TDEP Committee Meeting, October 30, 2017, San Diego, California

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

2. **Approval of Spring Minutes** (Chris Rogers)
   - Minutes were approved

3. **Developing a Database to Collect Information on Flux Studies** (Walker and Rogers)
   - The database would be for modelers to use for model development, evaluation, for compounds of interest, ecosystems, processes, etc.
   - A collection of information on what flux studies have been conducted, measurements collected, methods used
   - Basically, this will be like a literature review that summarizes when, where, methods, compounds, etc.
   - It was pointed out that the literature review conducted for the Pollutant Standard includes more recent observational studies and this would be a good start for us
   - We would summarize major findings of the studies as relevant to flux measurements
   - Group present was very interested and agreed that such a database would be very valuable
   - The scope of this effort was discussed and it was decided to include worldwide studies but to limit the species to reactive nitrogen
   - The database would be used to:
     - Address TDEP methodology for the US
     - Test model algorithms under a wider range of conditions, and
     - Help other groups such as ecosystem research studies as this group is having problems with model evaluation and deposition is becoming an issue
   - Mike Bell is conducting a similar effort; so steps will be taken not to duplicate Mike's efforts while making our efforts as useful to CLAD as possible
   - Donna was recently at the Ozone Deposition Workshop and a similar effort will be undertaken by Eileen Fiori in putting together ozone data sets
   - Chris and John will put together a survey stating the purpose of this project and send it out to the TDEP listserv for people to respond with information on data sets that they are working on. A list of items we are starting with will be included in the survey.
   - Database housing for this effort is to be determined. The hope is that at some point it will be on the NADP web page
   - Survey will go out between the Fall 2017 and Spring 2018 meeting.

4. Update on CLAD/TDEP Work Group on Deposition Uncertainty (Mike Bell)

- The uncertainty issue has been an ongoing conversation between TDEP and CLAD that was again discussed in Santa Fe, NM.
- The questions raised were
  - What is the proper way to apply TDEP maps to critical loads?
  - Where and what is the uncertainty in doing this?
- Objectives of this effort are:
  1. Compare deposition measurement types and data quality/comparability;
  2. Compare deposition models to one another to understand areas that do not have similar results, and
  3. Compare deposition measurements to model measurements
- In order to achieve the first objective, data sets will be identified, spatio-temporal maps of measurements will be created, and best practices/recommended measurement types for different systems will be developed.
- Measurement Types will include:
  - IER throughfall deposition
  - Throughfall deposition
  - Snowpack measurements
  - Lichen community
  - Lichen Tissue
- Data sources to be used for this effort are:
  - Snow pack chemistry – Alpine, deep snow pack/mixed with summer IER
    - Snowpack chemistry in MORA and NOCA
    - Pacific northwest snow pack
  - Bulk deposition collectors
    - Wind River range
    - Coweeta Hydrologic Lab
    - Flathead Lake, MT
  - Ion exchange resins
    - Clow 2105
    - Root et al 2014
  - Lake chemistry
    - Pacific northwest
    - High elevation lakes in northwest
  - Lichen chemistry
    - Root et al 2014
    - Lichen Air Quality Biomonitoring Program
  - Lichen community
    - Lichen Air Quality Biomonitoring Program
- Metadata will include:

    - Timing of deployment/measurement
    - Ion concentrations
    - Observer(s)
    - Bulk deposition – size of funnel
    - Throughfall – species of collector placed under canopy
    - Number of replicates at site
- Site details will include:
    - GPS coordinates
    - Elevation
    - Slope
    - Aspect
    - Vegetation type
- Database will initially reside on Mike Bell's computer with the hope of eventually moving it to the NADP website.
- If effort proves to be functional then can expand it to international effort
- How well can total deposition estimated by these various methods compare to TDEP method estimates? How comparable are all of these values? Long term goal is to deploy the different collection methods next to CASTNET flux towers and/or NADP collection sites.
- Need to develop a list of biases/uncertainties
- Very important for TDEP steering committee to engage in issues of uncertainty and to work with CLAD.

5. **Status of TDEP Maps** (Gary Lear)
    - There has not been much progress in the last six months due to server difficulties. The old CAMD server has just been restored.
    - Annual wet deposition estimates were just made available so new maps are just getting started
    - Need a Python programmer experienced in NetCDF and raster calculations to convert TDEP scripts!
    - Since Gary is retiring he is proposing that a TDEP Maps Committee be formed. The committee will need a captain to oversee the project and committee members to tackle specific functions and algorithms. The mapping effort should not be so dependent on one individual.
    - Donna volunteered to be the captain
    - List of tasks that go into creating TDEP maps:
        1. Download and interpolate weekly ambient measurement data into rasters. Current taskmaster: CAMD
        2. Download and interpolate annual wet deposition measurement data into raster files. Current taskmaster: CAMD, but could be the PO

3. Extract layers and variables from hourly NetCDF model output files into subsetted NetCDF files. This task will migrate to a Python platform. Current taskmaster: Donna Schwede
4. Download, inventory, manage, and archive extracts in NetCDF format. Current taskmaster: CAMD, however, not publicly accessible as it is behind EPA firewall. If public accessibility becomes an issue, this task will have to move.
5. Extract hourly values from NetCDF and aggregate into weekly raster files. Taskmaster needed.
6. Manipulate weekly raster files:
    - Calculate average model bias
    - Calculate aerosol particle ratios
    - Combine weekly model and measurement raster files
    - Aggregate combined weekly raster files into annual raster file

   Taskmaster needed.
7. Plot/format maps from annual raster files. Taskmaster needed.
8. Export and distribute annual raster files. Taskmaster needed.
9. Documentation as SOP's. Taskmaster needed.

- Finding a Python script guru is high priority. Several names were put forth as people that could help with this effort: Brian Kirsner (CAL) and Baron Henderson (EPA). Since there are no updates right now what we do have will take about two weeks of a Python person's time.
- There are many other tasks than those listed here but Gary mainly concerned with how do we maintain what we currently have and how do we move forward?
- Contractor may be the best option to get this done before Gary retires.

6. **Atmospheric Deposition Analysis Generated by optimal Interpolation from Observations (ADAGIO) Mapping Project Update** (Amanda Cole)
    - This is an ECCC project for fusing model output fields and observations to produce annual deposition maps of sulfur and nitrogen for North America
    - Progress made this year includes:
        - Wet, dry and total deposition maps for 2010 (pilot year) have been completed
        - Next steps are validation with external data; addition of ozone; and draft manuscript
        - Also provided expertise at 2017 WMO workshop on Measurement-Model Fusion (MMF)
    - ADAGIO and TDEP map outputs are similar but there are some differences.
    - Created difference rasters between the two and plotted this out
        - ADAGIO results higher than TDEP at some stations but TDEP results higher in some regions

    - Regional patterns for nitrogen look very similar but there are still some differences, especially in the central valley of California
    - Differences are due to different input amounts as well as different dry deposition schemes
    - Not broken down to specifics as to which parameters are involved
    - Results should be closer at specific stations
    - ADAGIO puts more weight on measurements that are further out; the grid scale is also larger
- ADAGIO is another tool to look at overall variability and uncertainty in different methods and models
- There is a Can-Am working group that would like to create maps for all of North America
- Version 2 Highlights:
    - More consistent procedure to estimate error statistics (use of 3 sets of independent data, 3 ensemble mean)
    - Sensitivity of variance ratio (model/measurement) much smaller than version 1
    - Reduce empiricism in the methodology error stats
    - Independent validation procedure
    - Results are more consistent maps overall and variance ratio consistent with other published methods
- Comparison with IMPROVE sampler data was not feasible for independent validation due to poor agreement between collocated CASTNET and IMPROVE samplers
- Ozone dry deposition effort is in progress. This has been identified as a priority for the global MMF project in order to evaluate ecosystem impacts and atmospheric chemistry.
- Gary commented that the comparison of results between ADAGIO and TDEP was better than expected
- Useful information the audience would like to see:
    - The specifics that lead to different model values, Is it all desert areas? Alpine areas? If possible, break down into ecosystems
    - A distribution of average differences for each pixel. Is the difference between 5 and 6 or between 5 and 16?
    - Need relative contributions of reduced versus oxidized nitrogen

7. **Federal Land Managers' Air Quality Related Values Group (FLAG) Update** (Kristi Morris and Jill Webster)
    - When the CAAA was enacted there was a PSD permitting requirement that Class I areas could not be graded. Also applies to Class II areas
    - FLAG will have to get revised based on updates to regulation
    - FWS, USFS, and NPS involved in FLAG; BLM would also like to be associated with this effort
    - FLAG used to use the CALPUFF model but EPA has delisted this model

- Group thinking of using CAMx to replace CALPUFF since CAMx has capability to do future deposition and emission scenarios as well as source apportionment easier then CMAQ and decision makers are more familiar with CAMx
- Group working on coming up with a consistent set of guidelines for permit applicants such as what type of information is needed from applicants and how to consistently evaluate applications
- Group agreed that it was important to revisit FLAG
- Lots of questions still out there about this process
- Process will take several years due to lack of support
- As conversation continues, FLAG representatives will let us know when there are significant updates

8. **White Paper – Update on Total Nitrogen Deposition Research Science Needs** (John Walker and Greg Beachley)
   - Status of Document:
     - Chapters 1 (Background and purpose) and 2 (policy relevance of Nr deposition) are complete
     - Chapter 3 (science needs) is under way; all draft science needs that have been received (18 out of 22) have been incorporated into white paper; need to redraft the "Science Needs Summary". Introductions for each of the four main topic areas are under development
     - Draft of Chapter 4 (Path forward) is complete. This chapter synthesizes broad research needs that span across agencies and proposes activities to increase coordination across agencies to address the science needs that have been identified.
     - An example of Main Topic introduction was presented for Spatial and Temporal Pattern of Total N Deposition
     - Chapter 4: Examples of broad research themes that span across agencies:
       1. Evolving current monitoring networks to better resolve patterns and trends in Nr deposition for urban, agricultural and alpine ecosystems
       2. Organic N
       3. Quantifying and reducing uncertainty in deposition estimates used for CL applications
       4. Improved understanding of the linkages between agricultural emissions and Nr deposition
     - Examples of areas for opportunities for coordination and collaboration:
       1. Nr isotopes: new techniques could be used to examine samples collected under existing water quality networks through government/academic partnerships. There is also a potential for collaboration between air and water monitoring networks.

2. AMoN flux modeling: Multi-disciplinary aspect of this study provides opportunities for collaboration with other networks such as Ameriflux and NEON. The micrometeorological and biogeochemical data collected by these networks can be combined with AMoN measurements to estimate NH3 dry deposition. This effort would also involve collaboration with sites funded by DOE, NSF, NOAA, USFS, and others.

- Status of Science Needs
  - A template has been developed for review of the science needs
  - Future Research section template has been added to encourage further development of this section
  - Comments have been returned for most of the science needs that have been submitted
  - Remaining reviews will be sent out in November
  - Some outstanding issues are:
    - Topics that have not been initiated and will represent important gaps
    - No leads have been specified for following topics:
      1. Modeling evaluation and TDEP Uncertainties
      2. Importance of Deposition Episodes
- Updated Schedule
  - November 2017: Greg and John to complete reviews for all submitted science needs
  - November/December 2017: Topic captains (TC) to complete drafts of science needs still under development
  - January 2018:TCs return revised science needs
  - March 2018:Greg and John to finalize draft
  - April 2018:Review of document by TCs and other contributors
  - May 2018:Submit for NADP and agency reviews
  - August 2018: Submissions for special issue of EM
  - Potential scientific publication: Open special issue of *Science of the Total Environment* in March, close in August
- White Paper Publication: Journal Special Issues
  - EM: This publication is geared toward environmental managers
    - Publication in November 2018
    - Submission in August 2018
    - Up to 4-5 papers; 1500 words, excluding text for figures, tables, and references
  - Science of the Total Environment (STOTEN): Geared toward scientific community
    - This would be a virtual special issue
    - Timeline is flexible

- Up to 5-6 papers
- No page limit

➢ Recommend moving forward with the EM option since the low word count means we have sufficient material in most cases. Also, publishing in a science journal will require further development of topics and buy-in from TCs/lead authors

➢ Potential Paper Topics for EM:
- Executive summary of white paper
- Transference Ratios
- Urban Deposition
- Long-term Trends in Deposition and Emission
- In-canopy Source/Sink Models
- Source Apportionment

➢ Potential Paper Topics for STOTEN:
- Isotopes
- Organic N
- Satellites
- Spatial Variability of NH3 in Agricultural Areas
- Modeled N Aerosol Deposition
- Throughfall Methods
- Completion Criteria for High-elevation Sites
- Occult Deposition
- Bidi-NH3 Modeling

➢ It was recommended to consider EST as this journal has both a policy and a scientific section

➢ Expectations from TCs:
- Incorporate comments on respective sections (January 2018)
- *Science Need Summary* will end up as an abstract with clearly stated knowledge gaps
- Respond by by November 22, 2017 as to preference for which publication, commitment to bringing topic to publication requirements, and feasibility of publication schedule

9. White Paper Focus: Isotopic Advances in Understanding Reactive Nitrogen Deposition (Emily Elliott)

- Isotopic techniques can help fill gaps identified by TDEP:

➢ What are sources of atmospherically deposited nitrogen (ADN) in ecosystems experiencing exceedances?

➢ Are national monitoring networks sufficient to characterize the variability of wet and dry ADN?

➢ What methodological advances are needed to speciate the ADN budgets and to

quantify air-surface exchange processes?
    - What fraction of ADN is deposited N and subject to regulatory control?
- Stable isotopes have a different number of neutrons, thus small mass differences
    - Mass differences cause different reaction rates or “fractionations” during chemical and biological reactions
- Due to method advances mass requirements for isotopic analysis are a fraction of what they used to be
- Samples are converted to nitrate or nitrite through bacterial denitrification
- Isotopic analyses have been conducted on:
    1. Precipitation samples: NTN, high resolution storm sampling, bulk deposition (open bucket and/or resin column)
    2. Passive dry deposition samples: Ogawa O3 and NO2, USFS HNO3, and ALPHA NH3
    3. Active dry deposition: CASTNET filter pack
- NOx sources with significantly distinct isotopic composition are:
    1. Coal-fired EGU with scrubber versus without scrubber
    2. EGUs versus vehicle engines
    3. Gasoline versus diesel engines
    4. Fertilized soils versus all fossil fuel sources
- Cannot differentiate as successfully between:
    1. Biomass burning versus gasoline vehicles
    2. Lightning versus gasoline engines, EGUs without scrubbers
- Insight has been gained on controls of 15N variability from NOx sources
- NH3 sources are distinguishable and those that are significantly different are:
    1. Fossil fuels versus volatilized fertilizer
    2. Fossil fuel versus livestock waste that is measured in field conditions
    3. Fossil fuel versus human waste
- Isotope ratios are also temperature dependent. The amount of 15N-NH3 in liquid manure is dependent on temperature and percent volatilization
- Isotope ratios can change during chemical reactions
- Despite complexities, 15N/14N “fingerprints” can trace NOx emission sources across spatial scales
- Current State: Methodological advances have ushered in rich, new literature:
    - Evaluating isotope ratios from NOx and NH4 emission sources
    - Modeling the chemical reactions that can influence isotope ratios downstream of emission sources
- The Future:
    - Next wave of studies will likely apply new fractionation information to empirical observations
    - Measurement-model fusion:

    - Mass independent 17O as tracer of oxidation chemistry in CMAQ or GEOS-CHEM
    - Coupling isotope tracers with regional chemistry-transport models to predict 15N, 18O of N deposition
    - Isoscapes: spatial predictions of isotope values
- Still need to answer these questions:
  1. What is the mechanism for 18O-NO2 correlations with NOx source?
  2. How does the presence of VOCs influence reaction chemistry and isotope ratios?
- Also needed are:
  - Collaboration between networks and isotope geochemists
  - Larger pool of reviewers for the peer-reviewed literature
  - Creative funding since much of this work falls in a gap. Currently, NSF will not fund anything related to air pollution

10. Additional Business

- **Mercury Dry Deposition Estimates Update** (Kristi Morris)
  - Effort on this project is ongoing
- **TDEP Map Summary** (Chris Rogers)
  - The map summary will be electronic this year and will not be printed
- **Lear Retirement**
  - Committee thanked Gary Lear for forming the TDEP committee and all his work on producing the TDEP maps

11. Meeting Adjourned