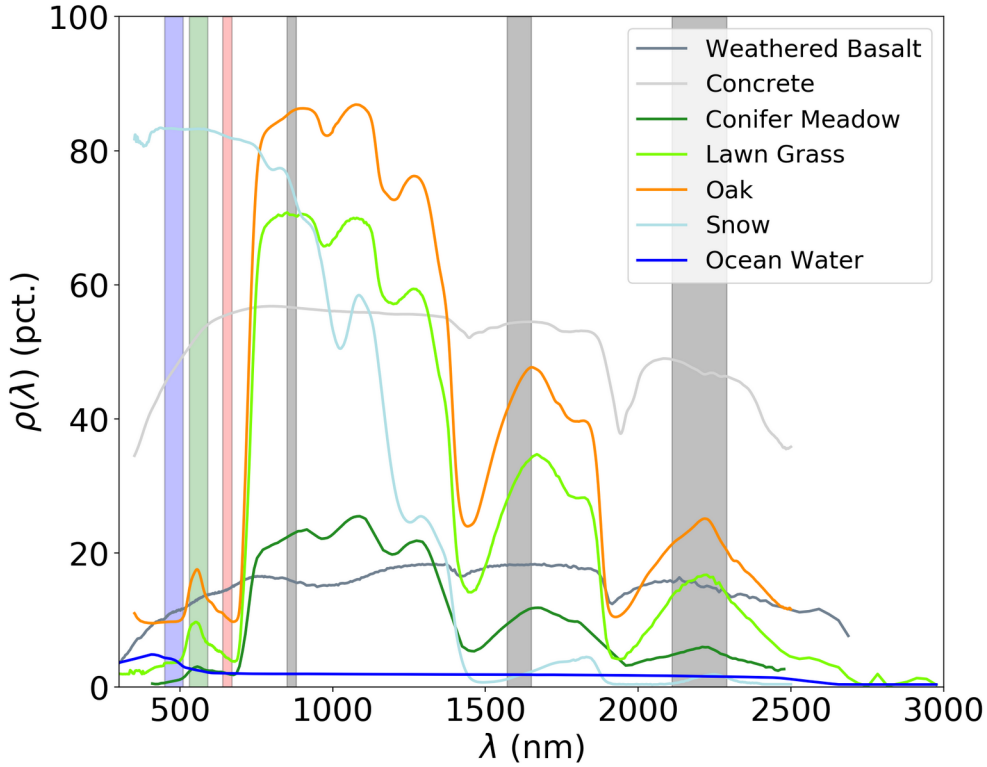
EGM702 – Photogrammetry and Advanced Image Analysis

Week 3, Part 3: Band Math(s)

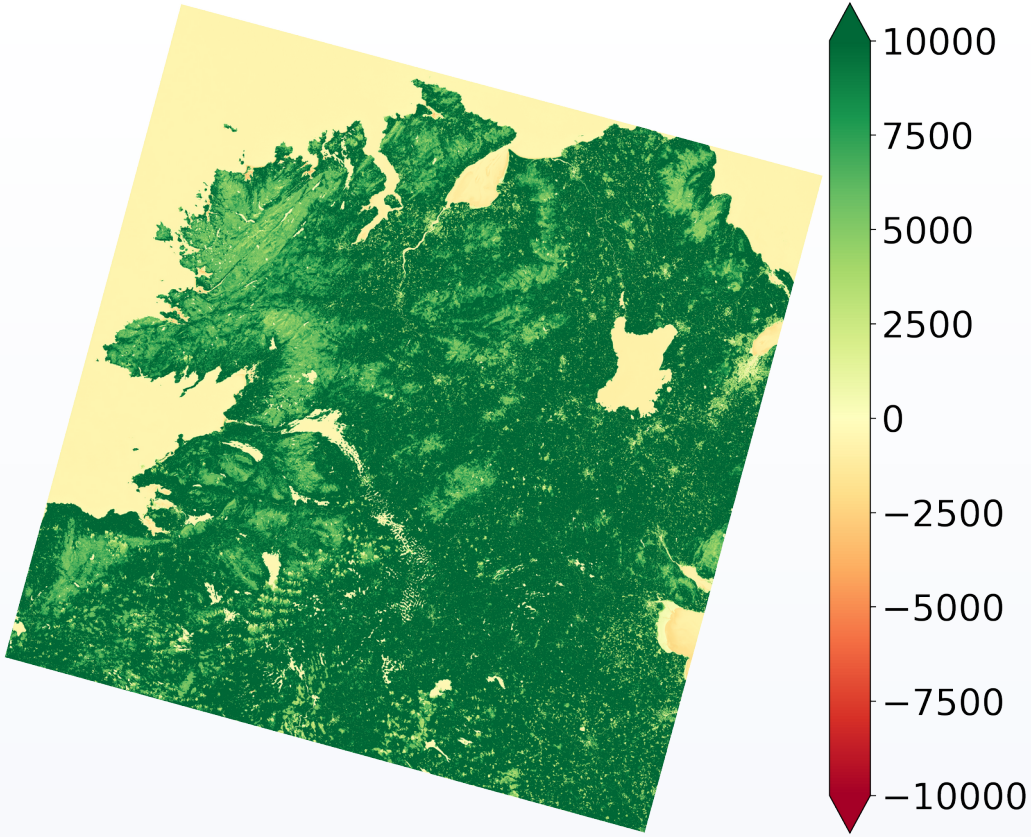
Band Maths

- We can also add, subtract, multiply, divide different bands
- Enhances the differences between different bands
- Example:
  - For plants*, ρ(NIR) >> ρ(Red)
  - For most other surfaces, ρ(NIR) ≈ ρ(Red)
  - By taking NIR–Red, can highlight vegetation



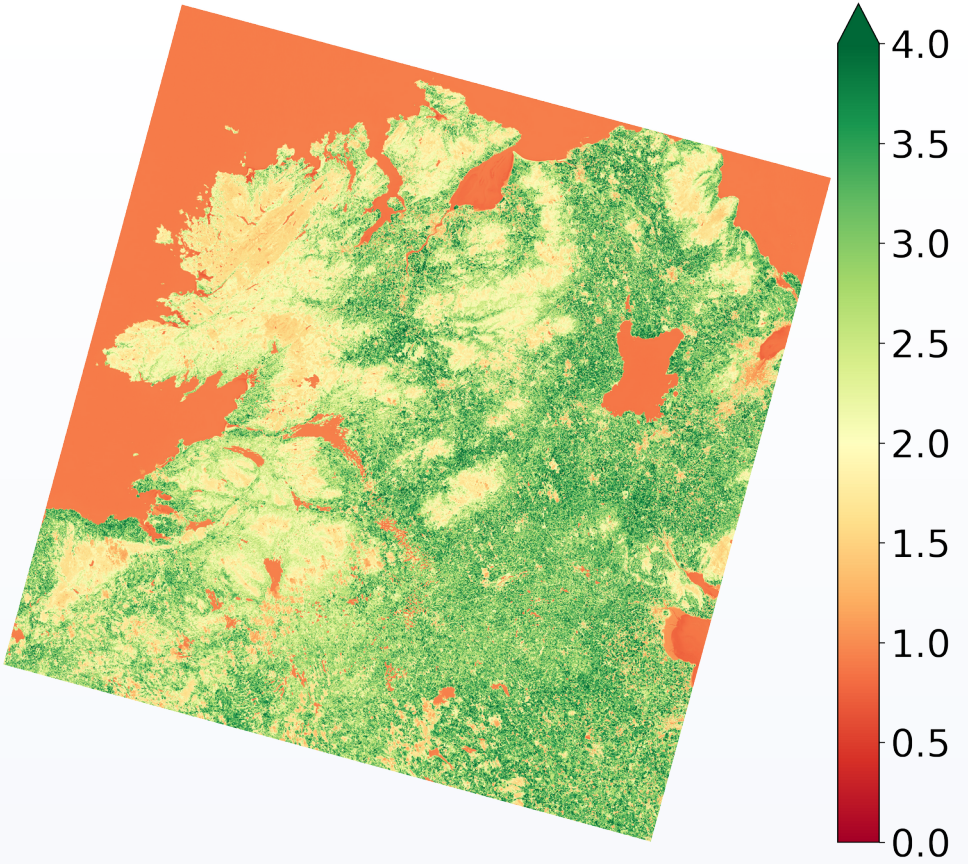
Band Differences

- Subtracting bands can highlight differences in reflectance
- Subject to:
  - Topographic effects (e.g., shadow)
  - Solar illumination



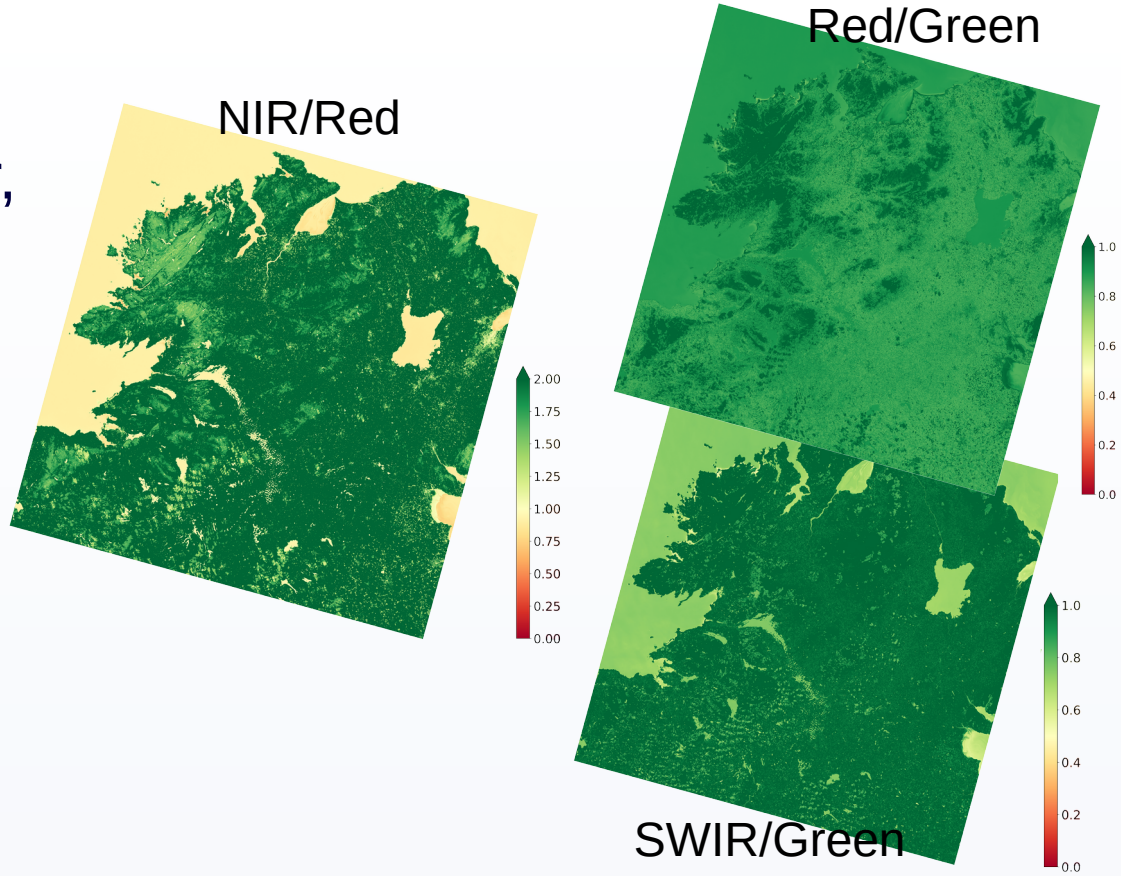
Band Ratios

- Differences in illumination hinder interpretation:
  - Shadow
  - Seasonal changes
  - Aspect/slope
- Band ratios:
  - Reduce influence of scene conditions
  - Enhance spectral differences
  - Provide relative intensity



Sample Applications

- NIR/Red – vegetation
- SWIR1/SWIR2 – land/water, soil moisture
- Red/SWIR1 – snow/ice
- Red/Green – vegetation classes (e.g., forest/crops)
- SWIR2/Green – forest/cropland, land/water



Selecting band ratios

- Goal: maximize differences, minimize redundant information
- Optimum Index Factor (OIF; Chavez et al., 1982):

$$\mathrm{OIF} = \frac{\sum_{k} \sigma_k}{\sum_{j} |r_j|}$$

Standard deviation

Correlation coefficient

- Sheffield Index (Sheffield, 1985) uses determinant (magnitude) of covariance matrices

Summary

- Band maths (arithmetic operations) can help enhance different landcovers
- Band ratios help minimize environmental effects due to topography, season
- Selecting bands depends on application – check the spectral signatures

Additional Resources

- Tempfli et al. – Chapter 5.4
- Jensen – Chapter 8
- Chavez et al., 1982 [J Appl Photographic Eng]
- Sheffield, 1985 [Photog Eng & Rem Sens]
- Beauchemin and Fung, 2001 [Photog Eng & Rem Sens]