

Interactive comment on “Variability of aerosol properties over Eastern Europe observed from ground and satellites in the period from 2003 to 2011” by A. Bovchaliuk et al.

Anonymous Referee #1

Received and published: 12 February 2013

General Comments

The manuscript presents an analysis of POLDER/POLDER-2 and AERONET data over Eastern Europe. AERONET sun photometer data are used to characterize seasonal changes in aerosol loading and particle size. Comparisons are made to the current version of the POLDER algorithm using AERONET data recomputed to match the limited aerosol particle range ($r < 0.03 \mu\text{m}$) used to derive the AOD from POLDER. Further, a new algorithm for POLDER developed by Dubovik 2011 is evaluated for retrievals of AOD and SSA and compared to AERONET retrievals.

The Reviewer finds the paper has scientific merit but has deficiencies in citations to

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substantiate claims, statements, and methods; some figures are very difficult to read and interpret: and while the topic and material are scientifically justifiable, the analysis is weak at times and discussion is often difficult to follow. The Reviewer recommends major revisions prior to publication including (as discussed below) reorganization a significant portion of the first two sections, rewriting several parts of the analysis section, improving figure readability, adding new figures and relevant references to previous work, and providing more solid conclusions from the analysis presented.

Specific Comments

Pg 2642:

Ln 5-8: it is not clear if you refer to satellite retrieval, Aeronet, or both?

Ln 10, 13: “first peak observed” and “second peak” is not very descriptive.

Ln 15: “presence of soil dust aerosols due to harvesting activity”; citations needed on pg 2649; ln 21-23 and pg 2658; ln 9-11.

Ln 20-26: needs to be revised and condensed

Pg 2643:

Ln 4-4: What is meant by “stable atmospheric conditions”? Clear skies, no aerosol plumes, etc.?

Ln 10-11: Forest fires may not always be natural and caused by anthropogenic activities

Ln. 20-21 and 25-26: these phrases are redundant and discussion in ln 20-27 should be condensed.

Pg 2644:

Ln 4 What is meant by “modifying the amounts?” What are you referring to?

Ln 6-11: Need to include relevant references for networks and satellite observations

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here and throughout introduction and analysis sections.

Ln 15-16: Be more descriptive on why Lidar is different than passive remote sensing techniques and provide references.

Ln 22-23: This statement is not very clear. Satellites may also provide long term records. I think you are trying to say the "ground based remote sensing systems provide high temporal resolution at specific locations while satellites provide greater geographic resolution at low temporal resolution."

Ln 28-29: References needed on synergism of ground- and space- based remote sensing data.

Pg 2645

Section 2: The section is not very well organized and should significantly be revised. Perhaps one or two figures will help focus the discussion and orient the reader? You could, for example, use data from AERONET to show changes in aerosol loading and particle size at some of the sites in the regions. In that case, you may need to discuss AERONET data first and then analyze the aerosol dynamics.

Ln 2: Why are satellite remote measurements "problematic"; please be more descriptive and add references.

Ln 4-7: This transition statement does not state well the comparisons made with POLDER/POLDER-2 satellite measurements.

Ln 10-11: delete "where a lot of natural and anthropogenic aerosol sources are located"

Ln 12-14: References missing

Ln 21-24: Smoke characteristics also depend on fuel types and combustion phases.

Ln 25: State why the "particle size is likely to increase with the age of the advected air mass".

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Pg 2647:

Ln 14: Wavelengths in AERONET range from 340 nm to 1640 nm. A statement should be made regarding the uncertainty of AERONET spectral AOD measurements (+/-0.01 to +/-0.02) with the highest uncertainty in the UV (Holben et al 1998; Eck et al 1999).

Ln23-24: Should include Holben et al. 1998, 2006, Smirnov 2000, Dubovik et al 2002, 2006.

Pg 2648

Ln 1-19: It is recommended that the Authors consider their own AOD and AE analysis (as described above) using the latest data from AERONET dynamics since the studies cited. Ln 27-29: This sentence is difficult to read. Place this information in a table

Pg 2649:

Ln3: Figure 1 is very difficult to read and should be revised. In the PDF, I need to zoom to at least 400% to evaluate the charts.

Ln6-10: Needs reference. Perhaps "banned" (instead of illegal) would be more appropriate here? The months "April-May" are not clearly visible on the graph.

Ln 14-15: It should be indicated that these estimates are from "model simulations".

Ln 15-18: References are needed here regarding the transport of sea salt aerosols to Moldova which is not immediately convincing given the 160 km distance from the Black Sea. SSA spectra at Moldova in April 2003 are quite absorbing (0.91 to 0.86 from 440 nm to 870 nm), hence, sea salt may not be so significant. Supporting evidence (e.g., particle sphericity) is also needed to show it is not partly Saharan dust which can also occur in the spring. Figure 2 and 3 should show the number of retrievals for each year to understand the significance of the average plots. Also, how do you explain the coarse mode peak at Moscow?

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Ln 1-29: The analysis is very difficult to read and is not informative. These paragraphs should be rewritten to give scientific analysis and not dictation of the data charts.

Pg 2651

Ln 3-6: The NCEP analysis is quite old 1961-1990. More recent data (through 2013) are available using the same reanalysis package and resolution (6 hourly, 2.5 degree). In addition, more advances in data assimilation have been made since the 1990s (including improved spatial resolution) and information on these reanalysis data sets can be found at the NCAR Climate Data Guide web site.

Ln 6-14: A figure is not provided for the analysis indicated. A figure showing the wind field or back trajectory analysis should be useful here.

Pg 2652

Ln 10: What wavelength range do you refer to for Angstrom exponent?

Pg 2653

Ln 1: Why "except 2004"?

Ln 2: Figure 4 is difficult to follow with so many plots the authors point seems to be lost. Also, it is confusing having differ scales in different images. Ln 20: Why is it "problematic"?

Ln21-259 Listing of cities is not very helpful and should not be in the main body. Please delete or put in a table. Perhaps you can show AOD data over each city and place in a temporal plot?

Pg. 2654

Ln 5: "aerosol radius cutoff" Are you referring to $r < 0.03 \mu\text{m}$ or another threshold? Please state.

Ln 21-23: What methodology did you use to determine the fine mode aerosols as

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computed by AERONET? Did you run your own algorithm or extract the information from AERONET products? More details are needed here.

Ln 24-25: You should reference this technique is typical for matching AERONET data.

Ln 25-26: Are zero values from POLDER or AERONET? Why would AERONET Level 2 have zero values for AOT?

Ln 27: What is meant by "recomputed"? You will need to provide the equation(s) or reference to the model used to recompute AERONET data for AOD 870nm with radius less than 0.3. Do you use AERONET Level 2 or another data level?

Ln 19: "the fine aerosol mass concentration is typical for this territory" This statement is not clear. Please provide reference and/or further explanation.

Ln 21-29: A distinction should be made here that the "new" algorithm does not have the $r < 0.03 \mu\text{m}$ limitation (at least Dubovik 2011 does not show this).

Pg 2656

Ln 28-29: The 2-hour period is quite long. Why is the period so long? Please provide references as to why this is a technique used for POLDER collocations with ground sites.

Pg 2657

Ln 1: What does it mean the atmosphere usually changes in 1-2 hours? What atmospheric property or condition are you referring to? Please provide a reference.

Ln 5-15: In Figure 6, the data show very low SSA values for both POLDER and AERONET. A check of the AERONET Level 2.0 product shows SSA above 0.8 at 440 nm (see plot 1). How do you obtain values below? Do you use Level 1.5 AERONET data instead (see plot 2)? Only AERONET Level 2.0 data should be used for publications and matchups with satellite data. It also should be stated that AERONET SSA has uncertainty of ± 0.03 (Dubovik et al. 2002). Temporal plots are not very reveal-

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ing of the performance of the algorithm. Perhaps you can provide the scatter plot of POLDER and AERONET (similar to Figure 5) with uncertainty intervals for POLDER retrievals.

Pg. 2658:

The conclusions section does not provide many conclusions but a summary of the paper. Please focus on key results and present the conclusions appropriately.

Pg 2659:

Ln. 9: What is meant by “low loading”? Is this an AOD threshold or another measure?

Acknowledgements: Authorship should be offered to AERONET PIs for which data has been use and if declined should be at least acknowledged by name.

Technical Corrections

Pg 2643:

Ln 2: “accomplished”; do you mean “evaluated”

Pg 2647:

Ln 16: Probably not necessary to provide a specific web address (address to www.cimel.fr should be appropriate)

Ln 18: Change “vapour” to “vapor”

Pg. 2654

Ln 24- “tranfer” should be “transfer”

Interactive comment on Atmos. Chem. Phys. Discuss., 13, 2641, 2013.

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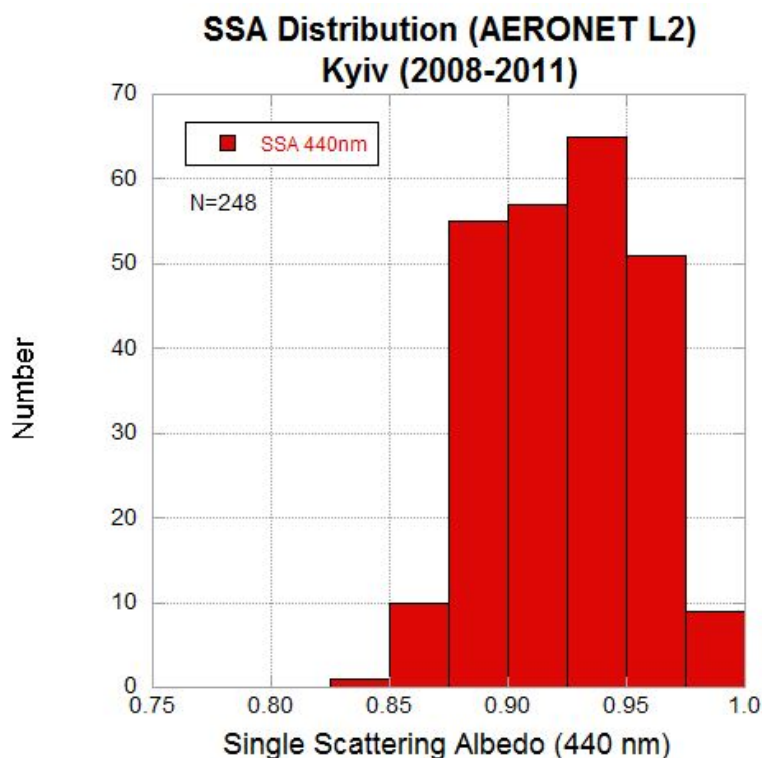


Fig. 1. Number Distribution of SSA at 440 nm (L2) at Kyiv AERONET Site from 2008-2011

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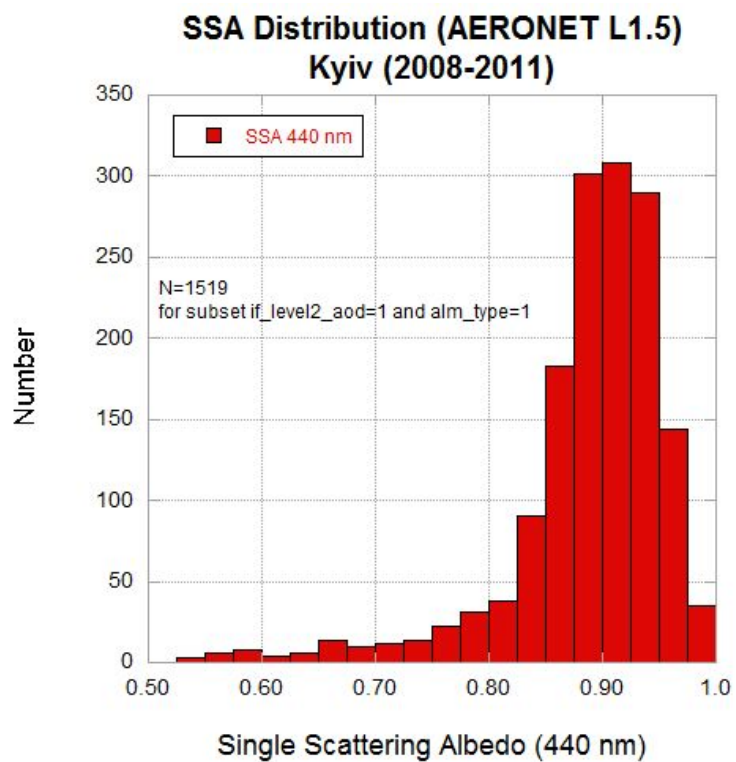


Fig. 2. Number Distribution of SSA at 440 nm (L1.5) at Kyiv AERONET Site from 2008-2011