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**OTGA/INIOAS: Remote Sensing of Coral Reefs**  
20 - 23 October 2019, Tehran, Iran



Iranian National Institute for  
Oceanography and Atmospheric  
Science (INIOAS)

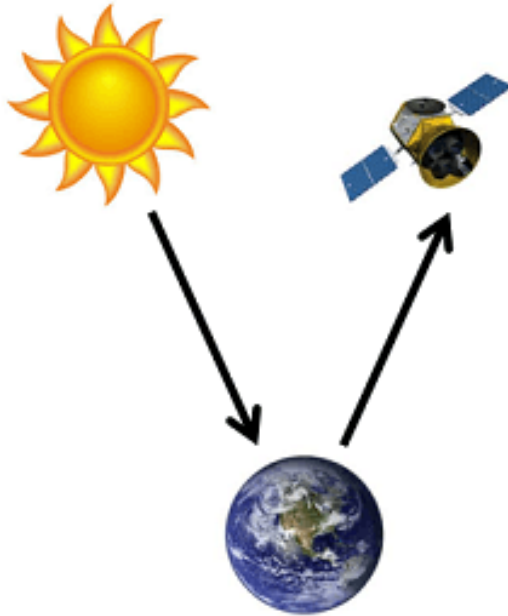
# An Introduction to Remote Sensing

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*Department of Marine Remote Sensing*

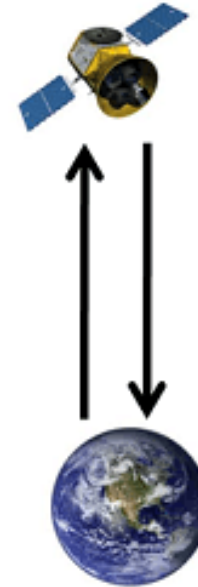
## Definition of Remote Sensing:

**Remote Sensing** is defined as the science and technology by which the characteristics of objects of interest can be identified, measured or analyzed without direct contact.

## Active vs Passive sensors

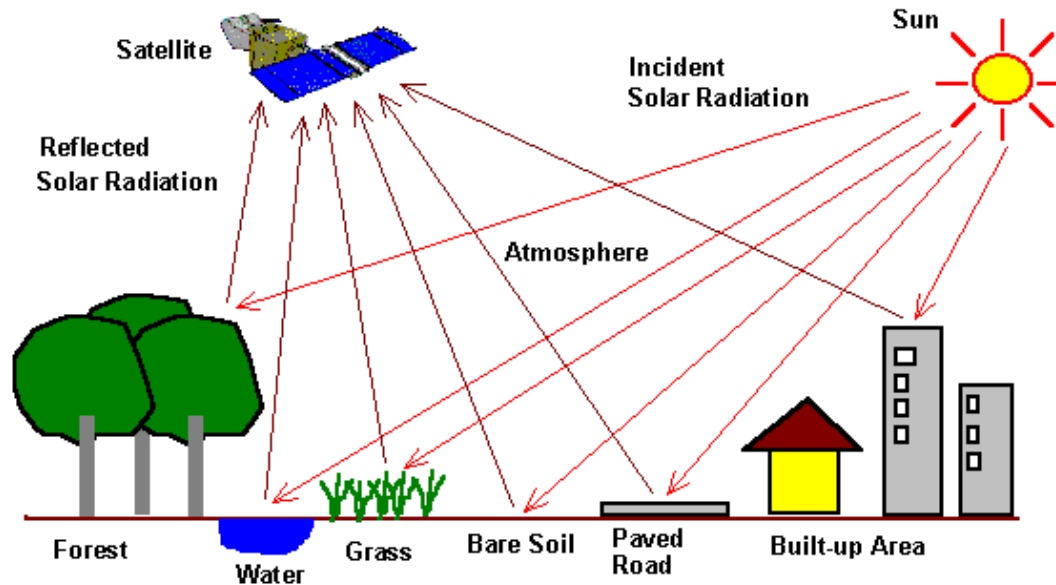


Passive remote sensor



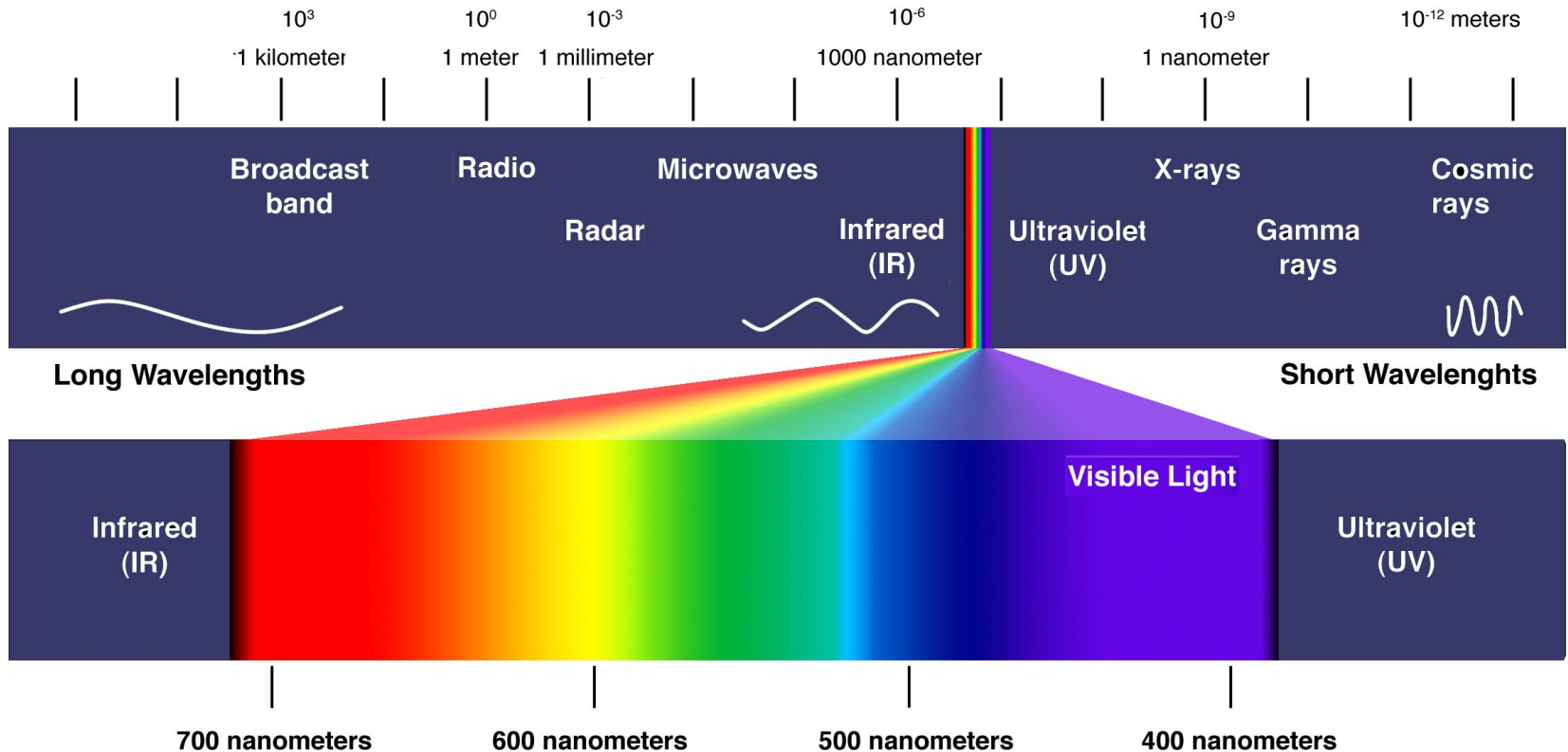
Active remote sensor

## Passive sensors



**Electro-magnetic radiation** which is reflected or emitted from an object is the usual source of passive remote sensing data

# Electromagnetic spectrum



# Definitions

## Digital Number (DN):

The generic term for pixel values is Digital Number or DN. It is commonly used to describe pixel values that **have not yet been calibrated into physically meaningful units.**

## Radiance:

The amount of radiation coming from an area. To derive a radiance image from an uncalibrated image, a gain and offset must be applied to the pixel values.

units  $\rightarrow \mu\text{W}/(\text{cm}^2 \cdot \text{sr} \cdot \text{nm})$ .

## Reflectance:

The **proportion** of the **radiation striking** a surface to the **radiation reflected** off of it. (Normal values are between 0 (no reflection) and 1 (total reflection))

# Definitions

## Top of Atmosphere Reflectance (TOA):

The reflectance measured by a **space-based sensor** flying higher than the earth's atmosphere. These reflectance values will include contributions from clouds and atmospheric aerosols and gases.

## Surface Reflectance:

The reflectance of the surface of the Earth. Clouds and other atmospheric components **do not** affect surface reflectance spectra.

# Definitions

Typically images of surface reflectance are derived from calibrated radiance images. There are many ways to derive reflectance images from radiance images, including model-based atmospheric corrections such as those included in ENVI's Atmospheric Correction Module (**FLAASH**).



# Definitions

## Resolution:

The resolution of an image refers to the potential detail provided by the imagery.

In **remote sensing** we refer to **four types** of **resolution**.

# Definitions

## Spatial Resolution:

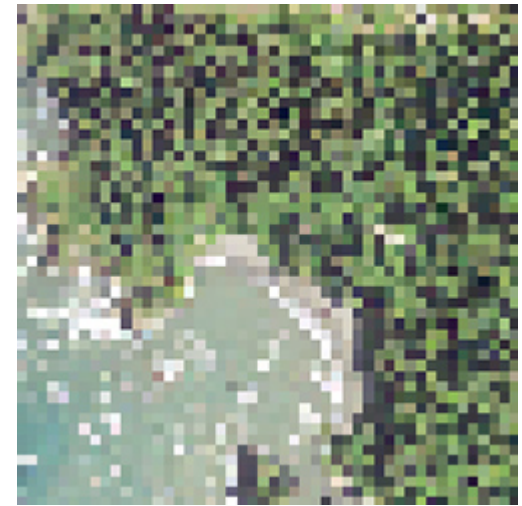
Refers to the size of the smallest feature that can be detected by a satellite sensor or displayed in a satellite image. For example, a spatial resolution of 2m means that one pixel represents an area 2 by 2 meters on the ground.



1m Resolution



15m Resolution

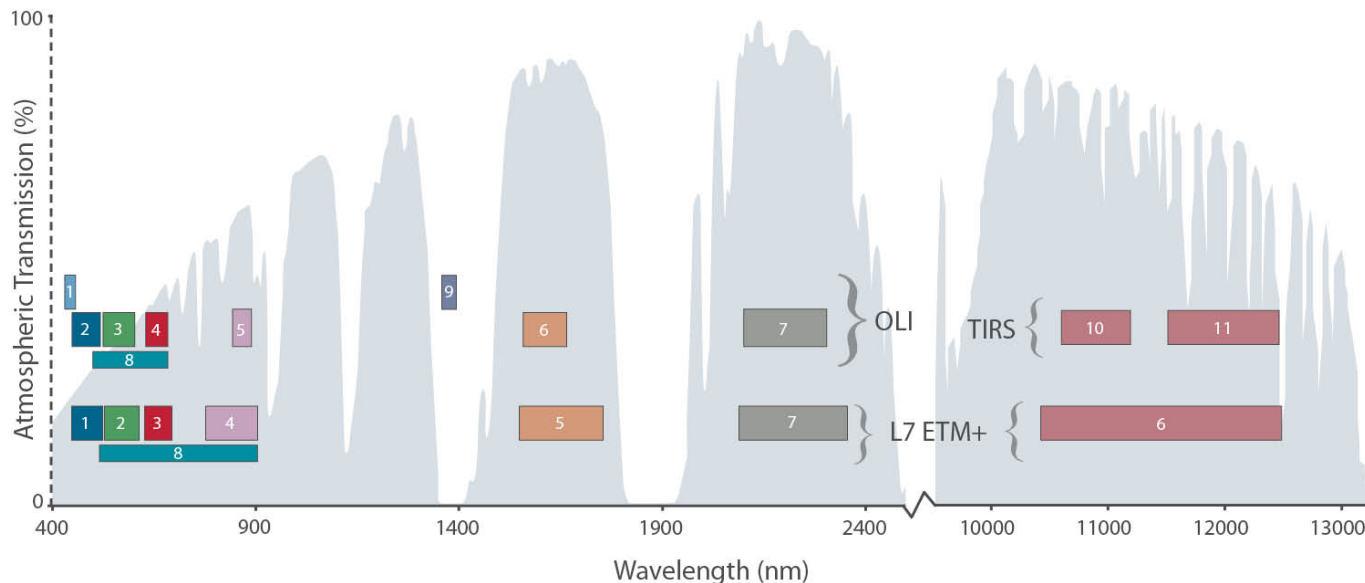


30m Resolution

## Definitions

### Spectral Resolution:

Refers to the ability of a satellite sensor to measure specific wavelengths of the electromagnetic spectrum. The **finer** the spectral resolution, the **narrower** the wavelength range for a particular channel or band.



# Definitions

## Temporal resolution (Revisit cycle):

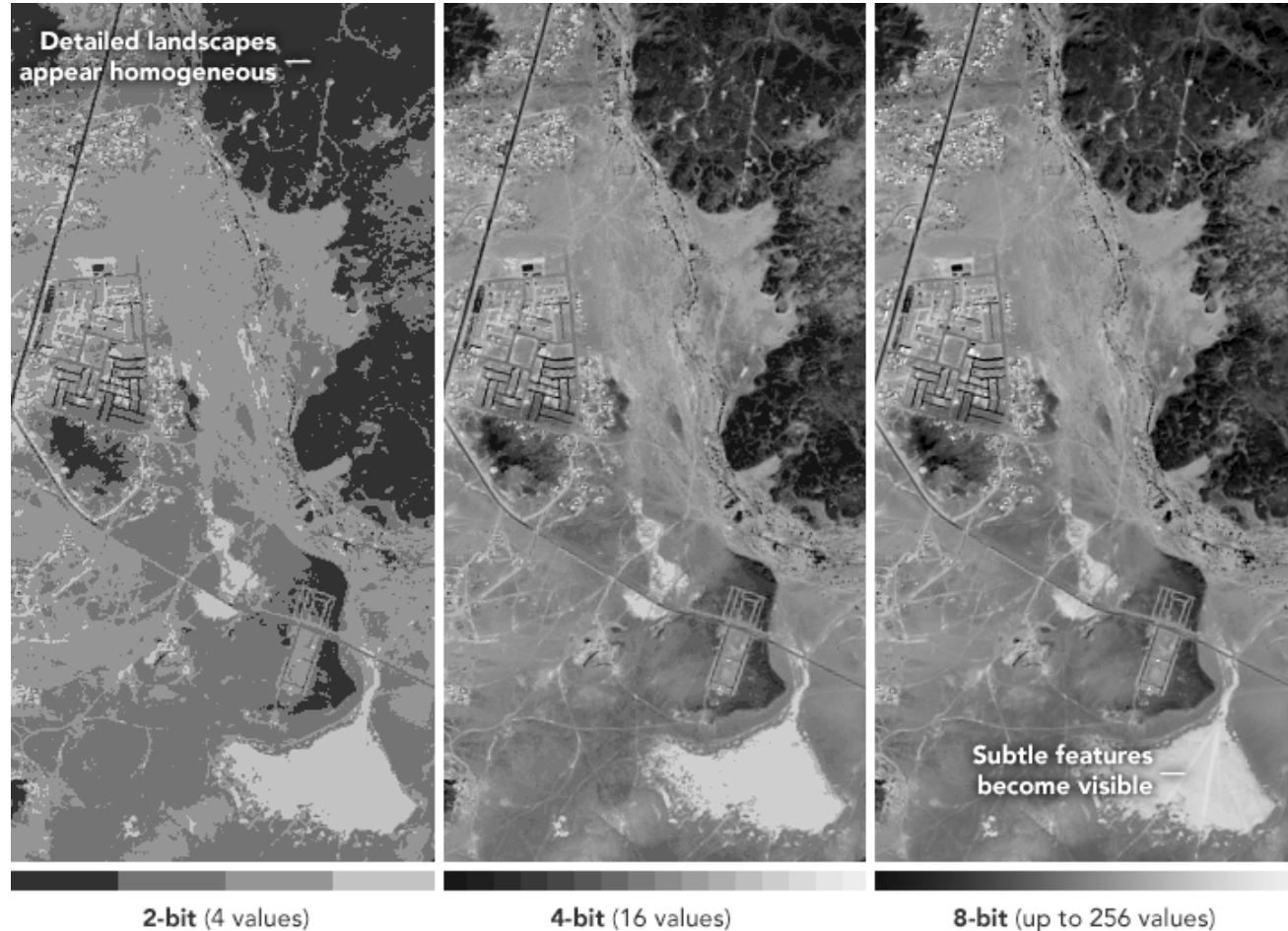
Refers to the time between images. The capability for satellites to provide images of the **same geographical area** more frequently has increased dramatically since the dawn of the space age.

<b>MODIS</b>	<b>1-2 days</b>
<b>Landsat</b>	<b>16 days</b>
<b>QuickBird</b>	<b>5 days</b>
<b>WorldView</b>	<b>1.1 days</b>

# Definitions

## Radiometric resolution:

Refers to the number of possible brightness values in each band of data and is determined by the number of **bits** into which the recorded energy is divided. For example, in a 8-bit data, the brightness values range from 0 to 255 for each pixel (256 total possible values).

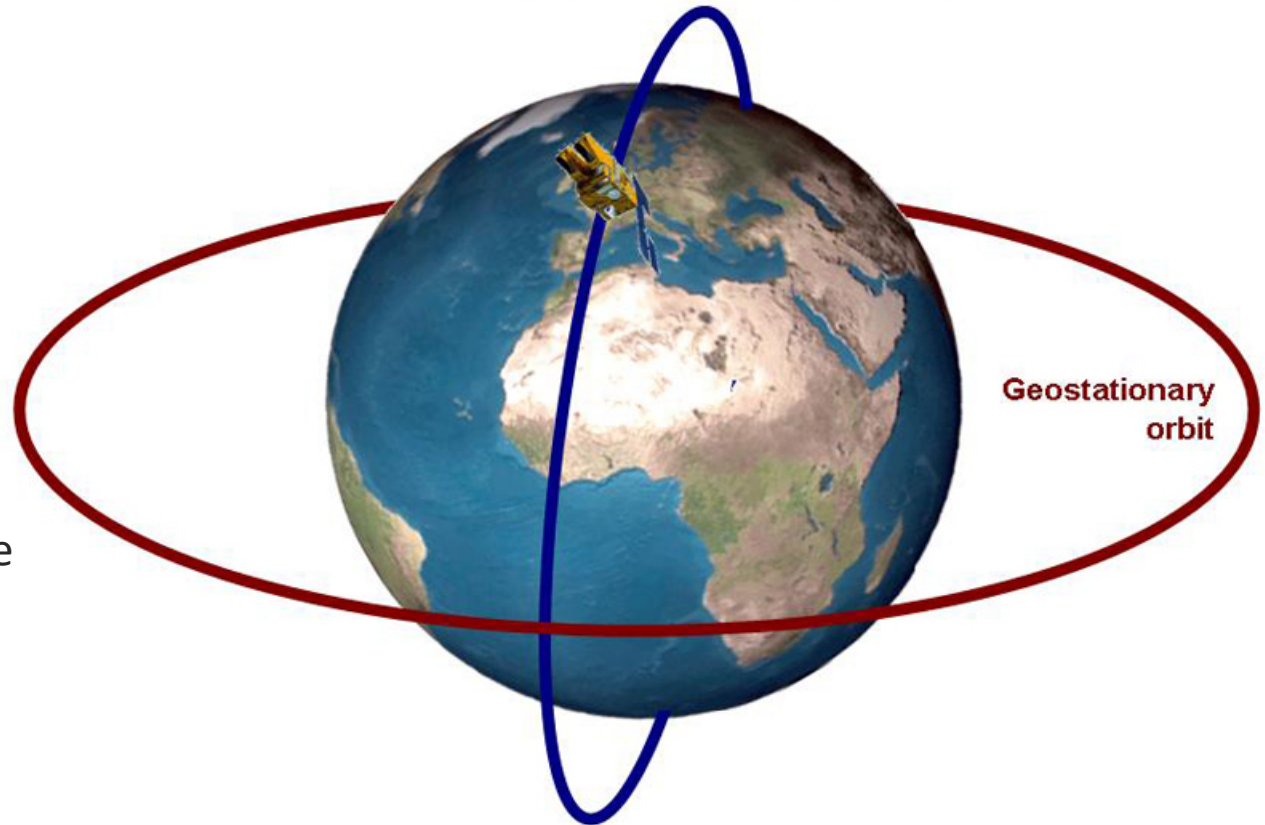


## Types of satellite Orbit

**Geosynchronous orbit:** is an orbit around the Earth, where the object orbits once per day. A common kind of geosynchronous orbit is called a **geostationary orbit**, where the object orbits above the same part of the Earth at all times.  
Distance to earth surface=  
36000 km

Examples: [Weather satellites](#)

Sun-synchronous, near polar orbit



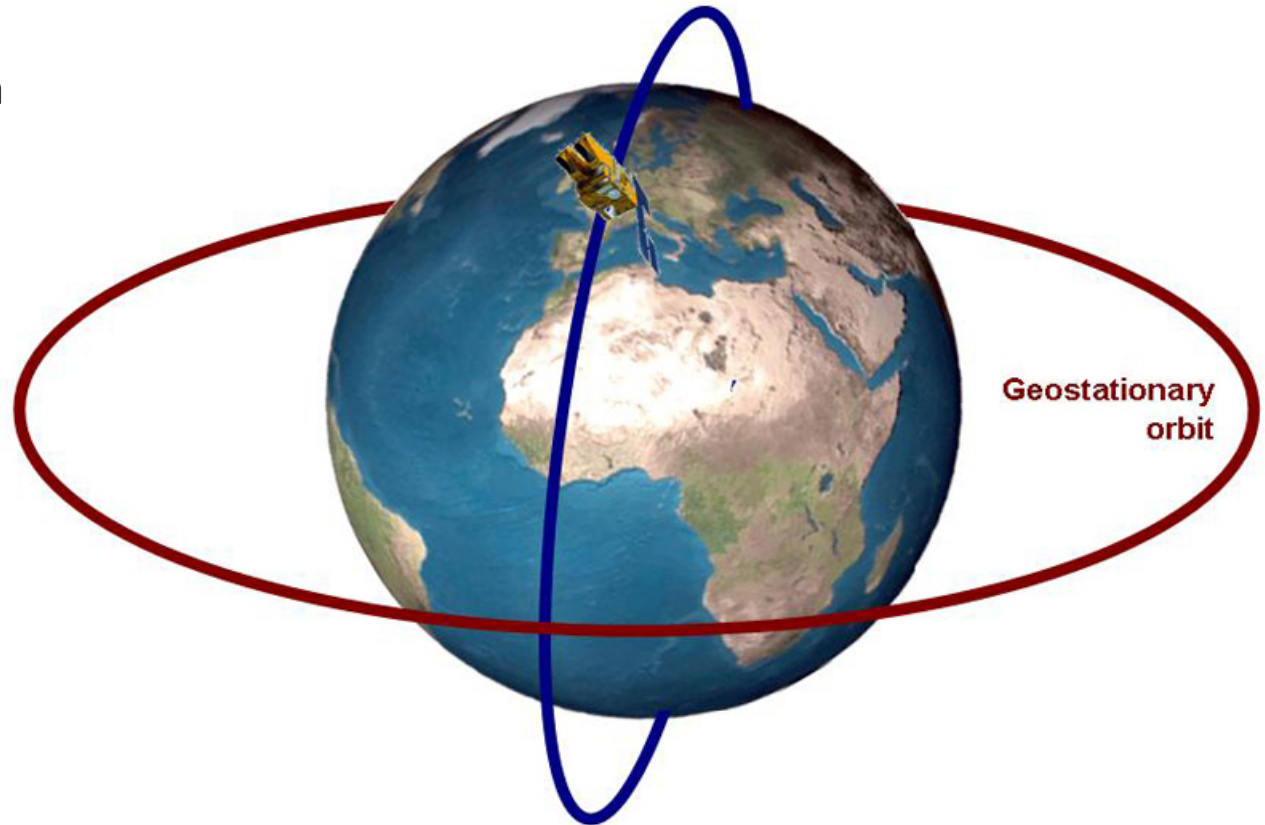
## Types of satellite Orbit

**Sunsynchronous orbit:** is a nearly polar orbit around a planet, in which the satellite passes over any given point of the planet's surface at the **same local mean solar time**.

Distance to earth surface=  
100-1000 km

Examples: [Landsat](#) and  
[WorldView](#)

Sun-synchronous, near polar orbit





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# Coordinate systems

A coordinate system is a method for identifying the location of a point on the earth





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# Coordinate systems

## Geographical coordinate system

Latitude= 25° 30' 47"

Longitude= 47° 28' 52"

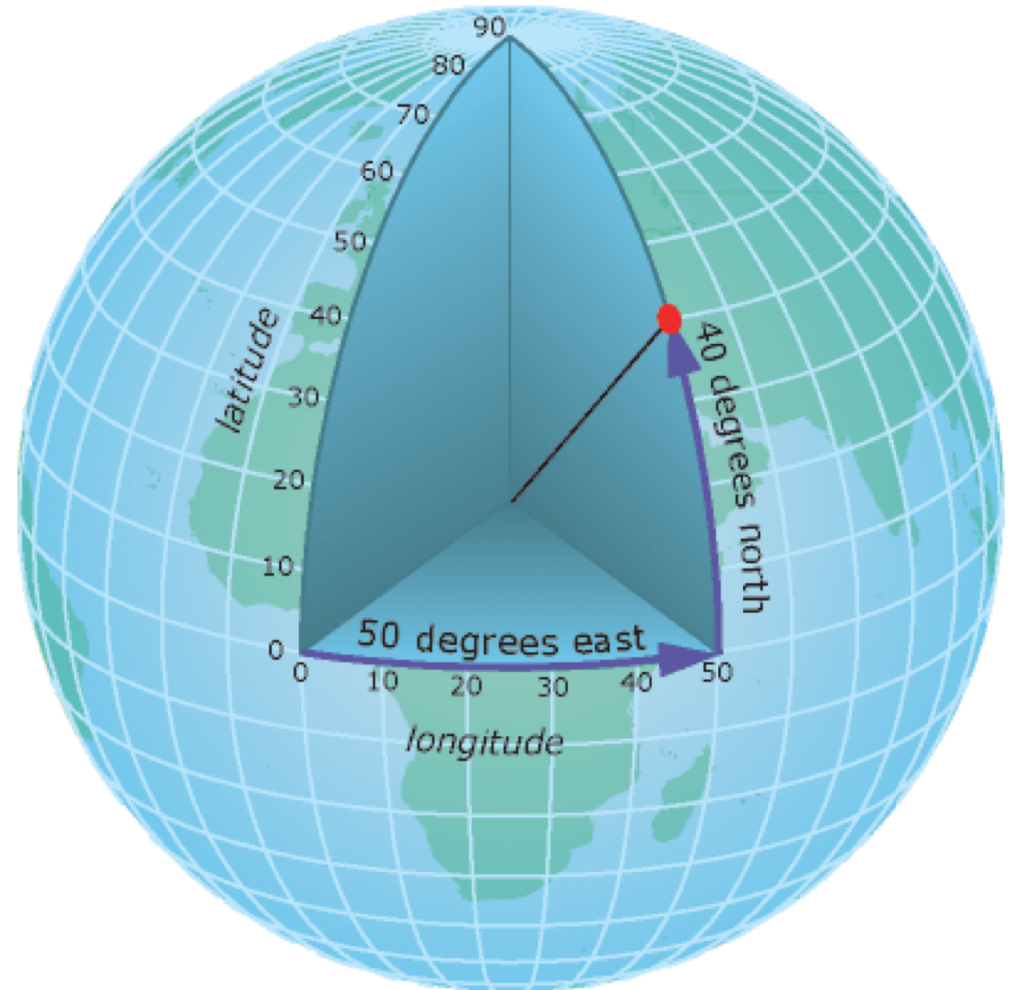
$25 + 30/60 + 47/3600 = 25.513056$

$47 + 28/60 + 52/3600 = 47.481111$

Latitude= 25.513056°

Longitude= 47.481111°

Decimal degrees





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# Coordinate systems

## Universal Transverse Mercator (UTM)

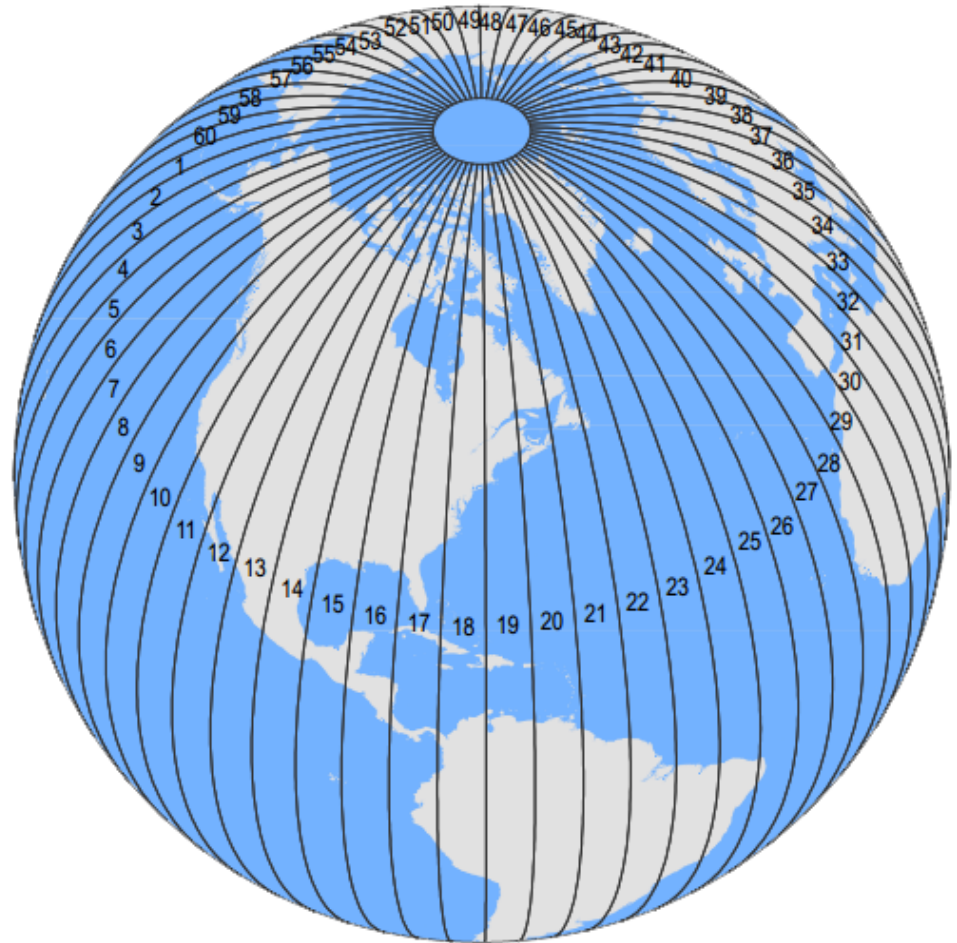
X= 749367.88 m

Y= 2824086.19 m

Zone= 38

(Zone number must be indicated)

An example [website](#) for online  
converter





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# Where to find and buy high resolution satellite images

<https://discover.digitalglobe.com>



**Thanks for your attention**