

Interactive comment on “Comparing the cloud vertical structure derived from several methods based on measured atmospheric profiles and active surface measurements” by M. Costa-Surós et al.

Anonymous Referee #2

Received and published: 23 August 2013

Review of the article titled “Comparing cloud vertical structure derived from several methods based on the measured atmospheric profiles and active remote sensors” by Costa-Surós and coauthors for publication in the Atmospheric Chemistry Physics. The authors have used data from the ARM SGP site in Oklahoma to deduce cloud vertical structure using the balloon borne radiosondes and active remote sensors like cloud radar and lidar. They have also used data from the GOES to characterize the cloud structure. The study compares different techniques proposed in the past literature to deduce cloud layers from the radiosonde data among each other and to that observed

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by the ground based active remote sensors and satellite data. They also propose modification to one of the technique so as to be comparable to the Global Climate Model (GCM) resolution. Although the idea of comparing the different techniques and observations for detecting cloud layers is innovative, the article fails to do detailed analysis of the reasons of the poor performance of the techniques or observations. Hence I recommend this article for publication with major revisions.

Major Comments:

1) Radiosondes are launched at the ARM SGP site four times a day. Out of the data from the entire year (~1460 sondes), you've only used 125 soundings. This is a major drawback of the study. I highly recommend the authors to use as many soundings as possible in their study. This will make the statistics robust, as currently you have low number of samples. Also, the way cases have been selected is a little confusing; it almost seems that there is no objective way the soundings have been selected.

2) Page 14421 line 1-5: you've plotted the sounding on the ARSCL recorded cloud boundaries. The plots are shown in Fig 2-5. Although this is a good approach to start, it is not scientific. I recommend you plot the relative humidity on the upper x-axis by converting the distance to time using the wind speeds at various heights. This will be a significant improvement to the paper. This will also address the cloud in-homogeneity issue.

3) Panels in Fig 6 should be added to the respective case they are referring to. It is ok, to only show one snapshot of the Total Sky Imager. So you can have four panels for all the figures from 2-5. Another idea, since this is an online publication, would be to completely remove the TSI images from figures 2-5 and then make animated GIF loops of the TSI images for each day out of the example cases. The single TSI images next to the current figures do not add much to the paper.

4) In the second of the four example cases, you used a radiosonde launch from night-time, when no visible satellite data or TSI image is available. The lack of this data

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is detrimental to your study because part of your method involves checking for cloud homogeneity of the surrounding area and that cannot be applied for this case. A much better example case for low clouds would be a case during the daytime hours, much like the other three example cases.

5) While you argue that you have been able to visibly check for cloud homogeneity in the surrounding area by looking at both the visible and infrared imaged from the GOES satellite (in order to compare ARSCL data and radiosonde data), I am not quite convinced that this method is scientifically solid, especially since the median displacement distance of the radiosonde from the launch site is very large (79 km!!). How have you taken into account secondary (and tertiary, etc) cloud layers that exist below the uppermost layer?

6) Page 14410, line 20: Please explain why there is a need to lower the resolution of the technique designed to retrieve the cloud vertical structure from the radiosonde data. The temperature and moisture profiles simulated by GCM and the cloud layer profile from the GCM are related to each other in a much more complex way than any of the listed retrieval technique. The cloud vertical structure retrieved from the GCM simulated temperature and moisture profiles, is not comparable to the GCM simulated cloud structure as the simulated cloud structure depends on the parameterization used which are fairly complex.

7) I believe that your equation for Total Agreement (where Total Agreement = Perfect Agreement + Approximate Agreement) is flawed. Approximate agreement should not be given the same weight as Perfect Agreement since a case can have approximate agreement even though the majority of the cloud vertical structure was wrongly identified, so long as one layer was correctly identified. To make your results more robust, it would be helpful to create a weighted equation for Total Agreement, so that Perfect Agreement carries more weight than Approximate Agreement. In doing this, your results should change, and it should become more apparent which method is correct MOST of the time (and which method correctly identifies the most cloud layers), rather

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than which methods identify at least one cloud layer correctly.

An additional idea would be break down Approximate Agreement into different categories (where each category has its own weight in the equation of Total Agreement), where one category could be a method that correctly identifies at least 25% of the cloud layers, another category could be a method that correctly identifies 50% of the cloud layers, and another category could be a method that correctly identifies 75% of the cloud layers.

8) It would be helpful if an additional figure were added to the paper that showed a time distribution of the radiosonde data that was used. So please plot the time in months on the x-axis and the number of radiosondes used from that months on the y-axis for the year 2009.

9) The article contains several grammatical mistakes. Also the writing style can be improved to help the general flow of the article. I highly recommend the authors to give the article a thorough read to correct the grammatical mistakes and improve the writing. Several of the grammatical mistakes are pointed out as minor comments below. Thanks.

Minor Comments:

1) Reference to Mather and Voyles (2012 BAMS) should be added as it has thorough description of the instrumentation at the ARM sites.

2) The classification used for low, middle and high clouds seems arbitrary; please follow the convention used by ISCCP. <http://isccp.giss.nasa.gov/cloudtypes.html>

3) Table 5 lists the seasonal value of agreement between different techniques in percent. Similar to Table 4, please also mention the number of sondes. Also, please mention the months rather than the seasons.

4) Page 14409, line 1 and also elsewhere: The word is ceilometer and not ceilometerS. Thanks.

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- 5) Page 14407, line 1-5: The high level cirrus cloud warm the surface because they are transparent to the shortwave radiation but opaque to the longwave radiation.
- 6) Page 14407, line 8-11: Your sentence beginning with "Moreover, Crewell et al. (2004)..." is worded in a very confusing way. Please change the sentence
- 7) Page 14409, line 15-16: Your sentence beginning with "Some of them add conditions..." is poorly written.
- 8) Page 14409, line 27: "They concluded that the Wang and Rossow (1995) method..."
- 9) Page 14410, line 4: It is Wang instead of Wand.
- 10) Page 14410, line 5: "every radiosonde instrument..." NOT instruments
- 11) Page 14410, line 9: "radiosonde" NOT radiosondeS
- 12) Page 14411, line 16-18: In your sentence beginning: "The greatest strength...", add the word 'it': "...but it may miss some..."
- 13) Page 14411, line 18-20: Your sentence beginning, "Yet the detection..." is a fragment.
- 13) Page 14412, line 13: "ascend" not ascent
- 14) Page 14412, line 18-20: Your sentence beginning, "The used profiles..." should be edited as follows: "...as a result of taking measurements every 2 s and having an ascent rate in the range of..."
- 15) Page 14413, line 8-9: "Considering these...crossed by the RS..."
- 16) Page 14415, line 21-22: Your sentence beginning "The WR95 method..." should read: "...by comparing cloud properties..."
- 17) Page 14415, line 23-24: Your sentence beginning, "The Radiosonde data..." is not properly formatted and does not make sense.

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- 18) Page 14416, line 26-28: Your sentence beginning, "For this reason...", should read: "...resolution to approximately the same..."
- 19) Page 14420, line 12-13: Your sentence beginning, "Then, the next step..." should read: "...of the six methods described above..."
- 20) Page 14421, line 12: The sentence should read: "Thus, Figs 2 to 5 are composed of..."
- 21) Page 14421, line 24: The sentence should read: "...every 3 km in height..."
- 22) Page 14423, line 27: The sentence should read: "According to the results..."
- 23) Page 14424, line 16: The sentence should read: "...than actually in existence..."
- 24) Page 14425, line 14: Please add a comma in this sentence (after 'method'): "...approximately double that for any other method, indicating that this..."
- 25) Page 14425, line 21: The sentence should read: "...across the year."
- 26) Page 14429, line 6-7: The sentence should read: "...in order to assure the homogeneity of the cloud field in the region, so that a suitable comparison can be made, GOES images..."

Interactive comment on Atmos. Chem. Phys. Discuss., 13, 14405, 2013.

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