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Proximal and remote sensing techniques for ecosystem monitoring

Remote and Proximal Sensing

To acquire information by remote on an object, or a physical phenomenon, without entering in contact with it

→ Main platforms: satellites, airplanes, drones. Cover from larger to smaller areasDrones can be considered proximal sensing.

→Platforms are equipped with sensors

→ Collection of information on natural vegetation, water, agriculture areas, land use and land cover changes, climate change impacts, biodiversity....

Remote Sensing Advantages

Passive Remote Sensing   Active Remote Sensing

RGB | Multispectral | Hyperspectral | Thermal | Chlorophyll-Fluorescence | 3D-Sensors

- **Data collection over large areas: possible to generalize local (field) information**

- **Data collection over time: possible to monitor changes in different years or months**

Type of sensors / data

Active sensors: they emit energy and record the power returning to the sensor after the interaction with the object (target)
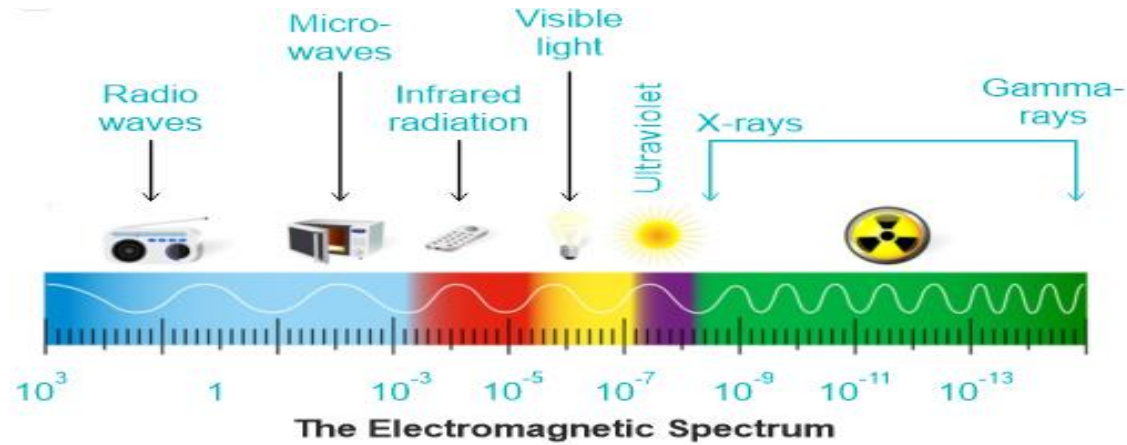e.g. SAR, LiDAR

Passive sensors: the energy is emitted by the sun (light, an electromagnetic wave) and the sensor records the energy (light or thermal) returning to the sensor after the interactions with the object (target)
e.g. MULTI AND HYPERSPECTRAL
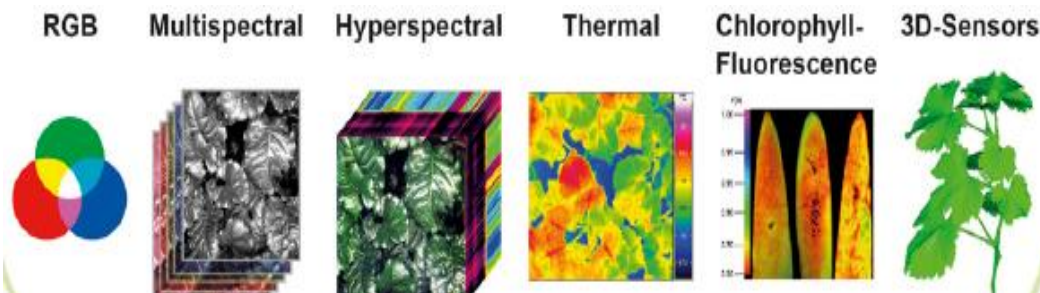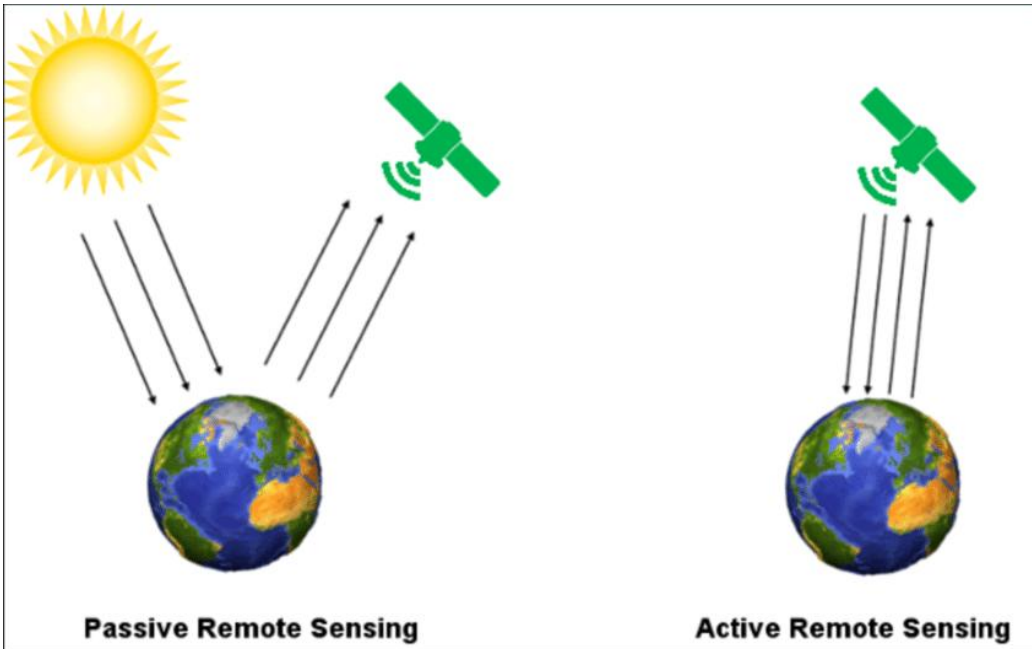
Light is electromagnetic energy

The Electromagnetic Spectrum

- **The sensor records the energy returning from the object in different regions (bands)**

- **Bands are stored as a multidimensional matrix (quantity of energy)**

- **The visualization of different bands on a screen allows to highlight features**

- **The amount of returned energy allows for quantitative ecology analyses**
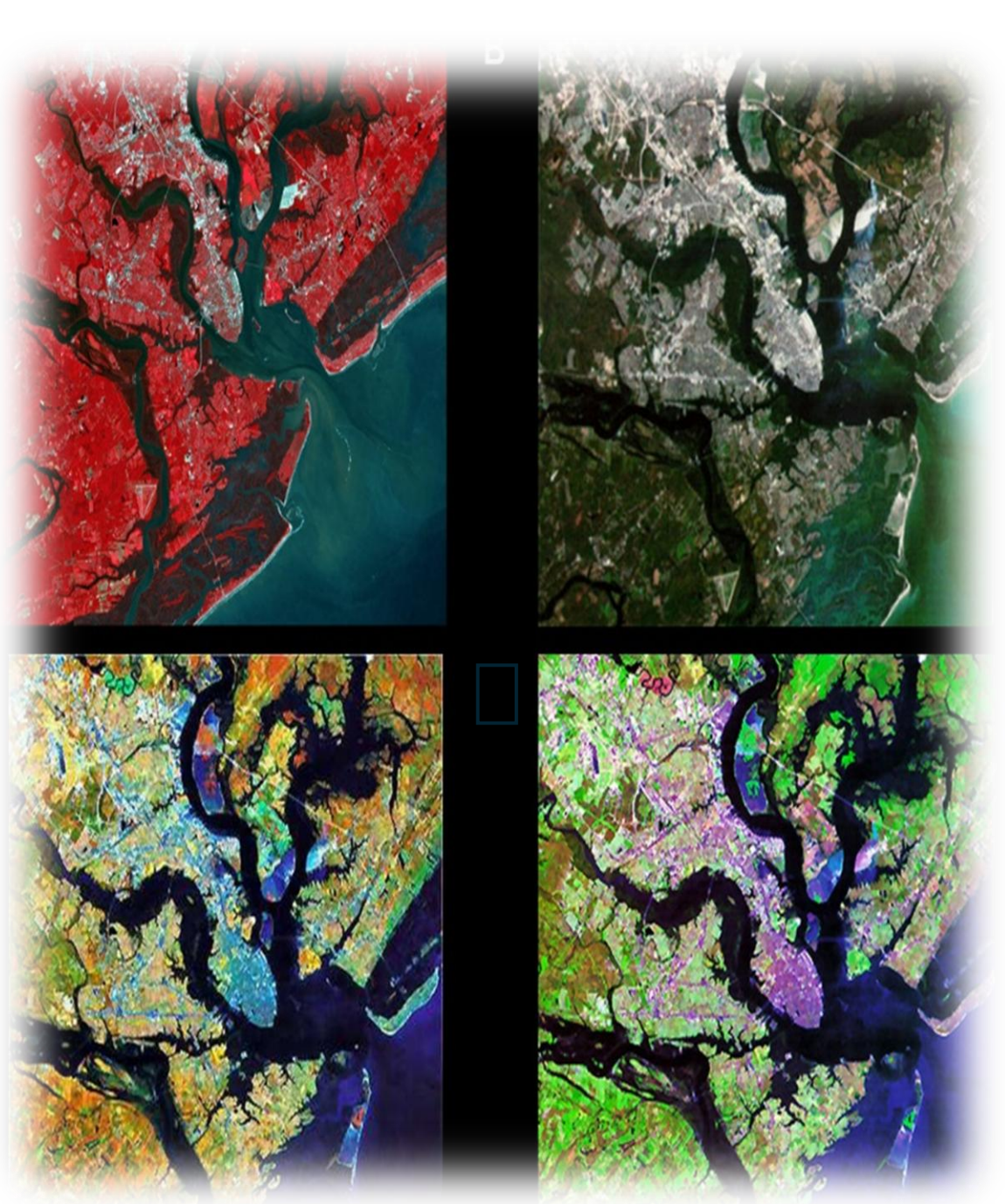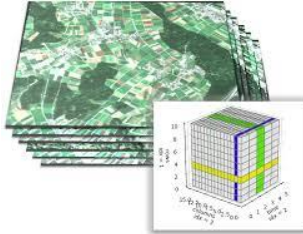
Acquatic ecosystems monitoring

Estuaries

Inside and around a water body. Including inland, transitional, coastal surface waters, and also groundwaters. Many types of acquatic ecosystems
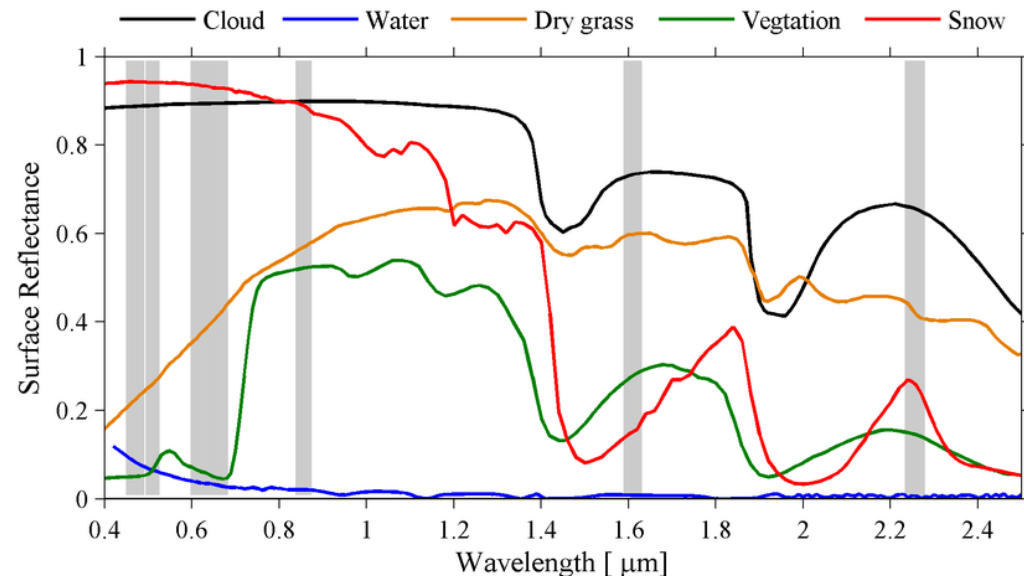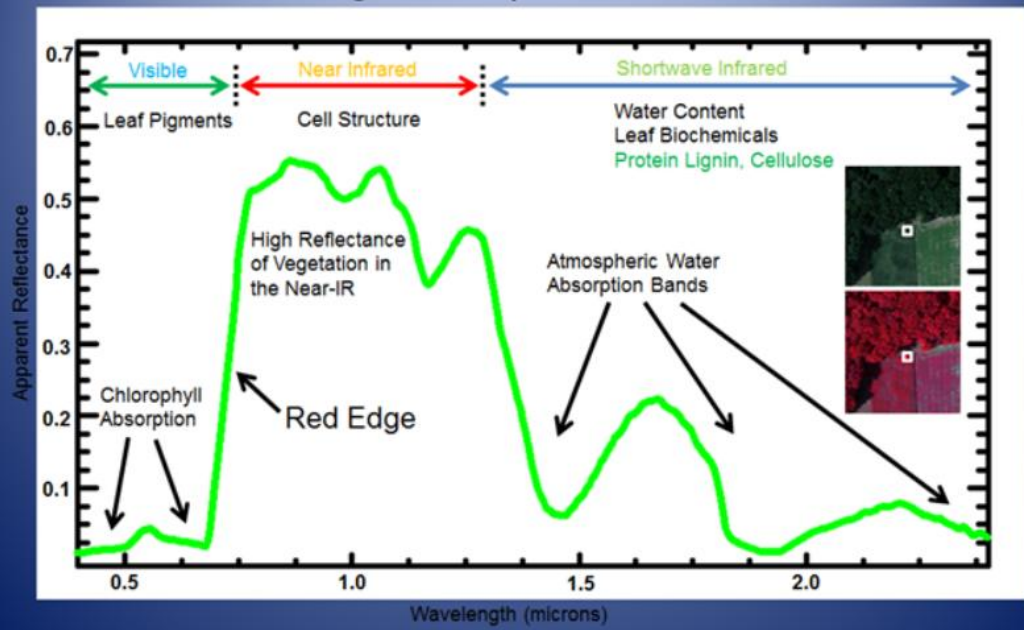
Lakes

Wetlands

Remote/proximal sensing supports monitoring ecosystem vegetation, single species, water quality, or ecosystem changes in time due to anthropic and climate issues
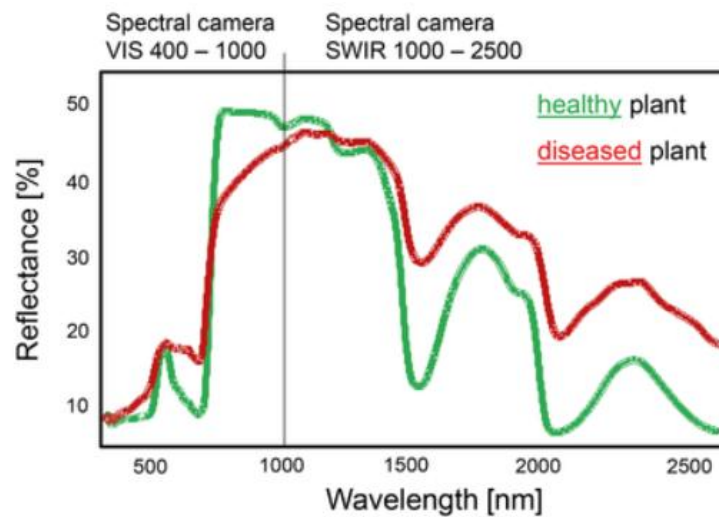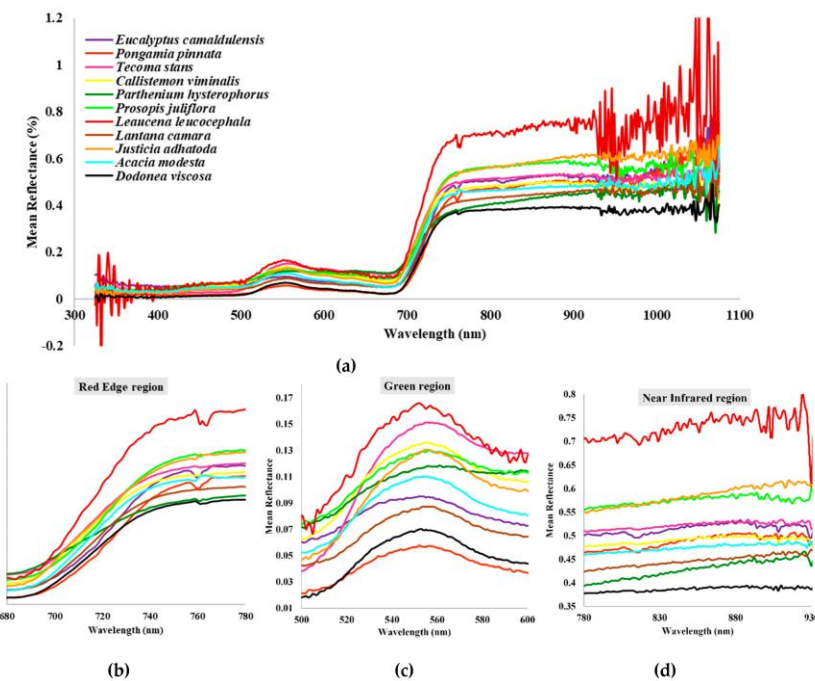

Each surface has a specific spectral behaviour

This helps to distinguish communities, species, health status, sediments, alien species.....and more!
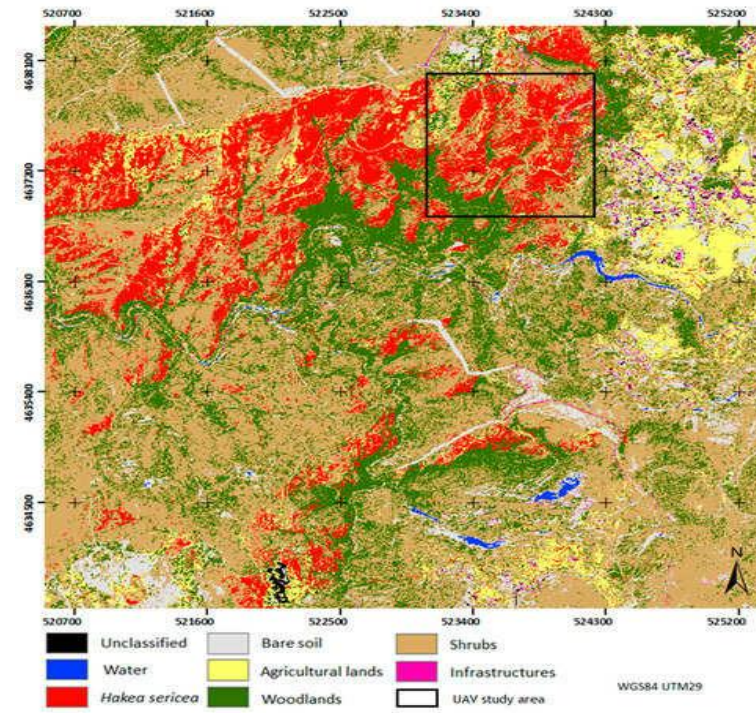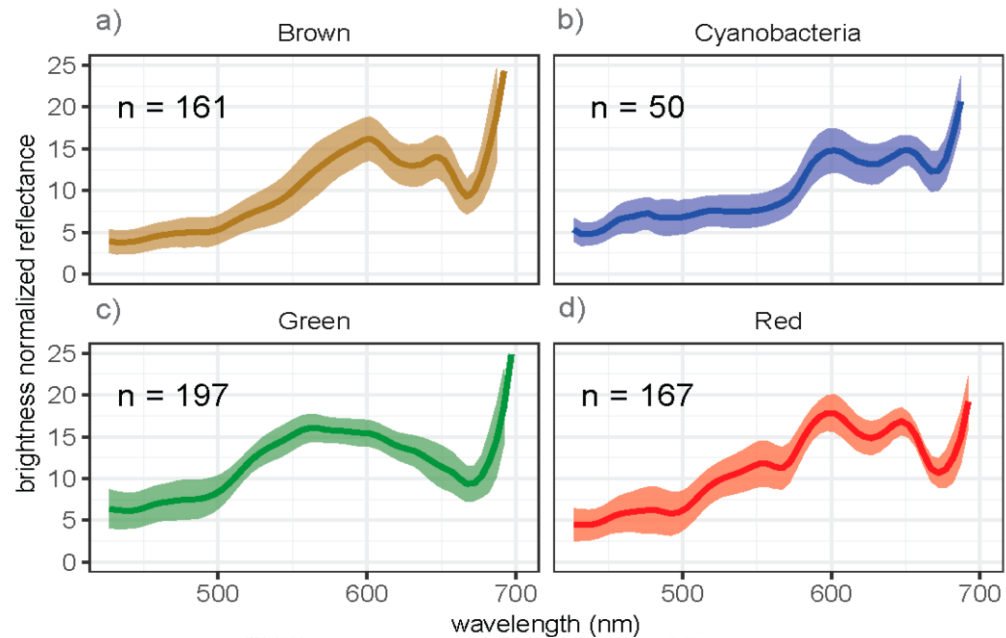
The Vegetation Spectrum in Detail

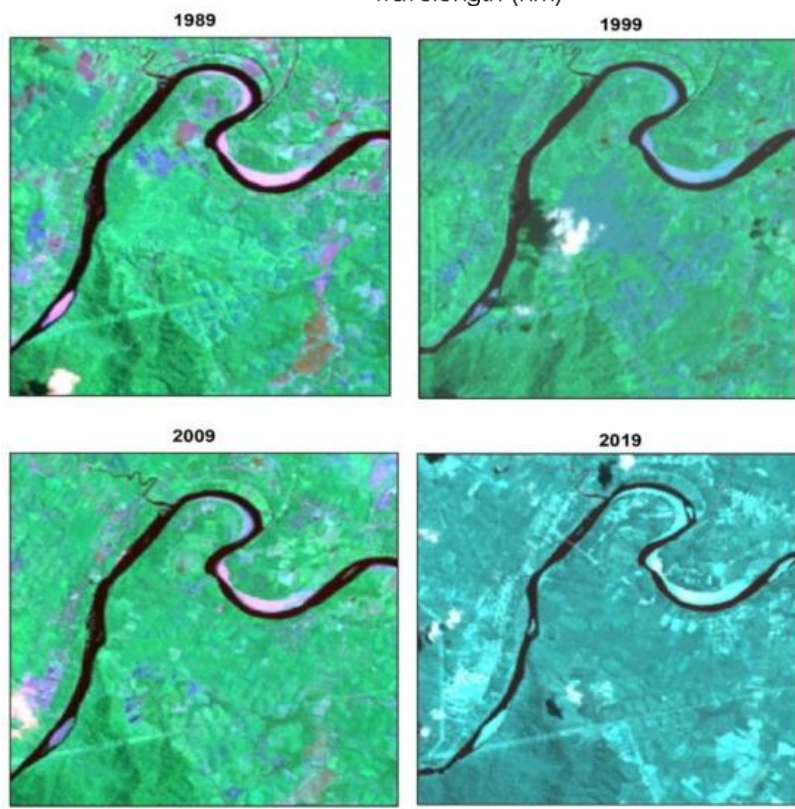*Single species detection based on different spectral behaviours*

Changes in spectral behaviour between healthy and disease vegetation

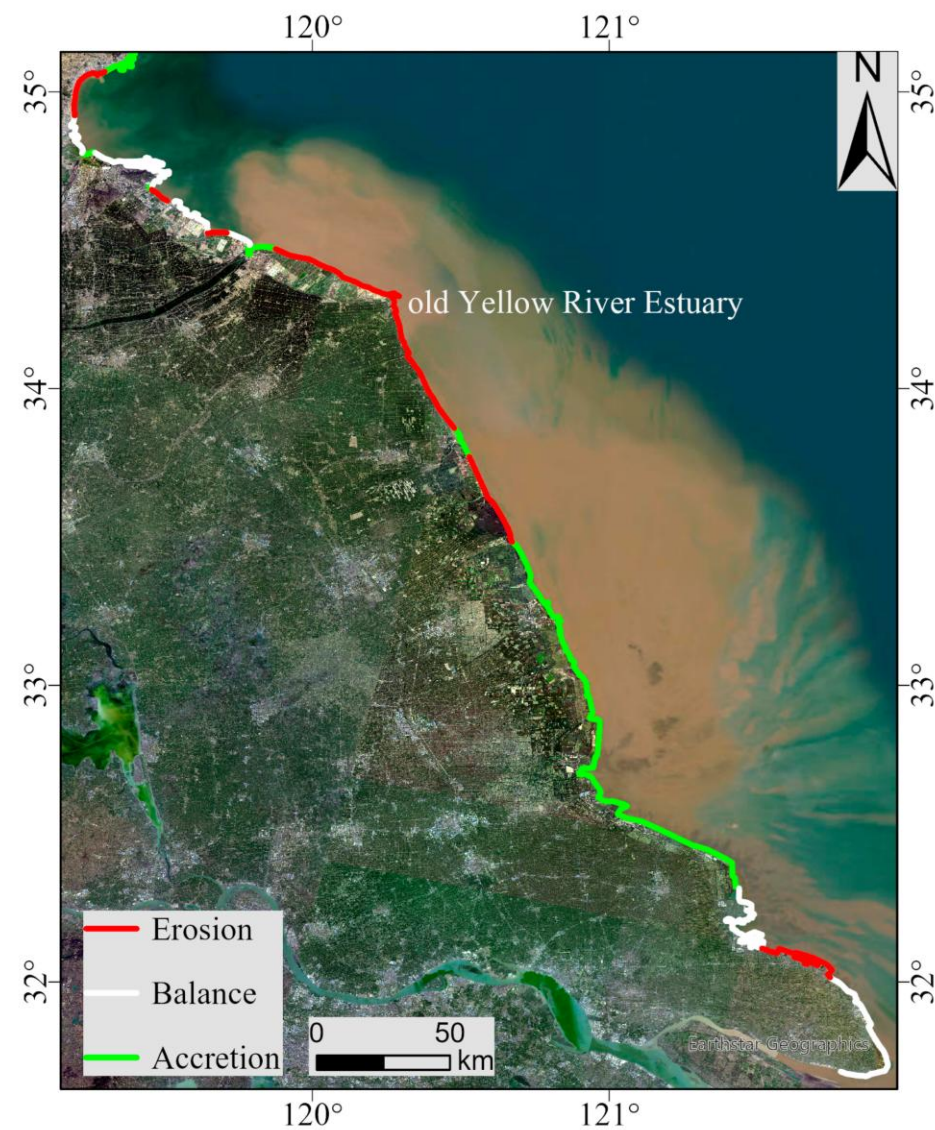*Invasive species mapping (Hakea sericea, Portugal)*

Different spectral signatures of marine algae

Sedimentation assessment in Malaysia

Coastal erosion and suspended sediment monitoring

Take home message

→ Proximal and remote sensing are powerful tools to monitor acquatic ecosystems and their changes

→ Multiple sensors, data, and techniques are now available. Expertise is required to select best option for each study case

→ Nature based solution shall include a monitoring components

→ Climate change is imposing frequent monitoring to establish mitigation measures

→ Biodiversity loss (genetic, species, ecosystes) requires monitoring and it is especially high in acquatic ecosystems

→ Anthropogenic pressure and derived land and water changes also requires monitoring

The CNR IRET institute is glad to consider scientific collaborations in the application of proximal and remote sensing to monitoring acquatic ecosystems. Thank you!