Critical Loads of Atmospheric Deposition (CLAD) Science Committee

October 2, Fall 2012 NADP Meeting, Portland, ME

NOTES

10:00-10:05 AM Welcome (Rich Pouyat & Jason Lynch)

The 41 Participants introduced themselves: Claire O'Dea (USFS), Rich Pouyat (USFS), Cindy Huber (Focus Project management, NADP Contractor), Jason Lynch (EPA), Tamara Blett (NPS), Ann Mebane (USFS), Charles Driscoll (Syracuse), Doug Burns (USGS), John Sherwell (MD DNR), Clara Funk (EPA), Donna Schwede (EPA), Dan Johnson (WESTSTAR), Habibollah Fakhraei (Syracuse), Colin Fuss (Syracuse), Kris Novak (EPA), Berkeley Almand (CU Boulder), Ginger Tennat (EPA), Randy Waite (EPA), Jennifer Phelan (RTI), Salim Belyazid (BCCAD Sweden), Ralph Perron (USFS), Harold Sverdrup (Lund University, Sweden), Ellen Porter (NPS), Tim Sullivan (E&S Environmental Chemistry), Robin Dennis (EPA), Chuck Sams (USFS), Gary Lear (EPA), John Ray (NPS), Tim Sharac (EPA), Krish Vijayaraghavan (Environ), Tom Butler (Cornell), Eladio Knipping (EPRI), Allen Van Arsdale (EPA), Jon Kachmar (TNC), Rich Scheffe (EPA)

Phone: Scott Lorey (Adirondack Council), Jeff Herrick (NCEA), Tonnie Commings (NPS), Georgia Murry (Appalachian Mountain Club), Chris Clark (EPA), Jack Cosby (UVA)

CLAD was the first science committee formed under NADP approximately two years ago, after being an ad-hoc committee for several years.

10:05-10:45 AM FOCUS Update (Jason Lynch, Cindy Huber, and Rich Pouyat)

A. Report on FOCUS status (Huber)

FOCUS (Focal Center Utility Study) is a project of CLAD that was initiated in the fall of 2010. FOCUS followed the guidance of UNECE to assemble a national critical loads database; the first version was completed in the spring of 2011. The Phase I report was presented in the spring of 2012; Tamara Blett is leading the way on a publication/report. A work plan was created for FOCUS Phase II to improve and refine the database. Goals included expanding and improving the existing database, making the database more widely accessible, bringing together scientists and professionals to improve the database, describing and reducing uncertainty, identifying information gaps and prioritizing how to fill gaps, and identifying and defining database-related needs. Phase II work is in progress, expanding and bringing in new people and ideas.

The FOCUS timeline was reviewed: The database was developed by March 2011. Detailed documentation of the critical load (CL) database version 1 was completed in April 2012. The Phase I report was completed in September 2011. Phase II work plan completed in June 2011. Phase II projects were proposed and accepted at October 2011 CLAD meeting. Work groups organized were launched over the winter of 2012 and are currently active.

Work groups (and current status) include:

- Work Group A: base cation (BC) weathering and acid neutralizing capacity (ANC) leaching for simple mass balance (SMB) model to estimate terrestrial critical loads of acidity – methods summary and recommendations from Work Group to be discussed during CLAD afternoon session;
- Work Group B: nitrogen (N) leaching, N immobilization, and detnitrification for simple mass balance (SMB) model to estimate terrestrial critical loads of acidity – N immobilization has been discussed;
- Work Group C: assess current knowledge and data linking soil chemistry and vegetation response and provide recommendations on critical thresholds for simple mass balance (SMB) model to estimate terrestrial critical loads of acidity – literature review underway/group convening this fall;
- Work Group D: improve CLs of nutrient N for epiphytic lichens – new ecoregion CLs expected by March 2013;
- Work Group E: improve empirical CLs of nutrient N – project underway, project approach presented to NADP science symposium;
- Work Group F: improve surface water CLs and uncertainty – one conference call; and
- Work Group G: maintain and expand the CL database – detailed documentation has been completed, protocols and mapping ideas will be discussed today.

FOCUS Phase I was completed. Phase II is in progress, but it is doubtful that all objectives will be met by spring 2013. We propose extending the Phase II timeline and initiating a "call for data" to update the national CL database. We are making progress, especially given that these are voluntary workgroups.

B. National Critical Load Database (Lynch)

The national CL database was developed to unofficially submit to a UNECE Call for Data. Improvements have been made to the original version before release. Corrections have been made and the database is being transitioned to a 4km grid. Most of the GIS work has been completed, and mistakes have been corrected. Issues are 85-90% complete, and our goal is to complete by November 1. The database will go into a 2-week review process where data contributors can review and verify information. Adjustments will be made, if necessary. We hope to post database on NADP/CLAD website by December 1, or on a collaborative website. There may be three separate databases (surface water CLs, terrestrial CLs, nutrient N CLs) for easier downloading. Posting GIS shape files can be difficult because of file size. We are working to create a template shape file or geodatabase that links to Access databases. A procedure has been created for submitting data to the database. We only want information that can be made public. The review process will ensure that the person who submits data can review its incorporation into the database, as well as internal review, to minimize mistakes.

C. Future Directions (Pouyat and Huber)

We've come a long way over the past three years, on volunteer time! Thanks to everyone for helping us get this far!

Workshops: We can potentially get workshops funded to help move forward. The Powell Center is funded by USGS and headquartered in Ft. Collins. The purpose of a Powell Center workshop grant is to aid in the synthesis of available data, bringing together scientists to address various questions. Proposals are due in April. Powell Center workshops are held in Ft. Collins with staff to help and support database aggregation. Funding pays for a post-doc to oversee the project, as well as money for travel to workshops. The post-doc would probably be located there. There can be several meetings (at least one face-to-face to launch). We will look to the FOCUS work groups for ideas and potentially leadership in applying for a Powell Center grant. For a Powell Center application, a USGS scientist must be a co-lead. Tamara Blett explained that we need to develop a proposal to submit to the Powell Center this winter. The FS is looking for some funding to add to the effort which could increase chances for success.

Chris Clark and Edie Allen received a Powell Center workshop grant in late January 2013, aligning with Linda Pardo's work. They are examining vegetation and biodiversity response along N gradients – candidate datasets include FIA P3 vegetation data and others. Chris Clark explained that proposal preparation process for the Powell Center was not that onerous.

Another opportunity is the Research Cooperative Network grant (funded by NSF). Money is provided for scientists to travel and meet face-to-face. In an existing, already funded grant, there is a reactive N RCN section, with a placeholder for CLs. Other reactive N workshops include NIH looking at reactive N and public health, as well as an agriculture reactive N workshop next year. We should have an N CLs workshop in late 2013 or early 2014. For example, we could have a workshop where we bring managers and scientists together to discuss the use of CLs for management. The RCN proposal must be related to reactive N. The RCN CLs workshop can be held anywhere, depending on the chosen topic.

Let us know if you have workshop ideas for us to pursue.

10:45-10:55AM Soil Critical Loads (Jennifer Phelan & Ginger Tennant)

Application of PROFILE to develop a national coverage of BC weathering rates to support terrestrial CLs of acidity: pilot trial in Pennsylvania State. The researchers are focusing on BC weathering because it accounts for 49-90% of variation in simple mass-balance equation. The clay-substrate model is most commonly used but the source/developer of this model is unknown; based on discussion with critical load experts in the U.S. and Canada, the clay-substrate model may not be suitable for older, more weathered soils (most of the US). We need to find a better method to estimate base cation weathering to support the estimation of terrestrial critical loads of acidity!

The objective of the project is to develop a methodology to produce a national coverage for BC weathering in the US. The PROFILE model was selected because its application is not restricted to specific regions and can be applied across the US. However, it is very data intensive, so national application may be problematic.

A first phase application of PROFILE demonstrated that sufficient national and readily-available state datasets are available to support PROFILE model runs, but there were specific concerns regarding the soil mineralogy data layer. This continuous coverage data layer was built using the USDA-NRCS dataset of soil pits extrapolated based on soil taxonomy groups with probable comparable soil mineralogy (14 mineralogy groups). Concerns regarding this source data set are: data points are highly clustered (not well distributed across the state), and sample collection (different soil horizons) and analysis (different particle size classes) are not consistent between soil pits.

The next (second) phase of this work is to improve the soil mineralogy data layer by improving the mineralogy dataset. In the last year, the USGS Landscapes project conducted by David Smith and William Cannon (geological division of USGS) was completed. This project involved the collection of soil samples across the U.S. at a spacing of approximately 1 point/1600 sq km, and although a main goal of the project was to sample for trace elements, determination of soil mineraology was also a component of this work. Soil samples were collected at georeferenced locations and at multiple depths using consistent and reproducible methods. The dataset associated with project is expected to be released during the fall of 2012, and will be used by the soil BC weathering project. BC weathering rates, critical loads and critical load exceedances in Pennsylvania will be recalculated with PROFILE using the new dataset. In addition, the researchers will review the potential methods for extrapolating the new soil mineralogy dataset to produce a continuous coverage datalayer of mineralogy and/or BC weathering.

Tim Sullivan advised being careful about basing CLs on this database. Although a large improvement, the 1 site per 1,600 km2 spacing of samples in the Landscapes dataset may not represent the areas most sensitive to acidifying deposition (i.e., areas with lowest CLs – e.g., the Southern Appalachain Mountains). This should be considered when the dataset is publically available.

Extrapolation methods that will be reviewed include: statistical extrapolation and development of polygon layers for overlays. These methods will be reviewed using PA as pilot state to determine the benefits and drawbacks of each method and the associated time and resource requirements. EPA divisions including CAMD and ORD are providing funding for this project.

10:55-11:05 AM Forest Service Critical Loads Portal (Claire O'Dea & Cindy Huber)

The US Forest Service released a new Planning Rule early in 2012 that guides the way National Forests create their Forest Plans. The new Planning Rule calls for an assessment of air quality. The USFS Air Resources Management program is designing a portal to guide air specialists through the evaluation of CLs for forest planning. Issues in designing this portal have included determining what deposition information to use for calculating CL exceedances, incorporating uncertainty in CL and deposition calculations, and deciding which CLs to base air quality assessments on. Decisions have been made to provide CLs and CL exceedances for all national CLs efforts included in the national CLs database from FOCUS. Exceedance information will be based on an interim bias-adjusted 2006 CMAQ product, until the new total deposition layer from the Total Deposition Science Committee of NADP is available.

Georgia Murry asked about the incorporation of local information (including occult deposition) and asked about Eastern Forests. The portal includes the ability to substitute local information where available and preferable to the national information.

11:05-11:15 AM Trail MEGA-Transect Deposition Effects Study (Doug Burns & Tim Sullivan)

This project is currently at the point where there are data to look at. The project covers the entire Appalachian Trail, and a wide range of climatic and elevation gradients. CLs are just part of the investigation. Project components include: site selection, atmospheric deposition model, soil surveys, water analyses, vegetation composition and stress, critical loads modeling, and extrapolation. CL calculations rely on MAGIC modeling at site locations.

Stream sample collection was completed in late spring, and spatial aspects of the data are being finalized. Doug will be giving presentation tomorrow at the NADP science symposium on data. Soil data will be provided to Tim soon for analyses.

Ellen Porter explained that we want better linkages between soil and vegetation response.

Sample collection was designed so that soil sites are collocated with water sites. There are very few vegetation sites (15-20 sites). This is part of the planned analyses. They plan to bring in other sites where soil data is available, for example bringing in FIA soils data into analysis and NP and FS data. Relationships will be established using all data, when possible. There are two databases on stream chemistry that can supplement sites for this study; they just need to decide what database is the most appropriate to use. There are almost 300 streams (low flow and high flow sample). Extensive database with new stream chemistry and existing that has been compiled. Soil/Veg linkage: herbaceous – Martin Dovcheik from Suny-ESF (student dissertation); tree cores for stress indicators – Rakesh Minosha.

Data will be binned in many ways, and results will be stratified in meaningful ways. Are there enough representative sites for each side of Appalachian Mountains (east/west)? That was not a criterion for site selection. Forest type was a criterion. Results of site-specific CLs analysis (60-70 sites) will be extrapolated to corridor and used with variables associated with low CLs (geological sensitivity, topography, moisture regimes). A priori we don't know which will be most significant predictors.

Will you replicate with extrapolation variables to see how different CLs would have been? Yes.

11:15—12:00 PM General Discussion & CLAD Business (Rich Pouyat & Jason Lynch)

A. CLAD Webpage (Claire O'Dea)

Website now offers CL references. These will be updated by the CLAD secretary in advance of each NADP meeting.

Cindy Huber discussed BOX collaborative site. It is a web location for groups (FOCUS leadership, FOCUS Work Groups) to share information, post documents, and send notifications. We can set up a site open

to all of CLAD, if desired. We are unsure how that would be used. Advantage to these collaborative sites is the ability to transfer large files (unlimited size). This might be useful for the CLAD database.

B.   Project Summary Report (Jason Lynch)

At the CLAD spring meeting we discussed producing an annual progress report of projects. CLAD meets currently consist of good updates, but these updates leave us without time to advance CLAD's agenda. We can put together a publication that outlines ongoing projects, so that we can focus less on updates at meetings and focus instead on moving the CLAD agenda forward. Do people agree this would be useful? Do we have a volunteer? The volunteer would gather information and organize quarterly update conference calls and webinars to discuss these updates amongst CLAD. We could also list this information on the website or through a BOX collaborative site. We will look into Box participant maximums. We want to take advantage of face-to-face time to discuss issues and save most project updates for webinars. FOCUS could present updates, but the proposed report and webinars are mainly for updates on other projects. Hearing about these projects can benefit everyone. After the spring meeting, we had ideas of themes for discussions people would be interested in (biodiversity, ecosystem services). Show of hands indicates interest. Volunteer: Berkeley Almand (CU Boulder)

Salim mentioned that quarterly reports are too frequent. Jason explained that people won't be reporting at each webinar. Only report when you have new information to share. We can adjust the frequency of webinars based on demand. Something will be put on the website to summarize the webinars. This will be trying something new, so once we launch it we can adjust and tweak as appropriate. Given the amount of time, we will likely still have presentations at the Spring CLAD meeting.

We need a better balance of meeting time at NADP meetings given the number of committee members in CLAD/Total Dep. This will be discussed with NADP Exec Comm. We would like more CLAD time so we can have presentations and move CLAD agenda forward.

C.   Issues related to publishing national critical loads maps (Jason Lynch)

We have the potential to publish CLs and exceedance maps. Do we want to move forward with that and put out maps as CLAD products? We're not going to vote today, but we wanted to introduce this topic to the broader group. Before the spring meeting, we want to facilitate this discussion. We can just have the database or we can publish maps. Think about issues associated with publishing CL maps and exceedance maps. Send emails to Jason with your perspective, as well as your agency's perspective. Why this is a good idea and what is the value AND what are your concerns? Lynch.jason@epa.gov

The maps will be a CLAD product, and this will have implications for NADP. This is also a question for the Exec Comm; it is already on their radar. We will discuss this at the spring meeting.

Jon Kachmar (TNC) asked how TNC can support CL maps, because there is no other way to get them. This is extremely important to TNC. Tim Sullivan agrees that these are vitally important to a lot of

groups, but advises that we not underestimate the magnitude of the effort to do this and do it properly. This is a big effort. If people are going to use this information, it needs to be right.

D. Accept minutes from the spring 2012 CLAD meeting.

Motioned, seconded, and accepted.

E. Discuss/Elect CLAD chair(s) and secretary for 2012

Election of officers

Co-Chairs of CLAD: Jen Phelan (RTI) was nominated, accepted, and approved.

Secretary: Clara Funk (EPA) volunteered and was approved.

F. Announce CL papers and posters that will be presented at the NADP science symposium

Adjourned at 12:00 PM.   Information from this meeting was reported by Jason Lynch at the joint subcommittee meeting later in the day at 1:30 PM.

1:30 PM – 2:30 PM FOCUS Working Group Discussion & Project Reports (Cindy Huber)

This afternoon CLAD session is focused on FOCUS Phase II Work Group updates. If a group is not making progress, how do we help reinvigorate the effort?

Work Group A (Jen Phelan): The objective is to review existing methods and provide recommendations on how to improve estimates of BC weathering and ANC leaching in the SMB model to estimate CLs of acidity in terrestrial ecosystems. BCw methods: rate estimation (soil profile approach and catchment/mass balance approach) and regionalization (extrapolate/interpolate between points) methods. There are six ANC methods. Review criteria: equations to estimate parameters, descriptions, +/- (keeping in mind applications in US), source (references). The Work Group produced two documents: one for BCw and one for ANC.

Recommendations: there are multiple suitable methods to estimate BCw in the US. Method selection will be largely determined by data availability. Therefore, a first step to improve estimates of BCw would be to produce maps that show data availability for soil profile and catchment methods that can be applied throughout the US (e.g., PROFILE and MAGIC). There are also multiple suitable methods to calculate ANC leaching. Method selection depends on biological indicators of interest in receptor ecosystems and soil type (mineral (Al-based criterion) v. organic soil (pH-based criterion)). BC:Al of 1 or 10 to protect tree health makes a significant difference. ANC is species specific (because includes the chemical criterion linked to a biological indicator of interest within a receptor ecosystem). We need to establish stronger relationships between biological indicators and chemical criteria (then set associated critical limits to protect the health of the biological indicators).

Harold: You can have multiple limits for different indicators. There can be two levels for limit-setting.

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Steps to establish relationship between biological indicators and chemical criteria include selecting biological indicators (determined by receptor ecosystems of interest and management objectives – interagency CLAD effort?), selecting chemical criteria (determined by soil type, relationships between biological indicator and criterion, and available data).

Salim: It is necessary to relate soil solution chemistry to soil chemistry.

Evaluate relationships between biological indicators and chemical criteria. Existing studies: Sverdrup and Warfvinge (1993), Cronan and Grigal (1995), Work Group C literature review. New studies: BC/Al, Ca/Al, base saturation relationships using existing national datasets (e.g., FIA). FIA P3 soils indicator program evaluates exchangeable BC, Al, pH, ECEC for soil (not soil solution). Need translation to soil solution to bring into SMB equation.

This provides guidance on where CLAD can go.

Charles Driscoll: Have efforts been put into sites where data is co-located? Not in the US. The Appalachian Trail project will have this, minus the soil solution piece. Headwater catchments have a stronger linkage between soil water and stream. This is not true in lower elevation areas.

Harold: Half of the Sverdrup and Warfvinge (1993) book is data from US studies and species. These data should be evaluated to examine the relationships.

Tamara: What next? Workshops? RCN workshop to discuss how to proceed with these recommendations? How do we evaluate the literature? Projects to establish relationships with existing data? Someone needs to pull together useful data. Then we can make decisions on how to proceed. A workshop isn't necessary to create proposals, but it can be helpful. The infusion of European ideas have been very important. Doing a national assessment that people can use for policy and management is a significant undertaking and must be taken seriously.

We need to gather existing data and have a workshop to evaluate and determine next steps. Consistent data can be used to refute hypotheses. We can use Appalachian Trail to prove things in the reverse. Background papers need to be created prior to workshops. Workshop creates commitment and ownership. We need a group of people who can do serious work investigating some of these issues. Use workshop to bring key people together.

Another potential data source is the March meeting of the Northeastern Soil Monitoring Cooperative in conjunction with Northeastern Ecosystem Research Cooperative. This is an opportunity for us to make a link and discuss these issues with that community. There is agreement in the room about making this connection for soil data (at least in this geographic area). It wouldn't hurt to bring this front and center and ask them directly what we want! Are there similar groups in other regions? This is the first. Also, NERC has a biannual meeting with a CL session in March. Solicit participation. How do we bridge gap to use soil chemistry instead of soil solution? No one is suggesting we collect soil solution data across US. Can we use soil data? If so, how do we use it? We don't need to collect anything new.

Charley: There is a group at Penn State looking across N manipulation studies: they have plant response, root response, and soil data under systems to critically review relationships. They also have soil solution data. They're interested in the same things and are trying to get funding. They are working in Harvard Forest, Millbrook, PA, and Bearbrook, ME, with connections with Duke Forest and China.

Harold: there was no soil solution data in Sweden. They used experiments in key regions, similar to the efforts of the Penn State group. Fundamental response belongs to the plant, not the site. Once you know the fundamental property, you have it. We probably have the data we need. We just need to find it and aggregate it.

Create a chronology of steps and build in a proposal for RCN workshop. We may have soil component, nutrient N/lichen component, etc. Identify where time/funding are needed for FOCUS Steering Team to consider.

Work Group B (Mark Fenn): Examine N parameters in SMB equation to make improvements on calculation assumptions: N immobilization, denitrification, and N leaching. They have had one conference call to discuss N immobilization and written a 1-page paper on the information they would like to look for in preparation for a literature review. They are currently waiting for people to get back from field research so they can continue to make progress. This group is in need of revitalization.

Work Group C: Examining the link between soil chemistry and vegetation response to understand whether chemical criteria for ANC leaching is correct. Currently, we use BC:Al of 1 or 10 depending on whether it is a hardwood or conifer forest. We need to look for new information that would support this criterion or suggest using alternate values. We should have someone from the vegetation community and someone from the soil community co-chairing. Paul Shaberg, Erik Lilliskov, and Richard Warbee have been contacted. There haven't been any conference calls yet. Richard Warbee has had a student do a literature review of over 200 citations to determine what might be useful.

There are people from Penn State doing work in this area (Erica Smithwick and Dave Eisenstaff). They would like to be in the loop and have relevant information. Follow up with Charles Driscoll for names.

Salim: Germany, Holland, and France have thousands of records of soil chemistry and vegetation. We can combine things to see if they have what we need. These have been used in Europe. US ecosystems are different but the correlations could be relevant and useful (e.g., certain plants won't grow at a certain pH, etc.). For example, we can look for where thresholds are affiliated with certain plants or functional types of plants. We need some US data as a baseline to understand if relationships are the same as the relationships in Europe. With that much data you can find thresholds in temperature and pH, etc. European data can be used to fill in the gaps. Best available knowledge – a poor try is better than no try.

Tim Sullivan: BC:Al ratio is based on soil solution information. You need thousands of sites to do this on a large scale. Until we commit resources to do this (unlikely), we need to think of a different approach than using BC:Al. Explore using soil data instead of soil solution (base saturation, soil pH). Data can be used to ground truth or calibrate models.

Harold: Overlap between North America and Europe of ~30%.

Work Group D (Linda Geiser): This group is on schedule and plans to complete work by March 2013. The relationship between eutrophic and oligotrophic lichens indicates when lichens have been impacted by N deposition. Work was done in Pacific NW, but model was applied nationally across ecoregions. The FIA database has been used with other lichen datasets to validate and adjust models to be more site-specific nationally. The GIS work is close to completion. Lichen databases are being joined by December. The group will then have new relationships to recalculate N CLs for lichens.

Work Group E (Linda Pardo): This group has developed an approach to refine the empirical CLs for nutrient N to a scale finer than that of an ecosystem using endorsement theory. They are doing a pilot study in the North East, but hope to automate the process to refine the empirical CLs nationally.

Work Group F (Jason Lynch & Jack Cosby): This group is focused on the surface water CLs. They have had one conference call. Their initial goal is similar to the soil CLs group, describing methodologies currently being used (see mapping and modeling manual, but add in new methods). They want to integrate what has been done to tables similar to work group A, and do a comparison among methods. There are different methods for estimating CLs with considerable overlap. They can look at differences and create a hierarchy to provide the best available coverage for SW in US. Also, some datasets need to be incorporated into the database. The work group wants to bring high resolution modeling into that context, with discussion on how that would be done. How do we bring in N CL into the database to have a better western presence?

Salim: How much uncertainty is there with deposition of base cations? We have good wet deposition estimates from NADP to use for extrapolation. There is less certainty with dry deposition. CASTNET misses fine dry deposition. Having an inventory of base cations would be important, specifically because of the importance of BC deposition as inputs. We would like to add BC to CMAQ deposition (wet and dry).

Tim: We need to pay more attention to the ANC leaching limit when calculating CLs.

Adjourned at 3:30 PM.

Notes recorded by Claire O'Dea, FY2012 CLAD Secretary. Send corrections to cbodea@fs.fed.us