France

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Critical Loads of Nitrogen and Dynamic Modelling

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Working Group on Effects
of the
Convention on Long-range Transboundary Air Pollution

ICP M&M Coordination Centre for Effects

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Modelled critical loads and dynamic modelling data

The objectives of this call for data were to submit updated critical loads and to provide time series of modelled chemical variables for different deposition scenarios, i.e. dynamic modelling results. In 2005, the French National Focal Centre (NFC) provided updated critical load values for nitrogen (acid and nutrient) and sulphur as well as dynamic modelling results (Probst et al., 2005). In 2007, the French NFC: (1) tested the updated critical concentrations for the calculation of critical loads of nutrient nitrogen proposed by the Coordination Centre for Effects (CCE) and, (2) sent data for dynamic modelling. In comparison with 2005, the only major change is the removal of costal ecosystems (EUNIS code B1.4) from the dynamic modelling database as, for those ecosystems, critical loads were determined empirically (Probst et al., 2005).

Calculation method

The data were computed following the method used in 2005 by the French NFC (Probst et al., 2005) which is in accordance with the Mapping Manual (UBA, 2004). For steady state critical loads, the Steady State Mass Balance (SSMB) model was applied on the soil top-layer (0–20 cm). VSD (Posch et al., 2003) was used for dynamic modelling. The results obtained with VSD for soils with high buffering capacity show significant differences with more complex models (Probst et al., 2003; Probst et al., 2005). However VSD allows better consistency for impact assessment within Europe (Probst et al., 2005). Due to software inconsistencies, the French NFC could not run VSD in 2007. In consequence, the modelling was performed by the CCE with the data provided by the French NFC.

Data sources

Table FR-1. *Critical loads and dynamic modelling parameters.*

Parameter	Unit	Description
Chemical criterions used and critical values		See Table FR-3
Acceptable critical nitrogen concentration	meq m^{-3}	Derived from the acceptable nitrogen leaching (0 for plain deciduous forest; 50 for plain coniferous forest; 100 for mountain forest ecosystems — Party and Thomas, 2000) and the amount of water percolating through the root zone.
BCdep	eq $ha^{-1}a^{-1}$	RENECOFOR network measurements extrapolated at the national scale (Ulrich et al., 1998; Croisé et al., 2002)
BCweath	eq $ha^{-1}a^{-1}$	PROFILE simulations (Party, 1999)
BCuptake	eq $ha^{-1}a^{-1}$	Calculated from [BC] in vegetation (Party, 1999) and net uptake of biomass by harvesting (IFN, 2002)
Nuptake	eq $ha^{-1}a^{-1}$	Calculated from [N] in vegetation (Party and Thomas, 2000) and net uptake of biomass by harvesting (IFN, 2002)
fde	eq $ha^{-1}a^{-1}$	Extrapolated from Guidance manual data (UBA, 2004) to French soil conditions (see Table FR-2)
All soil parameters		From RENECOFOR network data (Brêthes et al., 1997) and CCE network data (Badeau and Peiffer, 2001). See Table FR-4.

Table FR-2. *Denitrification factor values (adapted from UBA, 2004).*

Soil type	*fde*
Non hydromorphic soil	0.05 to 0.2
Hydromorphic silt or sandy soil	0.3
Hydromorphic clay	0.4
Peat soil and marshes	0.5

Table FR-3. *Critical limit values.*

Soil and bedrock type	**ANC criteria**	**Critical limit value**
Soft calcareous sediments	Al:BC	1.2
Hard calcareous sediments	Al:BC	1.2
Soft acid sediments		
Sands	pH	4.6
Sandy silex formations	pH	4.6
Others	Al:BC	1.2
Hard acid sediments		
Schists	pH	4.6
Sandstones	pH	4.6
Others	Al:BC	1.2
Metamorphic rocks		
Acid granite	pH	4.6
Others	Al:BC	1.2
Volcanic rocks	Al:BC	1.2

Table FR-4. *Soil parameters (from Brêthes and Ulrich, 1998).*

	Units	Min	Max	Median
Bulk density	g cm^{-3}	0.732	1.4	0.915
Conc. Org. Acids	eq m^{-3}	0	0.02436	3.5×10^{-5}
CEC	meq kg^{-1}	1	38	20
Base saturation	-	0.12	1	0.78
Carbon	g m^{-2}	3920	14000	9878
C:N ratio		12	28	15

The total concentration of organic acids in soil solution is calculated from *DOC* (Dissolved Organic Carbon) which is estimated from pH and clay content in soil layer. Due to the lack of data on *pCO2*, only one value (5 atm) was considered for *pCO2* in the topsoil.

Results

As no major changes were made between 2005 and 2007, please refer to the 2005 national report (Probst et al., 2005) for results and comments.

Empirical critical loads of nutrient nitrogen

Method

The determination of empirical critical loads of nitrogen for French ecosystems was based on the method described in chapter 5.2 of the Mapping Manual (UBA, 2004). The values given in table 5.1 of the Mapping Manual, were adapted to the French terrestrial ecosystems (Party et al., 2001) based on: (1) the information available on the potential vegetation and the land use for each ecosystem and, (2) the adaptation rules given in table 5.2 of UBA (2004) using temperature, frost period and base cation availability estimated by expert judgement. The subsequent empirical critical loads are given in Table FR-5.

Table FR-5. *Empirical critical loads, in eq $ha^{-1}a^{-1}$, derived for the French ecosystems (adapted from Party et al., 2001). K: calcareous ecosystem; A: acidic ecosystem; Out Cors.: outside Corsica; Per.+Bord.: Perigord and Bordeaux regions;SW+Nantes: South-West and Nantes regions.*

Potential vegetation	Land use			
	Coastal dune	Grassland	Upland meadow	Forest
Coastal dunes and heathlands	1786			
Swamps, bogs and wet heathlands	1786	714		714
Quercus robur dominated woodlands		1214		714
Quercus-Carpinus or *Ulmus* woodlands with *Quercus petraea*	1214	1214	500	857
Quercus petraea and *Q. pubescens* woodlands	1429	1429		1214
Quercus petraea, *Q. robur* or *pubescens* and *Q. pyrenaica* woodlands		1214		Per. + Bord.: 1214 SW + Nantes: 714
Mixed *Fagus-Quercus* and *Fagus* woodlands	1214	1214	500	1071
Quercus pubescens woodlands		K: 1789 A: 714		Corsica: 1071 Out Cors.: 1429
Quercus ilex woodlands	K: 1789 A: 714	K: 1789 A: 714		Corsica: 1071 Out Cors.: 1429
Quercus suber woodlands		714		Corsica: 1071 Out Cors.: 1429
Pinus halepensis and *P. nigra laricio corsicana* Mediterranean woodlands		857		1071

Potential vegetation	Land use			
	Coastal dune	Grassland	Upland meadow	Forest
Pinus pinaster woodlands		714		500
Abies and mixed *Abies-Fagus* woodlands		714	714	857
Picea woodlands		714		714
Pinus sylvestris woodlands		714		500
Pinus uncinata and *P. cembra* woodlands		500		500
Larix woodlands		714		714
Alpine and subalpine grasslands			500	

Data Sources

The French ecosystem classification and map was updated in 2003 for calculation and mapping of the critical loads of acidity and nutrient nitrogen (Probst *et al*., 2003; Moncoulon et al., 2004). The map of potential vegetation was synthesised for the French territory by Party (1999) from various vegetation maps (Dupias and Rey, 1985; Houzard, 1986; Ozenda and Lucas, 1987). Land use was derived from the map of forested and grassland areas in de Monza (1989) as well as the Digital Elevation Model GTOPO30 (USGS, 1996).

Results

The most sensitive areas to nitrogen deposition are located in the Landes (SW), the eastern part of the Paris basin, the eastern part of the Massif Central as well as in the Alps. Empirical critical loads of nitrogen are higher than critical loads for nutrient nitrogen determined with the Steady State Mass Balance (SSMB) model (Probst et al., 2005). Consequently, the sensitivity of the ecosystems is lower when derived from the empirical method. Comparatively to the SSMB model, most of the ecosystems shifted to a higher critical load class with the empirical method (+ 1 class for 49 % of the ecosystems and + 2 classes for 35 % of the ecosystems).

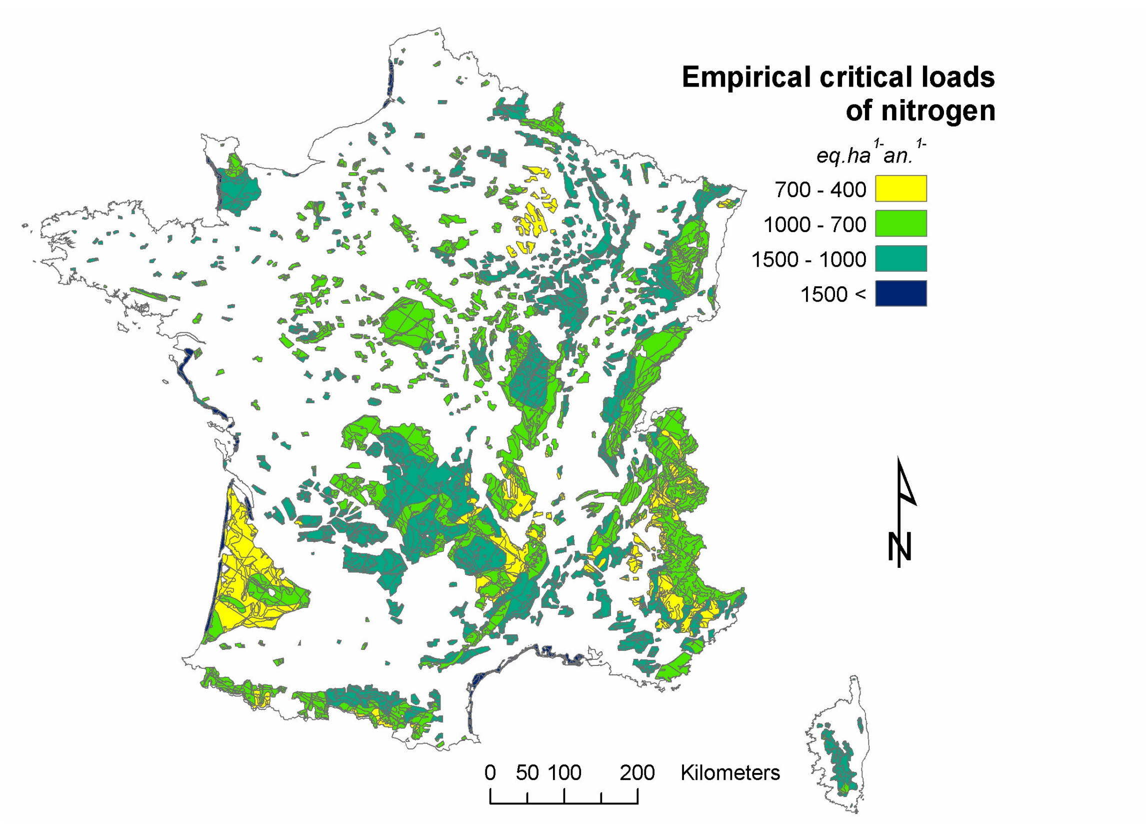

Figure FR-1. *Map of empirical critical loads of nitrogen.*

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