National Aeronautics and Space Administration

NASA earth

Commercial SmallSat Data Acquisition (CSDA) Program Update

Thomas Wagner, PhD
Associate Director for Earth Action
Earth Science Division
Science Mission Directorate, NASA Headquarters

Outline

- General description
- Goals and objectives
- Recent changes
- Data access and use
- Contract, evaluation and licensing
- Science examples
- Further information

Why buy commercial data?

Enhances our science and makes unique contributions to our mission.

Complements existing NASA/US Gov satellite fleet with shorter revisit times, higher spatial resolution, and complementary or unique measurements.

What is NASA's role?

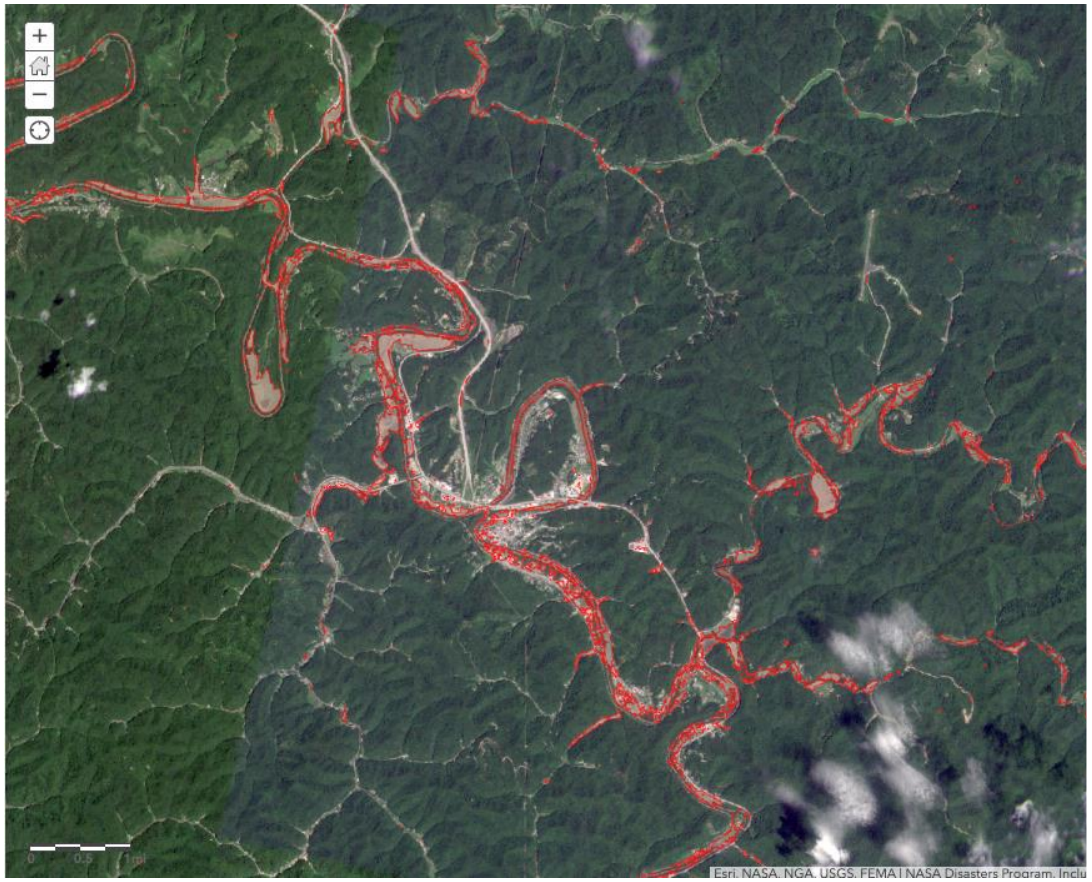
Acquiring, evaluating, using, and archiving the data.

NASA has broad expertise in the techniques as well as the research & application fields.

Partnering with other federal agencies to maximize the value of commercial data.

Kentucky Flooding in 2022

- MSFC produced PlanetScope imagery for responders to use for damage assessment.
- Science team recognized damage scarring similar to landslide damage.
- Collaborated with GSFC Landslide team to use the SALAD tool designed to detect landslide scars to help quickly identify where the flooding scoured (changed) the landscape.

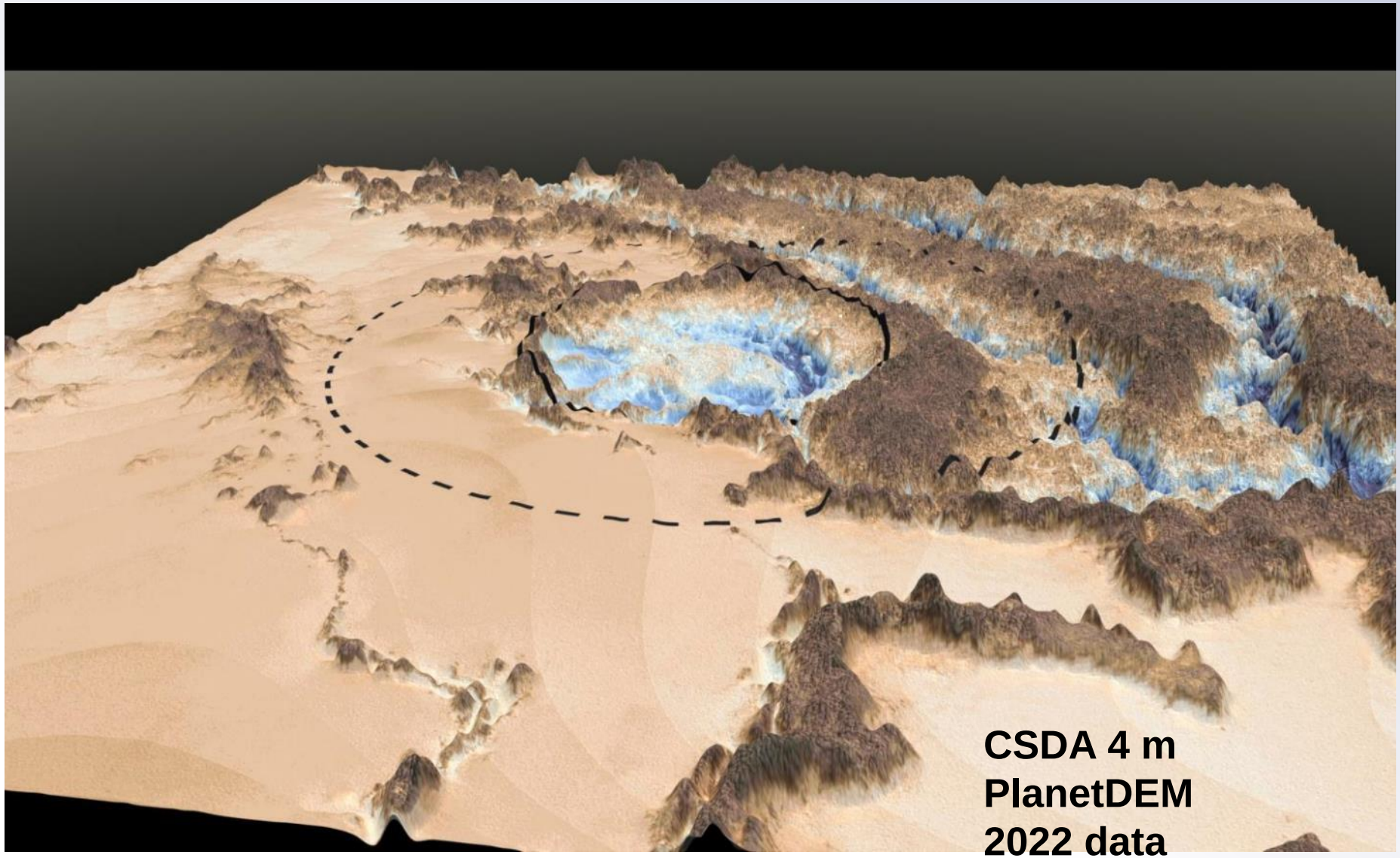


Basic research: Impact structures

Iturralde Bolivia: Inner Ring 8 km; Outer Ring 17 km

High revisit by Planet's Doves allow DEM production in areas of frequent cloud cover.

Registration to NASA ICESat-2 & GEDI lidar for calibration & accuracy.



Program Timeline

2017

Pilot initiated in November 2017 to evaluate data from operating commercial small-satellite constellations for research and applied science activities

Augment and/or complement NASA Earth observations

Cost effective means to advance/extend research and applications

2020

Pilot successfully ended early 2020, transitioned to sustained program - CSDA Program

2022

2nd Commercial SmallSat Data Analysis solicitation released (ROSES 2022 A.44) to promote scientific use of purchased data by the scientific and applied science communities.

22 proposals selected

2023

Move from BPAs to Multiple-Award Indefinite-Delivery, Indefinite-Quantity (IDIQ) contract with Firm-Fixed-Price (FFP) task orders.

Awarded 7 vendors October 2023

2024

Two vendors in evaluation phase: Umbra and PlanetiQ.

IDIQ Multiple award contract on-ramp-1: Closes March 25, 2024

CSDA's tiered End User License Agreement (EULA) approach is modeled after National Reconnaissance Office (NRO) Geospatial Intelligence Systems Acquisition Directorate Commercial Systems Program Office (CSPO) common, standardized family of EULAs.

Scope of Program & Vendor Status

Data evaluation to be initiated

- PlanetiQ
- Umbra Lab

Data evaluation underway

- GHGSat
- GeoOptics
- Capella Space
- ICEYE US

Data evaluation complete

- BlackSky *
- AIRBUS US

*Final Report pending

Additional data available

- DESIS
- EarthDEM (2 m digital elevation model for non-polar regions (60 S to 60 N). A derived product from stereo pairs of Maxar data via NextView license)

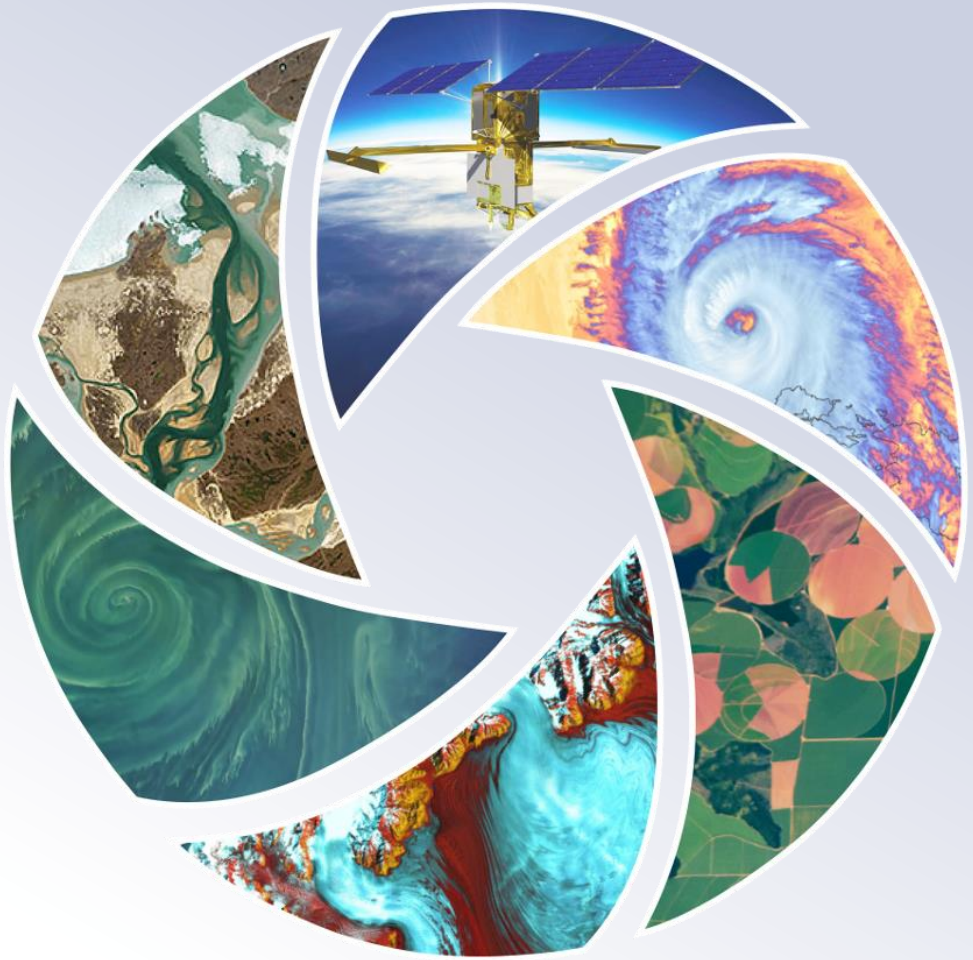
Data purchased and available for community use

- Planet
- Spire
- MAXAR (NASA and NGA-purchased via NGA NextView license)

- Surface
- GNSS
- Radar
- GHGs
- DEM

CSDA Program Goals

Identify, evaluate, and acquire commercial small-satellite (smallsat) data that support NASA's Earth science research & application goals.



https://www.earthdata.nasa.gov/esds/csda/commercial-datasets

CSDA Program Objectives

- Establish a continuous and repeatable process to on-ramp new commercial data vendors.
- Enable sustained use of purchased data for broader use and dissemination by NASA scientific community.
- Ensure long-term data preservation, access and distribution of purchased data and long-term access for scientific reproducibility.
- Coordinate with other US Government agencies and international partners on the evaluation and scientific use of commercial data.
- Compliance with 2003 US Commercial Remote Sensing Policy

Commercial Smallsat Data Acquisition (CSDA) Program | Earthdata (nasa.gov)

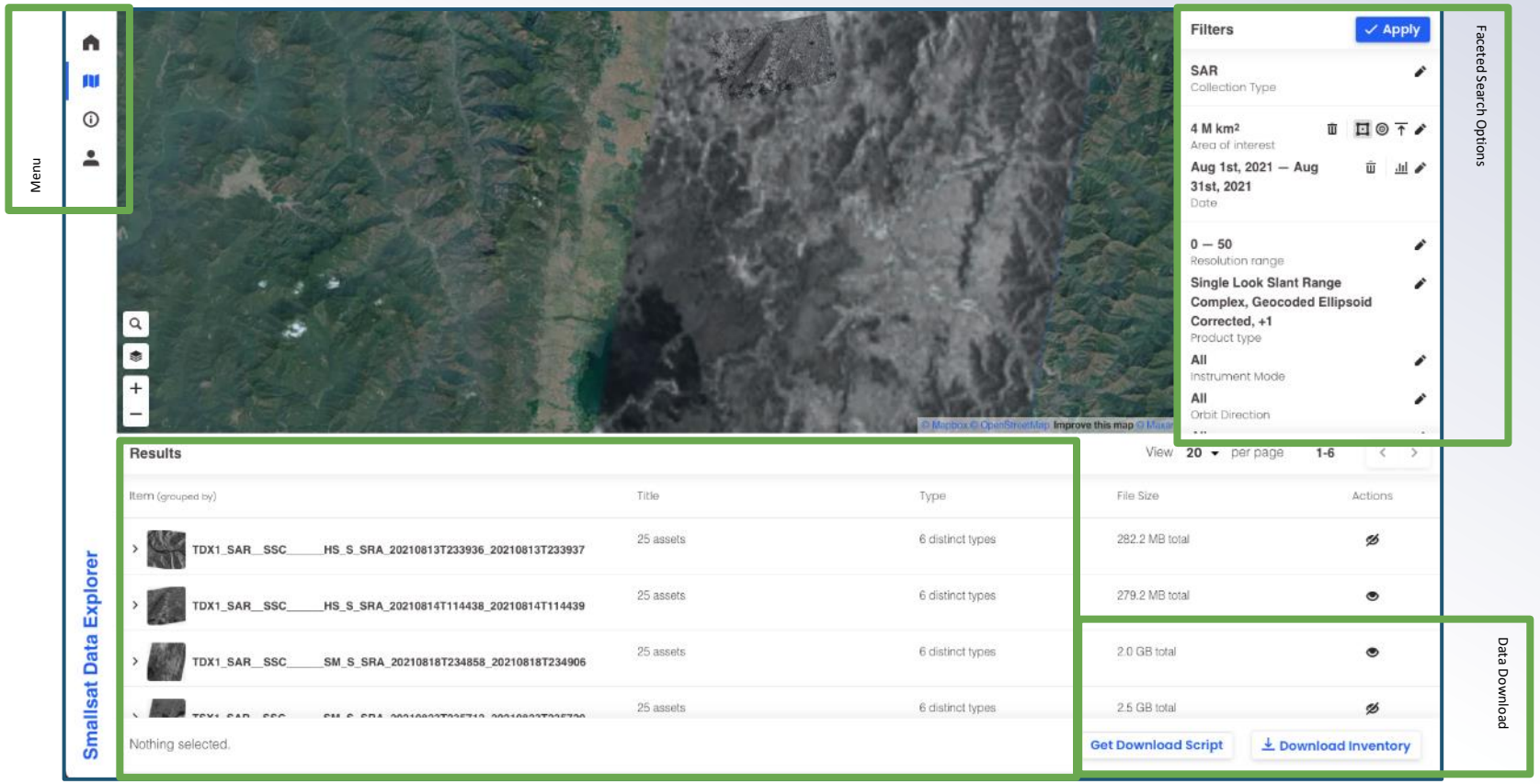
Recent Changes

- New leadership in CSDA:
  - Thomas Wagner, NASA HQ, Associate Director for Earth Action (covers CSDA Program)
  - Melissa Martin, NASA HQ, CSDA Program Scientist (**main contact**)
  - Dana Ostrenga, NASA GSFC, CSDA Project Manager
- All new business is on-ramped via Indefinite Delivery Indefinite Quantity (IDIQ) process. Competitive task orders will be issued for vendors to propose
- CSDA Program Indefinite Delivery Indefinite Quantity (IDIQ) On-Ramp 1 - Request for Proposals (RFP), closes March 25, 2024
- Established a new EULA structure, a three-tiers of End User License Agreement (EULAs): Public Release, U.S. Federal Government Plus, U.S. Federal Government
- CSDA-acquired data now discoverable through Earthdata Search
- Two new vendors are in evaluation phase: PlanetiQ and Umbra

CSDA Data Holdings

Vendor	Data Products	Availability Dates	Who is authorized	Where to get the data	EULA
Planet Labs, Inc	PlanetScope, RapidEye	12/31/05 - Present	U.S. Federal Civil Agency funded researchers	Planet Explorer	Planet Expanded EULA
	SkySat	3/10/15 - 12/12/19		SDX	
Spire Global, Inc	GNSS-R and -RO	9/24/18 - 4/18/19 (partial); and 11/1/19 - present (all)	U.S. Government funded researchers	SDX	Spire USG EULA
Teledyne Brown Engineering, Inc.	DESIS	11/21/18 - present	U.S. Government funded researchers	TCloud	DESIS EULA
Maxar	WorldView 1-3, GeoEye, QuickBird	10/24/99 - present	NASA funded researchers	CSDA Maxar Request Form; Earthdata Cloud	Commercial Data/Imagery EULAs Fact Sheet
	WorldView 4				Maxar EULA
	IKONOS				NextView License
Polar Geospatial Center	EarthDEM	2009 - present	U.S. Government funded researchers	SDX	Commercial Data/Imagery EULAs Fact Sheet
Airbus U.S.	TerraSAR-X, TanDEM-X, PAZ	11/19/07 - 11/4/22	U.S. Government funded researchers	SDX	Airbus U.S. USG EULA.

CSDA Data Holdings & SDX (Smallsat Data Explorer)



CSDA Smallsat Data Explorer (SDX) with thumbnails from Airbus U.S. displayed

https://csdap.earthdata.nasa.gov/explore/

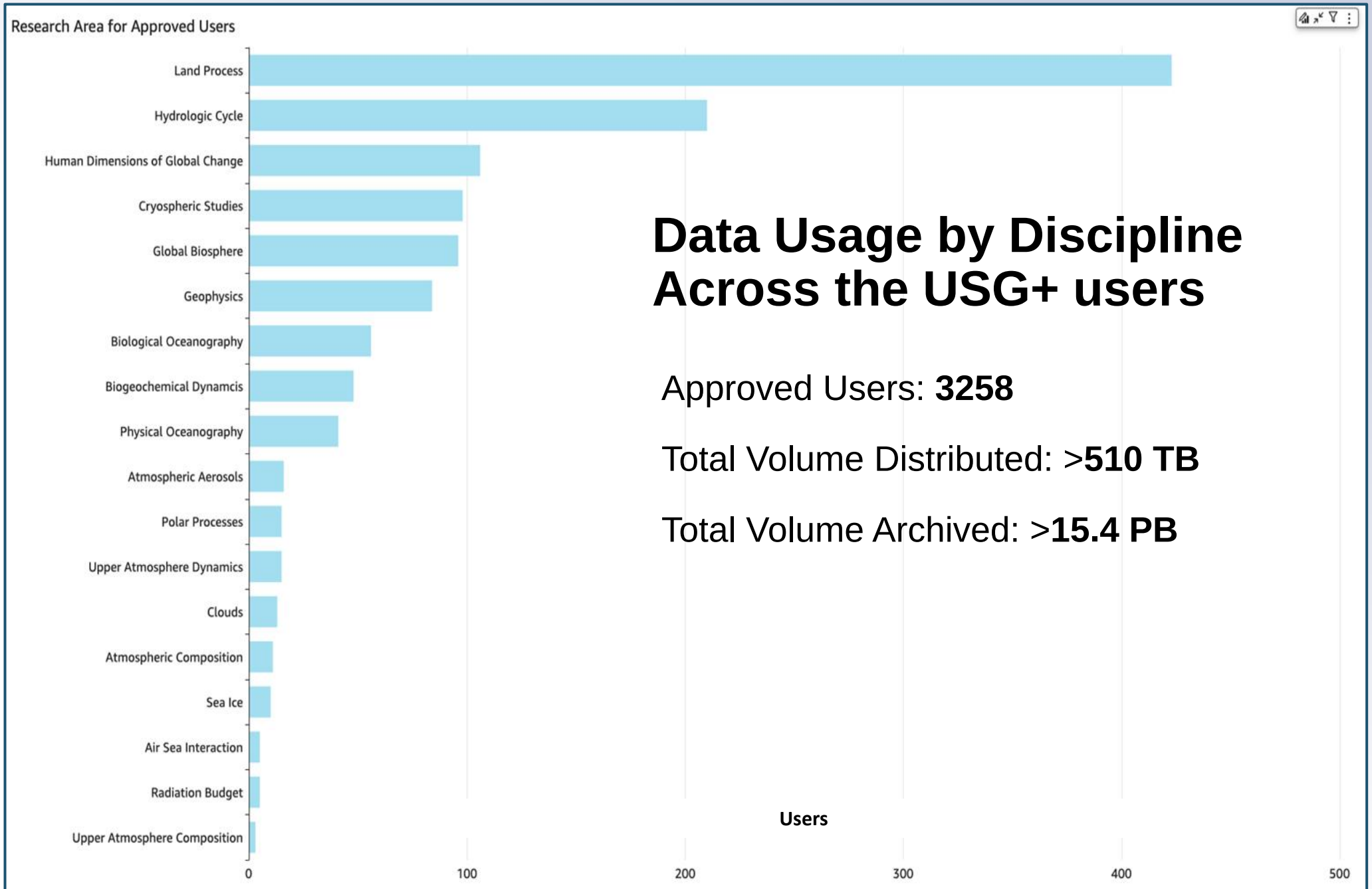
Web application to search, discover, and download NASA acquired commercial data

Available archive [increase since last year]

SDX

- Planet* - 2.7 M km^2 [2.2 M km^2]
- Spire - 78 TB [31.65 TB]
- EarthDEM - 13.8 TB [0 TB]
- Airbus U.S. - 4.1 TB [4.1TB]

*Only SkySat data available through SDX



Data Usage by Discipline Across the USG+ users

Approved Users: **3258**

Total Volume Distributed: >**510 TB**

Total Volume Archived: >**15.4 PB**

Data Access and Use

Access

- Access through NASA ESDIS, where approaches currently vary with vendors https://www.earthdata.nasa.gov/esds/csda/commercial-datasets
- Eligibility to download validated through grant license or NASA email – validation and additional download support by NASA CSDA MSFC team.

Limits on data use

- No research limits under licenses
- No publication limits in contract statements of work (Maxar has an additional permission step)
- Sharing of data limits exist – e.g., cannot put data out on anonymous FTP
- Sharing of derived data products not limited if manipulated in a nonreversible way
- **Licensing is for science use only—restricted from use for Operations**

Three-Tiers of End User License Agreements (EULAs)

Authorized User Community	Type of EULA		
	Public Release	U.S.G. Plus	U.S.G.
U.S. Federal Government including: ○ U.S. State/Local/Tribal Government; Academia; Contractors and Grantees associated with Government Agency			X
U. S. Federal Government, Foreign Civil Partners		X	X
Public Release	X	X	X

USG license is minimum level for CSDA

Scientific Non-Commercial Use License

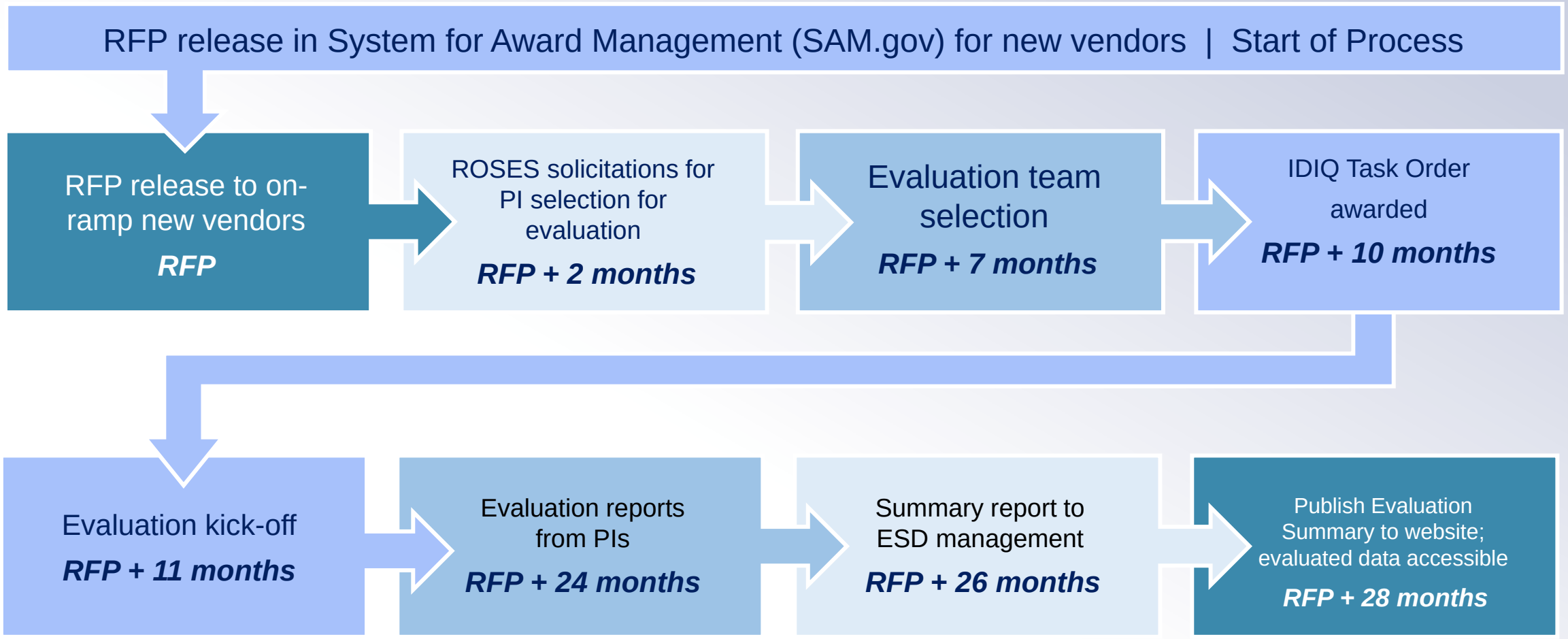
CSDA Contract Basics – IDIQ

- Contract Type: Multiple Award, Indefinite Delivery Indefinite Quantity (IDIQ), Fixed-Price Contract
- Effective Ordering Period: 5-years from contract effective date

  October 4, 2023 through October 3, 2028
- Data is evaluated with regards to utility for NASA Earth Science

  Evaluation to be conducted by PIs that have been identified as experts on the unique data type and potential users of commercial data in their research and applications
- Under IDIQ, NASA only buys what it needs through competitive task orders; fair and consistent process.

Evaluation Process



We recognize that this process is slow and are working to make it more efficient.

Note: approximate times

Evaluation Criteria

1. Accessibility of vendor supplied imagery and data

   Ease and efficiency of search, discover, and download from vendor systems.

2. Accuracy and completeness of metadata

   Accuracy and completeness of metadata provided by vendor.

3. Quality of User Support Services

   Availability, responsiveness, and technical expertise required to answer PI inquiries.

4. Usefulness of data for advancing Earth system science research and applications

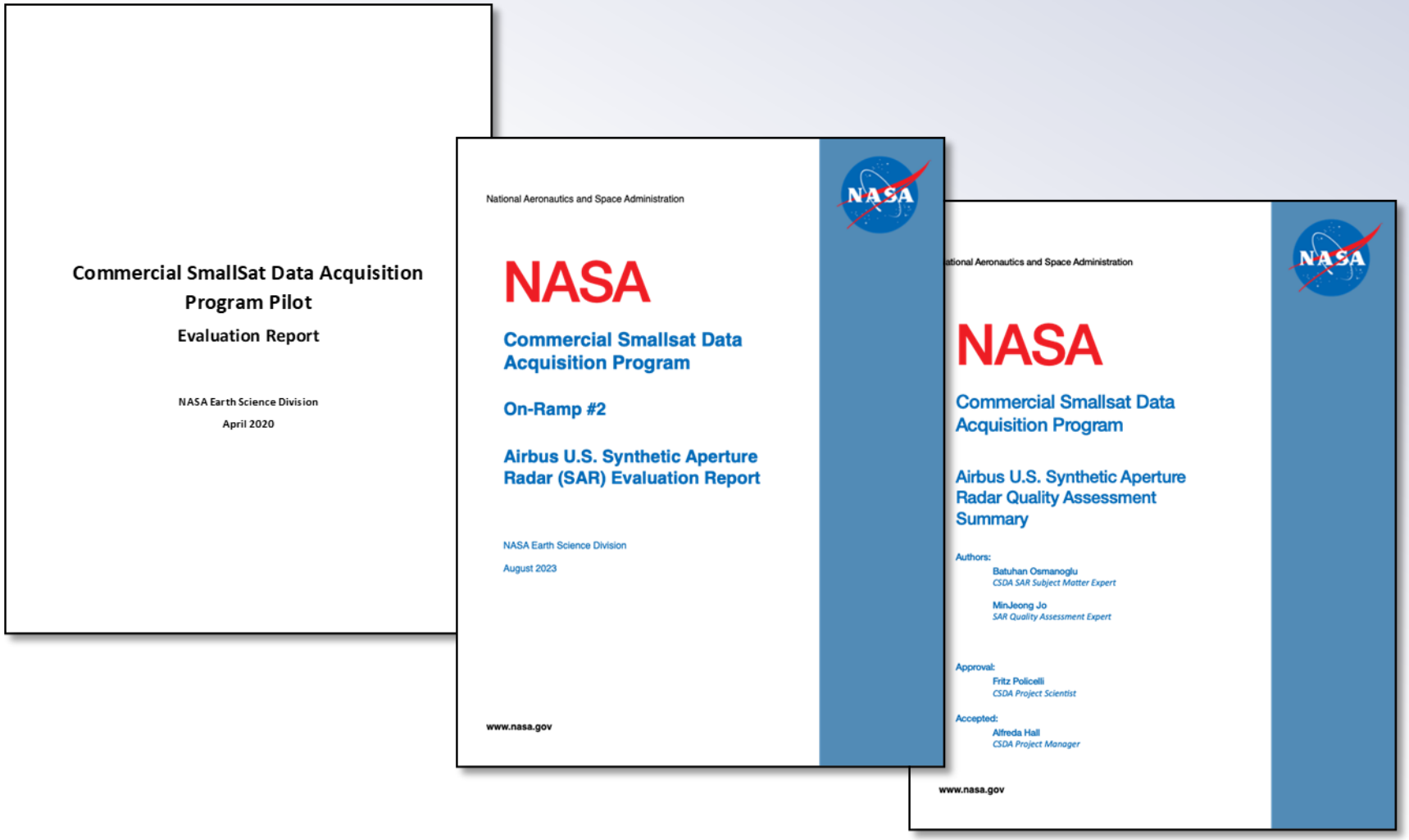
   Ability of data to support Earth system science research and applications activities.

5. Quality of vendor supplied imagery and/or data

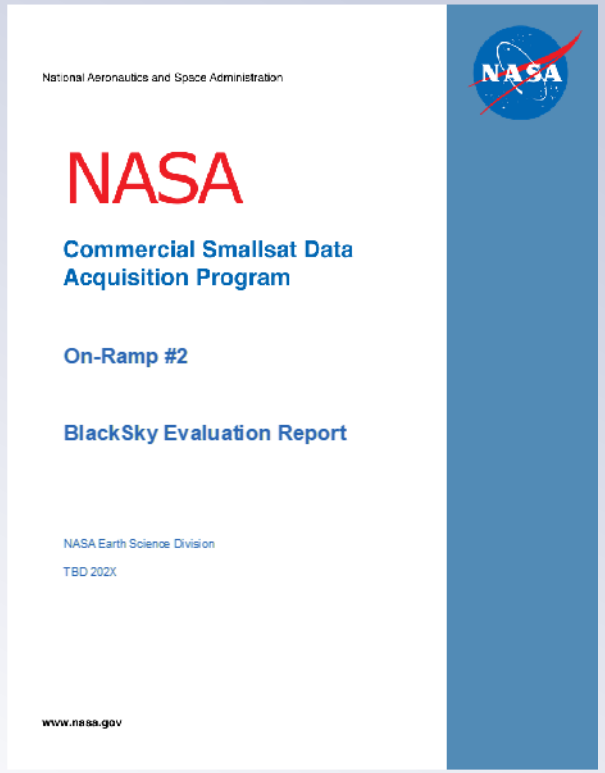
   Data attributes such as geolocation accuracy, radiometric accuracy, and platform intercalibration. Data quality evaluation will use the ESA-NASA Evaluation Guidelines.

NASA is working to decrease the time it takes to complete evaluations while maintaining the high levels of evaluation and reporting.

Evaluation Reports

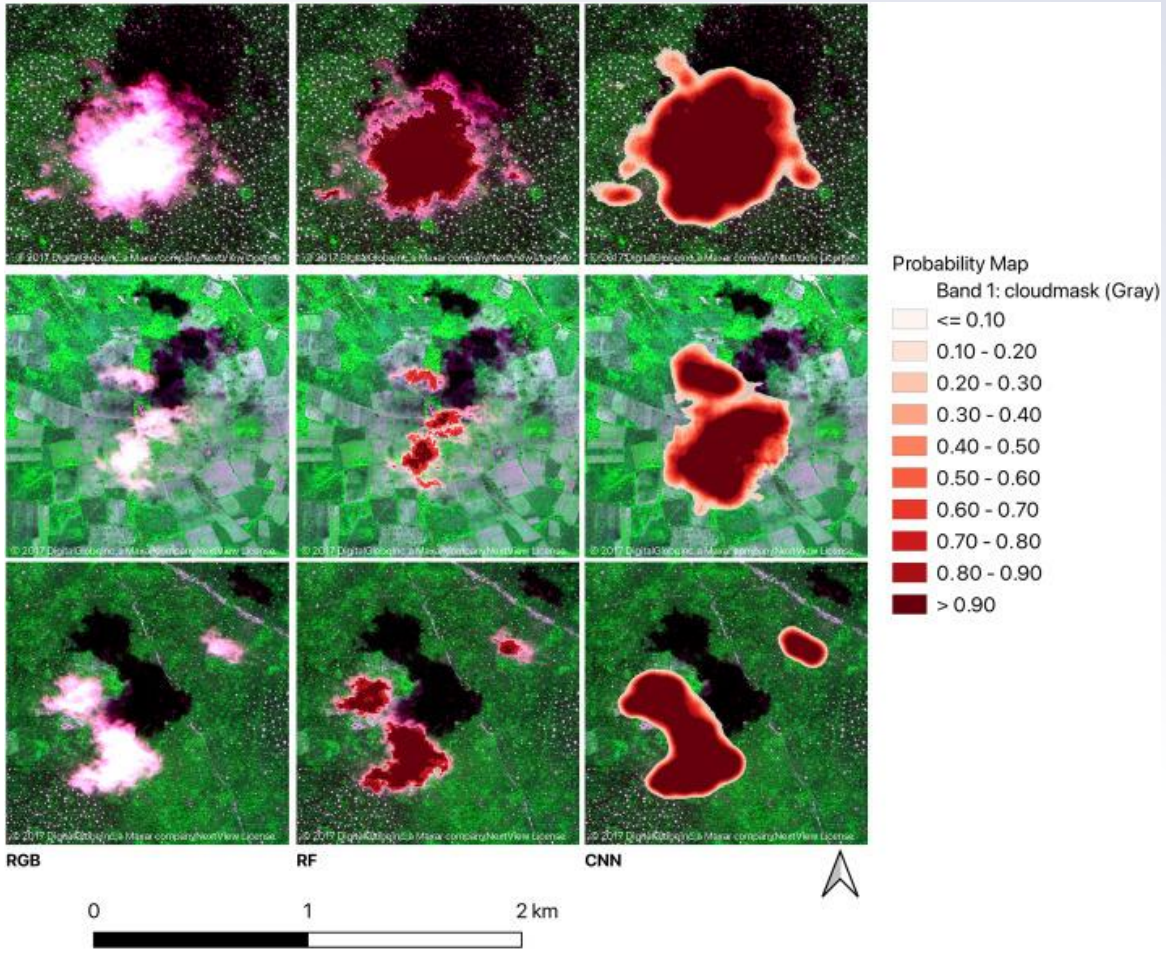


Upcoming:



https://www.earthdata.nasa.gov/esds/csda/evaluations

CSDA Science Results



True color (red, green, blue) WorldView imagery overlain with Random Forest (RF) and Convolutional Neural Network (CNN) probability maps (left to right). The red mask shows the probabilities for each model's classification of cloud pixels. The higher the probability, the more confident the model is in classifying the pixel as cloud. CNN outperforms RF in identifying cloud edges on both dense (top) and thin (middle) clouds. © 2017 DigitalGlobe, Inc., a Maxar company, NextView License.

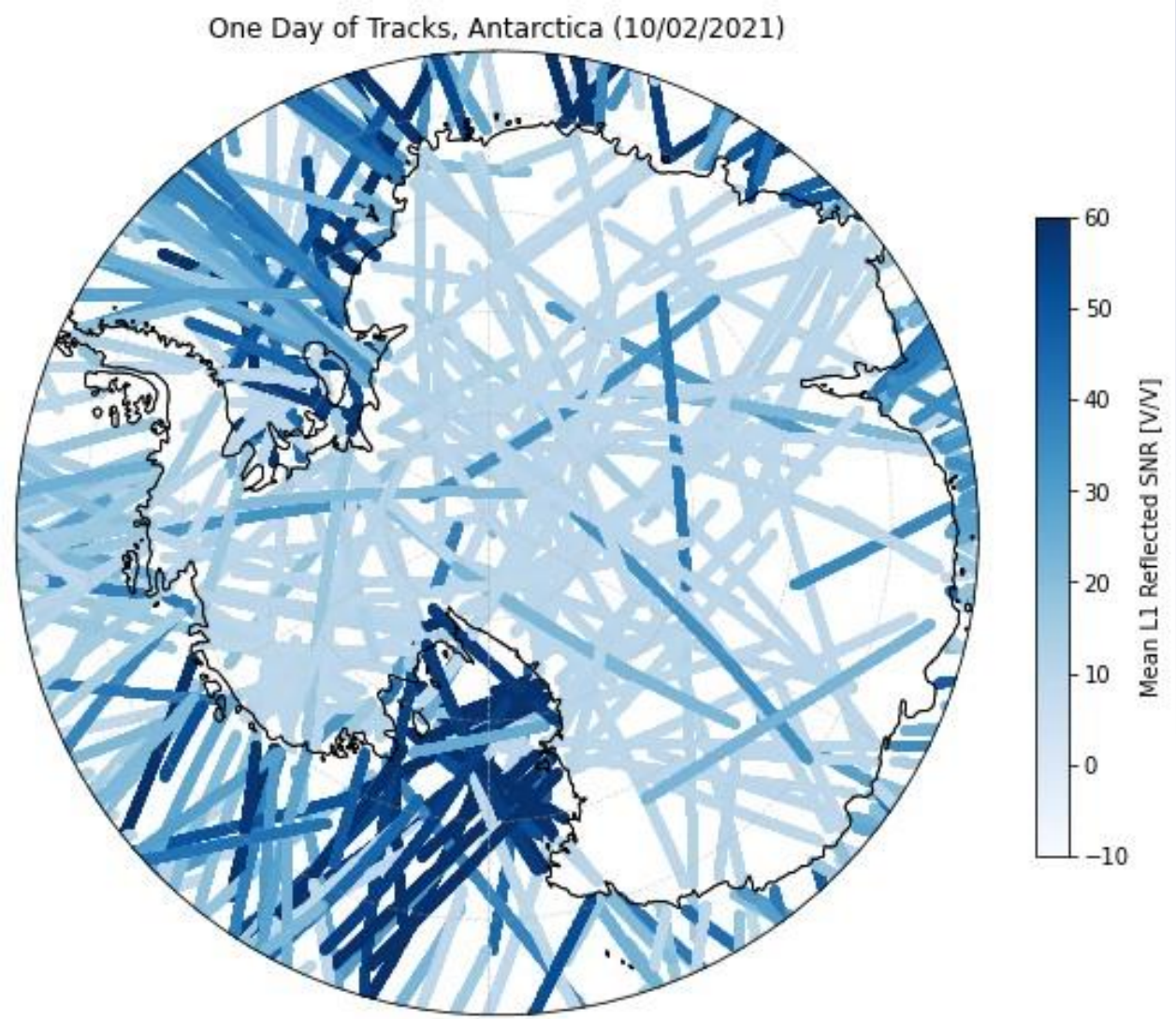
Optimizing WorldView-2, -3 Cloud Masking Using Machine Learning Approaches[1]

Detection of clouds is one of the first steps in pre-processing remotely sensed data

- The CNN Machine Learning model
  - was able to generalize consistently through both space and time.
  - has a superior overall accuracy of 94.9%, 6.4% higher than the RF.
  - is robust to seasonality effects over a 12-year period
  - is robust enough to leverage diversified location-time training.

Further investigation is required to assess effectiveness in mid/high latitudes.

1. Caraballo-Vega, J. A.; Carroll, M. L.; Neigh, C. S. R.; Wooten, M.; Lee, B.; Weis, A.; Aronne, M.; Alemu, W. G.; Williams, Z. Optimizing WorldView-2, -3 Cloud Masking Using Machine Learning Approaches. *Remote Sensing of Environment* **2023**, *284*, 113332. https://doi.org/10.1016/j.rse.2022.113332.



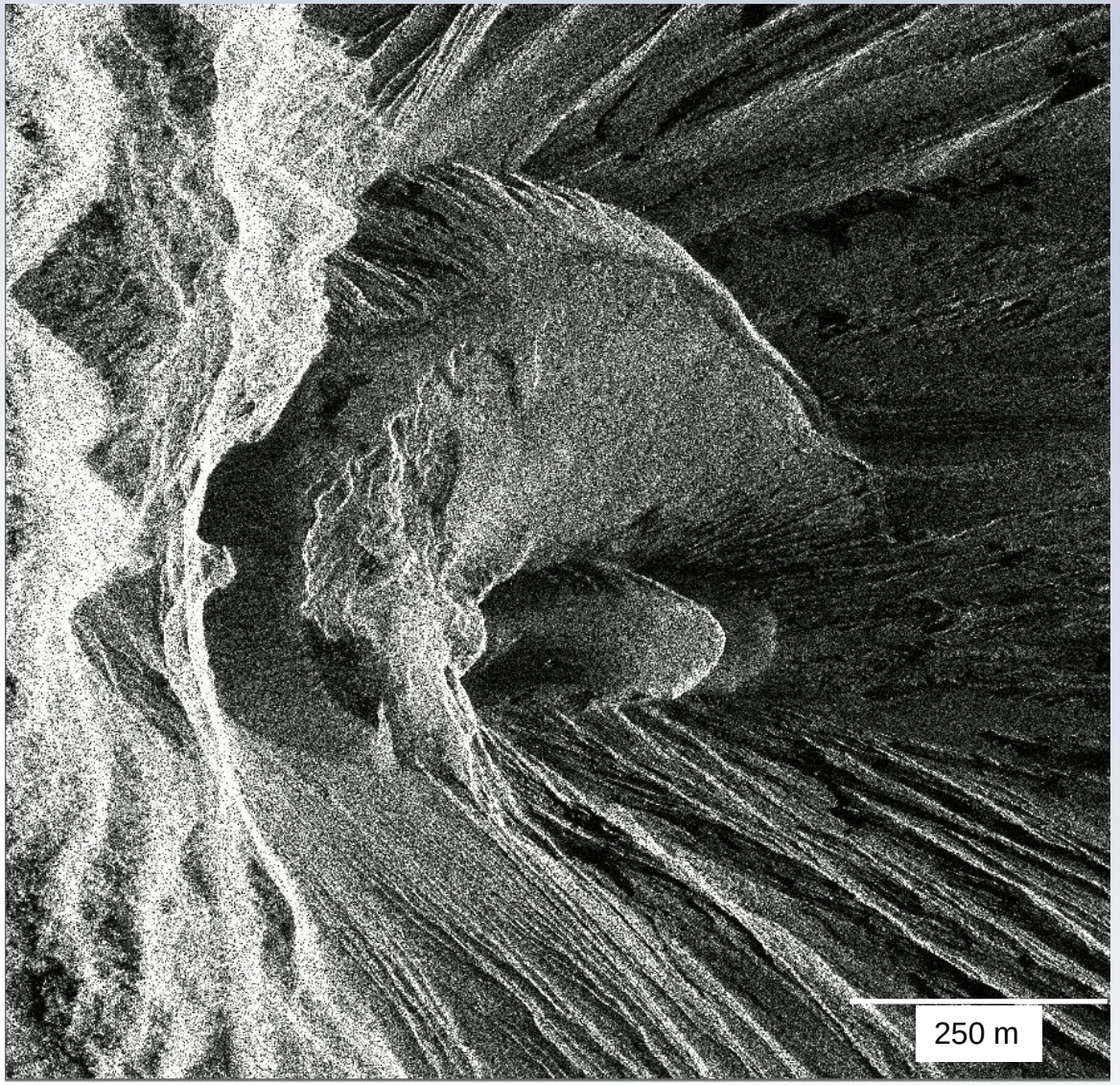
Credit – Jade Morton, U. Colorado

Spire GNSS-R data for Land Ice Mapping

- Land ice is an early-stage application for GNSS-R, with potential for widespread use
- Surface roughness measurements
- Precision altimetry
- Identified empirical thresholds for sufficient coherency for altimetry.
- Identified a seasonal trend

Airbus U.S. Science Results

Lewotolok, Indonesia lava flow and explosion crater Jan-Jul 2021
Spotlight mode



22-day pair in S. California, showing coherence and signals in agricultural fields and clear signal at geothermal plant.

CSDA Tree Carbon Work in Semi-Arid Africa

Our "Viewer" from Tucker et al. 2023 *Nature*

- CSDA developed machine learning methods to map individual trees across 10,000,000 km^2 of semi-arid Africa north of the equator and south of the Sahara Desert at the 50 cm scale;
- Converted tree crowns into leaf, wood, and root carbon for 10 B trees with a carbon uncertainty of ±20% at the tree, hectare, or square km level;
- A "viewer" was developed to enable our data to be used at the tree level; &
- This work will advance restoration work such as the Great Green Wall.

Summary

- Tremendous value in commercial data to augment NASA/U.S. satellite fleet.
- Scientific evaluation process is unique to NASA and critical to procurement.
- NASA is working with other agencies on licensing agreements to maximize data use within budgetary constraints.
- **We have opportunities at NASA to support the scientific research and application use of commercial data.**

Accessing and Requesting Commercial Smallsat Data FAQ: https://earthdata.nasa.gov/esds/small-satellite-data-buy-program/faq-commercial-data

Learn more about CSDA

https://earthdata.nasa.gov/csda

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