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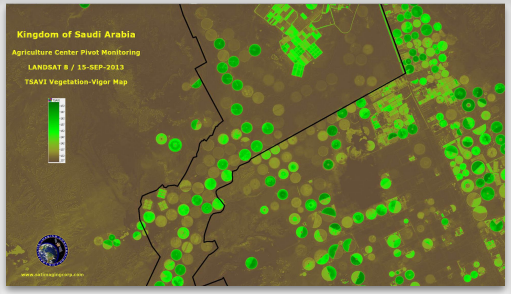
Landsat use for vegetation mapping

What is vegetation mapping ?

Vegetation mapping is an image processing task that uses satellite imaging to provide detailed information about the plant coverage on Earth's surface. This process enables scientists to rapidly document and monitor vegetation evolution. There are many applications, but they are mainly aimed at managing and monitoring ecosystems.

Major applications :

1. **Biodiversity monitoring** : to point vulnerable regions that need protection
2. **Human activities impact surveillance** (deforestation, mass agriculture, …)
3. **Climate change research** : long-term comparison of images to assess changes in vegetation (quantity and diversity) can help understand the temperature and humidity evolution in a region
4. **Natural recovery** after a disaster (wildfire, hurricane, …)
5. **Carbon storage estimation** in vegetation



Vegetation mapping in Saudi Arabia desert revealing irrigated agriculture areas, using transformed soil adjusted vegetation index (TSAVI)
Image by Landsat-8

Areas where the forest disappeared between 2001 and 2023 in a region of Paraguay, highlighting deforestation to create arable land

Landsat 9

Key bands and their corresponding Landsat and sensors :

Band name	Satellite	Sensor
Blue	Landsat 4-7, 7-9	MSS,TM,ETM+,OLI,OLI-2
Green	Landsat 4-7, 7-9	MSS,TM,ETM+,OLI,OLI-2
Red	Landsat 4-7, 7-9	MSS,TM,ETM+,OLI,OLI-2
Near infrared	Landsat 4-7, 7-9	MSS,TM,ETM+,OLI,OLI-2
SWIR (short wave infrared)	Landsat 4-7, 7-9	TM,ETM+,OLI,OLI-2
Panchromatic	Landsat 7-9	ETM+,OLI,OLI-2

Note: The bands described in the table refer to types of bands, not specific bands. These types may correspond to different bands across various Landsat missions.

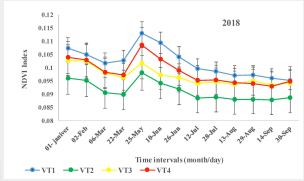
Multi-temporal Landsat imagery for Vegetation Types mapping :

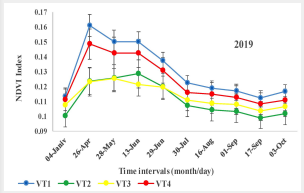
High-resolution satellite data, like Landsat 8, is useful for mapping vegetation and land cover, but single-date images often fail to accurately classify vegetation types (VTs) in diverse landscapes.

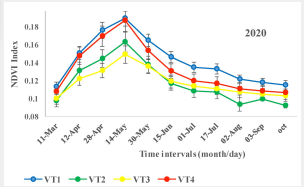
A 2021 study showed that multi-temporal Landsat images improve accuracy by capturing vegetation changes throughout the year.

Actively growing plants absorb red light and reflect near-infrared (NIR), making NDVI (Normalized Difference Vegetation Index) a key tool for tracking vegetation dynamics during the growing season, and allows more accurate discrimination between VTs based on their unique seasonal spectral signature.

Multi-temporal data helps reduce the impact of poor-quality observations (clouds, shadows) and captures phenological changes, but analyzing these datasets is time-consuming and requires optimization of plant behavior patterns.







The NDVI temporal profile and error bars for 4 distinct VT class for the years 2018-2020

Key band combinations for vegetation mapping and analysis :

natural color : Blue, green and red -> Replicates natural human vision. where healthy vegetation is green.

near infrared : Red and near infrared -> Chlorophyll in healthy plants reflects NIR light. Healthy vegetation appears bright red, while stressed or dead plants look green.

SWIR : SWIR -> Shortwave infrared bands detect moisture levels. Healthy plants appear bright green, while moisture-stressed or dead vegetation shows as pale green or gray.

panchromatic band : Panchromatic -> The panchromatic band captures a wide range of visible light and produces black-and-white (grayscale) images with **higher spatial resolution** than other bands. It can be particularly useful in vegetation mapping by providing sharper details, which helps in identifying fine features like vegetation boundaries and patterns.

Images and graphics sources:
https://www.satimagingcorp.com/gallery/landsat-8/landsat-8-center-pivot-monitoring-saudi-arabia/
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