2018 Quality Assurance Report
Atmospheric Mercury Network

National Atmospheric Deposition Program

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Abbreviations

AMNet	Atmospheric Mercury Network
GEM	Gaseous Elemental Mercury (expressed in ng/m^3)
GOM	Gaseous Oxidized Mercury (expressed in pg/m^3)
MDN	Mercury Deposition Network
NADP	National Atmospheric Deposition Program
$PBM_{2.5}$	Particulate-Bound Mercury less than 2.5 μm in diameter (expressed in pg/m^3)
QAP	Quality Assurance Plan
SOP	Standard Operating Procedures

Units and Conversion Factors

°F	degrees Fahrenheit
°C	degrees Celsius
cm	centimeters
L	liters
µl	microliter (1 µl = 10^{-6} L)
lpm	liters per minute
ng	nanograms (1 ng = 10^{-9} g)
ng/m^3	nanograms per cubic meter
pg	picograms (1 pg = 10^{-12} g)
pg/m^3	picograms per cubic meter

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1.0 Introduction

The Atmospheric Mercury Network (AMNet) was established in 2009. Twenty-one AMNet sites operated in 2018, including one site (Mt Lulin) in Taiwan (Table 1). The concentration of gaseous elemental mercury (GEM) was measured at all sites. Speciated mercury: gaseous oxidized mercury (GOM), and particulate bound mercury ($PBM_{2.5}$), was measured at 13 sites in 2018. Eight sites (AK03, IN34, MA22, MN06, NJ54, NY06, NY20 and NY43) measure GEM only. All measurements followed the AMNet Standard Operating Procedures (SOPs) found at http://nadp.slh.wisc.edu/AMNet/docs.aspx.

The AMNet Site Liaison provides remote technical support to site operators, completes site performance and systems surveys, and reviews the data on a monthly basis to identify problems. Data review includes both manual and automated quality control checks. Site operators are notified whenever problems are discovered.

In 2018, NADP moved from the University of Illinois Champaign-Urbana/Illinois State Water Survey to the University of Wisconsin/Wisconsin State Laboratory of Hygiene. Due to the challenges of the transition, only four sites were surveyed by the AMNet Site Liaison in 2018. This was the first time any site exceeded the 2-year site visit criteria (MS12 surveyed 12/13/2016). This report includes a summary of the findings from each of the 2018 surveys.

Changes in 2018 include the following:

- Two sites (AK03 and NS01) closed in 2018.
- Two sites (IN34 and MN06) started in 2018.

Table 1. AMNet Sites

NADP Site ID	State	Operating Agency	START_DATE	END_DATE	Lapse
AK03	Alaska	National Park Service	2/5/2014	12/20/2018	
AL03	Alabama	ARA Inc.	1/29/2016	11/9/2016	
AL19	Alabama	ARA Inc.	1/1/2009	6/28/2016	
FL96	Florida	ARA Inc.	1/1/2009	10/5/2016	
GA40	Georgia	ARA Inc.	1/1/2009	10/4/2016	
HI00	Hawaii	NOAA/EPA	12/30/2010	Current	
IL11	Illinois	NADP/CAL	3/30/2017	Current	
IN21	Indiana	LADCO	4/29/2016	Current	
IN34	Indiana	LADCO	10/2/2018	Current	
MA22	Massachusetts	MIT	7/29/2017	Current	
MD08	Maryland	University of Maryland	1/1/2008	Current	6/30/2011 - 1/12/2012
MD98	Maryland	NOAA	11/7/2006	Current	
ME97	Maine	Micmac Tribe	12/3/2013	12/31/2015	
MI09	Michigan	University of Michigan	8/10/2015	7/11/2016	
MN06	Minnesota	Leech Lake Band of Ojibwe	5/2/2018	5/29/2019	
MS12	Mississippi	NOAA	9/29/2006	Current	
NJ30	New Jersey	State of New Jersey	10/11/2016	Current	
NJ54	New Jersey	State of New Jersey	10/12/2016	Current	
NS01	Nova Scotia, Canada	Environment Canada	1/26/2009	11/27/2018	
NU15	Nunavut, Canada	Environment Canada	1/4/2002	Current	
NY06	New York	State of New York	8/27/2008	Current	
NY20	New York	SUNY ESF	11/21/2007	Current	
NY43	New York	State of New York	11/21/2007	Current	
OH02	Ohio	Ohio University	1/1/2007	Current	2/15/2012 – 9/24/2013
OH52	Ohio	Ohio State University	1/1/2012	Current	
OK99	Oklahoma	Cherokee Nation	10/20/2008	5/31/2015	
TW01	Taiwan	EPA Taiwan	1/1/2010	Current	
UT97	Utah	State of Utah	11/23/2008	8/14/2017	
VT99	Vermont	University of Vermont	1/1/2008	1/4/2016	
WI07	Wisconsin	State of Wisconsin	2/1/2012	Current	

2.0 Site Performance and Systems Surveys

Sites are surveyed at least once every two years by the AMNet Site Liaison. Site survey reports are completed to document problems that are discovered during the survey and their resolution.

Site surveys evaluate both field and laboratory operations (including equipment operation), and siting criteria. Site surveys ensure data comparability within the network, resolve operational problems that may not be apparent in data review, and address training needs at each site. Siting criteria obstructions are either towers or trees. Recommendations and influences are explained to the Site Operators. Repairs or changes are left to the sites to resolve although some are difficult or impossible to rectify.

Typically the data before repairs was invalid. Repairs and data evaluation is explained at each Site Visit. Following the repair that data should be valid.

Additional information regarding site surveys may be found in the document titled *Atmospheric Mercury Network: Site Performance and Systems Survey*. This document is available from the NADP website (http://nadp.slh.wisc.edu/AMNet/docs.aspx).

2.1 AMNet Sites Surveyed in 2018

Site surveys were conducted at four AMNet sites in 2018. Station ID's, survey dates and station names are presented in Table 2.

Table 2. AMNet Sites Surveyed in 2018.

Site ID	Station Name	Survey Date
AK03	Denali	11/22/2018 (Surveyed prior to closure per site request)
MN06	Leach Lake	5/1/2018
NY06	Bronx	6/12/2018
NY20	Rochester	6/11/2018

2.2 Instrument Test Results

As part of the site survey, instrument sensitivity (i.e., response factor) and the internal calibration source are verified. Independent, third party calibration certificates for the survey test equipment are kept on file. Table 3 lists the serial numbers for the AMNet instruments at each site. Illegible serial numbers are listed as "n/a" (not available). Not present instrumentation is listed as "n/p". All sites surveyed on 2018 were GEM only.

Table 3. Serial Numbers for Instruments at Surveyed Sites.

Site ID	Instrument Models					
	1102	2537	1130P	1130	1135	2505
AK03	n/p	215	n/p	n/p	n/p	150
MN06	n/p	320	n/p	n/p	n/p	n/p
NY06	n/p	5035	n/p	n/p	n/p	n/p
NY43	n/p	5039	n/p	n/a	n/a	n/p

Table 4. Instrument Descriptions

Instrument ID	Description
1102	Tekran Air Dryer for Speciation System
2537	Tekran CVAFS Automated Mercury Analyzer
1130P	Tekran Speciation Pump Module
1130	Tekran Oxidized Mercury Speciation Module
1135	Tekran Particulate Mercury Speciation Module
2505	Mercury Vapor Calibration Unit

Table 5 lists the results [i.e., pass (p), fail (f)] for each test of the field instruments. Criteria for assigning pass/fail are defined in *Atmospheric Mercury Network: Site Performance and Systems Survey*. Significant deviation from the test criteria would be indicated by an uppercase "F". No significant deviations were noted in 2018. Parameters that were not tested are listed as "n/a." MN06 was a newly installed site in 2018. Warning and control limits are set and published in the *Atmospheric Mercury Data Management Manual:* http://nadp.slh.wisc.edu/lib/manuals/AMNet-2406_Data_Management_Manual_v_2.pdf. If a parameter exceeds control limits upon departure, that parameter receives a failing grade. The failing grade can apply to both analytical and siting criteria.

Table 5. Survey Results.

Site ID	Air Flow and Leak Tests				Cartridge A and B Recoveries			
	Temps OK	Inlet Flow	2537 Flow	Leak Check	Response Factor	Low Level	High Level	Ambient Air
AK03	n/a	P	p	p	p	f	f	p
MN06	n/a	P	p	p	n/a	n/a	n/a	n/a
NY06	n/a	P	p	p	p	p	p	p
NY43	n/a	P	p	p	p	p	p	p

2537 = Tekran continuous mercury vapor analyzer

2.3 Siting Criteria

Compliance with siting criteria is evaluated with regard to obstructions (>20^{o}) in each of 8 directions (i.e., N, NE, E, SE, S, SW, W, and NW) from the instrument inlet. Also, the height from the ground to each inlet is measured. Results are presented in Table 6. Obstructions are evaluated as pass (p) or fail (f). Deviations from the siting criteria are discussed with the operator during the site survey. Failures of siting criteria failures can affect the speciated data because turbulence is changed by the obstruction. Analytical failures should be corrected during or soon after the Site Visit. Corrective action, when possible, is the responsibility of the site operator and the site supervisor. Site photos can be found at: http://nadp.slh.wisc.edu/AMNet/.

Table 6. Siting Criteria Obstructions and Inlet Heights.

Site	Inlet Height (m)	N	NE	E	SE	S	SW	W	NW
AK03	3.2	p	p	p	p	p	p	p	p
MN06	2.4	p	p	p	p	p	p	p	p
NY06	14.1	p	p	p	p	p	p	p	p
NY43	4.3	f	p	p	p	p	p	p	f

2.4 Instrument Repairs

In 2018, no instruments needed repair prior to operational assessment.

2.5 Test Equipment Calibration

Due to ongoing as-received calibration failures, the Bios flowmeters were retired in 2018 and a TetraCal venturi flow meter was purchased for use in the field. The TetraCal has no moving parts, can measure the complete dynamic range, continuously measures both Standardized and Volumetric flow and has an operating range down to -30° C. The TetraCal is expected to perform better "as-received" and will only require one certification saving the program hundreds of dollars a year.

Table 7. Flow Meter Calibration Results for 2018 and 2019.

Flow Meter		Calibration Date	
		04/2018	11/2019
TetraCal	as-received	n/a	In Tolerance
	as-shipped	Purchased new	In Tolerance

A Tekran 2505 Mercury Vapor Primary Calibration Unit and a certified Hamilton 25 µL syringe (Model 1702RN) are used to validate instrument internal permeation sources. On September 10, 2018 syringe SN 5647 and SN 7473 was found to be within tolerance both as-received and as-shipped. SN 7473 was certified again on December 3, 2019 and found to be within tolerances. The syringes and flowmeters are certified annually by the manufacturer, the syringe is NIST traceable, while the flow meters are NELAP certified.

3.0 Training

No formal AMNet training sessions were held in 2018. Operator performance is reviewed with each site visit.

4.0 Data

AMNet data are evaluated using a series of automated checks and through manual inspection by the AMNet Site Liaison. Additional information on this process is available in the *Atmospheric Mercury Network Data Management Manual*. Table 8 lists the percentage of valid data collected at each site in 2018. Values are presented for each of the three forms of mercury that are measured including: GEM, GOM, and $PBM_{2.5}$. Two sites, IN21 and MD08, did not meet data quality objectives (≥ 75% data completeness on an annual basis) for GEM in 2018. One site

(MD08) did not meet data quality objectives for GOM and $PBM_{2.5}$. Table 9 lists problems impacting data completeness for individual sites.

Table 8. Percent Valid Data by Site for 2018*.

Site ID	GEM	GOM	$PBM_{2.5}$
AK03	81	n/a	n/a
HI00	80	80	82
IL11	92	n/a	n/a
IN21	74	80	80
MA22	96	n/a	n/a
MD08	74	74	73
MD98	81	98	98
MS12	81	92	94
NJ30	89	97	97
NJ54	93	n/a	n/a
NS01	87	92	92
NY06	100	n/a	n/a
NY20	83	92	92
NY43	93	n/a	n/a
OH02	88	91	91
OH52	88	91	91
TW01	Data QA performed external to NADP.		
WI07	83	84	87
Average	86	88	89

* Based on period of operation

Table 9. Problems Impacting Data Completeness.

SiteID	Problem Description	Period Impacted
IN21	Low Response Factor	February – March August - September
MD08	High baseline deviation Low Response Factor	February March

5.0 References

- AMNet Data Management: http://nadp.slh.wisc.edu/lib/manuals/AMNet-406_Data_Management_Manual_v_2.pdf
- AMNet Standard Operating Procedures: http://nadp.slh.wisc.edu/AMNet/docs.aspx