Geophysical Research Abstracts,
Vol. 10, EGU2008-A-02527, 2008
SRef-ID: 1607-7962/gra/EGU2008-A-02527
EGU General Assembly 2008
© Author(s) 2008

Impact of greenhouse gases on the ozone layer in the Polar Regions

I. G. Dyominov and A. M. Zadorozhny

Novosibirsk State University, Novosibirsk, Russia (dyominov@phys.nsu.ru / Fax: +7 383-3634001

A numerical 2-D zonally averaged interactive dynamical radiative-photochemical model of the ozonosphere including aerosol physics is used to examine the role of the greenhouse gases CO_2, CH_4, and N_2O in the future long-term changes of the Earth's ozone layer, in particular in its recovery after reduction of anthropogenic discharges of chlorine and bromine compounds into the atmosphere. The model allows calculating self-consistently diabatic circulation, temperature, gaseous composition of the troposphere and stratosphere at latitudes from the South to North Poles, as well as distribution of sulphate aerosol particles and polar stratospheric clouds (PSCs) of types I and II. The scenarios of expected changes of the anthropogenic pollutants for the period from 1980 through 2050 are taken from Climate Change 2001.

The processes, which determine the influence of anthropogenic growth of atmospheric abundance of the greenhouse gases on the dynamics of recovery of the Earth's ozone layer in the Polar Regions, have been studied in details. Expected cooling of the stratosphere caused by increases of greenhouse gases, most importantly CO_2, essentially influences the ozone layer by two ways: through temperature dependencies of the gas phase reaction rates and through enhancement of polar ozone depletion via increased PSC formation. The model calculations show that a weakness in efficiencies of all gas phase catalytic cycles of the ozone destruction due to cooling of the stratosphere is a dominant mechanism of the impact of the greenhouse gases on the ozone layer in Antarctic as well as at the lower latitudes. This mechanism leads to a significant acceleration of the ozone layer recovery here because of the greenhouse gases growth. On the contrary, the mechanism of the impact of the greenhouse gases on the ozone

through PSC modification begins to be more effective in Arctic in comparison with the gas phase mechanism in springs after about 2020, which leads to retard the expected recovery of the ozone layer here. The mechanism of the impact of the greenhouse gases on the polar ozone by means of modification of sulphate aerosol distribution in the atmosphere has been revealed and investigated, too. Numerical experiments show that enhancement of the surface area density of sulphate aerosol in the stratosphere caused by the growth of the greenhouse gases will reduce significantly the ozone depletion during the Antarctic ozone hole.

As for the global total ozone, continuous anthropogenic growth of the greenhouse gases will lead to significant acceleration of its recovery. In the case of the used scenario of expected long-term changes of the greenhouse gases, the global ozone will reach its undisturbed level of 1980 by about 2043. If the CO_2 growth stops, the global total ozone will reach this level only by the end of the 21^{st} century.