Austria

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Introduction

In response to the 2014/15 call for data the NFC for Austria provides updated critical load data on acidity (Simple Mass Balance, SMB) and eutrophication (SMB and empirical critical loads) in the new grid resolution of 0.10° Lon × 0.05° Lat. Protection status is reported in addition to the EUNIS habitat type. Biodiversity critical loads are not reported, but will be available in the year 2016 because they are in the focus of an ongoing Austrian research project (CCN-Adapt).

Method

For acidity and nutrient N critical loads the SMB was applied with the methods described in ICP Modelling & Mapping Manual (2014). Only forested areas were taken into account.
Nutrient critical loads were derived from climatic, and soil maps, Austrian-wide forest yield data in a resolution of 0.5°Lon x 0.25°Lat, and a detailed habitat map (Umweltbundesamt, 2015). Following the Swiss method (Posch et al., 2003), we used an altitude-dependent acceptable (critical) N leaching (Nle(acc)). Nle(acc) is linearly decreasing between 500 m with 4 kg N/ha/yr (= 285 eq/ha/yr) and 2000 m with 2 kg N/ha/yr (= 143 eq/ha/yr).
In order to calculate acidity critical loads we additionally used forest point data with soil profile information (FBVA, 1992). We calculated lgKAlox based on the percent organic matter (OM) of the soils:

$$\mathrm{lgKAlox} = 9.8602 - 1.6755 * \log(OM) \qquad \text{for } 1.25 < OM < 100;$$
$$\mathrm{lgKAlox} = 9.7 \qquad \text{for } OM <= 1.25$$

Base cation weathering was derived following De Vries et al. (1993) by using soil texture, parent material, and annual mean temperature. Base cation uptake was taken from the forest yield data.
The empirical critical loads were derived with the habitat map together with minimum critical load values given in Bobbink & Hettelingh (2011).

Minor adjustments of empirical values were done for some habitat types based on expert knowledge (Table AT.1).

Table AT.1 Empirical Critical Loads (kg N ha-1yr-1) for N effects in ecosystems. Minimum and maximum values as given in Bobbink & Hettelingh (2011), and adjustments

EUNIS	**Name (EUNIS, own)**	**Min Cl_{emp}**	**Max Cl_{emp}**	**AT Cl_{emp}**
C1.4	Permanent dystrophic lakes, ponds and pools	3	10	3
D1	Raised and blanket bogs	5	10	5
D1.1	Raised bogs	5	10	5
D1.2	Blanket bogs	5	10	5
D2	Valley mires, poor fens and transition mires	10	15	10
D2.3	Transition mires and quaking bogs	10	15	10
D3	Aapa, palsa and polygon mires	5	10	5
D4	Base-rich fens and calcareous spring mires	15	30	15
D4.1	Rich fens, including eutrophic tall-herb fens and calcareous flushes and soaks	15	30	15
D4.2	Basic mountain flushes and streamsides, with a rich arctic-montane flora	15	25	15
D4.22	Alpine riverine [Carex maritima] ([Carex incurva]) swards	15	25	15
	X04: Raised bog complexes			5
E1	Dry grasslands	15	25	15
E1.1	Inland sand and rock with open vegetation	15	25	15
E1.12	Euro-Siberian pioneer calcareous sand swards	15	25	15
E1.2	Perennial calcareous grassland and basic steppes	15	25	15
E1.22	Arid subcontinental steppic grassland ([Festucion valesiacae])	15	25	15
E1.23	Meso-xerophile subcontinental meadow-steppes ([Cirsio-Brachypodion])	15	25	15
E1.24	Central alpine arid grassland ([Stipo-Poion])	15	25	15
E1.26	Sub-Atlantic semi-dry calcareous grassland	15	25	15
E1.27	Sub-Atlantic very dry calcareous grassland	15	25	15
E1.29	[Festuca pallens] grassland	15	25	15
E1.2B	Serpentine steppes	15	25	15
E1.2C	Pannonic loess steppic grassland	15	25	15
E1.7	Closed non-Mediterranean dry acid and neutral grassland	10	15	10
E1.76	Dry sub-continental acid steppic grasslands	10	15	10
E1.831	Iberian montane [Nardus stricta] swards	15	25	15

E1.9	Open non-Mediterranean dry acid and neutral grassland, including inland dune grassland	10	15	15
E1.99	Pannonic inland dunes	10	15	10
E1.D	Unmanaged xeric grassland	10	15	10
	E1_calc: calcareous dry grassland	15	25	15
	E1_acid: acid and neutral dry grassland	10	15	10
E2.2	Low and medium altitude hay meadows	20	30	20
E2.3	Mountain hay meadows	10	20	20
E3.5	Moist or wet oligotrophic grassland	15	25	15
E4	Alpine and subalpine grasslands	5	10	5
E4.3	Acid alpine and subalpine grassland	5	10	5
F2	Arctic, alpine and subalpine scrub	5	15	5
F2.2	Evergreen alpine and subalpine heath and scrub	5	15	5
F2.222	Pyrenean rusty alpenrose heaths	5	15	5
F2.3	Subalpine deciduous scrub	5	15	15
F2.4	Conifer scrub close to the tree limit	5	15	5
F4.2	Dry heaths	10	20	10
G1	Broadleaved deciduous woodland	10	20	10
G1.6	[Fagus] woodland	10	20	10
G1.7	Thermophilous deciduous woodland	10	20	10
G1.8	Acidophilous [Quercus]-dominated woodland	10	15	10
G1.A	Meso- and eutrophic [Quercus], [Carpinus], [Fraxinus], [Acer], [Tilia], [Ulmus] and related woodland	15	20	15
G3	Coniferous woodland	5	15	10
G3.1	[Abies] and [Picea] woodland	10	15	10
G3.2	Alpine [Larix] - [Pinus cembra] woodland	5	15	10
G3.3	[Pinus uncinata] woodland	5	15	10
G3.4	[Pinus sylvestris] woodland south of the taiga	5	15	5
G3.5	[Pinus nigra] woodland	15	15	15
G3.D	Boreal bog conifer woodland			5
G3.E	Nemoral bog conifer woodland			5
G4	Mixed deciduous and coniferous woodland	10	20	10

Data sources

Habitat map: we used a new habitat map with a resolution of 100 x 100 m of entire Austria including EUNIS Level 2 and Level 3 habitats (Umweltbundesamt, 2015).

Loss of N and base cations via forest harvest: Forest yield data was derived for a 0.5° Lon x 0.25° Lat grid from the Austrian forest inventory. The data covers the period between 1981 and 2009. For each cell, biomass removal of conifers and deciduous trees was calculated, while element contents given in Jakobsen et al. (2003) were used to derive N and base cation loss per unit area. Additional to biomass removal, the per-cell area percentage of forests out of use, and thus without element loss, was calculated. The respective share of forest areas were distributed evenly among all forest types.

Base cation deposition: Deposition of base cations was taken from Van Loon et al. (2005) for the year 2000 and was provided by the Coordination Centre of Effects. The original 50 x 50 km resolution was statistically downscaled to the 0.10° Lon × 0.05° Lat grid with mapped precipitation data.

Forest soil plots: We used 496 soil profiles from the forest soil status inventory (FBVA 1992) as additional input for the SMB to calculate acidity critical loads. The soil data was collected between the years 1987–1991 in a rectangular 8.7 km grid over entire Austria.

Reported data sets

Critical loads of acidity (CLacid): CLmaxS, CLminN and CLmaxN as computed with the SMB model. Only forest sites with an area >0.01 km² are included

Critical loads of nutrient nitrogen (CLnut): also here the SMB was applied. Only forest sites with an area >0.01 km² are included

Empirical critical loads (CLemp): based on a habitat map and empirical values given in Bobbink & Hettelingh (2011). Only forest sites with an area >0.01 km² are included.

Instruction for the use of Critical Loads

In broader applications of the N critical loads by the CCE the following procedure should be applied. Since for the same 'ecord' different critical load methods were applied, a decision has to be made as to which to use. For Austria only for forests different methods have been applied. Therefore, for all but forests empirical critical loads for eutrophication effects (CLemp) should be used. For forests, mass balance critical loads (CLnut) should be used because the detail in EUNIS forest types was too coarse to differentiate sufficiently.

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