Eutrophication risk of European forests: a first approximation using empirical critical loads and atmospheric chemistry transport models

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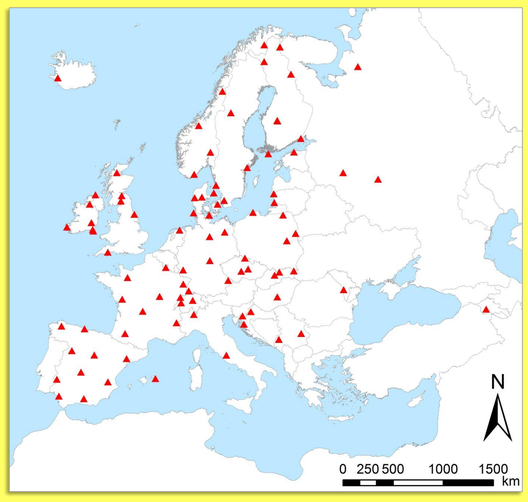
An inter-comparison and evaluation of 14 atmospheric chemistry transport models used in AQMEII3 project (Task Force on Hemispheric Transport of Air Pollutants) and EURODELTA-Trends project (Task Force on Measurements and Modelling) was performed. An ensemble of the best models for estimating N wet deposition was used to explore the implications of N deposition for the conservation of protected terrestrial habitats within the Natura 2000 network.

Evaluation of the models

Modeled values for concentration and wet deposition of pollutants were compared with measurements (annual and monthly) made at >80 **EMEP monitoring sites** for 2010.

In general, the protected forest habitats within the **Natura 2000 Network** were well represented within a buffered area of 50 km-radius around the EMEP monitoring sites (with respect to their abundance within the entire Network). Regarding EMEP sites with measurements for all N variables (wet-deposited, gaseous and particulate N), the representativity was slightly poorer.

A more robust estimate of deposition was obtained through a **multi-model ensemble** of the best models, constructed using the mean and standard deviation of the total deposition for each grid cell calculated from the model estimates.



EMEP sites used for evaluation

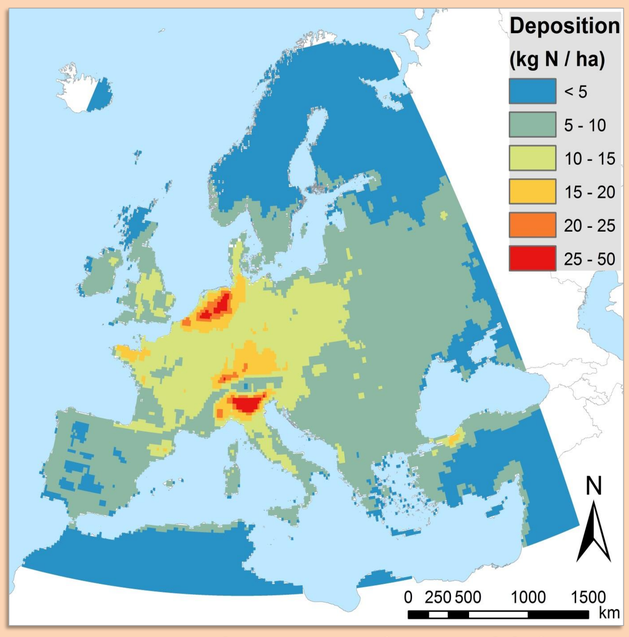
Example of buffer areas used for testing sites' representativity

Risk assessment

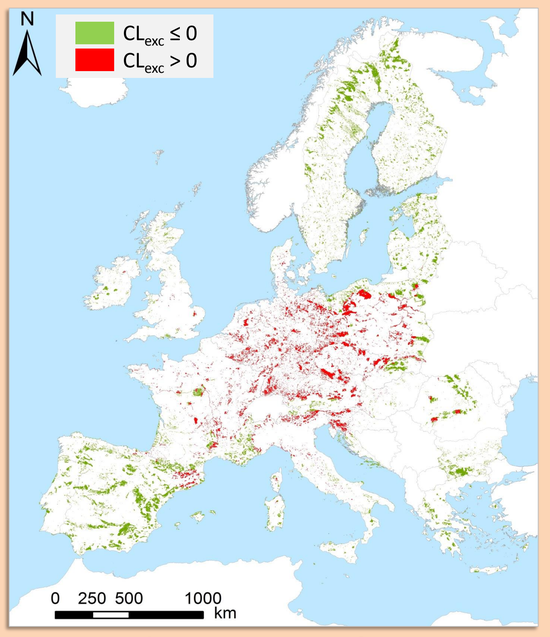
Critical Loads (CL) are thresholds for deposition of atmospheric pollutants, set by the *Working Group on Effects* (CLRTAP) for the protection of ecosystems.

Mean N deposition from the model ensemble and a map of *most-likely habitats* in Europe (EEA) were used for calculating **exceedances** of CL (CL_{exc}). The areas showing exceedances were identified for each habitat class.

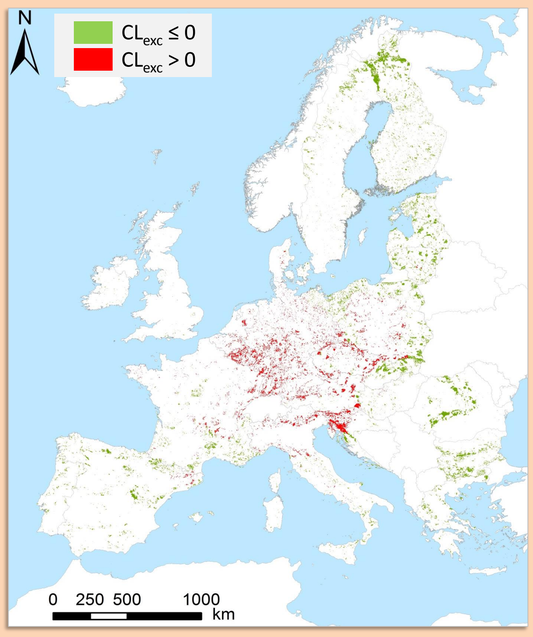
Coniferous (G3) and mixed woodlands (G4), with CL_{exc} in 34% and 32% of their respective areas, were among the six terrestrial habitats with the largest surface area at risk of experience effects from eutrophication.



Mean N deposition (ensemble)



Risk assessment for G3



Risk assessment for G4

EUNIS code	Area in Natura 2000 network	CL (kgN/ha)	CL_{exc}	CL_{exc}^2
G1	25%	15.0	3%	12%
G2	1%	15.0	0%	5%
G3	21%	10.0	30%	51%
G4	9%	10.8	29%	55%

RISK ASSESSMENT OF FOREST HABITAT CLASSES

CL: Empirical Critical Load used in this assessment; **CL_{exc}:** Percentage of the assessed area with a N deposition (mean of ensemble) exeeceding the CL; **CL_{exc}^2:** CL_{exc} when using mean plus standard deviation of the ensemble.

***EUNIS codes: G1** - broadleaved deciduous woodland; **G2** - Broadleaved evergreen woodland; **G3** - coniferous woodland; **G4** - mixed deciduous and coniferous woodland*

Risk assessment in the Mediterranean Basin

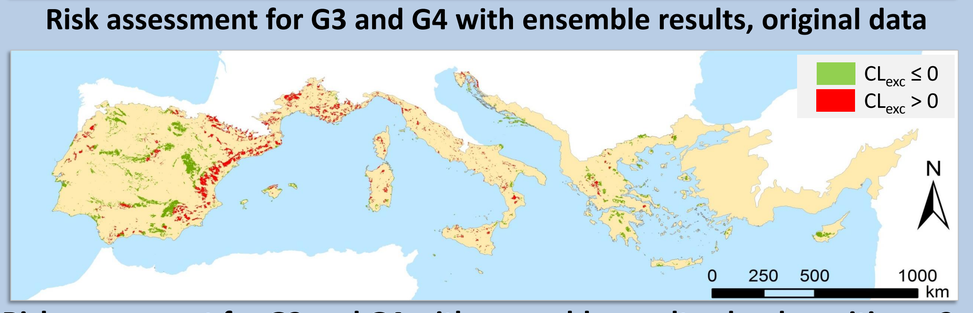
According to previous studies, modelled dry deposition of N might be underestimated for Mediterranean forests by up to 63%. This is why a new risk assessment was performed for the Mediterranean Basin using a **dry deposition** value equal to two-times that from the multi-model ensemble. According this methodology, the threatened area increased drastically for coniferous (G3) and mixed woodlands (G4).

EUNIS code	Area assessed (km^2)	CL_{exc}	CL_{exc} (dry x 2)
G1	35613	0%	16%
G2	7269	0%	11%
G3	30985	5%	41%
G4	8385	6%	41%

MEDITERRANEAN RISK ASSESSMENT

CL_{exc}: Percentage of the assessed area with a N deposition (mean of ensemble) exeeceding the CL; **CL_{exc} (dry x 2):** CL_{exc} when using the ensemble mean of dry deposition times-two.

Risk assessment for G3 and G4 with ensemble results, original data



Risk assessment for G3 and G4 with ensemble results, dry deposition x 2

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