NOAA Report

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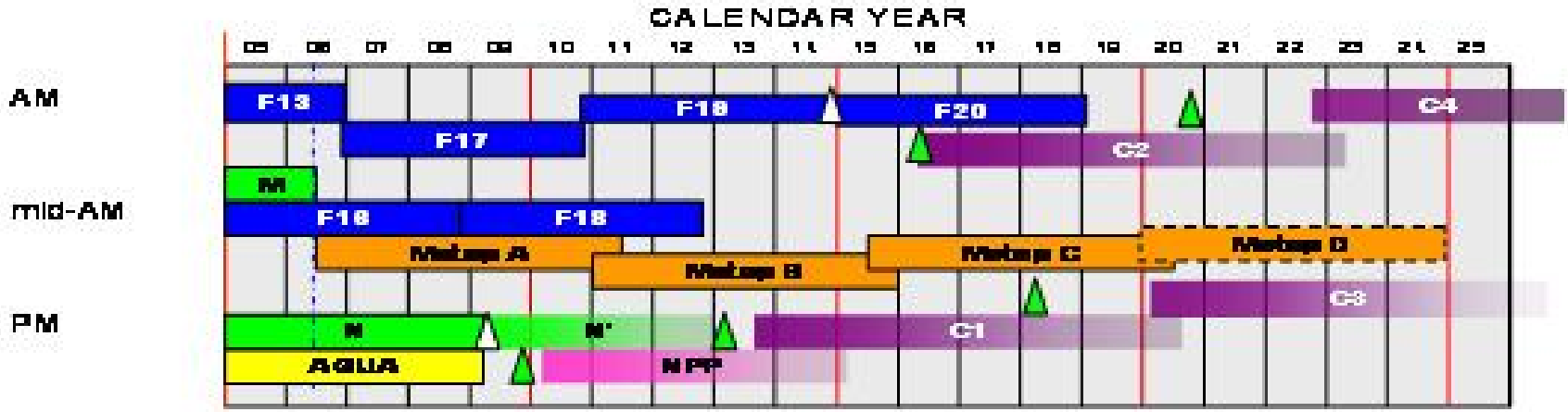
NOAA/NESDIS
Center for Satellite Applications and Research

NOAA JOINT POLAR SATELLITE PROGRAM



Sensor Configuration

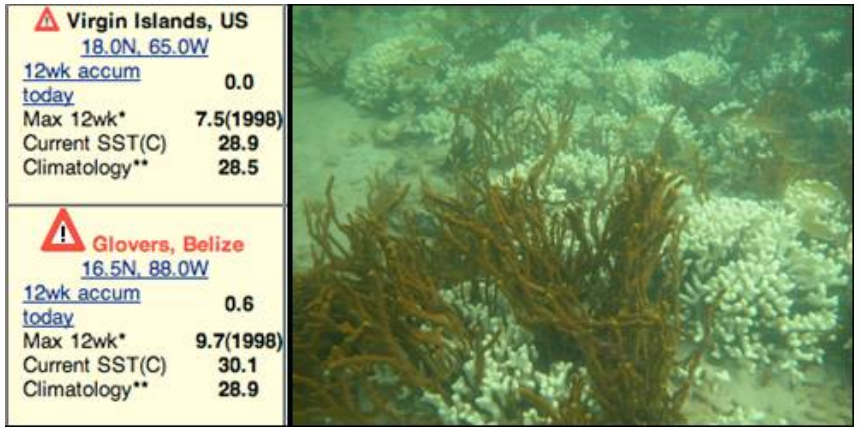
AM: Fxx – OLS, SSMI/S,
Cxx - VIIRS, Microwave Image/Sounder, SARSAT

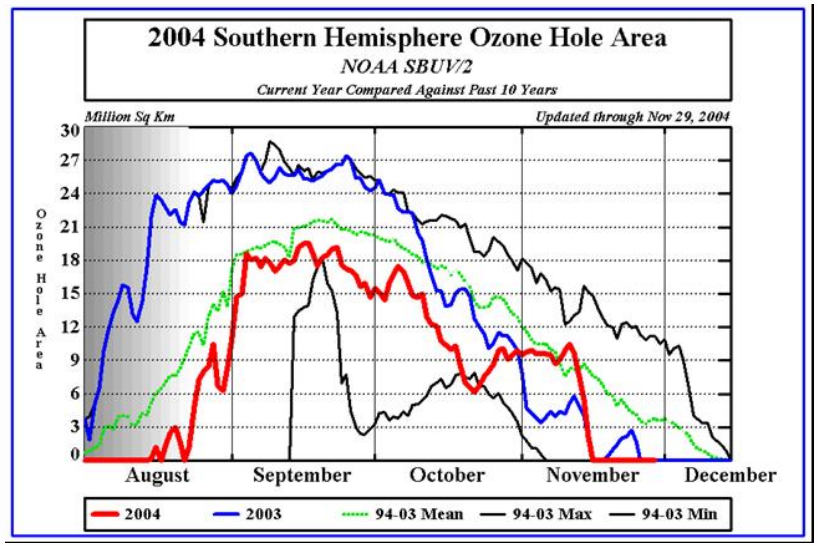
PM: Nxx – AVHRR, HIRS, AMSU
Aqua – MODIS, AIRS, AMSU, MHS
NPP – VIIRS, CrIS, ATMS, OMPS-Nadir
Cxx - VIIRS, Microwave Imager/Sounder (C3), SARSAT, CrIS, ATMS, ADCS, CERES (C1), OMPS-Nadir, SEM, ACDS

Mid-AM: Fxx – OLS, SSMI/S
Metop - AVHRR, HIRS, IASI, AMSU, MHS, GRAS, ASCAT, GOME

Mission Support to NOAA Programs

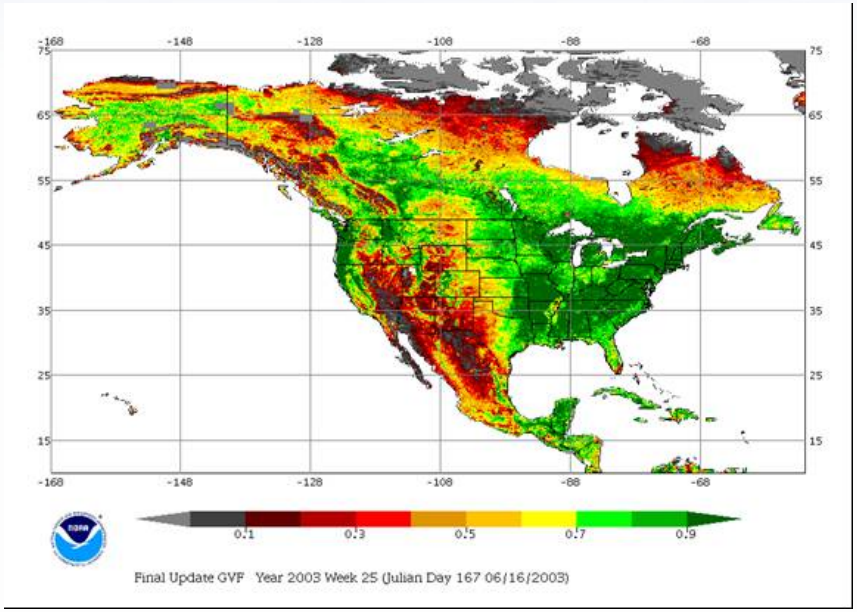
- **Ecosystems**
  - **NOAA CoastWatch Program**
    - **Real-time distribution of regional SST, Ocean Color and Ocean Winds**
  - **Coral Reef Watch Program**
- **Climate**
  - **Integrated Climate Data Record Program**
    - **Improved calibrated radiances**
    - **Time Series of Ozone , Vegetation Condition (Drought), Hydrology, Temperature, Moisture, Radiation Budget, Clouds, Aerosols, and Carbon**
  - **Reanalysis Project**
    - **Data assimilation algorithms**
    - **Radiative transfer models**

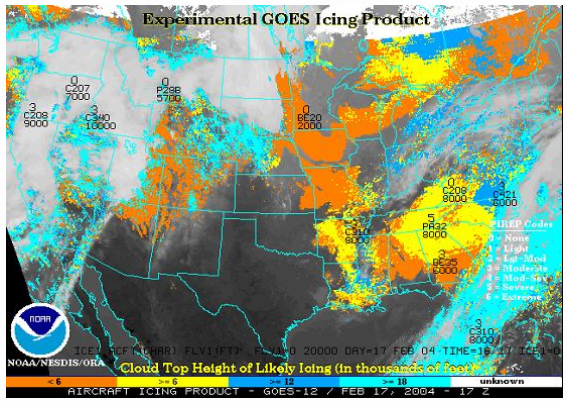


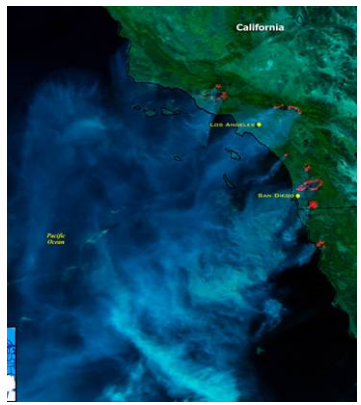


Mission Support to NOAA Programs

- **Weather and Water**
  - **Joint Center for Satellite Data Assimilation**
    - **Radiative transfer models**
    - **Surface emissivity models**
    - **Improve utilization of hyperspectral infrared radiances and microwave radiances**
    - **Satellite Derived Winds**
    - **Surface conditions**
  - **Hazards**
    - **Air Quality**
    - **Forest Fires/Biomass Burning**
- **Commerce and Transportation**
  - **Aviation Weather Satellite Applications**
    - **Clear-sky turbulence**
    - **Convective cloud conditions**
    - **Icing**
    - **Volcanic Ash**







Key Activities

- **NPOESS**
- **Processing systems for MeTOP and NPOESS Data Exploitation**
- **GOES-R Algorithm and Cal/Val Effort**
- **Integrated Cal/Val Enterprise Systems**
  - **Includes both radiance and products**
- **WMO Global Space-based Calibration System (GSICS)**
- **JCSDA**
- **Climate Data Records**
- **Air Quality**

METOP and NDE

- **Use integrated approach in algorithm development and validation**
  - **Same algorithms to process AIRS, IASI, and CrIS**
  - **Same algorithms to process AMSU, SSMI, SSMIS, ATMS**
- **Completed processing system for IASI radiance distribution**
- **Developing IASI level 2 processing – includes trace gases**
- **Begin to develop CrIS and ATMS processing systems**

CrIS/ATMS Product System
IT System Architecture

NCEP forecasts radiosonde

IDPS

SDRs

Operational

Backup

P5+ Node

P5+ Node

Distribution

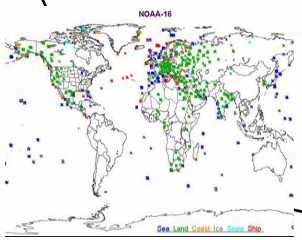
Radiance Products*

T(P), Q(P), O3(P)

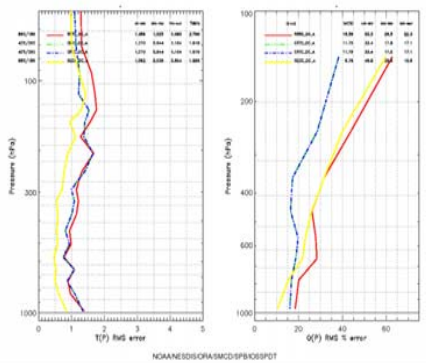
CO2, CH4, CO

User System(s)
NCEP, FNMOC, AF, UkMO,ECMWF…

CLASS



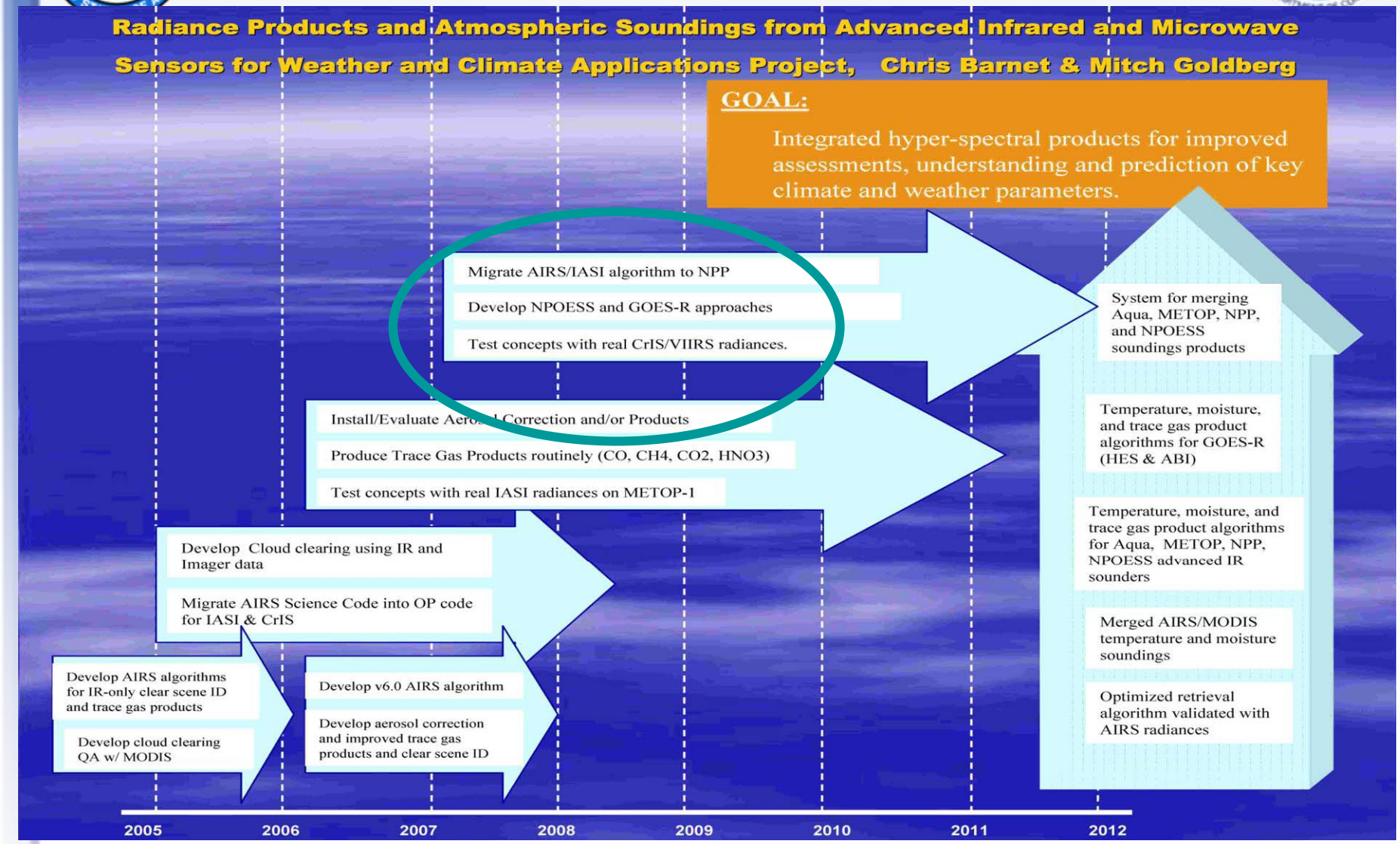
Validation



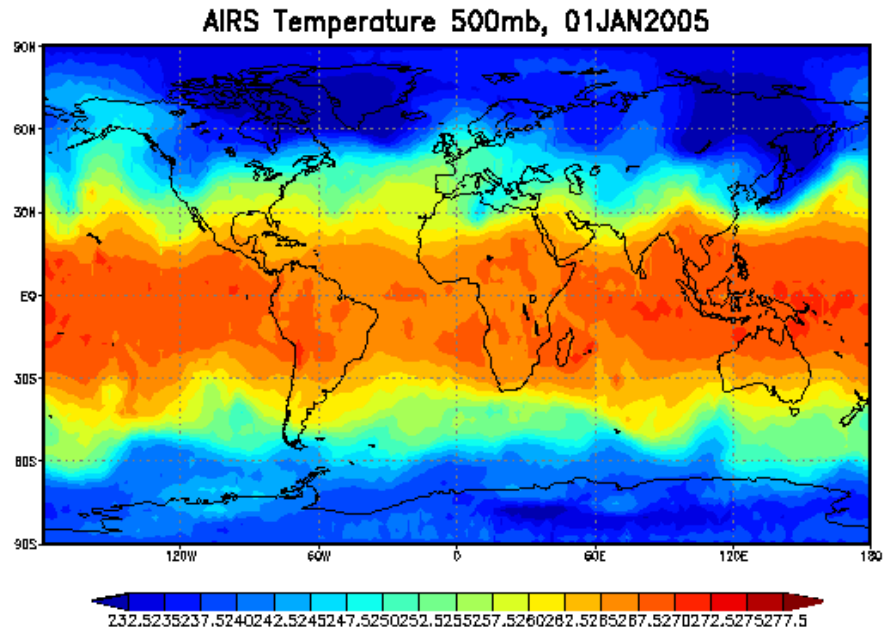
Radiance Products*

Cloud Cleared Radiances using clear VIIRS radiances and ATMS Principal Component Scores for noise filtering

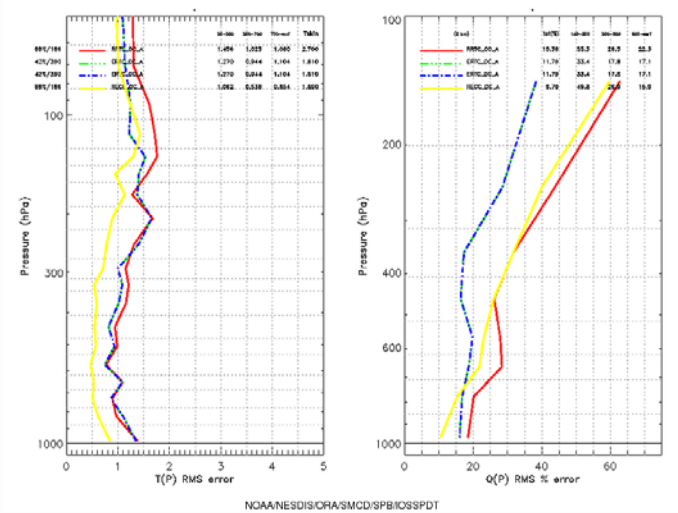
CrIS/ATMS/VIIRS Product System is part of the NESDIS Advanced Product Roadmap

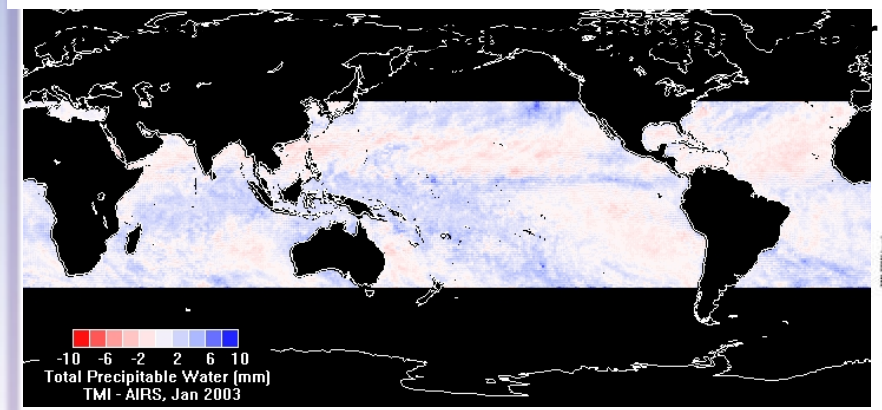


Temperature & Moisture Products

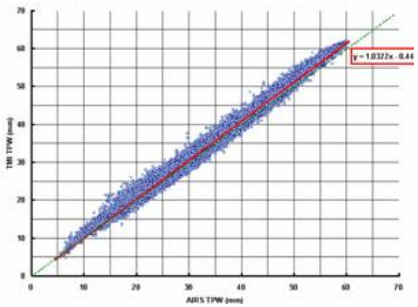


AIRS Regression (red), AIRS Physical (blue), ECMWF (yellow) vs. radiosonde





AIRS vs TMI



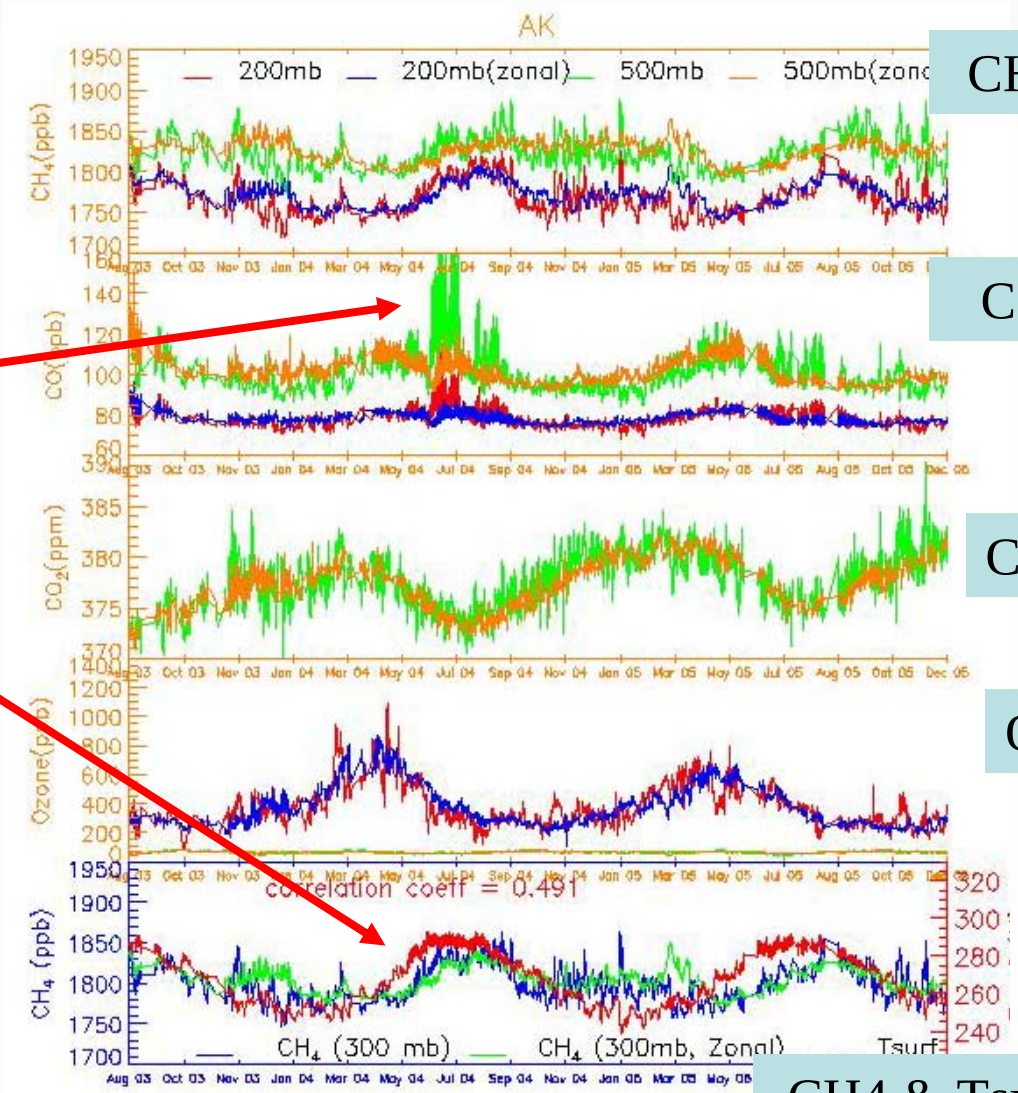
AIRS Performance

1K per 1 Km layers

< 20% per 2 km layers

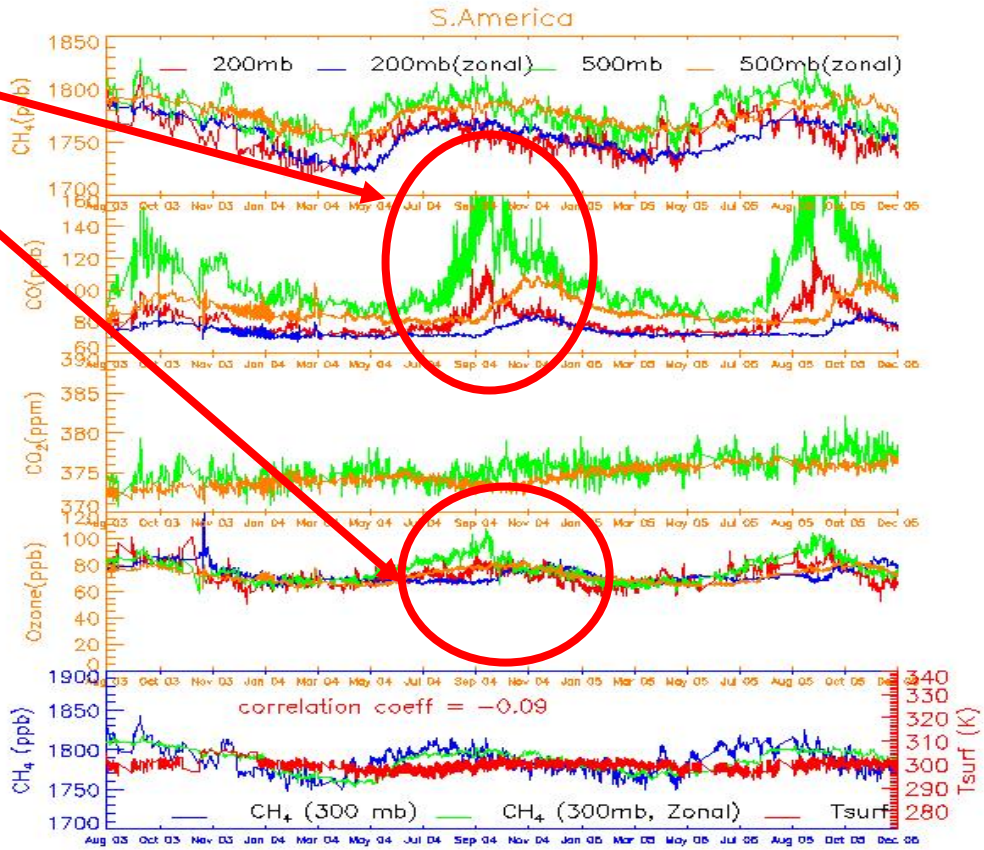
AIRS measures multiple gases (and temperature, moisture and cloud products) simultaneously

- 29 month time-series of AIRS trace gas products: Alaska & Canada Zone ($60 \leq lat \leq 70$ & $-165 \leq lon \leq -90$)
- July 2004 Alaskan fires are evident in CO signal (panel 2)
- Seasonal methane may be correlated to surface temperature (wetlands emission?)
- We have begun to investigate correlations that should exist between species (e.g., O_3, CO, CH_4 interaction)



29 month time-series of AIRS products
South America Zone (-25 ≤ lat ≤ EQ , -70 ≤ lon ≤ -40)

Biomass burning



Microwave Integrated Retrieval System

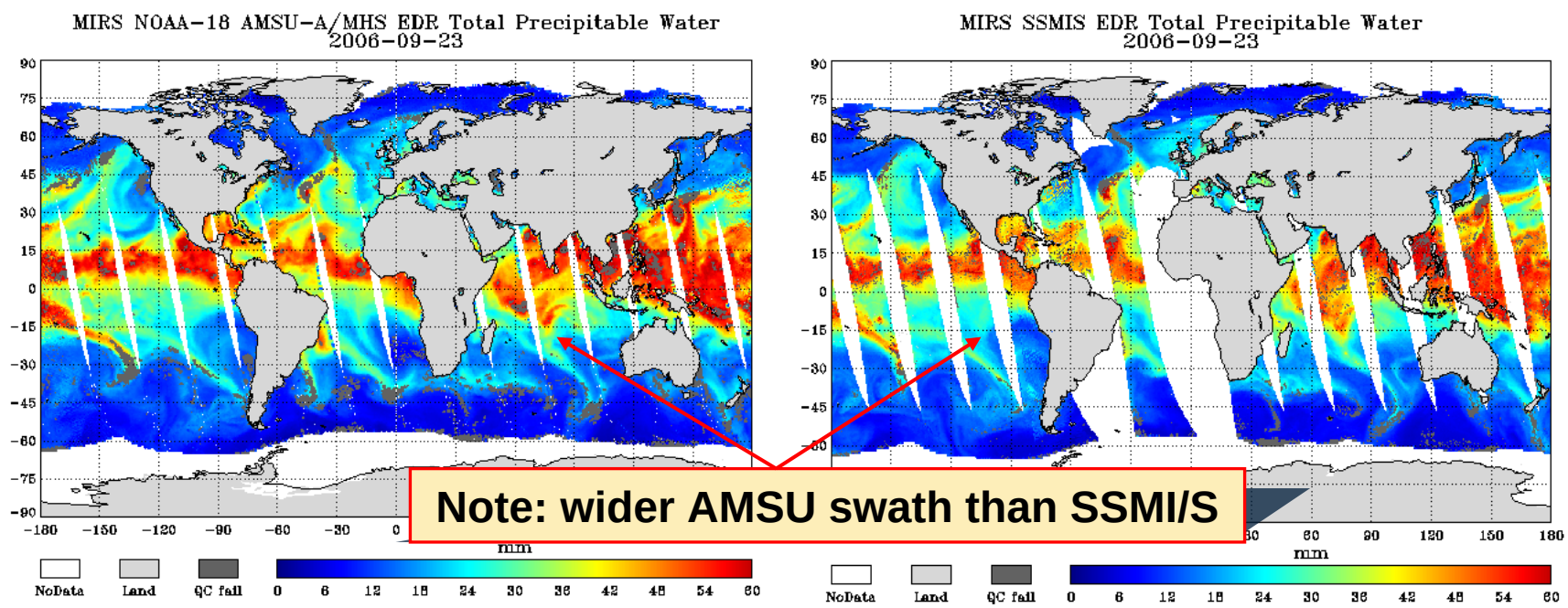
MIRS Capability

SDR/EDR	POES/METOP AMSU-A/B; MHS	DMSP SSMIS	NPOESS ATMS
Radiances	✓	✓	✓
Temp. profile	✓	✓	✓
Moist. profile	✓	✓	✓
Total precipitable water*	✓	✓	✓
Hydr. profile	✓	✓	✓
Precip rate*	✓	✓	✓
Snow cover*	✓	✓	✓
Snow water equivalent*	✓	✓	✓
Sea ice *	✓	✓	✓
Cloud water*	✓	✓	✓
Ice water*	✓	✓	✓
Land temp*	✓	✓	✓
Land emis*	✓	✓	✓
Soil moisture			✓

* - Currently produced through MSPPS

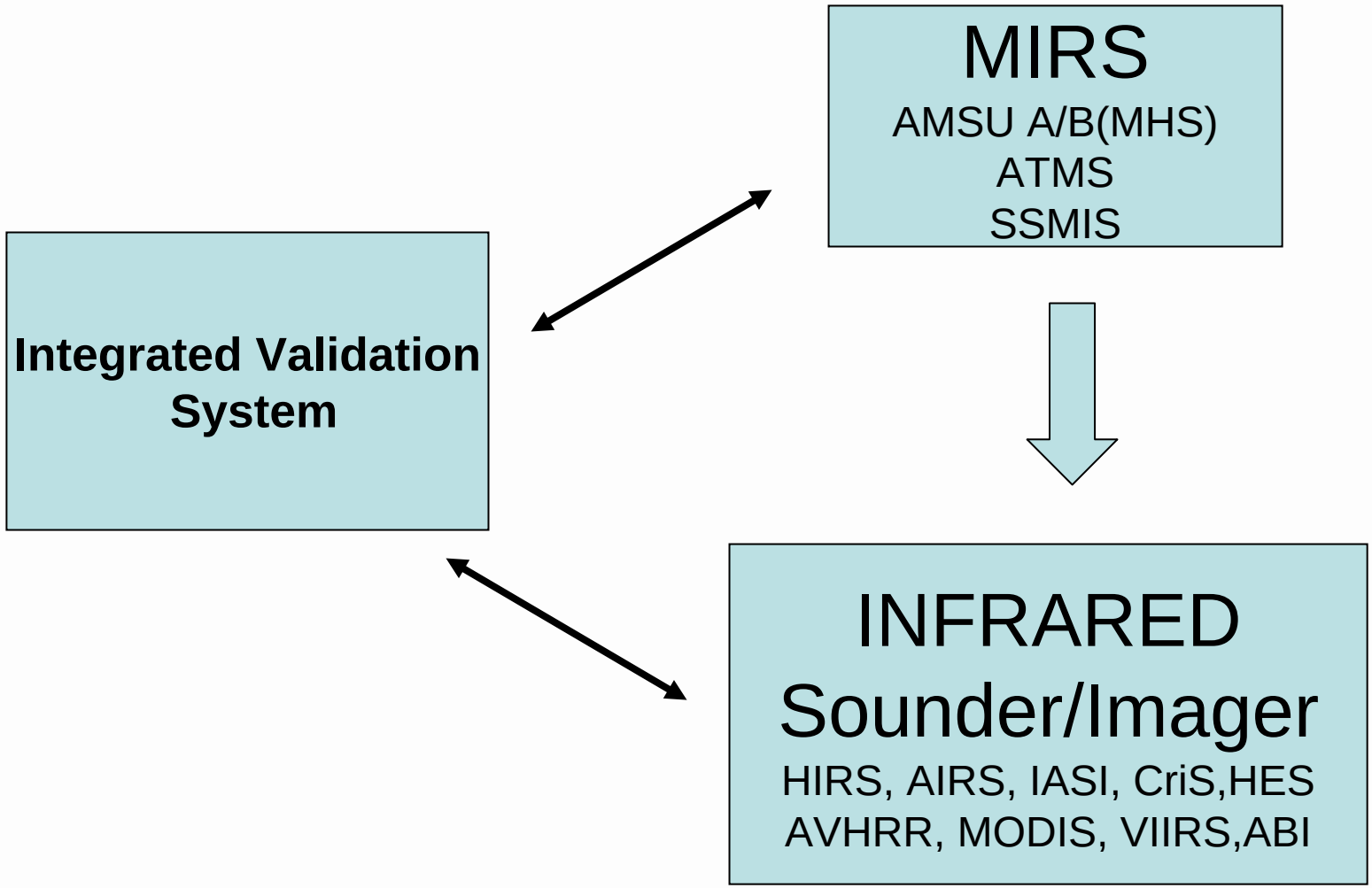
** - Ocean surface parameters are intermediate products and not produced operationally through MIRS

- Cross-Sensor Intercomparison
  - **Comparison of advanced products from AMSU/MHS and SSMI/S (TPW images below)**



Our Vision: Sounding Products System

MIRS to provide front-end retrievals for the robust first guess to infrared sounding system (HIRS, hyperspectral)



NPOESS vs. GOES-R Process

- **NPOESS acquisition strategy is for the System Prime to be responsible for algorithm development, calibration/validation, and the development of the operational product generation system.**

- **For GOES-R, the process was changed whereby the Government provides recommended and demonstrated algorithms, cal/val and a notional design for operations to the System Prime. The System Prime can provide alternatives, however these alternatives must be approved by the Government. If approval is not granted, the System Prime must use the Government's recommended solution.**

- **STAR leads GOES-R Algorithm Working Group**

JCSDA FY07 PRIORITIES

- **Initial impact assessments of IASI**
- **Optimize the use of Windsat, COSMIC, GRAS and AIRS observations for further risk reduction for using upcoming operational sensors.**
- **Prepare for new observational systems.**
  - **Earth Explorer Atmospheric Dynamics Mission (ADM-Aeolus)**
  - **GOES-R**
- **Continue to develop and improve all-weather CRTM**
- **Improve surface emissivity retrievals**
- **Expand four-dimensional data assimilation capability to better use observations taken at non-synoptic times.**

GSI will replace SSI in early 2007

- **GSI analysis system**
  - **Grid point definition of background errors**
  - **Improved balance constraints**
  - **Complete rewrite of code**
  - **Inclusion of new observational data sets**
- **Hybrid sigma-p forecast model**
  - **Little change in forecast skill**

Table 1: Satellites/Instruments Transitioned into Operations in 2005-2006

Satellite/Instrument	Analysis	Comments
EOS/AIRS radiances υ.1	**SSI (GSI)**	**υ.2 in GSI will use all footprints etc.**
AQUA/AMSU-A	**SSI (GSI)**	**Transitioned**
AQUA MODIS AMVs υ.1	**SSI (GSI)**	**Transitioned.**
TERRA/MODIS AMVs .υ.1	**SSI (GSI)**	**Transitioned**
NOAA/18 AMSU-A	**SSI (GSI)**	**Transitioned**
NOAA/18 HIRS/4	**----------**	**Instrument not fully operational**
NOAA/18 MHS	**(GSI)**	**Transitioned for next operational analysis (GSI)**
NOAA18/AVHRR	**SST**	**Oper. SST produced at EMC**
NOAA17/AVHRR	**SST**	**Oper. SST produced at EMC**
JASON/ALTIMETER	**GODAS**	**Transitioned (July 2006)**

Table 2. Some Satellite Instruments in the Process of Being Transitioned into Operations

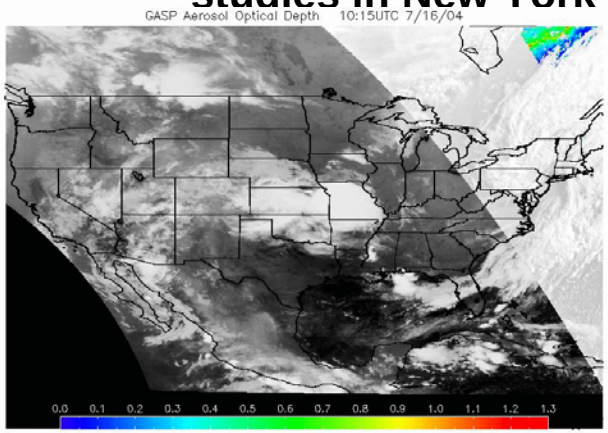
Satellite/Instrument	Analysis	Comments
COSMIC Jan/Feb	**GSI**	**Currently RT cycling in GSI**
CHAMP	**GSI**	**NRT tests completed, cycling currently**
WINDSAT	**SSI, GSI**	**Initial trial with NRL EDRs successfully completed. RT trial underway**
SSMIS	**GSI**	**Cycling with UKMO corrections.Impact +ve**
MODIS υ.2 (EE)	**GSI**	**EE implemented for intelligent thinning of AMVs**
AIRS υ.2 (every fov -251 channels used) Jan/Feb	**SSI/GSI**	**SSI Assim. Testing complete, GSI testing current.**
AURA OMI	**GSI**	**Total ozone successfully assimilated, still testing**
AMSR (E)	**GSI**	**Currently cycling in GSI, impacts positive.**

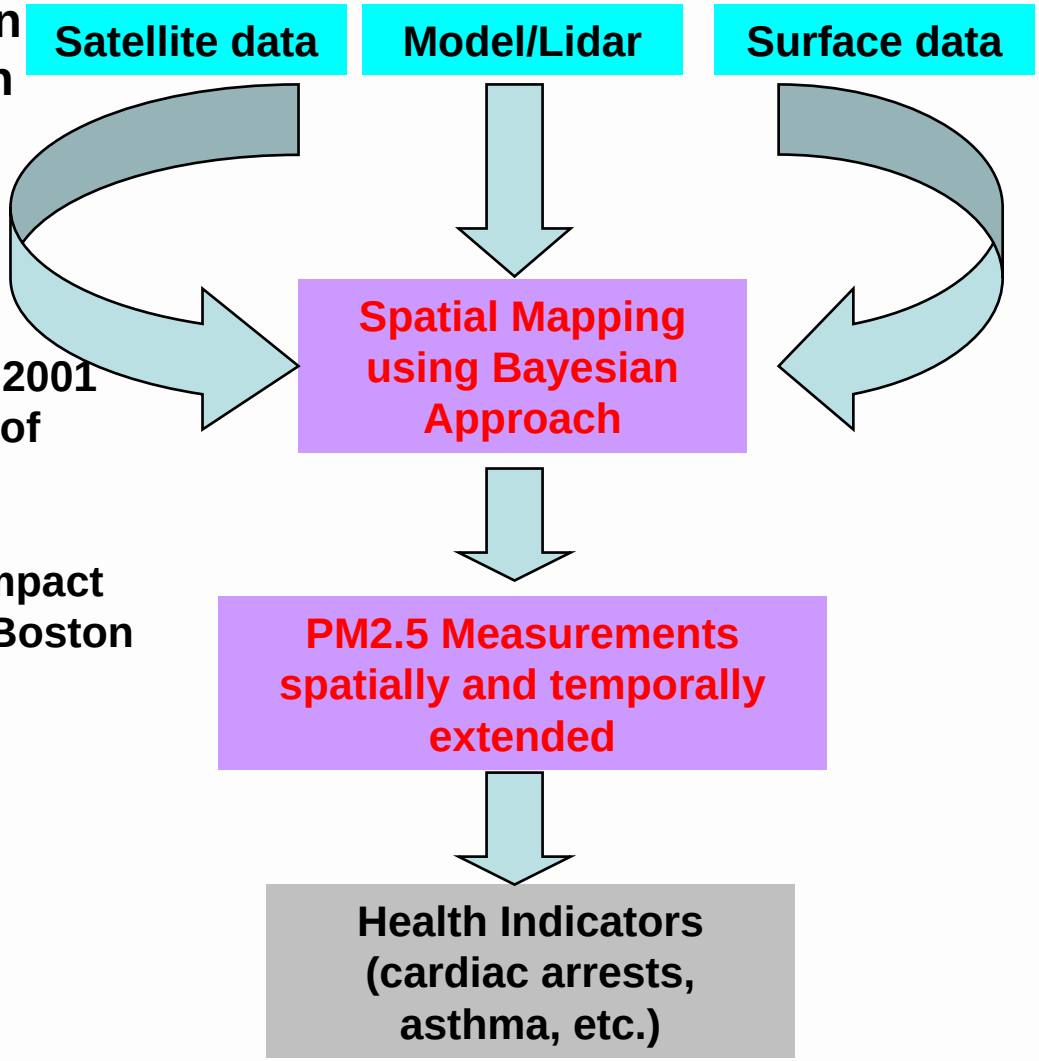
New observational data sets (planned)

- **Met-8 Winds**
- **GPS IPW**
- **GOES 1x1 replaces GOES 5x5**
  - **Unique RTA for each detector**

Three Dimensional Air Quality Mapping System

- **Understand the mechanisms behind AOD/PM2.5 correlations**
- **Fill temporal and spatial gaps to study the linkages between poor air quality and human health**
  - **GEOSS effort led by EPA**
  - **NESDIS an active co-investigator**
  - **Initial study will focus on 2001 data. In future, ten years of GOES AOD data will be integrated with ground observations for health impact studies in New York and Boston**





Near Real Time Air Quality Products from MeTOP GOME-2 at NOAA/NESDIS

- **Algorithm development to begin in 2006**
- **OMI DOAS algorithms will be employed, tested, and implemented**
- **Products will be made available in NRT in 2008**
- **Products will be available at 40 X 40 km^2 spatial resolution**

Product	User	Application
NO2	**EPA** **NWS**	**• Assessments** **•Constrain NOx emissions in air quality forecast model** **•Verification of precursor forecast fields**
H2CO	**EPA** **NWS**	**• Assessments** **•Constrain isoprene emissions in air quality forecast model** **•Verification of precursor forecast fields**
Ozone	**NWS**	**• Ozone forecast improvements**
Aerosol optical Depth (absorption vs scattering)	**EPA** **NWS** **NESDIS**	**• PM2.5 Monitoring** **•PM2.5 and ozone forecast improvements** **•Hazard Mapping System**
Volcanic SO2	**NESDIS**	**• Hazard Mapping System**

NPP Capable EDRS

(green – alternative sensor from NPP)

	1	2
1	EDR	Sensor
2	Atmospheric Vertical Moisture Profiles	CrIMSS , ATMS
3	Atmospheric Vertical Temperature Profiles	CrIMSS , ATMS
4	Sea Surface Temperature	VIIRS
5	Aerosol Optical Thickness	VIIRS
6	Aerosol Particle Size	VIIRS
7	Aerosol Refractive Index	VIIRS
8	Albedo (Surface)	VIIRS
9	Cloud Base Height	VIIRS, CMIS
10	Cloud Cover/Layers	VIIRS
11	Cloud Effective Particle Size	VIIRS
12	Cloud Ice Water Path	CMIS ATMS
13	Cloud Liquid Water	CMIS ATMS
14	Cloud Optical Thickness	VIIRS
15	Cloud Top Height	VIIRS
16	Cloud Top Pressure	VIIRS
17	Cloud Top Temperature	VIIRS
18	Down LW Radiance (sfc)	ERBS , CrIS
19	Down SW Radiance (sfc)	ERBS , CriS
20	Ice Surface Temperature	VIIRS
21	Land Surface Temperature	VIIRS
22	Ocean Color	VIIRS
23	Outgoing LW (TOA)	ERBS , CrIS
24	Ozone total column profile	OMPS, CrIS
25	Precipitable Water	VIIRS , CMIS CrIMSS, ATMS
26	Precipitation Type/Rate	CMIS, ATMS
27	Pressure (surface/profile)	CrIMSS , ATMS
28	Sea Ice Characterization	CMIS, ATMS
29	Snow Cover/Depth	CMIS, ATMS
30	Surface Type	VIIRS, CMIS, CrIS ATMS
31	Active Fires	VIIRS
32	Suspended Matter	VIIRS
33	Total Water Content	CMIS, ATMS, CrIS
34	Vegetation Index	VIIRS