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Numerical modeling of simultaneous changes of ozone content in the lower and middle atmosphere in the past, present and future

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Two chemistry-climate models of INM RAS RSHU and SOCOL are used to analyze the factors influencing the ozone content in the troposphere and stratosphere. Among the influencing factors, changes in ozone-depleting substances, greenhouse gases, solar activity, aerosol content, ocean surface temperature and ice coverage are considered. Particular attention is paid to changes in ground-level ozone due to changes in surface emissions of greenhouse gases and primarily methane, nitrogen oxides, and the influence of stratospheric ozone variability. Several scenarios of changes in the atmospheric content of greenhouse gases and nitrogen oxides are considered. It is shown that in the past and present, the variability of ground-level ozone is determined by the competing influence of the increase in the greenhouse gas content, contributing to the increase in the ground-level ozone content, and ozone-depleting substances, determining the decrease in the stratospheric ozone content at the end of the twentieth century, which led to a decrease in the inflow of ozone from the stratosphere to the troposphere. In the present, at the beginning of the twenty-first century, the stratospheric ozone content has stabilized, while the greenhouse gas content continues to increase. Numerical estimations have shown that in the future, depending on the scenarios of increase in the content of greenhouse gases and nitrogen oxides, the content of ground-level ozone, which is a toxic gas, can both increase and decrease starting from a certain point.