Notes from Critical Loads Ad-Hoc Subcommittee
NADP Fall Meeting, Madison, WI, Oct. 14, 2008

Doug Burns, Chair: Welcome, overview

Participants: Doug Burns, Janea Scott, Ellis Cowling, Tamara Blett, Ellen Porter, Jason Lynch, Paul Miller, Angela Zahniser, Rich Pouyat, Gail Lacey, Randy Waite, Rick Haeuber, Tim Sullivan, Leora Nanus

Updates from Principal Investigators on Inter-agency Critical Loads (CL) projects

Mid-Atlantic project – Tim Sullivan

- Steady-state (SS) model is being calibrated for streams in WV, VA; MAGIC will be run for 100 lakes in Northeast, 100 streams in Southeast (SE); results will be extrapolated to larger SE region
- ANC can be used to roughly estimate CL, especially if some other water chemistry is available. Other watershed variables can be used to help develop CLs, including lithology, soils, and vegetation
- About 530 streams in region have sufficient water chemistry data to run SS model; about 100 sites have sufficient data to run MAGIC
- Terrestrial CL SS models include Simple Mass Balance (SMB), Steady-state Mass Balance (SSMB) Models
- Aquatic CL SS model is the Steady-state Water Chemistry Model (SSWC)
- BC weathering is the most important factor in the steady state models.
- Weathering estimates from MAGIC can be used to evaluate estimates derived from the steady state modeling.
- Water – what's coming out in streams can help predict BC weathering. This provides a useful constraint on what the weathering rates can be. In other words, if you know the base cation load out of the watershed in drainage water, this strongly constrains the base cation weathering rate.
- ANC leaching – used as starting point for deriving CL for acidification of soils and surface water; because of the way that the critical ANC leaching term is defined, CL for water is always less than the CL for soil. If soils are sufficiently thin, the CL values for soil and water will tend to converge.
- BC weathering is most important estimate; calculations made for Europe not appropriate for direct transfer to U.S.; in U.S., MAGIC can be used to estimate BC weathering; there's a good relationship between stream excess soluble BC and soil BC weathering; this will be the approach to estimating BC weathering (won't use F factor – F factor has been used by others to estimate the part of the base cation flux that is due to soil acidification).
- Timeline – will finish SS modeling by some time during winter of 09; complete by spring 09.

Rocky Mountain project – Leora Nanus

- CL for nitrogen (N) – range: northern NM to Canada – project will include deposition mapping, empirical modeling, identification of threshold values of NO3, and mapping of CL of N
- Will develop 400 m resolution maps of N deposition, using snow, NADP, and PRISM data; data will be quality assured.
- Modeling –empirical models are being developed to predict surface water NO3 based on basin characteristics and N deposition. Historical NO3 data was gathered for over 4800 sites. Screening criteria included an elevation cutoff based on latitude, sites located in Wilderness Areas and National Parks, and sites with historical NO3 data collected between August through mid-October. GIS datasets for calculating basin characteristics have been compiled, basin delineation for the region is in progress.
  - Ex: basin delineation: 171 basin boundaries were delineated in Arc Hydro for surface water sites in Rocky Mtn NP that had NO3 data. Basin characteristics were calculated including topography, elevation, geology, vegetation, and soils.
- Developed preliminary regression equation for Rocky Mtn NP: certain characteristics correlated well. The significant explanatory variables that were included in the equation were as follows: mean slope, west facing slopes, rock, and IN deposition were positively related to surface water NO3 concentrations, and south facing slopes and tundra were negatively related to surface water NO3 concentrations.
- Developed preliminary map for Rocky Mtn NP of lake NO3 predicted < 2 microequivalents per liter to > 6 microequivalents per liter (data from Aug to Oct); In general predicted surface water NO3 concentrations are higher in the southern part of the park and lower in the northern part of the park.
- Will identify threshold NO3 based on diatom species shift; changes are well documented in some lakes, e.g., Beartooth Mts (MT) and Rocky Mtn NP – Asterionella and Fragellaria are good indicators of increased N deposition.
- Will construct diatom calibration set to infer the amount of lake NO3 that causes changes
- Growth kinetic experiment: Maximum growth is first achieved at 5 micrograms per liter for Asterionella; preliminary map of exceedances of 5 micrograms per liter- approximately 70% of Rocky Mtn NP.
- Report on NO3 in lakes in Mount Rainier and North Cascades NPs is now in press for a USGS publication
- Will address climate change effects, e.g., the diatom calibration dataset will take into account factors likely to be affected by climate change (length of growing season, etc.)

Northeast project – Eric Miller (by phone)

- Project includes developing SS CL for NY and NE states
- Will use predicted deposition for 2018, based on NESCAUM CMAQ estimates at 30 m resolution for dry deposition; will update deposition regime to include NY.
- Will include both terrestrial and aquatic CLs; adding some aquatic data
- Will integrate terrestrial and aquatic CL and exceedances into maps
- Will work with Tim Sullivan to use spatial datasets to determine what areas of NE the dynamic MAGIC modeling will apply to

- Stakeholder meeting will be held in late winter/spring 09; Stakeholder input will be used to guide development of ecosystem indicator thresholds for CL; thresholds may vary by region.
- SS CL will be completed by June 09; dynamic by??
- Spatial scaling and final products by April 2010
- Although CAIR is uncertain, its assumptions and modeling will be used for project, as whatever replaces CAIR is likely to be similar (comment from Paul Miller – if CAIR is not reinstated, other requirements of CAA (e.g., NSR, AEP settlement) will require reductions. States will use this information in future planning).

Business part of Meeting

- Tamara Blett has agreed to serve as CLAD Chair for 2009
- We will want to consider someone from USFS for 2010 to keep with rotating the position among different agencies

Discussion of the future of CLAD –

- Do we want to become a permanent subcommittee? We will not petition to become a permanent subcommittee at this time unless NADP Exec. Committee feels strongly that they would like us to.
- Consider combining parts of agenda with other subcommittees. We are doing this by meeting with EROS later this morning.
- How might we structure future meetings associated with the fall and spring NADP meetings? Want to continue a format of having a discussion about a science issue related to critical loads at each meeting. Jason Lynch has offered to lead a discussion about models at next meeting. He even suggested something more formal like a workshop for model users---a hands-on event. This might have to take place outside of the formal CLAD meeting since all attendees may not want such a hands-on event.
- What is current thinking of NADP Executive committee on subcommittee structure going forward? CLAD is okay for now as Ad-Hoc subcommittee.
- Comments on CLAD mission statement? Does anyone have good notes about mission statement discussion?

Open discussion (sponsored jointly with the EROS subcommittee)
Questions: Threshold levels for establishing ecosystem effects of acid deposition and critical loads. What is the current scientific thinking? What is the evidence to support various threshold levels? How uncertain are we about establishing certain threshold levels?

Discussion of Thresholds
- Acidification thresholds
  - Thresholds for aquatic acidification are usually based on ANC, pH, Al concentrations

- Commonly used ANC values are 0, 20, 50 ueq/L; 100ueq/L may also be used, as it is a threshold for overall aquatic biota health
- Base cation surplus may be more useful than ANC because it's directly related to aluminum leaching and is not affected by organic acids (Greg Lawrence)
- When deposition is reduced, ANC may recover, but calcium will not follow, so you can get effects to biota from low calcium availability
- Thresholds for soil acidification
- Soil base saturation values of 10, 15% have been used as thresholds for soil acidification; limited data suggest 12% may be a good threshold (Greg Lawrence)
- Ca:Al is also used, with values of 1 and 10
- Aquatic biota health, e.g., brook trout
- Foliar Ca (Rich Hallett is using satellite imagery to relate foliar Ca to B horizon Ca)

- Thresholds for N enrichment:
  - Lake NO3 concentrations – often values of 10, 20 ueq/L are used for modeling, but there is no real data that suggests that either value is related to a specific harmful effect; and, in the West, those values are inappropriate, as western lakes (especially high elevation lakes) often have very low NO3 concentrations, and effects to biota have been documented at very low NO3 concentrations.
  - Foliar N concentration. Is there a relationship/threshold between foliar N and soil N saturation?
  - Species composition, abundance, diversity

Other Topics:

- Effects of air pollutants on the Appalachian Trail – Greg Lawrence/Doug Burns – proposal is in review by NPS; project would explore linkages between soil and tree chemistry, develop CLs for soils and streams along trail
- Status of EPA/QAQPS Secondary Standards report – fate of critical loads during review of that document – EPA has completed its 2nd draft of the Integrated Science Assessment, which has discussed critical loads and summarized CLs for U.S.; EPA is now working on 2nd draft of Risk and Exposure Assessment, which describes how ecosystem indicators and thresholds could be used to develop a secondary NOx/SOx standard. Information at http://www.epa.gov/ttn/naaqs/standards/no2so2sec/index.html.
- NARSTO report
- NAPAP progress