Preliminary Performance Assessments of the Cross-Track Infrared and Microwave Sounder Suite (CRIMSS) Environmental Data Records (EDR)

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Thanks for the contributions from the CrIMSS EDR Team members

Introduction

- The Suomi National Polar-orbiting Partnership (NPP) environmental satellite was launched on October 28, 2011.
- The sounding Environment Data Records (EDRs) generated from NPP include the Atmospheric Vertical Temperature Profile (AVTP), Atmospheric Vertical Moisture Profile (AVMP), and the Atmospheric Vertical Pressure Profile (AVPP).
- Global statistics of the pre-beta EDRs from both the off-line version of the CrIMSS EDR IDPS operational code (OPS-EDR) and the STAR NOAA-Unique Cris/ATMS Product System (NUCAPS-EDR) has been generated for the Feb. 24, 2012 focus day .
- Although the operational CrIS SDR products showed stable quality, the CrIS instrument still had some small calibration errors; however, these statistics represent a baseline from which we can show improvements as we progress.
- Evaluation of CrIMSS Retrievals for the Global-Ocean (Day and Night),Tropics, and MidLatitude Regions are “Very Promising”.
- The CrIMSS T(p) and q(p) retrievals are quite comparable to AIRS Retrievals in terms of RMS differences with Reference to ECMWF.
- By updating CrIS/ATMS tuning and error covariance matrix we are expecting the CrIMSS EDRs will be further improved.

CrIMSS EDRs

Atmospheric Vertical Moisture Profile (AVMP)

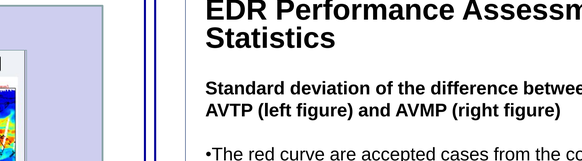
Parameter	IORD-II	NGAS SY15-0007
AVMP Partly Cloudy, surface to 600 mb	Greater of 20% or 0.2 g/kg	14.1% ocean, 15.8% land and ice
AVMP Partly Cloudy, 600 to 300 mb	Greater of 35% or 0.1 g/kg	15% ocean, 20% land and ice
AVMP Partly Cloudy, 300 to 100 mb	Greater of 35% or 0.1 g/kg	0.05 g/kg ocean, 0.1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

•Pressure product is a EDR derived product that requires validation.
•Ozone is an intermediate product (IP) used by the OMPS team.
•CO and CH4 are pre-planned product improvements(P^3I)

Parameter (P^3I in Blue)	IORD-II / JPSS-L1RD	NGAS SY15-0007
Pressure Profile	4 mb threshold, 2 mb goal	3 mb (with precip and Psurf error exclusions)
CH4 (methane) column	1% ± 5% / 1% ± 4% (precison ± accuracy)	n/a
CO (carbon monoxide) column	3% ± 5% / 35% ± 25% (precision ± accuracy)	n/a

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



Example of AIRS carbon monoxide product: CO from California fires impacted Denver Colorado on Aug.30 and Oklahoma on Sep. 1, 2009 (Image courtesy of Wallace McMillan, UMBC)

Plans for CrIMSS SDR/EDR Maturity (new sensor, new forward model, new EDR alg.)

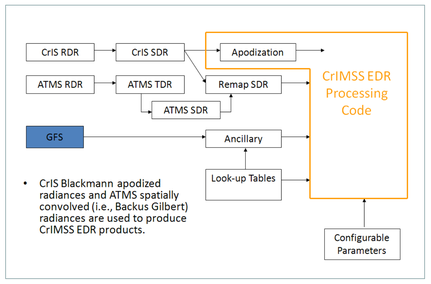
ATMS SDR	CrIS SDR	CrIMSS EDR	Date
Beta			Feb 2012
	Beta		April 2012
Provisional			April 2012
		Beta	July 2012
Validated			July 2012
	Provisional		Aug 2012
		Provisional	Oct 2012
	Validated		Nov 2012
		Validated (Stage 1)	April 2013

Overview of CrIMSS EDR Algorithm

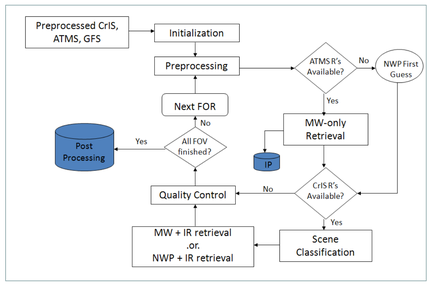
•The CrIMSS EDR retrieval algorithm is an iterative physical retrieval algorithm that simultaneously estimates the geophysical states of both the atmosphere and the surface from the infrared and microwave radiances measurements.

•The CrIMSS EDR derives AVTP, AVMP, AVPP, O3-IP, surface temperature, surface emissivity simultaneously.
•AVTP reconstructed from 20 EOF’s; AVMP from 10 EOF’s; 1 surface temperature; 5 MW EOF’s; 12 IR emissivity and reflectivity hingepoints; MW cloud top pressure and cloud liquid water path

•The CrIMSS EDR uses optimal estimation
•All channels used, daytime excludes non-LTE region
•New forward model and new retrieval methodology.



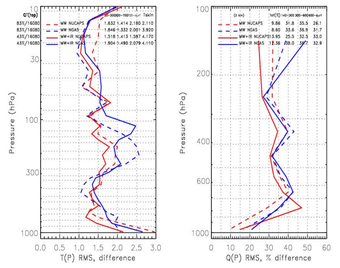
CrIMSS EDR Dataflow



CrIMSS EDR Flowchart

More information on Algorithm: CriMSS ATBD: http://www.star.nesdis.noaa.gov/jpss/documents/ATBD/GSFC_474-00056_JPSS_CrIS_ATBD_Vol.2_EDR__Alt._doc._no._D43772_P1187-TR-I-08_.pdf

Global statistics - The pre-beta EDRs from the IDPS operational code (OPS-EDR) and the STAR NOAA-Unique Cris/ATMS Product System (NUCAPS)

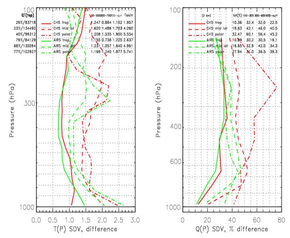


RMS difference of AVTP and AVMP w.r.t. ECMWF

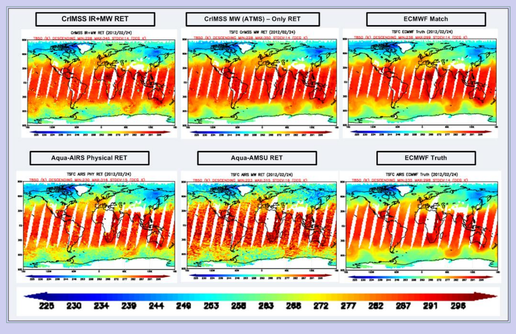
- Solid lines are ATMS+CrIS (43% of the cases)
- Dashed lines are ATMS-only (83% of the cases)
- NUCAPS in red
- NGAS in blue
- NUCAPS acceptance used for all cases
- Potentially some cases rejected by NGAS should be ignored

→Standard deviation (SDV) between the AVTP (left) and AVMP (right) retrieval results and the ECMWF analysis for the accepted cases from the coupled retrievals of AIRS+AMSU or CrIS+ATMS.

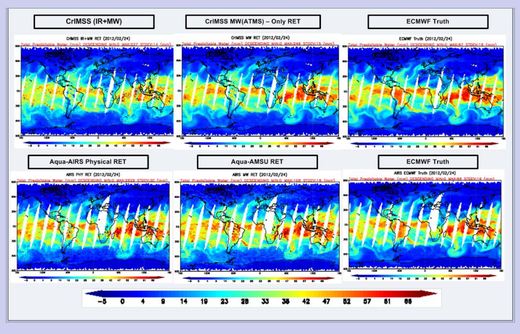
The NUCAPS system is shown in red and the AIRS v.9 system is shown in green. Tropical cases are shown with solid lines, mid-latitude cases are shown with dashed lines, and polar cases are shown with dash-dot line



EDR Performance Assessments – Global Retrievals



850 mb Temp (K) Map (Descending)
NPP-CrIMSS, Aqua-AIRS (V5.9), and ECMWF
(Feb. 24, 2012 focus day)
•Preliminary AVTP without QC
•NGAS code has known issues with QC at this time, only 17% of final retrieval is accepted at this time
•However, ~60-80% of the retrievals appear to be reasonable (pass ATMS residual tests)



Total Precipitable Water (Descending)
NPP-CrIMSS, Aqua-AIRS (V5.9), and ECMWF
(Feb. 24, 2012 focus day)

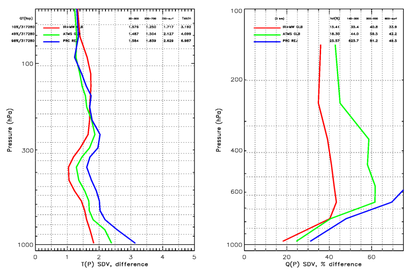
• Preliminary TPW without QC

•Seem to be issues with dry retrievals over land

EDR Performance Assessments – Global Statistics

Standard deviation of the difference between the OPS-EDR and ECWMP for AVTP (left figure) and AVMP (right figure)

•The red curve are accepted cases from the coupled (CrIS+ATMS) retrieval
•The green curve are the accepted cases from the ATMS-only retrieval
•The blue curve are all the non-precipitating cases from the ATMS-only retrieval.



Summary:

- Initial assessments by the CrIMSS EDR team demonstrate that the algorithm is performing reasonable well; however, we still have problems with the quality control (QC) of the retrieval system.
- For AVTP, the coupled CrIS/ATMS retrievals in the KPP region are within 1.7K of ECMWF (requirement is 1.6K) and the ATMS-only is within 2.1 K for the 48% of the accepted cases (requirement is 2.5K for ATMS-only).
- This demonstrates that the accepted cases for the operational AVTP are performing near the requirement at this time; For AVMP the current system is still far from requirements (20% for surface to 600 hPa, 35% from 600 to 100 hPa); however, we expect results to improve significantly as we optimize the system.