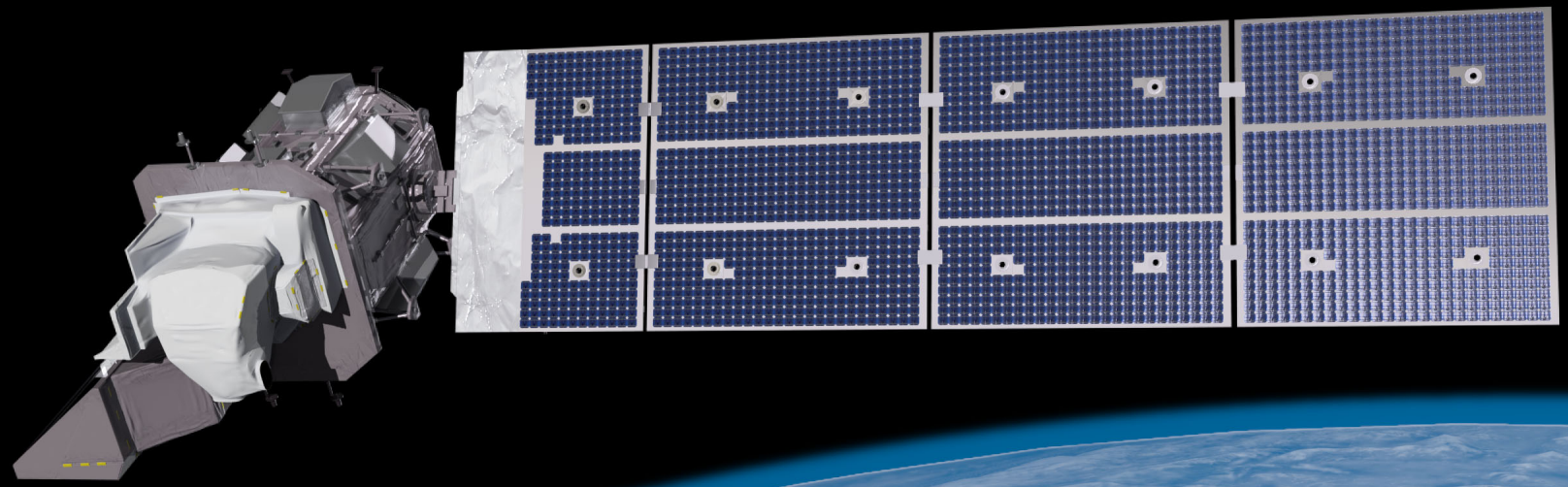
Landsat Next

Extending the 50+ Year Record with a NEW Constellation Architecture and 2-3x the temporal, spatial, and spectral resolution!



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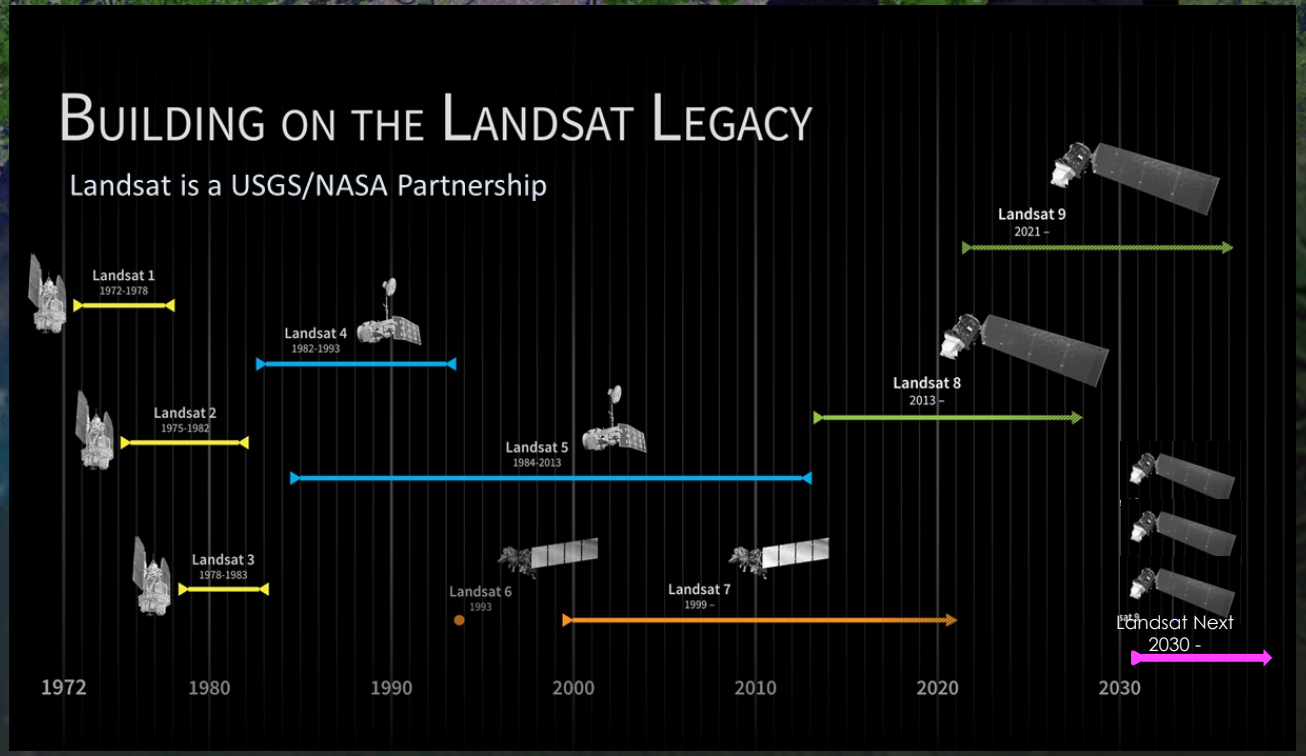
NASA Goddard Space Flight Center, Greenbelt, MD

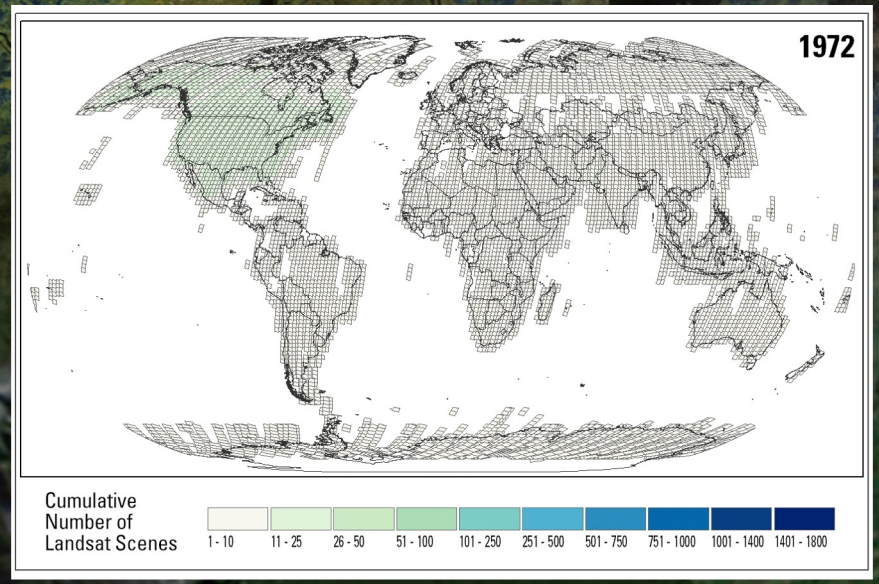
Chris Crawford, USGS Project Scientist

USGS Earth Resources Observation and Science (EROS) Center, SD

The Landsat Legacy

Landsat was the first satellite designed to systematically monitor the Earth's surface with a digital multispectral sensor imager for the purpose of surveying, monitoring, and managing natural resources such as croplands, forests, water and mineral deposits.





- USGS EROS Archive contains *>10 million scenes*
- Adds ~1200 scenes (*40 million km²*) per day

Sustainable Land Imaging (SLI) is a DOI/USGS-NASA partnership that ensures no-cost, nondiscriminatory access to high-quality, global, land-imaging measurements that are compatible throughout time.

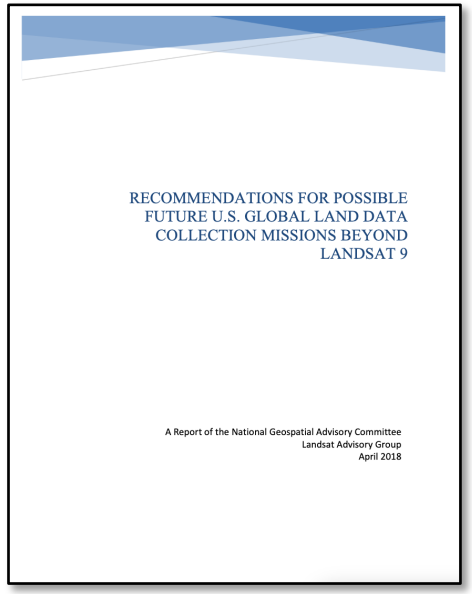
- NASA is responsible for developing the space segment, launch and on-orbit check-out
- DOI/USGS is responsible for developing the ground segment, flight and ground system operations

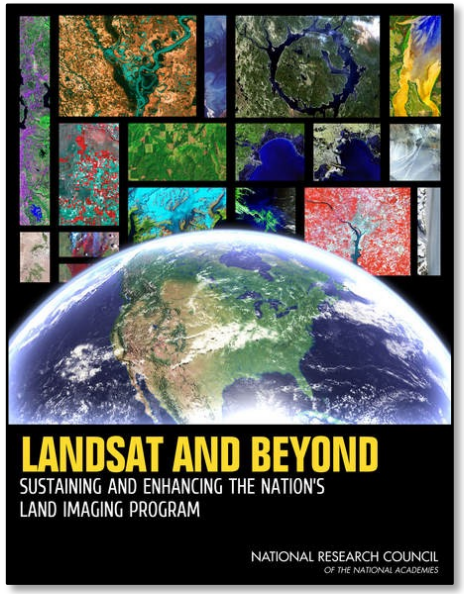
USGS Earth Resources Observation and Science (EROS) Center, Sioux Falls, SD

Origin of Mission Science Requirements

Landsat Next Requirements reflect user priorities for land monitoring, as reflected in key documents

- USGS User Needs Survey of Federal Agencies (Wu et al., 2019)
- USGS Landsat Advisory Group (LAG) “Recommendations for Possible Future US Global Land Data Collection Missions Beyond Landsat 9” (2018)
- National Research Council “Landsat and Beyond” (2013)
- Recommendations from the NASA/USGS Landsat Science Team
- Feedback from Landsat Next Request for Information (RFI, Fall 2020)



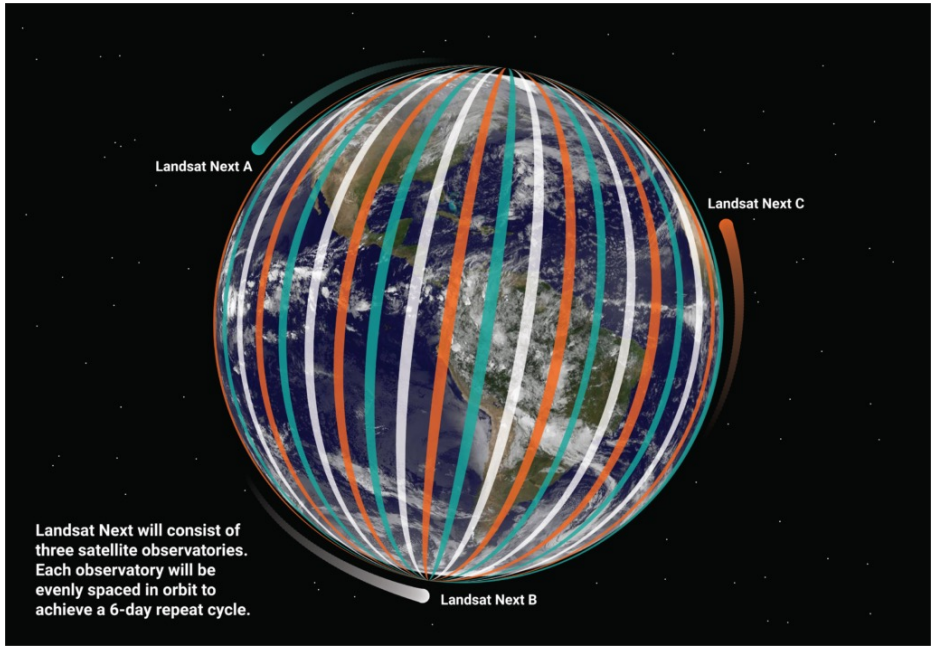


Landsat Next – Mission Overview

Landsat Next is a triplet constellation of “superspectral” observatories that will extend the 50+ year Landsat record and provide ***2-3x greater temporal, spatial and spectral resolution*** of previous missions:

1) **Greater Revisit with Triplet Constellation** - shortened from 16 to ***6 days with 3 observatories.***

*1) **Greater Revisit with Triplet Constellation***



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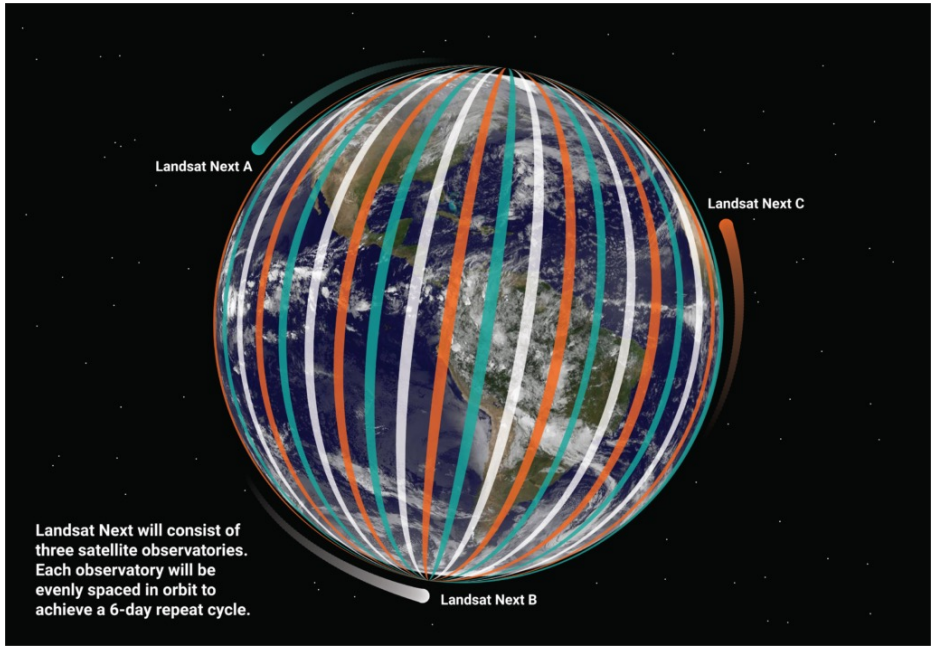
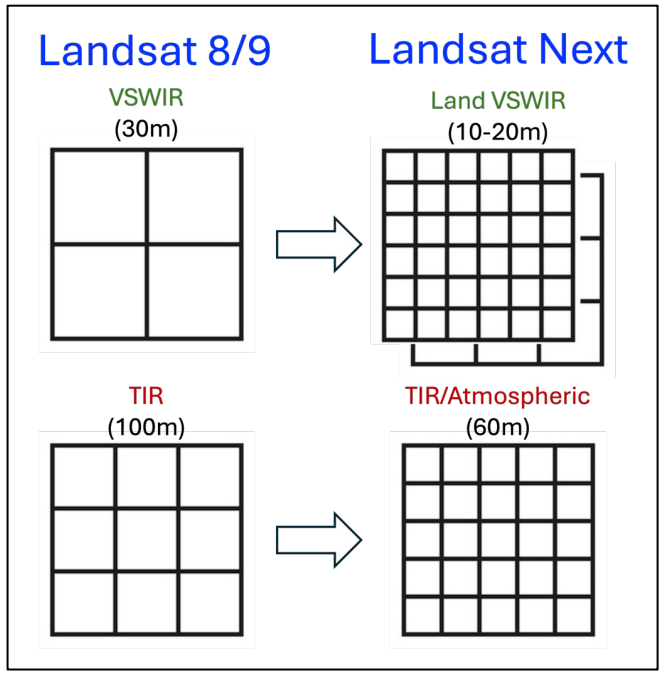
2) **Improved Spatial Resolution** - increased to ***10-20m for land VSWIR*** and ***60m for TIR/atmospheric*** bands.

1) Greater Revisit with Triplet Constellation



2) Improved Spatial Resolution



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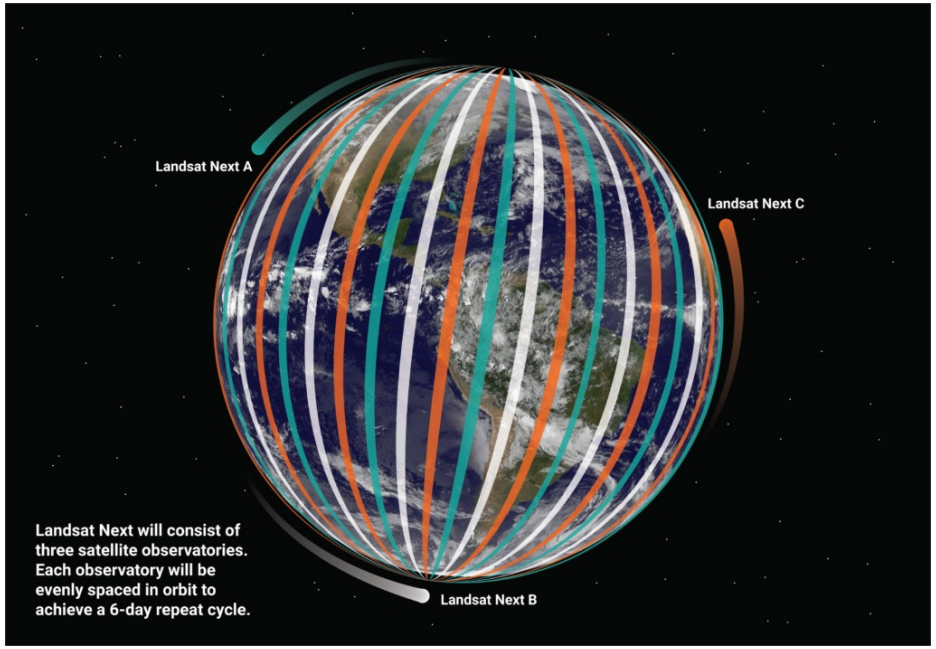
1) **Greater Revisit with Triplet Constellation** - shortened from 16 to ***6 days with 3 observatories.***
2) **Improved Spatial Resolution** - increased to ***10-20m for land VSWIR*** and ***60m for TIR/atmospheric*** bands.
3) **Richer Spectral Information** - ***26 “Superspectral” bands*** support Landsat continuity (L8/9’s 11 bands), Sentinal-2 compatibility, and emerging applications.

1) Greater Revisit with Triplet Constellation



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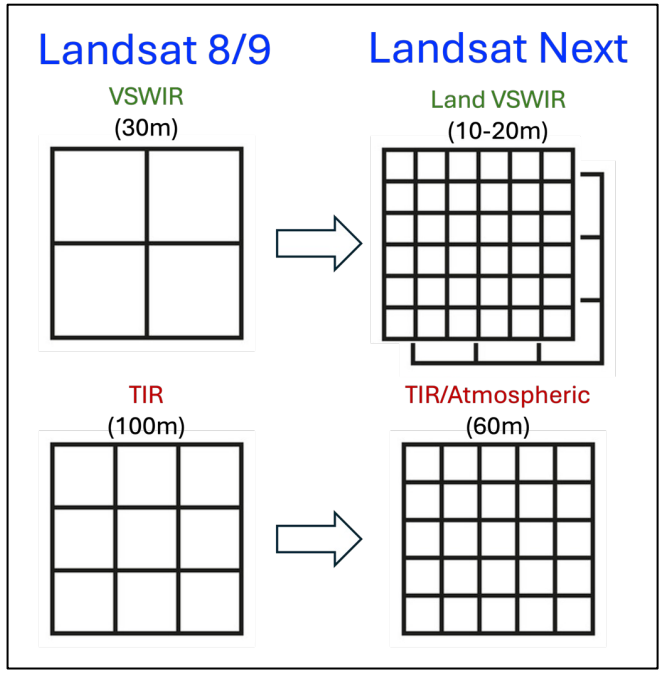
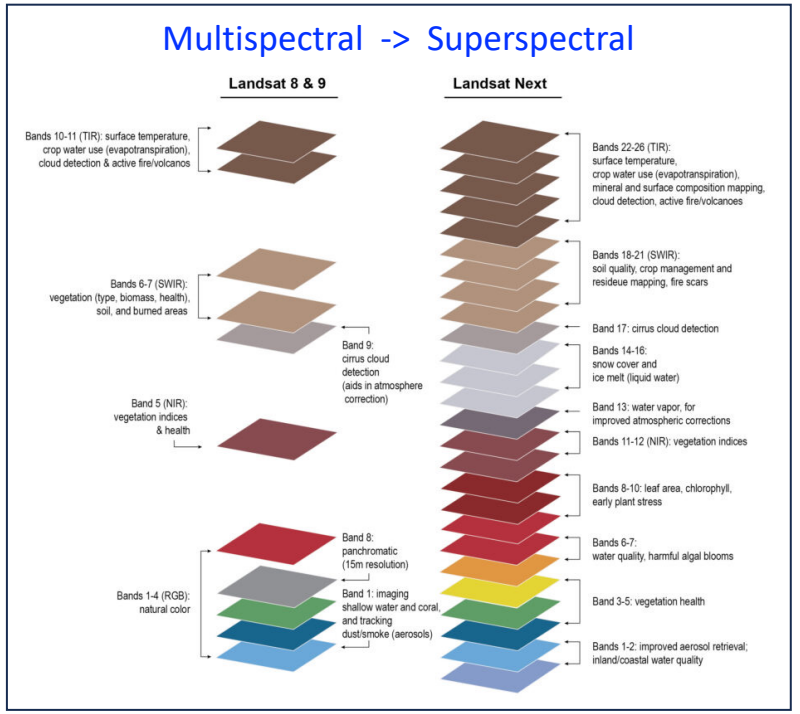


3) Richer Spectral Information



Landsat Next: Spectral Capabilities

	Band Name	Ground Sample Distance (m)	Center wavelength (nm)	Band width (nm)	Rationale
1	Violet	60	412	20	Improved aerosol retrieval; CDOM from inland/coastal water
2	Coastal Aerosol	20	443	20	Landsat
3	Blue	10	490	65	Landsat
4	Green	10	560	35	Landsat
5	Yellow	20	600	30	Leaf chlorosis, vegetation stress and mapping
6	Orange	20	620	20	Phycocyanin detection for Harmful Algal Blooms
7	Red 1	20	650	20	Phycocyanin, chlorophyll
8	Red 2	10	665	30	Landsat
9	Red Edge 1	20	705	15	LAI, Chlorophyll, plant stress (S2)
10	Red Edge 2	20	740	15	LAI, Chlorophyll, plant stress(S2)
11	NIR_Broad	10	842	115	10m NDVI (S2)
12	NIR1	20	865	20	Continuity (note-S2 narrower than L8)
13	Water vapor	60	945	20	Improved atmospheric correction for LST, SR (S2)
14	Liquid Water	20	985	20	Liquid water, water surface state
15	Snow/Ice 1	20	1035	20	Snow grain size for water resources
16	Snow/Ice 2	20	1090	20	Ice absorption, snow grain size
17	Cirrus	60	1375	30	Landsat
18	SWIR 1	10	1610	90	Landsat
19	SWIR 2a	20	2038	25	Subdivided for cellulose/crop residue measurement (Landsat)
20	SWIR 2b	20	2108	40	Subdivided for cellulose/crop residue measurement (Landsat)
21	SWIR 2c	20	2211	40	Subdivided for cellulose/crop residue measurement (Landsat)
22	TIR 1	60	8300	250	Mineral and surface composition mapping (ASTER)
23	TIR 2	60	8600	350	Emissivity separation, volcanos (SO2) (MODIS/ASTER)
24	TIR 3	60	9100	350	Mineral and surface composition mapping (ASTER)
25	TIR 4	60	11300	550	Surface temperature (Landsat), carbonates
26	TIR 5	60	12000	550	Surface temperature, snow grain size (Landsat)

1) Landsat Continuity

2) Sentinel-2 Synergy

3) New Capabilities

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Fine-Res (10m) VSWIR

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3) New Capabilities

Fine-Res (10m) VSWIR

Vegetation attributes

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Fine-Res (10m) VSWIR

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Atmospheric correction

Water Quality / Algae

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Vegetation attributes

Atmospheric correction

Water Quality / Algae

Snow/Ice Dynamics

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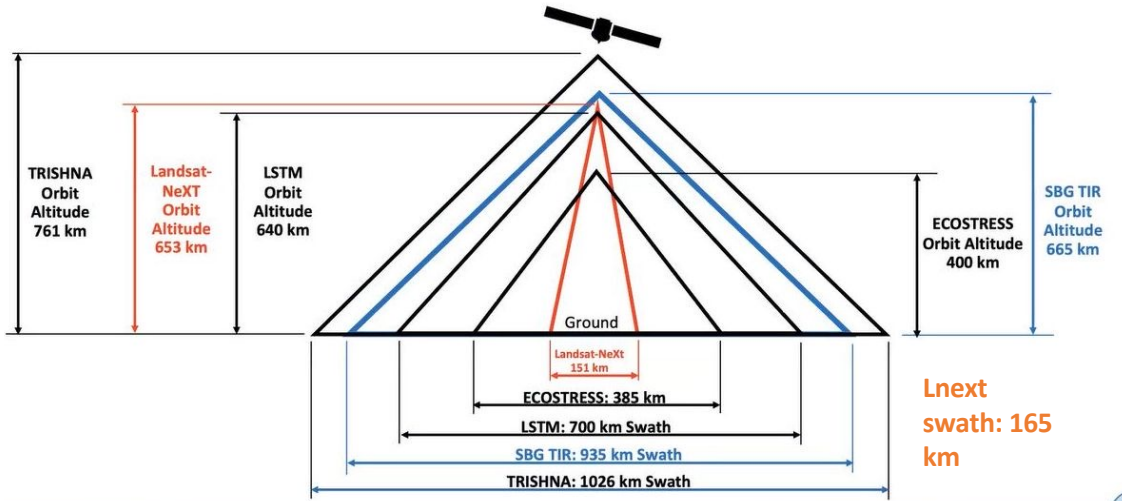
Mineral Mapping

Virtual Constellation of Diurnal TIR Measurements

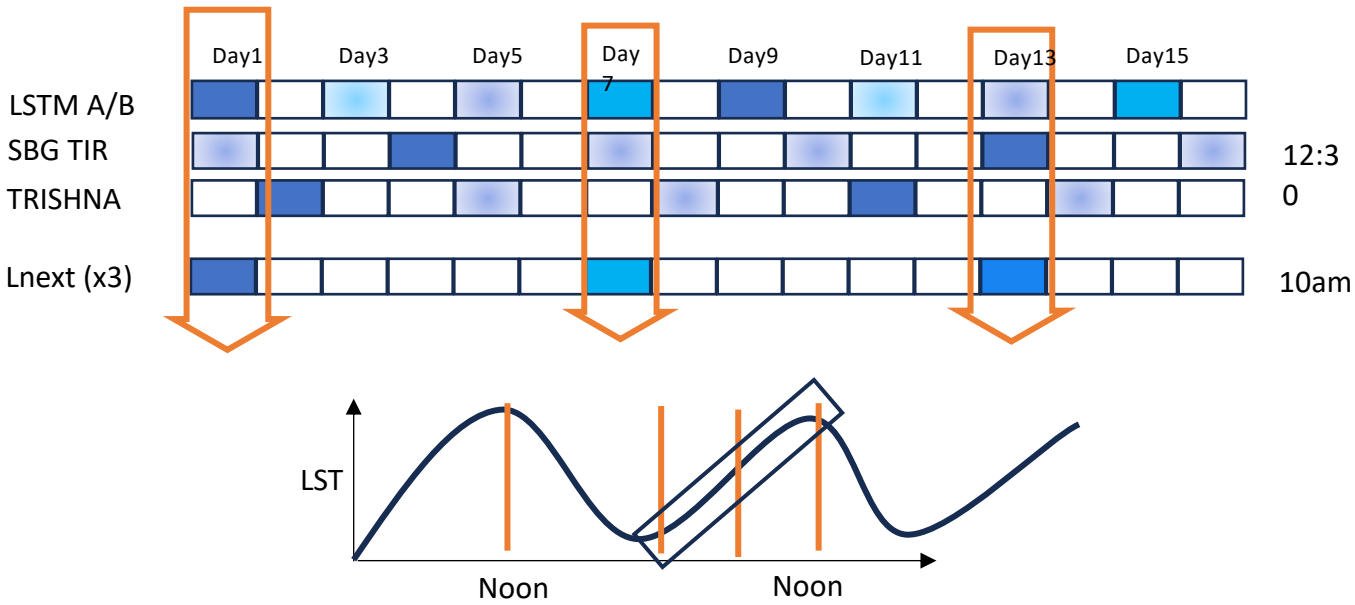
- Similar TIR measurement requirements (≤60m GSD, ≥4 TIR bands) will facilitate data harmonization of Landsat Next, LSTM, TRISNA, ECOSTRESS and SBG-TIR.
- Landsat Next and Copernicus' LSTM (and others, see below) will provide complementary morning and midday TIR observations (about half will be ±10º nadir) for improved diurnal ET estimation.

Similar TIR measurement from 5 observatories

(≤60m GSD, ≥4 TIR bands)



Data harmonization will provide diurnal TIR observations and improved ET estimation



LNext
Landsat Next

Current and Future Work

Mission Architecture concept definition is complete, and **Landsat Next is officially in Phase A!**

Pre-Phase A - user surveys; architectural studies to determine science mission requirements

Phase A – science flow down to hardware requirements; architecture credibility and refinement

Phase B – preliminary design and technology completion

Phase C – final design and fabrication

Phase D – system assembly, integration/testing, and launch readiness;

Launch Readiness Date – November 2030

Phase E – starts after on-orbit operational checkout and ends at the mission's operational end.

Ongoing Phase A Work:

- **Landsat Next Instrument Suite (LandIS)** is on the Mission's critical path.
  - Proposals are being evaluated, and NASA expects to have a vendor on contract by summer 2024.
- **NASA Spacecraft** Request for Proposals (RFP) is planned to be distributed during Fall 2024, and the project expects to have a vendor on contract by summer 2025.
- **USGS Ground System studies** to assess ground stations, data compression, constellation mission operations.

Questions?

Backup

Must See Videos – Harmonized Data Products

[NASA’s Harmonized Landsat and Sentinel-2 Project]

[ExtraDimensional - The Fusion of Landsat & GEDI Data]

Must See Videos – Current Landsat Mission Status

Landsat 8/9

Landsat 2023: A Year in Review

Landsat Next

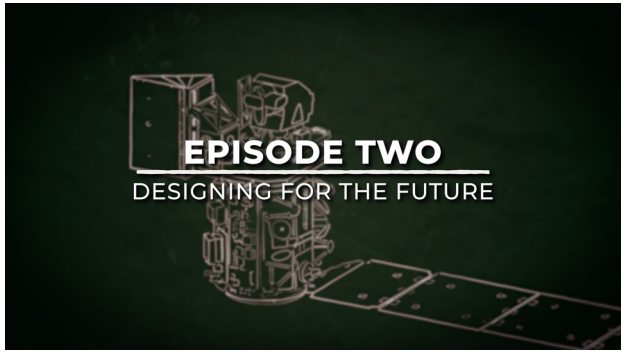
Landsat's Next Chapter

Landsat Next Defined

Must See Videos – Landsat's 50+ Year History

Continuing the Legacy Series

E01: Getting Off the Ground



E02: Designing for the Future

E03: More than Just a Pretty Picture

E04: Plays Well With Others

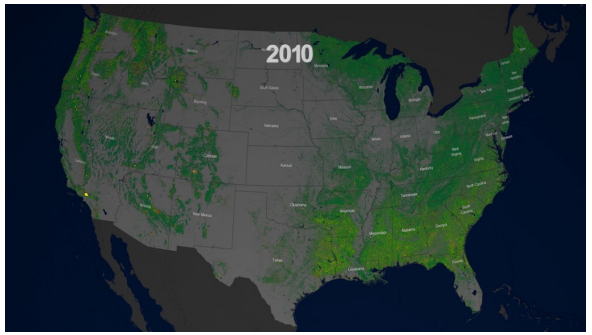
A Trip Through Time with Landsat 9

Landsat 8: A Decade of Service

Virginia Norwood and
the Little Scanner that Could

Must See Videos – Selected Landsat Applications

Landsat's Role in Monitoring Water Quality



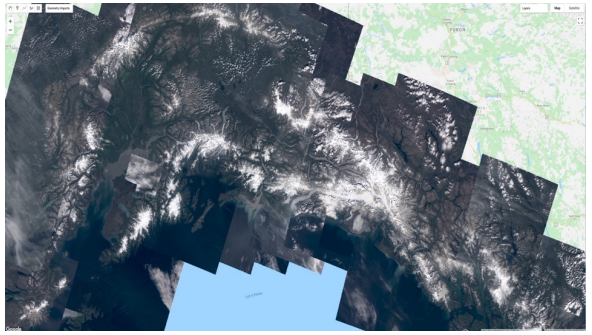
Landsat Croplands Data Overview

Tracking Amazon Deforestation

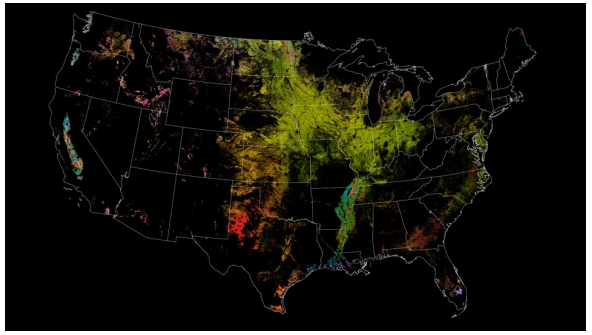
Tracking Three Decades of Dramatic Glacial Lake Growth

Landsat: Farming Data from Space

Mapping Ecosystems to Understand Their Value



48 Years of Alaska Glaciers



25 Years of Forest Dynamics

NASA Joins Jane Goodall to Conserve Chimp Habitats

LANDSAT APPLICATIONS (L8)

https://landsat.gsfc.nasa.gov

FIRE
Burning Wildlands and a Burning Need for Landsat

LAND USE AND LAND COVER CHANGE
Effective Tools for Cleaning our Waterways

WATER
Mapping Water Use

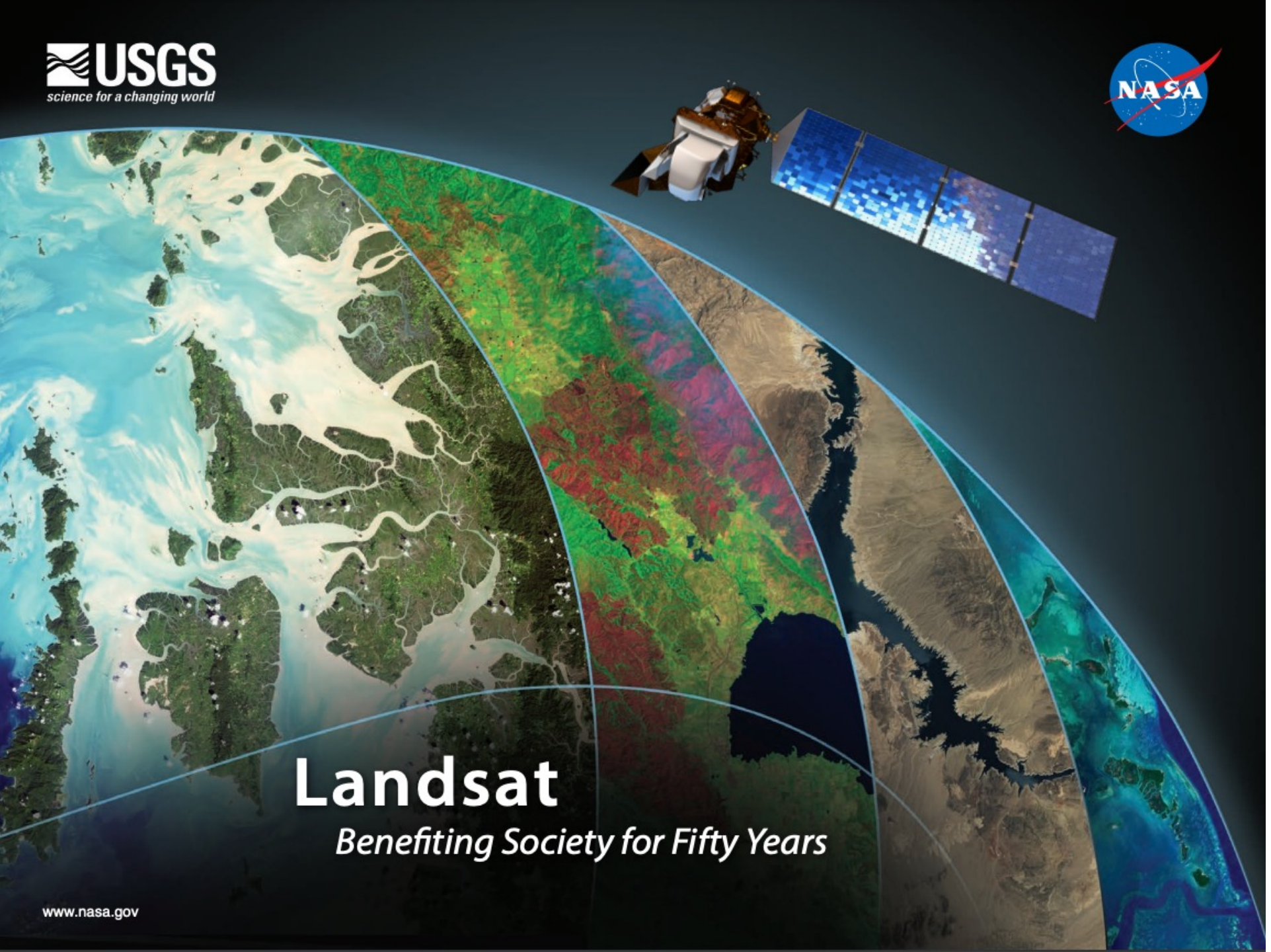
FOOD
Monitoring Crops from Space: A Decades-Long Partnership

ECOSYSTEMS
Mapping the Western Pine Beetle

FORESTS
Counting the World's Trees

DISASTERS
Mapping Disaster: A Global Community Helps from Space

BATHYMETRY
Avoiding Rock Bottom: How Landsat Aids Nautical Charting



LANDSAT APPLICATIONS (L9)

https://landsat.gsfc.nasa.gov

FOREST MANAGEMENT
Spotting Deforestation with Landsat

BATHYMETRY
Avoiding Rock Bottom: How Landsat Aids Nautical Charting

AGRICULTURE
Addressing the Water Consumption Riddle

WATER
Satellites on Toxic Algae Patrol

CLIMATE
Landsat Provides Global View of Speed of Ice

FIRE
After the Fire: Landsat Helps Map the Way Forward