Geophysical Research Abstracts, Vol. 8, 00626, 2006
SRef-ID: 1607-7962/gra/EGU06-A-00626

Estimating ozone fluxes with a coupled transport-deposition model

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In the consequence of high emissions of the ozone precursor substances, elevated ozone concentrations may cover large areas in Europe for either shorter episodes or longer periods under certain meteorological conditions. These high concentration fields can be potentially damaging to agricultural and natural vegetation. The harmful effect of ozone is frequently described by the accumulated exposure over a threshold value (AOT40). However in the last decade, several studies have shown that the plant response is more closely related to the stomatal ozone flux than to atmospheric concentrations. Since ozone enters the plant through the stomata, the effective ozone load depends on the plant species, and also on its growing phase and the environmental conditions that influence the aperture of stomata. For this reason a coupled chemical transport model and a detailed dry-deposition model (together the so-called TREX model) were used to estimate the ozone load over Hungary for a summer month (July, 1998). The reaction-diffusion-advection equations relating to ozone formation, transport and deposition are solved on an unstructured triangular grid using the SPRINT2D code. The meteorological data utilised in the model were generated by the ALADIN meso-scale limited area numerical weather prediction model used by Hungarian Meteorological Service. Spatial and temporal variability of ozone concentration, AOT 40 values, deposition velocity of ozone, as well as total- and stomatal ozone fluxes are presented in this study. The differences between the accumulated stomatal flux and AOT 40 have been analysed. Average deposition velocities as well as ratios of stomatal and total fluxes for five different vegetation types are also showed. After these model calculations, the effects of different meteorological conditions (temperature, vapour pressure, and soil moisture stress) on stomatal fluxes have also been analysed separately.