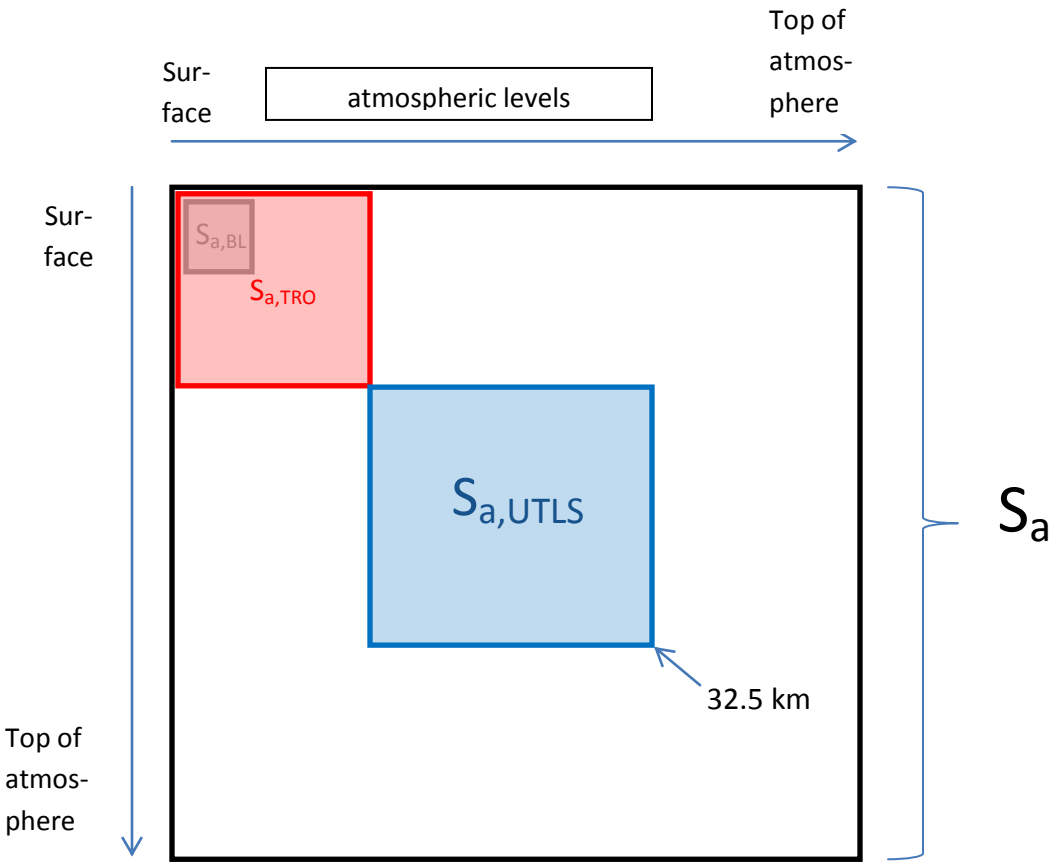
We thank the referee for the quick feedback and hope to clarify their questions with this response.

Concerning Equations (5), (6) and (7). The interpretation as interference error is not sufficient. Please describe the details of the relation Sa = Sa,BL + Sa,TRO + Sa,UTLS. Are these block diagonal matrices? What is the dimension of these matrices? If the matrices are block-diagonal, indicate where Sa,(BL,TRO,UTLS) have non-vanishing components.

The following schematics explains the non-vanishing components of $S_a = S_{a,BL} + S_{a,TRO} + S_{a,UTLS}$. All covariance matrices (S_a, $S_{a,BL}$, $S_{a,TRO}$, and $S_{a,UTLS}$) have the same dimensions. The dimension is number of atmospheric levels x number of atmospheric levels (i.e., they are for the full atmospheric CH4 state vector). The filled areas as depicted in the schematics are the blocks with non-vanishing entries.



The reference to equations (7) and (8) in the 2003 paper could make sense (they extract from the full state vector two components: the profile component and the extra elements). Do you extract only the tropospheric components of the retrieved profile? If so indicate this and a notation change is required: the A in equation (5) is not the same as in equations (6) or (7) or as in equation (9) (where also stratospheric components are considered). If not, a detailed description of the decomposition of Sa is required to understand the structure of equations (5), (6) and (7), i.e. why TRO is treated differently.

We work with the full CH4 state vector. In all equations A is the same. It is the averaging kernel matrix for the full state vector.

We want to measure the signals that are characterised by the covariance $0*S_{a,BL}*0 + I*S_{a,TRO}*I + 0*S_{a,UTLS}*0 = S_{a,TRO}$. However, the remote sensing system detects $A*S_a*A^T = A*S_{a,BL}*A^T + A*S_{a,TRO}*A^T + A*S_{a,UTLS}*A^T$. In consequence the error covariance is $A*S_{a,BL}*A^T + (A-I)*S_{a,TRO}*(A-I)^T + A*S_{a,UTLS}*A^T$, as given in equations (5) – (7).

Concerning equations (9) – (11), we split into the tropospheric and the stratospheric state vector: A_{TT} in equation (9) means the tropospheric part (from the surface up to the tropopause) and A_{SS} the stratospheric part (from the tropopause to the top of atmosphere). A separation into three components like troposphere, UTLS, and altitudes above the UTLS (for instance 32.5km – top of atmosphere) could be made, but would complicate the formulae and not significantly affect the results, since above 32.5km the surface row kernels have extremely low entries (see right panel of Fig. 4).