

Persistent Organic Pollutants (POPs) and Emerging Chemicals in Canadian Arctic Air

Fiona Wong¹, Enzo Barresi², Ed Sverko^{2,5}, Helena Dryfhout-Clark¹, Phil Fellin⁴, Hayley Hung¹

¹Air Quality Research Processes Section, Environment and Climate Change Canada, 4905 Dufferin St., Toronto, ON, Canada

²National Laboratory for Environmental Testing, National Water Research Institute, Environment and Climate Change Canada, Burlington, ON, Canada

⁴Airzone One Ltd., 222, Matheson Blvd. E., Mississauga, ON, Canada

⁵Currently at: Harbin Institute of Technology, Harbin China

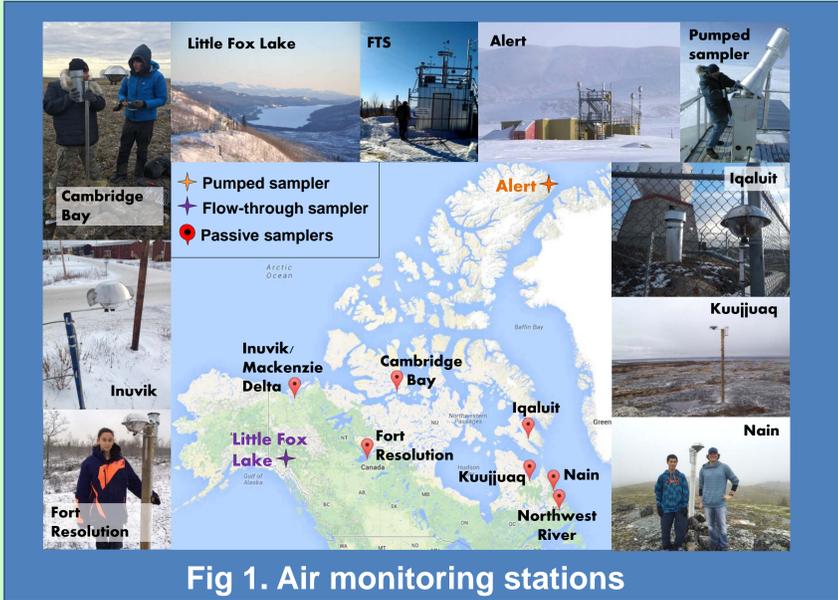


Environment and Climate Change Canada

Environnement et Changement climatique Canada

Introduction

- Persistent organic pollutants (POPs) and Chemicals of Emerging Arctic Concern (CEAC) are measured in air (Fig. 1) at:
 - Alert, Ellesmere Island (82°30' N, 62°20' W) using a pumped sampler
 - Little Fox Lake, Yukon (61°21' N, 135°38' W) using a flow-through passive sampler (FTS)
 - 7 passive sampling sites using foam and resin passive samplers



- These contaminants can be carried by air and move to remote places very far from their sources, like the Arctic. Once they deposit to land and water, they can accumulate through the food web and affect the health of wildlife and people (Fig. 2).

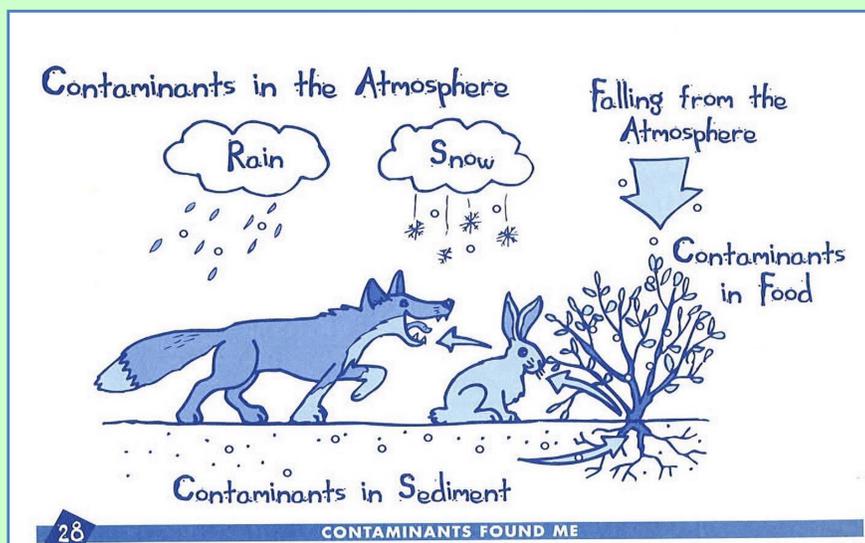


Fig. 2. Contaminants in the environment

(Artwork by Tanya Handley for Contaminants Found Me Curriculum)

Why are we measuring pollutants in Arctic air?

- Long-term air monitoring can tell scientists if the levels are going ↑ or ↓.
- This information helps policy makers to put in place chemical control plans to reduce or eliminate pollutants coming into the Arctic.
- For example, **Endosulfan**, a pesticide used widely around the world, is declining in air at Alert starting from 2010 (Fig. 3). The pesticide was phased out in Canada from 2010-2016. Now, it is no longer used in Canada and most of the world.

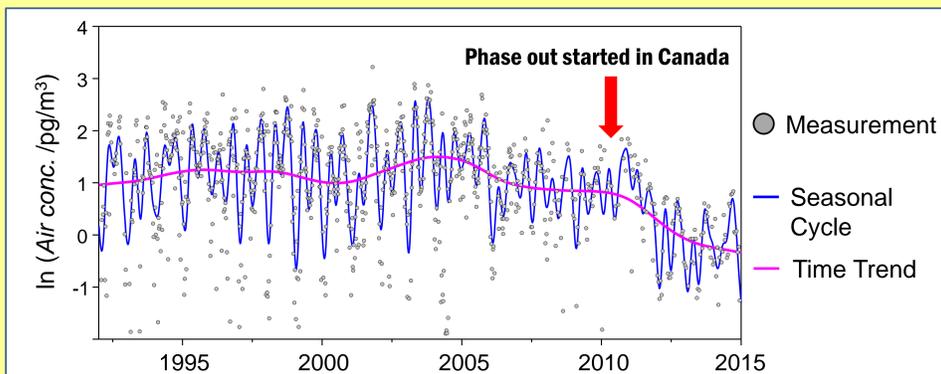


Fig. 3. Endosulfan in air at Alert (1992-2014)

References
Yu, Y, Hung, H, Alexandrou, N, Roach, P, Nordin, K. *Environ. Sci. Technol.*, 2015, 49, 8623-8630.

Acknowledgements
We acknowledge the Canadian Forces Station Alert for supporting data collection; all site and laboratory operators and students for sample collection and analysis.

Financial Support
Northern Contaminants Program, Indigenous and Northern Affairs Canada
Chemicals Management Plan, Environment and Climate Change Canada

Contact
Hayley Hung
hayley.hung@canada.ca

Findings

Flame retardants

- Flame retardants are applied in a wide-range of consumer products, including couches, clothes, furniture, cars and electronics. They are found everywhere in the environment including air, water, soil, dust, wildlife and people.
- Polybrominated diphenyl ethers (PBDEs)** were the most commonly used flame retardants. They can stay very long in the environment without degrading, accumulate in the food webs and are toxic. They pose serious health and environmental concerns. Canada started phasing out most PBDEs since 2006.
- In the air at Alert, PBDE levels were similar from 2002-2012 and started to decline after. Higher air level is seen during summer, which maybe caused by the increased outgassing from surfaces (e.g. water or soil) (Fig. 4).

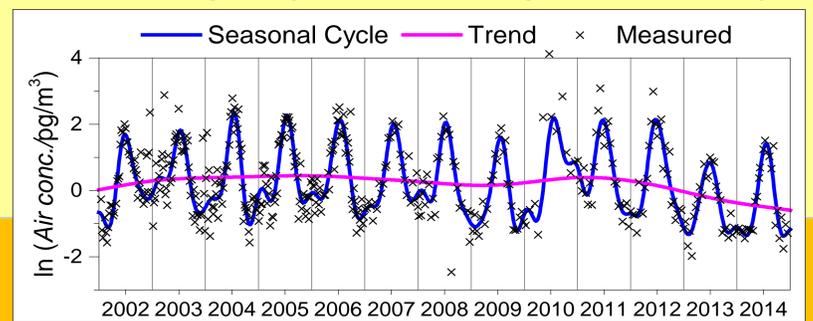
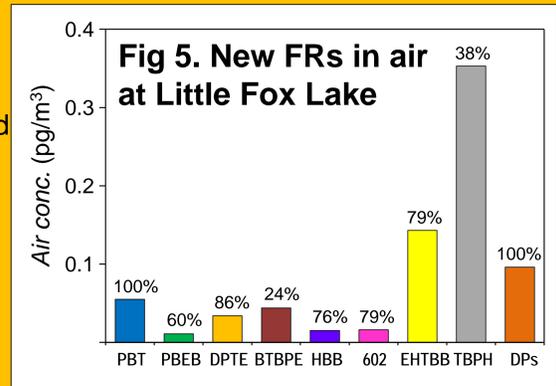


Fig 4. PBDE 47 in air at Alert

New Flame retardants. As PBDEs are being phased out, many new flame retardants are put into the market even though little is known about their movements in the environment.

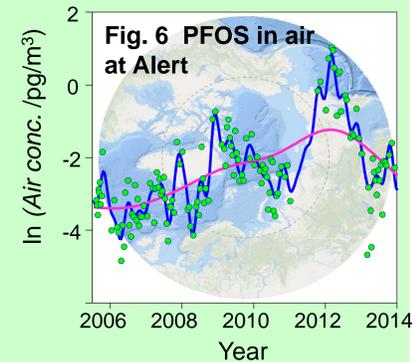
- Many new flame retardants are frequently detected in air at Little Fox Lake. For example, PBT and DPs were found in 100% of the air samples (Fig. 5).
- Air containing these new flame retardants may have come from sources in East Asia, Russia, the Pacific, as well as Northern Canada (Yu et al., 2015).



Water and Oil-Repellents - Per and polyfluoroalkyl substances (PFASs)



- PFASs** are chemicals used to make products oil, heat, grease and water repellent. Commonly used in non-stick cookware, carpets, fabrics, food wraps, ski wax and fire-fighting foam.
- Similar to PBDEs, PFASs are persistent and toxic. They are found everywhere in the environment.
- For example, **PFOS**, a widely used PFASs, is increasing in air at Alert (Fig. 6).



Pesticides and industrial chemicals

- Pesticides and industrial chemicals lowest levels were found at Fort Resolution.
- We are continuing to monitor these chemicals, and other toxic substances (e.g. mercury) in our Arctic air passive sampling stations.
- Highest levels of these chemicals were generally found at the most populated site of Iqaluit (Fig 7.)

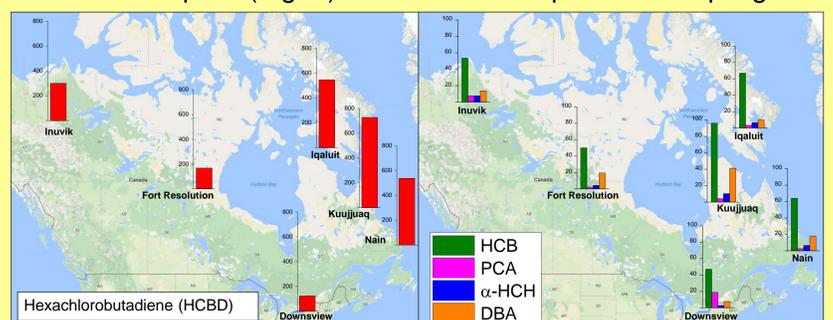


Fig 7. Pesticides and industrial chemicals in Arctic air in 2015 comparing with urban site at Downsview (Amount, pg per resin-based passive sampler/day)