

Weekly cycle of minor air gases in Moscow

Mikhail A. Lokoshchenko (1), Nikolay F. Elansky (2), and Alexandra V. Trifanova (3)

(1) Lomonosov Moscow State University, Faculty of Geography, Department of Meteorology and Climatology, Moscow, Russian Federation (loko@geogr.msu.su), (2) Obukhov Institute of Atmospheric Physics, (3) Dubna State University

The weekly cycle of the surface concentrations of five trace atmospheric gases in Moscow has been analyzed based on continuous automatic once-a-minute measurements. The data of joint ecological station of the Institute of Atmospheric Physics and Moscow State University for nine years (2002–2010) were used. This station operated in conditions of comparatively clear park zone of the University on the South-Western periphery of the city at a distance of 8 km from the city centre. Fortunately, none of the great sources of the air pollution – neither point sources, nor linear ones – are present in the vicinity of the station so that the measurements there are quite representative.

Results of spectral analysis demonstrate statistically significant maximum of spectral density close to 7 days. Any clear periodicity of around seven days may be a consequence of either natural synoptic period or weekly cycle. The fact that the influence of human activity on urban air composition changes with a weekly periodicity is confirmed by statistically significant difference between concentrations of trace gases on working days and on Sunday (when emissions from both the traffic and the industrial sources are minimal). On average, both primary pollutants (nitrogen oxide and carbon oxide) and the secondary ones (NO_2) show the lowest concentrations of the week on Sunday whereas ozone, by contrast, peaks on this day. Besides, usual diurnal cycle of air pollutants is transformed on Sunday – e.g., secondary nocturnal maximum of ozone in the city is absent on Sunday like at rural area.

On Saturday concentrations of trace gases are in between working days and Sunday; this ‘Saturday effect’ is a result of a gradual clearing of the urban air. An additional effect is that in the first half of Monday (before noon) surface concentrations of NO and NO_2 are generally less, whereas the concentration of O_3 is, on the contrary, a bit higher than at the same time on the rest of working days. The ‘Monday effect’ is a result of the gradual contamination of the urban air after week-end. Any other changes from one working day to another are occasional and non-regular in time, so the average differences between working days are usually insignificant.

Usually there is no gradual accumulation of air pollutants during working days in Moscow except only for specific conditions of fires during extremely hot weather (e.g., heat wave in summer of 2010). Weekly and annual cycles of NO, NO_2 and CO surface concentrations have nearly the same amplitudes whereas the weekly variability of O_3 is less than the annual one for this gas. Average differences between working days and weekend days (Saturday and Sunday), i.e. an amplitude of the weekly cycle, has a tendency to be reduced in time during nine years, but statistical significance of these inter-annual changes remains doubtful due to insufficient length of the row. Unlike other trace gases, sulphur dioxide doesn’t demonstrate clear weekly cycle because the urban heating, the main source of it, has the same intensity on any day of the week.