Python from Space

Analyzing Open Satellite Imagery Using the Python Ecosystem

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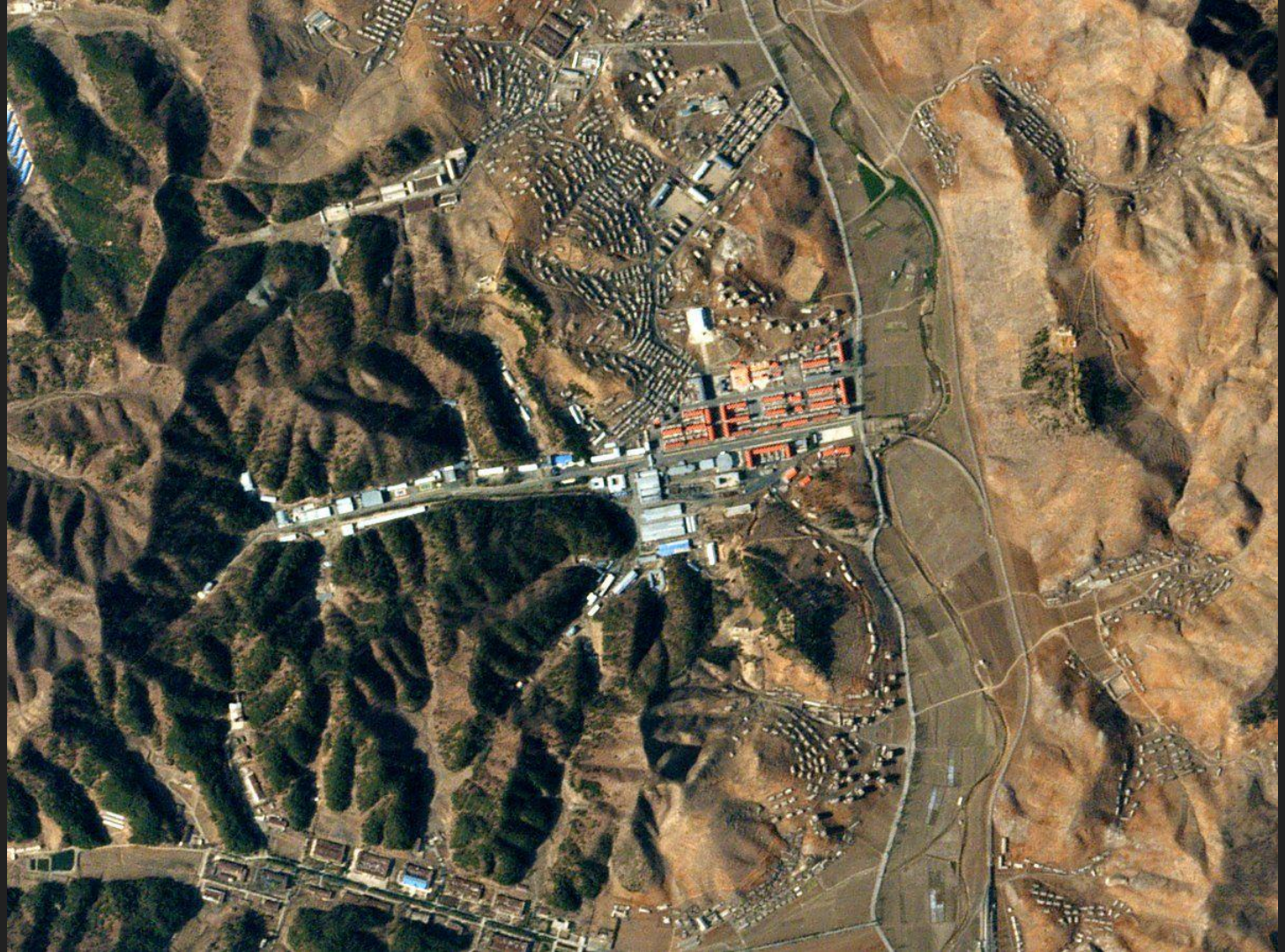
Why should you care about satellite imagery?

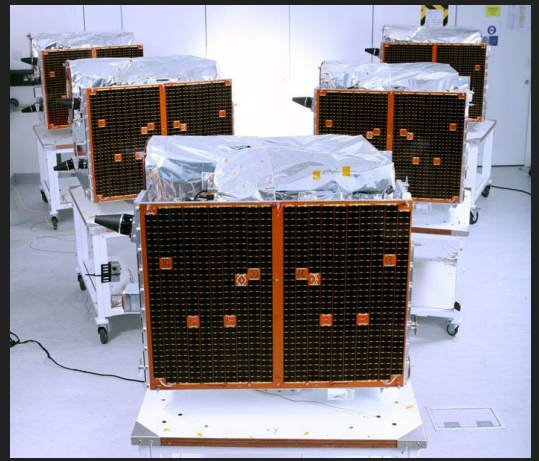


Landsat 8
NASA

Landsat 7
NASA

Sentinel 3
ESA

RapidEye
Planet



SkySat
Planet

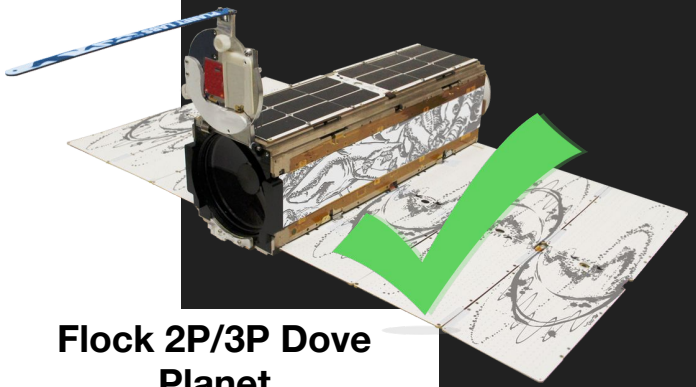
Flock 2P/3P Dove
Planet

Landsat 8
NASA

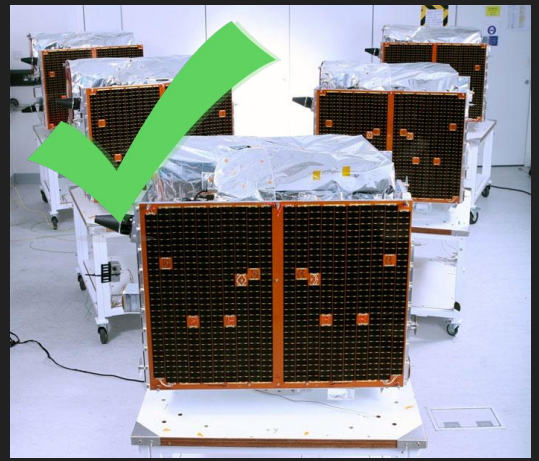
Landsat 7
NASA

RapidEye
Planet

SkySat
Planet



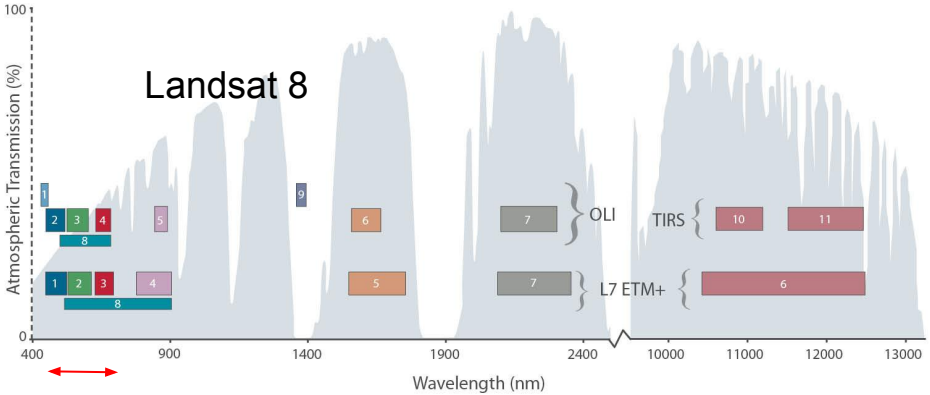
Flock 2P/3P Dove
Planet



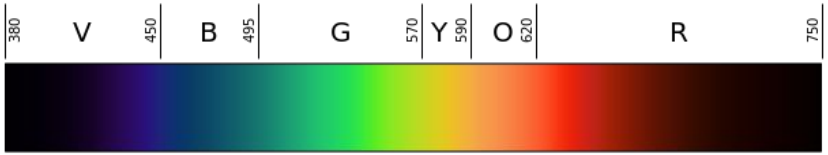
Free Commercial Satellite Data

- 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)

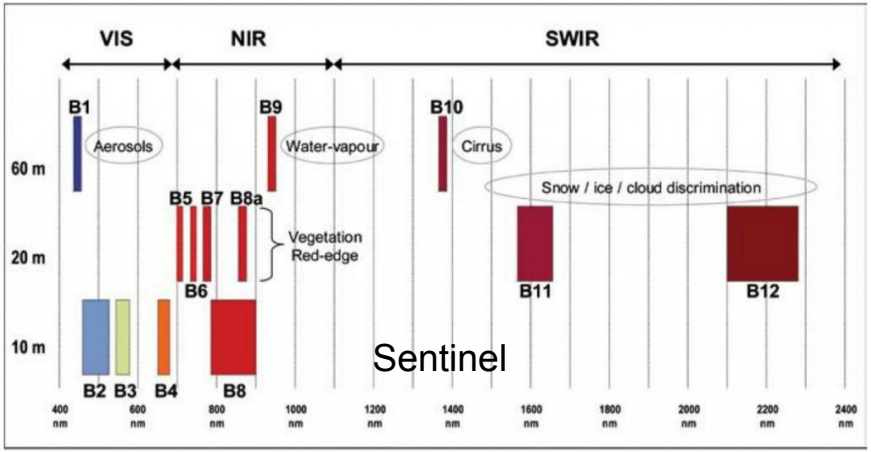
Satellite Terminology: Bands



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!




X-RAY
VISION

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.

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!