

# NESDIS ATOVS Operational Sounding Products Processing and Distribution

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# NOAA/NESDIS Operation Updates



Products Processing Update

Processing Changes

Systems Changes

Instruments Changes

Soundings System Upcoming Changes  
and Activities

Summary



# Product Processing Changes



Product Generation

Level 1 Data

Levels 2 and 3

### SATEPS (SSD)

<b>Snow/Ice</b> •AVHRR	<b>Hazards Fire/Smoke Volcanic Ash</b> •AVHRR	<b>Heavy Precip</b> •AMSU-A
<b>Significant Event Imagery</b> •AVHRR	<b>Tropical Cyclone Analysis</b> •AVHRR •AMSU-A	

### CEMSCS (IPD)

<b>Aerosol</b> •AVHRR	<b>Global Vegetation</b> •AVHRR	<b>Cloud Imagery</b> •AVHRR	<b>Global Sea Surface Temp</b> •AVHRR •HIRS/4	<b>Local Sea Surface Temp</b> •AVHRR	<b>MW Surface/Hydro</b> •AMSU-A •MHS
<b>Radiation Budget</b> •AVHRR •HIRS/4	<b>Soundings</b> •AVHRR •AMSU-A •HIRS/4 •MHS	<b>Ozone</b> •SBUV/2 •GOME-2	<b>Cloud Flags</b> •AVHRR	<b>Advanced Soundings</b> •IASI	<b>Ocean Surface Winds/Sea Ice</b> •ASCAT

### Other

<b>Sea Ice (NIC)</b> •AVHRR	<b>Space Environment (SEC)</b> •SEM-2
<b>Data Collection</b> •DCS	<b>Search and Rescue</b> •SAR

User Interfaces (Servers, Web Pages, GTS, NWS Gateway, etc.)

- ▲ Possible upgrades to use AVHRR global 1-km data from Metop
- ▲ New product systems
- ▲ Upgrade for pipeline processing



# Upcoming Launches



- NOAA-N
  - NOAA-N Readiness Date: October 31, 2003
  - NOAA-N Launch Date: September 30, 2004
- First Metop Launch Date: December 2005
- NPP Launch Date: 2006
- NOAA-N' Launch Date: March 2008
- NPOESS Launch: 2009
- Second Metop Launch Date: August 2010



# NOAA-N/N' Changes

- MHS will replace AMSU-B
- Field of View Size Change for HIRS
- HIRS specify calibration and format changes
- AMSU-A specify calibration and format changes
- AVHRR specify format change
- Other 1b/1b\* format changes
- New Telemetry data file



# NOAA-N/N' Changes Continue



- MHS/MIU
  - MHS and AMSU-B Differences
    - Channels Frequency are Similar
      - Channels with different frequency
        - » H2 and 17 (change from 150 to 157)
        - » H5 and 20 (183 +/- 7 to 190 GHz)
    - Number of warm target PRTs
      - MHS has 5
      - AMSU-B has 7
    - Different Algorithms for Calibration
    - 1b/1b\* format similar



# NOAA-N/N' Changes Continue



- MHS/MIU
  - Understanding different modes
    - Nominal modes
    - Non-nominal modes
    - MIU nominal modes
    - MIU non-nominal modes
  - Accommodating different modes
    - Set flag for Nominal and Non-Nominal modes
      - Operational nominal modes 99% of time



# NOAA-N/N' Changes Continue

- HIRS
  - Field of View Size Change for HIRS
    - HIRS/4 10KM FOV compared to HIRS/3 20KM FOV
      - Users may need to change software, especially where co-location with other sensors such as AVHRR
  - Patch Temperature changed from 100 to 95K
  - Added a 5<sup>th</sup> Internal Warm Target temperature sensor and third telescope temperature sensor
  - Added extra bit to the electronic serial number in the Digital A data stream Element 63 Bits 40-44
    - Software change
    - Bits will be redefined in 1b





# NOAA-N/N' Changes Continue

- HIRS Issues (Cont.)
  - Software Correction for the Operational HIRS Lunar Intrusion
  - HIRS Calibration Algorithm Version 4.0
    - New algorithm to be introduced as a supplement or replacement to current operational HIRS calibration algorithm



# NOAA-N/N' Changes Continue

- AMSU-A
  - Correction of Lunar contamination
    - Will require minor change to 1b format
      - Header and Data record
  - Correction for sudden jumps in the calibration counts (NOAA-17 Channel 3 anomaly)
    - Will require minor change to 1b format
      - Header and Data record



# NOAA-N/N' Changes Continue

- AVHRR
  - Change to AVHRR Scaling Factors for some of the AVHRR nonlinear radiance coefficients
    - IR Operational/Test Cal Channel 4 coefficient 3
    - IR Operational/Test Cal channel 5 Coefficient 3



# NOAA-N/N' Changes Continue



- Other 1b/1b\* Format changes
  - Additional Headers added
    - Ancillary Data Set Names added
    - Quality Information added
      - Could be used to determine which data to keep



# AVHRR (GAC, HRPT, LAC) Modifications



## Header Record Modifications

- Added definitions for bits 0 and 1, which were previously undefined (zero fill), of "Earth Location Error Code" (byte offset 151-152). These are defined the same as in "Scan Line Quality Flags [Earth Location Problem Code]" in data record (see below).
- Updated the "ANALOG TELEMETRY CONVERSION" section (byte offset 425-952) as follows:
  - Replaced "<Reserved>" fields with a 6th coefficient for each telemetry item.
  - Increased the word size of each field in this section from 2 bytes to 4 bytes to allow for more and better precision.
  - Changed these coefficients' scale factors, which were all 2s, to 6 (coefficient 1), 6 (coef. 2), 7 (coef. 3), 8 (coef. 4), 9 (coef. 5), and 10 (coef. 6).

## Data Record Modifications

- Changed the scale factor of the following fields from 6 to 7:
  - IR Operational Cal Ch 4 Coefficient 3 (byte offset 261-264)
  - IR Test Cal Ch 4 Coefficient 3 (byte offset 273-276)



# AVHRR (GAC, HRPT, LAC)

## Modifications Continue

- IR Operational Cal Ch 5 Coefficient 3 (byte offset 285-288)
- ○ IR Test Cal Ch 5 Coefficient 3 (byte offset 297-300)
  - Added definition for bit 0, which was previously undefined (zero fill), of "Scan Line Quality Flags [Calibration Problem Code]" (byte offset 31): "scan line was not calibrated because of satellite maneuver (Metop) or <zero fill> (NOAA)".
  - Added definitions for bits 0 and 1 of "Scan Line Quality Flags [Earth Location Problem Code]" (byte offset 32):
- ○ bit 1: "not earth located because of satellite in-plane maneuver (Metop) or <zero fill> (NOAA)"
- ○ bit 0: "not earth located because of satellite out-of-plane maneuver (Metop) or <zero fill> (NOAA)"



# HIRS L1B Modifications



- **Header Record Modifications**

- Added "Digital A Telemetry Conversion" section (byte offset 1321-1892) to hold the digital A telemetry conversion coefficients.
- "Ramp/Auto Calibration Indicators Bit Field" renamed to "Auto Calibration Indicators Bit Field" (byte offset 187-188) and description of meaning of the "auto calibration override switch for HIRS/4" bit added. This field is based on the pre-NOAA-K header field of a similar name. The pre-K 1b headers were all the same. Thus this field meant one thing for AVHRR and a different thing for HIRS. The "ramp" portion of this field name is applicable to AVHRR, and thus eliminated here in the HIRS 1b specification.
- Inserted new field, "24-Hour Average Space View Counts", at byte offset 513-592. This field contains each channel's 24-hour average space view counts. Note that the byte offsets of all subsequent fields, beginning with "Temperature-radiance Ch 1 Central Wave number" have increased by 80 bytes.
- Added definitions for bits 0 and 1, which were previously undefined (zero fill), of "Earth Location Error Code" (byte offset 151-152). These are defined the same as in "Scan Line Quality Flags [Earth Location Problem Code]" in data record (see below).
- Increased word sizes of "Analog Telemetry Conversion" coefficients (byte offset 937-1320) from 2 bytes to 4 bytes to allow for more and better precision.



# HIRS L1B Modifications

## Continue ...



- **Data Record Modifications.**

- Modified contents of element 59 because of changes in the HIRS/4 data stream. In particular, replaced.
  - ○ the first "Space View" (byte offset 4293-4302) with "Internal Cold Target, Temperature Sensor #1."
  - ○ the second "Space View" (or "Internal Cold Target, Temperature Sensor #2") (byte offset 4303-4312) with "Analog Ground 3."
  - ○ the third "Space View" (or "Internal Cold Target, Temperature Sensor #3") (byte offset 4313-4322) with "Internal Warm Target, Temperature Sensor #5."
  - ○ the fourth "Space View" (or "Internal Cold Target, Temperature Sensor #4") (byte offset 4323-4332) with "Tertiary Telescope Temperature Sensor."
    - Added definition for bit 0, which was previously undefined (zero fill), of "Scan Line Quality Flags [Calibration Problem Code]" (byte offset 35). It is now defined as "scan line was not calibrated because of satellite maneuver (Metop) or <zero fill> (NOAA)".
    - Added definitions for bits 0 and 1, which were previously undefined (zero fill), of "Scan Line Quality Flags [Earth Location Problem Code]" (byte offset 36). They are now defined as follows:
      - ○ bit 1: "not earth located because of satellite in-plane maneuver (Metop) or <zero fill> (NOAA)."
      - ○ bit 0: "not earth located because of satellite out-of-plane maneuver (Metop) or <zero fill> (NOAA)."





# AMSU-A 1b format Modifications



## • Header Record Modifications

- The name and meaning of the field "Count of Data Frames Without Frame Sync Word Errors" (byte offset 153-154) was changed in order to match the way the field is actually being set, and to be consistent with its definition for other instruments (e.g., HIRS and AVHRR). The field was originally named "Count of AMSU Frames without Frame Sync Word Errors".

- The following fields, related to the new lunar contamination correction algorithm, were added in the filler area at the end of the header record:

- ○ "Count of Scans Containing Lunar-Contaminated Space Views" (byte offset 2357-2358).

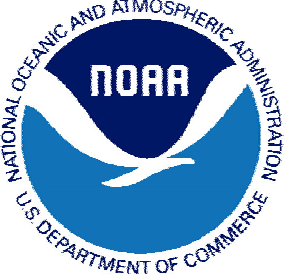
- ○ "Distance Between the Earth and Moon" (byte offset 2359-2360).

- ○ "Angle Between the Moon and Sun" (byte offset 2361-2362).

- Defined bits 0 and 1, which were previously undefined (zero fill), of "Earth Location Error Code" field (byte offset 167-168):

- ○ bit 1: "not earth located because of satellite in-plane maneuver (Metop) or <zero fill> (NOAA)"

- ○ bit 0: "not earth located because of satellite out-of-plane maneuver (Metop) or <zero fill> (NOAA)"



# AMSU-A 1b format Modifications Continue



## • Data Record Modifications

- The following set of modifications were made because of changes in the AMSU-A data stream:

- ○ Updated meaning of word 16 of "Temperature Sensor Telemetry" (byte offset 1985-2076) to "<unused> (s/n 105-109); PLL0 (reference oscillator) (s/n 101-104)". (Used to be "PLL0 (reference oscillator)".)

- ○ Updated meaning of word 16 of "A1 Analog Telemetry" field (byte offset 2153-2180) to "+10 VDC receiver mixer/IF (s/n 105-109); +8.5 VDC phase lock loop ch. 9/14 (s/n 101-104)". (Used to be "+8.5 VDC phase lock loop ch. 9/14".)

- ○ Updated meaning of bit 16 of "Analog Telemetry Update Flags" (old "Invalid Word Bit Flags") (byte offset 2149-2152) to "bit 16: +10 VDC receiver mixer/IF; +8.5 VDC phase lock loop ch. 9/14". (Used to be "+8.5 VDC phase lock loop ch. 9/14".)

- ○ Updated meaning of word 11 of "A2 Analog Telemetry" (byte offset 2513-2528) to "+10 VDC (receiver/mixer/IF) (s/n 105-109); +8 VDC (receiver) (s/n 101-104)". (Used to be "+8 VDC (receiver)".)

- ○ Updated meaning of bit 11 of "Analog Telemetry Update Flags" (old "Invalid Data Bit Flags") (byte offset 2509-2512) to "bit 11: +10 VDC (receiver/mixer/IF) (s/n 105-109); +8 VDC (receiver) (s/n 101-104)". (Used to be "+8 VDC (receiver)".)

- The meaning of the bits 9-12 of the fields "Digital B Telemetry for AMSU-A1" (byte offset 2143-2144) and "Digital B Telemetry for AMSU-A2" (byte offset 2503-2504) has changed when they are all zero. According to KLM documentation, when these bits are zero, the instrument is in the warm calibration position. For NOAA-N and the IJPS era, when all of these bits are zero, the AMSU-A instrument is operating in no mode. Digital A telemetry, analog telemetry, and bits 3 (A1 only), 13, and 14 of the digital B telemetry should be ignored.



# AMSU-A 1b format Modifications Continue ....



- Defined bit 8, which was previously undefined (zero fill), of each word in the "Calibration Quality Flags" field (byte offset 33-64). Its definition is "this scan line is either the last one before or the first one after a sudden, anomalous jump (or drop) in calibration counts".
- The following modifications, related to the new lunar contamination correction algorithm, were made (NOTE: all changes were made to spare or filler areas of the data record):
  - ○ Defined bits 7 and 6, which were previously undefined (zero fill), of each word of "Calibration Quality Flags" as follows:
    - ⑩ § bit 7: "lunar contamination was detected in the space view of this channel"
    - ⑩ § bit 6: "the space views of this channel were corrected for lunar contamination when used in the calibration (only applicable if the previous flag [bit 7] is 1; otherwise, zero)"
  - ○ Added the field "Space View Count Corrections" (byte offsets 2529-2543).
  - ○ Added the field "Lunar Azimuth Angles" (byte offsets 2545-2550).
  - ○ Added the field "Lunar Elevation Angles" (byte offsets 2551-2556).
  - Unused (reserved) byte of the "Scan Line Quality Flags" field (byte offset 29) changed to contain additional calibration problem indicators (now named "Scan Line Quality Flags [Additional Calibration Problem Code]"). Defined bit 7 to indicate if the "scan line was not calibrated because of satellite maneuver (Metop) or <zero fill> (NOAA)".
  - Defined bits 0 and 1, which were previously undefined (zero fill), of "Scan Line Quality Flags [Earth Location Problem Code]" field (byte offset 32):
    - ○ bit 1: "not earth located because of satellite in-plane maneuver (Metop) or <zero fill> (NOAA)"
    - ○ bit 0: "not earth located because of satellite out-of-plane maneuver (Metop) or <zero fill> (NOAA)"



# NOAA-N/N' Changes Continue

- New Telemetry File
  - File will contain telemetry that is not contained in instrument 1b
    - Will be useful for MIU data when in Non-nominal modes
    - All telemetry data will now be archived
  - May be similar to AIP 1a file
    - May also contain science data



# 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)

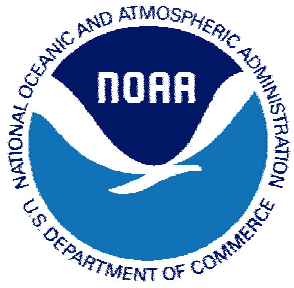


# IJPS, IPS

## Overview of Upgrades for Metop (Continue)



- New Preprocessor
  - IBM RS/6000 (development) and P655 (operations) AIX platform for parallel processing
  - 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)



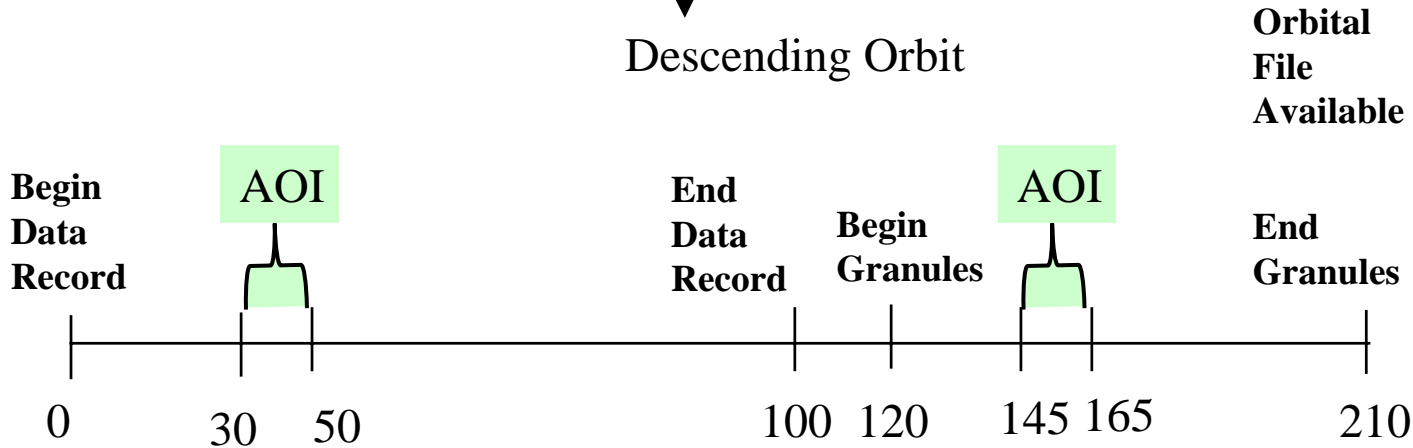
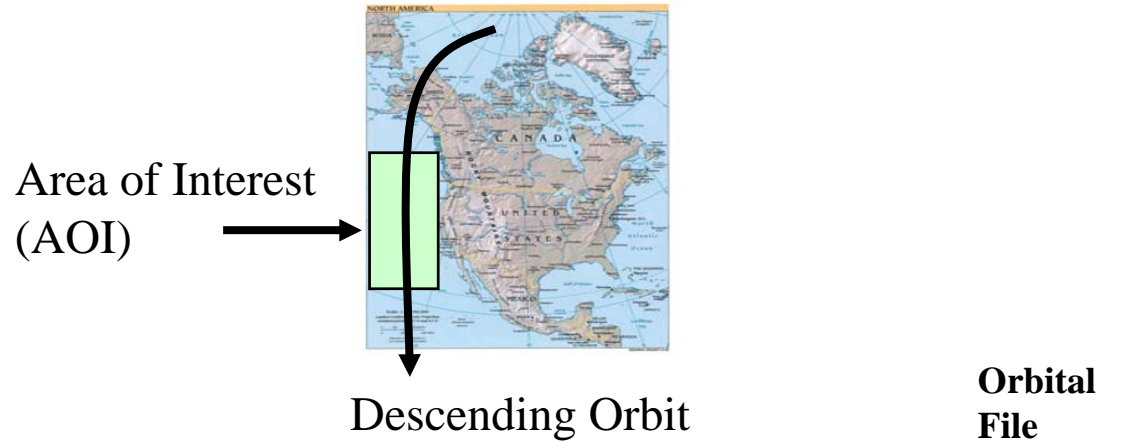
# IJPS, IPS Products Overview



- 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



# Pipeline Processing: Descending Pass Example



AOI product generation begins ~45 minutes sooner in pipeline vs orbital processing





# 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**
- **Pipeline concept: End to end test with preprocessor (initial test Sept/Oct 2004)**



# Soundings System Upcoming Changes and Activities

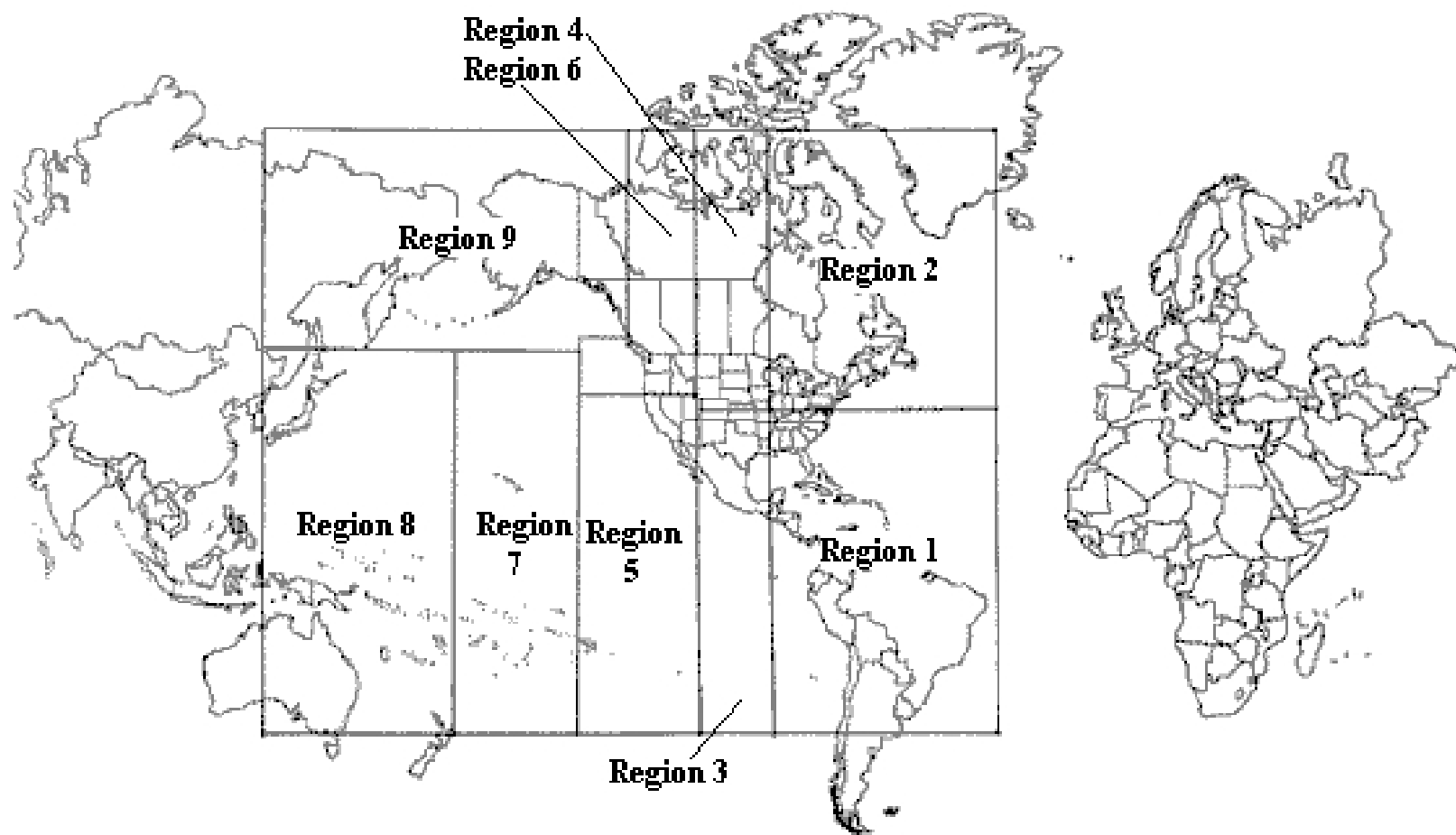


## AWIPS

- U.S. only system (current distribution)
- NOAA-16 ---- NOAA-17 will be added soon
- Nine regions (shown on the next slide)
- Retrievals parsed by region
- Used by U.S. Forecast Offices on AWIPS-dedicated machines

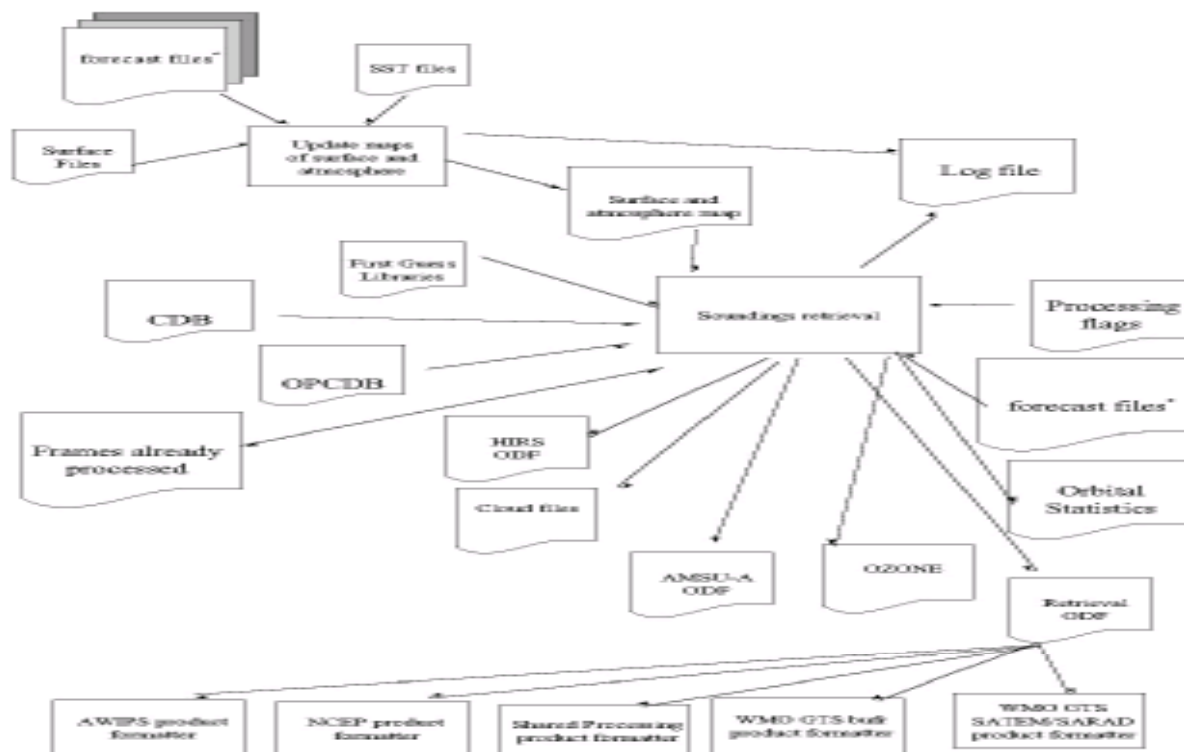


# AWIPS Regions





# ATOVS Orbital Data Flow



\*forecast potential temperature and surface pressure from the NCEP aviation model are used. Model output from differing times are used to update the atmospheric map and to make the atmospheric retrieval.



# ATOVS Porting



## Porting ATOVS from Cray to IBM SP

- Old Cray (J90)

- New IBM SP P655 (4 nodes)

  - 2 nodes (called East and West) for parallel, pre-production testing

  - 2 nodes (called North and South) for production

  - ATOVS from all 3 polar orbiters (N15, 16, and 17)

  - Reduces orbital processing time by 17 minutes ( From 20 minutes to 3 minutes)



# ATOVS System-2004



- 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-2004

## 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

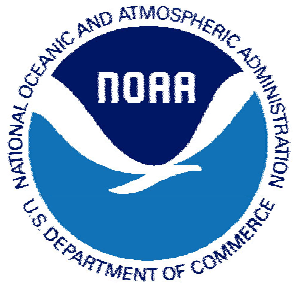


# ATOVS System-2004 Milestones



- **Parallel baseline on SP ...** *early October (03)*
- **Parallel Sys-2004 (version 1) ...** *November (03)*
  - current AMSU-B
  - regression guess
  - calc guess rad
  - old retrieval (phase-1)
- **Parallel Sys-2004 (version 2) ...** *January (04)*
  - revised AMSU-B
  - bias adjustment
  - retrieval with new OPTRAN (phase-2)
- **Peripheral Science ... limb adjustment ...** *January-Feb (04)*
- **Test and Evaluation (w/new validation) ...** *Jan-March (04)*
- **Operational Implementation ...** *June 04*





# Open Issues



User receipt of IJPS products

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.



# CEMSCS Daily Satellite Data Volume Ingest



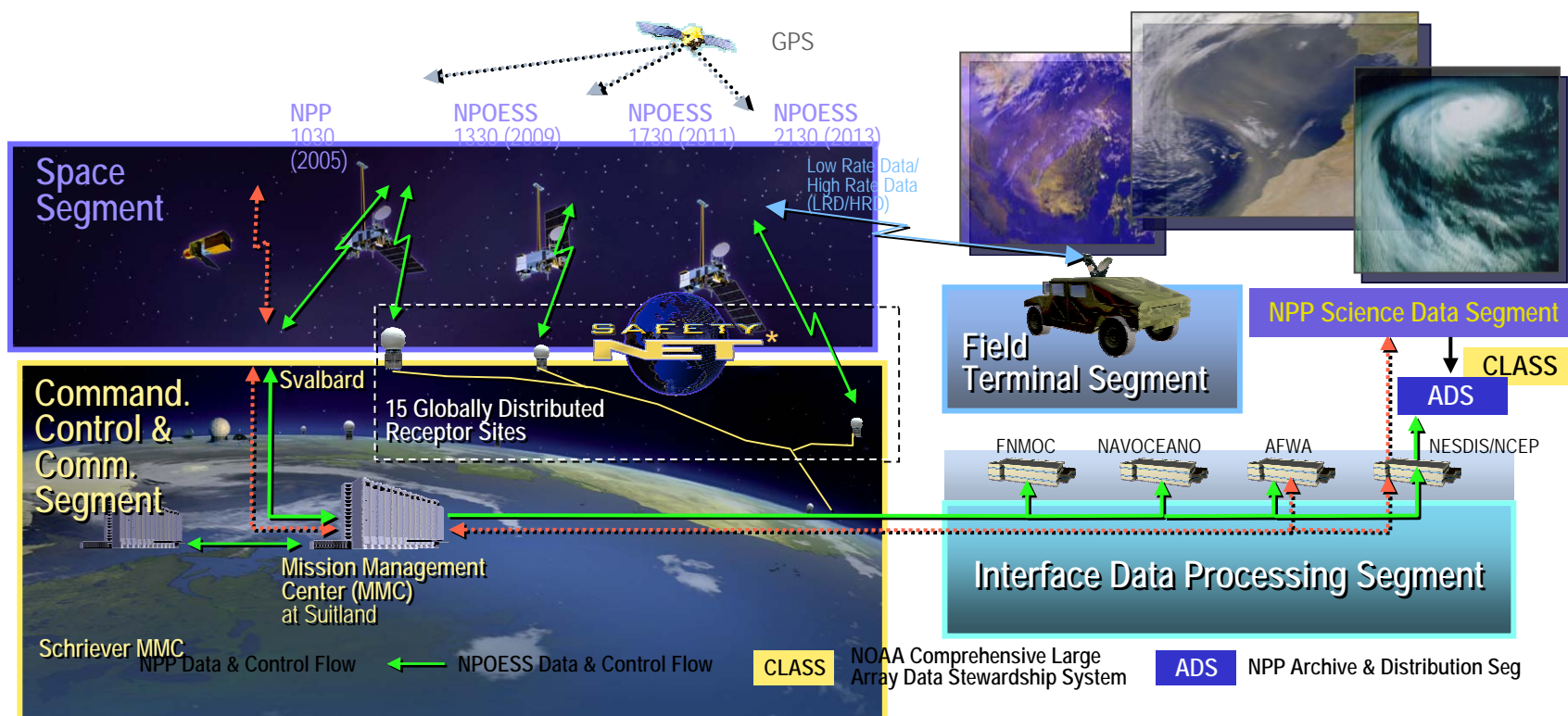
- **NOAA Polar**
  - NOAA-15, 16 & 17 6.3GB
- **GOES**
  - GOES East/West 35.0GB
- **DMSP**
  - F13, 14 & 15 1.7GB
- **Non-NOAA Satellites**
  - METEOSAT 5 (INDOEX) .4GB
  - TRMM 1.3GB
  - MODIS 175.0GB
  - AIRS .6GB
  - ERS 2 .2GB
  - QuikSCAT .4GB
  - GMS .1GB
  - METEOSAT 7 .8GB
  - RadarSat 5.0GB
  - Seawifs (not included in total, must be ordered)

**232.2 GB**



# NPOESS Mission

- Provide a national, operational, polar-orbiting remote sensing capability



A Tri-agency Effort to Leverage and Combine Environmental Satellite Activities

\* Patent Pending



# OSDPD Product Access



**<http://www.osdpd.noaa.gov/IPD/IPD.html>**

**<http://satprod.osd.noaa.gov:8081/satprod/controlcenter.cfm>**

**<http://www.osdpd.noaa.gov/>**

**<http://www.oso.noaa.gov/>**

**<http://www.osd.noaa.gov/>**

**<http://www.saa.noaa.gov>**

**<http://www.ipo.noaa.gov/>**