Supplementary Materials: Assessment of Urban CO_2 Measurement and Source Attribution in Munich Based on TDLAS-WMS and Trajectory Analysis

Lijuan Lan[1,*], Homa Ghasemifard[2], Ye Yuan[2], Xinxu Zhao[1], Stephan Hachinger[3], Xiao Bi[1], Shrutilipi Bhattacharjee[1], and Jia Chen[1,*]

1. Allan Deviation

As shown in Figure S1, the logarithmic scale slope of the Allan Deviation (σ_{Allan}) curves is utilized to identify different noise modes: white noise is dominant when the slope is –0.5, while Brownian noise is dominant with the slope of 0.5. Where σ_{Allan} decreases to its minimum value ($\sigma_{\mathrm{Allan}}^{\mathrm{min}}$), the optimum integration time (τ_{opt}) and the detection limit are obtained.

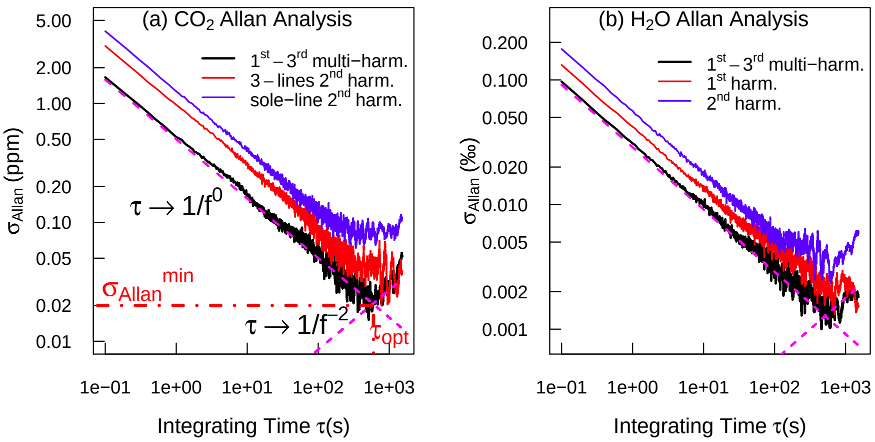

Figure S1. Allan Deviation of CO_2 and H_2O concentration measurements.

2. Comparison with H_2O Measurements from a Weather Station

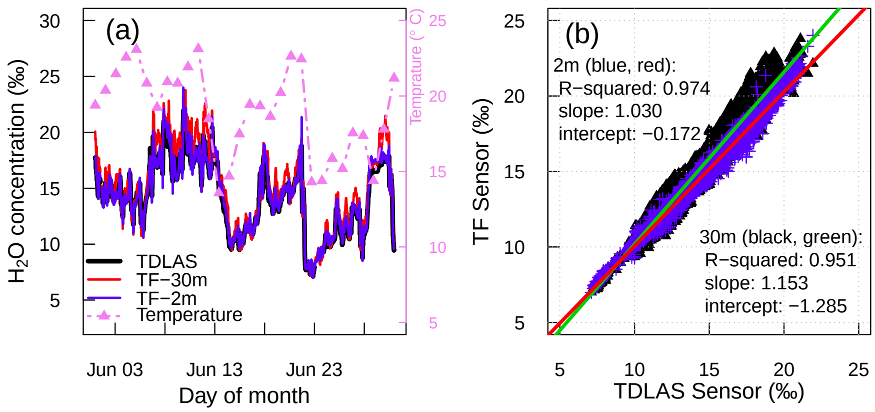

Figure S2. Our absolute H_2O measurements (unit: ‰, parts per thousand) compared with weather station measurements (Fischer TF sensor). (**a**) Our measurement data in June versus those of the TF sensors at 2 m and 30 m a.g.l. The temperature is averaged for every day. (**b**) Linear regression between TF sensor measurements at different levels and TDLAS results. It shows that the TDLAS measurements have better consistency with the TF sensor at 2 m.

3. Supporting Data for Analysis

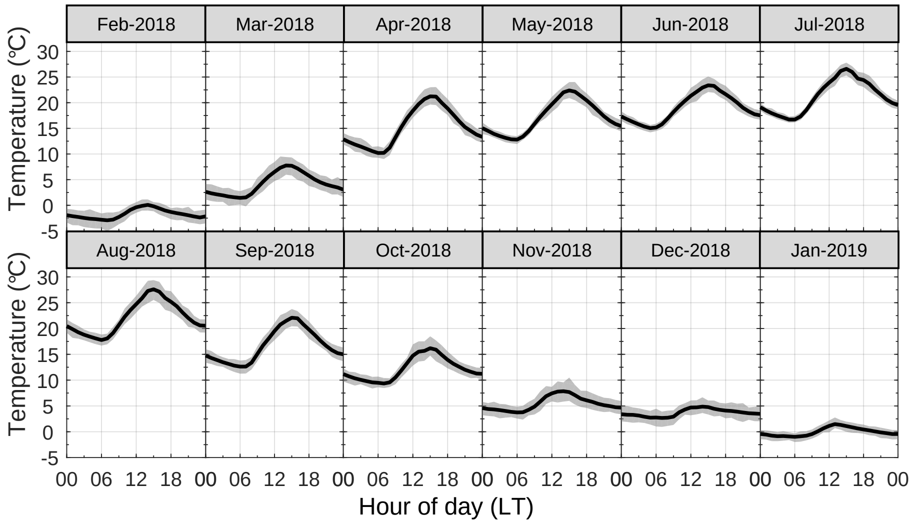

Figure S3. Ambient temperature averaged over every month. The gray shaded areas denote $\pm 2\sigma$ of the mean.

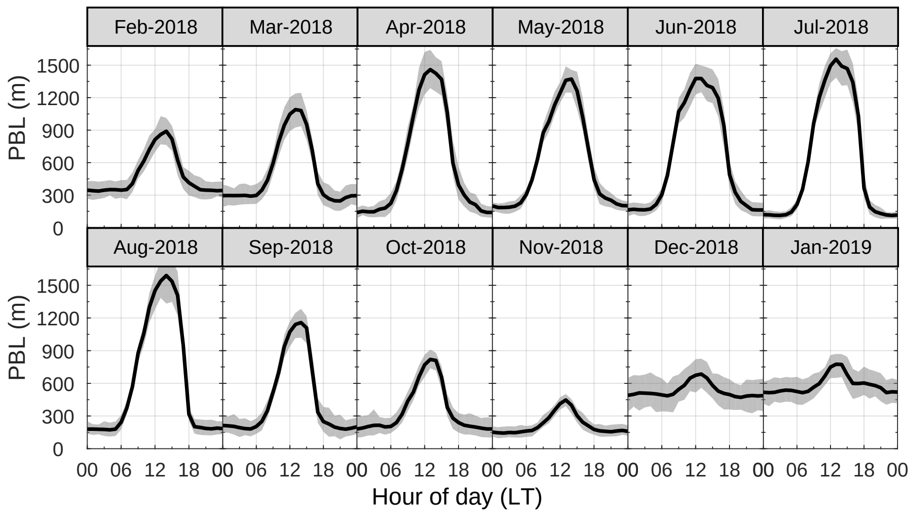

Figure S4. PBL height in different months. The PBL data was obtained from the HySPLIT model and averaged over every month with hourly data. The gray shaded areas denote $\pm 2\sigma$ of the means.

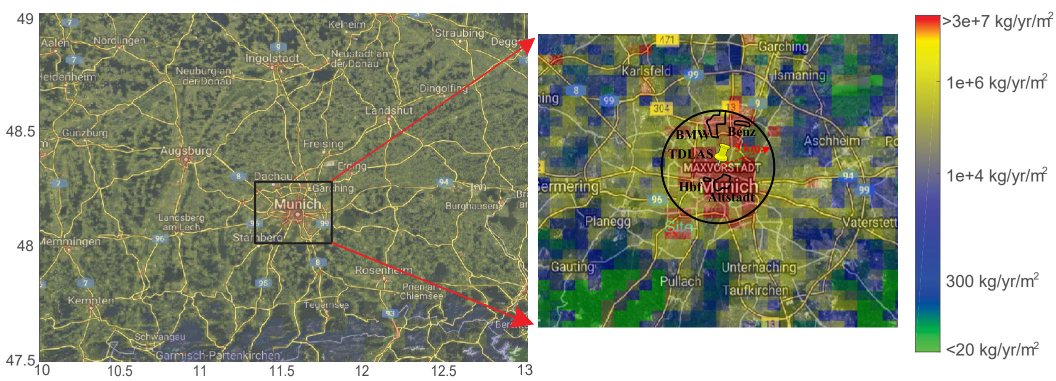

Figure S5. The 2015 yearly fossil fuel and biofuel CO_2 emission map around Munich from a subset of TNO GHGco version 1.1 with resolutions of 1×1 km^2 [48]. The second figure is the enlarged view of Munich's city center, where the measurement site and main places are marked in the map.