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Using WRF-Chem to investigate the impact of night time nitrate radical chemistry and N_2O_5 heterogeneous chemistry on the chemical composition of the UK troposphere.

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It is believed that NO_3 is the primary oxidant at night time, significantly impacting ozone formation, rain acidification and the formation and transformation of aerosols, particularly through the formation of the ammonium nitrate particulate (Allan *et. al.*, 2000). However, many of the basic chemical processes controlling the formation and removal of NO_3, in particular, the N_2O_5 heterogeneous reactions, are often not represented in models, although general parameterisations have been developed (c.f. Bertram & Thornton, 2009). The ROle of Night time chemistry in controlling the Oxidising Capacity of the atmOsphere (RONOCO) campaign is a project being funded by NERC and being carried out by a collaboration of UK Universities. It aims to better understand the role of the NO_3 radical on the chemistry of the night time atmosphere, its oxidation capacity and thus its overall effects on the composition of the troposphere.

The Weather Research and Forecasting model with Chemistry (WRF-Chem) is a state of the art regional climate model with fully coupled online air quality and meteorological components allowing for better resolution of aerosol and gas-phase chemistry (Grell *et. al.*, 2005). It has been extended to include the Common Representative Intermediates scheme (CRIv2-R5) (Watson *et. al.*, 2008), a reduced chemical scheme designed to simulate the atmospheric degradation of 220 species of hydrocarbons and VOCs. The MOSAIC aerosol scheme (Zaveri *et. al.*, 2008), has been extended to include a reduced complexity condensed organic phase consisting of 13 semi-volatile and 2 involatile species (Topping *et. al.*, 2012), as well as the N_2O_5 heterogeneous reaction scheme of Bertram & Thornton (2009). We aim to use WRF-Chem to compare the oxidation capacity of nighttime NO_3 chemistry with that of daytime OH chemistry.

The model was run using two nested grids: a 15km resolution domain over western Europe, containing a 5km resolution domain over the UK. The RONOCO campaign consisted of two flight periods: one during July 2010; the other during January 2011. We have run five model scenarios for both these periods: a base case, with standard emissions and chemistry; two scenarios with standard chemistry, but with halved and doubled NO_x transport emissions respectively; and two scenarios with standard emissions, but one without N_2O_5 heterogeneous chemistry, and the other with the Cl^- reaction pathway disabled.

We will present results from the application of WRF-Chem to model the regional chemical composition of the atmosphere about the UK. Sensitivities to changing emission profiles and the impact of N_2O_5 heterogeneous chemistry will be discussed. Preliminary comparisons between model results and aircraft data will be shown. The strengths and weaknesses of our modelling approach, in particular the gains and drawbacks of using a fully coupled online model for use in this campaign, will be highlighted. The wider impacts of the processes investigated on the regional climate and air quality will be further discussed.

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