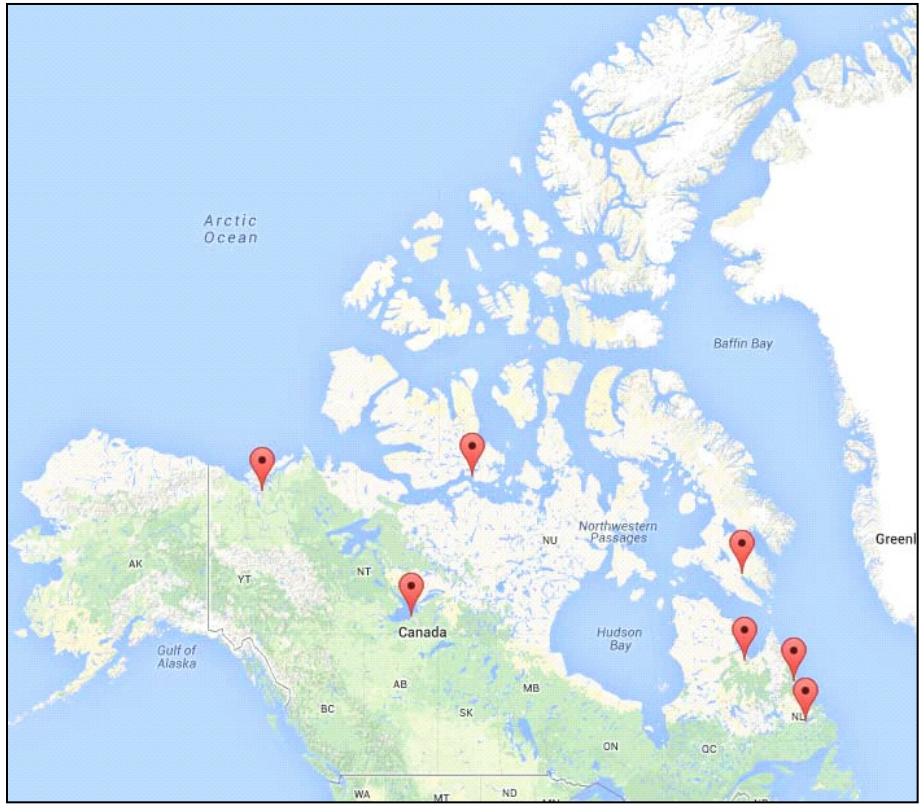
Canadas Global Mercury Passive Sampling Network – A Global International Collaboration

Alexandra Steffen

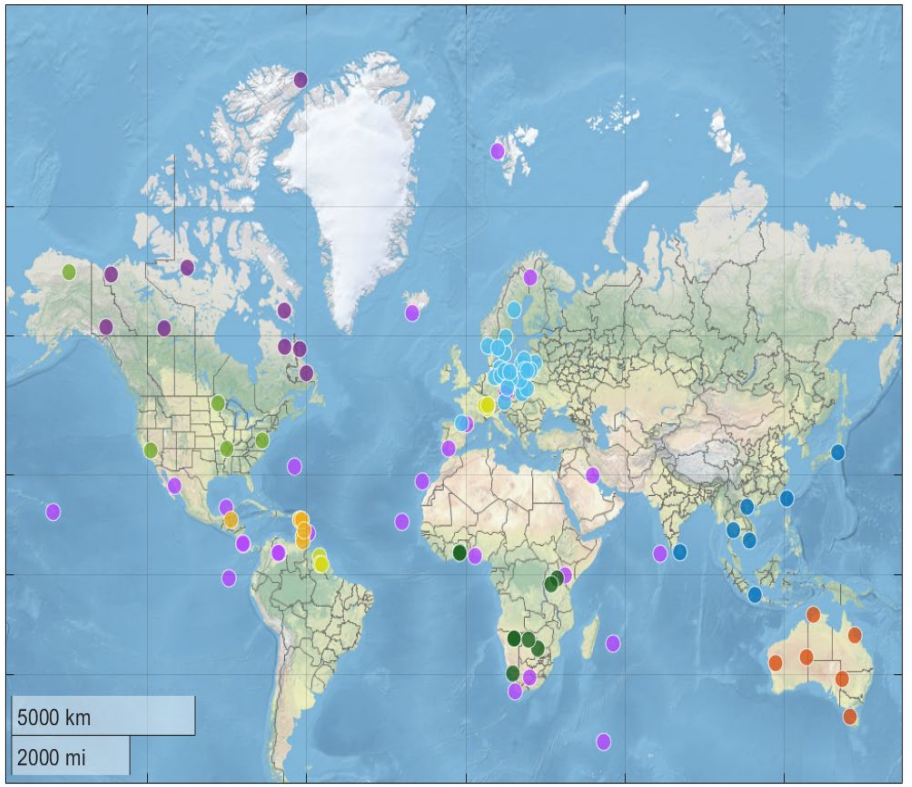
Air Quality Research Division, Environment and Climate Change Canada

We have come a long way!

2017 (concept)

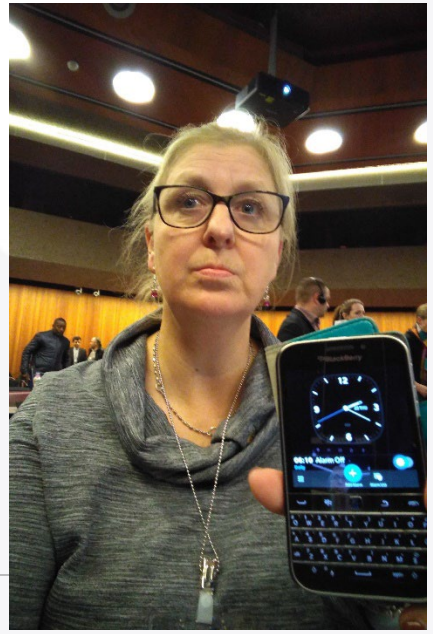


Today (implemented)



The evolution of an international program

- David McLagan developed passive air sampler for mercury
- Published in 2016
- My initial intent – Arctic Monitoring
- In 2017
  - Passive sampler gained traction at the ICMGP
  - Idea for a global network similar to Stockholm Convention
  - Started to propose idea at COP1 (Minamata)
  - Idea did not fly at COP1
- 2018
  - Started Arctic passive Hg program
  - Regrouped on the idea for the global



Canadian led global pilot study

✓ Got the Artic Network off the ground

How do I start a global network?

- Assess the feasibility of a global network
- Assess the passive sampler (MerPAS®)
- Develop an SOP
  - Preparation
  - Analysis
  - Reuse
- Assess

Atmos. Meas. Tech., 14, 3657–3672, 2021
https://doi.org/10.5194/amt-14-3657-2021

Atmospheric Measurement Techniques

A field intercomparison of three passive air samplers for gaseous mercury in ambient air

Attilio Naccarato[1], Antonella Tassone[1], Maria Martino[1], Sacha Moretti[1], Antonella Macagnano[2], Emiliano Zampetti[2], Paolo Papa[2], Joshua Avossa[2], Nicola Pirrone[1], Michelle Nerentorp[3], John Munthe[3], Ingvar Wängberg[3], Geoff W. Stupple[4], Carl P. J. Mitchell[5], Adam R. Martin[5], Alexandra Steffen[4], Diana Babi[6], Eric M. Prestbo[6], Francesca Sprovieri[1], and Frank Wania[5]

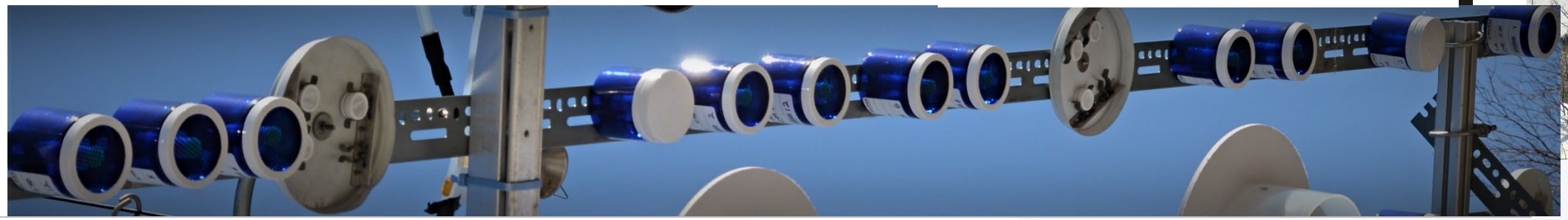
[1]CNR-Institute of Atmospheric Pollution Research, Division of Rende, UNICAL-Polifunzionale, 87036 Arcavacata di Rende, CS, Italy
[2]CNR-Institute of Atmospheric Pollution Research, Research Area of Rome 1, Via Salaria km 29,300, 00016 Monterotondo, Italy
[3]IVL Swedish Environmental Research Institute, Gothenburg 41133, Sweden
[4]Air Quality Processes Research Section, Environment and Climate Change Canada, Toronto, M3H 5T4, Canada
[5]Department of Physical and Environmental Sciences, University of Toronto Scarborough, Toronto, M1C 1A4, Canada
[6]Tekran Instruments Corporation, 330 Nantucket Boulevard, Toronto, Ontario, M1P 2P4, Canada

Correspondence: Attilio Naccarato (attilio.naccarato@iia.cnr.it) and Frank Wania (frank.wania@utoronto.ca)

Received: 12 November 2020 – Discussion started: 29 December 2020
Revised: 16 March 2021 – Accepted: 23 March 2021 – Published: 20 May 2021

Abstract. Passive air samplers (PASs), which provide time-averaged concentrations of gaseous mercury over the timescale of weeks to months, are promising for filling a gap in the monitoring of atmospheric mercury worldwide. Their usefulness will depend on their ease of use and robustness under field conditions, their availability and affordability, and most notably, their ability to provide results of acceptable precision and accuracy. Here we describe a comparative evaluation of three PASs with respect to their ability to precisely and accurately record atmospheric background mercury concentrations at sites in both southern Italy and southern Ontario, Canada. The study includes the CNR-PAS with gold nanoparticles as a sorbent, developed by the Italian National Research Council, the IVL-PAS using an activated carbon-coated disk, developed by the Swedish Environmental Research Institute, and the *Mer*PAS® using a sulfur-impregnated activated carbon sorbent, developed at the University of Toronto and commercialized by Tekran. Detection limits are deduced from the variability in the amount of mercury quantified in more than 20 field blank samples for each PAS. Analytical and sampling precision is quantified through 22 triplicate deployments for each PAS, ranging in duration from 2 to 12 weeks. Accuracy and bias are assessed through comparison with gaseous elemental mercury concentrations recorded by Tekran 2537 automated mercury analyzers operating alongside the PASs at both locations. The performance of the PASs was significantly better in Italy, with all of them providing concentrations that are not significantly different from the average concentrations of the Tekran 2537 instruments. In Canada, where weather conditions were much harsher and more variable during the February through April deployment period, there are differences amongst the PASs. At both sites, the *Mer*PAS® is currently the most sensitive, precise, and accurate among the three PASs. A key reason for this is the larger size and the radial configuration of the *Mer*PAS®, which results in lower blank levels relative to the sequestered amounts of mercury when compared to the other two PASs, which rely on axial diffusion geometries. Since blank correction becomes relatively smaller with longer deployments, performance tends to be closer amongst the PASs during deployments of 8 and 12 weeks.

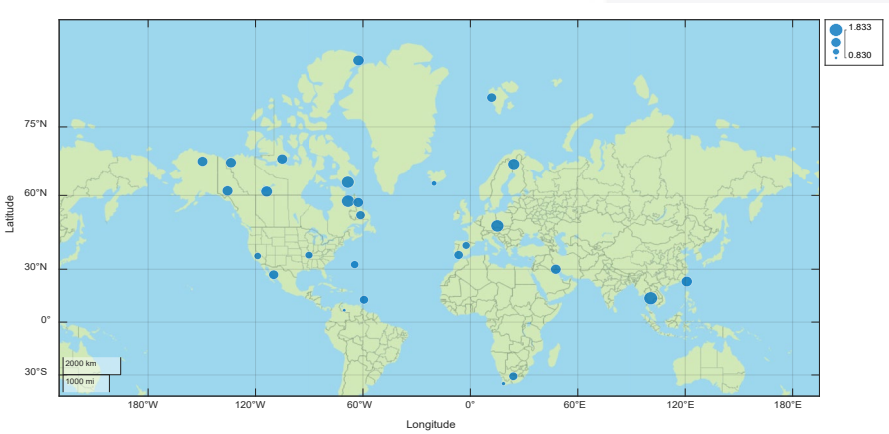
Published by Copernicus Publications on behalf of the European Geosciences Union.



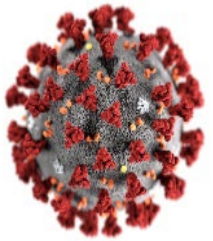
Getting it off the ground

Network of Networks

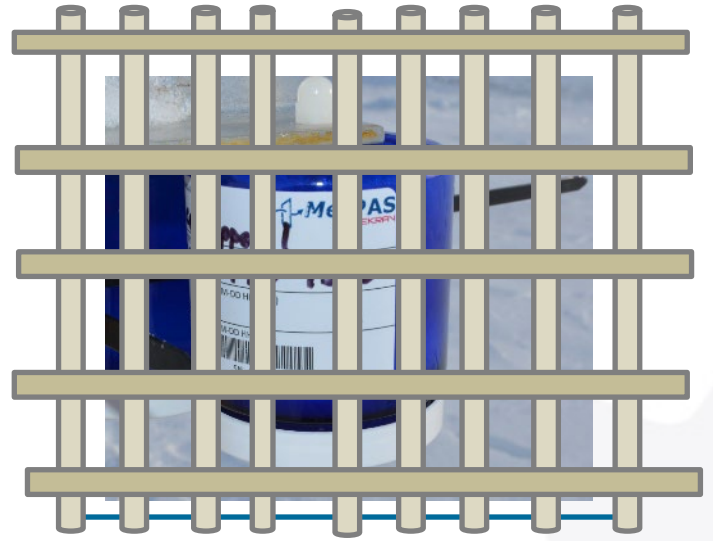
1. Internally run programs
   - Northern Contaminants Program
   - Global Atmospheric Passive Sampling (GAPS)
2. Word of mouth/personal connections
   - Emails, discussions, cold calls
3. Mercury networks
   - APMMN, NADP, GMOS, ICP IM, AMAP
4. Newly developed networks
   - CRMMN, SAMNet, AMMN
5. *Networks run outside of mercury*
   - *LAPAN, MONET etc*



Then….



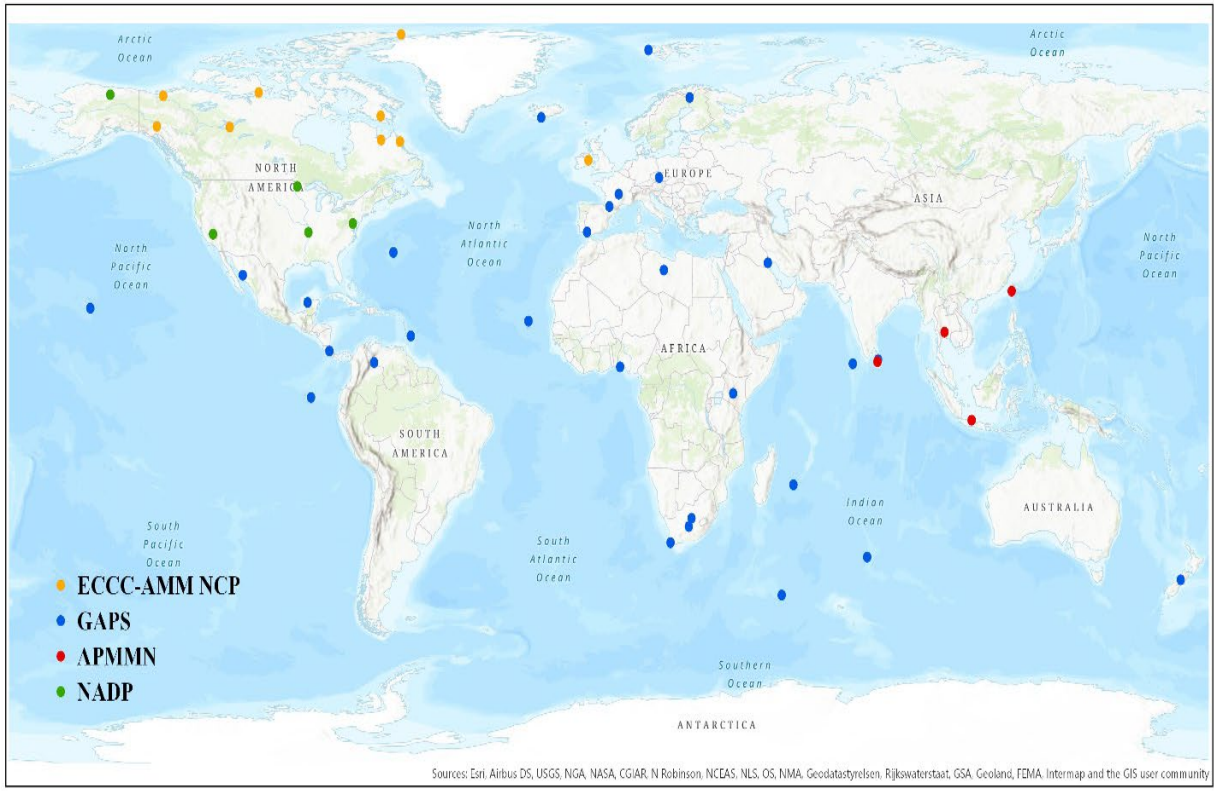
- COVID
- Our labs were shut down for nearly 1 year
- Collaboration with Tekran
- Creative thinking
- Lost about 1 year



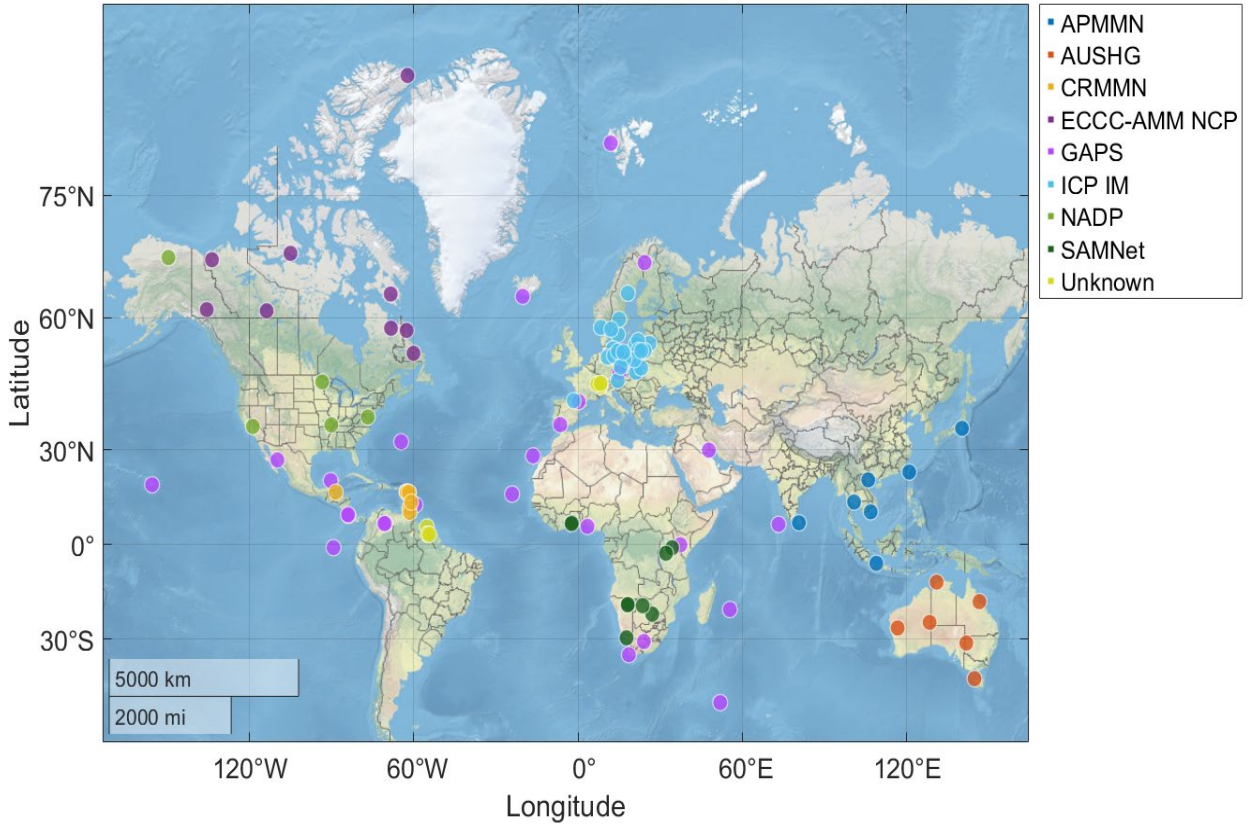
- Started the momentum again

Network of Networks grew

2021 (46)



2024 (104)



Poster: Canada's Global mercury passive sampling network study, MacSween *et al.*

Summary and Next Ste

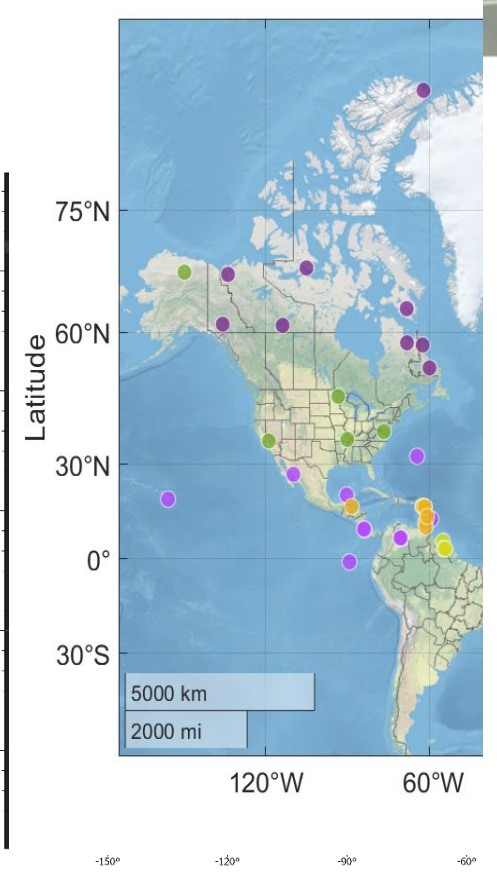
- ✓ Demonstrated a proof of conc
- ✓ Developed SOPs for sampling, samplers etc
- ➢ Data management still needs
- ➢ Needs to find a home
- ➢ Still have BIG gaps
- ✓ Next collaboration
- ✓ Not for donor countries…
- ➢ Still lots to work on together!

Global Chemicals Monitoring Programme to support implementation of Stockholm and Minamata Conventions (GCMP)

Global monitoring of POPs and mercury to contribute to the effectiveness evaluation of the Stockholm Convention and provide data to support the effectiveness evaluation mechanism of the Minamata Convention.

Project Details

GEF Project ID | Country



Thank you!

Geoff Stupple

Katrina MacSween

Tracey Inkpen and Alison Dickson

Jamie Knill

All our collaborators from 104 sites!!!

Financial support from this project from Environment and Climate Change Canada 1) the Chemicals Management Division, Organic Substances; Metals Section and 2) the Air Quality Research Division, Air Quality Processes Research Section and 3) Northern Contaminants Program, Crown-Indigenous Relations Canada