Photochemical Aging in the Large Aerosol Chamber (PHOTO-LAC)

H. Czech[1], O. B. Popovicheva[2], D. Chernov[3], A. S. Kozlov[4], E. Schneider[1], C. P. Rüger[1], V.S. Kozlov[3], V.P. Shmargunov[3], and R. Zimmermann[1]

[1]Department of Analytical and Technical Chemistry, University of Rostock, Rostock, 18059, Germany
[2]Skobeltsyn Institute of Nuclear Physics, Lomonosov Moscow State University, Moscow, 119991, Russia
[3]V. E. Zuev Institute of Atmospheric Optics (IAO), SB RAS, Tomsk, 634021, Russia
[4]Voevodsky Institute of Chemical Kinetics and Combustion, SB RAS, Novosibirsk, 630090, Russia

Aerosol emissions from large wildfires may dramatically increase local levels of particulate matter (PM) by long-range transport over thousands of kilometers, transferring emissions from remote areas to densely populated regions. It has been established that short-term exposure to wildfire PM is associated with increased mortality, particularly by cases of cardiovascular and respiratory mortality. In dense plumes, atmospheric transport oxidation chemistry and aerosol aging may differ from the fate of organic aerosol at typical ambient levels. For example, in dense plumes nitrate radicals and ozone may even dominate the oxidation at daytime, which is usually driven by hydroxyl radical chemistry.

Smog chambers are widely used to investigate atmospheric aging of combustion aerosols. To the best of our knowledge, the Large Aerosol Chamber (LAC) in Tomsk (Russia) with a volume of 1,800 m3 (25 m length, 10 m diameter) refers to one of the largest smog chambers in the world. The LAC contains two ovens enabling the generation of combustion aerosols under flaming and smoldering conditions. 198 UV-lamps (Cosmedico Ltd.; 2 m length, 40 mm diameter) were placed inside the LAC. The lamps cover an emission the range from 300 to 400 nm (centered at ~350 nm) and an irradiance of 29 W m-2 for UV-A.

Figures of merits for the new Photochemical Large Aerosol Chamber (PHOTO-LAC) were provided for NO_2 photolysis experiments, wall loss rates for a model aerosol, formation of secondary organic aerosol from toluene photooxidation and photochemical/dark BB plume ageing. Overall, the PHOTO-LAC resembles the photochemistry of conventional chamber but additional offer the opportunity for long-term plume aging experiments of more than 24 h.