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Measurements of Total Ozone Reactivity from biogenic organic compounds

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Biogenic volatile organic compounds (BVOC) account for a large fraction of the organic carbon loading in the atmosphere. Reactions of BVOC with ozone (O_3) are especially important because they lead to the formation of secondary organic aerosol (SOA) and because they can be significant sources of oxidant radicals, especially at night. These reactions can also represent a significant sink for tropospheric ozone, and therefore affect the overall ozone budget. Only a small fraction of the total number of BVOC has been identified and is routinely measured, which creates substantial uncertainties in our assessment of their role in the atmospherci chemical processes and in our estimate of the tropospheric ozone budget.

Total ozone reactivity is a measure of ozone chemical loss rate that does not require prior knowledge of the chemical composition of the BVOC pool. A newly developed instrument designed to directly measure the total ozone reactivity is presented here. The Total Ozone Reactivity System (TORS) measures the decay of a known quantity of ozone caused by the presence of unsaturated hydrocarbons, such as BVOC. The TORS instrument was extensively tested in the laboratory using nitric oxide (NO) and alpha-pinene. Together with a proton-transfer-reaction mass spectrometer, the TOR instrument was then used to determine the ozone reactivity of BVOC emissions from lemonthyme plants (Thymus citriodorus) in a laboratory enclosure, as well as quasi-ambient measurements of total ozone reactivity in a glasshouse. The results of these experiments demonstrate the validity of the TORS approach and provide new insight into the importance of BVOC/O_3 interactions for the Earth's carbon budget and for the tropospheric ozone cycle.