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Near-real time disturbance monitoring using satellite image time series

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Near real-time monitoring of ecosystem disturbances is critical for rapidly assessing and addressing impacts on carbon dynamics, biodiversity, and socio-ecological processes. Satellite remote sensing enables cost-effective and accurate monitoring at frequent time steps over large areas. Yet, generic methods to detect disturbances within newly captured satellite images are lacking.

We propose a multi-purpose time-series-based disturbance detection approach that identifies and models stable historical variation to enable change detection within newly acquired data.

Satellite image time series of vegetation greenness provide a global record of terrestrial vegetation productivity over the past decades. Here, we assess and demonstrate the method by applying it to (1) real-world satellite greenness image time series to detect drought-related vegetation disturbances (2) landsat image time series to detect forest disturbances.

First, results illustrate that disturbances are successfully detected in near real-time while being robust to seasonality and noise. Second, major drought-related disturbance corresponding with most drought-stressed regions in Somalia are detected from mid-2010 onwards. Third, the method can be applied to landsat image time series having a lower temporal data density. Furthermore the method can analyze in-situ or satellite data time series of biophysical indicators from local to global scale since it is fast, does not depend on thresholds and does not require time series gap filling. While the data and methods used are appropriate for proof-of-concept development of global scale disturbance monitoring, specific applications (e.g., drought or deforestation monitoring) mandates integration within an operational monitoring framework.

Furthermore, the real-time monitoring method is implemented in open-source environment and is freely available in the BFAST package for R software. Information illustrating how to apply the method on satellite image time series are available at http://bfast.R-Forge.R-project.org/ and the example section of the bfastmonitor() function within the BFAST package.