



# RECONSTRUCTING THE “UNKNOWN” FEATURES IN AC-TC, UTILIZING AN ML-BASED APPROACH



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## GOAL

### CLASSIFICATION OF ATMOSPHERIC HYDROMETEORS AND AEROSOLS IN EARTHCARE LEVEL 2B AC-TC PRODUCT PIXELS WHERE CLASS IS NOT PROVIDED OR IS HIGHLY UNCERTAIN DUE TO LIDAR ATTENUATION

## MOTIVATION

- Correct classification of the atmospheric constituents is critical for monitoring the vertical distribution of clouds, aerosols and precipitation, which is useful for improving remote sensing retrievals, radiative effect and atmospheric models.
- Inherent limitations in EarthCARE observations and retrievals for certain regimes and target hydrometeors: for cases with attenuated lidar signal the classification is highly uncertain.

## DATASET

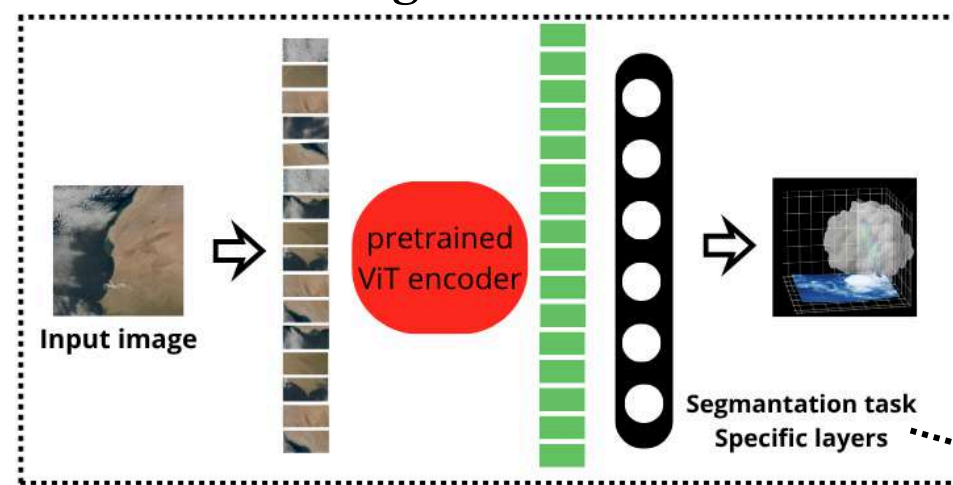
- MTG FCI Level 1C, Level 2 CLM
- EarthCARE Level 2B AC-TC
- Cloudnet Classification Product and ECMWF Temperature Data for the stations

Girtsou et al., Mon 16:54, T130

## ML MODEL

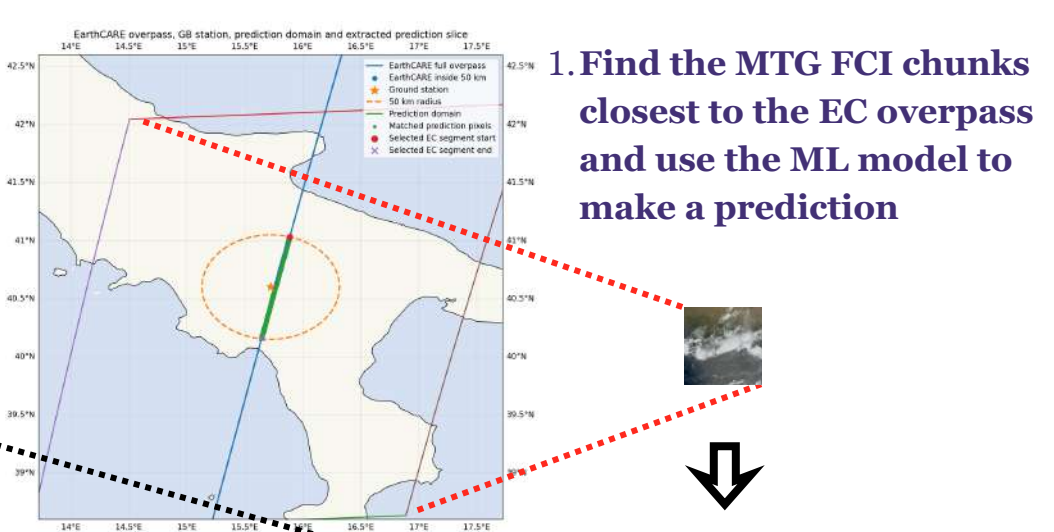
### Sat-MAE

- pretrained on unlabeled MTG Level 1C
- finetuned using colocated MTG-EC scenes



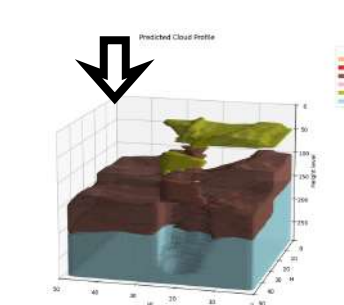
## VALIDATION METHODOLOGY

Dataset of 70 colocated EarthCARE overpasses within a 50 km radius from 8 Cloudnet Stations

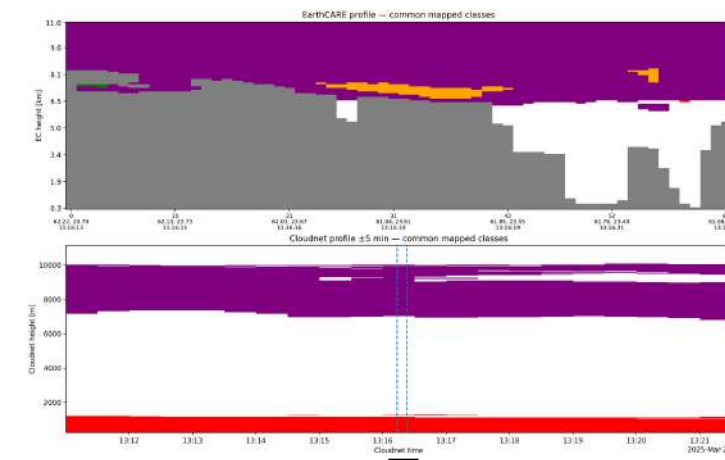


1. Find the MTG FCI chunks closest to the EC overpass and use the ML model to make a prediction

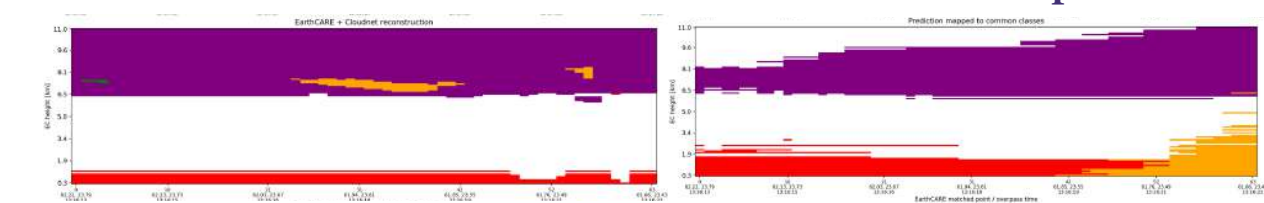
ML model



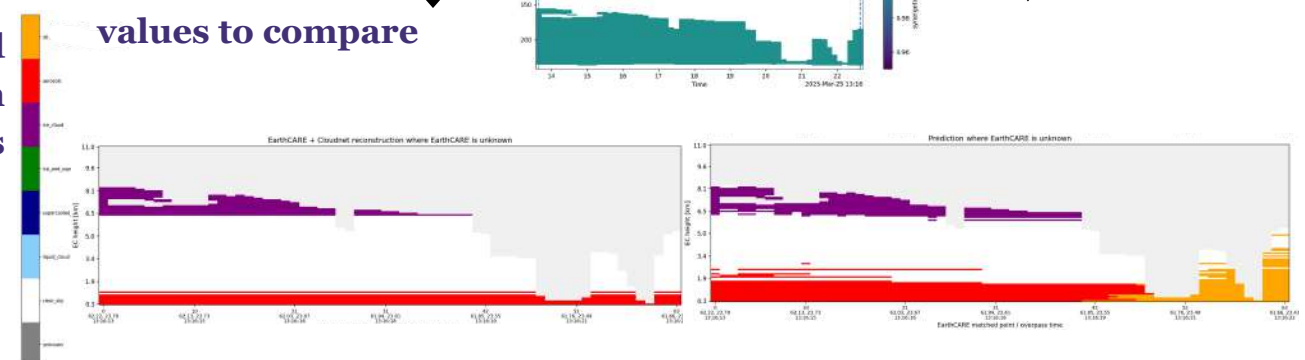
3. Extract slice closest to the EC overpass



2. Combine AC-TC grid with closest Cloudnet classification to produce validation labels



4. Keep data only where the AC-TC has unknown values to compare

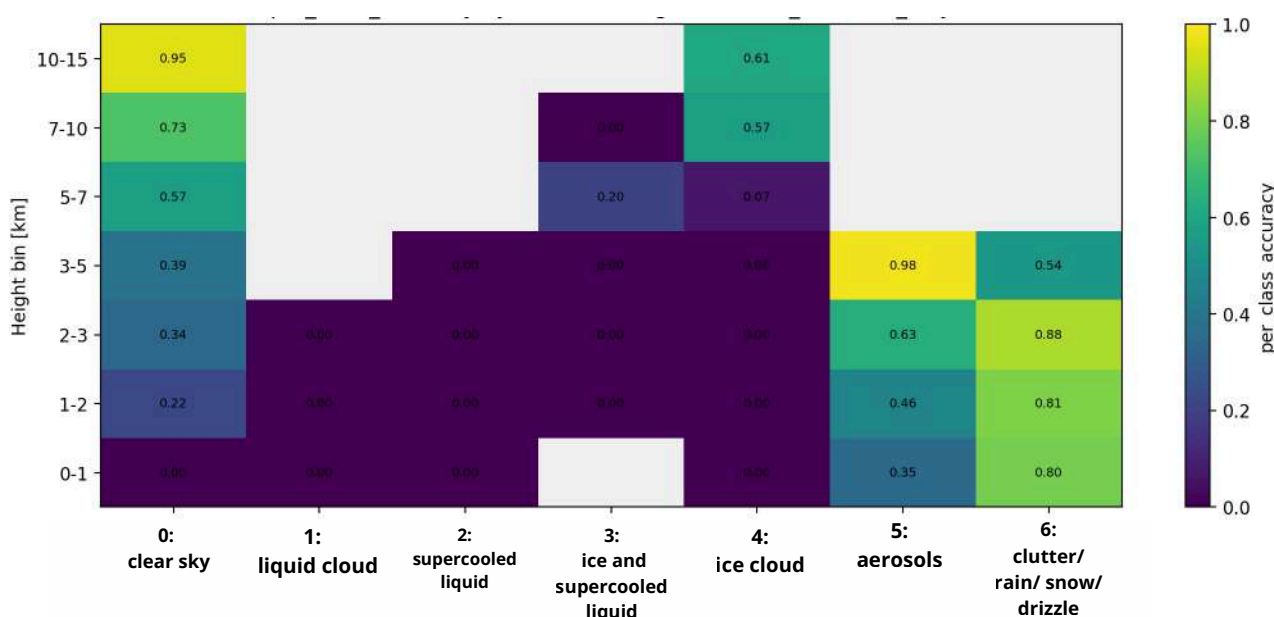


5. Map Cloudnet labels and ML-model labels to common classes based on insights from Tsikoudi et. al, P065

## RESULTS

For the validation we focus on the “unknown” mask

weighted accuracy per height bin and per class



The ML model manages to reconstruct from 2D MTG images the “unknown” profiles of EarthCARE with accuracy of:

- Aerosols: up to 98%
- Other (clutter, rain, drizzle, snow, insects): up to 88%
- Ice cloud: up to 61%
- Clear sky: up to 95%
- Liquid cloud: not well reproduced

## NEXT STEPS

- Train the ML model to provide the distinct precipitation classes (that are now grouped in “other” class), which are more likely to be present in “unknown” AC-TC regions
- Improve the ML model by incorporating vertical information from the EC data as input for more accurate 3D reconstructions
- Validate also with airborne data
- Provide estimations of confidence score for the MTG 3D cloud product

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