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# Dynamical Mechanism of Stratospheric Ozone Influences on the Tropospheric Circulation Patterns

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Stratospheric ozone distribution and tropospheric dynamical formations are interconnected and both affect each other in manifold processes of stratosphere-troposphere interactions. In particular, numerous observational studies suggest a clear relation between the total ozone column (TOC) field and the distribution of air-masses in both the stratosphere and the troposphere. The tropopause height being a result of two rival categories of processes (tropospheric vertical convection and stratospheric radiative heating from the ozone cycle), it is natural that tropospheric and stratospheric phenomena have an effect on each other. Indeed, it has been shown that virtually all local ozone anomalies (synoptic-scale deviations in the TOC field) correspond to local uplifts of the tropopause, and a significant amount of research was dedicated to identification of local patterns in the stratospheric ozone distribution as the outcome of tropospheric synoptic formations and weather systems. However, in the present study we focus our attention to the opposite side of this interaction: the impact of stratospheric ozone distribution on the features of tropospheric circulation and the associated weather patterns and regional climate conditions.

For that purpose, we proceed from analyzes of the observational data performed at the A.I. Voeikov Main Geophysical Observatory, which suggest a distinct correlation between stratospheric ozone distribution, synoptic formations and air-masses boundaries in the upper troposphere and the temperature field of the lower stratosphere. Furthermore, we analyze local features of atmospheric general circulation and stratospheric ozone distribution from atmospheric reanalyses and general circulation model data. We focus our attention to the instantaneous position of stationary atmospheric fronts (subtropical and polar fronts) defining regional characteristics of the general circulation cells in the troposphere and separating global tropospheric air-masses, which are known to correspond to distinct meteorological regimes in the TOC field [2, 3]. Finally, we perform a series of numerical simulations of ozone anomalies of different scales, introducing disturbances to the stratospheric ozone and temperature variable fields and tracing the propagation of this perturbation to tropospheric model levels. Aiming to simulate dynamical processes both in the troposphere and the stratosphere with high model resolution, we use a modified version of the WRF-Chem system for regional modeling of finer-scale stratospheric dynamics and mesoscale tropospheric processes in combination with using a general circulation model for global-scale simulations.

We assume that by altering the tropopause height, stratospheric ozone-related processes can have an impact on the location of the stationary atmospheric fronts, thereby exerting influence on circulation processes in troposphere and lower stratosphere, and the tropopause shift itself can also have a direct impact on dynamical parameters of general circulation cells. For midlatitudes, the tropopause height controls the position of the polar stationary front, which has a direct impact on the trajectory of motion of active vortices on synoptic tropospheric levels, thereby controlling regional weather patterns and climate. In particular, this can be exemplified by high TOC values in the Northern Hemisphere in 2013 lowering the tropopause over the Atlantic region and causing a cold season in Europe, the tropopause depression leading to intensification of blocking processes.

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