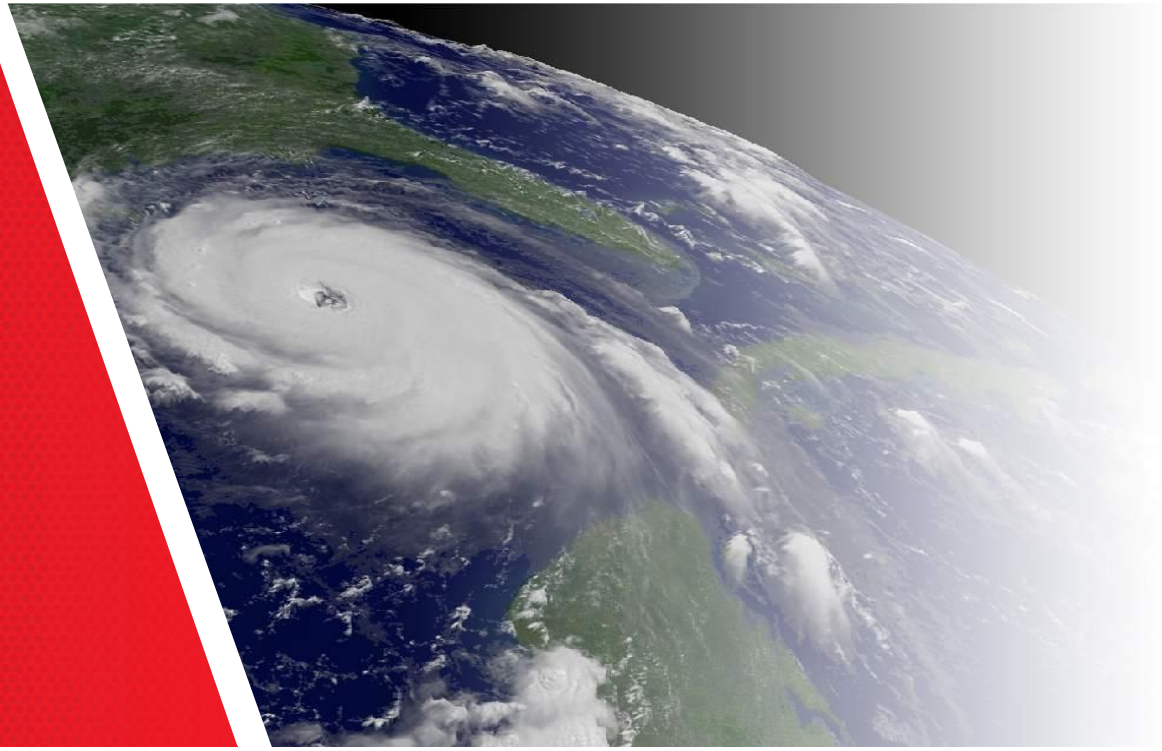


GOES-R Industry Day – GRB Simulator

Ed Czopkiewicz

Harris IT Services, GOES-R User Outreach

Introduction

- Last name is pronounced “Chop-ke-vich”
- Senior Test Engineer from Harris IT Services (HITS) in Omaha, NE
- HITS User Outreach Liaison for GOES-R
- Primary trainer/technical point of contact for GOES Rebroadcast (GRB) Simulators
- Retired USAF MSgt aviation weather forecaster
- Over 30 years experience in weather, space, and satellite programs
- Jeff Hohenstein is the secondary trainer/technical point of contact for GRB Simulators
  - HITS Training Lead for GOES-R

Agenda

- Overview of GRB Service
- GRB Data Structure
- Transition Information
- Purpose of GRB Simulator
- Description of GRB Simulator
- GRB Simulator GUI Functions
  - Configurations
  - Scenarios
  - Test Patterns
  - Proxy Data
  - GRB Packet Generation
  - Event Logs and Reports
- Image Segmenter Utility
- Status of GRB Simulators
- Training Approach
- Demonstrations this afternoon
- Questions

Overview of GRB Service

Overview of GRB Service

- Purpose of the GRB service for terminal users:
  - Provides the primary relay of full resolution, calibrated, near real-time direct broadcast space relay of Level 1b data from 6 GOES-R satellite instruments
    - Advanced Baseline Imager (ABI)
      - 16 channels ranging from 0.47 µm band to 13.3 µm band
    - Solar Ultra-Violet Imager (SUVI)
    - Extreme Ultra-Violet/X-Ray Irradiance Sensor (EXIS)
    - Space Environmental In-Situ Suite (SEISS)
    - Magnetometer (MAG)
  - Provides the primary relay of Level 2 data from Geostationary Lightning Mapper (GLM)

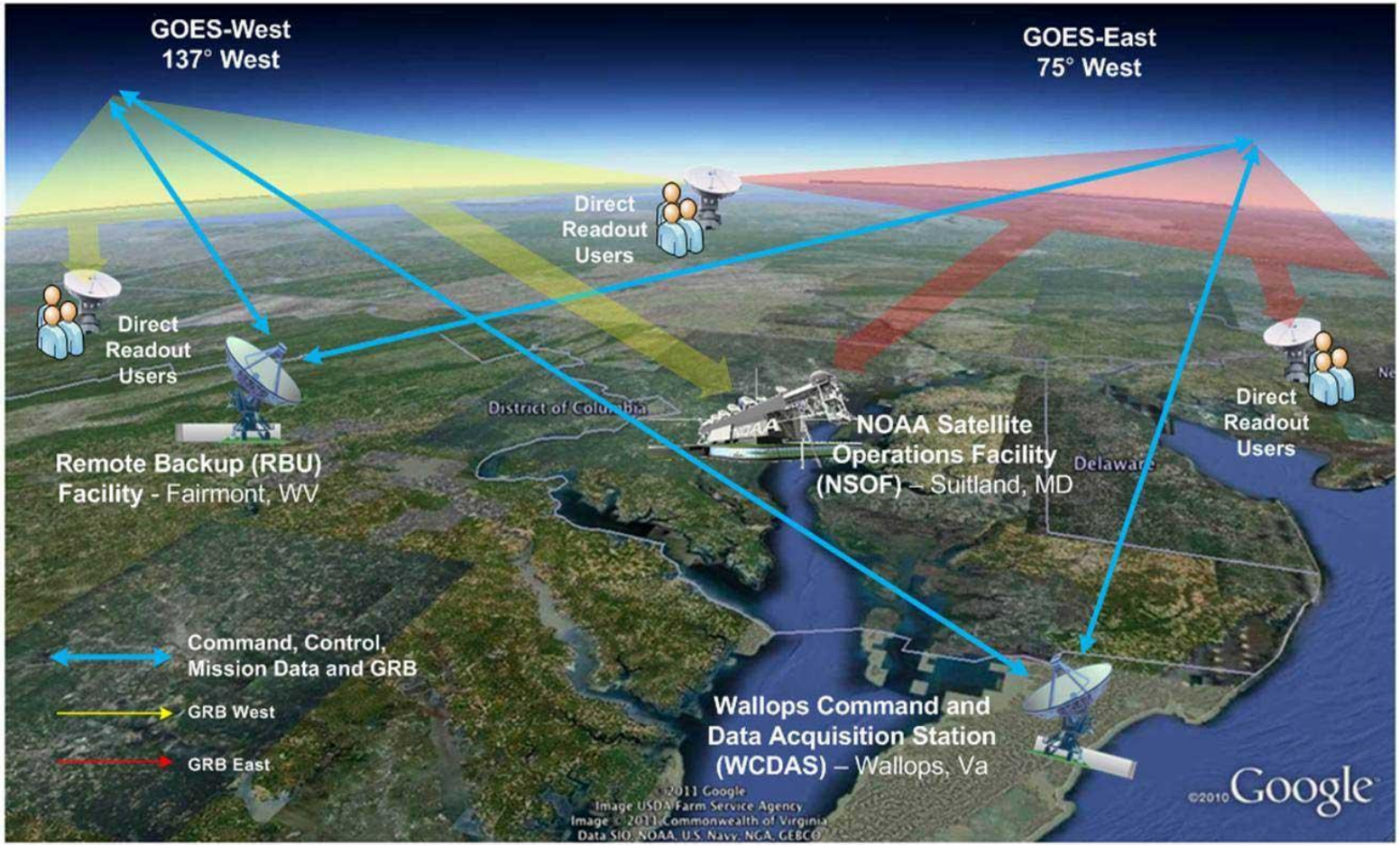
Overview of GRB Service

- The raw satellite data from all 6 instruments are downlinked from the GOES-R satellite to the Wallops Command and Data Acquisition Station (WCDAS) at Wallops Island, VA and the Remote Backup (RBU) Facility at Fairmont, W.VA
- Upon algorithm processing of the raw satellite data at WCDAS and RBU, the L1b and GLM L2 data output are stored in the Comprehensive Large Array-Data Stewardship System (CLASS) and uplinked back to the GOES-R satellite

Overview of GRB Service

- The processed L1b and GLM L2 data are then downlinked from the GOES-R satellite to the National Oceanic and Atmospheric Administration (NOAA) Satellite Operations Facility (NSOF) in Suitland, MD and to direct readout users with GRB terminals
- The NSOF facility will then process the L1b ABI data to create L2+ ABI products
  - NSOF stores L1b data from all instruments into the Product Distribution and Access (PDA) subsystem at the Environmental Satellite Processing and Distribution Services (ESPDS) for users to subscribe and access
- Next slide shows the flow of GRB processing between the satellites (GOES-West and GOES-East) and NSOF, WCDAS, RBU, and Direct Readout Users

GRB Processing



GRB Data Structure

GRB Data Structure

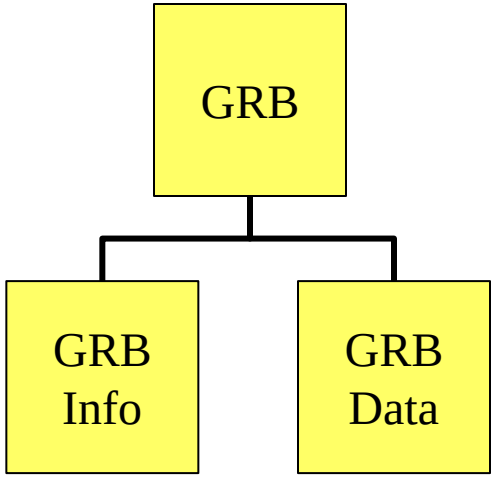
- GRB data consists of scientific and engineering telemetry data from six instruments on GOES-R satellite:
  - Advanced Baseline Imager (ABI) – L1b data, QC data, Data Quality Flags (DQF), and Metadata
    - L1b data consists of Channels 1 through 16 radiance products for Full Disk, CONUS, and Mesoscale scenes for Mode 3 and Channels 1 through 16 radiance products for Full Disk for Mode 4
  - Solar Ultraviolet Imager (SUVI) – L1b data, QC data, DQF, and Metadata
    - L1b data consists of 6 angstrom wavelength channels for Full Solar X-Ray Spectrums (XRS) and Extreme Ultraviolet Spectrums (EUVS)
  - Extreme Ultraviolet and X-Ray Irradiance Sensor (EXIS) – L1b data, QC data, and Metadata
    - L1b data consists of 3 channels of Full Solar EUVS and 2 channels of Full XRS

GRB Data Structure

- Space Environmental In-Situ Suite (SEISS) – L1b data, QC data, and Metadata
  - L1b data consists of 5 bands Energetic Heavy Ion Sensor samples, 15 bands of Magnetospheric Particle Sensor – Low Energy samples, 11 bands of Magnetospheric Particle Sensor – High Energy samples, and 13 bands of Solar and Galactic Proton Sensor samples
- Magnetometer (MAG) – L1b data, QC data, and Metadata
  - L1b data consists of samples of charged particles in the magnetosphere
- Geostationary Lightning Mapper (GLM) – L2 data, QC data, and Metadata
  - L2 data consists of lightning flash samples over the Americas and adjacent oceanic regions

GRB Data Structure

- GRB data packets are in CCSDS format:
  - 16,390 octet (16Kb) is maximum size for each packet
- There are 2 components to GRB data structure:
  - GRB Information
  - GRB Data

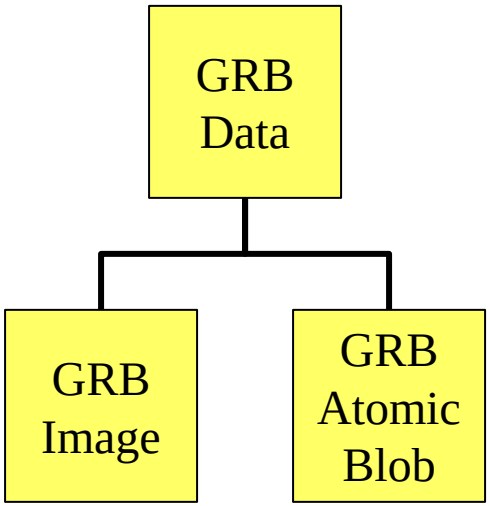


GRB Data Structure

- GRB Information is:
  - used to transfer configuration files across the GRB link
  - sent nominally once every 5 minutes
- GRB Information files consist of:
  - Operations schedules
  - Periodic data status informing users of process performance
  - Periodic state vectors for orbit knowledge
  - Static data unit conversion tables
  - Static calibration tables as changed

GRB Data Structure

- GRB Data is:
  - used to transfer product data from the Data Fabric (DF) at WCDAS and RBU to the DF at NSOF and user sites
- The GRB Data on the DF contains two data types: Images and Atomic Blobs:
  - Images
  - Atomic Blobs (Binary Large Objects)



CCSDS Structure of the GRB Data

	Bits	Field	Description
Standard Primary Header	3	Packet Version Number	CCSDS Protocol Version
	1	Packet Type	Indicates whether this is a telecommand or telemetry packet
	1	Secondary Header Flag	Indicates whether this packet has a secondary header (Set to 1 for all GRB Packets)
	11	APID	Application Process Identifier
	2	Sequence Flags	Flags for data segmentation
	14	Packet Sequence Count	Sequence Count
	16	Packet Data Length	Data Length
GRB Secondary Header	16	Days Since the Epoch	Number of full days since the GOES-R epoch date of January 1, 2000 12:00:00 UTC
	32	Milliseconds of the Day	Milliseconds of the Day
	3	GRB Version	GRB Version Number
	5	GRB Payload Variant	Describes the underlying payload
	4	Assembler ID	Identifies the assembler by location, string, and whether it is primary or backup
	4	Operational Environment	Identifies the Operational Environment
User Data	130976	GRB Data Payload	GRB Data Payload
	32	Checksum	Packet Checksum

GRB Data Structure

- Image Data
  - created by L1b processing at Product Generation (PG) element level
  - broken down by Scene data, Data Quality Flag (DQF), and Block Level Metadata for ABI instrument
  - L1b data blocks broken down into smaller GRB data blocks

Image Payload Structure

Bits	Field
8	Compression
32	Product Time Seconds Value
32	Product Time microseconds of Second
16	Image Block Identifier
24	Row Offset of Fragment within Image Block
32	Upper Left (UL) X: Pixel Coordinate of Image Block
32	Upper Left (UL) Y: Pixel Coordinate of Image Block
32	Image Block Height (pixels)
32	Image Block Width (pixels)
32	Offset to DQF Data (if present)
Varies	Image Payload

GRB Data Structure

- Atomic Blobs (Non-Image)
  - created by L1b/L2+ processing at PG element level
  - broken down by Data Blobs and QC Blobs for MAG, EXIS, SEISS, and GLM L2

GRB Atomic Blob Data Packet Structure

Bits	Field
8	Compression Algorithm
32	Product Time Seconds Value
32	Product Time microseconds of second
64	Reserved
32	Block ID
32	Reserved
Varies	Product Data

GRB Data Structure

- **Left-Hand Circular Polarization (LHCP) Data**
  - ABI 0.64 µm band (Channel 2) - Daytime cloud imaging
  - ABI 3.9 µm band (Channel 7) - Surface and cloud / fog at night: fire
  - ABI 6.185 µm band (Channel 8) - Upper tropospheric water vapor
  - ABI 7.34 µm band (Channel 10) - Lower tropospheric water vapor; SO_2 detection
  - ABI 11.2 µm band (Channel 14) - Total water; clouds
  - ABI 12.3 µm band (Channel 15) - Total water; ash; sea surface temperature
  - ABI 13.3 µm band (Channel 16) - Air temperature; cloud heights

GRB Data Structure

- **Right-Hand Circular Polarization (RHCP) Data**
  - ABI 0.47 µm band (Channel 1) - Daytime aerosol-on-land / coastal water mapping
  - ABI 0.865 µm band (Channel 3) - Daytime vegetation; aerosol-on-water
  - ABI 1.378 µm band (Channel 4) - Daytime cirrus clouds
  - ABI 1.61 µm band (Channel 5) - Daytime cloud water; snow
  - ABI 2.25 µm band (Channel 6) - Daytime land/cloud properties; particle size; vegetation
  - ABI 6.95 µm band (Channel 9) - Middle tropospheric water vapor
  - ABI 8.5 µm band (Channel 11) - Total water for stability; cloud phase; dust; SO_2
  - ABI 9.61 µm band (Channel 12) - Total ozone
  - ABI 10.35 µm band (Channel 13) - Supports 11.2 and 12.3 µm bands to enhance cloud particle size measures
  - GLM Lightning Detection: Events and Flashes - Geostationary detection of lightning events and flashes

GRB Data Structure

- **Right-Hand Circular Polarization (RHCP) Data**
  - SEISS Energetic Heavy Ions - Measures energetic heavy ions (10-200 MeV/n) in 4 mass groups: He, (C, N, O), Ne-S, and Fe
  - SEISS Magnetospheric Electrons and Protons: Low Energy Measures electrons and protons in the 30 eV - 30 keV range
  - SEISS Magnetospheric Electrons and Protons: Medium and High Energy -
    Measures electrons in the 30eV - 4 MeV range
    Measures protons in the 30eV - 1 MeV range
  - SEISS Solar and Galactic Protons - Measures solar energetic protons and galactic cosmic ray protons (1 MeV - 500 MeV)
  - MAG Geomagnetic Field - Measures Earth's magnetic field and it's variations at geosynchronous orbit
  - EXIS Solar Flux: EUV - Measures disk-integrated solar extreme ultraviolet flux
  - SUVI Solar Flux: X-ray - Measures solar images in the X-ray region

Transition Information

Transition Information

- GVAR
- Full Disc Image: 30 minutes
- Other modes: Rapid Scan, Super Rapid Scan
- Polarization: Linear
- Receive Frequency: 1685.7 MHz (L-band)
- Packetization: GVAR Blocks
- Data Compression: None
- Data Rate: 2.11 Mbps
- Antenna Coverage: Earth coverage to 5°
- Data Sources: Imager and Sounder SXI (MDL Link) SEM & Magnetometer (PCM / Telemetry link)
- Space Weather: None
- Lightning Data: None

- GOES-R
- Full Disc Image: 5 minutes (Mode 4), 15 minutes (Mode 3)
- Other modes: 3000 km x 5000 km CONUS: 5 min (Mode 3)
  1000 km x 1000 km Mescoscale: 30 sec
- Polarization: Dual circular
- Receive Frequency: 1690 MHz (L-band)
- Packetization: CCSDS 133.0-8-1
- Data Compression: Lossless compression
- Data Rate: ~28.4 Mbps (31 Mbps link rate)
- Antenna Coverage: Earth coverage to 5°
- Data Sources: ABI (16 bands), GLM, SEISS, EXIS, SUVI, MAG
- Space Weather ~2 Mbps
- Lightning Data: ~0.5 Mbps

Transition Information

- For information on Downlink Specifications, go to GOES-R web site at: http://www.goes-r.gov/users/docs/GRB_downlink.pdf

Purpose of GRB Simulator

Purpose of GRB Simulator

1. Generate Consultative Committee for Space Data Systems (CCSDS) formatted GRB output data based on scenarios, test patterns, and proxy data
   - Uses test data to simulate Level 1b data packets from these instruments:
     - Advanced Baseline Imager (ABI) - 16 channels ranging from 0.47 µm band to 13.3 µm band
     - Geostationary Lightning Mapper (GLM)
     - Solar Ultra-Violet Imager (SUVI)
     - Extreme Ultra-Violet/X-Ray Irradiance Sensor (EXIS)
     - Space Environmental In-Situ Suite (SEISS)
     - Magnetometer (MAG)
   - Uses test data to simulate Level 2 data packets from GLM

Purpose of GRB Simulator

2. Simulate up to 15 Mbps of output streams for each circular polarization (left-hand and right-hand) using either baseband (digital) or IF transmission method
   - GRB output data used for on-site testing of user ingest and data handling systems
3. Manage configuration, scenario, test pattern, proxy data, and event log files used for simulations
4. Prepare End Users for transition from GVAR to GRB service

Description of GRB Simulator

Description of GRB Simulator

- The GRB Simulator is a fully self-contained system which includes all hardware units needed for operation

Front side **Back side**

Transit Case 1
(on Top)

Approx. Weight
200 lbs

Transit Case 2
(On the Bottom)

Approx. Weight
250 lbs

Description of GRB Simulator

- Here is an example of how the GRB Simulator looks when powered up and KVM tray is extended for operations
  - Approx. dimensions are 2’W X 4’ L X 4’ H

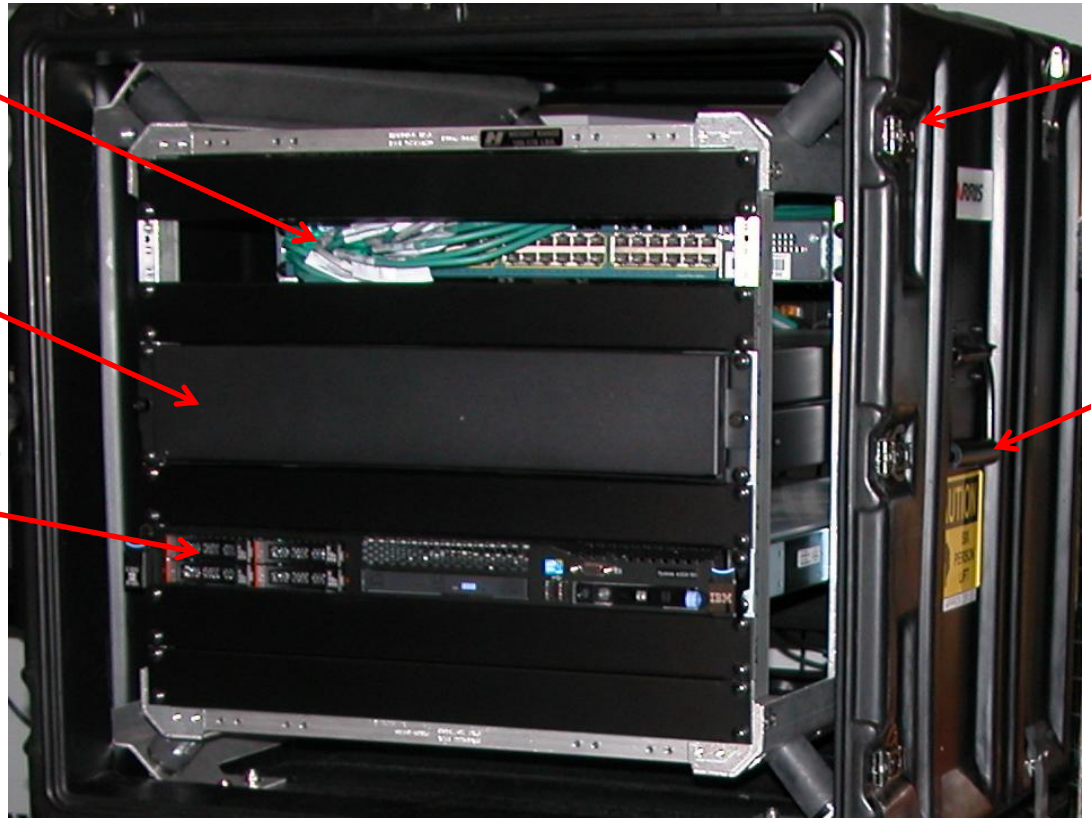
Description of GRB Simulator

Front side of Transit Case 1

Network Switch

KVM

IBM X3550 Linux Server



Clamps

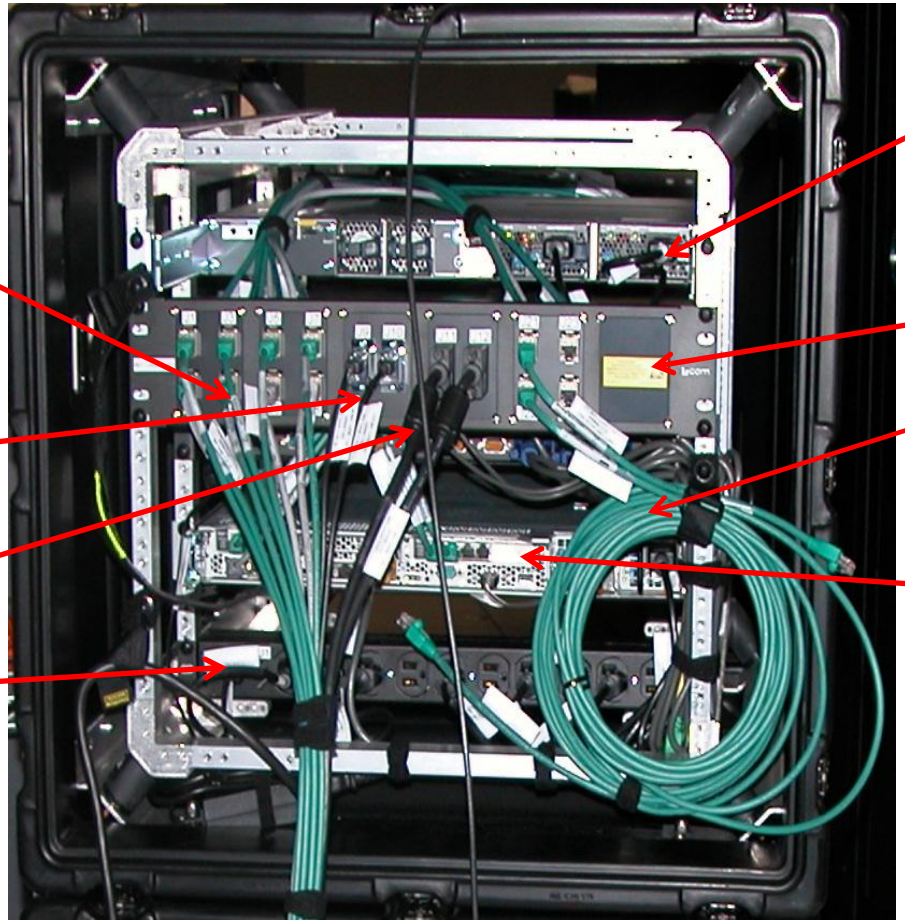
Handles

Description of GRB Simulator

- Cisco 3560 Switch
  - 48 ports
  - Provides the Ethernet network for the simulator
- KVM Switch
  - 8 ports
  - Provides the primary user interface for:
    - GRB Simulator Server
    - FEP
    - Modem
- IBM X3550 Server
  - Hosts the GRB Simulator software that produces GRB data and provides an interface for the users to interact with
- 2 cover lids
    - Front lid includes GPS antenna and all cabling required for intra-case and external connections
    - Back lid includes casters for bottom of transit case

Description of GRB Simulator

Back side of Transit Case 1



Description of GRB Simulator

Front side of Transit Case 2

TRAK 9000 Time Code Generator

RT Logic T500 HR
Front End Processor

RT Logic T400 XR
Modem

Description of GRB Simulator

- TRAK 9000 Time Code Generator
  - Allows user to:
    - manually adjust a specific time format
    - default to a standalone system time
    - set to a GPS tracking system time
- Front End Processors (FEP)
  - Front End Processor (FEP / T500HR) sends a test pattern to the MODEM (T400XR)
- Modem
  - Outputs Modulated Waveform at IF to 70.0 MHz
  - IF Signal from 70.0 MHz is looped back to MODEM and is Demodulated
  - Constellation for 8PSK/QPSK modulation is displayed
- 2 cover lids
    - Front lid is empty
    - Back lid includes casters for bottom of transit case

Description of GRB Simulator

Back side of Transit Case 2

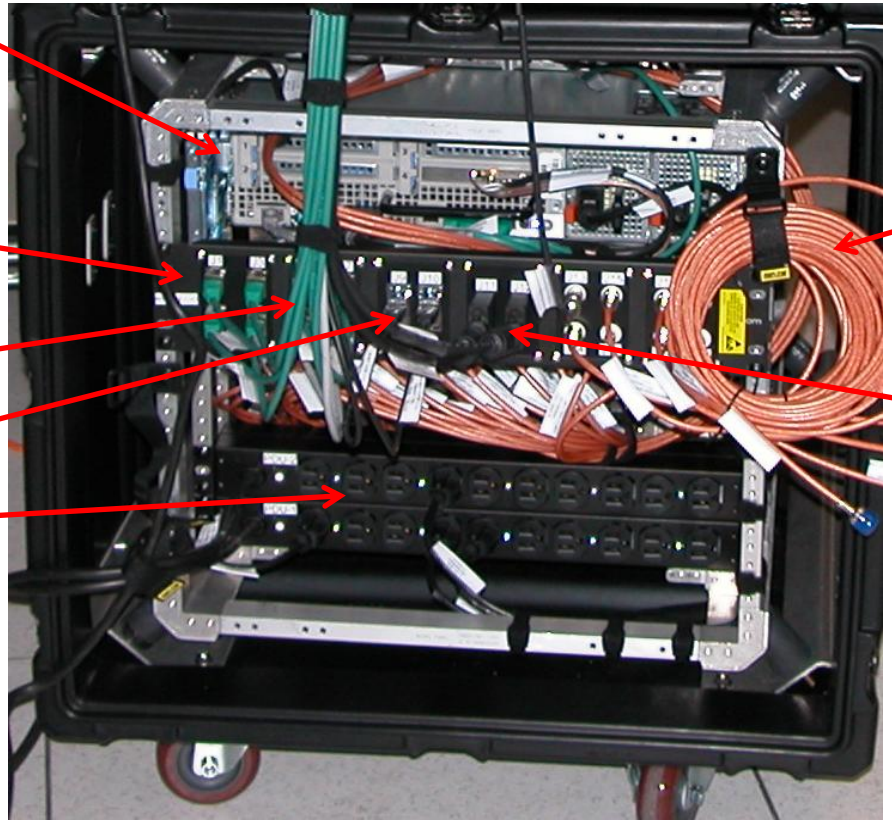
TRAK Time Code Generator

Patch Panel

RJ45 Cables

USB Cables

Power Distribution Unit

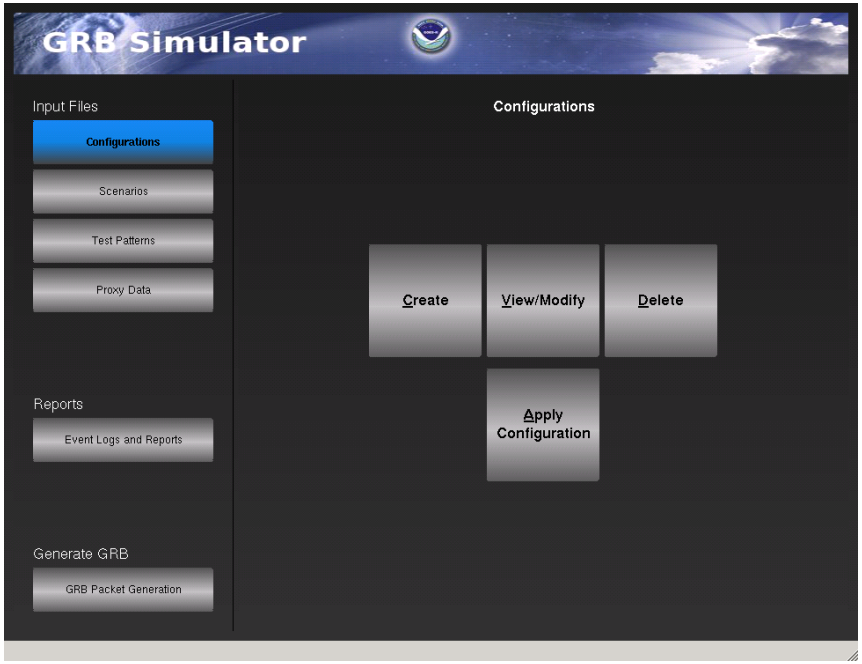


IF Cables

VGA Cables

Description of GRB Simulator

- The GRB Simulator GUI is launched by double-clicking on the shortcut icon located in the desktop area of the IBM server

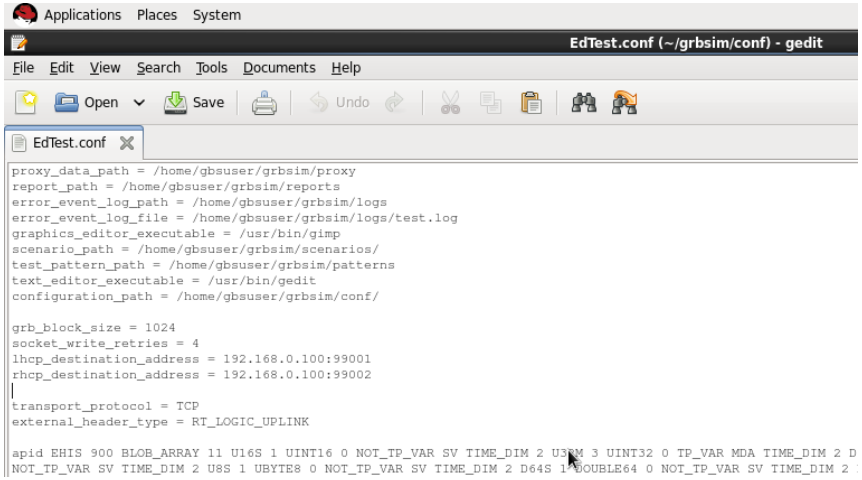


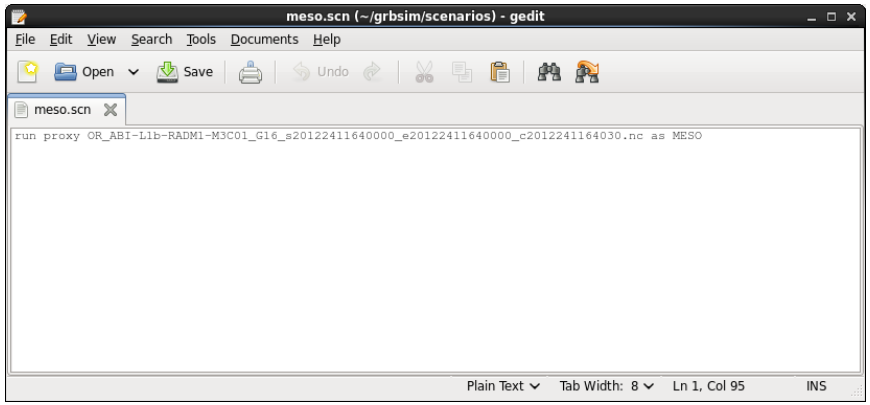
Description of GRB Simulator

- The GRB Simulator software uses a simple, efficient Human Machine Interface (HMI)
- The GRB Simulator GUI:
  - allows the user to launch a simulation
  - performs setup activities such as:
    - setting up configuration
    - running reports
    - writing scripts to run the simulations
    - managing input data from which GRB packets are generated

Description of GRB Simulator

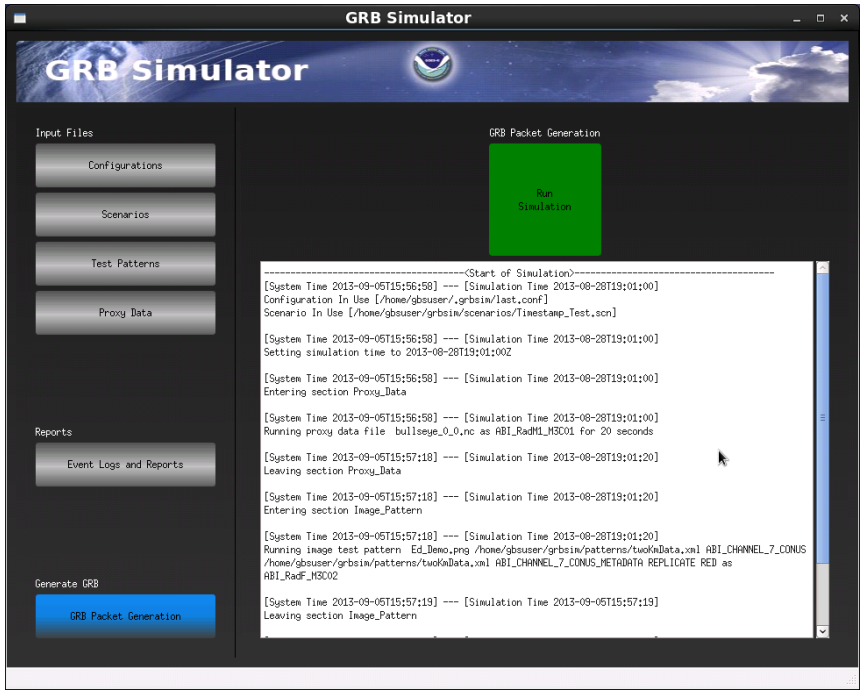
- GRB Simulator provides a built-in text editor (gedit) using a GUI application for managing:
  - Configurations
  - Scenarios
  - Event Logs and Reports





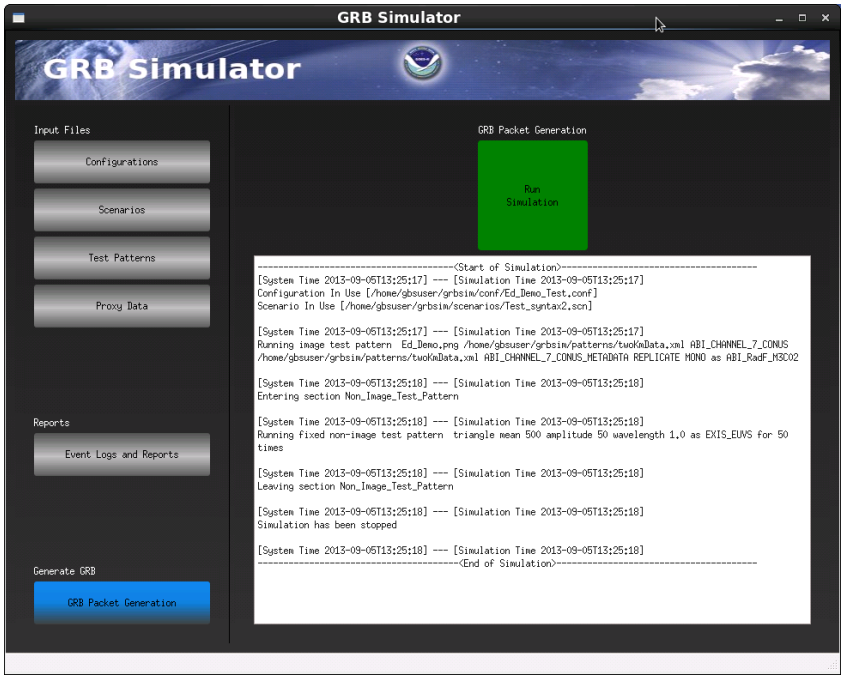
Description of GRB Simulator

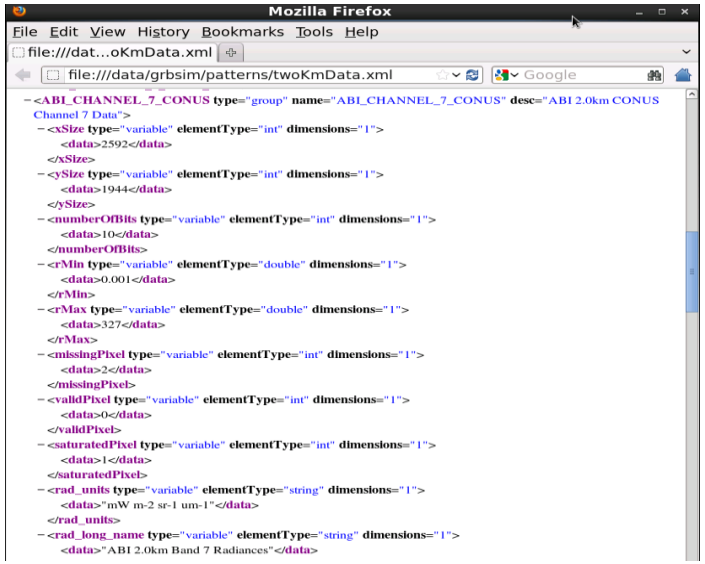
- Alters time via user configurable simulation times



Description of GRB Simulator

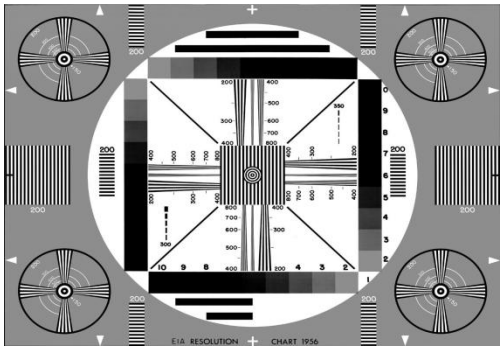
- Builds GRB CCSDS packets on the fly from stored L1b product data and XML information files

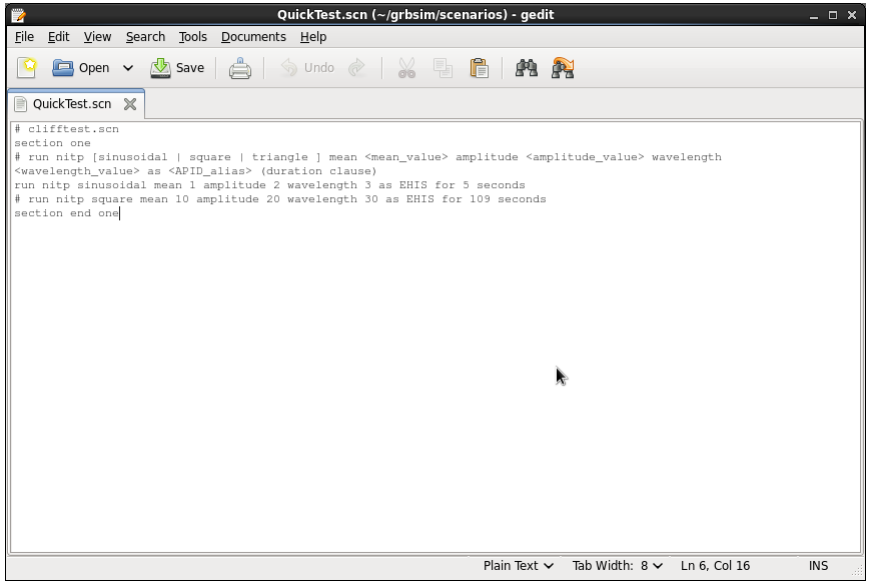




Description of GRB Simulator

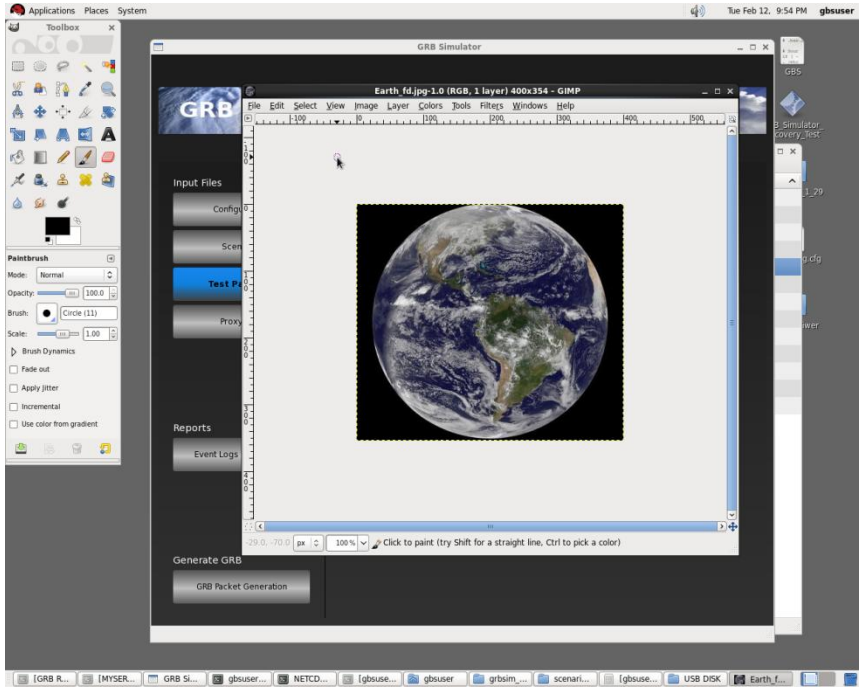
- Data output by the simulator is derived from:
  - proxy data files containing Level 1b (L1b) or GLM L2 data
  - test pattern images
  - non-image test pattern generation commands specified from within a scenario





Description of GRB Simulator

- GRB Simulator also provides a built-in graphics editor, GNU Image Manipulation Program (GIMP), using a GUI application for managing image test patterns

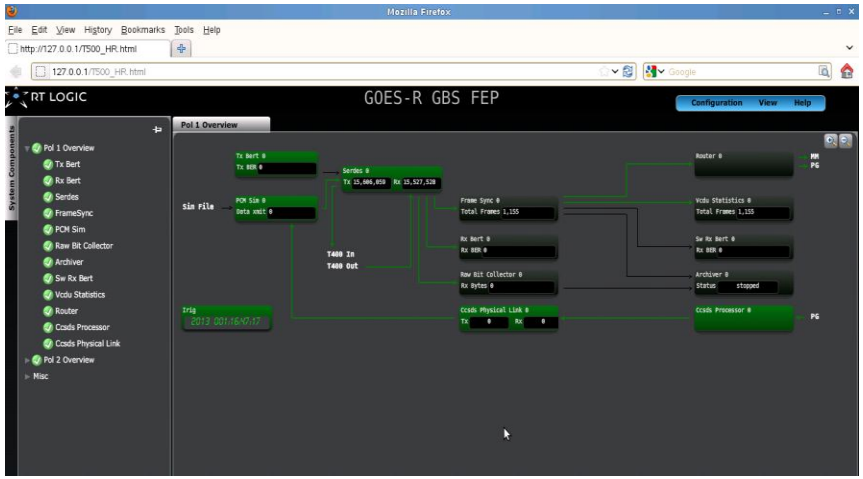


Description of GRB Simulator

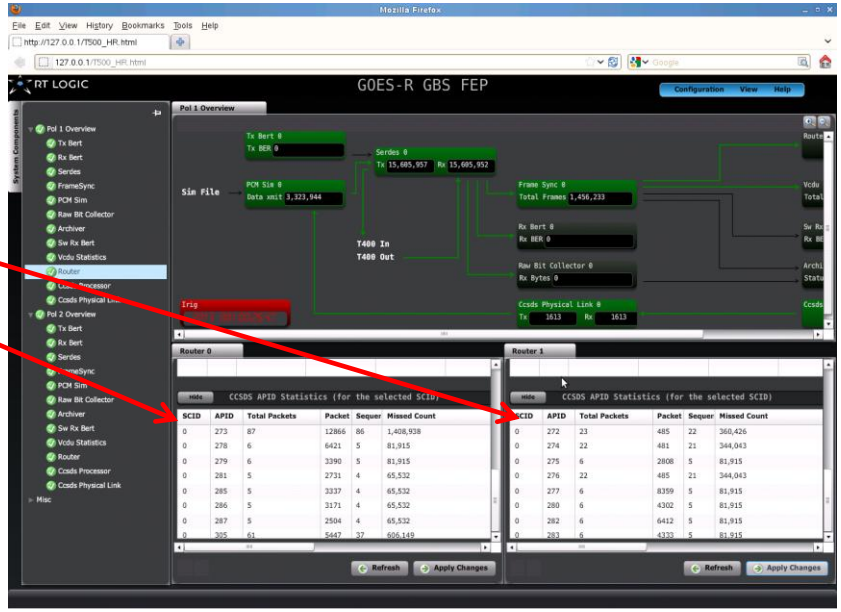
- Time Code Generator ensures FEP and Modem times are in sync with designated source of time

Description of GRB Simulator

- A Mozilla Firefox browser on the RT Logic T500 displays the FEP GUI
  - monitors the transfer frames and CCSDS packet processing

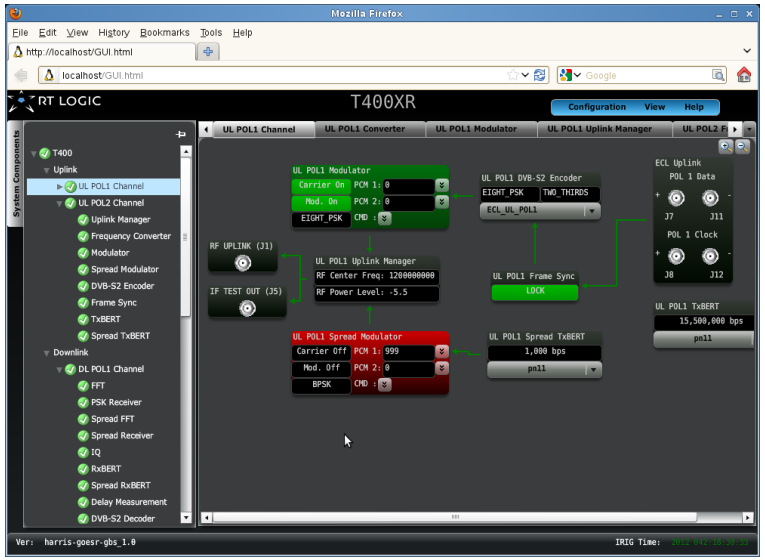


- In this example, CCSDS packets are being generated for both polarizations

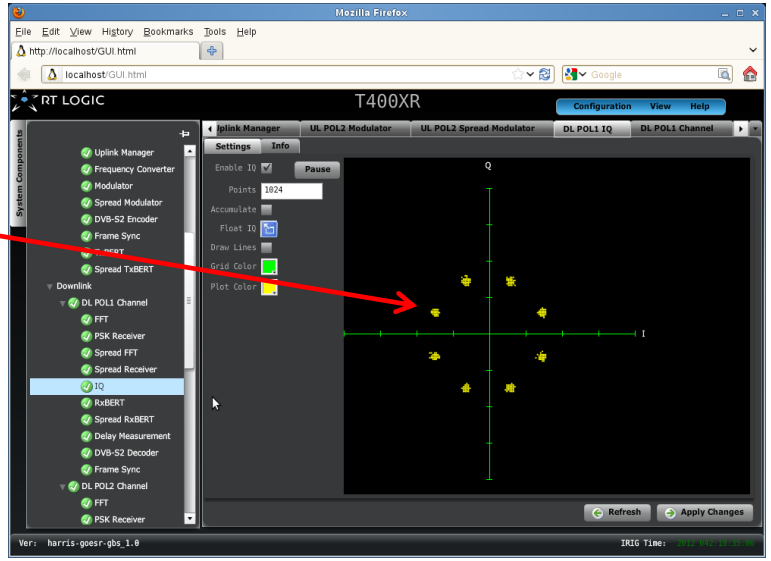


Description of GRB Simulator

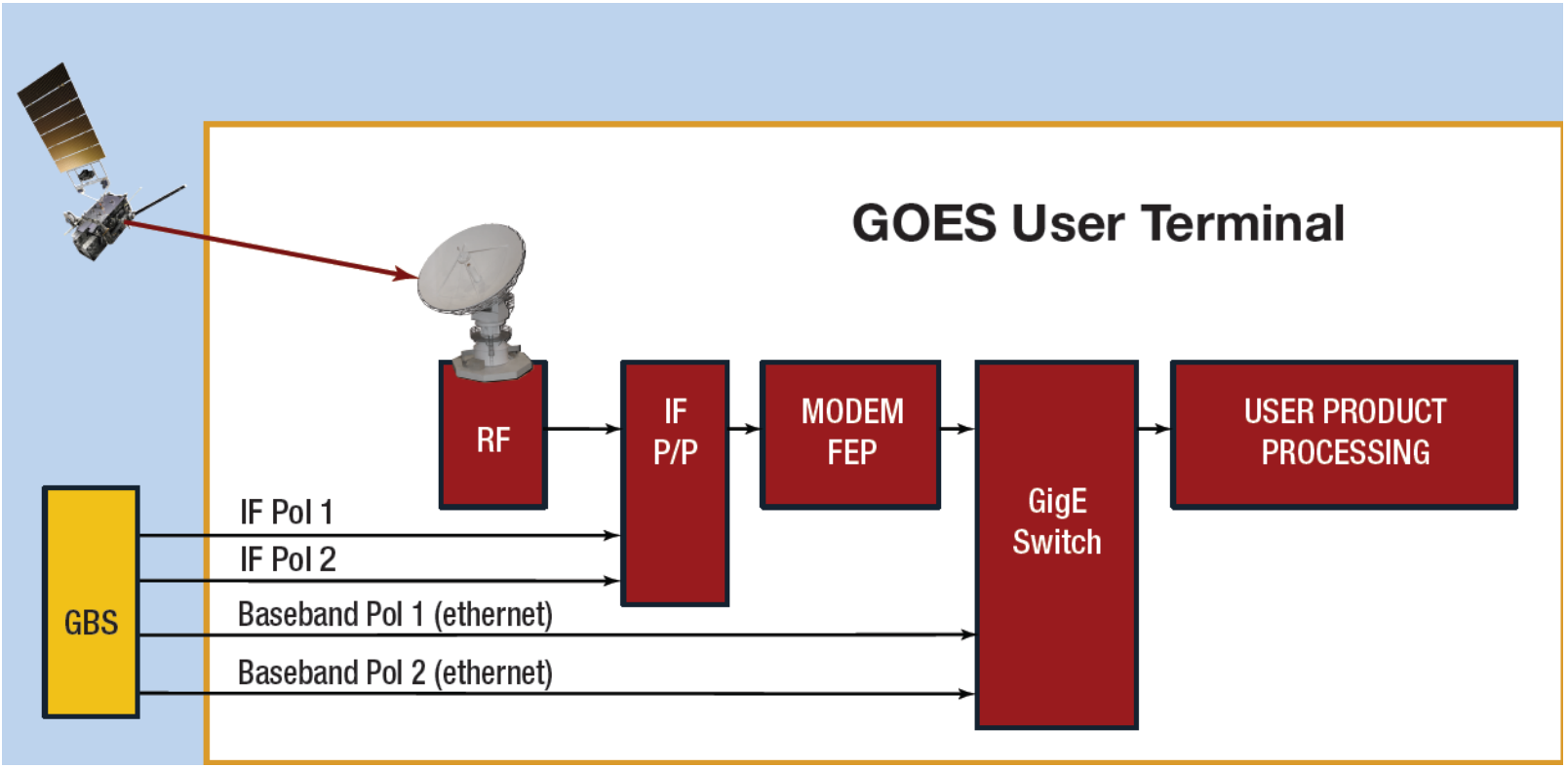
- A Mozilla Firefox browser on the RT Logic T400 XR displays the Modem GUI
  - monitors the uplink and downlink activity for each polarization process



- In this example, the ‘IQ’ display is a constellation map of the 8-PSK modulation.



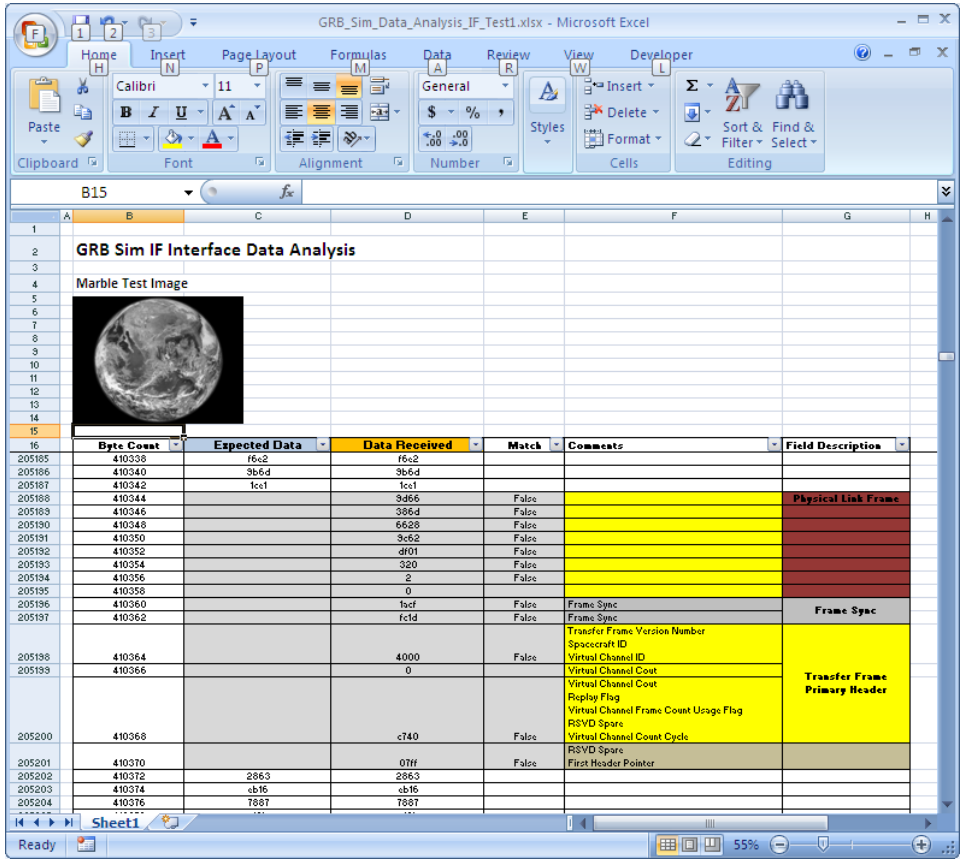
Description of GRB Simulator



NOTE: This diagram displays the path of the GRB signal from the satellite transponder to the GOES User terminal. The GRB simulator uses the FEP and Modem to transmit IF signals to the GRB receiving system.

Description of GRB Simulator

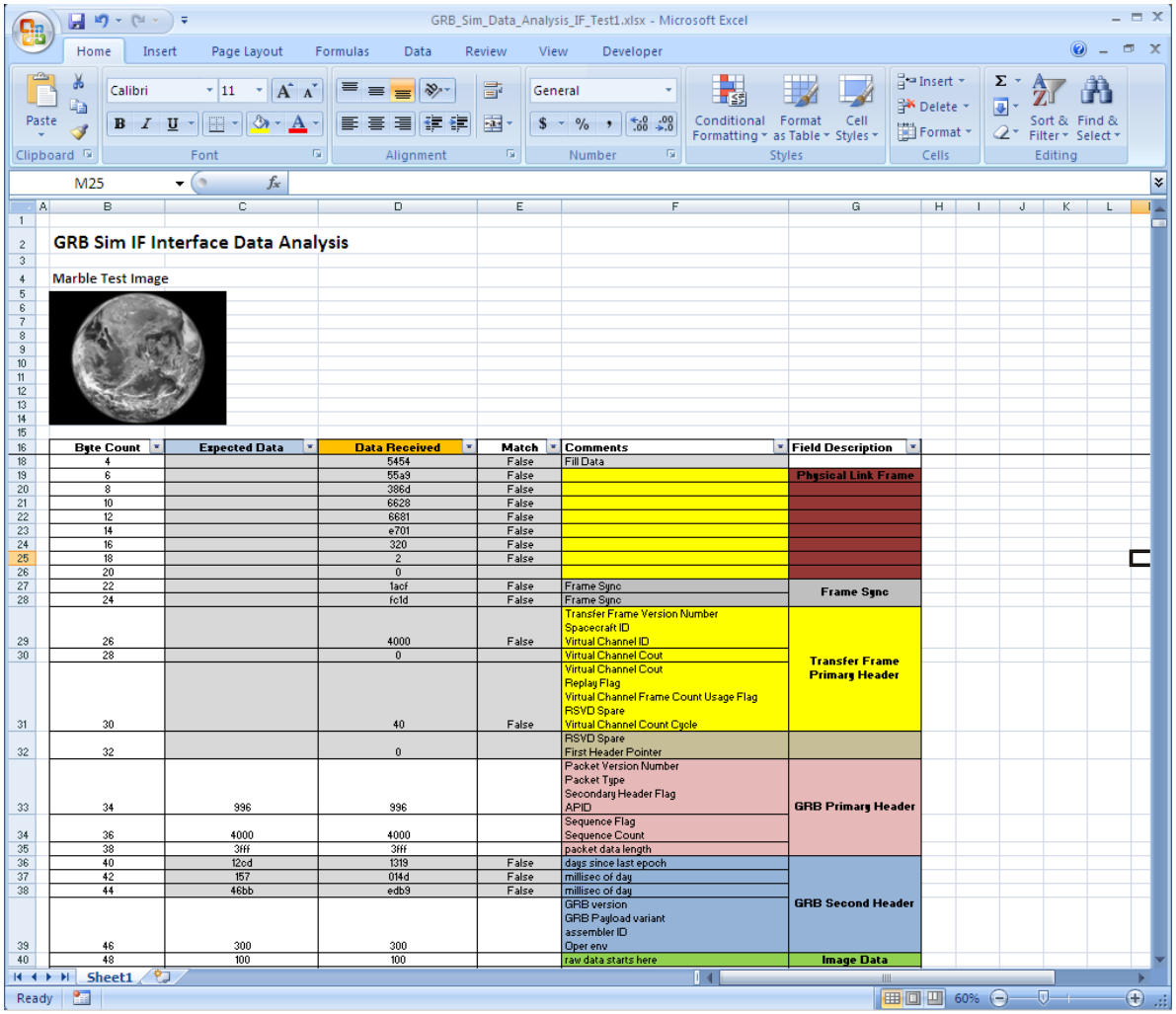
- An ‘GRB_Sim_Data_Analysis_IF_Test1.xls’ spreadsheet is provided to the end user as shown below for testing purposes:



Description of GRB Simulator

- The spreadsheet uses the Marble proxy image file as the example
- The purpose of this spreadsheet file is:
  1. To show the structure and content of the data that will be received from the user's GRB receiver output including:
     - Transfer Frame Headers
     - GRB Primary and Secondary Headers
     - Data fields
     - Checksum
  2. To provide an example of data that the users can start with to check out their software

Description of GRB Simulator



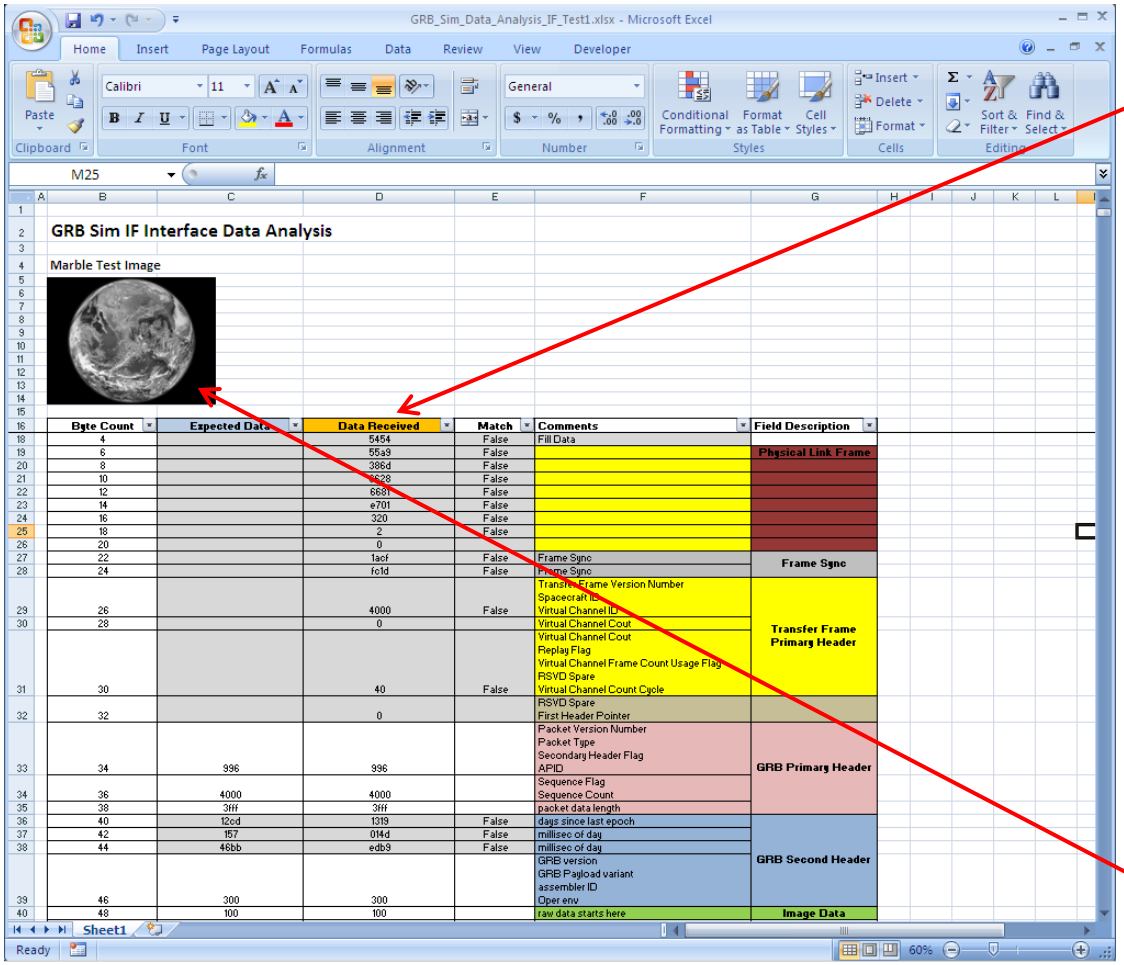
Byte Count	Expected Data	Data Received	Match	Comments	Field Description
4		5454	False	Fill Data	
6		55a9	False		Physical Link Frame
8		386d	False		
10		6628	False		
12		6681	False		
14		e701	False		
16		320	False		
18		2	False		
20		0			
22		1acf	False	Frame Sync	Frame Sync
24		fc1d	False	Frame Sync	
26		4000	False	Transfer Frame Version Number Spacecraft ID Virtual Channel ID	Transfer Frame Primary Header
28		0		Virtual Channel Cout	
30		40	False	Virtual Channel Cout Replay Flag Virtual Channel Frame Count Usage Flag RSVD Spare Virtual Channel Count Cycle	
32		0		RSVD Spare First Header Pointer	
34	996	996		Packet Version Number Packet Type Secondary Header Flag APID	GRB Primary Header
36	4000	4000		Sequence Flag Sequence Count	
38	3fff	3fff		packet data length	
40	12cd	1319	False	days since last epoch	GRB Second Header
42	157	014d	False	millisec of day	
44	46bb	edb9	False	millisec of day	
46	300	300		GRB version GRB Payload variant assembler ID Oper env	
48	100	100		raw data starts here	Image Data

- The spreadsheet defines fill data fields “5454”, transfer frame headers, GRB primary and secondary headers, data fields and check sum
- Each GRB packet is a maximum of 16,390 bytes of data

Description of GRB Simulator

- The RT Logic FEP in the GRB Simulator slices the GRB packets into transfer frames that are a maximum of 2,034 bytes
- Each transfer frame includes a header that is 26 bytes long and includes a repeated frame sync word of “1acf fc1d”
- The GRB Simulator only sends full transfer frames
- Therefore, there will be transmissions of fill data (“5454”) interspersed with the transfer frames that have actual image data in the real system

Description of GRB Simulator



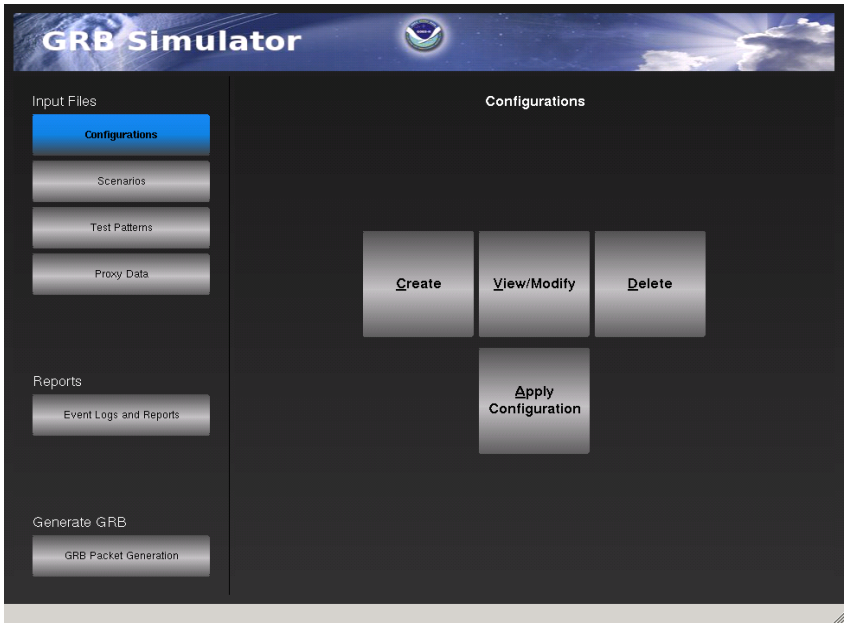
- The data in column D is representative of the GRB output that can be used to check against an end user's receiving system software
- Once the data is reconstructed and viewed with a netCDF viewer, the user should be able to replicate the image in the top left-hand corner of the spreadsheet as shown here

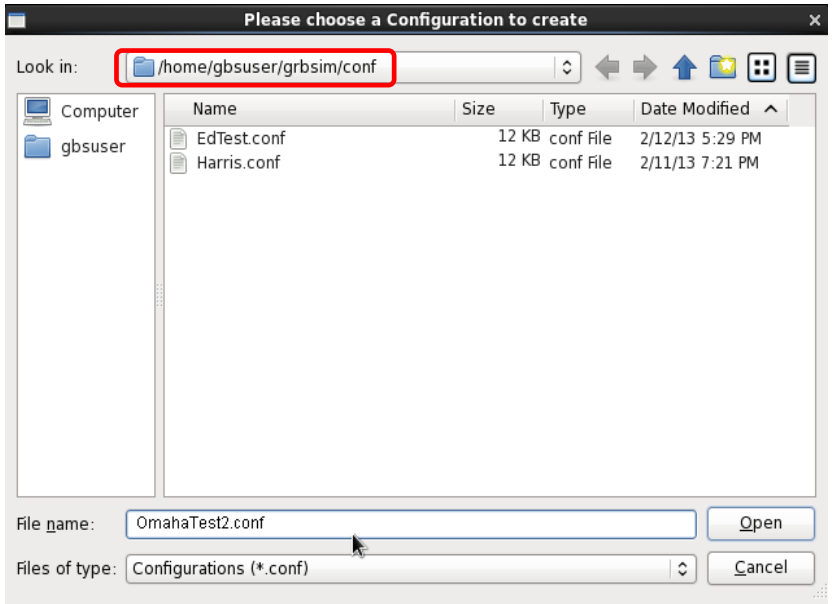
GRB Simulator GUI Functions

GRB Simulator GUI Functions

- **NOTE:** The following slides display the main functionalities of the GRB Simulator GUI. The end user is not required to create any new configurations, scenarios, test patterns or proxy data to test their receiving system or software. Included in the GRB Simulator baseline are files that have ready-to-use configurations, scenarios, test patterns and proxy data for end users to run upon powering up the equipment.

GRB Simulator GUI Functions - Configurations





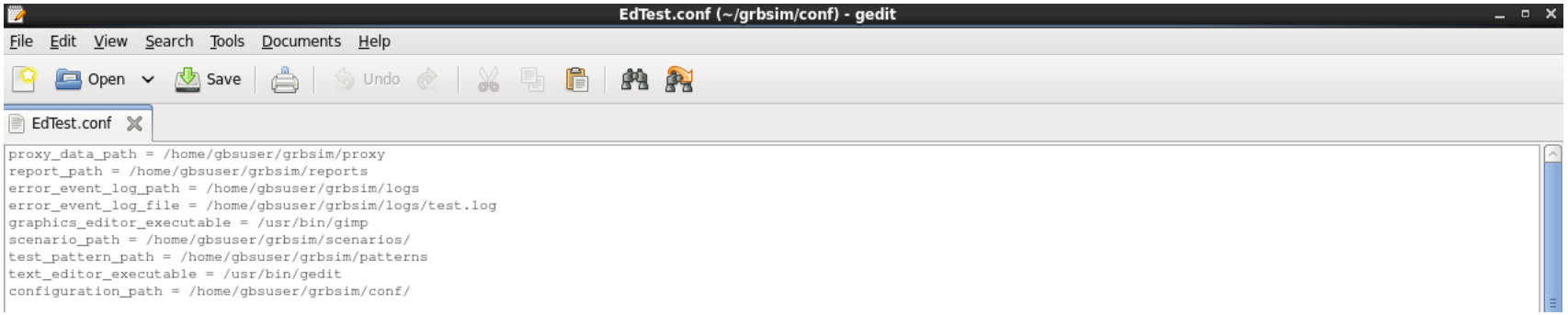
- Configurations define overall setup and runtime parameters for the GRB Simulator
- The user can create, view, modify, apply, and delete configurations on the GRB Simulator
- Configurations contain paths to scenarios, paths to test data, paths to error logs, paths to event logs, paths to editor executables, and a report storage location

GRB Simulator GUI Functions - Configurations

- The default configuration file used to run the GRB Simulator is *GRBSM.conf*
- It is important to have all the configuration parameters set correctly in the configuration file
  - Incorrect file paths will generate errors when using the GRB Simulator
- The configuration file must have the correct APID references for the sample files being processed
  - Incorrect APID references will cause errors when attempting to run packet generations

GRB Simulator GUI Functions - Configurations

- The default text editor for the GRB Simulator GUI is the ***gedit*** editor as shown here:



GRB Simulator GUI Functions - Configurations

- Example of ***GRBSM.conf*** :

GRBSM.conf - WordPad

File Edit View Insert Format Help

```
proxy_data_path = /home/gbsuser/grbsim/proxy
report_path = /home/gbsuser/grbsim/reports
error_event_log_path = /home/gbsuser/grbsim/logs
error_event_log_file = /home/gbsuser/grbsim/logs/GRBSM.log
graphics_editor_executable = /usr/bin/gimp
scenario_path = /home/gbsuser/grbsim/scenarios
test_pattern_path = /home/gbsuser/grbsim/patterns
text_editor_executable = /usr/bin/gedit
configuration_path = /home/gbsuser/grbsim/conf

socket_write_retries = 3
lhcp_destination_address = 192.168.5.125:1024
rhcp_destination_address = 192.168.5.125:1025

transport_protocol = TCP
external_header_type = RT_LOGIC_UPLINK

# L1b ABI Full Disk Radiance Images
apid ABI_RadF_M3C01 272 IMAGERY rad DQF y x
apid ABI_RadF_M4C01 400 IMAGERY rad DQF y x
apid ABI_RadF_M3C02 273 IMAGERY rad DQF y x
apid ABI_RadF_M4C02 401 IMAGERY rad DQF y x
apid ABI_RadF_M3C03 274 IMAGERY rad DQF y x
```

For Help, press F1 NUM

File paths

Packet processing

Protocol/Header Info

APID Reference Info for Image and Non Image Test patterns and Metadata

GRB Simulator GUI Functions - Configurations

- The first 3 sections of the configuration file begins with the declared variable name followed by an '=' sign and the variable settings, e.g., proxy_data_path = /home/gbuser/grbsim/proxy.
- ***File Paths*** section indicates where files, logs, reports, and editors are located at as shown below:

GRBSM.conf - WordPad

File Edit View Insert Format Help

```
proxy_data_path = /home/gbsuser/grbsim/proxy
report_path = /home/gbsuser/grbsim/reports
error_event_log_path = /home/gbsuser/grbsim/logs
error_event_log_file = /home/gbsuser/grbsim/logs/SIQT.log
graphics_editor_executable = /usr/bin/gimp
scenario_path = /home/gbsuser/grbsim/scenarios
test_pattern_path = /home/gbsuser/grbsim/patterns
text_editor_executable = /usr/bin/gedit
configuration_path = /home/gbsuser/grbsim/conf
```

For Help, press F1 NUM

GRB Simulator GUI Functions - Configurations

- ***Packet Processing*** section indicates:
  1. Number of attempts to write GRB data packets to socket connection
  2. The RHCP receiving IP address for data stream
  3. The LHCP receiving IP address for data stream
  4. The third octet of the IP address represents the GRB Simulator unit the network switch resides at. For example, in the IP address '192.168.**2**.120:50001', the '**2**' value represents SN0002 GRB simulator in use.
  5. The fourth octet of the IP address represents either the IBM server (for baseband) or FEP server (for IF).

GRB Simulator GUI Functions - Configurations

- In the first example, the fourth octet value of ‘120’ represents the IBM server for Baseband option

GRBSM.conf - WordPad

File Edit View Insert Format Help

```
socket_write_retries = 3
lhcp_destination_address = 192.168.5.120:50001
rhcp_destination_address = 192.168.5.120:50002
```

For Help, press F1 NUM

- In the second example, the fourth octet value of ‘125’ represents the FEP server for IF option

GRBSM.conf - WordPad

File Edit View Insert Format Help

```
socket_write_retries = 3
lhcp_destination_address = 192.168.5.125:1024
rhcp_destination_address = 192.168.5.125:1025
```

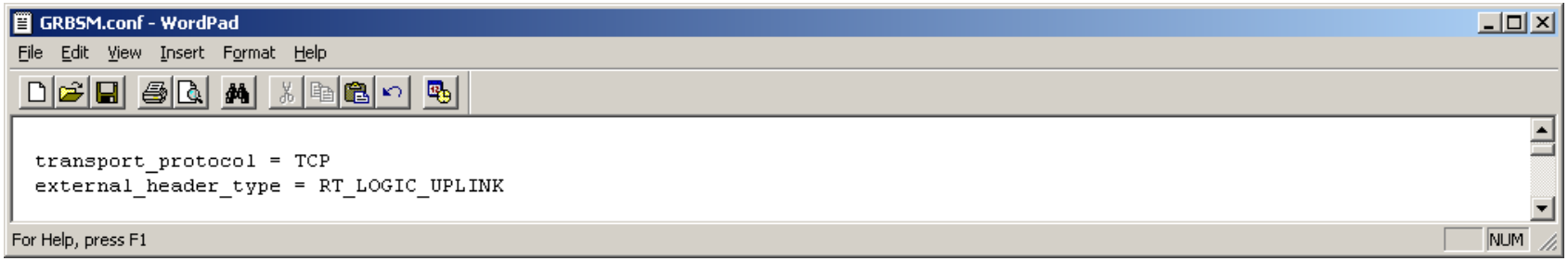
For Help, press F1 NUM

GRB Simulator GUI Functions - Configurations

6. The fifth octet of the IP address represents the port connection for the receiving system. For example, in the IP address ‘192.168.2.125:**50001**’, the ‘**50001**’ value represents the port connection for the receiving system being used.

GRB Simulator GUI Functions - Configurations

- The ***Protocol/Header Info*** section indicates:
  - Transport method for the GRB packet generation and
  - External header type depending on how testing is conducted (i.e., baseband or IF).
  - In the example below, the configuration is set for Transmission Control Protocol (TCP) transport method and IF testing:



GRB Simulator GUI Functions - Configurations

- The options for *Transport Protocol* are:
  - TCP for IF, baseband, or loopback testing
  - UDP* for baseband testing
  - UDP_MULTICAST for baseband or loopback testing

  *UDP = User Datagram Protocol
- The options for *External Header Type* are:
  - RT_LOGIC_UPLINK for IF or loopback testing
  - IPDU*_DOWNLINK for baseband or loopback testing
  - NONE for baseband or loopback testing

  *IPDU = Internet Protocol Data Unit

GRB Simulator GUI Functions - Configurations

- The ***APID Reference Info*** section is broken down by Image and Non-Image patterns.
  - The APID configuration tells GRB Simulator how to handle both proxy data AND non-image test patterns, since it is not unique and specific to image test patterns.

- **NOTE:** In the configuration file, APID numbers are displayed in decimal values. In the SE-16 Product Definition and Users Guide (PUG), Volume 4, GRB document, the APID numbers are displayed in hex values.

GRB Simulator GUI Functions - Configurations

- To convert an APID decimal value to a hex, you can use a scientific calculator from a PC desktop or go to a Linux terminal session and type a command as shown below:
  - From a Linux terminal session, type the following to convert from decimal to hex value**:** ***echo "obase=16;* <value>*" | bc***
  - Hit *Enter* key to get results. For example, a value of 308 decimal would equal a value of 134 hex.
  - From a Linux terminal session, type the following to convert from hex to decimal value: ***echo "ibase=16; <value>" | bc***
  - Hit '**Enter**' key to get results. For example, a value of 134 hex would equal a value of 308 decimal.

GRB Simulator GUI Functions - Configurations

- In this example, we are looking at the APID configurations for non-image test patterns that are part of EXIS, GLM, MAG, and SEISS instrument data:

GRBSM.conf - WordPad

File Edit View Insert Format Help

```
# Non Image
apid EXIS_EUVS 897 BLOB_ARRAY 60 irradianceSpectrum 2 FLOAT32 0.00 TP_VAR MDA report_number 30 wavelenth_bin 23 time 1 DOUBLE64
100.01 NOT_TP_VAR SV report_number 30 low_wavelength 2 FLOAT32 101.02 NOT_TP_VAR MDA report_number 30 wavelenth_bin 23
high_wavelength 2 FLOAT32 124.25 NOT_TP_VAR MDA report_number 30 wavelenth_bin 23 EUV_CaseNumber 1 UBYTE8 147 NOT_TP_VAR SV
report_number 30 qualityFlags 1 UINT64 148 NOT_TP_VAR SV report_number 30 quaternion_Q0 1 FLOAT32 149.01 NOT_TP_VAR SV report_number
30 quaternion_Q1 1 FLOAT32 150.02 NOT_TP_VAR SV report_number 30 quaternion_Q2 1 FLOAT32 151.03 NOT_TP_VAR SV report_number 30
quaternion_Q3 1 FLOAT32 152.04 NOT_TP_VAR SV report_number 30 ECEF_X 1 FLOAT32 153.05 NOT_TP_VAR SV report_number 30 ECEF_Y 1 FLOAT32
154.06 NOT_TP_VAR SV report_number 30 ECEF_Z 1 FLOAT32 155.07 NOT_TP_VAR SV report_number 30 YawFlipFlag 1 UBYTE8 112 NOT_TP_VAR SV
report_number 30 SolarArrayCurrent 1 FLOAT32 157.09 NOT_TP_VAR SV report_number 30 nXRS 1 UBYTE8 114 NOT_TP_VAR SV report_number 30
nGoodXRSA 1 UBYTE8 115 NOT_TP_VAR SV report_number 30 nGoodXRSB 1 UBYTE8 116 NOT_TP_VAR SV report_number 30 nEUVSA 1 UBYTE8 117
NOT_TP_VAR SV report_number 30 nGood256 1 UBYTE8 118 NOT_TP_VAR SV report_number 30 nGood284 1 UBYTE8 119 NOT_TP_VAR SV report_number
30 nGood304 1 UBYTE8 120 NOT_TP_VAR SV report_number 30 nEUVSB 1 UBYTE8 121 NOT_TP_VAR SV report_number 30 nGood1175 1 UBYTE8 122
NOT_TP_VAR SV report_number 30 nGood1216 1 UBYTE8 123 NOT_TP_VAR SV report_number 30 nGood1335 1 UBYTE8 124 NOT_TP_VAR SV
report_number 30 nGood1405 1 UBYTE8 125 NOT_TP_VAR SV report_number 30 nEUVSC 1 UBYTE8 126 NOT_TP_VAR SV report_number 30 nGoodMg 1
UBYTE8 127 NOT_TP_VAR SV report_number 30 xrsQualityFlags 2 UINT32 128 NOT_TP_VAR MDA report_number 30
max_num_XRS_obs_spectrum_interval 30 euvsaQualityFlags 2 UINT32 158 NOT_TP_VAR MDA report_number 30
max_num_EUVS_A_obs_spectrum_interval 30 euvsbQualityFlags 2 UINT32 188 NOT_TP_VAR MDA report_number 30
max_num_EUVS_B_obs_spectrum_interval 30 euvscQualityFlags 2 UINT32 218 NOT_TP_VAR MDA report_number 30
max_num_EUVS_C_obs_spectrum_interval 6 euvsaAvgTemp 1 FLOAT32 219.01 NOT_TP_VAR SV report_number 30 euvsbAvgTemp 1 FLOAT32 220.02
NOT_TP_VAR SV report_number 30 euvsc1AvgTemp 1 FLOAT32 221.03 NOT_TP_VAR SV report_number 30 euvsc2AvgTemp 1 FLOAT32 222.04
NOT_TP_VAR SV report_number 30 avgIrradianceXRSA 1 FLOAT32 223.05 NOT_TP_VAR SV report_number 30 avgIrradianceXRSB 1 FLOAT32 224.06
NOT_TP_VAR SV report_number 30 avgIrradiance256 1 FLOAT32 225.07 NOT_TP_VAR SV report_number 30 avgIrradiance284 1 FLOAT32 226.08
NOT_TP_VAR SV report_number 30 avgIrradiance304 1 FLOAT32 227.09 NOT_TP_VAR SV report_number 30 avgIrradiance1175 1 FLOAT32 228.10
NOT_TP_VAR SV report_number 30 avgIrradiance1216 1 FLOAT32 229.11 NOT_TP_VAR SV report_number 30 avgIrradiance1335 1 FLOAT32 230.12
NOT_TP_VAR SV report_number 30 avgIrradiance1405 1 FLOAT32 231.13 NOT_TP_VAR SV report_number 30 avgRatioMgExis 1 FLOAT32 232.14
NOT_TP_VAR SV report_number 30 avgRatioMgNoaa 1 FLOAT32 233.15 NOT_TP_VAR SV report_number 30 dailyIrradianceXRSA 1 FLOAT32 234.16
NOT_TP_VAR SV report_number 30 dailyIrradianceXRSB 1 FLOAT32 235.17 NOT_TP_VAR SV report_number 30 dailyIrradiance256 1 FLOAT32
236.18 NOT_TP_VAR SV report_number 30 dailyIrradiance284 1 FLOAT32 237.19 NOT_TP_VAR SV report_number 30 dailyIrradiance304 1 FLOAT32
238.20 NOT_TP_VAR SV report_number 30 dailyIrradiance1175 1 FLOAT32 239.21 NOT_TP_VAR SV report_number 30 dailyIrradiance1216 1
FLOAT32 240.22 NOT_TP_VAR SV report_number 30 dailyIrradiance1335 1 FLOAT32 241.23 NOT_TP_VAR SV report_number 30 dailyIrradiance1405
1 FLOAT32 242.24 NOT_TP_VAR SV report_number 30 dailyRatioMgNoaa 1 FLOAT32 243.25 NOT_TP_VAR SV report_number 30
averageSPSdispersionAngle 1 FLOAT32 244.26 NOT_TP_VAR SV report_number 30 averageSPScrossDispersionAngle 1 FLOAT32 245.27 NOT_TP_VAR
```

For Help, press F1 NUM

GRB Simulator GUI Functions - Configurations

- In this configuration example, we are looking at the APIDs for the ABI Full Disk Radiance Images. The information includes:
  - The short name for each ABI L1b product based on mode and channel ID
  - Variables and dimensions

GRBSM.conf - WordPad

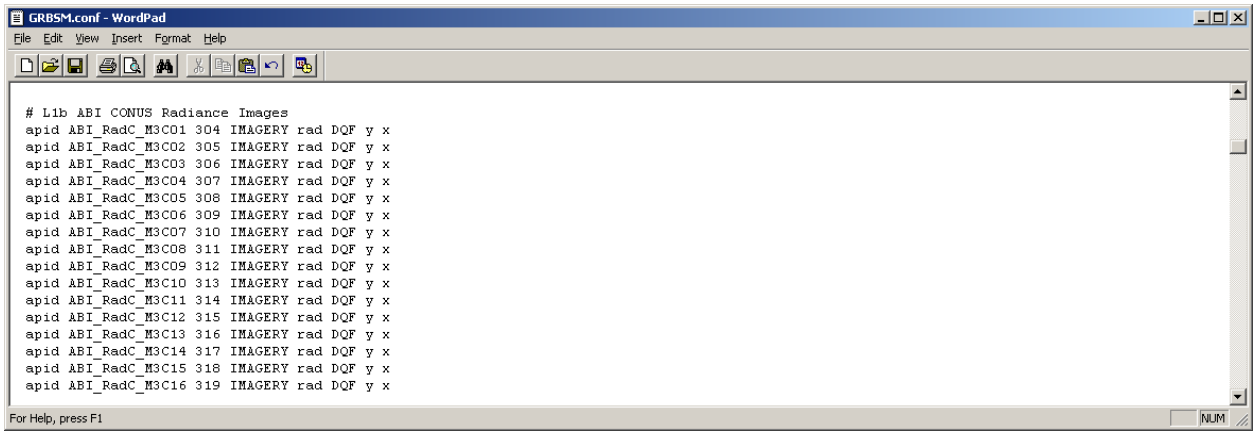
File Edit View Insert Format Help

```
# L1b ABI Full Disk Radiance Images
apid ABI_RadF_M3C01 272 IMAGERY rad DQF y x
apid ABI_RadF_M4C01 400 IMAGERY rad DQF y x
apid ABI_RadF_M3C02 273 IMAGERY rad DQF y x
apid ABI_RadF_M4C02 401 IMAGERY rad DQF y x
apid ABI_RadF_M3C03 274 IMAGERY rad DQF y x
apid ABI_RadF_M4C03 402 IMAGERY rad DQF y x
apid ABI_RadF_M3C04 275 IMAGERY rad DQF y x
apid ABI_RadF_M4C04 403 IMAGERY rad DQF y x
apid ABI_RadF_M3C05 276 IMAGERY rad DQF y x
apid ABI_RadF_M4C05 404 IMAGERY rad DQF y x
apid ABI_RadF_M3C06 277 IMAGERY rad DQF y x
apid ABI_RadF_M4C06 405 IMAGERY rad DQF y x
apid ABI_RadF_M3C07 278 IMAGERY rad DQF y x
apid ABI_RadF_M4C07 406 IMAGERY rad DQF y x
apid ABI_RadF_M3C08 279 IMAGERY rad DQF y x
apid ABI_RadF_M4C08 407 IMAGERY rad DQF y x
apid ABI_RadF_M3C09 280 IMAGERY rad DQF y x
apid ABI_RadF_M4C09 408 IMAGERY rad DQF y x
apid ABI_RadF_M3C10 281 IMAGERY rad DQF y x
```

For Help, press F1 NUM

GRB Simulator GUI Functions - Configurations

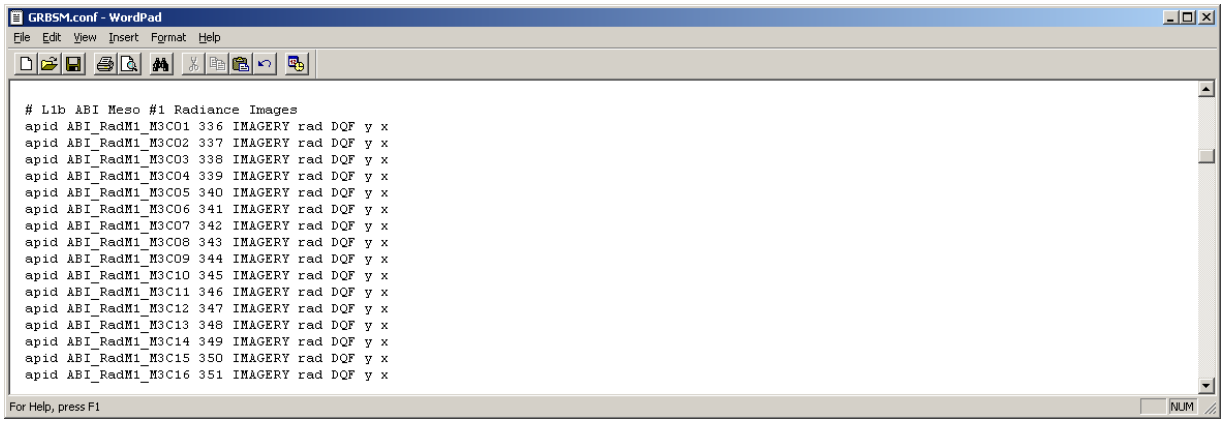
- In this configuration example, we are looking at the APIDs for the ABI CONUS Radiance Images. The information includes:
  - The short name for each ABI L1b product based on mode and channel ID
  - The netCDF variables containing image radiance data and ‘y’ and ‘x’ dimension names used in the netCDF file.




```
# L1b ABI CONUS Radiance Images
apid ABI_RadC_M3C01 304 IMAGERY rad DQF y x
apid ABI_RadC_M3C02 305 IMAGERY rad DQF y x
apid ABI_RadC_M3C03 306 IMAGERY rad DQF y x
apid ABI_RadC_M3C04 307 IMAGERY rad DQF y x
apid ABI_RadC_M3C05 308 IMAGERY rad DQF y x
apid ABI_RadC_M3C06 309 IMAGERY rad DQF y x
apid ABI_RadC_M3C07 310 IMAGERY rad DQF y x
apid ABI_RadC_M3C08 311 IMAGERY rad DQF y x
apid ABI_RadC_M3C09 312 IMAGERY rad DQF y x
apid ABI_RadC_M3C10 313 IMAGERY rad DQF y x
apid ABI_RadC_M3C11 314 IMAGERY rad DQF y x
apid ABI_RadC_M3C12 315 IMAGERY rad DQF y x
apid ABI_RadC_M3C13 316 IMAGERY rad DQF y x
apid ABI_RadC_M3C14 317 IMAGERY rad DQF y x
apid ABI_RadC_M3C15 318 IMAGERY rad DQF y x
apid ABI_RadC_M3C16 319 IMAGERY rad DQF y x
```

GRB Simulator GUI Functions - Configurations

- In this configuration example, we are looking at the APIDs for the ABI Mesoscale #1 Radiance Images. The information includes:
  - The short name for each ABI L1b product based on mode and channel ID
  - The netCDF variables containing image radiance data and ‘y’ and ‘x’ dimension names used in the netCDF file.




```
# L1b ABI Meso #1 Radiance Images
apid ABI_RadM1_M3C01 336 IMAGERY rad DQF y x
apid ABI_RadM1_M3C02 337 IMAGERY rad DQF y x
apid ABI_RadM1_M3C03 338 IMAGERY rad DQF y x
apid ABI_RadM1_M3C04 339 IMAGERY rad DQF y x
apid ABI_RadM1_M3C05 340 IMAGERY rad DQF y x
apid ABI_RadM1_M3C06 341 IMAGERY rad DQF y x
apid ABI_RadM1_M3C07 342 IMAGERY rad DQF y x
apid ABI_RadM1_M3C08 343 IMAGERY rad DQF y x
apid ABI_RadM1_M3C09 344 IMAGERY rad DQF y x
apid ABI_RadM1_M3C10 345 IMAGERY rad DQF y x
apid ABI_RadM1_M3C11 346 IMAGERY rad DQF y x
apid ABI_RadM1_M3C12 347 IMAGERY rad DQF y x
apid ABI_RadM1_M3C13 348 IMAGERY rad DQF y x
apid ABI_RadM1_M3C14 349 IMAGERY rad DQF y x
apid ABI_RadM1_M3C15 350 IMAGERY rad DQF y x
apid ABI_RadM1_M3C16 351 IMAGERY rad DQF y x
```

GRB Simulator GUI Functions - Configurations

- In this configuration example, we are looking at the APIDs for SUVI . The information includes:
  - The short name for each SUVI product based on wavelength
  - Variables and dimensions

GRBSM.conf - WordPad

File Edit View Insert Format Help

```
# L1b SUVI Imagery
apid SUVI_Fe94 1184 IMAGERY solar_imagery solar_imagery_quality_flag NAXIS1 NAXIS2
apid SUVI_Fe132 1185 IMAGERY solar_imagery solar_imagery_quality_flag NAXIS1 NAXIS2
apid SUVI_Fe171 1186 IMAGERY solar_imagery solar_imagery_quality_flag NAXIS1 NAXIS2
apid SUVI_Fe195 1187 IMAGERY solar_imagery solar_imagery_quality_flag NAXIS1 NAXIS2
```

For Help, press F1 NUM

GRB Simulator GUI Functions - Configurations

- In this configuration example, we are looking at the APIDs for metadata files associated to all 6 instruments (ABI, SUVI, GLM, SEISS, EXIS, and MAG).

GRBSM.conf - WordPad

File Edit View Insert Format Help

```
# Metadata
apid ABI_MetaF_M3C01 256 METADATA_INFO
apid ABI_MetaF_M3C02 257 METADATA_INFO
apid ABI_MetaF_M3C03 258 METADATA_INFO
apid ABI_MetaF_M3C04 259 METADATA_INFO
apid ABI_MetaF_M3C05 260 METADATA_INFO
apid ABI_MetaF_M3C06 261 METADATA_INFO
apid ABI_MetaF_M3C07 262 METADATA_INFO
apid ABI_MetaF_M3C08 263 METADATA_INFO
apid ABI_MetaF_M3C09 264 METADATA_INFO
apid ABI_MetaF_M3C10 265 METADATA_INFO
apid ABI_MetaF_M3C11 266 METADATA_INFO
apid ABI_MetaF_M3C12 267 METADATA_INFO
apid ABI_MetaF_M3C13 268 METADATA_INFO
apid ABI_MetaF_M3C14 269 METADATA_INFO
apid ABI_MetaF_M3C15 270 METADATA_INFO
apid ABI_MetaF_M3C16 271 METADATA_INFO
apid ABI_MetaC_M3C01 288 METADATA_INFO
apid ABI_MetaC_M3C02 289 METADATA_INFO
apid ABI_MetaC_M3C03 290 METADATA_INFO
apid ABI_MetaC_M3C04 291 METADATA_INFO
apid ABI_MetaC_M3C05 292 METADATA_INFO
apid ABI_MetaC_M3C06 293 METADATA_INFO
apid ABI_MetaC_M3C07 294 METADATA_INFO
```

For Help, press F1 NUM

GRBSM.conf - WordPad

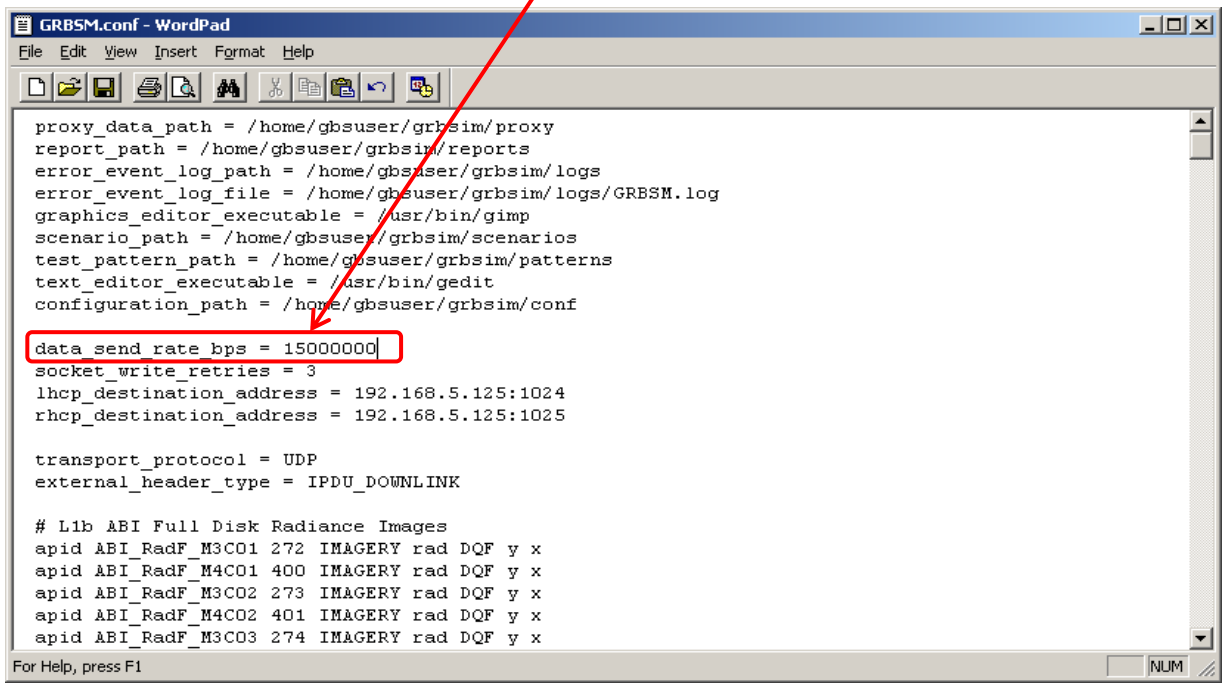
File Edit View Insert Format Help

```
apid ABI_MetaF_M4C08 391 METADATA_INFO
apid ABI_MetaF_M4C09 392 METADATA_INFO
apid ABI_MetaF_M4C10 393 METADATA_INFO
apid ABI_MetaF_M4C11 394 METADATA_INFO
apid ABI_MetaF_M4C12 395 METADATA_INFO
apid ABI_MetaF_M4C13 396 METADATA_INFO
apid ABI_MetaF_M4C14 397 METADATA_INFO
apid ABI_MetaF_M4C15 398 METADATA_INFO
apid ABI_MetaF_M4C16 399 METADATA_INFO
apid GLM_Meta 768 METADATA_INFO
apid EXIS_SFEU_Meta 896 METADATA_INFO
apid EXIS_SFXR_Meta 912 METADATA_INFO
apid SEIS_EHIS_Meta 1024 METADATA_INFO
apid SEIS_MPSL_Meta 1040 METADATA_INFO
apid SEIS_MPSH_Meta 1056 METADATA_INFO
apid SEIS_SGPS_Meta 1072 METADATA_INFO
apid SUVI_Fe94_Meta 1152 METADATA_INFO
apid SUVI_Fe132_Meta 1153 METADATA_INFO
apid SUVI_Fe171_Meta 1154 METADATA_INFO
apid SUVI_Fe195_Meta 1155 METADATA_INFO
apid SUVI_Fe284_Meta 1156 METADATA_INFO
apid SUVI_He304_Meta 1157 METADATA_INFO
apid MAG_Meta 1280 METADATA_INFO
apid GRB_INFO 1408 METADATA_INFO
```

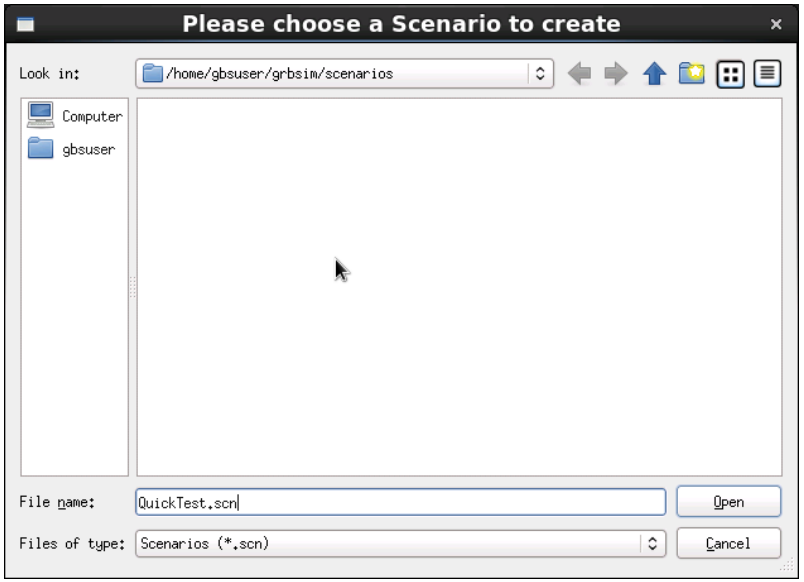
For Help, press F1 NUM

GRB Simulator GUI Functions - Configurations

- The **data_send_rate_bps** variable is used to throttle data output to a specified rate for each CCSDS packet that gets sent during packet generation.
  - It would be entered in the ***Packet Processing*** section.
  - It is in bits values (e.g. 15 mbps would be entered as '15000000')



GRB Simulator GUI Functions - Scenarios



- A scenario is a script that defines a series of steps for generating GRB output
- The scenario may contain control constructs such as looping and conditionals

GRB Simulator GUI Functions - Scenarios

- The scenario specifies:
  - the test data to use for the simulation
  - the time or duration of simulation execution
  - header content modification
- The test data for the GRB Simulator consists of
  - Image and non-image test patterns
  - proxy data
  - or both in any given scenario

GRB Simulator GUI Functions - Scenarios

- The GRB Simulator software uses the Tool Command Language (TCL) for the scripting of scenarios.
- Here are some of the common commands used:
  - **RUN** – required in order to initialize scenario
    - Includes the following CLAUSES:
      - ***IMAGE-PROXY-CLAUSE***
      - ***PROXY-CLAUSE***
      - ***METADATA-CLAUSE***
      - ***PATTERN-CLAUSE***
      - ***NITP-CLAUSE***
      - ***INFO-CLAUSE***

    NOTE: Commands are in lowercase. Using uppercase lettering will cause the command execution to fail upon running simulation.
- ***SECTION*** – used to create a grouping of script commands for the benefit of the user (optional only)

GRB Simulator GUI Functions - Scenarios

- **TIME** – used for setting up timestamps for the test data
- **REPLACE** – normally used when replacing a field value with an error condition
- **PROXY-COMMAND-NAME** – used to declare the proxy name to be tested
- **PATTERN-COMMAND-NAME** – used to declare the test pattern name to be tested
- **Additional CLAUSES**
  - ***APID-CLAUSE*** – used to identify the APID alias for a test file
  - ***DURATION-CLAUSE*** – used to declare a specific integer length for a duration type
    - **Duration Types** include:
      - Times
      - Seconds
      - Minutes
      - Hours
      - Days

GRB Simulator GUI Functions - Scenarios

- The variables include:
  - **SHAPE**
    - *Sinusoidal*
    - *Square*
    - *Triangle*
  - **COLOR-BAND**
    - *Intensity*
    - *Red*
    - *Green*
    - *Blue*
    - *Mono*
  - **FIELD**
    - *ccsds_version*
    - *packet_type*
    - *secondary_header_flag*
    - *APID*
    - *packet_sequence_count*

GRB Simulator GUI Functions - Scenarios

- *data_length*
- *sequence_flag*
- *grb_version*
- *payload_variant*
- *assembler_id*
- *operational_environment*
- *time_code*

– **CONDITION**

- = or != (equal or not equal to)
- < or <= (less than or equal to)
- > or >= (greater than or equal to)

- **NOTE:** The field entries can be uppercase or lowercase when used in the scenario scripts.

GRB Simulator GUI Functions - Scenarios

- The ***Duration Clause*** is always at the end of the run command unless it is followed by an optional product start time in an image proxy command. Here are some examples of the duration clause:

run proxy abi_test.nc as ABI_RadC_M3C01 for 3 seconds

run proxy test.nc as ABI_CONUS_M3_RAD_C10 for 10 times

run proxy abi_test.nc as ABI_RadC_M3C02 for 5 minutes product_start_time 2000-01-02T13:01:01Z

GRB Simulator GUI Functions - Scenarios

- The ***FIELD*** variable can refer to either the field being replaced or the field being compared in a "when" replacement condition
  - **NOTE:** Replacement conditions are on separate lines
- Fields being replaced without comparison use the "*every*" replacement condition. Here is an example:

  replace ccsds_version with 1 every 100 packets with error
- Fields being replaced with comparison use the "*when*" replacement condition. Here are a few examples:

  replace secondary_header_flag with 0 when secondary_header_flag = 1

  replace grb_version with 1 when packet_sequence_count >= 1

GRB Simulator GUI Functions - Scenarios

- Example of **Non-Image Test Pattern** scenario with various commands, variables, and instruments used:

 # Example Non-Image scenario script

time 2013-03-14T17:15:25Z

section EXIS

run non_image_tp triangle mean 50 amplitude 10 wavelength 1 as EXIS_EUVS for 3 hours

section end EXIS

section SEISS

run nitp square mean 1000 amplitude 100 wavelength 0.2 as SEISS_MPS_LO for 5 minutes

section end SEISS

section MAG

run ni_tp sinusoidal mean 300 amplitude 75 wavelength 2 as MAG for 50000 times

section end MAG

section GLM

run glm_tp sinusoidal mean 300 amplitude 75 wavelength 2 as GLM_EVENT for 1 days

run glmtp square mean 500 amplitude 150 wavelength 0.5 as GLM_FLASH for 45 seconds

section end GLM

GRB Simulator GUI Functions - Scenarios

- Example of **Image Test Pattern** scenario with various commands and variables used:

 # Example Image scenario script

section testPatternBilinearRed

run pattern Colored_Bullseye.png /home/gbsuser/grbsim/patterns/twoKmData.xml ABI_CHANNEL_7_CONUS /home/gbsuser/grbsim/patterns/twoKmData.xml ABI_CHANNEL_7_CONUS_METADATA

REPLICATE GREEN as ABI_FD_M4_Rad_C4

section end testPatternBilinearRed

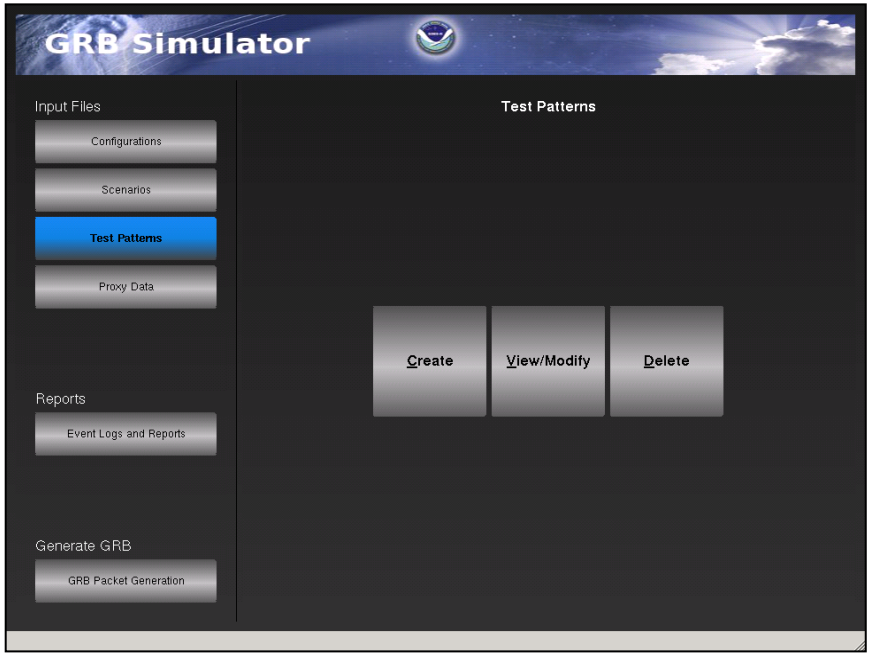
GRB Simulator GUI Functions - Scenarios

- Example of **Proxy Data** scenario with various commands and variables used:

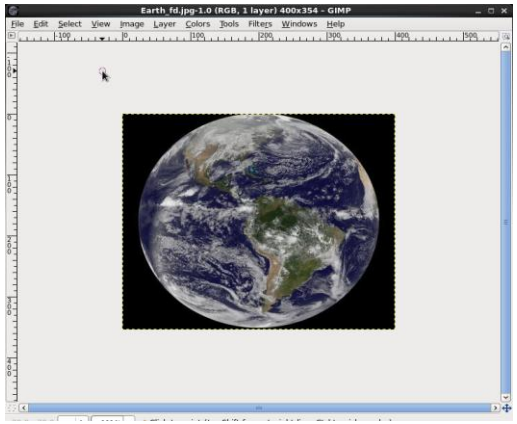
```
# Example Proxy Data scenario script

run proxy my_proxy.nc as apid ABI_RadF_M3C08 for 30 seconds

replace APID with 123 when PACKET_SEQUENCE_COUNT = 20

run metadata my_meta.ncml as ABI_MetaF_M3C08
```

- **NOTE:** In this example, notice that the field ‘APID’ variable is used in both uppercase and lowercase letters.

GRB Simulator GUI Functions – Test Patterns



- Test patterns are test data that are defined by a user
- For imaging instruments (ABI and SUVI), a user can manually create test pattern images using a provided graphical editor
- These graphical image test patterns can be saved in JPEG or PNG format as monochrome or color (RGB) images

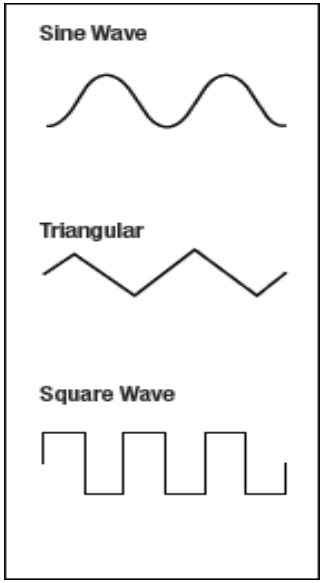


GRB Simulator GUI Functions – Test Patterns

- GRB Test Pattern Conversion uses either JPEG and/or PNG formatted files:
  - PNG file format supports both 8 and 16 bit monochromatic and RGB imagery
  - JPEG file format supports 8 and 12 bit monochromatic and RGB imagery
- GRB Test Pattern Conversion is capable of:
  - ingesting and converting input imagery up to 22176 pixels by 22176 pixels to output data variables of smaller or equal size
  - ingesting channel configuration parameters

GRB Simulator GUI Functions – Test Patterns

- Non-image test patterns, which apply to non-imaging instruments (GLM, SEISS, EXIS, and MAG), may also be defined by the user. **However,** this is accomplished by creating or editing a scenario that defines the boundaries of the non-image pattern and references the APID to use in the configuration file.
- Non-image test patterns are limited to sinusoidal, square, and triangle patterns.

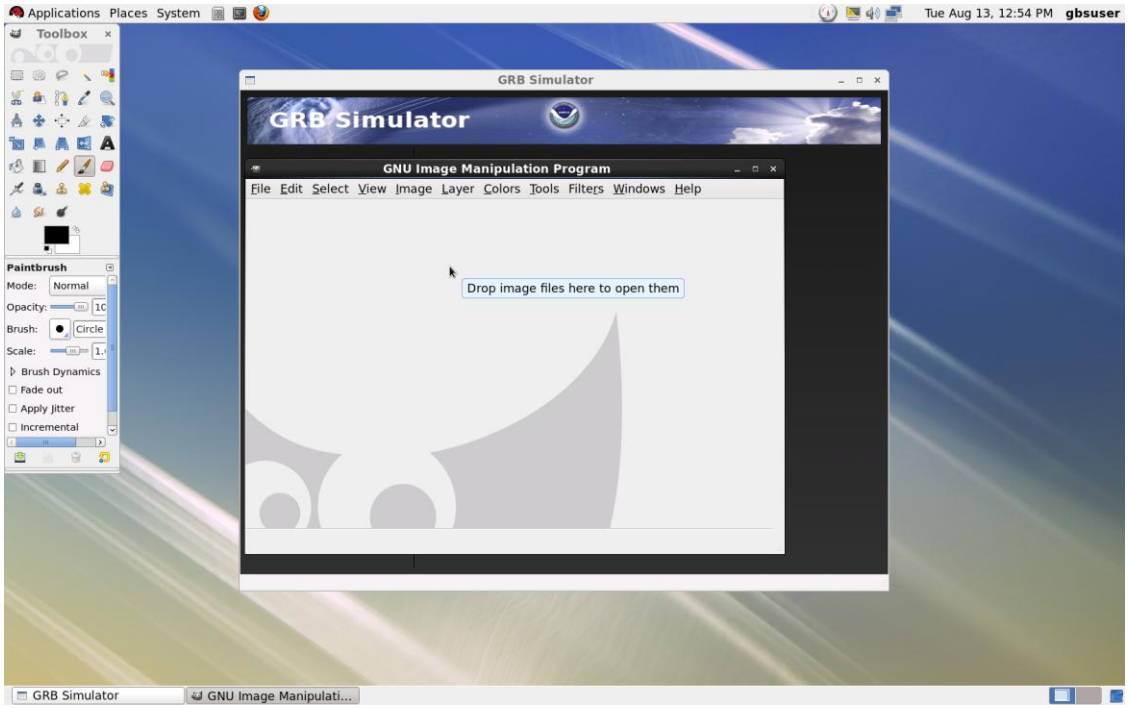


GRB Simulator GUI Functions – Test Patterns

- Selecting the ***Create*** button in the GRB Simulator GUI will launch the default graphical editor, GNU Image Manipulation Program (GIMP).

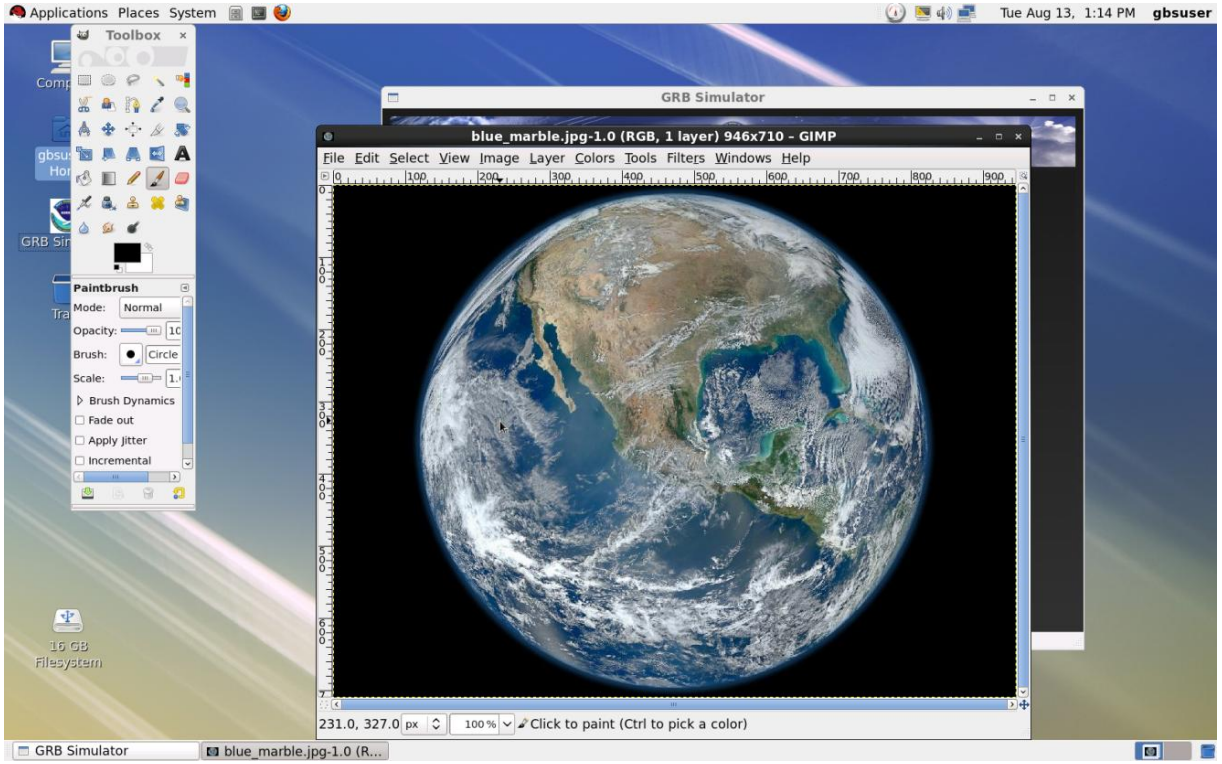
GRB Simulator GUI Functions – Test Patterns

- Upon opening up the **GIMP** program, a window will appear as shown below. You can either drag an image to the window, create a brand new image, or use the **File** menu to locate an image to use.



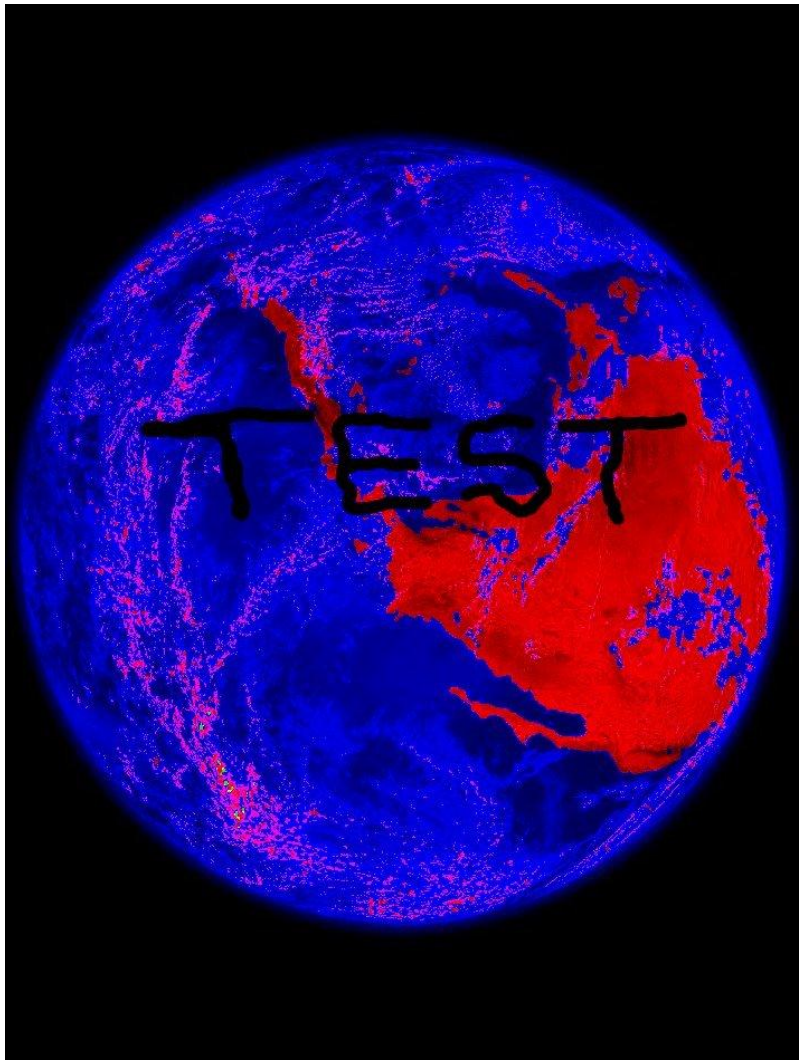
GRB Simulator GUI Functions – Test Patterns

- This is an example of an image test pattern that was selected.

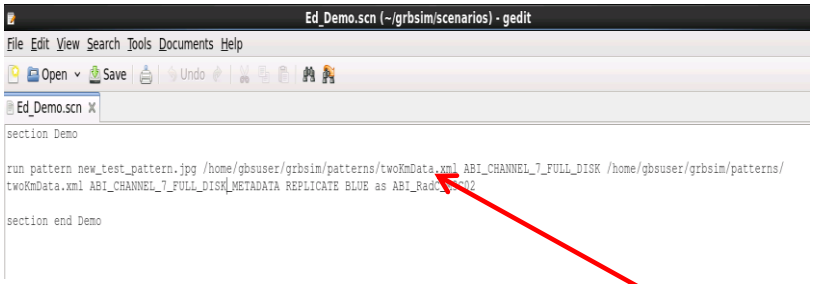


GRB Simulator GUI Functions – Test Patterns

- This is the result of using some of the tools in the GIMP graphics editor to change the color background and orientation of the image and appending the ‘TEST’ label.

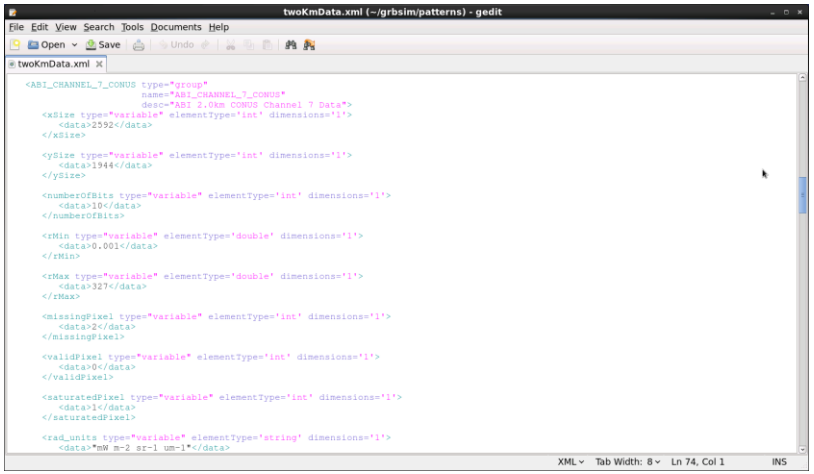


GRB Simulator GUI Functions – Test Patterns



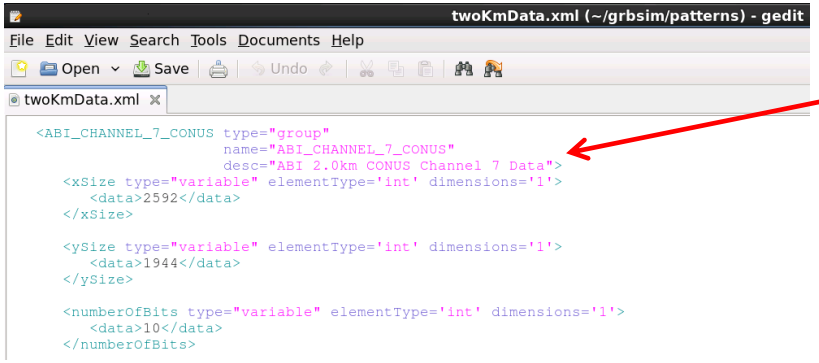
- Each image test pattern in a scenario script refers to an XML file for its data and metadata content.
- In this example, the image test pattern called '***new_test_pattern.jpg***' is referring to the '*twoKmData.xml*' file in the directory path '***/home/gbsuser/grbsim/patterns***'.

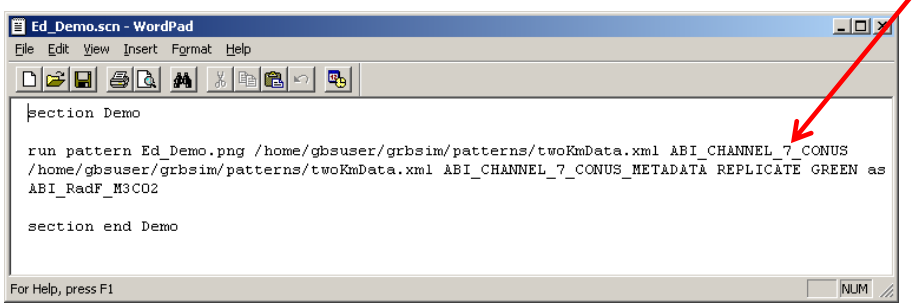
GRB Simulator GUI Functions – Test Patterns



- To open an XML file, navigate to the ***'/home/gbsuser/grbsim/patterns'*** directory and open the XML file in ***gedit*** application. In this example, we will open the ***twoKmData.xml*** file

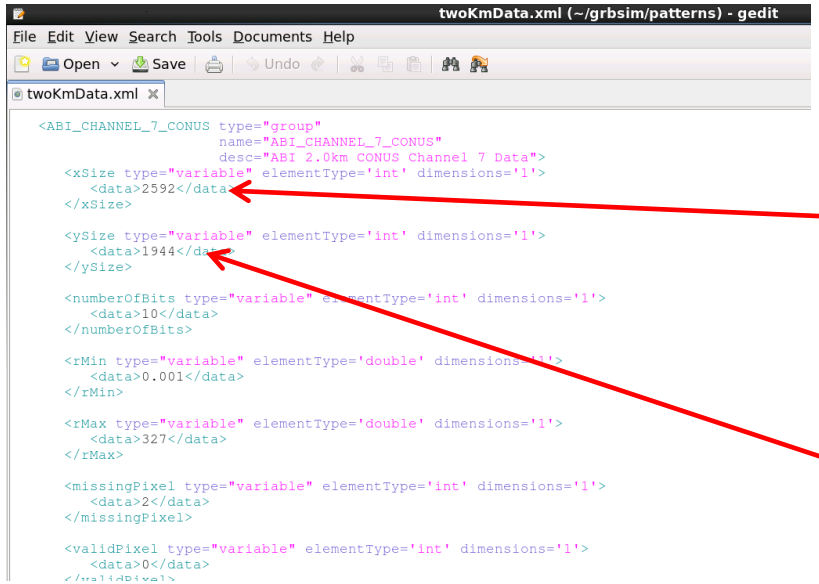
GRB Simulator GUI Functions – Test Patterns





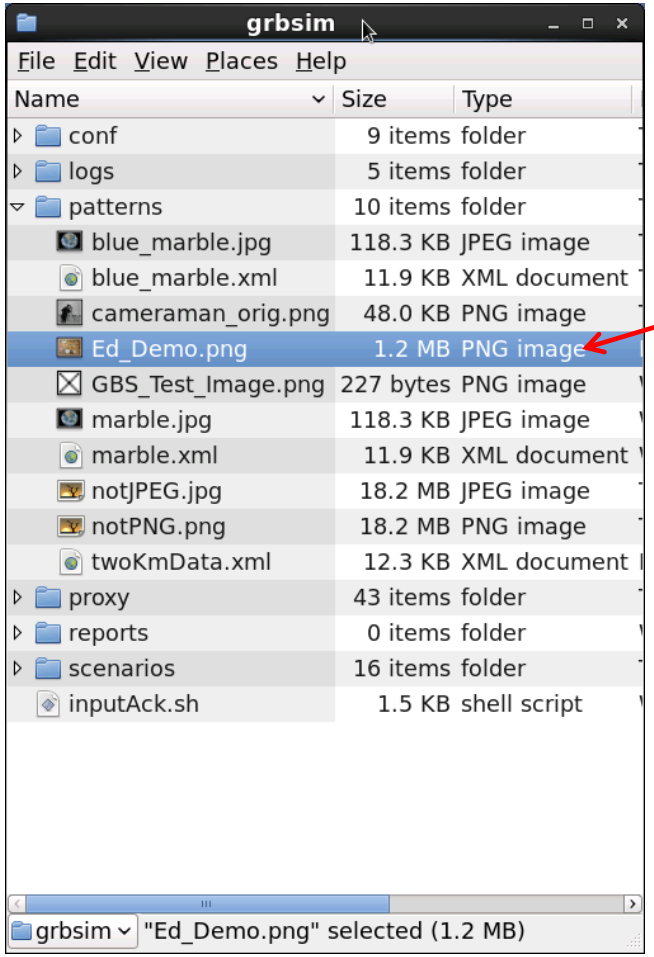
- The tag in this example, "***ABI_CHANNEL_7_CONUS***", specifies the values to use when converting image based test patterns from JPEG or PNG images. This must match the "***xml_band_section***" parameter of the "run pattern" command given in the scenario script, and must be present in the file designated by the "***xml_file_name***" parameter or the "***run pattern***" command in the scenario script.

GRB Simulator GUI Functions – Test Patterns



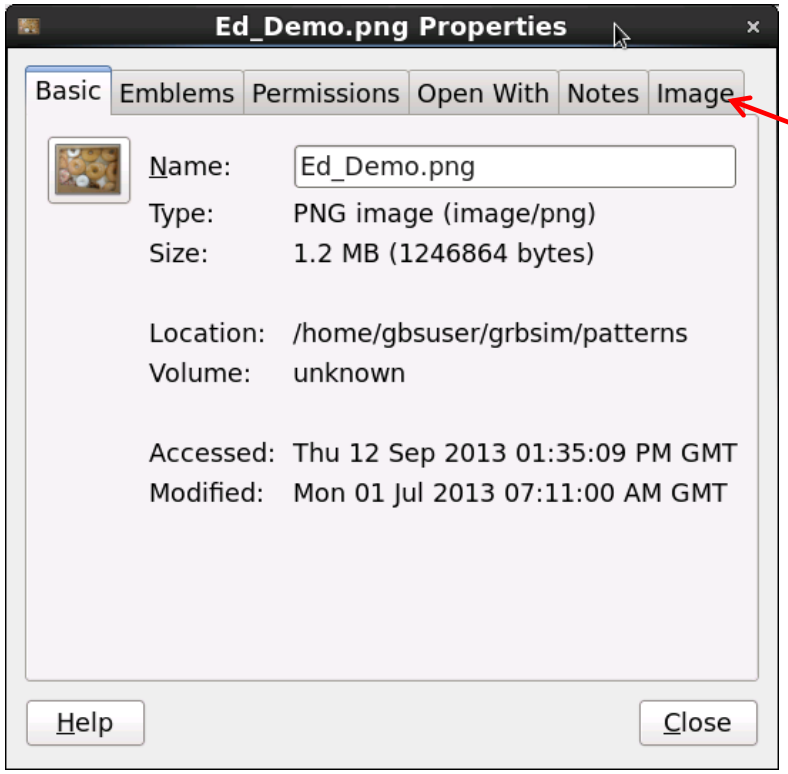
- The ***x*** dimension (width) of the test pattern image should be the same in the XML file. In this example, it is set to '***2592***' pixels.
- The ***y*** dimension (height) of the test pattern image should be the same in the XML file. In this example, it is set to '***1944***' pixels.

GRB Simulator GUI Functions – Test Patterns



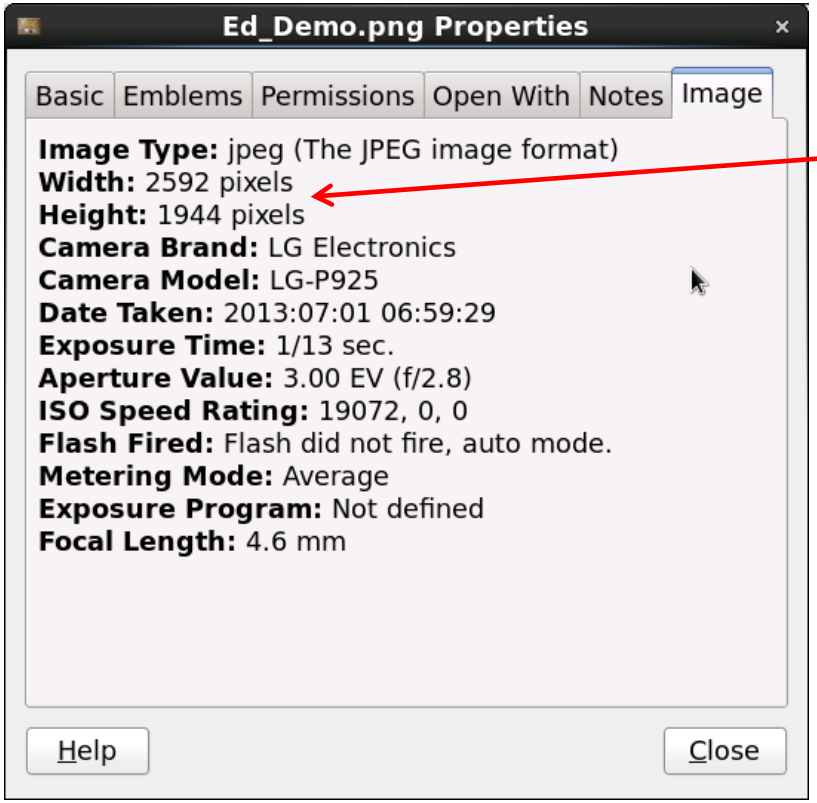
- To view the size of the image test pattern, you can right-click on the file from the ***'/home/gbsuser/grbsim/patterns'*** directory as shown here.

GRB Simulator GUI Functions – Test Patterns



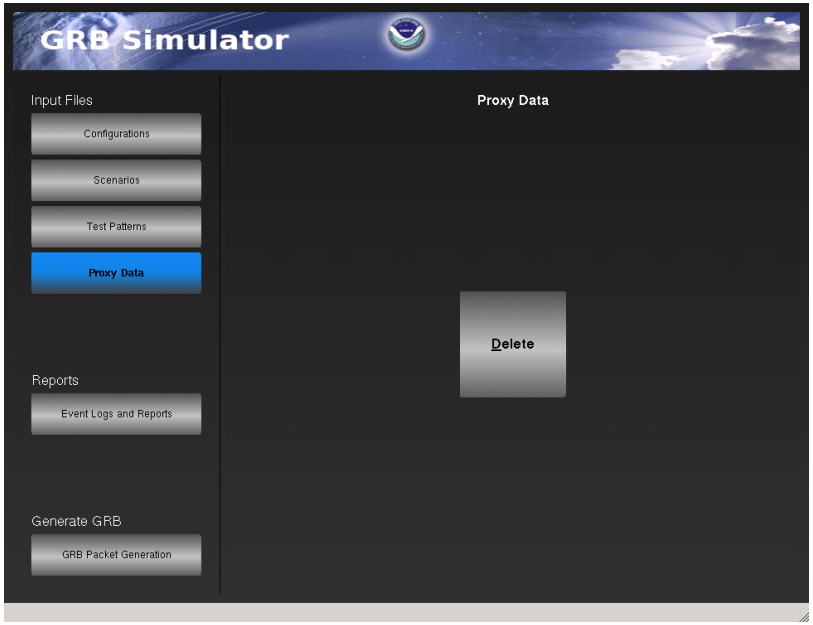
- A Properties display of the file will appear as shown below. Click on the **Image** tab to view the ***height*** and ***width*** of the image.

GRB Simulator GUI Functions – Test Patterns



- The ***height*** and ***width*** of the image is displayed as shown here.

GRB Simulator GUI Functions – Proxy Data

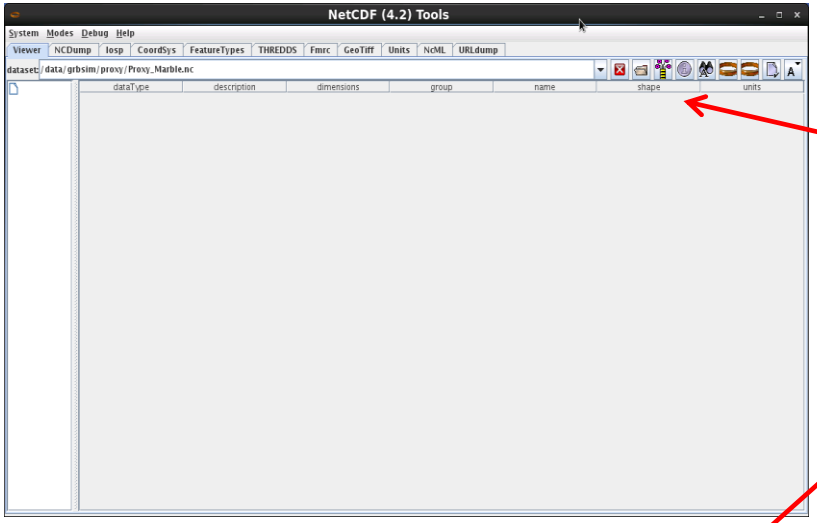


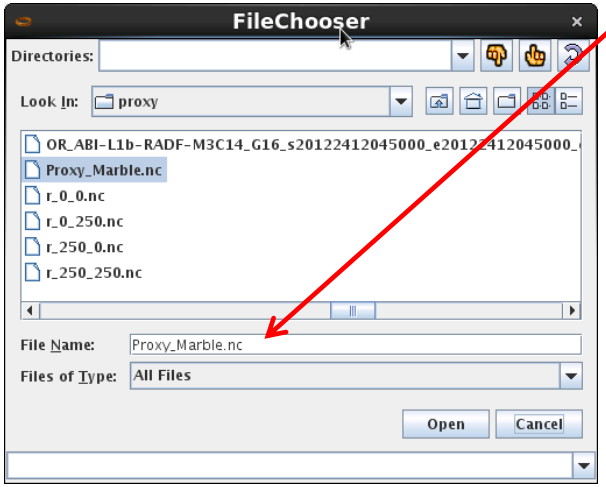
- Proxy data files:
  - contain L1b/GLM L2 equivalent data
  - are provided by a source external to the GRB Simulator
  - are specified in the configuration files
- Proxy metadata files:
  - contain L1b/GLM L2 equivalent metadata
  - are provided by a source external to the GRB Simulator
- The user cannot modify or view proxy data or metadata files via the GRB Simulator GUI. They can only delete them from the GUI.

GRB Simulator GUI Functions – Proxy Data

- Proxy data is also generated when test patterns are used in a scenario
  - GRB Simulator converts image and non-image test patterns into L1b formatted proxy data at the beginning of a simulation
  - stores them in a temporary location during the simulation
  - deletes them after the simulation terminates

GRB Simulator GUI Functions – Proxy Data

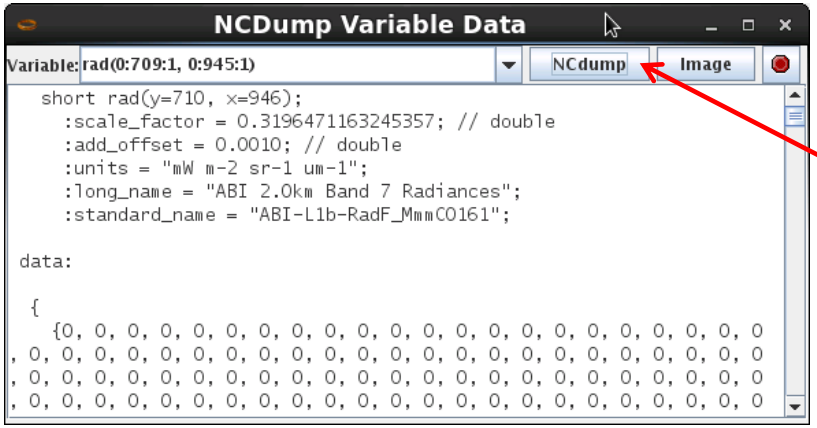




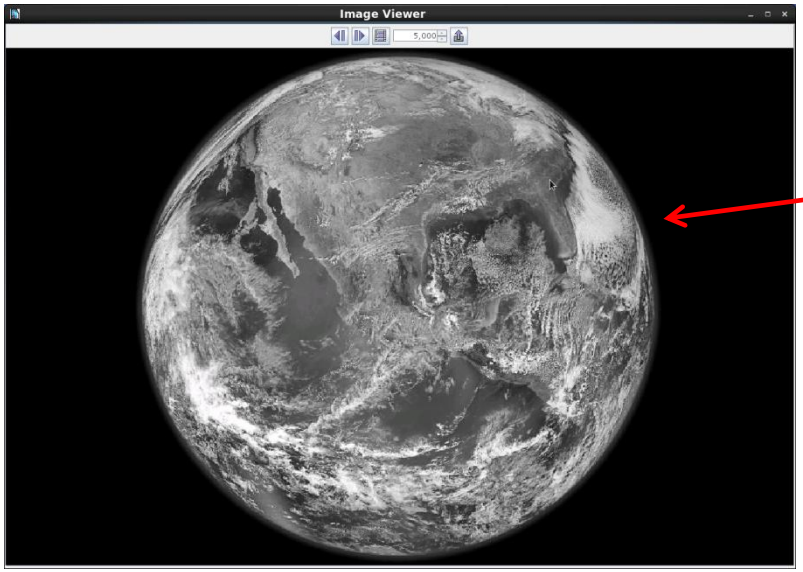
- To view the output of a proxy data, use the NetCDF viewer as shown here.
- Select the proxy file from the FileChooser dialog window as shown here.

NOTE: This tool is provided with the GRB Simulator.

GRB Simulator GUI Functions – Proxy Data

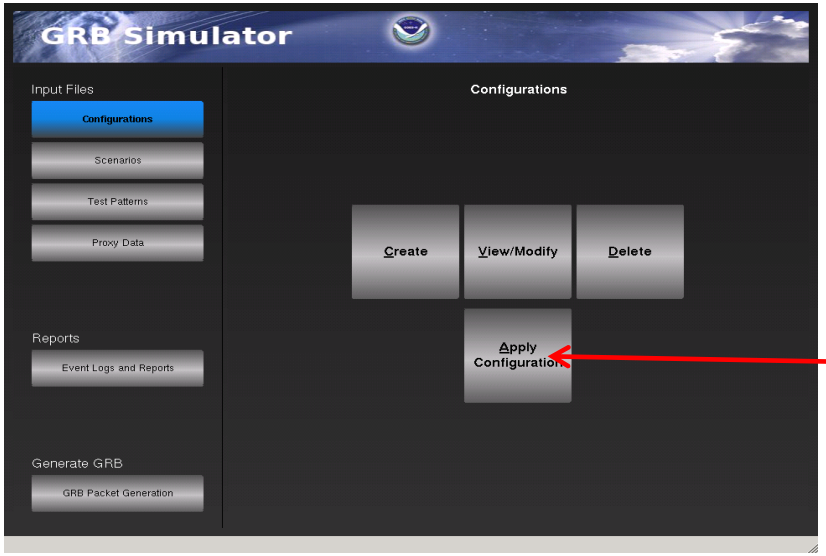


- The user can view either the binary information in the proxy data by clicking the ***NCdump*** button as shown here. The output will also display the variables.

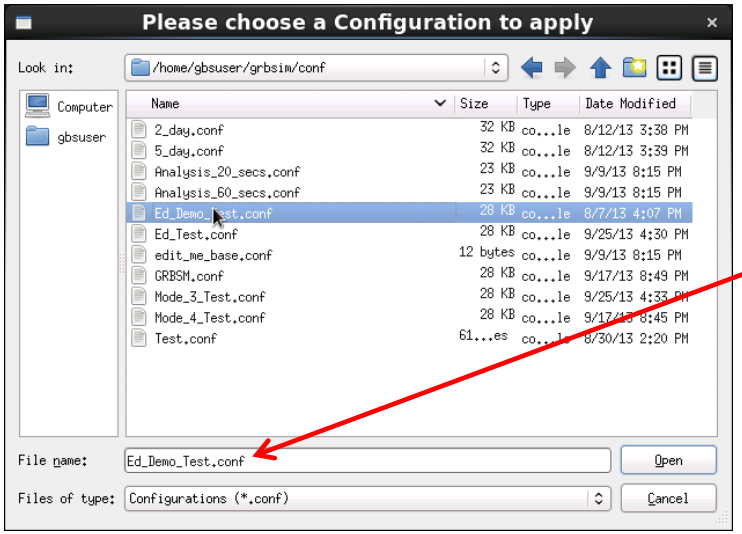


- To view the image, the user would click the ***Image*** button and view the proxy data as shown in this example here.

GRB Simulator GUI Functions – GRB Packet Generation

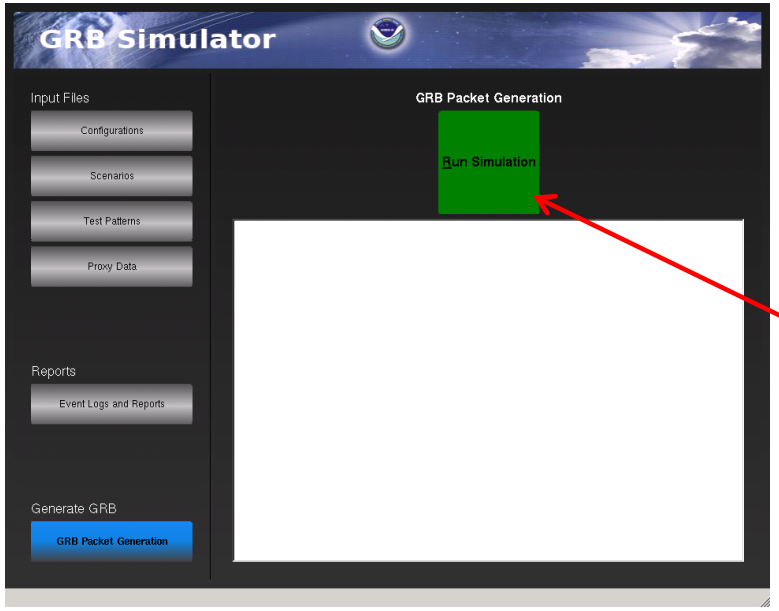


- To begin the GRB packet generation process, the user would need to apply a configuration file for the test pattern being generated. Click the ***Apply Configuration*** button as shown here.

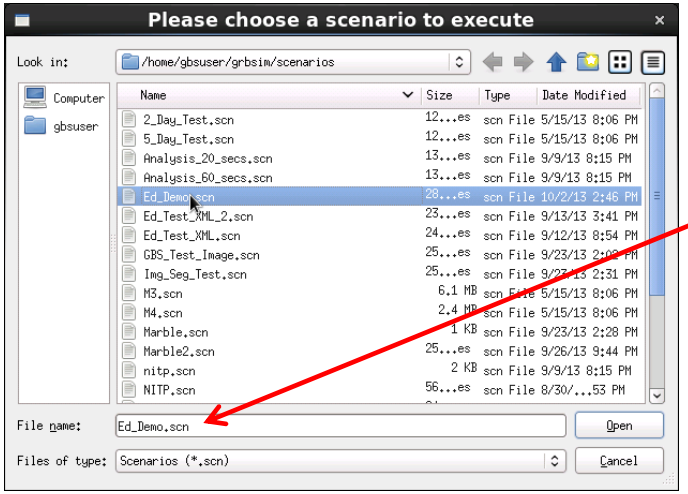


- Then select the configuration file to apply. In this example, **Ed_Demo_Test.conf** is selected.

GRB Simulator GUI Functions – GRB Packet Generation



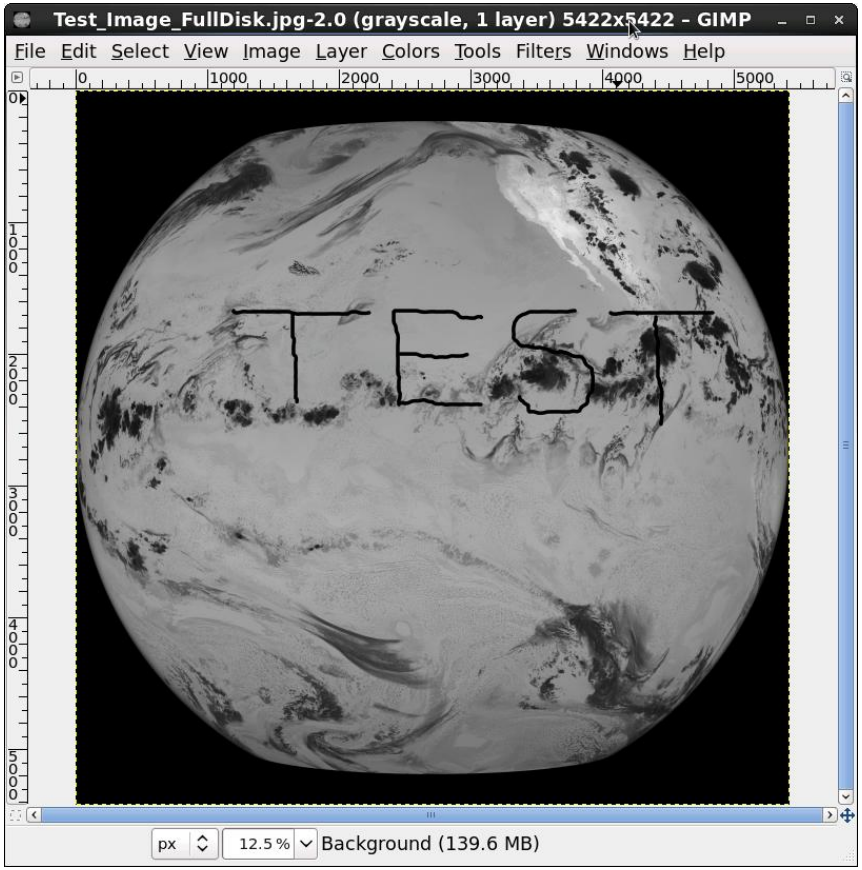
- Once a configuration file is applied, a scenario must be selected to run a GRB simulation.
- This is accomplished by clicking on the green ***Run Simulation*** button as shown here.



- Then select the scenario to run. In this example, **Ed_Demo.scn** scenario script is chosen.

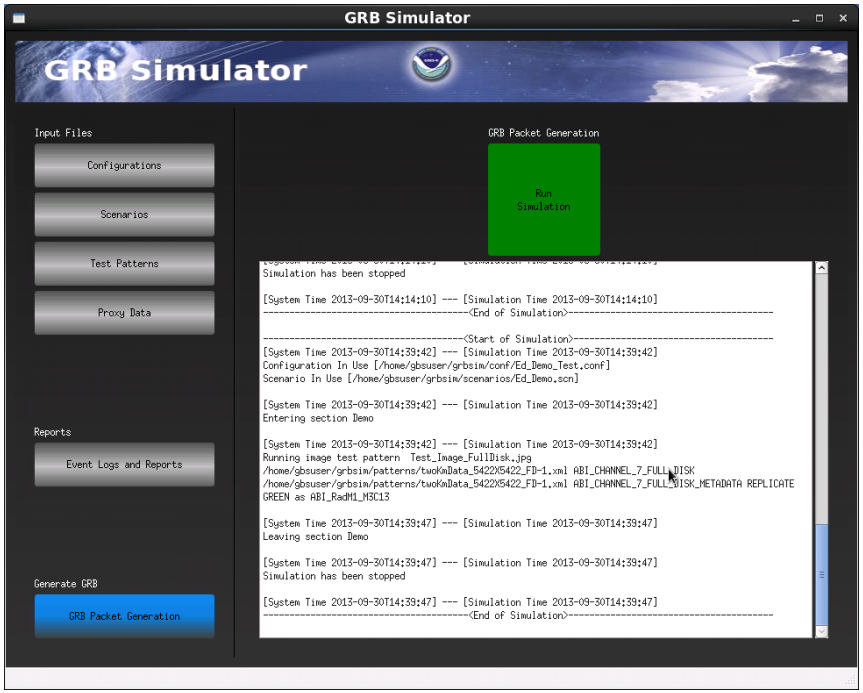
GRB Simulator GUI Functions – GRB Packet Generation

- The GRB Simulator software will inject the image test pattern into the ABI product that is referenced in the XML file that is used in the scenario. In this example, we are looking at an ABI L1b Full Disk Radiance product. This is the test pattern referenced in the scenario **Ed_Demo.scn** script.



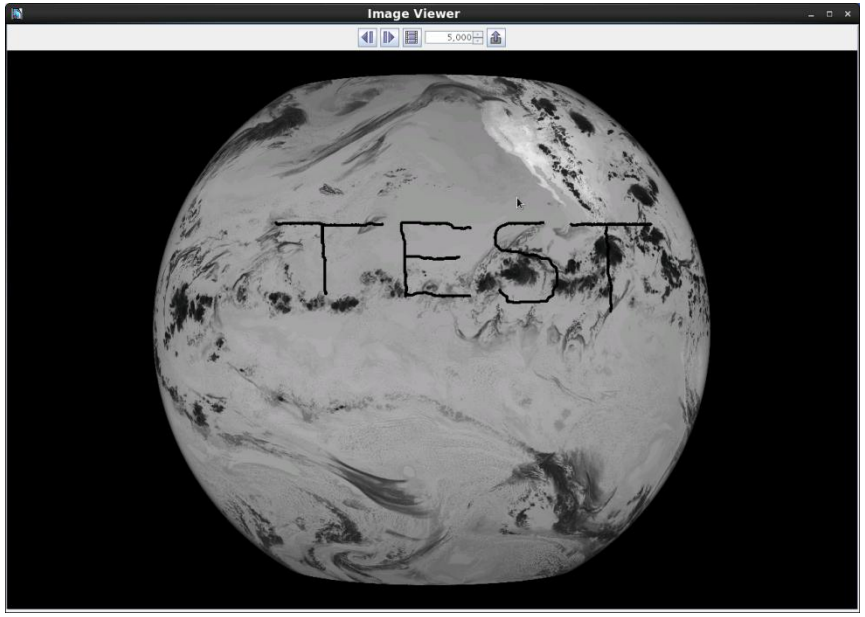
GRB Simulator GUI Functions – GRB Packet Generation

- In this first example of image test patterns, a simulation was conducted for an ABI L1b Channel 7 Full Disk radiance product.



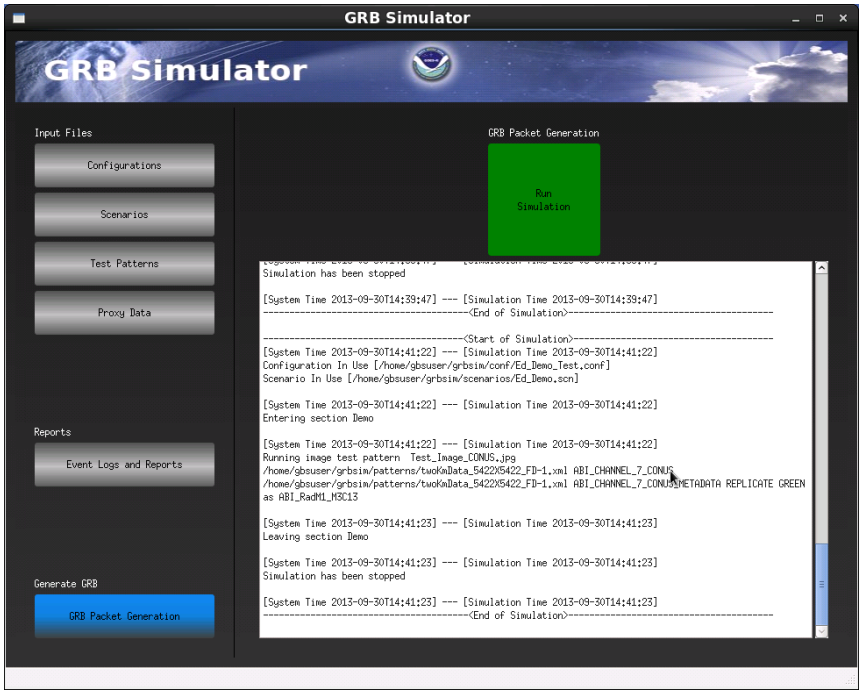
GRB Simulator GUI Functions – GRB Packet Generation

- This is the output result of the simulation using NetCDF Viewer application to view the .nc file for the ABI L1b Channel 7 Full Disk radiance product



GRB Simulator GUI Functions – GRB Packet Generation

- In this example of image test patterns, a scenario was conducted for an ABI L1b Channel 7 CONUS radiance product.

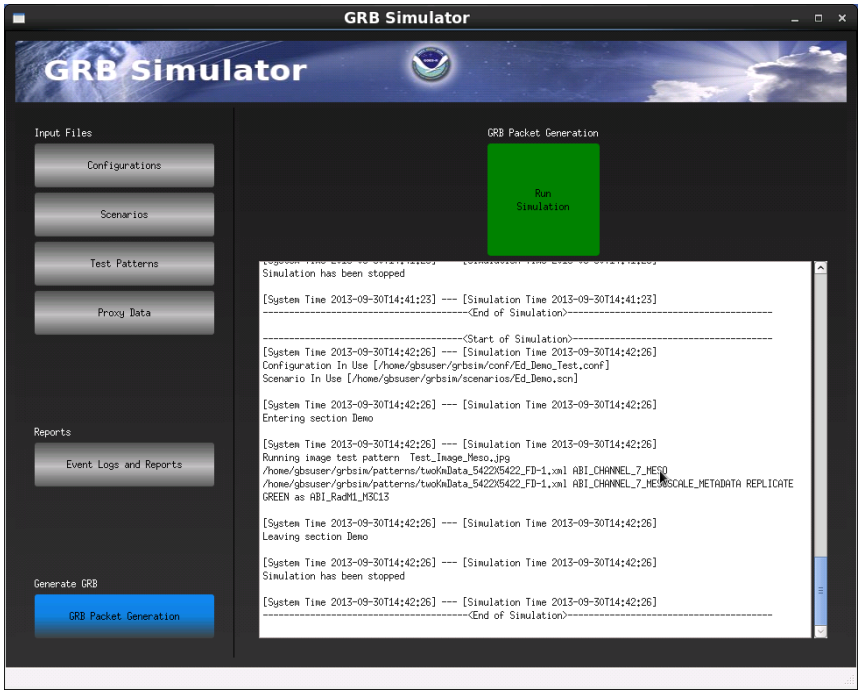


GRB Simulator GUI Functions – GRB Packet Generation

- This is the output result of the simulation using NetCDF Viewer application to view the .nc file for the ABI L1b Channel 7 CONUS radiance product

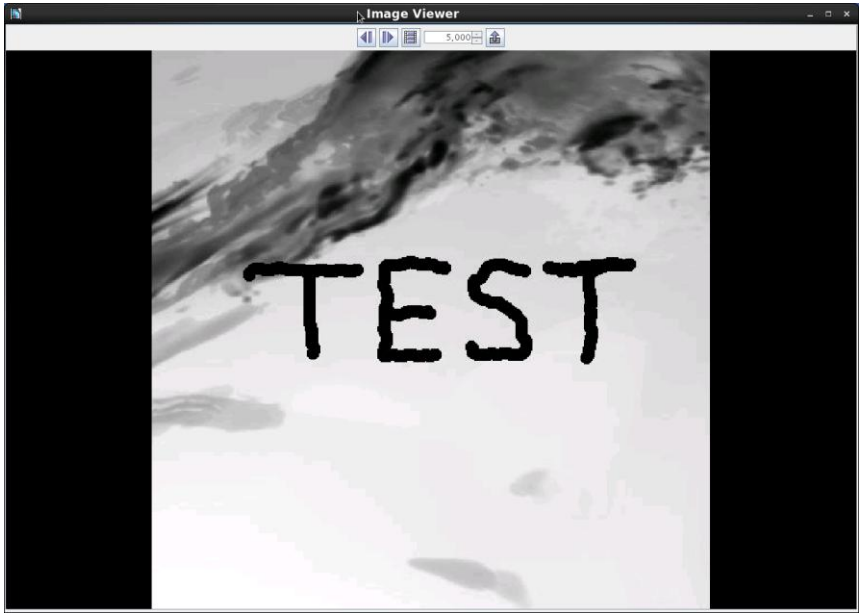
GRB Simulator GUI Functions – GRB Packet Generation

- In this example of image test patterns, a scenario was conducted for an ABI L1b Channel 7 MESO radiance product.



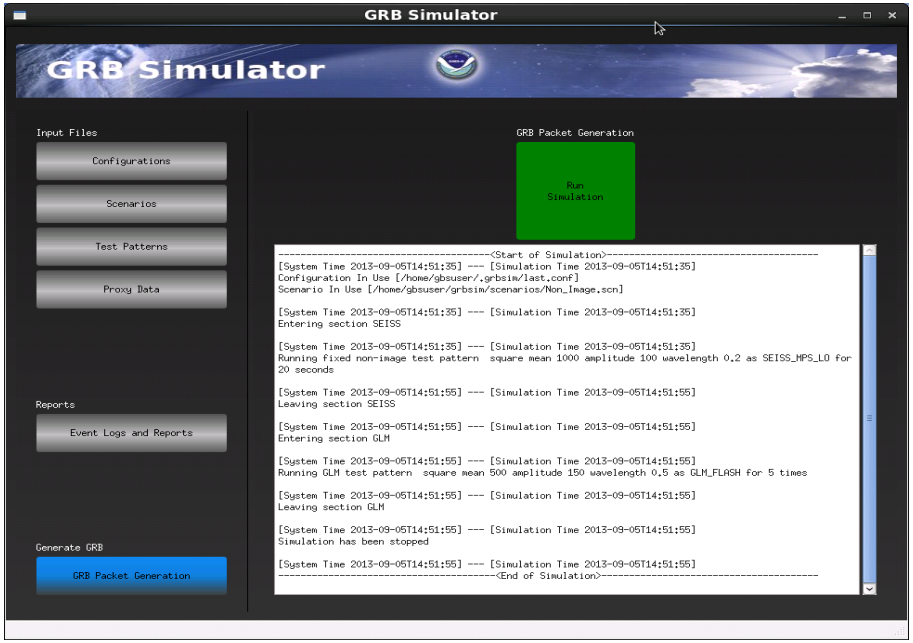
GRB Simulator GUI Functions – GRB Packet Generation

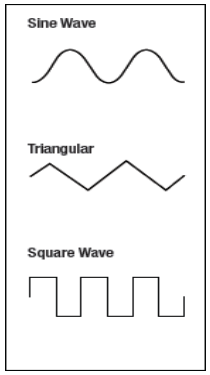
- This is the output result of the simulation using NetCDF Viewer application to view the .nc file for the ABI L1b Channel 7 MESO radiance product



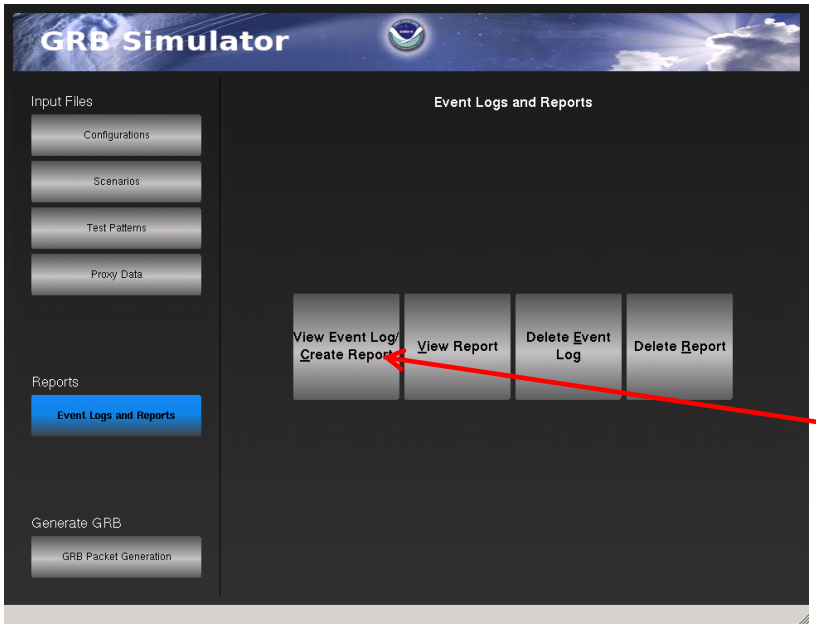
GRB Simulator GUI Functions – GRB Packet Generation

- For non-image test data:
  - The APID information in the configuration file are used to generate output for GLM, MAG, SEISS, and EXIS products
  - A repetitive pattern (e.g. sine wave, triangle wave or square wave function) will be superimposed onto the data output
  - GRB terminal users can plot the data output to see the test pattern



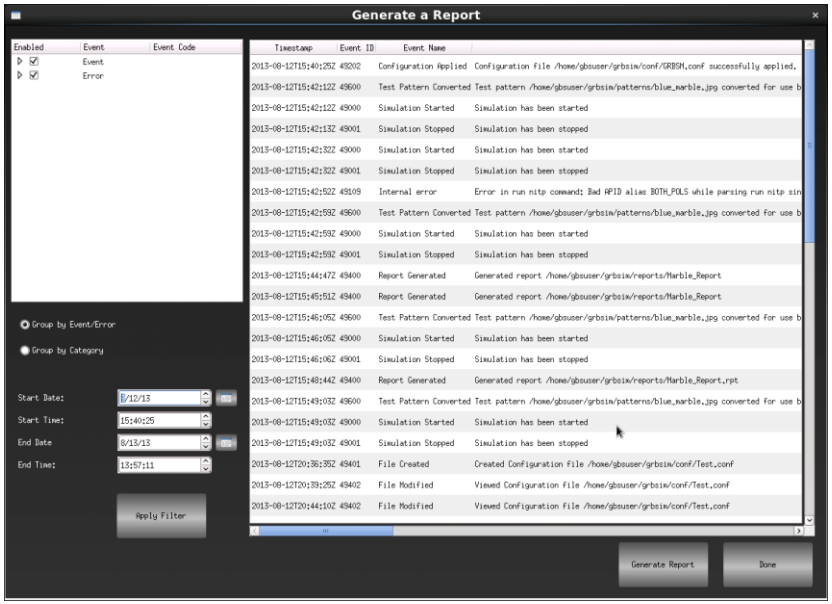


GRB Simulator GUI Functions – Event Logs and Reports



- Users can view simulation event logs and reports that were generated, create reports based on filter criteria, and delete logs and reports.
- To view the log screen, click on the ***View Event Logs/Create Report*** button as shown here.

GRB Simulator GUI Functions – Event Logs and Reports



- The log screen allows the user to filter by groups using a radio button to select the options:
  - Event/Error
    - Simulation
    - Application
    - File
    - TPC (Test Pattern Conversion)
  - Category
- These groups can also be filtered by:
    - Start Date
    - Start Time
    - End Date
    - End Time

Image Segmenter Utility

- The Image Segmenter Utility is a command line utility used to break up ABI NetCDF files (i.e. proxy data) into smaller NetCDF files
- It enables a user to set up scenarios of interleaved chunks of ABI L1b data from their own proxy data
- An example of the usage and command syntax is as follows:

  img_seg_util <optional_args> <Source NetCDF ABI file (with relative path)>

Image Segmenter Utility

- The command line is run from the directory of where the proxy data is located
- The source NetCDF ABI file is the only required argument and is always the last argument
  - The height and width of the block size defaults to 500 if nothing is specified in the argument
    - Values must be greater than zero and less than the corresponding image height and width
  - The output files default to 2500 if nothing is specified in the argument
    - If the utility will generate more than 2500 files, a confirmation message will appear to proceed
    - This will prevent the file system from being flooded
    - To disable the number of output files, use the zero ‘0’ value

Image Segmenter Utility

- The default of the output destination directory will be the location of the source proxy data file
- To remove informational output and only show errors, use the '-q' flag for Quiet mode
- To include more detailed level of output, use the '-v' flag for Verbose mode

• The source file must be ABI only

- Specifically, it must contain the variables 'rad' and 'DQF' and each variable must have the 'x' and 'y' dimensions
- The source image must be a complete image.
- If the source image has a 'top_left_x_y' attribute specified, it must be '(0,0)'

Image Segmenter Utility

- Here are some examples of the commands:

Example 1: height value = 1000, width value = 500

img_seg_util –h 1000 –w 500 PD_ABI-L1b-RadF05_M3C02.nc

Example 2: height value = 300, width value = 400, number of output files = 5000, change output directory

img_seg_util –h 300 –w 400 –l 5000 –d /home/segments/output/ PD_ABI-L1b-RadF10_M3C05.nc

Example 3: height value = 200, width value = 300, disable number of output files

img_seg_util –h 200 –w 300 –l 0 PD_ABI-L1b- RadF20_M3C07.nc

Image Segmenter Utility

- Here is an example of the output files generated from a command using the Image Segmenter Utility tool:

```
gbsuser@gs9-pggsvr005:~/grbsim/proxy/M4_Proxy
File  Edit  View  Search  Terminal  Help
[gbsuser@gs9-pggsvr005 M4_Proxy]$ img_seg_util -w 200 -h 200 -d /home/gbsuser/grbsim/proxy/ImgSegmenterOutput/ -v PD_ABI-L1b-RadF10_M4C05_0_0.nc
Source File: PD_ABI-L1b-RadF10_M4C05_0_0.nc
Original Image Dimensions: (904,37)
UpperLeft : (0,0)
Output base name: /home/gbsuser/grbsim/proxy/ImgSegmenterOutput/PD_ABI-L1b-RadF10_M4C05_0_0
Block Height: 37
Block Width: 200
5 segments will be generated.
Creating segment at location (0,0)
Lower right (199,36)
Current block size 200 x 37
Writing /home/gbsuser/grbsim/proxy/ImgSegmenterOutput/PD_ABI-L1b-RadF10_M4C05_0_0_0_0.nc.....................................
Creating segment at location (200,0)
Lower right (399,36)
Current block size 200 x 37
Writing /home/gbsuser/grbsim/proxy/ImgSegmenterOutput/PD_ABI-L1b-RadF10_M4C05_0_0_200_0.nc.....................................
Creating segment at location (400,0)
Lower right (599,36)
Current block size 200 x 37
Writing /home/gbsuser/grbsim/proxy/ImgSegmenterOutput/PD_ABI-L1b-RadF10_M4C05_0_0_400_0.nc.....................................
Creating segment at location (600,0)
Lower right (799,36)
Current block size 200 x 37
Writing /home/gbsuser/grbsim/proxy/ImgSegmenterOutput/PD_ABI-L1b-RadF10_M4C05_0_0_600_0.nc.....................................
Creating segment at location (800,0)
Lower right (903,36)
Current block size 104 x 37
Writing /home/gbsuser/grbsim/proxy/ImgSegmenterOutput/PD_ABI-L1b-RadF10_M4C05_0_0_800_0.nc.....................................
[gbsuser@gs9-pggsvr005 M4_Proxy]$
```

NOTE: The arguments in the command line need to have the correct syntax. Otherwise, errors will be generated.

Image Segmenter Utility

- After executing an Image Segmenter utility command on an ABI full image proxy data file, the user could then use all the output proxy data files for a new scenario script as shown below:

Img_Seg_Test_Screenshot.scn - WordPad

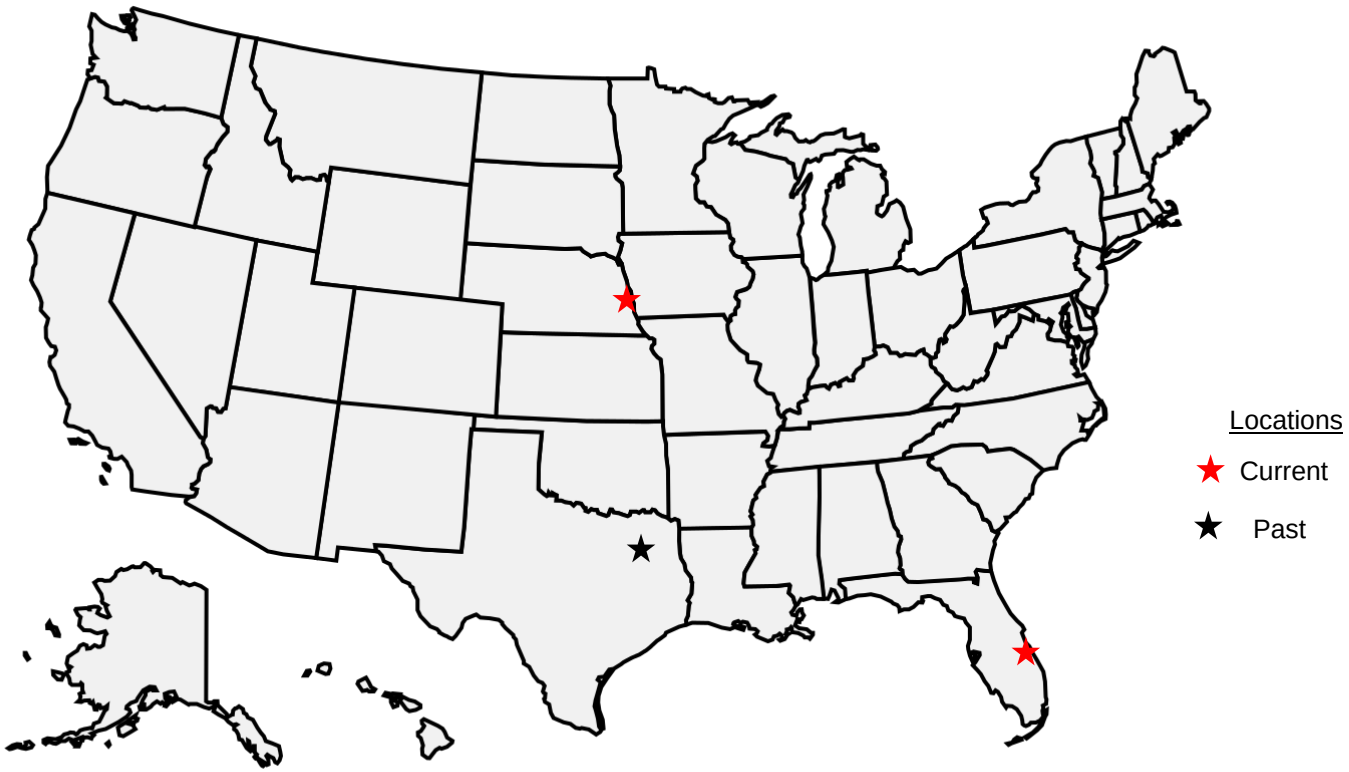
File Edit View Insert Format Help

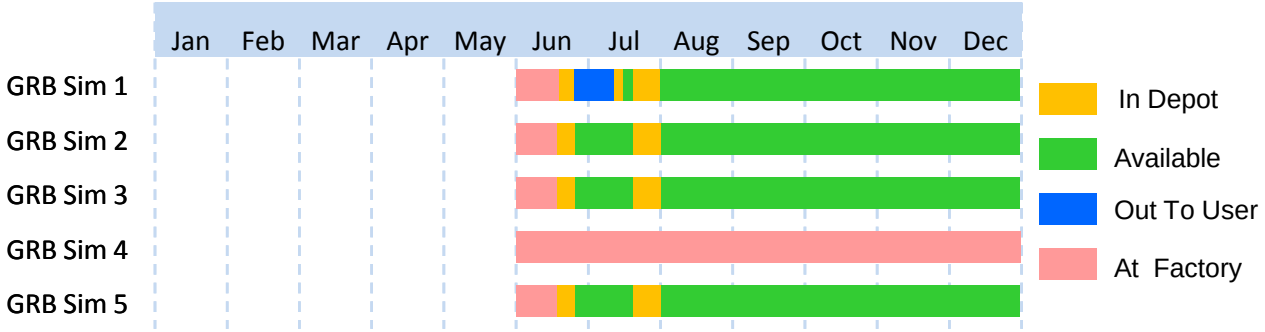
```
section Img_Seg_Test
run proxy IMG_SEG_PROXY_0_0.nc as ABI_RadF_M3C02
run proxy IMG_SEG_PROXY_0_300.nc as ABI_RadF_M3C02
run proxy IMG_SEG_PROXY_400_0.nc as ABI_RadF_M3C02
run proxy IMG_SEG_PROXY_400_300.nc as ABI_RadF_M3C02
section end Img_Seg_Test
```

For Help, press F1 NUM

Status of GRB Simulators

Status of GRB Simulators





Training Approach

Training Approach

- Deliver TO-11 GRB Simulator Training Power Point slides to borrowers of GRB simulators prior to hands-on training
- Provide 2-day hands-on training course for borrowers at vendor/end user site:
  - Includes functionality checklists for all materials covered in course
  - Supplement with TO-16 GRB Simulator Operator Manual and User Guide and SE-16 Product Definition and User's Guide (PUG) Volume 4, GRB document
- Visit GOES-R web site at: http://www.goes-r.gov/users/grb.html
- Technical assistance for borrowers (via phone and email) of GRB simulators
- Future NOAA Satellite conferences

Demonstrations this afternoon

Demonstrations this afternoon

1. Provide brief overview of GRB Simulator equipment
2. View a Configuration, Scenario, and Test Pattern
3. Edit a Configuration, Scenario, and Test Pattern
4. Create a new image test pattern
5. Create a new scenario using the new test pattern
6. Run the GRB Simulation of new scenario
7. View the output of the test pattern in the NetCDF Viewer application
8. View the Event Logs
9. Execute the Image Segmenter Utility function
10. Run the GRB Simulation of Mode 3 scenario
11. View the FEP GUI to show APID packets being generated
12. View the Modem GUI to show 8-PSK pattern
13. Allow users to interact with GRB Simulator GUI

Questions/Comments

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