



USGS EROS Center

“40 Years of Service to Our Planet”



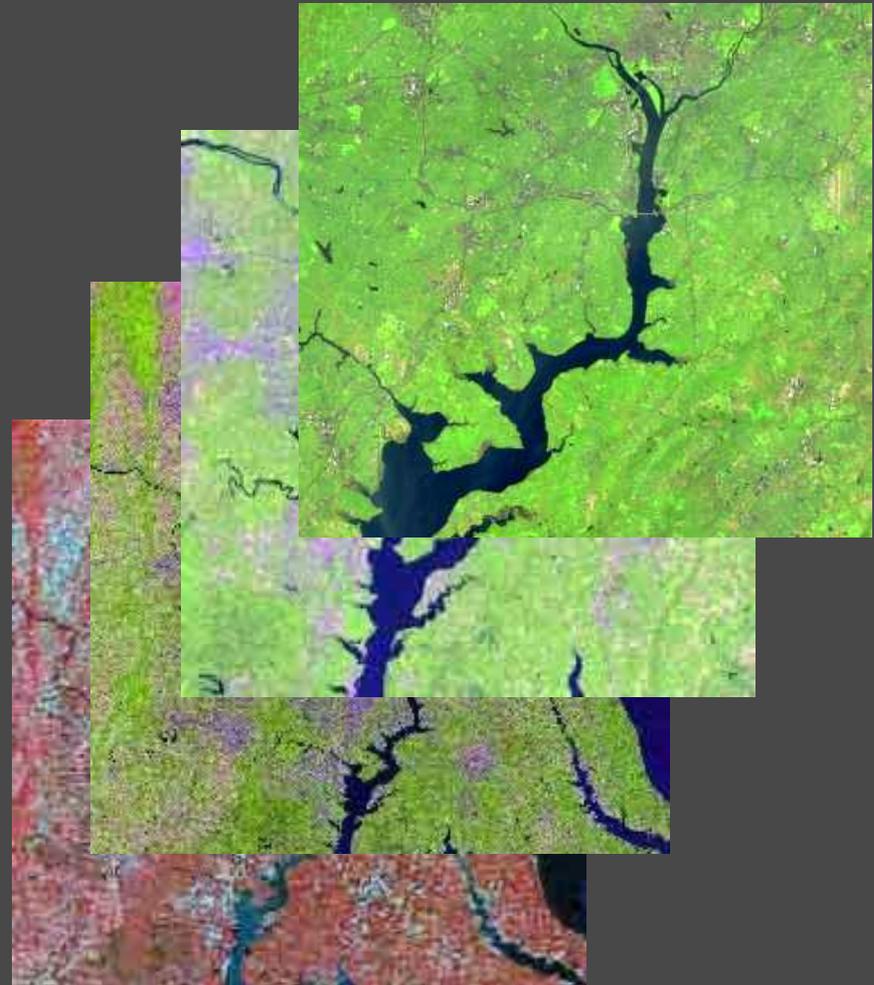
U.S. Department of the Interior
U.S. Geological Survey

Jenn Sabers Lacey
USGS EROS Center

U.S. Landsat Archive Overview

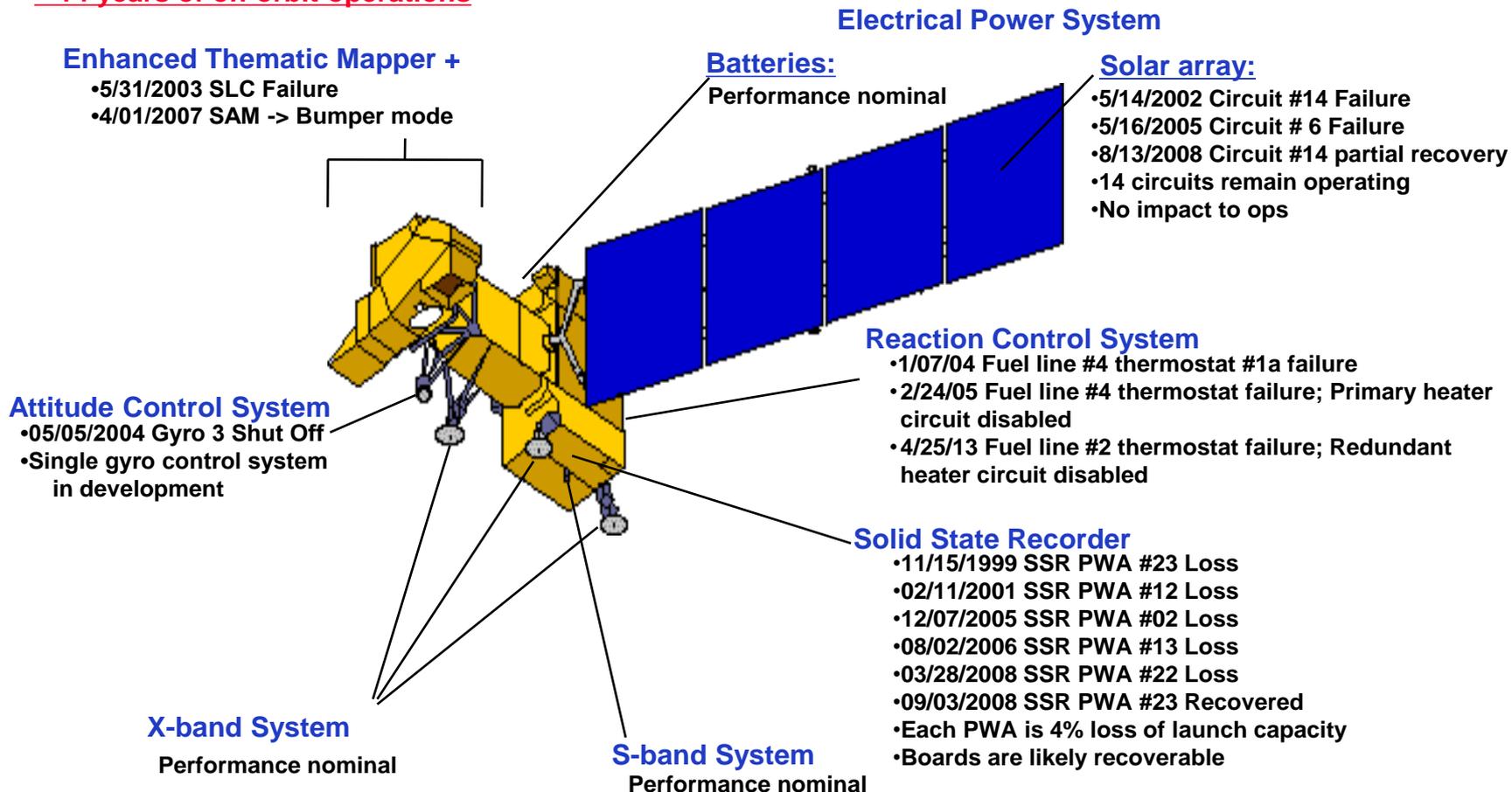
(March 3, 2014)

- **OLI-TIRS: Landsat 8**
 - 180,916 scenes
 - ~ 625 TB Raw and L0Ra Data
average scene size 1813 MB
- **ETM+: Landsat 7**
 - 1,708,353 scenes
 - ~ 1,586 TB Raw and L0Ra Data
average scene size 487 MB
- **TM: Landsat 4 & Landsat 5**
 - 1,928,801 scenes
 - ~ 967 TB Raw and L0Ra Data
average scene size 263 MB
- **MSS: Landsat 1 through 5**
 - 1,318,917 scenes
 - ~ 80 TB Raw and L0Ra Data
average scene size 32 MB
- **Total:**
 - 5,136,987 scenes
 - ~ 3,258 TB Raw and L0Ra Data

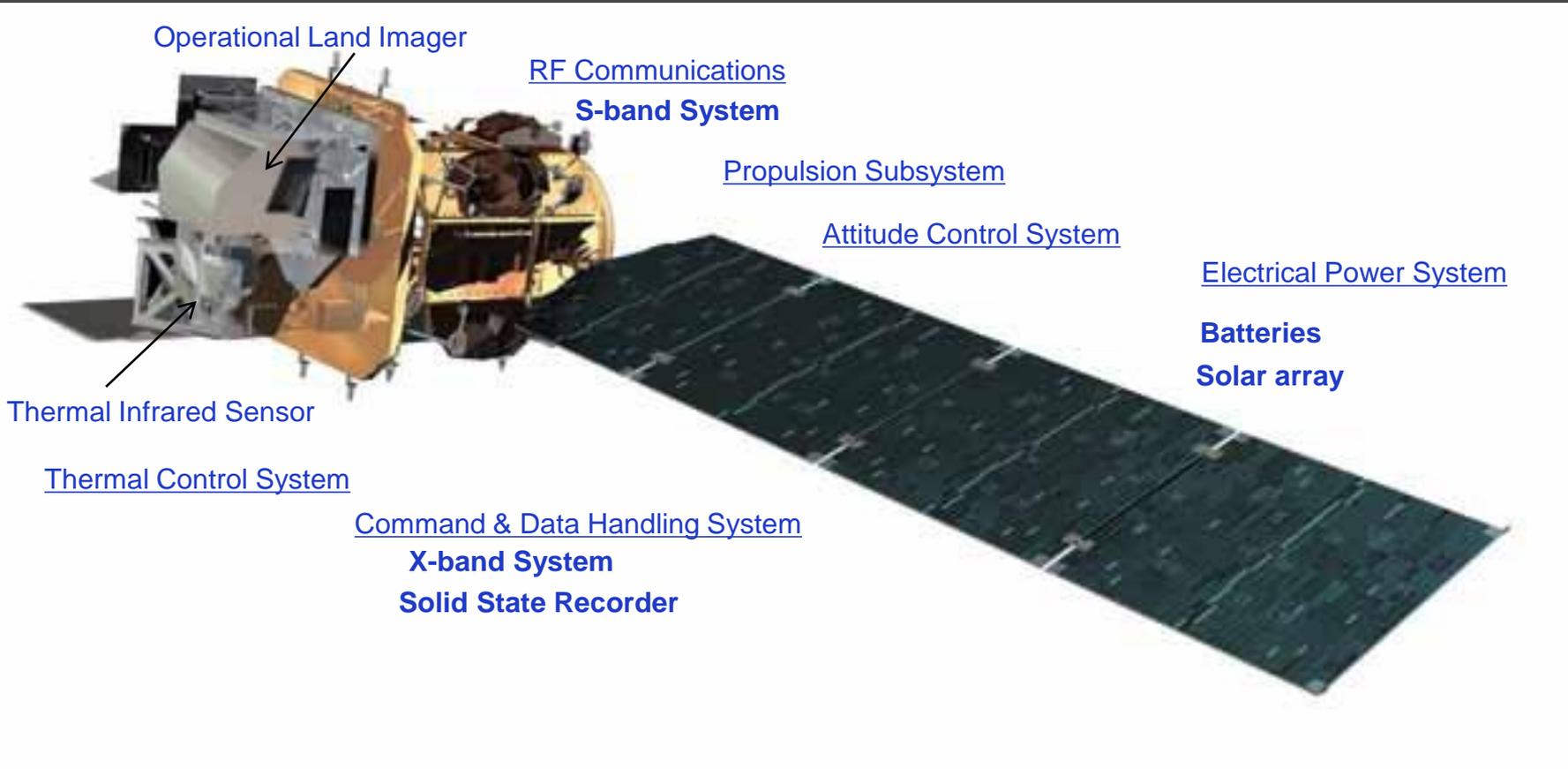


Landsat 7 Spacecraft Status

≈ 14 years of on-orbit operations



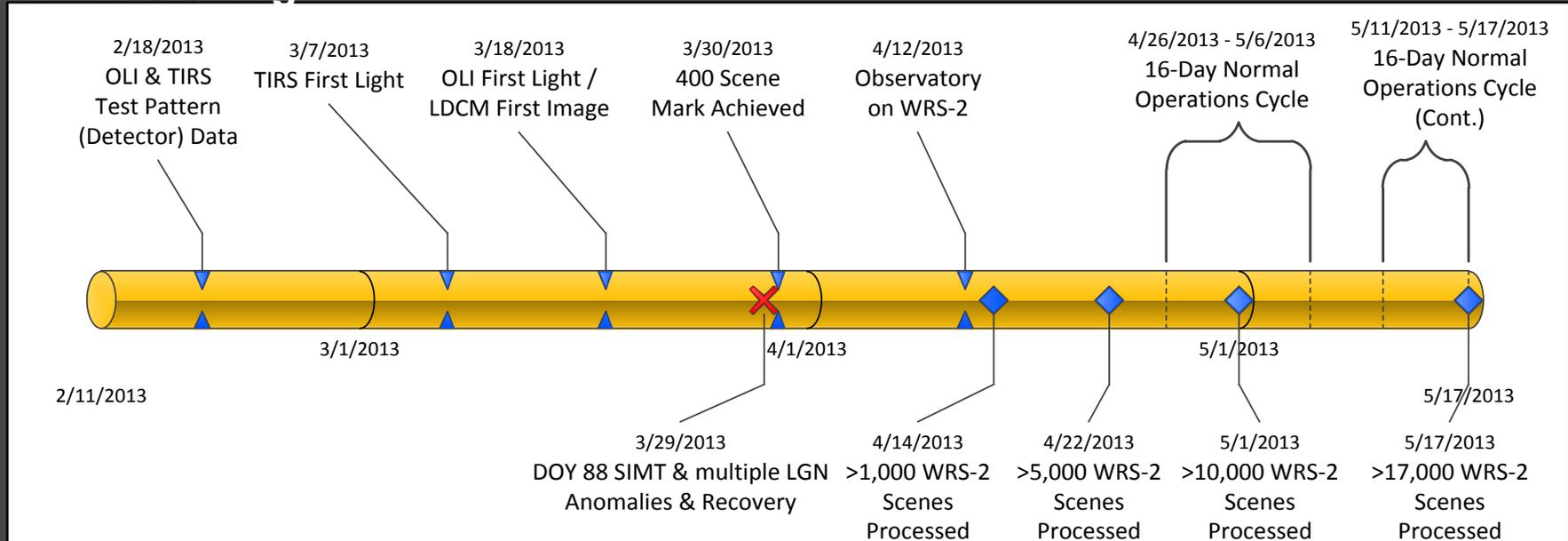
Landsat 8 Spacecraft Status



All systems good

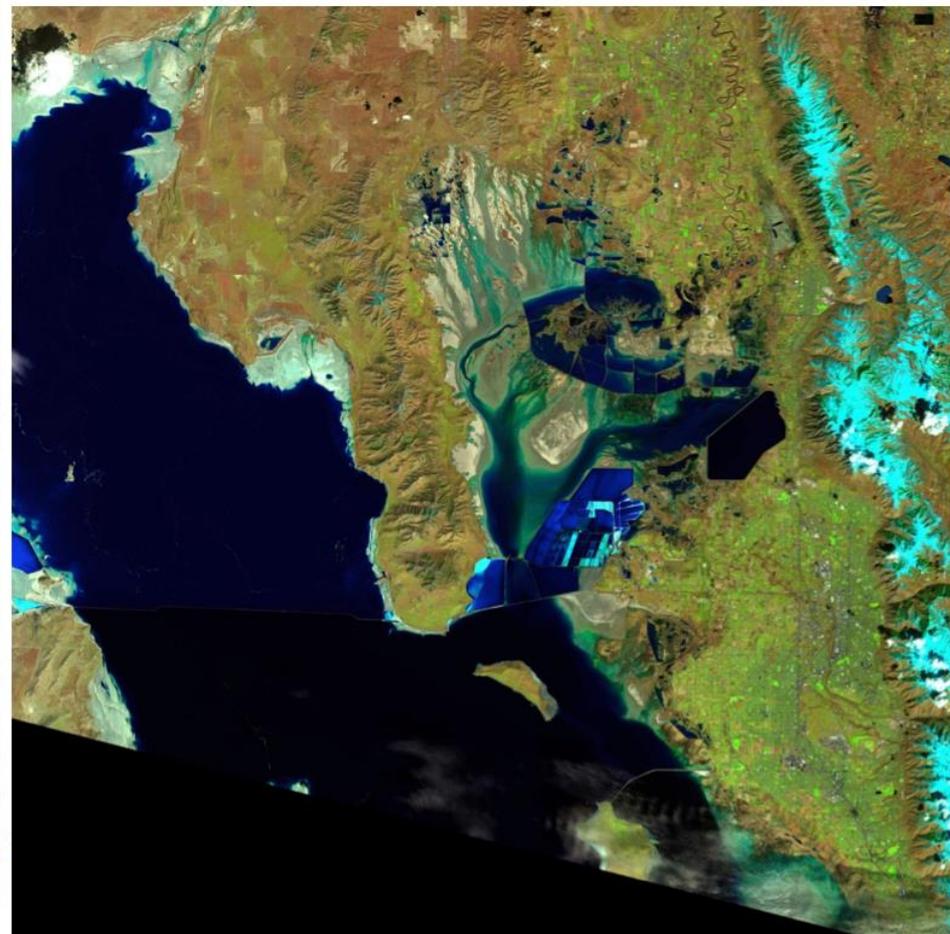
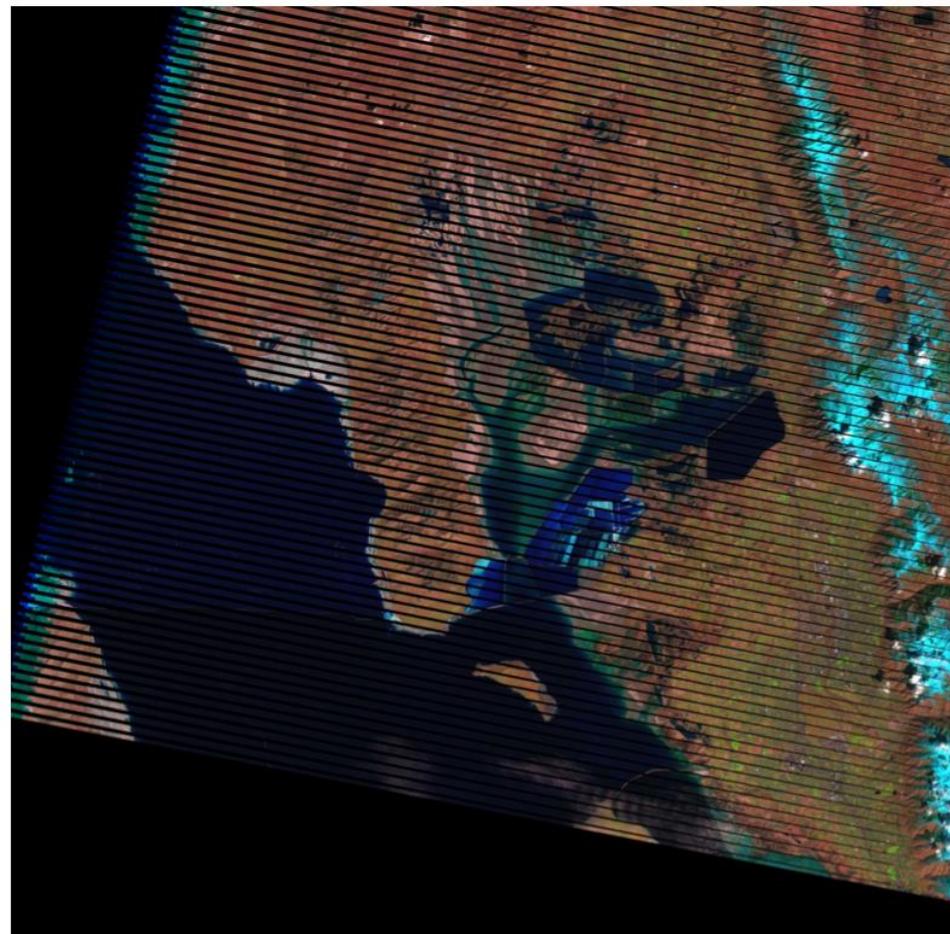
Data Operations Commissioning Summary

>17,000 OLI & TIRS scenes collected and processed by the conclusion of Commissioning



- Acquired L7/LDCM coincident imaging (Friday March 29 (DOY 088) – Sunday March 31 (DOY 090)), total of 1256 images.
- Post Launch Assessment Review (PLAR) – Held May 29, 2013
- Mission Transition Review (MTR) – Held May 30, 2013

Underfly of Landsat 7 – March 29, 2013



These images show a portion of the Great Salt Lake, Utah as seen by Landsat 7 (left), and LDCM/ Landsat 8 satellites (right). Both images were acquired on March 29, 2013.

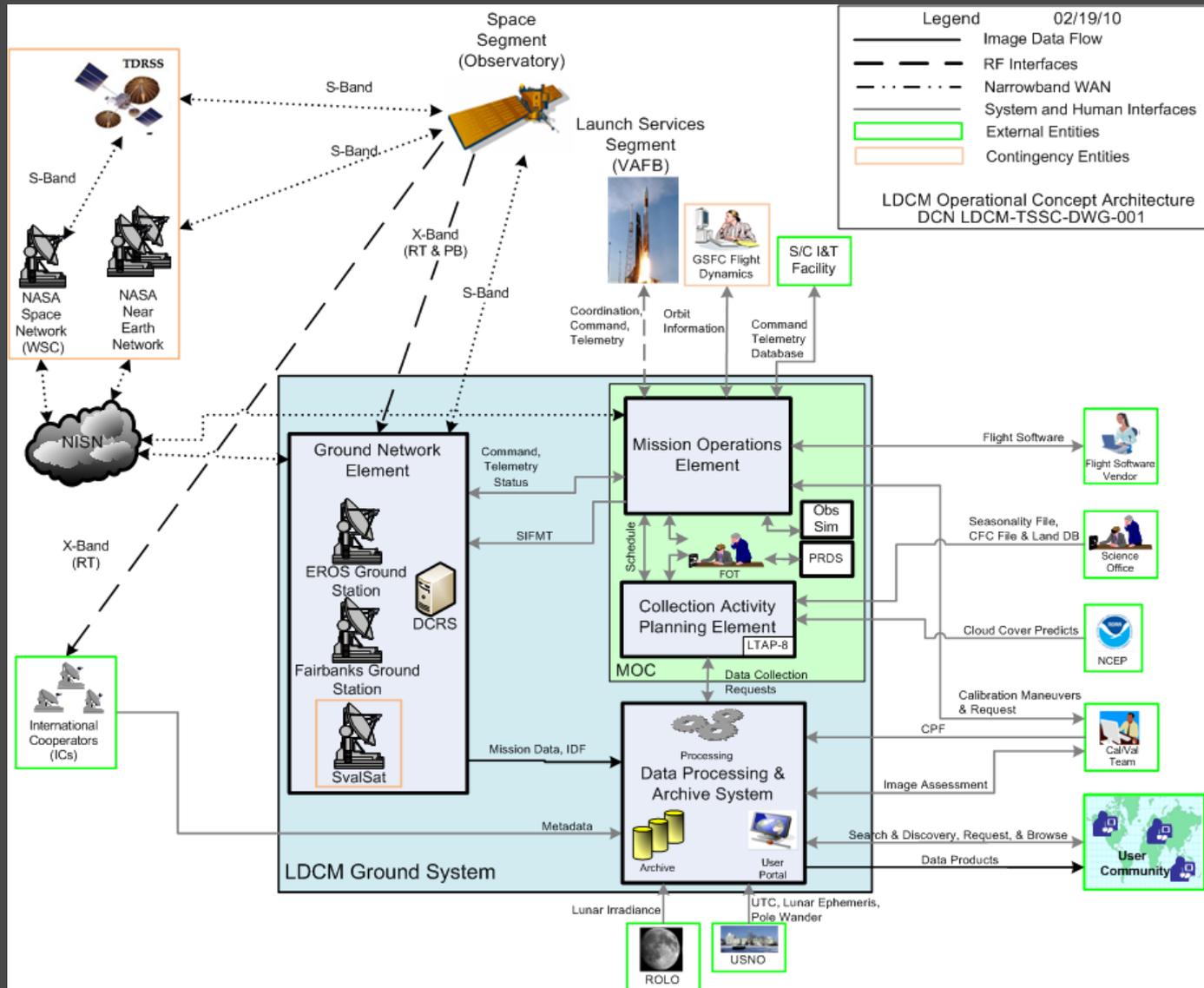
Ground Field Campaign



Atmospheric measurements collected coincident with sensor overpasses

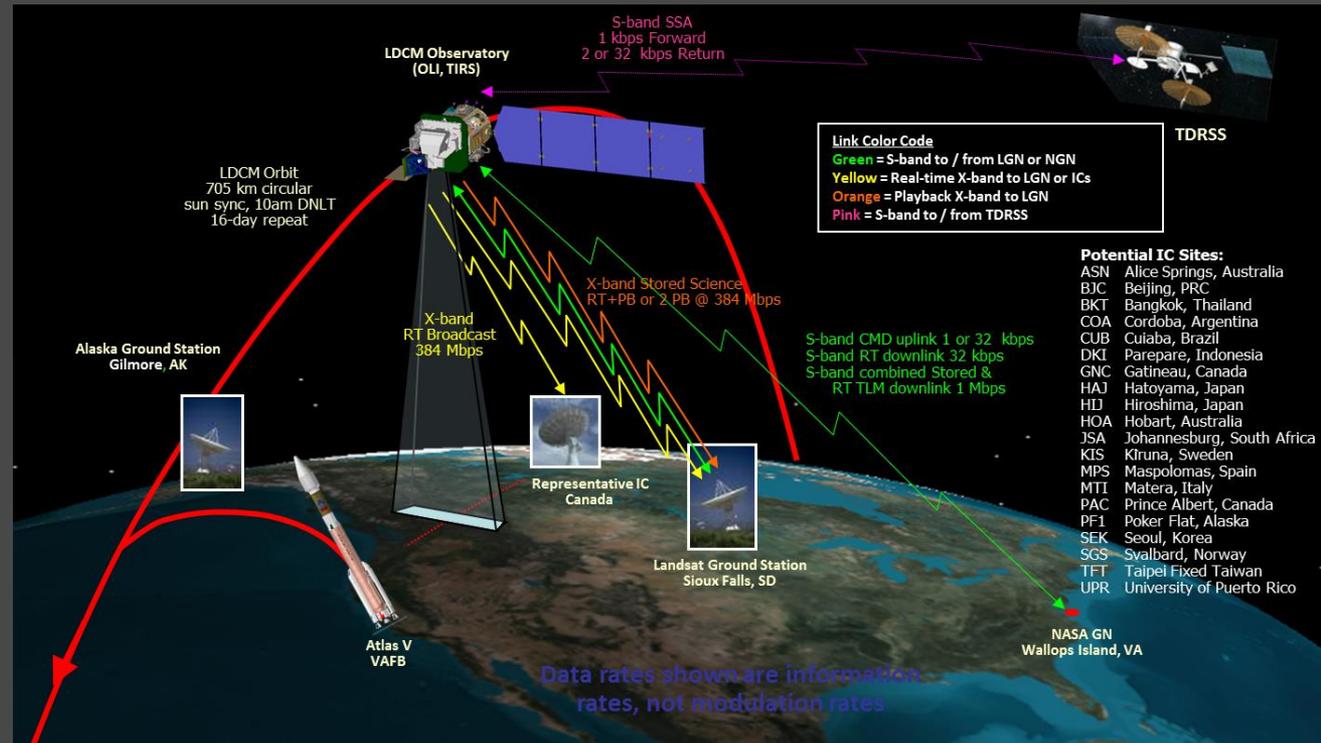


Ground System



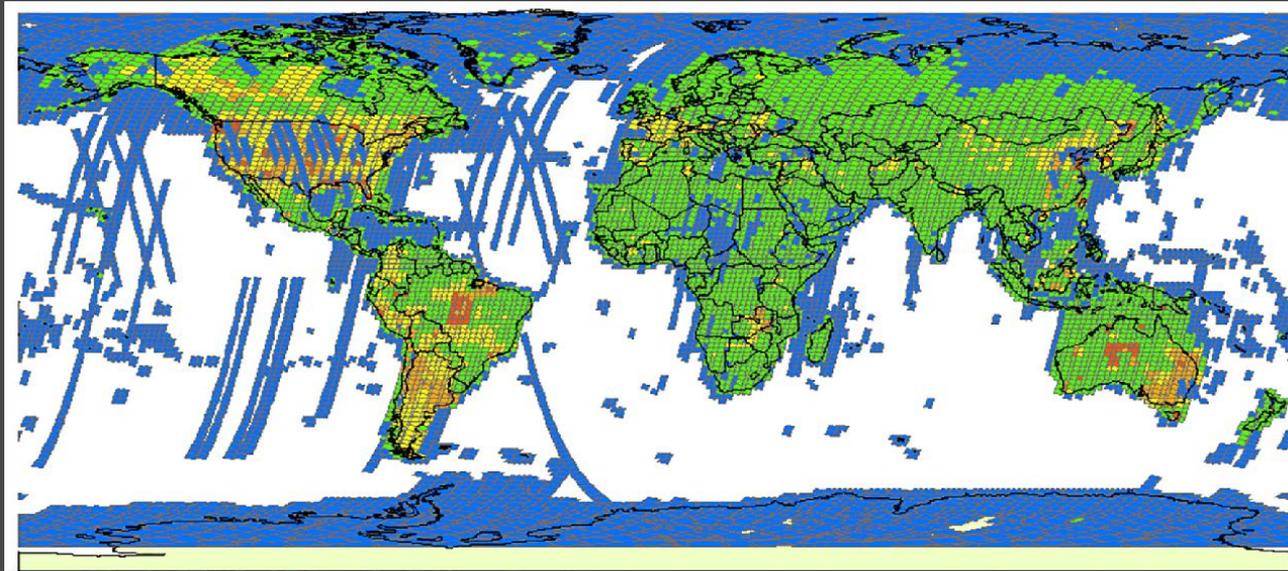
Landsat 8 Operational Characteristics

- Processing latency for real-time downlinks
- Average latency is ~ 5 hours from acquisition to product availability
- Closed loop between ground and space for data management



Data Latency

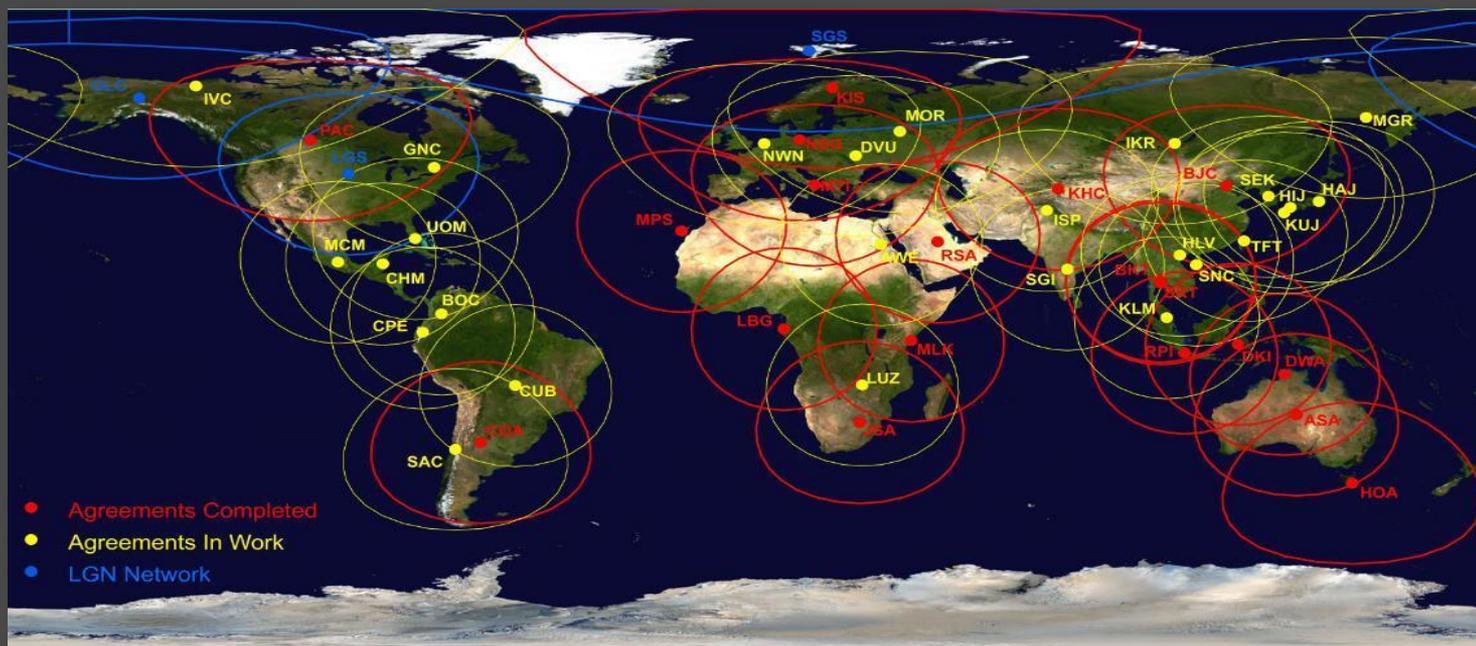
- System Requirement to have 85% data available to the user through EROS Portal within 48 hours
 - Actual performance for L8 averages within 5 hours



International Cooperators

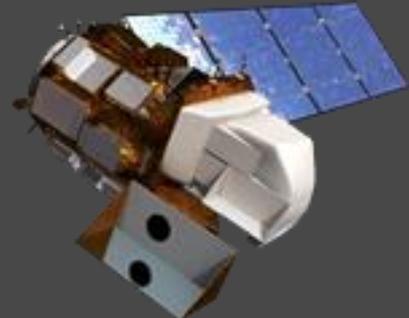
- International Cooperator (IC) Ground Stations
 - In 41 years, 39 IC stations in 23 countries
 - Most still collect and/or distribute Landsat products, reducing the load on U.S. systems
 - More than 215,000 products distributed in 2012
 - Represents a nearly 10% off-loading of network bandwidth
 - Enhanced regional exploitation of Landsat data

34 Countries
40 Organizations
50 Ground Stations



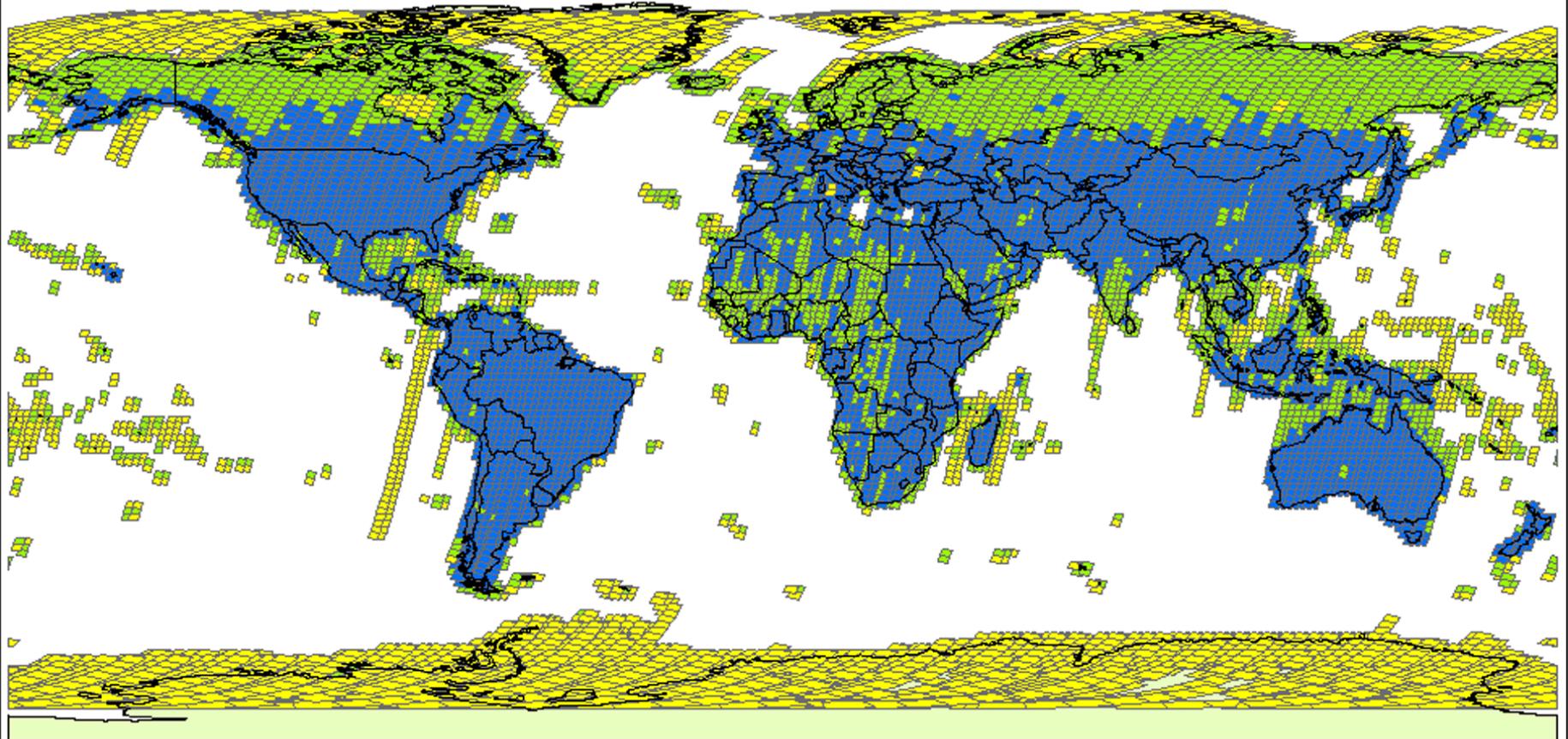
Summary of New Landsat 8 Capabilities

- We are receiving significantly more image data
 - Averaging 550 images a day
 - New images are available to users in less than 8 hours after acquisition
 - With Landsat 7, we have returned to an 8 day repeat cycle
- Better image data – improves surface characterization
 - 8-10x improvement in signal to noise ratios
 - 12 bit quantization permits improved measurement of subtle surface conditions and assessment of bright targets
 - Improved pixel geolocation ~ 12m
- New measurements – enabling new applications
 - Coastal blue band (0.433–0.453 μm)
 - Cirrus band (1.360–1.390 μm)
 - Additional thermal band



Recent L7/L8 Acquisitions

FY13/FY14 L8 OLI & TIRS / L7 ETM+ Acquisitions



L8 OLI & TIRS / L7 ETM+ Acquired Scenes

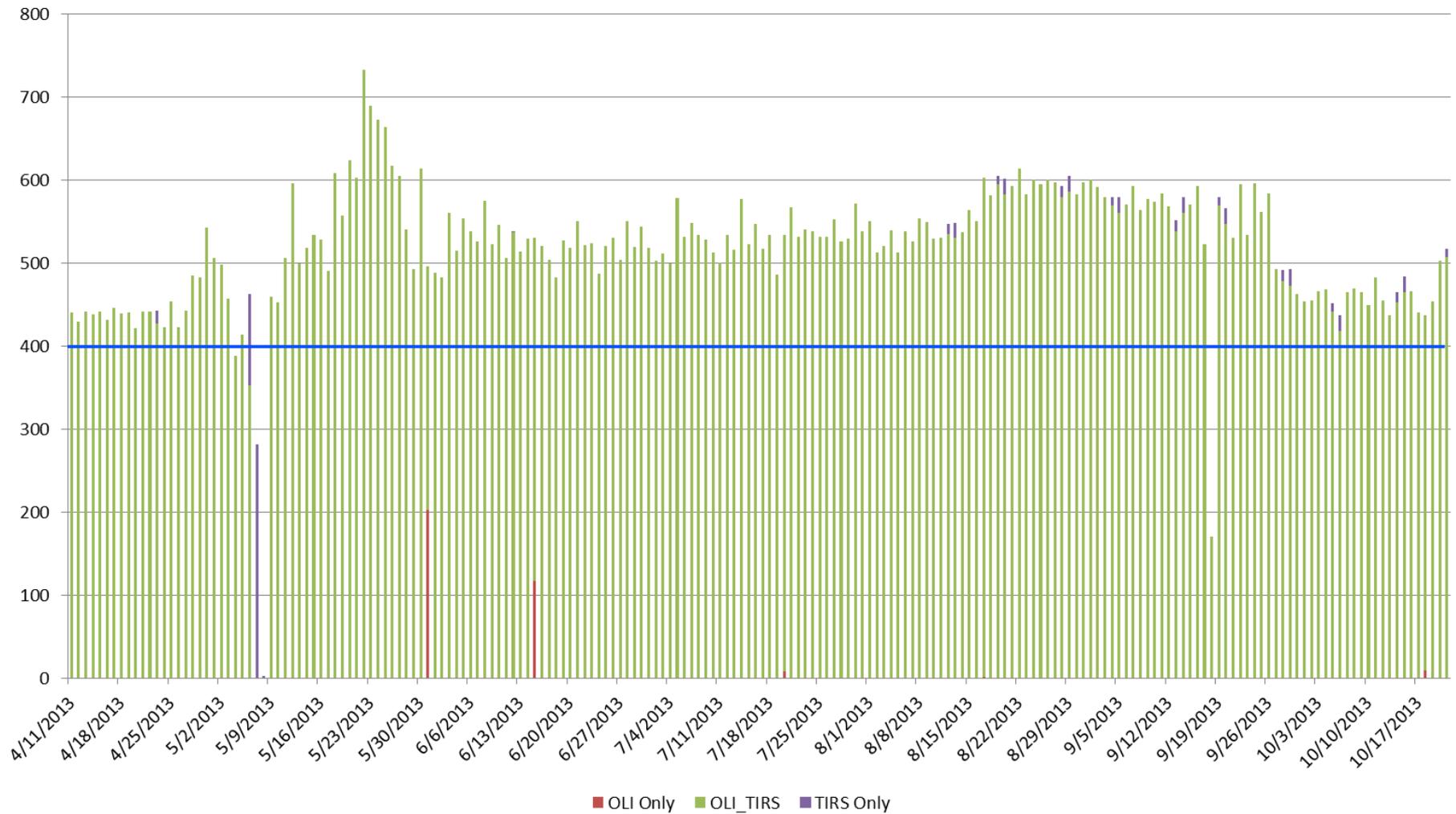
June 01, 2013 through January 31, 2014

220,216 Total Scenes

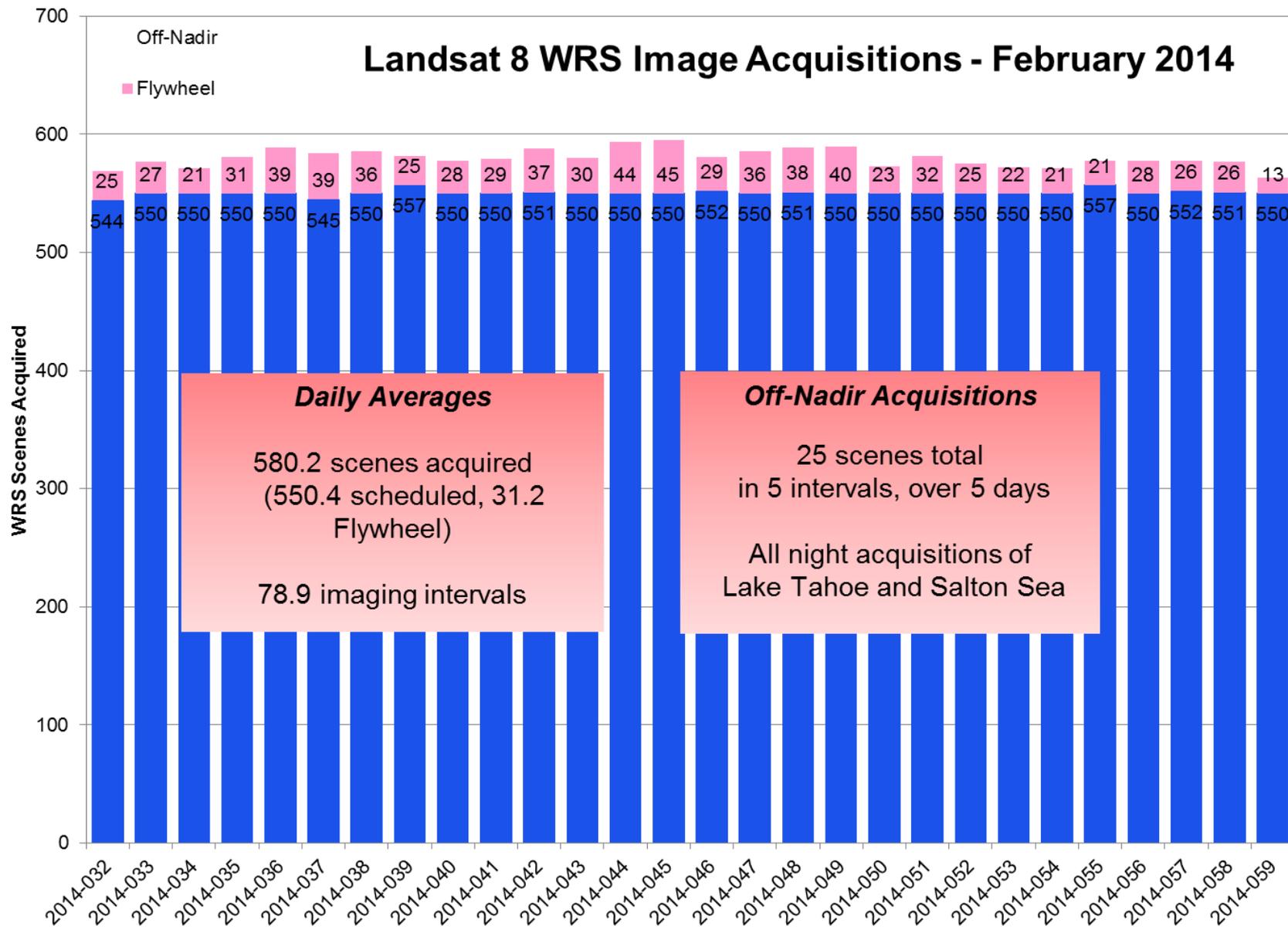
13,443 Unique Locations

 Target 8-day coverage  Target 16-day coverage  Target greater than 16-day coverage

Landsat 8 Scenes Acquired per Day

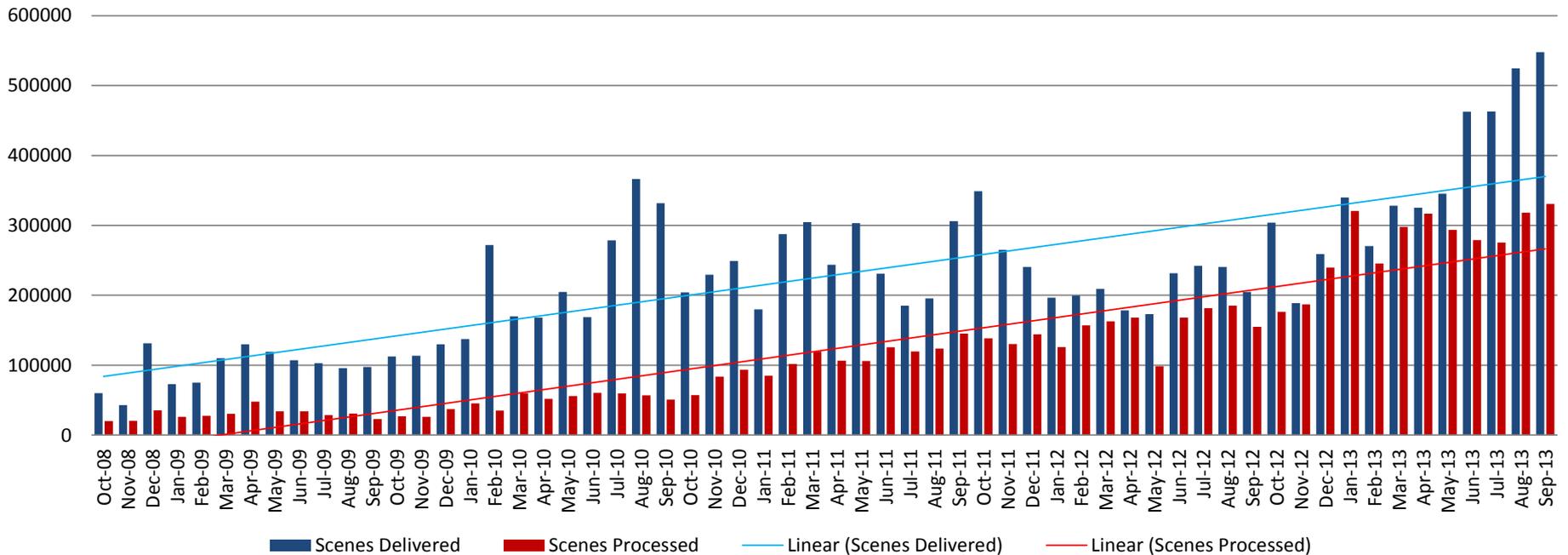


Landsat 8 WRS Image Acquisitions - February 2014



Monthly Downloads / Processed

Landsat Monthly Distribution Statistics



FY09 (Oct '08–Sep '09)

Delivered: 1.14M
Processed: 358K

FY10 (Oct '09–Sep '10)

Delivered: 2.45M
Processed: 567K

FY11 (Oct '10–Sep '11)

Delivered: 2.92M
Processed: 1.27M

FY12 (Oct '11–Sep '12)

Delivered: 2.73M
Processed: 1.82M

FY13 (Oct '12–Sep '13)

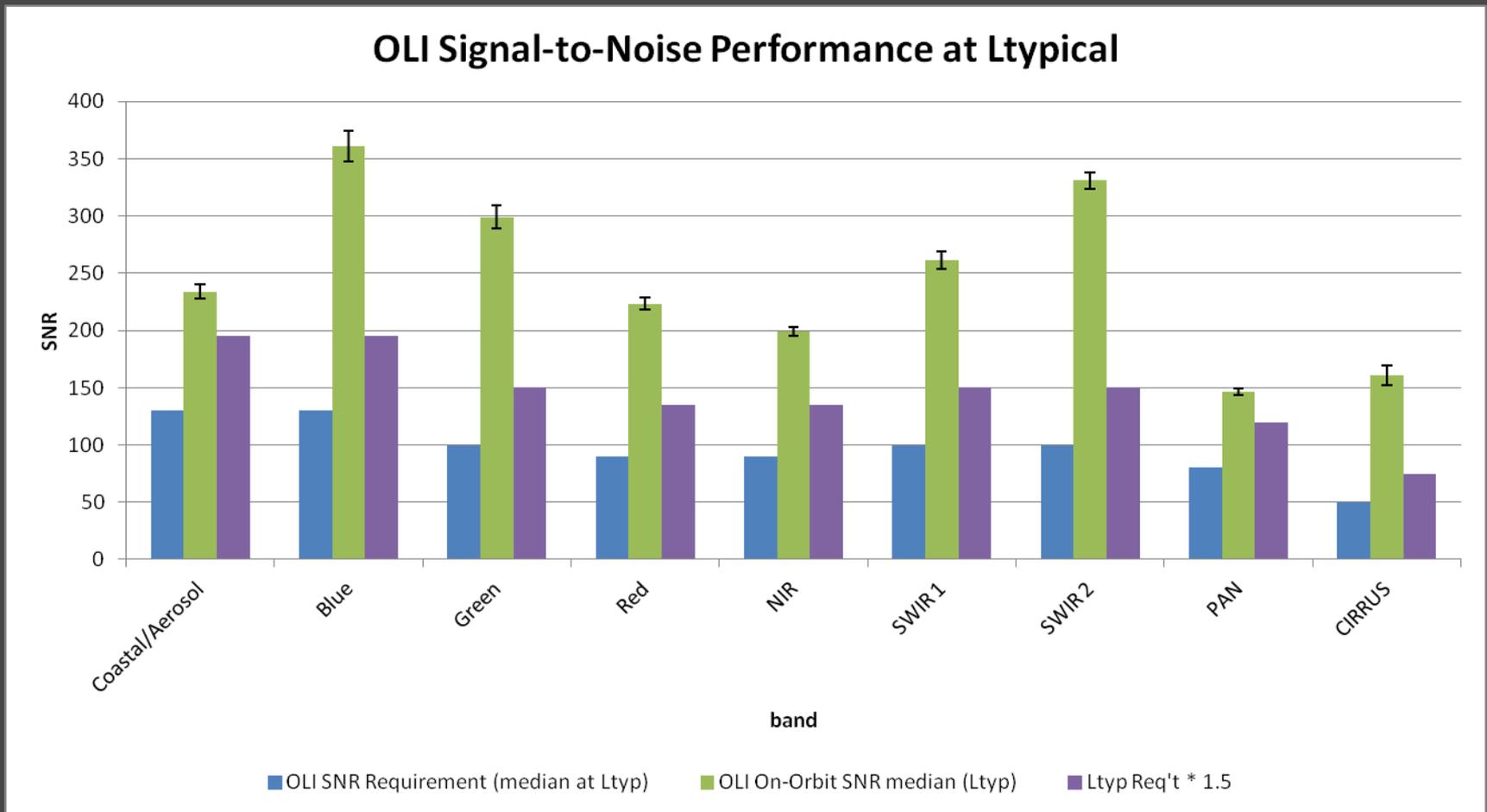
Delivered: 4.36M
Processed: 3.28M



Landsat 8 Reprocessing

- All Landsat 8 data is being reprocessed to make corrections based on first year data analysis.
- Reprocessing began on February 3, 2014
- Corrections to both Operational Land Imager (OLI) and the Thermal Infrared Sensor (TIRS) data are being made including:
 - all calibration parameter file updates since launch
 - improved OLI reflectance conversion coefficients for the cirrus band
 - improved OLI radiance conversion coefficients for all bands
 - refined OLI detector linearization to decrease striping
 - a radiometric offset correction for both TIRS bands
 - a slight improvement to the geolocation of the TIRS data
- Approximately 90% of reprocessing is completed with estimated completion by March 30, 2014.

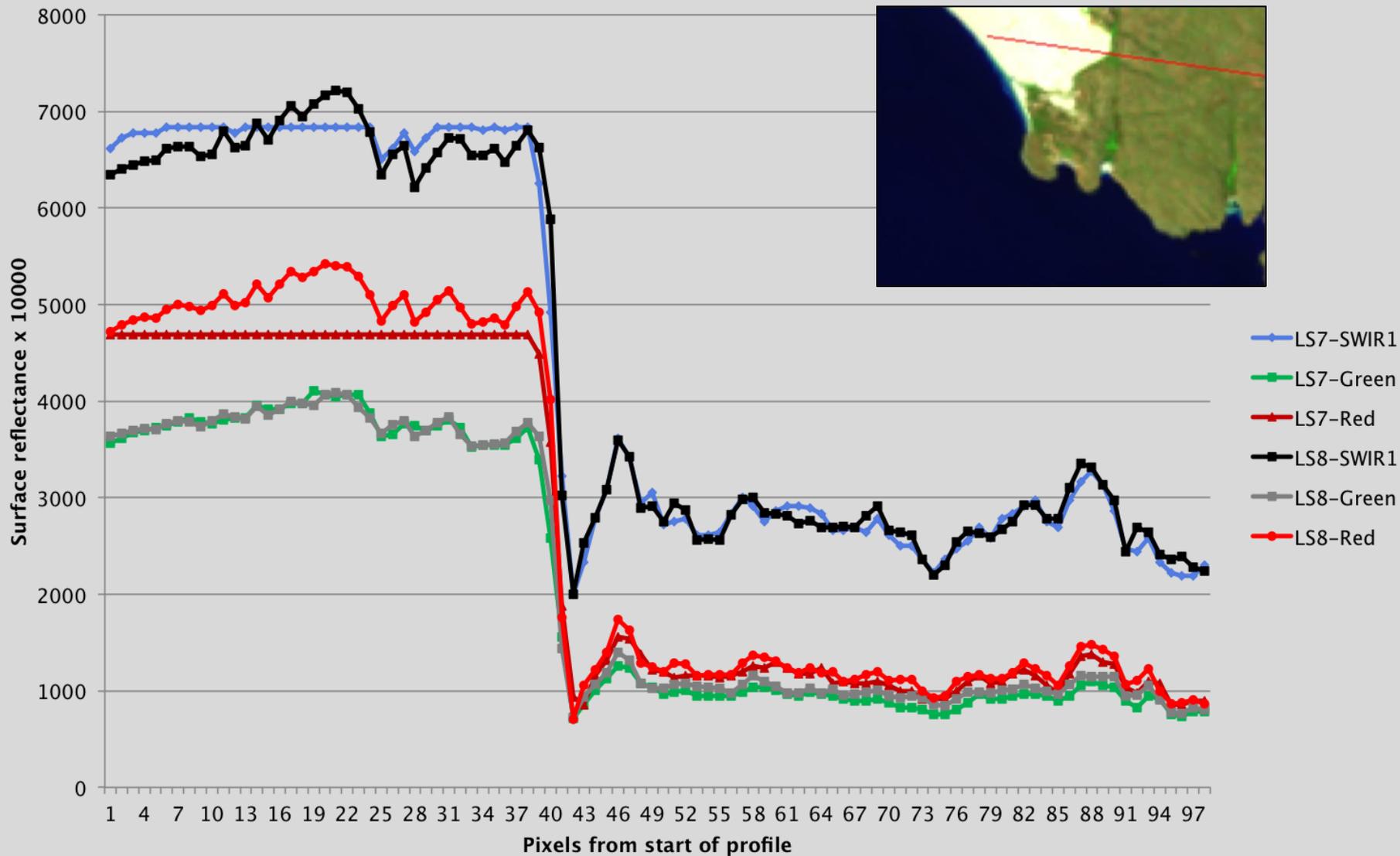
Landsat 8 Single-to-Noise



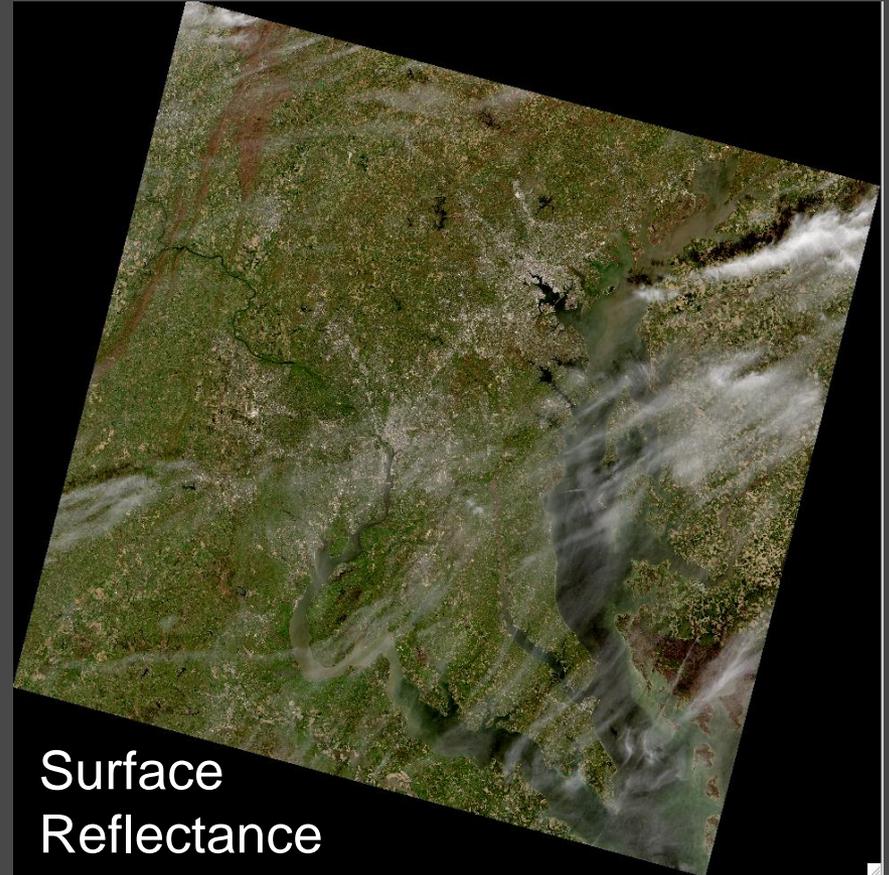
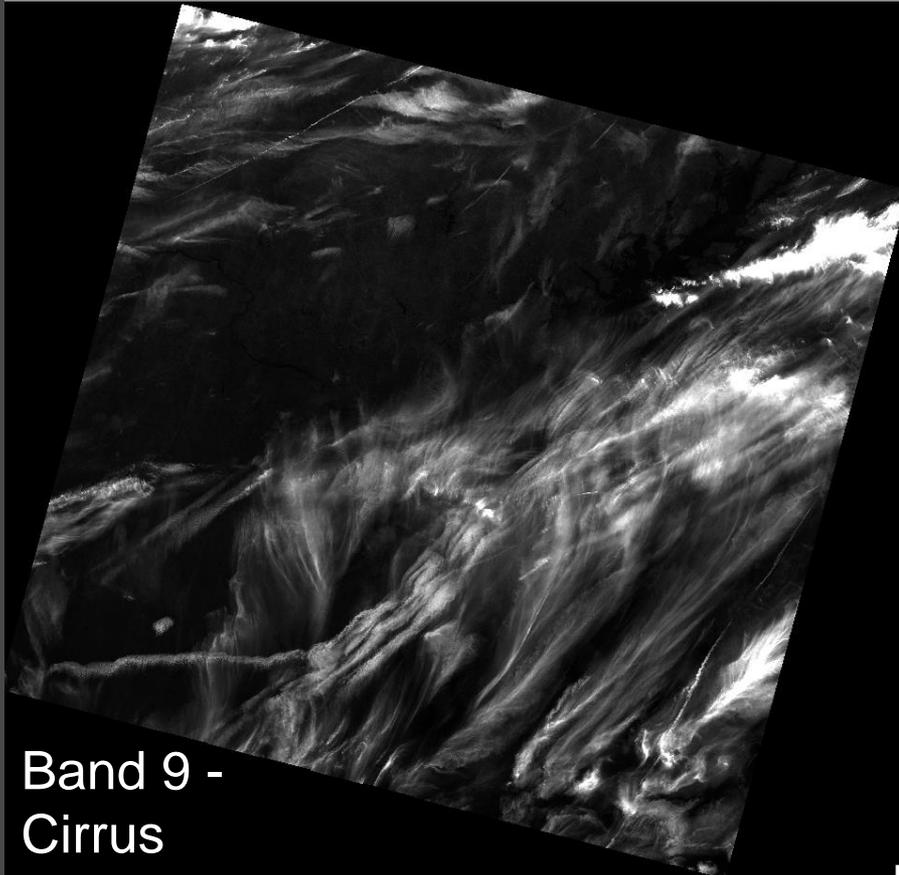
Improved SNR allows the more accurate detection and characterization of subtle land and water conditions.

12-bit Quantization Eliminates Bright Target Saturation

Surface reflectance profiles for Landsat 7 and Landsat 8



Landsat 8 Improved Cloud Detection



Detection of cirrus clouds using band 9 improves atmospheric correction of Landsat 8 multispectral data.

Remote Sensing Technologies

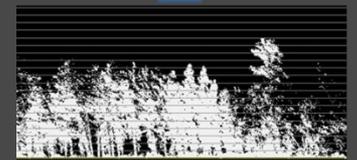
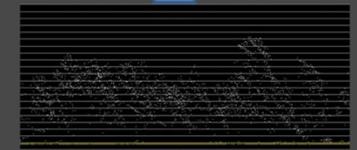
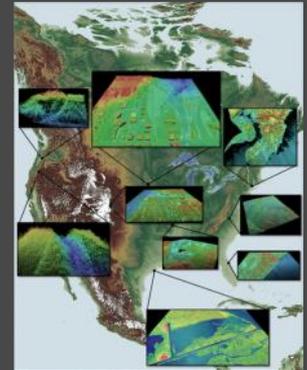
<http://calval.cr.usgs.gov/>

Key Project Objectives:

- **Understanding Land Remote Sensing information and technology in support of science needs**
 - Assessment / trending of Land Imaging satellites to allow interoperability
 - Work with global partners on remote sensing data quality and standards
 - Technical comparison of sensors to understand complementarity with Landsat
 - Create calibration/characterization data record for long term archive use
 - Explore data validation efforts - FCDRs/ECVs
 - Inform and educate science on new and future capabilities

Key Accomplishments

- **USGS has led JACIE since 2006 and is a co-chair with NASA, NOAA, & USDA**
- **Database of JACIE Civil/Commercial assessments includes over 400 presentations and publications**
- **Leading a USGS/ASPRS team to define community-wide LiDAR quality processes for 3DEP**



Evolution of NLI Requirements

- **President's FY 2012 budget request included funding for Landsat 9**
 - Request included language for “understanding Federal land imaging requirements”
- **USGS issued a Landsat Request for Information**
 - Notional requirements against which to assess alternative for future mission profiles
- **OSTP initiated national Earth Observation Assessments – Fall 2012 and follow-on 2015**
- **Collected value tree information to assess impact of observing systems across the societal benefit areas (SBAs)**
 - Served as an aid to the Administration in formulating a National Plan for Earth Observations

USGS NLIR Program Goals

- **Institutionalize the characterization and exploitation of all Earth Observation User requirements to attain greater awareness of user community needs and potential solutions**
 - **LRS Focus on service to Land EO Requirements**
 - **Understanding the broader picture critical**
 - **Build on Previous Successful Models**
 - **Design towards a Unified EO requirements architecture**
 - **Partner with EO community Practitioners**
 - **Producers and Consumers**
 - **US Federal**
 - **International**

NLIR Plans

- Collaborative effort with NOAA to develop and operate a capability to obtain, characterize, maintain and prioritize project requirements
 - Goal: Better understanding of the community needs that can be supported with observation resources
- Publishing land imaging requirements pilot project
 - Developing, exercising, and documenting processes for capturing value tree information
 - Focus on requirements for moderate resolution imagery, suitable for:
 - Sensor trade studies, and
 - Landsat mission formulation
 - Creating a value tree for moderate resolution imagery that provides traceability of requirements to users and missions
 - Building off of the EOA work
 - Lessons learned to apply to future requirements gathering

Sustainable Land Imaging

- The Administration has committed to continue the Landsat program and its invaluable data stream
- US President's FY14 budget language calls on NASA and DOI-USGS to jointly develop a follow-on mission to Landsat 8
- Work with NASA and use the information from NLIR process to determine best items to study

“Near-term activities led by NASA, in cooperation with USGS, will focus on studies to define the scope, measurement approaches, cost, and risk of a viable long-term land imaging system that will achieve national objectives. Evaluations and design activities will include consideration of stand-alone new instruments and satellites, as well as potential international partnerships.”

NASA – USGS Collaboration

Study Phase

- NASA will lead the overall system architecture study, utilizing its space systems engineering expertise
- **USGS will support all aspects of the study; USGS will represent the consolidated needs and desires of the Landsat user communities and provide expert analyses of the data processing and data dissemination aspects of the system**

Implementation Phase

- NASA will be responsible for the overall system design, as well as the implementation, launch, and commissioning of the system's space-borne elements
- USGS will provide unique expertise and guidance in the design of the operations, ground network, data processing (including integration of measurements from multiple sources), and data dissemination components of the complete system
- USGS will be responsible for operating the space-borne assets after commissioning, as well as the downlink, ground processing, archiving, and distribution of the system's information and data products
- The USGS will maintain the national archive of Landsat data, distribute data to users, and administer, on behalf of the U.S. Government, data acquisition by non-USG ground stations.



Architecture Study Team Objectives

- Define a system for delivering sustained global land-imaging multispectral and thermal infrared information for an approximately 20-year period starting in 2018
- Provide options which consider various weightings of near-term capability, continuity/gap risk mitigation, technology infusion over the system's lifetime, and cost
- Consider refined capabilities requested by the user communities
- Include consideration of new measurement approaches, as well as potential international and private sector partnerships
- Provide complete system architecture recommendations to the Executive Office of the President by August 15, 2014

Questions?