

**MEETING NOTES FOR CRITICAL LOADS AD HOC SUBCOMMITTEE (CLAD)
NADP SPRING BUSINESS MEETING
PENSACOLA, FLORIDA
April 29-30, 2008**

TUESDAY (APRIL 29, 2008)

1. CLAD Updates

A. Nitrogen Critical Loads Workshop Update (Lynch and Porter)

Workshop was organized by Linda Pardo, Forest Service, and held Feb 26-28, 2008, in Baltimore; purpose was to synthesize (in a monograph) current information on N effects to a variety of ecosystems and determine critical loads, where possible; participants included experts on ecosystem effects to ecosystems; prior to workshop experts provided chapters to a draft monograph, which was reviewed at the meeting and is now being revised. Anticipated products include a detailed report (Forest Service Technical Report) and a summary article that will be submitted to a journal and will include a table of critical loads for nitrogen deposition to U.S. ecosystems.

Pardo has developed a critical loads database that Lynch is now restructuring into Access and developing maps to accompany the critical loads information. Maps will include deposition estimates based on CMAQ and NADP data.

Pardo could not attend the CLAD meeting but mentioned via email that CLAD should consider increased interactions with European efforts to determine critical loads for biodiversity. The next meeting of the European modeling group on biodiversity in Spain in October and it would benefit U.S. efforts to participate.

B. Status and update of NARSTO Multi-Pollutant Assessment (Burns)

NARSTO – purpose is to improve air quality management in North America; current assessment takes multipollutant approach that will also have focus on air quality management. Burns and Tom Clair heading chapter on ecosystem science, including effects from acid deposition, ozone, mercury, and POPs; will include recommendations to increase efforts to monitor NH₃, maintain long-term Hg deposition monitoring sites, monitor dry Hg deposition, increase monitoring of acid deposition effects in terrestrial ecosystems; also notes that a better indicator for acidification is needed than measured ANC because natural acidity affects ANC – alternative may be inorganic aluminum; chapter will also note that CLs are underutilized in U.S.

C. Update on 2009 NAPAP report –(Burns)

Burns will meet with AQRS subcommittee May 15 to discuss plans for report. Will aim for having the report out in late 2009 or early 2010.

D. NO_x/SO_x secondary standards report (Anne Rea, EPA)

EPA is on court ordered deadline for this review, with final rulemaking required by fall 2010; first draft Integrated Science Assessment was out last fall, 2nd draft this fall; EPA

has developed the scoping plan for risk assessment, which has been approved by CASAC; review will consider effects of SOX/NOX on acidification and eutrophication in both aquatic and terrestrial ecosystems; CASAC has recommended including NH₃ effects in the review. EPA will use case studies to illustrate effects; will consider S-Hg interactions; will consider climate change effects (N₂O is greenhouse gas), including effects of N deposition on carbon sequestration. The NOX and SOX standards are based on air concentrations, so EPA needs to relate (by modeling) ambient concentrations to deposition.

E. Update on NYSERDA CLs project (Tim Sullivan)

Not started yet (will take 2 yrs) – project will focus on lakes in Adirondacks; working with Driscoll, Burns, Cosby, Herlihy. 100 watersheds have MAGIC chemistry; will be able to extrapolate to other lakes. Goals – determine where acidified lakes and forest soils can recover, and what deposition levels would support recovery; determine where recovery is unlikely or will take long time. Will classify and map lake watersheds by CL; evaluate sensitivity of CL calculations to watershed features, biogeochemical processes (using PnET), selection of chemical indicators and critical limits. Refine biological response algorithms for use in CL calculations (link chemical indicator to biological indicator. Use MAGIC at about 100 sites, PnET –BGC at about 20 sites; Regional extrapolation using EMAP statistical frame and GIS spatial extrapolation. Assess biological response – literature provides some thresholds for fish species richness, zooplankton response (e.g., Bulger et al 1999).

Proposed indicators, critical levels, and timeframes for CL modeling:

With MAGIC model (n=100): lake ANC 0, 20, 50; timeframes 2020, 2050, 2100, steady-state; lake NO₃ – 10, 20 µeq/L; B soil horizon base saturation 10, 15%; B-horizon Ca:Al – 1, 10.

With PnET-BGC (n=20): lake ANC 0, 20, 50 µeq/L; lake NO₃ 10, 20 µeq/L; foliar N TBD, can be remotely sensed, probably needs to be species-specific

Will include uncertainty analyses to assess importance of sensitive resources, chemical indicator for sensitive resources, critical value for indicator, timeframe, biological response functions, model input data quality and quantity, timing of observed data.

Outreach will include journals, fact sheets, report, website.

F. Update on North American Forestry Commission NA critical loads map (Steve McNulty, USFS)

Purpose is to map forest resources and risks across North America; also CL and exceedances, recommend conservation and management strategies for forests

G. Update on alpine vegetation workshop (Ellen Porter, NPS)

Multiagency CL Workgroup is sponsoring workshop in Fall 2008 to evaluate utility of European model for categorizing alpine vegetation sensitivity to N deposition in the U.S. Workshop will include small (6-8) group of subject matter experts, including European scientists.

2. Ongoing CL Project Updates

A. EPA/NPS/FS CL project (Sullivan)

Two components:

(1) Eric Miller will expand his previous CL work for forest acidification in the NE to include NY; Sullivan will model CL for aquatic systems in the NE so that regional CL maps will be developed for both aquatic and terrestrial acidification in the NE;

(2) Sullivan and Cosby will use MAGIC and SSWC to model steady state and dynamic CLs for watersheds in VA/WV.

Tasks: review SSWC parameters (e.g., ANC flux limit, weathering); evaluate inconsistencies between models; estimate CL for 100 sites with previous MAGIC modeling and chemistry; 550 sites with SSWC chemistry; apply SSWC CLs as deposition driver to MAGIC and determine time to achieve ANC limit (100 sites); MAGIC simulation of future base case (CAIR/CMAQ) – evaluate projections relative to desired endpts (100 sites); compare weathering rates between models

Technical report due Aug 2009; journal article due June 2009.

B. Discussion of Simple Mass Balance model (Cosby) and importance of understanding model inputs (tweaking any of the models used to develop SMB model inputs will affect outcome)

SMB includes base cations, chloride, N uptake, denitrification, N immobilization, ANC Base cation weathering, ANC critical limit are conceptually different between soils and waters (in soils, adverse effects don't begin until you reach acidic range; in waters, adverse effects begin in the alkaline range)

Climate change can be incorporated into models (discharge rates, leaching, weathering)

C. EPA/NPS CL project update (Leora Nanus)

Nanus and Clow project will map CL for N in the Rocky Mts

Approach: Deposition mapping, empirical modeling, determine a threshold NO₃ for biological response, mapping CL of N

Deposition mapping will be based on NADP and snowpack (400 m resolution maps)

Will develop empirical model to predict surface water NO₃, based on basin characteristics, N deposition, water quality data (n=4131) for sites, most have elevation >5000 ft; will include national parks and wilderness areas

Will identify threshold NO₃ for surface water by relating NO₃ to diatom community structure; calculate N deposition at which threshold NO₃ is exceeded

Will create grid-based CL maps for N at 1 km resolution, maps of predicted surface water NO₃, and CL exceedances

Related studies: Nanus probability mapping; Clow empirical modeling in Rocky Mountain NP with seasonality effects; Alisa Mast diatom calibration study (Rocky Mountain NP and Great Sand Dunes NP – 25 lakes)

Timeframe: reports spring 2009

Complicating factors: Climate change and temperature and snowcover, may affect diatom community structure

WEDNESDAY (APRIL 30, 2008)

D. EMDS Project – Keith Reynolds, USFS

Development (FS and EPA) of expert system (EMDS) to estimate CL for the Blue Ridge
Integrates GIS with logic based decision support system for landscape analysis

Domain – Blue Ridge province; biogeographically diverse; extensive soil, water data,
will use Pfafstetter watersheds (fine scale)

Will eventually address N CLs

Timeframes, endpoints: 2020, 2040, 2100; historical ANC, future ANC; ANC of 20, 50
 $\mu\text{eq/L}$; evaluate regulatory scenarios

Conduct uncertainty analyses – probabilistic and linguistic

E. Colorado N Reduction Plan (Curt Taipale – State of Colorado)

Colorado entered into an MOU with the National Park Service to remedy impacts from N
deposition to ecosystems at Rocky Mountain NP

State has developed N reduction plan; will get emission reductions through the Regional
Haze Rule's (RHR) BART controls at powerplants and cement kilns –up to 5000 tpy
reductions

Problem with timing because BART controls aren't required by RHR until 5 years after
State Implementation Plan for regional haze is approved; however, N reduction plan has
set a goal for deposition reductions by 2012; if 2012 goal isn't met, State will have to
institute more controls; State is also considering NO_x reductions to remedy ozone
nonattainment issues; Tier 2 controls will reduce mobile emissions; oil and gas
development is producing a lot of NO_x and development is rapidly expanding out West
State cannot regulate NH₃ emissions from agriculture, except for swine farm. This
complicates N reduction strategies, but agriculture groups in Colorado want to institute
voluntary best management practices to reduce NH₃.

F. Aquatic critical loads using the FAB model (Steve McNulty, USFS)

Previously McNulty and Erika Cohen developed national map of CL for terrestrial
acidification, which helped identify high risk areas. Harbin Lee and McNulty did
uncertainty analysis – weathering is 60% of uncertainty

Now developing CLs for aquatic acidification

Initially planned to use lakes with NWS data; may switch to using streams and
extrapolate to lakes and watersheds

Will produce GIS layers with water quality information

G. Integrated nitrogen/climate change project – Steve McNulty, USFS

Project assessed relative impacts from drought, beetle outbreaks, and N deposition on red
spruce in southern Appalachia Mountains

Hypothesis: climate change, insects, and N deposition contributed to red spruce decline

Drought occurred from 1999-2002, stressing trees

Dying trees had previously been healthiest, fastest growing trees; N deposition may have
shifted carbohydrate allocation in these trees to aboveground biomass at the expense of
roots, reducing tree's ability to withstand drought stress; carbohydrate reserves (including
oleoresin, which repels beetles) decreased; foliar analysis revealed that foliar N

concentrations on plots with dead trees was higher; also looked at foliar Mg:N; plots with live trees had higher Mg:N indicative of healthier growth; looked at isotopic ratios - trees that died previously grew faster, used more water, but were more vulnerable
Hypothesis for mortality: all areas rec'd elev N dep, but below CL; ratio of shoot to root increased; N had fertilization effect; drought reduced available water, carbohydrate reserves (oleoresin) decreased; in essence, climate change reduced the CL

H. Use of critical loads in PSD permitting by USFS – Cindy Huber

Dominion Power's new plant was predicted to exceed the deposition analysis threshold (0.01 kg/ha/yr) for S deposition at Linville Gorge

FS had MAGIC estimates for CLs for the area

Streams are already acidified; soil pH is low, Ca:Al < 0.3 with likely stress to roots, etc.; soil S adsorption capacity nearly exceeded.

FS provided evidence of CL exceedances (NPS also provided evidence of CL exceedances at Great Smoky Mountains NP, which would also be impacted by Dominion emissions)

VA Air Board has taken permit from State; the State had proposed a permit limit for SO₂ that was greater than the limit for 5 other plants in VA

Because of FS letter, Dominion has agreed to reduce SO₂ emissions by 50%

I. Effects of Climate Change (CC) on Deposition in NA

Proposal submitted to USGS to determine how CC will change deposition and effects to sensitive ecosystems. Proposal didn't get funded; project still of interest to CLAD.

CC will affect reaction rate of atmospheric chemistry, amount and distribution of precipitation, with more droughts and large events. This will have implications for ecosystem effects from air pollution.

The project would model and map future deposition scenarios, using PRISM; would use CMAQ linked to climate models, and link with DayCENT-Chem for ecosystem effects; produce national maps

J. General Discussion and New Business

Ongoing effort to develop a water/soils study along the Appalachian Trail corridor that could inform/test critical loads efforts (Doug Burns)

Discussion of status of CLAD in NADP: Should CLAD remain an ad-hoc committee or become a permanent subcommittee? Group agreed that ad-hoc status worked well and allowed flexibility.

CL sessions at upcoming professional conferences (Lynch)

CLAD will coordinate CL session for Fall 2008 NADP meeting

Ideas for speakers: Melanie Hartmann – DayCent-Chem ecosystem modeling; Canadian on CLs in Canada; European on CL for biodiversity

Lynch and Burns will investigate putting together a CL session for the December AGU Conference

Format for Spring 2009 CLAD meeting: will use workshop format, rather than series of scientific talks (which are more appropriate for the NADP Fall Technical Meeting); spring meeting may focus on certain topics.

Coordination with European Efforts: at present, CLAD will pursue establishing a link from the NADP CLAD website to the ICP modeling and mapping group website.