The paper presents and discusses a polarization-lidar technique to determine cloud microphysical parameters under subadiabatic conditions from dual field-of-view depolarization measurements. The method builds on a long tradition of multiple field-of-view lidar techniques for cloud studies that are cited in the bibliography. The authors claim that the method proposed in this paper combines both a relative simplicity and the use of strong signals (volume linear depolarization ratios), the latter allowing high time resolution in day and night conditions, which in turn makes it possible to track cloud-aerosol interaction dynamics.

The proposed technique relies on a simplified multiple scattering model that is tested by comparing its results against a more complex model and to observations supported by a sophisticated model. With the proposed technique, the droplet effective radius is first determined at a reference distance from the bottom of the cloud using the ratio of depolarization ratios at an outer (wide) and an inner (narrow) receiver field of view. Then the cloud extinction coefficient is derived from the droplet effective radius found in the previous step and the measured volume depolarization ratio at the inner field of view. Subadiabatic condition in the lowest part of the cloud are assumed to retrieve droplet number concentration and the liquid water content profile from the cloud base.

The paper – the first of a series of two, the second one presenting the results of case studies using the technique discussed in this one – is well and clearly written, and it supports convincingly the originality and the potential practicability of the method, which is supposed to be demonstrated with the case studies to be presented in the second paper of the series. I would only suggest some minor additions and modifications:

1. The final pair of field of views proposed by the authors seem to be 1 mrad and 2 mrad. The authors also state that, after performing simulations, with different fields of view (FOV), "the highest sensitivity (optimum pair of FOVs) is given for the case with the highest FOV_{out}-to-FOV_{in} ratio". While it can be understood that the maximum FOV (FOV_{out}) may be limited for the sake of exploring a horizontally homogenous zone of the cloud, one would expect more explanations on the reason why FOV_{in} is chosen as 1 mrad, and not a smaller value. The term "optimum" in the quoted sentence (line 28, page 11) is perhaps not accurate in this case. In my understanding and optimum pair would mean that every other pair shows worse performance, which I'm not sure is what the authors mean.
2. The authors also state that their "data analysis scheme [] will deliver the cloud microphysical products for height z_{ref} that is 50–100 m above cloud base height z_{bot}" (lines 28-29, page 9). However in the later analysis they choose z_{ref} = 75 m. Some explanation on the considerations for this choice would also be helpful.
3. I would suggest that the explanation on the polynomial fitting to the simulations of $R_e(z_{ref})$ as a function of $\overline{\delta}_{rat}$ in the caption of fig 7 is moved to or repeated in the main text.
4. In line 14 of page 11, the authors say that the "striking feature in Fig. 5 is the clear dependence of the droplet effective radius $R_e(z_{ref})$ on δ_{in}/δ_{out}". While from the formal point of view this is correct, I think it would be more "physical" to say that it is δ_{in}/δ_{out} what depends on $R_e(z_{ref})$.

5. I found the last two sentences of section 7 (Summary) ("The field site of Punta Arenas..., etc.") somewhat misplaced. Earlier in the paragraph, the authors already explain that the technique introduced is being used in a field campaign in Punta Arenas. If the quoted sentences are intended to highlight the interest of the campaign, I think it would be better placed right after the first mention to the campaign.

6. The function $n(r)$, the radius distribution function of droplet number concentration, used in Eq. (1) and subsequent equations, is never defined. Although its meaning is clear, I would strongly suggest to define it.

Other <u>minor remarks</u> follow:

1. Page 2, line 6: "the become cloud droplets" should probably be "to become cloud droplets".

2. Page 2, line 29: "was however". Do the authors mean "was therefore"?

3. In page 5, line 18, the cloud extinction coefficient and the droplet effective radius are called observables: "In the next sections, we evaluate the possibilities of retrieving information about these two observable parameters". It's perhaps a matter of definition and context, but, in the paper context, can a parameter be called an observable parameter when the retrieval of information on it from cloud depolarization measurements is under evaluation? In the paper context, the observables are, in my opinion, the depolarization ratios. Admittedly, this is a debatable issue and I don't absolutely oppose to the use of observable, in the sense of a physical quantity that can be measured, applied to the cloud extinction coefficient and the droplet effective radius; I wish just to make aware the authors of a possible overuse of the term.

4. Page 5, lines 26-27: "rotations of the polarization plane of the laser pulse will occur". It would probably be more accurate to write "rotations of the polarization plane with respect to that of the laser pulse will occur".

5. Page 6, line 23: "can not" should probably be "cannot".

6. Page 7, line 22: "After presenting the principle relationship". Do the authors mean "principle" or "principal"?

7. The paragraph after Eq. (12) defining the parameters appearing in Eqs. (10) and (11), should probably better placed right after Eq. (11).

8. Page 8, lines 18-19: "second mirror" should probably be "secondary mirror.

9. Page 9, line 19: "well describes". Probably "describes well" is a better construction.

10. Page 9, line 29: "for height z_{ref} that is 50–100 m above cloud base height z_{bot}". I would suggest "for a height z_{ref} that is 50–100 m above the cloud base height z_{bot}"

11. The pass from Eq. (21) to Eq. (24) is straightforward. The intermediate equations could probably be dropped without impairing the manuscript intelligibility.

12. Page 11, line 1: “The profile of $\alpha(z)$ is shown in Fig. 4 as well”. I would say that the profile of $\alpha(z)$ is sketched, rather than shown, in Fig. 4.

13. Page 12, paragraph starting in line 10. It should be made clear that the references to Fig. 7 are more specifically to Fig. 7a.

14. Page 13, line 11 “we conclude that” is repeated (already said in the preceding line).

15. Page 13, last line: “POortable” should probably be “POrtable”.

16. Page 14, line 29: “The parameterization hold” should be “The parameterization holds”