GOES-R Program Status

2008 GOES Users' Conference

American Meteorology Society

New Orleans, Louisiana

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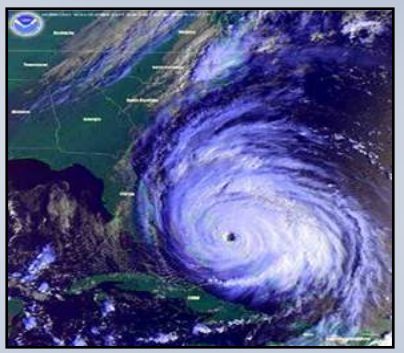
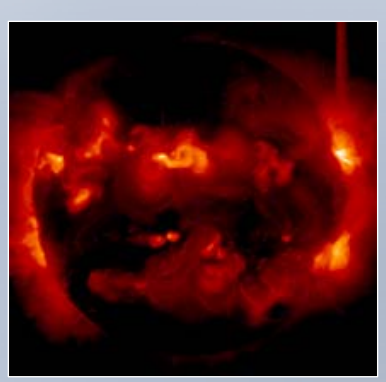
National Oceanic and Atmospheric Administration
NOAA Satellite and Information Service

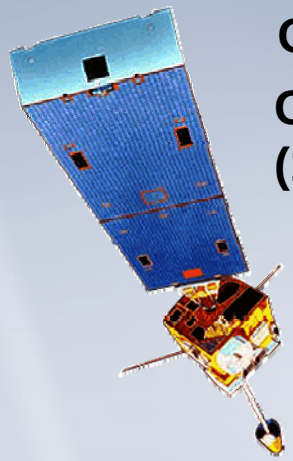
GOES Satellite Mission

- **Weather sentinel**
  - Hurricanes
  - Severe storms
  - Flash floods
- **Input to weather models, forecasts and warnings**
- **Fire and smoke products for air quality monitoring and forecasting and fire fighting**
- **Sea surface temperature monitoring for fisheries and climate**
- **Winds for aviation**
- **Solar imagery for communication satellites, utility companies, and astronaut safety**
- **Environmental data collection–buoys, rain gauges…**
- **Search and Rescue**
- **GOES data shared within the western hemisphere**



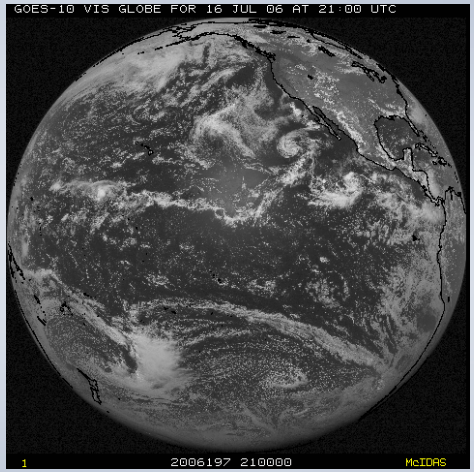


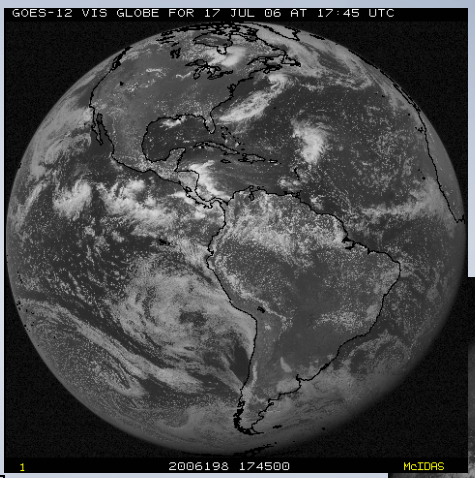
Current GOES Constellation



Operational-West

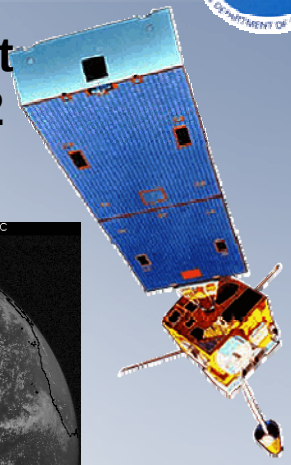
GOES-11
(135W)





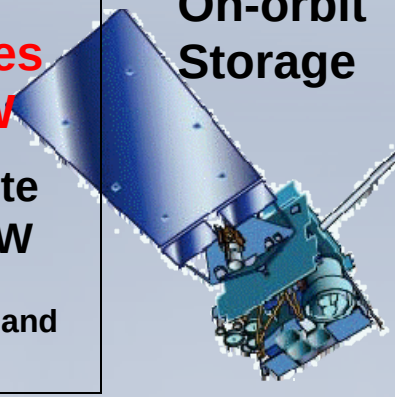
Operational-East

GOES-12
(75W)

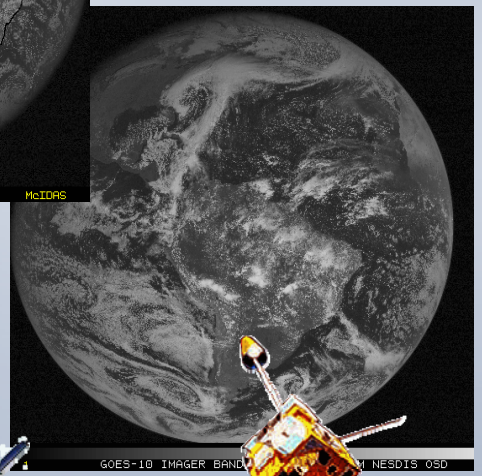


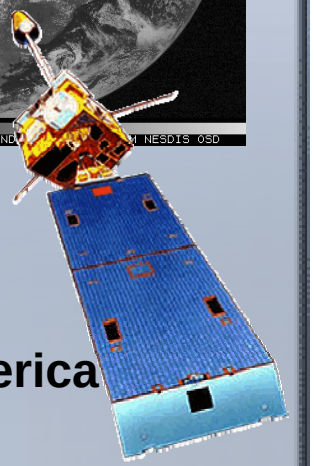
- **GOES mission requires two on-orbit operational satellites and one on-orbit spare**
- **GOES-West location in GOES-R series to be 137°W instead of current 135°W**
  - **Eliminates conflicts with other satellite systems in X-band frequency at 135°W**

*** Note: Satellites are labeled with letters on the ground and changed to numbers on-orbit**



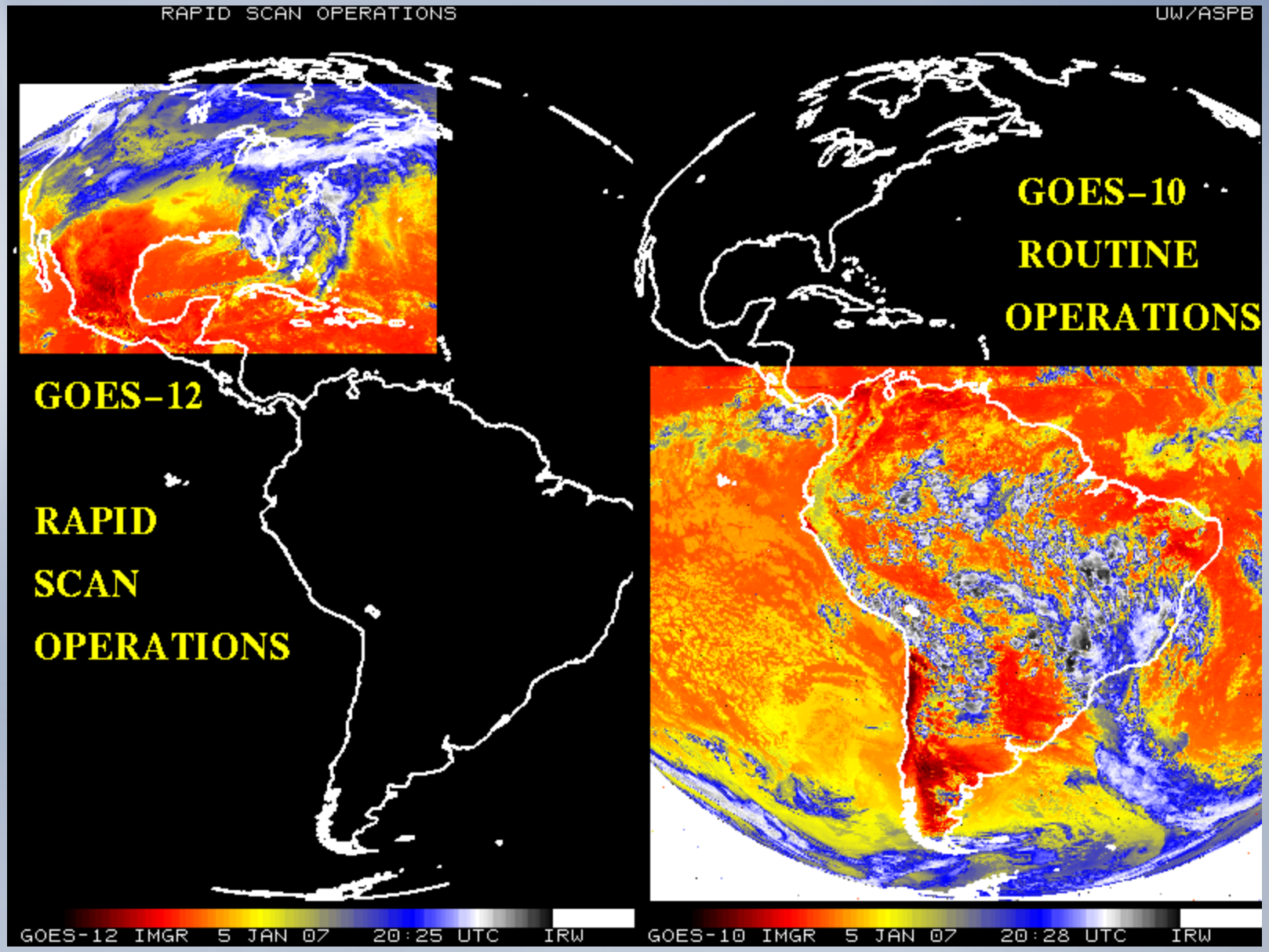
GOES-13
(105W)
On-orbit
Storage





GOES-10
(60W)
South America

GOES-12 and GOES-10



Basis For Investment

User Need	GOES-R Instruments
• **Improve hurricane track & intensity forecast** • **Improve thunderstorm & tornado warning lead time** • **Improve aviation flight route planning**	Advanced Baseline Imager (ABI) and Geostationary Lightning Mapper (GLM)
• **Improve solar flare warnings for communications and navigation**	Extreme Ultra Violet Sensor/X-Ray Sensor Irradiance Sensor (EXIS)
• **Improve power blackout forecasts due to solar flares**	Solar Ultra Violet Imager (SUVI)
• **Improve energetic particle forecasts**	Space Environmental In-Situ Suite (SEISS)

Basis For Investment

- **The annual estimated potential benefit of GOES-R beyond current system exceeds $4.6 billion**
  - "An Investigation of the Economic and Social Value of Selected NOAA Data and Products for Geostationary Operational Environmental Satellites (GOES)," Centrec Consulting Group LLC, 28 February 2007

GOES-R Program Influences

- **Lessons Learned from previous satellite acquisitions**
  - Conduct a Program Definition and Risk Reduction phase: key element for success
  - Include satellite operations and support organizations early in architecture design and development teams
  - Consider security early
  - Stringent latency requirements drive architecture and costs
  - Consider Government expertise in User Product Generation options
  - Be cognizant of pushing technology limits

- **FY08 Omnibus Budget Language**

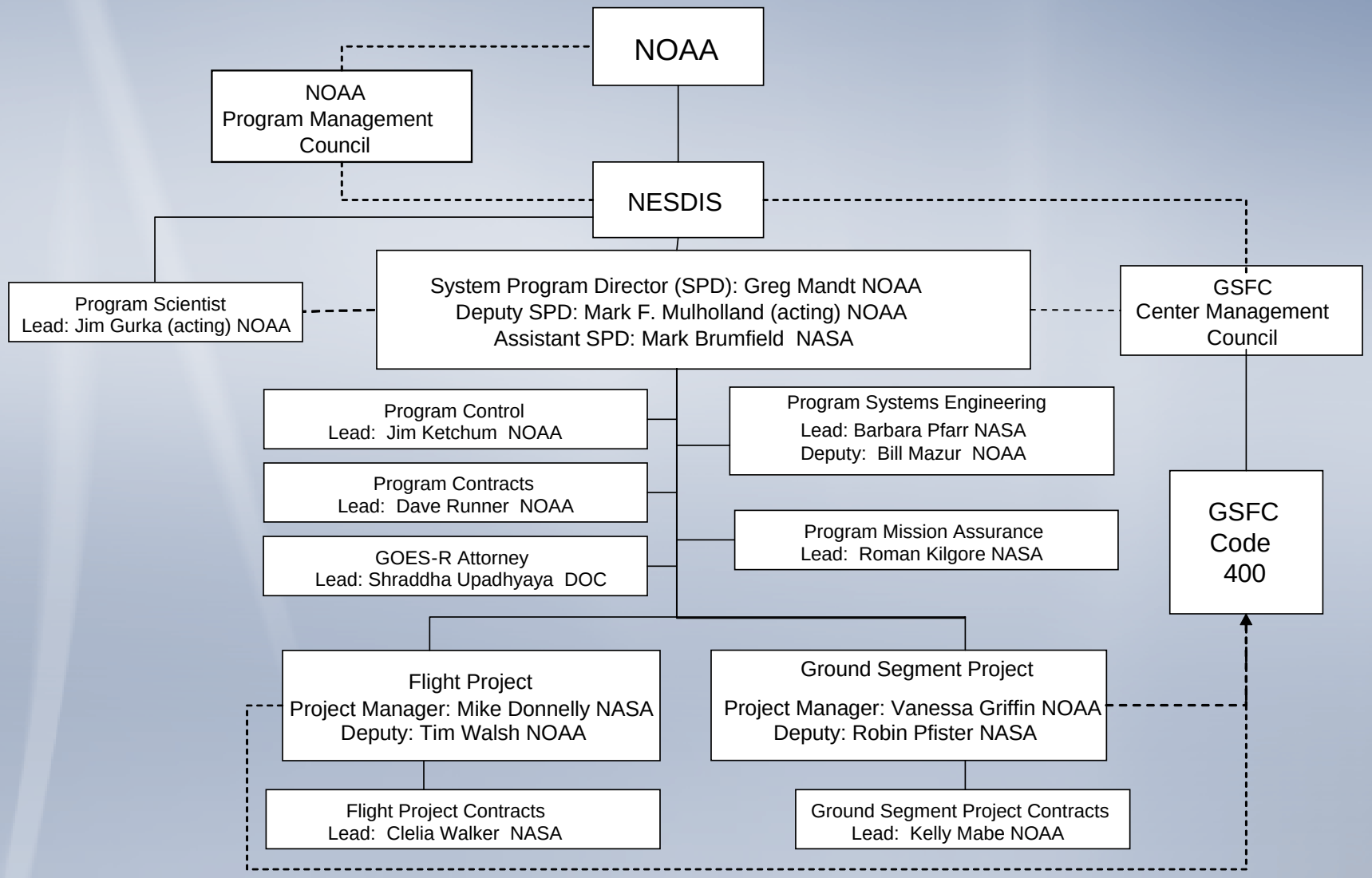
GOES-R Acquisition Background

- **Architecture Studies**
  - **12 Architecture Study contracts awarded November 2003 to evaluate end-to-end architecture approaches**
- **Program Definition and Risk Reduction (PDRR)**
  - **September 2005 – April 2007**
  - **3 firm-fixed-price contracts**
    - define an end-to-end system architecture
    - create detailed concept designs and cost estimates
    - conduct system and subsystem level trade studies to identify and mitigate program risk
    - prepare and plan for instrument transition to a space segment contractor during the A&O phase

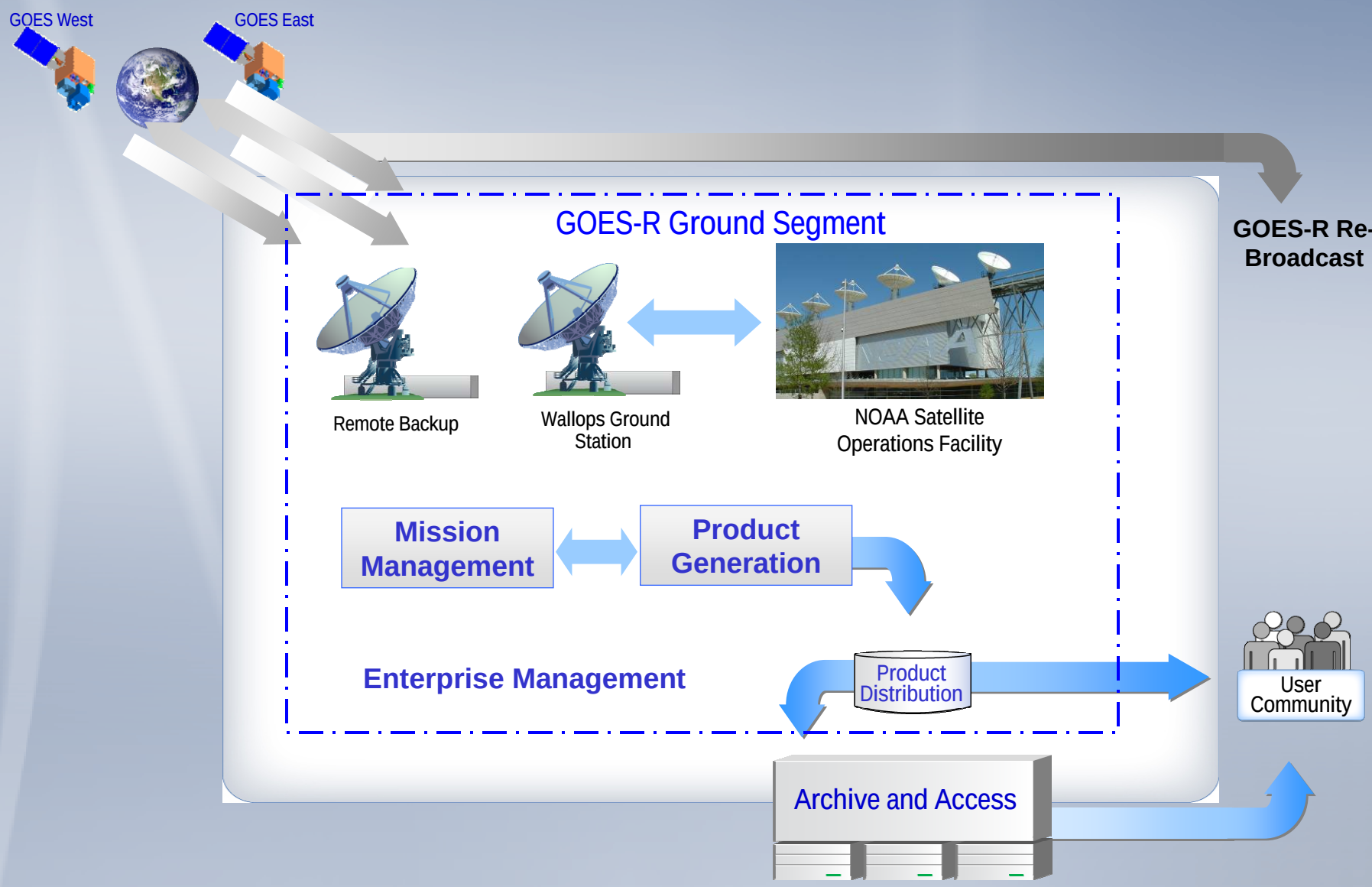
GOES-R Acquisition Background
(continued)

- **Current Strategy:**
  - Split of Flight and Ground Segments providing more of an opportunity to industry leaders
  - NOAA to retain overall program management responsibility and procure the ground segment
  - NASA to procure the space segment
  - Government to perform the System Engineering and Integration (SE&I) activities required to integrate the space and ground segments

GOES-R Organization



Notional System Overview



Current Program Status

- **Key program documents signed**
  - Level 1 Requirements Documents – June 10, 2007
  - NOAA/NASA Memorandum of Understanding - June 15, 2007

- **Spacecraft acquisition**
  - Draft Request for Proposal (RFP) released August 28, 2007
  - Responses received September 15, 2007
  - Final RFP no earlier than January 25, 2008

- **Ground acquisition**
  - RFP documents under final development
  - Draft RFP release currently planned for February 2008
  - Final RFP planned April 2008

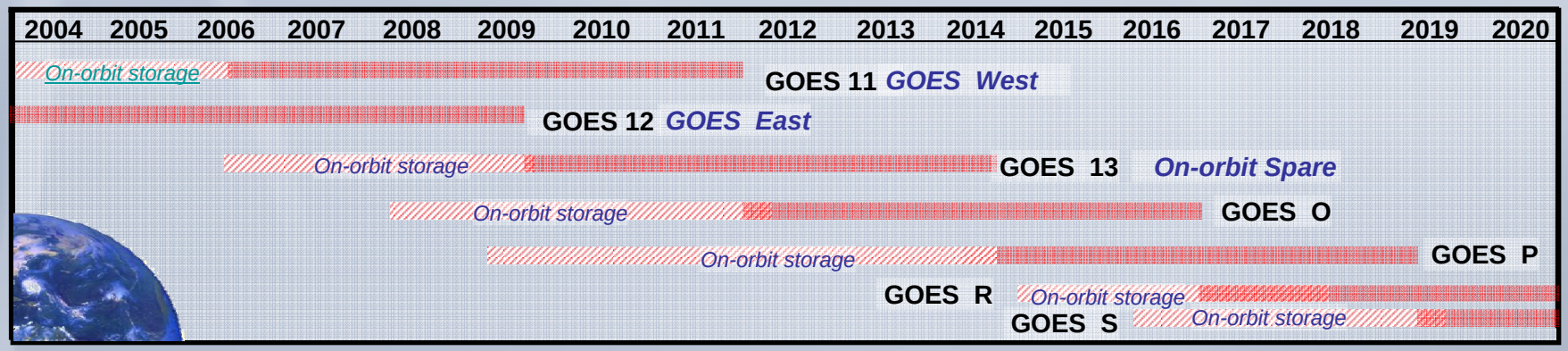
- **GOES-R Launch Readiness Date**
  - December 2014

- **Information from FedBizOps posted Dec 21, 2007, updated Jan 16, 2008 http://www.fedbizopps.gov/ and NASA/GSFC Business Opportunities page http://prod.nais.nasa.gov/cgi-bin/eps/bizops.cgi?gr=D&pin=51**
  - Spacecraft: NNG07193033J, NNG08193033R
  - Ground: DG133E-08-RP-0068

Launch Schedule

- **GOES R series is a follow-on to the existing line of NOAA's geostationary weather satellites.**
  - GOES I series [8-12]: Operational since 1994
  - GOES N series [13]: N launched May 24 2006, O planned launch late 2008, P planned launch late 2009

- **Based on an availability analysis of the current GOES I and N-series, a GOES-R launch is required in the 2014 timeframe to maintain mission data continuity**



Note: Satellites are labeled with letters on the ground and changed to numbers on-orbit

***GOES T and U are currently not baselined for GOES-R series. Flight procurement includes these as options.**

Increased Performance

Performance Capability	GOES I-M	GOES N-P	GOES R
Imaging			
Visible Resolution	1 km	1 km	0.5 km
IR Resolution	4-8 km	4-8 km N 4 km O/P	1-2 km
Full Disk Coverage Rate	30 min	30 min	5 min
# of Channels	5	5	16
Solar Monitoring	GOES-M only	Yes	Yes
Lightning Detection	No	No	Yes
Operate through Eclipse	No	Yes	Yes
Ground System Backup	Limited	Limited	Limited
Archive and Access	Limited	Limited	Yes
Raw Data Volume per spacecraft	2.6 Mbps	2.6 Mbps	75 Mbps

- GOES-R maintains continuity of the GOES mission
- GOES-R also provides significant increases in spatial, spectral, and temporal resolution of products

GOES-R Instruments

- **Advanced Baseline Imager (ABI)**
  - Implementation phase
  - Contractor: ITT Corporation

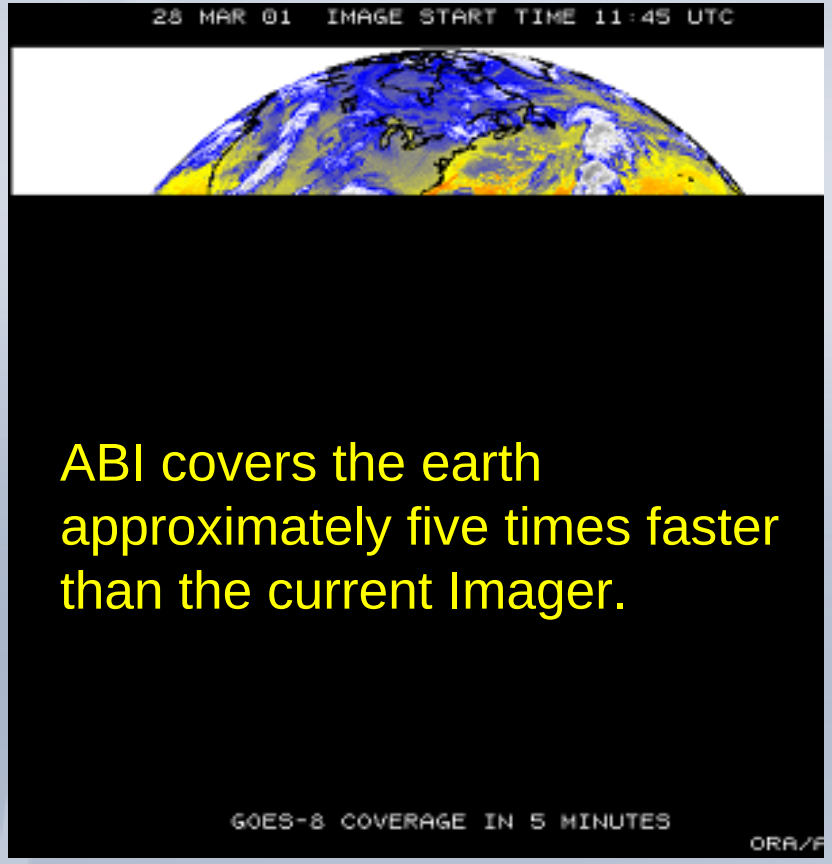
- **Space Weather**
  - **Space Environmental In-Situ Suite (SEISS)**
    - Implementation phase
    - Contractor: Assurance Technology Corporation (ATC)
  - **Solar Ultra Violet Imager (SUVI)**
    - Implementation phase
    - Contractor: Lockheed Martin Advanced Technology Center
  - **Extreme Ultra Violet/X-Ray Irradiance Sensor (EXIS)**
    - Implementation phase
    - Contractor: Laboratory for Atmospheric and Space Physics (LASP)
  - **Magnetometer**
    - Procured as part of spacecraft contract

- **Geostationary Lightning Mapper (GLM)**
  - Implementation contract awarded in December 2007
  - Contractor: Lockheed Martin Space Systems Company

ABI Improvements

5 Minute Coverage

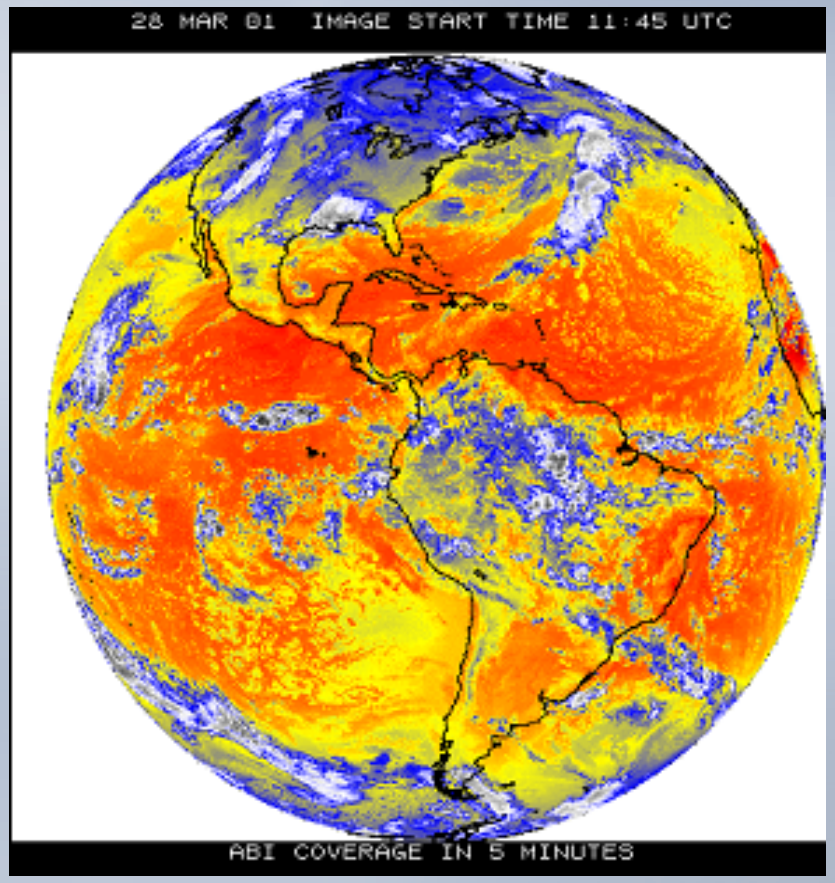
GOES-I/P



ABI covers the earth approximately five times faster than the current Imager.

1/5 Disc

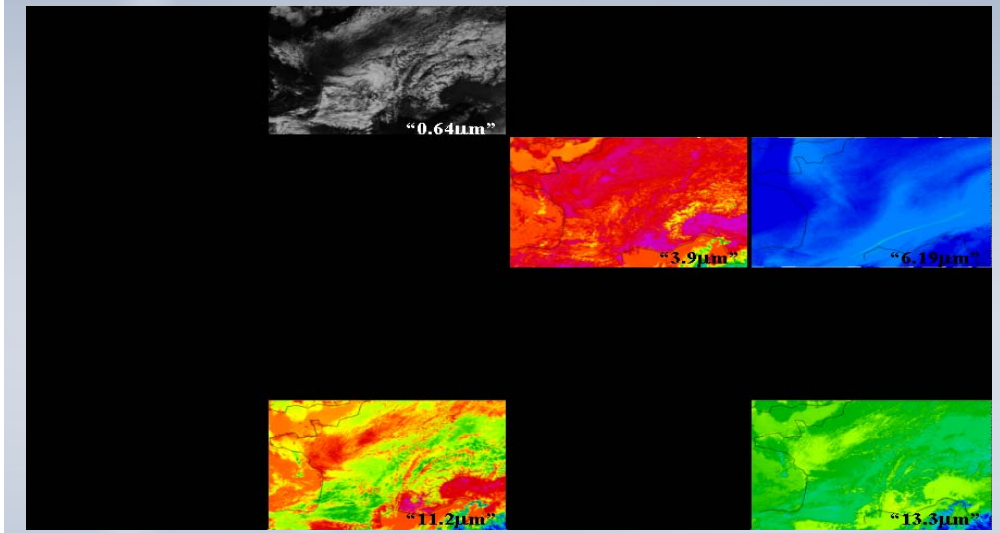
GOES-R



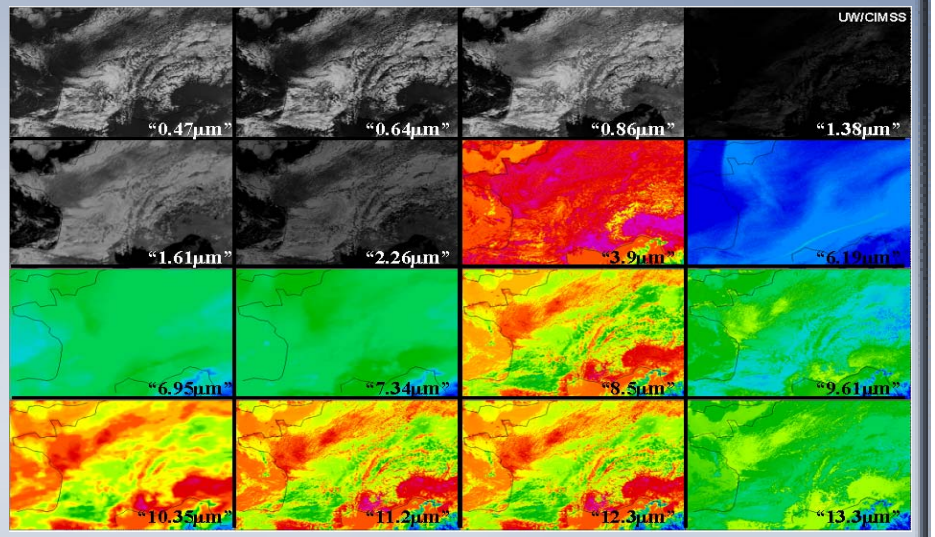
Full Disc

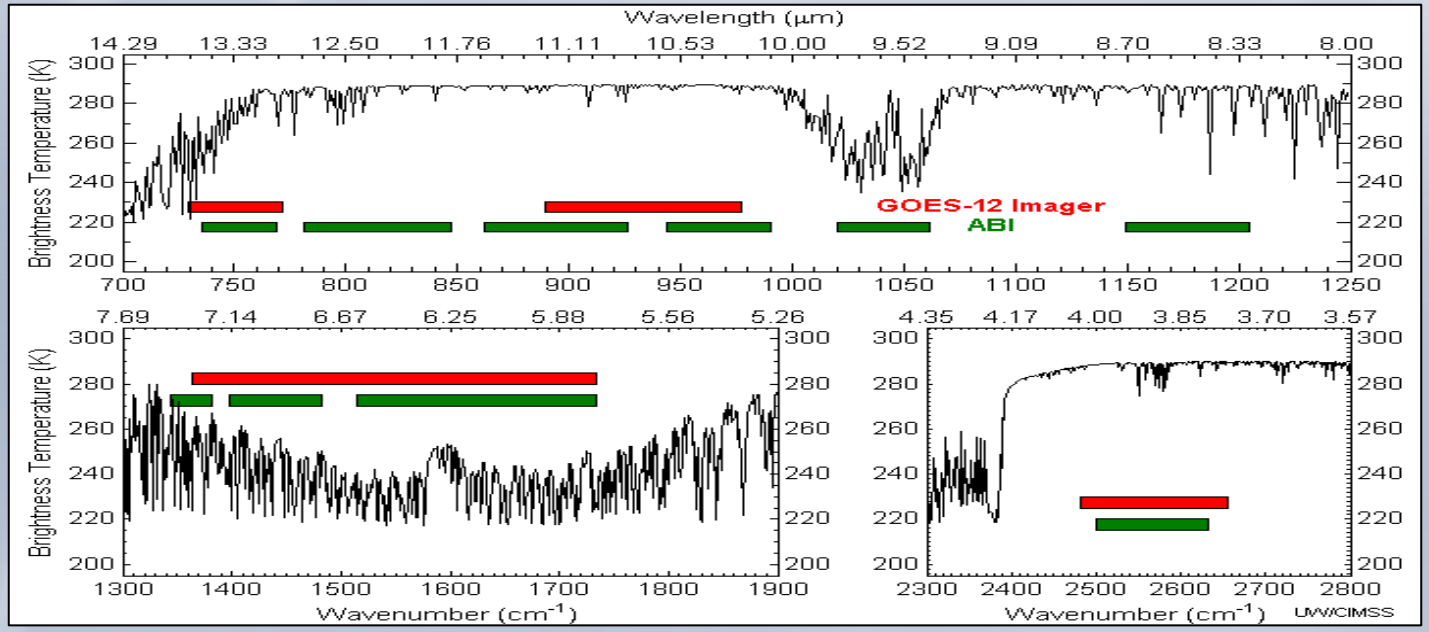
ABI: Improved Resolution

Corresponding Simulated GOES Imager Spectral Bands:



Simulated "ABI" Spectral Bands:

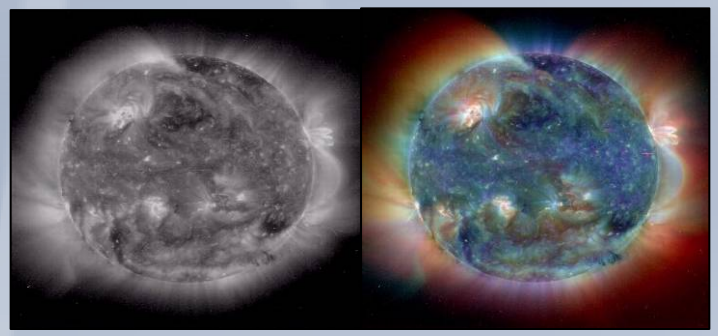


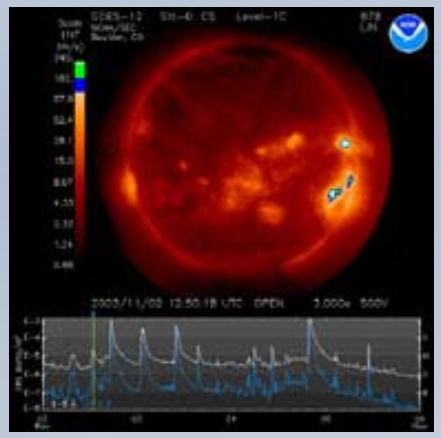


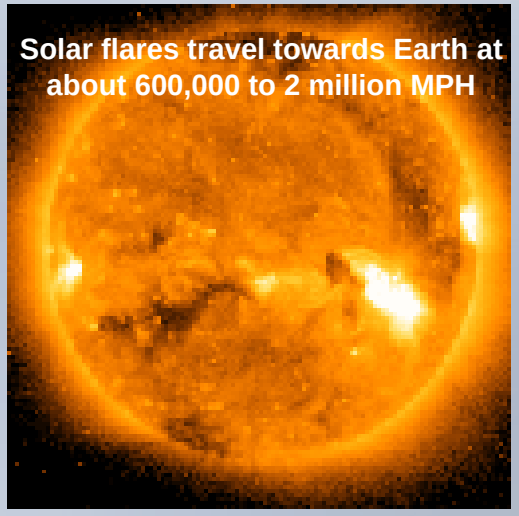
. . . over a wider spectrum

Space Weather Instruments

- **Essential for the NOAA Space Weather Prediction Center's real-time monitoring, forecasting and warnings of solar and geophysical events and disturbances**
- **Provide key measurements for the Radio Blackout Space Weather Scale**
- **GOES-R improvements**
  - Multi-band "color" images at the same rate as GOES N-P produces single band images
  - Solar X-ray image dynamic range, resolution, and sensitivity
  - EUV measurements for improved modeling of ionosphere and thermosphere
  - Medium energy radiation environment responsible for spacecraft charging

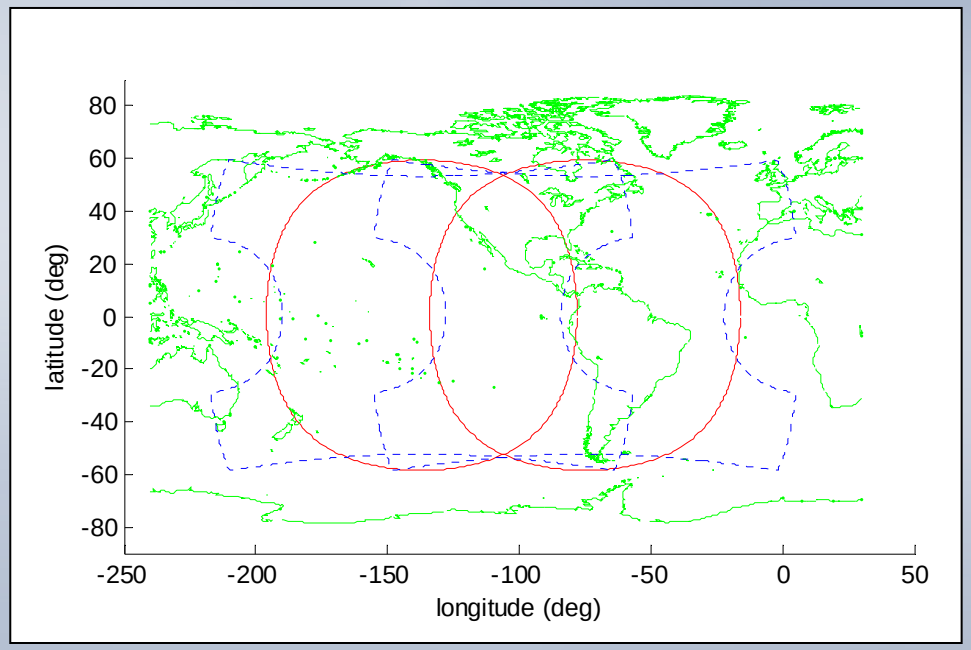






Geostationary Lightning Mapper (GLM)

- **Detects total strikes: in cloud, cloud to cloud, and cloud to ground**
  - **Compliments today's land based systems that only measures cloud to ground (about 15% of the total lightning)**
- **Increased coverage over oceans and land**
  - **Currently no ocean coverage, <u>and</u> limited land coverage in dead zones**



Advanced Sounding

- **Hyperspectral Environmental Suite (HES) instrument removed from GOES-R program – August 2006**

- **NOAA continues to have strong requirements for measurements from advanced hyperspectral sounder in Geo orbit**

- **Subsequent efforts included:**
  - Assessment of ABI data for derived sounder products
  - NOAA Analysis of Alternatives (AOA) study
    - Advanced sounding
    - Coastal waters imaging
  - Contractor studies of advanced sounding concepts for later GOES spacecraft

- **Conclusions**
  - ABI can approximate current GOES sounder capabilities
  - A geostationary advanced sounder demonstration mission should be funded as soon as possible

GOES-R Communications Payload

- **Communications**
  - **GOES Rebroadcast (GRB)**
    - Replacement of today's GVAR
    - Data rate of 31 Mbps in L-band
      - GVAR - 2.11 Mbps
        - Previous GRB specifications - 17 Mbps
  - **Low Rate Information Transmissions (LRIT)**
  - **Emergency Managers Weather Information Network (EMWIN)**
  - **Search and Rescue (SAR)**
  - **Data Collection System (DCS)**
  - **EGVAR (Emulated GVAR)**
    - Transmission between GOES-N/O/P and GOES-R series
    - GVAR like data set consisting of GOES-R data
    - For transmission through existing GOES-N/O/P legacy system

Coming Soon!* A new one-stop source for all GOES-R information.

http://www.GOES-R.gov

A joint web site of NOAA and NASA (**pending final approval)*