



Rapid Scan Operations for GOES

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AMS Conference

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AGENDA

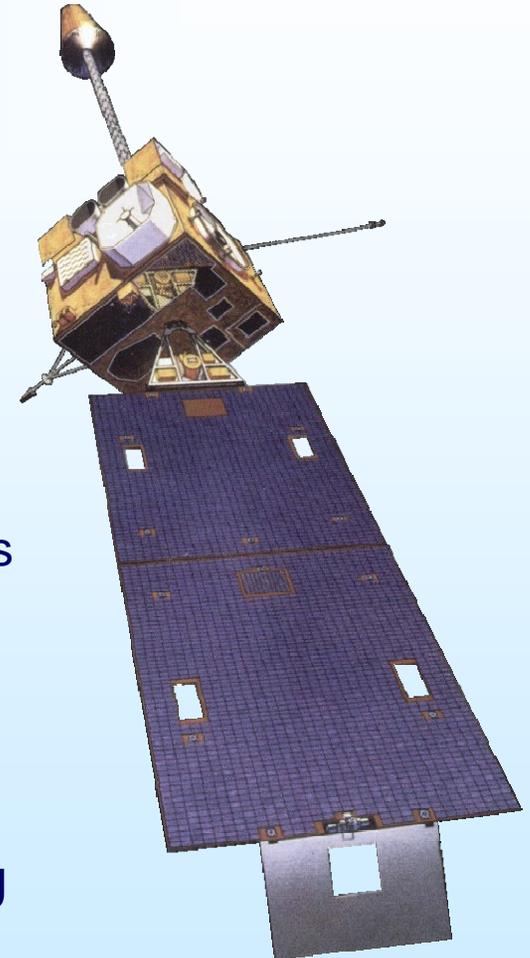
- GOES Mission / Imager Overview
- Imager Scan Control / Scan Operations
- Scheduling
- Types of Schedules
- Rapid Scan Operations
- Rapid Scan Process
- Rapid Scan History



Geostationary Environmental Operational Satellites (GOES)



- Warnings to U.S. Public -- Detect, track and characterize
 - Hurricanes
 - Severe or possibly tornadic storms
 - Flash flood producing weather systems
- Imagery for weather forecasting
- Derived products for analysis and forecasting
 - Surface temperatures (sea and land), Winds, Atmospheric Stability, soundings, air quality, hazards
- Soundings and radiances for NWS models
- Sea Surface Temperature monitoring
- Winds for aviation and NWS numerical models
- Environmental data collection – platforms including buoys, rain gauges, river levels, ecosystem monitoring
- Search and Rescue



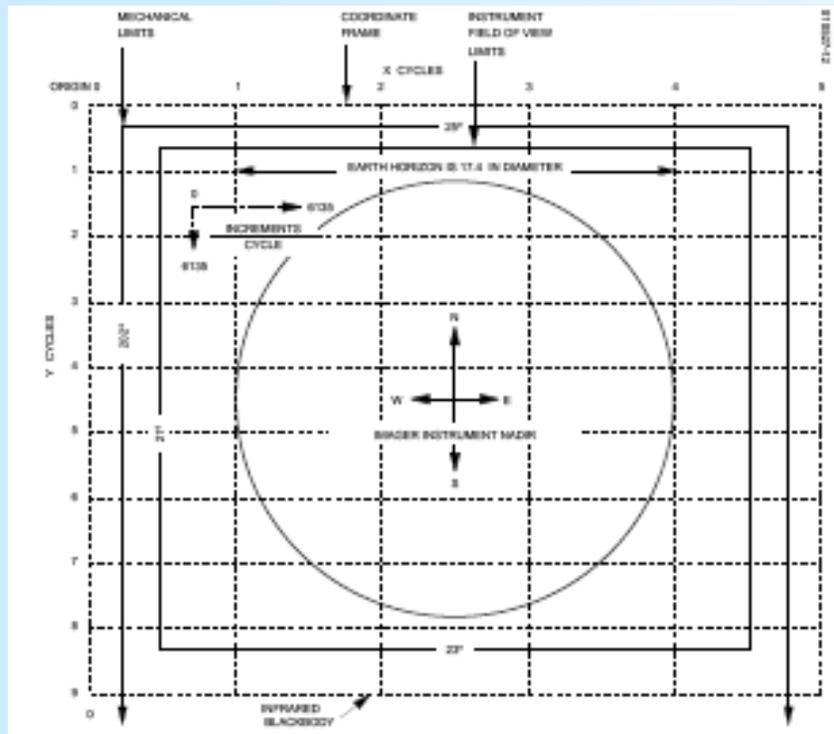


Definitions

- Routine Scan Operations (RTN)
 - Default scan operation used by the NWS to track synoptic scale weather patterns
 - Provides Northern and Southern Hemisphere scan coverage.
- Rapid Scan Operations (RSO)
 - Used by the NWS to monitor and track real-time mesoscale phenomena such as Hurricanes and Severe Storms
 - Other Federal Government Agencies (e.g. NASA, DHS) also make request to support high profile events: Presidential Inauguration, Space Shuttle Launches, etc.
- Super Rapid Scan Operations (SRSO)
 - Used by researchers to study mesoscale phenomena
 - Rarely used in operations
- Office of Satellite Operations (OSO)
 - Operates GOES Satellites
- Office of Satellite Data Processing and Distribution (OSDPD)
 - Satellite Services Division (SSD) is user interface to request RSO or SRSO operations
 - Operate and maintain the GOES Ingest and NOAAPORT Interface (GINI) that distributes the GOES data to NOAAPORT and AWIPS



GOES I-P Imager Scan Control



- Scan mirror position is controlled by two servo motors,
 - One for N/S gimbal angle
 - One for E/W gimbal angle
- Each motor has an inductosyn that measures shaft rotation angle
- Mirror location is defined by inductosyn *cycle* and *increment* number within cycle
 - E/W increment = $16\mu\text{rad}$ (optical)
 - N/S increment = $8\mu\text{rad}$ (optical)
 - 6135 increments/cycle
- Scan lines are generated by rotating mirror east to west ($20^\circ/\text{s}$ optically) followed by a step in the N/S direction
- Next scan line is acquired by rotating the mirror in (opposite) west to east direction



GOES I-M Scheduling

- All routine operations conducted via daily command schedule
- Schedule runs in real-time mode
- Most special operations conducted via daily schedule
 - Commands are sequentially sent to the spacecraft at required execution time
 - Does not allow for execution of multiple, unrelated functions
 - Typically 16,000 lines/day
 - Approximately 5,300 commands/day



GOES N-P Scheduling



- Commands are uploaded to on-board schedule buffer once per day
- On-board schedule allows for execution of multiple, unrelated functions
- Ground schedule runs on ground in “shadow” mode to verify on-board command execution
 - Schedule can be executed from ground similar to GOES I-M



Types of Schedules



- Routine (Default)
- Rapid Scan
- Super-Rapid Scan
- Full-Disk
- All 4 types are generated daily



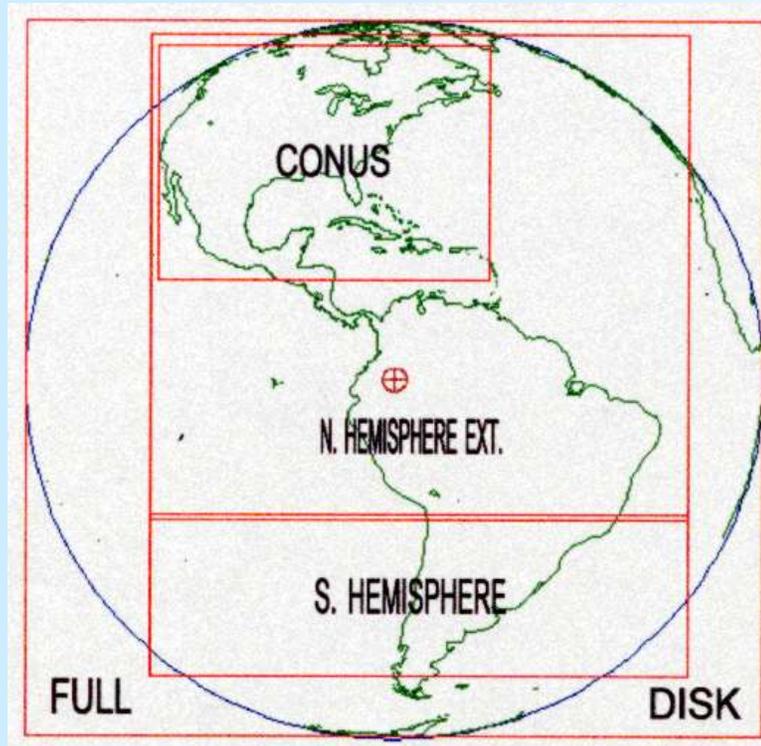
GOES Schedules

- Schedules consist of the following:
 - Imaging operations (frames, BB Cals, Star Looks)
 - Image Navigation and Registration (INR) Operations
 - Special Operations (Eclipse, Sensor Intrusions, etc)
 - Housekeeping Operations (momentum unloads, clock adjusts)



Routine Operations

GOES East Imager Routine Scan Operations

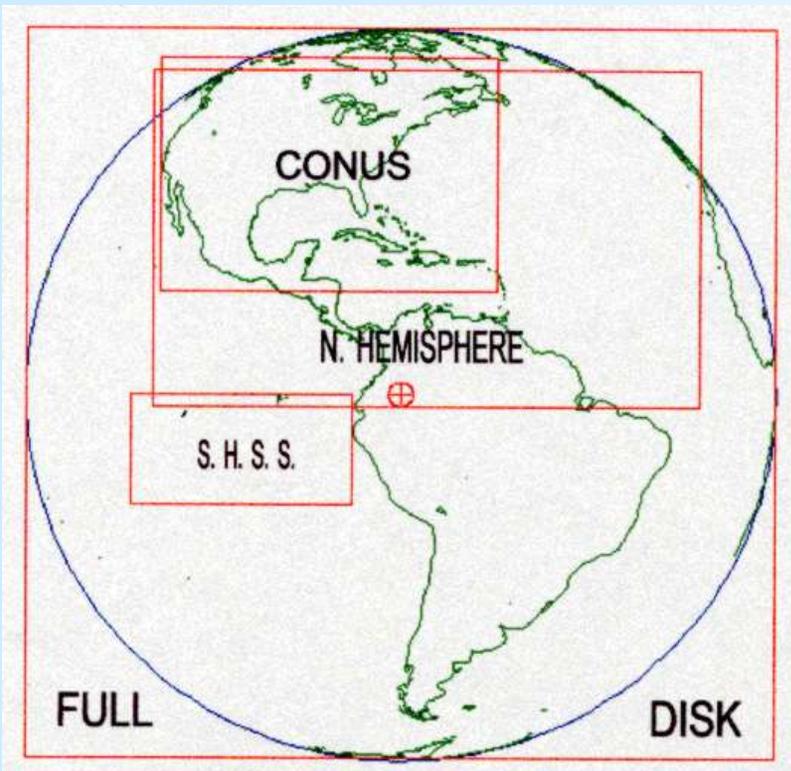


02:45:00.0 FULL DISK 26:06
03:15:00.0 NORTHERN HEMISPHERE-EXTENDED 14:15
03:31:30.0 CONTINENTAL US (CONUS) 4:48
03:39:10.0 SOUTHERN HEMISPHERE-SOUTH 4:49
03:45:00.0 NORTHERN HEMISPHERE-EXTENDED 14:15
04:01:30.0 CONTINENTAL US (CONUS) 4:48
04:09:10.0 SOUTHERN HEMISPHERE-SOUTH 4:49
04:15:00.0 NORTHERN HEMISPHERE-EXTENDED 14:15
04:31:30.0 CONTINENTAL US (CONUS) 4:48
04:39:10.0 SOUTHERN HEMISPHERE-SOUTH 4:49
04:45:00.0 NORTHERN HEMISPHERE-EXTENDED 14:15
05:01:30.0 CONTINENTAL US (CONUS) 4:48
05:09:10.0 LIMITED S-HEMISPHERE-SOUTH 4:32
05:15:00.0 NORTHERN HEMISPHERE-EXTENDED 14:15
05:31:30.0 CONTINENTAL US (CONUS) 4:48
05:39:10.0 SOUTHERN HEMISPHERE-SOUTH 4:49
05:45:00.0 FULL DISK 26:06



Rapid Scan Operations

GOES East Imager Rapid Scan Operations

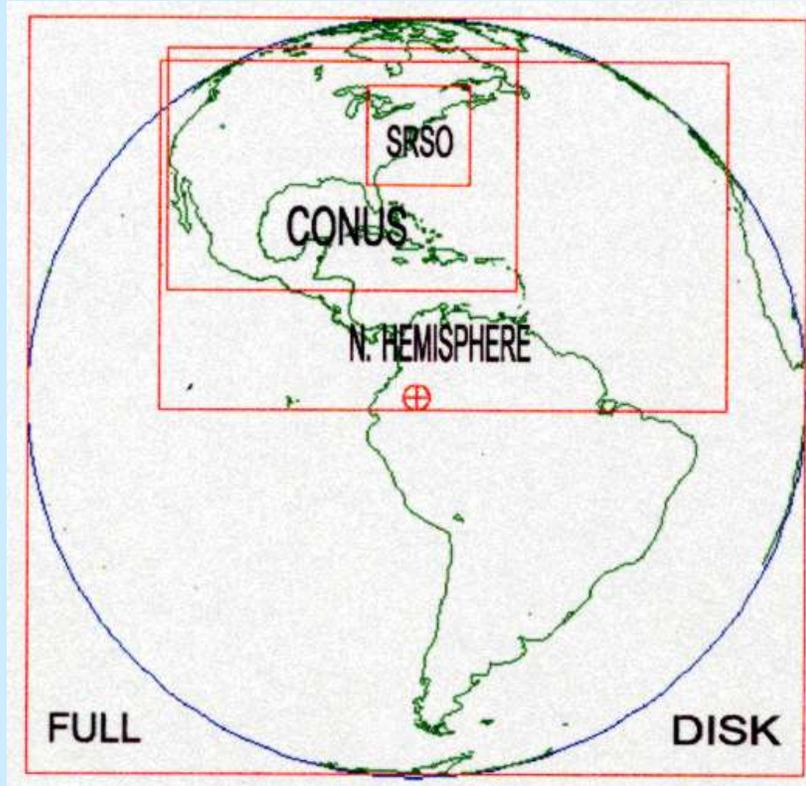


02:45:00.0 FULL DISK 26:06
03:15:00.0 NORTHERN HEMISPHERE 9:44
03:25:00.0 CONTINENTAL US (CONUS) 4:43
03:30:00.0 S. HEMISPHERE SMALL SECTOR 1:45
03:32:11.0 CONTINENTAL US (CONUS) 4:43
03:40:00.0 CONTINENTAL US (CONUS) 4:43
03:45:00.0 NORTHERN HEMISPHERE 9:44
03:55:00.0 CONTINENTAL US (CONUS) 4:43
04:02:11.0 CONTINENTAL US (CONUS) 4:43
04:10:00.0 CONTINENTAL US (CONUS) 4:43
04:15:00.0 NORTHERN HEMISPHERE 9:44
04:25:00.0 CONTINENTAL US (CONUS) 4:43
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05:15:00.0 NORTHERN HEMISPHERE 9:44
05:25:00.0 CONTINENTAL US (CONUS) 4:43
05:30:00.0 S. HEMISPHERE SMALL SECTOR 1:45
05:32:11.0 CONTINENTAL US (CONUS) 4:43
05:40:00.0 CONTINENTAL US (CONUS) 4:43
05:45:00.0 FULL DISK 26:06



Super Rapid Scan Operations

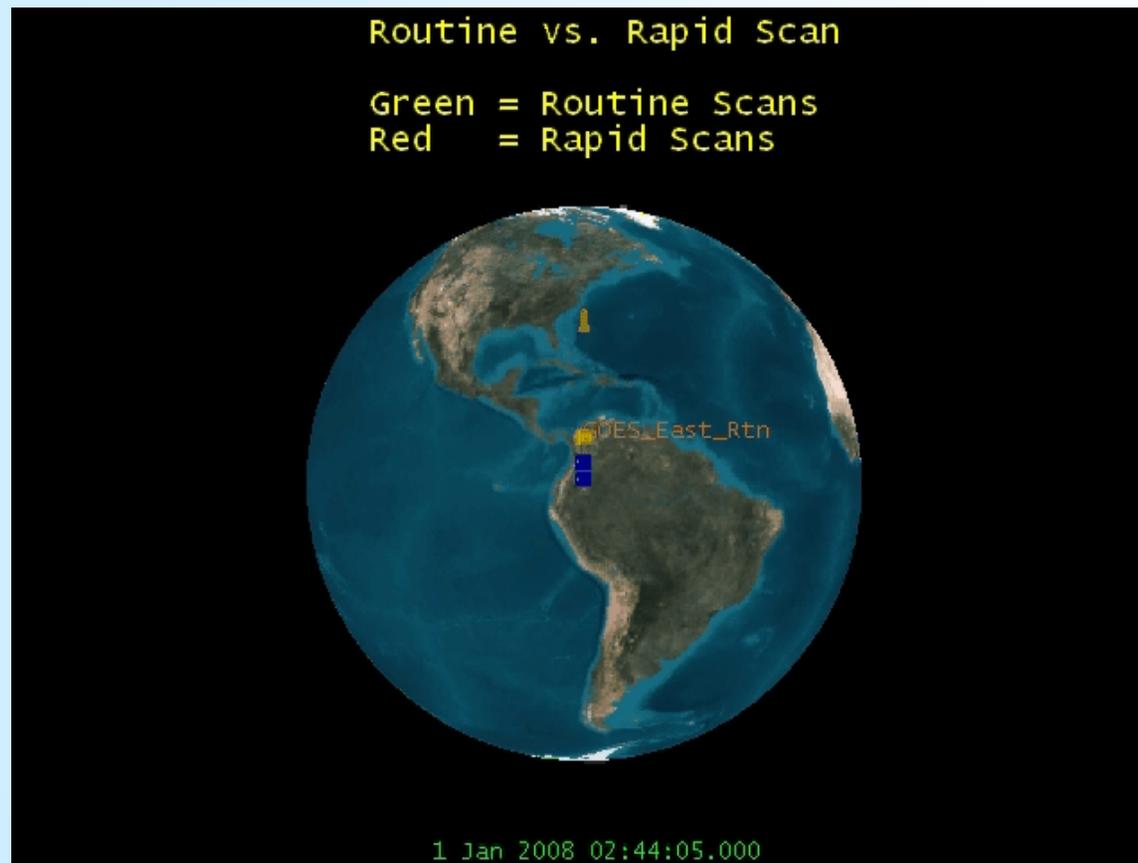
GOES East Imager Super Rapid Scan Operations



02:45:00.0 FULL DISK 26:06
03:15:00.0 NORTHERN HEMISPHERE 9:44
03:25:00.0 SRSO SECTOR 1:00
03:30:00.0 CONTINENTAL US (CONUS) 4:43
03:35:00.0 SRSO SECTOR 8:00
03:45:00.0 NORTHERN HEMISPHERE 9:44
03:55:00.0 SRSO SECTOR 1:00
03:59:05.0 CONTINENTAL US (CONUS) 4:43
04:04:00.0 SRSO SECTOR 8:00
04:15:00.0 NORTHERN HEMISPHERE 9:44
04:25:00.0 SRSO SECTOR 1:00
04:30:00.0 CONTINENTAL US (CONUS) 4:43
04:35:00.0 SRSO SECTOR 8:00
04:45:00.0 NORTHERN HEMISPHERE 9:44
04:55:00.0 SRSO SECTOR 1:00
04:59:05.0 CONTINENTAL US (CONUS) 4:43
05:04:00.0 SRSO SECTOR 8:00
05:15:00.0 NORTHERN HEMISPHERE 9:44
05:25:00.0 SRSO SECTOR 1:00
05:30:00.0 CONTINENTAL US (CONUS) 4:43
05:35:00.0 SRSO SECTOR 8:00
05:45:00.0 FULL DISK 26:06

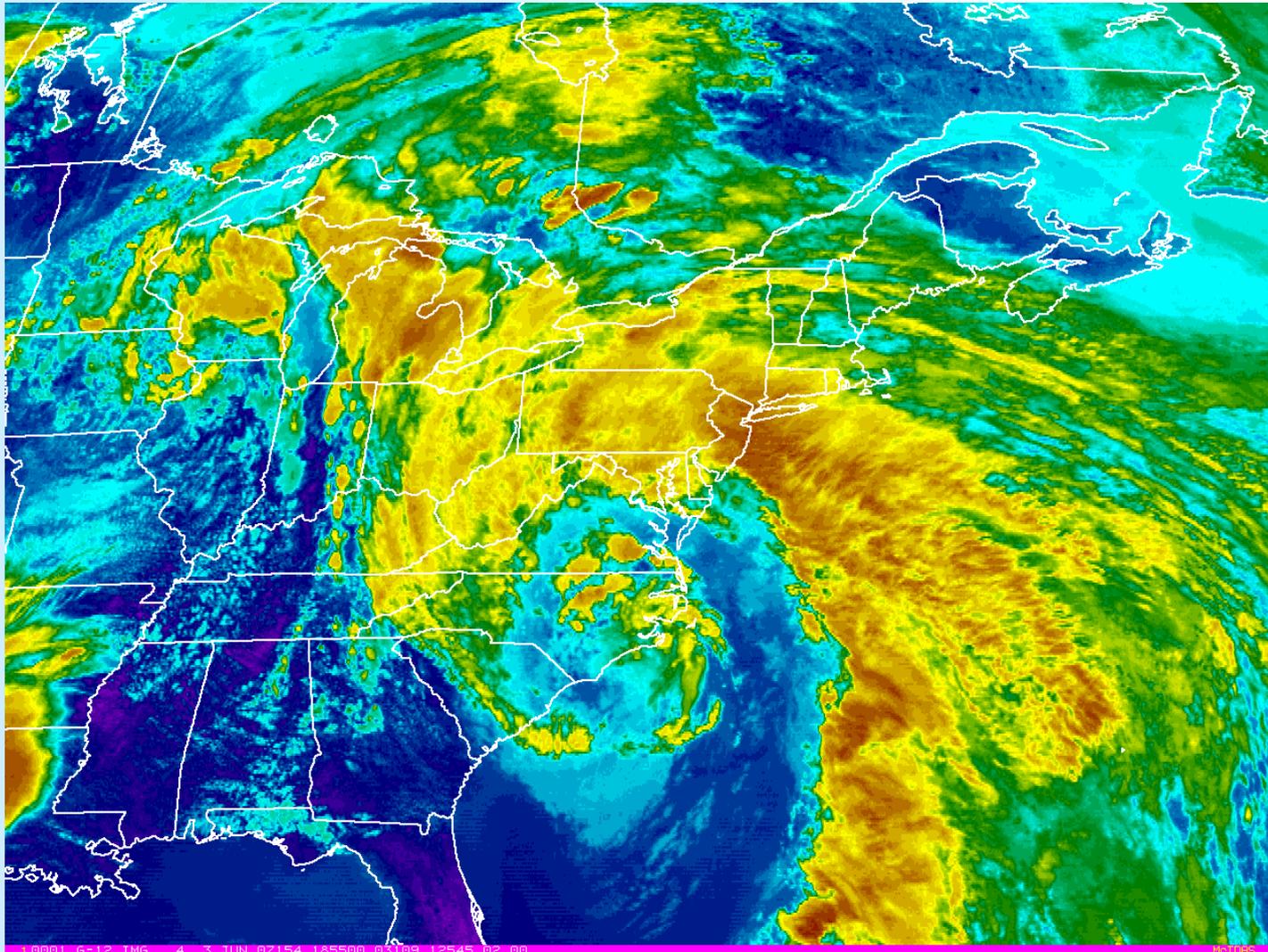


Rapid Scan Schedule Animation



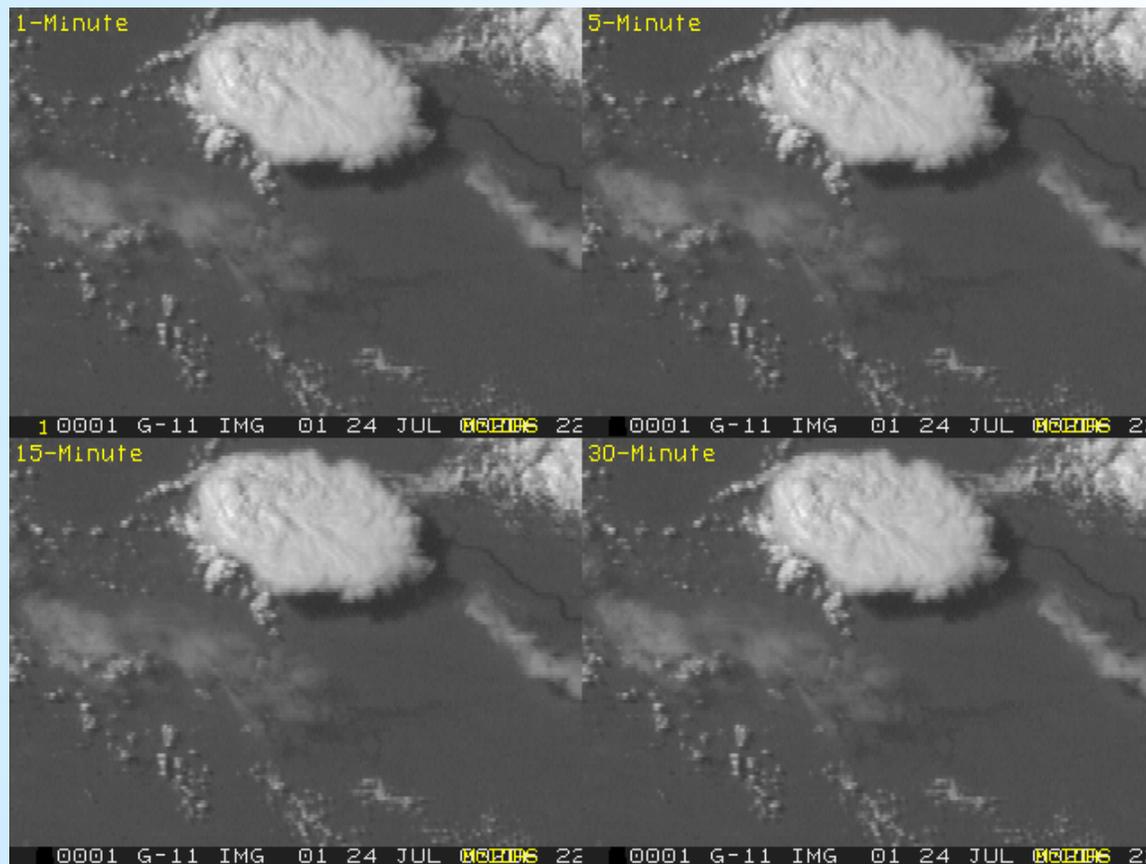


RSO Animation





Rapid Scan Comparison – Thunderstorm Development





Special Operations

- Station keeping maneuvers
- Eclipse operations
- Keep Out Zone (KOZ)
- Storage mode operation
- Yaw-Flip Mode operation
- Contingency operations



GOES Organizations

- Office of Satellite Operations
 - Satellite Operations Control Center (SOCC) – Suitland MD
 - Schedule generation and execution, engineering inputs
 - Command Data Acquisition (CDA) Facility – Primary site Wallops Va
 - Provides uplink/downlink carrier services
- National Weather Service / OSDPD/SSD at the World Weather Building
 - Defines image and sounder frame coordinates
 - Defines imaging schedule
 - Requests for “rapid scans” in cases of severe weather
 - Predefined sectors
 - Variable definition sectors



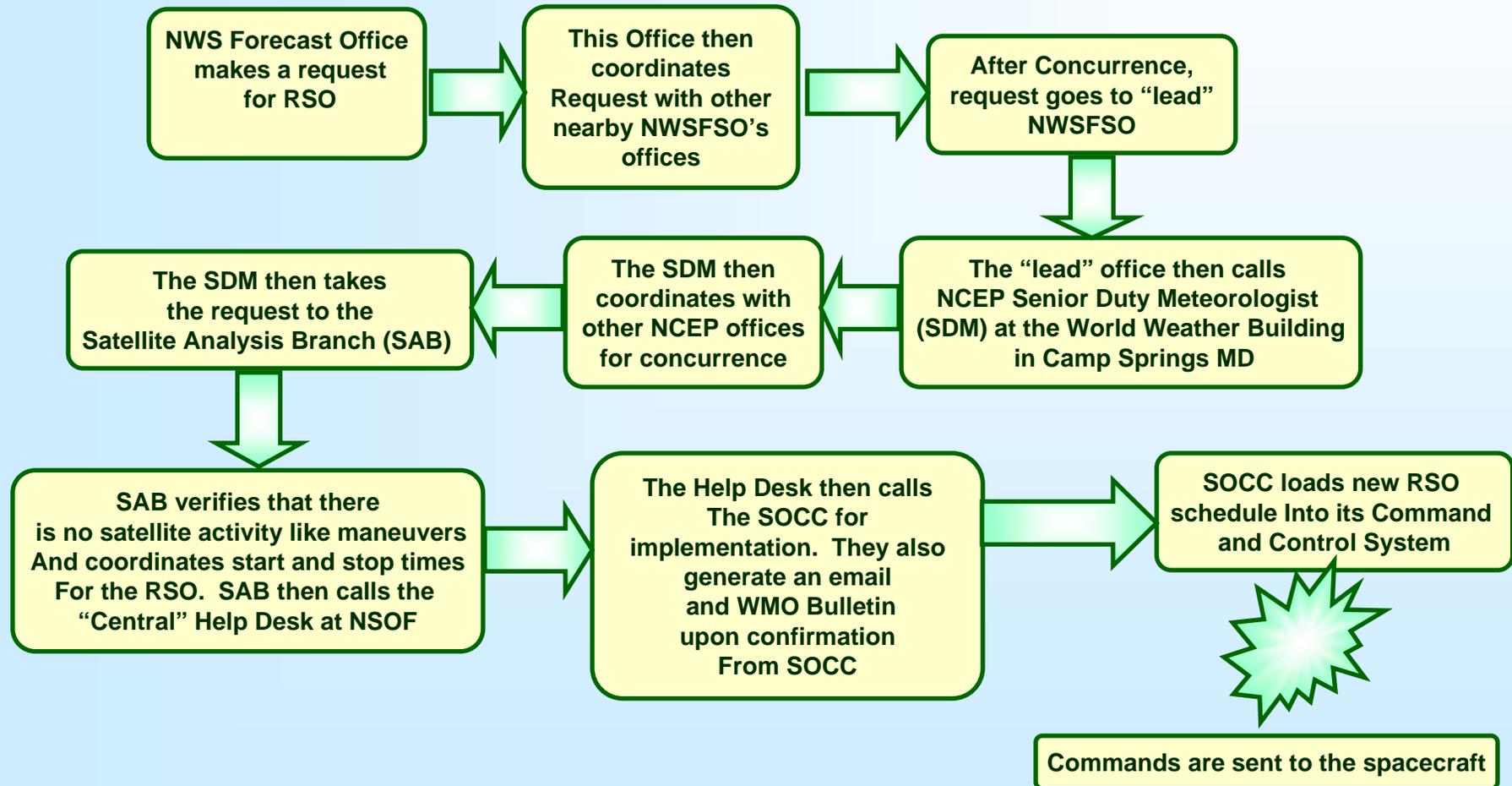
GOES Organizations



- Space Weather Prediction Center - Boulder CO
 - Defines SXI imaging schedule (GOES-12/13)
 - Requests detector protect procedure during periods of intense solar activity
 - Weekly SEM calibrations
- Others (SAR, DCS, U. of Wisconsin)



RSO Process



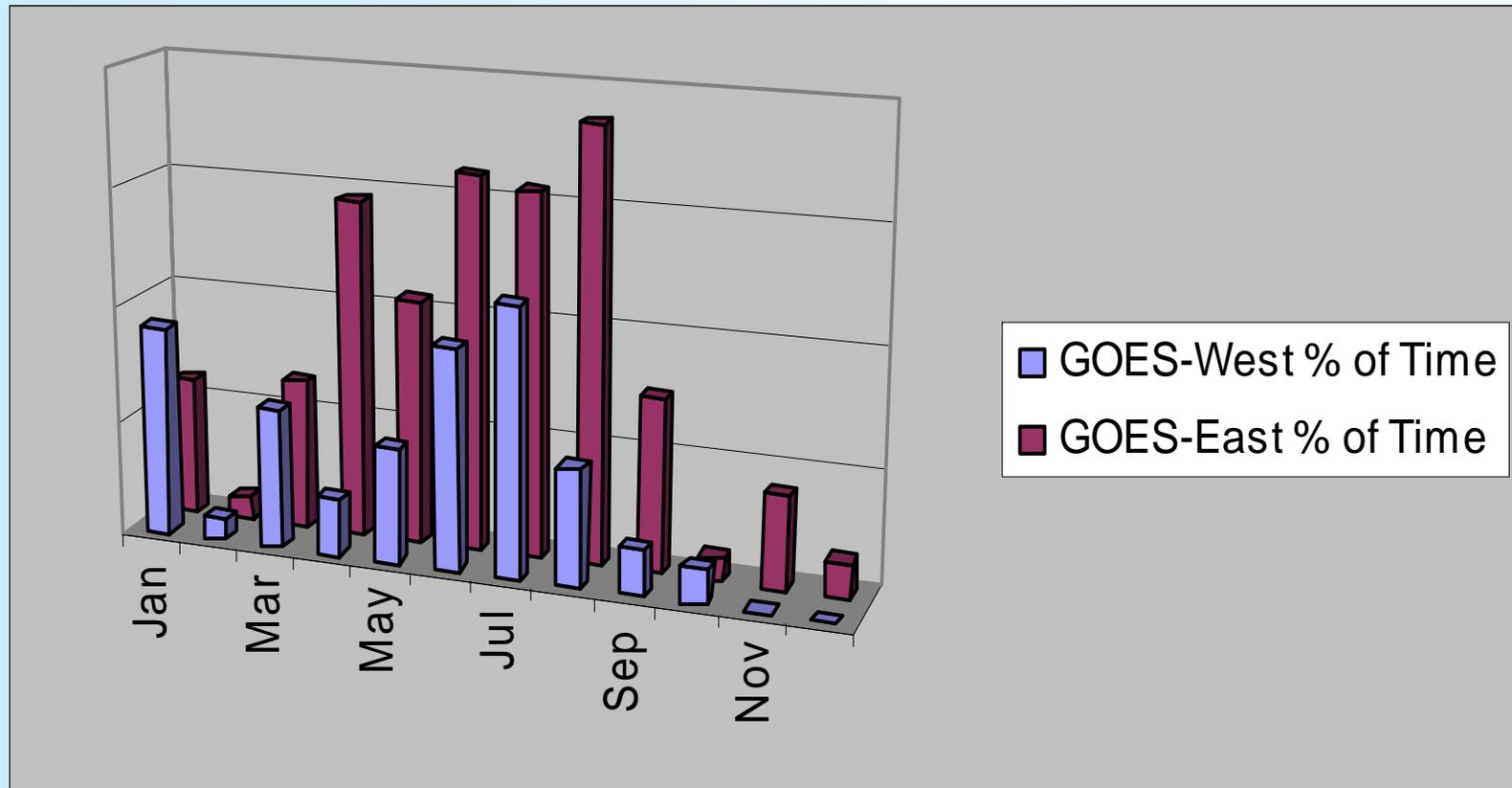


Routine to Rapid Schedule Transition

- Operational Constraints
 - Schedule transition can occur once/hour at XX:26
 - One hour notification to SOCC Operations is required
- Eclipse/Solar KOZ Constraints (GOES I-M Only)
 - All schedules contain routine scans during the 3 hr period surrounding eclipse
 - No imaging during eclipse periods; Instruments are turned off
 - While GOES East is in eclipse GOES West is nominally in Full Disk mode (and vice versa)
 - *It is the Senior Duty Meteorologist call whether he will permit a GOES West rapid scan*
- Stationkeeping Constraints
 - Stationkeeping command schedule begin 6 hours prior to maneuver and extends up to 6 hours following maneuver
 - Allows for pre-maneuver configuration, maneuver, and post-maneuver image navigation recovery
 - Once maneuver schedule begins, no rapid scan requests can be accommodated
 - Stationkeeping maneuvers are scheduled for Tuesdays with Thursdays as a back-up
 - *The Senior Duty Meteorologist can postpone a maneuver from Tuesday to Thursday if weather conditions warrant*
- GOES N-P
 - No Eclipse/KOZ constraints
 - No imaging constraints for E/W stationkeeping

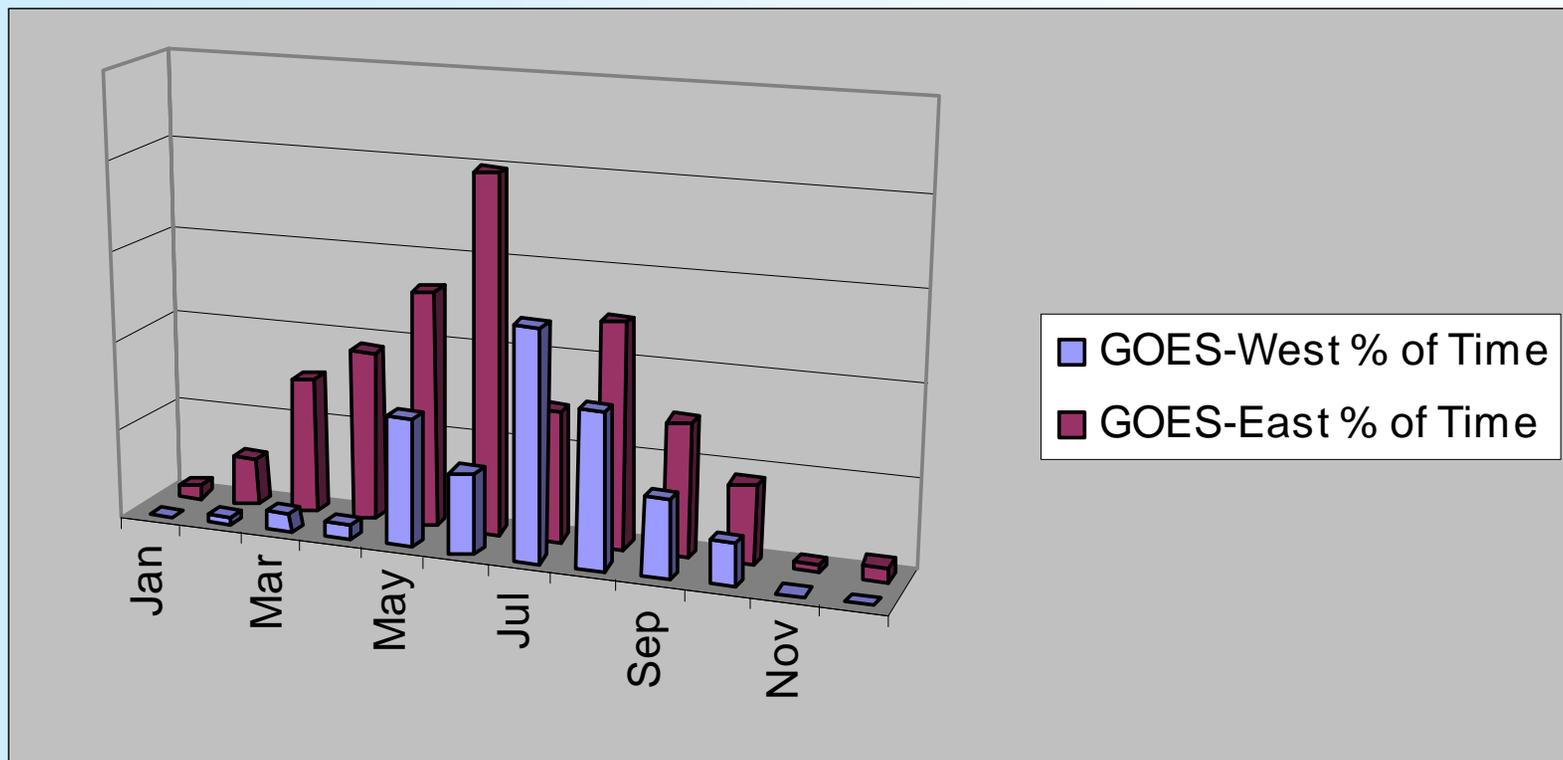


RSO's Conducted in 2006





RSO's Conducted in 2007





Summary

- Rapid Scan Operations are an effective method of monitoring meso-scale weather phenomenon
- Current RSO process is effective and efficient
- GOES N-P will eliminate many of the current rapid scan constraints