

Asia Pacific Mercury
Monitoring Network

The Asia Pacific Mercury Monitoring Network (APMMN): An Update on Progress and Opportunities for the Future

APMMN Partners Meeting

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Taipei, Taiwan

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Network Goal and Objectives

Goal

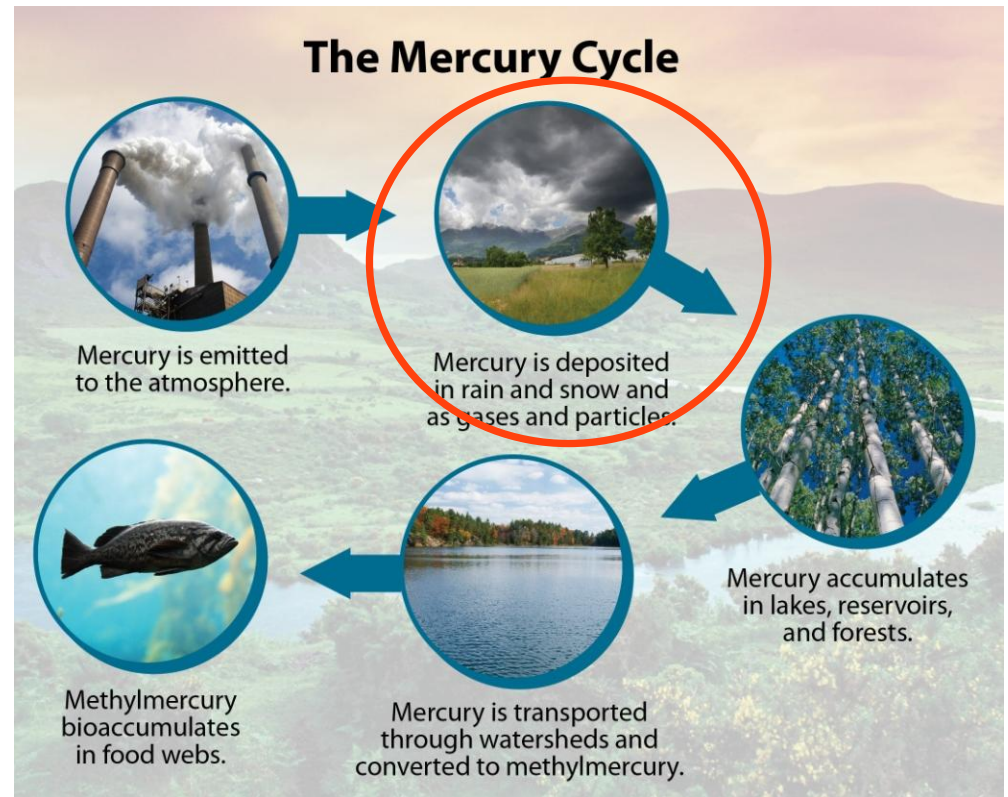
- Systematically monitor wet deposition and atmospheric concentrations of mercury in a network of stations throughout the Asia-Pacific region

Objectives

- Determine the status and trends in concentrations of ambient mercury species, and wet, dry, and total atmospheric deposition of mercury
- Develop a robust dataset for regional and global modeling
- Assist partner countries in developing monitoring and assessment capacity
- Share data and monitoring information

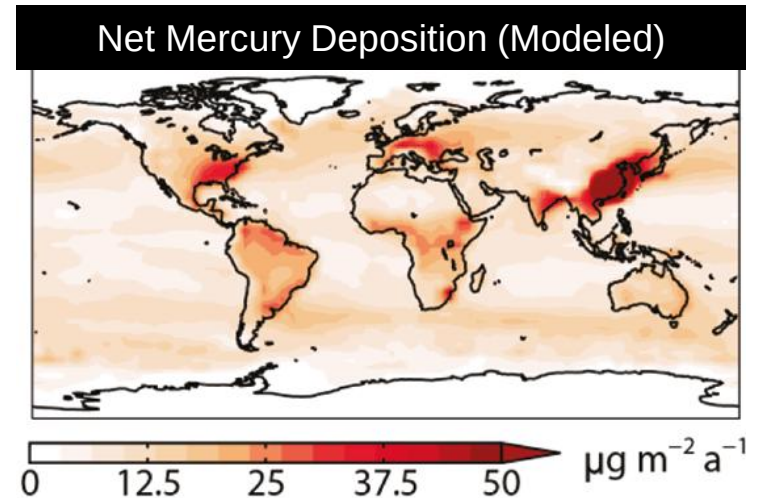
APMMN focus is mercury deposition

- **Mercury in rainwater and in the atmosphere**
 - Deposition is major source of mercury to many water bodies
 - The atmosphere is the first place to identify changes in emissions
- Lots of monitoring experience; many experts regionally/globally
- We have an opportunity to fill data gaps and improve monitoring coordination



Why do we need mercury monitoring?

1. Understand the mercury problem
 - What is the extent of the problem?
 - Where is it getting better or worse?
2. Track changes over time and space
 - Are there trends?
 - Are they going up or down?
3. Ground-truth models
 - How do model results compare to monitored data?
4. Determine if policy is working
 - What are the benefits and effectiveness of mercury controls?



Corbitt et al., 2011

Summary of Progress

- We built a community
 - **15** mercury wet deposition sites in **14** countries currently operating
 - Routine air and rainwater mercury monitoring training by Taiwan, Japan, and U.S. mercury scientific experts
 - Information sharing with partners in other regions (e.g., South Africa)
- Japan/Taiwan collaboration on a sampler inter-comparison since March 2020
- Air monitoring
 - Passive air sampling field testing
 - Same day monthly active manual sampling (Japan, IDEA-coordinated)
 - Participation in ECCC Global Passive Air Pilot Network
- Domestic investments in mercury monitoring (Examples)
 - Vietnam - 18 site mercury wet deposition network
 - Thailand - mercury laboratory
 - Indonesia – new mercury analyzer
- Included in plan for monitoring data compilation and summary to inform Effectiveness Evaluation of Minamata Convention

What makes APMMN successful?

Ingredients for an Effective Network

1. Participatory - multiple stakeholders collaborating
2. Transparency is key; all network information publicly available
 - Webpage - APMMN.org
 - Goal -> quality assured data archived in an online database
3. Scientifically credible – grounded in mercury science; routine training by Taiwan, Japan, and U.S. mercury scientific experts
4. Field and laboratory QA plans and SOPs
 - Network-wide consistency (field and lab operations)
5. Cost effective
 - Minimize costs by leveraging existing infrastructure where possible
6. Data sharing – More on this shortly...



Proposals

Data Sharing

1. Data Sharing Agreement

First, Why should we want to share data?

- APMMN wet deposition data is more valuable if we share it,
 - with each other and
 - with UNEP (Minamata Protocol)
 - And researchers will use it, providing research information for the area

Second, what would we share?

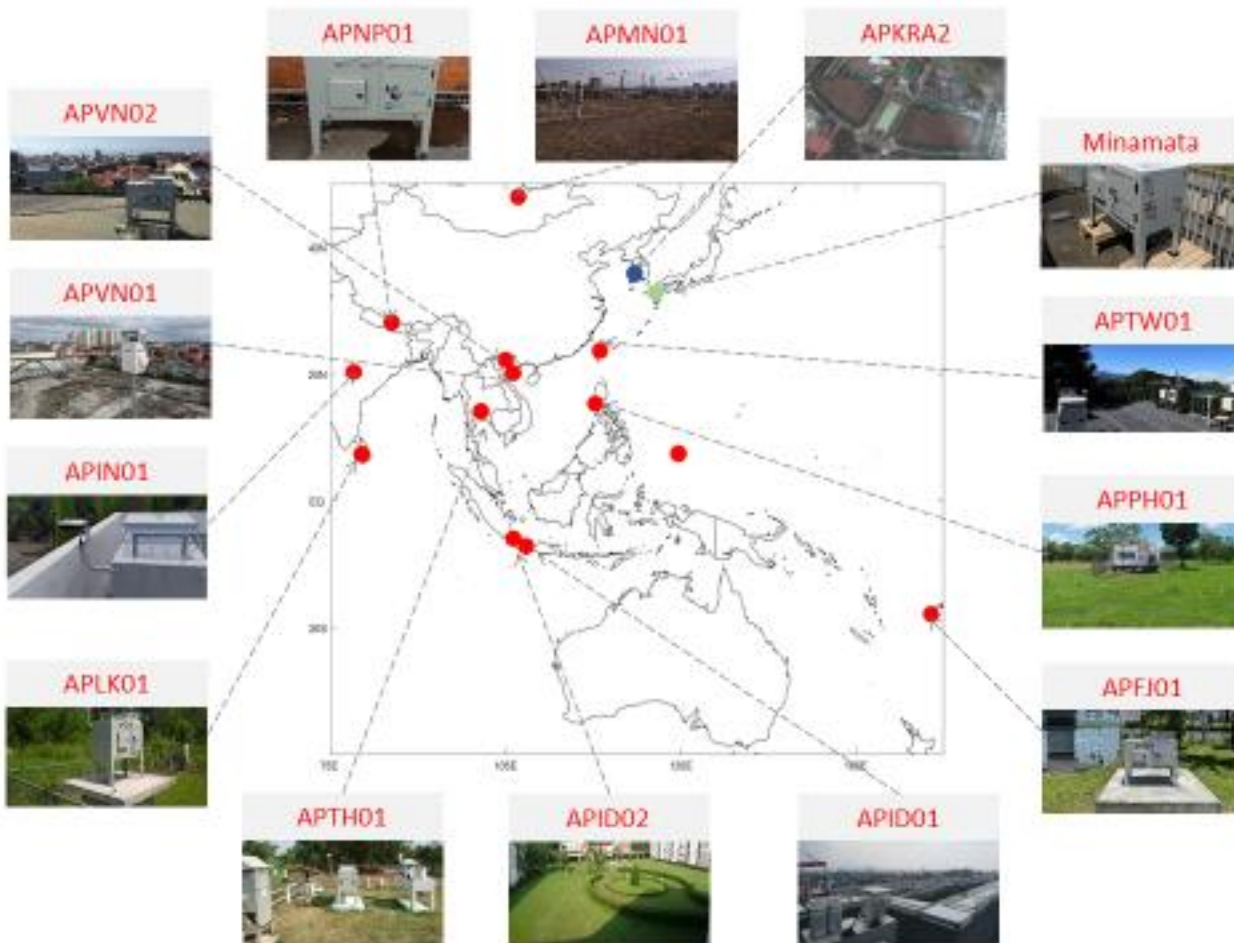
- Weekly values of wet concentration and precipitation amount
- Calculate deposition flux (using volume collected)
- Estimate of quality (A/B/C)
- Also the measurements of gaseous concentration made on the first of each month; Japan “Manual Method”

Third, I would propose a vote this meeting:

- Sharing by country, vote by country
 - Each country that wants to share, shares their data
 - If you don't want to share your data, it won't be
 - You can change your mind later if you wish
- Share on the APMMN website, and in each country, by own method
- A “rest” period will be established, with data shared about 1 year later
- Note on the data:
 - *“These hg wet deposition observations are not official government measurements, but observations of Hg made at this particular location, in Vietnam, in Thailand, in Mongolia, ...”*
 - *“They will only be used for scientific purposes”*
- Simple Share: download all (shared) data in an excel sheet

	A	B	C	D	E	F	G	H	I	J	K
1	siteID	dateOn	dateOff	sampletype	qr	notes	rgPpt	sVol	subppt	HgConc	HgDep
2	KS24	5/20/2008 19:45	5/27/2008 18:45	W	B	dm	-9	607.1	50.671	35.82	1815.39
3	KS24	5/27/2008 18:45	6/3/2008 18:30	W	B	dm	13.716	159.3	13.716	12.43	170.51
4	KS24	6/3/2008 18:30	6/10/2008 18:30	W	B	m	4.826	60.3	4.826	28.35	136.81
5	KS24	6/10/2008 18:30	6/17/2008 20:00	W	A		33.528	396.1	33.528	19.03	638.07
6	KS24	6/17/2008 20:00	6/24/2008 19:15	W	B	mz	35.052	420.4	35.052	11.2	392.86
7	KS24	6/24/2008 19:15	7/1/2008 20:30	W	B	mz	23.622	295.7	23.622	17.29	408.61
8	KS24	7/1/2008 20:30	7/8/2008 19:00	W	B	dmz	17.272	267.9	17.272	33.05	570.96
9	KS24	7/8/2008 19:00	7/15/2008 19:00	W	B	mz	1.524	17.8	1.524	43.16	65.78
10	KS24	7/15/2008 19:00	7/22/2008 18:45	W	B	mz	42.164	572.6	42.164	8.78	370.36
11	KS24	7/22/2008 18:45	7/29/2008 18:45	W	B	m	12.7	149.7	12.7	6.82	86.69
12	KS24	7/29/2008 18:45	8/5/2008 18:50	D	B	mi	0	3.5	0	-9	0
13	KS24	8/5/2008 18:50	8/12/2008 18:45	W	B	m	115.062	1431.2	115.062	4.97	572.2
14	KS24	8/12/2008 18:45	8/19/2008 20:30	W	B	m	18.034	185.2	18.034	26.86	484.53
15	KS24	8/19/2008 20:30	8/26/2008 18:15	W	B	mz	17.526	193.2	17.526	22.98	402.78
16	KS24	8/26/2008 18:15	9/2/2008 18:55	W	A		17.78	158.8	17.78	6.73	119.76
17	KS24	9/2/2008 18:55	9/9/2008 18:35	W	B	h	13.716	183.5	13.716	13.27	182.03
18	KS24	9/9/2008 18:35	9/16/2008 19:35	W	B	d	29.718	370.1	29.718	7.92	235.39
19	KS24	9/16/2008 19:35	9/23/2008 17:50	D	A		0	0	0	-9	0
20	KS24	9/23/2008 17:50	9/30/2008 19:45	W	B	m	0.254	27.4	0.254	16.47	4.18
21	KS24	9/30/2008 21:45	10/7/2008 18:30	W	B	m	34.544	419.9	34.544	2.74	94.96

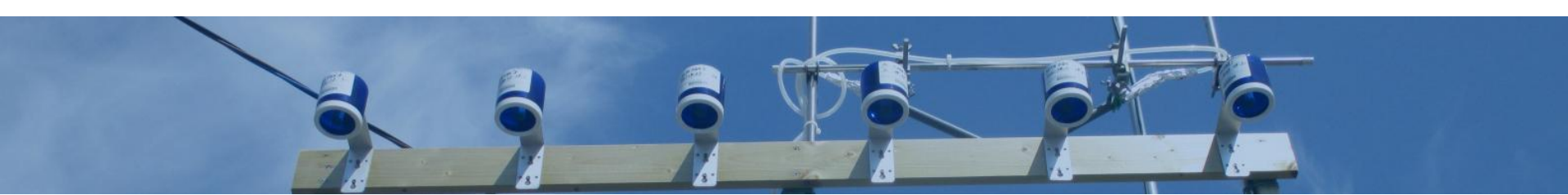
2. New Wet Sites



- Possible New Countries?
 - Cambodia
 - Laos
 - Malaysia
 - Singapore
 - Bhutan
- Additional sites in partner countries (examples)
 - Indonesia
 - Australia

3. Regular Passive Measurements

- Passive measurements within the APMMN, on a regular basis
- APMMN becomes both a wet deposition and gaseous measurement network
 - Quarterly average concentrations of GEM around the network
 - 4 samples per year
 - Analysis at the APMMN
 - Learn to use the passive APMMN sampler
- Allow countries (with analysis capabilities) to do more sampling where they would like
 - Shorter time periods at higher concentrations
 - Areas of gold mining



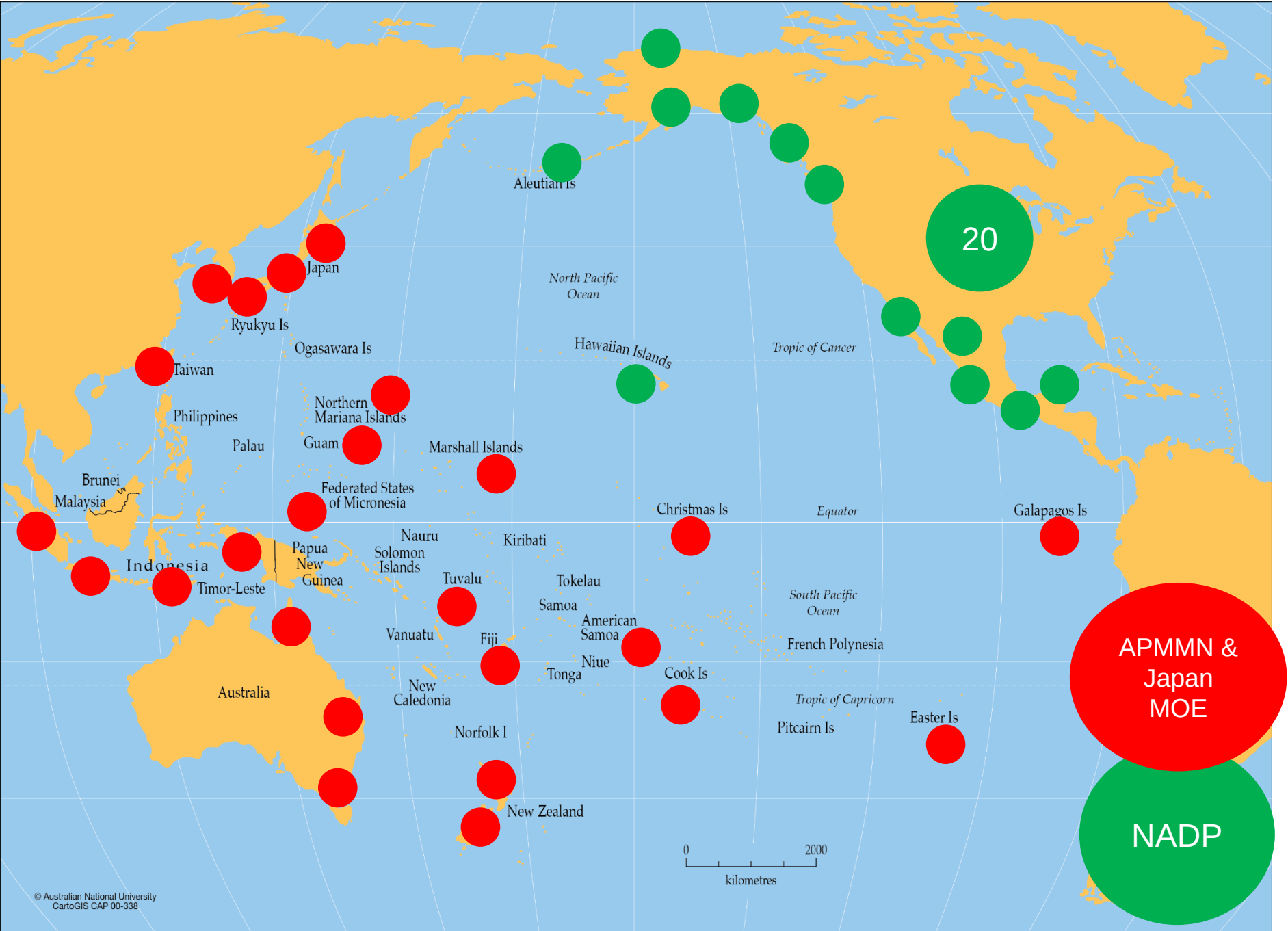
Passive Hg Effort

- Using the Taiwan version of the MerPAS
- Simple measurement
- No electricity needed
- Can easily site and get started (10 minutes)
- Many countries in the world are beginning use this method



4. Pacific Mercury Network of Passives (gaseous concentrations)

- A collaboration between Japan MOE and APMMN and NADP
- Using passive mercury collectors (MerPAS)
- a combined network to cover the Pacific for mercury gases
 - Regular MerPAS measurements
 - Also offer the Manual Method (Japan)
 - Become part of the regular 1st of the month passive measurements
 - Form a collaboration with all of the island nations in the Pacific, and the APMMN, and the NADP
 - To measure TGM over the Pacific, Asia and North America



- This Pacific network can be built up slowly
 - Start with 10 sites in the Pacific
 - Add sites as we can afford to do this.
- We could potentially estimate dry deposition using these values

- flux (F) = air concentration $\times$ dry deposition velocity (V_d)

$$F = V_{\text{deposition}} * \text{Concentration}_{\text{air}}$$

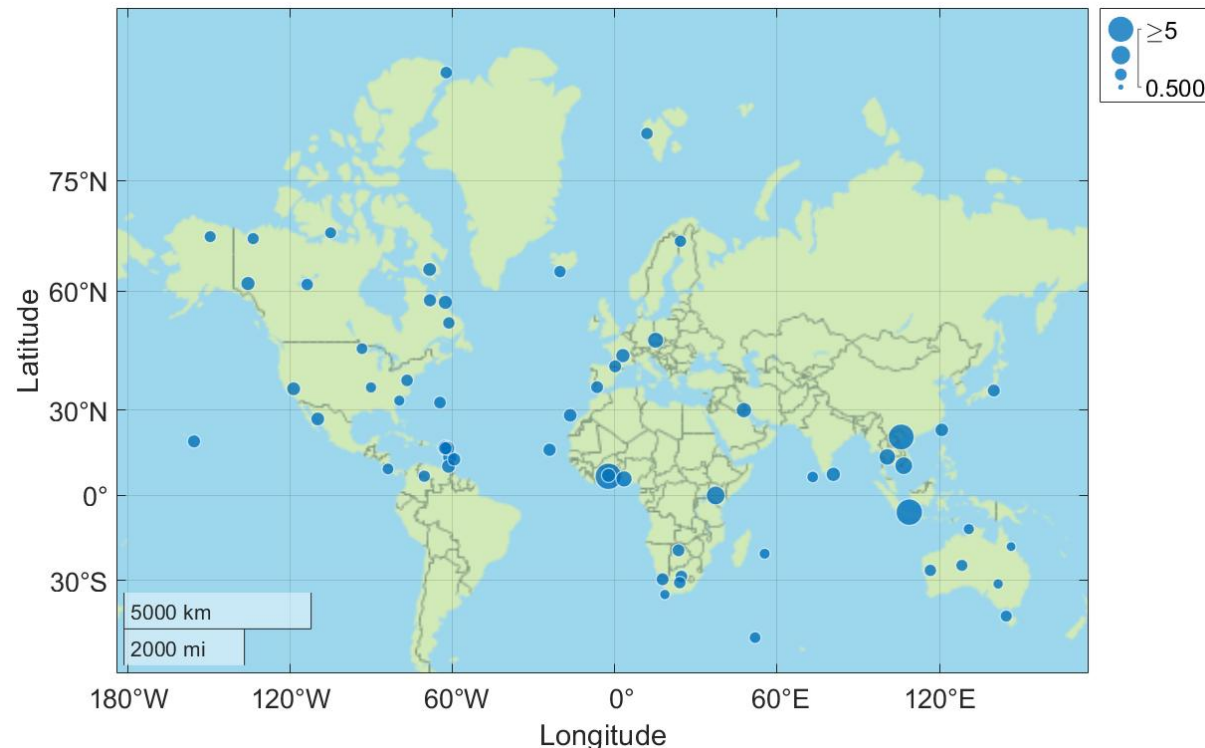
where:
$$V_d = \frac{1}{R_a + R_b + R_c}$$

- R_a as aerodynamic resistance, R_b as quasi-laminar resistance, and R_c as canopy resistance

5. ECCC Global Passive Monitoring

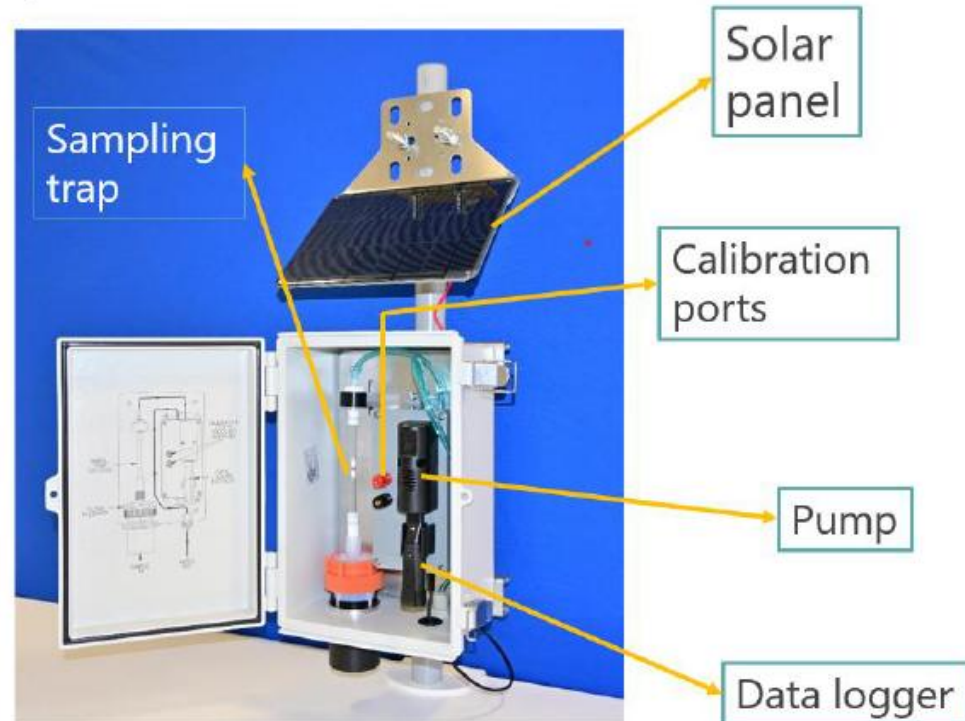
- APMMN take over operation of the ECCC Global Passive Monitoring Network?
 - 100 active sites operating in 39 countries
 - Very important to continue for Minamata Protocol

- 400 samples per year
- Low cost
- High impact/visibility



6. New Speciation System: Perhaps we would like to adopt this?

- PS Analytical, Inc (Scotland), “Air Sentinel”
- Make a new routine measurement of GEM, BPM, and GOM
- Appropriate for a weekly sample
- Easy to use
- Low cost
- Would provide weekly concentrations of all
- Simple change out weekly
- Can be run on solar



Specifics

- **Accurate sample flowrates** are measured and logged allowing an accurate volume calculation.
- The volume calculations are unaffected by weather conditions or any power fluctuations.
- **Typical flow rate of 12L/h** allows much greater mercury mass loading in a short time frame leading to
- Larger & more comprehensive data sets
- Lower measurement uncertainty due to larger and accurate sample volumes
- **Short and long-time event monitoring**
- Faster turnaround of analysis
- **Minimal maintenance** required
- **Continuous sampling for 8 days** without solar charging and extended sampling periods limits using solar panel charging
- Easy deployment, installation and various panel mounting options
- Compliant with USEPA, ASTM, iso and CEN methods
- **Low-cost entry to the technology**
- Ability to perform sampling for atmospheric speciation measurements including particulate and oxidized Hg
- Field and easy flow calibration
- Selectable sampling periods between minutes, hours, days and months.
- **Reusable Amasil collection traps**
- Weatherproof Cabinet suitable for harsh environments

Summary - - The Asia-Pacific Mercury Monitoring Network (APMMN) is...

- A group of countries, ministries, federal agencies, academics and monitoring groups cooperating to make measurements of
 - Mercury in wet deposition
 - Concentrations of mercury in gaseous and particle bound forms
- Using the same instruments and standard operating procedures across Asian countries and consistent with U.S. operations
- Sharing data to solve the mercury problem is very important