

Flame Retardants, Plasticizers and Pesticides in the Canadian Arctic

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Introduction

Persistent Organic Pollutants are transported to the Arctic by air and ocean currents.

Sampling in the Canadian Archipelago has been done at land based stations and on cruises aboard Canadian Coast Guard ships (Louis S. St. Laurent and Amundsen). These studies have been conducted by the same team since 1992.

Compounds of interest are organochlorine pesticides and organophosphate esters.

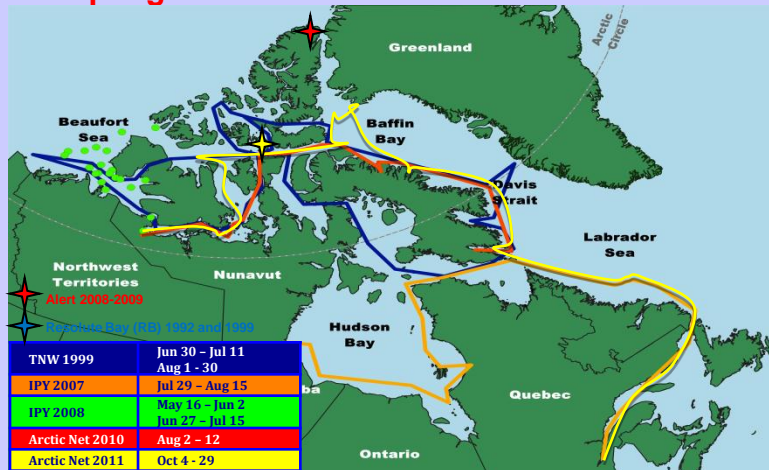
Rationale

Contributions to Domestic and International Initiatives

Domestically/Canada – Northern Contaminants Program, Canadian Environmental Protection Act (CEPA) 1999, Chemicals Management Plan and Canadian Arctic Contaminants Assessment Report (CACAR) and Pesticide Management Regulatory Agency (PMRA).

Internationally - Global Monitoring Plan of the UNEP Stockholm Convention on POPs, UNECE Convention on Long-range Trans-boundary Air Pollution POPs Protocol and AMAP Assessments.

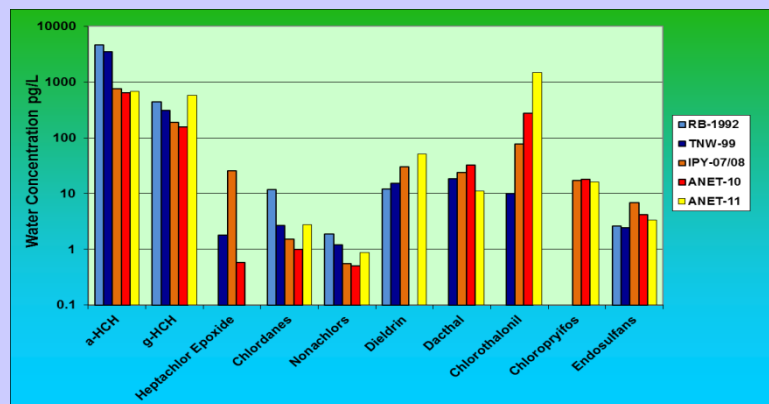
Sampling Locations and Cruise Tracks



MATERIALS AND METHODS

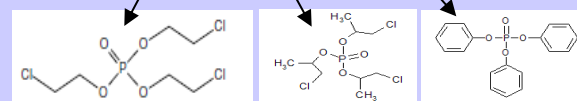
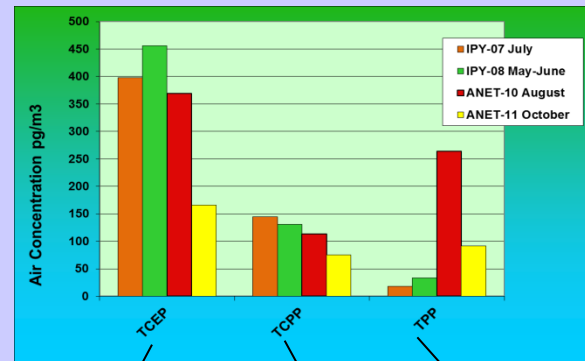
- Water: 40-100 L were processed through a glass-fiber filter followed by XAD-2 resin.
- Air: 400 – 1500 m³ were sampled with a glass fiber filter – polyurethane foam cartridge.
- OCPs and OPEs were determined by capillary GC using a DB-5 column, with detection by ECNI-MS (OCPs + OPEs) and EI-MS (OPEs).
- Labelled surrogates (¹³C and deuterated) were added to each sample to monitor recoveries (range from 67-109%).

COMPOUND	Year Banned In Canada	TYPE	Arctic Atmospheric Concentration 1999-2011 (pg/m ³)
α-HCH	1971	Insecticide	12-60
Lindane (γ-HCH)	2004	Insecticide	1.5-15
Chlordanes	1988	Insecticide	-0.25-10
Σ-Chlordanes			-0.2-5.0
Σ-Nonachlor			-0.5-7.6
Heptachlor Epoxide	metabolite		
Dieldrin	1990s	Insecticide	<1-30

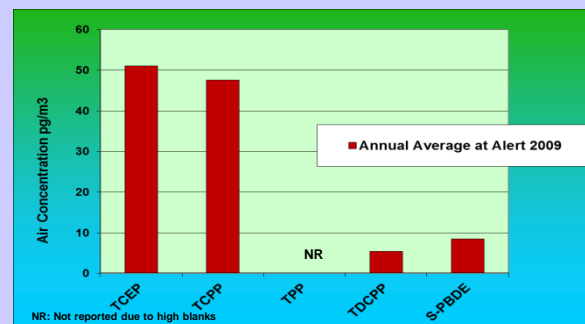


- Concentration of legacy and current use pesticides in arctic water.
- Generally, most legacy pesticides are declining where most current use pesticide are remaining constant or increasing.

Organophosphate (OPEs) Compounds



- Most OPEs are flame retardants and plasticizers
- CMP priority compounds, TCEP is being phased out in Canada due to toxicity
- High in indoor air (up to 1000s pg/m³) and dust (up to 10000s ng/g) (van der Veen and deBoer, 2012).
- OPEs were found only on air particles.
- Very high levels of OPEs were found compared to levels of other flame retardants; ie ΣPBDEs (Su et al., 2007).
- Similar levels of OPEs were found over the North Sea and the Bering and Chukchi Seas (Moller et al., 2011, 2012).



References:

Möller, A., Xie, Z., Caba, A., Sturm, R., Ebinghaus, R. Environ Pollut. 2011, 46, 346.
 Möller, A., Sturm, R., Xie, Z., Cai, M., He, J., Ebinghaus, R. Environ. Sci. Technol. 2012, 46, 3141.
 Su, Y., Jiang, H., Sverko, E., Fellin, P., Li, H., Atmos. Environ. 2007, 41, 8725-8736.
 van der Veen and de Boer. Chemosphere, 2012, 88, 1119.

Acknowledgements:

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Sampling Techniques



air sampler
 submersible water sampler
 rosette water sampler

Target Compounds

Organochlorine pesticides

- Hexachlorocyclohexanes (α-HCH and γ-HCHs)
- Chlordanes, Nonachlor, Heptachlor Epoxide
- Dieldrin

Current Use Pesticide

- Dacthal, chlorothalonil, chlorpyrifos and endosulfans

Organophosphate Esters (OPEs)

- Tri-phenyl phosphate (TPP)
- Tris(chloro-propyl) phosphate (TDCPP)
- Tris(chloro-ethyl) phosphate (TCEP)
- Tris(dichloro-propyl) phosphate (TDCPP)