Geophysical Research Abstracts
Vol. 21, EGU2019-9637, 2019
EGU General Assembly 2019


# Thermodynamic phase transition analysis by cloud tracking

Quentin Coopman (1), Corinna Hoose (1), and Martin Stengel (2)

(1) Karlsruhe Institute of technology, Intitute of meteorology and climate research, Troposphere Research, Germany (quentin.coopman@kit.edu), (2) Deutscher Wetterdienst (DWD), offenbach, Germany (martin.stengel@dwd.de)

Clouds have an important impact on the Earth radiation budget and whether a cloud phase is ice or liquid has a strong impact on precipitation, latent heat release, and radiative properties. Unfortunately, factors which trigger the cloud phase transition from liquid to ice remain poorly understood and disagreements between the different theories persist.

From the CLoud property dAtAset using SEVIRI, edition 2 (CLAAS-2) dataset using measurements from the geostationary space-based instrument Spinning Enhanced Visible and Infrared Imager (SEVIRI), we develop a cloud-tracking algorithm in the aim to observe cloud phase transitions from liquid to ice with a time resolution of 15 minutes. We analyze more than 1000 cloud transitions above Europe from 2004 to 2015 during summers. Different cloud microphysical and radiative properties are retrieved by CLAAS-2 and we are able to associate cloud freezing temperatures with cloud vertical velocities, droplet effective radii, or cloud optical depth.

Our results analyze factors which influence cloud phase transition. We divide our results in two main sections: the evolution of cloud parameters over time and a focus on cloud freezing temperatures by defining different atmospheric regimes. For example, vertical velocity regimes are defined by values less or greater than $1.78\,\mathrm{m\,s^{-1}}$ and we find that clouds freeze at warmer temperature under strong updraft with a difference in freezing temperature of 12.2°C. Similarly, the cloud freezing temperature is warmer by about 9.9°C for liquid cloud droplet effective radius greater than 15.02 $\mu m$ compared to liquid cloud droplet effective radius less than 15.02 $\mu m$.

The different cloud parameters can be correlated with each other. For example, a strong updraft is more likely to be correlated with larger liquid cloud droplet. It is therefore difficult to disentangle the effect of meteorology and microphysics on the cloud phase transition. We propose a robust statistical method, which takes into account the correlation between the different parameters to explain and simplify the problem of cloud phase transition. Therefore, the problem of cloud phase transition is reduced to 3 main parameters, encompassing the variability of cloud phase temperature.