SUPPLEMENT

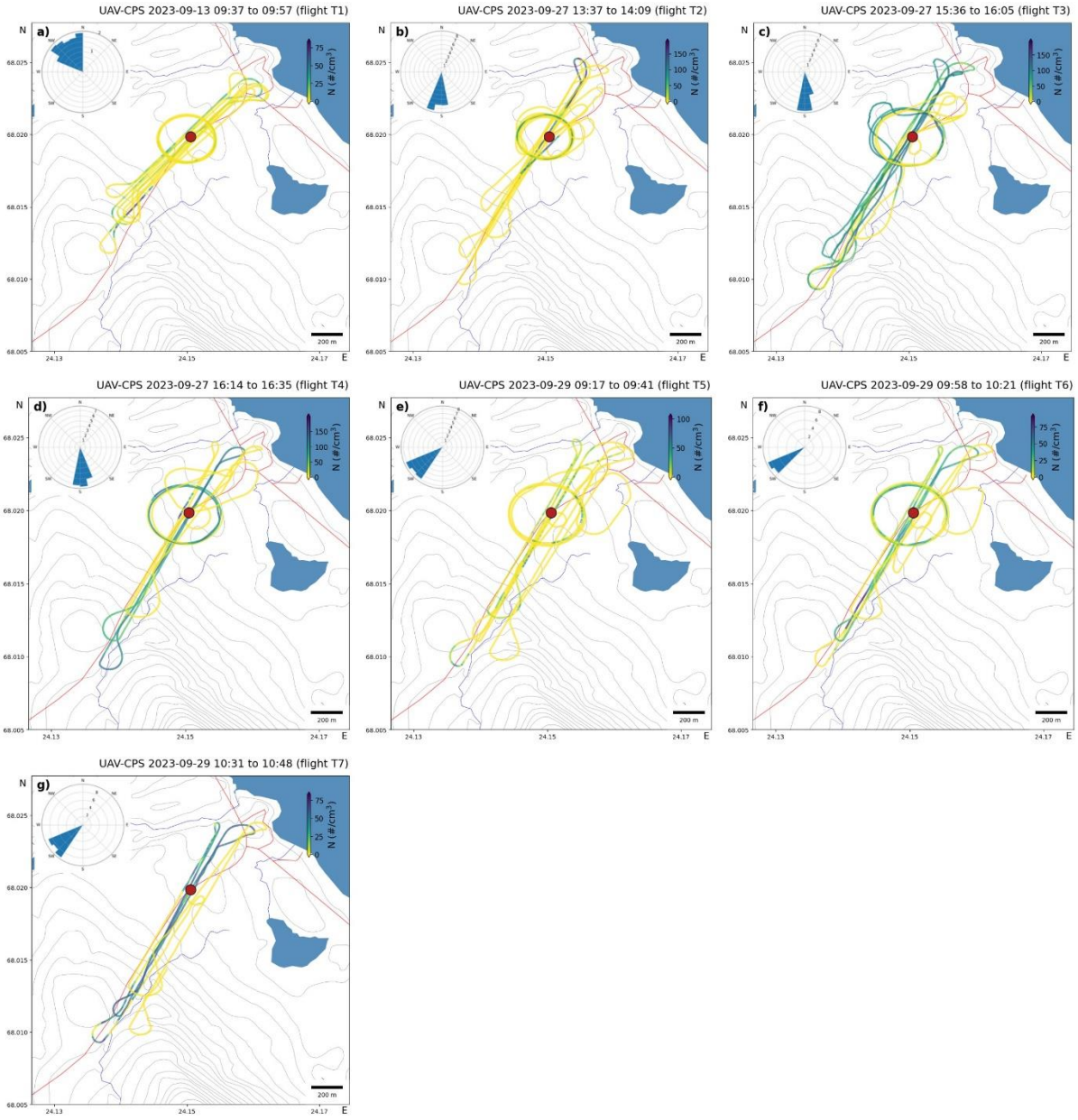


Figure S1. The UAV-CPS flight paths and cloud droplet number concentrations, including the prevailing wind rose.

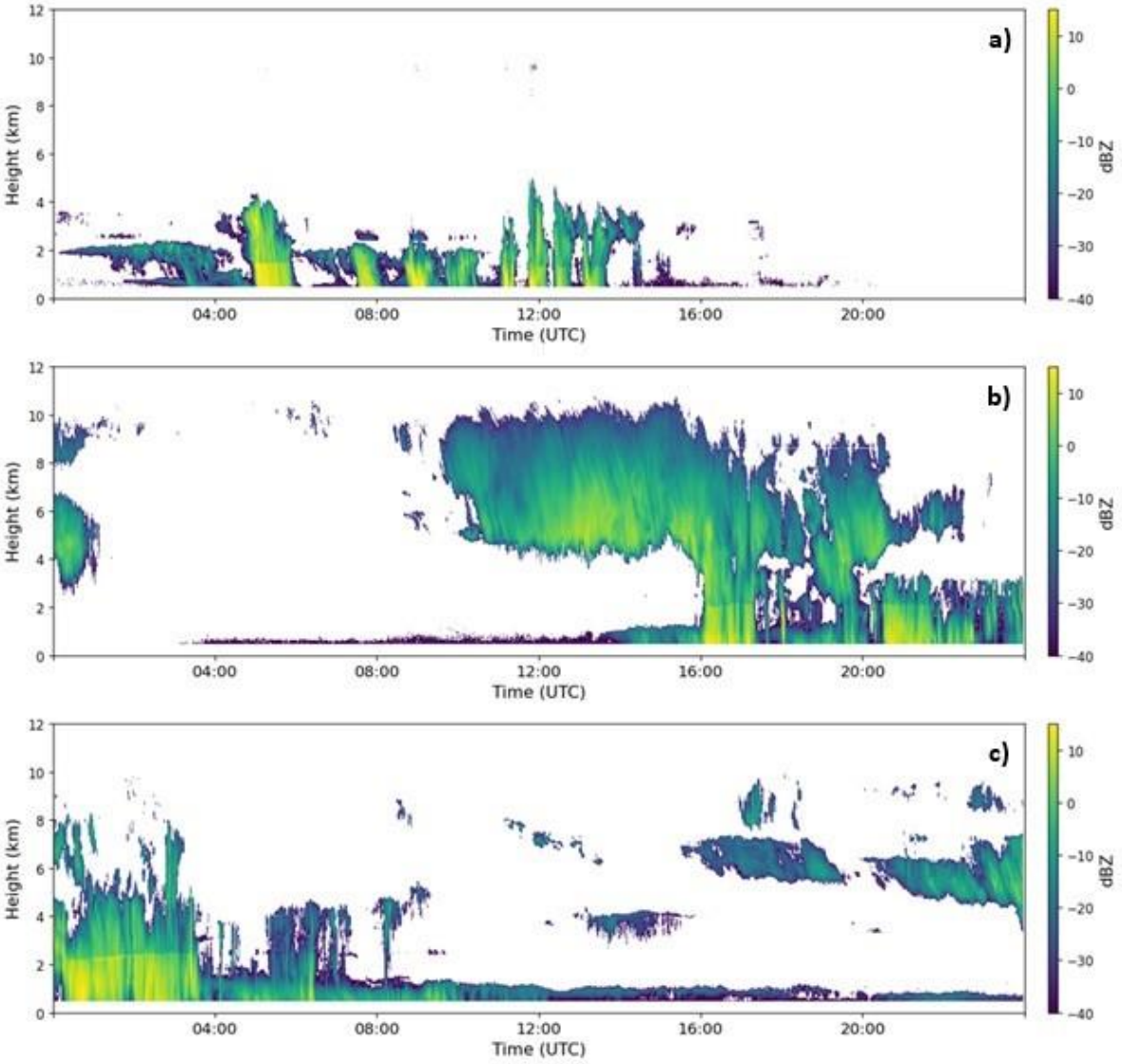


Figure S2. Cloudnet radar reflectivity factor product, Kenttärova, Finland, from a) 13 September (O'Connor, 2024a), b) 27 September 2023 (O'Connor, 2024b) and c) 29 September 2023 (O'Connor, 2024c).

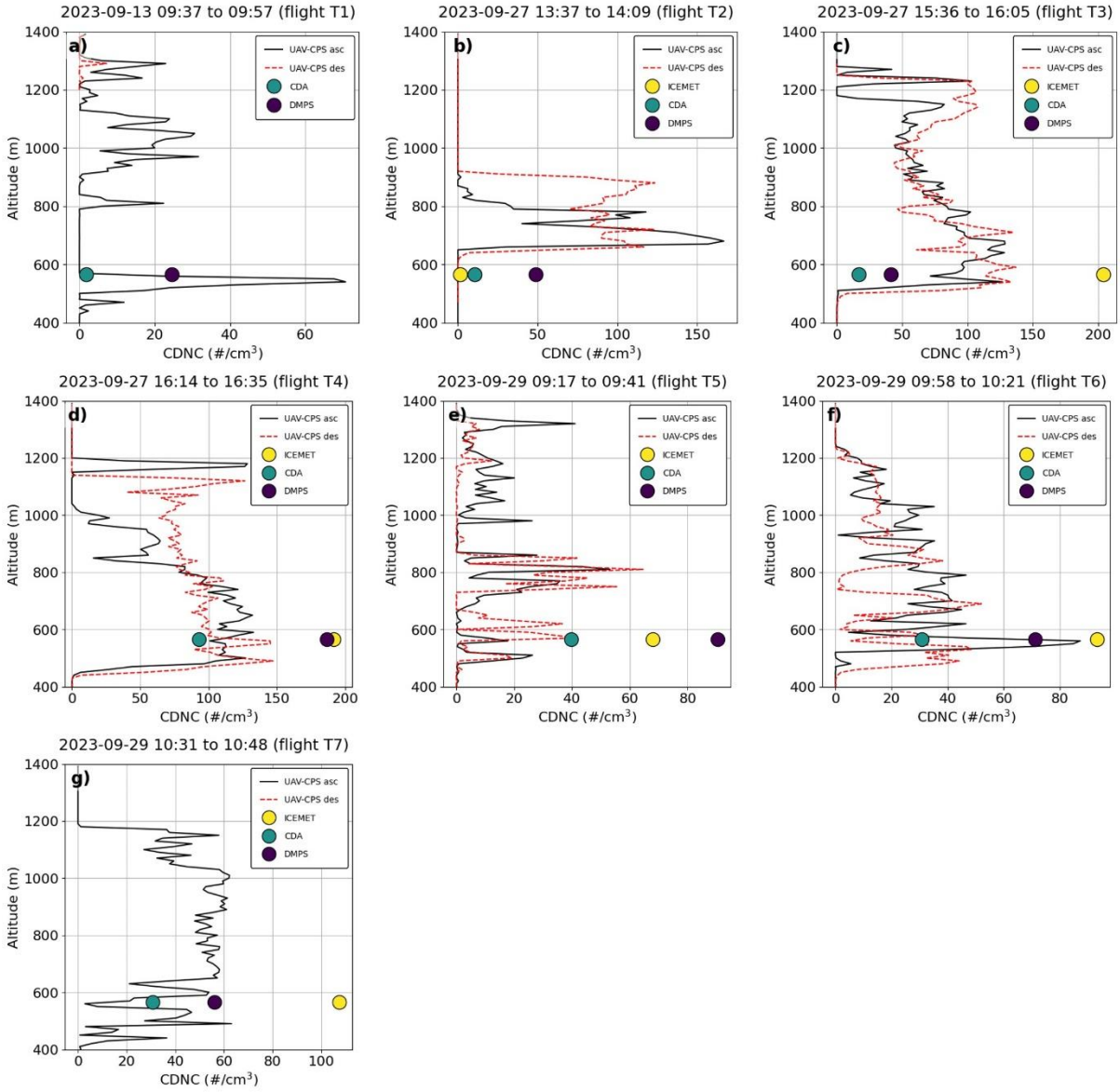


Figure S3. Cloud droplet number concentration during flights T1-T7.

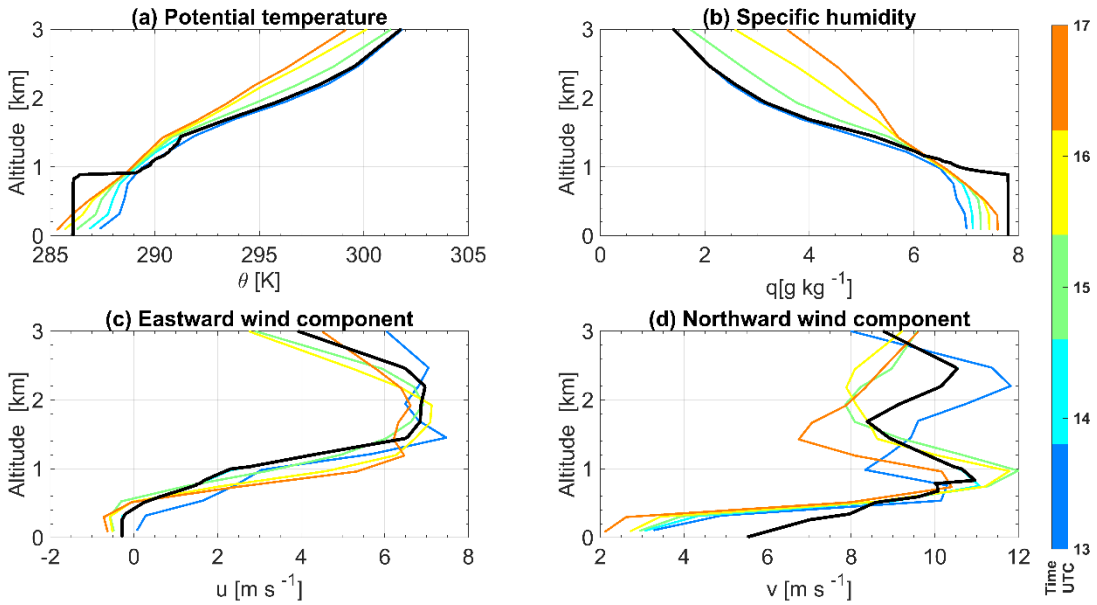
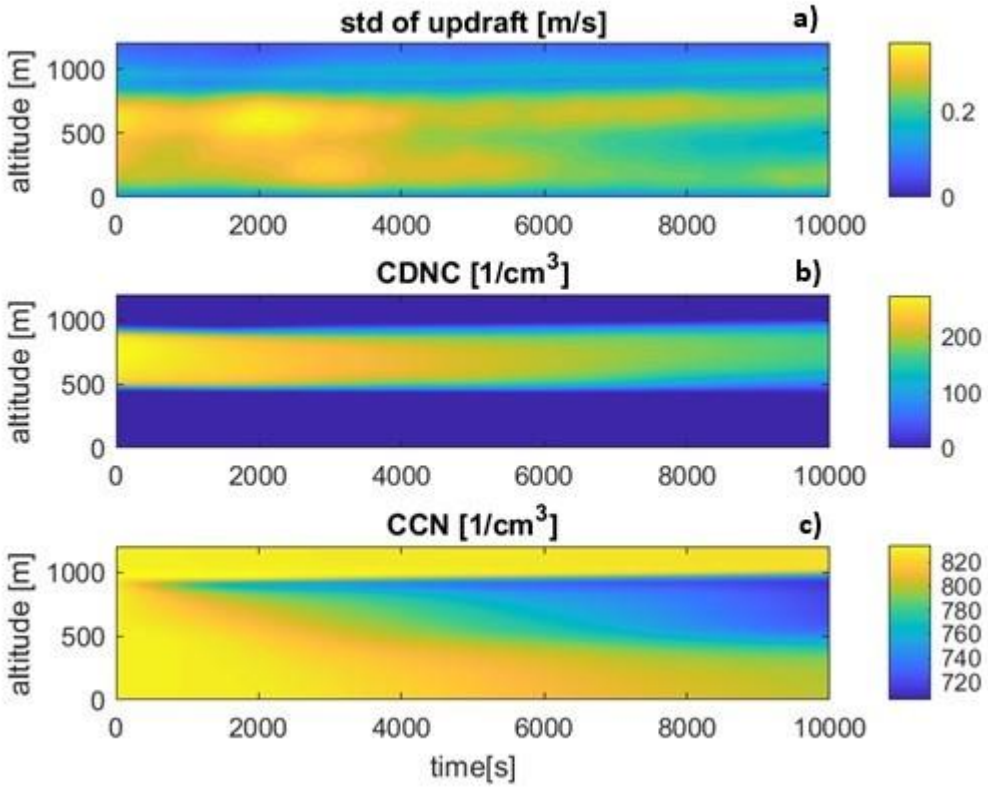


Figure S4. Vertical profiles of atmospheric variables used to define the initial thermodynamic state in UCLALES-SALSA simulations of the cloud case of 27 September 2025. Data derived from ECWMF-ERA 5 reanalyzed hourly data on pressure levels (Hersbach et al. 2023)



27

28 Figure S5. Average vertical profiles from UCLALES-SALSA simulations of the cloud case
29 of 27 September 2025. a) standard deviation of updraft velocity, b) cloud droplet
30 number concentration, c) concentration of aerosol particles (including the interstitial
31 particles from cloud droplets) with diameter larger than 50 micrometers.

UCLALES-SALSA simulations

The influence of the overlaying ice clouds was accounted for in calculations of radiative transfer including an ice layer of 100 gm^{-2} with vertically constant effective radius of 40 µm. Figure S4 shows the sounding profiles to define the initial atmospheric thermodynamic state. Aerosols particles are distributed over ten size bins from 3 nm to 10 µm in dry diameter, cloud droplets are assigned to the last seven aerosol bins depending on the activation diameter. Precipitation droplets are distributed over ten size bins with minimum diameter of 20 µm separated by a constant volume ratio of 2. The model was initialized with vertically constant aerosol loading comprising particles composed of pure organic carbon in a bimodal lognormal size distribution (geometric mean diameter of 0.058 µm and 0.178 µm; geometric standard deviation of 1.56 and 1.34; and total number concentration of 715 mg^{-1} and 143 mg^{-1}). The surface forcing was constant along the simulation time with sensible heat and latent heat fluxes of 5 Wm^{-2} and 20 Wm^{-2}, respectively.

DATA AVAILABILITY

The Cloudnet data used in this study are generated by the Aerosol, Clouds and Trace Gases Research Infrastructure (ACTRIS) and are available from the ACTRIS Data Centre using the links given in the references.

ACKNOWLEDGEMENTS

We acknowledge ACTRIS and Finnish Meteorological Institute for providing the data set which is available for download from https://cloudnet.fmi.fi. We acknowledge ECMWF for providing IFS model data.

REFERENCES

O'Connor, E.: Categorize data from Kenttärova on 13 September 2023, ACTRIS Cloud remote sensing data centre unit (CLU), https://hdl.handle.net/21.12132/1.926e86e1dda743f1, 2024a.

O'Connor, E.: Categorize data from Kenttärova on 27 September 2023. ACTRIS Cloud remote sensing data centre unit (CLU). https://hdl.handle.net/21.12132/1.d8daf091a8554971, 2024b.

O'Connor, E.: Categorize data from Kenttärova on 29 September 2023. ACTRIS Cloud remote sensing data centre unit (CLU). https://hdl.handle.net/21.12132/1.775e5abfe6ad4022, 2024c.