Geophysical Research Abstracts
Vol. 21, EGU2019-11151, 2019
EGU General Assembly 2019

Impact of C_1-C_3 alkyl nitrate chemistry on tropospheric ozone: box and global model perspectives

Maria Zamyatina (1), Claire E. Reeves (1), Alex T. Archibald (2), Paul T. Griffiths (2), and Marcus O. Köhler (1)

(1) Centre for Ocean and Atmospheric Sciences, School of Environmental Sciences, University of East Anglia, UK, (2) National Centre for Atmospheric Science, Department of Chemistry, University of Cambridge, UK

Alkyl nitrates ($RONO_2$) are important reservoirs of tropospheric reactive nitrogen (NO_x). They are produced from the oxidation of hydrocarbons in the presence of NO_x and emitted from the ocean and biomass burning. Due to their relatively long lifetime they can be destroyed far away from their sources and release NO_2 back to the local atmosphere. That might change ozone concentrations on regional levels and alter the oxidising capacity of the atmosphere.

To investigate the impact of the most abundant, C_1-C_3 $RONO_2$ on tropospheric chemistry, we analysed the differences in HO_x, NO_x and NO_y burden and distribution in long-term perpetual year global chemistry climate model (UKCA) runs with and without $RONO_2$. First, we updated the reaction rate coefficients of the inorganic and C_1-C_3 alkane (RH) chemistry of UKCA's standard tropospheric chemistry mechanism. This was done to keep the model inline with the latest chemical kinetics recommendations. Then we extended the mechanism to include C_2-C_3 $RONO_2$ photochemical production and loss. We tested the new mechanism in a steady state box model in a range of NO_x-RH conditions using the Master Chemical Mechanism as a benchmark. Finally, we implemented the new mechanism into UKCA and validated it with a variety of aircraft observations. It appears that UKCA (a) overestimates C_1 $RONO_2$ during NH summer outside equatorial region due to a low C_1 $RONO_2$ loss and (b) underestimates C_1 $RONO_2$ within the equatorial region because of a lack of an oceanic source. To explore the sensitivity of the model to $RONO_2$ dry deposition and oceanic emissions and to calculate the contribution of these processes to the global $RONO_2$ budget, we ran the model with and without $RONO_2$ dry deposition and C_1 and C_2 $RONO_2$ oceanic emissions. The latter were implemented using data from Fisher et al. (2018).

Fisher, J. A., Atlas, E. L., Barletta, B., Meinardi, S., Blake, D. R., Thompson, C. R., Ryerson, T. B., Peischl, J., Tzompa-Sosa, Z. A., and Murray, L. T. (2018). Methyl, ethyl, and propyl nitrates: global distribution and impacts on reactive nitrogen in remote marine environments. Journal of Geophysical Research: Atmospheres, (x):1–23.