

We are thankful to the reviewer for her/his help in improving the quality of the manuscript. Our detailed responses to the comments are given below in italic

General comments :

The paper « Direct radiative effect of the Russian wildfires and their impact on air temperature and atmospheric dynamics during August 2010 » by J. C. Péré et al., describes the estimation of the direct radiative forcing and local to regional impacts of aerosol emissions from one fire event that took place in Russia in August 2010. The smoke properties and impacts over a period of about one week (5-12 August 2010) were simulated and analyzed using a chemical-transport model (CHIMERE) that is coupled off-line with the Weather Research and Forecasting (WRF) model, and the model simulation were evaluated using ground-based (AERONET) and satellite (POLDER and CALIOP) aerosol remote sensing data. The models and data are well described, the research is well documented, and the results systematically reported. However, the main concern I have with this paper is that it is not clear what its new and unique scientific value is to the larger science. Some of the highlighted impacts of the smoke radiative forcing include the reduction of the mid-day atmospheric boundary layer (ABL) and the diurnally-averaged near surface air temperatures, as well as a “large increase in the near-surface PM10 concentrations”. Nevertheless, the study was focused on just a single fire event, with simulations and analyzes covering only a very short time period of about a week (5-12 August 2010), making it extremely localized in space and time. As such, the significance of the results within the larger context of the climate impacts of biomass burning smoke is not captured. Comparisons should be made with other fire events that occurred at other times in the same region or other regions, to establish whether these impacts are peculiar to this single fire event or a regular occurrence in this region and/or elsewhere. The authors do not need to conduct such other research themselves, but can find a few other representative cases in the literature and place their study in the larger context to enhance the scientific value of their results.

As suggested by the reviewer, a paragraph dedicated to the comparison of our results with other fire events has been now added in the revised manuscript. This paragraph has been included in the form of concluding remarks in the conclusion section that has been now re-organized in the two following subsections:

4.1 Summary and perspectives

4.2 Concluding remarks

The section 4.2 is as follows in the revised manuscript:

“An important characteristic of the 2010 Russian fires is their high solar scattering efficiency. Elevated SSA values (0.95-0.96 in the visible spectrum) have been already observed over the same region by Chubarova et al. (2011) during the 2002 fire event and could be explained by smoldering conditions (Chubarova et al. 2011, 2012). Such SSA are however higher than values measured for smoke aerosols at other locations. For example, Calvo et al. (2010) obtained a mean SSA of 0.87 (at 440 nm) during a fire episode that occurred over Spain during September 2000. Moreover, a moderate aerosol solar absorption has been measured by Gyawali et al. (2009) (SSA = 0.88-0.93 at 405 nm) during the summer 2008 California wildfires. In numerous cases, the direct radiative forcing of biomass burning aerosols induces significant changes in the atmospheric dynamics at regional scale (Vendrasco et al. 2009, Ott et al. 2010, Randles and Ramaswamy 2010, Tummon et al. 2010, Turquety 2013). For example, Randles and Ramaswamy (2010) and Tummon et al. (2010) showed that the atmospheric heating due to absorbing smoke particles associated to the aerosol-induced surface cooling tend to stabilize the lower troposphere over southern Africa. It is interesting to note that, in our study, even a moderate atmospheric radiative shortwave heating due

to very low absorbing smoke aerosols is also favorable to a stabilization of the atmospheric boundary layer. This result is coherent with the modeling sensitivity study performed by Randles and Ramaswamy (2010) indicating that the response of the southern African regional climate to the direct radiative forcing of scattering aerosols could be non-negligible.

In turn, we showed that the lowering of the ABL development due to the ADRF could favor the accumulation of pollutants near the surface. However, the atmospheric shortwave heating induced by absorbing smoke particles could affect the atmospheric circulation and the transport of particles in a different way, over certain regions such as the tropics (Ott et al. 2010) or the equatorial region (Tummon et al. 2010). For instance, Ott et al. (2010) highlighted that the aerosol solar absorption was shown to induce an elevated heat pump mechanism, enhancing the vertical motion and the transport of CO, produced by the Indonesian biomass burnings, from the low troposphere to the tropopause and the stratosphere. The ADRF by smoke particles is also found to affect the precipitation regime and thus aerosol scavenging. It could result either in an intensification or a reduction of precipitation in function of the aerosol-induced changes in the air temperature gradient and low-level horizontal pressure (Vendrasco et al. 2009, Tummon et al. 2010).

The above-mentioned studies, using measurements and modeling experiments, emphasize the great complexity and variety of the atmosphere response to the biomass burning direct radiative forcing. Indeed, not all study results agree on the magnitude and patterns of the feedbacks. Thus, it is necessary to continue efforts in the characterization and understanding of the wildfires radiative impacts.

References quoted in the response to the reviewer and included in the revised manuscript:

- Calvo A. I., V. Pont, A. Castro, M. Mallet, C. Palencia, J. C. Roger, P. Dubuisson and R. Fraile (2010): Radiative forcing of haze during a forest fire in Spain, *Journal of Geophysical Research*, 115, D08206, doi:10.1029/2009JD012172
- Chubarova N., E. Gorbarenko, I. Nezval and O. Shilovtseva (2011): Aerosol and radiation characteristics of the atmosphere during forest and peat fires in 1972, 2002 and 2010 in the region of Moscow, *Journal of Atmospheric and Oceanic Physics*, 47, 729-738
- Chubarova N., Y. Nezval, I. Sviridenkov, A. Smirnov and I. Slutsker (2012): Smoke aerosol and its radiative effects during extreme fire event over Central Russia in summer 2010, *Atmos. Meas. Tech.*, 5, 557-568
- Gyawali M., W. P. Arnott, K. Lewis and H. Moosmüller (2009): In situ aerosol optics in Reno, NV, USA, during and after the summer 2008 California wildfires and the influence of absorbing and non-absorbing organic coatings on spectral light absorption, *Atmospheric Chemistry and Physics*, 9, 8007-8015
- Ott L., B. Duncan, S. Pawson, P. Colarco, M. Chin, C. Randles, T. Diehl and E. Nielsen (2010): Influence of the 2006 Indonesian biomass burning aerosols on tropical dynamics studies with the GEOS-5 AGCM, *Journal of Geophysical Research*, 115, D14121, doi:10.1029/2009JD013181.
- Randles C. A. and V. Ramaswamy (2010): Direct and semi-direct impacts of absorbing biomass burning aerosol on the climate of southern Africa: A Geophysical Fluid Dynamics Laboratory GCM sensitivity study, *Atmospheric Chemistry and Physics*, 2010, 10, 9819-9831
- Tummon F., F. Solmon, C. Lioussé and M. Tadrass (2010): Simulation of the direct and semidirect aerosol effects on the southern Africa regional climate during the biomass burning season, *Journal of Geophysical Research*, 115, D19206, doi:10.1029/2009JD013738
- Turquety, S. (2013): *The Atmospheric Impact of Wildfires* in: Belcher C.M. (ed) *Fire Phenomena and the Earth System: An Interdisciplinary Guide to Fire Science*. Wiley

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- Vendasco E. P., P. L. Silva Dias and E. D. Freitas (2009): *A case study of the direct radiative effect of biomass burning aerosols on precipitation in the Eastern Amazon*, *Atmospheric Research*, 94, 409-421

Specific comments:

Although the paper is well written in clear English language, there are quite a large number of grammatical and other errors sprinkled throughout, some of which are subtle, but still need to be corrected. A few examples are as follows: Page 15831, Line 16: Change “plume is” to “plume was”. Page 15831, Line 18: First mention of “SSA”, spell it out in full. Page 15836, Lines 6–7: Change: “. . . aerosol impacts on longwave radiation, such as sea salt and mineral dust, . . .” to “. . . sea-salt and mineral-dust aerosol impacts on longwave radiation . . .”. Page 15837, Line 11: Change “platform” to “constellation”. Page 15837, Line 15: Change “constituted of” to “constituted by”. Page 15837, Line 16: Change “population” to “properties”. Line 15838, Lines 11–12: Move “rather well” to the end of the sentence starting with “The model is . . .”. Line 15838, Line 12: Replace “associated to” with “associated with”. Line 15838, Line 13: Replace “into” with “within”. Throughout the paper: Change “in term of” to “in terms of”. Change “specie” to “species”.

I have only listed a small fraction of such issues, and encourage the authors to have a native English speaker who is accustomed to technical writing read the paper carefully and find and correct all of such errors.

Thank you, the corresponding sentences have been now corrected in the revised manuscript. Also, we have now put a significant effort in improving its grammar quality.