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Corrigendum to

"On the statistical optimality of CO_2 atmospheric inversions assimilating CO_2 column retrievals" published in Atmos. Chem. Phys., 15, 11133–11145, 2015

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The title, abstract, introduction, practical results and concluding discussion of the paper deal with the column-average dry-air mole fraction of CO_2 ($X CO_2$), but Sect. 2, which covers theoretical aspects, develops the equations for the assimilation of the CO_2 profile. The motivation behind this inconsistency was to simplify the equations by not including the total column operator t. However, this cosmetic choice was not appropriate. Indeed, Eq. (1) offers more reformulation possibilities than suggested in the text, for instance because $\check{\mathbf{K}}$ is included in $\widehat{\mathbf{H}}'$ and in $\check{\mathbf{R}}'$. Some colleagues could demonstrate that the requirements given by Eqs. (7) and (8) as they are written are not needed (D. Baker, S. Basu and C. O'Dell, personal communication, 2015). The situation is different for $X CO_2$ because the total column operator t prevents smart rearrangements of the terms and the denominator of Eq. (5) can unambiguously be identified in Eq. (6). In order to enable Sect. 2 to focus on $X CO_2$, $\widehat{\mathbf{y}}$, $\widehat{\mathbf{y}}'$ and $\widehat{\mathbf{R}}$ have to be defined as column quantities by applying operator t: $\widehat{\mathbf{y}} = t^T \check{x}^{\mathrm{a}}$, $\widehat{\mathbf{y}}' = t^T \check{x}^{\mathrm{a}} - t^T (\mathbf{I} - \check{\mathbf{K}}\check{\mathbf{H}})\check{x}^{\mathrm{b}}$ and $\widehat{\mathbf{R}} = t^T \mathbf{A} t$. $\check{\mathbf{K}}$ should also be replaced by $t^T \check{\mathbf{K}}$ everywhere in the section, including when it is expanded in Eqs. (6) and (8); therefore, Eqs. (6) and (8) now read

$$\widehat{\mathbf{K}}' t^T \check{\mathbf{K}} =$$
$$\widehat{\mathbf{B}}\widehat{\mathbf{H}}'^T (\widehat{\mathbf{H}}'\widehat{\mathbf{B}}\widehat{\mathbf{H}}'^T + \widehat{\mathbf{R}}')^{-1} t^T \check{\mathbf{B}}\check{\mathbf{H}}^T (\check{\mathbf{H}}\check{\mathbf{B}}\check{\mathbf{H}}^T + \check{\mathbf{R}})^{-1}, \qquad (6)$$
$$\check{\mathbf{H}}^T \check{\mathbf{K}}^T t (t^T \check{\mathbf{K}}\check{\mathbf{H}}\check{\mathbf{B}}\check{\mathbf{H}}^T \check{\mathbf{K}}^T t + \widehat{\mathbf{R}}')^{-1} t^T \check{\mathbf{B}} = \mathbf{I}. \qquad (7)$$

Note that t is not invertible.

The sentences "In practice, the retrieval averaging kernel for profiles is far from unity because current radiance measurements do not provide any vertical resolution for CO_2. The situation is better if the state vector $\check{x}$ is the integrated column (in that case $\check{\mathbf{H}}$ includes an operator to distribute the column in the vertical)" are no longer appropriate and should be deleted.