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Investigating the impacts of HO_x recycling in the oxidation of isoprene: Sensitivity studies of past, present and future atmospheres using the UKCA model.

Alexander T. Archibald (1,2), N. Luke Abraham (1,2), Paul J. Telford (1,2), Mike E. Jenkin (3), John A. Pyle (1,2)

(1) National Centre for Atmospheric Science, United Kingdom, (2) Department of Chemistry, University of Cambridge, Cambridge, CB2 1EW, UK. , (3) Atmospheric Chemistry Services, Okehampton, Devon, E20 1FB, UK

For several decades the importance of isoprene to global atmospheric chemistry has been highlighted. With annual emissions on the order of 500 Tg per year it represents a major source of reduced carbon in the atmosphere. However, our ability to understand many of the fundamental processes involving emissions and oxidation of isoprene remain questionable. In particular recent evidence suggests that the current understanding of low NO_x oxidation of isoprene is poorly represented in numerical models. In this work we present results from a range of sensitivity experiments that focus on exploring the effects of inclusion of recent mechanistic changes, based on laboratory and theoretical studies, concerning the oxidation mechanism of isoprene. We show that based on our current knowledge, intermolecular reactions of the isoprene hydroxy-peroxy radicals are the most favourable route to novel chemistries for recycling HO_x radicals in isoprene oxidation. Furthermore, we present global model simulations performed using the UKCA chemistry climate model to which a modified isoprene mechanism has been developed. The results of sensitivity studies concerning climate scenarios relevant to the pre-industrial, present day and future are presented. The results suggest that inclusion of a HO_x recycling mechanism from the oxidation of isoprene has significant effects to the modelled levels of HO_x, more than doubling the levels of HO_x in regions which are currently much lower than observations suggest. The effects of increased HO_x are presented in terms of their impact on more long lived and climatically important gases such as O_3, CO and CH_4 and discussed in terms of local and global scales over the different climate scenarios.