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

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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
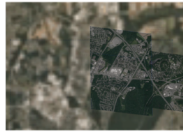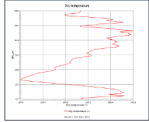
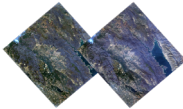https://earthdata.nasa.gov/csda

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
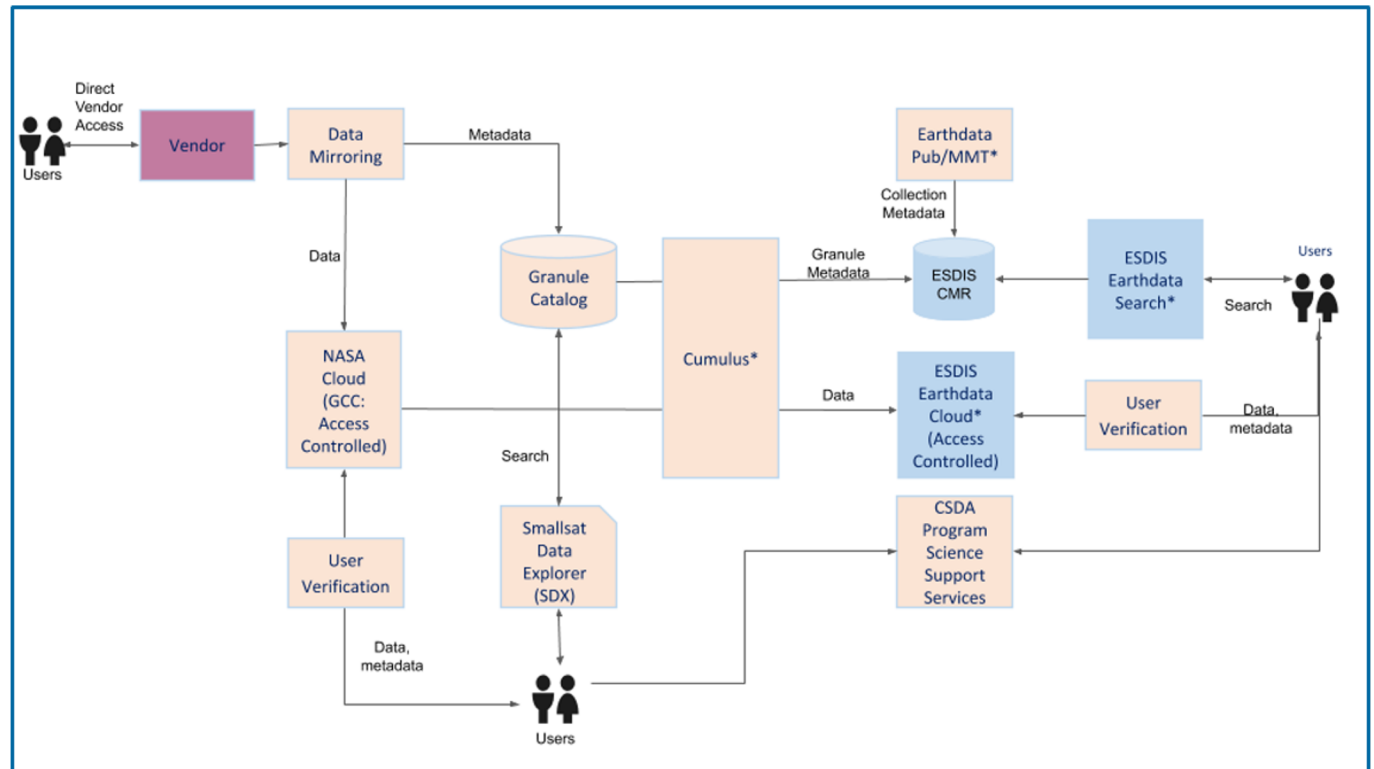
Vendor and Data Product Overview

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	PlanetScope 4 band RGB thumbnail with Skysat RGB thumbnail overlain
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			Spire GNSS-RO L2A atmospheric vertical profile of dry temperature (left)
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)	Maxar WorldView3 L2A surface reflectance RGB thumbnail
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	DESIS L2A (right) surface reflectance and L1A (left) top of atmosphere reflectance RGB thumbnails
EarthDEM	individual strips and mosaics	2009 - Present		2 meters		EarthDEM mosaics for Hawai'i

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

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

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

SpatioTemporal Asset Catalog

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

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

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 Explore largely using previously developed, repeatable processes
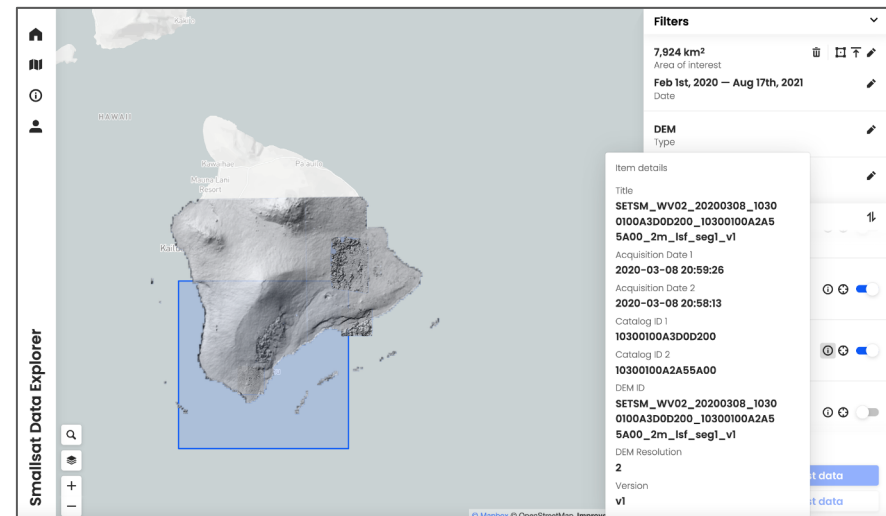
NASA EOSDIS Incorporation

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
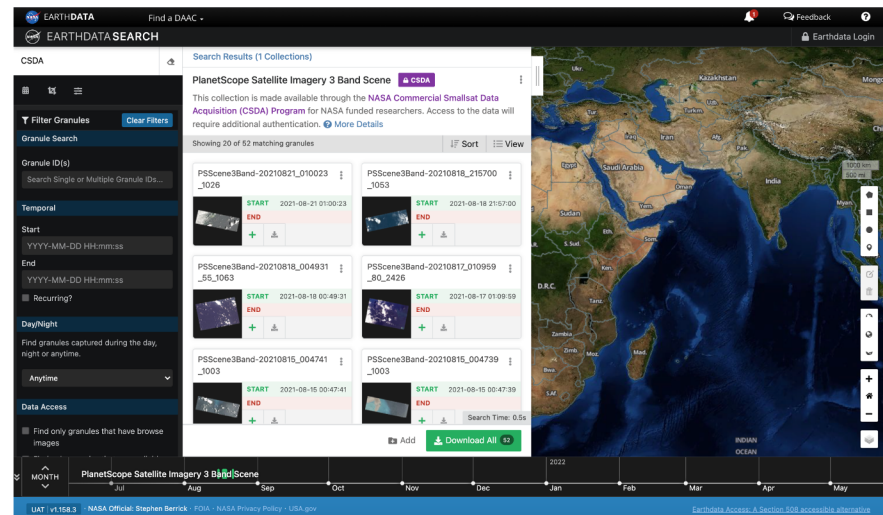
Data Discovery

Data in Action

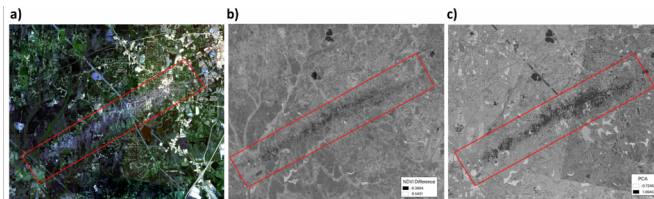- Provide data information and code through stories highlighting science use cases

Story submitted to website

Committed to directory, call Actions to generate Approver HTML

Once reviewers approve story

Call Github Actions to create story HTML and list on site
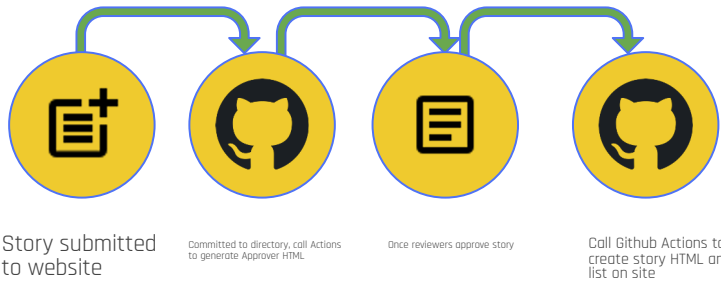
High Value Target Acquisitions

- Contribute to building a valuable data archive by utilizing NASA resources to identify and acquire data from areas of interest
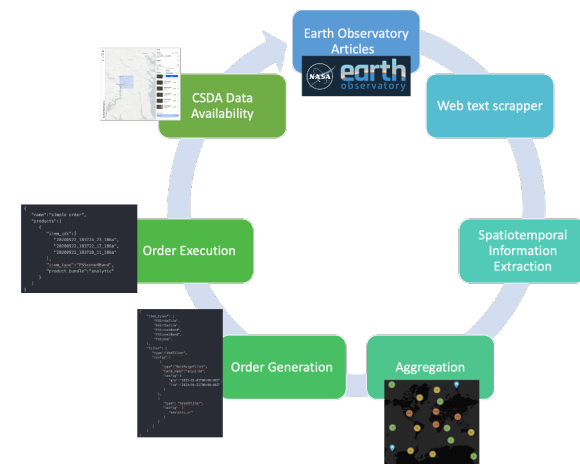
FY22 Activities and Beyond

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.