Exploring Geospatial Raster Images

RCC Workshop Series 2019

Parmanand Sinha

Content

What is raster data

Raster data models

Type of Sensors

Night at Light

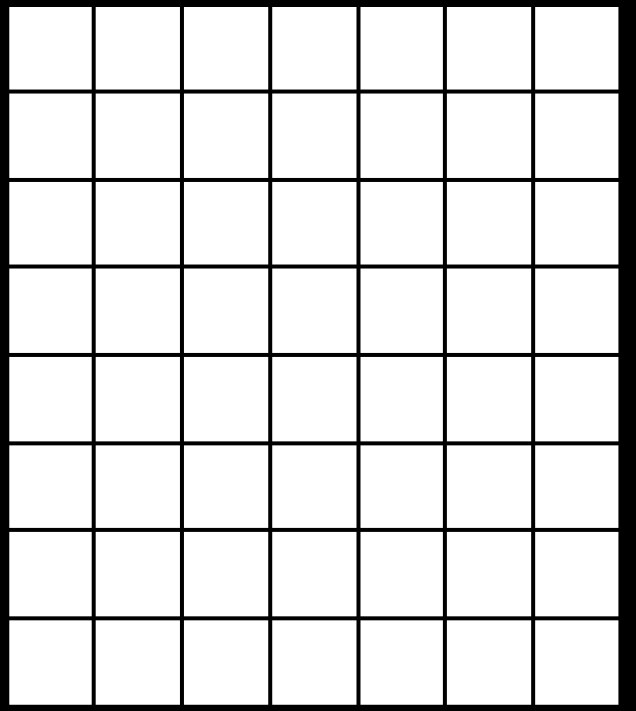
GHSL, GUF

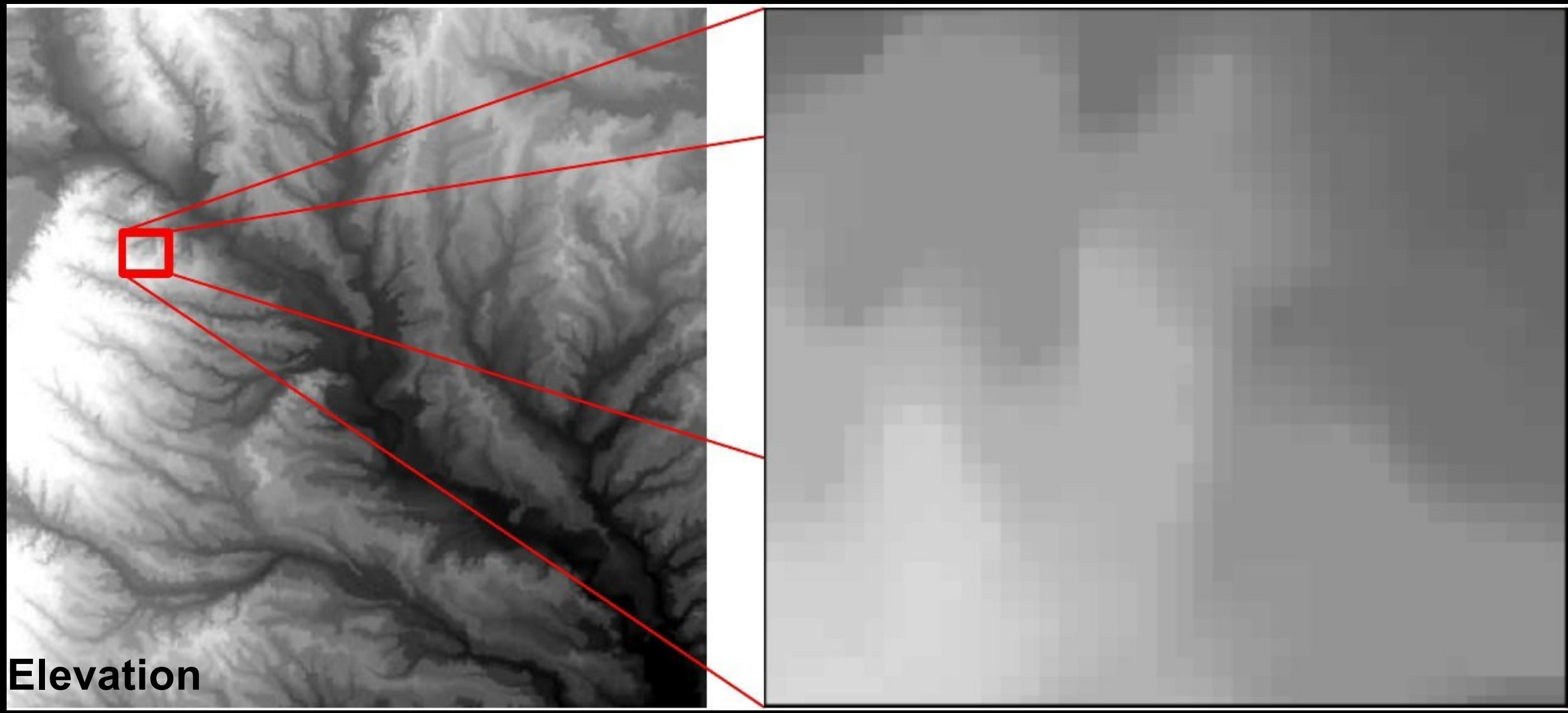
Building Footprint

Gridded population

Raster Data Model

- Study area is covered by grid
- Conventionally, stored row by row from the top left corner
- Equal sized cells
- Cells are often called pixels
- Attributes are recorded by assigning each cell a single value
  - E.g., landuse type
- Simple data structure
  - Directly store each layer as a single table
    - basically, each is analogous to a "spreadsheet" or "matrix"





- High : 262

- Low: 73

Elevation in Dallas county

The whole county and a small area in thecounty

(Data Source: USGS)

Remote Sensing - what is it?

"Remote sensing is the science and art of obtaining information about an object, area, or phenomenon through the analysis of data acquired by a device that is not in contact with the object, area, or phenomenon under investigation."

- Lillesand et al., 2008

Hearing, seeing, smelling are all remote sensing, but here we focus on one kind:

Measurement, by sensors, of the electromagnetic energy reflected or emitted from objects on the Earth's surface.

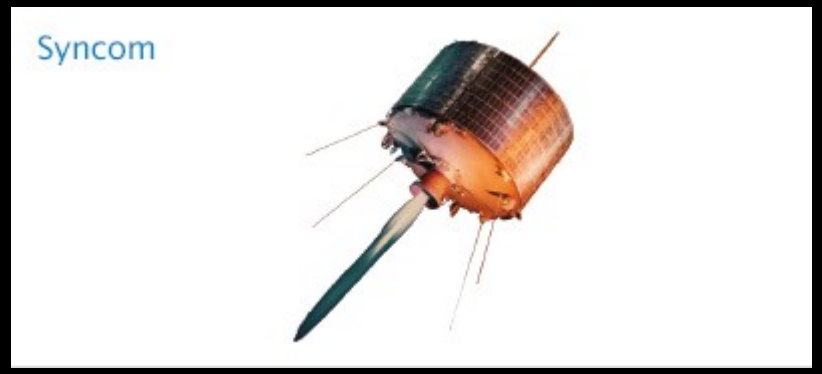
Specifically, we will focus on observations of Earth's land and water surfaces by means of reflected and emitted electromagnetic energy

Remote Sensing

Many platforms, many applications

Sensor altitude plays a role in determining purpose

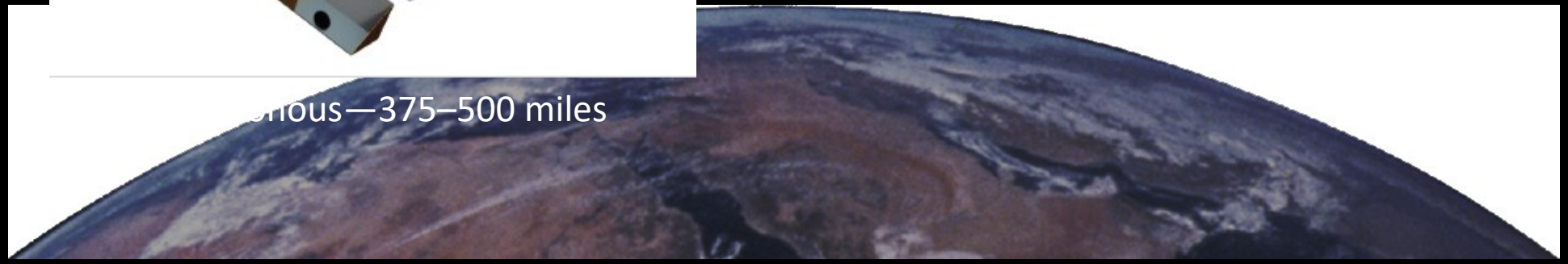
Remote Sensing – Quick Overview



Geosynchronous—22,236 miles

nous—375–500 miles

Atmospheric satellite—100,000 feet

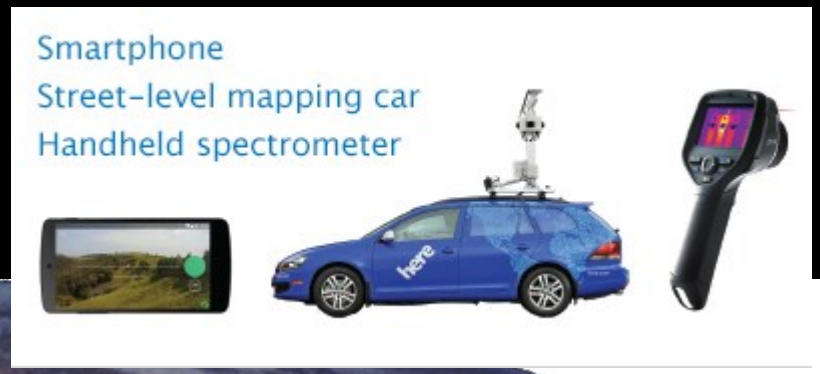


Remote Sensing – Quick Overview

Jet aircraft—90,000-30,000 feet

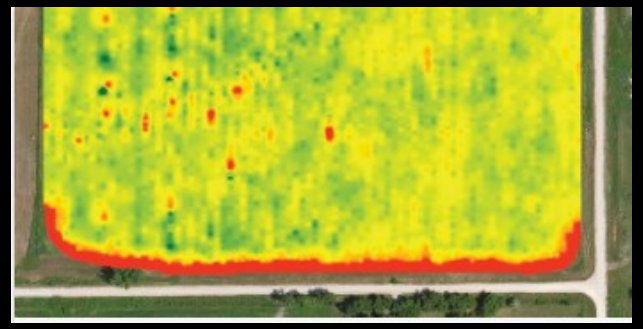
Drones—100-500 feet

ation aircraft—
0,000 feet



Ground based/handheld—Grou

Imagery Applications

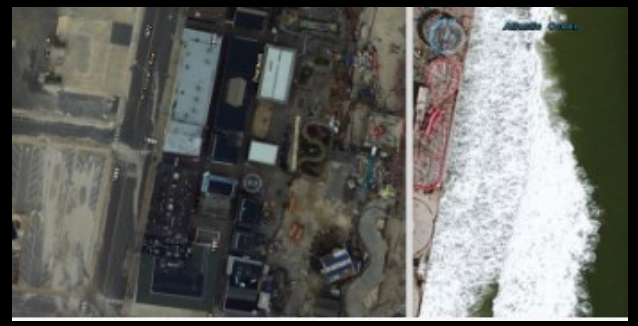


Precision Agriculture

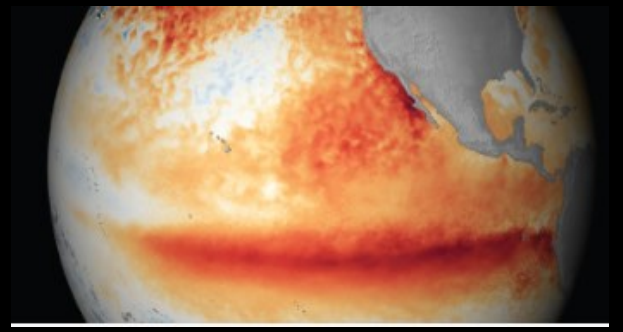
Humanitarian Aid

Forestry

Mining

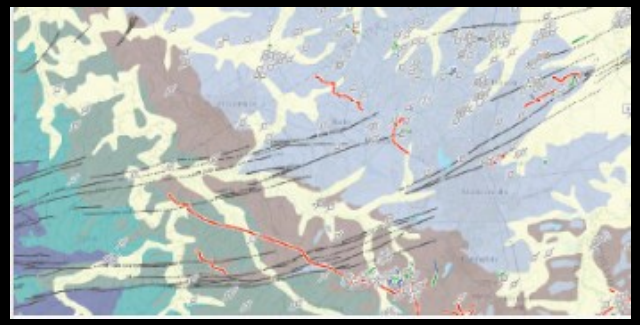


Natural Disasters

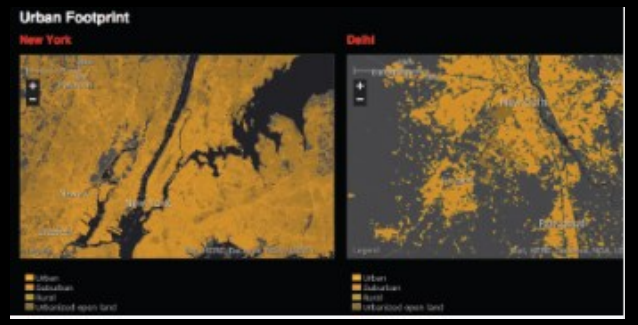


Climate/Weather

Engineering



Natural Resources



Urban Planning

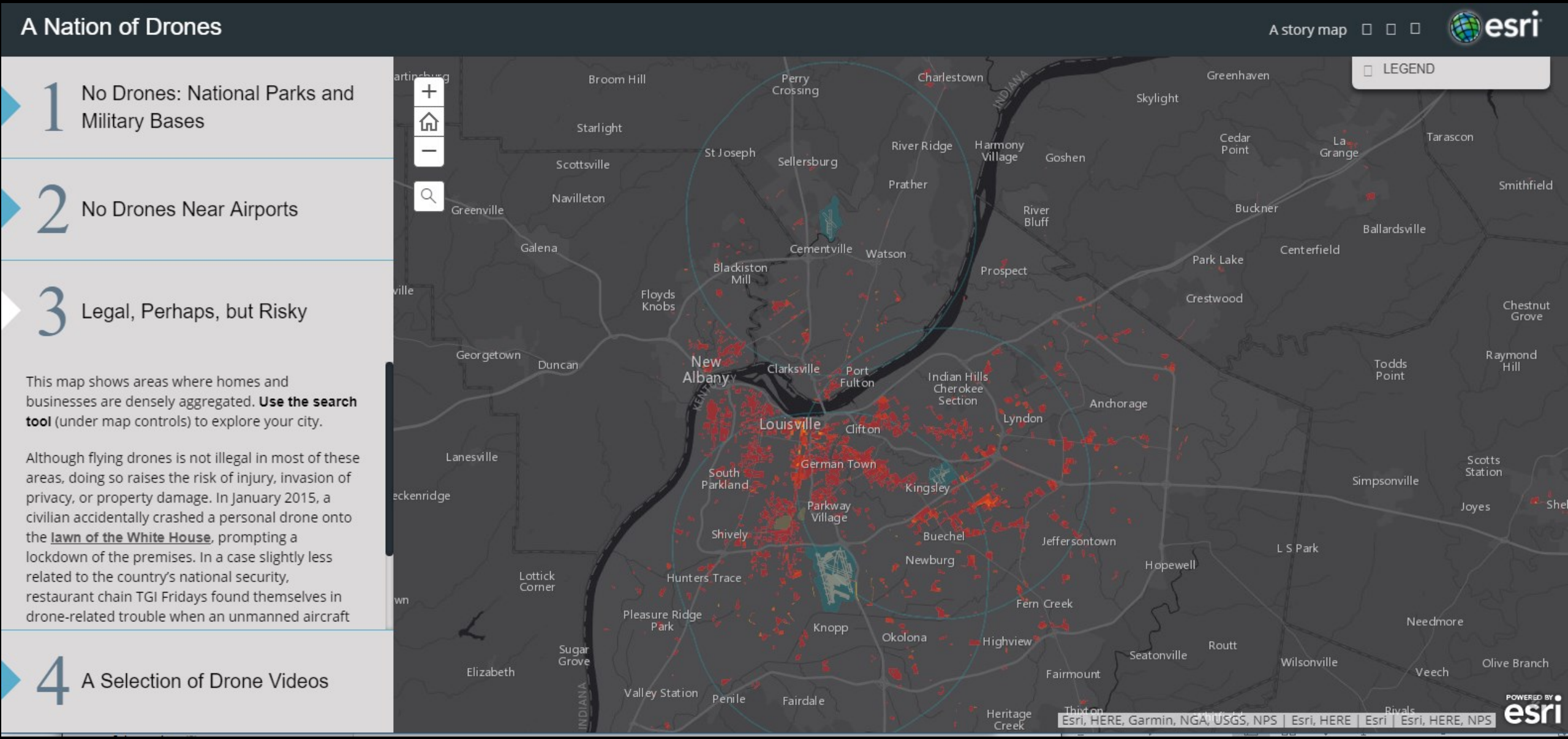
Remote Sensing – Quick Overview

NADAR élevant la Photographie à la hauteur de l'Art

s in Germany

1860 Nadar taking photograph using a hot air balloon
Image Credit: Online Collection of the Brooklyn Museum

A Nation of Drones – Story Map



http://story.maps.arcgis.com/apps/MapSeries/index.html?appid=79798a5671 5c4df183448cc5b7e1b999

Fundamental Principle of Studies Using Remote Sensing

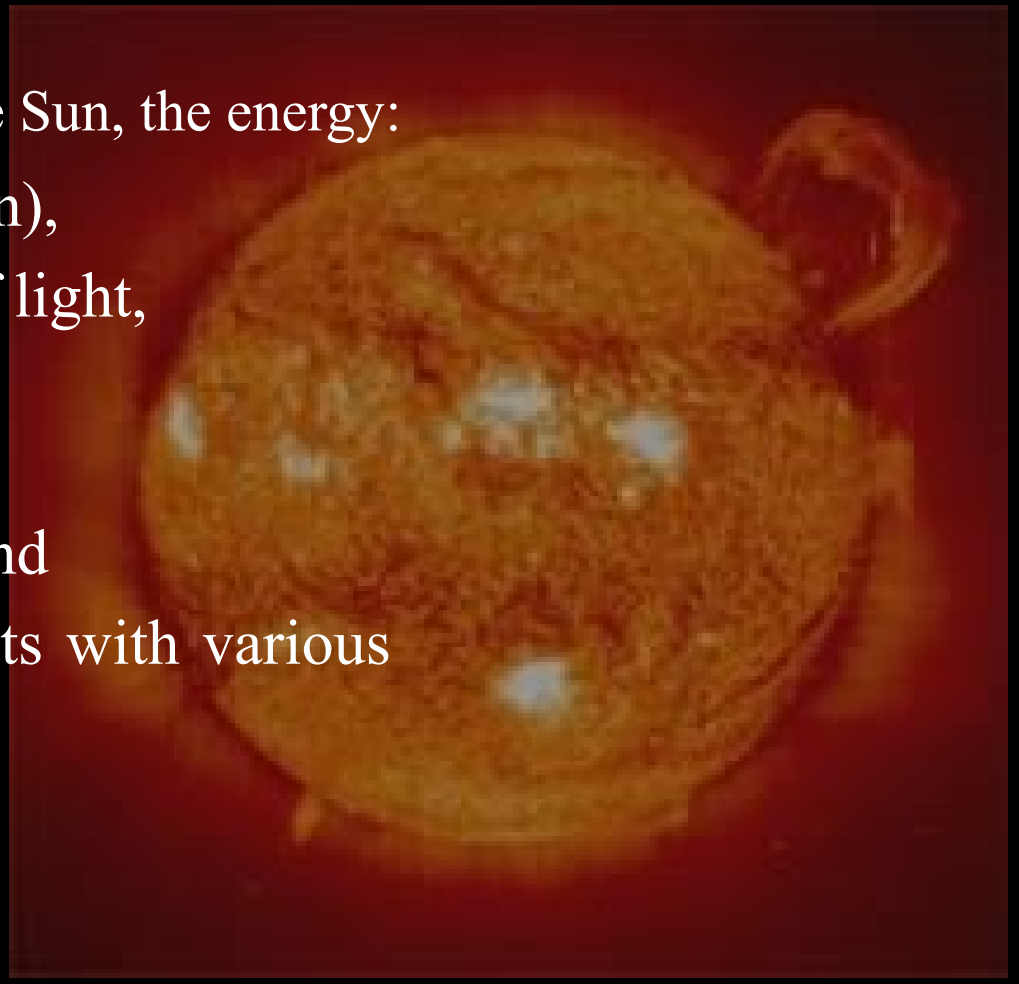
For any given material, the amount of radiation that is reflected (absorbed, transmitted) varies with wavelength. Different materials have different reflectance characteristics.

Electromagnetic Energy

Energy recorded by remote sensing systems undergoes fundamental *interactions* that should be understood to properly preprocess and interpret remotely sensed data.

For ex. if the energy being remotely sensed comes from the Sun, the energy:

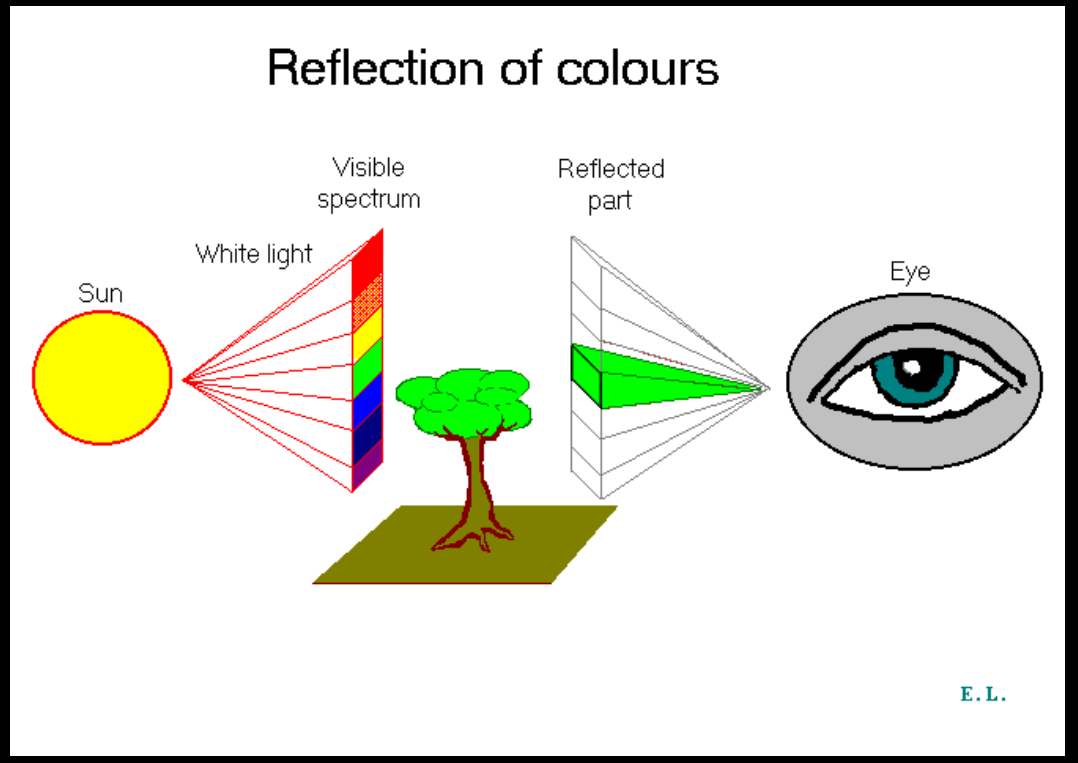
- is radiated by atomic particles at the source (the Sun),
- travels through the vacuum of space at the speed of light,
- interacts with the Earth's atmosphere,
- interacts with the Earth's surface,
- interacts with the Earth's atmosphere once again, and
- finally reaches the remote sensor, where it interacts with various optics, filters, film emulsions, or detectors.



In remote sensing, we are largely concerned with REFLECTED RADIATION.

This is the radiation that causes our eyes to see colors, causes infrared film to record vegetation, and allows radar images of the earth to be created.

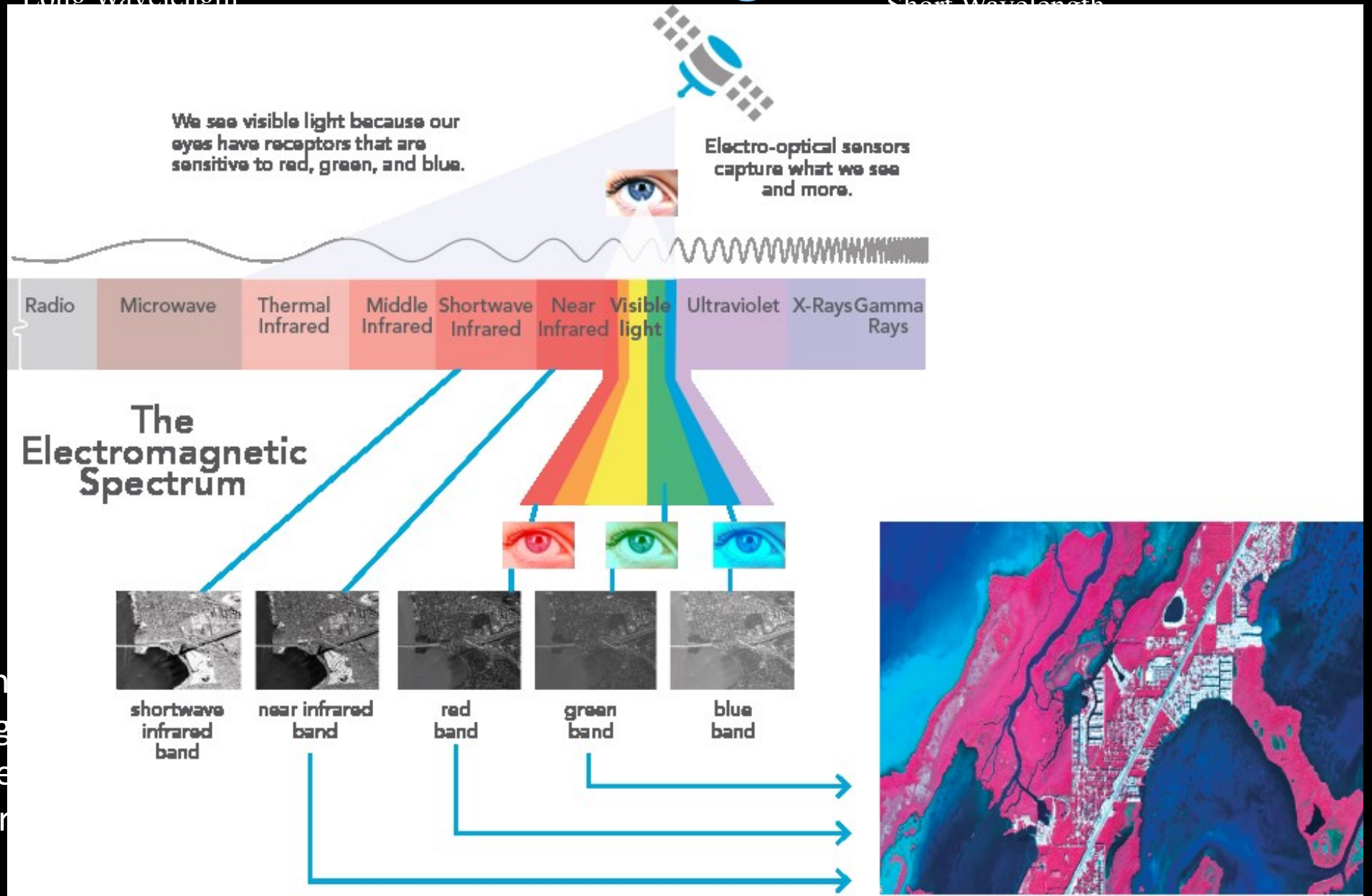
The source of a vast majority of this reflected radiation is the sun.



Remote Sensing

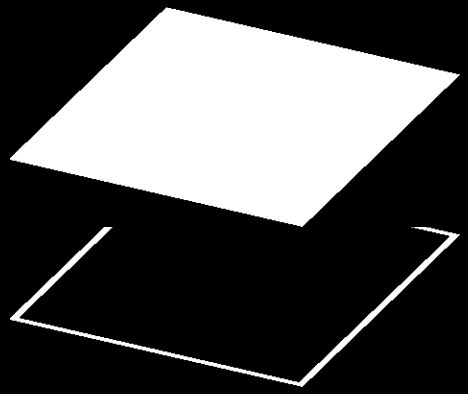
Long Wavelength

Short Wavelength

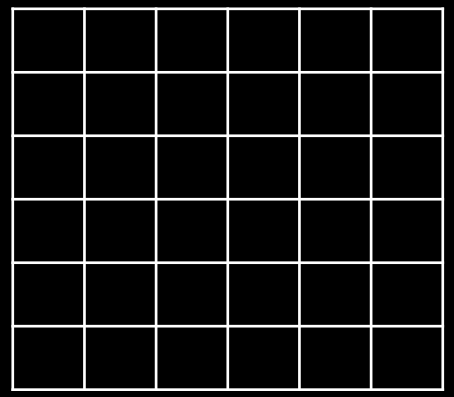


Remote sensing is the science of collecting an interpreting electromag information about the e using sensors on platfor our atmosphere

Multiscale Remote Sensing

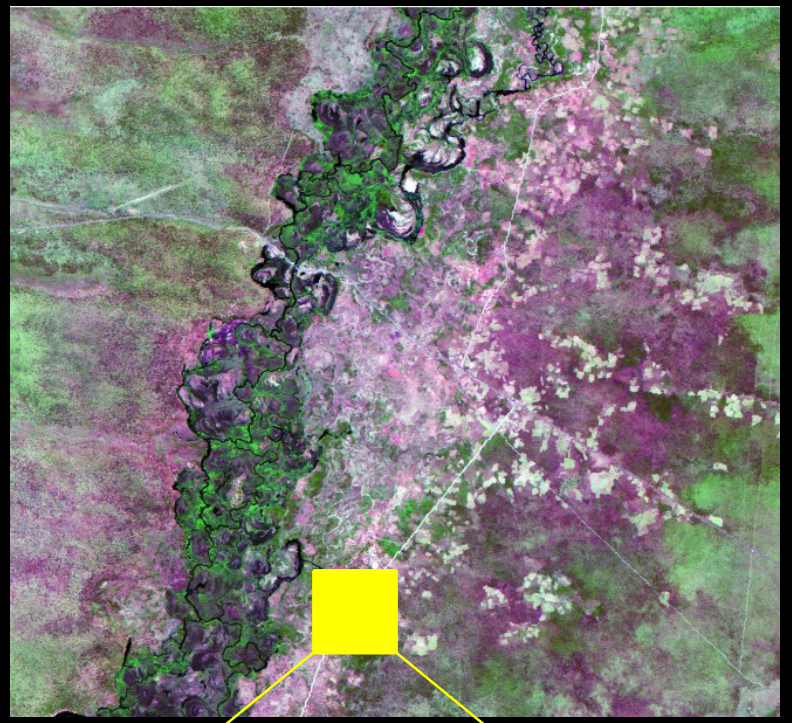


Bands



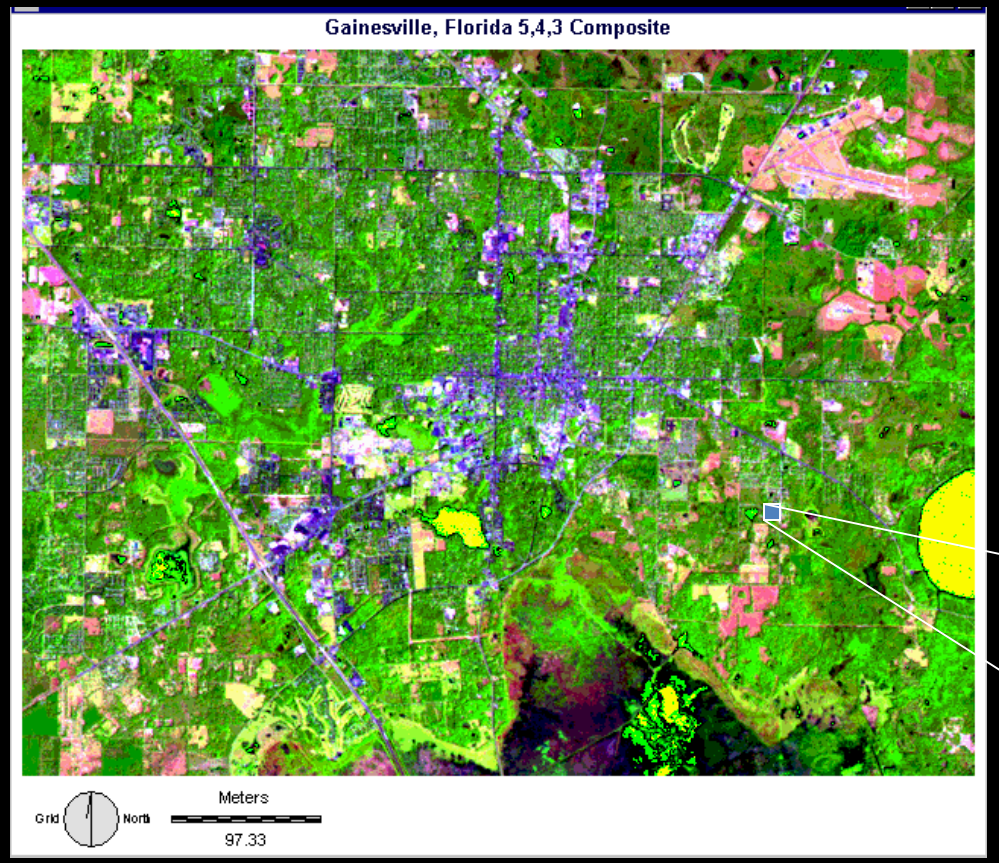
Columns
and Rows

Pixel

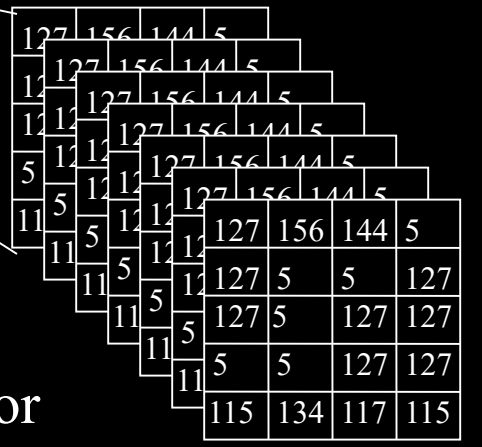


Landsat TM
April 22, 2007
Caprivi, Namibia

Nature of Remote Sensing Data



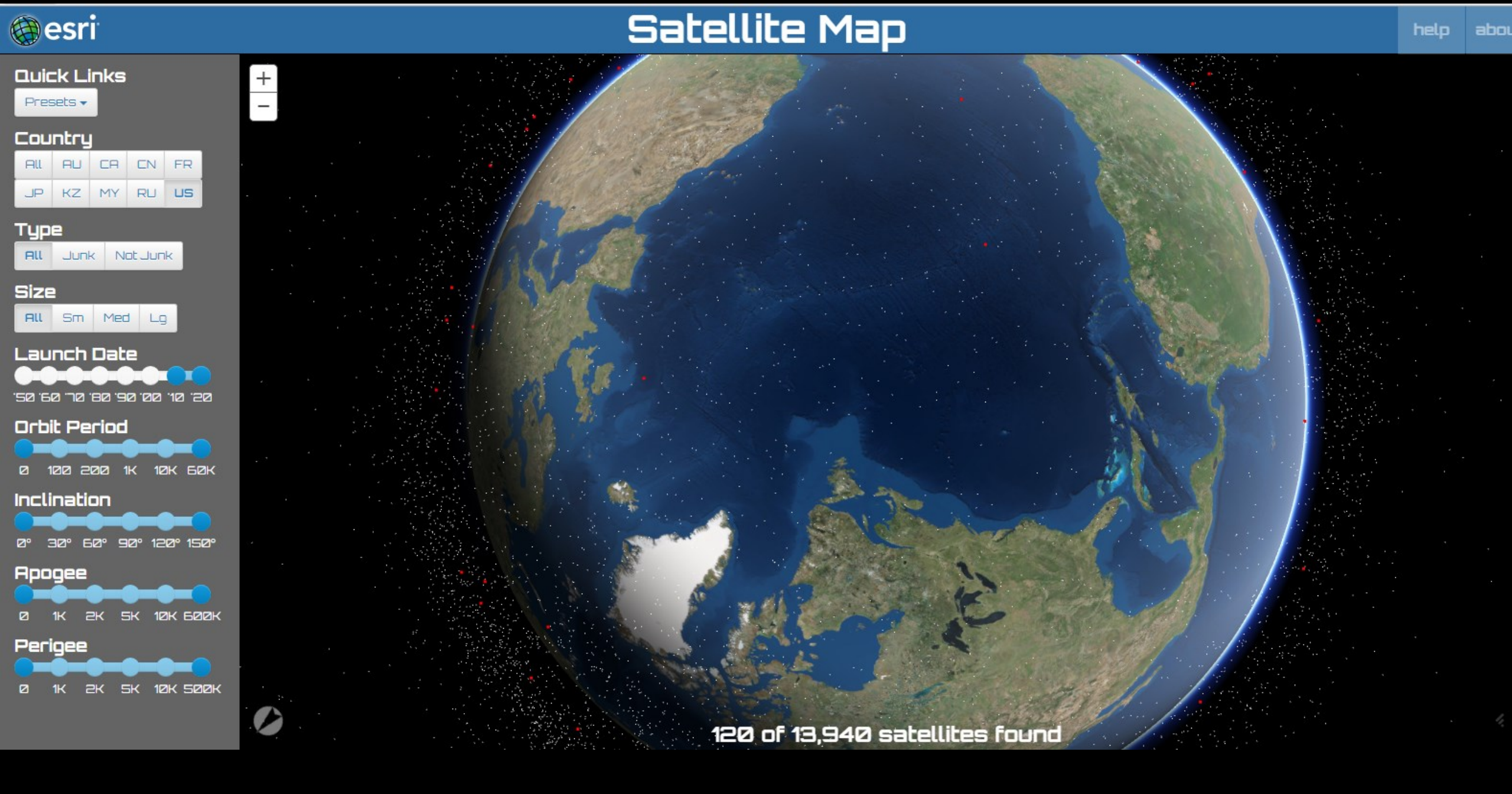
Quantized grid of small areas on the Earth's surface. The energy of reflected electromagnetic radiation in each grid cell is a function of the characteristics of the objects in that cell.



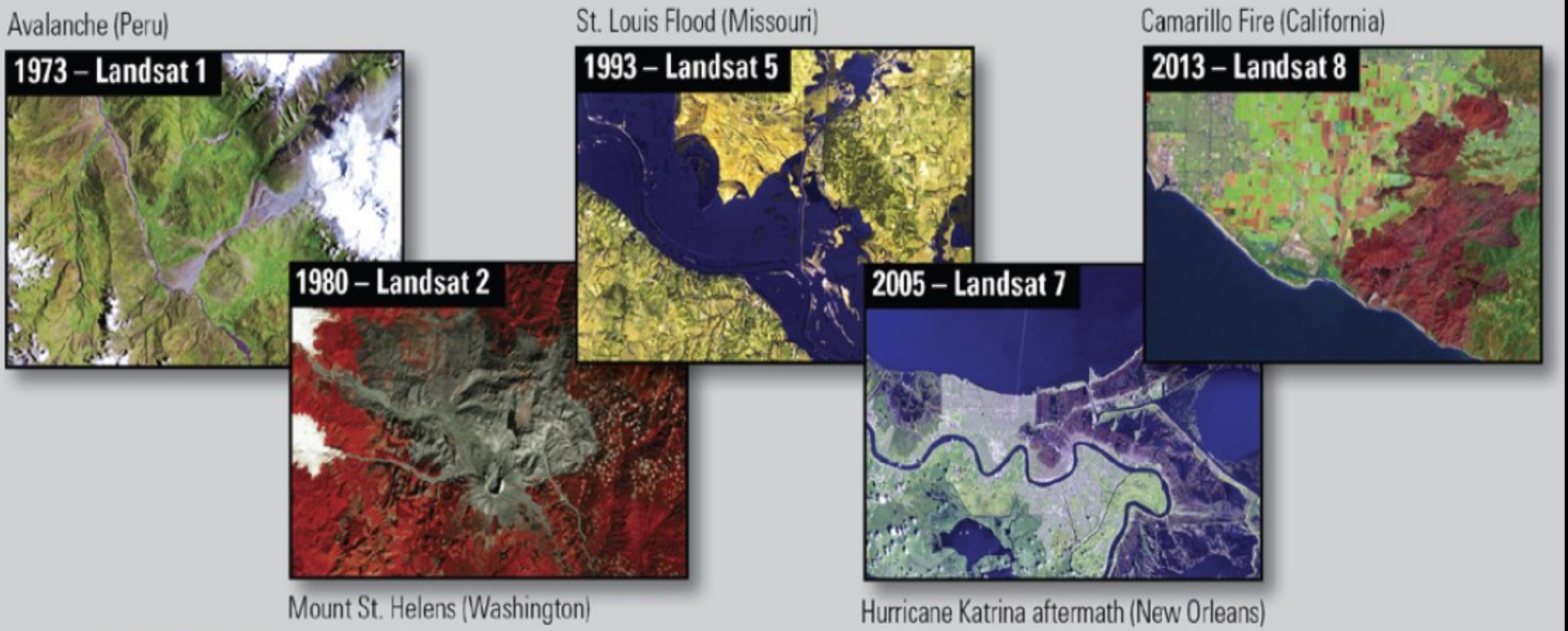
7 Landsat Bands – Individual Data Files

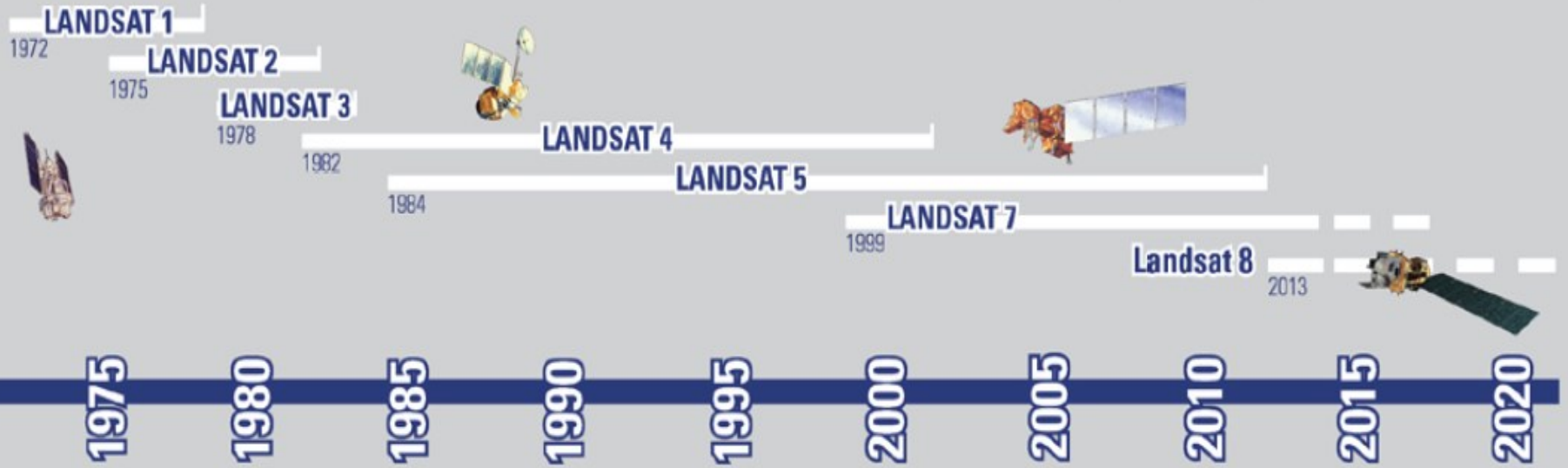
AN IMAGE, NOT A PHOTOGRAPH!

Digital Numbers (DN), that are proportional to the reflectance, or Brightness Value (BV) in some subset (band) of the EM spectrum.


esri
Satellite Map
help
abou
Quick Links
Presets
Country
All AU CA CN FR
JP KZ MY RU US
Type
All Junk Not Junk
Size
All Sm Med Lg
Launch Date
'50 '60 '70 '80 '90 '00 '10 '20
Orbit Period
0 100 200 1K 10K 60K
Inclination
0° 30° 60° 90° 120° 150°
Apogee
0 1K 2K 5K 10K 600K
Perigee
0 1K 2K 5K 10K 500K
120 of 13,940 satellites found

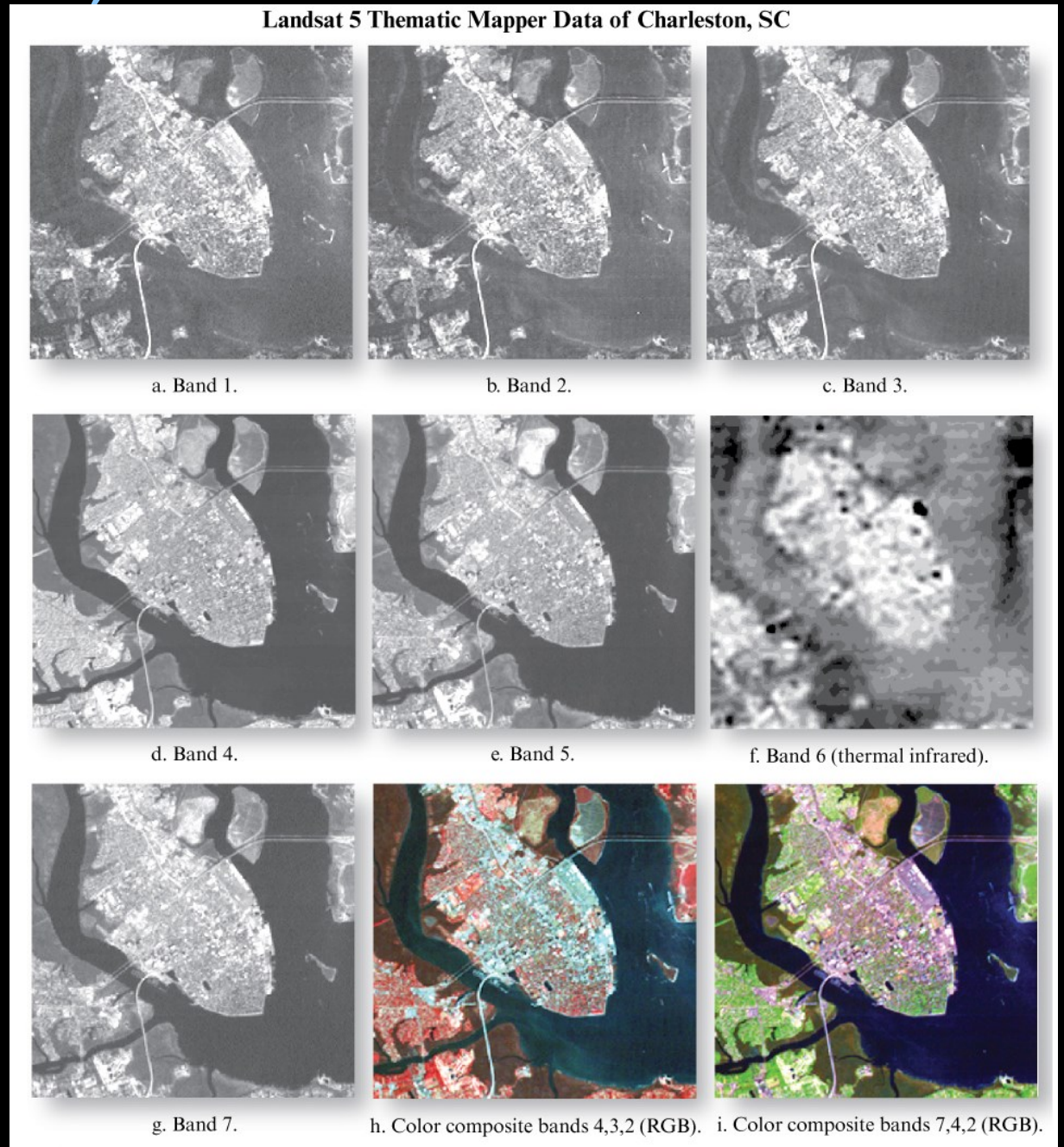
Four Decades of Earth Imaging





Landsat TM 5 – Charleston, SC

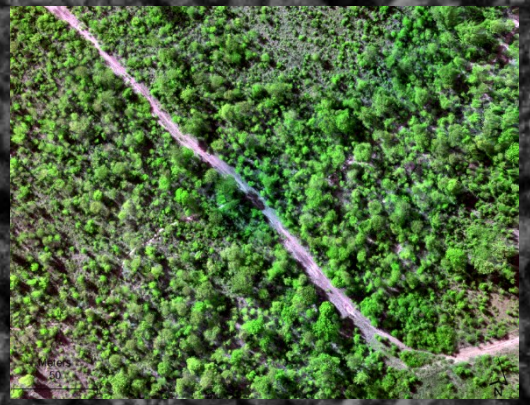
- Seven spectral bands, including a thermal band:
- Band 1 Visible (0.45 - 0.52 µm) 30 m
- Band 2 Visible (0.52 - 0.60 µm) 30 m
- Band 3 Visible (0.63 - 0.69 µm) 30 m
- Band 4 Near-Infrared (0.76 - 0.90 µm) 30 m
- Band 5 Near-Infrared (1.55 - 1.75 µm) 30 m
- Band 6 Thermal (10.40 - 12.50 µm) 120 m
- Band 7 Mid-Infrared (2.08 - 2.35 µm) 30 m



Multiscale Remote Sensing

What does this look like in practice?

10 cm



5 m

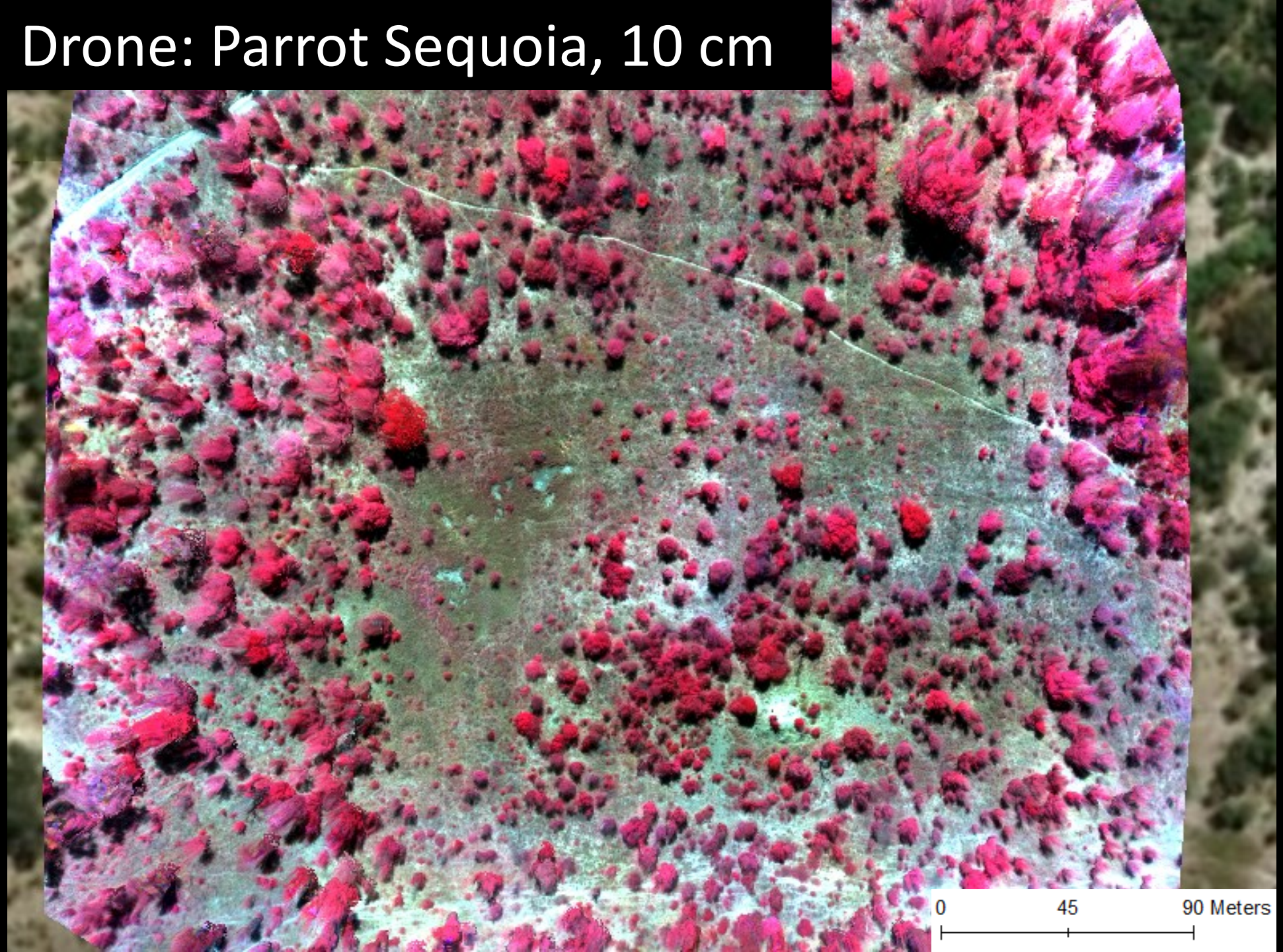
30 m

Meters
50

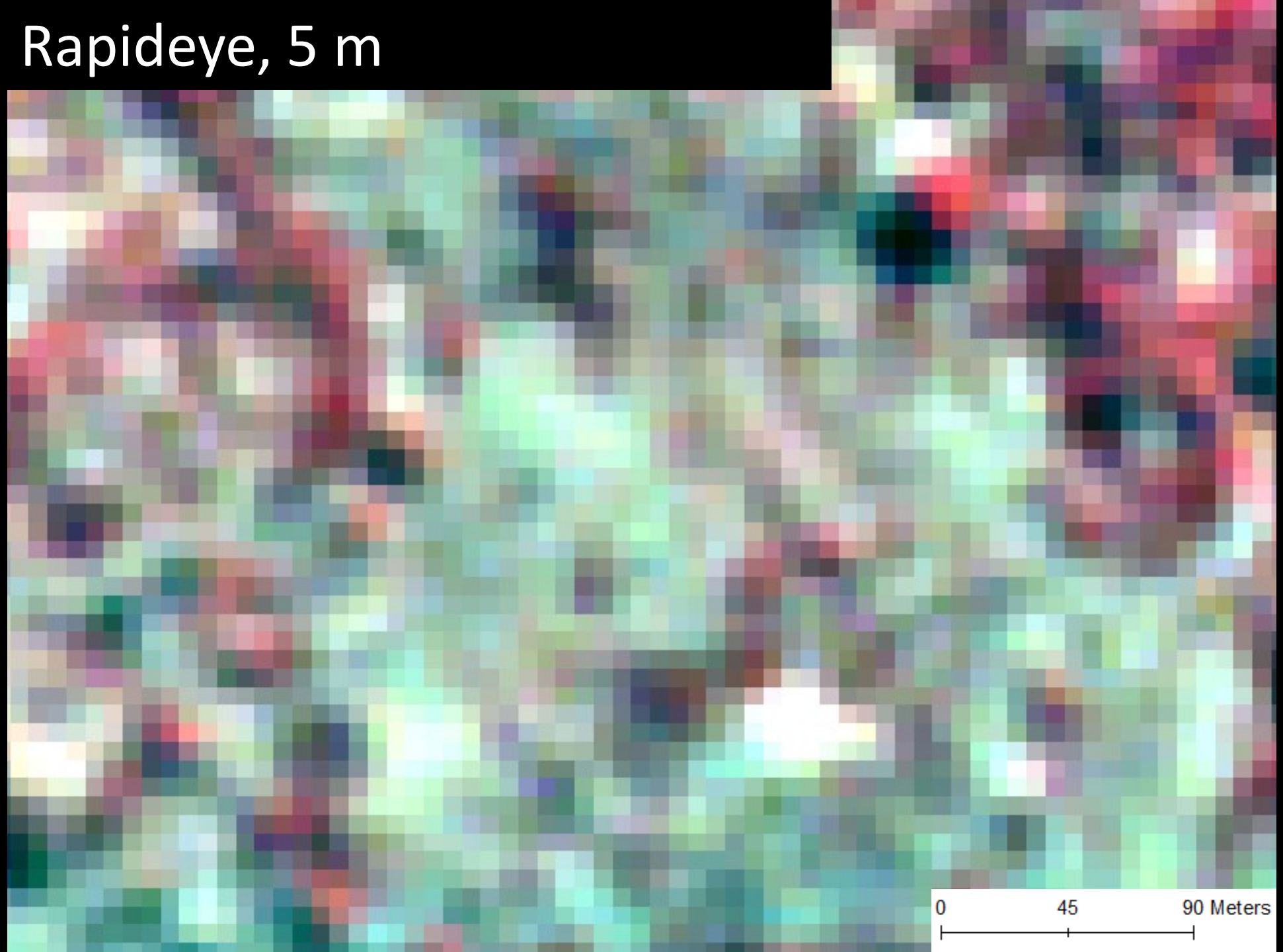
N

Digital Globe, ESRI Basemap

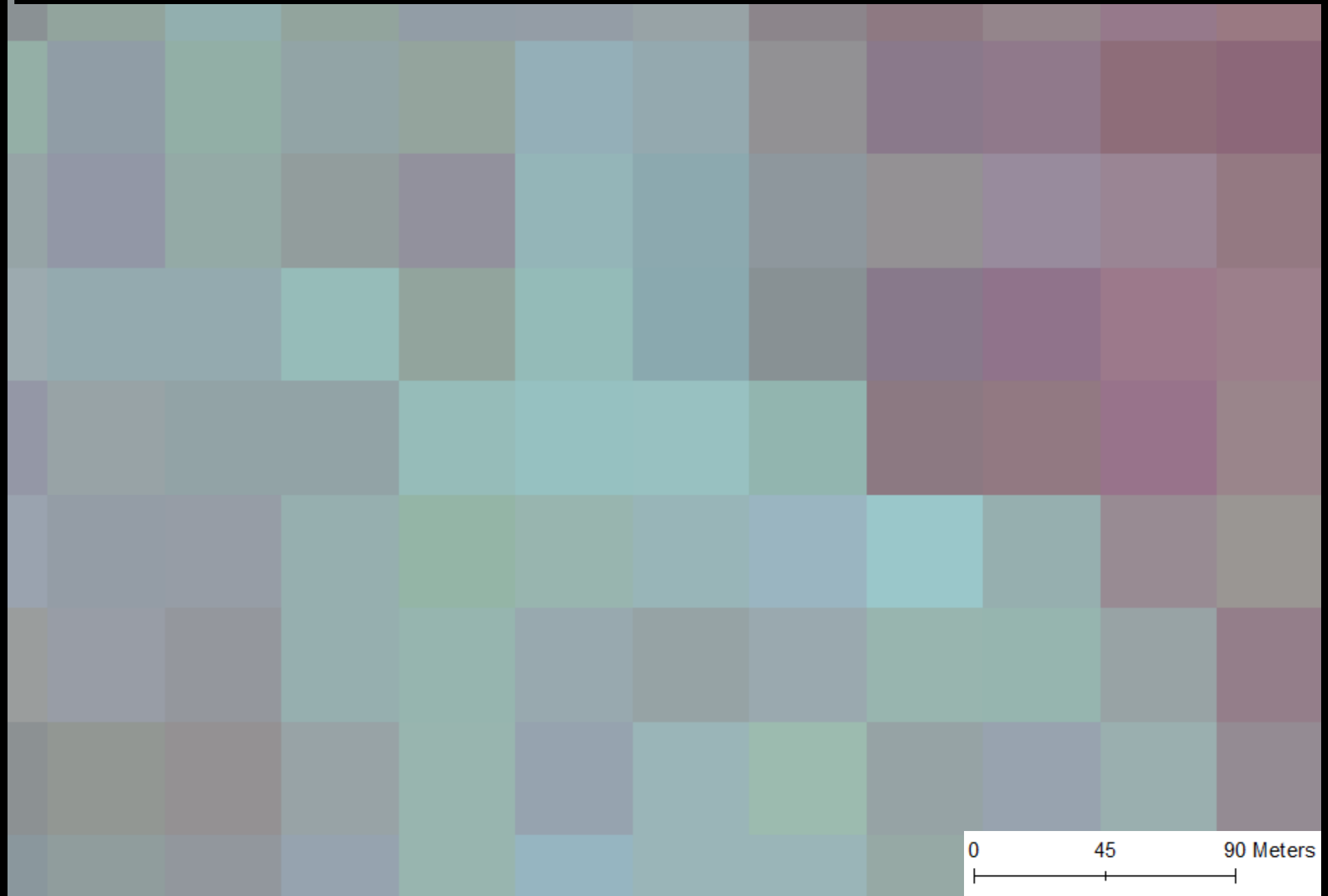
Drone: Parrot Sequoia, 10 cm



Rapideye, 5 m



Landsat 8 Operational Land Imager (OLI), 30 m



Global Imagery Browse Services (GIBS)

https://worldview.earthdata.nasa.gov

Using ArcGIS Online

- Navigate to https://livingatlas.arcgis.com
- Sign in using CNETid
- Search “Global Imagery Browse Services”

Global Imagery Browse Services

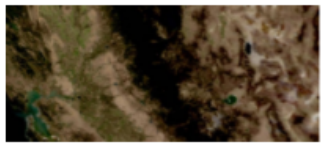
Search examples

All Trending Basemaps Imagery Boundaries People Infrastructure Environment

Filters: All content types All time All regions Esri-only content

Sort by: Relevance

21 Results

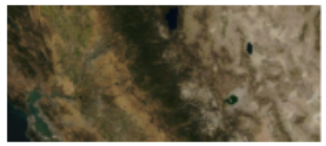


MODIS True Color - Terra Surface Reflectance

Imagery Layer By: esri

This layer provides access to NASA Global Imagery Browse Services, which delivers global, full-resolution satellite imagery. This band composition (Bands 1 4 3) most accurately represents how we see the earth's surface with our own eyes.

Authoritative



MODIS True Color - Aqua Corrected Reflectance

Imagery Layer By: esri

This layer provides access to NASA Global Imagery Browse Services, which delivers global, full-resolution satellite imagery. This band composition (Bands 1 4 3) most accurately represents how we see the earth's surface with our own eyes.

Authoritative

MODIS True Color - Terra Corrected Reflectance

Imagery Layer By: esri

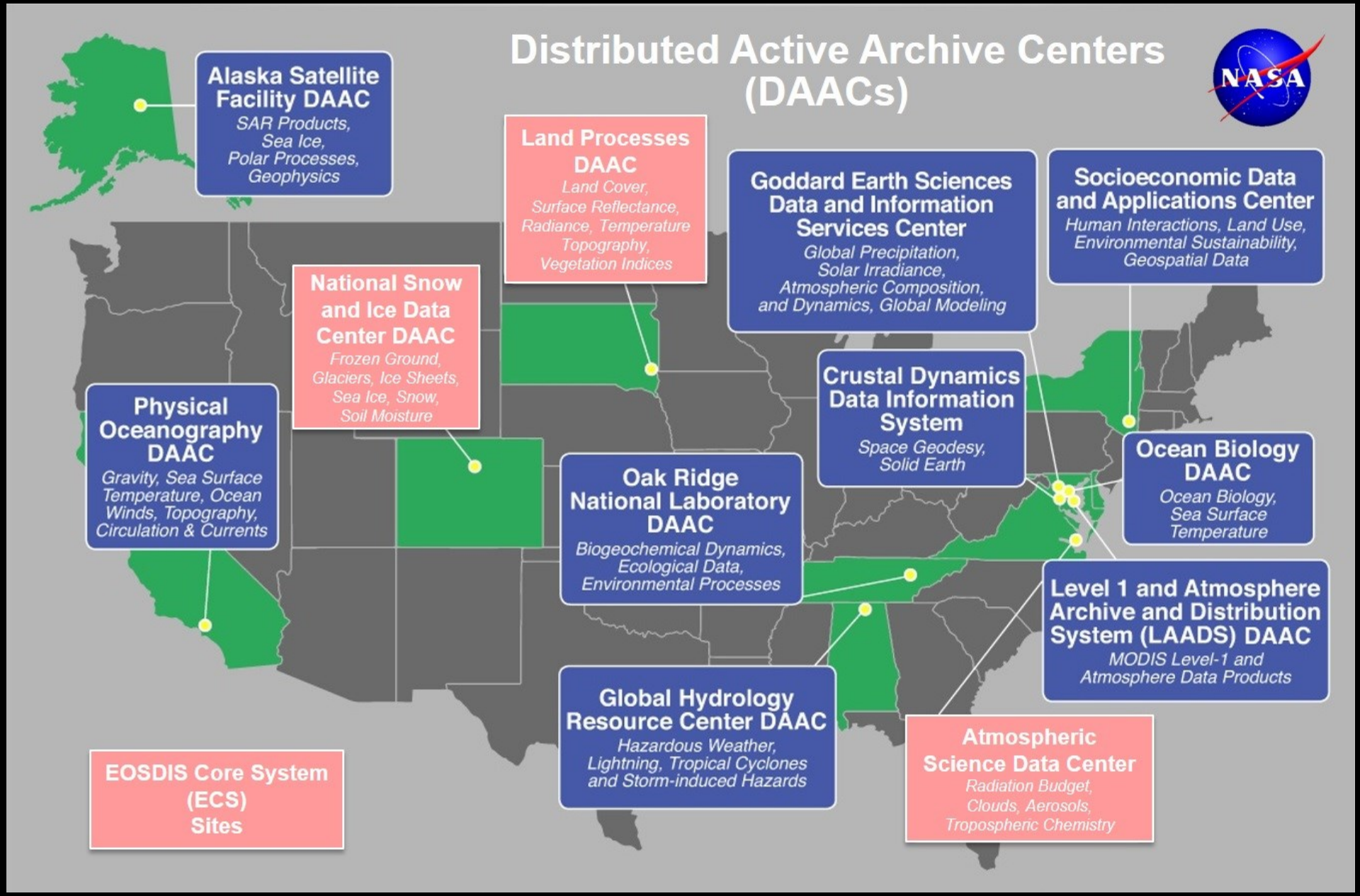
This layer provides access to NASA Global Imagery Browse Services, which delivers global, full-resolution satellite imagery. This band composition (Bands 1 4 3) most accurately represents how we see the earth's surface with our own eyes.

Daily Planet Imagery

Web Map By: esri

This map shows imagery for the planet that is updated on a daily basis. It features the NASA MODIS imagery True Color band composition (Bands 1 4 3 | Red, Green, Blue) which most accurately shows how we see the earth's surface with our own eyes.

EOSDIS Distributed Active Archive Centers (DAACs)



Lights At Night!

Cities

Boats

Industrial Sites

Gas Flares

Fires

Artificial lighting is a excellent remote sensing observable!

Two Satellite Systems Collect Global Low Light Imaging Data at Nights

- The fundamental purpose of both DMSP and VIIRS low-light imaging is to enable the detection of clouds using moonlight instead of sunlight as the illumination source.
- https://ngdc.noaa.gov/eog/dmsp/downloadV4composites.html
- U.S. Air Force Defense Meteorological Satellite Program (DMSP) Operational Linescan System (OLS). 1972 to present.
- NASA-NOAA Suomi NPP Visible Infrared Imaging Radiometer Suite (VIIRS). Launched October 28, 2011.
- https://ncc.nesdis.noaa.gov/VIIRS/

Secondary Products

- GHSL: Global human Settlement layer 1973, 2000, 2012
- https://ghsl.jrc.ec.europa.eu/datasets.php
- GUF: Global Urban Footprint 2015
- https://www.dlr.de/eoc/en/desktopdefault.aspx/tabid-9630/#gallery/24114

Sample Building Footprints from Maxar (DG)

- Download San Francisco
  Download Berlin
  Download Hong Kong
  Download Washington DC
  Download Santiago
  Download Mexico City
  Download Yaounde
-

- https://www.digitalglobe.com/products/building-footprints
- Facebook
- Microsoft

Popgrid

- https://sedac.ciesin.columbia.edu/mapping/popgrid/

Thank You