Total Deposition Science Committee Fall Meeting 2022

November 14, 2022 (Knoxville and online).

1. Greg Beachley (co-chair) began with welcoming remarks and housekeeping. Ryan Fulgham (co-chair) will track online chat.

2. Introductions in the room and online; list of participants appended to these minutes.

3. Recap of Spring 2022 meeting. Minutes are on website. Highlights:

    - Reviewed new website, 2021 annual report and project tracker
    - Workgroup updates
    - Thanks to presenters Luke Valin, Nate Topie, Olivia Clifton, Jeff Herrick/Emmi Felker-Quinn
    - Discussion of possible ozone deposition product

4. Annual report 2022: need to begin process of drafting soon. If you have projects to highlight in TDep Project Tracker, these are helpful to have short descriptions as resource to describe what TDep is doing.

5. Website status: Maps update (v2022.01) will be coming in the next week or so and will cover 2000-2021. Expands EQUATES time series from 2002-2017 by adding 2018 and 2019. More to come in MMF workgroup update.

6. Upcoming NADP meeting: Spring 2023 will be May 1-5 in Madison. Feel free to reach out with suggested presentations or topics of discussion

7. Nominations for TDep Secretary. TDep now has 3-year cycle of secretary to co-chair to co-chair.

    - Ryan Fulgham would like to nominate Colleen Baublitz. Colleen is a federal postdoctoral researcher with John Walker at EPA's Office of Research and Development. She is working on a framework for inferential modeling of ammonia dry deposition across the AMoN, which she will be presenting at the symposium. Given her experience with dry deposition and chemical transport modeling, familiarity with NADP monitoring data, and enthusiasm will make her a good fit for TDep leadership.
    - No other nominations
    - Vote: approximately 80% voting yes in the room, zero no votes in the room or in chat.
    - Mike Bell motions to approve Colleen as secretary, Selma Isil seconds. Motion is approved. Congratulations, Colleen!

8. EOS update - Kristi Morris, NPS

- TDep had one social media post to highlight new maps being posted (July)
- Next month would be May for posting
- There will be discussions in EOS this week regarding support for social media posts
- Fact sheet update is still pending. Current one is for 2015 model. Will need volunteers to help with this. Please contact Kristi, or she will reach out to individuals.

9. Measurement and monitoring workgroup - Bret Schichtel, NPS

- Bret is new lead for this WG, along with Kristi Morris
- What role does this WG play? NOS, TDep, other WGs all have component of measurement and monitoring activities
- MMWG can support these other groups, consolidate activities to single place
- Proposed mission: Assess and advance AQ monitoring related to pollutant deposition in support of the NADP TDep Science Committee goals as well as scientific and regulatory activities
- Proposed objectives:
    - Support national networks relevant to atmospheric deposition by providing information on emerging measurement techniques and their uncertainties
    - Identify and prioritize knowledge gaps in current direct and indirect monitoring of atmospheric deposition and promote research to address those gaps
    - Promote and support the incorporation of monitoring data into TDep products and workgroups and scientific and regulatory assessments
    - Facilitate communication between monitoring data generators and users
- Discussion - what pollutants should the WG focus on?
    - Support deposition monitoring in general but focus on monitoring programs that support the primary TDep activities and products: N deposition, O3, any remaining S dep issues, direct dry dep monitoring
    - Mercury? Already focus of MELD
    - Maintain awareness of emerging issues: P, dust, PFAS, microplastics, POPs
- Create live catalog of routine ambient and dep monitoring programs of reactive N, S P (2012 TDep project need spreadsheet)
- Identify current monitoring gaps in routine networks
- Identify alternative datasets, e.g. NO_2 and NH_3 satellite products
- Next steps:
    - WG members! Can contact Bret or Kristi if would like to join
    - First meeting Jan-Feb timeframe
    - Finalize mission and objectives
    - Develop project list with leads
- List was circulated in the room for signing up; online participants please contact leads

10. CityDep Workgroup – Greg Wetherbee, USGS

- Recent meeting:
    - Research coordination network project still planned; Alexandra Purnett leading

    - Doug Burns presented on work with White House Office of Science and Technology on methods of better coordinating AQ information between agencies, focus on human health and environmental justice. Group is meeting monthly.
    - Brainstorming on collaborative projects to inform TDep products - radius of influence of urban data; forms of N in urban areas
- David Felix presented on isotope study of NH_3 (now published in Environmental Pollution)
    - Looking at source apportionment in Colorado front range region: urban to rural transect in CO front range urban corridor
    - ^{15}N isotope signature distinct for different sources of NH_3
    - Used ALPHA passive samplers monthly samples, bacterial denitrification
    - NH_3 concentration gradient: highest at CO87 (Denver), lowest in foothills
    - ^{15}N-NH_3 spatial gradient smaller, but urban sites had higher ^{15}N due to higher proportion of vehicle contribution
    - Source apportionment model suggests highest contributions from biomass burning (2018 was a high wildfire year), vehicles; fertilizer application highest contribution in April/May and September
    - If biomass burning is removed, vehicles contribute 46% of NH_3 at WUI site, 60% at urban
    - Mitigation efforts for AQ should also address vehicle emissions of NH_3
    - Suggest to include urban AMoN sites to improve accuracy of TDep products
- Considering the new Measurements and monitoring WG, would it make sense to roll CityDep into this new WG? Point for consideration
- Questions/comments:
    - Linda G: what is the mission of CityDep? Response: assist with incorporating urban observations in TDep products, look for urban sources
    - Greg B: certainly the WGs don't always need to continue for ever and it's a good idea to reexamine how they interact. It's been helpful to organize the meetings around these WGs, have additional points of contact with the community

11. Deposition Uncertainty Workgroup – Mike Bell, NPS (Exploring uncertainty of the TDep Model: WDUM and beyond)

- WG founding questions from CLAD users:
    - What is the deposition where we see ecosystem harm begin?
    - Where are critical loads exceeded and **how confident are we**?
    - Deposition is both used for developing models of CL and applying them to evaluate harm
- Weighted Deposition Uncertainty Metric
    - Relative measure of what we think we know better/worse
- CLAD is developing a CL uncertainty categorization using 5 criteria. Should we use something similar for TDep?
    - Possible criteria:
        - Distance of a cell from closest site (NADP/CASTNET);
        - Proximity to urban areas (city >50k)
        - Range of precipitation depth values within a cell
        - Elevation range within a cell
        - Similarity of TDep and CMAQ values
        - Downscaled dry deposition variability within a cell
- Showed a first cut using first 4 criteria above, weighting all equally, as starting point for discussion. Noted that the scale is such that high values represent lower uncertainty

- Questions/comments:
    - Doug: Martin S. raised question of quantifying uncertainty/precision of network measurements. Could that feed into this effort? Mike: Yes, we want to provide overall uncertainty of TDep products for decision-makers and the measurements contribute to that.
    - [Unidentified] How do you break down the uncertainty between analytical vs. modeling, etc.? Also, can you use computational methods like jackknifing to build confidence intervals? Mike: This was an idea we were interested in for NTN sites in particular. Needs someone to look at it.
    - Jesse: could satellites be used to provide additional gradient info? NH_3 and NO_2 data are available. Mike: yes, could be used for the relative contribution part. Greg B: This was brought up in WMO MMF meeting – inverse distance weighting leads to "circles" that may not be realistic, so better capturing spatial gradients is desirable.
    - John W: Quantifying uncertainty is a daunting objective; need to consider how we express uncertainty to users as we move forward, and try to be consistent with CL metric approach. Mike: also need to consider the range of values depending on the stakeholders, e.g. in the west there are different scales, wilderness vs. urban-adjacent
    - Amanda: is the idea to combine these criteria with WDUM? Mike: Yes, this started as a way to modify the WDUM. Can finesse, e.g. applying precipitation range criteria to wet deposition particulary, etc.

12. Measurement-Model Fusion Workgroup – Greg Beachley, EPA

- A lot of the QA work completed, so can move on to more fun projects that have been on the list.
- Updates since Spring meeting:
    - Outreach:
        - Summary from Kristen Foley for ORD public webinar
        - Released v2021.01 maps in July with PDF summary, documentation
        - Will release v2022.01 maps in November (completed). Corrections not included with this version, just 2018-19 EQUATES.
    - Product development:
        - Annual site inclusion table
        - Intermediate products, grid statistics, individual site impact info --> policy decisions, uncertainty
        - Identified corrections that will be implemented in 2023 (bias corrections, new radii of influence)
    - Improvements:
        - Script for running aggregation on ORD remote server which speeds up run time
- Work in progress/planned:
    - Scott Riley, EPA, assisting with routinization and QA
    - Outreach:
        - Obtaining DOI, distributing scripts on GitHub
        - Manuscripts on script transcription, regional trends comparison
        - MMF fact sheet revision
        - Collaboration with stakeholders e.g. deposition uncertainty
        - Ozone deposition pilot study for WMO MMF-GTAD with Jeff Geddes, Bo Wang
        - Bring back annual maps summary report?
    - Product development

        - Incorporate fixes identified in v2023.01
        - Strategy to handle loss of sampling in 2022
    - Improvements:
        - Incorporate CMAQ wet deposition
        - Urban site radii of influence
        - Use AMoN NH_3 data (see Colleen Baublitz presentation Thursday)
- QA protocol: long-term goal to improve and routinize these
    - Automatic analyses such as trends, site completion, summary stats for weekly grids
    - Site completeness table summarizes number of weeks (requested by users). Unsure where to include, format so email Greg if you have requests
    - Comparison of EQUATES and Tdep trends can highlight issues with model
    - Comparison of v2021.01 (old CMAQ) and 2022.01 (EQUATES) TDep products
        - Increase in NH_3 due to increased emission inventory (20-30%)
        - Smaller decreases in base cations, NO_3
    - Mothballed CASTNET, AMoN, NTN sites will have significant effect on TDep trends
- Questions/comments:
    - Greg W: for mothballed sites, would those that have minimal impact on TDep maps be left closed? If so, would new sites be possible where TDep would most benefit? Greg B: If new sites were on the table, that would certainly be a consideration. Other factors as well.
    - Colleen B.: What's causing the difference in 2018-2020 NH_3 using the new EQUATES runs compared to the old TDep? Jesse speculated could be due to effects of temperature, surface wetness, on the evasion; availability of acid gases for partition to particles. Kristen Foley confirmed emission estimates were different.

13. WMO Measurement-Model Fusion for Global Total Atmospheric Deposition update – Amanda Cole, ECCC

- MMF Science Symposium September 19-21
    - State of the science of MMF, including other air quality applications, precipitation
    - Guidance from users on potential global products
    - Panel discussion key messages:
        - A number of techniques are being used for other global products (AQ, precipitation depth) and for deposition on regional scales. There's a need for global deposition product.
        - Will need to evolve with the science, especially dry deposition advances
        - A diversity of user needs, e.g. spatial and temporal resolution, identified
- Steering Committee meeting
    - Shared updates on regional projects, internal sub-projects, collaborators
    - Will first look at evaluating existing routine global model output with a view to making these available first
    - Continue data gathering, screening, preparation
    - Preparing for potential sponsor meeting for ongoing resources
- Questions/comments:
    - Greg W.: on the monitoring side, we have collocation between NADP and CAPMoN. For other networks, is there an opportunity to engage internationally to compare other networks other than the lab only? Amanda: This would be a great idea. The initiative itself is focused on providing a service, but there are other groups within WMO that could push for this.

14. Stakeholder workgroup - John Walker, EPA

- One of main focuses is to better interact with agricultural community
- Stakeholder engagement plan was developed 2021/22 and intent is to update annually
- Focus for last year on developing stakeholder engagement workshop, building on 2019 workshop
    - Intent is to invite presentations from agricultural perspective
    - This is now planned for 2023
- New member Ian Rumsey
- Will also be exploring new activities to add to plan
- Project led by Dan Miller (next presentation) is example of engagement they are trying to foster with agricultural research community

15. ADAPT: A USDA Multi-Location Project Monitoring Ammonia Deposition Near Animal Production Sites – Dan Miller, USDA

- USDA Agricultural Research Service traditionally performs research mostly on NH3 emissions
- Nitrate contamination of ground water exceeding drinking water standards is an issue in rural areas, e.g. Nebraska. Associated with high cancer rates, expensive to treat the water
- Debate on animal vs. crop sources to the water
- Local N budget (soil inputs to groundwater, leaching) can assess impact of local activities to deposition. Deposition from atmosphere typically small compared to fertilizer BUT would like to quantify impact of nearby animal production facilities
- ADAPT: Ammonia Deposition near Animal Production Team:
    - Jacek Koziel, April Leytem, Dan Miller, Philip Moore, Kyoung Ro, Phil Silva, Mindy Spiehs, Steve Trabue, Heidi Waldrip, Bryan Woodbury, Peter Vadas, John Walker
- Objectives are to encourage collaboration to measure NH_3 deposition, standardize measurement and modelling approaches, refine estimates of N input to livestock-adjacent landscapes, constrain CMAQ
- Harmonize data collection so it feeds into STAGE model seamlessly (meteorological data, biogeochemical inputs, NH_3 measurements)
- 3 initial sites selected:
    - Iowa cropland near swine production housing
    - Nebraska seasonal wetland near cattle feedlot
    - Texas rangeland near cattle feedlot
- Running footprint model to determine good meteorological sites
- Need additional support for modelling (postdoc) and equipment
- Advice welcome on setting this up from experts in making these measurements
- Suggest AMoN sites could be good future locations for additional study
- Questions/comments:
    - Kristi Morris: National Park Service works with producers for Rocky Mountain NP study. Any contact with these producers to do a study in CO? Dan: we any don't have ADAPT contacts there, but would be interested in collaborating. Kristi: I could invite you to quarterly meeting to start making these connections. Dan: That would be great. Some of the conditions from the TX site may be quite similar to CO front range

16. Ozone deposition CLAD working group (WG6) – Jeff Herrick, EPA

- WG has formed and held a couple of meetings, led by Jeff, Kris Novak, Emmi Felker-Quinn
- 45 researchers interested, including some in Europe
- At EPA, driven by secondary NAAQS
- Most discussion is around the concentration standard, W126
- Deposition-based metrics don't have a lot of data from ecologists linking to effects
- Will meet in room 400A at 10:00 tomorrow to discuss critical levels, potential for collaboration with TDep

17. TDep pilot project on O3 deposition – Bo Wang, Boston University

- Goal is to apply TDep methodology to O_3 in the U.S. with view toward expanding globally, in support of MMF-GTAD initiative
- Pilot: estimate 2010 O3 deposition using TDep V6 scripts
    - Weekly average concentrations from sites in US and Canada from hourly data compiled by ECCC
    - EQUATES output for O_3 concentration and deposition velocity provided by EPA
    - Next step is to calculate O_3 radius of influence as in Schwede and Lear 2014
    - Then will complete interpolation, bias adjustment, flux calculation
- Additional project to develop a framework for offline O_3 deposition velocity calculation for global flux
    - Evaluate sensitivity of flux estimates to inputs such as land cover, leaf area index, meteorology
    - Example: plant functional type-specific deposition velocity calculations
- Questions/comments:
    - Greg B.: is it you or Jeff who will present this at AGU? Bo: I will have a poster
    - Jeff H: what is meant by plant functional type? Bo: I've just started running these scripts provided by another team; I believe it's derived from the satellite land cover data but can confirm later
    - Nathan: as far as implementation, will you modify the existing TDep scripts and add ozone or will it be a separate module? Bo: first will use offline scripts to trial 2010 and see if the result makes sense, can look into integrating with TDep later

18. Discussion on existing and new projects – Greg Beachley leading

- Where do we see the ozone deposition topic going, and how can TDep contribute?
    - Amanda: Would it be helpful to have the O3 deposition fields from TDep to help with developing flux-based metrics? Are there specific plant types that are of interest?
    - Tomorrow's CLAD WG6 meeting will be a chance to further discuss ideas
- Potential for Tdep collaborative project, e.g. apply for USDA NIFA grants?
    - Initial approach to NIFA regarding types of grants generated questions about what TDep would like to do
    - Greg W.:

        - there may be opportunities involving minority-serving institutions, since there is specific money set aside for these
        - NIFA funding needs to have a university recipient so this would involve partnering
        - Radius of influence of CAFOs on TDep grid might be of interest to USDA. Could we build on ADAPT, which is looking in fairly close proximity to sources, to do a transect further out? This could help clarify interpolation radius and use these near-source data appropriately. Could even build in isotopic component to separate urban vs. agricultural source influences.
    - Rich Grant: building on what Greg W. was saying, what is defined as urban? Small towns that are still areas of vehicle emissions could be used and could be USDA funded if embedded in agricultural region
    - Greg B.: perhaps we could get a smaller group together who is interested in fleshing this out more and potentially applying for grant
    - Greg W.: lots of expertise in this group, and institutions that could collaborate (CSU, Purdue, Texas A&M, Pitt, Boston, others). Some of the grants are quite substantial.
    - Amanda: Do we know the timeline for the grants? Greg B: they are annual, so have some flexibility as far as whether we apply this year or next, etc.
    - Greg B: This seems like it has potential. Propose to have a small group flesh this idea out and discuss again in spring

19. Short summary of TDep-related sessions and posters at the Science Symposium – Ryan Fulgham

20. Greg B. motion to adjourn, second by Greg W. End of meeting.

In-person attendees:

Greg Beachley, USEPA
Amanda Cole, ECCC
Rodolfo Sosa, U. of Mexico
Greg Wetherbee, USGS
Nate Topie, WSP
Kevin Mishoe, WSP
Doug Burns, USGS
Jeff Collett, CSU
Jesse Bash, USEPA
Todd McDonnell, ES Environmental
Mike Bell, NPS
Becky Dalton, USEPA
Catherine Collins, USFWS
Ian Rumsey, USEPA
Yijia Dietrich, USEPA
Melissa Puchalski, USEPA
Selma Isil, WSP
Nathan Pavlovic, Sonoma Tech
John Jansen, Southern Company
Ross Edwards, UW
Rick Saylor, NOAA
John Walker, USEPA
Linda Geiser, USFS
Kristi Morris, NPS
Colleen Flanagan-Pritz, NPS
David Gay, NADP PO
Noelle Dieppe, USGS
Mark Kuether, NADP
Jason Lynch, USEPA
Justin Coughlin
Chris Clark, USEPA
Jeff Herrick, USEPA
Anne Rea, USEPA
Colleen Baublitz, USEPA

Online attendees:

Ryan Fulgham, USEPA
Bo Wang, Boston U.
Kulbir Banwait, ECCC
Russ Bullock, USEPA
Kristen Foley, USEPA
Bret Schichtel, NPS
Chris Rogers, WSP
Cheryl Sue, ECCC
Hazel Cathcart, ECCC
Tom Butler, Cary Inst./Cornell U.
Naomi Tam, Alberta Environment
Yuan You, ECCC
Jian Feng, ECCC
Jim Renfro, NPS
John Offenberg, EPA
Irene Cheng, ECCC
Jason O'Brien, ECCC
Dan Miller, USDA
Mauro Cortez Huerta, UNAM
Yayne-Abeba Aklilu, Alberta Environment