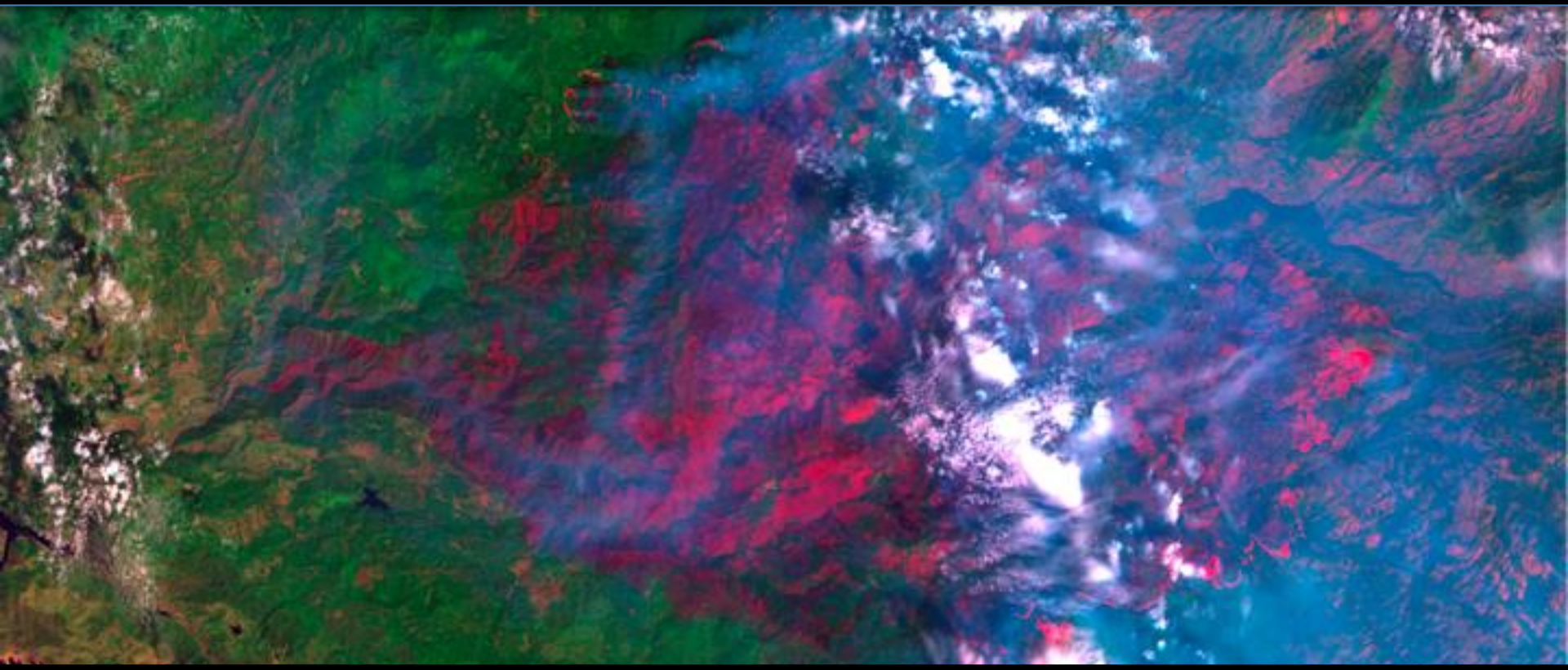
SUSTAINABLE LAND IMAGING




Formulation
Implementation
Primary Ops
Extended Ops
JPSS-2 (NOAA)
SLI-TBD
Formulation in 2015
RBI
OMPS-Limb
TSIS-2
NI-SAR
PACE
SWOT
TEMPO
GRACE-FO (2)
ICESat-2
CYGNSS
SAGE III (on ISS)
SMAP
OCO-2
TRMM
QuikSCAT
SORCE
EO-1
Landsat-7
(USGS)
ACRIMSAT
Aquarius
Terra
Suomi NPP
(NOAA)
Aqua
CloudSat
Landsat-8
(USGS)
CALIPSO
Aura
GPM
GRACE (2)
OSTM/Jason 2
(NOAA)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GRACE (2)
OSTM/Jason 2
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GPM
Contributing to
Water Cycle Studies

Landsat 8 Launch – Feb. 11, 2013

- Landsat Data Continuity Mission (LDCM) developed through an interagency partnership between NASA and the U.S. Geological Survey (USGS)/Dept. of the Interior
- LDCM launched Feb. 11, 2013 from Vandenberg Air Force Base (VAFB), California – ATLAS V 401 launch vehicle
- On-orbit commissioning completed May 30, 2013
  - USGS assumed lead responsibility for mission operations
  - Satellite renamed Landsat 8

Landsat 8 Performance Summary

- The performance of the Landsat 8 sensors, OLI & TIRS, spacecraft, and ground system exceeds specifications in almost all respects
  - Landsat 8 collects, and USGS EROS archives, over 500 scenes per day compared to a 400 scene per day requirement
  - By the first anniversary of the launch, USGS EROS distributed 1,332,969 Landsat 8 scenes (Level 1 digital data products)
  - Scenes are typically available within 5 hours of data collection compared to a 24 hour latency requirement
  - Image geometry and cartographic registration exceed specifications
  - The radiometric performance of OLI and TIRS exceeds specifications with one exception
    - The absolute radiometric uncertainty of TIRS data currently exceeds a 2% requirement due to a stray light issue under investigation
  - Early analyses are demonstrating backward compatibility with the Landsat archive and more accurate land cover mapping results

Land Imaging in FY 2014

In FY14 NASA will initiate the definition of a sustained, space-based, global land imaging capability for the nation, ensuring continuity following LDCM. 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. It is expected that NASA will support the overall system design, flight system implementation, and launch of future missions, while USGS will continue to fund ground system development, post-launch operations, and data processing, archiving, and distribution.*

- President's FY 2014 Budget release

OMB-OSTP Direction to NASA

- $30 million in FY14 for NASA to study options for a future sustained land imaging system, in collaboration with USGS.
- The study shall define a system for sustained global land-imaging multispectral and thermal infrared information for an approximately 20-year period starting in 2018.
- The study should provide options which consider various weightings of near-term capability, continuity/gap risk mitigation, and technology infusion over the system's lifetime.
- While the basic system requirement is the continuation of global data and information having the quality of Landsat-8 products, the study should consider refined capabilities requested by the user communities.

OMB-OSTP Direction to NASA - continued

- The study should also consider a range of implementation strategies that could spur innovation and increase efficiencies, including international and private sector collaborations.

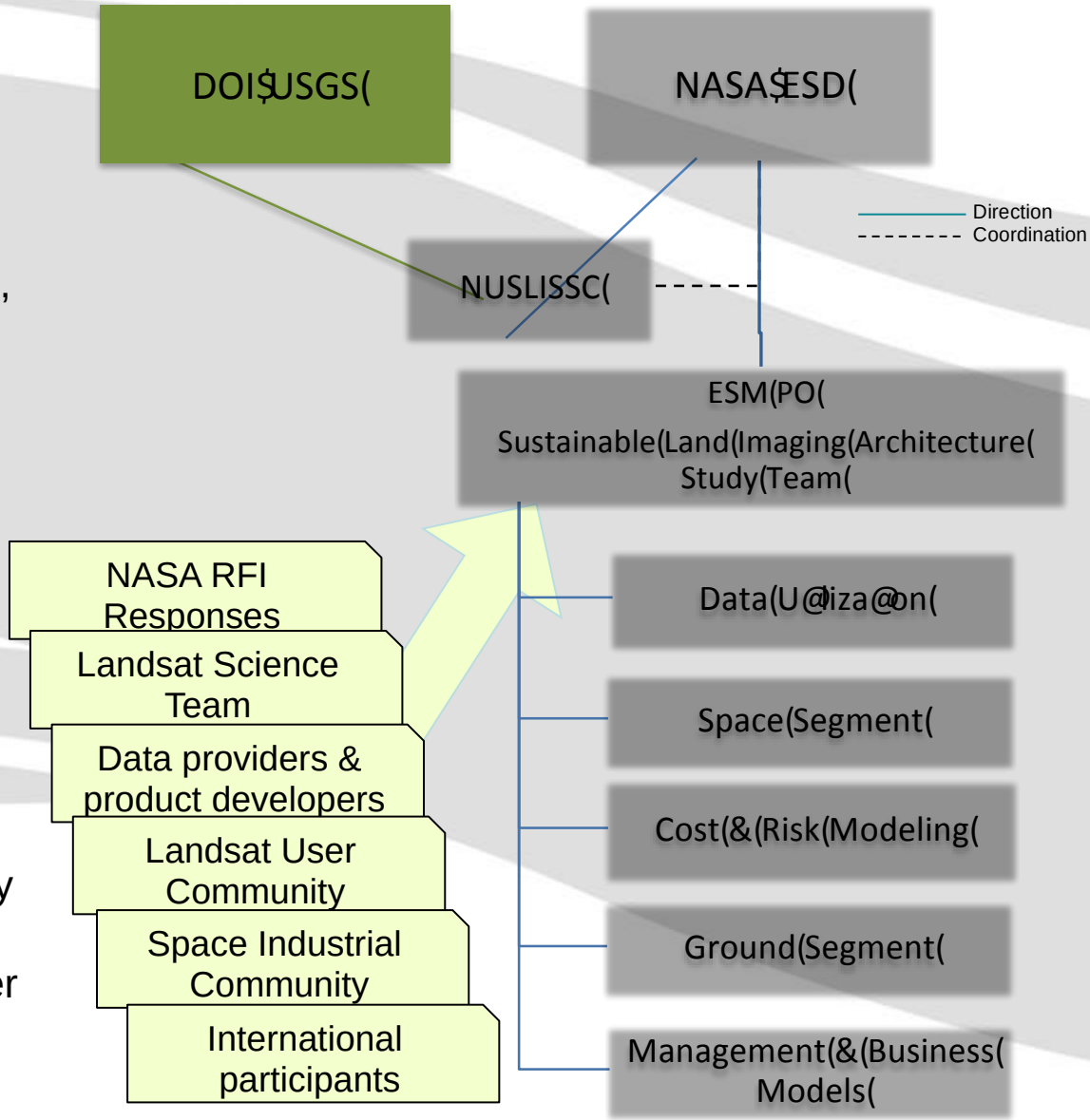
- The study should recognize that lowering the cost of the system (Sustainable!) is an important goal.

- NASA should report the results of the study to OSTP and OMB by August 15, 2014.

Sustainable Land Imaging Study Execution

- NUSLISSC = **N**ASA/**U**SGS **S**ustainable **L**and **I**maging **S**ystem **S**teering **C**ommittee
  - NASA Members: Dave Jarrett, Brad Doorn, Woody Turner
  - USGS Members: Tim Newman, Tom Cecere, John Crowe, Ray Byrnes, Steve Covington

- Landsat Science Team (LST) also will provide the AST with technical evaluation of:
  - Applications requirements
  - Possible contributed measurements (Sentinel 2, for example)
  - Status on radiometric sensitivity analyses
  - Architecture trade spaces under consideration



Three Basic Study Tenets for the Program

- Sustainability
  - The LI program should provide the *data products* with a long-term support plan, without extraordinary infusions of funds, within the budget guidance provided.
- Continuity
  - The LI program should continue the long term Landsat data record. This does not mean a continuity of how the Landsat data record is produced. Also, it should not preclude adjustments to the data record that improve the efficacy of how the data records are produced OR used, as long as there is an adequate ability to relate the data records over time.
- Reliability
  - The LI program should be robust and *not susceptible to single point failures*. The loss of a single satellite or instrument on orbit should not cripple the program or significantly impact users.

Legacy Landsat Performance

Performance Parameter	Rationale
Spectral coverage across VNIR, SWIR, and TIR	• *Most applications require multiple spectral regions*
30m (120m) spatial resolution for VSWIR (TIR)	• *Spatial resolution supports land management, land use, and ecosystem studies;* • *Broad area coverage supports regional/continental monitoring*
Ability to image each point on the globe every 16 days (8 days realized for majority of Landsat history)	• *Time series needed to characterize seasonal change* • *More frequent observations help mitigate cloud cover*
Sun-synchronous orbit, ~10 AM crossing time	• *Radiometric continuity with existing Landsat record*
Near co-incident imaging of spectral bands (VSWIR within seconds; TIR within minutes of VSWIR)	• *Near-simultaneous VSWIR required for multi-band indices;* • *TIR and VSWIR coincidence supports ET, water resources applications*
Global coverage of land area	• *Required for global land science & applications*
Less than 5% uncertainty in absolute spectral radiance	• *Provides radiometric continuity for long-term monitoring and change detection*
View angles < +/- 15 degrees	• *Limit BRDF variability within archive*
Free and open data distribution	• *Hallmark of Landsat program*

Four Classes of Candidate Architectures

- Architecture 1: Full Capability Observatories
  - Two instrument (or combined instrument) strategies on same spacecraft
  - No international partnership – U.S. Government covers all costs
- Architecture 2: Disaggregated System
  - Alternate building of thermal and reflective imagers on dedicated spacecraft
  - Viability of mini-sat and micro-sat constellations
  - No international partnership – U.S. Government covers all costs
- Architecture 3: International Participation
  - Reliance on International partners to provide reflective imagers and/or data to preserve continuity
  - International partnership a must – U.S. Government covers portions of cost
- Architecture 4: Commercial Approach
  - Reliance on commercial partners to provide hosted or data buy opportunities
  - Partnerships with Commercial or other Federal Agencies
- Common Features for All:
  - Launch vehicle can be shared or dedicated
  - Consider various risk classes
  - Consider precursor full-spectrum or thermal-only “gap filler” mission
  - International/commercial systems assessed for backup role
  - Technology infusion is an option in this architecture

Architecture Study Highlights To-Date

- ✓ Complete Check Point 1 Review and Industry/User Briefings Posted at:

http://espd.gsfc.nasa.gov/landimagingstudy/

- ✓ Check Point 2 Review completed and will be posted soon.