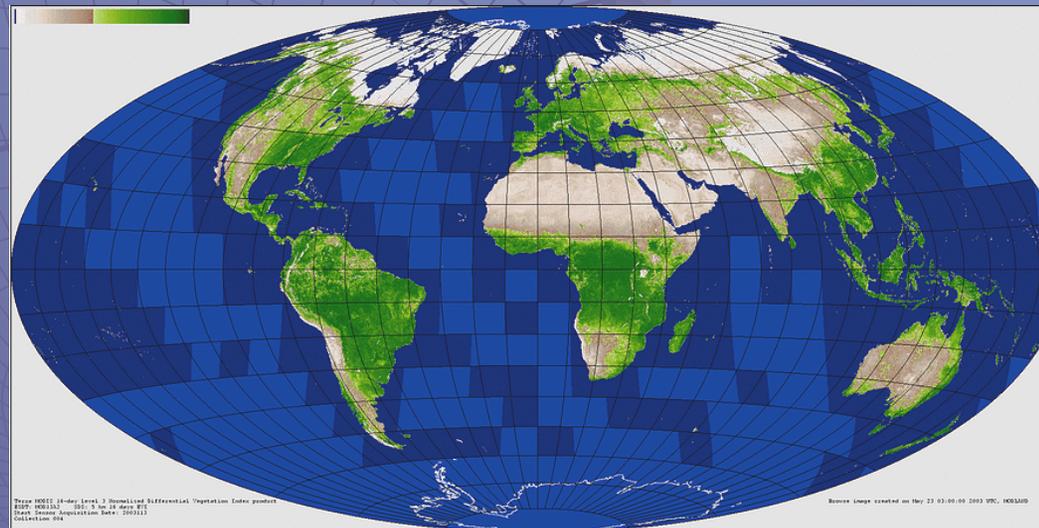




Normalized Difference Vegetation Index (NDVI)



Training Center
U.S. Geological Survey
Center for Earth Resources
Observation and Science (EROS)
Sioux Falls, South Dakota, USA



Normalized Difference Vegetation Index (NDVI)

Michael Budde – SAIC / USGS EROS



Bamako , Mali

6 - 17 February, 2006



Normalized Difference Vegetation Index (NDVI)

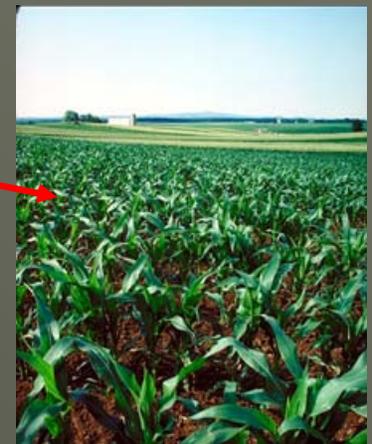
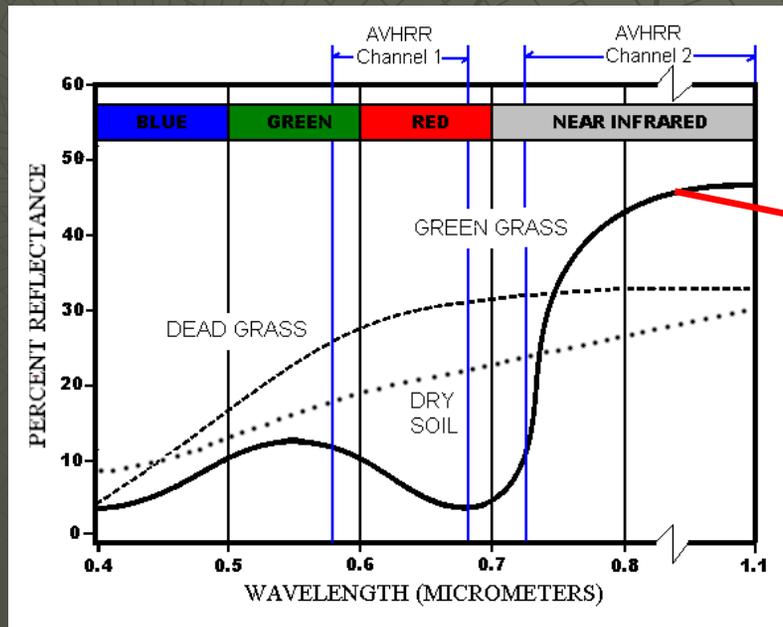
- Definition, Calculation, Compositing
- NDVI Datasets (AVHRR, SPOT VEG, MODIS)
- NDVI Availability
- NDVI Analysis



What is NDVI?

A ratio of the intensity of light reflected off the Earth's surface in the visible and near-infrared spectral wavelengths which quantifies the photosynthetic capacity of the vegetation in a given pixel of land surface.

- Clouds, snow, and water have high reflectivity in the visible band, while non-vegetated soil reflects equally in both channels.
- Surfaces containing large amounts of chlorophyll have larger reflectivity in the NIR band.

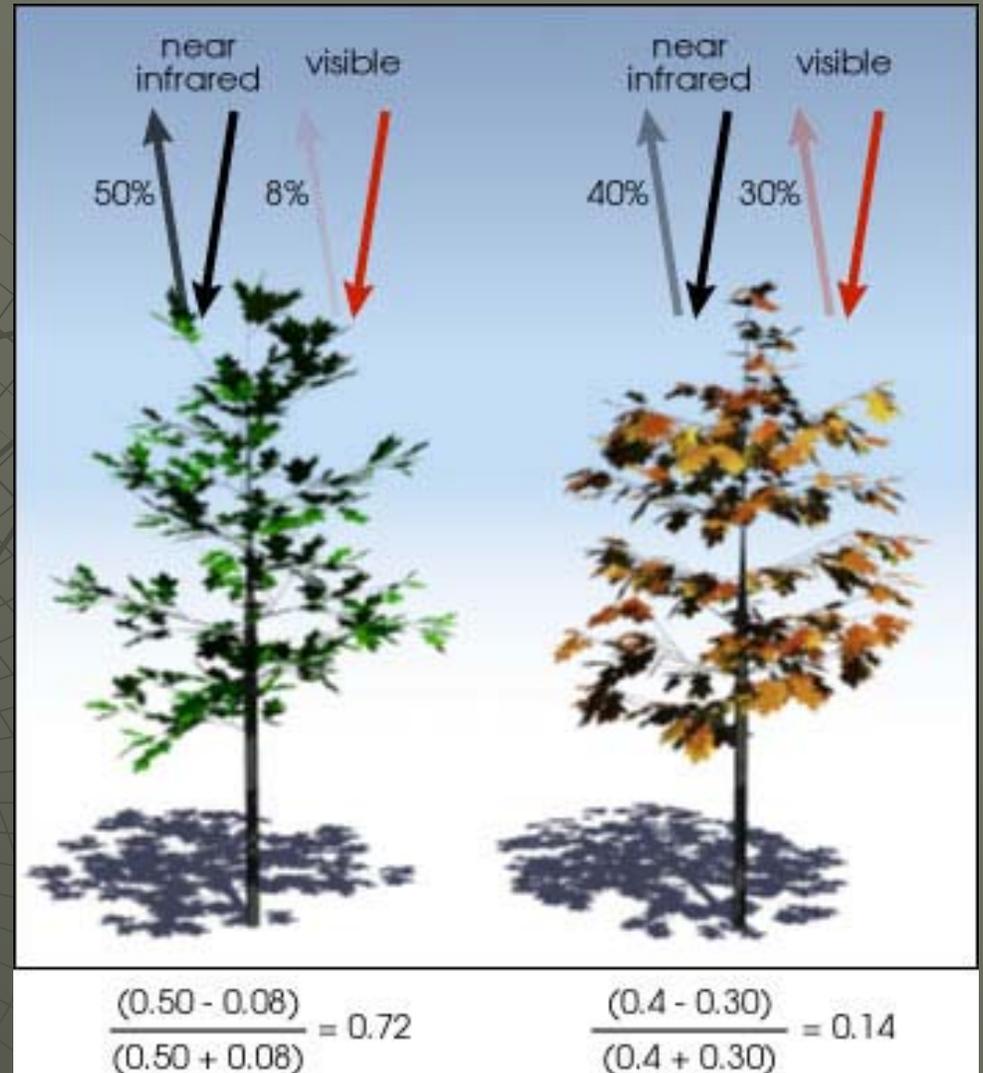




Healthy vegetation (left) absorbs most of the visible light that contacts it, and reflects a large portion of the near-infrared light. Unhealthy or sparse vegetation (right) reflects more visible light and less near-infrared light.

What about atmospheric effects?

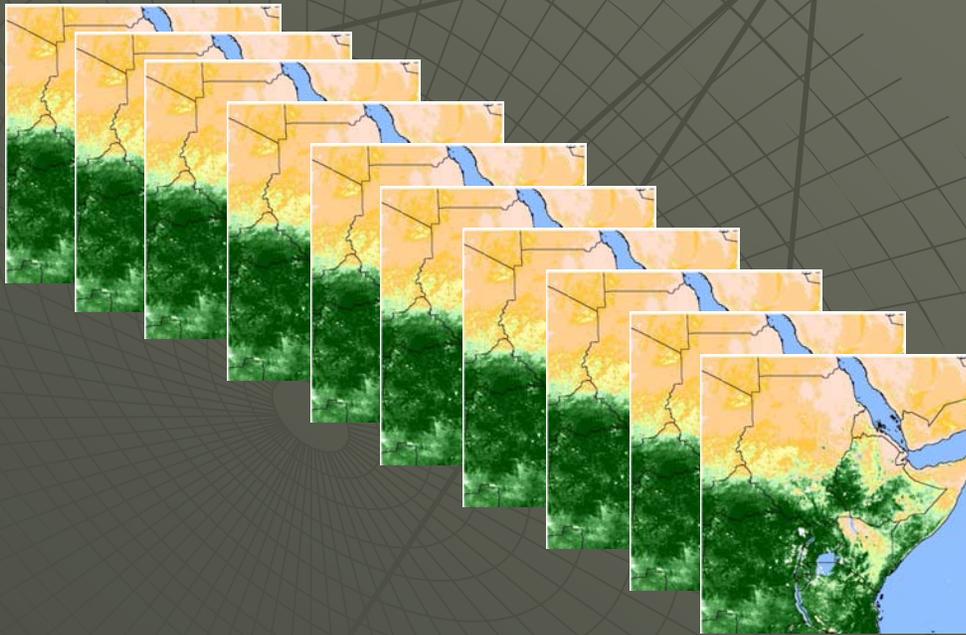
$$\text{NDVI} = (\text{NIR} - \text{Red}) / (\text{NIR} + \text{Red})$$





NDVI – MAXIMUM VALUE COMPOSITING (MVC)

- MVC for a period of a dekad (10 days), 15-days, or in the case of MODIS 16-days is used to address the problem of atmospheric contamination while still allowing for detection of vegetation variability:



The maximum value for each pixel of a composite period is used as the value for that pixel. Since cloud and other atmospheric perturbations reduce NDVI values, these are eliminated from the final composite product.



NDVI Datasets:

Sensor	Spatial Resolution	Composite Period
AVHRR	GAC : 4 & 8 km LAC : 1 km	15day – 10day
SPOT Veg	1 km	10 day
MODIS	250 m 500 m 1000 m	16 day



AVHRR NDVI

- ◆ Global Area Coverage – 8km
 - 1982 - present
- ◆ Local Area Coverage – 1km
 - 1990 – current (West Africa)



SPOT VEGETATION

- ◆ VEGETATION instrument on SPOT provides near-daily global coverage at 1-km resolution.
- ◆ Areas above 35 degrees are imaged daily; areas at lower latitudes are imaged less frequently.
- ◆ Swath is 2250 km.



SPOT VEGETATION

◆ Spectral Bands

- Blue: 0.43 to 0.47 μm
- Red: 0.61 to 0.68 μm
- Near-infrared: 0.78 to 0.89 μm
- Mid-infrared: 1.58 to 1.75 μm



MODIS

Vegetation Indices

The MODIS 16-day Vegetation Index product (MOD13) uses, as input, MODIS surface reflectance corrected for molecular scattering, ozone absorption, and aerosols.



Two vegetation index (VI) algorithms are produced globally for land.

One is the standard normalized difference vegetation index (NDVI), which is referred to as the "continuity index" to the existing NOAA-AVHRR derived NDVI.



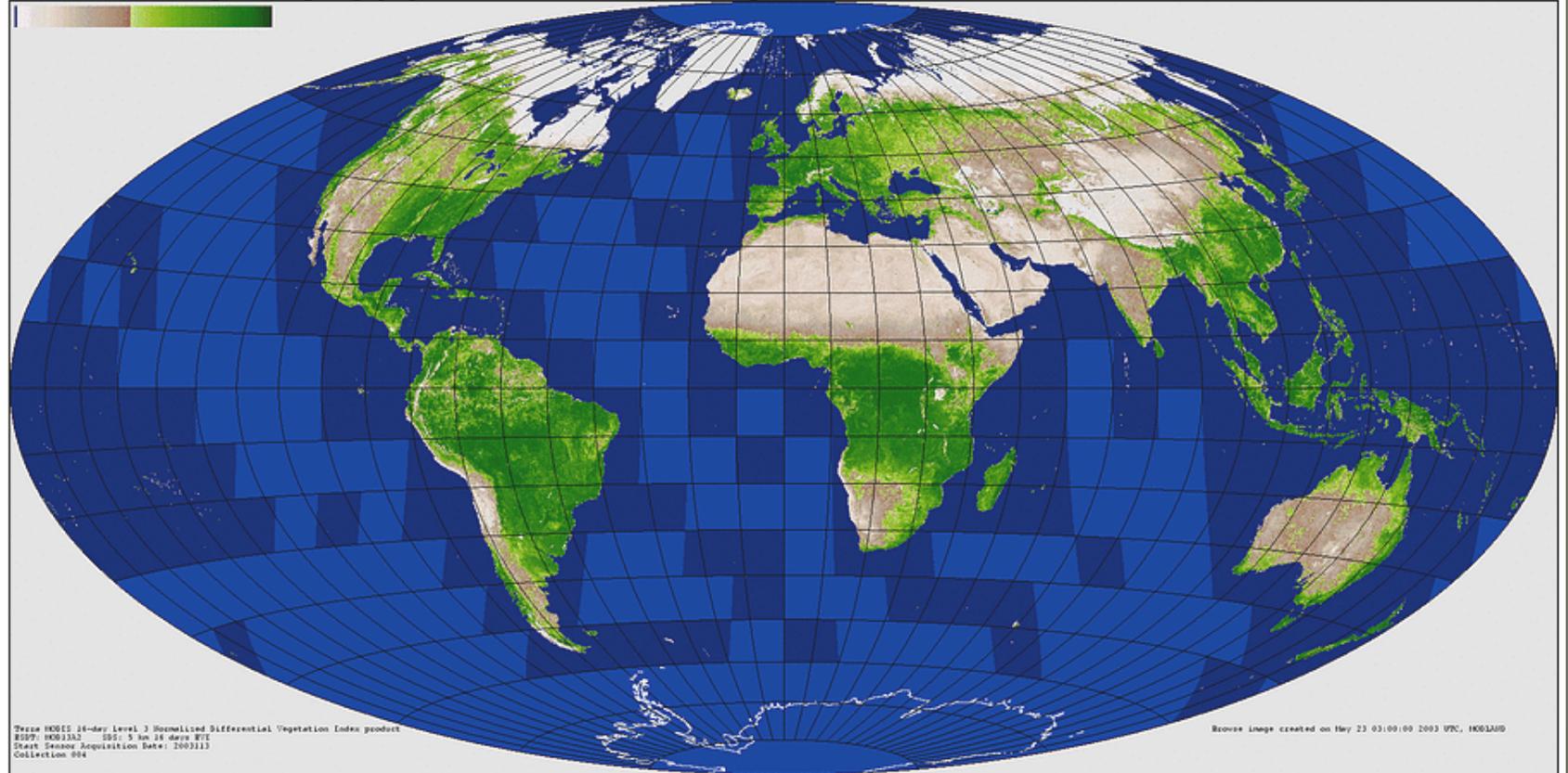
The other is an 'enhanced' vegetation index (EVI) with improved sensitivity into high biomass regions and improved vegetation monitoring through a de-coupling of the canopy background signal and a reduction in atmosphere influences.



Global Browse

TERRA, MOD13.NDVI, day 2003113, Collection 4

Click to an area in the global image to pop-up a 5km-resolution close-up of this region

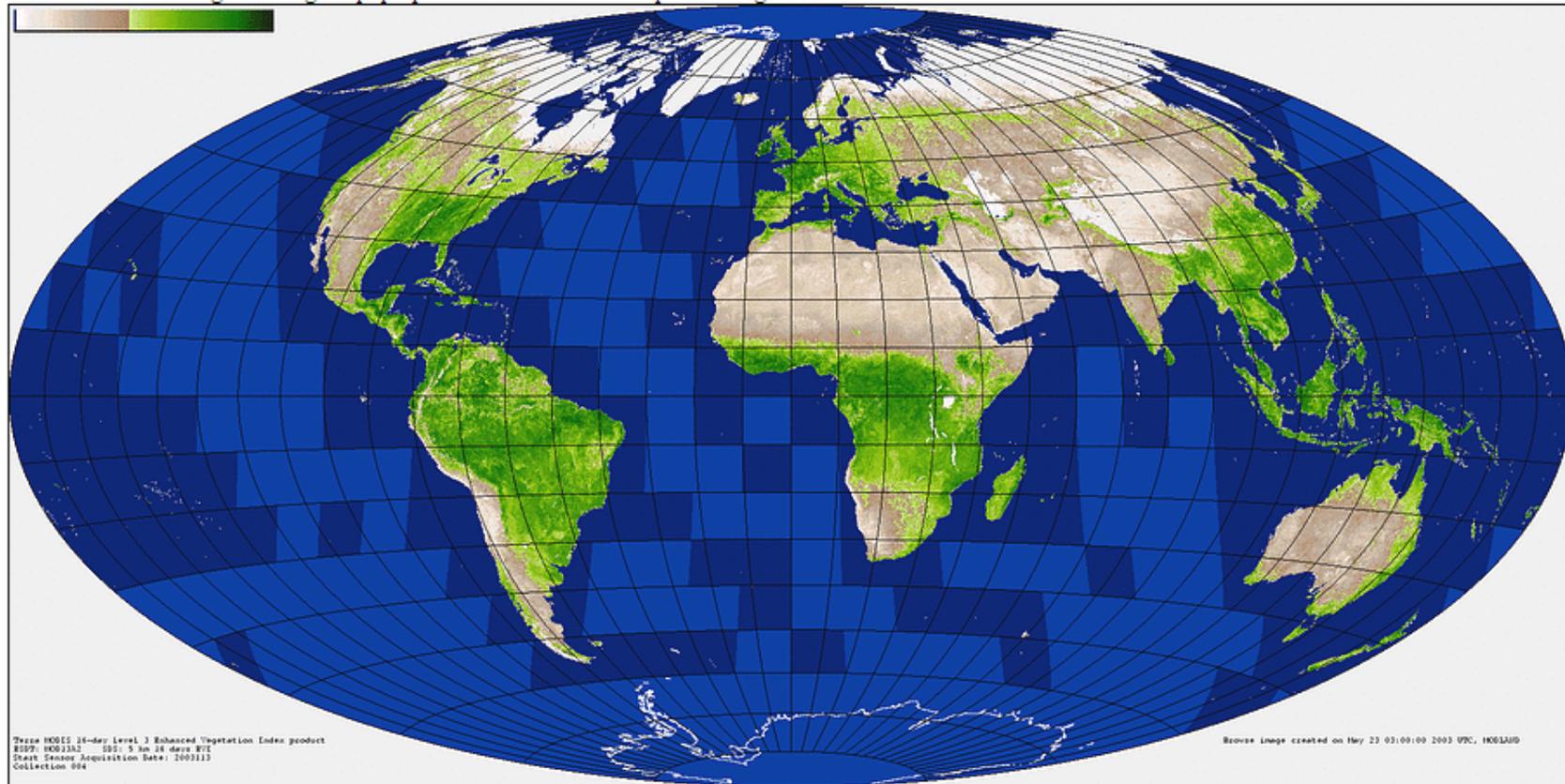




Applications of Coarse to High Resolution Satellite Imagery for Land Productivity Assessment & Management

TERRA, MOD13.EVI, day 2003113, Collection 4

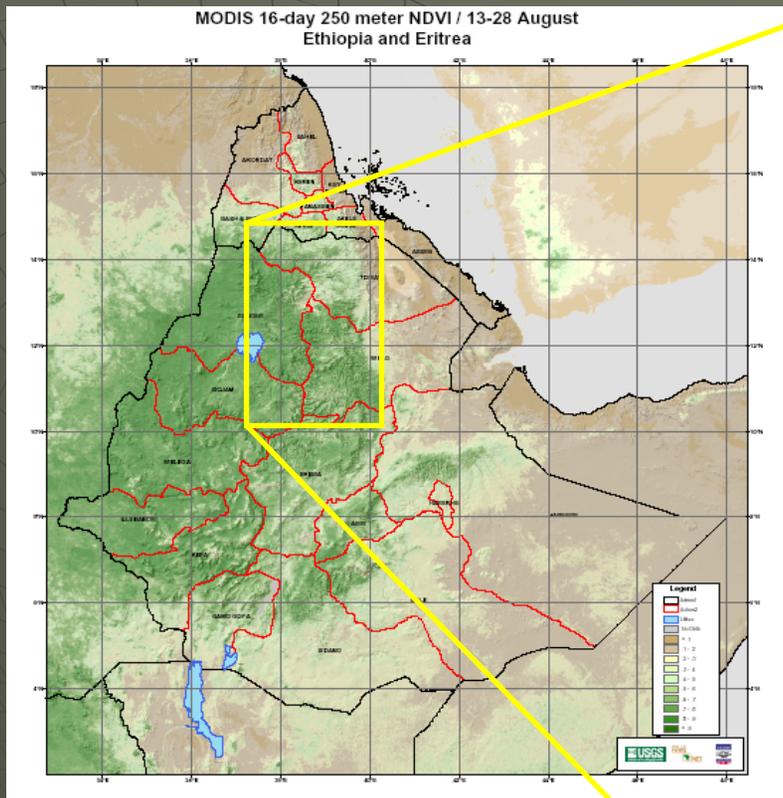
Click to an area in the global image to pop-up a 5km-resolution close-up of this region



Applications of Coarse to High Resolution Satellite Imagery
for Land Productivity Assessment & Management



250m NDVI draped over elevation identifies subtle variation in vegetation conditions for this area in northern Ethiopia



250m data provides drastically improved detail over coarser resolution vegetation index products



NDVI Data Availability:

Sensor	Availability / Source
AVHRR	8-km 15 day for the Globe / via NASA Goddard Space Flight Center (GSFC) 8-km 10 day for Africa / via USGS FEWS NET (earlywarning.usgs.gov/adds)
SPOT Veg	1-km 10 day for the Globe / historical data available via VITO, limited availability for current data (http://free.vgt.vito.be/)
MODIS	250-m, 500-m, 1000-m 16 day for the Globe / via USGS EROS LPDAAC (http://edcimswww.cr.usgs.gov/pub/imswelcome/)



NDVI Data Analysis:

Comparison to an Average Condition

- Current vs Short Term Average
- Current vs Long Term Average
- Current vs Previous

Time-series Analysis

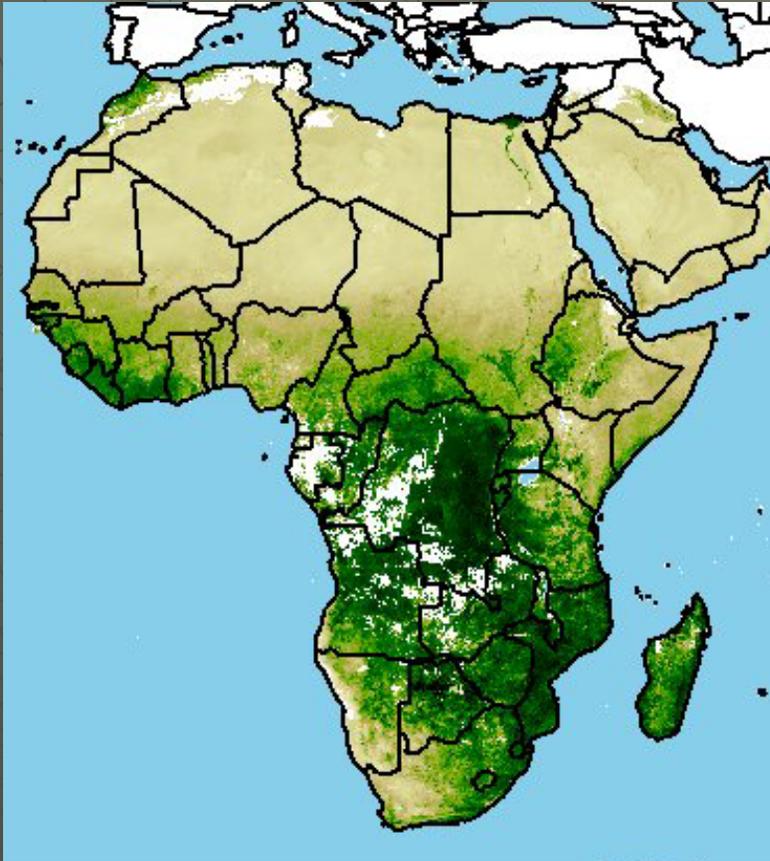
- Seasonal Characteristics (metrics)
- Trends

Spatial Analysis

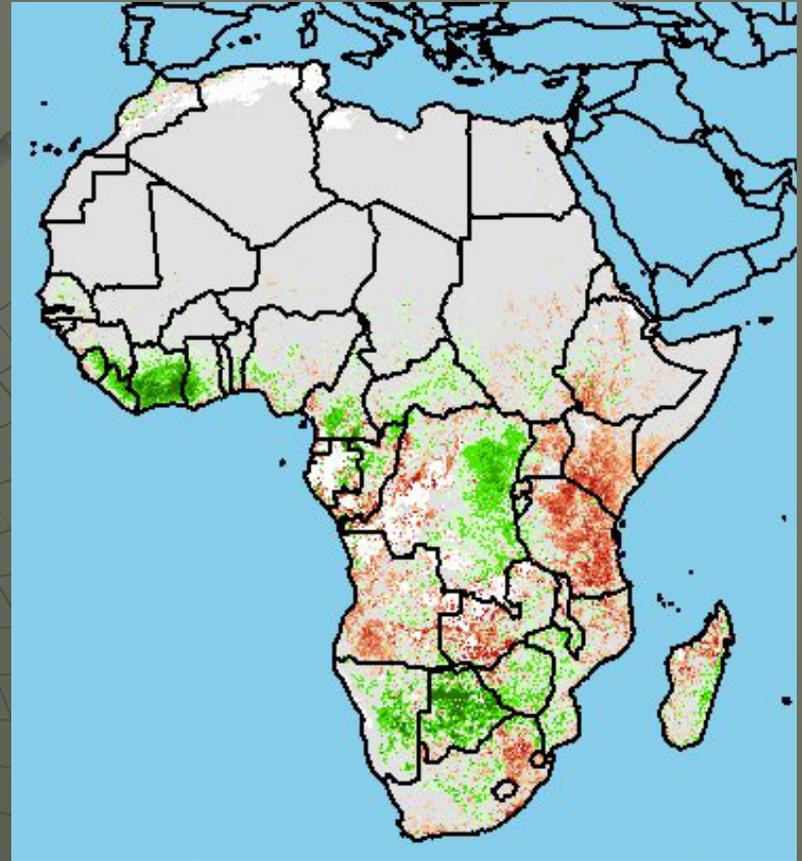


Comparison to an Average Condition

AVHRR 8km NDVI



Current Dekad (10day)

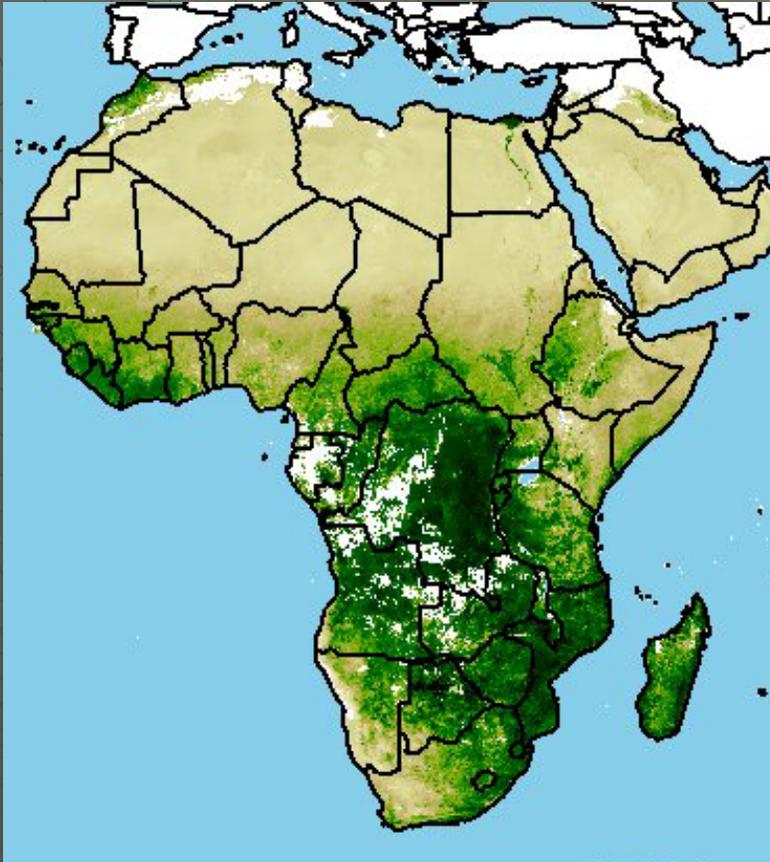


Difference with
Long-term Average

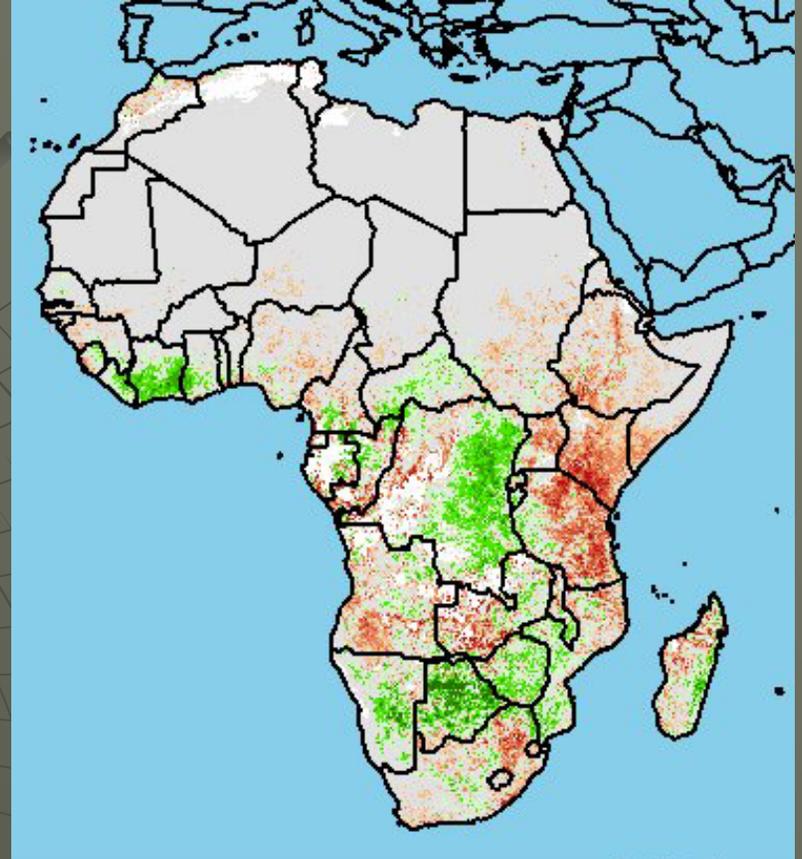


Comparison to an Average Condition

AVHRR 8km NDVI



Current Dekad (10day)

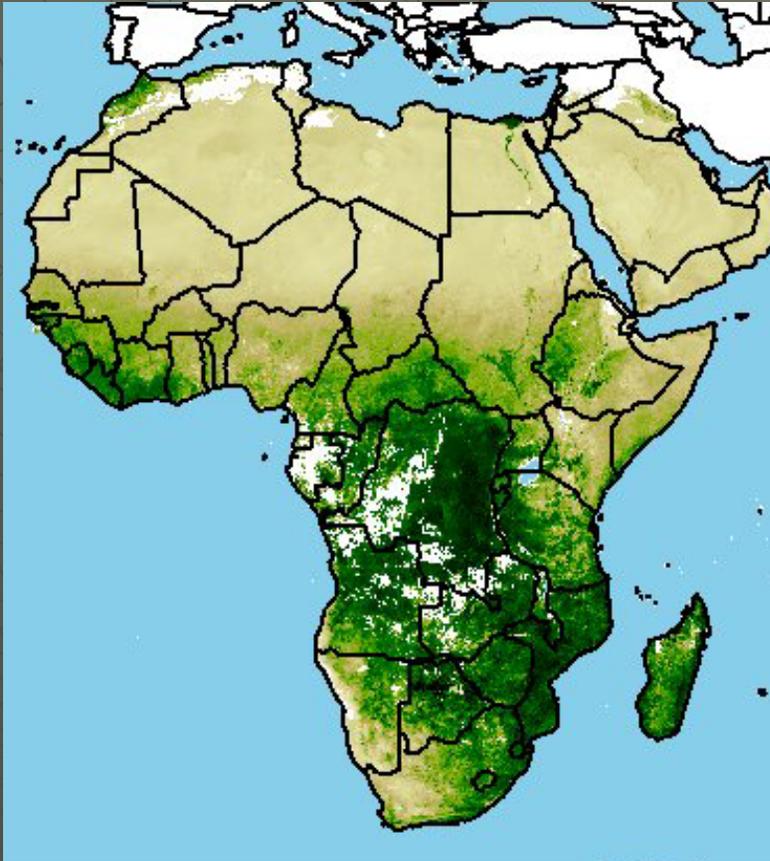


Difference with
Short-term Average

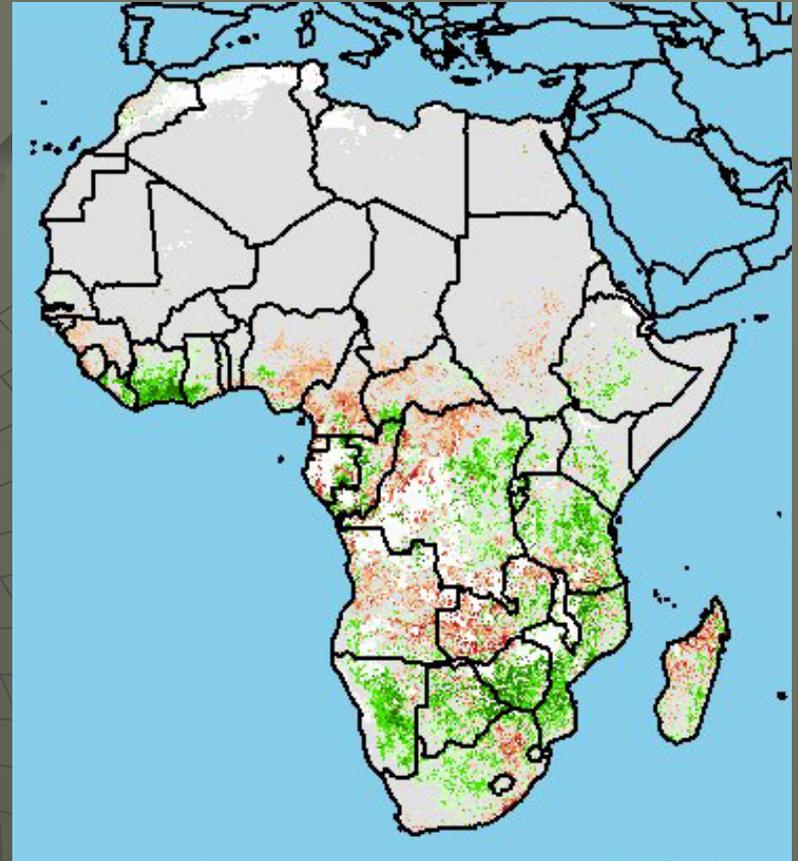


Comparison to an Average Condition

AVHRR 8km NDVI



Current Dekad (10day)



Difference with
Previous Dekad



Times Series Analysis

AVHRR 8km NDVI : 1982 - 2003

“stacked” images with each band
representing a 15day period during the year



Available Bands List

File Options

- yer (Band 1:AF82may15b.n07-Vlg.tif):AF82_V
- yer (Band 1:AF82jun15a.n07-Vlg.tif):AF82_V
- yer (Band 1:AF82jun15b.n07-Vlg.tif):AF82_V
- yer (Band 1:AF82jul15a.n07-Vlg.tif):AF82_V
- yer (Band 1:AF82jul15b.n07-Vlg.tif):AF82_V
- yer (Band 1:AF82aug15a.n07-Vlg.tif):AF82_V
- yer (Band 1:AF82aug15b.n07-Vlg.tif):AF82_V
- yer (Band 1:AF82sep15a.n07-Vlg.tif):AF82_V
- yer (Band 1:AF82sep15b.n07-Vlg.tif):AF82_V
- yer (Band 1:AF82oct15a.n07-Vlg.tif):AF82_V
- yer (Band 1:AF82oct15b.n07-Vlg.tif):AF82_V
- yer (Band 1:AF82nov15a.n07-Vlg.tif):AF82_V
- yer (Band 1:AF82nov15b.n07-Vlg.tif):AF82_V
- yer (Band 1:AF82dec15a.n07-Vlg.tif):AF82_V
- yer (Band 1:AF82dec15b.n07-Vlg.tif):AF82_V
- yer (Band 1:AF83jan15a.n07-Vlg.tif):AF83_V
- yer (Band 1:AF83jan15b.n07-Vlg.tif):AF83_V
- yer (Band 1:AF83feb15a.n07-Vlg.tif):AF83_V
- yer (Band 1:AF83feb15b.n07-Vlg.tif):AF83_V
- yer (Band 1:AF83mar15a.n07-Vlg.tif):AF83_V
- yer (Band 1:AF83mar15b.n07-Vlg.tif):AF83_V
- yer (Band 1:AF83apr15a.n07-Vlg.tif):AF83_V
- yer (Band 1:AF83apr15b.n07-Vlg.tif):AF83_V
- yer (Band 1:AF83may15a.n07-Vlg.tif):AF83_V
- yer (Band 1:AF83may15b.n07-Vlg.tif):AF83_V
- yer (Band 1:AF83jun15a.n07-Vlg.tif):AF83_V

Gray Scale RGB Color

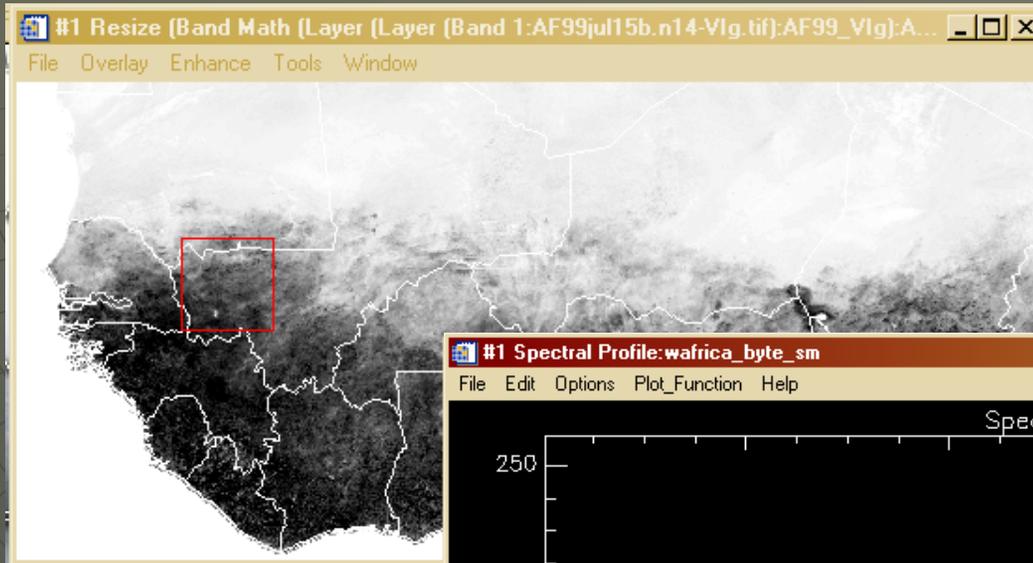
Selected Band

Resize (Band Math (Layer (Layer (Band 1:AF

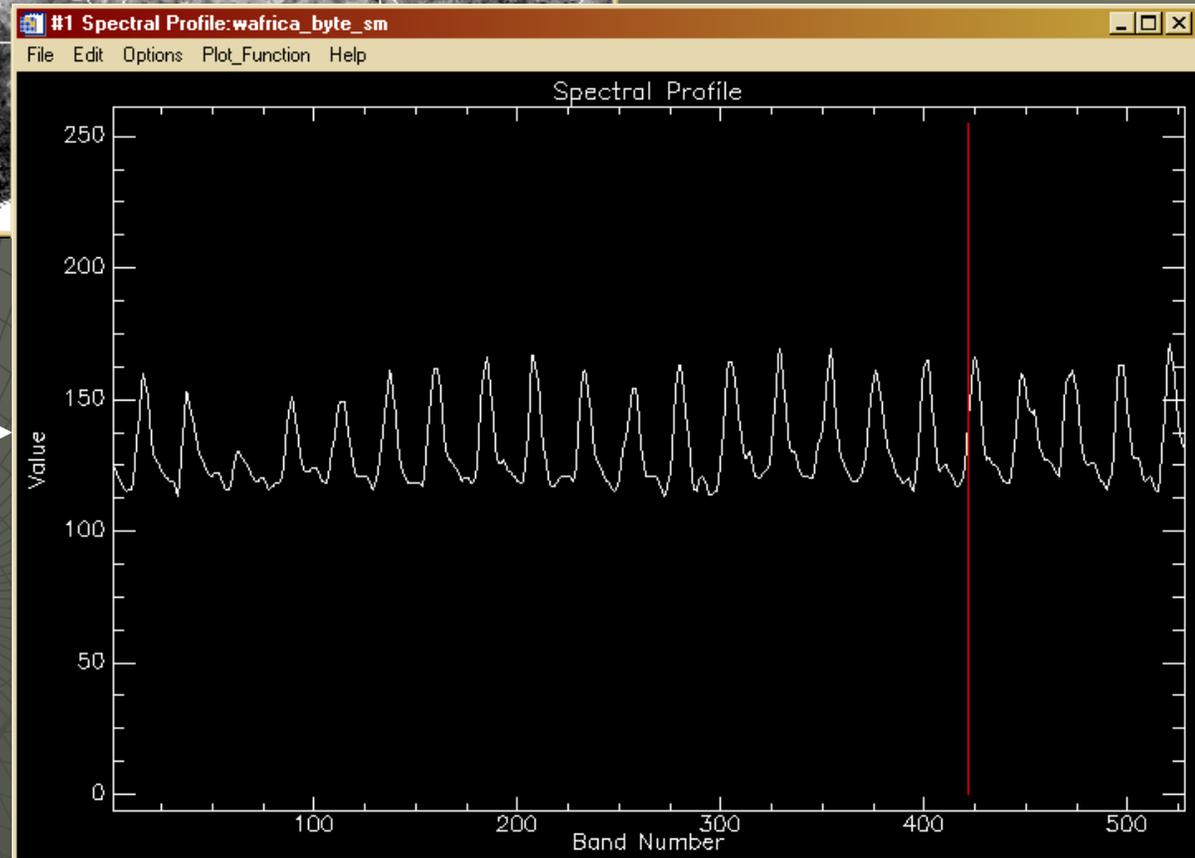
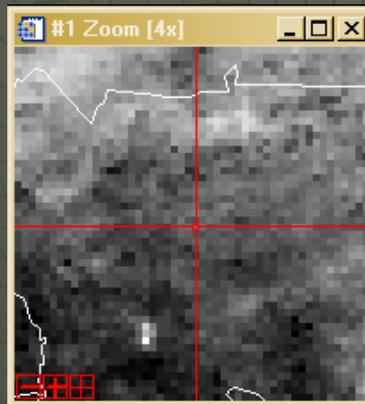
Dims 550 x 255 (Byte) [BSQ]

Load Band Display #1

Applications of Coarse to High Resolution Satellite Imagery for Land Productivity Assessment & Management

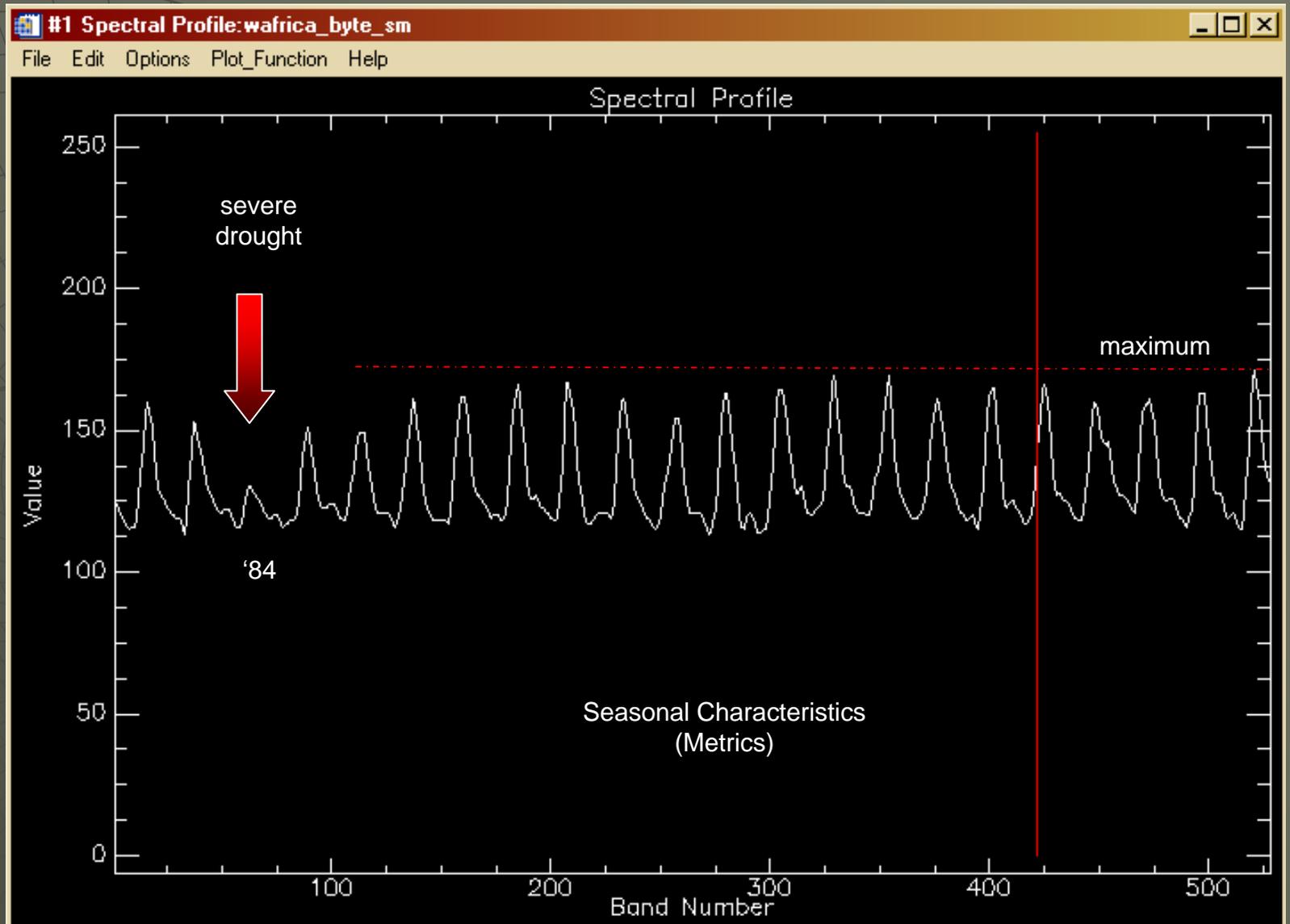


Time series profile
for a single pixel



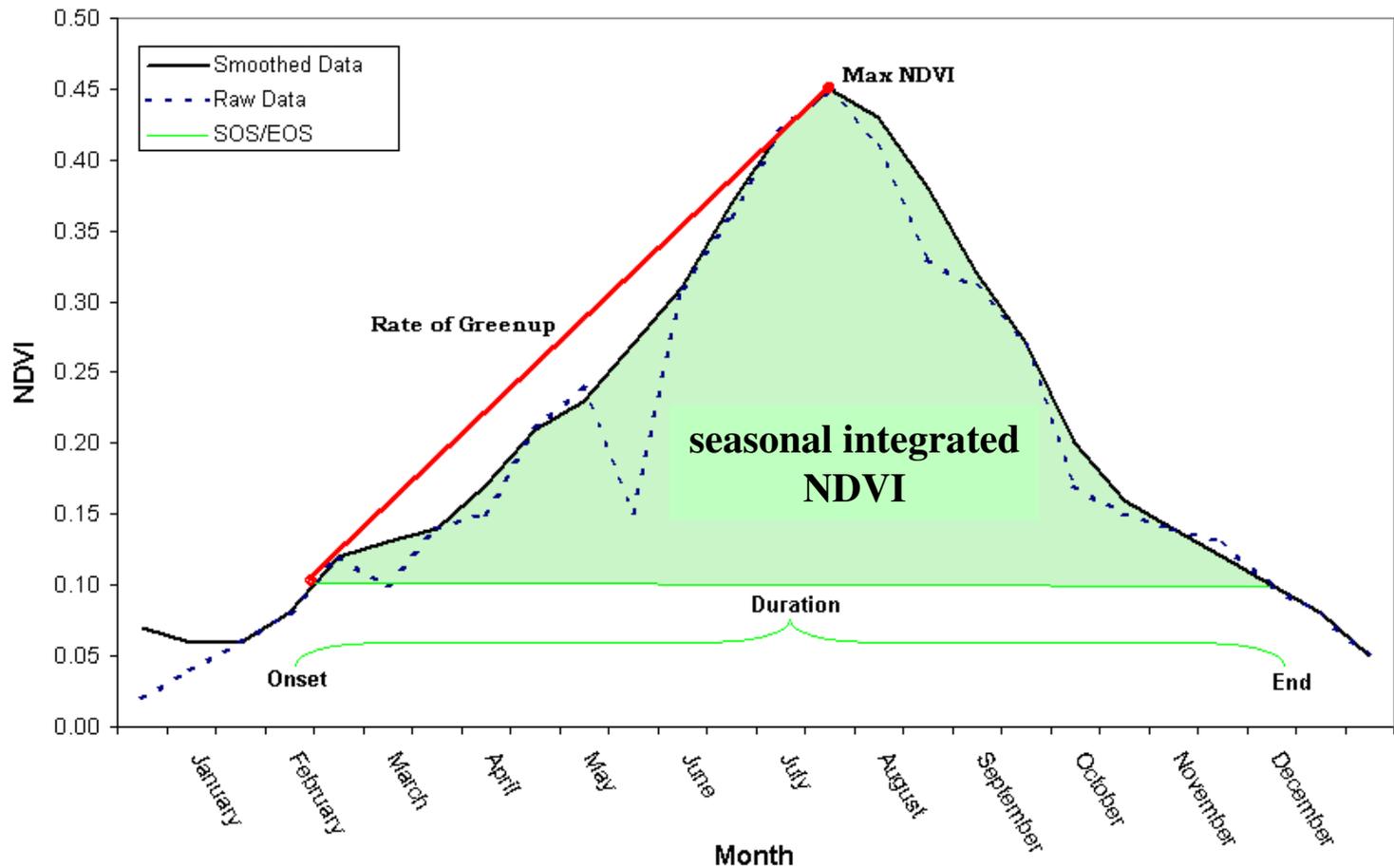


What kind of information can we get from this example?

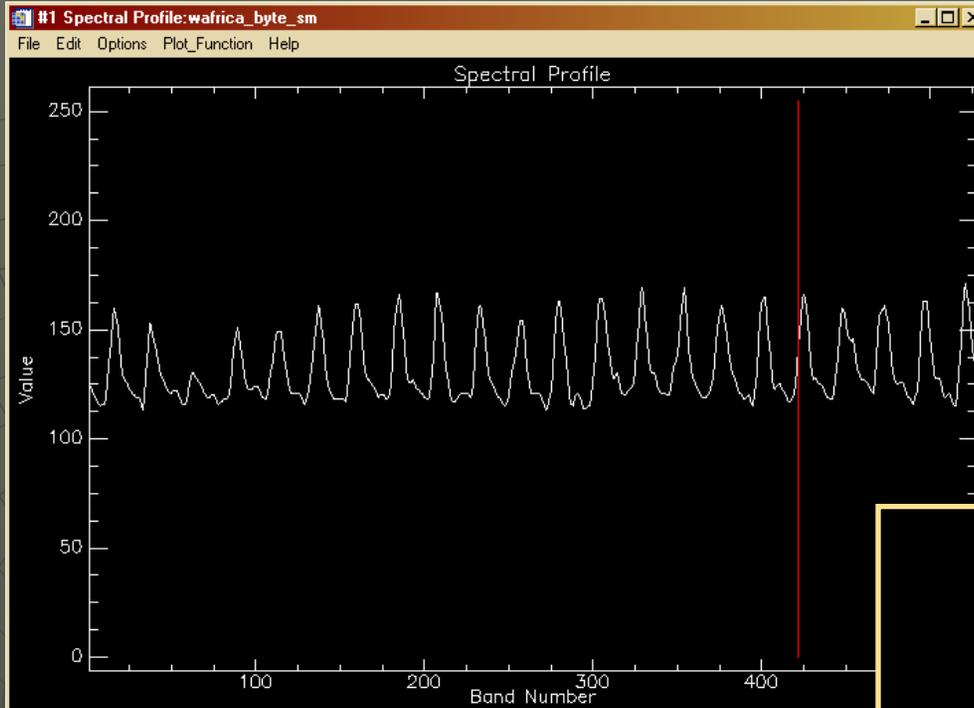




Seasonal Metrics Derivation



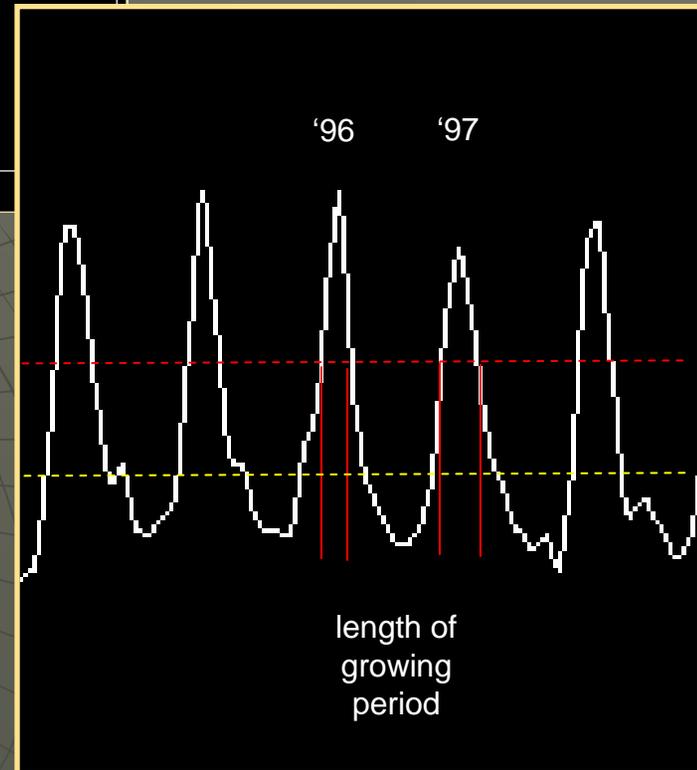
Applications of Coarse to High Resolution Satellite Imagery for Land Productivity Assessment & Management



The 'kurtosis' or shape of the seasonal curves illustrates a longer period above half-maximum NDVI in '97 versus '96.

Based on other seasonal characteristics, how would you expect the total growing season NDVI for the two years to compare?

NDVI



time



Spatial Analysis:

- ◆ **Summarizing NDVI statistics over a region or zone (zonal statistics)**
 - Administrative Unit
 - Crop Zone
 - Reserve Area
 - Some Combination of Such Zones
- ◆ **On-line Demonstration**