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TAKING THE PULSE OF OUR PLANET FROM SPACE

Towards Robust and Timely Deforestation Detection with Sentinel-1 in the Absence of Reliable Reference Data

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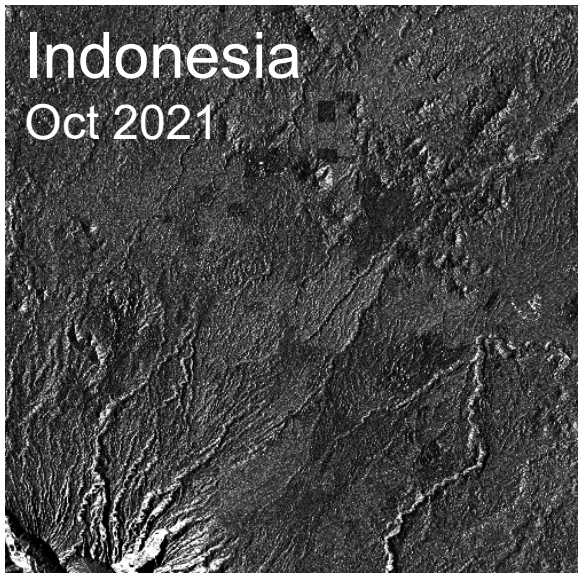
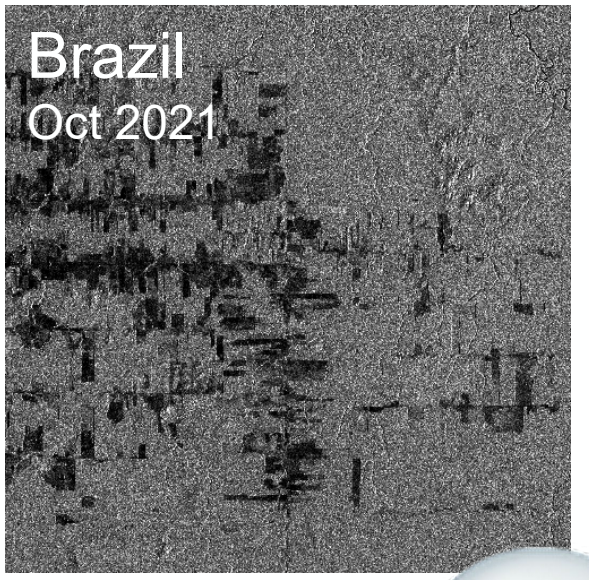
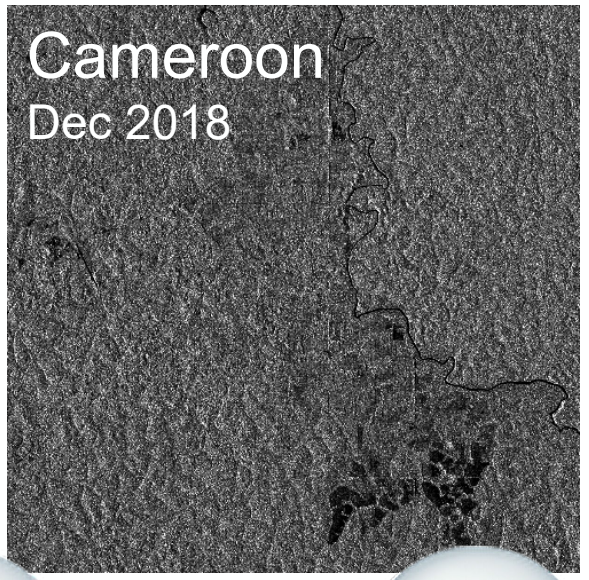
Motivation: Sentinel-1 vs. Optical (Planet)







Motivation (continued)

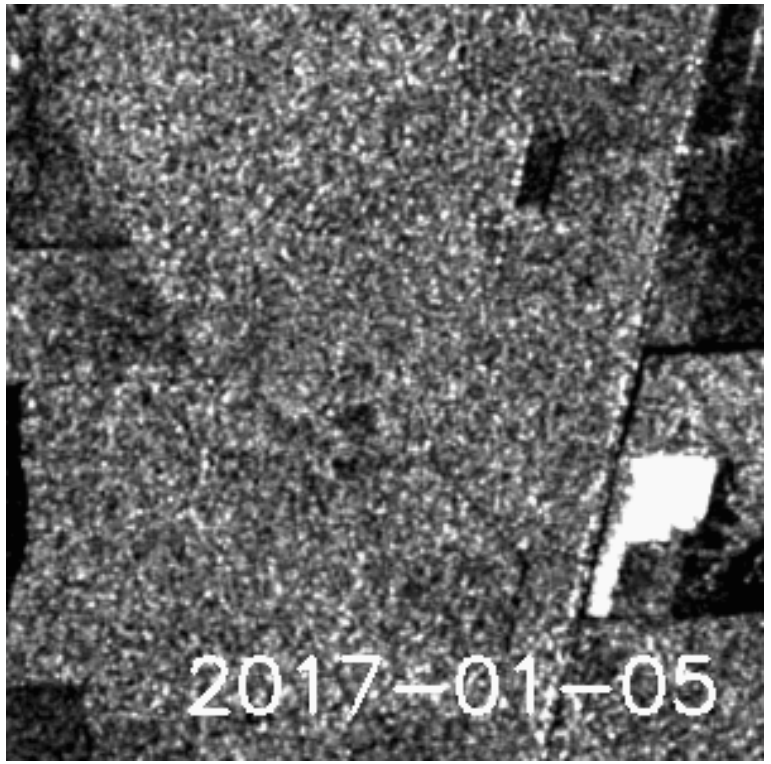
- Optical data are good for creating annual maps, but not for sub-annual change detection (clouds…)

Supervised Change Detection	Unsupervised Change Detection
• F/NF models need to be **locally calibrated**. • The quality is limited by the **quality of the training data**. • The NF class in particular is highly **heterogeneous** and hard to parametrize.	• A change in the observed data need not reflect a change of land cover (e.g., seasonality, moisture). • Not all land cover changes are deforestation.

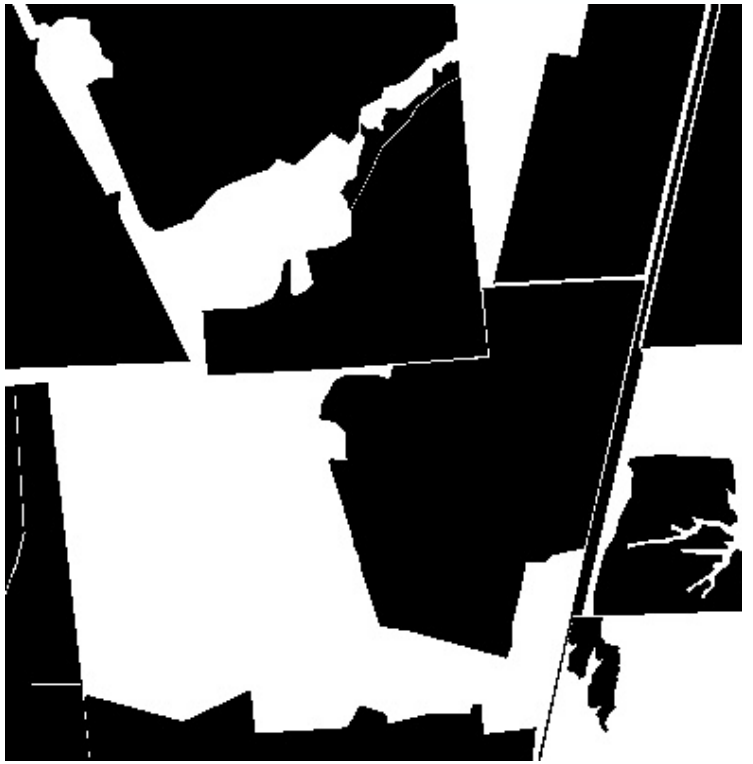
Solution: Semi-supervised?

- Use a static reference mask that is assumed to carry some error.
- Perform a change detection with respect to a derived prototype time series

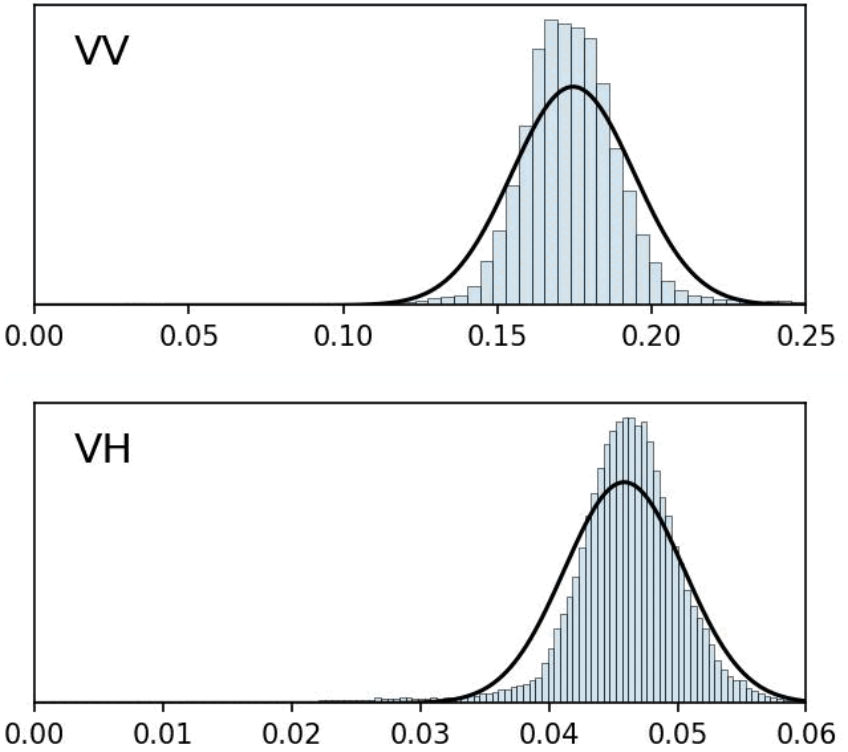
VV / VH Distribution over Forest



Sentinel-1 image

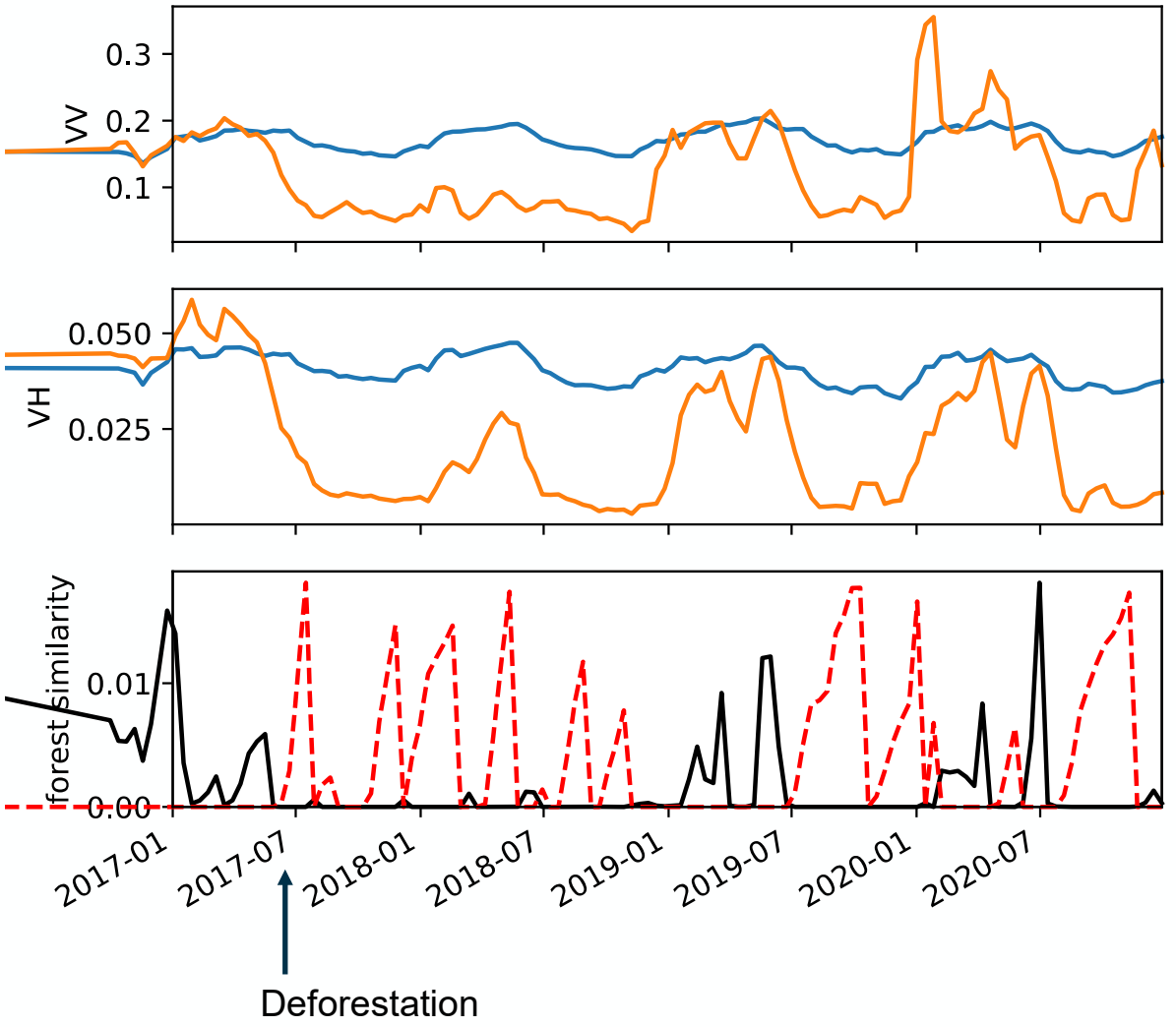


F/NF Mask



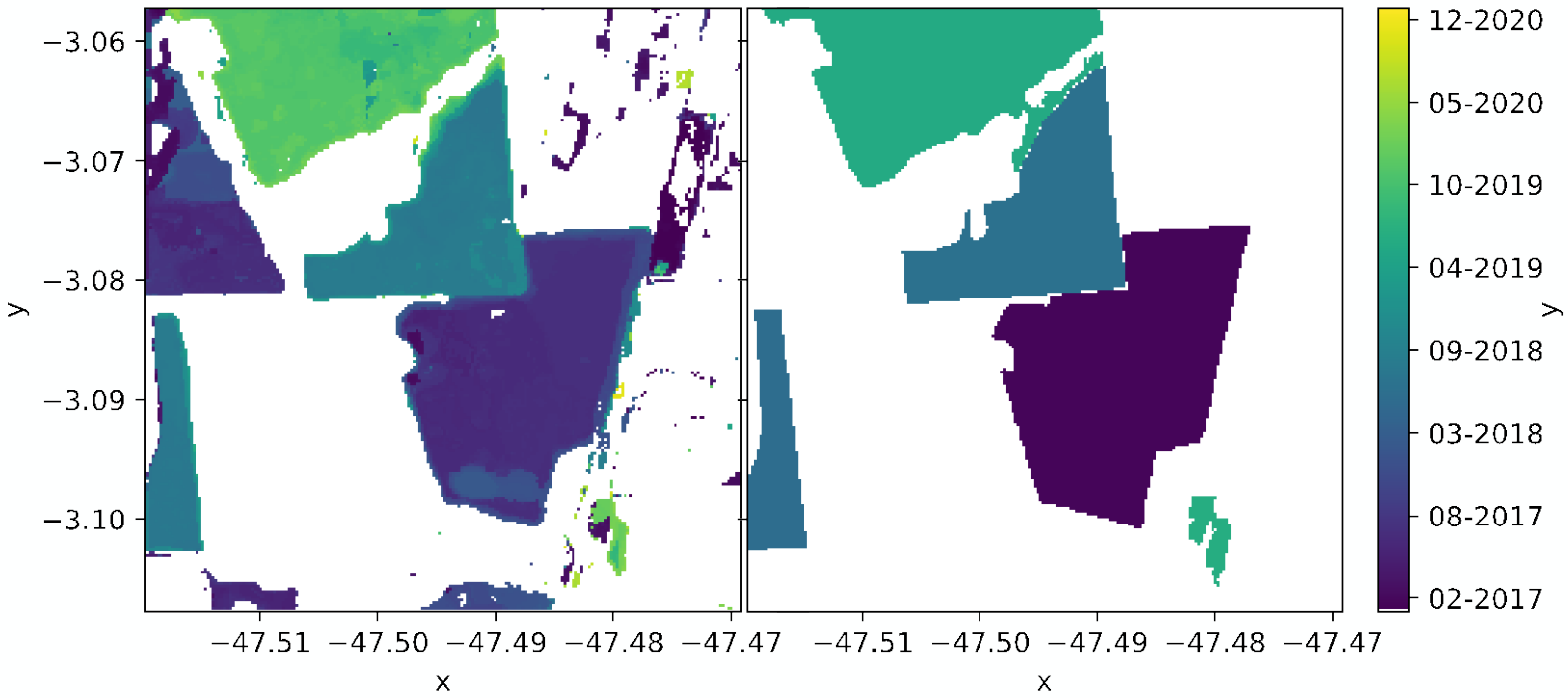
Forest Pixel Distribution

Change Detection Demo



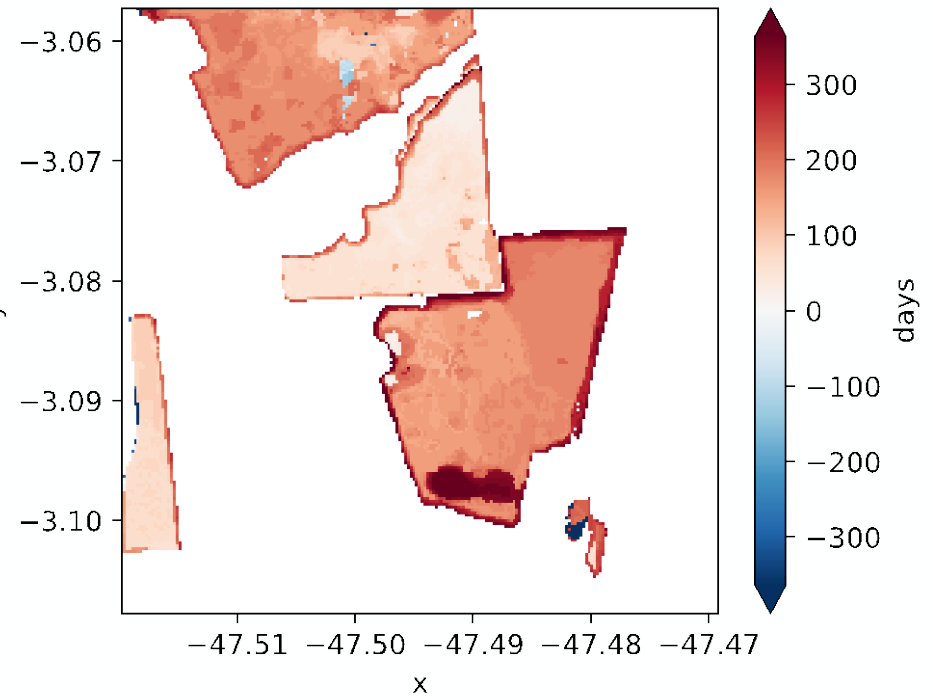
forest mean
forest 98% confidence
pixel value
forest similarity
cumulative forest dissimilarity
non-forest

Change Detection Result



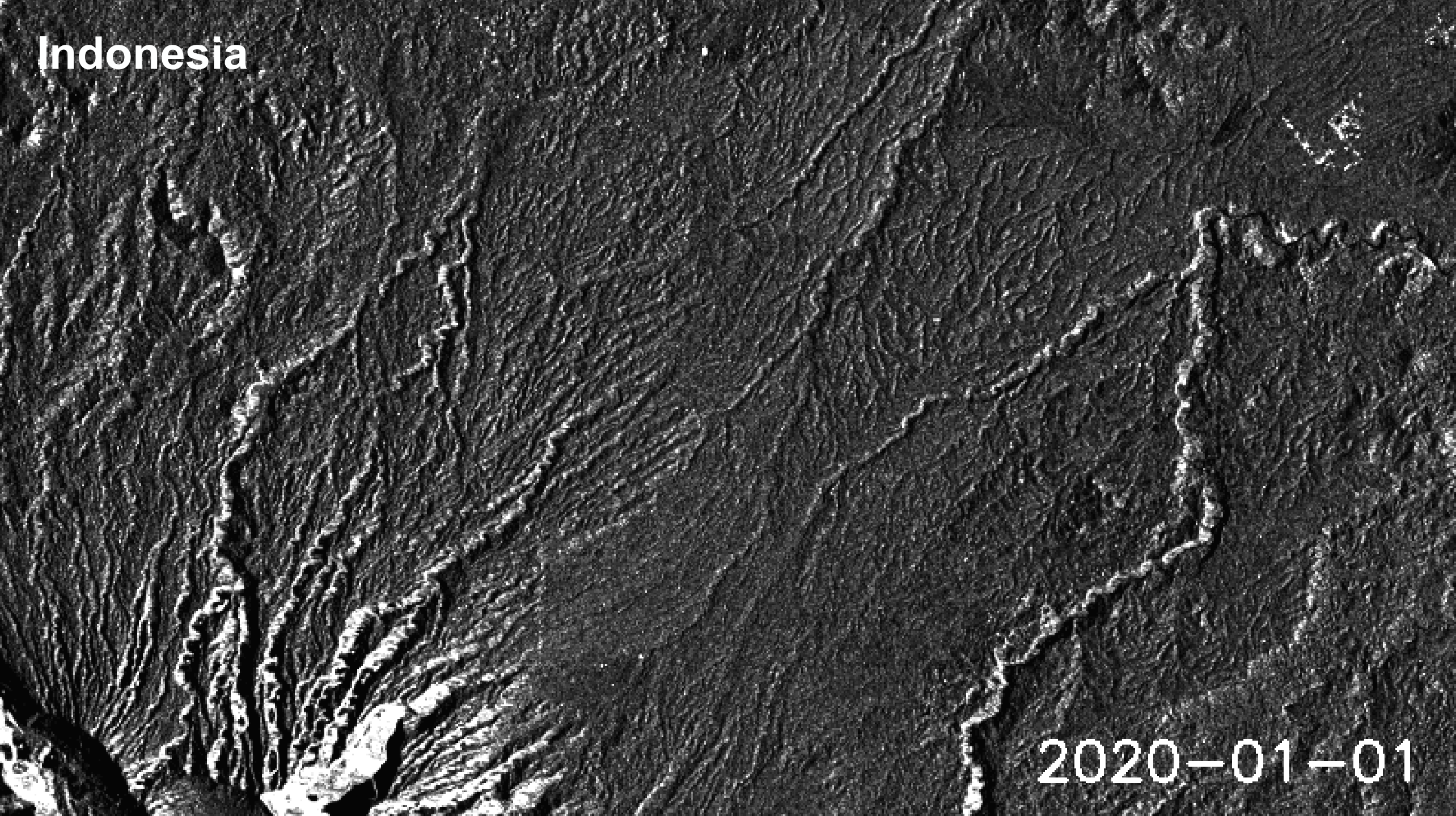
Change Detection Map

Visually Interpreted Reference

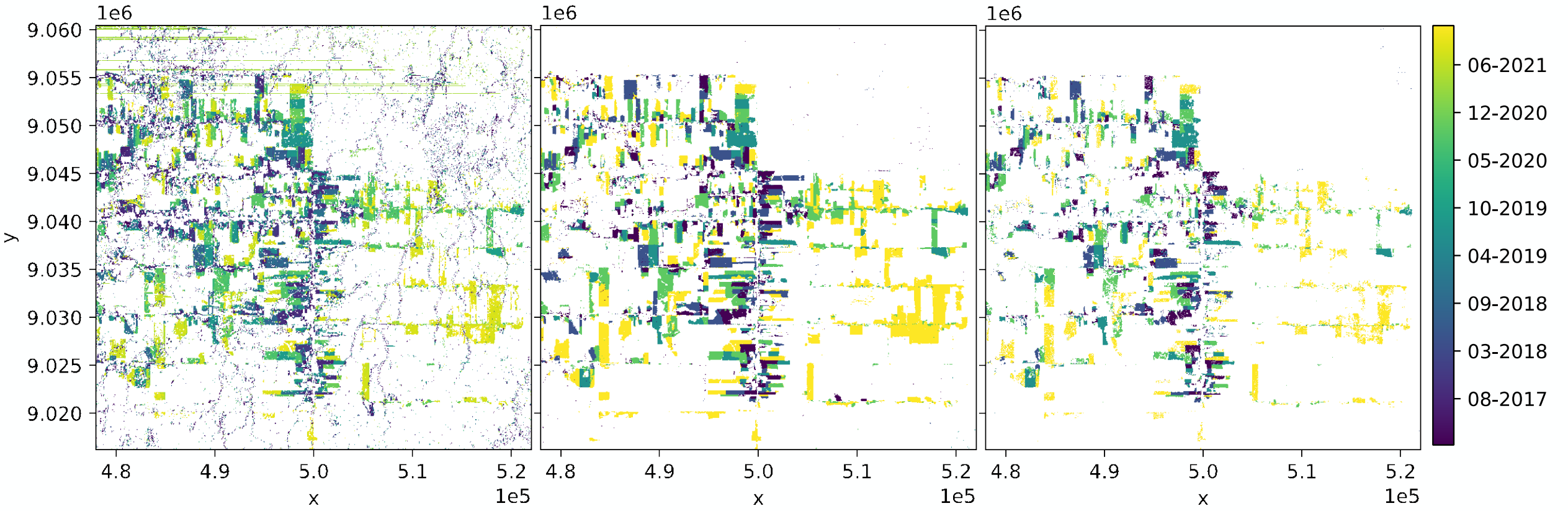


Change Detection Delay

Cameroon
2017-01-02

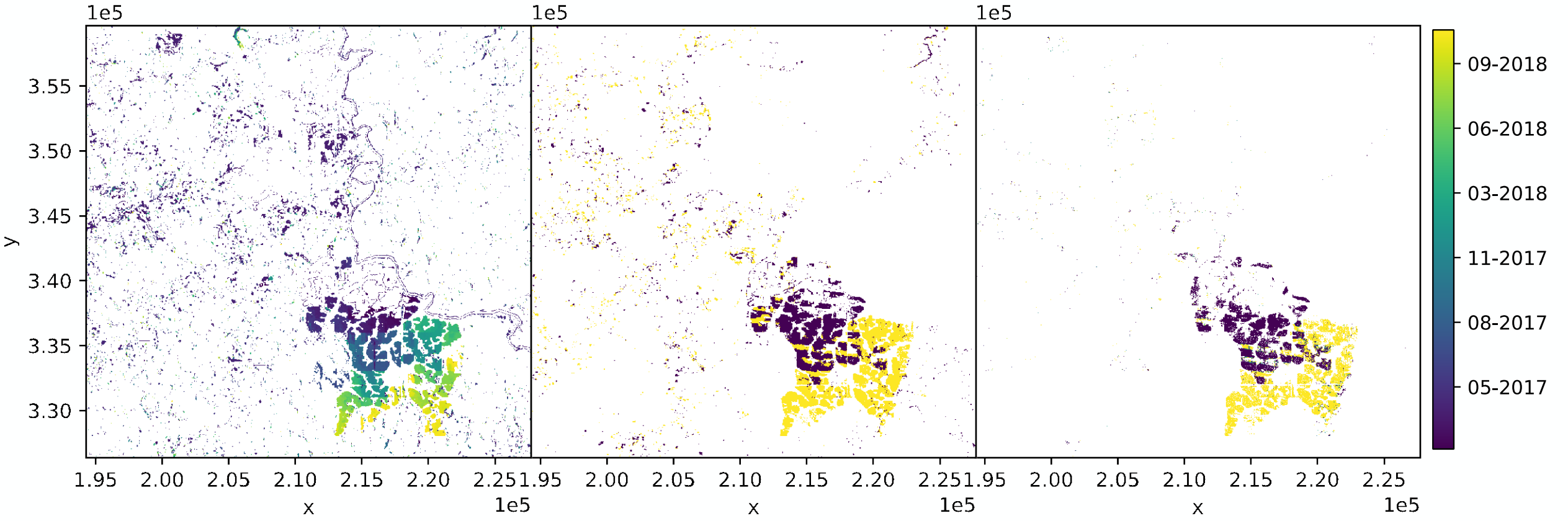

Indonesia
2020-01-01

Change detection results (Brazil)



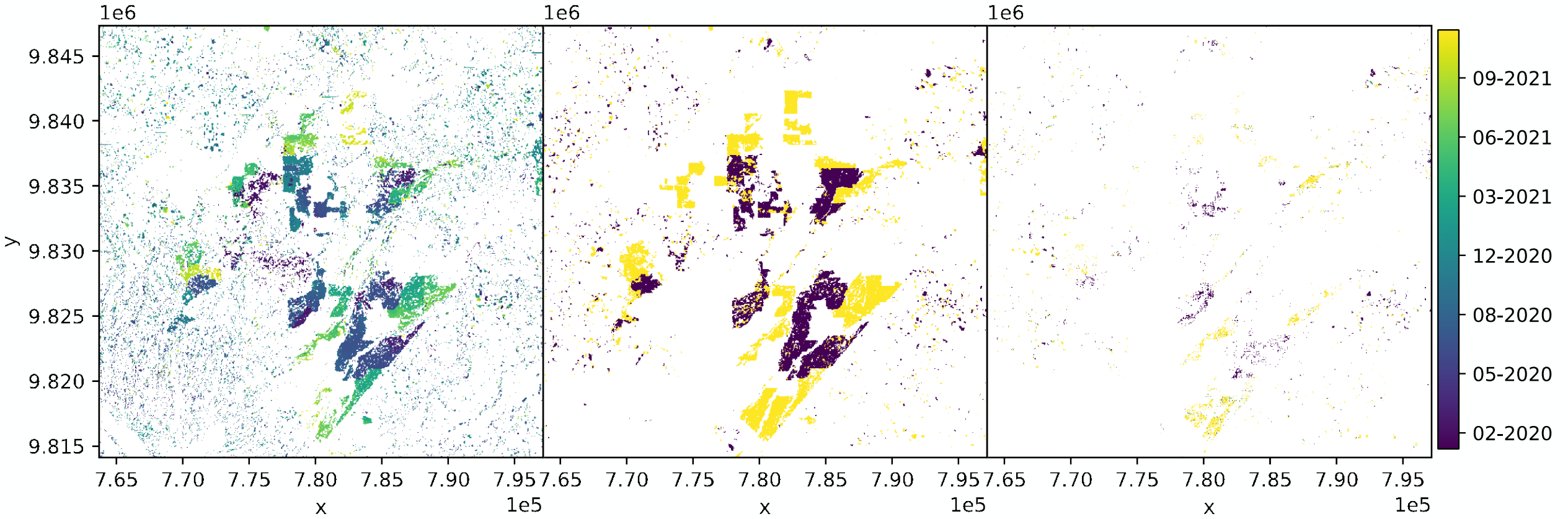
Change Detection Map | Hansen et al. | JRC Tropical Moist Forests

Change detection results (Cameroon)



Change Detection Map | Hansen et al. | JRC Tropical Moist Forests

Change detection results (Indonesia)

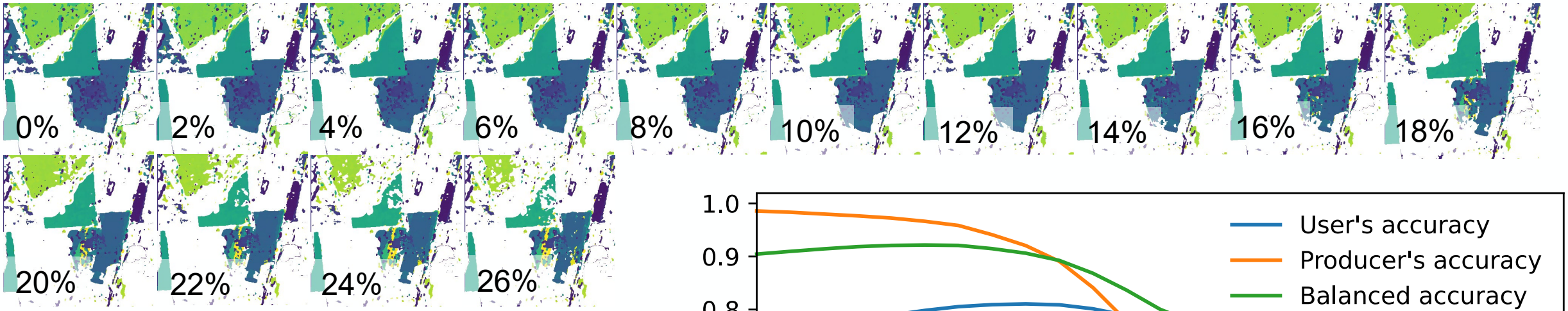


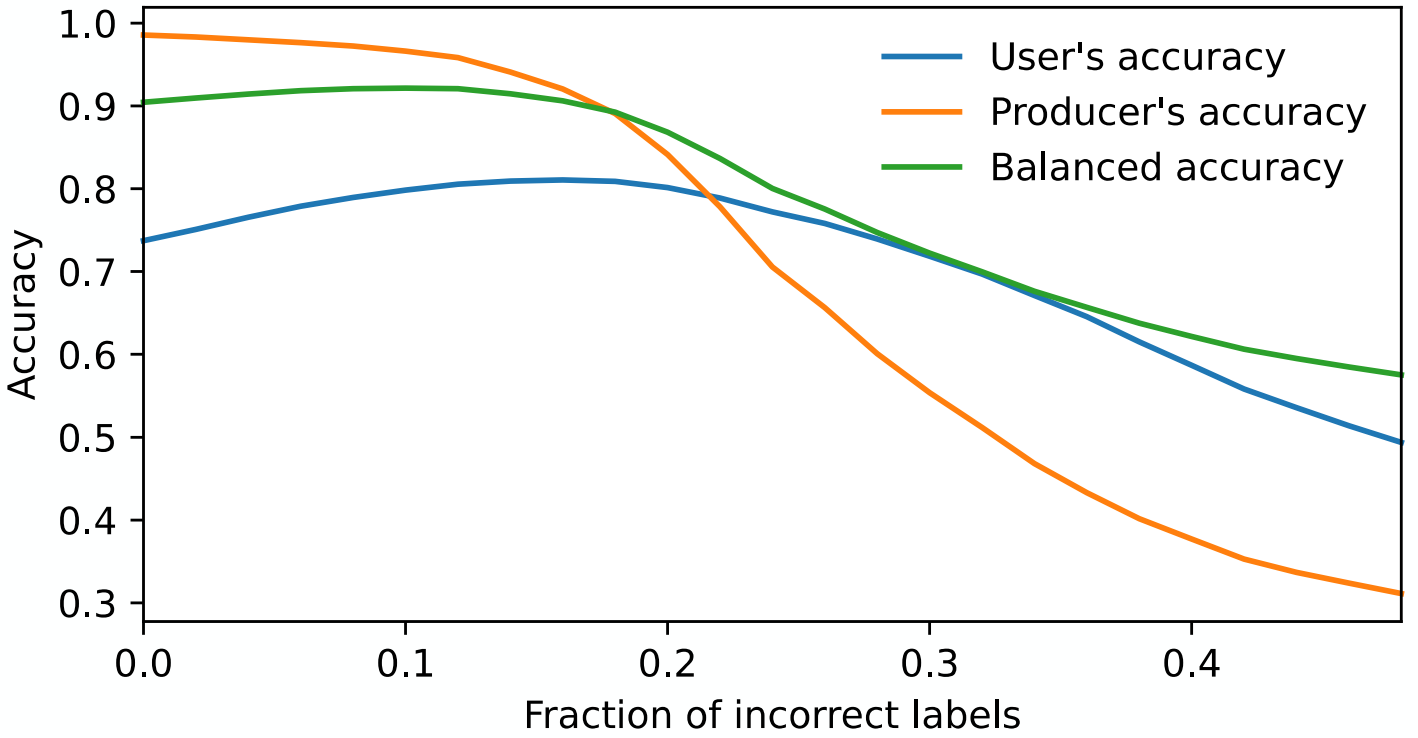
Change Detection Map | Hansen et al. | JRC Tropical Moist Forests

Change Detection Accuracy Assessment

Reference	Site	UA	PA	BA
Hansen	Paragominas	77.7%	86.5%	85.5%
	Cameroon	48.0%	67.7%	81.4%
	Riau	49.8%	61.0%	76.9%
	Porto Velho	62.0%	76.4%	83.2%
JRC	Paragominas	57.9%	91.7%	83.6%
	Cameroon	34.9%	82.2%	88.1%
	Riau	5.3%	48.3%	68.0%
	Porto Velho	42.9%	84.0%	85.0%
Visual	Paragominas	75.7%	96.5%	90.4%

Robustness to Noisy Labels





Conclusions

- Semisupervised change detection using Sentinel-1 can be used to **iteratively improve on existing (optical-based) deforestation maps**
- The method is not limited to deforestation, but can potentially **detect any deviation from a reference class**
  - Crop harvesting
- The specifics of the method can still be improved:
  - Reduce noise (false positives)
  - Improve change detection delay

Work in progress. Preprint at:

Hansen, J. N., Mitchard, E. T. A., and King, S., “Detecting Deforestation from Sentinel-1 Data in the Absence of Reliable Reference Data”, *arXiv e-prints*, 2022. https://arxiv.org/abs/2205.12131