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Editorial

Special Issue on New Insights into Atmospheric Chemistry and Climate

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Atmospheric gases and aerosols affect air quality and play an important role in the Earth's climate system. Aerosol particles, or particulate matter (PM), can affect the climate directly, by scattering or absorbing solar radiation and altering the reflectivity of the planet, and indirectly, by acting as cloud condensation and ice nuclei, i.e., due to aerosol-cloud interactions. Among different aerosols components, Black Carbon (BC) readily absorbs radiation, warming the atmosphere but also shading the surface; Organic Carbon (OC), sometimes called brown carbon or organic matter, has a warming influence on the atmosphere depending on the brightness of the underlying ground. Mineral dust aerosol affects climate through direct and indirect effects. Primary biological aerosol and humic-like substances (HULIS) can affect atmospheric processes.

This Special Issue aimed to highlight the results of new insights into the composition of aerosols and the physicochemical properties that are related to climate effects.

A total of seven papers (six papers and one review) covering different fields of atmospheric chemistry and climate effects are presented in the Special Issue. In Ielpo et al. [1], indoor and outdoor Volatile Organic Compounds (VOCs) trends, investigated in a secondary school actively involving students both in the planning of monitoring campaigns and results discussion, highlighted the relevant VOCs sources in the school air. Apart from their toxic nature for health and environment, VOCs are precursors of ozone (O3), secondary organic aerosol (SOA), and particulate matter (PM) via photochemical oxidation under illumination. To control the concentrations of O3 and PM, a series of regulations and policies related to VOCs should be better implemented. In Cesari et al. [2], the impact of ship emissions on both gaseous and particulate pollutants has been investigated through an integrated methodology which includes atmospheric flow and numerical dispersion modelling as well as chemical composition and statistical analyses. BOLCHEM results showed that the impact of ship emissions covered an area of a few dozen kilometers and was 37.6% for NOx, −11.7% for O3, 4.3% for PM10, and 6.1% for PM2.5. At a local scale, the analysis performed by ADMS-Urban highlighted that the impact of ship emissions on PM2.5 was 6.8% in downwind sampling site condition with respect to the port area and reduced to lower than 3.0% at about 2 km far from the sources. In Settimo et al. [3], the importance of characterizing the total deposition rates of airborne particles in the surroundings of an industrial area along the north cost of the Lazio Region in Italy has been highlighted to increase knowledge about the potential impact of emissions from the coal-fired thermoelectric (CTE) power plant and other possible sources existing in the surrounding area. This study becomes more relevant considering that the Italian Integrated National Plan for Energy and Climate (INPEC) will provide for the decarbonization of the energy system starting from 2025, with a sharp cut in the use of coal for the production of electricity. In this frame, electricity production is a major source of greenhouse gas emissions. Mineral dust, recognized as the main component of atmospheric aerosols, may be defined as one of the largest natural aerosol sources significantly influencing the weather and climate system. In Rizza et al. [4], WRF-Chem model is applied to study an intense Saharan dust outbreak event affecting the Italian peninsula during April 2018. Results of model simulations have been compared with XMed-Dry samples from Lecce (Italy), Athens (Greece) and San Lawrenz/Gozo (Malta) analyzed with respect to aerosol particle size distribution, relative dust contribution and composition. Black carbon is the fraction of the carbonaceous aerosol in the atmosphere that is characterized by its strong absorption of visible light and it plays significant roles in atmospheric radiative properties and in its warming. Piñeiro-Iglesias et al. [5], describes the equivalent Black Carbon (eBC) temporal variability over two years in a residential area in the northwest of Spain and identifies eBC local and regional sources of emissions from fossil fuel combustion and biomass burning. In Lawson et al. [6], by using a variety of geochemistry techniques, physicochemical properties of particulate matter coal fly ash collected in Svalbard have been characterized, discussed and put in relationship with the emissions of the local coal-fired power station. This local pollution source affects an already sensitive region, in fact, the Arctic region is a global 'hot-spot' that is warming more quickly than any other region on the planet, with the major changes in earth-surface phenomena being declines in glacier ice and snow, melting of permafrost and heavy impacting on the biota. The study and characterization of atmospheric aerosols, as well as their effects on radiative climate forcing, are some of the most predominant research topics in atmospheric chemistry. Organic aerosols (OA) are an important component of air particles and one of the key drivers that impact both climate and human health. Full characterization of organic aerosol fraction is particularly difficult to achieve due to the complexity of this aerosol component and its structural diversity. In the review, Duarte et al. [7] highlighted the multidimensional non-targeted analytical strategies that have been developed and employed for providing new insights into the structural and molecular features of water-soluble organic components present in air particles.

The submissions for this Special Issue have closed, but research in the field of atmospheric sciences and climate change needs continuous efforts and new knowledge, especially in relation to the severe energetic crisis and current global political impasse due to the Ukrainian war.

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