



Pre-Launch to Post-Launch Transition and Evaluation of CrIMSS EDR Algorithm and Products



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MIT Lincoln Laboratories, MA

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Pre-launch → Post Launch - Tailored for JPSS KPP Evaluations (AVTP and AVMP)



- Objectives

- » Evaluate CrIMSS EDR Algorithm for Launch-Ready Performance
 - Official CrIMSS (NGAS/Raytheon) Operational Algorithm
 - EDR Product Assessment with RAOBs/ECMWF
 - Functional Testing of Operational Data Flow – GRAVITE/IDPS JPSS-Rehearsal-II Evaluation of EDR algorithms (Science code, IDPS, Off-line)

- Approach

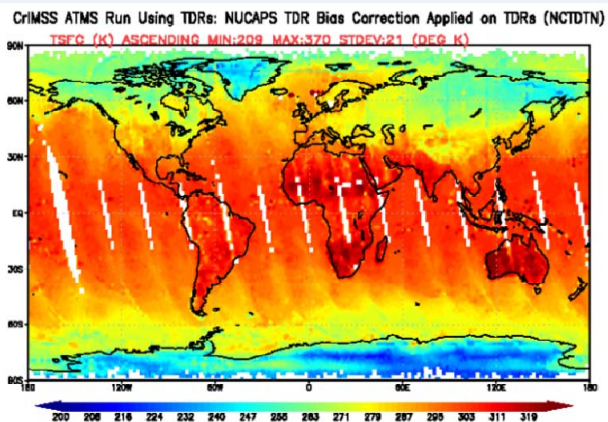
- Coordination of cal/val Activities (STAR/NGAS/LaRC/UW)
- Leverage Existing Capabilities and Utilize Experience Gained Through AIRS and IASI Validation Systems
- Identify Post-Launch Processes and Exercise with Pre-Launch Proxy SDR/EDR Products
- Risk Reduction- Consistency in CrIMSS EDR Codes (Science Code, IDPS-Operations, and Ported off-line), NOAA-NUCAPS, MIRS



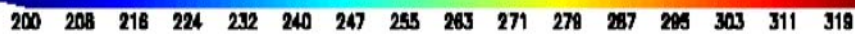
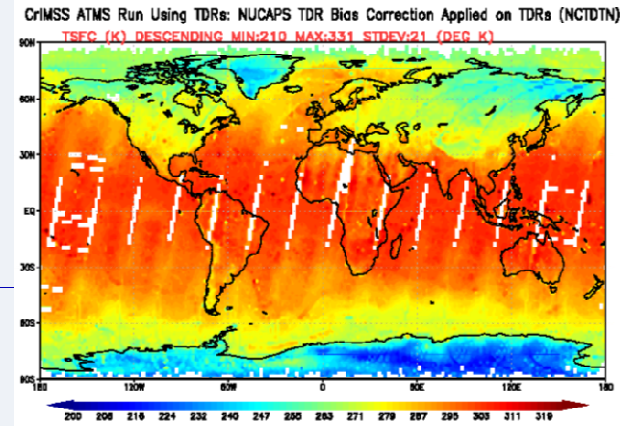
First-Light CrIMSS 'MW-only' Retrievals Using 'the Day-1 Bias Tuning' - Day 11/11/2011 Advantages at NOAA/STAR



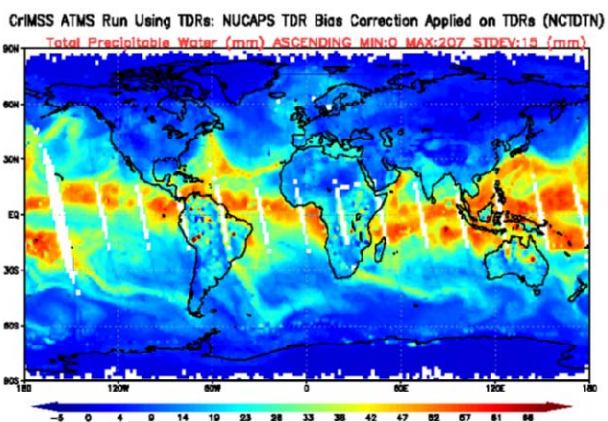
CrIMSS – 'MW-only' Surface Temperature Retrieval (ASC)



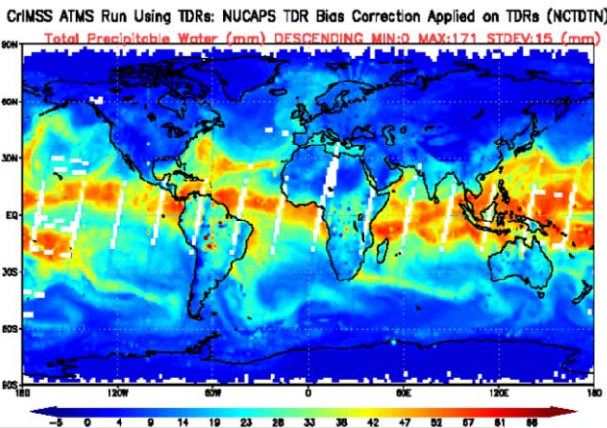
CrIMSS – 'MW-only' Surface Temperature Retrieval (DESC)



CrIMSS – 'MW-only' Total Precipitable Water (ASC)



CrIMSS – 'MW-only' Total Precipitable Water (DESC)



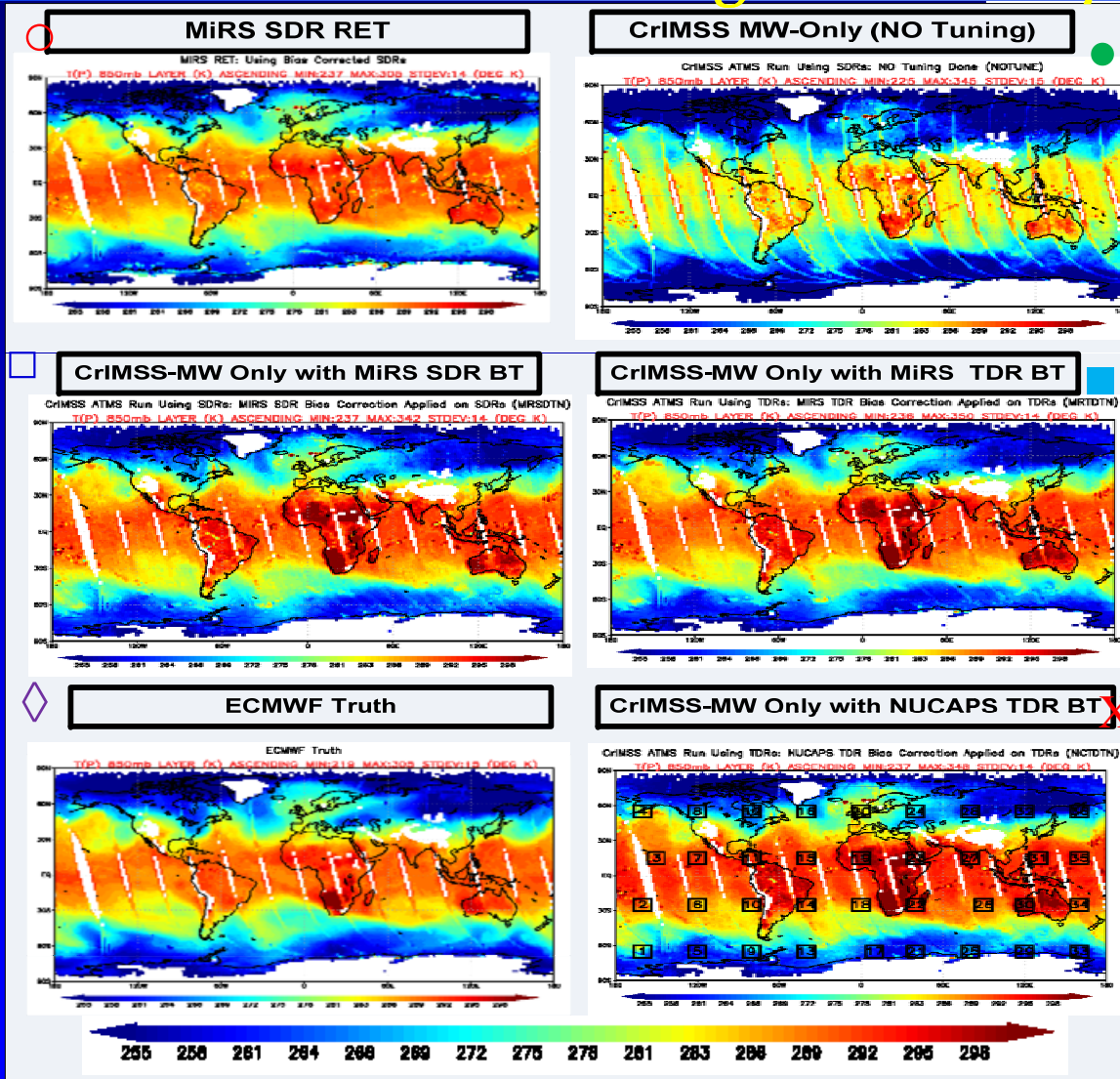
- **CrIMSS Off-line EDR ALG (Liu and Kizer, LaRC)**
- **Implemented at STAR**
 - **RTM – OSS**
- **Application Development Library (ADL) availability**
- **NUCAPS (Heritage Algorithm – AIRS Science Team Approach)**
- **Adapted at STAR for AIRS/IASI/CrIS**
 - **RTM – MIT FM**
- **MIRS – MW only Algorithm (Sid Boukabara, Kevin Garrett, Fuzhong Weng, Others)**
 - **RTM - CRTM**



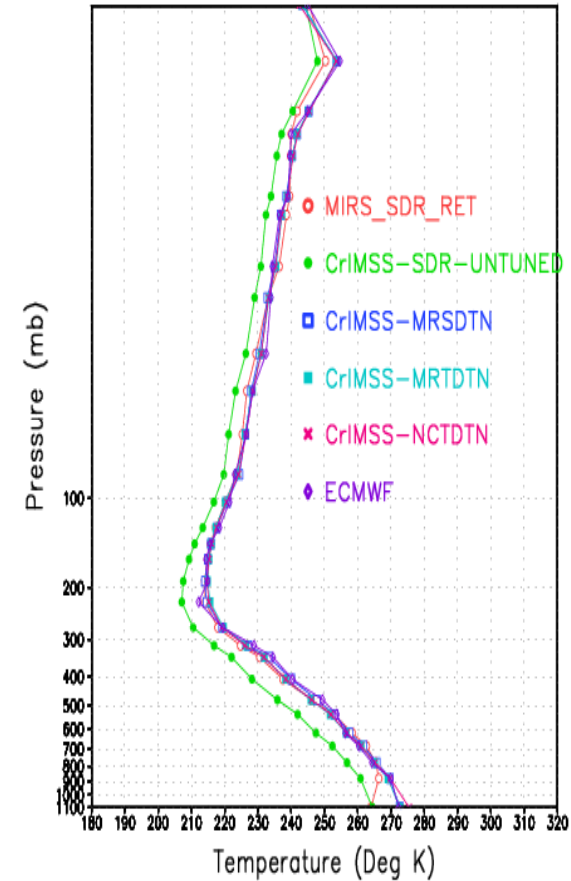
First-Light CrIMSS 'MW-only' Retrievals

Using SDRs/TDRs, 'the Day-1 Bias Tuning' - Day 11/11/2011

Advantages at NOAA/STAR



T(p) LAYERS Prof #1 LAT/LON:65S 160W ASC



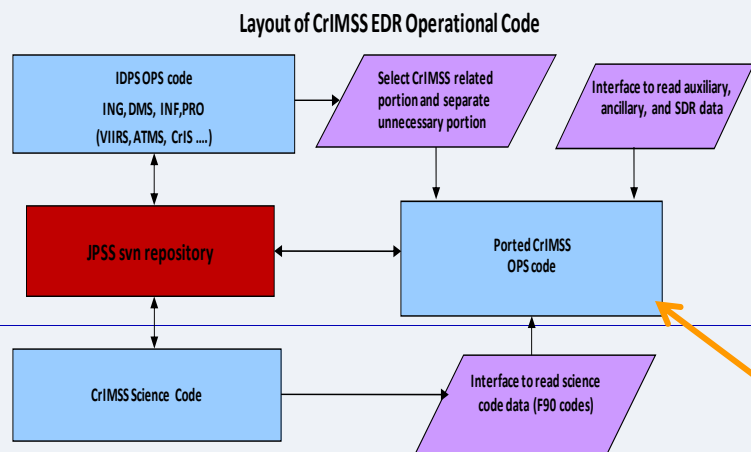
Thanks to Kevin Garrett for providing MIRS Bias Tuning, and Antonia for providing NUCAPS Bias tuning



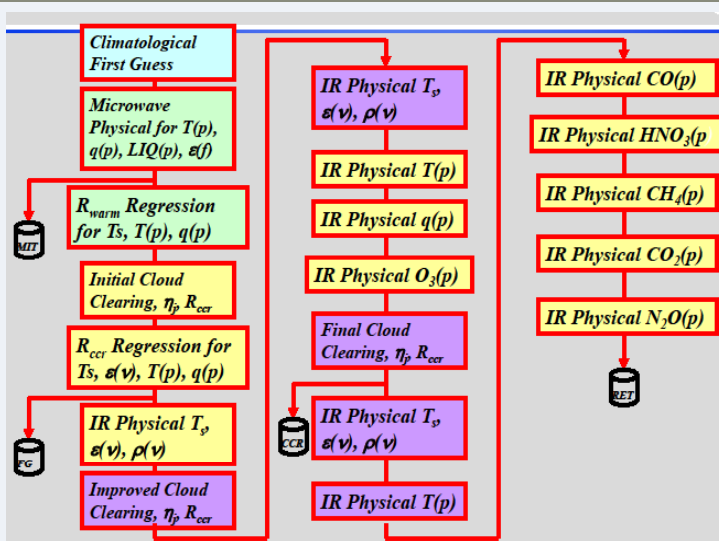
Infrastructure Built to Evaluate CrIMSS EDR Products/Functional Testing (Pre-Launch)



CrIMSS EDR Algorithm
(AER/NGAS/Raytheon/LaRC)



NOAA-IASI Retrieval Algorithm(STAR)
Heritage Algorithm (Susskind et al., 2003)



1. Proxy Data Generator Algorithms from LaRC and MIT

- » CrIS Proxy – Xu Liu and Kizer
- » ATMS Proxy - Bill Blackwell
- **Implemented at NOAA/STAR**

2. Product Retrieval Algorithm(s) Retrieval Products (EDRs)

- » NGAS CrIS and ATMS EDR Product Algorithm (off-line)
 - Crimss_Larc_v1.5.05, Developed by Liu and Kizer
 - **Implemented at NOAA/STAR**
- » NOAA-IASI Operational Retrievals from NOAA/NESDIS/NUCAPS (Gambacorta and many others from STAR)
 - » **Operating at NOAA**



Infrastructure Built to Evaluate CrIMSS EDR Products/Functional Testing (Pre-Launch)



3. Data Sets for CrIS/ATMS Proxy Data Generation and NGAS-CrIMSS EDR Product Evaluation

- » Focus Day Data Set – IASI/AMSU-A/MHS, ECMWF, GFS, RAOBs
- » Retrieval Evaluations with Global RAOBs, ECMWF, GFS
- » AEROSE-2010/2011 (Dedicated RAOBs, ECMWF, GFS)
 - **Generated and Evaluated at NOAA/STAR (Divakarla, AMS, 2011)**

4. Evaluation of CrIMSS EDRs

- With Corresponding IASI/AMSU-A/MHS EDRs
- With ECMWF/RAOBs and IASI EDRs.
- JPSS Rehearsal –II, P-72 Data Sets
 - **Performed at NOAA/STAR**

5. Functional Testing of Data Flow from GRAVIGTE/IDPS Operations

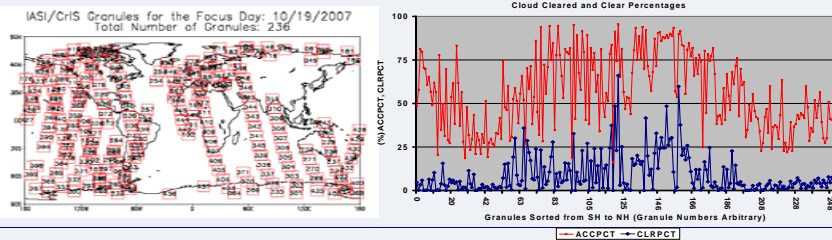
- Automated Scripts for IDPS SDR/EDR Processing - P72 Experience/ ADL
- Plans for ‘on-request’ Focus-Day Runs for Special Campaign Events



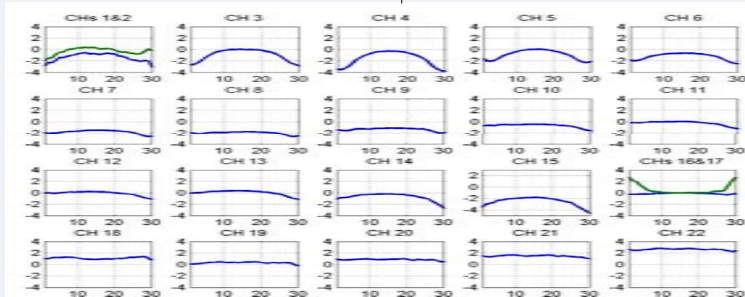
Post-Launch Exercise(s) with Pre-Launch Proxy Data Use of NOAA-STAR CrIS/ATMS Proxy Data Package for Bias-tuning the CrIS/ATMS



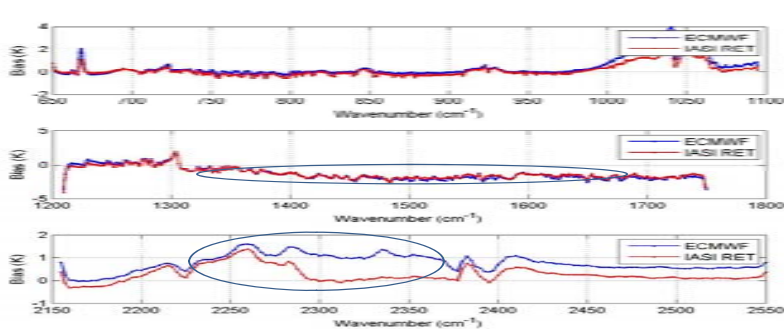
Bias Tuning for CrIS/ATMS by NGAS/LaRC/STAR
Matched ECMWF/RAOBs (Divakarla et al.,)
NOAA-IASI System Bias Tuning Efforts (Gambacorta et al.,)
Have Provided Added Advantage



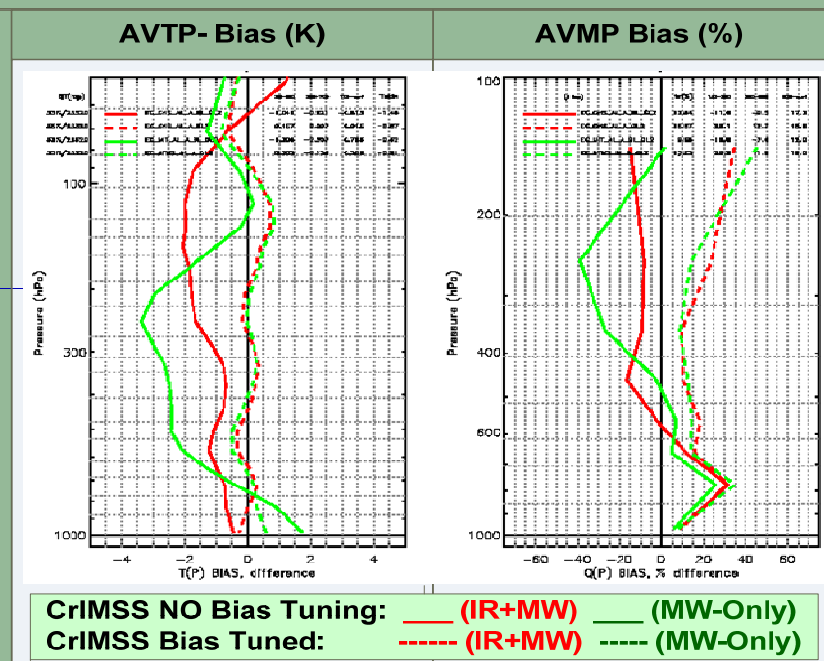
ATMS Bias Tuning by NGAS Using NOAA Proxy CrIS SDRs



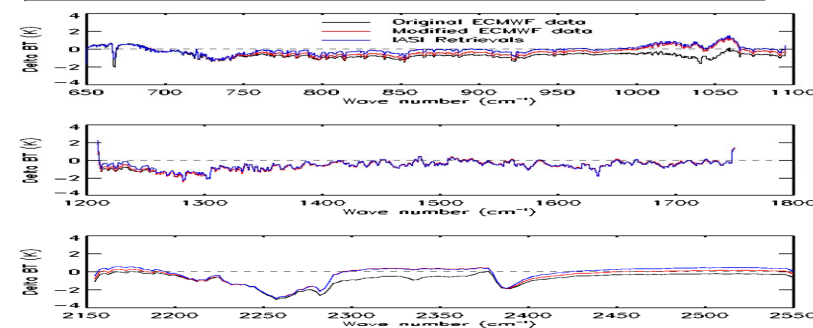
CrIS Bias Tuning by NGAS using NOAA Proxy CrIS SDRs



Bias-Tuned vs. No Bias Tuning (Divakarla et al., 2011)



CrIS Bias Tuning by STAR using Proxy CrIS SDRs





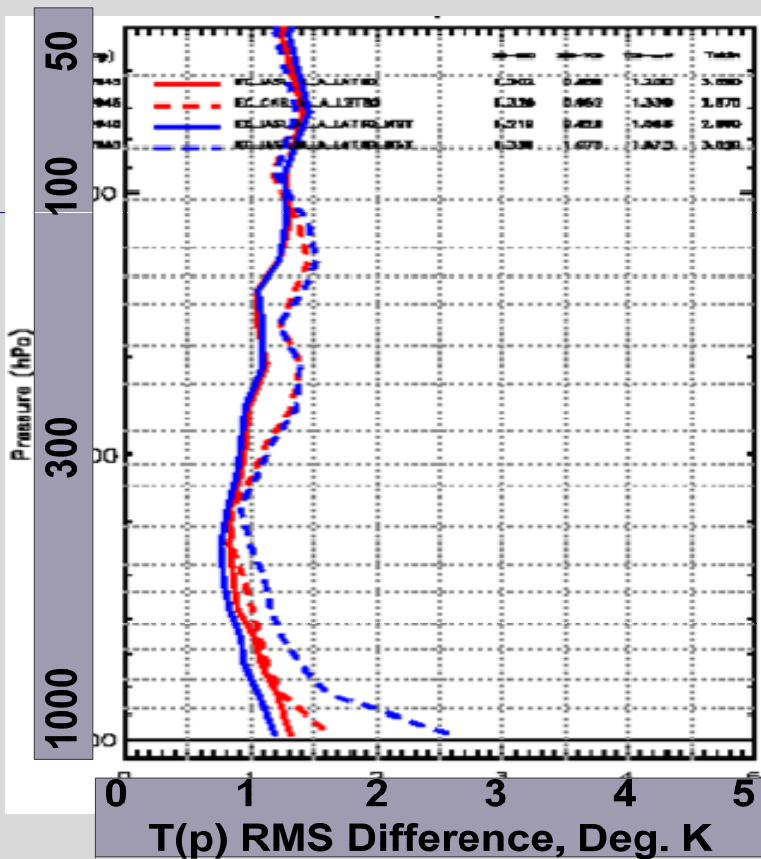
Pre-Launch Validation of CrIMSS EDRs (and IASI EDRs) with ECMWF for Focus Day 10/19/2007

N: 22,000 CrIMSS Retrieval Yield: 43% IASI Yield: 78%

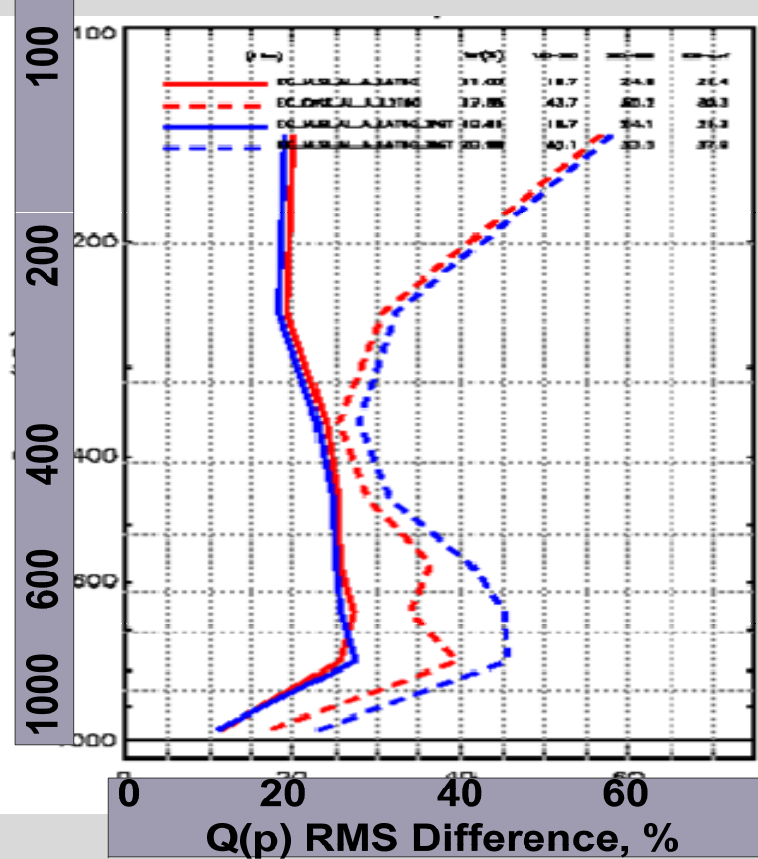


ALL (O+L+C) Cloud_Cleared: IASI & CrIMSS QC Flags

AVTP- RMSD (K)



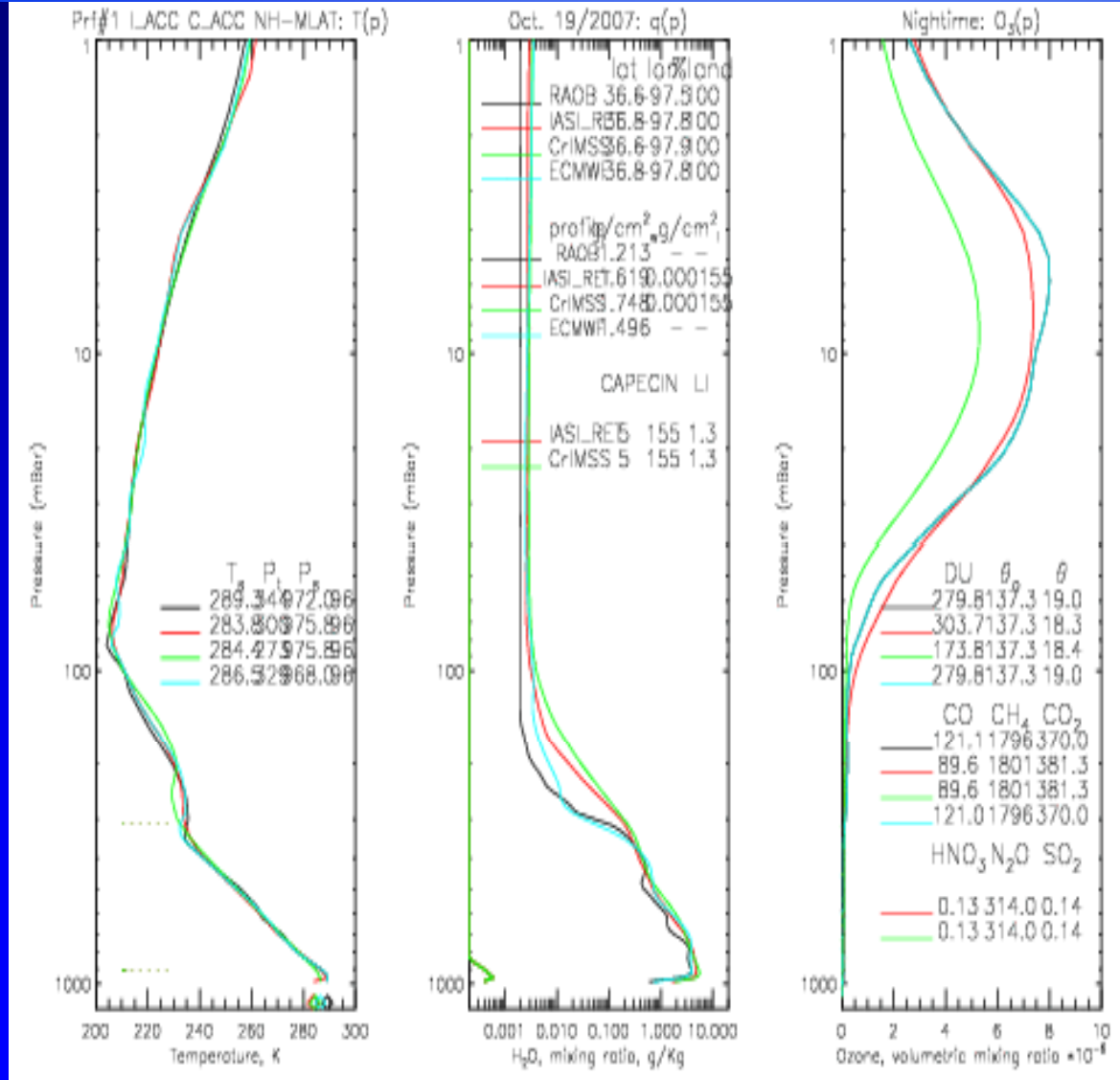
AVMP RMSD (%)



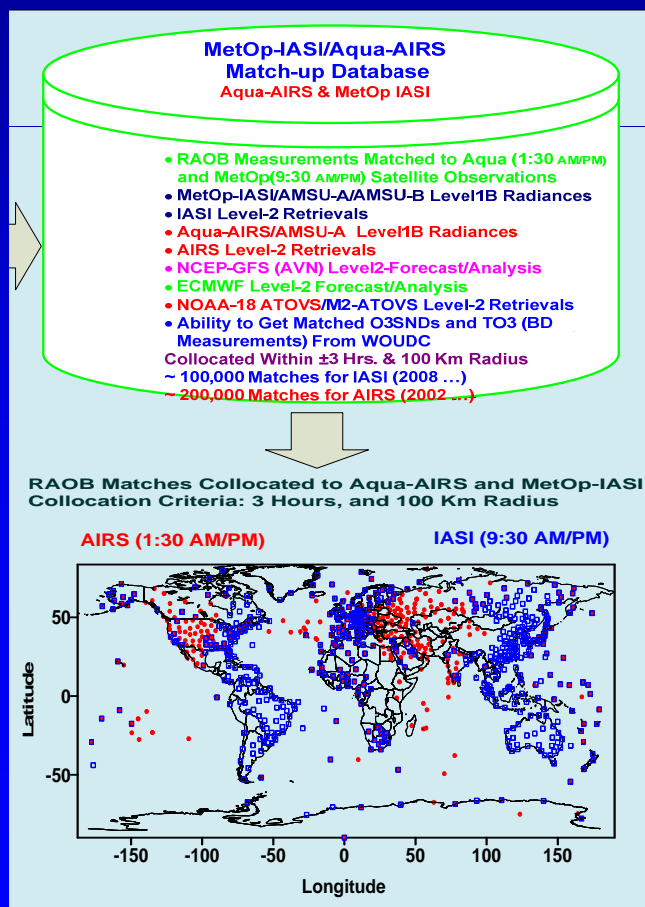
— IASI (IASI Acc 78%) - - - - - CrIMSS (CrIMSS Acc 43%)
— IASI (CrIMSS Acc 43%) - - - - - CrIMSS (IASI Acc 78%)



IASI, CrIMSS, ECMWF, RAOBs Animation Focus Day Matches (10/19/2007)

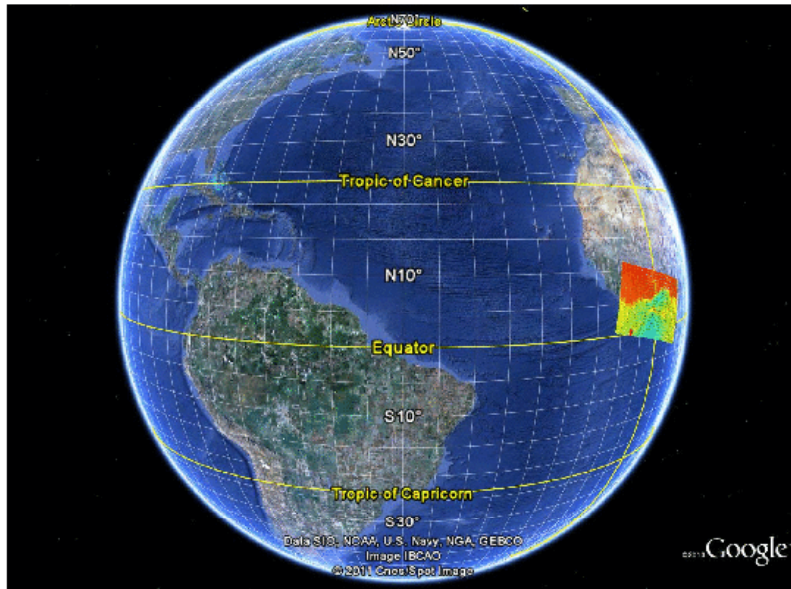


Validation Tools Developed for Aqua/MetOp are being Adapted to NPP-CrIMSS

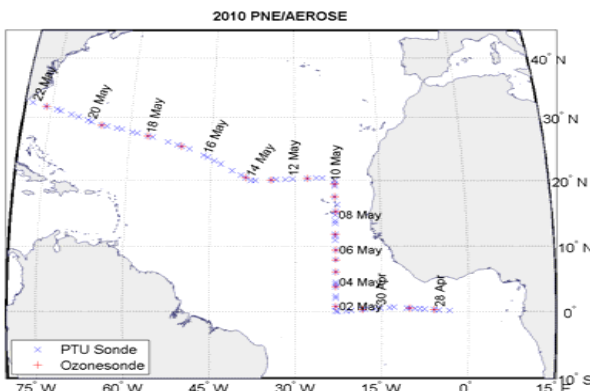




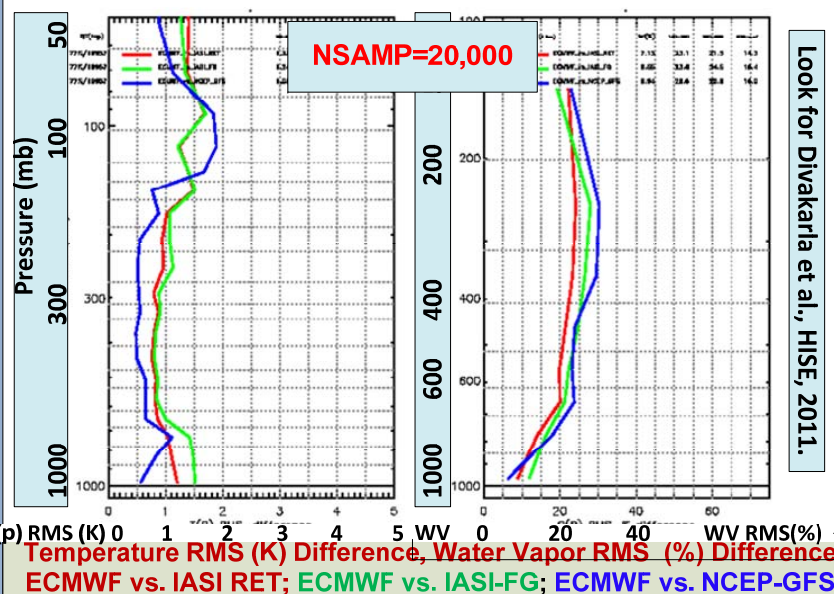
AEROSE-2010/2011 and Future 2012 Campaign Experiments IASI/ECMWF/NCEP-GFS/Dedicated RAOB Matches for CrIMSS EDR Evaluation (Divakarla et al., HISE, 2011)



04/28/2010 to 05/22/2010



- The NOAA Aerosols and Ocean Science Expedition (AEROSE) provides marine *in situ* cross-sectional correlative measurements over the tropical Atlantic Ocean.
 - Dedicated RAOBs matched with IASI/AIRS
 - PTU, GPS Wind and Height, and Ozone
 - RAOBs not assimilated into models, thus truly “independent”
 - M-AERI Spectra and Skin Temperatures
 - Microtops Sunphotometer AOD
 - ceilometer attenuated backscatter
- **Nalli et al., Poster 500, Wed., Session-II, 12/25, AMS-2012**
- The data is acquired within an under-sampled region of meteorological interest for sounder missions
 - Dust and smoke aerosols
 - Saharan air layer (SAL)
 - Tropospheric ozone/carbon





CrIMSS EDRs Resilient to Dust?

Dust-Free and Dusty CrIMSS Retrieval Study- AEROSE-2011

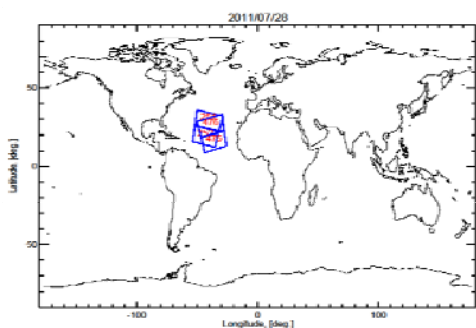
Future Collaborations with GOCART



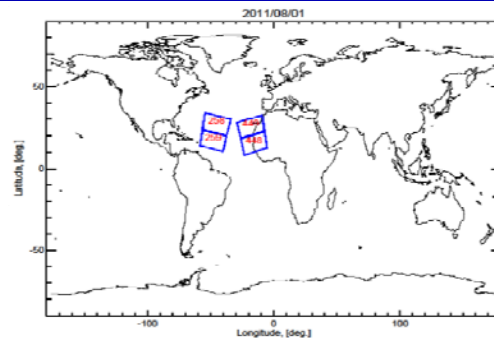
AEROSE-2011 (Nick Nalli's Talk) provides an opportunity to look into the retrieval error characteristics over 'dusty' and 'dust-free' granules.

- Two Days were Chosen to test how CrIMSS-EDR responds in these cases.
 - 07/29/2011 'Dust-Free' – 4 Grnaules (251, 252, 475, 476)
 - 08/01/2011 'Dusty' – 2 Granules (448, 449)
- IASI dust score is based on S. De-Souza Machado's recipe of channel differences for AIRS (GSFC, JPL, UMBC, personal communication) for similar IASI channels (Implemented by Eric Maddy into NOAA-IASI Retrieval System)

07/28/2011 G- 251, 252, 475, 476



08/01/2011 G- 448, 449

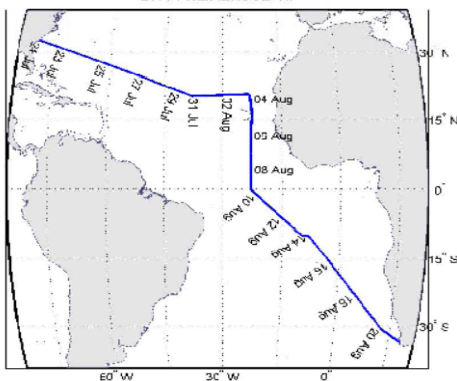


NCEP Global Aerosol Forecast Capability

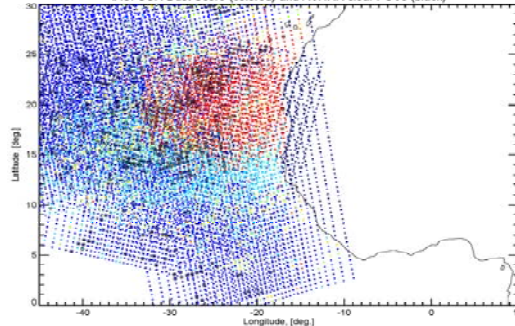
(S. Liu et al., 2011) <http://www.emc.ncep.noaa.gov/gmb/sarah/NGAC/html/realtime.fcst.html>

- Near-real-time experimental system
- 120-hr dust-only forecast once per day (00Z), output every 3-hr
- ICs: Aerosols from previous day forecast and meteorology from operational GDAS
- Operational Implementation - March 2012

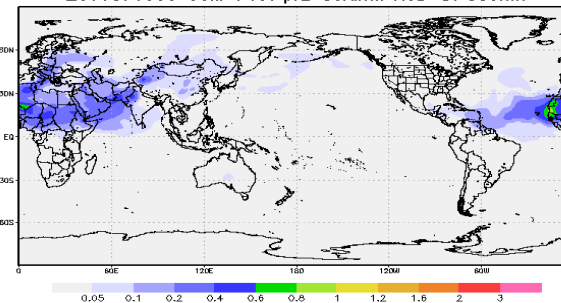
2011 PNE/AEROSE-VII



IASI CCR Dust Score (colored) and AVHRR clear FOVs (black)



2011071500 00hr Fcst prz Column AOD at 550nm



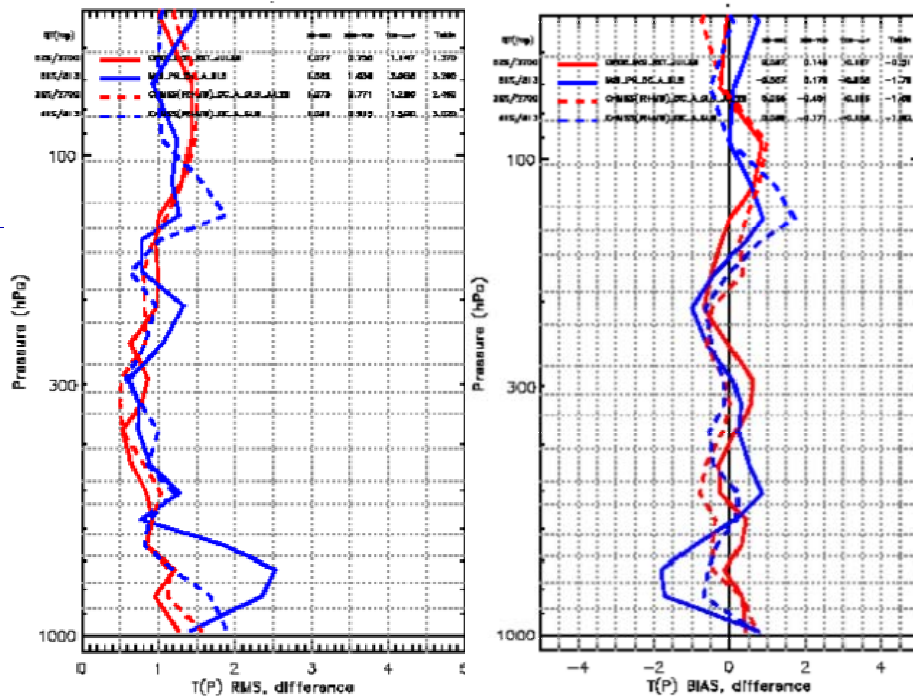


'Dust-Free' vs. 'Dusty' Granule Retrievals 07/28/2011, 08/01/2011 IASI and CrIMSS

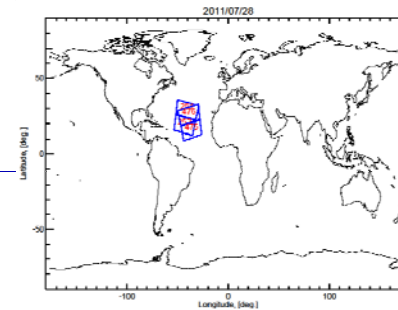


AEROSE-2011 Matched IASI(RET), ECMWF and CrIMSS (RET) - T(p) Dust-Free/Dusty

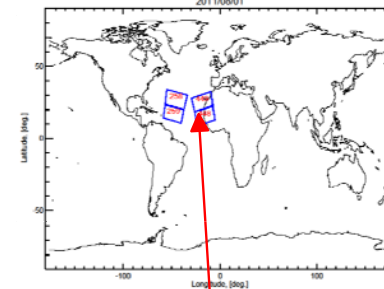
NOAA- AEROSE-2011 IASI-TRET vs. ECMWF; CrIMSS-TRET vs. ECMWF



07/28/2011 G- 251, 252, 475, 476

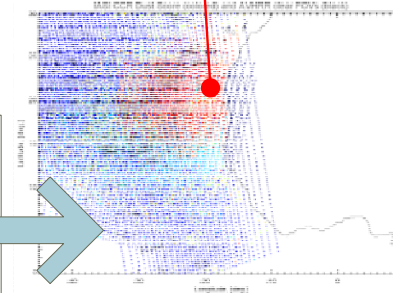


08/01/2011 G- 448, 449



Date		IASI Retrievals (NOAA)	CrIMSS Retrievals (NGAS)
07/28/2011	Dust-Free	Solid Red _____ (82%)	Dotted Red - - - - - (36%)
08/01/2011	Dusty	Solid Blue _____ (81%)	Dotted Blue - - - - - (41%)

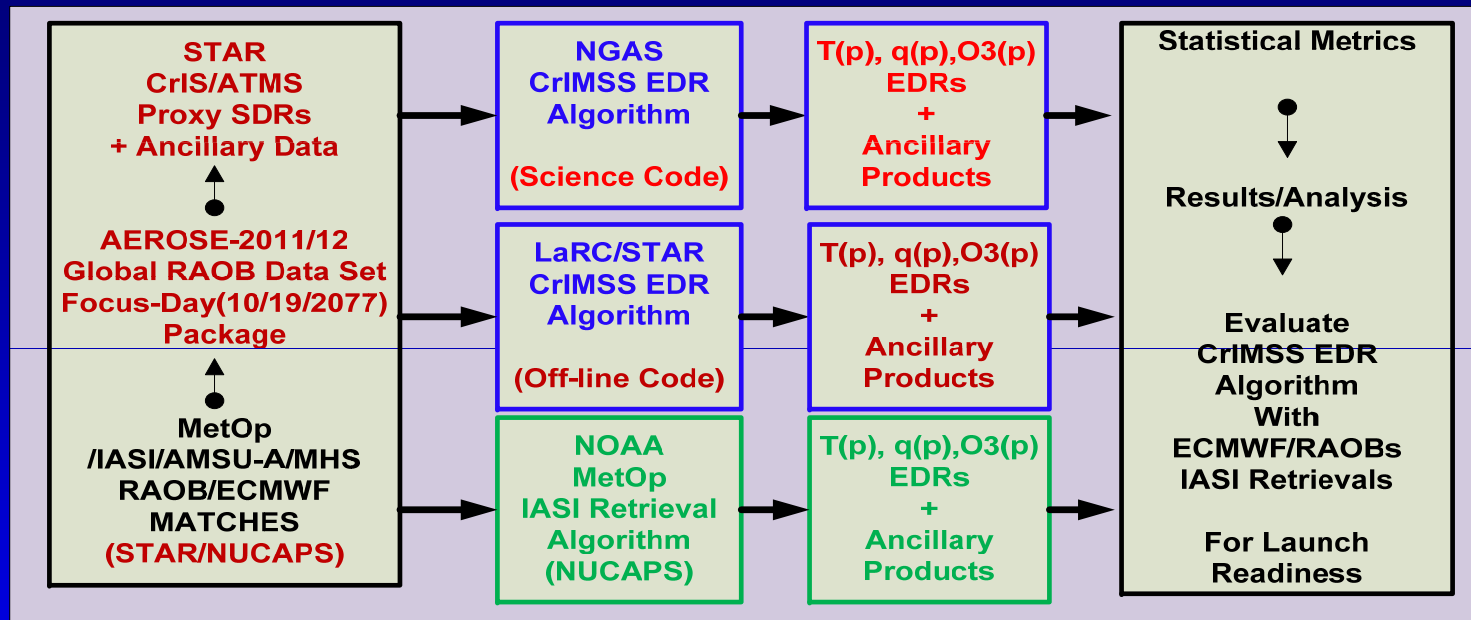
- From Eric Maddy's findings and IASI Research Team at NOAA
- IASI dust score is based on S. De-Souza Machado's recipe of channel differences for AIRS (GSFC, JPL, UMBC, personal communication) for similar IASI channels.
- Score is calculated using IASI CCRs (operational version + new regressions) and can range between 0. and 511.
- Warmer colors implies higher probability of contamination
- Side note: AVHRR clear scenes can be dust contaminated (see black circles surrounding red dots).



CrIMSS T(p)
Retrievals
are Resilient
to Dust?



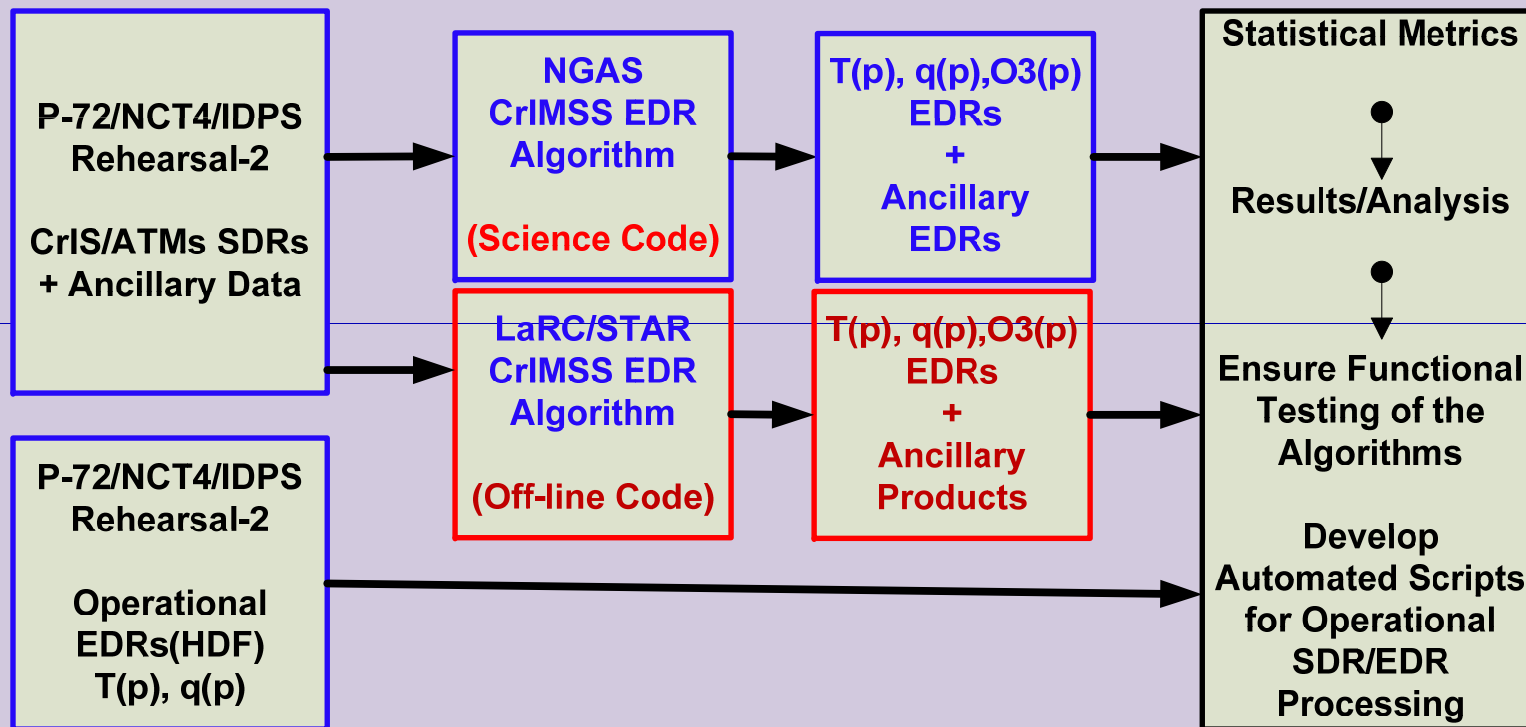
CrIMSS EDR Algorithm Evaluation NOAA-CrIS/ATMS Proxy SDR And Matched Correlative Measurements



- **Intent:** Pre-Launch evaluation of CrIMSS algorithm and EDR products with RAOB/ECMWF and NOAA-IASI retrievals (NUCAPS)
- **Results:** The CrIMSS EDR Algorithm performance is comparable to Heritage Algorithm (NOAA-IASI Retrievals) and shows promise for launch readiness.
 - Helped to develop interfaces to generate matched correlative data sets.
 - Helped to develop post-launch procedures with pre-launch proxy data.
 - Development of empirical bias-tuning procedures for CrIS/ATMS;
 - Unification of statistical routines and testing with common data sets.



P-72 Proxy Data SDRs/EDR Data Sets (JPSS Rehearsal -2 August 18-21, 2011)



- **Intent:** Operational Data Stream Access /Processing from GRAVITE/IDPS , and Functional Testing of Algorithm, Data Flow, Development of Reader/Write Routines, Matched Correlative Data Sets Generation
- **Results:** All the above, + Verification of CrIMSS EDR Products from: IDPS Operations, NGAS:Science Code and Ported Off-line Code.



Summary



An array of CrIS/ATMS proxy SDRs and matched EDR products from NOAA-IASI , ECMWF/GFS, and RAOB Measurements were used to Evaluate CrIMSS EDR Products.

- » **The CrIMSS algorithm shows Reasonable Ability for a Post-Launch Performance.**

Infrastructure Developed in the Pre-Launch Phase helps To

- » **Acquire and Process CrIS/ATMS SDRs /EDRS from IDPS**
- » **Generate Matched Measurements of Global RAOBs, ECMWF and GFS analysis fields**
- » **Process Campaigns of Opportunity (e.g. AEROSE) Data Sets.**

Post-Launch Exercises Performed in the Pre-Launch Phase provide adequate know-how towards

- » **Fine-Tuning of the EDR algorithm using ADL and CrIMSS off-line**
- » **Evaluation of First-Light AVTP, AVMP and other EDR Products.**

Validation tools Developed During the Pre-Launch Helps Post-Launch Processing