Modeling of agricultural SAR Time Series using Convolutional Autoencoder for the extraction of harvesting practices of rice fields

Thomas Di Martino[1,2], *Régis Guinvarc'h*[1], *Lætitia Thirion-Lefevre*[1], *Elise Colin*[2]

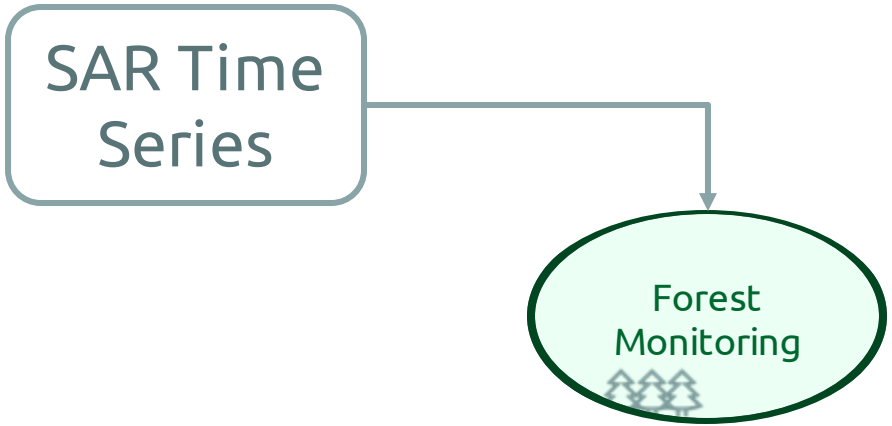
[1]SONDRA, CentraleSupélec, Université Paris-Saclay, 91190 Gif-sur-Yvette, France
[2]ONERA, Traitement de l'information et systèmes, Université Paris-Saclay, 91123 Palaiseau, France

European Conference on Synthetic Aperture Radar 2022 | Leipzig, Germany 26th of July, 2022

SAR Time Series & Vegetation Monitoring

SAR Time Series

SAR Time Series & Vegetation Monitoring



SAR Time Series & Vegetation Monitoring

- Forest Mapping
- Perturbation detection (Wildfires, illegal cuts…)

SAR Time Series & Vegetation Monitoring

- Forest Mapping
- Anomaly detection (Wildfires, illegal cuts…)

SAR Time Series & Vegetation Monitoring

- Crop-type mapping
- Seeding/Harvest detection

- Forest Mapping
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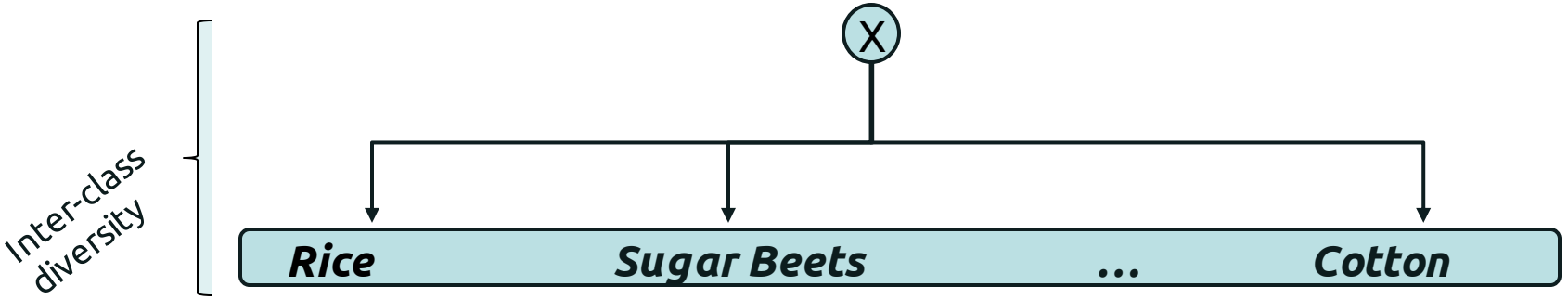
SAR Time Series & Labels limitations in Agriculture



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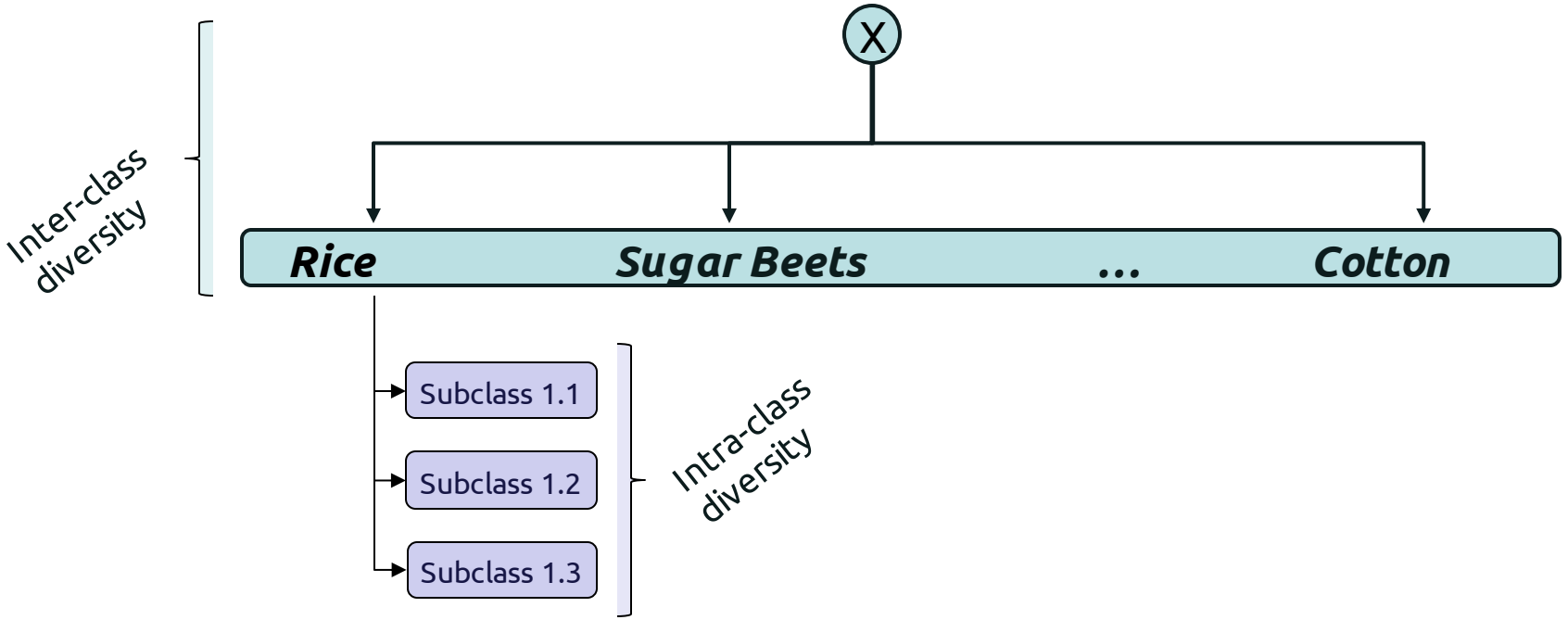

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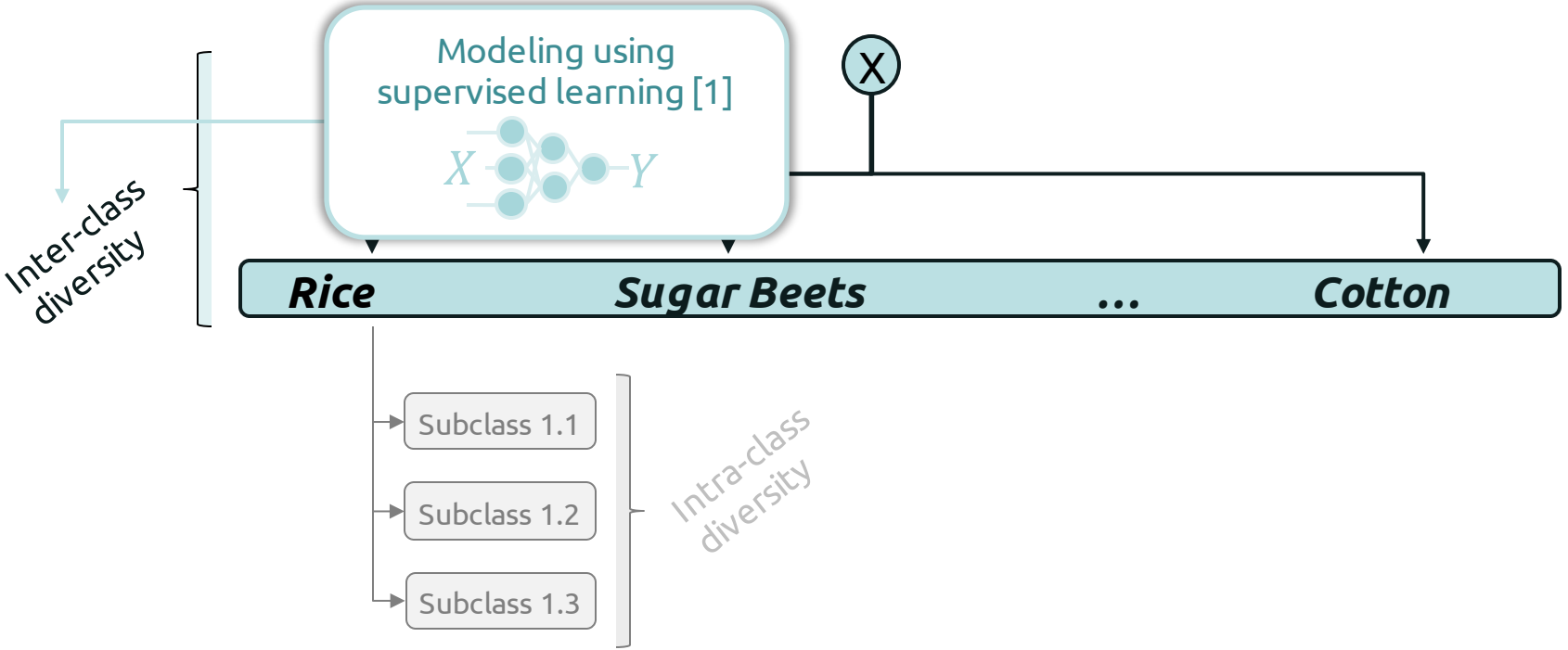
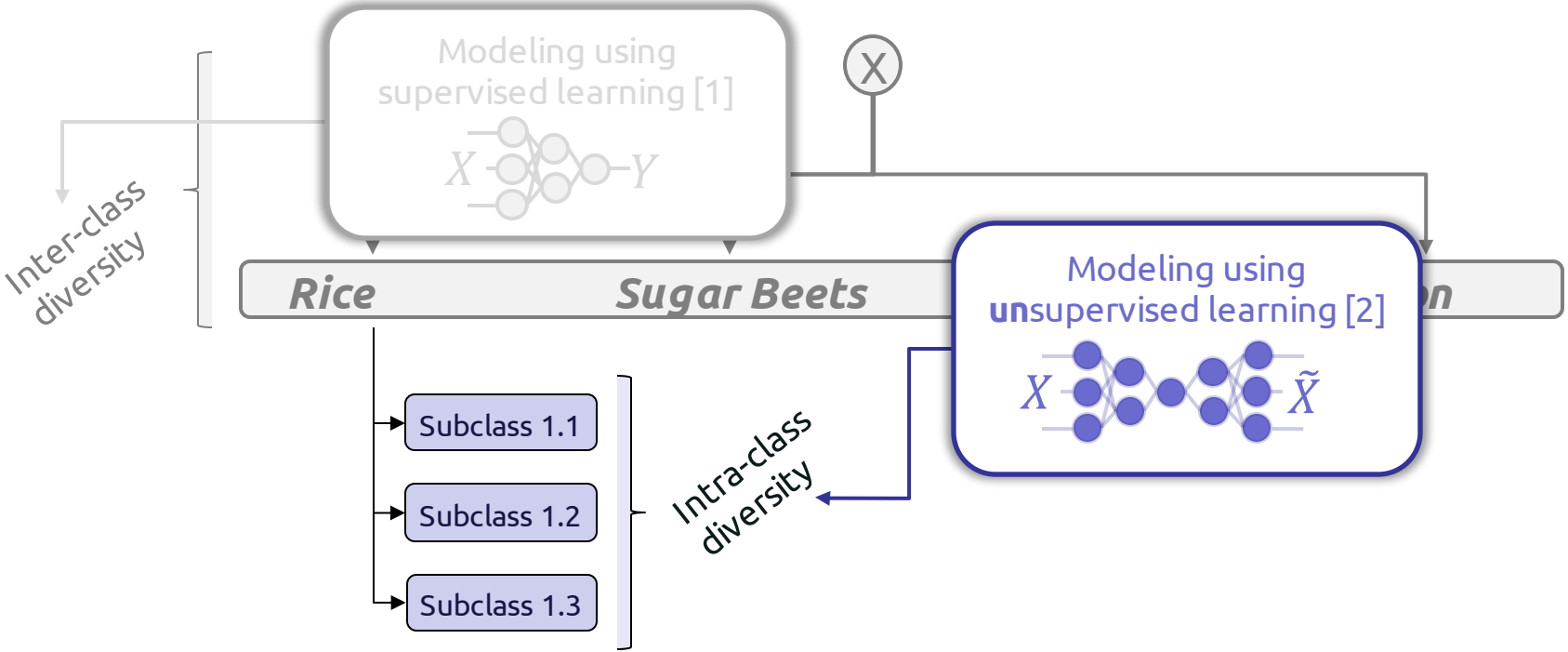


[1] Xu, Lu, Hong Zhang, Chao Wang, Bo Zhang, and Meng Liu. 2019. "Crop Classification Based on Temporal Information Using Sentinel-1 SAR Time-Series Data" *Remote Sensing* 11, no. 1: 53. https://doi.org/10.3390/rs11010053

SAR Time Series & Labels limitations in Agriculture



[2] Thomas Di Martino, Régis Guinvarc'h, Laetitia Thirion-Lefevre and Élise Colin, "Beets or Cotton? Blind Extraction of Fine Agricultural Classes Using a Convolutional Autoencoder Applied to Temporal SAR Signatures," *IEEE Transactions on Geoscience and Remote Sensing*, vol. 60, pp. 1-18, 2022.

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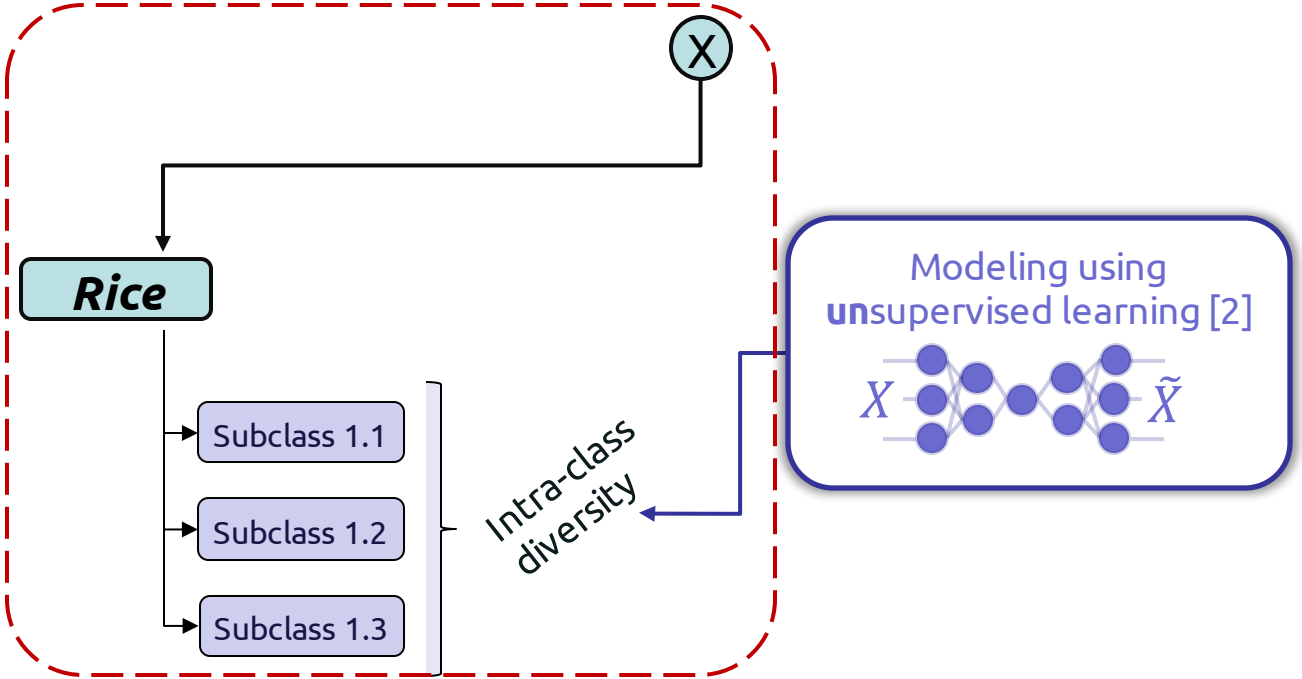

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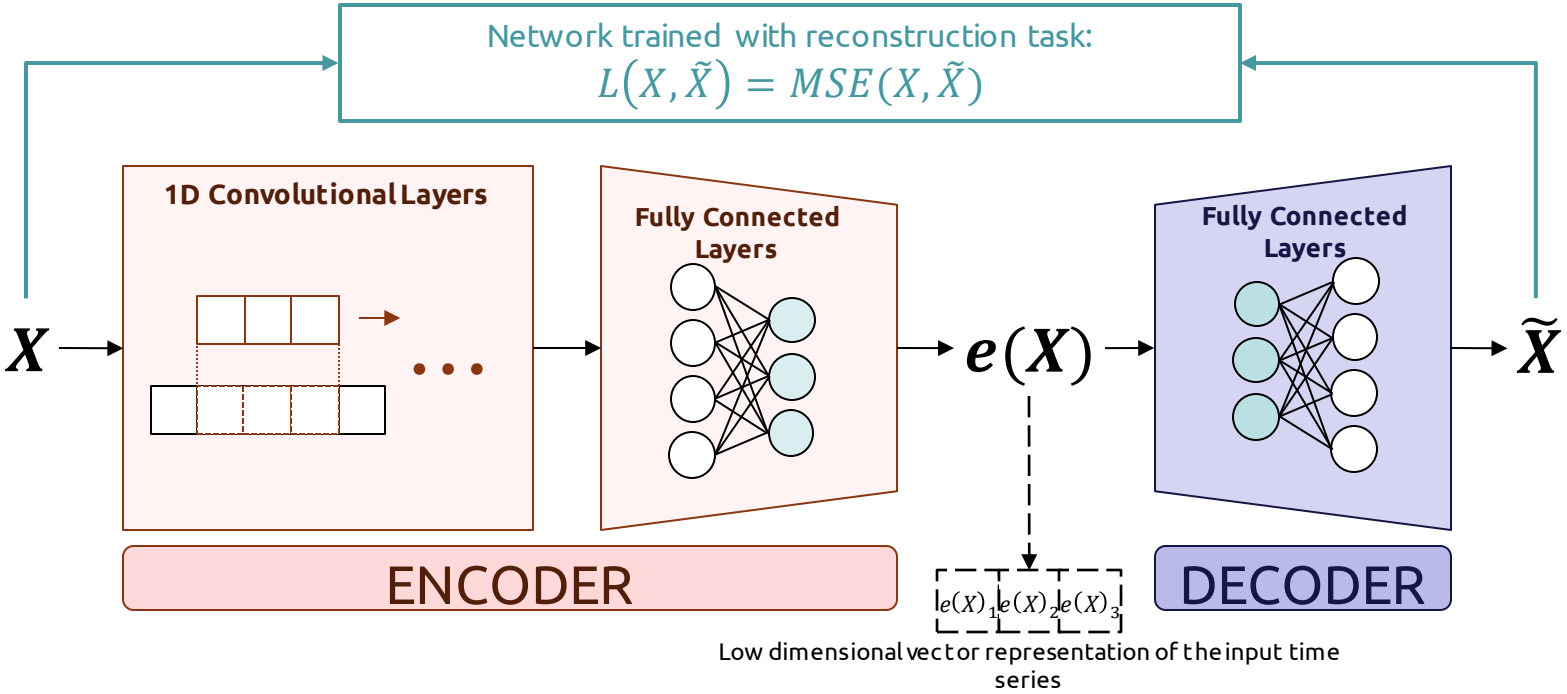
Autoencoding of SAR Time Series



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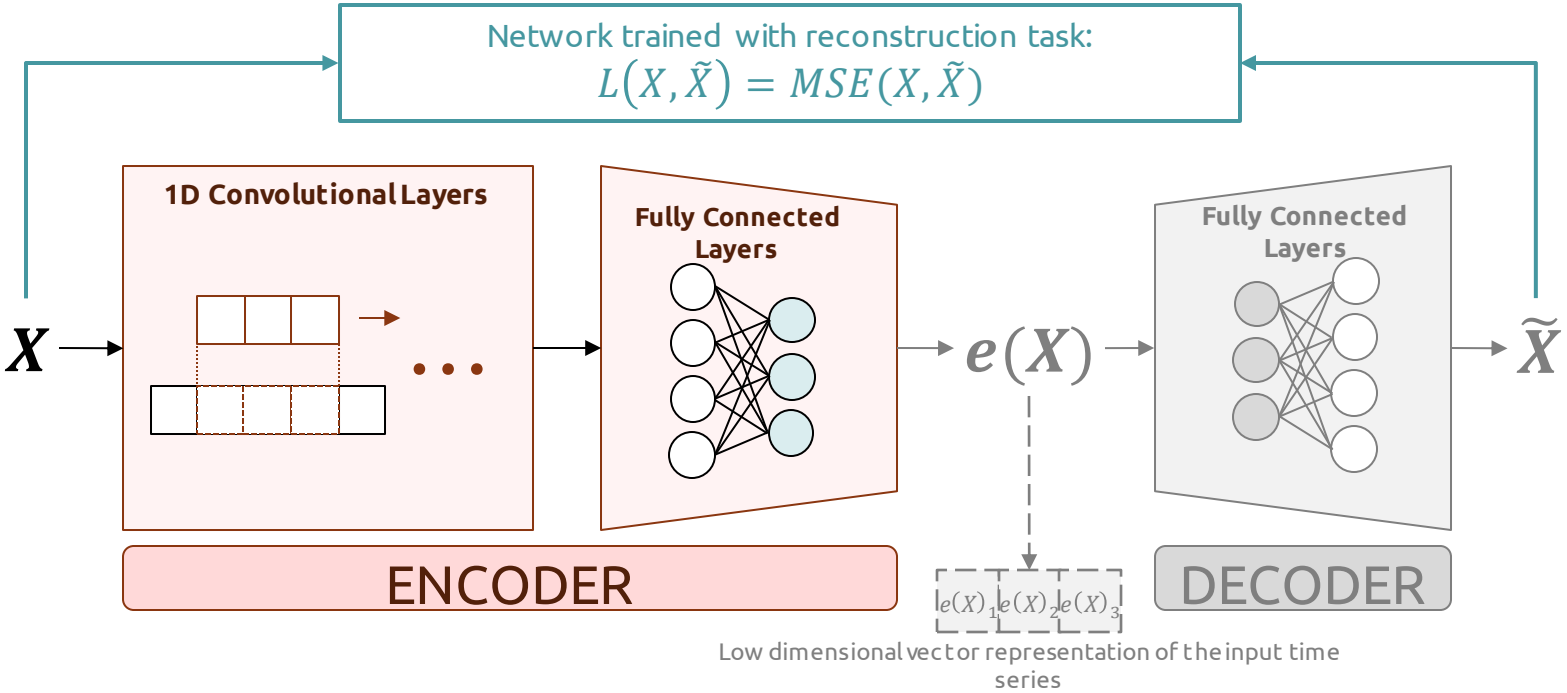

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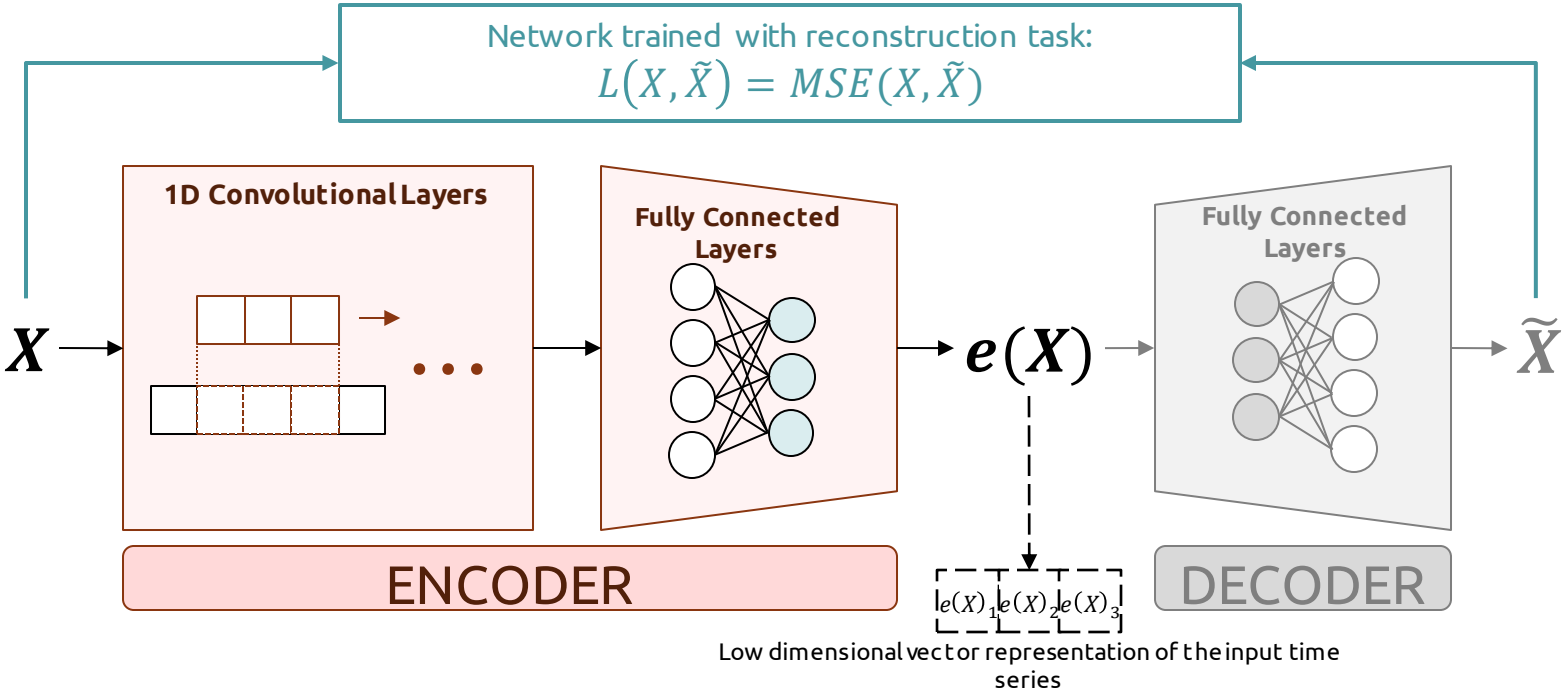

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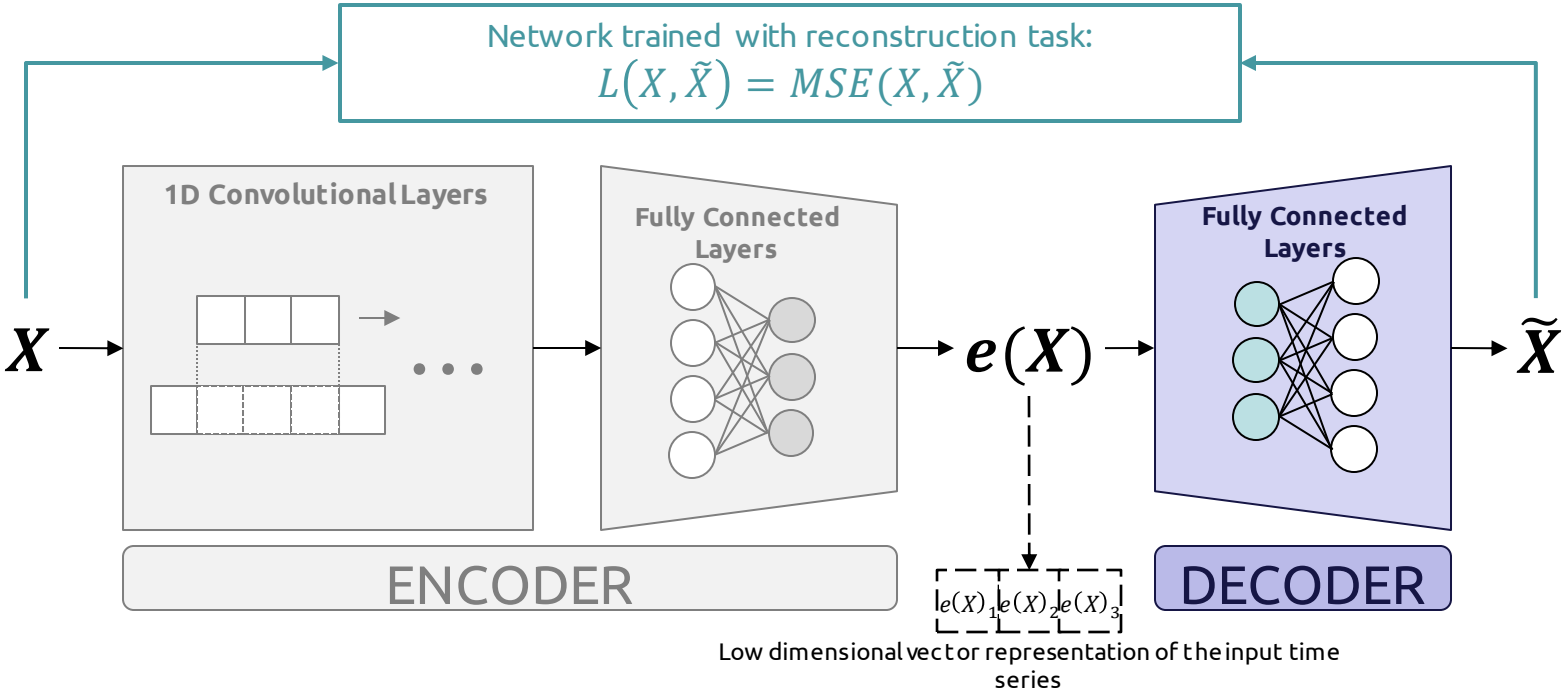

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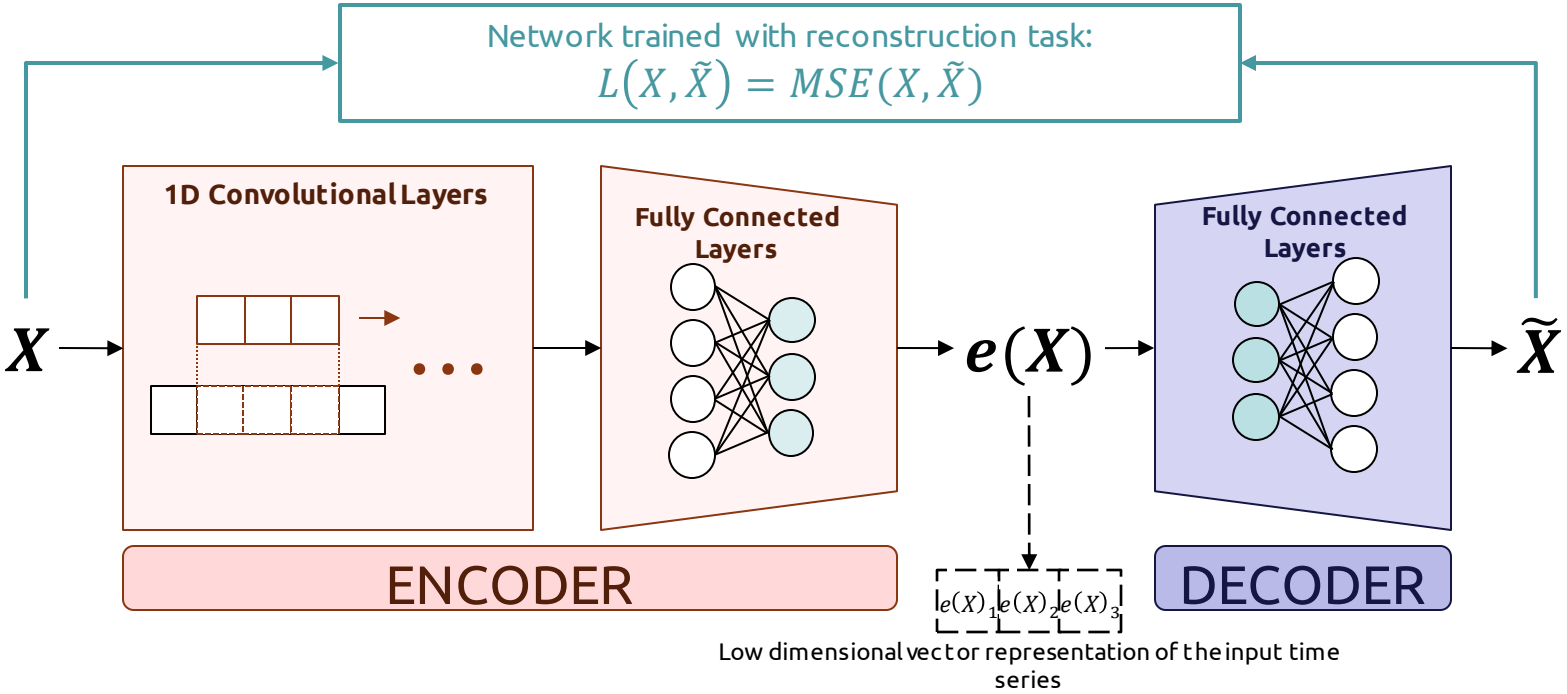

Study location: Sector BXII, Andalusia, Spain

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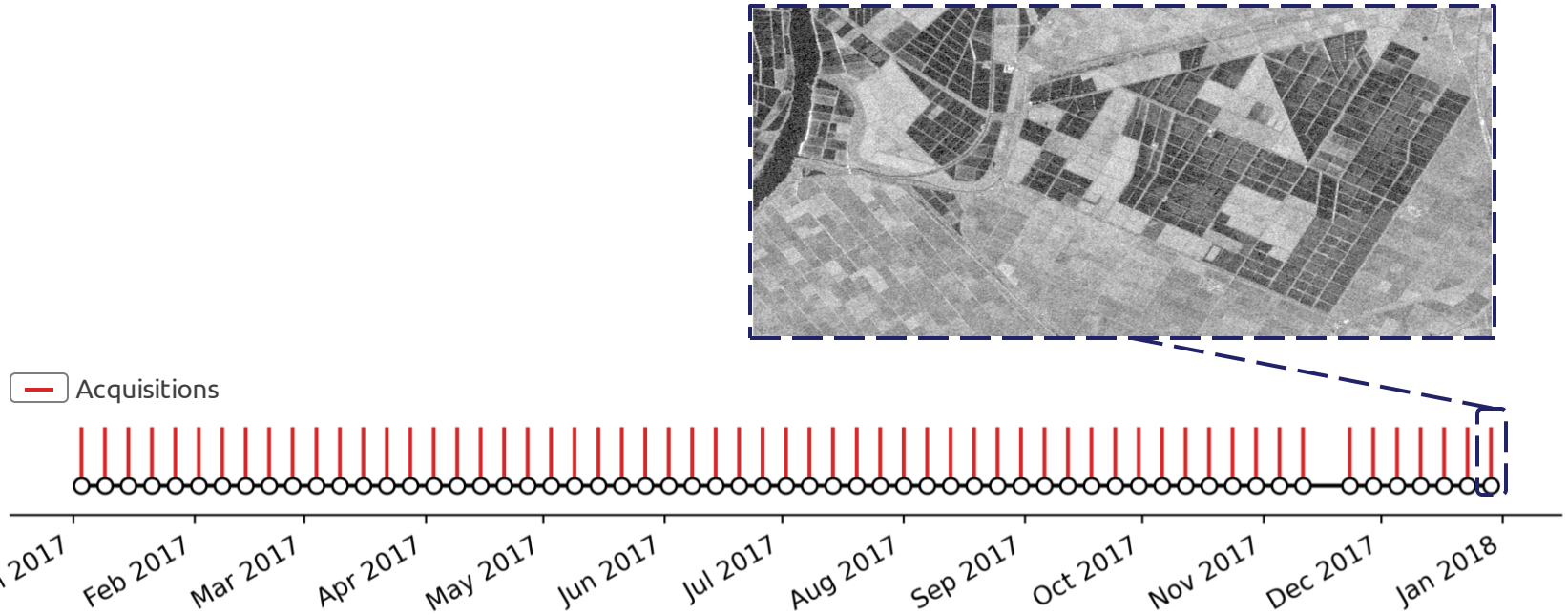
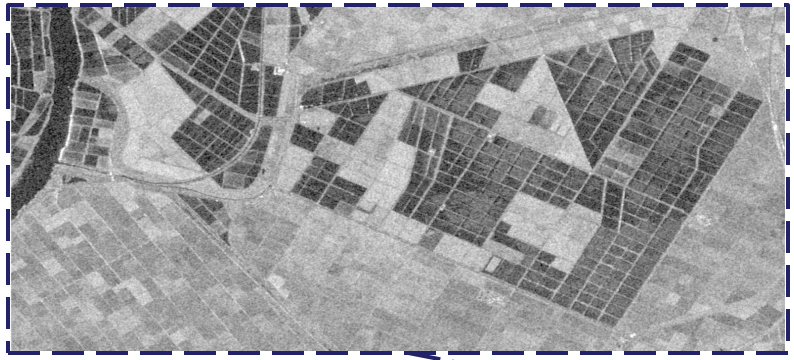
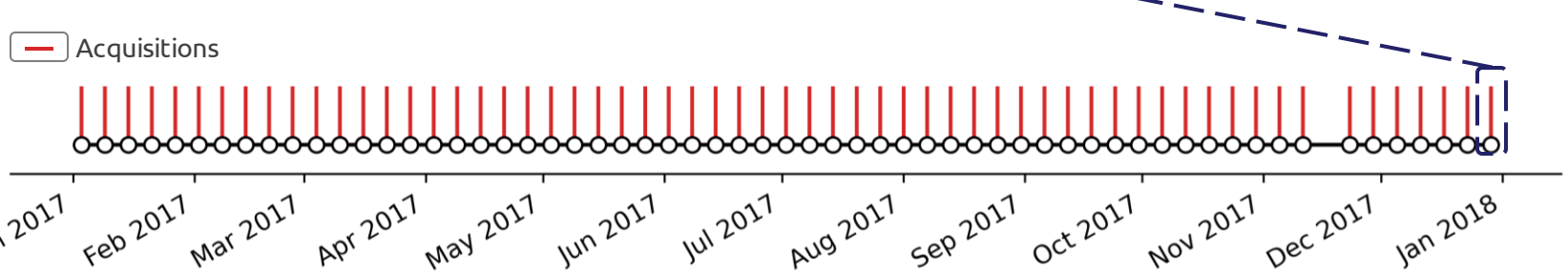


[3] A. Mestre-Quereda, J. M. Lopez-Sanchez, F. Vicente-Guijalba, A. W. Jacob and M. E. Engdahl, "Time-Series of Sentinel-1 Interferometric Coherence and Backscatter for Crop-Type Mapping," in IEEE Journal of Selected Topics in Applied Earth Observations and Remote Sensing, vol. 13, pp. 4070-4084, 2020, doi: 10.1109/JSTARS.2020.3008096.

Study location: Sector BXII, Andalusia, Spain

- Data source [3]
- Preprocessed as in [3]
- Sentinel-1 σ_0 VV, VH
- 1 Year, 60 dates, 6-day revisit





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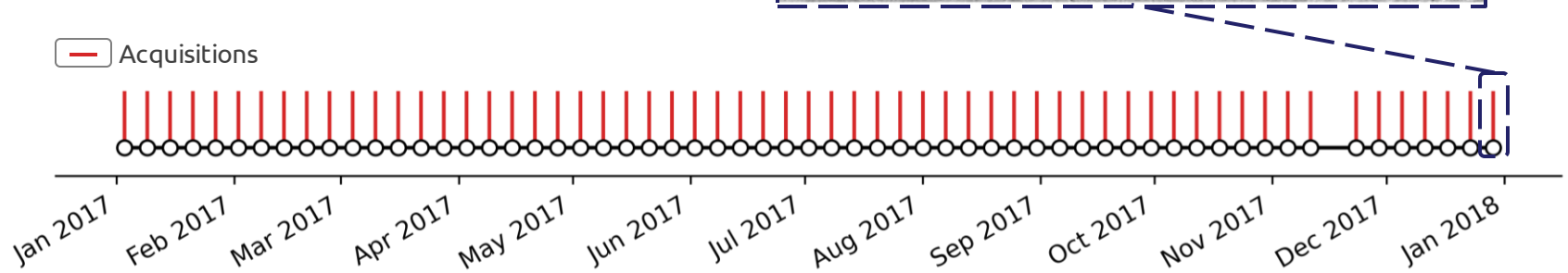
- Preprocessed as in [3]
- Sentinel-1 σ_0 VV, VH
- 1 Year, 60 dates, 6-day revisit
- ~ 350k rice time series

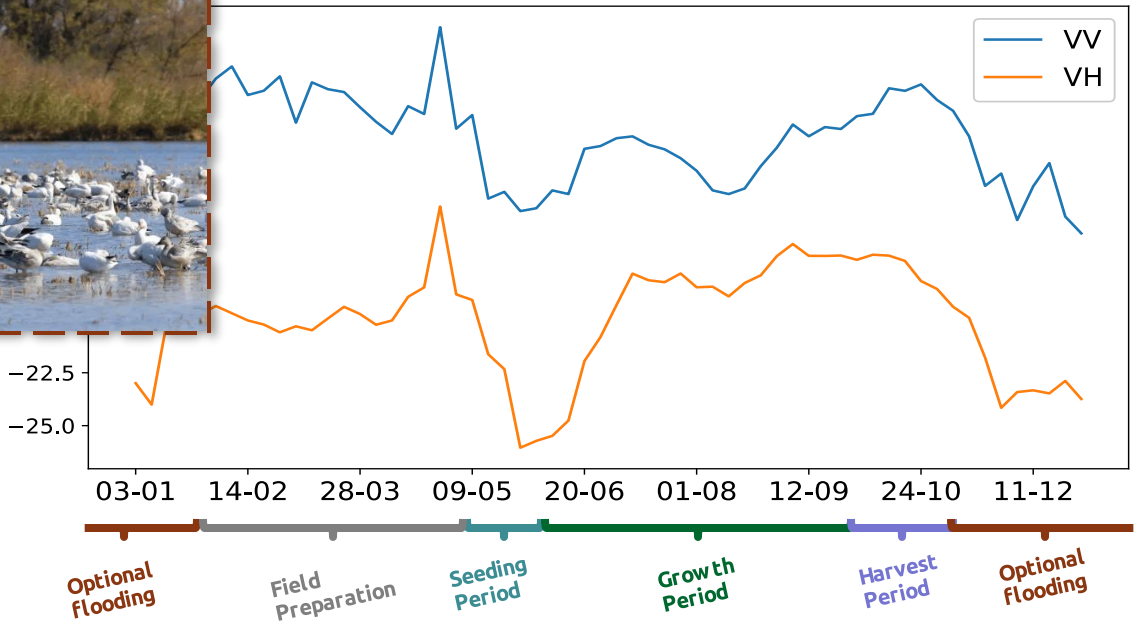


[3] A. Mestre-Quereda, J. M. Lopez-Sanchez, F. Vicente-Guijalba, A. W. Jacob and M. E. Engdahl, "Time-Series of Sentinel-1 Interferometric Coherence and Backscatter for Crop-Type Mapping," in IEEE Journal of Selected Topics in Applied Earth Observations and Remote Sensing, vol. 13, pp. 4070-4084, 2020, doi: 10.1109/JSTARS.2020.3008096.

SAR Time Series & Modeling of rice fields

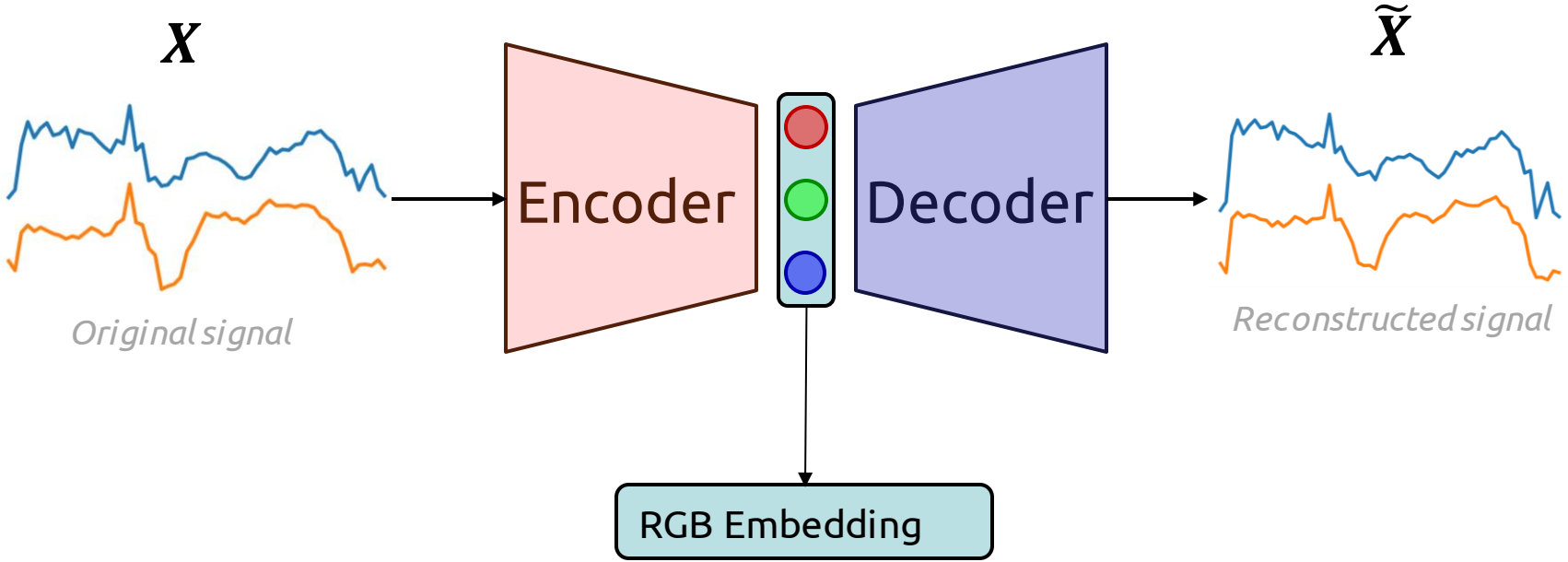
Waterfowl in the flooded rice fields under the Yolo Bypass. JIM MORRIS COURTESY

Average Sentinel-1 backscatter temporal profile of rice fields over the studied area



Calendar source: [4] S. Dey et al., "Synergistic Use of TanDEM-X and Landsat-8 Data for Crop-Type Classification and Monitoring," in IEEE Journal of Selected Topics in Applied Earth Observations and Remote Sensing, vol. 14, pp. 8744-8760, 2021, doi: 10.1109/JSTARS.2021.3103911.

Autoencoding of SAR time series of rice



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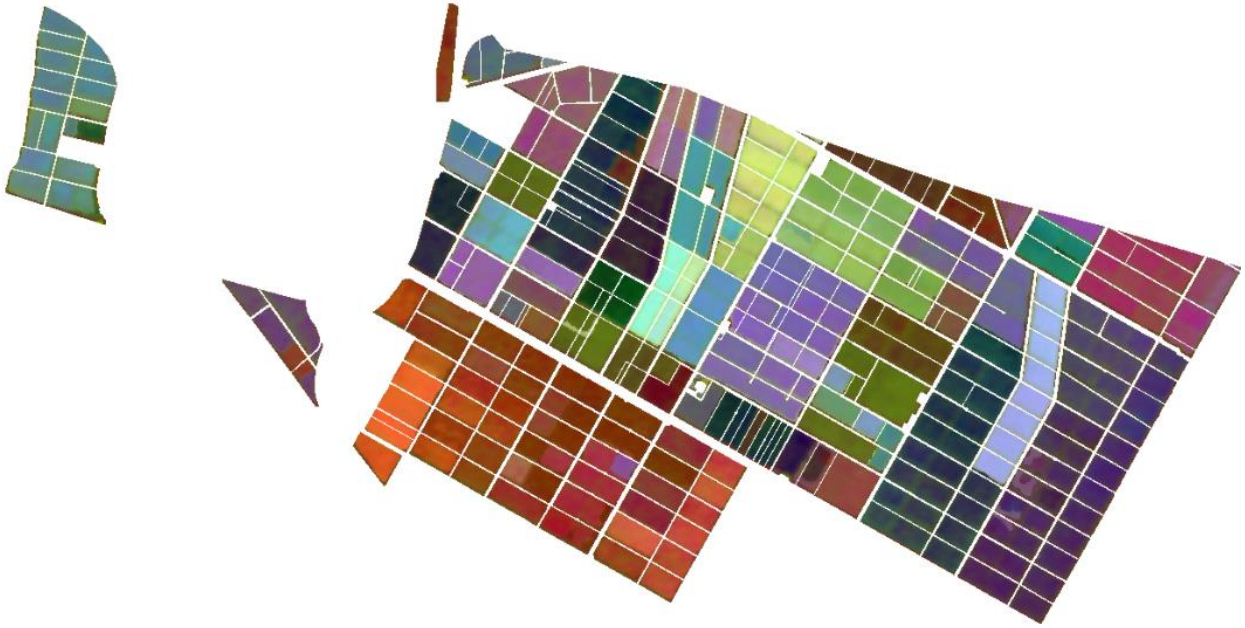

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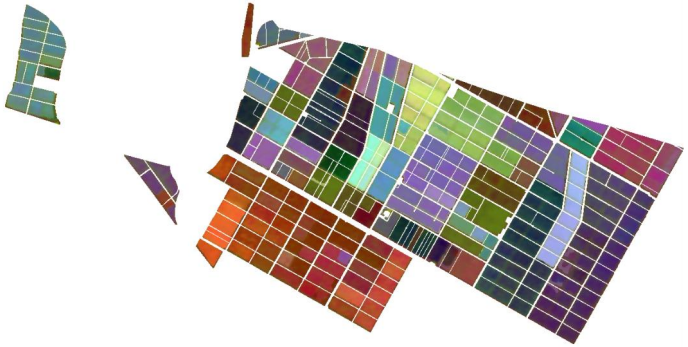

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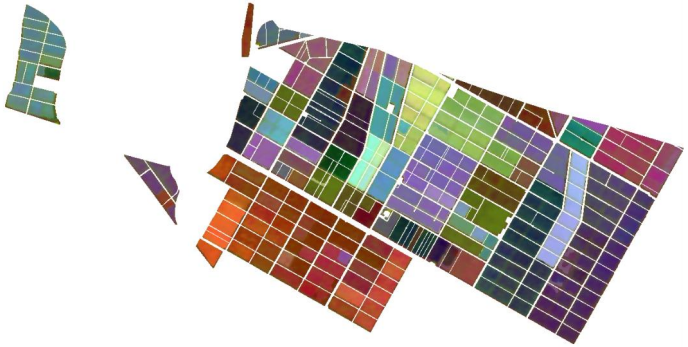

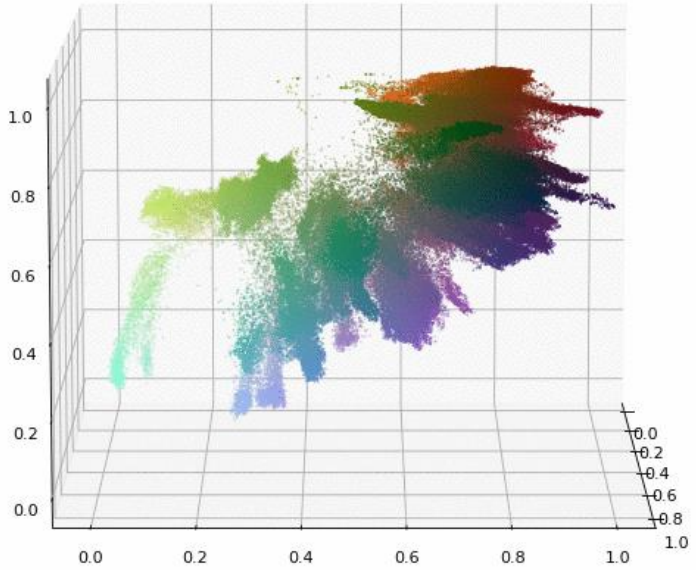

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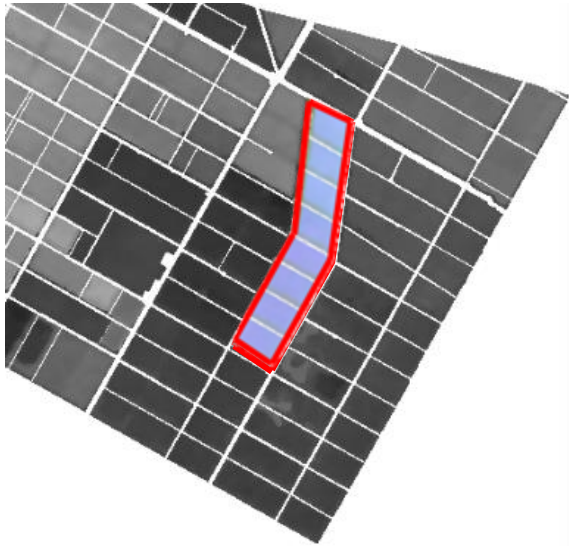
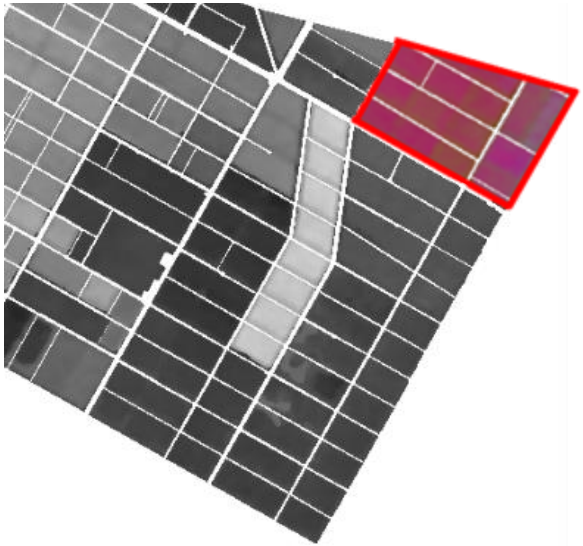
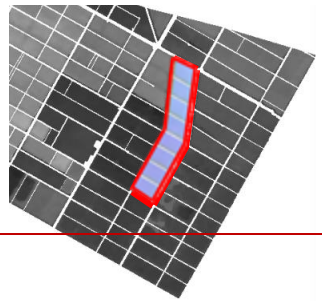


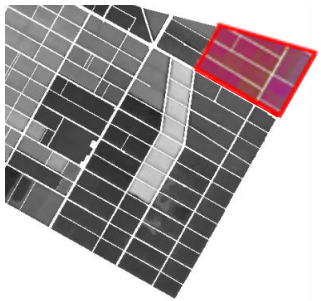


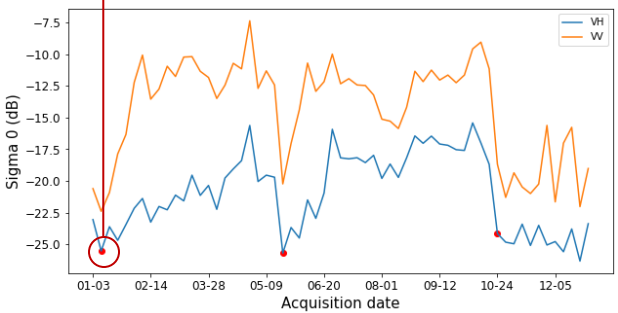
Autoencoding of SAR time series of rice

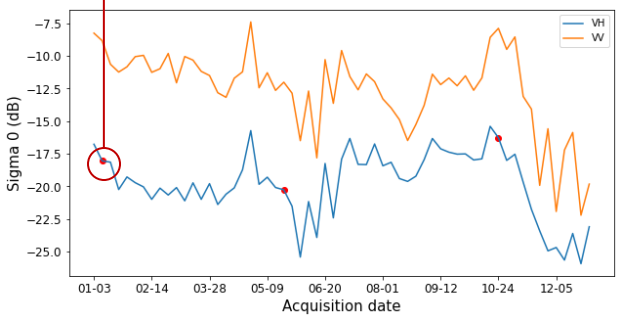
1st date: 9Th Jan. 2017 (Optional Flooding period)

2nd date: 24th October 2017 (Harvest period)









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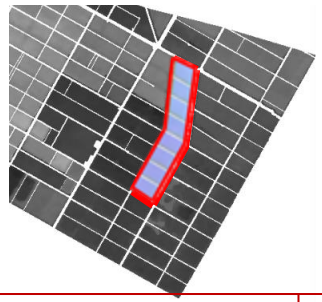
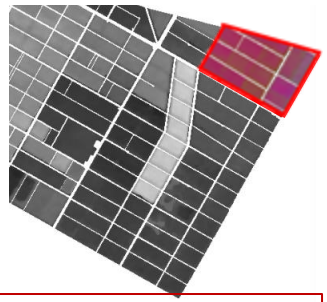
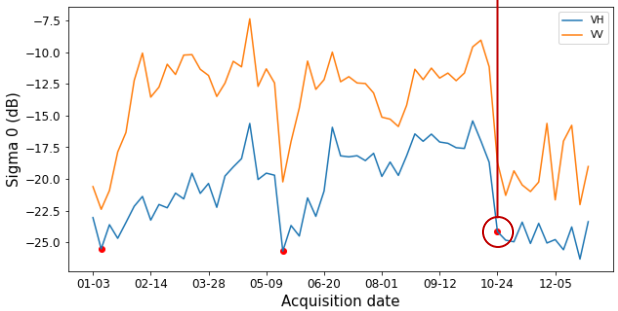
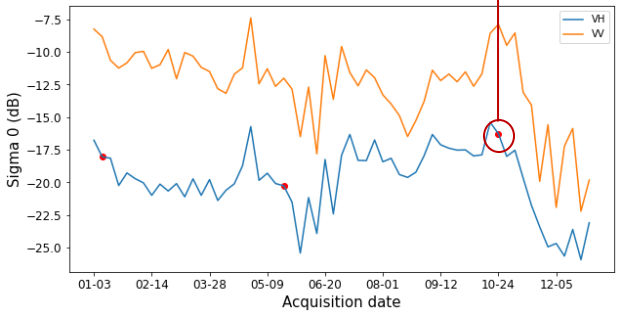






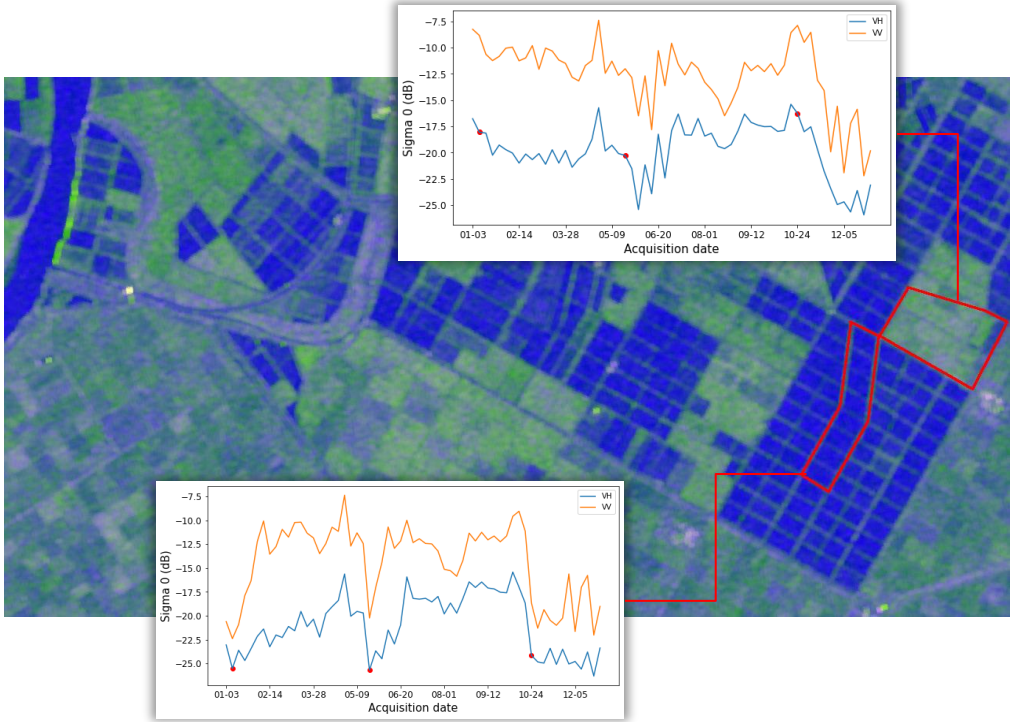


Analysis of the 9th of January acquisition

Optional Flooding

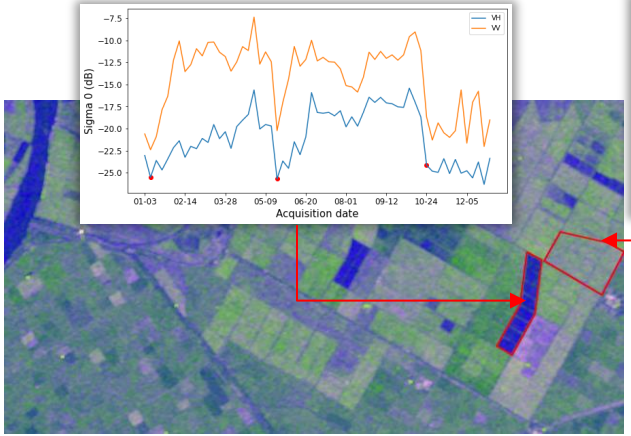
Sentinel-1 image:

- Red: VV
- Green: VH
- Blue: VV/VH



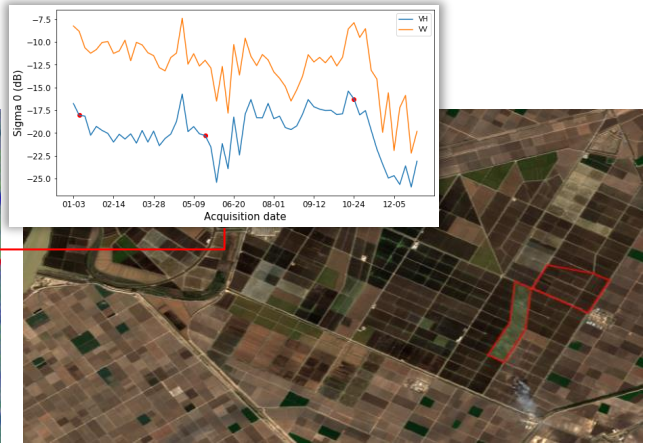
Analysis of the 24th of October

Harvest

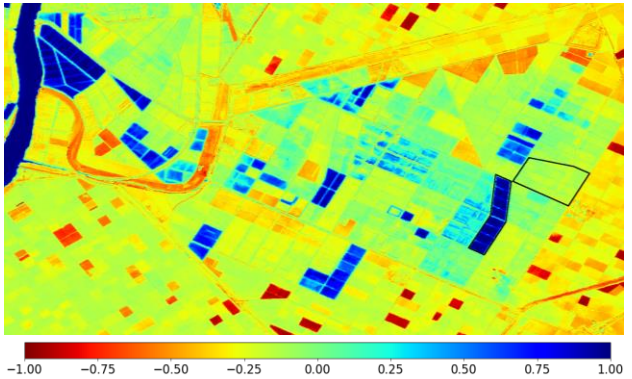


Sentinel-1 image:

- Red: VV
- Green: VH
- Blue: VV/VH



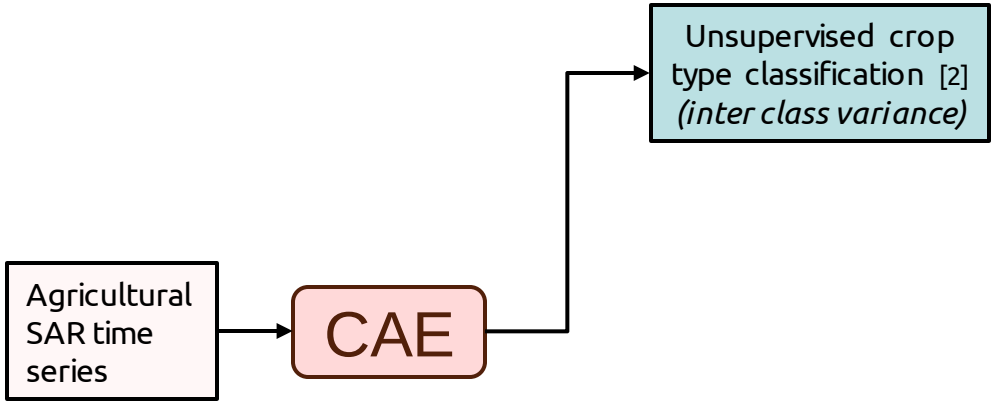
Sentinel-2 RGB image (24th of October)



Sentinel-2 derived Normalized Difference Flood Index [5] (24th October)

[5] Fabio Cian, Mattia Marconcini, Pietro Ceccato,"Normalized Difference Flood Index for rapid flood mapping: Taking advantage of EO big data", *Remote Sensing of Environment*, 209, 2018, pp. 712-730, 10.1016/j.rse.2018.03.006.

Applicative potentials of embeddings & Sentinel-1 data



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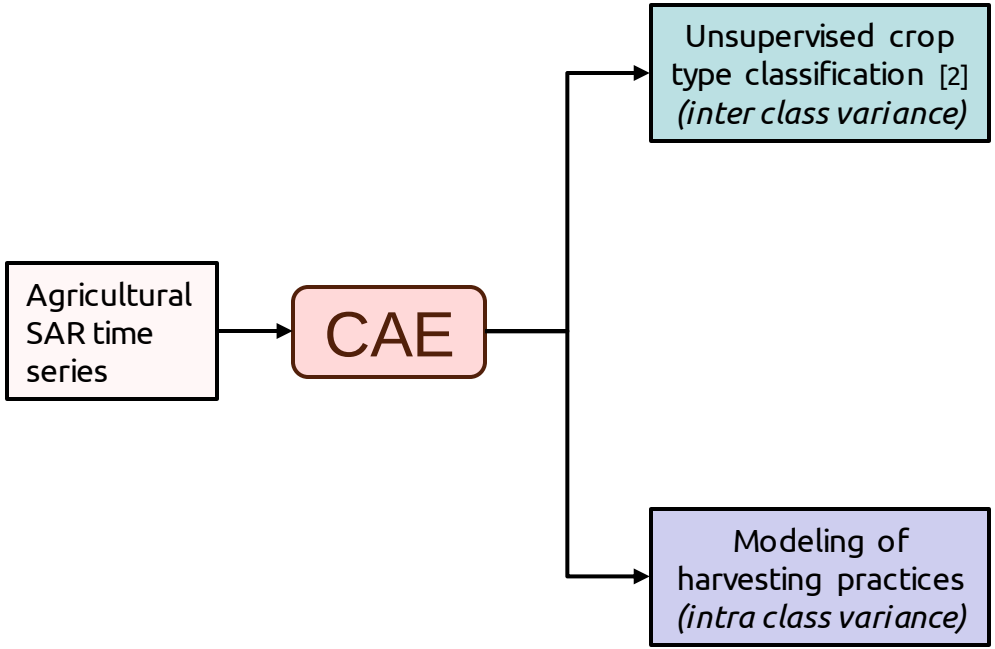

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Contacts

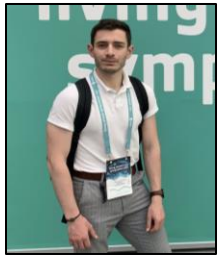
Thank your for listening !

For contact purposes:

thomas.di-martino@centralesupelec.fr

https://dimartinot.github.io

@DimartinotFR



Thomas
Di Martino

SCAN ME