Empirical Critical Loads for Lichen
Geiser et al., 2010 & Root et al., 2015

Metadata for supporting GIS file

NCLD_EMP_GIS_GeiserRoot_v31.gdb

Content

These geographic information system (gis) files contain only critical loads from Geiser et al. 2011 and Root et al. 2015 that are part of the National Critical Load Database v3.1 (NCLD) for Empirical Nitrogen.

Data and Project Citation

Geiser, L.H., Jovan, S.E., Glavich, D.A., Porter, M. 2010. Lichen-based critical loads for atmospheric nitrogen deposition in Western Oregon and Washington Forests, USA. Environmental Pollution. 158: 2412-2421.

Root, R.T., L.H. Geiser, S. Jovan, P/ Neitlich. 2015. Epiphytic macrolichen indication of air quality and climate in interiorforested mountains of the Pacific Northwest, USA. Ecological Indicators 53 (2015) 95–105. http://dx.doi.org/10.1016/j.ecolind.2015.01.029

NCLD Database Citation

Lynch, J.A., Phelan, J., Pardo, L.H., McDonnell, T.C., Clark, C.M., and Bell, M.D. 2020. Detailed Documentation of the National Critical Load Database (NCLD) for U.S. Critical Loads of Sulfur and Nitrogen, version 3.1, National Atmospheric Deposition Program, Wisconsin State Laboratory of Hygiene, Madison, WI.

Critical Load Overview

A second set of lichen-based CL estimates were calculated following a method developed by Geiser et al., (2010) that used "air score," by Ecoregion Level I with average annual precipitation using the following equation:

$$CL\ (kg/ha\text{-}yr) = [Air\ Score + 0.091756 + (0.002388 \times precip)] / 0.1493339 \qquad \text{(Eq. A3-1)}$$

Geiser et al. (2010) developed air scores based on quantitative measures of lichen community composition (Table As-2). The mean air scores combined with annual precipitation, mapped at a 4x4 km grid resolution, were used to calculate the CLs. This analysis used the 30-year annual average precipitation for the period 1961-1990 (http://prism.oregonstate.edu/products/matrix.phtml?vartype=tmax&view=data) (Table A3-2).

Table A3-2. Air Scores for Ecoregions Level I (Geiser et al., 2010)

EcoRegion Level 1	EcoCode 1	Minimum Air Score	Maximum Air Score
Northern Forests	5	0.21	0.21
Marine West Coast Forests	7	0.21	0.21
Northwest Forested Mtns	6	0.21	0.49
Eastern Temperate Forest	8	0.33	0.33
Mediterranean CA	11	0.33	0.49
Temperate Sierras	13	0.49	0.49

Geiser et al., (2010) CLs were modified by Root et al., (2015) for selected regions in the Pacific Northwest. Geiser et al., (2010) CLs were replaced with the Root et.al., (2015) CL minimum and maxium value of 1.54 and 2.51 Kg N/ha-yr for the following five Ecoregion level III: (1) North Cascades, (2) Northern Rockies, (3) Cascades, (4) Eastern Cascades Slopes and Foothills, and (5) Blue Mountains.

Root et al., (2015) based their CLs on two lichen-based indicators of depositional N for inte-rior forested mountain ecosystems of the Pacific Northwest. Lichen community composition and concentration of elemental N in lichen thalli are proven approaches to biomonitoring N deposition patterns in many regions (Geiser et al., 2010, Root et al., 2013). As N deposition increases, N-loving eutrophic lichens become dominant over oligotrophic lichens that thrive in nutrient-poor habitats. Based on the this lichen communities shift, CLs of 1.54 and 2.51 Kg N/ha-yr of through-fall dissolved inorganic N deposition were determined for lichen communities and lichen N concentration, respectively. Please see Geiser et al., (2010) and Root et al., (2015) for more details.

Projections

USA_Contiguous_Albers_Equal_Area_Conic_USGS_version	
Projection: Albers	Geographic Coordinate System: GCS_North_American_1983
False_Easting: 0.00000000	Datum: D_North_American_1983
False_Northing: 0.00000000	Prime Meridian: Greenwich
Central_Meridian: -96.00000000	Angular Unit: Degree
Standard_Parallel_1: 29.5.00000000	
Standard_Parallel_2: 45.00000000	
Latitude_of_Origin: 23.00000000	
Linear_Unit: Meter	

No Data Values

Missing numeric values are noted as -9999, -9999.99, -9999.999, which indicate both situations where information is not determined or does not apply. Missing text values where information is not determined are noted as “(no data)” while “(n/a)” indicates missing information that does not apply.

Attribute Descriptions

Variable	Explanation	Format
CLID	Unique(!) identifier across all three CL grouping: Forest Ecosystem, Surface Waters, and Empirical Nitrogen.	Text
PRID	Unique(!) identifier of the CL project.	Integer
LOCID	Unique(!) identifier of a particular location (e.g. lake, stream reach, or sample plot), gridded area, or Ecoregion I-IV. Lakes and stream reaches are classified by NHDPlusV2. In many cases, a single lake/stream reach or ecoregion may have more than one CL value. The LOCID can be used to aggregate CLs for a particular location.	Text
CL_Class	Critical load type: Empirical Terrestrial Nitrogen	Text
SiteID	Project specific identifier of the site.	Text
LatDD	Latitude (decimal degrees).	Double
LongDD	Longitude (decimal degrees).	Double
EcoRegionI	EcoRegion code Level I. (http://www.epa.gov/wed/pages/ecoregions/na_eco.htm).	Text
EcoNameI	EcoRegion name Level I. (http://www.epa.gov/wed/pages/ecoregions/na_eco.htm).	Text
CL_Type	Critical load type: Empirical.	Text
CLN_MIN	Empirical minimum CL of N (kg/ha-yr).	Double
CLN_MAX	Empirical maximum CL of N (kg/ha-yr).	Double
RecepI	Biological and physical entity being affected: Herbaceous plant community.	Text
Response	The negative response of that biological or physical entity that is to be avoided: Reduction in community composition	Text
Threshold	The threshold of related to the receptor and its response: No biodiversity loss	Text
CL_Description	Text description of what the CL represents.	Text
PrimRef	Publication citation for primary study for the CL. For some CLs, there is more than one publication. For CLs with more than one publication, use Tables 5 and 6 to determine the additional references.	Text
Canopy	Closed canopy or Open canopy. Based on the National Vegetation Classification System where woodlands, grasslands, and shrublands were “open” and forests were “closed.”	Text
DepoUnitsStudy	kg/ha-yr	Text

Linking/Joining to Database Tables

NCLD tables (1C, 2C, and 3C) can be joined to this feature dataset by the CLID.

National Critical Load Database (NCLD) Information Use Conditions

Disclaimer

The National Atmospheric Deposition Program (NAPD) Critical Loads of Atmospheric Deposition (CLAD) Science Committee National Critical Loads Database (NCLD) for Nitrogen (N) and Sulfur (S) was developed cooperatively with individuals or groups sharing critical load (CL) data and is NOT intended to be comprehensive of all known CLs for the U.S. While substantial efforts are made to ensure the accuracy of data and documentation contained in the NCLD, complete accuracy of the information cannot be guaranteed. The qualities and accuracy of the CLs are best described in the associated research publication(s). It is important to review material and information in the cited papers prior to using the CL data within the NCLD. In addition, any opinions, findings, conclusions, or recommendations as part of these datasets do not necessarily reflect the views of CLAD, NADP, and/or respective members' affiliations.

Use Condition and Citation

The intended use of the NCLD is for scientific, policy-related, and/or educational purposes. Any published use of the database information must acknowledge the original source(s) of the data. Each CL value is linked to its origin source(s) through the RefID field. The proper citations for each RefID can be found in Table 6 of the database. In addition, whenever the Data User presents and/or publishes research based on CLs in the database, NADP and CLAD must be acknowledged. A suggested Acknowledgement is:
"We acknowledge the Critical Loads of Atmospheric Deposition (CLAD) Science Committee of the National Atmospheric Deposition Program (NADP) for their role in making available NCLD_v3.0 datasets"

and please cite:

Lynch, J.A., Phelan, J., Pardo, L.H., McDonnell, T.C., Clark, C.M., and Bell, M.D. 2020. Detailed Documentation of the National Critical Load Database (NCLD) for U.S. Critical Loads of Sulfur and Nitrogen, version 3.1, National Atmospheric Deposition Program, Wisconsin State Laboratory of Hygiene, Madison, WI.

We request one copy of any printed publications using data from the NCLD to be sent to the NADP Program Office at the address below. Citations or electronic copies are acceptable. For online uses, we request that the author notify the Program Office of the URL address of the online publications or website that includes NCLD data. We encourage teachers and professors to send the program office a brief description of how they have used the NCLD in their curriculum. Students who use the NCLD to complete academic assignments are not required to seek permission from the Program Office, but must acknowledge NADP and CLAD in any publications (e.g., a thesis).

NADP Program Office
Wisconsin State Laboratory of Hygiene
465 Henry Mall
Madison, WI 53706
nadp@slh.wisc.edu (Program Office)

Questions, Errors and Corrections

Please contact NCLD manager, Jason Lynch (US EPA) with any questions about the NCLD or to report errors or corrections at lynch.jason@epa.gov or 202-343-9257.

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Please contact Jason Lynch, US EPA if you have any questions about the database or to report any errors or corrections.

References

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