Atmospheric
Chemistry
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Discussions

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Interactive comment on "Properties of biomass burning aerosol mixtures derived at fine temporal and spatial scales from Raman lidar measurements: Part I optical properties" *by* Lucja Janicka and Iwona S. Stachlewska

Anonymous Referee #1

Received and published: 19 April 2019

The paper by Janicka and Stachlewska discusses the optical properties of biomass burning aerosol during a heat wave event over Warsaw. The study employs a multi-wavelength Raman lidar and model simulations to identify and characterize the different biomass burning layers. The results constitute an interesting database of biomass burning particles as well as mixtures over Eastern Europe. In many parts, the paper is worded poorly and some important aspects are not fully covered, hence there is lack of clarity in the presentation. I suggest that the English must be improved. I have several technical comments addressing this. The paper is not yet suitable for

publication in ACP unless some major issues are addressed.

Firstly, important and minor revisions are given for consideration in Major and Minor Specific Comments. Secondly, I tried to give Technical Comments although it was impossible to include all of them. Pg1Ln1 means line 1 of page 1.

Major Specific Comments

Pg1Ln11: What is a sub-layer? I think in the abstract this term is confusing.

§3: It would be nice to see some discussion on how you retrieve the 'sub-layer' along with an example. Similarly, you should discuss in detail the aerosol typing process. It is not clear to me what information you use to make your aerosol mask. I think, also, that in the last paragraph of this section you can add a summarizing table with the available measurements and the averaging time.

Pg5Ln23: If I understand well, you identified the layers using the particle extinction coefficient and RH data. Can you discuss more on this method? You can give an example.

Pg5Ln26: For the identification of the layer boundaries, which extensive parameter are you using? Is this parameter at full resolution? Does the smoothing affect this decision? I am asking all these because the minimum layer thickness is 89 m.

Pg5Ln27-30: Why do you use mean backscatter and extinction coefficient values in order to estimate the intensive parameters? To my knowledge, the profiles of the intensive parameters, which are type dependent, indicate layer homogeneity etc. Therefore, the intensive properties profiles will serve the purpose of your study.

Pg6Ln28: Why do you use reanalysis and GDAS? I think that reanalysis data perform better and should be preferred.

Pg7Ln16: Where does the statement 'look less reliable' come from? Expand please.

§4.2: I recommend to remove section 4.2 and the description of the event with backward trajectory analysis moved to section 4.1. The comparison of reanalysis and GDAS falls out of the scope of this study and the findings do not support the preference for one dataset over the other.

§4.3: Is the layer characterization assisted with the backward trajectory simulations? If this is the case, the way you classify biomass burning aerosol should be part of the methodology (I think I made this comment already). Could you specify the time window you used in order to characterize the BBA layers as fresh, moderately fresh, etc. I presume that this information is incorporated from the model simulations, therefore I insist that this description should be part of the methodology.

§5: I did not find connection with other studies on the topic. You could create a summarizing table with your findings and the findings from other studies. I think this point is important.

Pg8Ln30: 'The sub-layers... α profiles'. Will you explain how this selection is made?

Pg9Ln8-10: The assumption of dust particles over Warsaw for this specific case is far-fetched when taking into account the simulated trajectories. The depolarization ratio value of 8 % is rather too low. Does this come from a 'sub-layer' (Fig. 5a)? What do the other intensive properties show?

Pg9Ln15: What does this anti-correlation mean? Is it due to dust contamination? Checking Wiegner et al. (2011) there is no such thing observed.

Pg9Ln25-31: Could you expand on the technique for the aerosol typing? Is this technique based only on RH and δ? Are these two parameters sufficient? However, in lines 27-28 you refer to intensive properties, do you use them for the typing? If yes, do you use lookup tables or other information? Furthermore, the different colours refer to different layer aging, is this information solely based on intensive properties or do you

use Hysplit info? I am a bit confused. Please clarify.

Pg10Ln23-25: I would expect that pollen is depolarizing, whereas in your measurements I do not observe depolarizing layers. Can you comment? Moreover, the event presented by Sicard et al. (2016) is during the pollination period (i.e., Spring). Could pollen be observed in August? Can you support this statement?

Pg10Ln27: What does this ratio show? Please, describe. How is this ratio connected to pollen?

Pg11Ln7: Give literature values for fresh BBA and link it with your findings.

Pg11Ln17: Give literature values for aged BBA and link it with your findings.

Pg11Ln17: Give more information on the CRLR threshold.

Pg12Ln23: In Fig. 7c, where is the aging effect in the scatter plot?

Pg12Ln30-31: Please expand.

Pg13Ln1-2: How can you deduce that the particle size is increasing from the β-RH plot? Do you imply that the RH is linearly correlated with particle size? Please expand. Also, which is the reference?

Pg13Ln25: Try to revisit the Conclusions as this section is very confusing.

Minor Specific Comments

Pg1Ln1: I counted 8 distinct layers when I checked Table 1. L1a and L1b are the same as well as the pair L2a and L4b.

Pg1Ln15: You mention fresh, moderately fresh, and moderately aged. In Table 1, you also refer to aged BBA. Why not include it in this sentence?

Pg1Ln15-17: Why do you refer to this specific layer in the abstract?

Pg4Ln11: Do the data shown in this study follow the QA and QC procedures of EAR-LINET?

Pg8Ln14: Do you have any literature reference to support this claim?

Pg8Ln31: Give more information for the PolandAOD database.

Pg9Ln19-24: Aren't the lidar signals too noisy to make any deductions? I would omit this discussion.

Pg10Ln24: You mention high values of depolarization ratio, whilst 4.8 % is definitely a small value. Please clarify.

Pg11Ln5-7: What did the model simulations show?

Pg11L11: I think the statement 'small depolarizing particles' is untrue. Please rephrase.

Pg13Ln20: Can you quantify 'partly consistent'?

Pg13Ln31-34: Better remove this sentence.

Pg14Ln15-16: What does this finding show?

Pg28: Can you overlay the position of the EARLINET sites of Poland? If the empty dots correspond to the sites, make sure to change the size, or colour, or icon.

Pg29: Consider removing this figure or keep the figures related to the reanalysis data.

Pg31: A legend is required for Fig. 5. Also, why don't you report the profiles of lidar ratio and Ångström exponent? The profiles will give an insight into the aerosol layers. Furthermore, the figures are poorly rendered. Make sure to improve the quality of the Figures 5, 6, and 7.

Pg32: Consider a legend describing the colours or incorporate this information in the colour-bar. In Fig. 7a, the layers 7 and 8 are not discernible. In Fig. 7b, merge layers 6-7. You could have the same colour for layers that correspond to the same aerosol

type. E.g. L1 in both layers corresponds to pollution.

Technical Comments

Pg1Ln8: Add 'the' after 'during'.

Pg1Ln8: The 'th' is not needed in the date.

Pg1Ln9: Add 'the' before 'so-called'.

Pg1Ln10: Replace 'The' with 'A'.

Pg1Ln11: Write 'optical properties of 116 layers' instead of 'properties within 116 sub-layers in the profiles'.

Pg1Ln13: Add 'the' before 'aerosol/mixture'.

Pg1Ln16: Replace 'characteristic for' with 'characteristic for'.

Pg1Ln16: Delete 'scattered'.

Pg1Ln18: Delete '4.8'.

Pg1Ln18: Replace 'were' with 'was'.

Pg1Ln24: Replace 'studying of' with 'studying the'.

Pg1Ln26: Add 'the' before 'microphysics'.

Pg1Ln26: Delete 'forming in the presence of aerosols'.

Pg1Ln27: Replace 'particles' with 'particle'.

Pg1Ln28: Add 'the' before 'aerosol'.

Pg1Ln28: Delete 'suspension'.

Pg2Ln2: Replace 'what' with 'which'.

Pg2Ln8: Replace 'consist' with 'consists'.

Pg2Ln9: Replace 'is the subject of' with 'is subject to'.

Pg2Ln9: Replace 'processes' with 'process'.

Pg2Ln9: Replace 'lead' with 'leads'.

Pg2Ln10: Replace 'evolutions' with 'change'.

Pg2Ln11: Delete ',' after 'fact'.

Pg2Ln13: Add 'the' before 'development'.

Pg2Ln13: I do not understand 'yield in the'.

Pg2Ln13: Replace 'allow' with 'allows'.

Pg2Ln14: Add 'the' before 'characterization'.

Pg2Ln14-15: Please rephrase 'a signal depolarization by unspherical particles'.

Pg2Ln15: Replace 'unspherical' with 'aspherical'.

Pg2Ln17: Delete 'the' after 'during'.

Pg2Ln19: Replace 'the' with 'a'.

Pg2Ln21: Delete 'the' after 'by'.

Pg2Ln21: Please rephrase 'to increase the research quality and reliability'.

Pg2Ln23-24: Please rephrase 'The automatic aerosol typing algorithms operate with...'.

Pg2Ln24: The abbreviation is missing. Make sure to include abbreviations throughout the manuscript with specific references and website links when needed.

Pg2Ln27: Add 'a' before 'maximum'.

Pg2Ln28: Replace 'This' with 'these'.

Pg2Ln29: Delete 'a very'.

Pg2Ln29: Please rephrase 'to use the lidar data by the specialist'.

Pg2Ln31: Delete 'a' before 'high'.

Pg2Ln33-34: Please rephrase the last sentence.

Pg3Ln1-2: Please rephrase the first sentence.

Pg3Ln2: Delete 'A'.

Pg3Ln3: Delete 'a' before 'long'.

Pg3Ln5-6: What do you mean 'found in the systematic observations'?

Pg3Ln6-8: Also, what does this sentence mean? The message is not clear.

Pg3Ln9: Delete 'a' before 'favourable'.

Pg3Ln14: Replace 'according with' with 'according to', however, I do not think that fits here.

Pg3Ln16: Replace 'were' with 'was'.

Pg3Ln16: Replace 'based on' with 'using'.

Pg3Ln18: 'which coincide with the analysed in the paper'. What do you mean?

Pg3Ln19: Replace 'aerosol' with 'aerosols'.

Pg3Ln19: Write 'as biomass burning smoke from Ukrainian wildfires'.

Pg3Ln20-21: What do you mean by 'deepening study'?

Pg3Ln21: Please rephrase 'to reflect atmospheric variability and to catch all individual sublayers'.

Pg3Ln22: What do you mean by 'can be likely kinds of mixtures'?

Pg3Ln23: Delete 'the' before 'separation'.

Pg3Ln28-29: Please rephrase 'as the one… in each sub-layer'.

Pg3Ln29: Delete 'mentioned'.

Pg3Ln30: Please rephrase 'performed as a standard'.

Pg3Ln31: Add 'the' before 'study'.

Pg3Ln32-34: Please rephrase the last sentence. Also, a reference is missing.

Pg4Ln1: Replace 'contain' with 'contains'.

Pg4Ln1-6: The abbreviation 'Sect.' should be used when it appears in running text.

Pg4Ln5: Replace 'is' with 'are'.

Pg4Ln5: Please rephrase 'outlooks potential use of the obtained results'.

Pg4Ln10: Replace 'as' with 'following'.

Pg4Ln15: Replace 'consist of the' with 'consists of a'.

Pg4Ln20: Add 'an' after 'where'.

Pg4Ln23-24: Add 'the' before 'particle' and 'water'.

Pg4Ln26: Replace 'Baars et al., 2016' with 'Baars et al. (2016)'. Make sure when you are citing a paper to comply with the guidelines of ACP. Several mistakes of this kind were found throughout and it is not possible to list them all out.

Pg4Ln28: For the dates, consider using dashes and not slashes. E.g. 9-10 August.

Pg5Ln2: Replace 'meteorology' with 'meteorological'.

Pg5Ln4: Add 'the' before 'retrieval'.

Pg5Ln9: Add 'the' before 'free'.

Pg5Ln14: You refer to 'the latter', which is the former?

Pg5Ln19: Delete 'of' after 'Comparing'.

Pg5Ln19: Delete 'the' after 'showed'.

Pg5Ln20: Add 'the' before 'calculation'.

Pg5Ln20: Delete 'the' before 'mean'.

Pg5Ln23: Add 'for' before 'further'.

Pg5Ln24-25: Delete 'of the intensive optical properties'.

Pg5Ln25: Replace 'sets' with 'set'.

Pg5Ln32: What do you mean by 'aerosol layers occurrence'?

Pg5Ln33: Add 'the' before 'residual'.

Pg6Ln8: Replace 'On the' with 'At the'.

Pg6Ln8: Add 'a' before 'persistent'.

Pg6Ln10: Write 'Inflow of warm air from Western Africa'.

Pg6Ln10: What do you mean by 'was dominating in the troposphere'?

Pg6Ln14: Delete 'the' after 'within'.

Pg6Ln14: I cannot understand 'insensitively'?

Pg6Ln15: Delete 'territory'.

Pg6Ln15: Replace 'In the three days period' with 'In the next three days'.

Pg6Ln15: Replace 'at the direct' with 'located in direct'.

Pg6Ln16 and Pg6Ln18: Delete 'panel'.

Pg6Ln18: Replace 'depict' with 'depicts'.

Pg6Ln18: Add 'the' before 'distinct'.

Pg6Ln19: Replace 'splitted' with 'split'.

Pg6Ln22: Delete 'occurrence'.

Pg6Ln22: What does the sentence 'air settlement in the conditions of high pressure' mean?

Pg6Ln23: Delete 'of aerosol structures'.

Pg6Ln25: Replace 'directions of the aerosols inflow' with 'aerosol origin'.

Pg6Ln31: What is a 'high interval'?

Pg7Ln1: What does 'reflect' mean?

Pg7Ln2: Replace 'have' with 'has'.

Pg7Ln3: Add 'the' before 'general'.

Pg7Ln3: Please rephrase 'ran starting on the territory'?

Pg7Ln5: Replace 'At the altitudes' with 'For the altitudes'.

Pg7Ln6: Add 'the' before 'trajectories'.

Pg7Ln6-7: Please rephrase 'from the mentioned before direction of the lower trajectories to the direction from western Europe'.

Pg7Ln7: Add 'the' before 'Czech'.

Pg7Ln7-8: Please rephrase 'Over the time… over Spain'.

Pg7Ln9-11: Please rephrase 'At the altitude… Sahara Desert'.

Pg7Ln11: Replace 'originate' with 'originates'.

C11

Pg7Ln14: Add 'the' before 'consistency'.

Pg7Ln17: Write 'the two simulations is the origin of the aerosols over Warsaw'.

Pg7Ln21: Replace 'analogous' with 'same'.

Pg7Ln23: Delete 'at the analogous altitudes'.

Pg7Ln28: Delete 'with'.

Pg7Ln28: Add 'the' before 'GDAS'.

Pg8Ln2: The period should be 10-11 August and not 9-11.

Pg8Ln3: Replace 'panel (a)' with 'Fig. 4a'.

Pg8Ln4-5 and Ln14: The same change applies to these sentences.

Pg8Ln5: What do you mean by 'The trajectory altitude is rising…'?

Pg8Ln6: Replace 'as in' with 'to'.

Pg8Ln7: Delete 'the' before 'satellite'.

Pg8Ln9-10: Please rephrase.

Pg8Ln12: Replace 'point that biomass' with 'point out that the biomass'.

Pg8Ln15: Replace 'most likely originates' with 'might have come'.

Pg8Ln16: Delete 'the' before 'copper'.

Pg8Ln16: Add 'the' before 'possible'.

Pg8Ln16: Delete 'the' before 'pollution'.

Pg8Ln16: Add 'the' before 'altitude'.

Pg8Ln17: Replace 'origin' with 'originate'.

Pg8Ln19: Add 'the' before 'Iberian'.

C12

Pg8Ln20: Replace 'origin' with 'originate'.

Pg8Ln21: Replace 'Hungry' with 'Hungary'.

Pg8Ln22: Delete 'the' before 'moderately'.

Pg8Ln22-23: Please rephrase

Pg8Ln26: Replace 'origin' with 'originate' everywhere.

Pg8Ln29: What do you mean by 'representative for the layers'?

Pg8Ln29: Delete 'the' before 'mean'.

Pg9Ln1: Replace 'in further study' with 'for further study'.

Pg9Ln1: Delete 'of the intensive properties'.

Pg9Ln11: Add 'the' after 'course of'.

Pg9Ln11: Add 'A' before 'similar'.

Pg9Ln14: Add 'the' before 'data'.

Pg9Ln17: Add 'the' before 'slight'.

Pg9Ln17: Replace 'from over Sahara' with 'from the Sahara Desert'.

Pg9Ln25: Replace 'performed' with 'made'.

Pg9Ln31: Please explain 'have some features'.

Pg10Ln8: Replace 'splitted' with 'split'.

Pg10Ln14: Replace 'in the first' with 'for the first'.

Pg10Ln14: Replace 'cooper' with 'copper'.

Pg10Ln23: Replace 'domination' with 'dominance'.

Pg10Ln23-25: Consider to rephrase this sentence.

Pg10Ln26: Please rephrase 'To easy compare'.

Pg10Ln28: Replace 'has' with 'have'.

Pg10Ln32: Replace 'have' with 'has'.

Pg10Ln34: What do you mean by 'stronger contamination'?

Pg11Ln1: Delete 'i' from '0.12i' and '0.30i'.

Pg11Ln5: Replace 'of' with ','.

Pg11Ln7: Replace 'weakly' with 'less'.

Pg11Ln8-12: Please rephrase, the message is not clear.

Pg11Ln13-14: Please rephrase.

Pg11Ln18: Replace 'this' with 'these'.

Pg11Ln18: 'This… sr).' What do you mean?

Pg11Ln18: Delete 'of' after 'was'.

Pg11Ln21: Delete 'of' before 'the BBA'.

Pg11Ln27: Delete 'one' before 'case'.

Pg12Ln4: Delete ',' after 'shows'.

Pg12Ln4: Delete 'rather'.

Pg12Ln7: Add 'the' before 'linear'.

Pg12Ln7: Delete 'the' before 'details'.

Pg12Ln9: I do not get the meaning of 'alternatively'.

Pg12Ln9: Write 'the dependence is not linear'.

Pg12Ln9-12: Please rephrase.

Pg12Ln13: Please rephrase.

Pg12Ln14: Replace 'mixture' with 'mixtures'.

Pg12Ln16: Replace 'another' with 'other'.

Pg12Ln16: Please rephrase 'another stage… atmosphere'.

Pg12Ln19: Replace 'splitted' with 'split'.

Pg12Ln21: Replace 'this' with 'these'.

Pg12Ln23: Replace 'hygroscopicity' with 'the hygroscopic growth'.

Pg12Ln24-25: Please rephrase the two sentences. It is impossible to understand.

Pg12Ln25-27: Please explain.

Pg12Ln27: Delete 'the' before 'model'.

Pg12Ln29: Replace 'for' with 'to'.

Pg12Ln29: Add 'the' before 'imaginary'.

Pg12Ln32: Replace 'shows' with 'show'.

Pg12Ln33: Delete 'the' before 'negative'.

Pg13Ln1-2: Please rephrase. It is impossible to understand.

Pg13Ln2-4: Please rephrase. It is impossible to understand.

Pg13Ln6: What do you mean by 'assessed'?

Pg13Ln17: Add 'the' before 'troposphere'.

Pg13Ln17: Add 'the' before 'aerosol'.

Pg13Ln17: Delete 'the' before 'observed on that days'.

Pg13Ln17: Replace 'were' with 'was'.

Pg13Ln18: Pleas rephrase 'present a consistent course'.

Pg13Ln19: Add 'the' before 'radiometer'.

Pg13Ln20: Replace 'this' with 'the'.

Pg13Ln22: I cannot understand 'what'.

Pg13Ln26: Delete 'an' before 'aerosol'.

Pg13Ln26: Delete 'the' before 'biomass'.

Pg13Ln28: Replace 'show' with 'showed'.

Pg13Ln29: Write 'that 2-3 days old air from Germany…'.

Pg13Ln30: Delete 'about'.

Pg13Ln31: Replace 'is' with 'in'.

Pg14Ln1: 'specifying… sub-layers'. Please rephrase.

Pg14Ln3: Add 'A' before 'total'.

Pg14Ln4: Replace 'o' with 'of'.

Pg14Ln4-5: 'general… approach'. Please rephrase.

Pg14Ln8-9: 'slight… possible'. Please rephrase.

Pg14Ln9: Add 'the' before 'upper'.

Pg14Ln9: Replace 'were' with 'was'.

Pg14Ln10-11: 'In one layer… information'. Please rephrase.

Pg14Ln11: Replace 'do' with 'does'.

Pg14Ln11: Replace 'an' with 'a'.

Pg14Ln11-13: Please rephrase 'occurs… formation)'.

Pg14Ln17: Replace 'of some kinds of mixtures' with 'mixed'.

Pg14Ln23-24: Please rephrase.

Pg27: Insert the following 'black dots depict the', 'calculated with the', 'purple bars depict the', 'estimated from'.

Pg27: Replace 'selected to the evaluation' with 'selected for evaluation'.

Pg29: Please improve the caption of Figure 3.

Pg30: What do you mean by 'the trajectory altitude is rising north-westward'?

Pg31: Replace 'in further analysis' with 'for further analysis'.

Pg32: Insert the following 'the same colour depicts' and 'layer 8 depicts'.

Pg32: Delete 'further' wherever appears in the caption.

Pg33: Please rephrase the last sentence of the caption.