Post-Launch Calibration and Testing of Space Weather Instruments on GOES-R Satellite

Sivakumara S.K. Tadikonda, Cynthia S. Merrow, Jeffrey A. Kronenwetter, Gustave J. Comeyne, Daniel G. Flanagan, Monica Todirita

NASA Goddard Space Flight Center, Greenbelt, MD

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Geostationary Operational Environmental Satellite - R

Not explicitly seen:
Space Environment In-Situ Suite SEISS

Solar UltraViolet Imager

EXIS - Extreme ultraviolet and X-ray Irradiance Sensor

Magnetometer

Geostationary Lightning Mapper

GLM

Advanced Baseline Imager

SUVI

Tadikonda et al
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Space Weather Instruments: EXIS & SUVI

- X-Ray Sensor
- Extreme UltraViolet Sensor

- Normal Incidence Imaging Telescope
- Guide Telescope Provides Accurate Sun Position

Both Located on Sun-Pointing Platform; Spacecraft Points them to the Sun
Space Weather Instruments: SEISS

5 Particle Count Measuring Sensors
- MPS-Lo, MPS-Hi, SGPS-1, EHIS mounted on the SEISS cabinet
- SGPS-2 Mounted to the Spacecraft +X face
- Digital Processing Unit mounted inside the Spacecraft bus
GOES-R Characteristics

- Operational Mission
  - 5 year ground storage, 5 year on-orbit storage, 10 year operational lifetime
  - Products delivered on a set schedule
  - Minimal outages
    - Spacecraft interfaces comply through Station keeping and momentum dumps
    - Eclipses do not effect SEISS Products

- Requirements on Cadence, Latency, and Product Performance
  - Maintaining accuracy requires pre-flight calibration, in-flight calibration tracking, and careful tracking of uncertainties

- Ground Processing Algorithms

- **Dynamic Range:**
  - Varies on all sensors by many orders of magnitude as a function of wavelength and on all timescales
Science Performance Verification

- Requirements Verification
  - Plans
  - Technical Interchange Meetings
  - Approved Documents

- End-to-End Calibrations
  - Interpolation & Extrapolation as needed

- Component Calibration + Modeling
  - Accuracy, Alignments, Cal Coefficients

Performed Prior to Launch
End-to-End Ground Calibration

- **EXIS**
  - Synchrotron Ultraviolet Radiation Facility @ National Institute of Standards Technology, Gaithersburg, MD
    - Pre- and Post-Environmental Testing
  - ...

- **SEISS**
  - Air Force Research Laboratory @ Kirtland Air Force Base
  - Van de Graaff & Cockroft-Walton Accelerators @ NASA Goddard Space Flight Center
  - Northeast Proton Therapy Center Cyclotron Facility at Massachusetts General Hospital
  - Brookhaven National Laboratory
  - National Superconducting Cyclotron Laboratory @ Michigan State University
  - ...

Extensive Ground Calibrations
Component Calibration - SUVI

- Primary and Secondary Mirrors
  - Surface Roughness Measurement
  - Reflectance Measurements for Coated Multi-layered Mirror at Lawrence Berkeley National Laboratory
- Entrance and Analysis Filters
  - In-band performance and Out-of-band rejection
- CCD
  - Gain, Quantum Efficiency

Performance Prediction with Synthesized Model
On-orbit Calibrations / Characterizations: EXIS

- XRS, SPS, and EUVS A/B Darks
- EUVS Filter Characterization
- XRS and EUVS Signal-to-Noise
- Field-of-View Mapping
- XRS and EUVS Signal-to-Noise
- Cruciform Scan Slew
- ...

On-Orbit Calibration Tests Finalized ...
On-orbit Calibrations / Characterizations: SUVI

• CCD Dark Current Characterization
• Shutter Light Leakage
• Off-Band Signal Characterization (filter light leaks)
• Flat-Field Calibration (Kuhn-Raster, Boustrophedon)
• Focus Check
• Guide Telescope Calibration
• Cross calibration with EXIS

... with Inputs from Scientists and Engineers, and ...
On-orbit Calibrations / Characterizations: SEISS

- In-Flight Calibration
  - To determine detector threshold characteristics
- EHIS On-Orbit Calibration, Pulse Height Analysis
- MPS-Lo Voltage Bias Optimization
- Cross Calibration of the +X SGPS and the –X SGPS
- SGPS D3-D1 Logic Circuit Test
  - To determine effectiveness of rear entry particle suppression

Calibration Sequence of Events Developed
Next Generation Waiting in the Wings!

Can’t wait for the launch!

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