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Progress in Global Multicompartmental Modelling of DDT

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Dichlorophenyltrichloroethane, DDT, and its major metabolite dichlorophenyldichloroethylene, DDE, are long-lived in the environment (persistent) and circulate since the 1950s. They accumulate along food chains, cause detrimental effects in marine and terrestrial wild life, and pose a hazard for human health. DDT was widely used as an insecticide in the past and is still in use in a number of tropical countries to combat vector borne diseases like malaria and typhus. It is a multicompartmental substance with only a small mass fraction residing in air.

A global multicompartment chemistry transport model (MPI-MCTM; Semeena et al., 2006) is used to study the environmental distribution and fate of dichlorodiphenyltrichloroethane (DDT). For the first time a horizontally and vertically resolved global model was used to perform a long-term simulation of DDT and DDE. The model is based on general circulation models for the ocean (MPIOM; Marsland et al., 2003) and atmosphere (ECHAM5). In addition, an oceanic biogeochemistry model (HAMOCC5.1; Maier-Reimer et al., 2005) and a microphysical aerosol model (HAM; Stier et al., 2005) are included. Multicompartmental substances are cycling in atmosphere (3 phases), ocean (3 phases), top soil (3 phases), and vegetation surfaces. The model was run for 40 years forced with historical agricultural application data of 1950-1990.

The model results show that the global environmental contamination started to decrease in air, soil and vegetation after the applications peaked in 1965-70. In some regions, however, the DDT mass had not yet reached a maximum in 1990 and was still accumulating mass until the end of the simulation.

Modelled DDT and DDE concentrations in atmosphere, ocean and soil are evaluated by comparison with observational data. The evaluation of the model results indicate that degradation of DDE in air was underestimated. Also for DDT, the discrepancies between model results and observations are related to uncertainties of input parameters. Furthermore, better resolution of some processes could improve model performance.

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