NOAA Unique CrIS ATMS Processing System (NUCAPS)

Phase 2 Delivery

Algorithm Readiness Review

January 14, 2013

Prepared By: Antonia Gambacorta[1], Letitia Soulliard[1], Kexin Zhang[1], Tom King[1] and Chris Barnet[2], Walter Wolf[2]

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Review Agenda

Section	Time	Presenter
Introduction	9:00 – 9:15	Tom King
ARR Phase 1 Report	9:15 – 9:35	Tom King
Updated Requirements	9:35 – 9:40	Tom King
Phase 2 Software Architecture	9:40 – 10:00	Tom King
Algorithm and DAP Readiness	10:00 – 10:45	Antonia Gambacorta and Tom King
Risk Summary	10:45 – 10:55	Tom King
Summary and Conclusions	10:55 – 11:00	Tom King

Review Outline

- Introduction
- ARR Phase 1 Report
- Updated Requirements
- Phase 2 Software Architecture
- Algorithm Readiness
- Risk Summary
- Summary and Conclusions

Section 1 – Introduction

Presented by

Tom King

NUCAPS Phase 2 ARR

- NUCAPS ARR is the final review before delivery and implementation.

- Review Objectives:
  - » Demonstrate that the NUCAPS Phase 2 software package has been tested, meeting requirements and ready for delivery and implementation in NDE.
  - » Explain what is new vs old in the package and how this will impact production rules.
  - » Cover any updates to project requirements and risks and actions.

NPP/JPSS

- NPP and JPSS, a joint NOAA/NASA effort, is the next series of polar-orbiting satellites dedicated to among other things, operational meteorology. The objective of the JPSS mission is to ensure continuity, improvement and availability of operational observations from an afternoon polar orbit (13:30 pm).

- Meteorological/Climatological Instrument packages on NPP/JPSS:
  - » CrIS, ATMS, VIIRS, OMPS, CERES

- NPP launched October 28, 2011 and is the first of 3 satellites.

NUCAPS Objectives Phase 1

- Phase 1 Objectives:
  - » Apodize and subset the CrIS SDR's both spatially and spectrally to produce thinned radiance datasets for use by NWP and DOD centers within 3 three hours of observation (or 30 minutes of data receipt from IDPS) to NWS and DOD.
  - » SDR Validation Products: Global Grids, Matchups, and Binaries

NUCAPS Objectives Phase 2

- Phase 2 Objectives:
  - » Provide CrIS/ATMS NOAA Unique products within three hours of observation (or 30 minutes of data receipt from IDPS) to NWS and DOD.
    - – Temperature, moisture, pressure profiles
    - – Cloud cleared radiances
    - – NOAA Unique trace gas products
    - – Principal components
    - – Science QC products for OSPO
  - » Provide NOAA Unique CrIS/ATMS Products with metadata to CLASS.
  - » EDR Validation Products: Global Grids, Matchups, and Binaries.

NUCAPS Objectives Phases 3 - 5

- Phase 3 Objectives:
  - » Retrieval updates
  - » ILS correction
- Phase 4 Objectives:
  - » Collocated CrIS/VIIRS-cloud datasets
  - » CrIS OLR
- Phase 5 Objectives:
  - » Retrieval updates

NUCAPS Project: Organization Chart

Customers/Users
NCEP, GMAO, NRL/FNMOC
STAR,CLASS
UK Met Office, ECMWF, DWD
Meto-France, CMC, EUMETSAT

NDE Project
Jim Silva (NDE Project Manager)
Geof Goodrum (NDE System Architect)
Kevin Berberich (Integration Coordinator)
Tom Schott (Satellite Product Manager)

NUCAPS Project
Laurie Rokke (Branch Chief)

NDE Integrators
Peter MacHarrie (System Developer)
Dylan Powell (System Integrator)
Lou Fenichel (System Integrator)

Research Algorithm
Chris Barnet (Algorithm Lead)
Antonia Gambacorta (Algorithm Scientist)
Kexin Zhang (PC)

Development IPT
Walter Wolf (Lead)
A.K. Sharma (Backup Lead)

Operations & Maintenance
A.K. Sharma (Operations Lead)
Oleg Roytburd (Maintenance Programmer)

Pre-Operational Algorithm
Tom King (Programming Lead)
Letitia Soulliard (Programmer)
Kexin Zhang & Haibing Sun (Simulation)

Support
Kexin Zhang (QA Lead)
Xinping Liu & Yunhui Zhao (CM)
Peter Keehn (Maintenance)
Xingpin Liu (Web)
Larisa Koval (Documentation)

Project Stakeholders – Development Team

- STAR (Walter Wolf-P.I., Thomas King, Chris Barnet, Antonia Gambacorta, Letitia Soulliard, Larisa Koval, Haibing Sun, Kexin Zhang, Xingpin Liu, Yunhui Zhao, Peter Keehn)
  - » Develop the NUCAPS algorithms
  - » Integrate algorithm code into a package designed to interface with NDE system
  - » Conduct testing and validation
  - » Develop documentation
  - » Work with data users to obtain product requirements

Project Stakeholders – Operations and Maintenance

- NDE – NPOESS Data Exploitation (Geoff Goodrum, Kevin Berberich, Peter MacHarrie)
  - » Develop the NDE system
  - » Integrate science algorithm packages received from STAR
- OSPO (A.K. Sharma – NUCAPS PAL)
  - » Run and maintain the NDE system on the operation side
  - » Distribute the data and products to users

Project Stakeholders – Customers and Users

- U.S. Users:
  - NCEP (John Deber, Andrew Collard, Dennis Keyser)
  - GMAO (Emily Liu)
  - AWIPS (Jim Heil)
  - STAR (Tony Reale, Murty Divakarla, Kexin Zhang, Xingpin Liu)
  - CLASS (Phil Jones)
- International Users:
  - EUMETSAT (Simon Elliott)
    - UK Met Office (Nigel Atkinson)
    - ECMWF (Tony McNally)
    - DWD (Reinhold Hess)
    - Meteo-France (Lydie Lavanant)
    - Plus other EUMETSAT members states
  - CMC (Louis Garand)
  - EC (Sylvain Heilliette)
  - JMA (Hidehiko Murata)
  - BOM (John Le Marshall)

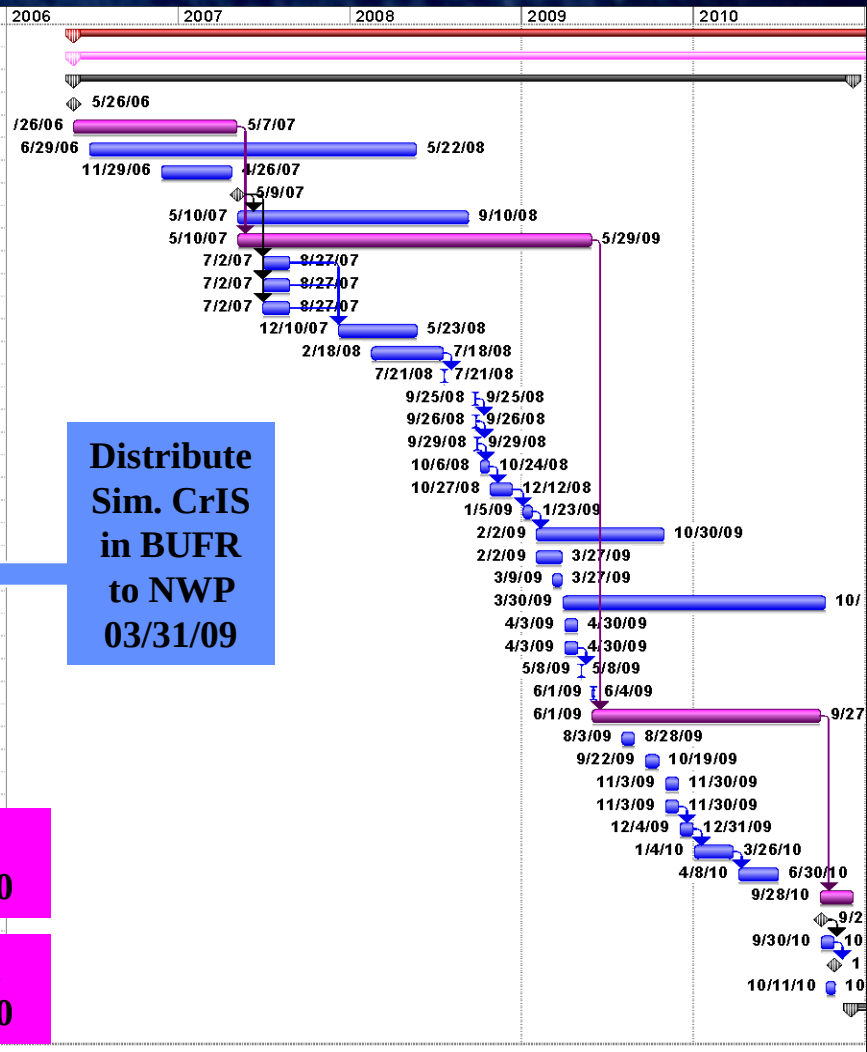
Project Plan: Task and Schedules

- Tasks:
  - Defined in the PSDI project plan (FY13_Polar_CrIS-ATMS_Slides.ppt)

- Schedule (key milestones):
  - Preliminary Design Review – May 9, 2007
  - Critical Design Review – Sep. 29, 2008
  - Test Readiness Review – Sep. 29, 2010
  - Code Unit Test Review – Oct. 20, 2010
  - Phase 1 Algorithm Readiness Review – Mar. 14, 2012
  - NUCAPS Phase 1 Delivery – Mar. 19, 2012
  - NUCAPS Phase 2 Delivery – Dec. 3, 2012
  - Phase 2 Algorithm Readiness Review – Jan. 14, 2013
  - NDE Implementation of NUCAPS Phase 2 – Jan 2013
  - SPSRB Briefing – May 2013 (Jun. 2012) (Jan. 2012)
  - Operations Commence – June 2013 (Jul. 2012) (Feb. 2012)

Project Timeline

ID	Task Name
1	CrIS/ATMS Product System
2	Principal Comonts and Subsetter
3	Development Phase
4	IPT Branch Lead informed to begin product development
5	Algorithm Evaluation
6	Begin building the CrIS/ATMS simulation system
7	Development processing system defined
8	Preliminary Design Review
9	Preliminary System Development
10	Algorithm Development
11	Initial Archive Requirements identified
12	Quality Monitoring Concept Defined
13	Long-term Maintenance Concept Defined
14	Test case processed for simulation system
15	Final Archive requirements identified
16	Development processing capabilities in place
17	Critical Design Review for PC's & L2 combined
18	Operational and backup processing defined, initiate procurement
19	Begin collaboration with NWP centers on CrIS BUFR table
20	Subsetter and NUCAPS system development
21	Subsetter code is prepared for implementation
22	Implement updates to CrIS BUFR table
23	NDE Build Content Reviews
24	Distribute near real-time simulated CrIS subset data to NetCDF4 BUFR/GRIB Tailoring Tool
25	Distribute simulated CrIS data in BUFR format to NWP centers for review
26	NDE Prototype Integrated Product Team Meetings
27	Development of PCF files
28	Work with IPO to distribute L1C IASI radiances to GRAVITE
29	Operational and backup processing capabilities in place
30	NUCAPS code is prepared for implementation
31	Algorithm Testing
32	Set up accounts on GRAVITE
33	Receive format for simulated CrIS and ATMS from GRAVITE
34	Initial work with NDE to implement NUCAPS system into NDE Data Handling System
35	Update CrIS/ATMS ingestors to read IPO simulated data
36	Read IPO simulated data into NUCAPS system
37	Run simulated IPO data through the NUCAPS system in near real-time
38	Prepare documentation
39	Algorithm Demonstration
40	Test Readiness Review (TRR)
41	Unit testing completed
42	Code Unit Test Review (CUTR)
43	Check System Security for C&A Compliance
44	Pre-operational Phase
64	Operational Phase



PDR 05/09/07

CDR 09/29/08

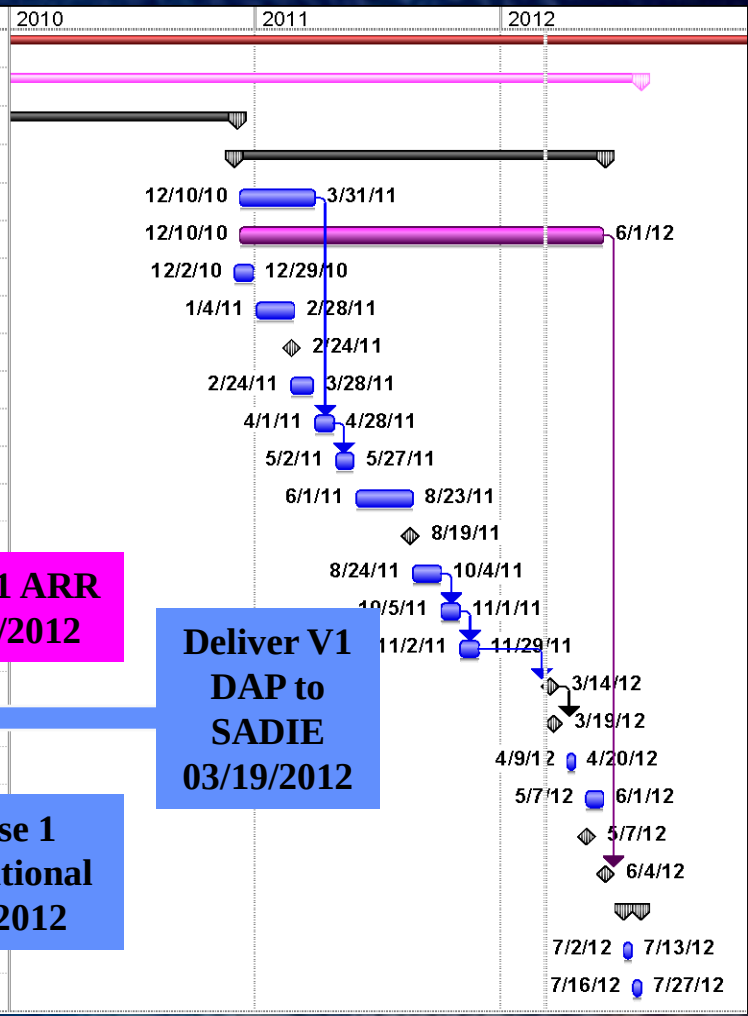
Distribute Sim. CrIS in BUFR to NWP 03/31/09

TRR 09/23/10

CUTR 10/20/10

Project Timeline

ID	Task Name
1	**CrIS/ATMS Product System**
2	**Principal Components and Subsetter**
3	**Development Phase**
44	**Pre-operational Phase**
45	Transition development system to pre-operational system
46	Pre-operational Algorithm Testing
47	Developed Operational Products Implementation Plan
48	Evaluated and Modify Operational Documentation
49	Delivery of Draft DAP to SADIE
50	Validation and Verification of Operational Quality Assurance for CrIS/ATMS Products
51	Validation and Verification of Monitoring capability for CrISis/ATMS Products
52	OSPO Contractor Staff Training for CrIS/ATMS Products System
53	Prepare for Transition to Operation
54	Delivery of Draft DAP to SADIE
55	Pre-operational Subsetter and PC code output evaluated & tested
56	PC and Subset system baselined
57	Operational and backup capabilities reach ops status
58	Algorithm Readiness Review for Subsetter and PC Code
59	Delivery of DAP version 1 to SADIE
60	PC Code transitions to operations; all PC and Subsetter documentation is complete
61	Subsetter and PC Code transition to operations
62	Brief SPSRB Oversight Panel(s) on product status
63	Brief SPSRB capability is ready to operational
64	**Operational Phase**
65	SPSRB Secretaries/manager update the SPSRB product metrics web pages
66	OSD updates Satellite Products database



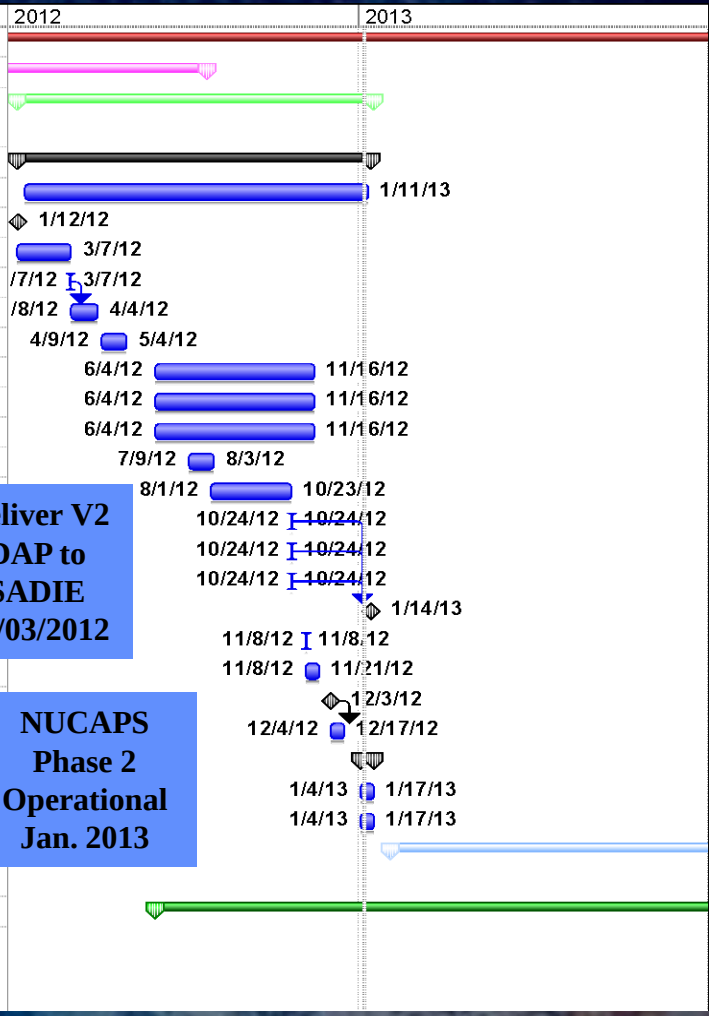
Phase 1 ARR 03/14/2012

Deliver V1 DAP to SADIE 03/19/2012

Phase 1 Operational Jul. 2012

Project Timeline

ID	Task Name
1	**CrIS/ATMS Product System**
2	**Principal Componts and Subsetter**
67	**CrIS/ATMS Cloud Clear Radiance, PCA Cloud Cleared Radiance, Ozone and Carbon Products, Temperature Profile, Water Vapor Profiles, Pressure Profile, Cloud and Stability Products**
68	**Pre-operational Phase begins**
69	NUCAPS algorithm development
70	Delivery of draft DAP to SADIE
71	Pre-operational product output evaluated & tested
72	NUCAPS L2 system baselined
73	NUCAPS L2 code transitions to pre-operations; preliminary products distributed through Test DDS
74	Developed Operational Products Implementation Plan
75	Evaluated and Modify Operational Documentation
76	Validation and Verification of Operational Quality Assurance for CrIS/ATMS Products
77	Validation and Verification of Monitoring capability for CrIS/ATMS Products
78	OSPO Contractor Staff Training for CrIS/ATMS Products System
79	Prepare for Transition to Operation
80	NUCAPS L2 system baselined
81	Check System Security for C&A Compliance
82	Perform System Scans for intrusion detection and firewall setup
83	Algorithm Readiness Review for NUCAPS L2 Product
84	All NUCAPS L2 documentation is complete
85	NUCAPS L2 product system baselined
86	Delivery of DAP version 2 to SADIE
87	NUCAPS L2 product transition to operations
88	**Operational Phase Begins**
89	SPSRB Secretaries/manager update the SPSRB product metrics web pages
90	OSD updates Satellite Products database
91	**Principal, Components, Cloud Cleared Radiances, PCA Cloud Cleared Radiance, Ozone and Carbon Products Updates Phase I**
128	**CrIS and VIIRS Collocations and CrIS Sub-Pixel Instrument Line Shape Correction (ILS)**
175	**CrIS/ATMS Principal Components, Subsetter, Cloud Cleared Radiances, PCA Cloud Cleared Radiance, Ozone and Carbon Products, Temperature Profile, Water Vapor Profiles, Pressure Profile, Cloud and Stability Products Updates Phase II**



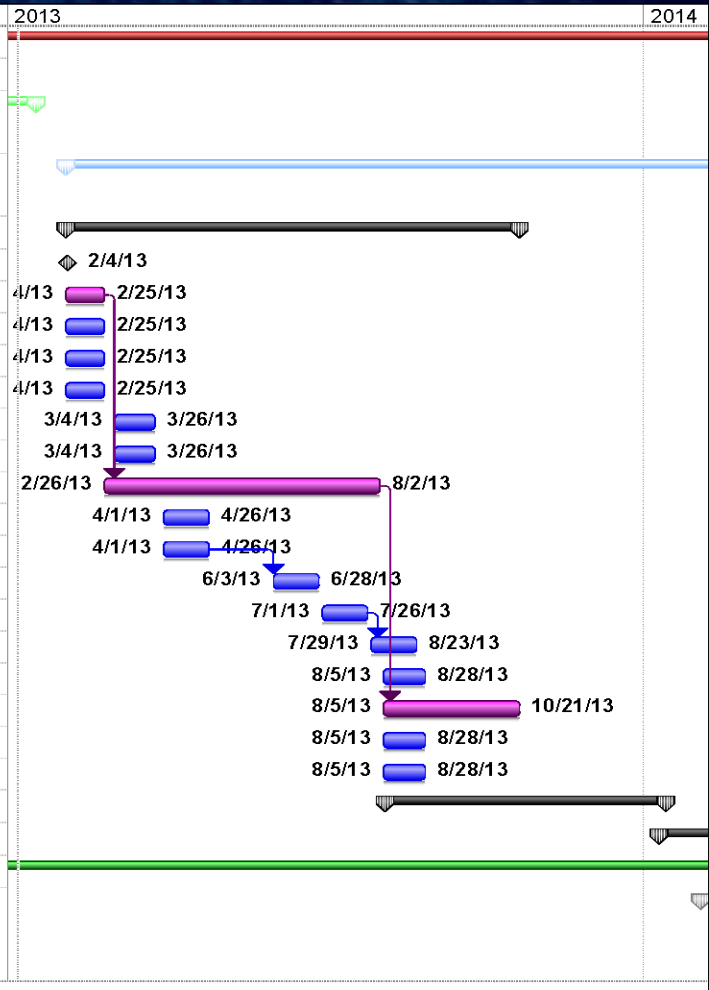
NUCAPS Phase 2 ARR 01/14/2013

Deliver V2 DAP to SADIE 12/03/2012

NUCAPS Phase 2 Operational Jan. 2013

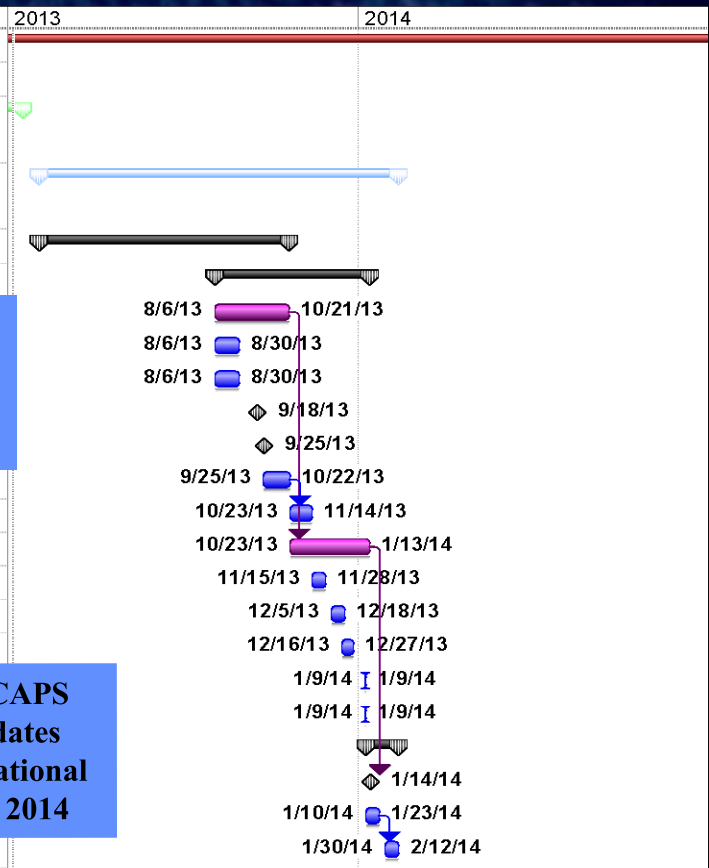
Project Timeline

ID	Task Name
1	**CrIS/ATMS Product System**
2	**Principal Comonts and Subsetter**
67	**CrIS/ATMS Cloud Clear Radiance, PCA Cloud Cleared Radiance, Ozone and Carbon Products, Temperature Profile, Water Vapor Profiles, Pressure Profile, Cloud and Stability Products**
91	**Principal, Components, Cloud Cleared Radiances, PCA Cloud Cleared Radiance, Ozone and Carbon Products Updates Phase I**
92	**Development Phase**
93	IPT Branch Lead informed to begin product development
94	Algorithm Evaluation
95	Initial Archive Requirements identified
96	Quality Monitoring Concept Defined
97	Long-term Maintenance Concept Defined
98	Initial Information Security (IT) concept defined
99	CrIS/ATMS Product Upgrade Development
100	Algorithm Development
101	Development, Operational and backup processing system defined
102	Start using VIIRS data to QA L2 cloud clear products
103	Update coefficients for PCA and NOAA Unique Products
104	Make tuning and RTA adjustments
105	Make refinements to difficult trace gas products, methane and carbon dioxide
106	Test case processed
107	Algorithm Testing
108	Code is prepared for implementation
109	Archive process updated
110	**Pre-operational Phase**
123	**Operational Phase**
127	**CrIS and VIIRS Collocations and CrIS Sub-Pixel Instrument Line Shape Correction (ILS)**
174	**CrIS/ATMS Principal Components, Subsetter, Cloud Cleared Radiances, PCA Cloud Cleared Radiance, Ozone and Carbon Products, Temperature Profile, Water Vapor Profiles, Pressure Profile, Cloud and Stability Products Updates Phase II**



Project Timeline

ID	Task Name
1	**CrIS/ATMS Product System**
2	**Principal Comonts and Subsetter**
67	**CrIS/ATMS Cloud Clear Radiance, PCA Cloud Cleared Radiance, Ozone and Carbon Products, Temperature Profile, Water Vapor Profiles, Pressure Profile, Cloud and Stability Products**
91	**Principal, Components, Cloud Cleared Radiances, PCA Cloud Cleared Radiance, Ozone and Carbon Products Updates Phase I**
92	**Development Phase**
110	**Pre-operational Phase**
111	Algorithm Demonstration
112	Operational and backup processing capabilities in place
113	Final IT Security Concept Defined
114	Algorithm Readiness Review
115	Delivery of DAP version 3 to SADIE
116	Check System Security for C&A Compliance
117	Pre-operational product output evaluated & tested
118	Pre-operational Algorithm Testing
119	System Baselined
120	Code transitions to operations; all documentation is complete
121	Operational and backup capabilities reach ops status
122	Brief SPSRB Oversight Panel(s) on product status
123	Brief OSPO capability is ready to operational
124	**Operational Phase**
125	SPSRB declares product operational
126	SPSRB Secretaries/manager update the SPSRB product metrics web pages
127	OSD updates Satellite Products database
128	**CrIS and VIIRS Collocations and CrIS Sub-Pixel Instrument Line Shape Correction (ILS)**
175	**CrIS/ATMS Principal Components, Subsetter, Cloud Cleared Radiances, PCA Cloud Cleared Radiance, Ozone and Carbon Products, Temperature Profile, Water Vapor Profiles, Pressure Profile, Cloud and Stability Products Updates Phase II**



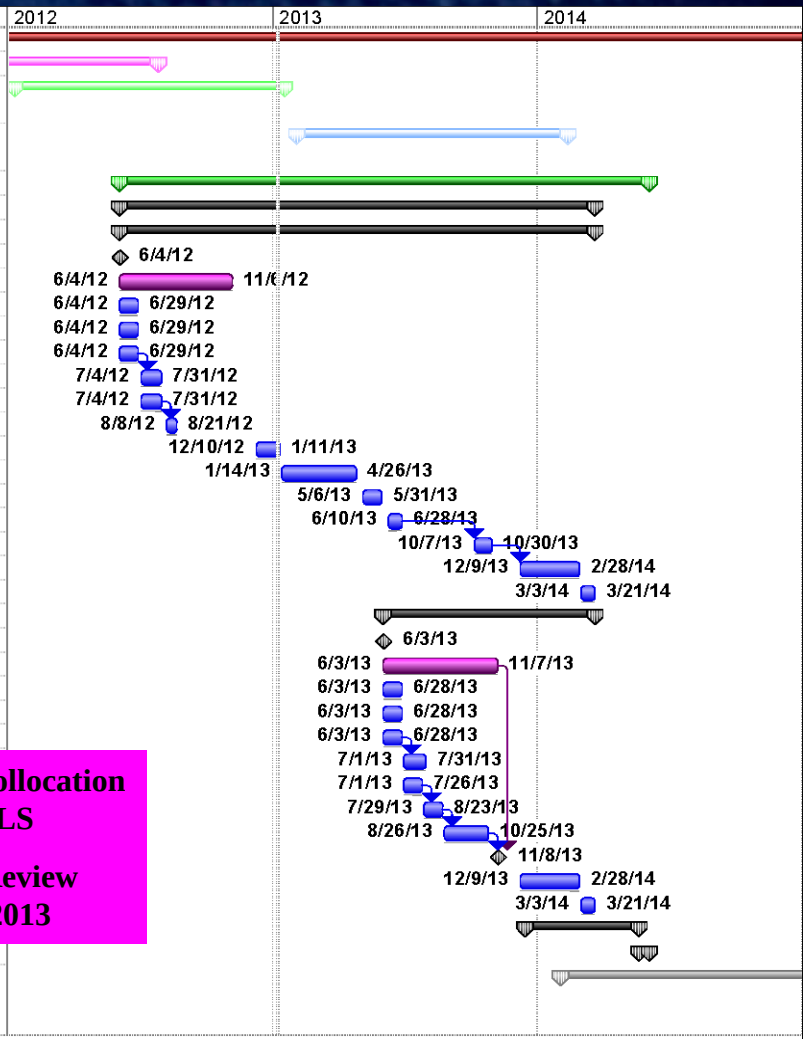
ARR 09/18/2013

Deliver V3 DAP to SADIE 09/25/2013

NUCAPS Updates Operational Jan. 2014

Project Timeline

ID	Task Name
1	**CrIS/ATMS Product System**
2	**Principal Comonts and Subsetter**
67	**CrIS/ATMS Cloud Clear Radiance, PCA Cloud Cleared Radiance, Ozone and Carbon Products, Temperature Profile, Water Vapor Profiles, Pressure Profile, Cloud and Stability Products**
91	**Principal, Components, Cloud Cleared Radiances, PCA Cloud Cleared Radiance, Ozone and Carbon Products Updates Phase I**
128	**CrIS and VIIRS Collocations and CrIS Sub-Pixel Instrument Line Shape Correction (ILS)**
129	**Development Phase**
130	**CrIS/ATMS Product System: CrIS and VIIRS Collocations**
131	IPT Branch Lead informed to begin product development
132	Algorithm Estimation
133	Initial Archive Requirements identified
134	Quality Monitoring Concept Defined
135	Long-term Maintenance Concept Defined
136	Initial Information Security (IT) concept defined
137	Preliminary CrIS and VIIRS Collocation Development
138	Development, Operational and backup processing system defined
139	CrIS and VIIRS Collocation Development
140	Start modifications to retrieval package to read VIIRS data collocated to CrIS
141	Retrieval package est case processed
142	CrIS and VIIRS Collocation Development refinements
143	Collocation test case processed
144	Code is prepared for implementation
145	Archive process updated
146	**CrIS Sub-Pixel Instrument Line Shape Correction (ILS)**
147	IPT Branch Lead informed to begin product development
148	Algorithm Evaluation
149	Initial Archive Requirements identified
150	Quality Monitoring Concept Defined
151	Long-term Maintenance Concept Defined
152	Initial Information Security (IT) concept defined
153	CrIS Sub-Pixel ILS Correction Development
154	Development, Operational and backup processing system defined
155	Test case processed
156	Design Review
157	Code is prepared for implementation
158	Archive process updated
159	**Pre-operational Phase**
170	**Operational Phase**
174	**CrIS/ATMS Principal Components, Subsetter, Cloud Cleared Radiances, PCA Cloud Cleared Radiance, Ozone and Carbon Products, Temperature Profile, Water Vapor Profiles, Pressure Profile, Cloud and Stability Products Updates Phase II**



NUCAPS Collocation and ILS

Design Review 11/08/2013

Project Timeline

ID	Task Name	2014	2015
1	**CrIS/ATMS Product System**		
2	**Principal Comonts and Subsetter**		
67	**CrIS/ATMS Cloud Clear Radiance, PCA Cloud Cleared Radiance, Ozone and Carbon Products, Temperature Profile, Water Vapor Profiles, Pressure Profile, Cloud and Stability Products**		
91	**Principal, Components, Cloud Cleared Radiances, PCA Cloud Cleared Radiance, Ozone and Carbon Products Updates Phase I**		
128	**CrIS and VIIRS Collocations and CrIS Sub-Pixel Instrument Line Shape Correction (ILS)**		
129	**Development Phase**		
159	**Pre-operational Phase**		
160	Operational and backup processing capabilities in place	3/24/14	4/8/14
161	Final IT Security Concept Defined	5/7/14	5/22/14
162	Check System Security for C&A Compliance	5/21/14	5/29/14
163	Pre-operational product output evaluated & tested	6/4/14	6/19/14
164	System Baselined	6/18/14	9/3/14
165	Code transitions to operations; all documentation is complete	7/9/14	7/29/14
166	Operational and backup capabilities reach ops status	7/23/14	8/12/14
167	Algorithm Readiness Review	8/6/14	
168	Delivery of DAP version 4 to SADIE	8/13/14	
169	Brief SPSRB Oversight Panel(s) on product status	8/14/14	9/3/14
170	Brief OSPO capability is ready to operational	8/14/14	9/3/14
171	**Operational Phase**		
172	SPSRB declares product operational	9/3/14	
173	SPSRB Secretaries/manager update the SPSRB product metrics web pages	10/23/14	11/5/14
174	OSD updates Satellite Products database	10/23/14	11/5/14
175	**CrIS/ATMS Principal Components, Subsetter, Cloud Cleared Radiances, PCA Cloud Cleared Radiance, Ozone and Carbon Products, Temperature Profile, Water Vapor Profiles, Pressure Profile, Cloud and Stability Products Updates Phase II**		

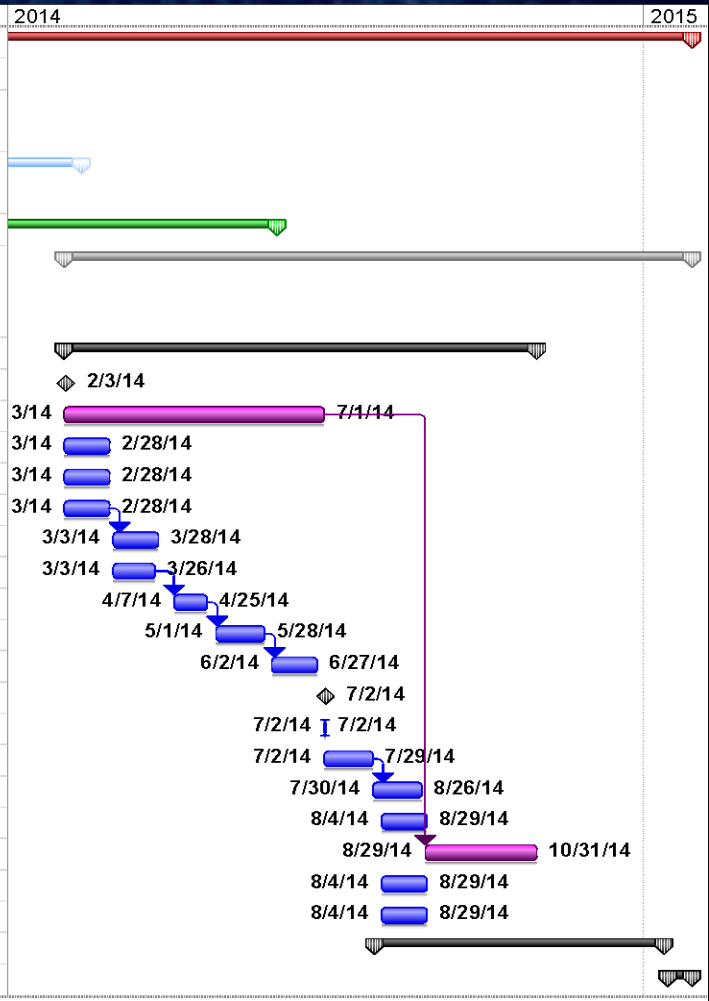
ARR 08/06/2014

Deliver V4 DAP to SADIE 08/13/2014

NUCAPS Co-location Operational 09/03/2014

Project Timeline

ID	Task Name
1	**CrIS/ATMS Product System**
2	**Principal Comonts and Subsetter**
67	**CrIS/ATMS Cloud Clear Radiance, PCA Cloud Cleared Radiance, Ozone and Carbon Products, Temperature Profile, Water Vapor Profiles, Pressure Profile, Cloud and Stability Products**
93	**Principal, Components, Cloud Cleared Radiances, PCA Cloud Cleared Radiance, Ozone and Carbon Products Updates Phase I**
130	**CrIS and VIIRS Collocations and CrIS Sub-Pixel Instrument Line Shape Correction (ILS)**
177	**CrIS/ATMS Principal Components, Subsetter, Cloud Cleared Radiances, PCA Cloud Cleared Radiance, Ozone and Carbon Products, Temperature Profile, Water Vapor Profiles, Pressure Profile, Cloud and Stability Products Updates Phase II**
178	**Development Phase**
179	IPT Branch Lead informed to begin product development
180	Algorithm Evaluation
181	Initial Archive Requirements identified
182	Quality Monitoring Concept Defined
183	Long-term Maintenance Concept Defined
184	Initial Information Security (IT) concept defined
185	CrIS/ATMS Product Upgrade Development
186	Development, Operational and backup processing system defined
187	Upgrade retrieval algorithm using VIIRS collocated data
188	Update coefficients for PCA and NOAA Unique Products
189	Design Review
190	Algorithm Development
191	Make tuning and RTA adjustments
192	Make refinements to difficult trace gas products, methane and carbon dioxide
193	Test case processed
194	Algorithm Testing
195	Code is prepared for implementation
196	Archive process updated
197	**Pre-operational Phase**
210	**Operational Phase**



NUCAPS Enhancements Design Review 07/02/2014

Project Timeline

ID	Task Name	2014	2015
1	**CrIS/ATMS Product System**		
2	**Principal Comonts and Subsetter**		
67	**CrIS/ATMS Cloud Clear Radiance, PCA Cloud Cleared Radiance, Ozone and Carbon Products, Temperature Profile, Water Vapor Profiles, Pressure Profile, Cloud and Stability Products**		
93	**Principal, Components, Cloud Cleared Radiances, PCA Cloud Cleared Radiance, Ozone and Carbon Products Updates Phase I**		
130	**CrIS and VIIRS Collocations and CrIS Sub-Pixel Instrument Line Shape Correction (ILS)**		
177	**CrIS/ATMS Principal Components, Subsetter, Cloud Cleared Radiances, PCA Cloud Cleared Radiance, Ozone and Carbon Products, Temperature Profile, Water Vapor Profiles, Pressure Profile, Cloud and Stability Products Updates Phase II**		
178	**Development Phase**		
197	**Pre-operational Phase**		
198	Algorithm Demonstration	8/29/14	10/31/14
199	Operational and backup processing capabilities in place	7/31/14	8/27/14
200	Final IT Security Concept Defined	8/4/14	8/27/14
201	Delivery of DAP version 5 to SADIE	9/16/14	
202	Check System Security for C&A Compliance	10/6/14	10/17/14
203	Pre-operational product output evaluated & tested	11/3/14	11/12/14
204	Pre-operational Algorithm Testing	11/3/14	1/12/15
205	System Baselined	11/3/14	11/28/14
206	Code transitions to operations; all documentation is complete	12/1/14	12/26/14
207	Operational and backup capabilities reach ops status	12/3/14	12/31/14
208	Brief SPSRB Oversight Panel(s) on product status	1/8/15	1/8/15
209	Brief OSPO capability is ready to operational	1/8/15	1/8/15
210	**Operational Phase**		
211	SPSRB declares product operational		1/15/15
212	SPSRB Secretaries/manager update the SPSRB product metrics web pages	1/15/15	1/28/15
213	OSD updates Satellite Products database	1/15/15	1/28/15

Deliver V5 DAP to SADIE 09/16/2014

NUCAPS Enhancements Operational Jan. 2015

NUCAPS Phase 2 ARR Entry Criteria

- Phase 1 ARR Report (Review Item Disposition)
  - » PDR Risks and Actions
  - » CDR Risks and Actions
  - » TRR Risks and Actions
  - » Phase 1 ARR Risks and Actions
- Updated Phase 1 Algorithm Readiness Document
- Updated Requirements Allocation Document
- Phase 2 Algorithm Readiness Document – the presentation package for the review

NUCAPS Phase 2 ARR Exit Criteria

- Phase 2 Algorithm Readiness Review Report
  - » The ARR Report (ARRR), a standard artifact of the STAR Enterprise Process Lifecycle (EPL), will be compiled after the ARR
  - » The report will contain the Review Item Disposition containing all risks, issues, actions and comments
- Updated Phase 2 ARD if required after ARR

Review Outline

- Introduction
- ARR Phase 1 Report
- Updated Requirements
- Phase 2 Software Architecture
- Algorithm Readiness
- Risk Summary
- Summary and Conclusions

Section 2 –
Phase 1 ARR Report

Presented by

Tom King

Phase 1 ARR Report

- The NUCAPS Phase 1 ARR Report is available as the Review Item Disposition spreadsheet at:
  - » http://www.star.nesdis.noaa.gov/smcd/spb/iosspdt/qadocs/NUCAPS_ARR/NUCAPS_ARR_Review_Item_Disposition.xlsx
- The Phase 1 ARR Report covers the following:
  - » Open PDR Risks and Actions at CDR
  - » Open CDR Risks and Actions
  - » Open TRR Risks and Actions
  - » Phase 1 AAR Risks and Actions
- Risks closed in previous reviews are not shown here, but are located in the RID.
- Risks shown here that are marked as “closed” will be closed with the approval of this review.

PDR Risks and Actions

- **Risk #9:** Project metadata do not meet user requirements
- **Risk Assessment:** Medium
  - » Granule-level metadata have been created, but still needs to be reviewed by CLASS. That effort and the SA development haven't moved forward because of a lack of funding on the CLASS side. CLASS wants to begin archiving NUPs in Spring 2013. However, NUCAPS EDR capability needs to be delivered now for AWIPS to receive EDRs in January 2013. Therefore, CLASS will receive the EDRs and metadata in Spring 2013, but if they don't approve of the metadata, they will have to wait for the next NUCAPS DAP (version 3 to be delivered 09/25/2013) for any modifications.
- **Impact:** Medium
- **Likelihood:** Medium
- **Risk Mitigation:**
  - » Work with CLASS on the SA and making metadata available to them for approval.
  - » Work with Jay Morris at CLASS via the STAR CSWG to update and formalize the metadata methodology.
- **Status:** Open
- **Closure Date:** Sep., 2013

CDR Risks and Actions

- **Risk #22:** The NUCAPS unit tests will not be able to fully test external interfaces.
- **Risk Assessment:** Medium
  - » New risk at CDR. Only the NDE system tests will be able to identify problems with external interfaces.
- **Impact:** Medium
- **Likelihood:** Medium
- **Risk Mitigation:**
  - » After delivery and integration of the NUCAPS software, the NUCAPS development team should work closely with the NDE integration team to evaluate their system tests.
  - » The NDE system test results (for NUCAPS products) should match those obtained from the NUCAPS Code Unit Tests.
  - » The risk can be closed only when system test and unit test results are matching.
- **Status:** Closed

CDR Risks and Actions

- **Risk #23:** There is no way to directly verify the NUCAPS timeliness requirements.
- **Risk Assessment:** Medium
  - » New risk at CDR. The current requirement applies to the end-to-end process. To verify NUCAPS timeliness, there must be a requirement that applies to the NUCAPS portion of the end-to-end process. Risk is MEDIUM, rather than LOW, to reflect the importance of determining a timeliness requirement for the NUCAPS portion.
- **Impact:** Medium
- **Likelihood:** Low
- **Risk Mitigation:**
  - » Work with NDE to determine processing time allocation for NUCAPS
  - » Revise the timeliness requirement in the RAD to be the NUCAPS processing time allocation
  - » NUCAPS unit runs times are documented in the TRD. These actual run times should at least meet those stated in the revised RAD.
- **Status:** Closed

CDR Risks and Actions

- **Risk #26:** NDE target platform is slightly different than the NUCAPS development platform.
- **Risk Assessment:** Low
  - » New risk at CDR.
- **Impact:** Low
- **Likelihood:** Medium
- **Risk Mitigation:**
  - » After delivery and integration of the NUCAPS software, the NUCAPS development team should work closely with the NDE integration team to evaluate their system tests.
  - » As part of the NDE system test, checks should be made to ensure that the test results match those of the NUCAPS unit tests
  - » This risk can only be closed by verifying the agreement between NDE system test output and NUCAPS test output.
- **Status:** Closed

CDR Risks and Actions

- **Risk #29:** CrIS SDR's may not have adequate calibration and/or stability to meet required NUCAPS EDR performance (all products)
- **Risk Assessment:** Low
  - » New risk at CDR.
- **Impact:** TBD
- **Likelihood:** TBD
- **Risk Mitigation:**
  - » Produce simulated CrIS SDRs with degraded performance (noise, calibration bias, etc.)
  - » Run retrievals with the simulated degraded data and compare retrieval to truth
  - » Repeat with revised degradations until retrieval errors become too large
  - » Document required CrIS SDR performance in the VVR
- **Status:** Closed

CDR Risks and Actions

- **Risk #30:** The current CrIS instrument's spectral resolution in the short-wave band is too low for retrieval of carbon monoxide within requirements.
- **Risk Assessment:** Low
  - » New risk at CDR. The NPP CrIS will not be able to maintain continuity on this product.
  - » Even though the likelihood is high, we've assessed this issue as low because our one user (AWIPS) has not requested CO.
- **Impact:** Low
- **Likelihood:** High
- **Risk Mitigation:**
  - » JPSS Project Office has been investigating bringing down full resolution data in the CrIS RDR, but there is not yet a plan to put it into the SDR.
  - » NUCAPS science development team will continue to work with the Project Office to have these data available in the SDR.
- **Status:** Open

TRR Risks and Actions

- **Risk #33:** There is no local angle correction to the retrieval.
- **Risk Assessment:** Low
  - » Because of the complexity of this correction (due to CrIS' rotating FORs) and the minimal impact this work has been given low priority.
- **Impact:** Low
- **Likelihood:** Low
- **Risk Mitigation:**
  - » Investigate implementing this for the next delivery in Sep. 2013.
- **Status:** Open
- **Closure Date:** Sep, 2013

TRR Risks and Actions

- **Risk #38:** NDE may have to deliver the system to operations without the completed documentation. SPSRB may or may not find this acceptable.
- **Risk Assessment:** High
  - » New risk added after TRR. This was a risk for the BUFR toolkit, but it also applies to this project as well.
- **Impact:** High
- **Likelihood:** Medium
- **Risk Mitigation:**
  - » NDE will work with STAR and OSPO PALs to complete the required sections of the SPSRB documents.
- **Status:** Open
- **Closure Date:** June, 2013

ARR Phase 1 Risks and Actions

- **Risk #39:** The review team would like to have a Software Code Review prior to operational implementation.
- **Risk Assessment:** Low
  - » The code was prepared and delivered to OSPO in June 2012, but OSPO could not review it because they had not received funding to make NPP operational. This is still true as of today.
- **Impact:** Low
- **Likelihood:** Low
- **Risk Mitigation:**
  - » After IASI code review, we cleaned up NUCAPS code on our side so it would meet operational requirements.
  - » We could do an SCR after delivery to NDE, once OSPO gets funding. Then, do a delta delivery.
- **Status:** Open
- **Closure Date:** May, 2013

ARR Phase 1 Review Report

- 39 Risks Total
  - » 18 PDR Risks
    - – 17 Closed
    - – 1 Open
  - » 11 CDR Risks
    - – 10 Closed
    - – 1 Open
  - » 6 TRR Risks
    - – 4 Closed
    - – 2 Open
  - » 1 ARR Phase 1 Risk
    - – 1 Open

Review Outline

- Introduction
- ARR Phase 1 Report
- Updated Requirements
- Phase 2 Software Architecture
- Algorithm Readiness
- Risk Summary
- Summary and Conclusions

Section 3 – Requirements Allocation

Presented by

Tom King

Requirements Allocation

- All requirements are presented in this section, but we'll only cover new or updated requirements since TRR.
- The following color coding is used:
  - » Yellow - Basic requirements
  - » Green - New or updated requirements since Phase 1 ARR
  - » Gray - Removed requirements
- The revised Requirements Allocation Document (RAD) is available.
  - » http://www.star.nesdis.noaa.gov/smcd/spb/iosspdt/qadocs/NUCAPS_ARR_Phase2/NUCAPS_RAD_1.4.docx

NUCAPS Requirements – Basic Requirement 0.0

- **Requirement 0.0:** *The NUCAPS project shall adopt the standard practices of the STAR Enterprise Product Lifecycle (EPL), as established in the STAR EPL process assets v2.0, except as specified in requirement 0.1* (process)

- **Requirement 0.1:** The checklist items for the NUCAPS reviews shall be tailored. The tailored checklist items shall be established in the NUCAPS project file “NUCAPS Review Checklists v1r0.xls”. (process).

- **Requirement 0.1.1:** The NUCAPS project file “NUCAPS Review Checklists v1r0.xls” shall be established and maintained under CM in the NUCAPS project artifact repository. (process)

- **Requirement 0.1.2:** The review artifacts specified in the file "NUCAPS Review Checklists v1r0.xls" shall be available to reviewers in advance of each review. (process)

NUCAPS Requirements – Basic Requirement 1.0

- **Requirement 1.0***: The NUCAPS shall generate CrIS thinned radiance products for NWP center users.* (product, functional)
- **Requirement 1.1**: *For NCEP, NUCAPS shall generate CrIS full spatial resolution granule files containing 399 CrIS channels. (*system, functional*)*
- **Requirement 1.1.1**: *The CrIS radiances for shall be apodized.* (product)
- **Requirement 1.1.1.1**: *The type of apodization shall be specified in the delivered system documentation.* (delivery, product)
- **Requirement 1.1.2**: *The NUCAPS shall develop the BUFR table for the CrIS radiances.* (system, functional)
- **Requirement 1.1.2.1**: *The CrIS radiance data for shall be represented as scaled radiances in the BUFR (instead of brightness temperatures).* (system, functional)

NUCAPS Requirements – Basic Requirement 1.0

- **Requirement 1.1.2.1.1**: *The BUFR radiance scaling shall allow for the storage of negative radiances.* (product)
- **Requirement 1.1.2.2**: *The radiance data shall be represented by 16 bit words in the BUFR format.* (system, functional)
- **Requirement 1.1.2.3**: *The NUCAPS shall supply the NDE System Development Team (SDT) with BUFR table as well as the frequency list.* (product, operational)
- **Requirement 1.1.2.4**: *The BUFR table shall contain a table 8 descriptor to allow users to differentiate between (a) CrIS radiances, (b) CrIS cloud-cleared radiances, and (c) CrIS principal component reconstructed radiances.* (product)
- **Requirement 1.1.2.5**: *The BUFR table shall use delayed replication for writing subsets of channels.* (product)
- **Requirement 1.1.2.6**: *The BUFR must contain the VIIRS derived cloud fraction and cloud height.* (performance)
- **Requirement 1.1.2.6.1**: *The VIIRS fields of view must be collocated to those of CrIS.* (performance)

NUCAPS Requirements – Basic Requirement 1.0

- **Requirement 1.1.2.7:** *The BUFR table shall contain the following variables. Variables with parentheses indicate dimensionality.* (product)

Satellite ID
ID of originating center
Satellite instrument
Satellite classification
Year
Month
Day
Hour
Minute
Second
Subsattellite Latitude
Subsattellite Longitude
Latitude
Longitude
Satellite Height
Satellite Zenith
Satellite Azimuth
Solar Zenith
Solar Azimuth

Orbit Number
Granule Number
Scan Line
CrIS FOR
CrIS FOV
Land Fraction
Land-Sea-Coast-Flag
Cloud Fraction
Cloud Height
CrIS Channels(1305)
CrIS Radiances(1305)
CrIS Quality Flag 1
CrIS Quality Flag 2(3)
CrIS Quality Flag 3(3)
CrIS Quality Flag 4(3)
CrIS Quality Flag 5
CrIS Quality Flag 6

NUCAPS Requirements – Basic Requirement 1.0

- **Requirement 1.1.3**: *The product for shall be available within three hours of observation.* (performance)

- **Requirement 1.1.4**: *The NUCAPS shall write CrIS radiance data for NCEP into netCDF4 format so they can be reformatted downstream into BUFR by the N4RT toolkit. Therefore, the contents of the BUFR table defined in section 1.1.2 are, at least, a subset of the netCDF4 output files.* (system, functional)

- **Requirement 1.1.4.1:** *The contents of the BUFR table defined in Requirement 1.1.2 are, at least, a subset of the netCDF4 output files. (system functional)*

- **Requirement 1.5:** *For EUMETSAT, NUCAPS shall generate CrIS full spatial resolution granule files containing all CrIS FOVs and FORs for all 1305 channels. All the other derived requirements for the NCEP product in section 1.1 also apply to this requirement.*

NUCAPS Requirements – Basic Requirement 1.0

- **Requirement 1.2 - Removed**: *For NRL and FNMOC, NUCAPS shall generate CrIS spatially thinned radiance granule files containing the warmest CrIS FOV per FOR for approximately 399 channels.* (system, functional)

  REMOVED: NRL and FNMOC will use the CrIS full channel set from the AirForce (email from Ben Ruston 5/19/2011)

- **Requirement 1.2.1 - Removed**: *The NUCAPS shall write CrIS thinned radiances for NRL and FNMOC into netCDF4 format so the NDE tailoring can convert it into BUFR format.* (system, functional)

- **Requirement 1.2.1.1 - Removed**: *In addition to the variables listed in 1.1.2.7, the BUFR table shall include "ascending and descending flag" variable.* (product)

- **Requirement 1.3:** *For GMAO, NUCAPS shall generate full spatial resolution CrIS radiance granule files for approximately 399 channels.* (system, functional)

- **Requirement 1.3.1:** *The NUCAPS shall write CrIS thinned radiances for GMAO into netCDF4 format so the NDE tailoring tool can convert it into BUFR format.* (system, functional)

NUCAPS Requirements – Basic Requirement 2.0

- **Requirement 1.4**: *The NUCAPS Integrated Product Team (IPT) shall perform validation and verification of CrIS thinned radiances.* (system, operational)

- **Requirement 1.4.1**: *The NUCAPS IPT shall verify that the thinned radiances in the output netCDF4 files are generated correctly and document this in the Validation and Verification Report (VVR).* (system, operational)

NUCAPS Requirements – Basic Requirement 2.0

- **Basic Requirement 2.0 - Removed**: *The NUCAPS shall generate granule files of Principal Components for NRL and FNMOC.* (product, functional)

  NRL and FNMOC will use the full 1305 channel set from the AirForce (email from Ben Ruston 5/19/2011)

- **Requirement 2.1 - Removed**: *The NUCAPS shall generate the eigenvector files that are needed to generate the principal components.* (product, functional)

- **Requirement 2.1.1 - Removed**: *The NUCAPS shall generate the global coverage input datasets used for generating eigenvector files.* (product, functional)

- **Requirement 2.1.2 - Removed**: *The NUCAPS shall supply NDE with the eigenvector files, to give to the customer, during delivery of the DAP.* (product, operational)

NUCAPS Requirements – Basic Requirement 2.0

- **Requirement 2.2 - Removed:** *The NUCAPS shall generate the Principal Component granule files for NRL and FNMOC from the CrIS warmest FOV per FOR.* (product, functional)
- **Requirement 2.2.1 - Removed:** *The NUCAPS shall write principal components into NetCDF4 format.* (system, functional)
- **Requirement 2.2.1 - Removed:** *The NUCAPS shall write principal components into NetCDF4 format.* (system, functional)
- **Requirement 2.2.2 - Removed:** *The NUCAPS IPT shall perform validation and verification of principal components products for NRL and FNMOC.* (system, functional)
- **Requirement 2.2.2.1 - Removed:** *The NUCAPS IPT shall verify that the principal components are being generated correctly and document these results in the VVR.* (system, operational)

NUCAPS Requirements – Basic Requirement 2.0

- **Requirement 2.3 - Removed:** *The NUCAPS shall generate the Principal Component granule files for NRL and FNMOC meeting the following temporal specifications.* (product, functional)

- **Requirement 2.4 - Removed**: *The NUCAPS shall generate the Principal Component files meeting the following spatial specifications:*

  Global coverage.

  Horizontal resolution of ≈50 km (Set of 9 CrIS FOV's collocated with ATMS FOR).

- **Requirement 2.5 - Removed**: *The NUCAPS shall generate approximately 85 principal components from the original 1305 CrIS channel set.*

NUCAPS Requirements – Basic Requirement 3.0

- **Basic Requirement 3.0:** *The NUCAPS shall generate trace gas profile products for U.S users.* (product, functional)

- **Requirement 3.1:** *The NUCAPS shall generate profiles of following trace gases for NRL and FNMOC, derived from a retrieval of CrIS/ATMS radiances:* (product, functional)

  Ozone
  Carbon Monoxide
  Carbon Dioxide
  Methane
  Volcanic Sulfur Dioxide Product
  Nitric Acid
  Nitrous Oxide

NUCAPS Requirements – Basic Requirement 3.0

- **Requirement 3.1.1**: *The NUCAPS trace gas profiles for NRL and FNMOC shall consist of at 100 levels.* (product, functional)

- **Requirement 3.1.2**: *The NUCAPS trace gas profiles for NRL and FNMOC shall meet performance specifications*. (product, functional)

- **Requirement 3.1.2.1**: *Trace gas profiles for FNMOC and NRL shall have the following accuracy*

  O3: 20%/5-km near tropopause
  O3: 10% total column
  CO: 40% mid-trop column (w/ 0.2 cm OPD SW band)
  CH4: 1% mid-trop column
  CO2: 1% mid-trop column
  HNO3: 50% mid-trop column. (product, performance)

- **Requirement 3.1.2.2**: *Trace gas profiles for FNMOC and NRL shall meet the following temporal specifications:*

  Timeliness of less than 3 hours after observation.
  Latency of no more the 15 minutes after granule data are available.

NUCAPS Requirements – Basic Requirement 3.0

- **Requirement 3.1.2.3**: *Trace gas profiles for FNMOC and NRL shall meet the following spatial specifications:*

  Global coverage.

  Horizontal resolution of ≈50 km (Set of 9 CrIS FOV's collocated with ATMS FOR).

- **Requirement 3.1.2.4**: *Trace gas profiles for FNMOC and NRL shall include the vertical weighting functions.*

- **Requirement 3.1.3**: *The NUCAPS shall produce the trace gas products in netCDF4 format for NRL and FNMOC.* (system, functional)

- **Requirement 3.2:** *The NUCAPS shall generate trace gas profile products for CLASS derived from CrIS/ATMS radiances.* (system, functional)

- **Requirement 3.2.1:** *The NUCAPS shall write the trace gas profile products for CLASS in netCDF4 format.* (system, functional)

NUCAPS Requirements – Basic Requirement 3.0

- **Requirement 3.2.2:** *The EDR product for CLASS shall contain the following trace gas profiles and surface and cloud properties calculated on each CrIS FOR:*

Time
Latitude
Longitude
View Angle
Satellite Height
Mean CO2
Solar Zenith
Ascending/Descending Status
Topography
Land-Sea-Coast Flag
Surface Pressure
Skin Temperature
MIT Skin Temperature
First Guess Skin Temperature
Microwave Surface Class
Microwave Surface Emissivity
Number of Cloud Layers
Retrieval Quality Flag

Cloud Top Pressure
Cloud Top Fraction
Pressure (at 100 levels)
Effective Pressure (at 100 levels)
Temperature (at 100 levels)
MIT Temperature (at 100 levels)
First Guess Temperature (at 100 levels)
H2O layer column density (at 100 levels)
H2O mixing ratio (at 100 levels)
First Guess H2O layer column density (at 100 levels)
First Guess H2O mixing ratio (at 100 levels)
MIT H2O layer column density (at 100 levels)
MIT H2O mixing ratio (at 100 levels)
O3 layer column density (at 100 levels)
O3 mixing ratio (at 100 levels)
First Guess O3 layer column density (at 100 levels)
First Guess O3 mixing ratio (at 100 levels)
Liquid H2O layer column density (at 100 levels)
Liquid H2O mixing ratio (at 100 levels)

NUCAPS Requirements – Basic Requirement 3.0

Ice/liquid flag (at 100 levels)
CH_4 layer column density (at 100 levels)
CH_4 mixing ratio (at 100 levels)
CO_2 mixing ratio (at 100 levels)
HNO_3 layer column density (at 100 levels)
HNO_3 mixing ratio (at 100 levels)
N_2O layer column density (at 100 levels)
N_2O mixing ratio (at 100 levels)
SO_2 layer column density (at 100 levels)
SO_2 mixing ratio (at 100 levels)
Microwave emissivity
MIT microwave emissivity
Infrared emissivity
MIT infrared emissivity
Infrared surface emissivity
First Guess infrared surface emissivity
Infrared surface reflectance
Atmospheric Stability
Cloud infrared emissivity
Cloud reflectivity

NUCAPS Requirements – Basic Requirement 3.0

- **Requirement 3.2.3**: *The NUCAPS shall generate granule-level ISO-compliant metadata for CLASS.* (product, quality)
- **Requirement 3.2.4**: *The NUCAPS IPT shall create a Submission Agreement (SA) with CLASS. The SA shall include all information regarding the archival of EDR product granule files.* (product, quality)
- **Requirement 3.3**: *The NUCAPS shall generate trace gas profiles for GMAO, derived from CrIS/ATMS radiances.* (system, functional)
- **Requirement 3.3.1**: *The NUCAPS trace gas profiles for GMAO shall meet performance specifications.* (system, functional)

NUCAPS Requirements – Basic Requirement 3.0

- **Requirement 3.3.1.1**: *Trace gas profiles for GMAO shall have the following accuracy*

  O3: 20%/5-km near tropopause

  O3: 10% total column

  CO: 40% mid-trop column (w/ 0.2 cm OPD SW band)

  CH4: 1% mid-trop column

  CO2: 1% mid-trop column

  HNO3: 50% mid-trop column. (product, performance)

- **Requirement 3.3.1.2**: *Trace gas profiles for GMAO shall meet the following temporal specifications:*

  Timeliness of less than 3 hours after observation.

  Latency of no more the 15 minutes after granule data are available.

- **Requirement 3.3.1.3**: *Trace gas profiles for GMAO shall meet the following spatial specifications:*

  Global coverage.

  Horizontal resolution of ≈50 km (Set of 9 CrIS FOV's collocated with ATMS FOR).

NUCAPS Requirements – Basic Requirement 3.0

- **Requirement 3.3.1.4**: *Trace gas profiles for GMAO shall include the vertical weighting functions.*
- **Requirement 3.4**: *The NUCAPS IPT shall perform tests to demonstrate that all trace gas profile products are being produced correctly and to user specification.* (system, operational)
- **Requirement 3.4.1**: *The results of the tests on the trace gas profile products shall be documented in the VVR.* (system, operational)
- **Requirement 3.5**: *The NUCAPS software shall perform a local angle correction to the CrIS radiances to generate retrievals.* (system, functional)
- **Requirement 3.6**: *The NUCAPS software will need to extract topography and land mask information from a Digital Elevation Model (DEM).* (system, functional)
- **Requirement 3.7**: *The NUCAPS software will need to resample the ATMS FOV to the resolution of the CrIS field of regard.*

NUCAPS Requirements – Basic Requirement 3.0

- **Requirement 3.8**: *The NUCAPS software will produce an SO_2 alert file if an SO_2 anomaly is detected by the retrieval preprocessing.*

- **Requirement 3.9:** *The NUCAPS software shall generate NOAA-Unique profiles for AWIPS derived from CrIS/ATMS radiances.*

- **Requirement 3.9.1:** *The NUCAPS shall write the retrieval products for AWIPS in netCDF4 format.*

NUCAPS Requirements – Basic Requirement 3.0

- **Requirement 3.9.2:** *The retrieval product for AWIPS shall contain the following variables.*

- *Note: This is a subset of the existing set of variables produced by the retrieval. It is our understanding that NDE will extract this subset of variables.*

CrIS FOR
Latitude
View Angle
Topography
Skin Temperature
Pressure (at 100 levels)
Temperature (Kelvin at 100 levels)
O3 (ppb at 100 levels)
Ice/Liquid Flag (at 100 levels)
Stability parameters

Time
Longitude
Ascending/Descending Status
Surface Pressure
Quality Flag
Effective Pressure (at 100 levels)
H2O (g/g at 100 levels)
Liquid H2O (g/g at 100 levels)
SO2 (g/g at 100 levels)

NUCAPS Requirements – Basic Requirement 4.0

- **Basic Requirement 4.0**: *The NUCAPS shall generate CrIS Cloud-clear Radiance (CCR) products for NWP centers and CLASS.* (product, operational)

- **Requirement 4.1**: *The NUCAPS shall generate CrIS CCR products for GMAO.* (system, operational)

- **Requirement 4.1.1**: *CCR products for GMAO shall have an accuracy of less then 1 Kelvin.* (system, functional)

- **Requirement 4.1.2**: *CCR products for GMAO shall meet the following temporal specifications. (system, functional):*

  Timeliness of less than 3 hours after observation.

  Latency of no more the 15 minutes after granule data are available.

NUCAPS Requirements – Basic Requirement 4.0

- **Requirement 4.1.3**: *CCR products for GMAO shall meet the following spatial specifications:*

  Global coverage.

  Horizontal resolution of ≈50 km (Set of 9 CrIS FOV's collocated with ATMS FOR).

- **Requirement 4.2**: *The NUCAPS shall generate CrIS CCR products for CLASS.* (system, operational)

- **Requirement 4.2.1**: *The NUCAPS shall write the CrIS CCR products for CLASS in netCDF4 format.* (system, functional)

- **Requirement 4.2.2**: *The product shall contain CrIS cloud-cleared radiances from all channels.* (product, quality)

- **Requirement 4.2.3**: *The NUCAPS shall generate for CLASS ISO-compliant granule-level metadata for the CCR product.* (product, quality)

NUCAPS Requirements – Basic Requirement 4.0

- **Requirement 4.2.4**: *The NUCAPS IPT shall create a Data Submission Agreement (DSA) with CLASS. The DSA shall include all information regarding the archival of CrIS CCR granule files.* (product, quality)

NUCAPS Requirements – Basic Requirement 5.0

- **Basic Requirement 5.0**: *The NUCAPS shall generate daily global products for system validation, maintenance, and development.* (product, operational)
- **Requirement 5.1**: *The NUCAPS shall generate matchup datasets between satellite measurements and other existing correlated instruments. These products are for STAR.* (system, operational)
- **Requirement 5.1.1**: *The NUCAPS shall generate daily matchups for CrIS and ATMS radiances.* (system, operational)
- **Requirement 5.1.1.1**: *The NUCAPS radiance matchups file shall be a direct access binary file.* (system, operational)
- **Requirement 5.1.1.1.1**: *The NUCAPS shall have code that can write radiance matchup files in direct access binary format.* (product, functional)
- **Requirement 5.1.1.2**: *The NUCAPS radiance matchups file shall be available one day after observation.* (system, operational)

NUCAPS Requirements – Basic Requirement 5.0

- **Requirement 5.1.2**: *The NUCAPS shall generate daily matchups for the CrIS/ATMS retrievals.* (system, operational)
- **Requirement 5.1.2.1**: *The NUCAPS daily matchups file shall be a direct access binary file.* (system, operational)
- **Requirement 5.1.2.1.1**: *The NUCAPS shall have code that can write the retrieval matchup files in direct access binary format.* (product, functional)
- **Requirement 5.1.2.2**: *The NUCAPS daily matchups file shall be available one day after observation.* (system, operational)
- **Requirement 5.2**: *The NUCAPS shall generate gridded products for STAR.* (system, operational)
- **Requirement 5.2.1**: *The NUCAPS shall generate daily Principal Component and reconstructed radiance gridded product files at 0.5X2.0 and 3.0X3.0 degree resolution for STAR.* (product, functional)

NUCAPS Requirements – Basic Requirement 5.0

- **Requirement 5.2.1.1**: *The NUCAPS principal component and reconstructed radiance gridded files shall be in direct access binary format.* (product, functional)
- **Requirement 5.2.1.1.1**: *The NUCAPS shall have code that can write principal component gridded files in direct access binary format.* (product, functional)
- **Requirement 5.2.1.2**: *The NUCAPS principal component and reconstructed radiance gridded files shall be available one day after observation.* (system, operational)
- **Requirement 5.2.1.3:** *The NUCAPS shall generate the eigenvector files that are needed to generate the principal components.*
- **Requirement 5.2.1.3.1:** *The NUCAPS shall generate the global coverage input datasets used for generating eigenvector files.*
- **Requirement 5.2.1.4:** *The NUCAPS shall generate the Principal Component files meeting the following spatial specifications:*

  Global coverage.

  Horizontal resolution of ≈50 km (Set of 9 CrIS FOV's collocated with ATMS FOR).

NUCAPS Requirements – Basic Requirement 5.0

- **Requirement 5.2.1.5:** *The NUCAPS shall generate approximately 85 principal components from the original 1305 CrIS channel set.*
- **Requirement 5.2.2**: *The NUCAPS shall generate daily CrIS/ATMS radiance gridded product files at 0.5X2.0 and 3.0X3.0 degree resolutions for STAR.* (product, functional)
- **Requirement 5.2.2.1**: *The NUCAPS CrIS/ATMS radiance gridded files shall be in direct access binary format.* (product, functional)
- **Requirement 5.2.2.1.1**: *The NUCAPS shall have code that can write radiance gridded files in direct access binary format.* (product, functional)
- **Requirement 5.2.2.2**: *The NUCAPS CrIS/ATMS radiance gridded files shall be available one day after observation.* (system, operational)
- **Requirement 5.2.3**: *The NUCAPS shall generate daily CrIS/ATMS EDR gridded product files at 0.5X2.0 and 3.0X3.0 degree resolutions for STAR.* (product, functional)

NUCAPS Requirements – Basic Requirement 5.0

- **Requirement 5.2.3.1**: *The CrIS/ATMS EDR gridded files shall be in direct access binary format.* (product, functional)
- **Requirement 5.2.3.1.1**: *The NUCAPS shall have code that can write the EDR gridded files in direct access binary format.* (product, functional)
- **Requirement 5.2.3.2**: *The NUCAPS CrIS/ATMS EDR gridded files shall be available one day after observation.* (system, operational)
- **Requirement 5.2.4**: *The NUCAPS shall generate daily CrIS CCR gridded product files at 0.5X2.0 and 3.0X3.0 degree resolution for STAR.* (product, functional)
- **Requirement 5.2.4.1**: *The NUCAPS daily CrIS CCR gridded files shall be in direct access binary format.* (product, functional)
- **Requirement 5.2.4.1.1**: *The NUCAPS shall have code that can write the CCR gridded files in direct access binary format.* (product, functional)

NUCAPS Requirements – Basic Requirement 5.0

- **Requirement 5.2.4.2**: *The NUCAPS daily CrIS CCR gridded files shall be available one day after observation.* (system, operational)

NUCAPS Requirements – Basic Requirement 6.0

- **Basic Requirement 6.0**: *The NUCAPS package shall be delivered to NDE for integration into the NDE Data Handling System (DHS). The following is required as part of this delivery.* (system, operational)

- **Requirement 6.1**: *NUCAPS shall be delivered in the form of a Delivered Algorithm Package (DAP) whose name and contents are defined in the NDE document entitled "Algorithm Delivery Standards, Integration, and Test V1.3". (system, delivery)*

- **Requirement 6.2**: *The NUCAPS shall be able to run on the NDE SADIE platform.* (system, functional)

- **Requirement 6.3**: *The NUCAPS unit driver scripts shall be able to read and handle the content from a Process Control File (PCF) passed to them from the NDE Product Generation Manager (PGM) for each run of the script.* (system, functional)

- **Requirement 6.4**: *The NUCAPS unit driver scripts shall each produce a Process Status File (PSF) after each run of the script in the format required by the NDE Data Handling System (DHS).* (system, functional)

NUCAPS Requirements – Basic Requirement 6.0

- **Requirement 6.5**: *The NUCAPS code shall adhere to the STAR/NDE coding and ESPC security standards.* (system, functional)
- **Requirement 6.6**: *The NUCAPS software shall be able to write all output product into CF-compliant netCDF4 format.* (system, functional)
- **Requirement 6.7:** *The NUCAPS IPT shall deliver an System Maintenance Manual. (product, operational). This is an SPSRB required document.*
- **Requirement 6.8:** *The NUCAPS IPT shall deliver a External Users Manual for NUCAPS products. (product, operational). This is an SPSRB required document.*
- **Requirement 6.9**: *Delivered code within the DAP must compile without errors or unexpected warnings using one or more of the following compilers:*

  xlC version 9.0 or greater (C/C++); gcc version 3.4.6 or greater (C/C++)

  xlf version 11.1 or greater (Fortran 77/90/95)

  java version 1.4.2 or greater. (system, functional)

NUCAPS Requirements – Basic Requirement 6.0

- **Requirement 6.10**: *Delivered Perl scripts must be compatible with version 5.8.2 or greater.* (system, functional)

- **Requirement 6.11:** *Delivered DAP must be compressed using gzip and follow the following naming convention:*

  Project-name_algorithm-identifier_Vnumber_date.tar.gz

- **Requirement 6.12:** *All NUCAPS output product files shall adhere to the naming convention specified in the NDE DAP Content Standards document.*

NUCAPS Requirements – Basic Requirement 7.0

- **Basic Requirement 7.0**: *The delivered NUCAPS system shall be able to read and check NDE input data.*

- **Requirement 7.1**: *All NUCAPS software units shall be able to perform data range checks on the input HDF5 files provided by the NDE DHS.* (system, functional)

- **Requirement 7.2**: *The NUCAPS software shall be able to read the CrIS, ATMS and VIIRS HDF5 input data supplied by NDE.* (system, functional)

- **Requirement 7.3**: *The NUCAPS software shall not process any instrument data if the input file ATMS or CrIS metadata indicates the platform is undergoing a maneuver. If the CrIS instrument is being calibrated, no data will be processed as well.*

NUCAPS Requirements – Basic Requirement 8.0

- **Basic Requirement 8.0:** *The NUCAPS software shall comply with OSPO coding standards identified in the OSPO security checklist.*

NUCAPS Requirements – Basic Requirement 9.0

- **Basic Requirement 9.0:** *The NUCAPS software shall produce data files for science quality monitoring of SDR and EDR data.*

- **Requirement 9.1:** *The NUCAPS software shall produce retrieval output statistics files from each retrieval run to monitor the CrIS EDR quality.*

- **Requirement 9.2:** *The NUCAPS software shall produce principal component score statistics files for each granule to monitor the CrIS SDR quality.*

Note: These files are produced in support of OSPO science quality monitoring efforts.

NUCAPS Requirements – Summary

- The NUCAPS Requirements have been established.
- The NUCAPS Requirements have been documented in the Requirements Allocation Document (RAD).
- The NUCAPS Requirements are traceable to drivers (customer needs or expectations) and other requirements.

Review Outline

- Introduction
- ARR Phase 1 Report
- Updated Requirements
- Phase 2 Software Architecture
- Algorithm Readiness
- Risk Summary
- Summary and Conclusions

Section 4 – NUCAPS Phase 2 Software Architecture

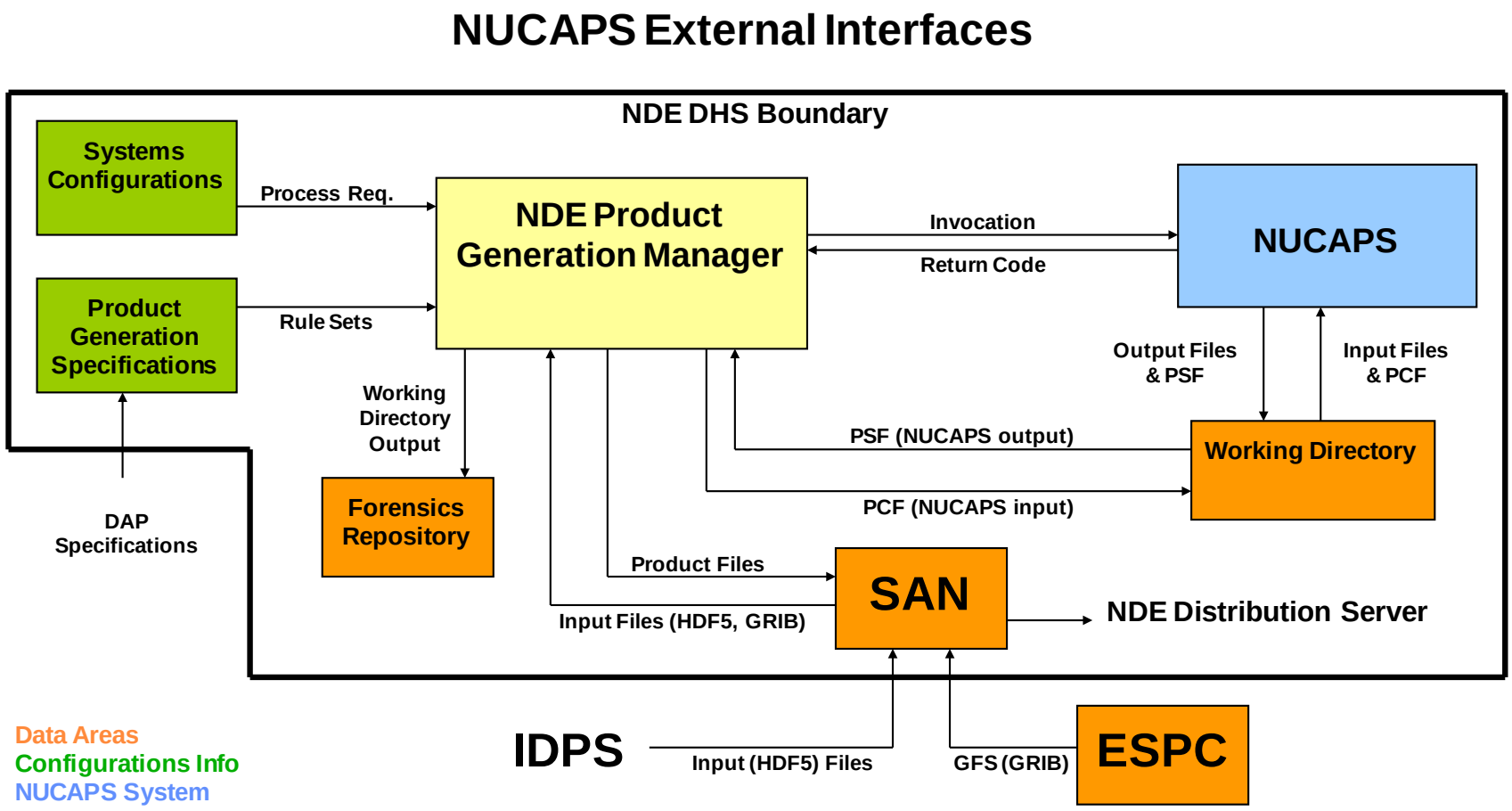
Presented by

Tom King

NUCAPS Phase 2 Software Architecture

- This section shows the architecture to be delivered for Phase 2. We are presenting this because:
  - » Phase 1 architecture is present within Phase 2. Phase 2 is merely an addition to the existing NUCAPS system.
- In this section. Color coding indicates new and future items within tables and flow charts.
- 3 Layers of design will be presented.
  - » External Interfaces
  - » System Layer
  - » Unit Layer

NUCAPS Phase 2 External Interfaces



NUCAPS External Interfaces

- The following tables identifies the input files and output files for the entire NUCAPS package.

- The following new items will be present in Phase 2:
  - » NUCAPS EDR and CCR files (containing metadata in header)
  - » NUCAPS EDR global validation products (grids and matchups)
  - » Principal components global products (grids)
  - » SDR and EDR monitoring files for OSPO QC

NUCAPS Phase 2 External System Inputs

File	Input/ Output	Source	Description	State
CrIS SDR HDF5	Input	NDE	CrIS granule files containing science data (radiances).	Dynamic
CrIS SDR Geo HDF5	Input	NDE	CrIS granule files containing geolocation information for the science data.	Dynamic
ATMS TDR HDF5	Input	NDE	ATMS granule files of ATMS antenna temperatures. 3 files are needed: the granule matching that of the CrIS granule and the 2 neighboring ATMS granules. The neighboring granules are needed for the FOV resampling.	Dynamic
ATMS TDR Geo HDF5	Input	NDE	ATMS granule files containing geolocation information for the TDR.	Dynamic
GFS Forecast	Input	NCEP	The GFS 6-hour forecast file in GRIB2 format	Dynamic
VIIRS Cloud Top Products from CLAVR-X	Input	NDE	CLAVR-X granule files containing cloud data at VIIRS moderate resolution.	Dynamic

NUCAPS Phase 2
External System Outputs (1)

File	Input/ Output	Source	Description	State
CrIS/ATMS all FOVs 399 channels	Output	NUCAPS	The CrIS/ATMS netCDF4 granule file for 399 channels on all CrIS FOVs for all FORs. This is will be converted to BUFR outside of NUCAPS .	Dynamic
CrIS/ATMS all FOVs 1305 channels	Output	NUCAPS	The CrIS/ATMS netCDF4 granule file for 1305 channels on all CrIS FOVs for all FORs. This is will be converted to BUFR outside of NUCAPS. It is also used for quality monitoring at OSPO.	Dynamic
NUCAPS EDR netCDF4	Output	NUCAPS	This is the netCDF4 granule output file containing the EDR product.	Dynamic
NUCAPS CCR netCDF4	Output	NUCAPS	This is the netCDF4 granule output file containing all the CCR product data.	Dynamic
NUCAPS EDR Monitoring	Output	NUCAPS	This is a small text file output from the NUCAPS retrieval that is to be made available to OSPO for EDR QC monitoring.	Dynamic
NUCAPS PCS Monitoring	Output	NUCAPS	This is a small text file output from the NUCAPS PCS processing that is to be made available to OSPO for SDR QC monitoring.	Dynamic

NUCAPS Phase 2 External System Outputs (2)

File	Input/ Output	Source	Description	State
CrIS/ATMS 0.5X2 Global Grids	Output	NUCAPS	CrIS/ATMS daily global grids at 0.5X2 degree grid resolution.	Dynamic
CrIS/ATMS 3X3 Global Grids	Output	NUCAPS	CrIS/ATMSdaily global grids at 3X3 degree grid resolution.	Dynamic
CrIS 3X3 PCS Global Grids (3-band)	Output	NUCAPS	CrIS 3-band principal component daily global grids at 3X3 degree resolution.	Dynamic
CrIS 0.5X2 PCS Global Grids (1-band)	Output	NUCAPS	CrIS 1-band principal component daily global grids at 0.5X2 degree resolution.	Dynamic
CrIS 3X3 PCS Global Grids (1-band)	Output	NUCAPS	CrIS 1-band principal component daily global grids at 3X3 degree resolution.	Dynamic
CrIS/ATMS 0.5X2 EDR global grids	Output	NUCAPS	CrIS/ATMS EDRs on a daily global grid at 0.5X2 degree resolution.	Dynamic
CrIS CCR 0.5X2 global grids	Output	NUCAPS	Cloud-cleared CrIS radiances on a daily global grid at 0.5X2 degree resolution.	Dynamic

NUCAPS Phase 2 External System Outputs (3)

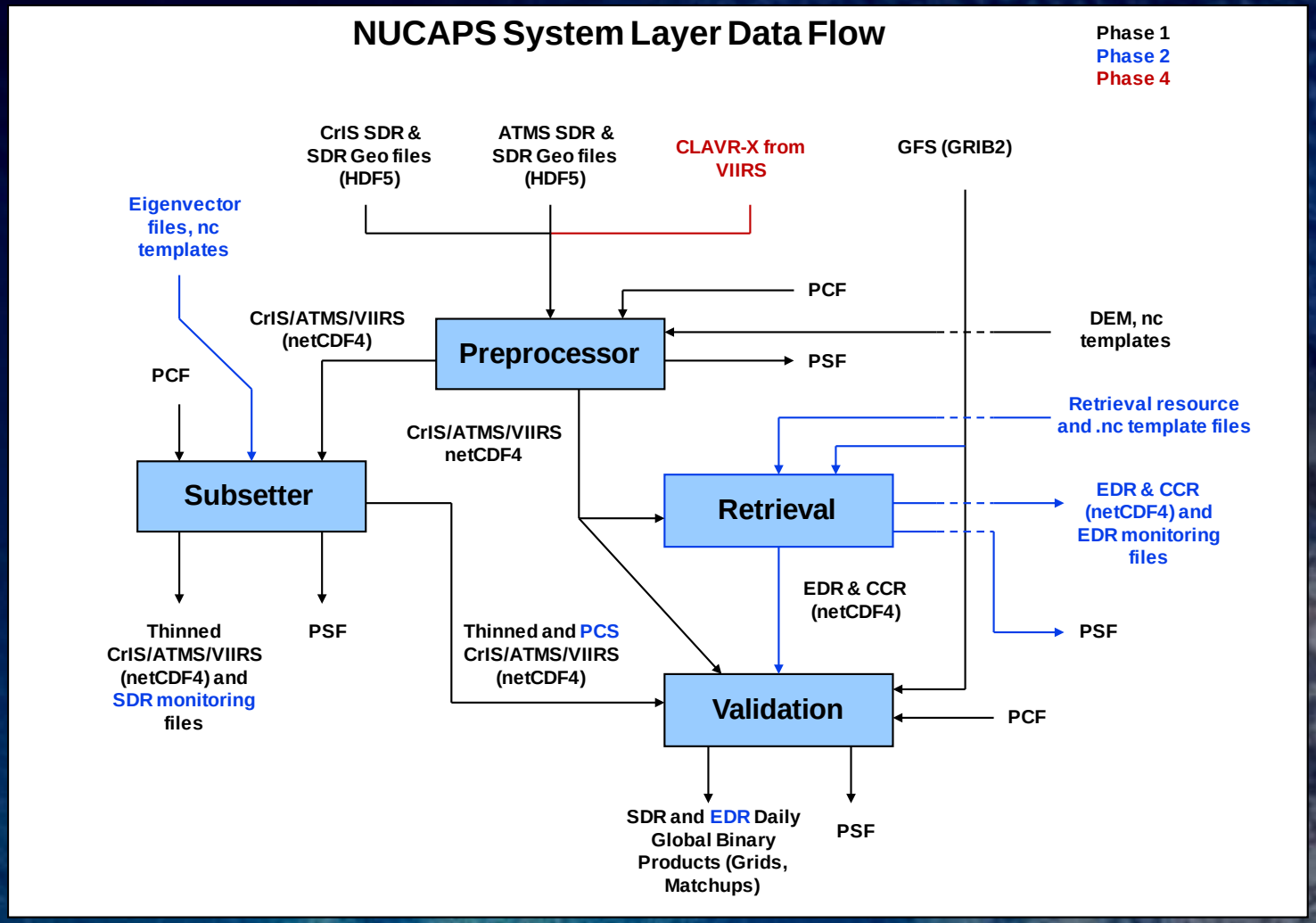
File	Input/ Output	Source	Description	State
GFS 0.5X2 global grids	Output	NUCAPS	A daily global coverage file of selected GFS forecast fields collocated to the same 0.5X2.0 degree grid as the CrIS/ATMS/VIIRS global grids.	Dynamic
CrIS 1-scan global binary	Output	NUCAPS	This file is a CrIS global binary used solely for off-line eigenvector generation at STAR	Dynamic
NUCAPS SDR matchups	Output	NUCAPS	This is a binary file containing all the NUCAPS SDR output matched to radiosonde locations.	Dynamic
NUCAPS SDR matchups list	Output	NUCAPS	This is a text file listing all the possible radiosonde matchup locations/times	Dynamic
NUCAPS EDR matchups	Output	NUCAPS	This is a binary file containing all the NUCAPS EDR output matched to radiosonde locations.	Dynamic
NUCAPS EDR matchups list	Output	NUCAPS	This is a text file listing all the possible radiosonde matchup locations/times	Dynamic

NUCAPS Phase 2 System-Layer Data Flow

- The next figure shows the NUCAPS Phase 2 “system layer” once it is configured within NDE.

- The text and figure elements labeled in blue also identify those components that are added to the Phase 1 configuration for Phase 2.

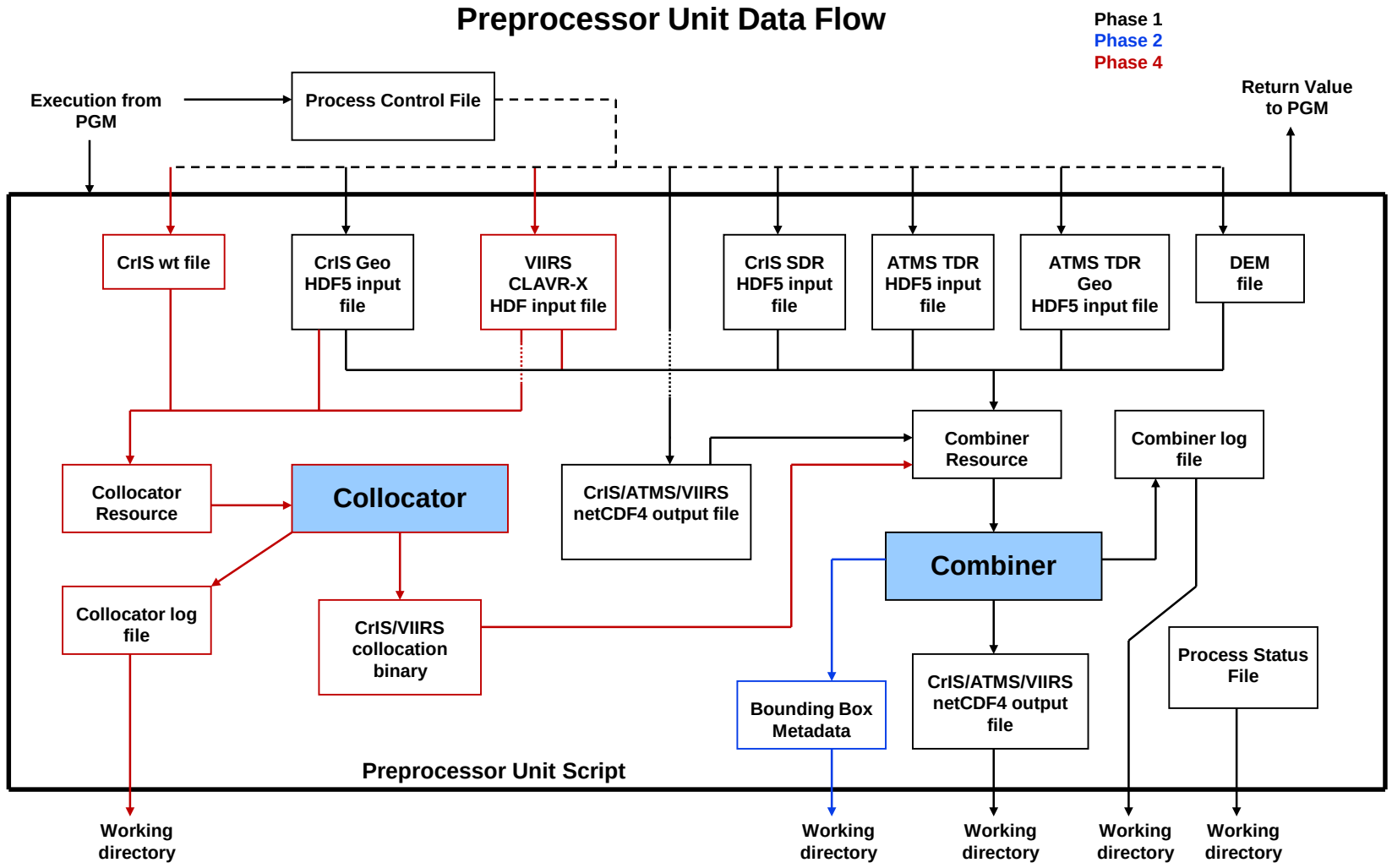
NUCAPS Phase 2 System-Layer Data Flow



Preprocessor Unit

- The following figure and tables shows the Phase 2 Preprocessor unit data flows.
- The tables identify the input, intermediate, and output files.
- Noteworthy items:
  - The only change to this unit is the production of a Bounding Box metadata file.

Preprocessor Unit



Preprocessor Unit Interfaces (1)

File	Input/ Output	Source	Description	State
PCF	Input	NDE	The Process Control File supplied by the NDE PGM.	Dynamic
CrIS SDR HDF5	Input	NDE	CrIS granule files containing science data (radiances).	Dynamic
CrIS SDR Geo HDF5	Input	NDE	CrIS granule files containing geolocation information for the science data.	Dynamic
ATMS TDR HDF5	Input	NDE	ATMS granule files of ATMS antenna temperatures at native ATMS resolution.	Dynamic
ATMS TDR Geo HDF5	Input	NDE	ATMS granule files containing geolocation information for the TDR.	Dynamic
VIIRS CLAVR-X	Input	NDE	CLAVR-X cloud top data at VIIRS moderate resolution.	Dynamic
DEM binary	Input	NUCAPS	Digital Elevation Model file containing surface elevation and land-sea-coast coverage for the globe at 1km.	Static
CrIS/ATMS/VIIRS CDL template	Input	NUCAPS	The netCDF4 CDL template used to create the output file.	Static
CrIS wt file	Input	NUCAPS	The CrIS weighting function coefficients which determine how averaging to be performed on the VIIRS data collocated to CrIS	Static

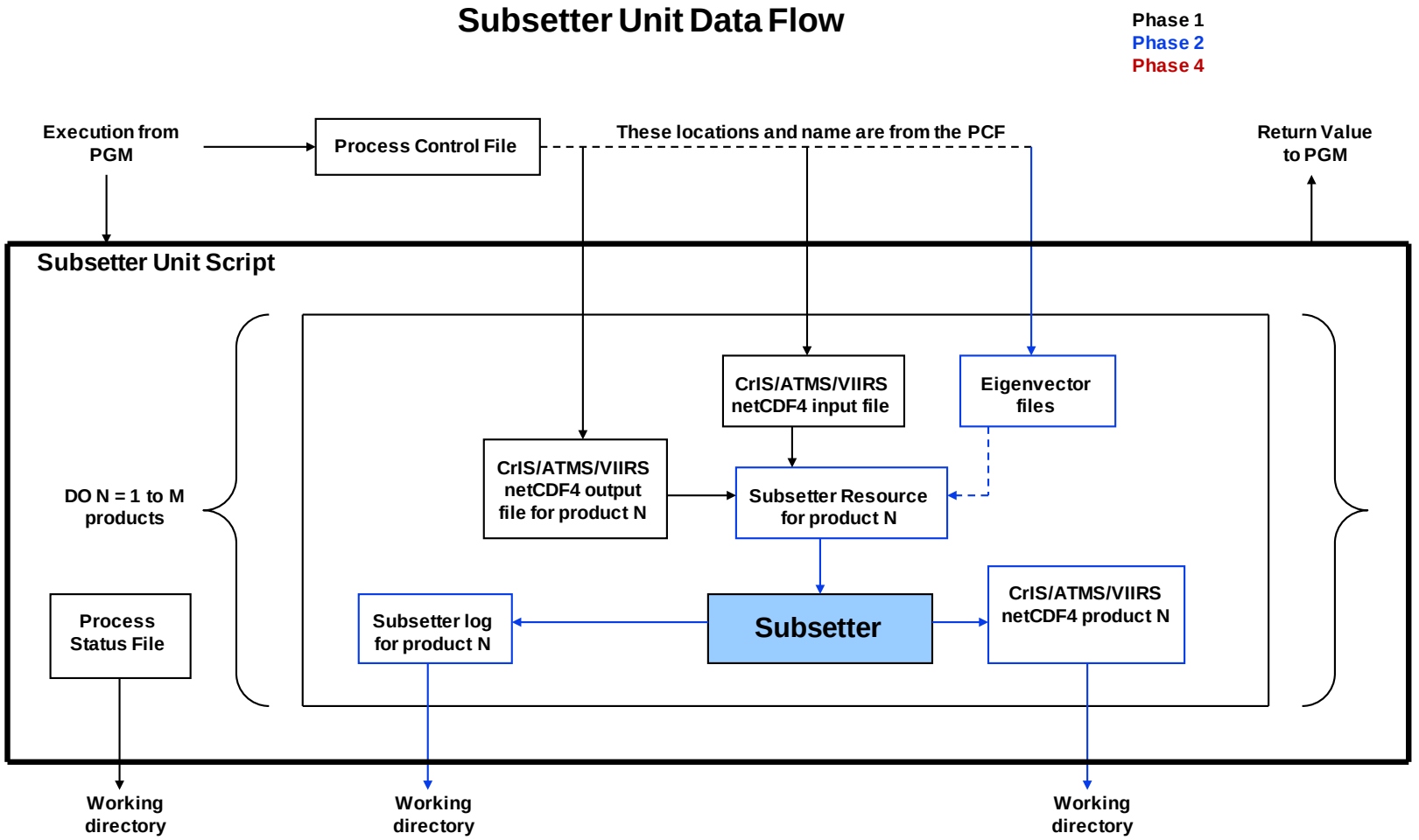
Preprocessor Unit Interfaces (2)

File	Input/ Output	Source	Description	State
Collocator Resource	Intermediate	NUCAPS	This is the resource text file containing the input file names and input parameters for the collocator program.	Dynamic
Combiner Resource	Intermediate	NUCAPS	This is the resource text file containing the input file names and input parameters for the combiner program.	Dynamic
CrIS/ATMS/VIIRS netCDF4	Output	NUCAPS	The output spatially and temporally collocated CrIS, ATMS, and VIIRS data. The CrIS and ATMS data file consist of radiances and the VIIRS data will consist of the cloud fraction and height averaged onto the CrIS FOVs. CrIS radiances have also been apodized and corrected for local angle viewing. The surface information has been added in from the DEM as well.	Dynamic
Bounding Box metadata	Output	NUCAPS	This is a small text file containing NUCAPS internal metadata about the bounding box of the granule and ascending/descending status. This file is required as input to the Retrieval Unit.	Dynamic
Collocator Run log	Output	NUCAPS	This is the run log containing the standard output and return status of Collocator sub-unit.	Dynamic
Combiner Run log	Output	NUCAPS	This is the run log containing the standard output and return status of Combiner sub-unit.	Dynamic
PSF	Output	NUCAPS	This is the Process Status File which is the formatted output status for the entire Preprocessor unit	Dynamic

Subsetter Unit

- The following figure and tables shows the Phase 2 Subsetter unit data flows.
- The tables identify the input, intermediate, and output files.
- Noteworthy items:
  - » Principal Components have been added to the production in phase 2.

Subsetter Unit



Subsetter Unit Interfaces (1)

File	Input/ Output	Source	Description	State
PCF	Input	NDE	The Process Control File supplied by the NDE PGM.	Dynamic
CrIS/ATMS/VIIRS netCDF4	Input	NUCAPS (Preprocessor unit)	The full spectral and spatial resolution netCDF4 files of spatially and temporally collocated CrIS, ATMS, and VIIRS granule files. CrIS radiances have been apodized and corrected for local angle viewing.	Dynamic
Full-band eigenvector File	Input	STAR	The full-band (for 1305 channels) eigenvector file used to generate the principal components.	Static
Band-1 eigenvector file	Input	STAR	The band-1 eigenvector file used to generate the principal components.	Static
Band-2 eigenvector file	Input	STAR	The band-2 eigenvector file used to generate the principal components.	Static
Band-3 eigenvector file	Input	STAR	The band-3 eigenvector file used to generate the principal components.	Static
CrIS/VIIRS template, all FOVs 399 channels	Input	STAR	The thinned radiance netCDF4 template used to make all FOVs on all FORs, 399 channel file.	Static
CrIS/VIIRS template, center FOVs 399 channels	Input	STAR	The thinned radiance netCDF4 template used to make center FOVs on all FORs, 399 channel file.	Static

Subsetter Unit Interfaces (2)

File	Input/ Output	Source	Description	State
PCS CrIS/VIIRS template 1-scan	Input	STAR	This is a thinned radiance netCDF4 template file for generating subsets with full resolution CrIS data on only 1 scans per granule.	Static
PCS CrIS/VIIRS template (3-band) All FOVs	Input	STAR	The principal component netCDF4 template file used to make the 3-band, 300 PCS file, for all FOVs.	Static
PCS CrIS/VIIRS template (1-band) All FOVs	Input	STAR	The principal component netCDF4 template file used to make the 3-band, 100 PCS file, for all FOVs.	Static
PCS CrIS/VIIRS template (3-band) Center FOV	Input	STAR	The principal component netCDF4 template file used to make the 3-band, 300 PCS file, for the center FOV.	Static
PCS CrIS/VIIRS template (1-band) Center FOV	Input	STAR	The principal component netCDF4 template file used to make the 3-band, 100 PCS file, for the center FOV.	Static
CrIS/ATMS/VIIRS all FOVs 399 resource	Intermediate	NUCAPS	This is the resource file needed to generate the CrIS/ATMS/VIIRS all FOVs 399 channel file.	Dynamic
CrIS/ATMS/VIIRS center FOV 399 resource	Intermediate	NUCAPS	This is the resource file needed to generate the CrIS/ATMS/VIIRS center FOV 399 channel file.	Dynamic

Subsetter Unit Interface (3)

File	Input/ Output	Source	Description	State
CrIS/ATMS/VIIRS 1-scan resource	Intermediate	NUCAPS	This is the resource file needed to generate the CrIS/ATMS/VIIRS 1-scan file.	Dynamic
PCS CrIS/ATMS/VIIRS 3-band resource (All FOVs)	Intermediate	NUCAPS	This is the resource file needed to generate the PCS CrIS/ATMS/VIIRS 3-band file (for all FOVs).	Dynamic
PCS CrIS/ATMS/VIIRS 1-band resource (All FOVs)	Intermediate	NUCAPS	This is the resource file needed to generate the PCS CrIS/ATMS/VIIRS 1-band file (for all FOVs).	Dynamic
PCS CrIS/ATMS/VIIRS 3-band resource (Center FOV)	Intermediate	NUCAPS	This is the resource file needed to generate the PCS CrIS/ATMS/VIIRS 3-band file (for the center FOV).	Dynamic
PCS CrIS/ATMS/VIIRS 1-band resource (Center FOV)	Intermediate	NUCAPS	This is the resource file needed to generate the PCS CrIS/ATMS/VIIRS 1-band file (for the center FOV).	Dynamic
CrIS/ATMS/VIIRS all FOVs 399 run log	Output	NUCAPS	This is the run log for the CrIS/ATMS/VIIRS all FOVs 399 channel file.	Dynamic
CrIS/ATMS/VIIRS center FOV 399 run log	Output	NUCAPS	This is the run log for the CrIS/ATMS/VIIRS center FOV 399 channel file.	Dynamic
CrIS/ATMS/VIIRS 1-scan run log	Output	NUCAPS	This is the run log for the CrIS/ATMS/VIIRS 1-scan run log file.	Dynamic
PCS CrIS/ATMS/VIIRS 3-band run log (all FOVs)	Output	NUCAPS	This is the run log for the CrIS/ATMS/VIIRS 3-band file (all FOVs).	Dynamic

Subsetter Unit Interface (4)

File	Input/ Output	Source	Description	State
PCS CrIS/ATMS/VIIRS 1-band run log (all FOVs)	Output	NUCAPS	This is the run log for the CrIS/ATMS/VIIRS 1-band file (all FOVs).	Dynamic
PCS CrIS/ATMS/VIIRS 3-band run log (center FOVs)	Output	NUCAPS	This is the run log for the CrIS/ATMS/VIIRS 3-band file (center FOVs).	Dynamic
PCS CrIS/ATMS/VIIRS 1-band run log (center FOVs)	Output	NUCAPS	This is the run log for the CrIS/ATMS/VIIRS 1-band file (center FOVs).	Dynamic
CrIS/ATMS/VIIRS, all FOVs 399	Output	NUCAPS	The CrIS/ATMS/VIIRS netCDF4 granule file for 399 channels on all CrIS FOVs for all FORs. This is will be converted to BUFR outside of NUCAPS	Dynamic
CrIS/ATMS/VIIRS, center FOV 399	Output	NUCAPS	The CrIS/ATMS/VIIRS netCDF4 granule file for 399 channels on the center CrIS FOV for all FORs. This file is used as input to the 05.X2.0 degree global grids.	Dynamic
CrIS/ATMS/VIIRS 1-scan product	Output	NUCAPS	The CrIS/ATMS/VIIRS netCDF4 granule file with only 1 full resolution scans of CrIS FOVs for all 1305 channels. This file is used in the validation unit to generate a thinned coverage daily global file.	Dynamic
PCS CrIS/ATMS/VIIRS 3-band (all FOVs)	Output	NUCAPS	The CrIS PCS full spatial resolution netCDF4 granule file for 3-bands of 300 PCS (all FOVs)	Dynamic
PCS CrIS/ATMS/VIIRS 1-band (all (FOVs)	Output	NUCAPS	The CrIS PCS full spatial resolution netCDF4 granule file for 1-band of 100 PCS (all FOVs)	Dynamic

Subsetter Unit Interfaces (5)

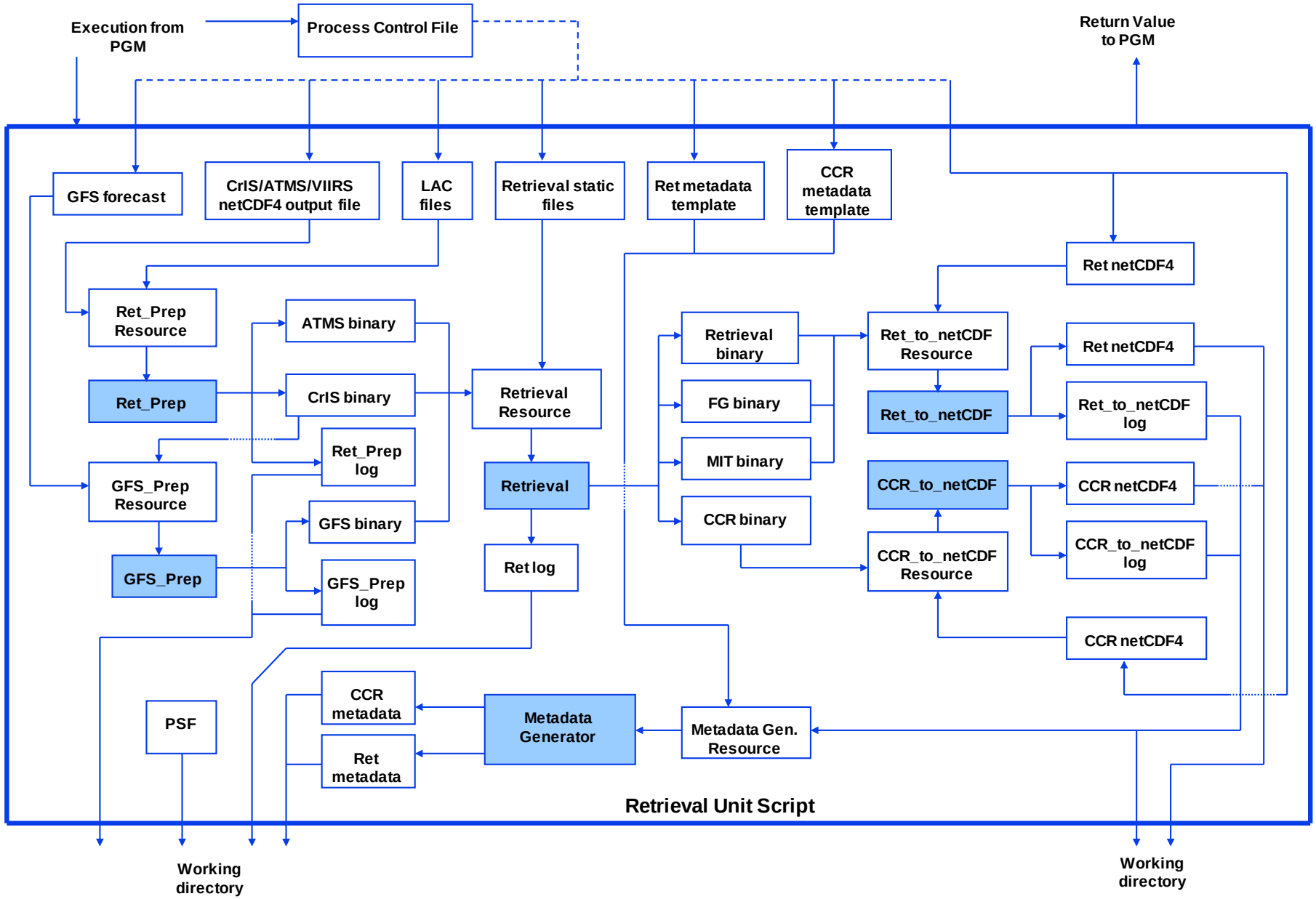
File	Input/ Output	Source	Description	State
PCS CrIS/ATMS/VIIRS 3-band (center FOVs)	Output	NUCAPS	The CrIS PCS full spatial resolution netCDF4 granule file for 3-bands of 300 PCS (center FOVs)	Dynamic
PCS CrIS/ATMS/VIIRS 1-band (center (FOVs)	Output	NUCAPS	The CrIS PCS full spatial resolution netCDF4 granule file for 1-band of 100 PCS (center FOVs)	Dynamic
PCS SDR monitoring file	Output	NUCAPS	This is the PC Score statistics monitoring file which is used for SDR monitoring by OSPO	Dynamic
PSF	Output	NUCAPS	This is the Process Status File containing the formatted status output for the entire Subsetter unit	Dynamic

Retrieval Unit

- The following figure and tables shows the Retrieval unit data flows.
- The tables identify the input, intermediate, and output files.
- Noteworthy items:
  - » The entire unit is new.

Retrieval Unit Data Flow

Phase 1
Phase 2
Phase 4



Retrieval Unit Interfaces (1)

File	Input/ Output	Source	Description	State
PCF	Input	NDE	The Process Control File supplied by the NDE PGM.	Dynamic
CrIS/ATMS/VIIRS netCDF4	Input	NUCAPS (Preprocessor unit)	The spatially and temporally collocated CrIS, ATMS, and VIIRS granule data files. CrIS radiances have been apodized and corrected for local angle viewing.	Dynamic
GFS Forecast	Input	NCEP	The GFS 6-hour forecast file in GRIB format	Dynamic
NUCAPS Bounding Box	Input	NUCAPS (Preprocessor Unit)	This is an internal metadata file for NUCAPS. It is produced by the Preprocessor Unit and contains the bounding box and ascending/descending status.	Dynamic
NUCAPS EDR template	Input	STAR	This is the netCDF4 template file needed to create the EDR output file.	Static
CrIS CCR template	Input	STAR	This is the netCDF4 template file needed to create the CCR output file.	Static
CrIS AR CCR template	Input	STAR	This is the netCDF4 template file needed to create the CCR output file specifically for the CLASS (“AR” = Archive).	Static

Retrieval Unit Interfaces (2)

File	Input/ Output	Source	Description	State
Cloud namelist	Input	STAR	Cloud files name list	Static
IO namelist	Input	STAR	Input/Output name list	Static
Microwave namelist	Input	STAR	Microwave file name list	Static
Ozone namelist	Input	STAR	Ozone file name list	Static
Pro namelist	Input	STAR	Profile file name list	Static
Temp namelist	Input	STAR	Temperature file name list	Static
Water namelist	Input	STAR	Water vapor file name list	Static
CC_DAY_FILENAME			This is the name and location (if not in the local working directory) of the clear flag day time file needed by the retrieval.	Static
CC_NIGHT_FILENAME	Input	STAR	This is the name and location (if not in the local working directory) of the clear flag night time file needed by the retrieval.	Static
OLRCOEFFILE	Input	STAR	This is contains the rapid transmittance coefficients to compute outgoing longwave radiation.	Static
TUNINGCOEFFILE	Input	STAR	The tuning coefficient file.	Static
TUNINGMASKFILE	Input	STAR	The tuning mask file.	Static
RTAERRFILE	Input	STAR	The error coefficient file for the radiative transfer model.	Static
MWNOISEFILE	Input	STAR	This is microwave noise file.	Static
TC_AMSU	Input	STAR	This is the ATMS transmittance coefficient file.	Static
TC_AIRS	Input	STAR	This is the post-flight CrIS RTA coefficient file.	Static

Retrieval Unit Interfaces (3)

File	Input/ Output	Source	Description	State
IRNOISEFILE	Input	STAR	This is post-flight CrIS RTA coefficients file.	Static
SOLARFILE	Input	STAR	This is the CrIS solar irradiance file for the radiance calculation.	Static
NOAAEIGFILE	Input	STAR	This is the NOAA IR regression radiance eigenvector file.	Static
NOAAFRQFILE	Input	STAR	This is the NOAA IR regression frequency file.	Static
NOAAANGFILE	Input	STAR	This is the NOAA angle depended regression coefficient file.	Static
NOAAREGFILE	Input	STAR	This is the NOAA IR regression coefficient file.	Static
CLDAVGFILE	Input	STAR	This is the cloud averaging table.	Static
L2ERROR_IN	Input	STAR	This is a file containing the ensemble error estimate of climatology.	Static
MASUDAFILE	Input	STAR	This is coefficients file for the Masuda surface emissivity model for ocean.	Static
MWCOVFILE	Input	STAR	This is a microwave retrieval covariance file.	Static
ECOFFILE	Input	STAR	This is a microwave retrieval error covariance file.	Static
HSBWEIGHTFILE	Input	STAR	This is a microwave weighting file.	Static
UARSCLIMFILE	Input	STAR	This is the UARS climatology file for upper atmosphere.	Static
NCEPCLIMFILE	Input	STAR	This is the NCEP climatology file for Temperature and water vapor.	Static

Retrieval Unit Interfaces (4)

File	Input/ Output	Source	Description	State
CrIS ret binary	Intermediate	NUCAPS	The CrIS retrieval input format binary file.	Dynamic
ATMS ret binary	Intermediate	NUCAPS	The ATMS retrieval input format binary.	Dynamic
GFS ret binary	Intermediate	NUCAPS	The GFS retrieval input format binary.	Dynamic
Retrieval binary	Intermediate	NUCAPS	The retrieval output binary.	Dynamic
FG binary	Intermediate	NUCAPS	The first guess output binary.	Dynamic
MIT binary	Intermediate	NUCAPS	The MIT retrieval output binary.	Dynamic
CCR binary	Intermediate	NUCAPS	The CCR output binary.	Dynamic
TRU binary	Intermediate	NUCAPS	The TRU (Truth file) output binary.	Dynamic
F61 binary	Intermediate	NUCAPS	The f61 output binary.	Dynamic
F69 binary	Intermediate	NUCAPS	The f69 output binary.	Dynamic
F70binary	Intermediate	NUCAPS	The f75 diagnostic output binary.	Dynamic
F95 binary	Intermediate	NUCAPS	The f95 diagnostic output binary.	Dynamic
BIN binary	Intermediate	NUCAPS	The BIN diagnostic output binary.	Dynamic
Ret_Prep resource	Intermediate	NUCAPS	The Ret_Prep resource file required to reformat the satellite data into the retrieval input format.	Dynamic

Retrieval Unit Interfaces (5)

File	Input/ Output	Source	Description	State
GFS_Prep resource	Intermediate	NUCAPS	The GFS_Prep resource file required to reformat the GFS surface pressure data into the retrieval input format.	Dynamic
Retrieval resource	Intermediate	NUCAPS	The resource file required to run the retrieval.	Dynamic
Ret_to_netCDF resource	Intermediate	NUCAPS	The resource file required to reformat the retrieval, FG, and MIT output into netCDF4.	Dynamic
CCR_to_netCDF resource	Intermediate	NUCAPS	The resource file required to reformat the CCR output into netCDF4 format.	Dynamic
Ret_Prep run log	Output	NUCAPS	The Ret_Prep run log file.	Dynamic
GFS_Prep run log	Output	NUCAPS	The GFS_Prep run log file.	Dynamic
NUCAPS Retrieval run log	Output	NUCAPS	The Retrieval run log file.	Dynamic
Ret_to_netCDF run log	Output	NUCAPS	The Ret_to_netCDF run log file.	Dynamic
CCR_to_netCDF run log	Output	NUCAPS	The CCR_to_netCDF run log file.	Dynamic
NUCAPS EDR netCDF4	Output	NUCAPS	This is the netCDF4 granule output file containing the EDR.	Dynamic

Retrieval Unit Interfaces (6)

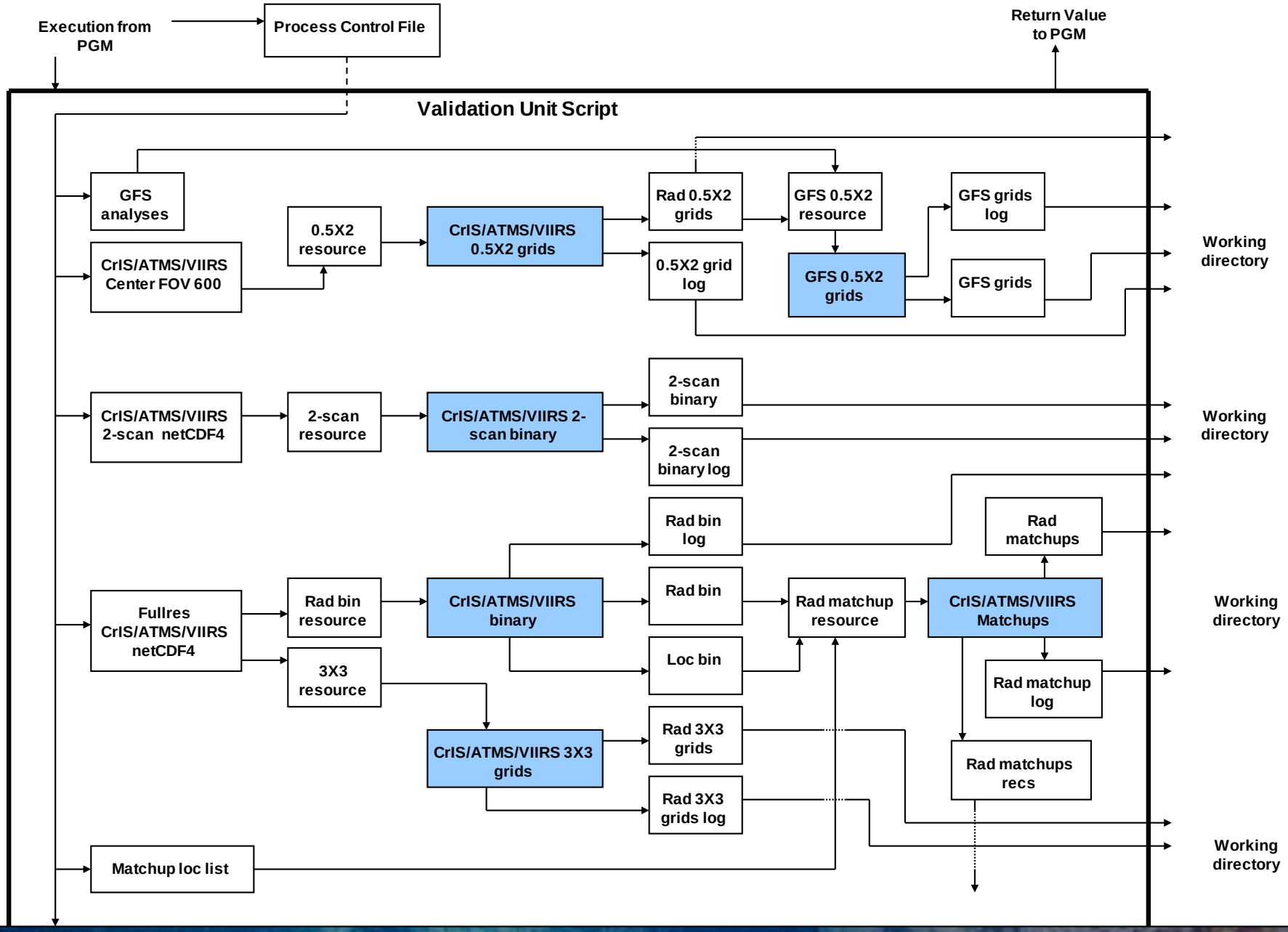
File	Input/ Output	Source	Description	State
CrIS CCR netCDF4	Output	NUCAPS	This is the netCDF4 granule output file containing all the CCR product data.	Dynamic
NUCAPS EDR monitoring file	Output	NUCAPS	This is the retrieval.out EDR statistics monitoring file for OSPO.	Dynamic
Retrieval log	Output	NUCAPS	This is the run log containing the standard output and return status of retrieval sub-unit processes.	Dynamic
PSF	Output	NUCAPS	This is the Process Status File containing the formatted status output for the entire Retrieval unit	Dynamic

Validation Unit

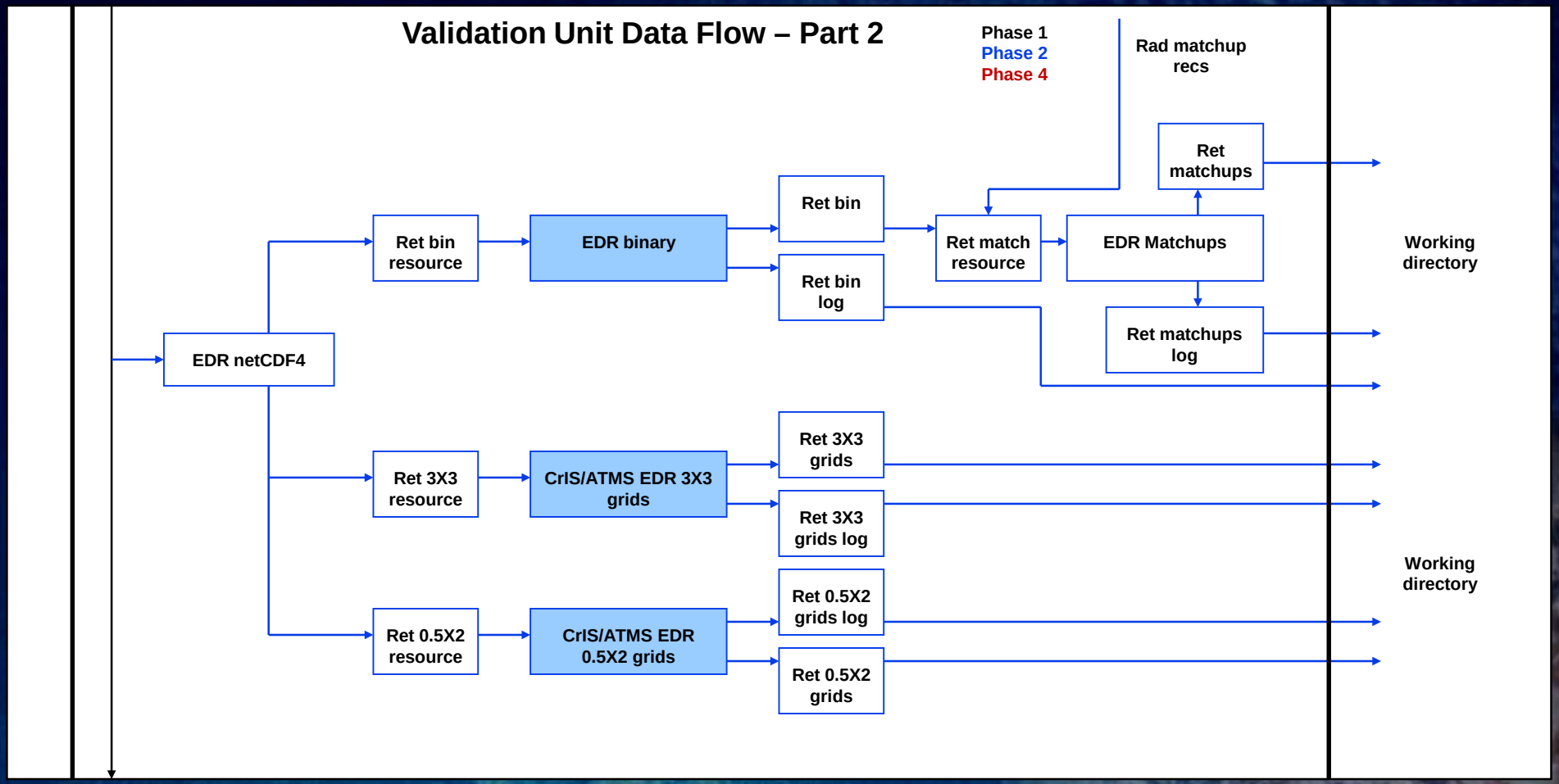
- The following figure and tables shows the Phase 2 Validation unit data flows. All new items are identified in blue
- The tables identify the input, intermediate, and output files.
- Noteworthy items:
  - » PCS grids
  - » EDR global grids and matchups

Validation Unit Data Flow – Part 1

Phase 1
Phase 2
Phase 4

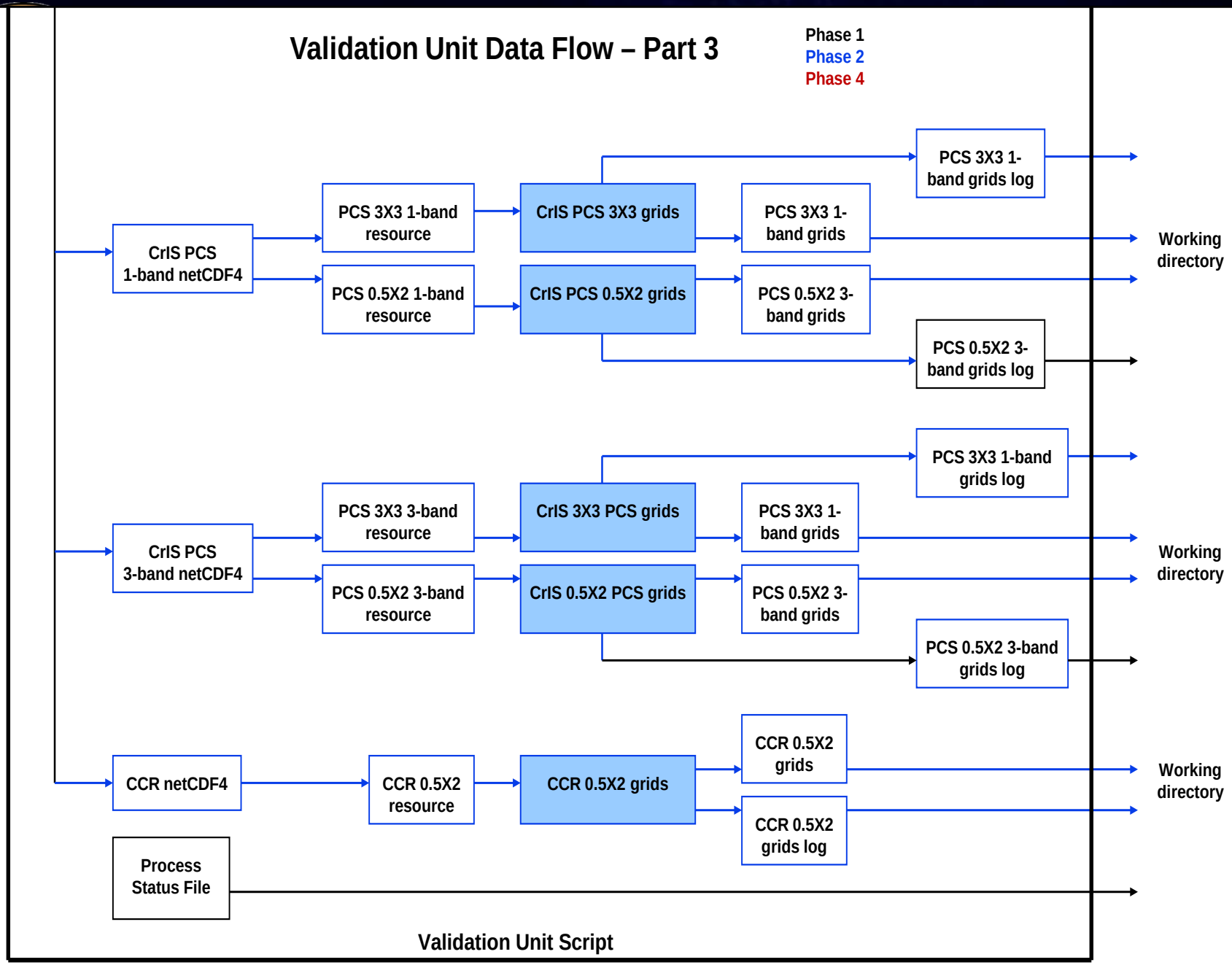


Validation Unit (2)



Validation Unit Data Flow – Part 3

Phase 1
Phase 2
Phase 4



Validation Unit Interfaces (1)

File	Input/ Output	Source	Description	State
PCF	Input	NDE	The Process Control File supplied by the NDE PGM.	Dynamic
CrIS/ATMS/VIIRS netCDF4	Input	NUCAPS (Preprocessor)	The spatially and temporally collocated CrIS, ATMS, and VIIRS granule data files (all CrIS FOVs and channels) CrIS radiances have been apodized.	Dynamic
Thinned CrIS/ATMS/VIIRS netCDF4 file for a center FOV, 399 channels	Input	NUCAPS (Subsetter)	The CrIS/ATMS/VIIRS netCDF4 files for the center FOV.	Dynamic
Thinned CrIS/ATMS/VIIRS netCDF4 1-scan file.	Input	NUCAPS (Subsetter)	The CrIS/ATMS/VIIRS netCDF4 files containing only 1 scans of CrIS FOVs per granule.	Dynamic
PCS CrIS/ATMS/VIIRS 1-band (all (FOVs)	Input	NUCAPS (Subsetter)	The CrIS PCS full spatial resolution netCDF4 granule file for 1-band of 100 PCS (all FOVs)	Dynamic
PCS CrIS/ATMS/VIIRS 3-band (center FOVs)	Input	NUCAPS (Subsetter)	The CrIS PCS full spatial resolution netCDF4 granule file for 3-bands of 300 PCS (center FOVs)	Dynamic
PCS CrIS/ATMS/VIIRS 1-band (center (FOVs)	Input	NUCAPS (Subsetter)	The CrIS PCS full spatial resolution netCDF4 granule file for 1-band of 100 PCS (center FOVs)	Dynamic
EDR netCDF4	Input	NUCAPS (Retrieval)	This is the netCDF4 granule file containing the EDR product.	Dynamic
CrIS CCR netCDF4	Input	NUCAPS (Retrieval)	This is the netCDF4 granule file containing all the CCR product data.	Dynamic
GFS analyses	Input	NCEP	These are the GFS analysis files generated at 00, 06, 12, and 18Z.	Dynamic

Validation Unit Interfaces (2)

File	Input/ Output	Source	Description	State
Matchup loc list	Input	NUCAPS	This is a static ASCII text file containing a list of in-situ measurement locations and observations times. These are mostly radiosonde observations, but could include aircraft or dropsondes as well.	Static
Rad bin	Intermediate	NUCAPS	The CrIS/ATMS/VIIRS global binary used as the input to the CrIS/ATMS/VIIRS matchups.	Dynamic
Ret bin	Intermediate	NUCAPS	The EDR global binary used as the input to the EDR matchups.	Dynamic
Rad matchups recs	Intermediate	NUCAPS	The matchup direct access record list produced by the CrIS/ATMS/VIIRS matchups and used by the NUCAPS EDR matchups.	Dynamic
CrIS/ATMS/VIIRS 0.5X2 grids resource	Intermediate	NUCAPS	The resource file required to generate the CrIS/ATMS/VIIRS 0.5X2 grids.	Dynamic
CrIS/ATMS/VIIRS 3X3 grids resource	Intermediate	NUCAPS	The resource file required to generate the CrIS/ATMS/VIIRS 3X3 grids	Dynamic
1-scan resource	Intermediate	NUCAPS	The resource file required to generate the CrIS/ATMS/VIIRS 1-scan binary.	Dynamic

Validation Unit Interfaces (3)

File	Input/ Output	Source	Description	State
CrIS/ATMS/VIIRS binary resource	Intermediate	NUCAPS	The resource file required to generate the CrIS/ATMS/VIIRS global binary which is needed for the matchups.	Dynamic
GFS forecast grids resource	Intermediate	NUCAPS	The resource file required to generate the 0.5X2 GFS global grids.	Dynamic
Rad matchup resource	Intermediate	NUCAPS	The resource file required to generate the CrIS/ATMS/VIIRS matchups.	Dynamic
Ret bin resource	Intermediate	NUCAPS	The resource file required to generate the EDR global binary which is needed for the retrieval matchups.	Dynamic
Ret match resource	Intermediate	NUCAPS	The resource file required to generate the EDR matchups.	Dynamic
Ret 3X3 resource	Intermediate	NUCAPS	The resource file required to generate the NUCAPS EDR 3X3 grids	Dynamic
Ret 0.5X2 resource	Intermediate	NUCAPS	The resource file required to generate the NUCAPS EDR 0.5X2 grids	Dynamic
PCS 3X3 1-band resource	Intermediate	NUCAPS	The resource file required to generate the 1-band PCS CrIS/ATMS/VIIRS 3X3 grids.	Dynamic
PCS 0.5X2 1-band resource	Intermediate	NUCAPS	The resource file required to generate the 1-band PCS CrIS/ATMS/VIIRS 0.5X2 grids.	Dynamic

Validation Unit Interfaces (4)

File	Input/ Output	Source	Description	State
PCS 0.5X2 3-band resource	Intermediate	NUCAPS	The resource file required to generate the 3-band PCS CrIS/ATMS/VIIRS 0.5X2 grids.	Dynamic
CCR 0.5X2 resource	Intermediate	NUCAPS	The resource file required to generate the CCR 0.5X2 grids.	Dynamic
CrIS/ATMS/VIIRS 0.5X2 grids run log	Output	NUCAPS	The run log generated by the running of the CrIS/ATMS/VIIRS 0.5X2 grids program.	Dynamic
CrIS/ATMS/VIIRS 3X3 grids run log	Output	NUCAPS	The run log generated by the running of the CrIS/ATMS/VIIRS 3X3 grids program.	Dynamic
1-scan run log	Output	NUCAPS	The run log generated by the running of the CrIS/ATMS/VIIRS 1-scan binary program.	Dynamic
CrIS/ATMS/VIIRS binary resource	Output	NUCAPS	The run log generated by the running of the CrIS/ATMS/VIIRS global binary program.	Dynamic
GFS forecast grids run log	Output	NUCAPS	The run log generated by the running of the GFS 0.5X2 grids program.	Dynamic

Validation Unit Interfaces (5)

File	Input/ Output	Source	Description	State
Rad matchup run log	Output	NUCAPS	The run log generated by the running of the CrIS/ATMS/VIIRS radiance matchups program.	Dynamic
Ret bin run log	Output	NUCAPS	The run log generated by the running of the EDR binary program.	Dynamic
Ret match run log	Output	NUCAPS	The run log generated by the running of the EDR matchups program.	Dynamic
Ret 3X3 run log	Output	NUCAPS	The run log generated by the running of the EDR 3X3 grids program.	Dynamic
Ret 0.5X2 run log	Output	NUCAPS	The run log generated by the running of the EDR 0.5X2 grids program.	Dynamic
PCS 3X3 1-band run log	Output	NUCAPS	The run log generated by the running of the 1-band PCS CrIS/ATMS/VIIRS 3X3 grids program.	Dynamic
PCS 0.5X2 1-band run log	Output	NUCAPS	The run log generated by the running of the 1-band PCS CrIS/ATMS/VIIRS 0.5X2 grids program.	Dynamic
PCS 0.5X2 3-band run log	Output	NUCAPS	The run log generated by the running of the 3-band PCS CrIS/ATMS/VIIRS 0.5X2 grids program.	Dynamic

Validation Unit Interfaces (6)

File	Input/ Output	Source	Description	State
CCR 0.5X2 run log	Output	NUCAPS	The run log generated by the running of the CCR 0.5X2 grids program.	Dynamic
CrIS/ATMS/VIIRS 0.5X2 Global Grids	Output	NUCAPS	CrIS/ATMS/VIIRS daily global grids at 0.5X2 degree grid resolution.	Dynamic
CrIS/ATMS/VIIRS 3X3 Global Grids	Output	NUCAPS	CrIS/ATMS/VIIRS daily global grids at 3X3 degree grid resolution.	Dynamic
CrIS 0.5X2.0 PCS Global Grids (3-band)	Output	NUCAPS	CrIS 3-band principal component daily global grids at 0.5X2 degree resolution.	Dynamic
CrIS 0.5X2 PCS Global Grids (1-band)	Output	NUCAPS	CrIS 1-band principal component daily global grids at 0.5X2 degree resolution.	Dynamic
CrIS 3X3 PCS Global Grids (1-band)	Output	NUCAPS	CrIS 1-band principal component daily global grids at 3X3 degree resolution.	Dynamic
CrIS/ATMS 0.5X2 EDR global grids	Output	NUCAPS	CrIS/ATMS EDRs on a daily global grid at 0.5X2 degree resolution.	Dynamic
CrIS CCR 0.5X2 global grids	Output	NUCAPS	Cloud-cleared CrIS radiances on a daily global grid at 0.5X2 degree resolution.	Dynamic

Validation Unit Interfaces (7)

File	Input/ Output	Source	Description	State
GFS forecast global grids	Output	NUCAPS	A daily global coverage file of selected GFS forecast fields collocated to the same 0.5X2.0 degree grid as the CrIS/ATMS/VIIRS global grids.	Dynamic
CrIS 1-scan global coverage binary	Output	NUCAPS	This file is a CrIS global binary used solely for off-line eigenvector generation at STAR	Dynamic
NUCAPS SDR matchups	Output	NUCAPS	This is a file with matches between CrIS/ATMS/VIIRS FORs and radiosonde (or other instrument) locations.	Dynamic
NUCAPS EDR matchups	Output	NUCAPS	This is NUCAPS EDR output matched to radiosonde locations.	Dynamic
Run log	Output	NUCAPS	This is the run log containing the standard output and return status of Validation unit sub-unit processes.	Dynamic
PSF	Output	NUCAPS	This is the Process Status File containing the formatted status output for the entire Validation unit	Dynamic

Updates to PCF Files

- No changes to the NUCAPS_Preproc.pl.PCF
- NUCAPS_Subset.pl.PCF has some new and modified fields (highlighted in red on the next slide)
  - » PCS are turned “ON”
  - » New template added for ALLFOVs 3-band PCS. Required for OSPO monitoring.
- NUCAPS_Retrieval.pl.PCF is entirely new.
- NUCAPS_Validation.pl.PCF has some updates
  - » PCS grids are turned “ON”
  - » EDR, CCR grids are turned “ON”
  - » EDR matchups are turned “ON”

Updates to PCF Files – Subsetter PCF

- Here is an example of a Phase 2 NUCAPS_Subset.pl.PCF:

```
job_coverage_start=201211260349459
job_coverage_end=201211260350157
OPS_BIN=/disk3/pub/tking/NUCAPS/CrISOPS/Common_Bin
NUCAPS_C0300_ALLFOVS_TEMPLATE=/disk3/pub/tking/NUCAPS/CrISOPS/CDLFILES/nucaps_c0300_allfovs.nc
NUCAPS_C0300_CENTERFOV_TEMPLATE=/disk3/pub/tking/NUCAPS/CrISOPS/CDLFILES/nucaps_c0300_centerfov.nc
NUCAPS_C0300_ALLFOVS_PCS1B_TEMPLATE=/disk3/pub/tking/NUCAPS/CrISOPS/CDLFILES/nucaps_c0300_allfovs_pcs1b.nc
NUCAPS_C0300_ALLFOVS_PCS3B_TEMPLATE=/disk3/pub/tking/NUCAPS/CrISOPS/CDLFILES/nucaps_c0300_allfovs_pcs3b.nc
NUCAPS_C0300_CENTERFOV_PCS1B_TEMPLATE=/disk3/pub/tking/NUCAPS/CrISOPS/CDLFILES/nucaps_c0300_centerfov_pcs1b.nc
NUCAPS_C0300_CENTERFOV_PCS3B_TEMPLATE=/disk3/pub/tking/NUCAPS/CrISOPS/CDLFILES/nucaps_c0300_centerfov_pcs3b.nc
NUCAPS_C1317_1SCAN_TEMPLATE=/disk3/pub/tking/NUCAPS/CrISOPS/CDLFILES/nucaps_c1317_1scan.nc
PC_1BAND_COEFF=/disk3/pub/tking/NUCAPS/CrISOPS/pc_coeffs/eigvec_20120515_band1_ascii_real
PC_2BAND_COEFF=/disk3/pub/tking/NUCAPS/CrISOPS/pc_coeffs/eigvec_20120515_band2_ascii_real
PC_3BAND_COEFF=/disk3/pub/tking/NUCAPS/CrISOPS/pc_coeffs/eigvec_20120515_band3_ascii_real
PC_FBAND_COEFF=/disk3/pub/tking/NUCAPS/CrISOPS/pc_coeffs/eigvec_20120515_full_ascii_real
NUCAPS_ALL_PRODUCT=NUCAPS_ALL_20121126_0349459_0350157.nc
NUCAPS_C0300_ALLFOVS_FLAG=ON
NUCAPS_C0300_CENTERFOV_FLAG=ON
NUCAPS_C0300_ALLFOVS_PCS1B_FLAG=ON
NUCAPS_C0300_ALLFOVS_PCS3B_FLAG=ON
NUCAPS_C0300_CENTERFOV_PCS1B_FLAG=ON
NUCAPS_C0300_CENTERFOV_PCS3B_FLAG=ON
NUCAPS_C1317_1SCAN_FLAG=ON
```

Updates to PCF Files – Retrieval PCF (1)

- Here is an example of a Phase 2 NUCAPS_Retrieval.pl.PCF:

```
job_coverage_start=201211260349459
job_coverage_end=201211260350157
SCRIPT_OPS=/disk3/pub/tking/NUCAPS/CrISOPS/scripts
OPS_BIN=/disk3/pub/tking/NUCAPS/CrISOPS/Common_Bin
NUCAPS_ALL_PRODUCT=NUCAPS_ALL_20121126_0349459_0350157.nc
BOUNDING_BOX_PRODUCT=Bounding_Box_20121126_0349459_0350157.txt
WGRIB_LOC=/disk3/pub/tking/NUCAPS/CrISOPS/Common_Bin/wgrib2
WGRIB_COMMAND=/disk3/pub/tking/NUCAPS/CrISOPS/scripts/run_wgrib2.pl
CC_DAY_FILENAME=/disk3/pub/tking/NUCAPS/CrISOPS/retrieval/regress/clearflag/L2.I.cleartest_coef.v2.0.2.day.anc
CC_NIGHT_FILENAME=/disk3/pub/tking/NUCAPS/CrISOPS/retrieval/regress/clearflag/L2.I.cleartest_coef.v2.0.2.night.anc
AVN_FILE1=/disk3/pub/tking/NUCAPS/Model_Forecast/AVIATION/2012/11/26/gfs.t00z.pgrbf03
AVN_FILE2=/disk3/pub/tking/NUCAPS/Model_Forecast/AVIATION/2012/11/26/gfs.t00z.pgrbf06
LAC_FILENAME=none
NUCAPS_L2_TEMPLATE=/disk3/pub/tking/NUCAPS/CrISOPS/CDLFILES/nucaps_l2.nc
NUCAPS_AWIPS_TEMPLATE=/disk3/pub/tking/NUCAPS/CrISOPS/CDLFILES/nucaps_awips.nc
NUCAPS_CCR_TEMPLATE=/disk3/pub/tking/NUCAPS/CrISOPS/CDLFILES/nucaps_ccr.nc
NUCAPS_CCR_AR_TEMPLATE=/disk3/pub/tking/NUCAPS/CrISOPS/CDLFILES/nucaps_ccr_archive.nc
H5DUMP_LOC=/disk3/pub/letitias/hdf5/bin/h5dump
UUIDGEN_LOC=/etc/ncs/uuid_gen
AWIPS_FLAG=OFF
BYTESWAP_FLAG=OFF
TUNINGCOEFFILE=cris_20120515_v10a_fin.asc
TUNINGMASKFILE=120214_cris_tuning_mask.asc
NOAAEIGFILE=eigvec_2d_ascii_real
NOAAFRQFILE=cris_v03.frq
NOAAREGFILE=cris_ccr_less5k_16.asc
```

Updates to PCF Files – Retrieval PCF (2)

- Here is an example of a Phase 2 NUCAPS_Retrieval.pl.PCF (continued):

```
NOAAANGFILE=cris_cld_2d_less5k_16.asc
L2ERROR_IN=jpl_100.inp
OLRCOEFFILE=airs_olr.dat
HSBWEIGHTFILE=L2.M.weight.hsb.v1.0.0.anc
ECOFFILE=L2.M.ecof_705.v1.0.0.anc
MWCOVFILE=L2.M.cov100av.v1.0.0.anc
UARSCLIMFILE=L2.uars_clim.v1.0.3.anc
NCEPCLIMFILE=ncep_clim.bin
RTAERRFILE=cris_rtaerr_v10a.asc
SOLARFILE=cris_solar_v10a.txt
TC_AIRS=binary.trcoef.cris.v10a
IRNOISEFILE=tobin120120.dat
MASUDAFILE=L2.masuda.v2.0.0.anc
MWNOISEFILE=atms_1.dat
TC_AMSU=tr_atms_new.dat
CLDAVGFILE=cris_v10a.t1
IO_NL=io_cris.nl
CLOUDS_NL=clouds_cris.nl
MICROW_NL=microw_cris.nl
OZONE_NL=ozone_cris.nl
PRO_NL=pro_cris.nl
TEMP_NL=temp_cris.nl
WATER_NL=water_cris.nl
```

Updates to PCF Files – Validation PCF

- Here is an example of a Phase 2 NUCAPS_Validation.pl.PCF:

```
job_coverage_start=20121125000000
job_coverage_end=20121126000000
OPS_BIN=/disk3/pub/tking/NUCAPS/CrISOPS/Common_Bin
SCRIPT_OPS=/disk3/pub/tking/NUCAPS/CrISOPS/scripts
MATCHUPS_TABS=/disk3/pub/tking/NUCAPS/CrISOPS/matchups/radiosonde_matchup_template
WGRIB_LOC=/disk3/pub/tking/NUCAPS/CrISOPS/Common_Bin/wgrib2
AVN_GFS_FILE=gfs.t00z.pgrbf00.20121125
AVN_GFS_FILE=gfs.t06z.pgrbf00.20121125
AVN_GFS_FILE=gfs.t12z.pgrbf00.20121125
AVN_GFS_FILE=gfs.t18z.pgrbf00.20121125
AVN_GFS_FILE=gfs.t00z.pgrbf00.20121126
NUCAPS_C1317_1SCAN_BINARY_FLAG=ON
NUCAPS_FG_GRIDS_FLAG=ON
NUCAPS_GG_GRIDS_FLAG=ON
NUCAPS_FG_PCS1B_GRIDS_FLAG=ON
NUCAPS_GG_PCS1B_GRIDS_FLAG=ON
NUCAPS_GG_PCS3B_GRIDS_FLAG=ON
NUCAPS_GG_GFS_GRIDS_FLAG=ON
NUCAPS_GG_L2_GRIDS_FLAG=ON
NUCAPS_GG_CCR_GRIDS_FLAG=ON
NUCAPS_SDR_MATCHUPS_FLAG=ON
NUCAPS_L2_MATCHUPS_FLAG=ON
NUCAPS_C1317_1SCAN_PRODUCT=/disk3/pub/tking/NUCAPS/SATELLITE_DATA/NPP/2012/11/25/Granule_0000019_0000317/subset/N
UCAPS_C1317_1SCAN_20121125_0000019_0000317.nc
NUCAPS_C1317_1SCAN_PRODUCT=/disk3/pub/tking/NUCAPS/SATELLITE_DATA/NPP/2012/11/25/Granule_0000339_0001037/subset/N
UCAPS_C1317_1SCAN_20121125_0000339_0001037.nc
.
```

Updates to PSF Files

- NUCAPS_Preproc.pl.PSF now has a bounding box metadata file added to its output.
- NUCAPS_Subset.pl.PSF now has the PCS monitoring file added to its output.
- NUCAPS_Retrieval.pl.PSF is entirely new.
- NUCAPS_Validation.pl.PSF has additional fields for:
  - » PCS grids
  - » EDR & CCR grids
  - » EDR matchups

Updates to PSF Files

- Here is an example of a Phase 2 NUCAPS_Preproc.pl.PSF:

```
NUCAPS_ALL_20121126_0349459_0350157.nc
Bounding_Box_20121126_0349459_0350157.txt
```

- Here is an example of a Phase 2 NUCAPS_Subset.pl.PSF:

```
NUCAPS_C0300_ALLFOVS_20121126_0349459_0350157.nc
NUCAPS_C0300_CENTERFOV_20121126_0349459_0350157.nc
NUCAPS_C1317_1SCAN_20121126_0349459_0350157.nc
NUCAPS_C0300_ALLFOVS_PCS1B_20121126_0349459_0350157.nc
NUCAPS_C0300_CENTERFOV_PCS1B_20121126_0349459_0350157.nc
NUCAPS_C0300_CENTERFOV_PCS3B_20121126_0349459_0350157.nc
NUCAPS-PCS-MONITORING_v1r0_npp_s201211260349459_e201211260350157_c20121126064514.txt.
```

- Here is an example of a Phase 2 NUCAPS_Retrieval.pl.PSF:

```
NUCAPS-EDR_v1r0_npp_s201211260349459_e201211260350157_c20121126064815.nc
NUCAPS-EDR-MONITORING_v1r0_npp_s201211260349459_e201211260350157_c20121126064815.txt
NUCAPS_CCR_20121126_0349459_0350157.nc
NUCAPS-CCR-AR_v1r0_npp_s201211260349459_e201211260350157_c20121126064815.nc
```

Updates to PSF Files

- Here is an example of a Phase 2 NUCAPS_Validation.PSF:

NUCAPS-1SCAN-BINARY_v1r0_npp_s20121125000000_e20121126000000_c20121126120524.bin
NUCAPS-FG-GRIDS-ASC_v1r0_npp_s20121125000000_e20121126000000_c20121126120524.bin
NUCAPS-FG-GRIDS-DSC_v1r0_npp_s20121125000000_e20121126000000_c20121126120524.bin
NUCAPS-GG-GRIDS-ASC_v1r0_npp_s20121125000000_e20121126000000_c20121126120524.bin
NUCAPS-GG-GRIDS-DSC_v1r0_npp_s20121125000000_e20121126000000_c20121126120524.bin
NUCAPS-FG-PCS1B-GRIDS-ASC_v1r0_npp_s20121125000000_e20121126000000_c20121126120524.bin
NUCAPS-FG-PCS1B-GRIDS-DSC_v1r0_npp_s20121125000000_e20121126000000_c20121126120524.bin
NUCAPS-GG-PCS1B-GRIDS-ASC_v1r0_npp_s20121125000000_e20121126000000_c20121126120524.bin
NUCAPS-GG-PCS1B-GRIDS-DSC_v1r0_npp_s20121125000000_e20121126000000_c20121126120524.bin
NUCAPS-GG-PCS3B-GRIDS-ASC_v1r0_npp_s20121125000000_e20121126000000_c20121126120524.bin
NUCAPS-GG-PCS3B-GRIDS-DSC_v1r0_npp_s20121125000000_e20121126000000_c20121126120524.bin
NUCAPS-SDR-GLOBAL-MATCHUPS_v1r0_npp_s20121125000000_e20121126000000_c20121126120524.bin
NUCAPS-SDR-GLOBAL-MATCHUPS_v1r0_npp_s20121125000000_e20121126000000_c20121126120524.txt
NUCAPS-EDR-GLOBAL-MATCHUPS_v1r0_npp_s20121125000000_e20121126000000_c20121126120524.bin
NUCAPS-GG-GFS-GRIDS-ASC_v1r0_npp_s20121125000000_e20121126000000_c20121126120524.bin
NUCAPS-GG-GFS-GRIDS-DSC_v1r0_npp_s20121125000000_e20121126000000_c20121126120524.bin
NUCAPS-GG-EDR-GRIDS-ASC_v1r0_npp_s20121125000000_e20121126000000_c20121126120524.bin
NUCAPS-GG-EDR-GRIDS_DSC_v1r0_npp_s20121125000000_e20121126000000_c20121126120524.bin
NUCAPS-GG-CCR-GRIDS-ASC_v1r0_npp_s20121125000000_e20121126000000_c20121126120524.bin
NUCAPS-GG-CCR-GRIDS-DSC_v1r0_npp_s20121125000000_e20121126000000_c20121126120524.bin

NUCAPS Phase 2 Software Architecture Summary

- Phase 2 delivery will consist of redelivery of the 3 original software units plus the new retrieval unit.

- Updates have been made to the PCF and PSF files to account for:
  - New internal bounding box file for the retrieval unit
  - New SDR and EDR QC files for OSPO
  - New EDR grids & matchups
  - New PCS grids
  - New EDR/CCR files
  - Setting of flags to activate the above production

Review Outline

- Introduction
- ARR Phase 1 Report
- Updated Requirements
- Phase 2 Software Architecture
- Algorithm Readiness
- Risk Summary
- Summary and Conclusions

Section 5 – Algorithm and DAP Readiness

Presented by

Antonia Gambacorta and Tom King

NUCAPS Phase 2 Algorithm Readiness

- Unit Tests demonstrating the functionality of all 4 units have been shown in previous reviews:
  - NUCAPS Phase 1 & 2 TRR (September 10, 2010)
  - NUCAPS Phase 1 ARR (March 14, 2012)
  - Each unit was run separately at the command line.
  - The output from one unit was then used as the input for the next to demonstrate system continuity.

- In this section we will show the results of new unit tests that needed to be done to demonstrate science quality of the EDR products.

Outline

- The NOAA Unique CrIS/ATMS Processing System (NUCAPS) is an inversion algorithm, heritage of the AIRS Science Team and NOAA IASI inversion algorithm (same code, same underlying spectroscopy) applied to the CrIS and ATMS Sounding System data.
  - Inputs: CrIS and ATMS radiance
  - Outputs: Temperature, Water Vapor, cloud cleared radiance, trace gases, cloud parameters

- Outline of the validation results presented in this review:
  - **Part I: Temperature, water vapor , ozone**
    - Global, Tropical, Mid-Latitude, Polar; Day/Night; Ocean/Land regimes validation versus
      - collocated ECMWF and AVN analyses
      - AIRS operational version 6 retrievals (uses same spectroscopy as NUCASP, neural network first guess)
      - AIRS version 5.9 retrievals (uses same spectroscopy and retrieval algorithm as NUCAPS)
  - **Part II: Temperature and geo-potential height**
    - Collocated cal/val RAOBs over Hawaii (tropical ocean regime)
  - **Part III: Cloud clearing radiance; cloud fraction and top pressure**
    - OBS – CALC results, comparisons with AIRS
  - **Part IV: Trace gases: ozone, methane, CO2, CO, HNO3, N2O**
    - Global map comparisons of NUCAPS and AIRS collocated retrievals

Part I: Temperature, Water Vapor, Ozone Statistics vs Model Analyses

- RMS and BIAS statistics vs ECMWF and AVN analyses (slides 7 -24):
  - Global,
  - Tropical,
  - Mid-Latitude,
  - Polar;
  - Day/Night;
  - Ocean/Land

- Focus day used: 05-15-2012 (high coincidence between AIRS and CrIS footprints)

Overview of CrIMSS EDR Product Specifications

- **Atmospheric Vertical Temperature Profile (AVTP).**

Lower tropospheric temperature are KPPs.

Parameter (KPP in Blue)	IORD-II, JPSS-L1RD
AVTP Partly Cloudy, surface - 300 mb	**1.6 K/1-km layer**
AVTP Partly Cloudy, 300 to 30 mb	1.5 K/3-km layer
AVTP Partly Cloudy, 30 mb to 1 mb	1.5 K/5-km layer
AVTP Partly Cloudy, 1 mb to 0.5 mb	3.5 K/5-km layer
AVTP Cloudy, surface to 700 mb	**2.5 K/1-km layer**
AVTP Cloudy, 700 mb to 300 mb	1.5 K/1-km layer
AVTP Cloudy, 300 mb to 30 mb	1.5 K/3-km layer
AVTP Cloudy, 30 mb to 1 mb	1.5 K/5-km layer
AVTP Cloudy, 1 mb to 0.05 mb	3.5 K/5-km layer

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Overview of CrIMSS EDR Product Specifications

- **Atmospheric Vertical Moisture Profile (AVMP).**

Lower tropospheric moisture layers are Key Performance Parameters (KPPs) .

Parameter (KPP in Blue)	IORD-II, JPSS-L1RD
AVMP Partly Cloudy, surface to 600 mb	**Greater of 20% or 0.2 g/kg**
AVMP Partly Cloudy, 600 to 300 mb	Greater of 35% or 0.1 g/kg
AVMP Partly Cloudy, 300 to 100 mb	Greater of 35% or 0.1 g/kg
AVMP Cloudy, surface to 600 mb	**Greater of 20% of 0.2 g/kg**
AVMP Cloudy, 600 mb to 300 mb	Greater of 40% or 0.1 g/kg
AVMP Cloudy, 300 mb to 100 mb	Greater of 40% or 0.1 g/kg

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Overview of CrIMSS EDR Product Specifications

- Ozone is an intermediate product (IP) used by the OMPS team.
- CO, CH4 and CO2 are pre-planned product improvements(P^3I)

Parameter (P^3I in Blue)	IORD-II / JPSS-L1RD
Ozone IP	20% precision for ~5 km layers from 4 hPa to 260 hPa
CH4 (methane) column	1% ± 5% / 1% ± 4% (precison ± accuracy)
CO (carbon monoxide) column	3% ± 5% / 35% ± 25% (precision ± accuracy)

T, q Retrieval Statistics vs ECWMF; o3 vs AVN

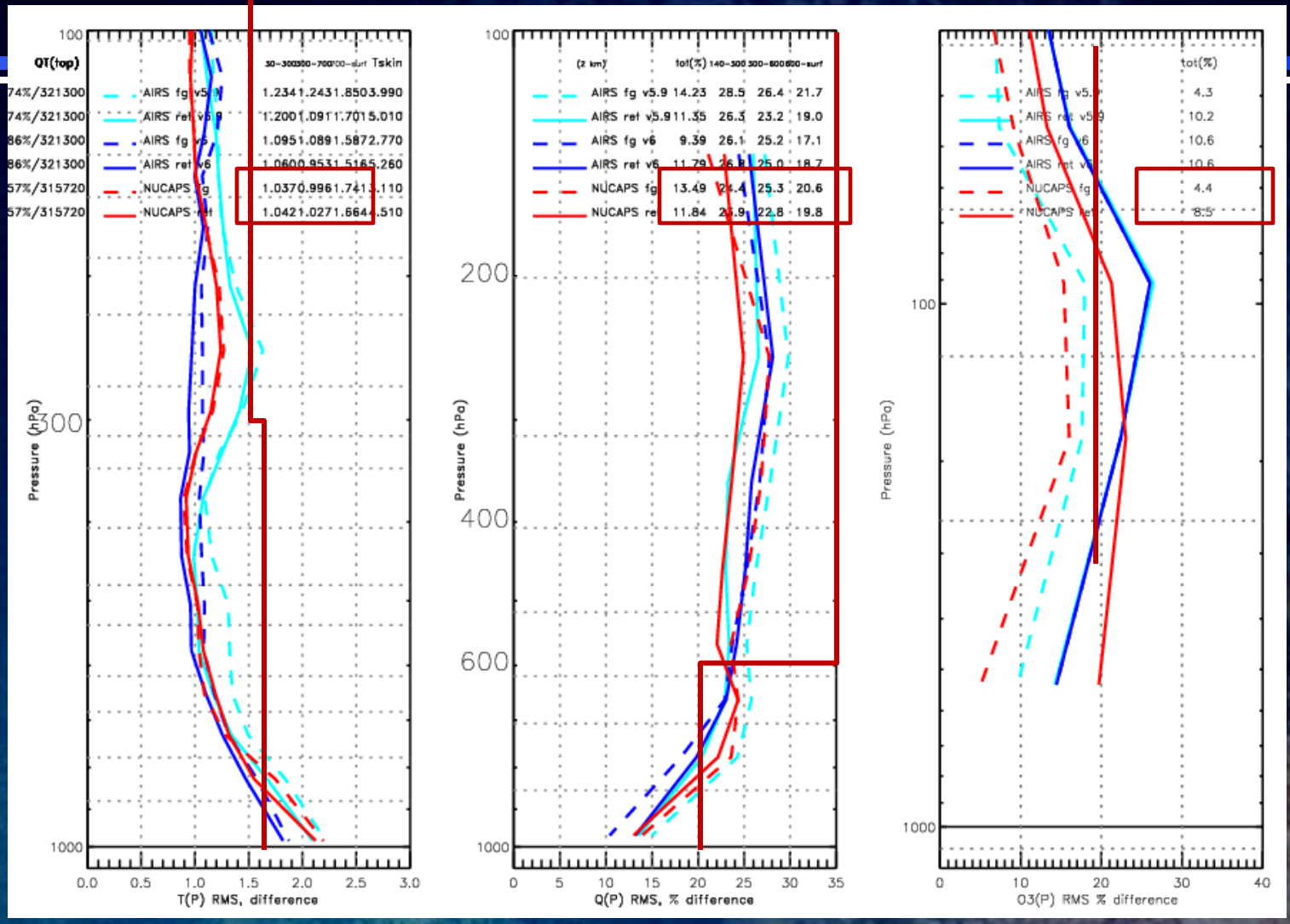
NUCAPS: ECMWF trained ccr FG (dash), final RET (solid)

AIRS v5.9: ECMWF trained ccr FG (dash), final RET (solid)

AIRS v6: NN FG (dash), final RET (solid)

GLOBAL RMS

vertical red bars indicate specification values (listed on previous slides 7,8 and 9)



NUCAPS T, q, and O3 meet specifications almost everywhere.

See next slide for further comments on statistical performance.

Temperature, Water Vapor, Ozone Statistics vs Model Analyses

- **NUCAPS global RMS and BIAS temperature, water vapor and O3 statistics generally meet specifications.**
- **After only one year in orbit, NUCAPS T, q and O3 RMS and BIAS statistical performance is comparable to AIRS v6 and AIRS v5.9 (10 year maturity product) .**
- **NUCAPS global acceptance yield is ~60%, AIRS v6 yield is 86% (different rejection criteria than NUCAPS) and AIRS v5.9 is 75% (same rejection criteria as NUCAPS). Possible sources of difference in the acceptance yield and retrieval performance (future work for NUCAPS):**
  - **a) AIRS v6 has an improved surface emissivity first guess;**
  - **b) AIRS v5.9 has a multi-year temperature and water vapor first guess regression training;**
  - **c) AIRS radiance tuning uses a dedicated raob training sample ;**
  - **d) AIRS retrieval QAs are fully optimized.**
- **NUCAPS lower troposphere temperature RMS and BIAS degradation is consistent throughout all geophysical regimes (see next slides) but might be a good sign: ECMWF has known problems in lower troposphere temperature (cold bias). Need an independent truth assessment.**

T, q Retrieval Statistics vs ECWMF; o3 vs AVN

NUCAPS: ECMWF trained ccr FG (dash), final RET (solid)

AIRS v5.9: ECMWF trained ccr FG (dash), final RET (solid)

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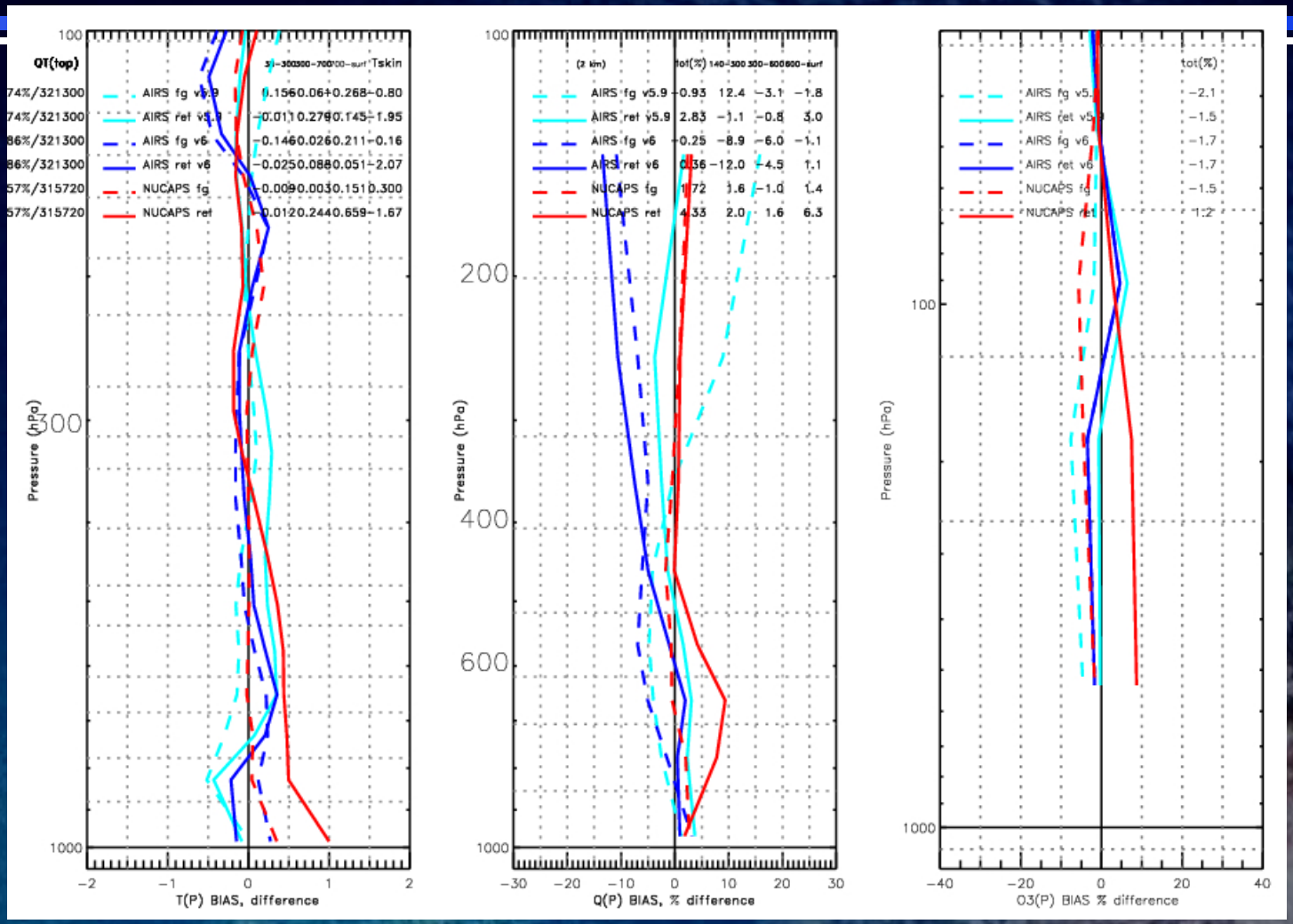
GLOBAL BIAS



T, q Retrieval Statistics vs ECWMF; o3 vs AVN

NUCAPS: ECMWF trained ccr FG (dash), final RET (solid)

AIRS v5.9: ECMWF trained ccr FG (dash), final RET (solid)

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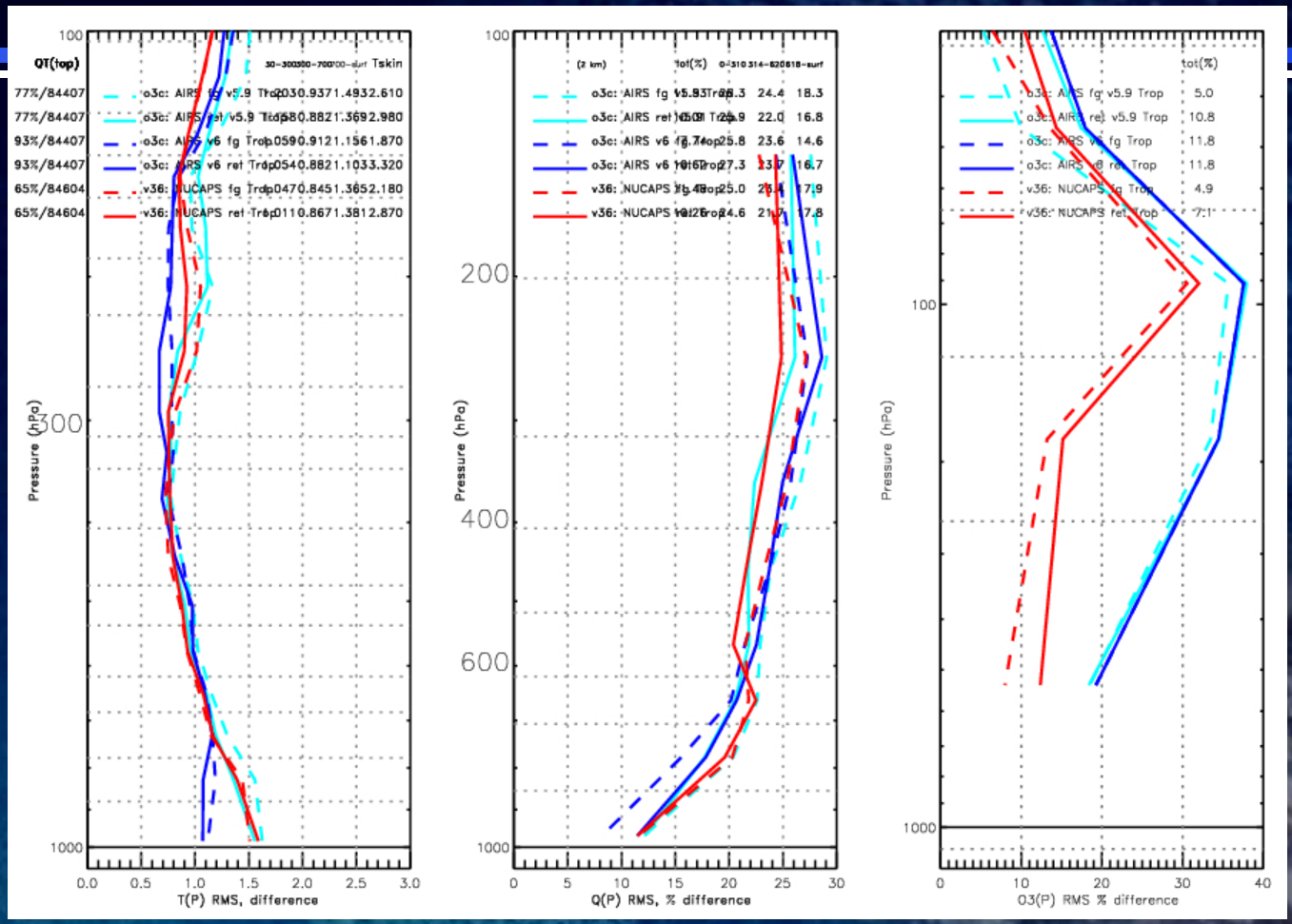
TROPICS

RMS



Possible sources of difference in the performance and acceptance yield:

- **AIRS v6 improved surface emissivity first guess; AIRS v5.9 multi-year regression training; dedicated raob based tuning**
- **Future work (phase II): NUCAPS QAs optimization ; multi-seasonal regression and tuning training**

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NUCAPS: ECMWF trained ccr FG (dash), final RET (solid)

AIRS v5.9: ECMWF trained ccr FG (dash), final RET (solid)

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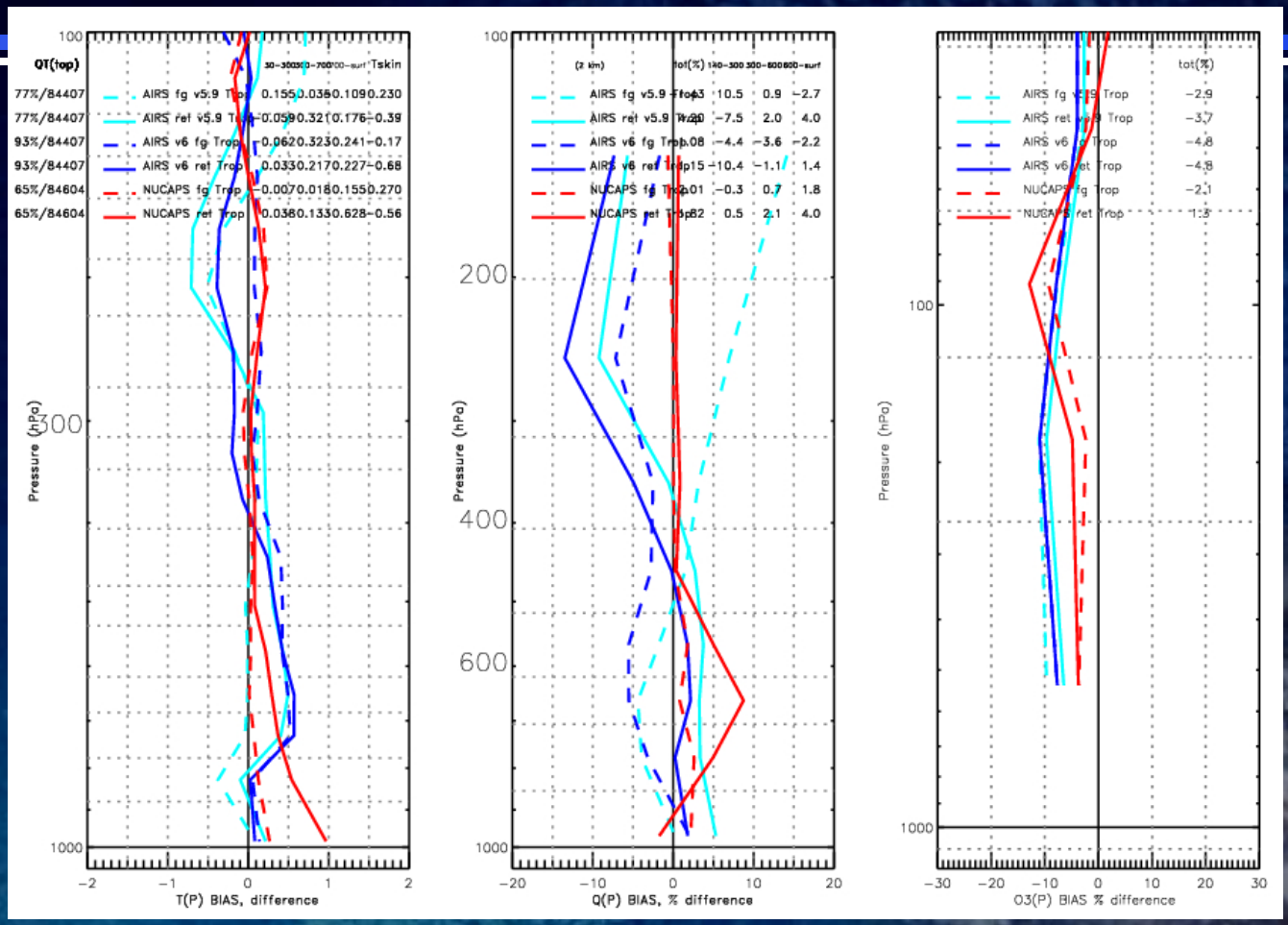
TROPICS

BIAS



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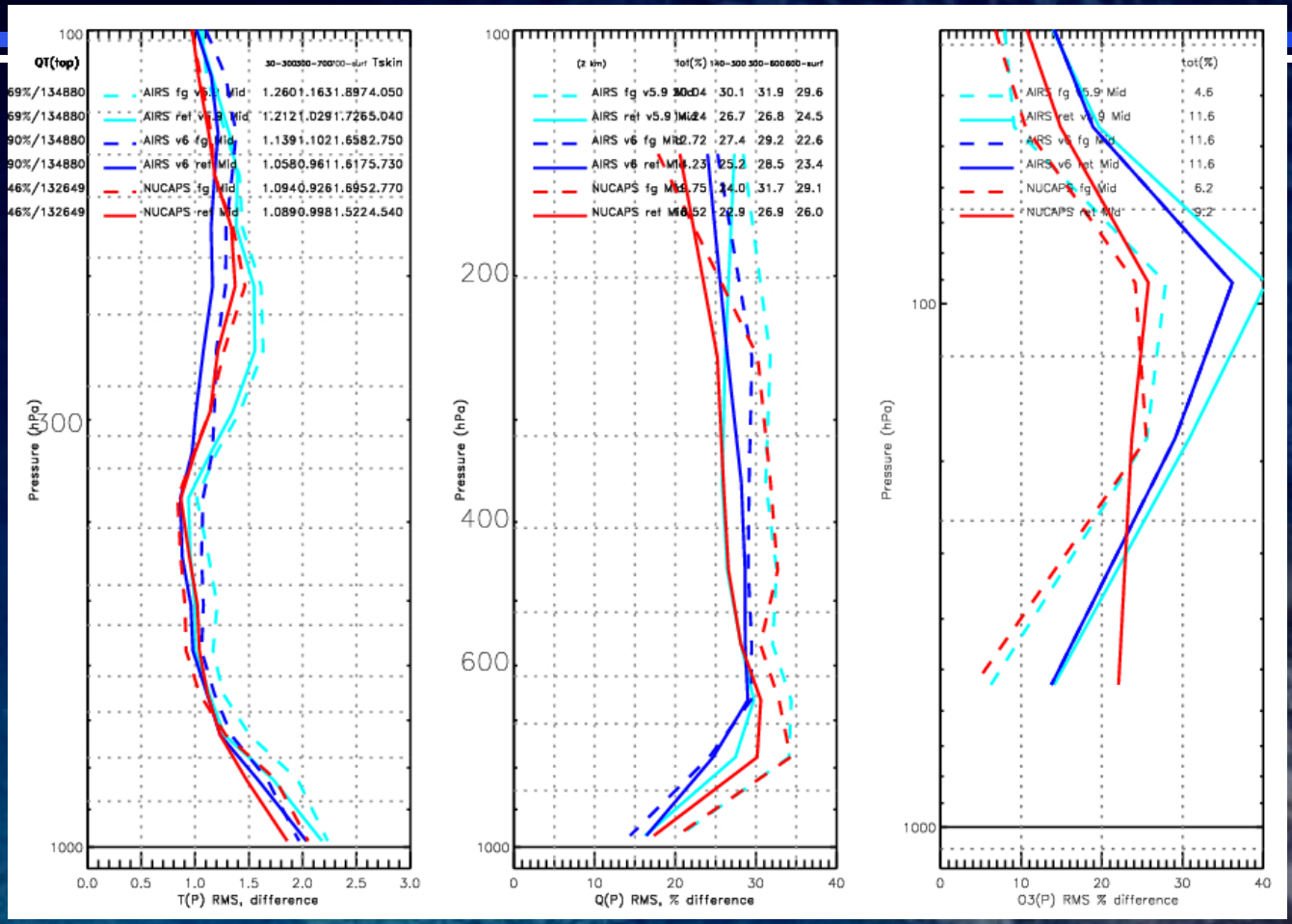
AIRS v6: NN FG (dash), final RET (solid)

MIDLAT

RMS



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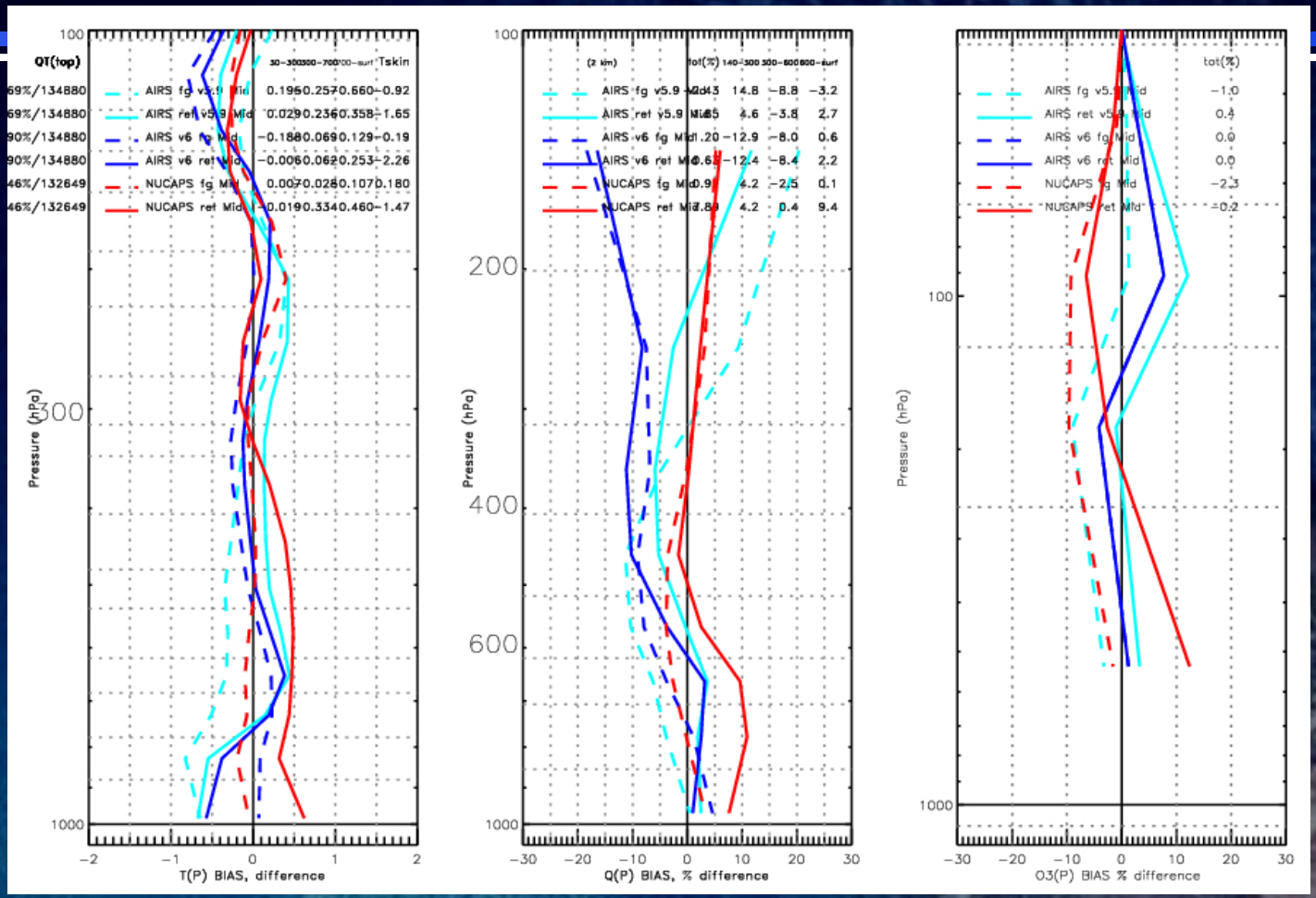
MIDLAT BIAS



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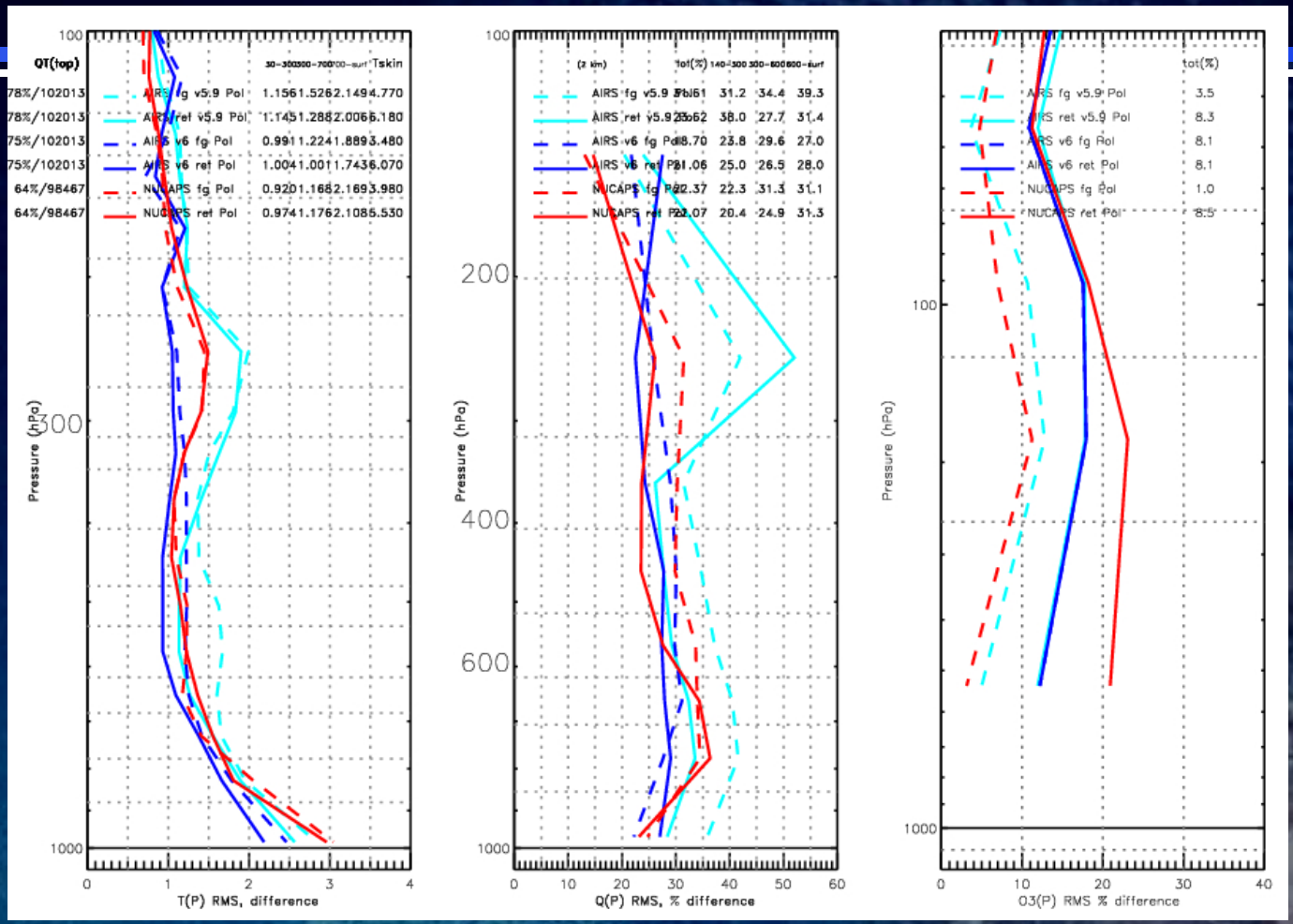
NUCAPS: ECMWF trained ccr FG (dash), final RET (solid)

AIRS v5.9: ECMWF trained ccr FG (dash), final RET (solid)

AIRS v6: NN FG (dash), final RET (solid)

POLAR

RMS



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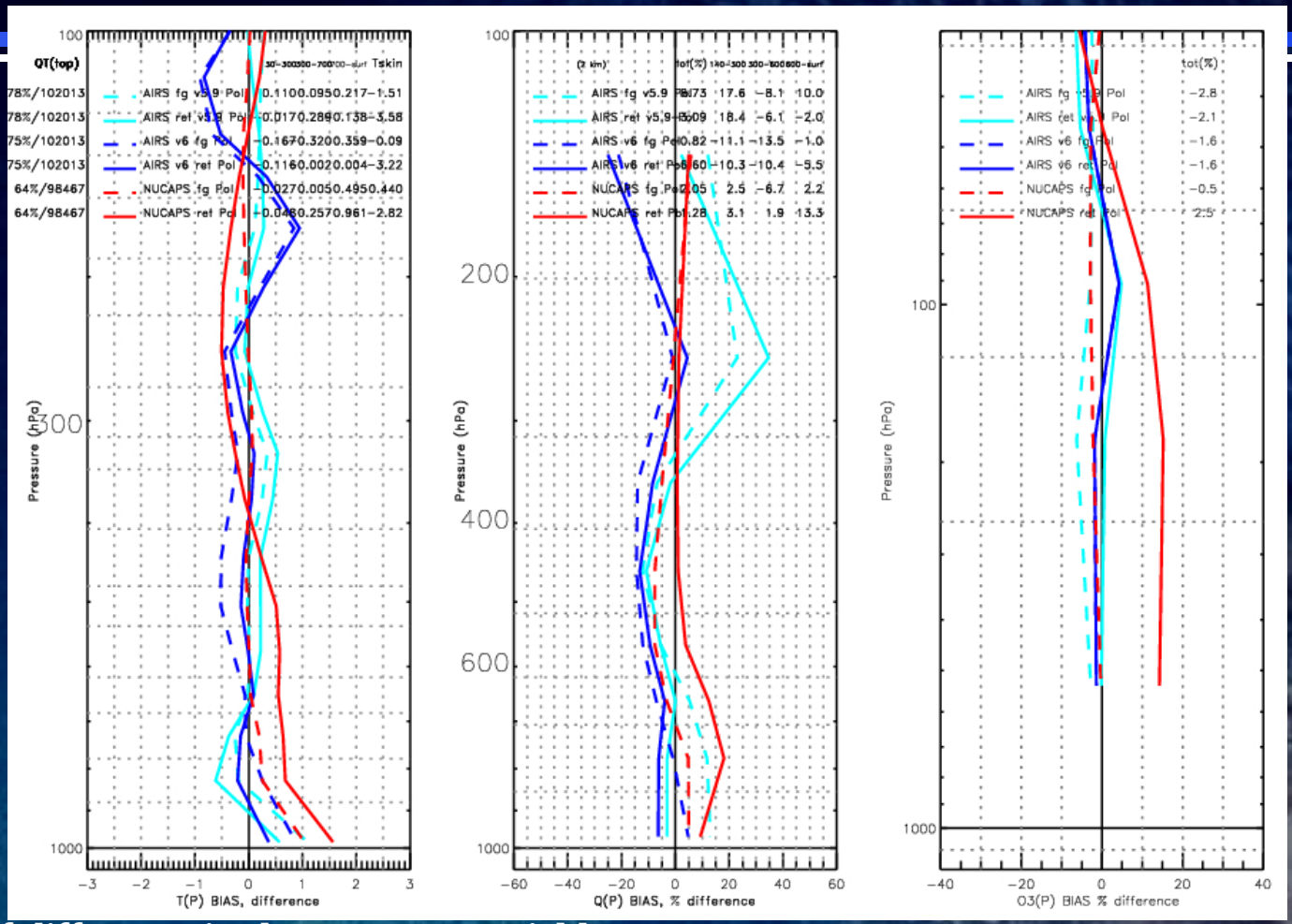
POLAR BIAS



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T, q Retrieval Statistics vs ECWMF; o3 vs AVN

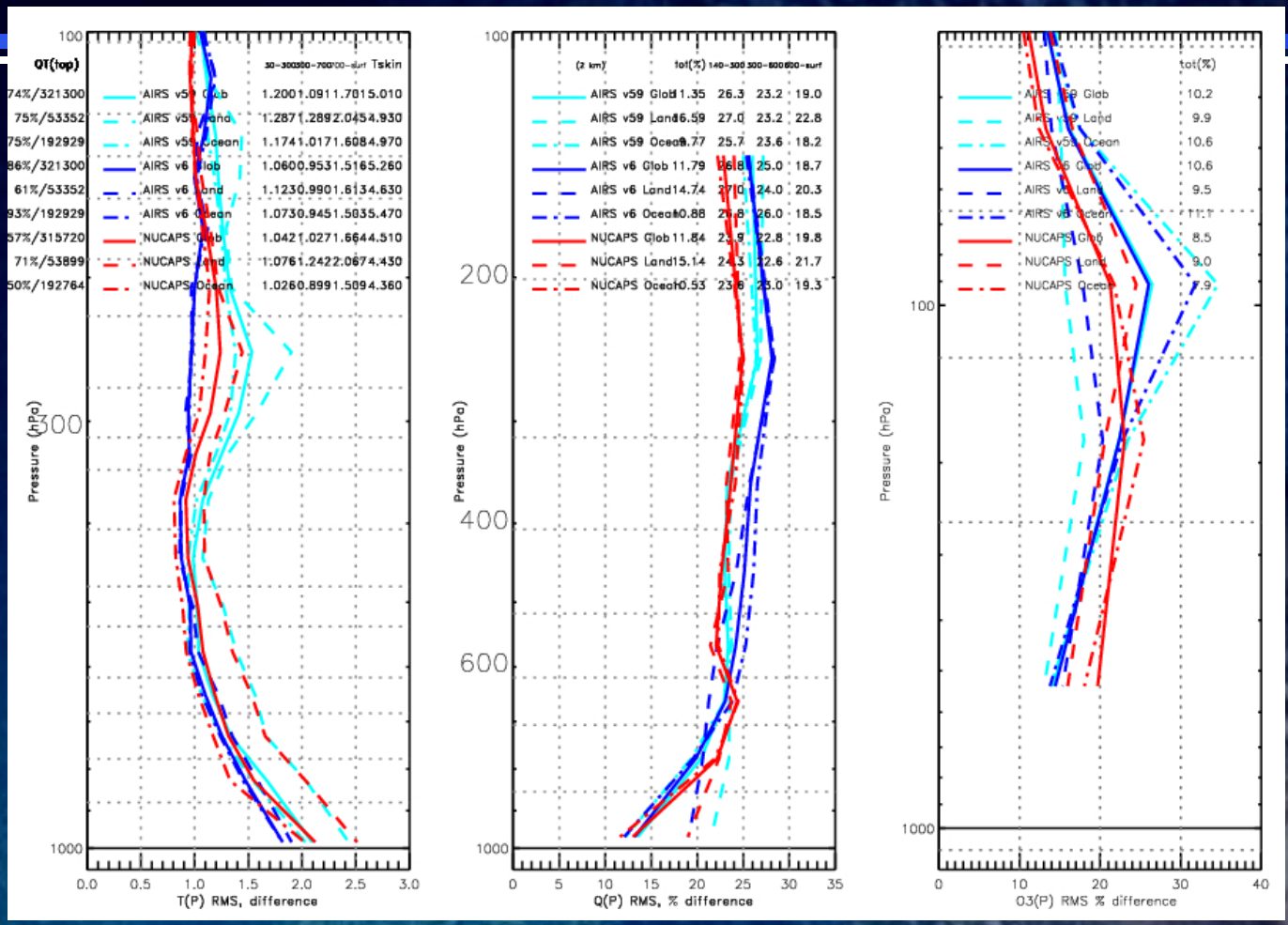
NUCAPS: Global (solid), Land (dash), Ocean (dash-dot)

AIRS v5.9: Global (solid), Land (dash), Ocean (dash-dot)

AIRS v6: Global (solid), Land (dash), Ocean (dash-dot)

Ocean/Land

RMS



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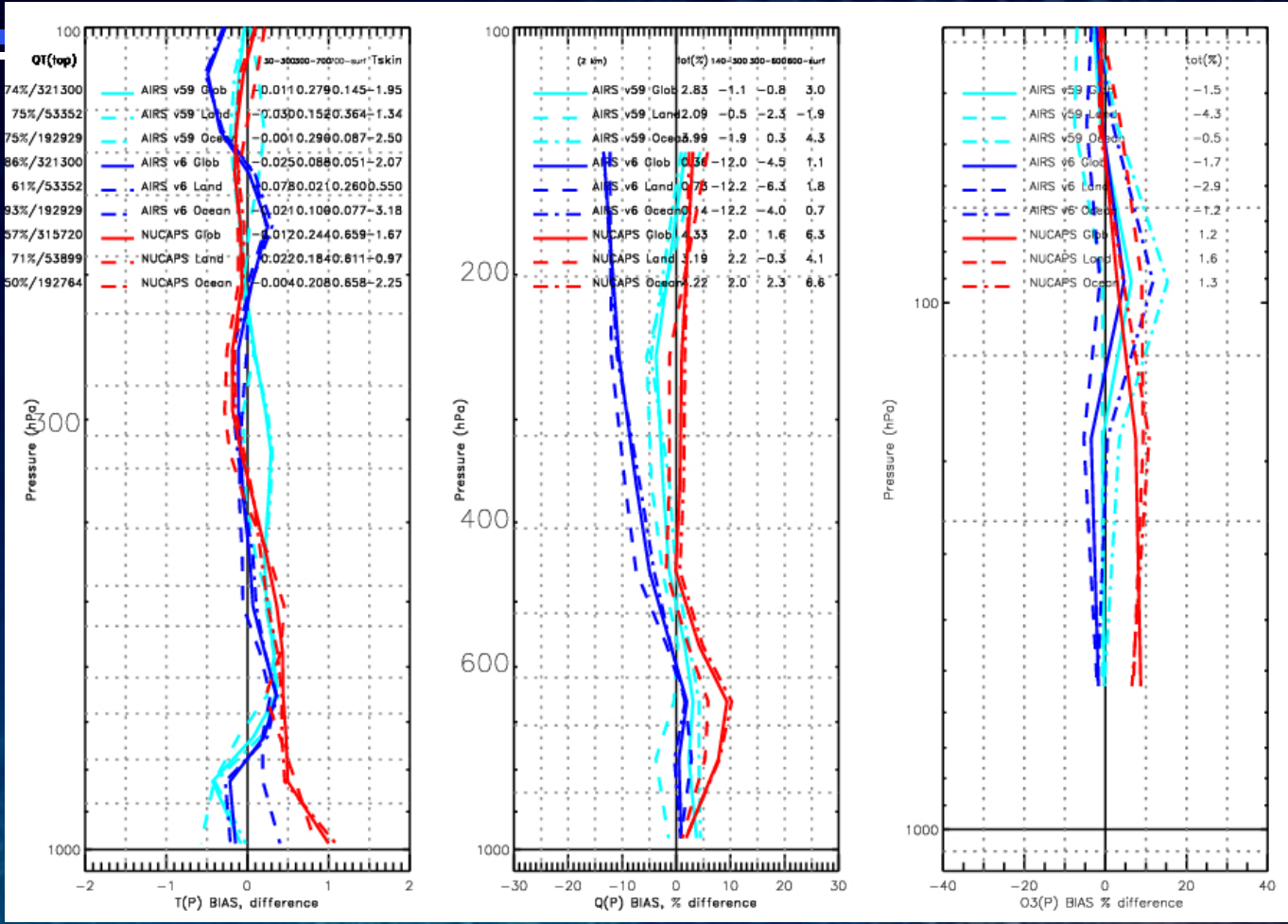
Ocean/Land

BIAS



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T, q Retrieval Statistics vs ECWMF; o3 vs AVN

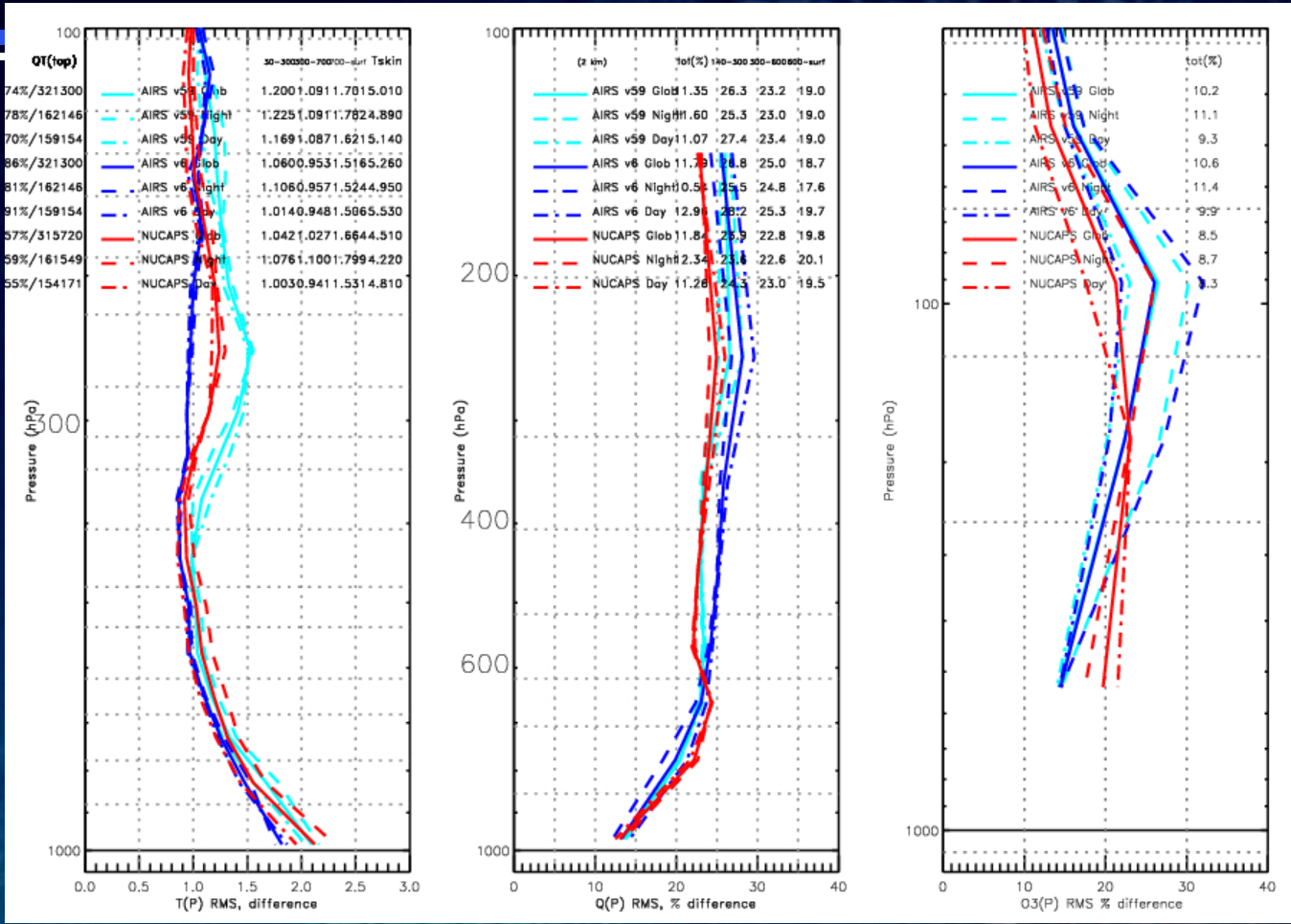
NUCAPS: Global (solid), Night (dash), Day (dash-dot)

AIRS v5.9: Global (solid), Night (dash), Day (dash-dot)

AIRS v6: Global (solid), Night (dash), Day (dash-dot)

Day/Night

RMS



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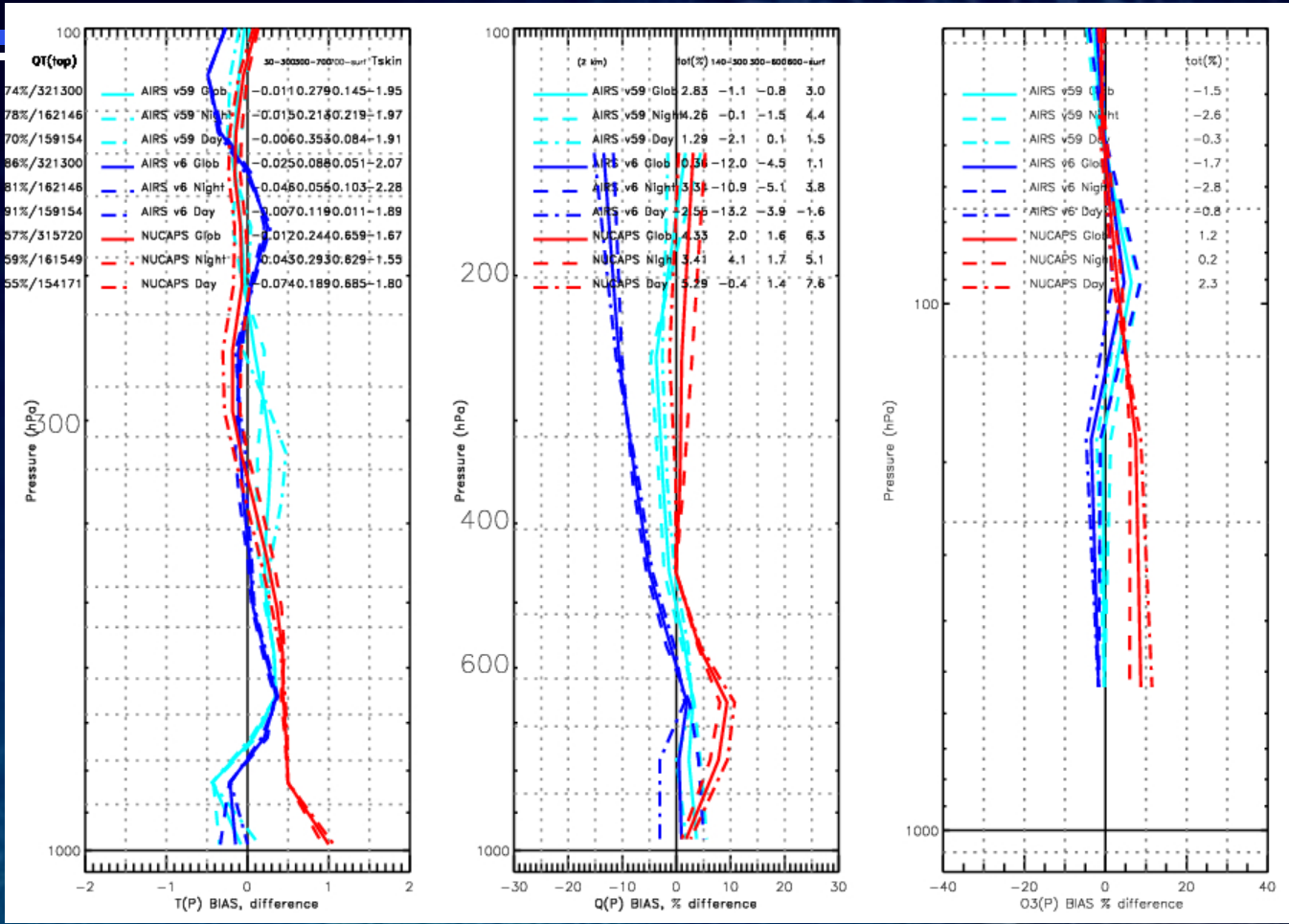
AIRS v6: Global (solid), Night (dash), Day (dash-dot)

Day/Night

BIAS



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- **AIRS v6 improved surface emissivity first guess; AIRS v5.9 multi-year regression training; dedicated raob based tuning**
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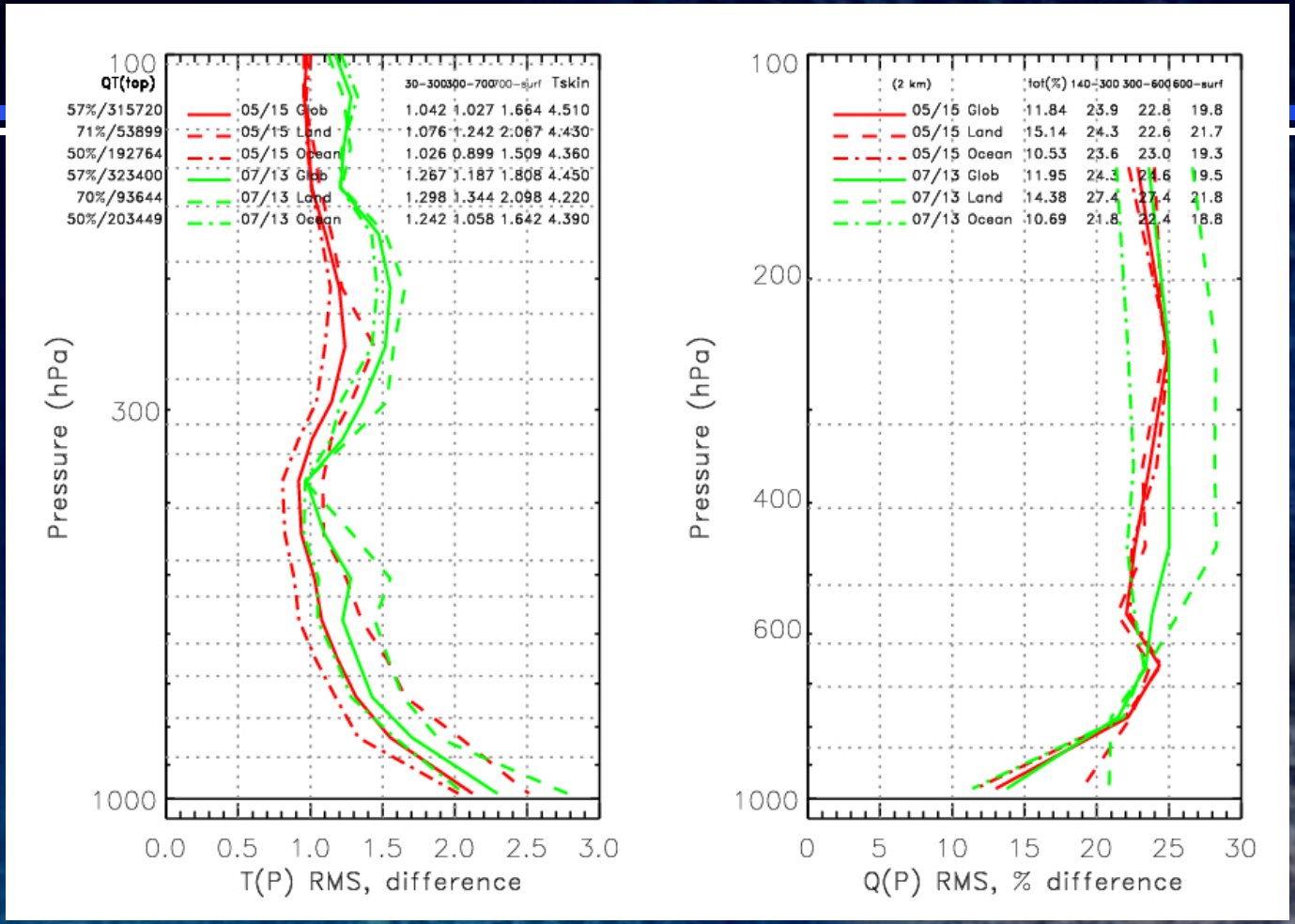
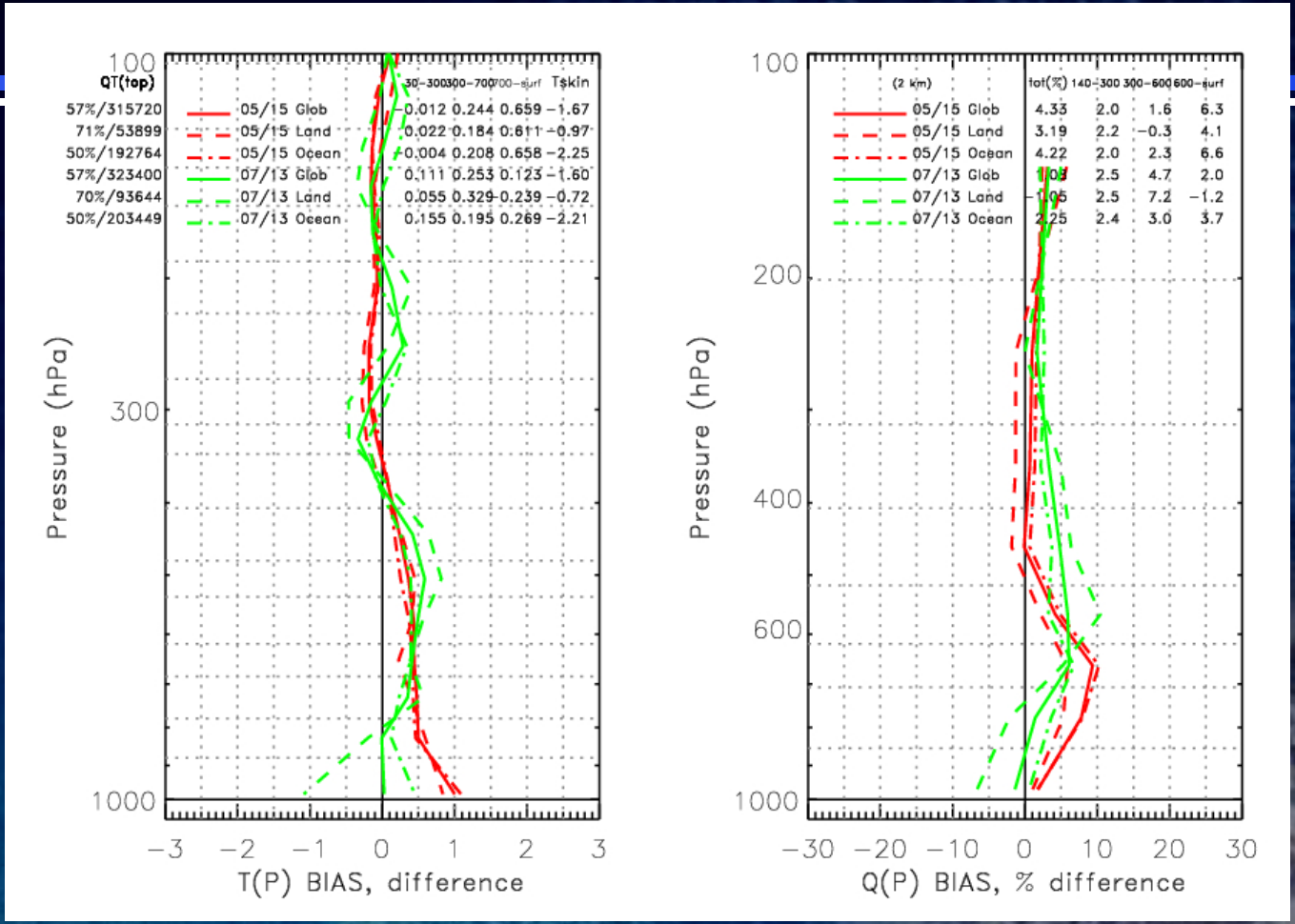
05/15 vs 07/13 focus day RMS statistics



Significance: NUCAPS performance is stable and robust over multiple focus days, including those not used for tuning and regression training :05/15 focus day (red curves) was used for training, 07/13 (green curves) was not.

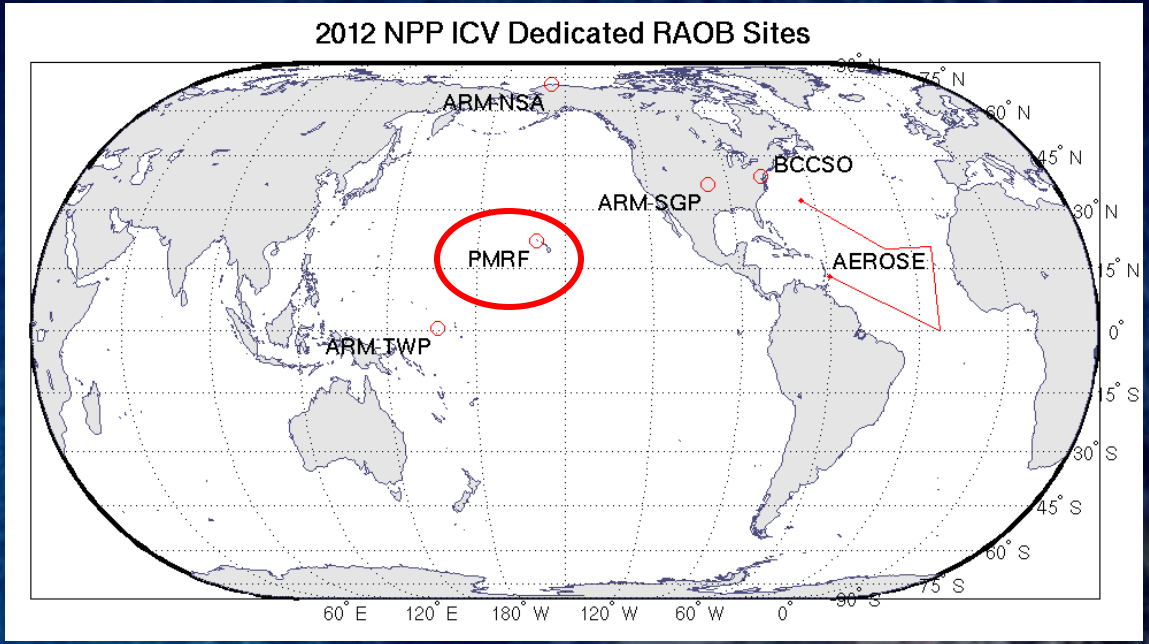
05/15 vs 07/13 focus day BIAS statistics



Significance: NUCAPS performance is stable and robust over multiple focus days, including those not used for tuning and regression training :05/15 focus day was used for training, 07/13 was not.

Part II: (1) Temperature and (2) Geopotential Height Statistics vs Dedicated Radiosondes

- ARM Sites (*n* = 450)
  - » Tropical Western Pacific (TWP, island) (90)
  - » Southern Great Plains (SGP) (180)
  - » North Slope Alaska (NSA) (180)
  - » Jul–Sep 2012
  - » JPSS funded
- Kauai, Hawaii (PMRF) Site (*n* = 20+)
  - » Tropical Central Pacific (island)
  - » May 2012 (20),
  - » Collocated lidar
  - » Collaborator: The Aerospace Corp.
- Beltsville, MD (BCCSO) Site (*n* = 10+)
  - » Urban midlatitude
  - » Jun–Sep 2012
  - » Collaborator: HU/NCAS
- NOAA AEROSE Cruise (*n* ≈ 60)
  - » Tropical Atlantic (ship)
  - » September 2012
  - » Possible HS3 Campaign AC overflight
  - » JPSS funded
  - » Collaborators: HU/NCAS, NOAA/ESRL



Picture courtesy of Nick Nalli

Significance:

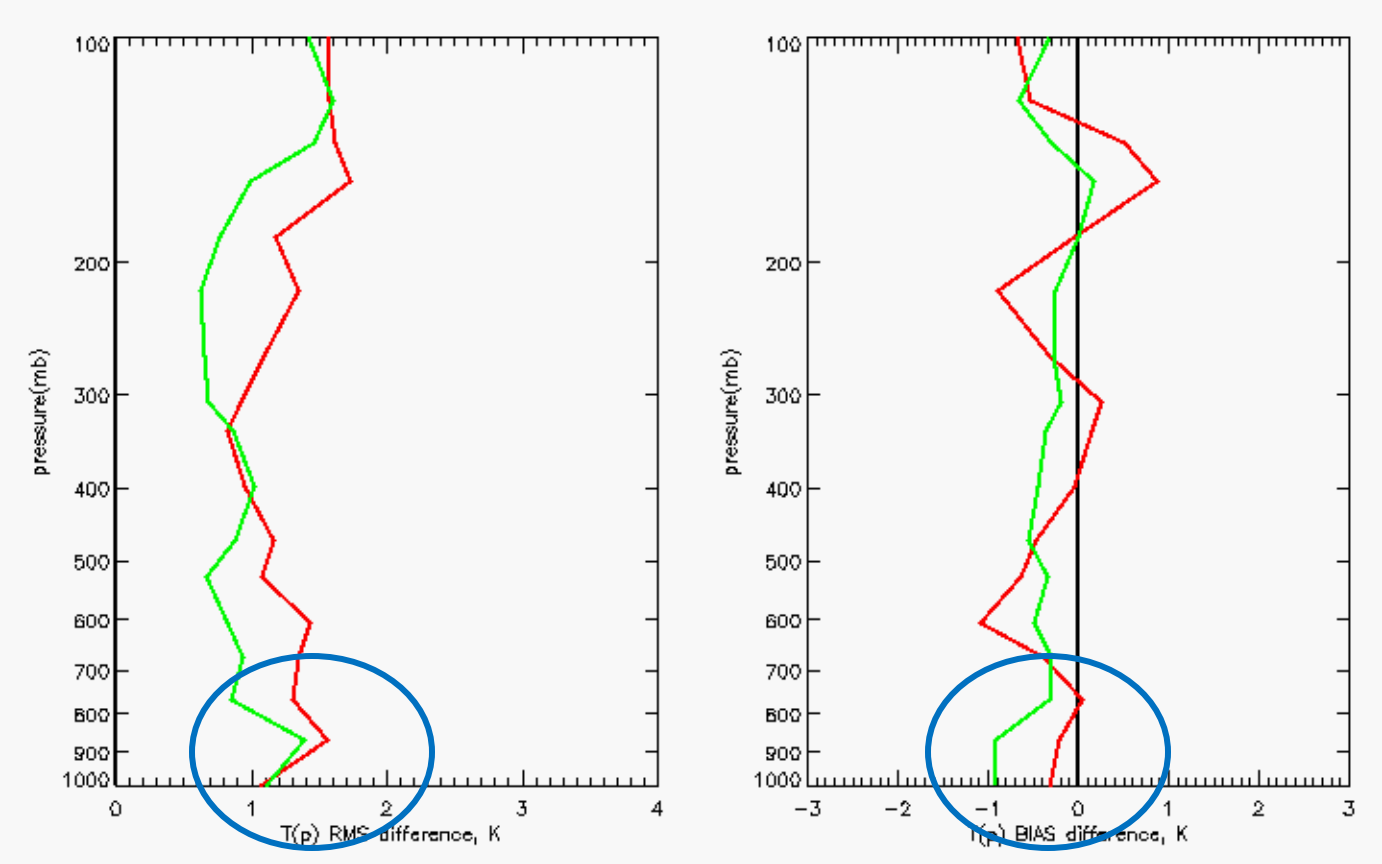
- (1) Dedicated RAOBs can provide *independent* correlative data *not* assimilated into NWP models
- (2) Dedicated RAOBs can provide detailed performance specification

Kauai, Hawaii validation campaign results

- **Kauai, Hawaii (PMRF) Site**
  - *Tropical Central Pacific Ocean Regime*
  - **May 2012 13,14,15,18,19,25,29**
  - **Collaborator: The Aerospace Corporation.**

(1) Temperature coarse layer (1km) statistics NUCAPS, ECMWF vs RAOB

(+/- 3 hours; <= 200km; 7 RAOBs profiles, 188 collocated retrievals)



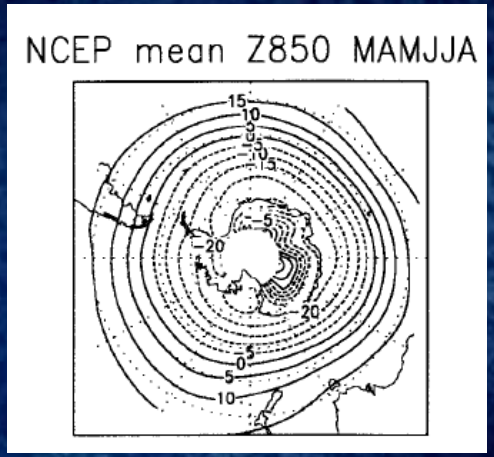
• **NUCAPS temperature statistics against model independent and dedicated RAOBs over the tropical ocean regime meets specs** (and shows improved lower troposphere RMS and BIAS performance wrt NUCAPS against ECMWF statistics shown on previous slides)

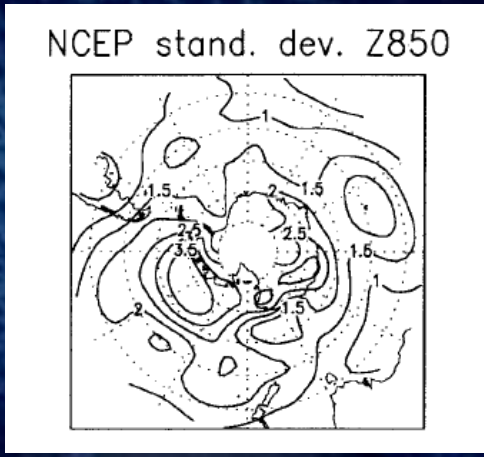
(2) NUCAPS Geopotential Height

- **Geopotential height** is a vertical coordinate referenced to Earth's mean sea level. It is an adjustment to geometric height (=elevation above mean sea level) using the variation of gravity with latitude and elevation. Thus it can be considered a "gravity-adjusted height". One usually speaks of the geopotential height of a certain **pressure level**, which would correspond to the geopotential height necessary to reach the given pressure.
- The geopotential height is one of the most fundamental and widely used meteorological variables for characterizing the general atmospheric circulation.
  - » **NCEP 850 mb geopotential height**
    - – **BIAS from the global mean: 0 to 150 m**
    - – **SQRT of variance from the mean:**

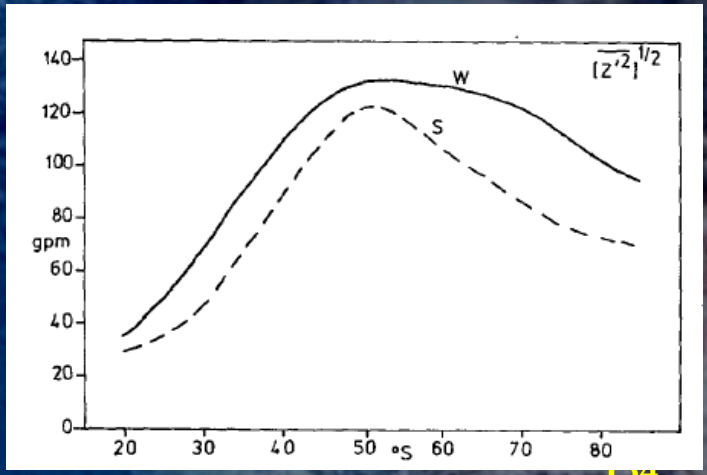
    100 to 250 m (E. Kalnay et al., 1996)
  - » **500 mb geopotential height**
    - – **SQRT of variance from the mean:**

    20 to 40 m in the tropical region (k. Trenberth, 1982**)**



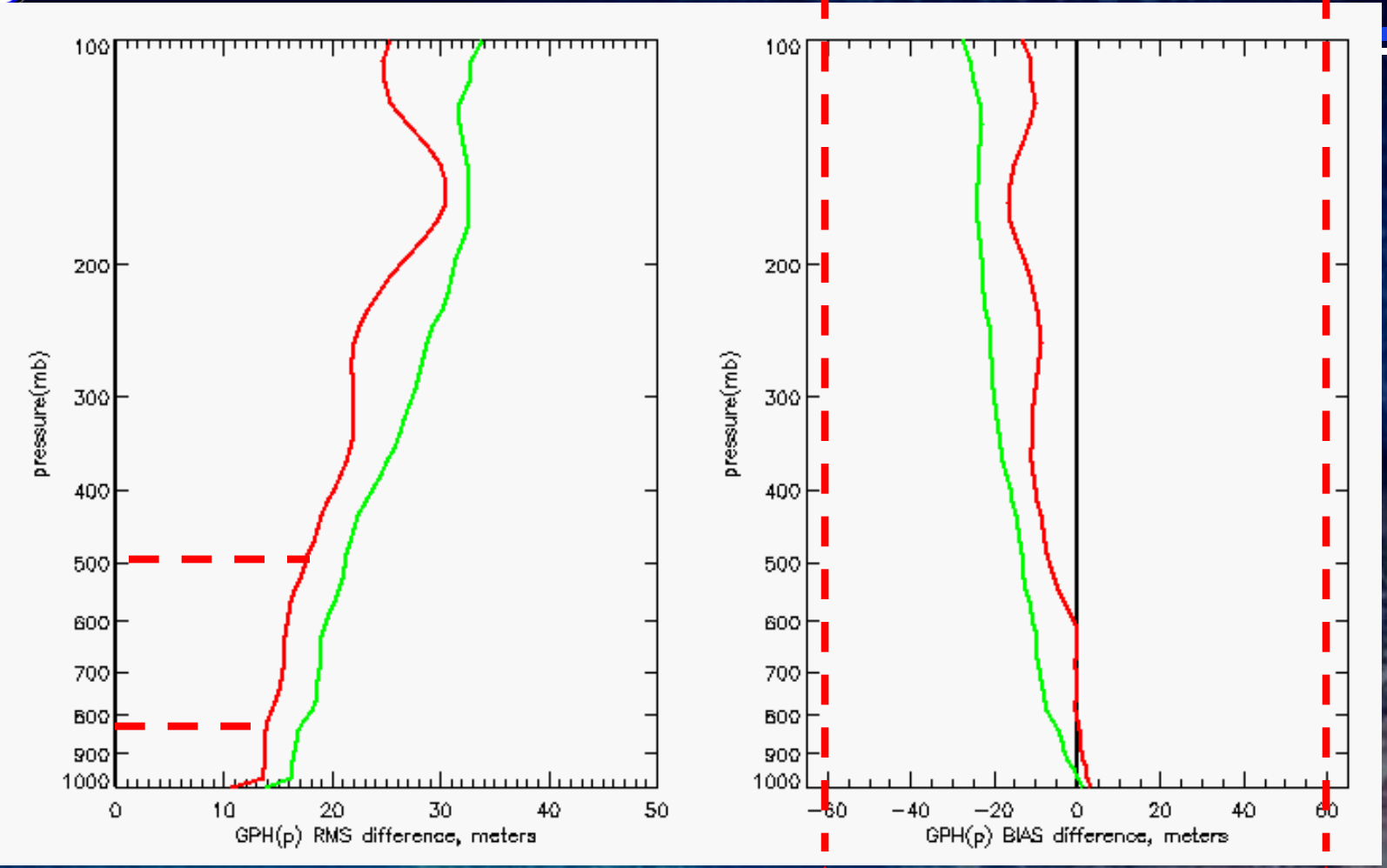


E. Kalnay et al., 1996. Units: decameters



K. Trenberth, 1982

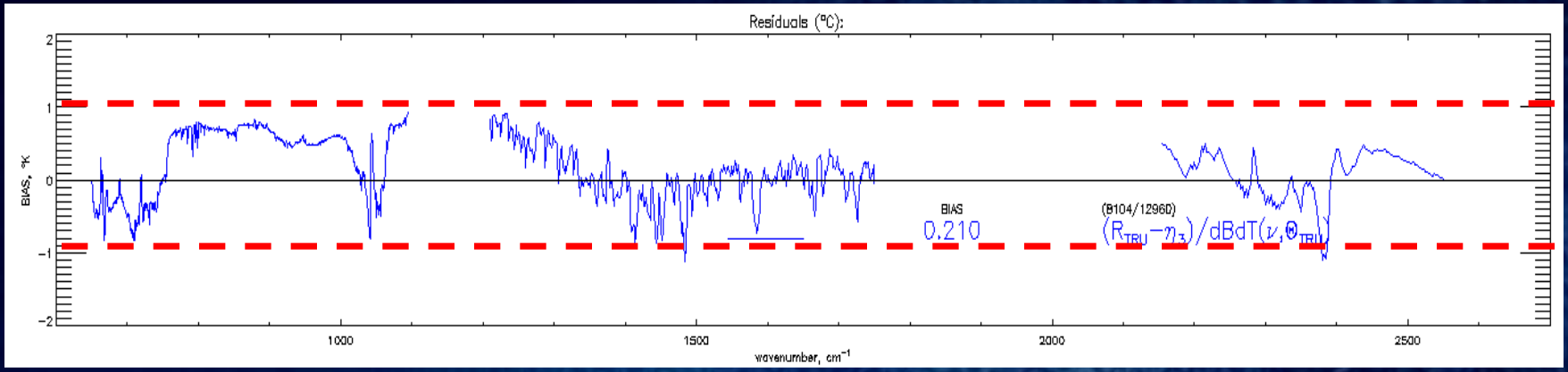
(2) Geopotential Height statistics
NUCAPS, ECMWF vs RAOB
(+/- 3 hours; <= 200km; 7 RAOBs profiles, 188 collocated retrievals)



- NUCAPS RMS is below the SQRT of the global variance at 500 (20 – 40 m) and 850 mb (=100 – 250m)
- NOTE: increase in RMS and BIAS with altitude can arise from RAOB drift

- NUCAPS BIAS meets specs (+/- 60m)

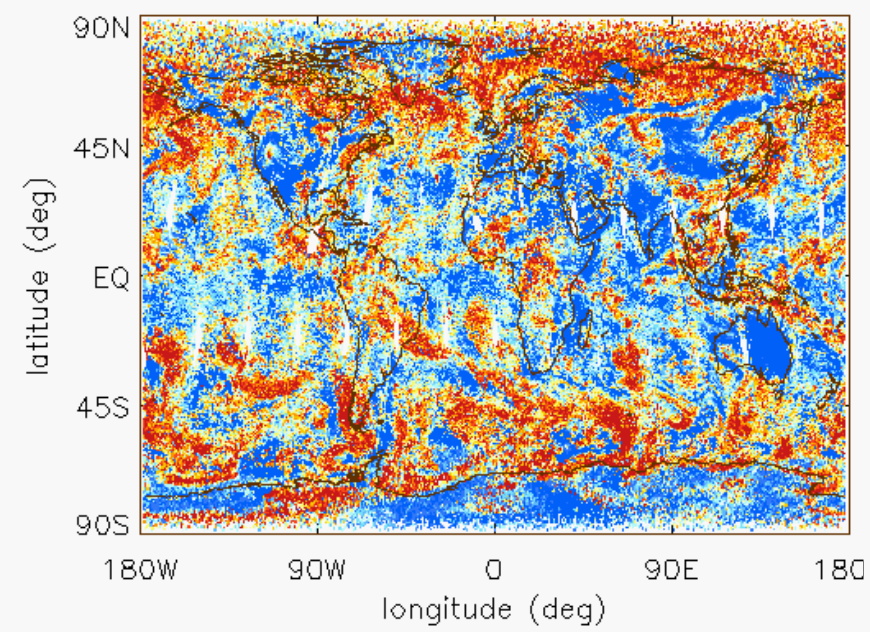
Part III: (1) Cloud Cleared Radiance Validation Results



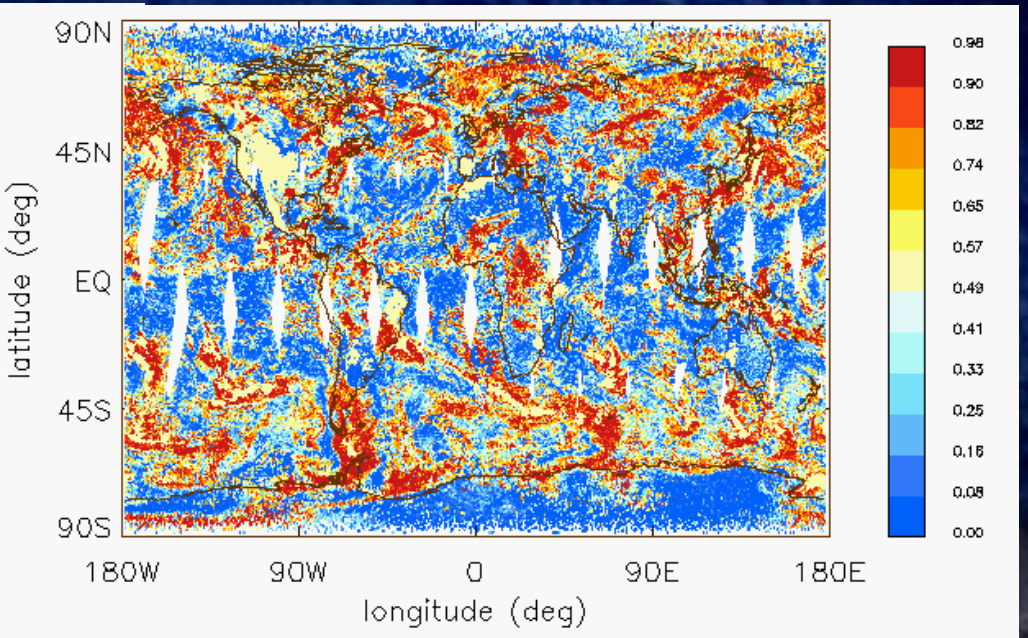
- CALC(ECMWF) - NUCAPS CCR sample of ~100 granules uniformly distributed across the globe: land/ocean/desert; trop/midlat/polar; night/day;
- **The average global bias ccr statistics meets specs: +/- 1K**
- Note: large biases occurring over window, ozone, water vapor regions likely rest on known ECMWF inaccuracy when used as “truth” over these regions.

Part III:
(2) Cloud Fraction Validation Results

NUCAPS total cloud fraction



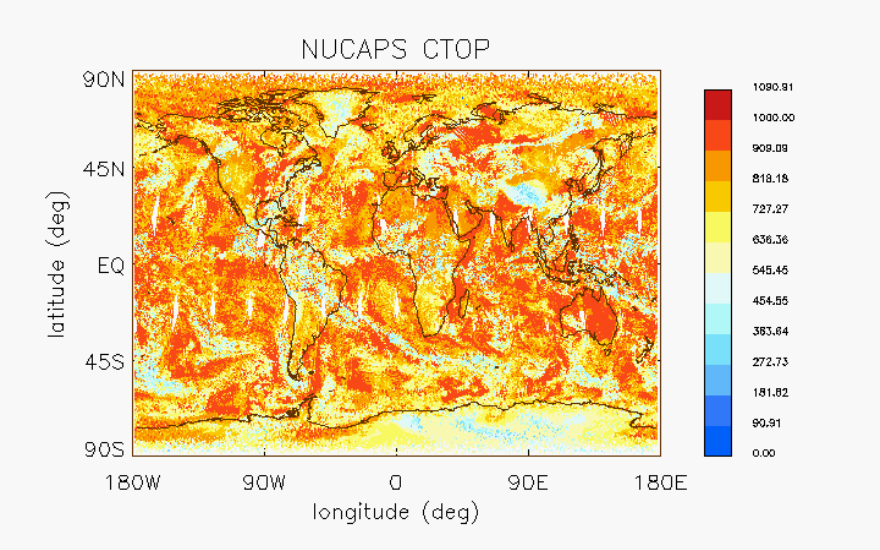
AIRS v5.9 total cloud fraction



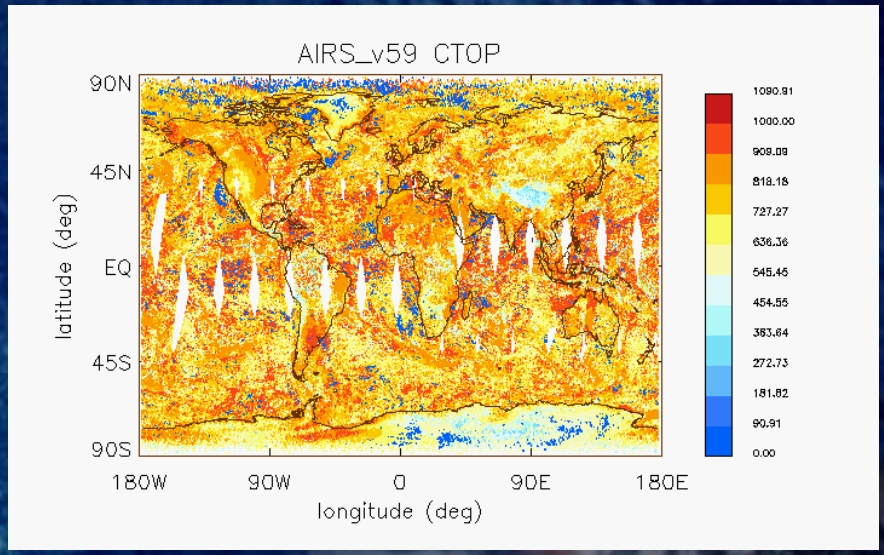
- Focus day 2012/05/15
- Both spatial patterns and range of magnitude of NUCAPS cloud fraction compare remarkably well with AIRS retrievals

Part III:
(3) Cloud Top Pressure Validation Results

NUCAPS cloud top pressure

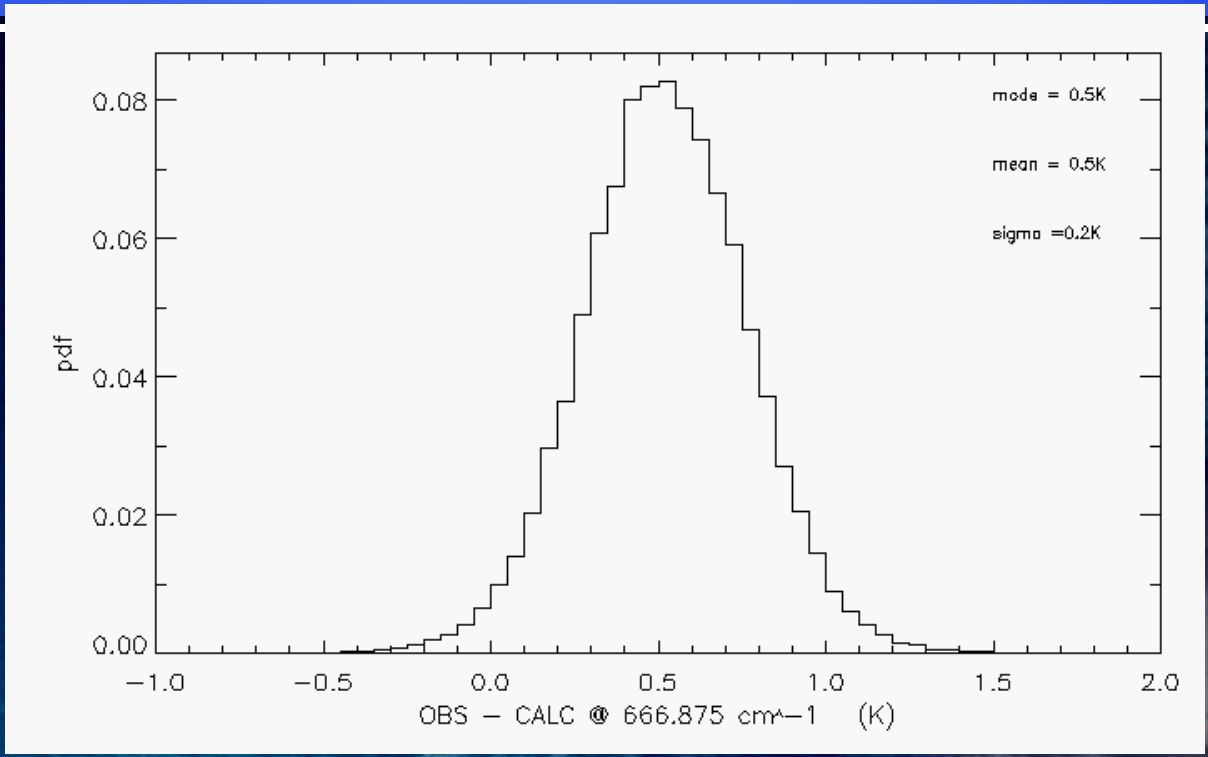


AIRS v5.9 cloud top pressure



- Focus day 2012/05/15
- A thorough assessment of cloud top pressure necessitates a well spatially collocated truth measurement, such as those provided by lidar backscattering coefficient profiles: work in progress from the AEROSPACE and BELTSVILLE cal/val campaign (data currently not available)

Cloud fraction and top pressure (*indirect*) validation study



- In the figure: pdf of cloudy OBS – CALC(truth) at 667 cm^-1
- Truth = ECMWF temperature and water vapor + NUCAPS cloud parameter retrievals and trace gases)
- Sample used for this study: ~87,000 cases uniformly distributed across the globe: land/ocean/desert; trop/midlat/polar; night/day; *see comments on next slide*.

Cloud fraction and top pressure validation results

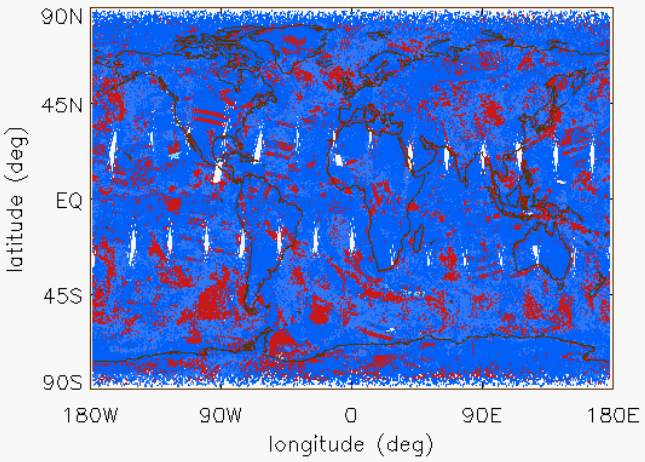
- Cloudy OBS – CALC(ECMWF + NUCAPS cloud parameter retrievals and trace gases) at 667 cm^-1, using a sample of ~87,000 cases, uniformly distributed across the globe: land/ocean/desert; trop/midlat/polar; night/day;
- Mean and mode are equal to 0.5K.
- *Important note:* ECMWF temperature inaccuracy over this region of the spectrum can be responsible of a bias up to ~0.3K (AIRS, IASI, CrIS IR tuning experience results).
- Future work: use a statistical significant sample of robust truth profiles
  - » dedicated “best estimate” RAOB measurements with temporal and spatial interpolation (AEROSE and ARM Site RAOB measurements).
  - » Lidar measurements for direct comparison of cloud top pressure retrievals (AEROSPACE Lidar measurements are still under calibration).
- Cloud top temperature is derived as an interpolation of the temperature profile onto the cloud top pressure. All temperature validation results shown previously apply to this product.

Part IV: NUCAPS Trace gas results

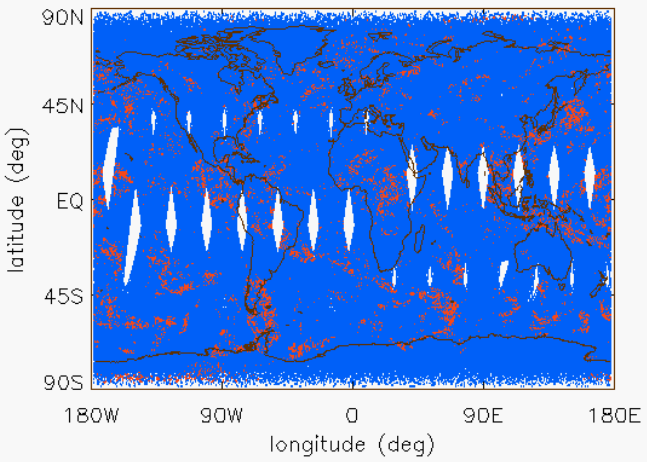
- Full trace gas validation will require intensive and dedicated in situ measurement campaigns
- Due to low S/N, trace gas validation requires averages of large data samples (weekly, monthly, etc.)
- When possible, we will leverage on our scientific collaborations (low cost activities for NOAA) to exchange data and perform trace gas validation.
- In the next slides, we perform a trace gas characterization by comparison with respect to AIRS product (~10 maturity and thoroughly validated system).
- NOTE: AIRS global acceptance yield is ~75%. NUCAPS's yield is ~60%. Regions of highest disagreement in the next slides mainly correspond to NUCAPS rejected cases.

NUCAPS vs AIRS v59 acceptance yield (blue = accepted; red = rejected)

NUCAPS

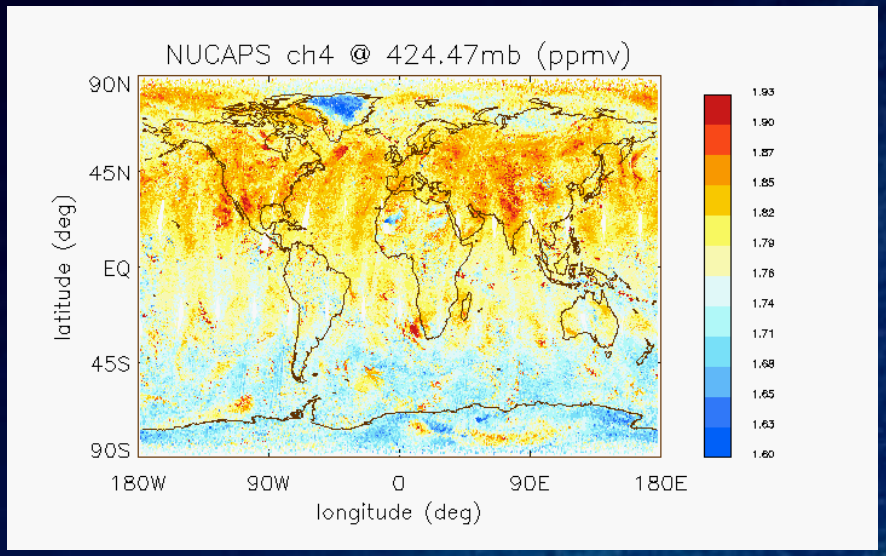


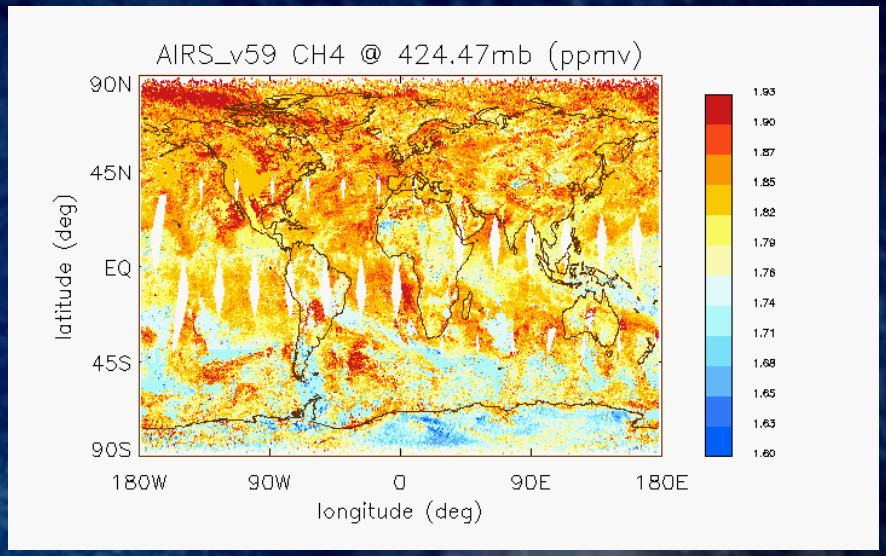
AIRS v59



- NUCAPS global acceptance yield is ~60% (focus day 2012/05/15)
- AIRS v59 global acceptance yield is ~75% (focus day 2012/05/15)

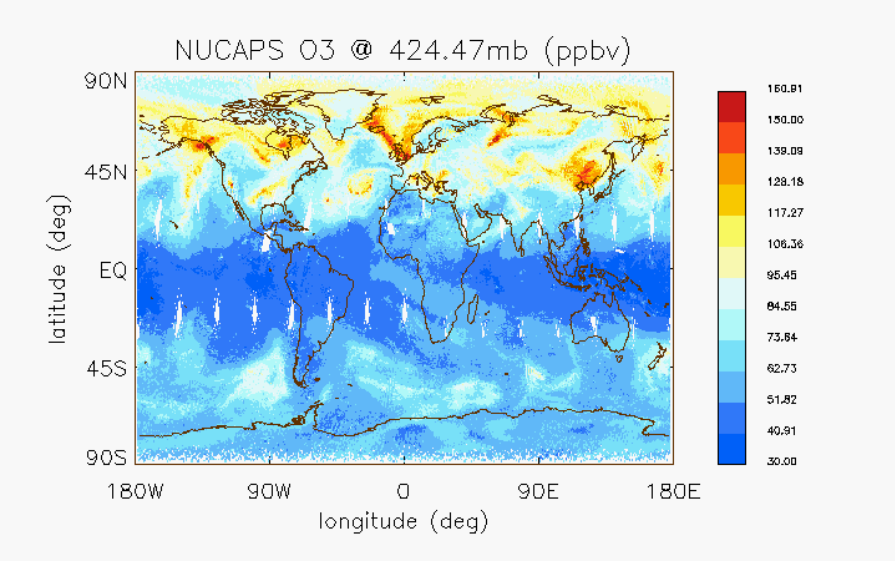
(1) CH4 results (Focus day 2012/05/15)

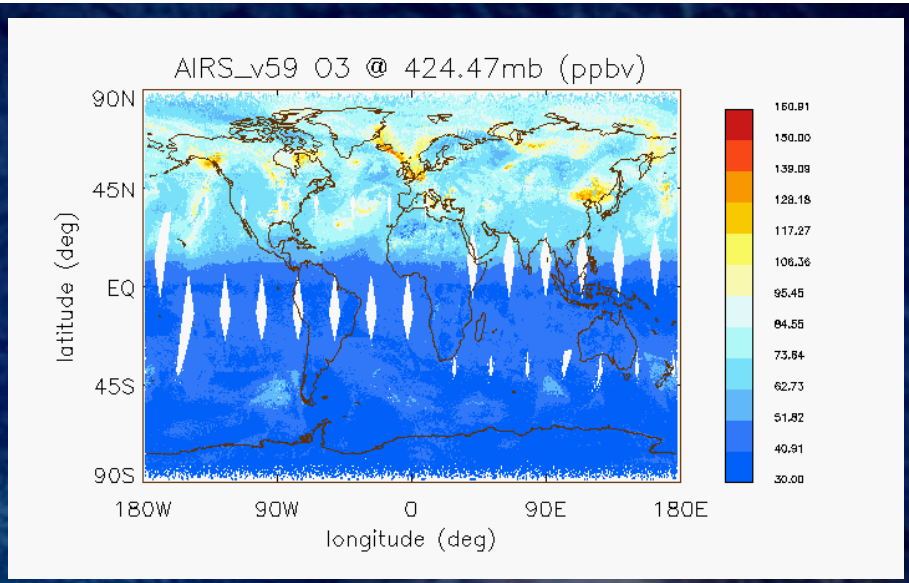




- Ongoing optimization study includes channels, perturbation functions, first guess and damping parameter.
- Future validation will fully assess performance.

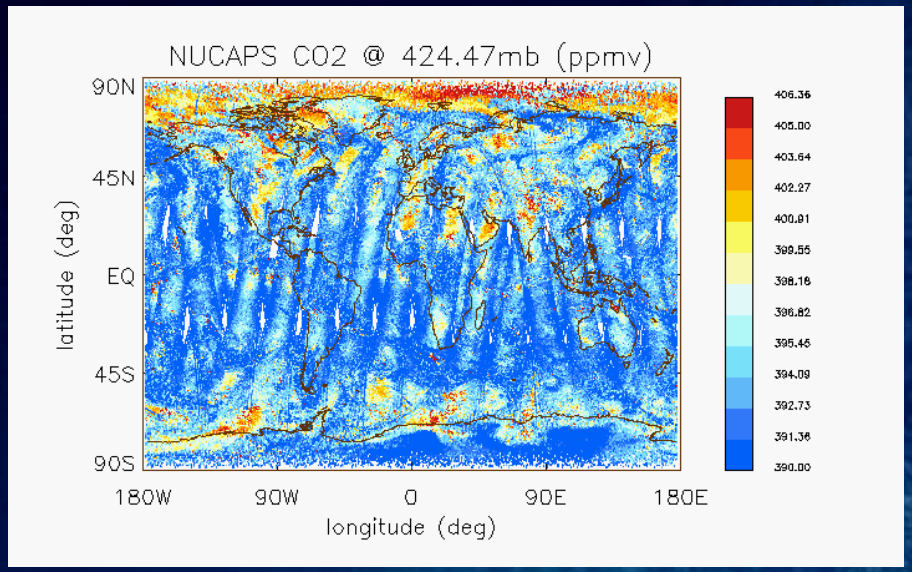
(2) Ozone results (Focus day 2012/05/15)

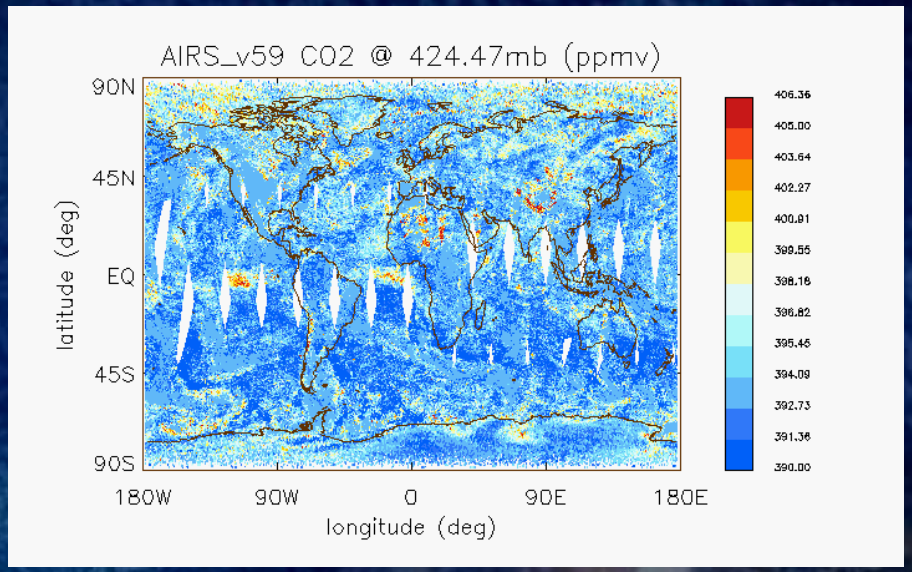




- NUCAPS shows more sensitivity than AIRS.
- Ongoing optimization study includes channels, perturbation functions, first guess and damping parameter.
- Future validation will fully assess performance.

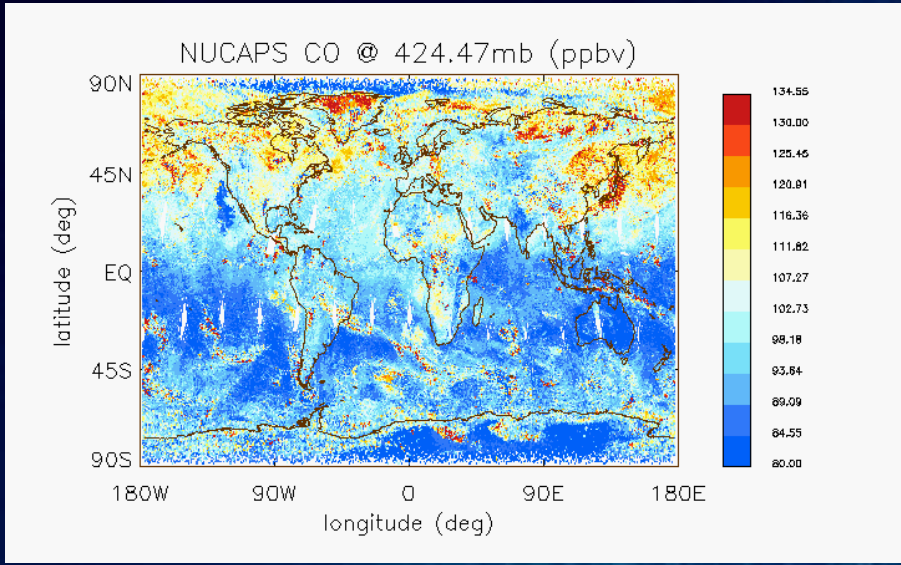
(3) CO2 results (Focus day 2012/05/15)

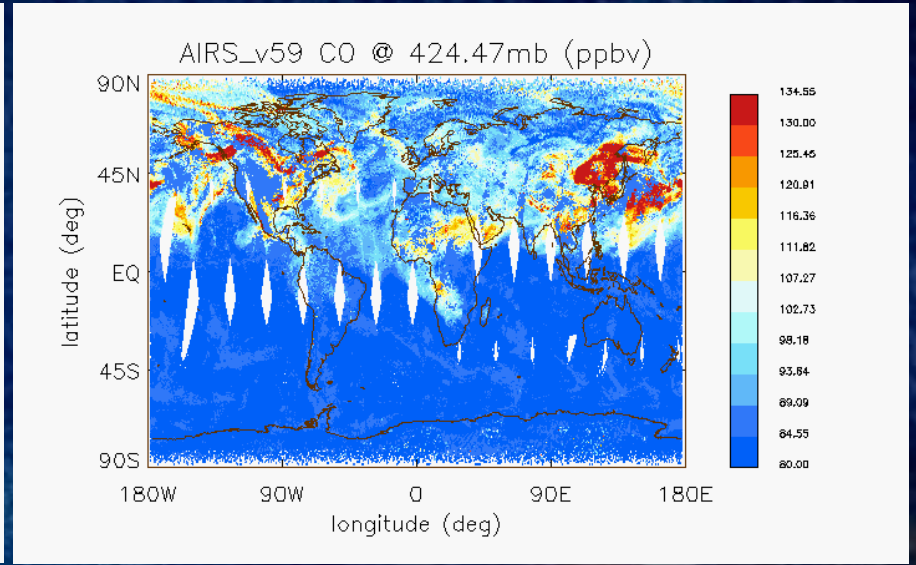




- Ongoing optimization study includes channels, perturbation functions, first guess and damping parameter.
- Future validation will fully assess performance.

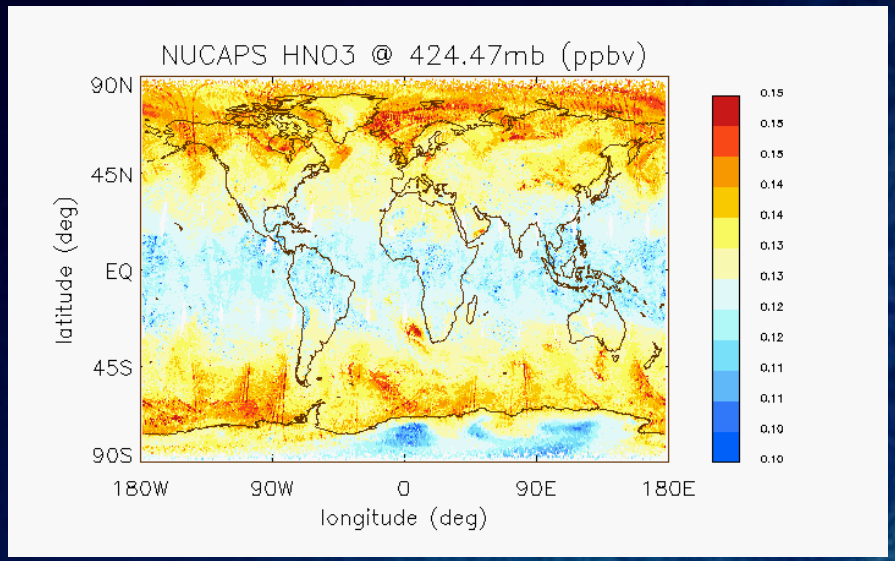
(4) CO results (Focus day 2012/05/15)

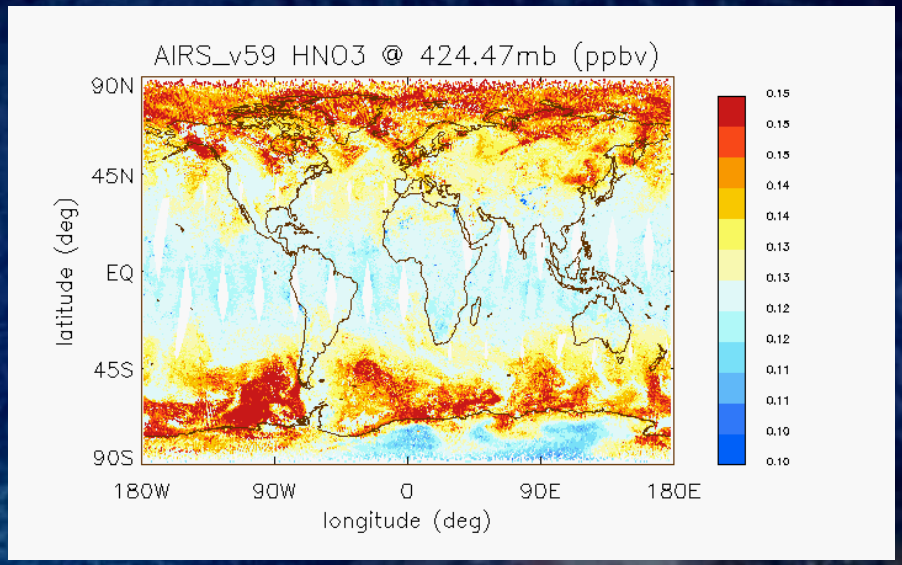




- Known instrument limitations for CO retrievals.
- Ongoing optimization study includes channels, perturbation functions, first guess and damping parameter.
- Future validation will fully assess performance.

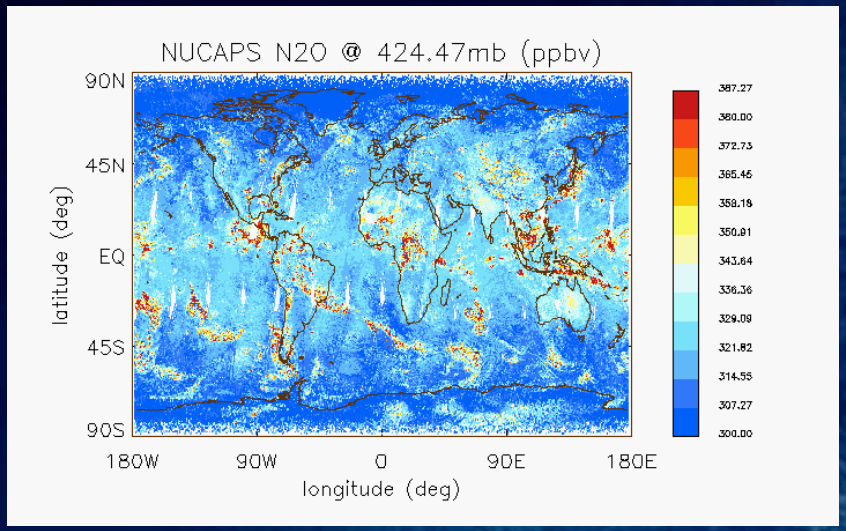
(5) HNO3 results (Focus day 2012/05/15)

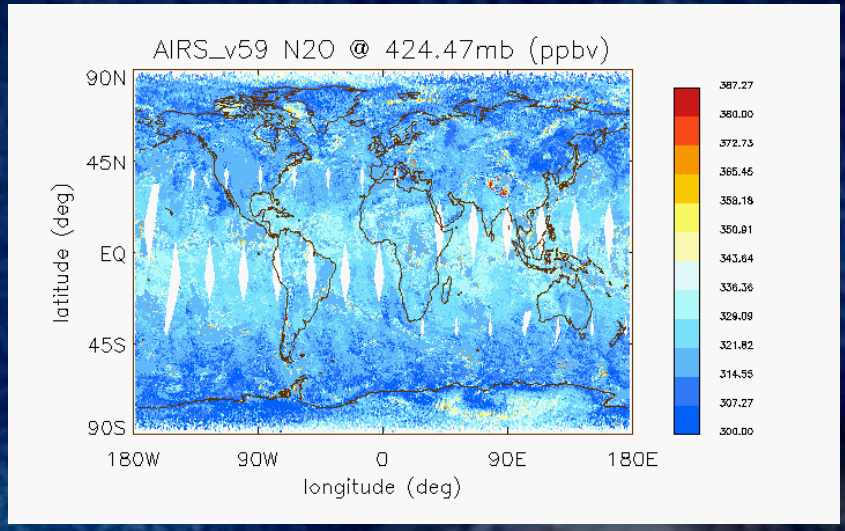




- Ongoing optimization study includes channels, perturbation functions, first guess and damping parameter.
- Future validation will fully assess performance.

(6) N2O results (Focus day 2012/05/15)





- Ongoing optimization study includes channels, perturbation functions, first guess and damping parameter.
- Future validation will fully assess performance.

Summary and Conclusions

- Summary of the validation results presented in this review:
  - » **<u>Part I:</u> Temperature, water vapor , ozone**
    - Global, Tropical, Mid-Latitude, Polar; Day/Night; Ocean/Land regimes validation versus collocated ECMWF and AVN analyses and AIRS retrievals (operational version 6 and version “5.9”)
    - **NUCAPS generally meets the required specification of:**
      - **Surface – 300mb 1.6K/1-km layer; 300mb- 30mb 1.5K/3-km layer for global temperature**
      - **Surface- 600mb 20%/2-km; 600mb – 300mb -100mb 35% /2-km layer for global water vapor**
      - **260mb – 4mb 20%/5-km layer for global ozone**
  - » **<u>Part II</u>: Temperature and geo-potential height**
    - Collocated cal/val RAOBs over Hawaii (tropical ocean regime)
    - **NUCAPS temperature RMS is ~1.5K and BIAS is +/-1K: specifications are met.**
    - **NUCAPS geo-potential height BIAS is ~0m in the lower – mid troposphere and ~ -20 m in the free troposphere: specifications (+/- 60m) are met.**

Summary and Conclusions (2)

- **<u>Part III</u>: Cloud clearing radiance; cloud fraction and top pressure**
  - OBS – CALC results, comparisons with AIRS
  - **NUCAPS Cloud clearing global BIAS ranges between +/-1K. The total bias across the spectrum is ~0.2K. NUCAPS cloud clearing meets specifications (+/-1K).**
  - **NUCAPS cloud fraction and top pressure compares well with AIRS retrievals.**

- **<u>Part IV</u>: Trace gases: ozone, methane, CO2, CO, HNO3, N2O**
  - Global map comparisons of NUCAPS and AIRS collocated retrievals
  - **NUCAPS trace gas retrievals (methane, ozone, CO2, CO, HNO3, N2O) compare well in both magnitude and spatial patterns with respect to AIRS trace gas retrievals.**

Future work

• Ongoing optimization study includes channels, perturbation functions, first guess and damping parameter.

• Use dedicated cal/val field campaign in situ measurements to fully assess NUCAPS retrieval performance of temperature, water vapor, cloud cleared radiance, cloud parameters and trace gases.

•Leverage on ongoing scientific collaborations (low cost activities for NOAA) to perform trace gas validation.

NUCAPS DAP

- The NUCAPS DAP is contained in a single tar file that has been compressed using gzip. It has the following name: NUCAPS_Phase2_v1-0_20121205.tar.gz
- It is currently located here on SADIE: /utilraid/data/users/tking/NUCAPS_20121205/NUCAPS_Phase2_v1-0_20121205.tar.gz
- Note that the DAP file name complies with the DAP naming convention identified on page 6 of the DAP document.
- When ungzip'd and untar'd, there are 4 main subdirectories and a README file produced in the current working directory:
  - *SOURCE/* - All Fortan 77/90, C/C++ code
  - *OPS/* - All scripts and static system files
  - *DATA/* - All sample/test data
  - *DOCS/* - All SPSRB and NDE documentation
  - README - the README file for NUCAPS

DAP Checklist

Required DAP Item	Location in Delivered DAP
Science algorithm source code, including make files and scripts.	./SOURCE/code/
Test plans, test description, test procedures, and detailed performance testing results.	./DOCS/
Test input data, temporary files, and expected output data.	./DATA/
Coefficient files and/or look-up tables.	./OPS/CDLFILES ./OPS/DEM ./OPS/matchups ./OPS/pc_coeffs ./OPS/resample ./OPS/retrieval
Quality monitoring information (quality flags, quality flag values).	Section 6 of ./DOCS/NUCAPS_SMM_2.0.docx
Production rule-set definitions.	./DOCS/NUCAPS_Production_Rules.docx

DAP Checklist

Required DAP Item	Location in Delivered DAP
Product file specifications – layout, content, and size.	Section 7 of ./DOCS/NUCAPS_SMM_2.0.docx Section 1 of ./DOCS/NUCAPS_EUM_2.0.docx
Data flow diagrams.	Section 7 of ./DOCS/NUCAPS_SMM_2.0.docx
List of exit codes and their associated messages.	Section 6 of ./DOCS/NUCAPS_SMM_2.0.docx
List of expected compiler warnings (see bullet 5 below).	Section 4.3 of ./DOCS/NUCAPS_SMM_2.0.docx
Estimates of resources required for execution.	Section 2 of ./DOCS/NUCAPS_SMM_2.0.docx
Algorithm Theoretical Basis Documents (ATBDs) or reference to where the ATBDs can be obtained.	./DOCS/NUCAPS_ATBD_1.0.docx
Delivery Memo.	./DOCS/Delivery_Memo To be sent via email at time of delivery to NDE
README text file.	./README

NUCAPS Source Code

NUCAPS Code Area	Language	Number of Files	Number of Lines
NUCAPS system	Fortran 90	225	83219
NUCAPS system	C	39	7018
GFS Preprocessor	C	38	7332
GFS Preprocessor	C++	24	5820
Retrieval	Fortran 77	1055	417657
Unit Scripts and utilities	Perl	17	8168
Makefiles	Make	39	4011

NUCAPS DAP Documentation

- The NUCAPS DAP will contains the following documents:
  - Delivery Memo (also included in email notification)
  - README
  - NUCAPS_SMM_2.0.docx
  - NUCAPS_EUM_2.0.docx
  - NUCAPS_ATBD_1.0.docx
  - NUCAPS_Production_Rules.docx
  - NUCAPS_ARD_2.0.pptx

- The SMM, EUM, and ATBD contain unfinished sections that need to be completed by Integration Programmers (NDE) and the PAL (OSPO).
  - The document objects for sections have been highlighted in yellow
  - ATBD is not yet complete. This has been identified as a risk.

NUCAPS Algorithm Readiness Summary

- The NUCAPS software has been tested. The results have been presented.
- The DAP contents have been verified.
- DAP has been delivered to SADIE.
- NUCAPS developers will work with NDE to address any issues that arise during integration and NDE system testing.

Review Outline

- Introduction
- ARR Phase 1 Report
- Updated Requirements
- Phase 2 Software Architecture
- Algorithm Readiness
- Risk Summary
- Summary and Conclusions

Section 6 – Risks Summary

Presented by

Tom King

Open Risks and Actions

- **Risk #9:** Project metadata do not meet user requirements
  - **Risk Mitigation:**
  - Work with CLASS on the SA and making metadata available to them for approval.
  - Work with Jay Morris at CLASS via the STAR CSWG to update and formalize the metadata methodology.
- **Closure Date:** Sep, 2013

- **Risk #30:** The current CrIS instrument's spectral resolution in the short-wave band is too low for retrieval of carbon monoxide within requirements.
  - **Risk Mitigation:**
  - JPSS Project Office has been investigating bringing down full resolution data in the CrIS RDR, but there is not yet a plan to put it into the SDR.
  - NUCAPS science development team will continue to work with the Project Office to have these data available in the SDR.
- **Closure Date:** TBD

Open Risks and Actions

- **Risk #33:** There is no local angle correction to the retrieval.
  - » **Risk Mitigation:**
    - – Investigate implementing this for the next delivery in Sep. 2013.
- **Closure Date:** Sep, 2013

- **Risk #38:** NDE may have to deliver the system to operations without the completed documentation. SPSRB may or may not find this acceptable.
  - » **Risk Mitigation:** NDE will work with STAR and OSPO PALs to complete the required sections of the SPSRB documents.
- **Closure Date:** June, 2013

Open Risks and Actions

- **Risk #39:** The review team would like to have a Software Code Review prior to operational implementation.
  - » **Risk Mitigation:**
    - After IASI code review, we cleaned up NUCAPS code on our side so it would meet operational requirements.
    - We could do an SCR after delivery to NDE, once OSPO gets funding. Then, do a delta delivery. Or, do the review prior to the next scheduled delivery in Sep 2013.
- **Closure Date:** May, 2013 or Sep, 2013

New Risks and Actions

- **Risk #40:** ATBD is not finished.
  - » **Risk Mitigation:**
    - Finish ATBD
- **Closure Date:** Jan, 2013

- **Risk #41:** NUCAPS EDR and CCR files will initially fail to be archived because CLASS does not currently have funding.
  - » **Risk Mitigation:**
    - Expedite work on the Submission Agreement as soon as CLASS has its funding to minimize the amount of data lost to the archive.
- **Closure Date:** June, 2013

New Risks and Actions

- **Risk #42:** PAL and his team need to complete assigned sections of the SPSRB documents as they are already funded to do so.
  - **Risk Mitigation:**
    - NUCAPS team will deliver the DAP or at least the document part to OSPO so they can finish their sections.
- **Closure Date:** Jun, 2013

- **Risk #43:** PAL needs to identify the trace gas community users.
  - **Risk Mitigation:**
    - AK Sharma will work with Chris Barnet to identify who the trace gas users are prior to SPSRB meeting.
- **Closure Date:** June, 2013

Review Items Summary

- 43 risks have been addressed at during the lifecycle of this project
- 34 have been closed
- 4 new risks have been identified
- 8 remain open

Review Outline

- Introduction
- ARR Phase 1 Report
- Updated Requirements
- Phase 2 Software Architecture
- Algorithm Readiness
- Risk Summary
- Summary and Conclusions

Section 7 – Summary and Conclusions

Presented by

Tom King

Review Objectives Have Been Addressed

- The following have been reviewed
  - Phase 1 Algorithm Readiness Review Risks and Actions
  - Updated Requirement Allocation
  - Updated Software Architecture
  - NUCAPS Phase 2 Algorithm Readiness
  - Delivered Algorithm Package Verification
  - Risks and Actions Summary

Next Steps for NUCAPS

- Assist NDE with integration and their system testing.
- Finish ATBD.
- Work with CLASS on the SA and any required updates to metadata.
- Begin development for future NUCAPS phases.

Open Discussion

- The review is now open for free discussion