



Joint Polar Satellite System (JPSS) Cross-Track Infrared Microwave Sounding Suite (CrIMSS) Environmental Data Record Validation Status

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- L. Strow (UMBC)
- J. Susskind (NASA/GSFC)
- E. Joseph and V. Morris (Howard Univ./NCAS)



Outline



- **CrIMSS (CrIS/ATMS) EDR Product Overview**
 - AVTP, AVMP (KPPs), AVPP, O₃ (IP)
 - JPSS Specification Performance Requirements
- **Cal/Val Program Status Highlights**
 - Overview
 - Team Members
 - Phases
 - Pre-Launch Phase Efforts
 - EOC–ICV Phase Near-Term Efforts



CrIMSS EDR

PRODUCT OVERVIEW

Atmospheric Vertical Temperature, Moisture and Pressure Profile (AVTP, AVMP, AVPP) Environmental Data Records (EDRs)



- **AVTP and AVMP EDRs**

- Used for initialization of NWP models, forecasting / nowcasting weather, severe weather, cloud info and winds, basic science research, etc.
- **Key Performance Parameter (KPPs)** for lower troposphere

- **AVPP EDR**

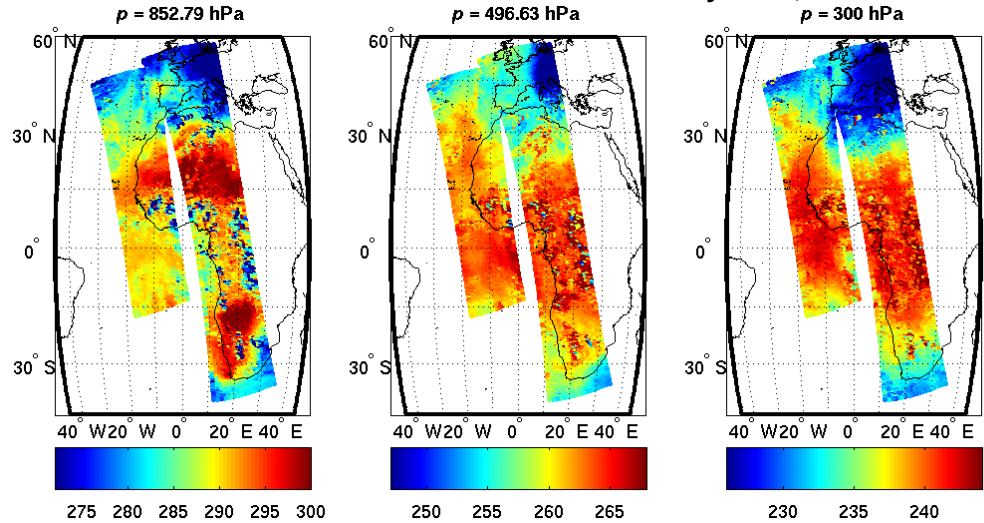
- Derived from AVTP and AVMP

- **Non-precipitating scenes**

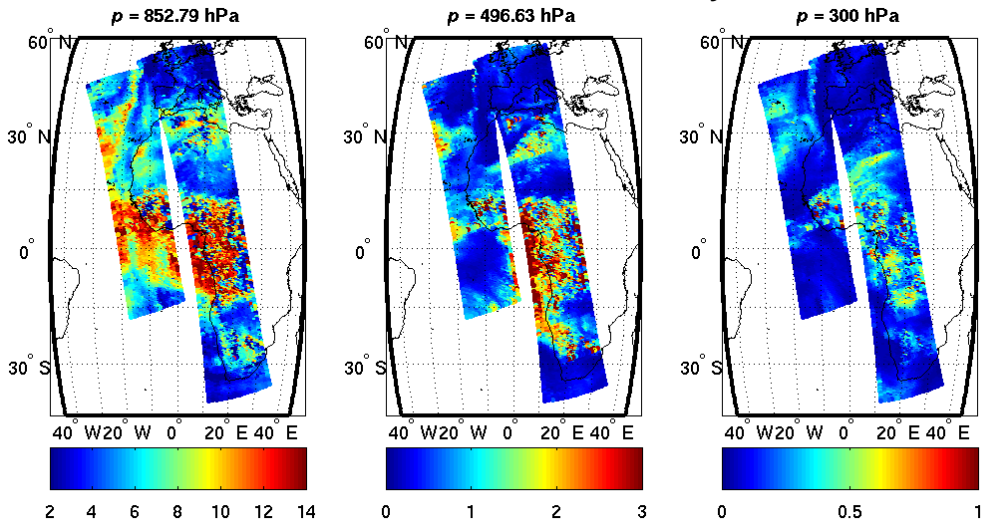
- **O₃ intermediate product (IP)**

- Necessary for optimal EDR retrieval
- Trace gas retrievals from IR sounders are desirable for basic science (e.g., greenhouse gases)

CrIMSS AVTP EDR retrieved from SDR Proxy Data, 19-Oct-07



CrIMSS AVMP EDR retrieved from SDR Proxy Data, 19-Oct-07



JPSS Specification Performance Requirements



Atmospheric Vertical Temperature Profile (AVTP) Measurement Uncertainty – Layer Average Temperature Error

PARAMETER	THRESHOLD
AVTP Clear, surface to 300 mb	1.6 K / 1-km layer
AVTP Clear, 300 to 30 mb	1.5 K / 3-km layer
AVTP Clear, 30 mb to 1 mb	1.5 K / 5-km layer
AVTP Clear, 1 mb to 0.5 mb	3.5 K / 5-km layer
AVTP Cloudy, surface to 700 mb	2.5 K / 1-km layer
AVTP Cloudy, 700 mb to 300 mb	1.5 K / 1-km layer
AVTP Cloudy, 300 mb to 30 mb	1.5 K / 3-km layer
AVTP Cloudy, 30 mb to 1 mb	1.5 K / 5-km layer
AVTP Cloudy, 1 mb to 0.5 mb	3.5 K / 5-km layer

Bold = KPP

Atmospheric Vertical Moisture Profile (AVMP) Measurement Uncertainty – 2-km Layer Average Mixing Ratio % Error

PARAMETER	THRESHOLD
AVMP Clear, surface to 600 mb	Greater of 20% or 0.2 g/kg / 2-km layer
AVMP Clear, 600 to 300 mb	Greater of 35% or 0.1 g/kg / 2-km layer
AVMP Clear, 300 to 100 mb	Greater of 35% or 0.1 g/kg / 2-km layer
AVMP Cloudy, surface to 600 mb	Greater of 20% of 0.2 g/kg / 2-km layer
AVMP Cloudy, 600 mb to 400 mb	Greater of 40% or 0.1 g/kg / 2-km layer
AVMP Cloudy, 400 mb to 100 mb	Greater of 40% or 0.1 g/kg / 2-km layer



CrIMSS EDR

CAL/VAL PROGRAM STATUS HIGHLIGHTS

CrIMSS Cal/Val Overview



- **NPP CrIMSS EDR Cal/Val Plan:** Ensure the data products comply with the requirements of the sponsoring agencies and have **met global performance specifications**.
 - Incorporated the IPO and NGAS plans
- **Draws on validation experience** from **AIRS/AMSU** and **IASI/AMSU/MHS** systems.
 - **Use proven datasets** for global validation (ECMWF, NCEP/GFS, RAOBs, etc)
 - **Leverage Team of Subject Matter Experts (SME)** for heritage knowledge, experience
 - **Leverage existing capabilities** wherever possible
 - **Assess against heritage sensors and algorithms**
 - Hyperspectral AIRS and IASI processing and validation systems
 - NOAA Unique CrIS ATMS Processing Systems (NUCAPS)
 - ATOVS (HIRS/AMSU) legacy products to demonstrate the value of hyperspectral
 - » NOAA Products Validation System (NPROVS)
 - **Intensive field campaign** cal/val experience
 - **Roll-up regional assessments** to assess that EDRs have met **global spec**
 - Validation methods typically characterize the performance of the EDRs in various ensembles
 - Stratifying specs according to various bins
 - day/night and latitude bands (i.e., polar, midlatitude, tropical)
 - land/ocean/ regional, and (possibly) altitude and surface characteristics

Team Members – Roles & Responsibilities



Cal/Val	Name	Organization	Funding Agency	Task
NOAA Team Members				
Lead	Chris Barnet	NOAA/NESDIS/STAR	NJO	Lead CrIMSS EDR Team
AVTP/AVMP	Changyong Cao	NOAA/NESDIS/STAR	NJO	Coordination w/ GSICS
AVTP/AVMP	Mitch Goldberg	NOAA/NESDIS/STAR	NJO & NOAA-PSDI	NGAS-code, NUCAPS
AVTP/AVMP	Anthony Reale	NOAA/NESDIS/STAR	NJO	NPROVS
AVTP/AVMP	Fuzhong Weng	NOAA/NESDIS/STAR	NOAA-PSDI	MiRS
CrIS SDR	Yong Han	NOAA/NESDIS/STAR	NJO	Lead CrIS SDR
ATMS SDR	Tsan Mo	NOAA/NESDIS/STAR	NJO	Lead ATMS SDR
NOAA-External Team Members				
AVTP/AVMP	Bill Blackwell	MIT	NJO	Microwave products
AVTP/AVMP	Allan Larar	NASA/LaRC	NJO	EDR Validation
AVTP/AVMP	Xu Liu	NASA/LaRC	NJO	IASI proxy, EDR validation
AVTP/AVMP	Hank Revercomb	SSEC	NJO	SDR, PEATE
AVTP/AVMP	Dave Tobin	SSEC	NJO	ARM-RAOBS
AVTP/AVMP	Larrabee Strow	UMBC	NJO	OSS validation
AVTP/AVMP	Joel Susskind	NASA/GSFC	NJO	AIRS proxy
CrIMSS SDR	Steven Beck	Aerospace Corp.	external	RAOB, LIDAR
CrIMSS SDR	Steven English	UKMET	external	UKMET analysis
CrIMSS SDR	William Bell	ECMWF	external	ECMWF analysis
AVTP/AVMP	Steve Friedman	NASA/JPL	NASA	Sounder PEATE
AVTP/AVMP CrIS SDR	Denise Hagan Degui Gu	NGAS	NG Prime	EDR Validation / SDR coordination

Cal/Val Phases



- *Pre-Launch*
- *Early Orbit Checkout (EOC)*
 - $L + 90$ days, as sensors are activated
- *Intensive Cal/Val (ICV)*
 - Stable SDR out to $L + 24$ months
 - Validation of EDRs against multiple correlative datasets
- *Long-Term Monitoring (LTM)*
 - From end of ICV ($L + 24$ months) to the end of operational lifetime
 - Characterization of all EDR products and long-term demonstration of performance

EDR Validation Activities by Phase (1/2)

Pre-Launch – Early Orbit Checkout



- **Pre-launch**
 - **Global synthetic datasets**
 - Tests algorithm for theoretical robustness – self-consistent profiles are “controlled”
 - Simulated for a wide range of environmental scenes
 - **Proxy datasets**
 - Data derived from existing satellite systems with similar specs (here AIRS/AMSU and IASI/AMSU)
 - Support launch readiness (functionality of the code, developing methods of empirical bias correction)and porting of algorithms)
 - AIRS (9 IR FOVs and 01:30 orbit); IASI (exact IR radiance spectral transform and MHS channels)
- **Early Orbit Checkout**
 - **Model comparisons**
 - Sanity checks on “obs – calc” using ECMWF and NCEP/GFS
 - **Simultaneous nadir overpass and double differencing**
 - **Inter-compare** with operational AIRS and/or IASI products
 - Useful to identify and mitigate issues with the operational EDRs
 - **PCA analysis** of noise characteristics and instrument monitoring

EDR Validation Activities by Phase (2/2)

Intensive Cal/Val – Long-Term Monitoring



- **Operational RAOBs**
 - Useful for **global latitude representation** and **long-term characterization**. Statistical significance after a couple months' accumulation.
- **Dedicated RAOBs**
 - Useful for **regional characterization**.
 - Will take many months (years?) to accumulate for statistics.
 - Funding for large number of RAOBs at ARM sites; ideally GCOS Reference Upper Air Network (GRUAN) volunteer coordination
- **Intensive Field Campaigns** (e.g., *Tobin et al. 2006*, *Nalli et al. 2006*, *JGR*, **111**; *Taylor et al. 2008*, *BAMS*, **89**; *Blackwell et al. 2001*, *TGARS*, **39**)
 - Project-coordinated aircraft campaign using NAST-I, -M and/or S-HIS
 - Coordinate with other NASA missions (e.g., SEAC4RS)
 - Useful for **regional characterization** and **SDR cal/val**; state specification for “cal/val dissection”
 - **Scientific campaigns of opportunity**
 - Low cost, low risk; synergism; engages science community
 - **NOAA Aerosols and Ocean Science Expeditions (AEROSE)** (*Nalli et al. 2011*, *BAMS*, **92(6)**)

Pre-Launch Phase Efforts (1/3)



- **Proxy Data Results**

- **CrIS/ATMS proxy SDR datasets**

- IASI/AMSU based
 - Focus Day 19-Oct-07 global granules
 - NOAA AEROSE 2010-11 campaigns
 - Include matched ECMWF/NCEP-GFS, IASI/AMSU, and proxy CrIS/ATMS SDRs
 - Available on NOAA/STAR FTP
ftp://ftp2.orbit.nesdis.noaa.gov/smcd/king/CrIMSS_C_ALVAL/
 - AIRS/AMSU based
 - Raytheon Plantinum-72 (P72) data package
 - IDPS operational CrIMSS SDR/EDR
 - Available on GRAVITE FTP during JPSS Rehearsal

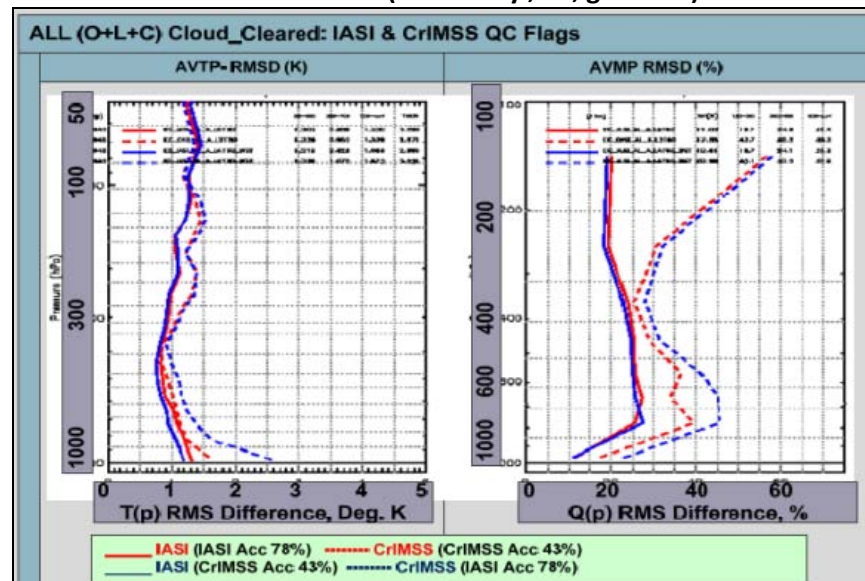
- **CrIMSS EDR runs**

- IDPS operational algorithm and environment; NGAS ADA environment; LaRC v1.5 algorithm, STAR offline environment ; STAR NUCAPS algorithm
 - CrIMSS EDR products retrieved from proxy data were seen to compare reasonably against ECMWF/RAOB matchups and current products
 - *Divakarla et al.* (AMS, HISE, 2011); *Gu et al.* (AMS, 2011); **Oral 3.8** (*Divakarla et al.*) this session

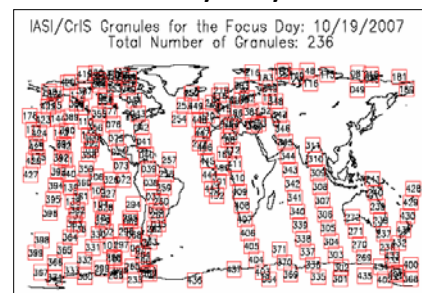
- **CrIS Radiance Bias Tuning**

- The NOAA-unique IASI radiance bias-tuning procedures are being used for CrIS radiance bias tuning.
 - Focus day (19 Oct 2007) ECMWF (original and “improved” for RTM) data are being used for CALC using the OSS model

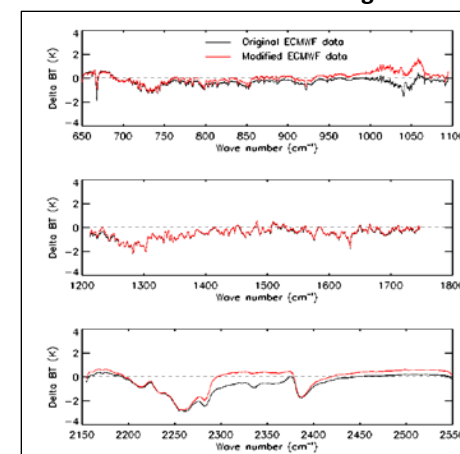
RET vs. ECMWF (Focus-Day , 48, granules)



Focus Day Proxy Data



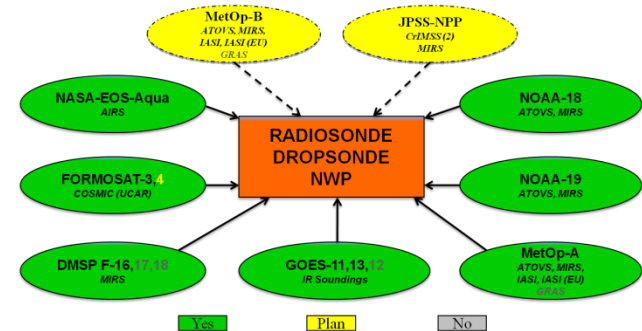
Prelaunch CrIS Tuning



Pre-Launch Phase Efforts (2/3)

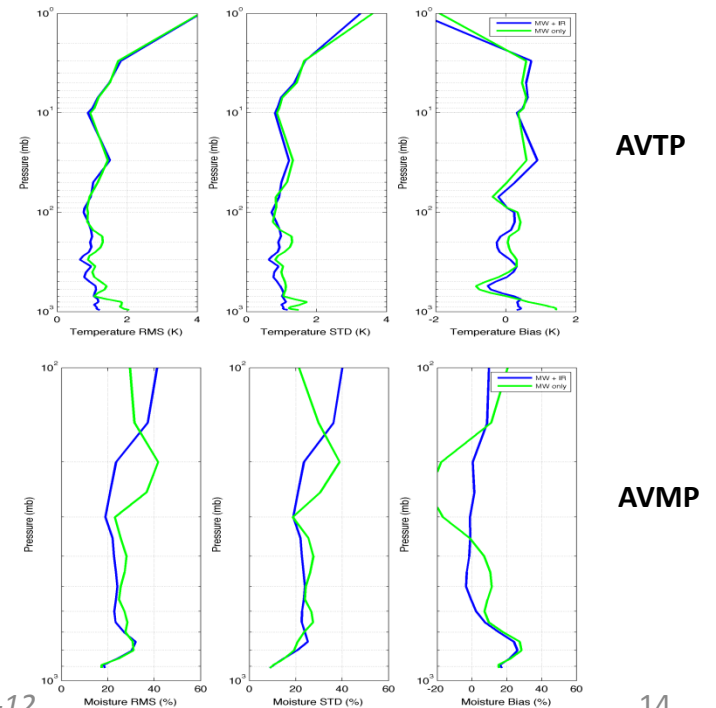


NOAA Products Validation System (NPROVS) Schematic



- **NOAA Products Validation System (NPROVS)**
 - Profile Display (PDISP) and NPROVS Archive Summary (NARCS) analytical interface clients (JAVA)
 - Inter-comparisons of all existing heritage satellite product systems, in addition to RAOB
 - <http://www.star.nesdis.noaa.gov/smcd/opdb/poes/NPROVS.php>
 - For more information, cf.
 - Oral 8.3 (*Reale et al.*) and 13.1 (*Petty et al.*)
 - Poster #509 (*Sun et al.*) and #169 (*Reale et al.*)
- **JPSS Cal/Val Rehearsal-2**
 - Successfully held 22-26 August 2011
 - Generated detailed work plan on using data downloaded from GRAVITE and CLASS, including utility of Focus Day and other datasets
 - SDR and EDR proxy data sets were quality checked for the purpose of mitigation prior to launch

Performance for LaRC CrIMSS v1.5.04 (with bias correction)

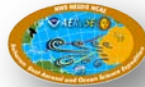


Pre-Launch Phase Efforts (3/3)



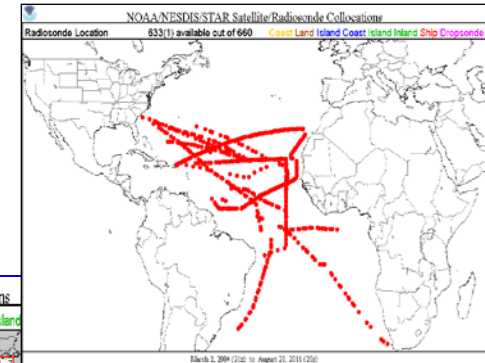
- **NOAA PNE/AEROSE Campaigns**

- Dedicated RAOB (*PTU, z, wind, O₃*) over the tropical North Atlantic Ocean
- Ocean region germane to CrIMSS mission
- AEROSE 2011 campaign successfully conducted in August



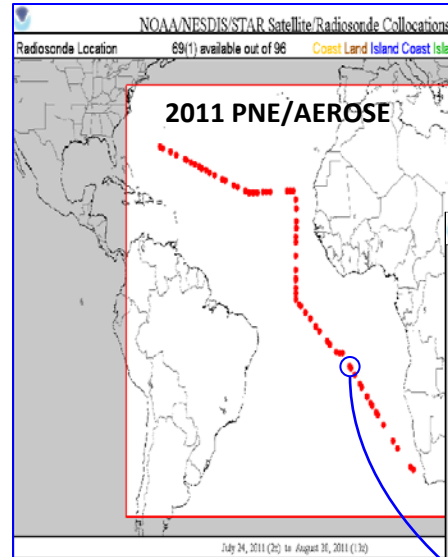
AEROSE RAOB matchups (IASI and AIRS) ingested within NPROVS

NOAA AEROSE (2004, 2006–2011)

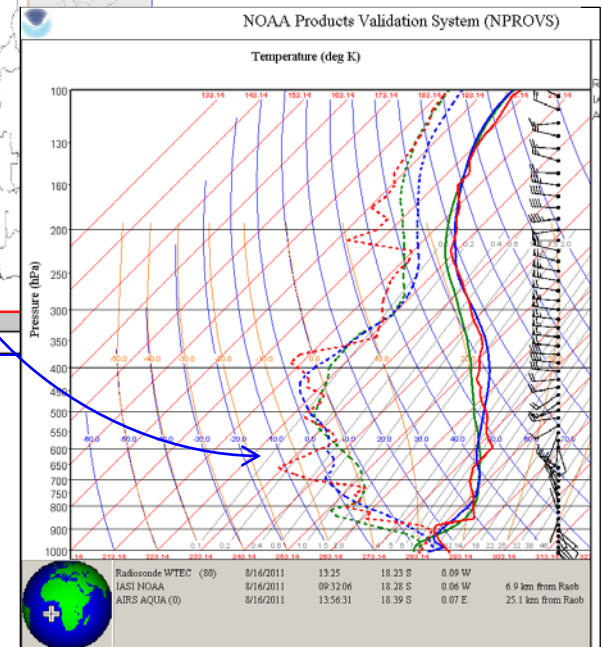


- **AEROSE 2010, 2011 proxy datasets** were developed by NOAA/STAR, MIT, and LaRC

- Available on STAR FTP server
- **Dust impact risk reduction**
- Cf. Oral 3.8 (*Divakarla et al.*) this session
- Cf. Poster Session 2 #500 (*Nalli et al.*)



Matchup selected within Biomass Burning Smoke Plume



- **Next AEROSE – September 2012**

- Campaign of opportunity to provide **dedicated RAOB matchups** over open ocean for ICV phase NPP cal/val
- September is during the **peak of the Atlantic hurricane season**

EOC–ICV Phase Near-Term Efforts



- Early assessments will be obtained using **matched ECMWF fields**
- **Global operational RAOB-NPP matchups** will be accumulated for a statistical *in situ* sample
- Funding is in place for dedicated **RAOBs from ARM sites**
- Assuming no changes in ship schedule, **2012 NOAA AEROSE campaign** to provide dedicated RAOB-NPP matchups over open ocean

Early Orbit Checkout Milestones	
Date	Milestone
28 Oct 2011	NPP Launch
08 Nov 2011	ATMS First Light
17 Nov 2011	NPP reaches mission orbit
21 Nov 2011	VIIRS First Light
Dec 2011 – Jan 2012	ATMS Tuning
18 Jan 2012	CrIS First Light
Feb–Mar 2012	CrIS Tuning
Mar–Apr 2012	Segue into ICV phase of Cal/Val Plan
30 Jun 2012	Beta Stage Validation Report

CrIMSS EDR Maturity					
Algorithm	Beta	Provisional	Val 1	Val 2	Val 3
AVTP AVMP AVPP	L + 6m	L + 12m	L + 18m	L + 24m	L + 36m

Summary



- The status of the **NPP CrIMSS EDR Cal/Val Program** for Sounding EDRs was overviewed in this presentation. The validation program is to ensure the data products comply with the requirements of the sponsoring agencies (i.e., meet spec).
- **Pre-launch Cal/Val efforts have been successful for demonstrating launch readiness** in exercising and performing initial tests of the IDPS EDR algorithm using proxy datasets, including focus days and intensive campaigns-of-opportunity.
- **Early-Orbit Checkout Cal/Val efforts** are currently underway in preparation for the **Intensive Cal/Val (ICV) phase** to follow.