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Trends, Long-range Transport and Lifetime of DDT in and over Central Europe

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Dichlorophenyltrichloroethane, DDT, and its major metabolites dichlorophenyldichloroethylene, DDE, and dichlorophenyldichloroethane, DDD, 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 is a multicompartmental substance with only a small mass fraction residing in air. Decreasing concentration trends are recorded in Europe, where the substance has not been used since ≈1988 (Holoubek et al., 2007). Transport in the free troposphere is expected by models (Lammel & Semeena, 2005; Semeena et al., 2006), but no observations in the free troposphere had been reported in Europe. The degradation rates of DDT, DDE and DDD are uncertain. In particular, the hydroxyl radical reaction rate coefficients in air are unknown.

DDT monitoring data in air at a central European continental background station, Kosetice, Czech Republic, were used in combination with back-trajectories (HYSPLIT model, NOAA) to localize DDT sources in central, western and northern Europe. The decreasing trend continued during recent years, 2004-06.

During 2 campaigns at a high mountain site in the Alps (Zugspitze, 2650 m a.s.l.) mean concentrations of 0.23, 0.63 and 0.08 pg m^{-3} of DDT, DDE and DDD, respectively, were measured in summer and 0.73, 2.22, and 0.52 pg m^{-3}, respectively, in winter. The levels were not lower in free tropospheric air than in boundary layer air. Transport and residence times in air were quantified using Lagrangian particle dispersion model retroplume analyses (FLEXPART model; Stohl et al., 1998). During a stable anti-cyclonic situation photochemical lifetimes corresponded to $k_{OH} < 1.5\text{x}10^{-12}$ cm^3 $molec^{-1}$ s^{-1} are found for p,p'-DDT, $k_{OH} < 0.75\text{x}10^{-12}$ cm^3 $molec^{-1}$ s^{-1} for p,p'-DDE and $k_{OH} < 1.0\text{x}10^{-12}$ cm^3 $molec^{-1}$ s^{-1} for p,p'-DDD. The k_{OH} values for DDE and DDD are significantly lower than estimated (QSAR).

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