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Impact of Stratospheric Ozone Distribution on Features of Tropospheric Circulation

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In this work we study connections between stratospheric ozone distribution and general circulation patterns in the troposphere and aim to investigate the causal relationship between them, including the practical side of the influence of stratospheric ozone on tropospheric medium-range weather and regional climate.

Analysis of several decades of observational data, which has been performed at the A.I. Voeikov Main Geophysical Observatory, suggests a clear relation between the stratospheric ozone distribution, upper stratospheric temperature field and planetary-scale air-masses boundaries in the troposphere [1]. Furthermore, it has been shown that each global air-mass, which can be attributed to the corresponding circulation cell in a conceptual model of tropospheric general circulation, has a distinct “regime” of ozone vertical distribution in the stratosphere [1-3].

Proceeding from atmospheric reanalyses combined with satellite and ground-based observations, we study time evolution of the upper-level frontal zones (stationary fronts) with the relevant jet streams, which can be treated as boundaries of global air-masses, in connection with the tropopause height and distribution of ozone in the stratosphere. For that, we develop an algorithm for automated identification of jet streams, stationary fronts and tropopause surface from gridded data (reanalyses or modelling results), and apply it for several cases associated with rapid changes in the stratospheric temperature and ozone fields, including SSW events over Eastern Siberia. Aiming to study the causal relationship between the features of tropospheric circulation and changes in the stratospheric ozone field, we estimate the time lag between these categories of processes on different time scales.

Finally, we discuss the possibility to use the elementary circulation mechanisms classification (by B.L. Dzerdzeevski) in connection with analysis of the stratospheric ozone field and the relevant stratosphere-troposphere interactions.

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