Environmental Computational Science and Earth Observation Laboratory

Sion, 21 April 2026

ECEO-swisstopo collaboration, final report 2026

By V. Zermatten, D. Tuia

Collaboration status

The production and the update of the TLM3D traditionally rely on photointerpretation, which is time-consuming and tedious for the operators. Artificial intelligence methods and specifically deep learning provide alternative approaches for pattern recognition and image segmentation, allowing automation of the land cover classification.

The fourth year of collaboration focused on detecting large rocks in Switzerland. Together with the annotators team, Hans Baertschi (H.B.) provided a set of large rocks annotations for 62 swissIMAGE tiles (1km^2 per tile), located in cantons of Valais, Grisons Ticino and Bern. The dataset amounted to a total of 2,625 manually annotated large rocks (larger than 5x5x5m). Valérie Zermatten (V.Z.) prepared the training dataset for detecting large rocks based on swissIMAGE, swissSURFACE3D and swissALTI3D raster and proposed it as a course project for the course of Prof. Devis Tuia “Image processing for Earth observation” in Fall 2024.

Given the successful output of the course project, EPFL student Alexis Rufer (A.R.) conducted a semester project in the ECEO laboratory in Spring 2025. A.R. adapted the YOLO object detector model to predict large rocks and performed a systematic study on the best way to combine the input imagery sources (RGB and DSM). To further improve the predictions accuracy under limited annotation conditions, he implemented a semi-supervised active learning approach, known as Active Teacher. This approach leverages unlabelled data, by iteratively incorporating pseudo-labelled data (i.e., outputs of the models with high confidence) in the training process and led to increased performance.

To observe the generalization capacity of the model, predictions over an area of roughly 30x40km between the canton of Bern and Valais were produced. A total of roughly 14,000 large rock predictions were delivered to swisstopo in October 2025. After integrating swisstopo feedback, the predictions for all of Switzerland are made available in Spring 2026 as a GitHub repository (*https://github.com/eceo-epfl/large-rock-detection*) and correspond to a deliverable of the fourth year of the collaboration.

The final status of the project is as follows:

- The final report of the work of A.R. was shared with Tobias Kellenberger (T.K.) and H.B.
- 14'000 large rocks predictions for a larger area in Bern were delivered to swisstopo in October, to have a qualitative estimate at the prediction performance, with some suggestion on improvements.
- A final shapefile with approx. 400,000 rock large rocks predictions for all of Switzerland were delivered to swisstopo in April 2026. A short descriptive report, code and model weights are also provided in the associated repository: *https://github.com/eceo-epfl/large-rock-detection*

Doctoral thesis

The doctoral thesis proceeded as planned, with the submission of the fourth and last chapter to the journal *Methods in Ecology and Evolution*, and has now entered its final phase. The final thesis including the four technical chapters has been submitted to EPFL doctoral school on March 26 and will be defended privately on April 30. As per EPFL rules, following the private defense, the thesis will be defended publicly; the tentative date is Friday May 22nd. An official invitation to the collaborators at swisstopo will be sent as soon as the date will be confirmed.

Scientific presentations in 2025-2026

- VZ presented her research:
  - Talk at *Maison de la Télédetection* in Montpellier, France, February 27th, 2025.
  - Talk at « AI-Imagery Workshop » in Le Grand Bornand, France on March 13th, 2025.
  - Online presentation for the WikiWorkshop, on May 21th, 2025
  - Lightning talk and poster at the EarthVision Workshop of the Computer Vision and Pattern Recognition Conference in Nashville USA, on June 11th, 2025
  - Poster at the *Living Planet Symposium*, organised by the European Spatial Agency, in Vienna, Austria, on June 26th 2025.
  - Presentation at the *Swiss Remote Sensing Days* in Dubendorf, Switzerland, on August 25th, 2025.
  - Panellist at the *Swiss AI Weeks* for the online event *AI for Space - Lifting Off with AI: From Earth to Space*, on September 26th, 2025.
  - Poster at the *AI + Environment Summit* in Zurich, Switzerland, on October 1st, 2025
  - Panellist at the online event « AI for conservation» from WILDLABS, on December 11th, 2025
  - Public PhD Defense is scheduled for May 2026

Publications

- V. Zermatten work « Learning transferable land cover semantics for open vocabulary interactions with remote sensing images » was accepted in the *ISPRS Journal of Photogrammetry and Remote Sensing*.
- V. Zermatten work «EcoWikiRS: Learning Ecological Representation of Satellite Images from Weak Supervision with Species Observations and Wikipedia» was accepted at the *EarthVision Workshop* of the *Proceedings of the Computer Vision and Pattern Recognition Conference* 2025
- V. Zermatten work «A Geolocation-Aware Multimodal Approach for Ecological Prediction» was submitted to the journal *Methods in Ecology and Evolution*.