

# Identifying Unusual Fire Events in Tropical Forests: Isolation Forest

## Approach to Understanding Disturbances in Madagascar

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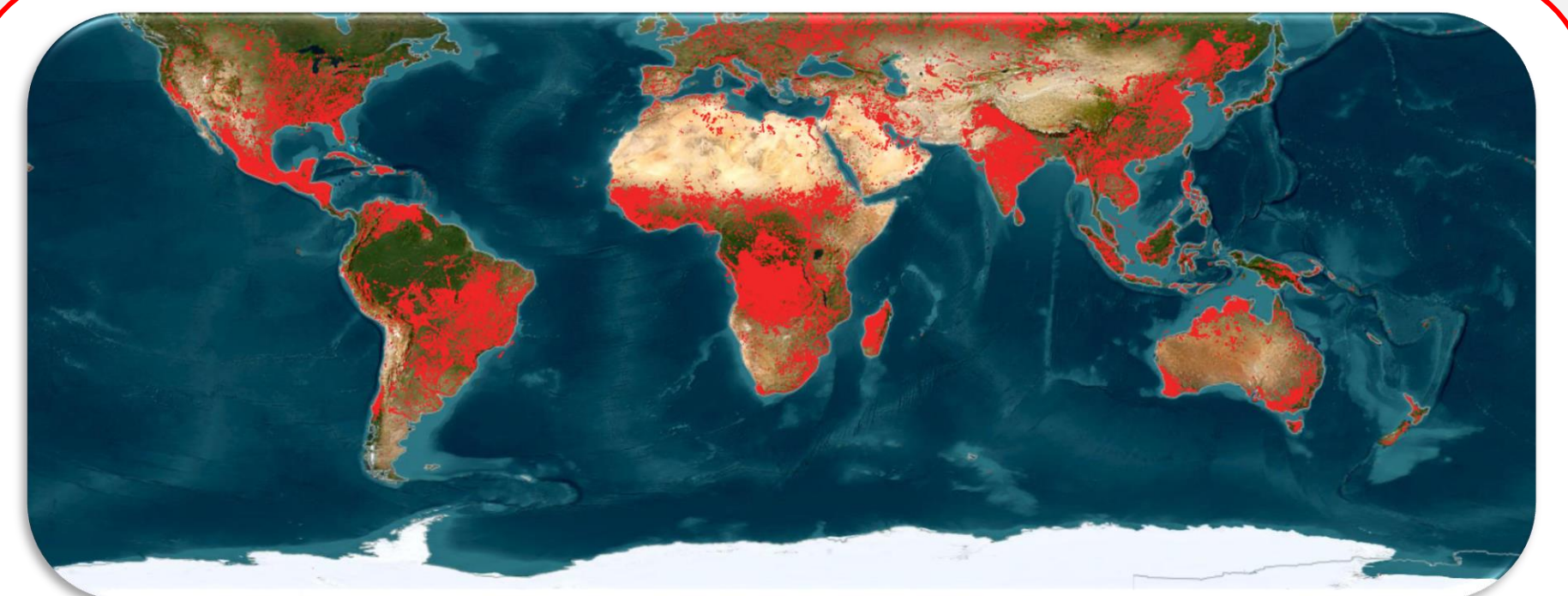


### Disturbances in the Tropical Forests

- Wildfires are raging across the globe with an average of **4.63 million km<sup>2</sup> area** burned globally from 2001 to 2018 - roughly 12 times the size of the UK.
- Fires driven by human activities, dry climates, and abundant fuels are pumping massive amounts of **CO<sub>2</sub> (8 billion tonnes per year)** into the atmosphere.
- Tropical Forests, like **the Amazon**, are at high risk of collapsing due to disturbances, threatening **global carbon storage**.
- These disturbances significantly impact upon the **global carbon cycle**, ultimately driving the Earth system towards an irreversible change or **"tipping point."**

### Satellite Monitoring

Recent advancement in remote sensing have improved burned area monitoring, while **machine learning** techniques facilitate data interpretation.

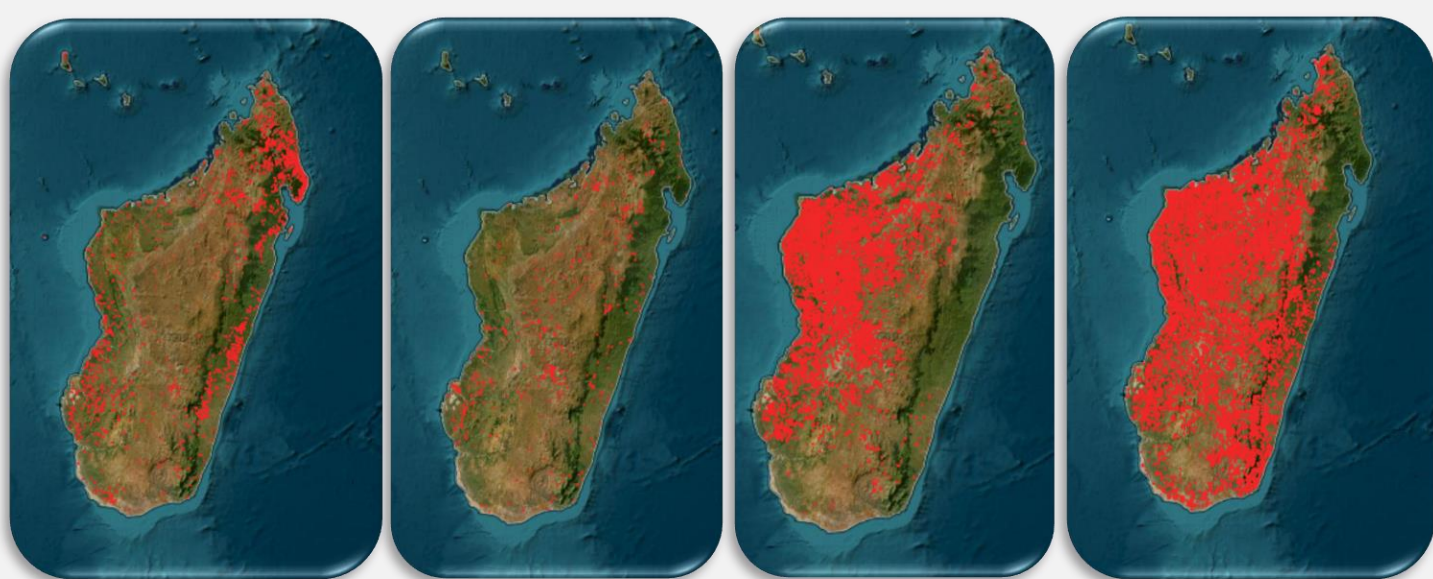


A burned area map derived from NASA satellite data.

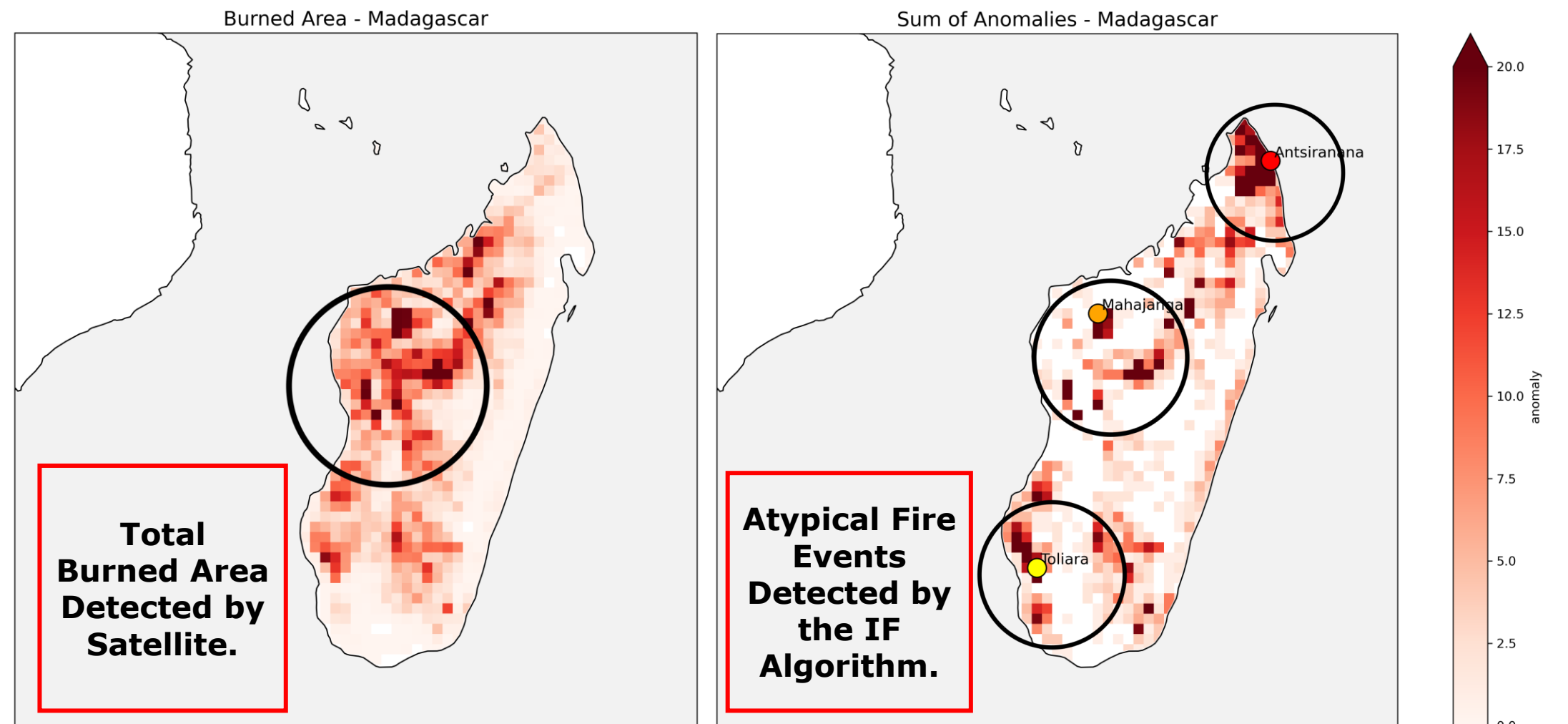
### Isolation Forest Machine Learning Approach

The most **high-impact disturbance** isn't always due to the largest fire, it could be a **modest fire event** but in a region that does not typically experience burning, or a **fire event outside of typical fire season**.

- Our machine learning approach, **Isolation Forest (IF)**, isolates the data point by randomly splitting the features.
- Anomalies are easy to isolate as fewer are splits needed thus identifying **atypical fire events**.
- IF helps in **identification of anomalies** that traditional detection approach may overlook.
- IF works well with **complex, high - dimensional data** and is **easy to interpret**.



Weekly fire activity for Madagascar derived from NASA satellite data.

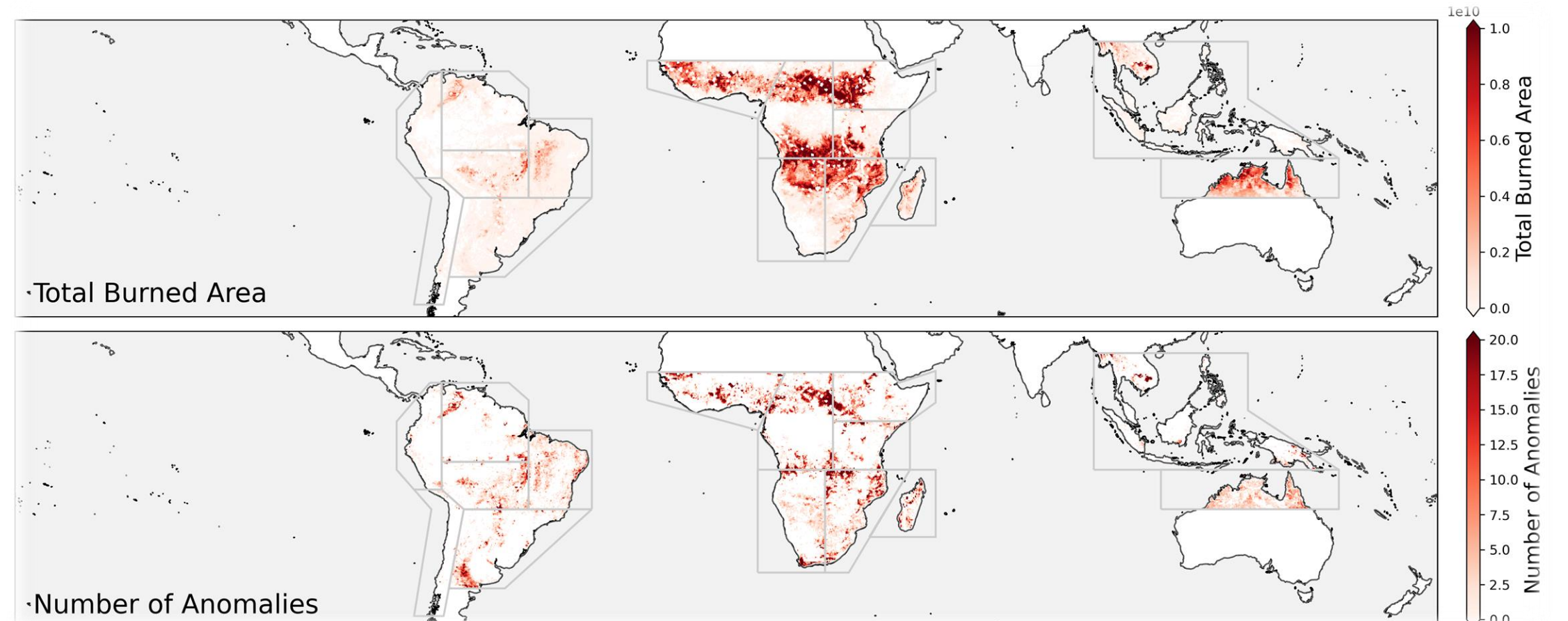


Total Burned Area Detected by Satellite.

Atypical Fire Events Detected by the IF Algorithm.

### Way Forward - Policy Implications

- This method can help understand disturbances that may **not be considered significant by traditional analysis**.
- Future research will additionally explore tropical forest's response to climate tipping points, both from satellite observations and using **the UK Earth System Model (UKESM)**.
- Using the **IF algorithm and UKESM**, policymakers can **predict the long-term effects** of **climate change** and **human impact** on tropical forests.
- This approach is especially crucial in **vulnerable regions** where **advanced analysis using UKESM** is relatively underexplored and can positively impact **local communities, the tropics, and the global environment** in long-term.



Total burned area and total anomalies detected across the whole of the tropics.