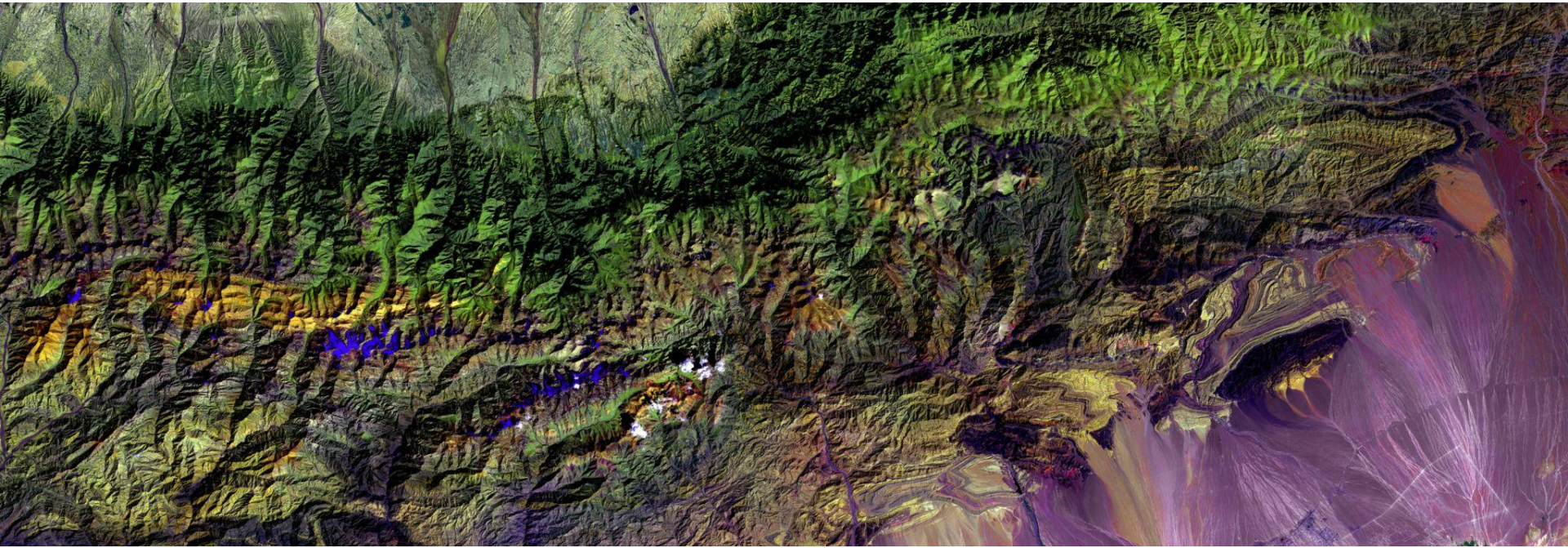
EDS 223: Geospatial Analysis & Remote Sensing
Week 8

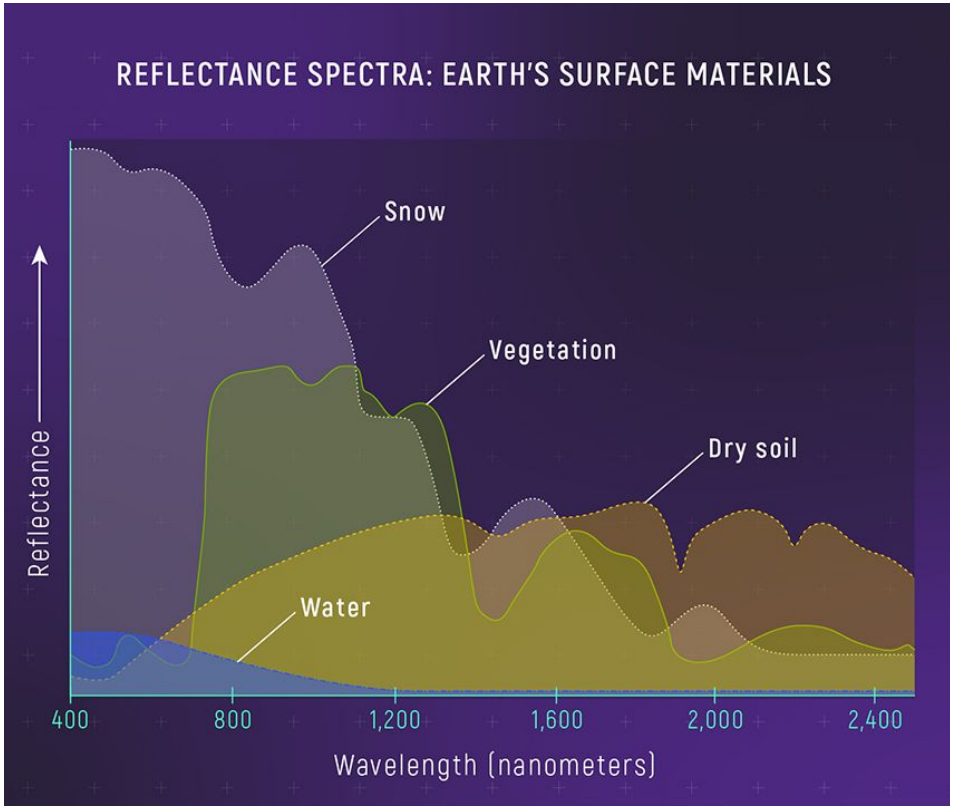


USGS via Unsplash

Welcome!

- **Remote sensing of vegetation**
  - Leaf
  - Canopy
  - Landscape
    - Vegetation indices
- **Investigating plant phenology in Southern CA**

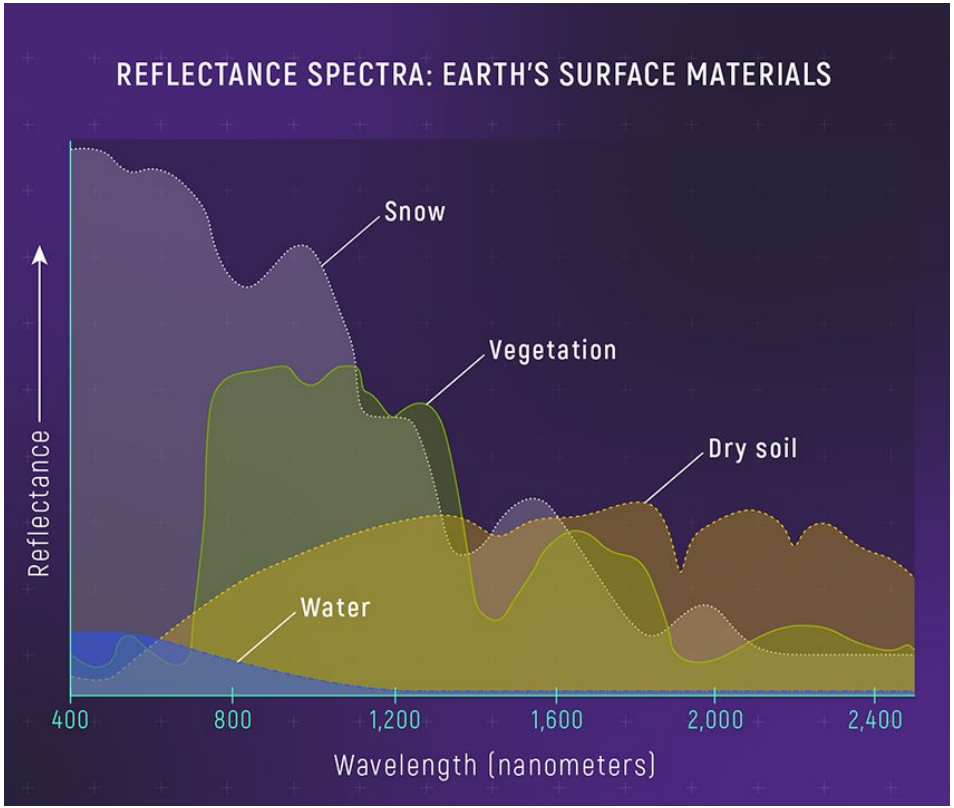
Remote sensing of vegetation



Source: NASA, Leah Hustak

Remote sensing of vegetation

Why does the reflectance spectra for vegetation look like this?



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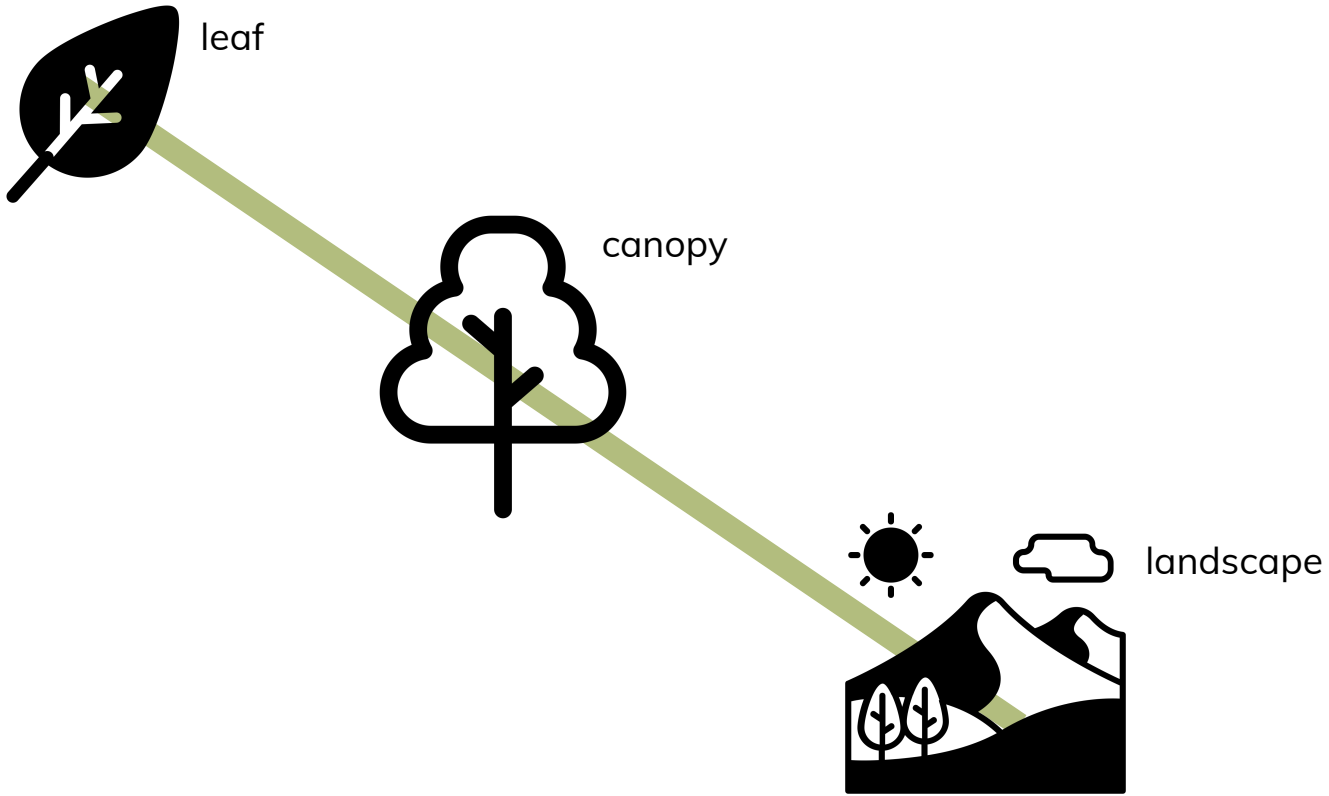
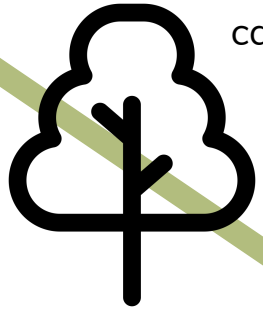
Remote sensing of vegetation



Remote sensing of vegetation

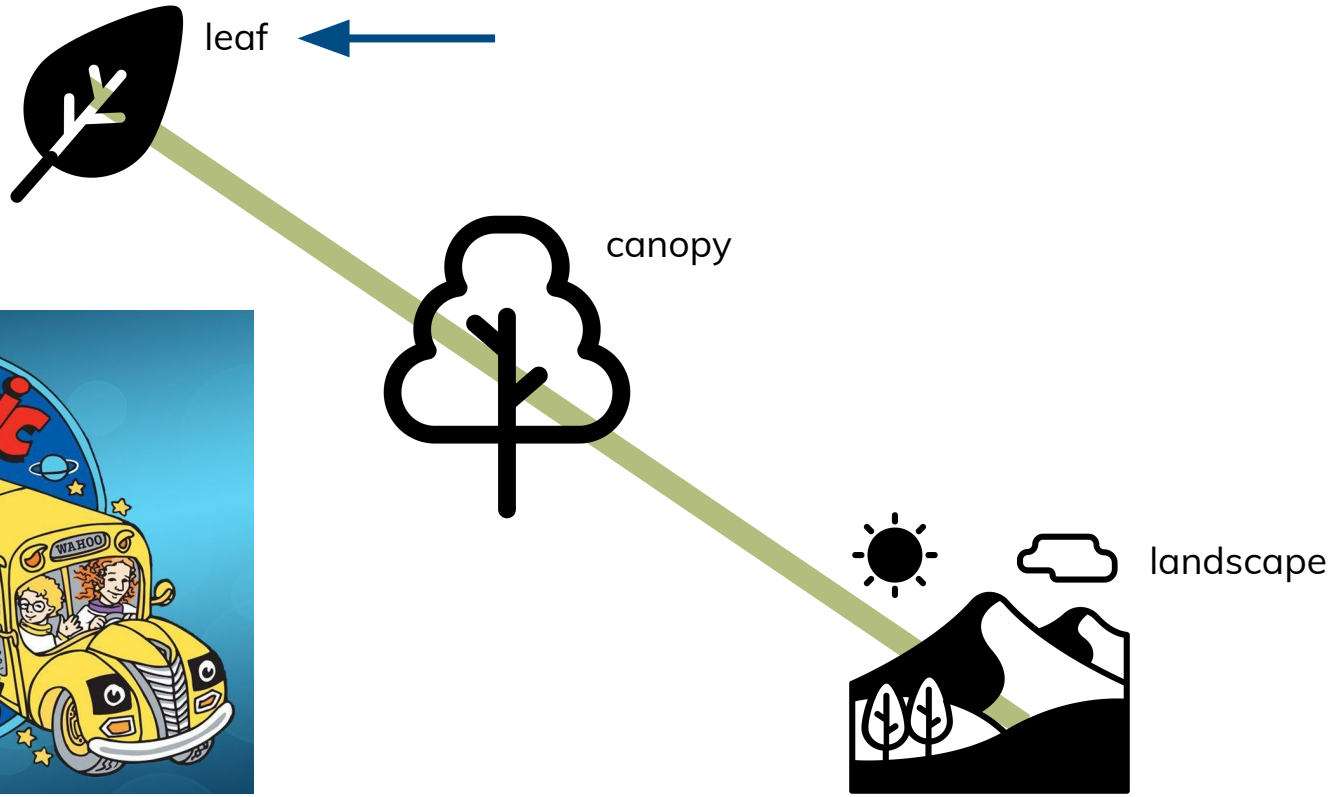
leaf



canopy

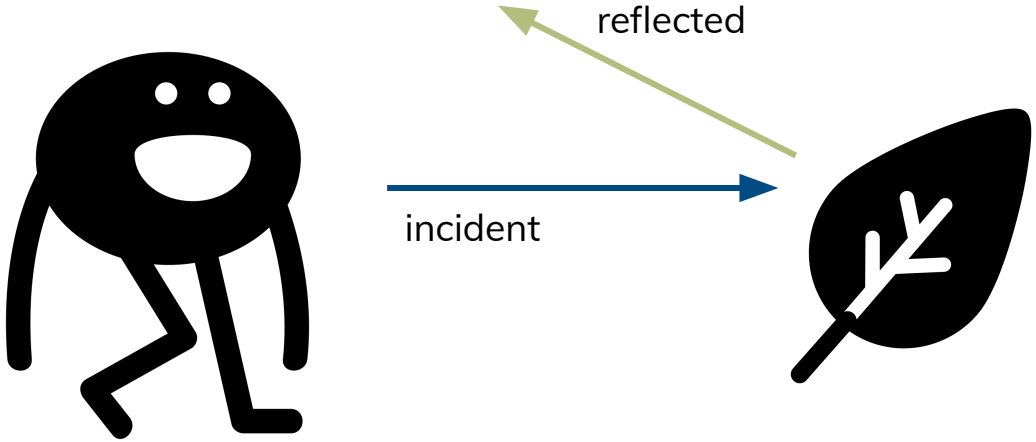
landscape

Remote sensing of vegetation



A photon’s journey

A photon’s journey



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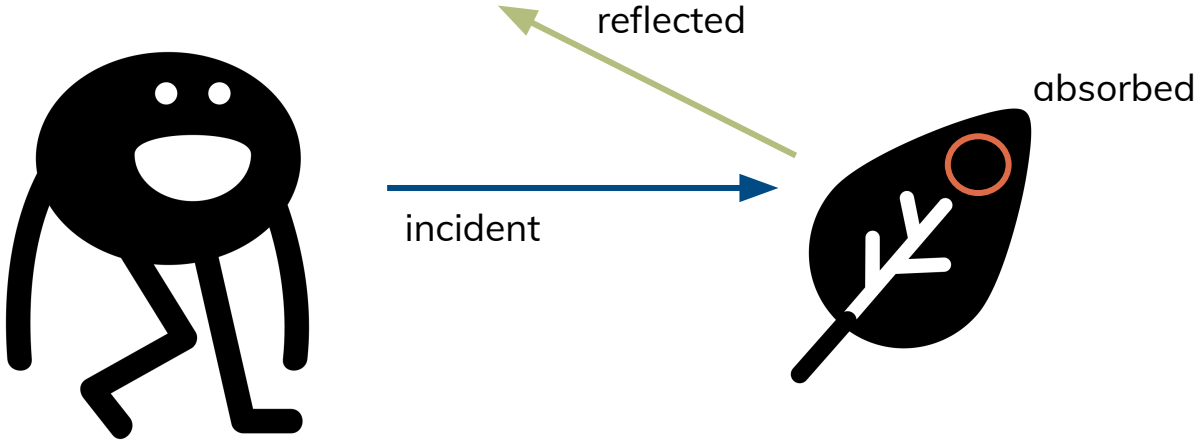

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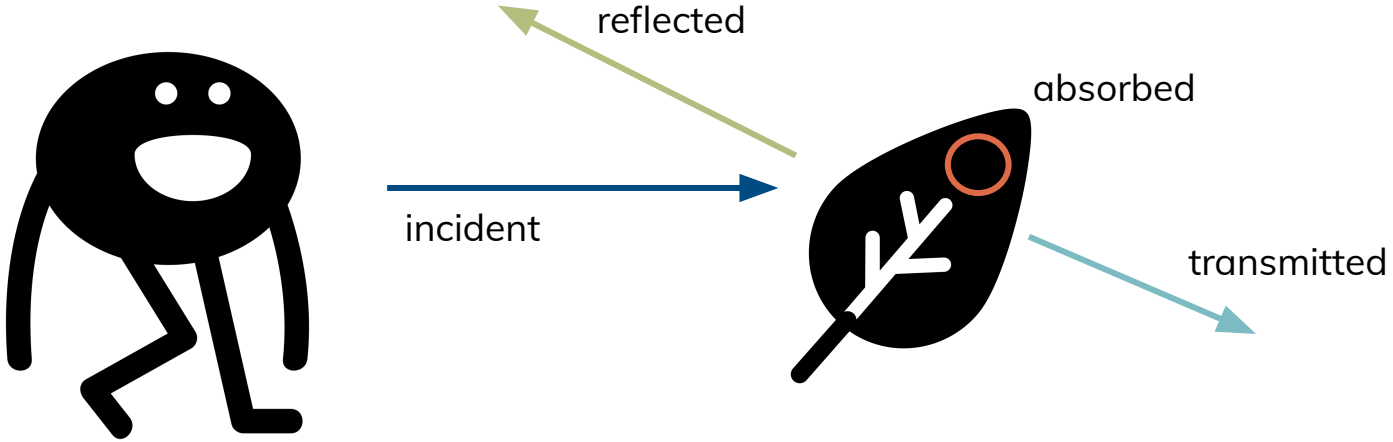
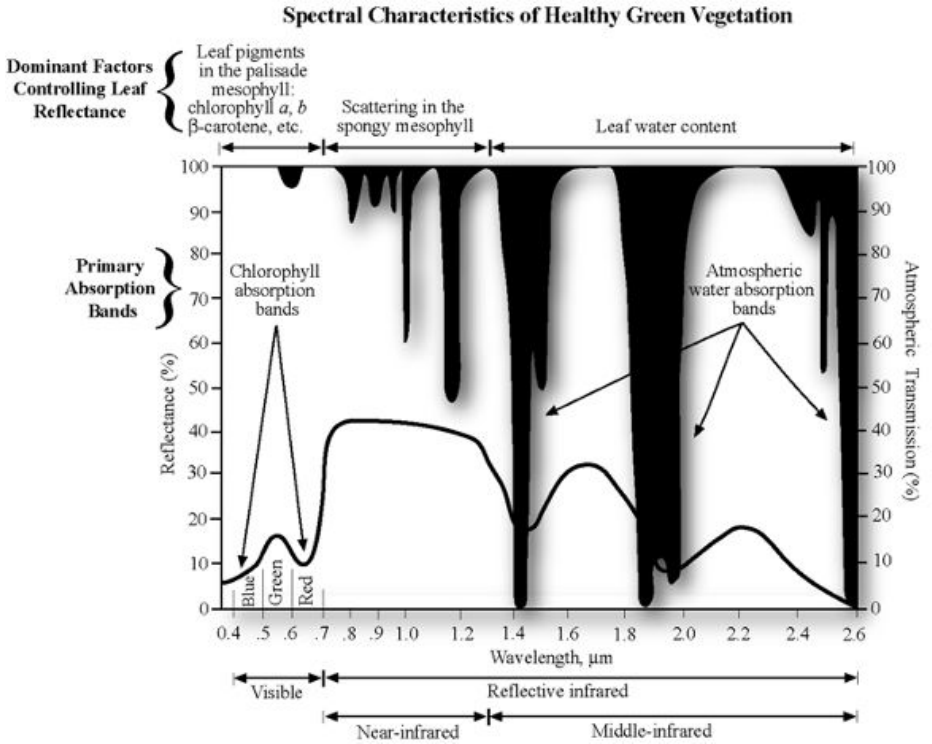
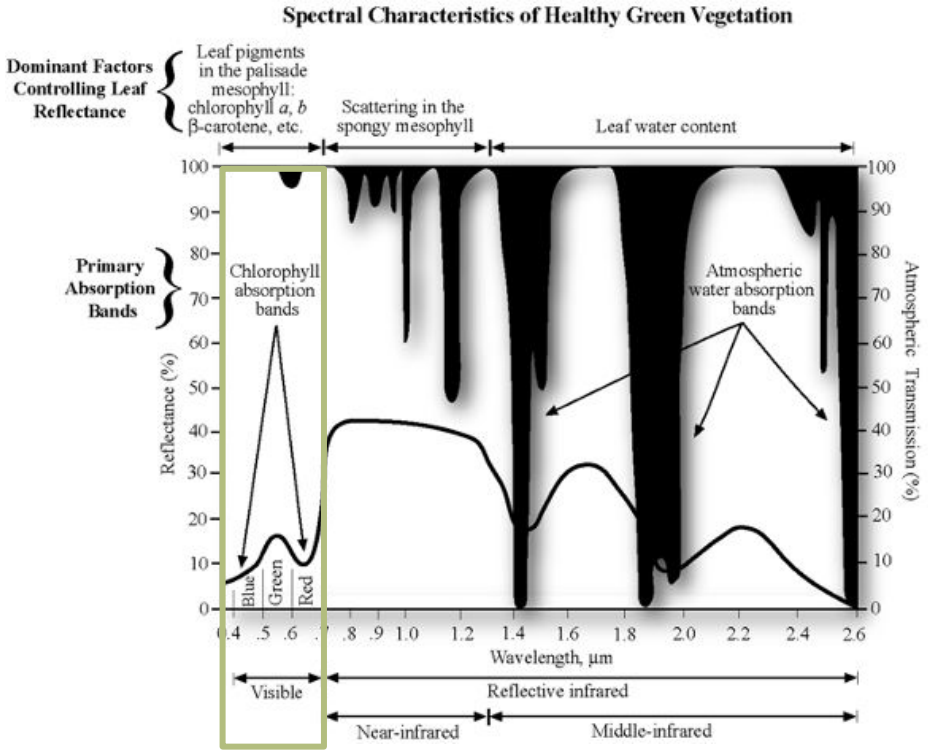


Factors controlling leaf reflectance



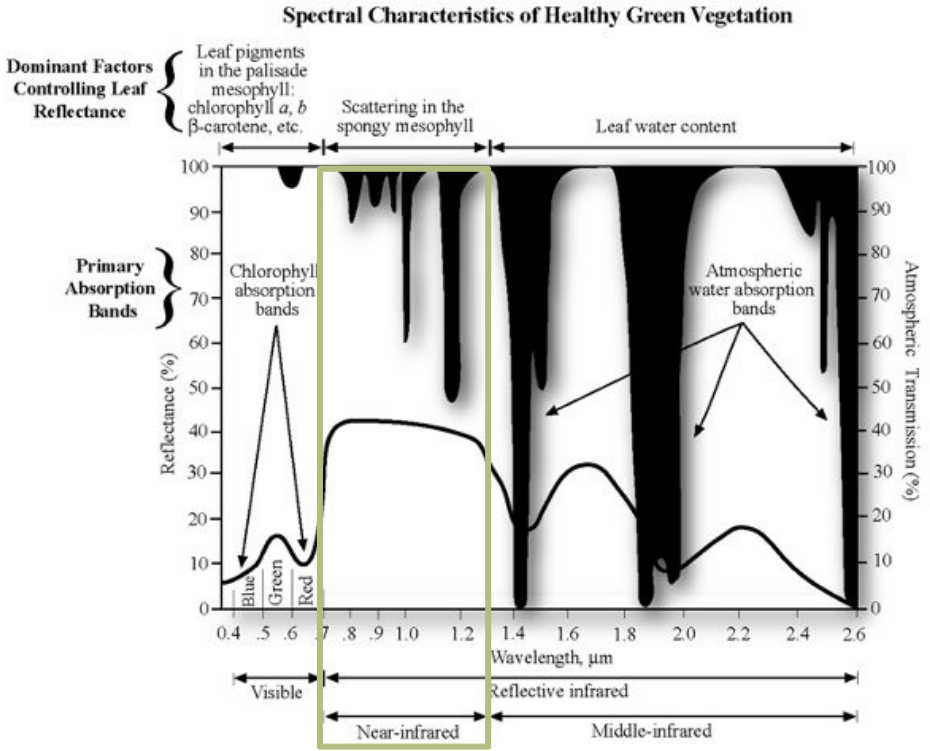
Source: Jensen 2007

Factors controlling leaf reflectance



Source: Jensen 2007

Factors controlling leaf reflectance



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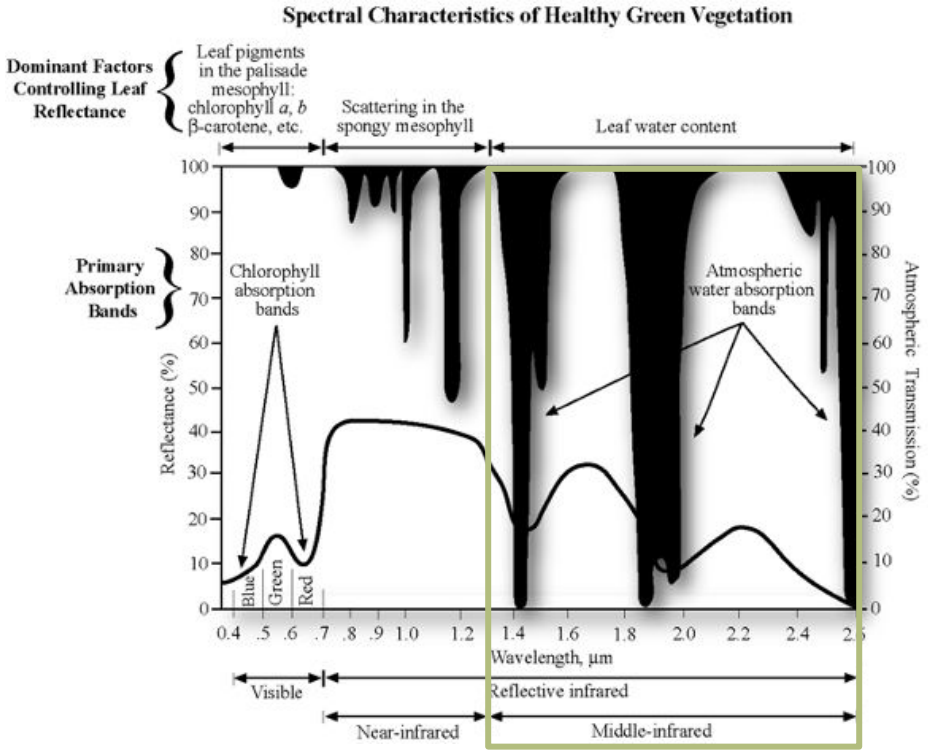
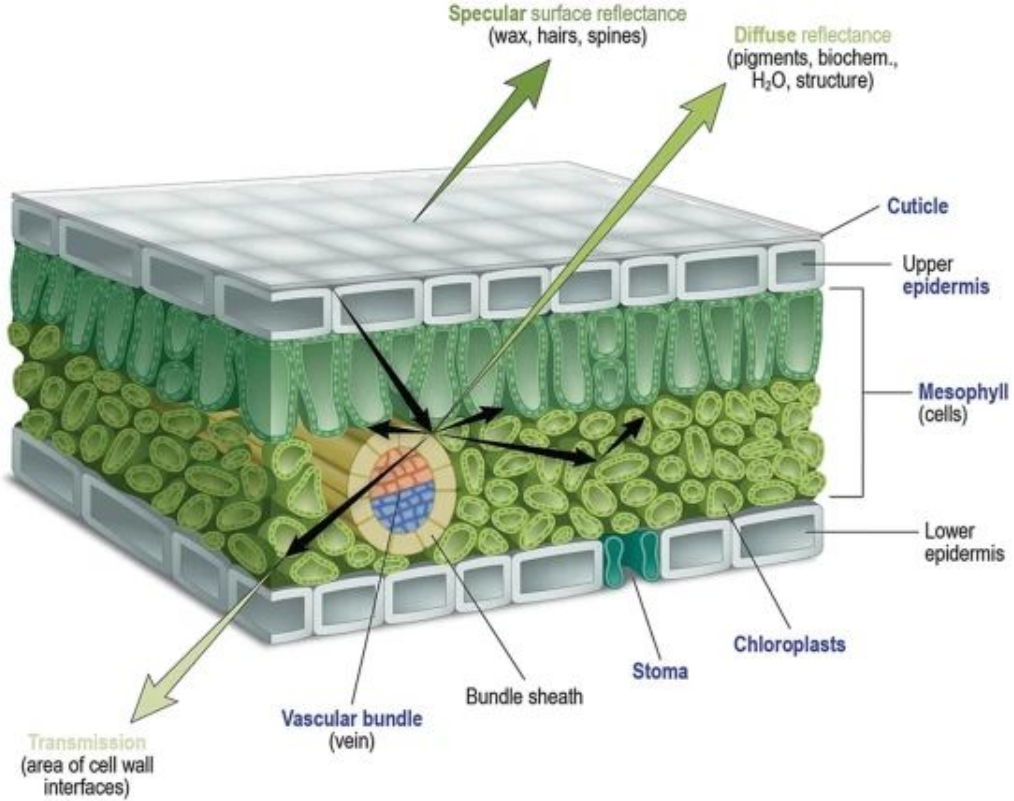


Source: Jensen 2007

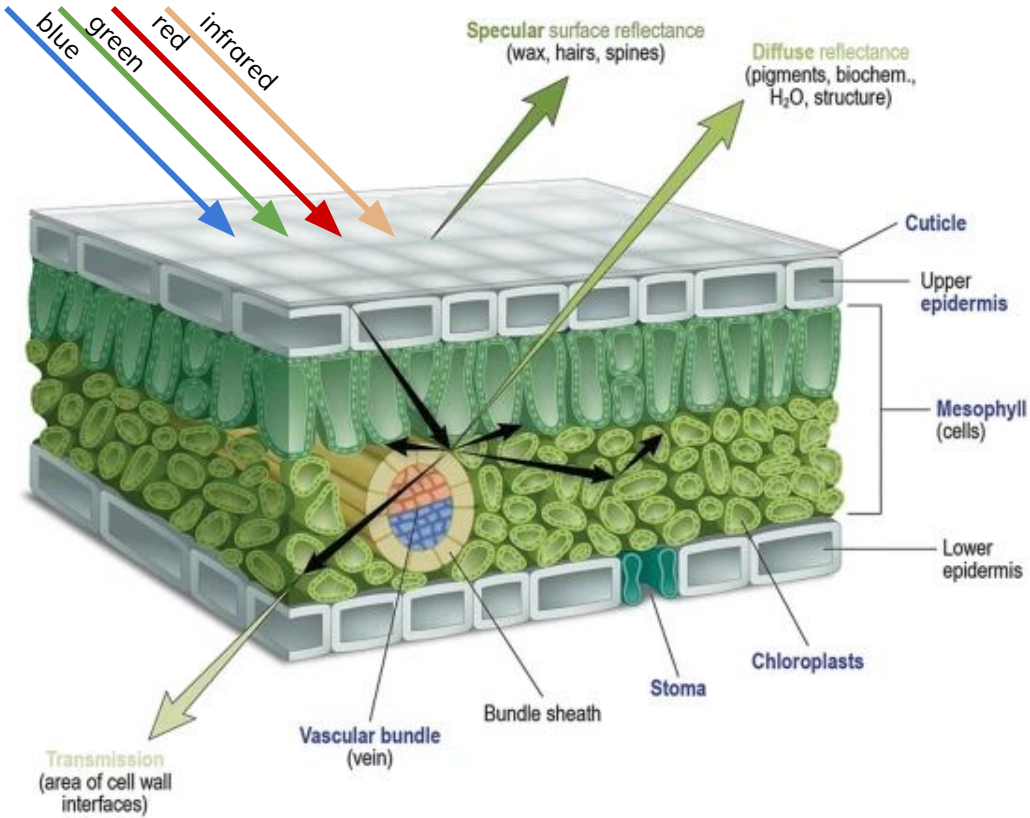
Interaction of light with leaf structure

More complex leaves:
- More internal scattering
- Lower transmission
- More diffuse scattering



Source: Serbin and Townsend 2020

Interaction of light with leaf structure



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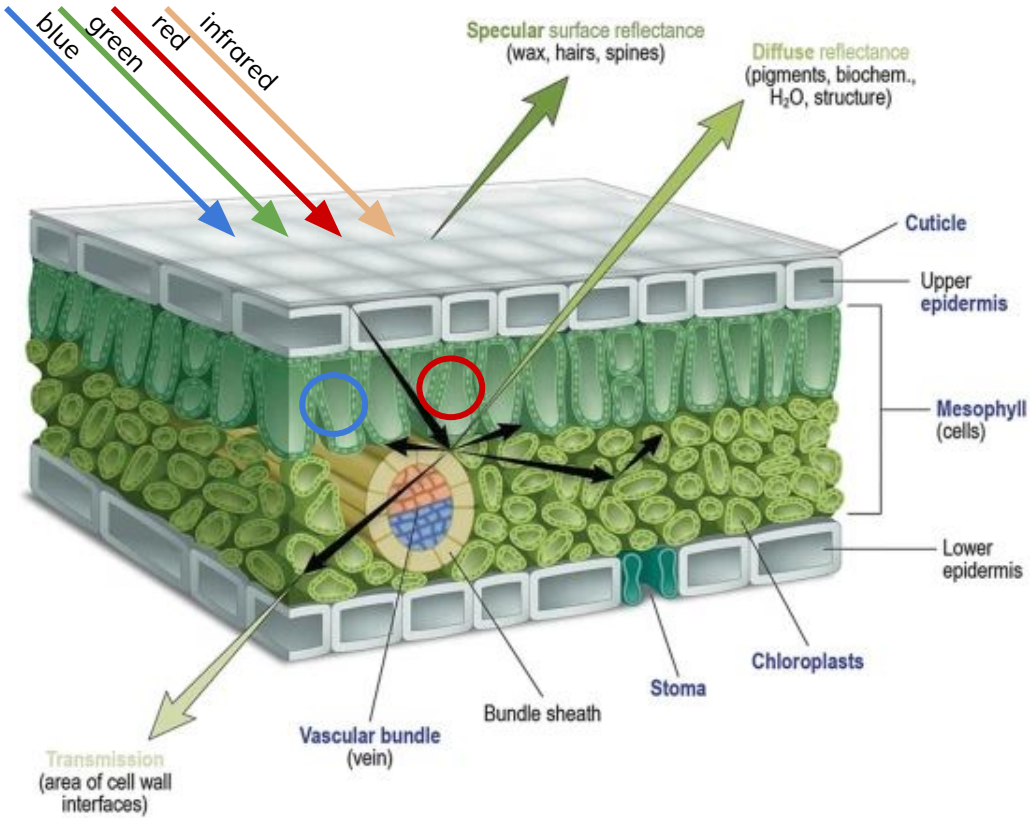
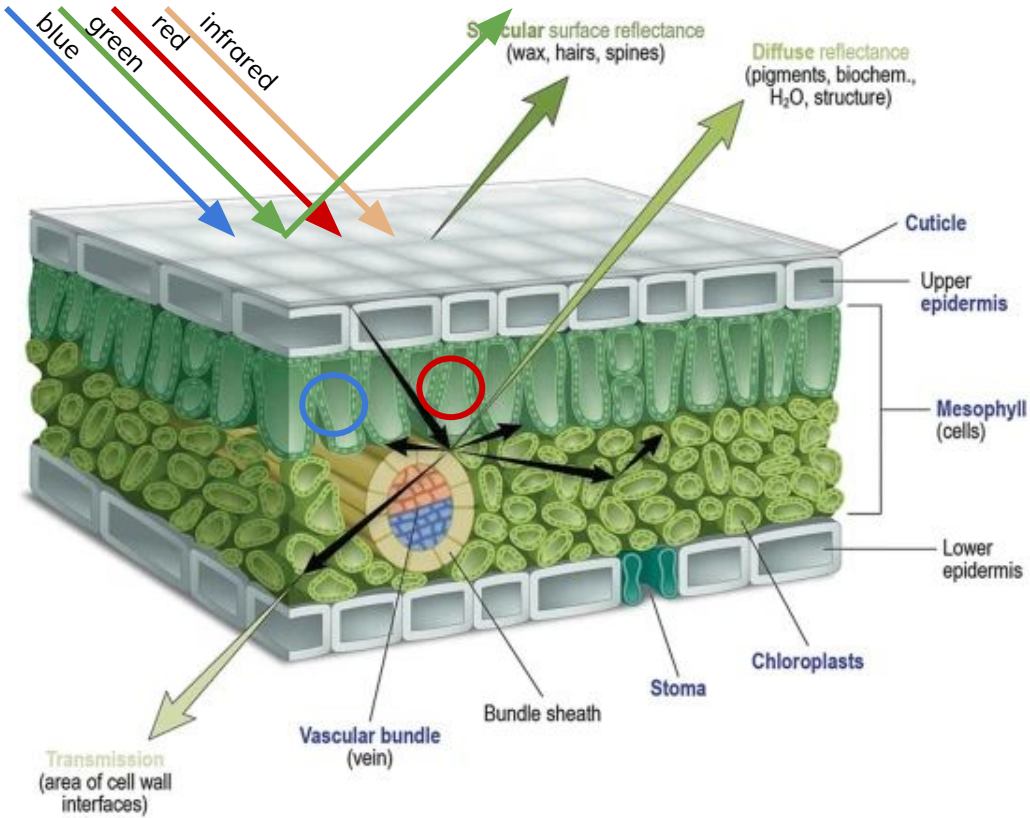
Interaction of light with leaf structure



Source: Serbin and Townsend 2020

Interaction of light with leaf structure



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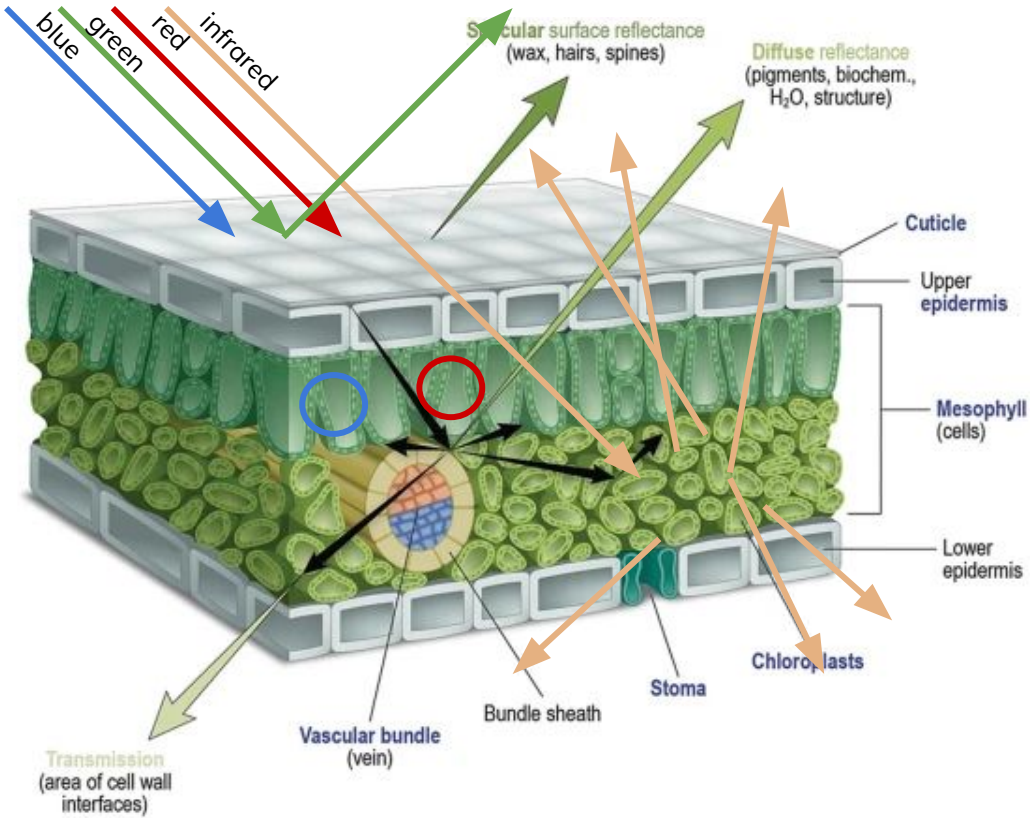
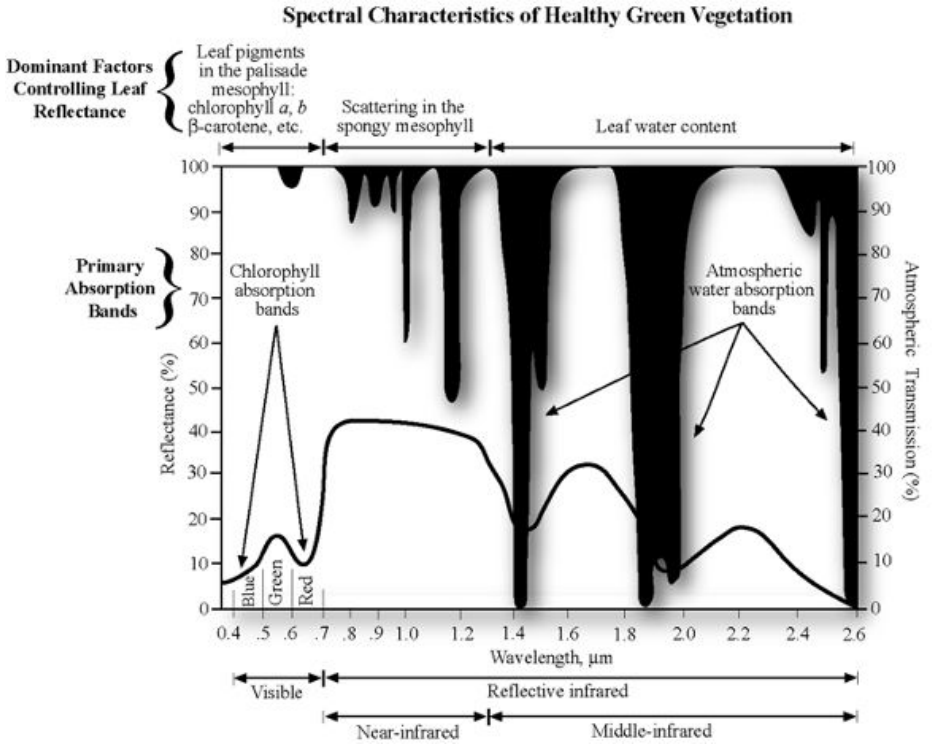


Source: Serbin and Townsend 2020

Factors controlling leaf reflectance



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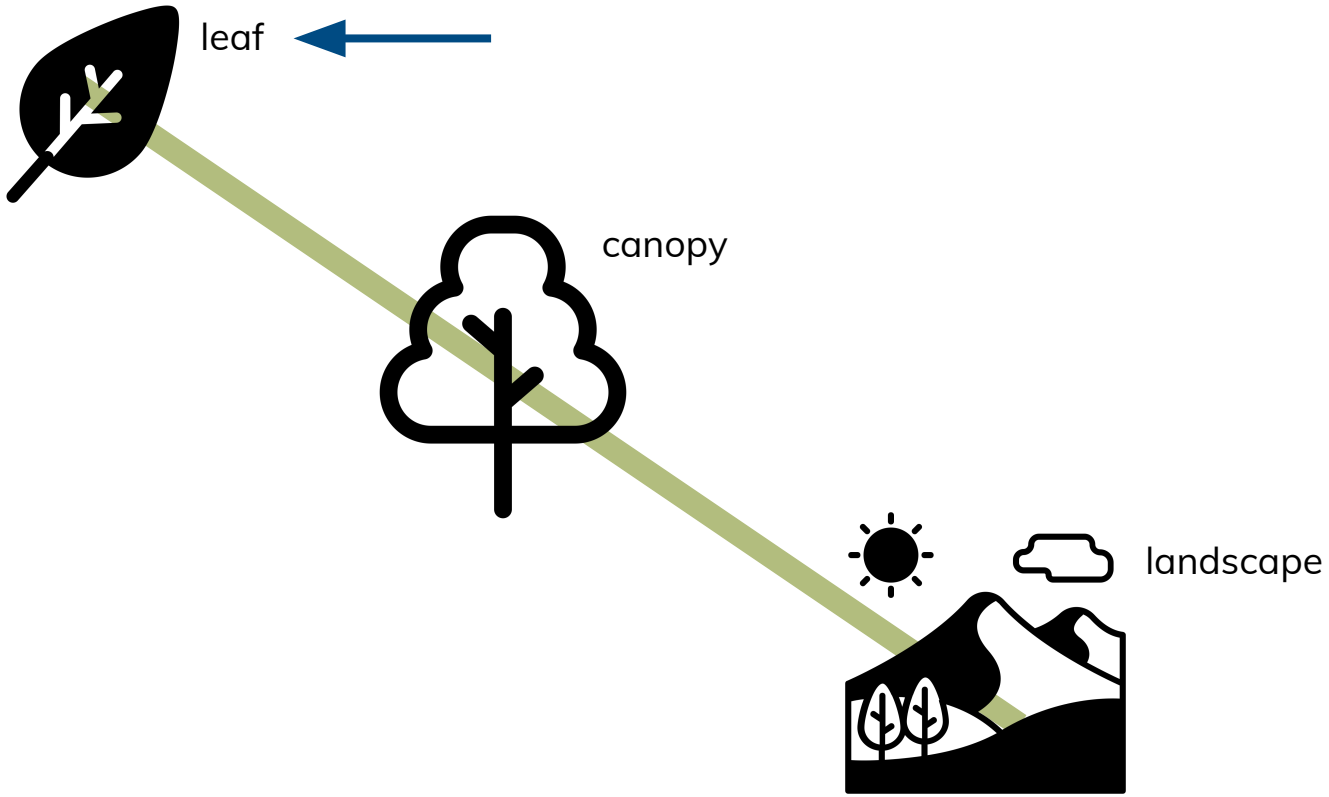
Remote sensing of vegetation



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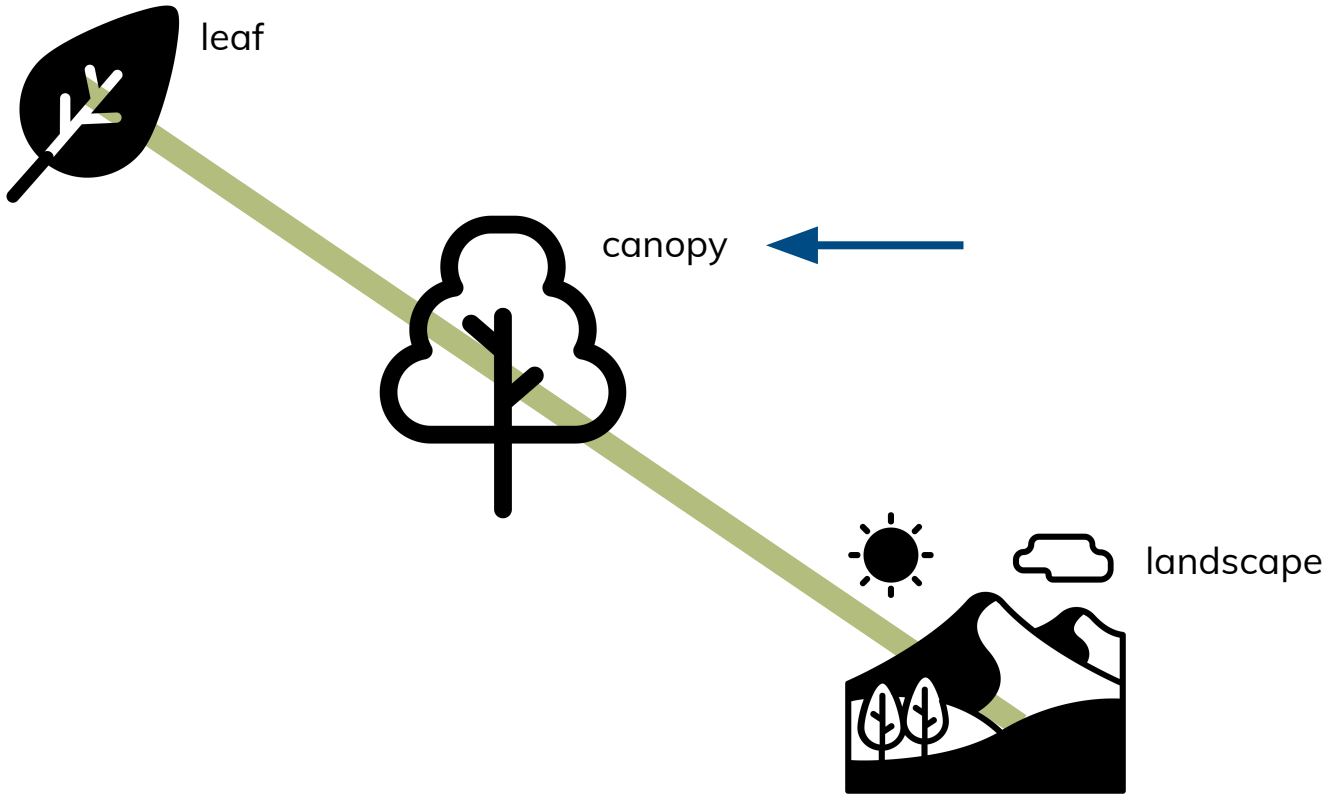
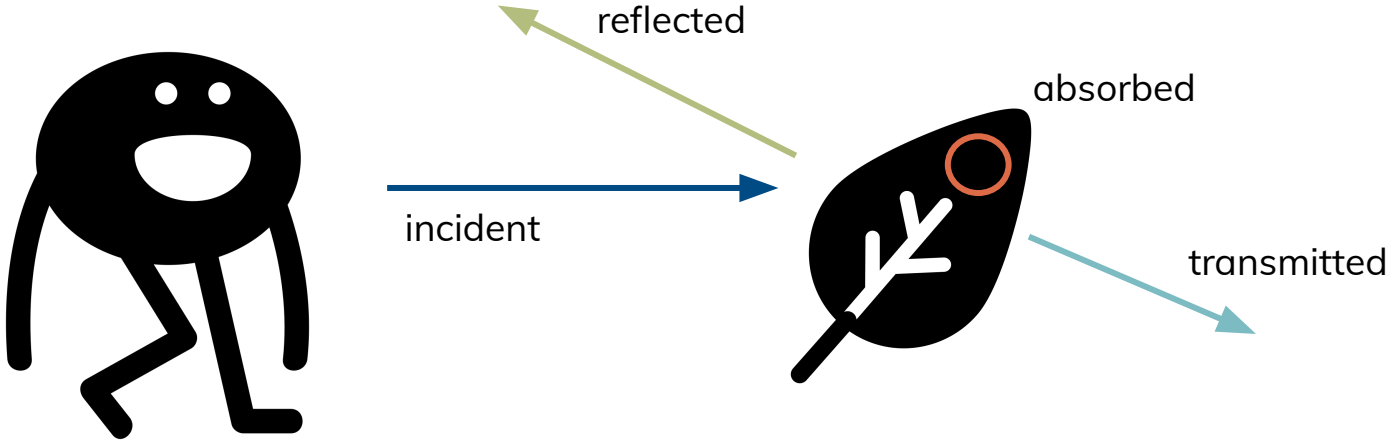
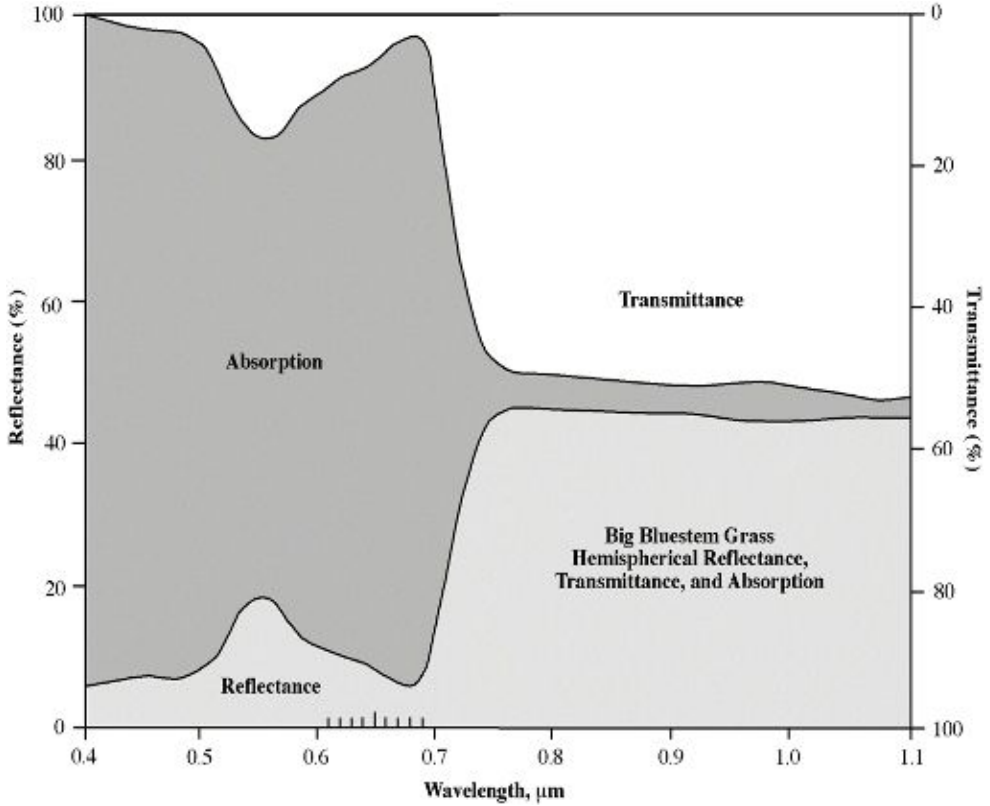
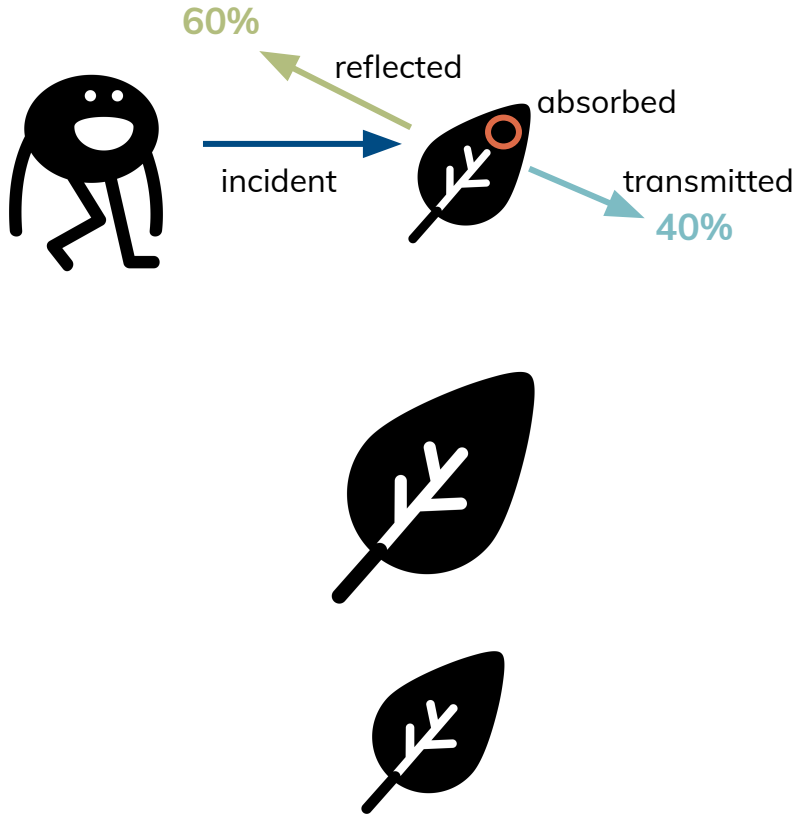


A photon's journey



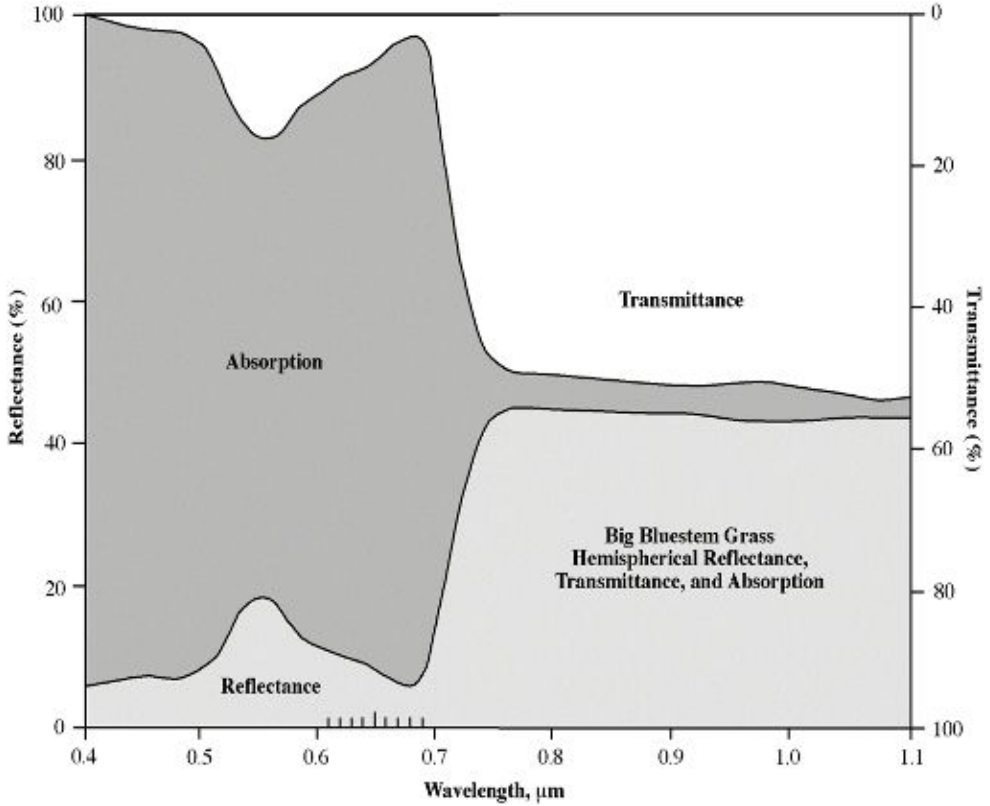
Spectral properties of vegetation

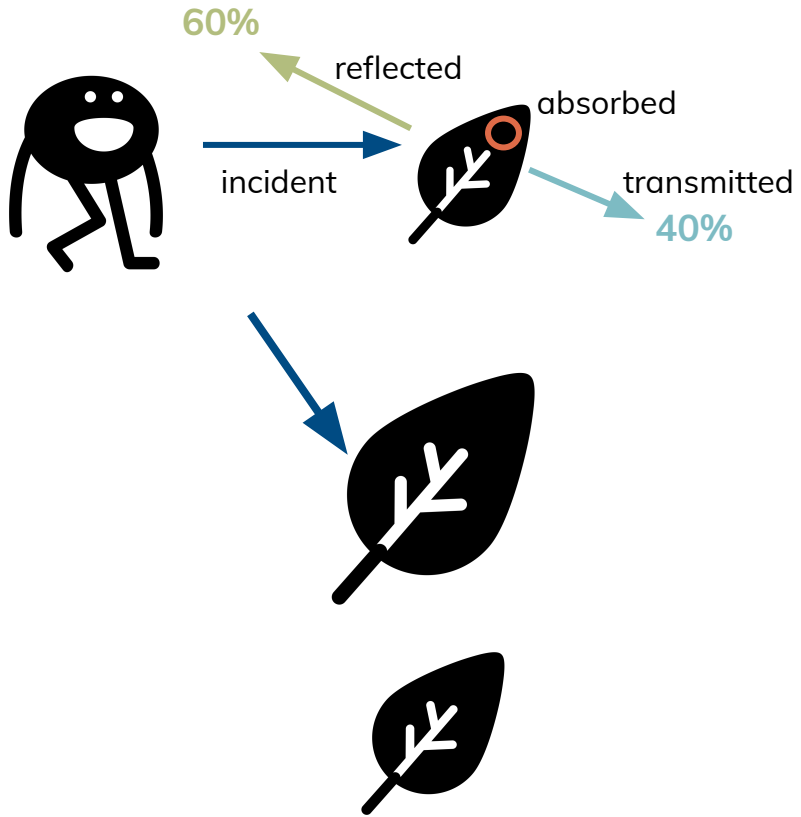




Source: Jensen 2007

Spectral properties of vegetation





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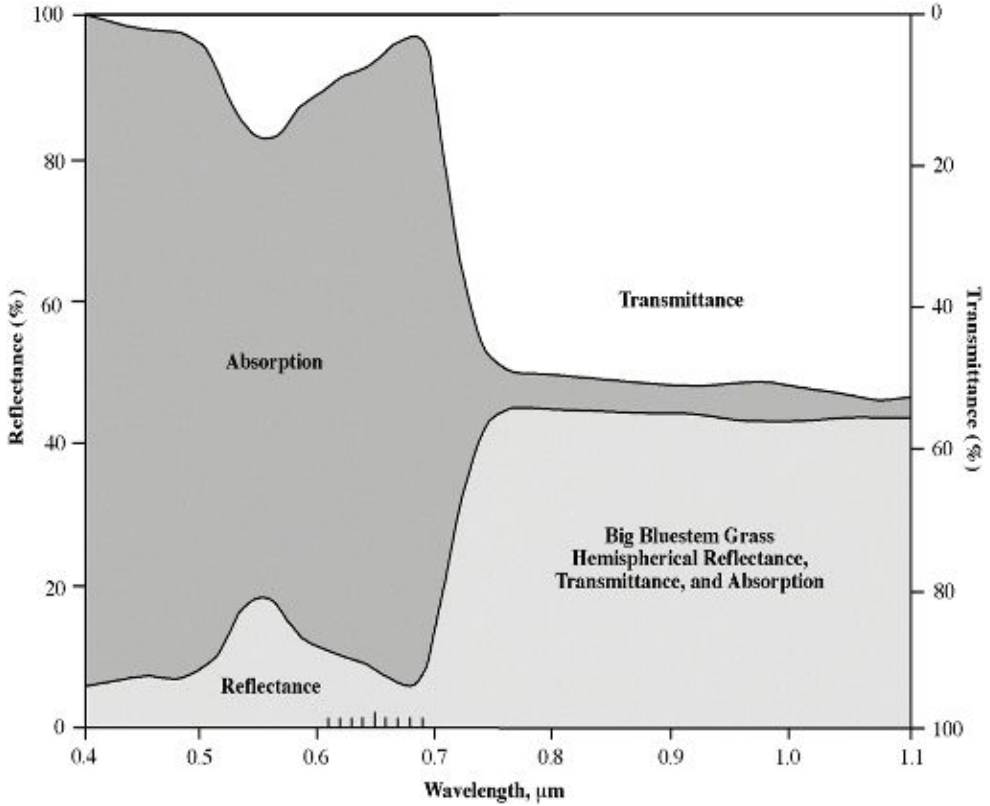

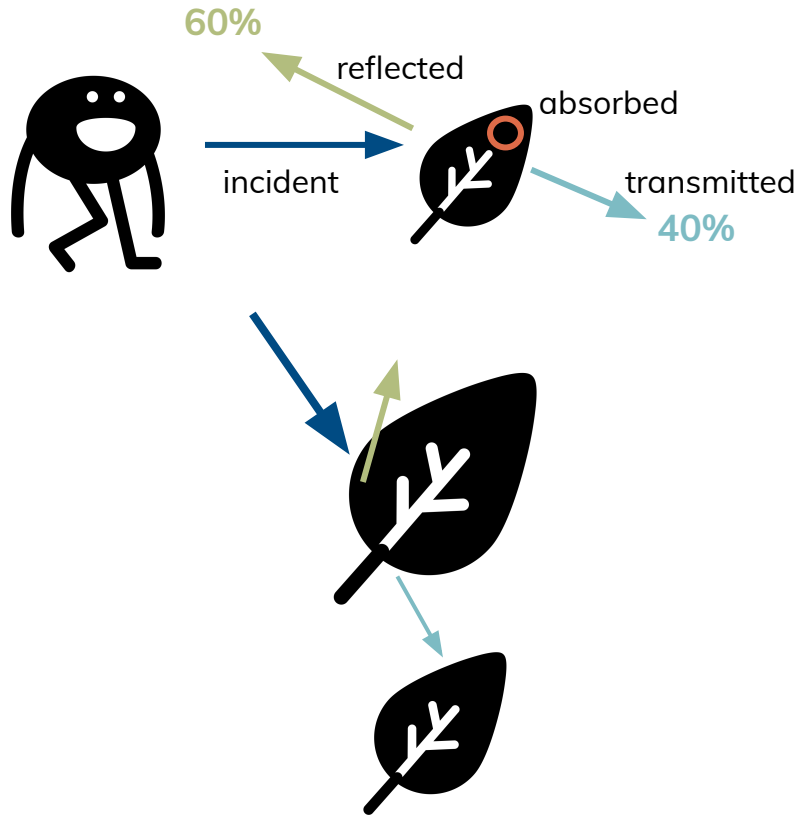

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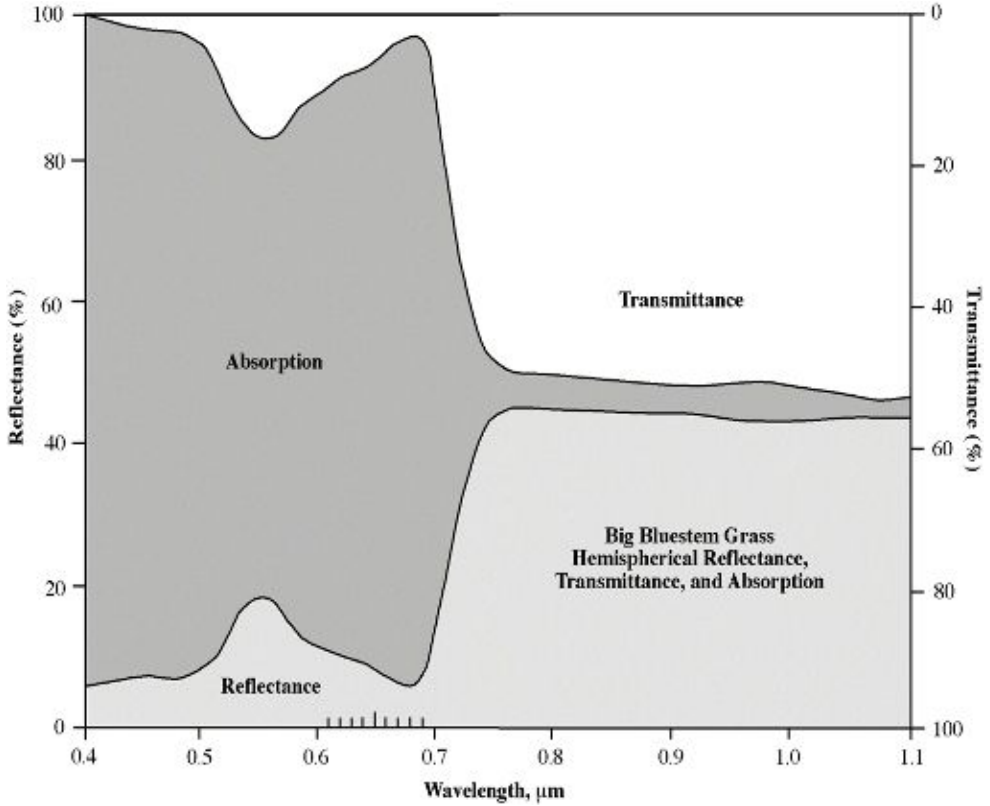

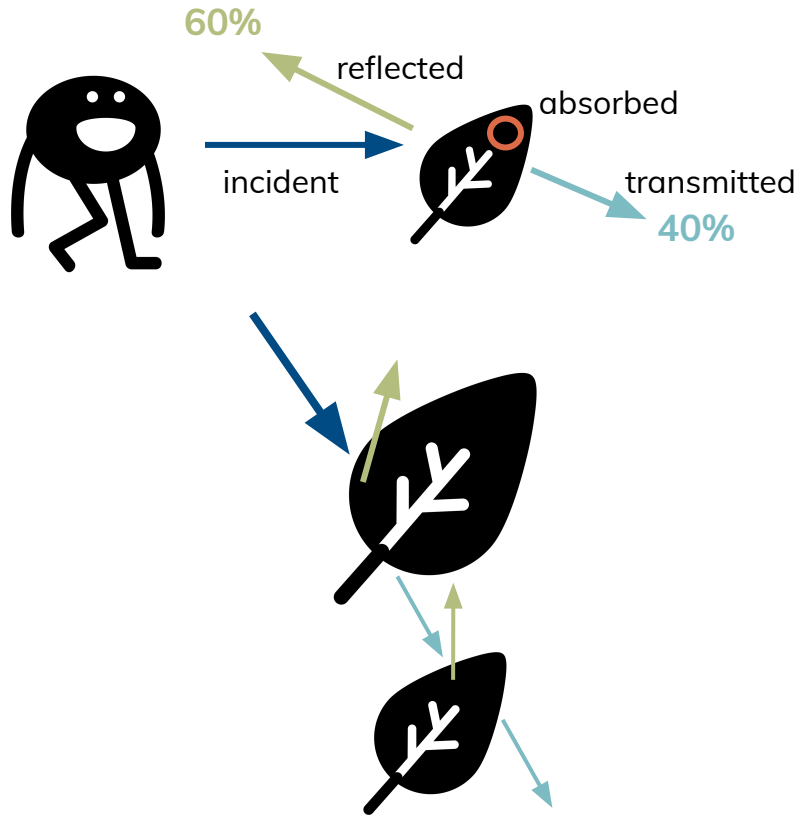

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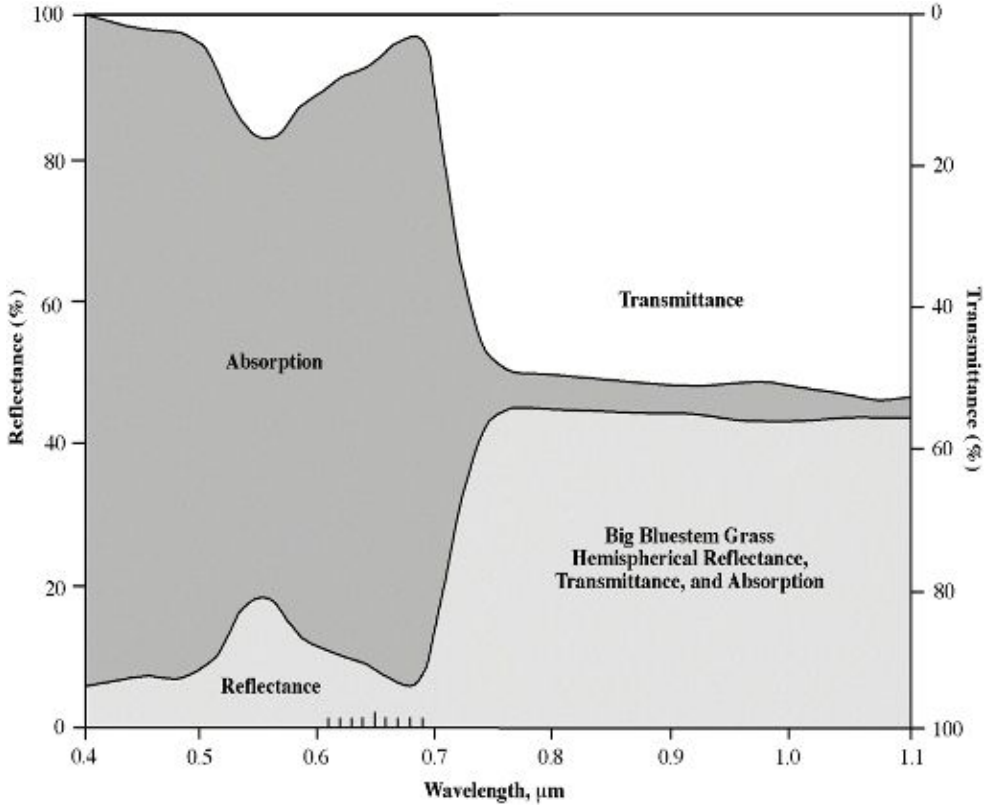
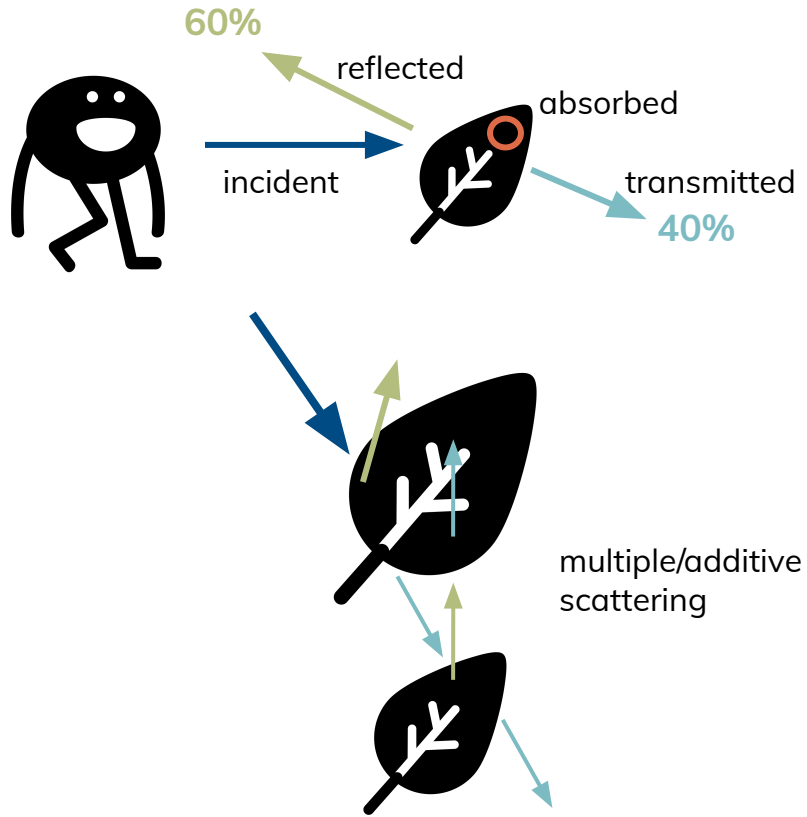
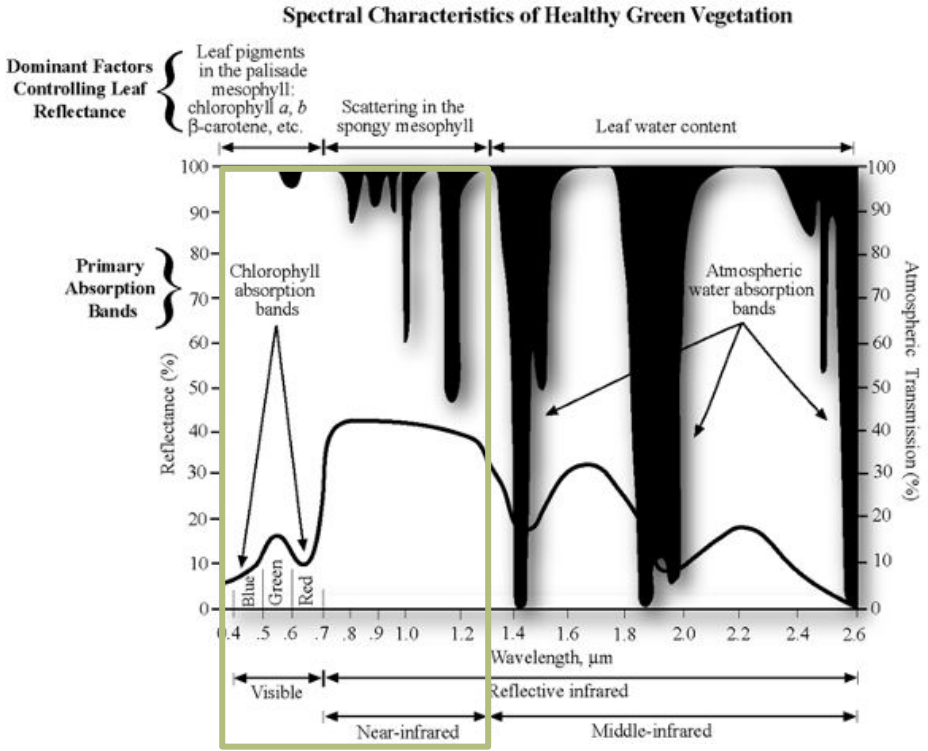
Spectral properties of vegetation





Source: Jensen 2007

Factors controlling leaf reflectance



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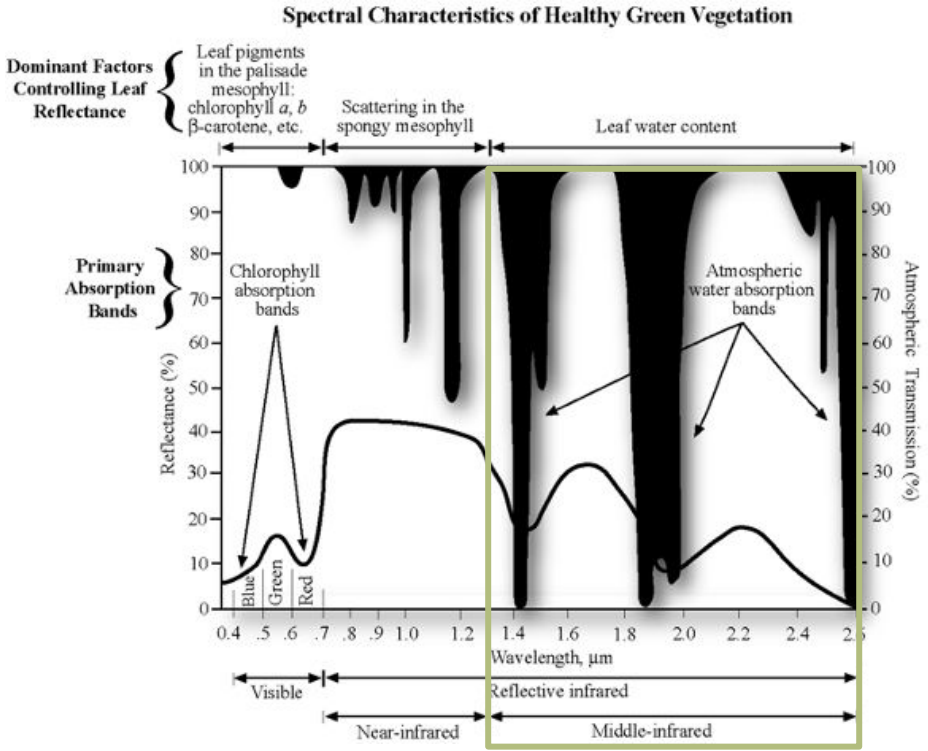
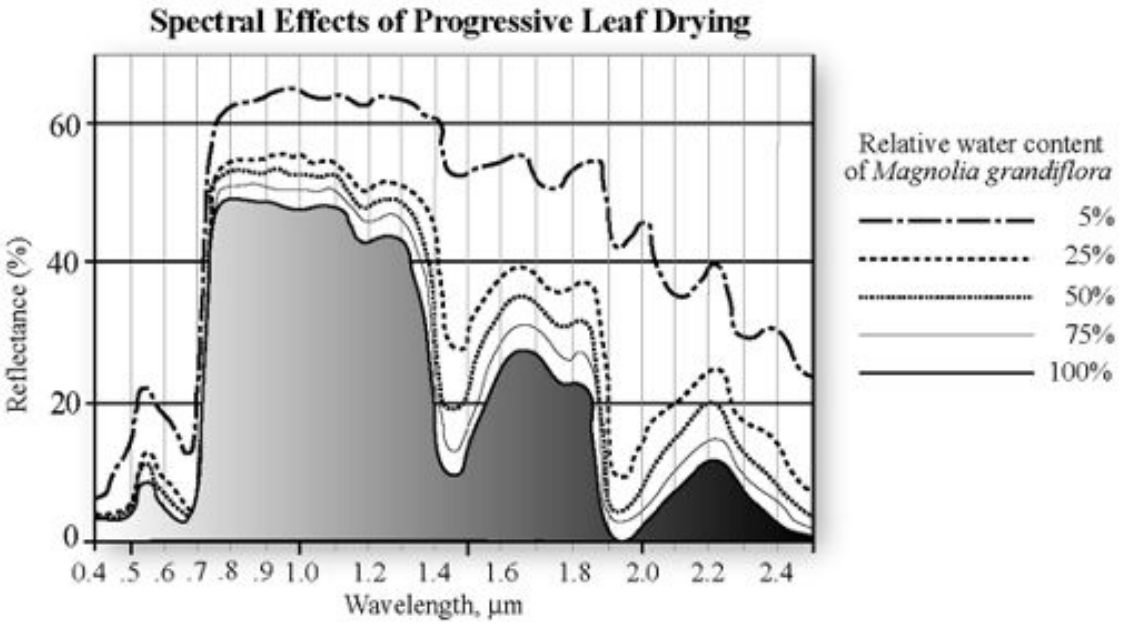


Source: Jensen 2007

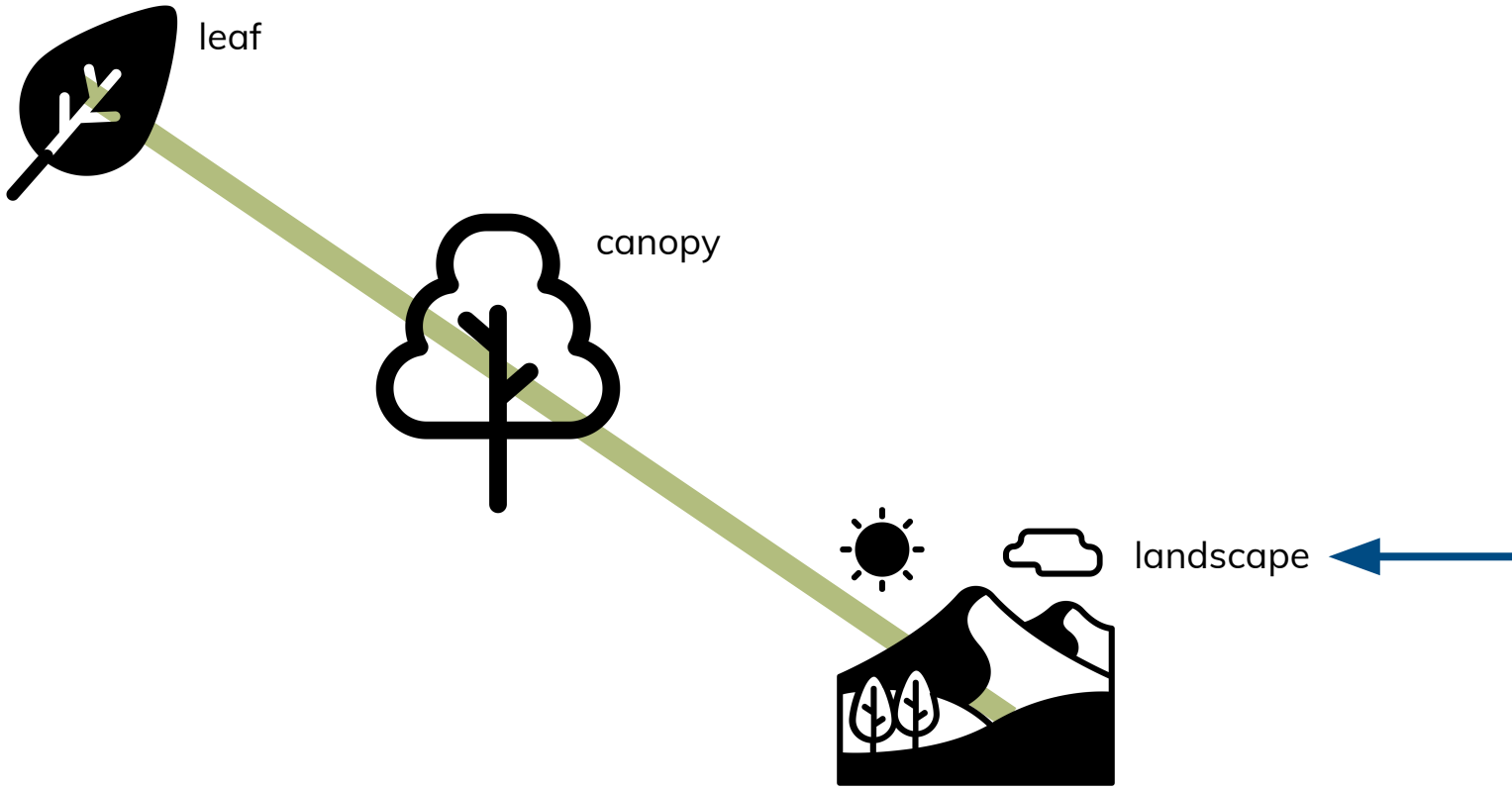
Remotely sensing leaf moisture content



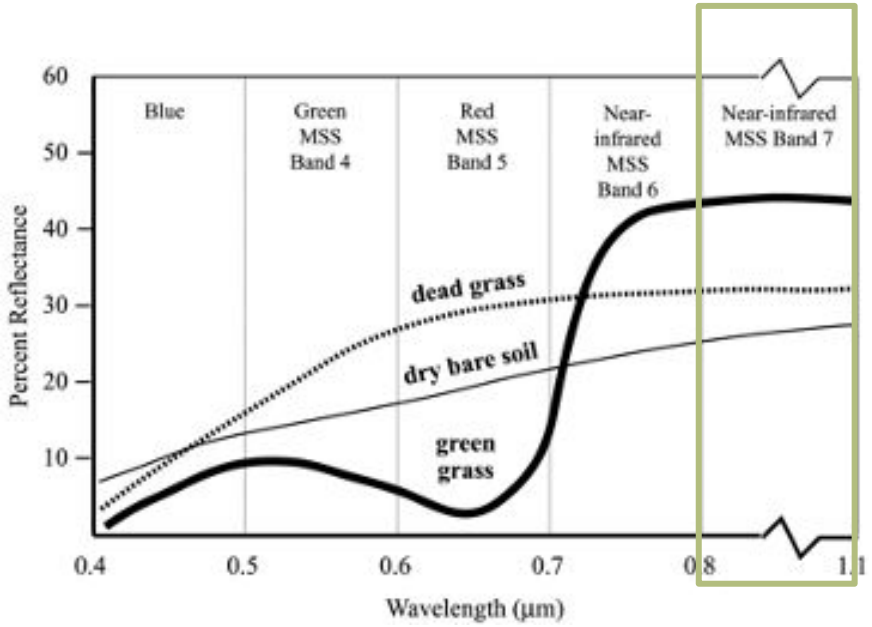
↓ moisture content

↑ shortwave infrared reflectance

Remote sensing of vegetation

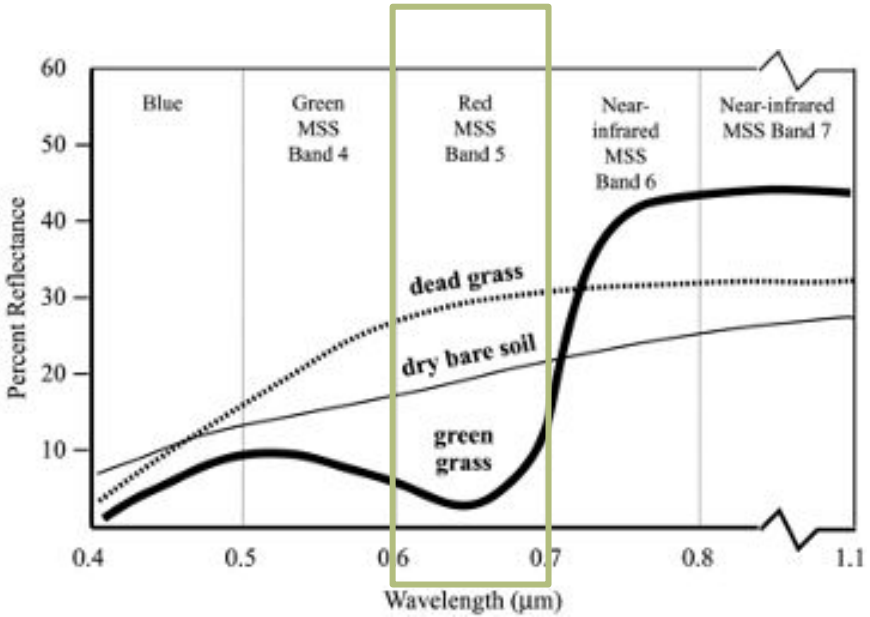


Soil reflectance



soil and vegetation both strongly reflect near infrared

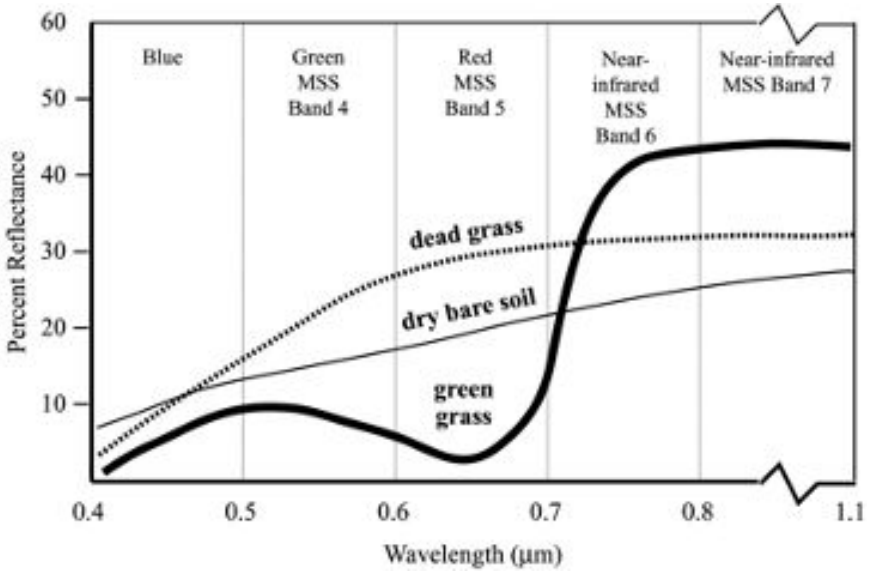
Soil reflectance

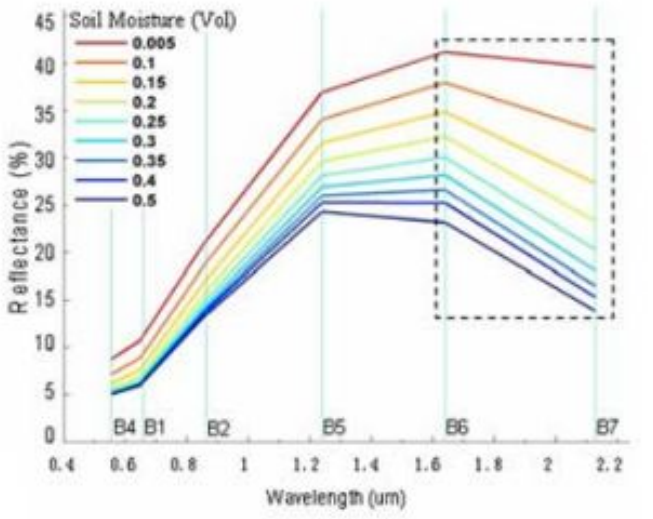


soil and vegetation both strongly reflect near infrared

healthy vegetation absorbs more red

Soil reflectance





soil and vegetation both strongly reflect near infrared

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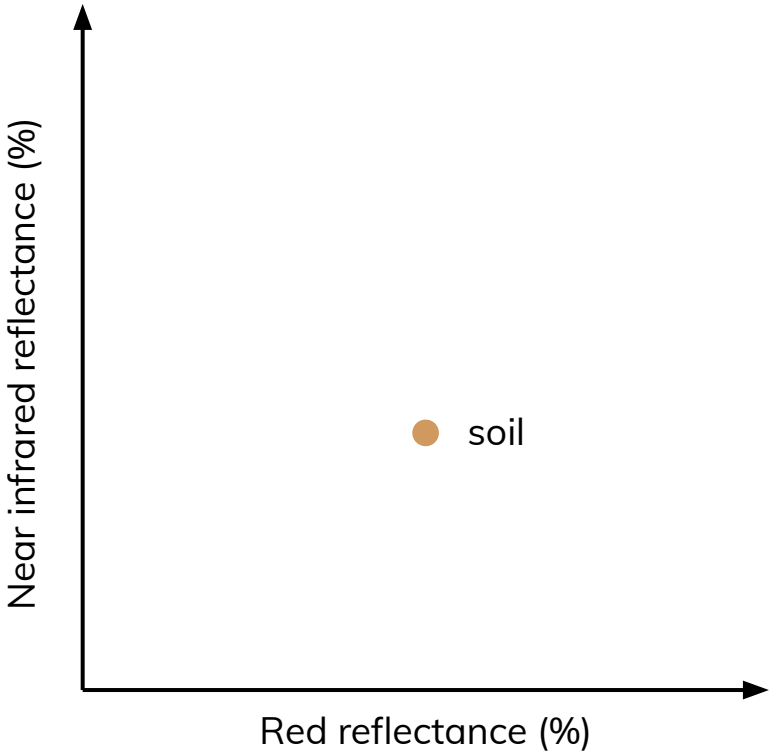
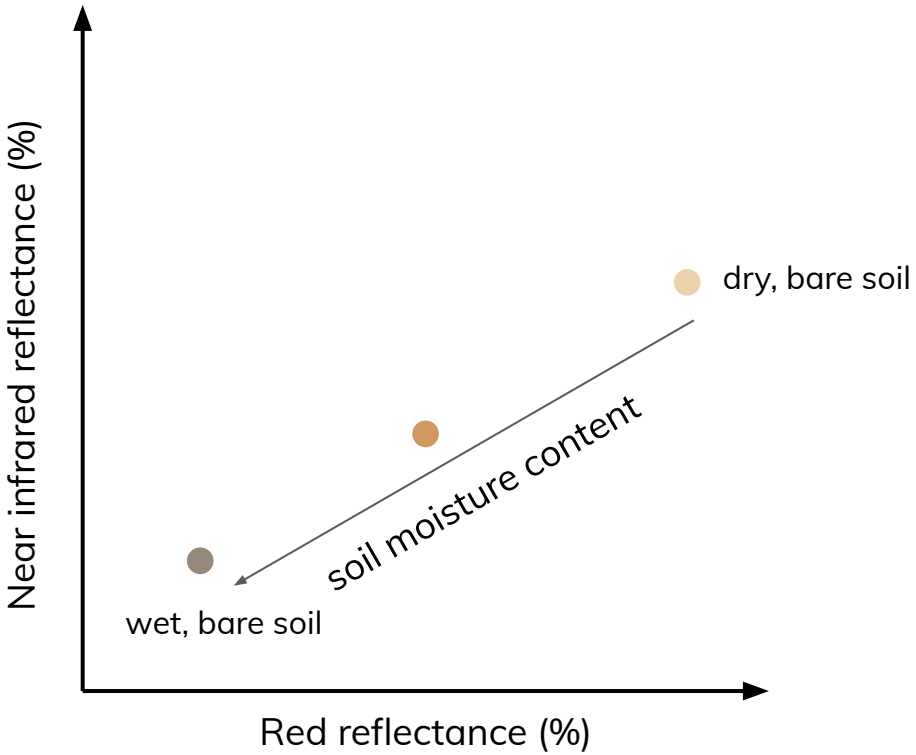
↓ moisture content

↑ near infrared reflectance

Distinguishing soil and vegetation



Distinguishing soil and vegetation



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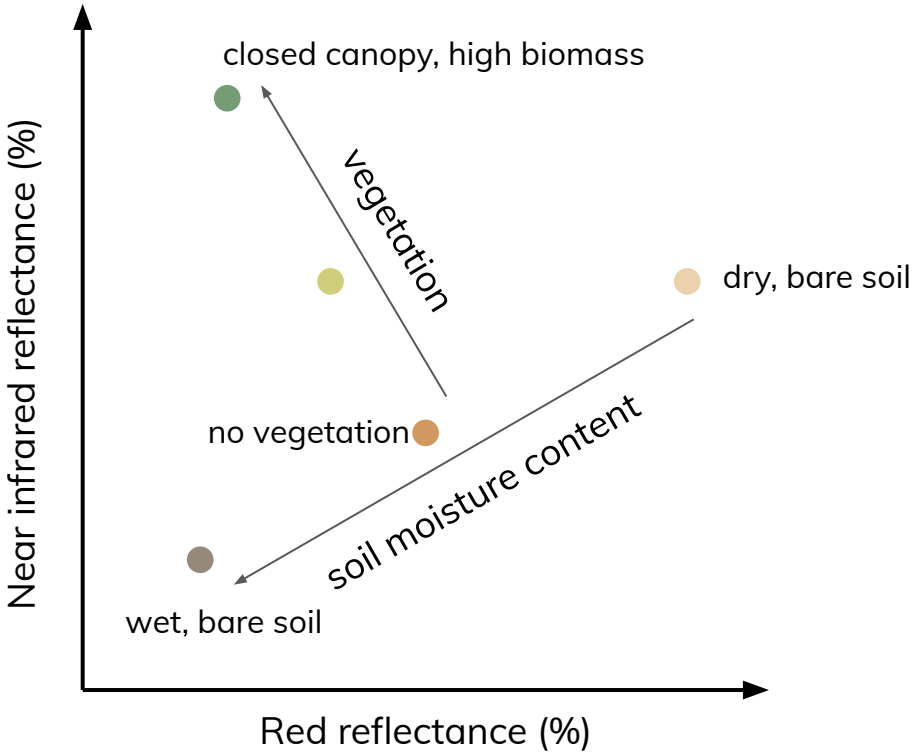

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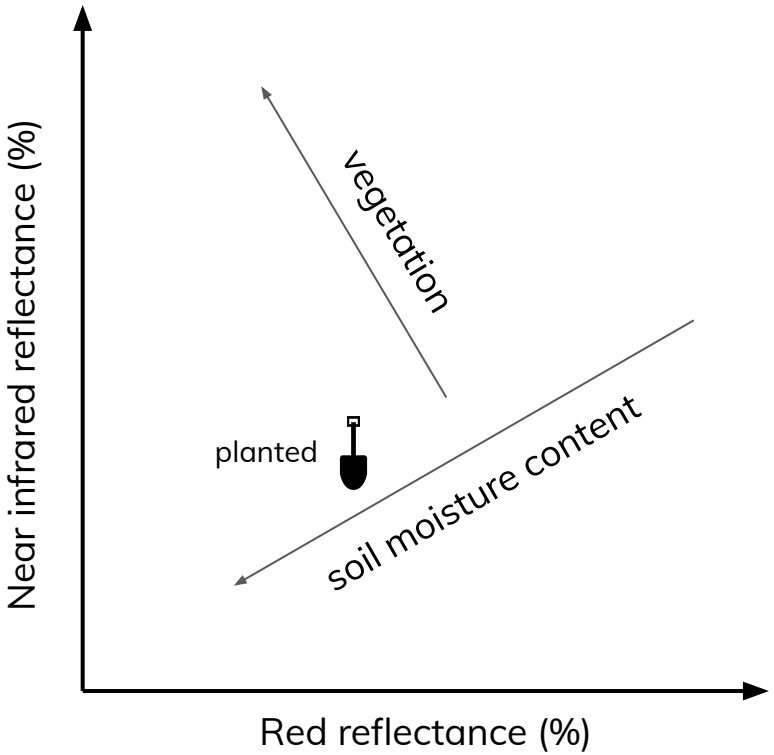

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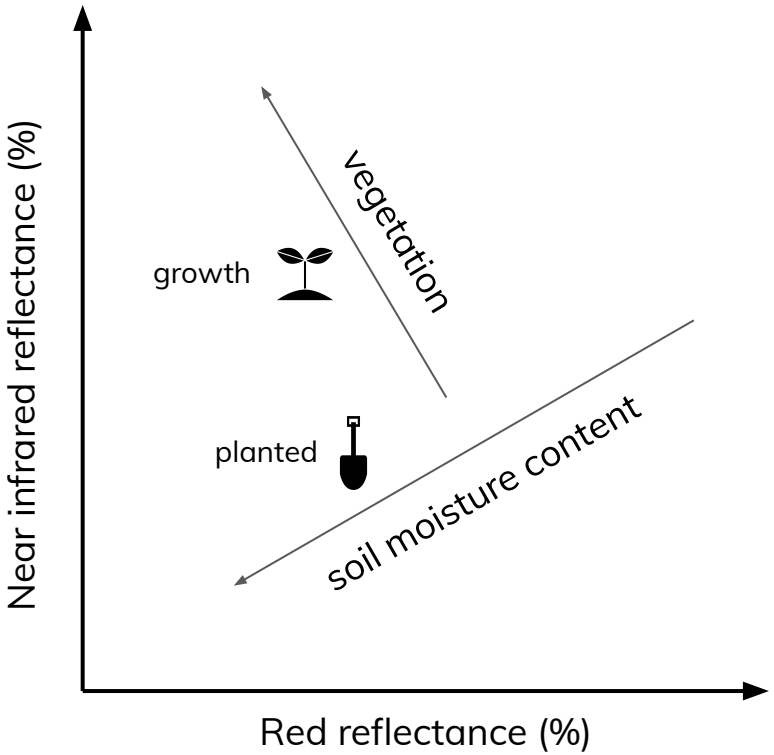

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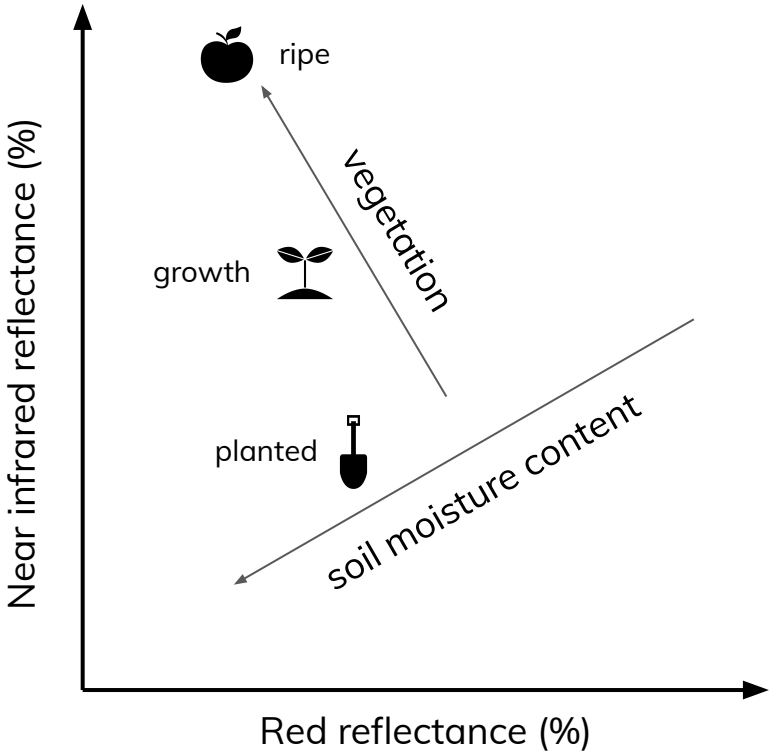

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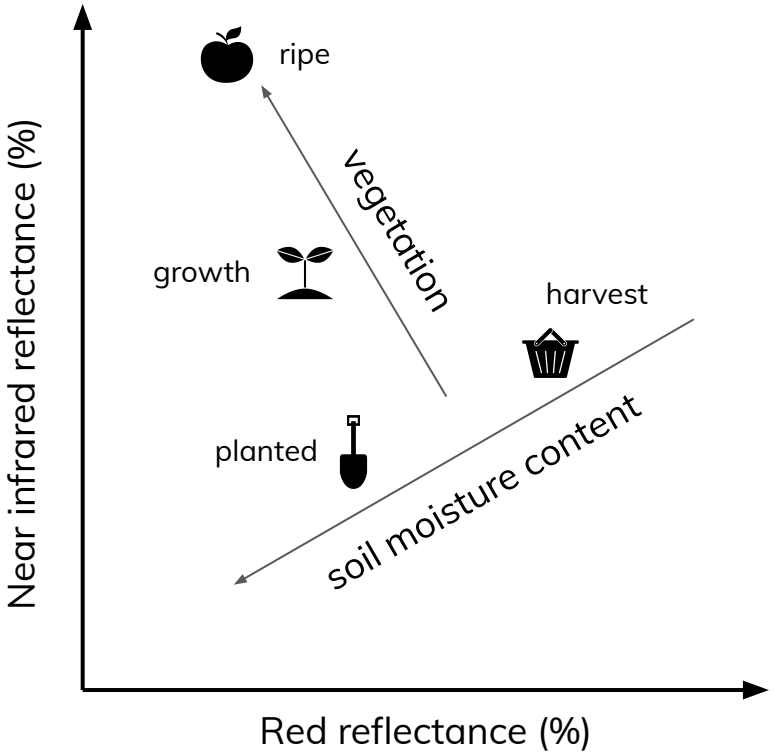
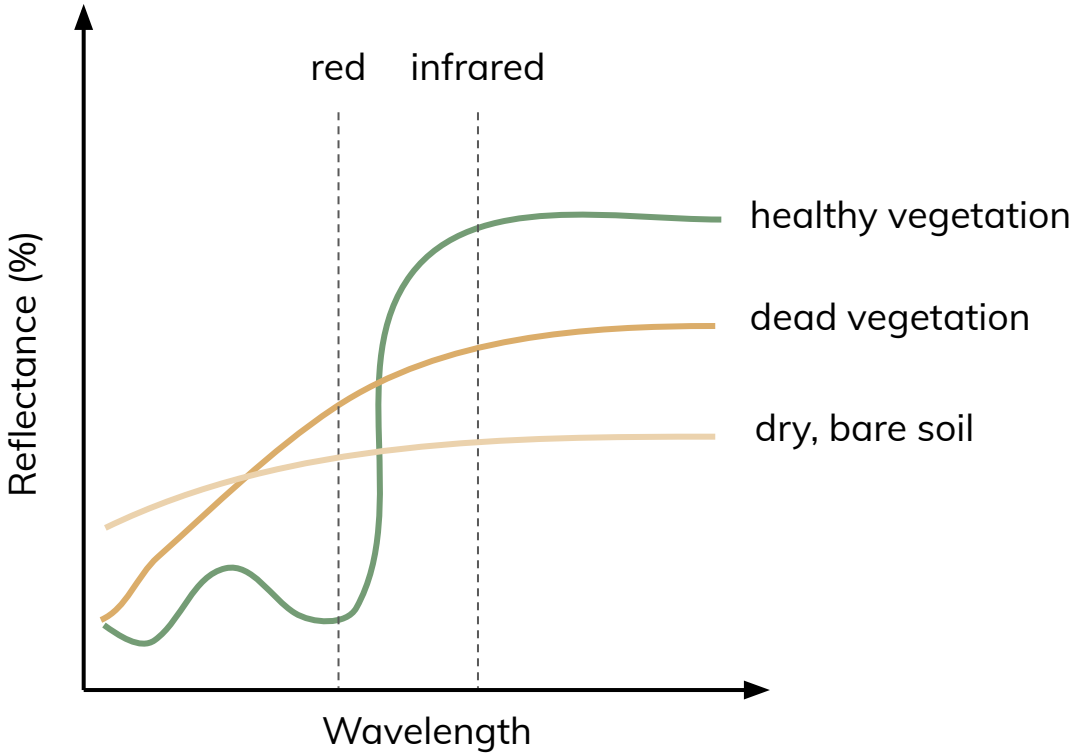
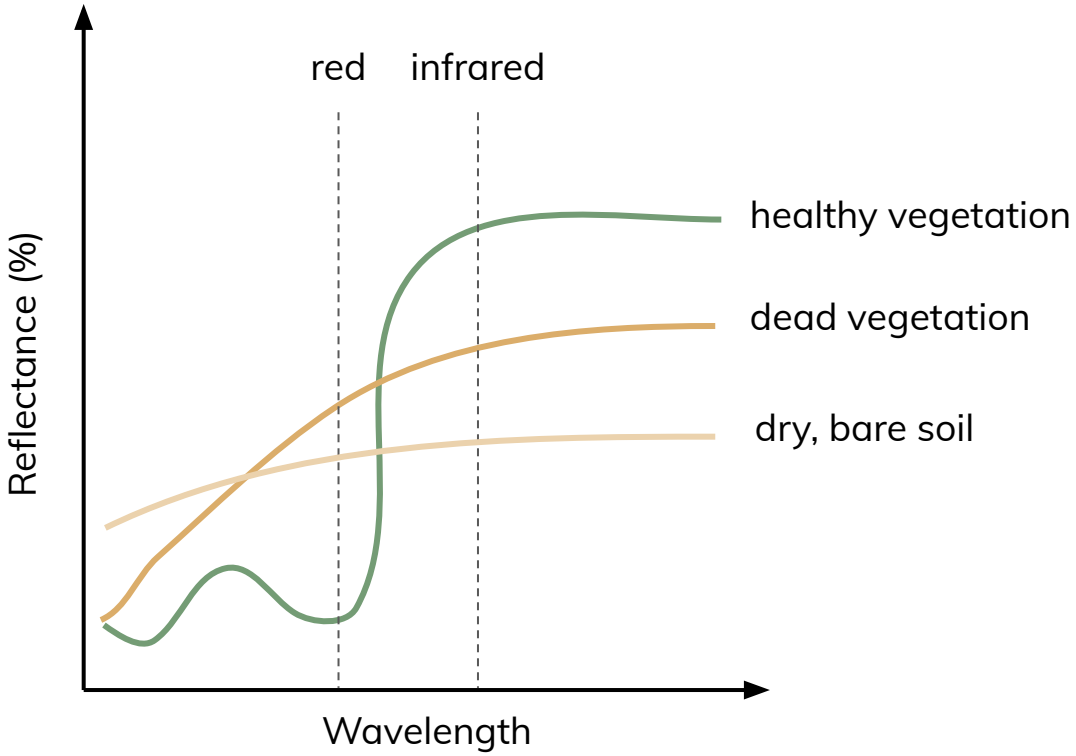


Vegetation indices



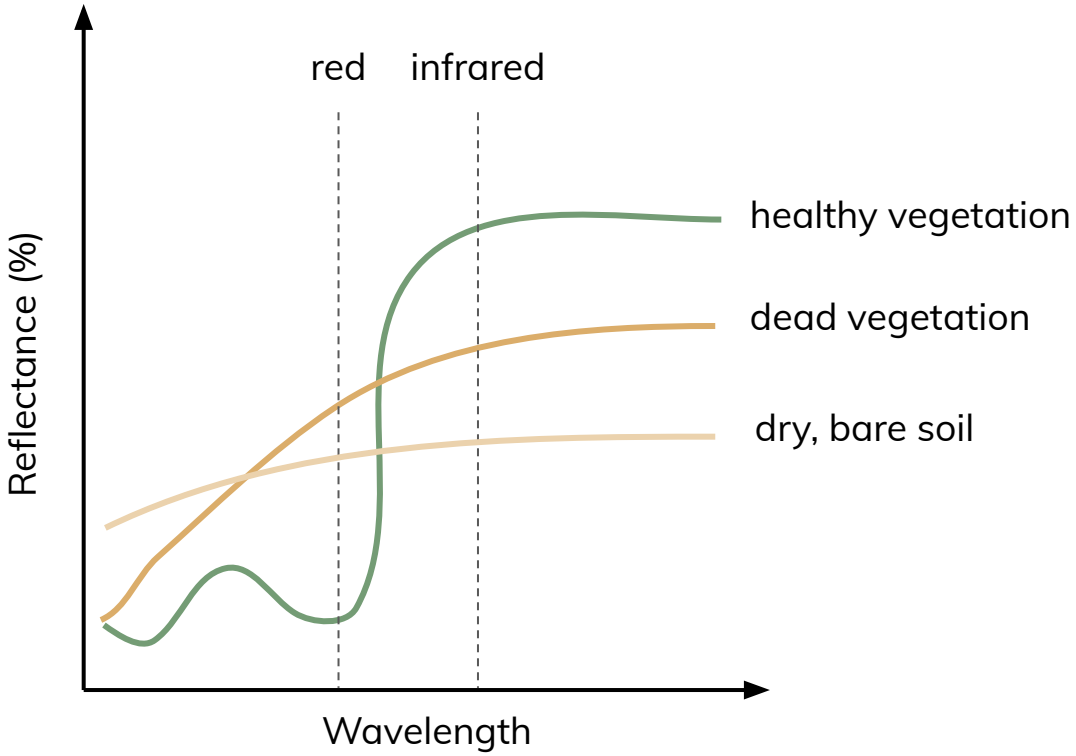
Vegetation indices



Goals:

- Distinguish (un)healthy vegetat and soil
- Stay constant across images

Vegetation indices



Goals:

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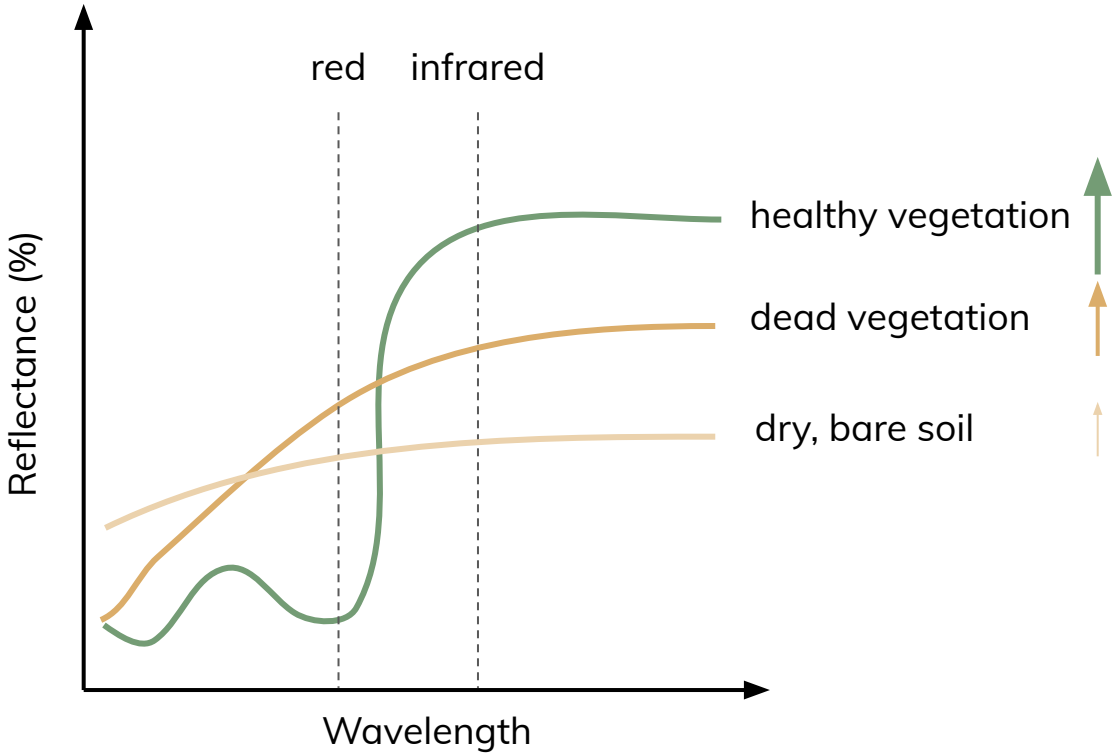
Difference Vegetation Index

DVI = Near infrared - Red

Vegetation indices



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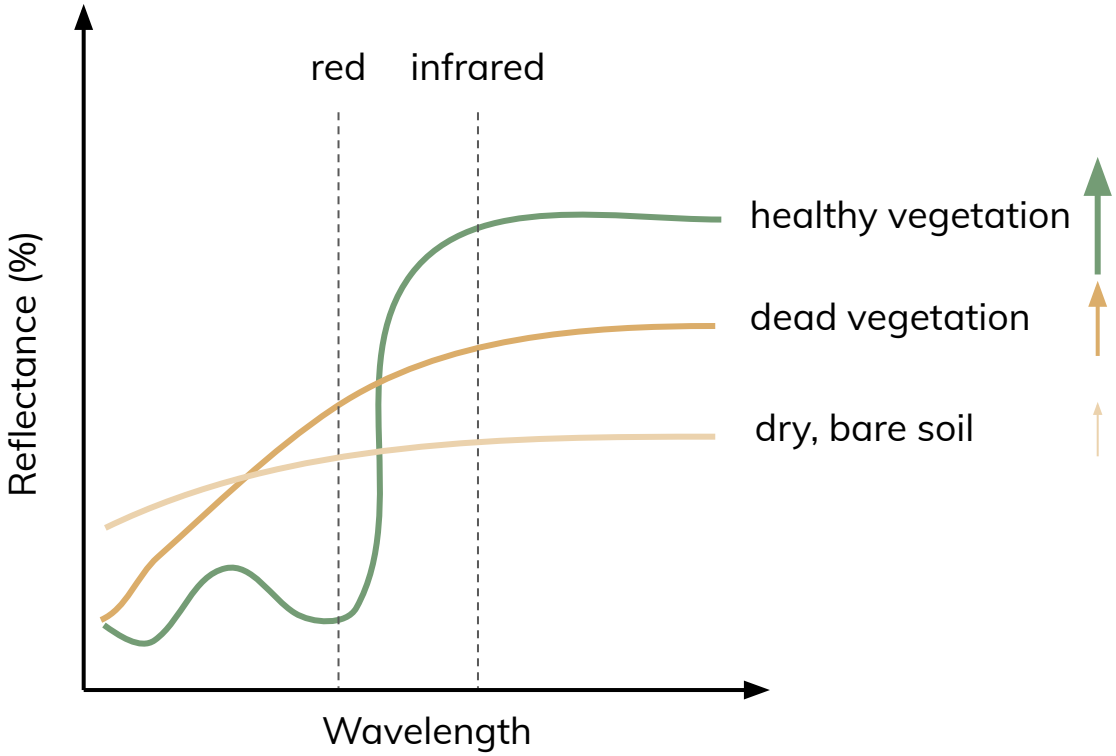

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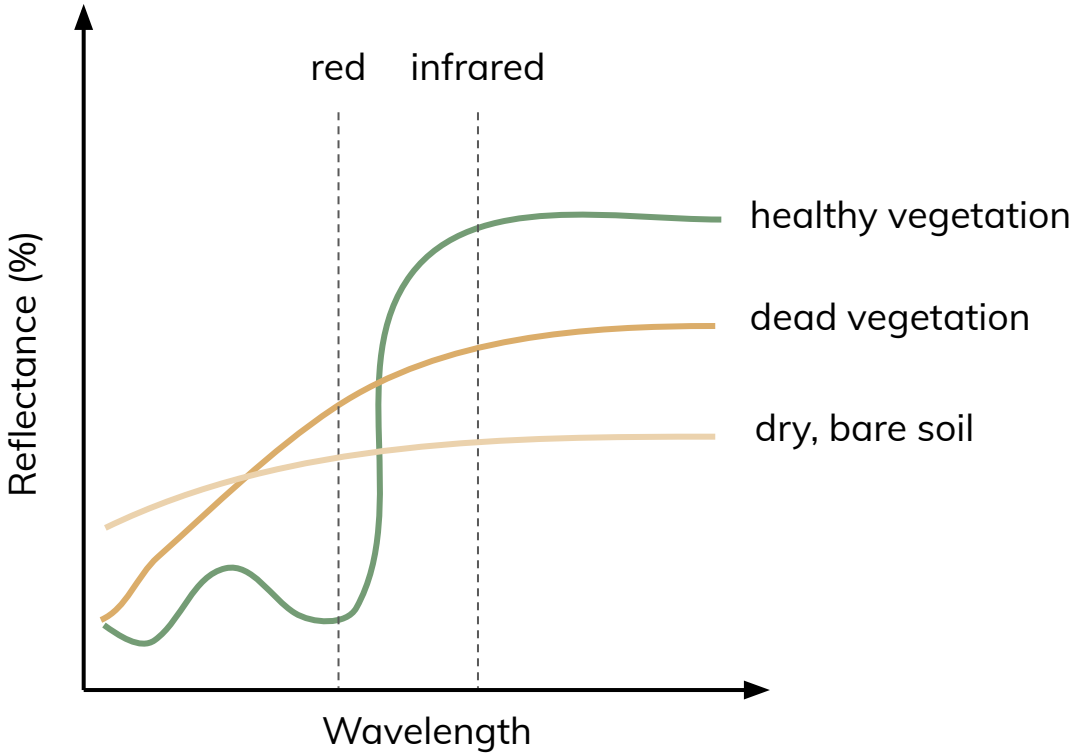

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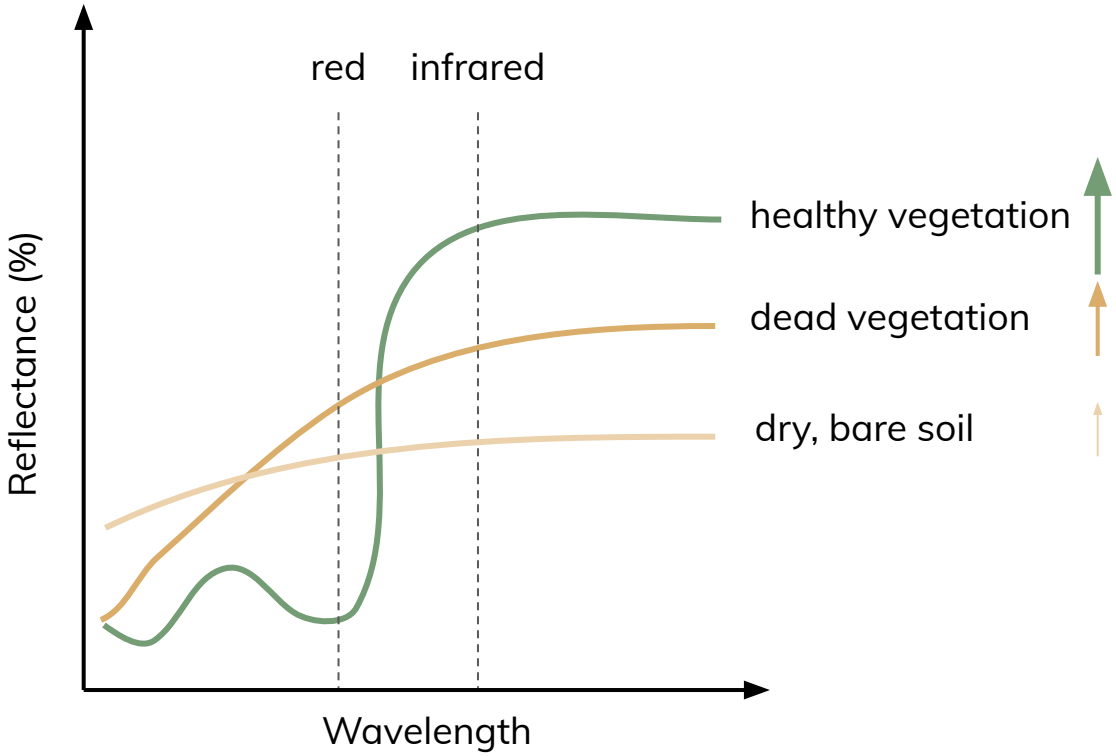
Ratio Vegetation Index

RVI = Near infrared ÷ Red

Vegetation indices



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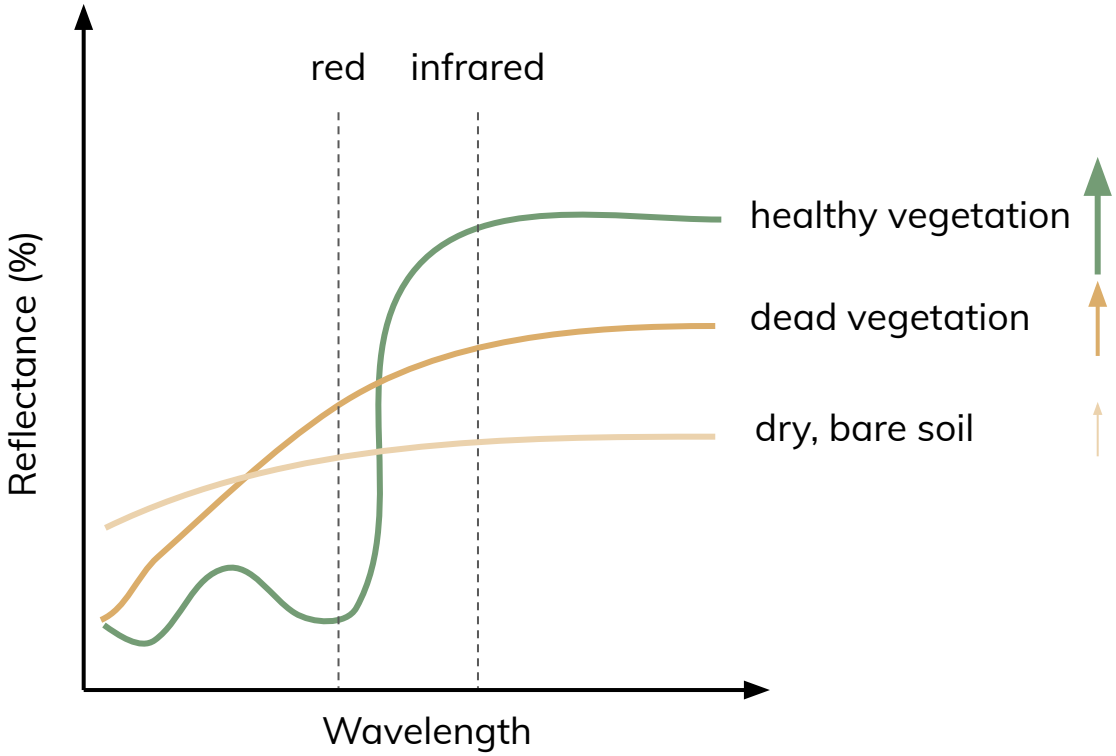

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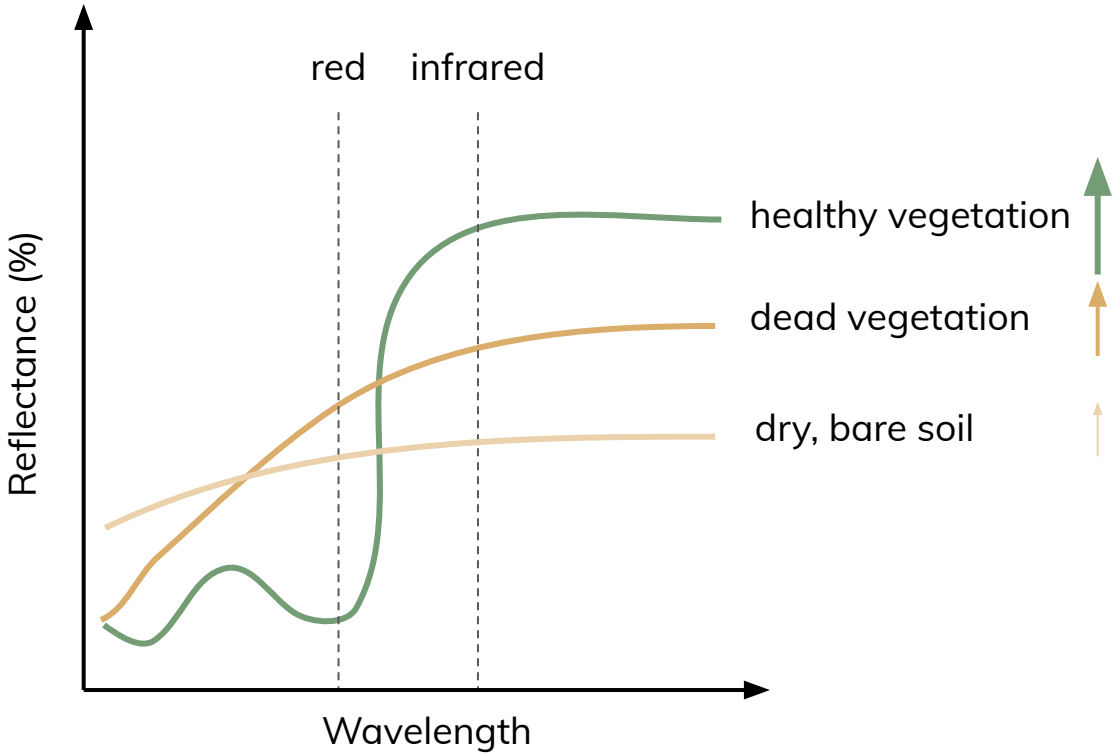

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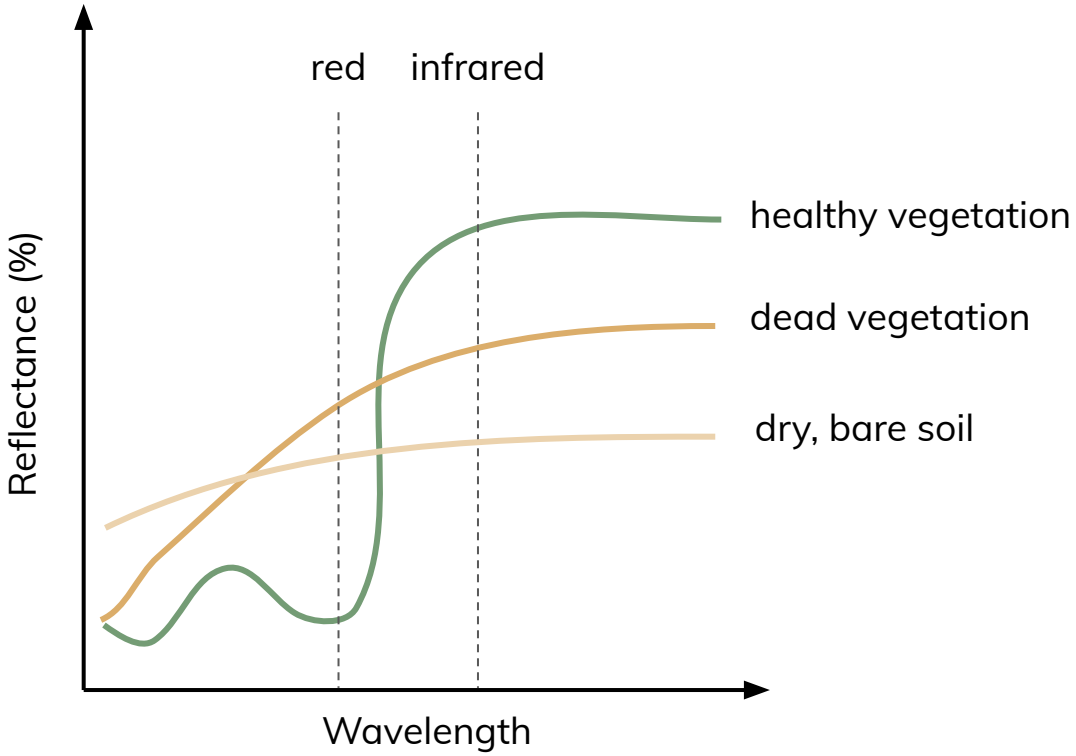
But, division by zero errors....

Vegetation indices



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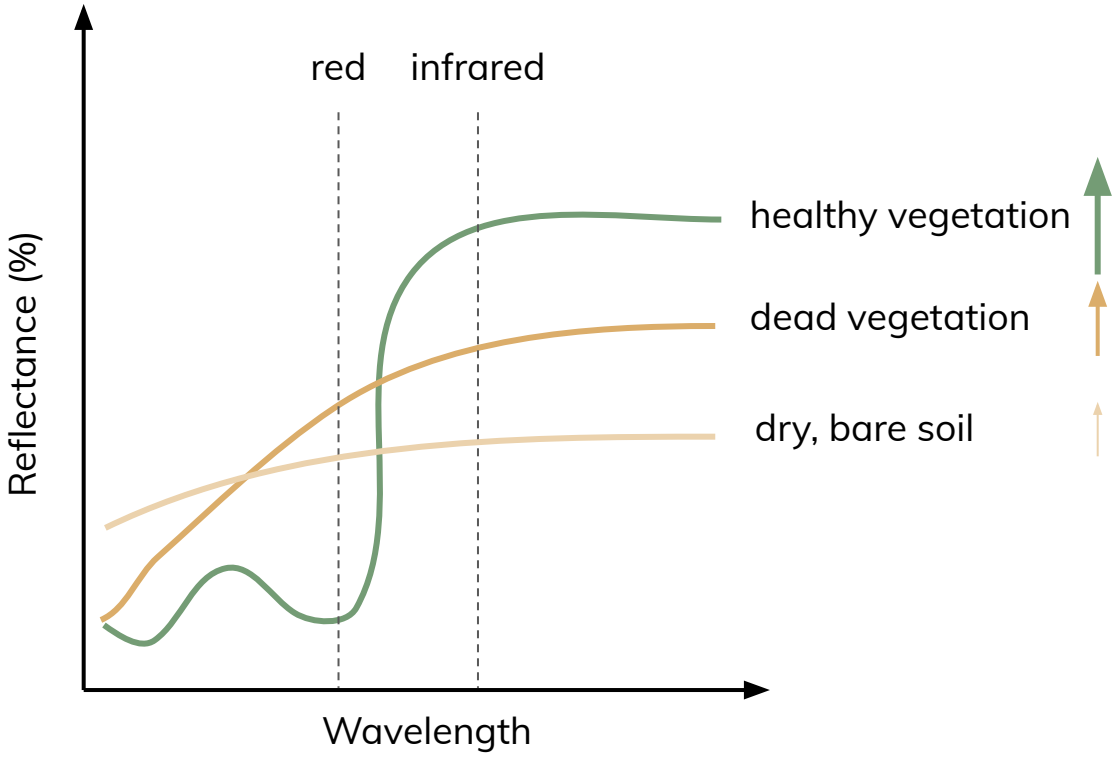
Normalized Difference Vegetation Index

$$NDVI = \frac{\text{Near infrared - Red}}{\text{Near infrared + Red}}$$

Vegetation indices



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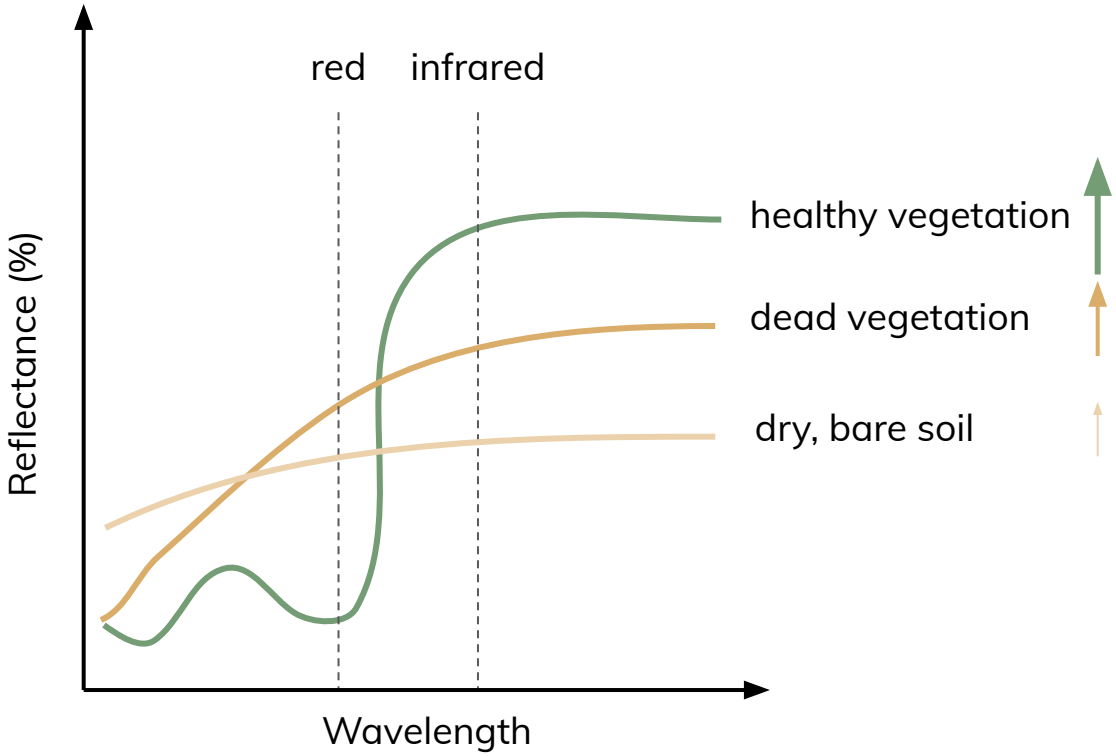
Vegetation indices



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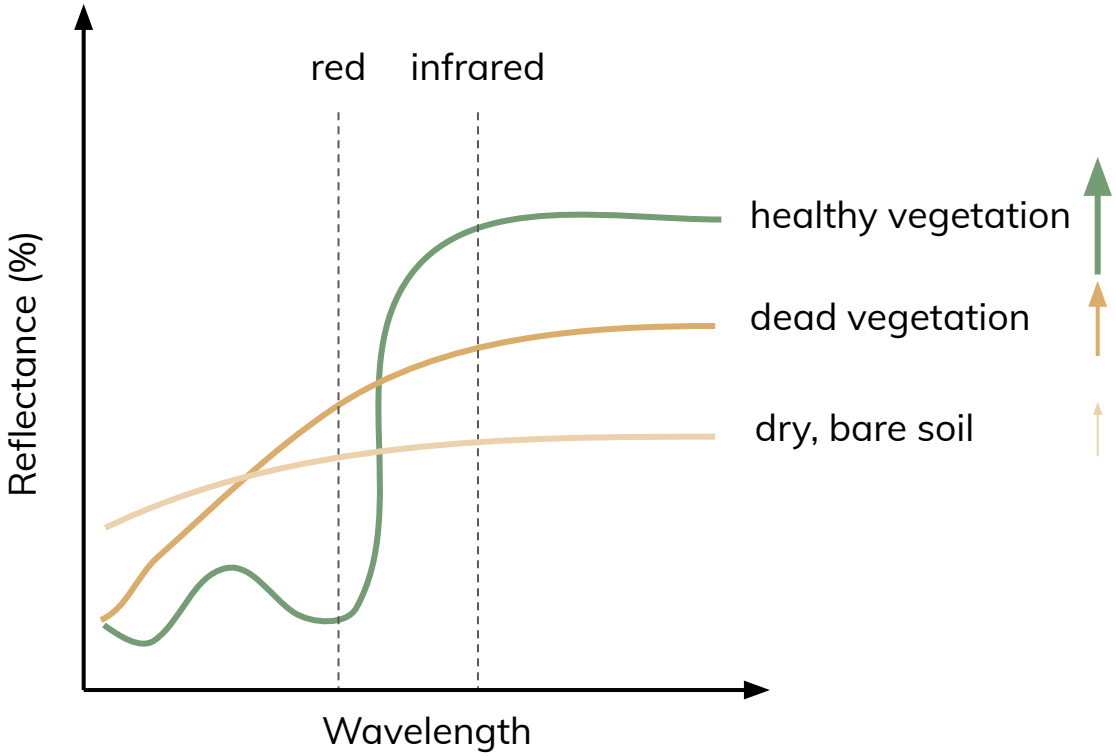

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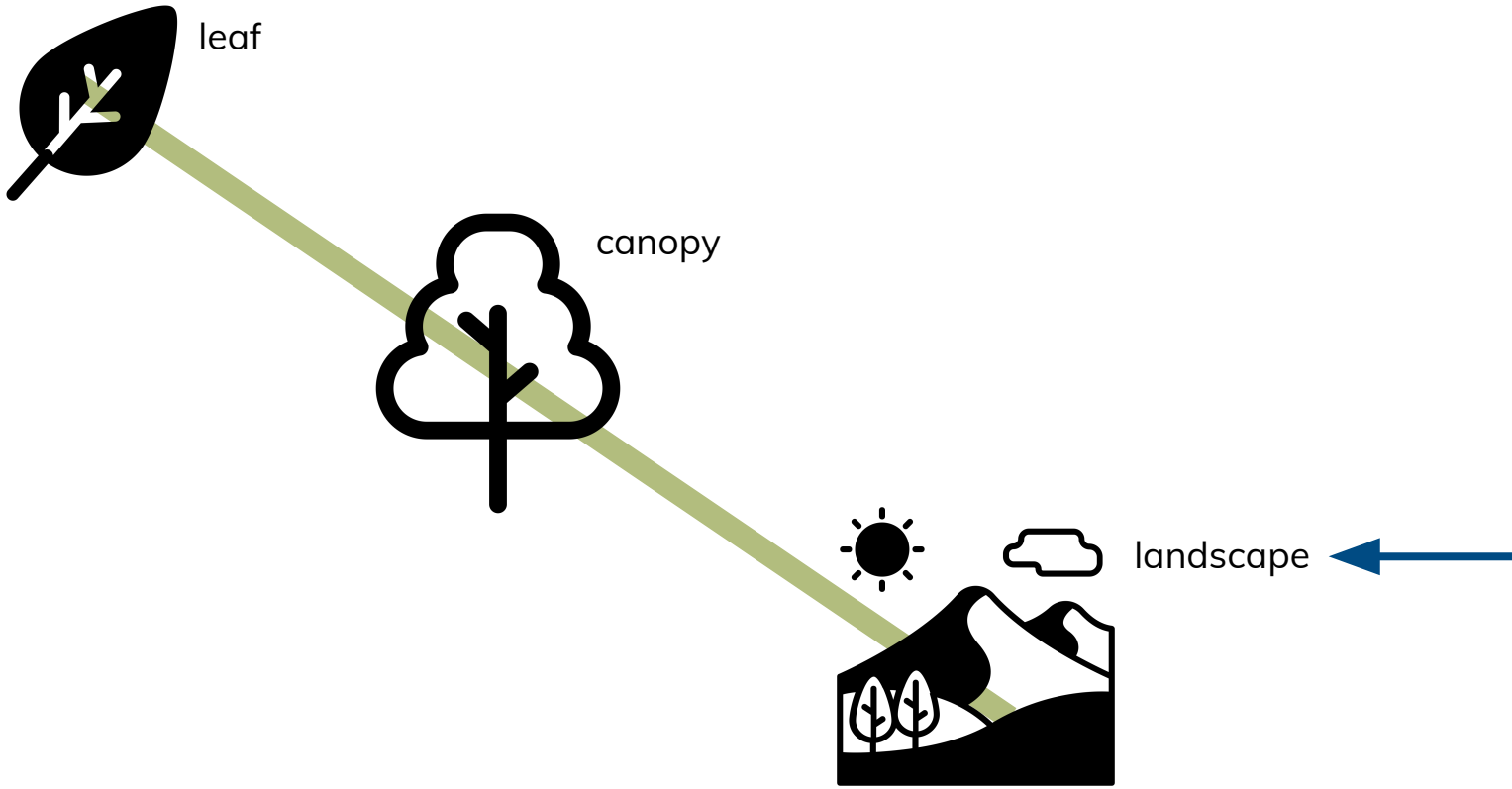
Normalized Difference Vegetation Index

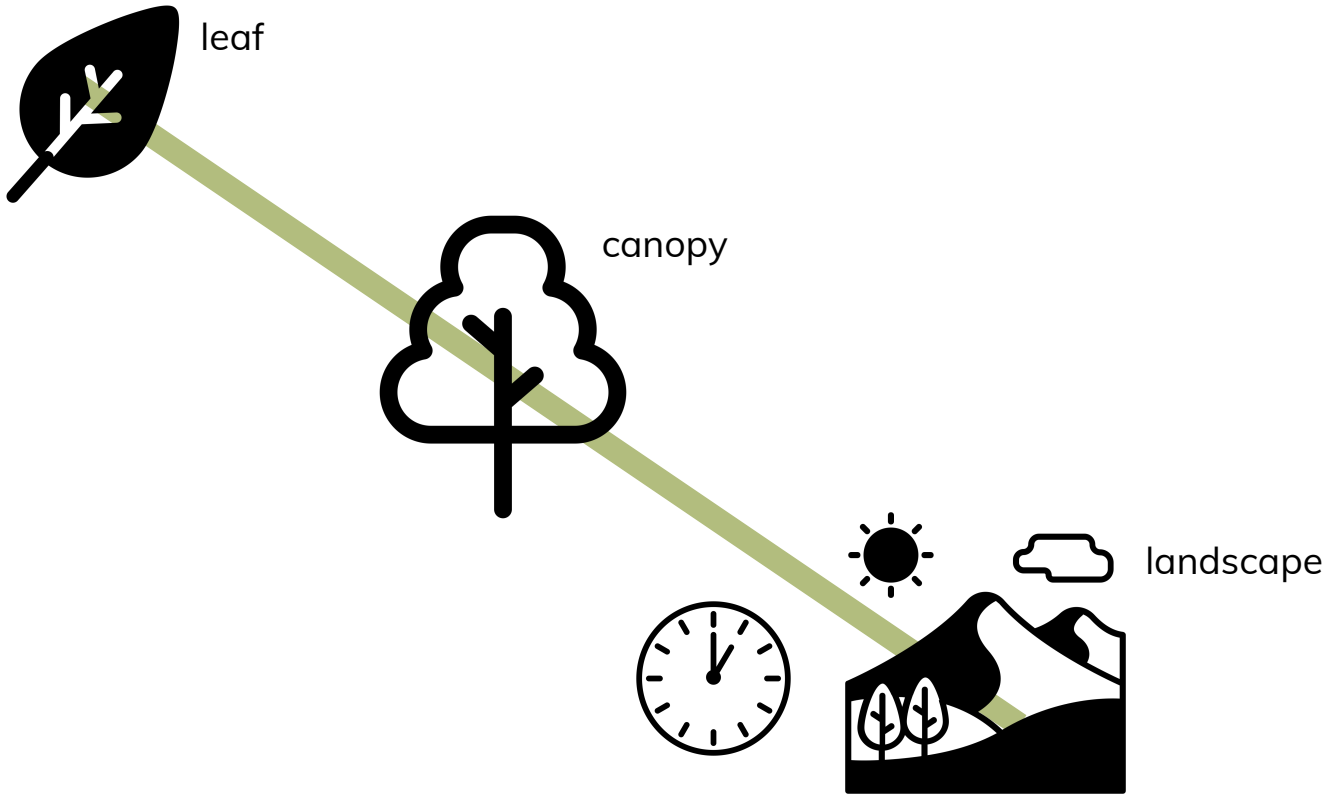
$$NDVI = \frac{\text{Near infrared - Red}}{\text{Near infrared + Red}}$$

- Rarely divides by zero

Remote sensing of vegetation



Remote sensing of vegetation



Vegetation phenology

Source: EcoTree

Vegetation phenology

Goals:

- Understand the phenological cycles of plant communities near the Santa Clara River

Approach:

- Estimate NDVI from monthly Landsat images
- Use study sites representing:
  - Riparian forest
  - Grasslands
  - Chaparral shrublands

Source: The Nature Conservancy