Mining Activities from Space (Indonesia)

Global Webinar on Geospatial and Other Data Sources for Environment Statistics:
Assessing the Impact of the Economy on the Environment

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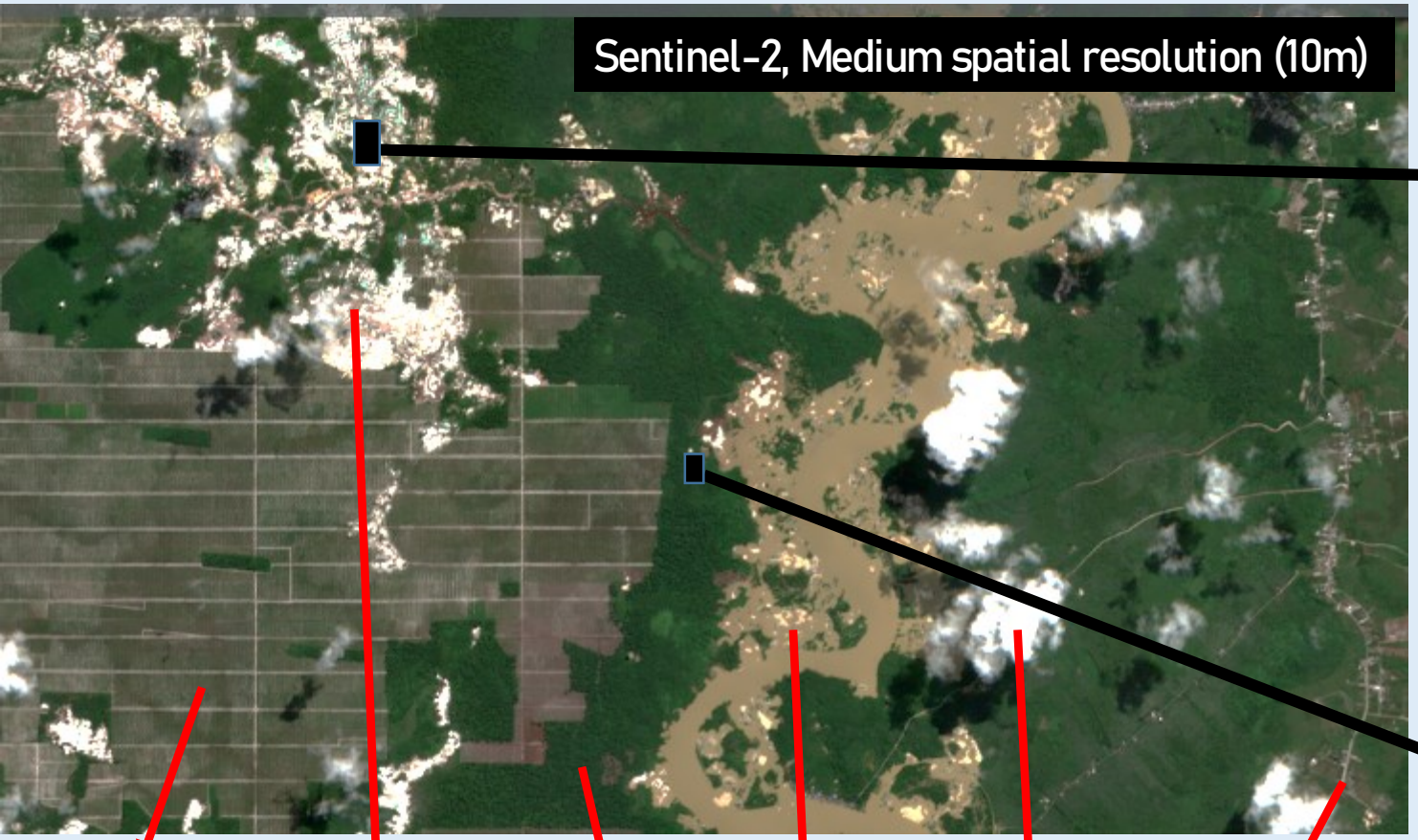
How to detect mining activities from space ?

- Mining activities can interpreted from the related object or land cover: open-pit, camp (“blue camp”), void, road, etc.
- Visual manually based and Machine automatic based
- Key of interpretation: color, texture, pattern, size, shape, association, site
- Remote sensing only detect the mining characteristic or related object, not the legal status. Need combine with concession map to classify illegal mining clearly

What the satellite see



Medium Vs High Spatial Resolution

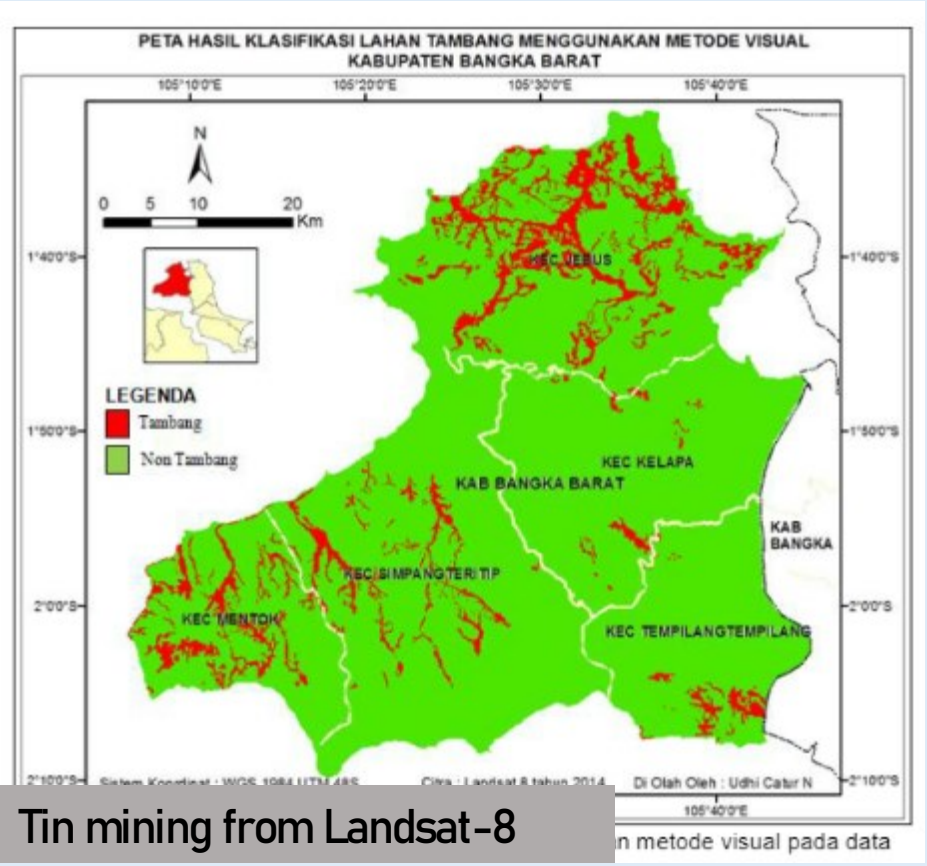
Medium spatial resolution

- Fee access, frequently acquisition
- Less detail object, 5 – 15 m
- routine monitoring, time series analysis
- Wall-to-wall / region mapping

High spatial resolution

- Paid access, on-demand acquisition
- Detailed object, less than 2 m
- Deep investigation
- Local/site mapping
- Some institute classify high resolution (2-1 m) and very high resolution (< 1m)

Visually manual classification

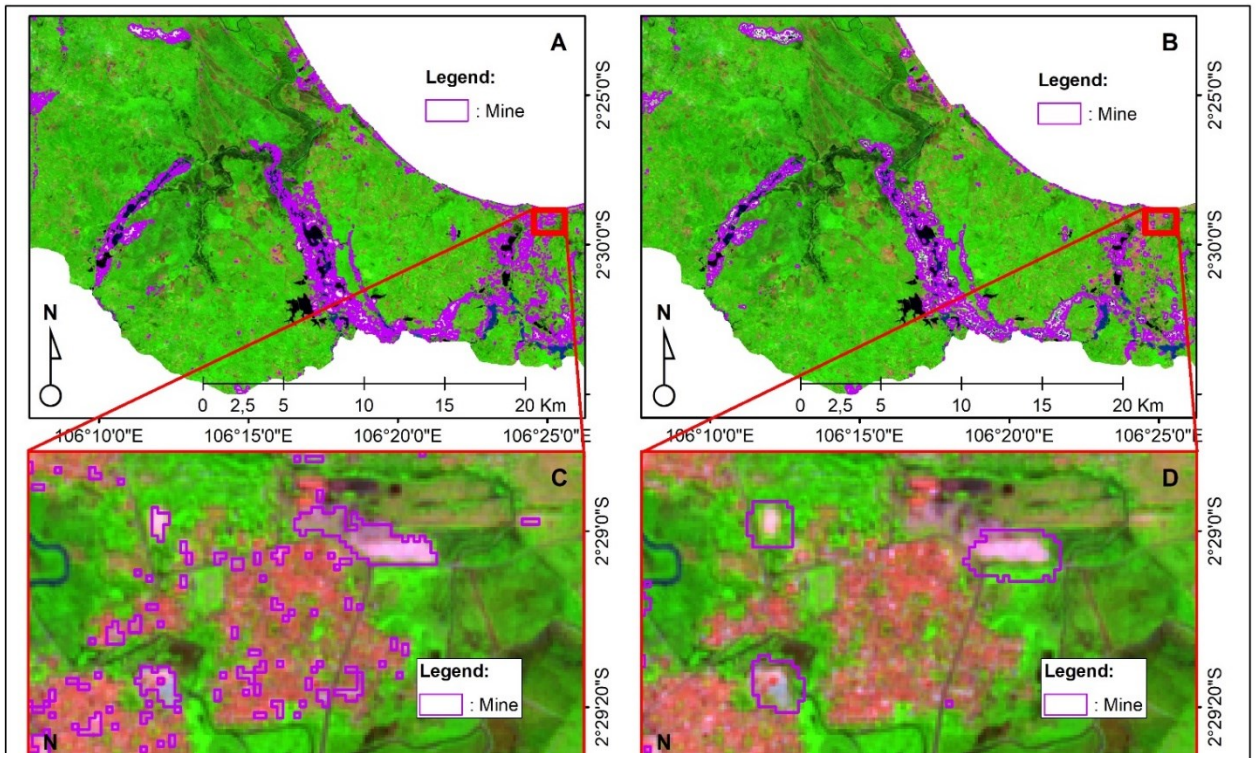


Tin mining from Landsat-8

- Subjective result, good skill interpreter produce good accuracy
- Need more time for large area

Land cover on mining area using Pleiades

Digital classification (computer learning)



A and C. Random Forest method with original band input
B and D. Random Forest method with GLCM and PCA input

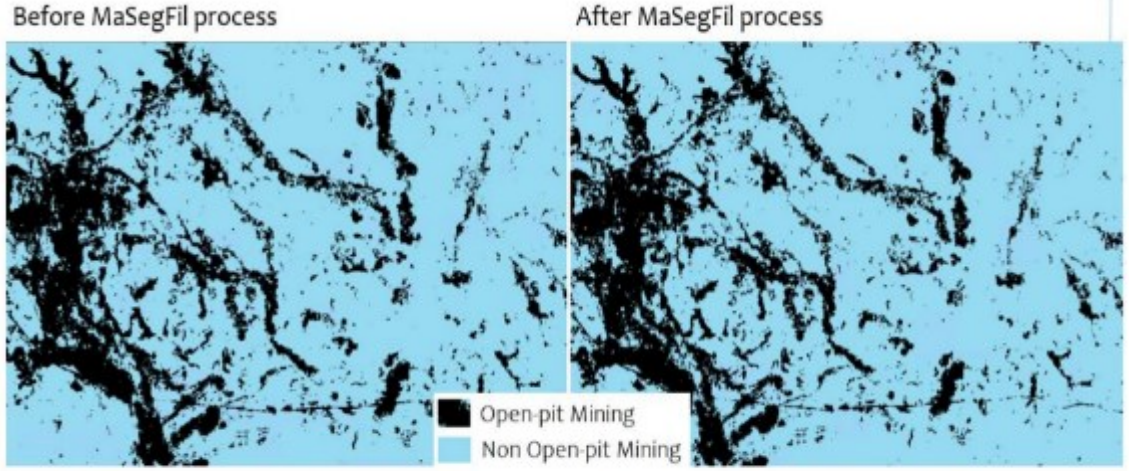
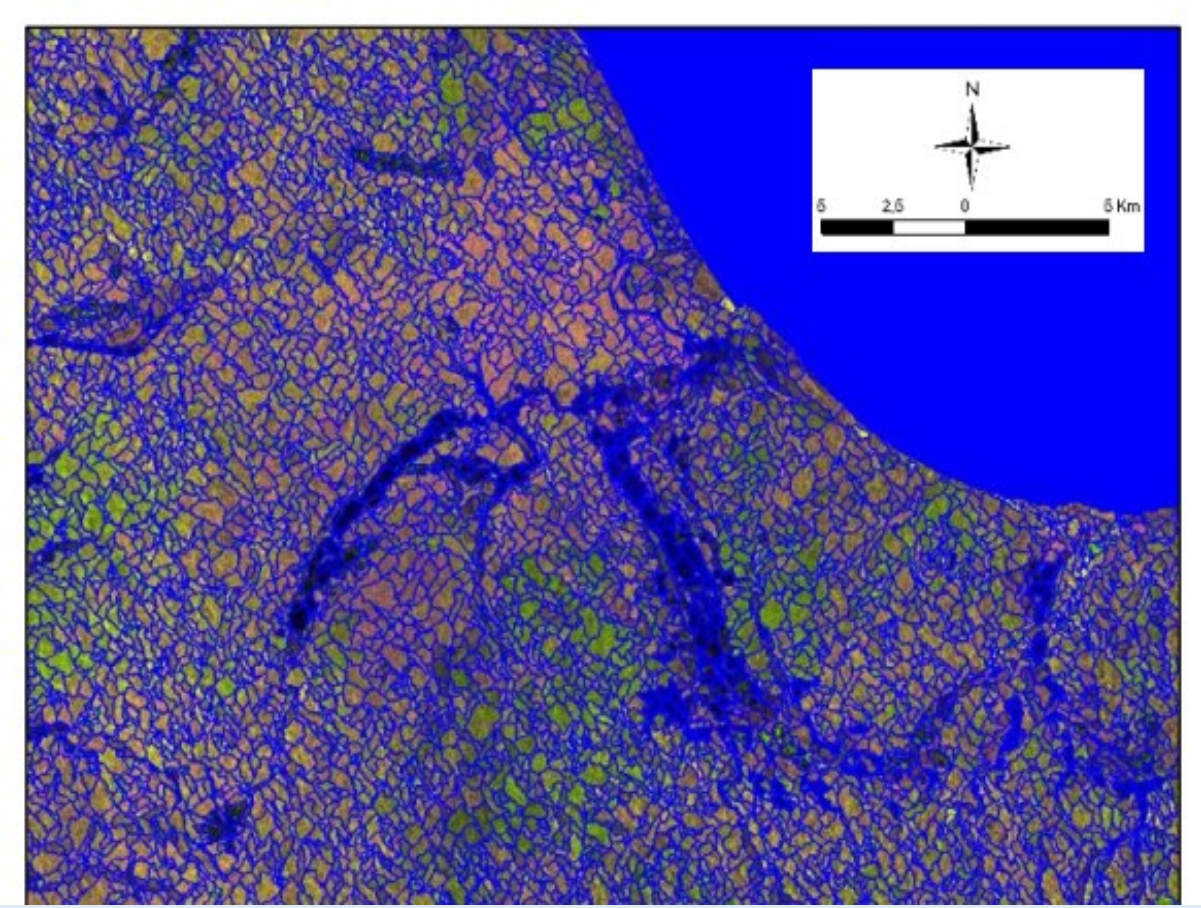
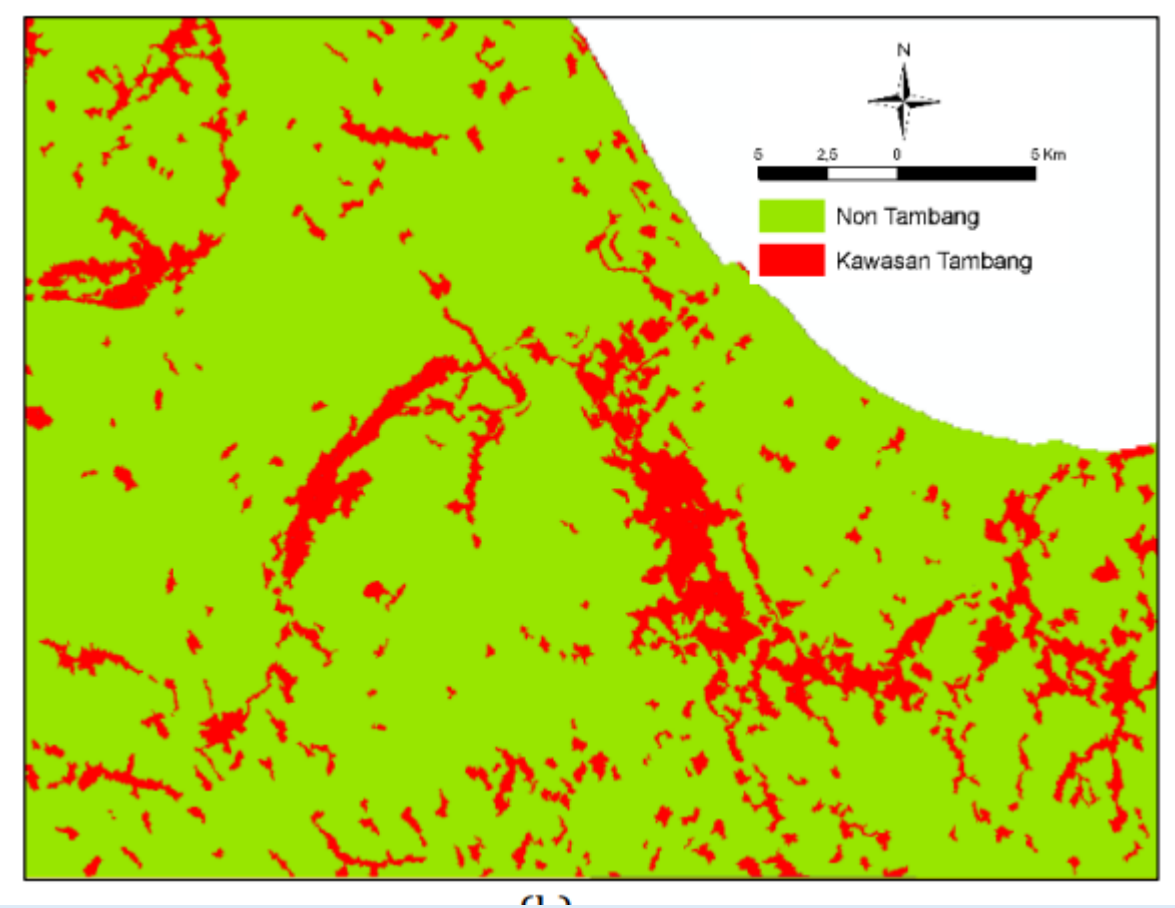


Fig 5 The result of stage 3 post-classification using Majority Segment Based-Filtering (MaSegFil)

- Objective result, result depend on sample learning
- Less accuracy than visual interpretation (the best interpreter)
- Less time for large area
- Need good processor computer

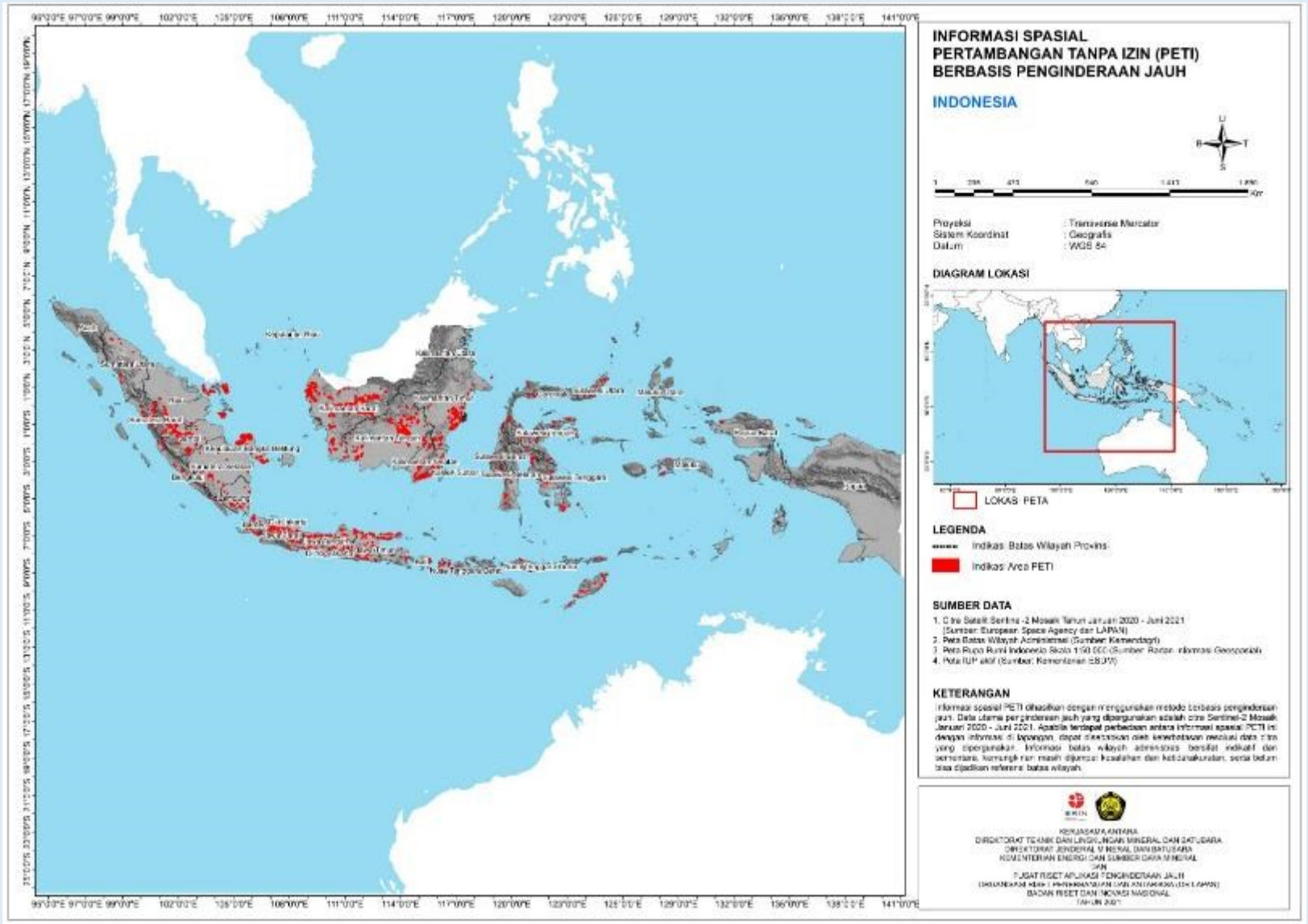
Some of Work





Open mining detection with Object Based Image Analysis (OBIA) with texture approach from Sentinel – 1 (radar data). This work support local government to analysis the environment impact.

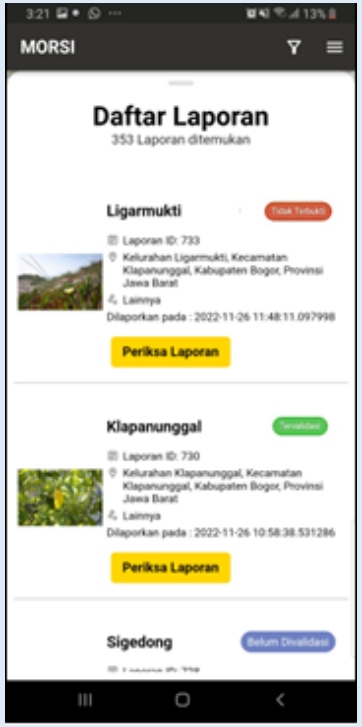
Some of Work



Identification of open mining without concession using random forest method and visually validated. The algorithm run on each region. Sample represent each characteristic of mining.

This work support Ministry of Energy and Mineral Resources

Some of Work



Develop web and android platform for reporting illegal mining

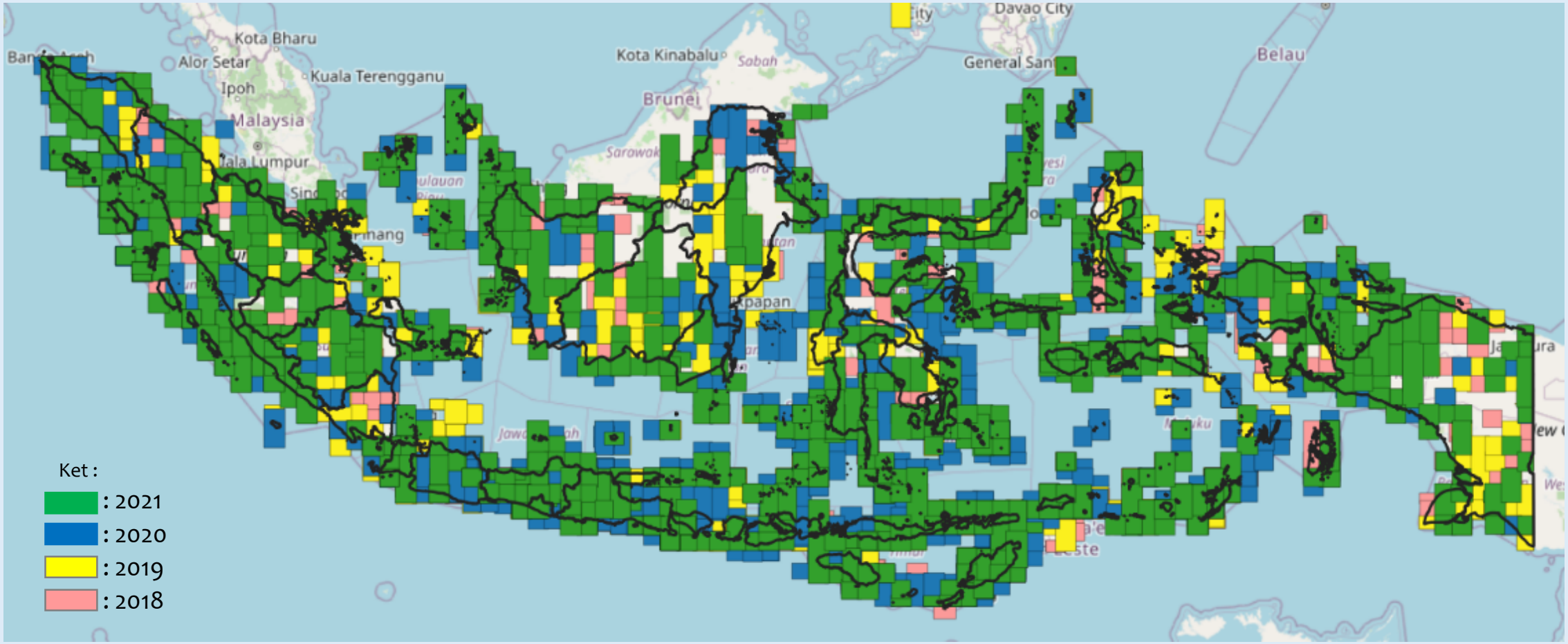
Ground data gather from the public. Space based data processed automatically with cloud computing GEE

This work support Ministry of Energy and Mineral Resources

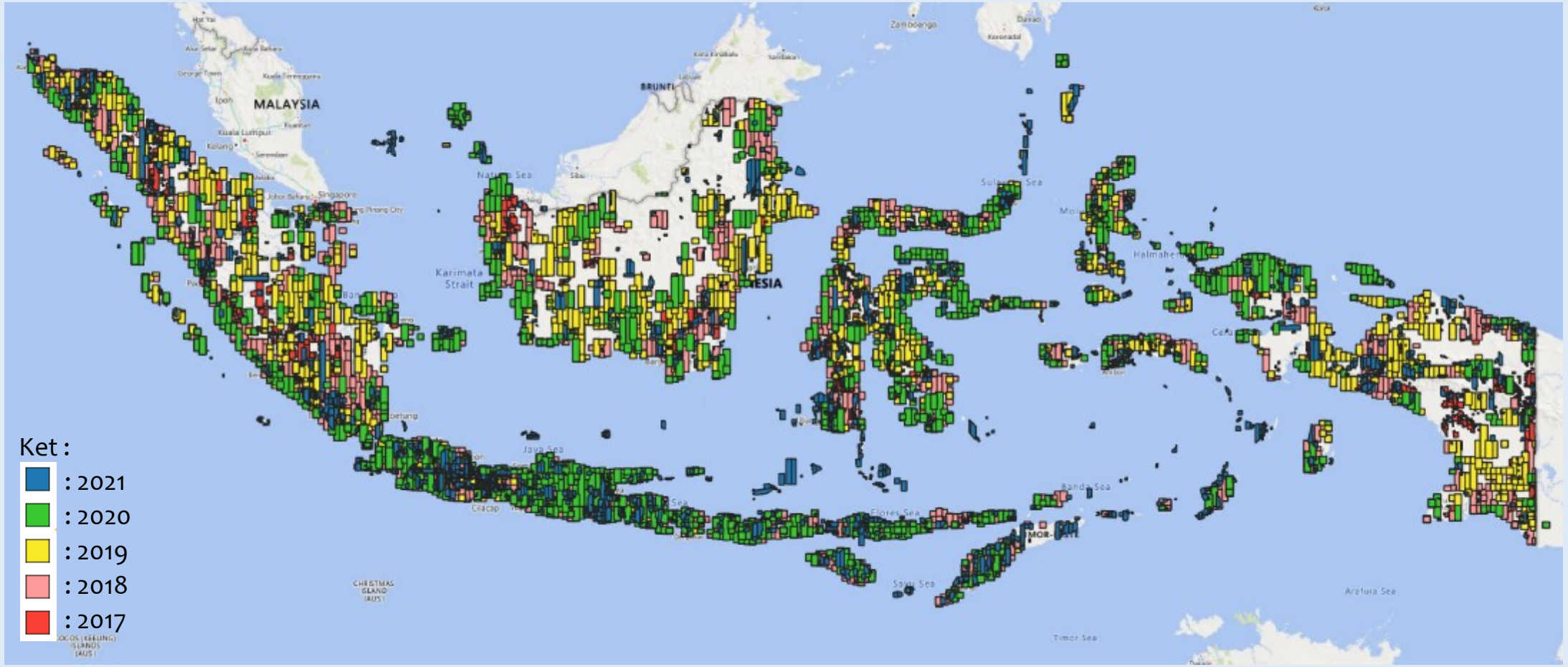
Some of Work

Map of illegal mining conditions for preparation of law enforcement. This work support Indonesian police

High Resolution Data Availability (SPOT-6/7) 2018 – 2021
(Spatial resolution 1,5 m with Cloud Cover ≤ 15%)



Very High Resolution Data Availability 2017 – 2021
Spatial resolution 1,5 m with Cloud Cover ≤ 15%



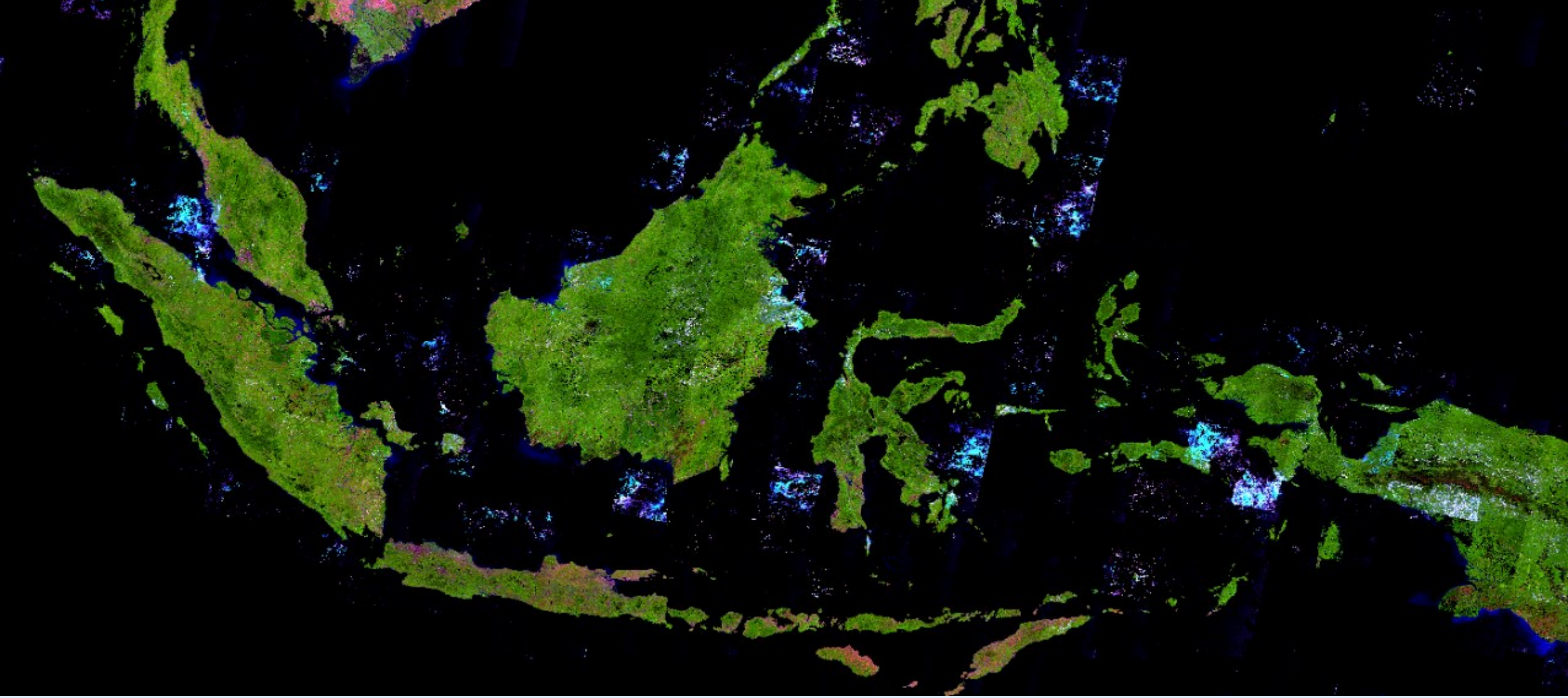
Very high resolution data : Pleiades, Worldview

The challenges to detect mining activities from space

- Remote sensing only detect surface object, need complementary ground data to detect underground mining.
- Difficult to delineate automatically the mining area on river bank.
- Remote sensing difficult to detect illegal mining within concession area. Need VHR data with pattern approach to distinguish legal and illegal mining within concession.
- In tropical countries, optical data is constrained by cloud cover. Radar data does not have this problem but there is speckle noise

Our publication

- Nugroho, U.C., Susanto, S., Yudhatama, D., & Mukhoriyah, M. (2015). Identifikasi Lahan Tambang Timah Menggunakan Metode Klasifikasi Terbimbing Maximum Likelihood pada Citra Landsat 8. *Majalah Ilmiah Globë*, *17* (1), 09-15.
- Nugroho, U. C., Kushardono, D., & Dewi, E. K. (2019). Identifikasi kawasan pertambangan timah menggunakan data satelit sentinel-1 dengan metode object based image analysis (OBIA). *Jurnal Ilmu Lingkungan*, *17*(1), 140-148.
- Nugroho, G., Sofan, P., Nugroho, U. C., Pambudi, A. I., Yulianto, F., & Ichsan, N. (2022, November). The use of texture analysis and band transformation on multispectral imagery to map open-pit mines using machine learning. In *IOP Conference Series: Earth and Environmental Science* (Vol. 1109, No. 1, p. 012071). IOP Publishing.
- Yulianto, F., Sofan, P., & Gatot Nugroho, S. (2022). Artificial intelligence remote sensing for open-pit mining detection in the tropical environment of Indonesia. *Journal of Positive School Psychology*, *6*(3), 8922-8929.



Thank You

We are ready for collaboration

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