

Supplementary materials for

“Latitude-time variations of atmospheric column abundances of CO₂, CH₄ and N₂O”

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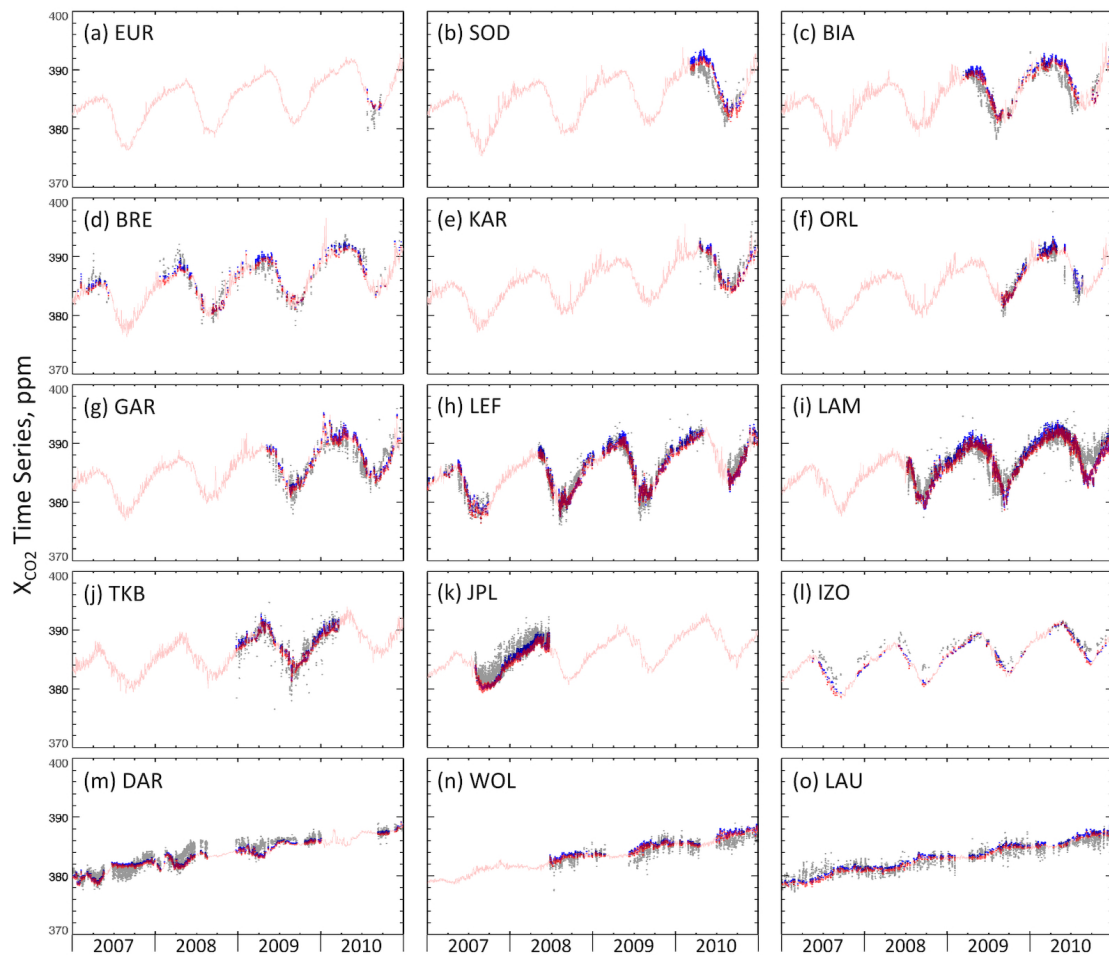


Figure S1: Comparisons of TCCON measurement (black dots) and ACTM-simulation smoothed by averaging kernels and a priori profiles (red dots) for X_{CO_2} at all the sites considered in this study. Only a sub-set of sites are presented in Fig. 4.

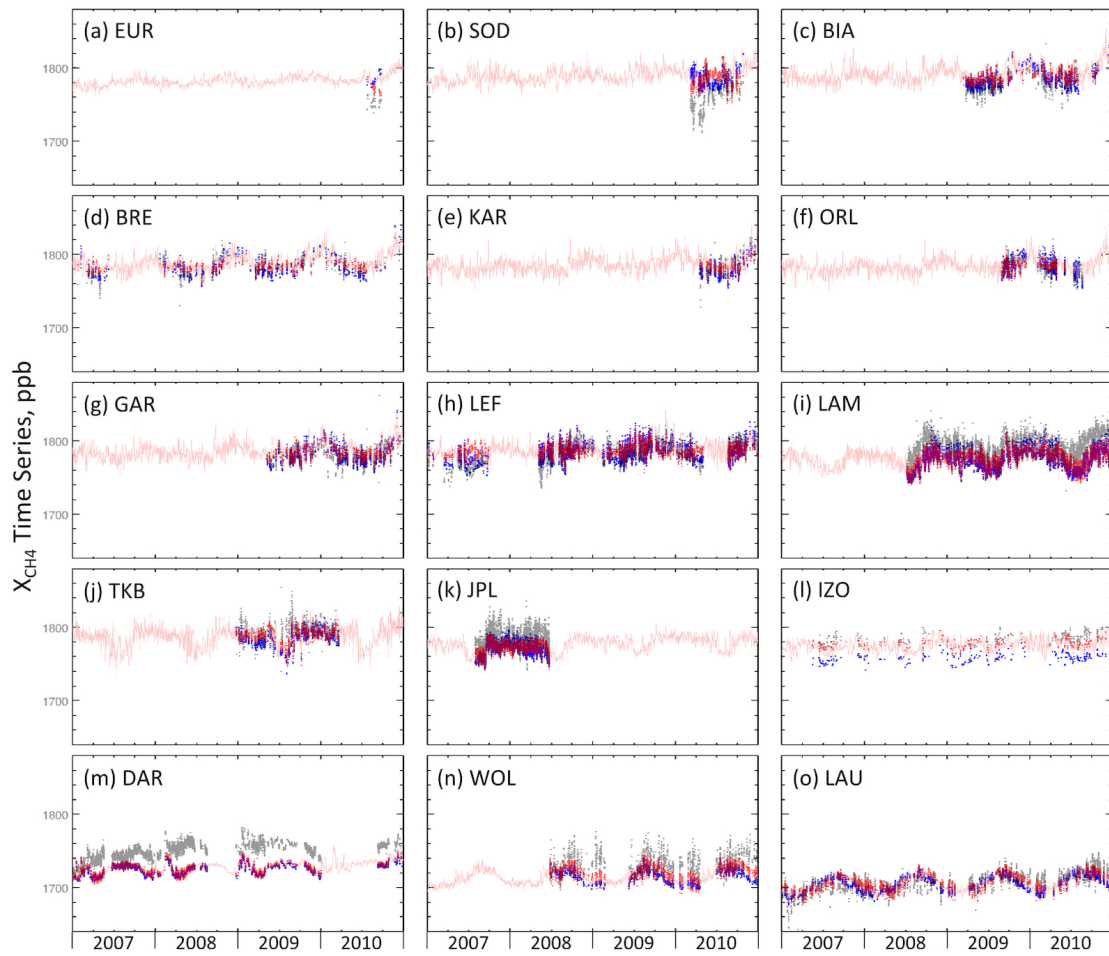


Figure S2: Same as Fig. S1, but for time series of X_{CH_4} .

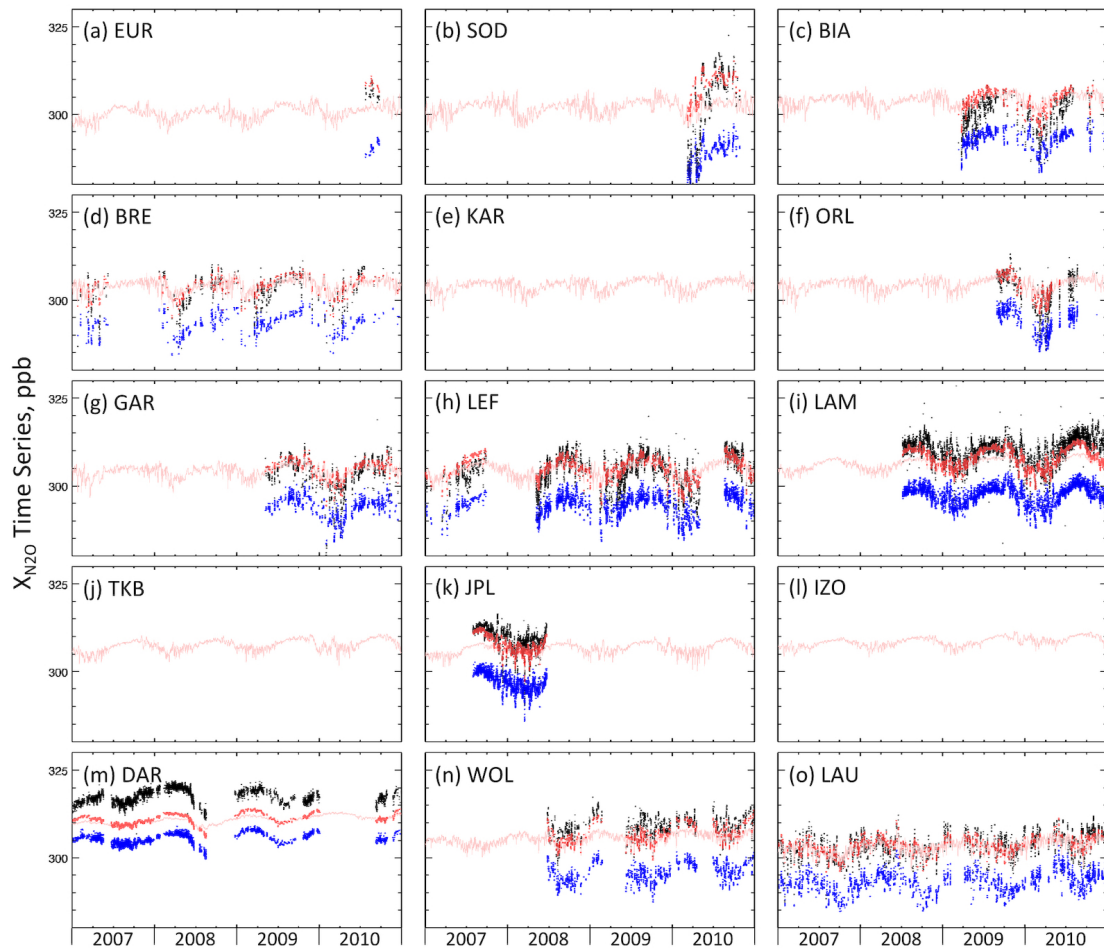


Figure S3: Same as Fig. S1, but for time series of X_{N_2O} .

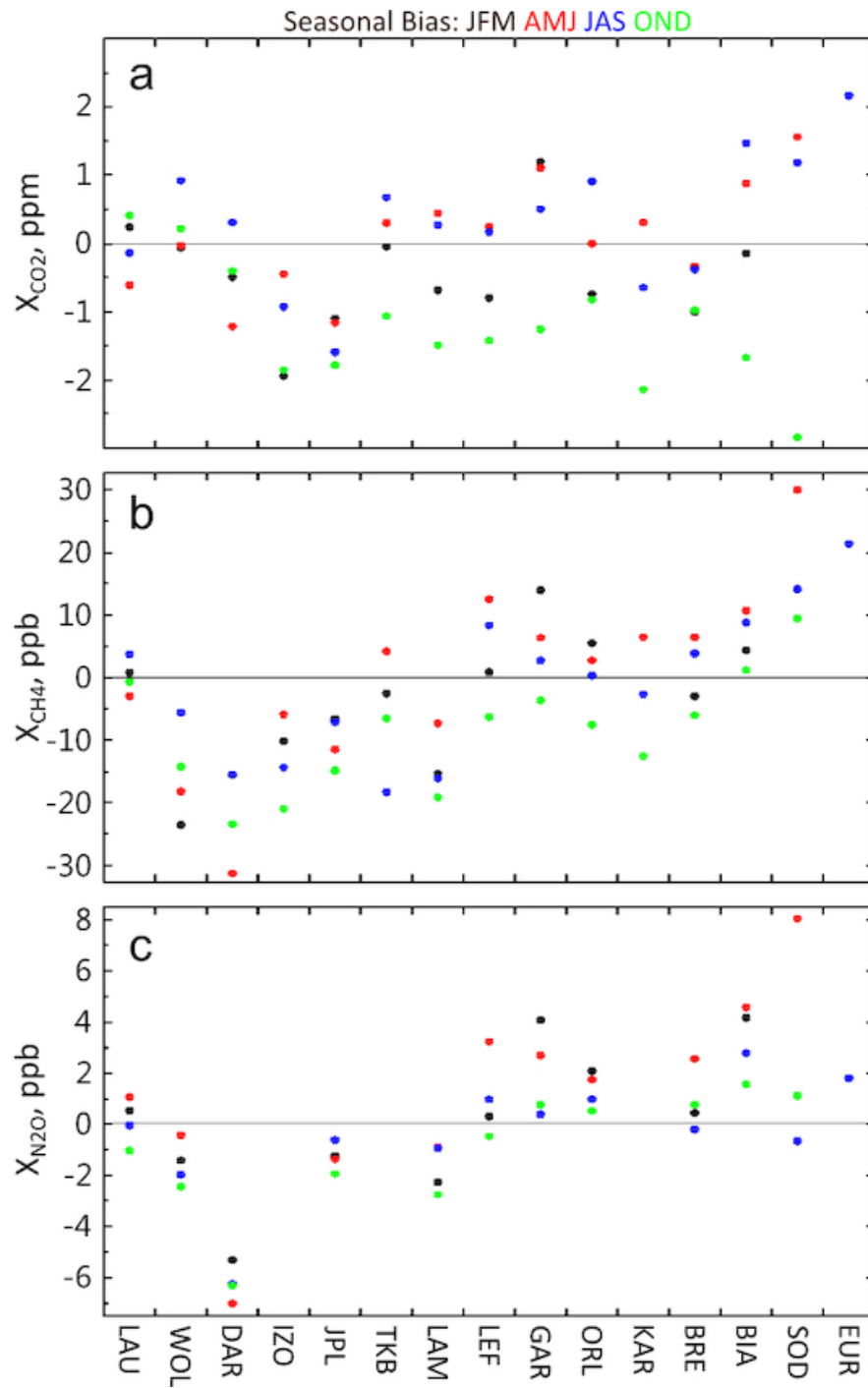


Figure 4: Variations in bias b between seasons: January-March (JFM; black), April-June (AMJ; red), July-September (JAS; blue) and October-December (OND; green).

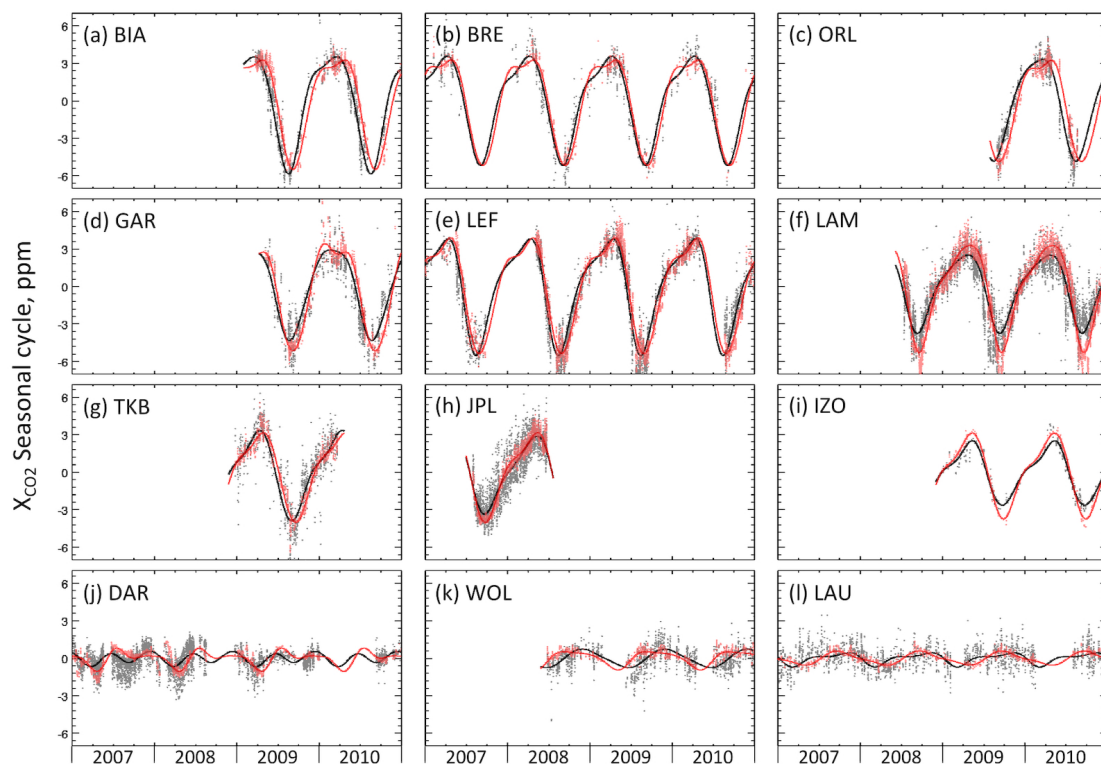


Figure S5: Seasonal cycles of X_{CO_2} are compared for ACTM and TCCON time series (smoothed lines for [fitted curve – long-term trends], and dots are for [original time series – long-term trends]). The seasonal cycles for EUR, SOD and KAR are not depicted because the time series are too short for fitting (ref. main text).

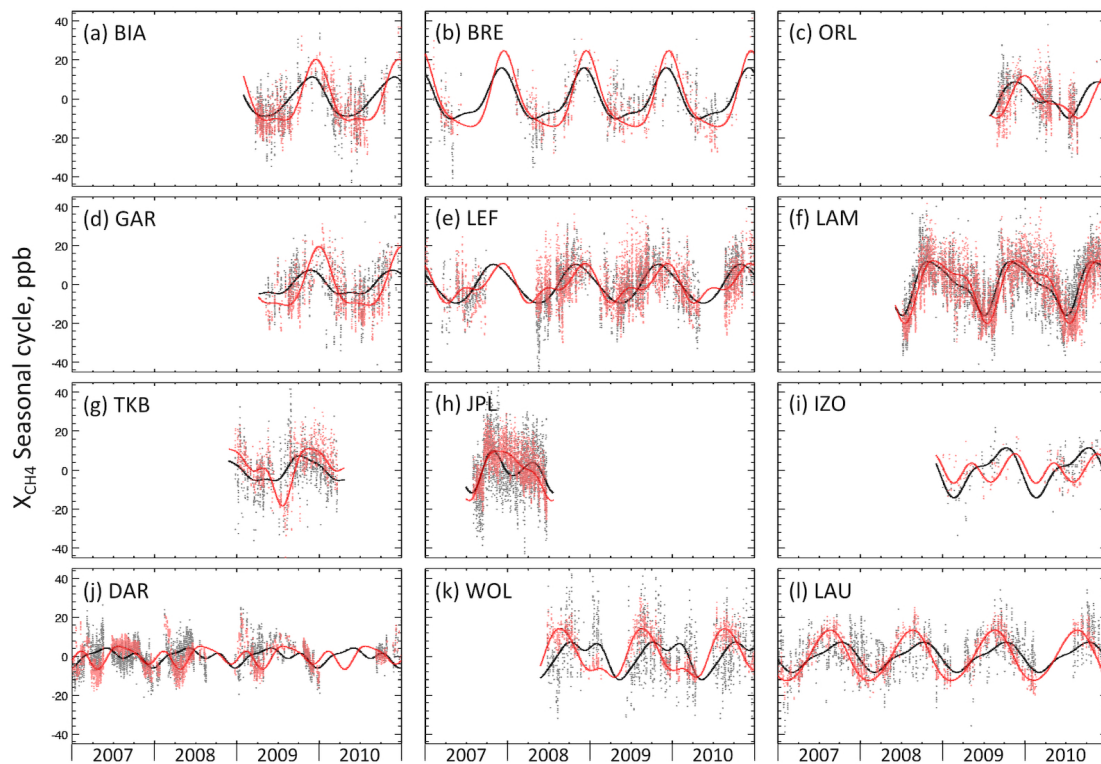


Figure S6: Same as Fig. S5, but the seasonal cycles of X_{CH_4} are shown.

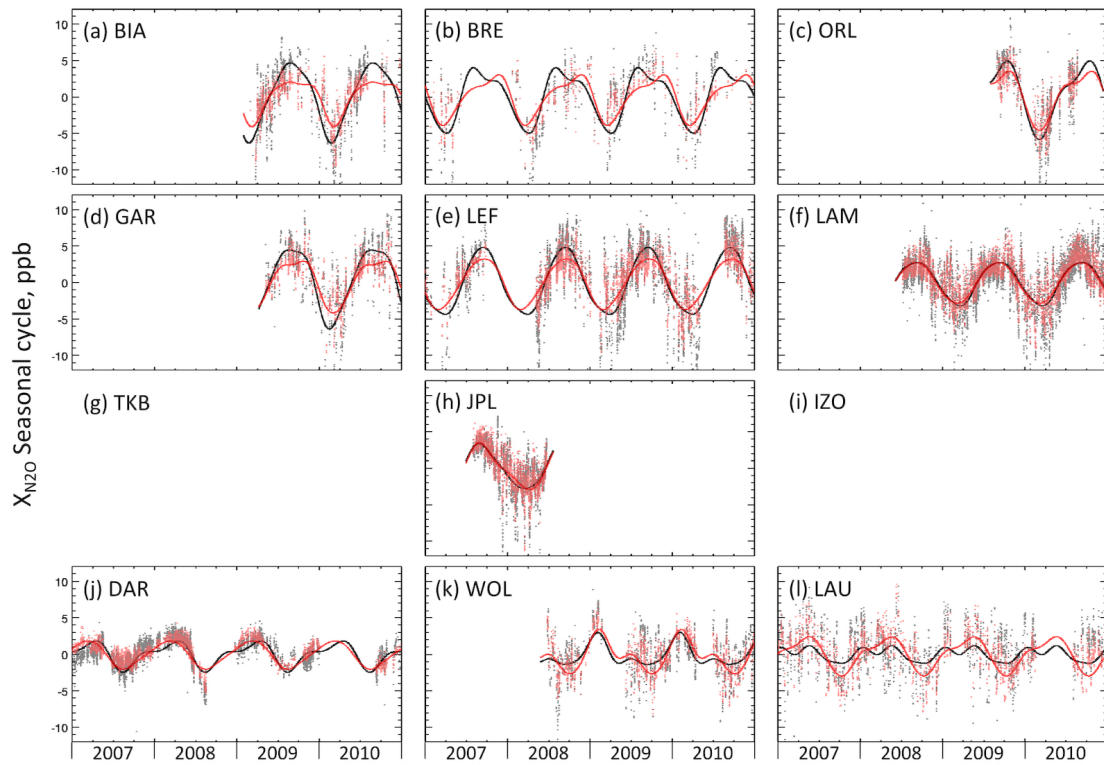


Figure S7: Same as Fig. S5, but the seasonal cycles of X_{N_2O} are shown. No X_{N_2O} data are retrieved for KAR, TKB and IZO.

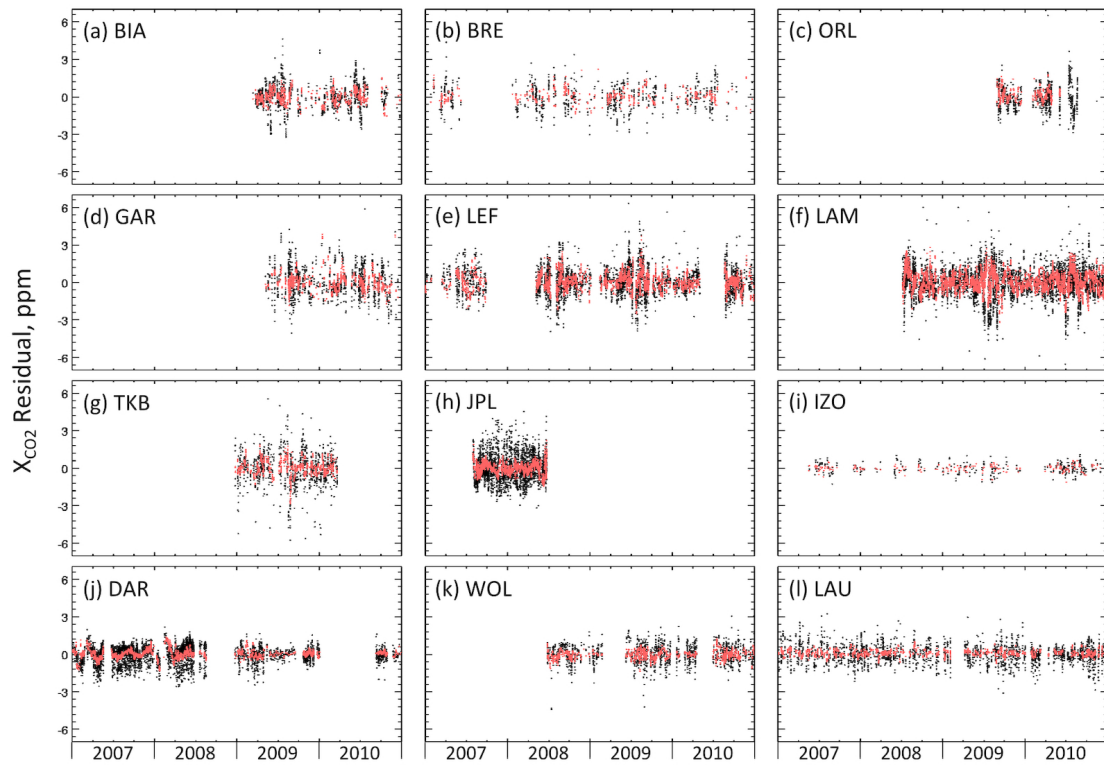


Figure S8: Time series of X_{CO_2} residuals (original time series – fitted curve)

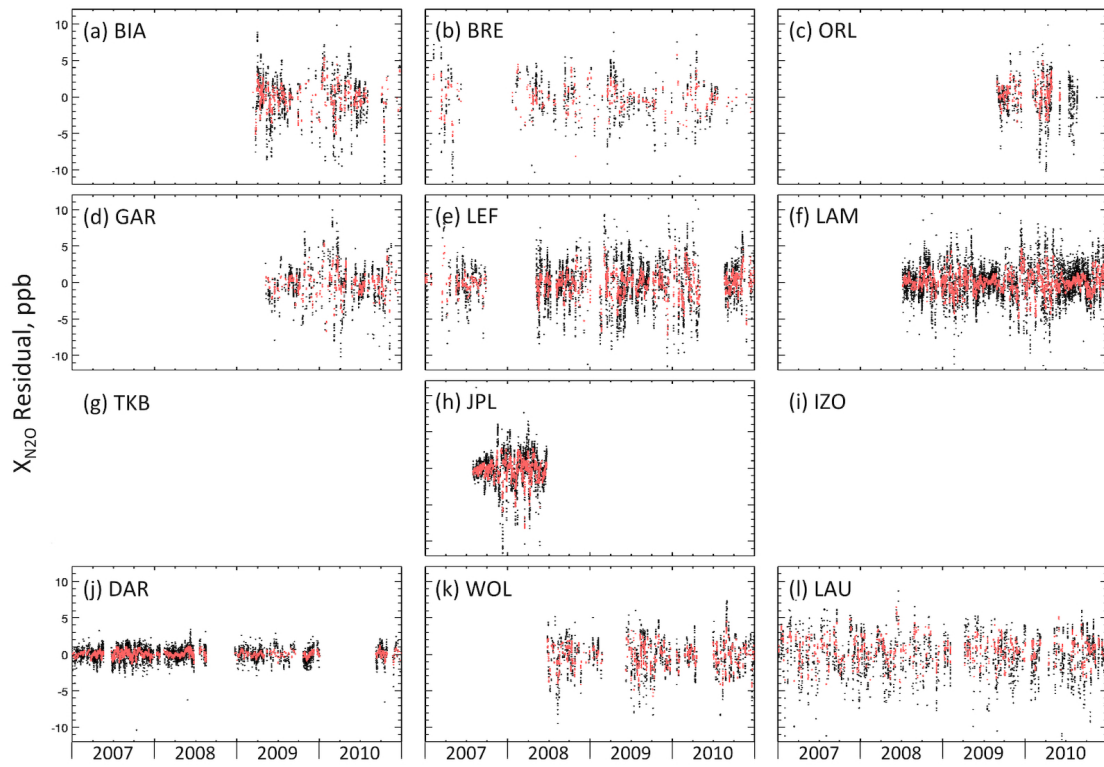


Figure S9: Time series of X_{CH_4} residuals.

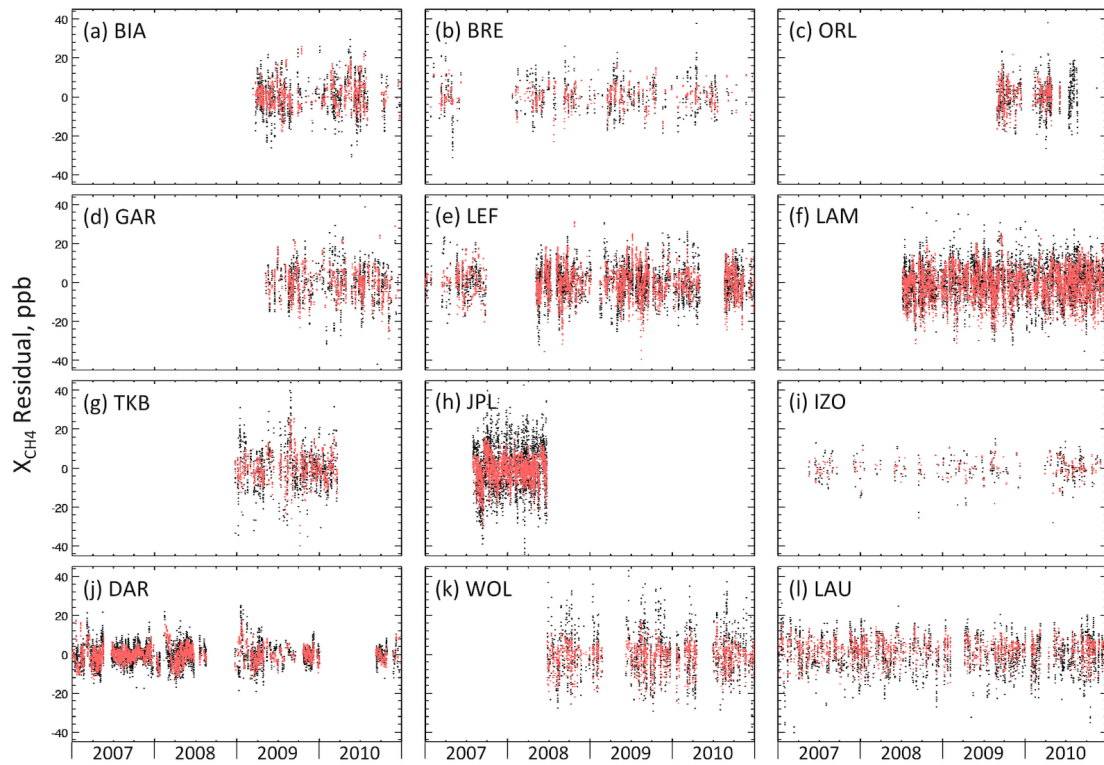


Figure S10: Time series of X_{N_2O} residuals.

We have also calculated the partial columns, normalized by the surface pressure, as opposed to normalization by the partial pressures of the troposphere and stratosphere (Eqn. 2 and 3). The tropopause height over the FTS sites are chosen to vary with month as well as kept constant at the annual mean tropopause height.

$$X_{y,tropo} = PC_{y,tropo}/P_s \quad (\text{Eqn. S2})$$

$$X_{y,strato} = PC_{y,strato}/P_s \quad (\text{Eqn. S3})$$

In this calculation the tropospheric and stratospheric partial columns add to the total column.

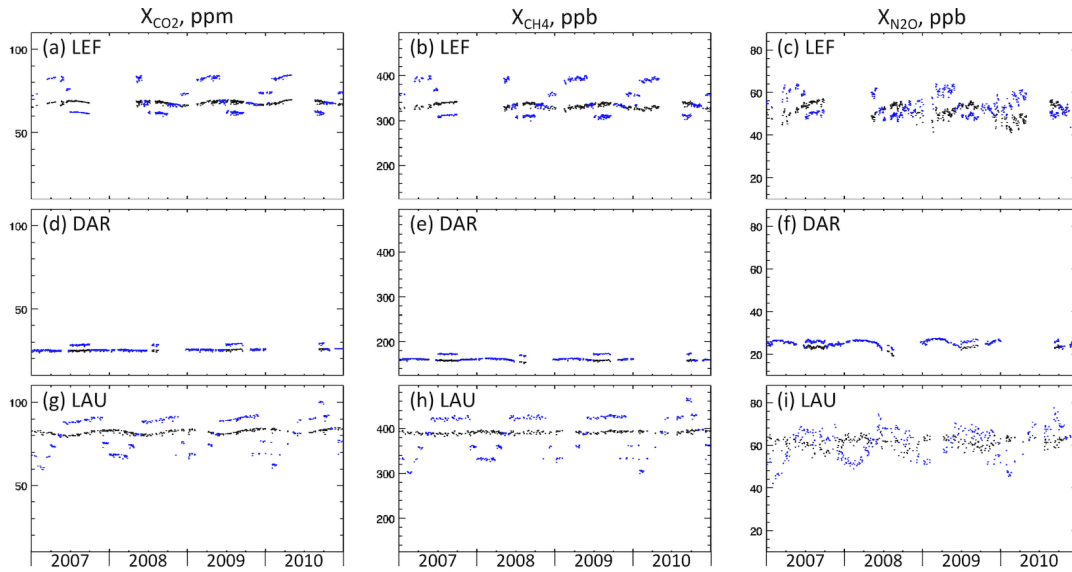


Figure S11: Time series of $X_{\text{CO}_2,\text{strat}}$, $X_{\text{CH}_4,\text{strat}}$ and $X_{\text{N}_2\text{O},\text{strat}}$ at three selected sites (black for annual mean tropopause, blue for tropopause varying monthly). Similar to Fig. 6, but using a different methodology for calculating stratospheric partial column (see above).

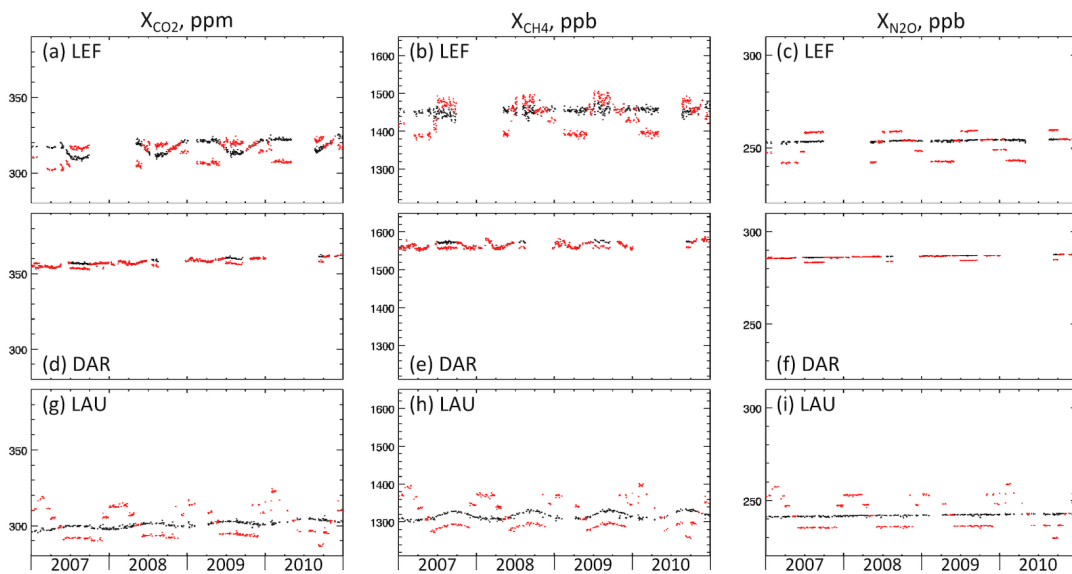


Figure S12: Time series of $X_{\text{CO}_2,\text{trop}}$, $X_{\text{CH}_4,\text{trop}}$ and $X_{\text{N}_2\text{O},\text{trop}}$ at three selected sites (black for annual mean tropopause, red for tropopause varying monthly).