planet.

PlanetScope

Caleb Mathias GEOG 457/657 28 January 2022

Planet: PlanetScope

- Launcher: Planet (USA)
- Launch date: Multiple launches since 2016
- Comprised of 3 constellation of over 180 satellites total. Each constellation is composed of CubeSat 3U satellites, informally called "Doves":
 - PS2 "Dove Classic"
 - PS2.SD "Dove-R"
 - PSB.SD "SuperDove"
- Launches new satellites every 4 to 6 months
- Spatial resolution: 3.7 4.1 m
- Radiometric resolution: 12 bit
- Temporal resolution: Daily...?



Illustration of a CubeSat 3U satellite [2].

Spectral Resolutions

Dove Classic (PS2)	Dove-R (PS2.SD)	SuperDove (PSB.SD)
		Coastal Blue: 431 – 452 nm
Blue: 455 – 515 nm	Blue: 464 – 517 nm	Blue: 465 – 515 nm
		Green I: 513 – 549 nm
Green: 500 – 590 nm	Green: 547 – 585 nm	Green II: 547 – 583 nm
		Yellow: 600 – 620 nm
Red: 590 – 670 nm	Red: 650 – 682 nm	Red: 650 – 680 nm
		Red Edge: 697 – 713 nm
NIR: 780 – 860 nm	NIR: 846 – 888 nm	NIR: 845 – 885 nm

New Problems...

- Daily revisit time?
- Patchwork of satellites impacts:
 - Radiometric and geometric quality
 - Image consistency
 - 'Analysis ready' imagery
- Issues have hindered wide uptake of this technology



Example of scene-to-scene differences for two PlanetScope images captured on the same day (8 October 2020) by different satellites in the constellation [5].

22 October 2019

10 Kilometers

2 December 2018







22 October 2019

2 December 2018

- Image availability is not quite what was promised... swaths of imagery were inexplicably unavailable
- Unexpectedly hindered our research

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- 4. "Understanding Planetscope Instruments." Planet, Planet, <u>https://developers.planet.com/docs/apis/data/sensors/</u>.
- Frazier, Amy E., and Benjamin L. Hemingway. "A technical review of planet smallsat data: Practical considerations for processing and using planetscope imagery." *Remote Sensing* 13.19 (2021): 3930.
- 6. <u>https://www.planet.com/explorer</u>

PLEIADES-1A AND 1B

- Built by AIRBUS Defence & Space
- Operator is CNES (Space Agency of France)
- 1A launched Dec. 16, 2011
- 1B launched Dec. 2, 2012
- Soyuz launch vehicle
- European Space Centre in French Guiana
- Followed by Pleiades Neo in 2021

- Blue: 430-550 nm
- Green: 490-610 nm
- Red: 600-720 nm
- Near-Infrared: 750-950 nm
- Panchromatic: 480-830 nm
- Multispectral: 2 m
- Pansharpened: 0.5 m
- Panchromatic: 0.5 m
- Radiometric Resolution: 12-bit



3D DEM of Bingham Canyon Copper Mine in Utah (Pleiades-1A)

IMAGE EXAMPLES



Fertilizer Plant Explosion West, Texas (Pleiades-1B)

PROJECT EXAMPLES

- Daily Revisit Interval
- Ideal for large-scale area mapping, including construction, mining, industrial, and crisis/disaster applications
- Moussallam, Y., Barnie, T., Amigo, Á., Kelfoun, K., Flores, F., Franco, L., Cardona, C., Cordova, L., & Toloza, V. (2021). Monitoring and forecasting hazards from a slow growing lava dome using aerial imagery, tri-stereo Pleiades-1A/B imagery and PDC numerical simulation. *Earth and Planetary Science Letters*, 564, 116906. https://doi.org/10.1016/j.epsl.2021.116906
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Pleiades Neo

A P. Mind Mr.

Satellite Constellation

Pléiades Neo Satellite Image - Tucson - USA © Airbus 26 2021

Pleiades Neo

Pan: 30cm

MS: 120 cm

- Deep blue 0.4 to 0.45 μm
- Blue 0.45 to 0.52 μm
- Green 0.53 to 0.59 μm
- Red 0.62 to 0.69 μm
- Red-edge 0.7 to 0.75 μm
- NIR 0.77 to 0.88 μm

14 km Swath

12 bits

Twice daily revisit frequency

Neo 3 April 28, 2021

Neo 4 August 16, 2021

AIRBUS Defense and Space

\$22.50/km^2

Applications

Agriculture

Energy

Engineering

Land Use

Environmental Monitoring

Airport Mapping

Sports and Tourism

Forestry

Landuse

The Sco-Flooddam Project: New Observing Strategies for Flood Detection, Alert and Rapid Mapping. Kettig et al. 2021. IEEE International Geoscience and Remote Sensing Symposium.



Insta House

-1- 25

and in the





BY: MCKENNA CHRISTIANSON

SkySat is a group of 21 satellites. SkySat-1 and 2 are A and B generation and SkySat 3-21 are generation C

The following data was collected for the latest SkySat

These are owned by Planet Labs

Launched by SpaceX on August 18, 2020 Still in orbit

Bands include

- □ Blue: 450 515 nm
- □ Green: 515 595 nm
- □ Red: 605 695 nm
- □ NIR: 740 900 nm
- □ PAN: 450 900 nm

Has a pixel size of 0.50m

Radiometric resolution of 8bit and 16bit



https://www.satimagingcorp.com/gallery/skysat-1/skysat-1-satellite-image-gold-mine-western-turkey/



https://www.satimagingcorp.com/gallery/skysat-1/skysat-1-satellite-imageinfrared-port-fuad-egypt/



https://www.satimagingcorp.com/gallery/skysat-1/skysat-1-satellite-imagenice-cote-dazur-airport-nice-france/

PROJECT EXAMPLE

https://ojs.lib.unideb.hu/landsenv/article/view/83 58/8708

This study is about the classification of vegetation between Planetscope and Skysat

The study area is from Rome Italy

Use of NDVI and supervised classification algorithms (random forest and support vector machine) for each imagery

Data was collected from August 28 2018.

PlanetScope has a resolution of 3m

SkySat has a resolution of 1m



Fig. 5. Samples of each classification. (Left column: Planet, right column: SkySat; input: BANDS or BANDS+NDVI; classifier: RF - Random Forest, SVM - Support Vector Machine)

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- <u>https://earth.esa.int > eogateway > missions > skysat</u>
- <u>https://www.planet.com/products/hi-res-monitoring/</u>
- <u>https://www.satimagingcorp.com/satellite-sensors/skysat-1/</u>

TerraSAR-X



- Launch date: June 15th, 2007
- German satellite mission owned and operated by DLR (German Aerospace Center)
- Operates in the X-Band (3.8 2.4 cm) using synthetic aperture radar (SAR) at 9.65Ghz, or approximately 3.1 cm wavelength, capable of capturing data in several modes and resolutions
- Operational expectancy: 5 years
- As of Jan. 25th, 2022, TerraSAR-X is still fully functional despite being nearly 15 years old. Reportedly, it has at least enough resources to operate until 2026!
- TerraSAR-X is used for generating global DEMs (along with its companion satellite, TanDEM-X), mapping surface movement, environmental and disaster monitoring, and more.
- Currently, its Staring Spotlight mode is the highest resolution available from a commercial SAR satellite

Synthetic Aperture Radar

- Active sensor (beams signals to the Earth's surface and records their reflections, or "echoes"
- Combination of sequential readings simulates typical radar, giving it the "synthetic" nature
- Unaffected by weather or day/night cycle
- TerraSAR-X's sensing modes apply this principle in multiple configurations (scanning with different aperture times and frequencies)
- Search "Staring Spotlight in Motion" on YouTube to see TerraSAR-X in action. You can even see moving cars and boats in real-time!





TerraSAR-X: Surface Model

- Surface model of the Greenland Glacier
 Network
- Glacier movements in the centimetre range can be detected
- Elevation changes due to melting can be detected in the metre range



TerraSAR-X: Rainforest Monitoring

- Surface model of a Bolivian rainforest
 Note the strip-like sections; these are
 - swaths of land cleared for plantations



TripleSat

Travis Fortune 230099642 GEOG457



Overview

- Owned and operated by Twenty First Century Aerospace Technology based out of Singapore
- Launched on July 10, 2015 from the Satish Dhawan Space Centre in Sriharikota, India
- Expected life span of 7 years
- Sun-synchronous orbit at 650km, travelling north to south
- Spaced 120° apart



Characteristics

Band	Wavelength (nm)	
Panchromatic	450-650	
Blue	440-510	
Green	510-590	
Red	600-670	
NIR	760-910	

- 98 minutes to complete an orbit
- < 3m³ unit
- 0.8m panchromatic resolution and 3.2m multispectral
- Up to 45° off nadir
- 10 bit
- 23.8km swath
- 634,441km² collected daily





SYRIA - JORDAN BORDER

can donder prossing

Imagery analysis: 26 June 2017 | Published 11 July 2017 | Version 1.0





Shelter density map at Rukban border crossing

This map Eustrates shelters in the atea of the Rukban bolder crossing on the Syrian-Jordanian dorder. Using a salelite trage collected by the TripleSat assailte on 24 June 2017, UNOSAT incated 9,175 probable shelters along the postanian side of the border. 25 selameters southwest of the At Walcoel crossing. This is a 3.45 percent increase in accorner shefters visible compared to the previous UNDSAT analysis done using an intage onliected 29 April 2017. Due to the small size and the invegularity of the shelters it is likely that some shefters may have bien missed in this analysis, or some shalters uses included enterwously. Dog in the acale of this was and the tack of autable border information at this scale, the border in this map has seen excluded. This map is midwled for Teld support and local authorities should be comulted for boundary information. This is a stellininary analysis and has not yet been validated in the field. Places sand provid feedback to UNITAR-LINOSAT.

Legend Security term Disable density term



Determining the drying out of coniferous trees using airborne and satellite data Guliaeva et al. (2021) Emergency monitoring and post-disaster reconstruction monitoring in the tornado disaster in Yancheng, Jiangsu Yan et al. (2019)