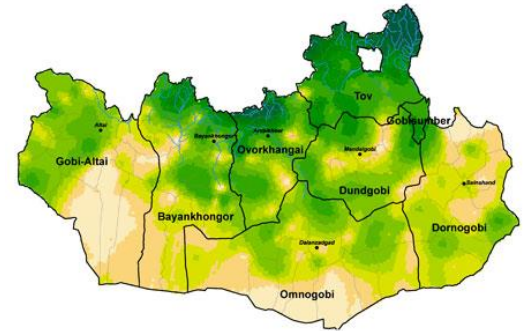
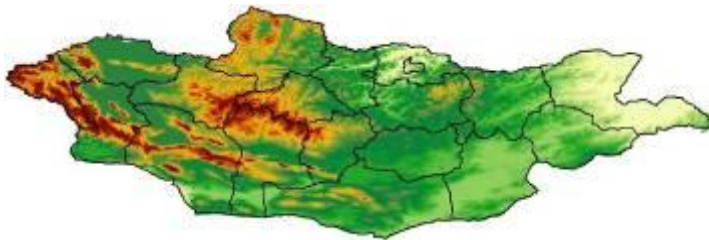


# Remote Sensing for Rangeland Applications



**Jay Angerer**  
**Ecological Training**  
**June 16, 2012**

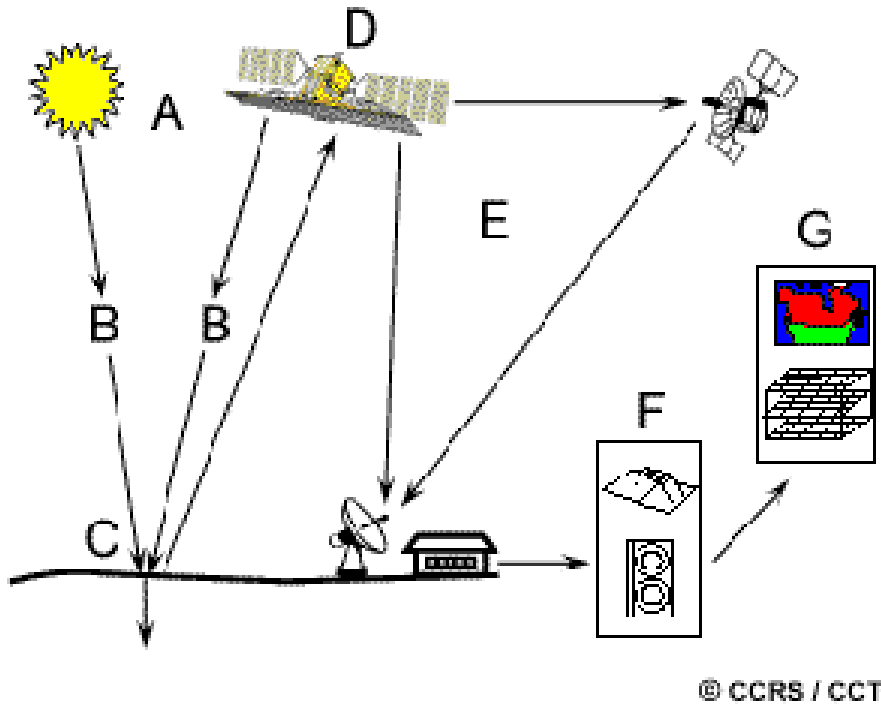
# Remote Sensing

- The term "remote sensing," first used in the United States in the 1950s by Ms. Evelyn Pruitt of the U.S. Office of Naval Research
- Defined as the science—and art—of identifying, observing, and measuring an object without coming into direct contact with it.
- Involves the detection and measurement of radiation of different wavelengths reflected or emitted from distant objects or materials, by which they may be identified and categorized by class/type, substance, and spatial distribution.

# Radiation

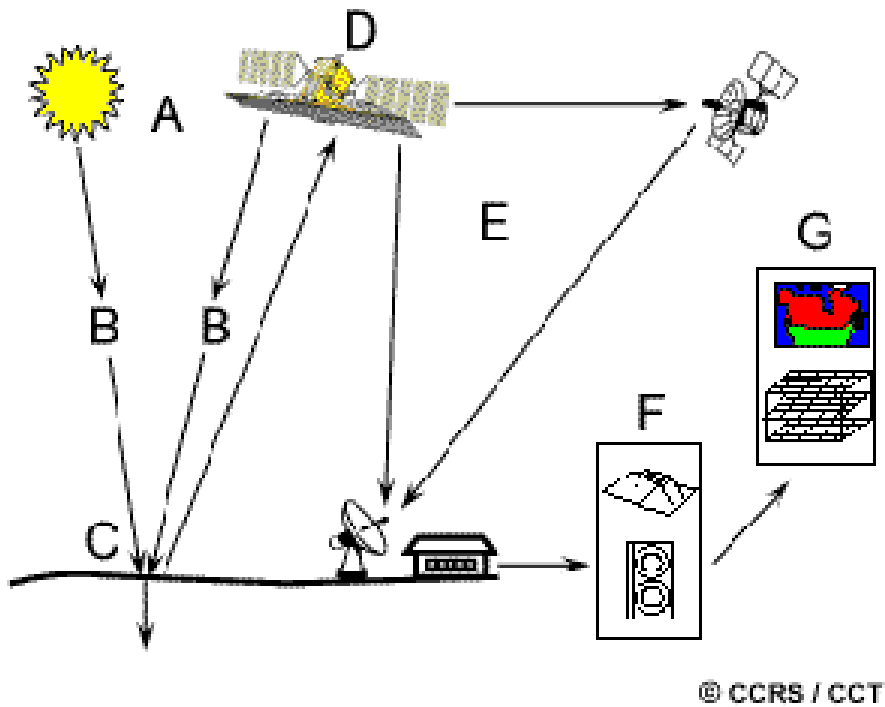
- Unless it has a temperature of absolute zero (-273°C) an object reflects, absorbs, and emits energy in a unique way, and at all times.
- This energy, called electromagnetic radiation, is emitted in waves that are able to transmit energy from one place to another.
- Soil, trees, air, the Sun, the Earth, and all the stars and planets are reflecting and emitting a wide range of electromagnetic waves.

# Remote Sensing Process Example



1. **Energy Source or Illumination (A)**
2. **Radiation and the Atmosphere (B)**
3. **Interaction with the Target (C)**

# Remote Sensing Process Example



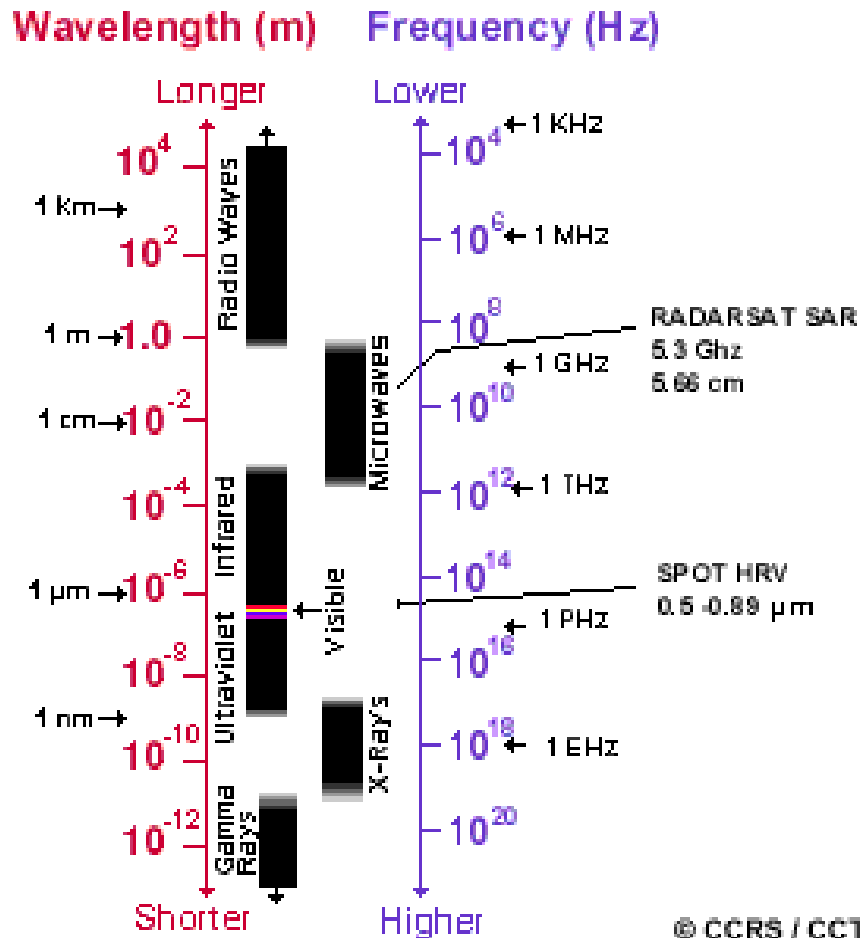
**4. Recording of Energy by the Sensor (D)**

**5. Transmission, Reception, and Processing (E)**

**6. Interpretation and Analysis (F)**

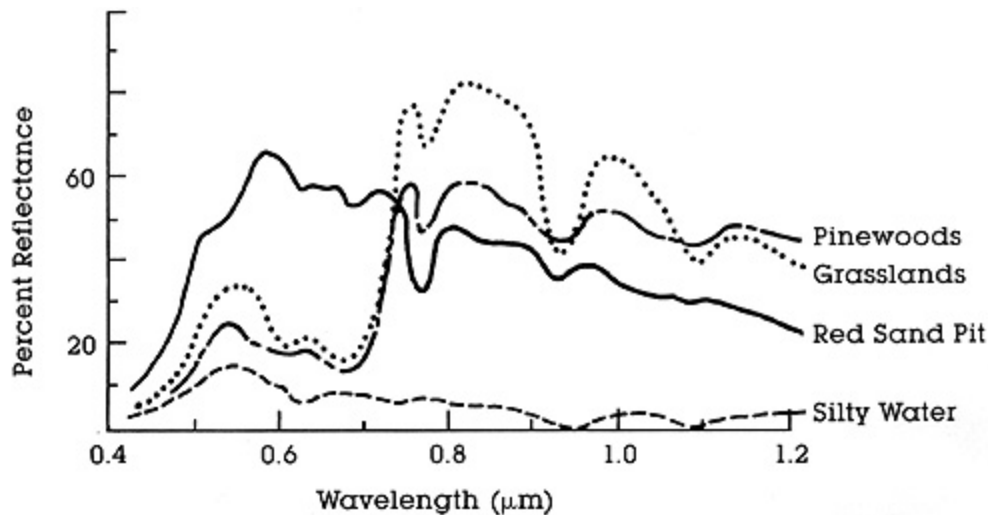
**7. Application (G)**

# Electromagnetic Spectrum



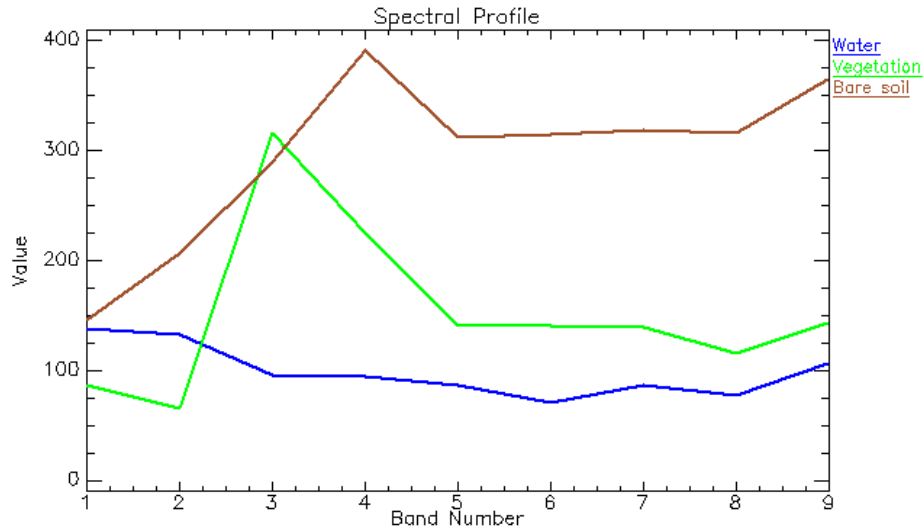
- Electromagnetic radiation is emitted at different wavelengths and frequencies
- Remote sensing generally involves use of the ultraviolet to microwave portions of the spectrum

# Spectral Signatures

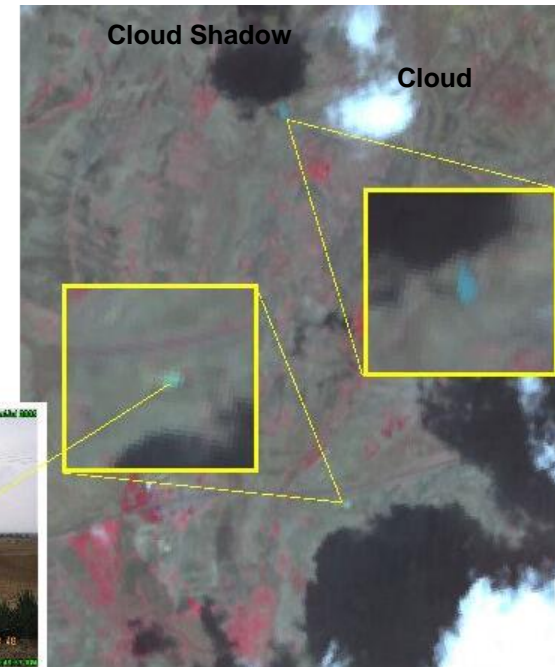


- For any given material, the amount of solar radiation that reflects, absorbs, or transmits varies with wavelength.
- This important property of matter makes it possible to identify different substances or classes and separate them by their spectral signatures (spectral curves)

# Spectral Signatures



$$BandRatio = \frac{NIR(b3)}{RED(b2)}$$



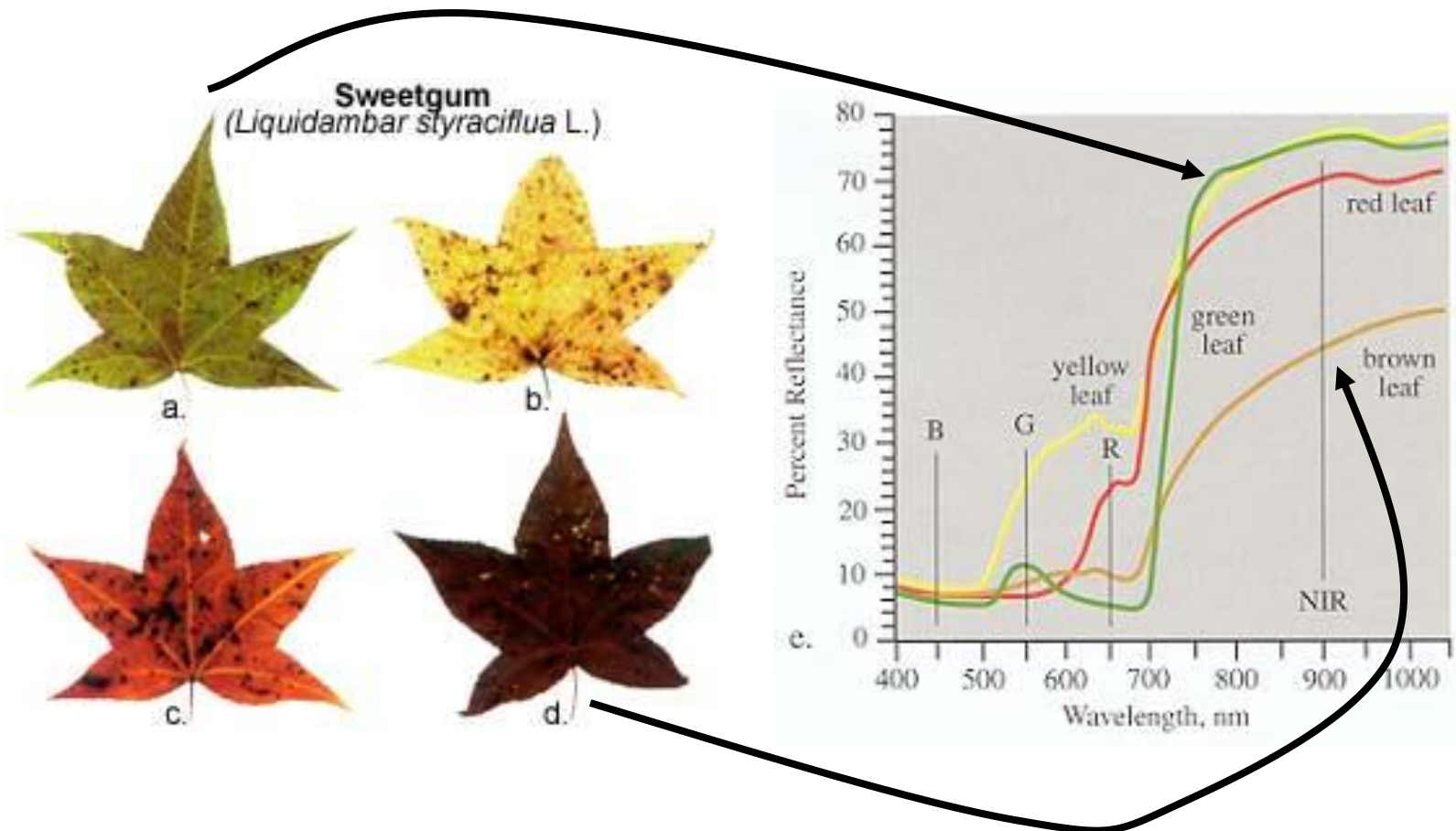


# Vegetation Indices

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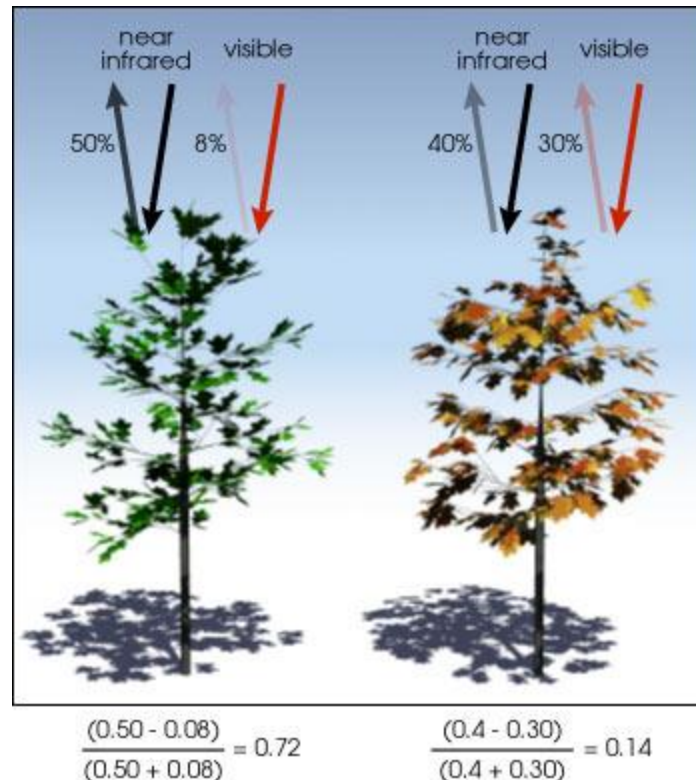
- **Uses differential between red and near infrared reflectance as measured by the satellite**
- **Actively growing plants show a contrast between strong absorption in the red and high reflectance in the near-infrared regions of the spectrum.**
- **The amount of absorption in the red and reflectance in the near-infrared varies with both the type of vegetation and the vigor of the plants.**

# Spectral Differences of Leaves



# NDVI Calculation

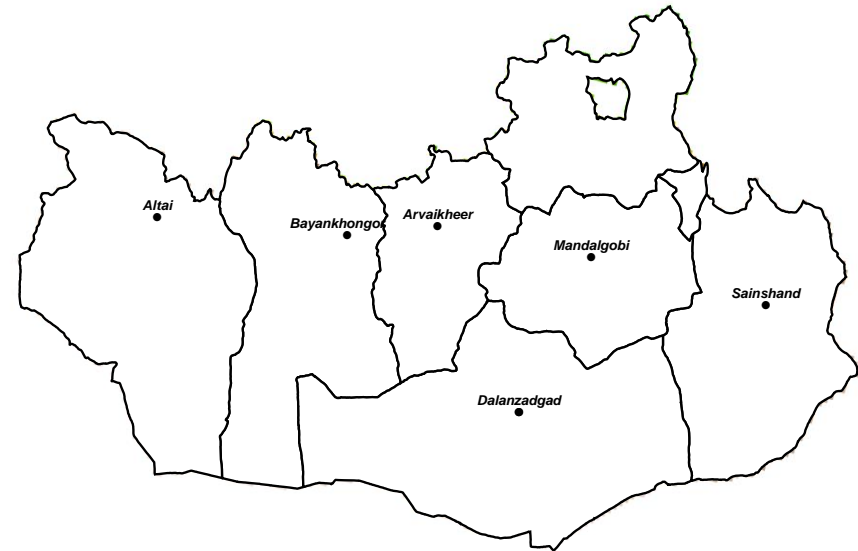
Calculated as  $NDVI = (NIR - VIS) / (NIR + VIS)$



# NDVI – Vegetation Greenness

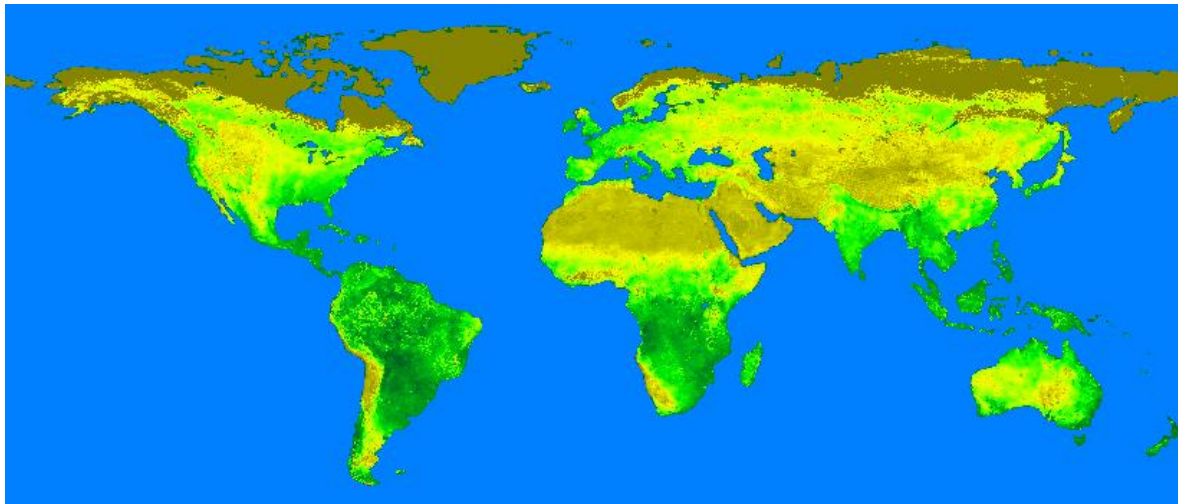
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- **Normalized Difference Vegetation Index (NDVI)** is a satellite derived measurement of vegetation greenness
- **NDVI is generally correlated to vegetation biomass in most regions**
- **Useful for many different applications**



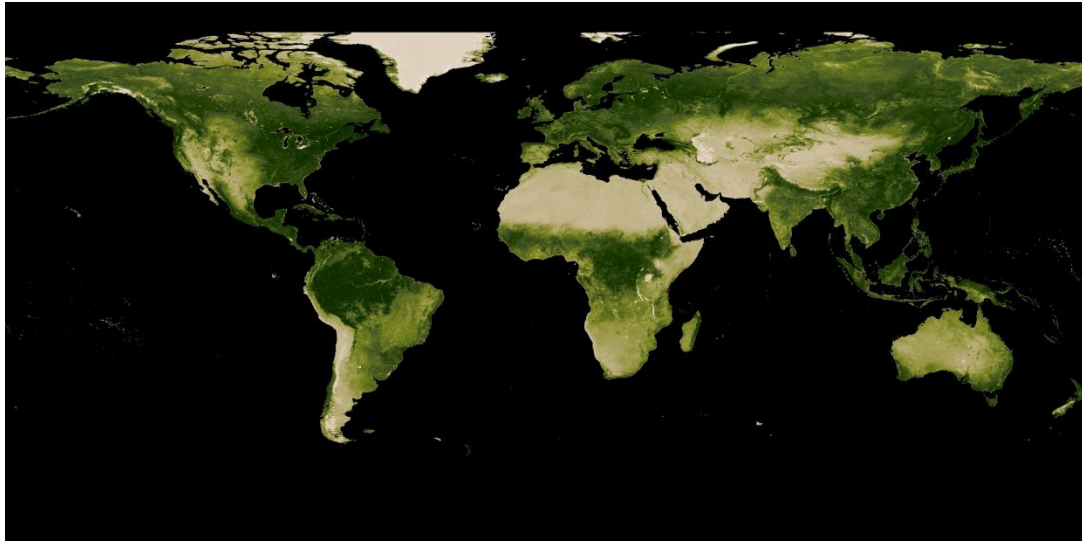
# NDVI Data Sources

- Advanced Very High Resolution Radiometer (AVHRR) – Normalized Difference Vegetation Index (NDVI) data (GIMMs data)
  - 1981 to 2010
  - 8 km resolution
  - Widely used
  - Available at <http://www.glcf.umd.edu/data/gimms/>
  - New version should be available soon



# Data Sources

- Moderate Resolution Imaging Spectroradiometer (MODIS)  
NDVI and Enhanced Vegetation Index (EVI)
  - 1 km, 500m, and 250 m resolution
  - Available from 2000 to present
  - Enhanced Vegetation Index (EVI) product builds in algorithms to adjust for soil distortions and canopy saturation
  - Available from [https://lpdaac.usgs.gov/get\\_data/data\\_pool](https://lpdaac.usgs.gov/get_data/data_pool)
  - Requires resampling and processing for use in GIS



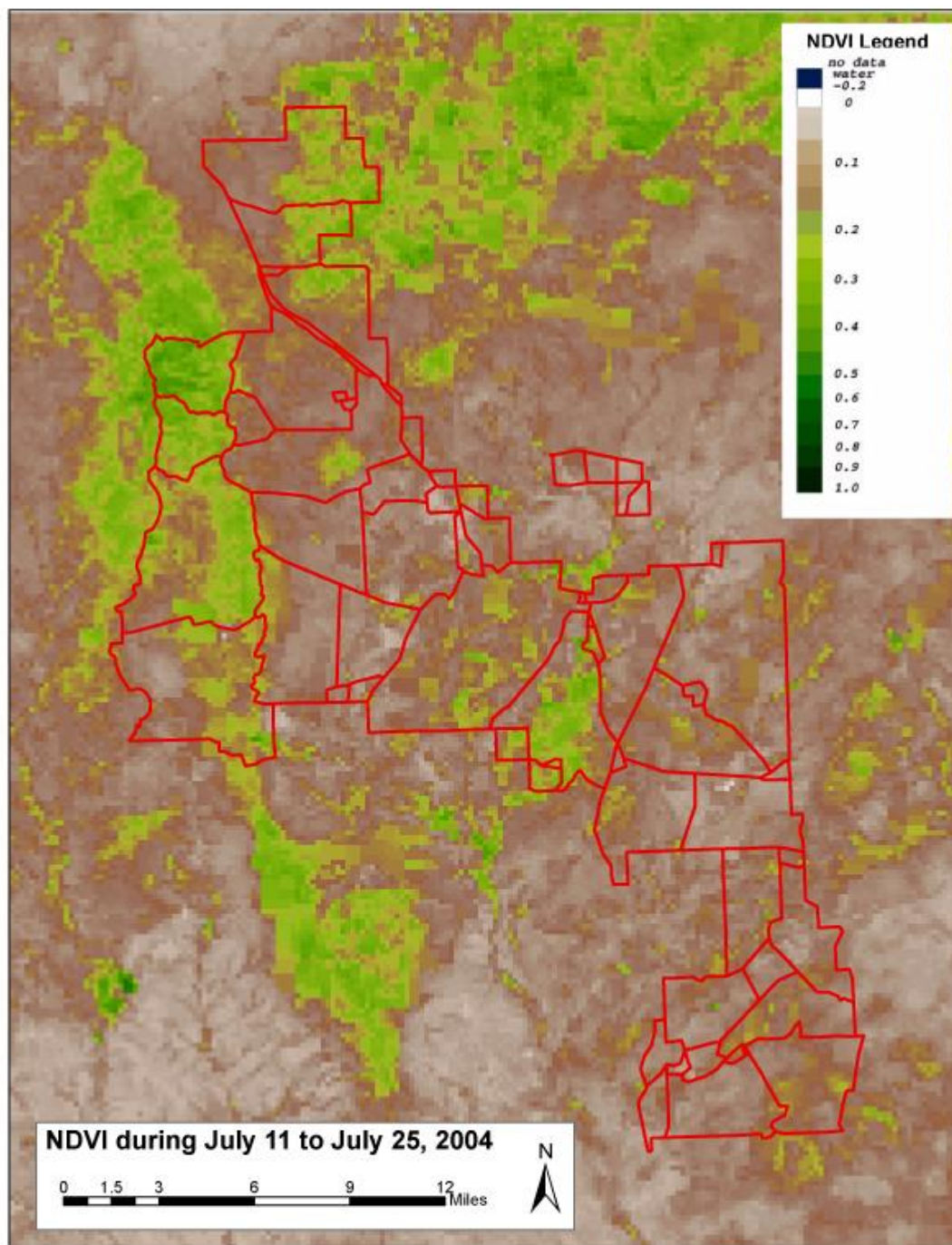
# Data Sources

- Expedited MODIS (eMODIS)
  - New product available from USGS
  - 2000 to present
  - Expedited means data are available within one day of last image acquisition in the composite window
  - Resolution of 250m
  - Geographic Projection
  - Available for Asia region
  - Download from:
  - <http://dds.cr.usgs.gov/emodis/CentralAsia/>

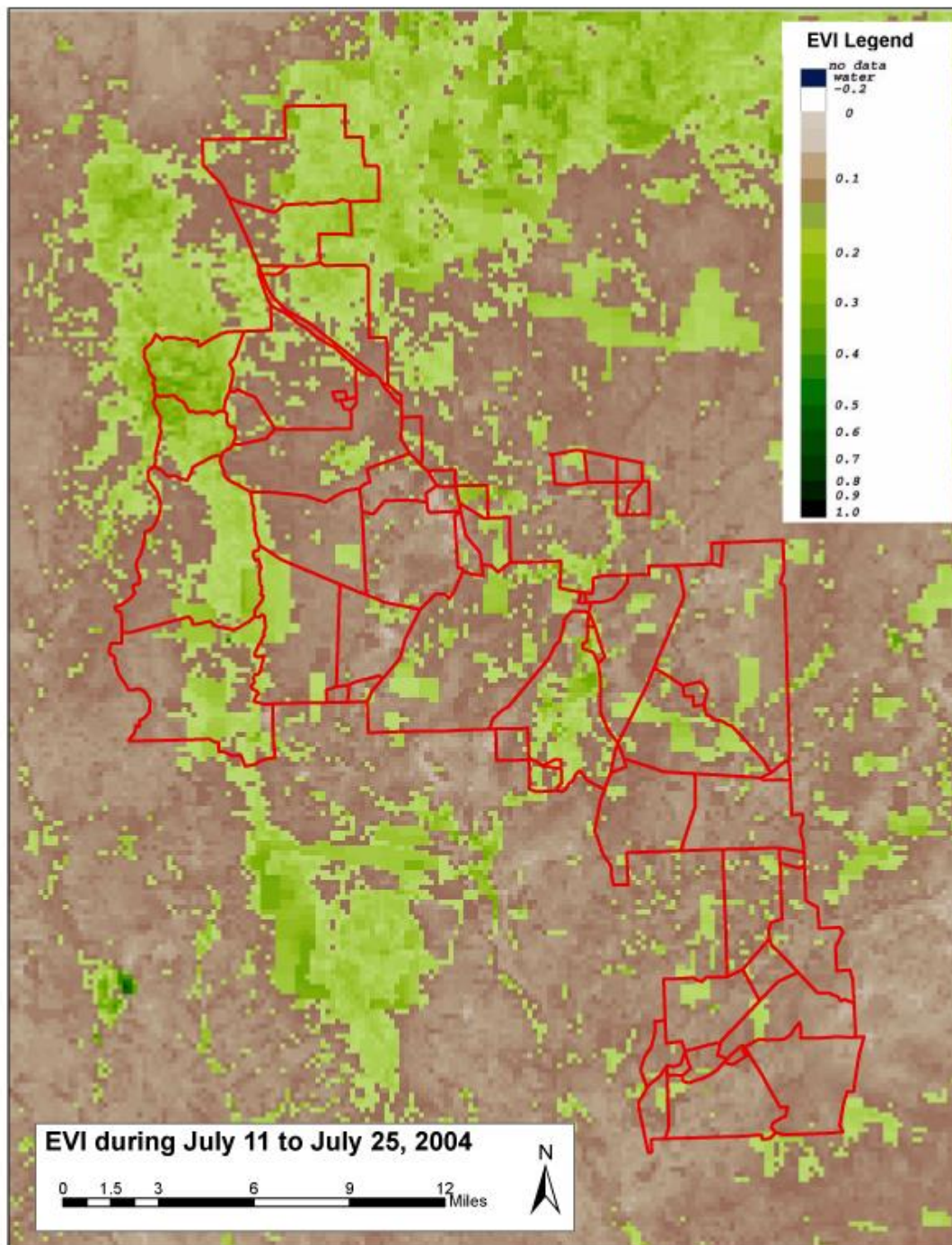
# Integration with GIS and other Remote Sensing Data

- GIS provides a means of examining information in relation to boundaries, locations, and other remote sensing data
- Integration of imagery with other Remote sensing products like digital elevation models (DEM) can allow examination of data by slope, aspect, etc.





**Normalized Difference  
Vegetation Index (NDVI)  
Product – 250 m resolution**

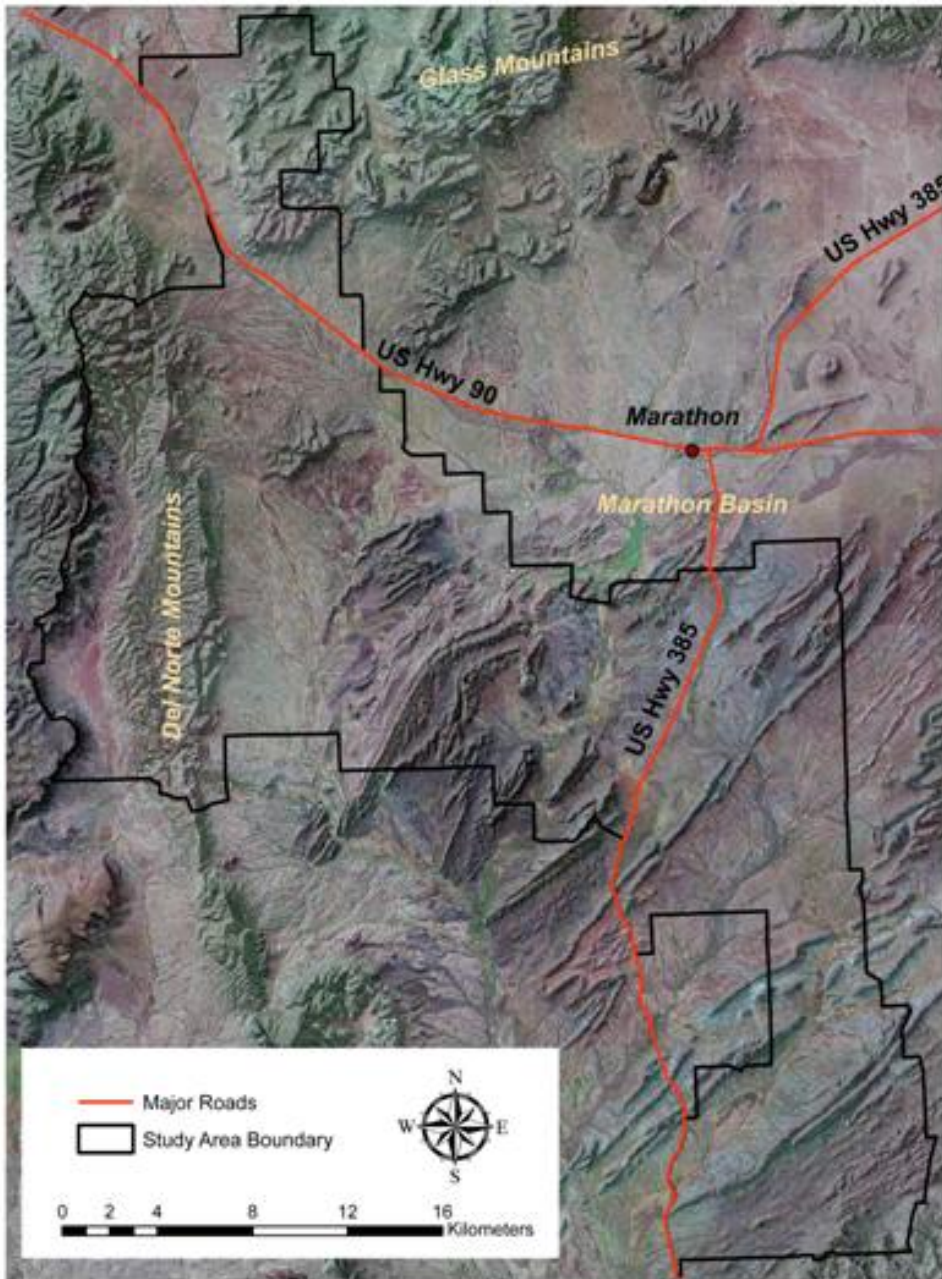


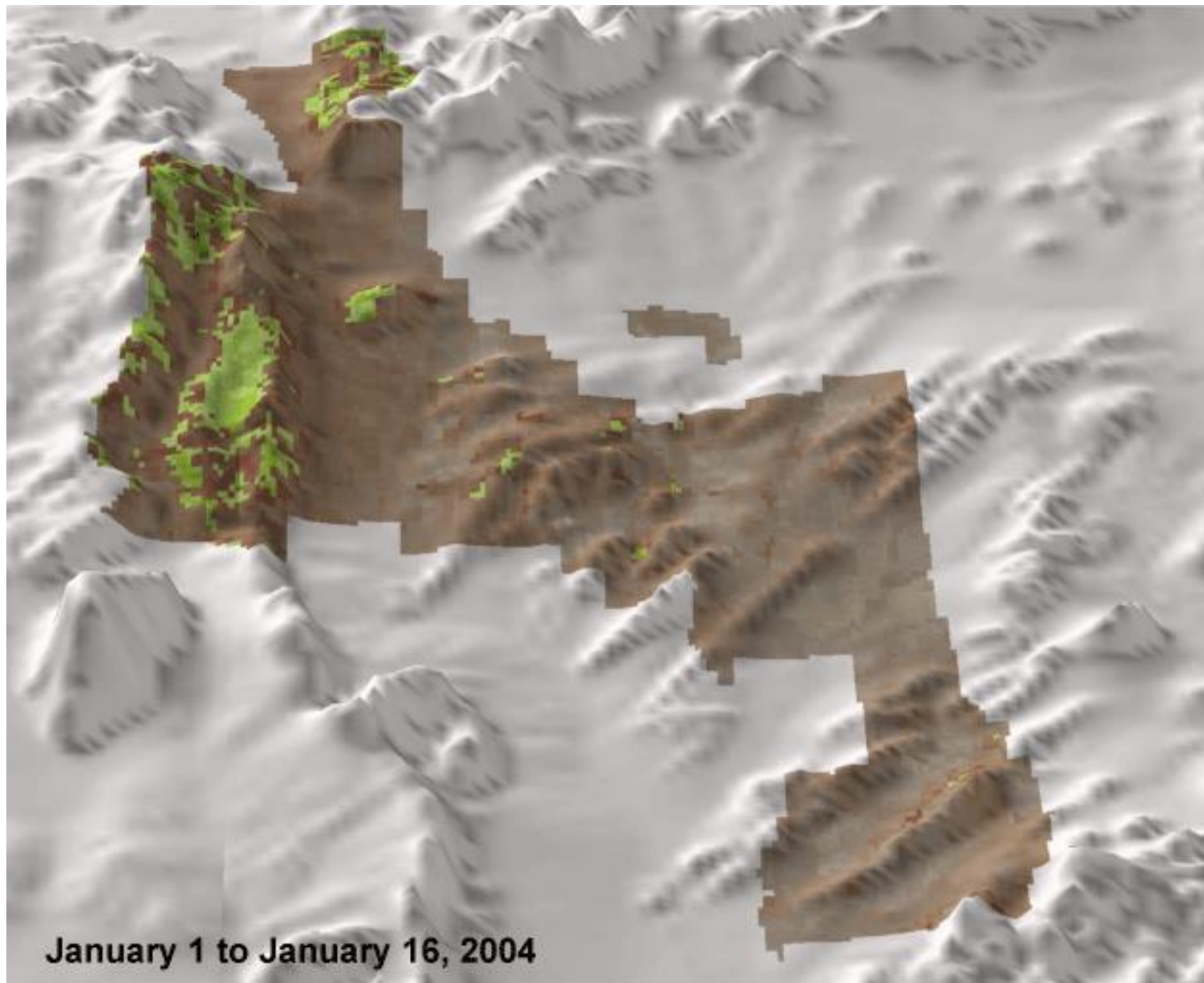
**Enhanced Vegetation  
Index (EVI) Product –  
250 m resolution**



# Imagery and Terrain

- Offers opportunity to examine data in relation to elevation
- Example uses integration of aerial photography, digital elevation data, and hill shading





# Other Products Useful For Rangelands

- NASA, USGS, and NOAA's Landsat satellite program with the following sensors:
  - Multispectral Scanner (MSS)
  - Thematic Mapper (TM) and Enhanced Thematic Mapper (ETM+)
  - [http://landsat.usgs.gov/products\\_data\\_at\\_no\\_charge.php](http://landsat.usgs.gov/products_data_at_no_charge.php)
- Ikonos
- Quickbird
- Digital Elevation Data
  - Shuttle Radar Topography Mission (<http://srtm.usgs.gov/index.php>)
  - ASTER Global Digital Elevation Map (<http://asterweb.jpl.nasa.gov/gdem.asp>)