Salahaddin university-Erbil
College of Science
Earth sciences and Petroleum department
2nd year
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Introduction to Remote Sensing (RS)

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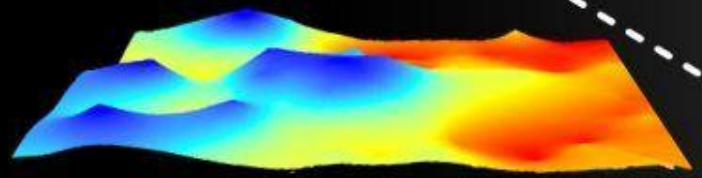
Lecture No.1

WHAT IS REMOTE SENSING?

SATELLITES

DRONES

ANALYSIS



CLASSIFICATION

IMAGERY

SOFTWARE

CAREERS

What is remote sensing:

Remote Sensing

Remote sensing refers to the activities of recording/observing/perceiving (**sensing**) objects or events at far away (**remote**) places. **OR**

Remote sensing is the science of acquiring, processing and interpreting images that record the interaction between electromagnetic energy and matter.

Sensor

In remote sensing, the **sensors** are not in direct contact with the objects or events being observed.

Electromagnetic Radiation

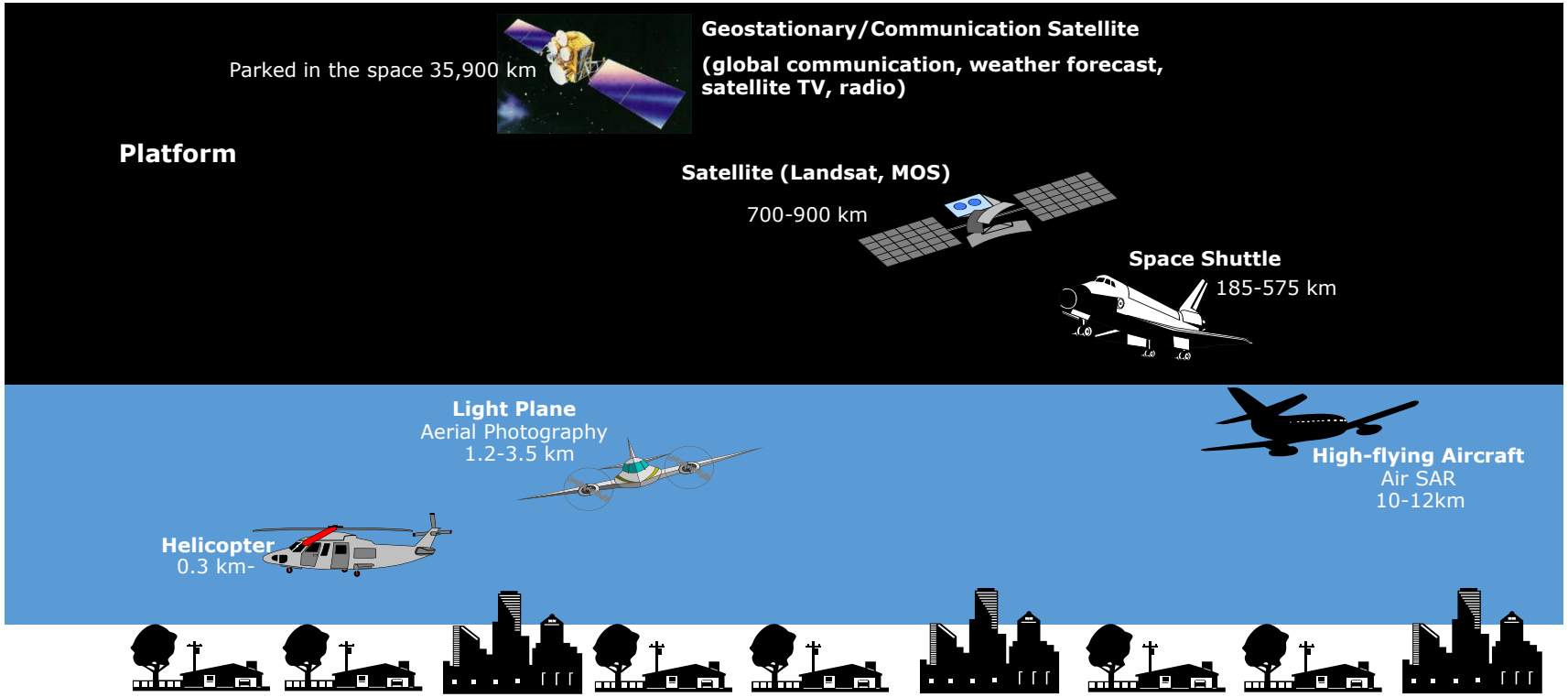
The information needs a physical **carrier** to travel from the objects/events to the sensors through an intervening medium. The **electromagnetic radiation** is normally used as an information carrier in remote sensing.

Remote sensing term

- The term "remote sensing," first used in the United States in the 1950s by Ms. Evelyn Pruitt of the U.S. Office of Naval Research.
- The term used to describe the science—and art—of identifying, observing, and measuring an object without coming into direct contact with it.
- This process involves the detection and measurement of radiation of different wavelengths reflected or emitted from distant objects or materials, by which they may be identified and categorized by class/type, substance, and spatial distribution.

Characteristics of a remote sensing Satellite:

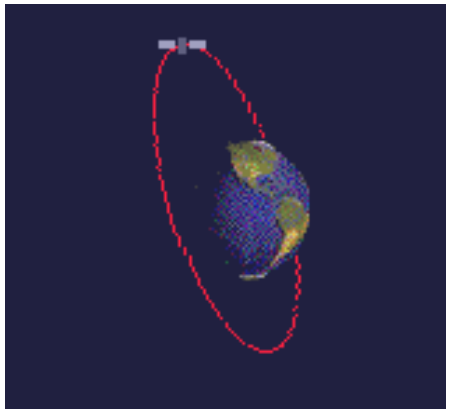
- **Altitude**: Altitude is the height of operation of a **remote sensing satellite** . The nature of an imagery captured by a **remote sensing satellite** varies depending on the altitude.



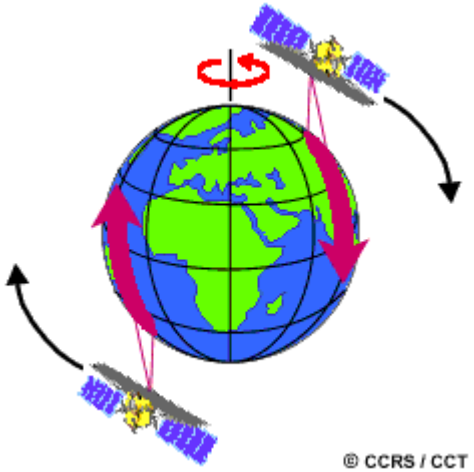
- Orbit
- Sensors

Characteristics of a remote sensing Satellite

- **Orbit**:



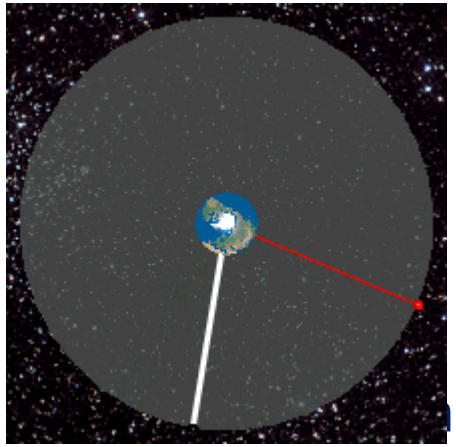
Sun synchronous orbit - Many remote sensing platforms are designed to follow an orbit (basically north-south) which, in conjunction with the Earth's rotation (west-east) so called '**Sun synchronous orbit'** allows them to cover most of the Earth's surface over a certain period of time.



- In this orbit the **remote sensing satellite** allows to cover most of the earth's surface over a certain period of time (**crosses the same point at approximately same (local) time**).
- The time interval after which a **remote sensing satellite** repeats its path is called **repeat circle**.

- **Sensor**

Characteristics of a remote sensing Satellite



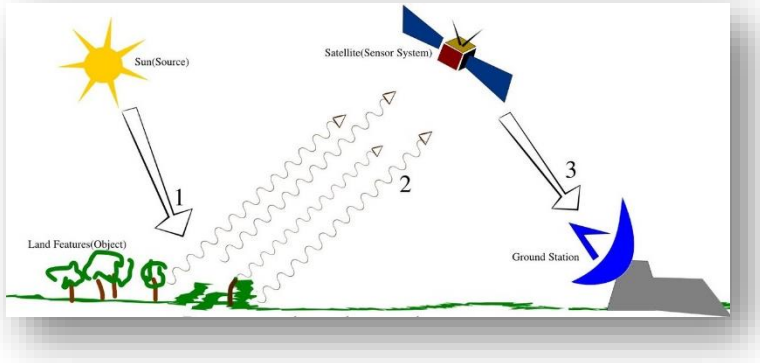
- **Orbit**:

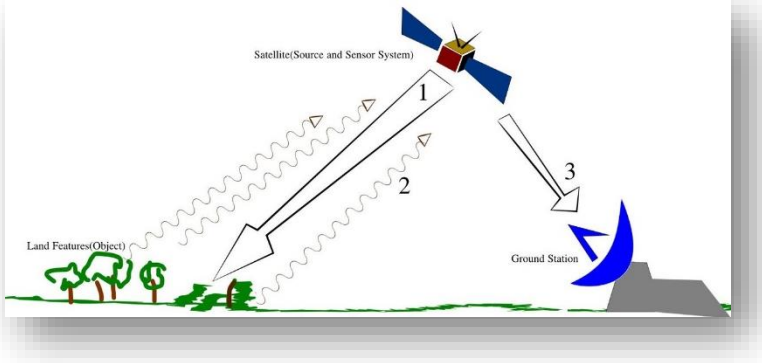
  Geostationary orbit – Satellites at very high altitudes, which **portions of the earth's surface at all time**. **An orbit revolves at speed which match the rotation of the Earth**. A worldwide network of operational geostationary meteorological satellites

  - Geostationary Operational Environmental Satellite (GOES) - The United States
  - Meteosat [Eumetsat] - Launched by the European Space Agency and operated by the European Weather Satellite Organization,
  - MTSAT - The Japanese Satellite, Operated by JMA, Monitoring typhoons and other weather condition in Asian-Oceanic Region

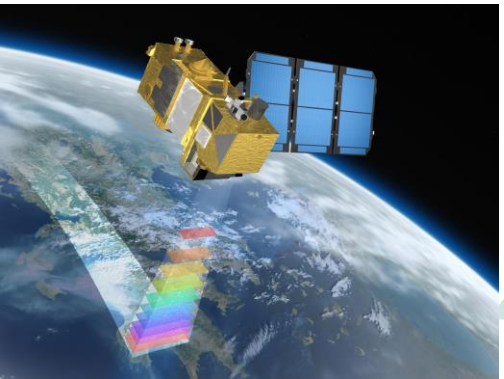
Characteristics of a remote sensing Satellite

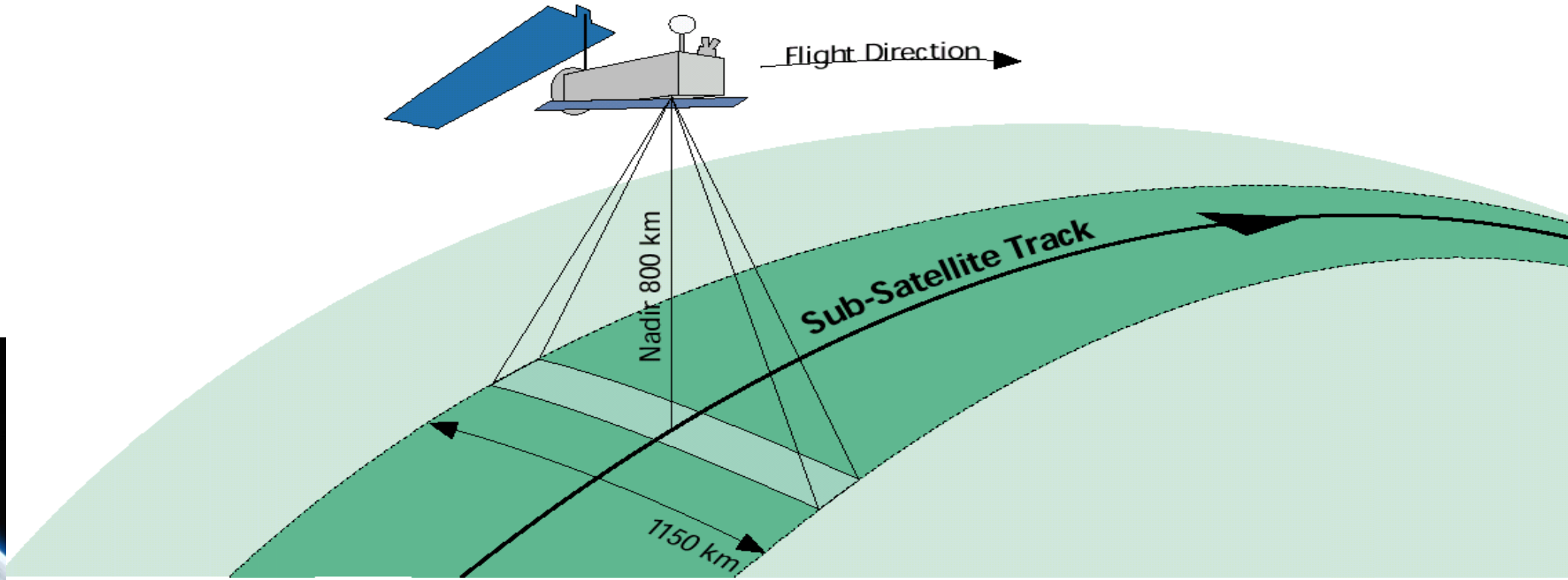
- **Altitude**
- **Orbit**
- **Sensors**: Sensors are of two kinds-passive and active **(in term of energy source)**. Passive sensors are those which accept reflectance from natural object whereas active sensors accept reflectance from man-made objects.





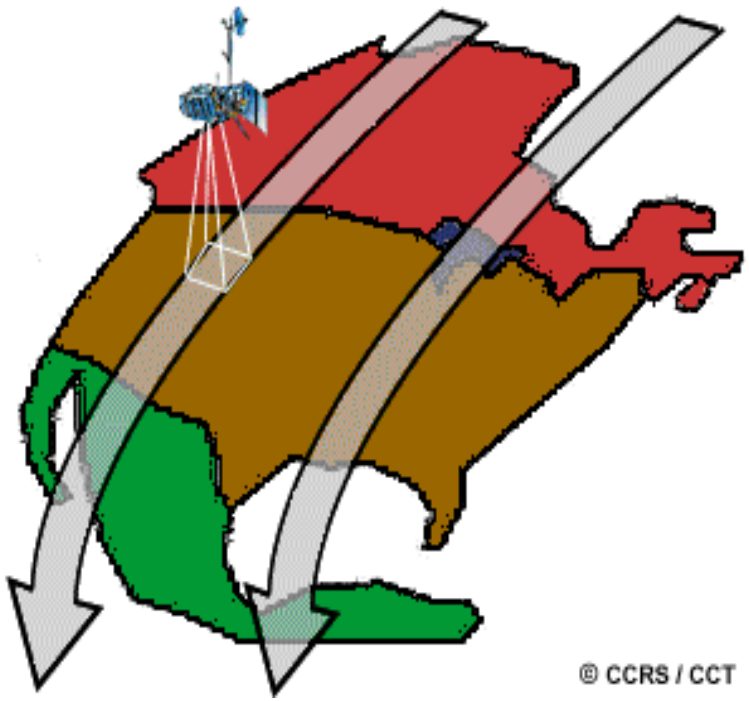
Swath: As a satellite orbits around the Earth, the sensor "sees" a certain portion of the Earth's surface. The area imaged on the surface, is referred to as the **swath**. generally, vary between tens and hundreds of kilometers wide.



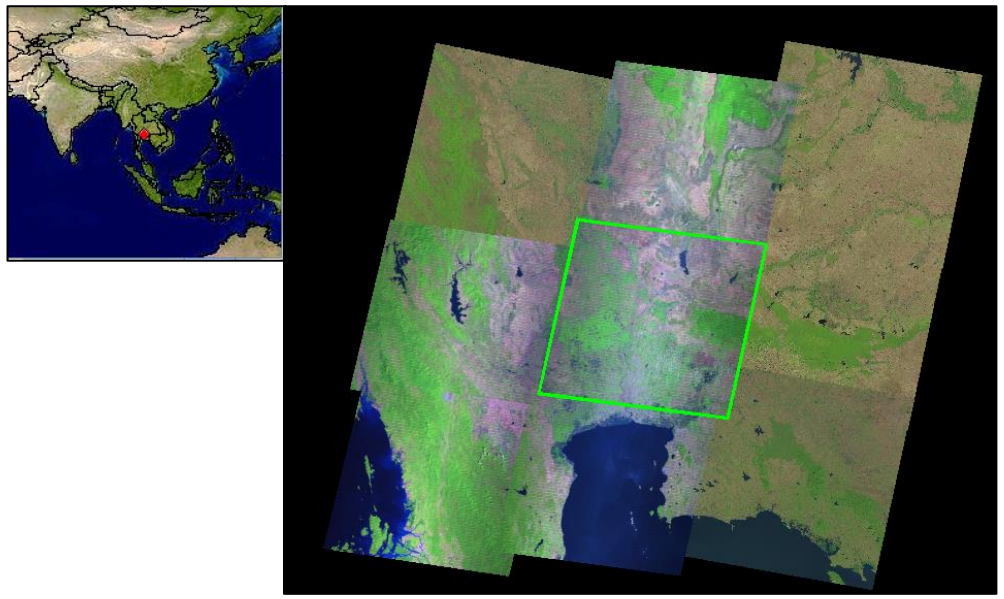


Source: National Resources Canada http://www.nrcan.gc.ca/earth-sciences/

Consecutive Path:



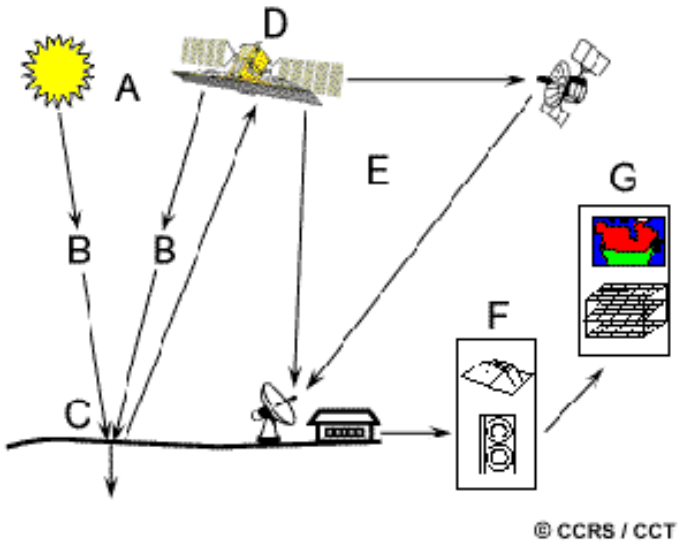
- As the satellite orbits the Earth from pole to pole, its east-west position would not change if the Earth did not rotate. However, as seen from the Earth
- Satellite path is shifting westward because the Earth is rotating (from west to east).
- This apparent movement allows the satellite swath to cover **a new area with each consecutive pass**.



Advantages of Remote Sensing:

- Provides a regional view (large area)
- Provides repetitive looks at the same area.
- Remote sensors “see” over a broader portion of the spectrum than the human eye.
- Sensors can focus in on a very specific bandwidth in an image or a number of bandwidths simultaneously.
- Provides geo-referenced, digital data.
- Some remote sensors operate in all seasons, at night, and in bad weather.

Process or elements of Remote Sensing



1. **Energy Source or Illumination (A)** - an energy source 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.
3. **Interaction with the Target (C)** - 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 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)** - 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.

Source: Natural Resources Canada, http://www.nrcan.gc.ca/earth-sciences

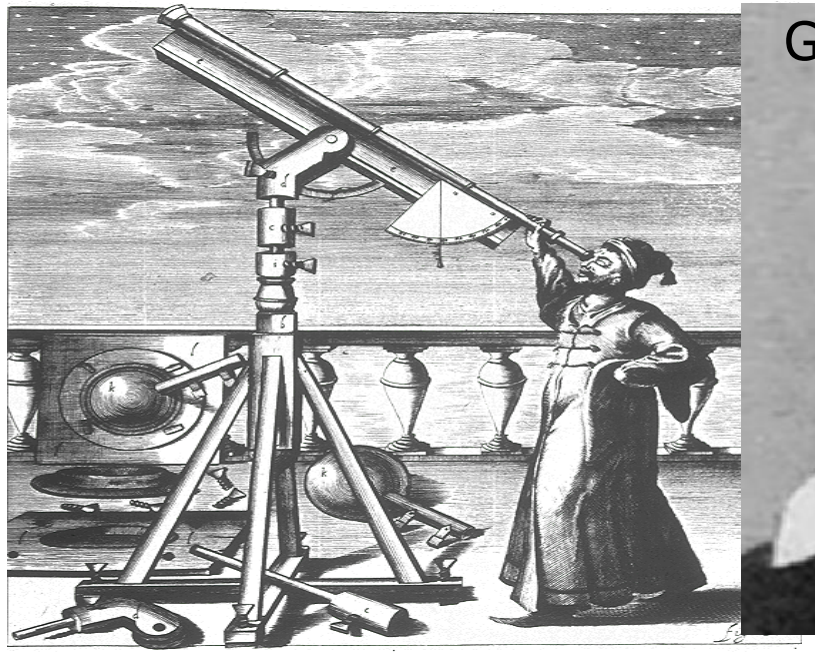
History of Remote Sensing:

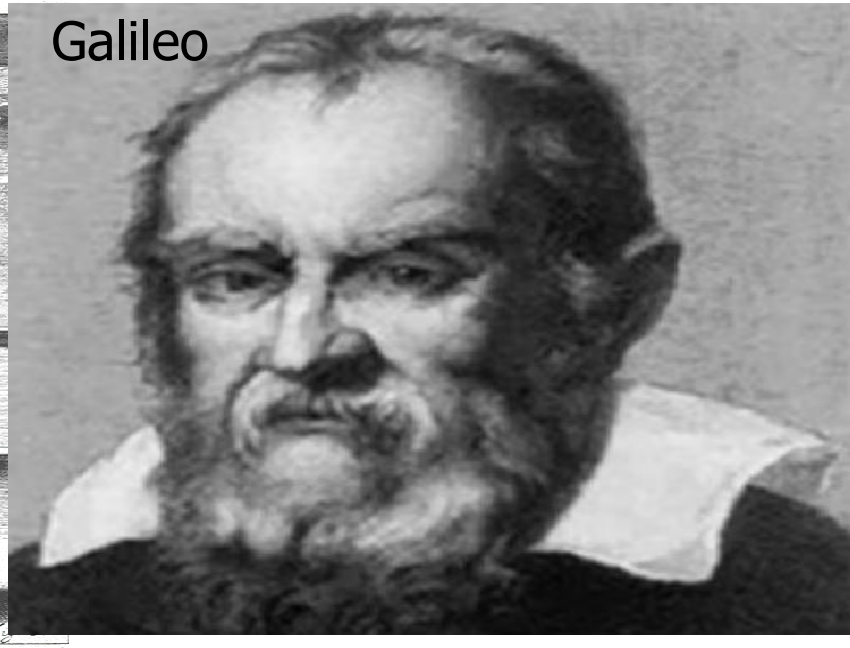
• The period from 1920 to 2019 has experienced some major changes in the field of remote sensing.

• The background for many of these changes occurred in the 1960s and 1970s.

• Remote sensing began when a balloonists took pictures of the ground using the newly invented photo-camera.

• 1609 Invention of the telescope.

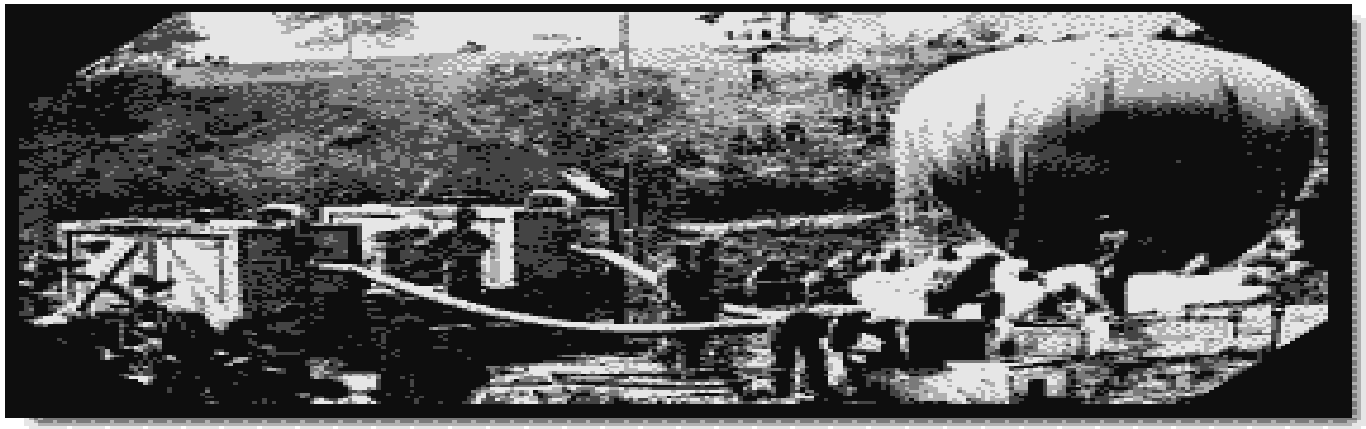


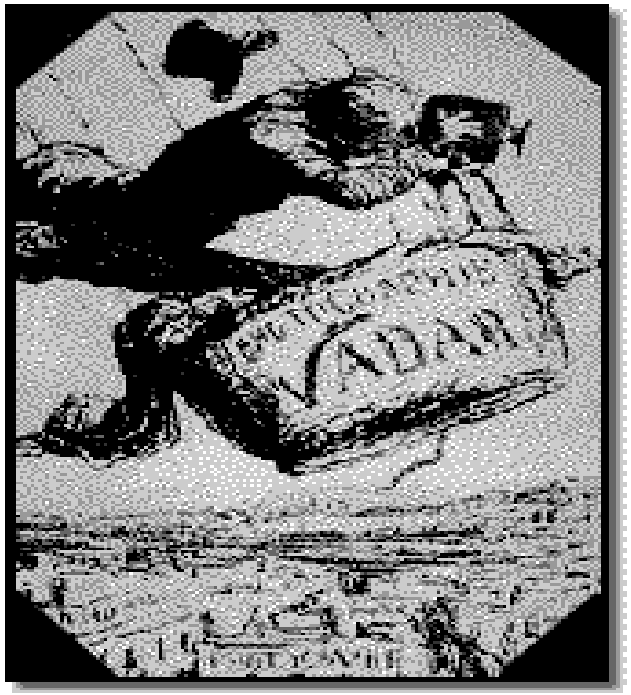


1859 - First aerial photographer

Gaspard Felix Tournachon, also known as Nadar

1862 - US Army balloon corp

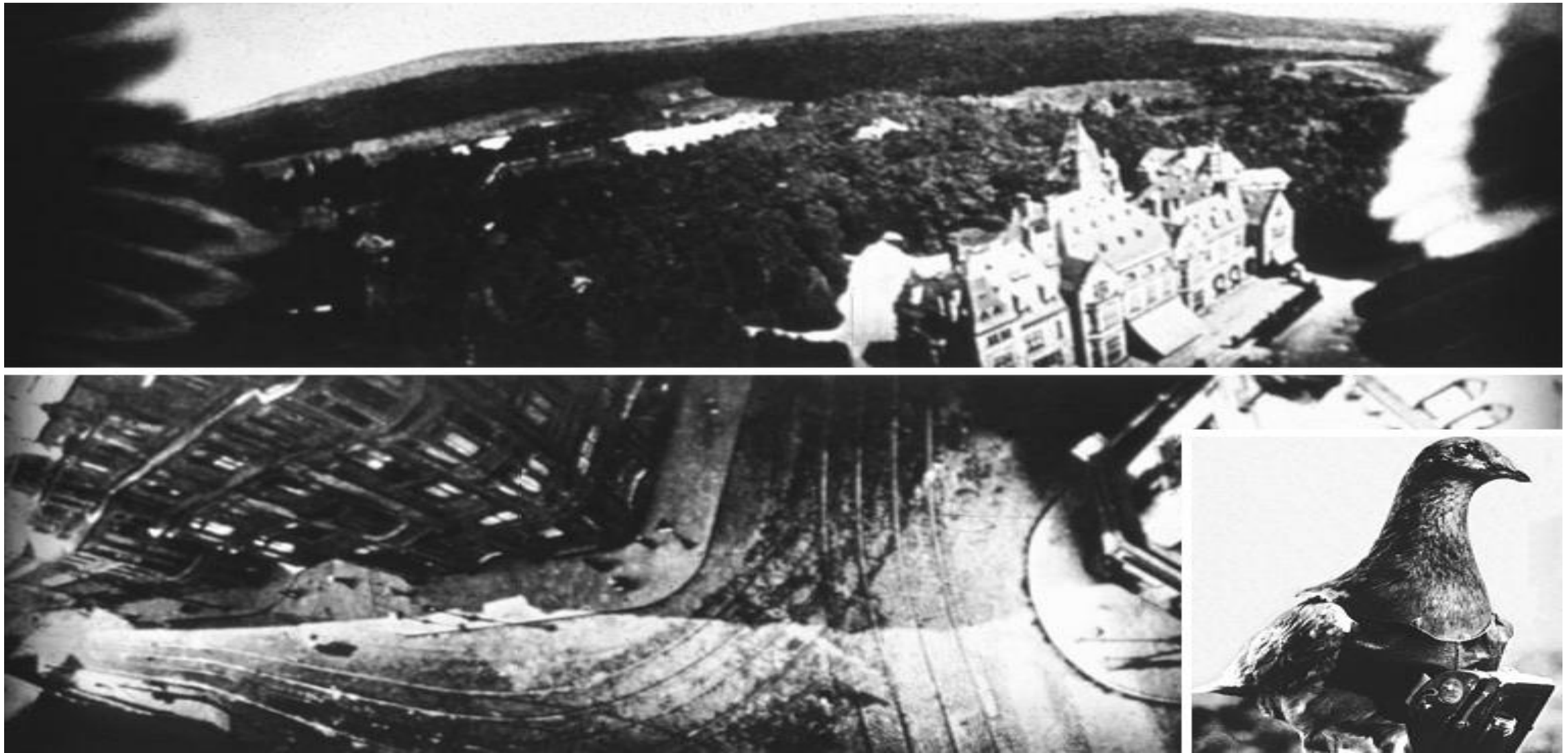




- In the 1880s, Arthur Batut in Labruguiere, France affixed cameras to kites.

What you get when you put cameras on pigeons. Note the wingtips in the top photograph!

1903 - The Bavarian Pigeon Corps



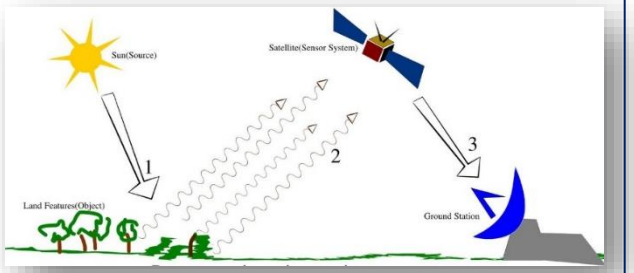
Type of Sensors

Optical Sensor

Measuring/observing visible lights and infrared rays (near infrared, intermediate infrared, thermal infrared).

Visible/NIR RS

Acquire visible light and near infrared rays of sunlight (detect solar radiation) reflected or scattered by objects on the ground.



Thermal IR Remote Sensing

- Acquire thermal infrared rays, which is radiated from land surface heated by sunlight.
- Observe the high temperature areas, such as volcanic activities.
- Examine Strength of radiation, we can understand surface temperatures of land and sea, and status of volcanic activities and forest fires.
- Can observe at night when there is no cloud.

Microwave Sensor

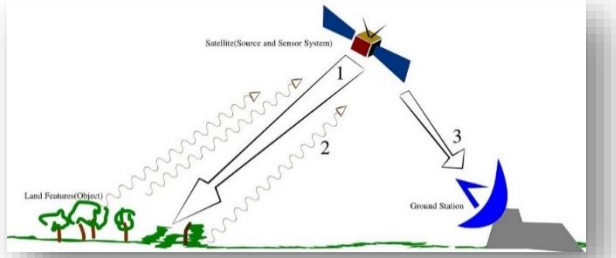
Measuring the microwave energy scattered by the ground or sea back to the sensors.

Passive Microwave

Objects at the earth's surface also emit microwaves at relatively low energy levels. When a sensor detects microwave radiation naturally emitted by the earth, that radiation is called *passive microwave*

Active Microwave (RADAR)

Satellites carry their own "flashlight" emitting microwaves to illuminate (lighten) their targets. The images can thus be acquired day and night. Microwaves have an additional advantage as they can penetrate clouds.



Source: EORC, JAXA, http://www.eorc.jaxa.jp/