Absorption and scattering of radiation by aerosols directly affect the radiation balance of the Arctic, which is thought to be very sensitive to changes in radiative fluxes. This is due to small amount of solar energy normally absorbed in the polar regions. These regions represent sensitive ecosystems, which are susceptible to even small changes in the local climate. Thus, for a given aerosol distribution, the specific optical properties are enhanced in these regions. In order to improve the knowledge about the origin, transport pathways, vertical structure of aerosol physical and chemical properties as well as the impact on climate in the polar regions, a combined effort of surface-based and remote sensing measurements is needed.

The Arctic studies of aerosol properties the authors originated in 1996 during the ARctic EXperiment (AREX) campaigns using the r/v Oceania vessel. Every year the vessel cruised for seven weeks (June-August) in the area of the Arctic between 0 and 14°E and 69 and 79°N. In 2002 the measurements were also carried out from the station in Ny-Alesund in Spitsbergen. The aerosol studies were conducted using an ensemble of instruments, including lidars, laser particle counters, sunphotometers and ozonometers. During the ship studies laser particle counter was placed on a mast of the vessel and moved vertically, which facilitated the determination of the vertical structure of aerosol concentrations and their size distribution at altitudes of up to 20 m a. s. l. Simultaneously, lidars provided the vertical profiles of aerosol concentrations. Those were further used for the calculation of aerosol optical thickness. Then the campaigns were launched in 2004 and 2006, within a framework of ASTAR (2004), POLAR-AOD and DAMOCLES (2006) international experiments, during which an ensemble of lidars and sunphotometers were applied.

Such measurement set ups facilitated the obtaining of data with good accuracy and well calibrated. The full meteorological coverage was always provided by the ship meteo station or from different meteo services, such as the British Atmospheric Data Center.

The Arctic aerosols in the Spitsbergen area show significant temporal and vertical variability. The results collected during the campaigns can be divided into two groups, the spring data and the summer data. Each winter, cold dense air settles over the Arctic. In the darkness, the Arctic seems to become more and more polluted by a buildup of mid-latitude emissions from fossil fuel combustion, smelting and other industrial processes. Then, in spring, when the light appears, there is a smog-like haze in the Arctic region. The values of aerosol optical thickness, e.g. at 500 nm, exceed 0.1 and they can be as high as 0.35.

In summer the situation differs from that in spring. The main problem in aerosol optical studies is related to cloud coverage over the region. Also the air mass trajectories can vary significantly which also influences the aerosol optical thickness. The summer values at 500 nm can also be high, up to even 0.3 (land origin of air masses) but majority of data are below 0.1, which indicates very clean air conditions, with very few aerosol particles suspended in it.

In order to fully describe the impact of aerosols on radiative budget it is necessary to continue the investigations of the vertical structure of physical and optical properties of aerosol particles, including solar radiative closure between observed and calculated aerosol properties also in different seasons, mainly in summer. Thus a new campaign is being prepared (summer 2007) during which r/v Oceania and an ensemble of lidars (ALOMAR, IOPAS, Warsaw University) and sunphotometers as well as other supporting instruments will be applied for measurements in the Arctic and the area of Andoya.