Commercial Smallsat Data Acquisition (CSDA) Program

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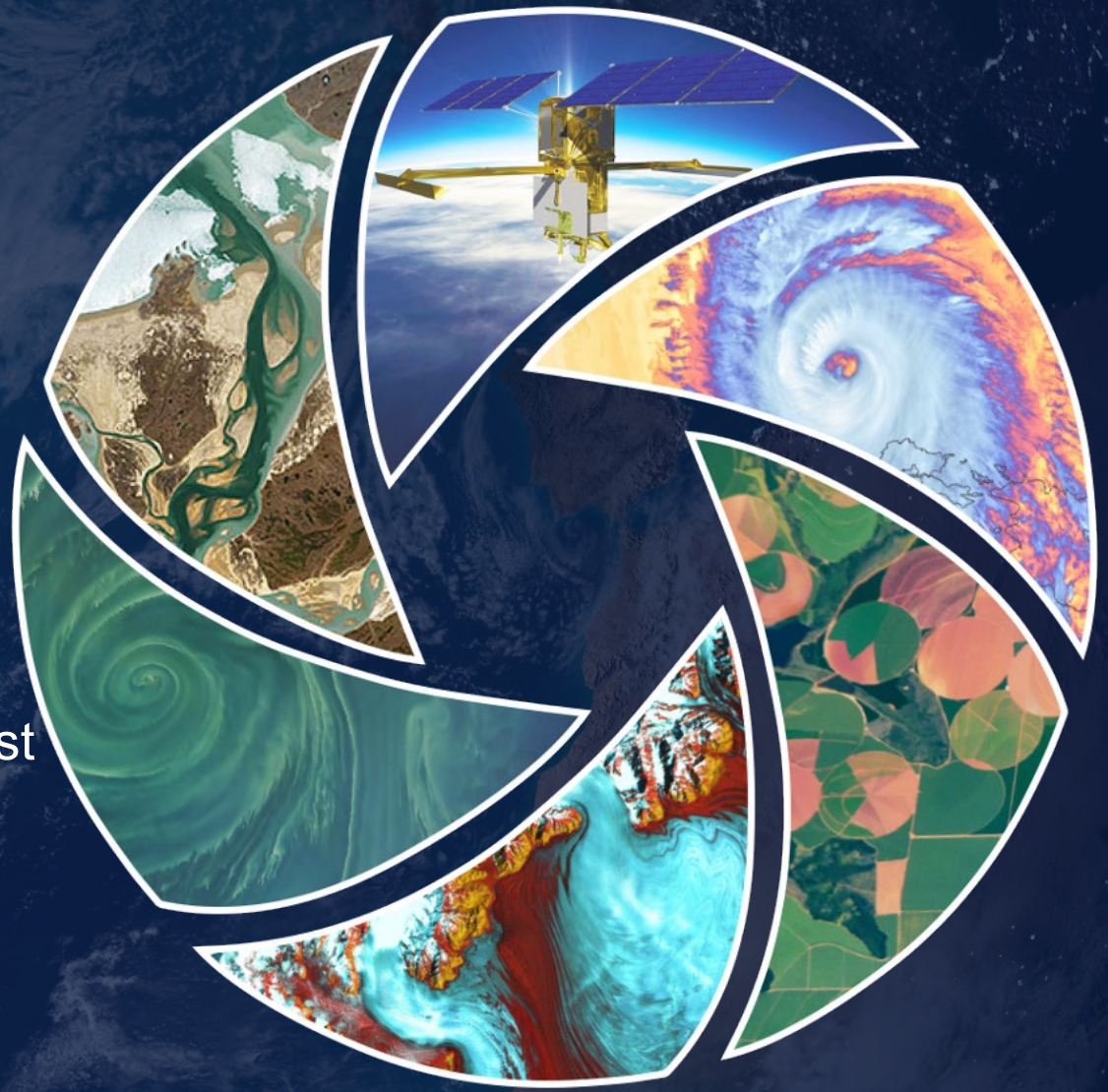
NASA



Overview

- Program Goals and Objectives
- Recent Changes - leadership
- Evaluation Process and Criteria
- Data Access and Use
- Science Research and Evaluation Cases
- Further Information and Contacts

*Backups contain Science Research and Evaluation Cases

Commercial Smallsat Data Acquisition (CSDA) Program Goals

The Commercial Smallsat Data Acquisition (CSDA) program was established by NASA's Earth Science Division (ESD) to identify, evaluate, and acquire commercial small-satellite (smallsat) data that support NASA's Earth science research and application goals.

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

Commercial Smallsat Data Acquisition (CSDA) Program Objectives

- Establish a continuous and repeatable process to onramp 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)

Commercial Smallsat Data Acquisition (CSDA) 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

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.

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

What is new?

Changes to Contracting Approach

- All new business is on-ramped via Indefinite Delivery Indefinite Quantity (IDIQ) process. We will issue competitive task orders for vendors to propose instead of sole source approaches.
- Vendors must improve data access options with both a GUI and API
- Two new vendors are being evaluated: PlanetiQ and Umbra
- ROSES A.51 released 12/05/23 to support this evaluation
- Planning for next Announcement-of-Opportunity for new vendors in FY24, but it is budget dependent. No further details available at this time.

IDIQ Vendors

- Airbus DS Geo, Inc.
- Capella Space Corp.
- GHGSat, Inc
- Maxar Intelligence, Inc.
- Space Sciences and Engineering (doing business as PlanetiQ)
- Spire Global Subsidiary, Inc.
- Umbra Lab, Inc.

What is new?

The Program has moved from ESDS to Earth Action through which we continue to:

- Leverage the commercial sector's capabilities to augment or complement our existing product suites, particularly with higher spatial and temporal resolution data

- Provide the avenue to capitalize on rapid technological enhancements in the commercial space industry to enhance our own capabilities, providing cost efficiencies

- Increase inter-agency partnerships and support development of standardization and interoperability across data production

What is new?

Management and Personnel

- Program management has been moved to the Earth Action portfolio at NASA HQ (under Associate Director Tom Wagner)
- New Program Manager at NASA HQ – Melissa Martin
- New Project Manager (at the Project Office at NASA Goddard replacing Alfreda Hall) - Dana Ostrenga

Development of a new strategic plan

- TBD

What hasn’t changed?

- Focus on evaluating and acquiring data to support NASA’s scientific & applications work.
- Some previous vendors continue under their Blanket Purchase Agreements (BPAs).
- Data access portals and vendor-specific licensing continues. https://www.earthdata.nasa.gov/esds/csda/commercial-datasets
- Evaluation process to determine usefulness of data has proven successful and continues, we will continue to improve the process.

NASA has 5 vendors with continuing BPAs

- Planet
- Airbus US
- ICEYE US
- GeoOptics
- Spire

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

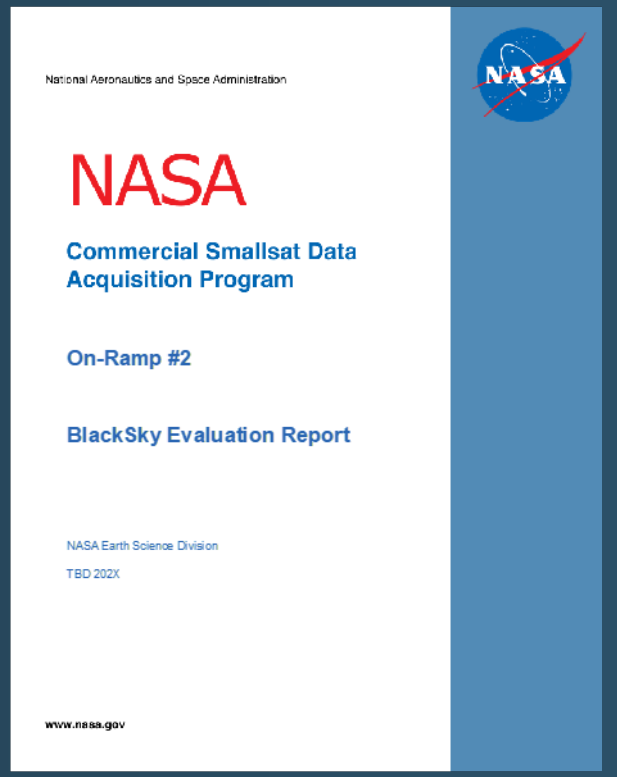
   Availability, responsiveness, and technical expertise required to answer PI inquiries.
4. Usefulness of data for advancing Earth system science research and applications

   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.

Evaluation Reports

Upcoming:



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

Vendor Status

Data purchased and available for community use

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

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 evaluation complete

- BlackSky *
- AIRBUS US

*Final Report pending

Data evaluation underway

- GHGSat
- GeoOptics
- Capella Space
- ICEYE US

Data evaluation to be initiated

- PlanetiQ
- Umbra Lab

- Surface
- GNSS
- Radar
- GHGs
- DEM

Data Access and Use

Access

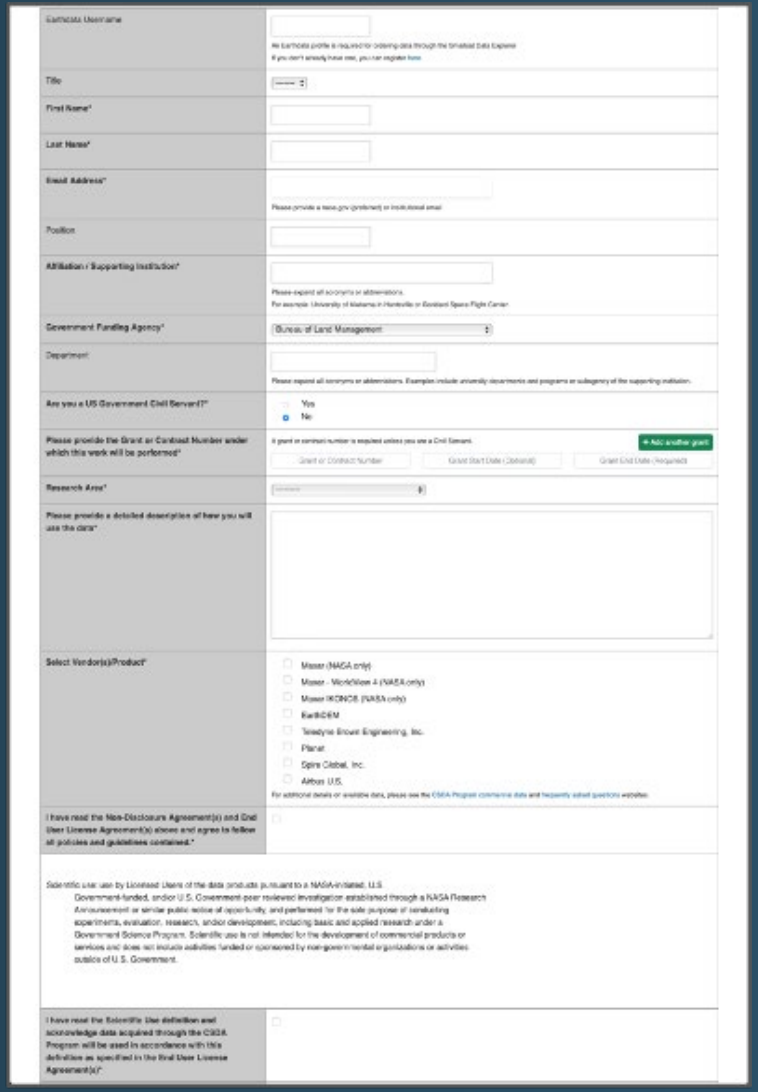
- Access through NASA ESDIS, where approaches currently vary with vendors… https://www.earthdata.nasa.gov/esds/csda/commercial-datasets
- Eligibility to download is validated though grant license or NASA email – validation and additional download support by NASA CSDA MSFC team.

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 – eg cannot put data out on 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**

User Access Request and Verification

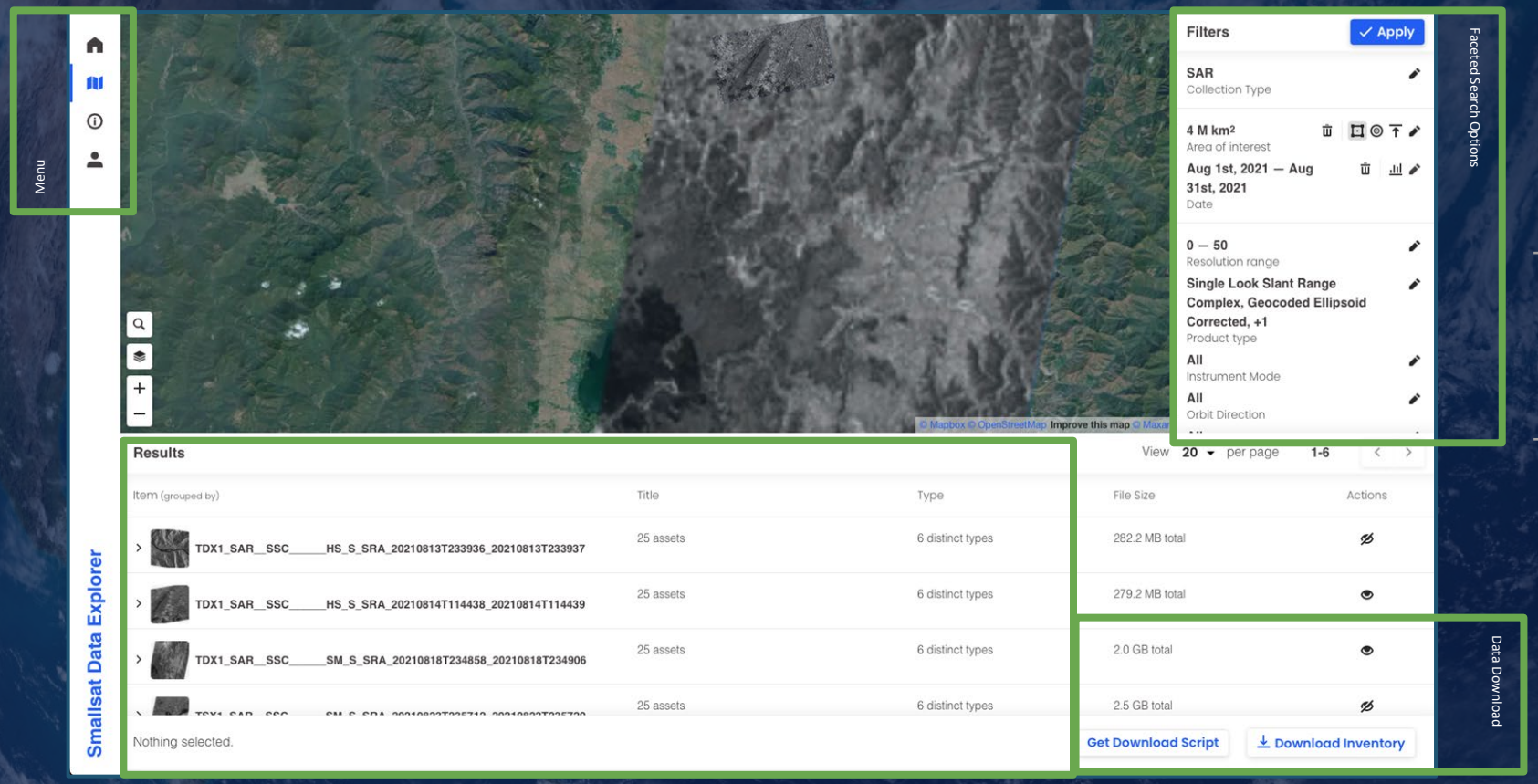
- All prospective users are subject to authorization prior to approving any data distribution request
- **Provide basic information: Name, Email, Funding Affiliation, Grant / Contract Number**
- Agree to the vendor specific *science use* EULA
- https://csdap.earthdata.nasa.gov/signup



Data Access varies by Vendor

Vendor	Data Products	Who is authorized	Where to get the data	EULA
Planet Labs, Inc	PlanetScope, RapidEye	U.S. Federal Civil Agency funded researchers	Planet Explorer	Planet Expanded EULA
	SkySat		SDX	
Spire Global, Inc	GNSS-R and -RO	U.S. Government funded researchers	SDX	Spire USG EULA
Teledyne Brown Engineering, Inc.	DESIS	U.S. Government funded researchers	TCloud	DESIS EULA
Maxar	WorldView 1-3, GeoEye, QuickBird	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	U.S. Government funded researchers	SDX	Commercial Data/Imagery EULAs Fact Sheet
Airbus U.S.	TerraSAR-X, TanDEM-X, PAZ	U.S. Government funded researchers	SDX	Airbus U.S. USG EULA.

CSDA Data Holdings & Smallsat Data Explorer (SDX)



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]

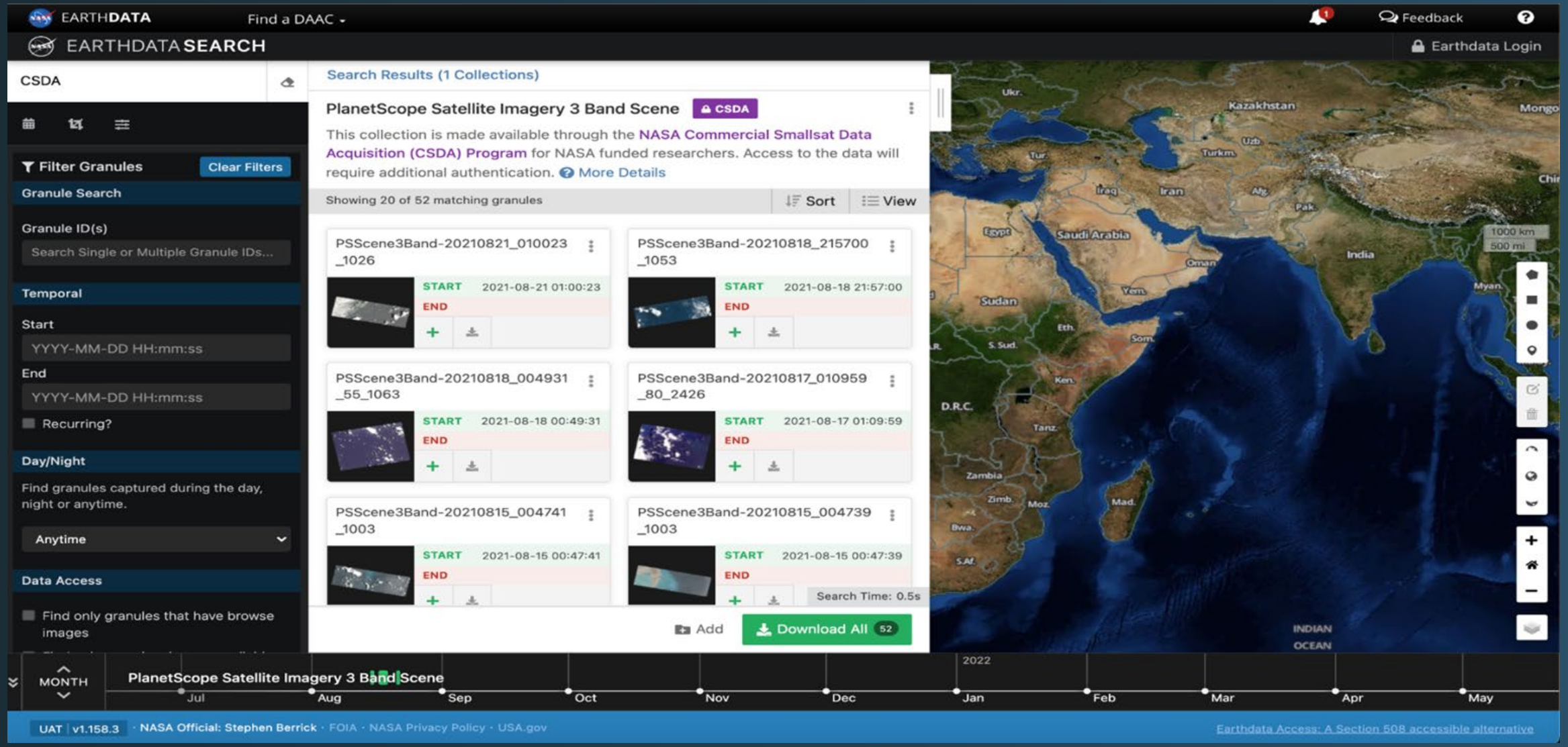
SDX

- 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]

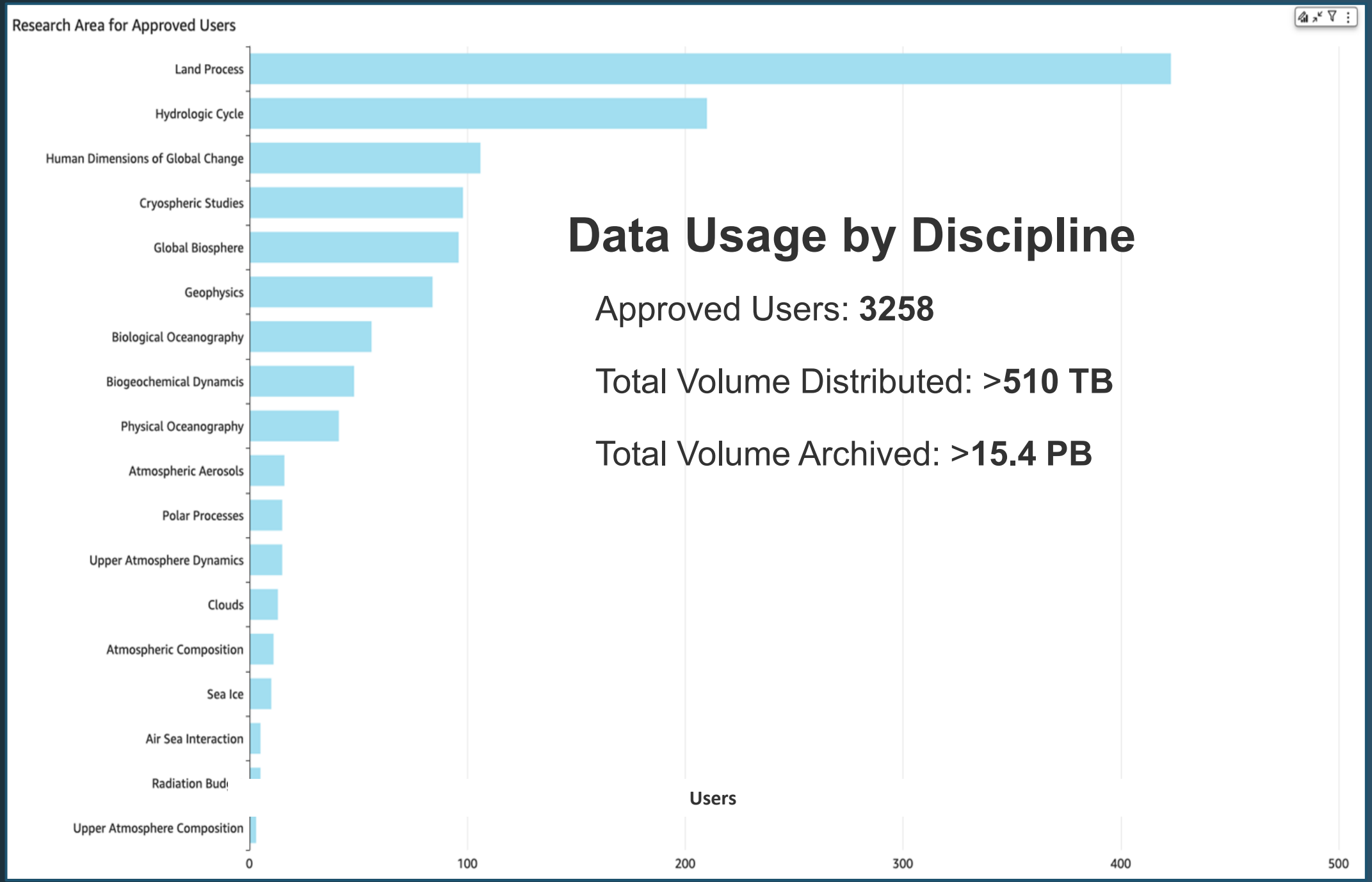
*Only SkySat data available through SDX

Data Search

https://search.earthdata.nasa.gov/search



Metrics



Data Usage by Discipline

Approved Users: **3258**

Total Volume Distributed: >**510 TB**

Total Volume Archived: >**15.4 PB**

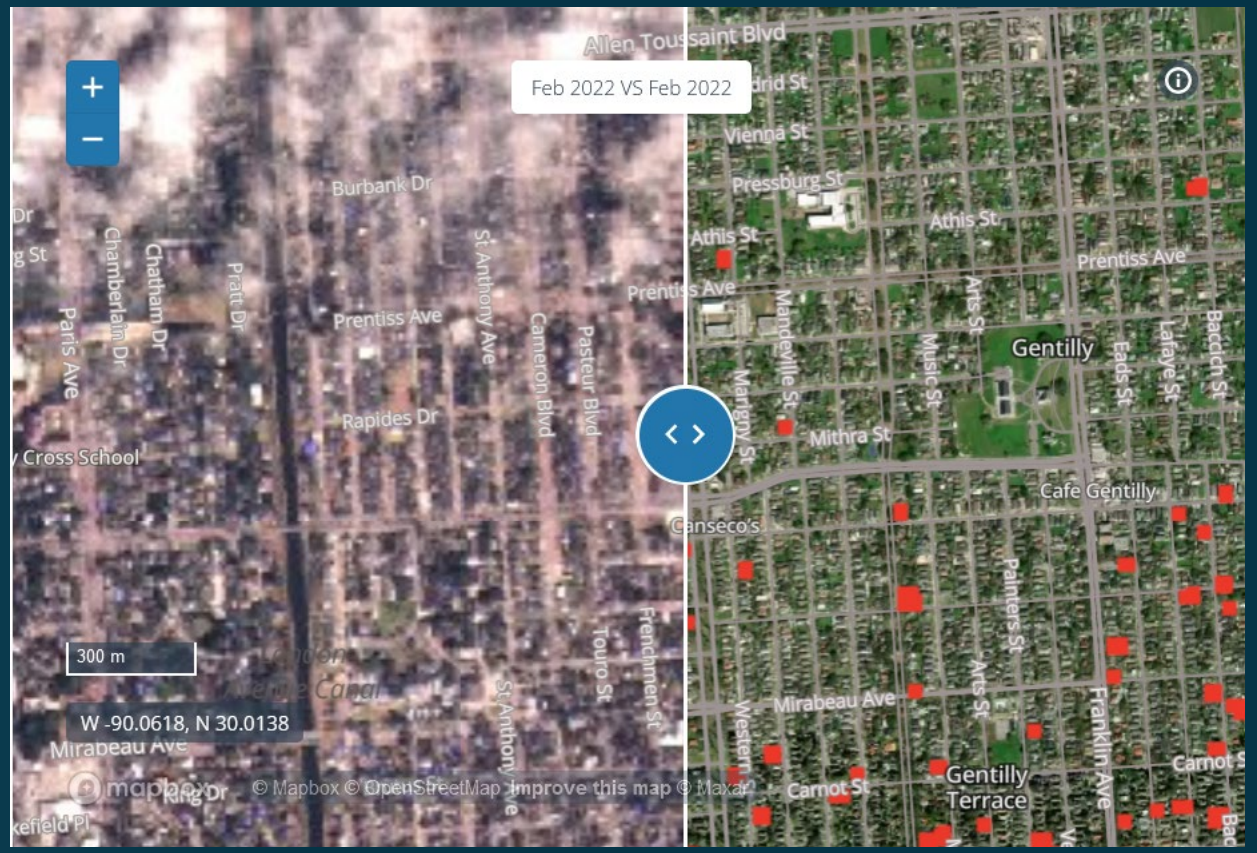
CSDA Science Results

CSDA

DA Science Results

Blue Tarp Detection

- September 20, 2017: Hurricane Maria
- August 29, 2021: Hurricane Ida
- Lives were lost, homes and businesses damaged or destroyed, wide-spread regions flooded, and electrical power grids rendered useless.
- Using machine learning with high-resolution data from Planet, the team "uncovered" the number of blue tarps deployed in the disaster-struck regions.
- The footprint of damaged construction as a percentage of the total original footprint.



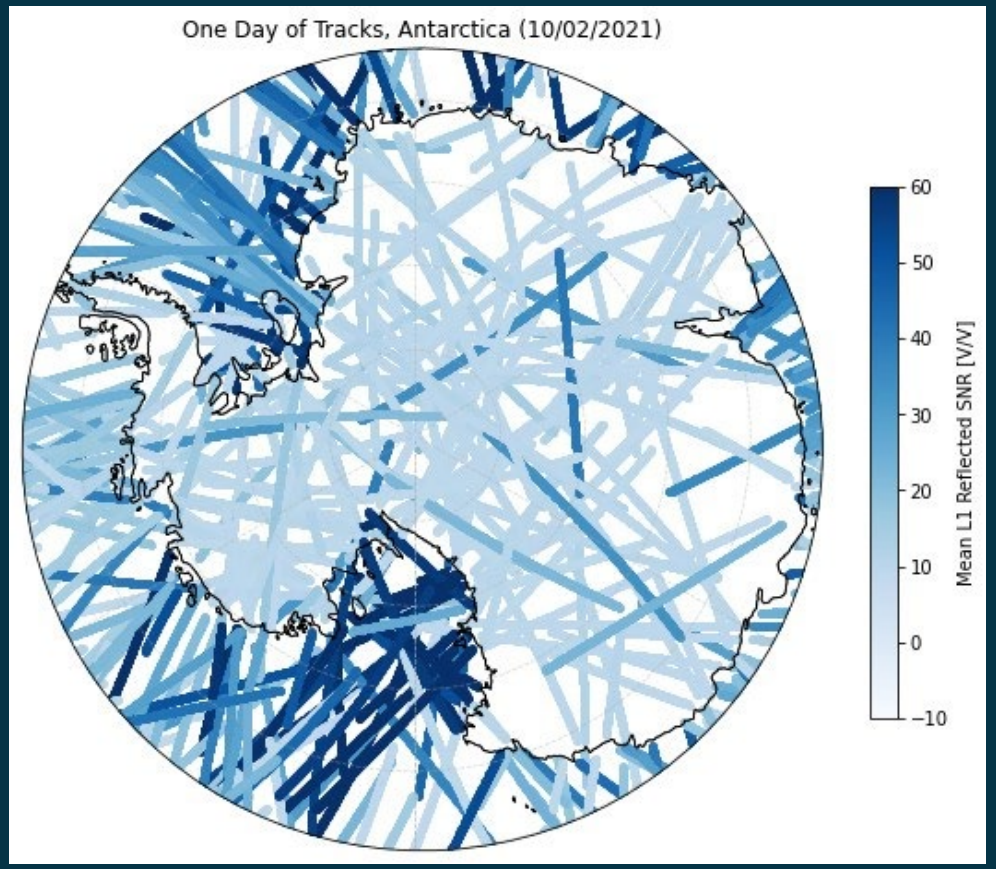
Credit – Hannah Friedrich U. Arizona (at Cornell)

CSDA

DA Science Results

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



Credit – Jade Morton, U. Colorado

DA Science Results

CSDA Tree Carbon Work in Semi-Arid Africa

- CSDA developed machine learning methods to map individual trees across 10,000,000 km² 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.

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

From Brandt et al. 2020 *Nature* and Tucker et al. 2023 *Nature*

Summary

- Commercial Smallsat Data Acquisition Program continues into the foreseeable future.
- New data is being purchased under the IDIQ framework.
- Scientific evaluation process is working well and continues.
- Planning for next Announcement-of-Opportunity for new vendors in FY24, but it is budget dependent. No further details available.
- Looking in FY24 to develop a program data strategy and requirements, as well as building on inter-agency relationships.

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

Contact Us

General Programmatic or Evaluation Questions

- HQ Program Manager/Scientist: Dr. Melissa Martin @ melissa.yang@nasa.gov

Commercial provider procurement questions

- Project Manager: Dana Ostrenga @ dana.ostrenga@nasa.gov

Data access and management

- Aaron Kaulfus @ aaron.s.kaulfus@nasa.gov

Project Scientist

- **Fritz Policelli @ frederick.s.policelli@nasa.gov**

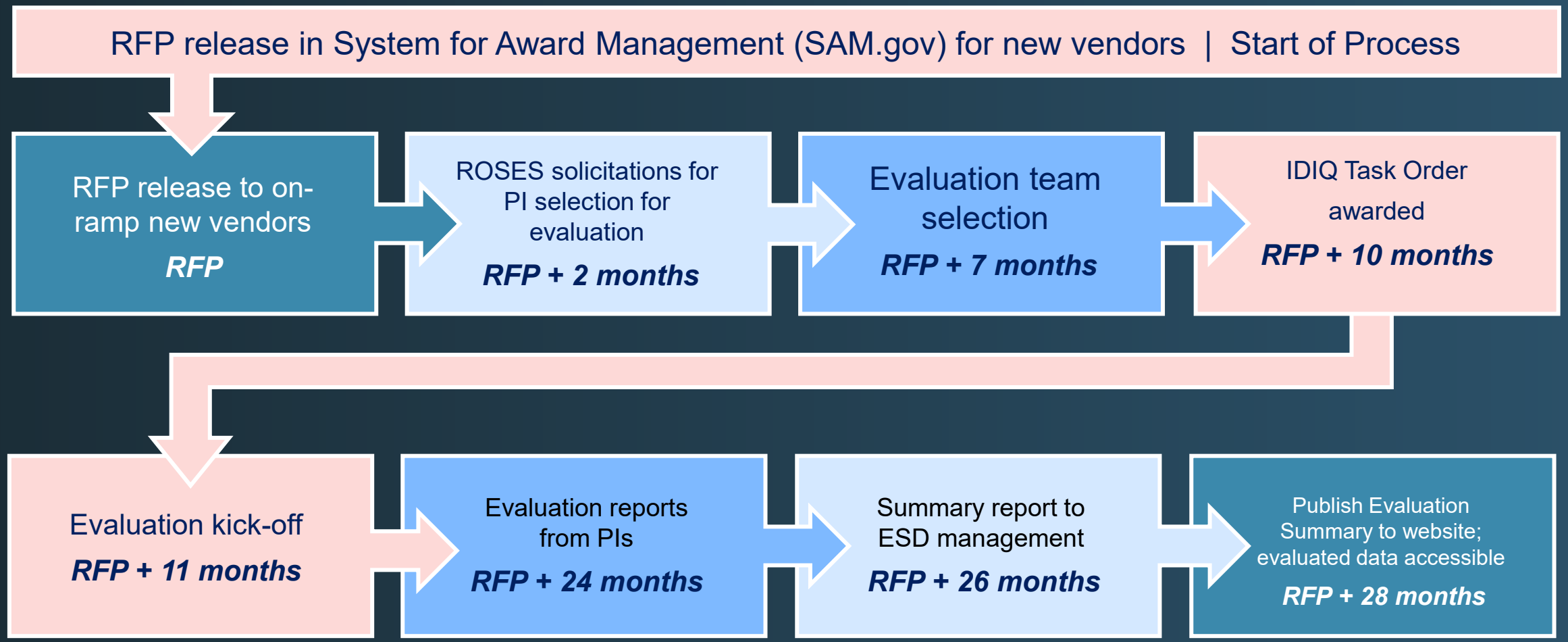
https://earthdata.nasa.gov/esds/csdap

Commercial Smallsat Data Acquisition (CSDA) Program
For further information:

https://earthdata.nasa.gov/csda

Backup

Evaluation Process for New Vendors



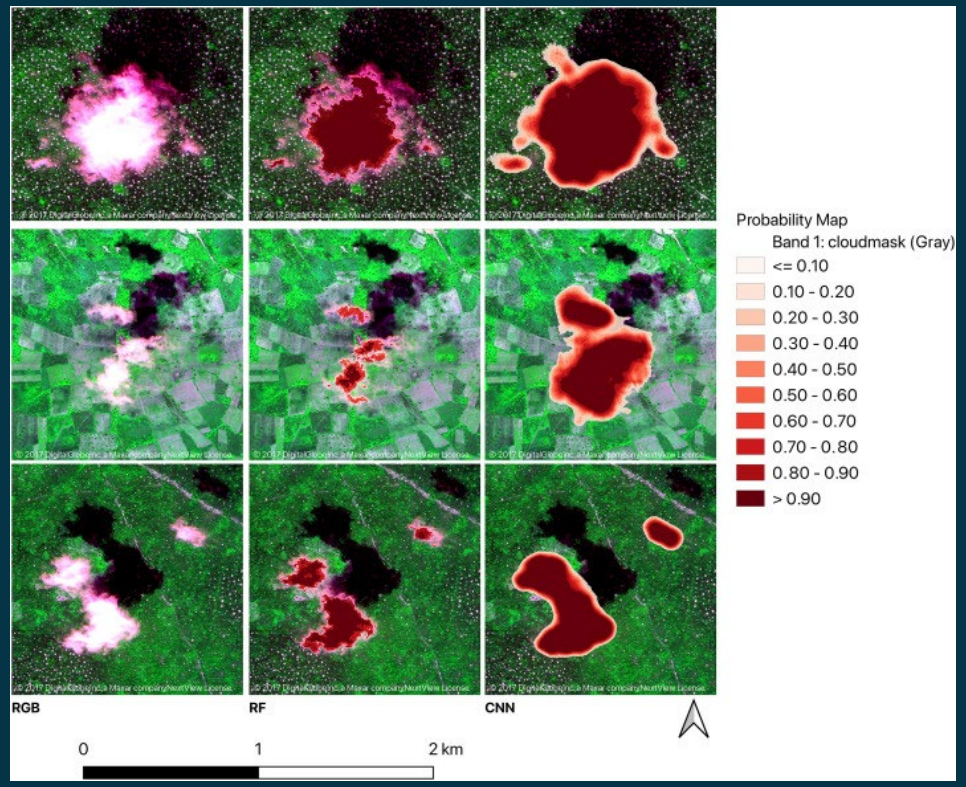
Note: approximate times

CSDA

DA Science Results

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.



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.

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.

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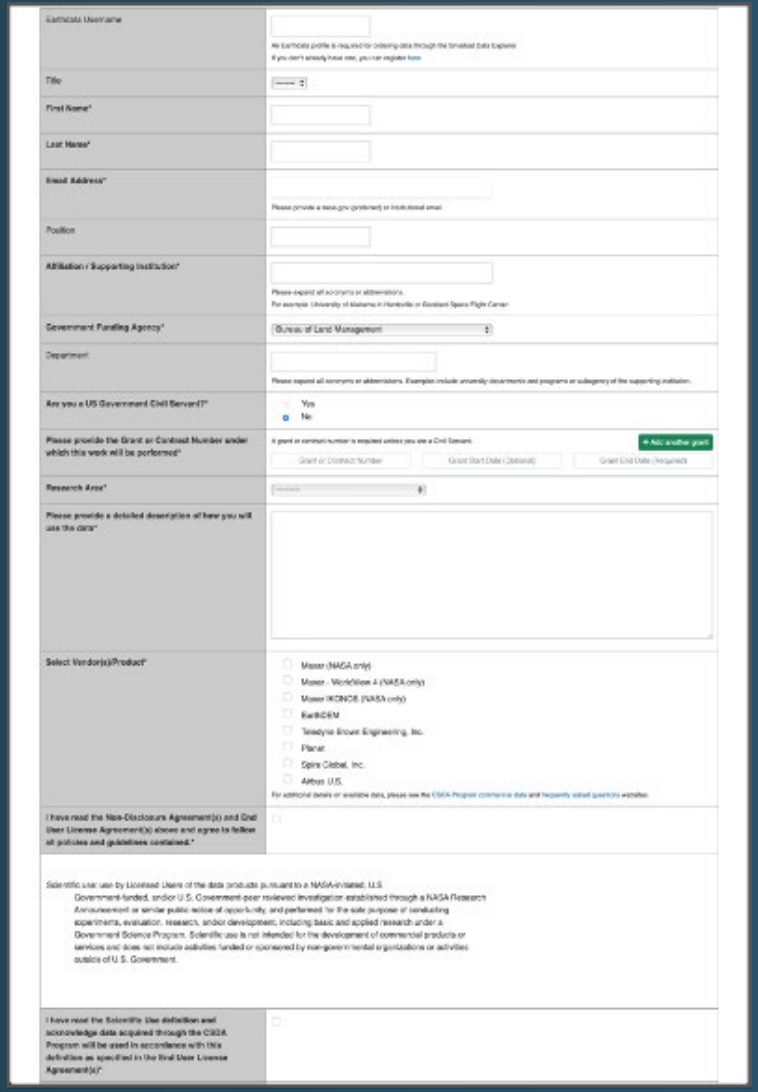

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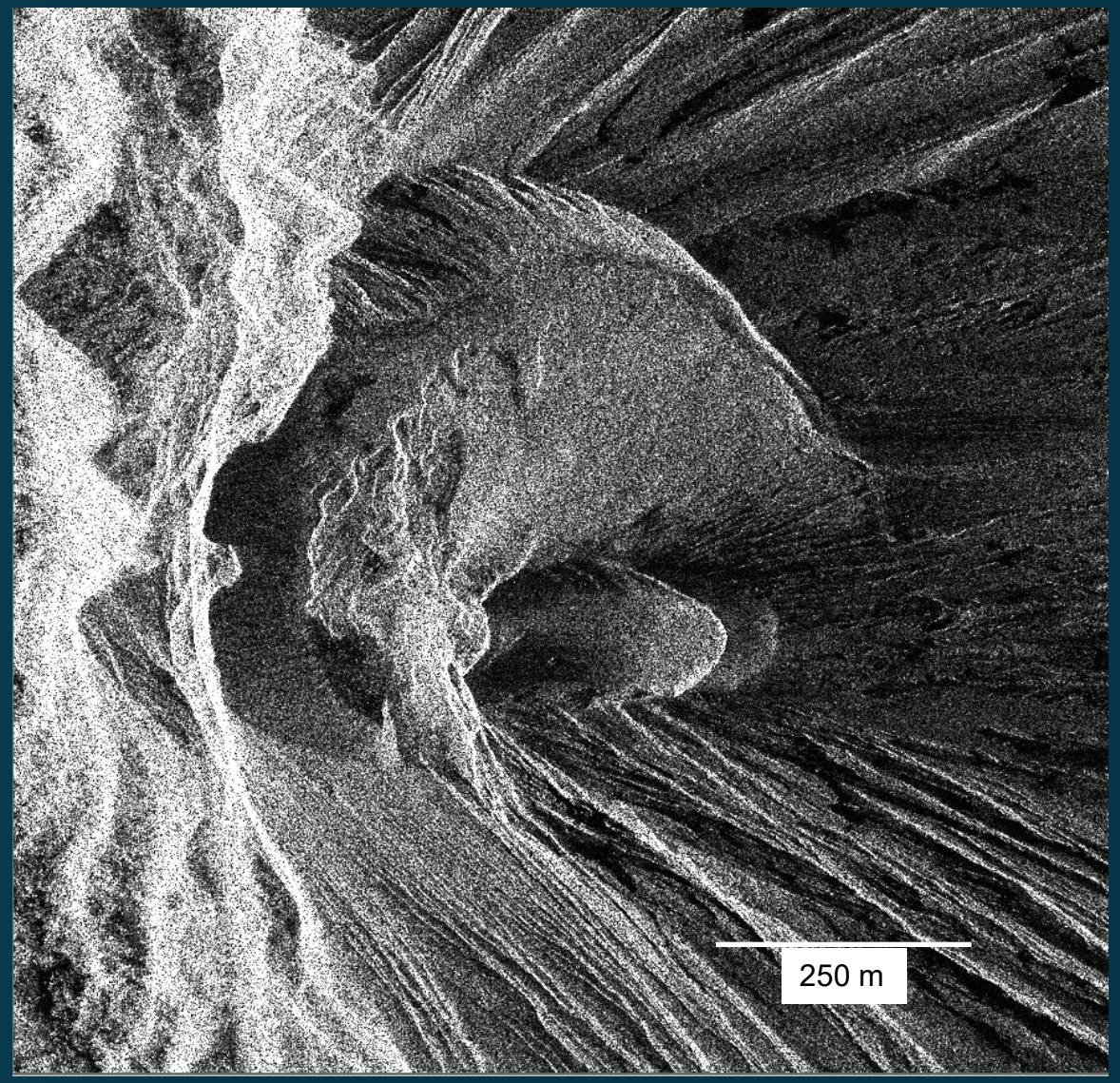
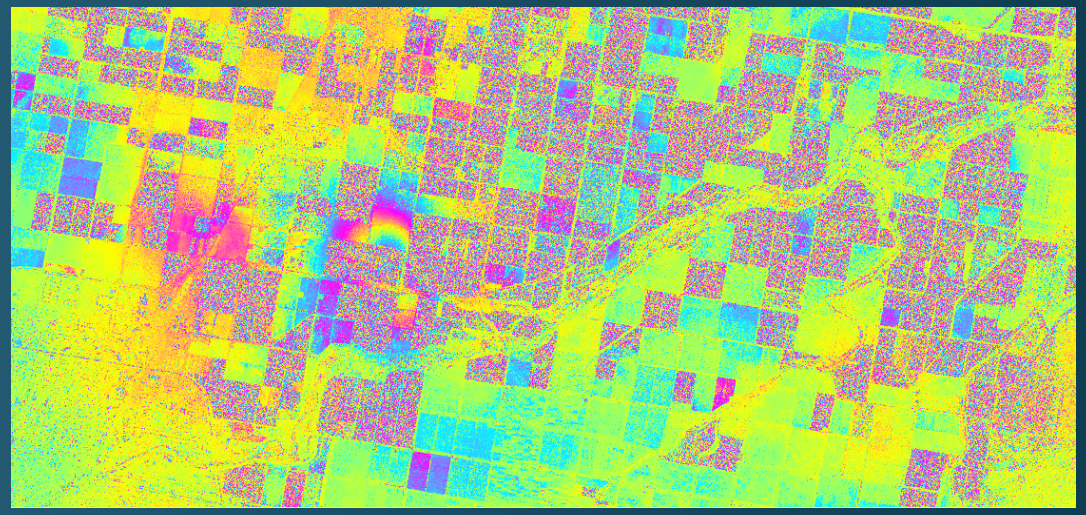
Airbus U.S. Science Results

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

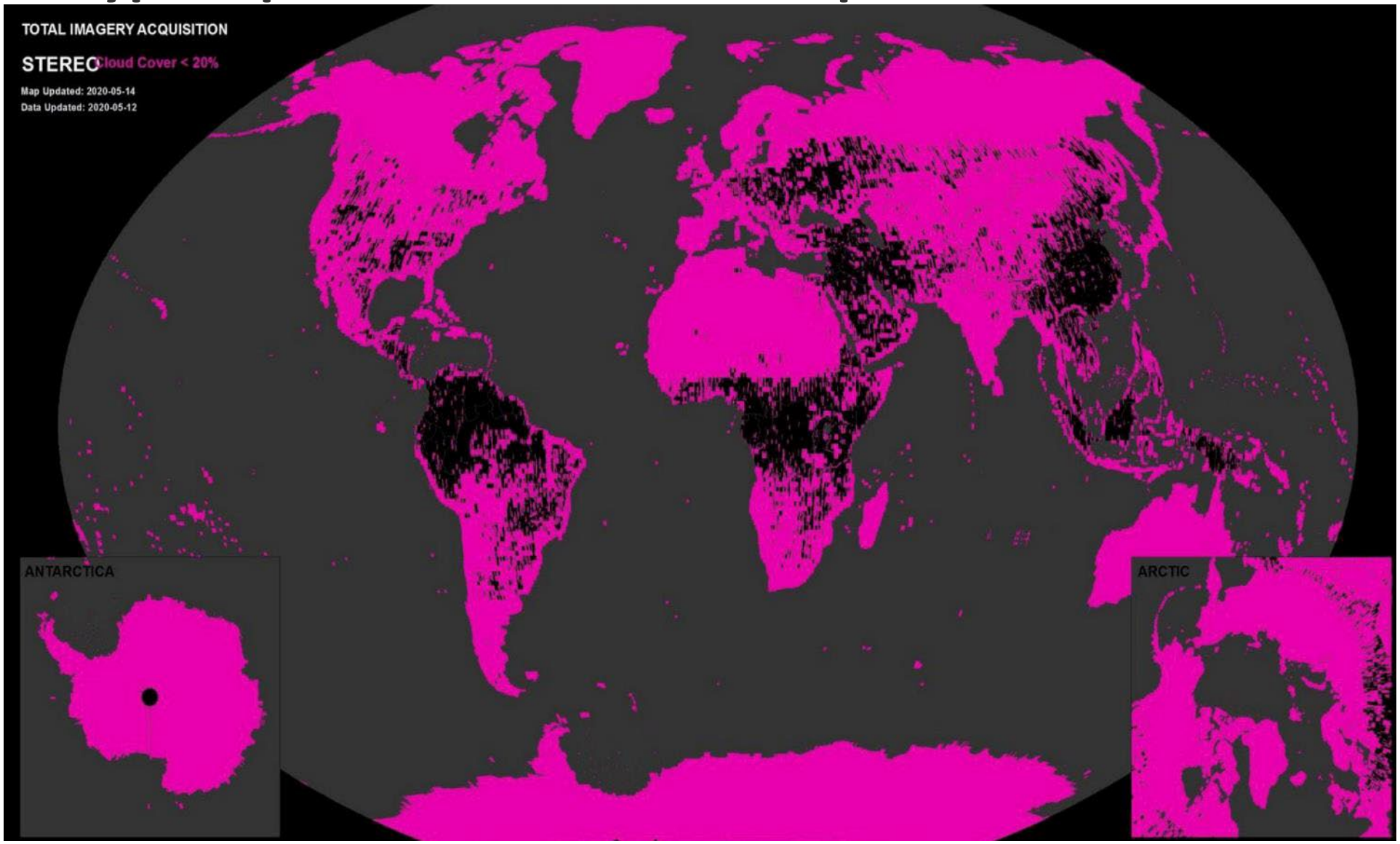




22-day pair in S. California, showing coherence and signals in agricultural fields and clear signal at geothermal plant.

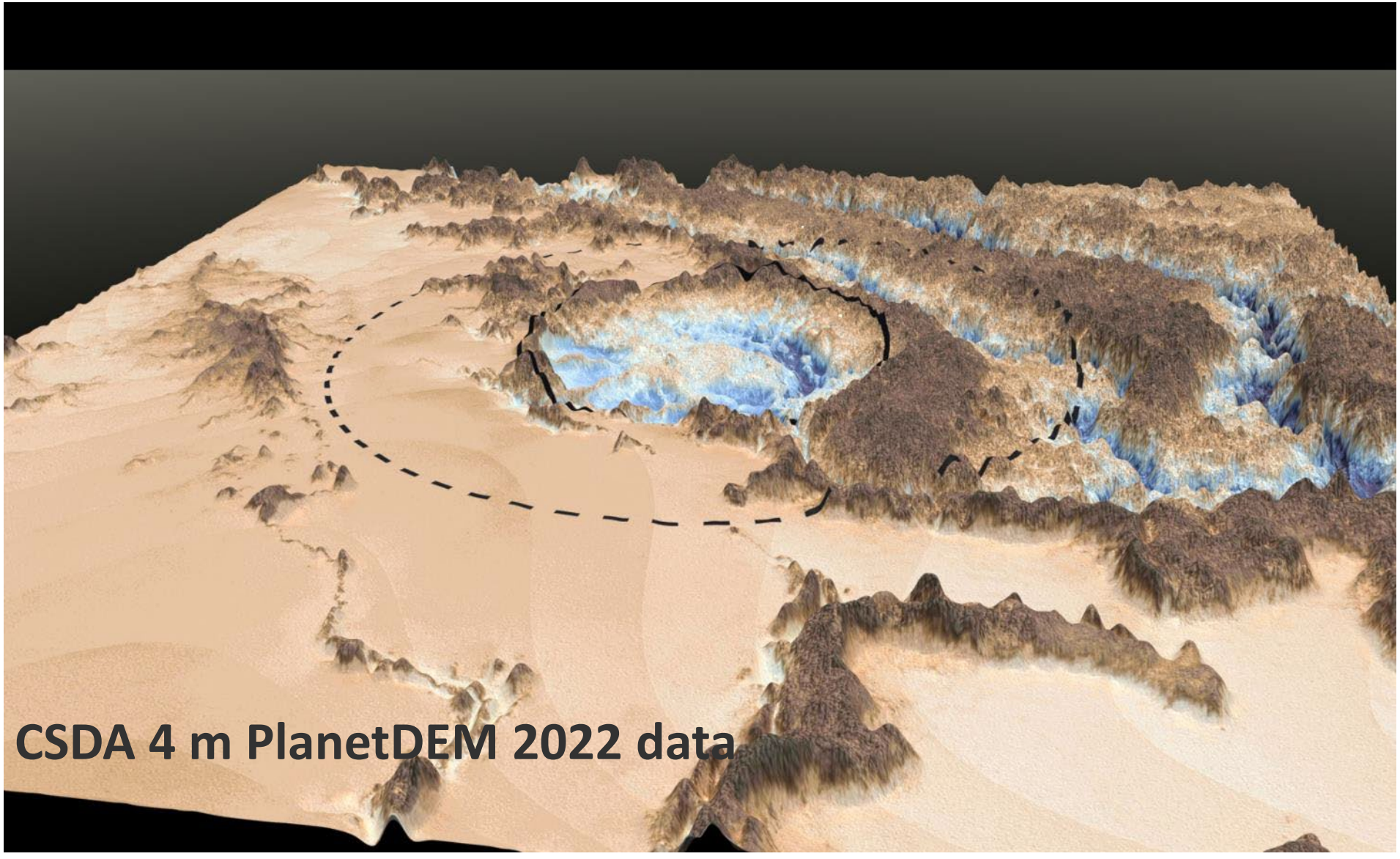
CSDA Planet DEMs

Hyper-spatial 4 m data to compliment 2 m DEMs

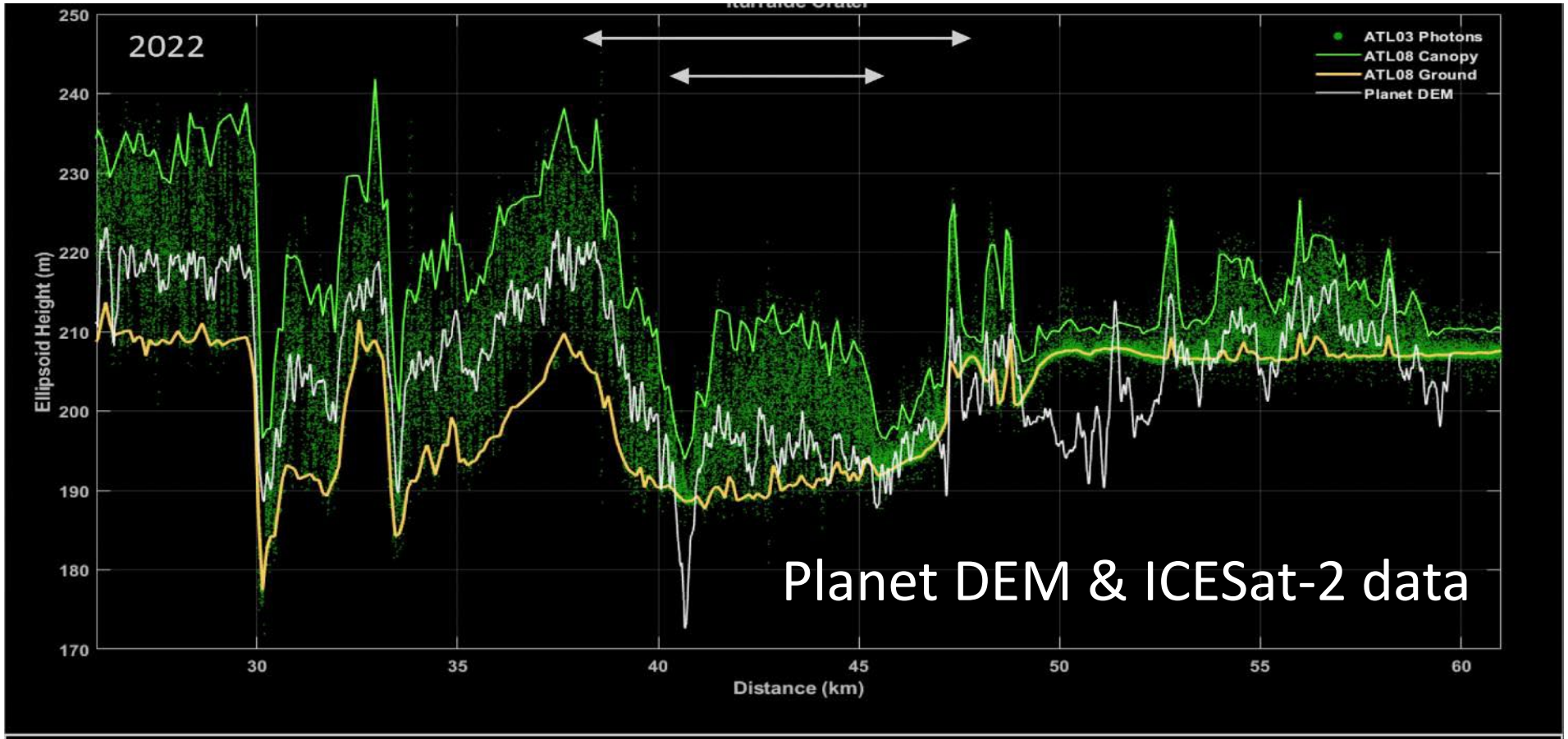


CSDA Planet DEMs

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



CSDA Planet DEMs



Iturralde Crater

- ICESat-2 overpasses in 2022, 2021, 2020 and 2019 were found
- the averaged Planet DEM (Summer 2020-2022) is used
- the perceived inner and outer rings are highlighted