Description for the general public

The impact of biomass burning aerosol on physical properties of the atmosphere, radiative budget and air quality over Central Europe

The presented project is aimed to determine the relationship between biomass burning (BB) aerosol advected over Central Europe from various fire types and via different transportation paths, and aerosol properties, radiative budget, as well as air quality.

Wildfires are large global emission sources of atmospheric trace gases and aerosols. Such emissions have a considerable impact on air quality, for instance, cause a major health hazard, but also BB aerosol influences the radiative balance of the atmosphere. A number of studies indicate that wildfire occurrence has increased significantly in recent decades and their frequency, as well as severity, are likely to escalate in the future due to positive feedback on climate change. The higher number of fires will most likely lead to the increase in emissions of BB aerosol and therefore to an increased importance of its role in the atmosphere. One of the main difficulties in evaluating BB aerosol influence concerns the fact that BB aerosol properties depend on a number of factors, such as type of combusted biomass, length of the transport, meteorological conditions, etc.

In the past years, a significant number of the long and medium-range transport of BB aerosols over Poland territory has been observed. BB aerosol advection originated from fires in North America, Siberia, Ukraine or South Europe significantly affected properties of the atmosphere. Even though part of these cases have been analyzed, all previous studies have concerned only individual events and selected aspect of the BB aerosol detection and determination of its properties. There is still a lack of comprehensive, long term study which investigated this topic. Therefore, issues mentioned before will be addressed in the proposed project with emphasis on the Central Europe area.

The key scope of the presented research includes the following topics:

- variability of fire frequency;
- BB aerosol transport over Central Europe;
- biomass burning aerosol columnar properties;
- vertical variability of BB aerosol optical and microphysical properties;
- radiative impact of biomass burning aerosol in Central Europe;
- the impact of BB aerosol on air quality and thermodynamical properties within PBL.

In the first part of the project studies over changes in fire frequency in the northern hemisphere, with respect to spatial distribution and long-term time scales are conducted. Further, the probability of BB aerosol transport from sources located around the northern hemisphere to areas over Central Europe is determined. The obtained set of fire cases will be the groundwork for the subsequent work. The next step of the study aims to provide a detailed look at the ptical properties of the emitted aerosols. Valuable information on the vertical distribution of aerosol parameters will be obtained from vertical profiling of the atmosphere with the use of balloon, dron, and lidar measurements. The following part utilizes databases created within previous tasks and radiative transfer models to derive the seasonal and annual variability of the radiative budget and the heating rates of biomass-burning aerosol in the study area. Lastly, the issue of BB aerosol influence on changes within PBL concerning both thermodynamical properties and air quality parameters is addressed.

The outcome of the project will allow us to verify the hypotheses and answer questions defined in research objectives and will contribute to the increase of knowledge about the properties and role of biomass burning aerosol transported over Central Europe in various aspects. Among other conducted calculations will help to determine the extent to which BB aerosol over Central Europe influence on the observed climate changes. Authors believe that collected data may be also useful in the future to parameterize aerosol physical properties in transport models and allow improving the air quality forecasts especially in Central Europe, where air pollution is still high.