

# Python from Space

## Analyzing Open Satellite Imagery Using the Python Ecosystem

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# Overview: A Play in Three Parts

- “Software Carpentry” level of capability.
- My “user persona” - person who wants to use satellite imagery for good.
- <https://github.com/kscottz/PyBay2017>
- Three examples:
  - Get images and make a time lapse GIF.
  - Use Open Street Maps to derive data about an area.
  - Create a video from satellite data.

*Why should you care about  
satellite imagery?*

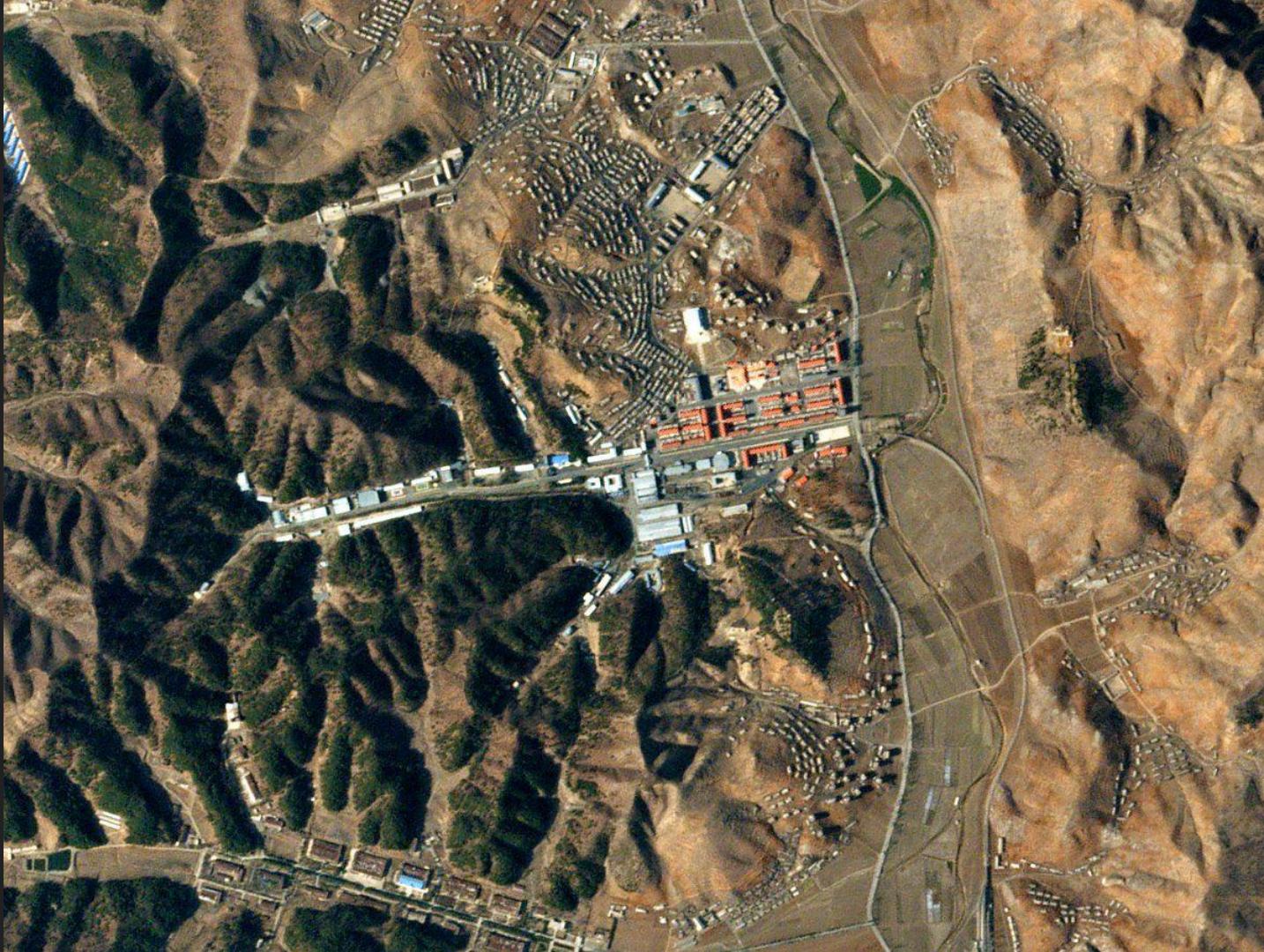




















**Landsat 8**  
NASA



**Landsat 7**  
NASA

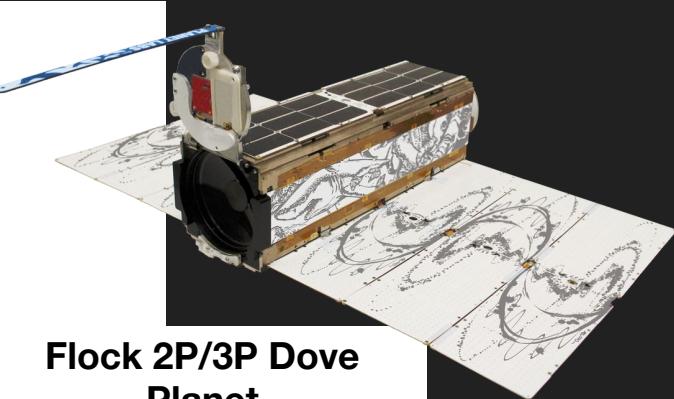


**Sentinel 3**  
ESA

**RapidEye**  
Planet



**SkySat**  
Planet

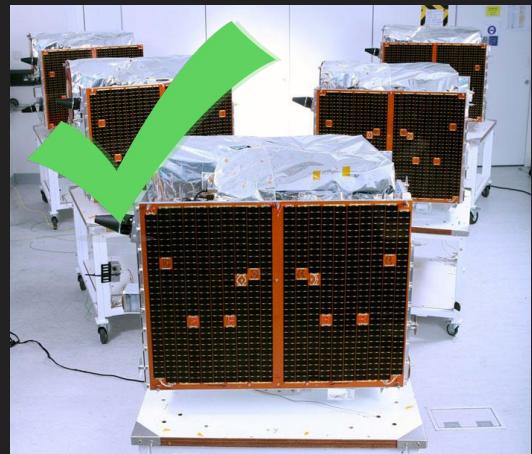


**Flock 2P/3P Dove**  
Planet





RapidEye  
Planet



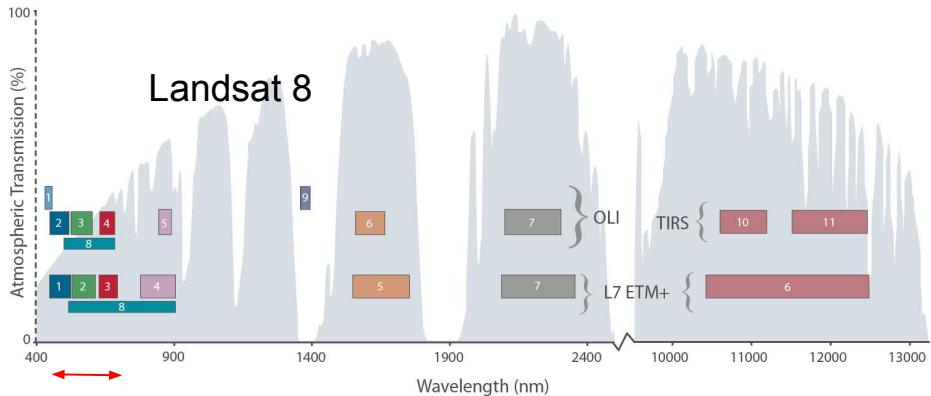
# Where do I get free public satellite data?

- 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](#)).
- Planet 2-Week API Trial. <https://www.planet.com/trial/>
- [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)

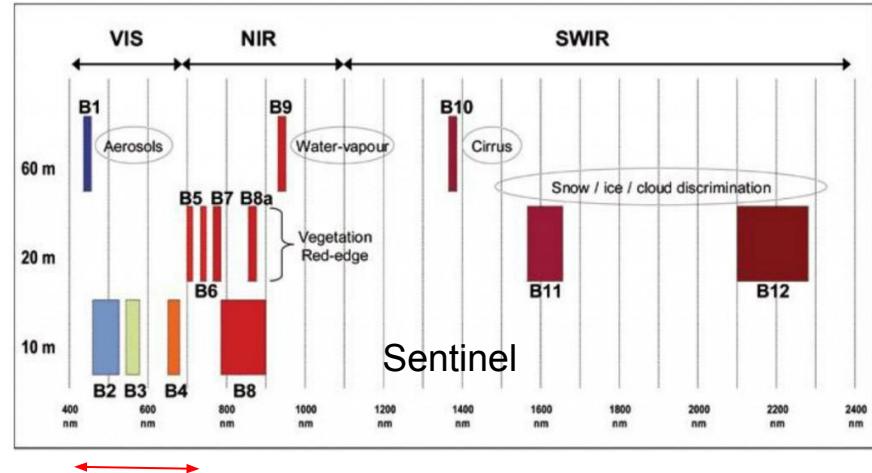
# Satellite Terminology: Bands



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!





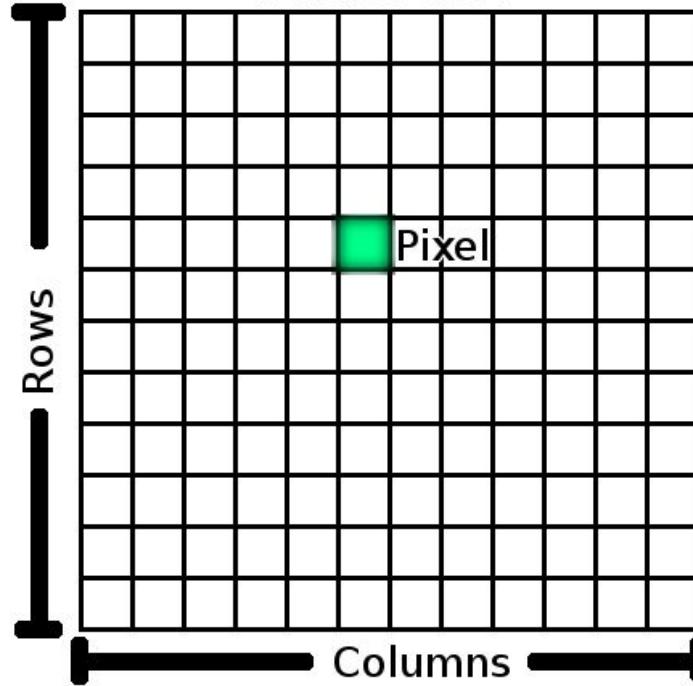
# Satellite Terminology: Details

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



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!