

## Interactive comment on “Mid-upper tropospheric methane retrieval from IASI and its validation” by X. Xiong et al.

Response to comments by S.M. Illingworth (samuel.illingworth@manchester.ac.uk)

SC: Overall, I thought this was a very well written and informative paper that makes a good argument for the importance of satellite retrieved CH<sub>4</sub> products, and highlights well the sensitivity of satellite based remote sensing techniques to tropospheric and stratospheric concentrations of methane. However, there were a couple of issues that I needed further clarification on:

1. On page 2511 lines 16-22, you state that as Averaging Kernels (AKs) were not available for each of the individual retrievals, monthly mean AKs were used instead in order to convolve the HIPPO measured profiles onto that used by the NOAA retrieval scheme, so that a like-for-like comparison could be made. In performing the necessary convolution, the use of monthly averaging kernels in the application of Eq.4 seems to me to be a less than ideal solution. Whilst you state that they the NOASS CLASS outputs do not incorporate individual AKs, would a sensitivity study be needed, so as to highlight the effect that using monthly averaged rather than specific AKs has on the convolution? In the future could the outputs of the operational system be modified to include individual AKs as a product?

A: To evaluate the error due to the use of the mean averaging kernels, in Section 3.2, we added eq.(5) and estimated the error is less than 0.6% :

The error due to the use of the mean averaging kernels ( $\bar{A}$ ) can be estimated as:

$$\Delta\hat{x} = (A - \bar{A})(x - x_a) \quad (5)$$

We found that the difference between  $x_a$ , the first guess, and  $x$ , in situ aircraft measurement profile from HIPPO, is mostly less than 3%. With an estimate of the variation of averaging kernels within one month is less than 20%, the error due to the use of the mean averaging kernels are less than 0.6%.

SC: 2. From Fig.7 (RHS), the a priori (dotted green line) actually appears to be doing a better job of capturing both the truth (red dots) and smoothed truth (purple lines). Is this actually the case, and if so what information is being added to the retrieval? Also, would an inclusion of the a priori error bars given an indication of the skill of the retrieval scheme in reducing error (from a priori to retrieved)?

A: I agree. Obviously, this is not a good case to show, as the first guess is too close to in situ observation (too good). To better demonstrate the performance of the retrieval, we changed it to another case on April 3, 2010, and re-plotted Fig.7. Different from other retrievals that need to give the variability of first guess in the a-priori, this is not needed in the NOAA retrieval, so we cannot add the priori error bars.

SC: I also noticed a slight technical error on pg 2511 line 1, which I believe should read: “where  $I$  is the identity matrix ...”

A: These corrections have been made as suggested.