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Interactive comment on "A review and framework for the evaluation of pixel-level uncertainty estimates in satellite aerosol remote sensing" *by* Andrew M. Sayer et al.

Andrew Sayer

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Dear Oleg,

Thank you for these comments. As I led the drafting of the paper, I am most directly responsible for the wording you are commenting on, and so thought I should post a response.

Your first main comment was on this sentence: "While notation differs between authors (cf. Thomas et al., 2009; Dubovik et al., 2011; Govaerts and Luffarelli, 2018), following Rodgers (2000) a general form of the cost function J can be written:" The wording

there was intended to state merely that we are following Rodgers's notation, and was not meant to imply that the full formulation below came from Clive's book. However I totally understand how you could have got that impression from reading the text as written, and so I am sorry about that. That was poor wording on my part and I should have been more careful given prior discussions. I agree with you that the formalism in the book doesn't extend to the additional smoothness constraints, and yes, as far as I am aware, the first application of these additional constraints in aerosol remote sensing was from your AERONET work. So when revising the paper we will change this sentence, and expand the paragraph afterwards to go more into the heritage (via some of the papers you mention).

Your second comment concerns systematic vs. random errors. Here, I partially agree with you, and partially disagree. From the point of view of uncertainty propagation, approaches such as Optimal Estimation can deal with systematic uncertainty sources via off-diagonal elements of the covariance matrices. This was only briefly mentioned, though, so again this could be emphasised more in the revised manuscript. We can also expand the discussion on prior constraints a little to emphasise the problems if these are not appropriate (e.g. the wrong strength, or systematically biased). This was touched on in the first and second points of the enumerated list in section 2.2.1 but could certainly be expanded a little. From the point of view of output uncertainty estimate evaluation (i.e. analysis of uncertainty estimates with respect to retrieval errors), I agree that the plots like Figure 7 assess only total uncertainty/error and do not split out random vs. systematic components. However, other parts of the analysis (e.g. left part of Figure 3, x-axis of Figure 9) do allow an analysis of whether retrievals are systematically biased at the same time as looking at random and total error.

Best wishes,

Andy