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A new portable generator to dynamically produce SI-traceable reference gas mixtures for VOCs and water vapour at atmospheric concentration

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In the framework of the KEY-VOCs and AtmoChem-ECV projects, we are currently developing new facilities to dynamically generate reference gas mixtures for a variety of reactive compounds, at concentrations measured in the atmosphere and in a SI-traceable way (i.e. the amount of substance fraction in mole per mole is traceable to SI-units). Here we present the realisation of such standards for water vapour in the range 1-10 μmol/mol and for volatile organic compounds (VOCs) such as limonene, alpha-pinene, MVK, MEK, in the nmol/mol range. The matrix gas can be nitrogen or synthetic air. Further development in gas purification techniques could make possible to use purified atmospheric air as carrier gas.
The method is based on permeation and dynamic dilution: one permeator containing a pure substance (either water, limonene, MVK, MEK or α-pinene) is kept into a permeation chamber with a constant gas flow. The mass loss is precisely calibrated using a magnetic suspension balance. The carrier gas is purified beforehand from the compounds of interest to the required level, using commercially available purification cartridges. This primary mixture is then diluted to reach the required amount of substance fraction. All flows are piloted by mass flow controllers which makes the production process flexible and easily adaptable to generate the required concentration. All parts in contact with the gas mixture are passivated using coated surfaces, to reduce adsorption/desorption processes as much as possible.
Two setups are currently developed: one already built and fixed in our laboratory in Bern as well as a portable generator that is still under construction and that could be used anywhere in the field. The permeation chamber of the portable generator has multiple individual cells allowing the generation of mixtures up to 5 different components if needed. Moreover the presented technique can be adapted and applied to a large variety of molecules (e.g., NO_2, BTEX, CFCs, HCFCs, HFCs and other refrigerants) and is particularly suitable for gas species and/or concentration ranges that are not stable in cylinders.