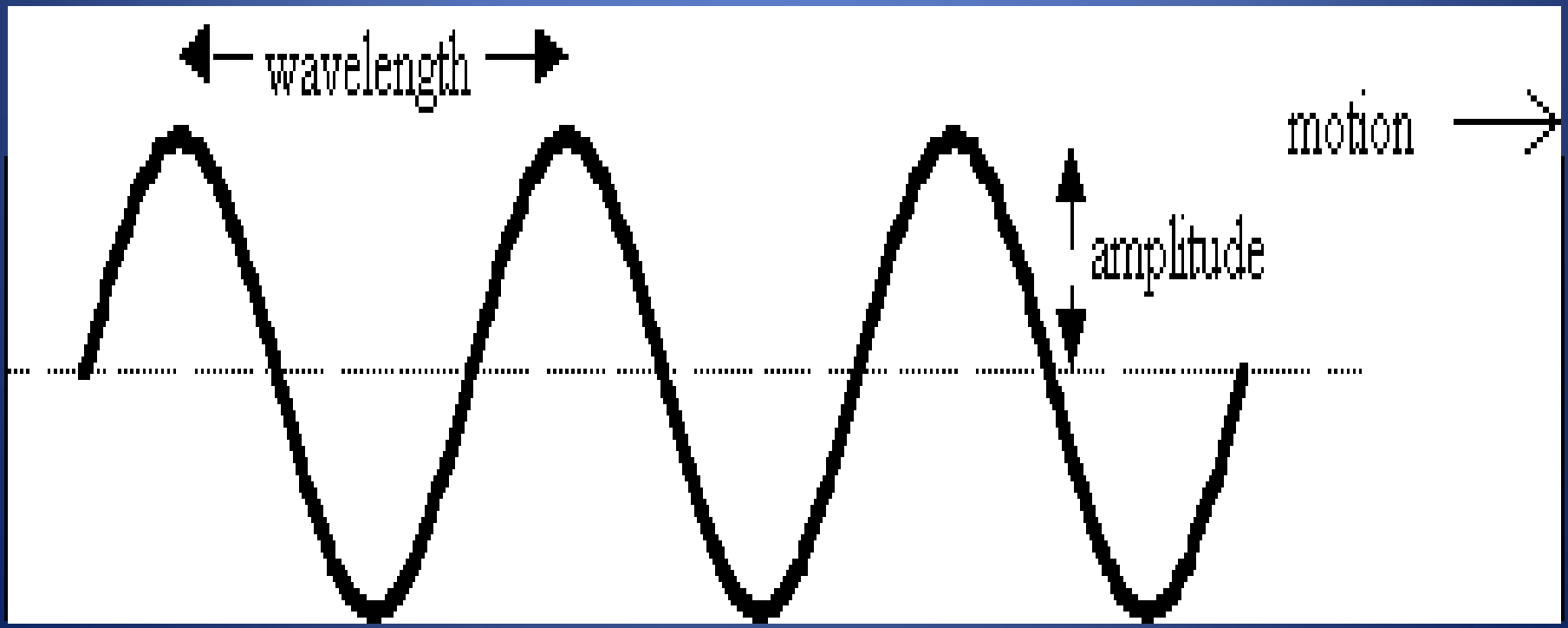
SPECTRAL REFLECTANCE OF VEGETATION, SOIL AND WATER

LWR314



Electromagnetic Spectrum

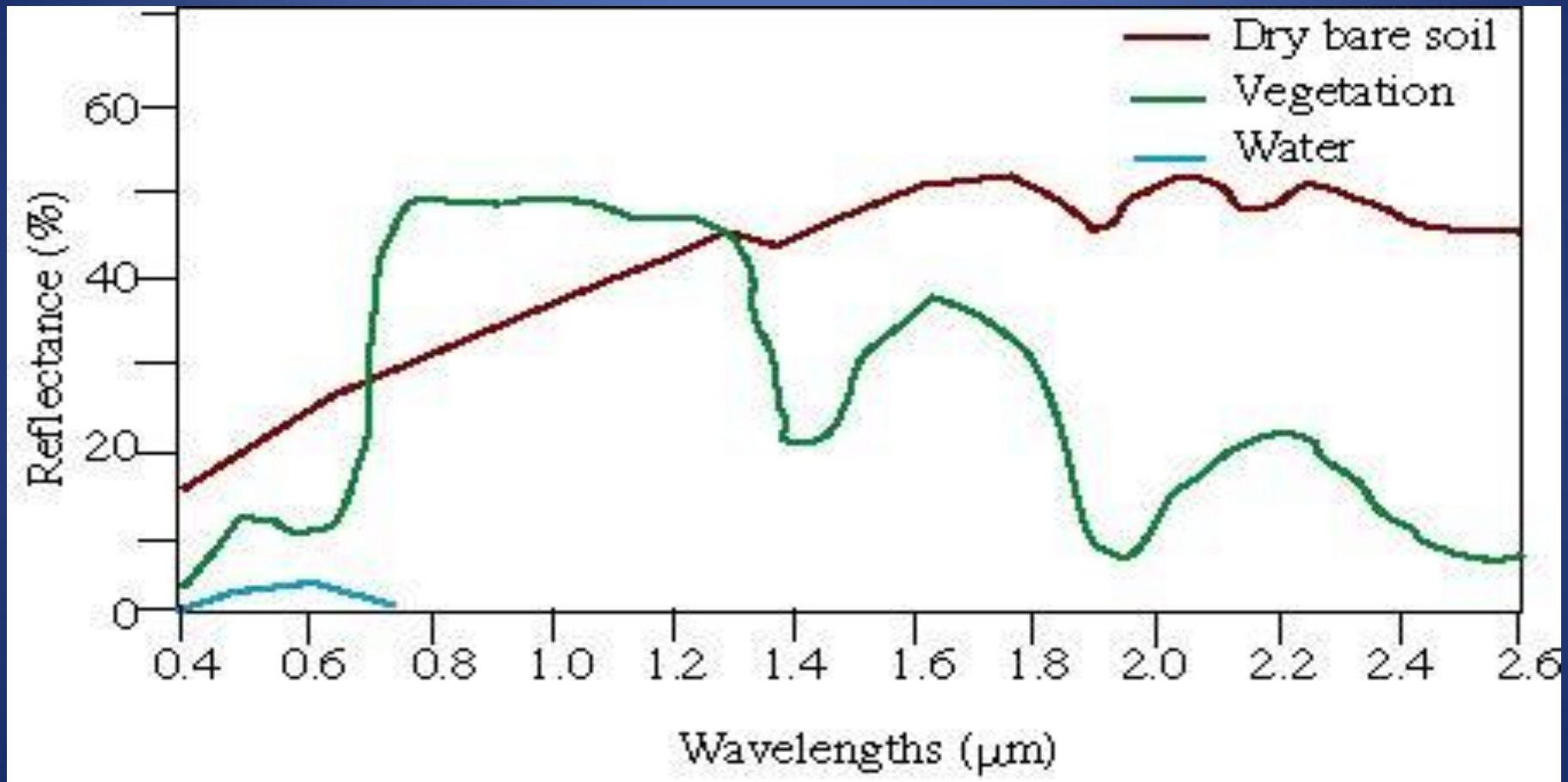
- Energy transfer from one body to another in the form of electromagnetic waves
- A fundamental characteristic of radiation is the wavelength (λ) of propagation



Spectral Reflectivity

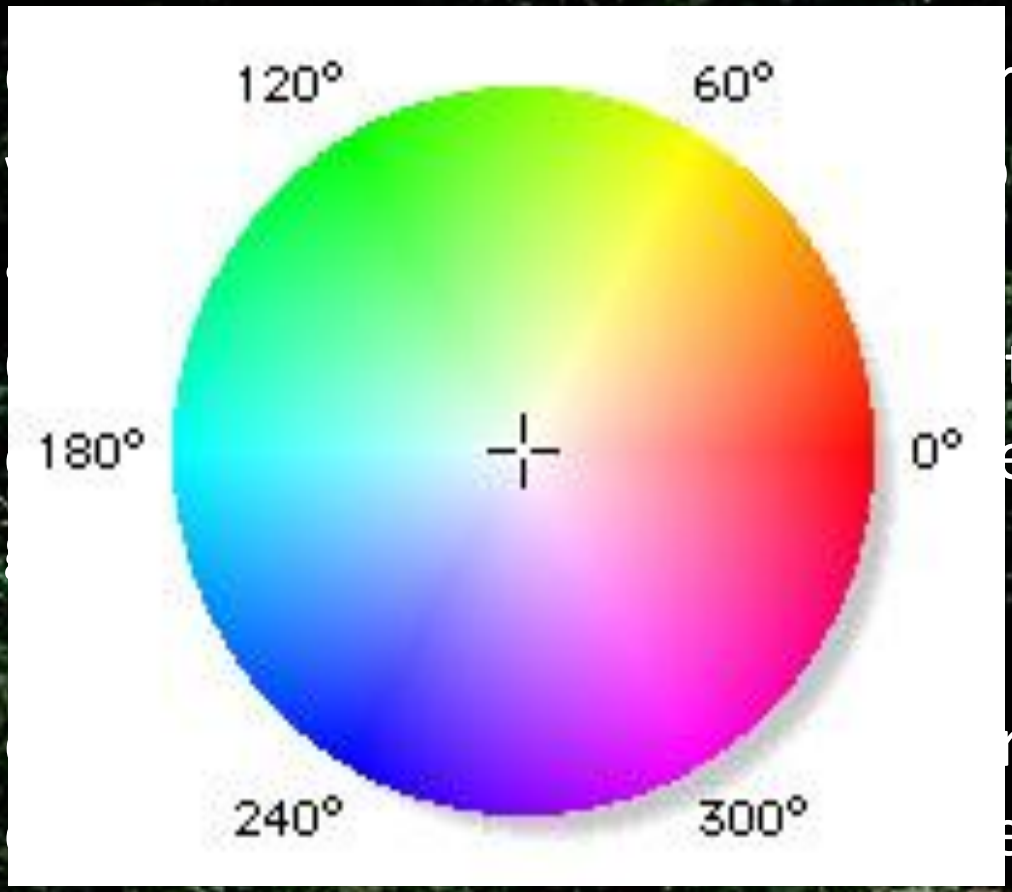
- Reflectivity is the fraction of incident radiation reflected by a surface
- The reflectance characteristics of Earth's surface features may be quantified by measuring the portion of incident energy that is reflected
- This is measured as a function of wavelength (λ) and is called spectral reflectance (r_λ)

Typical spectral reflectance curves for vegetation, soil and water



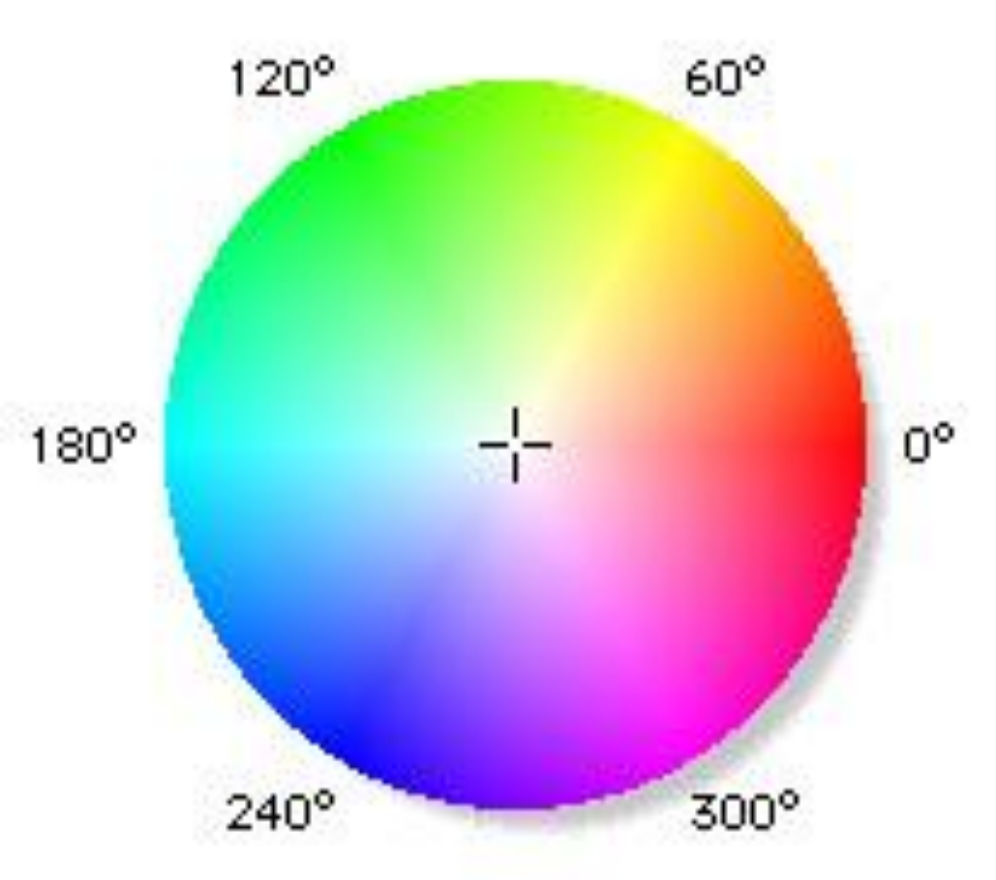
Typical spectral reflectance curves for vegetation, soil, and water.

Spectral reflectance of Vegetation

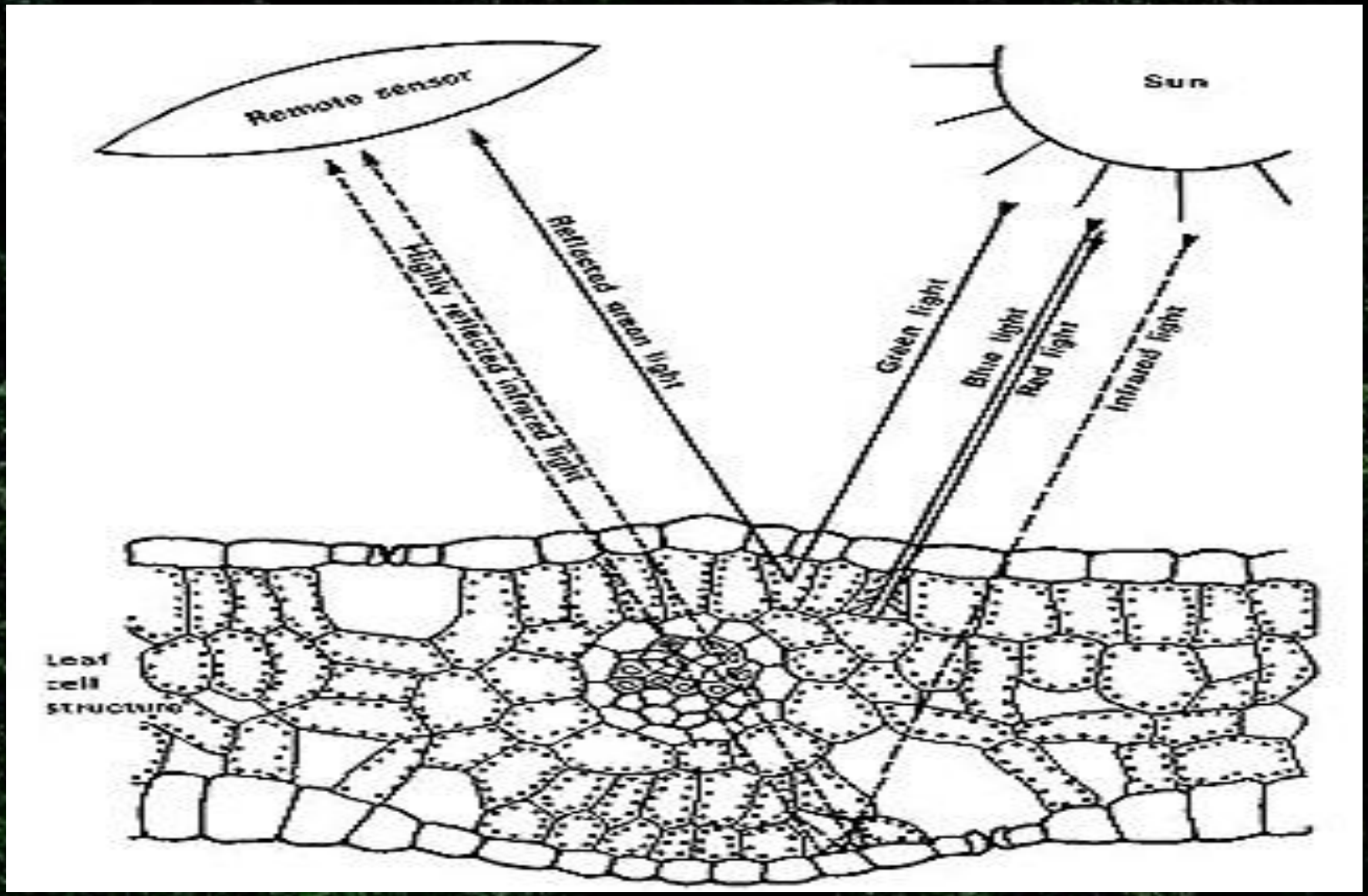


- rgy in the
  ut 0.45 µm (blue)
- tion as green in
  eflection of
- of stress, it may
  resulting in less
  e and red bands
- Often the red reflectance increases to the point that we see the plant turn yellow (combination of green and red)

Colour Wheel



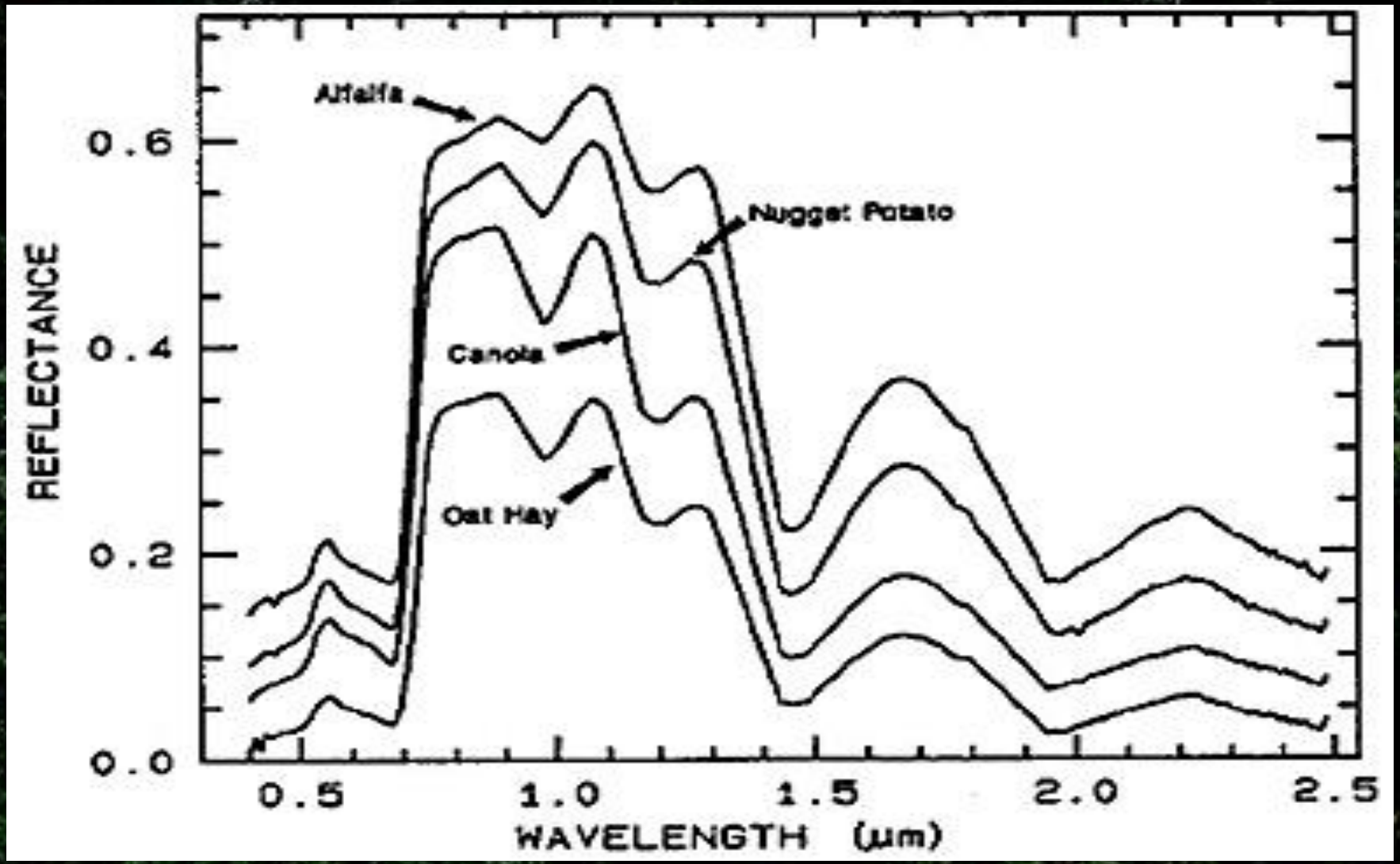
Spectral reflectance of Vegetation



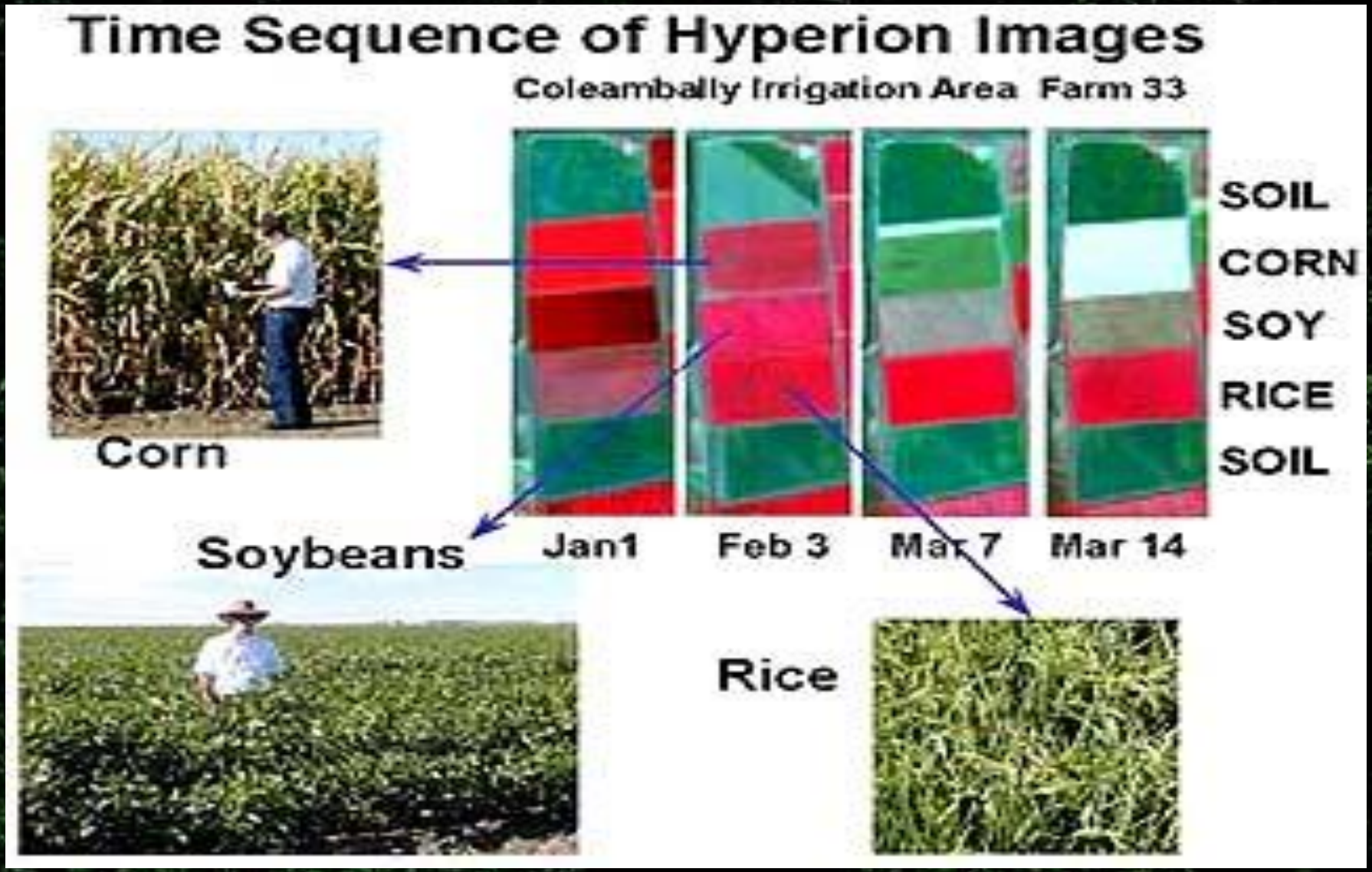
Spectral reflectance of Vegetation

- In the range from about 0.7 to 1.3 µm a plant leaf typically reflects 40 - 50% of the energy incident upon it primarily due to the internal structure of plant leaves
- Because the internal structure of leaves are highly variable between plant species, reflectance measurements in this range often permit us to discriminate between species (even if they look the same in visible wavelengths)
- Many plant stresses alter the reflectance in this region, and sensors operating in this range are often used for vegetation stress detection

Spectral reflectance of Vegetation



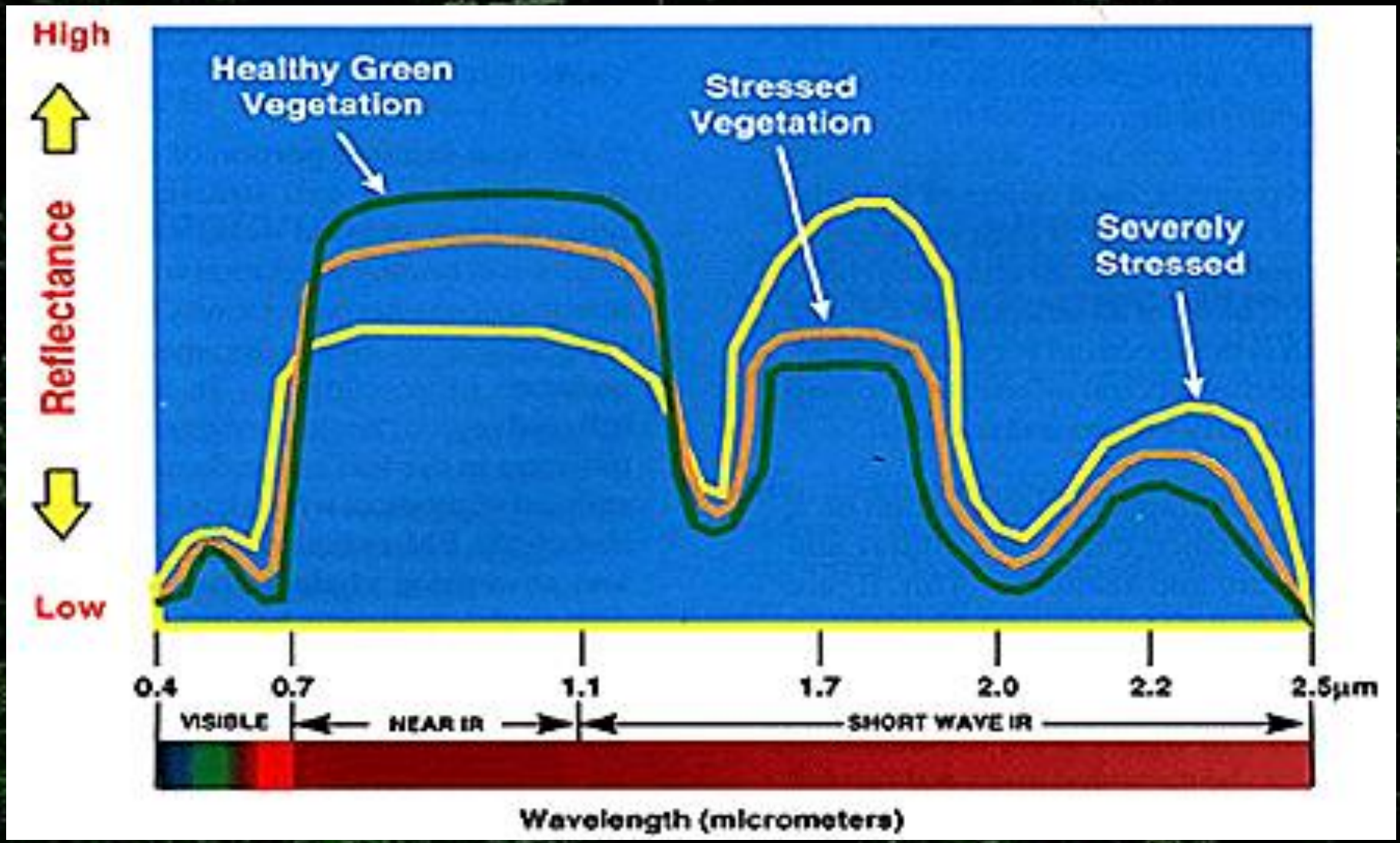
Spectral reflectance of Vegetation



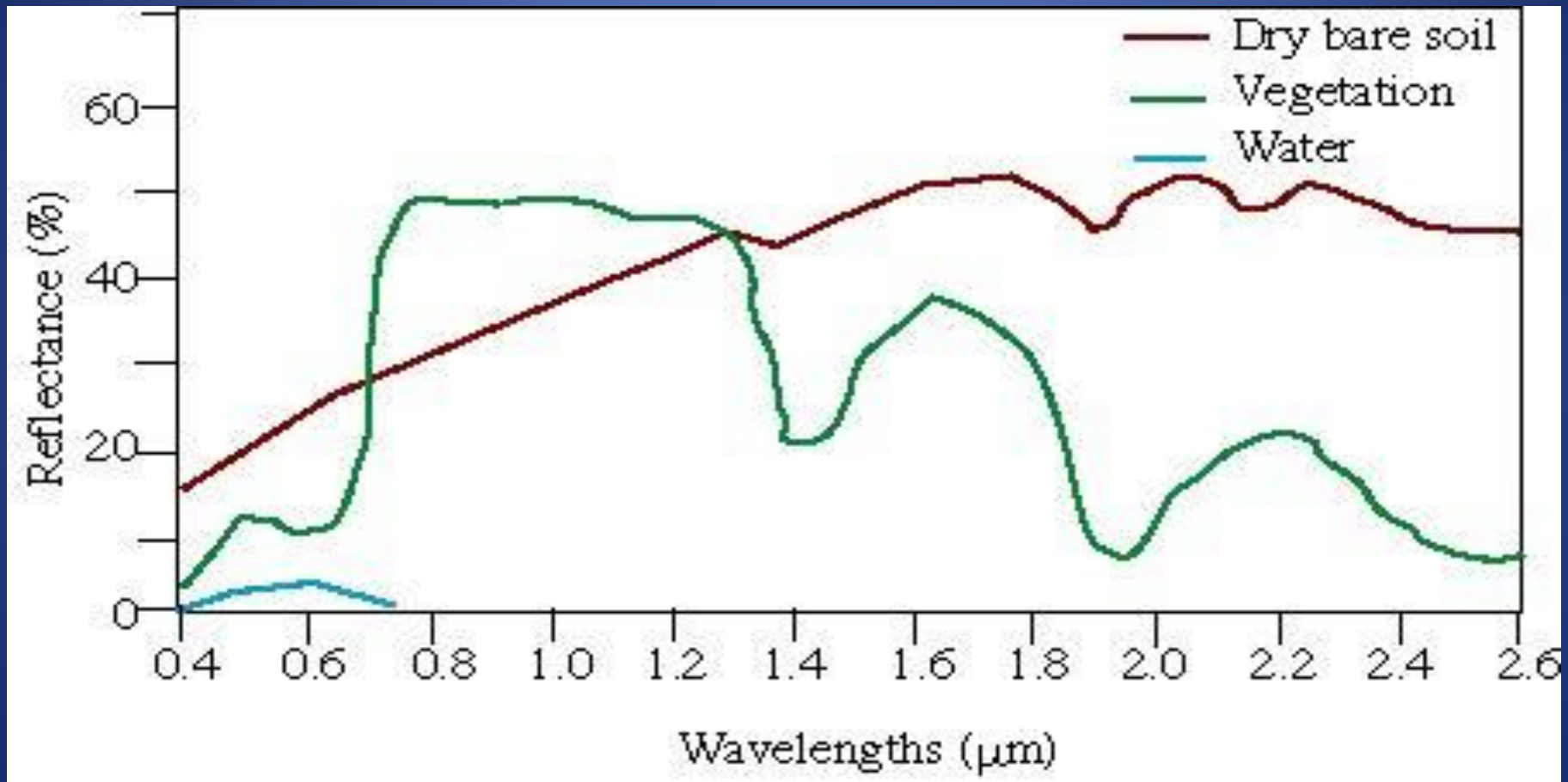
Spectral reflectance of Vegetation

- Beyond 1.3 µm energy incident upon vegetation is essentially absorbed or reflected with little to no transmittance of energy
- Dips in reflectance occur at 1.4, 1.9 and 2.7 µm because water in the leaf absorbs strongly at these wavelengths (*water absorption bands*)
- Reflectance peaks occur at about 1.6 µm and 2.2 µm, between the absorption bands
- Throughout the range beyond 1.3 µm, leaf reflectance is approximately inversely related to the total water present in a leaf which is a function of both the moisture content and the thickness of a leaf

Changes in the reflectance from a vegetative surface owing to water stress



Typical spectral reflectance curves for vegetation, soil and water

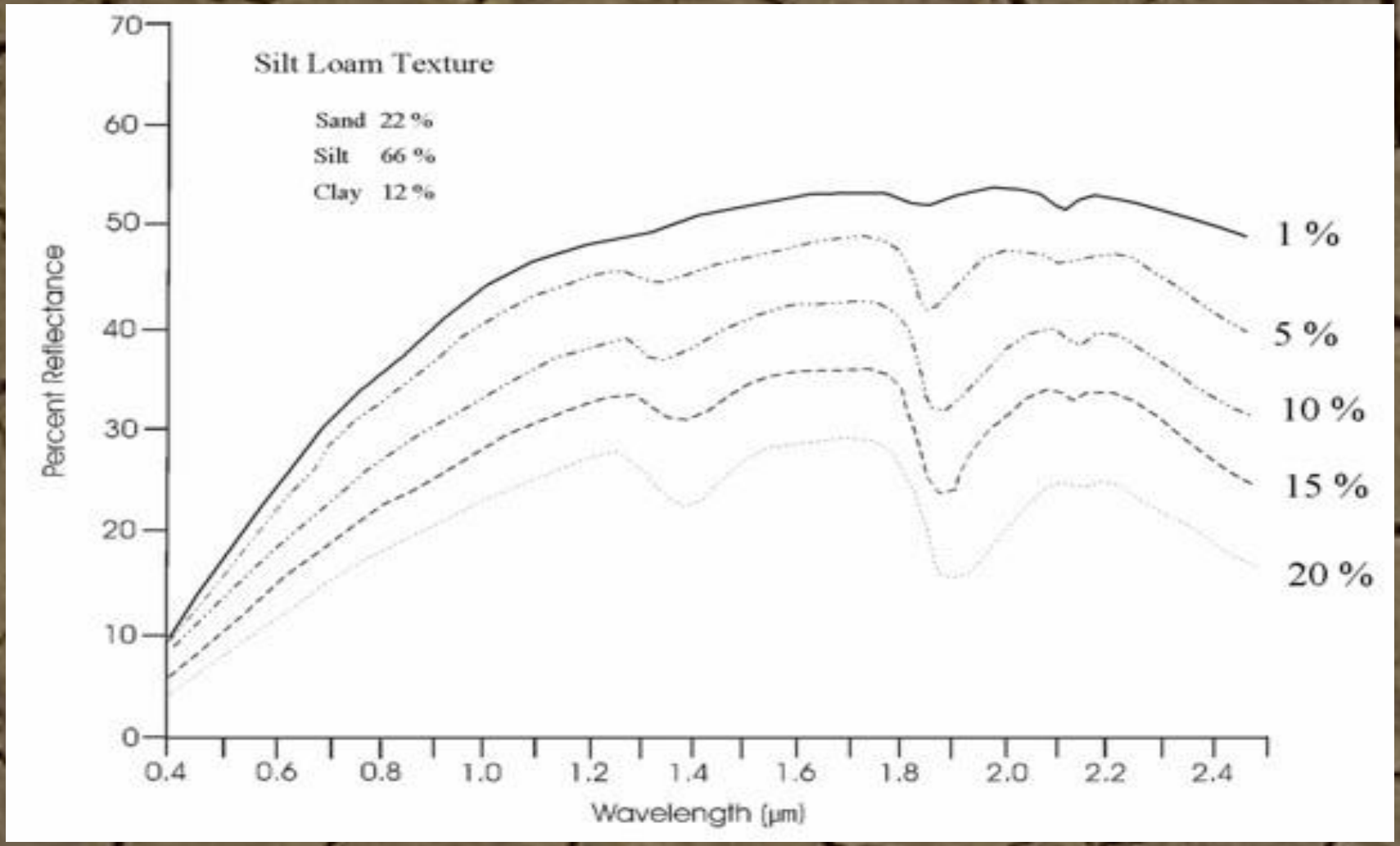


Typical spectral reflectance curves for vegetation, soil, and water.

Spectral reflectance of Soil

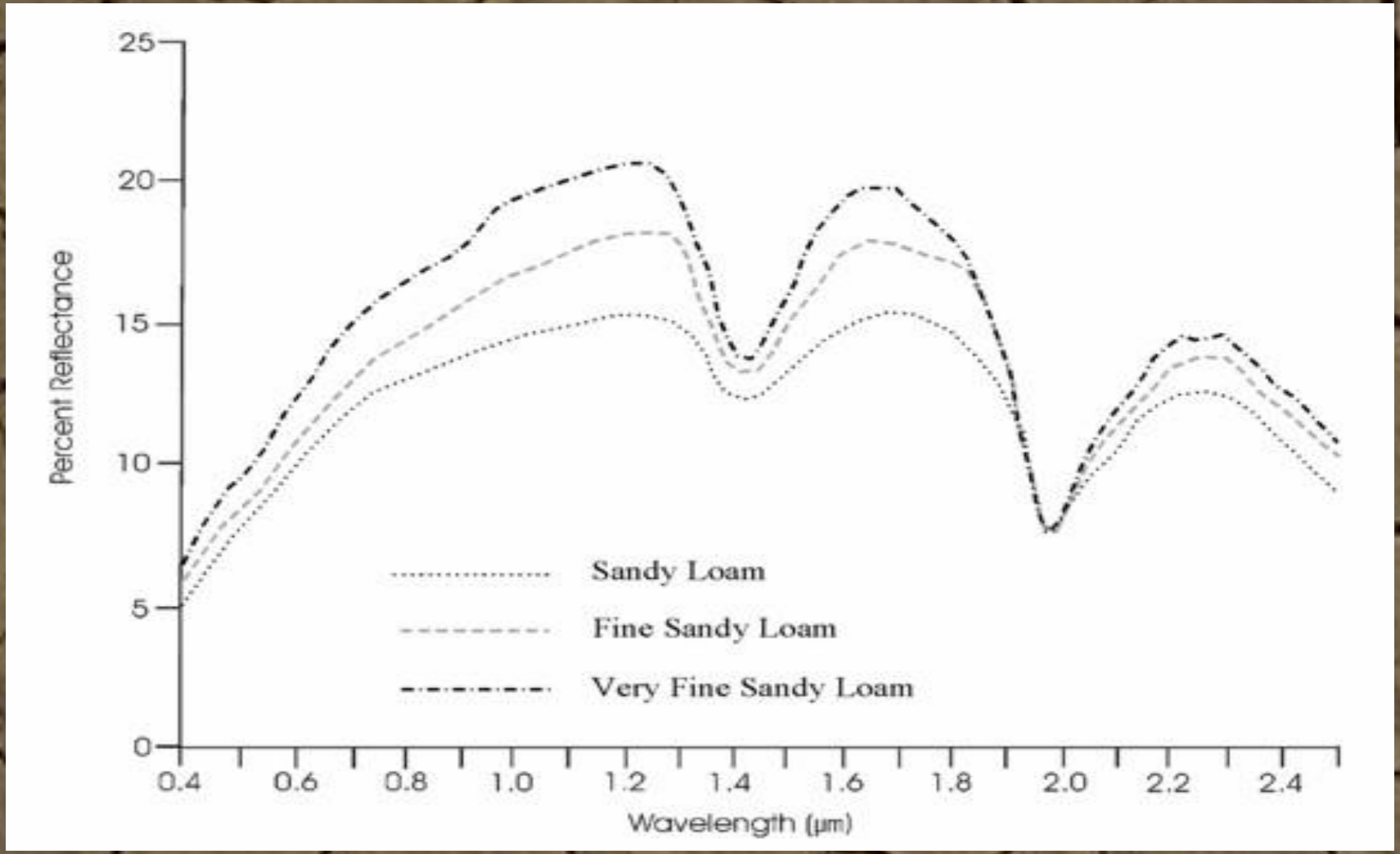
- The factors that influence soil reflectance act over less specified spectral bands
- Factors affecting soil reflectance are moisture content, soil texture (proportion of sand, silt and clay), surface roughness, presence of iron oxide and organic matter content
- The presence of moisture in soil will decrease its reflectance - this effect is greatest in the water absorption bands at about 1.4, 1.9, 2.2 and 2.7 µm
- Soil moisture content is strongly related to the soil texture

Spectral reflectance of Soil



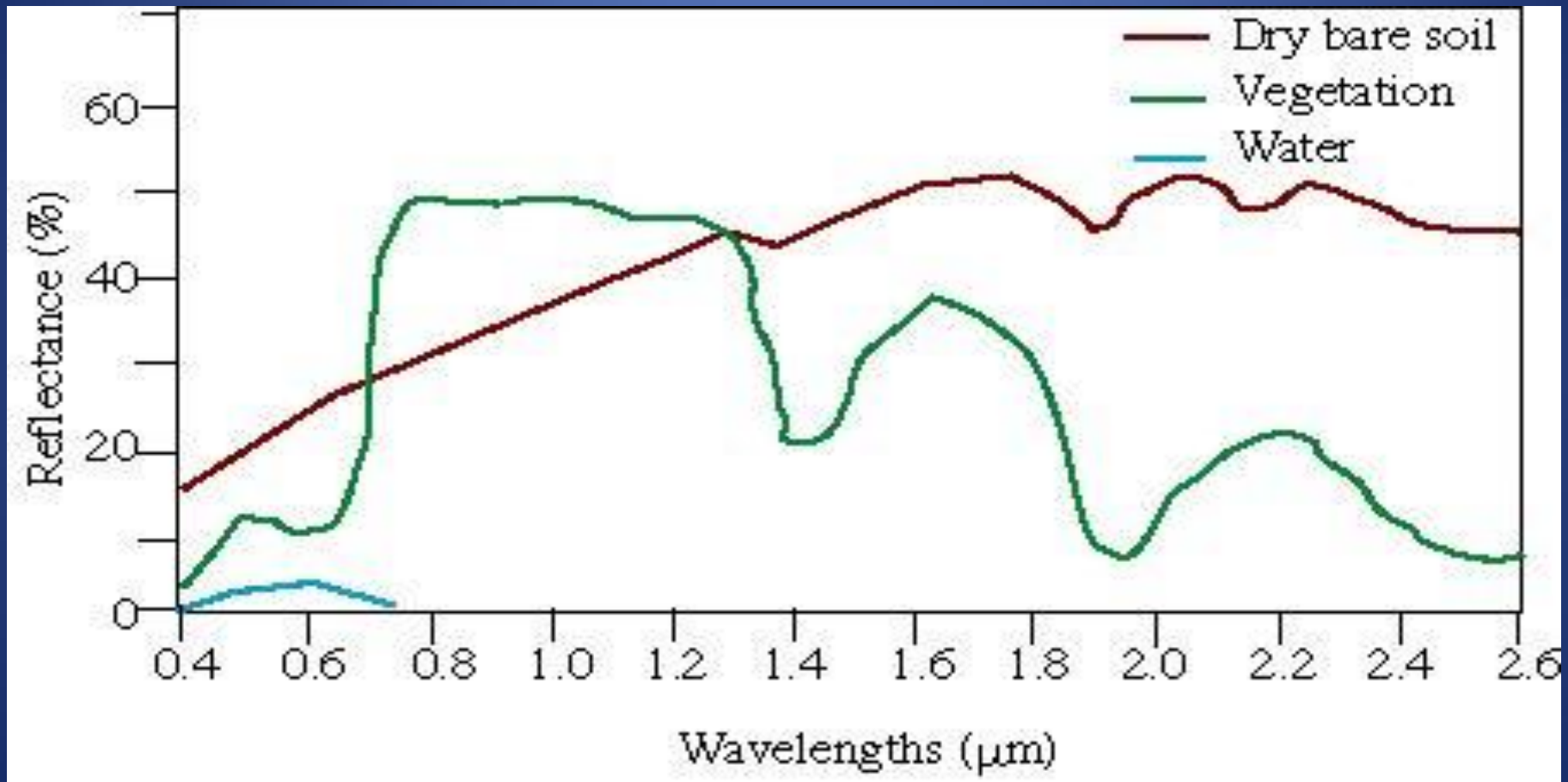
Variation in the spectral reflectance characteristics of soil according to moisture content

Spectral reflectance of Soil



Variation in the spectral reflectance characteristics of soil according to soil texture

Typical spectral reflectance curves for vegetation, soil and water



Typical spectral reflectance curves for vegetation, soil, and water.

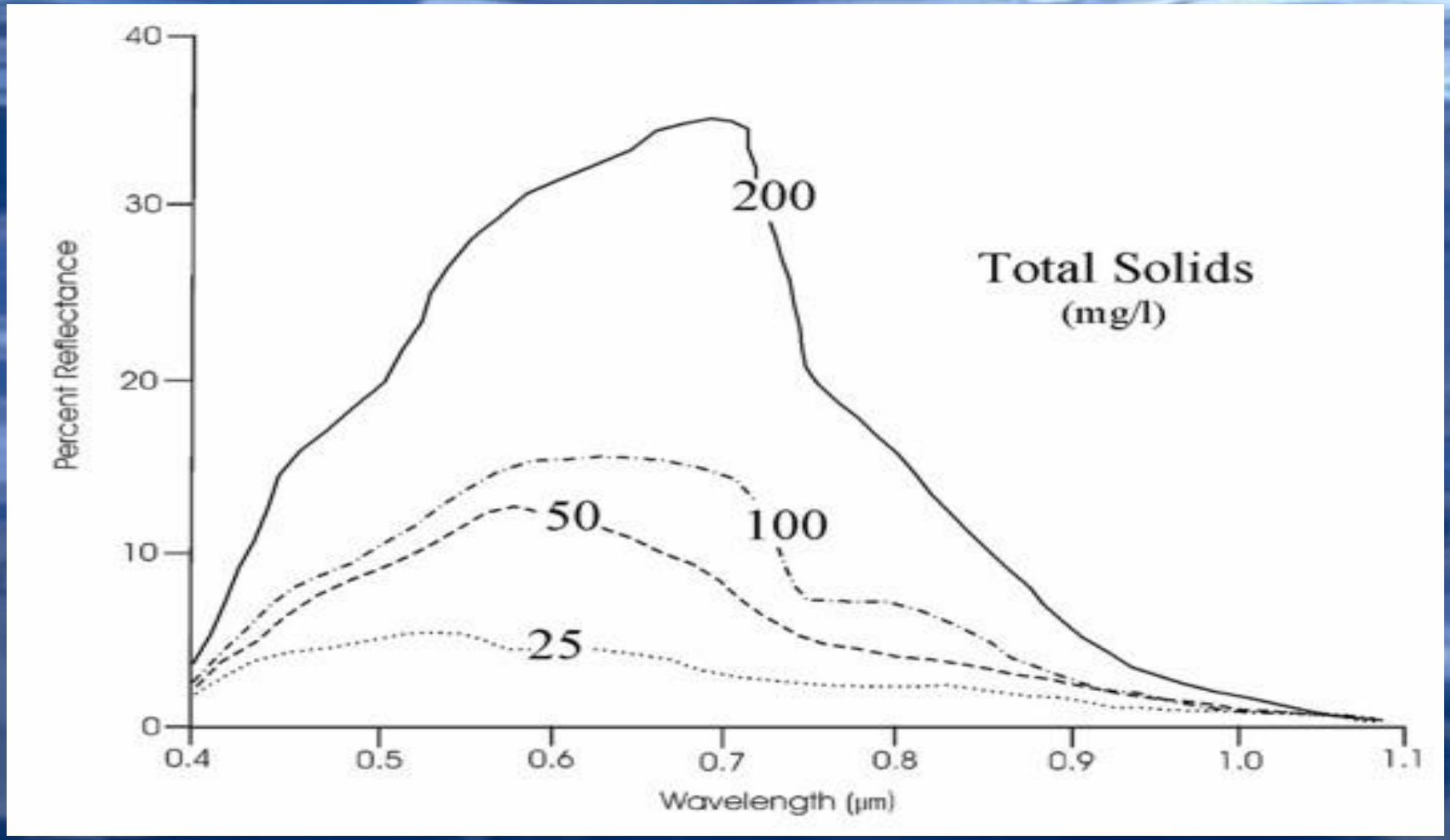
Spectral reflectance of Water

- Water (in soil, vegetation or water bodies) absorbs radiation at near-IR wavelengths and beyond (strong absorption bands at about 1.4, 1.9 and 2.7 μm)
- Reflectance from a water body can stem from an interaction with:
  - the water's surface (specular reflection),
  - with material suspended in the water, or
  - with the bottom of the water body

Spectral reflectance of Water

- Clear water absorbs relatively little energy with wavelengths < 0.6 µm, resulting in high transmittance in the blue-green portion of the spectrum
- As the turbidity of water changes, the reflectance changes dramatically
- Increases in chlorophyll concentration tend to decrease reflectance in blue wavelengths and increase it in green wavelengths (can monitor algae)

Spectral reflectance of Water



Variation in the spectral reflectance characteristics of turbid water according to the content of suspended solids