Microwave Integrated Retrieval System for NPOESS Preparatory Project

Preliminary Design Review

September 24, 2009

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Review Agenda

Introduction	9:30 – 9:50	Sid Boukabara Kevin Garrett
Description of MiRS/NPP ATMS	9:50 – 11:00	
MiRS/NPP ATMS Overview		Kevin Garrett
MiRS/NPP ATMS Infrastructure		Wanchun Chen
MiRS/NPP ATMS Processing		Chris Grassotti Flavio Iturbide-Sanchez
Integration with NDE	11:00 – 11:15	Kevin Garrett
Monitoring and Quality Control	11:15 – 11:25	Wanchun Chen
Summary and Conclusions	11:25 – 11:30	Kevin Garrett
Discussion	11:30 – 12:00	All

- **INTRODUCTION**
- DESCRIPTION OF MiRS/NPP ATMS
- INTEGRATION WITH NDE
- MONITORING AND QUALITY CONTROL
- SUMMARY AND CONCLUSIONS
- DISCUSSION

Section 1 – Introduction

Presented by

Kevin Garrett

Project Objectives (1/2)

- Overarching Objective
  - » The overarching objective of the Microwave Integrated Retrieval System (MiRS) is to contribute to the execution of the NOAA elements in the Integrated Earth Observation System (IEOS), which is a NOAA priority (Mission Support).
- Mission Objective
  - » MiRS aims at providing timely and effective acquisition and delivery of satellite-derived information that supports requirements from the Mission goal. *The integrated and generic natures of MiRS make it possible to reduce significantly the amount of time spent developing retrieval algorithms for new sensors, which in turn reduces dramatically the time needed to transition to operations.*

Project Objectives (2/2)

- Science Objectives
  - » Improved temperature and moisture profile retrievals
  - » The extension of the retrieved products to non-standard surfaces including sea-ice and snow-covered land
  - » The retrieval in all-weather conditions including cloudy and precipitating conditions
  - » An improved set of retrieved surface properties whose derivation is based on the retrieved emissivities instead of directly from the brightness temperatures

PDR Objectives

- Objectives of the Preliminary Design Review
  - » Goal #1: Gather all MiRS stakeholders to review the overall system integration of MiRS into the NPOESS Data Exploitation (NDE) environment
  - » Goal #2: Detail efforts to enable MiRS processing of NPP ATMS data

MiRS Stakeholders

- Development Team
  - » S.-A. Boukabara, K. Garrett, F. Iturbide-Sanchez, C. Grassotti, W. Chen, C. Kongoli
- OSDPD Partners
  - » L. Zhao, A. Li, J. Zhao
- MiRS Oversight Board
  - » F. Weng (chair), R. Ferraro (STAR), L. Zhao (OSDPD), J. Silva (NDE), T. Schott (OSD)
- Oversight Panels
  - » SPOP, PREPOP, ICAPOP, LSPOP
- MiRS Users
  - » J. Derber, B. Yan, M. Kim (JCSDA), Mike Eck and J. Janowiak (NCEP/CPC), G. Serafino (NESDIS/SAB), J. Turk and B. Ruston (NRL), G. Huffman (NASA/GSFC), AFWA, J. Tesmar (FNMOC), P. Wang (Taiwan Weather Bureau), S. Kidder (CIRA), and Universities
  - » Additional users of the MiRS package include a dozen users around the world, including CMA and NASA/JPL.

MiRS Timeline/History(1/5)

- Development Phase Begins (Sep. '05-Sep. '06)
  - » Go-ahead with product development (Sep. '05)
  - » Preliminary Design Review (Oct. '05)
  - » Critical Design Review (Sep. '06)
- Pre-Operational Phase Begins (Jul. '07)
  - » Operational/backup processing capabilities in place.
  - » SPSRB approves product to go operational
- Operational Phase Begins (Aug. '07)
  - » Operational/backup processing capabilities reach ops status
  - » Code transitions to operations (MiRS Release I)
  - » SPSRB updates product metrics web pages
  - » OSD updates Satellite Products database

MiRS Timeline/History (2/5)
List of Products

MiRS	Products	N18	Metop-A	DMSP F16
Phase I	-Atmospheric Temperature Profiles (T) -Quality Control (QC) based on convergence metric (Chi-sq) –optional-	Sep 2006	Jun 2007	Jun 2008
Phase I & II	-Water Vapor Profiles (Q) –over ocean- -Total Precipitable Water –over ocean- -Land Surface Temperature -SST –optional- -IST –optional- -Emissivity –all surfaces- -Surface Type	Jun 2007	Jun 2007	Jun 2008
Phase II	Em.-based Snow-Water Equivalent Em.-based Snow-Cover Extent Em-based Sea-Ice Concentration Soil Wetness –optional- Integrated Cloud Liquid Water –ocean- TPW and Q to non-ocean surfaces	Dec 2007	Dec 2007	Dec 2008

Transitioned to Ops

MiRS Timeline/History (3/5)
List of Products

MiRS	Products	N18	Metop-A	DMSP F16
Phase II & III	-Ice profile & Ice Water Path (IWP) -Rain profile & Rain Water Path (RWP) -Rain Flag (RF) –optional- -Precipitation Type (Water Phase) (PT) –optional-	Jun 2008	Jun 2008	Jun 2009
Phase III	-Rain Rate (RR) -Snow Fall Rate (SFR) –optional- -Cloud Top Pressure –optional- -Cloud thickness –optional- -Cloud base –optional- -Advance Quality Control Products: Average Kernel, Hessian, Contribution Functions -optional- -Extension to cloud retrieval over non-ocean -optional-	Dec 2008	Dec 2008	~~Nov 2009~~ June 2009

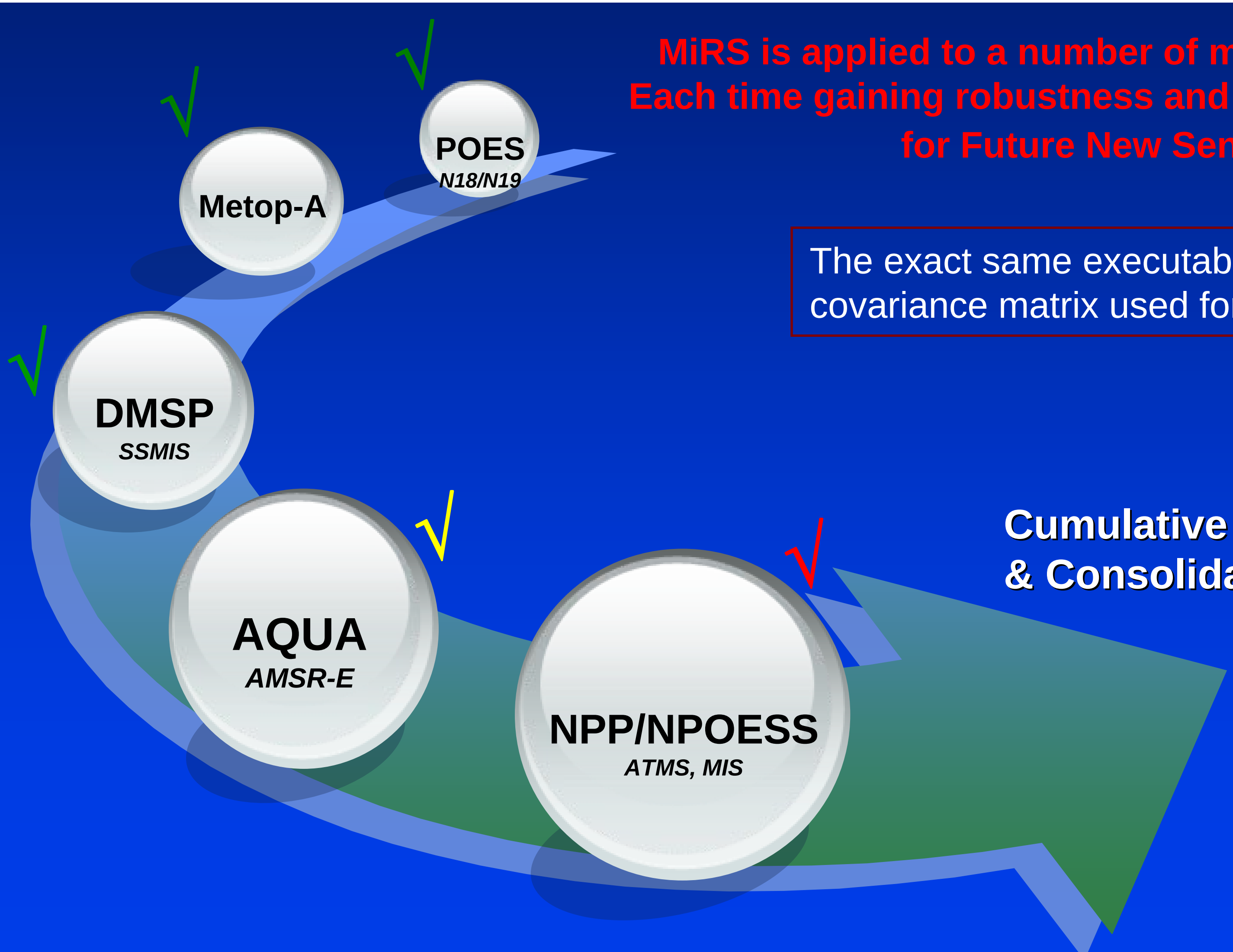
Transitioned to Ops | Originally scheduled for Nov 2009, transitioned June 2009

**** NOAA-19 delta-DAP delivered to OSPDP March 23, 2009***

MiRS Timeline/History(4/5)

MiRS is applied to a number of microwave sensors, Each time gaining robustness and improving validation for Future New Sensors

The exact same executable, forward operator, covariance matrix used for all sensors



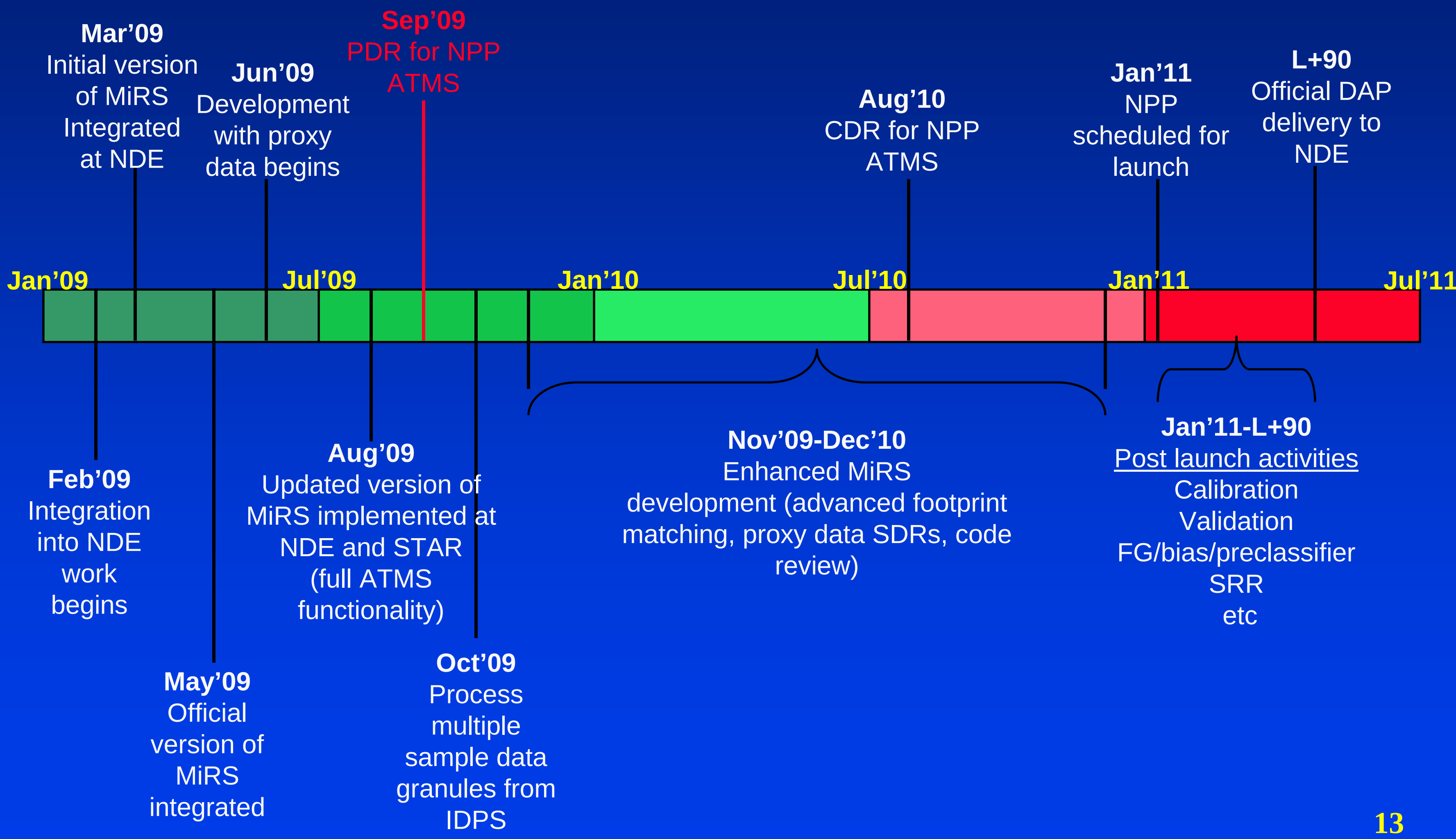
Cumulative Validation & Consolidation of MiRS

√: Applied Operationally

√: Applied occasionally

√: Tested in Simulation

MiRS Timeline/History(5/5)



- INTRODUCTION
- **DESCRIPTION OF MiRS/NPP ATMS**
- INTEGRATION WITH NDE
- MONITORING AND QUALITY CONTROL
- SUMMARY AND CONCLUSIONS
- DISCUSSION

Section 2 –

DESCRIPTION OF MiRS/NPP ATMS

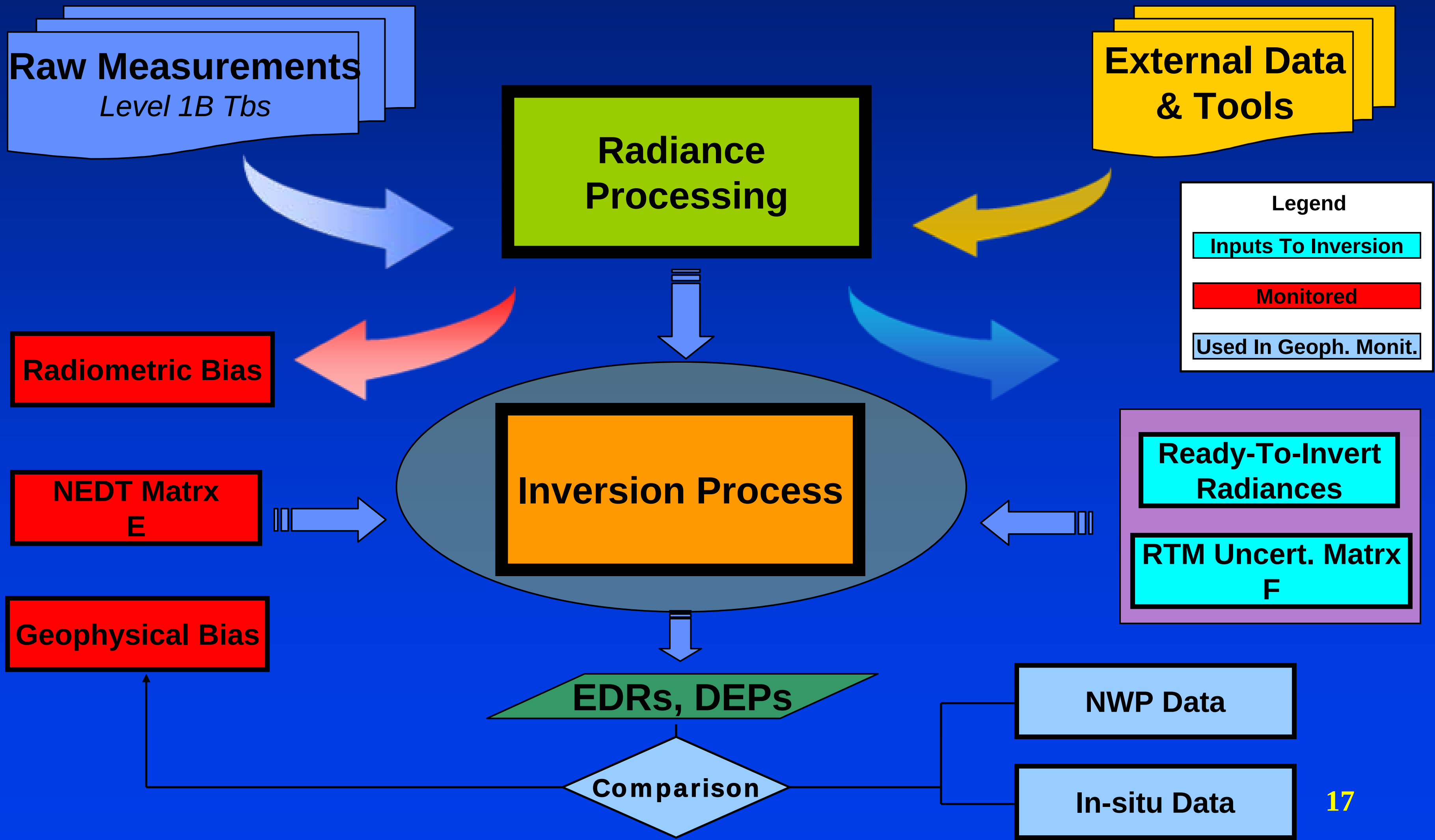
Presented by

Kevin Garrett

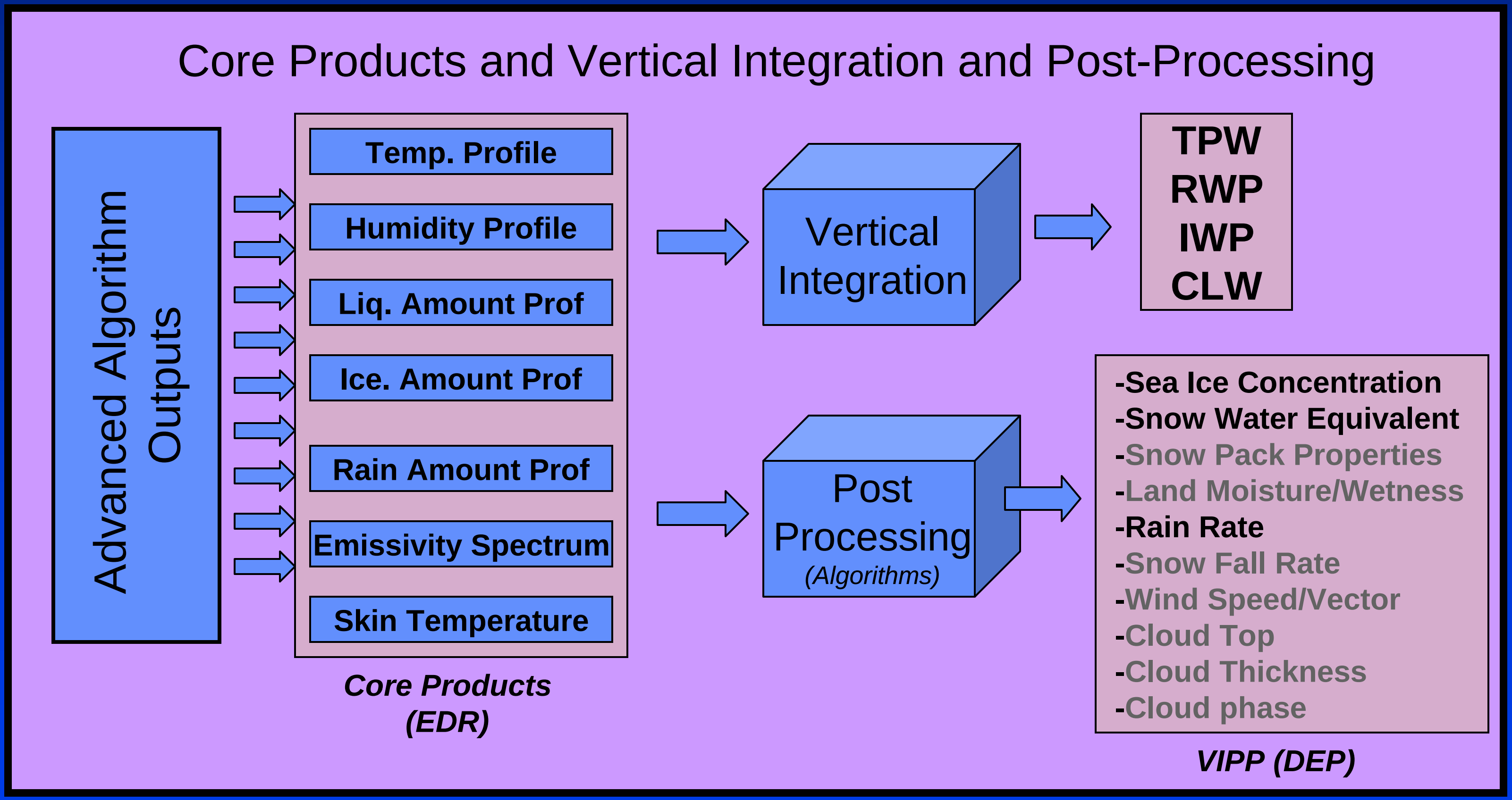
What is MiRS?

- The Microwave Integrated Retrieval System (MiRS) is a flexible variational retrieval algorithm which can function for a number of microwave sensors.
- The MiRS algorithm reads in radiances, has the ability to process them, and inverts them into meaningful meteorological and geophysical data.

MiRS Description
Processing Flow (1/2)



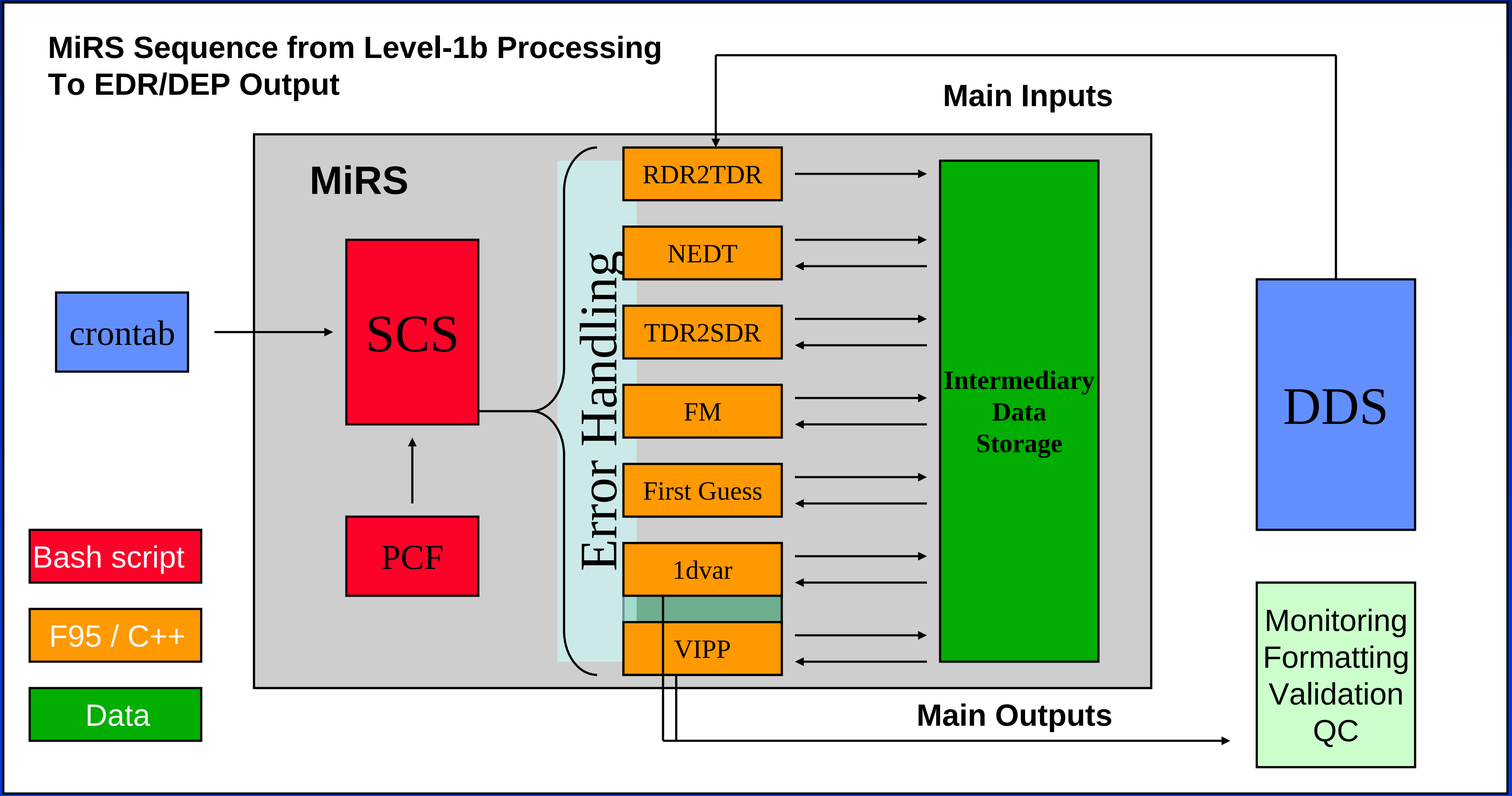
MiRS Description
Processing Flow (2/2)



MiRS Description
Processing Sequence (1/2)

- Each program in MiRS is initiated by an associated function written in .bash. This script function:
  - » generates the required namelist for that program
  - » calls the related Fortran, C/C++ or IDL program (IDL is not used in operations)
- A Process Control File (PCF) defines all variables for namelist input, and which programs should be executed
- A master Sequence Control Script (SCS) reads the PCF and calls the desired script functions (with arguments) that ultimately execute the programs
- SCS and PCF for all sensors are easily generated by the central GUI tool
- A Process Status File (PSF) is written listing all successful output product files

MiRS Description Processing Sequence (2/2)



Overview of MiRS NPP ATMS

- All aspects of MiRS have been extended to handle NPP ATMS
  - » I/O (both proxy data and sample data)
  - » Radiometric processing
  - » Inversion components
  - » Postprocessing components
  - » Validation system and monitoring
- MiRS is ready to process NPP ATMS data
  - » MiRS NPP ATMS has been implemented in NDE Data Handling System and in STAR
  - » The system is applied daily in STAR using proxy data

MiRS NPP ATMS
What updates are needed?

- **Preprocessing Components**
  - ➢ Readers (HDF5)
  - ➢ Footprint matching
  - ➢ Surface preclassification
  - ➢ CRTM coefficient files
  - ➢ Bias/RTM uncertainty/NEDT
  - ➢ Tuning Files
  - ➢ Surface emissivity mean and covariance matrix

- **Postprocessing Components**
  - ➢ Snow and Ice retrieval (LUTs)
  - ➢ Surface postclassification
  - ➢ Process Status File (PSF)
  - ➢ NetCDF 4 encoder

Program | Subroutine | Static File

- Highly modularized design allows for minimal changes to MiRS
  - » Driver scripts are generic
  - » No modifications are needed for core retrieval algorithm or any module accessed by the 1DVar program (including forward operator, I/O, error handling, inversion subroutines, etc.)
  - » Only changes to sensor-specific components are needed (readers, bias correction, etc.)

NPP ATMS
Sensor Characteristics

- NPOESS Preparatory Project (NPP) satellite Advanced Technology Microwave Sounder (ATMS)
  - » Follow on to AMSU-A/MHS sensors
  - » 22 Channels, 23-183 GHz
  - » Increased swath-width to 2503 km (complete daily global coverage)
  - » Increased resolution and over-sampling

Channel	Center Frequency (GHz)	Bandwidth (GHz)	Beamwidth (deg)	Approx. FOV size (km) for 833 km orbit
1	23.8	0.27	5.2	75
2	31.4	0.18	5.2	75
3	50.3	0.18	2.2	32
4	51.76	0.40	2.2	32
5	52.8	0.40	2.2	32
6	53.596 ± 0.115	0.17	2.2	32
7	54.40	0.40	2.2	32
8	54.94	0.40	2.2	32
9	55.50	0.33	2.2	32
10	57.290334	0.33	2.2	32
11	57.290334 ± 0.217	0.078	2.2	32
12	57.290334 ± 0.3222 ± 0.022	0.036	2.2	32
13	57.290334 ± 0.3222 ± 0.010	0.016	2.2	32
14	57.290334 ± 0.3222 ± 0.0045	0.008	2.2	32
15	57.290334 ± 0.3222 ± 0.048	0.003	2.2	32
16	88.2	2.0	2.2	32
17	165.5	3.0	1.1	16
18	183.31 ± 7	2.0	1.1	16
19	183.31 ± 4.5	2.0	1.1	16
20	183.31 ± 3	1.0	1.1	16
21	183.31 ± 1.8	1.0	1.1	16
22	183.31 ± 1	0.5	1.1	16

NPP ATMS Channel Characteristics

***V-pol** ***H-pol**

NPP ATMS
Proxy Data

- Development of critical MiRS NPP ATMS components based on proxy data
  - » Proxy data generator provided by Bill Blackwell - MIT Lincoln Lab
- Proxy data generator (regression) applied to Metop-A AMSU/MHS
  - » Converts to ATMS frequency domain
  - » Interpolates to simulate ATMS scan geometry
- Some caveats:
  - » TBs valid over Ocean 70º > latitude > -70º and Snow-free Land
  - » Interpolation artifacts at large scan angles
  - » ATMS TB discrepancies with its corresponding Metop-A AMSU/MHS channels (e.g. ~89 GHz)

MiRS NPP ATMS
MiRS Infrastructure

- HDF5 Reader
- netCDF4 Encoder
- SW/HW Requirements
- Benchmark Processing

Wanchun Chen

MiRS NPP ATMS

Data Formats for NPP (1/2)

- Input format for NPP ATMS TDRs (Sample and Proxy data) is HDF5
- Reader
  - » rdr2tdr_npp_atms.cc (in src/testbed/rdr2tdr)
  - » Input: HDF5
  - » Output: MiRS internal “tdr” format
  - » Language: C++
  - » External Libraries: HDF5
- Status
  - » Currently tested in STAR Linux and NDE AIX environment
    - – g++, xlc++, xlC compilers

MiRS NPP ATMS
Data Formats for NPP (2/2)

- Output format of MiRS products within NDE is netCDF4
- Encoder
  - » Package: Stand-alone utility
  - » Input: MiRS EDR and DEP files
  - » Output: 2 netCDF4 files (sounding and surface/precip products)
  - » Language: C
  - » External Libraries: HDF5, netCDF4, and szip libraries
- Status
  - » Currently tested in Linux and NDE AIX environment
    - – gcc, xlC

MiRS NPP ATMS
Coding Standards

- Follow Fortran 95 coding standards (ISO,STAR)
- Programs/Subroutines efficient and robust (use Valgrind)
- Modular design
- Centralized error handling
- Baseline profiling of the code
- All code changes are managed by Subversion: a source version control system

MiRS NPP ATMS
IT Requirements

Hardware Requirements

	Minimum* # of CPUs	Minimum RAM	Min. Hard Disk Space	Platform Type
MIRS Requirements	1	1GB	3GB	Any

Software Requirements

Not necessary for producing the outputs

	Operating System	C Compiler	F95 Compiler	Commercial Software	Freeware
MIRS Requirements	Linux or IBM AIX	xlC or xlc++ or gcc or g++	ifort or pgf95 or xlf95	IDL v5 and Up	BASH

**This is minimum required. Number of CPUs will affect the speed of execution. 14 CPUs are used in STAR to run three sensors daily.*

MiRS NPP ATMS
Benchmark Processing

- Based on 1 CPU-3.0 GHz, 16 GB RAM
  - » 1 ATMS granule in high resolution (1152 profiles)
    - – ~1.5 minutes of CPU time
    - – 22 MB Storage
  - » MiRS has ability to "chop" granules into sub-elements to utilize multiple CPU environments
    - – Can extrapolate CPU time based on # of CPUs available
  - » Disk storage requirements can be determined based on data retention policies (~195 granules/orbit)

MiRS NPP ATMS Radiometric Processing

- Footprint Matching
- Bias Correction

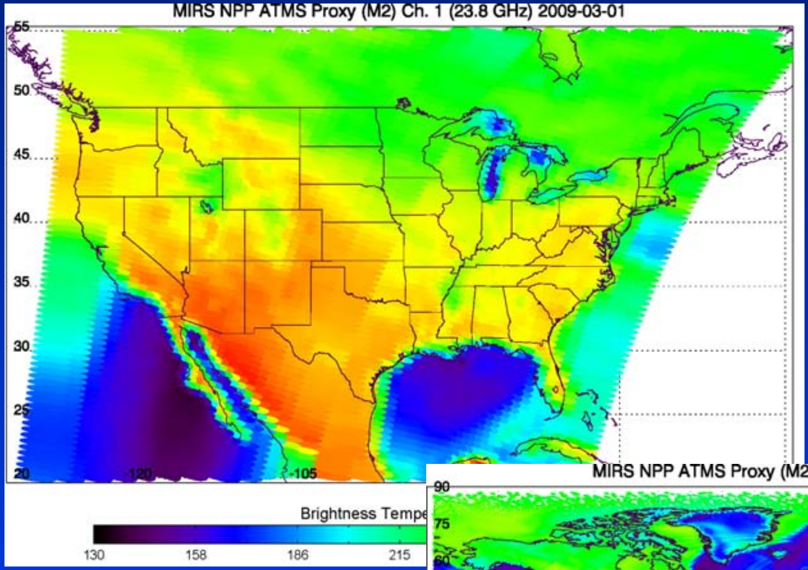
Chris Grassotti

MiRS NPP ATMS
Footprint Matching (1/2)

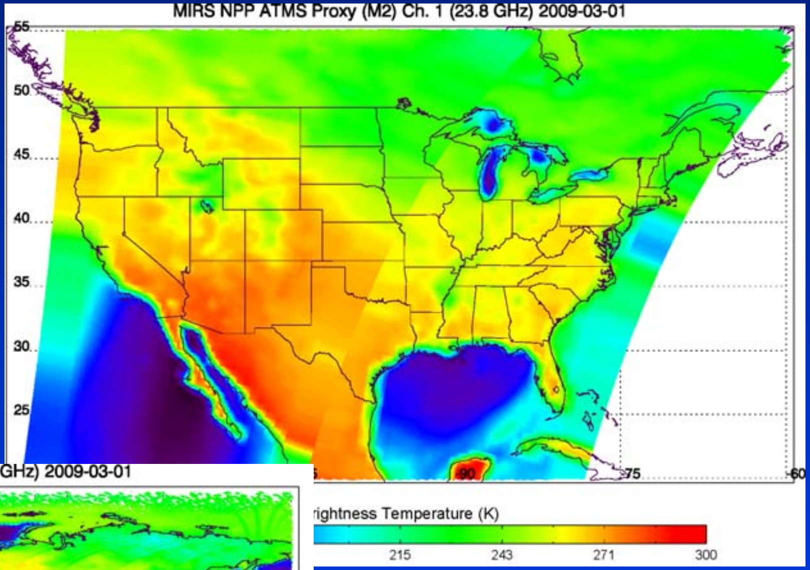
- Each ATMS granule will contain 4 scansets of 3 scanlines (12 scanlines total, 32 seconds of observation)
- NPP ATMS TDR data contain 96 FOVs/scanline for all channels
- Current MiRS FM code provides two options for MiRS NPP ATMS processing
  - » High resolution: 96 FOVs per scanline. Each channel measurement retains its value for each FOV
  - » Low resolution: 3x3 average for each FOV at each channel (3 FOVs x 3 scanlines), 32 FOVs per scanline
- Plan is to leverage other work using more sophisticated footprint matching which exploits the over sampling
  - » IDPS ATMS SDRs may contain footprint matched observations

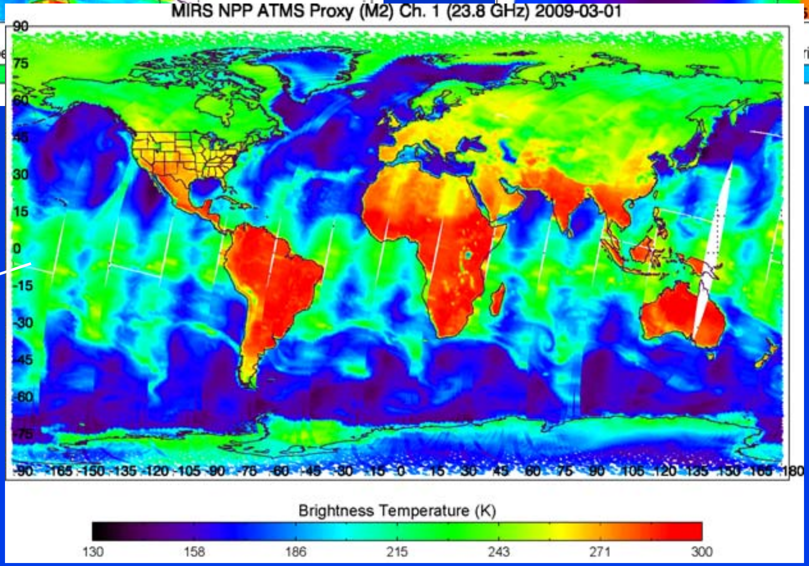
MiRS NPP ATMS
Footprint Matching (2/2)

MiRS NPP ATMS Ch 1 Proxy Low Resolution



MiRS NPP ATMS Ch 1 Proxy High Resolution





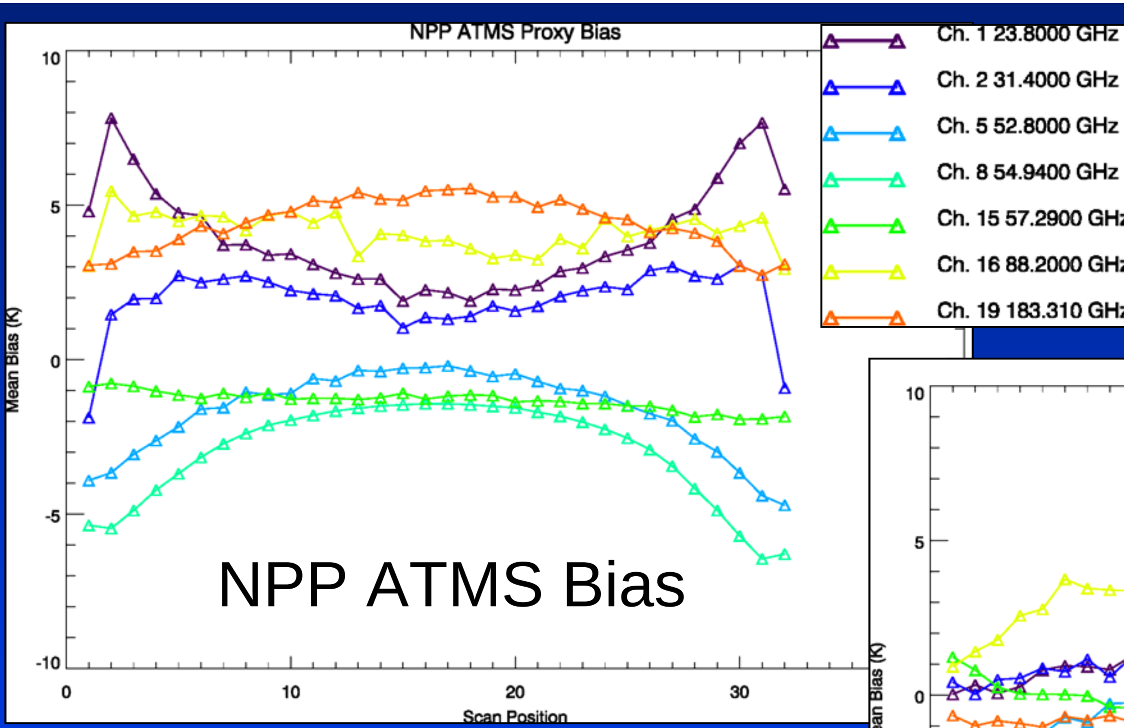
Low Resolution
Global

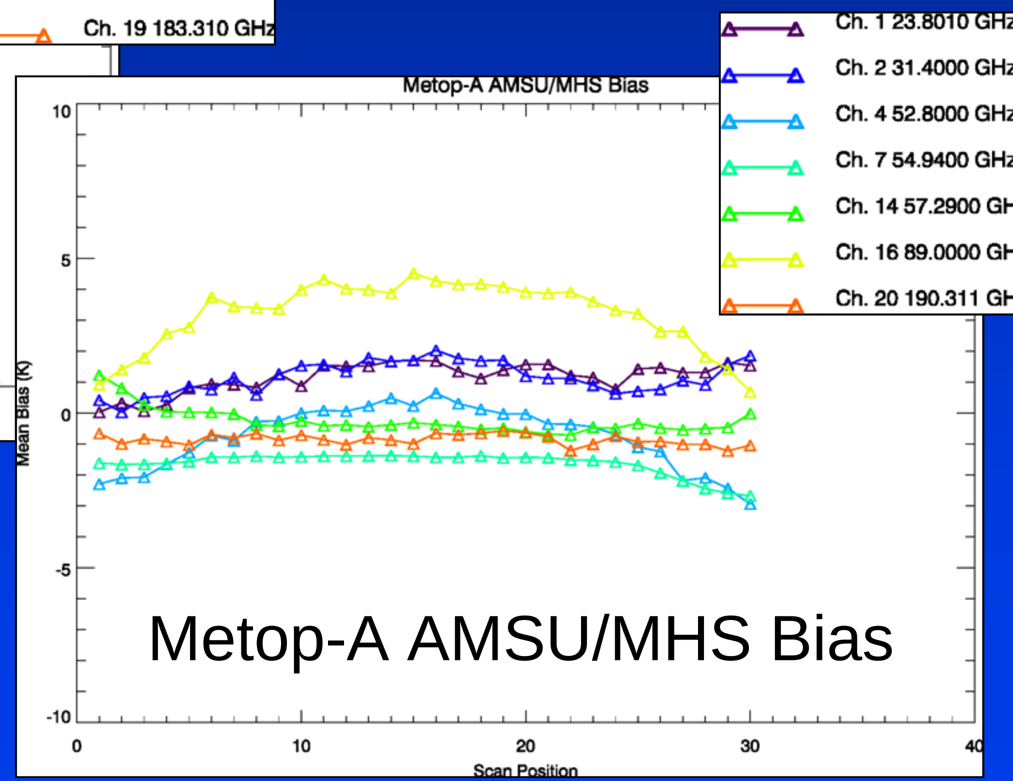
Proxy data based on Metop-A AMSU/MHS

MiRS NPP ATMS
Bias Correction/RTM Uncertainty (1/2)

- The MiRS applies a bias correction to measured TBs in order to make the measurements consistent with the forward model during the core retrieval
- Methodology:
  - » Observed (footprint matched) TBs are collocated with ECMWF global analysis
  - » ECMWF scenes are input into forward model to simulate TBs
  - » Difference between Observed and Simulated is calculated for each channel/scan position using scenes over Ocean only
  - » Peak of the histograms of the error distributions are adjusted to zero (histogram adjustment method)
  - » RTM uncertainty is calculated using same points
- Bias correction may be applied by channel/surface type

MiRS NPP ATMS
Bias Correction/RTM Uncertainty (2/2)





NPP ATMS bias reflects proxy data. Update to bias correction will be necessary with real data.

MiRS NPP ATMS Core Retrieval

- CRTM files
- Surface Preclassifier
- Emissivity Covariance Matrix
- Core Retrieval (examples)

Chris Grassotti

MiRS NPP ATMS
CRTM Coefficient Files/Tuning File

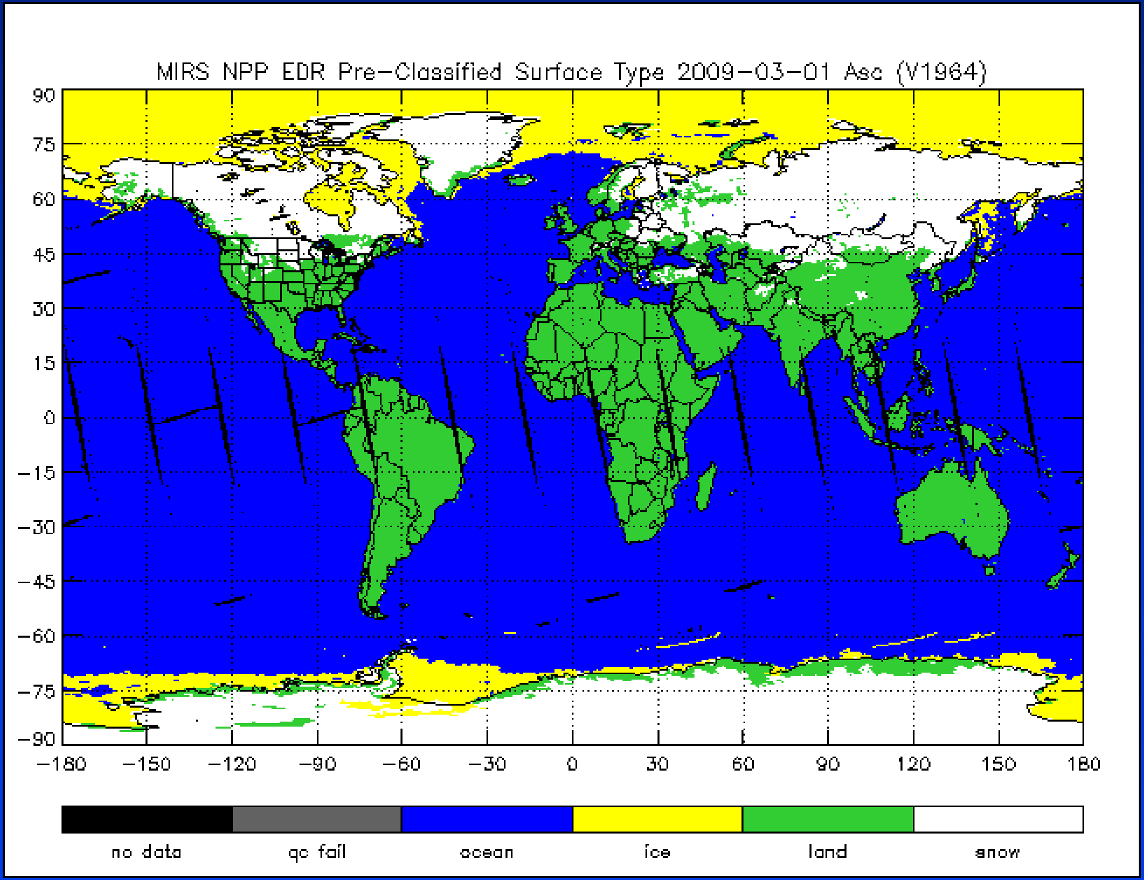
- MiRS uses the Community Radiative Transfer Model (CRTM) as a “black box” for its forward operator
  - » **Major leveraging of work done by JCSDA**
  - » CRTM is suited for computations across the microwave spectrum and beyond
  - » Spectral and Optical Thickness (Tau) coefficient files are needed for each sensor supported by CRTM
    - – Spectral Coefficient file contains sensor information
    - – Tau Coefficient file contains coefficients to use in optical depth calculation
    - – **These two files have been generated by JCSDA for NPP ATMS and are part of the MiRS package**
  - » A third static file, the CRTM cloud optical properties database, is sensor independent
- Tuning File contains flags for which parameters to retrieve, which channels to use, how/where to apply bias correction
  - » Static file which mostly mimics other POES Tuning Files

MiRS NPP ATMS
Surface Type Classification

- Preclassifier: Heritage AMSU/MHS surface type algorithm used for ATMS (channel selection similar)
  - Surface types: ocean, snow-free land, snow, sea-ice
  - Parameters used: Tb, FG Tskin (optional), latitude
  - Classification determines background mean and covariance used in 1DVar
- Postclassifier: Uses retrieved emissivity spectrum and Tskin to verify or adjust surface type classification
  - Sea-ice climatologies used to reduce misclassification

MiRS NPP ATMS
Surface Type Preclassifier

MiRS NPP ATMS 2009-03-01



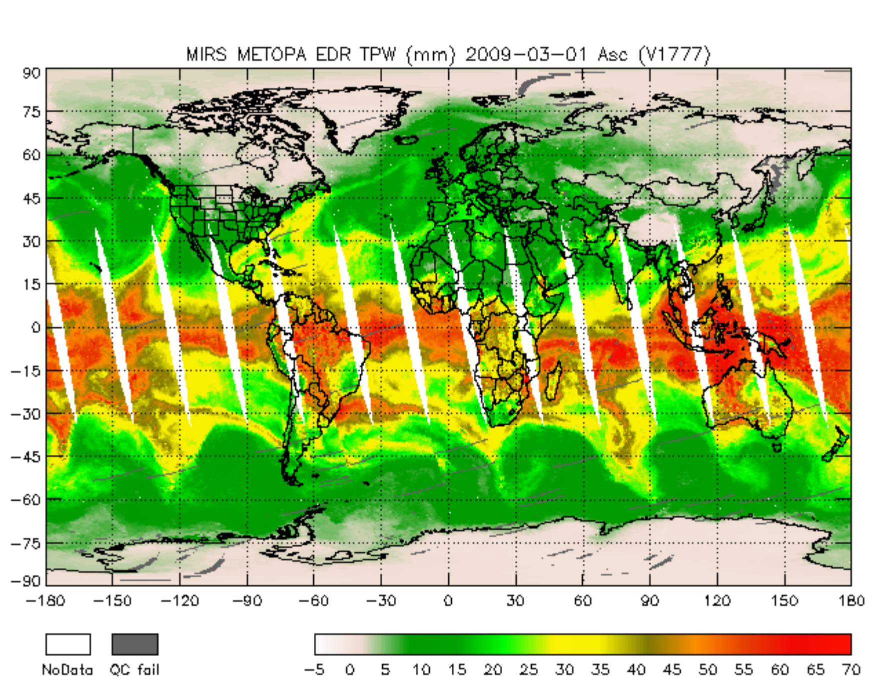
MiRS NPP ATMS
Background Emissivity/Covariance Matrix

- Needed as constraint on 1DVar
- Specific to surface type (determined by Preclassifier)
- Methodology:
  - » Ocean: FASTEM-3 with inputs frq, pol, ang from observations and SST and wspd from collocated ECMWF analyses from 4 different seasons
  - » All other surfaces: analytical emissivities using collocations of proxy NPP ATMS TBs and ECMWF analyses from 4 different seasons
- Updated background developed for NPP ATMS using proxy data; to be revised with real NPP ATMS data post-launch

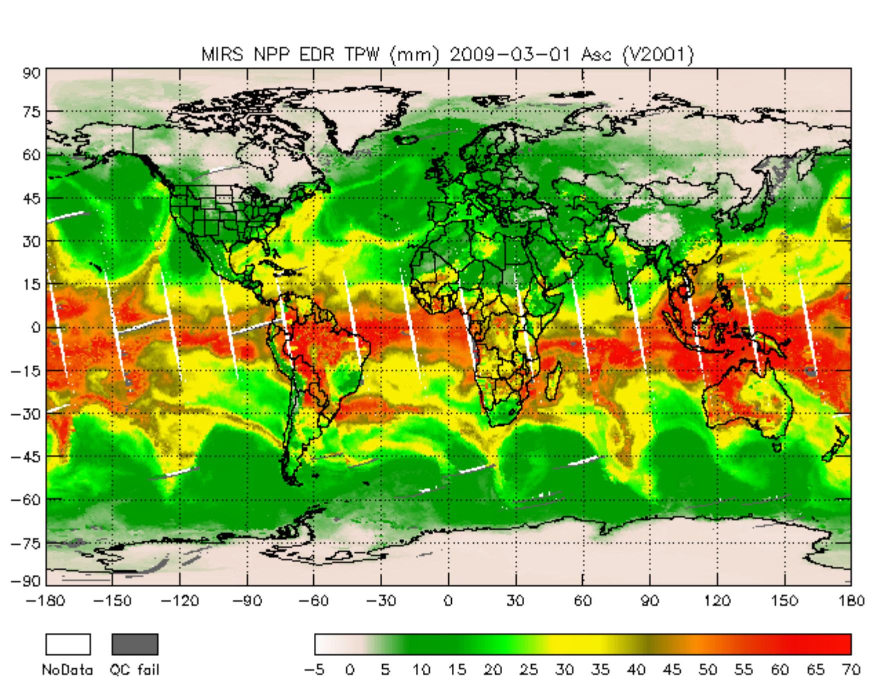
With all preceding components, the MiRS core retrieval can be executed

MiRS NPP ATMS
Core Retrievals (1/4)

MiRS Metop AMSU/MHS TPW



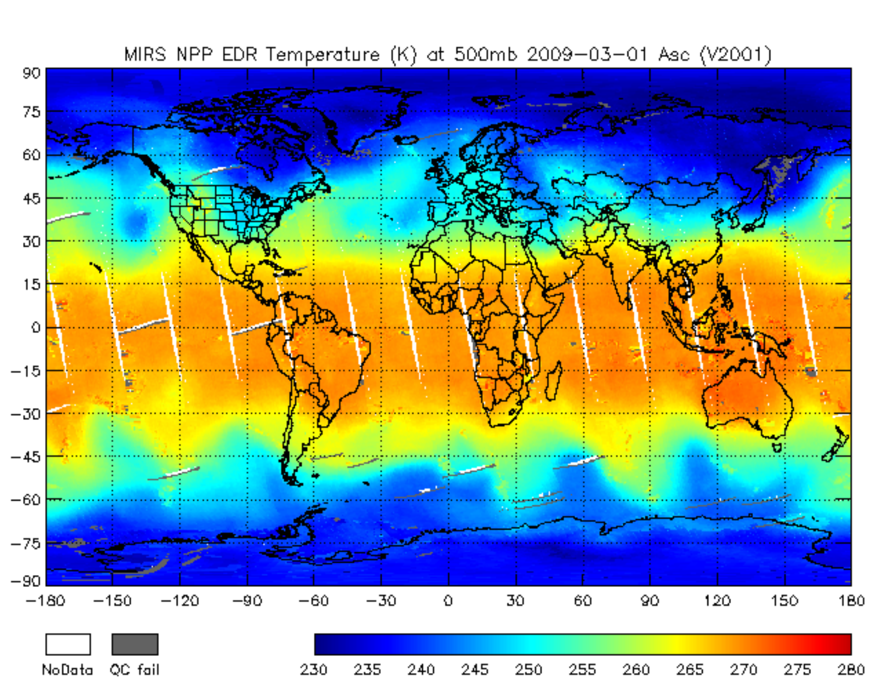
MiRS NPP ATMS TPW



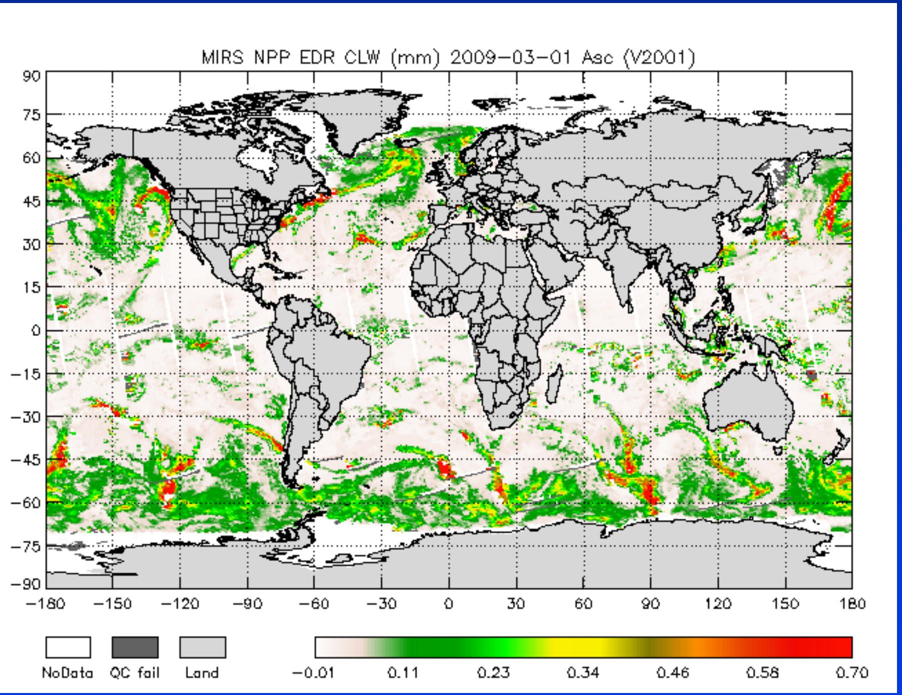
Increased coverage in NPP ATMS is noticeable

MiRS NPP ATMS
Core Retrievals (2/4)

MiRS NPP ATMS 500mb Temperature

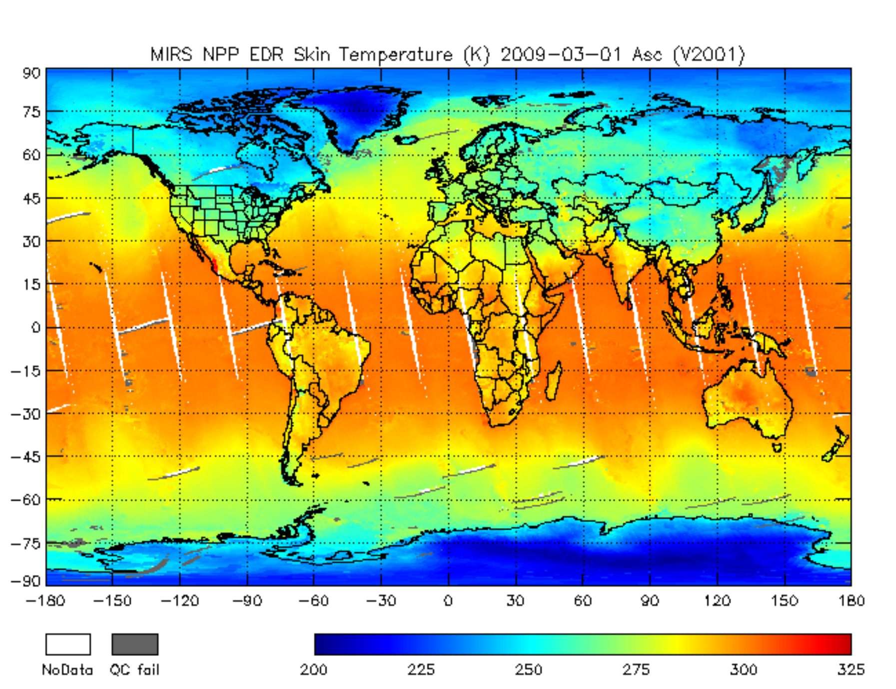


MiRS NPP ATMS CLW

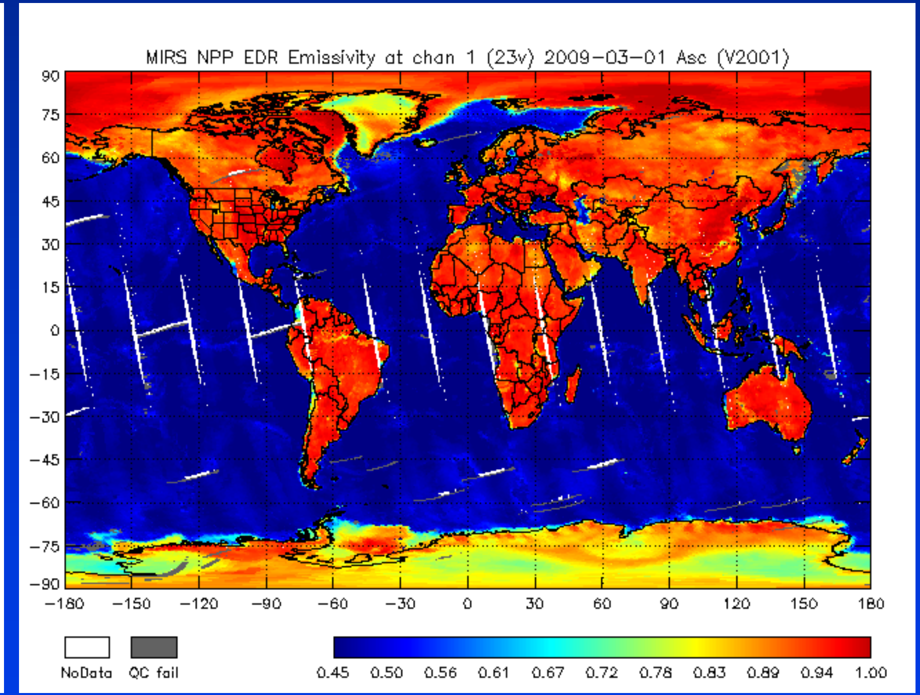


MiRS NPP ATMS
Core Retrievals (3/4)

MiRS NPP ATMS TSKIN

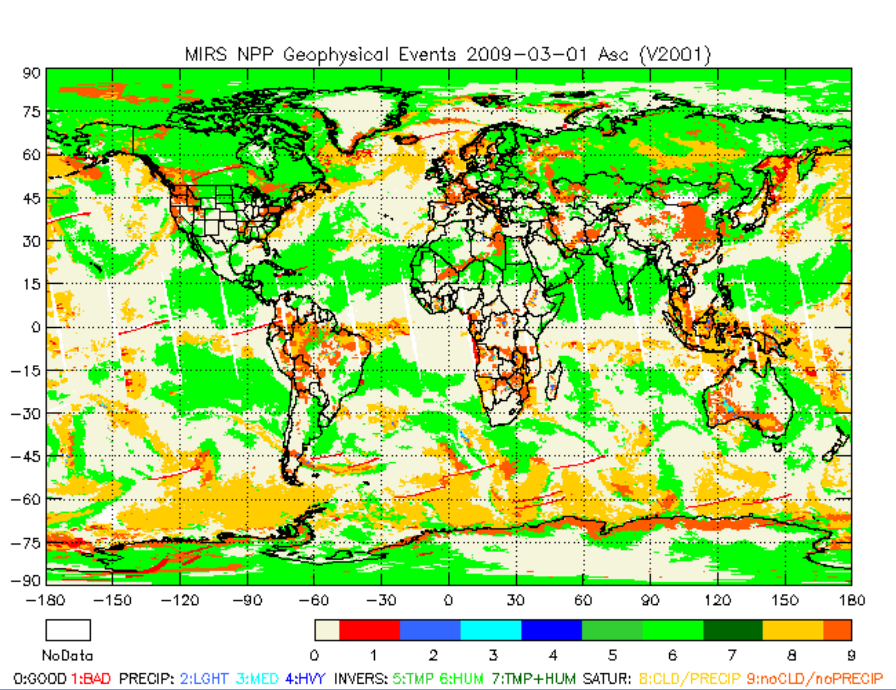


MiRS NPP ATMS EM

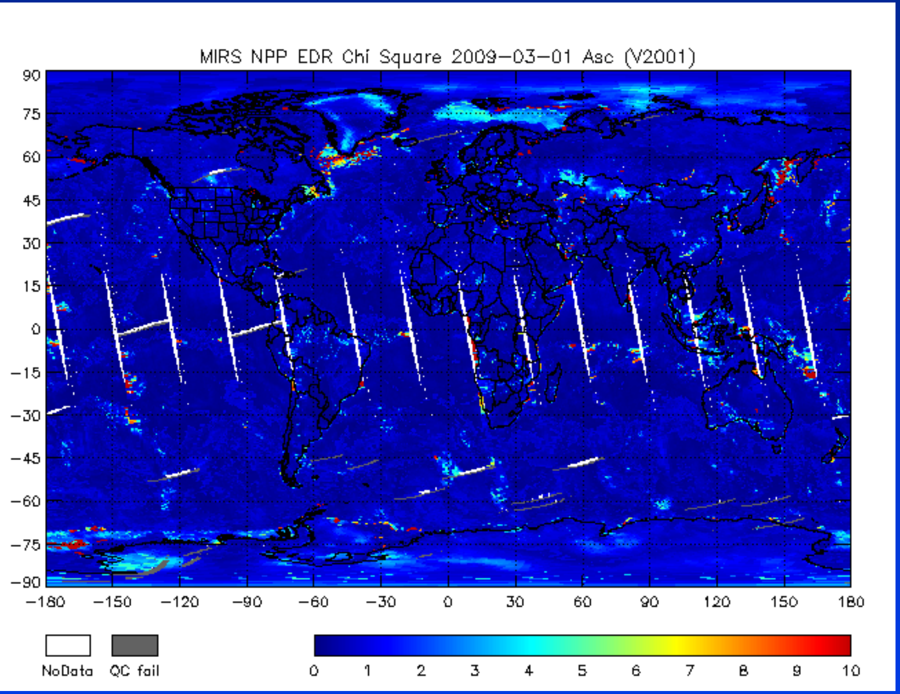


MiRS NPP ATMS Core Retrievals (4/4)

MiRS NPP ATMS QC



MiRS NPP ATMS ChiSq



MiRS NPP ATMS Surface Parameters

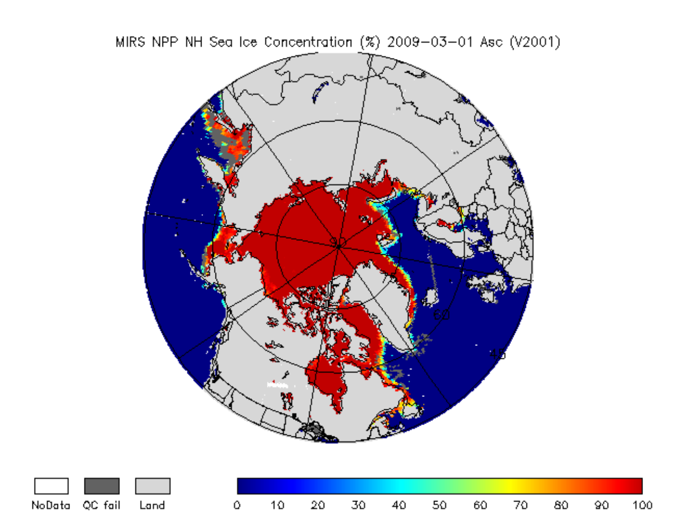
- Sea-ice Concentration
- Snow Water Equivalent
- Surface Postclassifier

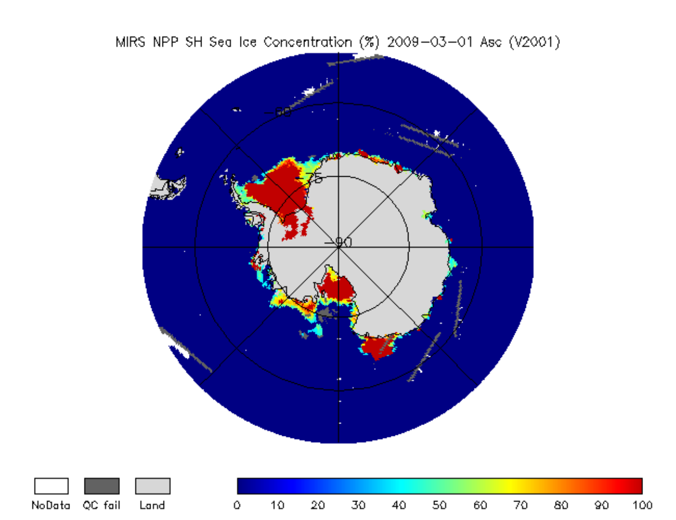
Chris Grassotti

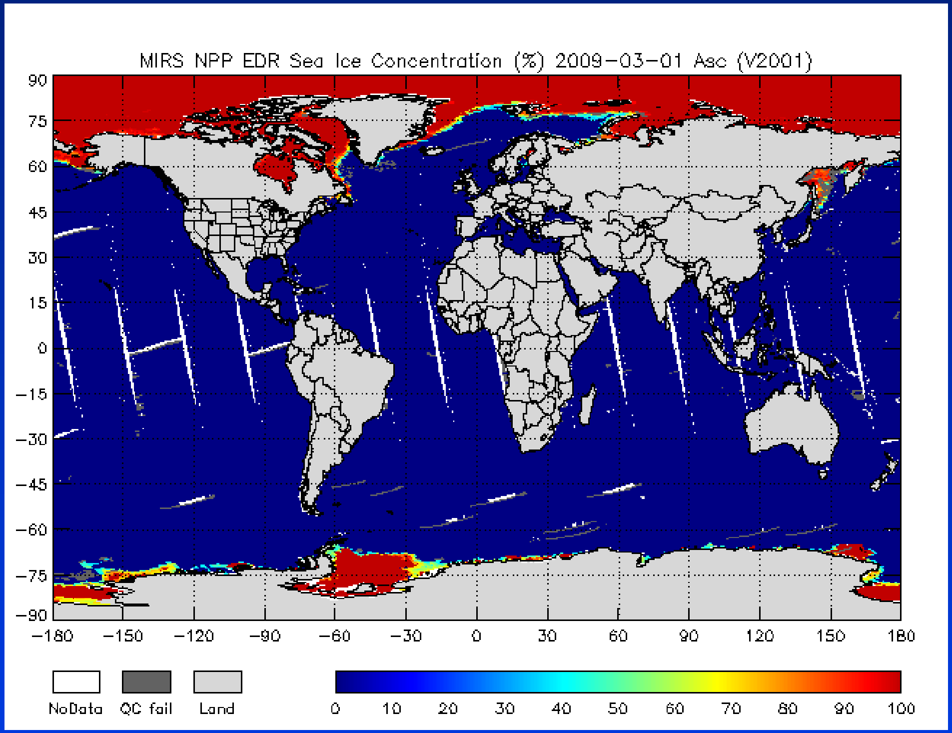
MiRS NPP ATMS
SIC/SWE

- Retrieval Methodology:
  - » Preclassification: ocean, land, ice, snow
  - » Post-processing of retrieved surface emissivities in window channels using pre-computed catalogs: search and choose value minimizing difference between retrieved and catalog values
  - » Sea Ice: Emissivity=f(channel, ice fraction, ice type, inc angle); Pure ice type signatures for FY and MY ice mixed to obtain best match
  - » Snow Water: Emissivity=f(channel, SWE, grain size); spectral gradients used to reduce sensitivity to errors in retrieved emis magnitudes
  - » Current testing with minimal adjustments to thresholds and catalogs (NPP ATMS window channels similar freq and pol to AMSU/MHS); Refinements expected post-launch

MiRS NPP ATMS
Sea Ice Concentration



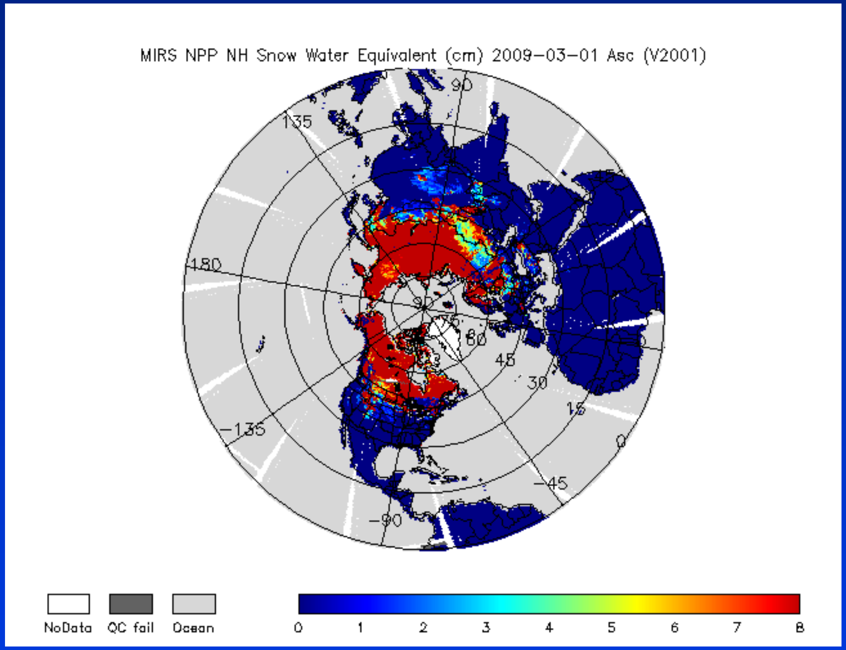


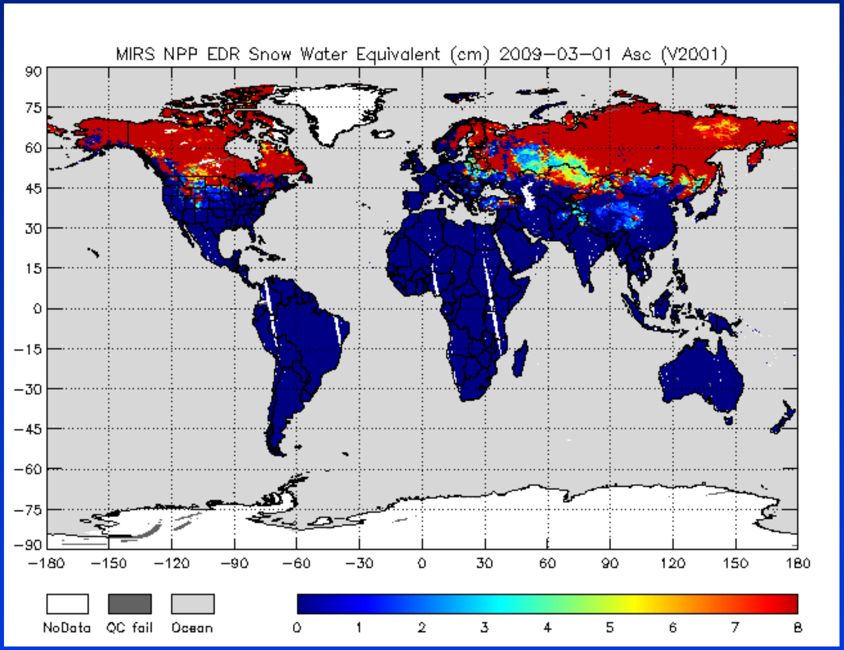


MiRS NPP ATMS Sea-ice Concentration 2009-03-01

based on ATMS proxy data

MiRS NPP ATMS
Snow Water Equivalent

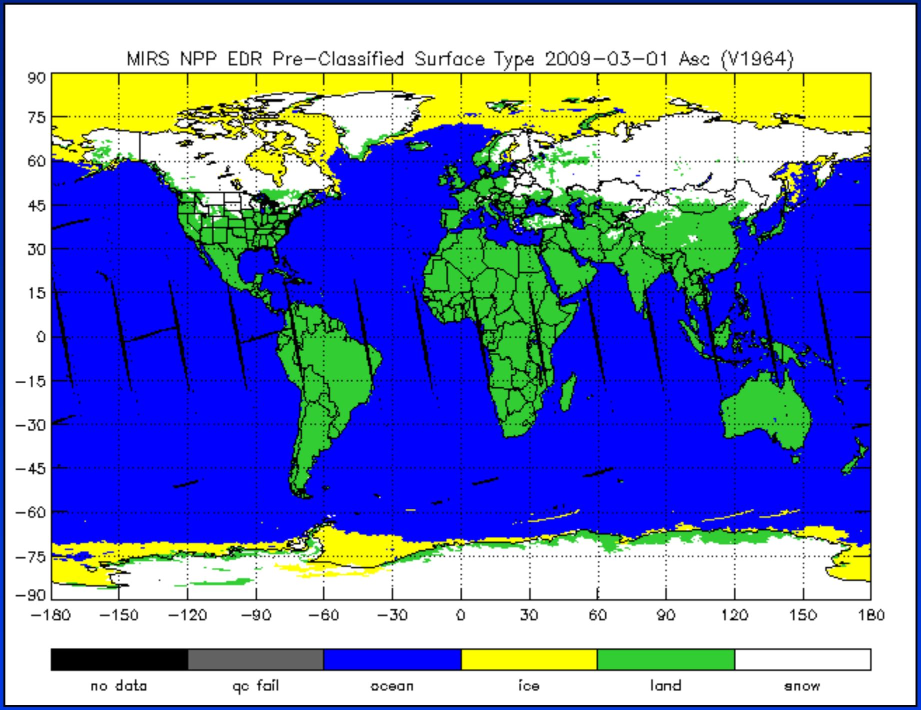




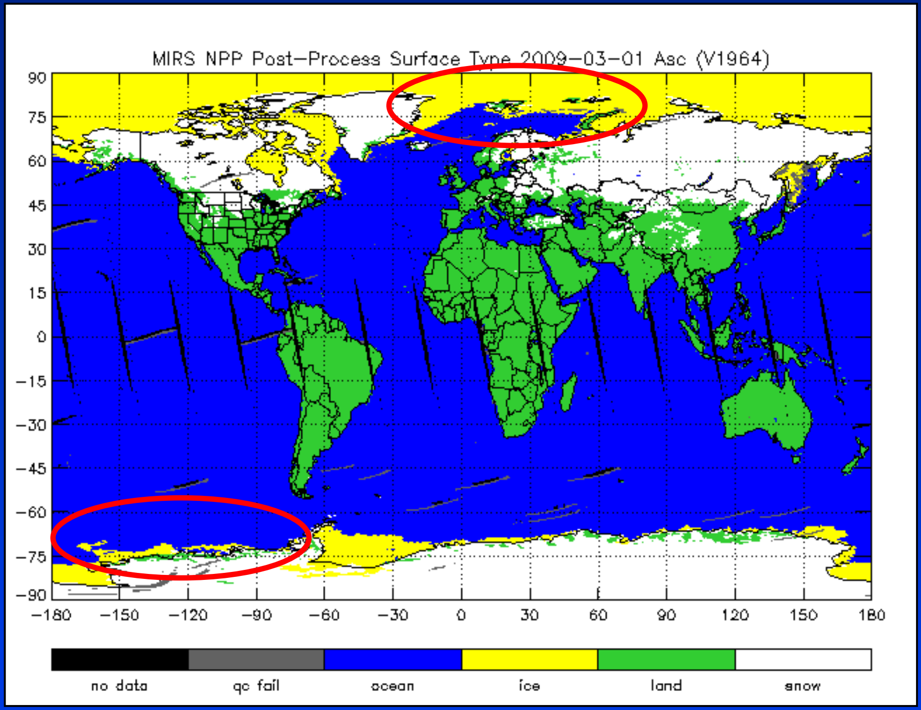
MiRS NPP ATMS Snow Water Equivalent 2009-03-01

based on ATMS proxy data

MiRS NPP ATMS
Surface Type Postclassifier



MiRS NPP ATMS Preclassified Surface Type



MiRS NPP ATMS Postclassified Surface Type

MiRS NPP ATMS Rainfall Parameters

Flavio Iturbide-Sanchez

MiRS NPP ATMS
Rainfall Rate

The MiRS Rain Rate computation is *generic* and based on the MiRS core products. This property simplifies its implementation on current and future sensors, including *NPP ATMS.*

MiRS Core Products
CLW, IWP and RWP

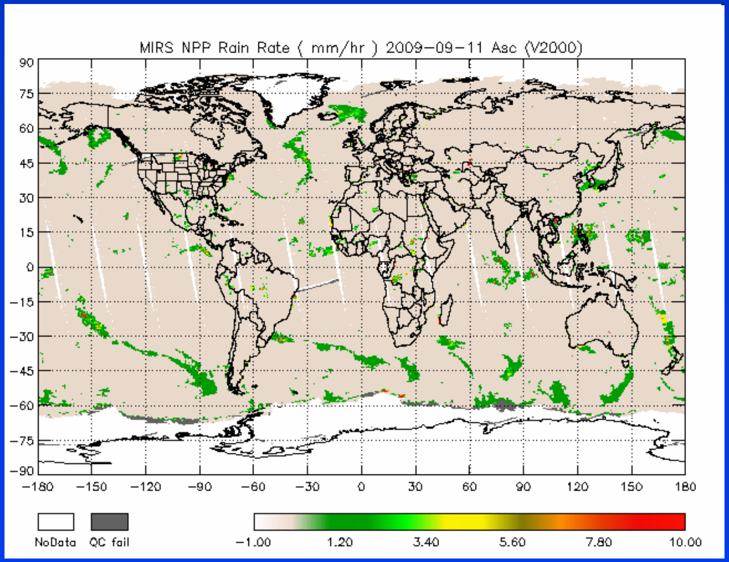
Rainfall Rate Regression

$$MIRS\_RR = A_0 + A_1 IWP + A_2 RWP + A_3 CLW$$

A_i are coefficients generated by a multi-linear regression approach using the MiRS products and a reference rain rate.

Rain Rate (mm/hr)

MiRS NPP ATMS Rain Rate over Land and Ocean
(computation based on proxy data) (mm/hr)

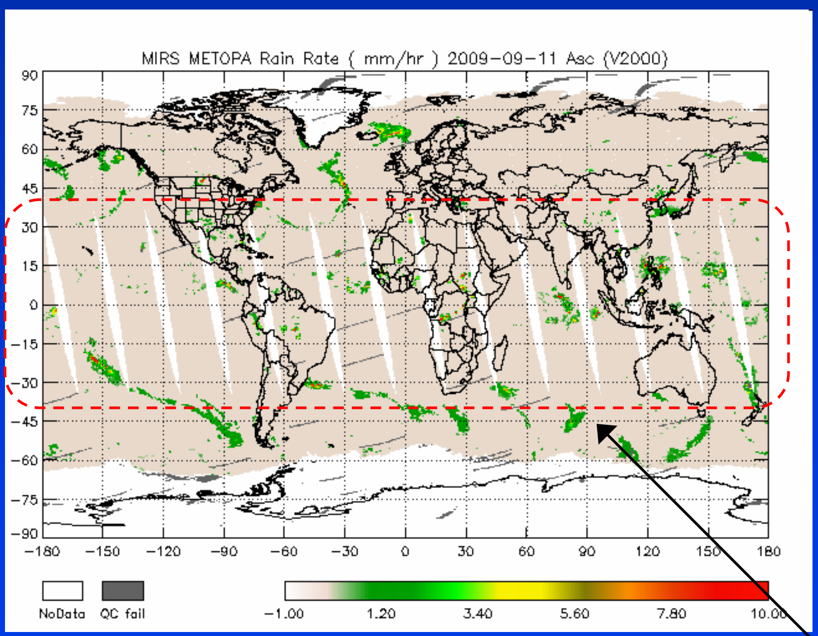


The algorithm is ready for its implementation to NPP ATMS, and currently is being applied to retrieve rainfall rate from N18, N19, MetopA and F16 satellite sensor observations over land and ocean.

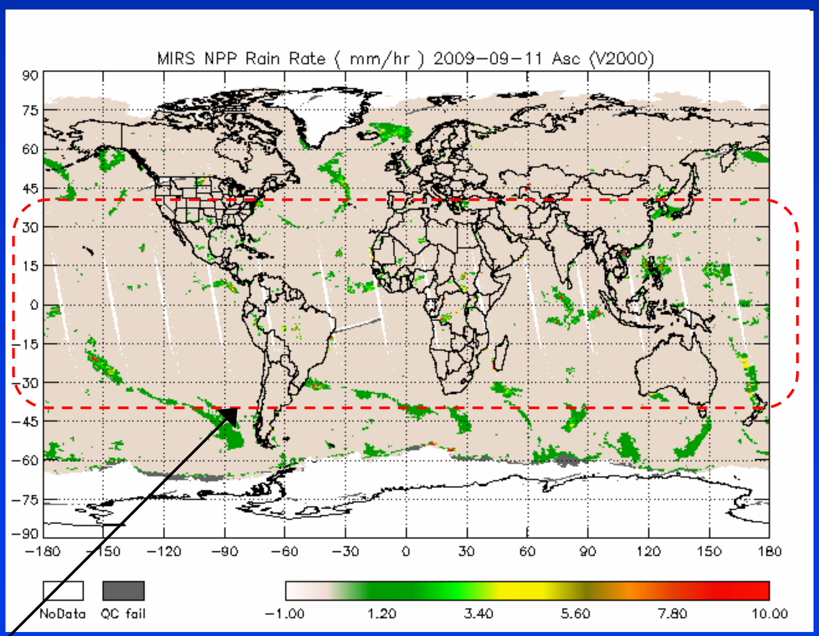
MiRS NPP ATMS
Rainfall Rate

For more than one month, NPP ATMS Rain Rate has been retrieved over land and ocean surfaces using the MiRS system. Improved precipitation coverage is possible due to the reduced orbital gaps.

MiRS MetopA Rain Rate (mm/hr)



MiRS NPP ATMS Rain Rate (mm/hr)
(computation based on proxy data)



Improved precipitation coverage

MiRS NPP ATMS
Validation of MiRS Rainfall Rate

• The MiRS Rain Rate is being extensively validated over ocean and land using multiple well-known precipitation references, including:

- Rain Gauge observations (Using CPC precipitation).
- Ground-based Radars and Rain Gauge Observation (performing at the International Precipitation Working Group and using and NCEP-Stage IV precipitation)
- Satellite-Based Observation (CloudSat, TRMM-Precipitation Radar, TRMM-TMI).

• Current validations are being applied to precipitation retrieved from N18, N19, Metop-A and F16 satellite sensor observations.

• With current resources, the comparison and validation of NPP ATMS precipitation results is a straight and consequent implementation.

MiRS Rainfall Rate

Rain Gauge

Ground-Based Radar

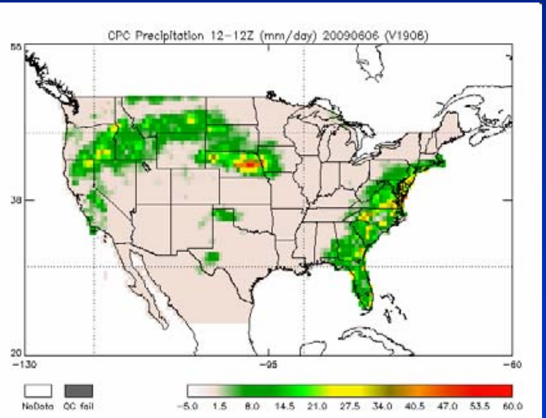
Satellite-Based Observations

MiRS NPP ATMS
Impact on Daily Precipitation Estimate Composite

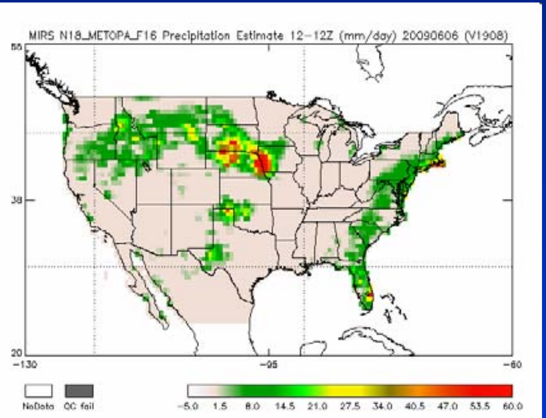
- In cases where the precipitation estimate (daily rainfall rate in mm/day) is calculated, the rainfall rates from all MiRS sensors are included as inputs.

- When/if NPP is declared operational, it may be included to increase coverage (in time and space) of rainfall events, or replace heritage sensors if needed.

Daily CPC Precipitation (mm/day)

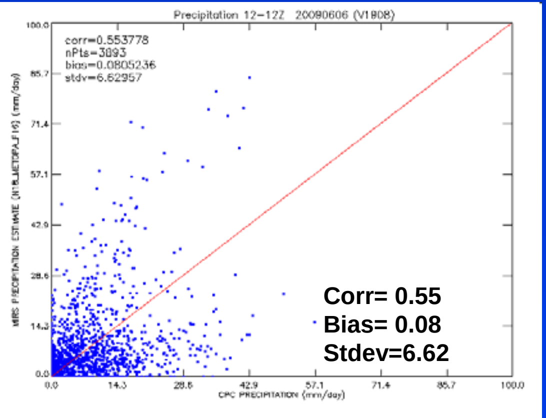


Daily MiRS Precipitation Estimate Composite (N18, MetopA and F16) (mm/day)



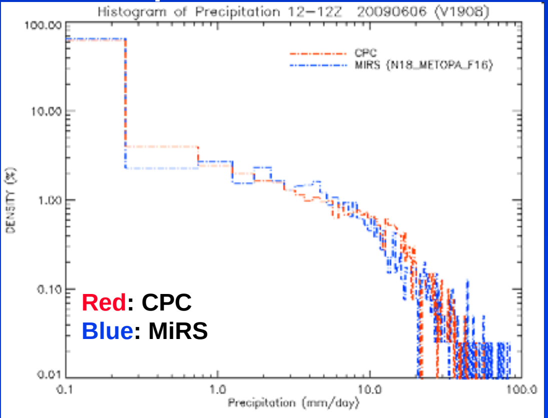
Scatter Plot

Daily MiRS Precipitation Estimate (N18, MetopA and F16) (mm/day)



Daily CPC Precipitation (mm/day)

Precipitation Distribution



MiRS NPP ATMS
Summary

- The MiRS has been extended to NPP ATMS and is processing ATMS proxy data daily in STAR
  - » Same package has also been integrated into NDE
- All necessary sensor dependent components have been added (may need updates with real data)
  - » Bias correction, surface type preclassification
- MiRS retrievals with NPP proxy data: stable, convergent
- MiRS rainfall rate regression is generic, main extension efforts are in the validation realm

- INTRODUCTION
- DESCRIPTION OF MiRS/NPP ATMS
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- MONITORING AND QUALITY CONTROL
- SUMMARY AND CONCLUSIONS
- DISCUSSION

Section 3 –

INTEGRATION WITH NDE

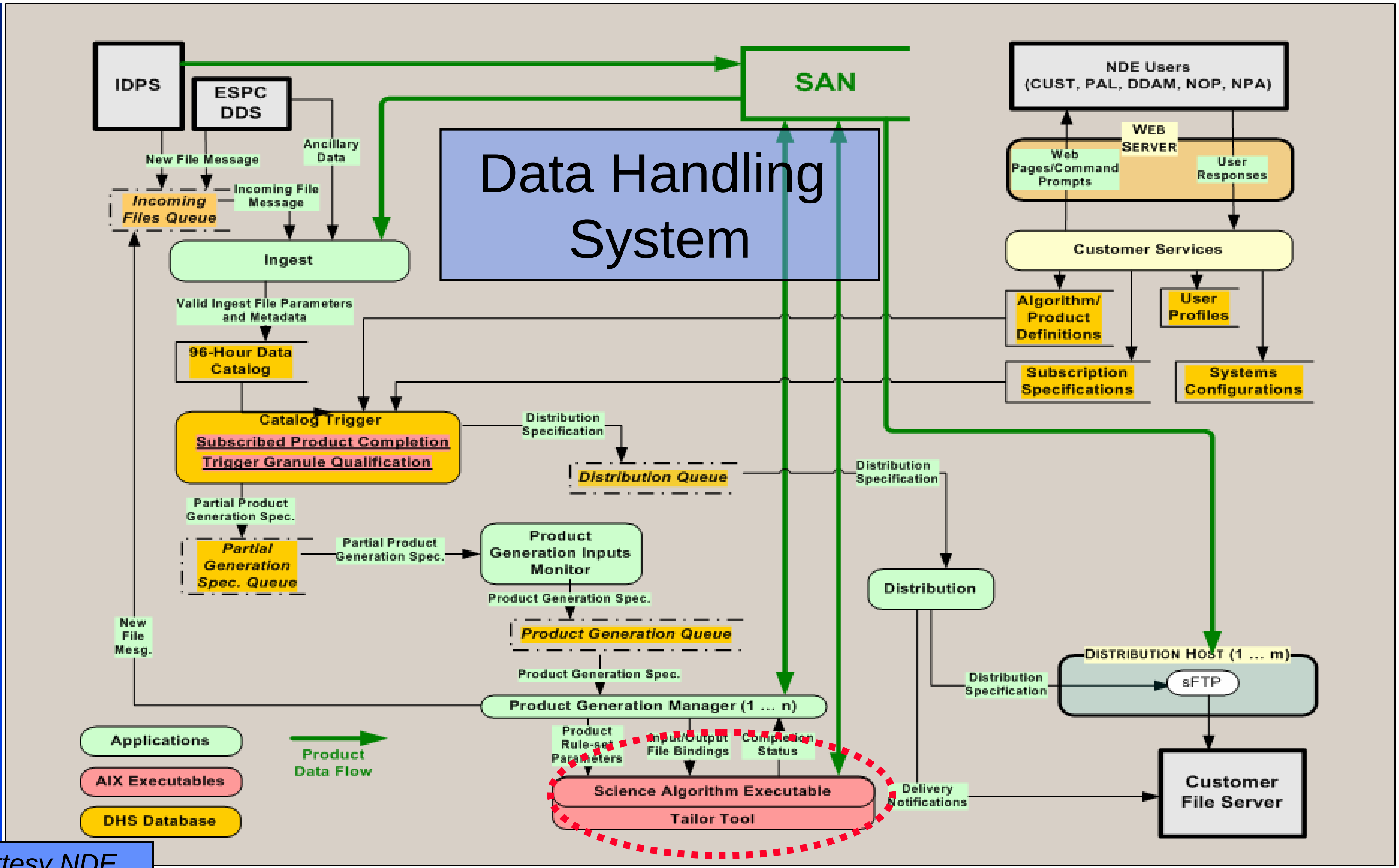
Presented by

Kevin Garrett

Integration with NDE
Overview

- The MiRS is running operationally at the Office of Satellite Data Processing and Distribution (OSDPD) for N18, N19, Metop-A and F16
- Processing of NPP ATMS data will be handled by NPOESS Data Exploitation (NDE) before transitioning to OSDPD
- MiRS, NDE and other development teams have worked closely to integrate science algorithms into NDE as the system is being developed
- MiRS has been delivered, implemented, and tested within the NDE environment
  - » The main interface between MiRS and the NDE environment is the *Data Handling System (DHS)*

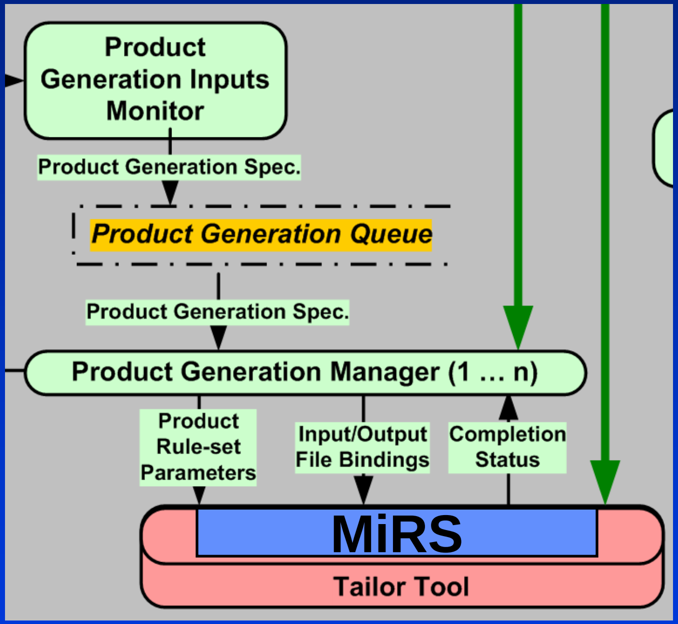
Integration with NDE
The Data Handling System



Courtesy NDE

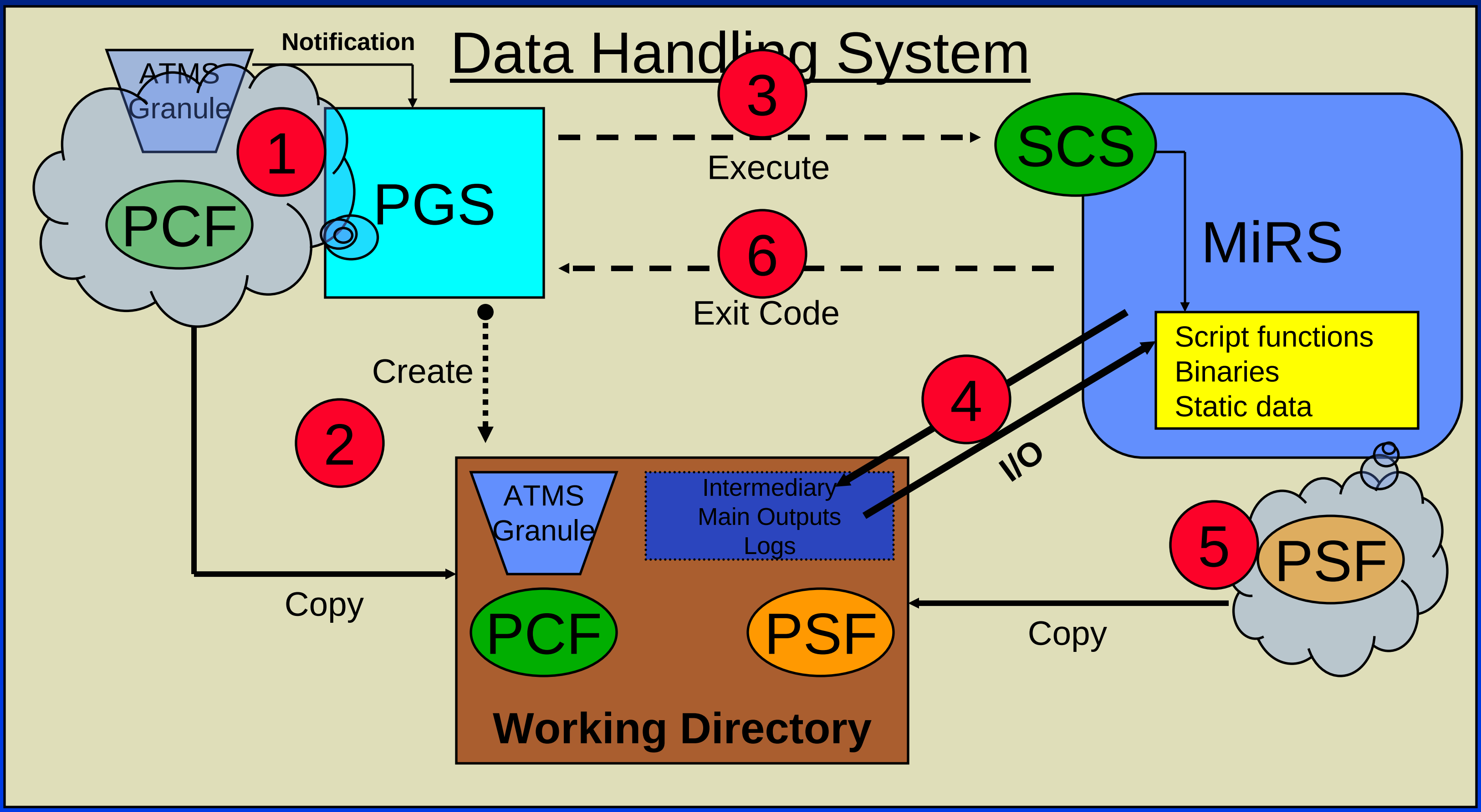
Integration with NDE
DHS Interface

- DHS is a JBoss app server with Oracle database backend where an algorithm is “registered” with all necessary parameters
  - » Production rules are assigned to the algorithm
- When the Ingest Subsystem receives and input file (granule) to the algorithm:
  - » DHS creates a job spec for MiRS
  - » DHS creates a PCF and working dir
  - » DHS runs the MiRS executable
- When MiRS completes:
  - » MiRS returns a Product Status File (PSF)
  - » MiRS returns an exit code to the DHS



MiRS interfaces with the DHS

Integration with NDE
DHS Processing Flow



Integration with NDE

- File format requirements for NPP ATMS
  - » ATMS level 1b granules/geo formatted in HDF5
  - » MiRS outputs formatted in netCDF4
  - » *MiRS readers and encoders support these formats and have been tested in NDE*
- A note about metadata: Metadata to accompany netCDF outputs and should be ISO (19115) compliant
  - » Will be developing a script to create Granule level metadata file by modifying static Collection level metadata file
    - – Need to acquire template to create Collection level file (OSDPD/NGDC?) and work with NGDC to convert to ISO (currently FGDC standard)
    - – Separate .xml or encapsulated in netCDF?

Integration with NDE

- We will continue to support NDE as they develop current and future prototypes
  - » Current prototype addresses product tailoring and error handling

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Section 4 –

MONITORING AND QUALITY CONTROL

Presented by

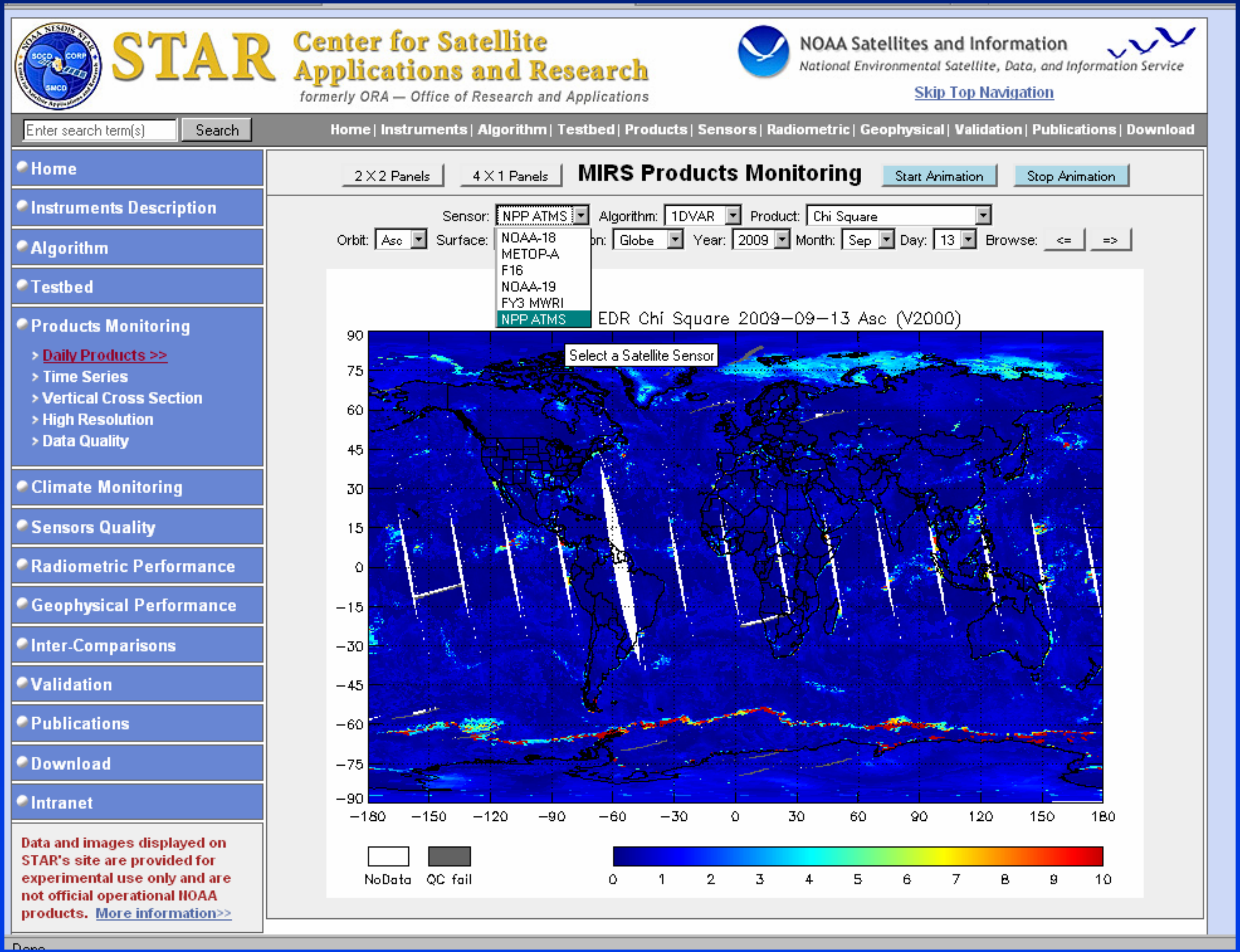
Wanchun Chen

Monitoring and Quality Control Overview

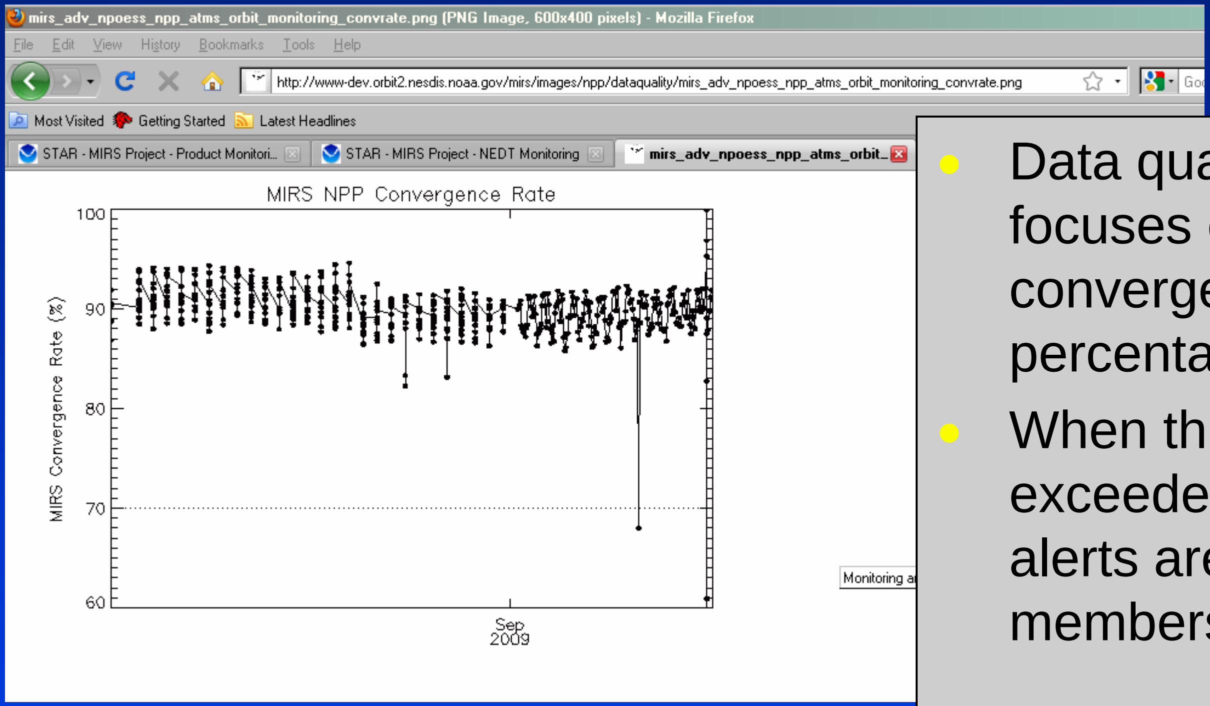
- Main resource for assessment and monitoring of MiRS is web-based
- MiRS website features extended to MiRS NPP ATMS
  - » Products Monitoring
  - » Data quality/NEDT monitoring
  - » Geophysical/Radiometric bias monitoring
  - » Inter-sensor comparisons
  - » Validation section
- URL is http://mirs.nesdis.noaa.gov

Monitoring and Quality Control Products Monitoring

- Product monitoring provides visualization of retrieved parameters and retrieval metrics to help determine the quality of MiRS processing
- The same options are available for all MiRS supported sensors



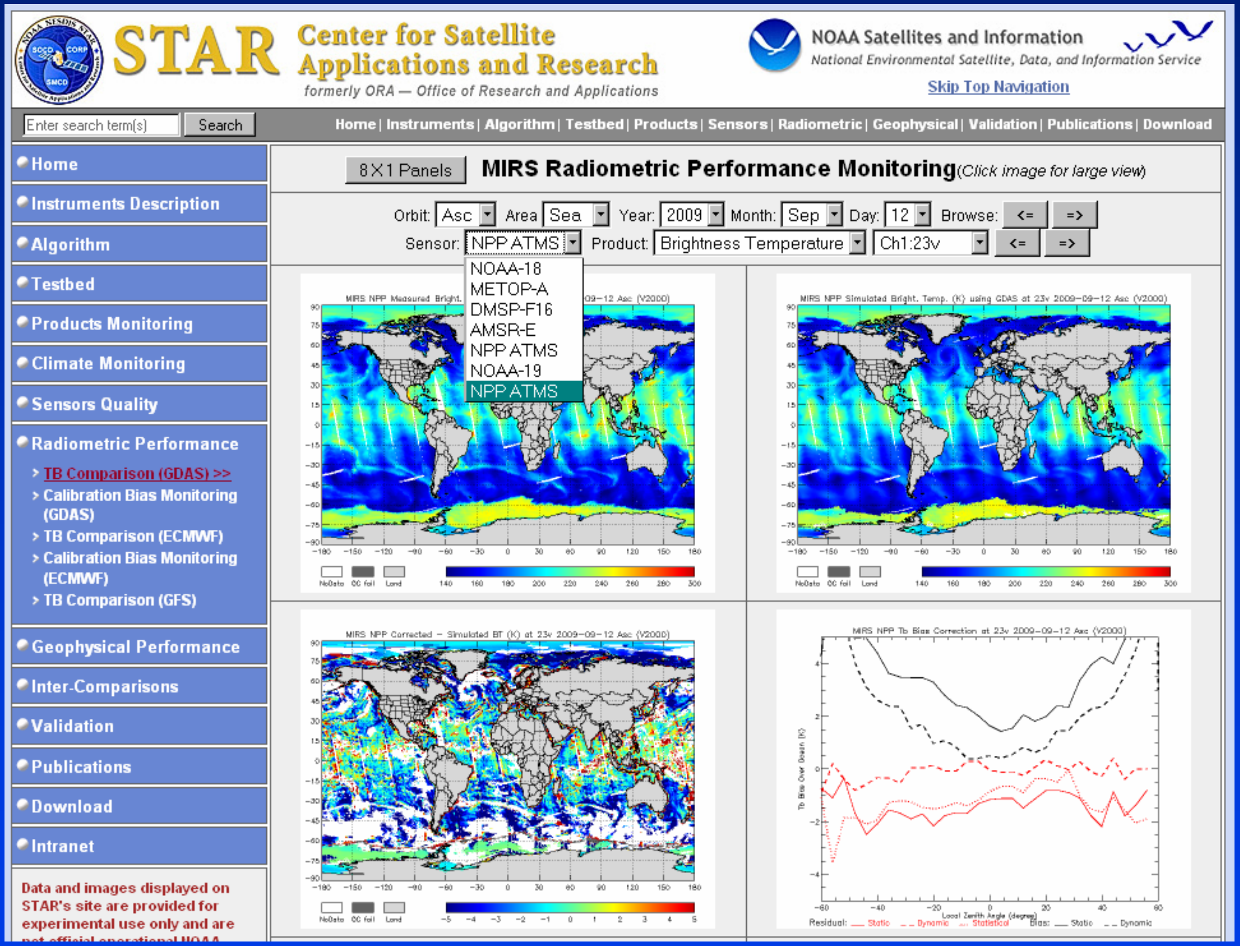
Monitoring and Quality Control
Data Quality Monitoring



- Data quality monitoring focuses on assessment of convergence rate and percentages of the QC flags
- When thresholds are exceeded, automated email alerts are sent to MiRS team members

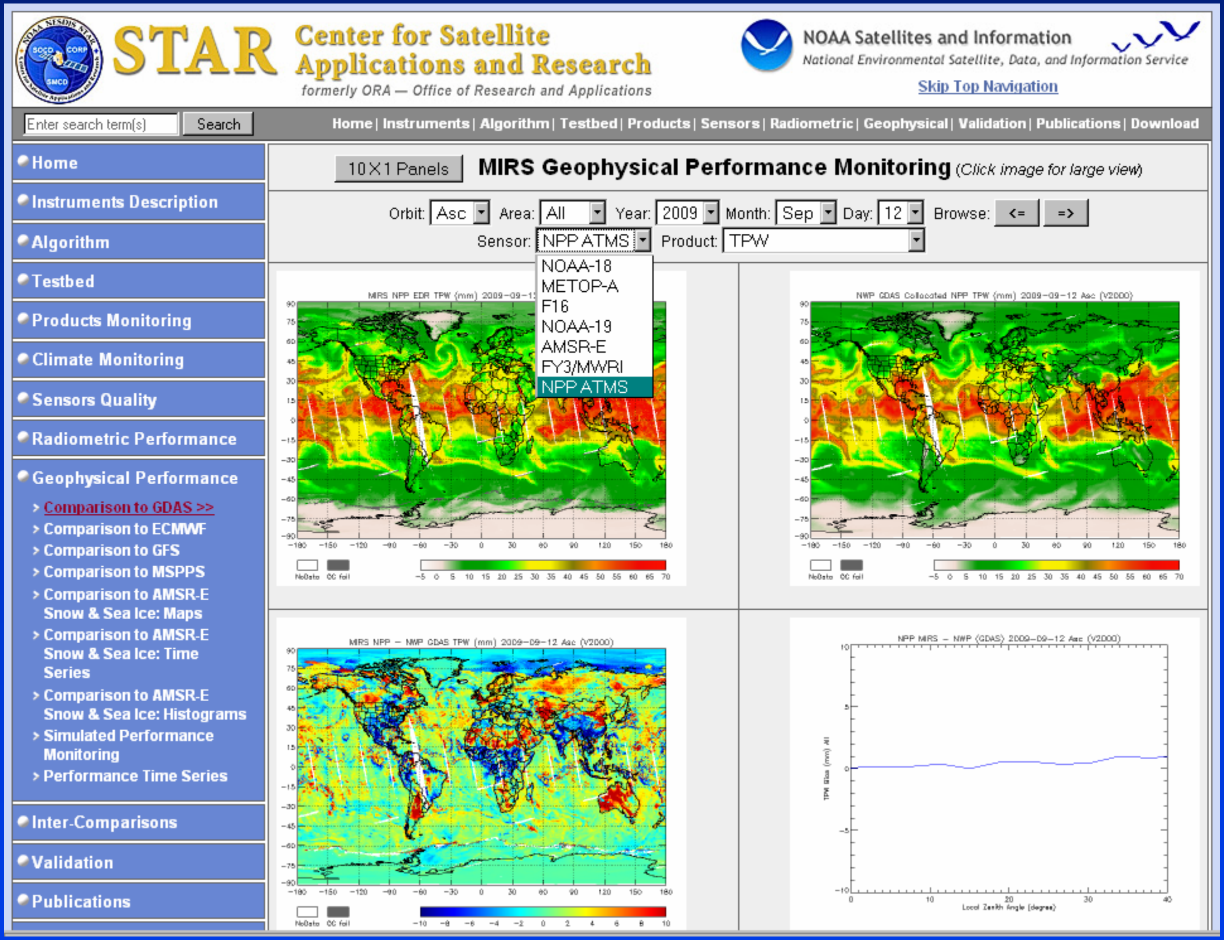
Monitoring and Quality Control Radiometric Performance

- Radiometric Performance monitoring helps to assess the radiometric bias between observations and the forward model used in MiRS, and how well MiRS is accounting for this bias



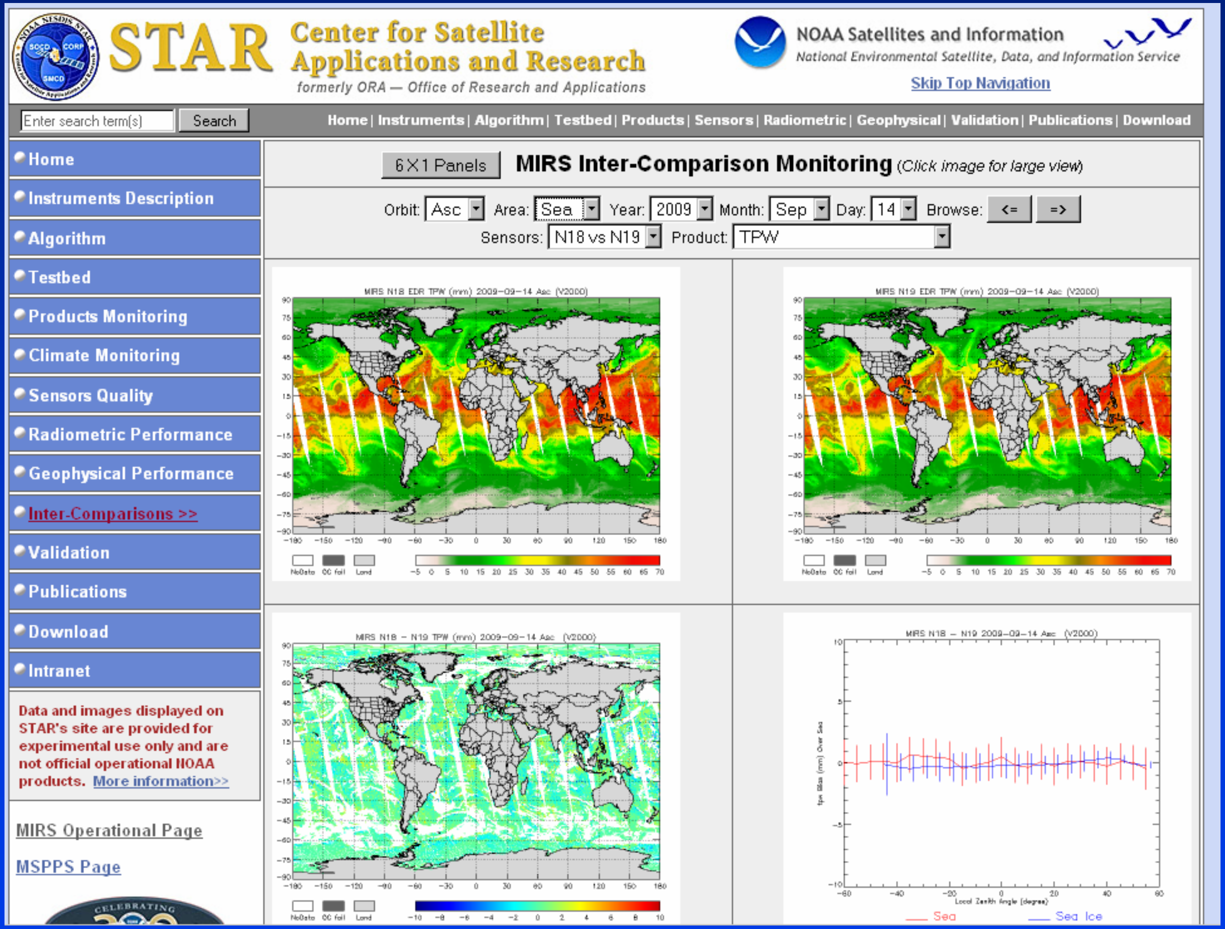
Monitoring and Quality Control Geophysical Performance

- Geophysical Performance monitoring helps to assess the quality of products relative to a reference dataset (GDAS, ECMWF), as well as the time series of performances to track seasonal variations or instrument degradation



Monitoring and Quality Control Inter-sensor Comparisons

- MiRS has the ability to perform inter-sensor comparisons, such as:
  - » between MiRS NPP ATMS proxy data and MiRS Metop-A
  - » between MiRS NPP ATMS and N18/N19 once NPP is available
- Snapshot shows inter-sensor comparison of MiRS applied to N18 and N19



Monitoring and Quality Control Validation

- The MiRS validation system extensively compares MiRS retrieved parameters to a number of reference datasets (radiosonde, forecast, rain gauge/radar, TRMM, AMSR-E sea-ice, etc.), collocated with MiRS retrievals
- Generic scripts which drive these comparisons have been modified in order to be applied to NPP ATMS
  - » Tested offline
  - » System is in place
  - » Daily collocations/aggregation of collocation records will be activated when real data is available

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Section 5 –
Summary and Conclusions

Presented by

Kevin Garrett

Summary and Conclusions

- MiRS components required for NPP ATMS processing have been added/developed
- MiRS with NPP ATMS capability has been implemented and tested within STAR and NDE environments
- MiRS NPP ATMS is processing daily within STAR using proxy data (from MIT proxy data generator)
- The MiRS website has been modified to display all MiRS NPP ATMS monitoring metrics

Next Steps

- Leverage work for footprint matching (FM)
  - » Expect SDRs to contain FM data. SDR readers in place of optimized FM code
- Keep TDR readers up to date with each sample data release (and upcoming proxy data)
- Work on ISO compliant metadata output
- Set up daily processing in NDE using test data for live proxy data stream
- Enhanced components (Preclassifier/covariance matrix) with more robust proxy data/real data.

Open Discussion

- The review is now open for discussion