



HAL
open science

Towards a multi-Modal, multi-Temporal and multi-Phenomena dataset for natural phenomena observation through deep learning

Antoine Bralet, Abdourrahmane M. Atto, Jocelyn Chanussot, Emmanuel Trouvé

► To cite this version:

Antoine Bralet, Abdourrahmane M. Atto, Jocelyn Chanussot, Emmanuel Trouvé. Towards a multi-Modal, multi-Temporal and multi-Phenomena dataset for natural phenomena observation through deep learning. 6ème colloque "Mesure de la Déformation par Imagerie Satellitaire (MDIS)", Oct 2022, Ax-Les-Thermes, France. . hal-03844884

HAL Id: hal-03844884

<https://hal.science/hal-03844884>

Submitted on 9 Nov 2022

HAL is a multi-disciplinary open access archive for the deposit and dissemination of scientific research documents, whether they are published or not. The documents may come from teaching and research institutions in France or abroad, or from public or private research centers.

L'archive ouverte pluridisciplinaire **HAL**, est destinée au dépôt et à la diffusion de documents scientifiques de niveau recherche, publiés ou non, émanant des établissements d'enseignement et de recherche français ou étrangers, des laboratoires publics ou privés.

Towards a multi-Modal, multi-Temporal and multi-Phenomena dataset for natural phenomena observation through deep learning

A. Bralet¹, A. M. Atto¹, J. Chanussot², E. Trouvé¹

¹ LISTIC, Université Savoie Mont Blanc, 74940 Annecy, France

² Univ. Grenoble Alpes, CNRS, Grenoble INP, GIPSA-Lab, 38000 Grenoble, France



La Région
Auvergne-Rhône-Alpes



1. Key points

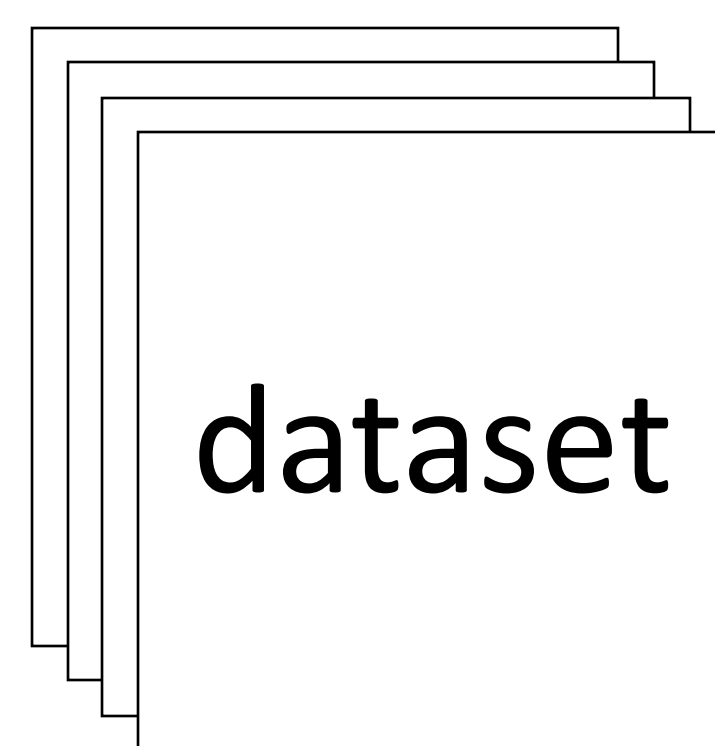
- **A common dataset** of standard products for fair comparisons
- **Multi-modal dataset** for early warning systems
- **Multi-temporal dataset** for ground motion monitoring
- **Multi-phenomena dataset** for cascaded event prevention

Acknowledgments

This work is supported by the region Auvergne-Rhône-Alpes (AURA, France) through the project IATOAURA. Special thanks to the CNES, ISTerre and EDYTEM for providing the interferogram from FLATSIM program.

2. Problem statement

Problem specific
Region specific
Small
No standard products
No free access



Training

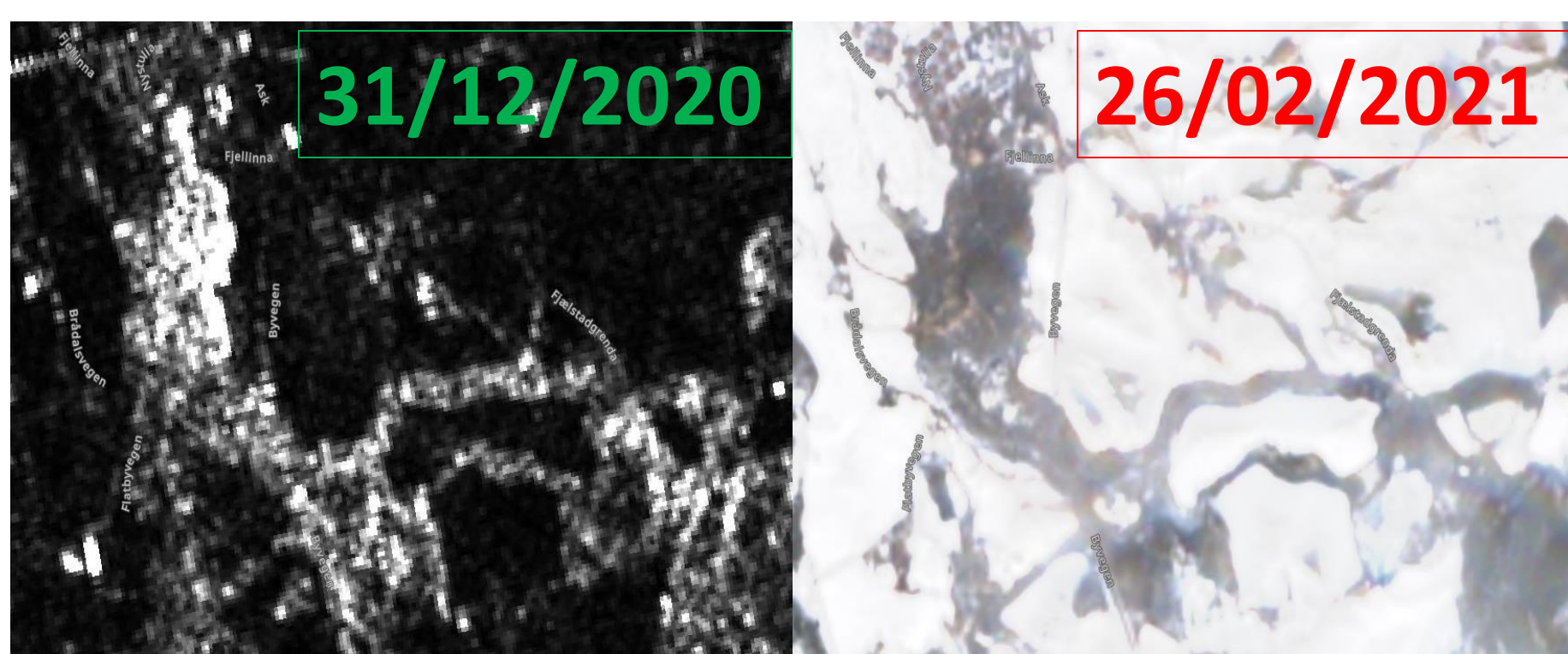
DL Model



~~Generalizability
Reproducibility
Fair comparison
Improvements~~

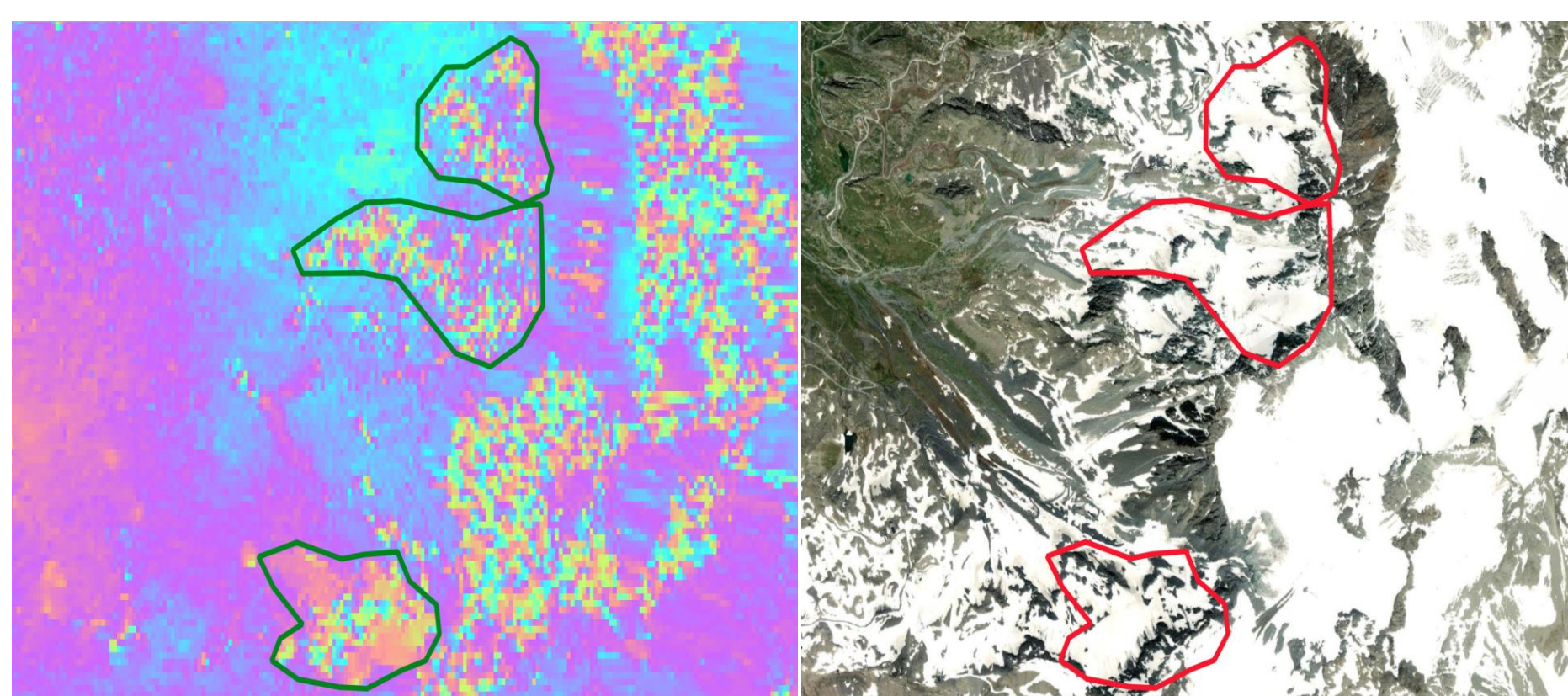
3. Multi-modal dataset

- **Complementarity**
 - Significant improvements due to modality specific features [1]
- **The earlier the better !**
 - First available modality used for emergency [2]



31/12/2020 Gjerdrüm Landslide.
First post-event SAR image (left) and cloud-free optical image (right)

4. Multi-temporal dataset

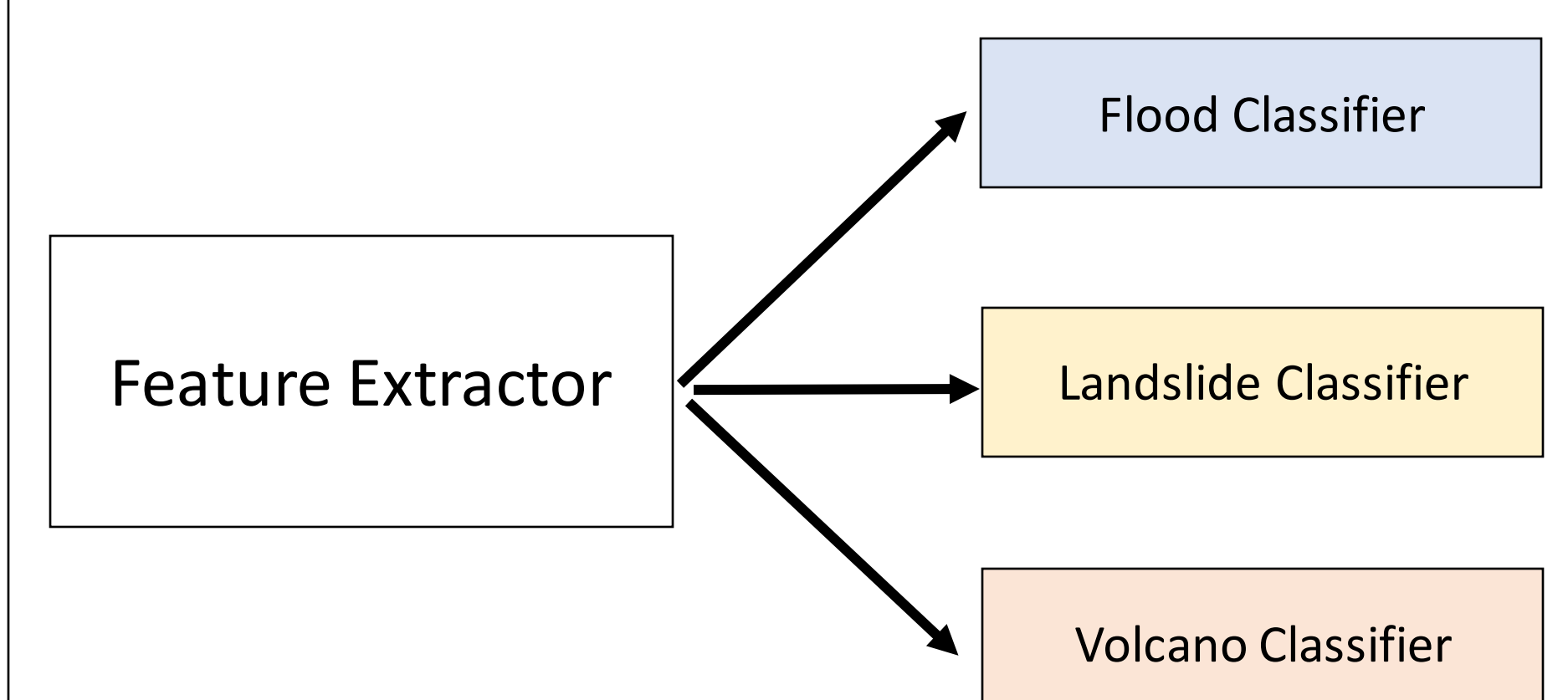


Interferogram generated (left) and its corresponding optical view (right). Green and red lines are suspicions of moving areas based on the interferogram.

- **Slow ground motions**
 - Monitoring of rock glaciers [3], slow moving landslides [4] and volcanoes [5]
- **Change detection**
 - Multitemporal images improve detections [6]

5. Multi-phenomena dataset

- **To leverage similarities**
 - Multi-task learning to strengthen tasks independently [7]



- **To detect triggered events**
 - Cascaded phenomena preventions

6. Common efforts

- Events **occurrence dates and locations** listing
- **Standard products** collection (Sentinel-1 / 2)
- Phenomena annotations with **expert knowledge**
- **Free release** of the dataset for community use

7. Conclusion

Need a common effort for a multi-MTP dataset for even more relevant deep learning researches and overcome specific dataset issues



References

- [1] Ienco, Dino, et al. "Combining Sentinel-1 and Sentinel-2 Satellite Image Time Series for land cover mapping via a multi-source deep learning architecture." *ISPRS Journal of Photogrammetry and Remote Sensing* 158 (2019): 11-22.
- [2] Luppino, Luigi Tommaso, et al. "Deep image translation with an affinity-based change prior for unsupervised multimodal change detection." *IEEE Transactions on Geoscience and Remote Sensing* 60 (2021): 1-22.
- [3] Bodin, Xavier, et al. "Regional evaluation of rock glacier activity in the semi-arid Andes using optical and radar satellite imagery." *5th European Conference On Permafrost*. Edytem, 2018.
- [4] Zhao, Yinggang, et al. "A new algorithm for intelligent detection of geohazards incorporating attention mechanism." *International Journal of Applied Earth Observation and Geoinformation* 113 (2022): 102988.
- [5] Bountos, Nikolaos Ioannis, et al. "Hephaestus: A large scale multitask dataset towards InSAR understanding." *Proceedings of the IEEE/CVF Conference on Computer Vision and Pattern Recognition*. 2022.
- [6] Nava, Lorenzo, Oriol Monserrat, and Filippo Catani. "Improving landslide detection on SAR data through deep learning." *IEEE Geoscience and Remote Sensing Letters* 19 (2021): 1-5.
- [7] Nagendra, Savinay, et al. "Constructing a large-scale landslide database across heterogeneous environments using task-specific model updates." *IEEE Journal of Selected Topics in Applied Earth Observations and Remote Sensing* 15 (2022): 4349-4370.