



StateO

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Earth Observation Based Detection of Crop Residues for Official Statistics in Sweden

Sebastian Hafner¹, **Burcu Koçoğlu**¹, Kristine Berezkova^{1,3}, Johanna Wicht^{1,3}, Tobias Edman¹, Erik Källman¹, Linus Rispling², Jerker Moström², Ylva Andrist Rangel², Sergio Yena Vasco²

¹RISE Research Institutes of Sweden, ²Statistics Sweden (Statistiska centralbyrån - SCB), ³University of Stockholm

SATDES: Earth Observation Data for Urban Land Use and Agri-Environmental Statistics

- **Relevance:** Greenhouse gas inventory and nutrient balance for agricultural land

- **Current approach:**

- Statistics Sweden conducts sample surveys (~3,000 farms)
- Farmers report crop residue management practices:

Crop residues
Area left: 15 ha
Area removed: 35 ha



- **Challenges:**

- Funding: Lack of permanent funding to produce crop residue statistics
- Respondent burden: Data collection from farmers imposes administrative burden on agricultural holdings



- **Aim:** Investigate Earth observation as a cost-efficient alternative data sources

EU funded project "Earth Observation Data for Urban Land Use and Agri-Environmental Statistics" (Project 101195601 – 2024-SE-GEOS_SATDES)



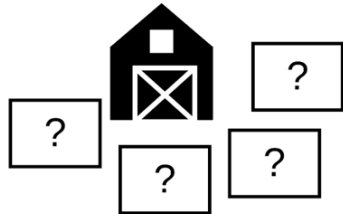
Co-funded by
the European Union

Annotate field parcels for deep learning model training

- Join field parcels to farms¹
- Annotate fields of farms with uniform crop residue management

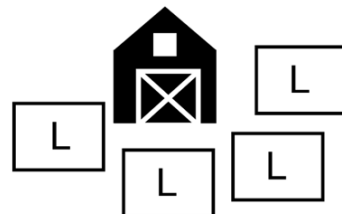
Mixed crop residue management

Crop residues
Left (L): 15 ha
Removed (R): 35 ha



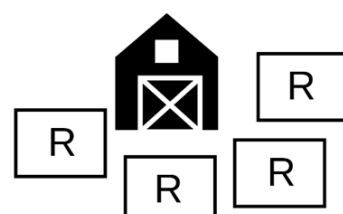
Uniform crop residue management

Crop residues
Left (L): 50 ha
Removed (R): 0 ha



Uniform crop residue management

Crop residues
Left (L): 0 ha
Removed (R): 50 ha



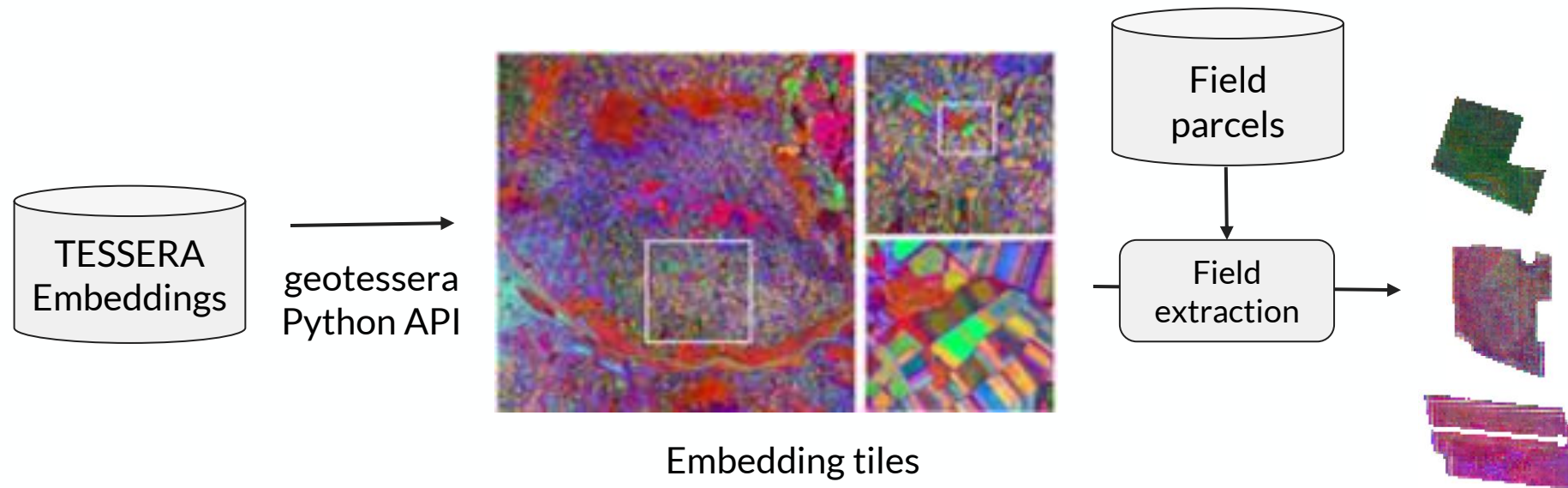
- Subset to county of interests: Skåne and Dalarna



¹Field parcels were derived from the Swedish Board of Agriculture's field database (Årslager skiftesdata) for 2022, 2024, and 2025.

Prepare TESSERA Embeddings for annotated field parcels

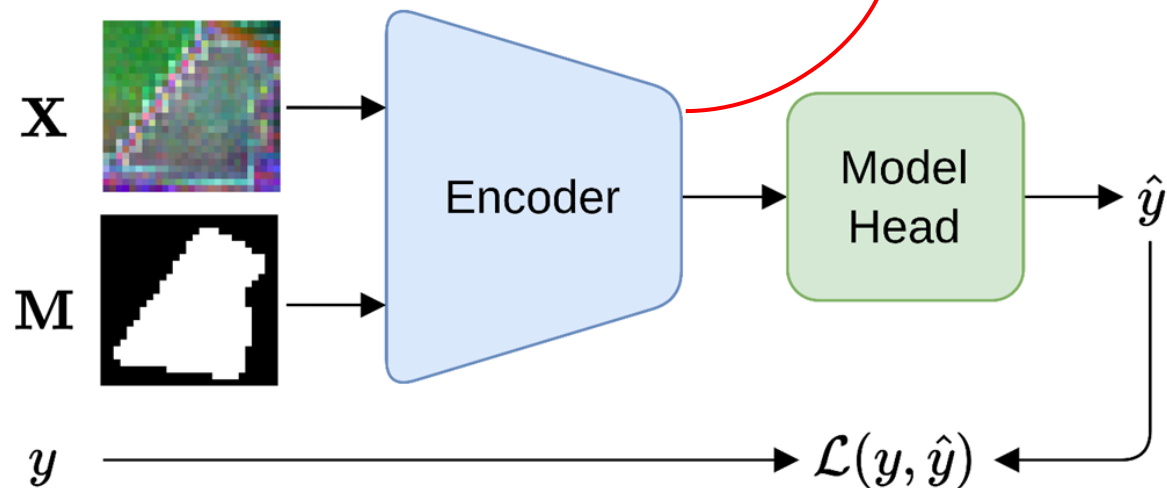
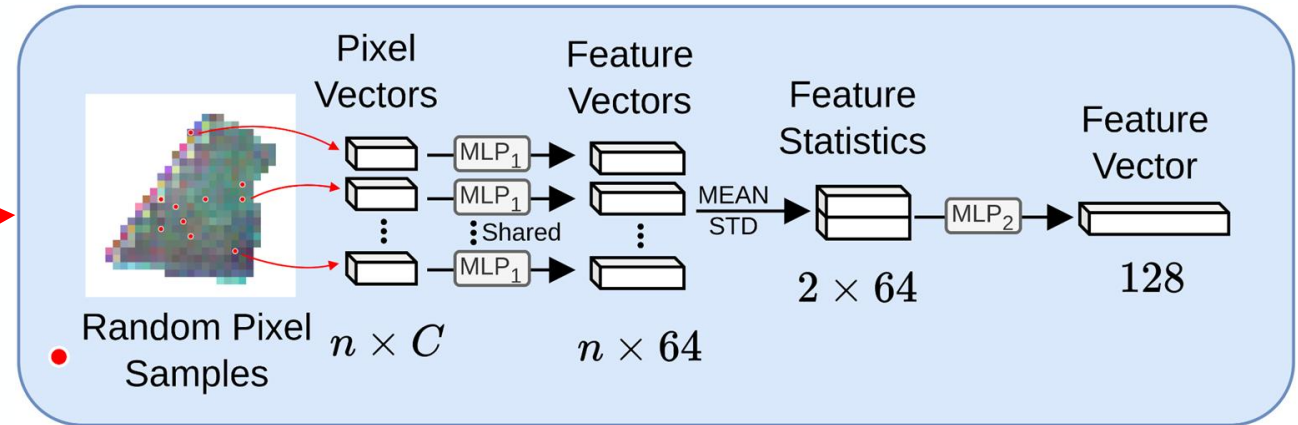
- TESSERA is a self-supervised foundation model that generates 128-dimensional pixel embeddings from Sentinel-1 and Sentinel-2 time series at 10 m resolution with annual global coverage



TESSERA Embeddings: Feng et al. (2026): Tessera: Temporal embeddings of surface spectra for earth representation and analysis.

Crop Residue Detection Model

1. Pixel set encoder converts field-embeddings to a feature vector used by the model head
2. Model head predicts crop residue management practice from feature vector
3. Model is trained on micro survey data



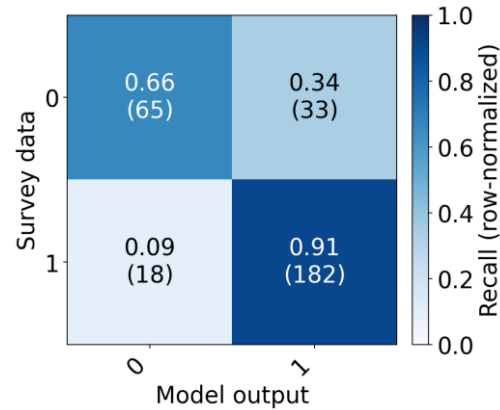
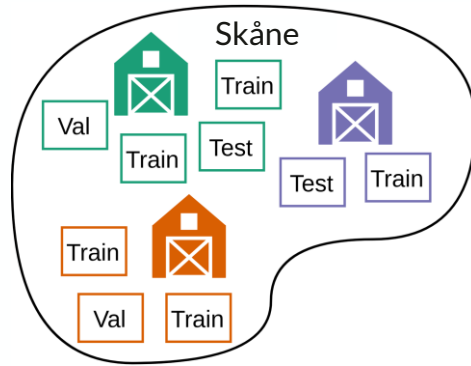
0.82	Crop residues left
0.18	Crop residues removed

Pixel set encoder: Garnot et al. (2020): Satellite image time series classification with pixel-set encoders and temporal self-attention.

Preliminary Results

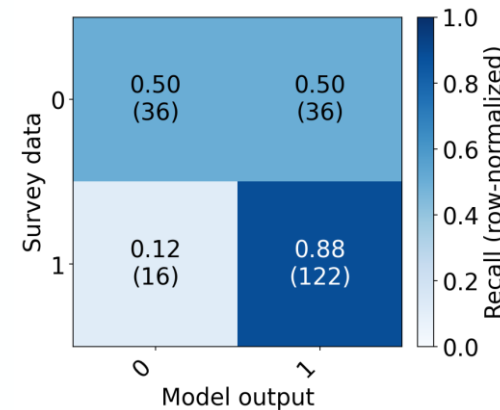
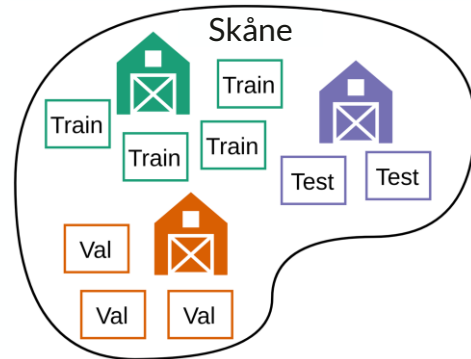
- To investigate generalization ability, we test two different dataset splits:

Field-Level Split



Overall accuracy: 89.3 %
Macro F1 score: 87.8 %

Farm-Level Split



Overall accuracy: 75.2 %
Macro F1 score: 70.2 %

Legend:

- 0: Crop residue removal
- 1: Crop residue retention

Conclusions:

- Crop residues can be detected from Earth observation data (geospatial embeddings)
- Model generalization is challenging and needs to be further investigated

Ongoing and Future work:

- Investigate standalone, Sentinel-1 and Sentinel-2 time series for crop residue detection
- **Potential desirable work:** Leverage our national Earth Observation platform, [Digital Earth Sweden](#), for model deployment

Key recommendations:

- Acknowledge the yet dependent and complementary nature of EO-based statistical modernisation
- For end-to-end operational pipelines, transparency and documentability of AI-driven methods should be a design requirement while yet in early stages, not an afterthought

Thanks a lot for your attention! 😊

✉ burcu.kocoglu@ri.se

✉ sebastian.hafner@ri.se