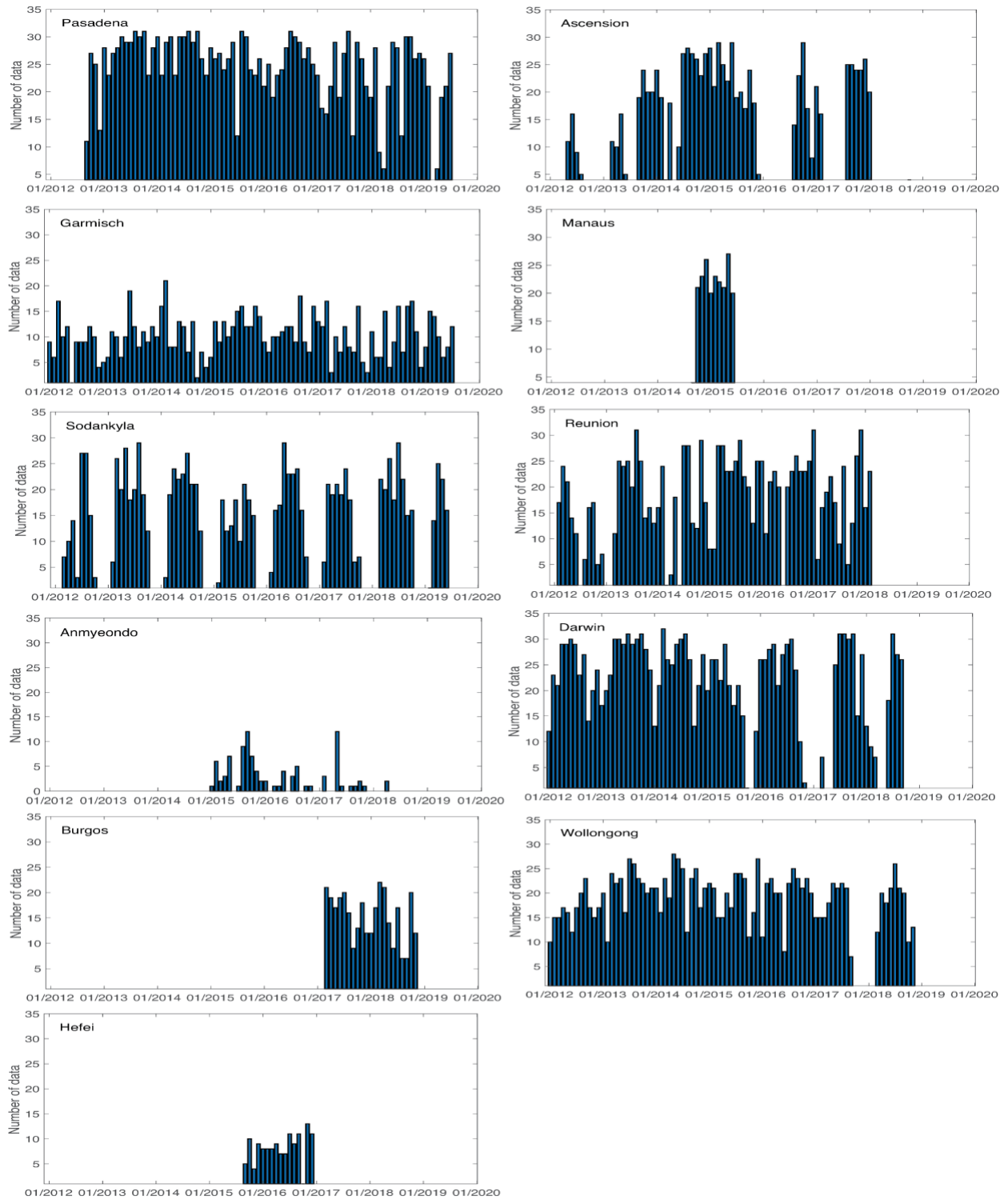Atmospheric
Measurement
Techniques

Supplement of

Local and regional enhancements of CH_4, CO, and CO_2 inferred from TCCON column measurements
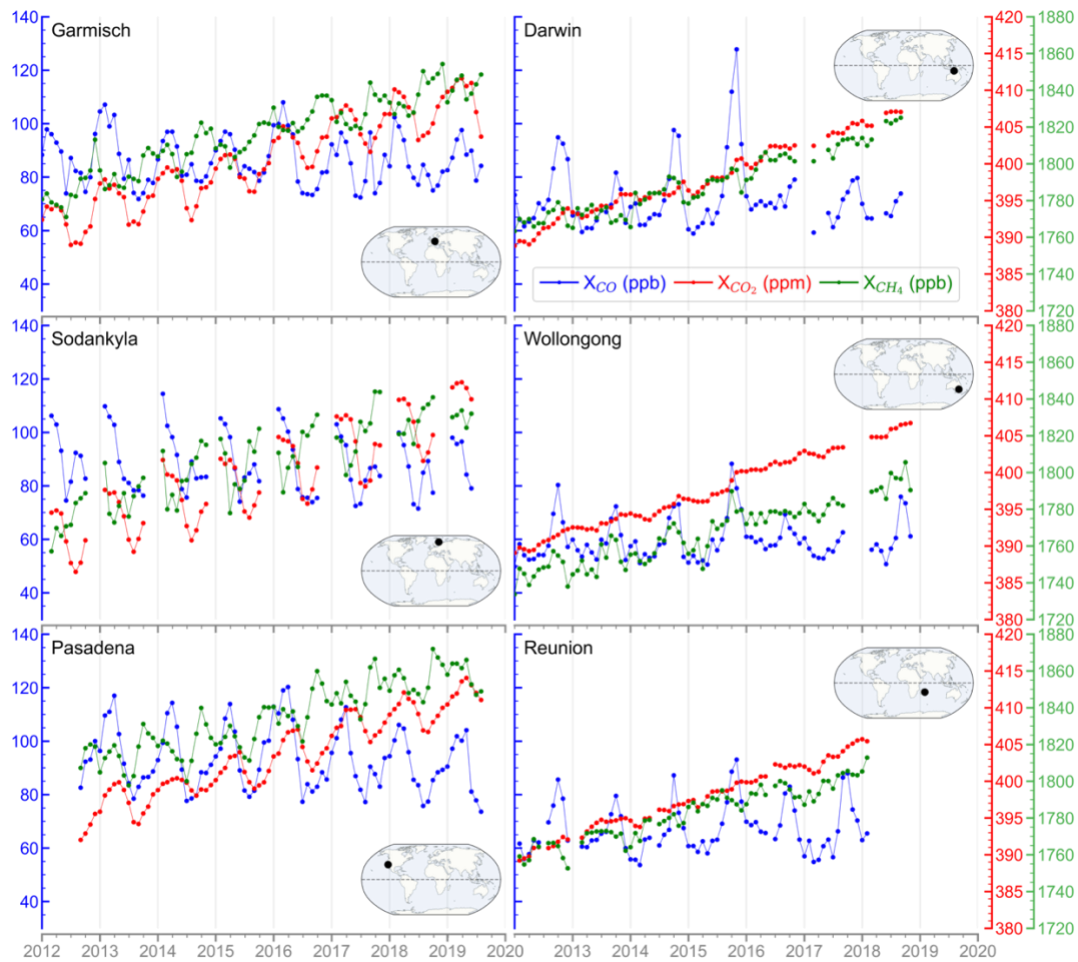
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**Figure S1.** Number of data in a month during 2012-2019 for the 11 TCCON sites.

Fgiure S2. Monthly variation of TCCON CO, CO_2, and CH_4 over 6 TCCON sites, (Garmisch, Darwin, Sodankylä, Wollongong, Pasadena, and Reunion) during 2012 to 2019. The insert maps depict the location of the TCCON sites and are marked by black circles.
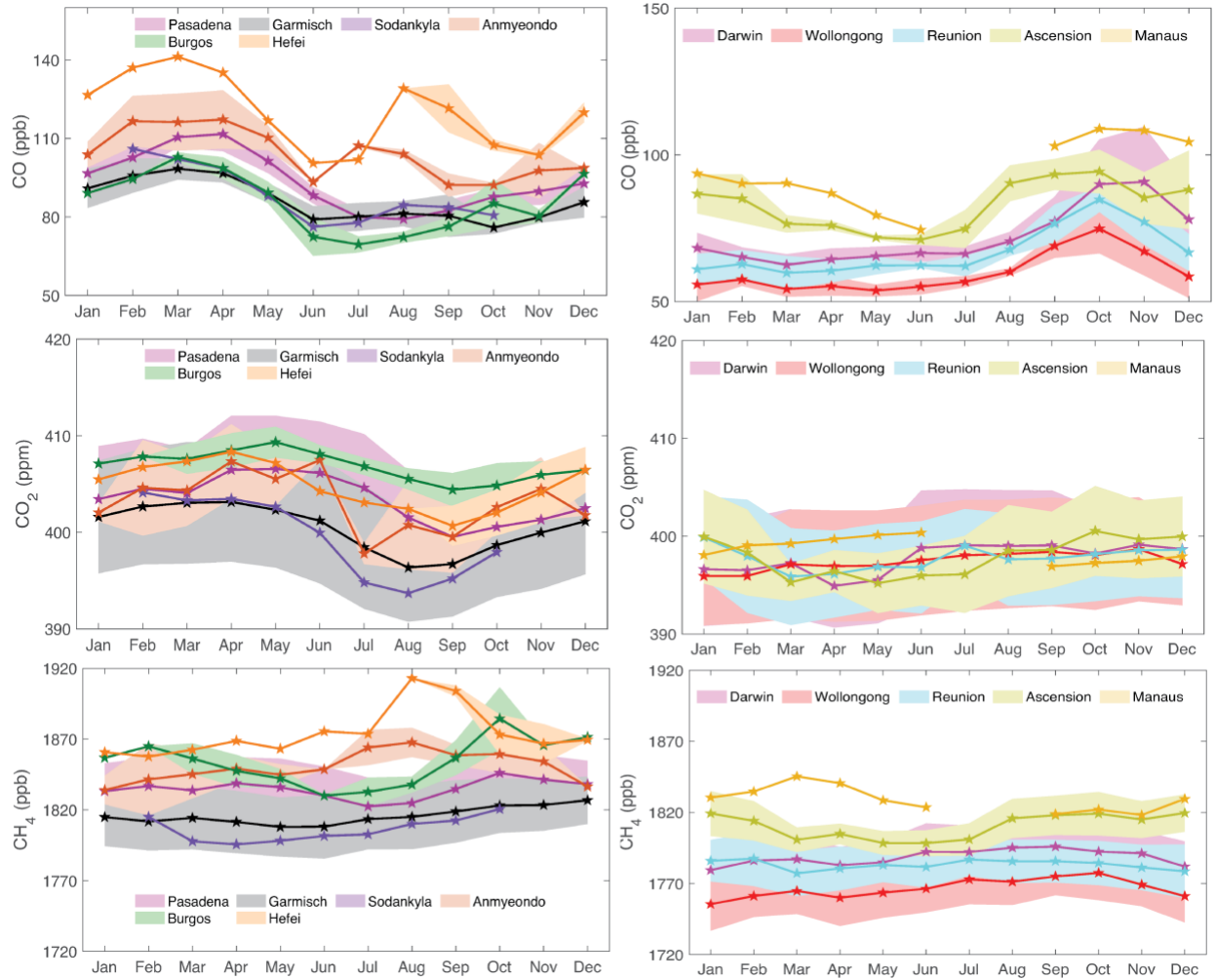
Figure S3. Average monthly variation of CO, CO_2, and CH_4 over the Northern Hemispheric locations (Pasadena, Garmisch, Sodanklya, Anmyeondo, Burgos, Hefei) and Southern Hemispheric locations (Darwin, Wollongong, Reunion, Ascension, Manaus) during 2012-2019. Shading corresponds to the standard deviation during each monthly averaging period.
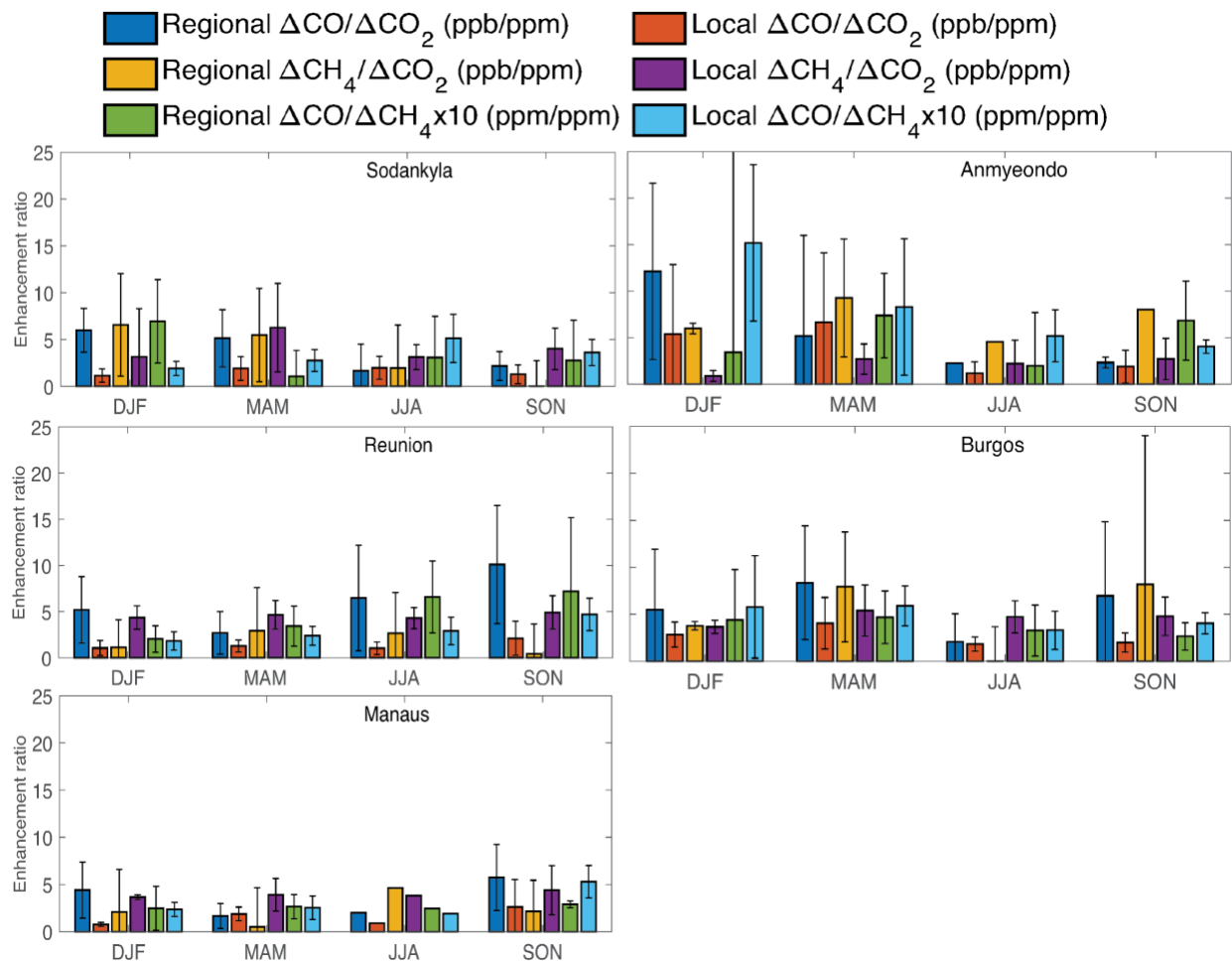
Figure S4. Average seasonal variation of regional and local enhancement ratio of X_{CO}/X_{CO2}, X_{CH4}/X_{CO2} and X_{CO}/X_{CH4} over Sodankyla, Anmyeondo, Reunion, Burgos, and Manaus during 2012-2019.
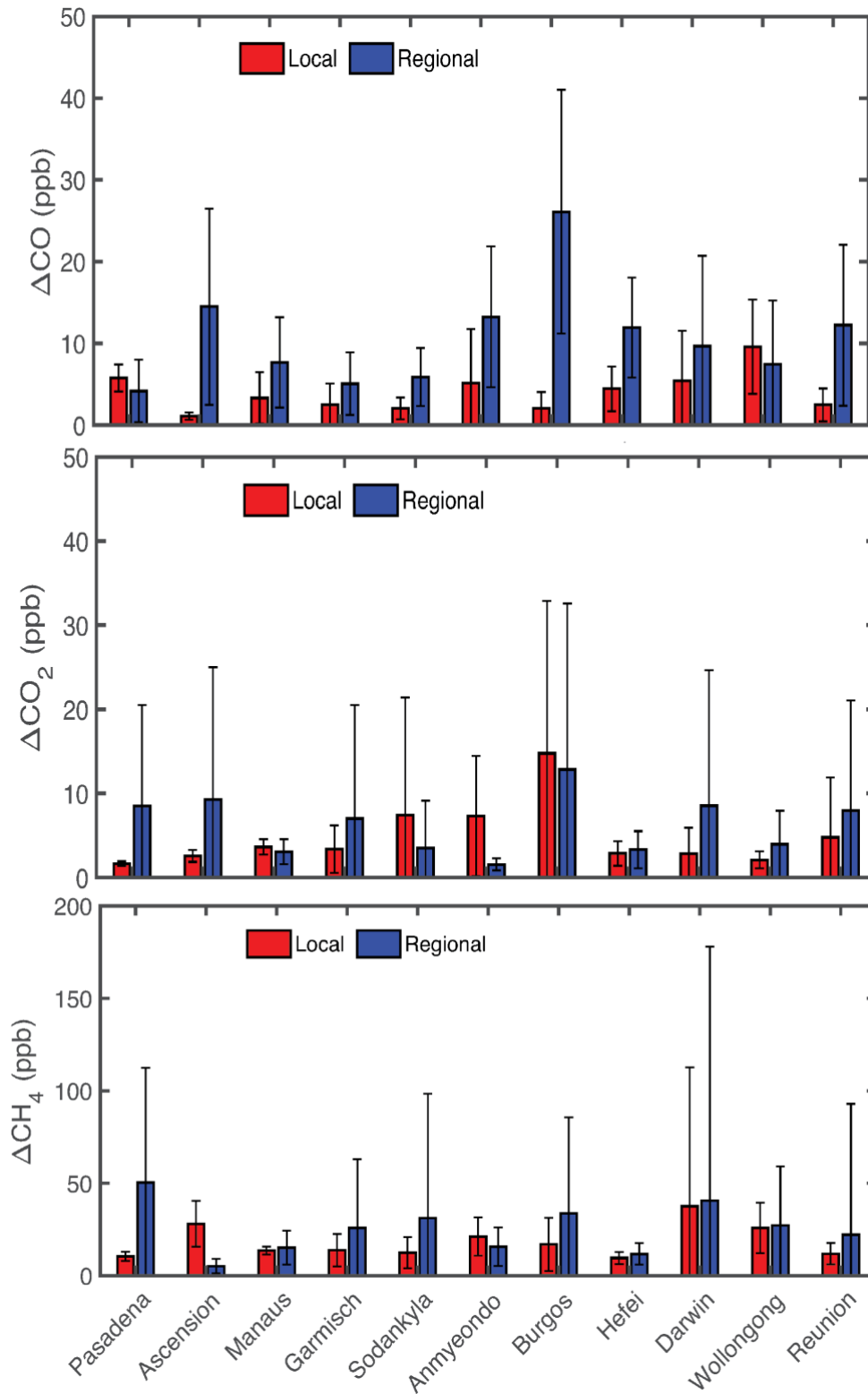
Figure S5. The relative increase in CO, CO_2 and CH_4 from the regional and local enhancements over Pasadena, Ascension, Manaus, Garmisch, Sodankyla, Anmyeondo, Burgos, Hefei, Darwin, Wollongong and Reunion during 2012-2019.
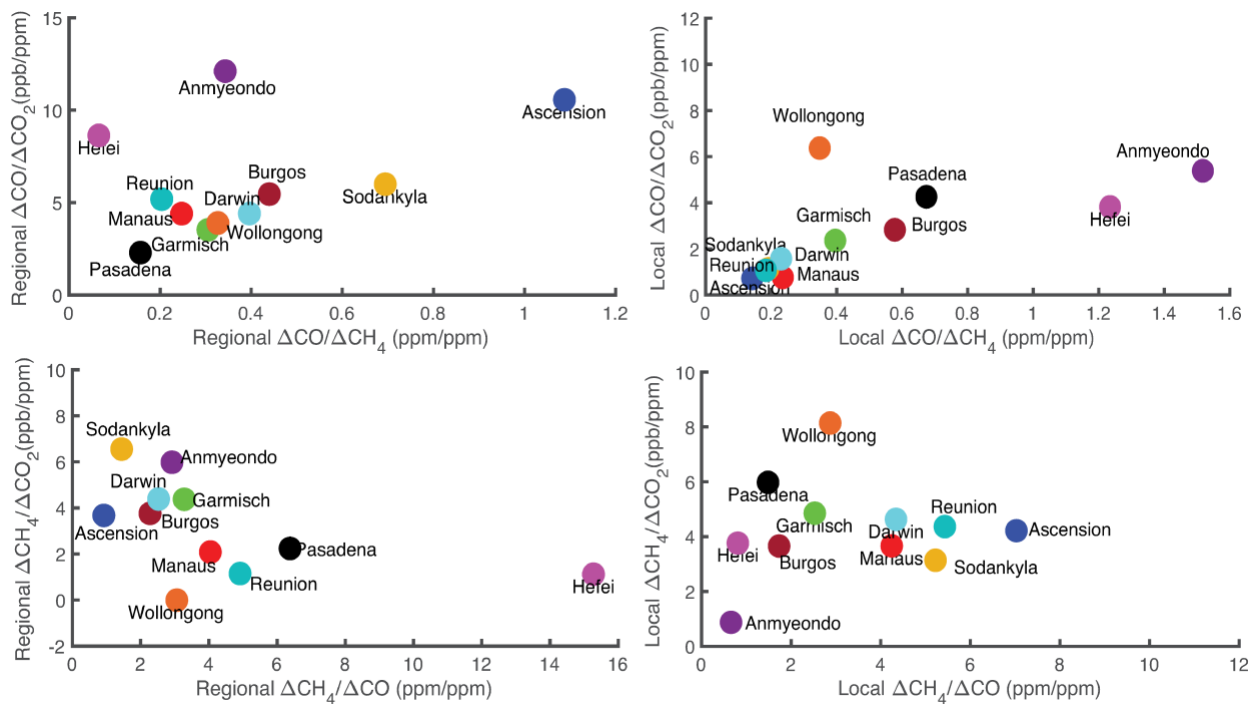
Figure S6. Scatter plot of average regional and local CO/CO_2 vs CO/CH_4 and CH_4/CO_2 and CH_4/CO during DJF months.
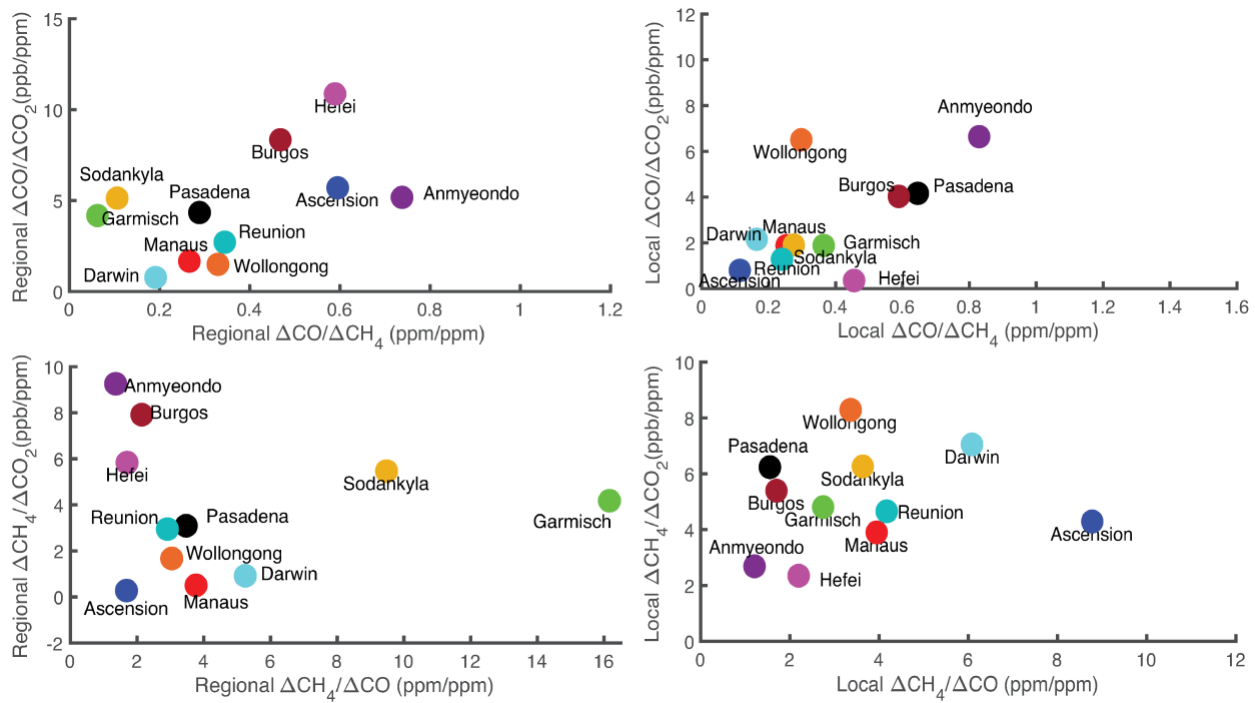
Figure S7. Scatter plot of average regional and local CO/CO_2 vs CO/CH_4 and CH_4/CO_2 and CH_4/CO during MAM months.
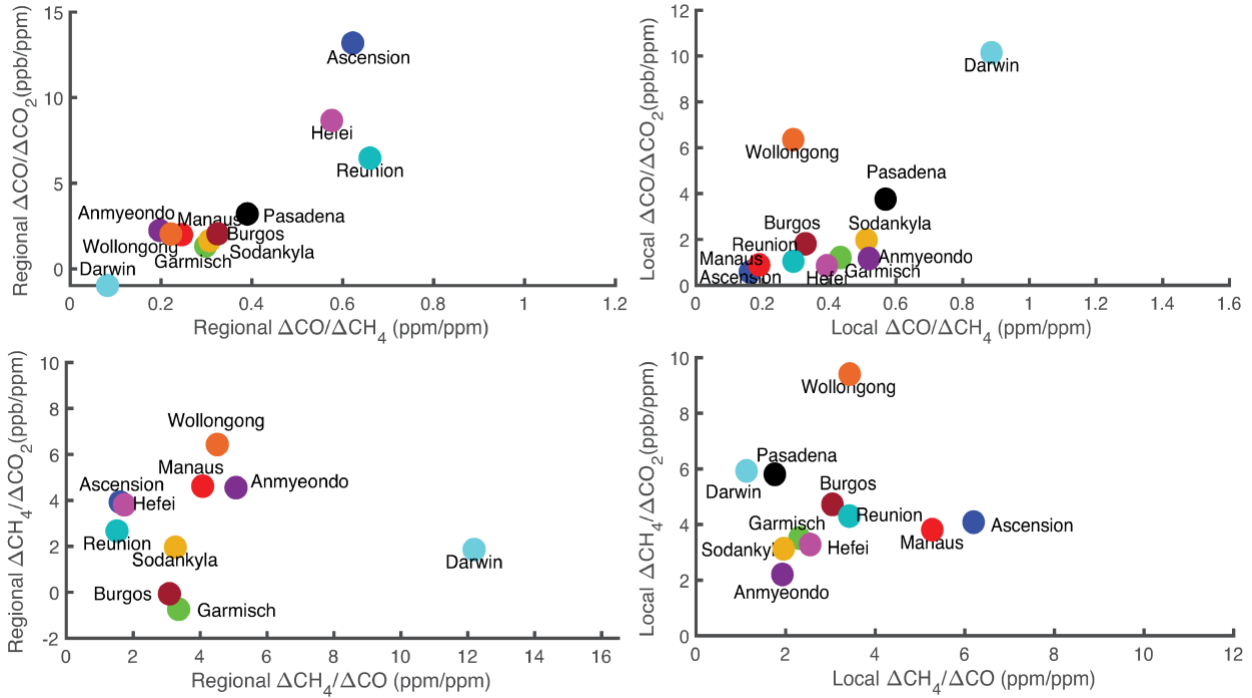
Figure S8. Scatter plot of average regional and local CO/CO₂ vs CO/CH₄ and CH₄/CO₂ and CH₄/CO during JJA months.

Figure S9. Scatter plot of average regional and local CO/CO₂ vs CO/CH₄ and CH₄/CO₂ and CH₄/CO during SON months.

Table S1. Number of monthly data points used to generate Figure 5 and seasonal averages of regional enhancement ratios during 2012-2019.
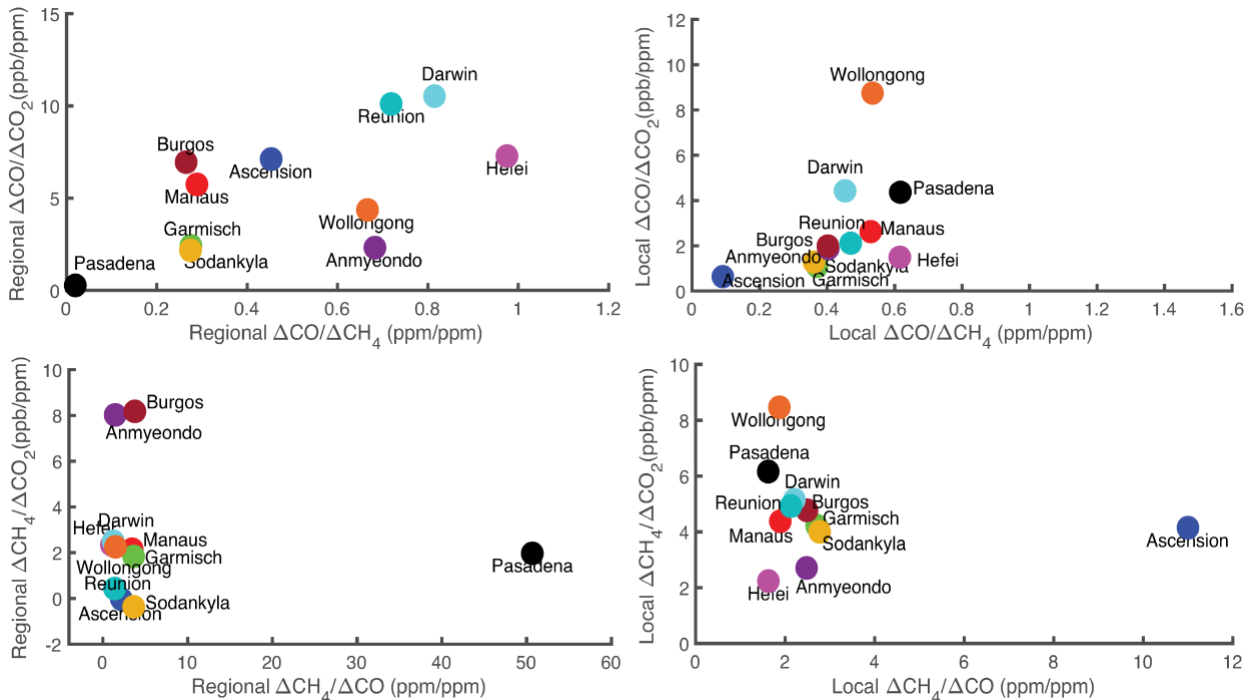
Locations	Regional enhancement ratio of CO/CO_2				Regional enhancement ratio of CH_4/CO_2				Regional enhancement ratio of CO/CH_4			
	DJF	MAM	JJA	SON	DJF	MAM	JJA	SON	DJF	MAM	JJA	SON
Pasadena	21	19	8	18	15	13	0	9	21	17	18	20
Ascension	12	7	5	15	12	7	6	6	12	4	6	4
Manaus	3	2	1	2	2	3	1	2	3	3	1	2
Garmisch	22	18	7	14	18	17	3	14	21	21	19	19
Sodankylä	4	24	12	4	4	17	8	10	4	19	22	12
Anmyeondo	2	4	1	2	2	4	1	1	2	3	2	2
Burgos	3	5	3	6	3	5	3	5	3	6	6	5
Hefei	4	3	3	5	4	3	2	5	4	3	3	5
Darwin	11	10	14	9	17	13	19	12	10	14	16	13
Wollongong	16	20	20	19	17	19	20	19	13	14	18	17
Reunion	9	11	10	17	13	14	13	14	10	12	8	9

Table S2. Number of monthly data points used to generate the Figure 5 and seasonal average of local enhancement ratios during 2012-2019.

Locations	Local enhancement ratio of CO/CO_2				Local enhancement ratio of CH_4/CO_2				Local enhancement ratio of CO/CH_4			
	DJF	MAM	JJA	SON	DJF	MAM	JJA	SON	DJF	MAM	JJA	SON
Pasadena	21	20	19	21	17	16	10	19	21	19	18	21
Ascension	12	7	10	15	12	8	12	16	12	7	10	13
Manaus	3	3	1	2	3	3	1	2	3	3	1	2
Garmisch	22	21	20	18	19	23	20	18	22	23	22	19
Sodankylä	4	24	22	14	4	24	22	13	4	24	22	14
Anmyeondo	3	4	3	3	3	5	3	3	5	5	5	2
Burgos	3	5	3	6	3	6	6	6	3	6	6	5
Hefei	4	3	3	6	4	3	3	6	4	3	3	5
Darwin	17	16	20	15	17	17	21	18	15	15	16	14
Wollongong	16	20	20	19	17	20	20	19	13	14	19	17
Reunion	17	16	12	17	17	17	15	18	10	12	8	9