A TANSO data: version v.1 versus version v.2.0

To better examine the behaviour of the TANSO experiment during the change of the version of the assimilated data, we studied the month of October 2011 during which we had the two data sets (version v.1 and v.2.0). Figure 5 (left) presents the average gridded difference between the xCH_4 product of version v.2.0 and version v.1 for the whole month. Apart from East Europe the differences are small with both positive and negative values. In average, version v.2.0 has nevertheless higher xCH_4 values compared to version v.1, with a mean difference of 4 ppb. This difference drops to 2 ppb if we exclude latitude above $30°N$. This difference does not explain anyhow by itself the behaviour of the TANSO experiment. We thus made another experiment, referred to as TANSO.V.1 experiment, starting from the same initial condition as for the TANSO experiment on the 1 October 2011, but assimilating the version v.1 of the TANSO data (while the TANSO experiment was assimilating the version v.2.0 of the data from the 1 October 2011).

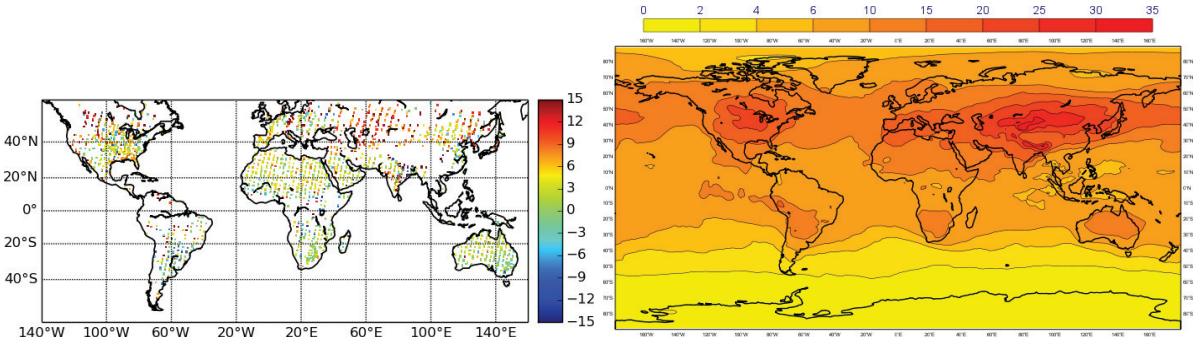

Figure 5: Left: average difference (in ppb) between the version v.2.0 and the version v.1 of the xCH_4 product from TANSO. Right: Dry molar fraction average column difference (in ppb) between the TANSO *experiment and the* TANSO.V.1 *experiment. The differences are averaged over the month of October 2011.*

We found that the average difference between the two analyses is in average 8.5 ppb (Fig. 5 Right) which is more than twice the difference between the assimilated observations. Even if the difference between the two analyses has a similar pattern as the difference between the two assimilated data sets (e.g. higher values over East Europe), the difference in the TANSO products can not explain the difference in the analyses.

The differences between the analyses come in fact from the averaging kernel information as illustrated by Fig. 6 (left). The two versions of the TANSO product provide a similar information (blue and red dots). The analyses of the two versions also provide similar information in the observation space (using the averaging kernel information, plain lines). In the model space (computing the molar fraction average column), the two analyses differ by about 20 ppb (dotted lines), the analysis of the version v.1 being lower.

We did the same but for the comparison with the TCCON data at Park Falls (Fig. 6 right). From the two analyses (TANSO experiment and TANSO.V.1 experiment) in the nearest grid point to Park Falls, we computed the columns (dashed lines). When a TCCON data was available, we computed the model equivalent using the TCCON a priori information. Then we computed the daily average of these quantities (small dots) as well as the daily average of the TCCON data (black dots).

As seen previously, the two analyses differ by about 20 ppb in terms of average column. When

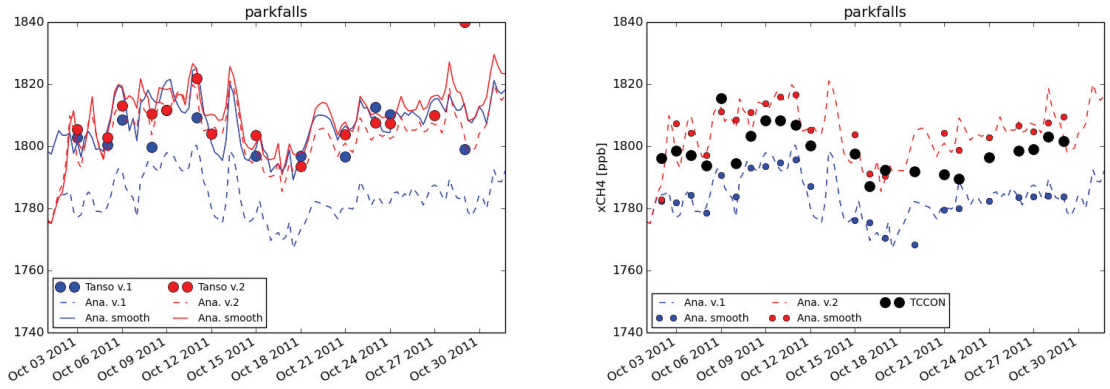

Figure 6: Time series of the TCCON, TANSO data and model data near Park Falls (45.945° N, 90.273° W). **Left***: the plotted TANSO data are the daily average of the data found within a radius of 2° around Park Falls: (blue dots) version v.1, (red dots) version v.2.0. The model data come from the nearest grid point of Park Falls. The dotted lines are the molar fraction average column computed from the analyses: (blue) analysis of version v.1 TANSO data, (red) analysis of version v.2.0. The solid lines are the smoothed columns using the data averaging kernel information: (blue) analysis of version v.1 TANSO data, (red) analysis of version v.2.0.* **Right***: Black dots: TCCON measurements. Dotted lines: molar fraction average column computed from the analysis of version v.1 TANSO data (blue) and analysis of version v.2.0 (red). Small dots: smoothed columns using the TCCON averaging kernel information.*

applying the TCCON a priori information, the difference remains the same. And the TANSO experiment compares better with the TCCON measurement than the TANSO.V.1 experiment.

In conclusions, the two versions of the TANSO data are similar even if the version v.2.0 has slightly highest values in average. The difference in the analyses projected in the observation space (using the averaging kernel information of the two version respectively) are also similar. But in the model space the columns differ substantially.