UPDATES ON OPERATIONAL PROCESSING FOR NOAA/NESDIS SOUNDING DATA PRODUCTS AND SERVICES

A.K. Sharma (**O**ffice **S**atellite **D**ata and **P**roducts **D**istribution)… OSDPD
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NOAA/NESDIS Operation Updates

POES Missions and Schedule (ATOVS… METOP … NPOESS)

Road Map for Atmospheric Soundings from IR and MW Sounders

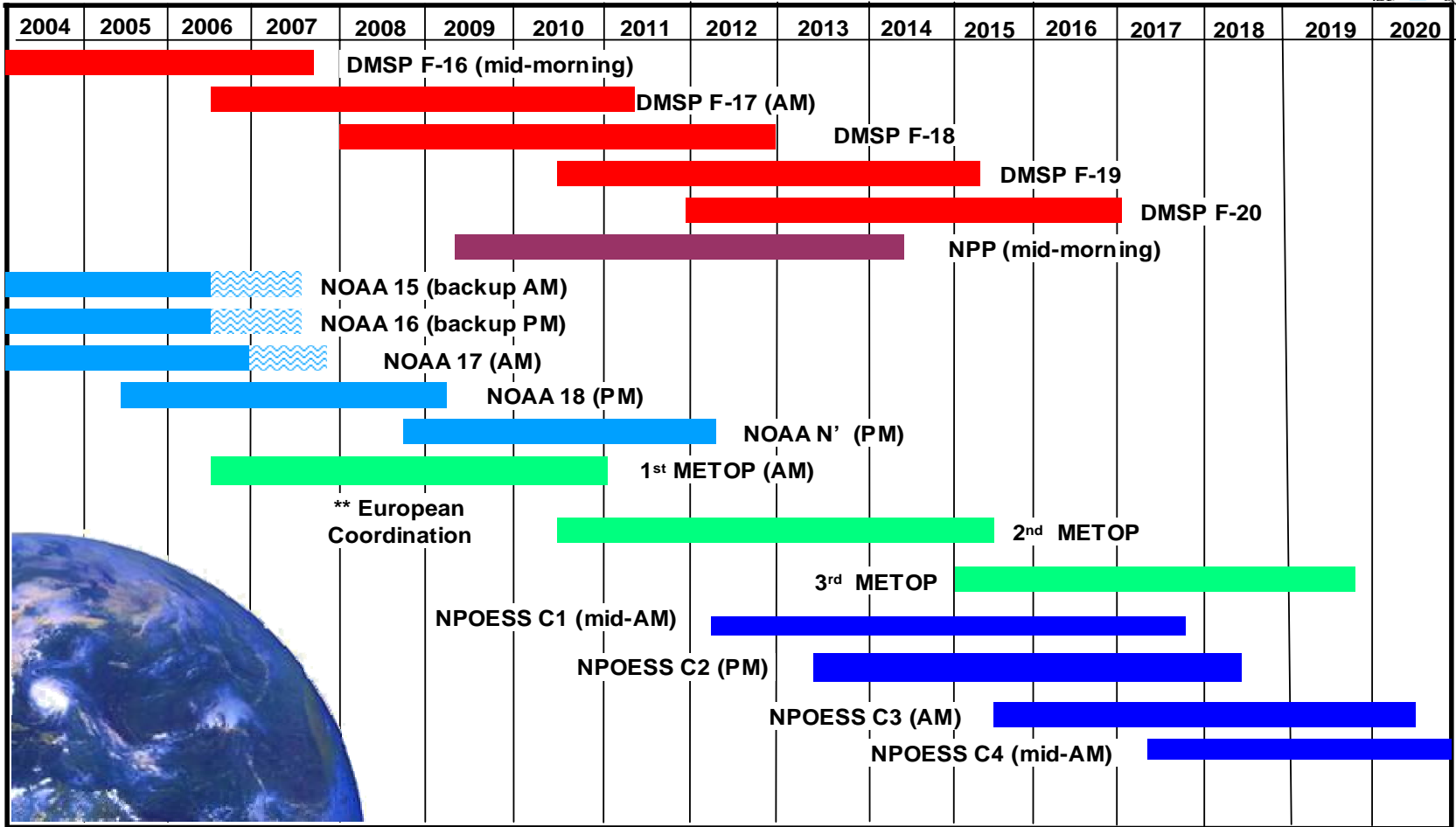Products Processing Update

Processing Changes

Systems Changes

Instruments Changes

ATOVS Soundings System Changes

Summary

POES Satellite Launches* Schedules (Calendar Year)

* Actual launch dates are determined by the failure of on-orbit assets
** Assumes METOP will provide the morning orbit and NOAA-N' will provide afternoon orbit instruments

Upcoming Launches

- Metop
  - Readiness Date: October, 2006
  - Launch Date: Possible Oct 17, 2006
  - Operational Data Distribution – Launch + 90 days
- NPP Launch Date: 2009
- NOAA-N' Launch Date: March 2008
- NPOESS Launch: 2012
- Second Metop Launch Date:August 2010

Product Processing Changes

ATOVS NOAA-15, 16 and 18 systems moved from IBM Mainframe (MVS Operating System) to IBM P570 (Unix System)

ATOVS Metop system is being developed on IBM P570 Unix System… similar to NPOESS

IJPS, IPS
Products Overview

- Level 1 Products Created at NOAA
  - AVHRR
  - AMSU-A
  - HIRS
  - MHS
  - SBUV
  - SEM
  - [A]DCS
  - SAR

- Level 1 Products Obtained from Eumetsat
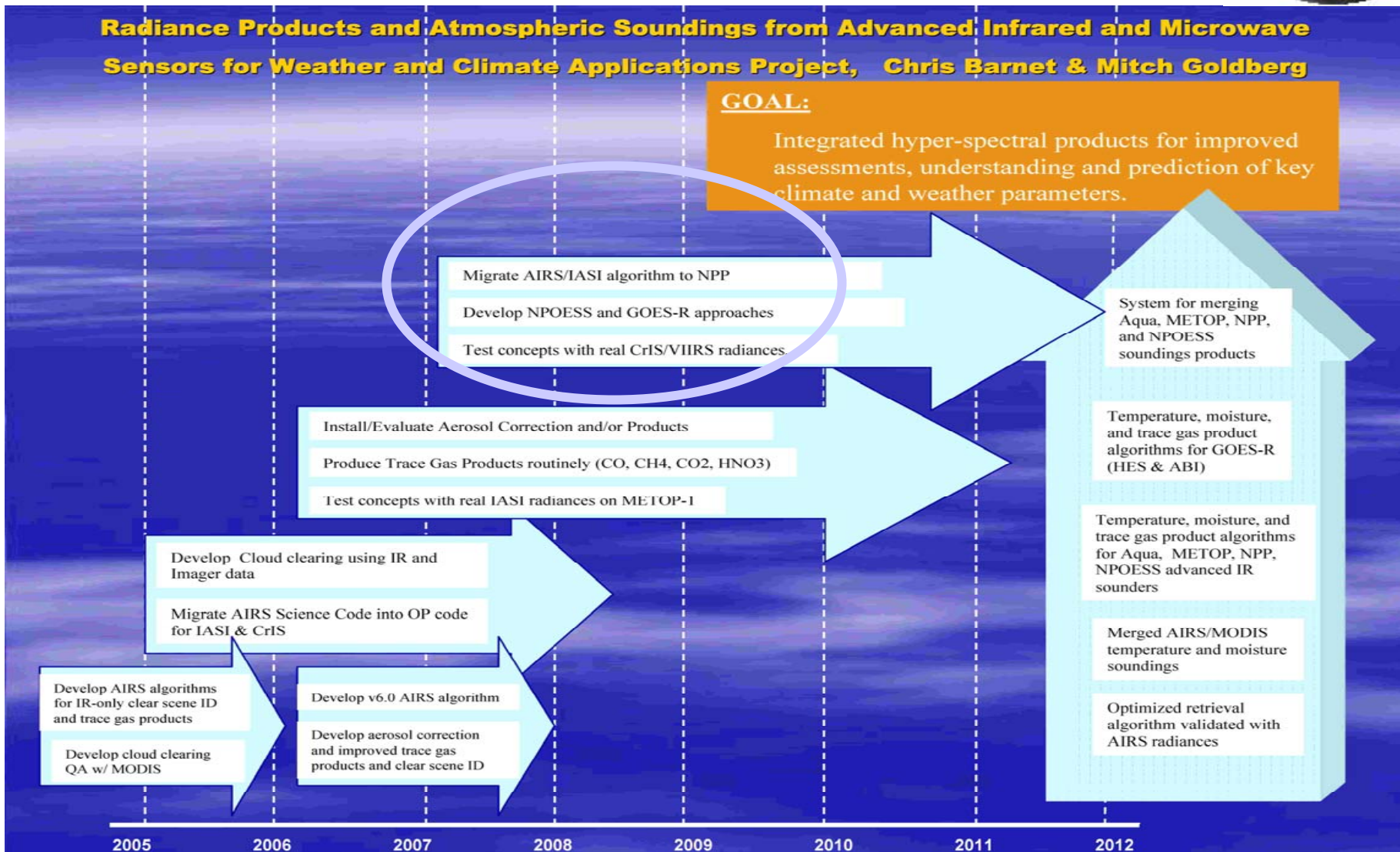 - ASCAT
  - IASI
  - GOME
  - GRAS

CrIS/ATMS/VIIRS Product System is part of the NESDIS Advanced Product Roadmap

Radiance Products and Atmospheric Soundings from Advanced Infrared and Microwave Sensors for Weather and Climate Applications Project, Chris Barnet & Mitch Goldberg

GOAL: Integrated hyper-spectral products for improved assessments, understanding and prediction of key climate and weather parameters.

Migrate AIRS/IASI algorithm to NPP

Develop NPOESS and GOES-R approaches

Test concepts with real CrIS/VIIRS radiances

System for merging Aqua, METOP, NPP, and NPOESS soundings products

Install/Evaluate Aerosol Correction and/or Products

Produce Trace Gas Products routinely (CO, CH4, CO2, HNO3)

Test concepts with real IASI radiances on METOP-1

Temperature, moisture, and trace gas product algorithms for GOES-R (HES & ABI)

Develop Cloud clearing using IR and Imager data

Migrate AIRS Science Code into OP code for IASI & CrIS

Temperature, moisture, and trace gas product algorithms for Aqua, METOP, NPP, NPOESS advanced IR sounders

Develop AIRS algorithms for IR-only clear scene ID and trace gas products

Develop v6.0 AIRS algorithm

Develop cloud clearing QA w/ MODIS

Develop aerosol correction and improved trace gas products and clear scene ID

Merged AIRS/MODIS temperature and moisture soundings

Optimized retrieval algorithm validated with AIRS radiances

2005 2006 2007 2008 2009 2010 2011 2012

Instruments on Metop Used for Soundings

- AMSU-A: The Advanced Microwave Sounding Unit A1 and A2
  - » Microwave sounder with 15 channels in the spectral range of 23 to 89 GHz.

- MHS: The Microwave Humidity Sounder
  - » Microwave sounder with 5 channels from 89.0 GHz to 190.3 GHz.

- HIRS/4: High Resolution Infrared Radiation Sounder/4
  - » 19 infrared channel (3.8 – 15 microns) and one visible channel.

- AVHRR/3: Advanced Very High Resolution Radiometer/3
  - » 6-channel 1 km visible/IR (0.6-12 microns) imager

# Infrared Atmospheric Sounding Interferometer (IASI)

- Fourier Transform Spectrometer based upon a Michelson Interferometer (8461 channels)
  - Highly accurate atmospheric temperature and moisture data
- NESDIS products will include thinned radiances, principal component scores, cloud cleared radiances, carbon products, temperature, moisture, ozone profiles

Cloud Cleared Radiances

Typically, less than 5% of a sensors Field of View's (13.5 km) are clear.
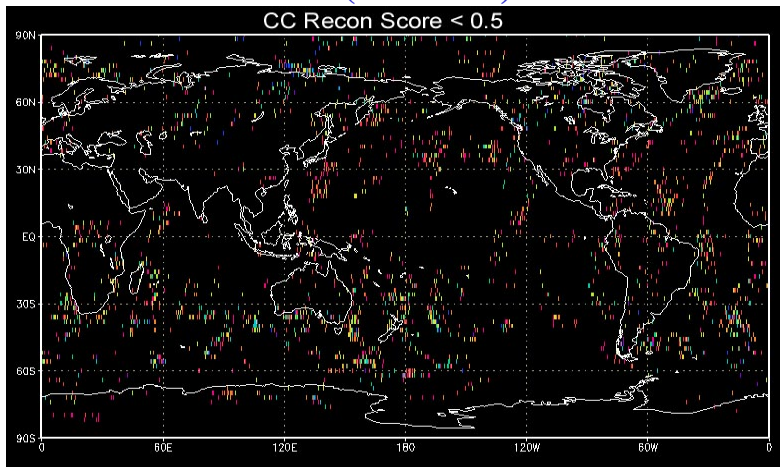
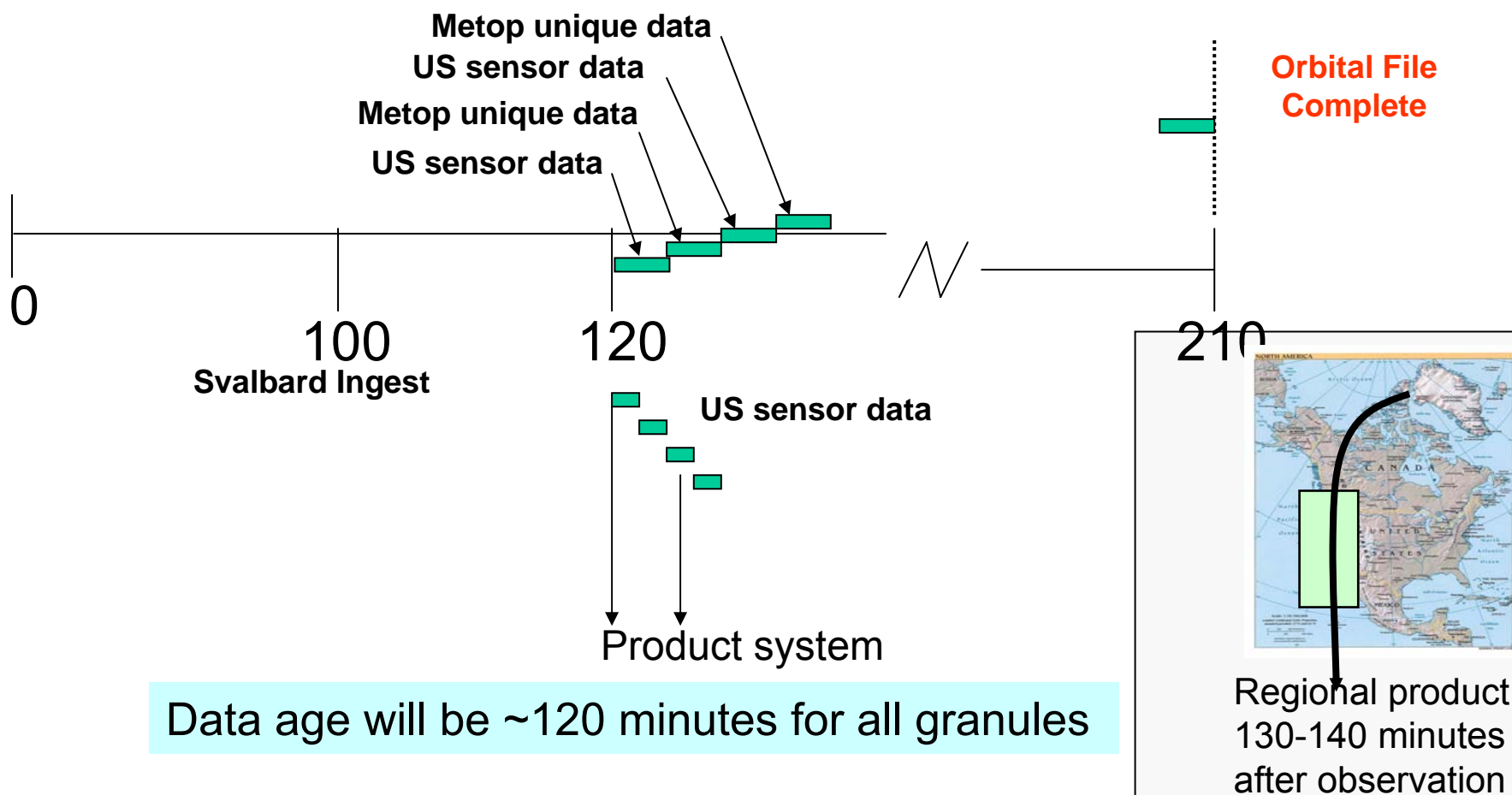**Cloud Clearing can increase yield to 50-80%.**
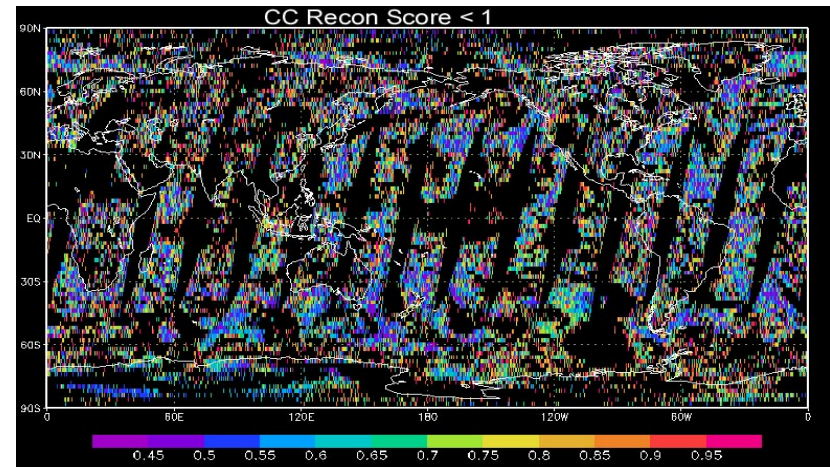
(Thomas King talk 12.3)

IASI HIRS like OLR Products from Metop

•The IASI HIRS-like OLR Products would preserve the continuation of the HIRS OLR climate data record from future satellite instruments.

•The improved HIRS OLR will be the longest and continuous high quality satellite OLR product that has climate data record quality and would greatly complement the discontinuous broadband measurements.

•Improved and enhanced the capability in climate monitoring and climate analysis, especially through the implementation of the inter-satellite calibration and diurnal cycle adjustments.

•Improved quantitative accuracy and long-term stability in the Infrared Sounder OLR data record, which enables more accurate description and diagnostic studies of global climate.

•Data consistency can be preserved when AVHRR OLR is less likely available during NPOESS era.

•Data will be made available in December 2008

METOP Pipeline Processing

- Pipeline processing: all data received ~120 minutes after observation
  - Applications with timeliness requirements will process in pipeline mode
- Orbital files generated ~210 minutes after observation

Metop unique data

US sensor data

Metop unique data

US sensor data

Orbital File Complete

0

100
Svalbard Ingest

120

US sensor data

210

Product system

Regional product 130-140 minutes after observation

Data age will be ~120 minutes for all granules

NOAA-18 Updates

- MHS has shown improvement over AMSU-B
- N18 HIRS very unstable
- N18 HIRS is Frequently un useable
- HIRS-based operational products are not operationally produced.
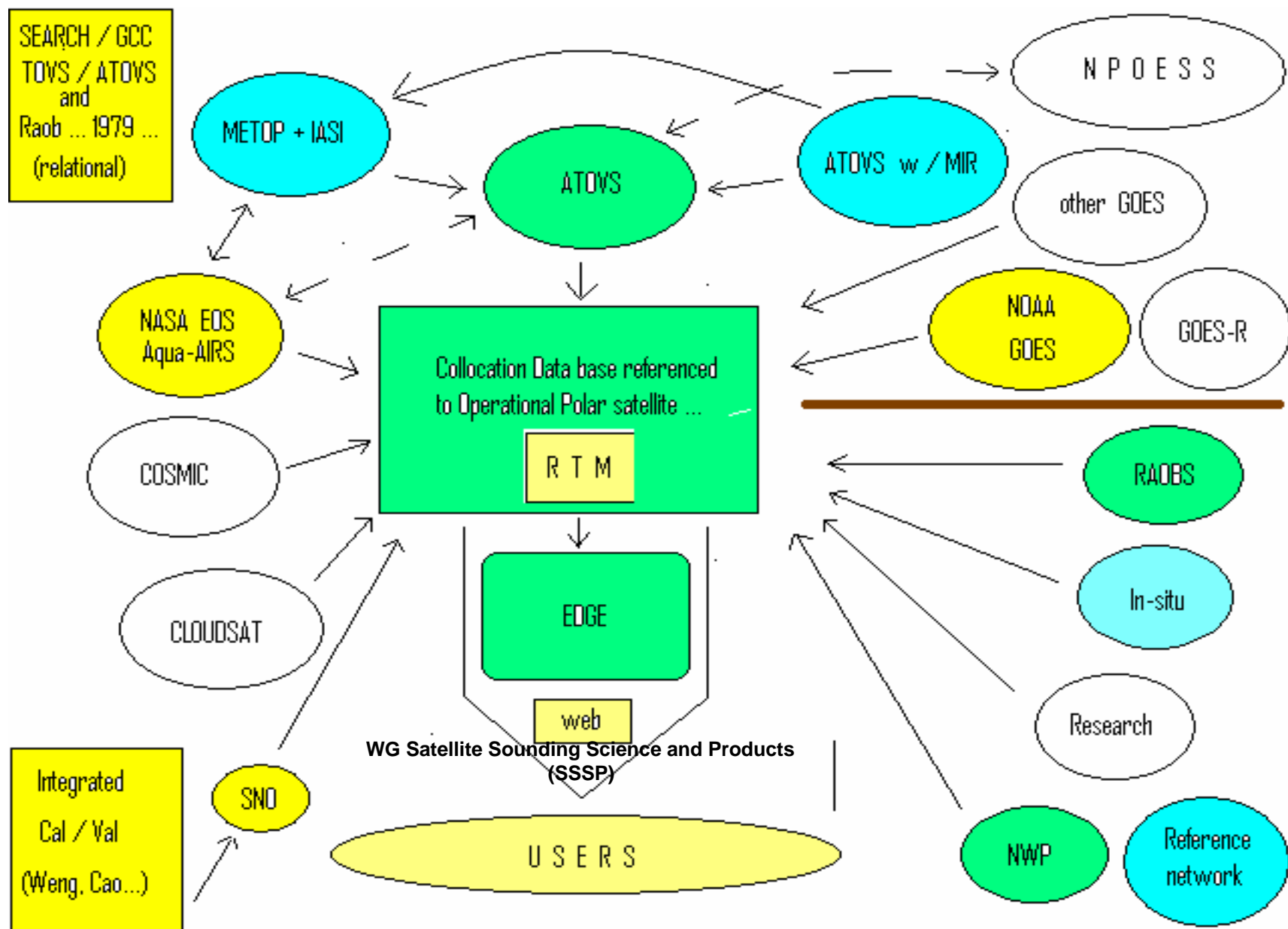- Improved timeliness for NOAA-18 blind orbits.

ATOVS Surface / Sounding Products

(Fuzhong Weng, Tony Reale, Mitch Goldberg)

- *Incorporate MHS*

- Regression Guess replaces Library Search
  - Calculate First Guess Radiance (CRTM)

- *Integrate Microwave Integrated Retrieval System (MIRS) Products*
  - *TPW, CLW, Emissivity … (Sid Boukabara talk 11.6)*

- Measurement (Radiance) Bias Adjustment
  - AMSU-A
  - MHS
  - HIRS

- *Integrate MIRS Retrieval Solution (CRTM) per sounding (Paul Van Delst, Fuzhong Weng, Yong Han)*
  - *based on Guess Temp and Moisture*

- *Baseline for NPOESS (… AIRS and IASI)*

- Peripheral Upgrades
  - Limb-adjustment
  - Complete NWP Profile (Srfc data, +/- 90 minutes, 3hr fcst …)

Operational Product Environment to Provide
## Integrated Validation Datasets and Analysis

Integrated Operational Product Data Validation
(NPOESS IPO Award)

SEARCH / GCC
TOVS / ATOVS
and
Raob ... 1979 ...
(relational)

METOP + IASI

ATOVS

NPOESS

ATOVS w / MIR

other GOES

NASA EOS
Aqua-AIRS

NOAA
GOES

GOES-R

Collocation Data base referenced
to Operational Polar satellite ...

R T M

COSMIC

RAOBS

In-situ

CLOUDSAT

EDGE

web

WG Satellite Sounding Science and Products (SSSP)

Research

Integrated
Cal / Val
(Weng, Cao...)

SNO

U S E R S

NWP

Reference
network

NPOESS Mission

- Provide a national, operational, polar-orbiting remote sensing capability
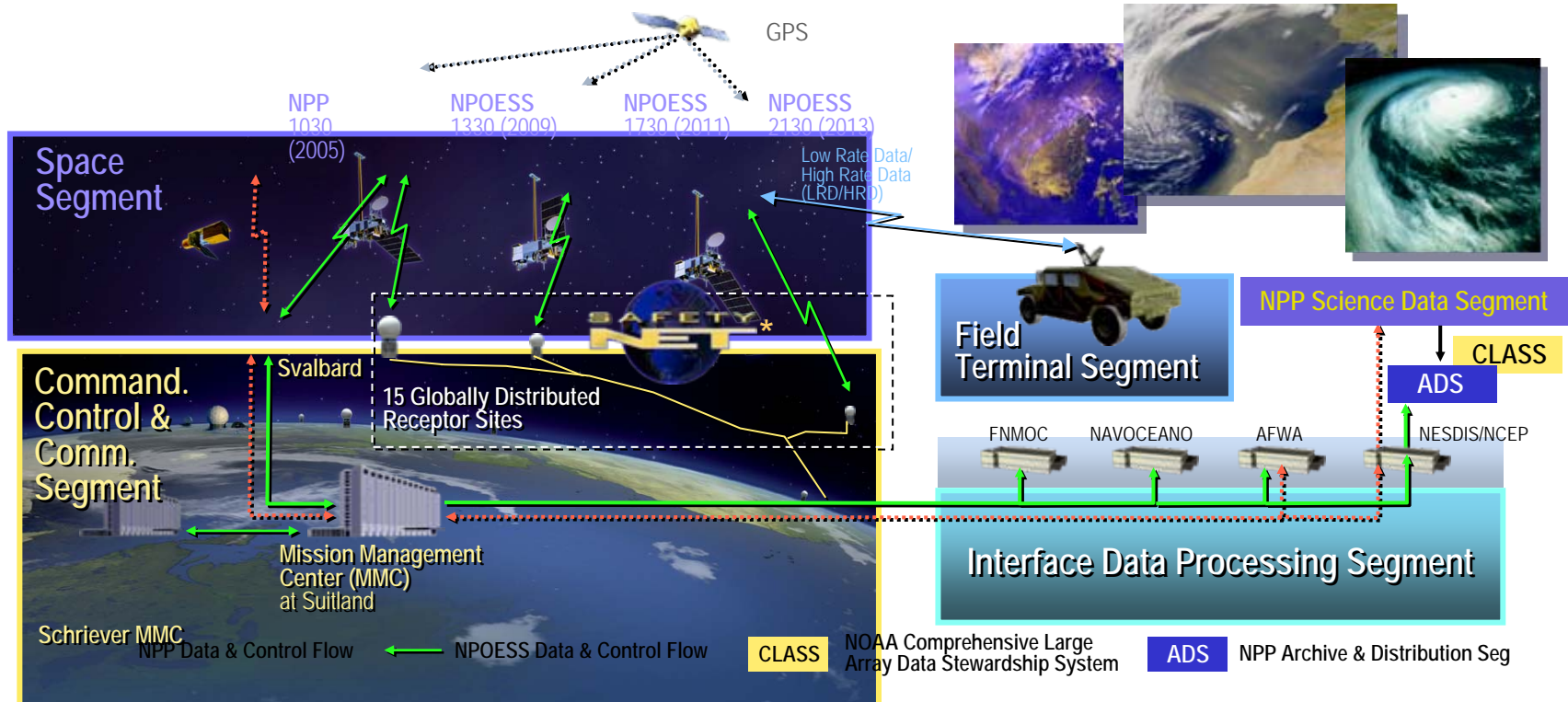
A Tri-agency Effort to Leverage and Combine Environmental Satellite Activities

* Patent Pending

Open Issues

User receipt of IJPS products Granule vs Orbital

Shared Processing requirements

Dissemination of products generated in pipeline mode

Orbital to Granule Processing

Granule Size, Granule Naming convention, Missing Granules, Multiple Strings for operational and backlog processing, Granule Reprocessing, and Data Transmission Problems.
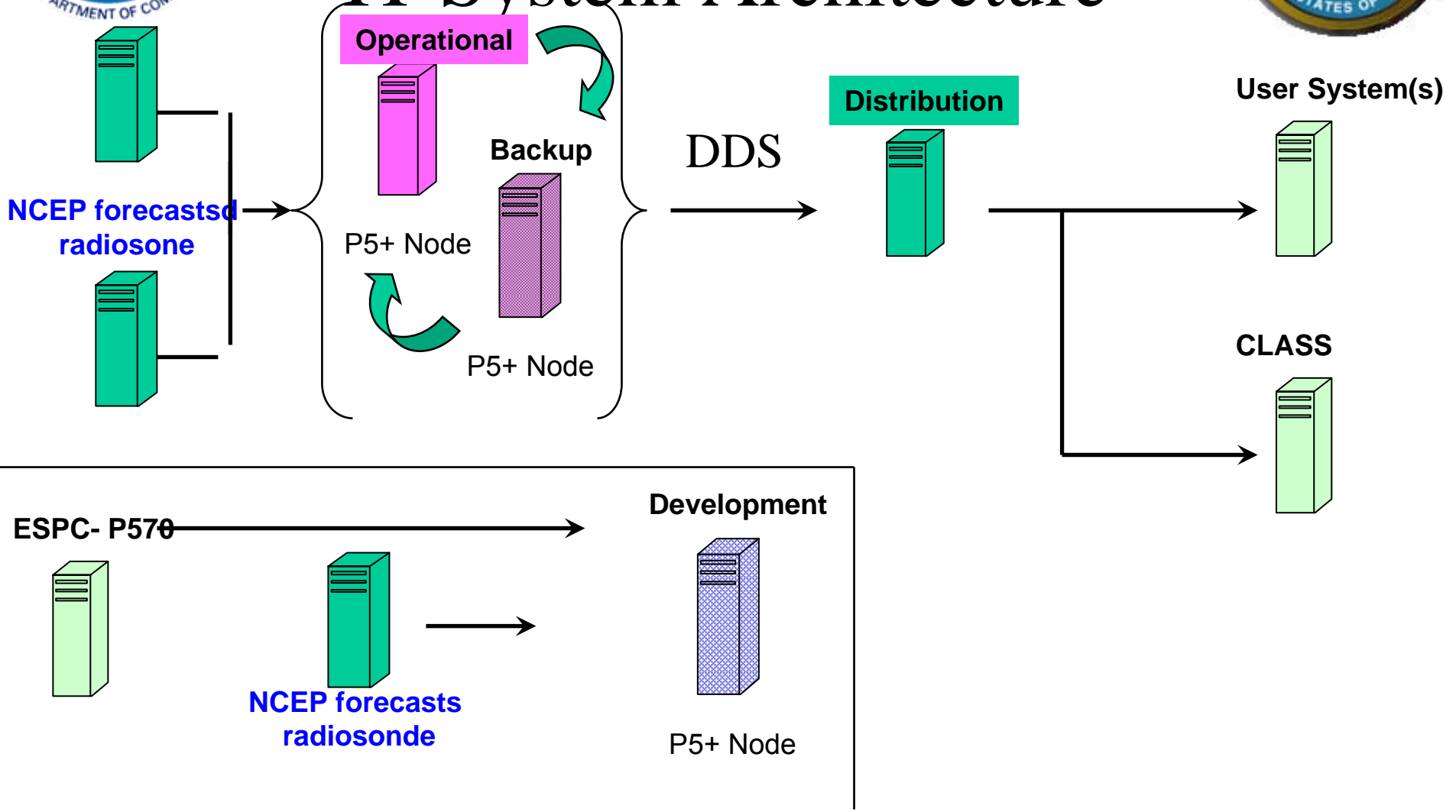
Summary

- POES timelines … ATOVS, DMSP, (AIRS), METOP, NPP, NPOESS

- Advanced Product Processing Roadmap (AIRS, IASI, Cris)

- NOAA will produce IASI-based Level-1 and Level-2 Products … Distribution?... RARS

- ATOVS Operational Product Upgrades (w/ MIRS) and Integrated Product Validation

- Integrated NPOESS products for improved assessment, understanding and prediction of key weather and climate parameters

Extras

IASI Product System
IT System Architecture

Operational

Distribution

Backup

DDS

User System(s)

NCEP forecastsd radiosone

P5+ Node

P5+ Node

CLASS

ESPC- P570

Development

NCEP forecasts radiosonde

P5+ Node

Input Data Includes: **NCEP forecasts, and radiosonde data**

IASI Capabilities Assessment

	Current Capabilities	Requested Capabilities				
Satellite Source (s)	AIRS (pseudo operational)	IASI	IASI	IASI	IASI	IASI
Product Name	AIRS Principal Components	IASI Principal Components	IASI Cloud Cleared Radiances	IASI Cloud Cleared PCA	IASI-ozone	IASI CO, CH4, CO2
Accuracy	n/a	n/a	≤ 1 K	n/a	20%/5-km near tropopause	CO: 40% mid-trop column (w/ 0.2 cm OPD SW band)
Latency	5 minutes after granule data is available	5 minutes after granule data is available	15 minutes after granule data is available	20 minutes after granule data is available	10% total column	CH4: 1% mid-trop column
Timeliness	3 hours	≤ 3 hours	≤ 3 hours	≤ 3 hours	15 minutes after granule data is available	CO2: 1% mid-trop column
Coverage	Global	Global	Global – scenes which satisfy cloud clearing assumptions	Global – scenes which satisfy cloud clearing assumptions	≤ 3 hours	15 minutes after granule data is available
Horiz Resolution	Every 5th AIRS FOV	Per IASI FOR	50 km (One IASI FOV collocated with AMSU FOV)	50 km (One IASI FOV collocated with AMSU FOV)	Global – scenes which satisfy cloud clearing assumptions	≤ 3 hours
Other attributes	2378 channels represented within 85 PC's	Compresses 8461channels into N PC's. N needs to be determined, but it should be approximately 85 values	Optional QA w/ AVHRR clear masked pixels		50 km (One IASI FOV collocated with AMSU FOV)	Global – scenes which satisfy cloud clearing assumptions

OSDPD Product Access

http://www.osdpd.noaa.gov/IPD/IPD.html

http://satprod.osd.noaa.gov/satprod/controlcenter.cfm

http://www.osdpd.noaa.gov/

http://www.oso.noaa.gov/

http://www.osd.noaa.gov/

http://www.class.noaa.gov/nsaa/products/welcome

http://www.ipo.noaa.gov/

ATOVS System-200X

- Online and Offline Systems
  - Incorporate AMSU-B
  - Regression Guess replaces Library Search
  - Calculate First Guess Radiance (OPTRAN)
  - Measurement (Radiance) Bias Adjustment
  - "Unique" Retrieval Solution (OPTRAN)
  - Facilitate Channel Swapping

ATOVS System-200X Continue …

Regression Coefficients for First Guess Temperature and Moisture using AMSU-A/B

Retrievals Based on Channel Combinations, Predictors (ie, surface emissivity…)

Extended Validation …

      Radiance statistics … including vs NWP

      Product Grids

      Instrument Health

Regression Coefficients for Radiance Bias Adjustment of AMSU-A, AMSU-B, and HIRS

MDB… First Guess and Bias Regressions

Radiance ... Gridding

Limb Adjustments

IASI Hardware

Procured three sets of hardware (three IBM power 5 racks P570 with 16 CPUs in each).

3 TB of disk space for each machine (Operations, Test/Backup, and Development) on the SAN.

STAR is using one machine for development.

The other two will be used by OSDPD for operations and a test/backup.

IJPS, IPS
Overview of Upgrades for Metop (Continue)

- New Preprocessor
  - IBM RS/6000 (development) and P570 (operations) AIX platform for parallel processing
  - New Server for Data Distribution (DDS)
  - Processing based on Data Driven Scheduler (OPUS)
  - Processing on a distributed (scalable processor) UNIX platform for parallel operations
  - Preprocessing of blind orbit GAC in pipeline mode
  - Producing common instrument Level 1b's from Metop in pipeline mode
  - Producing new Level 1b's for MHS and Full Resolution GAC (FRAC)

IJPS, IPS
Overview of Upgrades for Metop

- New Ingestor and Front End Processor (FEP)
  - Ingest of common instrument data, from the GDS as CCSDS VCDUs, in pipeline mode
  - Frame synchronizing and filtering of GDS data at Ingest
  - Receipt and distribution of ASCAT, GOME and GRAS Level 1b and IASI Level 1c products
  - Ingest blind orbit GAC, in pipeline mode
  - Produce instrument (NOAA) Level 1a's (i.e., for POES data - decommutate the TDM stream)

Metop Data Storage Requirements

Unique EUMETSAT Level 1

File	Size (bytes)	Bytes/Day
ASCAT 1b	25,060,966	353,359,626
IASI 1c	2,083,059,139	29,371,133,854
GOME 1b	582,892,913	8,218,790,068
GRAS 1b	188,743,680	2,661,285,888
TOTAL:	2,879,756,698	40,604,569,436

File size and "Bytes/Day" are based on a 102-minute orbit and 14.1 orbits per day

NPP RDR Sizing Estimates

Sensor	Granule Size (MB)	Granule Size with HDF5 (MB)	Total Size per Orbit (GB)	Total Size per Day (GB)
VIIRS	38.52	46.22	9.61	136.33
CrIS	2.66	3.19	2.37	33.62
ATMS	0.19	0.23	0.17	2.40
OMPS	1.26	1.51	0.24	3.34

- Numbers are based upon the IDPS Sizing models

Sensor	Granules per Orbit	Granule Length (sec)
CrIS/ATMS	761	8
VIIRS	213	28.58
OMPS	160	38

Update Product Applications for Pipeline Processing

- Atmospheric Soundings, Real-time Ozone, Hazards, Microwave Surface and Precipitation, CLAVR Cloud Flags

- Applications that plan to use 1-km AVHRR data from Metop are CLAVR cloud flags, Aerosol, Imagery, CoastWatch, Radiation Budget, Sea Surface Temperature, Vegetation, Hazards, Snow/Ice & Significant Event Imagery

- Level 1 Metop Unique Products (IASI, ASCAT, GOME, and GRAS) EUMETSAT will process this data via pipeline mode and transmit 3-minute files as the data becomes available. These data are pushed to NOAA from EUMETSAT through the NOAA Gateway (NRT) in Darmstadt. The NRT will send the Level 1 Metop Unique Products (3-min. files) via FTP protocol to the GFT, which in turn will ship the data to the AIX for processing.

ATOVS Porting

Porting ATOVS from IBM Mainframe to IBM Unix Platform

- Old IBM Mainframe (Amdahl) MVS Operating System

- New IBM P570 (2 nodes) Unix Operating System

    Diamond is Operational Production System

    Emerald is a test and back system

    OPUS Data Driven Scheduler

    DDS Data Distribution System

- ATOVS systems running for NOAA Satellites (N15, 16, and 18) and will be extended for EUMETSAT (Metop-2)

- AMSU-B Standalone System is terminated