Candidate topics for consideration by the Landsat Advisory Group (LAG) of the NGAC in 2016

1. Revisit of the small sat investigation from the FY15 NGAC study

From the 2015 NGAC paper on "Sentinel 2 data use policies", and specifically "on the subject of non-Federal success with new commercial small sats and microsats related to data access, delivery mechanisms, etc.," the LAG recommended "it was determined the current industry status was insufficiently mature to make any meaningful assessment at this time…..It is further recommended that the USGS consider how the LAG can provide input in formulating the 2016 LAG guidance to produce a meaningful and achievable response."

On the subject of small sats, the USGS is proposing a refinement of the 2015 study question as follows: USGS is requesting that the LAG formulate a comprehensive narrative on the pros and cons of *existing* small sat technology juxtaposed with Landsat 8 and Landsat 9 capabilities. Although small sat technology is still maturing, there should be sufficient background material available from which to draw meaningful distinctions to clarify misperceptions in regards to capabilities related to:

- Spectral collection capabilities and user needs, e.g., visible and near-IR, versus shortwave and thermal IR wavelengths.
- Radiometric and geometric calibration needs to support robust change analysis from a continuity of collection over time.
- Collection tradeoffs among swath width, spatial resolution, and area coverage.
- Support to different mission needs, e.g., situational awareness versus science driven; tactical versus strategic monitoring; spatial and temporal scales of the process being monitored; etc.

For purposes of this study, the term "small sat" implies miniaturized satellite designs driven mainly by rationales of cost, agility, resilience, and revisit rates.

Broader study questions to consider include:

- How does the leveraging of small sat technologies and products, as they sufficiently mature to address operational and scientific needs, satisfy interests of the civil user community?
- How can maintaining a broad portfolio of capabilities reduce the risk to meeting current operational needs?
- How could efficient synergy be realized among government and commercial roles for small sat development and operation across broad community needs?

Proposed report date: March 31, 2017

2. The feasibility and utility of implementing temporal data cubes to support projection or 'forecast' models of land change trends.

This is intended as a follow on topic to the LAG study papers on "Product Improvement" and "Cloud computing" published in 2013. The USGS/EROS is developing new products standards for "analysis ready data", (e.g., top-of -atmosphere reflectance, surface reflectance, surface temperature, and pixel-based seamless access to time-series data)-- all of which to be made available for public access. A significant goal is to make time-series data available for generating temporal data cubes over the entirety of the Landsat record going back to 1972. From such data cubes, land change trends can be

analyzed in conjunction with climatological trends, and subsequently feed models to forecast land and climate change for decision making. At this point it remains unclear as to what extent a market demand for forecasting land change will develop, e.g., among sectors of commercial, civil, academic, defense, and intelligence. To that end, the following questions are posed for further study:

- In addition to Landsat, what other data sources (to include EO, SAR, and LIDAR) are optimally suited for leveraging (e.g., co-registered) to support data cube implementations for land change analysis and forecast modeling?
- What kinds of Landsat time-series products would have the broadest community use, or most impactful contribution in specific areas?
- Which organizations with expertise in forecast modeling are best postured to evaluate and demonstrate the forecast potential from a Landsat-based temporal data cube?
- How far back in time into the Landsat archive should the staging of 'analysis ready data' be considered? E.g., early data collections such as multi-spectral scanner (MSS) data are less equipped (in terms of metadata) to support rigorous geometric and radiometric calibration compared to later collections.
- How could efficient synergy be realized among government and commercial roles for data cube development, and operations (processing, storage, distribution) to satisfy broad community needs?

Proposed report date: June 30, 2017

3. Data continuity mission enhancements

A working premise of the data continuity mission is that future collection sensor specifications maintain a level of 'backward compatibility' with past missions to facilitate time-series analysis over the entire record. For this reason, Landsat sensor specifications have evolved deliberately over time. However, the impact to the data continuity mission from 'significant' sensor design enhancements, e.g., spectral and/or spatial resolution, needs to be better understood. This issue applies to future Landsat mission design, as well as integrating continuity data from third party sensors.

The following question is proposed for potential LAG investigation: To what extent could 'significant' sensor enhancements be made in future Landsat missions, while maintaining acceptable backward compatibility? What would be the suggested methods for data aggregation and validation?

Proposed report date: September 30, 2017