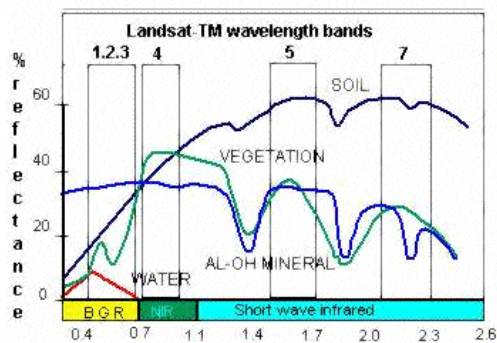# Band Combinations

Most earth observation satellites record in several spectral bands, in other words; the satellite records a number of small wavelength intervals within the electromagnetic spectrum (visible light, near and short wave infrared). By means of the basic colours red, green and blue (RGB) it is possible to construct several band combinations in which the colours tell something about the parts of the spectrum that are represented in RGB.

Wellenlängen der Kanäle des Landsat Thematic Mapper

Demonstrated hereunder is how various band combinations are shown by the Landsat satellite. Landsat records in 7 spectral bands, see the Landsat TM wavelength bands in the figure above, and RGB combination of certain bands lead to images with different information content. Demonstrated is how a band combination will show in flat agricultural area (The Netherlands) and how this will be for a mountainous area (Bosnia Herzegovina).

21: combination of red (3) - green (2) - blue (1)
red: 0.61 - 0.69 µm
green: 0.51 - 0.60 µm
blue: 0.45 - 0.51 µm

This band combination is used to represent an image in natural colour and therefore best approaches the appearance of the landscape in reality. Band 3 detects chlorophyll absorption in vegetation (thus low reflection). Band 2 detects the green reflectance from vegetation. Band 1 is more suited for penetration in water, in clear water this can be some 25 meters. On the other hand one can also derive information about sediment transportation in water from this band. Band 1 also differentiates between soil and vegetation and distinguishes forest types.

432: combination of VNIR (Visible Near Infra Red) (4) - red (3) - green (2)
VNIR: 0.76 - 0.90 µm
red: 0.61 - 0.69 µm
green: 0.51 - 0.60 µm

These three bands are typically combined to make a 'traditional' false colour composite as one also knows from aerial photography. In band 4, especially the high reflectance peak from vegetation is detected, also enabling discrimination of numerous vegetation types. Also detecting land-water is well possible with band 4. This false colour combination makes vegetation appear as redtones, brighter reds indicating more the growing vegetation. Soils with no or sparse vegetation range from white (sand, salt) to greens or browns depending on moisture and organic matter content. Water appears blue; clear water will be dark blue to black while shallow waters or waters with high sediment concentrations are lighter blue. Urban areas will appear blue towards gray.

453: combination of VNIR (4) - SWIR (Short Wave Infra Red) (5) - red (3)
VNIR: 0.76 - 0.90 μm
SWIR: 1.55 - 1.75 μm
red: 0.61 - 0.69 μm

The short wave infrared band (band 5 for Landsat) is sensitive to variations in water content, for leafy vegetation as well as soil moisture. This band features a very high water absorption, thus enabling detection of very thin water layers (less than 1 cm). Also variations in ferric iron (Fe_2O_3) content in rocks and soils can be detected; higher reflections with higher contents. In this combination vegetation appears in shades of red. When a crop has a relative lower moisture content, the reflection from band 5 will be relatively higher, meaning more contribution of green and thus resulting in a more orange colour. The colour green will begin to dominate in this combination when the vegetation reflects lower in the VNIR and higher in the SWIR. Non vegetated soils and urban areas will appear in blue towards gray colours.

742: combination of SWIR (7) - VNIR (4) - green (2)
SWIR: 2.08 - 2.35 μm
VNIR: 0.76 - 0.90 μm
green: 0.51 - 0.60 μm

In this band combination the vegetation shows in various green shades because band 4 (high reflectance of vegetation) is presented in the colour green. Like Landsat band 5 (also SWIR), band 7 is sensitive to variations in moisture content and especially detects this in hydrous minerals in geologic settings (such as clays). This band can discriminate in various rock and mineral types. Differences originating from these various types are presented in shades of red to orange in this band combination but also the brighter shades in the blue can give information about soils. In comparison to the other IR channels and apart from recording the normal reflective radiation, band 7 is increasingly sensitive to the emissive radiation so that it's possible to detect heat sources with this band. Bright green spots indicate vegetation and the waters appear dark blue or black. Urban areas will be also dark blue or pink.

Quelle: http://gdsc.nlr.nl/gdsc/en/earth_observation/band_combinations