



# Time Series Analysis of Satellite Imagery for Drought Monitoring and Mitigation

Ankit Duncan\*

Department of Geosciences, University of Copenhagen, Copenhagen, Denmark

## DESCRIPTION

Droughts are natural disasters with severe consequences for agriculture, water resources, and ecosystems. Monitoring and mitigating the impacts of droughts is crucial for sustainable development and disaster preparedness. With advancements in satellite technology and remote sensing, time series analysis of satellite imagery has emerged as a powerful tool for drought monitoring and mitigation.

### Satellite imagery for drought monitoring

Satellite imagery provides a synoptic view of large areas, enabling the continuous monitoring of vegetation health, water availability and soil moisture. Time series analysis involves collecting satellite data over an extended period and studying patterns, trends, and anomalies in various environmental variables. It allows for the detection of subtle changes in vegetation cover, water bodies, and precipitation, which can be indicative of drought onset and severity. Normalized Difference Vegetation Index (NDVI) is one of the widely used indicators for drought monitoring. NDVI measures the greenness of vegetation, reflecting its health and growth. During droughts, vegetation may become stressed, leading to a decrease in NDVI values. By analyzing NDVI time series policymakers can identify regions affected by drought and assess its spatial extent. Additionally, satellite-based monitoring of soil moisture provides essential information about the availability of water in the root zone of plants. Combining NDVI with soil moisture data allows for a comprehensive analysis of drought impacts on vegetation health and agriculture productivity.

### Time series analysis techniques

Various time series analysis techniques are employed to extract valuable information from satellite imagery for drought monitoring. Some of the common techniques include:

**Seasonal decomposition:** This method separates the time series data into three components: trend, seasonal, and residual. It

helps to understand the long-term trends and identify drought events that deviate from the normal seasonal patterns.

**Change detection:** Change detection algorithms analyze temporal differences in satellite images to detect abrupt changes, such as vegetation decline or water body shrinkage, which might indicate the onset of drought.

**Machine learning:** Supervised and unsupervised machine learning techniques can be used to classify satellite imagery into different drought severity categories based on historical drought events and corresponding ground truth data.

**Anomaly detection:** Anomaly detection methods identify unusual or unexpected patterns in satellite data that might indicate the occurrence of drought or abnormal environmental conditions.

### Applications in drought mitigation

Time series analysis of satellite imagery not only aids in drought monitoring but also facilitates effective drought mitigation strategies.

**Early warning systems:** By detecting drought onset and severity in its early stages, decision-makers can implement timely drought mitigation measures. This may include water conservation measures, irrigation management, and allocation of resources to vulnerable regions.

**Crop monitoring and yield estimation:** Satellite-based time series analysis allows for continuous monitoring of crop health and growth. By assessing vegetation stress and predicting potential yield losses farmers can make informed decisions about planting, irrigation, and crop selection.

**Water resource management:** Monitoring changes in water bodies and soil moisture can help water resource managers allocate water efficiently during drought periods. It aids in optimizing reservoir levels and planning for water supply and demand.

**Correspondence to:** Ankit Duncan, Department of Geosciences, University of Copenhagen, Copenhagen, Denmark, E-mail: ankitdu@gmail.com

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**Ecosystem health assessment:** Time series analysis of satellite imagery facilitates monitoring the health of natural ecosystems. It enables the identification of vulnerable regions that require conservation efforts during droughts.

Time series analysis of satellite imagery is a valuable tool for drought monitoring and mitigation. By providing a comprehensive understanding of drought patterns and their impacts on vegetation,

water resources, and ecosystems, this technology enables decision-makers to take proactive measures to reduce the adverse effects of droughts.

As satellite technology continues to advance, the accuracy and accessibility of time series analysis are expected to improve enhancing our ability to respond effectively to future drought challenges.