

# STATUS AND TRENDS OF PERSISTENT ORGANIC POLLUTANTS IN THE GLOBAL ENVIRONMENT

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## Abstract

Man-made chemicals such as chlorinated, brominated and fluorinated compounds are well known global environmental pollutants. The residues of these compounds are known/suspected to persist in the global environment for decades and even centuries. Since these compounds elicit chronic toxic effects in wildlife and humans, long-trend monitoring studies are essential in order to understand the status of environmental contamination by these compounds and to prevent further contamination and toxic health effects. Classical chlorinated compounds such as DDTs and PCBs contaminate the environment and then enter the food chain and it takes long time to reach highest trophic level organisms such as humans in the terrestrial environment and marine mammals in the aquatic environment. However, emerging new pollutants such as PBDEs, PFCs, pharmaceutical and personal care products, nanomaterials etc., the exposure pathway is different from organochlorines. Most emerging pollutants arise from materials that are being used indoor and human exposure to these compounds is direct and through food chain. This overview presents historical, present status and future trends of global environmental contamination by classical organochlorines and emerging new pollutants.

## Introduction

Man-made chemicals such as chlorinated-, brominated-, and fluorinated compounds are well known global environmental pollutants and are known for their persistent properties, bioaccumulation in the food chain and long-term health effects in aquatic and terrestrial animals including humans.<sup>1-4</sup> Since these compounds have recalcitrant properties and chronic toxic effects, temporal trend studies are essential for understanding their environmental behavior and to prevent related health hazards. Temporal trend studies on the organohalogens, especially organochlorines have been carried out extensively using sediment, fish and other biological samples including human adipose tissues.<sup>5-8</sup> Due to inherent limitations such as sample availability, long-term sampling programs etc., most studies focus on understanding the existing status of pollutant concentrations compared to those in the past. Very limited information is available on the various physical, biological and chemical factors that affect long-term trends of pollutant levels in the environment. This overview addresses the trends of organohalogen contamination in the world and future implications of these trends. Existing information was compiled and interpreted to explain the clearance rates in various geographical locations. The conclusions derived are based on temporal trend studies conducted during the past twenty five years and on the information obtained from the published data.

## Organohalogen Contamination Trends in the Global Environment and Biota

Comparison of temporal trend studies in one region with those of another need careful consideration of spatial, biological and chemical factors. The issue of organohalogen pollution is rather complicated since it is difficult to obtain clear picture of the amount of production and use of these chemicals in various countries. Although the present review provides a generalized assessment, it is representative of existing situation for organochlorine trends in the global environment. The organochlorine trends in the global environment follow pattern similar pattern summarized in Figure 1.

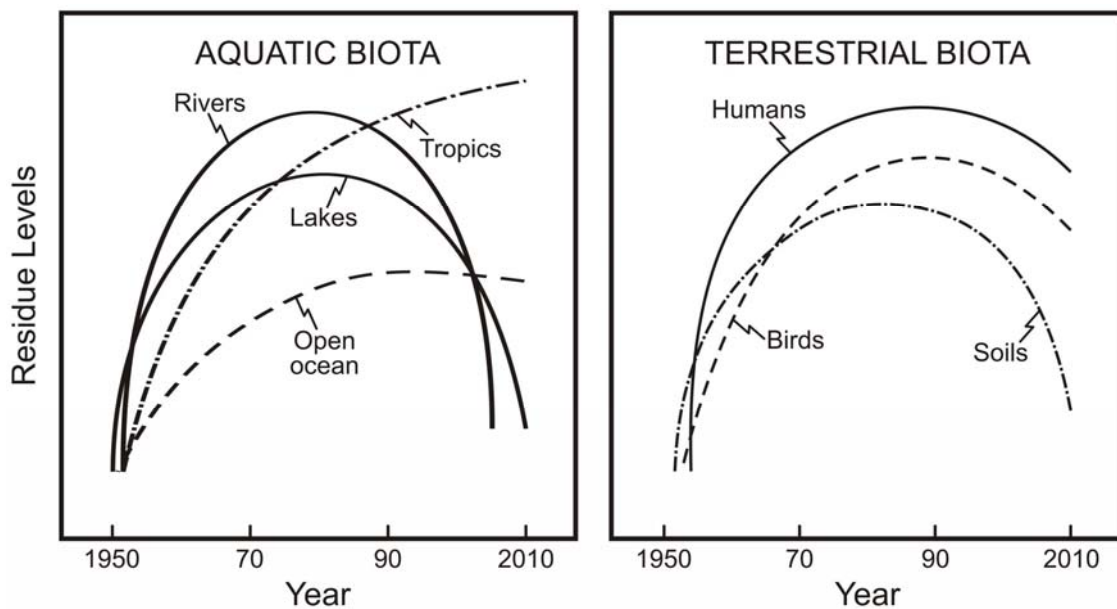


Figure 1. Schematic representation of the organochlorine contamination trends and clearance rates in aquatic and terrestrial ecosystems.

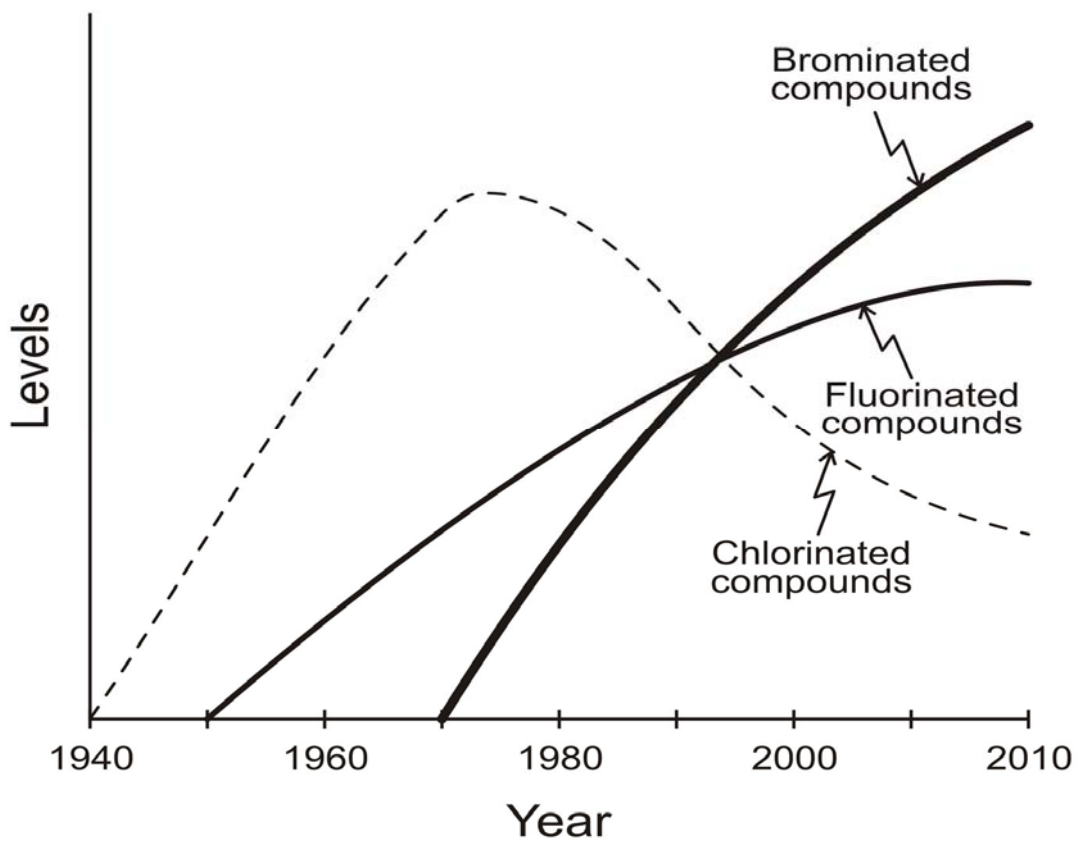


Figure 2. Schematic representation of global environmental contamination trends of organohalogen compounds.

A schematic representation of time perspectives of environmental contamination and exposure to wildlife and humans is expressed in Figure 2. Chlorinated compounds such as PCBs and pesticides very rapidly contaminated the environment and biota during the periods of their use for agricultural and public health purposes. The contamination levels declined after the ban/severe restrictions placed on the production and use of these compounds in most of the developed countries. However, developing countries still continue to use these inexpensive chemicals for agricultural pest control and to control insects that spread malaria, typhoid, dengue fever etc. Thus, developing countries form the point source for continued global contamination with the organochlorine compounds. Therefore, future chronic toxic effects in humans and wildlife by organochlorine compounds cannot be ruled out. In contrast, brominated and fluorinated compounds are being produced in large quantities and used globally, both developed and developing countries. These compounds are heavily used in indoors appliances and materials. Human exposure pathway for PBDEs and PFCs are direct and intimate. Considerable data have been amassed on the presence of PBDEs and PFCs in indoor environmental media (air, water, dust, lint, clothing, food packaging materials etc.) and human tissues (blood, breast milk, liver, fetus etc.). Based on PBDEs and PFCs use, their recalcitrant property, bioaccumulation, and biomagnification potential, it can be predicted that the environmental contamination as well as human exposure and health effects by these compounds will continue to increase for several decades in both developed as well as developing countries (Figure 1). These factors need consideration in the effort to minimize exposure to humans from indoor pollution, and dietary exposure to protect human health from possible long-term health effects caused by the organohalogen compounds.

For persistent organic pollutants (POPs) especially PCBs and dioxins, consumption of contaminated fish and other food materials have been the main route of exposure to humans<sup>6-10</sup>. The exposure pathway for these chlorinated organic compounds in humans is mainly from outdoor environment/biota. However, for the emerging environmental pollutants such as brominated (PBDEs) and perfluorinated compounds (PFCs), the human exposure pathway is predominantly from indoor contamination<sup>2,4</sup>. Given the widespread use of PBDEs in household items, indoor contamination may be a significant source of human exposure. Similarly, perfluorinated compounds are used in a variety of consumer products and exposures from indoor environment and consumption of PFC contaminated food stuffs may contribute to exposures. The human exposures and health effects by these organohalogens will continue for long period of time even after ban on their production, as has been evidenced for organochlorines.

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