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Geographers' Tools: Gathering Information

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Gathering Information

We need to collect the information for inclusion on a map by:

- ✓ Using what's out there *(from libraries and data banks)*.
- ✓ Conducting field work.
- ✓ Employing photographic and electronic imagery.
- ✓ Using remotely-gathered data from surface, air, satellite and underwater sensing devices and techniques.

This diagram is available on the course home page

Photographs and Imagery

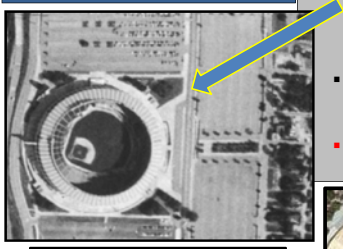
- ❖ Photos and images provide us with **temporal** (time span) and **seasonal** comparisons.
  - ➢ We can **identify** features.
  - ➢ We can **measure** objects (if the scale is known).
  - ➢ We can **document change**.

Flooded NC pig farm with a breached pig waste-holding pond.

http://thescholarship.ecu.edu/bitstream/handle/10342/5143/HARMIN-MASTERSTHESIS-2015.pdf?sequence=1

SPIN-2 Satellite Image
Atlanta, GA

How can we determine scale from this image?



It is a 1995 image from a Russian satellite in orbit 550 miles above the earth.

- Has a 2 meter resolution (i.e., the smallest object we can see is 6 ft long).
- **What can we use to take a measurement?**

Markings on sport fields.

REMOTE SENSING

- ❖ **Gathering information from afar using sophisticated devices as electronic cameras and scanners.**
  Categorized as PHOTOGRAPHY and NON-PHOTOGRAPHY.
- ❖ **Photogrammetry** is the use of photographs and images to make maps.

REMOTE SENSING

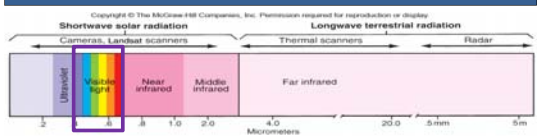
Photography

- **Dates from the 1860s.**
- **Uses light-sensitive chemically treated film.**
- **First planned aerial recon flights occurred in the 1930s for agric.**
- **Extensively used in WWII for reconnaiss-ance and mapping.**
- ➢ **Must be processed in a photo lab.**

Non-Photography

- **Dates from the 1970s.**
- **Does not use film.**
- **Light rays are turned into electrical signals and stored digitally.**
- **Full-spectrum electro-magnetic sensitive,** not just visible light, **including:**
  - **radio waves** (RADAR)
  - **laser light** (LIDAR)
  - **thermal radiation** (heat)
- ➢ **Needs computer soft-ware to store, retrieve and process the data.**

REMOTE SENSING



Spectral or **Radiometric Signature**

- **All features** (living or inanimate) **absorb and reflect energy from the electromagnetic spectrum.**
- **Recording instruments can detect this energy and "see" bands of the spectrum the human eye cannot detect.**

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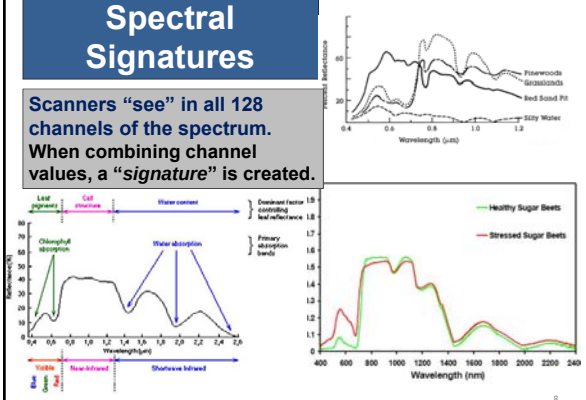
Spectral Signatures

Scanners "see" in all 128 channels of the spectrum. When combining channel values, a "*signature*" is created.



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Spectral Signatures

- **Spectral signatures** have to be **processed** to make the image is meaningful to people.
- **Colors are assigned to each signature** or groups of signatures by the person or program processing the image.
- **Data dictionaries are created** to record and unify processed information. They can then be referenced and read by other computer programs.
- **All information is stored** so it can be accessed and compared at any time.

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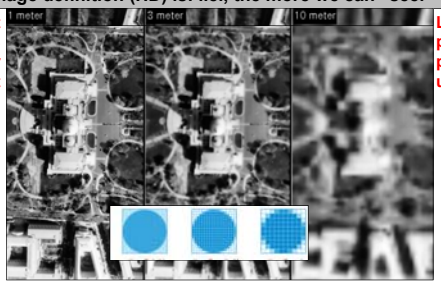
Camera/Sensor Image Resolution

- **The smallest picture element distinguished by an instrument is called a PIXEL.**
  - **The more pixels per unit,** as a square inch, **the higher the image definition (HD) is: i.e., the more we can "see."**

Most pixels per unit



Least pixels per unit

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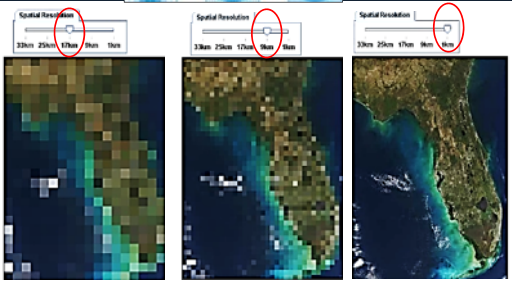
Sensor Resolution



Smallest object seen is 111 sq. mi.

Smallest object seen is 31 sq. mi.

Smallest object seen is **.4** sq. mi

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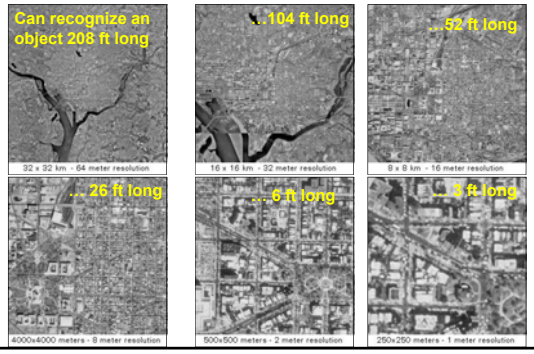
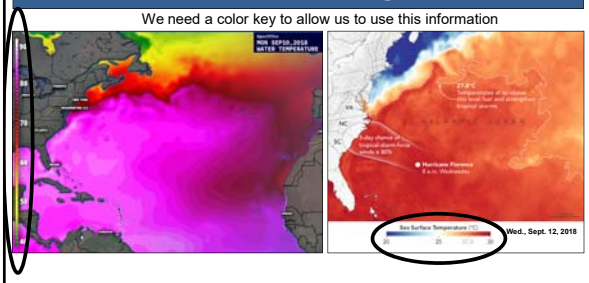
Satellite Sensor Resolution (detail)



Colors "Assigned" to Surface Ocean Temperatures

We need a color key to allow us to use this information



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Processing Satellite Imagery

Need to process/correct images for:

1. Motion of the earth.
2. Motion of the spacecraft.
3. Motion of the recording instrument.
4. Incorrect alignment of channels/signature bands on the focal plane.
5. Curvature of the earth.

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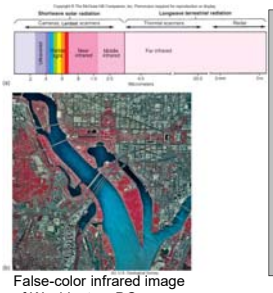
Satellite Imagery



False-color infrared image of Washington, DC

False-color infrared imagery:

- **Good for showing water and vegetation features.**
- Colors that appear on the image are **not** "real".
- **Computer programs** (via people) **assign colors to specific data sets**.
- Looks like a photograph, but it isn't!

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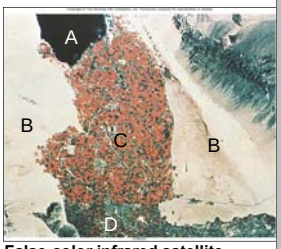
Satellite Imagery: Agriculture



False-color infrared satellite image of the Imperial Valley of California at the Mexican border.
Can you see where the border is?

A: Black is fresh water.
B: Light colors are desert and mountain areas without vegetation.
C: Brightly colored squares are agricultural fields of healthy, growing crops. Each crop has a unique color.
D: Irregular, less colorful areas are agricultural fields of crops not doing as well as those in area C.

First developed by the military for surveillance, including vegetation disturbance (camouflage).

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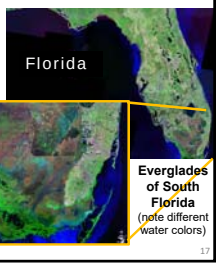
Satellite Imagery

The colors associated with specific conditions are determined by a data dictionary created by people. **Colors will change as conditions change** based on the spectral signatures picked up by the sensing unit.



Everglades of South Florida (note different water colors)

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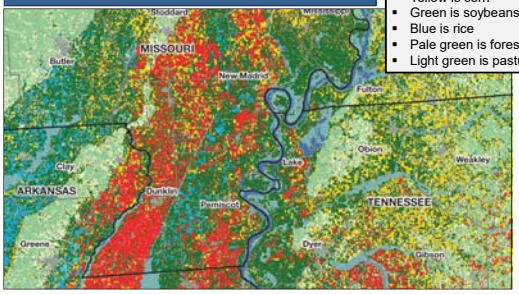
Satellite Imagery

USDA Cropscape image of the Central Mississippi Valley

Color key:

- Red is cotton
- Yellow is corn
- Green is soybeans
- Blue is rice
- Pale green is forest
- Light green is pasture



https://nassgeodata.gmu.edu/CropScape/ USDA Cropland data site. Zoom in the see local data.

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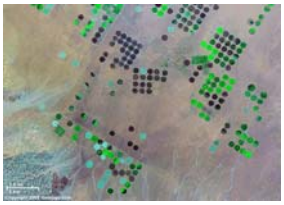
Satellite Imagery



Agricultural area of Saudi Arabia

Agricultural area of Texas.

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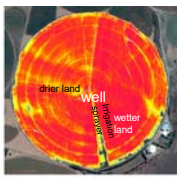
Remote Monitoring of an Irrigation System



Vegetation in wetter areas shows up differently than vegetation in drier areas and give off a variation of their spectral signatures. The farmer can monitor remote fields from an office using satellite remote sensing.

Thermal Imagery

Monitoring the industrial heated water outflow into a waterway.
Water temperature can be monitored on a regular basis to assure compliance and protect waterways and ecozones from thermal pollution.

http://www.thermalsavingsuk.co.uk/drone-surveys/drone-survey.html 2 min fly over (play thermal scan video)

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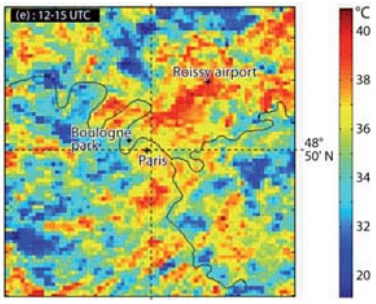
Thermal Image of Paris and Environs

Studying urban heat islands.



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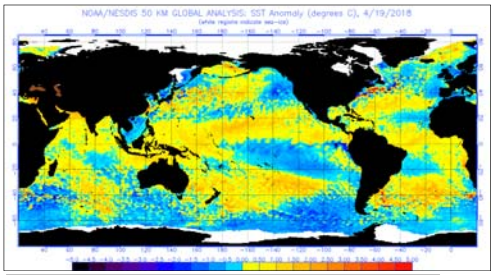
Observing Sea Surface Temperatures from Space

Continuous thermal scanning of the oceans is used to monitor global warming and predict tropical storm development.



example of water temperature monitoring: http://www.ospo.noaa.gov/Products/ocean/sst/contour/

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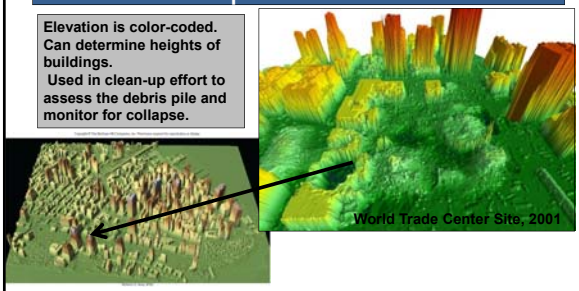
LIDAR

❖**LiDAR (Light Detection and Ranging).**
✓ **Uses laser light instead of radio waves (radar) to measure elevation.**
✓ **Accurate to within 6 inches.**
✓ **15,000 pulses per second produce an image when combined with an aerial photograph and GPS data.**
✓ **Thermal imaging can be added** (e.g., to monitor volcanic activity).

Bare earth model of **Mount Rainier** in Mt. Rainier Nat'l Park, WA. Vegetation cover is eliminated, thus only the soil/rock layer is shown.

LIDAR Image of Lower Manhattan after Sept. 11 attack

Elevation is color-coded. Can determine heights of buildings.
Used in clean-up effort to assess the debris pile and monitor for collapse.



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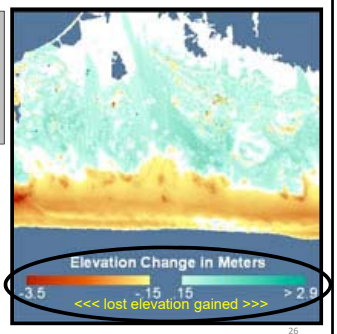
LIDAR Image of Fire Island

Monitoring the change in elevation of a portion of Fire Island, NY after Superstorm Sandy

http://coastal.er.usgs.gov/hurricanes/sandy



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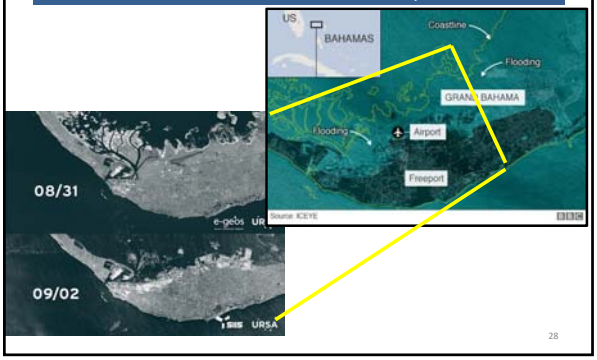
Satellite Surveys

Satellite surveys allow us to track the movement of storms and after they pass give responders an idea of what to except before they arrive on scene.

https://www.washingtonpost.com/graphics/2017/national/hurricane-irma-before-after/?utm_term=.3a75b8fdb393

Before and After Hurricane Dorian Grand Bahama Island, 2019



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Images and Photographs vs. Maps

Why bother with maps if we can see so much from images and photographs?

- Photographs show **everything** and give **too much information**.
- Objects can be **hidden** from view.
- Images have to be **processed** to show features.

➢**Maps are selective!**

GOOGLE Views
https://www.google.com/earth
https://www.google.com/maps

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N E X T

Automated Map Making

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