Commercial Smallsat Data Acquisition (CSDA) Program Update

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CSDAP program objectives

- Establish continuous and repeatable process to onramp new commercial data vendors and evaluate data for its potential to advance NASA's Earth science research and applications activities.

- Enable sustained use of purchased data for broader use and dissemination by NASA scientific community.

- Ensure long-term data preservation through 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 evaluation and scientific use with the European Space Agency.

Data assessment and management - overview

Evaluation

- PIs directly interact with vendors to request and access data
- Vendors provide a list of requested data
- NASA mirrors data
- Support scientific evaluation

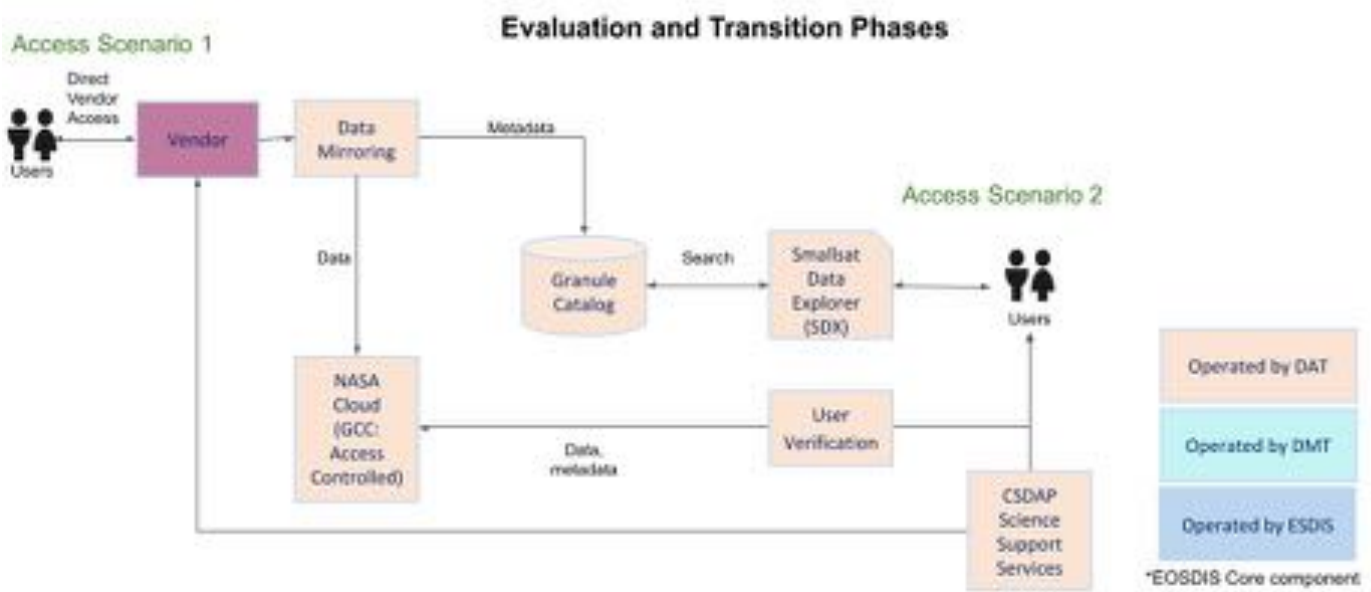
Transition

- Manage and archive mirrored data in NASA cloud
- Extract metadata, develop catalog
- Provide search and access to the data (SDX)
- Make data available to NASA funded researchers
    - Verify users
    - Validate quotas

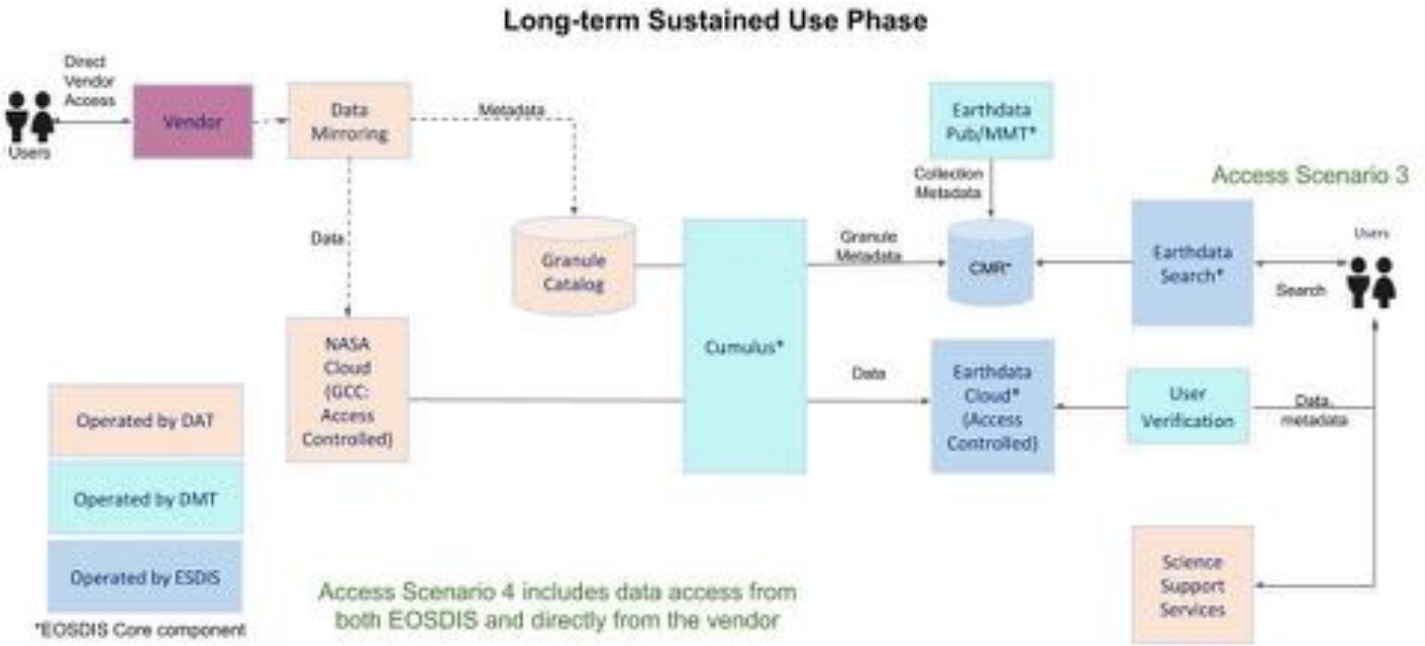
Long-term Sustained

- Users will first search whether the data to be requested is already available in NASA catalog (already mirrored from vendor)
- Eventually Earthdata cloud will host the data long-term and provide an egress solution
- All purchased data will be made available to NASA funded researchers*

System


Evaluation and Transition Phases
Access Scenario 1
Direct Vendor Access
Users
Vendor
Data Mirroring
Metadata
Data
Granule Catalog
Search
Smallsat Data Explorer (SDX)
Access Scenario 2
Users
NASA Cloud (GCC: Access Controlled)
Data, metadata
User Verification
CSDAP Science Support Services
Operated by DAT
Operated by DMT
Operated by ESDIS
*EOSDIS Core component

System


Long-term Sustained Use Phase
Direct Vendor Access
Users
Vendor
Data Mirroring
Metadata
Data
Granule Catalog
NASA Cloud (GCC: Access Controlled)
Cumulus*
Granule Metadata
Data
Earthdata Pub/MMT*
Collection Metadata
CMR*
Earthdata Search*
Access Scenario 3
Users
Search
Earthdata Cloud* (Access Controlled)
User Verification
Data, metadata
Science Support Services
Operated by DAT
Operated by DMT
Operated by ESDIS
*EOSDIS Core component
Access Scenario 4 includes data access from both EOSDIS and directly from the vendor

Smallsat Data Explorer (SDX)

Search and discovery of all commercial data archived by NASA

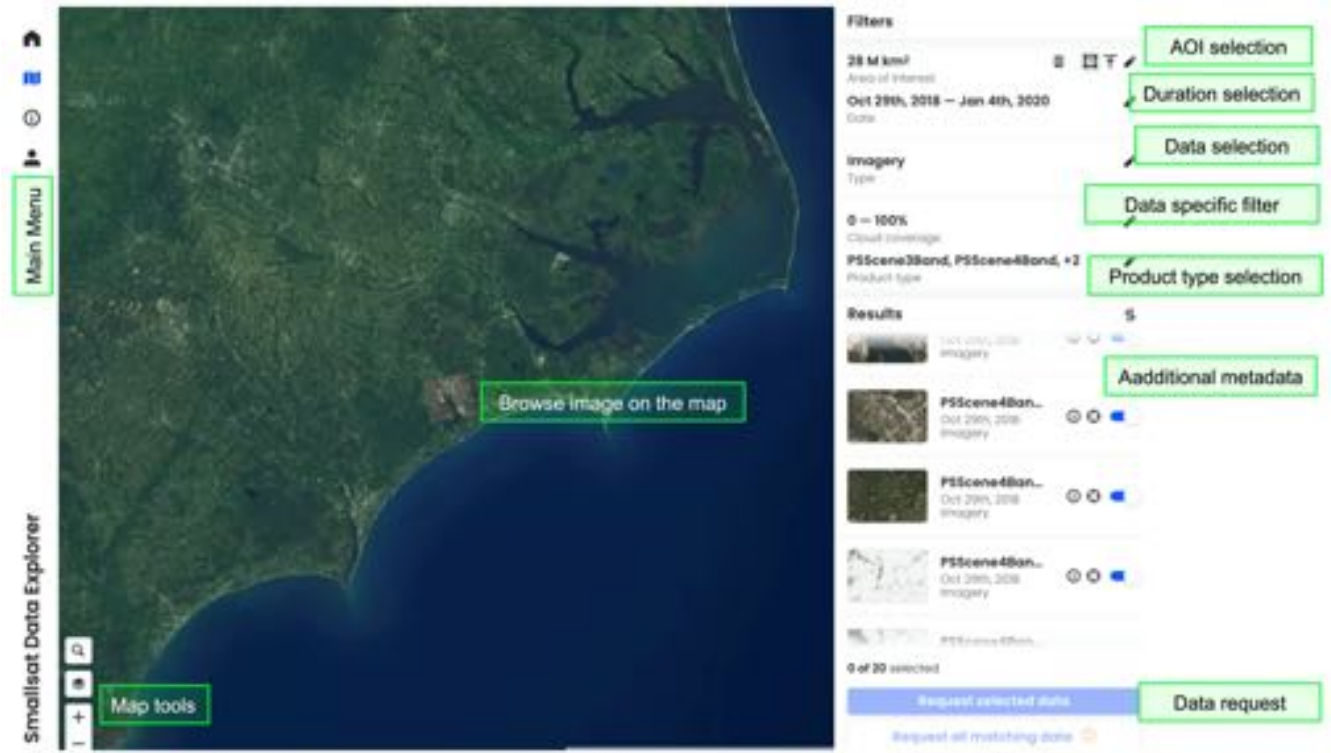
Metadata extracted during mirroring

User authentication

User data request approval process

Enforce EULA acceptance

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



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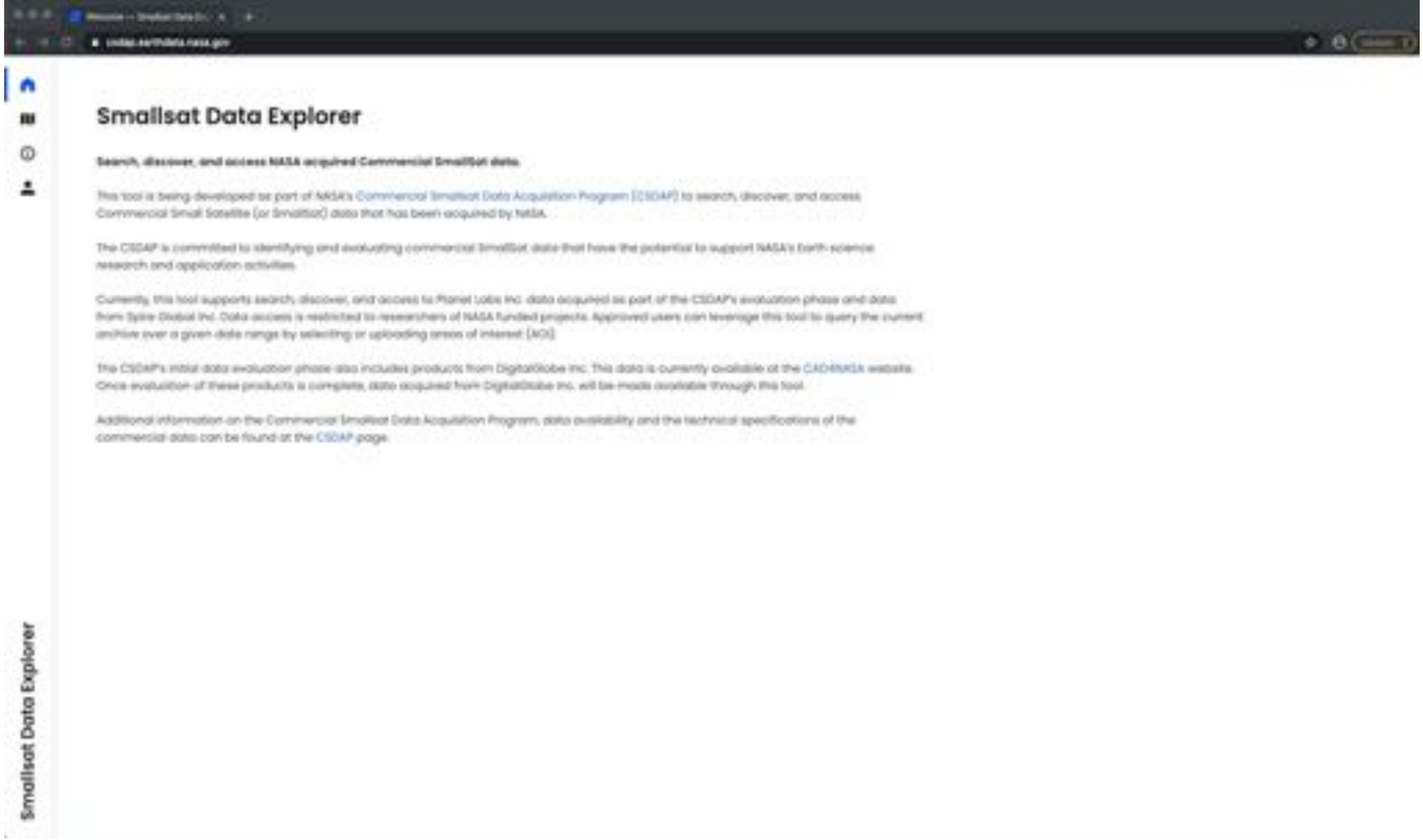

Smallsat Data Explorer
Search, discover, and access NASA acquired Commercial SmallSat data.
This tool is being developed as part of NASA's Commercial Smallsat Data Acquisition Program (CSDAP) to search, discover, and access Commercial Small Satellite (or Smallsat) data that has been acquired by NASA.
The CSDAP is committed to identifying and evaluating commercial SmallSat data that have the potential to support NASA's Earth science research and application activities.
Currently, this tool supports search, discover, and access to Planet Labs Inc. data acquired as part of the CSDAP's evaluation phase and data from Spire Global Inc. Data access is restricted to researchers of NASA funded projects. Approved users can leverage this tool to query the current archive over a given date range by selecting or uploading areas of interest (AOI).
The CSDAP's initial data evaluation phase also includes products from DigitalGlobe Inc. This data is currently available at the CADRNASA website. Once evaluation of these products is complete, data acquired from DigitalGlobe Inc. will be made available through this tool.
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 page.
Smallsat Data Explorer

Data in action:

Projects:

Planet Labs, Digital Globe, and Spire Global

Burnt Area Mapping In South/Southeast Asia using Multi-Satellite and Very High-Resolution Planet data

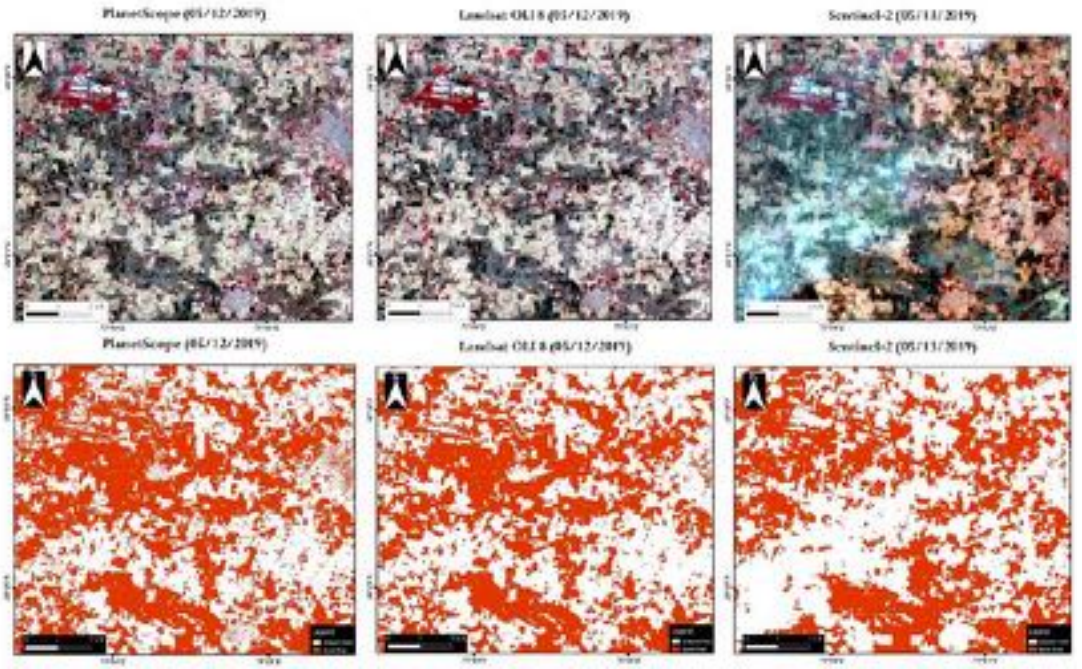
Krishna Vadrevu, Marshall Space Flight Center

Purpose: Global monitoring of burned areas for air quality and climate studies

Study Objective: Assess the potential use of PlanetScope imagery for monitoring of burnt areas in agriculture and forested regions of India

Imagery: PlanetScope, Landsat-8, Sentinel-2

Findings: The imagery allowed mapping of burnt areas and delineation of field borders. Using single date, 90% cloud free imagery from Planet, we were able to detect 5% more burnt area than Landsat, and 9% more burnt area than Sentinel-2. We employed a more robust atmospheric correction algorithm. Because of its higher spatial and temporal resolution PlanetScope imagery allowed a more effective capture of transient biomass burning events.



Visible imagery and burnt area extent derived from PlanetScope (left column), Landsat (middle column), and Sentinel-2 (right column) over Barnala, Punjab, India. Using a single date 90% cloud free imagery, PlanetScope was able to detect 5% percent more burnt area than Landsat and 9% more than the Sentinel.

Evaluation of the Potential to Use Commercial High-Resolution Multispectral Imagery for Monitoring Small Water Bodies in West Africa

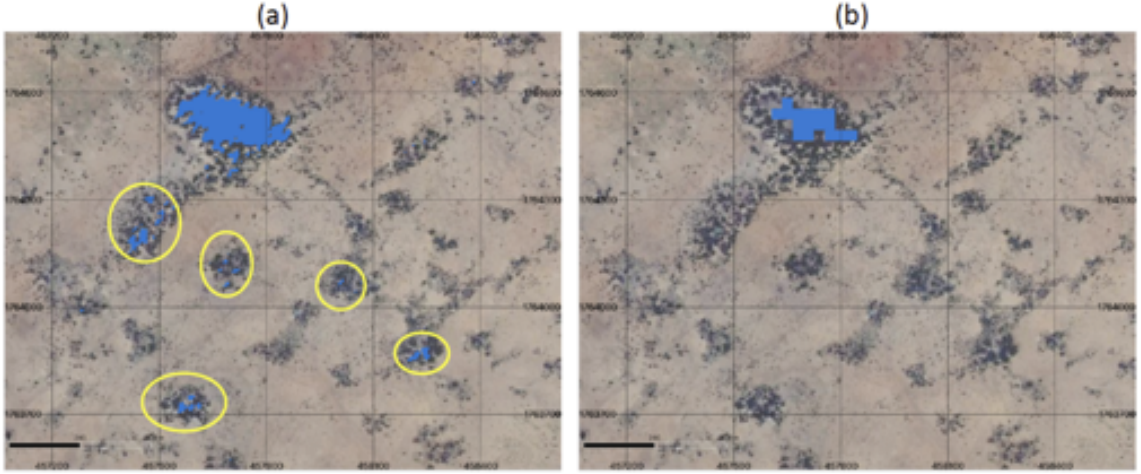
Ashutosh Limaye, Marshall Space Flight Center

Purpose: Improve NASA's ability to detect and monitor freshwater resources in Africa and elsewhere

Study Objective: Identify and monitor small ephemeral water bodies in West Africa that are currently being left out due to the use of medium resolution, less frequent satellite imagery

Imagery: PlanetScope, Landsat-8

Findings: Higher spatial and temporal resolution commercial imagery allows mapping of small ephemeral water bodies. The capability will assist pastoralists in West Africa better guide their herds, increasing their resiliency to changes in climate.



Zoomed in image from study area, displaying the additional ponds (identified in yellow circles) detected by high resolution PlanetScope data (a) vs Landsat 8 Imagery (b) at threshold > 40% for year 2018.

	PlanetScope area with water (km^2)			Landsat area with water (km^2)		
Threshold	Annual	Summer	Rain	Annual	Summer	Wet
30	7.93	0.40	9.39	2.31	0.17	1.29
35	4.49	0.21	5.65	1.40	0.10	0.86
40	2.47	0.12	3.38	0.90	0.06	0.61
45	1.35	0.07	2.02	0.60	0.05	0.45
50	0.75	0.05	1.20	0.42	0.03	0.34

A table displaying the water availability area (in square kilometer) as detected by PlanetScope and Landsat. Large water bodies (e.g., river) are excluded from this analysis of high-resolution imagery to detect previously unknown water bodies.

Augmentation to Disaster Response and Coordination Activities at Marshall Space Flight Center to Support NASA Commercial Data Buy Pilot

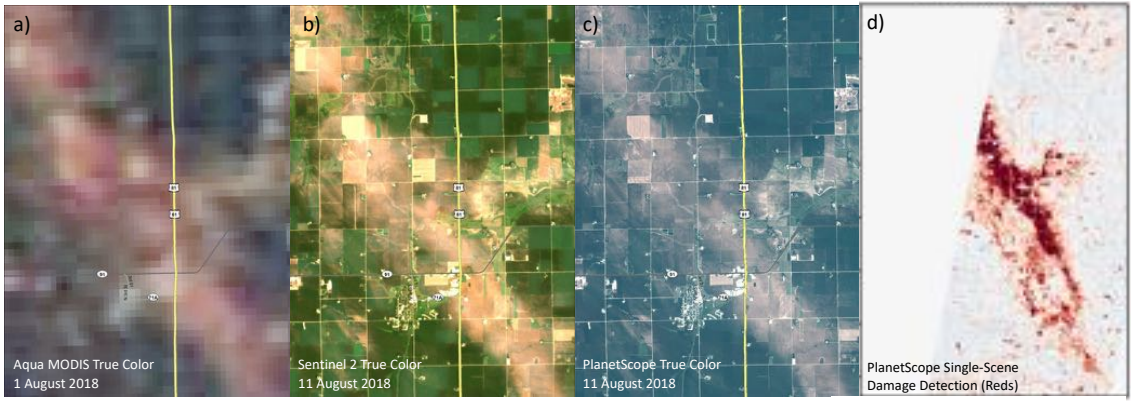
Andrew Molthan, Chris Hain, Marshall Space Flight Center

Purpose: Improve NASA's ability to support disaster response

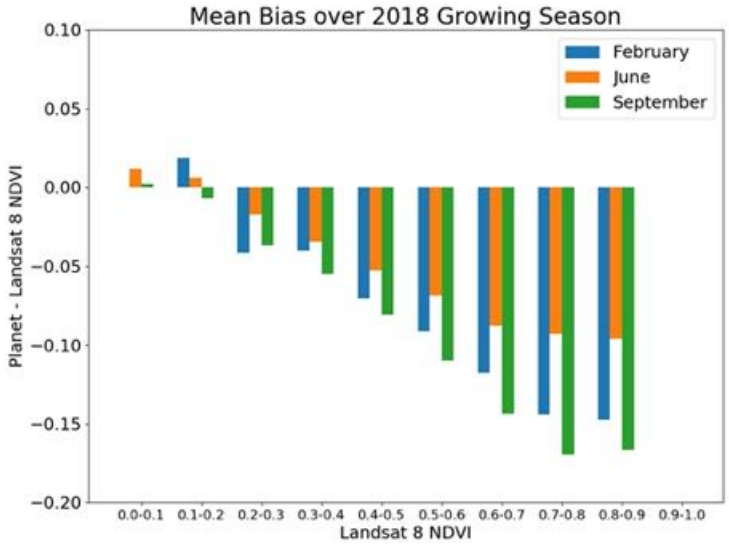
Study Objective: Mapping of damage from severe wind and flood over agriculture and forested areas

Imagery: PlanetScope surface reflectance product, Sentinel-2, LandSat-8

Findings: We found significant differences in surface reflectance and NDVI derived from PlanetScope, Landsat, and Sentinel-2 imagery over agriculture and open (flood) water. For NDVI, the bias between PlanetScope and Landsat seem to vary by overall green vegetation density and time of year. While Planet data provided better temporal sampling, it exhibited a significant amount of among-satellite calibration uncertainty which limited its usability at the advertised repeat frequency.



Hail damage from a July 2018 severe weather event is shown in true color from a) MODIS, b) Sentinel-2, and c) PlanetScope imagery along with d) preliminary extraction of damage region in shades of red through statistical analysis of a post-event Planet scene.



Mean bias as the difference between NDVI derived from PlanetScope and Landsat-8 imagery, binned by Landsat-8 derived NDVI value.

Multi-sensor geohazard assessment along key transportation corridors in high mountain Nepal

Dalia Kirschbaum, Goddard Space Flight Center

Purpose: Improve NASA's ability to understand, detect and accurately predict landslides in support of disaster mitigation and response efforts

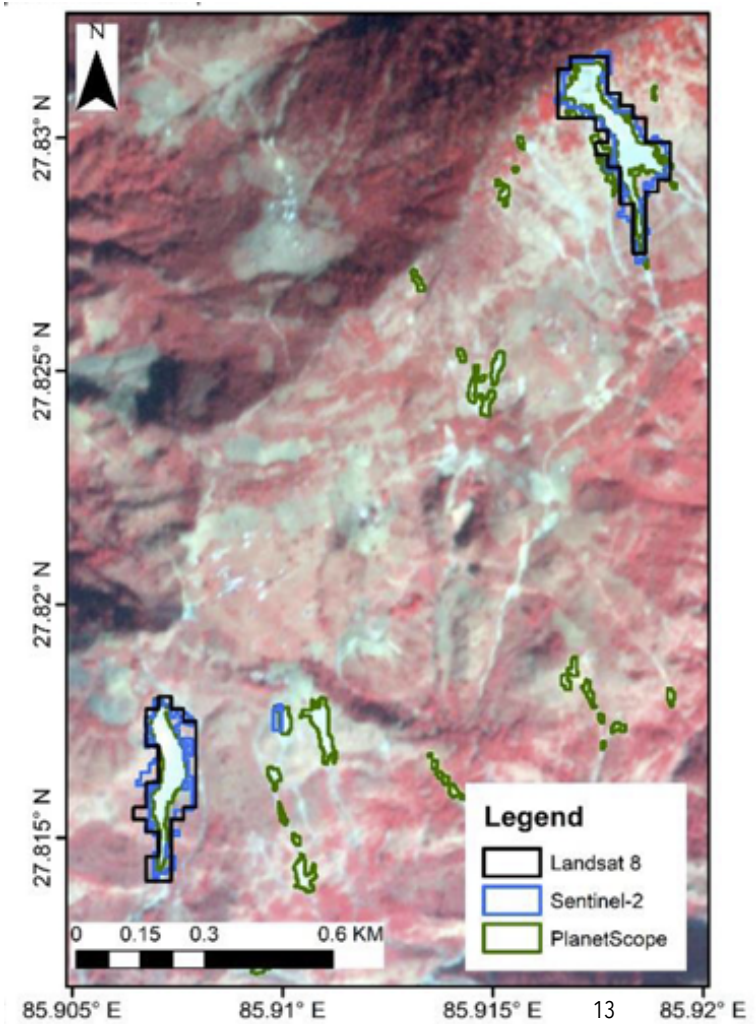
Study Objective: Create multi-temporal landslide inventory for three key transportation corridors in Nepal: the Karnali, Arniko and Trishuli Highway

Imagery: PlanetScope and RapidEye

Findings: We were able to detect up to 94% more landslides when compared to Landsat, and 74% more when compared to Sentinel-2. Access to PlanetScope and Rapideye imagery has been game changer in terms of supporting the timely mapping of major landslides with a high degree of accuracy, and for creating inventories aimed at advancing NASA's landslide modeling capability.

Number of landslides detected:
PlanetScope = 176
Sentinel-2 = 46
Landsat 8 = 11

Percentage of landslides missed relative to PlanetScope:
Sentinel-2 = 74%
Landsat 8 = 94%



Comparison of landslide areas detected by Landsat (black), Sentinel-2 (blue) and PlanetScope (Green). The results highlight the improved accuracy of PlanetScope in identifying smaller landslide areas relative to the other coarser resolution products. The images were acquired on November of 2018 over the Arniko Highway, Nepal.

Precipitation and Glacier Change in High Mountain Asia Over the Modern Era

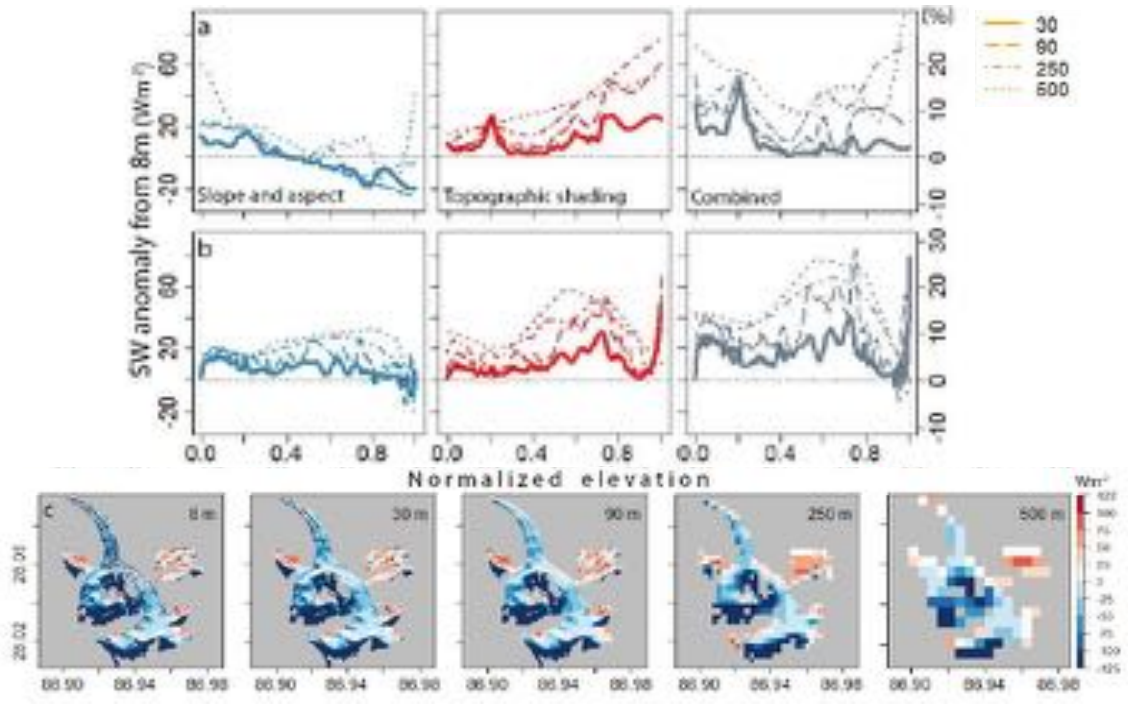
Summer Rupper, University of Utah

Purpose: Achieve process-level understanding of snow and glacier response to anthropogenic forcing

Study Objective: Evaluate the added benefit of supplementing medium resolution imagery with higher spatial resolution commercial imagery for energy balance modeling

Imagery: WorldView-3, GeoEye

Findings: Higher spatial resolution Digital Elevation Model (DEM) derived from commercial imagery improved the reliability of energy balance modeling for glaciers in rugged terrain, such as over High Mountain Asia. The availability of the near-infrared bands and their high radiometric quality improved the ability to differentiate snow from other bright surfaces.

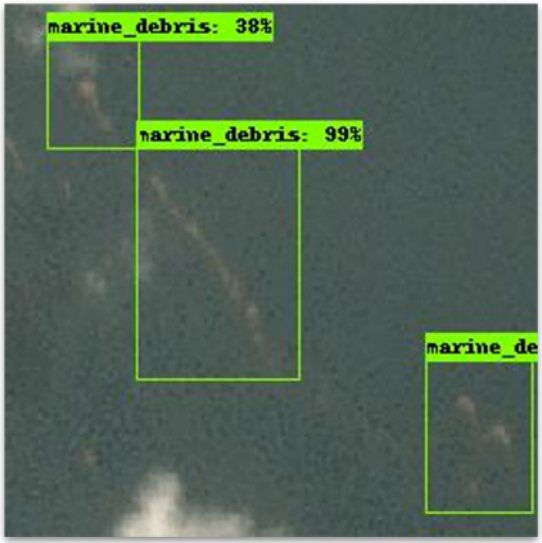


The Shortwave anomaly is the difference between the change in irradiance determined at each coarse DEM resolution relative to the change in irradiance calculated with the 8-m HIMAT DEM. The anomaly is shown at 30-, 90-, 250-, and 500-m resolutions for the East Rongbuk Glacier (a, top panels) and the Lumsamba Glacier (b, middle panels) on March 21. Panel (c) shows the combined change in irradiance due to all terrain attributes on this day at each down sampled resolution for East Rongbuk Glacier.

Overall, incident SW radiation is overestimated when resolution is coarsened. For both glaciers, the combined bias is most impacted by changes in modeled topographic shading and slope/aspect. This holds true for all 10 glaciers in this study.

Marine Debris Detection

IMPACT team



The Use of Spire Radio Occultation Measurements in the GEOS Atmospheric Data Assimilation System

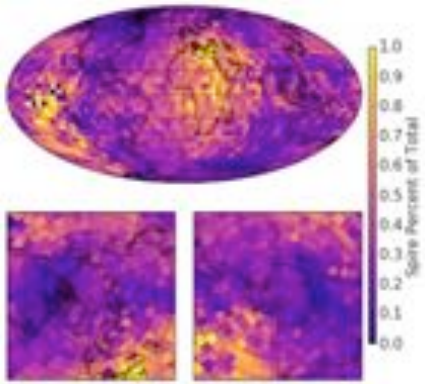
Will McCarty, NASA Goddard Space Flight Center

Purpose: Combine all available atmospheric observations via the Goddard Earth Observing System (GEOS) Atmospheric Data Assimilation System (ADAS) to produce the best multidimensional analysis of the atmospheric dynamic and thermodynamic state

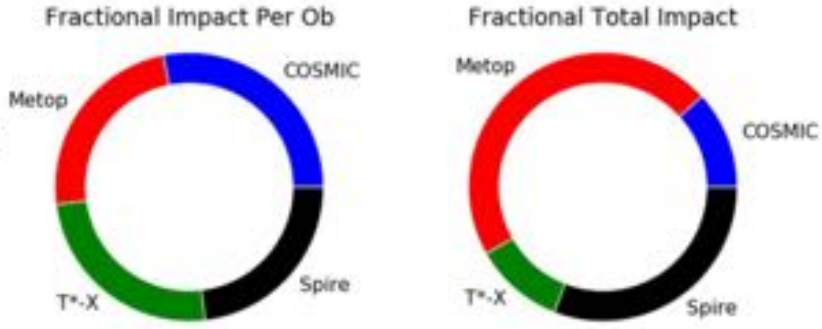
Study Objective: Evaluate the Spire Level 2 bending angle profiles in the context of the GEOS ADAS and other RO observing systems

Data: Spire Level 2 retrievals of Bending Angle

Findings: The Spire observations were found to be generally consistent and complementary to existing radio occultation observing systems. In terms of quantity, the Spire observations accounted for ~20-40% of the total RO observing system. Additionally, these observations were complementary to the other GNSS-RO observing systems in that they filled spatial data voids due to their broad global sampling (top). Statistically, the observations were found to be comparable to other RO observing systems, though there was a noted tropospheric bias in those observations derived from the GLONASS GNSS signals. Their impacts on forecast were found to be comparable to other RO observing systems. No statistically significant impact on medium range forecast (2+ days) was seen, but there was a quantifiable reduction on short-term (24 hour) forecast error via the FSOI metric (bottom). This was comparable to other RO observations when normalized per-observation. Thus, the constellation carried a total error reduction that scaled with the observation counts.



Distribution of the Spire data relative to the other RO observing systems illustrates that they are filling data voids (shown, observations at 00 UTC ± 3 hr)



Contribution of Spire, relative to the rest of the GNSS-RO observing system, to the reduction of 24 hour forecast error within the GEOS atmospheric data assimilation system.

Thank you

Contact: manil.maskey@nasa.gov