MELD Meeting Minutes
2020 NADP Spring Meeting

Virtual
May 11 & 12, 2020

Co-chair: Richard Haeuber
Co-chair: Colleen Flanagan Pritz
Secretary (unofficial): Katherine Ko/Colleen Flanagan Pritz

Action Items

1. Provide comments on background papers developed for the Minamata Interagency Group (MIG) – air, modeling, biota, multi-media – summarizing the state of the science in the context of the Minamata Convention. Comments requested by June 15.
2. Coordinate with the MELD community to review and comment on future monitoring guidance documents and other related documents to be developed to inform future plans for a Minamata effectiveness evaluation.
3. Form measurement and modeling workgroup – to include planning for future webinars/in person workshop to facilitate evaluation of additional Hg measurements for NADP to consider.
4. Explore directions and options for estimating deposition at certain paired dragonfly sites, in order to link deposition with ecological receptors. Also explore creating paired sites for the future.
5. Move that NADP Executive Committee change status of MELD from an ad hoc group to a science committee.
6. Plan for in-person or virtual Fall 2020 meeting.

- Day 1 meeting on May 11 commenced at 1:00 EST
- Colleen reviewed progress from 2019 meeting and logistics of Zoom meeting, and facilitated introductions
- Rick presented an overview of the agenda and set the stage for Day 1 discussions.

Genesis of the U.S. Government (USG) Technical Experts Group (TEG) on Mercury Monitoring Data and Gaps, in the context of the Minamata Convention on Mercury
Guest Speaker: David Krabbenhoft, USGS

- The USG Mercury TEG Meeting was held in January 2020 in Washington, D.C. at Main Interior.
- USG Mercury TEG Meeting goals:
  - Identify general USG mercury science capability strengths and weaknesses
  - Assess U.S. mercury data holdings relevant to an effectiveness evaluation (EE)
  - Establish a USG network of mercury technical experts
- UPDATE: USG Mercury TEG now referred to as *Mercury Interagency Group*, or *MIG*

Updates from the Third Conference of Parties (COP-3) Minamata Convention on Mercury
Guest Speaker: Liz Nichols, Dept. of State

- How can NADP help Hg policy and how can MELD contribute to international mercury science policy?
    - Contribute to ongoing development of Minamata Convention EE
        - I.e., MELD can contribute to content development
- Science diplomacy
    - Collaborate (academia, agencies, etc.)
    - Integrate
    - Negotiate
- Minamata EE
    - Goal: have something to look at by 2023
    - When last we met (COP-3), we wanted to develop framework- this is the study design, what data we're going to use, how we're going to write it, etc.
    - Monitoring means:
        - Air
        - Biotic media
        - Humans
- Decision text at end of COP-3
    - Requests secretariat to advance work by drafting guidance on monitoring and reports based on framework
    - Parties did NOT agree on a robust framework that could have included maximum qualities
    -
- From five reports to two reports:
    1. Article 21 Synthesis report
    2. (eliminated) Emission and releases report
    3. Trade, supply and demand report, which includes Hg waste flows and stocks
    4. (eliminated) Monitoring report
    5. (eliminated) Modeling report
- Visit http://www.mercuryconvention.org
    1. Overview Document: there is only 1 secretariat-driven document to date
    2. Roadmap to develop monitoring guidance (in process)
- Next steps going into COP-4 Nov. 2021 in Bali, Indonesia
    - Annotated outline of guidance document
    - Write the meat of the document
    - Invite party consultations
    - Secretariat will review document
- Discussion
    - C. Driscoll asked what the role of non-government scientists is. L. Nichols replied to contribute by way of MELD.
    - S. Steffen commented that the EE will be made using available data, and while we cannot spend convention resources on creating data for the EE, we can continue working with partners who are collecting data.

- o C. Chen asked about the human mercury group equivalent, and about the data or expertise on sea turtles, marine mammals, and other biotic indicators. L. Nichols replies that CDC holds data on humans and mercury. C. Flanagan Pritz commented that C. Eagles-Smith presentation will include sea turtles, but there is not consistent long-term monitoring. C. Eagles-Smith concurred.
- o R. Haeuber asked how MELD can help moving forward. L. Nichols replied that MELD can help fill the scientific gaps (although hard to convey those gaps and asks today). MELD can help generate content for monitoring document.

USG-TEG Presentations on Mercury Monitoring Data and Gaps

Atmospheric Mercury Monitoring Programs and Data, D. Schmeltz

- Look at utility of air monitoring data for EE
- Focus on atmospheric Hg concentrations and deposition in US
- Relevance to Minamata Convention
  - o Data and models
    - GEM (gaseous elemental Hg), TGM (total gaseous mercury), GOM (gaseous oxidized Hg), PBM (particle bound Hg)
    - Wet/dry deposition
- There are gaps in MDN (PWR, IMR), AMNet (IMR, PWR, SER)
- Literature: spatial and temporal patterns and trends
- NADP is looking into a plan to address data gaps
- Questions
  - o M. Gustin (in chat): "I think the atmospheric monitoring community believes the Tekran GOM and PBM data are not reliable. Also we have submitted a paper to ES&T that shows that RM (reactive mercury) concentrations collected using membranes are much higher in most cases and that if you put our active system adjacent to Tekran systems you may be able to better understand how underestimated concentrations have been in the past."
    - More reliable with dry, clean air with Bromine and Chlorine compounds. As you get into urban areas, high relative humidity, issues can occur with Tekran.

Atmospheric Mercury Modeling, R. Bullock

- Compound-specific information would help tremendously
- Questions:
  - o M. Gustin: paper submitted to ES&T found that there are different compounds in reactive Hg, and it makes sense. Able to identify mercury bromide vs mercury bromide, etc.
  - o M. Cohen: multiple models are useful. They bridge gaps in different ways, some are better for local vs. global, etc. Also, need both monitoring data and modeling to assess EE.
  - o S. Steffen: we plan to include modeling in attribution report/EE. Might end up negotiating modeling to appear on second report, but we will fight for both monitoring and modeling on EE.

Biological Mercury Monitoring, C. Eagles-Smith
- Specimen options: fish, birds, marine mammals/sea turtles, invertebrates
- Assessed individual states in their biotic monitoring effectiveness, and concluded that as a country, there is inadequate biotic mercury monitoring
- Data are most robust in spatial coverage, fish sampling, dragonfly larvae
- Data are weaker in temporal, repeat sampling, and marine environments
- Fatally weak data areas: wildlife sampling, sources attribution accounting for extrinsic and intrinsic factors
- Biotic monitoring is essential to inform effectiveness for ecosystem and human exposure
- Questions:
    - S. Steffen commented that she likes the idea of centralized technical effort, and then asked what indicator species is recommended, because right now the recommendation is Trophic Level 4. C. Eagles-Smith replied that we'd need to do a systematic analysis to determine a suitable bioindicator, and Sandy questioned if he foresees a recommendation by Liz's timeline of July 2021. C. Eagles-Smith replied yes, and I'd like to invite today's participants in on the conversation.

Mercury Monitoring Data and Gaps: Multimedia—Water & Sediment, C. Eckley
- Linking air emissions to fish MeHg
- Media: water, snowpack, soil, water/sediment
- Effectiveness for spatial-temporal trends:
    - Vegetation-3, snowpack-3, soil-3, river surface sediment-3, lake surface sediment-3, dated sediment core-1, river water-3, lake water-1
    - Recommend dated sediment core and lake water monitoring efforts
- Questions:
    - C. Chen asked if there is enough data for a baseline, and C. Eckley replied that we can improve on that.
    - M. Gustin: tree cores typically record (GEM), but you can see regional trends. There are many caveats to this method, but tree cores can potentially be a way to investigate regional long-term trends.

Day 1 Wrap Up
- C. Flanagan Pritz indicated that MELD should review the background papers and provide comments direct to her.
- S. Steffen mentioned she'd provide the framework to C. Flanagan Pritz for distribution
- T. Keating said that the Minamata committee will be putting out a call looking for experts and consultants.
- Meeting adjourned at 5:20 EST.

- Day 2 meeting on May 12 commenced at 1:30 EST
- Colleen reviewed logistics of Zoom meeting and facilitated introductions for new participants.
- Rick presented an overview of the agenda and set the stage for Day 1 discussions.

Mercury Measurement Straw Proposal
- Discussion led by D. Gay, D. Schmeltz, K. Morris
    - How can we meet atmospheric Hg data needs to serve management/action?
    - What are the data needs? Are we measuring the right things/locations?
- D. Gay presented Strawman Idea for NADP action plan
    - Hg Total Deposition- Monthly
        - Bulk wet deposition (column or bottle)
        - Passive GEM
        - Simple litterfall
        - Precipitation amount
        - Acknowledge advantages/disadvantages
    - Hg Total Deposition Weekly
- Discussion:
    - D. Burns: agree that this method is a crude approximate, and not highly quantitative. Low tech is attractive. Seems somewhat labor intensive. Why not say let's have a Hg monitoring site that will collect indicator measurement to compare geographic locations. It's not perfect, but neither is your current method.
        - D. Gay: Goal is to try to get some total deposition estimate.
    - R. Bullock: agree that this is an improvement, but a bit uncomfortable calling it Total Deposition. Collection always has question of if what you catch over time really stays in bucket. What if we put out 2 buckets, 1 out in open and 1 in canopy? I like litterfall.
        - D. Gay: Agree.
    - M. Gustin: not sure what Passive GEM gets you. Litterfall- good. Think about GOM measurement (arrowhead in middle of frisbee thing)? Experience with pretty good data despite long deployment time.
    - W. Luke (in chat): In response to Mae's comment – GEM concentration info will also be essential for the Minamata EE, if not ideal for dry dep estimates
    - S. Nelson (in chat): I don't see raise hand, but I have tons of experience with funnel-bottle collectors and would be glad to share some of the issues prior to deploying (volumes, winter collection, vapor loop, replication or analysis of potassium due to attraction of spiders and birds to ID contamination)
    - M. Cohen (in chat): From my point of view as a modeler, we need high-temporal resolution, speciated mercury information, for model evaluation and improvement. I'm not sure these are all that helpful for that. If you want wide spatial data, fine, but I'm not sure how useful it will be for model evaluation and improvement. Just my two cents.
    - Question: for bulk wet collection, is sampler open when no precipitation? If so, won't one get some dry dep of GOM and PBM included in bulk sample?
    - L. Zhang (in chat): The equation is not theoretically correct because of the double counting of both dry and wet protons in litterfall and throughfall, while missing GOM and PBM dry deposition
    - D. Krabbenhoft: what NADP is currently doing with deposition isn't necessarily satisfactory. With modestly good wet dep network, but poor dry dep network, we need to do something. Don't have to fixate on deposition, esp. within a budget. Instead, you

can get a spatial, relativized examination of these proposed metrics (I.e. bulk wet dep, GEM, litterfall comparisons across your network and get a relativized sense).

- o C. Driscoll: I have about 2 years data in urban/ag setting comparing wet/bulk dep. Maybe look at different types of vegetation beyond forest?
- o D. Krabbenhoft: could pencil/paper assess by looking at soil Hg concentrations from untilled grasslands from soil dataset. Grasslands and non-canopy settings do vary. Can convince yourself by looking here that grasslands are effective in picking up Hg.
- o D. Schmeltz: as an end user, what data do you want?
- o C. Driscoll: long term data (sediment cores? Other records to support) from sites. Meta-analysis looking at sediment cores across broad areas? To bolster historical data.
- o S. Steffen: re: Winston's chat comment. Thinking about what would be effective for EE/convention, must target questions/research to decisionmakers. I have a global passive MerPas network to address spatial/temporal trends re: elemental Hg. Recommendation: couple some of these ideas with existing sites. There is a difference between scientific questions and what is useful for EE/convention. Passive elemental monitoring will be useful for EE/convention.
- o D. Terpstra: involved in lower Wisconsin riverway. We currently have very little data in general. Idea of an inexpensive passive sampler is very attractive. Can we go ahead and throw this in some grant applications?
- o D. Terpstra (in chat): I have been interested in getting data in the Lower Wisconsin Riverway, AMON was a good start to raise funding, the low-cost approach is appealing to me. I have been working with local groups and have permission to use an existing riverway group to apply for grants through their organization. I am writing grant applications to keep the AMON site going long term. Is this something that could be prototyped and added as an option for grants? Passive and simple should be easy to add into the existing land agreements.
- o M. Cohen: agree that getting broader spatial coverage is good. Your ideas can be useful metrics even if they're not exact deposition estimates. As a modeler, we cannot evaluate and improve models without high temporal, chemical resolution. We need intensive sites. And we need models in addition to measurements.
- o K. Morris: agree. Some core intensive sites and cluster/less intensive sites are good.
- o M. Cohen: temporal trends are important. We don't want to create new data that will not work with our old data.
- o L. Zhang: have problem with equation. Rough estimate of GEM would be useful. Agree with Mark's comment that you need models.
- o D. Gay: agree, the question was kind of a placeholder. Agree, it would be a rough guess at total deposition.
- o S. Nelson: Have data from 4 years with event-based rain, total Hg deposition from 50 sites in Acadia. Different elevations, vegetation type. Jane Kirk in Canada has a paper.
- o C. Sams: While NADP has one AMNET in Taiwan, Taiwan has 12 additional mercury monitors across the island. Does anyone know what technology is used for those 12, and is that technology inexpensive enough to consider supplementing David G's proposal for North America?
- o D. Schmeltz: MIC technology, what Canadians are using.
- o C. Sam: ok so it would be more money.
- o D. Schmeltz: yes.
- Moving Forward
  - o D. Schmeltz: anyone want to form a MELD air measurement subgroup?

- Interested: Doug Burns, Dave Terpstra, Mae Gustin, Krabbenhoft, Winston Luke, Sandy Steffen, Huiting Mao, Mark Cohen
- D. Burns (in chat): Since I've been leading the Hg litterfall network for the past few years, it makes sense for me to join the Hg atmospheric measurements committee, as well.
  - T. Keating: seems like organizing a workshop is a useful step, but the real goal is that bullet point of an actual evaluation. Focus some efforts here re: who should be involved, how that works, etc. And then pull together workshop to discuss.
  - K. Morris: agree. Could be in person, or webinars, webinars leading up to in-person, etc. There is a lot of information sharing that needs to happen. Perhaps some webinars this summer to connect, as a starting point.
  - T. Keating: yes!!
  - D. Schmeltz: so, we'll discuss internally, and then approach the group with suggestions of a meeting or two in the near season and fall meeting.
  - K. Morris: there is currently no identified funding source. We need to investigate that.
  - K. Morris: also, MELD would synthesize these thoughts and suggest to exec committee of NADP. Therefore, MELD would be looking for recommendation from an impartial observer group that has evaluated all the info. I.e. when AMNet was being proposed, there was a group of "advocates" for the network. This would be useful in our situation.

Linking Deposition with Ecological Receptors
- Presentation and discussion led by C. Eagles-Smith
- Goal: looking to MELD for most effective means of incorporating atmospheric Hg metrics into our estimates of Hg bioaccumulation in dragonfly larvae, and implications to better understand trajectory changes
- How can we best incorporate deposition and atmospheric Hg; can we sub space for time?
- Are dry dep models of adequate resolution for this purpose? What other considerations are we neglecting?
  - R. Bullock: we have ability to resolve down to find scale if needed.
  - D. Krabbenhoft: temporal would likely tie in better than spatial. Is there any effort to focus on temporal over spatial?
  - C. Eagles-Smith: yes, we have data from several long-term sites. What we have working for us is sample site scale that can overpower variability. There is variation in taxa, etc.
  - M. Cohen: all models have this problem of multi-scale/local/global and resolving things. Approach with HySplit: adaptive receptor grid. Diff models do diff things. Agree with Russ that we can do it, but you need funding. This sounds like a 2-3-year project, maybe a post-doc.
  - H. Mao: very interesting presentation and background paper. We did a study on impact of NY state emission reduction on ecosystem; project under Dave Evers a couple years ago. Published in Ecotoxicology last year (paper provided). Very similar to your work. Agree that it's critical and difficult to link biotic to atmospheric. Used CMAQ. 12km x 12 km resolution, 10-month simulation (temporal investigation is out, the best we could do was seasonal cycle). If you reduced anthropogenic emissions at intensive sources (I.e. Rochester, NY), what happens all the way over at Great Lakes? Re: dragonflies, we could look to see if spatial variation in dragonflies fits with atmospheric Hg. We need to know more about life cycle to see how that works with dry dep data/simulation. If we keep

this conversation going and exchange ideas, we can probably make this work! Interested in working with you and DMP! Exciting!

o S. Nelson: spatial variability between sites is biggest variability
o C. Chen: what kinds of costs are associated with the passive monitoring
o S. Steffen: Like to do triplicates. Two samples in a blank. $75 each for samplers. Depends on who you get to analyze. In comparison to active monitoring, it is much less expensive. We don't currently have an annual estimate yet. Botswana set up 5 sites, we did 3. They worked with Tekran to get and deploy.
o DMP is great! Policy people keep demanding 1 bioindicator. People come back with Trophic Level 4. Maybe it's dragonflies, maybe not! But this type of project is perfect. Encourage talking to GEF and UN.
o C. Chen: inverts listed?
    ▪ S. Steffen: inverts are not listed in EE. Article 22.
    ▪ D. Evers: are you seeing things with Trophic Level 3?
    ▪ C. Eagles-Smith: yes, 2.5-3.5.
o D. Evers: yeah, so there's a workable range of indicators. We should maybe not send it to one bioindicator, but a trophic level instead. You can tell different countries with different animals in their range to use an animal that works for them. Selling point to upper level decision makers is connecting to human health.
o C. Eagles-Smith: yes, issue is ecological/temporal range and differences of animals. And making sure they work together.
o S. Steffen: DMP fits the policy bill.
o C. Chen: note that analysis shows fish Hg and dragonfly Hg do couple well together. So, dragonflies can be/are already connected to human health. It is relevant to the COP/Minamata.
o Mae Gustin (in chat): I am not sure how GEM with month long passive sampling will tell us anything that can inform the convention.
o S. Steffen: it'll give us a snapshot of what concentrations are like in diff areas of world. Right now, we have so many gaps in understanding of atmospheric Hg
o M. Gustin: do you have the resolution to do so?
o C. Flanagan Pritz: I suggest we defer this conversation to the subcommittee group that forms to address these technicalities. It'll be a long conversation. What instruments you want to deploy, where, for what reason, etc.
o D. Evers: re: approaching GEF with this: implementing countries, helps to couple with developing countries. But MELD could not just write and submit proposal to the GEF.
o R. Bullock: We can't understand link b/w Hg in environment and atmospheric deposition if we don't know the Hg in atmosphere is in the first place. Must have two end points before we make the link.
o R. Ankrah: re: convention/GEF: Take a step back and figure out that we can contribute to make a clearer understanding (particular for developing countries) of the tools they need/can use to: (1) address their own needs; (2) the better science as to what info we have that will lead to better outcomes. Simply being able to articulate WHAT and HOW will be useful, is a critical step. It is worth steering a larger conversation towards saying

"these are the things that need to happen" even if we might not be the people to make that happen.

- o D. Krabbenhoft: USG groups- one major motivation of our coming together was to discuss how we can do better with the funding we have. So, having things on the table to discuss like Dave(s) strawman idea, is valuable. It is hard to get GEF funding as a USG, but we can all work together with the funding we have to put our resources where it is best to help EE.

Round Robin/Research Open Microphone

- C. Chen: are coastal margins included in people's models and research?
  - o D. Gay: we do have a few coastal sites. NOAA has authority out there.
  - o M. Cohen: we've struggled for 10+ years with buy in. Unsuccessful with engaging NOAA. Agree that we have a lot of work to do in coastal and oceanic regions.
    - ▪ Might be moving our Grand Bay site to Alaska. We welcome people to do ecological research.
  - o H. Mao: We have 5 years of reactive Hg measurements and even more of GEM along NH coastal line (monitored up until 2010).
- S. Steffen: higher level argument at COP/global Minamata convention is that the indicators we propose must be globally useful. How can we respond to countries like Africa, where water is not acknowledged as an indicator of Hg contamination?
  - o C. Chen: in some cases, using water as an indicator doesn't seem efficient. It takes a long time, is difficult, etc.
  - o D. Krabbenhoft: if countries have the capabilities to monitor water, why not?? In terms of artisanal scale, you can support this.
  - o S. Steffen: so, they can seek funding to monitor water under a different Article.
  - o C. Driscoll: agree that water can be useful monitor. We talked about difficulties with fish as indicators, so water could be a good medium.
  - o D. Evers: through EE committee, if you had to pick and choose though, does water give you the best advantage?
- D. Evers: I've been working with UN on Mercury Initial Assessments (MIAs)
  - o R. Bullock: these are exactly what us modelers are looking for! The inventory that we work with would benefit from any new/additional information.
  - o M. Cohen: need a review of emissions inventory so that you can synthesize different countries work into a global inventory.
  - o D. Evers: agree. I'd like to send out report for people to review and identify gaps.
  - o M. Cohen: there is also the question of if the toolkit was applied correctly in each country, that needs to be reviewed.
  - o T. Keating: definitely good resource. But I predict people will find problems in reviewing MIA. Is there a plan/funding to conduct follow ups with MIAs?
- D. Schmeltz: our mercury network in the Asia Pacific region is growing with new wet deposition sites established in Fiji, Palau, India, Nepal, and Mongolia. Some of the APMMN sites are also sampling atmospheric mercury

Day 2 Wrap Up

- C. Flanagan Pritz presents next steps, and plan to recirculate background papers for comments by June 1, 2020.
- Plans for in-person or virtual Fall 2020 meeting will commence.

Meeting adjourned.