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

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Acknowledgements: Kevin Garrett, Tony Reale, Bomin Sun, and Frank Tilley, STAR/NOAA.

Eighth Annual Symposium on Future Operational Environmental Satellite Systems
92nd AMS Annual Meeting, New Orleans, LA (January 22-26), 2012.
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

- **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 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

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)

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 (Gambacorto 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

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

<table>
<thead>
<tr>
<th>AVTP- Bias (K)</th>
<th>AVMP Bias (%)</th>
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ATMS Bias Tuning by NGAS Using NOAA Proxy CrIS SDRs

CrlMSS NO Bias Tuning: (IR+MW) (MW-Only)
CrlMSS Bias Tuned: (IR+MW) (MW-Only)

CrlS Bias Tuning by NGAS using NOAA Proxy CrIS SDRs

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

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

RAOB Matches Collocated to Aqua-AIRS and MetOp-IASI Collocation Criteria: 3 Hours, and 100 Km Radius

- 300,000 Matches for AIRS (2002)
- RAOB Measurements Matched to Aqua (1:30 AM/PM) and MetOp (9:30 AM/PM) Satellite Observations
- MetOp-IASI/AMSU-A/AMSU-B Level3 Radiance
- IASI Level2 Retrievals
- Aqua-AIRSAMSU-A Level1B Radiance
- AIRS Level2 Retrievals
- NCEP-GFS (AVN) Level2-Forecast/Analysis
- ECMWF Level2-Forecast/Analysis
- NOAA-18 ATOS/MATOVS Level2 Retrievals
- Ability to Get Matched O3SNDs and TO3 (BD Measurements) From WOUDC
- Collocated Within ±3 Hrs. & 100 Km Radius
- 100,000 Matches for IASI (2008)
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
- Geodimeter 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

04/28/2010 to 05/22/2010

Temperature RMS (K) Difference, Water Vapor RMS (%): Difference
ECMWF vs. IASI RET; ECMWF vs. IASI-FG; ECMWF vs. NCEP-GFS
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 Granules (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)

<table>
<thead>
<tr>
<th>07/28/2011</th>
<th>08/01/2011</th>
<th>NCEP Global Aerosol Forecast Capability</th>
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<tr>
<td></td>
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<td>• Near-real-time experimental system</td>
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<td>• 120-hr dust-only forecast once per day (00Z), output every 3-hr</td>
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<td></td>
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<td>• ICs: Aerosols from previous day forecast and meteorology from operational GDAS</td>
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<td>• Operational Implementation - March 2012</td>
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‘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

<table>
<thead>
<tr>
<th>Date</th>
<th>IASI Retrievals (NOAA)</th>
<th>CrIMSS Retrievals (NGAS)</th>
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<tbody>
<tr>
<td>07/28/2011</td>
<td>Dust-Free Solid Red</td>
<td>Solid Red (82%)</td>
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<tr>
<td></td>
<td>Dusty Solid Blue</td>
<td>Solid Blue (81%)</td>
</tr>
<tr>
<td>08/01/2011</td>
<td>Dust-Free Solid Red</td>
<td>Dotted Red (36%)</td>
</tr>
<tr>
<td></td>
<td>Dusty Solid Blue</td>
<td>Dotted Blue (41%)</td>
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- 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, UMBG, personal communication) for similar IASI channels.
- Score is calculated using IASI CCRS (operational version + new regressions) and can range between 0 and 31.
- Warmer colors imply higher probability of contamination.
- Side note: AVHRR clear scenes can be dust contaminated (see black circles surrounding red dots).
**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.
**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 CrI/MSS 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