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Characterisation and first application of a cavity ring-down instrument for measurements of NO_3 and N_2O_5

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A new instrument was built for atmospheric measurements using the cavity ringdown technique for a simultaneous measurement of nitrate radicals (NO_3) and dinitrogen pentoxide (N_2O_5) using a red laser diode at 662 nm. The instrument consists of two channels: The inlet and the cavity of the first one is heated up to 120 °C to force the thermal equlibrium of N_2O_5 and NO_3 to the side of NO_3, so that this channel measures the sum NO_3 and N_2O_5. The other channel stays at ambient temperature to measure NO_3 only. To prevent aerosol extinction, a filter is installed upstream of the cavities. The detection limit is within the range of a few ppt at 1 s time resolution. Measurements have an accuracy of 15 %. Instrument losses were characterized by a titration method using the conversion of NO_3 to NO_2 by adding NO. Two addition points where chosen, right before and after the NO_3 intrument.The NO_2 concentration was measured downstream of the instrument with another CRDS intrument using a blue laser diode at 405 nm. Estimated losses are within the range of 40 % due two a high point loss on the used filter housing. First application took place at the SAPHIR simulation chamber at Forschungszentrum Jülich GmbH. Experiments were made by injecting known concentrations of NO_2 and ozone into the dark chamber filled with pure synthetic air to analyse the behavior of NO_3 and N_2O_5 in the clean chamber. Possible losses were estimated from the steady-state lifetime of NO_3, which can be calculated from measured NO_3, NO_2 and ozone concentrations. Estimated lifetimes of NO_3 and N_2O_5 were within the range of 19 min and 44 min, respetively. During futher experiments organic compounds (isoprene, β-pinene, limonene) were additionally injected, in order to test the applicability of chamber experiments for the invertigation of oxidation processes by NO_3.