



Commercial Small Satellite Data Discovery and Access to Support Scientific Research

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NASA Commercial Smallsat Data Acquisition (CSDA) Program

Program Objectives:

- Evaluate and acquire commercial data that complements NASA's Earth science research and application goals
- Ensure sustained use of purchased data and dissemination to NASA community
- Ensure long-term data preservation through establishment of robust data management process
- Coordinate evaluation and scientific use with the European Space Agency

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



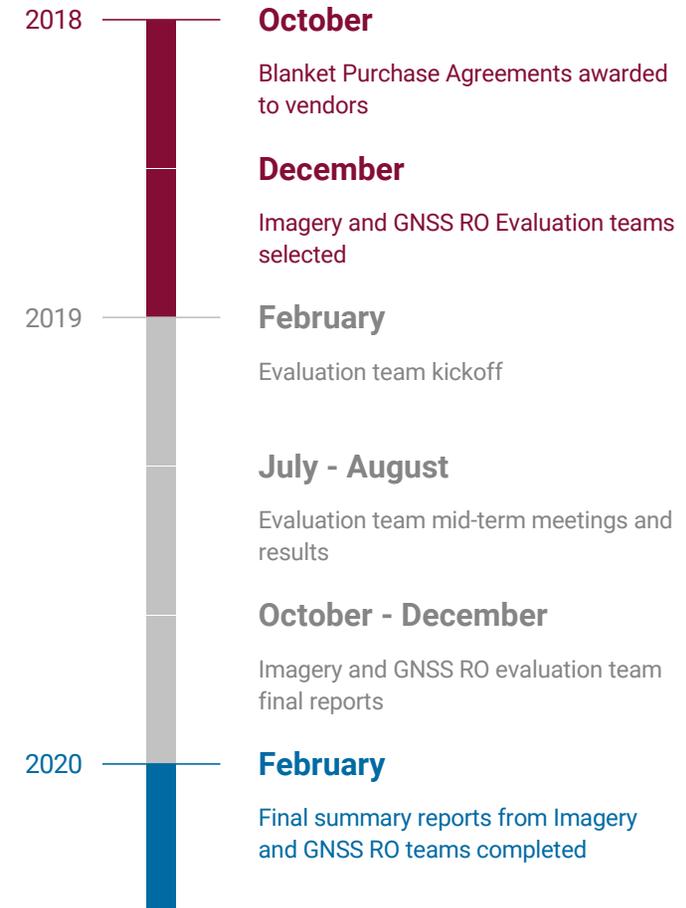
Pilot Program

Initiated in November 2017 and continued through early 2020

- Data productions from three commercial companies evaluated
 - Planet Labs Inc.
 - Maxar Technologies (formally DigitalGlobe)
 - Spire Global, Inc

NASA Earth Science Division (ESD) identified 39 projects to evaluate these vendors

- All six ESD Research and Analysis thematic areas and the four Applied Science program elements represented
- Each projected developed independent reports using common evaluation criteria
- Summary available:
<https://earthdata.nasa.gov/esds/csdap/csdap-pilot-evaluation>



Vendor and Data Product Overview

Planet Labs, Inc.

- Low Earth, sun synchronous orbit
- Visible and Near-IR multispectral imagery
- Spatial Resolution:
 - PlanetScope: 3-4m
 - RapidEye: 6.5m
 - SkySat: <1m



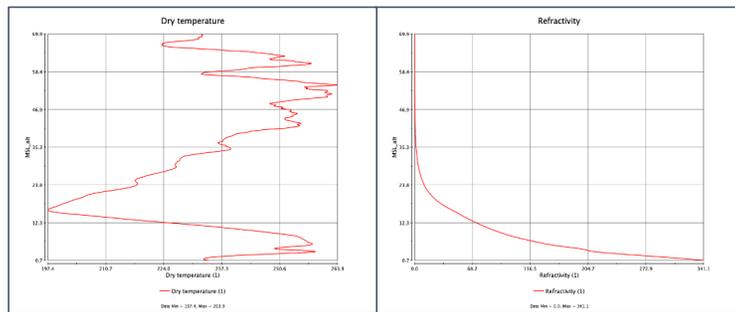
PlanetScope 4 band RGB thumbnail with Skysat RGB thumbnail overlain

Vendor	Constellations/Products	Availability Dates
Planet Labs, Inc.	PlanetScope, RapidEye	12/31/2005 - Present (partial)
	SkySat	3/10/2015 – 12/12/2019 (partial)
Spire Global, Inc	GNSS Radio Occultation, GNSS Grazing Angle Reflectometry, Satellite Precise Orbital Determination (POD) and Satellite Attitude, Total Electron Content, Ionospheric Profiles, Scintillation, Magnetometer	9/24/2018 - 4/18/2019 (partial) 11/1/2019 - Present (all)
Maxar Technologies	Worldview 1-4, GeoEye-1, QuickBird, IKONOS	10/24/1999 - Present (partial)
Teledyne Brown Engineering, Inc.	DESIS L1B, L1C, and L2A	11/21/2018 - Present (partial)

Vendor and Data Product Overview

Spire Global, Inc

- Constellation of Global Navigation Satellite System (GNSS) CubeSats in low earth orbit
- Greater than 10k atmospheric profiles collected each day



Spire GNSS-RO L2A atmospheric vertical profile of dry temperature (left) and refractivity (right)

Vendor	Constellations/Products	Availability Dates
Planet Labs, Inc.	PlanetScope, RapidEye	12/31/2005 - Present (partial)
	SkySat	3/10/2015 – 12/12/2019 (partial)
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Vendor and Data Product Overview

Maxar Technologies (formally DigitalGlobe)

- Low Earth, sun synchronous orbit
- Visible and Near-IR multispectral imagery
- Spatial Resolution:
 - Worldview: 30cm - 4m
 - Ikonos: 3.2m
 - GeoEye: 1.65m
 - Quickbird: 2.44m



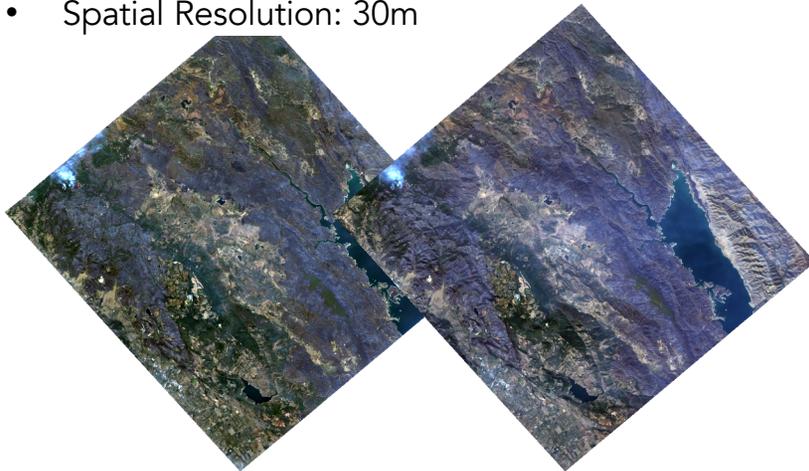
Maxar WorldView3 L2A surface reflectance RGB thumbnail

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Vendor and Data Product Overview

Teledyne Brown Engineering, Inc

- DLR Earth Sensing Imaging Spectrometer (DESI) on the Multi-User System for Earth Sensing (MUSES) platform deployed on the ISS
 - Instrument pointing capabilities
 - Coverage 55N to 52S
- Hyperspectral imagery in Visible and Near-IR
- Spatial Resolution: 30m



DESI L2A (right) surface reflectance and L1A (left) top of atmosphere reflectance RGB thumbnails

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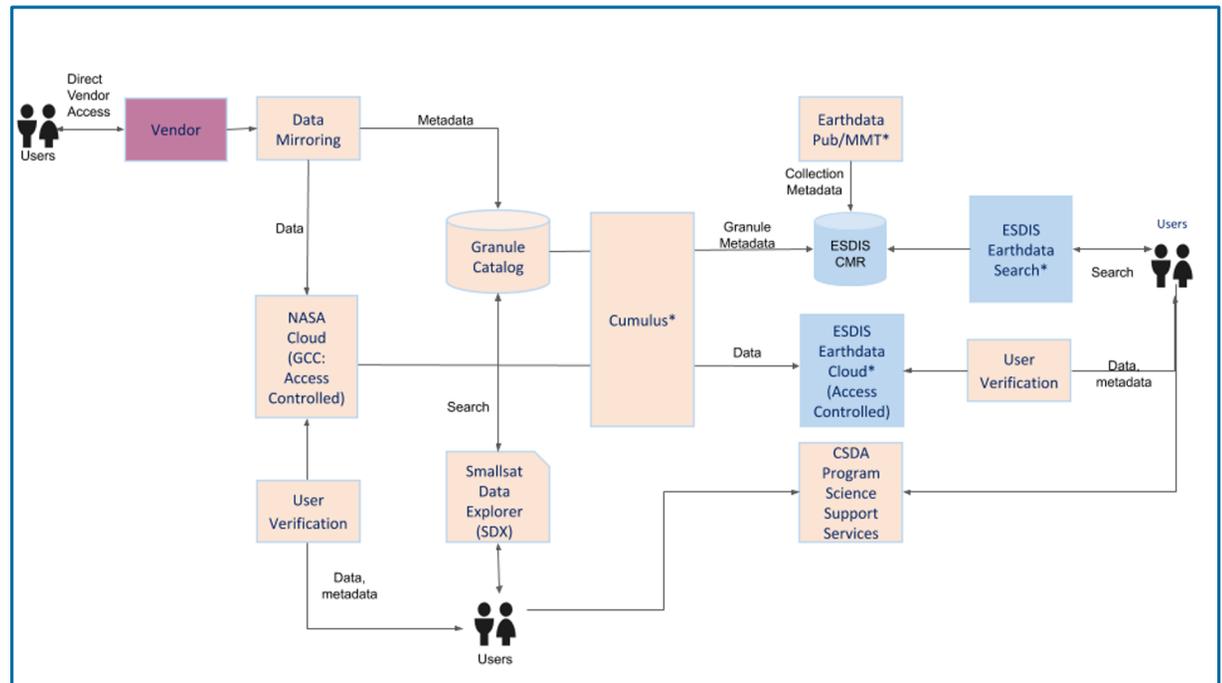
User Data Services

End science users are able to access data through three possible scenarios:

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

Science support services

- Product documentation
- CSDA science team



Cloud Tools

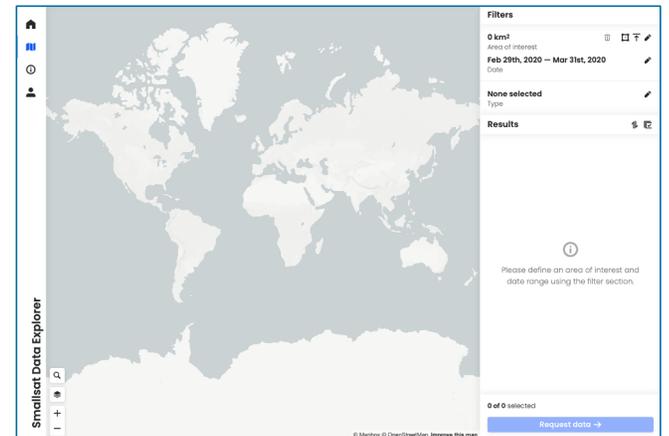
All metadata are ingested into a SpatioTemporal Asset Catalog (STAC) catalogue

- Standardized schema for describing geospatial data
- Flexible way to structure and organize disparate data
- Provides uniformity for indexing data assets

```
1 {
2   "$schema": "http://json-schema.org/draft-07/schema#",
3   "$id": "https://schemas.stacspec.org/v1.0.0-beta.2/catalog-spec/json-schema/catalog.json#",
4   "title": "STAC Catalog Specification",
5   "description": "This object represents Catalogs in a SpatioTemporal Asset Catalog.",
6   "allOf": [
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8       "$ref": "#/definitions/catalog"
9     }
10  ],
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13      "type": "object",
14      "required": ["title", "description", "links"],
15      "properties": {
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17        "description": {"type": "string"},
18        "links": {"type": "array", "items": {"type": "object", "required": ["rel", "href"], "properties": {"rel": {"type": "string"}, "href": {"type": "string"}}, "minItems": 1}
19      }
20    }
21  }
22 }
```

Smallsat Data Explorer (SDX)

- Front-end web application to search, discover, and download commercial data
- Supported by the STAC catalogue
 - Metadata filtering
 - Display quick view imagery



Smallsat Data Explorer (SDX) Capabilities

Web Interface and Layout

- Main Landing Page
 - Brief description of program and data availability
- Explore Page
 - Search, discover, and request commercial data products using map-based web application
- User Guide
 - Overview of CSDA Program objectives
 - Introduction to data products
 - Detailed description on using the Explore tool
- Login
 - Login using NASA Earthdata profile required to request data
 - Agreement to vendor specific End User License Agreement enforced

Smallsat Data Explorer

Welcome

User Guide

1. Introduction

Sign in via Earthdata Login [Sign in](#)

The Smallsat Data Explorer (SDX) is being developed as part of NASA's Commercial Smallsat Data Acquisition Program (CSDAP) to search, discover and access Commercial Small Satellite Data. The tool has been acquired by NASA. Currently, this tool supports search, discovery and access to Planet Labs Inc. and Spire Global, Inc. Access to these data products is restricted to NASA-funded projects. This document is intended to provide a detailed overview of the tool and its functionality. Additional information on the Commercial Smallsat Data Acquisition Program, data availability, and the technical specifications of the commercial data can be found at the [CSDAP informational page](#).

2. Pages

The Smallsat Data Explorer consists of three web pages accessible directly by the navigation links provided below or by a convenient navigation panel found on the left side of the webpage.

[Welcome](#) (🏠)

The SDX landing page. This page provides a brief explanation of the purpose of the tool for end users and describes currently supported data vendors.

[Explore](#) (🗺️)

The explore page allows the public to search, discover and order satellite data acquired by the CSDAP. Ordering of data is only available for approved NASA-funded projects and researchers. A complete guide on how to use the features on this page are found in the Data Exploration section of this User Guide.

[User Guide](#) (📖)

The SDX User Guide is provided on this page. This guide presents a brief description of the Commercial Smallsat Data Acquisition Program (CSDAP), the context of this tool within the program, and a detailed description of how the SDX supports search, discovery and distribution of commercial vendor data.

In addition to these options in the navigation panel, it is possible to login to the tool directly by clicking the login icon (👤). User login is described in detail in the next section.

3. Authorization and Login

Commercial data discoverable through the SDX is made available only to NASA funded researchers who have been approved for access. Authorized data users will be able to log into the SDX and submit requests for data archived by the CSDAP. The authentication and authorization process that must be completed prior to accessing data is described in the following sections.

Smallsat Data Explorer (SDX) Capabilities

Data Faceted Search

- Spatial filtering by drawing on map interface, uploading, or specifying area of interest
- Specify desired temporal extent with simple calendar selection
- Filter on key metadata
 - Select the desired product type
 - Filter on key metadata specific to each product type

The screenshot displays the Smallsat Data Explorer (SDX) interface. The main map shows a region around Washington D.C. with a blue polygon highlighting an area of interest. The interface includes a search bar, a map, and a results panel on the right. The results panel shows filters for area (349 km²), date (Jun 1st, 2018 - Jul 31st, 2018), and product type (Imagery). A 'Cloud coverage' filter is set to 0-100%. The results list shows several imagery products, including PSScene4Ban... and PSOrthoTile-15... with their respective dates and product types. A 'Faceted Search Options' label is visible on the right side of the interface.

Smallsat Data Explorer (SDX) Capabilities

Data Discovery

- Geographic representations displayed on map interface
- Quick view data images displayed on map
 - Supports mosaicking of individual images
- Display of product specific, key metadata

Select and Request

- Request only desired data by
 - Individually selecting granules
 - Requesting all granules that meet search criteria

The screenshot displays the Smallsat Data Explorer (SDX) interface. The main map shows a satellite view of a forested area with a red bounding box highlighting a specific region. A tooltip labeled "Browse Imagery on map" is visible over this region. On the right side, there is a "Filters" panel with the following settings:

- Area of Interest: 349 km²
- Date: Jun 1st, 2018 – Jul 31st, 2018
- Type: Imagery
- Scale: 0 – 100%

Below the filters, there is a list of search results. The first result is highlighted with a red box and has its details expanded:

- Title: PSScene3Band-20180615_1519
- Item ID: 34_0e0e
- Cloud Cover: 1
- Item Type: PSScene3Band
- Provider: planetscope
- Ground Sample Distance: 3.9

At the bottom of the interface, there is a "Data Request" panel with the following options:

- 0 of 60 selected
- Request selected data
- Request all matching data

Data Access and Scientific Non-Commercial Use License

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 NASA funding support*

To request access

- Planet Labs Inc., Spire Global, DESIS* - [user request form](#)
- Maxar - sign up through [CAD4NASA](#)

The image shows a screenshot of the 'CSDA Program Authorization Request Form'. The form is titled 'CSDA Program Authorization Request Form' and includes a thank you message and instructions. It contains several input fields and sections:

- Earthdata Username:** A text input field with a note: 'An Earthdata profile is required for ordering data through the Smallsat Data Explorer. If you don't already have one, you can register here.'
- Title:** A dropdown menu.
- First Name*:** A text input field.
- Last Name*:** A text input field.
- Email Address*:** A text input field with a note: 'Please provide a nasa.gov (preferred) or institutional email.'
- Position:** A text input field.
- Affiliation / Supporting Institution*:** A text input field with a note: 'For example: University of Alabama in Huntsville, Goddard Space Flight Center, etc.'
- Government Funding Agency*:** A text input field.
- Are you a NASA Civil Servant?*** Radio buttons for 'Yes' and 'No' (selected).
- Please provide the Grant or Contract Number under which this work will be performed*:** A text input field with a note: 'A NASA grant or contract number is required unless you are a NASA Civil Servant.' There are also fields for 'Grant or Contract Number', 'Grant Start Date (Optional)', and 'Grant End Date (Required)'. A green button labeled 'Add another grant' is visible.
- Research Area*:** A dropdown menu.
- Please provide a brief description of how you will use the data*:** A large text area.
- Select Vendors*:** Radio buttons for 'Planet', 'Spire', and 'DEGIS'.
- ACKNOWLEDGEMENT OF NON-DISCLOSURE:** A section at the bottom of the form.

*DEGIS is available to all U.S. Government funded investigators

FY21 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
- 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 search, discovery, and distribution of all data products to SDX
 - DESIS 2021
 - Maxar early 2022
- Data service user community research and feedback

Long-term Preservation Activities:

- Migrate data to NASA ESDIS Earthdata cloud infrastructure for long term stewardship

Summary

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

The CSDA has developed data curation and management procedures which support cloud native search and distribution tools for sustained science use of acquired data

The CSDA is continuing efforts to solicit new datasets for evaluation, enhance user services, and provide long term preservation for acquired data

Additional Information: <https://earthdata.nasa.gov/csdap>

Contact:

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