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Studies of the atmospheric degradation of pesticides at EUPHORE

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Pesticides are extensively used in agriculture, gardening and a variety of other household applications. They can be emitted into the atmosphere through dispersion during spraying, which is carried out mainly in spring and autumn, but also through volatilization from ground or leaf surfaces, especially in summer when the temperatures, particularly in Southern Europe, can reach 40 ˚C. Once in the atmosphere pesticides are distributed between the gas, particle and aqueous phases. The following range of pesticides are commonly used in many European countries; Trifluralin (dinitroaniline herbicide), Dichlorvos (organophosphate insecticide), chloropicrin (fungicide), diazinon (organothiophosphate insecticide), fenpropidin (piperidine fungicide), hymexazol (oxazol insecticide), propachlor (chloroacetanilide insecticide), chlorpyrifos (methyl organophosphate insecticide) and lindane- (chlorinated insecticide).

As for other organic compounds, the gas-phase degradation of pesticides in the atmosphere is controlled by photolysis and/or reaction with ozone, OH and NO_3 radicals. However, studies of the gas-phase degradation of pesticides are problematic because of their low vapour pressures. One advantage of large simulation chambers, such as those at the European Photoreactor (EUPHORE), is that compounds with vapour pressures as low as 5 mPa can be introduced into the chamber in the gas-phase.

In this work a general overview of the use of the EUPHORE chambers for studying the atmospheric fate of pesticides will be presented. Results obtained from the

experiments have been used to derive lifetimes, and provide information on particle and gas phase product formation. Photolysis by natural sunlight has been shown to be the main degradation pathway for several pesticides, including trifluralin (lifetime 15 minutes) and chloropicrin (lifetime 6 hours), whereas the OH radical reaction is a more important degradation pathway for others. Moreover, in some cases the reaction products are more volatile and stable than their precursor. For example, phosghene, $Cl_2C(O)$, a toxic compound, is one of the main products obtained from the photolysis of chloropicrin or from the reaction of dichlorvos with OH radicals.

The results obtained show the usefulness of the EUPHORE facility as a sophisticated tool for studying the atmospheric fate of pesticides under controlled conditions. The data derived from such studies are of potential importance to assess the impact of these species on air quality and on human health.