Provisional Maturity Assessment of Cross Track Infrared Sounder (CrIMSS) Temperature and Moisture Profile Products

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CrIMSS EDR Product Assessment Steps

On-Going and Future Plans

CrIMSS EDR Product Maturity Levels

Atmospheric Vertical Temperature Profiles(AVTP) ; Atmospheric Vertical Moisture Profiles(AVMP)

- Product Quality may not be optimal
- Incremental product improvements are still occurring
- Version control is in effect
- General research community is encouraged to participate in the QA and validation but need to be aware that product validation and QA are ongoing
- May be replaced in the archive when the validated product becomes available
- Ready for operational evaluation

Stage 1, Stage 2 [illegible] 3 Validations ([illegible] 13)
Dedicated RA[illegible] (CART)
Special C[illegible] (AEROSE)
Glo[illegible] Network
[illegible]y Data Sets

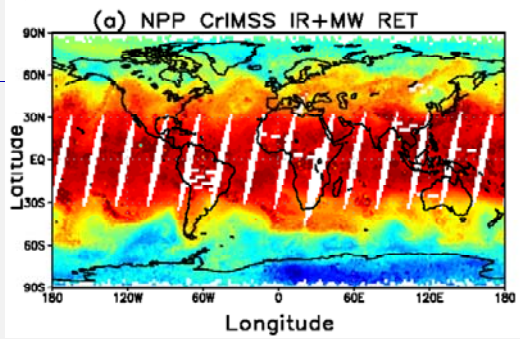
CrIMSS EDR Provisional [illegible] (Jan 2013)
Optimization of CrIM[illegible] [illegible]gorithm
Baseline IDPS V[illegible] [illegible]5.3 (Past)
Current IDPS V[illegible] [illegible]X6.3 (Current)
Upcoming IDPS [illegible] MX 7.1 (June 2013)
Off-line <-> [illegible]ynchronization -> DPE
Assessment [illegible]ed ECMWF/Dedicated RAOBs
Focus D[illegible] 2012; 09/20/2012; PMRF RAOBs

CrIMSS EDR Beta M[illegible] (July 2012)
CrIMSS IDP[illegible] Emulation
Assessme[illegible]tched ECMWF
Focus [illegible]/2012; 05/15/2012

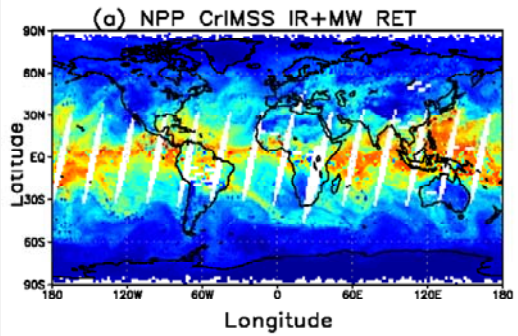
Pre-Launch [illegible]-Launch
November 11, 2011, ATMS
February 24, 24, 2012
Divakarla et al., AMS-2012

- Early release product; Minimally validated; May still contain significant errors.
- Versioning not established until a baseline is determined.
- Available to allow users to gain familiarity with data formats and parameters.
- Product is not appropriate as the basis for quantitative scientific publication studies and applications.

AVTP Product
Example: 500 hPa Temp
May 15, 2012



AVMP Product
Shown as
Total Precipitable Water
May 15, 2012



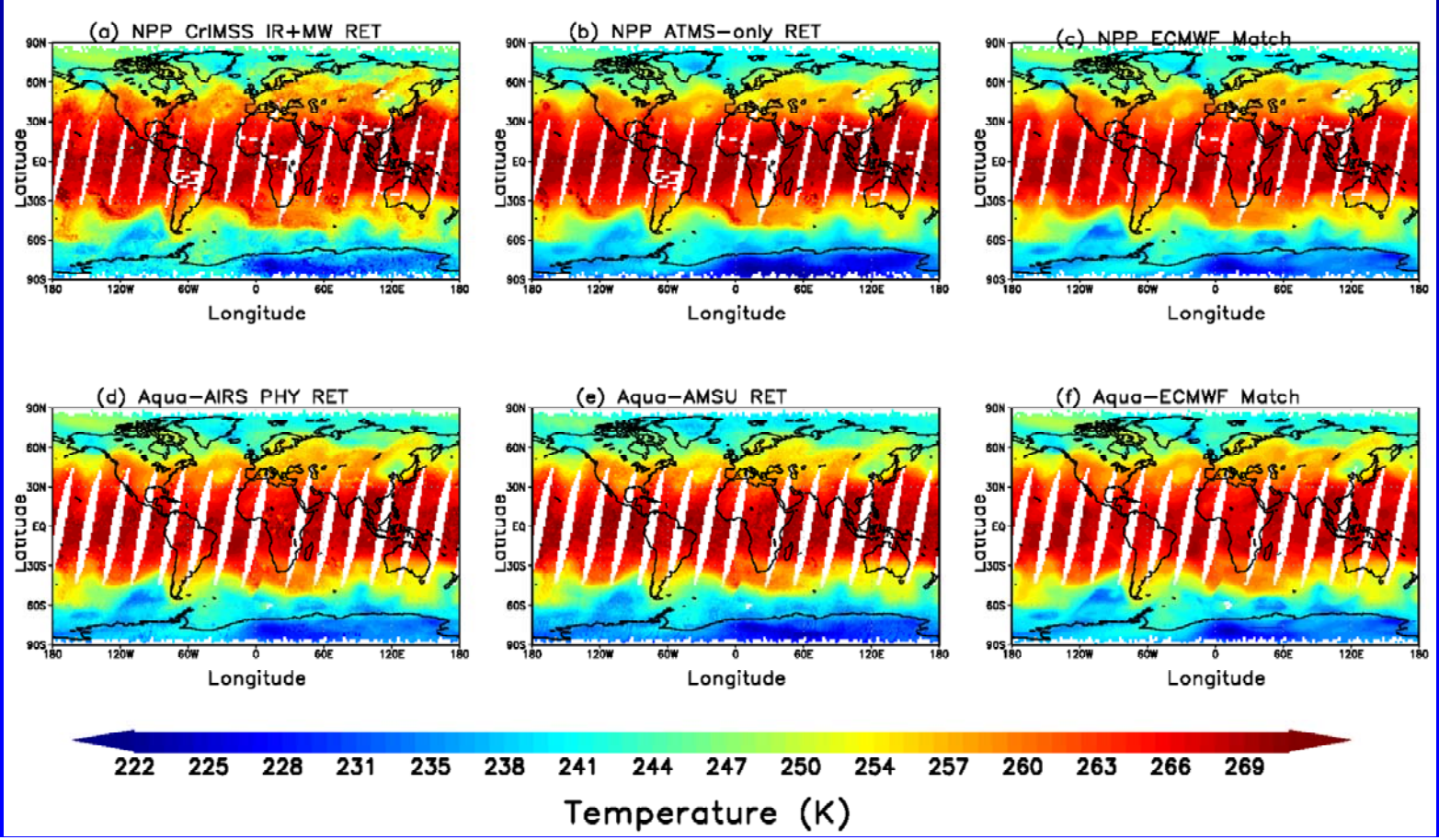
Outline of Presentation

Provisional Maturity Assessment for CrIMSS AVTP and AVMP IDPS-MX 7.1 Products

- Compare Results of CrIMSS EDR Algorithm Versions (Important Step):
  - All assessments were performed with a ported off-line EDR algorithm code.
    - AMS-2013: Kizer et al., Poster Paper: 665; Liu et al., Poster Paper:697, GOESRJPSS, Wed/Thu.
  - Ensure off-line EDR Algorithm emulates exact IDPS/ADL4.1 EDR versions
    - CrIMSS EDRs: Past (MX5.3 prior to Oct. 2012), Present (MX6.3 as of Oct. 2012), and Future (MX7.1)
- Two Focus Days (05/15 and 09/20/2012) for CrIMSS EDR product evaluations
    - Optimization of CrIMSS EDR algorithm (Wilson et al., Poster Paper 802, Wed/Thu)
    - Results presented are for the focus-day: 05/15/2012
    - Evaluations with ECMWF (as a proxy to truth) – shown for IR+MW product
    - Evaluation of two different algorithms: (1) the CrIMSS official EDR algorithm, and (2) the AIRS Science Team heritage algorithm
      - CrIMSS EDRs vis-à-vis Aqua-AIRS EDR products with reference to ECMWF
- Validations with Dedicated RAOBs: (Preliminary Results, On-going Effort)
  - PMRF- Kauai, Hawaii (Lat/Lon: 22.05N, -159.78W About 30+ RAOBs 05/15 - 09/30)
  - Future plans: Dedicated RAOBs from ARM sites (TWP, SGP, NSA) and Global RAOB collocations as was done for Aqua-AIRS (and) Stage 1 and Stage 2 Validations
    - Tobin, JGR, 2006; Divakarla, JGR, 2006; Divakarla, JGR, 2008, HISE-2011, AMS-2012)

CrIMSS EDRs - MW-only (1st Stage), IR+MW (2nd Stage), Aqua-AIRS Retrievals, and ECMWF Matches Data Sets on NOAA FTP Site (Focus Days 02/24; 05/15; 09/20)

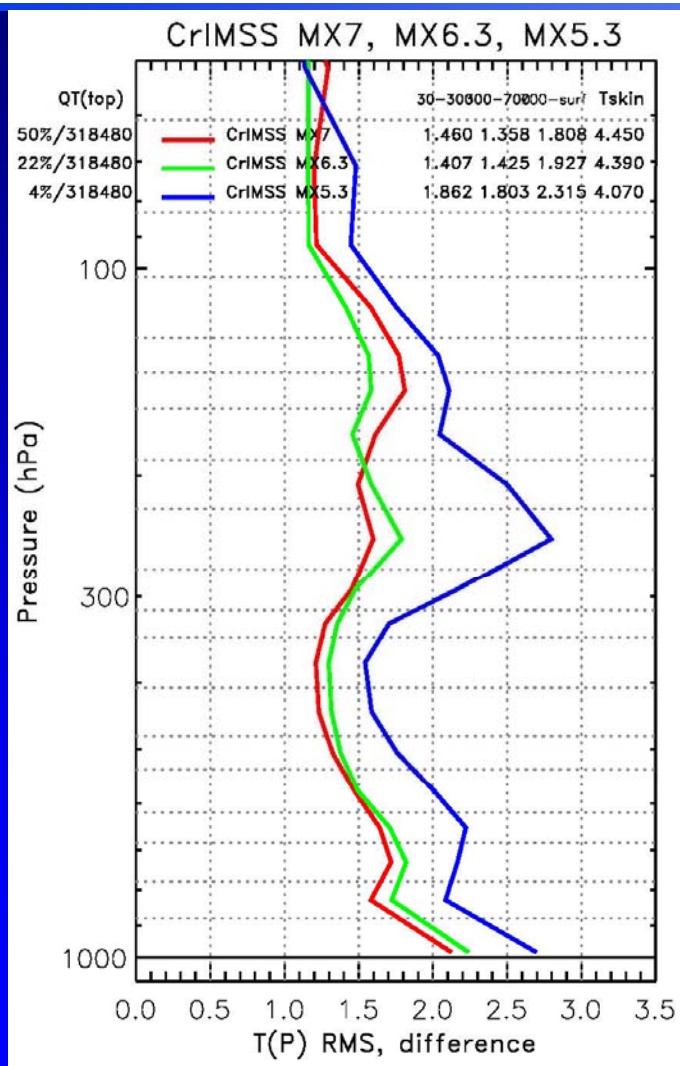
- AVTP (850 hPa-surface) temperature product for May 15, 2012
  - CrIMSS IR+MW (upper left) and MW-only (upper middle)
  - AIRS IR+MW (lower left) and AMSU-only (lower middle)
  - Co-located ECMWF for CrIS (upper right) and AIRS (lower right)

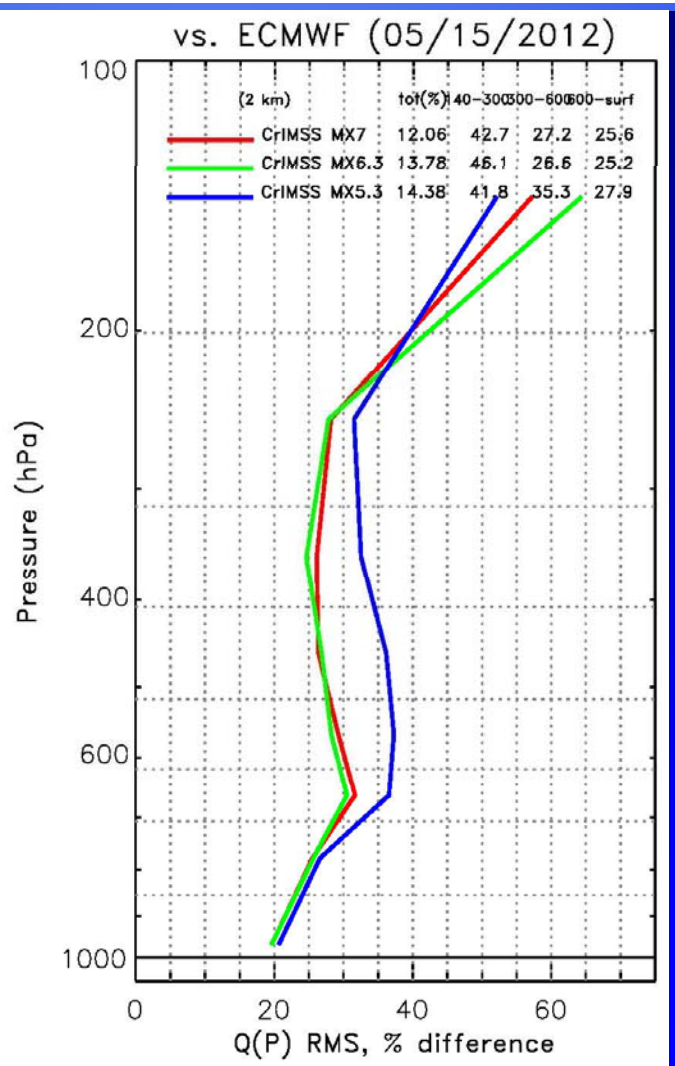


T(p), q(p) RMS Differences wrt ECMWF

MX 5.3 (Past), MX 6.3 (Present) and MX 7.1 (June 2013)

Data: Global (Focus Day: 05/15/2012)





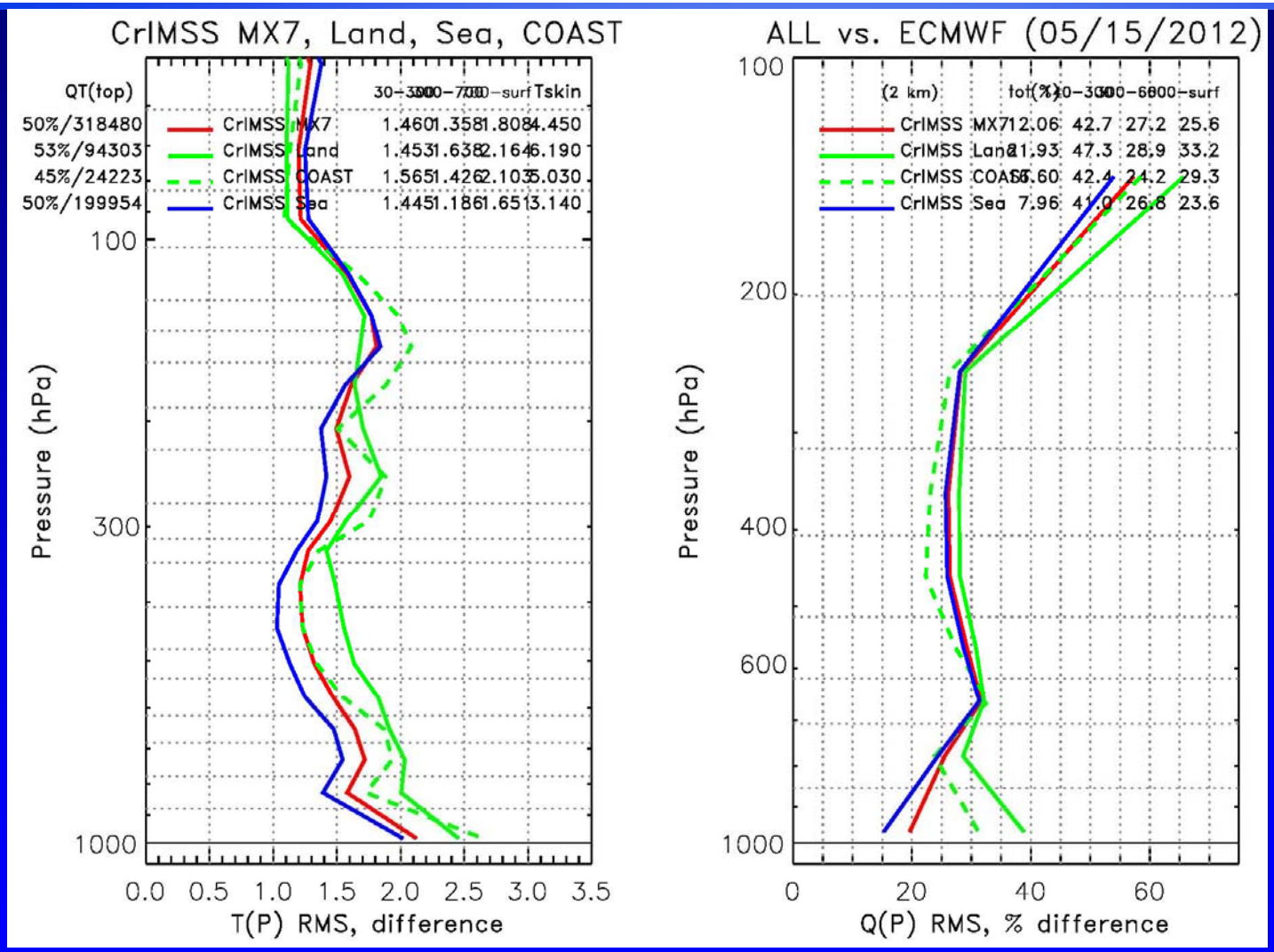
CrIMSS IR+MW
MX5.3
MX6.3
MX7.1

Global ALL
N=318,000
Yield:
MX7: 50%
MX6.3:22%
MX5.3: 4%

T(p) RMS (K)

q(p) RMS (%)

MX7.1 T(p), q(p) RMS Differences wrt ECMWF Global, Land, Sea, Coast, ALL(05/15/2012)



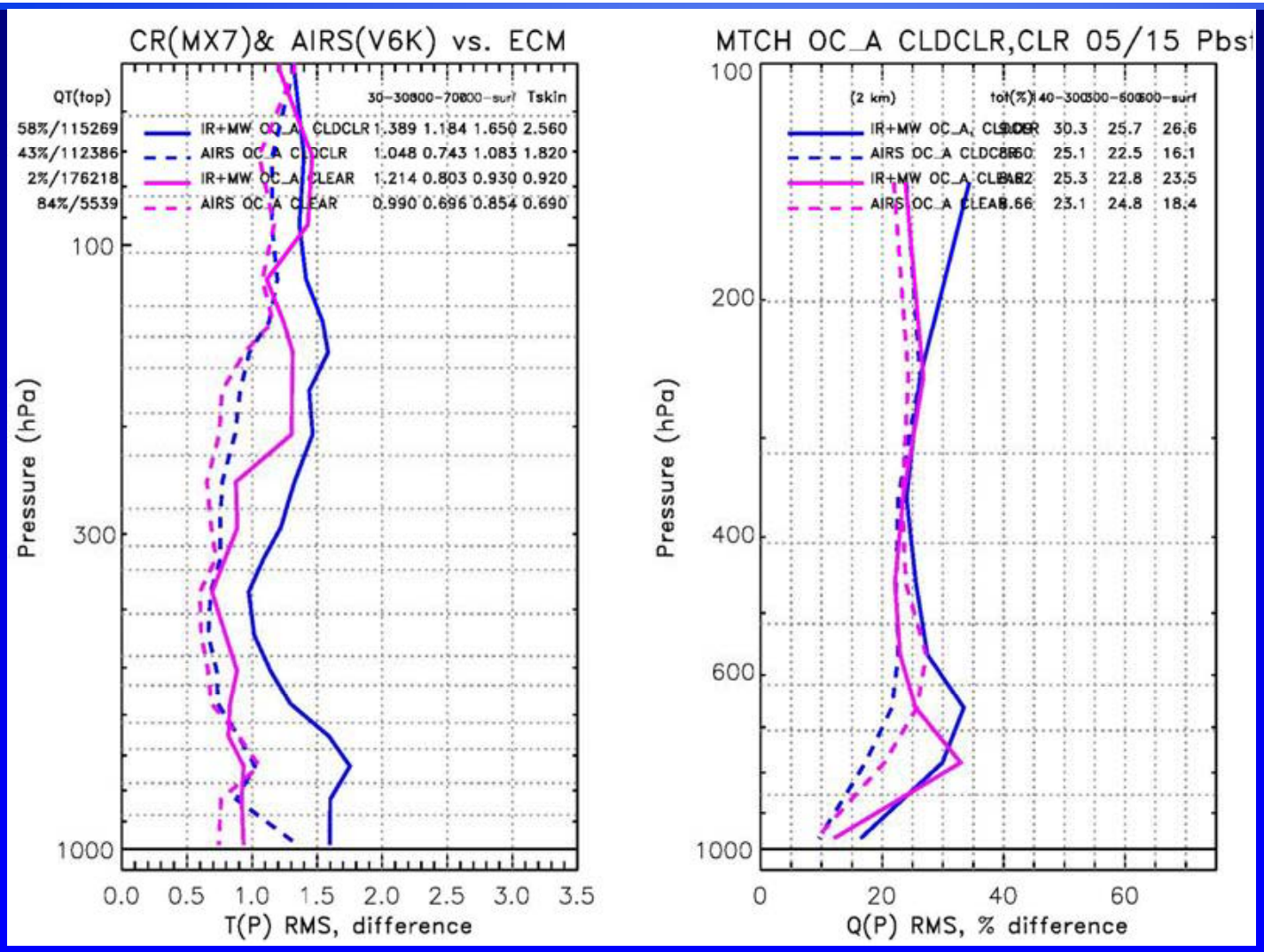
CrIMSS IR+MW MX7.1

Global ALL
N=318,000
Yield:
ALL: 50%
Land: 53%
Sea:50%
COAST(--):45%

T(p) RMS (K)

q(p) RMS (%)

CrIMSS vs. ECMWF; AIRS V6 vs. ECMWF
Matched EDRs - Global Ocean – CLDCLR, Clear Cases



T(p) RMS (K)

q(p) RMS (%)

Solid Lines
CrIMSS IR+MW

Dashed Lines
AIRS V6 RET
pbest

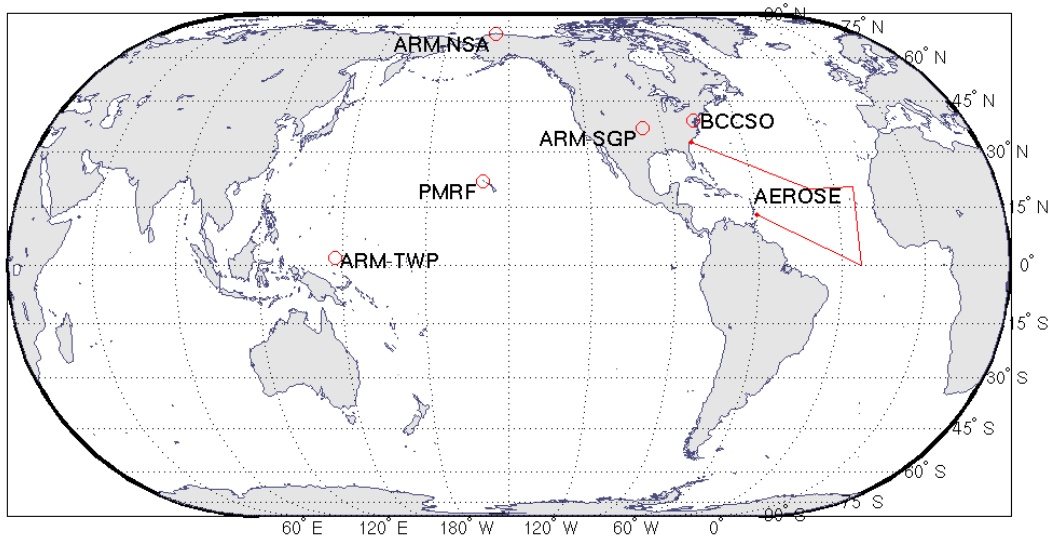
Blue Ocean
N= 116,000 - CLDCLR
AIRS:43% dashed
CrIMSS:58% solid

Clear
N= 5,538
AIRS: 5% dashed
CrIMSS solid

ICV Coordinated Dedicated RAOB Campaign
(Barnet et al., CrIMSS Beta Maturity, July 2012)

	ARM-TWP	ARM-SGP	ARM-NSA	PMRF	BCCSO	NOAA AEROSE
Location	Manus Island, Papua New Guinea	Ponca City, Oklahoma, USA	Barrow, Alaska, USA	Kauai, Hawaii, USA	Beltsville, Maryland, USA	Tropical North Atlantic Ocean
Regime	Tropical Pacific Warm Pool, Island	Midlatitude Continent, Rural	Polar Continent	Tropical Pacific, Island	Midlatitude Continent, Urban	Tropical Atlantic, Ship
Planned *N*	90	180	180	40	—	≈ 65
Launched n_1	**18**	**49**	**61**	**40**	**15**	**2**
Launched n_2	—	**47**	**59**	—	—	—
Time Frame	Aug–present	Jul–present	Jul–present	May, Sep	Jun–Jul, Sep–present	Jan 2013 tentative

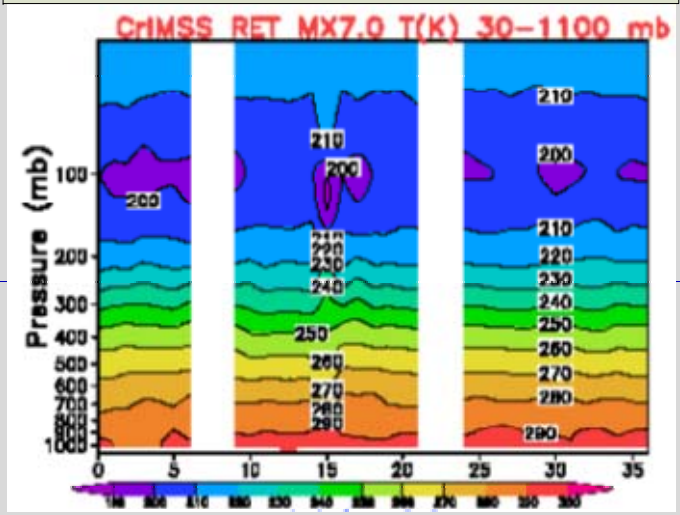
NPP CrIMSS EDR ICV Dedicated RAOB Sites

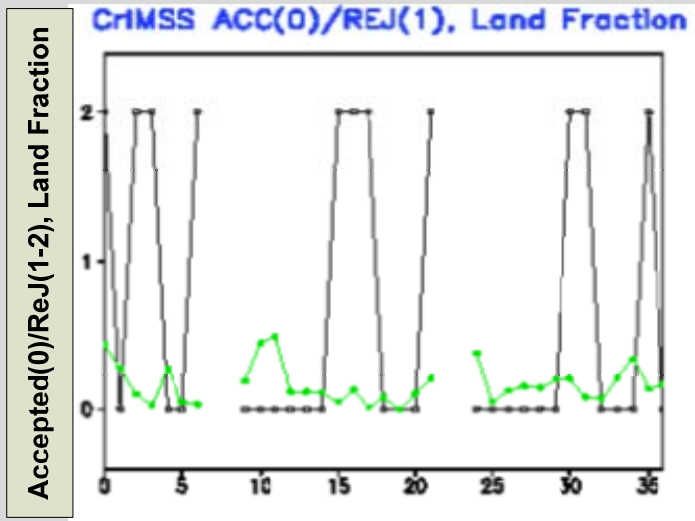


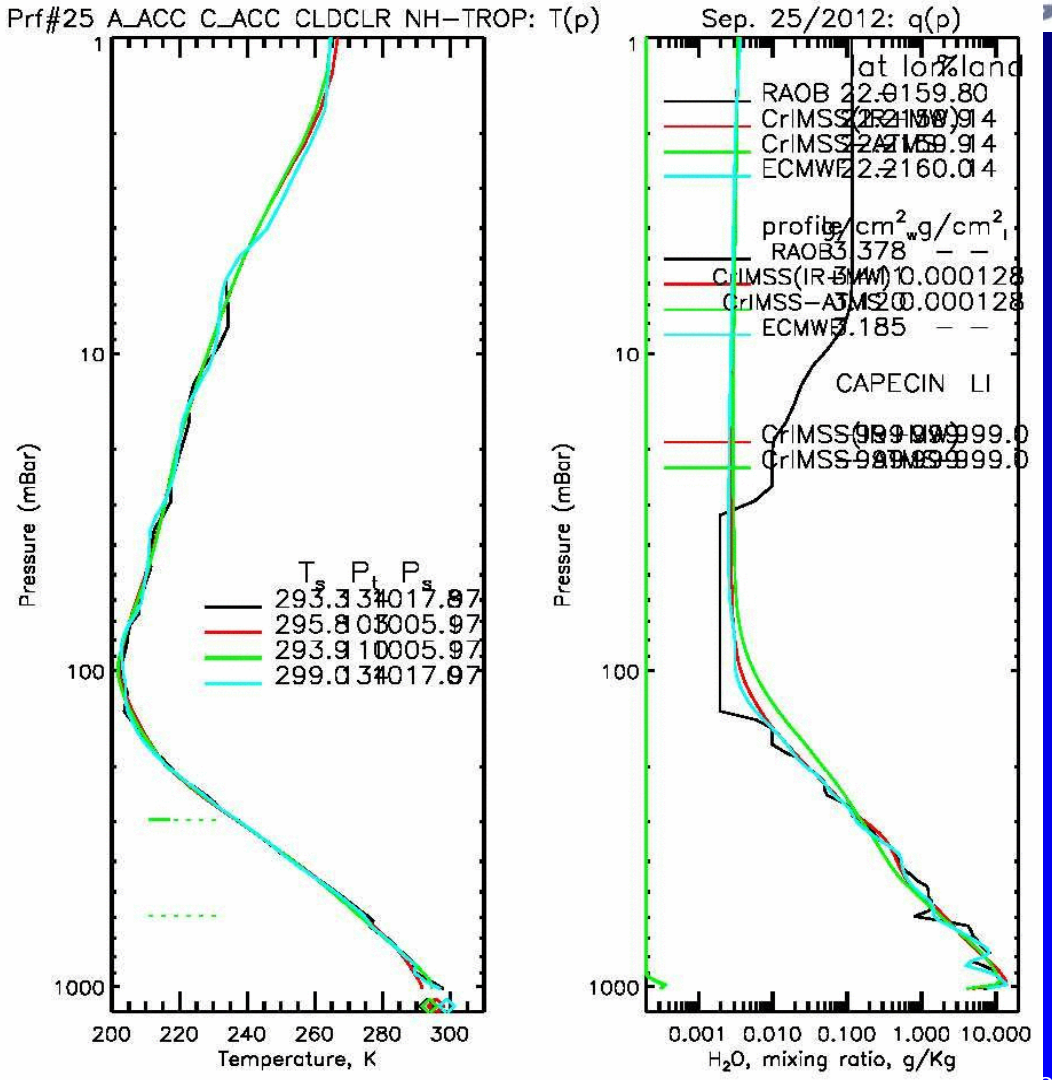
- CrIMSS EDR matchup granules are in the process of being acquired for these RAOBs
  - » IDPS OPS-EDRs ≤ 500 km
- Currently evaluating PMRF RAOBs and location specifics
- Kauai, Hawaii, About 30 RAOBs. Lat/Lon: 22.05N, -159.78W

Aerospace RAOB, ECMWF, CrIMSS MX7.01 EDR Matches (Kauai, 22.05N, 159.78W, Hawaii)

PMRF- Kauai, 37 Matches, May-Sep, 2012





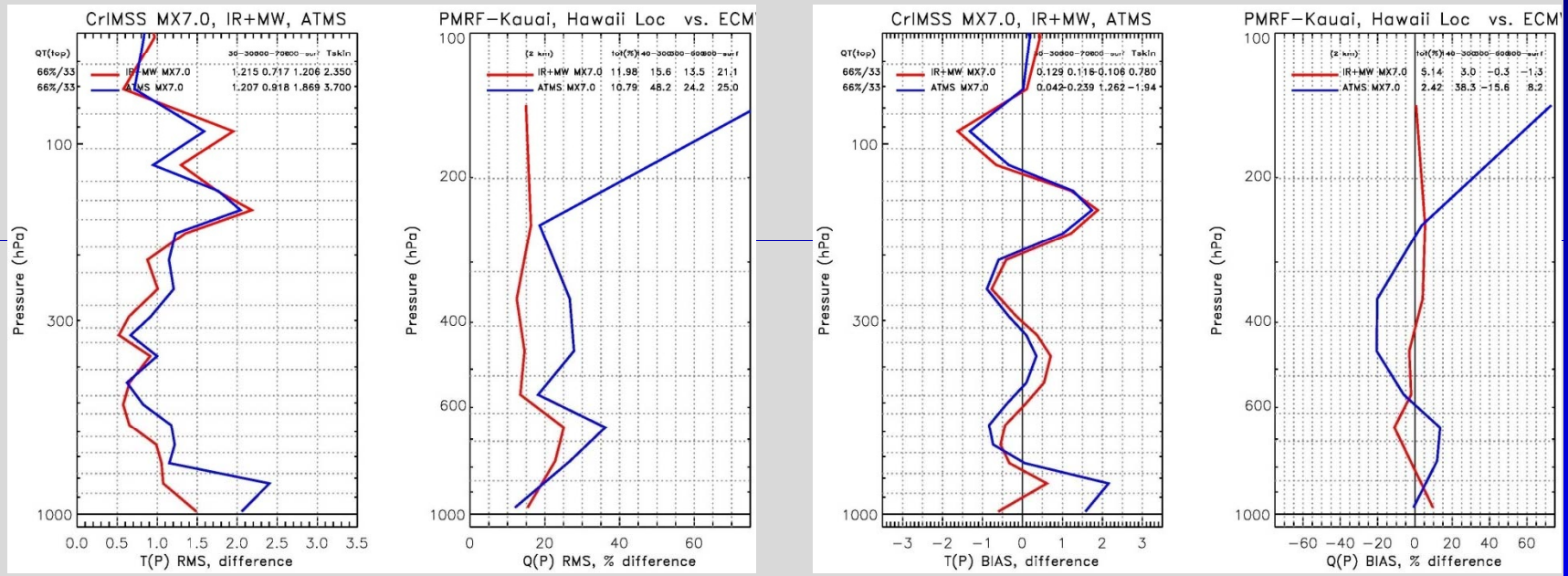


Black: RAOB; Red: 2nd Stage IR+MW; Green: 1st Stage MW; Cyan: ECMWF

RMS Difference and Bias - CrIMSS EDRs vs. ECMWF
NSAMP: 33 Data: May 12-31; September 16-30, 2012

PMRF- Kauai, CrIMSS vs. ECMWF T(p), q(p) RMS
Red: 2nd Stage IR+MW; Blue: ATMS-only

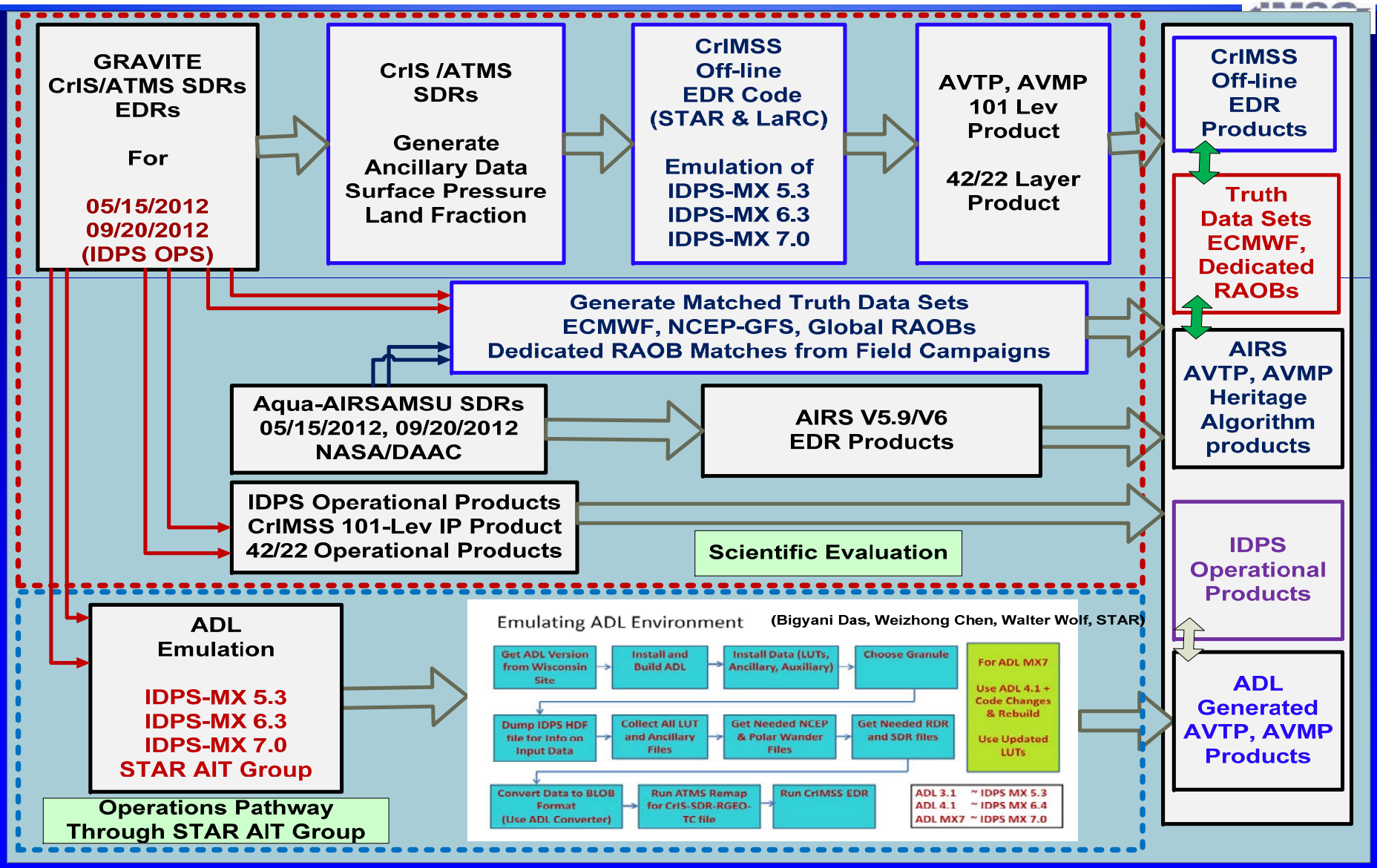
PMRF- Kauai, CrIMSS vs. ECMWF T(p), q(p) Bias
Red: 2nd Stage IR+MW; Blue: ATMS-only



T(p) RMS (K) **q(p) RMS (%)** **T(p) Bias (K)** **q(p) Bias (%)**

- The implications on using is-land based CrIMSS EDRs in validating the CrIMSS EDRs require further investigation.
- The 1st stage MW-only retrievals get affected by the land fraction (ATMS surface sensitive channels), and the retrievals may not represent a 'sea-only' CrIMSS EDR product as we would anticipate.
- We are currently evaluating CrIMSS EDRs vs. matched RAOBs.

Data and Pathways for CrIMSS Provisional Maturity



Results

- The CrIMSS EDR algorithm with current IDPS working version (MX6.3), and upcoming MX7.1 shows excellent promise and can be declared as of Provisional Quality.
- EDR products derived with off-line emulation of CrIMSS Versions (Past: IDPS-MX5.3; Current:IDPS-MX6.3; Future:IDPS-MX7.1) were validated with ADL 4.1 emulations to ensure that the results presented today represent the future MX7.1 IDPS operational product.
- EDR algorithm performance was evaluated with a common match-up data set of CrIMSS and Aqua-AIRS EDR products (~177,000/day) and matched ECMWF analysis fields.
  - CrIMSS AVTP and AVMP products are very competitive in comparison to AVTP and AVMP products generated with the AIRS-Science Team algorithm
    - CrIMSS-AVTP and AVMP products appear to be resilient to dust in comparison with matched Aqua-AIRS retrieval products
  - We are currently substantiating these results with validations using dedicated RAOBs and/or global RAOB match-ups of truth data sets for stage 1 and stage 2 validations.

AMS-2013 Relevant Oral/Poster Presentations and NOAA/STAR-Telecon Presentations

1. Cal/Val Program Status for Environmental Data Record (EDR) Products from the Suomi NPP Cross-track Infrared Microwave Sounder Suite (CrIMSS)
. . . Suite (CrIMSS) Exhibit Hall 3 (Austin Convention Center) Nicholas R. Nalli, NOAA/NESDIS, College Park, MD; and C. D. Barnet, M. **Divakarla**, D. Gu, X. Liu, S. Kizer, L. Zhou, D. Tobin, T. Reale, A. Gambacorta, M. Wilson, X. Xiong, E. Maddy, . . .
2. Suomi NPP Intensive Cal/Val Over Tropical Ocean: Results from the 2012 NOAA Aerosols and Ocean Science Expedition (AEROSE)
. . . Nicholas R. Nalli, NOAA/NESDIS, College Park, MD; and C. D. Barnet, E. Joseph, V. R. Morris, D. E. Wolfe, M. **Divakarla**, T. S. King, A. Gambacorta, M. Wilson, H. Xie, E. Maddy, P. J. Minnett, T. Reale, M. I. Oyola, A. . . .
3. Suomi NPP CrIMSS EDR Algorithms: Porting and Validation
. . . (Austin Convention Center) Susan Kizer, Science Systems and Applications Inc., Hampton, VA; and X. Liu, C. D. Barnet, M. G. **Divakarla**, D. Gu, X. L. Ma, D. K. Zhou, A. M. Larar, X. Xiong, G. Guo, A. Gambacorta, M. Wilson, W. . . .
4. NPP/JPSS CrIMSS EDR Alogirthm Validation and Tuning
. . . Tuning Exhibit Hall 3 (Austin Convention Center) Xu Liu, NASA/LaRC, Hampton, VA; and S. Kizer, C. D. Barnet, M. G. **Divakarla**, N. R. Nalli, D. Gu, D. K. Zhou, A. M. Larar, X. Xiong, A. Gambacorta, M. Wilson, W. J. Blackwell, . . .
5. Provisional Maturity Assessment of Cross Track Infrared Sounder (CrIS) Temperature and Moisture Profile Products
. . . Maturity Assessment of Cross Track Infrared Sounder (CrIS) Temperature and Moisture Profile Products Ballroom G (Austin Convention Center) Murty G. **Divakarla**, IM Systems Group, Inc., Rockville, MD; and C. D. Barnet, M. Wilson, X. Xiaong, C. Tan, D. Gu, X. Liu, . . .
6. On Empirical Bias Corrections of NPP CrIMSS OSS Forward Model
. . . Model Exhibit Hall 3 (Austin Convention Center) Changyi Tan, IM Systems Group, Inc.,, Rockville, MD; and A. Gambacorta, M. G. **Divakarla**, S. Kizer, E. Maddy, G. Guo, M. Wilson, X. Xiong, X. Liu, and C. D. Barnet The Cross-track Infrared Sounder . . .
7. A Global Perspective of the Current and Future CrIMSS EDR Algorithm
. . . Algorithm Exhibit Hall 3 (Austin Convention Center) Michael Wilson, I.M. Systems Group, Rockville, MD; and C. D. Barnet, M. G. **Divakarla**, C. Tan, X. Xiong, X. Liu, S. Kizer, D. Gu, N. R. Nalli, A. Gambacorta, and E. Maddy The Suomi . . .
8. Evaluation of CrIS/ATMS Proxy Data Generation Algorithms with Observed Radiances and Retrieval Products
. . . Evaluation of CrIS/ATMS Proxy Data Generation Algorithms with Observed Radiances and Retrieval Products Ballroom G (Austin Convention Center) Murty G. **Divakarla**, IM Systems Group, Inc., Rockville, MD; and C. D. Barnet, X. Liu, S. Kizer, E. Maddy, C. Tan, and M. . . .
CrIMSS Single FOV EDR Retrievals
. . . Hagan, Northrop Grumman Aerospace Systems, Redondo Beach, CA; and D. Gu, X. L. Ma, C. D. Barnet, and M. G. **Divakarla** The Cross Track Infrared/Microwave Sounding Suite (CrIMSS) State 2 algorithm was developed to enable single Field of View profile retrievals, . . .

NOAA/STAR: CrIMSS Algorithm Telecon Presentations:
Contact : Murty.Divakarla@noaa.gov

10. Evaluation and Improvement of the NPP CrIMSS Rain Flag
. . . 3 (Austin Convention Center) Ralph R. Ferraro, NOAA/NESDIS, College Park, MD; and W. Yang, C. D. Barnet, and M. G. **Divakarla** As part of the Suomi National Polar-orbiting Partnership (NPP), Crosstrack Infrared and Micrwoave Sounding Suite (CrIMSS), a joint system that . . .
11. Research to Operations Pathway for Satellite Data Retrieval Algorithms - Part 1
. . . Hagan, Northrop Grumman Aerospace Systems, Redondo Beach, CA; and D. Gu, X. L. Ma, C. D. Barnet, and M. G. **Divakarla** 11:45 AM TJ47.4 Calibration and Validation of the S-NPP Sensor Data Records and Environmental Data Records Heather Kilcoyne, NOAA/NESDIS/JPSS, . . .
12. Research to Operations Pathway for Satellite Data Retrieval Algorithms - Part 2
. . . Privette 2:00 PM TJ49.3 Evaluation of CrIS/ATMS Proxy Data Generation Algorithms with Observed Radiances and Retrieval Products Murty G. **Divakarla**, IM Systems Group, Inc., Rockville, MD; and C. D. Barnet, X. Liu, S. Kizer, E. Maddy, C. Tan, and M. . . .
13. Suomi NPP/JPSS Cal/Val and Product Development
. . . 4:15 PM 4.4 Provisional Maturity Assessment of Cross Track Infrared Sounder (CrIS) Temperature and Moisture Profile Products Murty G. **Divakarla**, IM Systems Group, Inc., Rockville, MD; and C. D. Barnet, M. Wilson, X. Xiaong, C. Tan, D. Gu, X. Liu, . . .
14. GOES-R/JPSS Posters Part 1 (Monday/Tuesday)
. . . NPP CrIMSS Rain Flag Ralph R. Ferraro, NOAA/NESDIS, College Park, MD; and W. Yang, C. D. Barnet, and M. G. **Divakarla** 301 Suomi NPP/JPSS Cross-track Infrared Sounder (CrIS): Non-linearity Assessment and On-Orbit Monitoring Robert Knuteson, CIMSS/Univ. of Wisconsin, Madison, WI; . . .
15. Poster Session: Transition of Research to Operations — Demonstrated Research
. . . Corrections of NPP CrIMSS OSS Forward Model Changyi Tan, IM Systems Group, Inc.,, Rockville, MD; and A. Gambacorta, M. G. **Divakarla**, S. Kizer, E. Maddy, G. Guo, M. Wilson, X. Xiong, X. Liu, and C. D. Barnet 439 Development of . . .
16. GOES-R/JPSS Posters Part 2 (Wednesday/Thursday)
. . . Porting and Validation Susan Kizer, Science Systems and Applications Inc., Hampton, VA; and X. Liu, C. D. Barnet, M. G. **Divakarla**, D. Gu, X. L. Ma, D. K. Zhou, A. M. Larar, X. Xiong, G. Guo, A. Gambacorta, M. Wilson, W. . . .
17. Poster Session: Transition of Research to Operations — Future Opportunities
. . . the Current and Future CrIMSS EDR Algorithm Michael Wilson, I.M. Systems Group, Rockville, MD; and C. D. Barnet, M. G. **Divakarla**, C. Tan, X. Xiong, X. Liu, S. Kizer, D. Gu, N. R. Nalli, A. Gambacorta, and E. Maddy 803 . . .

NOAA/STAR Cal/val Telecon Presentations:
ftp://ftp.star.nesdis.noaa.gov/pub/smcd/spb/nnalli/telecons

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