HOW TO

Find the Latest Satellite Imagery in 2021

azavea

Contents

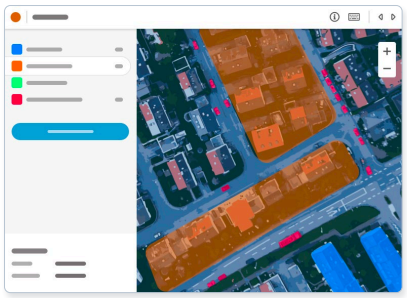
Introduction

At Azavea, we help our clients use machine learning and satellite imagery to map places around the world—we've trained AI to map everything from buildings, to bodies of water, to solar panels and crosswalks. But every project starts with the same question: "Where should I get my imagery?" Clients come to us wanting to know what's the newest, cheapest, and highest-resolution imagery that is best suited to build their model.

There is not one simple answer. In this white paper, we'll break down all satellite imagery providers by:

- Resolution
- Cost
- Update frequency
- Where to find live satellite imagery
- Access type

We'll also share our simple tool for triaging these decisions along with plenty of links to help guide you to the right image for your needs in 2021. Finally, we discuss the limitations of as well as forward-looking trends of satellite imagery.



We even built a tool called GroundWork to help others create machine learning training data from satellite imagery.

Highest resolution satellite imagery

The highest resolution satellite imagery that is commercially available is 30-50 cm "ground sampling distance" (GSD), which refers to the dimensions of each pixel in the image in real space. That may change in the future, as NOAA recently relaxed restrictions on sub-30cm imagery for US-based firms, and new companies are forming around the world in places like the European Union, China, India, and Japan.

There are currently three main suppliers of sub-meter imagery: Maxar, Airbus, and Planet. In all three cases, the process for purchasing imagery involves the same steps:

1. Visit their site
2. Fill out a form with your contact information
3. Wait for a sales representative to reach out to you
4. Go through a consultative sales process
5. Pay for imagery and receive a link to download it

Although the terminology, search portals, timelines, and prices all vary by company and change frequently over time, the process usually follows those steps.

Maxar

Maxar is the largest and oldest US provider of high resolution commercial satellite imagery. They have several satellites in orbit that can capture sub-meter images, including their WorldView-3 satellite which is capable of capturing up to 30cm resolution images.

How to access

To access Maxar data, contact their sales team on their website.

Cost

Cost varies greatly, and Maxar will issue a custom estimate. Generally expect the minimum order quantity to start in the thousands of dollars.

Coverage

Maxar has the largest archive of high resolution imagery in the world, and has global coverage.

Airbus

Headquartered in France, Airbus is one of the largest companies in the world. Their earth observation business is housed within it's Defence and Space unit and has an archive extending all the way back to the mid-80's (years before it was legal in the United States to form a commercial earth observation firm). Their constellation of satellites includes both optical sensors as well as synthetic aperture radar (SAR), a mode of imaging that can famously "see" through clouds and at night.

How to access

To access Airbus data, register for an account on their "GeoStore" or contact their sales team.

Cost

Like Maxar, cost varies greatly, and you should expect a custom estimate. Minimum order quantity will likely also start in the thousands (USD).

Coverage

Airbus has global coverage and estimates their archive covers over one billion square kilometers (the entirety of the Earth's surface is only ~317 million square kilometers and the land mass is less than 30% of that).

Planet: SkySat

Planet is the youngest of the three major high resolution providers outlined here, although they are not small by any normal measure. They image over 250 *million* square kilometers per day with multiple satellite constellations, although most of that is at a much lower resolution than the 30-50cm imagery we are covering here. Their SkySat constellation provides the highest resolution imagery in their fleet, clocking in at ~72cm GSD.

How to access

To access Planet data, contact their sales team here.

Cost

SkySat pricing is not publicly available on their website, but based on our experience, this data can start in the hundreds of dollars for archival imagery over small areas, and in the thousands of dollars for "tasked" imagery.

Coverage

SkySat has the smallest archive of high resolution imagery of the three main options, although as the constellation only recently became complete, the pace of collection has increased.

Free satellite imagery

In terms of raw data, the earth observation industry is undeniably exploding. Investments in freely available data from satellite constellations like MODIS, Landsat, and Sentinel have democratized access to timely satellite imagery of the entire globe (albeit at a lower resolution than you're accustomed to seeing on Google Maps). Meanwhile, cloud providers like AWS and Google Cloud have gone so far as to store satellite data for free, further accelerating global usage of these images.

- Sentinel-2 (the European Space Agency's constellation of satellites imaging the entire landmass of the earth once every five days)
- Landsat 8 (the USGS's satellite which images the earth once every 16 days)
- MODIS (NASA's satellite constellation which images the earth every 1–2 days)

Data from all three of these satellite constellations can be downloaded for free from either Earth on AWS or Google's Earth Engine Catalog. A warning: these are very large files and the imagery itself is lower resolution than what you might expect to see on a typical web map. Make sure you familiarize yourself with the data before downloading a lot of it.

Most frequently updated satellite imagery

Planet: PlanetScope

Planet's "doves," as they are called, are small shoebox-sized satellites that can capture 3-5m imagery of the entire landmass of the earth every single day. Collectively, this is known as their PlanetScope constellation.

How to access

To access PlanetScope data, sign up for a free 14-day trial here.

Cost

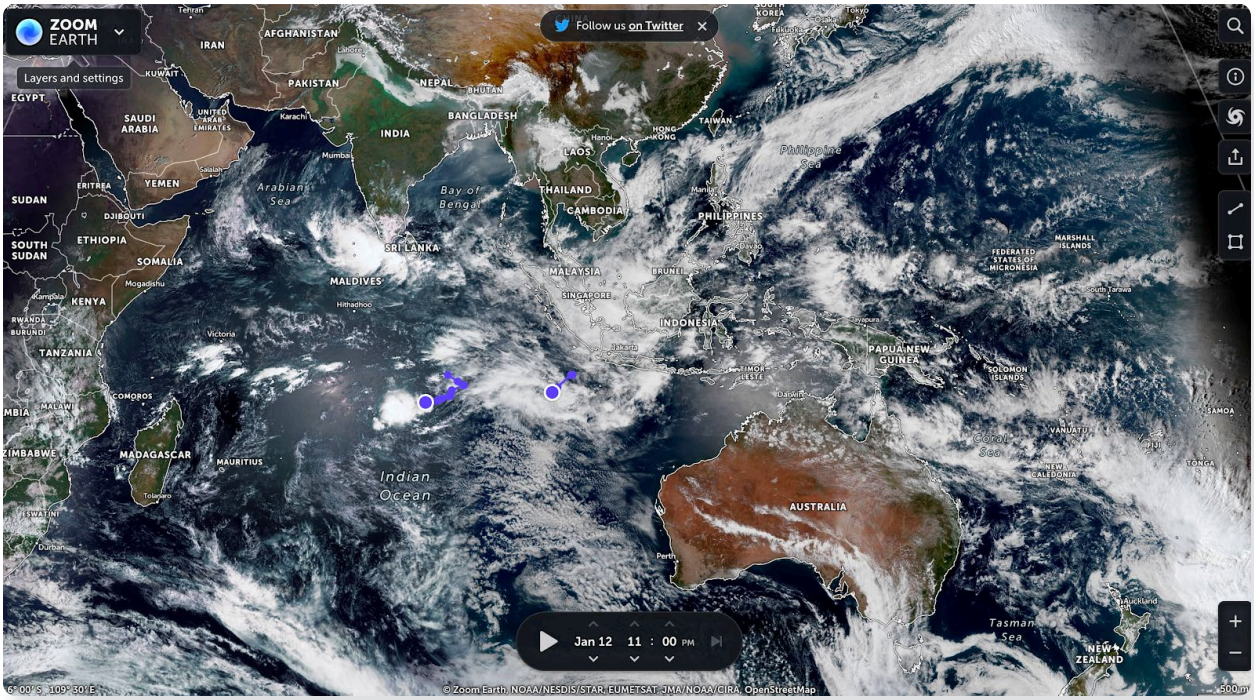
The cost of PlanetScope data depends on the product being purchased—monthly subscriptions to an updated "mosaic" or average of pixel values captured over the month are one popular product. Pricing changes regularly, and will be quoted on request.

Coverage

PlanetScope has global coverage of the landmass of the Earth updated daily, with weekly and monthly mosaics offered as well.

Where can I get live satellite imagery?

The closest thing currently available for “live” satellite imagery of the Earth is captured by satellites used for weather research like Himawari-8. These tend to be very low resolution satellites that are used to track weather patterns globally. One slightly higher-resolution satellite with close to “live” satellite imagery is MODIS, best visualized on the site Zoom.Earth.



Screenshot of satellite imagery in the site Zoom.Earth.

Third-party sites and resellers

If you or your organization is overwhelmed by these options or if you are unsure of how to navigate the buying process, it might be more cost effective to go with a third party reseller. In recent years, there has been an explosion of satellite imagery marketplaces, platforms, and even consultants who help customers navigate the complicated buying process. Below is a list of some of the most popular firms helping customers find and purchase satellite imagery (note that this is a constantly changing industry and this does not represent an exhaustive list).

Consultants

- Apollo Mapping
- European Space Imaging
- Satellite Imaging Corporation
- Satfotos

Marketplaces

- Arlula
- Astraea: Earth on Demand
- Bird.i
- SkyWatch
- Shadowbreak International

Platforms

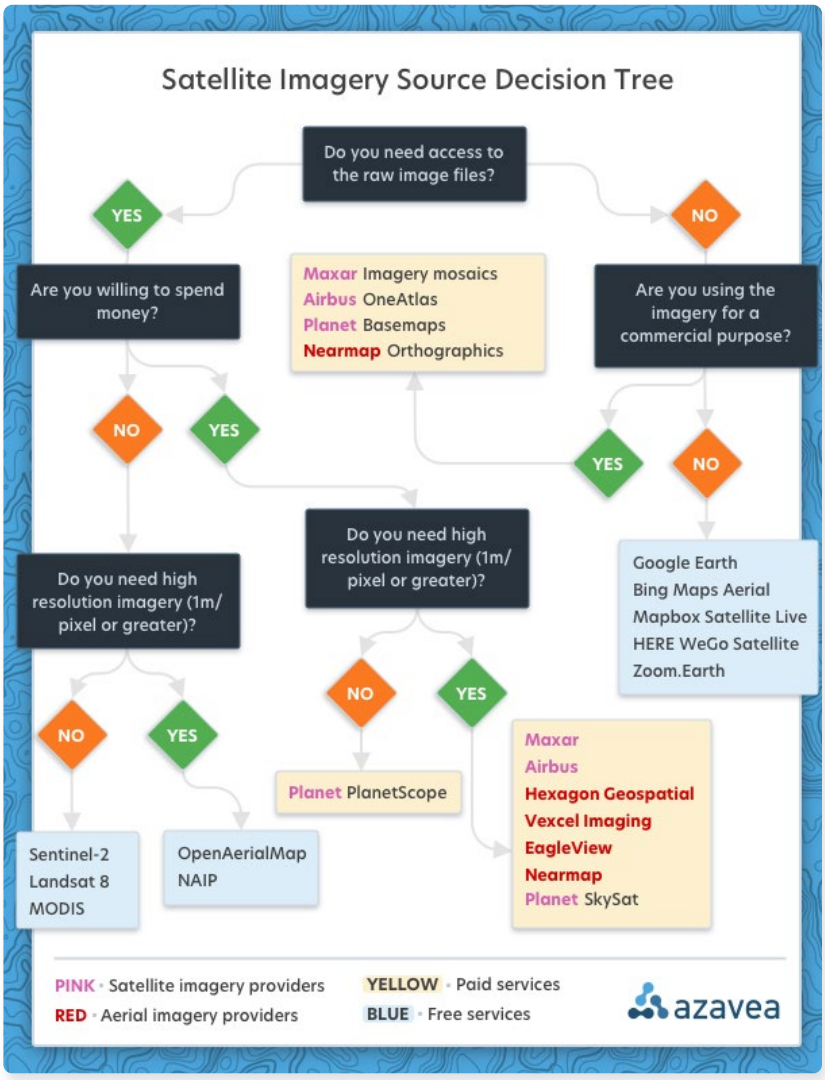
- Descartes Labs
- Orbital Insight
- Picterra
- Slingshot Aerospace
- SpaceKnow
- UP42

How do you decide which satellite imagery to use?

It can be difficult and overwhelming to navigate all of the satellite imagery providers. We've talked through many of the options and features of those imagery sets, but if you're still experiencing decision fatigue, here is a simple flowchart to find the right recent satellite imagery source for your project:

We're sharing our simple tool for triaging these requests according to your needs! Here is a simple flowchart to find the right recent satellite imagery source for your project.

[Download the PDF →]



What's not possible or affordable with satellite imagery

Unfortunately, when most people think of "satellite imagery," they imagine what they see on the satellite layer of Google Maps. Most of that imagery, in highly-populated urban areas, is actually sub-foot aerial imagery. It's impractical to capture imagery of that resolution from space because of the size of the lens required (and the historical regulation forbidding US companies from imaging below 30cm)—although in 2010, we got a glimpse of what kinds of capabilities the US intelligence agency is privy to. Companies like Planet, Maxar, and Airbus that have achieved sub-meter satellite imagery have invested hundreds of millions of dollars into their technology development, launches, and operations. As such, they typically cater to large, enterprise clients (e.g. Google) or government clients mostly purchasing imagery in a national defense setting.

We do not yet live in an era of ubiquitous, affordable, high resolution optical satellite imagery. Archival imagery is often months-to-years old and tasked imagery costs thousands of dollars to commission. Additionally, clouds obscure the sky in the majority of the world at any time, rendering many satellite images unusable.

Because of that, most monitoring use cases for imagery (e.g. tracking a job site or a farm during growing season) are untenable at high resolution. Lower resolution options, including free sources like Sentinel-2, are a great option for monitoring projects but can only distinguish large land cover changes. Most human-scale objects like cars and individual trees are difficult to recognize in imagery above 1m.

What optical satellite imagery is best used for in a commercial setting, today, is baseline mosaics or "basemaps" that provide a sense of what an area looks like but are not updated frequently and do not rely on tasked imagery.

Emerging trends in satellite imagery

In this paper, we cover optical imagery, because it's the most familiar modality of imagery for most people just beginning to research the space. But there are other types of "remotely sensed" data, and in 2021 and beyond we anticipate a large uptick in the number of commercial providers for two of these alternative phenomenology, both of which have their own quirks, advantages, and weaknesses:

Synthetic Aperture Radar (SAR)

Earlier, we mentioned that Airbus maintains a SAR system, but we didn't describe what it is. SAR uses radar pulses to image the Earth—as the satellite orbits the planet, it focuses a radar beam at a particular location and images it from several vantage points. A black-and-white image can subsequently be rendered from the radar return data. SAR is unique because it can "see" equally well at day or night, see through clouds, and even be used to estimate the depth of the surface of the earth.

Hyperspectral data

Many optical sensors can capture non-visible light like near-infrared and short wave infrared. These are called "multispectral" sensors. Hyperspectral sensors don't necessarily capture a wider range of electromagnetic frequencies, but rather, much more finely differentiate between them. Whereas a multispectral sensor may have 5-15 "bands" of specific wavelength signatures it picks up on (e.g. red, blue, green, etc.) a hyperspectral sensor may have 50-250 subdivided bands. This granularity allows for much greater pattern recognition and feature delineation.

Final thoughts

There are plenty of other places to get access to some of the datasets mentioned above. There are also plenty more satellite imagery providers—we simply listed some of the largest ones. If you decide you're going to pay for imagery, do your own homework.

Regardless of what piqued your interest in finding up-to-date satellite imagery in the first place, we hope you find what you're looking for.

Acknowledgments: Thank you, Joe Morrison for your contributions to this white paper!

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