Hunter College - CUNY
Dept. of Geography & Environmental Science
GEOG 101 Lecture Presentation Summary
Spring 2021

NOTE: In the absence of in-person lecturing and face-to-face explanation of the material presented in the PowerPoint lecture slides, I will summarize the content of each lecture presentation, stressing the concepts and interrelationships that are essential to an introductory geography course. In essence, it is like giving you a transcript of my classroom lectures.

If, after reading this summary and viewing the lecture presentation, the imbedded short videos and hot links to articles, you have any questions, or if you would like to contribute a comment or two, need clarification by other examples or have additional information on the topic, please do not hesitate to email me at agrande@hunter.cuny.edu.

LECTURE 07: Gathering Information

- The purpose of this lecture is to acquaint you with some of the ways geographers gather information for inclusion into maps, in particular, the gathering of data remotely and by using modern electronic research tools.

- **Slide 2: Research Diagram.** This diagram introduced in Lecture 3 is returned here with our focus on *Step 2: Collection*. While the focus of the lecture is on modern electronic tools, always remember that literature and library research are always the very first step, followed by field work. Why reinvent the wheel when someone already invented it. *You can use the material of others as long as it is properly cited in footnotes and bibliography.* Give credit where credit is due and make it better!

- **Slide 3: Photographs and Imagery.** Part of geographical research is the temporal (time) aspect of studying the earth and its people. Natural processes change the surface of the earth and people leave their imprint over time. Photographs and images allow us to make comparisons over time and document change. They allow us to identify features and we can also take measurements from them as long as they contain some indication of scale.

- **Slide 4: Determining Scale from an Image.** From this black and white 1995 image of a sports stadium (upper left) taken by a satellite in orbit 550 miles above the earth, we can easily determine scale. What are clues you would use? What can be your measurement guides? We can identify the stadium and look at the building specs. Knowing it's a baseball stadium, we can get the field dimensions. How about using the 90 ft between bases as a ruler? We can also use the average length of automobiles, the size of parking spaces, the width of traffic lanes. Other sports venues as soccer and football stadiums have standardized field markings which makes it really easy to determine scale.

- **Slide 5: Remote Sensing.** Gathering information from afar is called "remote sensing." Any camera is a remote sensing device. The two categories are *photography* and *non-photography.* The specialized field of study is called *photogrammetry,* the art and science of using photographs and images to make maps.

- **Slide 6: Photography vs. Non-photography.** This slide compares two means of gathering information from afar. Both need its raw data to be processed to make it useful to people. Photography as a tool dates from the 1860s and in America was extensively used to document battles of the Civil War. Non-photography instruments and techniques were developed by the military during World War II and many were declassified starting in the 1970s. It uses the full spectrum of light, not just visible light that is captured on photographic film. Light energy that is converted to electrical signals and stored as digital files.

- **Slides 7-9: Spectral Signatures**. Because remote sensing devices "see" across the spectrum (graph at top of slide), and not just visible light (purple boxed area) that people detect, objects may be identified by the way they interact with the electromagnetic spectrum. All objects generate a unique "signature" created from how this energy is absorbed and reflected. Instruments may be calibrated to see across the spectrum or just pick up the radiation within a narrow portion of the band. **Slide 8** shows examples of signatures. *Notice how sensitive the recording is when comparing healthy sugar beet plants with stressed plants. This is how agricultural monitoring agencies estimate farm yields. At each stage of plant development, there is a unique spectral signature generated. BTW, this was perfected during the Vietnam War because the US Defense Dept wanted to be able to distinguish between live vegetation and freshly cut vegetation that was being used by the Viet Cong for camouflage. Cut vegetation had a different spectral signature than live vegetation.* **Slide 9** tells us that these digital IDs have to be processed to make them useful, the colors assigned to each signature are artificial and assigned by the person processing the image. To add standardization to the whole process, "data dictionaries" are created to preserve this information and are used to compare any electronic signature collected with signatures on file. Color standardization enhances this.

- **Slides 10-12: Image Resolution.** "Resolution" refers to how "sharp" and "clear" an image is and what is the smallest object that is identifiable on it. You may know it has High Definition – the type of technology that allows you to read small print on your smart phone. The density of pixels per unit determines this. A pixel is the smallest picture element distinguished by the instrument.
    - **Slide 10.** The three images of the US Capitol are examples of this. The one on the right has the least number of pixels per unit area (10-meter resolution or c.33 sq. ft. of coverage) and the image is blurred. The one on the left (1-meter resolution or c.9 sq. ft. of coverage) has the most pixels per same unit-area and is much clearer. The squares in the blue circles illustrate this.
    - **Slide 11** uses Florida as an example. The image at left is so blurred that you can see the pixels, but not what is there. The smallest object that can be discerned is 111 sq. mi in size! The middle image is still pixelated but the smallest object is now 31 sq. mi. The image on the right looks like Florida from space and the smallest object that can be identified is no less than one-half square mile (.4 sq. mi.).
    - **Slide 12** is a comparison of the detail recorded by air-altitude imagery of Washington, DC. Start at the upper left and proceed to the lower right. The smallest object recognizable at that same altitude ranges from 208 ft long to 3 ft long. Classified military intelligence imagery can discern the width of a highway lane divider (6 inches) and maybe the lettering on license plates (4 inches) from an orbiting satellite.

- **Slide 13: Assigning Colors to Imagery.** To make spectral data meaningful to people, we need to make it easy to read. One way is the assign colors to variables. These examples each contain a color key calibrated to surface ocean temperatures. Notice how the colors make it easy to see boundary between cold and warm surface water temperatures. *Remember that the person formatting the image selects the colors, unless they are using a data dictionary with standardized colors.*

- **Slide 14: Processing Satellite Imagery**. There is a need for the raw digital data to be processed to correct recording errors. Slide 14 lists the 5 major items that need to be adjusted to create a clear image that looks like a photograph. Three of the variables concern motion: earth movement, spacecraft movement and vibrations, and recording scanner movements.

All 128 spectral channels which are sent as separate feeds need to be aligned (otherwise blur happens) and the curvature of the earth has to be addressed by selecting an appropriate map projection to represent the final product. *Compare the electronic image of New Orleans with the map of the same area. Remember that the colors seen on the electronic image are not "real" or "natural" colors, but selected and assigned to the raw data.*

- **Slides 15-20: Uses of Satellite Imagery**. These examples illustrate how remote sensing devices and the collection of data outside of the visible spectrum can help us study the earth and "see" change.
  - **Slide 15** is a false-color infrared image of Washington, DC.
  - **Slide 16** is a false-color infrared image of the Imperial Valley, CA agricultural area located along the border with Mexico. Because the health of plants varies with water supply and agricultural methods, notice the difference between the US and Mexican sides of the border area. The international border is clearly defined by the change in color.
  - **Slide 17** contrasts rural and urban areas. Sioux City, SD is surrounded by agricultural land use. In the image of the San Francisco Bay Area, you can distinguish between the urban and non-urban areas. Also, the water of San Francisco Bay shows up differently than Pacific Ocean water. In South Florida, The Everglades displays a multitude of colors because of its unique ecosystem. The colors of the water areas can indicate differences in salinity, temperature and even surface pollution.
  - **Slide 18** is taken from the USDA NASS "Cropscape" data site. Crops are identified by their spectral signatures. *The link is at the bottom of the slide. Once at the site, zoom into any area of interest to see and assess the agricultural situation. The top and side bars have tools for analysis.*
  - **Slide 19** compares agricultural land in Saudi Arabia and Texas. Water is a key factor in these dry areas. The Saudi image has colored circles while the Texas image has colored circles within squares. The Texas image shows a much denser use of land for agriculture. The colors are representation of the crops' spectral signatures.
    Why the difference in pattern? Texas land division is based on the American *Township and Range* land division system. (You may remember this from your American history courses.) This gives the land a checkerboard appearance. This method of land division does not exist in Saudi Arabia. The circles represent an American invention called *pivot irrigation.* Pivot irrigation uses a central water-pump attached to a rotating arm with sprinkler-heads that move in a circular pattern, spraying water on the field. (This is similar to the sweep hand of a clock ticking off the seconds.) In Texas there is a denser system of wells so the fields are closer together. The next slide shows a close-up of this method of irrigation.
  - **Slide 20: Pivot Irrigation and Monitoring Water Use.** Here is a close up view of pivot irrigation. The spraying arm is on wheels and moves around the field at a speed set by the farmer. Remote sensing can be used to monitor soil moisture from satellite images provided by a subscription service that the farmer receives on his computer or smart device.

- **Slides 21-23: Thermal Imagery.** Using this portion of the spectrum, we can take the temperature of any place on earth.
  - **Slide 21.** Here the temperature of industrial waste water is monitored as it flows into a waterway to avoid thermal pollution which can have an adverse effect on aquatic life.
  - **Slide 22.** Here we study urban heat islands.
  - **Slide 23.** Here we monitor the surface temperature of the oceans. The link brings you to a site that monitors temperature and presents current data.

- **Slides 24-26: LIDAR – Light Detection and Ranging.** LIDAR uses laser light to take measurements and is accurate to within 6 inches.
    - **Slide 24.** The laser pulses can be calibrated to penetrate different materials to a point that all surface material can be eliminated and a map of just bare rock surface can be constructed.
    - **Slide 25.** Using LIDAR to evaluate the World Trade Center site after the September 11 attack. The 3-D imagery helped plan the response. GPS located subway and building entrances. Elevation readings gave first responders indication if the rumble was collapsing. The thermal sensing add-on monitored the heat of underground fires. *Hunter College Geography played a role in the mapping of the site and the cleanup efforts.*
    - **Slide 26.** Monitoring erosion of Fire Island after Superstorm Sandy using before and after readings to analyze changes to the barrier island.

- **Slides 27-28: Satellite Surveys.** In the case of a hurricane, we can track the storm, monitor its intensity and do an initial damage assessment before rescue workers arrive. **Slide 28** looks at the damage done to Grand Bahama Island.

- **Slide 29: Images and Photographs vs. Maps.** In spite of the great amount of data collected and portrayed by remote sensing devices, the map is still a very useful and critical tools. Images and photographs show everything, while <u>maps are selective</u>, containing the necessary information selected by the cartographer to provide the information the user needs.

- **Slide 30: Next lecture topic: Automated Mapping.**