**TDEP Committee Meeting, October 31, 2016, Santa Fe, New Mexico**

1. **Welcome and Introductions**
   - See Attendance List for list of attendees, their organization and email addresses.

2. **TDEP Committee Renewal** (Kristi Morris)
   - Kristi presented all of the TDEP accomplishments to the NADP executive committee. The TDEP committee was renewed and is operational until 2019 when the committee will be up for renewal again.

3. **TDEP Outreach** (Kristi Morris)
   - Kristi worked with David Gay on the TDEP Summary pamphlet's cover.
   - The committee will try to get the TDEP message out to a greater audience by attending meetings, conferences, etc. To this end, the National Ambient Air Monitoring Conference (NAAMC) in St. Louis was attended by Chris Rogers, Kevin Mishoe and Melissa Puchalski. A TDEP fact sheet was available at the joint NADP/TDEP booth.
   - Greg Beachley presented the white paper at the AWMA Visibility conference.

4. **TDEP 2015 Map Update** (Gary Lear)
   - New version of the maps have been posted to NADP website. The Read Me file details all changes from version to version; also describes overview of processing steps.
   - The TDEP paper has had almost 800 downloads from the NADP site.
   - The TDEP map product was published using v2016.01.
   - All CMAQ data were updated to use runs from version 5.0.2.
   - All network data were updated through 2014. Aerosol data from SEARCH are now included.
   - Vd's are now weighted by concentration for the cross-correlation between concentration and Vd. File names have been changed to reflect this change.
   - $TNH_3$ and net $NH_3$ ($TNH_3$ minus emission) deposition grids are now included. Derivative N deposition grids, such as dry and total N, use the $TNH_3$ deposition value. $NH_3$ grids were not bias corrected by using monitoring data since the relationship between concentration and flux is not linear in the model. Some comments from ensuing discussion were:
     - Net $NH_3$ deposition should be relabeled Net NH3 Reemission;
     - Some $NH_3$ emission is from processes from different time scales; should focus on what is relevant to ecosystem;
     - Map users need to understand what the ecosystem is responding to;
     - How do we quantify deposition to ecosystem?
     - Discussion concluded that Net $NH_3$ needs to be focused on.

- Maps of base cations are now provided.
- Assumption used for particle size distribution of aerosols is now based on CMAQ modal concentrations in each grid cell for the relevant model year.
- Wet deposition grids now include precipitation measurements from NTN, MDN, and AIRMoN monitoring sites. Previously, only measurements from NTN were used.
- Caveats:
    - Incomplete characterization of the wet and dry components of organic N which results in an underestimate of total N deposition;
    - CMAQ does not include magnesium from windblown dust which may result in underestimation of $Mg^{+2}$ between monitoring sites;
    - $NH_3$ data from AMoN and SEARCH are only used for model evaluation; they are not included in the development of the concentration surfaces;
    - Net $NH_3$ flux does not include emissions from point sources such as CAFO's and industrial processes;
    - Urban areas most likely not well represented since measurement sites generating data used in the method are located primarily in rural areas;
    - Since interpolation techniques inherently minimize extreme values, more variability would be expected from use of more spatially resolved observations;
    - Use of monitoring data is limited to sites and times that meet network completion criteria to ensure that measurements are representative of actual conditions. Discontinuities in temporal and spatial trends at specific locations can occur where monitoring data are intermittent;
    - Methodology used to develop wet deposition grids differs from methodology used for the NTN grids.
- Where Do We Go From Here? (Next Steps)
    - CMAQ Modeling:
        - Version 5.2beta was released October 2016. New in this version are:
            - Updated organic N
            - SOA
            - New dust algorithm
        - How Do We Proceed?
            - New model version means discontinuity which complicates trends analyses;
            - Model runs for 2013 and 2014 have not been completed with new model;
            - Unclear which procedures will be used to account for different model biases.
        - NH3
            - Spatial variability
            - Accounting for bidirectionality

        - Better use of AMoN to justify its existence
    - Other Networks
    - Who Will Continue the Work?
        - Investigate other measurement –model fusion techniques (NSF GRIP proposal?)

5. **Map Product Review** (Gary Lear)
    - Product kept to less than 20 pages but can be expanded to 24 pages;
    - Maps were reviewed individually. Some questions/issues that came up were:
        - In the precipitation map, average precipitation amounts were compared to current year;
        - The partitioning of the pie pieces in the total N deposition pie chart (page 7) have not changed much with respect to older version of maps
        - What amount of change is big deal?
        - Is the net $NH_3$ deposition map useful since we don't understand what it means?
        - The combined sulfur+nitrogen map has changed dramatically and is misleading as transitions from year to year are not represented;

6. **White Paper – Science Needs for Continued Development of Total nitrogen Deposition Budgets in North America** (presented by John Walker via phone)
    - The idea of and a draft of the white paper was first presented at the Spring meeting in Madison.
    - The purpose of the paper is to describe the most relevant research priorities and then to describe the relevance of these priorities to agency programs and national monitoring networks as appropriate.
    - Paper would be shared with other groups for prioritizing and to motivate research, facilitate collaboration, request/justify funding, etc.
    - The audience for the paper is scientists, NADP and TDEP data users, federal and state air quality managers, program managers (e.g. EPA STAR, USDA NRI, ARS, NRCS, etc.), and stakeholders (USDA Agricultural Air Quality Task Force).
    - The priority research needs (PRN's) were developed from the original TDEP Needs Table.
    - The PRN's represent core needs relevant to the TDEP mission:
        - Datasets of fluxes and concentrations in key ecosystems,
        - Speciation of deposition budgets,
        - Assessment and development of methods,
        - Ability to estimate fluxes consistently over time to assess long term trends.
    - The PRN's also represent new topic areas:
        - Source apportionment/source receptors,
        - Episodes of high deposition,
        - Meteorological modeling in complex terrain.

- The paper will be framed by a series of overarching science questions that will motivate specific research needs in four topic areas:
  1. How much nitrogen is deposited to terrestrial and aquatic ecosystems?
  2. What are the relative fractions of wet versus dry deposition?
  3. What are the most important processes by which gases and particles dry deposit to the landscape?
  4. Are national monitoring networks sufficient to characterize the magnitude and important scales of variability of wet and dry deposition?
  5. What methodological advances are needed to adequately speciate the atmospheric nitrogen budgets and to quantify air-surface exchange processes?
  6. Do current landscape to regional scale models adequately simulate deposition processes?
  7. What fraction of atmospherically deposited nitrogen is subject to regulatory control?
  8. Are methods for source apportionment of nitrogen deposition sufficient to support advancement of current regulations?
- These science questions will then spur specific research needs in four topic areas:
  1. Measured total N budgets
     - Process level studies
     - Routine monitoring
     - Methods development
  2. Modeled total N deposition budgets
  3. Source contributions to total N deposition
  4. Spatial and temporal patterns of total N deposition
- An example:
  - Over-arching Science Question: How much nitrogen is deposited to terrestrial and aquatic ecosystems?
  - Topic Area: Measured total N deposition budgets
  - Specific Research Needs:
    - Direct measurement of speciated N fluxes in select ecosystems
    - Measurements of surface chemistry/wetness relevant to fluxes
    - Relationships between throughfall measurements and canopy-scale flux measurements
    - Urban deposition measurements
    - Deposition to snow and water surface
    - Occult deposition
- Approach
  - Organization of paper led by Walker and Beachley
  - Scientific content contributed by volunteer “Topic Captains”
  - Topic Captains are responsible for:
    - Contributing to TDEP white paper

        - Conducting or following research related to a specific research need
        - Guiding work/research toward a product meaningful to TDEP
        - Engaging scientists in the topic area to encourage greater TDEP participation
        - Reporting results, new directions, collaborative opportunities, etc. to TDEP
- Topic Captains for certain topic areas and specific science needs for within those areas have already been identified. Please see presentation for topic captains that have already been assigned;
- Schedule of Events:
    - November 2016: Finalize list of topic captains
    - December 2016: Walker and Beachley will provide skeleton of white paper containing motivation, background and framework of science needs to writing team (i.e. topic captains)
    - January to March 2017: Topic captains develop sections supporting/describing science needs
        - Will have monthly calls to discuss/assess progress
    - April 2017:
        - Walker and Beachley edit for continuity/integration
        - Provide section on recommendations geared toward resource/program managers
        - Return draft to writing team for final comments/edits
    - May 2017
        - Draft white paper for distribution to TDEP members at NADP Spring meeting; goal is to have a finished document at the NADP fall 2017 meeting.
    - White paper will be summarized as a journal article for submission fall of 2017.
    - "Science Needs: sections of white paper will be periodically updated as living road map for TDEP
- Points for Discussion
    - Some feedback had already been received from Bret Schichtel regarding the overarching science questions;
        - May not sufficiently express the underlying policy to capture interest of lawmakers;
        - Another approach would be to start with a list of higher level policy oriented questions, such as:
            1. What is the RN deposition critical load in various ecosystems?
            2. Which ecosystems have excess RN deposition (merging of TDEP quantification and critical loads)?
            3. What is the origin of the excess RN deposition?

4. What control scenarios will address/resolve RN deposition?
5. How successful are the management strategies?

- An example:
  - Policy Question: Which ecosystems have excess RN deposition?
  - The Science Questions that address this issue are:
    1. How much N is deposited to terrestrial and aquatic ecosystems?
    2. Are national monitoring networks sufficient to characterize the magnitude and important scales of variability of wet and dry deposition?
    3. What methodological advances are needed to adequately speciate the atmospheric N budgets and to quantify air-surface exchange processes?

- Some follow-up discussion items:
  - Jeff Collett wanted to know how these activities will be coordinated as they are doing something similar with the USDA Agricultural Air Quality Task Force.
  - John Walker noted that emission data were not specifically identified as a science need, but that it is very important to get the emissions right. It was decided to add agricultural emissions, at the very least, as a topic and we will therefore need a Topic Captain for this item. Addition of emission information should be valuable from a policy perspective.
  - Summaries of the 'Science Needs' will be especially important as talking points with respective managements.
  - It was noted that the list has been developed by a small group of people and there may be other items important to other groups. A benefit of reaching out to other groups may result in different priorities.

**7. NPS-CIRA-CSU Reactive Nitrogen (RN) Activities** (Bret Schichtel)

- Lots of recent publications on Rocky Mountain RN Studies
- Reactive and reduced N in Smoke studies have been published by Benedict et.al. (2016)
- Reactive N Deposition Levels and Trends: Increasing Importance of Deposition of Reduced Nitrogen (Li, Y, et. al. 2016)
  - Since the 1990's wet N deposition has changed from primarily oxidized to reduced N;
  - 50-75% of inorganic N deposition is in the form of reduced N;
  - The predominance of reduced N holds when $NH_3$ bi-directionality is included;
  - After publication, several letters to the editor noted the increasing importance of oxidized N in China and organic N.
- Atmospheric Processes at ROMO: Dew as a night-time reservoir and morning source for $NH_3$
  - Most ammonium in dew is remitted and does not contribute to RN deposition;

- Dry deposition rates with and without dew are similar
- There is some evidence of $NH_3$ loss in deposited precipitation; this area needs more work.

- Source Attribution: Composition and Sources of Winter Haze in the Bakken Oil and Gas Region Evanoski-Cole et al., (2016).
  - There have been two winter/spring studies in the Bakken region; both studies have shown significant contributions from ammonium nitrate and sulfate
  - High ammonium nitrate was associated with transport from oil and gas regions;
  - Warmer periods are $NH_3$ rich and HNO3 limited;
  - Formation of $PM_{2.5}$ during extreme cold temperatures are often limited by $NH_3$ (i.e. add more $NH_3$, get more particulate $NO_3$);
  - Studies suggest that increased NOx emissions from oil and gas production is inefficient producer of PM/haze in winter and a more efficient producer of PM/haze in warner spring months.
- Continuous $NH_3$ Monitoring in RMNP, Loveland (near foothills), and Greeley (the Plains)
  - Easterly, upslope winds caused high $NH_3$ in RMNP, elevated $NH_3$ in Loveland, and lower NH3 levels in Greeley;
  - Greeley and Loveland monitoring is supported by the agricultural community and state of Colorado
- $NH_3$ Flux Measurements in 2015 (Zondlo, et al.)
  - Flux was measured for 3 weeks;
  - Some major results are:
    - Open-path $NH_3$ sensor successfully employed in sub-ppv conditions with flux detection limit around 1.5 ng/s/m2;
    - $NH_3$ flux showed dependence upon upslope/downslope conditions;
    - $NH_3$ flux showed a diurnal pattern with local emissions from morning to mid-day;
  - Some issues are:
    - Zero-point drifting associated with temperature variation.
  - Goals for 2016 Deployment
    - The sensor is deployed at the same site but it has been installed at 3 m above ground versus 1m in 2015;
    - Improve stability of the sensor at low concentrations in order to reduce zero-point drift;
    - Evaluate absolute agreement at low concentrations by comparing with NH3 instruments at the site;
    - Monitor summer flux and concentrations in the RMNP in order to:
      - Compare 2015 and 2016 data
      - Conduct source identification

        - Identify temporal patterns
    - Evaluate deposition theory and modeling
- Primary Results from 2016:Diurnal Pattern
    - High $NH_3$ concentrations reported during the night
    - $NH_3$ concentrations dropped in the early morning which may be related to deposition/dew formation; other parameters are needed
    - More data are needed for the analysis

**9. Status Update and Proposal: AMNET Mercury Deposition**

- Background:
    - Producing estimates of Hg dry deposition is one of the goals of the NADP Atmospheric Mercury Network (AMNet);
    - Important to acknowledge and accept that Hg dry deposition estimates will be an evolving science with significant uncertainties;
    - There is a valid, acceptable, peer reviewed model by Zhang, et. al., and the collaboration of Environment Canada, with which to generate deposition velocities for gaseous oxidized mercury (GOM), particle bound mercury (PBM), and gaseous elemental mercury (GEM) at AMNet sites.
- Brief History and Status
    - White paper titled *Brief Description of the Proposed Method for Estimating Weekly Dry Deposition of Speciated Mercury at NADP AMNet Sites* by Zhang and Gay was presented;
    - TDEP Ad Hoc Committee was formed and composed of three expert Hg air modelers who conducted an independent review of Zhang, et.al., Hg dry deposition model;
    - There are multiple supporting peer–reviewed publications of Hg dry deposition model including 2009-2014 AMNeT Hg Dry Deposition Estimates, Zhang et. al., (2016, ES&T in press)
    - TDEP Committee approved motion during the Fall 2014 TDEP Committee Meeting to have Hg dry deposition estimates produced by the Zhang, et. al. model;
    - The Approved Motion is:
        - TDEP supports the work of Leiming Zhang and the contribution from Environment Canada to generate and deliver to NADP average weekly Vd for GOM, GEM, and PBM for the AMNeT sites as proposed in the white paper. To be delivered with a list of caveats.
            - This work helps the modeling community to test the deposition schemes implemented in their models;
            - Moving forward with this work would stimulate further evaluation, research, and model comparisons;

- Notwithstanding all the uncertainties, it would be useful to have dry deposition estimates for the AMNet sites and the future capability to recalculate depositions as new knowledge becomes available.

- Basis for following proposal:
  - Consistent with the mission of the Total Deposition Science Committee;
  - Realization that efficient progress necessitates that the Ad Hoc Committee and advocates develop an "end product" for TDEP to evaluate.
- Proposed Action Plan:
  - Develop content for a Hg Dry Deposition webpage under the TDEP banner (following model of Total Deposition Maps webpage);
  - Webpages will not be accessible until approved;
  - There will be embedded links in both AMNet and MDN to new webpage.
- Proposed Content for the Hg Dry Deposition Webpage:
  - Update the Gay&Zhang white paper
  - Readme file for Data/Model which will contain documentation regarding AMNet data, deposition model, methods and uncertainty;
  - External review summary presentation;
  - References or links to Zhang et.al. and other relevant papers;
  - Readme file for Air Mercury Speciation Accuracy – with links to relevant peer-reviewed papers;
  - Data: weekly average Vd's and valid average concentrations values for all three Hg fractions: GEM, GOM, and $PBM_{2.5}$
- Details:
  - Observations: Weekly average AMNeT\t GEM, GOM, and $PBM_{2.5}$ values, from Tuesday to Tuesday to match MDN, will be generated for each AMNet site;
  - Model Estimates: Weekly average AMNet GEM, GOM, and $PBM_{2.5}$ Vd's, from Tuesday to Tuesday to match MDN, will be generated for each AMNeT site;
  - Calculations: Downloaded data can be used to calculate dry deposition of each Hg fraction and then combined with MDN data to estimate total deposition. NADP/TDEP will only provide data tools for total Hg deposition estimates, with use at your own risk.

**9. CLAD Update: Map Summary and Database** (Jason Lynch)]

- There have been updates to the National Critical Load Database (NCLD)
  - The deadline for NCLD v3.0 is 12/20/2016
  - Surface Water Critical Loads of Acidity contains:
    - Added TMDLs for VT, NH, and NY
    - DuPont, et. al 2005
    - McDonnell et. al 2014
    - Sullivan and McDonnell et al. NY State

        - Critical loads and target loads
        - AT Trail Study
        - F-factor, regression, dynamic model
        - Greatly enhanced meta data
    - Forest Ecosystems Critical Loads of Acidity
        - Updated and enhanced metadata
    - Nutrient Enrichment for Nitrogen
        - Herb biodiversity, Simkin et.al 2016
            - Point locations and Ecoregion I
    - Coming Spring or Summer of 2017
        - Aquatic N-enrichment, William et al.
        - Individual studies (building on Pardo et al)
        - Forest trees, Horn et al (publication dependent)
        - Lichens (?)
    - Projects Using NCLD
        - USEPA CL Mapper
        - USEPA Clark et al manuscript
        - UT Sun et al manuscript
        - US-CA Progress Report
        - CAMD Progress Report
        - INI Phelan et al poster
        - LRTAP Report
        - Columbia University student
        - Fall NADP 2016 Scientific Symposium
- Recommendations: TDEP and CMAQ
    - CMAQ = 1200 m
    - TDEP = 4134.35 m
    - 4000m ??

**10. Uncertainty Discussion (TDEP/CLAD)**

A small working group of TDEP and CLAD members will meet to discuss uncertainty and will report back at the spring meeting.

**11. Meeting Adjourned**