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Spatial and temporal variations of CO_2 within and above the urban canyon of Taipei city, Taiwan

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Three experiments were carried out to understand the spatial and temporal variations of CO_2 concentration in and above the urban canyon of Taipei city, Taiwan. The first experiment was conducted in the Taipei 101 building (508 m tall, located in the city center) at the height of 400 m above the ground. The measurement height of 400 m is within the convective boundary layer during day time but above the stable layer at night. The second experiment was carried out within and at the top of an urban canyon in the city center with a height-to-width ratio (H/W) of 0.57 (average building height = 25.6 m; street width = 45 m). The measurement heights of CO_2 concentration were 26 m and 12 m, respectively. The third experiment was conducted in a residential area, 8.3 km away from the first experiment, and within the urban canyon (measurement height = 7 m). The height-to-width ratio of this canyon is 4.0, with an average building height of 16 m and a street width of 4 m.

Except for the measurement at 400 m, our results showed that the CO_2 concentration varied with a diurnal cycle which reached its maximum in the early morning (around 7:00) and had the minimum in the afternoon (around 14:00). This diurnal pattern could be attributed mainly to the growth of the convective boundary layer, but also influenced by the anthropogenic (e.g., traffic) and biospheric (e.g., photosynthesis; respiration) factors. The mean amplitudes of the diurnal cycles for the city center and residential areas were 25 ppm and 15 ppm, respectively. The maximum CO_2 concentrations in the city center and residential area were 450 and 410 ppm, respectively. As to the CO_2 concentration measured at 400 m, though variations betweens days were evident, a distinct diurnal cycle is not apparent.