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TITLE: Organophosphate Esters in Air, Snow, and Seawater in the North Atlantic and the Arctic

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ABSTRACT:

The concentrations of eight organophosphate esters (OPEs) have been investigated in air, snow and seawater samples collected during the cruise of ARK-XXVIII/2 from sixth June to third July 2014 across the North Atlantic and the Arctic. The sum of gaseous and particle concentrations (?OPE) ranged from 35 to 343 pg/m3. The three chlorinated OPEs accounted for 88 ± 5% of the ?OPE. The most abundant OPE was tris(2-chloroethyl) phosphate (TCEP), with concentrations ranging from 30 to 227 pg/m3, followed by three major OPEs, such as tris(1-chloro-2-propyl) phosphate (TCPP, 0.8 to 82 pg/m3), tri-n-butyl phosphate (TnBP, 2 to 19 pg/m3), and tri-iso-butyl phosphate (TiBP, 0.3 to 14 pg/m3). The ?OPE concentrations in snow and seawater ranged from 4356 to 10561 pg/L and from 348 to 8396 pg/L, respectively. The atmospheric particle-bound dry depositions of TCEP ranged from 2 to 12 ng/m2/day. The air?seawater gas exchange fluxes were dominated by net volatilization from seawater to air for TCEP (mean, 146 ± 239 ng/m2/day), TCPP (mean, 1670 ± 3031 ng/m2/day), TiBP (mean, 537 ± 581 ng/m2/day) and TnBP (mean, 230 ± 254 ng/m2/day). This study highlighted that OPEs are subject to long-range transport via both air and seawater from the European continent and seas to the North Atlantic and the Arctic.

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