

Python from Space

Analyzing Open Satellite Imagery Using the Python Ecosystem

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*Why should you care about
satellite imagery?*

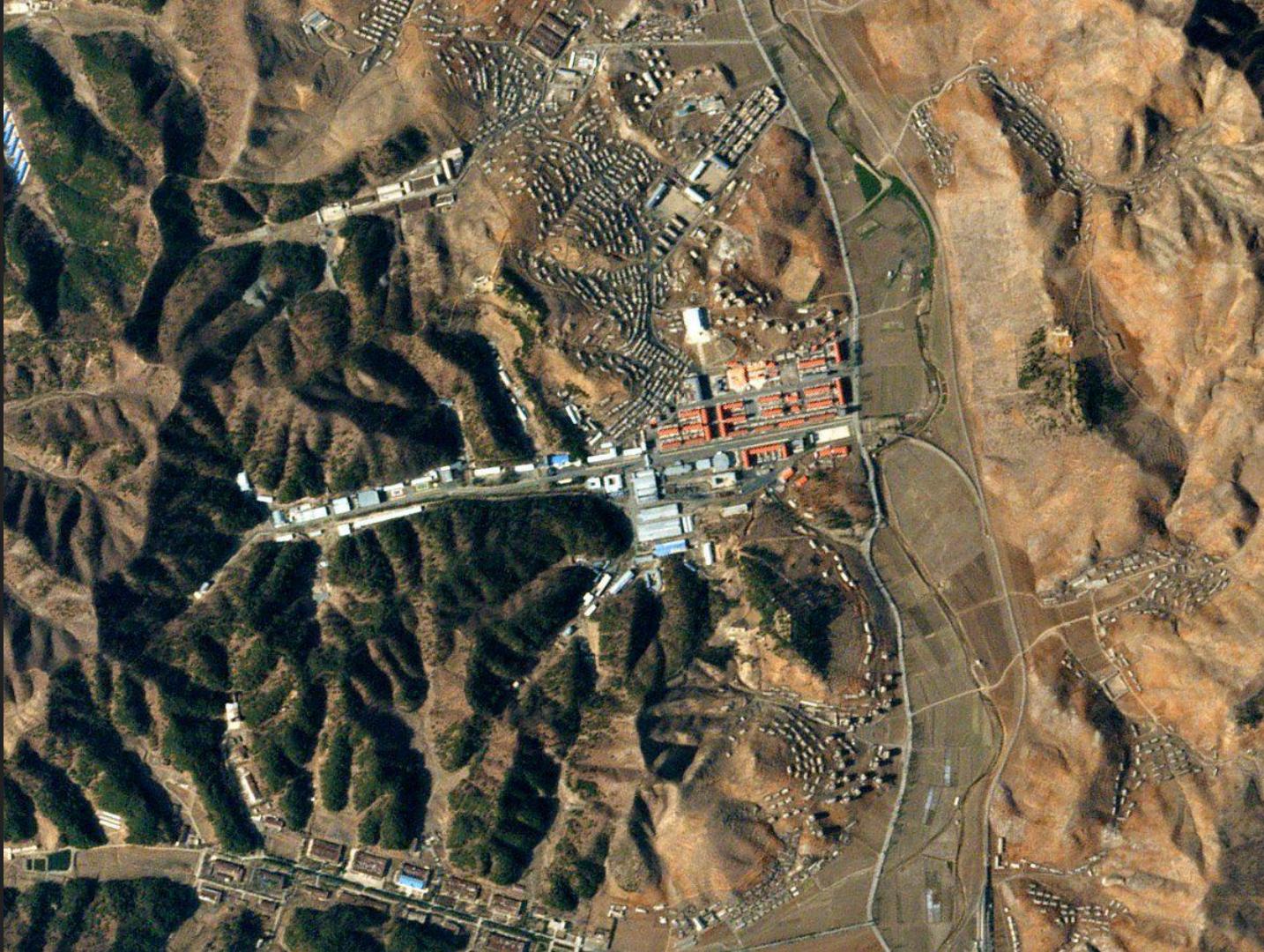




















Landsat 8
NASA



Landsat 7
NASA

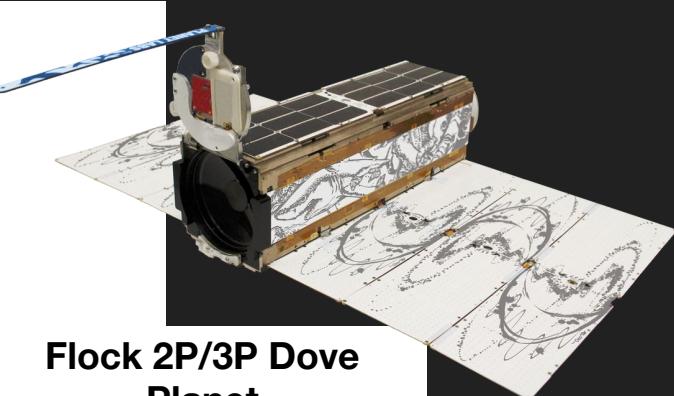


Sentinel 3
ESA

RapidEye
Planet



SkySat
Planet

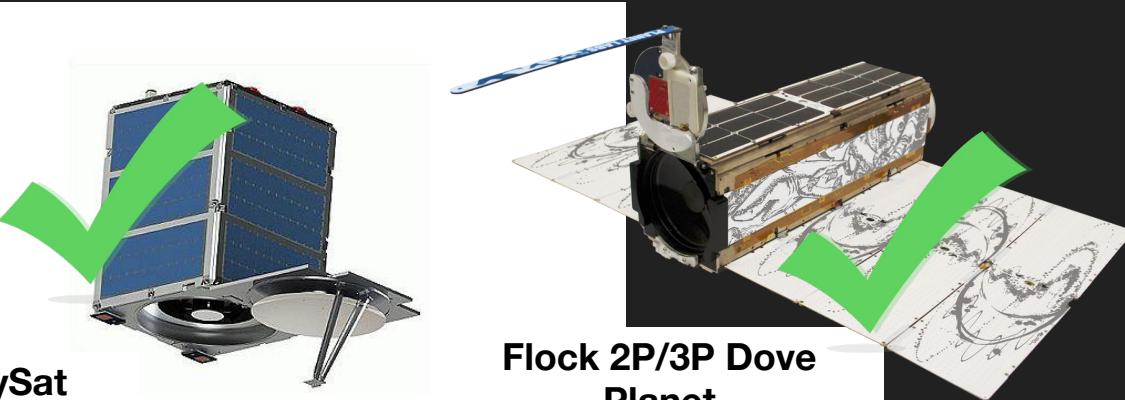
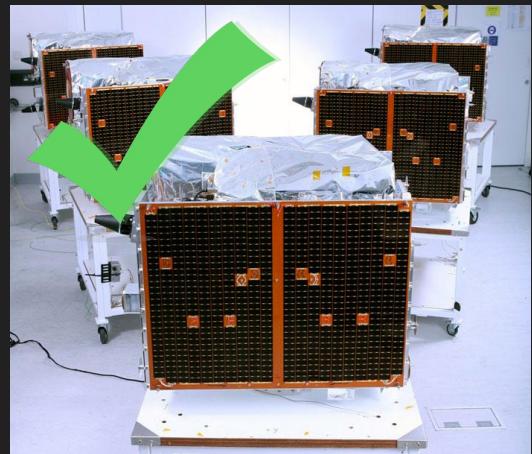


Flock 2P/3P Dove
Planet





RapidEye
Planet



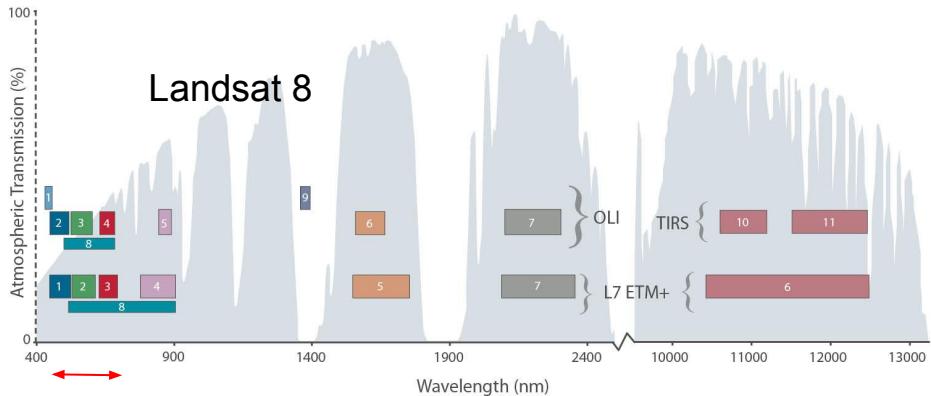
Where do I get free public satellite data?

- USGS Earth Explorer: 40 years of Landsat data and much more at
<http://earthexplorer.usgs.gov/>
- AWS Public Datasets: <https://aws.amazon.com/public-datasets/>
 - Landsat
 - Sentinel-2
 - MODIS
 - Terrain Tiles

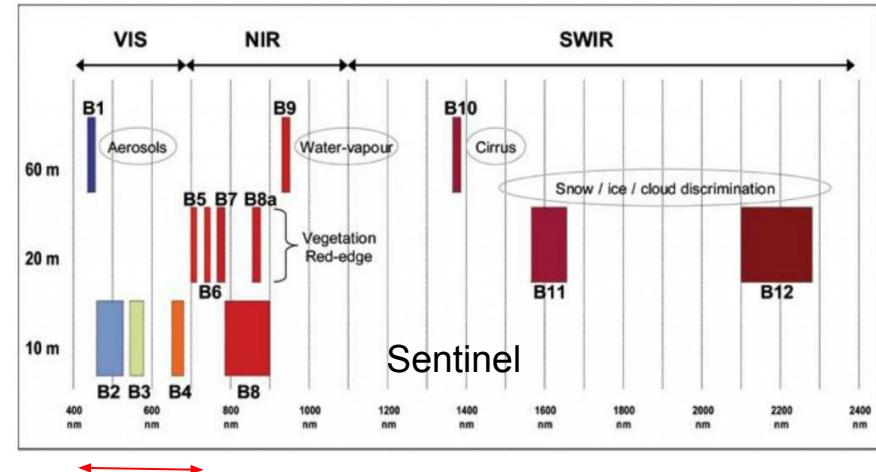
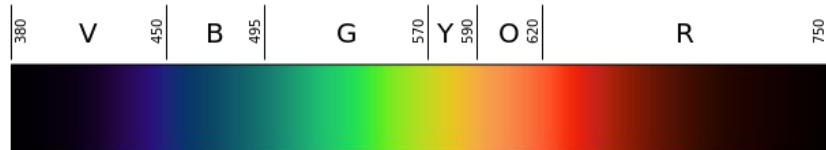
Free Commercial Satellite Data

- Free to view *right now* ([Planet explorer beta](#)).
- [Open California](#) - All of California, all Planet sats.
- [Planet emergency response](#).
- [Planet Ambassadors](#) (non-profit and education).
- Planet Open Amazon Data Set / Kaggle
- Digital Globe Open Data Program (disasters)

Satellite Terminology: Bands



Humans see in this range



- Most cameras and people see in just RGB.
- Satellites see in lots of “colors”.
- We call each *color channel* a band
- More bands = Super powers
 - See through clouds
 - “Read” Plants
 - Discriminate plant types!



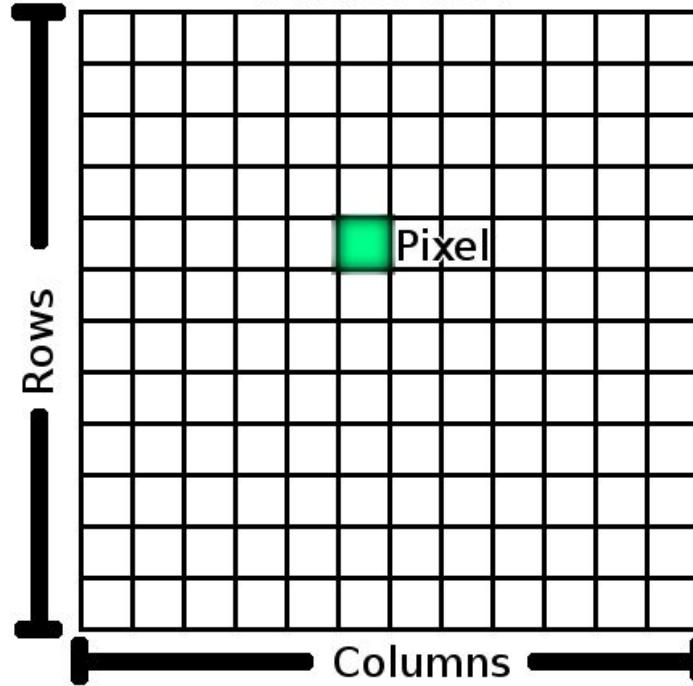
Satellite Terminology: Details

Term	LandSat 8	Sentinel 2	Doves	Rapid Eye	SkySat*
Cadence (revisit rate)	Monthly*	Monthly*	Daily	Monthly	Tasked
~GSD (m/pixel)	Varies 30m/15m	Varies ~10m	3.7m	5m	~0.9m
Number of Bands	9: Aerosol + RGB + NIR + 2SWIR + Pan + Cirrus	12: RGB + 3 Red Edge + NIR + 3 SWIR + Vapor + Aerosols	4: RGB + NIR	5: RGB + Red Edge + NIR	5: RGB + Pan + NIR

Satellite Terminology:

1. Remote Sensing - the fancy term for satellite images.
2. Ortho-rectification: process of lining up images to a base map, and correcting distortion.
3. Nadir Angle - How far off the satellite is from normal to the earth's surface.
4. Raster/Vector - Raster: pixel images. Vector: series of points
5. UTM - Universal transverse mercator. Coordinate system like latitude / longitude. Requires a “zone”
6. UDM - Usable data map. A mask that shows where clouds are etc.
7. DEM - Digital Elevation Map - the height of any place on Earth.

Raster



A Play in Three Parts

- My “user story” was a politically active person who wants to use satellite imagery to show change.
- “Software Carpentry” level of capability.
- Three examples:
 - Get images and make a time lapse GIF.
 - User Open Street Maps to derive data about an area.
 - Create a video from satellite data.

Enough yapping ... let's look at some code!

Tools of the trade.

GeoTIFF - Like a TIFF image but keeps map projection, and GIS metadata.

[GeoJSON](#) - Open standard for GIS Data

[QGIS](#) - Open Source program that is Gimp/Photoshop for GeoTiffs

[GDAL](#) - Geospatial Data Abstraction Library. “OpenCV for GeoTiffs”

[Rasterio](#) - Python package for reading and manipulating geotiffs.

[GRASS GIS](#) - Like QGIS but more tools, and python bindings!