



Weekly variations in atmospheric tracers and meteorological parameters over Central Russia

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On the basis of ground-based, balloon and satellite data the weekly variations in atmospheric tracers and meteorological parameters over Central Russia are studied. An analysis of OMI and MODIS observations shows a presence of anthropogenically-induced weekly cycles in tropospheric content of NO₂, CH₂O and SO₂ as well as a presence of the weekly cycles of aerosol optical depth (AOD) and cloudiness. The increased AOD values are observed from Saturday to Monday, while the decreased values are observed from Wednesday to Friday. The weekly cycle of NO₂ is near in opposite phase with that of AOD. Besides the period from Friday to Sunday (Monday to Wednesday) is characterized by the increased (decreased) cloud cover respectively. An analysis of ground-based and upper-air data shows that temperature, pressure, humidity, and static stability of air as well as zonal and meridional components of wind also reveal the weekly variations, which are more discernable in the warm season. Somewhat surprising that in temperature, pressure and wind the weekly variations are not confined to the surface layer but manifest themselves throughout the troposphere. In the period of 2000-2009 the tropospheric temperatures in the first half of the week were higher than those in the second half. In particular over Moscow the peak-to-peak amplitude of the weekly variations in temperature in April-September (in both the daytime and nighttime data) reached the values of 0.8 ° C. The results show a close similarity of the vertical structures of the weekly variations in temperature and pressure at four aerological stations located in Central Russia and spaced at a distance of 180-500 km. The in-phase changes of temperature at different heights lead to the "column-like" structures of the weekly cycles in temperature over these sites. In the upper (lower) troposphere the weekly cycles in temperature positively correlate with those in pressure (water vapor) respectively. The local intra-week temperature signals obtained by averaging temperature data within individual years reveal significant year-to-year variability at that the changes of the signals at different sites are highly correlated. The long-term changes in these signals are such that the average weekly cycles of temperature in the periods of 1973-1982 and 2000-2009 are in the opposite phases. Throughout the troposphere the weekly fluctuations of the wind vector are predominantly oriented in the NW-SE direction and the "column-like" structures of the weekly cycles of temperature at least in part can be attributed to a weekly modulation of horizontal advection of air caused by the weekly variability of wind. On the other hand the obtained results reveal a hint on mutually agreed changes in tracers and meteorological parameters during a week. In particular, the weekly cycle of AOD positively correlates with that of humidity, while the weekly variability of surface temperature is in opposite phase with that of cloudiness being however insignificant.