Update from TDep Science Commitee

Greg Beachley

CASTNET SUMMIT 2019

DURHAM, NC

TDep

National Atmospheric Deposition Program

Total Deposition Science Committee

Mission is to:

- Improve estimates of atmospheric deposition by advancing the science of measuring and modeling atmospheric wet, dry, and total deposition of species such as sulfur, nitrogen and mercury
- Provide a forum for the exchange of information on current and emerging issues within a broad multi-organization context including atmospheric scientists, ecosystem scientists, resource managers, and policy makers
- Committee includes participants from federal agencies, academia, state government, private industry
- Committee and collaborators developed a white paper on the state of the science and research needs for reactive N deposition to prioritize committee activities

Outline

- No 2019 Fall TDep meeting
  - due to TDep Agriculture N Workshop
  - Newsletter update to listserve
- TDep White paper and on-going efforts
- Workgroups Structure and Updates
  - Stakeholder Workgroup (StaWG)
  - Measurement Model Fusion Workgroup (MMFWG)
  - Deposition Uncertainty WG
  - Representatives for Education & Outreach Subcommittee (EOS)
  - potential host for Urban deposition committee (CityDep)

White Paper: *Science needs for continued development of total nitrogen deposition budgets in the United States*

Background (Sections 1 & 2)

- NADP/TDep
- U.S. air regulations relevant to Nr (NAAQS, Regional Haze Rule)
- Critical loads and ecosystem effects

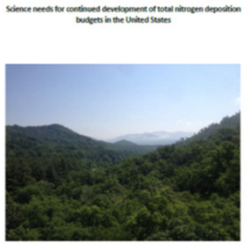
Nr deposition research topics and knowledge gaps (Section 3)

- 48 co-authors from multiple agencies, academia, and other stakeholders
- 19 different specific scientific topics relevant to Nr deposition
  - Summaries of current state of the science
  - Identified key knowledge and data gaps
  - Identified future research needed to address gaps

Examples of overarching research needs where enhanced coordination between stakeholders can help meet these needs (Section 4)

- How do we increase coordination across stakeholders to address the science needs that have been identified?
- Three key research themes discussed:
  - *Understanding the linkages between agricultural emissions and Nr deposition.*
  - *Evolution of monitoring networks to better characterize trends and patterns of Nr deposition*
  - *Quantifying and reducing uncertainty in deposition estimates for critical load applications*

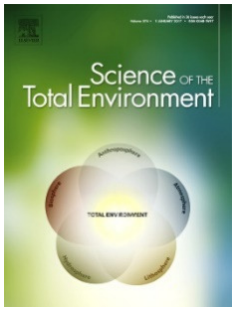
White paper on Nr deposition



http://nadp.slh.wisc.edu/committees/tdep/reports/nrDepWhitePaper.aspx

National Atmospheric Deposition Program
Total Deposition Science Committee

July 2019 issue of *EM* magazine



Special issue of *Science of the Total Environment*

All soon to be available on NADP TDep website!!!

White Paper related projects and on-going efforts

- Incorporation of relevant research priorities into ORD planning
- Monthly (3rd Wed at 2pm ET) seminar series organized by National Park Service
  - Lead authors summarize their specific scientific topic included in White Paper

Please reach out if you are interested in these webinars! (next up Oct 16th)

https://nadp.slh.wisc.edu/committees/TDep/webinars/

- Workshop at upcoming fall NADP meeting (Nov 4th):
  - *Connecting Stakeholder and Science Perspectives to Better Understand the Linkages Between Agriculture and Reactive Nitrogen Deposition*
  - http://nadp.slh.wisc.edu/nadp2019/TDepworkshop.asp

- Fact sheet on N deposition White Paper is in progress (EOS)
- TDep project queue and bibliography (Overall and MMF product)

Formation of Workgroups Structure

Motivation:

- Increase structure and organization within TDep promote collaborative work
- Distribute workload and make projects more accessible
- Get more accomplished between meetings

Current TDep Workgroups:

- Stakeholder Workgroup (StaWG; Lead: John Walker)
- Measurement Model Fusion Workgroup (MMFWG: Lead: Greg Beachley)
- Deposition Uncertainty (Lead: Mike Bell)
- EOS representative (Kristi Morris, Chris Rogers)
- *discussing possibility of CityDep (Greg Wetherbee) giving update at TDep meetings*

Stakeholder Workgroup

Objectives:

- Increase communication across scientific communities (i.e., atmospheric chemistry, ecology)
- Create new opportunities for collaborative research by promoting the inclusion of deposition science in grant programs
- Advance the integration of TDep science needs into existing research programs across stakeholder groups
- Facilitate communication among program managers within stakeholder Agencies and user groups

Current Projects:

- Ag N Workshop
- Participation in USDA North Central Regional Development Committee Project developed by Rich Grant and colleagues: '*NCDC233 Sources and Fate of NH_3 Across the Region*'
- International Deposition Uncertainty Workshop (still on table for 2021-2022?)

TDep Workshop: *Better understanding the linkages between agriculture and reactive N deposition*

Logistics:

- One-day workshop on Monday, 11/4/19 in lieu of fall TDep meeting

Objectives and Outcomes:

- Combine science and stakeholder engagement
- Exchange of scientific information relevant to TDep mission and knowledge gaps identified in Nr white paper
  - Advancement of research to meet those gaps
- Gather input from stakeholders on science needs and opportunities for engagement with TDep
  - Better coordination with stakeholders
- Stimulate new participation in TDep

TDep Workshop: *Better understanding the linkages between agriculture and reactive N deposition*

Products:

- Workshop report for NADP
- Journal article summarizing state of the science
    - Geared toward agricultural community
    - Should be distinct from white paper and STOTEN/EM articles
- Stakeholder engagement plan for TDep working group

TDep Workshop: *Better understanding the linkages between agriculture and reactive N deposition*

Format:

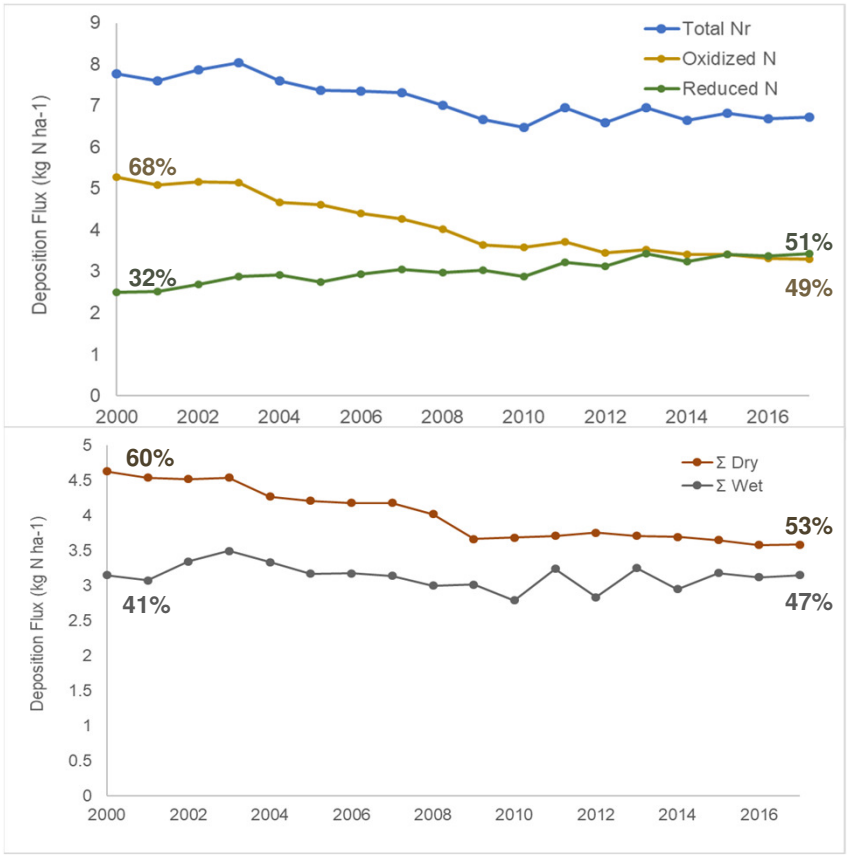
- Morning is three science-focused sessions:
  - Spatial and Temporal patterns of Nr
  - Emissions of Nr
  - Modeling and Source Apportionment of Nr
- Afternoon focused on two stakeholder engagement sessions:
  - Federal and state agency
  - Non-profits & commodity groups
- Sessions consist of two (science) and three (stakeholder) 15-minute invited presentations followed by a 40-minute panel consisting of speakers and 2 to 3 additional invited panelists
  - Panel members not giving platform presentations will be allotted time to described their interests/issues

Measurement Model Fusion (MMF) Workgroup

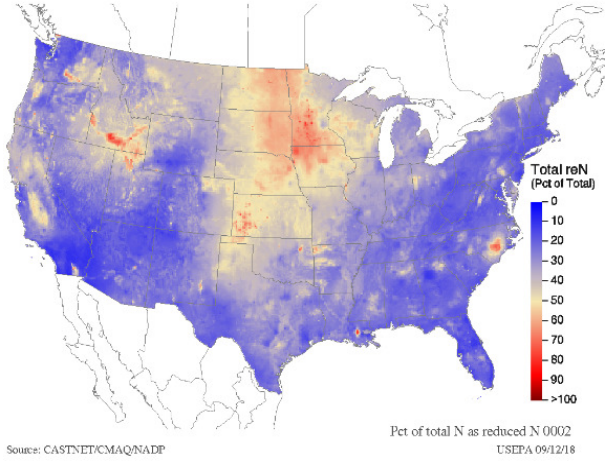
Held Kick-off meeting Sep 12th, 2019

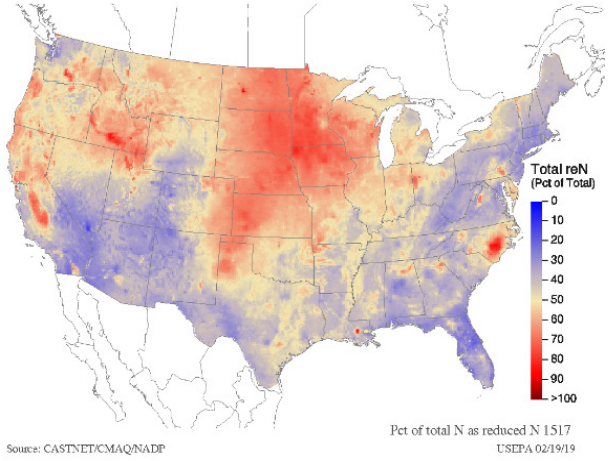
- Decided on Quarterly meeting framework (supplementing if needed)
  - Spring and Fall meeting will be (~1-mo) prior to TDep biannual meetings
    - Prep updates
  - Summer meeting will be focused on preparation of the Annual TDep maps run
  - Winter meeting
- Discussed plan for the TDep Product updates and script conversion
- Approved Workgroup Objectives and went through to breakdown to specific tasks
- Created a specific MMF Task list with some prioritization
  - Began assigning leads on specific tasks

TDep MMF Trends 2000 to 2017



TDep trends in Nr deposition flux for total Nr, its oxidized and reduced components, and grouped by wet and dry processes (kg-N ha-1).



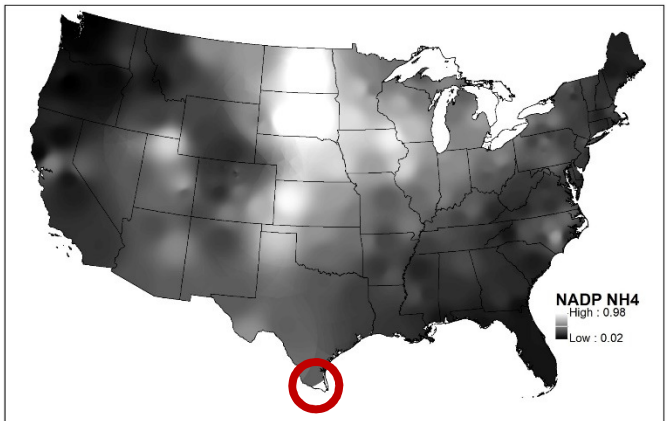


- Not much change from 2016 to 2017
- Major shift in total Nr deposition from NO_y to NH_x dominated
- Subtler shift from dry to wet.

MMFWG Objectives and Specific Tasks

Objective #1: *Caretakers of the TDep MMF grids and product output*

- *Grids*
  - *Quality assurance (e.g. 2017 maps South TX missing)*
    - *TASK: develop a routine for error-checking grids*
  - *Comparisons and assessing MMF performance*
    - *TASK: generate and review annual grid comparisons*
    - *TASK: Create product interpretation document?*
- *Documentation (descriptions of version years and archive handling)*
  - *Communicating errors & map "recalls" (e.g. the 2002 N=5 week averaging issue)*
    - *TASK: Log of versions, errors & artifacts, and fixes*
    - *TASK: Add statement on uncertainty of grid-cell values (and sub-grid variations) to product documentation?*



Beeville TX03 failed completion criteria #3 ~60%

- *Images*

  Ensure user satisfaction with current image products (.png and .jpg)?

  Hope that new script will allow easier customization

- *Maps summary*

  Current purpose is a summary snapshot of the grids (Keep)

  Potentially add any more info (interpretations or description of key changes or features)? (see Grids Tasks)

- ~~*Published studies*~~

  Perhaps members could be more involved in studies using the product (Out of scope of the workgroup? See product interpretation document task)

MMFWG Objectives and Specific Tasks

Objective #2: *Ensure that TDep MMF stays at the State of the Science*

- *Stay updated and log current research*
  - *TASK: Update Measurement Model Fusion Bibliography with relevant MMF studies*
  - *TASK: Update TDep Project Queue*
    - *List of relevant MMF work that group members will be on*
    - *Related to White Paper project tracker*
- *Identify, prioritize, and improve issues with the TDep MMF model*
  - *Summer MMFWG call for annual maps run preparation*
  - *TASK: Maintain desired list of improvements*
- *Communication with CMAQ team and other MMF groups*
  - *TASK: Identify relevant groups and assign points of contact*
    - *NO_x/SO_x/PM secondary standard (R. Pinder, EPA OAQPS)*
    - *NADP wet deposition MMF (B. Larson, NADP)*

Objective #3: *Field questions on the TDep products*

- *Serve as point of contact (email is listed on outreach materials)*
  - *Document the questions and fixes and add to log (Obj #1 Documentation Task)*
  - *Distribute questions to who can handle them*
  - *Ensure we drop fewer questions*
  - *TASK: Explore tool like FAQ in documentation or CMAQ forum (https://forum.cmascenter.org/)*

TDep Product Updates and Plan

- *2017 Maps summary completed*
- *2018 maps to be run with CMAQ v5.0.2 in AML (in progress; Fall 2019)*
  - *Expect comparison summary slides*
- *2010 maps rerun with ArcPy (Summer to Fall 2020)*
  - *Comparison with 2010 CMAQ v.5.0.2 AML;*
    - *discuss optimum performance metrics (outine in SOW) and report needed*
- *2010 maps rerun with CMAQ v5.3 in ArcPy (Winter 2020-2021)*
  - *Full CMAQv5.3 times series (2002-2017); expected in 2021 Q1*
  - *Comparison with 2010 CMAQv5.0.2 ArcPy runncluding any differences in (ArcPy/AML scripts)*
    - *discuss optimum performance metrics; including differences in ArcPy/AML scripts*
    - *any outputs necessary?*
- *2000-2019 maps run with ArcPy and CMAQv5.3 (Spring 2021)*

Script conversion

Map reproduction and consistency: recode the AML script using without significant modifications to ensure consistent deposition estimates for trends assessment.

Code and model flexibility and extensibility: open-source code and easier scripting structure to allow for easy modification for improvement and for custom applications (e.g. NOx/SOx secondary standard).

Good opportunity to accomplish both, but latter may result in significantly increased resources…

Some potential script conversion specifics

Streamlining of procedures, file structure and data storage, and redundant protocols.

- e.g. bring parameter definitions out to a universal input file rather than buried in scripts

Modifications to input data

- Currently pre-processed in ORACLE database, expand to include hourly data and 1 in 3 network data.
- Improve on the temporal resolution of wet deposition data (currently only available for annual data)

Modifications for different measurement model fusion techniques.

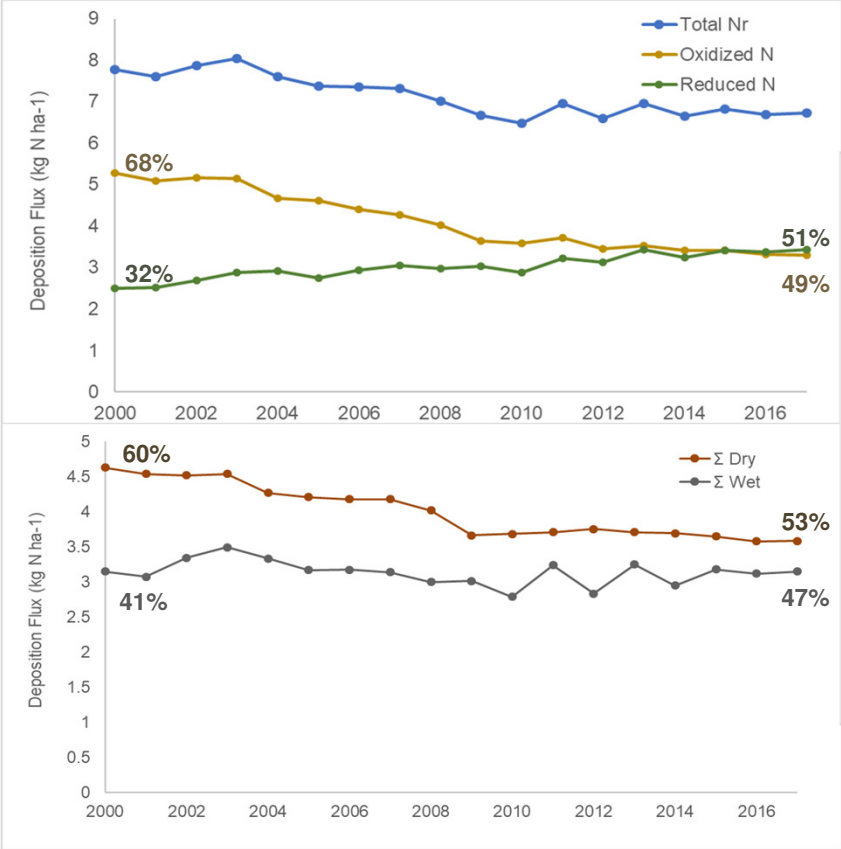
- Geo-spatial interpolation methods (radius of influence)
  - Satellite grids perhaps as constraints
- Bias-adjustments
  - Land-use specific based on ecosystems

Modernization and flexibility of output data

- *Tool to export grid data nearest to entered coordinates*

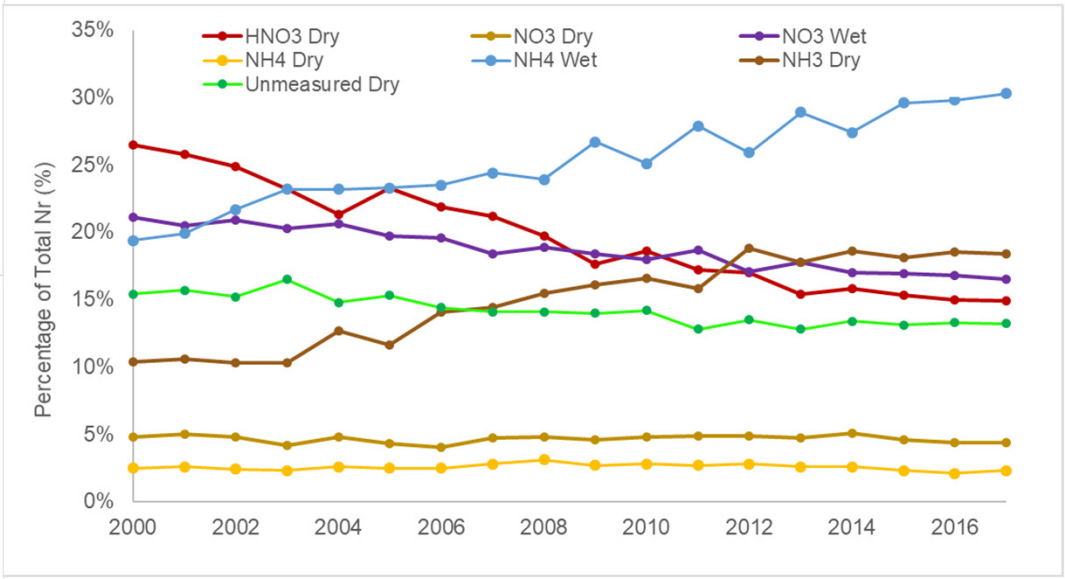
… hope to identify more improvements and prioritize them in Measurement Model Fusion Workgroup sessions

TDep MMF Trends 2000 to 2017



TDep trends in Nr deposition flux for total Nr, its oxidized and reduced components, and grouped by wet and dry processes (kg-N ha-1).

What is driving these shifts in terms of components?



TDep trends of Nr component deposition as a percentage (%) of total Nr deposition flux.

- Large increases in wet NH_4 (NADP) and dry NH_3 (CMAQ)
- Large decrease in dry HNO_3 (CASTNET) and wet NO_3 (NADP)

Deposition Uncertainty Workgroup

Objectives:

- Understand the uncertainty in measurements and models for deposition estimates
- Assess deposition measurements (bulk precipitation collectors, IER resin columns, snow pack, and lichen tissue)
- Evaluation of deposition model estimates (CMAQ, TDEP, CAMx, and ADAGIO) and comparison to measurements to assess the spatial variability of uncertainty
- Developing a framework of comparability of CLs developed from different sources

Current Projects:

- Weighted Deposition Uncertainty Metric (WDUM; Walker et al., 2019; TDep White Paper) and applying to near CL exceedance areas.
- Evaluation of how using different models (CMAQ, TDep, CAMx, and ADAGIO) impacts the exceedance of CLs in Class I areas (NPS-led).
- Downscaling deposition model data to land use type to develop more spatially explicit deposition data (EPA-led)
- exploring possible studies comparing throughfall deposition samplers at Coweeta (IER vs traditional) along with flux measurements next year.

Representatives for Education & Outreach Subcommittee (EOS)

TDep communication/Outreach items:

- Monthly (3rd Wed at 2pm ET) seminar series organized by National Park Service
    - Lead authors summarize their specific scientific topic included in White Paper https://nadp.slh.wisc.edu/committees/TDep/webinars/
- Posting pdfs of White paper related articles (AWMA & STOTEN) on TDep web
    - Related to TDep project queue and bibliography
- Developing FACT Sheet on White Paper
- Newsletter update to listserve
- Year-end Annual Report