

2.092 Impact of C1-C5 alkyl nitrate chemistry on tropospheric ozone: box and global model perspectives.

Early Career Scientist

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Abstract:

Alkyl nitrates (RONO_2) are organic trace gases that are emitted from oceanic and biomass burning sources and produced photochemically from the oxidation of hydrocarbons (RH) in the presence of nitrogen oxides (NO_x). Their formation terminates the catalytic tropospheric ozone production by temporarily storing the active form of nitrogen. Due to a relatively long lifetime of a few days to a few months they can be destroyed far away from their sources by photolysis or OH radical oxidation, releasing NO_2 back to the local atmosphere. Given the right circumstances, this might change ozone concentrations on regional levels and alter the oxidative capacity of the atmosphere. The RONO_2 chemistry is currently under-represented in global chemistry-climate models. If present, they appear in a lumped form or only short-chained nitrates are considered explicitly. Here we extend the tropospheric chemical mechanism (CheT) of the UK Chemistry and Aerosols (UKCA) model to include the chemistry of C_2 - C_5 RONO_2 and C_4 - C_5 alkanes. The new mechanism is tested in a box model in a range of NO_x and RH conditions using the Master Chemical Mechanism (MCM) as a benchmark. Two types of box modelling experiments show that the inclusion of RONO_2 chemistry slows down the conversion of NO to NO_2 and leads to lower O_3 concentrations in all NO_x -RH conditions considered (lower by 2% at steady state). However, the reactions responsible for the change are slightly different in low and high NO_x environments. We implement the new mechanism into the UKCA model, validate the model with ground-based, ship and aircraft observations of RONO_2 and their parent alkanes and evaluate the impact of C_1 - C_5 RONO_2 chemistry on O_3 , HO_x and NO_x burdens and distribution.