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Observation and modelling of the OH, HO_2 and RO_2 radicals at a suburban site of Beijing (Huairou) in winter 2016

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A comprehensive field campaign was carried out in winter 2016 in Huairou, a small town located 60 km northeast of Beijing downtown. Concentrations of OH, $HO_2$and RO_2 radicals were measured by a laser induced fluorescence instrument. Radical concentrations were smaller than during summer because of reduced solar radiation. Maximum hourly averaged OH, HO_2 and RO_2 radical concentrations were $(3\pm2)\times10^6$cm^{-3}, $(8\pm6)\times10^7$ cm^{-3} and $(7\pm5)\times10^7$ cm^{-3}, respectively. Chemical modulation measurements were applied on a few days showing no significant OH interference for different chemical conditions. HONO and HCHO photolysis were found to be the most important primary source of ROx radicals. OH reactivity, the inverse of the OH radical lifetime, was also measured by a laser-photolysis and laser induced fluorescence instrument. In general, CO and NO_x were the dominated OH reactants which contributed more than half of the total OH reactivity. The relative high OH concentrations in polluted episode enabled a fast oxidation of fresh emitted pollutants and the formation of secondary products. The observed radical concentrations were compared with the results from a chemical box model. The model is capable of reproducing radical concentrations in the moderate NO_x conditions but has difficulty in both the low and high NO_x regimes. The underestimation of RO_2 radical concentrations in the high NO_x conditions indicate a missing RO_2 source.