Title: Retrieval of aerosol backscatter and extinction from airborne coherent Doppler wind lidar measurements.

Authors: Chouza, Reitebuch, Gross, Rahm, Freudenthaler, Toledanop, Weinzierl.

General comment:
Doppler lidars are now commercially available from several companies. They have reached a good TRL and are deployed in numbers for wind speed observations. Although they were not designed for aerosol measurements, they produce information on the aerosol content of the atmosphere through the power of the detected signals. This information has already been used in several studies (see references in the paper), but the results were only qualitative as the wavelength used by coherent Doppler lidars is in the near IR where the backscatter from molecules is negligible and cannot be used as a known, reference target for calibration purposes. There is no well-established calibration technique for lidars operating in the SWIR. The technique proposed by O'Connor *et al*. is for ceilometers operating in the NIR, kts applicability to the SWIR is not guaranteed. Although it is complex and requires the combination of several instruments and the assumption of some horizontal homogeneity in the aerosol content in the atmosphere, the method proposed in the article is thus of great scientific interest. Of great interest also is the detailed study of all the technical aspects of the coherent lidar that have an impact on the power of detected signals. Some of them are well-know –the heterodyne efficiency for instance – others are not so well-known and the approach proposed in the article for characterizing them is of great value.

The article is well written, concise and clear. It deserves publication. However, details and justifications are missing here and there (see below). A minor revision would improve the article.

Specific comments:
- Page 1940, line 25: the letter L used here for designating the line-of-sight of the lidar is also used for the atmospheric layers later in the document. Two different letters would facilitate the reading of the article.
- Page 1941, line 17: the equation linking f_D and v_{los} (the Doppler equation) has no minus sign. The usual practice for lidars is to count v_{los} positive when the wind is blowing away from the lidar. In that case, there is a minus sign. The authors should clarify which sign convention is used here for v_{los}.
- Page 1944, line 10: the value of K should be given as the width of the rectangular window used for estimating $\langle P(R) \rangle$ from the $\langle \widehat{P(R,k)} \rangle$ may have an impact on the quality of the estimation. The width must be large enough so the entire return spectrum is inside the window.
- Page 1945, lines 4-5: considering equation (9), one can easily see that the heterodyne efficiency varies significantly in the range domain covered by the airborne lidar (see figure below). The argument that "no effects produced by the range dependency of the heterodyne efficiency were observed in the received atmospheric signal" shall be more elaborated. How the authors did come to this conclusion? Why not just correct lidar signals from the range dependence of the heterodyne efficiency with eq. (9)?
- Page 1946, line 11: To me, the overlap is contained in the heterodyne efficiency. I do think it should be mentioned here.
- Page 1955, lines 6-8: the authors should explain a little bit more how the different aerosol layers were determined from POLIS data? If it is a manual determination, they

should clearly say it. If there is a chance this separation between different layers can be automated, they should write it. In practice, the need to distinguish the aerosol layers could be a strong limit for the proposed method.

- Page 1955, lines 19-22: From figure 12 and table 3, it is not obvious that different values shall be considered for the aerosol layers. Did the authors tried to use a single value? What were the consequences on the result? If it happens that a single value can be considered, it is a good news for it facilitates the practical use of the method.
- Page 1966, table 3: the units of μ and σ should be given.