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# Effect of the soil wetness state on the stomatal ozone fluxes in continental region

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Introduction

Due to the rising emissions of the ozone precursor substances, elevated ozone concentrations may cover large areas in Europe for either shorter episodic or longer periods under certain meteorological conditions. These elevated concentrations can be harmful to agricultural and natural vegetation. Ozone basically reacts by plants through the stomata. Therefore, it can be state that the stomatal ozone flux is more appropriate measure for ozone damage than AOT 40 value, and this flux depends on the soil wetness state in the moderate soil water availability conditions. To this and the goal of this study is to analyse the sensitivity of ozone dry deposition to the soil wetness state. For estimating stomatal deposition of ozone over Hungary, an Eulerian photochemical reaction-transport model and a detailed ozone dry deposition model were coupled. The combined model was tested for a sunny, summer day (23rd July, 1998).

Method

A transport and a deposition models have been coupled for estimating the effective ozone load over Hungary. The deposition velocity is calculated as the inverse of the sum of the atmospheric and canopy resistances, where this latter term is parameterized by stomatal, mesophyll, surface and cuticular resistances. The reaction-diffusion-advection equations relating to ozone formation, transport and deposition are solved on an unstructured triangular grid using the SPRINT2D code. The model domain covers Central-Europe including Hungary, which is located at the centre of the domain and covered by a high resolution nested grid. Dry deposition velocity of ozone was estimated over different types of vegetation. The land-cover map was generated based on a Hungarian land-use map. The model was applied on the grid of the meso-scale limited area numerical weather prediction model ALADIN (Horányi et al., 1996). The time and space resolution of the data is 6 hours and 0.10 x 0.15 degrees, respectively. In Hungary, under continental climate conditions, deposition is frequently limited by soil water deficiency. This effect is expressed by a soil water stress function in modelling stomatal resistance. The soil water content has been modelled by a simplified water-budget model (Mintz and Walker, 1993). This sub-model requires daily average of temperature, relative humidity and precipitation amount together with some information about soil. The soil texture on the regular grid was made using a Hungarian soil-map. The grid cell soil texture is represented by the dominant soil texture. Soil characteristics were chosen according to Ács (2003). The meteorological data utilised in the model were generated by the ALADIN meso-scale limited area numerical weather prediction model used by the Hungarian Meteorological Service.

## Results

Based on the previous investigations (Lagzi et al., 2004), it seems that soil water deficiency can strongly reduce the stomatal conductance and so the ozone flux through it. In earlier studies prescribed soil water fields had been used. In contrast to this, in this study the soil water field has been calculated. Before doing so, the water-budget model was tested and calibrated on Hungarian datasets from two different sites and a sensitivity analyses was also performed. The stomatal ozone flux calculations for both taking and without taking into account the effect of the soil moisture stress on the ozone deposition were performed. For the tested hot, summer day a pregnant difference has been arose between the two cases. The obstructive effect of the soil wetness stress on the stomatal ozone deposition varies between 30 and 60 per cents. This phenomenon cannot be neglected in the continental climate region, especially in the hot summer period with the prevailing drought conditions.

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