Application of EO Technology in Monitoring and Mitigating Natural Hazards

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Overview

- Remote Sensing
- Main Elements of Remote Sensing
- Types of Satellite
- Space Agencies
- The Data
- Geographic Information System (GIS)
- Remote Sensing of Natural Hazards
- Example
- Conclusion

Remote sensing (RS)

Is a summary term for the instrumentation, techniques, and methods to observe the Earth's surface at a distance and to interpret the images or numerical values obtained to acquire meaningful information concerning the nature or state of the observed features.

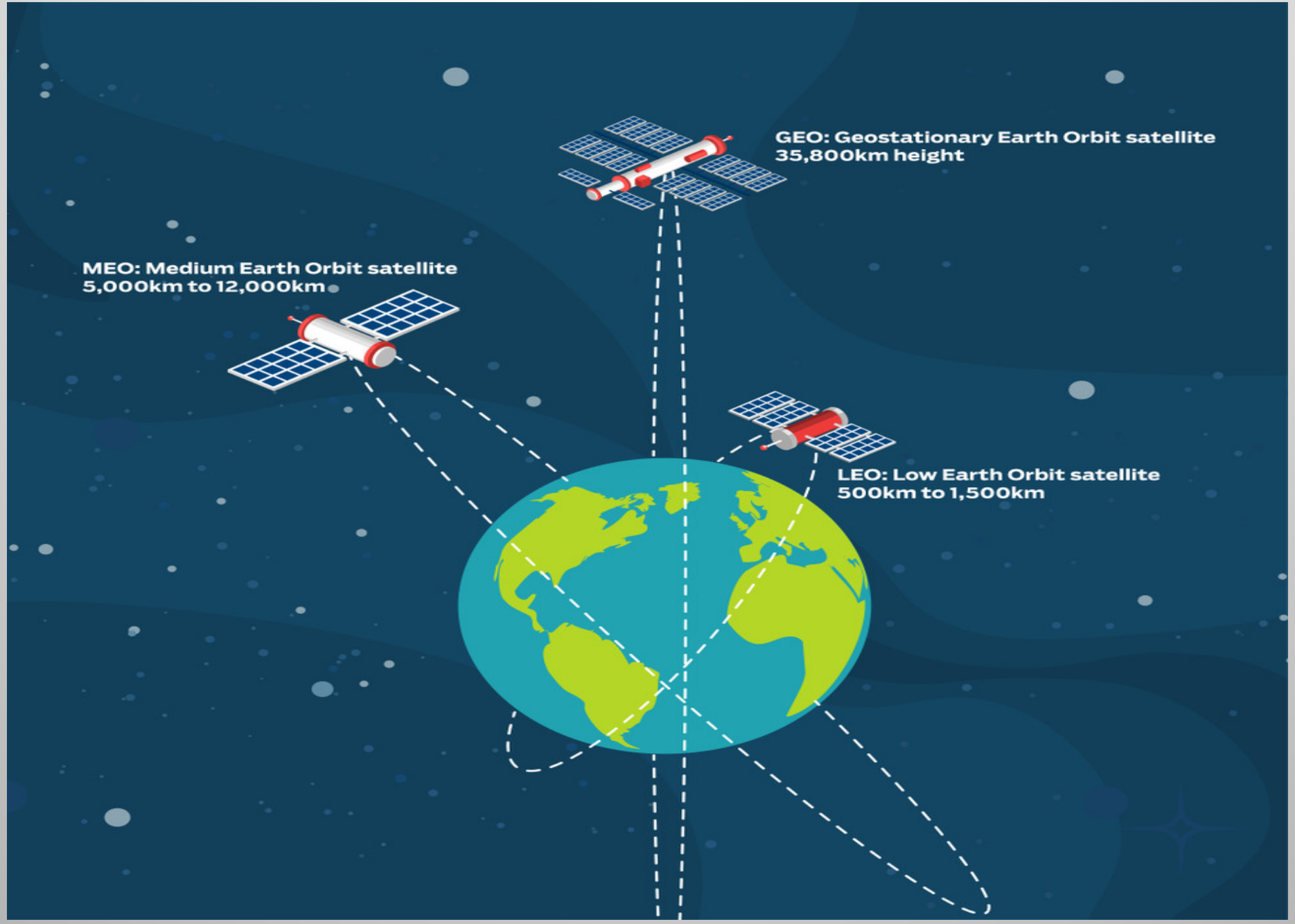
Main Elements:

- Sensor
  - Sensor is a device that gathered energy converts into signal and presents it in a form (image) suitable for obtaining information about the object under investigation.
  - Each satellite carries one or more sensors onboard that take measurements in different wavelengths.
  - Passive Sensor → Detect natural energy (radiation) that is emitted or reflected by the object or scene being observed. Reflected sunlight is the most common source of radiation measured by passive sensors(e.g. Landsat, ASTER)
  - Active Sensors → provide their own source of energy to illuminate the objects they observe. (e.g. RADAR)
- Platform
  - Aircraft
  - Satellite

Satellites Types

The earth observation satellite varies based on the area they see, and the frequency of observations

- Polar Orbit
  - Flying in low orbit (often at around 1000km above the ground),
  - High spatial resolution.
  - Only collect data over the same point once every few days.
- Geostationary Orbit
  - Positioned at a much higher altitude (about 36,000km)
  - Their spatial data is much coarser
  - Collect data at the same point every 15 minutes.



http://debuglies.com/2019

Space Agencies

CNSA, The Chinese National Space Agency

ESA, The European Space Agency

ISRO, The Indian Space Research Organization

JAXA, The Japanese space agency

NASA, The American space agency

Roscosmos, The Russian space agency

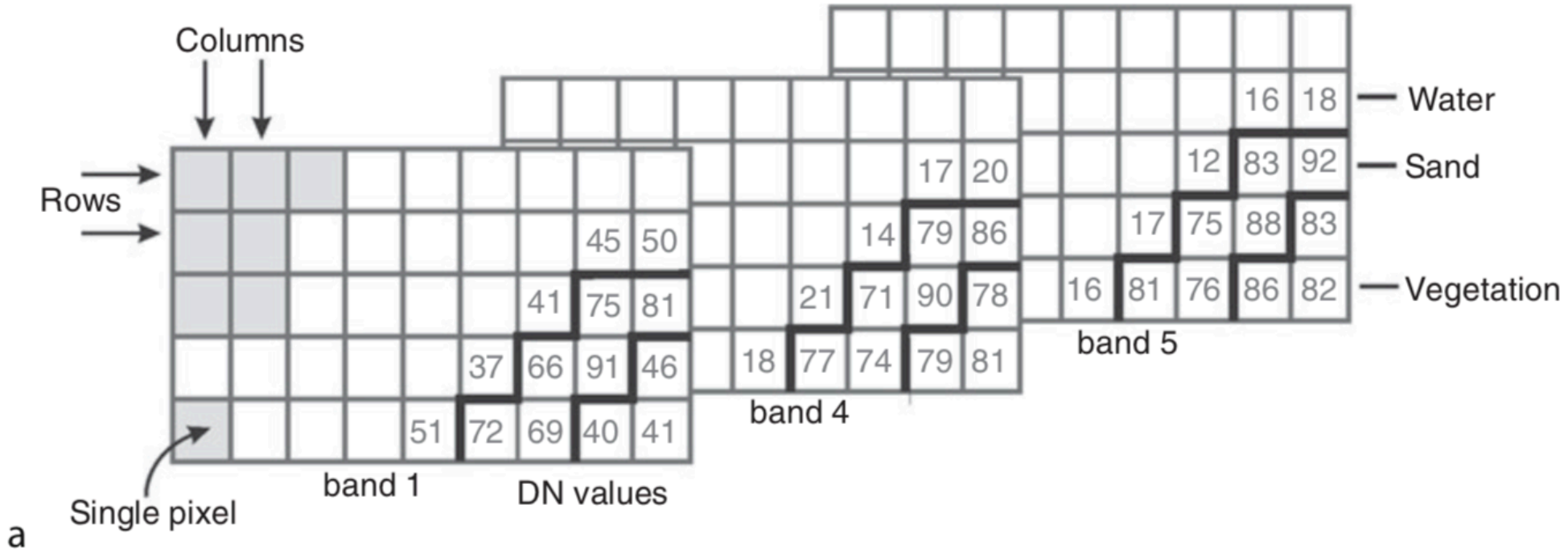
Programs & Missions

- The NOAA Satellite and Information Service :
  - Provides timely access to global environmental data from satellites to monitor and understand our dynamic Earth.

- Landsat satellites:
  - Have the optimal ground resolution and spectral bands to efficiently track land use and to document land change due to climate change, urbanization, drought, wildfire, biomass changes (carbon assessments), and a host of other natural and human-caused changes.

Data

- Obtained data depend on sensor.
- The data recorded by a sensor typically have the form of:
  - Grid (pixels) or raster ➔ Satellite images
- Satellite images :
  1. Allow us to map the variabilities of terrain properties
     - Vegetation, Water, and Geology, both in space and time.
  2. Provide us with a synoptic overview and provide very useful environmental information.
     - Wide range of scales, from entire continents to details of a few metres


Columns
Rows
Single pixel
band 1
DN values
band 4
band 5
Water
Sand
Vegetation
45 50
41 75 81
37 66 91 46
51 72 69 40 41
17 20
14 79 86
21 71 90 78
18 77 74 79 81
16 18
12 83 92
17 75 88 83
16 81 76 86 82

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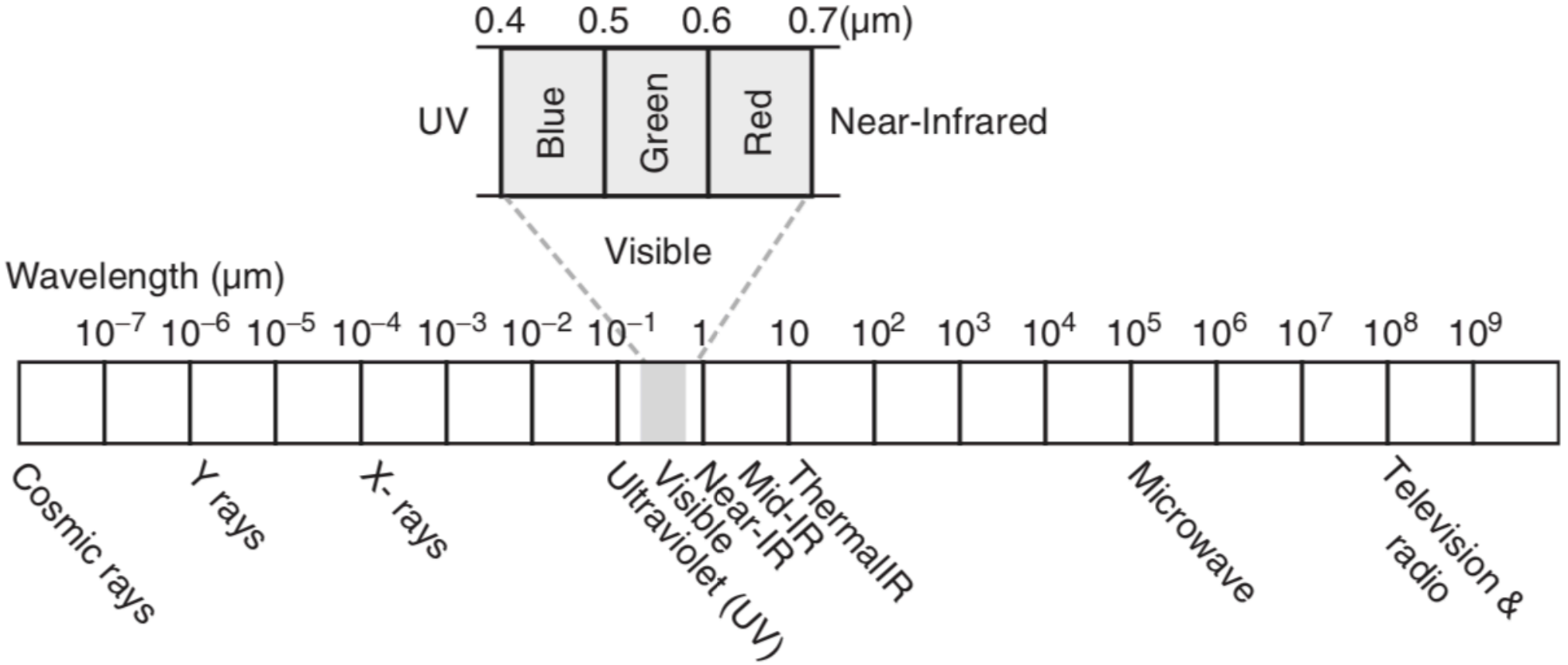

Electromagnetic Spectrum is the term used to describe the range of possible frequencies of electromagnetic radiations.

Bands and Resolution

Band	Wavelength (micrometers)	Resolution (meters)
Band 1 – Coastal Aerosol	0.43 – 0.45	30
Band 2 – Blue	0.45 – 0.51	30
Band 3 – Green	0.53 – 0.59	30
Band 4 – Red	0.64 – 0.67	30
Band 5 – Near Infrared (NIR)	0.85 – 0.88	30
Band 6 – SWIR 1	1.57 – 1.65	30
Band 7 – SWIR 2	2.11 – 2.29	30
Band 8 – Panchromatic	0.50 – 0.68	15
Band 9 – Cirrus	1.36 – 1.38	30
Band 10 – Thermal Infrared (TIRS) 1	10.60 – 11.19	100
Band 11 – Thermal Infrared (TIRS) 2	11.50 – 12.51	100

Different satellite data for providing structural information on a circular structure in the south of Makkah, Saudi Arabia