

# NPP Validation Program for the Cross-track Infrared Microwave Sounding Suite (CrIMSS)



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## Overview

- The Cross-track Infrared Sounder (CrIS) and the Advanced Technology Microwave Sounder (ATMS) are the two sensors that make up the **Cross-track Infrared Microwave Sounding Suite (CrIMSS)** onboard the Joint Polar Satellite System (JPSS) NPP Satellite.
- CrIMSS measurements will result in three **Environmental Data Records (EDRs)**
  - Atmospheric Vertical Temperature Profile (AVTP)
  - Atmospheric Vertical Moisture Profile (AVMP)
  - Atmospheric Vertical Pressure Profile (AVPP)
- The AVTP and the AVMP are both JPSS Key Performance Parameters (KPPs) used for initialization of high-resolution NWP models, atmospheric stability, etc. AVPP is derived from AVTP and AVMP and requires independent validation.
- The **CrIMSS EDR Algorithm** has been developed, implemented and the EDR performance has been assessed and characterized with the simulated global synthetic data sets.
- The **NPP CrIMSS EDR Validation Plan** is to ensure the data products comply with the requirements of the sponsoring agencies.
- Pre-launch phase work is **currently underway** – see Posters #642 (Zhou et al.), #587 (Guo et al.), and #571 (Divakarla et al.)

## Validation Plan Overview

- Given the long-term successful heritage of legacy systems, **the basis of our approach is to draw on lessons learned from validating the AIRS/AMSU and IASI/AMSU/MHS sounding systems** and to focus on those activities that have had the most impact in their respective validation efforts. This approach will leverage “user community” cal/val efforts and experience as much as possible.
- Typical validation methods characterize the performance of the EDRs in various ensembles of cases. **A “roll-up” of regional assessments will serve to determine whether the EDRs have met their global performance specifications.** Specifically, this will involve stratifying the specs according to various bins:
  - day/night
  - latitude bands (i.e., polar, midlatitude, tropical)
  - land/ocean/ regional
  - (possibly) altitude and surface characteristics

- The EDR validation will include assessments of current capabilities using heritage sensors and associated algorithms. Most significant will be to use the ATOVS (HIRS/AMSU) operational products as part of our validation efforts to demonstrate the value of the hyperspectral measurements to the user community.
  - NOAA/NESDIS has decades of experience with the operational ATOVS and has performed detailed assessments of hyperspectral products (AIRS/AMSU, IASI/AMSU/MHS) against these ATOVS legacy products.
- Heritage hyperspectral sounding systems (AIRS/AMSU and IASI/AMSU/MHS) have a number of **scientific users** that are currently exploiting those data products for weather, air-quality, and climate applications. **We expect that user requirements will become more sophisticated over time;** therefore, part of the validation efforts will be to characterize the CrIS/ATMS EDR products for those applications in the same manner as AIRS and IASI products are currently characterized.
- In the EDR Products section below, tables of the **Integrated Operational Requirements Document –II (IORD II)** and NPP contractor **specification performance requirements** are given. These requirements will be replaced by JPSS documents.

## EDR Products

### Atmospheric Vertical Temperature Profile – AVTP

Parameter	IORD-II	NGAS SY15-0007
AVTP Partly Cloudy, surface to 300 mb	1.6 K/1-km layer	0.9 K/1-km ocean, 1.7 K/1-km land/ice
AVTP Partly Cloudy, 300 to 30 mb	1.5 K/3-km layer	1.0 K/3-km ocean, 1.5 K/3-km land/ice
AVTP Partly Cloudy, 30 mb to 1 mb	1.5 K/5-km layer	1.5 K/3-km
AVTP Partly Cloudy, 1 mb to 0.5 mb	3.5 K/5-km layer	3.5 K/5-km
AVTP Cloudy, surface to 700 mb	2.5 K/1-km layer	2.0 K/1-km
AVTP Cloudy, 700 mb to 300 mb	1.5 K/1-km layer	1.5 K/1-km
AVTP Cloudy, 300 mb to 30 mb	1.5 K/3-km layer	1.5 K/3-km
AVTP Cloudy, 30 mb to 1 mb	1.5 K/5-km layer	1.5 K/5-km
AVTP Cloudy, 1 mb to 0.05 mb	3.5 K/5-km layer	3.5 K/5-km

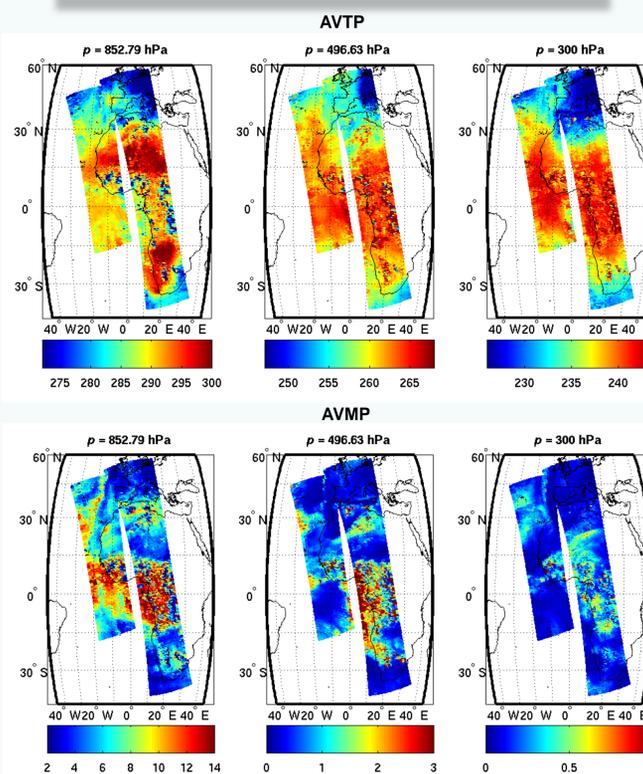
### Atmospheric Vertical Moisture Profile – AVMP

Parameter	IORD-II	NGAS SY15-0007
AVMP Partly Cloudy, surface to 600 mb	Greater of 20% or 0.2 g/kg	14.1% ocean, 15.8% land and ice
AVMP Partly Cloudy, 600 to 300 mb	Greater of 35% or 0.1 g/kg	15% ocean, 20% land and ice
AVMP Partly Cloudy, 300 to 100 mb	Greater of 35% or 0.1 g/kg	0.05 g/kg ocean, 0.1 g/kg land and ice
AVMP Cloudy, surface to 600 mb	Greater of 20% of 0.2 g/kg	15.8%
AVMP Cloudy, 600 mb to 300 mb	Greater of 40% or 0.1 g/kg	20%
AVMP Cloudy, 300 mb to 100 mb	Greater of 40% or 0.1 g/kg	0.1 g/kg

### Atmospheric Vertical Pressure Profile – AVPP

Parameter	IORD-II	NGAS SY15-0007
Pressure Profile	4 hPa threshold, 2 hPa goal	3 hPa (with precip and Psurf error exclusions)
CH4 (methane) column	1% precision, ±5% accuracy	CO and CH4 are experimental (P <sup>3</sup> ) products derived by science community from SDRs (not part of Program funded Cal/Val program).
CO (carbon monoxide) column	3% precision, ±5% accuracy	

### CrIMSS EDR Retrieved from Proxy Data – Focus Day 19-Oct-07



## CrIS/ATMS EDR Validation Team

Name	Organization	EDR
Chris Barnet	NOAA/NESDIS / STAR	Lead
Changyong Cao	NOAA/NESDIS / STAR	AVTP/AVMP
Mitch Goldberg	NOAA/NESDIS / STAR	AVTP/AVMP
Anthony Reale	NOAA/NESDIS / STAR	AVTP/AVMP
John Derber	NOAA/NCEP	CrIMSS SDR
Fuzhong Weng	NOAA/NESDIS / STAR	AVTP/AVMP
Gail Bingham	USU/SDL	CrIMSS SDR
Bill Blackwell	MIT	AVTP/AVMP
Allan Larar	NASA/LaRC	AVTP/AVMP
Xu Liu	NASA/LaRC	AVTP/AVMP
Hank Revercomb	SSEC	AVTP/AVMP
Dave Tobin	SSEC	AVTP/AVMP
Larrabee Strow	UMBC	AVTP/AVMP
Joel Susskind	NASA/GSFC	AVTP/AVMP
Denise Hagan, Degui Gu	NGAS	AVTP/AVMP; CrIMSS SDR
Steven Beck	Aerospace Corp.	CrIMSS SDR
Steven English	UKMET	CrIMSS SDR
William Bell	ECMWF	CrIMSS SDR
Steve Freidman	NASA/JPL	AVTP/AVMP
Steve Swadley, Ben Rustin	NRL	CrIMSS SDR

## Et al.

- SOAT Members
- M. Divakarla, G. Guo (NOAA/STAR)
  - X. Liu, S. Kizer (NASA/LaRC)
  - B. Blackwell (MIT)

## EDR Validation by Cal/Val Phase

### PRE-LAUNCH

- Derive proxy data from legacy systems (AIRS/AMSU, IASI/AMSU) and *in situ* correlative data (RAOB).
- Use proxy data to test concepts and exercise the CrIMSS EDR algorithm.
- Participate in field campaigns of opportunity (e.g., AEROSE).

### EARLY ORBIT CHECK-OUT (EOC)

- Compare forward models, sanity checks on differences between observations and calculations.
- Use Simultaneous Nadir Overpass (SNO) and double differencing methods (as used for AIRS/IASI).
- Intercompare CrIMSS SDRs/EDRs with operational AIRS and/or IASI products.

### INTENSIVE CAL/VAL (ICV)

- Compare early EDRs to operational products from AIRS & IASI to diagnose issues and find solutions.
- Compare SDRs w/ AIRS and IASI via SNOs and double differences to separate SDR and EDR issues.
- Principle Component Analysis and instrument monitoring to verify noise, random and systematic components, and monitor instrument health.
- Assess performance against operational and dedicated RAOBs.
- Participate in intensive field campaigns using aircraft-based FTS (e.g., NAST-I or S-HIS) for definitive assessment and analyze specific issues.

### LONG-TERM MONITORING (LTM)

- Continuously monitor and analyze long-term performance via comparison to heritage products and *in situ* correlative data.
- Analyze effects of instrument changes on EDRs.

PRE-LAUNCH  
2009 2010 2011

EOC

ICV

2012

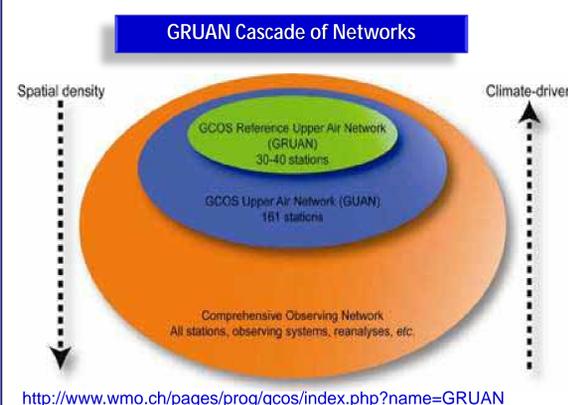
LTM

2013

## Correlative Data

### Sources

NPROVS (global RAOB), GRUAN, AEROSE, ECMWF, NAST-I, NAST-M, S-HIS, WAVES, START, HIPPO, ARM, GFS, ESRL/GMD Carbontracker, Suominet, CERES



<http://www.wmo.ch/pages/prog/gcos/index.php?name=GRUAN>

## NOAA AEROSE Campaigns

See Poster #632 (Nalli et al.)

AEROSE Cruises 2004, 2006-2010

