TDep Spring Science Committee meeting – 11 May 2021 (1100-1600)

1. Welcome (Greg Beachley, Lead TDep Co-Chair)
    - Shared and walked through full agenda
    - Reviewed highlights from Fall meeting 2020, including minutes; website status; 2020 Annual Report
    - TDep Project Queue changed to Project Tracker and Relevant Publications (to increase awareness of TDep activities and foster collaboration)
    - Highlighted following examples of projects:
        - In progress:
            - Fact sheet published
            - Lichen tissue study
            - Downscaling nitrogen deposition model
        - Outlook:
            - Incorporate EQUATES into TDep MMF
            - Test NADP total N / total P wet deposition sampler
        - Future ideas:
            - Measurement bias – NCON
            - Incorporate CMAQ wet deposition into TDep MMF
            - Urban deposition proposal
        - Request for projects to be posted on the web site
2. Fall 2021 meeting proposal (Greg Beachley)
    - Since TDep conflicts with CLAD workshop, MELD, and NOS and is broken up into two sessions, TDep Leadership proposed Tdep hold a virtual Fall 2021 meeting one week prior to the in-person NADP meeting with informal, in-person follow-up ("working lunch").
    - Advantages include virtual being a good format for TDep, easier for travel-restricted people to attend, allows for unbroken meeting with no conflicts.
    - CLAD members appreciate Leadership making space for CLAD and increasing engagement with the CLAD workshop.
    - Further discussions possible during joint committee meeting on Thursday, 13 May 2021.
    - No objections to plan for virtual Fall meeting were voiced, will plan on Virtual meeting.
3. Anticipated Fall 2021 TDep meeting topics
    - Approve TDep Leadership document
    - Elect new TDep Secretary
    - Final project summary of new MMF + EQUATES
    - Downscaling presentation and others
    - Progress on Agriculture Stakeholder Engagement Plan
    - Request for suggestions for future topics or presentations
4. TDep Leadership document
    - Document distributed to TDep mailing list beforehand
    - Since TDep is growing, Leadership has created a document to better define roles and procedures for TDep Leadership.
        - Document is modeled on CLAD leadership structure

    - Creates Leadership TEAM to involve secretary in co-chair meetings → helps to expand leadership
- Defining terms of Leadership will make positions more attractive and potentially create more leadership turnover
- Leadership proposed to proceed in an orderly fashion (secretary → vice co-chair → lead co-chair). Creates opportunity for growth and smoother transitions between Leadership positions.
- Proposed 2-year tenure as co-chair (1 year as Vice Co-Chair, 1 year as Lead Co-Chair)
- Any member can be nominated by a TDep member and can be re-elected
- Steering committee to include advisory committee, Leadership team, past co-chairs, workgroup leads, EOS representatives, and representatives from NADP-funding agencies
- Steering committee members may join by accepting invitation from current SC members.
- Document lays out procedure for adding / removing SC members as well as explanation of duties.
- Workgroup roles:
    - Formation requires statement of objectives, timeline for meeting them, list of resources, and active and committed leader
    - Provide update at biannual meetings
    - Lead needs to present intent to continue workgroup every 2 years or be dissolved
    - Not too formal, but implementing *some* structure
- Comments / edits requested by July 1, 2021
- Will move to approve by Fall meeting 2021 and post on website

5. Nominations for TDep Secretary are now being accepted!

WORKGROUP UPDATES

6. CityDep (Greg Wetherbee, CityDep Workgroup lead)
    - CityDep needs energy and a specific project(s) to bring everyone together.
    - Draft mission statement read out
    - Leora Nanus, Pam Tippler, and others working on NSF proposal to create a research coordination network. NSF feedback asks for incorporation of more public health components. Leora intends to submit while on sabbatical.
    - Greg Beachley made motion to approve CityDep as a TDep workgroup, John Walker seconded, and members approved with a vote.
7. SPARROW update (Greg Wetherbee)
    - SPAtially Referenced Regression On Watershed attributes (SPARROW)
    - Documented by Schwarz, Alexandre, and Smith in a USGS document
    - Control points needed to rein in relative contribution areas in deposition maps (why urban data isn't included in the maps
    - *CityDep+TDep could work on including urban data, but include some artificial control points in the raster to rein in the radius of influence*
    - In South Platte River basin, small fraction of atmospherically deposited N is from urban sources, but in some places, such as adjacent forested sites nearby, it's significant.

- Take home message: SPARROW uses TDep raster products → raster interpolation control is a problem because both urban and other deposition products are needed. Calibrated SPARROW models are available from USGS, but knowledge and skill are needed to run them.
- Greg Beachley suggested using an experimental raster that would allow for scenario analysis by modifying the ArcPy script. This could even be done with lichen measurements.

8. Atmospheric N deposition in the Chesapeake Bay watershed (Douglas Burns, Atmospheric Environment paper)
    - Data accessible via two references by Hopple et al. in the Atmospheric Environment paper.
    - Provides a similar measurement-model fusion approach using data from the Chesapeake Bay watershed to what Greg Wetherbee showed for the South Platte
    - Similar datasets about manure, fertilizer, and other point sources available and can be used to compare with deposition.
    - Chesapeake Bay data covers ~100 years and is publicly available. Could be compared with TDep's dataset.
9. EOS (Kristi Morris, NPS)
    - TDep fact sheet is on the TDep website and has been shared on the official Twitter twice.
    - Kristi requests suggestions for how to further distribute the white paper:
        - Communication materials should be included in packages for agricultural stakeholders
        - Would like to see as a news listing / feature on the NADP home page
        - Request for TDep attendees to like and share NADP content on social media
        - Factsheet already went out on social media pages and was one of the more popular posts
        - Katie Blaydes will highlight on Thursday
        - How to disseminate materials like the factsheet to educational groups?
        - EOS should have more detailed conversation about how to reach educational groups
        - Possible to send factsheet to federal agencies, including wildlife services in particular and the State of California
    - Graphic designed used for factsheet will be in talks to design for an NADP work up → discussed further on Thursday
    - Many figure color schemes will be problematic for the red-green color-blind. Several papers and websites shared for addressing figure creation.
    - Kristi suggests that NADP works to become "508" compliant, like NPS
10. Deposition Uncertainty (Mike Bell, NPS)
    - Working to have a workgroup meeting for a while but hasn't been able to put one together.
    - WG-4 deposition uncertainty:
        - How does uncertainty in deposition models and measurements impact critical load calculations and exceedances across the US? Where do discrepancies occur?
        - Showed weighted deposition uncertainty metric (WDUM) US map
    - Throughfall deposition analysis:
        - Lead by Leora Nanus
        - Compares measured values from throughfall and bulk IER collectors to TDep and CMAQ model outputs at 60+ sites across the western US
        - Project will move east and incorporate snowpack collectors

    - Thimonier et al., Atmospheric Environment 2019, is doing a similar study and the workgroup wants to work with them to understand how the researchers are evaluating their models.
- Using lichen to describe deposition in the Pacific Northwest:
    - Have lichen plots across forested areas in Washington and Oregon
    - Want to use tissue analysis to estimate N deposition gradients
    - Improve understanding of N fallout rate
- Downscaling deposition to land cover type:
    - Working with Jesse Bash to downscale from 12 km to ~30 m grid sizes using different land cover types
    - Want to look at specific locations, such as Shenandoah National Park, to determine whether using finer grid scale impacts critical loads / exceedances
- Deposition in complex terrain:
    - John Walker is working with UK researchers on this project
    - How does deposition uncertainty impact critical loads / exceedances in areas where grid cells have >250 m change in elevation?
    - Sensitive habitats in mountainous vs non-mountainous areas
    - Most exceedances occurred in complex terrain and may be a bias
    - Lots of mountainous terrain in the Western US
- New CMAQ time series (EQUATES)
    - Led by Kristin Foley
    - How do the updates impact critical loads?
- Comments / Questions
    - Donna Schwede and colleagues have looked at Nooksack basin using 4 km runs with land-use specific deposition + source apportionment. Would be nice to compare these with lichen data.
    - The way that deposition is modeled is very different from what a throughfall collector and even what lichen see. Deposition models are based on flux studies, which are different from throughfall measurements.
    - Throughfall at Duke Forest is moving forward in the summer. Will measure throughfall in the hardwood and pine canopies to explore differences in canopy type. Will compare canopy scale Nr flux measurements to throughfall numbers.
    - Greg Wetherbee asks if TDep or IER is a more representative measurement. According to Stuart, IERs miss the stomatal uptake, which is 30% of total deposition in the San Bernadino Mountains.
    - Donna Schwede pointed out that comparisons with throughfall/IER measurements are inconsistent with the modeling algorithms used for deposition and should be kept in mind for the comparison.
    - Further discussion at CLAD meeting on Wednesday @ 2 PM

11. Stakeholder workgroup (John Walker)
    - Develop stakeholder engagement plan:
        - Motivation: “Improving current understanding of the role of agriculture in Nr deposition was identified as an overarching need.”

    - Held TDep workshop in Fall of 2019, which brought together scientists and stakeholders to explore linkages between agriculture and Nr deposition to engage more closely with the ag community
    - Working on a draft of the plan using an EPA document as a template (background, purpose and goals, identifying stakeholders and partners, engagement activities, and timeline)
    - Working to identify stakeholders and engagement activities
    - Document should be short (<10 pages).
    - Defined stakeholder as "Any entity that can contribute to and benefit from a better understanding of the role of agriculture in Nr deposition."
    - Need most engagement in the NH_3 emissions component.
    - Engagement activities include recruitment, communicating, and collaboration
    - Goal to have plan ready by Fall meeting
- Questions / comments:
    - John Walker indicates that long-range transport and source attribution would fit in with Atmospheric Composition category
    - Greg Wetherbee suggests agricultural stakeholder attendees be invited to attend the Network Sustainability meeting on Friday morning.
    - Unclear if any linkages exist between NPN and the agriculture community. John Walker suggests there may be ties relevant to LTAR.

12. Update on NCDC sources and fate across the landscape (Rich Grant)
    - NCDC development project approved as NC1213 (Hatch project) called Sources and Fate of Ammonia across the landscape
    - Same objectives as Ag Stakeholders: better understand emission, deposition, and transport
    - Projects are not funded but provide an agricultural research station to assign a certain fraction of the Hatch dollars they receive to the project.
    - Goal is to expand agricultural community engagement.
    - Examples of what the project wants to accomplish:
        - *Understand and quantify NH_3 emissions from ground-up and top-down:*
            - improve understanding of NH_3 emissions to climate and surface variables,
            - improve national inventory of emissions,
            - increase awareness of producers of NH_3 losses,
            - improve products from satellites and chemical transport models,
            - improve routines in models
        - *Characterize NH_3 deposition:*
            - Relationships between NH_3 transport and deposition
            - Critical loads of NH_3
            - Awareness of NH_3 in the atmosphere
        - *Transport and fate:*
            - Where significant NH_3 emissions in PM2.5 come from agricultural sources
            - Sensitivity of PM2.5 to changes in NH_3 emissions from agricultural sources
            - Model estimates
    - Proposed timelines for project are available
    - Questions / comments:

    - Rich Grant clarifies that those who wish to be involved must self-advocate, the group does not have the means to bring people in
    - Jesse Bash (EPA) volunteers to participate as a modeler, Brett Schichtel knows a modeler at NPS that would like to be involved
    - David Gay offers to set up / host next meeting for this group via NADP
13. U.S. Agricultural Air Quality Task Force overview (Greg Zwicke)
    - Task force is a federal advisory committee established under the 1996 farm bill due to congressional concern over scientific basis behind air quality and agriculture
    - Task force provides advice and recommendations to U.S. Secretary of Agriculture
    - Functions on 2 year charters, last renewed in July 2020
    - Membership selected January 2021 and the first meeting scheduled for late June 2021 (meeting ~2-3x per year)
    - NRCS chief is chairperson, members selected by Secretary of Ag to include agricultural producers, researchers and scientists, ag industry representatives, and members of the health and regulatory communities. Task force also has representation from EPA, ARS, NIFA, and USFS
    - List of current task force members presented
    - Questions / comments:
        - Article from the Washington Post about agriculture and air quality shared
        - Task for has not met in 4 years, climate is of renewed interest, animal agriculture has been of interest historically, focus of the task force depends upon the current membership
14. Proposal to form Measurement-Monitoring workgroup (Katie Benedict, Los Alamos National Labs)
    - Fall meeting survey indicated interest in Measurement-Monitoring workgroup
    - Survey to be sent out to Spring meeting attendees to probe interest in this workgroup
    - A lead for the Measurement-Monitoring workgroup is needed.
15. Stability of nitrogen species in weekly precipitation samples (Amy Sullivan, CSU)
    - Tested buckets versus bags, refrigerated versus frozen storage, and filtered versus unfiltered samples
    - Collected weekly samples in Rocky Mountain National Park with 4 co-located NCON samplers (2 bags, 2 buckets)
    - Sample preparation and analysis performed at Colorado State University
    - 60 mL of precipitation samples were filtered using 0.2 micron PTFE syringe filter
    - Samples frozen and refrigerated for up to 4 weeks
    - Precipitation pH 5 – 7.5
    - Filtered samples do not show total nitrogen losses like unfiltered samples in either refrigerated or frozen samples
    - Filtering does not appear to change total N concentrations
    - No bias apparent between bags vs buckets; however, buckets show higher blanks than bags for total N and NH_4^+.
    - Freezing unfiltered samples decreases losses, but not as much as filtering samples.
    - Neither filtering, refrigerating, nor freezing has noticeable effect on NH_4^+ and NO_3^-.
    - Length of time in sampler, composition, pH, and bag or bucket appear to play a small roll
    - Questions / comments:

    - Filtering samples would be challenging in the field, but easy to do in the lab according to Amy Sullivan
    - No data for filter blanks available although John Walker has seen organic nitrogen on filters used in past experiments

16. Estimating sources, sinks, and fluxes of reactive nitrogen and sulfur within a mixed forest canopy (Zhiyong Wu, EPA)
    - Part of the Southern Appalachian Nitrogen Deposition Study (SANDS) 2015-2016 EPA
    - Goal: estimate vertical flux and concentration profiles of reactive N and S, identify dominant sources/sinks, and link the sources/sinks to specific ecosystem compartments
    - Vertical velocity skewness is important at Coweeta, which has complex terrain. While the Eulerian model can account for skewness, the Lagrangian approaches cannot.
    - Upper canopy is the strongest deposition sink, but all levels of the canopy were sinks for Nr and S (except for NH_3)
    - Questions / comments:
        - Rich Grant suggests a method to account for skewness in vertical velocity with the Lagrangian model although contends that Lagrangian approaches are better close to vegetative surfaces.
        - LAI not accounted for in the Eulerian model, which is only based on concentration profile and temperature
        - Paul Makar would like to know what happens if model assumes more sparsely distributed trees
17. Measurement-Model Fusion workgroup (Greg Beachley)
    - Current version is Arcpy v5.1
    - Improved script transcription by:
        - Including correction of errors
        - Modernization of calculation methods
        - More translatable grid formats (newer projection, grid size)
    - AML vs Arcpy direct comparison of 2010 grids shows good agreement despite differences
    - Differences, including “rainbows”, “bands”, “thatching”, “bullet or ghost holes”, and “spots” have been identified, tested, and explained by improvements.
    - Conducted experiments to try and understand differences between base cations, Cl^-, and SO_4^{2-}
        - Improvement in SO_4^{2-} by including corrected raw hourly CMAQ SO_4^{2-} dataset
        - Possible inconsistency between Arcpy and AML in processing ions in addition to the difference in aggregated weekly ions data. This is currently under investigation.
    - Conclusions of Script Conversion Comparison showed
        - Excellent agreement for wet deposition grids (>90% of values within ±10% and >98% within ±25%).
        - Good agreement for dry deposition grids for N and S compounds (> 50% of values within ±10% and > 87% within ± 25%).
        - Minor bias toward AML for HNO3, NOy, N
        - Poor agreement for dry deposition of base cations, Cl needs more investigation
    - Peer reviewed manuscript is underway, which will differentiate the method from Schwede and Lear, 2014.
    - Impacts on critical loads study conducted by Mike Bell using v4.0

    - Minimal changes for deposition between most grids (< +/- 1 kg ha^{-1} yr^{-1})
    - Two areas, one near Los Angeles, showed significant increase. LA basin was a known area of TDep underprediction.
    - At low end of deposition range, 9 areas lost exceedance of the lichen critical load
    - At high deposition range, 4 areas gained exceedance and 4 lost exceedance.
    - Issues with edge effects persist
    - Overall number of exceedances similar between Arcpy and AML despite some changes
    - New improvements in dry deposition of SO_4^{2-} and S will help
    - Deposition regions mostly occur in Appalachian Mountains
- Kristin Foley's group reformatted output from CMAQv5.3 with output from new Arcpy model allowing for successful runs.
- CMAQv5.3 runs for 2010-2016 are ready to run, 2017 complete by May 2021, and 2002-2009 by early September
- Goal to run 2020 Arcpy+CMAQv5.3 for Fall 2021
- EPA ORD plans on a 2018 run
- Scripts will be published to EPA GitHub site

18. EQUATES (Sarah Benish)
    - EQUATES supersedes CMAQ time series (ECODEP), is a unified set of modeling data across all applications (2002-2017)
    - Uses new meteorological modeling, new inventories, and more
    - Main updates for EQUATES include CMAQv5.3.2 from v5.0.2, incorporates the northern hemisphere, WRFv4.1.1 from v3.4, northern hemisphere CMAQv5.3.2 for boundary conditions from GEOS-Chem
    - Some disagreements between models, but lots of changes were made
        - Both models underestimate wet deposition and concentration ammonium
        - Year-to-year normalized mean bias for NO_3^- is more consistent for EQUATES
        - Changes in N deposition are driven by meteorology, emissions changes, and chemistry changes between models
        - Expansion of organic nitrogen and ammonia in EQUATES
        - Similar annual total sulfur deposition, and a low bias in sulfate wet deposition persists
    - Hope to release everything by October 2021
    - Questions/Comments:
        - Comparisons are needed between trends in ambient data to assess variable model performance
19. WMO MMF (Amanda Cole)
    - Update on the Global Atmosphere Watch (GAW)
    - MMF-GTAD is 1 of 3 GAW science-for-services initiatives
    - Goal is TDep-like products but on a global scale
    - Initially focused on nitrogen, sulfur, and ozone and client-focus
    - Proper implementation plan completed January 2021 (Kanakidou)
    - Overview/motivation paper submitted March 2021 (J. Fu)
    - Single year global maps – method development and proof of concept – now underway at Boston University (J. Geddes with ECCC support)
    - Data harmonization strategy underway at NILU (W. Aas) with WMO support

- Currently looking for stakeholder engagement consultant (similar to what John Walker is doing with the Agricultural Stakeholders Workgroup)
- Questions/Comments:

20. AQMEII-4 (Paul Makar)
    - Current status of the fourth phase of the Air Quality Model Evaluation International Initiative
    - Past studies focused on specific modeling systems and depositions totals
    - Deposition remains a crucial process in the species budget of any AQ model yet has not been systematically evaluated across multiple regional AQ modeling systems
    - Systematic analysis needed of individual and combined impacts of different representations of resistances, deposition media, land use, and meteorological conditions, on simulated total deposition
    - Goals:
        - Assess the deposition processes in regional scale models
            - Diagnostic evaluation
            - Why do differences occur?
            - Impact of different land types and land type databases
        - Assess variability of deposition estimates
        - Assess the different methodologies
        - Assess range of variability for estimated critical loads and exceedances
    - Two activities:
        - Regional model intercomparison: Identify variables to be requested (harmonization of nomenclature, harmonization of land use categories, which variables and parameters best represent equivalent deposition-related pathways)
        - Point model intercomparison
    - AQMEII provides common set of input emissions and boundary conditions
    - Each group provides meteorological field simulations
    - Each model operates on its "native" resolution, amalgamated, and submitted on common grid with 0.125 degree spacing.
    - Each model provides output at specified set of monitoring locations
    - Gas-phase deposition algorithms requested *in detail*
    - Models include:
        - COSMO / MUSCAT (TROPOS Leipzig)
        - GEM / MACH (ECCC)
        - WRF-Chem (UPM, IASS, NCAR)
        - LOTOS / EUROS (TNO)
        - WRF / CMAQ (EPA, Univ. Hertfordshire)
        - ECMWF / IFS / CHIMERE (CIEMAT)
    - Observation sites:
        - Auchencorth Moss
        - Borden Forest
        - Bugacpuszta
        - Easter Bush
        - Ispra
        - Harvard Forest

    - Hyytiala
    - Ramat Hanadiv
- Uses effective conductances and effective fluxes
- Gases – SO_2, NO_2, NO, HNO_3, NH_3, PAN, HNO_4, N_2O_5, organic nitrates, O_3, H_2O_2, and HCHO
- Particles – net dry flux for particle sulfate, nitrate, ammonium, total carbon, elemental carbon, base cations, sea-salt, crustal materials, and PM2.5
- Ions – wet fluxes of HSO_3^-, SO_4^{2-}, NO_3^-, NH_4^+, base cations, TOC, and precipitation
- Technical note for activity 1 submitted to ACP
- Questions/Comments
    - Asking participants to really document their modeling schemes. Sometimes people say they are using the same scheme, but they're really using *their own* version or implementation. AQMEII-4 will be really important to document these differences.
    - Will be interesting to look at models that use the same scheme if they have different results and use AQME to determine why the results are different

21. Motion to adjourn (Greg Beachley)
    - Seconded by Donna Schwede