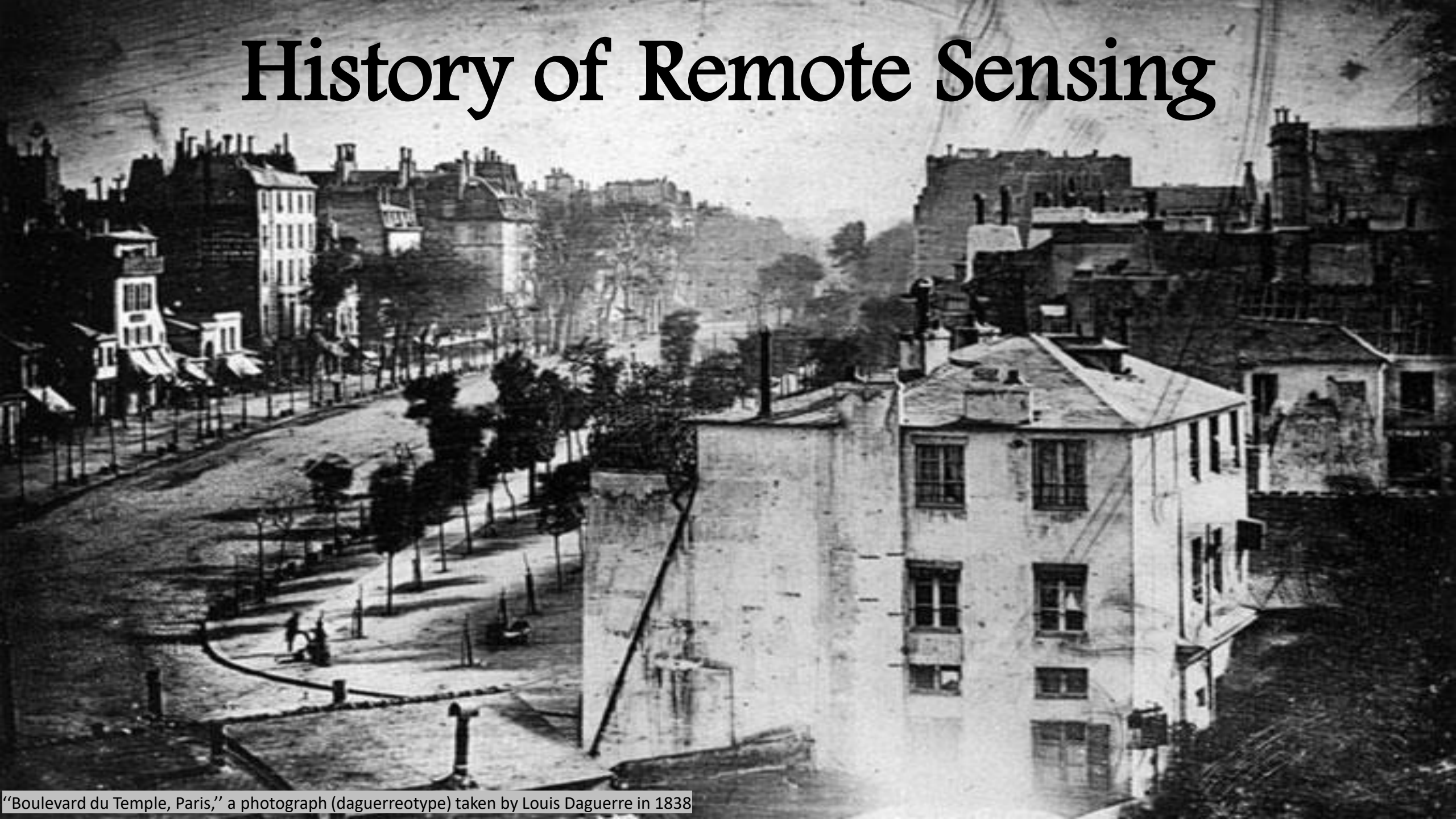
History of Remote Sensing



‘‘Boulevard du Temple, Paris,’’ a photograph (daguerreotype) taken by Louis Daguerre in 1838

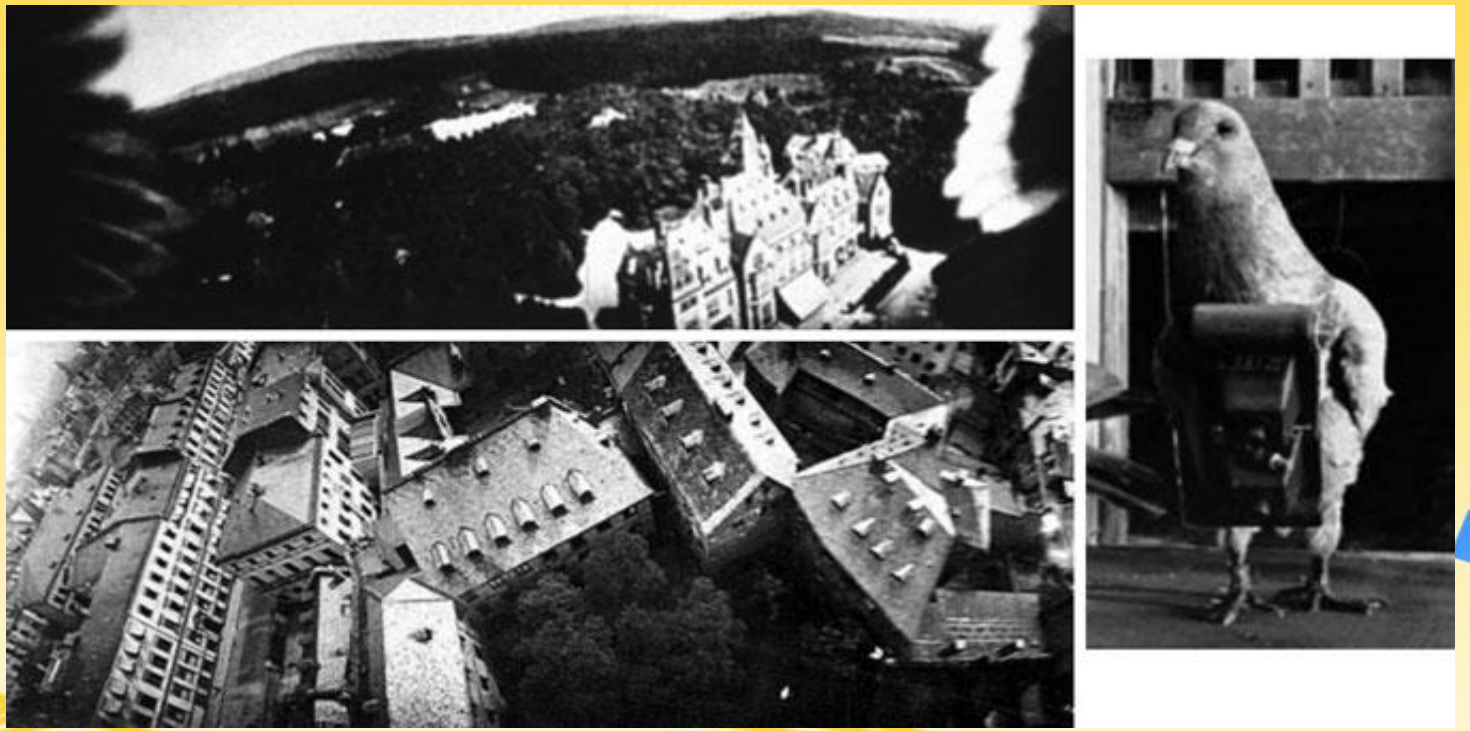
One of the key advances that laid the groundwork for the field of remote sensing was the invention of photography which enabled the near-instantaneous documentation of objects and events.

- The French inventor Joseph Niépce is generally credited with producing the first permanent photograph in 1826, which showed the view from his upstairs workroom window.
- In 1839, it was announced that Louis Daguerre—had invented a process for creating a fixed silver image on a copper plate, which he called a daguerreotype. One of his daguerreotypes, "Boulevard du Temple, Paris" taken in 1838 or 1839, is reputedly the oldest surviving photograph of a person.
- Daguerre's "Boulevard Du Temple" image has many characteristics of what is now called an oblique aerial photograph (i.e., an aerial photograph captured from an angle rather than vertically, or directly overhead)
- The credit for the first actual aerial photograph is given to the French photographer Gaspar Felix Tournachon, who used the pseudonym (fictitious name) "Nadar." Nadar patented the concept of using aerial photography for cartography and surveying in 1855.
- The oldest existing aerial photograph is a view of Boston, taken from a balloon by James Wallace Black in 1860.

The oldest surviving aerial photograph, an image of Boston taken from a balloon in 1860

- Messenger pigeons, kites, aeroplanes, rockets and unmanned balloons were also used for early imaging.
- History of remote sensing can be linked with the development and understanding of optics and aeronautics.
  - **Optics** is the branch of physics which involves the behaviour and properties of light, including its interactions with matter
  - **Aeronautics** is the science that involves the study, design, and manufacturing of flight or the techniques of operating aircraft.
- Aristotle (300BC) is credited with the first experiments on optics. Galileo Galilei (1609) and Sir Issac Newton (1666) scientifically explained optics and spectrometry.
- The systematic aerial photography began during the World War I for military surveillance and reconnaissance purposes.
- During World War I, aeroplanes were used on a large scale for these purposes as the aeroplanes were proved more reliable and stable platforms for Earth observation than balloons.
- However, the important developments of aerial photography and photo interpretation took place during World War II.
- During this time span, the development of other imaging systems such as near-infrared photography, thermal sensing and radar also took place.

- During the latter part of the nineteenth century and into the early twentieth century, a number of people experimented with the use of aerial photography from balloons, kites, and even birds as an effective means of mapmaking and surveying.
- In 1900, Eastman's company, Kodak, released the Brownie, an inexpensive box camera for rolled film, making photography accessible to a mass audience.
- Eastman's innovations shortly preceded the Wright Brothers' first successful flight, in 1903, of a heavier-than-air aircraft. Six years later, Wilbur Wright took the first aerial photograph from an airplane.



Examples of Julius Neubronner's pigeon aerial photography. Notably, the photograph of the Schlosshotel Kronberg (top left) accidentally included the pigeon's wingtips. The image on the right shows a pigeon with one of Neubronner's breast mounted cameras.

- The broader field of remote sensing effectively started with the Space Age, an era initiated by the Soviet Union's launch of the first manmade satellite, Sputnik-1, in 1957.
- The term "remote sensing" was coined in the mid-1950s by Evelyn Pruitt, a geographer with the U. S. Office of Naval Research, allegedly because the term "aerial photography" did not sufficiently accommodate the notion of images from space.
- After the launch of Sputnik-1, the U. S. and Soviet governments raced to design and implement new space-related technologies, including both manned spacecraft and satellites.
- The first (and rather crude) satellite image of Earth was captured by NASA's Explorer 6 in 1959, the U. S. Department of Defense's CORONA (also known as "Discoverer") Reconnaissance Satellite Program, which remained classified until 1995, may be seen as a key forerunner to future Earth-observing satellite programs.
- Astronauts from NASA's Mercury, Gemini, and Apollo space missions took thousands of photographs of Earth using handheld and automated cameras.
- In fact, "The Blue Marble," a photograph taken in December 1972 by the crew of Apollo 17, is often cited as the most widely reproduced image of Earth.

A new version of "The Blue Marble": this true-color image is a seamless mosaic of separate images, largely recorded with the Moderate Resolution Imaging Spectroradiometer (MODIS), a device mounted on NASA's Terra satellite. Image courtesy of NASA Goddard Space Flight Center.

- A more formative event for modern remote sensing occurred in July 1972, when NASA launched ERTS-A (Earth Resources Technology Satellite-Mission A), the first satellite dedicated to monitoring environmental conditions on Earth's surface. Shortly after its launch, the satellite's name was changed to ERTS-1. It was followed by ERTS-2 (launched in January 1975) and ERTS-3 (launched in March 1978). Later, the names for these satellites were changed to Landsat-1, -2, and -3, respectively.
- The Landsat program served as the primary source of space-based Earth imagery until the 1980s, when a number of other countries began to develop their own Earth-observing satellite programs, particularly France and the European Union, Canada, Japan, India, Russia, China, and Brazil. More recently, a number of private companies have emerged as providers of satellite imagery, demonstrating the feasibility of commercial, space-based remote sensing.
- The European Space Agency (ESA) estimates that, between the 1957 launch of Sputnik and January 1, 2008, approximately 5,600 satellites were launched into Earth orbit (ESA 2009). The vast majority of these are no longer in service (raising some concerns about the high volume of space debris encircling the planet.
- The vast majority of these are no longer in service (raising some concerns about the high volume of space debris encircling the planet).
- Today, just fewer than 1,000 operational satellites are orbiting Earth, approximately 9% of which are dedicated to Earth observation and remote sensing (plus roughly 4% for meteorology and related applications).

Debris objects in low-Earth orbit. These debris are largely comprised of inactive satellites and other hardware, as well as fragments of spacecraft that have broken up over time. (Objects are not to scale.) Image courtesy of the European Space Agency

- The development of artificial satellites in the later half of the 20th century allowed remote sensing to progress to a global scale. As a consequence various Earth resources (e.g. Landsat) and weather (e.g. Nimbus) satellites and more recent missions such as RADARSAT and UARS provided global measurements of various data for civil, research, and military purposes.
  - RADARSAT is a constellation of pair of Canadian Remote Sensing satellites.
  - UARS (Upper Atmosphere Research Satellite) was a NASA operated orbital observatory whose mission was to study the Earth's atmosphere, particularly the protective ozone layer.
- Space probes to other planets have also provided the opportunity to conduct remote sensing studies in extra terrestrial environments; synthetic aperture radar aboard the Magellan spacecraft provided detailed topographic maps of Venus, while instruments aboard SOHO allowed studies to be performed on the Sun and the solar wind, just to name a few examples.
  - **SOHO** (Solar and Heliospheric Observatory) is a spaceborne solar observatory jointly developed by European Space Agency (ESA) and National Aeronautics and Space Administration (NASA) of USA to study the Sun from its deep core to the outer corona and the solar wind. Launched i1995 it began its normal operations in May 1996. Originally planned as a two year mission, it still continues to operate after over fifteen years in space. Till date it has discovered over 2100 comets.

Major milestones in the history of remote sensing

Year	Milestones
1800	Discovery of infrared by Sir W. Herschel
1801	Theory of the perception of the colour by Thomas Young
1839	Beginning of practice of photography
1859	Photography from balloons
1873	Description of electromagnetic spectrum by J.C. Maxwell
1909	Photography from airplanes
1916	Aerial reconnaissance during the World War I
1935	Development of radar in Germany
1940	Applications of non-visible part of electromagnetic spectrum during World War II
1959	First space photograph of the Earth by Explorer-6
1960	Launch of the first TIROS meteorological satellite
1970	Skylab remote sensing observations from the space
1972	Launch of the first Earth resource satellite (Landsat-1)
1972	Rapid advances in digital image processing
1982	Launch of new generation of Landsat sensors (Landsat-4)
1986	Launch of French Earth observation satellite (SPOT-1)
1986	Development of hyperspectral sensors
1990	Development of high resolution space borne systems
1995	Launch of RADARSAT
1998	Advancements towards low cost one-goal satellite missions
1999	Launch of MODIS Terra EOS, Landsat-7 ETM+ and Earth observation satellites by commercial space agencies (IKONOS)
2000	Launch of SRTM
2002	Launch of ENVISAT, SPOT-5 and Launch of MODIS Aqua
2006	Launch of RADARSAT-2

Major milestones in the history of Indian remote sensing

Year	Milestones
1920	First use of aerial photography
1962	Establishment of a rocket launching station
1972	Establishment of the Department of Space
1975	Launch of the First Indian satellite 'Aryabhatta'
1979	Launch of the Earth observation satellite 'Bhaskara'
1982	Launch of INSAT-1A
1988	Launch of the First Indian Remote Sensing Satellite programme, IRS-1A
1991	Launch of IRS-1B
1994	Launch of IRS-P2
1995	Launch of INSAT-2C
1997	Launch of IRS-1D
1999	Launch of OCEANSAT-1 (IRS-P4)
2001	Launch of the GSAT-1 and Technology Evaluation Satellite (TES)
2002	Launch of KALPANA (METSAT)
2003	Launch of RESOURCESAT-1 (IRS-P6)
2005	Launch of CARTOSAT-1 (IRS-P6)
2007	Launch of CARTOSAT-2
2008	Launch of Chandrayaan-1
2009	Launch of ANUSAT, OCEANSAT-2 and RISAT-2
2010	Launch of CARTOSAT-2B
2011	Launch of YOUTHSAT, RESOURCESAT-2 and Megha-Tropiques