PARTICLE FLUXES IN URBAN ENVIRONMENT WITH REMOTE SENSING

In the last decades, there is an increasing interest on the climate change and air quality, and how natural and human-driven processes affect them. Human activities have caused approximately 1.0ºC of global warming above pre-industrial levels, and this warming is likely to reach 1.5ºC between 2030 and 2052. However, there are several atmospheric components and mechanisms that are not sufficiently understood, measured or whose effect still presents high uncertainties.

This is the case of atmospheric aerosols, i.e. the solid or liquid particles that are suspended in the air, excluding cloud particles and precipitation. Aerosol particles originate from natural sources, such as wind-blown dust, sea spray, volcanoes, smoke from fires or pollen, and from human activities, such as combustion of fuels or agricultural biomass burning. They can stay in the atmosphere from a few days to a few weeks and have a strong impact on it, modifying its warming rate, affecting cloud formation and even human health. In particular, the exchange of aerosol particles between the atmosphere and the Earth's surface (known as *aerosol* or *particle flux*) plays here a significant role, but this vertical exchange depends in a complicated way on surface characteristics and meteorological conditions in the lowermost region of the atmosphere. Moreover, the vertical movement of particles is often combined with other complex processes, such as water uptake due to changing humidity, cloud droplet formation, or chemical changes. For above-mentioned reasons, adequate measurements are difficult to obtain, and it is still unclear how different ecosystems emit particles of different sizes to the atmosphere and how different surfaces remove particles from the atmosphere.

For aerosol flux studies, a combined analysis of several processes is needed. In addition to a proper characterization of aerosols (in terms of shape, size, amount, etc.), the right measurement of air movements is crucial. Those movements include the mean wind, but also a *turbulent* component due to arbitrary air shifts driven by different sources. Therefore, the measurement of those winds and turbulent sources and mechanisms are essential.

In this context, the proposed project aims at evaluating the aerosol flux in the urban environment of Warsaw. We will compare the calculated exchanges with other urban locations from Northern and Southern Europe, where different meteorological conditions are predominant. This research will be done within an intensive international cooperation with Spain and Finland.

Our research will be based on lidar (acronym of LIght Detection and Ranging) systems. This technique has become in the last decades one of the most efficient for atmospheric studies, due to its huge potential. Its main strength is the possibility of routine measurements with high vertical and temporal resolution. Unique Raman lidar system at the Remote Sensing Laboratory (RS-Lab) of the Faculty of Physics of the University of Warsaw will provide information on the distribution of aerosols in the atmosphere, including characterization of their properties. This system measures continuously the aerosol optical properties in 12 channels and can be used to derive the amount of aerosol, the size, and shape of aerosol particles, as well as the height and thickness of the formed aerosol layers. A Doppler lidar from University of Granada (Spain) will be used for wind and turbulent measurements. This instrument measures the wind speeds and directions every 2 seconds at different altitudes from the ground, allowing to obtain both the mean winds and the turbulent structures and sources. This work will be carried out with a methodology developed in a cooperation with the Finnish Meteorological Institute (Helsinki, Finland).

The direct impact of this project in the scientific area will be the knowledge about the conditions and processes that facilitate vertical transport of aerosol particles in urban environments. As indirect and further impact, the knowledge obtained will be the basis for parameterizations of aerosol fluxes for Numerical Weather Prediction Models and for air pollution studies and models. This will then have a crucial social impact, as decision makers need solid scientific bases in order to apply proper mitigation and adaptation policies.