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Ozone variability near Saint Petersburg, Russia: Analysis of experimental and simulated time series (2000-2015)

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The location of Saint Petersburg (60N, 30E) near the border of mid and high latitudes allows observing the ozone changes under different atmospheric conditions, including polar vortex intrusion. We collected datasets of various ozone observations for the period between 2000 and 2015: satellite (SBUV, GOME-2, OMI, and MLS) and ground-based (Dobson, filter ozonometer M-124, FTIR, DOAS). Moreover, we got the ozone numerical simulations by the chemistry climate model (CCM) - the ECHAM5/MESSy for Atmospheric Chemistry model [1] and the chemistry transport model (CTM) - the model of low and middle atmosphere, which is based on the MERRA wind, temperature, pressure and humidity reanalysis [2]. The validation of CCM and CTM in comparison with experimental data is very important for improving models, which can simulate the spatial and temporal variations of gas composition as well as predict the future climate changes.
We analysed the time series of daily averaged ozone total and partial (2-4 atmospheric layers) columns as well as of corresponding monthly averages. Generally, the statistical characteristics of comparison (means, variations, correlations, etc.) demonstrate a high level of agreement between experimental and numerical datasets. However, we observe some systematic differences, e.g. models overestimate the ozone values in the late winter – early spring periods. In some cases, models experience strong high-frequency oscillations of ozone content, which may or may not be observed in the satellite measurements. Especially, we paid much attention to the quality of models in the periods of significant ozone loss over polar and subpolar regions. Additionally, we applied the Fourier analysis to experimental and simulated time series for better understanding the observed seasonal changes in ozone columns and the discrepancy between models and measurements.

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References

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