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On seasonality of the indirect greenhouse gas CO above Europe: an altitude-resolved picture from long-term FTIR measurements

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Carbon monoxide (CO) is only a very weak direct greenhouse gas, but has important indirect effects on global warming. Carbon monoxide reacts with hydroxyl (OH) radicals in the atmosphere, reducing their abundance. As OH radicals help to reduce the lifetimes of strong greenhouse gases, like methane, carbon monoxide indirectly increases the global warming potential of these gases.

Carbon monoxide in the atmosphere can also lead to the formation of the tropospheric greenhouse gas ozone. Atmospheric concentrations of carbon monoxide vary widely around the world and throughout the year, ranging from as low as 30 parts per billion up to around 200 parts per billion (Fischer et al., 2006). Up to now the altitude dependency of the seasonality has not yet been investigated in full detail, i.e. previous studies were either restricted to surface measurements, or did not cover the full year, or were limited to total-column observations (Yurganov et al., 2005).

To address this deficit in knowledge we perform an investigation based on combined analysis of 15 years of solar FTIR measurements at the NDACC* high-altitude station Zugspitze (47.42 °N, 10.98 ° E, 2964 m a.s.l.) and 5 years of measurements from the TCCON** station Garmisch (47.48 N, 11.06 E, 745 m a.s.l.). Multi-annual seasonal cycles for merged altitude layers of 0.75 - 2.96 km, 2.96 – 8.61 km, and 8.61 – 29.33 km are derived. We find significant differences in the phases and amplitudes of the seasonal cycles as a function of altitude, which will be discussed in geophysical terms.

*Network for the Detection of Atmospheric Composition Change
**Total Carbon Column Observing Network

References

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