BAND RATIO

NDVI & NDWI

Image Transformations

- Image transformations typically involve the **manipulation of multiple bands of data**,

whether from a single multispectral image or from two or more images of the same area acquired at different times (i.e. multitemporal image data)

- Either way, image transformations **generate "new" images**
- Highlight particular features or properties of interest, **better than the original input images**

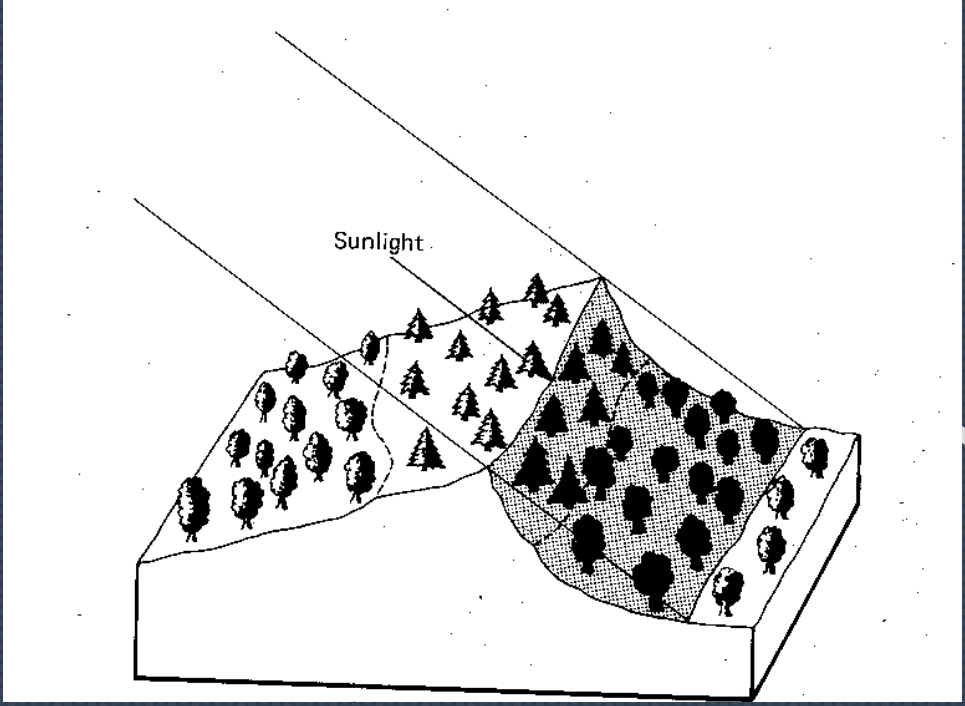
Image Division

- The most common transforms applied to image data
- On a **pixel-by-pixel basis** carry out the following operation
- **Band1/Band2 = New band**
- Resultant data are then rescaled to fill the range of display device
- Very popular technique, commonly called **‘Band Ratio**’

Reasons / Application of Ratios

- Undesirable effects on recorded radiances (e.g. variable illumination) caused by variations in topography.
- Sometimes differences in BV's from identical surface material are caused by **topographic slope and aspect, shadows or seasonal changes**
- These conditions **hamper the ability of an interpreter** to correctly identify surface material or land use in a remotely sensed image.
- Ratio transformations can be used to **reduce the effects of such environmental conditions**

Ratios for Elimination of Topographic Effect



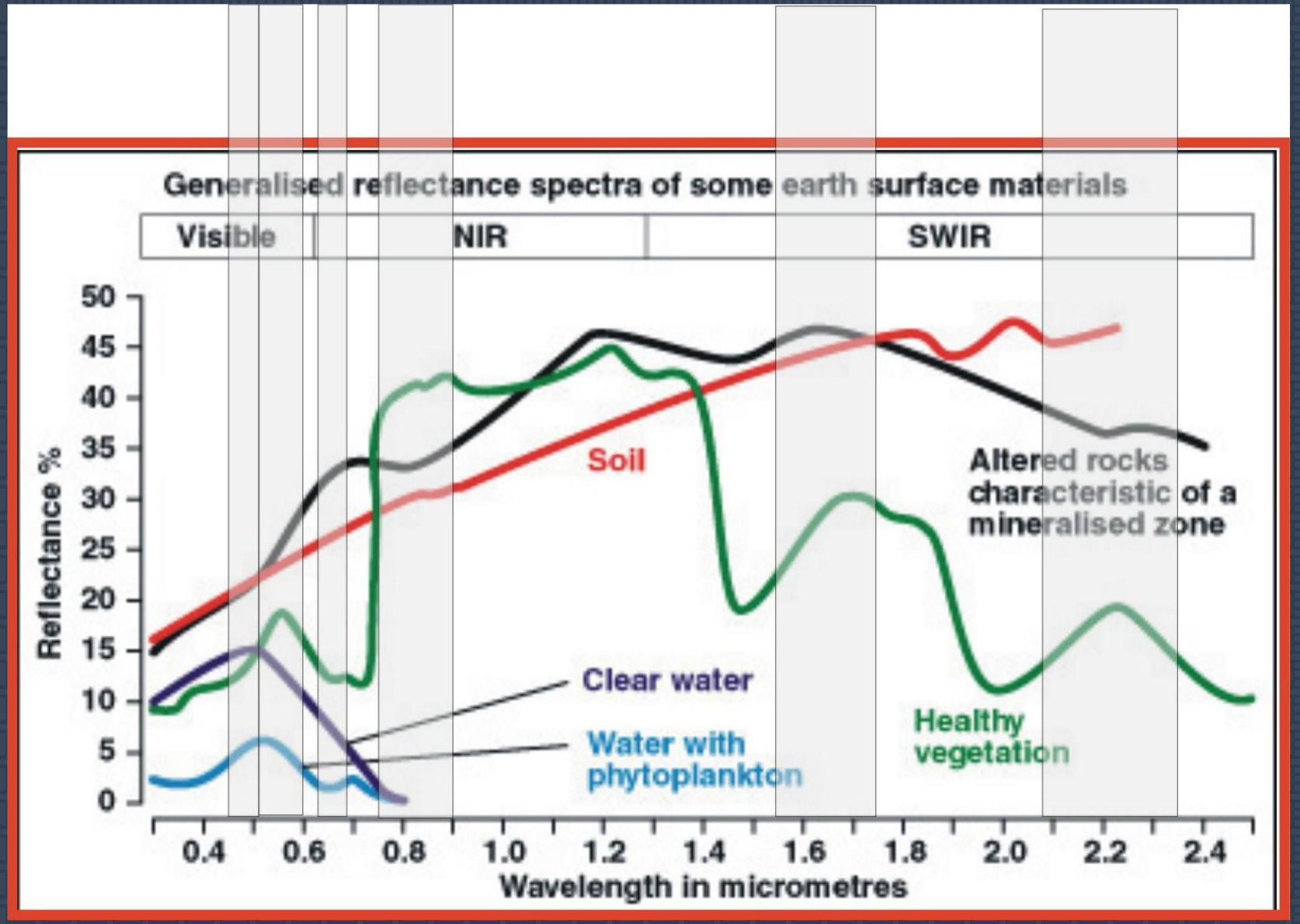
Land Cover/ Illumination	Digital Number		Ratio Band A/ Band B
	Band A	*Band B*	
Deciduous			
Sunlit	48	50	**0.96**
Shadow	18	19	**0.95**
Coniferous			
Sunlit	31	45	**0.69**
Shadow	11	16	**0.69**

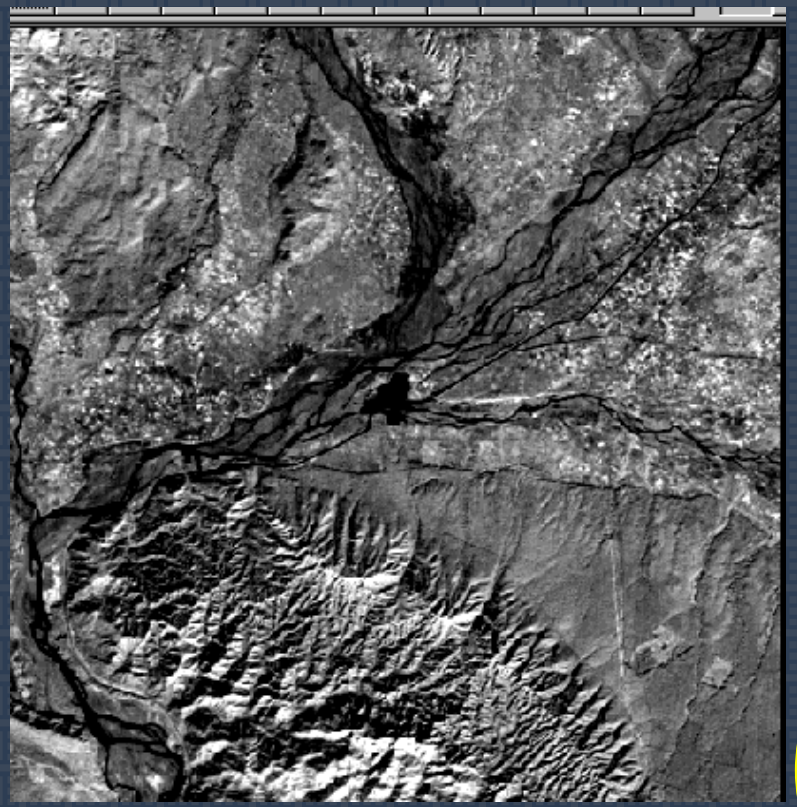
- ✓ Same land cover type
- ✓ Radiance at shadow is only **50%** of radiance at sunlit
- ✓ Ratio nearly identical

Use/ Application of Ratios

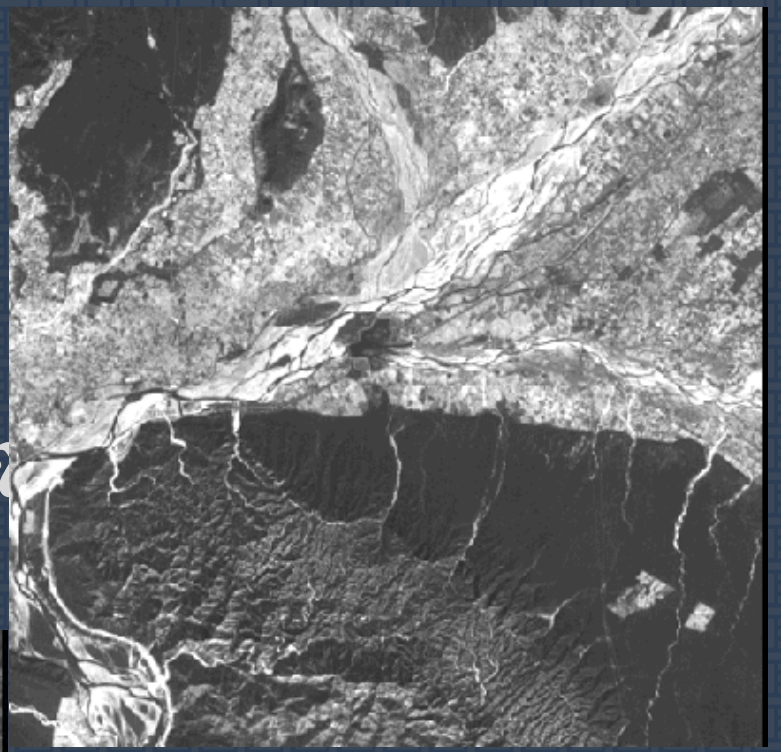
- Certain aspects of the **shape of spectral reflectance curves** of different Earth surface cover types can be brought out by ratioing.
- In addition, ratios may provide **unique information not available in any single band**
- Ratios discriminante **subtle spectral variances**
- Ratios clearly portray the **variations of slopes of spectral reflectance** curves between two bands involved
- Ratios are **independent of the absolute pixel values**
- Ratios can be used to generate false colour composites by combining three monochromatic ratio data sets

Which Bands to Ratio?





NIR

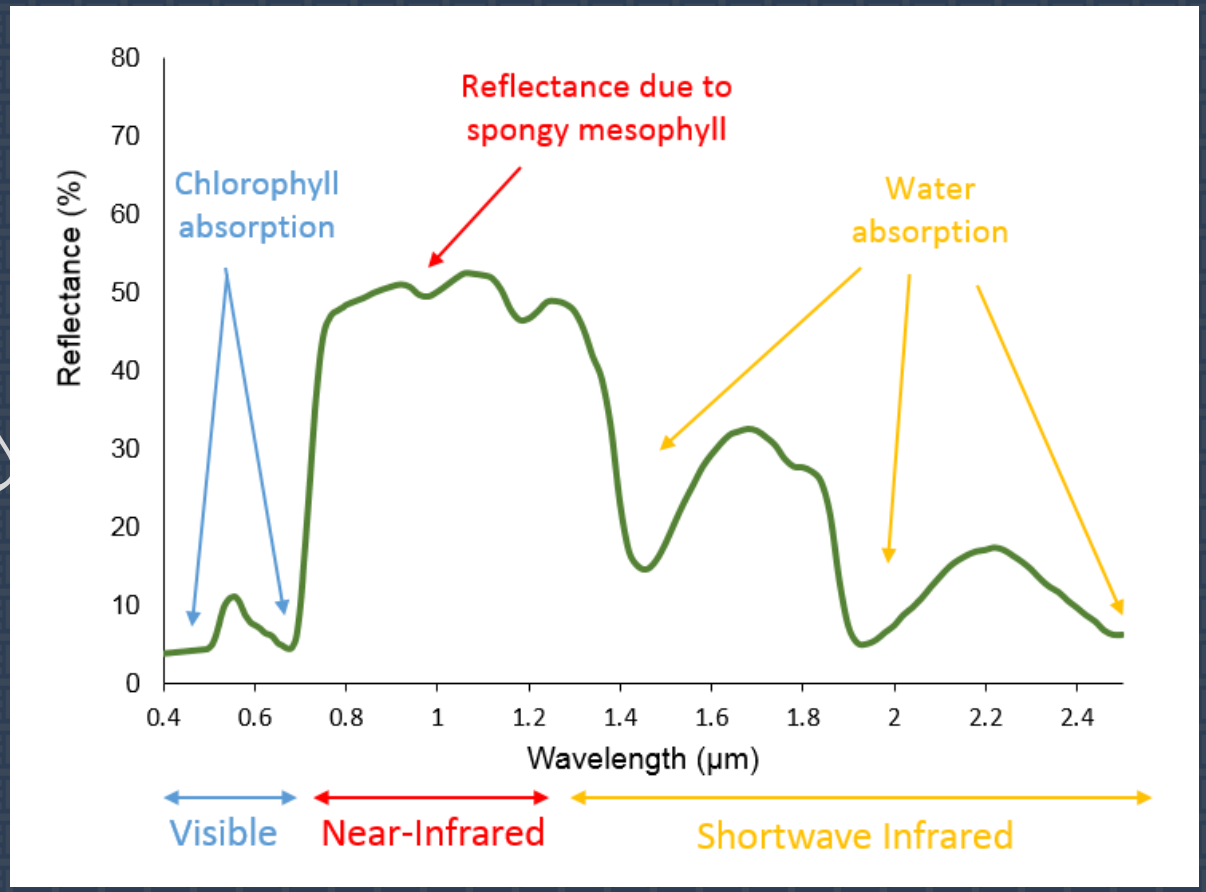


Red

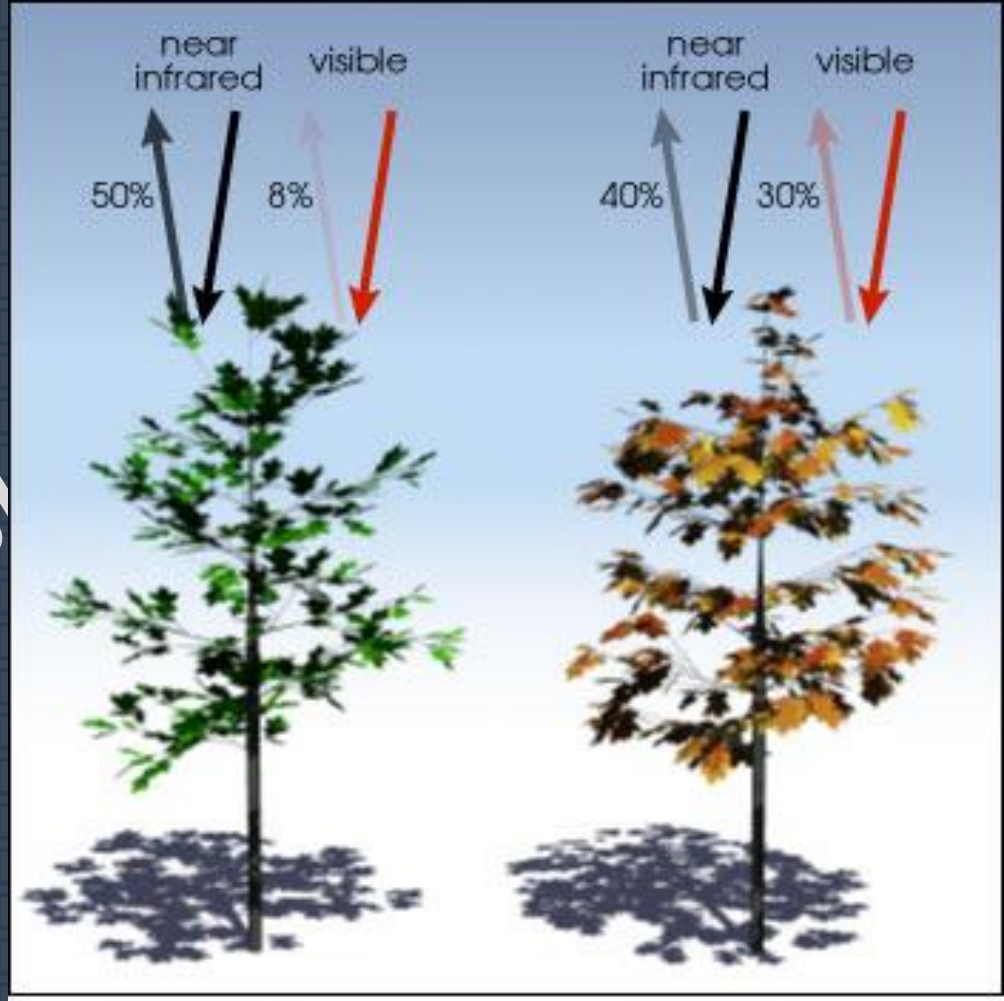
Ratio NIR/Red

NDVI

- The **normalized difference vegetation index** (NDVI) is a simple graphical indicator that can be used to analyze remote sensing measurements, often from a space platform, assessing whether or not the target being observed contains live green vegetation.
- NDVI = (NIR- Red) / (NIR + Red)
- By design, the NDVI itself thus varies between **(-1 to +1)**
- The green pigment in plant leaves, chlorophyll, strongly absorbs energy in the wavelengths bands centered at **0.45 & 0.67 µm**
- The **cell structure of the leaves**, on the other hand, strongly reflects near-infrared light (from 0.7 to 1.3 µm).



- NDVI always ranges from -1 to +1. But there isn't a distinct boundary for **each type of land cover**.
- For example,
  - ✓ when you have **negative values,** it's highly likely that it's **water** (low reflectance in both spectral bands)
  - ✓ On the other hand, if you have a **NDVI value close to +1**, there's a high possibility that it's **dense green leaves**.
  - ✓ when **NDVI is close to zero**, there isn't green leaves and it could even be an **urbanized area**.
  - ✓ **soils** which generally exhibit a near-infrared spectral reflectance somewhat larger than the red, and thus tend to also generate rather **small positive NDVI values (say 0.1 to 0.2)**



NDVI is used to identify health of the vegetation.

Healthy or stressed?

NDWI (Normalized Difference Water Index)

Normalized Difference Water Index (NDWI) may refer to one of at least two remote sensing derived indexes related to **liquid water**:

1. One is used to monitor changes in water content of leaves, using near-infrared (NIR) and short-wave infrared (SWIR) wavelengths, proposed by **Gao in 1996**:

$$NDWI = (NIR - SWIR) / (NIR + SWIR)$$

2. Another is used to monitor changes related to **water content in water bodies**, using green and NIR wavelengths, defined by **McFeeters** (1996):

$$NDWI = (Green - NIR)/ (Green + NIR)$$

- If looking to monitor vegetation in drought affected areas, then it is advisable to use NIR and SWIR.
- The combination of the **NIR with the SWIR removes variations induced by leaf internal structure and leaf dry matter content**, improving the accuracy in retrieving the vegetation water content.
- If looking for **water level or change in water level** (e.g. flooding), then it is advisable to use the **green** and **NIR** spectral bands.

Interpretation

- Visual or digital interpretation of the output image/raster created is similar to NDVI:
  - ✓ **-1 to 0**: Bright surface with **no vegetation or water content**
  - ✓ **+1**: represent **water content**
- For the second variant of the NDWI, another threshold can also be found in that avoids creating false alarms in urban areas:
  - ✓ < **0.3** - Non-water
  - ✓ >= **0.3** - Water
- The NDWI is commonly used to monitor **vegetation water stress** and thus can be used in the field of **irrigation management**