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Vertical measurements of atmospheric CO2 and 14CO2 at the northern foot of the Qinling Mountains in China

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Air at different heights within 2000 m at the northern foot of the Qinling Mountains were sampled by unmanned aerial vehicle to study the vertical variations and sources of atmospheric CO2 and 14CO2. The CO2 concentrations mainly exhibited a slight decreasing trend with increasing height during summer observations, which was in contrast to the increasing trend that was followed by a subsequent gradual decreasing trend during early winter observations, with peak CO2 levels (443.4 ± 0.4–475.7 ± 0.5 ppm) at 100–500 m. The variation in vertical concentrations from 20 to 1000 m in early winter observations (21.6 ± 19.3 ppm) was greater than that in summer observations (14.6 ± 14.3 ppm), and the maximum vertical variation from 20 to ˜2000 m reached 61.1 ppm. Combining Δ14C and δ13C vertical measurements, the results showed that fossil fuel CO2 (CO2ff, 56.1 ± 15.2%), which mainly come from coal combustion (81.2 ± 3.4%), was the main contributor to CO2 levels in excess of the background level (CO2ex) during early winter observations. In contrast, biological CO2 (CO2bio) dominated CO2ex in summer observations. The vertical distributions of CO2ff in early winter observations and CO2bio in summer observations were consistent with those of CO2 during early winter and summer observations, respectively. The strong correlation between winter CO2bio and ΔCO ($r = 0.81$, $p < 0.01$) indicated that biomass burning was the main contributor to CO2bio during early winter observations. Approximately half of the air masses originated from the Guanzhong Basin during observations. The results provide insights into the vertical distribution of different-sources of atmospheric CO2 in scientific support of formulating carbon emission-reduction strategies.

Student Submission

Yes

Primary author: LIANG, Dan

Co-authors: NIU, Zhenchuan; ZHOU, Weijian; WANG, Guowei; FENG, Xue; LYU, Mengni; LU, Xuefeng; LIU, Wanyu; QU, Yao

Presenter: LIANG, Dan

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