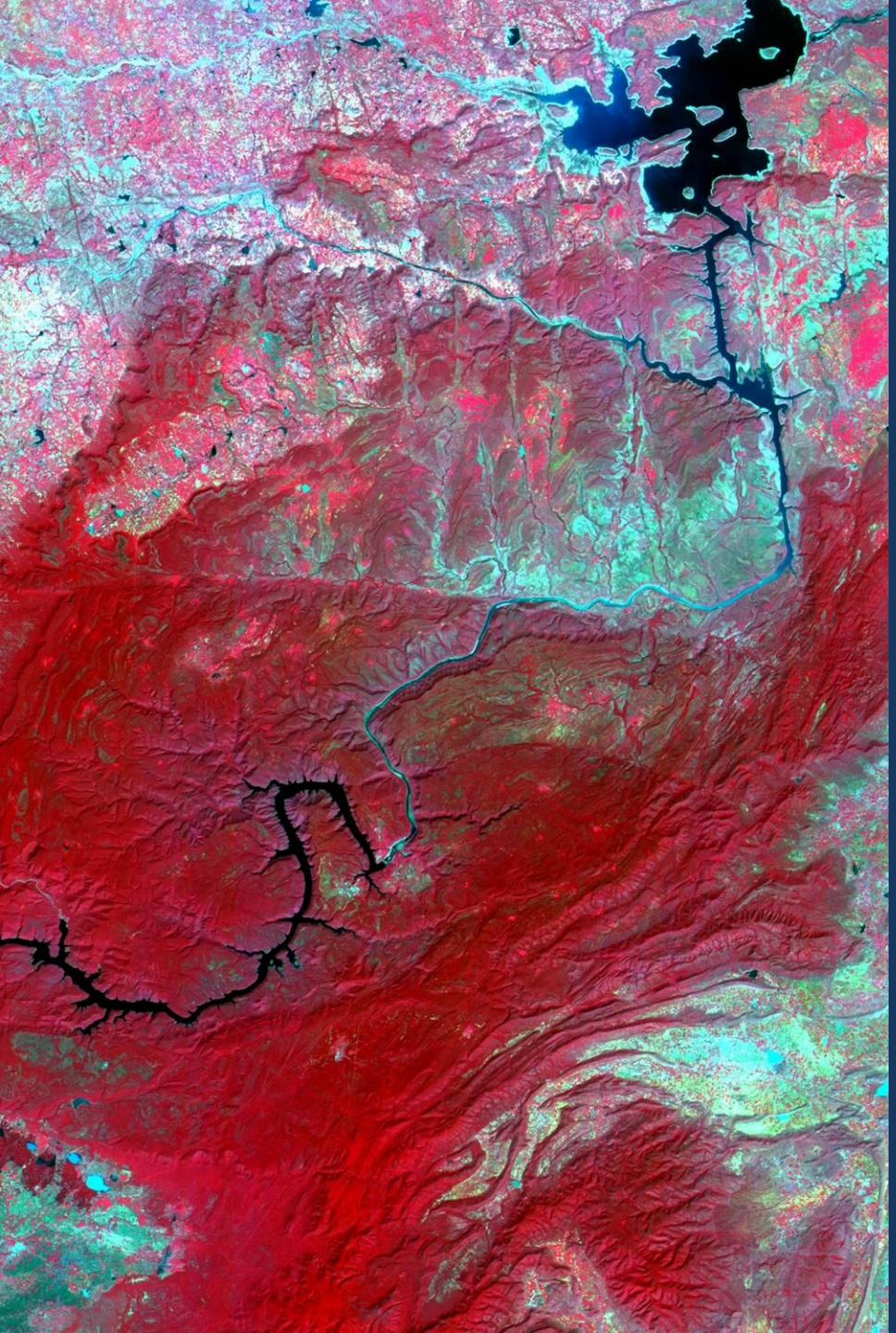


Principles of Remote Sensing

Remote Sensing Overview

What is Remote Sensing????

- Observing or measuring things from a distance

In its broadest definition, remote sensing means collecting information about an object, area or a phenomenon without being in direct physical contact with it: *learning without touching*.

The most familiar kind of remote sensing is the use of our eyes to detect light. We also use remote sensing when we hear, and when we feel heat that radiates from a warm object.

How Remote Sensing is Useful????

It enables us to study the surrounding world that would otherwise be beyond our capability, across great distances and at wavelengths of light invisible to us.

What Can We Study with Remote Sensing?

➛ Land, air, water, rocks, living things, ice, snow etc.

For example:

- Climate change and its effects
- Productivity of grasslands
- How human activities change the earth
- Landforms we can't see from the ground
- Photosynthesis on land and in the ocean
- Air quality: chemicals and particles (aerosols)
- The extent of natural hazards such as volcanoes, floods, and drought
- Shifting ecosystem boundaries: deserts, forests, and wetlands

*Very **fast** evolution due to technological advances (detectors, rockets, computers, ...)*

*What you learn today will be **obsolete** in ≈ 6 years :- (*

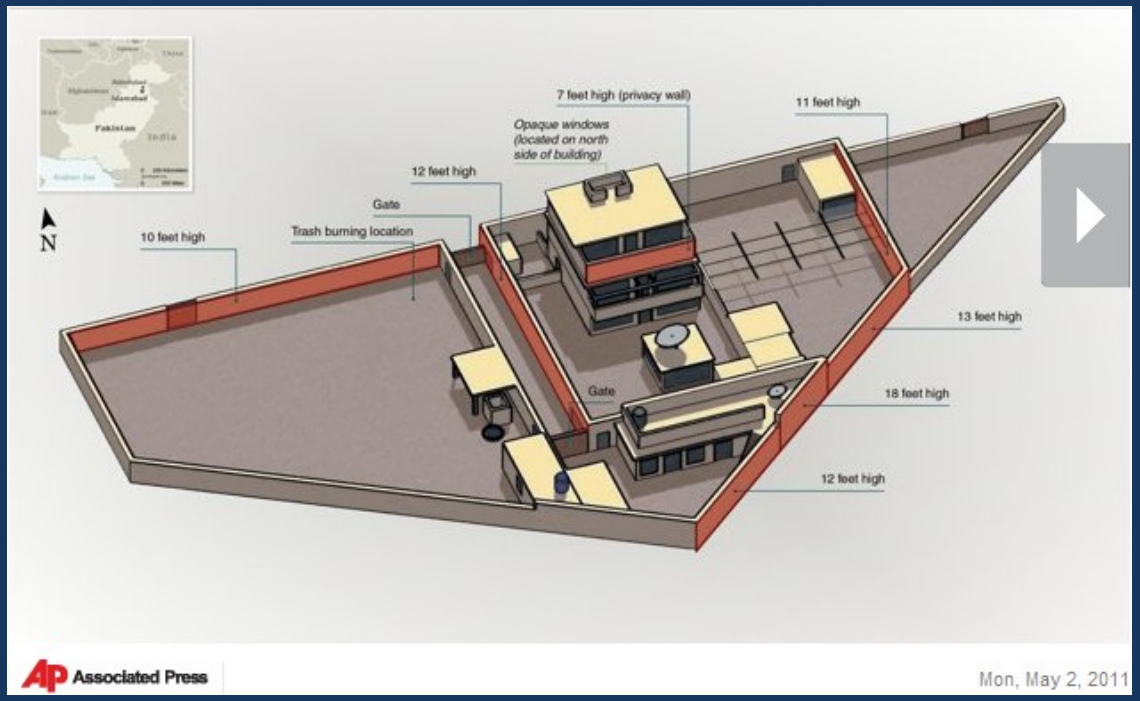
Remote Sensing Gives Us the Synoptic View

Minamisanriku Area, Japan

Before the Earthquake and Tsunami in Nov.2009

The same area after the onslaught of Earthquake and Tsunami in March 2011

Source – Geoeye Satellite Image



Satellite Image view of Osama's Mansion at Abbottabad, Pakistan

Remote sensing Images are used every day by:

- Archaeologists searching for ancient ruins
- Mapmakers / Surveyors
- Relief workers when there is an earthquake, flood, or volcanic eruption
- Urban planners for micro level planning
- Geologists to find minerals, oil, groundwater etc.
- Agronomists to forecast yield or assess insect damage
- Weather forecasters and climate researchers
- The fishing industry to locate the best areas for fishing
- Military reconnaissance experts
- Astronomers

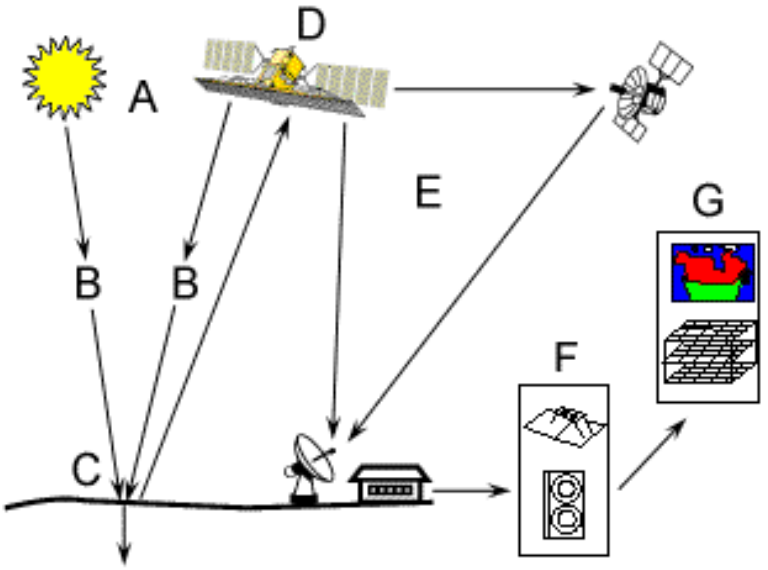
There are hundreds for uses of Remote Sensing. New ones are being developed every year!!!!

Interaction between incident radiation and the targets of interest

1. **Energy Source or Illumination (A)** - the first requirement for remote sensing is to have an energy source which illuminates or provides electromagnetic energy to the target of interest.

2. **Radiation and the Atmosphere (B)** - as the energy travels from its source to the target, it will come in contact with and interact with the atmosphere it passes through. This interaction may take place a second time as the energy travels from the target to the sensor.

3. **Interaction with the Target (C)** - once the energy makes its way to the target through the atmosphere, it interacts with the target depending on the properties of both the target and the radiation.



4. **Recording of Energy by the Sensor (D)** - after the energy has been scattered by, or emitted from the target, we require a sensor (remote - not in contact with the target) to collect and record the electromagnetic radiation.

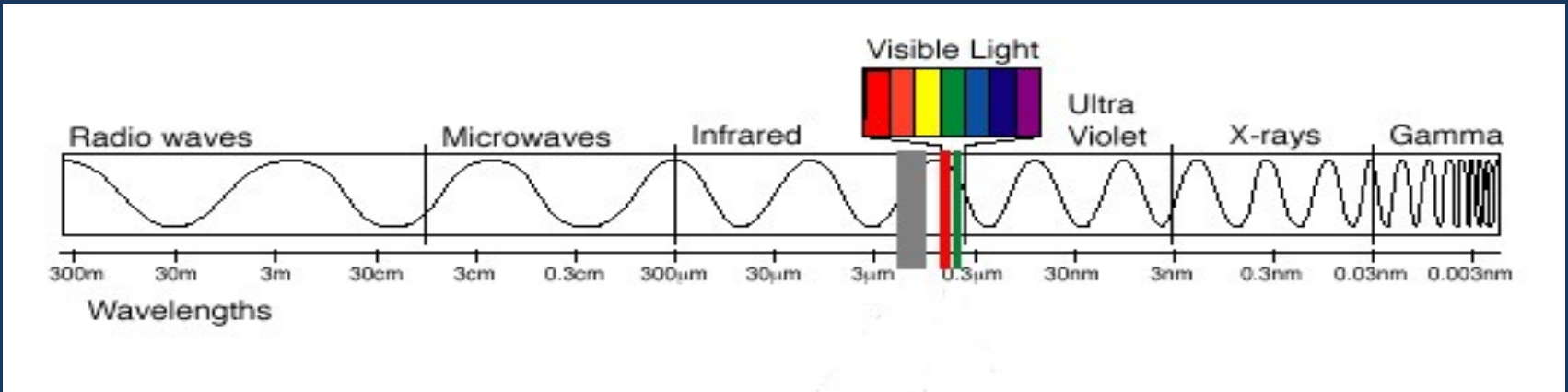
5. **Transmission, Reception, and Processing (E)** - the energy recorded by the sensor has to be transmitted, often in electronic form, to a receiving and processing station where the data are processed into an image (hardcopy and/or digital).

6. **Interpretation and Analysis (F)** - the processed image is interpreted, visually and/or digitally or electronically, to extract information about the target which was illuminated.

7. **Application (G)** - the final element of the remote sensing process is achieved when we apply the information we have been able to extract from the imagery about the target in order to better understand it, reveal some new information, or assist in solving a particular problem.

How does Remote Sensing work?

"By sensing and measuring radiation "

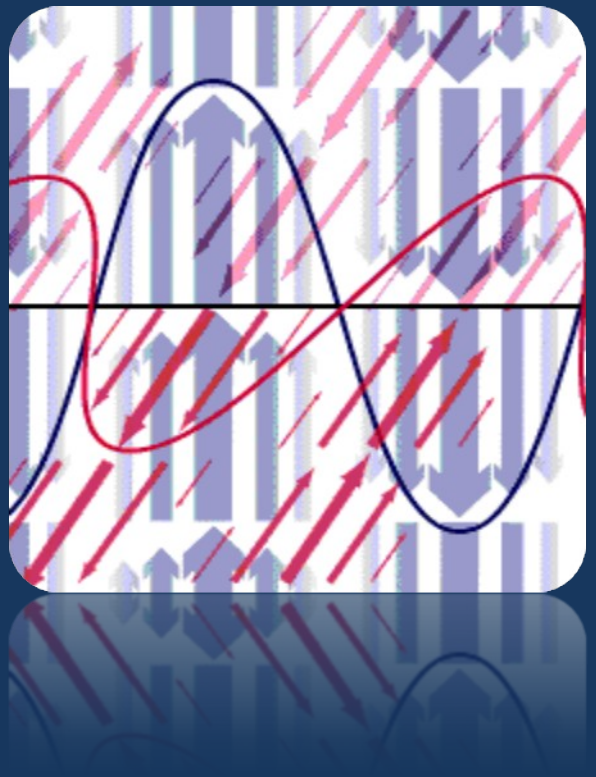


The Electromagnetic Spectrum

- *Remote sensing uses the radiant energy that is reflected and emitted from the Earth at various wavelengths of the electromagnetic spectrum.*
- *Our eyes are sensitive only to the **visible** wavelengths of the EM spectrum. Special sensors help us to capture the rest, and to translate it into a form we can see and understand.*

Electromagnetic waves are formed when an *Electric field* (shown as blue arrows) couples with a *Magnetic field* (shown as red arrows).

The magnetic and electric fields of an electromagnetic wave are perpendicular to each other and to the direction of the wave.



Satellites and Sensors

In order for a sensor to collect and record energy reflected or emitted from a target or surface, it must reside on a stable **platform** removed from the target or surface being observed. Platforms for remote sensors may be situated on the ground, on an aircraft or balloon (or some other platform within the Earth's atmosphere), or on a spacecraft or satellite outside of the Earth's atmosphere.