EO-1/HYPERION: UPDATE FOR ISIS

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July, 2014

IGARSS 2014
Québec City
Québec, Canada

HYPERION IMAGES FROM JULY 2014

July 1, 2014
Hyperion False-Color Image
Nitmiluk National Park, Australia

July 5, 2014
Hyperion False-Color Image
Mato Grosso, Brazil

July 8, 2014
Hyperion False-Color Image
Port-au-Prince, Haiti

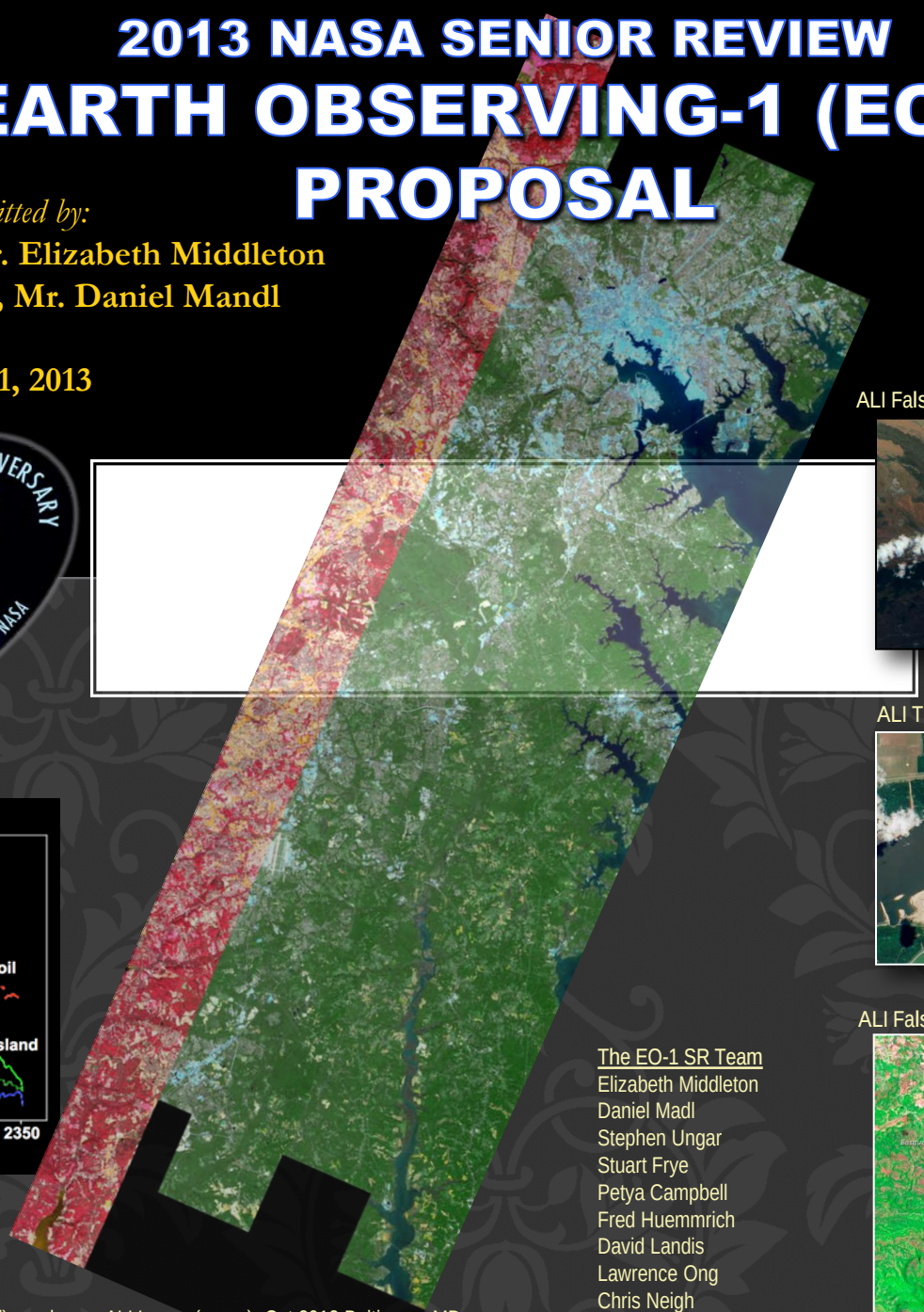
RECENT MAJOR EVENTS FOR EO-1

- February 2011: EO-1 ran out of fuel and began precession from 10:00am overpass toward earlier times.
- June 2012: started new lunar calibration scans that use Hyperion.
- April 6, 2012: EO-1 “Safe Hold” incident. This was our first major "safe hold" and there was no guarantee that the satellite would come back up. But the restart procedures worked properly and 2 weeks later EO-1 was working fine.
- March 2013: Senior Review proposal delivered to NASA HQ, resulting in 2 more years of funding.
- May 2013: IEEE JSTARS EO-1 Special Issue published, containing 20 papers.
- December 18, 2013: EO-1 “Safe Hold” incident, caused by a "low power" reading. EO-1 was restarted and the "low power" level was set higher.
- May 9, 2014: a piece of Chinese space debris had a chance of impacting the EO-1 satellite, so a 10-second thruster burn was attempted (without knowing if it would work). The thrusters fired correctly, shifting EO-1 into a slightly higher orbit, avoiding the collision.
- October 2015: EO-1 is scheduled to be shut down.

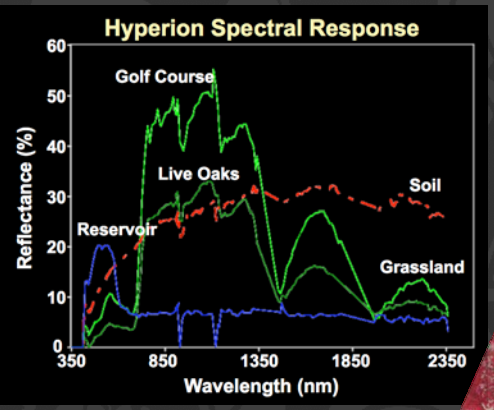
2013 NASA SENIOR REVIEW
EARTH OBSERVING-1 (EO-1) PROPOSAL

Submitted by:
Mission Scientist, Dr. Elizabeth Middleton
Mission Manager, Mr. Daniel Mandl

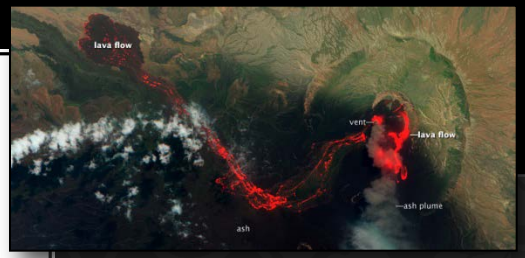
May 1, 2013



Hyperion (red) overlay on ALI Image (green), Oct 2012 Baltimore, MD



ALI False-Color Image, 2011 Lava Flows at Nabro Volcano



ALI True-Color Image, 2012 Low Water on Mississippi

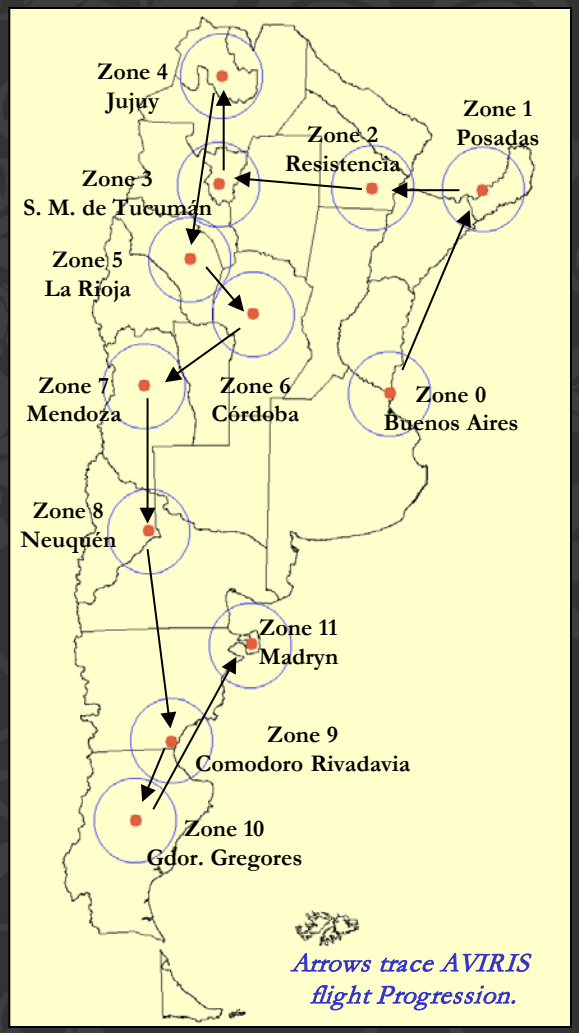
ALI False-Color Image, 2012 Fire-Charred Forest in Mexico

The EO-1 SR Team
Elizabeth Middleton
Daniel Madl
Stephen Ungar
Stuart Frye
Petya Campbell
Fred Huemmrich
David Landis
Lawrence Ong
Chris Neigh

AVIRIS/HYPERION CALIBRATION

AVIRIS supported Hyperion cal/val during the EO-1 post-launch Argentina Field Campaign in Jan-Feb 2001. Currently, Hyperion and AVIRIS are being jointly used in support of the 2013-2014 HyspIRI Airborne Campaign in California.

Argentine/AVIRIS (Jan-Feb 2001)



The HyspIRI Airborne Campaign

AVIRIS and Hyperion Overflights, April 2013, CA

Hyperion (colored bars) is currently being used along with AVIRIS (red lines are AVIRIS flightlines) in support of the HyspIRI Airborne Campaign.

ER-2 HYSPIRI 2013 OPERATIONS & 2014 PLANS

Objectives

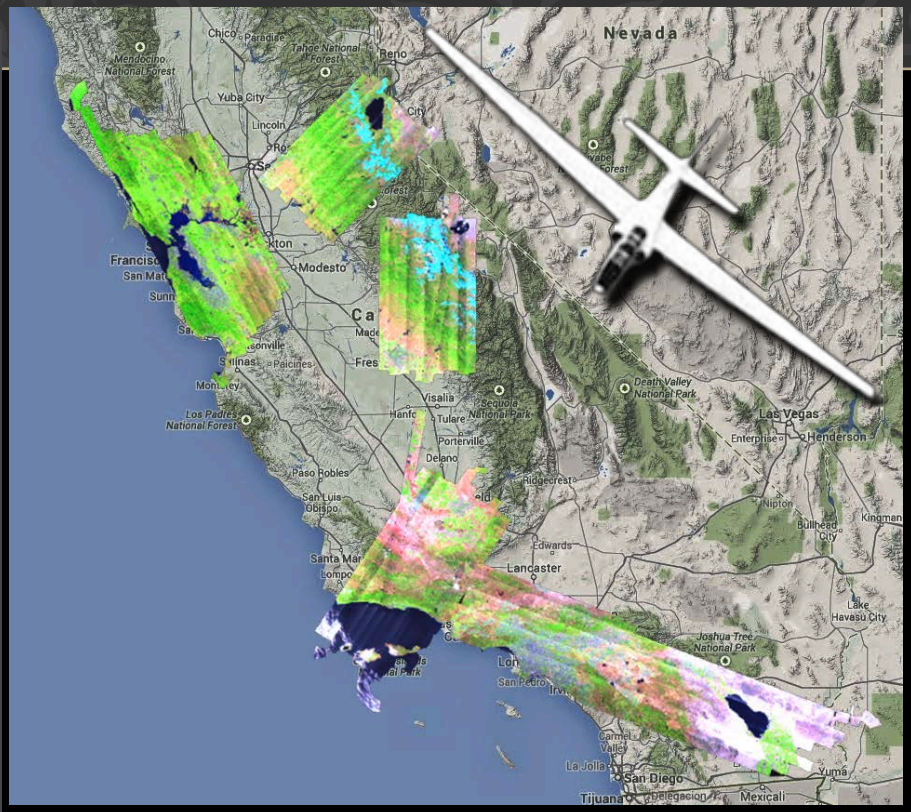
Conduct ER-2 Remote Sensing Missions with AVIRIS and MASTER over 6 regions for two years with measurements during Spring, Summer, and Fall.

CY2013 Operations

- All CY2013 planned data was collected
- Station and Rim fire data added to the plan
- 121.8 total HyspIRI flight hours
- Obtained Landsat 8 underpass, Monterrey Bay, and Yosemite/Neon box data through other funded flight requests
- Provided piggyback opportunity for AirMSPI, RSP, NAST-I, NAST-M, S-HIS, and DCS

CY2014 Flight Dates:

- Mar 31 – May 2
- May 27 – June 20
- Aug 18 – 29
- Sept 15 – Oct 31



CY2014 Plans

Flight Request	Study Name	Flight Hours	Principal Investigator
142016	HyspIRI	98.2	Rob Green
142020	Landsat 8	8	Rob Green
142006	ACOCO	14.2	Brian Cairns
142007	Precision Agriculture	9	Darren Drewry

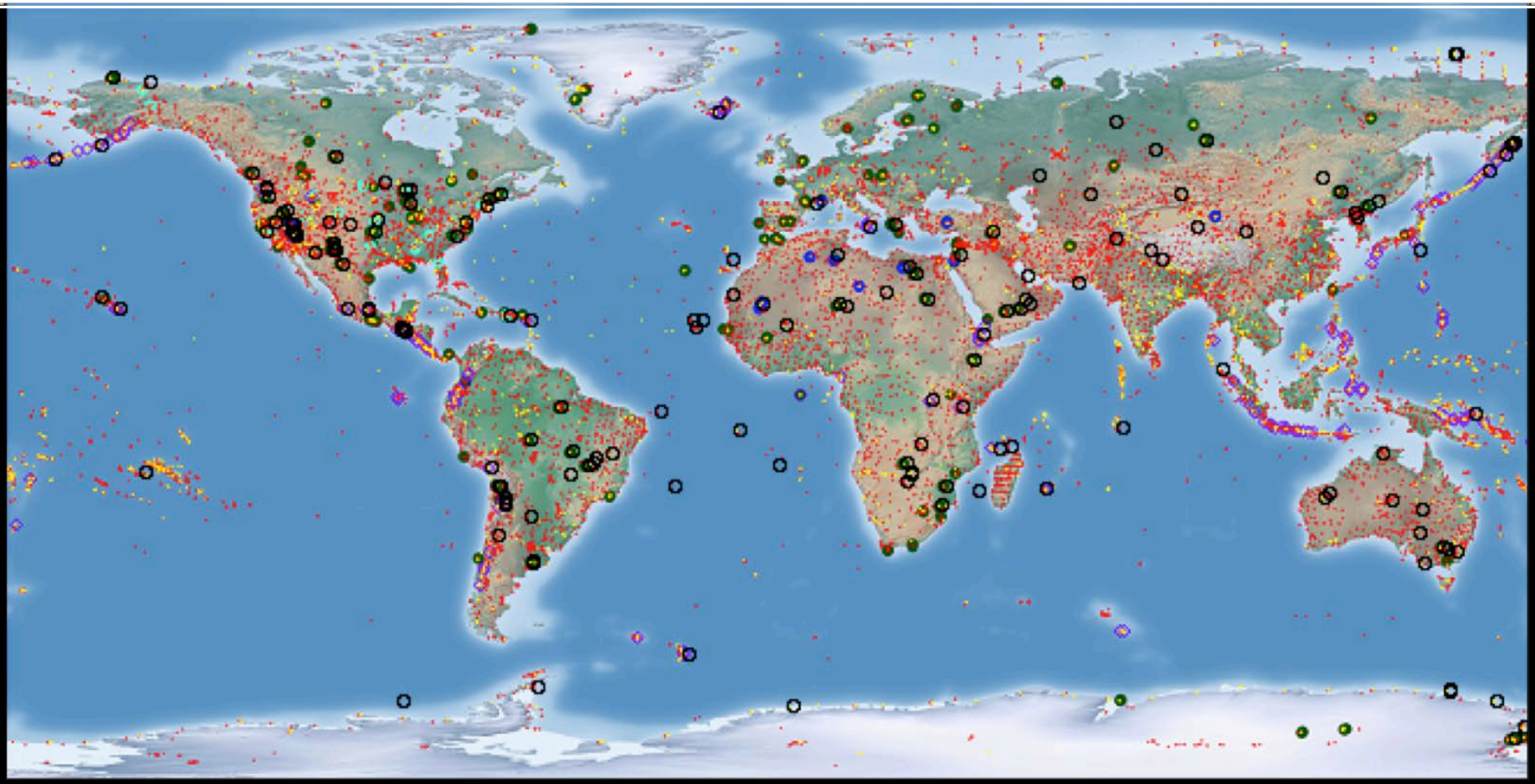
EO-1 SCENE STATISTICS

Total ALI Scenes	74,506
Total Hyperion Scenes	74,328
Total Scenes Available	**148,834**

As of June 2014

EO-1 ACQUISITIONS GLOBAL DISTRIBUTION

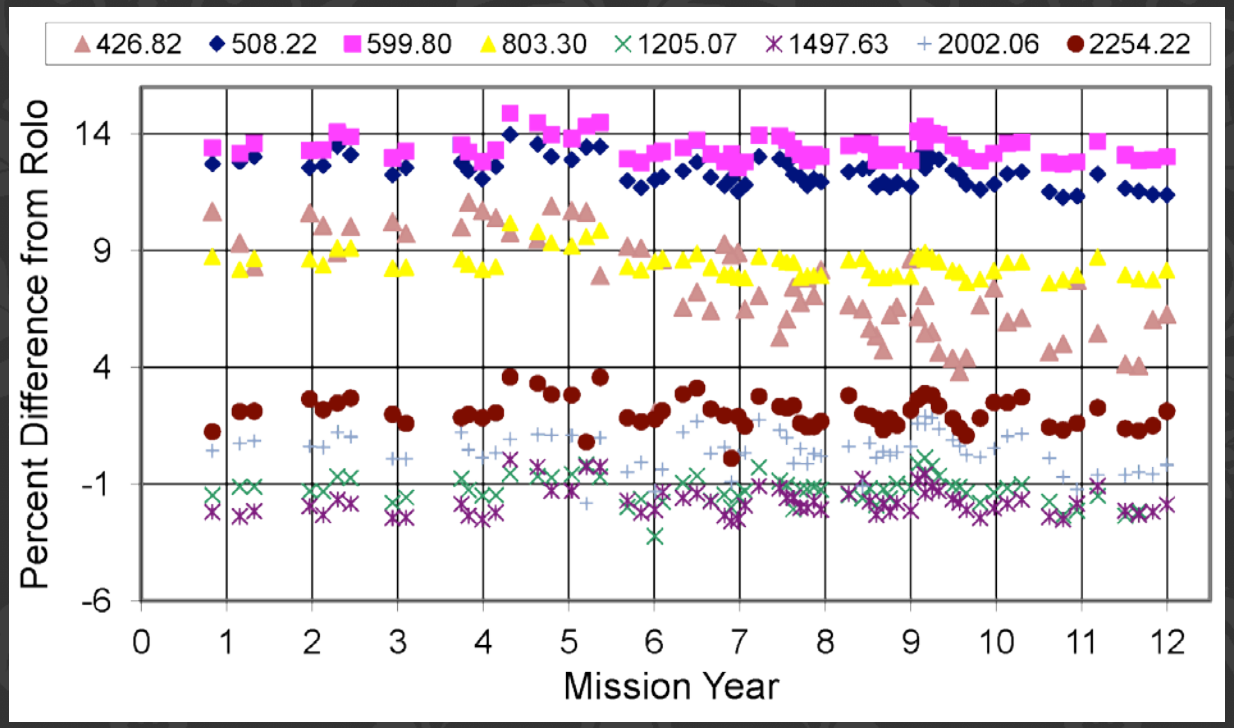
AS OF JUNE 2014



EO-1 observations in 13 years (2001 through 2014) total over 75,000 for each instrument. Locations of collections made in 2011-2012 (1300+ per instrument) are shown with yellow dots, whereas those collected during the first 10 years are shown with red dots. In addition, locations of 4 repetitively observed sites are highlighted: CEOS calibration sites (blue circles), MSO (dark green circles), NEON (cyan circles) and Volcanoes (purple diamonds). Locations having >10 collects are outlined with black circles.

HYPERION AND THE ROLO MODEL

- The lunar irradiances are dependent on parameters that include: the lunar librations, nutation, phase angles, viewing locations, solar distances. These factors are incorporated in the ROLO model.
- The EO-1 mission uses the ROLO model only as a basis to normalize the Hyperion data for long-term stability trending, not for absolute calibration comparison purposes.
- The Hyperion values are within the uncertainty of the ROLO comparisons with other instruments (e.g. MODIS, ASTER, MISR, LDCM) as shown by Kieffer and Stone (2005, *Astronomical Journal)* describing the ROLO model in detail. There have been on-going discussions with the model authors regarding these differences.



Comparison of the Hyperion integrated lunar responses with the USGS Robotic Lunar Observatory (ROLO) Lunar model.

IEEE JSTARS EO-1 SPECIAL ISSUE 2013

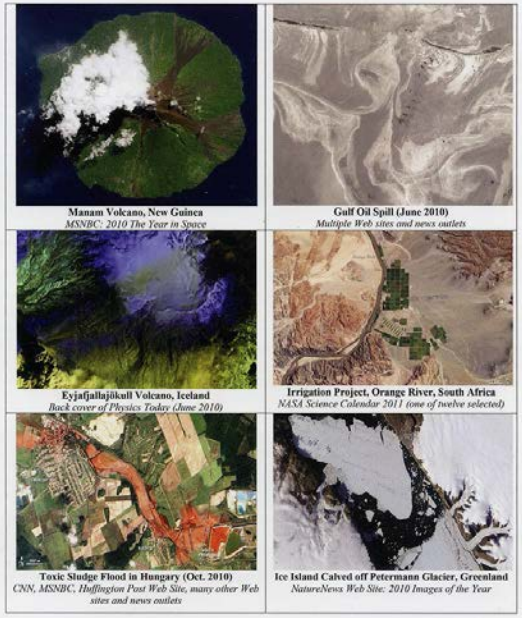
IEEE JOURNAL OF
SELECTED TOPICS IN APPLIED EARTH OBSERVATIONS AND REMOTE SENSING

A PUBLICATION OF THE IEEE GEOSCIENCE AND REMOTE SENSING SOCIETY

APRIL 2013 VOLUME 6 NUMBER 2 IJSTHZ (ISSN 1939-1404)

PART I OF THREE PARTS

SPECIAL ISSUE ON THE EARTH OBSERVING ONE (EO-1) SATELLITE MISSION: OVER A DECADE IN SPACE



Manam Volcano, New Guinea
MSNBC: 2010 The Year in Space

Gulf Oil Spill (June 2010)
Multiple Web sites and news outlets

Eyjafjallajökull Volcano, Iceland
Back cover of Physics Today (June 2010)

Irrigation Project, Orange River, South Africa
NASA Science Calendar 2011 (one of twelve selected)

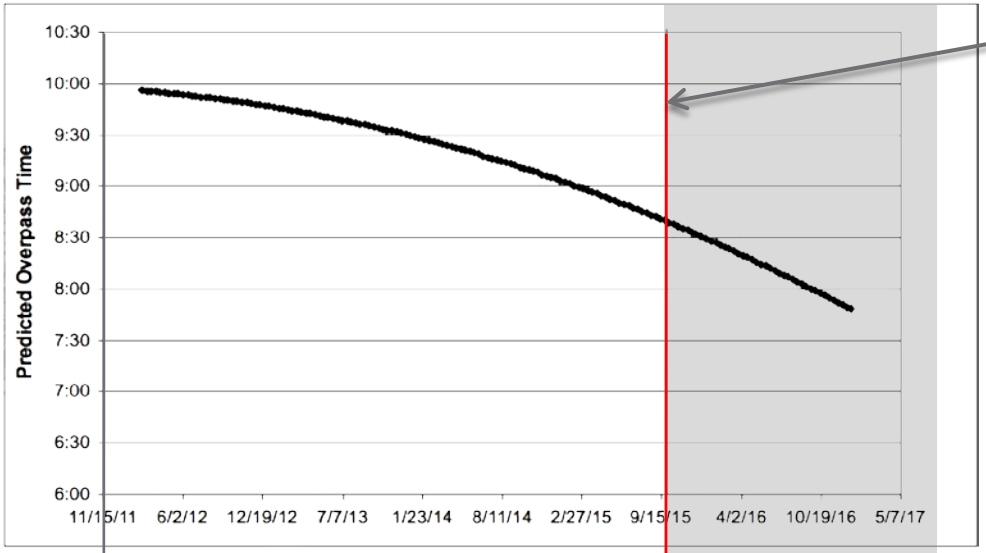
Toxic Sludge Flood in Hungary (Oct. 2010)
CNN, MSNBC, Huffington Post Web Site, many other Web sites and news outlets

Ice Island Calved off Petermann Glacier, Greenland
NatureNews Web Site: 2010 Images of the Year

Examples of ALI images posted by NASA's Earth Observatory. (See Middleton *et al.*, pp. 243–256.)

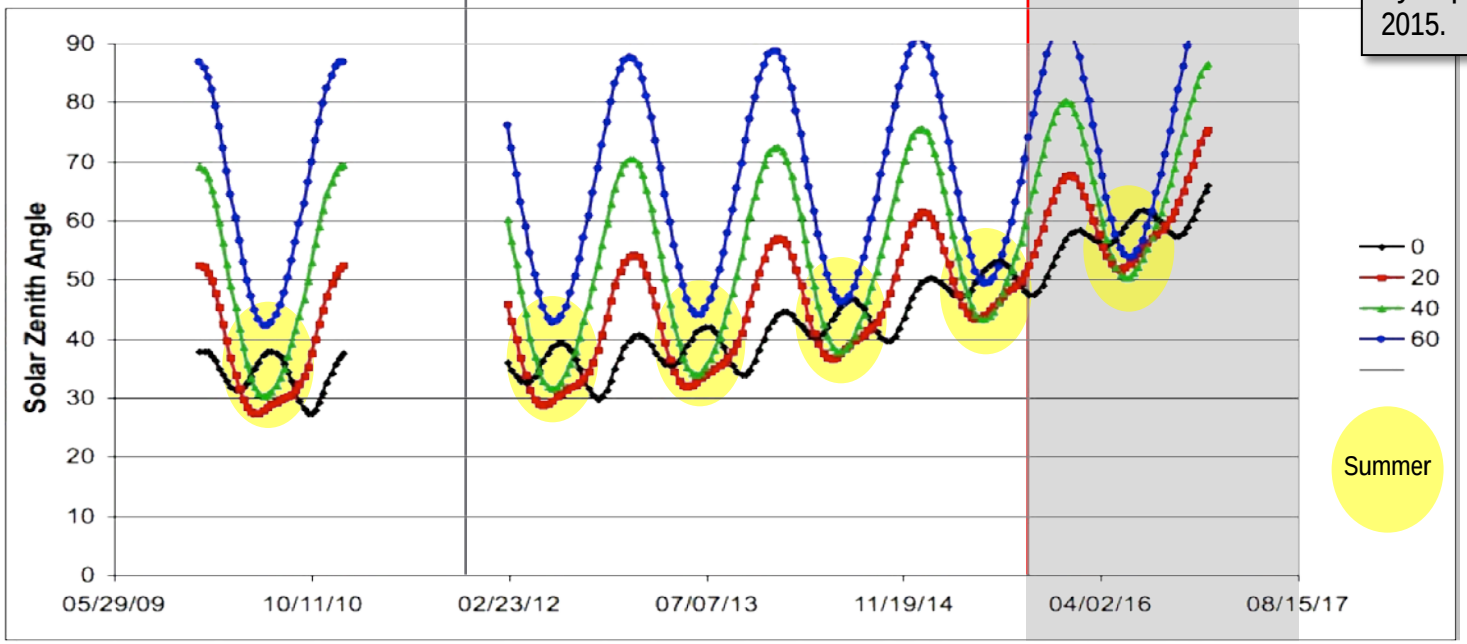
EO-1: End of Mission

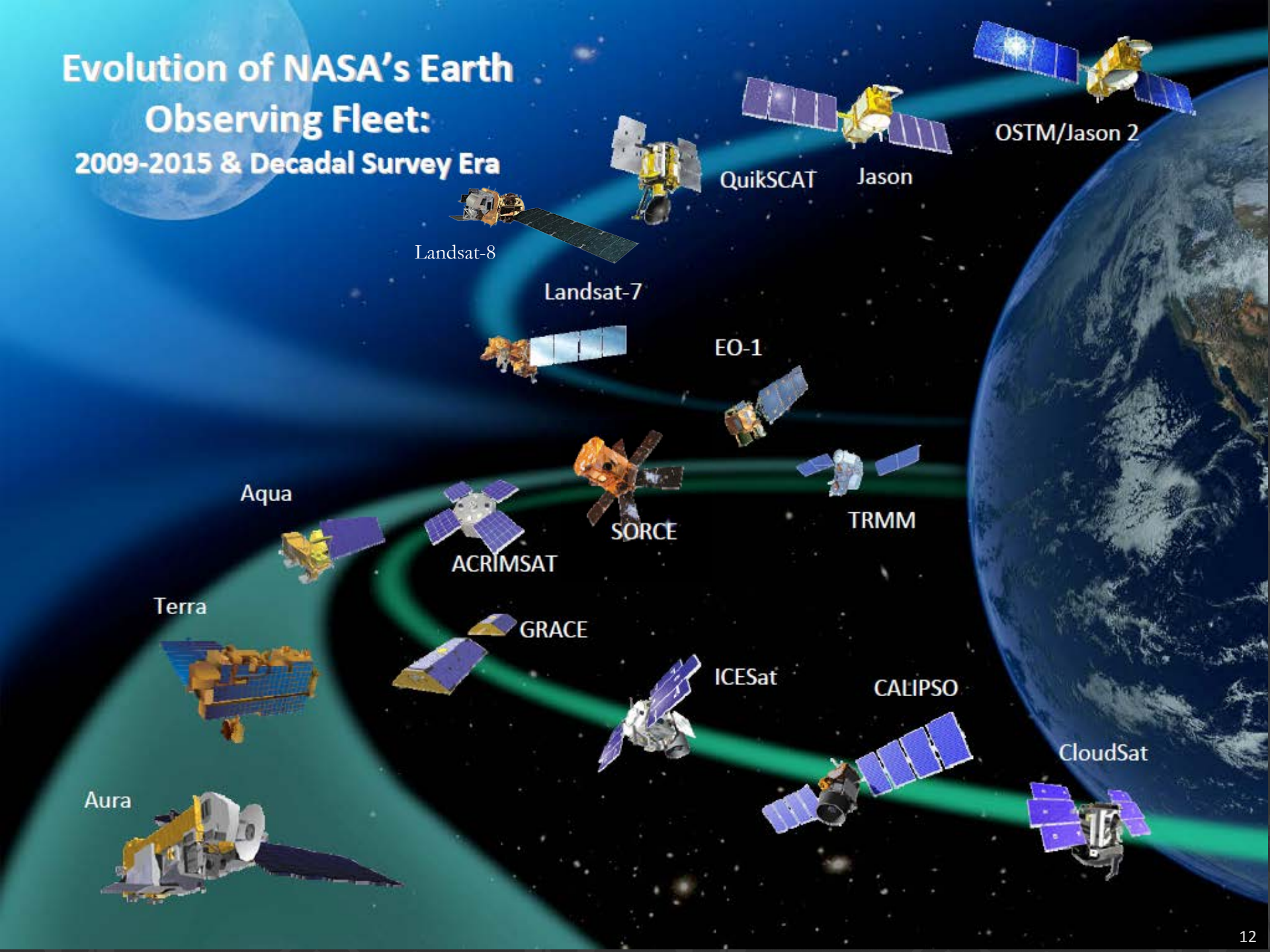
- As EO-1 continues to drift, the equatorial overpass time gets earlier and earlier,
- Equatorial image data are always usable, even in 2016. And even then, higher-latitude image data could still be acquired in the summer months.
- **The seasonal change in SZA is much larger than the change due to EO-1's orbital decay.**



Scheduled EO-1 Shutoff Date in September 2015.

Due to the collision avoidance burn on May 9, 2014, EO-1 will be 3 minutes earlier by September 2015.




Evolution of NASA's Earth Observing Fleet:
2009-2015 & Decadal Survey Era
OSTM/Jason 2
QuikSCAT
Jason
Landsat-8
Landsat-7
EO-1
Aqua
SORCE
TRMM
ACRIMSAT
Terra
GRACE
ICESat
CALIPSO
CloudSat
Aura

Today's satellites assumed still operable in 2015