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Atmospheric Chemistry and Physics Discussions

Interactive comment on "Spatial variation of aerosol optical properties around the high-alpine site Jungfraujoch (3580 m a.s.l.)" *by* P. Zieger et al.

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We thank the 2nd reviewer for his or her useful and productive comments, which helped to improve the clarity and quality of the manuscript.

Reviewer 2: The authors have performed an interesting closure study of in-situ and remote sensing aerosol data during an intensive observation period in the Jungfraujoch site, supported by additional instrumentation deployed in a lower but very near site in the Alps. The study involved a considerable array of instruments, including wet and dry nephelometers, in situ size distribution counters, an aethalometer and other remote sensing instruments such as lidar, sun photometers and radiometers. The description of the instrumentation is well detailed. The

results show a good correspondence within the involved uncertainties of experimental and modelling techniques. The data is put in context by using satellite data. The English usage is good. No important corrections to the current article are proposed.
Some minor specific comments:

Page 11113, line 22: The flow is checked at regular intervals. Could you be more speciffic about the interval chosen?

Reply: During the campaign, the flow was checked every 3-7 days. We have added this information to the manuscript:
"The flow was checked at regular intervals (3-7 days during the campaign) ..."

Reviewer 2: Page 11116, last sentence: Can you provide a reference describing the calibration procedure for the FUBISS instrument? Can you provide an estimation of the error obtained in the calibration method?

Reply: The calibration techniques for FUBISS are described in detail in Asseng et al.(2004) and Zieger et al.(2007) as mentioned in the first paragraph of Sect. 2.3.2. We have added the following sentence concerning the calibration accuracy of the Langley technique:
"Under clear sky and stable atmospheric conditions, the Langley-plot technique has an accuracy better than 1% of the extraterrestrial detector voltage (Schmid and Wehrli, 2005; Asseng et al., 2004, see Eq. 7 below)"

Reviewer 2: Page 11117, line 21: As before, please provide (if available) a reference describing the actual method for the retrieval (or cancellation) of the gas absorption effect.

Reply: The mentioned King and Byrne (1978) paper nicely describe the retrieval of the gas absorption effect. Zieger et al.(2007) also refer to the work of Livingston et

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al.(2005). We do not add this reference again and refer the reader to the technical papers of FUBISS-ASA1 and ASA2, which are cited in the manuscript.

Reviewer 2: Page 11120, line 22: Please provide a reference for the validation of SEVIRI AOD.

Reply: We have added to the manuscript: Validation of SEVIRI derived AOD with AErosol RObotic NETwork (AERONET, Holben et al., 1998) sites in Central Europe revealed a generally good performance (correlations well above 0.8, root-mean-square error (RMSE) of $\sim$ 0.05, and 75–80% of all retrievals within MODIS expected error over land of $\pm$(0.05+0.15$\times$ AOD), Popp et al.,2009). A validation of SEVIRI AOD carried specifically over some Alpine sites and the relative discussion can also be found in Emili at al., 2010.

Reviewer 2: Page 11121, line 4: please indicate that the AOD uncertainty expression corresponds to Land products.

Reply: Yes, we have changed this sentence to:
The accuracy of the MODIS AOD over land was found to be ...

Reviewer 2: Page 11125: indicate why the first webcam image appears black (in the figure caption).

Reply: We have added in the figure the wording ”nighttime measurement” on top of the webcam image.

Reviewer 2: Page 11127, line 6: Although a comparison between AOD from FUBISS and LIDAR has been made through a linear fitting, I miss the absolute value of the AOD difference in absolute terms.

Reply: In addition to the slope and intercept (which were already mentioned in the manuscript), we have added the RMSE to complete the picture:
”The RMSE of this comparison varied between 0.066 and 0.071.”

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Reviewer 2: Page 11128, line 28: 08:00 a.m., please indicate it is UTC time to avoid any misunderstanding.

Reply: We have added "UTC" in parenthesis.

Reviewer 2: Page 11131, line 23: I think that Levy (2003) or Levy (2009) documents already state that the MODIS Ansgstrom exponent is in general rather uncertain.

Reply: Yes, we agree. We have modified the sentence:
"The Ångström exponent retrieved by MODIS Terra and Aqua also follows a similar trend and magnitude as the Sun photometer measurements, this might be due to coincidence and/or the dominance of the Saharan dust over the Alps. However, one should be aware that the MODIS retrieved aerosol size parameters over land are in general highly uncertain (Levy et al., 2007; Levy, 2010) especially over mountains (L. Remer, personal communication, 2011) and should therefore only be interpreted as a qualitative value."

Reviewer 2: Page 11133, line 22: "which is usually mounted on an airplane". I suggest removing this sentence.

Reply: Changed accordingly.

Reviewer 2: Page 11134, line 5: Remove the Dubovik and King (2000) citation from the conclusions.

Reply: Changed accordingly.

Reviewer 2: Figure 4, caption: "with a zenith"

Reply: Changed accordingly.

Reviewer 2: Figure 8, plot: the magenta cross is hardly visible.

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Reply: The magenta cross was increased in size and should now be better visible.

Reviewer 2: Figure 9, caption: I suggest including the reason for the aui gap (due to saturation).

Reply: We have added this information to the caption.

References

Asseng H., Ruhtz T., and Fischer J., Sun and aureole spectrometer for airborne measurements to derive aerosol optical properties, Appl. Opt., 43(10), 2146–2155, doi: 10.1364/AO.43.002146 , 2004.

Emili E., Popp C., Petitta M., Riffler M., Wunderle S., and Zebisch M., PM10 remote sensing from geostationary SEVIRI and polar-orbiting MODIS sensors over the complex terrain of the European Alpine region, Remote Sens. Environ., 114(11), 2485–2499, doi: 10.1016/j.rse.2010.05.024 , 2010.

Holben B., Eck T., Slutsker I., Tanre D., Buis J., Setzer A., Vermote E., Reagan J., Kaufman Y., Nakajia T., Lavenu F., Jankowiak I., and Smirnov A., AERONET - A federated instrument network and data archive for aerosol characterization, Remote Sens. Environ., 66, 1–6, 1998.

Levy R., The dark-land MODIS collection 5 aerosol retrieval: algorithm development and product evaluation, Satellite Aerosol Remote Sensing over Land, pages 19–68, 2009.

Levy R., Remer L., Kleidman R., Mattoo S., Ichoku C., Kahn R., and Eck T., Global evaluation of the Collection 5 MODIS dark-target aerosol products over land, Atmos. Chem. Phys., 10(21), 10399–10420, 2010.

Livingston J.M., Schmid B., Russell P.B., Eilers J.A., Kolyer R.W., Redemann J., Ramirez S.R., Yee J.H., Swartz W.H., Trepte C.R., Thomason L.W., Pitts M.C., Avery

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M.A., Randall C.E., Lumpe J.D., Bevilacqua R.M., Bittner M., Erbertseder T., McPeters R.D., Shetter R.E., Browell E.V., Kerr J.B., and Lamb K., Retrieval of ozone column content from airborne Sun photometer measurements during SOLVE II: comparison with coincident satellite and aircraft measurements, Atmos. Chem. Phys., 56, 1969 – 1984, 2005.

Popp C., Riffler M., Emili E., Petitta M., and Wunderle S., Evaluation of Operationally Derived Aerosol Optical Depth from MSG-SEVIRI over Central Europe, in Geophysical Research Abstracts, volume 11, page 9362, 2009.

Schmid B. and Wehrli C., Comparison of Sun photometer calibration by use of the Langley technique and the standard lamp, Appl. Opt., 34(21), 4500–4512, 1995.

Zieger P., Ruhtz T., Preusker R., and Fischer J., Dual-aureole and sun spectrometer system for airborne measurements of aerosol optical properties, Appl. Opt., 46(35), 8542–8552, doi: 10.1364/AO.46.008542 , 2007.

Interactive comment on Atmos. Chem. Phys. Discuss., 12, 11105, 2012.