AMT-2013-175 Määttä, et al.: OMI aerosol model uncertainty

Anonymous Referee #2

Response to Referee #2

First, we would like to thank Referee for reading the manuscript and for useful and valuable comments and suggestions for improvements. They have been taken into account for improving the manuscript. Our point-by-point answers are found below.

> *A new method is proposed for the estimation of aerosol retrieval errors based on aerosol models. This method is well supported by theoretical considerations and appears to be applicable in a wider scope than discussed, i.e. to retrievals where the parameter space is not sampled continuously. The manuscript needs some modifications in the phrasing to improve comprehensibility.*
> *The manuscript is well suited for publication in AMT. I recommend publication after the minor issues specified below are adressed.*
> *1. The term 'model' is overused to a degree that the manuscript becomes hard to read. Please modify the text. It is proposed to introduce and consistently use throughout the text the acronym AM for aerosol model, to use the term 'describe', 'simulate', or other instead of 'model' whenever applicable;*

You are right. As suggested, we have modified the text by reducing the term 'model' appearance in the manuscript, and more carefully defined the different sources of modelling error and uncertainties we are dealing with. Furthermore, we now use "aerosol microphysical model" instead of "aerosol model".

> *2. p. 8510 l. 16 typo desSert;*

Corrected

> *3. p. 8512 l. 14 please introduce 'model discrepancy';*

As model discrepancy, we mean all uncertainties in the results not directly attributed to the measurement noise, both systematic and non-systematic. We have now defined this term more accurately in the revised manuscript.

> *4. p. 8516 l. 5 please add to the definition of 's' ... of the atmosphere as seen from below;*

We have revised the definition of s to be "spherical albedo s of the atmosphere as seen from below"

> *5. Section 3.1, 3.2: please make more clear why you need to introduce the 'evidence'. The weighted averaging is made using as weight the term p(m_i | R_obs). Can this term be evaluated directly?;*

The term evidence refers to the denominator in the Bayes' formula. It is the probability of the observations given the model. The "inverted" probabilities, i.e. the probability of a model given the observations cannot be calculated directly. When the prior probabilities for

individual models are equal we can work directly with the evidence, however, as then the relative evidences are the same as the relative posterior probabilities. The relative evidence between two models is sometimes called the Bayes factor in statistical literature. We have tried to make this clearer in the new revision.

6. Equation (5) typo: '|' is missing;
7. Equation (5) typo: '|' is missing;

Corrected

8. p. 8520 l. 19 typo: To acknowledgING;

Corrected: "To account for"

9. p. 8521 l. 15 please rephrase to improve readability;

As suggested, we have rephrased the first sentence of Section 4.1. as "Following Kennedy and O'Hagan (2001), we use a Gaussian process approach to describe the model discrepancy term $\eta(\lambda)$ originated from the difference between the aerosol model generated reflectance and the observations."

10. p. 8522 l. 8 and 9 typo? why 'spatial' and not 'spectral'?;

You are right. We have replaced spatial with spectral in the revised version of the manuscript.

11. p. 8522 Why is sigma_0 introduced? sigma_0 seems to describe solely the uncorrelated error, which is represented by epsilon and hence does not need to be captured by eta. Later, sigma is found to be zero emirically. It seems obsolete.;

In spatial statistics Sigma_0 is used to model "non-spatial" or small scale variability in the process we are interested in, which is not related to measurement uncertainty. Here, the interpretation is little different. Sigma_0 is used to allow extra diagonal variance in addition to the observation noise. It also might be used to correct underestimated observation noise if necessary. The original manuscript had an error here, too. In fact, we have used a small positive value Sigma_0 = 1e-6. We thank the Referee for pointing this and it is corrected in the revised manuscript.

12. p. 8525 l. 15 to 22, paragraph seems misplaced. Should it appear earlier and on a higher level?;

We agree. In the revised version of the manuscript this paragraph will appear earlier in the text, in the end of Sect. 3.1. But, we also kept some sentences in the original place to recall how we defined prior distributions used in our example cases.