Semester or Master project – CHOPIN: analysis of cloud radar data to study microphysical processes in mixed-phase clouds

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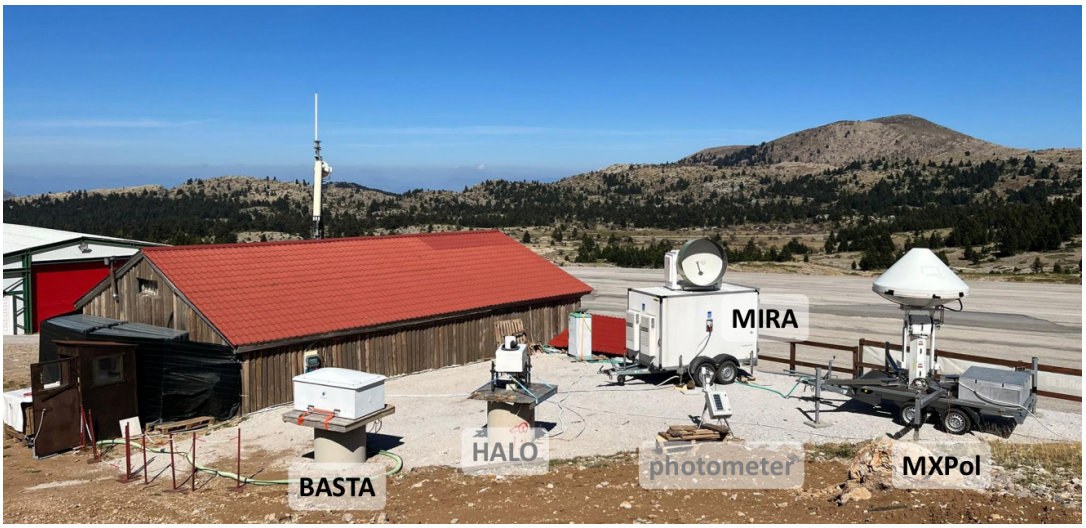
Characterising the microphysical properties and processes in clouds is key for improving numerical weather and climate models, both in terms of quantitative precipitation estimation and quantifying the radiative contribution of ice and mixed-phase clouds.

Meteorological radars are highly useful to study precipitation microphysics, as they can provide quantitative information about the microphysical properties of cloud and precipitation particles such as particle size, phase, bulk density, ice water content, etc.

In this project, the student will use radar measurements, (primarily reflectivity and mean Doppler velocity) collected during the CHOPIN field campaign (CleanCloud Helmos OrograPhic sIte experimeNt), taking place at Mount Helmos (Greece) from October 2024 to January 2025. Three meteorological radars (X-, Ka-, and W-band) were deployed to capture radar moments and multi-wavelength polarimetric Doppler spectra. Additionally, a number of radiosonde measurements of in-situ meteorological variables are available throughout the measurement period.



CHOPIN remote sensing site, with from left to right: BASTA (W-band/95 GHz vertically pointing Doppler radar), MIRA (Ka-band/35 GHz scanning polarimetric radar) and MXPol (X-band/9.4 GHz scanning polarimetric radar) as well as two other instruments.

Possible objectives of the project (can be adapted depending on time constraints and interests of the student):

- Perform statistical analysis of multi-frequency radar observations to identify which microphysical properties (e.g., particle phase, size, or density) can be reliably retrieved from the available radar variables.
- Explore and evaluate different hydrometeor classification techniques using the CHOPIN dataset and auxiliary observations.
- Develop a climatology of selected weather situations observed during the campaign, focusing on contrasting conditions such as orographic cloud formation versus frontal system development, and assess their microphysical characteristics and implications for precipitation formation.
- Combine radar, radiosonde, and ERA5 data to study how insect layer height and intensity respond to changes in boundary-layer stability and meteorological drivers.