Landsat Science Team

Landsat Advisory Group Status Report

July 7, 2015

Overview

- USGS response to LAG 2013 cloud computing and product recommendations
- LAG 2015 tasks
  - Sentinel 1
  - Non federal Landsat requirements
  - Follow up on 2013 cloud computing and product papers
- Questionnaire on non-federal user requirements for Landsat 10 and beyond

LAG Membership

Name	Organization
Jack Hild (LAG Chair, NGAC Member)	Hild Enterprises, LLC
Kass Green (LAG Co-Chair)	Kass Green & Associates
Roger Mitchell (LAG Co-Chair, NGAC Member)	MDA Information Systems, Inc.
Peter Becker	ESRI
John Copple	Sanborn Map Co.
Joanne Gabrynowicz (NGAC Member)	University of Mississippi
Kevin Hope	National Geospatial-Intelligence Agency
Roberta Lenczowski	AmericaView
Rebecca Moore	Google, Inc.
Cory Springer	Ball Aerospace & Technologies Corp.
Julie Sweetkind-Singer (NGAC Member)	Stanford University
Tony Willardson	Western States Water Council
Darrel Williams	Global Science & Technology, Inc.

Federal Contact: Tim Newman (USGS)

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science for a changing world

USGS EROS Center

Briefing to Landsat Advisory Group

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

Tom Kalvelage
USGS EROS Center
20150320

LAG Cloud Recommendations

1. Facilitate Landsat cloud implementations by third-party cloud providers.

- **In order to foster innovation, the EROS Center should create a policy and framework for supporting third-party cloud providers, most importantly by providing a bulk Landsat data download capability that is timely, comprehensive, reliable, and high-bandwidth. There is precedent for this: EROS today supports bulk download via FTP and HTTP.**

- **USGS policy and practice supports distribution to anyone, at no cost.**
- **User Services works with users to educate them on the options available, and to understand their needs.**
- **The EAST is considering public cloud providers available through the DOI Foundation Cloud Hosting Services contract.**
- **USGS and EROS have supported discussions with third-party cloud providers where appropriate.**

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LAG Cloud Recommendations

1. Facilitate Landsat cloud… continued

- Choosing cloud support from the DOI contract, public cloud, or EROS infrastructure is a cost/capability decision.
  - For the science and academic communities, EROS has very cost-efficient solutions available
  - Access for the public is where the public cloud may become more of a cost-efficient solution
- For the archive, EROS keeps a copy of the data internally within the National Satellite Land Remote Sensing Data Archive (NSLRSDA), so some level of archive is required.
- The NGAC recommendation is correct in that we are moving and storing multiple versions at EROS.
  - This is one thing being considered within the EAST to-be architecture.

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LAG Cloud Recommendations

2. Facilitate the implementation (by EROS and/or third-parties) of methods that provide fast and simple accessibility to imagery, such as Interactive Online Analysis (Model 3 above).

- **Multiple services can be defined from the same data source that will return specific products processed directly from the Landsat L1T products, such as different band combinations, imagery in 'radiance' or 'reflectance' values, or a wide range of vegetative indices.**

- **We are ensuring that what we do is "cloud enabled"**

  - **EROS LCMAP and Climate Data Record (CDR)/Environmental Climate Variables (ECV) development activities have an initiative to make all higher-level product algorithms open source so they are free and open to the public**

  - **The LCMAP has drafted an internal definition of Analysis Ready Data (ARD) that adopts CDRs (Surface Reflectance/Surface Temperature) and Top of Atmosphere (TOA) data formatted as tiles to provide base layers for monitoring Land Change and enabling assessments and projection.**
    - **These are also layers utilized for downstream ECV products**

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LAG Cloud Recommendations

- **Ensure what we do is “cloud enabled”, continued**
  - **The LCMAP is working on a specification for an information warehouse that includes a data cube of Application Ready Data and higher-level information that is enabled through Application Programmers Interfaces (APIs) to meet several land change monitoring, assessment and projection use cases.**
    - **The API will provide automated fast and simple access to imagery to enable use cases such as time-series analysis of land change**
    - **Source code and specifications for the information warehouse API will be made open source as part of the information warehouse acquisition provided the solution is not proprietary**

USGS

LAG Cloud Recommendations

3. Facilitate the implementation (by EROS and/or third-parties) of methods that provide Batch processing Analysis (Model 4 above), as there are many scientific tasks that cannot be handled by Interactive Online Analysis alone.

- **An optimal model would be one in which users can define the required processing to be performed on the imagery and then transmit the model to the cloud where processing can be spread across multiple CPUs.**

- **High throughput, high performance bulk processing in the cloud, along with burst processing in the cloud is being looked at by the EAST future architecture team.**
- **The EAST RFI also solicited information on partnerships**
- **The optimal model has issues on the business and policy sides**
  - **Private sector can do this at any time without consulting the government**
  - **Public sector must decide how to fund and who may use the capability**

USGS

LAG Cloud Recommendations

4. The EROS Center should investigate modification of their existing Data Download (Model 1) to enable subsets of L1T products to be downloaded.

- **Certain types of analyses need only operate over a time-series stack covering a small geographic area of pixels. Note that there is good synergy here with implementation of Interactive Online Analysis (Recommendation 2), as one way to facilitate access to such image subsets.**

- **EROS is discussing a change to the Level-1 format with the Landsat Science Team. This change would further enable interactive services such as spatial and spectral subsetting of the L1T data. These may be further exploited to enable a time-series subset stack of data to the end user.**

- **The response to recommendation #2 – the data cube and Application Ready Data – covers this point as well.**

USGS

LAG Cloud Recommendations

5. Special attention should be given to the use of open software standards when designing any future system(s) to avoid tying any of these services to proprietary software.

- **The EAST is considering both Open Software Standards and Commercial Off-the-shelf tools.**
- **Great care is being taken to ensure that the EAST is not architecting the Center into a corner.**
- **Overall, the EAST will make recommendations for architectural diversity in terms of functionality and distributed capability.**

USGS

LAG Cloud Recommendations

6. Although security is an important consideration, security solutions need to be streamlined so as not to slow things down appreciably and/or make things more complicated to implement.

- **EROS has taken a risk management versus a risk mitigation approach to securing the infrastructure.**
- **The EROS security team and EAST are considering security as the architecture is developed.**
  - **The right environment is one in which mission requirements are met in a secure environment.**
- **EROS is required to operate within the IT security framework (systems and requirements) defined by USGS and DOI.**

USGS

LAG Cloud Recommendations

The consensus opinion is that adaptation of the recommended cloud computing approaches is warranted at the EROS Center, whose people are charged with the responsibility of serving a very large, diverse, and growing user community.

- **EROS looks closely at cloud computing, both public and private.**
- **In addition to the technology changing, our users are also changing, as are the business models of the cloud computing vendors and providers, and the contracting environment.**
- **We track cost/benefit to see how best to improve services while meeting our mission.**

USGS

LAG Product Recommendations

1. The USGS should clearly define the level of products it will produce and avoid competition with commercial organizations.

- We have defined products for surface reflectance, surface temperature, dynamic surface water extent, burned area, and fractional snow covered area.
- We have not yet finalized the specifications for all products and communicated these to the public.

2. Refine Landsat geometric accuracy to enable better change detection and refinement of the radiometric measurements so that they can be better associated with known quantities.

- We have defined a task to refine and update the existing ground control points and to develop a plan for generating a new set of GCPs based on the Landsat 8 OLI and platform ephemeris data. White papers and slides have been prepared to summarize these efforts.
- We need to define a schedule of milestones and deliverables for the work that remains.

USGS

LAG Product Recommendations

3. Continue to improve the existing L1G product by refining both the geometric and radiometric accuracy through the use of additional control and terrain models used to geometrically correct the imagery as well as through continual calibration of the instruments against ground truth. In addition to geometric accuracy, USGS should seek to improve the co-registration of L1T products.

- **Work is in progress towards refining the existing GCP library with updated data for regions which have had persistent problems.**
- **Plans are in place to built an improved GCP library using Landsat 8 OLI data.**

USGS

LAG Product Recommendations

4. Define a standard surface reflectance product by documenting and publishing a standardized method for the creation of Surface Reflectance products from Landsat and collecting and distributing the parameters (such as elevation, weather, temperature & humidity) required to compute these from the L1T.

- We have an operational implementation of TM and ETM+ surface reflectance that includes a written user guide, peer reviewed publication of our methods for characterizing uncertainties, and a peer reviewed publication describing the original LEDAPS development.
- We need to update the paper on the methods for characterizing uncertainties to describe our approach for on going Quality Assurance.
- We are working on similar publications for the provisional ("beta") release of the Landsat 8 surface reflectance.

USGS

LAG Product Recommendations

5. Help consolidate scientific research and publish best practices on how to create a range of products including different indices of vegetation and soil types and Climate Variables. USGS should clearly define these products along with the associated validation criteria for such products, so that multiple commercial and government organizations can create and distribute the products backed by well-defined standards.

- **We need to define the scope of the product suite that we plan to develop and support.**
- **We have the CDR and ECV products identified, along with a set of spectral indices that are generated from surface reflectance through ESPA.**
- **We need to perform a gap analysis and develop a BOE for what is required to complete this work in FY15-16.**

USGS

LAG Product Recommendations

6. Provide documented samples of the derived products against which organizations can test their product processing.

- **This is related to a new action that was identified in the meetings on collaboration with Geoscience Australia, in particular defining product specifications for surface reflectance developed by USGS and GA that are sufficiently consistent and interoperable to support a broad base of applications work.**
- **This should also involve collaboration with scientists from the European Union for the same reasons and to work towards a common approach for synergistic use of Sentinel-2 and Landsat data.**

USGS

LAG Product Recommendations

7. Provide the facilities to certify or validate derived products generated by other organizations.

- **The USGS currently has in place procedures and protocols for validating L1T products generated by the Landsat International Cooperator (IC) stations. The concept of providing samples of higher level data products to external producers against which to compare their implementation for similar products was also defined as a potential topic of collaboration with GA towards developing a roadmap for consistent and interoperable Landsat surface reflectance products.**

USGS

LAG Product Recommendations

8. Make the L1T product simpler to access. It is suggested that new APIs (Application Programming Interface) are investigated that enable the subsets of imagery to be downloaded to multiple cloud processing environments which are likely to be used in the near future for the creation and distribution of multiple products created from Landsat imagery.

- **The USGS recently engaged in collaboration with a user in order to provide them with a machine-to-machine interface for bulk download of L1T data. We have not yet implemented an API to enable downloading subsets of data although low-level software services have been developed in ESPA for such purposes.**

USGS

2015 LAG Task 1

1. USGS Land Remote Sensing Program (LRSP); LAG members to provide the LRSP with information about non-Federal data requirements that could include both LAG member input plus information obtained from non-Federal users contacted by LAG members.

2015 LAG Task 2

2. Regarding the Sentinel 1 (radar), Sentinel 2 (land-imaging) satellites, and new commercial smallsats and microsats, the USGS is interested in learning what success non-Federal users are having with data access and delivery mechanisms, data-use policies, and data applications. The USGS would also be interested in hearing what recommendations the LAG may have for USGS actions associated with these systems.

2015 LAG Task 3

- Review the 2013 LAG paper on cloud implementation. Darrel had led the team who drafted the 2013 paper and has agreed to review the EROS brief and recommend any follow up actions for the LAG for 2015.
  - Topic to be briefed to EROS Leadership in July 2015
  - Decision to update the paper will be determined after the brief
- Review the 2013 LAG paper on product improvement. Peter had led the team who drafted the 2013 paper and agreed to review the EROS brief and recommend any follow up actions for the LAG for 2015.
  - There is justification to review and update.

Membership & Key Focus Areas (although some will support several)

Name	Organization	Key Focus
Jack Hild (LAG Chair, NGAC Member)	Hild Enterprises, LLC	
Kass Green (LAG Co-Chair)	Kass Green & Associates	Lead #1
Roger Mitchell (LAG Co-Chair, NGAC Member)	MDA Information Systems, Inc.	Lead #2
Peter Becker	Esri	Lead #3
John Copple	Sanborn Map Co.	#1
Joanne Gabrynowicz (NGAC Member)	University of Mississippi	#1
Kevin Hope	National Geospatial-Intelligence Agency	TBD
Roberta Lenczowski	AmericaView	#1
Rebecca Moore	Google, Inc.	#1
Cory Springer	Ball Aerospace & Technologies Corp.	#2
Julie Sweetkind-Singer (NGAC Member)	Stanford University	#1
Tony Willardson	Western States Water Council	#1
Darrel Williams	Global Science & Technology, Inc.	Lead #3

Subcommittee Activities – Task 3

- Review the 2013 LAG paper on cloud implementation. Darrel had led the team who drafted the 2013 paper and has agreed to review the EROS brief and recommend any follow up actions for the LAG for 2015.
  - Topic to be briefed to EROS Leadership in July 15
  - Decision to update the paper will be determined after the brief
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  - There is justification to review and update.

Next Steps

- Work through the summer to collect data with goal of having Task 1 summary drafted by 1 Oct
- Task 2 – Roger Mitchell to convene a small group meeting to outline work plan
- Task 3a - Defer any additional work on the Cloud paper until after the LST July meeting.
- Task 3b – Peter Becker will work with his group to prepare an update to the Product paper.

Analysis of nonfederal users' requirements

- Make sure your requirements are included in the analysis by participating in our short questionnaire at

https://www.surveymonkey.com/s/Landsat_requirements_analysis

OMIDYAR NETWORK

A WORLD OF POSITIVE RETURNS

Concept - Open Imagery Network

- Imagery revolutionizes people's relationship to the earth and to one other. It makes transactions and impacts transparent to all.
- As evidenced by Landsat, when imagery is free and accessible, its use explodes.
- Thanks to Landsat and now Sentinel (along with Google and Amazon), moderate resolution imagery is abundant and accessible.
- The supply of high resolution imagery is increasing with the upcoming constellations of small satellites, as well as the growing adoption and sophistication of drones.
- However, the costs of acquiring, accessing, and analyzing imagery, especially high resolution imagery, are still prohibitive.

OMIDYAR NETWORK

A WORLD OF POSITIVE RETURNS

Global Data Commons for Earth Observation

An “Open Imagery Network” that serves key stakeholders in a coordinated manner. Funded by a cooperative of foundations:

1. Offers users a single platform of unified, readily accessible imagery data at no cost, and a community of support and software tools for processing collected data (e.g. data that users and community service organizations collect with unmanned aerial vehicles);
2. Allows donors to spend in a single place for an annual unlimited amount of data from commercial operators, resulting in a more effective total spend that reduces market fragmentation;
3. Provides the opportunity for data imagery providers to support a single foundation maintained by an independent third party, thereby lowering their costs, reducing risk, and providing marketing upside; and
4. Increasing market transparency by establishing standards for all.

OMIDYAR NETWORK

A WORLD OF POSITIVE RETURNS

Benefits

1. Support the negotiations of prices, acquisition and aggregation of available image sets into a central repository for use by all key stakeholders.
2. An industry-wide foundation could set standards, make commercial deals, collect and assess industry-wide usage data, promote data education for nontraditional users, and mediate data processing.
3. Such an initiative would efficiently anchor funding and facilitate coordination between diverse stakeholders, creating a single voice in a vacuum where no coordination has previously existed.
4. It would also catalyze a range of innovative, efficient services related to land and the people who inhabit it.

OMIDYAR NETWORK

A WORLD OF POSITIVE RETURNS

Concept Study

- The Omidyar Network has initiated a study on the feasibility of creating an Open Imagery Network funded by a cooperative of stakeholders. Pivotal questions include
  - What is the demand for an Open Imagery Network?
  - What is the best technology for the potential platform?
  - What is the best organizational structure for the network?
  - What are the incentives for stakeholders and imagery providers to join the network?
  - What are the organizational challenges to creating and maintaining the network?
- The project is just beginning and we welcome your comments and insights.