CAPABILITY OF EXISTING REMOTE SENSING DATA PRODUCTS TO MEET THE NEEDS OF AMERICAVIEW'S USER CONSTITUENCIES

Report from Workshop Conducted 25 March 2019

at the

AmericaView Winter Business Meeting

Sterling, Virginia

Prepared by the

AmericaView Satellite-Based Sensors Working Group

Objective: AmericaView (AV), in its proposal to the USGS, included as our Objective 1 the following:

> As a nationwide consortium, led by 39 universities, AV will continue the critical role of defining, consolidating, and communicating data and information requirements of local user communities to decision makers and agency personnel. AV will similarly work closely with agency scientists and researchers to relay the availability of data and tools, and provide training, to local user communities. AV will improve the nation's capabilities and resources in land remote sensing by creating clear communication channels between all levels. This will be accomplished through AV's national and state consortia, which will enhance the assemblage of information regarding the capability of existing remote sensing data products to meet the needs of its user constituencies (including academic, scientific, and local end user communities). AV will assemble this information at the national level into a consolidated format, and will communicate the information to decision makers and agency personnel to help improve the nation's land remote sensing capabilities.

AV committed, as part of its work plan related to Objective 1 provided for Year 1, to communicate "the data and information needs and requirements of AV's constituents and stakeholders to agencies charged with the development and operation of the Landsat and related programs." Specifically, AV committed to conduct a workshop at its face-to-face meeting, "during which members will present, discuss, and consolidate the current remote sensing data and information requirements of the AV stakeholders. The results of this workshop will be summarized and presented as part of the AV annual report for this grant period." This summary is in fulfillment of that commitment.

Methods: A workshop was held on 25 March 2019 during the AV Winter Business Meeting in Reston, Virginia. AV members were sent an email on 11 February 2019 in anticipation of the workshop requesting members to prepare for the workshop by reaching out within their institutions and among their stakeholders. Three broad topics for the workshop were identified: (1) sensors (e.g., what's good and what can be improved with Landsat and follow-on missions); (2) data products (e.g., L1T, ARD, surface reflectance, land cover maps); and (3) data delivery (e.g., EarthExplorer, GloVis, Google Earth Engine, Amazon Web Services).

The workshop was conducted as a modified SWOT (strengths, weaknesses, opportunities, and threats) exercise. Each of the three topics was discussed in an open, facilitated forum. At the end of each discussion, the 45 participants representing 39 states were asked to fill out an index card listing up to three strengths and opportunities and up to three weaknesses and threats with respect to each topic. Responses were compiled by the chair of the AV Satellite-Based Sensors Working Group and summarized in this report, which was circulated among the Working Group for comment.

Results: The following summary consolidates the discussions and written comments from the 25 March 2019 meeting. Major findings are those where at least 20% of the comments noted the item as a SWOT element and are presented in greater detail. Additional comments are subsequently enumerated. Note that participants were limited to listing only three strengths and opportunities and only three weaknesses and threats. Therefore, percentage of responses should be only viewed as the relative importance assigned by the participants as a group to each item (e.g., only 73% listed no-cost data as a strength, but this was listed more than any other item and it was clear for the discussion that every participant views this as a strength).

Sensors (focused on Landsat)

Data Continuity: Data continuity was the most prominent issue with respect to the Landsat system, with 76% of respondents identifying it as a critical strength. In addition, 24% of respondents noted this as a weakness or threat. Specifically, 20% identified the change in the near infrared band for Landsat 8 as weakening data continuity and 6% viewed any future changes in bandwidths as a threat to the utility of the system. Discussion indicated that changes affecting data continuity, as was done with Landsat 8 bandwidths, should only be carried out with compelling evidence that the benefits outweigh the impact on data continuity.

Calibration: The quality of Landsat calibration was the second most frequently noted strength of the Landsat system and was included in responses from 40% of the participants. It was noted during discussions that Landsat remains the standard against which other sensors are measured and is even used as a calibration source for other sensors.

Spatial Resolution: Various aspects of spatial resolution were noted by most respondents as SWOT elements, and in the aggregate accounted for more written comments than data continuity. 20% of respondents viewed the current 30-m spatial resolution as a strength, while 66% viewed it as a weakness, opportunity (to improve spatial resolution in the future), or as a threat (as users turn to other sensors with finer spatial resolution). A clear majority wanted to see improved spatial resolution on future missions, and the discussion indicated the desirability of 10-m resolution for many applications. In addition, 55% of respondents expressly noted thermal resolution as a weakness.

Temporal Resolution: The Landsat return interval was perhaps the subject of greatest disagreement among respondents. While 18% of respondents identified this as a strength of the Landsat system, 26% saw it as either a weakness or noted it as an opportunity to increase the return interval. Discussions indicated that this was highly application dependent.

Spectral Resolution: The final major item related to sensors was spectral resolution, which covered a range of sub issues. 31% of respondents noted Landsat's thermal capabilities as a strength, while 22% noted the shortwave bands as a strength and 13% noted coastal blue as a strength. In addition, 22% noted the absence of certain bands as a weakness or an opportunity. The most comment band mentioned was red edge, while additional comments included the desire for additional blue bands and a UV band.

Additional SWOT items noted in responses:

Georeferencing accuracy – strength 2%

Interface with National Wetlands Inventory – opportunity 2%

Educational uses – strength/opportunity 11%

Spatial extent of archive – strength 7%

Availability of real-time product – strength 2%

Direct broadcast – opportunity 2%

High cost of system/future funding – threat 11%

Competition (private/Sentinel) – threat 4%

Radar addition – opportunity 2%

Thermal stray light issue – weakness 7%

Lack of thermal consistency – weakness 4%

Potential for big data analyses – threat 2%

Data Products

L1T: By far the most comments received with respect to data products revolved around Landsat L1T availability. 44% of respondents commented on L1T as being a particular strength with respect to data products being delivered by the USGS, while 40% viewed the loss of L1T, for example being replaced by ARD, as a threat. Both figures represent the most responses in terms of strengths and threats, clearly identifying the availability of Landsat L1T data as an item of high importance to AV and its constituencies in the respective states.

ARD: Notwithstanding the comments under L1T, many participants viewed the addition of ARD as a strength, 29%, although many respondents added comments that ARD was beneficial only for specific applications. Additionally, 16% of respondents reported difficulty or confusion from working with the ARD tile system, including dates included in a tile that did not contain data for a specific study area because the date was only partially populated for that tile.

Landcover Maps: Landcover maps (NLCD) were identified as a strength more often than any other derived data, 36%. During discussion, it was remarked that many less sophisticated users rely heavily on the existence of ready to use products, with NLCD being the most developed. Several respondents, however, raised concerns about the accuracy of the maps for local applications, while one respondent raised concerns that the production of these maps could stifle innovation by others who might otherwise produce landcover maps. 7% of respondents noted that the products tend to be too coarse spatial resolution for many local needs. Finally, many

respondents raised as a weakness the inadequate documentation associated with these dataset, for example in the metadata (see documentation comments below).

Real Time Landsat Data: A substantial number of respondents, 22%, praised the availability of the "real time" Landsat imagery. These data were noted as being particularly important for emergency response and for use in weather forecasting.

QA Date: The Landsat QA band, including the standardization of QA data across the archive was noted as a particular strength by 24% of respondents. However, 4% of respondents did raise concerns about the accuracy of the cloud detection methods supporting the QA band.

Reflectance and Land Surface Temperature: Reflectance and land surface temperature products were reported as strengths by 20% of participants. Concern was raised in two comments about the quality of surface reflectance at high latitudes.

Inadequate Documentation and Metadata: The quality of documentation and metadata was by far the most often listed weakness with respect to data products and was listed in 36% of the written comments. Concerns included the failure to include the methods for deriving the products with the products (often relying on references to external sources, such as journal articles), lack of metadata compatibility with commonly used geospatial software, and lack of inclusion of validation results (e.g., accuracy assessments for maps or validation data for reflectance and temperature products) with data delivery. One respondent considered existing metadata as a strength, while another viewed improving metadata as an opportunity.

Product Proliferation: Various aspects related to the increase numbers of products available were raised. 18% of respondents praised as a strength the provision of diverse products to meet diverse end-user needs, while 20% were concerned that the proliferation of products would overwhelm USGS's capacity.

Additional SWOT items noted in responses:

Standardization across the archive – strength 18%

Pixel based rather than scene or tile based products – opportunity 16%

Global products – opportunity 2%

Lack of instructional tutorials for less sophisticated users – weakness 2%

Thermal band resampling – weakness 7%

Data Delivery

No-Cost Data Availability: No-cost data availability was the most commonly listed strength of the current Land Remote Sensing data delivery system at 73%. The advantages are widely established, while specific examples related to the advantages in academic communities, including teaching, will be the subject of an AmericaView sponsored session at the 2019 Pecora Conference.

Multiple Platform Delivery: The second most listed strength at 51% related to data delivery was the current availability of data from multiple platforms. Discussions during the workshop focused particularly on how USGS platforms (i.e., EarthExplorer and GloVis) are complemented by other platforms, especially Google Earth Engine and Amazon Web Services. Each platform has potential advantages for different purposes, making a multi-platform infrastructure a particular strength, in that users are not tied to a single platform for all applications. It was also noted that this approach results in archive redundancy, which is important for security purposes.

EarthExplorer: The final data delivery strength listed by more than 20% of respondents was EarthExplorer, which was included in 33% of responses. Discussion indicated that this is a mature platform, easily accessed, with very low learning curve to use it effectively (although one respondent found EarthExplorer difficult for students, while two indicated the same for GloVis). The wide range of data available from this single source was also commented on as a particular strength.

Gzip and Tar: The most common weakness noted with respect to data delivery, included on 27% of responses, was the continued practice of using gzip and tar formats. Many comments noted that use of these formats resulted in particularly clumsy data handling among those who do not download satellite data as a regular part of their jobs, and that other modern data formats would seem to be more intuitive, more compact, and result in less steps in preparing data for analysis. A related weakness listed by an additional 11% was the delivery of data without the bands combined in a single image stack.

Projection Differences: The recent proliferation of projection differences for the delivery of Landsat data in particular was noted as a concern by 20% of participants. This was raised as a particular concern with Analysis Ready Data and Google Earth Engine.

Additional SWOT items noted in responses:

Data latency – strength 4%

Landsat collection system – strength 7%

ARD missing older data – weakness 2%

Too many outages/maintenance – weakness 13%

Different download processes for different sites – weakness 11%

Delay between USGS and GEE – weakness 2%

Specific Java version required for bulk download – weakness 2%

Confusion between what is available in EarthExplorer and GloVis – weakness 7%

Push delivery of new imagery to regular users – opportunity 4%

Cloud based web services – opportunity 9%

Slow download times – weakness 2%

Reduce scene size – opportunity 2%

File naming convention poorly ordered – weakness 2%

Google Earth Engine data differences from USGS not well documented – weakness 9%