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Interactive comment on "Description and evaluation of the tropospheric aerosol scheme in the Integrated Forecasting System (IFS-AER, cycle 45R1) of ECMWF" *by* Samuel Rémy et al.

Anonymous Referee #3

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The paper presents a fairly comprehensive description of the aerosol scheme at use in the IFS-AER modeling system, some presentation of the system budget, and a basic level of validation against AERONET AOD observations and surface observations. The paper is generally well organized and complete. I have two substantive comments on the paper. The first is that many of the figures are not really publication quality in that they are titled/labeled with a lot of jargon that means something to the writers but not to anyone else. I noted those occasions below and suggest redoing those figures to remove the title text (or else writing it in a way that is sensible to the general reader). My second substantive comment is that there is a great deal of text written that does not pertain specifically to the IFS-AER operational configuration. I understand this from

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Discussion paper

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the point of view of explaining the possible permutations of the system, but it is hard in the end to reconstruct in my head the actual configuration used in the operational system, which seems to be the point. Table 10 is not sufficiently comprehensive in this sense. I suggest to please add a table, and maybe do it up front, that writes down the details of the IFS-AER operational configuration as a reference (chemistry or lack of, BB emissions altitude, and so forth, sea salt emission scheme, etc,.). Otherwise I was getting lost in the details.

Otherwise I have mainly minor comments listed below.

Page 3, line 28: implication of using online ARI Page 4, line 1: A point of clarification: is IFS "the" ECMWF forecasting system? And if so, isn't it run at a considerably higher than global 40 km resolution? So is IFS-AER run run at the same resolution as the operational NWP system or not? Page 4, line 32: I don't follow the counting of species, please clarify. 12 species when running standalone I guess excludes the "optional" nitrate. When running coupled do you move the SO2 to the chemistry but still count the sulfate species? Are you now counting the nitrate? Did you not note an ammonium tracer, implied in section 2.4? Assuming all of that my count is 3 dust + 3 sea salt + 4 carbon + 1 sulfate + 2 nitrate + 1 ammonium = 14. Please clarify. And what is the condition for running the optional nitrate? Here and elsewhere in the paper it is useful to state explicitly what is in IFS-AER cycle 45R1 which is the main point of the paper. The operational configuration would seem to be IFS-AER standalone. Page 6, line 1: Any citation for the partitioning of hydrophobic and hydrophilic carbon? Page 6, line 18: I think the reason given here for the scaling factors is not credible. What you are really doing here is using a scaling factor to tune the emissions to give best agreement with simulated AOD, and that in fact implicates all of the model physics (especially sink processes) as well as whatever optical parameters are used to go from dry aerosol mass to hydrated extinction efficiency. So what you are doing here is finding the model "perceived emissions" needed to converge on observed AOD. If it were simply a gas to particle factor it is not clear why this would be model dependent since you are not

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doing that chemistry. I suggest rewriting this sentence in the spirit of the “perceived” emissions as I describe above. Page 7, line 21: Figure 1 does not show anything about seasonality. Page 8: there is something missing (like a “x”) before the 10ˆ-6 in equation 3. Page 9, line 19: do you mean “two schemes”? Page 9, line 20: “mode” instead of “model” Page 9, line 21: two schemes? Why do you write “three”? Section 3.2: The presentation suggests there are no global tuning factors. Experience tells me this is usually not the case, and that models at least need a scaling factor as a function of spatial resolution. I’m also skeptical of the utility of comparing the predicted emissions to the G14 estimate. I won’t dismiss G14’s estimate of emissions, I haven’t read the paper, but generally my sense is that non-inventory emissions are not usually observationally constrained sufficiently and so (like for biomass burning and dust later) some tuning is done to get emissions that in your model improve agreement with AOD, which is observed. Figure 3: The title is best cropped from this figure as it uses jargon not discussed in the paper (“gzis”, etc.) Page 12, line 8: Please explain better the dynamic nature of the lifting threshold velocity. What does “emission capacity” mean? Can you please provide an equation? page 12, line 12: I think you mean equations 10/11 and not 13. Page 21, line 3: Please explain the statement about the connection to the vertical turbulent flux scheme. Are emissions just added to the model grid boxes (flux*time = mass changed to cell)? What does it mean surface fluxes are unchanged here? Page 23, line 31: How have these been addressed? Page 25, line 15: Do you mean the settling velocity is horizontal invariant? Constant in space is too broad, because you do have vertical variability (don’t you?) Page 26, line 1: What is the origin of the numbers in Table 8 for Di? Page 26, line 10: What are the “R” values in equation 42? Page 27, line 24: Please define OPAC and provide citation. This is first time you use the term OPAC. Page 31, Table 11: You mean parentheses and not hyphen at the end of the caption. Page 23, figure 10: you mean top and bottom in the caption Page 32, Section 8: Is aerosol data assimilation invoked in this analysis? Page 35, Figure 11: suggest again removing the title from the figure as it is inside jargon Page 36, figure 12: suggest again removing the title from the figure as it is inside jargon

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Page 36, line 12: Observed values of PM2.5 seem to reach 20 ug m-3, not 30. Page 37, Figure 13: suggest again removing the title from the figure as it is inside jargon Page 37, line 5: I am confused about the text here. i don't see a persistent low bias in the model throughout the year (red line = model higher than blue line = observations generally May - November) Page 38, Figure 14: same comment about figure title Page 39, Figure 15: same Page 40, Figure 16: same Page 41, Figure 17: same Page 42, Figure 18: same

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