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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 $\Delta^{14}\text{C}$ and $\delta^{13}\text{C}$ vertical measurements, the results showed that fossil fuel CO₂ (CO₂^{ff}, $56.1 \pm 15.2\%$), which mainly come from coal combustion ($81.2 \pm 3.4\%$), was the main contributor to CO₂ levels in excess of the background level (CO₂^{ex}) during early winter observations. In contrast, biological CO₂ (CO₂^{bio}) dominated CO₂^{ex} in summer observations. The vertical distributions of CO₂^{ff} in early winter observations and CO₂^{bio} in summer observations were consistent with those of CO₂ during early winter and summer observations, respectively. The strong correlation between winter CO₂^{bio} and ΔCO ($r = 0.81$, $p < 0.01$) indicated that biomass burning was the main contributor to CO₂^{bio} 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

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