Reply to referees:

First of all, we would like to thank the referees for their efforts. The comments and questions have been very helpful and will certainly improve the manuscript.

Find below the Reviewer comments, followed by **the author's response in bold.**
Whenever needed and suitable "c*hanges in the Manuscript are explicitly shown below the response in italic"*

Most Figures have been redesigned for a better readability without changing the content!

Referee 2:

1) P6. Line 174-180, "For that reason ~~~ Baars et al. 2016". What does the term "hybrid approach" mean?

As non-native speakers, we probably misused the term "hybrid". We have changed the comment accordingly (see below).

- Do you use particle backscatter coefficients derived from Raman lidar measurements for nighttime data and derived by Klett-Fernald method for daytime data to evaluate particle extinction coefficients by multiplying the assumed lidar ratio of 55sr?

Yes, this is exactly what we mean. We have made this clear in the text, see new text below.

- Readers needs more explanation to understand this part.

Thanks for the suggestions. We rephrased the paragraph to make it more clear.

*"For that reason and because the particle extinction coefficient derived with the Raman method is only available during night time, we introduced a **2-step approach** to estimate the particulate transmission needed to solve Eq. 2. First, we calculate the particle extinction coefficient profile derived from the particle backscatter coefficient profile **(Raman or Klett - depending on time of day)** multiplied with a constant lidar ratio of 55 sr as a good compromise of the lidar ratio values observed during HOPE and at other European continental sites…."*

2) Figure 1. It seems that the variation of the 1064nm lidar system parameter is larger than the calibration constants at 355nm and 532nm. What is the cause on this larger variation?

In fact, the relative variation is the same, but it looks stronger in Fig.1 due to the scaling….we add a sentence in the text to clarify that!

"*The relative change of the lidar system parameter is similar for all three wavelengths, even though it looks different in Fig. 1 due to the scaling applied.**"***

5) Regarding to question 1), when you derive the 1064nm lidar system parameter, how do you evaluate the backscatter coefficients at 1064nm? If you use Klett- Fernald method, how you assume the boundary condition (can you find aerosol free layer for the 1064nm data) ?

The backscatter coefficients are determined as described in Baars, ACP, 2016,"PollyNET - …" as stated in the manuscript: We use a Rayleigh fit procedure to obtain atmospheric regions of almost pure molecular scattering which are then used as reference height. Then, the backscatter coefficient is calculated with a reference value of 1e-6 km^-1 sr^-1 with either the Klett-Fernald method or the Raman method (using 607 nm signal) depending on the SNR in the 607 nm channel. In Polly systems, photon counting is used to detect the 1064 nm signal, which allows us in most cases to detect the weak molecular contribution at this wavelength. However, this is not always possible and as result a slightly lower number of backscatter profiles at 1064 nm compared to 532 and 355 nm are obtained.

3) Figure 5 It may be difficult to distinguish each line by difference of only color. It would be better to use solid, dashed, and dotted lines with color difference.

We have redesigned this Figure according to your suggestions and furthermore have applied a 5-bin vertical smoothing which significantly increased the readability.

4) Figure 6 "Aerosol typing" is connected with "untyped aerosol/low concentration" by line.

You are right, this is confusing. We have corrected this.

5) p20 Line483, "Therefore, we conclude ~~~simultaneously". It is difficult to "con- clude" because there is no evidence to prove that ice and supercooled drops, and large, spherical aerosols coexisted though the lidar and radar measurements indicate the possibility of their co-exsistence as you suggest.

See response below.

6) P21 Line 526 "identifies large aerosol ~~~ evaporation" The target categorization of CloudNet and the lidar derived target categorization seem to indicate the coexistence of drizzle particle and large, spherical aerosol particles (evapolated drizzle particle) in the area, however, one can suggest that this lidar derived target categorization fails and identifies drizzle (or rain) particles as aerosol particles though you commented in this paper that the categorization of drizzle or rain was beyond scope. I recommend you to mention (or discuss) about possibility of identification (categorization) of drizzle particles using lidar data to make clear the performance and limitation of this target categorization method.

As also requested by the first referee, we state now that a coexistence of this type of scattereres is in principle possible and very likely in this case. Therefore, we present theoretical evidence combined with observed values. To make this topic clear, we have added a completely new discussion for the 4 April case and added a new Figure showing the simulations:

"This example shows the different sensitivity concerning particle size and thus the potential synergy between the lidar- and radar-based classifications. While the lidar is more sensitive to the numerous but comparably small aerosol particles, the radar is most sensitive to the few but large precipitation particles. If we assume a Marshall-Palmer rain droplet number size distribution (Marshall and Palmer, 1948), we can estimate the light extinction of the drizzle in dependence of the rain rate as shown in Fig. 11. For low rain rates, which have occurred in the case of 4 April 2013 because no precipitation reached the ground, extinction coefficients

well below typical aerosol values are calculated. Aerosol extinction in the PBL was about 150 to 200 Mm^-1 throughout the observation time in the case presented here. At a height of 1.5 km, which is 250 m below the cloud base, extinction coefficients of about 100 Mm^-1 were observed at 4 UTC. When no clouds were present at 1 UTC, they were 35 to 50 Mm^-1 at this height. Thus, if one considers hygroscopic growth, one can conclude that the lidar signal was dominated by aerosol instead of the few drizzle droplets even though they also contributed to the lidar return. On the other hand, as the radar is sensitive to the sixth power of the diameter of the scatterers (while the lidar is to the power of 2), it is sensitive to the few but large precipitation droplets. Therefore, the Cloudnet classification defines the region of interest to contain ice and supercooled drops and ice only - putting the priority on the cloud-sensitive radar observations. Given the added value of the multiwavelength lidar aerosol classification, we can however conclude that between 3 and 10 UTC all detected features, i.e., large, spherical aerosol particles and ice and supercooled drops were present simultaneously, even though the full instrument synergy of the here presented instruments is still a current research topic."

New Figure: