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Supporting Information

Title: Vertical Characteristics of Winter Ozone Distribution within the Boundary Layer in Shanghai Based on Hexacopter Unmanned Aerial Vehicle Platform

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To quantitively assess the correlation between two platforms, intra-class Correlation Coefficient (ICC) and Pearson Correlation Coefficient (r) were used. The specific calculation formulas of each metrics have been introduced in previous studies [22,34,36].

As shown in Figure S1, the ozone concentrations observed by POM at the surface are in good agreement with those observed by conventional instruments on the tethered balloon platform. Both the ICC value and Pearson coefficient are over 0.97. Thus, the linear equation obtained by ground-level comparisons are used to calibrate the ozone profiles obtained by the UAV platform.

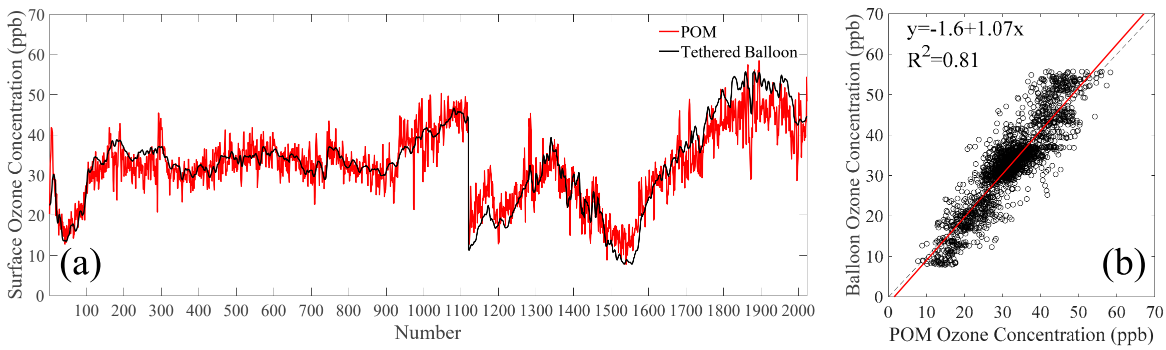

Figure 1. Ground-based Comparisons of ozone concentrations: (a)Times series of ozone concentrations between the UAV platform and the tethered balloon; (b) Linear regressions between the UAV platform and the tethered balloon. The light gray dash line is the 1:1 reference line. Measurements were all averaged at 1-min intervals.

Generally speaking, the ozone profiles observed by the tethered balloon are smoother than the UAV platform. This is reasonably because the UAV platform has an almost five times higher ascending and descending speed than the balloon platform. Thus, less response time resulted in more data fluctuations in the ozone profiles obtained by UAV platform. As shown in Table 3, two ozone profiles observed by the UAV in the afternoon are well consistent with those of the tethered balloon, with ICC values of over 0.74 and Pearson coefficients of over 0.84. As shown in Figure S2a and S2b, ozone variations of ~ 20 ppb occurred at the upper air.

These Discrepancies of ozone profiles could be explained by two reasons. First, the horizontal distance of two platforms are ~ 2.5 km, ozone concentrations obtained at these two sites may vary owing to different thermodynamic characteristics of land and sea. Second, the flight time of two platforms were not accurately identical. The ozone distributions may vary because of the convection mixing. Furthermore, according to the previous research [36], ozone variations large than 20 ppb have also been observed while doing vertical comparison.

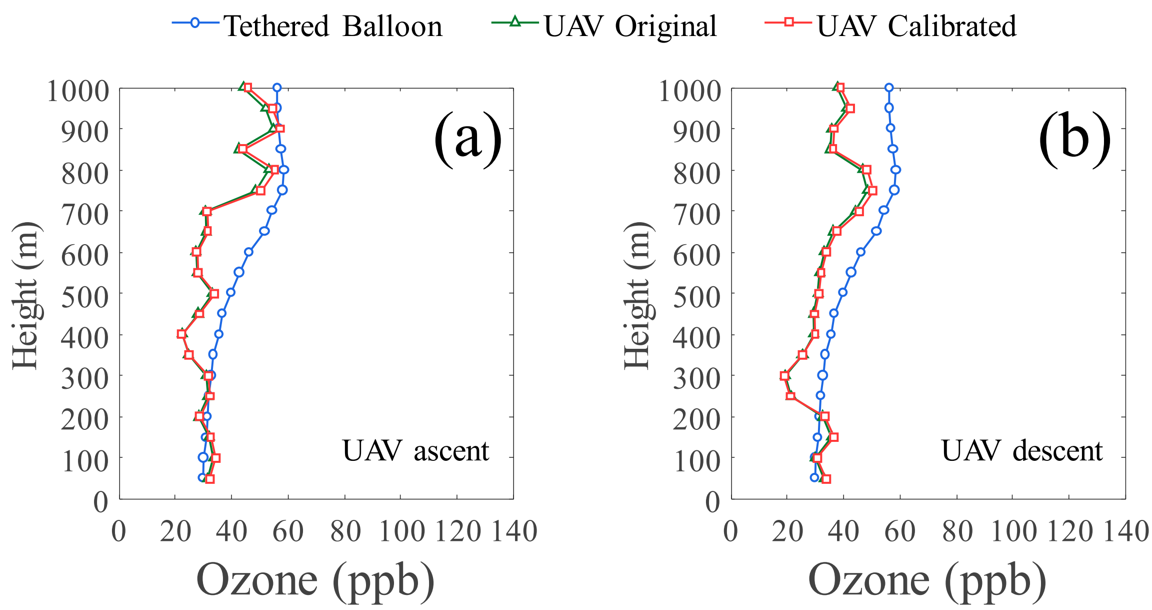

Figure 2. Comparisons of vertical profiles between the UAV platform (triangles) and the tethered balloon (circles): (a) Vertical profiles captured during UAV's ascent period (profile 1); (b) Vertical profiles captured during UAV's descent period (profile 2) between 16:30–17:30 LT on December 18, 2017. Measurements were all averaged at 50-m intervals.

Table 1. Summary of calculated metrics for ozone monitors used on the UAV platforms and the tethered balloon platform.

Species	ICC	Pearson r
O_3_Profile 1	0.85	0.74
O_3_Profile 2	0.84	0.76
O_3_Ground	0.97	0.97