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Recent advances in understanding atmospheric CO based on stable isotope measurements

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Carbon monoxide (CO) plays an important role for atmospheric chemistry and for carbon cycling in the atmosphere. Via its reaction with the OH radical it influences concentrations of many other trace gases, it is an important precursor for O_3 formation, and its oxidation leads to the formation of about 1 Pg C per year of CO_2. The natural and anthropogenic sources of CO are subject to relatively large temporal changes due to natural variability (e.g. biomass burning), industrial activity and mitigation measures (e.g. fossil fuel burning), variations in precursor compounds (e.g. CH4 and VOC) and variations in the abundance of the OH radical in the atmosphere, which are difficult to quantify. Isotope measurements can be used to distinguish between the effects of individual sources and sinks to put tighter constrains on its budget, but the isotopic characterization of the CO sources is in many cases still based on a few relatively old measurements that did not allow to account for dependence on parameters.

We will present an update of the isotopic composition of several sources and removal processes of CO that have been carried out in the past years with the automated continuous-flow IRMS system at Utrecht University. This includes:

− the previously unknown isotopic composition of direct biogenic CO emissions

− a surprisingly large variability in the isotopic composition of CO emitted by different vehicles and single vehicles under various driving conditions

− previously very poorly investigated signatures, like the fractionation in the removal of CO by soils, and its interaction with CO that is simultaneously emitted from soil.

These results from process specific investigations will be linked to recent atmospheric measurements at various locations.