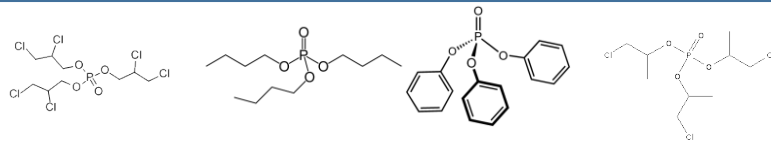




## HIGHLIGHTS

- Evidence that chlorinated organophosphate esters (Cl-OPE) are mobile contaminants with water-based transport
- OPE measurement results from > 100 samples taken in the Canadian Arctic Ocean
- Estimation of the OPE inventory for the Canadian Arctic Ocean



OPEs are chlorinated or non-chlorinated synthetic organic chemicals.

Wide range of applications: flame retardants, plasticizers, hydraulic fluids, floor polishes, etc...

Supposedly less persistent and bioaccumulative than brominated flame retardants (BFRs).

Production volumes are increasing.

Evidence of Cl-OPEs in Polar regions in concentrations exceeding BFRs.

Evidence of endocrine disruptive, reproductive or developmental toxicity and, in case of Cl-OPEs, carcinogenicity.

## OPE Inventory in the Canadian Arctic Ocean

Interpolation (nearest neighbour) using Ocean Data View  
Monte Carlo Uncertainty analysis

### Water inventory

Total volume of the Canadian Arctic Ocean:  $1.2 \times 10^{15} \text{ m}^3 = 1.2 \times 10^{18} \text{ L}$

Average scenario: mixing depth = 45 m (maximum observed EZ)

### Sediment inventory

Mixing depth: 2 cm

	Inventory in Water			Inventory in Sediment		
	5 <sup>th</sup>	Median	95 <sup>th</sup>	5 <sup>th</sup>	Median	95 <sup>th</sup>
<b>ΣCl-OPE [t]</b>	400	3500	12,000	0	5.1	19
<b>Σnon-Cl-OPE [t]</b>	48	616	4000	0	3.2	30

Peak Arctic Ocean inventory for the POP  $\alpha$ -HCH: 7000 t

Comparable environmental half lives (in water)

$\alpha$ -HCH: 30- 300 days

Cl-OPEs: 90 (TCEP) – 180 days (TDCIPP)

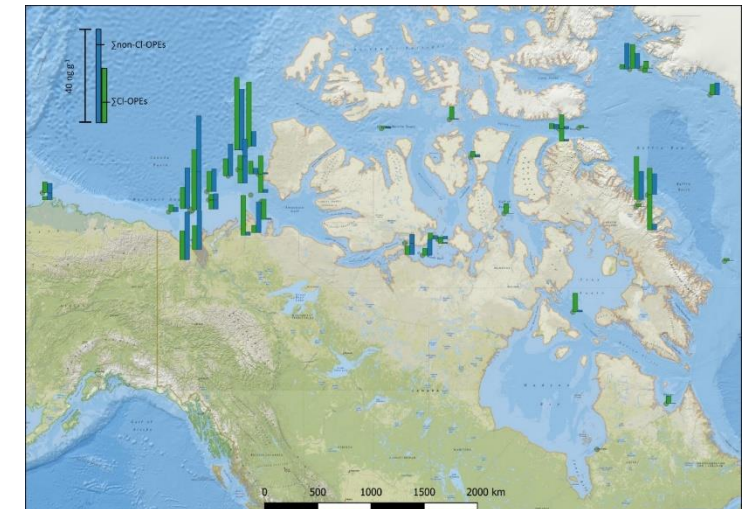
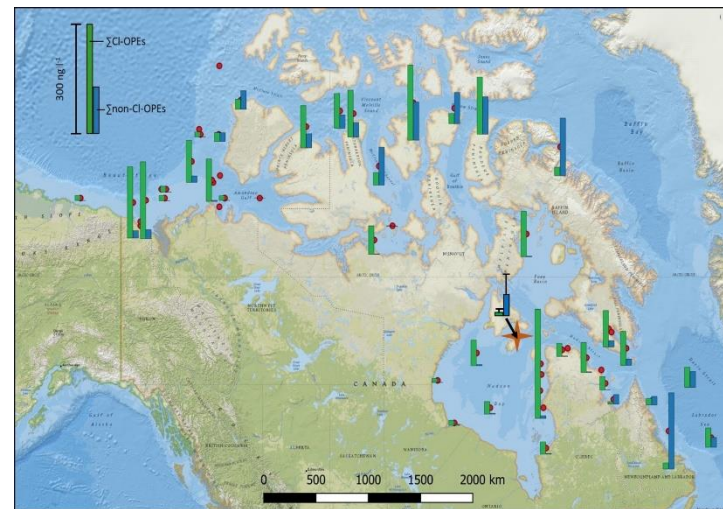
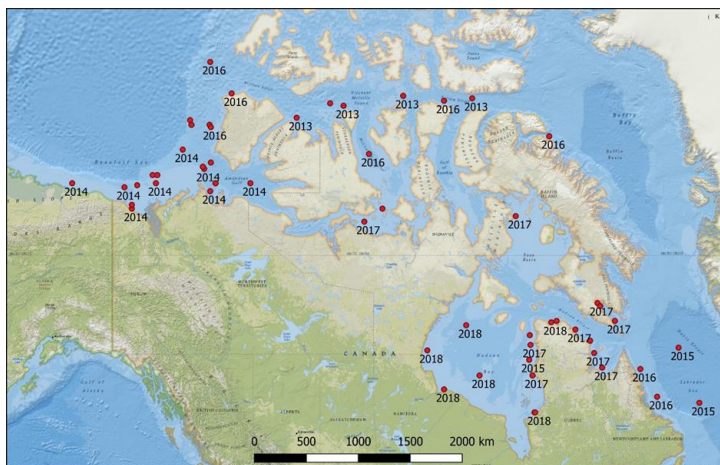
## What does that mean for OPEs as Arctic Contaminants?

OPEs are ubiquitous in the Canadian Arctic Ocean

The Mackenzie River appears to be a pathway for OPEs into the Canadian Arctic Ocean

Cl-OPEs are contaminants of Arctic concern: inventory in water is similar to that of the POP HCH during peak use

Cl-OPEs are persistent and mobile in water – sediments and volatilization are not efficient sinks



Citation: Sühling, R., Diamond, M.L., Bernstein, S., Adams, J., Schuster, J., Fernie, K., Elliot, K., Stern, G. and Jantunen, L.M. Organophosphate esters in the Canadian Arctic Ocean, *Environmental Science and Technology*, 2021, 55, 304-312.

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