# Global Contamination Trends of Persistent Organic Chemicals

Bommanna G. Loganathan
Paul K. S. Lam



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Edited by





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# Global Contamination Trends of Persistent Organic Chemicals

## **Preface**

The quality of life depends on the quality of our environment. Unexpected environmental disasters during the past few decades, such as the Gulf of Mexico oil spill in 2010, radiation leakage at the Daiichi nuclear power plant in Fukushima, Japan following the earthquake and tsunami in 2011, and uncertainties associated with global warming have prompted people to become more concerned about the future of the global environment than ever before. Environmental pollution by man-made persistent organic chemicals (POCs) has been a serious global issue for over half a century. This book addresses the past, present, and possible future trends of environmental contamination by POCs on the global scale. POCs in this book refer to any chemical species that are persistent in the environment and cause unintended effects on the environment and to the health of wildlife and humans. These chemicals are also referred to as PBTs (persistent, bioaccumulative, and toxic). POPs (persistent organic pollutants), and PLCs (persistent lipophilic contaminants), as their unique properties such as hydrophobicity and lipophilicity lead to their accumulation in biological tissues. Further, their low biodegradability and volatility (high vapor pressure) lead to their long-range transportation via atmosphere and water, resulting in widespread environmental contamination of biota and humans at sites remote from where these chemicals are produced and used. Exposure to certain POCs may result in serious health complications, including reproductive and immune dysfunction, birth defects, diminished intelligence, and certain types of cancers.

Given the long-range movement and dispersal of these chemicals, no one government acting alone can protect its citizens or the environment from POCs. Therefore, these chemicals have been the subject of an intensive regional, national, and international effort to limit their production and use, as well as the control and disposal of old or obsolete chemical stocks. In May 1995, the United Nations Environment Program (UNEP) determined that there were sufficient data on persistence and toxicity to eliminate or reduce emissions, or even in some cases halt production and use, of 12 POPs. Further, in 1998, 36 member states of the United Nations Economic Commission for Europe (UNECE), consisting of European countries, Canada, Russia, and the United States, agreed on a protocol that banned the production and use of some POPs, UNEP's Stockholm Convention on Persistent Organic Pollutants, a global treaty to protect human health and the environment, was adopted in 2001 and entered into force in 2004, requiring countries to take measures to eliminate or reduce the release of persistent chemicals into the environment. The countries that signed the treaty are expected to monitor and report trends in the occurrence and distribution of these chemicals in their national environments. New chemicals were added to the POPs list during the Stockholm Convention in 2009, emphasizing the importance of continual monitoring and assessment of environmental contaminants.

Studying the spatial and temporal trends of POCs has thus become an area of interest, since trend-monitoring data are useful in understanding past, present, and future trends of environmental contamination by these compounds. This book, *Global Contamination Trends of Persistent Organic Chemicals*, was prepared in order to provide the most comprehensive coverage of spatial and temporal trends of these "classical" pollutants, as well as emerging contaminants that have raised concerns around the world in recent years. These emerging chemicals constitute a diverse group, including halogenated compounds used in manufacturing, such as brominated flame retardants and perfluorinated surfactants, as well as personal care products, such as synthetic musks. Some of these chemicals have been studied for more than 10 years, while the environmental behavior of others is only beginning to be investigated. It is therefore important to have a greater understanding of how both "classical" and emerging chemicals are distributed in the global environment.

The content of this book is divided into five parts. Part I deals with perspectives on classical and emerging persistent chemicals, Part II presents POC trends in countries in the Asia-Pacific Region, Part III describes POC trends in countries from Europe and Africa, Part IV provides a detailed account of POC trends in the Americas, and Part V elucidates POC trends in remote regions such as coastal and open ocean environments as well as the Arctic and Antarctic regions.

The contributed chapters cover spatial and temporal trends of polychlorinated biphenyls (PCBs), chlorinated pesticides, polychlorinated naphthalenes (PCNs), polychlorinated dibenzodioxins/furans (PCDD/DFs), polybrominated diphenyl ethers (PBDEs), hexabromocyclododecanes (HBCDs), perfluorinated compounds (PFCs), synthetic musks, polynuclear aromatic hydrocarbons (PAHs), and octyl- and nonylphenols, in environmental and biological matrices such as the atmosphere, water, soil, sediment, bivalve mollusks, fish, marine mammals, birds, terrestrial mammals, and human breast milk, originating from Australia, Brazil, China, Estonia, Ghana, Hong Kong, India, Italy, Japan, Korea, Norway, Poland, Sweden, the United States, and the Arctic and Antarctic regions.

This book will provide information that will help students; researchers; legislators; environmental agencies; federal, state, and local authorities; and laymen to understand the history, present status, and possible future trends of persistent chemicals in the global environment and to facilitate the development of strategies/practices aimed at protecting the global environment for future generations.

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Bommanna G. Loganathan, PhD, is professor of environmental/analytical chemistry at the Murray State University (MSU), Murray, Kentucky. His current research involves investigations on the distribution, environmental transformation, and fate of persistent organic/organometallic pollutants in the environment and their effects on wildlife and human health. A major focus of his research is to evaluate the status and trends of classical as well as emerging pollutants in man-made freshwater lakes, such as Kentucky Lake, in comparison with natural lakes and marine ecosystems and to assess the effects of these compounds on human natural killer cells' ability to kill cancer cells using in vitro assays. He is the author/coauthor of over 100 publications in peer-reviewed journals and book chapters. He also serves as an associate editor for the *Journal of Environmental Monitoring and Restoration*.

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# Part I

Classical and Emerging Persistent Organic Chemicals: Perspectives