Large-scale land cover change mapping: a new co-developed service for the Philippines

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Objectives

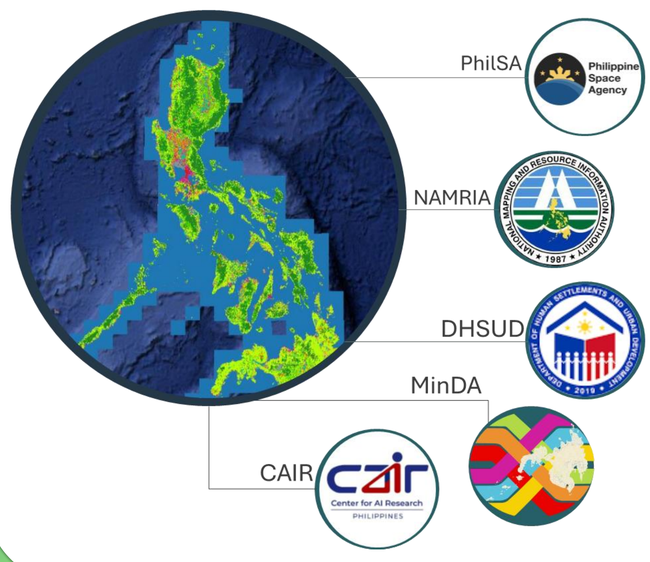
CopPhil (National Copernicus Capacity Support Action Program) is a European Union initiative to promote the use of Earth Observation data from Copernicus program, implemented by the European Space Agency (ESA).

Land Cover mapping is one of the three pilot services developed within the CopPhil program, along with the ground monitoring service, and the benthic habitat monitoring. The Land Cover service is cloud-based and is designed to provide annual updates on land cover changes over the Philippines.

Land Cover class	MMU (Ha)
Closed Forest, Open Forest	0.5 Ha
Brush/Shrubs, Grassland, Annual crop, Perennial crop, Open/Barren	0.3 Ha
Built-up, Marshland/Swamp, Fishponds	0.04 Ha
Mangrove Forest, Inland Water	No MMU

Minimum Mapping Unit (MMU) requirements defined by NAMRIA for the land cover classes in the Philippines

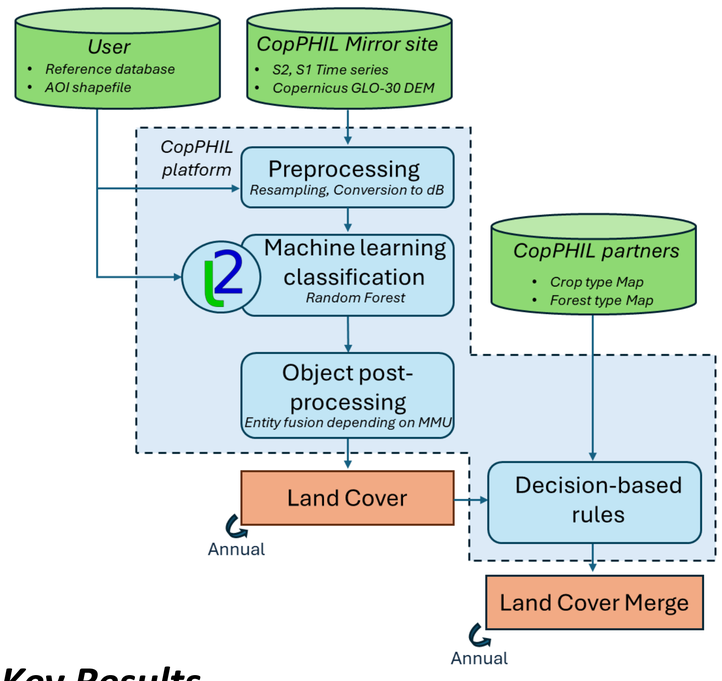
Co-development activities



- Several meetings took place online and onsite for each codevelopers. Three topics were discussed:
  - presentation and introduction of the service and the developers
  - definition of tests (selection of Iota² parameters)
  - training : launch of the chain to give the codevelopers the capacity to run the test

- Ongoing work
  - Reference dataset improvement with additional dataset
  - Testing of the chain

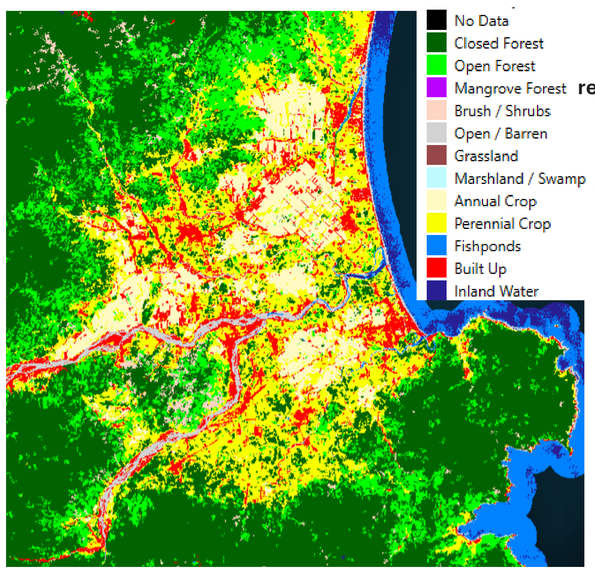
Land Cover Chain



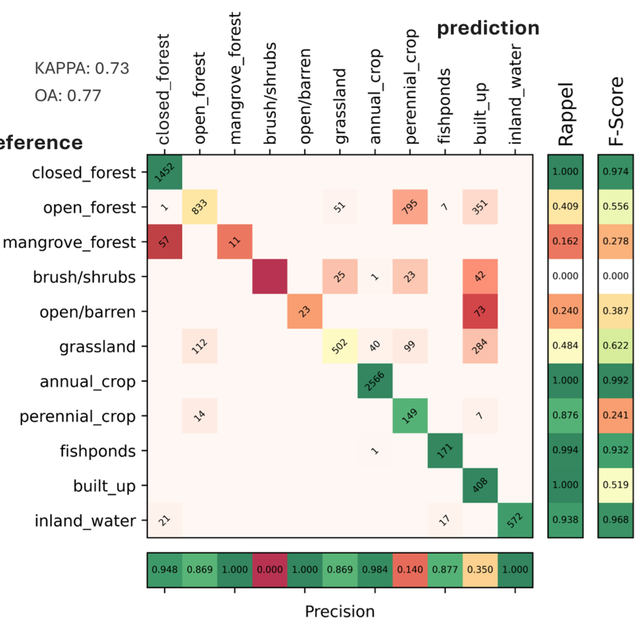
Key Features

- Based on IOTA² toolbox (Inglada et al., 2017)
- Use of annual spectral variations to detect classes
- 2 products are obtained:
  - Land Cover
  - Land Cover merge (fusion with CopPHIL partners products)

Key Results



2023 Land Cover Product example over Baler area, Central Luzon region



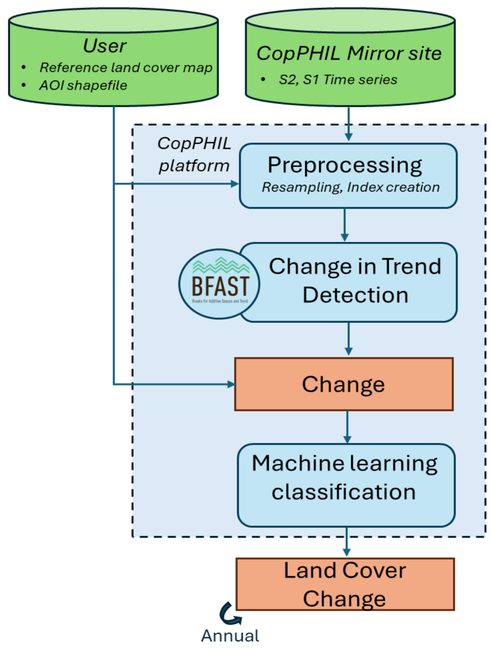
Confusion Matrix

Next Steps

Ongoing developments include tasks from the co-development activities:

- Selection of the most efficient hyperparameters
- Increase of the reference database

Land Cover Change Chain



Key Features

- Based on BFAST monitor algorithm (Verbesselt et al., 2012)
- BFAST algorithm decompose time series in trends and seasonal cycles, and isolate anomalies from those temporal variations.
- BFAST-monitor detects the last break in the global trend.
- 2 products are obtained:
  - Change map
  - Land Cover Change map

Key Results

Examples of the change map between 2023-2024

Next Steps

Ongoing developments include:

- Assessment of the accuracy of the chain through quantitative validation of the results (visual interpretation is performed by a blind approach using VHR image as reference).
- Implementation of the reclassification algorithm inside the chain.
- Integration in CopPhil platform.

Conclusion

This pilot project demonstrates the feasibility and relevance of a co-developed, cloud-based land cover mapping service tailored to the Philippines. By leveraging both Sentinel-1 and Sentinel-2 data, we achieved promising preliminary results with an overall accuracy of 0.77 across 11 land cover classes. The approach enables annual updates at national scale, overcoming traditional limitations in processing capacity and cloud cover.

In parallel, a complementary cloud-based land change detection service has been developed. It allows for regular updates of land cover maps without the need for extensive training datasets, which are often difficult to obtain. This innovation significantly enhances the operational capacity for timely and cost-effective land monitoring.

Beyond technical performance, this initiative exemplifies effective international collaboration and technology transfer, laying the groundwork for sustainable, autonomous land monitoring capabilities in the Philippines.

References

Inglada, J., Vincent, A., Arias, M., Tardy, B., Morin, D., & Rodes, I. (2017). Operational High Resolution Land Cover Map Production at the Country Scale Using Satellite Image Time Series. *Remote Sensing, 9*(1), 95. https://doi.org/10.3390/rs9010095

Verbesselt, J., Zeileis, A., & Herold, M. (2012). Near real-time disturbance detection using satellite image time series. *Remote Sensing of Environment, 123*, 98-108.