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Heterogeneous oxidation of pesticides on aerosol condensed phase

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Pesticides are widely used all over the world. It is known that they exhibit adverse health effects and environmental risks due to their physico-chemical properties and their extensive use which is growing every year. They are distributed in the atmosphere, an important vector of dissemination, over long distances away from the target area. The partitioning of pesticides between the gas and particulate phases influences their atmospheric fate. Most of the pesticides are semi-volatile compounds, emphasizing the importance of assessing their heterogeneous reactivity towards atmospheric oxidants.

These reactions are important because they are involved in, among others, direct and indirect climate changes, adverse health effects from inhaled particles, effects on cloud chemistry and ozone production. In this work, the importance of atmospheric degradation of pesticides is evaluated on the surface of aerosol deliquescent particles.

The photolysis processing and heterogeneous reactivity towards O_3 and OH, was evaluated of eight commonly used pesticides (cyprodinil, deltamethrin, difenoconazole, fipronil, oxadiazon, pendimethalin, permethrin, tetraconazole) adsorbed on silica particles. Silicate particles are present in air-borne mineral dust in atmospheric aerosols, and heterogeneous reactions can be different in the presence of these mineral particles. Depending on their origin and conditioning, aerosol particles containing pesticides can have complex and highly porous microstructures, which are influenced by electric charge effects and interaction with water vapour. Therefore, the kinetic experiments and consecutive product studies were performed at atmospherically relevant relative humidity (RH) of 55 %.

The identification of surface bound products was performed using GC-(QqQ)-MS/MS and LC-(Q-ToF)-MS/MS and the gas-phase products were on-line monitored by PTR-ToF-MS. Based on the detected and identified reaction products, it was observed that water plays a crucial role in the reaction mechanism of ozone and hydroxyl radical with the adsorbed pesticides on the silica particles.

The obtained results will allow better understanding of the impact of pesticides and their degradation products on human health, and to make recommendations in order to reduce population exposure to the pesticide plume and the pollution by phyto-sanitary products on the regional scale, which constitutes a necessary step in the development of environmental strategies.