

Review of ACPD-12-28305-2012 “Quantitative comparison of the variability in observed and simulated shortwave reflectance” by Y.L. Roberts et al.

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The observed shortwave radiances from SCIAMACHY and simulated counterparts from a CLARREO OSSE are compared with each other in terms of the spatial-spectral variability to assess to what extent the simulated spectral variability resembles the observed one. The PCA is used in such comparison. Qualitative comparisons and evaluations of the leading PCs are discussed first, followed by a more quantitative comparison of the PCA results. The authors show that the simulated radiances can largely capture the spectral variability as observed by SCIAMACHY, supporting the validity of such OSSE in the planning of climate observing system such as CLARREO.

Overall this is a well written manuscript. The description and discussion are solid and convincing, the figures are well presented, and the references are comprehensive and well cited. It is a pleasure to read through the manuscript. This work can be deemed as a follow-up work from Roberts et al. (2011), meanwhile it is an important study that advances our understanding of the merit of OSSE. I have some minor comments on the context. I recommend the acceptance of this paper after these minor comments are addressed.

1. Line 12 on page 28306: “PCA is a multivariate spectral decomposition technique”. “spectral” should be removed here. PCA is a multivariate decomposition technique, not relying on spectral decomposition such as Fourier transform and not being limited to study spectral radiances alone.

2. The first paragraph of Section 1. This paragraph started with net radiative forcing. Note the radiative forcing defined in the IPCC is not the same as what described here: it is not merely the imbalance at the top of tropopause; the stratosphere must be adjusted back to equilibrium in such calculation of radiative forcing. Then when it comes to “Hansen et al. (2011) estimated the global radiative imbalance between 2005 and 2010 to be $0.58 \pm 0.15 \text{ Wm}^{-2}$...”, it talks about the radiative imbalance at the top of atmosphere, not at tropopause. Moreover, the radiative forcing and radiative imbalance discussed in this paragraph has only remote connection with the theme of this study. I feel this paragraph is not that well delivered and not that related to the topic of this study. Maybe a rewrite would be better, or simply remove it. Actually even the section starts with the second paragraph, it seems to me totally fine.

3. Line 14 on page 28312, Anderson et al. 1999 is a reference for MODTRAN4 not MODTRAN5.3. MODTRAN5 has significant changes from the previous version. Appropriate references for MODTRAN5 can be found at http://modtran5.com/faqs/index.html#what_ref

4. Section 3.1.3, “Boundary between data signal and noise”. The authors nicely summarized different methods for deciding the truncation of PCs. The orthogonal nature of PCA technique decides that, regardless which PC components to be examined, it always contains some noise components as well as some signals. Only difference is the percentage of signals in that particular PC. In another word, such global decomposition methods such as PCA and SVD cannot really definite a boundary between data signal and noise. The best they can do is to find a truncation that retains most signals (inevitably some noises, even small, will be retained as well). For the benefit of readers, it would be useful to spend one or two sentences to point out this caveat.

5. Still in Section 3.1.3, Jerry North has a seminal paper (North et al., 1982, Month Weather Rev.) that gave a rule of thumb for the sampling errors in the estimation of empirical orthogonal functions. The rule can be used to decide the truncation as well. It has been widely used in the climate community. Might worth to include this method here as well.