

QOS2016-284-3, 2016

Quadrennial Ozone Symposium of the International Ozone Commission

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The climate in a world without ozone

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The impact of the radiative effects of ozone on the Earth's climate is explored in an extreme numerical experiment with a coupled global climate model in which the effects of ozone on radiation are removed. The control experiment consists of a 30 member-ensemble of 5-year simulations differing only in a small random perturbation to the initial condition. The no-ozone experiment differs only in neglecting the radiative effects of ozone. Chemical composition feedbacks are not taken into account. Inspection of ensemble mean differences provides insight into the role of ozone in the climate system.

We will discuss the initial radiative imbalances and a selection of the robust changes in climate over the 5-years period. These include lapse rate changes in the troposphere, the disappearance of the thermal tropopause, a general upward extension of the troposphere, fast and slow responses of the hydrological cycle, a strengthening of the Indian monsoon, a strong winter warming over Eastern-Canada and a cooling over Siberia associated with a weakening of the extra-tropical stationary waves.

One of the ensemble members has been extended with 20 years to study the decadal climate response which shows a two degree global surface cooling through changes in the surface energy budget. The surface warming due to an increase in net short wave fluxes is more than compensated for by a cooling caused by changes in the net long wave and turbulent heat fluxes.