

What is Hyperspectral Imagery (HSI)?

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Partnership (MoRAP)**



Missouri
Department of
Natural Resources





What is Remote Sensing?

- **The science and art of obtaining information about an object, area, or phenomenon through the analysis of data acquired by a device that is not in contact with it**

- **Requires platform and sensor**



Platform and Sensor



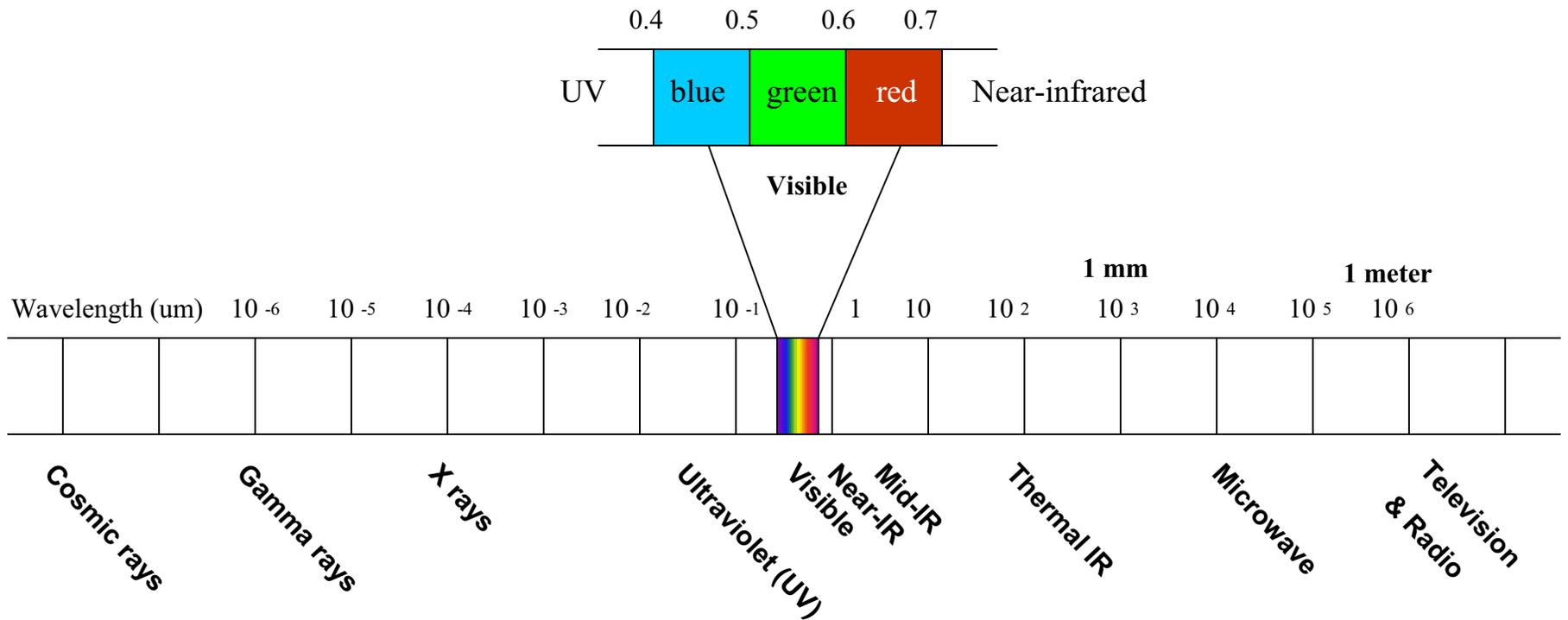


Why use Remote Sensing?

- **Bird's Eye View**
- **Large Area Data Collection**
- **Comprehensive Sampling**
- **Objectivity in Data Collection**
- **Repeatability / Intercomparability of Data**
- **High Temporal Resolution**



Electromagnetic Spectrum



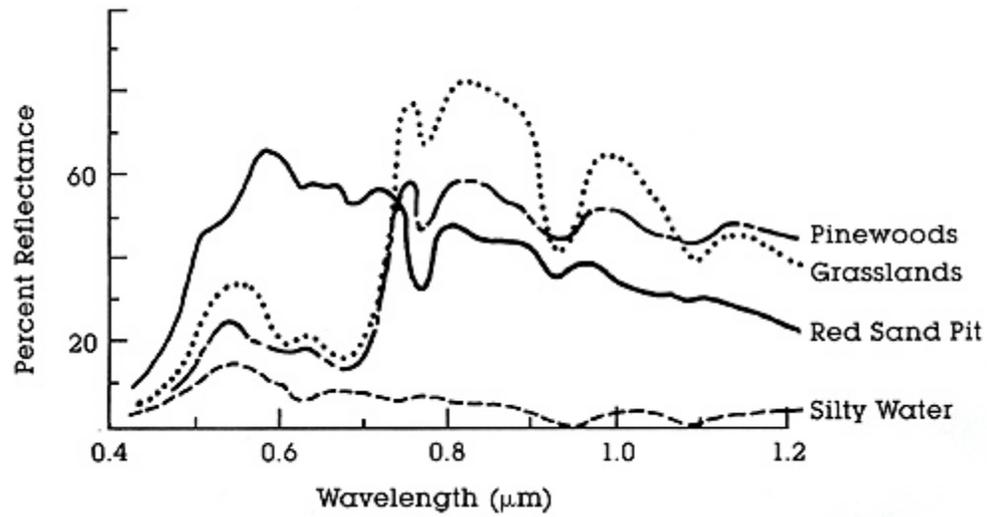


Electromagnetic Spectrum

- **'Visible' region very small**
- **Ultra Violet, Infrared (near, mid, thermal), microwave**
- **No clear-cut divisions**
- **Divisions grown out of a need to sense (acquire data) these areas**



Spectral Response Curve





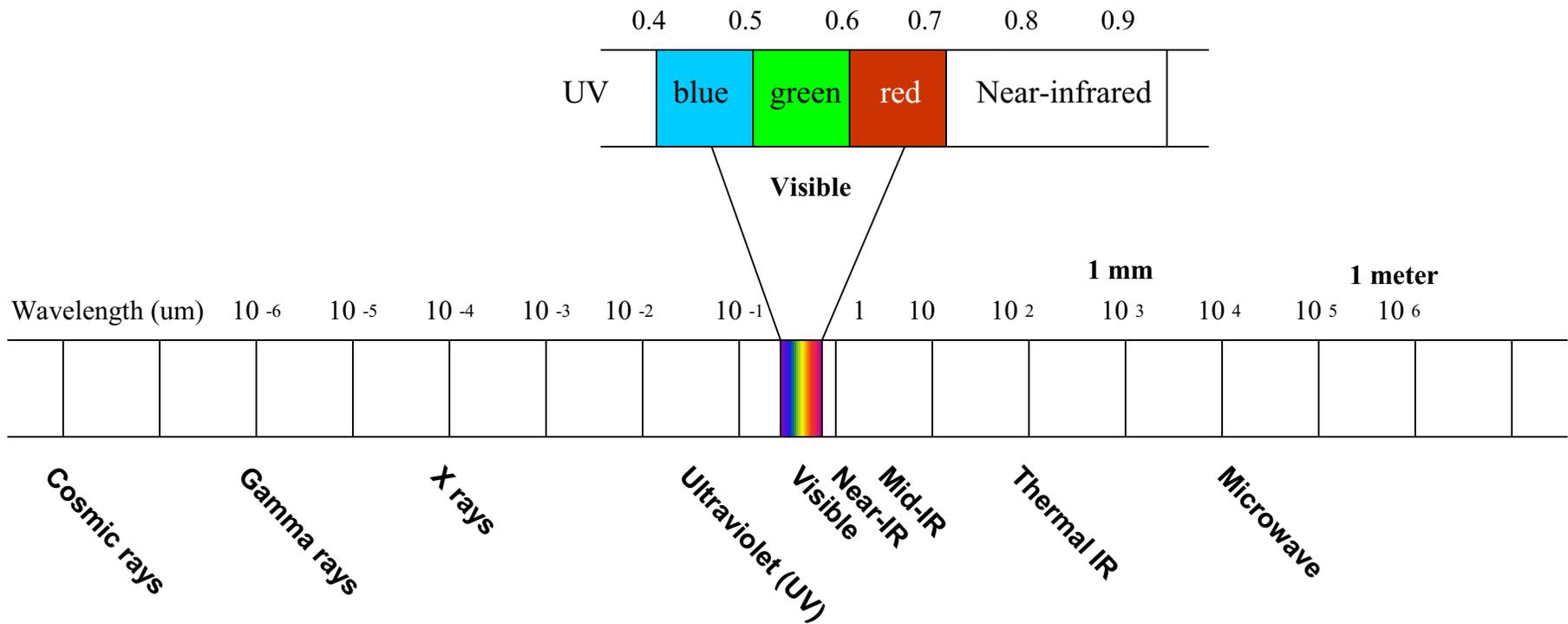
Panchromatic Imaging

- **An image collected in a broad wavelength range**
- **Generally rendered in black and white**
- **ETM+ sensor 15-meter images are collected over the visible portion of the electromagnetic spectrum**



Panchromatic Imaging

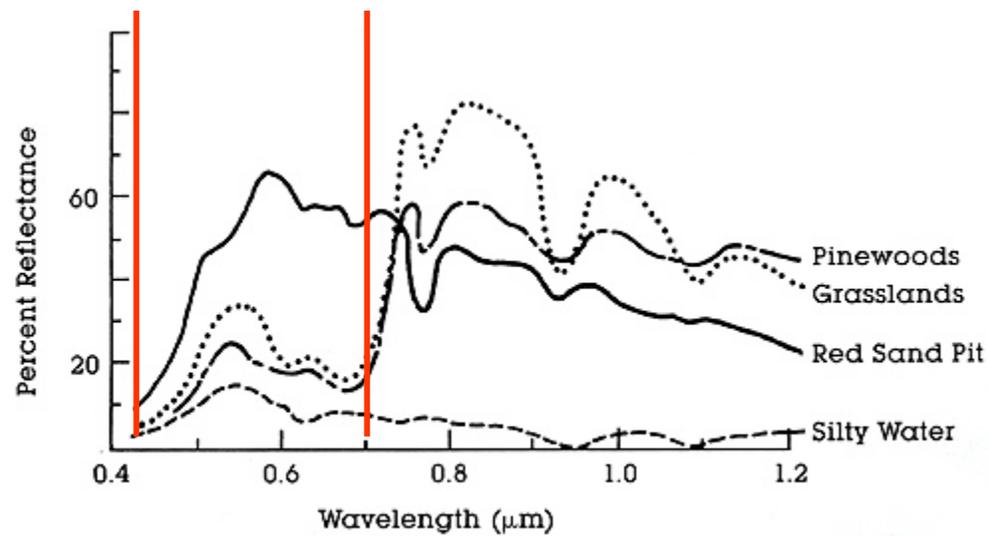
Single Wavelength Range





Panchromatic Imaging

Single Wavelength Range





Panchromatic Imaging



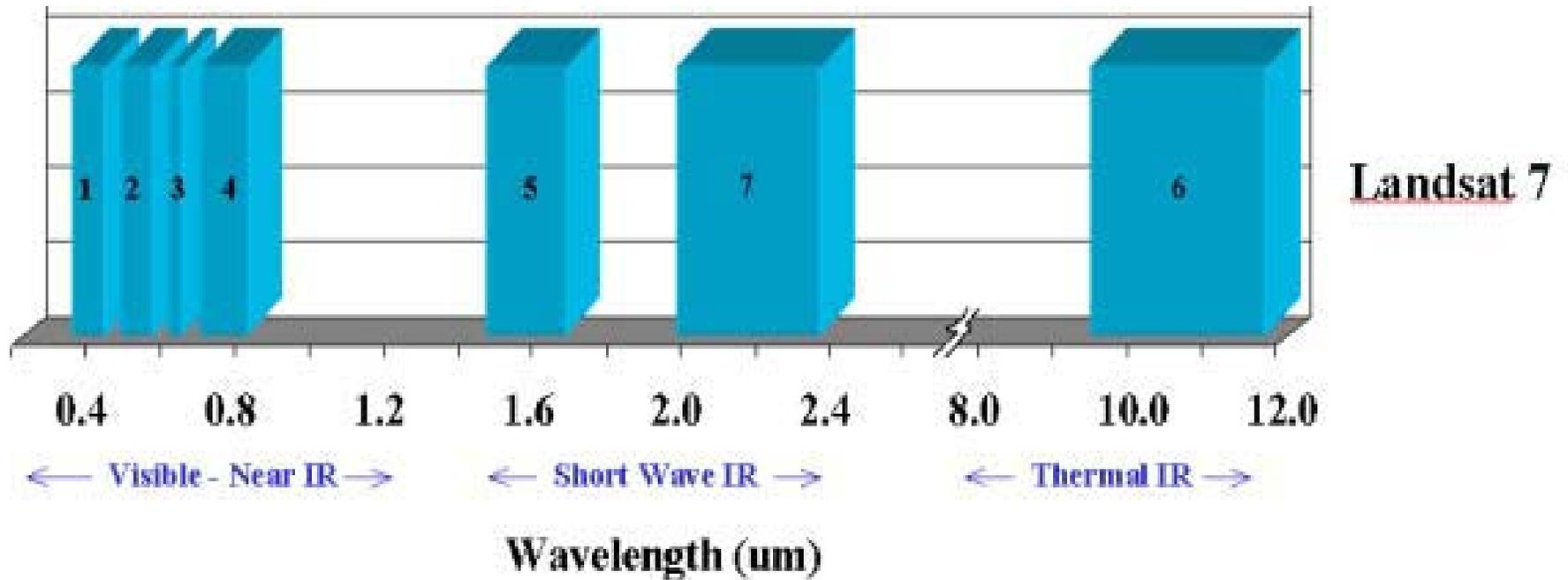


Multispectral Imaging

- **Images acquired in more than one spectral or wavelength interval**
- **Multispectral images are non-contiguous in their coverage of the spectrum**
- **The TM sensor scans and stores seven individual images in spectral bands ranging from the blue wavelengths up to those in the thermal infrared**

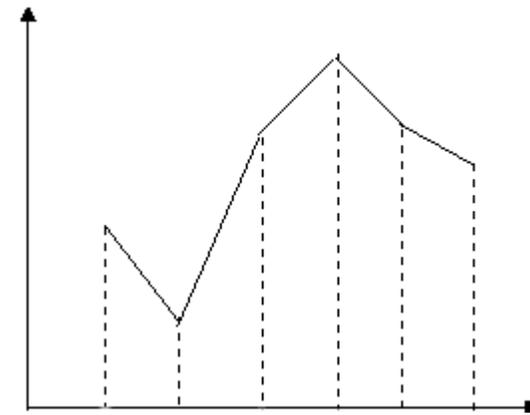
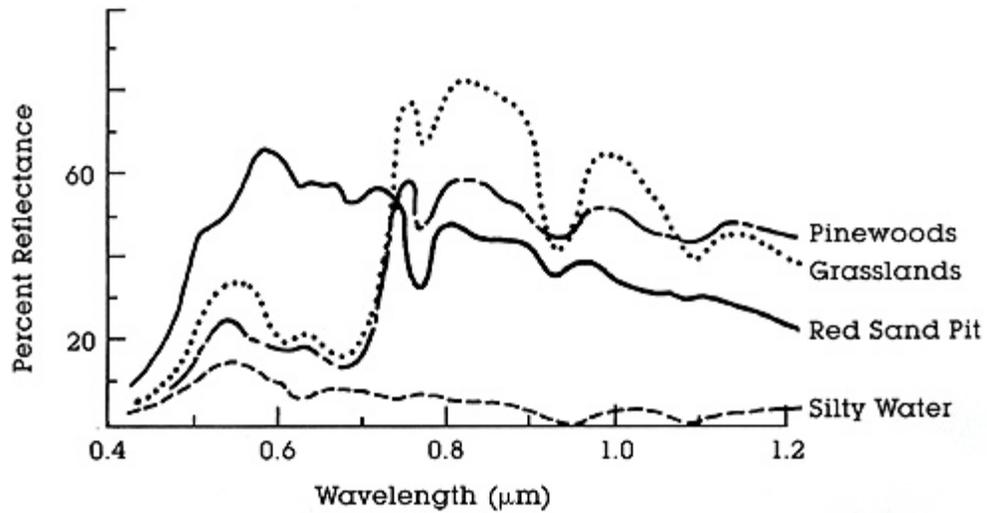


Multispectral Imaging



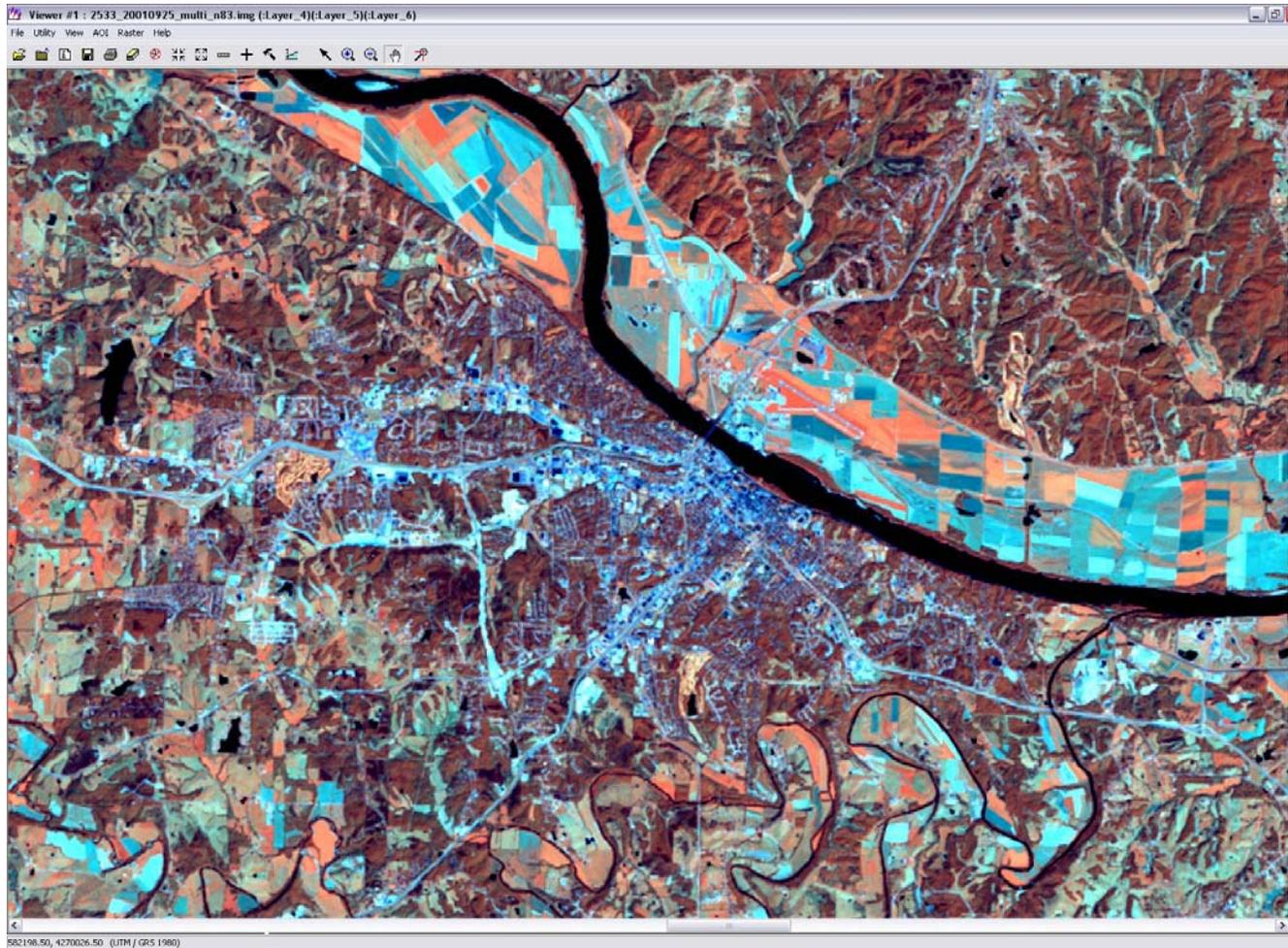


Multispectral Imaging





Multispectral Imaging

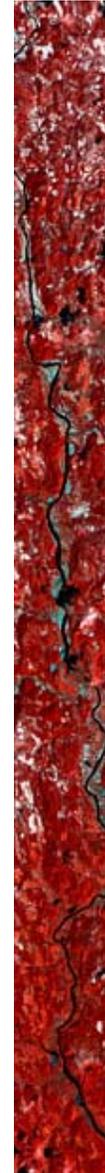
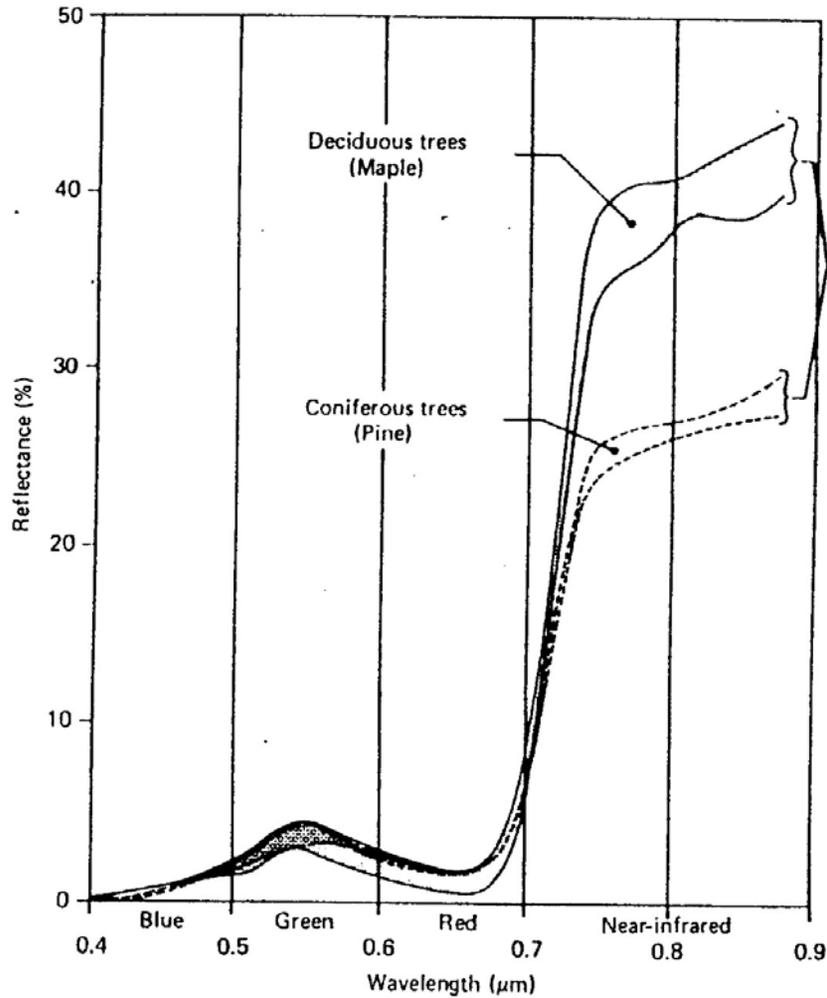




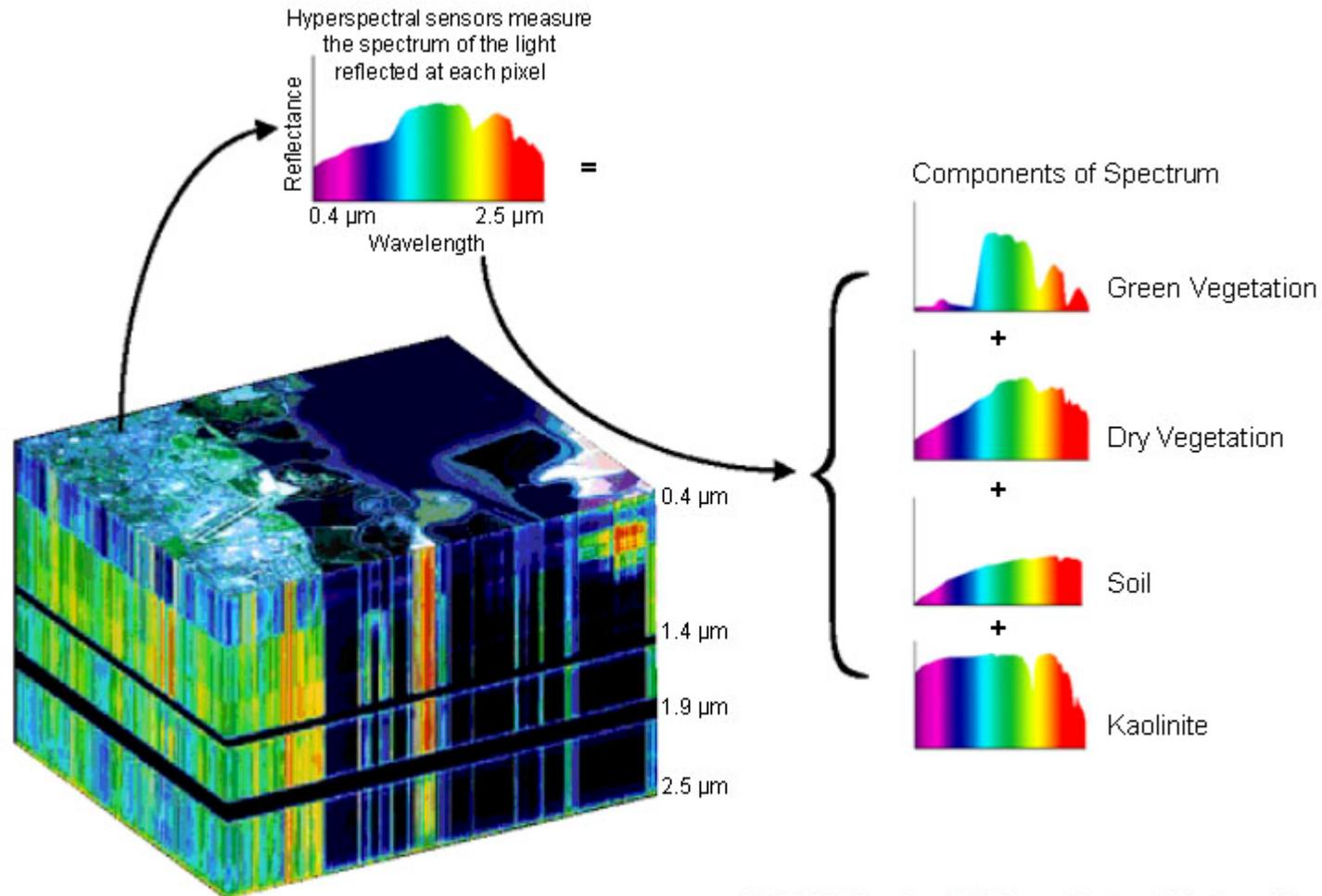
Hyperspectral Imaging

- **Images have dozens to hundreds of narrow contiguous bands**
- **Vast quantities of data because of the number of bands simultaneously imaged, creating a 3-dimensional image cube**
- **Hyperion images the earth's surface in 220 contiguous spectral bands, covering the region from 400 nm to 2.5 μm , at a ground resolution of 30 m**

Hyperspectral Imaging



Hyperspectral Imaging



(NEMO Project Office, United States Navy)



Hyperspectral Image Analysis

- **Anomaly Detection**
- **Target Detection**
- **Material Identification**



Anomaly Detection

- **Commonly used when nothing is known about the scene under surveillance, but we wish to identify anything that might be out of place**
- **Identify pixels that are uniquely different from the dominate spectra (background)**
- **Pixels that fail to conform to the background are flagged as anomalies**



Target Detection

- **Find within the imagery, materials that are present and match them to existing spectral libraries**
- **All pixels whose spectra match the target spectrum (to a specified level of confidence) are marked as potential targets**
- **The underlying assumption is that the pixels containing the target are "pure"**



Material Identification

- **Determine sub-pixel concentrations of materials by comparing unknown spectra against spectral libraries**
- **Sub-pixel materials are known as endmembers**
- **A spectral endmember is the spectral signature for a pure surface**



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