



07-20-2015



07-07-2022



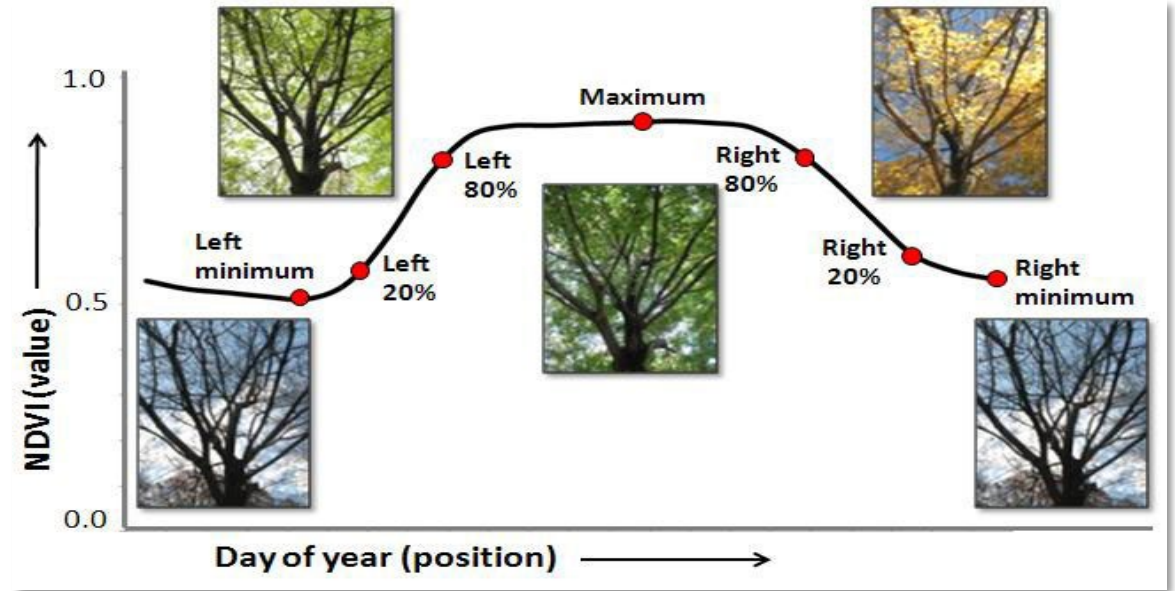
Overview and Access of Vegetation Indices (VI)

Sean McCartney

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Vegetation Stage and Health

- Vegetation Stage – Land Surface Phenology (LSP):
 - Use of satellites and sensors to track seasonal patterns of variation in vegetated land surfaces
 - [ARSET Phenology Training](#)
- Monitoring Stage and Health – Indices:
 - **NDVI** – Normalized Difference Vegetation Index
 - **EVI** – Enhanced Vegetation Index
 - **SAVI** – Soil-Adjusted Vegetation Index
 - Vegetation index anomalies



North America
NDVI Images in
Winter and
Summer.



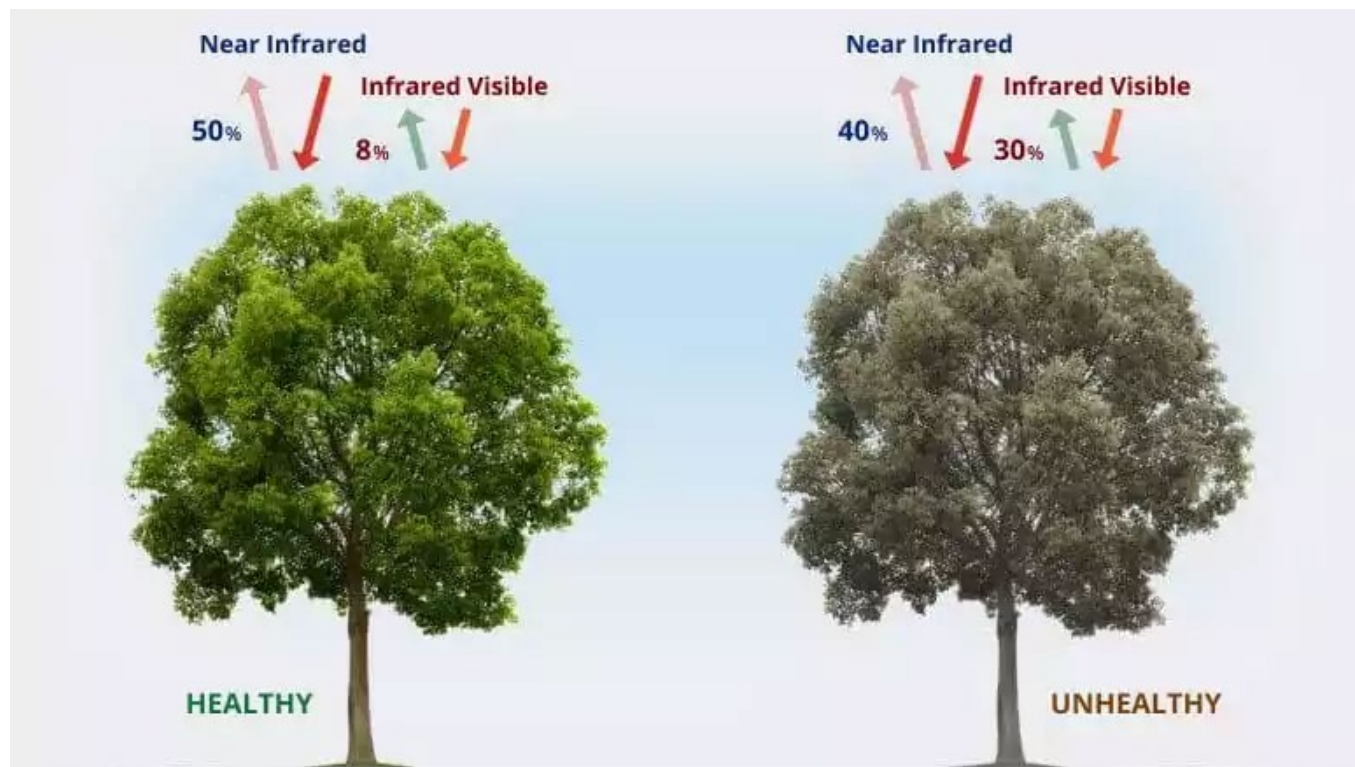
Image Credits:
Montana Space
Grant Consortium



Normalized Difference Vegetation Index (NDVI)

- NDVI is widely used as a metric for vegetation health and phenology.
- A measure of vegetation greenness
- Values range from -1.0 to 1.0
 - Negative values to 0 mean no green leaves.
 - Values close to 1 indicate the highest possible density of green leaves.
- NDVI Formula:

$$\frac{\text{Near-Infrared} - \text{Red}}{\text{Near-Infrared} + \text{Red}}$$



Chlorophyll strongly absorbs visible light, and the cellular structure of leaves strongly reflects near-infrared light. When a plant becomes dehydrated or sick the spongy layer deteriorates, and the plant absorbs more near-infrared light, rather than reflecting it. Observing how NIR changes compared to red light provides an accurate indication of the presence of chlorophyll, which correlates with plant health. Credit: [EOS Data Analytics](#)



Additional Vegetation Indices

Enhanced Vegetation Index (EVI)

$$EVI = G * \left(\frac{(NIR - R)}{(NIR + C1 * R - C2 * B + L)} \right)$$

Constants
 $G = 2.5$
 $C1 = 6$
 $C2 = 7.5$
 $L = 1$

- Can be used in place of NDVI to examine vegetation greenness
 - More sensitive in areas with dense vegetation, making it better for fuels assessment in dense forests
- Adjusts for canopy background and some atmospheric conditions

Soil Adjusted Vegetation Index (SAVI)

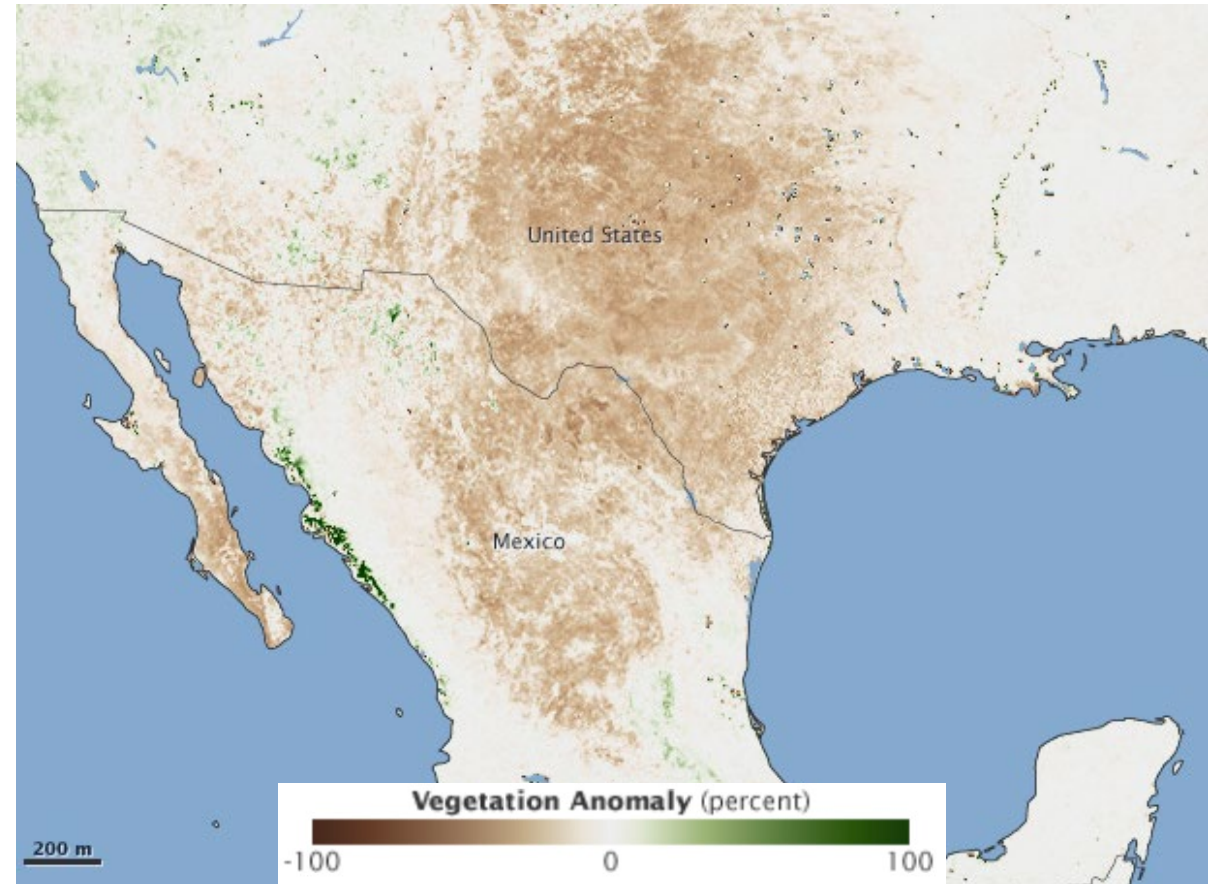
$$SAVI = \left(\frac{(NIR - R)}{(NIR + R + L)} \right) * (1 + L)$$

- Used to correct NDVI for the influence of soil brightness in areas where vegetative cover is low
 - Better index for areas with sparse vegetation and high bare soil coverage
- Contains a soil brightness correction factor (L)



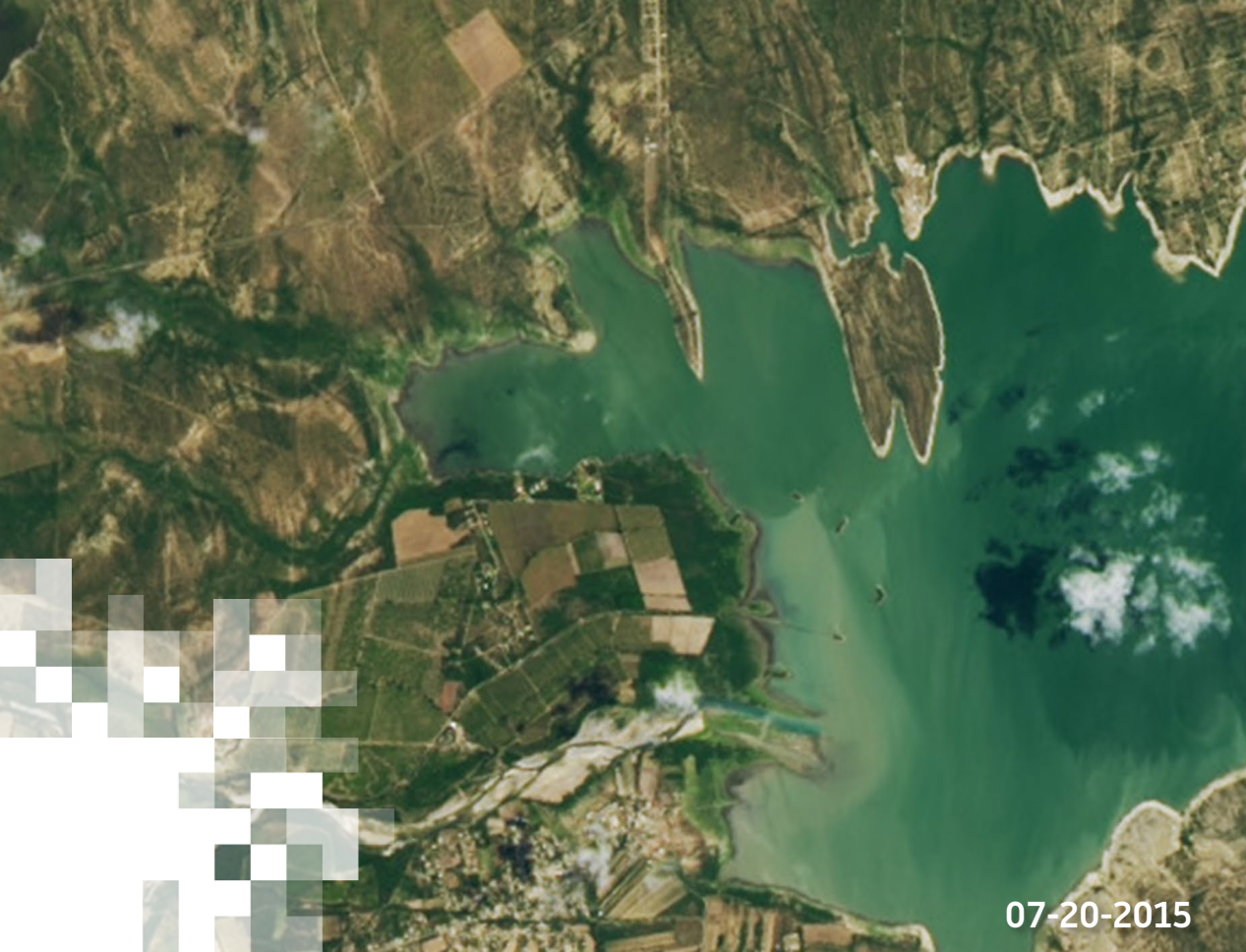
Vegetation Index Anomalies

- Anomalies are a departure of a vegetation index from the long-term average and are generated by subtracting the long-term mean from the current value for that month of the year for each grid cell.
- These departures can indicate changes in vegetation health (due to drought high temperatures, etc.).



Vegetation anomaly from July 1 – September 30, 2011. The image was made with data from the MODIS instrument on NASA's Terra satellite. Drought clearly slowed plant growth in both the United States and Mexico. Credit: [Earth Observatory](#)





Satellites and Sensors for Vegetation-Based Fire Applications

Landsat and Sentinel-2

- **Landsat**
 - First Landsat launched in 1972
 - Landsat 8 launched in 2013
 - Multispectral, 30-meter pixels, 15-meter panchromatic band, 16-day revisit
- **Sentinel-2**
 - Launched in June 2015
 - Multispectral, 10, 20, and 60-meter pixel bands, 2-5-day revisit
- **Vegetation-Based Fire Applications:**
 - Vegetation Extent and Type: Land cover classification
 - Vegetation Stage and Health: Variety of vegetation indices, including NDVI, EVI, SAVI
 - Vegetation Moisture: NDWI

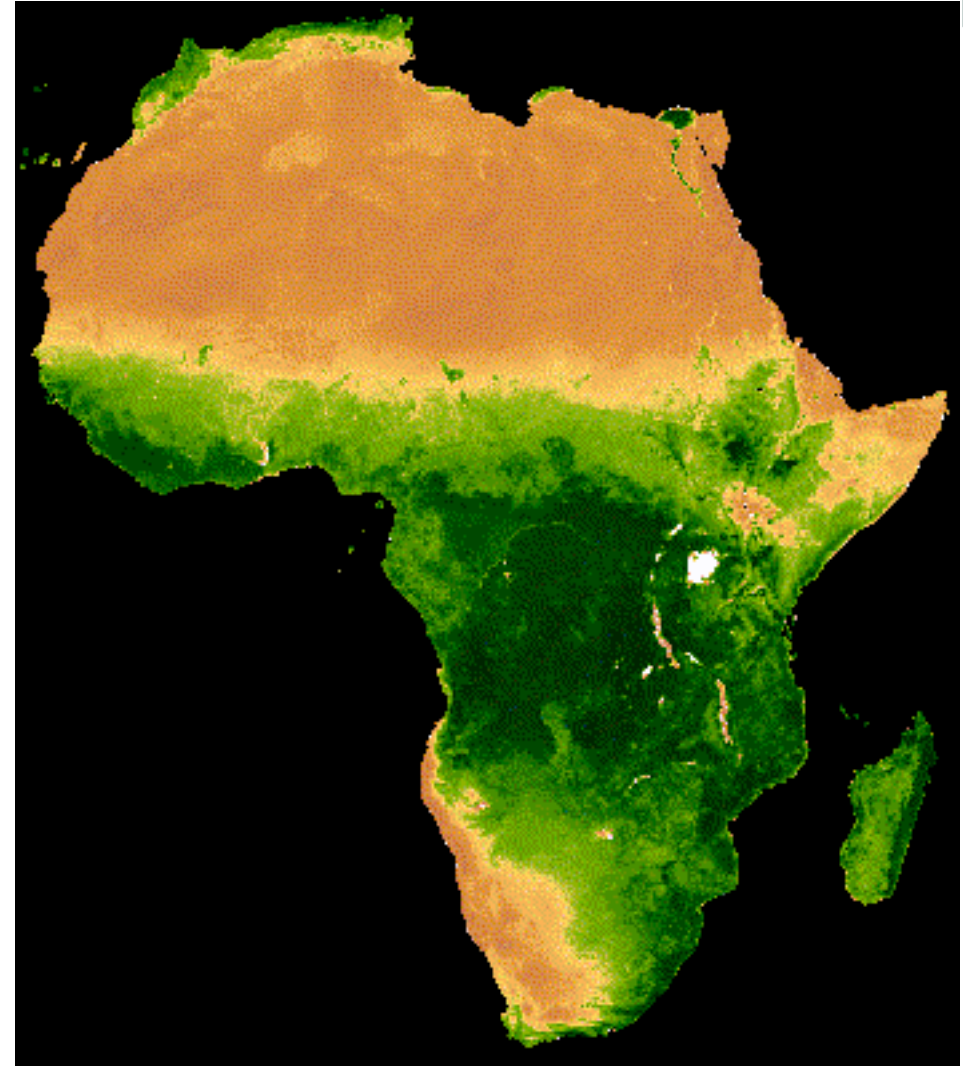


Image Credits: [USGS](#), [ESA](#)



MODIS

- **Vegetation-Based Fire Applications:**
 - Vegetation Extent and Type: Land cover classification
 - Vegetation Stage and Health: NDVI, EVI, High Temporal Resolution Phenology
- Spatial Resolution:
 - 250 m, 500 m, 1 km
- Temporal Resolution:
 - Daily, 8-day, 16-day, monthly, quarterly, yearly
 - 2000–Present
- Spectral Coverage:
 - 36 bands

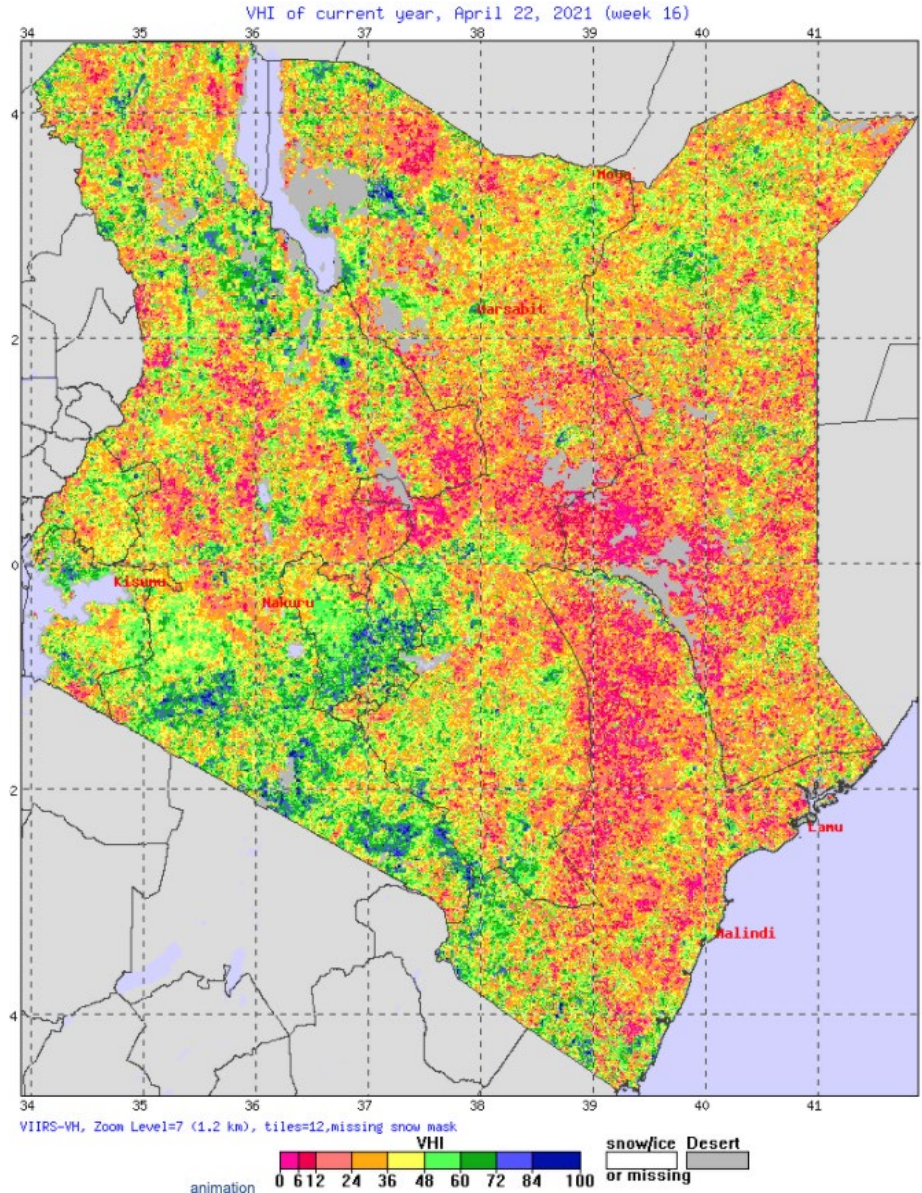


Time lapse of MODIS NDVI in Africa.
Image Credit: [Google Earth Engine Developers](#)



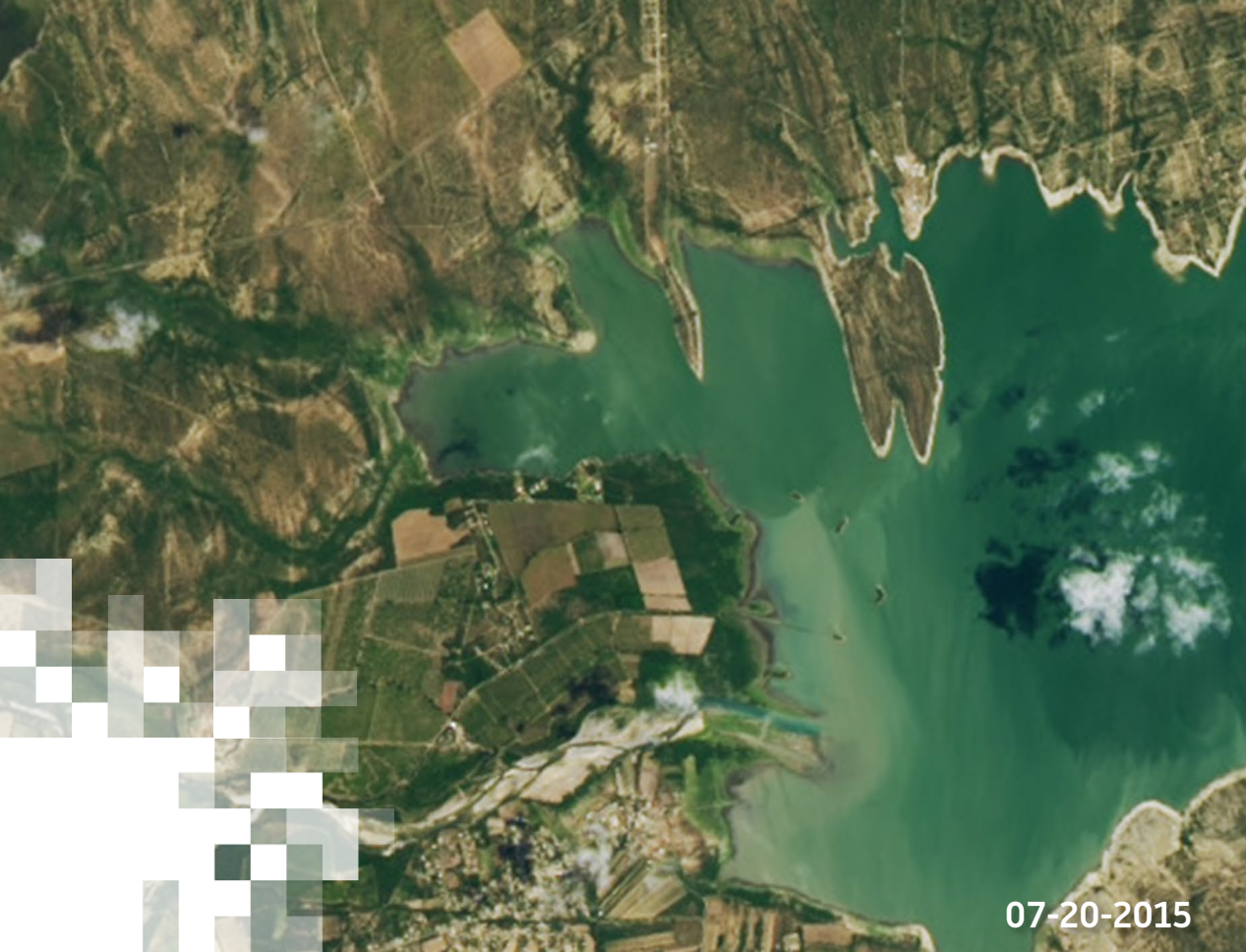
Visible Infrared Imaging Radiometer Suite (VIIRS)

- **Vegetation-Based Fire Applications:**
 - Vegetation Stage: VIIRS Vegetation Index include NDVI and EVI
 - Vegetation Health: VIIRS Vegetation Health product includes Vegetation Condition Index, Temperature Condition Index, and Vegetation Health Index
- Launched in 2012; collects visible and infrared imagery
- Daily temporal resolution and global coverage
- Spatial Resolution:
 - 5 high resolution bands: 375 m
 - 16 moderate resolution bands: 750 m



VIIRS Vegetation Health Index map of Kenya (April 22, 2021). Image Credit: [NOAA NESDIS](https://noaa.gov/education/outreach/training/remote-sensing/VIIRS)





Acquiring NDVI Data and Analyzing Anomalies in GEE JavaScript