

We thank our two reviewers for carefully reading our manuscript and supplying us with useful comments and constructive criticism.

Response to reviewer 2

In Page 1,

Line 5 “the field-of-view of ground-sites” is implied to be 10 km. In Page 2 Line 12 the AERONET is said to sample “no more than 5 km”. In fact, most of current ground-based aerosol measurements sample significantly shorter lengths over their native integration time (between 1s and minutes). The lengths are some centimeters or meters, depending chiefly on horizontal wind speed and secondarily on instrument flow rate and sunphotometer light collector width. Ground-based measurements represent a distance comparable to 10 km only if integrated over tens of minutes or a couple of hours. Perhaps the authors have an integration time of one hour in mind for the ground-based observations, as this is the temporal resolution of the simulations. This is very different from the native integration time and should be noted.

The reviewer is correct that the 10 km resolution of our models does not do full justice to the scales at which some observations are made. This is a limitation in our analysis and was discussed in our summary. We point out that, like many atmospheric properties, aerosol shows less variation on short length-scales than on larger length scales (power spectra of aerosol distributions in space or time show a typical power-law behavior). Consequently, we suspect that variability over 10 km will not substantially alter our conclusions (although our results may somewhat underestimate sampling errors).

A few words on the expression of differences and errors would be nice. The expression $(\text{observation} - \text{model}) / \text{model}$ (eq 4) produces numbers widely different from $(\text{model} - \text{observation}) / \text{observation}$ (e.g., +160% vs -62%). The latter expression encounters division by zero when the observation is zero, but is nonetheless fairly commonly used. I would recommend stating explicitly that the present study treats the model as the reference against which the “observation” is evaluated, and not the other way around.

For the reason given by the reviewer, we chose to use model data (210x210 box average) as the reference. This was explained in Sect. 3 but we now repeat it in the Summary and Introduction as well. We’ve also discussed this in more detail in Sect. 3.

Page 3. Line 20. Remove one of the two “from”.

Corrected

Page 3. Line 28. Replace “main island Japan” with “the largest island of Japan”. Japan has three more main islands.

While the reviewer is correct, the island we refer to is called Honshu, which means 'main island'. It would be identified as the main island by most Japanese. In the interest of non-Japanese readers we have changed the text to 'largest island'.

Page 4. Line 10. Move the first parenthesis to immediately before 2013.

Corrected

Page 4. Line 19. Move the first parenthesis to immediately before Seinfeld.

Corrected

Page 7. Line 20. I do not see the exception in Figure 6.

The bars to compare are the two orange bars in the left plot. The left bar is WRF-Chem, the right bar is EMEP. They are quite similar, certainly compared to the other bars in these plots. We have removed this line to prevent confusion.

Page 7. Line 29. "wet and dry and wet deposition" should read "wet and dry deposition" or "dry and wet deposition".

Corrected

Page 8. Line 17. Remove "e.g."

Corrected

Page 8. Line 26. I would think short life-time works to increase spatial heterogeneity, not decrease.

That is a good point. What we see in this simulation is low spatial but high temporal variation over Ocean. Presumably that is due to spatial correlations in rapidly varying windspeeds. In the current paper, only spatial sampling is considered and hence sampling errors over Ocean are small. In a paper that we are currently working on, also temporal sampling is considered which substantially increases errors over Ocean. We have corrected the text and removed reference to short life-times.

Page 10. Line 14. "Sofar" should read "So far". Also Line 27.

Corrected.

Page 11. Line 25. Remove the hyphen from "More-over".

Corrected

Page 13. Line 21. Replace no with not.

Corrected.