

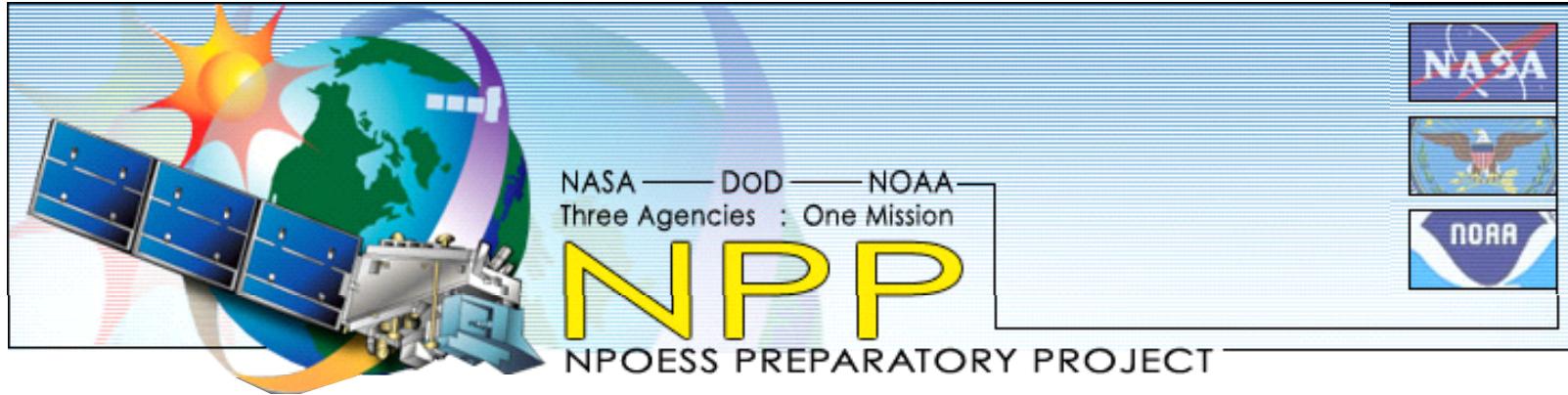
NPOESS Preparatory Project Cross-track Infrared Sounder Sensor Characterization and Performance Predictions

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@

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89th Annual AMS Meeting
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What is NPP?

The National Polar-orbiting Operational Environmental Satellite System (NPOESS) Preparatory Project (NPP) is a joint mission involving the National Aeronautics and Space Administration (NASA) and the NPOESS Integrated Program Office (IPO).

What is NPOESS?

The National Polar-orbiting Operational Environmental Satellite System (NPOESS) is the next generation of U.S. low Earth orbiting environmental satellites. The NPOESS will replace both the NOAA Polar-orbiting Operational Environmental Satellite (POES) series spacecraft and the US DOD Defense Meteorological Satellite Program (DMSP) spacecraft series.

What is the NPOESS Integrated Program Office (IPO)?

The NPOESS IPO was established to provide combined agency management of NPOESS. The IPO organizationally resides within the US Department of Commerce, NOAA, NESDIS and is staffed with personnel from the Department of Defense, Department of Commerce, and the National Aeronautics and Space Administration (NASA).



MISSION AREAS

<input checked="" type="checkbox"/> Atmosphere	<input type="checkbox"/> Climate
<input checked="" type="checkbox"/> Land	<input type="checkbox"/> Ocean
<input checked="" type="checkbox"/> Space Env.	<input checked="" type="checkbox"/> RDR/SDR Only

NASA/NPOESS NPP – 24 IORD EDRs

VIIRS (20)

- Albedo (Surface)
- Cloud Base Height
- Cloud Cover/Layers
- Cloud Effective Part Size
- Cloud Optical Thickness
- Cloud Top Height
- Cloud Top Pressure
- Cloud Top Temperature
- Land Surface Temp¹
- Surface Type
- Ocean Color/Chlorophyll²
- Suspended Matter
- Vegetation Index
- Aerosol Optical Thickness
- Aerosol Particle Size

- Ice Surface Temperature³
- Imagery³
- Sea Ice Characterization³
- Snow Cover/Depth³
- Sea Surface Temperature³

NOTES:

1. Precision limited by emissivity knowledge
2. Uncertainty degraded due to sensor limitations
3. No "all weather" capability
4. HCS limitation in cloudy conditions

CrIS/ATMS (3)

- Atm Vert Moist Profile⁴
- Atm Vert Temp Profile⁴
- Pressure (Surface/Profile)⁴

OMPS (1)

- O₃ Total Column (also CrIS)

- O₃ Profile

CERES

- Down LW Radiance (Sfc)
- Down SW Radiance (Sfc)
- Net Solar Radiation (TOA)
- Outgoing LW Rad (TOA)

KEY

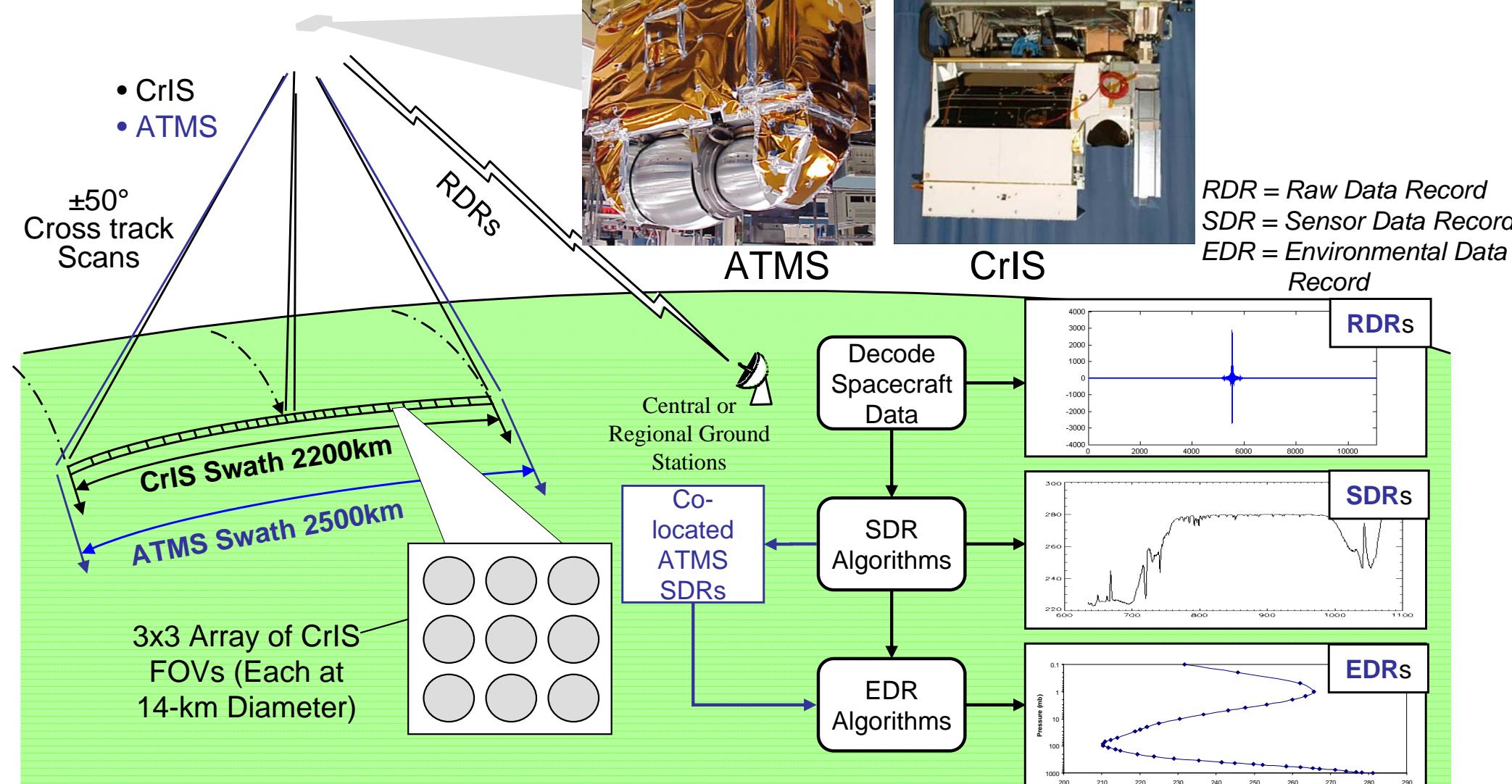
= EDRs with Key Performance Parameters

EDRs not delivered by NPOESS are not counted in totals

01 October 2008

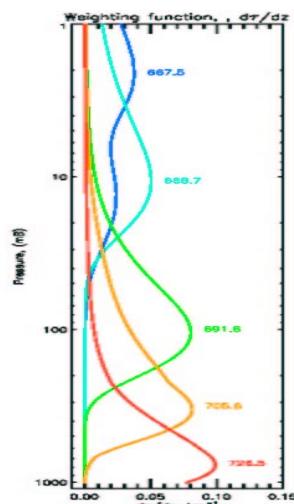
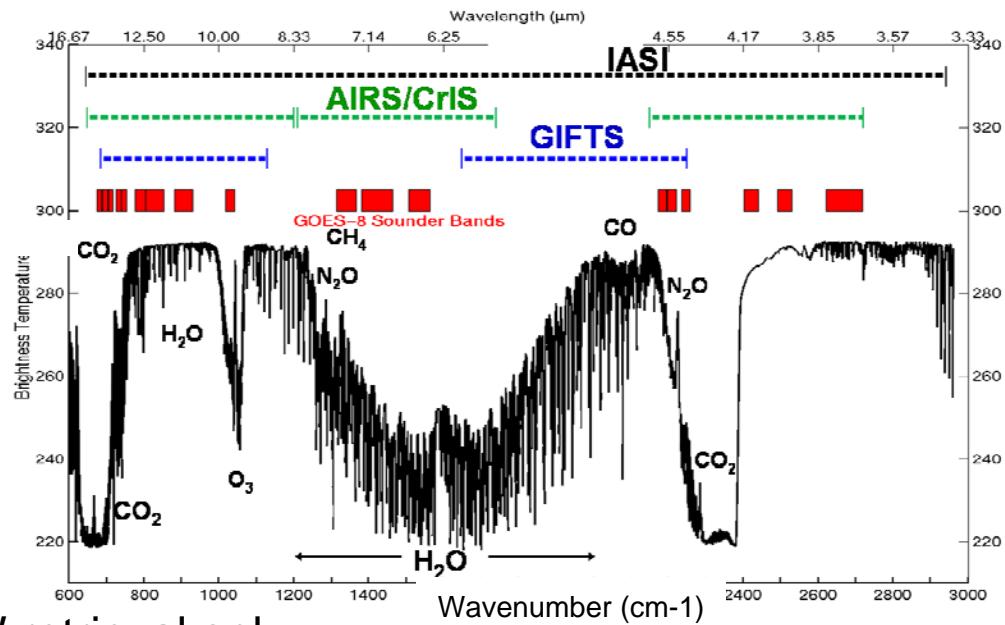
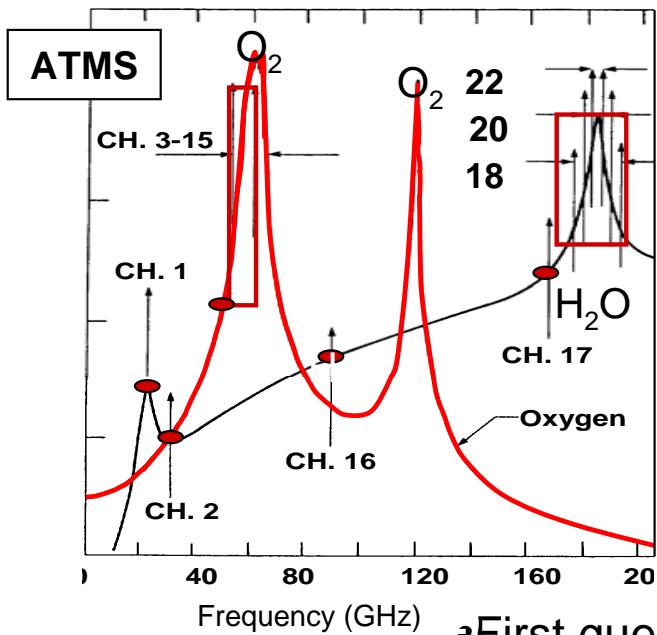
DoD, NOAA, NASA,
Integrated Program Office
M. Haas, F. Eastman
G. Mineart, J. Whitcomb

ATMS/CrIS



ATMS & CrIS work together to provide soundings in cloudy and clear conditions.

AVTP Retrieval Algorithm Overview



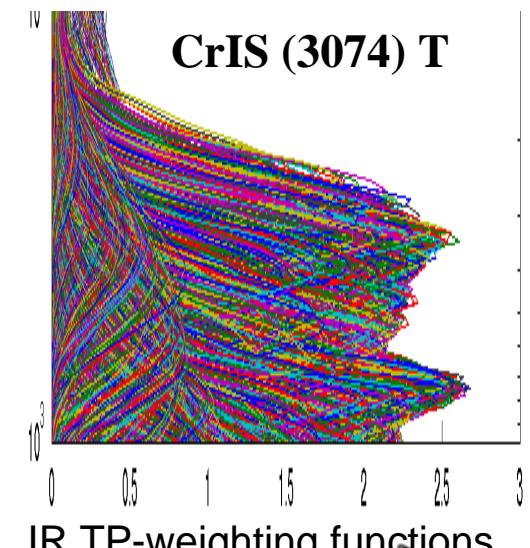
MW - weighting functions

- First guess - MW retrieval only
 - Scene classification
 - MW used for cloudy solution
 - IR and MW maximum likelihood inversion minimizing a cost function
- $$(\hat{\mathbf{R}} - \mathbf{R})^T \mathbf{S}_R^{-1} (\hat{\mathbf{R}} - \mathbf{R}) + (\hat{\mathbf{X}} - \mathbf{X}_a)^T \mathbf{S}_X^{-1} (\hat{\mathbf{X}} - \mathbf{X}_a)$$

EDR:

ATMP - Atmospheric Vertical Temperature Profile

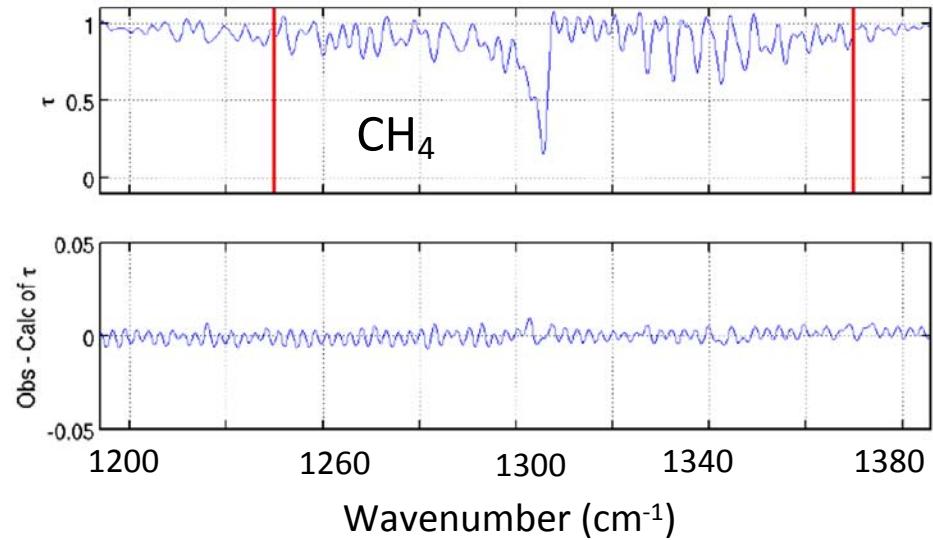
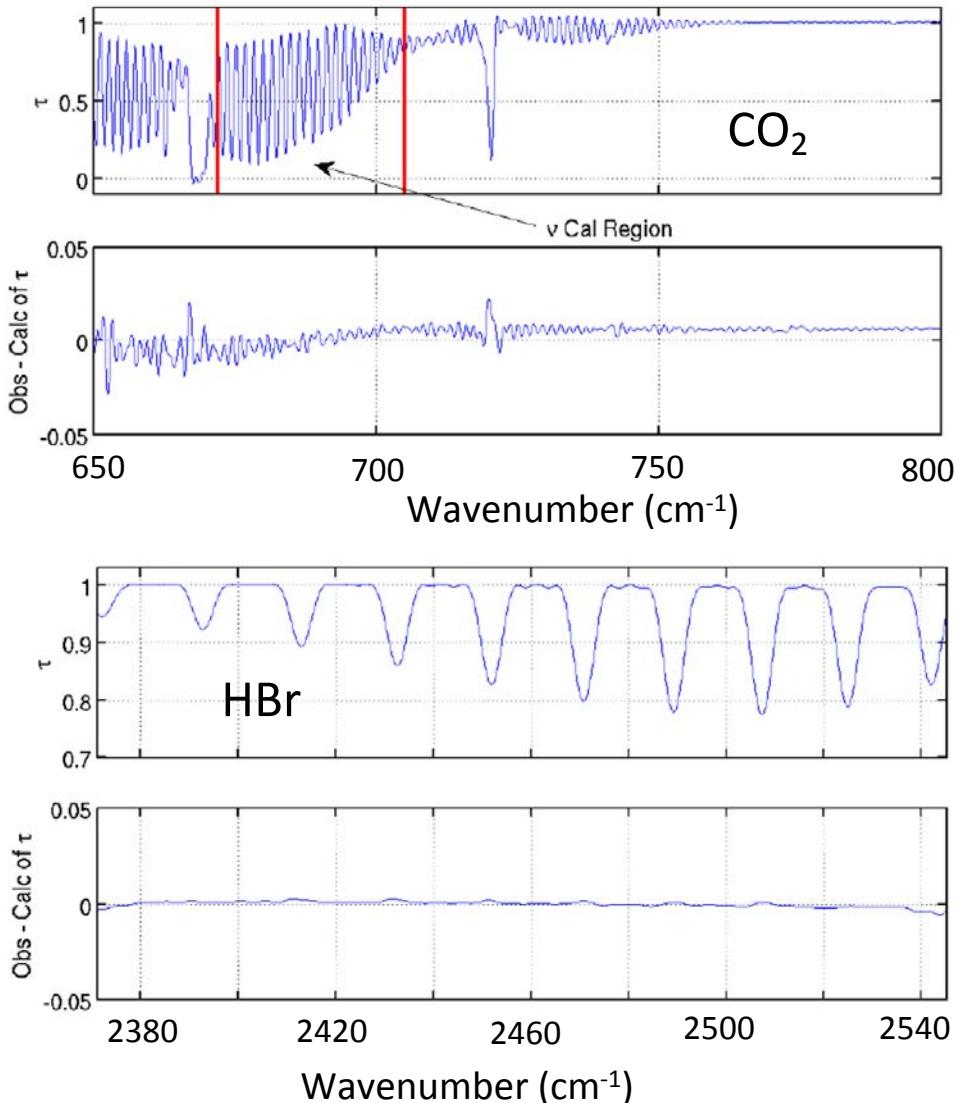
MW RT: OSS microwave routine
IR RT: OSS infrared routine
 1/30/2009



CrIS Instrument Status

- CrIS FM1 has completed Thermal Vacuum testing and is in the pre-ship review process
 - Vibration & EMI tests
 - FOV Shape / Coregistration
 - ILS / Spectral Accuracy
 - NEDN
 - Short Term Repeatability
 - Long Term Repeatability
 - Radiometric uncertainty and linearity testing on going
- NIST post TV External Calibration Target validation planning is in process and expected to occur in February, 2009
- Expected to ship to the spacecraft for integration testing in February, 2009

CrIS FM1 Spectral Calibration



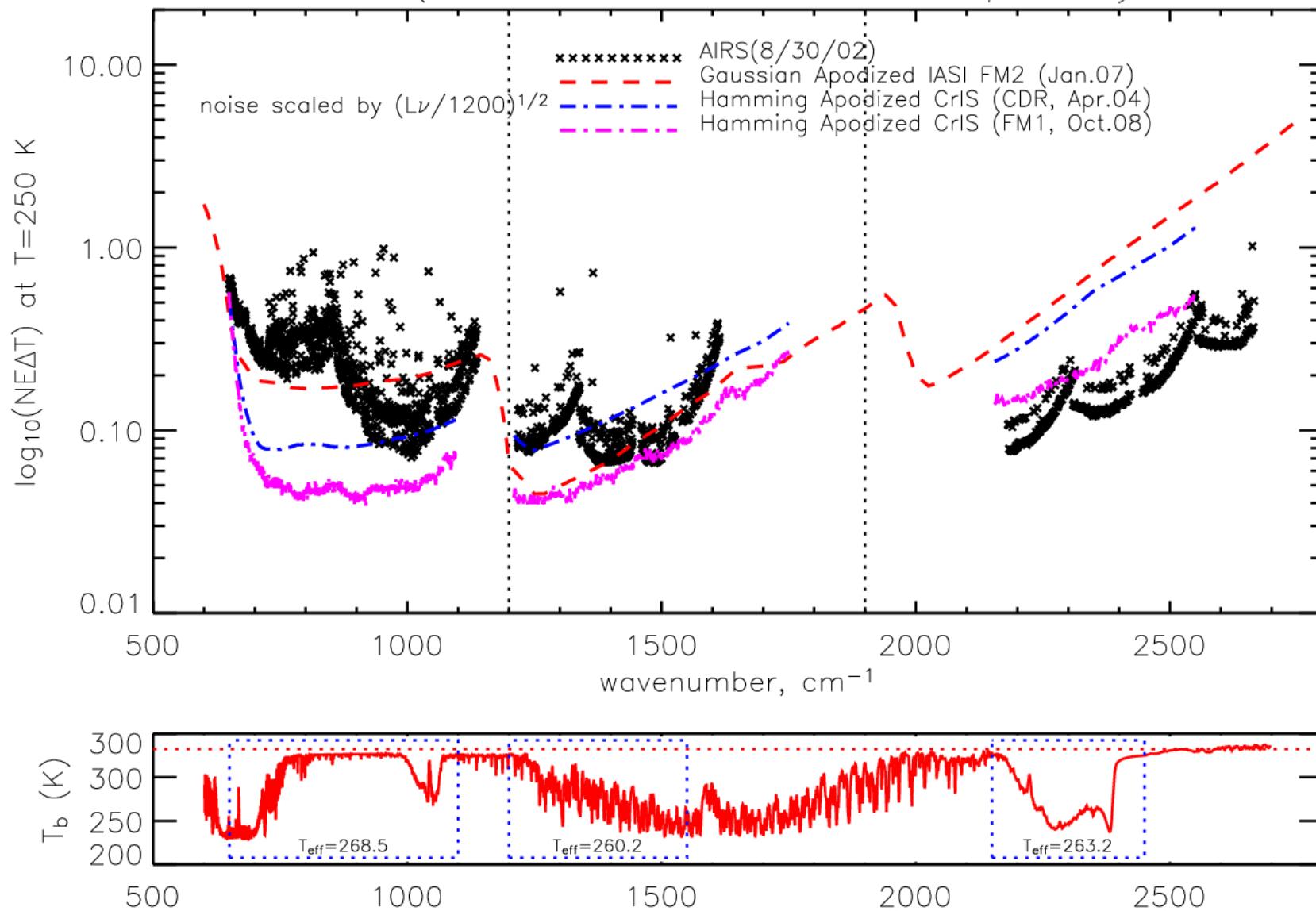
Conclusions

- CrIS frequency calibration using the Neon lamp worked extremely well in TVAC.
- ~ 1 ppm accuracy at a single operating temperature with only 2-3 adjustable parameters (x, y, Neon Cal).
- Measured CrIS ILS widths also appear to be extremely accurate, well within specifications.

From: Strow, Motteler and Hannon. *Pre-Launch Spectral Calibration of the CrIS Sensor on NPOESS/NPP*. CALCON 2008. Logan, UT, USA, September 10, 2008.

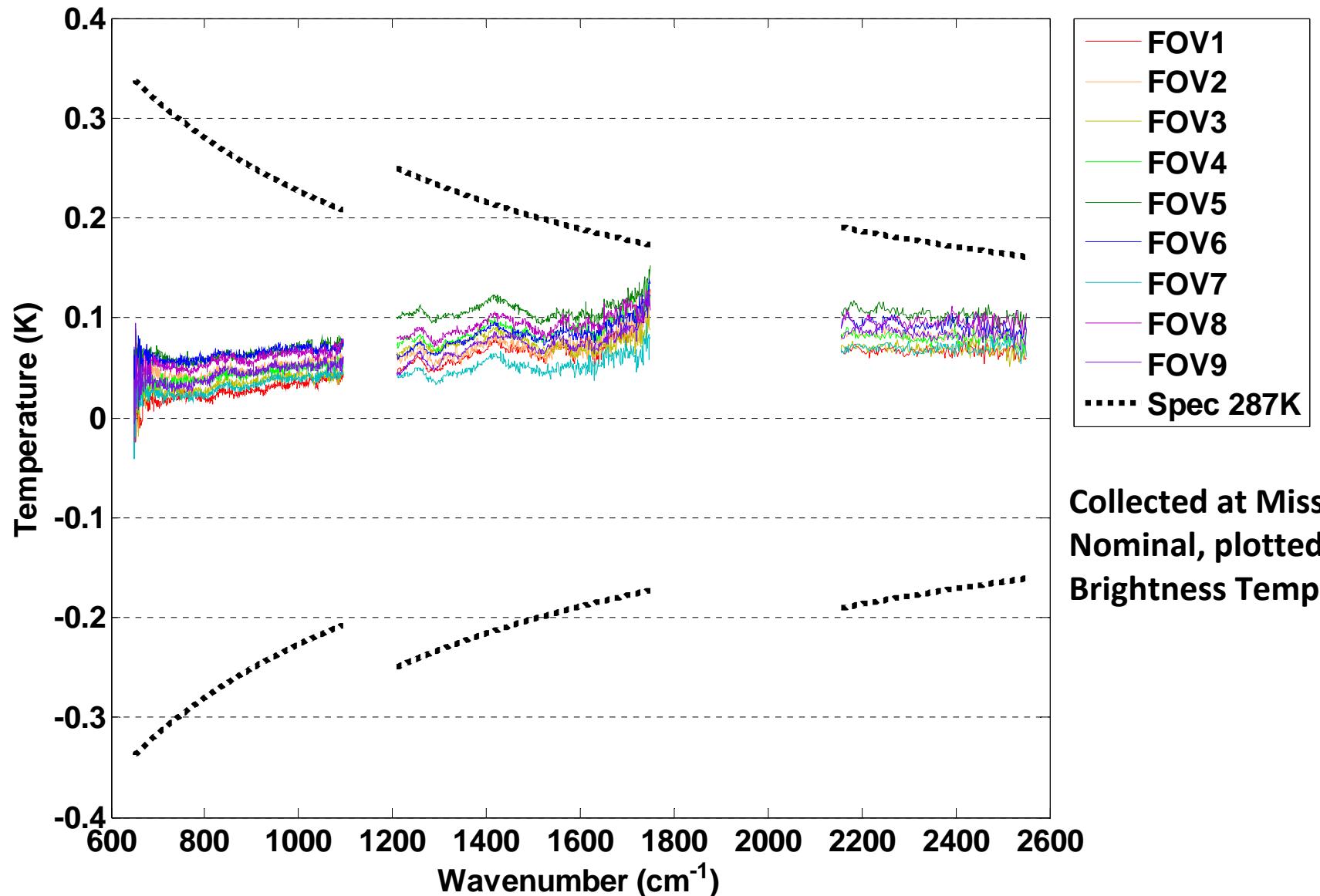
CrIS NEDT Comparison

AIRS, CrIS, IASI (NOTE: CrIS and IASI noise is spectrally correlated)

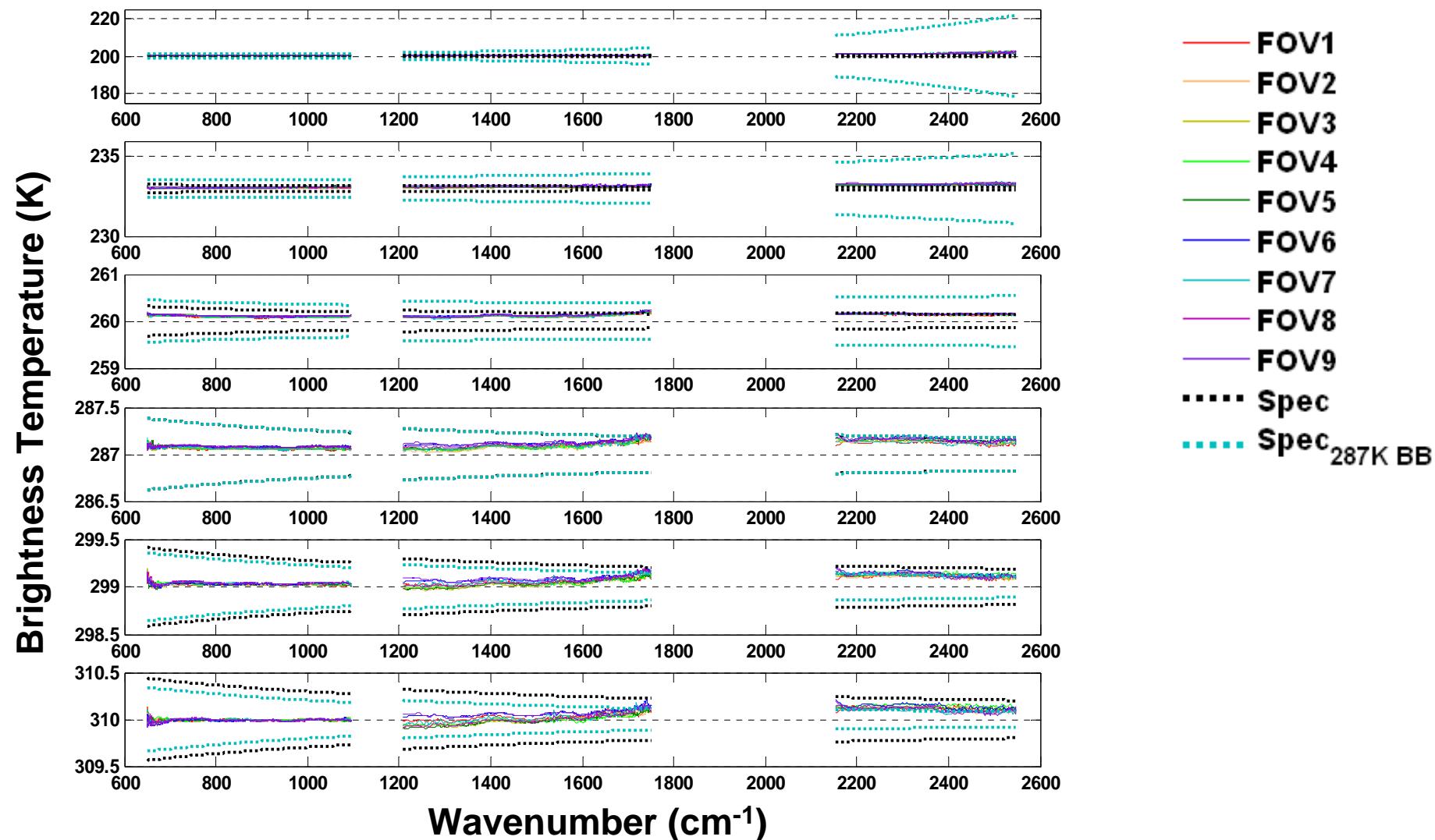


Radiance Uncertainty @ T = 287 K

Temperature Residuals for Radiometric Accuracy
FM1 TVAC3 MN Side1, $T_{\text{ECT}} = 287 \text{ K}$, 11/07/08 02:20:59 - 04:29:07

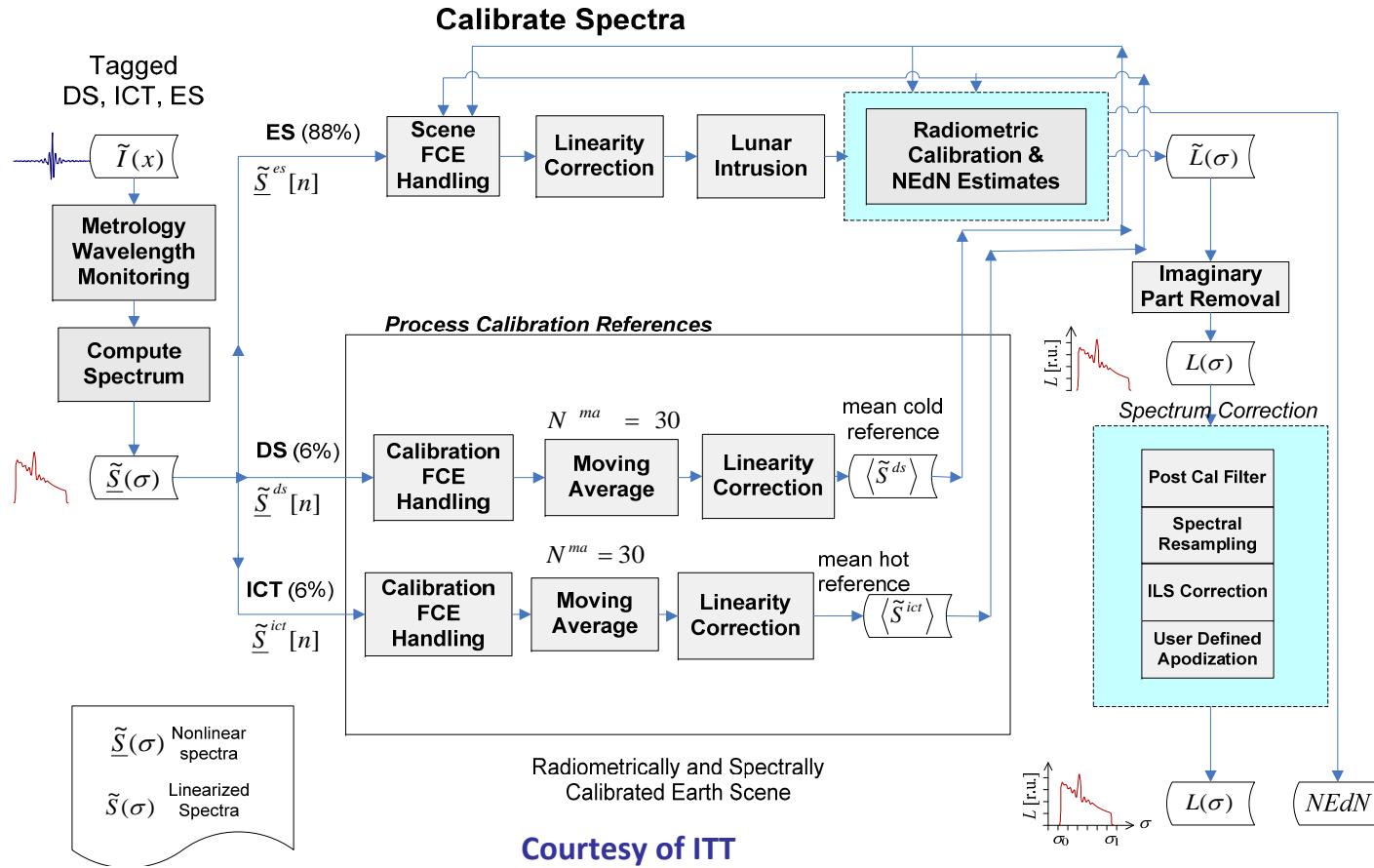


SDR: Brightness temperature uncertainties ($T_{ECT} = 200:310$ K)



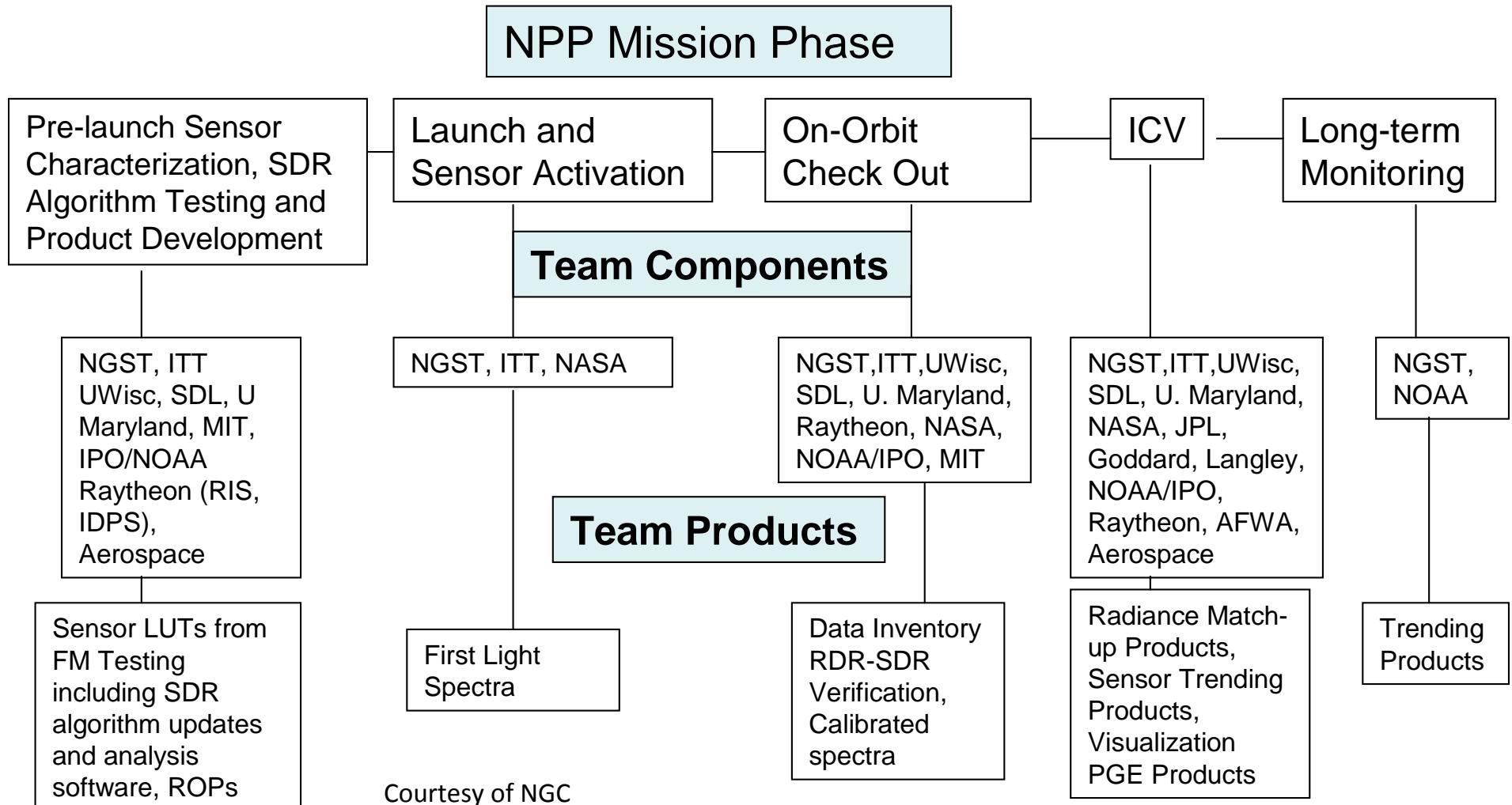
- Spec values are specified in requirements only for $T_{ECT} - 287\text{K}$
- “Spec” - % of RU at 287K was applied to all other temperatures
- “Spec 287K BB” - RU calculated at 287K were applied to all other temperatures

CrIS Calibration Processing



- CrIS Level 0 to Level 1B processing is provided by the Sensor Data Record (SDR) process
 - SDR algorithm is being developed by ITT in parallel with the sensor
 - Sensor performance processing during T/V is being analyzed using the SDR process software
- Current SDR process is being updated to contain non-linearity correction
 - Current T/V data collections are addressing non-linearity and absolute calibration

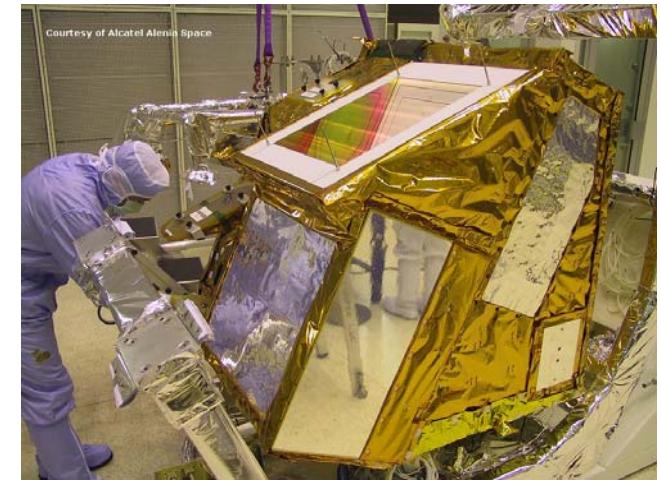
Cal/Val Process



CrIS is the 3rd Hyperspectral Sounder



AIRS



IASI

CrIS



CrIS follows two great, well calibrated instruments to orbit
SDR Cal/Val will utilize similar procedures

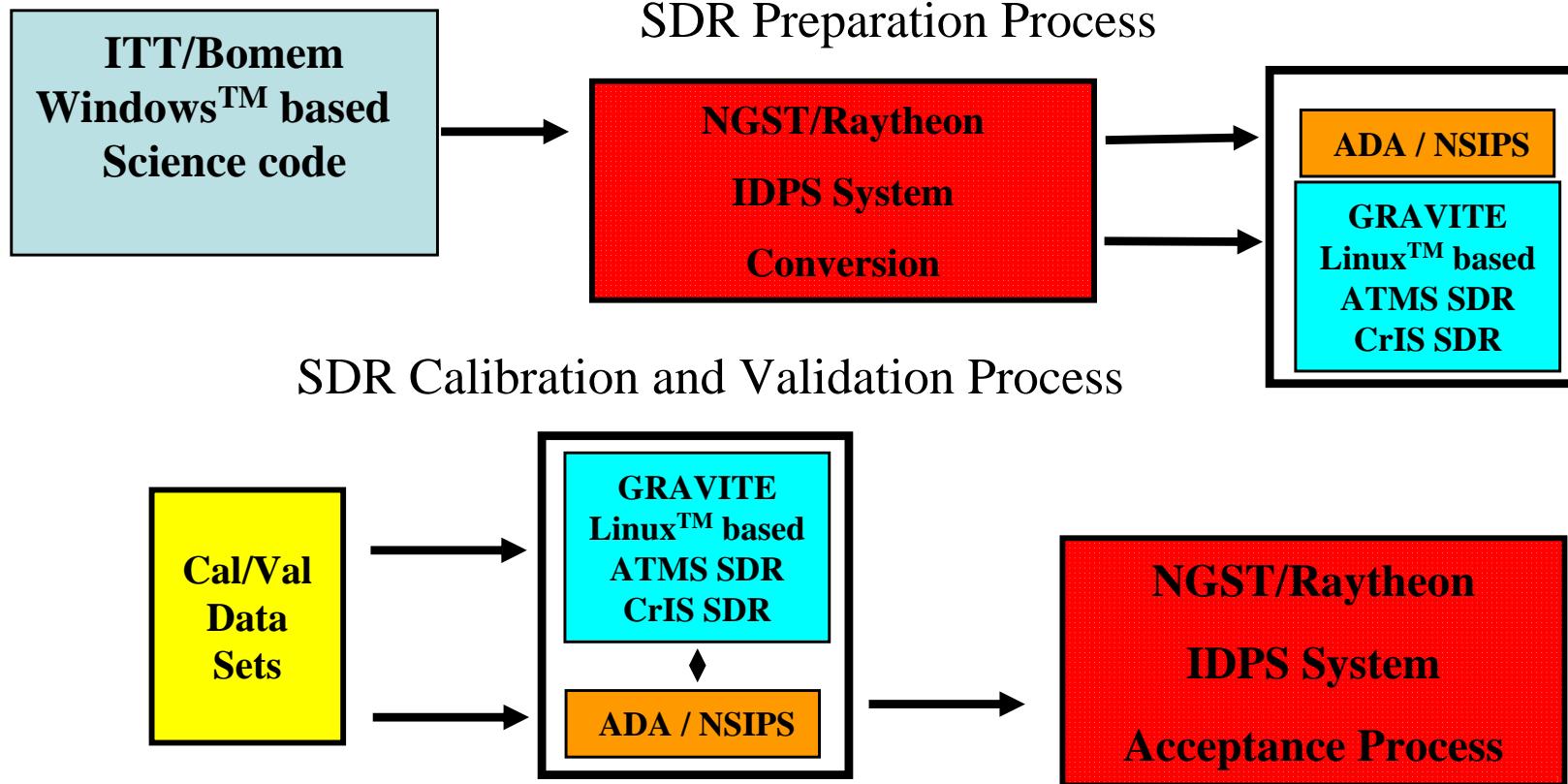
Co-existence enables direct comparison, and good comparisons from GSCICS
Cal/Val team brings direct AIRS/IASI experience

Hence, today's Cal/Val plan is significantly different than the first one

SDR Cal/Val Software Strategy

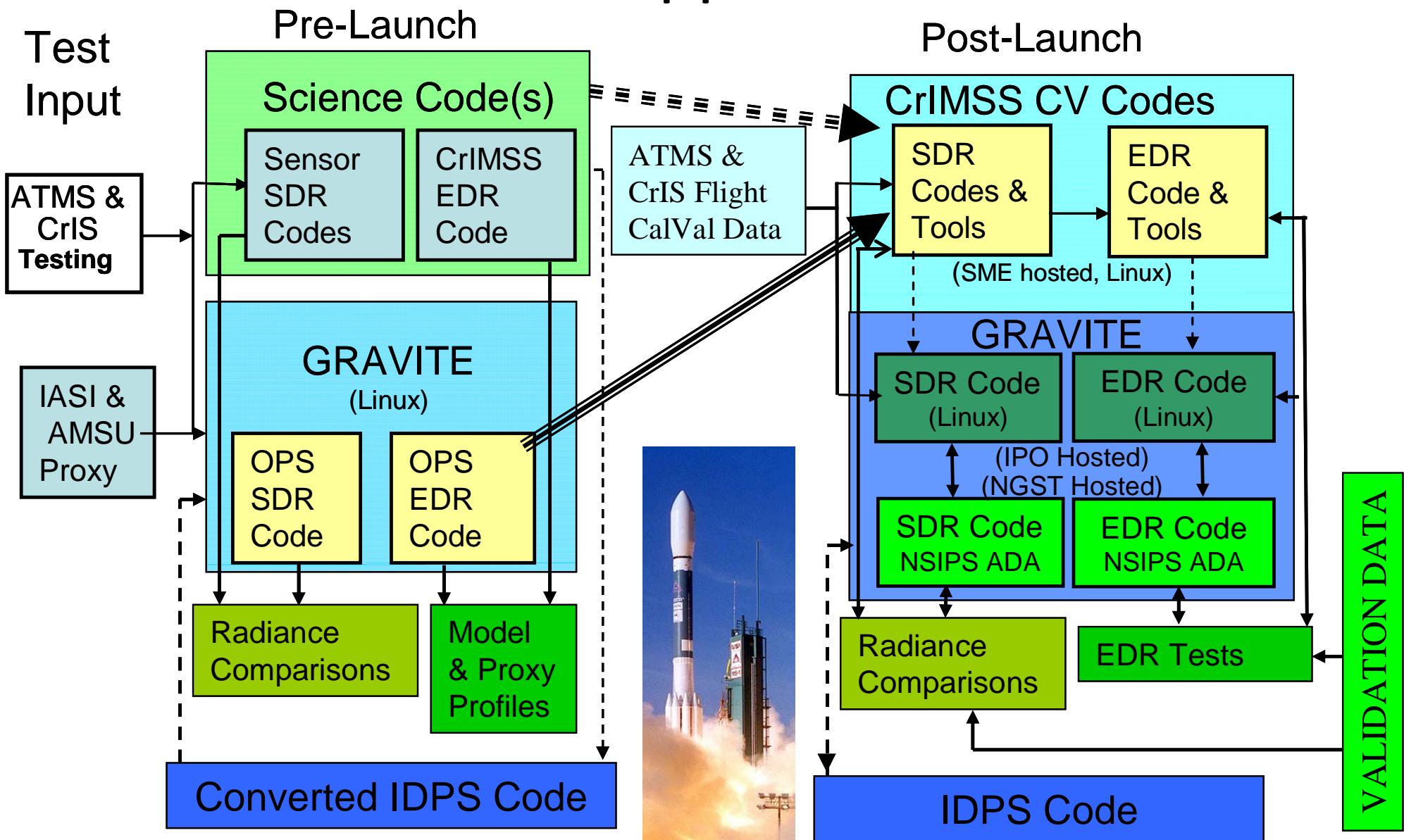
- The IDPS processing system is designed for operational data delivery and is carefully configuration controlled.
- It has no capability to provide the kind of look and see, and try this option required for Cal/Val data analysis.
- Early in the program it was decided to develop two separate, but limited capability systems to handle Cal/Val activities.
- These systems are known as NSIPS and GRAVITE and are physically located in the NOAA NSOF for easy data access.
 - NSIPS is an NGST/Raytheon-managed, off-line copy of the operational process with intermediate product storage access
 - Processes running in the operational environment
 - GRAVITE (Government Resource for Algorithm Verification, Independent Test, and Evaluation – Pronounced “Gravity”)
 - IPO-Data Products Division Linux based copy of the IDPS code
 - Linux code available to Cal/Val partners for their “local” processing

CrIS SDR Development System Flow

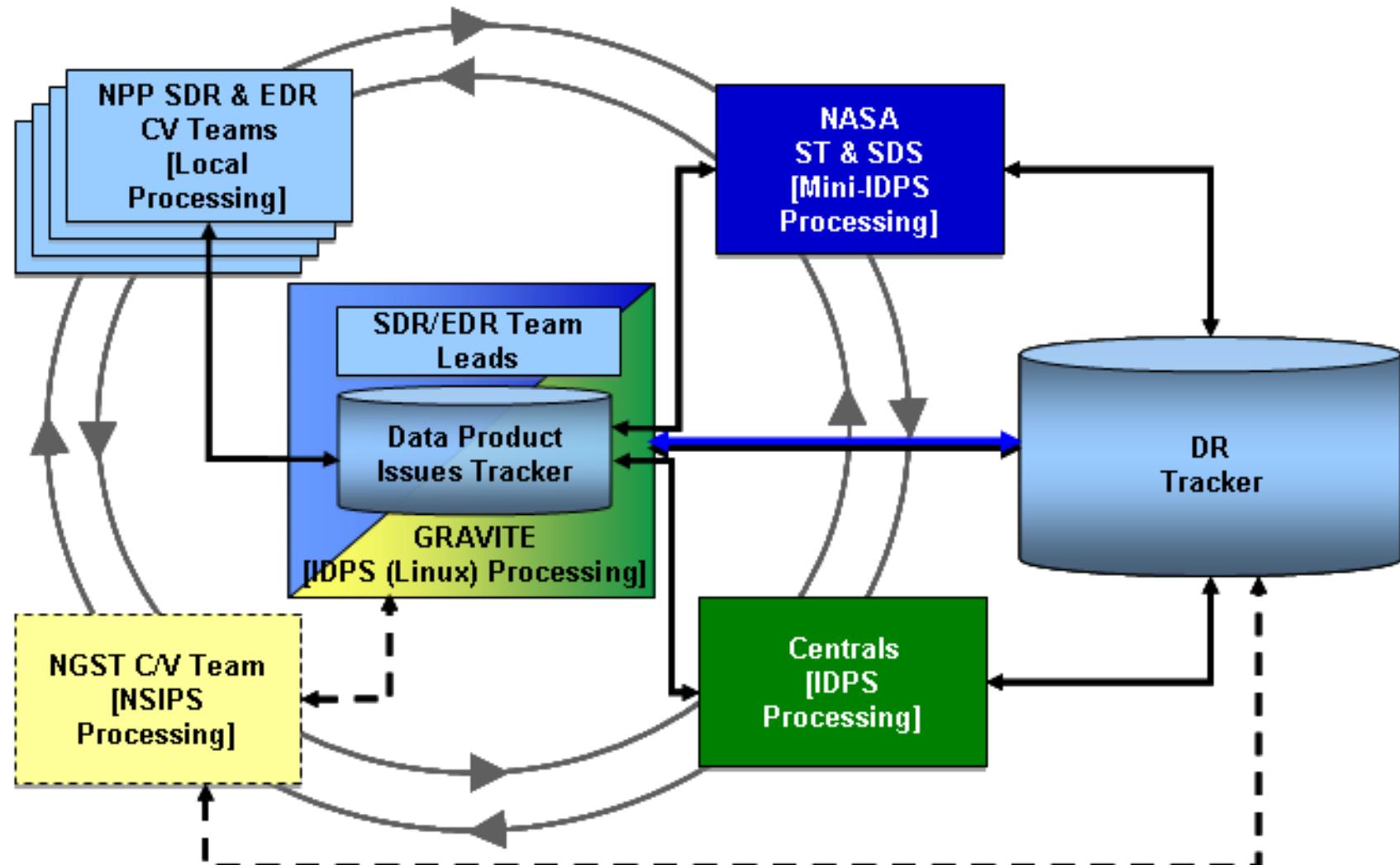


- ITT (ABB Bomem) - developed Science Code is the basis for IDPS development – provides preflight SDR coefficients and instrument performance analysis
- Our effort will validate the science and IDPS codes, before launch, using AIRS/AMSU and IASI/AMSU proxy data

Cal/Val Data Processing Support



Cal/Val Communications/Coordination



- Team members linked by Internet and teleconferencing links
- External partners attached on a case-by-case basis

NPP Cal/Val Plan Implementation

- Careful, in-depth coordination of CrIS SDR and CrIMSS EDR planning and development teams is critical to smooth function.
- CrIS/ATMS plans are being carefully coordinated to assure comparable results and timing.
- CrIS/ATMS plans are also being coordinated with the rest of the NPP SDR and EDR plans to provide a single, unified, resourced plan.
- Academic and agency cooperation is welcomed.
 - Initial contacts should be via the team leads (authors of this presentation).