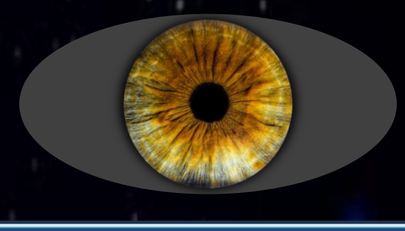
NANYANG TECHNOLOGICAL UNIVERSITY SINGAPORE

Satellite Research Centre
School of Electrical and Electronic Engineering

NTU Satellite Research Centre — Birthplace of Singapore Satellite

# Remote Sensing



**Spatial Resolution** measures the detail in an image, based on pixel size. Higher resolution shows finer details, while lower resolution covers larger areas with less detail. For example, a spatial resolution of 250m means that one pixel represents an area 250 by 250 meters on the ground.

**Spectral Resolution** shows how well a sensor separates different colors or light wavelengths. Higher resolution helps identify specific materials or features. It's useful in fields like mapping and environmental studies.

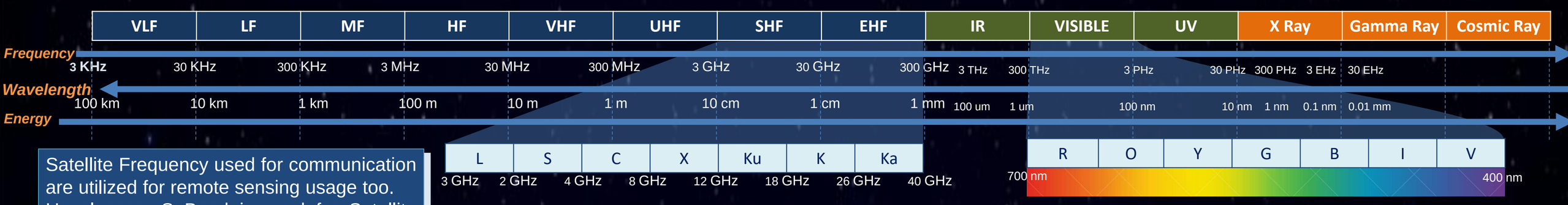
**Temporal Resolution** Temporal resolution refers to how often a sensor captures images of the same area. Higher temporal resolution means more frequent updates.

## *Ability to **SEE** the full spectrum – Deliver diverse and valuable **Insight***

### Electromagnetic Spectrum

*Low Frequency Long Wavelength Low Energy* — *High Frequency Short Wavelength High Energy*

*illustration is not proportional*




Satellite Frequency used for communication are utilized for remote sensing usage too. Usual case: S Band is used for Satellite TT&C, whereas X band is used for high throughput data downlink.

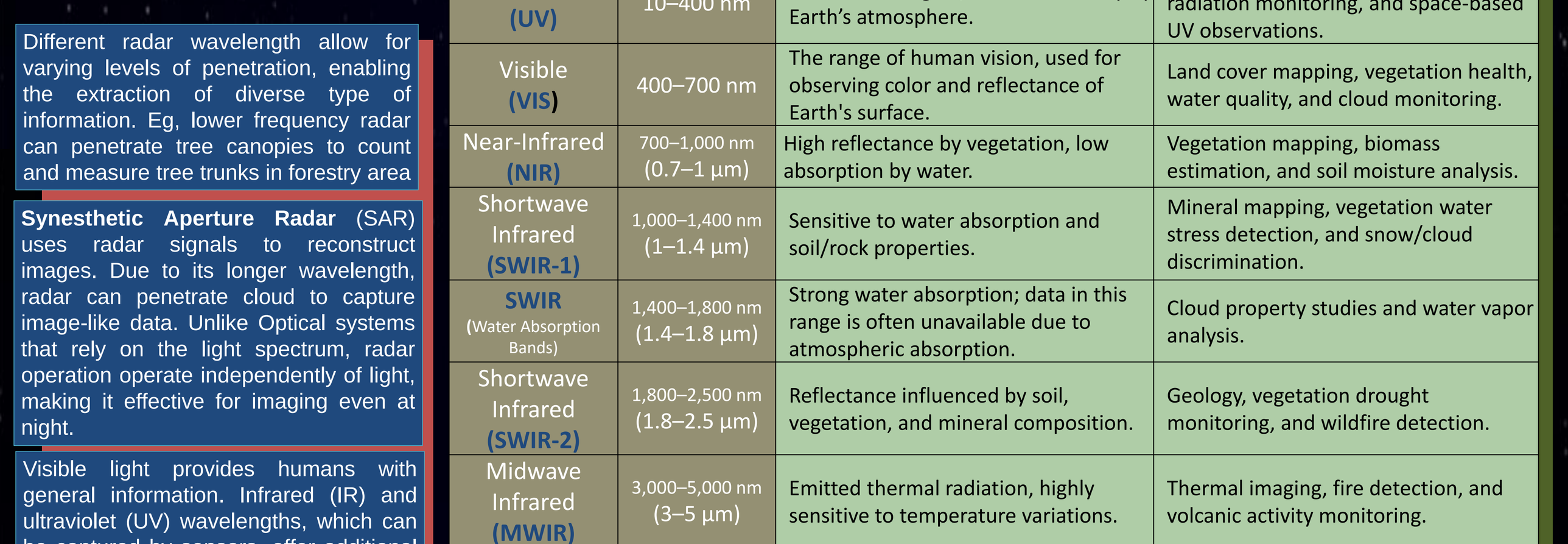
Different radar wavelength allow for varying levels of penetration, enabling the extraction of diverse type of information. Eg, lower frequency radar can penetrate tree canopies to count and measure tree trunks in forestry area

**Synesthetic Aperture Radar** (SAR) uses radar signals to reconstruct images. Due to its longer wavelength, radar can penetrate cloud to capture image-like data. Unlike Optical systems that rely on the light spectrum, radar operation operate independently of light, making it effective for imaging even at night.

Visible light provides humans with general information. Infrared (IR) and ultraviolet (UV) wavelengths, which can be captured by sensors, offer additional insight such as monitoring plant health, assessing reservoir conditions.

| Spectral Band | Wavelength | Description | Remote Sensing Applications |
|---|---|---|---|
| Ultraviolet (UV) | 10–400 nm | Short wavelengths, absorbed mostly by Earth's atmosphere. | Atmospheric ozone studies, solar radiation monitoring, and space-based UV observations. |
| Visible (VIS) | 400–700 nm | The range of human vision, used for observing color and reflectance of Earth's surface. | Land cover mapping, vegetation health, water quality, and cloud monitoring. |
| Near-Infrared (NIR) | 700–1,000 nm (0.7–1 µm) | High reflectance by vegetation, low absorption by water. | Vegetation mapping, biomass estimation, and soil moisture analysis. |
| Shortwave Infrared (SWIR-1) | 1,000–1,400 nm (1–1.4 µm) | Sensitive to water absorption and soil/rock properties. | Mineral mapping, vegetation water stress detection, and snow/cloud discrimination. |
| SWIR (Water Absorption Bands) | 1,400–1,800 nm (1.4–1.8 µm) | Strong water absorption; data in this range is often unavailable due to atmospheric absorption. | Cloud property studies and water vapor analysis. |
| Shortwave Infrared (SWIR-2) | 1,800–2,500 nm (1.8–2.5 µm) | Reflectance influenced by soil, vegetation, and mineral composition. | Geology, vegetation drought monitoring, and wildfire detection. |
| Midwave Infrared (MWIR) | 3,000–5,000 nm (3–5 µm) | Emitted thermal radiation, highly sensitive to temperature variations. | Thermal imaging, fire detection, and volcanic activity monitoring. |
| Longwave Infrared (LWIR) | 8,000–15,000 nm (8–15 µm) | Thermal emission from Earth's surface; key for heat and energy balance studies. | Land and sea surface temperature mapping, urban heat island studies, and climate monitoring. |

## Singapore Satellite Imaging of #NTUsg

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