

Landsat History

DESCRIPTION

The Landsat satellite program, a joint initiative of **NASA** and the **U.S. Geological Survey (USGS)**, is designed to monitor Earth's land surface from space. Its purpose is to capture detailed images of the planet's surface.

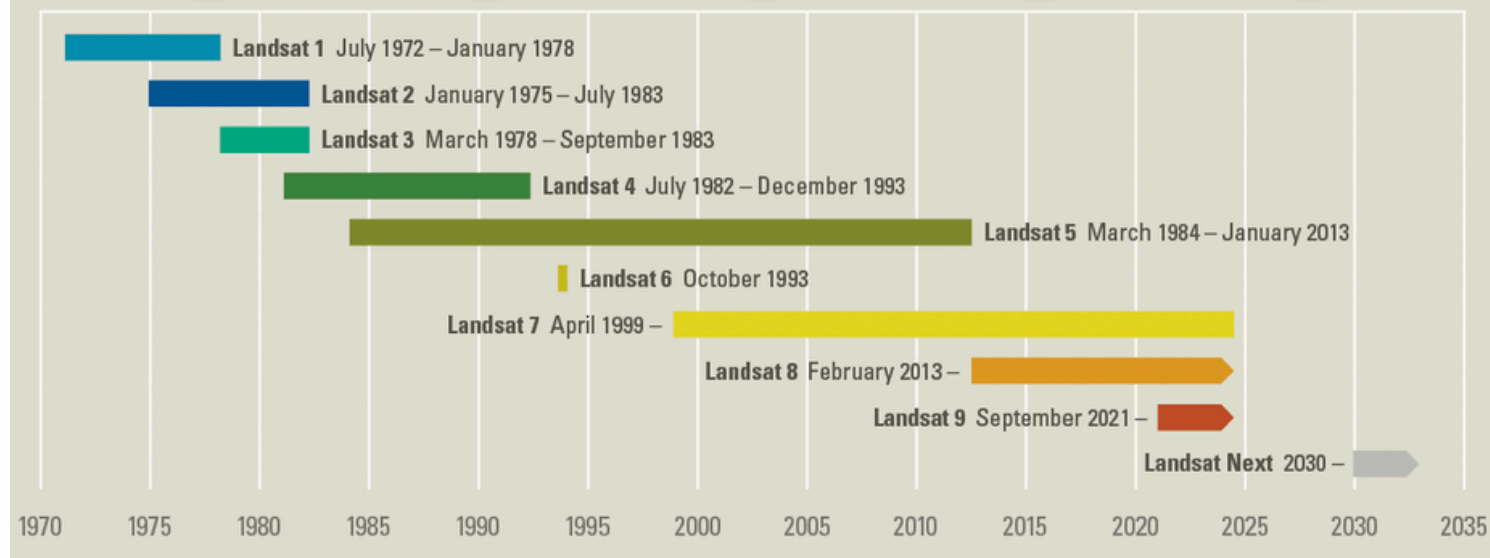
BRIEF HISTORY

The Landsat program began with the launch of Landsat 1, marking the **start of Earth observation** by satellite. It was initially created to provide detailed imagery of Earth's surface, focusing on **monitoring natural resources, agriculture, and land use**. With each new Landsat satellite (Landsat 2-7), sensor technologies improved, enabling higher spectral and spatial resolution. In the 2010s, the development of Landsat 8 & 9 saw a technological leap forward, with the introduction of a new image-taking technique called "Pushbroom". Unlike the older "Whiskbroom" method, which scanned the Earth in narrow strips using a rotating mirror, Pushbroom sensors capture a continuous band of the surface, resulting in greater data efficiency and reduced mechanical wear.

SENSOR EVOLUTION

- **Landsat 1**
 - Return Beam Vidicon **RBV** : captures high-resolution images by scanning the Earth's surface with an electron beam and converting the reflected light into an electronic signal.
 - Multispectral Scanner **MSS** : captures data in multiple spectral bands. Detect reflected light in different wavelengths.
- **Landsat 2-3**
 - **RBV** - improved in comparison of Landsat 1
 - **MSS**
- **Landsat 4-5**
 - **MSS**
 - Thematic Mapper **TM** : captures high-resolution multispectral images across seven distinct spectral bands, providing data on surface features in both visible and infrared wavelengths.
- **Landsat 6** (crashed at launch)
 - Enhanced Thematic Mapper **ETM** : captures high-resolution multispectral images across **eight** spectral bands, including a new shortwave infrared band.
- **Landsat 7**
 - **ETM+** : adds a higher-resolution panchromatic band for improved spatial detail and enhanced radiometric calibration.
- **Landsat 8 - 9**
 - Operational Land Imager **OLI** : multispectral radiometer acquiring images in nine spectral bands ranging from the visible to the mid-infrared, with an optical resolution of 30m.
 - Thermal Infrared Sensor **TIRS**, provides data in wavelengths observed by previous Landsat satellites aiming to ensure the continuity of measurements made in the past.

Landsat Missions: Imaging the Earth Since 1972



PRIVATIZATION

In 1984, Congress decided that Landsat satellites could be privatized. EOSAT and NOAA were put in charge of managing the next two Landsat satellites. Due to certain constraints, they raised image prices, causing users to migrate to free, low-resolution data. As a consequence, many phenomena were missed due to the lack of immediate customers. A strong protest was organized to save the mission, which led the government to reinvest in the Landsat program. operational control was officially returned to the government in 2001.

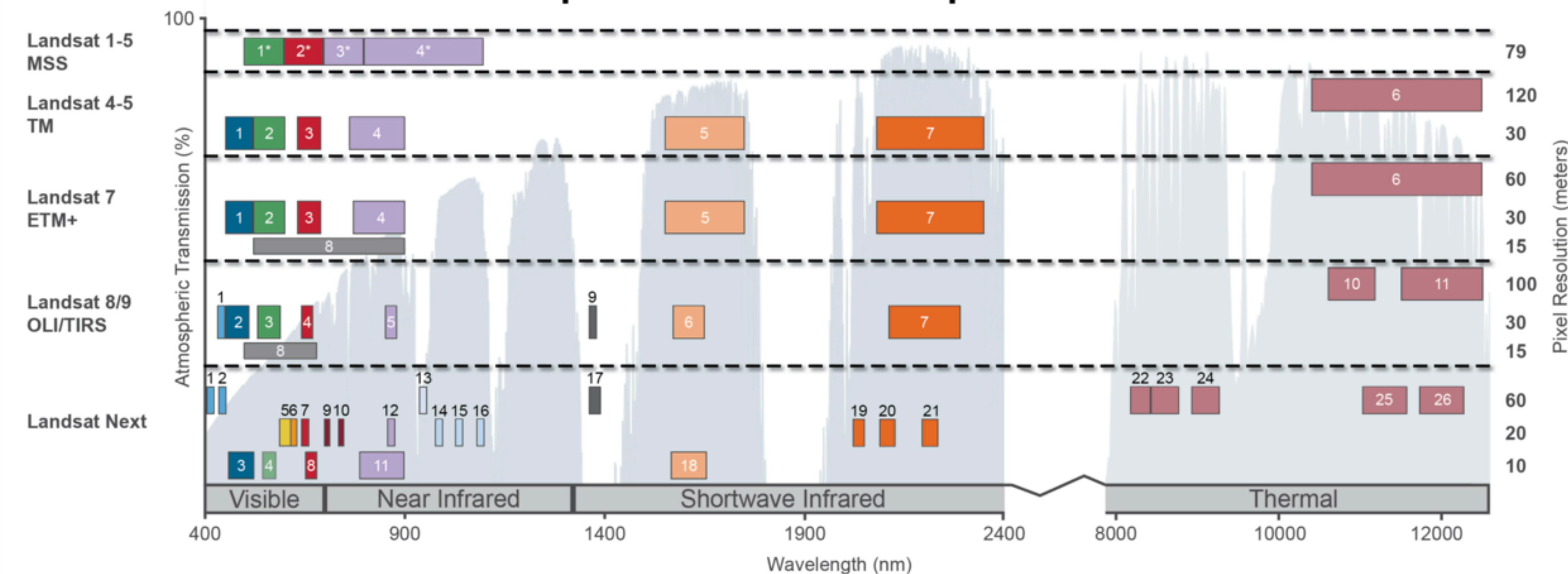
USES

- **Agriculture, Forestry and Range Resources**
- **Land Use and Mapping** (eg : Categorizing land capabilities)
- **Geology** (eg : Determining regional geologic structures)
- **Hydrology** (eg : Monitoring lake inventories and health)
- **Coastal Resources** (eg : Monitoring coral reef health)
- **Environmental Monitoring** (eg : Assessing drought impact)
- **Space-time studies** - since the satellites have been operational for a long time, it's now possible to analyze changes in the Earth's surface over time.



Example (cropped) of an analysis over time of a temporary lake in Spain.
Doña Monzo et al. (2016), "Monitoring Hydrological Patterns of Temporary Lakes Using Remote Sensing and Machine Learning Models," Remote Sensing, 8.

Comparison of Landsat Spectral Bands



* MSS bands 1-4 were known as bands 4-7, respectively, on Landsats 1-3
USGS, march 2024

• <https://www.usgs.gov/media/images/landsat-missions-timeline>
• <https://www.usgs.gov/landsat-missions/landsat-satellite-missions>
• <https://landsat.gsfc.nasa.gov>
• https://www.researchgate.net/figure/Time-course-of-landsat-7-etm-true-color-images-rgb-bands-3-2-1-of-lake-alcahozo-for_fig2_305658157