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Atmospheric Chemistry and Physics Discussions

Interactive comment on "Atmospheric impacts of the 2010 Russian wildfires: integrating modelling and measurements of the extreme air pollution episode in the Moscow megacity region" *by* I. B. Konovalov et al.

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We thank the reviewer for the thorough critical evaluation of our paper. The reviewer's comments will be carefully addressed in the revised paper and our in-detail response will be published in the interactive discussion later. Here we would like to highlight the most important results of our study (which we think received too little attention in the review) and also to provide a quick response to major critical remarks of the reviewer.

1. As it is noted in the Introduction of our paper, the extreme perturbation of atmo-

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spheric parameters in summer 2010 over European Russia provided a critical test for atmospheric models. Our study was focused on examining the ability of a chemistry transport model (CTM) to simulate the evolution of measured concentrations of major air pollutants. To our knowledge, the real situation with the so high air pollution levels caused by both anthropogenic and fire emissions was not addressed in any earlier modeling studies. Therefore, one of the most important findings is the demonstration that a typical regional CTM using certain satellite measurements as input parameters is capable to reproduce such an event rather adequately. At the same time, our study also revealed some discrepancies between simulations and measurements which cannot be easily explained (such as the difference in ozone concentrations on August 7). This kind of "negative" result is also important as it provides a stimulus for further investigations of ozone photochemistry (including heterogeneous chemistry) in a strongly polluted atmosphere.

2. Our study provided a major contribution to examining feasibility of using FRP data for quantifying emissions from wildfires in CTMs. As it is noted in the paper, an important advantage of this approach is its applicability in near real time data assimilation systems. The principle difference between "traditional" and FRP measurement based fire emission inventories is that the first is based on "past" observations (because estimation is possible only AFTER the biomass is burned and a fire is extinguished), while the latter uses ACTIVE fire measurements which can be further used for operational forecast. Sofiev et al. (2009) did important initial steps in studying advantages of assimilating FRP data in air pollution models; Here this method is applied to the major event of Russian fires in summer 2010, with major impact on air quality in the Moscow region. For the first time, we have demonstrated that the air quality model driven by FRP measurement based fire emission estimates in a situation when the atmospheric composition is strongly affected by fires is capable of simulating time series of major pollutants (here COand PM10) in a good agreement with air quality measurements (r>0.8).

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3. An interesting major finding of our study is the fact that ozone concentration was enhanced much less than concentrations of primary air pollutants. We argue that this effect is due to the strong attenuation of photolysis rates by aerosol. To our knowledge, this is a first demonstration of so strong impact of atmospheric aerosol on ozone concentration in real conditions. Our SSA value chosen is in the range of observed values, so we believe our method was appropriate at least to obtain a qualitative result. We recognize however, that our estimates of photolysis rates in the considered situation are not perfect, and we will try to improve this point. In particular, as suggested by the referee, we will address the sensitivity of the result to the chosen SSA value.

In comparison to these major issues addressed in our paper, the question about the agreement of our simulations with MOPITT CO data is in our mind a minor one. We used the comparison with MOPITT measurements only as a way to demonstrate the spatial extent of air pollution caused by wildfires. However, as it is argued in the paper, this comparison does not permit deriving any quantitative conclusions about CO emissions. The main reason is that our model cannot adequately simulate CO variability in the free troposphere (including magnitude of perturbations caused by fire emissions) due to strong constraints imposed by boundary conditions based on "climatological" values. So we should not overstress model results here.

Unfortunately, the reviewer seems to misunderstand our idea behind separation of measurement sites into optimization and validation subsets. It is indeed quite impossible to expect and show that any measurement sites in such a compact region are completely independent. On the contrary, our concern was to insure that the set of measurement sites used for optimization of emissions is, on the average, sufficiently representative of the whole region. Accordingly, we have managed to demonstrate that our model reproduces the average air pollution over the whole region rather than only in vicinity of selected measurement sites. The reviewer is concerned about possible overfitting of fire emissions, but the results of the TEST_2 run (see Fig. 13) clearly demonstrate that optimization of emission factors cannot insure good correlation be-

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tween measurements and simulations, unless spatial and temporal distributions of FRP values are sufficiently accurate.

We consider an estimate of total CO emissions in Russia in summer 2010 as a potentially useful “byproduct” of our study. We recognized that “we cannot claim that our estimates concerning the European part of Russia or the whole Europe are sufficiently constrained by measurements”. In the revised version, we will stress the inherent uncertainty of such an estimation. This point should not be a major criticism of the paper.

Finally, we would like to assure the reviewer that the useful comments of Dr. Chubarova will be taken into account during the revision processes. We will also compare our CO emission estimates it to other estimations including the one from the Yurganov et al. (ACPD, 2011). Their paper finds considerably larger CO fire emission from a top-down method based on CO satellite measurements, however over a larger domain. We note that this estimate is subject (as all estimates) to uncertainties pointed out for example by an anonymous reviewer, so we would not consider it as a reference for our study, but rather as an alternative estimate.

In conclusion we would like to stress that by demonstrating a very strong impact of wildfires on air quality in a densely populated and politically important region, this paper can provide a major impetus for further advances in the field of air pollution modeling, including modeling of pyrogenic emissions, radiative effects associated with biomass burning aerosol and heterogeneous chemical processes. The extreme character of the phenomena allowed us to examine the limits of current understanding of atmospheric processes driving air pollution. With changing climate similar extreme episodes will probably occur more and more frequently. The limited data set of measurement data that was available for our study implies some uncertainties in our results but these uncertainties should not alter qualitative conclusions. So we believe that our paper provides an important contribution to the field.

References:

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Sofiev, M., Vankevich, R., Lotjonen, M., Prank, M., Petukhov, V., Ermakova, T., Koskinen, J., and Kukkonen, J.: An operational system for the assimilation of the satellite information on wild-land fires for the needs of air quality modeling and forecasting, Atmos. Chem. Phys., 9, 6833–6847, 2009.

Yurganov, L., Rakitin, V., Dzhola, A., August, T., Fokeeva, E., Gorchakov, G., Grechko, E., Hannon, S., Karpov, A., Ott, L., Semutnikova, E., Shumsky, R., and Strow, L.: Satellite- and ground-based CO total column observations over 2010 Russian fires: accuracy of top-down estimates based on thermal IR satellite data., Atmos. Chem. Phys. Discuss., 11, 12207-12250, doi:10.5194/acpd-11-12207-2011, 2011.

Interactive comment on "Satellite- and ground-based CO total column observations over 2010 Russian fires: accuracy of top-down estimates based on thermal IR satellite data." by L. Yurganov et al. , Anonymous Referee #1, Received and published: 9 June 2011

Interactive comment on Atmos. Chem. Phys. Discuss., 11, 12141, 2011.

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