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Interactive comment on "Changes in the domestic heating fuel in Greece: effects on atmospheric chemistry and radiation" *by* Eleni Athanasopoulou et al.

Eleni Athanasopoulou et al.

eathana@meteo.noa.gr

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29. Because the manuscript is proposed for publication in a special issue on coupled chemistry-meteorology modelling, a discussion on the relevance of the on-line coupling approach on the presented results concerning atmospheric composition and aerosol chemistry is presently missing. The on-line coupling advantage is evident only for the studied aerosols feedback on meteorology, while it should be specified is any difference could be noticed on pollutants concentrations when feedback was switched off (Scenario 4). Author's response: We thank the reviewer for the positive comments and the interesting suggestion. We have calculated the differences on PM10 concentra-

tions (and their chemical composition) between Case2 and Case4. The feedback of the online coupling approach on aerosol is found very small, which was expected given the small negative effect of particles on radiation in our case study. The section 3.2 is now named after "Impact of RWB smog on radiation and feedbacks on atmospheric composition", and a relevant discussion is now added therein (p. 13 lines 21-26), plus some additions in abstract (p. 1 line 24) and conclusions (p. 14 lines 32-33).

The present form of the manuscript needs a revision including: clarifications, figures improvement, extension of feedback effects discussion. Specific comments:

2.2 Model framework and setup Page 5 Line 3 30. The model domain is defined to be "the extended area of Greece" (the same definition is repeated in Table 1). This definition is quite generic and should be made more specific adding a Figure or a better definition of the domain boundaries. Author's response: the definition of the horizontal domain in degrees is now added in Table 1.

Lines 5-6 31. The sentence "The atmospheric pressure...." is not understandable in this form. How where pressure and precipitation optimized? Do the authors refer to the choice of the microphysics scheme? What is the mentioned optimization? Author's response: In the COSMO-ART (and pre-processor) configuration, there are certain parameters/flags that are spatially-sensitive. Among others, these settings correspond to a better balancing of the pressure fields and to a tuning in precipitation, in accordance to the horizontal spatial resolution of 0.025 deg. Therefore, the input data remained intact, the microphysics scheme was not altered, but e.g. the mask for smoothing of steep orography is adjusted, the critical value for normalized over-saturation is adjusted and so on. It should be noted that these changes are imposed either by using 'true' or 'false' or by applying certain code numbering in specific flags of the model (and pre-processor) job scripts. In order to avoid further puzzling of readers, we have decided to remove the respective phrase from the document.

Line 9 32. Does "constant initial conditions" mean uniform initial conditions? Author's

response: Combining this with the next comment (no. 33), the phrase (p. 5 line 14) is now replaced by: "...the uniform (in space) and constant (in time) initial conditions (e.g. for SO2 and aerosol species)."

Table 1 33. It is not clear how the initial and boundary conditions for aerosols are defined. Are the values included in Table 1 uniform in space? Are those values kept constant at boundaries? Author's response: Yes to both. This is now better explained in text (cf. response to Comment no. 32).

2.3 Modifications of the aerosol emissions 34. Figure 2 is hardly understandable. Its quality should be improved. Author's response: all figures will be uploaded separately in high quality, following the ACP guidelines.

Page 6 Lines 21-23 35. Does the sentence "Combined with the temporal..." refer to Figure 2? Author's response: After this comment, the phrase (p. 7 lines 3-4) is modified for clarity as: "...in Figure 2. These rates, combined with the temporal profiles (Figure 1),..."

36. Does Figure 2 describe average emissions or do plotted values refer to a specific hour? Author's response: These are hourly emissions "for a night hour of a weekday (Tuesday, 21.00 UTC)", as indicated in the caption of the figure.

Lines 23-24 37. Maximum wood burning emissions are said to be located at the urban core, while it would be reasonable to expect to have maximum emissions over peripheral areas, where the access to wood should be easier that in the center. Author's response: In principle, population density is used as a spatial proxy in order to distribute wood combustion emissions (TNO report, 2010). The TNO-MACC_II emission database we have used for this study (Kuenen et al., 2014), uses a population map at high resolution, and a special proxy for the distribution of residential wood combustion. The latter takes into account both the population density, but also the proximity to wood (for more information on proxies for RWB, cf. Comment no. 7). Despite this combination for the distribution of residential wood combustion, an overallocation of the

emissions in urbanized centres is possible, as the reviewer also comments, which is already described in previous studies (Denier van der Gon et al., 2014 and Timmermans et al., 2013). We have now included this info in the text. (p. 7 lines 5-10).

2.4 The aerosol optical properties Page 7 Line 9 38. Concerning aerosols composition, it is not clear how the concentration values reported in brackets should be interpreted. Author's response: These are RWB smog period-averages of the respective hourly values measured at Thissio during the RWB periods of winter 2013-14. This is explained in the text, in the previous sentence: "...is based on observational data collected in Greece during the 2013-2014 RWB smog episodes. In particular, the average surface chemical composition of ultrafine aerosols in Athens (pure soot: 2.8 μg m-3, water soluble mixture of sulfate, nitrate, ammonium and organics: 22.2 μg m-3), local relative humidity (50-70 %) and an average mixing layer height (600 m a.g.l., Gerasopoulos et al., 2017), were used to feed the OPAC software (Hess et al., 1998), which then - by applying the Mie theory - provides the respective optical properties for 61 wavelengths between 0.25 and 40 μm". Thus, no interpretation should be extracted from these values; we provide information on the representative (average) values we used to calculate the aerosol optical properties for our case study.

Lines 15-18 39. The values used for Athens differ from those used by Vogel et al. (2009). Is the difference due to the geographic area of application or to any other understandable reason? Author's response: Yes, the difference is related both to the geographic area and to the selected events. The phrase (p. 7 lines 31-32) is now enriched as follows: "These values differ from the ones used in Vogel et al. (2009; black and red lines in Figure 3), which is expected due to the different geographical areas and periods of interest between the two studies."

40. To which geographic region do values reported by Takemura et al. refer? Author's response: They do not correspond to a specific area, but are used as model inputs for the model study of Takemura et al. (2002). Thus, they are directly comparable to our findings. This is now more clearly explained in p. 8 line 2).

3.1 Impacts of residential wood burning (RWB) on atmospheric aerosol mass and chemistry 3.1.1 Aerosol model performance under smog influence Page 8 Line 23 41. Do values reported in Table 3 as “daily mean” refer to the whole period mean as understood from the manuscript text? Author’s response: Yes, these are averaged daily mean values for the RWB smog sub-period of the simulation period. The phrase ‘averaged daily mean’ is now used instead of ‘daily mean’.

Page 9 Lines 1-2 42. How (on the basis of what parameters) is it evaluated the mentioned 70% improvement? Author’s response: The relevant phrase is now written as “Overall, the revised run shows improvements in the calculated PPEA values for more than the 70% of the day and nighttime PM10 peaks during the intense smog period.”, so that this question is answered in the manuscript (p. 9 lines 25-26).

Lines 10-11 43. The meaning of the sentence “which leads to the improvement of the half PM1 OA and of all PM1 BC the daytime peaks during the intense smog period” is not clear. Author’s response: The relevant phrase is now written as “The PPEA values for both carbonaceous species are significantly lower for case 2, i.e. for the half PM1OA and of all PM1BC the daytime peaks during the intense smog period”, so that its meaning is clear (p. 9 line 33 – p. 10 line 2).

3.1.2 Representative spatial aerosol fields Page 10 Lines 16-17 44. The reference to PM10 EU alarm threshold is not clear, please include proper references to EU directives. Author’s response: The reviewer is correct. The PM10 alarm value we refer to, is not suggested by any EU directive, but rather by the National Legislation (Joint Ministerial Decision by FEK 3272ÎŠ/23-12-2013, in Greek), which supplements the respective EU directive with respect to public information and emission reduction thresholds. The acronym ‘EU’ is now replaced with ‘National’ within text and a proper reference is added (p. 11 line 9). The same changes are now done for the alert threshold for the whole population (p. 6 line 29).

3.2 Impact of RWB smog on radiation Page 12 Lines 25-27 45. The sentence

concerning removal of absorbing BC is not very clear and should be rephrased to be more clearly understandable. Author’s response: This sentence (p. 13 lines 18-20) is now rephrased as: “. . .while the daytime mean was 98 μg m-3, 50% of which corresponding to RWB particles. By further subtracting the absorbing BC aerosols (14 μg m-3) from the RWB mean PM10 concentration value, it is found that. . .”

Please also note the supplement to this comment:
https://www.atmos-chem-phys-discuss.net/acp-2017-139/acp-2017-139-AC1-supplement.pdf

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