Spatial and Temporal Trends of Dissolved Polybrominated Diphenyl Ethers and Non-BDE Flame Retardants in the Aquatic Environment across Countries

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ABSTRACT: Measuring dissolved concentrations of polybrominated diphenyl ethers (PBDEs) and non-BDE flame retardants on a global scale provides critical insights into the effectiveness of the Stockholm Convention. In the present study, we deployed passive sampling devices at 43 seawater and freshwater sites covering 21 countries from 2016 to 2020. The detection frequencies were 20−94% for BDE congeners and 33−42% for dechlorane plus, higher than those (0−20%) for other target compounds. The median concentrations of dissolved Σ9PBDE (sum of BDE-28, -47, -66, -85, -99, -100, -153, -154, and -183) were 0.28 and 0.64 pg L−1 in seawater and freshwater, respectively. The concentrations of dissolved Σ9PBDE, along with published data, slightly increased before 2016 and remained steady from 2016 to 2018, indicating delayed effects of the global phaseout of technical Penta- and Octa-BDEs. The log-transformed concentrations of individual BDE congeners were better correlated with regional gross domestic product than with population density. The potential ecological risk of BDE-47 was low, and there was a lack of key risk indicators for other compounds. The present study documented the delayed response of the aquatic environment to the regulatory actions on reducing PBDE emissions.

KEYWORDS: AQUA-GAPS/MONET, passive sampling, halogenated flame retardants, seawater and freshwater, anthropogenic activity.