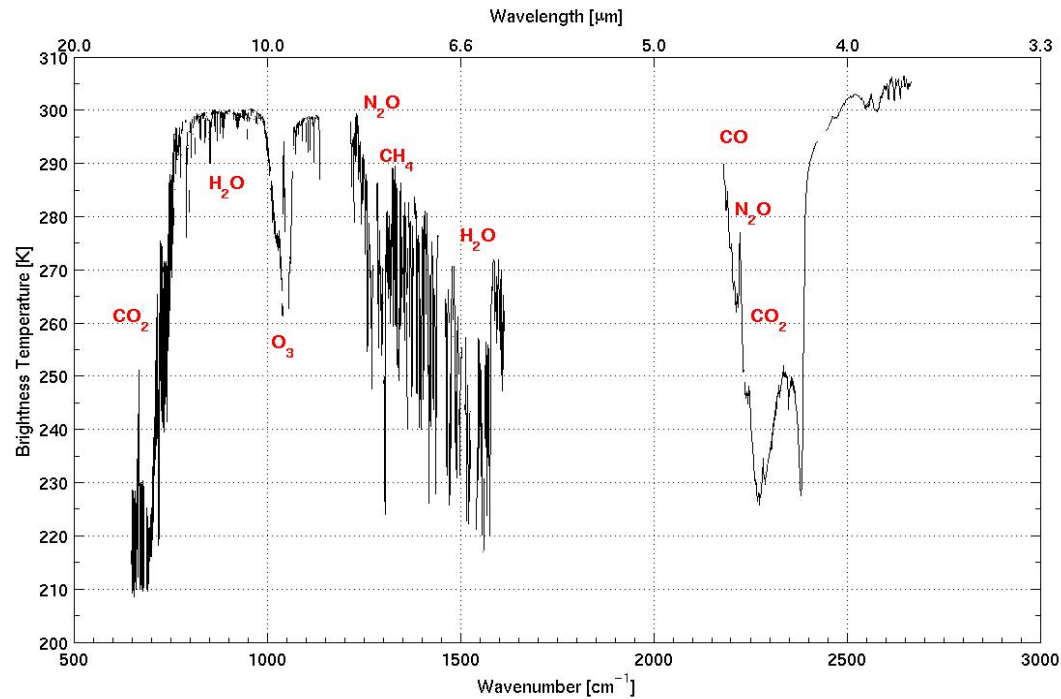
Cryogenic Cooling Systems
Dewar Assembly
Crycooler Assembly
Radiators and Earth Shield Assembly

Optics & Focal Planes
Infrared Spectrometer Assembly
Focal Plane Assembly

AIRS – Grating Spectrometer



- Array grating spectrometer
- Operating range: 3.7 – 15.4 μm
- Spectral resolution: $\lambda/\Delta\lambda=1200$
- Infrared energy dispersed across arrays of HgCdTe detectors (2378 detectors in 17 arrays)



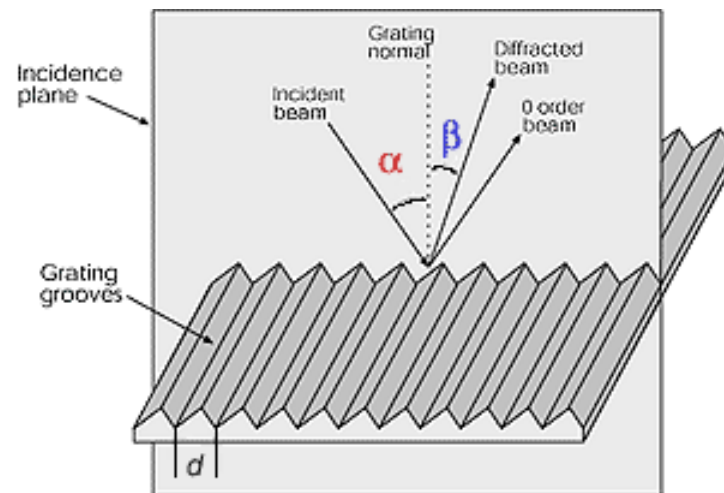
AIRS – Grating Spectrometer Basics

Different wavelength are diffracted into different angles

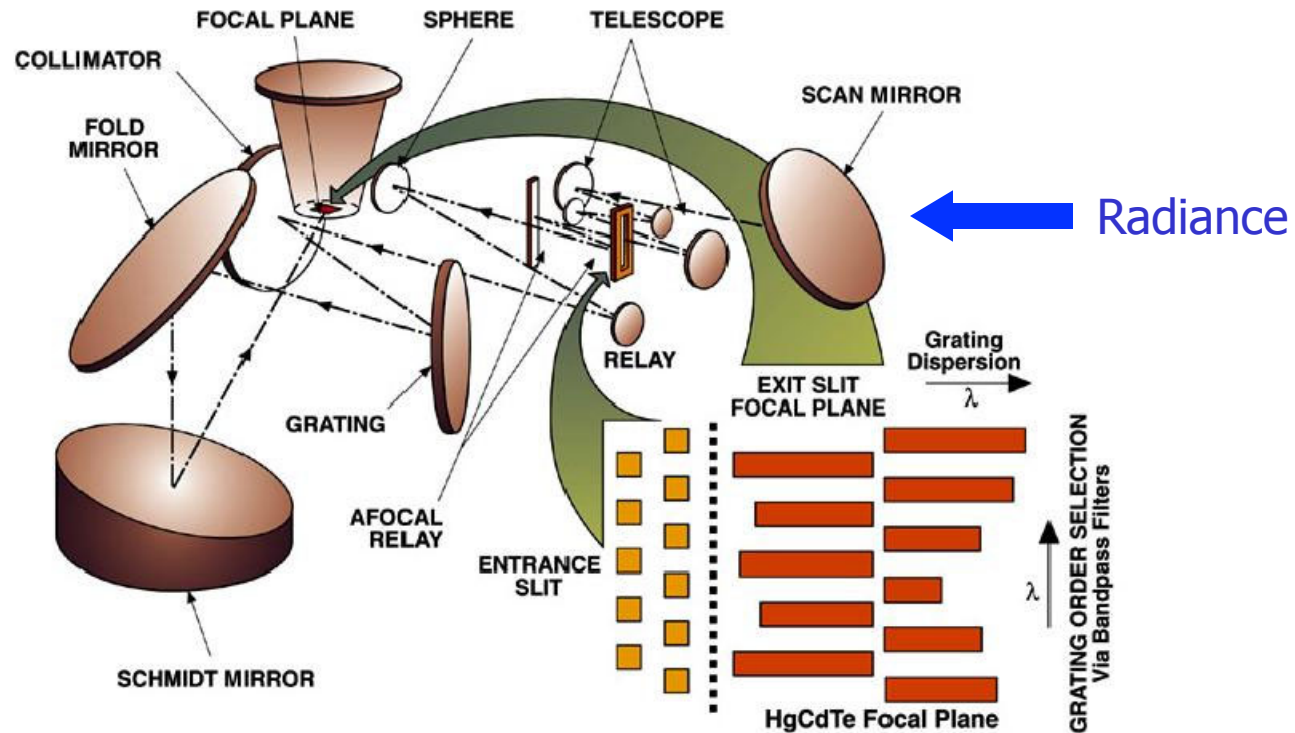
$$m\lambda = d (\sin\alpha + \sin\beta)$$

where

- λ wavelength
- α incident angle
- β diffraction angle
- d groove spacing of grating
- m diffraction order (integer)



AIRS – Grating Spectrometer Optics

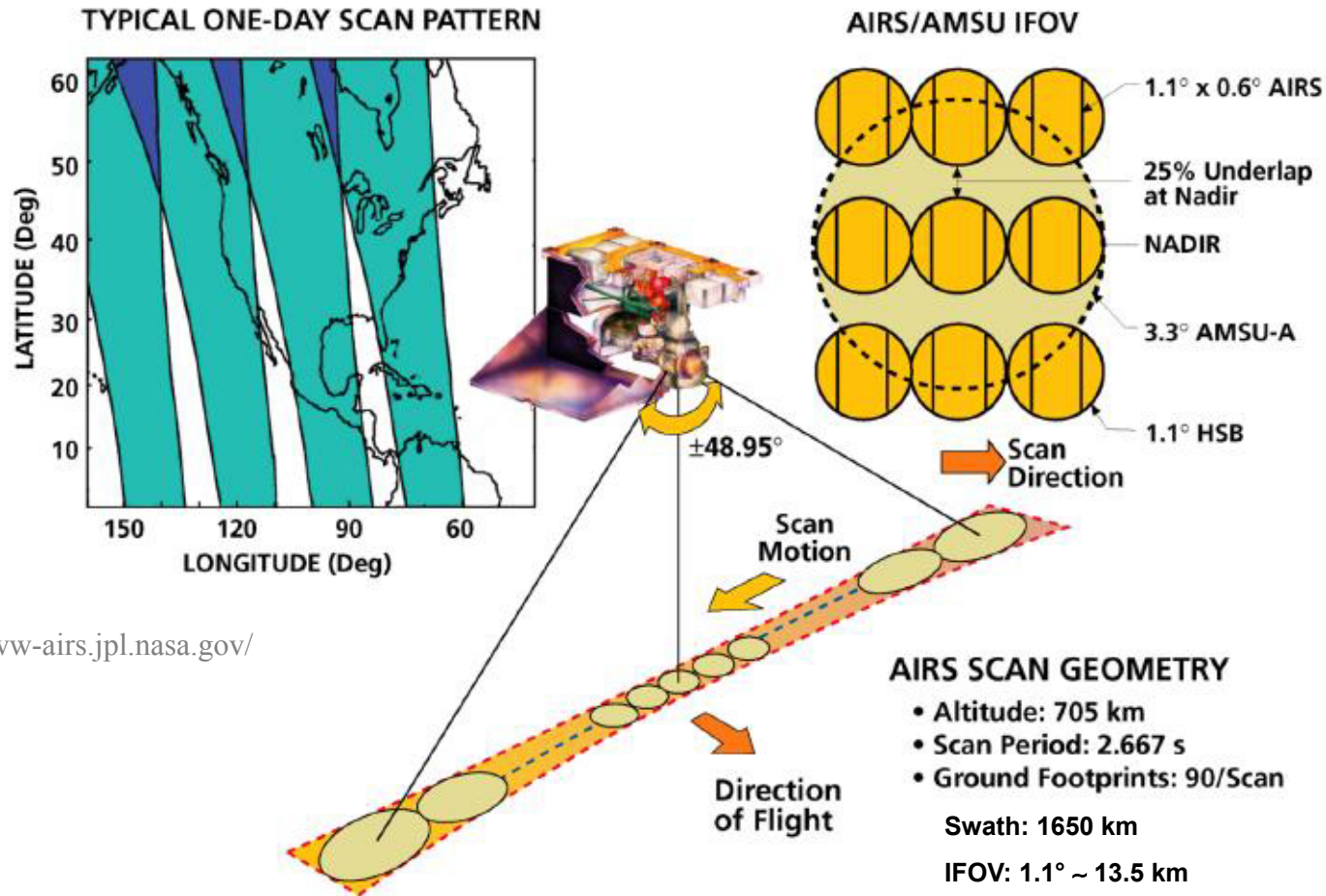


- Spectral filters at each entrance slit and over each FPA array isolate color band (grating order) of interest

<http://www-airs.jpl.nasa.gov/>

Radiance → Scan Mirror → Telescope → Spectrometer Entrance Slit → Grating → Array Detectors (HgCdTe Focal Plane Assembly)

AIRS Spatial Coverage (1)



<http://www-airs.jpl.nasa.gov/>

AIRS Spatial Coverage (2)

AIRS data is collected in 6 minute junks = 1 granule

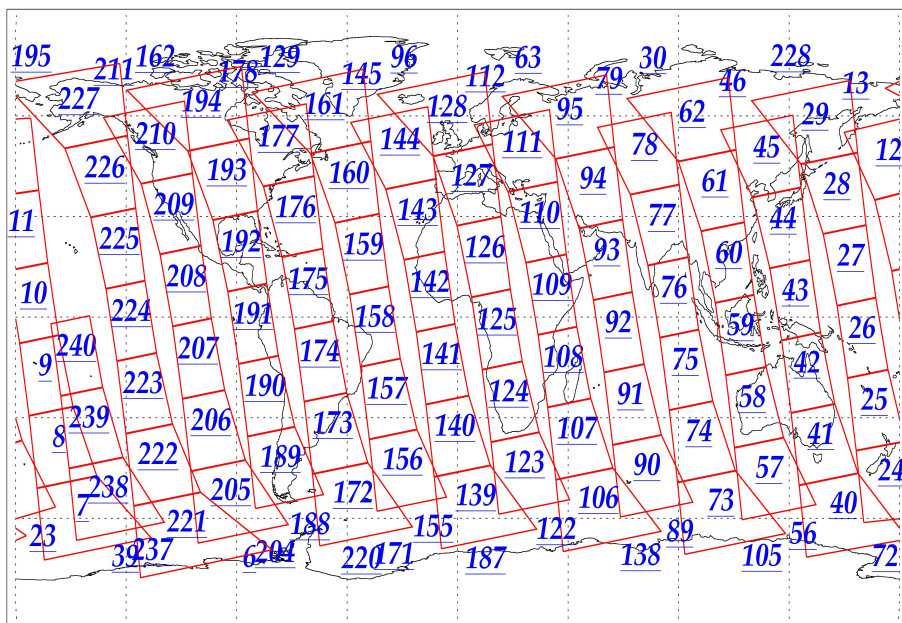
135 scanlines x 90 footprints = 12150 pixels per granule (~125 MB)

240 granules per day (120 ascending daytime and 120 descending nighttime granules)

L1A Availability
 AMSU Granules: 240
 HSB Granules: 240
 AIRS Granules: 240

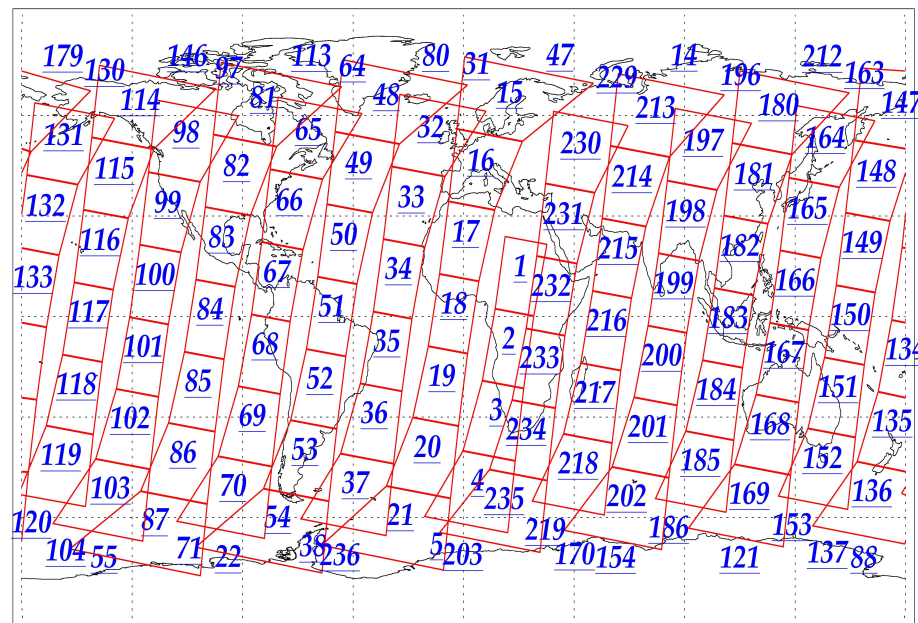
6 Sep 2002
 DoY 249
 Aqua Day 125

Ascending Granules



Descending Granules

Descending Granules

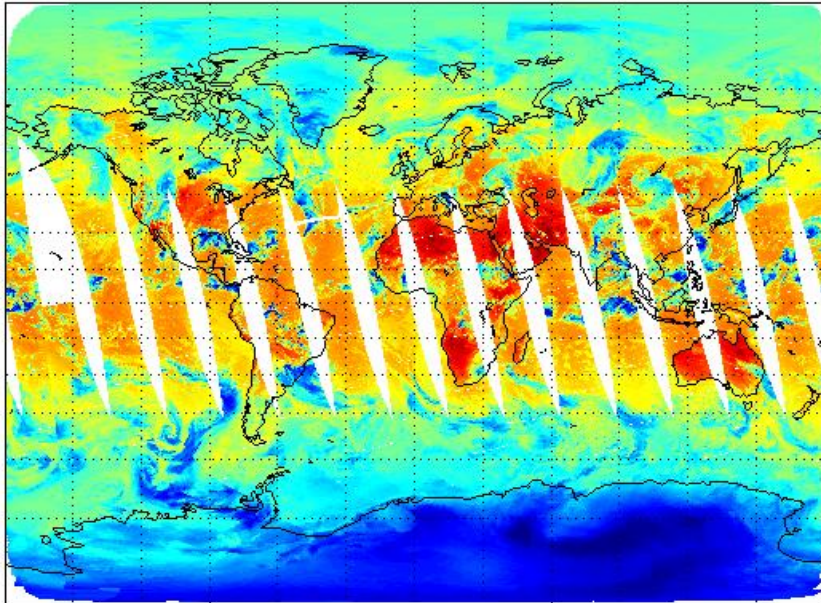


Legend: AMSU Available, HSB Available, AIRS Available

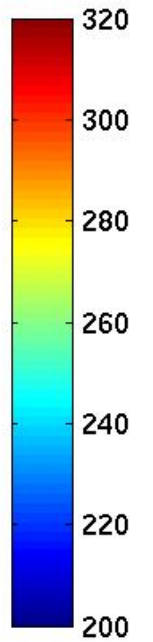
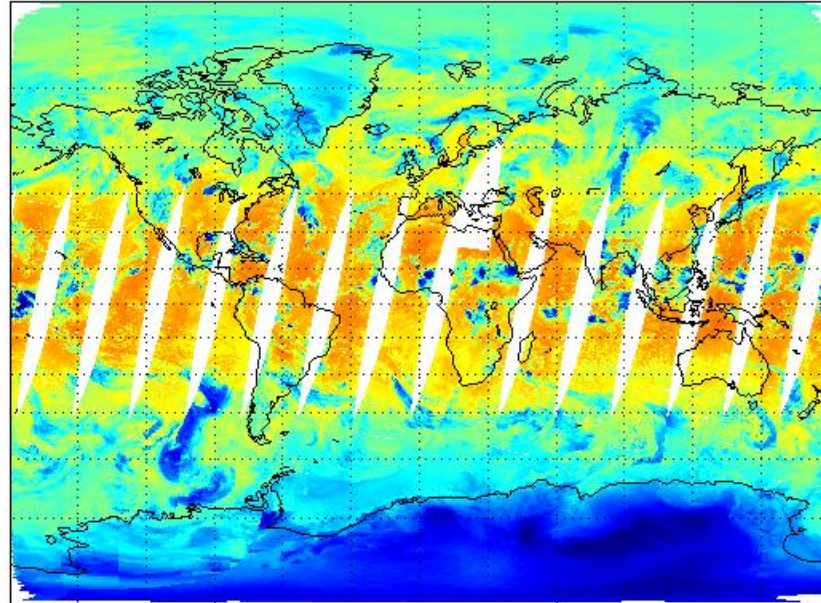
Created on 7 Oct 2002 17:39:22 PDT by eff@convection

AIRS Spatial Coverage (3)

6-Sept-2002, Brightness Temperature [K] at 1000 cm^{-1}
Ascending Granules

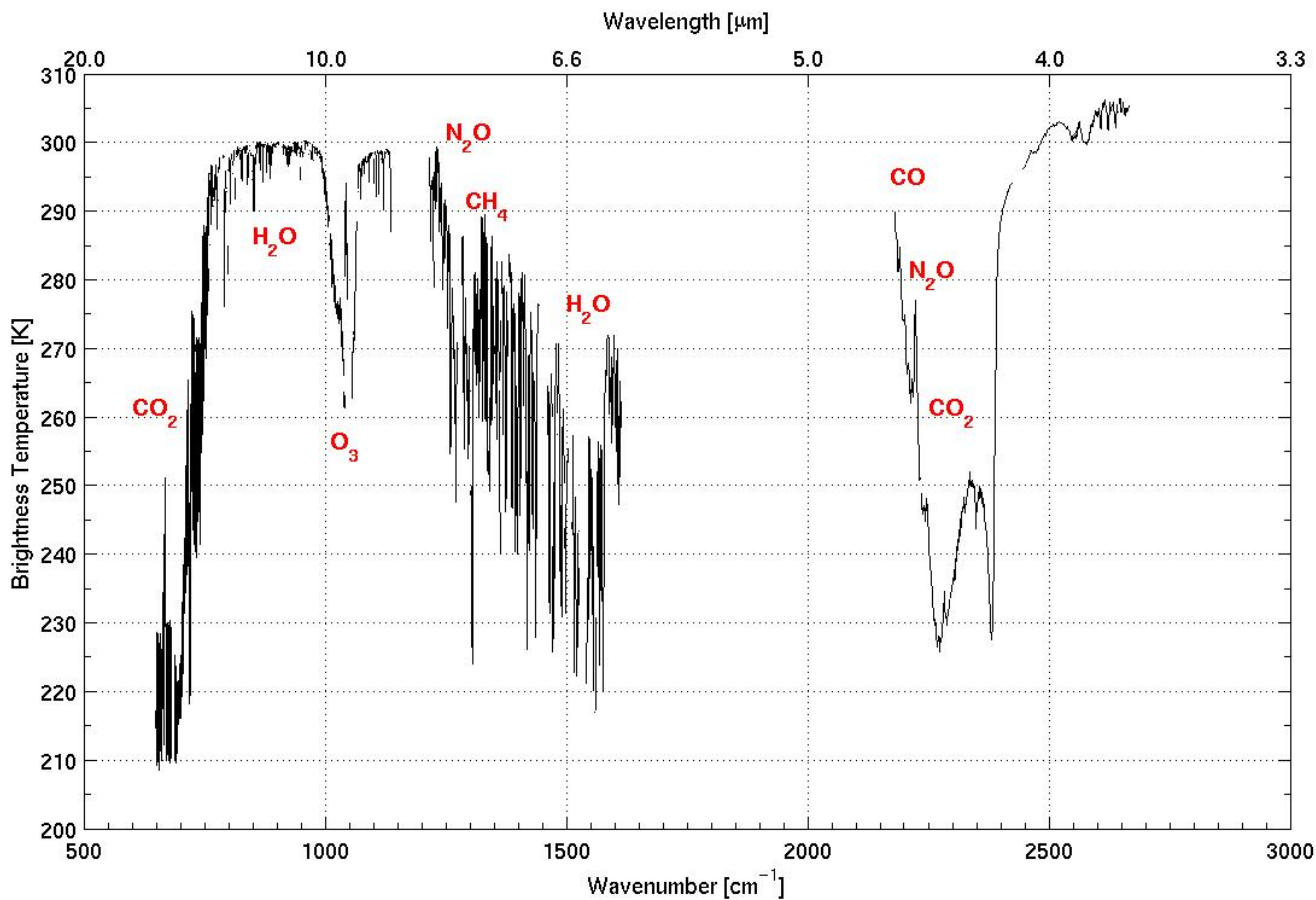


Descending Granules



AIRS Spectral Coverage

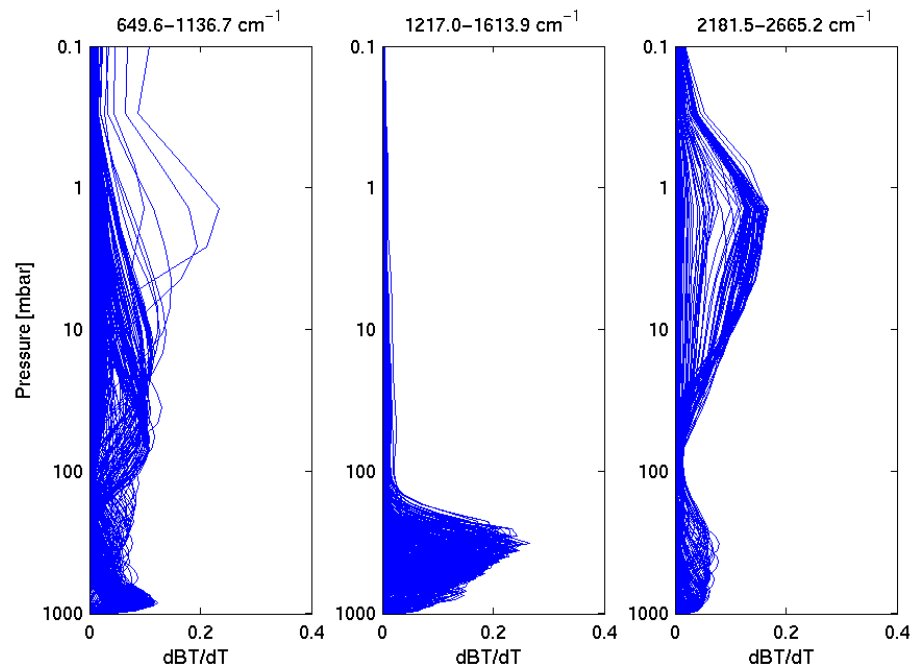
- IR sounder: 2378 channels
- spectral ranges: 3.7 - 4.61 μm , 6.2 - 8.22 μm , 8.8 - 15.4 μm ;



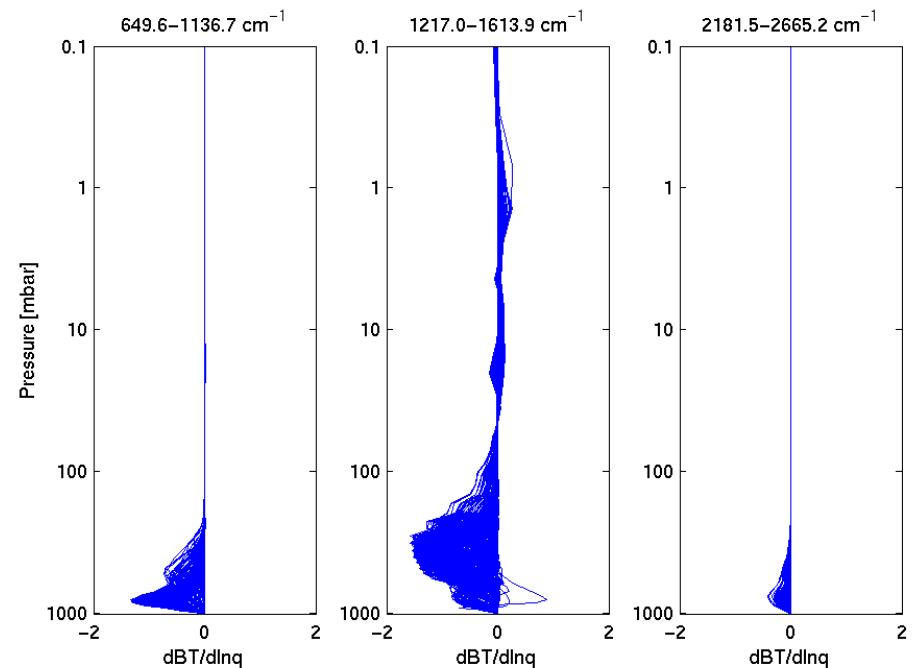
AIRS Spectral Coverage \rightarrow Vertical Resolution

Jacobian matrix $K=dBT/dX$ is the matrix of partial derivatives of the Brightness temperature with respect to the input parameter X . The weighting functions (=rows of K) reflect the relative contribution from each level to the total measured radiance.

Temperature weighting functions



Humidity weighting functions



AIRS IR Specification

Infrared Spectral Coverage:

3.74 μm - 4.61 μm	[2674 – 2170 cm^{-1}]
6.20 μm – 8.22 μm	[1613 – 1217 cm^{-1}]
8.80 μm – 15.4 μm	[1136 – 649 cm^{-1}]

Spectral Resolution: $\lambda/\Delta\lambda=1200$

Spatial Coverage:

$\pm 49.5^\circ$ around nadir
1.1° (~13.5 km dia) IFOV (Instantaneous Field of View)

Sensitivity (NEDT):

0.14 K at 4.2 μm
0.20 K from 3.7 to 13.6 μm
0.35 K from 13.6 to 15.4 μm

Power / Mass: 256 W / 166 kg

Lifetime: 5 years