Supplement of

Constraining fossil fuel CO_2 emissions from urban area using OCO-2 observations of total column CO_2

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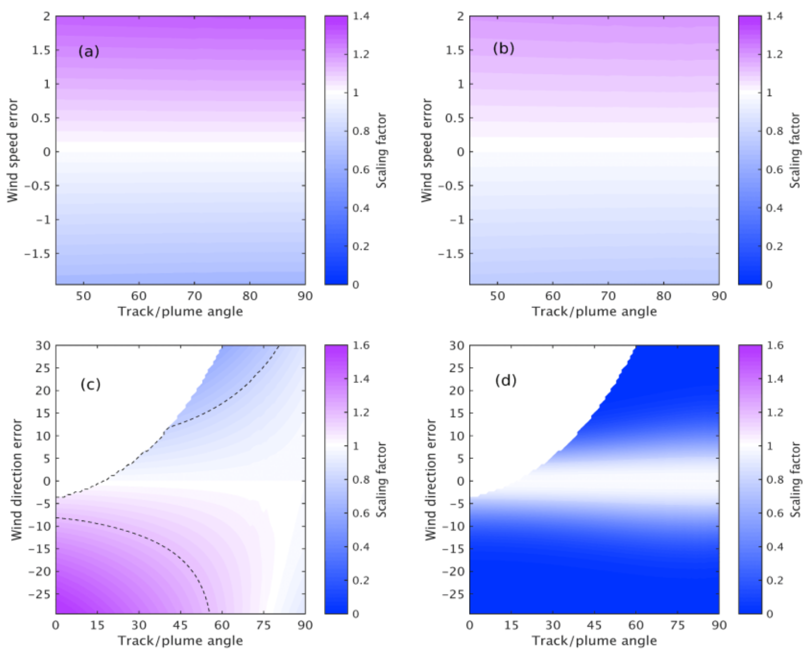

Figure S1. Scaling factor calculated by optimizing total enhancement of the X_{CO2} (a and c) and by least square error (b and d). An idealized eastward Gaussian plume is used here, with the angle between the plume axis and the pseudo track varying from 0° to 90°. The range of wind speed errors is -2.0 to 2.0 ms^{-1} with an interval of 0.04 ms^{-1}, and -30° to 30° for wind direction errors with an interval of 0.6°.

An idealized test of the emission optimization method is conducted based on a Gaussian plume to compare our method of optimizing total X_{CO2} enhancements (section 2.3.1) by using total X_{CO2} enhancement to least square error method. The pseudo observations are constructed by sampling along a track cutting the plume with an angle ranging from 0° to 90°. The errors in wind speeds and wind directions are predefined as -2.0 to 2.0 ms^{-1} and -30° to 30° with an interval of 0.04 ms^{-1} and 0.6°, respectively, and imposed to the plume using the method detailed in section 2.3.2. Figure S1 shows the scaling factor calculated by optimizing the total X_{CO2} enhancements and by least square error method. The blank top-left corners in Figs. S1c and S1d correspond to cases excluded in the calculation when the track is nearly parallel to the perturbed plume, thus the plume is not or only partially observed. With wind speed errors imposed, the two methods yield to similar distributions of the scaling factor (Figs. S1a, S1b). However for wind direction errors, the scaling factor is mostly less than one (the truth of S) when using the least square error method. The scaling factor exhibits a biased distribution. Therefore we used total X_{CO2} enhancement for the emission optimization purpose.