Lower troposphere impact of stratospheric perturbations in historical simulations of INM climate model

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Historical (1965-2014) simulation with five ensemble members of climate model of Institute of Numerical Mathematics of the Russian Academy of Sciences INMCM5 [Volodin et al., 2017] was analyzed to investigate the lower troposphere impact of Arctic stratospheric perturbations associated with strong and weak polar vortex events in late winter. The atmospheric model has 73 vertical levels up to 0.2 hPa and 1.5°×2° latitude-longitude grid. Among the advantages of the INMCM5 with respect to the previous version are: capability to reproduce the QBO, improved SSW statistic, implementation of new aerosol block [Volodin, Kostrykin 2016], a more sophisticated parameterization of condensation and cloudiness formation. Dynamic processes of extratropical boreal stratosphere simulated by INMCM5 are generally consistent with observations [Vargin, Volodin 2015]. Analyzed five historical simulations only differ in their initial conditions and incorporate all historical forcings as specified by the CMIP6, which include observed greenhouse gases concentrations, total spectral irradiance, volcanic aerosol and monthly 3-D ozone data. Interannual variability of the Arctic stratosphere is different in these five simulations, e.g. SSW frequency of one simulation is 2.5 times larger than the other one. Lower troposphere temperature impacts in March-April of strong vortex events (cold composites of winters with the largest volume of polar stratospheric clouds (Vpsc) in February and March) and weak vortex events (warm composites of the winters with the major SSW events in February with zonal wind reversal at 60°N and 10 hPa and during at least 3 days) were compared with simulated temperature climatological means. Obtained results shows a comparable with observations (mean of the Arctic winters with the largest Vpsc: 1996, 1997, 2000, 2005, and 2011) lower troposphere impact of positive temperature anomalies up to 2° over Northern Eurasia for cold composites and similar negative anomalies over Northern Siberia in March-April for warm composites. Propagation of polar geopotential height anomalies associated with the strong and weak vortex events into troposphere is discussed.
Key words: SSW, polar vortex, stratosphere, polar stratospheric clouds.

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