TDEP Committee Meeting, April 13, 2015, Pacific Grove, California

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1. **Welcome and Introductions**
   Self introductions by all attendees

   Presentations outlined below may be posted on the TDEP web page: http://nadp.sws.uiuc.edu/committees/tdep/ Please refer to the presentations for further information beyond what is provided in these minutes

2. **Status of TDEP Maps and Future Plans** (Presentation by Donna Schwede and Gary Lear)

A. Overview of Hybrid Approach

- Interpolation of monitoring concentrations where available
- Use of modeled data where monitoring is sparse or missing
- Monitoring concentrations multiplied by CMAQ generated Vd
- Merging of deposition grids from Steps 2 and 3. Weighting based on distance from monitoring location
- Calculations and interpolations done as NetCDF or ArcGRID rasters
- Scripts written as Bash, perl or Arc Macro language with the intention to migrate to R or Python

B. Current Status of Maps and Data

- New maps not presented during this meeting due to logistical issues
- Version 2014.02 maps and data for 2002-2013 are available from CASTNET ftp site (ftp://ftp.epa.gov/castnet/tdep/) and NADP web site (http://nadp/sws.uiuc.edu/committees/tdep/tdepmaps/)
- Includes:
  - Maps and data for 2000-2013
  - Updated monitoring results for CASTNET, NTN, AMoN
  - Addition of SEARCH particulate monitoring data for all years
- AE journal article describing methodology and results available from NADP web site as well as from: http://dx.doi.org/10.1016/j.atmosenv.2014.04.008. The reference for article is: Atmospheric Environment, Vol. 92, August 2014, pp.207-220

C. Near Term Plans

- Version 2015.01 will use CMAQ v5.0.2 runs
  - New bias surfaces, new correlograms
  - AIRMoN data will be added in
  - Account for cross-correlation between concentrations and Vd
  - Use of alternate method for particle size distribution instead of 80/20 rule
  - Provide additional variables such as base cations, sea salt sulfate, N+S. if appropriate
  - Consider how to merge monitoring and modeled values for NH3

D. CMAQ v4.7.1 versus v5.0.2

- Layer height is different: v4.7.1 first layer is 38 m, so Ra calculated with a reference height of 19m; V5.0.2 first layer is 20 m, so Ra calculated with reference height of 10 m
  - Concentrations and Vd will be different, but flux should be similar since we are dealing in the “constant flux layer”.
  - Concentration differences will impact bias surfaces. Bias should be less in v5.0.2

- Bidi:v5.0.2 is bidirectional for NH3
  - Extent of impact will vary spatially based on changes in land cover and concentrations
  - Some areas will show emissions with v5.0.2 whereas before these areas showed deposition
- Mesophyll Resistance
  - Mesophyll resistance not considered for all compounds in v4.7.1; new algorithm based on Henry's Law in v5.0.2
  - There will be particular impact on NO2 Vd
- Land use
  - The different CMAQ versions use different NLCD/MODIS categories
- Land-water Mask
  - Newer version of met preprocessor passes the land-water mask from WRF directly, and there was a bug correction in the land-water mask
  - Some grid cells that were treated as water cells in v4.7.1 are now land cells in v5.0.2
  - Vd for land and water cells is calculated differently
- Emissions
  - The emissions inventory platforms are always being updated as errors are discovered
  - Lightning NOx included as a source
  - NH3 Ag emissions
    - Significant error in 2008 for New Mexico was corrected in 2009 and corrected inventory used for v5.0.2
    - NH3 CAFO emission temporal profile was corrected in v4.7.1 and there are further changes in v5.0.2
    - Issue with the 2008 NC NH3 emissions was corrected in the v5.0.2 runs
- Bias Surfaces (BS): Preliminary results presented for discussion purposes
  - BS created using inverse distance (ID) weighting; may consider alternate methods such as kriging before finalizing
  - Current BS were calculated using median value for the period whereas previous version used the mean value due to the limited number of comparison years that were available
  - Weekly BS may provide improvement over seasonal BS where more than 10 years of measurement data are available
  - Current plan is to do rolling 3-week averages for doing BS correction. AMoN data will be handled seasonally for the moment as there is not yet enough data
  - Donna is interested in investigating the hot spot NH3 areas in more detail. There is more uncertainty in the western US due to lack of monitoring sites. Interpolation between point can be challenging and different interpolation strategies will be investigated
  - Example maps of BS differences between 2014.2 and 2015.1 showed that: SO2 maps were not too different and did not show as much improvement as expected
  - pNO3 maps showed big differences in winter, especially where values were small
  - pNH4 maps showed similar results to pNO3
- Bias Surfaces for NH3
  - Last fall it was proposed not to use AMoN data to adjust CMAQ concentration surfaces for v2015.01 due to the following reasons:

1. CMAQ model performance was improved and deemed to be pretty good with respect to NH3
2. Not many AMoN sites and not as many years of data as other networks.
3. Direction and magnitude of flux is dependent on the relative concentration difference between atmosphere and plant/soil system. CMAQ v5.0.2 models bidirectional flux. Doing a simple bias correction as done for other species will violate this
4. It has been challenging to come up with a different approach for fusing AMoN values and CMAQ

- Quarterly plots comparing CMAQ results with data from AMoN sites show overall good model performance
- Individual time series for specific AMoN sites showed good correlations for some sites but not so good for other sites like the Candor and Coweeta, NC sites; hoping the Coweeta experiment will shed some light on this issue
- Three strategies for dealing with NH3 issue:
  1. Use straight CMAQ results. This assumes minimal bias although need to resolve and understand the bias better
  2. Adjust CMAQ as done for other species, i.e. adjust the concentration for the bias and then merge with observed data
  3. Adjust CMAQ deposition by the concentrations bias, i.e. no merging with observed data
- Recommendation from John Jansen to use SEARCH data, but SEARCH data have already been incorporated. Donna would like to look more carefully though at the data from the 11 SEARCH sites. Some analysis help is necessary however as this is a tremendous amount of data to be researching
- Leiming Zhang commented that deciding on the main purpose of this work might help with selecting the approach. Ammonia is a somewhat different story than other species that are mostly coming from point sources as ammonia can from large areas. Posed the question of do we treat natural ecosystems differently than agricultural areas when it come to NH3?
- Question was posed to the CLAD members as to whether they want to see net deposition or emissions. Tim Sullivan replied that net deposition is very important. Gary is intending on using the positive deposition grids for total deposition estimates but will make the net deposition and re-emission grids available. Tim is confused by why the CMQA/TDEP estimates are so different than the CASTNET depositions and would like to have better understanding of the differences between all the methods. The main difference with CASTNET is that the MLM does not have a NH3 component.
- Donna reminded everybody that some key differences between MLM and grid based models are centered around the Ra calculation. This is particularly important to HNO3 deposition. The Rc differences can have major impacts on SO2 deposition. Gary noted that CMAQ does much better job than MLM for estimating total nitrogen deposition.
- It was commented that it would be nice to have NH3 values from each of the approaches. The biggest differences will arise from the smaller concentrations.
- Tom Butler asked if a comparison had been done between the two CMAQ versions for total nitrogen deposition with the answer being “not yet”. Donna would like to have a joint CLAD/TDEP webinar before deciding on how to proceed.

- Tim pointed out that EPA will be looking at critical load exceedance for the next round of NAAQS deliberations and EPA is on tight timeline which does not afford much time for reflection and/or consulting.
- Kristi wrapped up with concluding that TDEP will provide deposition values only from using total deposition from CMAQ. Leiming thinks we need to provide another estimate for agricultural lands.

- Correlograms
  - Used to define the radius of influence for combining observed and modeled data
  - For each chemical and season sample variograms were plotted and an exponential covariance model (with 3 parameters) was fitted using a nonlinear least squares algorithm, Covariance model was then normalized and plotted against distance. Results were still processing at time of conference
  - Suggestion from AGU meeting in Canada for use of "kernel measurements" where distance between sites is less than the true radius of influence. Spatial variability study at Coweeta will look at this for NH3, but no similar study currently for other species.
- Aerosols
  - Open-face filter pack used in CASTNET; does not have specific size cut for particulate species. CMAQ uses a modal aerosol model with 3 modes: I, J and K
  - Vd's vary by particle size. So need to know particle size to match up with correct Vd
  - Previous versions of TDEP used a fixed particle size distribution
    - pSO4 assumed to be all accumulation mode
    - pNO3 is assumed to be 80% accumulation and 20% coarse mode
    - pNH4 is assumed to be 80% associated with pSO4 and 20% associated with pNO3
  - Proposed new approach would use the CMAQ concentration ratio in the grid cell containing the site to split the CASTNET measurements into the size bins
- Base Cations
  - Base cation information provided by CMAQ but this area of the model needs improvement
  - CMAQ method of estimating the coarse mode base cation fraction uses:
    1. ASEACAT: speciation factors that are based on composition of seawater
    2. ASOIL: Wind-blown dust; speciation factors area based on coarse desert soil profiles in the SPECIATE database
    3. ACORS: coarse anthropogenic emissions; speciation factors are weighted average of these sources in SPECIATE
  - Results are hot off the press and not analyzed much at all.
  - Addition of base cations triples the number of variables and triples disk usage. So are base cations even worth the effort?
  - Uncertainty is pretty large due to uncertain emissions for model input and the large spatial variation not captured by CASTNET. Wet deposition is not as much of an issue
  - So does the uncertainty outweigh the need?
    - Response from Tim Sullivan is "Yes". Weathering adds to neutralizing capacity and if the model can be somewhat improved then it is worth doing.
    - Leiming commented that 50% is the best estimate that can be given
    - Tim: The dry to wet ratio is substantially higher in less remote areas and would like to focus more on less remote areas

- Eladio: In relation to sea salt, chloride is very important to ecosystems (according to EPA), but Tim countered that Cl- is not as important as base cations except for 20 miles within coastal areas. Canada is a different story
  - Proposal by Kevin Mishoe:
    - Do not use CMAQ base cation results until better understood. Use CASTNET/other monitoring network concentrations with CMAQ Vd's.
  - Eladio thinks it is important to have base cations presented as part of TDEP output. He is OK with proposed approach but would like to see the difference between the straight model output versus TDEP output.
  - Donna concluded that it is helpful if different agencies and program offices are made aware of what needs to be measured as it would be great to have more funding to do these measurements
- Cross-correlation
  - Meteorology affects both concentration and deposition which makes these values Correlated
  - Ignoring the cross-correlation by using weekly average concentrations and Vd's Can result in over or under prediction
  - Plan for v2015.1 for cross-correlation
    - Estimate cross-correlation coefficient using systematic sub-sample (1 in 6 days, every other year) of the CMAQ runs
    - The coefficient will be calculated from CMAQ and then the deposition will be adjusted by the coefficient

3. Update from the USDA National Institute of Food Administration (presentation by Ray Knighton via phone)

Under the Agriculture and Food Initiative Ray is managing a specific program that is asking for proposals that look at the fate, transport and cycling of nitrogen and phosphorus.

- Looking at other areas as well that contribute to agriculture.
- Specifically interested in projects that not only look at the fate, transport, cycling, but also look at ways to substantially reduce loading to environment.
- They are not looking for incremental improvement but projects that will increase efficiency of assimilation for improvement of natural resources by more than 50 percent over current levels.
- No transformative applications were received in the last year
- Also requesting for a national workshop/summit on the topic of nitrogen and phosphorus to get a handle on what is being done out there right now and the science of the current literature including international literature.Will fund up to 350K over 3 years for this project
- Standard project funding level is usually 500K over 2 to 4 years
- Both RFPs have June 10, 2015 deadline
- Overall goal is to reduce loading of reactive nitrogen and phosphorus which could be achieved by improving assimilation in the plant or animal systems or by targeting losses to the environment by remediation technologies. A multimedia approach would be best as they are looking at total system

4. Methyl Mercury and Other Chemical Constituents in Fog Water (Presentation by Peter Weiss-Penzias)

- Significant portion of precipitation on the northern California coast comes from fog water
- Surprisingly high levels of methyl Hg was found in fog water

- Seven collection sites were set up from a ship with funding by NSF; one inland site (30 km inland); Network is called FogNet
- Night time inversion along the coast is very strong; inland it is clear and warm
- This temperature differential pulls the fog inland. Redwood range corresponds with maximum fog frequency
- Dimethyl Hg exists in surface water. Gets converted to methyl mercury
- Estimated approximately 1400-1500 ng of mmHg deposition /year.
- All sites use Collett's cloud water collector; tent put up over collection apparatus
- Decline was seen in dimethyl Hg concentrations as season progressed (April through September)
- Inland site saw lowest concentrations; Humboldt site had the highest
- There is a distinct seasonal pattern controlled by upwelling
- Techniques will be improved during second year of three year grant
- Blank levels need to be better
- Bulk sample is collected over 12 hours
- Would like to pinpoint sources over the ocean; oily lipids on surface of sea water can be one of the sources
- Would these same processes translate to fresh water or is this process unique to the ocean?
- Thought to be unique to ocean from upwelling and depth of water
- Also looking at nitrogen and ammonium

5. Opportunities to Collaborate (Presentation by Eladio Knipping)

- SEARCH Network consists of 4 NADP/NTN sites in the southeast; 5 MDN sites; 3 AMNeT sites; 1 AMoN site; 3 trace element sites; and 3 NASA aeronet sites
- SEARCH provides both continuous and discrete measurements of gaseous and particulate forms of sulfur and nitrogen
- For NH3, use 24-hour denuders every 3rd day at 5-8 sites going back to 2004
- Continuous NH3 at multiple sites
- Eric Edgerton's results comparing SEARCH and AMoN data from March through December (2015?) show good agreement between the two
  - AMoN values always greater than SEARCH but within 95% confidence interval
  - Edgerton raised the issue of whether blank corrected data are used for the TDEP maps.
  - TDEP uses uncorrected values. EE recommends using blank corrected values as on the average there is about 0.16 ug/m3 on the blanks and this varies by geographic regions
  - Chris Lehmann disagreed that there is any geographic correlation, and he is looking for the source of what is on the blanks
    - Jansen: why not blank correct if response is stable?
    - Lehmann: not stable; noisy data sets. Would we really be correcting or adding uncertainty to the data set?
- SCUAM
  - Extensive measurements in Birmingham and Atlanta
  - Can host additional measurements to fill gaps if funding available
  - Both SEARCH and SCUAM have additional networks that could be similarly used to assess spatial variability
  - Both have rural counterparts that could be similarly used to assess urban/rural contrast

- New Initiatives
  - Interest in effort to estimate dry deposition of metals
  - Would fund at SEARCH sites
- New Project: Hindcasting and forecasting of emissions from 1970 onwards to 2020
- Approach: Determine trends in emissions from various sources across different regions and states; illustrate how regional trends in emissions have resulted in regional trends in pollutant concentrations; conduct CTM simulations to determine source and source-region contributions to air quality for different decades
- Trends using currently available data:
  - Emission trends by each state from 1990 to 2012 for different pollutants by source categories: CO, NH3, NOx, PM10, PM2.5, SO2, VOC
  - Ambient air quality trends at AQS sites for different time periods:
    CO, O3, SO2, NO2 from 1980 onwards
    PM2.5 from 2000 onwards
    PM10 from 1990 onwards
- Trends Using Model Generated Data (1970 to 2020)
  - Trend in contribution from following categories: emission outside USA, natural emissions, international shipping, on-road mobile, off-road mobile, EGU point sources, non-EGU point sources, area sources and agricultural ammonia
  - Trends in North American background as well as US background
- Development of US Historical Emissions
  - No long-term state-level trends available back to 1970
  - Emissions inventory methods change over time but re-building consistent inventories has not been done
  - Two difficult sectors are on-road mobile and fugitive dust
  - Most point source methodologies have not changed much over time
- Emission trends Methodology
  - Baseline 2005 emissions based on EPA's Transport Rule database
  - Use EPA's NEI trend to develop sector-specific projection factors by state for pre-2005 years and for 2008 and 2011
  - NEI trend state level not available, national level trend used together with activity data for projection factors by state
  - Petroleum and related industries required careful adjustment
- Emission Trends Results from the Midwest :
  - Focus on Midwest since this was the region with highest quantity of emissions in the US
  - SO2 emissions have dropped about 85% from peak levels in 1970 with a sharper decrease after 1990
  - NOx emissions have also dropped but since 1990 by about 55%
  - Not much of a drop for NH3
  - VOCs decreased by 69% from peak 1970 levels from controls on motor vehicles
  - CO emissions have decreased by 76% due to reduction from highway vehicles and smaller reduction from off-highway engines
  - PM2.5 emissions decreased by 2/3 due to controls on fuel combustion from various sectors as well as reductions from industrial processes and highway vehicles
  - PM10 follows a similar pattern to PM2.5
- Eladio posed the question of "How can we use emission files to do new simulations and analyses and bring all the information into the TDEP maps?
- Historical deposition estimates can be provided back to 1970 for use in ecosystem modeling even though there are differences between this effort and work

performed by TDEP group. Would these efforts be of interest to the TDEP community?

- Lear responded that there will be lots of interest in projecting backward and asked if there was a possibility of merging CAMX and CMAQ results?
- Files can be rerun with CMAQ
- Could be used for deposition modeling for CLAD efforts, but what to use for meteorology? Year specific or not?
- How to design an effort that provides historical deposition values?
- Donna knows of graduate student who developed historical estimates of emissions. Suggested looking at both methodologies and compare results to get at uncertainty since models are different, etc.
- David Gay: NADP has approved adding SEARCH data from Pennsylvania and New York to NADP database
- Jansen commented that Hg wet deposition data are already in NADP database and added that some comparisons need to be done due to different methodology for other parameters. How well do continuous measurements compare to denuders? Jansen would like a more complete evaluation including 24-hour denuders data that is run every 3rd day.
- Donna noted that there is involvement with SOAZ and that Eric Edgerton is collaborating with John Walker on organic nitrogen (ON) measurements at Coweeta.
- ON flux data from SOAS would be very helpful to TDEP
- David Gay: atmospheric Hg data from Edgerton would be very useful to add to AMNeT database
- Chris Rogers would like to know what Frontier uses the wet deposition trace Hg and trace metals data for and is it helpful? Jansen commented that there is hardly any modeling going on for wet deposition trace metals and atmospheric sources are not well understood. Edgerton has found some interesting stuff but just not presenting yet. Hard to get industry moving along these lines. Advent of regulation is a driving factor. There is a 5 year window to collect data and understand what is going on. Rubber will meet the road from the health risk standpoint.

6. **Atmospheric Mercury Speciation: Accuracy and Calibration** (Presentation by Eric Prestbo)

A. The challenge is integrating sample collectors and analyzers. As an example, in NTN the issues are:
   - Separation of wet versus dry
   - Fog? Should sensor open or not?
   - Are nitrogen species preserved?
   - How much splash occurs?
   - Does AIRMoN equal NTN?
   - How accurate is rain gauge in extreme conditions?
   - There is contamination by birds, bugs, etc.

B. Questions for automated air Hg speciation method
   - What is being measured?
   - How accurate are the GOM and PBM measurements?
   - What should be made of recent published research results?

C. What is the best method for measuring Hg speciation?
   - Eric thinks automated Hg speciation method is still the best method out there
   - Need to separate the reactive gas from the particle; denuders are often used for

atmospheric Hg measurement

- TEKRAN is an integrated method; problems with TEKRAN also apply to surface methods
- TEKRAN minimizes time for surface exchange
- Uses known and accepted method to separate large and fine particles and gases
- User can control sampling temp of all collection and transport surfaces
- Annular denuder may be customized with different coatings
- Short samples and real-time analysis maximizes sample integrity
- Hg speciation measurements are scientifically coherent

D. Problems:

- Gas/particle temperature bias suggested
- Loss of GOM from denuder in lab studies
- Conclusions suggest low bias for GOM when high RH and O3 with little or no bias in high O3, dry air
- Winston Luke doing a lot of work to this end

E. What has been and can be done to make the AMNeT automated Hg speciation system more accurate?

- Traceable Hg calibrations and performance check options
  - Automated calibration with permeation source
  - Manual standard additions at injection port
  - Validation of permeation source at injection port
  - Automated perm source standard additions with 1120
- Traceable Hg fictive-loss test options:
  - Simple: manual Hg injection upstream of the soda lime
  - Difficult: manual Hg injection at 1130 inlet
  - Automated: proposed permeation source Hg injection at 1130 inlet

F. GOM Calibration Challenges

- HgCl2 and HgBr are solids at room temp, so will adsorb to reactive and/or unheated surfaces
- Quantitative transport requires optimization for laminar flow and short residence time and/or brute force of high temp through entire, non-reactive flow path
- HgCl2 adsorbed to surfaces will convert to Hg, especially at high temp or even changing air chemistry
- Source must be stable, reproducible, robust and can be turned on and off

G. Traceable Calibration of GOM Measurements: Available Methods

- Reaction of traceable Hg; catalyzed by reactive metal surface
- Gas permeation of pure solid HgBr2 to Hg Br2 gas
- Nebulization of NIST traceable standard solution
- Manifold Spiking Research; use independent NIST traceable GOM

H. Problems with permeation for GOM Calibration

- Adsorption – loss to surfaces
- Stability
- Temperature
- Conversion
- Seth Lyman working with permeation surfaces
- Another option is to use a nebulizing liquid Hg standard
  - The challenge in this is modifying device for delivery of GOM to the Tekran Model 1130 inlet at 0.1 lpm and 20-1000pg/m3

I. Proposed Testing to Improve the Automated Hg Speciation System

- Modify inlet design and/or increase temperature
- Evaluate different AD coatings
- Perform Hg matrix spiking at inlet during sampling; will test for denuder or filter uptake
- Test Lyman's multi-species permeation source system in the field
- Work with Tekran to test the nebulizing, evaporative method to supply known GOM spikes to the sample inlet

J. How to Evaluate Surrogate Surface Research Results?
- Particles will collect on the surface
- Electrostatic attraction on plastic surface for fine particles
- Uptake of some elemental Hg, dew, and reactive compounds; uptake of 1% elemental Hg will result in huge GOM flux bias
- Uptake of fine and coarse PBM may be greater than GOM uptake
- No way to calibrate or test surface in the field
- Not representative of GOM dry deposition
- Good tool for time series and spatial differences
- Paper by Mae Gustin about to come out and should be read by all interested in Hg

K. Ion exchange Hg speciation approach has also been used. Showed a lot of promise but testing of method very difficult

L. Ion Exchange Filter Pack Method
- No particle filter assuming no collection of PBM particles; but will collect both fine and coarse PBM and other reactive particles
- One lpm flow for 14 days with low resolution; not helpful for air models
- High MDL
- No heating or temp control
- Requires storage, shipping, digestion, and analysis by skilled lab
- No field calibration

M. Nylon Filter Pack for Species Identification
- Two nylon membranes in series; not quantitative due to humidity bias
- No particle filter
- One lpm flow
- Requires storage, shipping, and thermal analysis by skilled lab
- No way to evaluate accuracy in the field

N. Conclusions:
- Use of FP membranes and surrogate surfaces have benefits but not the best tools to evaluate Hg species ID and for accuracy comparisons to the automated Hg speciation system
- Design of the method using impaction, AD, filter particulate capture and CVAFS is widely accepted atmospheric methodology and has many critical features that are needed for low-level Hg speciation. It is easy to modify the method to improve accuracy in challenging environments
- Determination of accuracy for GOM and PBM at the parts per quadrillion level difficult, but badly needed.
- Several reasonable approaches to evaluate accuracy in the field. Need funding!
- Comment by Weiss that he does not have much confidence in Tekran data as far as what he is seeing. Tekran method has lots of issues as well, not just other methods
- Leiming noted that all models over predict by about 2-10 times

7. **Mercury Dry and Wet Deposition Studies Using AMNeT Data** (Presentation by Leiming Zhang)

Presentation covered two main points:

A. Approach for estimating Hg dry deposition at AMNeT sites

B. Estimation of relative contributions of speciated Hg to Hg wet deposition

- One of AMNeT's major goals is to provide estimates of Hg dry deposition with reasonable accuracy
- TDEP sub-committee approved Zhang and Gay proposal at the 2014 NADP Fall meeting with an expected output of:
- Fluxes of GOM, PBM and GEM at all AMNeT sites
- Fluxes to each existing land use classification (LUC) within a 3-km circle of each site
- Vd's at weekly temporal resolution
- Missed flux from coarse PBM which is not monitored
- Data will come from:
  - 2-hourly concentration data from AMNeT
  - Hourly meteorological data archived from the Canadian weather forecast model
  - Land use data which needs to be generated
  - MODIS to be used for generating land use data and LAI
- Deposition algorithms will include:
  - Big-leaf gaseous dry deposition model for GOM
  - Bulk particle dry deposition model for PBM
  - Bi-directional air-surface exchange model for GEM

C. The motivation for Hg wet deposition:

- Coarse fraction of PBM is not negligible but it is not monitored in AMNeT
- Coarse particles are scavenged faster by precipitation than fine ones
- Most Hg CTMs do not simulate coarse PBM, but are frequently evaluated using monitored wet deposition data
- Most CTMs overpredict surface GOM and PBM by a factor of 2 to 10

D. Goals for Hg wet deposition

- To estimate relative contributions of speciated Hg (GOM, Fine PBM, Coarse PBM) to Hg wet deposition
- Examine factors affecting the spatial variability of the results such as particle size distribution, Hg point sources, gas-particle partitioning, site characteristics, and snow scavenging
- Provide needed knowledge for improving CTM's, making monitoring policies, etc.
- Data will be obtained from NADP, NAtChem, CASTNET and AirData
- Results to date show that GOM contributes 39-87%; FPBM 8-36%; CPBM 5-27%
- Comparison with literature shows that:
- The larger GOM wet deposition is consistent with field and modeling studies but CPBM had been considered very little

E. Model Verification and Uncertainties

- Are scavenging ratios estimated from particulate inorganic ions valid for Hg?
- Uncertainties:
  - Higher uncertainties in CPBM wet deposition results due to a lack of data on Hg

fraction in coarse particles

- Many factors affecting precipitation scavenging that have not been included in this study

F. Potential factors affecting results

- Site categories: coastal versus rural-remote versus rural-industrial versus urban locations
- On average, 46% of total Hg wet deposition in urban locations is due to PBM; greater than other site categories
- Snow scavenging: PBM>GOM wet deposition during winter at 4 locations; efficient particle scavenging by snow
- Local Hg point sources:
- No direct effect between amount of Hg emissions and GOM and FPBM contributions to Hg wet deposition
- Much larger inter-annual changes were found at sites that are distant from point sources
- Dry deposition of GOM and FPBM at near-source sites is an important factor to consider
- Wet deposition models suggest domestic anthropogenic sources contribute only 10-22% of the total Hg wet deposition in the US
- Fine PM mass fraction: FPBM contribution to wet deposition is small even when fine particles make up most of the total aerosol mass

G. Conclusions

- Total Hg wet deposition is predominantly from GOM
- FPBM and CPBM wet deposition is important
- During winter because of snow scavenging
- At urban sites because of higher FPBM in air
- At coastal sites because of efficient precipitation scavenging of sea salt
- Major factors that affect relative contributions are site characteristics, gas-particle partitioning, snow scavenging
- Despite uncertainties, study shows that CPBM contributions to total Hg wet deposition should be considered when Hg transport models are evaluated with Hg wet deposition measurements

H. Comments:

- John Jansen: coarse Hg greater than the sum of all other Hg species is not seen at the Florida SEARCH site. Asked if coarse particles can be measured with Tekran. Edgerton has worked on this but has used 2 Tekrans and has an estimate.
- David Gay: If Tekran can be used to measure coarse then would we come across other issues?
- Edgerton has argues that some of this is accounted for b his method but he would have to present. Coarse is a big part of Hg deposition and needs to be measured

TDEP Committee Meeting, April 13, 2015, Pacific Grove, California
Joint Session with CLAD

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1. **National Park Service (NPS) Critical Loads (CL) Website Content** (Tamara Blett)
   - Website has:
     - CL maps and exceedances of CL's
     - Nutrients (Nitrogen only)
     - Total Deposition
     - Meant for coarse scale identification of areas of concern
     - The link for the website is: http://www.nature.nps.gov/air/studies/criticalLoads/Ecoregions/index.cfm
   - Exceedances: divided by large ecoregions for CONUS
     - Click on an ecoregion to drill down
     - "How to Use Data" section on front page
     - Will be useful for people who are possible CL novices
     - Uses Pardo's CL values
     - Three categories of reliability
   - Overview of Table
     - Shows TDEP total nitrogen estimates, minimum and maximum CLs for each of 270 park units
   - How is this tool being used?
     - Assessing ecosystem health
     - PSD and NEPA reviews
     - Federal land management planning
   - CLs are used to select "Top 10" park resources impacted by air quality such as views/visibility, trees and shrubs, prairie and wetland vegetation, lakes, etc.
   - Next steps:
     - Develop fine scale CLs that are more realistic for park units; Donna pointed out that depositions over water are very different than depositions over land
     - Figure out how to link various CL web mapping efforts between agencies (NPS CL web mapper, Forest Service CL portal, EPA CL assessment tool)
     - As TDEP continues to refine it will be very helpful to them to know how we are developing the depositions
     - Chris Lehman wanted to know if there is a cross-reference to describe how the data were obtained
       - On front page there is a link that says what the data are that were used to populate specific page
   - When exceedances were calculated the maximum TDEP estimate for an area was used for maximum protection of ecosystem

2. **Uncertainty of TDEP Method** (Donna Schwede and Gary Lear)
   - At the Indianapolis meeting the uncertainty topic was not ready for hashing out. Might be better to hold such discussion at a time when the maps aren't changing so much
   - Gary is not sure how to characterize uncertainty for CL work
   - Some of the uncertainty information is provided in meta data
   - The question was asked whether things are resolved for some parts of the country more so than for others. For example, western sites may have much more

uncertainty than eastern sites because monitoring sites are sparse and terrain more varied.

- Kristi asked how Linda handles this issue for her report?
  - Currently a 3-tier set of criteria but moving to a 5-tier category
  - Can TDEP do something like this mathematically? Distance from monitoring site or a percent estimate due to model or measurement? On a grid cell basis?
  - Tamara brought up the other ways of estimating TDEP such as throughfall, nitrogen in lichen tissue, snow pack, etc.
  - Gary replied that it is difficult to compare CMAQ with throughfall because it is apples to oranges and it is not worth comparing it to MLM. However, lichen study might be feasible
  - Linda Geiser commented that she is correlating her lichen estimates with throughfall estimates using column resin. She found there is decent correlation for predicting lichen results from throughfall
  - Leiming used Marty's litterfall data with dry dep models and found pretty good correlation
  - Tim Sullivan thinks using distance from monitoring site for TDEP uncertainty is not a good idea since it does not account for terrain complexity
  - Tim was asked if he has done any work with CL estimates with respect to atmospheric deposition? Tim replied that deposition of sulfur and nitrogen is not used in calculation of CL estimates
  - Jason added that some of the empirical results though do use these depositions (Monte Carlo)
  - Donna wondered what the sensitivity of CLs are to varying deposition rates

3. TDEP Topics (Gary Lear and Donna Schwede)

A. TDEP Ammonia Estimates

- Plan is to finalize bias surfaces for NH3 before deciding on method for estimating N depositions due to NH3
- Will continue investigating method for merging monitoring and bidirectional model values for NH3

B. Base Cations

- Provide base cations based on monitoring concentrations and CMAQ Vd's, but will not merge with CMAQ deposition until there is a better understanding of the biases

C. Sea Salt and Non-sea Salt Sulfate

- Sea salt sulfate and non-sea salt sulfate will be added to TDEP estimates as requested by CLAD
- Wet sea salt is a more direct approach developed by WMO. Method consists of cascading range tests that compare samples' ion ratios to those in sea water. Can use sodium, magnesium, or chloride. But when this is applied to dry deposition things get much more complicated.
- The WMO approach can be used for sites within 100 to 200 km of the coast
- Will use CASTNET and SEARCH ion measurements on a weekly basis and aggregate up for annual sea salt. But have to deal with issue of bias being similar to those for base cations.
- Eladio commented that Cl- approach should not be used, but Gary said there were very few instances that Cl- formulas were used, about 5%.
- Linda Geiser noticed that map showed more intrusion in the mountains than she measured in the Columbia River Gorge. She has elemental analysis from her lichen

sites from OR and WA and reported that sulfate drops off very rapidly but Na+ carries in further. She recommends using the 100 km cutoff over the 200 km cutoff.

- Tim asked if assumption that Na+ source is solely from the sea? Gary answered yes, at least within that cutoff.
- Eladio suggested comparing Na+/Mg+2 ratio to sea salt ratios in order to track influence going inland.

D. Using TDEP for Trends

- It was commented, based on the 2014 version of maps, that these maps should not be used for trends
- However, things have improved in the 2015 maps due to consistent emission scenarios
- Donna wanted to know what happens when CMAQ is updated as it will take some time to get maps out there with more model runs. It will change N estimates and new CMAQ versions are not used to rerun for past years that have already been run with old versions.
- 2011 is new base year and will be used for bidi runs. So some comparisons can be made as to what changes happen from version to version
- Eladio says there have been requests for running the old model with the new meteorology.
- Version 5.1 though will not be run though until October and multi-year production mode will not happen until new version is tested thoroughly.
- Tim asked if correction possible based on comparisons? Donna answered “No”
- Tamara asked if this would be possible if money was available to do so?
- Donna does not anticipate having money to go back and rerun years before 2011. Any trends may be possible going forward from 2011.

TDEP Committee Meeting, April 14, 2015, Pacific Grove, California

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1. Monitoring Workshop

- A workshop was held about 5 years ago in the interest of serving the monitoring needs of CASTNET. Workshop dealt with CASTNET priorities and which direction(s) to take CASTNET in the future
  - Consequently, when $1 million was lost from the budget it was easier to know in which direction to proceed
- With declining SO2 deposition levels how do we justify network existence? NADP and SEARCH may be facing the same issue in the near future
- Reason for the workshop is to realign existing networks, but when inquiries started being made other networks did not seem to be interested or able to redirect priorities
- Workshop will cost about 50K and Gary wondering if there is any interest?
- It seems that all existing networks want to keep adding and nobody wants to cut from their programs but this is not realistic due to lack of budgets
- Workshop would include NADP, SEARCH, CSN, etc.
- Even if network managers are not interested in participating, prime users may be, but the networks managers and planners need to attend in order to hear what the users want
- Jantzen remarked that SEARCH cuts sites when budget cuts hit rather than getting rid of measurements as length and comprehensiveness of the network is very important. They also change the questions
- Each network is different with different objectives and outcomes
- So do we want to continue with the workshop idea? Kristi suggested that we should start a discussion with other networks via a conference call to flush out ideas
- Jantzen noted that CSN has just gone though realignment by cutting approximately 75 sites. We need to think about what the networks want and need. Best selling point with SEARCH has been to cite all the people that use the data. TDEP using SEARCH data has been a great selling point. Need good ideas to use the data and not be so provincial in using only your own data. Networks need users to survive.
- Spring 2016 mentioned as a possible time for the workshop

2. TDEP's Role in Mercury

- Kristi asked the question "what should TDEP's role be in the ongoing mercury discussion?
- Marty Risch replied that if both dry and wet mercury are not looked at then we can't report any reductions. Mercury would always need to be on TDEP's radar.
- There are lots of different opinions on accuracy of Hg measurements and it is best not to get involved as we do not want to take sides. But TDEP not sure how to use surrogate surfaces data in TDEP. Would NADP be interested in incorporating such data?
- TDEP will continue to host the discussion. Could facilitate a panel discussion with major Hg players
- Lei Ming pointed out that in just 4 to 5 years papers have been published from the Tekran data and that this is pushing forward the science. Have to start somewhere.
- Mark Olson said that NADP has taken a while to establish instrument accuracy and precision. If there is a better mouse trap, NADP will go there. Can do better than 30% precision for Tekran. Mark and Winston Luke will have a user meeting of all Hg

people soon.

3. Fall 2015 meeting

- There will be no time for TDEP to meet during this meeting, but can do a webinar if maps are getting rolled out
- There will be a Total Deposition Session that Kristi will be chairing. She needs six presentations. No planning discussion yet. Gary will be presenting for one of the talks
- Donna asked if there was a role for TDEP in advocating bringing back fog water sampling?
  - Gary wanted to know who would we advocate it to? But if we want to put it into modeling there is very little data according to Donna
  - Lei Ming wanted to know how we would use fog data, implying that it is not really depositing. If fog water sampling is to be done, we need the whole picture, not just bits and pieces
  - Pam pointed out that it is an important part of deposition in some places

4. The Future of TDEP

- What kind of structure do we go forward with for TDEP? What are the next steps? Do we continue with presentations on interpretation of maps?
- CLAD going through similar issue. Science Committees do have a sunset provision. Do we feel we are relevant as a Science Committee?
- TDEP is up for evaluation next spring and we need to have a reason to keep going but with proper justification.
- Kristi pointed out that maps will continue to evolve and will always provide discussion points
- CLAD is staying relevant through the FOCUS project which provides a pot of money. This may be what TDEP needs? How aggressively to pursue? This topic can be part of Monitoring Workshop
- Lei Ming working on putting out total Hg maps. The tools are there but no model.
- Canada had a workshop last month (March 2015) to kick off their total deposition program and had much broader representation than we do. They are taking a similar approach to TDEP. Canadian sites are not as dense so they have to use a slightly different approach.
- Gary is looking to add precipitation maps from Canada and Mexico. How will NADP fit into this?
- Tom Butler wanted to know if group had come to a consensus on the base cation issue with the reply that Gary will start looking at the biases of the model and we will proceed as we have with the other ions

5. Election of Officers

- The same officers were retained
- Meeting adjourned