

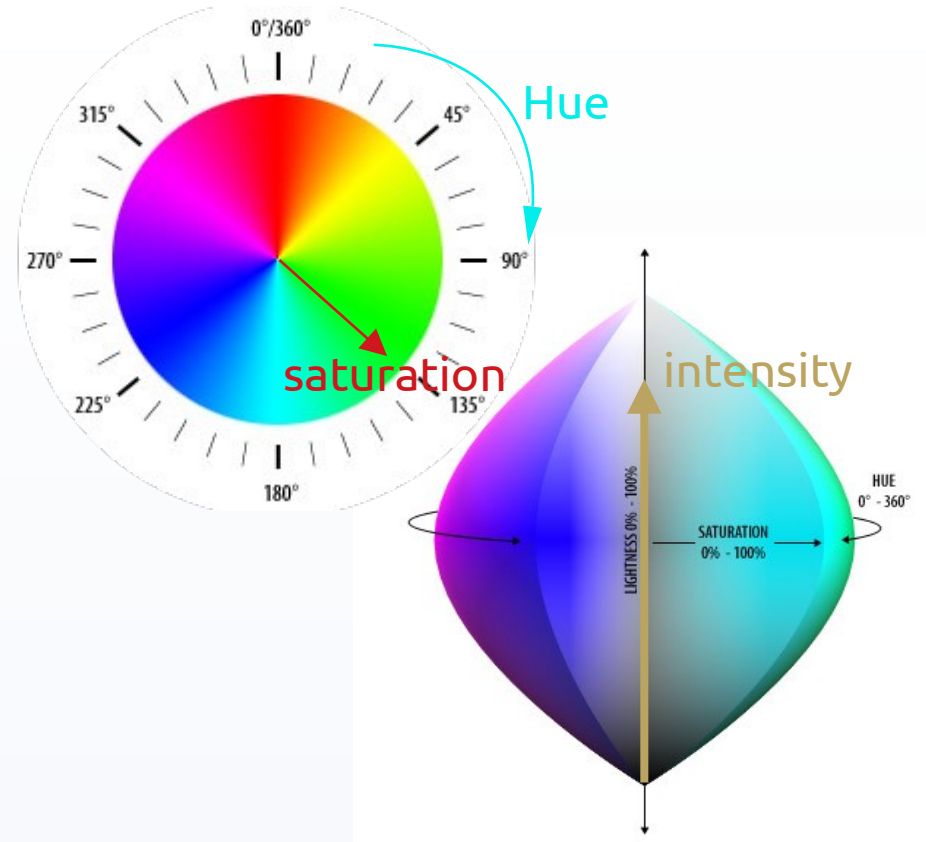
EGM310: GIS and Remote Sensing

Week 11, Part 4: Image Decomposition & Transformation

- RGB composites are not the only tool we have for visualizing, analyzing images
- RGB is only one colour system:
 - Red, Yellow, Blue (RYB)
 - Cyan, Yellow, Magenta, Black (CYMK)
 - Intensity, Hue, Saturation (IHS)
- Can also manipulate images to exploit spectral reflectance patterns

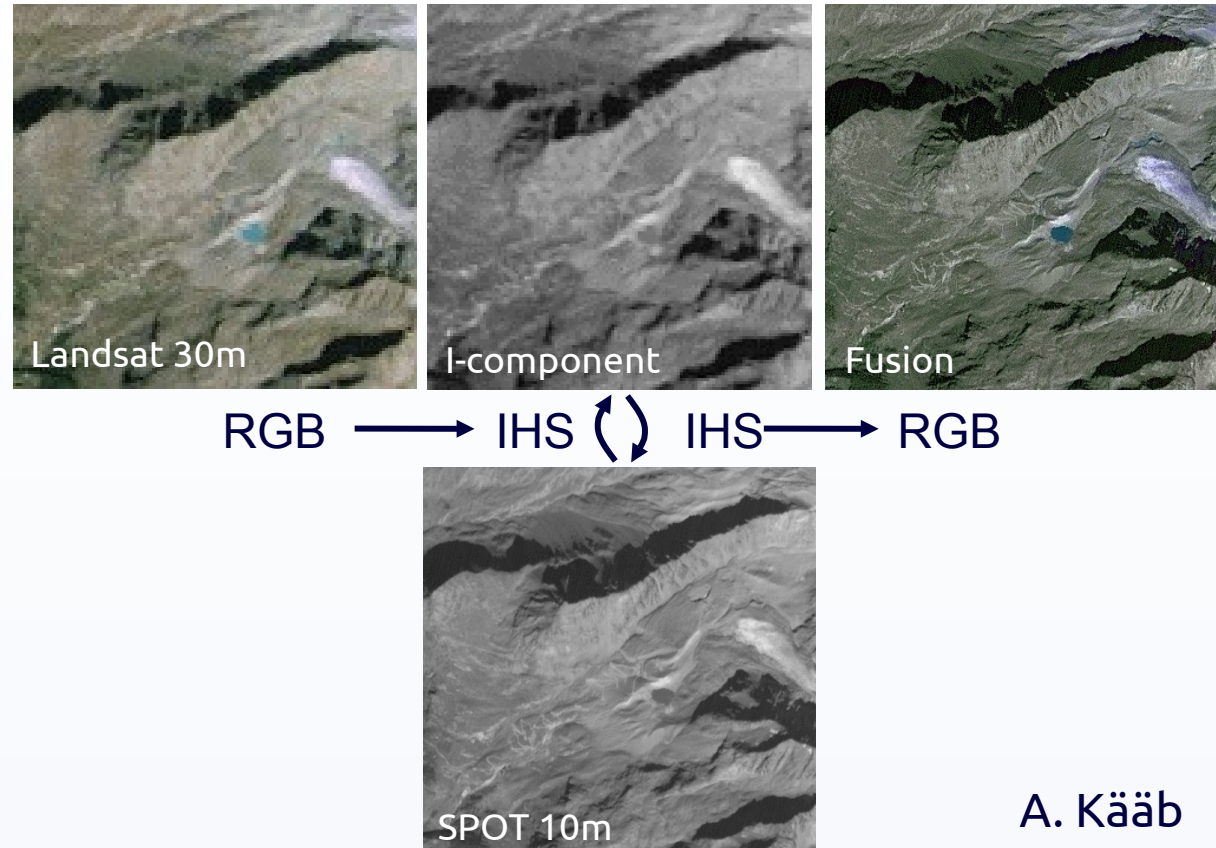
Intensity, Hue, Saturation (IHS)

- Sometimes also called Hue, Saturation, Lightness (HSL)
- Components:
 - **Hue**: the colour of the pixel
 - **Saturation**: how much white is mixed with colour
 - **Intensity/Lightness**: how bright the pixel is



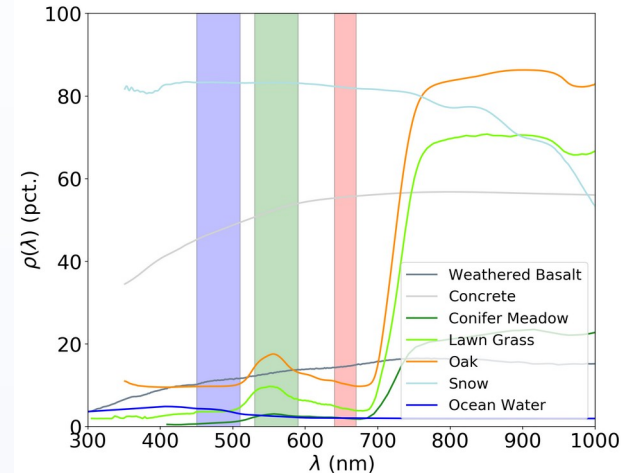
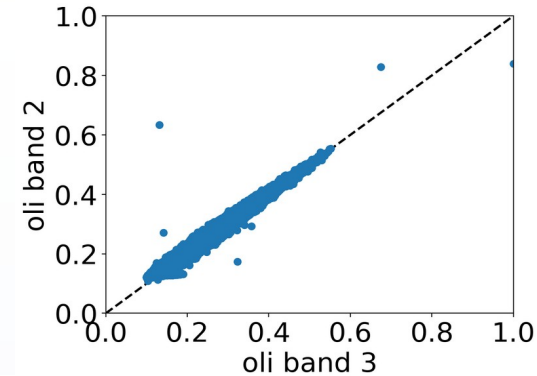
Example: IHS Fusion

- Use high-resolution pan-chromatic data to 'sharpen' multispectral data
- Steps:
 1. Re-sample MS data to same resolution as Pan
 2. Transform MS to IHS
 3. Swap intensity for high-resolution pan
 4. Transform IHS to high-resolution RGB

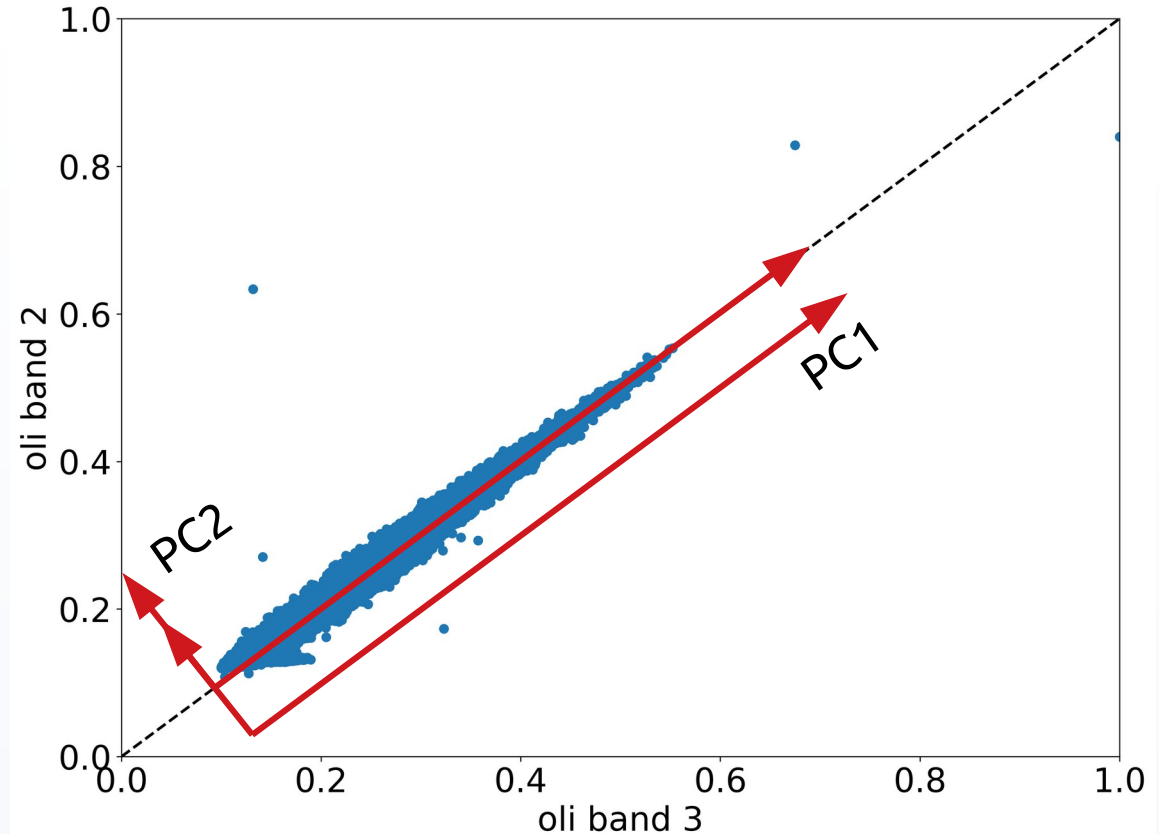
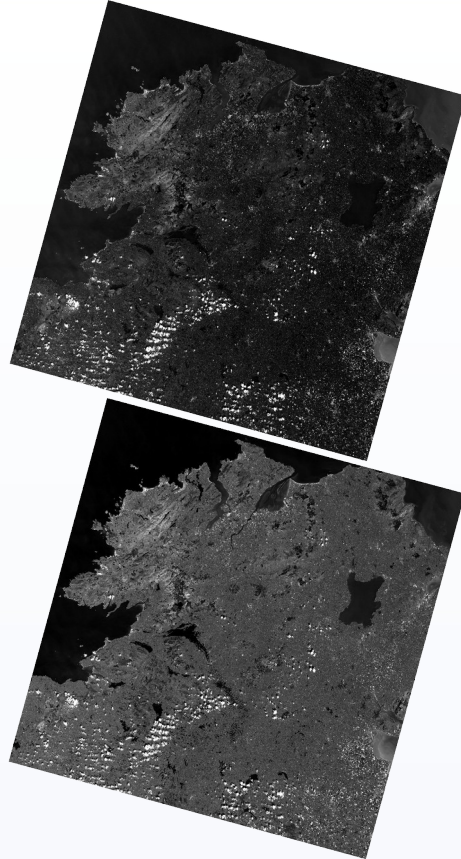


A. Kääb

- Many surfaces have similar reflectances in nearby wavelengths
- Results in **redundant** information being stored
- Can also make distinguishing different surfaces difficult
 - e.g., snow vs cloud, different kinds of vegetation
- Often, we want to maximise the differences between bands

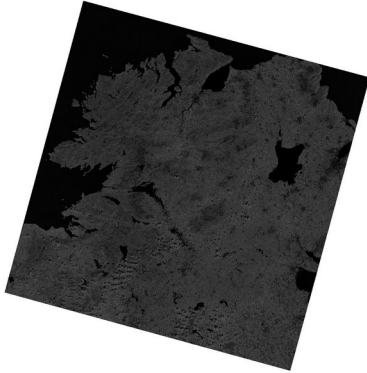


Principal Component Transformation

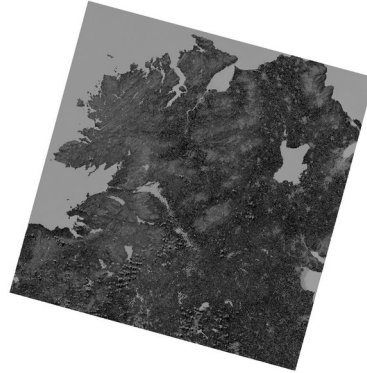


Principal components

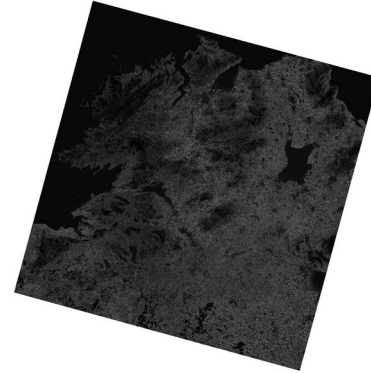
PC1



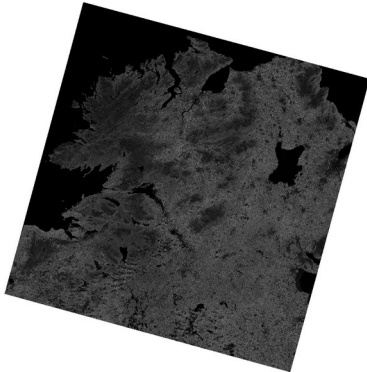
PC2



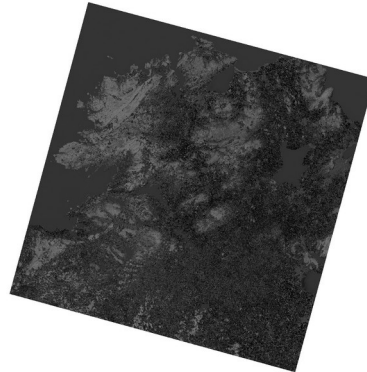
PC3



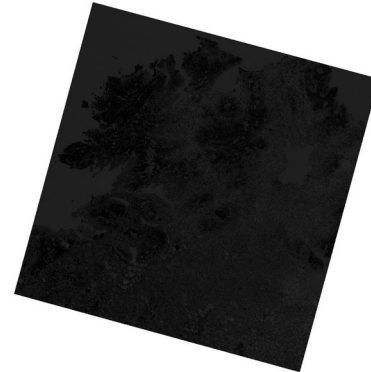
PC4



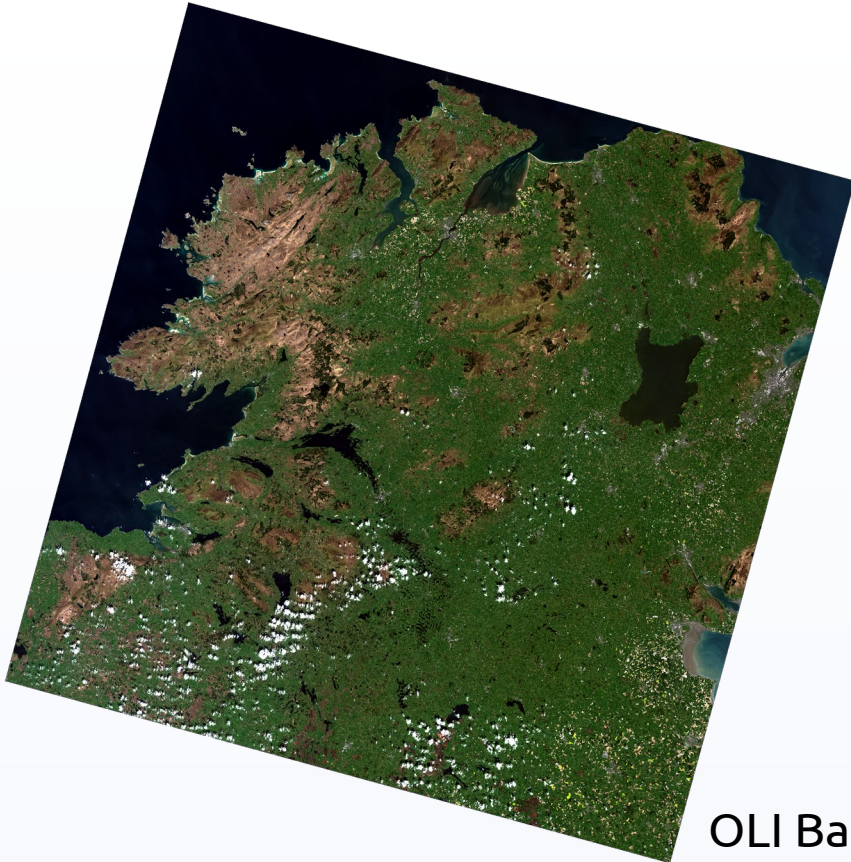
PC5



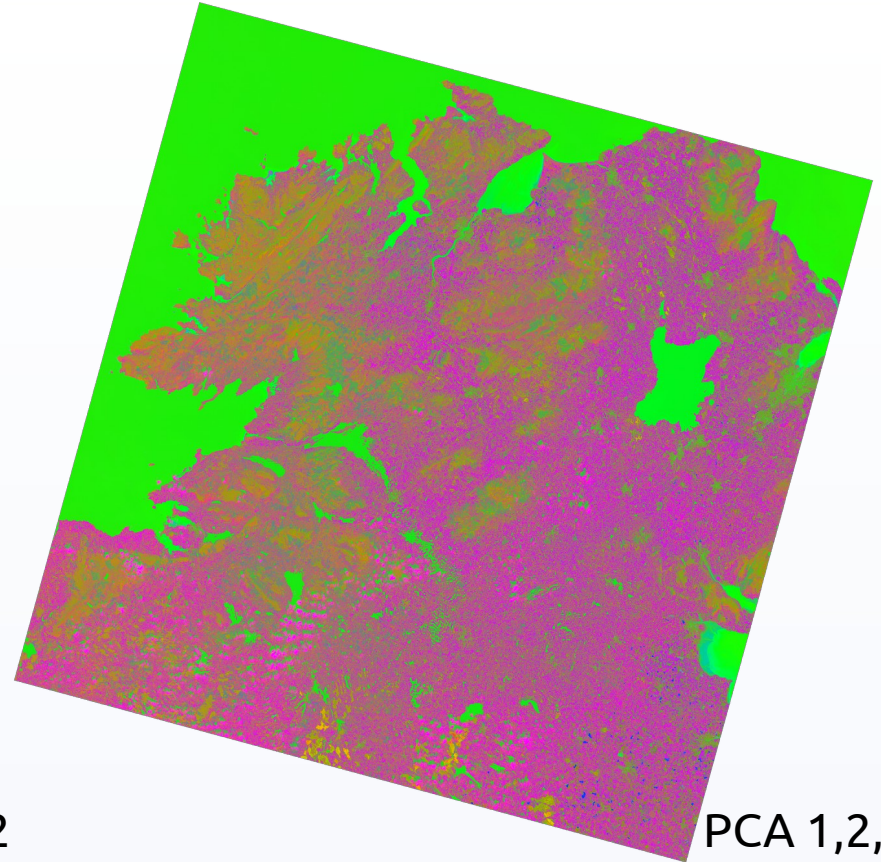
PC6



Decorrelation stretch

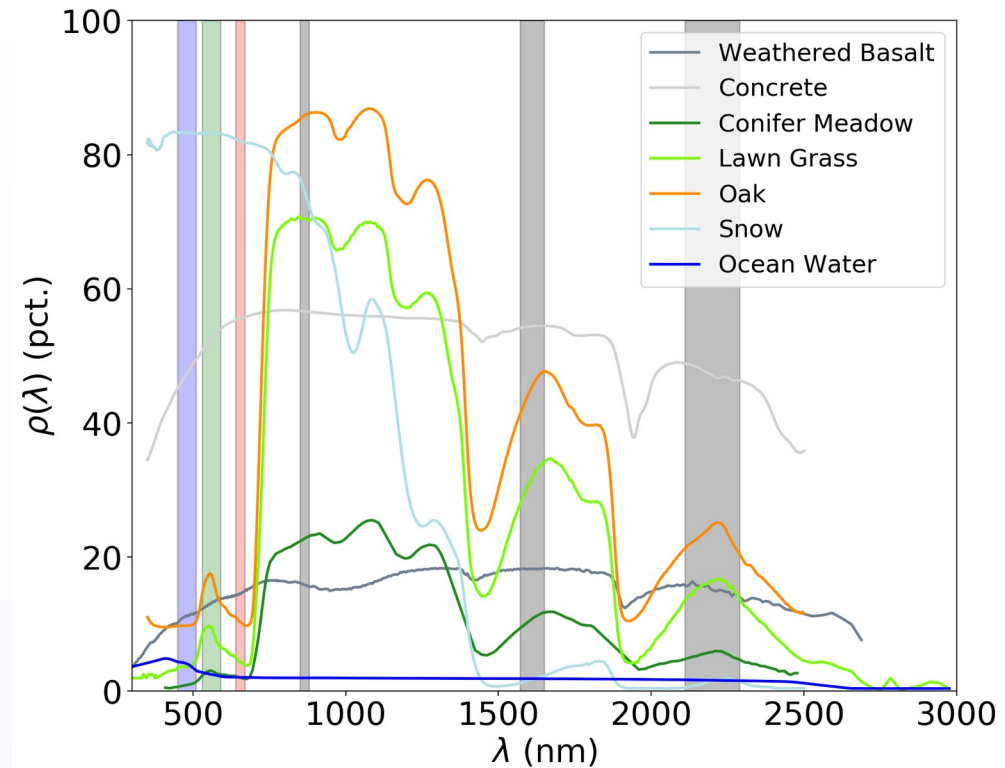


OLI Bands 4,3,2



PCA 1,2,3

- We can also add, subtract, multiply, divide different bands
- Enhances the differences between different bands
- Example:
 - For plants*, $\rho(\text{NIR}) \gg \rho(\text{Red})$
 - For most other surfaces, $\rho(\text{NIR}) \approx \rho(\text{Red})$
- To eliminate illumination effects, we can **normalize** by the total reflectance

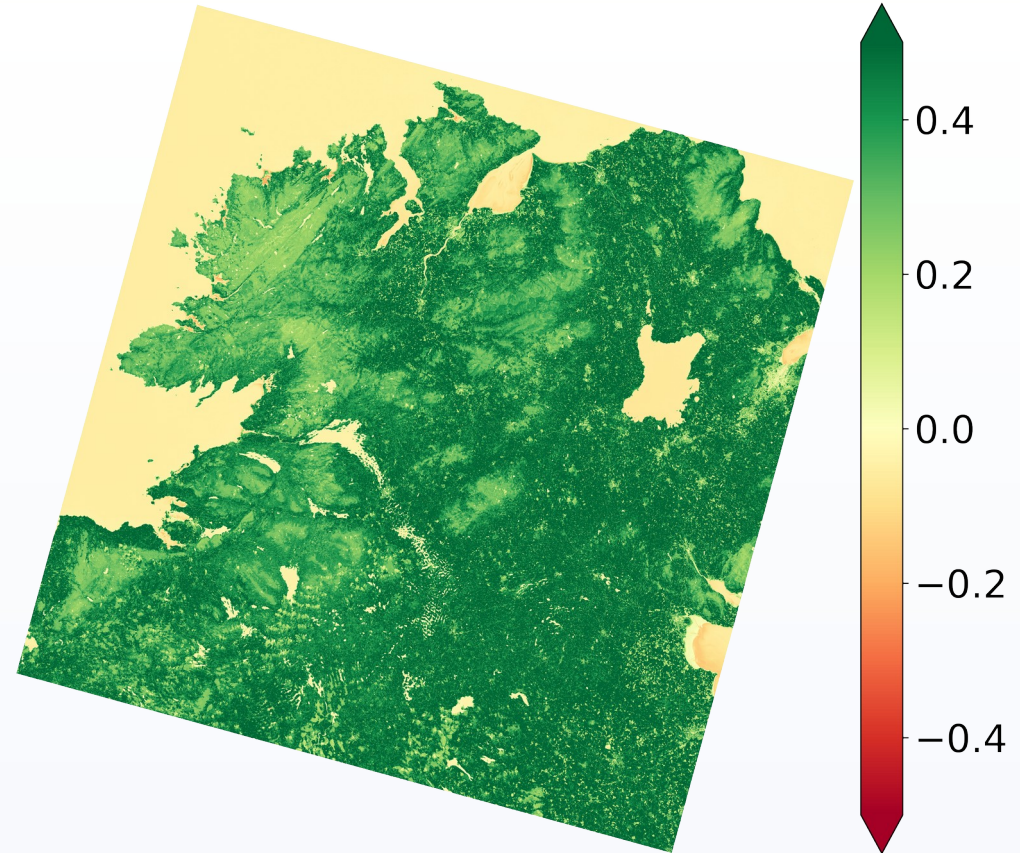


Normalized Difference Vegetation Index (NDVI)

- Formula:

$$NDVI = \frac{NIR - Red}{NIR + Red}$$

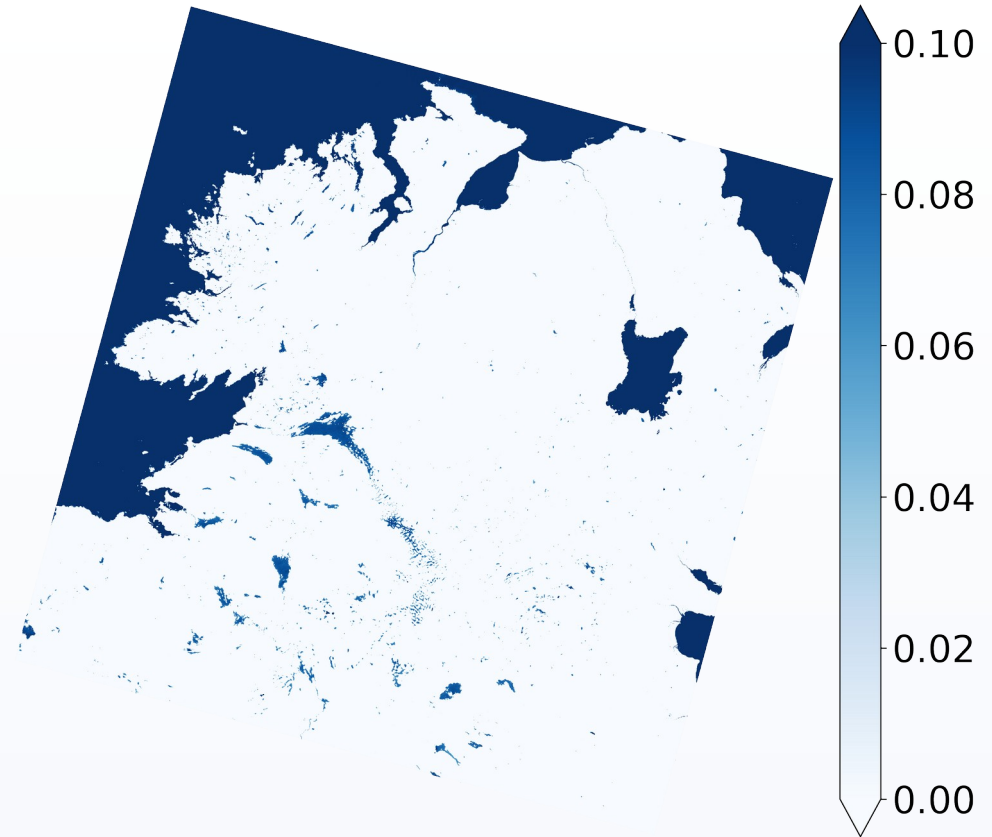
- $NDVI > 0$: healthy vegetation (usually)
- $NDVI < 0$: something else
 - Clouds, snow/ice
 - Soils
- Uses:
 - Mapping healthy vegetation
 - Deriving information about vegetation



Normalized Difference Water Index (NDWI)

- For water, $\rho(\text{green}) \gg \rho(\text{NIR})$
- Formula:

$$\text{NDWI} = \frac{\text{Green} - \text{NIR}}{\text{Green} + \text{NIR}}$$
- Used for:
 - Automatically mapping water bodies
 - Flood detection
- Using NIR, SWIR: leaf water content



- Transforming image data helps us make more use of the information
- Can be used to sharpen multispectral images
- Can be used to improve spectral differences between surface types
- Can also use arithmetic to enhance differences

- Lillesand, Kiefer & Chipman – Chapter 7
- Campbell & Wynne – Chapter 11
- Natural Resources Canada [Remote Sensing Tutorials](#)
- HSL Color Space [[Khan Academy](#)]
- NDVI [[Karen Joyce](#)]