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Discussions

Interactive comment on "Vertical level selection for temperature and trace gas profile retrievals using IASI" *by* R. A. Vincent et al.

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Dr. Worden, thank you very much for your comments on this paper. Detailed responses will be summarized in the final author response. However, we wanted to address your primary comment about the presented vertical selection method using degrees of freedom for signal, DFS, while also mentioning 'information content.' You also state that the phrase 'information content' refers to the reduction of variances of the posterior covariance with respect to the variances in the prior covariance, which is also a commonly used metric.

Perhaps the phrase 'information content' is misleading in the context used. This phrase was used to mean information in the general sense. Surely, the DFS can be thought

of as a scalar metric of information. There are at least two other scalar metrics of information that could be used instead of the DFS for this vertical selection method. The three to consider are:

1. Degrees of freedom for signal: $d_s = \mathrm{tr}(\mathbf{A})$, which gives the number of independent quantities that can be measured.

2. Shannon information content (bits): $H = -\frac{1}{2}\ln|\mathbf{I_n} - \mathbf{A}|$, where 2^H gives the number of different atmospheric states that can be distinguished.

3. Fisher information matrix: $\mathbf{F} = \hat{\mathbf{S}}^{-1}$ in the Gaussian linear case. The trace of $\mathbf{F}$ can be maximized, which is the same as minimizing the sum of the posterior variances.

All three are possible information metrics to consider when reducing the state space while maximizing some aspect of information. In this case we consider vertical profile levels of atmospheric constituents. Here, DFS is the most appropriate metric because it can be directly compared to the number of states estimated so as to minimize prior artefacting. When the DFS is approximately equal to the number of states, then little prior knowledge appears in the retrieved estimates.

To address this in the revised submission we will avoid using the phrase 'information content' so as not to be confused with the Shannon information content and just use 'information' in the general sense. We will also include a brief discussion of these other possible information metrics that could be used and why the DFS is the most appropriate for this particular case.

Thank you again for highlighting this facet of the proposed method.

Interactive comment on Atmos. Meas. Tech. Discuss., 8, 2591, 2015.