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Climate Sensitivity to Tropospheric Ozone Change: the Impact of NMVOC

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Changes in the global abundance and distribution of atmospheric greenhouse gases due to human activity and/or changes in the natural environment since the pre-industrial era have a major impact on the climate. On the basis of most recent estimates, about half of the global greenhouse forcing is associated with increasing atmospheric CO2 concentrations, the other half being attributed to changes in methane (CH4), nitrous oxide (N2O), halocarbons, and ozone (O3). Recently, the impact of ozone on the climate and its variation with time and space has drawn increasing attention. The interaction of ozone with atmospheric chemical composition and climate is both direct and indirect: Ozone absorbs both shortwave and longwave radiation and thus contributes directly to the radiative budget of the atmosphere and controls the UV-radiation flux which drives most of the chemistry in the atmosphere. Ozone is the primary source of the main oxidizing radicals (OH, O(1D)) thus playing a key role in controlling the residence time of other primary greenhouse gases (CH4, N2O) and hence providing indirect radiative forcings of climate. In turn, ozone production and the abundance of ozone precursors, volatile organic compounds (VOC) and nitrogen oxides (NOx), is determined to a substantial degree by the climate. Yet, the global feedback mechanisms of climate, chemistry, and changes in anthropogenic and biogenic sources of VOC and NOx, such as fossil fuel consumption, the biosphere, or lightning, are still poorly understood. In order to investigate the impact of these changes in atmospheric chemical composition on climate and related feedback mechanisms, we have developed an interactively coupled chemistry-climate model (CCM). The Canadian CCM includes a comprehensive and detailed chemical mechanism including both anthropogenic and biogenic VOC chemistry in the troposphere as well as stratospheric chemistry of halogens. The chemistry has been integrated into the

Third Generation Canadian Atmospheric General Circulation Model (AGCM3) and the model calculates emissions, transport and chemical transformation, and physical removal of key atmospheric trace species by dry and wet deposition. We will present a series of sensitivity studies that are designed to quantify the impact of tropospheric chemistry on key climate variables such as global temperature and precipitation and possible significant feedbacks on atmospheric chemical composition.