Community comment on “Continuous Remote Sensing Observations of Hydrometeor Sedimentation Evolution during the Transition from Ice Cloud to Precipitating Mixed-Phase Cloud” by Yuan et al.

Dear Yuan et al.,

When I stumbled upon this preprint I immediately got intrigued by the title mentioning hydrometeor evolution observed by remote sensing. I enjoyed reading the analysis on the observed case of ice and mixed-phase clouds and the application of the methodology of HIS. Nevertheless, there are a few concerns I have regarding the framing of the results and its implications. Some minor comments and suggestions are listed below.

Deriving rates of change for cloud properties from vertically pointing radar observations remains limited. Due to the advection of clouds, they are only measured once, and the same part of the cloud never returns into the radar beam. Therefore, changes in cloud or precipitation characteristics are attributed to advection, rather than evolution. Process rates derived from vertically pointing observations are ambiguous. They can result from the temporal evolution of one homogeneous cloud experiencing the same homogeneous influences or from the advection of another part of the cloud. This ambiguity constrains the interpretability of changes observed within Eulerian observations. Even though the manuscript addresses this, as the wording in sect. 3.1 (e.g. P9 l 3f), sect. 3.2 and 3.3 (p11 l.18) show, the discrimination between advected hydrometeor types and hydrometeor changes resulting from a hydrometeor evolution should be further emphasized. More discussion on how spatial and temporal evolution is disentangled and where it remains ambiguous would improve the strength of this study. For example, in section 3.3 and 3.5, the wording gives the impression of a stationary cloud that develops over time: “the cloud entered the persistent mixed-phase stage…” (p16, l26) meanwhile, it is rather: “A persistent mixed-phase cloud entered the scenery/area of observation.”

The step from temporally observed changes of the cloud to hydrometeor evolution are not fully clear to me. In this study the microphysical phase of the hydrometeors is ice in the beginning then liquid after the transition. A stationary cloud developing downwards would only melt at the 0°C-isotherm, but not at negative temperatures. So, the mixed-phase cloud cannot develop from the previous ice cloud under these conditions. Consequently, this new cloud layer formed through a different mechanism and was advected over the field site. This implies that different hydrometeors or hydrometeor populations are observed during the case study, instead of observing a hydrometeor evolution itself.

Minor comments:

- For an improved understanding of the large-scale conditions, ERA5 reanalysis data of moisture, humidity, vertical motion and circulation planes is shown for different altitudes and times. For a better comprehension of the relation between the ERA5 data and the observed remote sensing data it would help to roughly indicate the altitude of the pressure levels as well.
- In the large-scale conditions, focus more on the moisture and humidity in altitudes, where the remote sensing instruments observed the cloud layers. At the moment the moisture and humidity of the lower troposphere (750hPh ~ 2.5km amsl and 850hPa ~ 1.5km amsl) is presented including the wind field in these heights indicating little advection only. However, in the analysis of the radar reveals cloud layers in altitudes of 8-10 km from 19 to 23 CST and 5-8 km from 00:30 to 08:00 CST. For a clearer indication of the strength of advection, I suggest to also analyze the moisture and humidity and wind field for these altitudes as well.
- In this case study during the transition period: Hydrometeors are falling with 1.5 to 3m/s (= 5.4 to 10.8 km/h) and the cloud base lowered from 7km at 23:25CST to 5km at 00:10CST which gives a height difference of 2km within 45 minutes. The lowering of the cloud base is therefore less, than sedimentation fall speed suggests. Could you discuss on the role of sedimentation here, and expectations on the contribution of precipitation on the echo base lowering?
- Usually microwave radiometers are not reliable under rainy conditions. Therefore, LWP should not be used when precipitation reaches the ground.
- The selected period of this case study extends beyond one day- or nighttime. Please discuss the effect of solar radiation on the cloud and its relevance for the hydrometeor evolution.