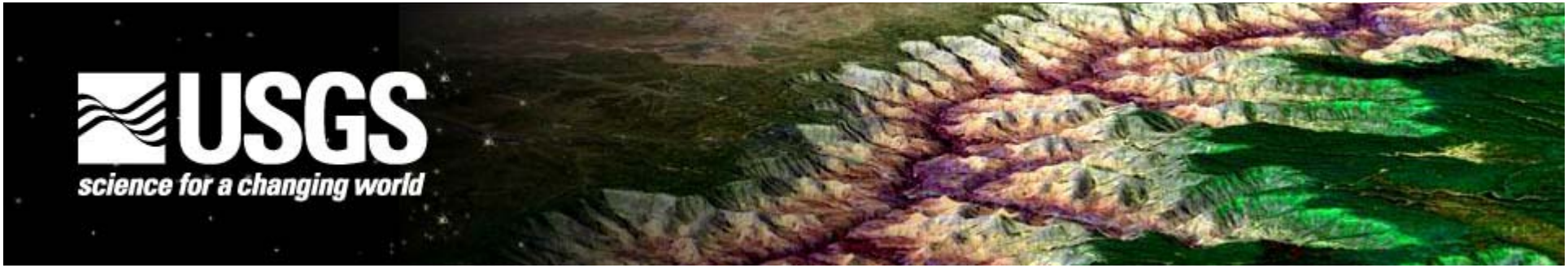


Landsat Project Status
Landsat Science Team Meeting

January 2010

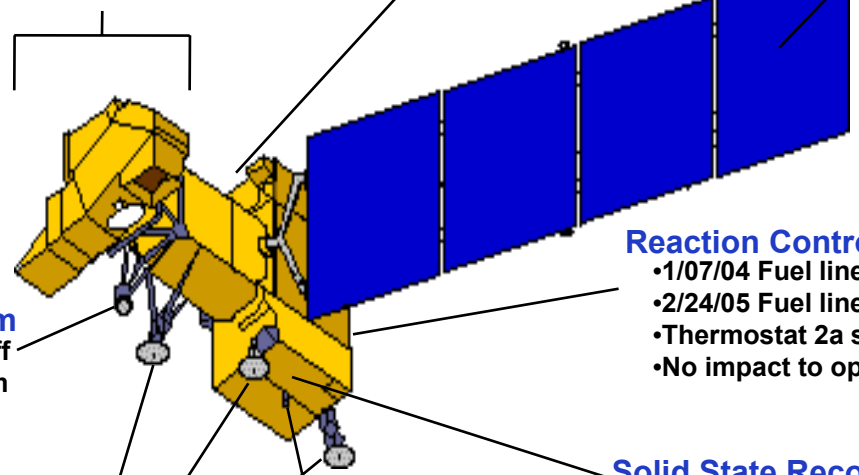
Presented By:

Thomas Kalvelage
Chief, Data Management Branch, U.S. Geological Survey/EROS
kalvelage@usgs.gov, (605) 594-6556

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

Satellite Segment

Landsat 7 Flight Segment



Electrical Power System

Enhanced Thematic Mapper +
- 5/31/2003 SLC Failure
- 4/01/2007 SAM -> Bumper mode

Batteries:
Performance nominal

Solar array:
- 5/14/2002 Circuit #14 Failure
- 5/16/2005 Circuit # 1 Failure
- 14 circuits remain operating
- No impact to ops

Reaction Control System
- 1/07/04 Fuel line #4 thermostat #1a failure.
- 2/24/05 Fuel line #4 thermostat #1b failure
- Thermostat 2a shows signs of failure
- No impact to ops; extended plan in place

Attitude Control System
- 05/05/2004 Gyro 3 Shut Off
- Singe gyro control system in development

Solid State Recorder
- 11/15/1999 SSR PWA #23 Loss
- 02/11/2001 SSR PWA #12 Loss
- 12/07/2005 SSR PWA #02 Loss
- 08/02/2006 SSR PWA #13 Loss
- 03/28/2008 SSR PWA #22 Loss
- Each PWA is ≈4% loss of launch capacity
- Boards are likely recoverable
- 09/03/2006 SSR PWA #23 Recovered

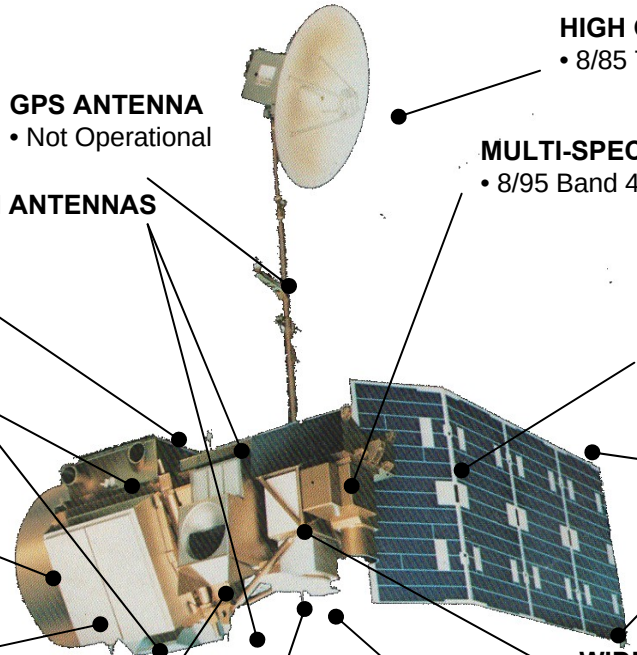
X-band System
Performance nominal

S-band System
Performance nominal

Landsat 7 Status

- **On December 9th, Landsat 7 was predicted by the Joint Space Operations Center to have a close approach with Formosat 3D**
  - Unfortunately identified 1 day after L7 executed delta-i orbit maintenance maneuver
- **On the 10th, the probability was about 1.2% with a miss distance predicted at 125m to 250m**
- **On the 11th, the probability of collision had grown to 2.28% and the miss distance dropped to 95m**
- **Later on the 11th, L7 executed a 2.5 second posi-grade burn, removing the risk of collision**
  - The best option would have been a retro-grade avoidance maneuver, but not worth the risk
- **No impact to end-of-life (EOL) from this maneuver**

Landsat 5 Flight Segment



HIGH GAIN ANTENNA
- 8/85 Transmitter A failure

GPS ANTENNA
- Not Operational

COMM & DATA HANDLING MODULE
- Located back side of s/c

OMNI ANTENNAS

MULTI-SPECTRAL SCANNER
- 8/95 Band 4 failure

ACS MODULE
- 07/03 FHST#1 Degradation
- Skew wheel tack anomaly 10/92
- 11/92 Earth Sensor 1 failure
- 02/02 Earth Sensor 2 failure
- Intermittent operations possible

SOLAR ARRAY DRIVE / PANELS
- 01/05 Primary Solar Array Drive failure
- Nominal Solar array panel degradation (12/04)
- 11/05 Redundant Solar Array Drive Malfunction

COARSE SUN SENSORS

PROPULSION MODULE
- 3/84 Primary Thruster D failure

POWER MODULE
- 05/04 Battery 1 failure / Removed from power circuits
- 10/07 1 of 22 Cells fails on Battery #2

WIDEBAND COMM. MODULE
- 07/88 Ku-band TWTA Prime failure (OCP)
- 07/92 Ku-band TWTA Redundant failure (OCP)
- 08/87 X-band TWTA Prime failure (OCP)
- 03/06 X-band TWTA Redundant Anomaly
- ***12/09 X-band TWTA Redundant Anomaly***
- ***01/10 X-band TWTA Primary Recovered***

X-BAND ANTENNA

THEMATIC MAPPER
- 10/94 Power Supply 1 stuck switch
- 06/02 TM switched to bumper mode

DIRECT ACCESS S-BAND
- 03/94 Side A FWD Power Sensor failure

Landsat 5 Status

- **Power/Attitude functioning nominally**
  - August 13th Attitude Anomaly Placed Spacecraft in Critical State
    - Characterized by saturated gyro rates
  - Recovered and Fully Operable Within 35 hours!

Landsat 5 Status

- **Redundant TWTA Failure**
  - Loss of redundant Traveling Wave Tube Amplifier (TWTA) resulted in the loss of science data
  - Redundant TWTA helix current rise caused trips that began on November 4th, resulting in lost of science data acquisitions
  - On December 18th, the redundant TWTA completely failed
    - Determined unrecoverable on December 23rd
  - Flight Operations Team (FOT) prepared for recovery of the primary TWTA between December 18th and January 6th
  - The first successful science data downlink utilizing the primary TWTA on January 7th
  - Incrementally added IC ground stations January 11th – 15th
  - Fully operational on Jan 15th
  - Science data is considered operational and is now available to the public back to January 10th

Ground Segment

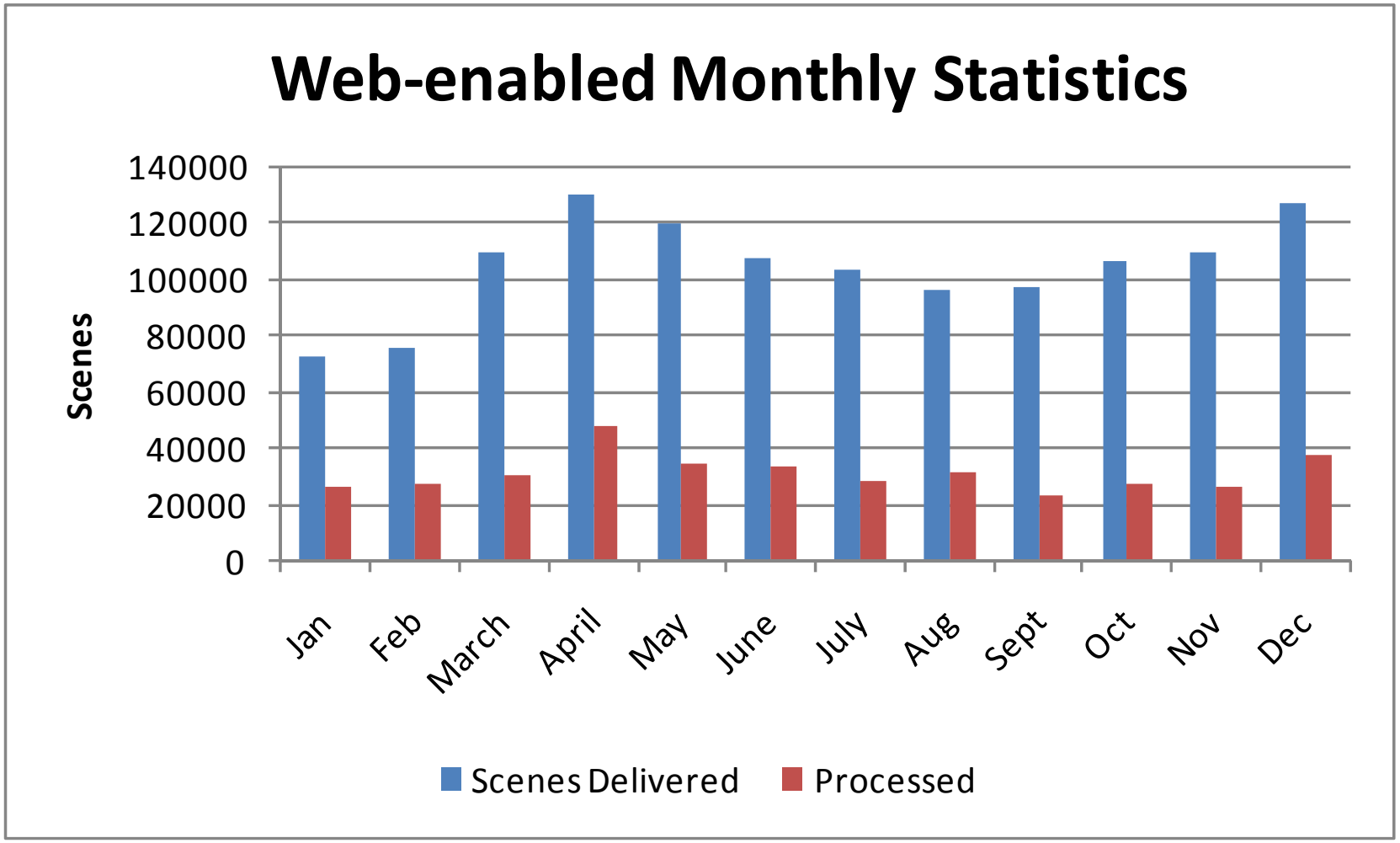
U.S. Landsat Archive Overview
(Available scenes through November 30, 2009)

- **ETM+: Landsat 7**
  - 990,735 scenes
  - 920TB RCC and L0Ra Data
  - Archive grows by 260 GB Daily
- **TM: Landsat 4 & Landsat 5**
  - 843,787 scenes
  - 211TB of L0Ra Data
  - Archive Grows by 40 GB Daily
- **MSS: Landsat 1 through 5**
  - 652,088 scenes
  - 19 TB of Data

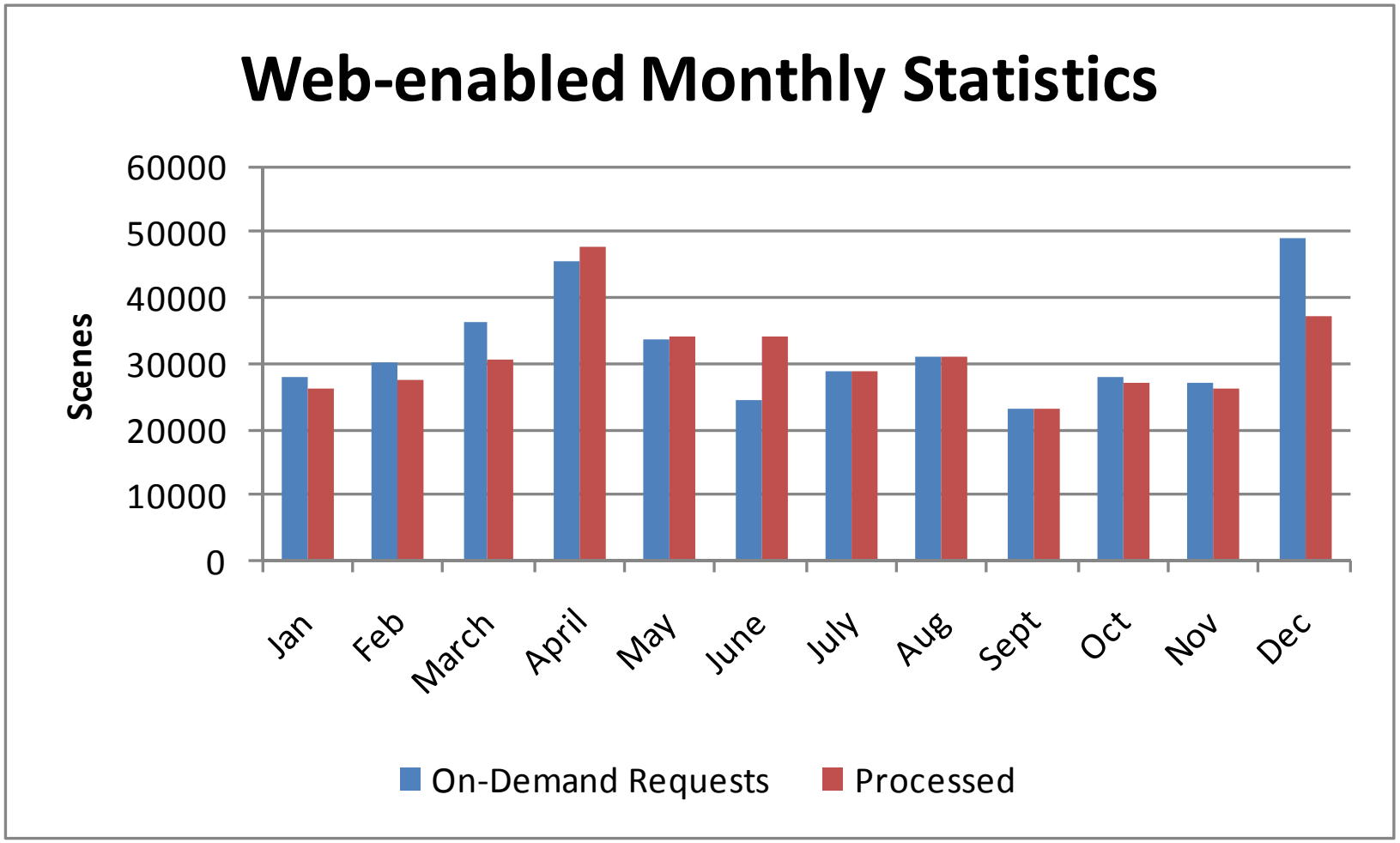
Global Land Survey

- **GLS2005**
  - Copying data for IC contributors
  - Received Thailand data (123 scenes)
- **GLS2010**
  - Campaign Stations and other exchanged data added to US Archive for October 2009: Total 5,020
    - Irkutsk, Russia 1,417
    - Matera, Italy 59
    - KaShi, China 1,305
    - Magadan, Russia 323
    - Moscow 587
    - Maspalomas 1,329
  - Began campaign at Malindi on Nov 2: data needs to be transcribed to raw computer compatible (RCC) exchange format at Matera
  - Chetumal fixed antenna; problems with software
    - Will continue operations now that Landsat 5 is able to transmit

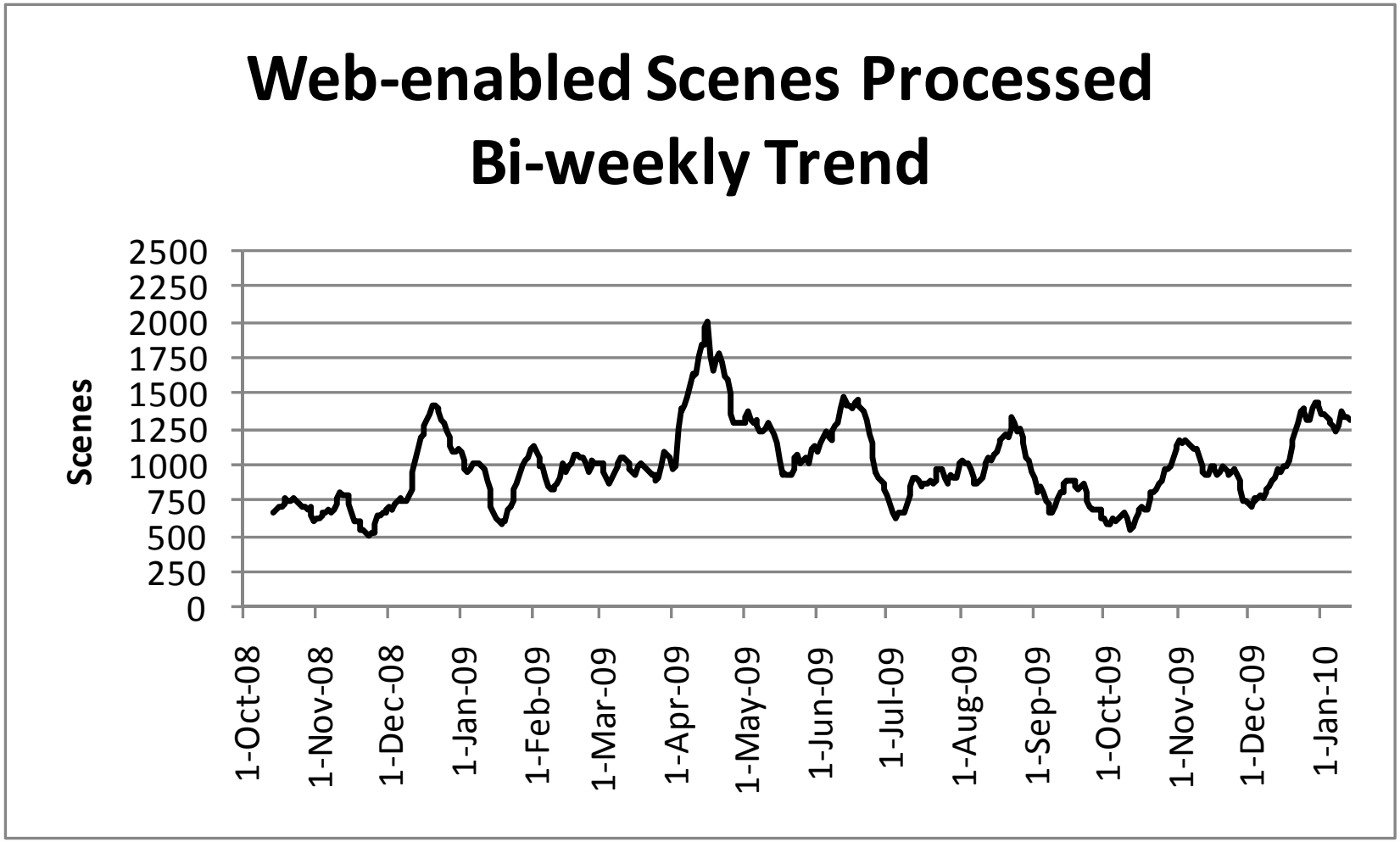
Monthly Downloads / Processed



Monthly On-demand Requests / Processed



Daily Scenes Processed



Remaining Issues with Web-enabling

- **Near-line Tape Archive**
  - Bottleneck in on-demand processing where L0Ra data is read from tape for processing to L1T
  - L0Ra is going on disk through archive consolidation project
    - Will stop when available disk is filled
- **Storage Area Networking / Processing Systems**
  - Aging equipment limits throughput
- **FTP distribution space for processed products**
  - Current disk holds approximately 10% of total archive
  - Data is removed from the distribution space as new data are processed
    - Currently removing data older than 7 months

Remaining Issues with Web-enabling

- **Processed Product (L1T) Metadata**
  - Infrastructure for processed product metadata not currently in place, but is on project priority list
  - Purpose
    - Users currently do not know if a product is processed to L1G or L1T
    - Users have no knowledge of when the product was process or with what Calibration Parameter File
    - Possible other useful information needed prior to product download
- **Small number of product issues reported**
  - L1G processed versus L1T
  - Georegistration issues
  - Please continue to report any issues you find!

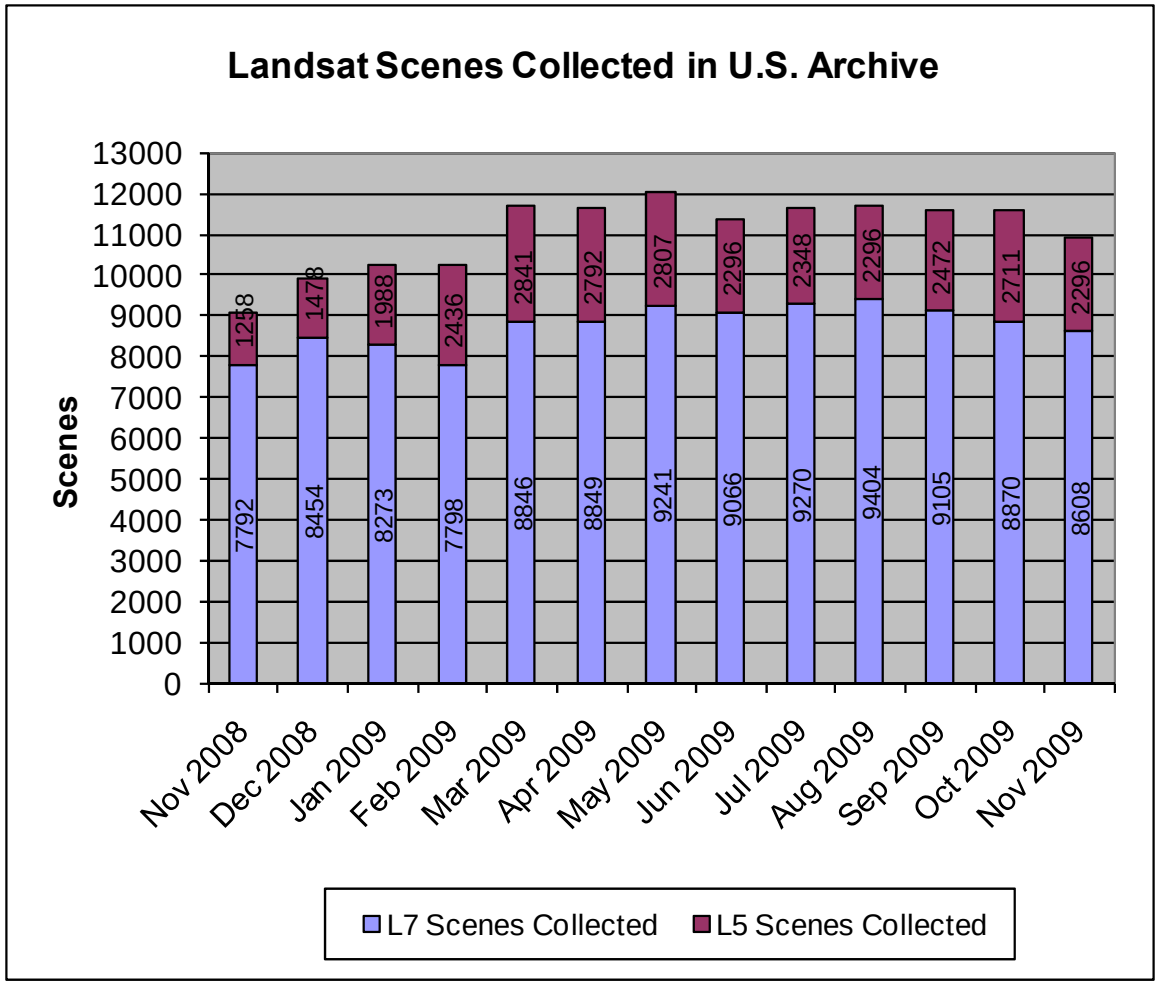
L0Rp To The Public

- **Released L0Rp on-demand capability in early January**
  - All requests are handled on-demand
  - Request access through customer services or contact Rachel Headley at rheadley@usgs.gov
  - Once given access, users may select L0Rp scenes in the shopping cart
  - Data will be placed on the FTP server and cleaned up after a configurable number of days
    - Currently set to 10 days

MSS Processing

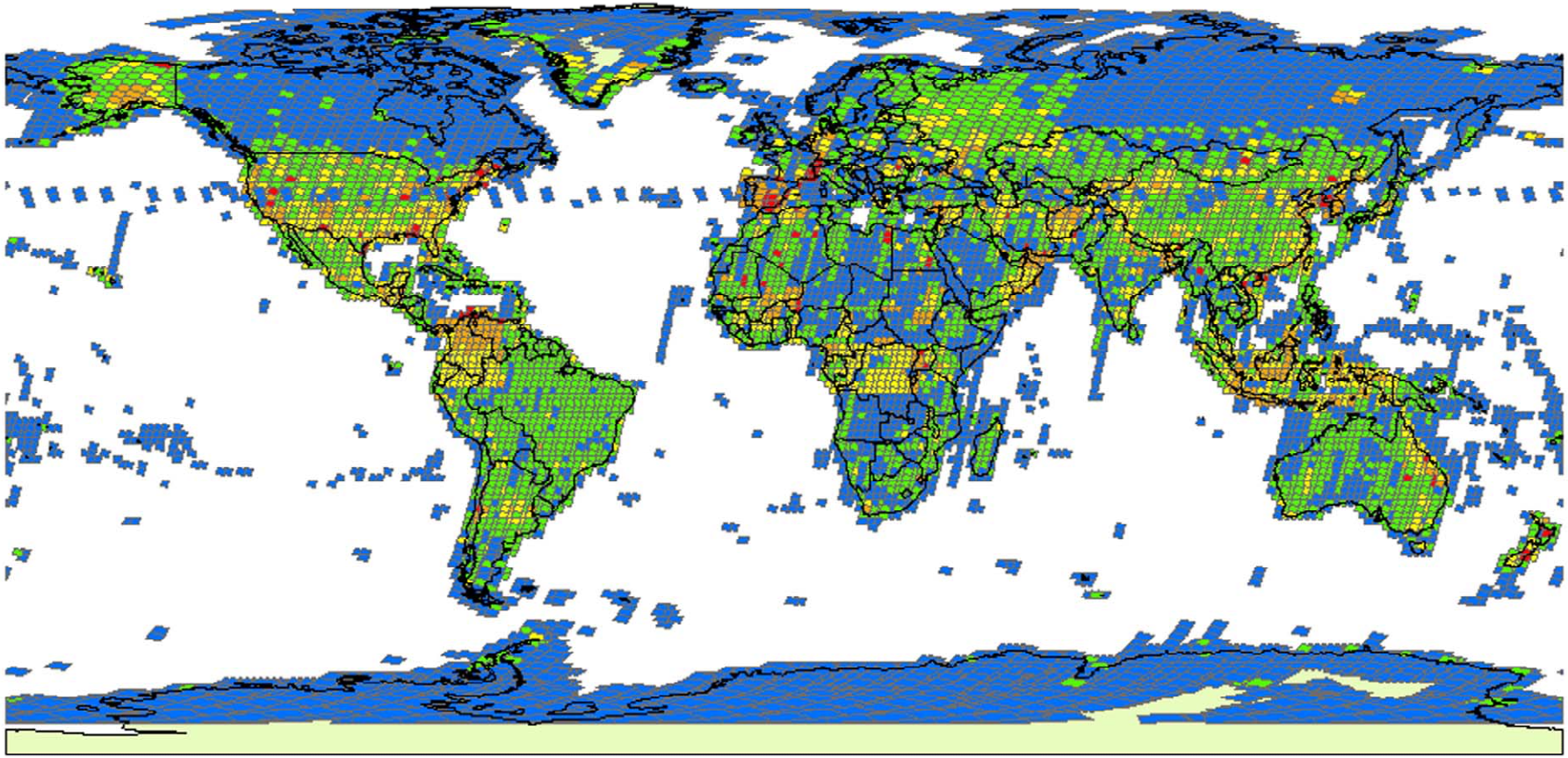
- **MSS Processing**
  - Migrating the NLAPS MSS production to LPGS
  - MSS Processing in NLAPS
    - Ceased manual precision processing
      - If L1T is not created automatically, scene is switched to L1G processing
      - Approximately 22% automatically process to L1T
  - MSS to LPGS Schedule
    - Three Phases (LPGS Dates)
      - MSS-P 3/2010
      - MSS-X 7/2010
      - MSS-A 9/2010

Landsat Data Acquired by Month



Web-enabled Statistics

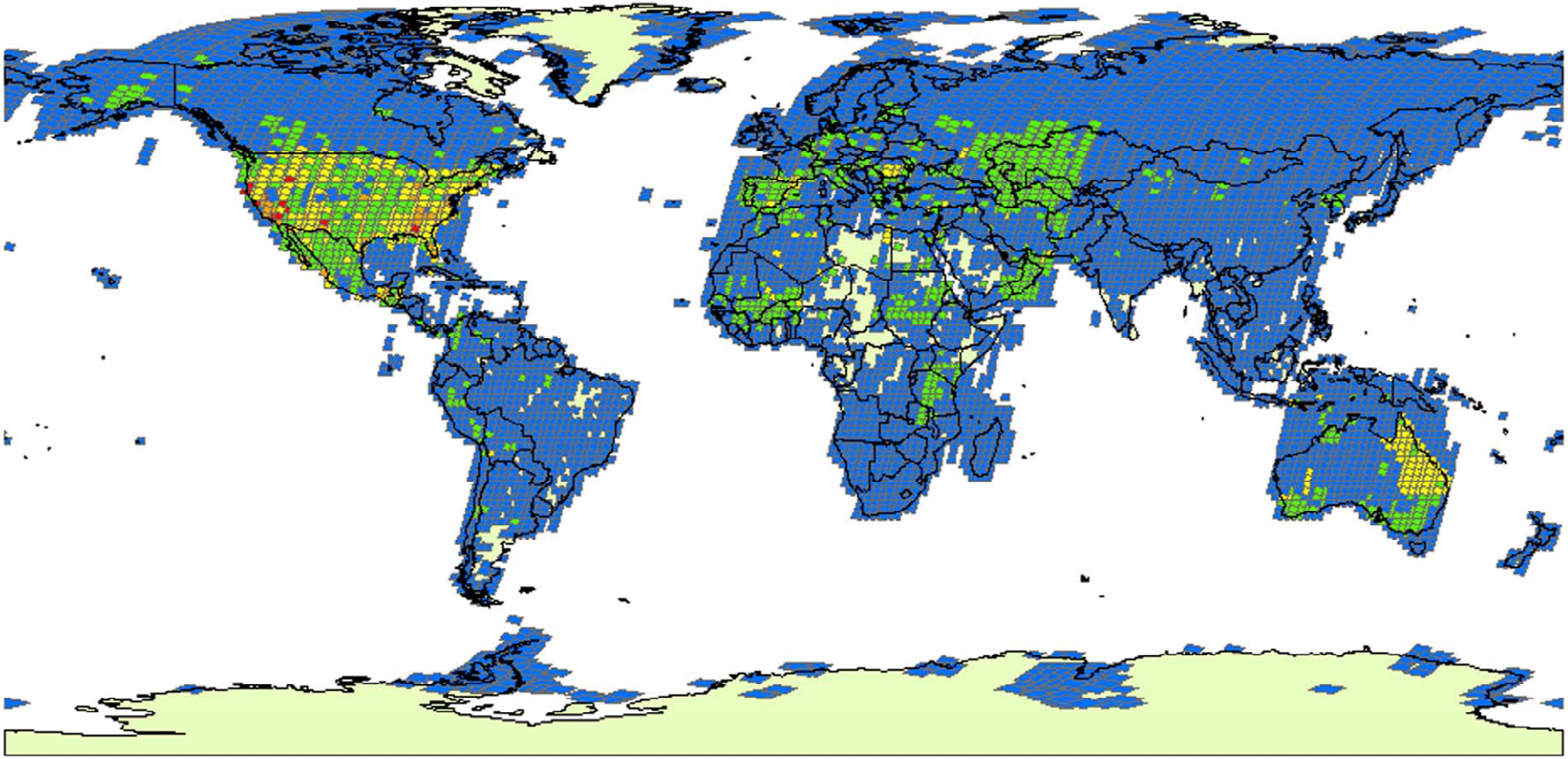
Scenes Processed (ETM+)



ETM+ Standard L1T Scenes on FTP Server
Status through December 31, 2009
350,558 Total Cumulative Scenes Available
189,101 Total ETM+ Scenes Available
13,144 Unique ETM+ Locations

1 - 11 | 12 - 28 | 29 - 55 | 56 - 101 | 102 - 208

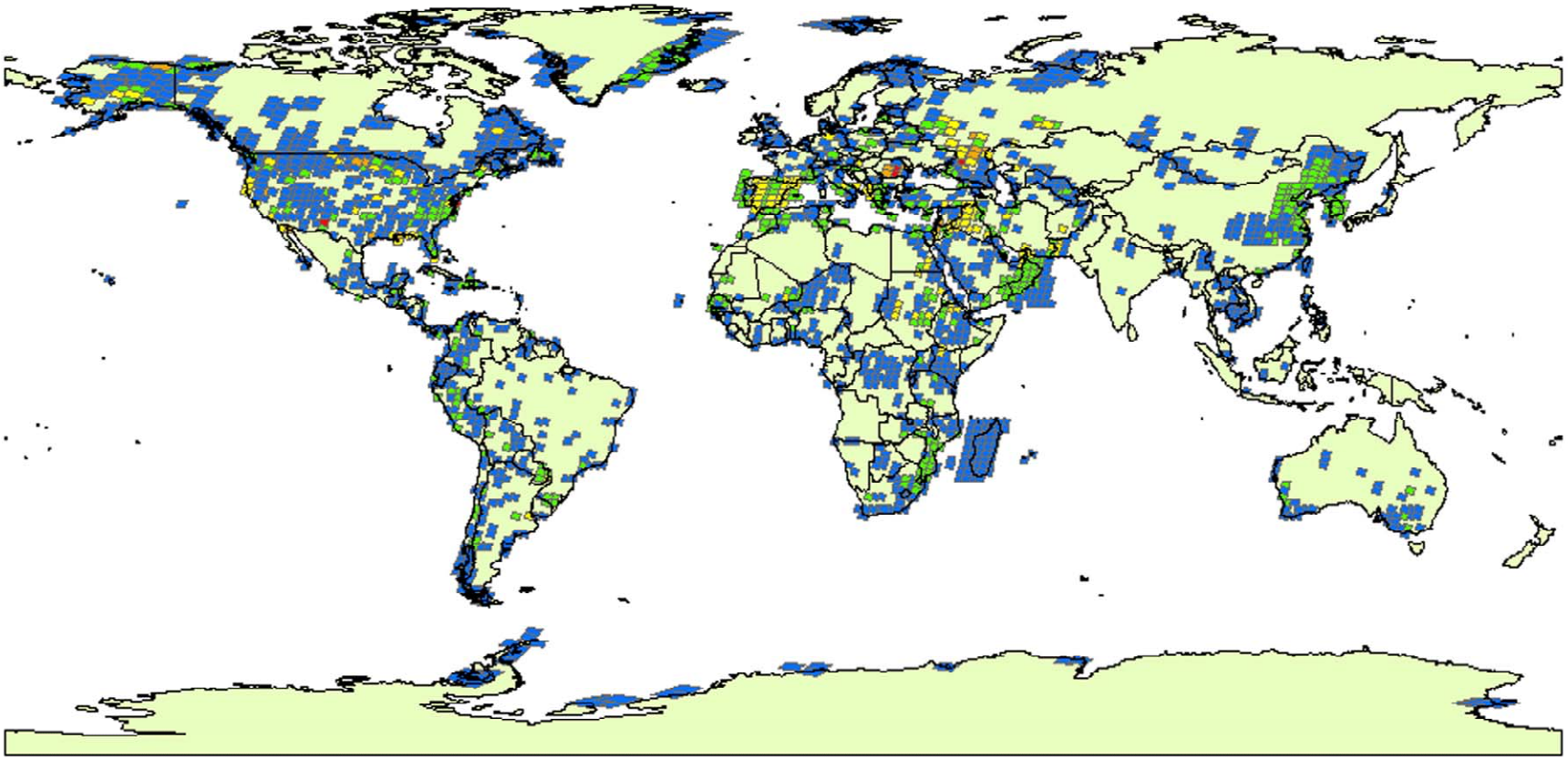
Scenes Processed (TM)



TM Standard L1T Scenes on FTP Server
Status through December 31, 2009
350,558 Total Cumulative Scenes Available
119,748 Total TM Scenes Available
8,509 Unique TM Locations

1 - 20 | 21 - 65 | 66 - 137 | 138 - 276 | 277 - 486

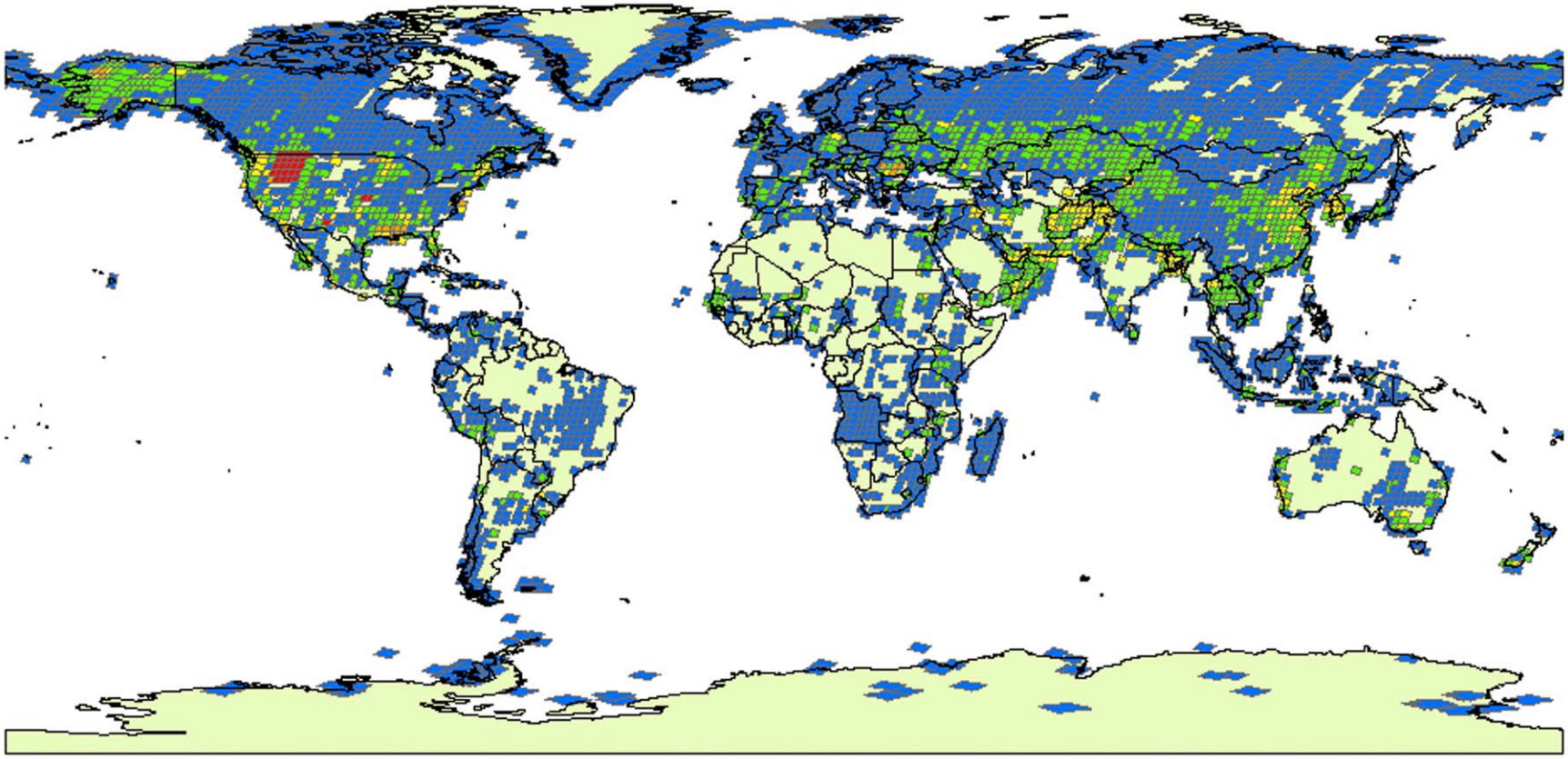
Scenes Processed (MSS – WRS2)



L4-5 MSS Standard L1T Scenes on FTP Server
Status through December 31, 2009
350,558 Total Cumulative Scenes Available
41,709 Total MSS Scenes Available
11,601 Total L4-5 MSS Scenes Available
2,096 Unique L4-5 MSS Locations

1 - 5 | 6 - 16 | 17 - 41 | 42 - 84 | 85 - 205

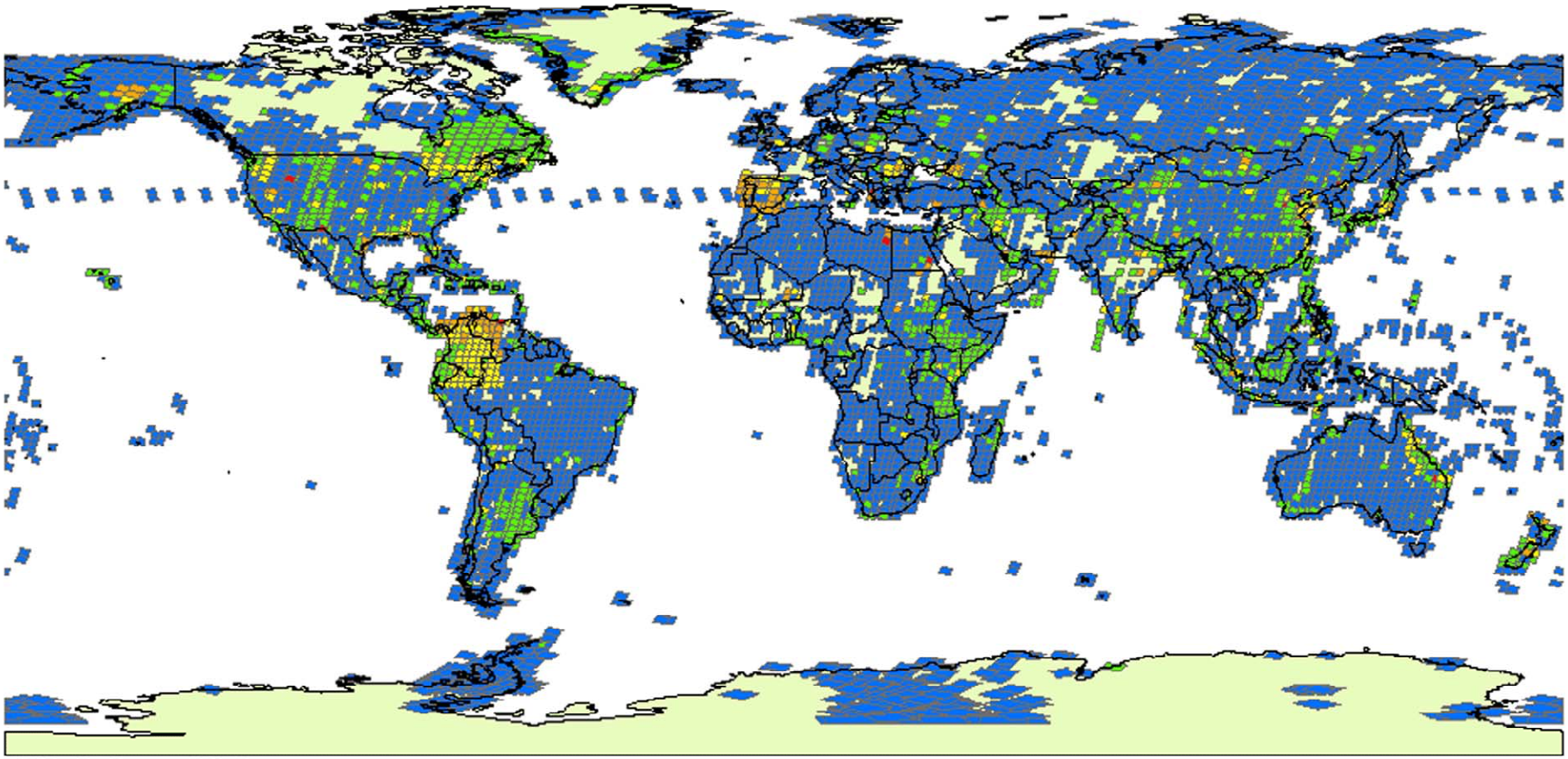
Scenes Processed (MSS – WRS1)



L1-3 MSS Standard L1T Scenes on FTP Server
Status through December 31, 2009
350,558 Total Cumulative Scenes Available
41,709 Total MSS Scenes Available
30,108 Total L1-3 MSS Scenes Available
5,329 Unique L1-3 MSS Locations

1 - 5 | 6 - 17 | 18 - 48 | 49 - 96 | 97 - 208

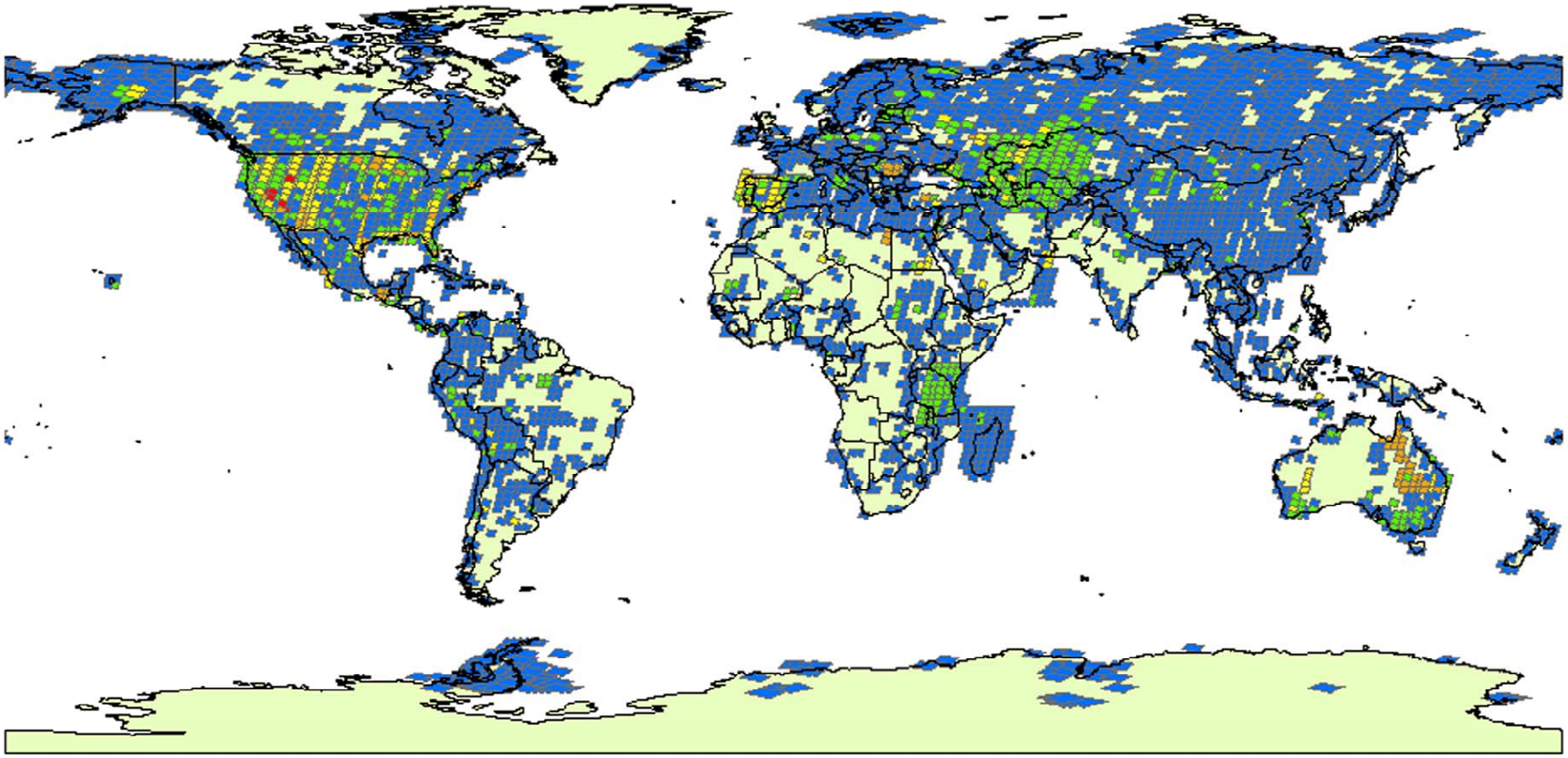
On-Demand Requests (ETM+)



ETM+ On-Demand Orders
October 01, 2009 through December 31, 2009
104,343 Total Cumulative Scenes Delivered
52,524 Total ETM+ Scenes Delivered
7,171 Unique ETM+ Locations

1 - 8 | 9 - 25 | 26 - 55 | 56 - 103 | 104 - 197

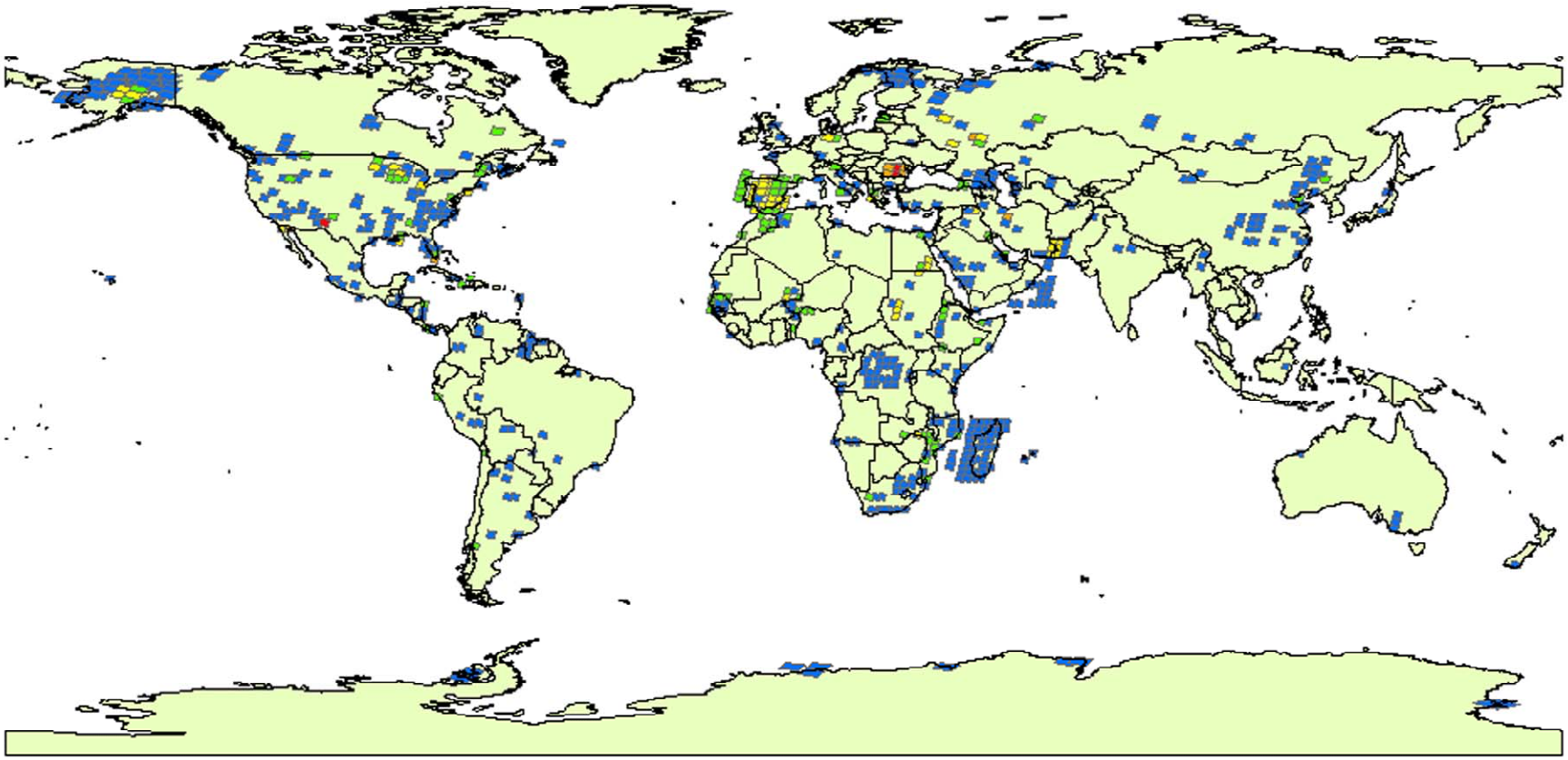
On-Demand Requests (TM)



TM On-Demand Orders
October 01, 2009 through December 31, 2009
104,343 Total Cumulative Scenes Delivered
44,346 Total TM Scenes Delivered
4,522 Unique TM Locations

1 - 12 | 13 - 39 | 40 - 85 | 86 - 228 | 229 - 586

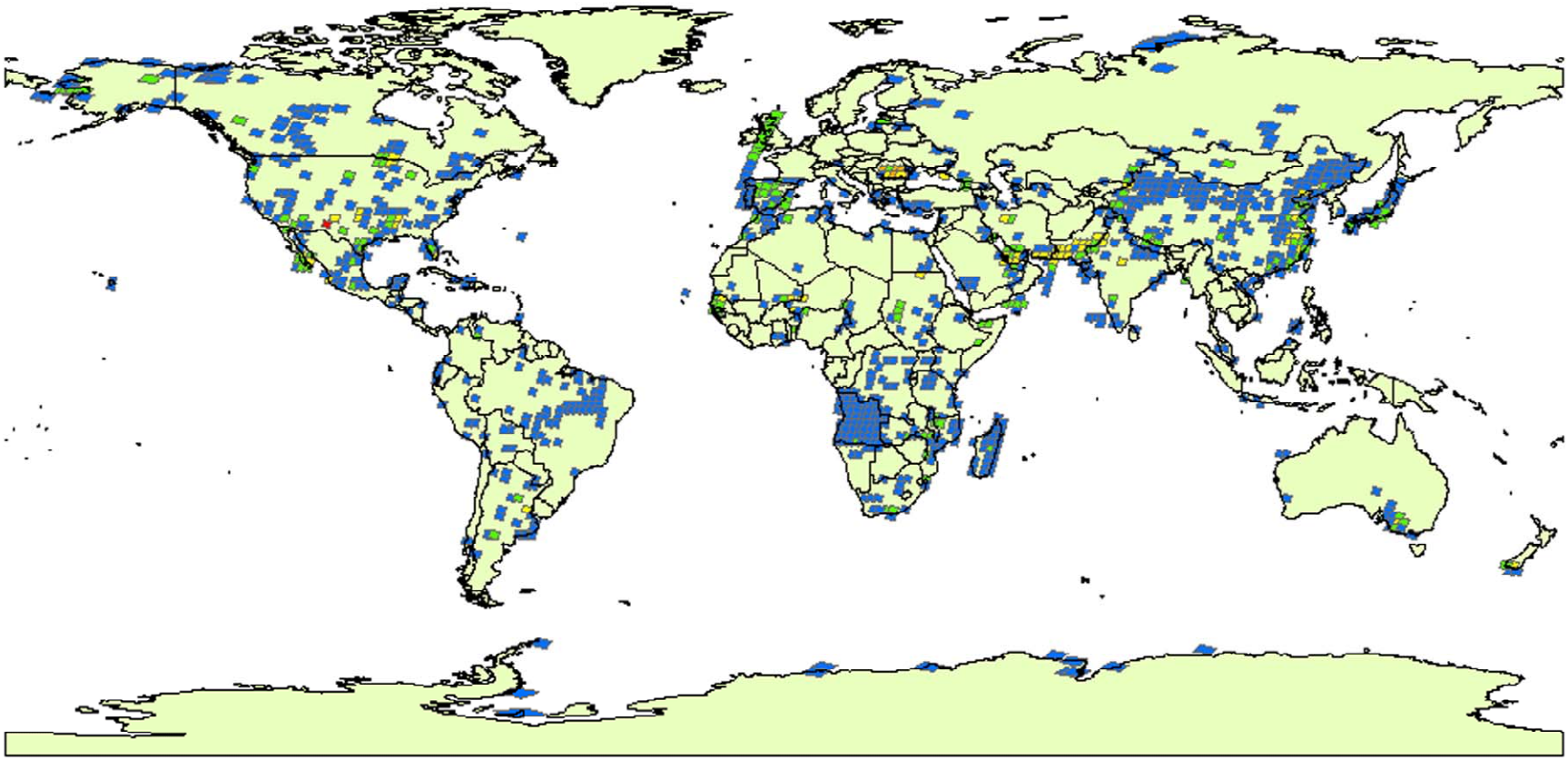
On-Demand Requests (MSS – WRS2)



L4-5 MSS On-Demand Orders
October 01, 2009 through December 31, 2009
104,343 Total Cumulative Scenes Delivered
7,473 Total MSS Scenes Delivered
3,365 L4-5 MSS Total Scenes Delivered
643 Unique L4-5 MSS Locations

1 - 5 | 6 - 14 | 15 - 34 | 35 - 64 | 65 - 136

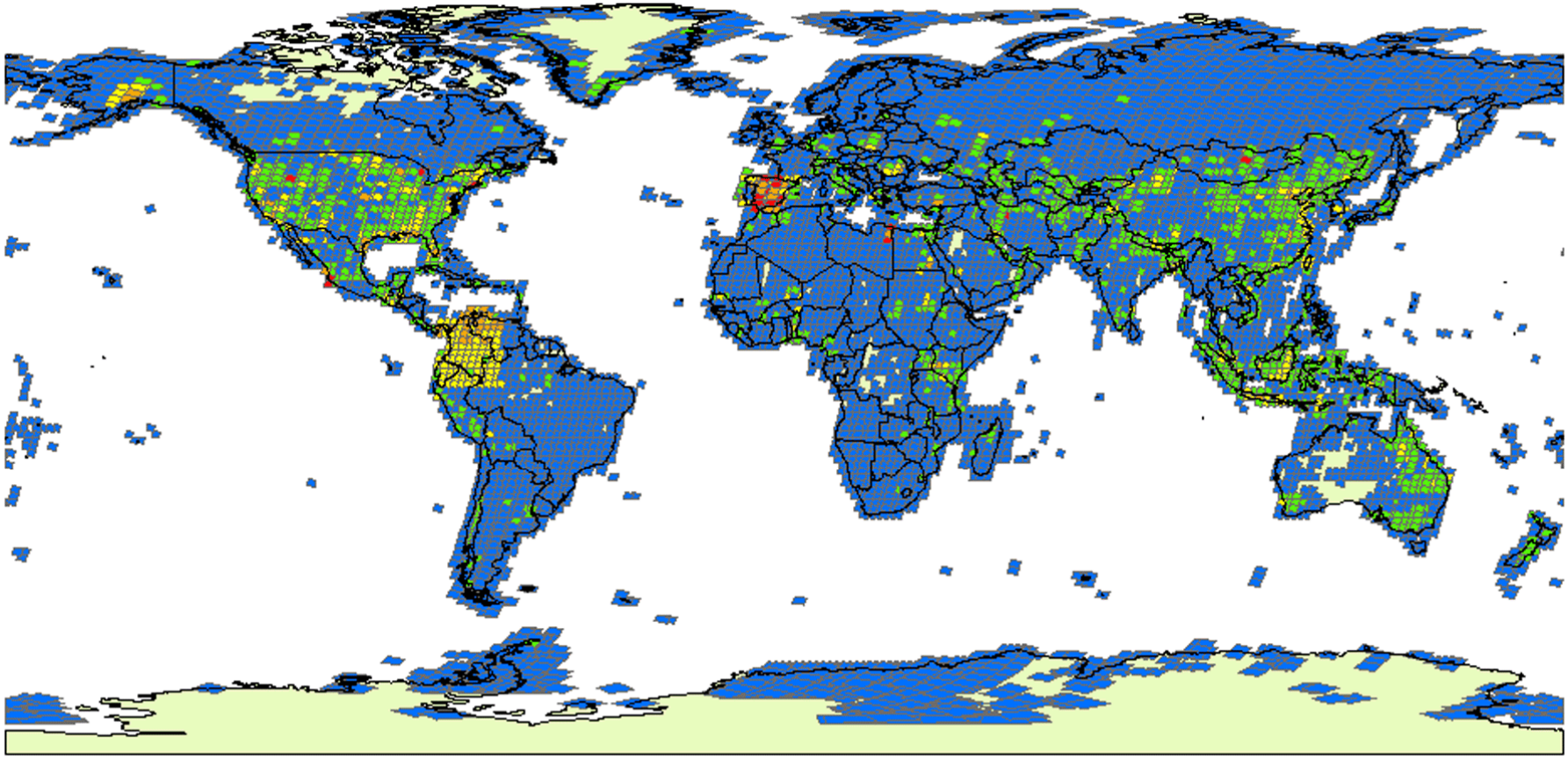
On-Demand Requests (MSS – WRS1)



L1-3 MSS On-Demand Orders
October 01, 2009 through December 31, 2009
104,343 Total Cumulative Scenes Delivered
7,473 Total MSS Scenes Delivered
4,108 Total L1-3 MSS Scenes Delivered
1,068 Unique L1-3 MSS Locations

1 - 4 | 5 - 14 | 15 - 40 | 41 - 72 | 73 - 177

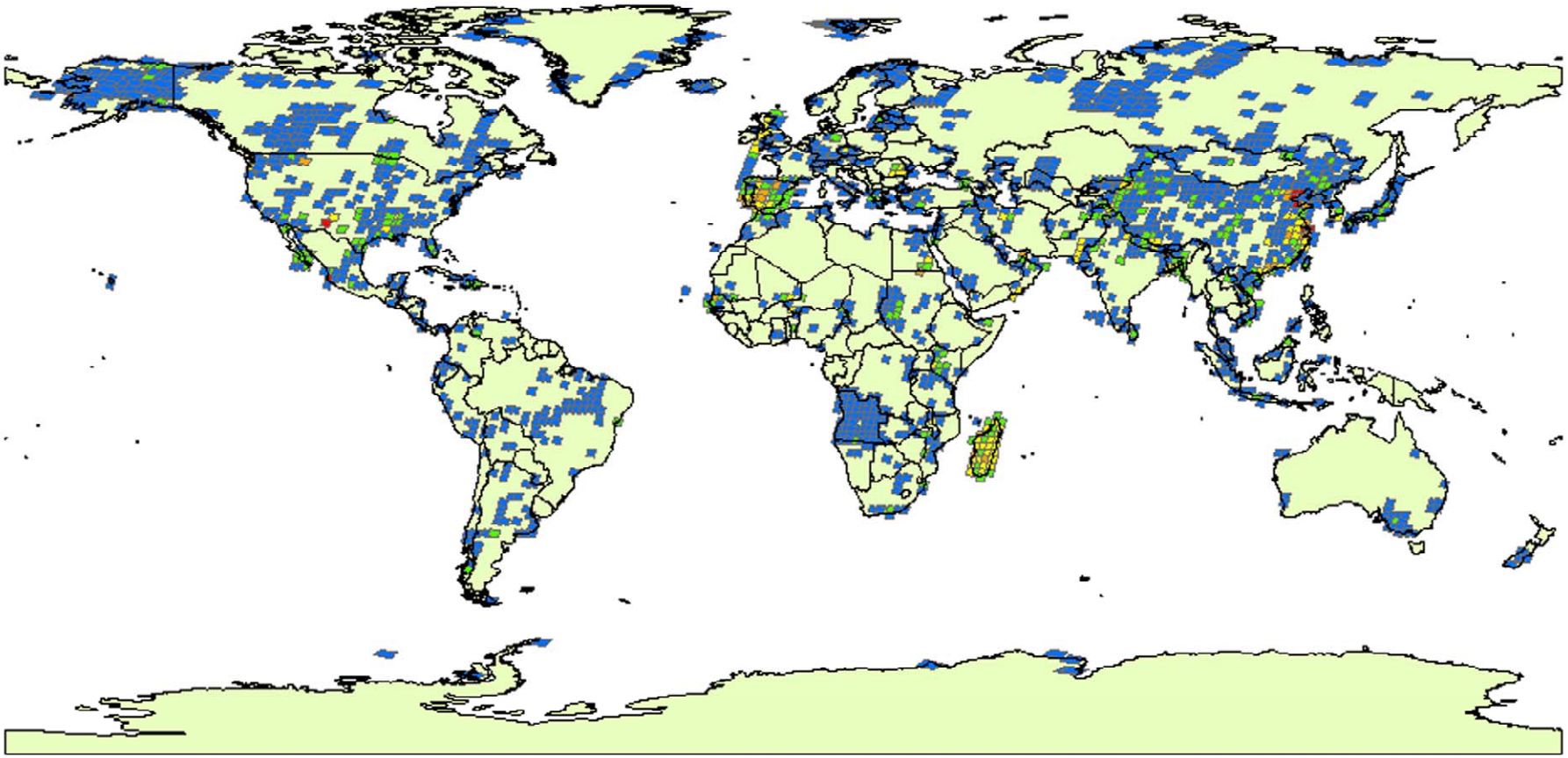
Downloads WRS2



WRS2 Standard L1T Downloads
via User Interface and Bulk Users
October 01, 2009 through December 31, 2009
355,934 Cumulative Scenes Delivered
340,500 Total WRS2 Scenes Delivered
8,844 Unique WRS2 Locations

1 - 48 | 49 - 165 | 166 - 389 | 390 - 819 | 820 - 1637

Downloads WRS1

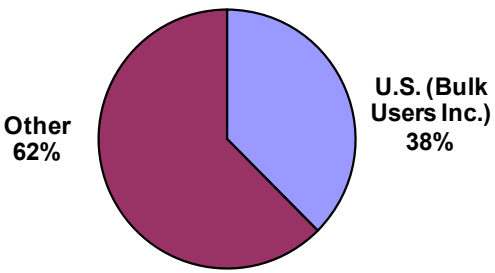


WRS1 Standard L1T Downloads
via User Interface and Bulk Users
October 01, 2009 through December 31, 2009
355,934 Cumulative Scenes Delivered
15,434 Total WRS1 Scenes Delivered
1,729 Unique WRS1 Locations

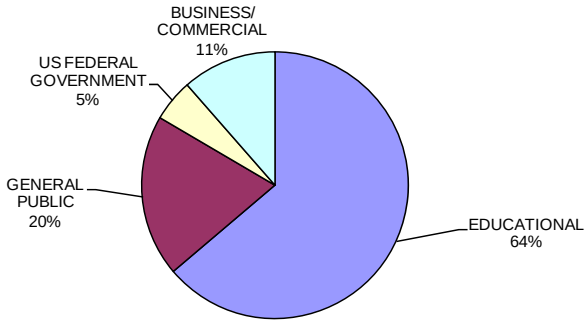
1 - 10 | 11 - 31 | 32 - 66 | 67 - 120 | 121 - 233

Web-enabled Customer Demographics

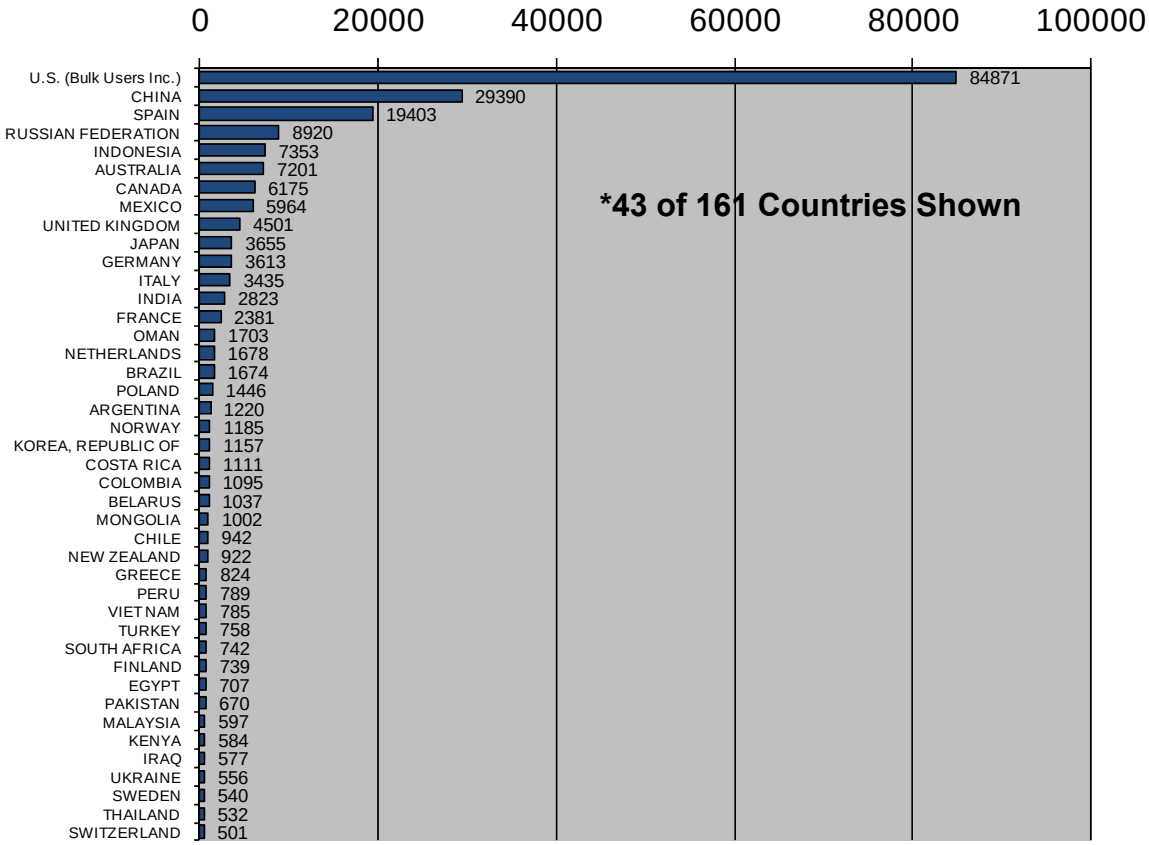
Downloads by Country



Downloads by Affiliation

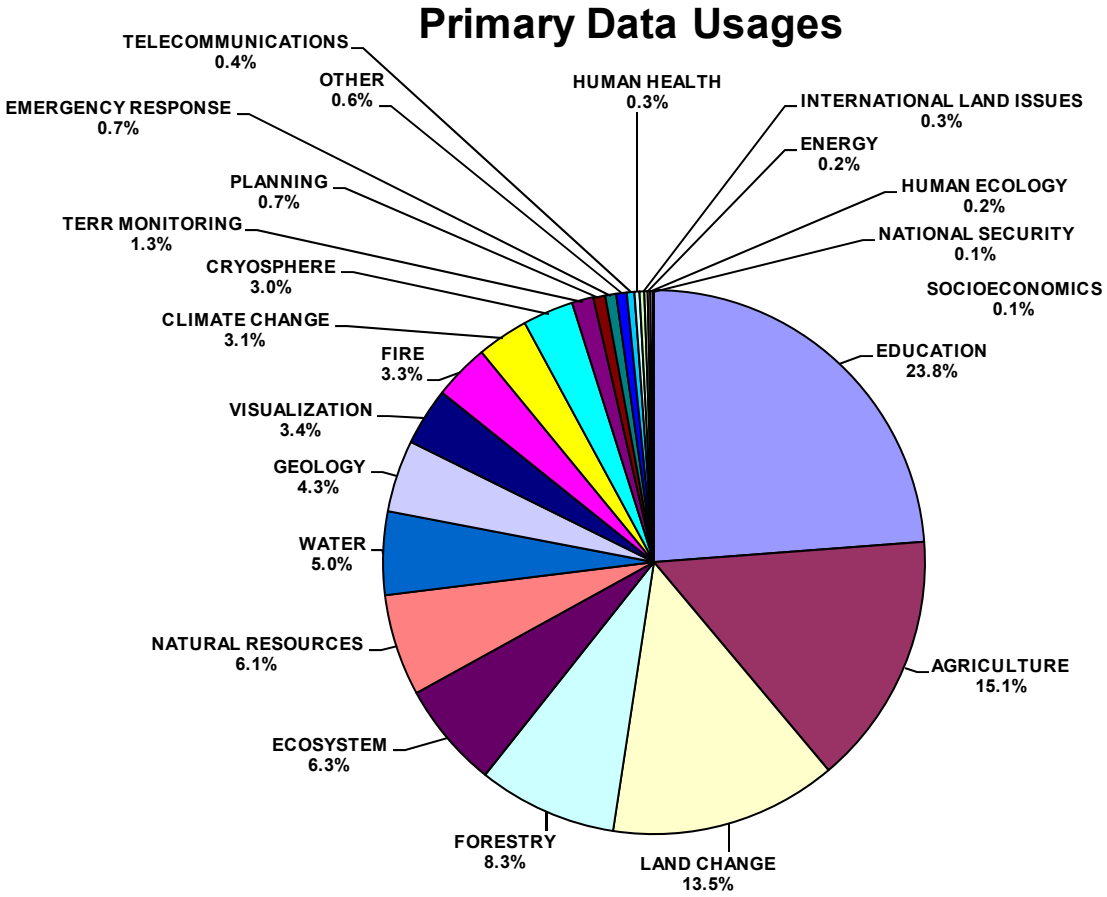


Standard L1T Downloads by Country
(Countries with >500 Scenes Downloaded)

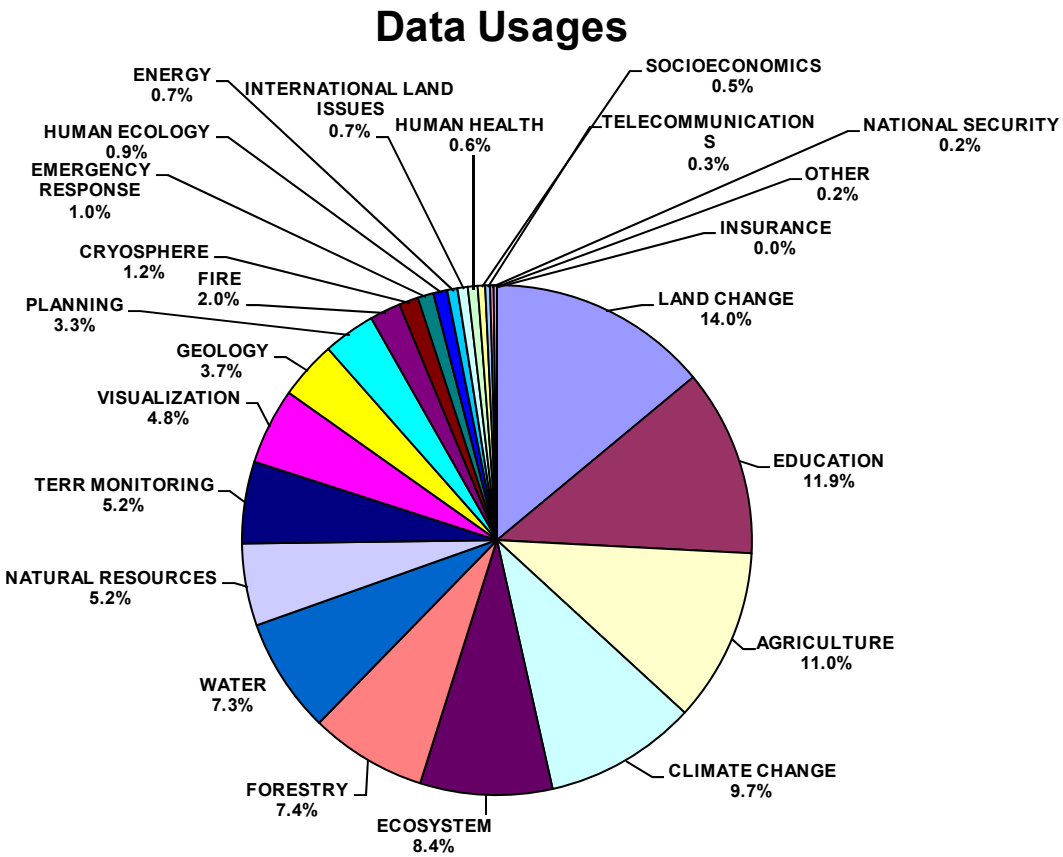


*** Stats 10/1/09 through 10/31/09**

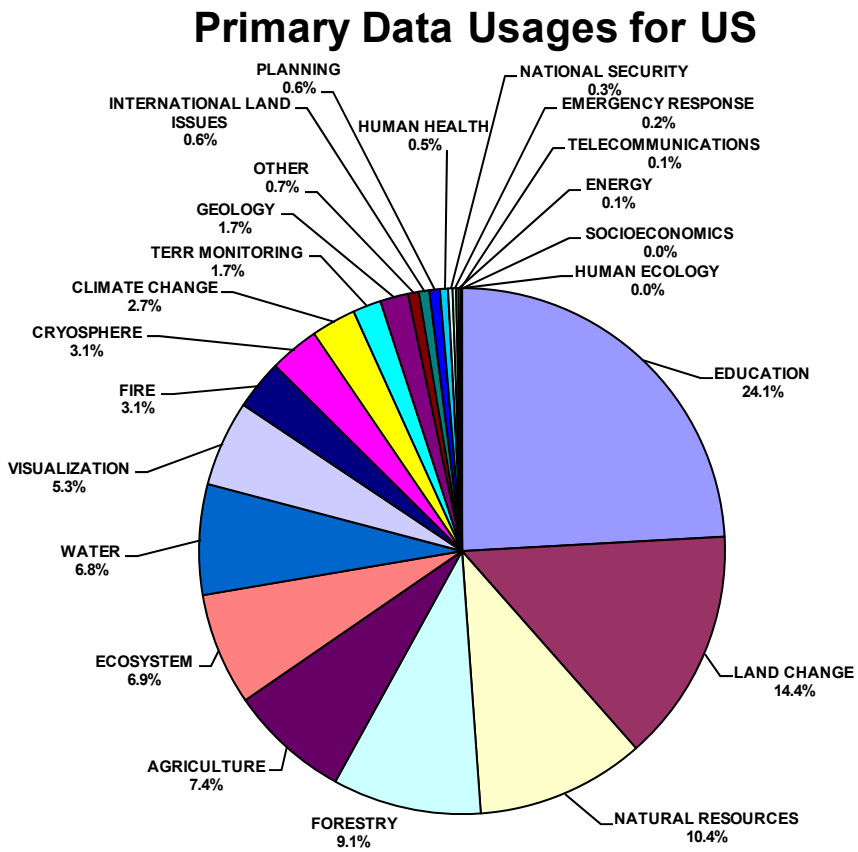
User Reported Primary Use of Landsat (Nov 1, 2009 – Nov 30, 2009)



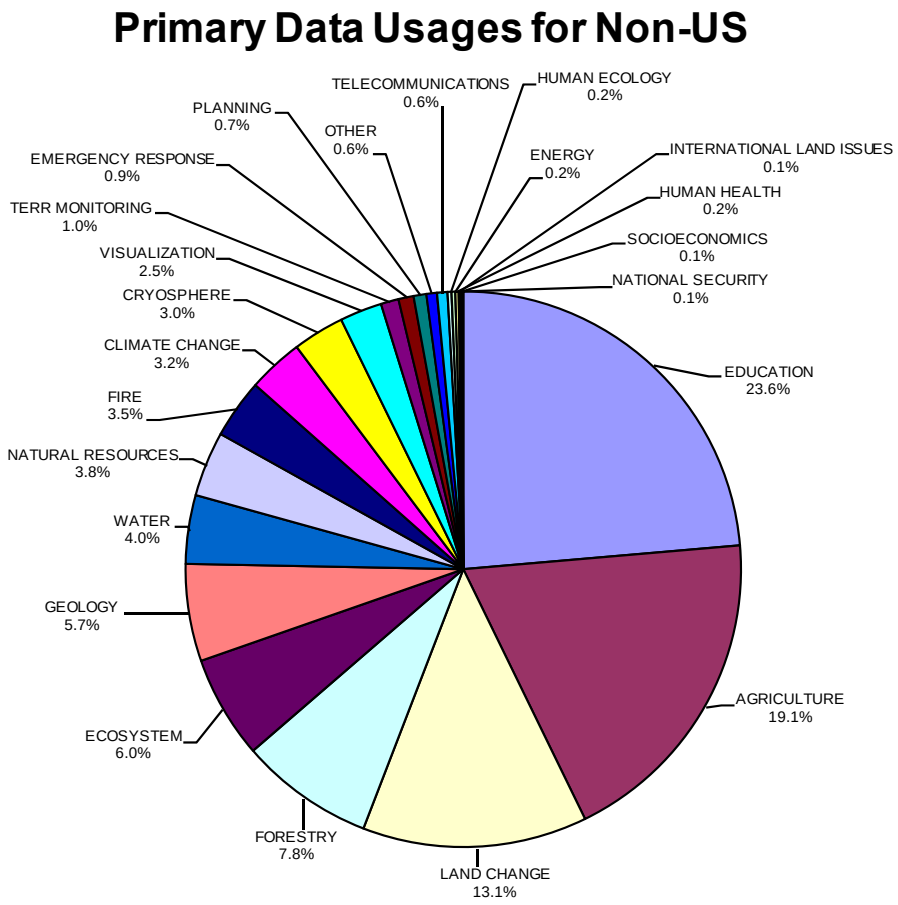
User Reported Other Use of Landsat (Nov 1, 2009 – Nov 30, 2009)



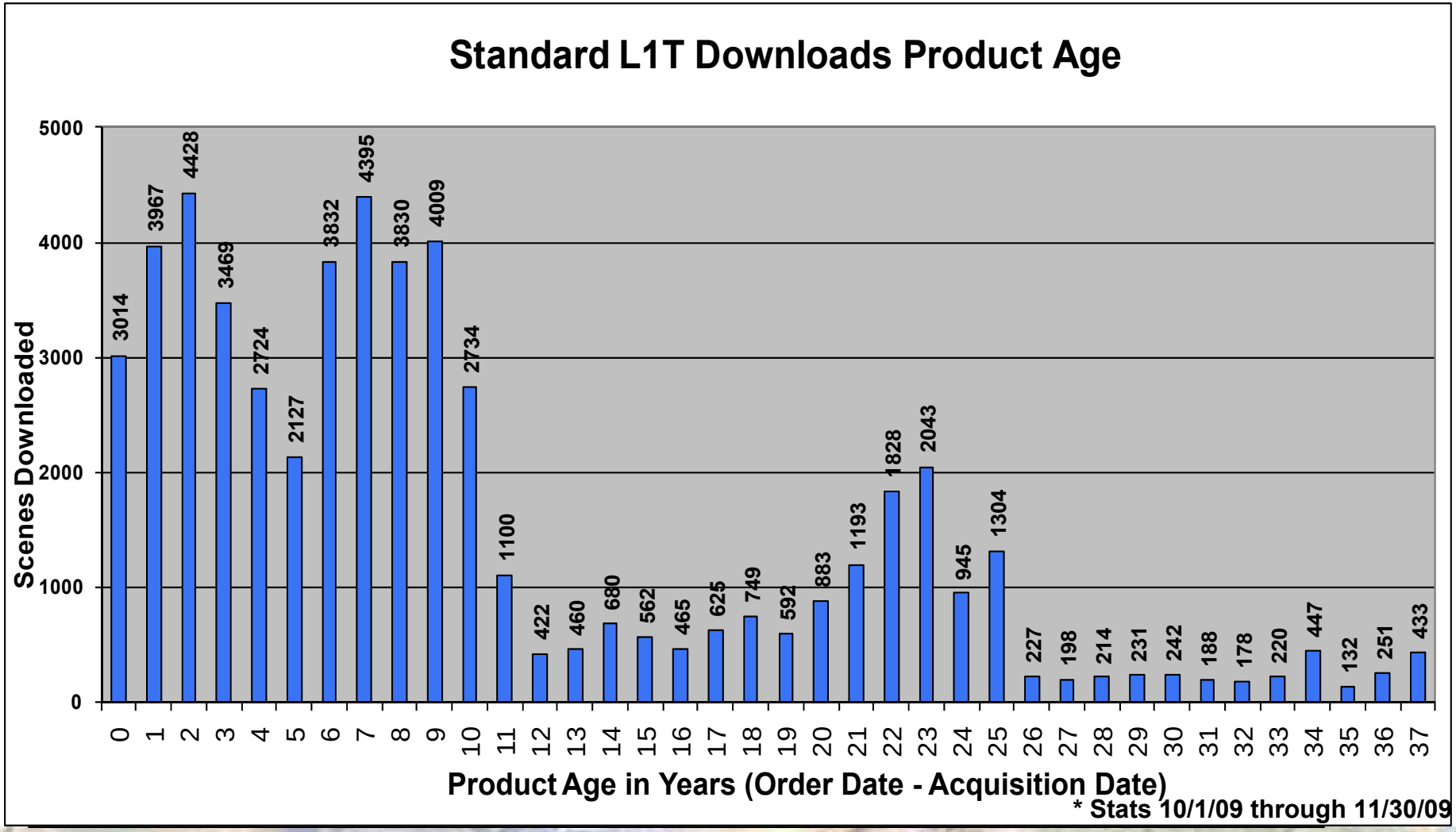
User Reported Primary Use of Landsat U.S. Users Only (Nov 1, 2009 – Nov 30, 2009)



User Reported Primary Use of Landsat Non-U.S. Users Only (Nov 1, 2009 – Nov 30, 2009)

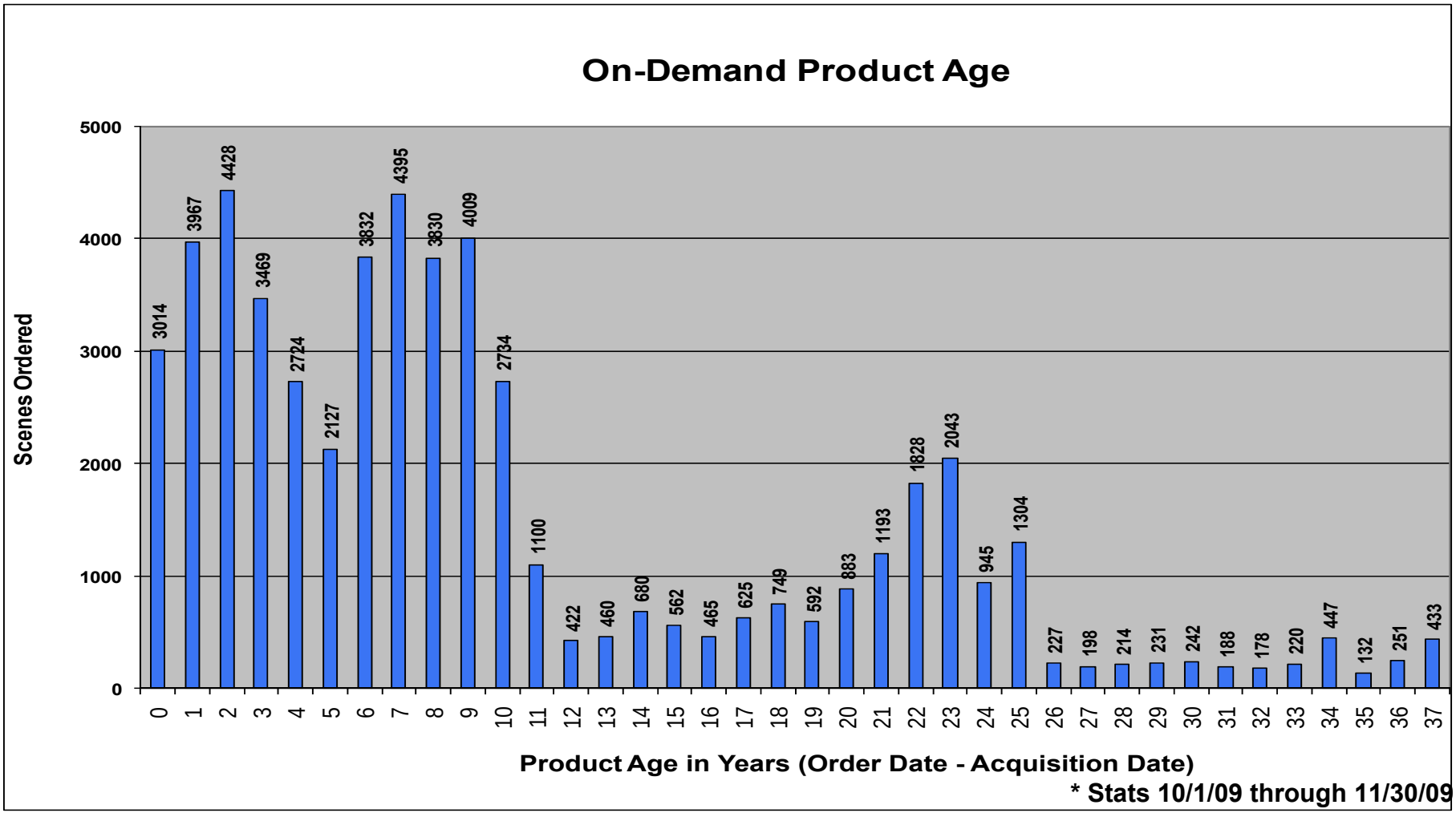


Age of Scenes Downloaded
(User Interface Only)

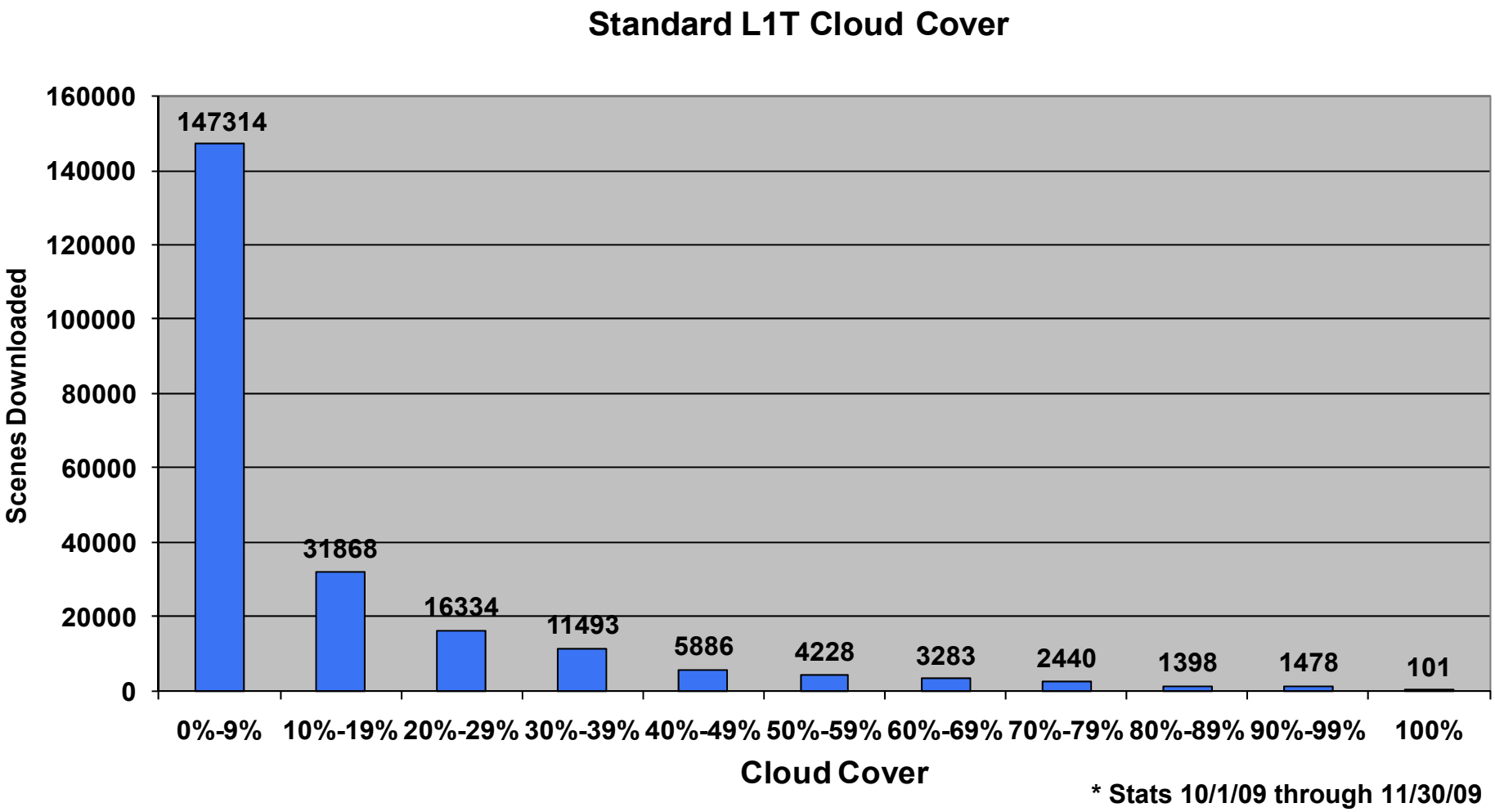


* Stats 10/1/09 through 11/30/09

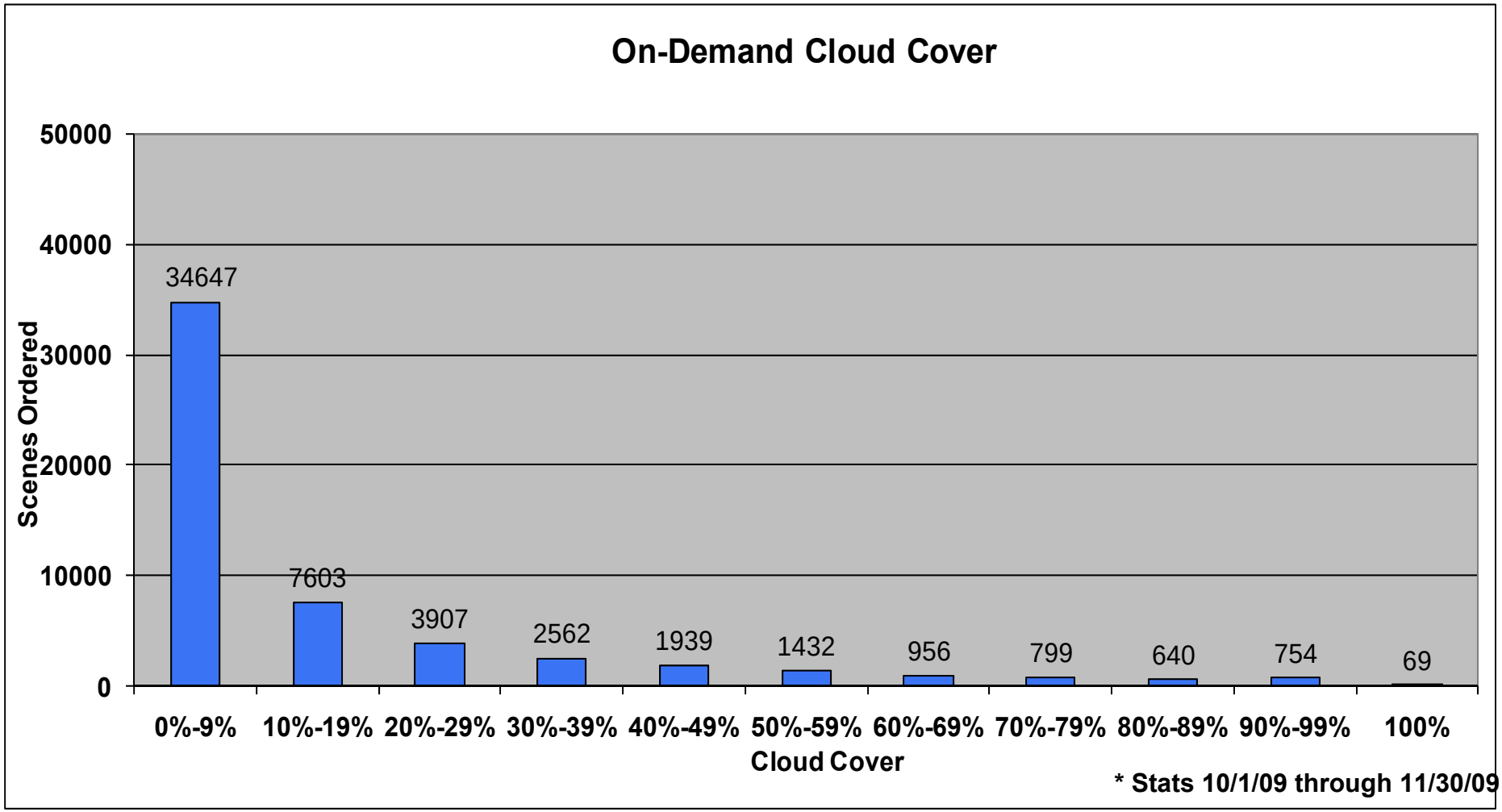
Age of Scenes Ordered from Archive



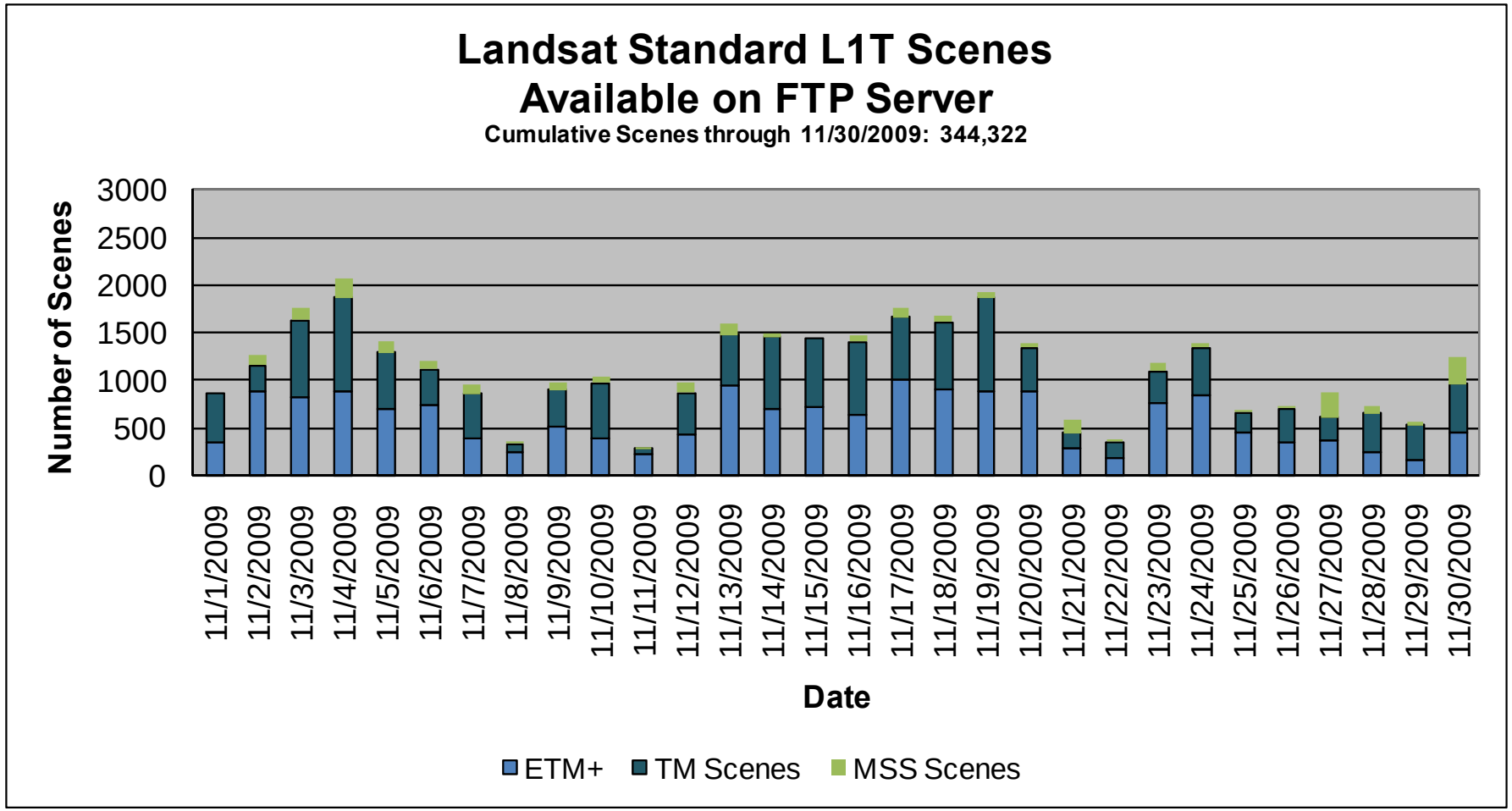
Cloud Cover of Scenes Downloaded
(User Interface and Bulk FTP)



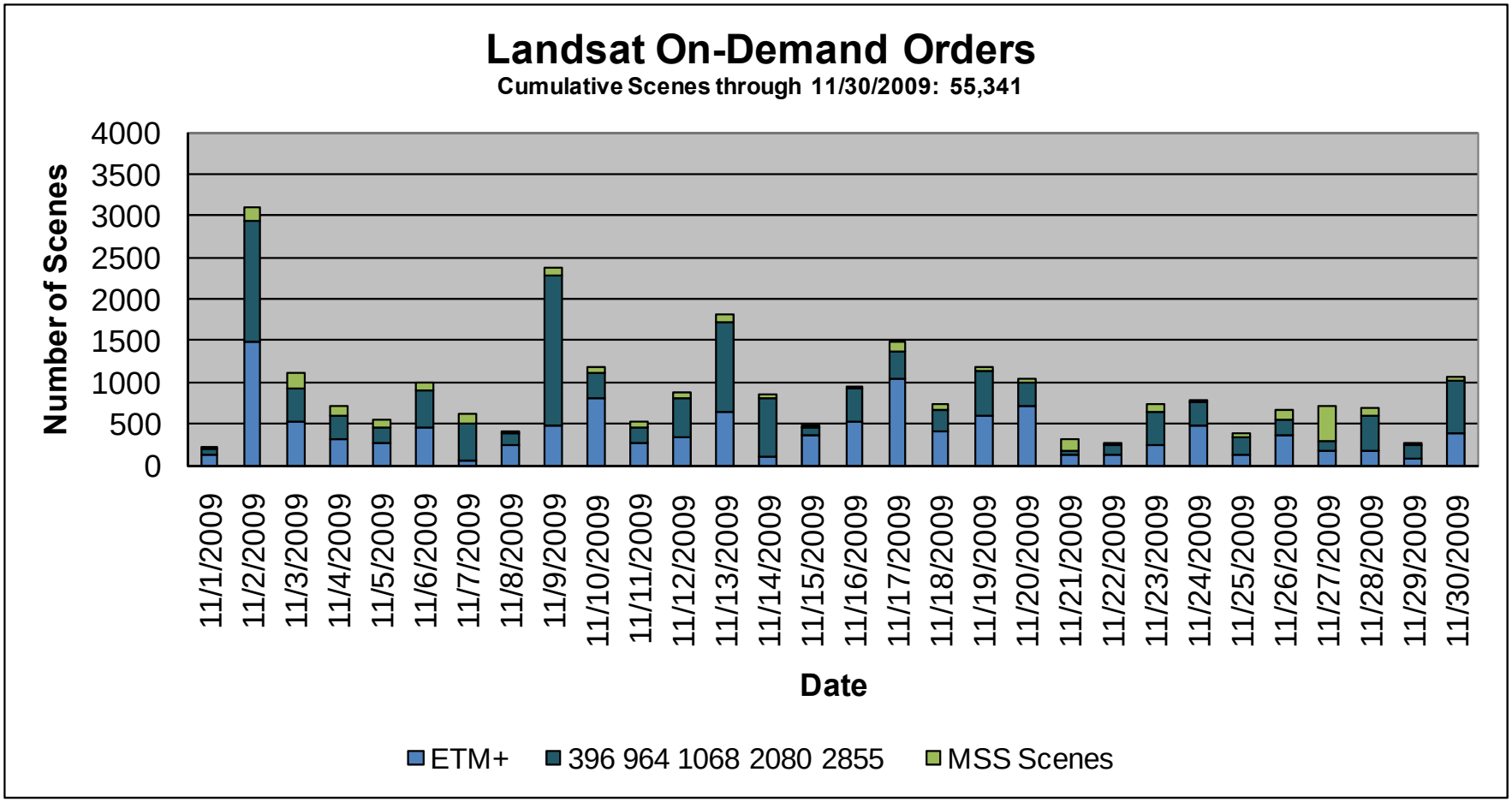
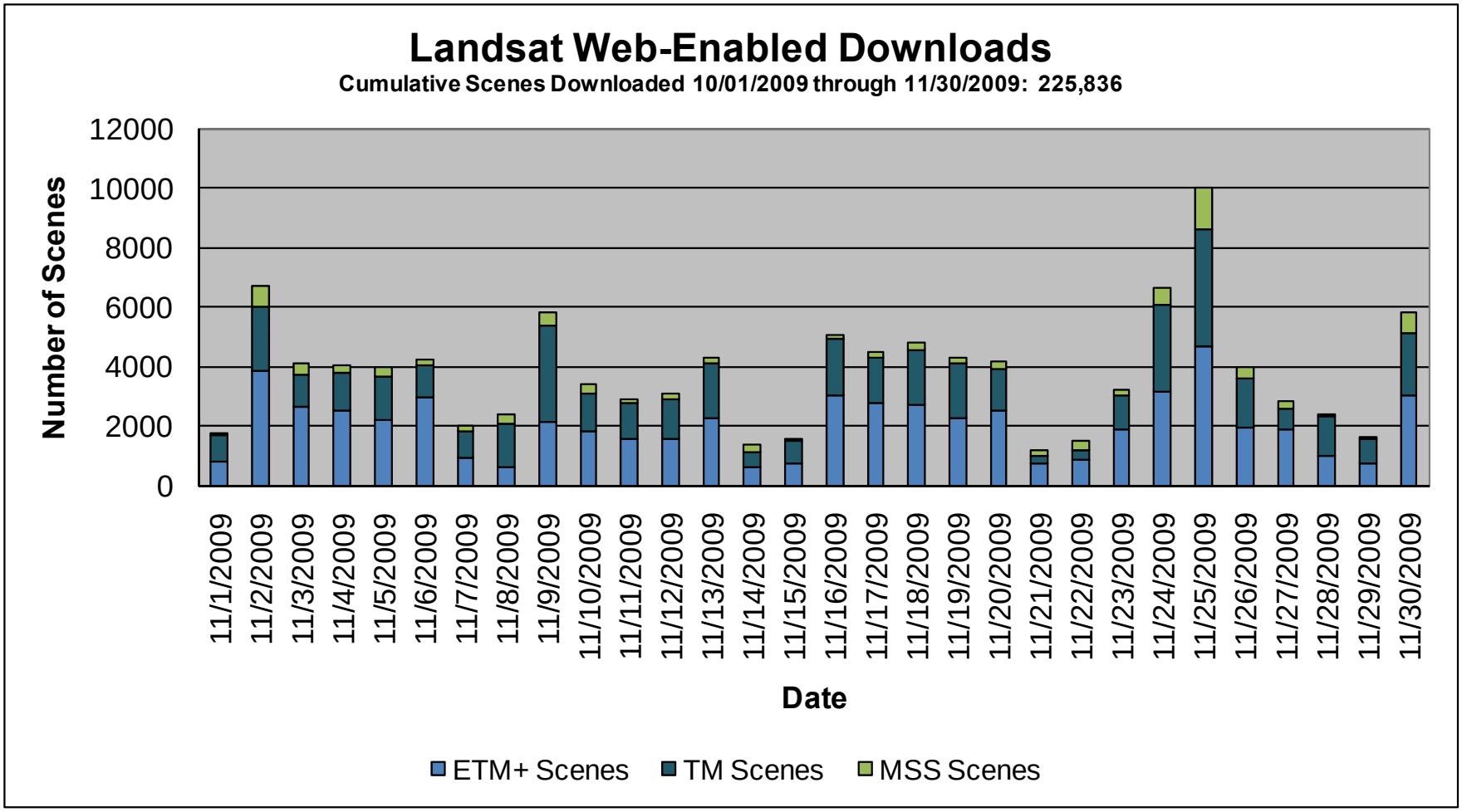
Cloud Cover of Scenes Ordered from Archive



Daily Processing



Daily On-demand Orders



Daily Downloads