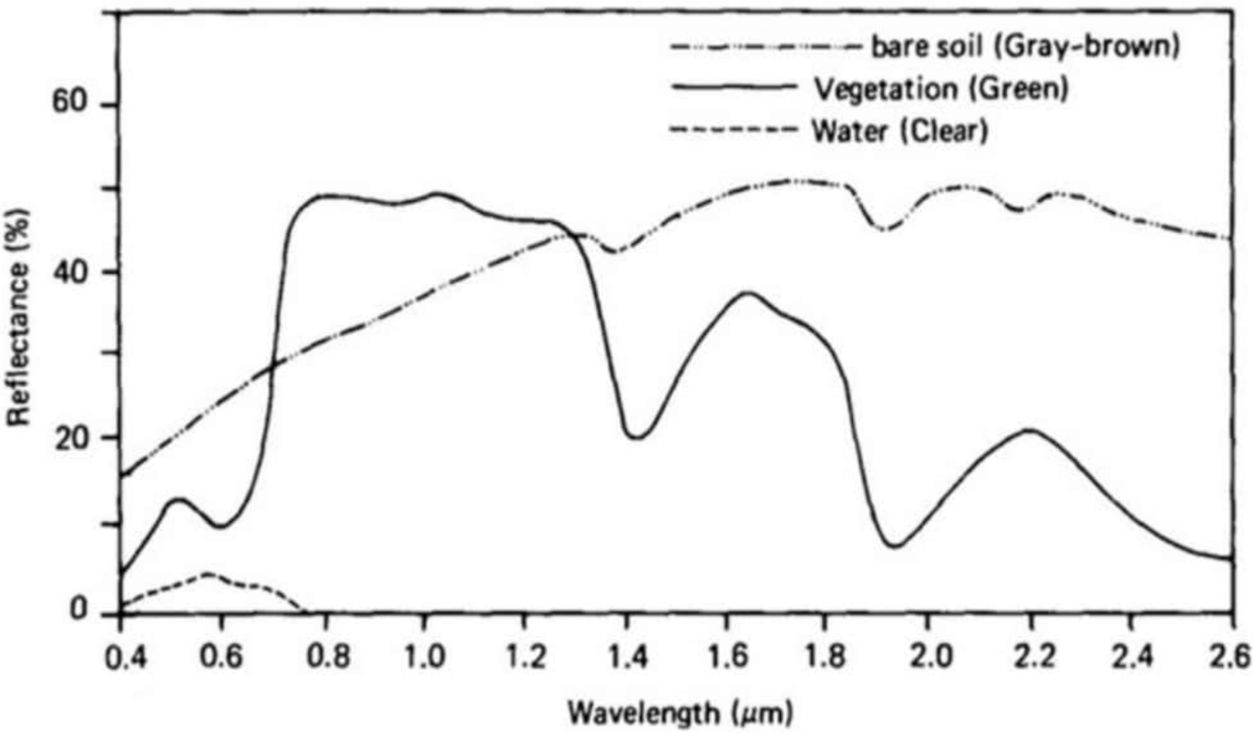
2. Spectral Reflectance of Soil



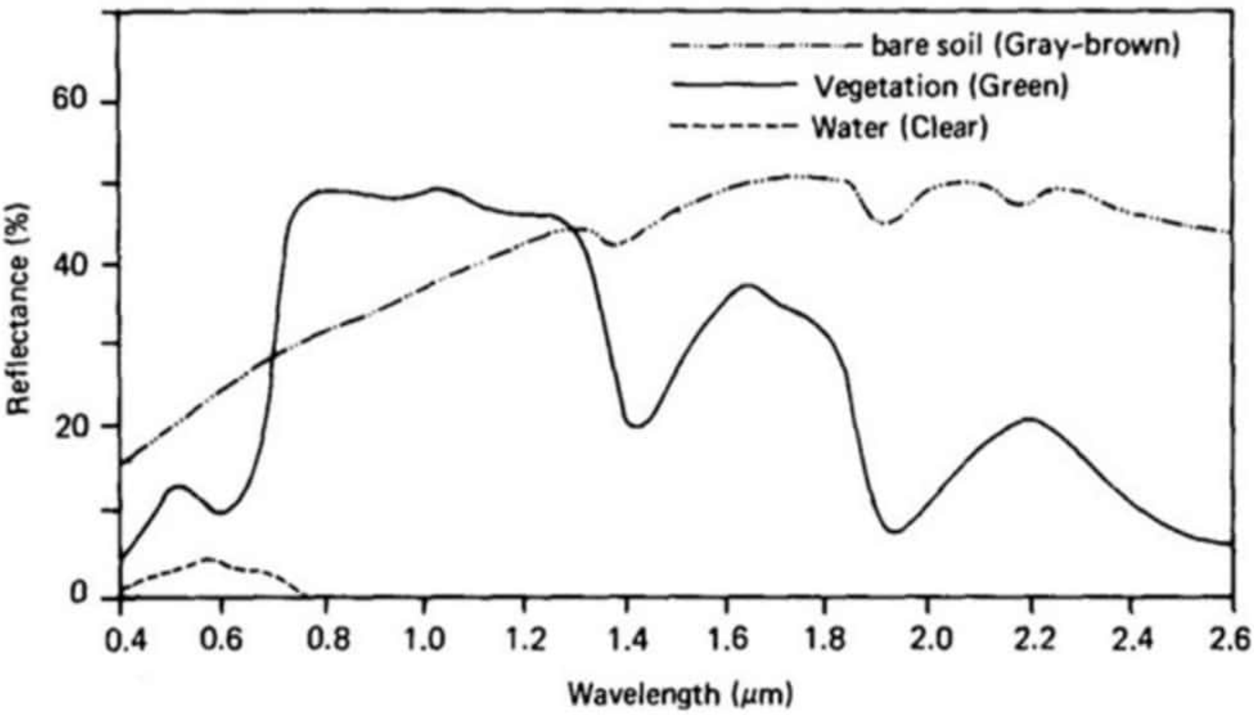
Some of the factors effecting soil reflectance are moisture content, soil texture (proportion of sand, silt, and clay), surface roughness, presence of iron oxide and organic matter content. These factors are complex, variable, and interrelated.

The presence of moisture in soil decreases its reflectance. This effect is greatest in the water absorption bands at 1.4, 1.9, and 2.1 μm. On the other hand, similar absorption characteristics are displayed by the clay soils. Clay soils have *hydroxyl ion absorption bands* at 1.4 and 2.2 μm.

Soil moisture content is strongly related to the soil texture. For example, coarse, sandy soils are usually well drained, resulting in low moisture content and relatively high reflectance. On the other hand, poorly drained fine textured soils generally have lower reflectance. In the absence of water, however, the soil itself exhibits the reverse tendency i.e., coarse textured soils appear darker than fine textured soils.

Two other factors that reduce soil reflectance are surface roughness and the content of organic matter. Presence of iron oxide in a soil also significantly decreases reflectance, at least in the visible region of wavelengths.

3. Spectral Reflectance for Water

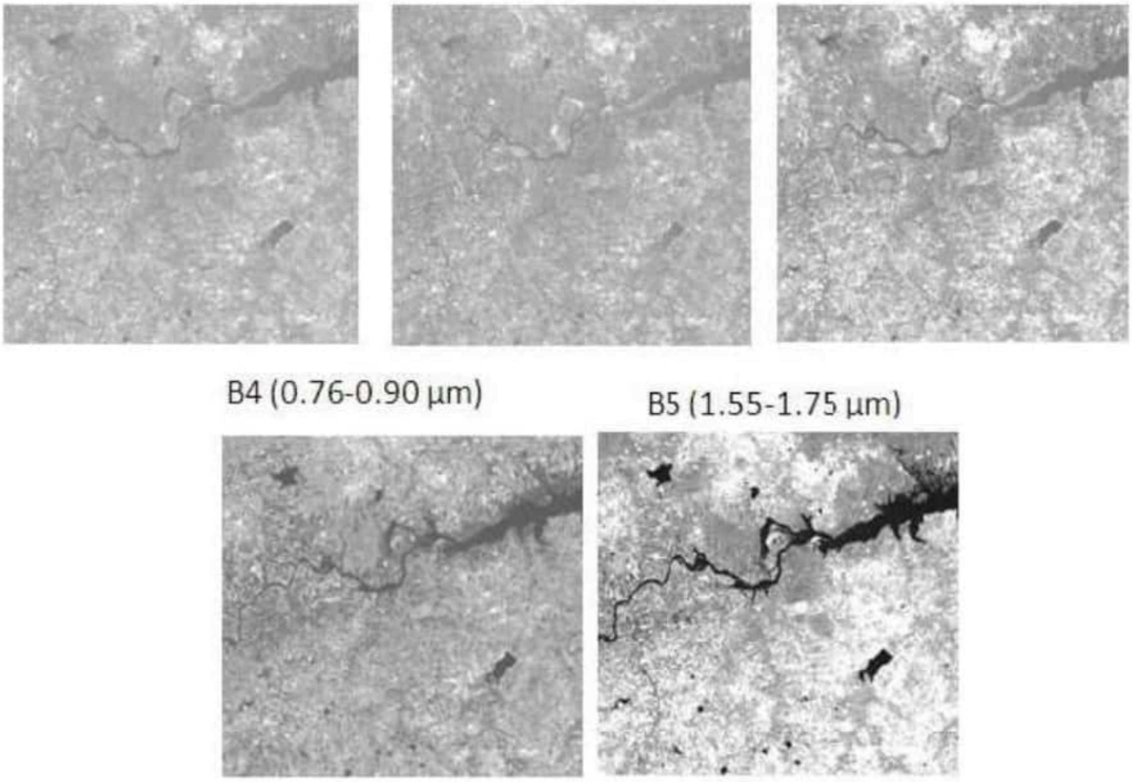


Water provides a semi-transparent medium for the electromagnetic radiation. Thus the electromagnetic radiations get reflected, transmitted or absorbed in water. The spectral responses vary with the wavelength of the radiation and the physical and chemical characteristics of the water.

Spectral reflectance of water varies with its physical condition. In the *solid phase* (ice or snow) water give good reflection at all visible wavelengths. On the other hand, reflection in the visible region is poor in case of water in *liquid stage*. This difference in reflectance is due to *the difference in the atomic bond* in the liquid and solid states.

In the visible region between 0.4μm and 0.7μm, around 0.6μm water in the liquid form shows high reflectance. Wavelengths ***beyond 0.7μm*** are completely absorbed (i.e. no curve formed beyond 0.7μm). Thus clear water appears in ***darker tone*** in the **NIR** image. Locating and delineating water bodies with remote sensing data is done more easily in reflected infrared wavelengths because of this absorption property.

For example, the next Fig. shows a part of the Krishna River Basin in different bands of the Landsat ETM+ imagery. The water body appears in dark colour in all bands and displays **sharp contrast** in the IR bands.

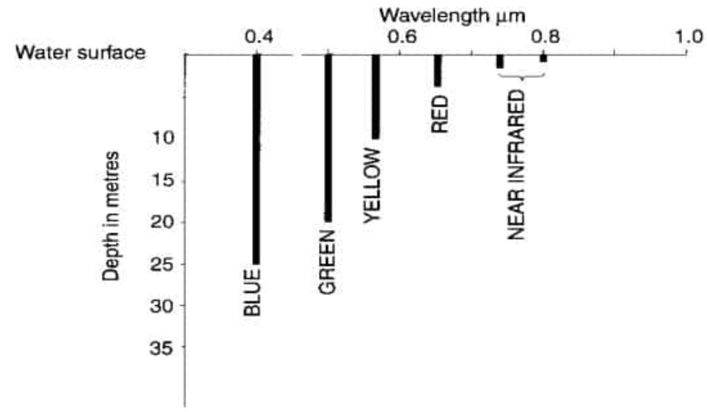


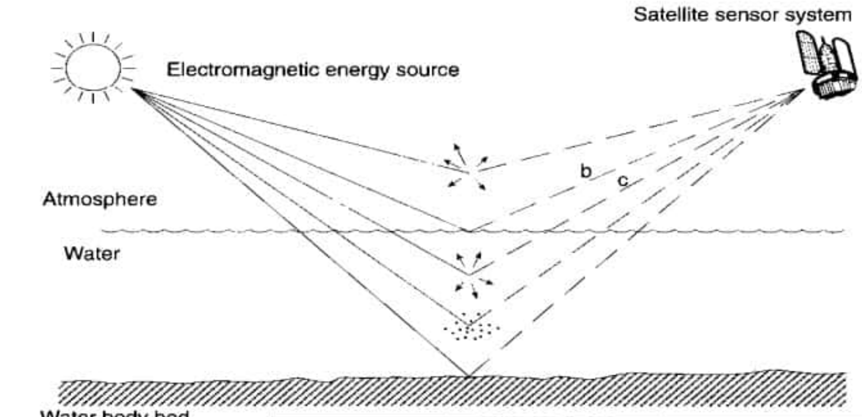
Some important features & facts:

a) Clear water absorbs relatively less energy having wavelengths shorter than 0.6 µm. as the turbidity of water changes (because of the presence of organic or inorganic materials), transmittance and therefore reflectance change dramatically. For example, water bodies containing large quantities of suspended sediments normally have much higher visible reflectance than clear water.

b) Likewise, the reflectance of water changes with the chlorophyll concentration involved. Increase in chlorophyll concentration tends to decrease reflectance in blue wavelengths and increase reflectance in green wavelengths. These changes have been used in remote sensing to monitor the presence and to estimate the concentration of algae.

c) The energy/matter interactions at visible wavelengths are very complex and depend on a number of interrelated factors (as shown in next fig.). Reflectance data in the visible region can also be used to differentiate shallow and deep waters, clear and turbid waters, as well as rough and smooth water bodies. Reflectance in the NIR range is generally used for delineating the water bodies and also to study the algal boom and phytoplankton concentration in water.





scattering and absorption of electromagnetic radiation

	Wavelength
a. Atmospheric attenuation	
b. Surface reflection	
c. Volume reflection	Blue, green
d. Reflection from suspended particles	Red, green
e. Reflection from bed material	Yellow, green, dark blue