Organic Contaminant Measurements in Air at Alert, Nunavut and Little Fox Lake, Yukon

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Background

- Organic pollutants can be carried over long distances by air and ocean currents to the Arctic.
- Air is the most rapid route of transport for these pollutants.
- Air monitoring of organic pollutants at Alert, NU (82°30'N, 62°20'W)(Fig. 1) and Little Fox Lake, YK (61° 21' N, 135° 38' W, 1128 m above sea level) (Fig. 2) under the Northern Contaminants Program (NCP) is part of the Arctic Council's Arctic Monitoring and Assessment Programme (AMAP).
- As the master station under NCP, the Alert Global Atmospheric Watch Station, operated by Environment Canada, is the world's longest running arctic air monitoring station for persistent organic pollutants (POPs) (1992-ongoing).
- Air sampling at Little Fox Lake has been restarted in August 2011 with a flowthrough air sampler and monitoring is ongoing.

Fig 1. Dr. Neil Trivett Global Atmosphere Watch Observatory at Alert, Nunavut


Fig 3. Changing air sample at Alert, NU

Fig 4. Sample Extraction & Analysis

Methods

Air sampling methods:

- At Alert, a custom-made super-high-volume air sampler (Fig. 3) collects weekly air samples for the analysis of organochlorine pesticides (OCPs), polycyclic aromatic hydrocarbons (PAHs), polychlorinated biphenyls (PCBs) and flame retardants (FRs). A separate PS-1 sampler collects weekly air samples (once a month from Oct to Feb and once every other week from Mar to Sep) for the analysis of emerging chemicals, including perfluorinated compounds (PFCs) and current-use pesticides (CUPs).
- At Little Fox Lake (LFL), a flowthrough air sampler is used to collect monthly air samples for the analysis of FRs and OCPs.

Analytical methods:

- Air samples from Alert & LFL were soxhlet extracted for 24 hours [polyurethane foams (PUFs) or PUF-XAD sandwich extracted with hexane; filters extracted with dichloromethane] (Fig. 4a).
- Alert samples: OCPs and PCBs were analysed with GC/ECD and PAHs and FRs were analysed with GC-MS.
- LFL samples: OCPs analysed with GC-ECD and FRs analysed with GC-MS (Fig. 4b).


Fig 2. Flowthrough air sampler at Little Fox Lake

Time Trends at Alert

Lindane

- agricultural insecticide
- phased out in Canada in 2004
- bans and use restrictions started in Europe in the 1990s
- listed for global control in May 2009
- accelerated decline (Fig. 5a)

Endosulfan

- insecticide and acaricide
- listed for global ban in May 2011
- will be phased out in Canada by December 31, 2016.
- no decline 1993-2001
- started to decline 2002-2010 (halving in about 7.5 years) (Fig. 5b)

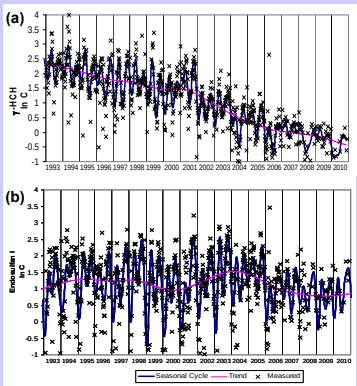


Fig 5. Trends of (a) lindane and (b) endosulfan I measured in air at Alert

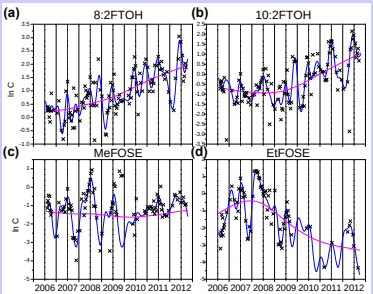


Fig 6. Trends of PFCs measured in air at Alert

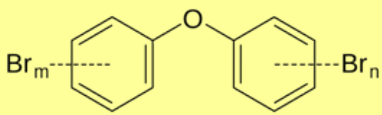
Perfluorinated Compounds (PFCs)

- Perfluorooctane sulfonate (PFOS), its salts and its precursors, are controlled under the Canadian Environmental Protection Act (CEPA) and the Stockholm Convention on POPs.
- EtFOSE, which is a PFOS precursors, show declining trends in Arctic air (Fig.6d). No trend was observed for MeFOSE (Fig.6c).
- However, the fluorotelomer alcohols (FTOHs) [precursors of perfluorinated carboxylic acids (PFCAs)] which were not regulated at the time of measurement are increasing (Fig. 6a,b)

Early Results from Little Fox Lake

Polybrominated diphenyl ethers (PBDE)

- flame retardants
- bans and use restrictions started in Europe and US in the 2000s
- listed for global control in May 2009



Brominated flame retardants (BFRs)

- organobromide compounds
- commonly used in electronic products

Early Finding

- Compare with their levels at Alert, both PBDEs and non-BDE FRs showed slightly lower concentrations at LFL

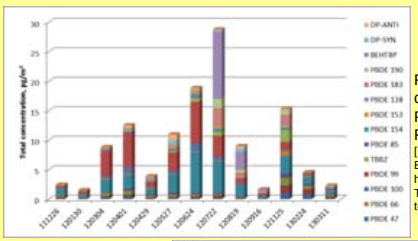


Fig. 7 Relative concentrations of PBDEs and selected FRs
[DP=Dechlorane Plus; BEHTBP = bis(2-ethly-1-hexyl)tetrabromophthalate; TBBZ= 2-ethylhexyl-2,3,4,5-tetrabromobenzoate]

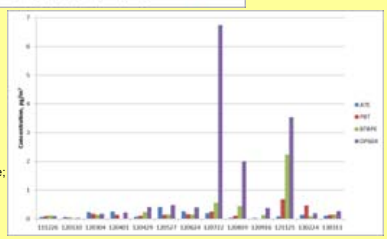


Fig. 8 Relative concentrations of selected FRs
[ATE=allyl 2,4,6-tribromophenyl ether;
PBT=polybutylene terephthalate;
BTBPE=1,2-bis(2,4,6-tribromophenoxy)ethane
DP604=Dechlorane 604]

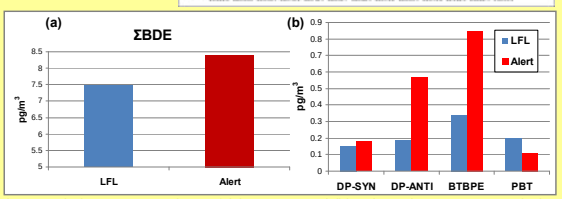


Fig. 9 Relative concentrations of (a) PBDEs and (b) selected FRs at LFL and Alert

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