EXTRA CREDIT

❖ **Extra Credit Atlas Exercise for Exam I is due today.**

http://www.geo.hunter.cuny.edu/courses/geog101_grande/extra_credit.html

➢ Submit answers to me using the blue Scantron sheet by **end of class today**.

- **Completely erase all mistakes and stray marks.**
- **Bubble in your last/first name on the back of the Scantron.**
- **LATE answer sheets will NOT be accepted.**

FIRST EXAM

❖ **Tues., Feb. 25, 2020.**

- **Combination of multiple choice questions and map/ diagram interpretation.**
- **Bring a #2 pencil with eraser.**
- **Based on class lectures supplementing Chapter 1.** Review lectures 1-8 on home page.

➢ **If you miss this exam, a written-response make up test** (with the place name maps) **will be given.**

7
Geographers' Tools: Gathering Information

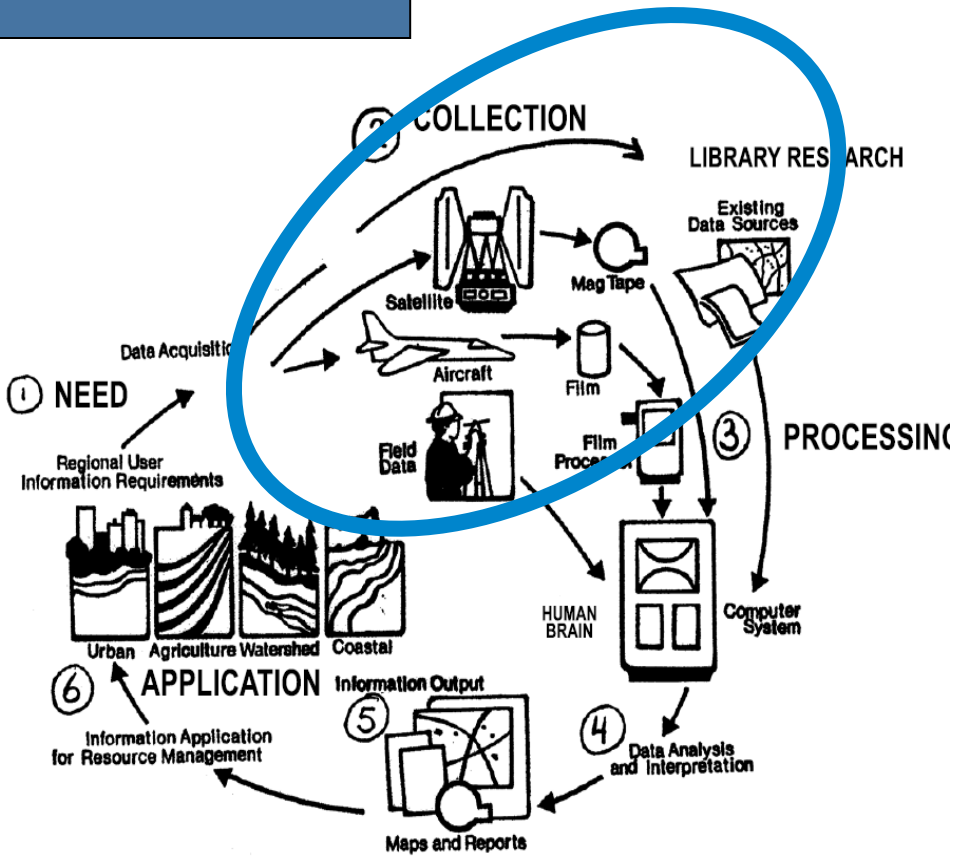
Prof. Anthony Grande

Hunter College Geography

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.

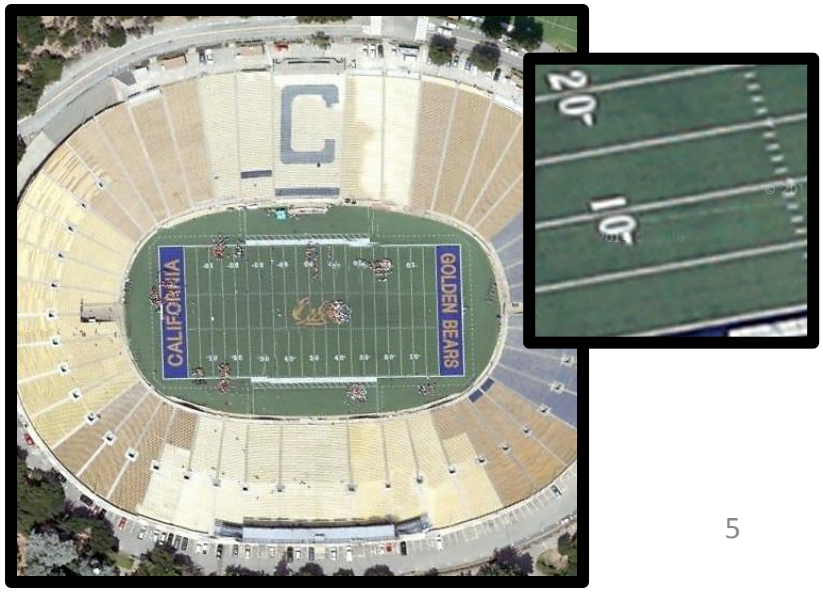
http://thescholarship.ecu.edu/bitstream/handle/10342/5143/HARMIN-MASTERSTHESIS-2015.pdf?sequence=1

SPIN-2 Satellite Image
Atlanta, GA

Soccer field

How can we determine scale from this image?

- 1995 image from a Russian satellite
- 550 mi high orbit
- 2 meter resolution (i.e., the smallest object we can see is 6 ft long)



REMOTE SENSING

- **Gathering information from afar using sophisticated devices as electronic cameras and scanners.**

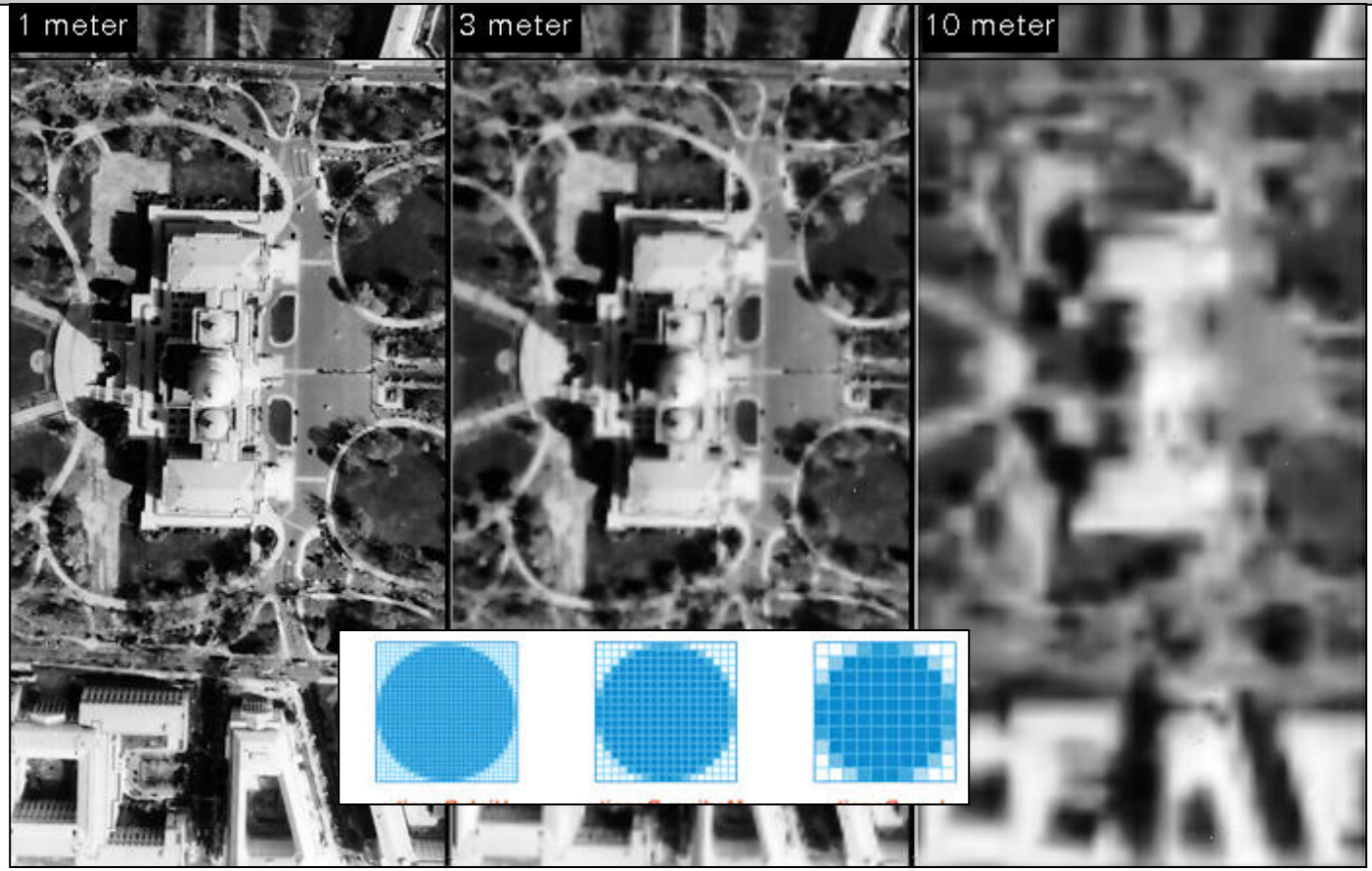
  Categorized as PHOTOGRAPHY and NON-PHOTOGRAPHY.

- **Photogrammetry** is the use of photographs and images to make maps.

Camera/Sensor Resolution

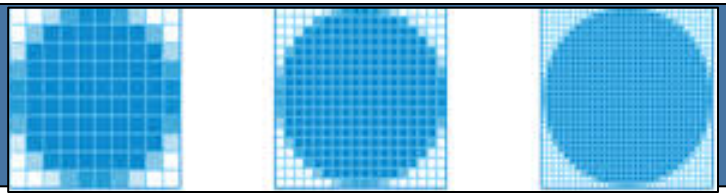
- **The smallest picture element distinguished by a scanner is called a PIXEL.**
  - **The more pixels per unit,** as a square inch, **the higher the image definition (HD) is: i.e., the more we can "see."**

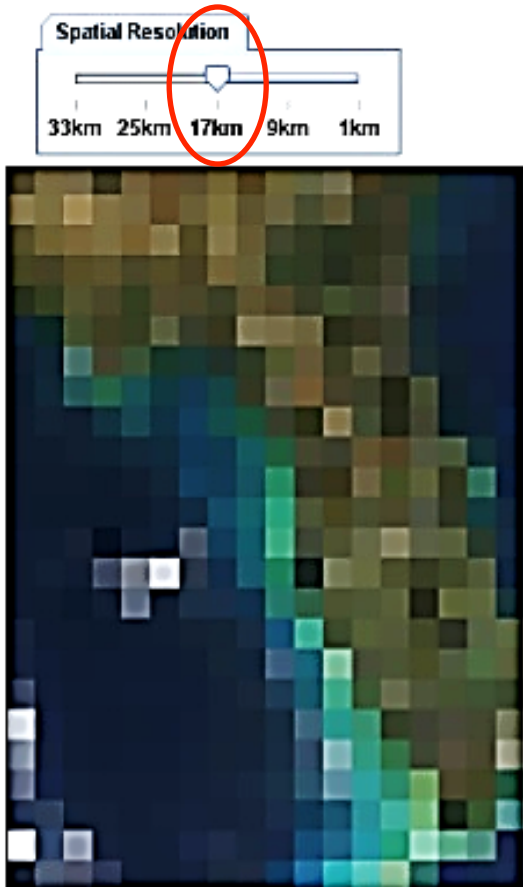
Most pixels per unit



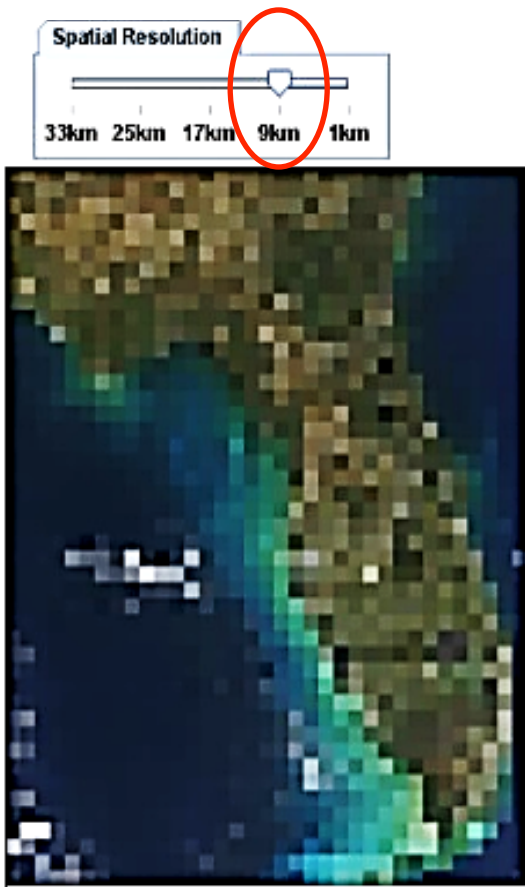
Least pixels per unit

Sensor Resolution





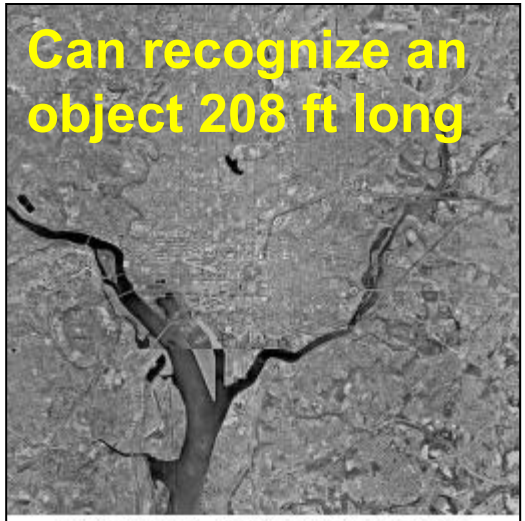
Smallest object seen is 111 sq. mi.



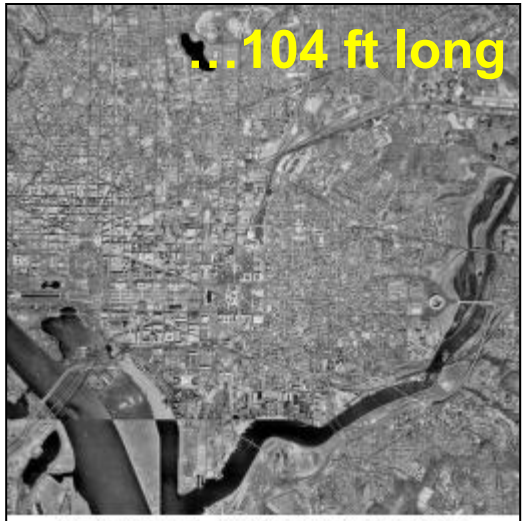
Smallest object seen is 31 sq. mi.

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

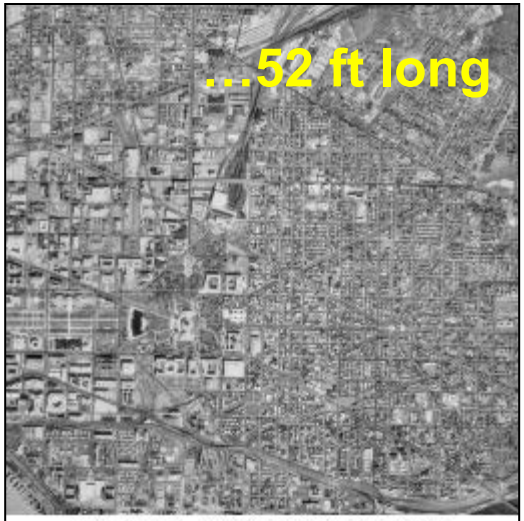
Satellite Sensor Resolution
(detail)



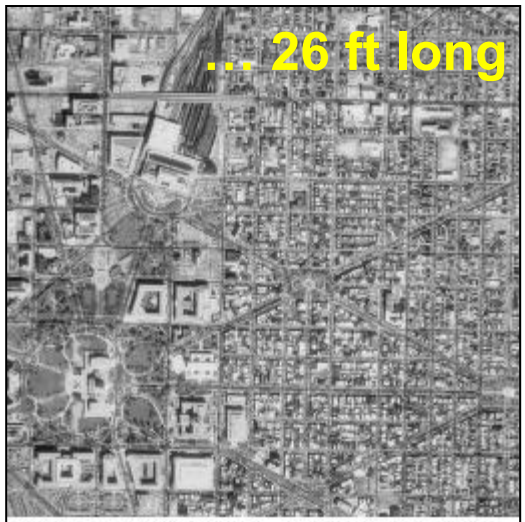
32 x 32 km - 64 meter resolution



16 x 16 km - 32 meter resolution



8 x 8 km - 16 meter resolution



4000x4000 meters - 8 meter resolution

500x500 meters - 2 meter resolution

250x250 meters - 1 meter resolution

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.**

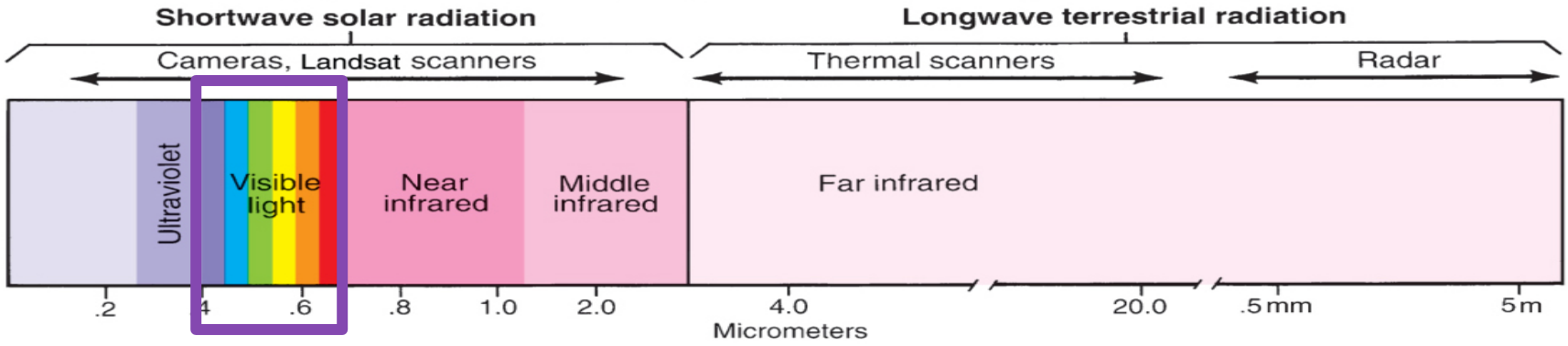
➢ **Must be processed in a photo lab.**

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

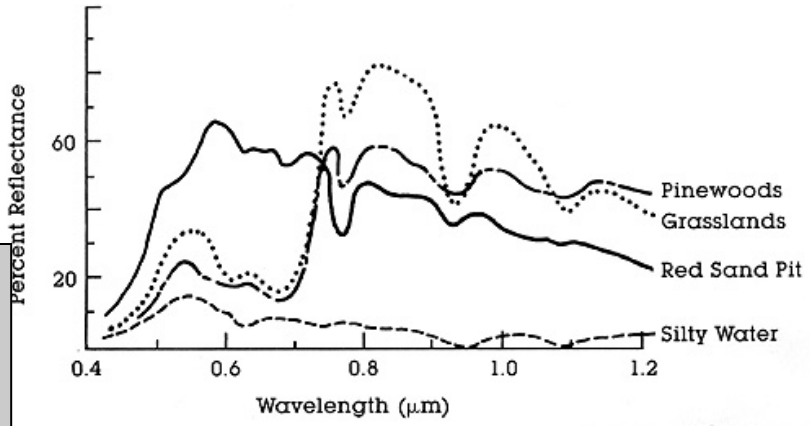


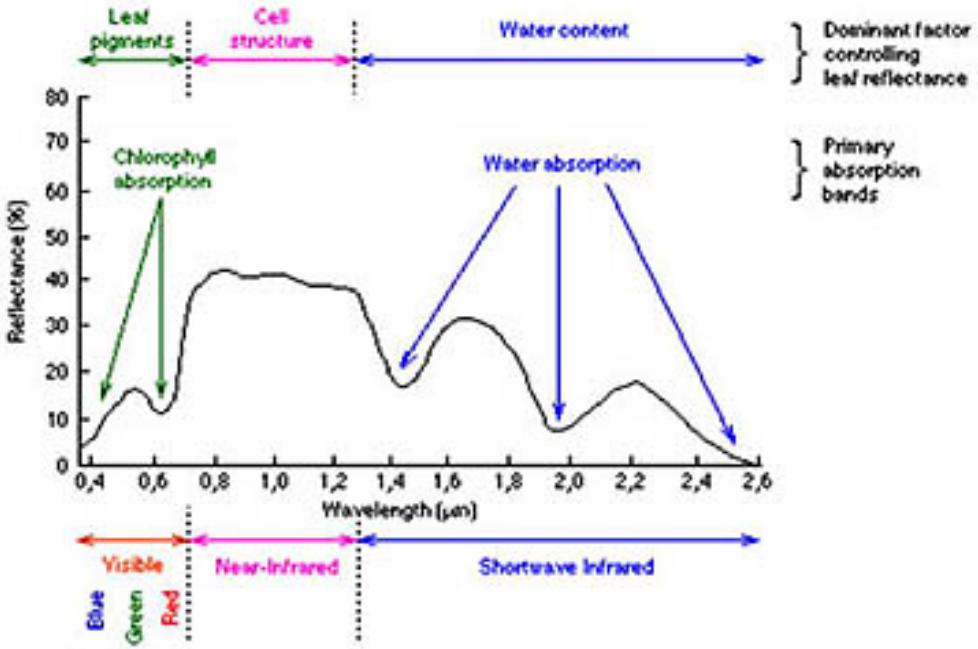
Spectral or **Radiometric Signature**

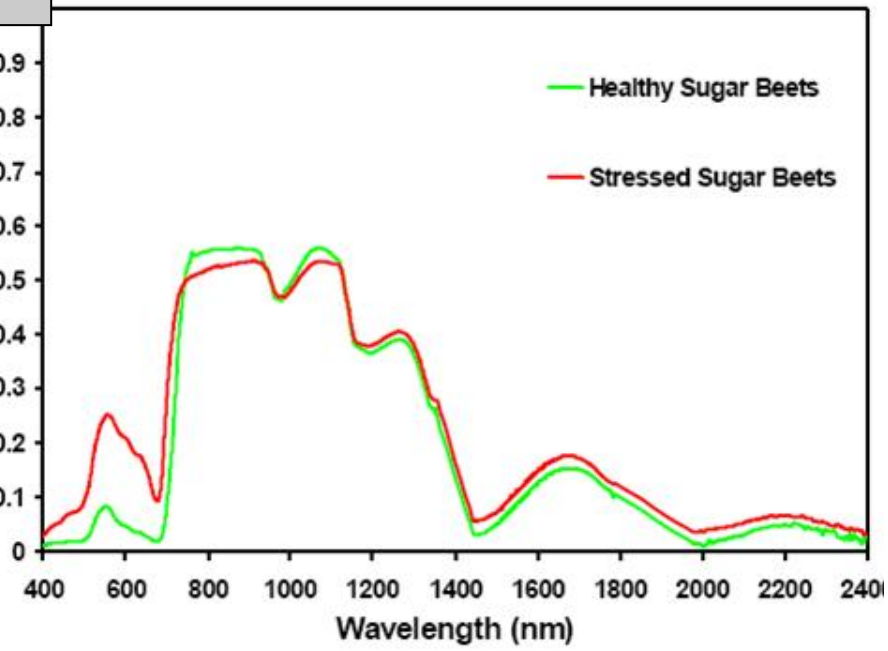
- **All features** (living or inanimate) **absorb and reflect energy from the electromagnetic spectrum.**
- **Recording instruments can detect this energy and "see" bands of the spectrum the human eye cannot detect.**

Spectral Signatures

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





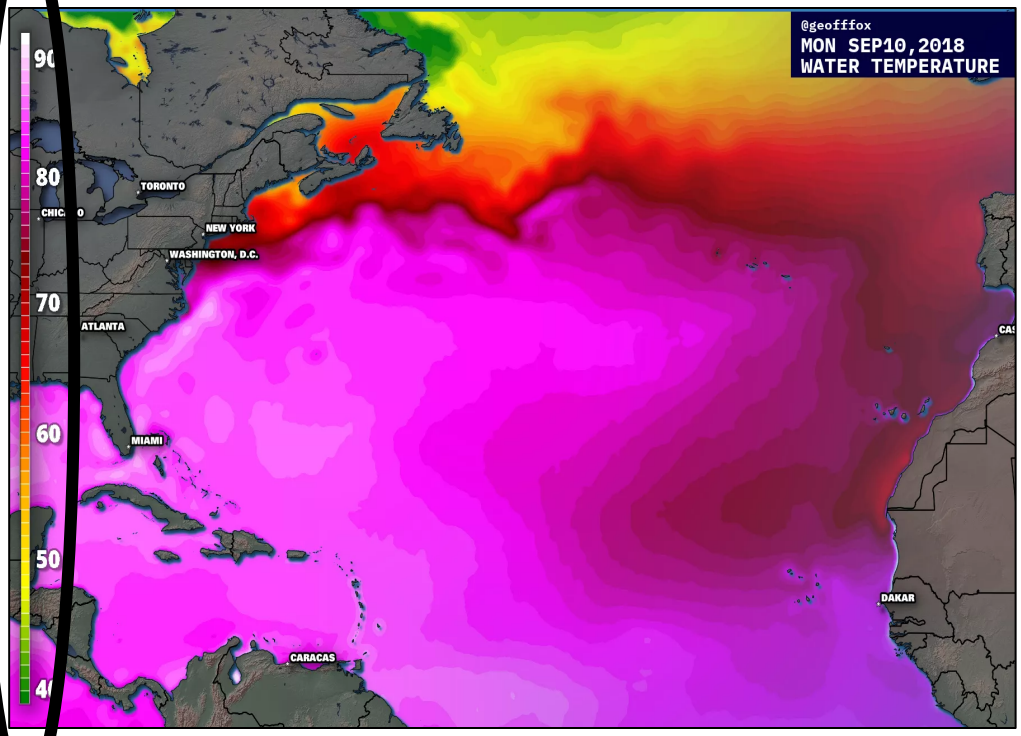


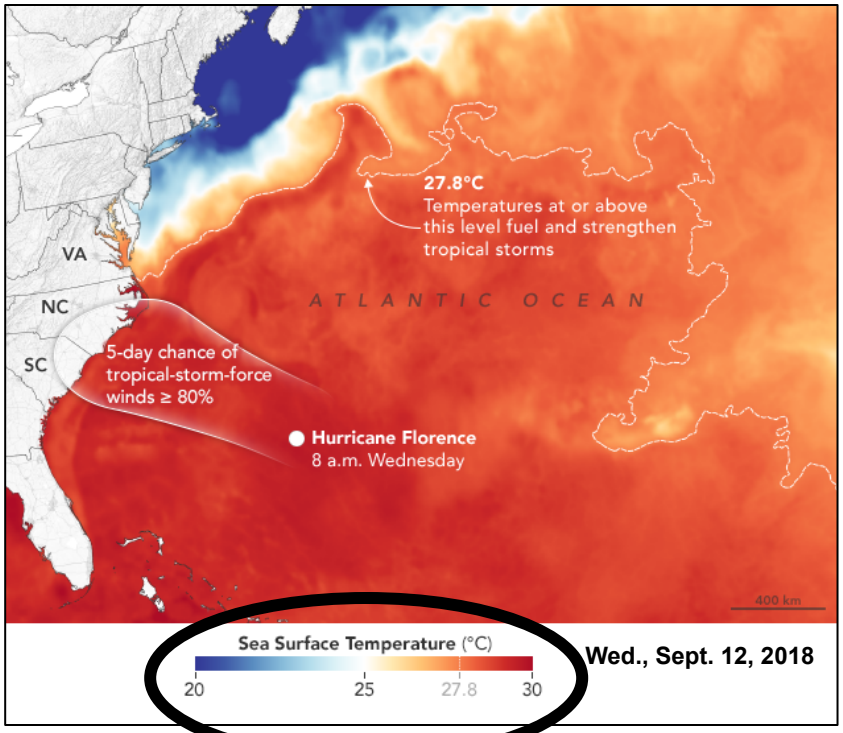
Spectral Signatures

- **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.

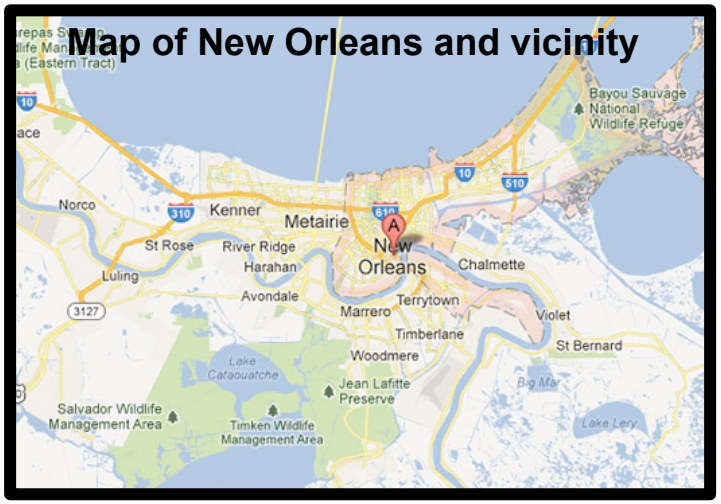
Colors "Assigned" to Surface Ocean Temperatures

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





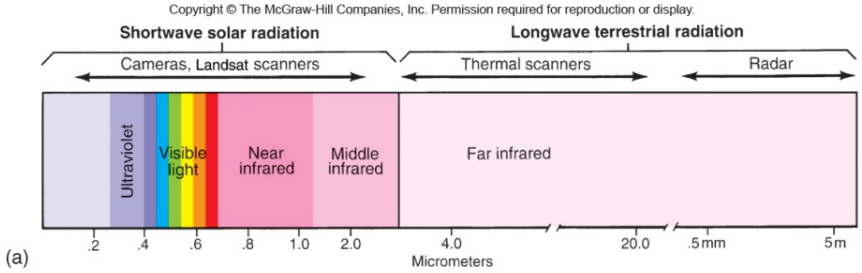
Satellite Imagery



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.

Satellite Imagery

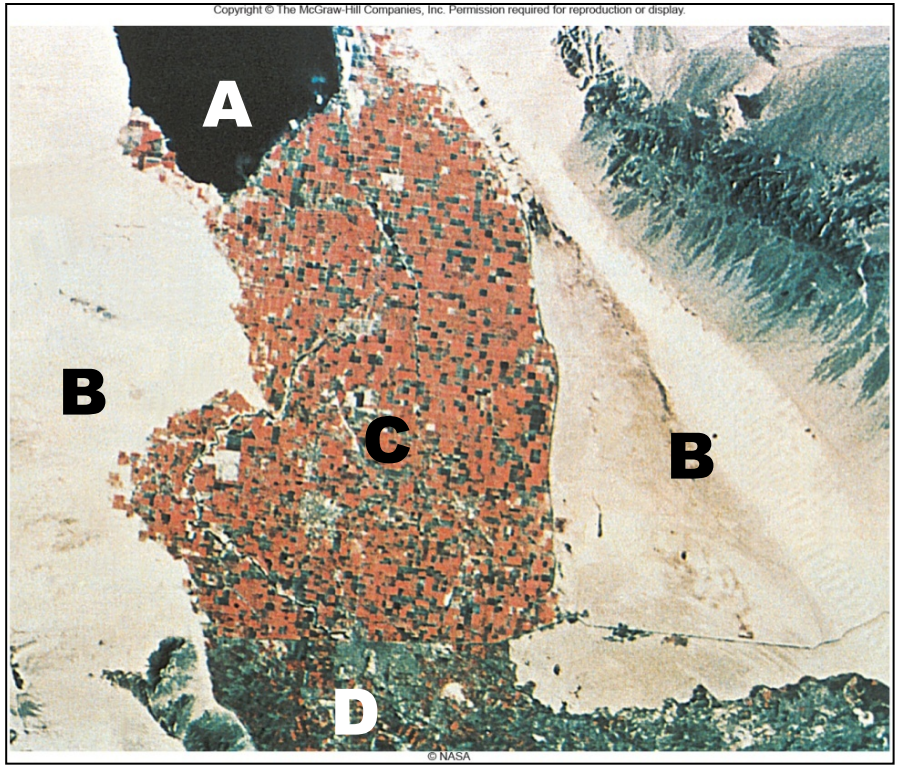


False-color infrared image of Washington, DC

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!

Satellite Imagery



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.

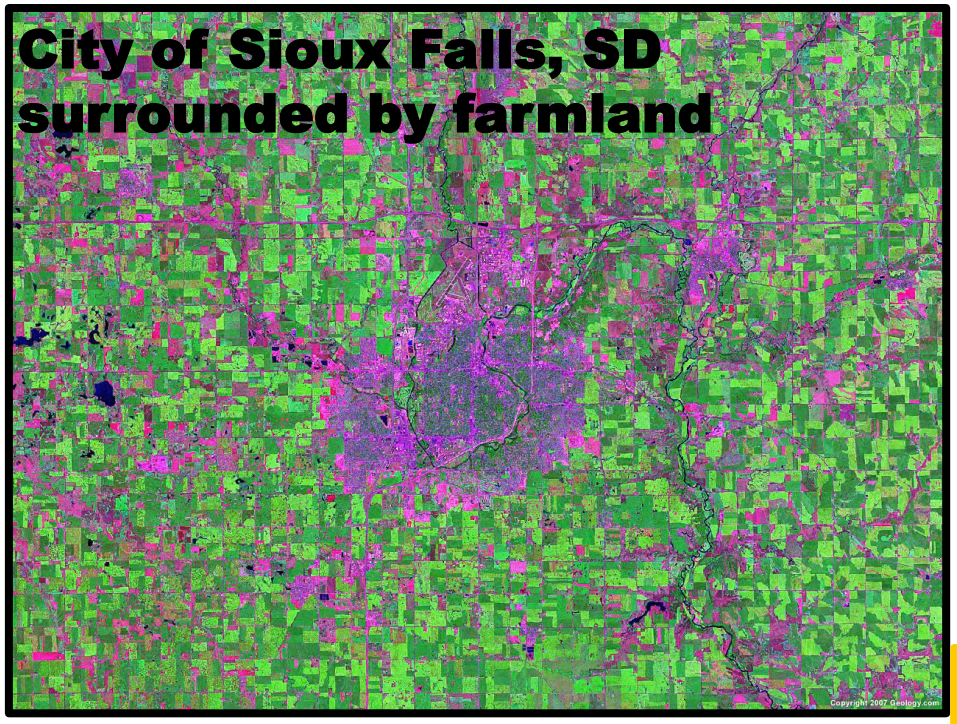
B: Light colors are desert and mountain areas without vegetation.

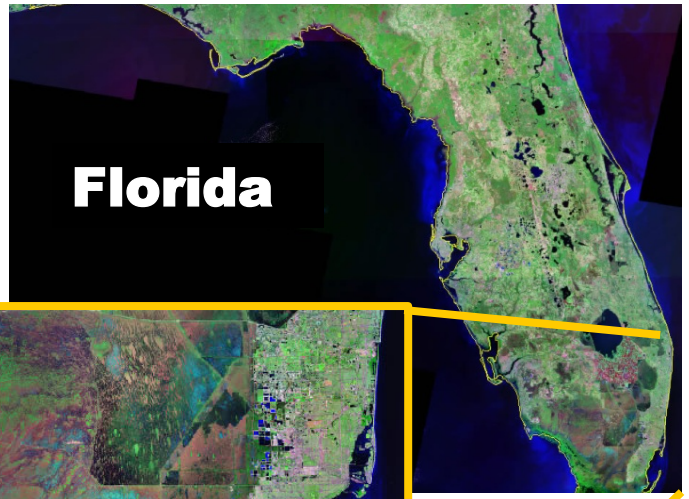
C: Brightly colored squares are agricultural fields of healthy, growing crops.

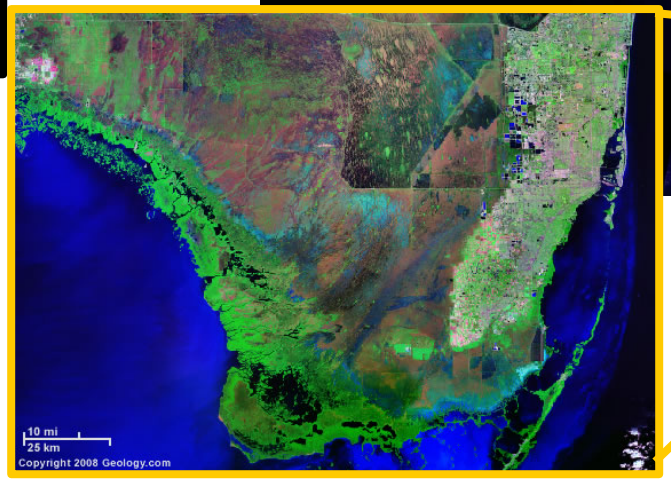
D: Irregular less vivid areas are agricultural fields of less prosperous crops.

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

Satellite Imagery







Everglades of South Florida (note different water colors)

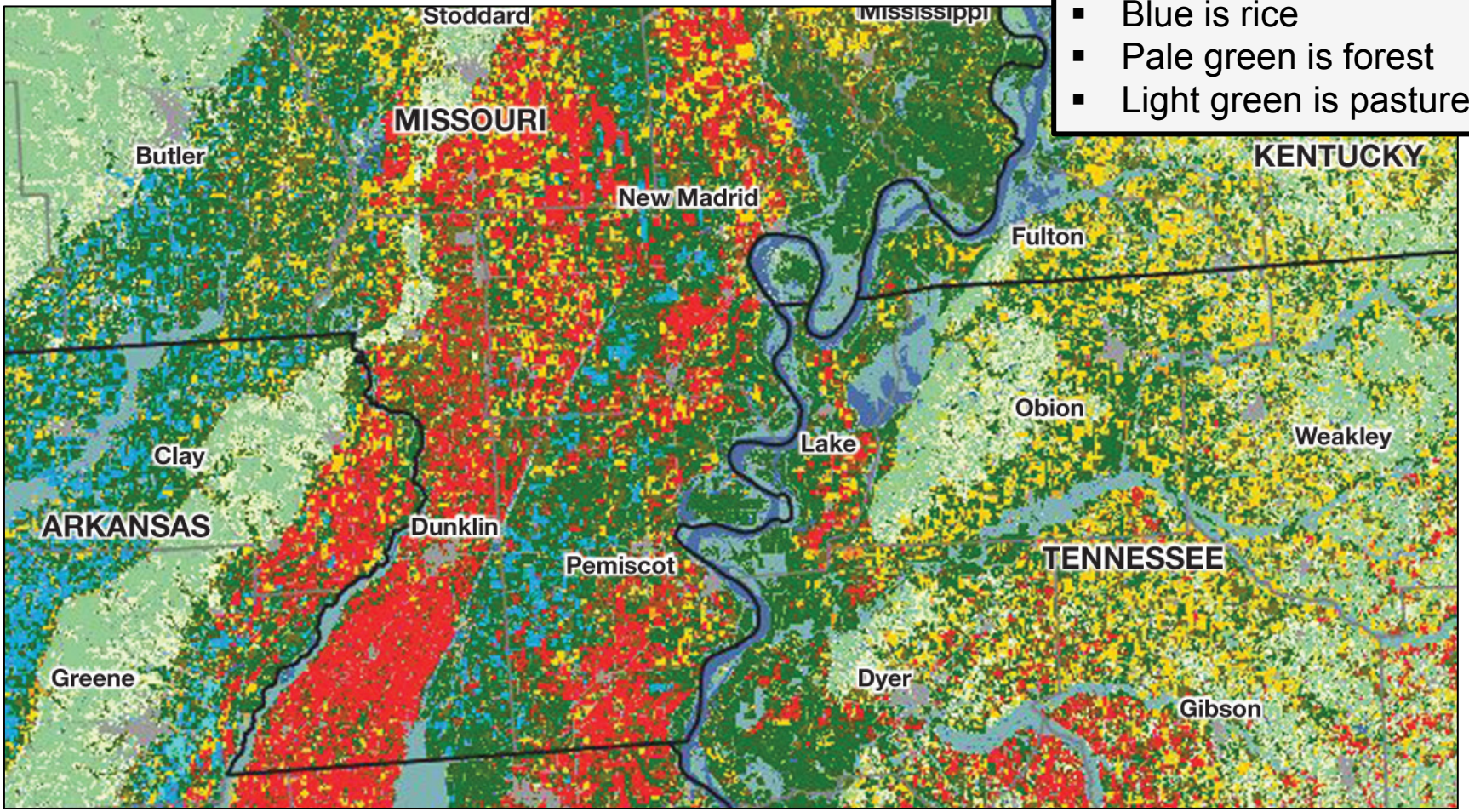
The colors associated with specific conditions are determined by a data dictionary created by people. **Colors will change as conditions change** based on the spectral signatures picked up by the sensing unit.

Satellite Imagery

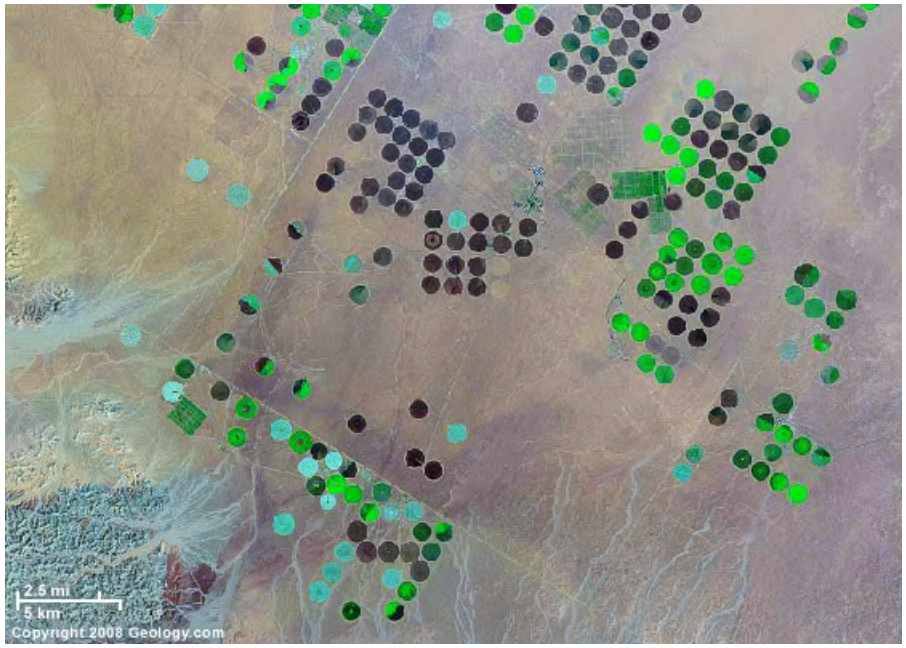
USDA Cropscape image of the Central Mississippi Valley

Color key:

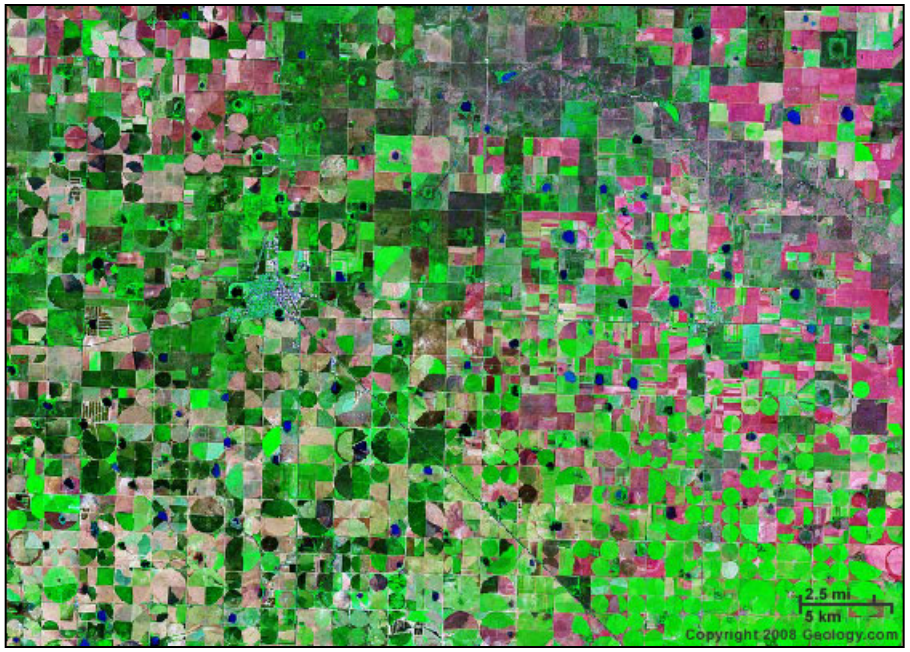
- Red is cotton
- Yellow is corn
- Green is soybeans
- Blue is rice
- Pale green is forest
- Light green is pasture



Satellite Imagery

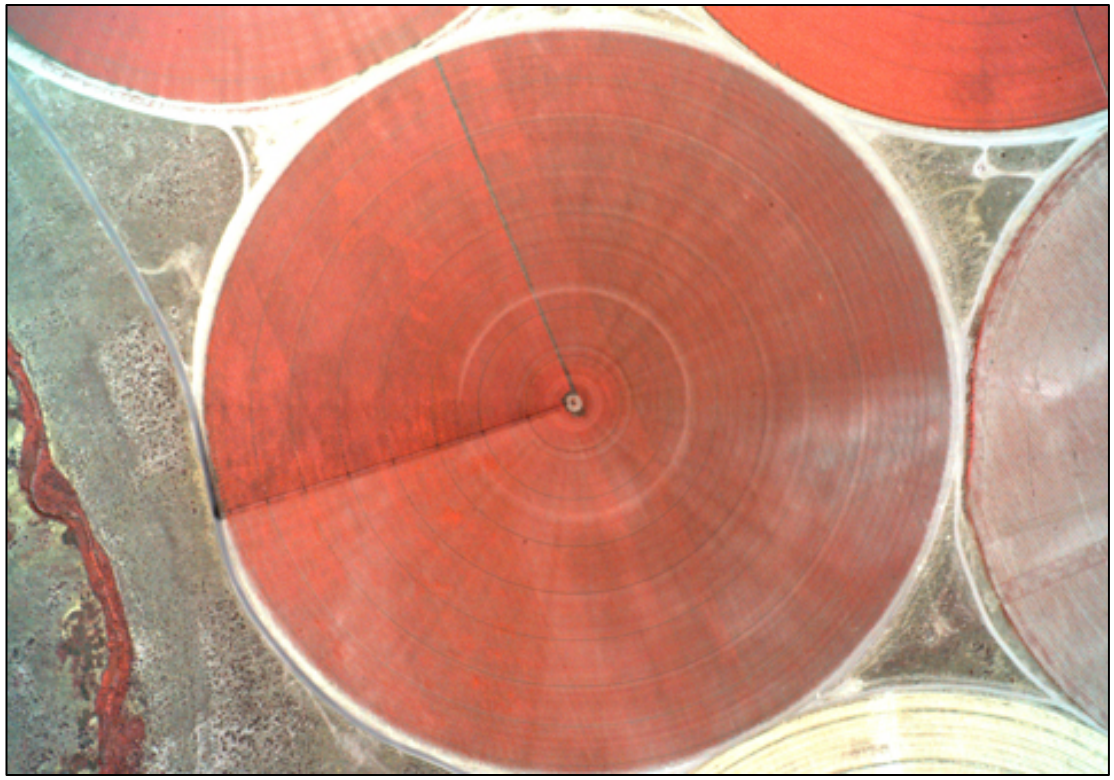


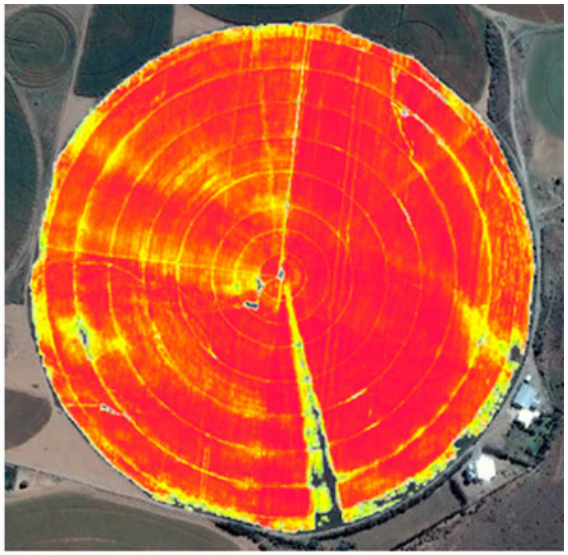
Agricultural area of Saudi Arabia



Agricultural area of Texas.

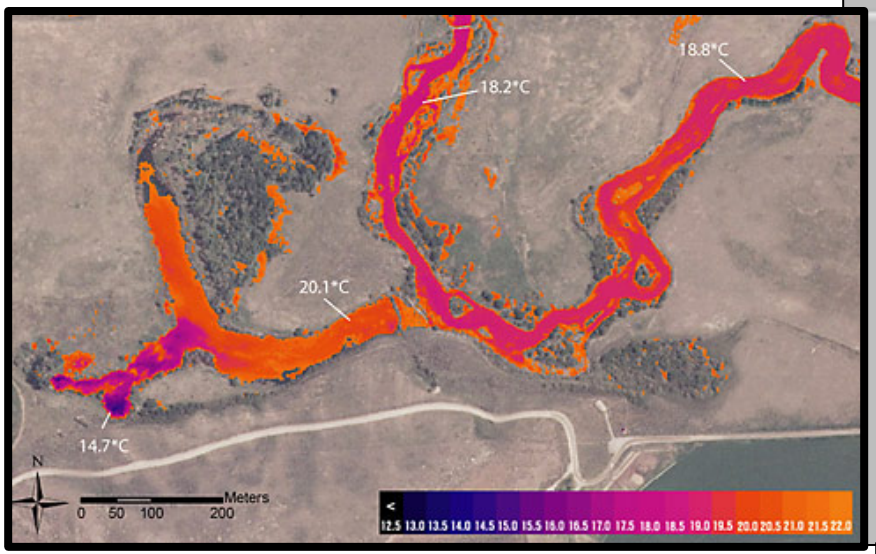
Remote Monitoring of an Irrigation System

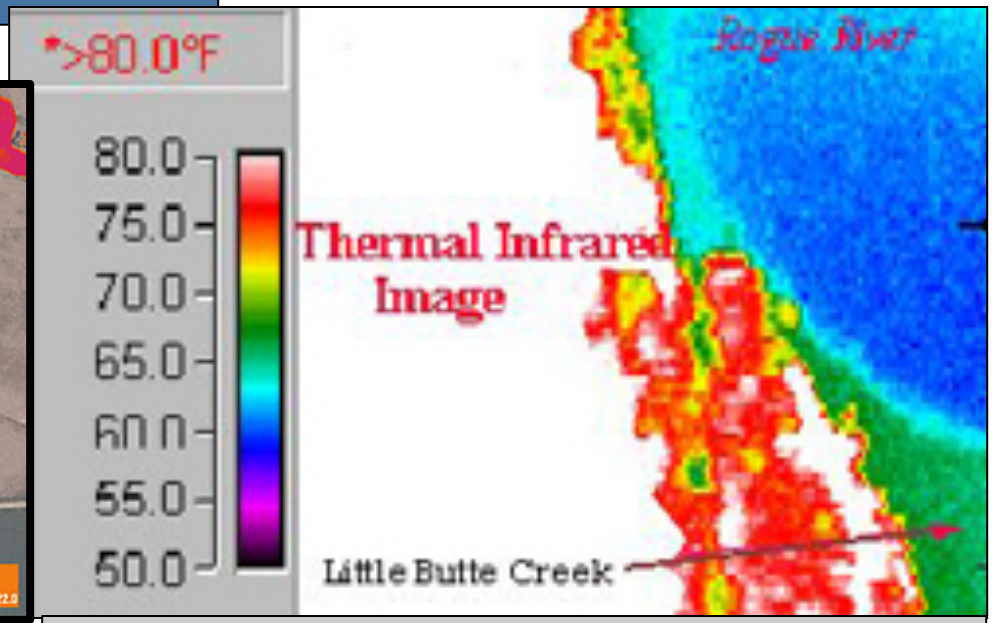




Vegetation in wetter areas shows up differently than vegetation in drier areas.

Thermal Imagery



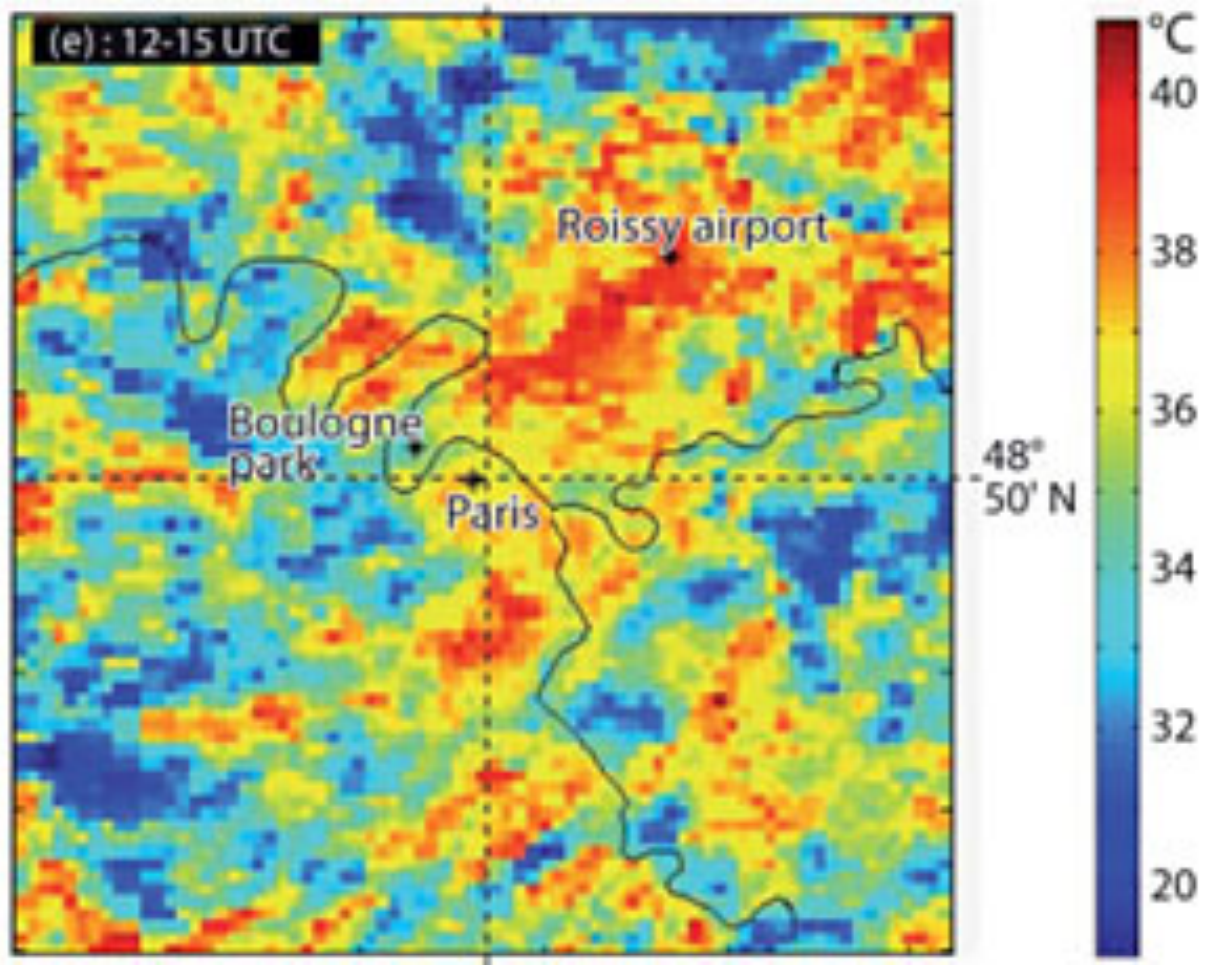


Monitoring the industrial heated water outflow into a waterway.
Water temperature can be monitored on a regular basis to assure compliance and protect waterways and ecozones from thermal pollution.

http://www.thermalsavingsuk.co.uk/drone-surveys/drone-survey.html 2 min fly over

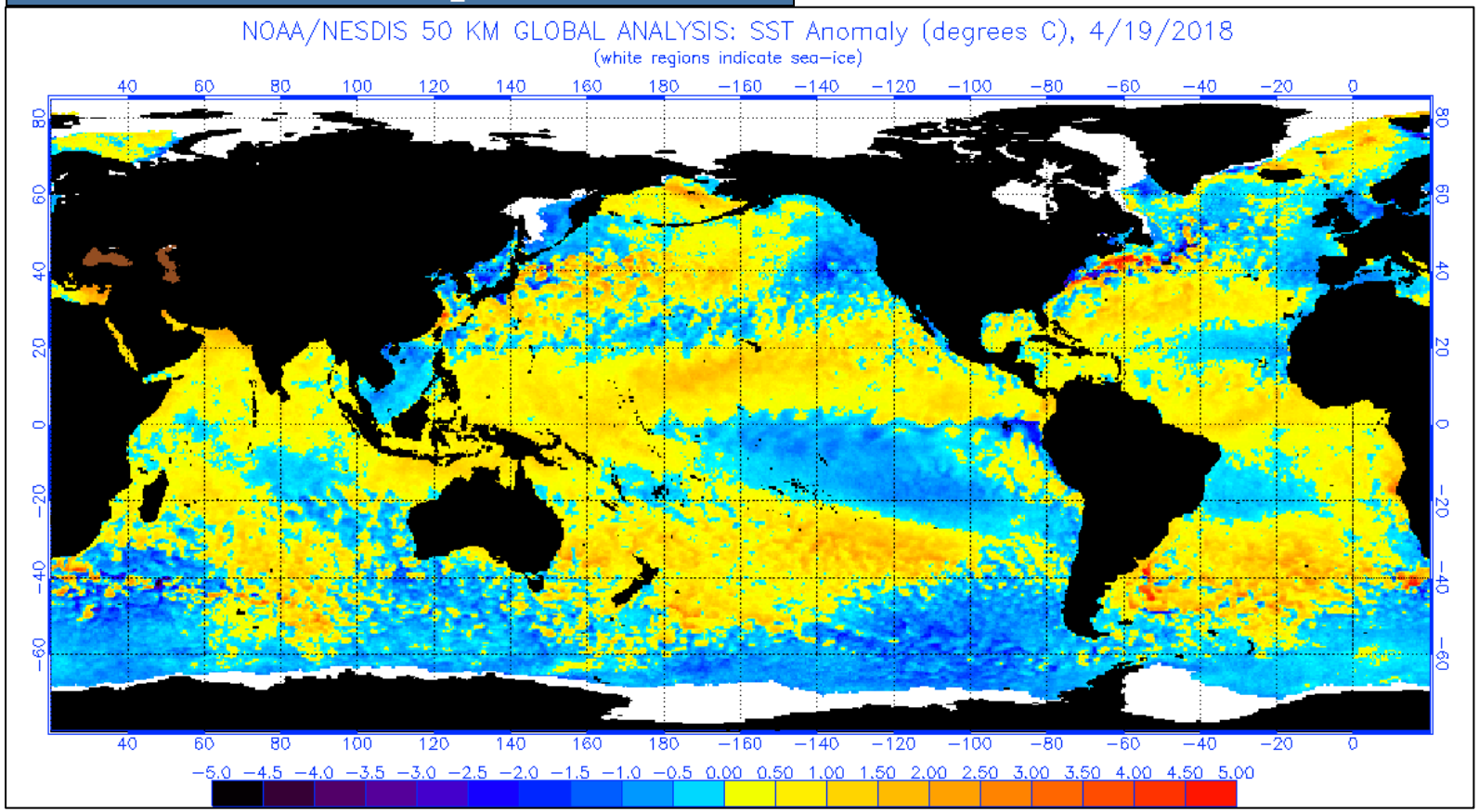
Thermal Image of Paris and Environs

Studying urban heat islands.



Sea Surface Temperature Observations 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/

LIDAR

❖**LiDAR (Light Detection and Ranging).**

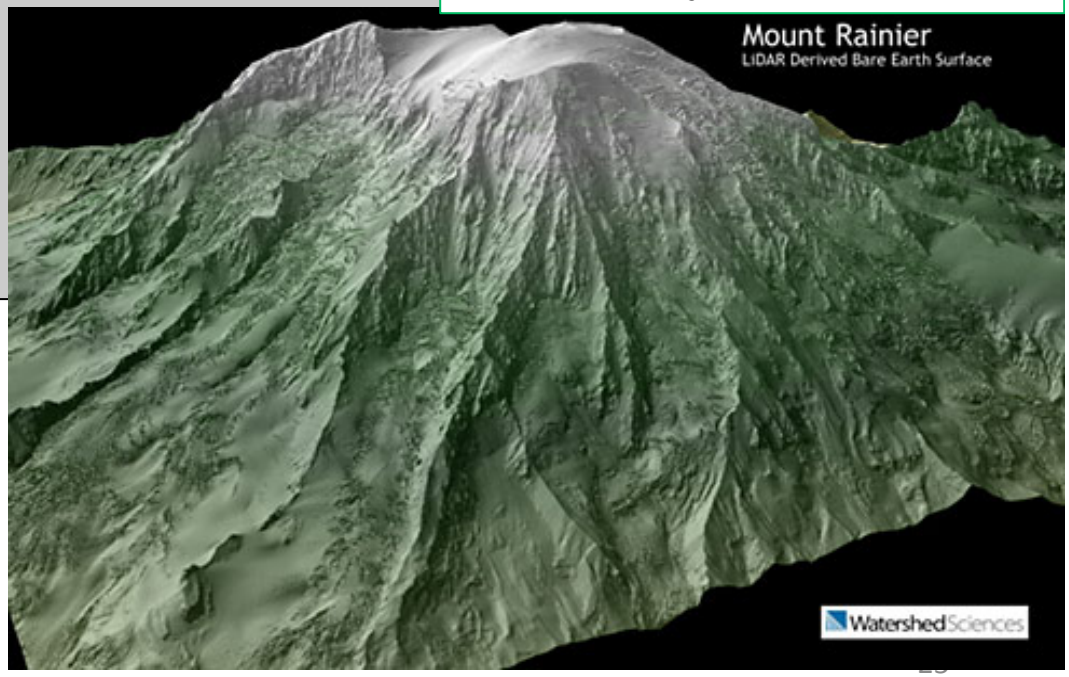
✓ **Uses laser light instead of radio waves (radar) to measure elevation.**

✓ **Accurate to within 6 inches.**

✓ **15,000 pulses per second produce an image when combined with an aerial photograph and GPS data.**

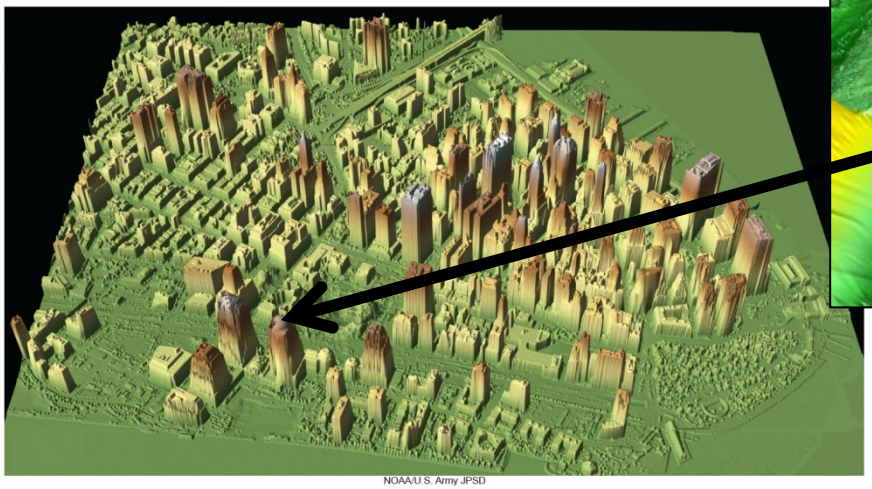
✓ **Thermal imaging can be added** (e.g., to monitor volcanic activity).

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.

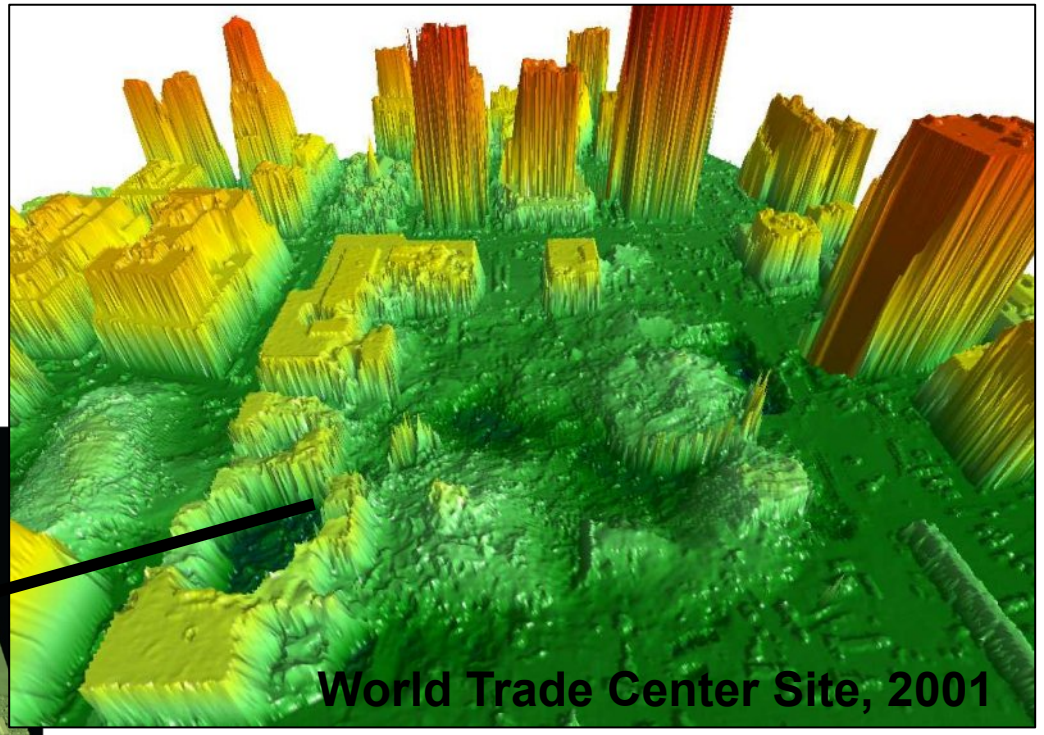


LIDAR Image of **Lower Manhattan** after Sept. 11 attack

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



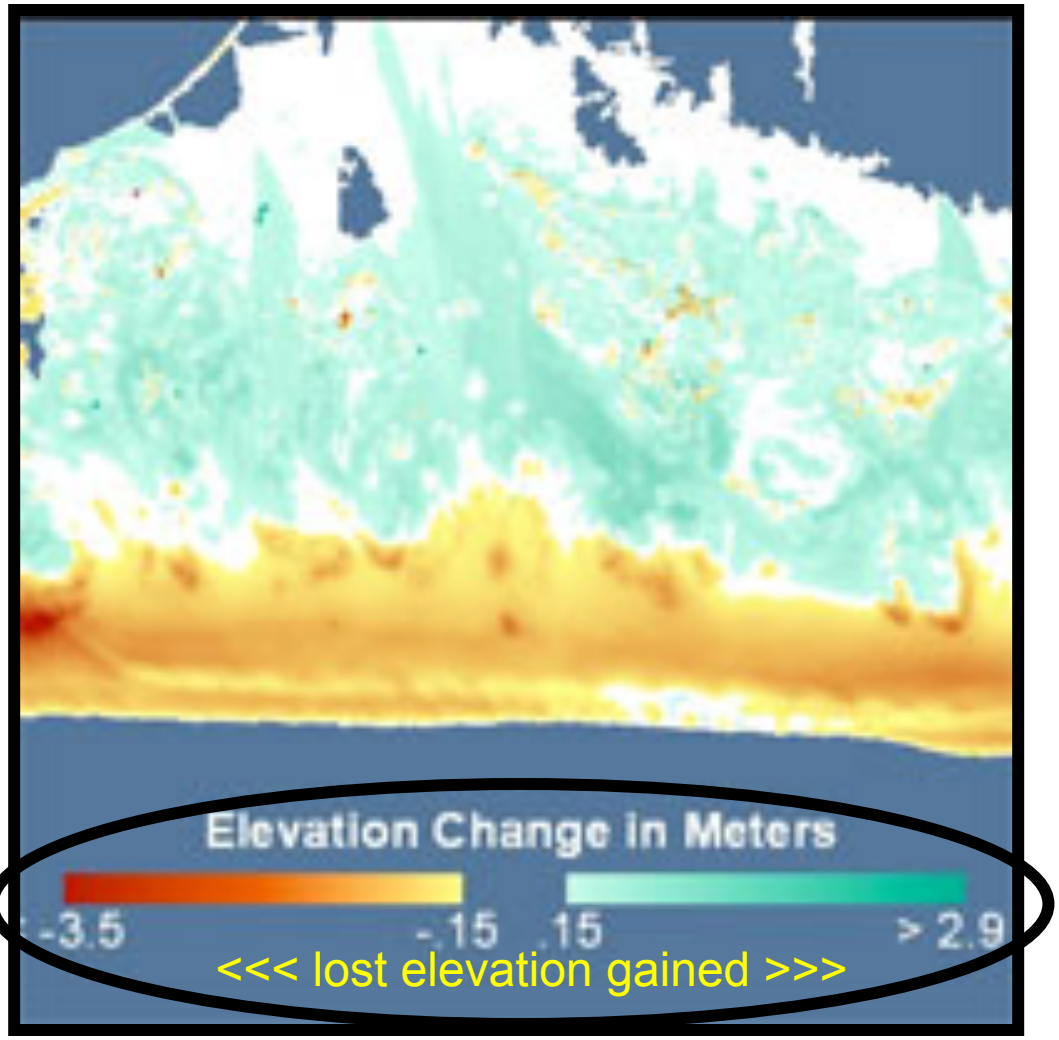
NOAA/U.S. Army JPSD



LIDAR Image of Fire Island

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

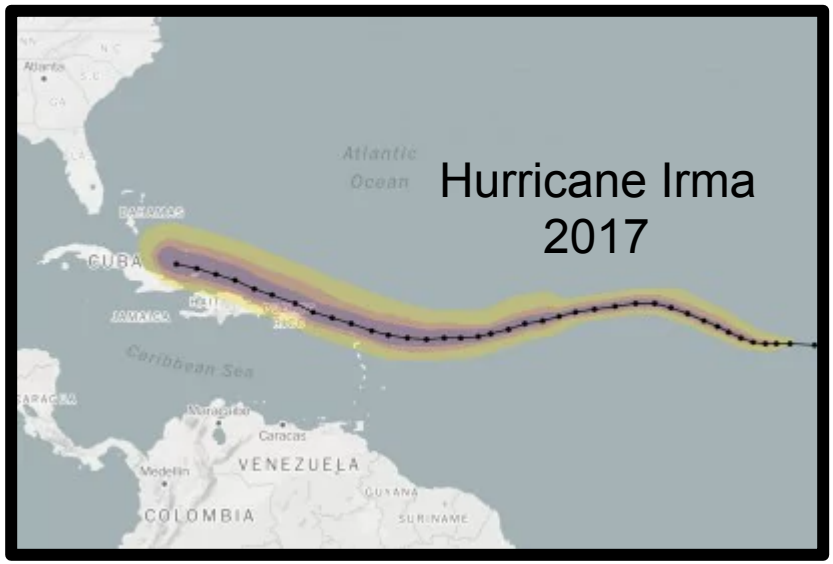
http://coastal.er.usgs.gov/hurricanes/sandy

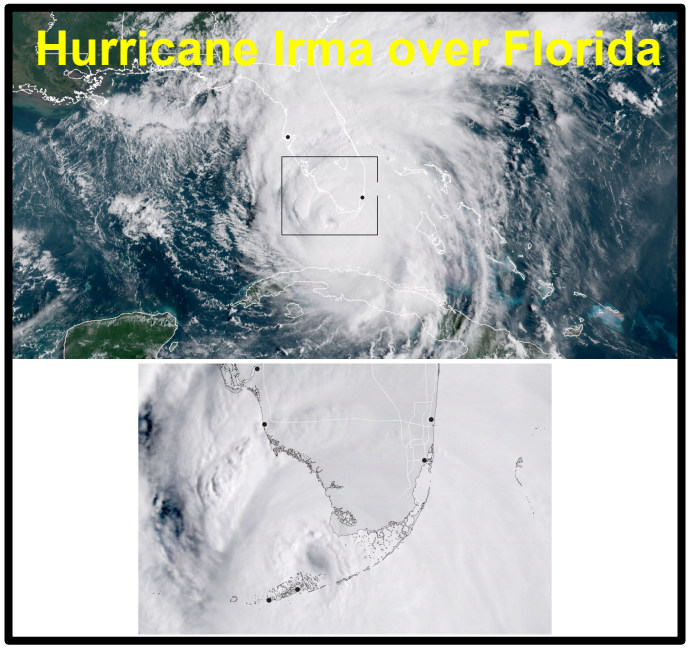


Damage Surveys

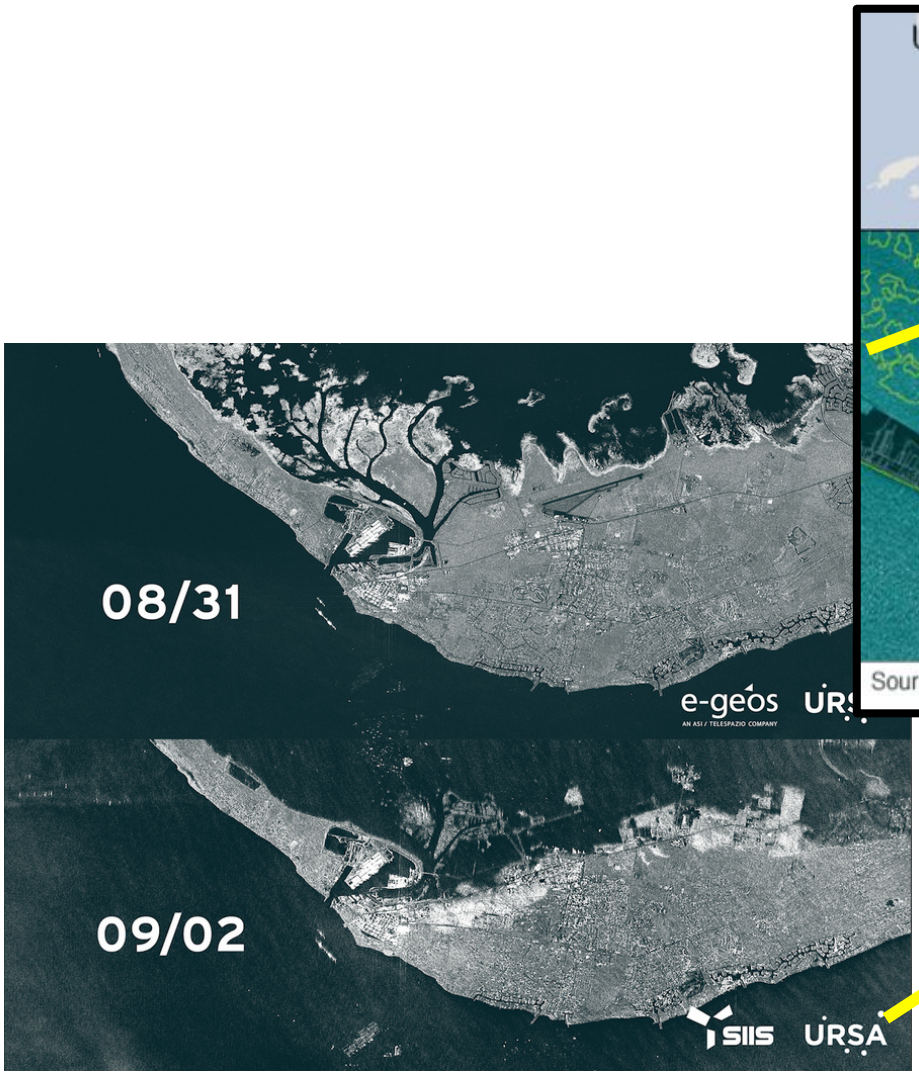
Satellite surveys allow us to track the movement of storms and after they pass give responders an idea of what to except before they arrive on scene.

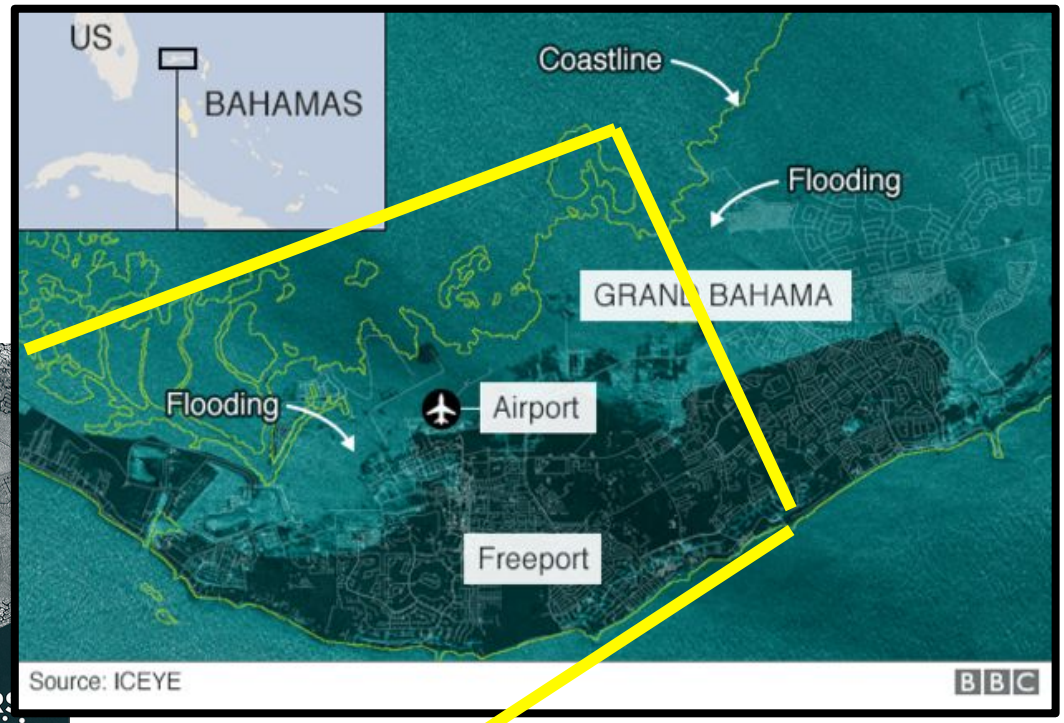
https://www.washingtonpost.com/graphics/2017/national/hurricane-irma-before-after/?utm_term=.3a75b8fdb393





Before and after Hurricane Dorian Grand Bahama Island, 2019





Images and Photographs vs. Maps

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

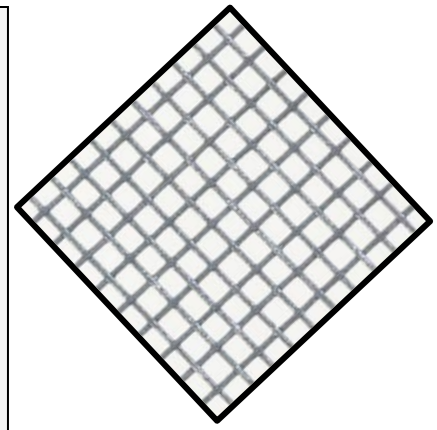
- Photographs show **everything** and give **too much information**.
- Objects can be **hidden** from view.
- Images have to be **processed** to show features.

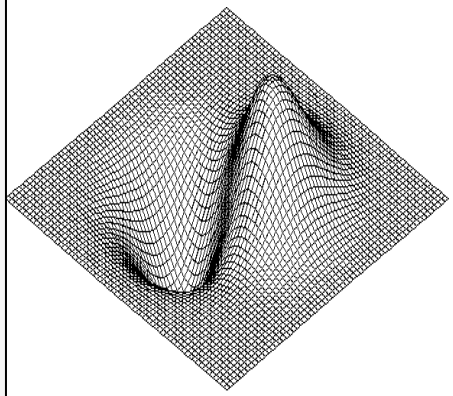
➢ **Maps are selective!**

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

Digitizing an Existing Map

- ✓ Older, printed maps are useful to geographic research and may be brought into the modern era through **"digitization."**
- ➢ A **digitizer** turns a printed map into electronic format by assigning **X,Y coordinates to every point** on the map like a mesh. *The closer the points, the sharper the image (similar to use of pixels and HD concept).*
  - ❖ **Attributes** (details) are added to each X,Y coordinate point: *these **may** include: latitude, longitude, time of day, elevation, photographs, land use, crime data, colors, or symbols, etc.*
  - ❖ This is called "**geocoding**": **The *adding of attributes** (or details) **to point locations.***



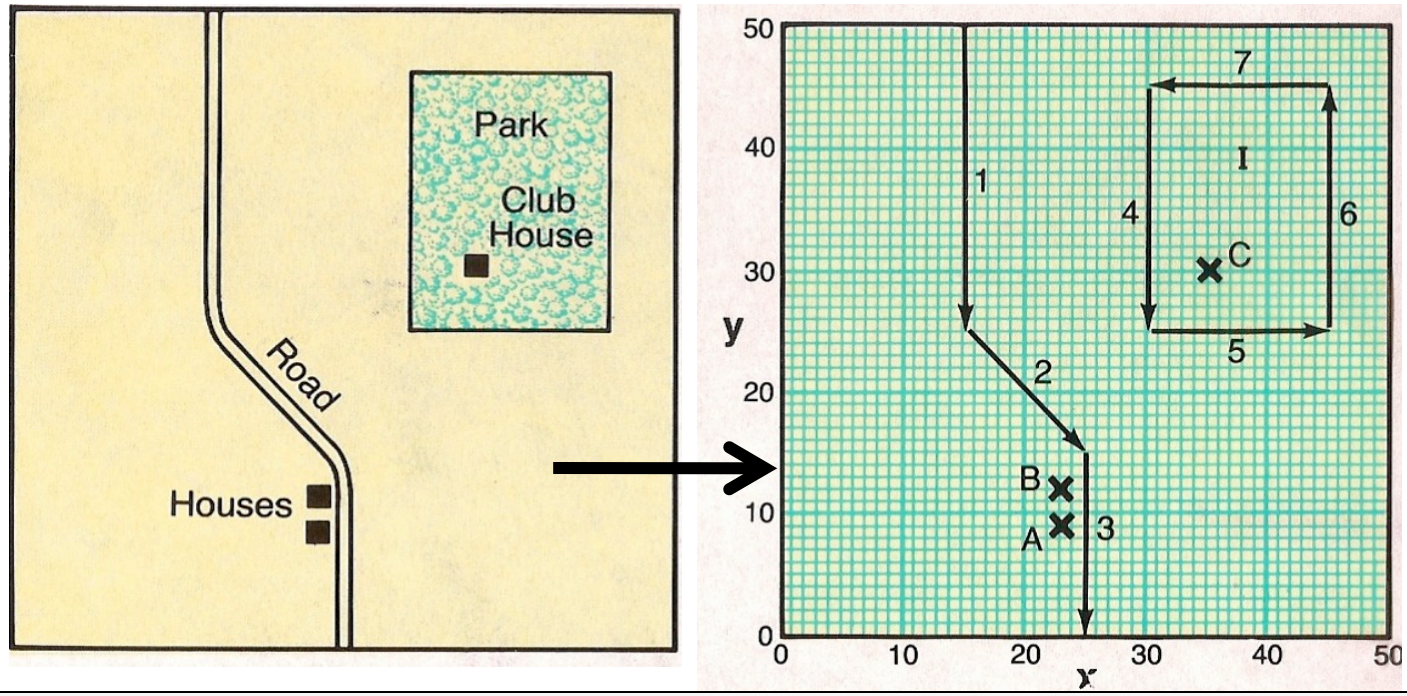


IMPORTANT

The electronic mesh created by the "X,Y coordinates" is NOT the same as the grid created by latitude and longitude.

Latitude and longitude information may be added to digitized X,Y coordinates as attributes, along with any other attribute the mapper/data entry person wishes to include in the data base.

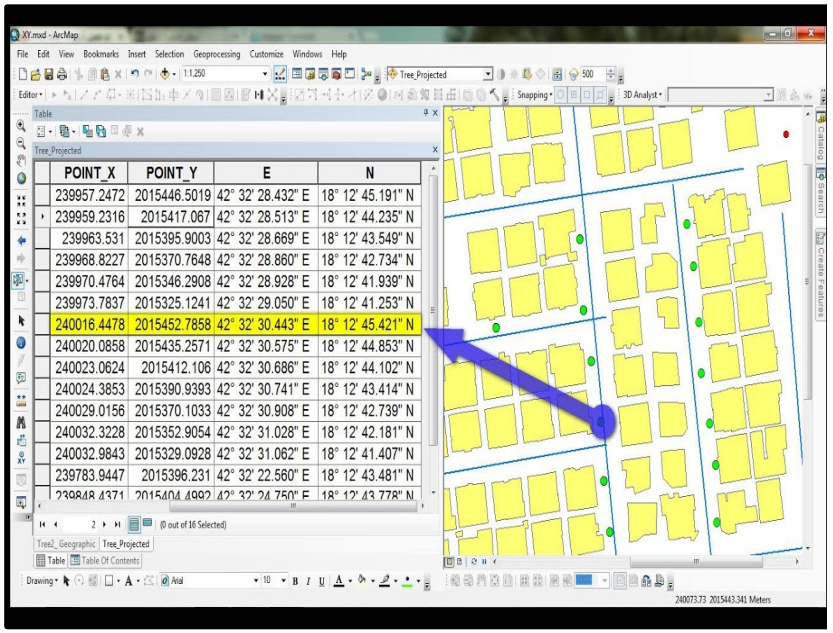
The Digitized Map



A printed map is turned into electronic format **by cover-ing it with an electronic mesh of reference points.**

Revising a Digitized Map

- **Now we can revise a map without redrawing it by just updating the attributes at a particular X,Y coordinate.**
  1. We go to the **geocoded list** and make needed changes.
  2. The mapping program will reconfigure the data as soon as “enter” is hit.
  3. A new, revised map will be produced and is ready to be viewed and/or printed.



NEXT TIME

Automated Map Making

EXTRA CREDIT

- **Extra Credit Atlas Exercise for Exam I is due NOW.**
  http://www.geo.hunter.cuny.edu/courses/geog101_grande/extra_credit.html
- Submit answers to me using the blue Scantron sheet.
- **Completely erase all mistakes and stray marks.**
- **LATE answer sheets will NOT be accepted.**

FIRST EXAM

- **Tues., Feb. 25, 2020.**
- **Combination of multiple choice questions and map/ diagram interpretation.**
- **Bring a #2 pencil with eraser.**
- **Based on class lectures supplementing Chapter 1.** Review lectures 1-8 on home page.
- **If you miss this exam, a written-response make up test** (with the place name maps) **will be given.**