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Isotopic signatures of traffic-emitted CO and CO_2

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Traffic is one of the main sources of CO_2 and CO in highly populated regions like Western Europe. 13C and 18O isotopic signatures of traffic-emitted CO_2 and CO were determined form air samples collected in the Islisberg highway tunnel (Switzerland), during a measurement and sampling campaign in 2011. The goal of the campaign was to characterize traffic emissions of the present west European vehicle fleet, at integrated fleet level.
The isotopic composition of traffic CO_2 reflects on average the isotopic composition of the fuel (13C) and of atmospheric oxygen (18O), although the 18O values are quite variable. In contrast, the isotopic values of CO show that significant fractionation takes place during CO formation (18O) and during the subsequent, partial CO destruction in the catalytic converter (13C). The 13C is enriched by 3 ‰ compared to the 13C in the fuel burnt, while the 18O is depleted by 7 ‰ compared to the 18O in atmospheric oxygen. We compute a kinetic isotope effect for 13C during CO destruction of 2.5 ± 0.7 ‰Ṫhe average 18O in traffic CO is 17 ‰ (VSMOW), similar to the biomass burning signature previously determined in Switzerland and Europe (e.g. Saurer et al., 2009). Thus, in the conditions represented by our study (Swiss fleet, highway driving conditions), the traffic and biomass burning CO emissions cannot be distinguished anymore based on 18O signature alone.

References

Saurer, M., Prévôt, A. S. H., Dommen, J., Sandradewi, J., Baltensperger, U., and Siegwolf, R. T. W.: The influence of traffic and wood combustion on the stable isotopic composition of carbon monoxide, Atmos. Chem. Phys., 9, 3147-3161, doi:10.5194/acp-9-3147-2009, 2009.