Geophysical Research Abstracts
Vol. 17, EGU2015-9204, 2015
EGU General Assembly 2015

The sensitivity of global ozone predictions to dry deposition schemes and their response to climate change

Federico Centoni (1,2), David Stevenson (1), David Fowler (2), Eiko Nemitz (2), and Mhairi Coyle (2)

(1) Institute for Atmospheric and Environmental Science, University of Edinburgh, King's Buildings, West Mains Road, Edinburgh, UK, (2) Centre for Ecology and Hydrology, Bush Estate, Penicuik, Midlothian, Edinburgh, UK

Concentrations of ozone at the surface are strongly affected by deposition to the surface. Deposition processes are very sensitive to temperature and relative humidity at the surface and are expected to respond to global change, with implications for both air quality and ecosystem services. Many studies have shown that ozone stomatal uptake by vegetation typically accounts for 40-60% of total deposition on average and the other part which occurs through non-stomatal pathways is not constant. Flux measurements show that non-stomatal removal increases with temperature and under wet conditions. There are large uncertainties in parameterising the non-stomatal ozone deposition term in climate chemistry models and model predictions vary greatly. In addition, different model treatments of dry deposition constitute a source of inter-model variability in surface ozone predictions.

The main features of the original Unified Model-UK Chemistry and Aerosols (UM-UKCA) dry deposition scheme and the Zhang et al. 2003 scheme, which introduces in UM-UKCA a more developed non-stomatal deposition approach, are presented. This study also estimates the relative contributions of ozone flux via stomatal and non-stomatal uptakes at the global scale, and explores the sensitivity of simulated surface ozone and ozone deposition flux by implementing different non-stomatal parameterization terms.

With a view to exploring the potential influence of future climate, we present results showing the effects of variations in some meteorological parameters on present day (2000) global ozone predictions. In particular, this study revealed that the implementation of a more mechanistic representation of the non-stomatal deposition in UM-UKCA model along with a decreased stomatal uptake due to the effect of blocking under wet conditions, accounted for a substantial reduction of ozone fluxes to broadleaf trees in the tropics with an increase of annual mean surface ozone. On the contrary, a large increase of deposition to C3 grass over central-northern Europe, N. Asia and N. America is associated with a considerable decrease of surface ozone.

Global and seasonal distributions of ozone concentrations and fluxes simulated using the revised UM-UKCA model were compared with global ozone concentration and flux data sets.

Finally, results from a future climate integration for the 2090s using RCP 8.5 climate change scenario are presented. This was done in order to highlight the response of UM-UKCA simulated ozone to climate change only. Another experiment took into account a future vegetation distribution with the aim to investigate how land use changes might contribute to affect future ozone.