

1. Welcome/Introduction/Overview (Greg Beachley. EPA)

- Self-introductions were skipped this year due to Zoom format of meeting. The meeting was well attended with 84 attendees. Over 60 of the attendees stayed for the entire duration of the meeting. Virtual accessibility may have boosted attendance as well as expansion of the email list with additions from the Fall TDep Ag workshop and CityDep participants.
- Review of meeting outline
- Approval of Fall 2020 Minutes
 - No meeting minutes to approve due to Fall 2019 TDep Workshop held in Boulder, CO instead of usual committee meeting.
- Motion for Nomination of TDep Co-Chair
 - A motion will be made at the end of the meeting to nominate and approve new TDep co-chair to replace outgoing co-chair John Walker.
- TDep Annual Report

Greg Beachley reviewed the 2019 TDep Annual Report including motivations for the report, 2019 committee achievements, and a TDep Project Queue that will be presented at the beginning of each TDep biannual committee meeting. The 2019 TDep annual Report is available at <http://nadp.slh.wisc.edu/committees/tdep/reports/> under "Annual Reports.
- TDep charter reauthorization document
 - Greg Beachley reviewed the items that were presented in this document that was presented to the Executive Committee for charter renewal.
- TDep Fall 2020 Meeting: Greg presented potential scenarios for handling scheduling issues and possible formats for the meeting.

2. Workgroup reports and Science Presentations

A. Stakeholder Workgroup (John Walker)

- Review of TDep Agricultural Workshop
 - Purpose of workshop was to 1) exchange scientific information relevant to knowledge gaps identified in TDep white paper: source apportionment models, emissions, spatial and temporal patterns of deposition, etc., 2) Gather input from stakeholders on knowledge gaps and research needs, 3) Identify opportunities for more stakeholder engagement, and to 4) encourage new participation;
 - A presentation summary and panel discussion summary were shown as examples of what the final workshop report will look like;
 - Timeline for completion of workshop summary was set with goal of completion by the Fall 2020 meeting;
 - Once the workshop summary report is complete, this workgroup will shift focus to

- stakeholder engagement plan and communication piece for the ag community;
- NIFA NCDC233 Proposal (Rich Grant)
 - Purpose of proposal is to link the ag community to Nr issues such as emissions, depositions, atmospheric chemistry;
 - Proposal will be submitted in September for evaluation;
- USDA ARS Soil and Air National Program Stakeholder Listening Sessions
 - This is an opportunity for stakeholders to discuss their research priorities;
 - John Walker participated on April 28, 2020 and recapped key needs identified in the TDep White Paper.

B. Measurement Model Fusion Workgroup (Greg Beachley)

- Review of why script transcription was needed of the old AML TDep application to the new TDep application
- This work is being conducted by Sonoma Tech as a subcontractor to Wood under the EPA CASTNET contract.
- Full draft code is finished and summer work will focus on error evaluation and bug-fixes.
- The main objectives of the script transcription are to 1) modernize the model code, 2) preserve functionality and consistency, 3) allow code to be modified for flexibility and extensibility of applications.
- More work will be needed by EPA/CAMD and the TDep MMF workgroup to update and modernize the TDep MMF product.

Presentation: TDep Measurement Model Fusion (MMF) Update: Progress on Python Implementation of the TDep Application (Nathan Pavlovic and Changsy Chang, Sonoma Tech)

- Modeling specifics, code streamlining, and modularized code formats were presented. Some details are listed below.
- Code Philosophy:
 - Application functionality split into modules
 - Operations within modules are performed by methods
 - Applications are controlled by configuration files (e.g. years, file paths)
- Steps for Base Model are: 1) ingest, 2) interpolate, 3) bias adjust, 4) fuse, 5) aggregate, 6) export.
- Clarified documentation includes a Readme file and use of “docstrings” for internal code documentation.
- Streamlined code structure has reduced number of files and lines of code.
- Configuration files streamline customization of application runs. This allows user to control behavior of application without changing Base Model code.
- Run options include single run, batch run and fine control run.
- Version control with git tracks changes made during development, allows multiple contributions, and is easier to distribute to users.

- Upcoming TDep MMF Outlook: Short Term
 - Grid comparison of ArcPy and AML using 2010. This will happen Fall 2020 by EPA/CAMD
 - ArcPy grids comparison for 2010 (CMAQ v5.0.2 versus v5.3). Scheduled for Winter 2021
- **Discussion:** Assessment and prioritization of future work that will be needed when the script transcription is completed ensued. The points raised during this discussion will help frame some of the upcoming grid evaluation work to be done.

Presentation: GAW's Measurement-Model Fusion for Global Total Atmospheric Deposition (MMF-GTAD) Initiative... and links to TDep (Amanda Cole)

- MMF-GTAD is one of three WMO "science-for-services" initiatives. This idea was explored 2017 and 2019 and had to be endorsed by new Research Board after WMO's restructuring. Steering committee officially appointed April 2020.
- Vision: Stakeholders will be able to access high-resolution, high-quality, global scale maps of total atmospheric deposition to meet societal needs as they relate to the environment and global sustainable development.
- Most of the interest comes from ozone. Wheat yield loss due to ozone deposition on stomata resulted in estimated financial losses of 14-26 U.S. billion dollars/year.
- Linkages to TDep: the steering committee is producing an implementation plan and state of the science overview and will focus on how to use regional models (like TDep) to develop methods for global models or ensemble models. This will involve a lot of data harmonizing or reconciling different methods/strategies. Sharing of information, data, and expertise are additional linkages.

Presentation: Update on CMAQv5.3 Timeseries Project (Kristen Foley)

- Project is a big group effort involving many EPA divisions, labs, etc. EPA/ORD/CEMM is involved with CMAQ modeling; EPA/OAR/OAQPS is working on emissions modeling; EPA/OAR/OTAQ has developed the mobile emissions model; and EPA/OAR/OAP/CAMD provides the TDep tie in and provides input to modelers on what is needed for deposition. Additional support is provided by contractors ERG and GDIT.
- Background: CMAQv5.0.2 used 2002-2012 as input for TDep. This series was also used as data layer for EPA's EnviroAtlas and for many nutrient assessments as well.
- CMAQv5.3 includes 2002-2017, addresses known biases in older versions of air quality, meteorology and emission models, and provides consistent set of emissions, meteorology, and air quality estimates and is suitable for a range of applications.
- Overview of CMAQv5.3 Modeling Effort:
 - 2002-2017 simulation over northern hemisphere (N Hemi) and CONUS. N Hemi simulations will provide boundary conditions for CONUS simulations;
 - New met and emissions inputs are being developed for N Hemi and CONUS simulations.

- Applications of Emissions and Meteorological Data
 - Met Modeling output will be used for met trends and evaluations of 'state of science' for regional and hemispheric scale numerical weather modeling;
 - Emissions model output will be used for emissions trends and inventories, trends analyses on specific emissions sources such as fires. CONUS emission inventories will be used by other groups such as Hemispheric Transport of Air Pollutants (HTAP), and ECCC's Long Term Emissions Inventory.
- CMAQ output will be used by many applications: ecosystem, health, background ozone and PM2.5, and model development and evaluation.
- Improvements on Past Time Series:
 - Met: WRFv4.1.1: Lower bias in precipitation, temperature and mixing ratios; improved estimates over high elevation locations in western U.S.; higher resolution land use data that is more consistent with CMAQ;
 - Emissions: New mobile emissions model from OTAQ (MOVES3) has emissions, activity, and speciation improvements. There is also ongoing collaboration with external groups (ECCC, CARB, TCEQ) to use the latest models and inventories.
- CMAQv5.3 versus v5.0.3:
 - Improvements in deposition algorithms provides model output that now includes land use specific deposition estimates for each land use class in each grid cell;
 - Improved ozone dry deposition;
 - Improved seasonal and diurnal patterns of ozone and PM2.5.;
 - Improvements in the vertical mixing introduced in v5.1.
- Timeline
 - July-October 2020: 2010-2017 CMAQ Modeling (N Hemi/CONUS);
 - October-December 2020: 2002-2009 will be redone;
 - 2010 CMAQ simulation is a priority and will be completed this summer.

Presentation: Update on the Canadian ADAGIO Project and TDep Comparison
(Amanda Cole, ECCC)

- The goal of ADAGIO is to produce annual wet, dry and total deposition maps for S, N and ozone for the U.S. and Canada. 2010 used as pilot year.
- Summary of the methodology was presented.
- ADAGIO versus TDep comparison is in progress and conducted in collaboration with Donna Schwede. The comparison results are expected to help define issues with approaches, provide an estimate of variability for users, and to create a mini-ensemble by combining the two approaches, and possibly others.
- In Progress:
 - 2010 versus 2016 analyses to test robustness of analysis methodology;
 - Completion of TDep-ADAGIO comparison;
 - Publication;
 - Grids of 2010 N and S deposition estimates to be publishes via Open Data;

- Resolution of issues with precipitation depth field.
- Next Steps:
 - Production of routine annual deposition maps;
 - Application to GEM-MACH reforecasts of 2000-2015 for production of time series;
 - Investigation of methods to incorporate satellite measurements of SO₂, NO₂ and NH₃.

C. TDep/CLAD Deposition Uncertainty Workgroup (Mike Bell)

- There are numerous ongoing projects the results of which pertain to future directions in understanding uncertainty:
 - Flux Measurement Database (John Walker): Still being compiled. Database will have information from different flux measurements from the U.S. and Europe;
 - Throughfall measurement Database (Mike Bell);
 - Throughfall versus Modeled Deposition (Mike Bell): Not much activity recently in evaluating data. There is a current contract to evaluate throughfall measurements against TDep data;
 - Flux versus Throughfall (John Walker): John Walker slated to start research site at Duke Forest. This will give us a better sense of what is measured in throughfall versus what is going on in the canopy;
 - Downscaling Deposition to Land Use (Jesse Bash): Looking at how to differentiate deposition to different land use/ecological categories;
 - Using Different Models to Evaluate Critical Load Exceedance (Todd Mc Donnell): NPS has contracted Todd to evaluate different deposition models against critical load exceedances. Will look at CAMx, CMAQ and TDep;
 - CMAQ Time Series (Donna Schwede); Will provide more recent time scale information;
 - AQMEII Comparisons: Donna Schwede/Christitan Hogrefe.

Presentation: Intermodel Comparison of Atmospheric Nitrogen Deposition Estimates for the Conterminous United States and Critical Load Exceedance for Selected National Parks (Todd McDonnell, ESE Environmental)

- Used lichen species richness, herbaceous plant species richness and tree growth and survival to compare deposition datasets. Comparing TDep and CMAQ for now.
- Ten national parks were chosen to look at whether CL's of nitrogen were below, above or at the CL's.
- Nitrogen deposition for 2003 and 2011 were compared for absolute and percent differences relative to TDep. Differences were evaluated based on ecoregions and land cover.
- Results:
 - Total N deposition was generally within 1.0 kg N/ha/year ($\pm 15\%$); tendency for TDep to be higher than CMAQ results; better agreement in 2011;

- Differences in dry dep are more normally distributed than for wet dep. Higher total N dep from TDep mostly attributed to higher wet dep;
- Differences are spatially variable: Western mountains near coasts (except for OR Cascades) have higher TDep values whereas eastern mountains near coasts have higher CMAQ values;
- CMAQ results are relatively higher near urban areas;
- Generally similar patterns in Total N wet deposition;
- Except for parts of California and immediate adjacent areas, results for dry N total deposition were within ± 1 kg N/ha/year;
- Total N deposition differences were evaluated using landscape characteristics (average annual total precipitation, average terrain roughness, percent landcover of agricultural, urban, forest and coniferous lands). Using absolute median difference, urban areas had higher CMAQ values, and forested regions had higher TDep values;
- Wet N deposition had higher TDep in areas with more precipitation, more roughness and more coniferous cover;
- Dry N deposition had higher CMAQ values in urban and agricultural areas.
- Conclusions: CL exceedance occurred in all parks regardless of deposition source; magnitude and spatial extent varied by deposition source; deposition source mostly relevant for lichen CL's.
 - Central/eastern parks: generally either in/out of exceedance regardless of deposition source.
 - Western parks: generally more area in exceedance when based on TDep.

3. EOS Update (Chris Rogers, Wood)

- Social media update
 - No more NADP newsletters like what was done at U of I;
 - Move to pushing out social media updates on Facebook /Twitter / Instagram / Linked In /reddit;
 - EOS officers have brainstormed about an annual calendar of relevant posts (taking into account meeting schedule, call for abstracts, etc.);
 - Catherine Collins from FWS has put together draft and will be sharing more details during EOS on Thursday;
 - TDep would be tasked with coming up with 2-4 social media posts for one month out of the year – currently May (2021). Could be recorded presentations, short write ups pointing to: photo/video/presentation, web link, 1 paragraph (2 – 4 sentences) and/or 144 characters, screen shot of post in other media.
- TDep White Paper Fact Sheet
 - Met several times dating back to September – sub-group of TDep steering

committee – Kristi, John, Greg B, Mike Bell, Chris Rogers;

- Two-page factsheet summarizing key messages from TDep white paper for quick digestion by managers, etc.;
- Kristi Morris has created a rough draft and sent out for review. Loosely based on format/structure of the National Parks Conservation Association's Polluted Parks 2019 Fact Sheet. Will contain visual elements/nice layout. Hope to have finished by fall meeting.

- TDep Flux Metadatabase update

- The initial 13 metadata submittals have been passed on to PO;
- Will be put on the TDep web site;
- When NADP web site rebuilt, will eventually add a data entry form for future Submittals.

4. NADP CityDep Subcommittee Update (Greg Wetherbee, USGS)

- This is an Ad Hoc committee
- NSF proposal in the works (Lead has been selected)
- Many sites are shutting down due to COVID-19
- Completing sampling intensives in Boulder and Ft. Collins in January 2021.
Boston studies on urban N deposition variability still on-going.

5. Additional Business

- Greg Beachley made a motion to nominate Katie Benedict as the next TDep Co-chair to replace John Walker who is moving on to become NADP secretary. Donna Schwede seconded the motion. No other nominations were put forth. The motion passed.

6. Meeting Adjourned