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Atmospheric Measurement Techniques Discussions
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Interactive comment on "Optical and Geometrical Properties of Cirrus Clouds over the Tibetan Plateau Measured by Lidar and Radiosonde Sounding at the Summertime in 2014" *by* Guangyao Dai et al.

Anonymous Referee #2

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General remarks

The paper presents Raman lidar and radiosonde measurements of cirrus clouds over the Tibetan Plateau during the time from July to August 2014. The instrumentation, calibration and data processing methods are outlined and the derived cloud properties are discussed. Specifically, cloud geometric properties, depolarization ratio, extinction ratio, and temperature are presented. Furthermore the relationship between these cloud properties and radiative properties as well as temperature is examined. In this work, already documented and established methods and instrumentation is used, to

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Discussion paper

gather information on relevant cirrus properties in a region that, according to the authors, has not been investigated with ground-based lidar before. Field campaigns like this help to broaden our knowledge on cirrus around the globe and its results are well worth publishing. However, AMT is “dedicated to the publication and discussion of advances in remote sensing, as well as in situ and laboratory measurement techniques”. As this paper does not involve new instrumentation or methods of data analysis, the submission at another journal is recommended.

Before publication, major revisions are needed. To make this work beneficial for the community, the authors should focus more on what the distinct features of cirrus clouds over the Tibetan Plateau at the specific time of measurement are, compared to other regions and seasons. When in chapter 3.3 the dependence of depolarization ratio on cloud middle temperature is presented, only the behavior of an ill-motivated fitting curve is discussed. But in parts, the data shows huge variability that seems to contradict the general remarks on the fitting curve (see specific remarks also). These up to now unmentioned deviations should be examined and discussed in more detail. Also the suggested interplay of Rossby waves and cloud appearance in chapter 3.4 seems to be very promising. But this section consists mostly of the presentation of measurements and a bold statement about the convective origin of the measured clouds, without references and sufficient back up from the data. Here a more thoroughly investigation and discussion is needed. The authors should avoid the excessive enumeration of measured and derived values in the abstract, in chapter 3, and in the summary (a table might help). This distracts the reader and after all, these numbers might not be generally valid due to the comparably short measurement period. Rather, more effort on drawing clearer conclusions on the distinguishing features should be made.

Following these remarks, I do not recommend the publication in AMT. After a revision, I would like to highly encourage the authors to submit their manuscript at a less technique-oriented and more science-oriented journal.

Specific remarks

1.: p.5, l.8: “cirrus occurred almost at nighttime and before dawn” What do you mean here? “Almost allways at nighttime and before dawn” or shortly before nighttime (almost nighttime)? Maybe give also the local time to make things clearer.

2.: p.5, l.9: “more conductive “ than what? Why is occurrence at night conductive for your measurement? How many radio sondes were launched? When were they launched? Regularly or only when cirrus was there? How many hours between soundings? Maybe put that information in chap. 1.2 already.

3.: p.6, l.19: “S is assumed as a constant and independent of the range”, How is it justified and what consequences does that have for the derived ext. coeff.?

4.: p.8, l.16: How is the opt. depth derived? Which assumptions do you make on particle size? How do the assumptions influence the retrieved variable?

5.: p.8, l.23: Radiosondes are launched twice a day. There are up to 6 hours between launch and lidar measurements. How does this affect the analysis of data?

6.: p.9, l.6: “there are two cirrus clouds layers were observed” -> “two cirrus cloud layers were observed”

7.: p.9, l.8: “For instant” -> “For instance”? Why do you choose this case?

8.: p.10, l.4: “Fig 3(a) shows the cirrus cloud structure. . .” it would be better to write “shows the horizontal extent of cirrus”

9.: p.10, l.5: “makes the details of cirrus clouds, much clearer.” Which details do you mean? It is actually less detailed than Fig 2. Also, do not say “it makes thinks much clearer.” Why even include Fig 3a)? It is not discussed in the text anymore and is redundant with Fig. 9. Just leave it out.

10.: p.10, l.5: “fluctuation”, what is this? Please clarify.

11.: p.10, l.15: I see a skewed distribution but not a skewed normal distribution.

12.: p.11, l.1-7: “Several investigations on the statistics of cirrus clouds have been accomplished. . .” First present your results than put them in perspective to earlier findings.

13.: p.11, l.16: “statistical uncertainty”, what do you mean? Please clarify.

14.: p.11, l.16: “fitting curves” Why choose this type of curve?

15.: p.11, l.21: “We propose that with the decrease of temperature. . . of the cirrus clouds” This might be correct generally (on a climatological view) but this idea is already well established. More interesting would be to know why at -68°C you only have 0.37 and at -55°C you have up to 0.55. How could these “anomalies” depend on specific influences at this site, season and weather?

16.: p.11, l.24: “. . . lower altitude is much more sensitive to the ambient temperature.” Your data base is rather small, can you really back up this statement confidently with your data, especially given the fact that there are huge fluctuations in data colder than -50°C?

17.: p.11, l.24: “Under the condition of low temperature, since the existence of the stability of the larger cirrus particle radius,...” What do you mean here (A particle radius cannot be stable or unstable)? Do you want to say that at cold temperatures, particles are bigger and therefore depolarization ratio is not changing with temperature anymore? How do you support that statement (references)? Why should particles be bigger at lower temp, where less water vapor is accessible?

18.: p.12, l.3: “stat. uncertainty” What is that exactly? Would it be better to show e.g. 10th and 90th percentiles of data at that temperature?

19.: p.12, l.15: “. . . stability of the larger cirrus particle radius. . .” again what do you mean? Please clarify and back up with references.

20.: p.12, l.19: “temperature anomalies”, how are they calculated? Temperature deviation from what?

21.: p.12, l.22: “less than 1,5 km above tropopause” Is this due to the time between cirrus measurement and temperature measurement? Or due to measurement uncertainties? Please comment on that. Also, might it be possible for cirrus to occur above the tropopause?

22.: p.13, l.2: add the height information: “the temperatures from 5 to 11 km, were higher. . .”

23.: p.13, l.3: You indicate that cirrus formation may be related to deep convective activity. Would lower liquid clouds be a common feature in that case? How would that influence your record of cirrus occurrence? I suspect that blocking of the lidar by the liquid clouds could be a problem. Please comment on that.

24.: p.13, l.8-11: “Considering the inherent characteristics of strong local heating . . . to the formation of cirrus clouds.” This is a very interesting point but up to now it is only a statement. I think it might be worthwhile investigating this in more detail. Provide references, check the connection with Rosby waves from other sources such as satellite data. What kinds of clouds are measured here? Are they convective outflow cirrus from farther away? Do they form directly in the convection above the lidar? How does the radiative exchange between cold anomaly at the tropopause and lower layers work to start deep convection?

25.: p.13, l.12-22: This section about radiative properties could be put into context of the above stated “deep-convection-theory”. Do the cirrus clouds influence the start and stop of deep convection? The particle size is modelled, how do the used assumptions influence the result?

26.: p.14, l.15-21: Consider putting this section (with Fig. 11) into the main body of this work, before the summary.

27.: Figure 9: Please use a diverging colormap with only three color hues, e.g. “red-white-blue” (http://colorbrewer2.org/#type=diverging&scheme=RdBu&n=11)

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