Keywords:
#satellite, #image, #data, #radar, #earthobservation, #forest #monitoring #EOSCinPractice

Monitoring Tropical Forest Recovery Capacity Using RADAR Satellite Images

An EOSC in Practice Story where time series of satellite radar images are collected to measure forest recovery capacity at unprecedented spatial and temporal scales.

The project involved

The C-SCALE project (funded from the European Union's Horizon 2020 research and innovation programme under grant agreement No 10101752) aims at enhancing the **EOSC Portal** with pan-European federated Copernicus data and computing infrastructure for their processing and analysis. The project provided resources which proved to be extremely useful for the RETURN use case. This aims at exploring time series of satellite radar (Sentinel-1) images from the EU Copernicus Earth Observation (EO) Programme to understand the recovery capacity of the Amazon rainforest. The outcomes of the RETURN research are important to help identify areas with slower forest recovery in the Amazon basin and potentially understand their causes.

The Context

Recent extreme droughts combined with accelerating human exploitation are pushing tropical forests to the point where they cannot recover, making them vulnerable to large unprecedented wildfires. This causes an urgent need to monitor the recovery capacity of tropical forests.

The Challenge

While time series-based break detection approaches have demonstrated potential to measure tropical forest recovery capacity, they have not yet been applied over large amounts of satellite data. The reasons for this are twofold:

» These methods require expert knowledge and are very compute intensive
» They cannot be easily scaled over large amounts of satellite data

"The radar images are collected every six days and have a pixel size of 10 m, resulting in terabytes of data when a period of several years is analysed over a large area such as the Amazon basin. EOSC services help users face the main challenge to efficiently store, access, and analyse such big spatio-temporal data"

Milutin Milenković, Research Scholar, International Institute for Applied Systems Analysis, and Associated Researcher, Wageningen University & Research

The radar images are indeed collected every six days and have a pixel size of 10 m, resulting in terabytes of data when a period of several years is analysed over a large area such as the Amazon basin. Therefore, the main challenge for users is how to efficiently store, access, and analyse such big spatio-temporal data. There are different big satellite data processing platforms available, but many of them are not flexible enough, as they do not support user-defined codes or a complex workflow involving different software solutions.

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The solution

To address this challenge, the SURF computing infrastructure, i.e., the SPIDER cluster and the Sentinel-1 data cube prepared by the EODC GmbH was used. Those resources were available within the C-SCALE project as a part of a use case defined and designed together with EOSC experts. The interaction with the computing infrastructure and data was established through ssh connections and Jupyter Notebook. The RETURN use case researcher, Milutin MIlenković has developed a Python code to analyse satellite radar image time series and used tools such as Jupyther and slurm to test and upscale the analysis on the cluster. Once the analysis is done, all the results and the code with usage examples will be available on the following GitHub repository

The researcher

Milutin Milenković is a Reserch Scholar at the International Institute for Applied Systems Analysis, Novel Data Ecosystems for Sustainability group, and Associated Reseacher at Wageningen University & Research in the Geo-information Science and Remote Sensing Lab. His current research focuses on combining earth observation and citizen science for monitoring environmental change on the global scale.

Why do I need EOSC?

EOSC played a crucial role in Milutin's study by hosting big satellite data and providing computational capacity to analyse those data. Furthermore, EOSC cloud computing experts helped Milutin onboard his code to the EOSC computing infrastructure. The EOSC services helped overcome the challenge of processing and analysing terabytes of satellite images. As the results and code will be freely available, the whole computational setup and the outcomes will be fully reproducible, ensuring credible information about environmental change and nurturing open science practices. Moreover, the study will provide highly detailed and spatially-explicit information about signal disturbance and recovery over the Amazon basin, enabling studies on the relationship between areas with different signal recovery properties and their potential causes, i.e., contributing to the understanding of the resilience of the Amazon rainforest.

The EODC JupyterHub for global Copernicus data is available on the EOSC Marketplace

Across disciplines

The study's outcomes will be relevant for ecologists, foresters, and the remote sensing community. The computing approach will be relevant for the remote sensing community as an example of a custom analysis upscaling over a larger area. Furthermore, ecologists and foresters can further explore the study results, for example, by analysing spatial patterns and statistics of signal recovery to gain a different look at the forest disturbance and recovery process in the Amazon basin.

Future developments

The study's results, i.e., spatially-explicit features of signal recovery, can be further explored and analysed by other experts. Those features can be an input for machine learning models to map and analyse causes of forest disturbance or predict follow-up land use classes. EOSC can foster such cross-disciplinary analysis by hosting the study results close to their computational resources and onboarding the code (analysis) from other researchers.

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