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Atmospheric Chemistry and Physics Discussions

Interactive comment on "A decadal satellite analysis of the origins and impacts of smoke in Colorado" *by* M. Val Martin et al.

Anonymous Referee #2

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In this analysis, the authors investigate the impact of fires on aerosol loading and air quality in Colorado from 11-yr period (2000-2012) through both the total column aerosol optical depth (AOD) from satellites aerosol products and observations of surface PM2.5 in Colorado.

This is an interesting study and the manuscript has an appropriate structure and it is well written. The methodology and data set used are appropriately presented. The manuscript is worthy to be published and appropriate for the scope of Atmospheric Chemistry and Physics Discussion. However, there are some aspects that need to be clarified and revised before publication.

Major comments:

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Discussion Paper

- The manuscript tries to establish the contribution of fires to the air quality in Colorado. Therefore, a background about the air quality levels in the study region it would be needed in the introduction section. You add a summary about the number of PM2.5 and PM10 exceedances per year with non-fire and fire conditions. This could help to determine the background levels and the effect of fires emissions in your air quality levels.

- In the analysis, the authors applied the filter to the MODIS data introduced in Zhang and Reid (2006) which was developed for oceanic regions. Different algorithms are applied to MODIS to obtain the aerosol product over land and over ocean. Could you include any estimation or reference about the errors associate to MODIS/AOD product over land in your study region? I understand that MODIS/AOD is not filtered for smoke, then, could you find other aerosols present that contribute to high AOD in your analysis?

- It would be desirable to include in your analysis AERONET data to evaluate the uncertainty in MODIS AOD. Moreover, AERONET observations can help you to characterize the different aerosol presents in your study region. Boulder site would be the most appropriate choice because inside the Front Range Corridor defined by the authors. For example, in Green et al. (2009) you can find an analysis using collocated ground-based observations (PM10, PM2.5 and AOD) and satellites for Illinois.

- The CALIPSO Level 2 product categorizes aerosol layers as one of six subtypes (Omar et al., 2009): dust, marine, smoke, polluted dust, polluted continental, and clean continental. It would be desirable that the authors includes in the text, a discussion about if the algorithm is capable to distinguish whether or not biomass burning plumes and the possible errors associated. Additionally, some studies (Mamouri et al., 2009; Koffi et al., 2012) highlight the differences between day- and night-time backscattering profiles from CALIOP. Did you analysis the day- and night-time CALIOP profiles separately? In this case, did you detect differences in the smoke vertical profile between day- and night-time?

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Minor comments:

Page 8235 Line 18: In the sentence “In the last decade, satellite observations of total column aerosol optical depth (AOD) have provided an important tool to estimate PM2.5 levels at the ground (e.g. Engel-Cox 20 et al., 2004), with the objective of developing smoke air quality advisories (Al-Saadi et al., 2005) and establishing links to human health (Evans et al., 2013).” I would remove smoke, because this can be applied to all aerosols, not only for smoke.

Figure 3 (panels c and d). The labels of the right vertical axe are confusing. The blue and red colours are no adequate, because MODIS is in grey in these cases.

It would be helpful if Figure 6 and Figure 5 are plotted in the same range and units.

References:

Green, Mark, Shobha Kondragunta, Pubu Ciren and Chuanyu Xu (2009): Comparison of GOES and MODIS Aerosol Optical Depth (AOD) to Aerosol Robotic Network (AERONET) AOD and IMPROVE PM2.5 Mass at Bondville,Illinois, Journal of the Air & Waste Management Association, 59:9, 1082-1091, http://dx.doi.org/10.3155/1047-3289.59.9.1082.

Koffi, B., M. Schulz, F.-M. Breon, J. Griesfeller, D. Winker, Y. Balkanski, S. Bauer, T. Berntsen, M. Chin, W. D. Collins, F. Dentner, T. Diehl, R. Easter, S. Ghan, P. Ginoux, S. Gong, L. W. Horowitz, T. Iversen, A. Kirkev ag, D. Koch, M. Krol, G. Myhre, P. Stier, and T. Takemura (2012), Application of the CALIOP layer product to evaluate the vertical distribution of aerosols estimated by global models: AeroCom phase I results, J. Geophys. Res., 117, doi:10.1029/2011JD016858.

Mamouri, R. E., V. Amiridis, A. Papayannis, E. Giannakaki, G. Tsaknakis, and D. S. Balis (2009), Validation of CALIPSO space-borne-derived attenuated backscatter coefficient profiles using a ground-based lidar in Athens, Greece, Atmospheric Measurement Techniques, 2, 513-522.

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