Introduction to Planet's New 8-Band Data and Access via NASA's Commercial SmallSat Data Acquisition (CSDA) Program

Dr. Tanya N. Harrison, Director of Strategic Science Initiatives, Planet

Shark Bay, Australia
PLANET’S MISSION

To image the whole world every day, making change visible, accessible, and actionable.
PLANET'S MISSION
To image the whole world every day, making change visible, accessible, and actionable.
# Planet’s Industry-Leading Constellations

## 180+ PlanetScope Dove Satellites

<table>
<thead>
<tr>
<th>Satellite Type</th>
<th>SATELLITES</th>
<th>GSD</th>
<th>CAPACITY</th>
</tr>
</thead>
<tbody>
<tr>
<td>Doves</td>
<td>180+</td>
<td>3.7 m</td>
<td>200 million km²/day</td>
</tr>
<tr>
<td>ORBIT ALTITUDE</td>
<td>475 km</td>
<td></td>
<td></td>
</tr>
<tr>
<td>8 SPECTRAL BANDS</td>
<td>Coastal Blue, Blue, Green I, Green II, Yellow, Red, Red Edge, Near Infrared</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

## 21 SkySat Satellites

<table>
<thead>
<tr>
<th>Satellite Type</th>
<th>SATELLITES</th>
<th>GSD</th>
<th>CAPACITY</th>
</tr>
</thead>
<tbody>
<tr>
<td>SkySat</td>
<td>21</td>
<td>0.65 m</td>
<td>400 K km²/day</td>
</tr>
<tr>
<td>ORBIT ALTITUDE</td>
<td>450 km</td>
<td></td>
<td></td>
</tr>
<tr>
<td>SPECTRAL BANDS</td>
<td>RGB, PAN and NIR</td>
<td></td>
<td></td>
</tr>
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<tr>
<td>25</td>
<td>26</td>
<td>27</td>
<td>28</td>
</tr>
</tbody>
</table>

**Introducing Next-Generation PlanetScope**
PLANTATION, TAILÂNDIA, BRAZIL

Introducing Next-Generation PlanetScope
Dove Builds in 6 Years

- Continuous iterations
- 3-6 month design lifecycle
- Leverage other industries’ R&D
4.29 & 47 million images every day

Area covered: 350 million km² per day, 10x all other commercial sources and public sources (e.g. Landsat/Sentinel combined)

More than 2 times the total landmass of Earth!

496 satellite deployments from 10 rocket types
10 sites in 7 countries

An average of 1700 images for every point on the Earth’s landmass

25TB data per day downlinked

48 groundstation antennas

100% successful first contact

31 successful launches

planet.
## Constellation Overview: Planetscope

<table>
<thead>
<tr>
<th>Mission Characteristics</th>
<th>Sun-synchronous Orbit</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Instrument</strong></td>
<td><strong>PS2</strong></td>
</tr>
<tr>
<td><strong>Orbit Altitude</strong></td>
<td>450 - 580 km [-98° inclination]</td>
</tr>
<tr>
<td><strong>Max/Min Latitude</strong></td>
<td>±81.5° (dependent on season)</td>
</tr>
<tr>
<td><strong>Equator Crossing</strong></td>
<td>9:30 - 11:30 am (local solar time)</td>
</tr>
<tr>
<td><strong>Sensor Type</strong></td>
<td>Four-band frame imager with split-frame VIS+NIR filter</td>
</tr>
<tr>
<td><strong>Ground Sample Distance</strong></td>
<td>3.7 m (approximate)</td>
</tr>
<tr>
<td><strong>Frame Size</strong></td>
<td>24 km x 8 km (approximate)</td>
</tr>
<tr>
<td><strong>Maximum Image Strip per orbit</strong></td>
<td>20,000 km³</td>
</tr>
<tr>
<td><strong>Revisit Time</strong></td>
<td>Daily at nadir</td>
</tr>
<tr>
<td><strong>Image Capture Capacity</strong></td>
<td>200 million km²/day</td>
</tr>
<tr>
<td><strong>Imagery Bit Depth</strong></td>
<td>12-bit</td>
</tr>
</tbody>
</table>
History of Dove payloads (2016-2020)

- **Dove Pilot** (2016):
  - 12 km FOV telescope
  - 4K CCD sensor

- **Dove Classic** (2017):
  - 25 km FOV telescope
  - NIR band
  - JP2K 12-bit FPGA
  - 6K sensor
  - Star tracker

- **Dove-R** (2018):
  - Interference filters
  - Advanced AR coatings
  - Sentinel-2 compatibility
  - 2.5X NIR QE
  - +47MP CCD

- **SuperDove** (2019):
  - Reduced central obscuration
  - Advanced anti-blooming
  - Advanced dark frames

- **SuperDove +** (2020):
  - 35 km FOV telescope
  - 8-bands
  - Low stray light
  - 9K sensor

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SuperDove upgrades PlanetScope to eight spectral bands

**BLUE**

Useful for bathymetry applications, i.e., monitoring water quality and algal blooms.

Monitoring aerosol particles, such as smoke and haze in the atmosphere.

Improves accuracy of land cover classification for a breadth of cover types.

**GREEN II**

Monitoring vegetation health, productivity, and volume.

More accurate vegetation & crop classification (often used with the yellow band).

**RED**

Improves accuracy of land cover classification for a breadth of cover types.

Analyzing sediment load in water & coastal applications.

**NEAR INFRARED**

Detecting vegetation stress & tracking senescence.

Estimating nitrogen & chlorophyll concentration in crops.

**RED EDGE**

Detecting vegetation stress earlier, more finely, and more consistently through the year than via NDVI, esp. in areas of thick foliage.

Measuring water turbidity & quality.

Introducing Next-Generation PlanetScope
Spectral Bands of the Dove and SuperDove Satellites

- **Dove Pilot**
  - RGB
  - 2672 pixels
  - 1 pixel = 5.5 µm

- **Dove**
  - RGB
  - 6600 pixels
  - 1 pixel = 5.5 µm
  - 2-stripe raw frame

- **Dove-R**
  - Green II
  - Red
  - NIR
  - Blue
  - 4-stripe composite
  - 6600 pixels
  - 1 pixel = 5.5 µm

- **SuperDove**
  - RGB
  - 8880 pixels
  - 1 pixel = 5.5 µm
  - 660 pixels spacing
From Doves towards Sentinel **through the years**
From Doves towards Sentinel through the years

Dove Classic
Dove-R
SuperDove

Sentinel-2

PLANETSCOPE

Coastal Blue 431-452 nm*
Blue: 465-515 nm
Green I: 513 - 549 nm
Green II: 547 - 583 nm*
Yellow: 600-620 nm*
Red: 650 - 680 nm
Red-Edge: 697 - 713 nm
NIR: 845 - 885 nm

(*) avail. after 8-band release

Turning off this month
SuperDove is **natively interoperable with Sentinel-2**

All 9304 orthotile events between a Superdove and Sentinel-2 for September. This dataset covers 19 separate dates in September and shows the results of the initial calibration.
Now with eight spectral bands

Introducing Next-Generation PlanetScope

red edge, yellow, coastal blue
Equipment Failure Use Case
Marion County, Illinois

Introducing Next-Generation PlanetScope
Monitoring water quality use case
Introducing Next-Generation PlanetScope
Improved visual sharpness & clarity

Pearl Harbor, Honolulu, HI

Before

Introducing Next-Generation PlanetScope

After
Improved Spectral Band Alignment

Before

After
Improved Spectral Band Alignment

Before

After
Harmonized Data for More Consistent Time Series

NORMALIZED DIFFERENCE VEGETATION INDEX (Sadat City Region, Egypt)

Introducing Next-Generation PlanetScope
Remote sensing research demonstrates consistently high-accuracy sensor fusion between Planet data and other Earth Observation datasets

Latte and Lejeune 2020 Remote Sensing, fused Dove and Sentinel-2 imagery to achieve 2.5m superresolution data using Residual Convolutional Neural Networks, stabilizing radiometry across time-series and multiple S2 target sites.

Kimm et al. 2020 Remote Sensing of Environment, fused Dove and MODIS imagery to achieve 3m resolution LAI with STAIRS algorithm

Wang et al. 2020 Remote Sensing of Environment, fused Dove and MODIS imagery using histogram matching to explore dense tropical forest phenology
Understanding how Planet’s data is used today

~1,800 peer-reviewed publications & conference papers:
www.planet.com/pulse/publications

Planet data used to understand surface deformation and other displacement events in near-real time, in combination with other sensors

Chen et al. 2020 Nature Communications, used Planet and Sentinel-2 imagery to measure surface deformation caused by the July 4, 2019 Ridgecrest earthquake. The authors reported that Planet imagery was collected July 4 (pre-) and July 5 (post-quake), versus June 28 and July 8 with Sentinel 2. Panel c shows a strong correspondence between the Planet and Sentinel displacement estimates.

Kirschbaum et al. 2019 Frontiers in Earth Science, used Dove, RapidEye, and Sentinel-2 data to see how these data could benefit natural hazard assessment within High Mountain Asia, looking at the complex interplay between humans, infrastructure, and ecosystems.

Bradley et al. 2019 Nature Geoscience, analyzed landslides triggered by 2018 M7.5 Palu earthquake via PlanetScope images captured directly before and after the earthquake.

Surface deformation; Earthquakes; Geohazards;

See also, e.g., Mazzanti et al 2020, Remote Sensing Milliner and Donnellan 2020, Seismological Research Letters Aldeghi et al. 2019, Remote Sensing
Deadly Flash Flood in India Triggered by Landslide

- On Feb 7, 2021, a **massive flash flood** in the state of Uttarakhand killed dozens and washed away two hydroelectric power stations.
- Initial reports suggested a glacial collapse triggered the flood.
- PlanetScope images taken **27 minutes apart** caught a landslide as it was happening—including **catching the destruction of one of the power stations in that time interval**—and demonstrated it was the true culprit behind the flood.
- Scientists analyzed these images **within hours of the landslide** with a coordinated response at Planet to task high-resolution SkySat coverage.

[Science News coverage](#)
Landslide Caught in Progress; Power Station Destroyed
2018 Sulawesi Earthquake

- On September 28, 2018, a magnitude 7.5 earthquake struck Indonesia near a provincial capital city, Palu.

- The quake triggered a tsunami and some of the largest soil liquefaction mudflows ever observed, killing an estimated ~5000 people, and causing widespread destruction of infrastructure.

- Dr. Kyle Bradley of the Earth Observatory of Singapore: “We were able to use PlanetScope images captured directly before and after the earthquake, which allowed us to focus on and isolate the landsliding caused by ground shaking.”

- Bradley’s team found that based on the locations of the mudflows, rice farming practices in the area played a significant role in creating the conditions for the massive landslides to occur with such a strong earthquake.
Displacement ~10 m!
Displacement After Palu Earthquake: Analysis Within Hours

Co-Seismic Displacement
Palu Fault Segment

Legend
Displ m
0.04
1.25
2.5
3.63
4.88
6.03
7.23
8.43

BaseMap data @OpenStreetMap

Image Correlation w/MiroMac
Imagery Source @Planet 2018

Dr. Vukanic Sotiris @ 2018
Understanding how Planet’s data is used today

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Coral reef bathymetry, habitat classification;
Flooding;
Stream discharge and sediment transport;
Marine ecosystems;

See also, e.g., Li et al. 2019, Remote Sensing of Environment

Kikaki et al. 2020 Remote Sensing, used Planet to track the discharge of plastic debris in the Caribbean Sea

Kääb et al. 2019 Hydrology and Earth Systems Science, used Planet imagery to track intra-day river flow rates in the arctic, leveraging multiple Dove passes separated by only a few seconds.

Tay et al. 2020 Scientific Data, used dense time-series Planet imagery to verify SAR analyses (Sentinel-1 and ALOS 2) of flooding caused by Typhoon Hagibis
Water Quality Changes During COVID Lockdown

Analysis published within months of observations

- COVID lockdowns in Europe led to dramatic reductions in vessel traffic in Venice, Italy.
- Behavior changes in watercraft were visible within Planet imagery.
- Niroumand-Jadidi et al. (2020) leveraged Planet data to generate estimates of total suspended sediments, exploring water attenuation in Dove imagery.

Above, true color image during Lockdown; Left: Total suspended solids before & during lockdown.

“The high spatial resolution in combination with daily revisits of the PlanetScope constellation potentially enables advances in near real-time monitoring of inland/coastal aquatic systems.”

Niroumand-Jadidi et al. 2020 (Remote Sensing)
Using PlanetScope to Estimate Methane Emissions from Wetlands

- Wetlands emit methane into the atmosphere when water levels decline.
- Hondula et al. (2021) used 421 PlanetScope images covering 5,118 forested wetland areas over the course of one year to see how much the wetlands changed in size.
- Found wetlands <1 hectare are responsible for the majority of methane emissions—requiring high-resolution imagery to be spotted.

“Understanding the source of methane is important for mitigation strategies and policies aimed at reducing carbon emissions from local to global scales.”
Shoreline Changes from Cyclone Oma

- Cat 2; struck Feb 2019

- Kelly and Gontz (2020) used 3-m PlanetScope data to map the high water line along 200 km of coastline
  - Not resolvable with Landsat or Sentinel-2
  - Planet captured images with few enough clouds to see the shoreline before and immediately after the cyclone

Kelly and Gontz (2020), Journal of Coastal Research
Image: NASA Worldview, EOSDIS
Shoreline Changes from Cyclone Oma

Kelly and Gontz (2020), *Journal of Coastal Research*

Changes in the shoreline visible in PlanetScope imagery pre- (top row) and post-Oma (bottom row). The red lines in the post-Oma imagery denote changes compared to the green lines from the pre-Oma imagery.
Understanding how Planet’s data is used today

Planet data used to produce large scale estimates of air quality, using CNNs to link imagery with air quality data from ground stations

Zheng et al. 2020 *Atmospheric Environment*, fused Planet imagery with ground-station based PM 2.5 air quality sensors using CNNs, allowing them to generate predictive maps of estimated PM 2.5 at scale in China.

Shendryk et al. 2019 *ISPRS Journal of Photogrammetry and Remote Sensing*, developed cloud- and cloud-shadow masking algorithms using CNNs. “The performance of our CNN models was also comparable to the state-of-the-art methods (i.e. Sen2Cor and MACCS) developed specifically for classifying cloud and shadow classes in Sentinel-2 imagery.”

Atmospheric correction; Air quality; Cloud masking

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www.planet.com/pulse/publications
Planet data used to understand cryosphere dynamics, including permafrost, arctic lakes, and glacier flow rates


Glacier flow rates and hazards;
Optical flow;
Permafrost dynamics;
Snow depth and seasonality;

See also, e.g.,

~1,800 peer-reviewed publications & conference papers:
www.planet.com/pulse/publications

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Collapse of the Last Intact Arctic Ice Sheet

- On July 30, 2020, the Milne Ice Shelf in the Canadian Arctic broke apart, triggered by warm air temperatures and offshore winds.

- Planet captured imagery immediately before and after the collapse.

- Growing melt ponds visible on the ice sheet leading up to the collapse—a potential early warning sign.

- BBC News coverage.
Seasonal changes of high-latitude lakes

- Used **thousands** of Dove images to track near-daily changes in water extent via machine learning across Alaska and Northern Canada
- Revealed that in some areas, lake shorelines **fluctuated much more widely than previously known**
- Suggests these lakes are potentially **emitting more greenhouse gases** than previously thought
- [Brown University coverage](#)
Accessing Planet Data through NASA’s Commercial SmallSat Data Acquisition (CSDA) Program
Data access for all researchers funded by NSF and/or any U.S. federal civilian agency

Data is available for scientific, non-operational research purposes

What is included?

- PlanetScope with 30-day latency*
- RapidEye archive
- 5,000,000 km² initial quota per user*

What is not included?

- SkySat tasking + archive
- PlanetScope + SkySat Basemaps

Questions?

nasa_cs@federal.planet.com

*Exceptions may be approved by NASA on a case-by-case basis
Planet Imagery Usage Terms

**PlanetScope and RapidEye data are provided under a Scientific Use License.**

- Imagery can be used for the purpose of conducting experiments, evaluation, research, and/or development, including applied research
  - **Cannot** be used for the development of commercial products or services
  - **Cannot** be used for operational work (i.e., resource management, facility monitoring, regulation/compliance enforcement, law enforcement)

- Derivative products (i.e., maps, figures, etc.) **can be used** in conference presentations, journal publications, and media releases about your research
  - Original imagery **cannot** be shared with researchers not registered with CSDA
  - Products using Planet imagery should be noted as such in the caption information where possible

- Use this citation in publications when Planet imagery is used:
Apply here: go.planet.com/nasa

NASA

Commercial SmallSat Data Acquisition Program

The Commercial Smallsat Data Acquisition (CSDA) Program was established to identify, evaluate, and acquire data from commercial providers that support NASA’s Earth science research and application goals.

Through this program, all researchers funded by any U.S. federal civilian agency and/or the National Science Foundation have access to Planet’s vast archive of PlanetScope imagery for scientific use and Earth science applications for societal benefit.
Let us know when you’re going to publish something, or present at a conference—we’d love to see what you’re doing with the data!
PlanetScope Imagery Basics
How our satellites collect images

Our satellites take many overlapping images as they circle the Earth.

Overlaps are necessary to ensure we provide gap-free images.

Each image is called a scene.
## PlanetScope Data Products

<table>
<thead>
<tr>
<th>Basic Scene</th>
<th>Ortho Scene</th>
<th>Ortho Tile</th>
</tr>
</thead>
<tbody>
<tr>
<td>Scaled Top of Atmosphere Radiance (at sensor)</td>
<td>Orthorectified</td>
<td>25 x 25 km tiles comprised of consecutively acquired scenes</td>
</tr>
<tr>
<td>No atmospheric or terrain correction</td>
<td>Terrain corrected</td>
<td>Orthorectified</td>
</tr>
<tr>
<td>Not map projected</td>
<td>Scaled Top of Atmosphere Radiance (at sensor) product</td>
<td>Radiometrically, sensor, and geometrically corrected</td>
</tr>
<tr>
<td></td>
<td>Visual (8-bit)</td>
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<tr>
<td></td>
<td>Surface Reflectance product</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Analytic (16-bit)</td>
<td></td>
</tr>
<tr>
<td>Designed for users with advanced image processing capabilities</td>
<td>Atmospheric correction on Surface Reflectance products</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Map projected (UTM, WGS84 datum)</td>
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</tr>
<tr>
<td></td>
<td>Map projected (UTM, WGS84 datum)</td>
<td></td>
</tr>
</tbody>
</table>
PlanetScope Ortho Tiles

Striped Scenes Collection  Single RGB + IR Striped Scene  Scenes Strip

UTM Grid Overlay  PlanetScope Tiled Product  Single PlanetScope Tile
Downloading Planet Data
Five main options depending on your needs

**Planet Explorer**
Best for: Browsing; small downloads (<100 images)
https://developers.planet.com/docs/apps/explorer/

**Planet QGIS Plug-in**
Best for: QGIS users; more advanced browsing; small & large downloads
https://developers.planet.com/docs/integrations/qgis/

**Planet ArcGIS Plug-in**
Best for: Easily searching for & downloading Planet data directly into your Arc projects
https://developers.planet.com/docs/integrations/arcgis/

**Planet Command Line Interface (CLI)**
Best for: Heavy users that want fine-tuned controls

**Planet Data API**
Best for: Heavy users proficient in Python
https://developers.planet.com/docs/apis/
Say hello to Planet Explorer

Search, Order, Manage
Order Imagery

**Name order**

**Select assets**

**Tools & review**

**Rectified Assets**

**Visual**
- Optimized for visual analysis - RGB only
  - GeoTIFF
  - NITF

**Surface reflectance - 4 band**
- Corrected for surface reflectance: recommended for most analytic applications - includes RGB NIR
  - GeoTIFF
  - NITF

**Surface reflectance - 8 band**
- Corrected for surface reflectance: recommended for most analytic applications - also includes coastal blue, green, FL, yellow, red edge
  - GeoTIFF
  - NITF
  - UDM2

**Analytic radiance (TOAR) - 4 band**
- Calibrated to top of atmosphere radiance - includes RGB NIR
  - GeoTIFF
  - NITF

**Analytic radiance (TOAR) - 8 band**
- Calibrated to top of atmosphere radiance - also includes coastal blue, green, FL, yellow, red edge
  - GeoTIFF
  - NITF

**Order Summary**

**Order name**

**User Guide**

Orders to be placed: 1

*Selections below will be placed as a separate orders

**PlanetScope Scene**

3 items

- Surface reflectance - 4 band
  - NITF
  - UDM2

- Harmonized
Iowa Fields Weather Impact

9 of 9 scenes

- **August 20, 2020**
  - 4-band PlanetScope S...
  - 3m/px

- **August 15, 2020**
  - 4-band PlanetScope S...
  - 3m/px

- **August 7, 2020**
  - 4-band PlanetScope S...
  - 3m/px

- **August 4, 2020**
  - 4-band PlanetScope S...
  - 3m/px

---

**BAND COMBINATIONS**

- RGB
- True color visualization (default)
- CIR
- Color Infrared

**SPECTRAL INDICES**

- NDVI
- Normalized Difference Vegetation Index
- NDMI
- Normalized Difference Water Index
- VARI
- Visible Atmospherically Resistant Index
- MSAVI2
- Modified Soil Adjusted Vegetation Index
- MTVI3
- Modified Triangular Vegetation Index

Not finding an index that meets your needs?
Simplified management with ‘PSScene’ Item Type

A unified catalog for PlanetScope data from all sensors, simplifying searches, access, and data management.

What’s included in PSScene

Access to 3, 4, and 8-band PlanetScope
Calibrated to Sentinel-2
Accessible across the Data, Orders, and Subscriptions API

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"item_types": ["PSScene"],
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  "config": [
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      "type": "AssetFilter",
      "config": ["ortho_analytic_4b_sr"]
    },
    {
      "type": "AssetFilter",
      "config": ["ortho_udm2"]
    }
  ]
}
Integrations 101
developers.planet.com/integrations/

Planet’s integrations extend the usability of Planet APIs and data products within popular work-tools in order to reduce friction in 3rd party application workflows.

GIS Desktop Integrations: ArcGIS Pro & QGIS

GEE Delivery Endpoint

NICFI Basemaps in GEE

Introducing Next-Generation PlanetScope
Planet GIS Integrations: V2.2 Released!

Updates to Search

- Users can search for PlanetScope Scene and apply NIR or 8-band filters
- Users can preview any image as a RGB tile in their GIS map
- Users can still filter for specific satellite sensors if needed (e.g., SuperDove)
- Additionally users can filter for SR assets so that results are limited to only images with SR assets
Planet GIS Integrations: V2.2 Released!

Updates to Search

- Users can still access and order their legacy image types via their saved searches.
- Users will be prompted to update their legacy saved searches to the new PSScene item type.

Introducing Next-Generation PlanetScope
Planet GIS Integrations: V2.2 Released!
Updates to Order

- What users can order is reflective of what they filtered for

  - E.g., if the “NIR” filter is applied you will be able to order 4-band and 8-band assets

- Users can apply the harmonization and clip tools to their orders at check out

Introducing Next-Generation PlanetScope
Planet GEE Delivery Integration
Updates to the Orders API

- Users can deliver PSScene AND PSScene4Band item types via the GEE Delivery destination from the Orders API
- Users can also apply the harmonization tool and clip tool to their GEE deliveries
- We also added delivery support for a few new assets like pansharpened and sr assets for SkySat item types
Planet APIs
The bedrock of the Planet Platform

Data API
Discovery of available PlanetScope data

Orders API
One-time bulk delivery of PlanetScope data

Subscription API
Archive & ongoing delivery of PlanetScope data

Introducing Next-Generation PlanetScope
Scale with Subscriptions API

Search, Processing, and Delivery in a single API.

With one API call, get continuous delivery of the imagery and metadata that meet your criteria.

Set-it-and-forget-it ordering that powers scale and efficiencies
Band math, delivered

- Band math handled by Planet API and calculated indices delivered directly to you
- Simplified imagery management with raw data and indices stored in the same raster
- Up to 15 different calculations per order

Introducing Next-Generation PlanetScope
Harmonization
New sensor target in the APIs

- Haromization to Sentinel-2 radiometry handled by Planet API and delivered directly to you
- Drive consistency within your workflows by having Planet deliver harmonized imagery at scale
- Available in the Orders & Subscriptions API

```json
"tools": [{
  "type": "harmonize",
  "parameters": {
    "target_sensor": "Sentinel-2"
  }
}]
```
Resources to Get Started

- Planet Imagery Product Specifications Guide
- Planet Technical Support Help Center
- Planet Developer Resource Center
- Planet Documentation
- Dove Harmonization Technical Information
- Dove On-Orbit Radiometric Calibration
- Sign up for Planet Science Updates
- NASA CSDA Program
Upcoming Trainings (1–2x/month)

- **April 28, 9AM PT/12PM ET** - Radiometric Calibration of PlanetScope and SkySat Data
  - Dr. Hannah Bourne, Scientific Geospatial Software Engineer at Planet, will describe the process for radiometric calibration of our PlanetScope and SkySat data using near-simultaneous crossovers with Sentinel-2.
  - [Register here](#)

- Sign up for our [monthly Science Update](#) to be notified of future training sessions, new papers from the research community, and more!
What would you do if you could see daily change of _______?
Questions?

tanya@planet.com
BACKUP SLIDES
WHY 2 GREEN-EDGE BANDS?

- When vegetation undergoes stress (loss of chlorophyll due to nitrogen or water stress), the peak of the green reflectance noticeably shifts towards yellow.

- Research strongly suggests that this shift is observable earlier than the red-edge shift towards Red.

What new vegetation indices can be calculated?

1. PRI (Photochemical-Response-Index) \(^\text{(Gamon, et al. 1992)}\)
   - index uses 2 green-edge bands on either side of the green peak in order to observe this shift at 531nm and 570nm respectively.
   - PRI is also related to LUE (Light Use Efficiency). LUE drives photosynthetic fixation of CO2 and determination of GPP (Gross Primary Productivity) for biomass growth modeling.

2. CCI (Chlorophyll-Carotenoid-Index) \(^\text{(Gamon, et al. 2016)}\)
   - CCI is sensitive to seasonally changing chlorophyll / carotenoid pigment ratios, and is a suitable method for tracking photosynthetic activity in evergreen conifers.
   - Helps to improve carbon uptake models
Carbon Mapper

<table>
<thead>
<tr>
<th>SATelliteS</th>
<th>GSD</th>
<th>Capacity</th>
</tr>
</thead>
<tbody>
<tr>
<td>TBD</td>
<td>30 m</td>
<td>93k - 315k km²/day/satellite</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Orbit Altitude</th>
<th>Spectral Bands</th>
</tr>
</thead>
<tbody>
<tr>
<td>400 km</td>
<td>400-2500 nm @ 5 nm spacing</td>
</tr>
</tbody>
</table>
What’s Next? Carbon Mapper

- Accelerate near-term mitigation of methane (CH4) super-emitters - critical 10 year window to meet Paris climate objectives
- Builds upon decades of NASA/JPL heritage in imaging spectroscopy and methane research in collaboration with CARB
- This high sensitivity at the methane absorption band makes this data useful to regulators, oil & gas, dairy and landfill operators to directly mitigate methane emission
- Aligns with Planet’s values to do good
Carbon Mapper enhances and complements Planet’s current capabilities

**Spatial**
The linear dimension on the ground represented by each pixel

- 2015: 3.7m pixel Dove
- 2017: 0.72m pixel SkySat
- **2020: 0.5m pixel SkySat**

**Spectral**
The ability of a sensor to define fine wavelength intervals

- 2015: 4 bands (BGRN) Dove
- 2016: 5 bands RapidEye
- **2020: 8+ bands Dove**
- **2023: ~400 bands Carbon Mapper Tasking**

**Temporal**
The amount of time needed to revisit and acquire data for the exact same location

- 2015: Dove Weekly
- 2017: 2x SkySat; Dove Daily
- **2020: ~10x Daily SkySat Tasking**
Carbon Mapper enhances and complements Planet’s current capabilities

For spectral range comparison purposes only – sensor does not provide uniform reflectance across spectrum.