



NASA's Commercial Smallsat Data Acquisition Program Data Stewardship and Data Management

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102nd American Meteorological Society Annual Meeting, 21st Conference
38th Conference on Environmental Information Processing Technologies



NASA CSDA Program

Pilot Program established in November 2017 transitioning to a sustained Program in early 2020 with the following objectives:

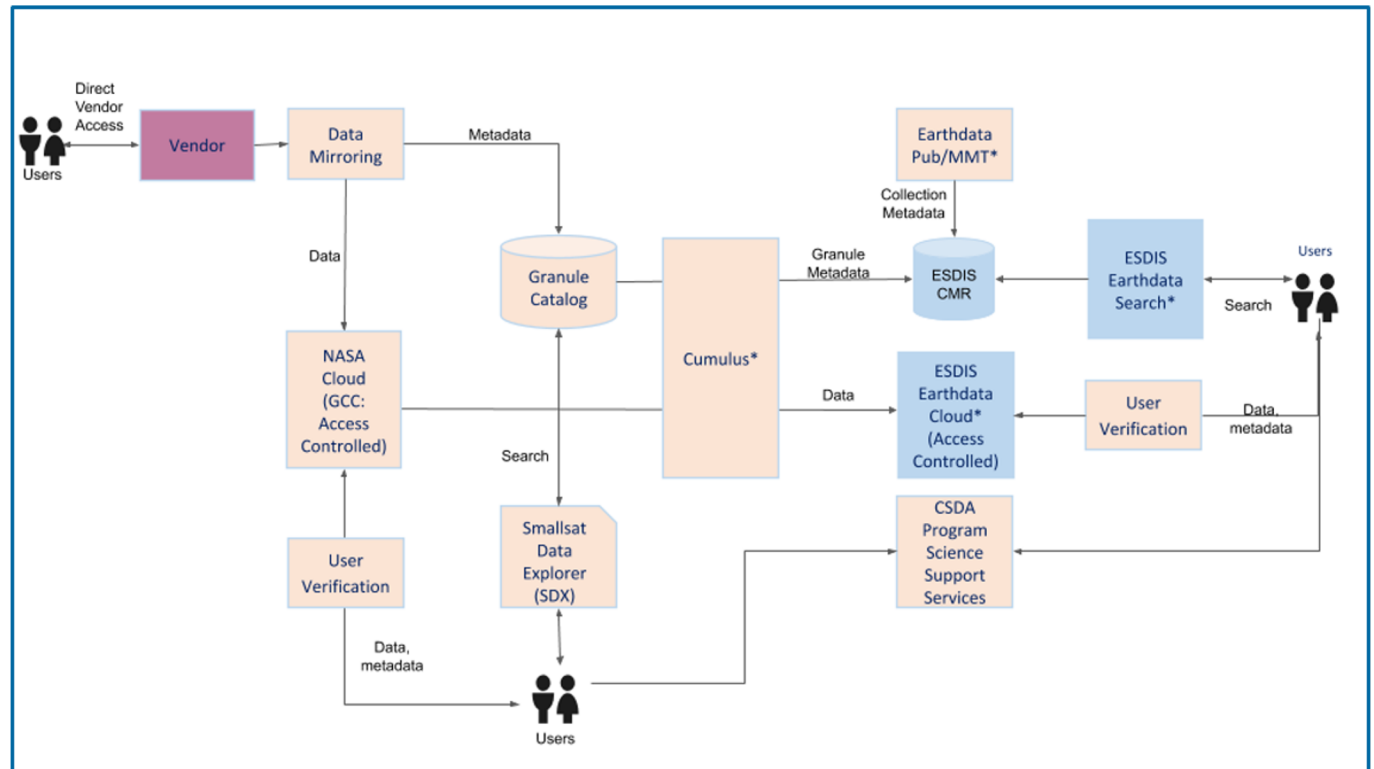
- Establish continuous and repeatable processes to onramp new commercial data vendors and evaluate data for its potential to advance NASA's Earth science research and application activities
- Enable the sustained use of purchased data for broader use and dissemination by NASA scientific community
- Ensure long-term data preservation through the establishment of data management processes and systems to support rapid evaluation, access and distribution of purchased data, and long-term access to purchased data for scientific reproducibility
- Coordinate with other U.S. Government agencies and international partners on the evaluation and scientific use of commercial data

<https://earthdata.nasa.gov/csda>

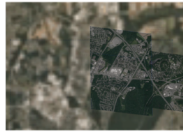
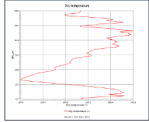

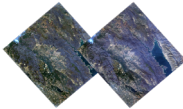

CSDA High Level Data System

The CSDA data team has develop a system to support end science user access to data through three possible scenarios:

1. Direct from the vendor user vendor provided interfaces
2. From cloud-based tools developed by the CSDA
3. Standard NASA Earthdata infrastructure services



Vendor and Data Product Overview

Vendor	Constellations/ Products	Availability Dates	Orbit Characteristics	Spatial Resolution	Spectral Characteristics	Sample
Planet	PlanetScope, RapidEye	12/31/2005 - Present	Sun Synchronous	3 - 6.5 meters	RGB, NIR (440-860 nm), Panchromatic	
	SkySat	3/10/2015 - 12/12/2019		< 1 meter	RGB, NIR (450-900 nm), Panchromatic	
Spire Global, Inc	GNSS Radio Occultation, GNSS Grazing Angle Reflectometry, Satellite Precise Orbit Determination (POD) and Satellite Attitude, Total Electron Content, Ionospheric Profiles, Scintillation, Magnetometer, Raw IF	9/24/2018 - 4/18/2019 (partial) 11/1/2019 - Present (all)	GNSS-R and GNSS-RO receivers satellites: 37 ⁺ and Sun Synchronous			
Maxar Technologies	Worldview 1-4, GeoEye-1, QuickBird, IKONOS	10/24/1999 - Present	Sun Synchronous	0.31 - 4.0 meters	Multispectral and Panchromatic (400 - 2245 nm)	
Teledyne Brown Engineering, Inc.	DESIS L1B, L1C, and L2A	11/21/2018 - Present	Non Sun Synchronous 52° N - 55° S (ISS)	30 meters	235 channels, 2.5nm from 402 to 1000 nm	
EarthDEM	individual strips and mosaics	2009 - Present		2 meters		

Data Access and Scientific Non-Commercial Use License

All prospective users are subject to authorization prior to approving any data distribution request

- Agreement to the vendor specific science end user license agreement
- Ability to copy, store, share and use data and derivatives including in scientific and technical articles and publishing academic, technical or professional journals, symposia proceedings, or similar works.
- Verification of funding support

Single service authorization request form captures basic user information for account creation and concurrence with respective license agreements

Earthdata Username	<input type="text"/> <small>An Earthdata profile is required for ordering data through the Smallsat Data Explorer. If you don't already have one, you can register here.</small>
Title	<input type="text"/>
First Name*	<input type="text"/>
Last Name*	<input type="text"/>
Email Address*	<input type="text"/> <small>Please provide a nasa.gov (preferred) or institutional email</small>
Position	<input type="text"/>
Affiliation / Supporting institution*	<input type="text"/> <small>Please expand all acronyms or abbreviations. For example: University of Alabama in Huntsville or Goddard Space Flight Center.</small>
Government Funding Agency*	<input type="text" value="National Aeronautics and Space Administr"/>
Are you a US Government Civil Servant?*	<input type="radio"/> Yes <input checked="" type="radio"/> No
Please provide the Grant or Contract Number* under which this work will be performed*	<small>A grant or contract number is required unless you are a Civil Servant.</small> <input type="text" value="Grant or Contract Number"/> <input type="text" value="Grant Start Date (Optional)"/> <input type="text" value="Grant End Date (Required)"/> + Add another grant
Research Area*	<input type="text"/>
Please provide a detailed description of how you will use the data*	<input type="text"/>
Select Vendor(s)/Product*	<input type="checkbox"/> Teledyne Brown Engineering, Inc. <input type="checkbox"/> Spire Global, Inc. <input type="checkbox"/> EarthDEM <input type="checkbox"/> Planet <small>For additional details on available data, please see the CSDA Program commercial data and frequently asked questions websites.</small>
I have read the Non-Disclosure Agreement(s) and End User License Agreement(s) above and agree to follow all policies and guidelines contained.*	<input type="checkbox"/>

Data Delivery and Storage

The entire CSDA Program data system is cloud native, deployed in Amazon Web Services in NASA managed environments

- Established repeatable system for vendors upload of data and metadata into S3 buckets
- Usage-based, cost efficient storage solution implemented
- Inventory and hash based data integrity verification

Upon delivery, all data is indexed in a SpatioTemporal Asset Catalog (STAC)

- Standardized metadata schema for describing geospatial data
- Flexible means to organize disparate data
- Provides uniformity for indexing data assets
- CSDA collaborate with vendors to ensure metadata needed for long-term preservation is curated

S3 Standard	S3 Intelligent-Tiering	S3 Standard-IA	S3 One Zone-IA	S3 Glacier	S3 Glacier Deep Archive
Frequent <ul style="list-style-type: none">• Active, frequently accessed data• Milliseconds access• ≥ 3 AZ• \$0.0210/GB	Access frequency <ul style="list-style-type: none">• Data with changing access patterns• Milliseconds access• ≥ 3 AZ• \$0.0210 to \$0.0125/GB• Monitoring fee per object• Min storage duration	Access frequency <ul style="list-style-type: none">• Infrequently accessed data• Milliseconds access• ≥ 3 AZ• \$0.0125/GB• Retrieval fee per GB• Min storage duration• Min object size	Access frequency <ul style="list-style-type: none">• Re-creatable, less accessed data• Milliseconds access• 1 AZ• \$0.0100/GB• Retrieval fee per GB• Min storage duration• Min object size	Archive <ul style="list-style-type: none">• Archive data• Select minutes or hours data• ≥ 3 AZ• \$0.0040/GB• Retrieval fee per GB• Min storage duration	Archive <ul style="list-style-type: none">• Long-term archive data• Select hours• ≥ 3 AZ• \$0.00099/GB• Retrieval fee per GB• Min storage duration

AWS S3 storage scaling and cost architectures. Image Source: <https://catalog.us-east-1.prod.workshops.aws/v2/workshops/f238037c-8f0b-446e-9c15-ebcc4908901a/en-US/002-services/002-storage/003-s3>



STAC logo from <https://stacspec.org>

Smallsat Data Explorer

Front-end web application for search, discover, and download of commercial data

- Data Faceted Search
 - Spatial filtering by drawing on map interface, uploading geojson, or specifying area of interest
 - Specify desired temporal extent
 - Filter on key metadata
- Data Discovery
 - Geographic representations and quick view display
 - Display of product specific, key metadata
- Select and Request
 - Individual selection of desired granules or request of all granules that meet search criteria
 - Distributed using user specific, signed URLs

The screenshot displays the Smallsat Data Explorer (SDX) interface. It features a central map with a 'Browse Imagery on map' overlay showing a satellite image of a forested area. To the right, there is a 'Filters' panel with the following details: 349 km² Area of interest, Date range from Jun 1st, 2018 to Jul 31st, 2018, Imagery Type, 0 - 100% Cloud coverage, and All Product type. Below the filters is a 'Results' panel showing a list of search results with thumbnails and metadata, including 'PSScene4Ban...', 'PSOrthoTile-15...', and 'PSScene4Ban...'. At the bottom, there is a 'Request' panel showing '0 of 80 selected' and buttons for 'Request selected data' and 'Request all matching data'. A 'Map Options' button is visible in the bottom left of the map area.

CSDA Smallsat Data Explorer (SDX) with thumbnails from Planet Labs, Inc displayed

Smallsat Data Explorer - New Features

Revamp of download capabilities transitioning from data request to quota based download system

- Removes the current administrator review and deliver system thereby decreasing time from data discovery to download
- Enables direct download from the interface for small orders or use the bulk download script provided for scalable download
- User profiles provide available quota and downloaded data inventory

Coverage Map for data collections

- Supports quick view to determine if data exists in the desired region and time period prior to detailed search
- Monthly aggregation with dynamic spatial aggregation using leaflet heatmap
- Aggregation from STAC metadata

The screenshot displays the Smallsat Data Explorer interface. At the top, a map shows a satellite's ground track over a region. To the right, a 'Profile' panel shows user information and a table of quotas. Below the map, a 'Results' table lists search results with columns for title, type, file size, and actions. A 'Download selected as CSV' button is visible. At the bottom, a 'Coverage Map' shows a world map with red dots indicating data collection locations. The map includes filters for year and month (2019-05), vendor (Planet), and product (PSScene4Band). A legend for the number of assets is shown at the bottom left of the map.

Title	Type	File Size	Asset Size	Actions	
SETIM_17101_20190508_102010001H000_102010003C000	4 assets	4 distinct types	894.2 MB total	1100 kb total	Download
img001_application-post	img001	10.4 MB	1100 kb	Download	
img002_application-ter	img002	883.8 MB	1100 kb	Download	
img003_application	img003	10.9 MB	1100 kb	Download	

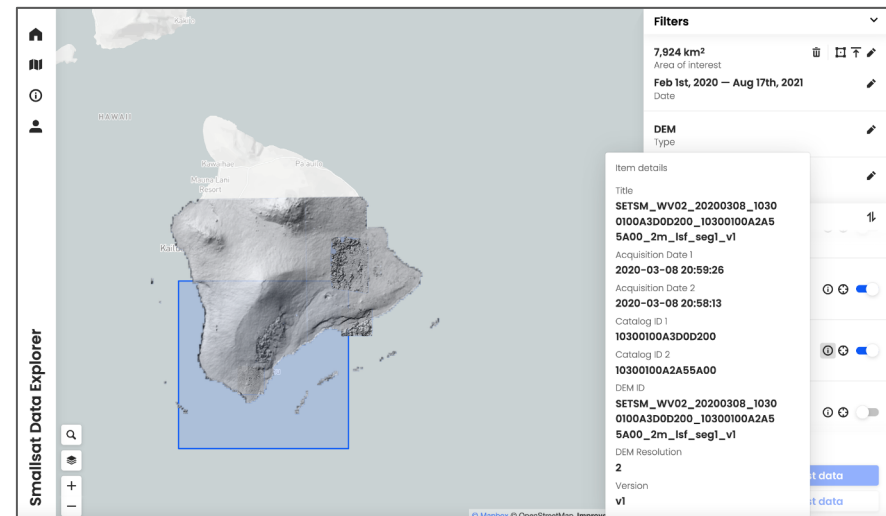
EarthDEM data distribution

High-resolution terrain maps for temperate and tropic regions constructed from DigitalGlobe (Maxar) satellite imagery obtained through the NGA Nextview license.
<https://www.pgc.umn.edu/data/earthdem>

Limited area release to gather feedback on format and usability of 2 meter DEMs

- Mosaic tiles (50 km x 50 km)
- Individual strip

Integrated into Smallsat Data Explorer largely using previously developed, repeatable processes



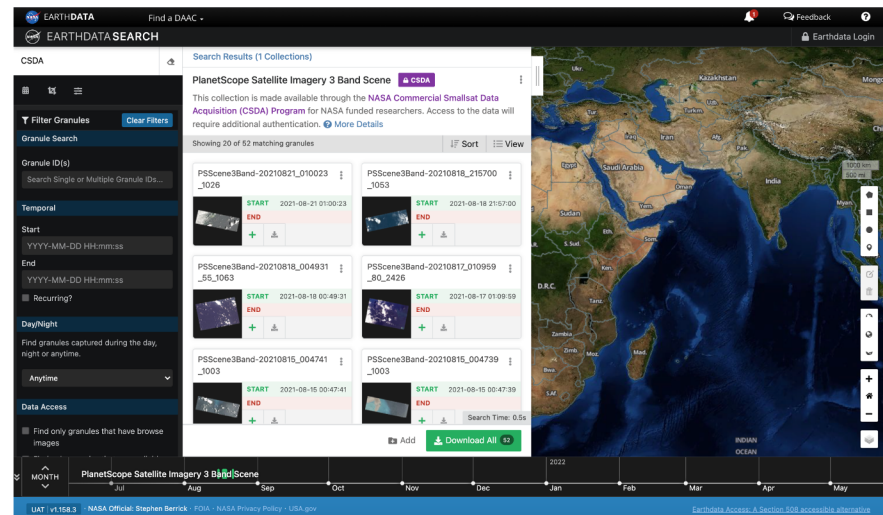
NASA EOSDIS Incorporation

Post to NASA's Common Metadata Repository (CMR) in Unified Metadata Model (UMM) format

- Collection metadata generated using the Metadata Management Tool (MMT)
 - Landing page generated from this metadata
 - Digital Object Identifier (DOI) created
- Created scalable cloud workflow for generating granule metadata

Ingest and archive using the Cumulus service with cloud data backup automated using the Operational Recovery Cloud Archive (ORCA) service

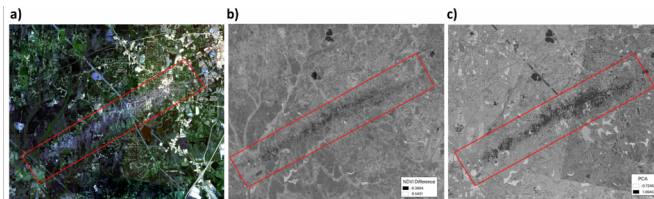
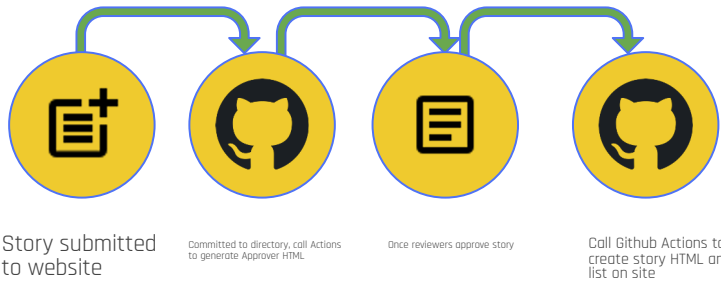
Data discoverable and downloadable through NASA's CMR, Earthdata Search Client



Data Discovery

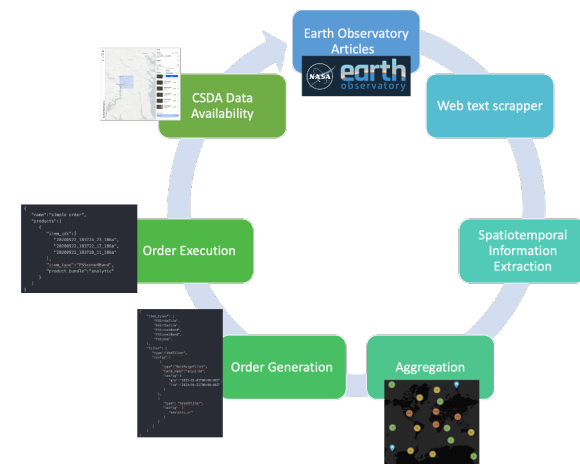
Data in Action

- Provide data information and code through stories highlighting science use cases



High Value Target Acquisitions

- Contribute to building a valuable data archive by utilizing NASA resources to identify and acquire data from areas of interest



FY22 Activities and Beyond

Onramp and Evaluation

- CSDA releases a new Request For Information for commercial vendors every 12-18 months with the goal of identifying new evaluation candidates
- Recently entered into agreement with Blacksky and Airbus for data evaluation
- Data from selected vendors will be evaluated by Principal Investigators (PIs) selected through Research Opportunities in Space and Earth Science (ROSES) solicitations

Sustained Use Activities

- Consolidate and enhance search, discovery, and distribution for all commercial data products to the SDX
- Data service user community research and feedback; update SDX data ordering and distribution system

Long-term Preservation Activities

- Continued transfer of Planet data and Maxar data to NASA ESDIS Earthdata cloud infrastructure

Summary

NASA has established the CSDA Program to evaluate and acquire commercial satellite data that supports NASA's science and application goals

The CSDA data team continues to develop data management procedures which support search, discovery, and access for sustained use of acquired commercial data

To request access to CSDA managed data, subject to review and approval

- Planet, Spire, DESIS, EarthDEM - [CSDA user authorization request form](#)
- Maxar - sign up through [CAD4NASA](#)

Thank you.

