BioSpace25 - Biodiversity insight from Space
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BioSpace25 - Biodiversity insight from Space

Monitoring forest ecosystem restoration with FERM and SEPAL geospatial tools

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What is FERM?

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PURPOSES

The **official monitoring platform**:

- **Tracking global progress** and **disseminating good practices** for the **UN Decade on Ecosystem Restoration**.
- **Reporting areas** under restoration for the Kunming-Montreal **Global Biodiversity Framework Target 2**.

The FERM consists of:

- a **registry** of restoration initiatives and their good practices covering all ecosystems.
- a **geospatial tool** to visualize restoration data.
- a **search engine** that shares good practices and initiatives on ecosystem restoration.
- a **dashboard** (under development) that provides analytics on the compiled restoration data

https://ferm.fao.org

What is SEPAL?

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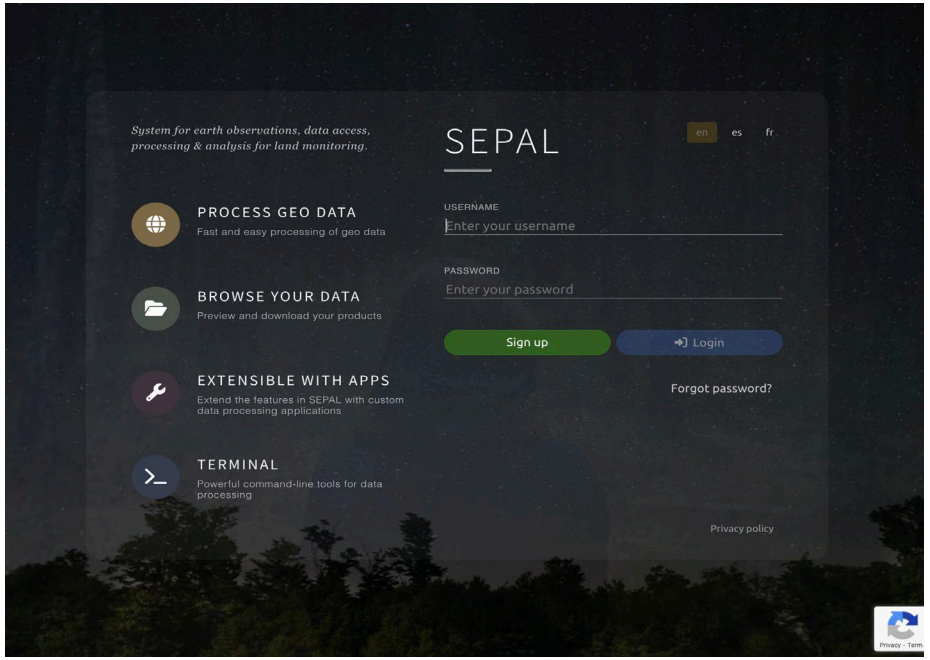
PURPOSES

- A platform for easy query, access, and processing of earth observation data (satellite images)
- Open source / Free to use
- A ‘barrier buster’ - a cloud-based catalyst for autonomous land monitoring

What can you do in SEPAL?

- **Satellite Image Processing & Analysis** – Process satellite imagery (Sentinel, Landsat, Planet), generate indices (e.g. NDVI, EVI) and detect land-use changes.
- **Custom Geospatial Workflows** – Create your own process in SEPAL using pre-built algorithms (e.g. Continuous Change Detection and Classification (CCDC))
- **Data Visualization and Export** – Create maps and export data into GEE



https://sepal.io/

Proposed Methodology

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PHASE 1

FRAMEWORK FOR ECOSYSTEM RESTORATION MONITORING

Global database with areas under restoration

PHASE 2

SEPAL

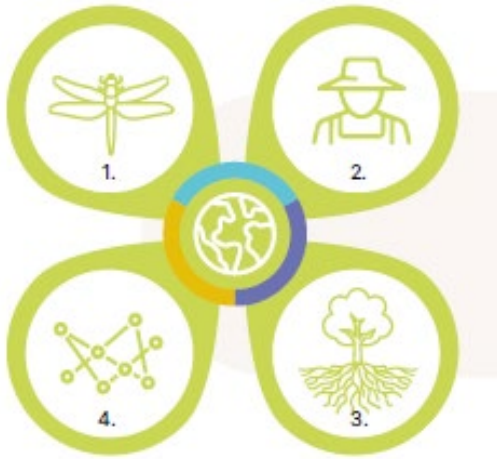
Performing calculations with indices (NDVI, NDMI) and dense time series algorithms

PHASE 3

Sample data collection and validation with local experts

Ecosystem Restoration Outcomes and Metrics :

1. **Biodiversity:** Species richness, Abundance of indicator species
2. **Ecosystem services and functions:** Aboveground Biomass Stock, Percentage Income from Restoration Related Activities
3. **Ecological integrity:** Species Diversity Indices, Soil decomposition and infiltration rate
4. **Connectivity:** Mean Nearest Distance Between Habitat Patches, Genetic Diversity of Vegetation



Methods

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Create Mosaics in SEPAL using Remote Sensing Data for the time-period

→

Classify the mosaics using random forest to create a class change map

→

Apply time series to real data and compare against synthetic data from CCDC

Seamless, cloudless mosaics over your AOI which can be viewed in **different band combination**s using **Sentinel, Landsat or Planet imagery**

Built in classification algorithm that will output a map showing **land cover followed by land use change**

Time series analysis provides **information about trends, patterns, changes and evolution** over a given area over a period of time. Real data is good for **short term changes** and complementing it with CCDC data using **harmonic detection will help you do gap filling and detect gradual changes over multiple years and smooth out any noise**

Community Based Sustainable Land and Forest Management in Afghanistan

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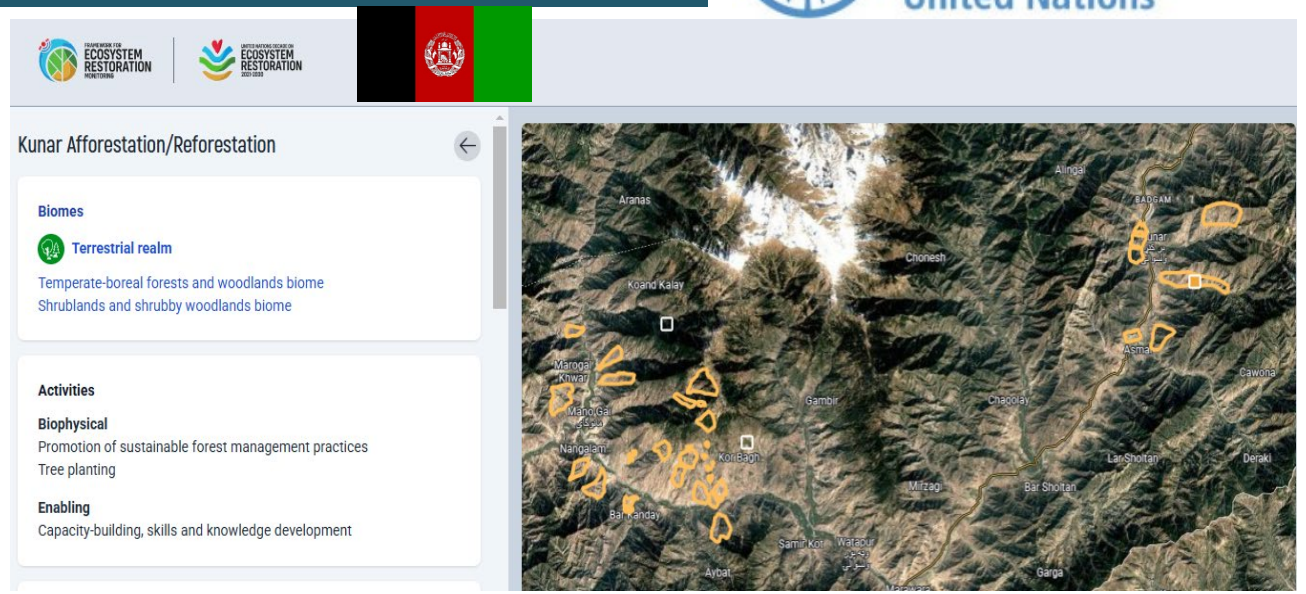
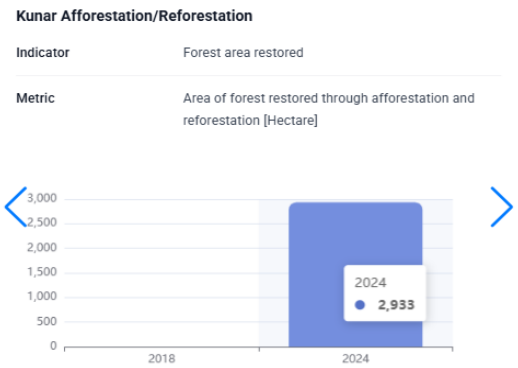
Main objectives of the practice: Support integrated, community-based approaches to sustainable land and forest management
Ecosystem: Forests and Shrublands
Biomes to be restored:
T2 - Temperate-boreal forests and woodlands biome
T3 - Shrublands and shrubby woodlands biome
Activities: Promotion of sustainable forest management, Tree Planting
Project Timeline: 2021 to 2026
Indicators: 2933 ha of forest restored, 471000

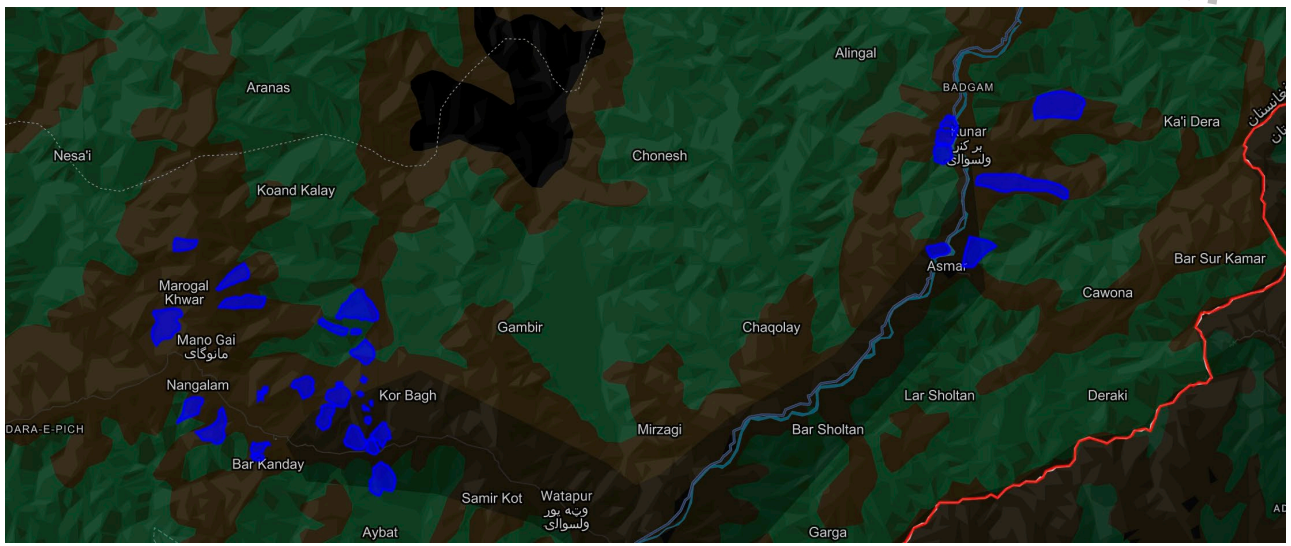


Challenge: Deforestation was driven by the lack of alternative livelihoods, with tree felling as a key income source.
Solution: A GEF-funded project introduced awareness sessions on sustainable forest management and provided saplings for reforestation.
Impact: Communities now have a sustainable income source, contributing to forest restoration.



Project published in FERM
https://ferm.fao.org/search/initiatives/Xmp0epr7TTPP8KYffyW5

FRAMEWORK FOR ECOSYSTEM RESTORATION MONITORING



*For the creation of mosaics, AOIs are buffered by 1 km as some of them are small areas

Mosaics

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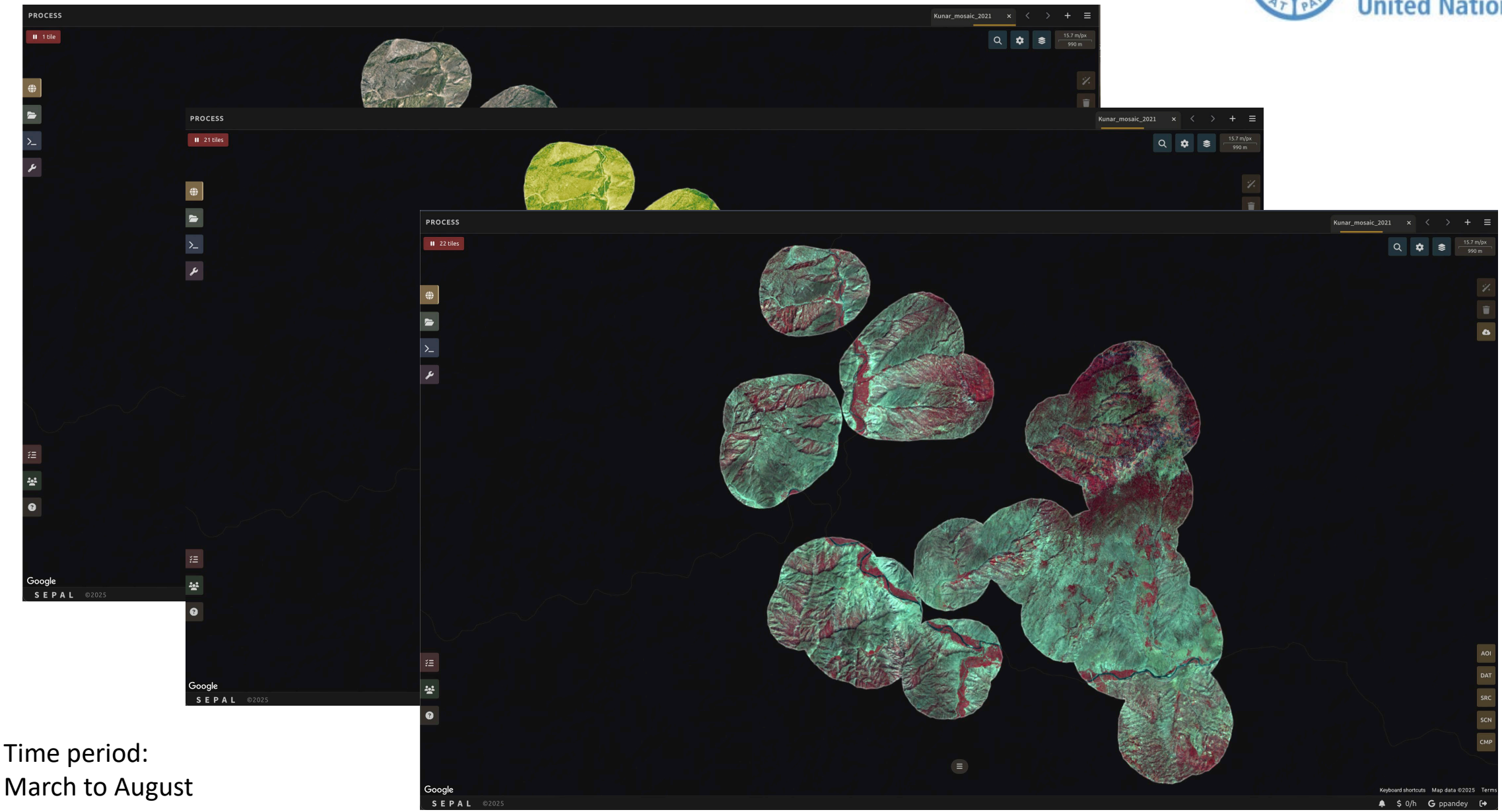

Time period:
March to August

Classification

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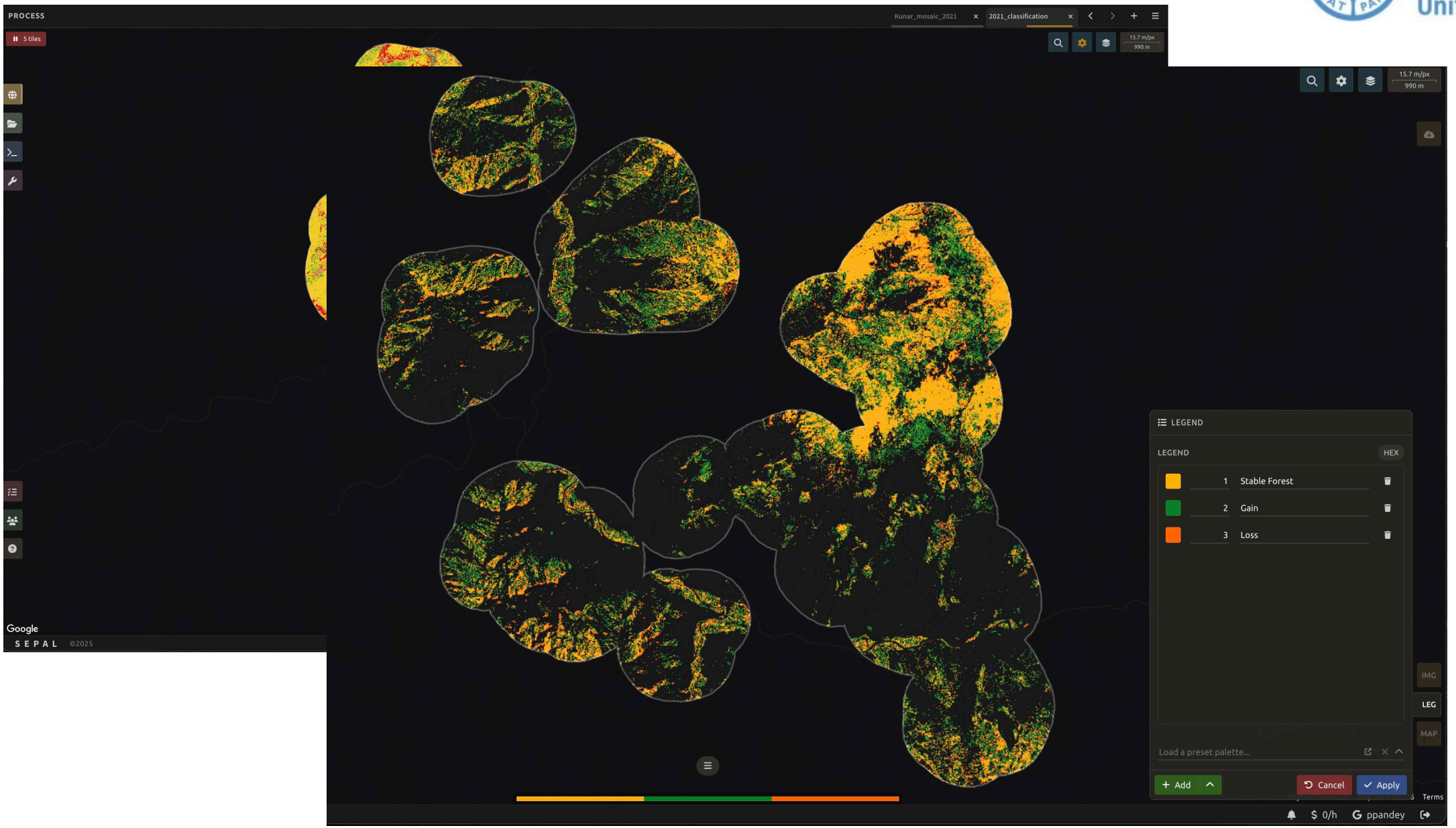

Time Series

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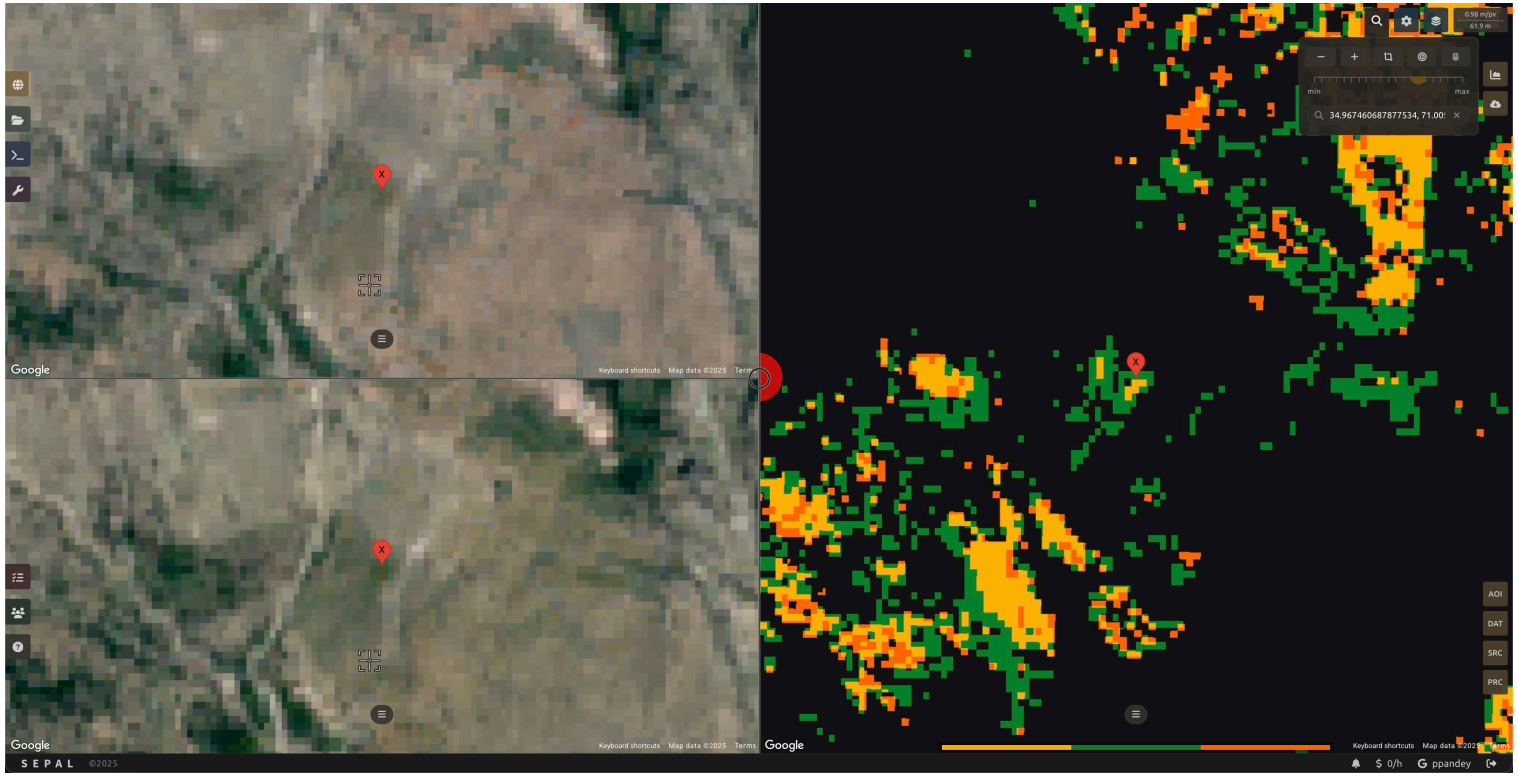

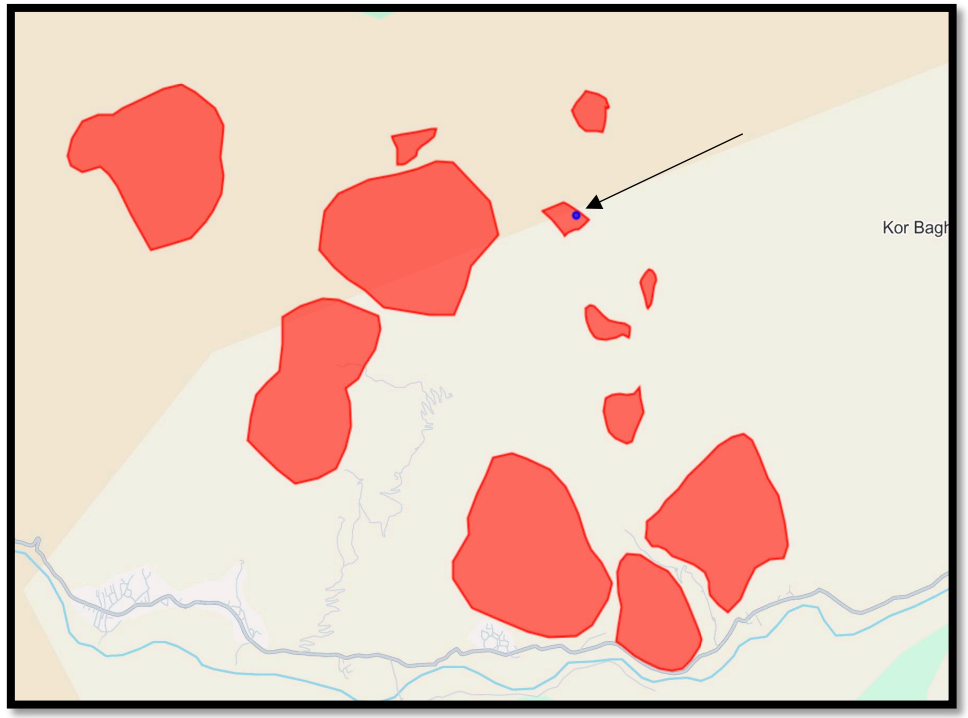

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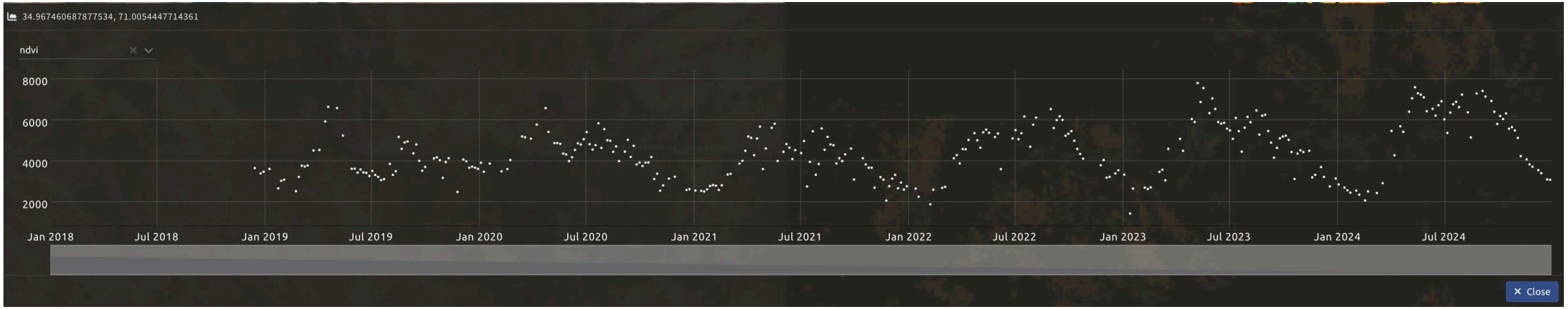

Time Series - CCDC

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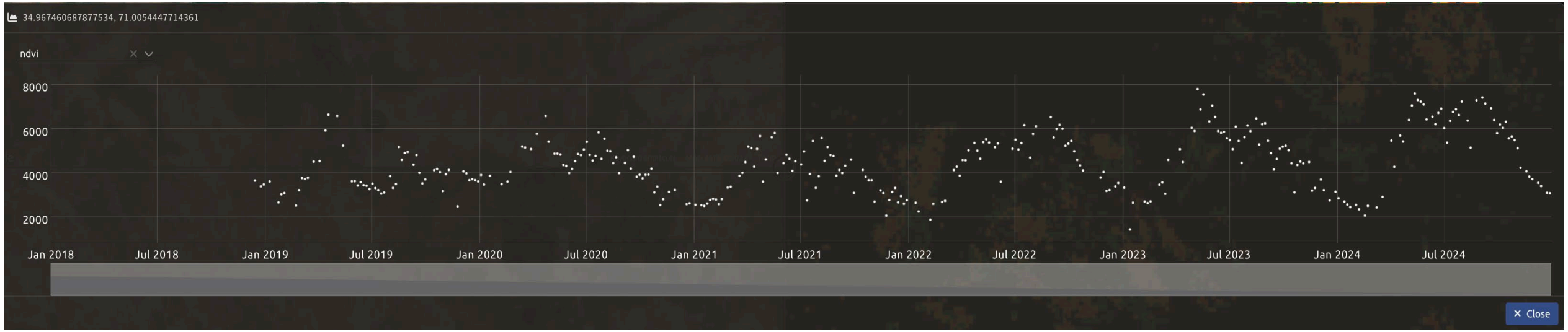

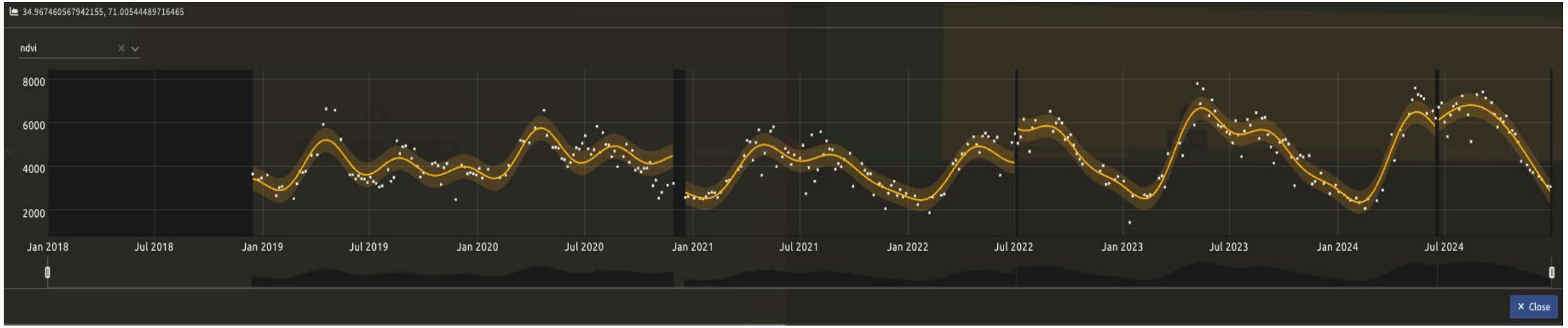

Restoration of mangrove sites along the Mombasa coastline

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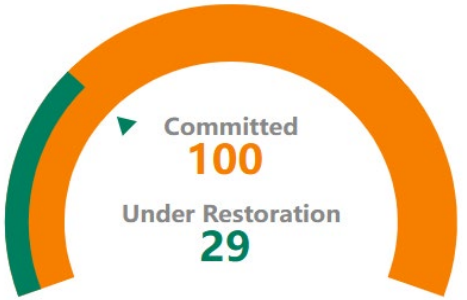
Main objectives of the practice: To increase the area under restoration
Ecosystem: Marine-Freshwater-Terrestrial realm
Biomes:
MFT1 - Brackish tidal biome
Project Timeline: 2018 to 2030

Area of land and ecosystems under restoration



Challenge: Tudor Creek has experienced significant mangrove deforestation, with over 80% loss since the 1960s due to illegal harvesting, land encroachment, and pollution.

Solution: Community-led efforts focus on vegetation restoration and capacity-building through skills training and sustainable management practices.

Impact:

- **Mitigation** Increased biomass stock and sequestered GHG emissions.
- **Quality** Improved abundance of indicator species.
- **Protection** Expanded protected areas for key biodiversity.

Contributions to SDGs

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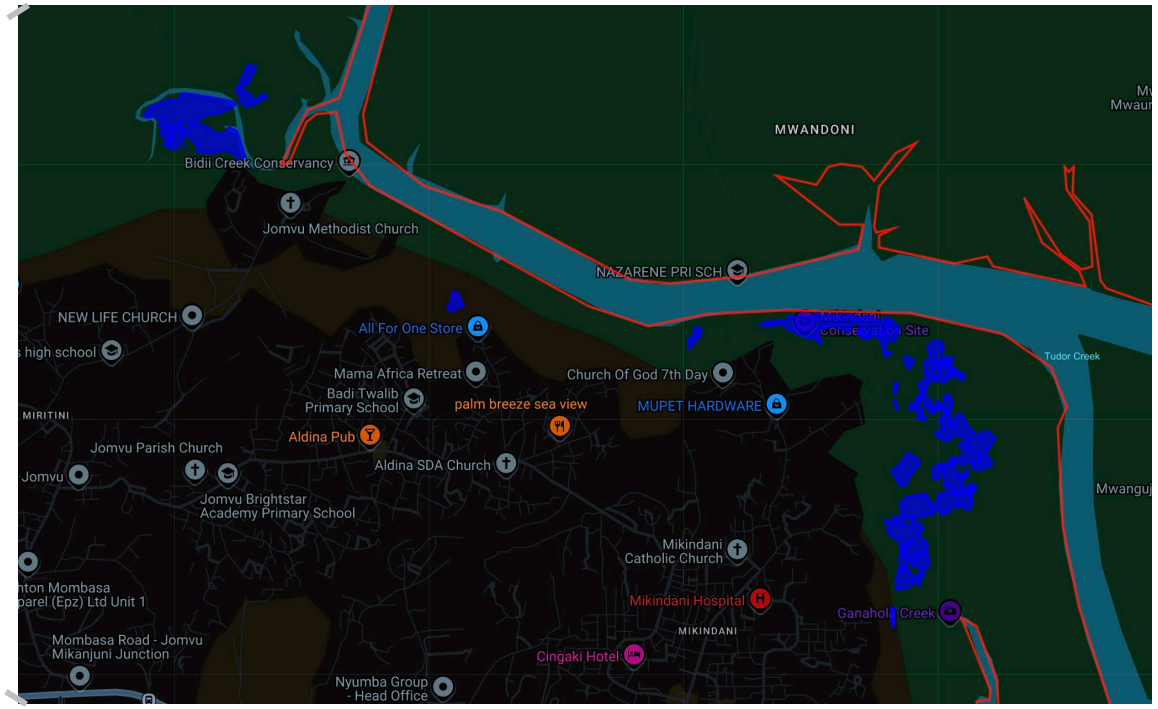

Sentinel Mosaic (e.g.2024)

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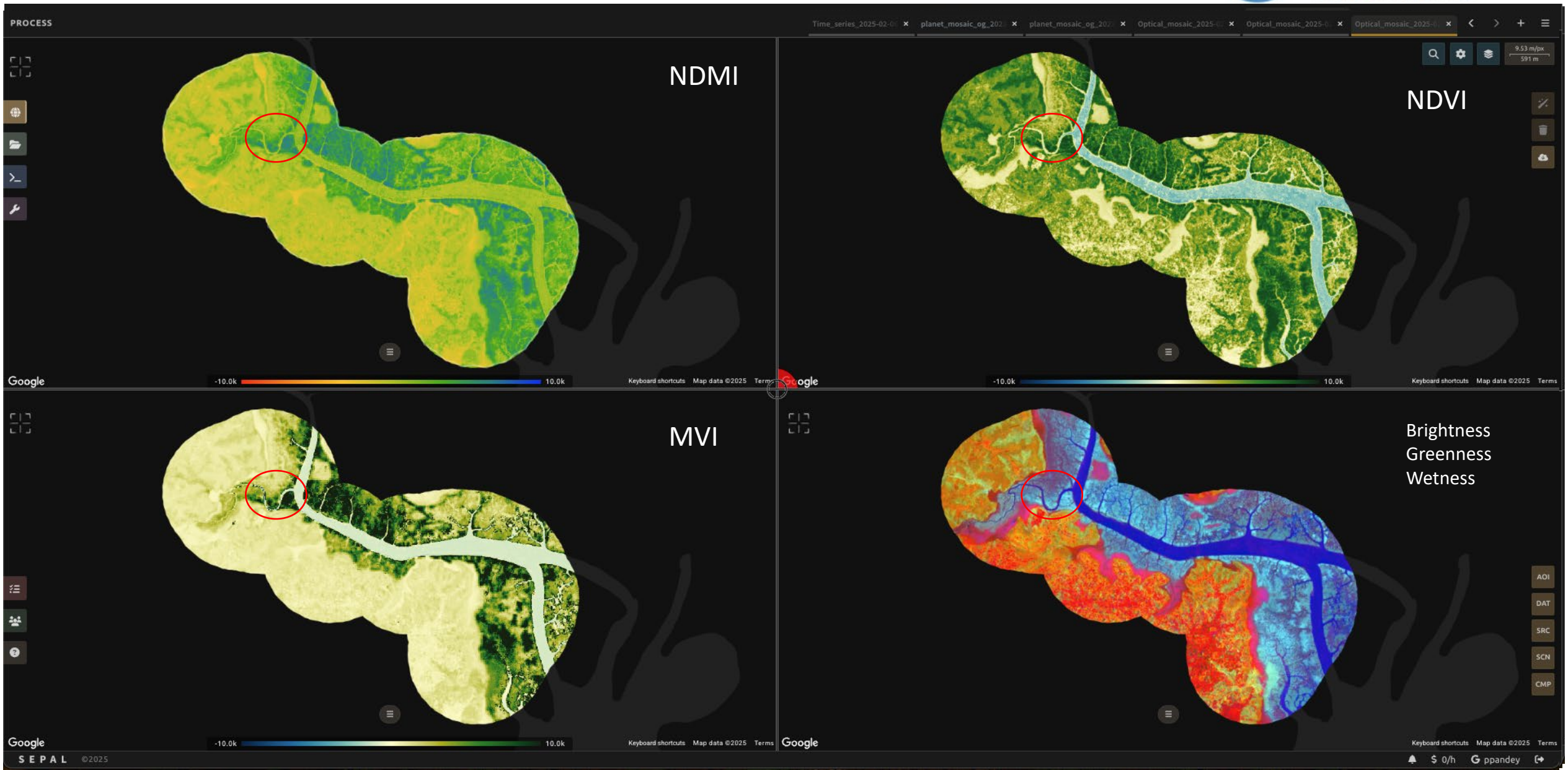

Planet Mosaic (2019,2022,2024)

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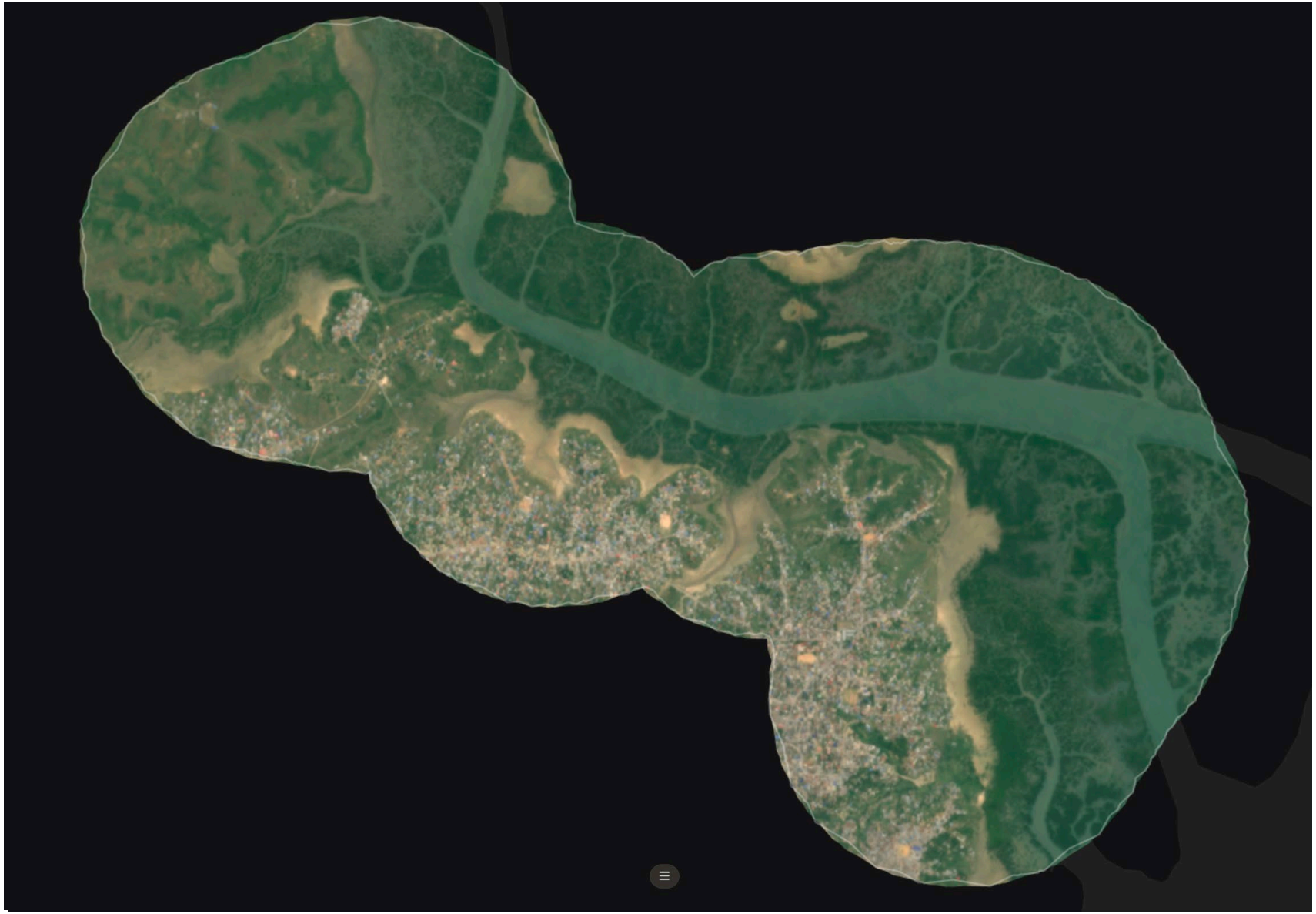

Imagery from the NICFI Satellite Data Program at 4.5m resolution

Time Series

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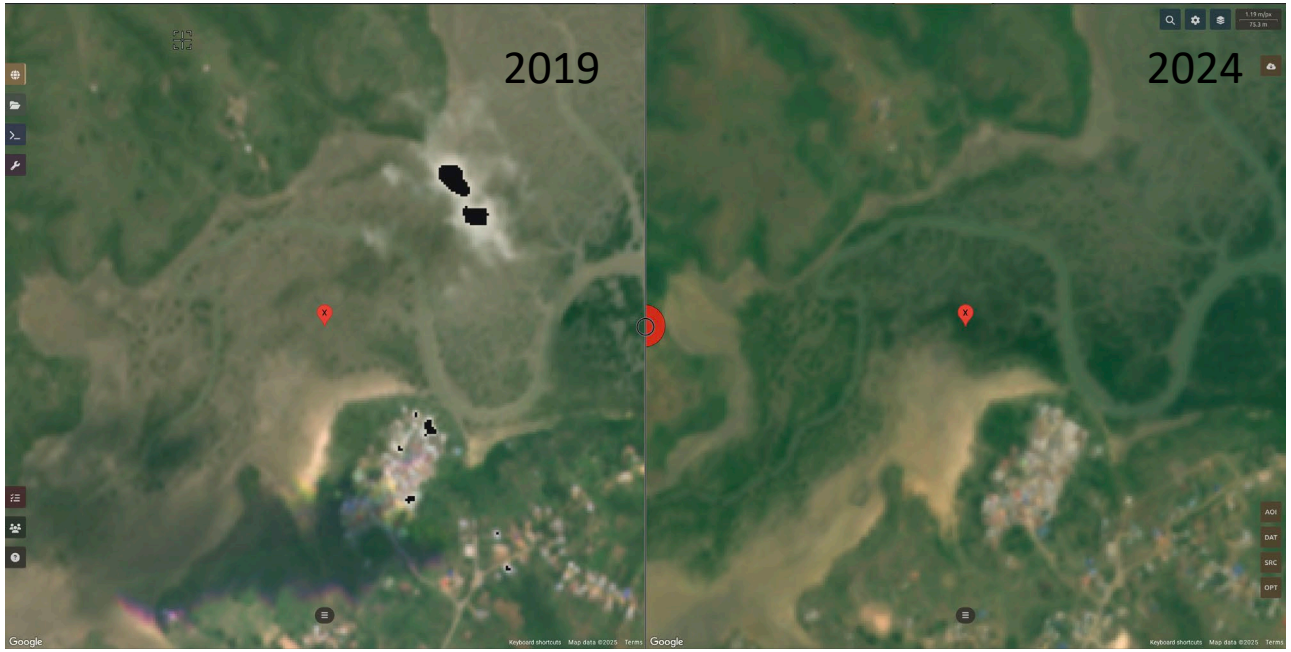

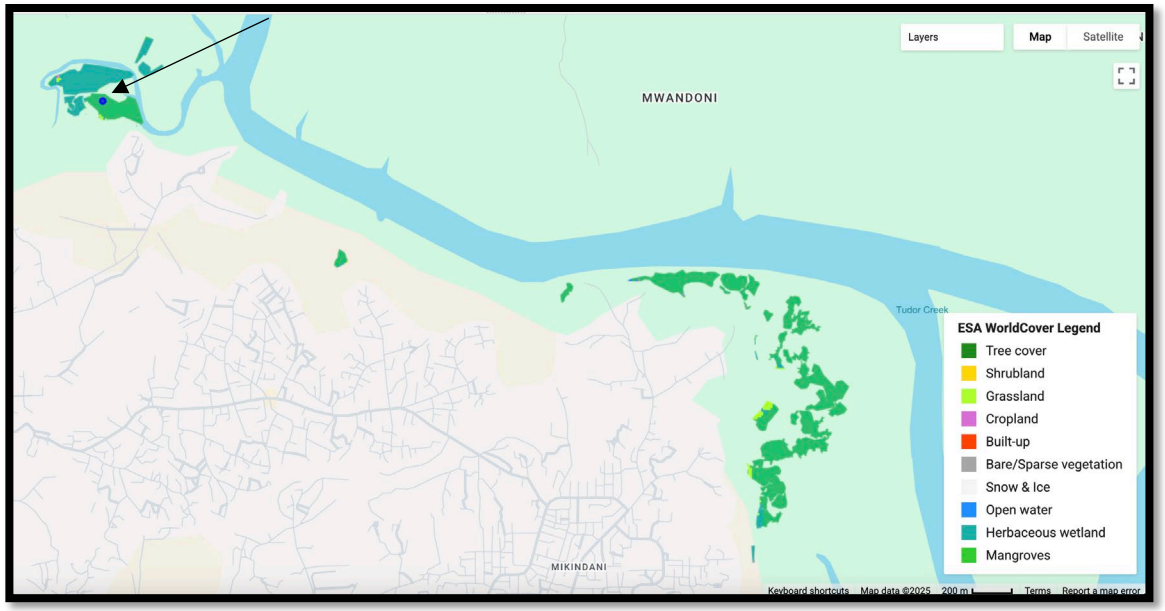

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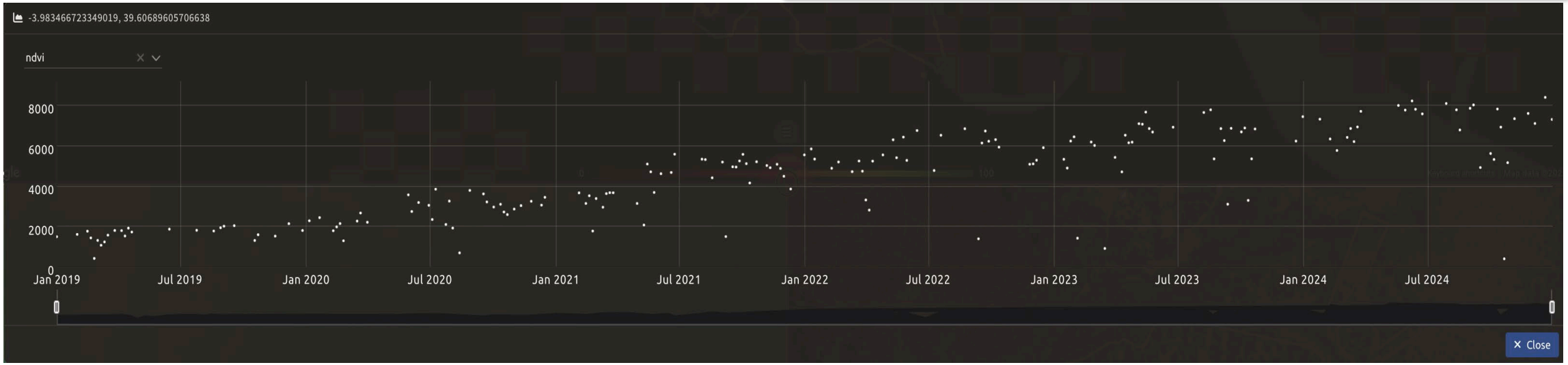

Time Series - CCDC

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Recommendations

- **Machine Learning for Ecosystem Restoration Monitoring**
  - Machine Learning can enable predictive modeling, anomaly detection, and optimized resource allocation for conservation. These technologies enhance data collection, speed up processing, and provide comprehensive monitoring dashboards leading to faster decision making
- **Community-Driven Restoration and Citizen Science**
  - By empowering local communities and NGOs with accessible tools for data collection, analysis, and monitoring. This democratization leads to more relevant strategies, leverages indigenous knowledge, and promotes community ownership for the long term.
- **Focus on Quantifiable Impact**
  - By establishing comprehensive metrics that are communicable and understandable to stakeholders and communities for improved design, scaling, and education