USGS Expectations of the Decadal Survey

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USGS interest in the Decadal Survey

- USGS is an owner (Landsat), data provider (LP DAAC and other land imagery), and user of space-based Earth observing systems

- Landsat perspective:
  - Time horizon: Administration has committed to Landsat-compatible land imaging for Landsat 9 + 20 years
  - Uses are in both research and decision support
  - Priorities include both continuity and innovation, driven by users' needs
  - Capabilities should not be static. For next generation of Landsat, need input on emerging capabilities and benefits to users.

- Of recent NASA ESD missions, Department of the Interior's heaviest uses have been:
  - Rely heavily on: Terra (MODIS), Suomi NPP (VIIRS), Aqua (MODIS, ASTER), GRACE.
  - Also heavily used: Aura, EO-1 (fewer users but critical for those uses), CALIPSO.
  - Also very useful: TRMM, QuikSCAT.

Increasing understanding of users and uses

- Since the 2008 Landsat free data policy, expansion in:
  - The amount of data downloaded (was 20,000 scenes/yr; is now 10 million scenes/yr and growing)
  - Disciplines & domains using Landsat; types of applications
    - Rapid growth in research and academic uses of Landsat. Researchers and educators can now afford to conduct extensive land-surface change studies. Older scenes are downloaded in substantial volumes.
    - More & more direct decision support. As of 2012, 2/3 of users described themselves as researchers, 1/3 as operational (by a strict definition of operational).
    - Commercial sector use is increasingly dramatically.

Recent studies on Landsat users' needs

USGS/NASA Landsat Applications Survey of 33 Landsat products (2012)

- 2/3 of studied Landsat products require 8-day or more frequent revisit
- 3/4 require simultaneous visible/near-infrared/shortwave infrared (V/NIR/SWIR) data
- 1/3 require thermal infrared (TIR) data in combination with either V/NIR or SWIR bands

OSTP-led National Plan for Civil Earth Observations (2014), Assessment (2012)

- Assessment of 362 Earth observing systems' contributions to 13 societal benefit areas
- Among 132 satellite systems, Landsat ranks second-highest in impact, behind only GPS (#1 for contributions in Biodiversity, Ecosystems, and Energy; #2 in Agriculture/Forestry, Climate, Human Health, and Water)

National Research Council/Space Studies Board report, "Landsat and Beyond: Sustaining and Enhancing the Nation's Land Imaging Program" (2013)

- Coverage/repeat cycle requirement: "Ability to acquire and make available imagery anywhere on Earth, except perhaps for areas very the near poles, at approximately weekly frequency."

USGS National Land Imaging Requirements Moderate-Resolution Pilot Project (2014)

- Formalized process also used for OSTP's Assessment and for NOAA
- Elicited requirements for 11 application areas across 12 Federal agencies
- 60% of requirements collected require 8-day or more frequent revisit

Sample findings: Spectral, temporal, spatial requirements

USGS/NASA survey of 33 Landsat products (2012)

Green: Required for application

Blue: Helpful for application

		Spectral Requirements				Revisit			
Application	Landsat Information Product	VIS	NIR	SWIR	TIR	4d	8d	16d	30d
MRLC National Land Cover Database	Cover type/change	G	G	G				G	
	% Tree cover	G	G	G				G	
	% Impervious	G	G	G	G			G	
USGS/USFS Landfire	Vegetation characteristics	G	G	G	G		G		
	Disturbance	G	G	G	G		G		
Burned Area Emergency Response	Burn severity maps (dNDVI, dNBR)	G	G	G		B	G		
FAO FRA Forest Change	Forest change maps	G	G	G				G	
Foreign Agricultural Service	Crop area	G	G	G			G		
	Crop production	G	G	G			G		
	Crop health	G	G	G			G		
USDA National Ag. Statistics Service	National cropland data layer (crop type)	G	G	G			G		
USDA Crop Insurance	Verify crop insurance/damage claims	G	G	G			G		
Western States Evapotranspiration	Land surface temperature				G	B		G	
	Surface reflectance	G	G	G			G		
	NDVI	G	G				G		
	Cloud/shadow mask	G	B		G		G		
USDA Tillage/Residue Monitoring	Crop residue		G	G			G		
Landsat Image Mosaic of Antarctica	Ice sheet features		G				B		G
Minnesota Lake Clarity Monitoring	Water clarity	G				B	G		
USFS Forest Management	Terrestrial Ecological Unit Inventory	G	G	G			G		
	Mid-level Vegetation Classification	G	G	G			G		
	National insect disease risk map	G	G	G		B	G		
	Post-storm damage assessments	G	G	G		G			
	Rapid Assessment of Vegetation	G	G	G		G			
MDA/NGA Land Change	Correlated land change (new construction)	G	G	G	B		B	B	G
Ohio Agricultural Tax Verification	NDVI (to establish presence of crops)	G	G				B	G	
USGS Volcano monitoring	At-sensor radiance (plumes, minerals)	G	G	G	G		B	G	
	Surface temperature				G		B	G	
USGS Flood Monitoring	At-sensor radiance (flooded area)	G	G	G	G		G		
USGS Landsat science products (including essential climate variables)	Surface reflectance	G	G	G			G		
	Surface temperature				G		G		
	Land cover / Surface water	G	G	G	G			G	
	LAI/fPAR	G	G	G			G		

Sample findings: Federal uses of Landsat

OSTP-led National Plan (2014), Assessment (2012)

- Used GEO Societal Benefit Areas
- Assessment criteria included:
  - What's critical for 1 SBA
  - What's infrastructural/used by many
  - What's in need of attention (either continuity or new technology)
- 10 of 13 SBAs use Landsat
- 31 of 52 Sub-areas use Landsat

Landsat findings for the first 6 of 13 SBAs:

Agriculture and Forestry	Sustainable Agriculture
	Sustainable Forestry
Biodiversity	Terrestrial Biota
	Aquatic Biota
	Invasive Species
	Habitat Status and Trends
Climate	Fundamental Climate System Understanding
	Climate System Models
	Greenhouse Gases and Mitigation
	Vulnerability, Impacts, and Adaptation
Disasters	Emergency Management
	Solid Earth Disasters
	Terrestrial Disasters
	Coastal Disasters
Ecosystems	Terrestrial Ecosystems
	Freshwater Ecosystems
Energy and Minerals	Renewable Energy
	Minerals

Focus on needs and products vs. technologies and measurements

- Landsat users are asking for continuity and incremental improvement to better support consistent research directions and decision support needs.

- USGS is developing national Landsat products for multi-temporal land change monitoring, assessment, and projection in many fields, including:
  - Drought indicators
  - Snow cover
  - Surface water extent
  - Burned area extent

- How can new NASA missions – Landsat and others – improve and support new land cover and condition products at regional, national, and global scales?