



# Operational Implementation of Microwave Integrated Retrieval System



Limin Zhao<sup>1</sup>, Aiwu Li<sup>2</sup> and Jiang Zhao<sup>2</sup>  
<sup>1</sup>NOAA/NESDIS/OSDPD/Satellite Product and Service Division  
<sup>2</sup>NOAA/NESDIS/ESPC/Perot Systems Government Services  
<http://www.osdpd.noaa.gov/PSB/mirs>

## Introduction

The MIRS is a state-of-the-art retrieval system developed to support POES, MetOp, DMSF, NPP/NPOESS programs at NESDIS in generating operational temperature, water vapor and hydrological parameters from microwave sensors. It is based on an assimilation-type scheme and capable of optimally retrieving atmospheric and surface state parameters in all weather and over all-surface conditions. The MIRS is being implemented into operation at NESDIS to upgrade the current operational surface and precipitation products from Microwave Surface and Precipitation Products System (MSPPS) and build a one-stop shop for operational microwave products from various satellites with different instrumental configurations.

With the capability of providing optimal and physically-based retrievals of atmospheric and surface state parameters, the operational MIRS aims to produce advanced near-real-time surface and precipitation products in all-weather and over all-surface conditions using brightness temperatures from the microwave instruments, which include AMSU-A and AMSU-B/MHS instruments on board of NOAA and EUMETSAT polar orbiting satellites, SSMIS on DMSF polar satellites and ATMS on NPP/NPOESS. Currently, the following products from NOAA-18 and MetOp-A are made operationally available: temperature profile over ocean, moisture profiles over ocean and non-coastal land, total precipitable water over ocean and non-coastal land, cloud liquid water over ocean, snow cover, sea ice concentration, snow water equivalent, surface emissivity over land and snow from all AMSU-A and MHS channels.

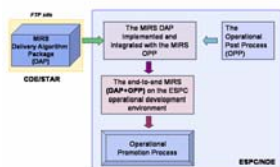
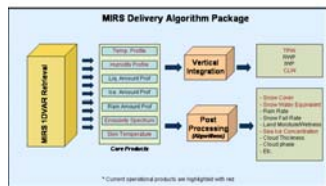
## MIRS Concept



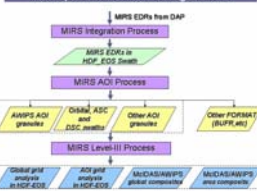
Goal is to find an optimal set of atmospheric and surface state parameters which generates the best fit radiance to the satellite measurements. More scientific details on the algorithm, please refer to the poster B.28 presented by Sid-Ahmed Boukabara in the same section.

## Transition from Research to Operation

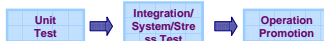
There are several elements need to be worked through during the transition of MIRS from Research to Operation, which include: (1) Transition of the MIRS DAP from STAR's collaborative development environment to operational environment; (2) Integration/development of the MIRS DAP with the operational post-processing modules; (3) Promotion of MIRS into operation following the ESPC CM process; (4) Real-time operational products generation, dissemination, monitoring and maintenance; (5) Integration/development of the web-based tools for real-time monitoring of product quality generation, dissemination and maintenance.



### MIRS Operational Post-Processing Flowchart

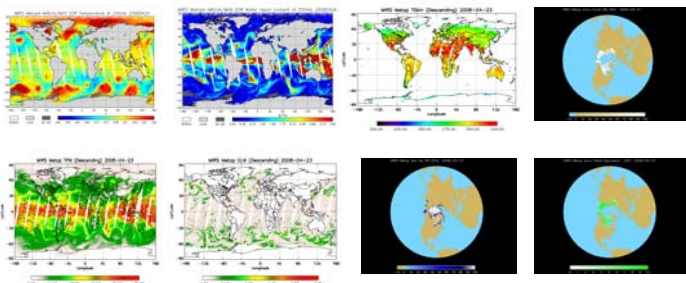


### Operational End-to-End Test/Promotion Cycle

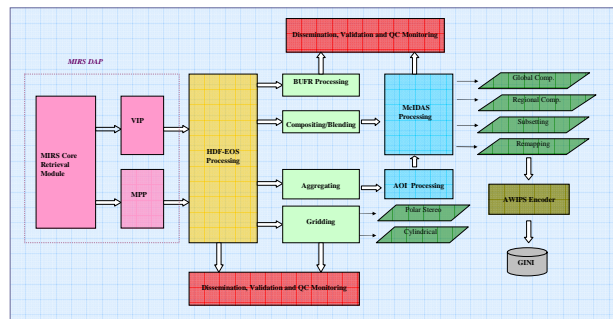


## Operational MIRS Products and Their Dissemination

- The current operational MIRS products include: temperature profiles over ocean, moisture profiles over ocean and non-coastal land, total precipitable water over ocean and non-coastal land, cloud liquid water over ocean, snow cover, sea ice concentration and snow water equivalent. Image examples are shown below.
- The near real-time MIRS products are available through NESDIS/OSDPD, and user requests should be addressed to [Limin.Zhao@noaa.gov](mailto:Limin.Zhao@noaa.gov). Image products can be accessed through <http://www.osdpd.noaa.gov/PSB/mirs>.
- Historical MIRS data files can be queried from NOAA/CLASS/NCDC: <http://www.class.ncdc.noaa.gov/sa/products/welcome>  
> CLASS ID for MIRS orbital products: MIRS\_ORB  
> Searchable by Temporal, Satellite, Data Type and Format.  
> Products separated into SND and IMG files with the following name convention:  
NPR.MIRS.V2.SND.AAMH.\*.Dyydd.Shhmm.Emmhh.B\*.he4  
NPR.MIRS.V2.IMG.AAMH.\*.Dyydd.Shhmm.Emmhh.B\*.he4



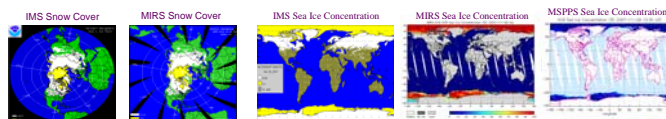
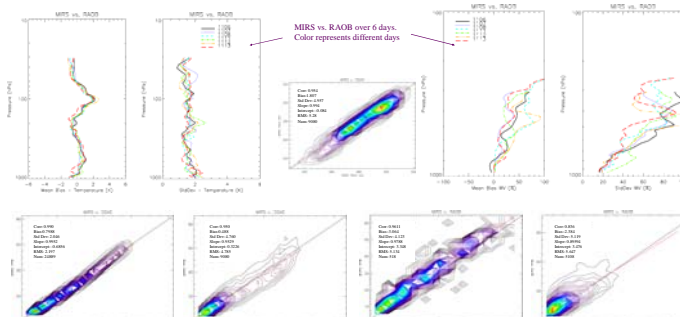
## The Operational MIRS System Design and Architecture



The MIRS is eventually implemented into operation with the following enhanced capability: (1) Data Format Convention; (2) Level-3 processing with the gridding, compositing and aggregation capabilities; (3) Level-4 processing to provide blended MIRS products from multi-satellites. The high level system design and architecture is shown above with its functionality color coded.

## Validation and QC Monitoring

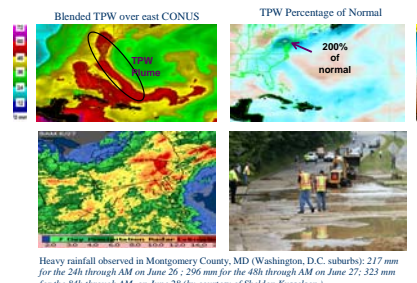
While the QC monitoring on the product generation, timeliness and dissemination is being performed in real-time mode on a 24/7 base at NESDIS/OSDPD, the validation of product quality currently is heavily relied on research scientists at NESDIS/STAR who are continuously check out and improve the quality of products on a day-to-day base. Intensive validations are being performed to compare the MIRS products with these from ROAB, GDAS, MSPPS, ECMWF and COSMIC and results can be accessed through <http://mirs.nesdis.noaa.gov>. The following images show a general performance of MIRS products when compared with GDAS, ROAB and NESDIS operational Interactive Multi-sensor Snow and Ice Analysis (IMS).



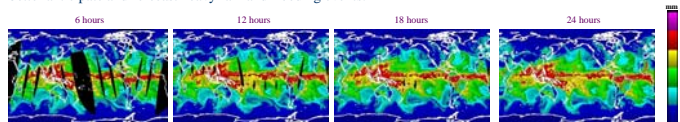
(Images cited by courtesy of Sid-Ahmed Boukabara, Kevin Garrett and Cesar Kongoli in the MIRS development team. The collocated ROAB data are provided through the NOAA Products Integrated Validation Dataset (Database).)

## Potential Use of Global MIRS TPW on Precipitation Analysis

TPW is used by forecasters for locating high concentrations of low level moisture, so-called TPW plume or atmospheric river, which is one of the most recognizable satellite signatures of potential heavy rainfall and subsequent flooding. Shown right are the current NESDIS experiment blended TPW products that merge AMSU, SSM/I and GPS products into an unified resource to provide forecasters non-gap TPW coverage over oceans and CONUS and have been approved to be a very helpful tool for forecasters to identify conditions that could result in heavy precipitation and subsequent flooding.



The TPW over land from the MIRS would extend this capability into the global and adds a big addition to the exist capability and allow analysts to more effectively monitor surges of moisture from the ocean areas to land and better anticipate and forecast heavy rain and flooding events.



One of the important components of the operational MIRS is to generate value added MIRS products and make them available to satellite analysts and forecasters. Shown above are examples of the blended MIRS TPW from NOAA-18 and MetOp-A with data accumulation of 6 hours, 12 hours, 18 hours and 24 hours. It's shown that a global non-gap TPW map can be produced with 24 hours accumulation from two satellites, which is expected to enhance the TPW tools that have approved valuable on helping meteorologists understand the contributions of low level moisture for the development of weather hazards and contribute to improved forecasts and lead times for hazardous weather events and enhance NOAA's mission of protecting lives and property.

International TOVS Study Conference, 16<sup>th</sup>, ITSC-16, Angra dos Reis, Brazil, 7-13 May 2008.  
Madison, WI, University of Wisconsin-Madison, Space Science and Engineering Center,  
Cooperative Institute for Meteorological Satellite Studies, 2008.