

General comments:

The present paper combined ground-based and spaceborne lidar observations to detect cloud-aerosol transition zones across Europe and evaluate the strengths/limitations of these instrument capabilities. The authors found an overall consistency for cloud classification between ground-based and spaceborne observations except for some differences in aerosol and transition zone detections due to instrument capability.

Overall, the manuscript is well-written and scientifically engaging for the aerosol-cloud society and within the scope of ACP. The comparison between ground-based ALC and CALIOP observations is useful for understanding the complementary capabilities of these two observing systems. The case studies are also interesting and clearly demonstrate the differences in cloud, aerosol, and transition-zone detection between the two instruments.

I suggest publishing the manuscript in ACPD. I have some minor comments that I believe could further improve the manuscript, mainly related to the interpretation of TZ detection and the comparison between the two observing systems. Some additional discussion would be helpful.

Specific comments:

1. Definition of the transition zone

The definition of the transition zone (TZ) is an important part of this study. The TZ identified from ground-based ALC and CALIOP observations is based on different criteria. The ALC TZ is mainly determined using backscatter/SNR thresholds, while the CALIOP TZ is related to the CAD classification and other optical properties. I suggest the authors add a short discussion to clarify that the TZ detected by the two instruments may not represent exactly the same physical atmospheric condition. Some of the detected TZ may also be related to weak cloud, hydrated aerosol, cloud fragments, or classification uncertainty.

2. CALIOP filtering and TZ frequency (Results 3.1)

The manuscript shows that a relatively large fraction of potential CALIOP TZ layers are removed by the applied quality-control and filtering criteria. This is an important point for interpreting the reported TZ frequency. I suggest the authors discuss more clearly that the final CALIOP TZ frequency should be considered a conservative estimate based on the applied quality-control criteria. If possible, it would also be helpful to briefly show or discuss how the TZ frequency changes before and after the main filtering steps.

3. Comparison of TZ frequencies between ALC and CALIOP (Sec. 3.2)

The manuscript reports differences in TZ frequency between ground-based ALC and CALIOP observations. These differences are interesting and are likely related to the different characteristics of the two observing systems. However, in addition to instrument sensitivity, the differences may also be influenced by spatial sampling, temporal sampling, vertical resolution, viewing geometry, and the different TZ classification methods. The authors could add some sentences for these caveats.

Minor comments:

1. It would be useful to provide the number of observations used for each station together with the reported percentages (Sec. 3.2).