

USGS Satellite Earth Observation Systems: Continuity and Change

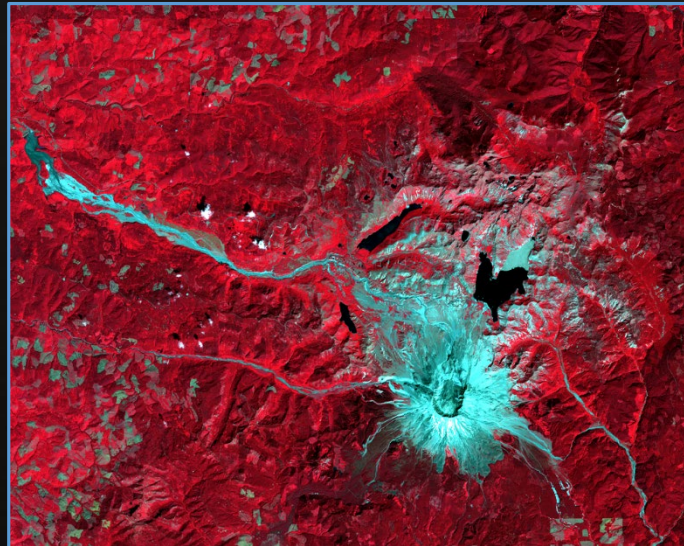
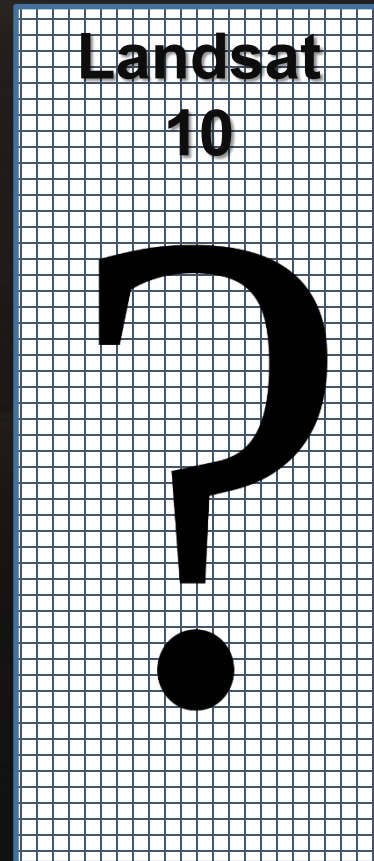
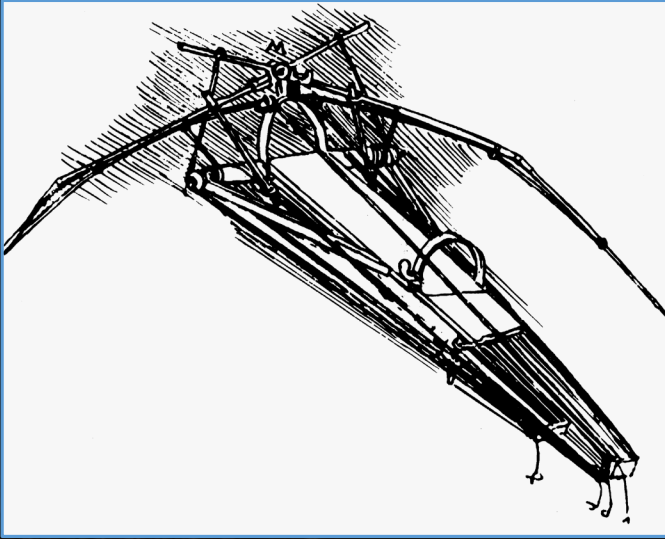
Keynote to the 2019 Ground System Architecture Working Group
February 27, 2019

Jim Reilly

Director, US Geological Survey
Department of Interior

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

From Here to There

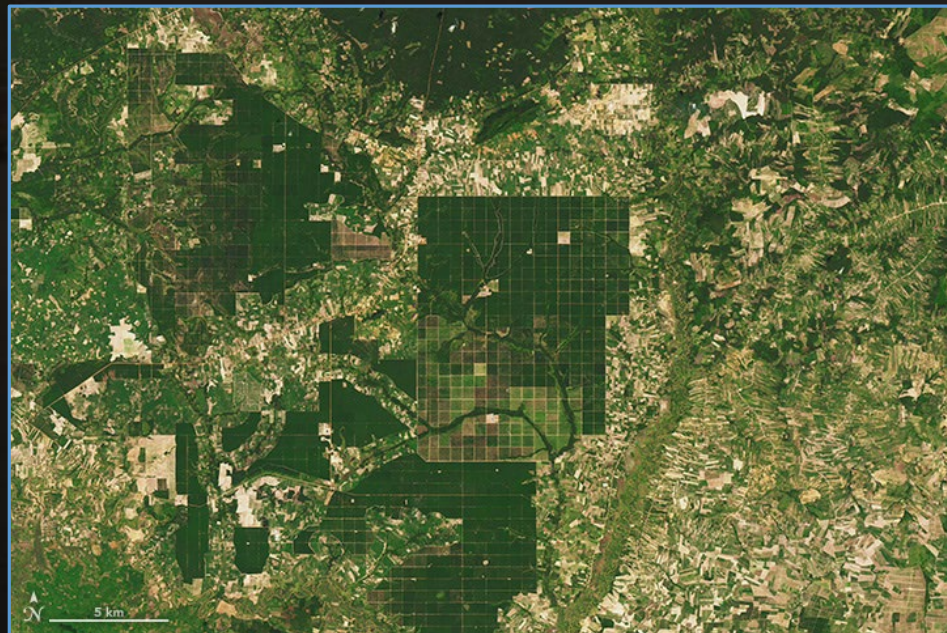


Landsat: Mapping Change Worldwide *(1 of 2)*

Cambodia



Landsat 7 -
2000



Landsat 8 -
2015

Landsat: Mapping Change Worldwide (2 of 2)



You Have to Be in the Room

Apollo 11
Mission Control



National Water Center
Operations Center



Johnson Space Center
Mission Control -- 2006



Landsat 8
Mission Control





#372



#17



USGS Mission: *Our Raison D'être*

The Organic Act of 1879 provided for....

“...the classification of the public lands and examination of the geological structure, mineral resources, and products of the national domain.”

USGS Mission: *Linking Science to Decisions*

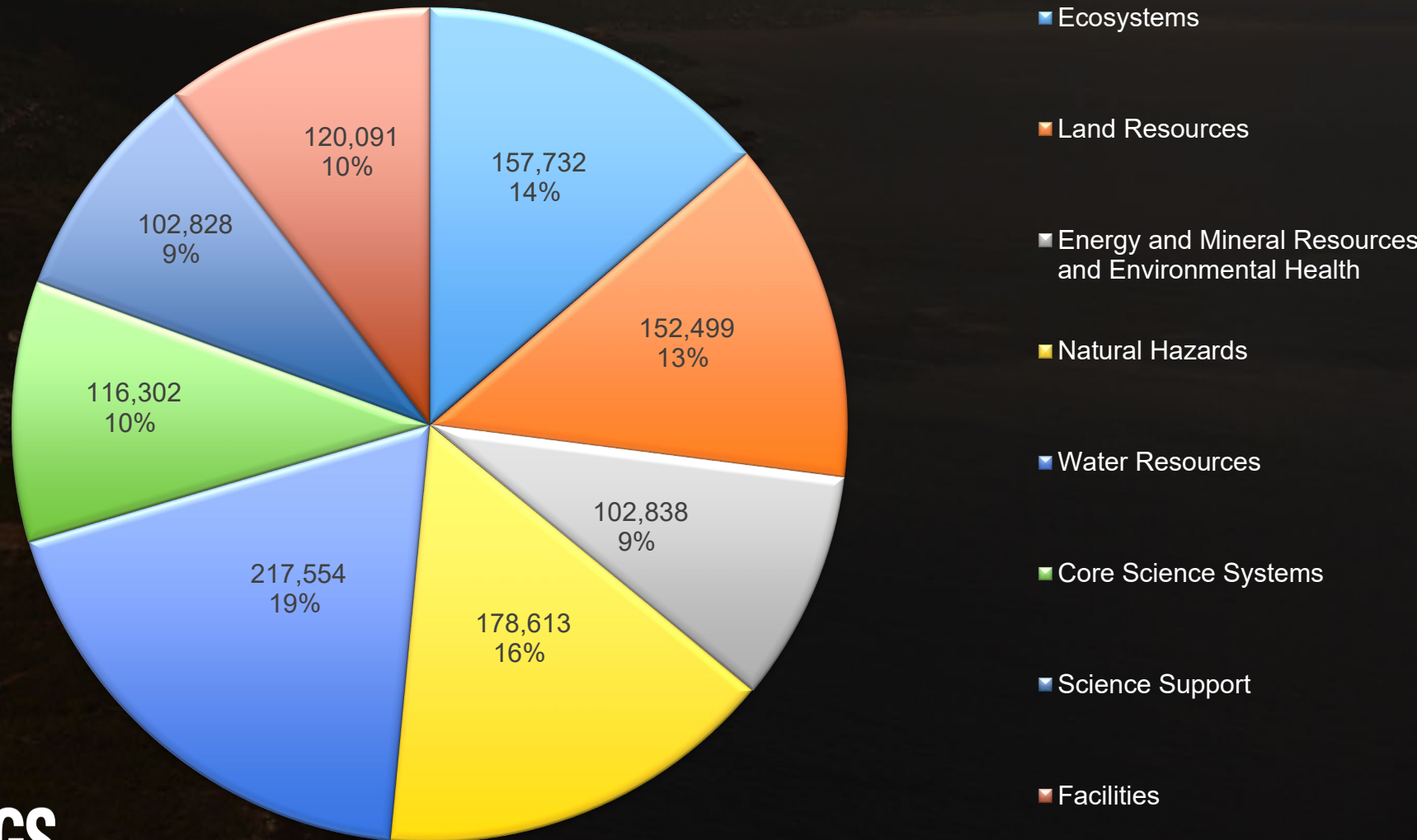
The USGS serves the Nation by providing reliable scientific information to:

- describe and understand the Earth.
- minimize loss of life and property from natural disasters.
- manage water, biological, energy, and mineral resources.
- enhance and protect our quality of life.



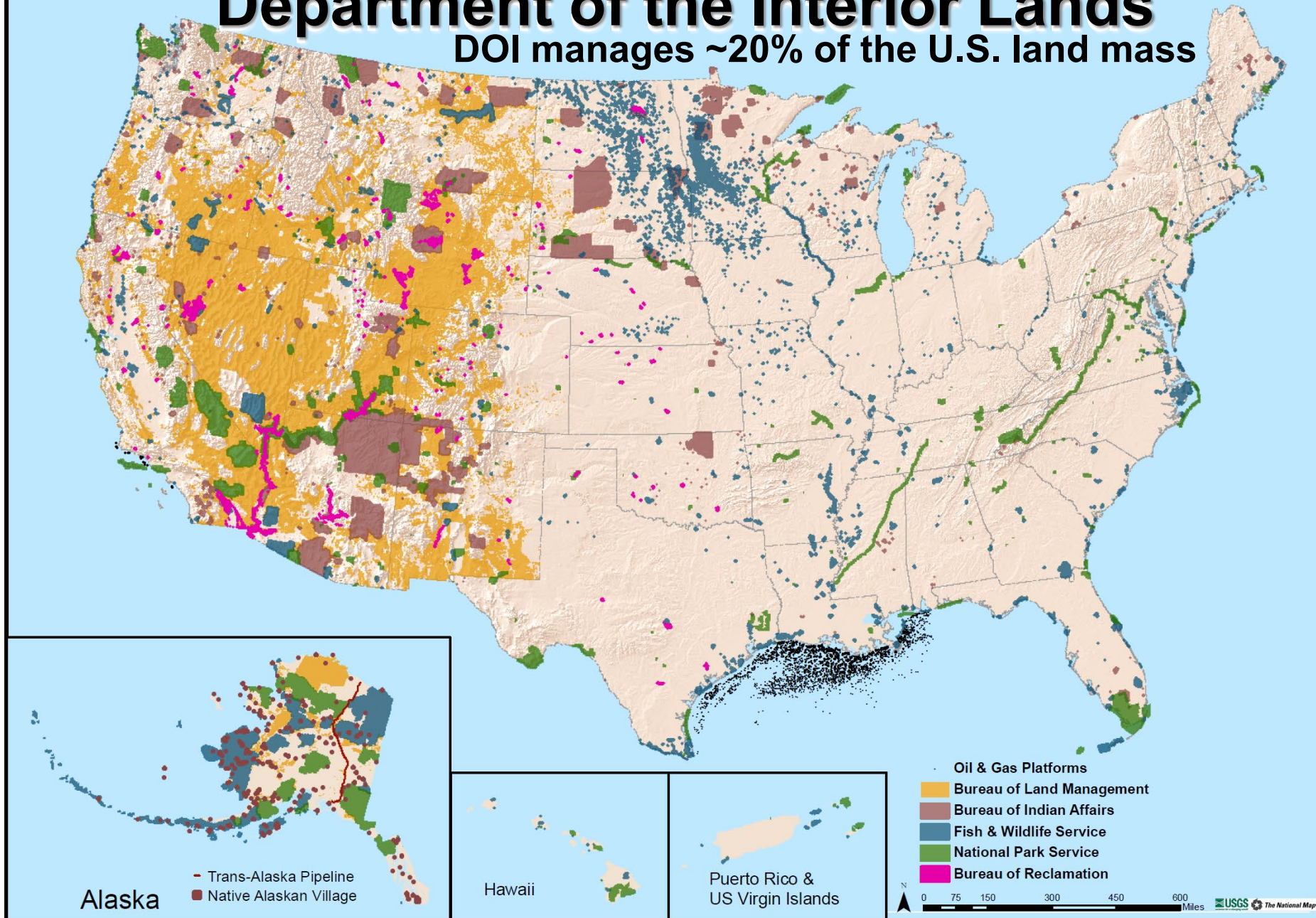
2018 USGS Budget: *Enacted by Mission Area*

\$1.15 Billion



Department of the Interior Lands

DOI manages ~20% of the U.S. land mass





Landsat

- Landsat 1 launched in July 1972
- Landsat 8 launched in February 2013
- Landsat 9 on track for LRD in December 2020

USGS Programs *Using Satellite Observations*

Core Science Systems

National Cooperative Geologic Mapping
National Geospatial
Science Synthesis, Analysis, and Research

Ecosystems

Landscape Science
Fish & Wildlife
Invasives & Disease

Land Resources

Land Change Science
National Land Imaging
National and Regional Climate
Adaptation Science Centers

Energy and Mineral Resources

Energy Resources
Mineral Resources

Natural Hazards

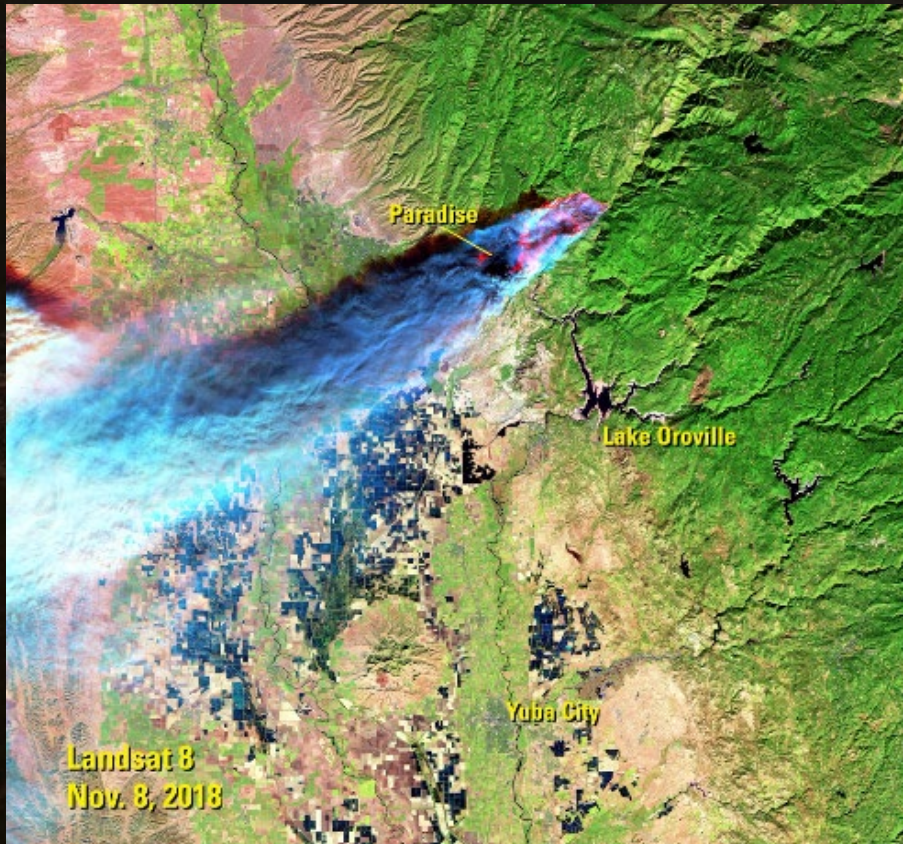
Coastal & Marine Geology
Earthquake Hazards
[Geomagnetism]
Global Seismographic Network
Landslide Hazards
Volcano Hazards

Water Resources

National Groundwater and Streamflow
Information
National Water Quality
Water Availability and Use
[Water Resources Research Act]

What is Landsat?

With a 46+ year archive of natural and human-induced changes to the global landscape, Landsat observations inform land and natural resource management decisions, and helping us understand Earth system change



Multi-spectral coverage in VNIR-SWIR-TIR
-> to map surface composition and temperature

15 / 30 / 100 meter spatial resolution
-> to resolve human-scale land dynamics

16-day revisit frequency (8-days w/ two operational satellites)
-> global, seasonal coverage

Broad area collection => 12,000+ square miles per image
-> 1200 images/day = 15 million square miles/day

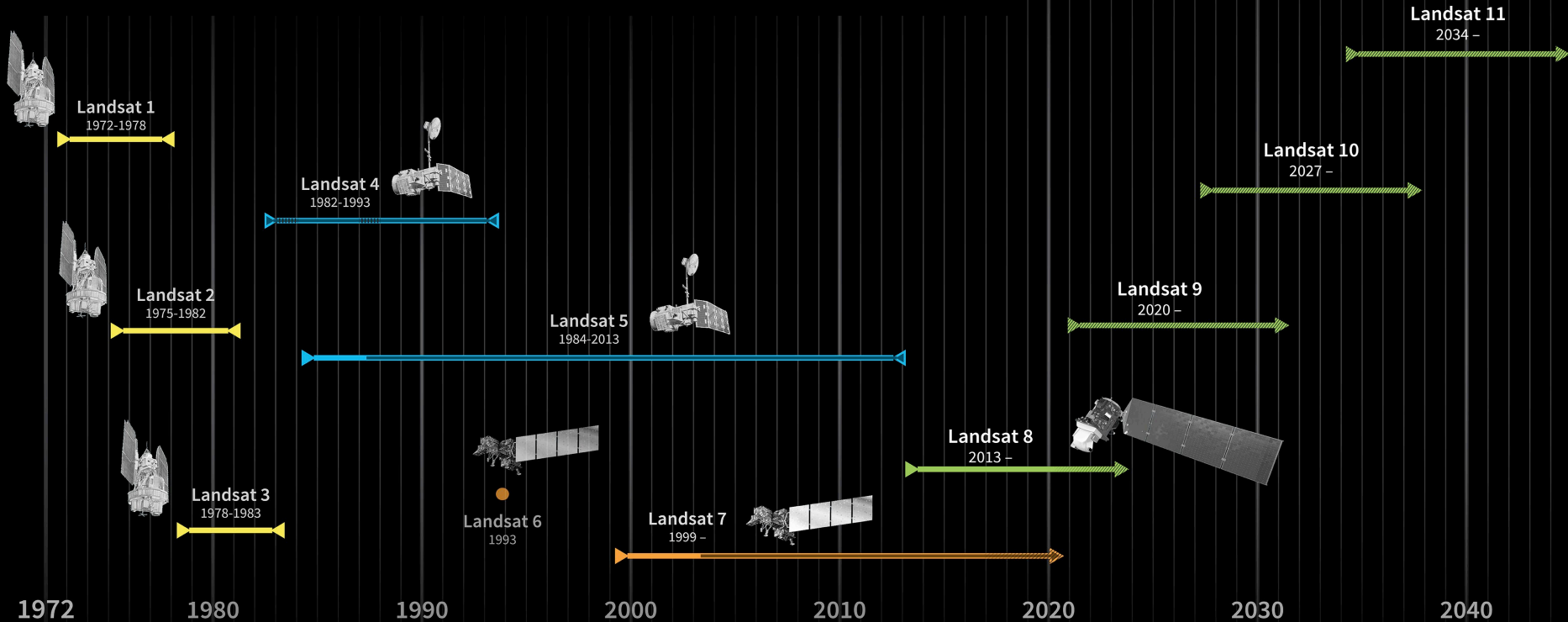
Highly-calibrated “science quality” data
-> to resolve long-term trends & retrieve biophysical variables

Free and Open Data policy since 2008
-> 20 million products distributed by USGS last year

Landsat 8 Orbit for Global Coverage

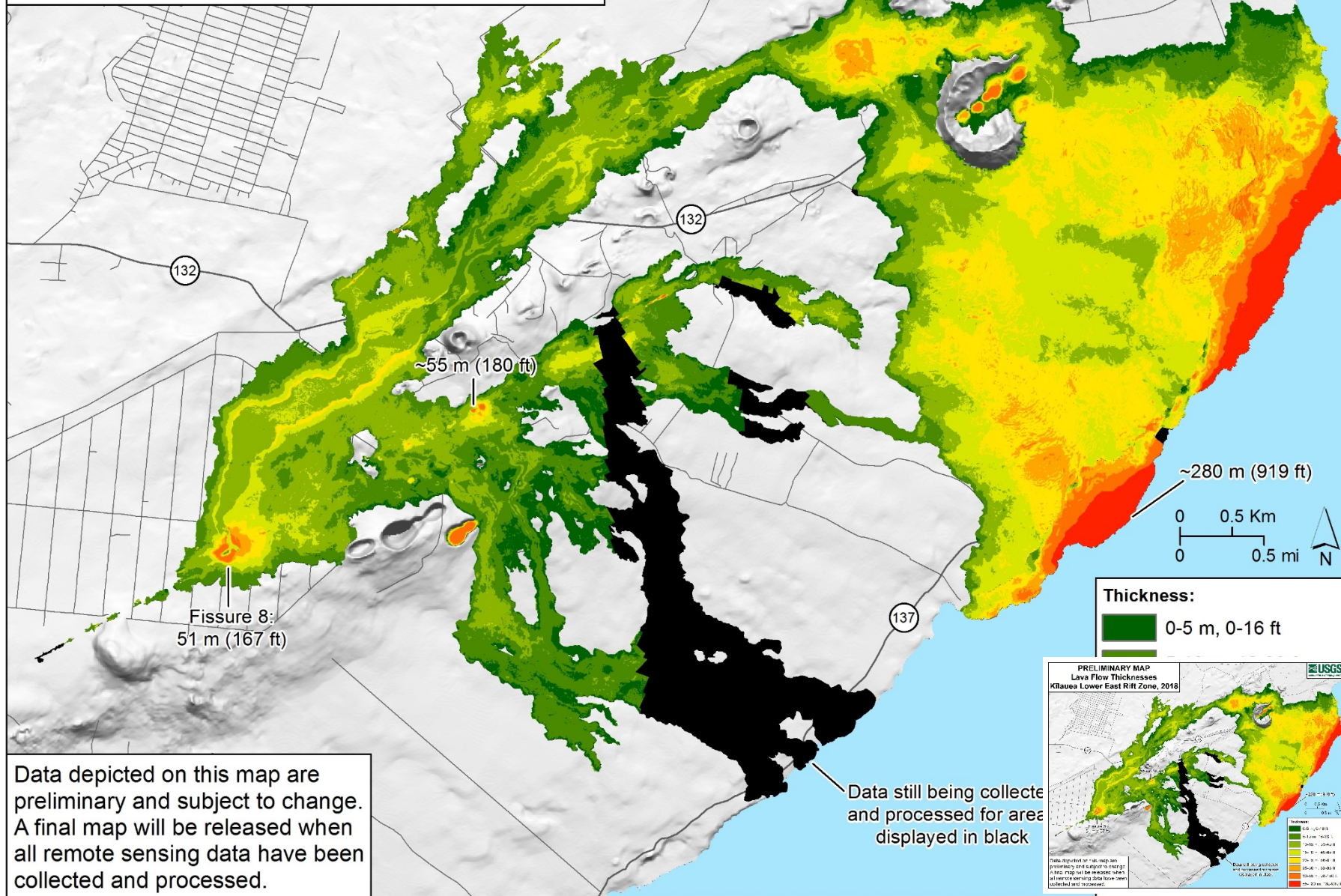


Building on the Landsat Legacy

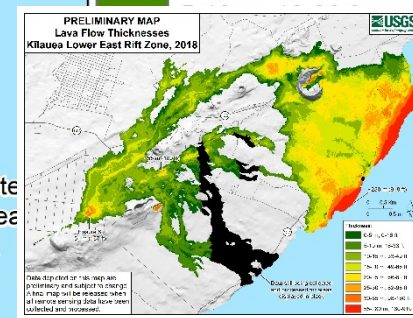


Sustainable Land Imaging (SLI) is a partnership between DOI/USGS and NASA to maintain a sustainable program for spaceborne land imaging

PRELIMINARY MAP Lava Flow Thicknesses Kīlauea Lower East Rift Zone, 2018



Data depicted on this map are preliminary and subject to change. A final map will be released when all remote sensing data have been collected and processed.



Landsat Operations and Development Status

Landsat 7 Flight Operations (1999-)

- Collecting about 470 new scenes per day; latest fuel estimate projects operations into 2021.

Landsat 8 Flight Operations (2013-)

- Collecting up to 740 new scenes per day; frequent night and off-nadir imaging of volcano and fire imaging.

Landsat Archive Operations

- Over 8 million Landsat scenes available; many other datasets: ResourceSat-2 over US, Sentinel-2, Commercial satellite data, aerial photography, UAS data.

Landsat 9 (December 2020 launch)

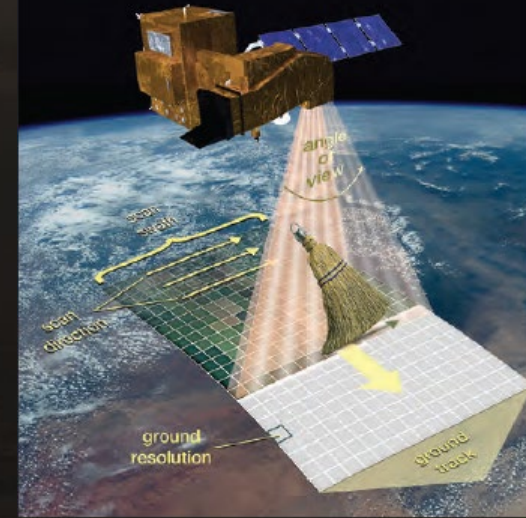
- Essentially a copy of Landsat 8, but with important improvements for accuracy and resiliency (upgrade to fully Risk Class B); 14-bit data.

Landsat 10 (~2026-2030 launch)

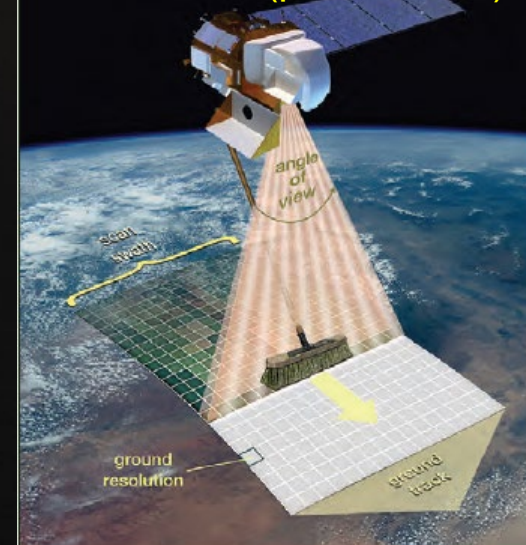
- Technology and user needs studies over the past year led to standup of an architecture study team.
- Everything is on the table at this point (e.g., smallsats, hyperspectral, data buys, Public-Private Partnerships).



Landsat 7 (whiskbroom)

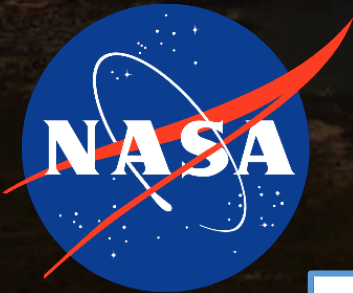


Landsat 8 (pushbroom)



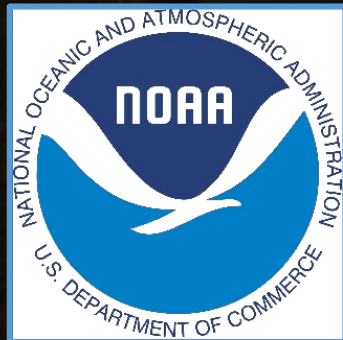
Efficient Operations

- Transition to Multi-Mission Ops Center
- Landsat 8/9 co-hosted in same facility
- Strategic Partners to increase resiliency while reducing costs
- Diversification of data sources

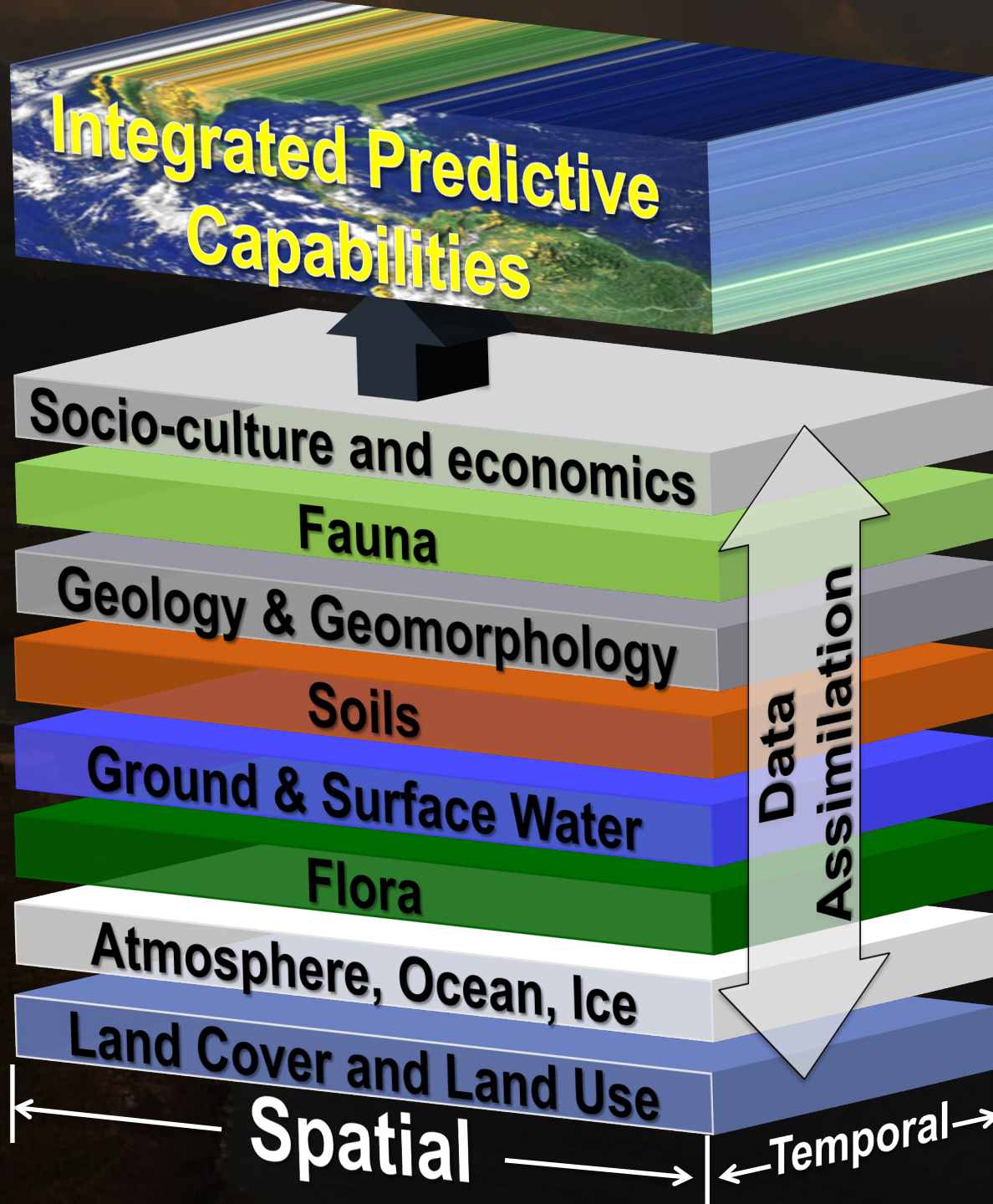


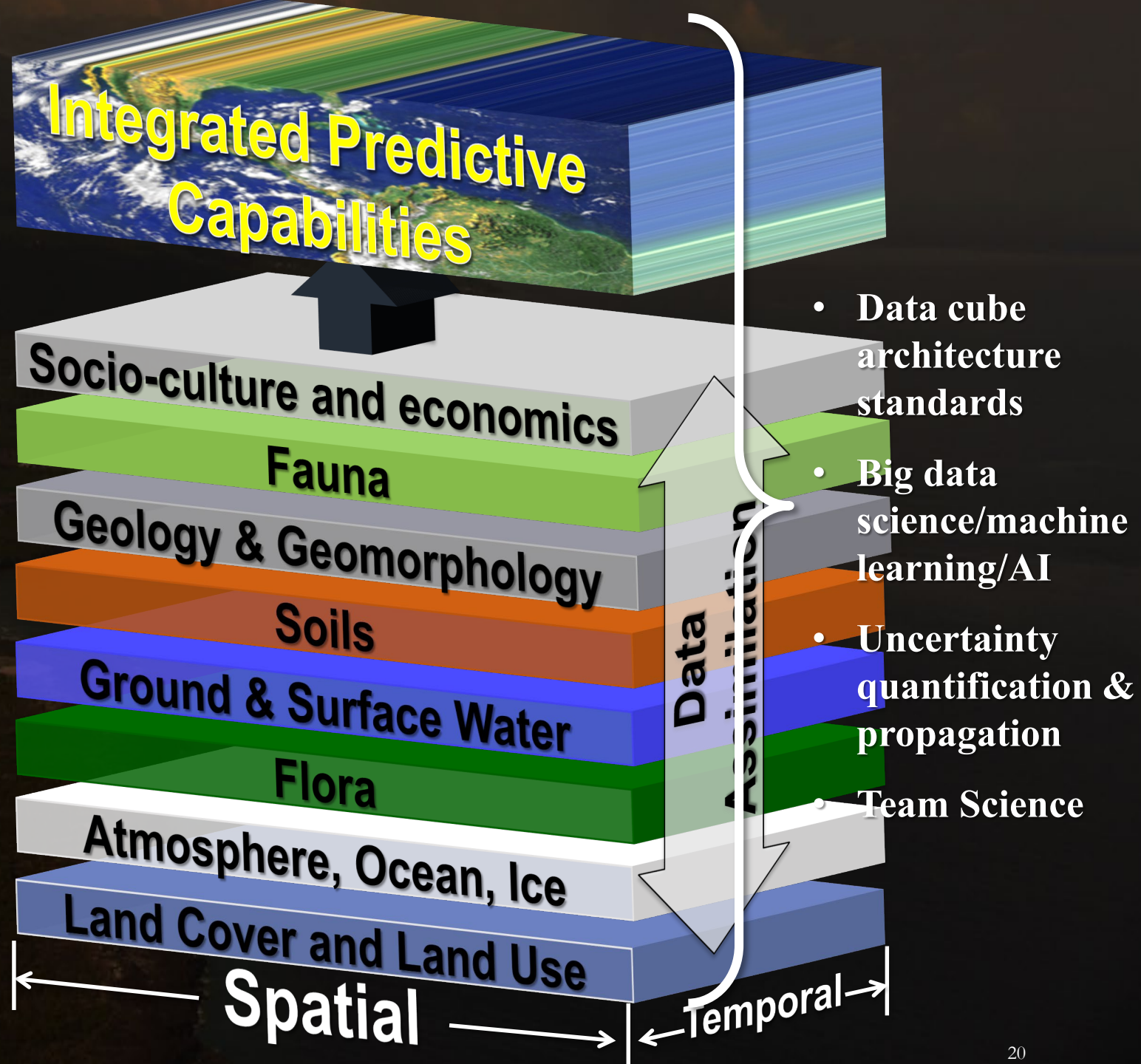
DLR

Deutsches Zentrum
für Luft- und Raumfahrt
German Aerospace Center



Australian Government
Geoscience Australia





Analysis Ready Data



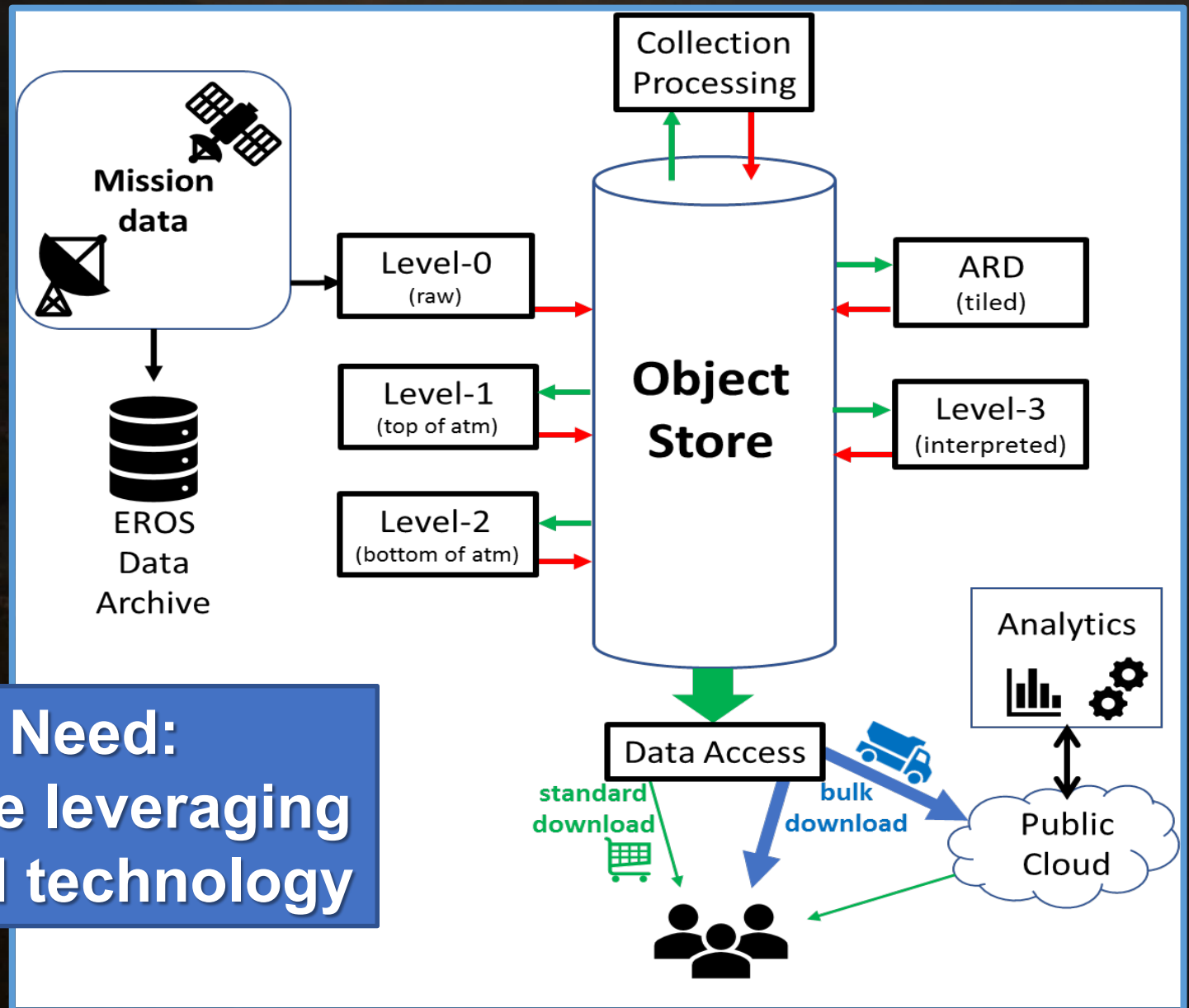
Facilitates time-series analysis

2017/01/03 Sentinel2



A harmonised data stream providing
consistent surface reflectance measurements
from Landsat-8 and Sentinel-2 (*source: sen2like project*)

EROS Landsat Production Architecture



**Current Need:
Effective leveraging
of cloud technology**

2018-2019 SLI Architecture Study Team

- Joint NASA-USGS Team; study initiated in August 2018
- Will factor in existing and future capabilities of the international and private sectors
 - European Sentinel-2 missions expected to operate well into the 2030s
 - India's space agency has a long-running Earth observing program
 - Planet, DigitalGlobe and other commercial firms are continuing to improve their capabilities and products
- Will consider improvements in technology
 - More capability on smaller satellites to reduce space segment costs
 - Develop improved “lossless” compression to reduce data volume, and store and deliver products
 - Improved product offerings and packaging to reduce product sizes
 - User-defined areas of interest, spectral subsets, information products
 - Utilization of commercial cloud provider resources to house, process and disseminate basic and higher-level products to users

The background of the slide is a dark, moody landscape. It features a body of water in the foreground, with a rocky or grassy shoreline on the left. In the distance, there are silhouettes of mountains or hills under a sky with some light, wispy clouds. The overall color palette is dark, with shades of brown, grey, and muted blue.

THANK YOU...
QUESTIONS?