



Project Number 282910

ÉCLAIRE

Effects of Climate Change on Air Pollution Impacts and Response Strategies for European Ecosystems

Seventh Framework Programme

Theme: Environment

D19.3 Report on magnitude, location and robustness of assessments of adverse effects of GAINS scenarios

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CO	Confidential, only for members of the consortium (including the Commission Services)	<input type="checkbox"/>

1. Executive Summary

The focus in the reporting period was on the development and testing of methods and possible indicators to assess “no net loss of biodiversity”. The aim is to assess to which extent “no net loss of biodiversity” is achieved by countries using suitable biodiversity endpoints (e.g. protection of rare species, provisioning, regulating or cultural services) of interest on a regional scale.

A call for data – adopted under the Convention on Long-range Transboundary Air Pollution – is part of this work. The first call for “no net loss of biodiversity” data to Parties under the Convention was issued in October 2012 (MS87) with a deadline in March 2014. It has been reported under the Convention on Long-range Transboundary Air Pollution (CLRTAP). The second call will be issued in October 2014 after an evaluation of the methodology that took place at the CCE workshop (MS89) and adopted at the 33rd session of the Working Group on Effects (Geneva, 17-19 September 2014) where the WP19 methodology was presented as planned under MS84.

In conjunction with the data calls mentioned here above, progress was made in the development of a novel indicator, the “habitat suitability index” (HSI) developed at the CCE workshop under the auspices of the LRTAP Convention and ECLAIRE, hosted by ENEA (MS89; Rome, 7-10 April 2014). The HSI is still under development. The HSI can be used in scenario analysis of ecosystem impacts of emission mitigation strategies simulated in the GAINS system.

The geographical location of preliminary assessments of the HIS index (in collaboration with C4) has been implemented in the GAINS system. The HSI can, at this stage of the project only illustratively, be mapped on a European scale for all European Nature Information System (EUNIS) classes. The HIS methods and available plant species input data need to be verified to enable final GAINS system implementation in the remaining period of the project.

HSI maps can be produced for reference and target years GAINS emission abatement scenario. The following scenarios have been made operational under the ECLAIRE project (in collaboration with WP20) i.e. the “Current Legislation” (CLE), “Maximum Feasible Reduction”(MFR), “Decarbonisation” (DECARB), and Maximum Control Effort” (MCE).

The habitat suitability index completes other GAINS system impact indicators (i.e. computed - and empirical critical loads of nutrient as a basis for the comparison between GAINS scenario-specific impacts.

Finally, the methodology for the robustness analysis of ecosystem impacts of GAINS scenarios is in place. It is based on the analysis of the location and magnitudes of exceedances of various critical thresholds, following the principle of “ensemble modelling”. The use of computed and empirical critical loads critical in robustness analysis is now further strengthened with the habitat suitability index loads to assess the reliability of the location and magnitude of exceedances caused by nitrogen deposition.

Objectives:

Objectives under WP19 are:

- (1) To operationalize new critical thresholds for the GAINS assessment of adverse effects of air pollution abatement scenarios (incl. climate change) on plant species diversity and ecosystem services
- (2) To provide operational indicators for the support of policy with the assessment of scenario-specific adverse effects
- (3) To analyse the robustness, the magnitude and location of scenario specific adverse effects on a regional scale.

2. Activities under D19.3:***Task 19.1 New Critical thresholds***

In conjunction with the data calls mentioned here above, progress was made in the development of a novel indicator, the “habitat suitability index” (HSI) developed at the CCE workshop under the auspices of the LRTAP Convention and ECLAIRE, hosted by ENEA (MS89; Rome, 7-10 April 2014). The HSI is still under development. The HSI can be used in scenario analysis of ecosystem impacts of emission mitigation strategies simulated in the GAINS system.

Task 19.2 Dynamic modelling:

A combined dynamic growth (EUgrow) and soil (VSD+) model is further developed under C4 and used on a European scale to simulate the temporal development of abiotic variables (in WP15). These variables are then used in the PROPS model (from C4) to assess the habitat suitability index described in 2.1, for any GAINS scenario under WP19.

A call for data (see below) has been extended to also include parameters relevant for the assessment of the HSI. Under the ECLAIRE program use is also made of the *background database* on soil chemistry and EUNIS vegetation developed in a collaboration between C4 and C5. This background database is consistent over Europe and may be employed in addition to – or instead of – country specific data submissions. The latter need to be reviewed at the 34th session of the Working Group on Effects in 2015, i.e. at the end of the ECLAIRE project..

Task 19.3 Dose response relationships

This task addresses the use in GAINS system scenario analysis of relationships in European natural areas between scenario specific nitrogen dose in combination with climate change and ozone exposure and habitat suitability indices, described in 2.1. The applicability of the concept on a European scale has been illustrated in Figure 1 in para 3 below.

Task 19.4 Robustness analysis of GAINS scenario impacts

Robustness analysis of ecosystem impacts of GAINS scenarios is based on the analysis of the location and magnitudes of exceedances of various critical thresholds. Next to the of computed and empirical critical loads critical loads to establish the location and magnitude of exceedances caused by nitrogen deposition, robustness analysis may now be further strengthened with the habitat suitability index.

Robustness analysis would be geared around the question whether nitrogen deposition causes different impact indicators to point in the same direction, either positive (‘recovery’) or negative (‘damage’) or opposite direction in interaction with climate change. The method is based on “ensemble assessment” of impact indicators

Task 19.5 Workshops

A CCE workshop (Rome, 7-10 April 2014) was held (MS89). The workshop, which was held back to back with the ICP-Modelling and Mapping of the LRTAP Convention, was attended by 63 experts from 20 countries. The workshop included:

- (a) sessions on the review of the 2012-2014 call for data on “no net loss of biodiversity” and its follow-up, i.e. the development of the HSI indicator (see 2.1),
- (b) a session entitled “Novel critical thresholds, status of ECLAIRE, other scientific progress and effect-oriented policy support” (MS91)
- (c) sessions reporting on impacts of nitrogen and ozone in the field and under laboratory conditions.

3. Results:

The development and testing of the HSI indicator, requires that the modelling of soil chemical processes (VSD+ model) is linked to a methodology that assesses the probability of occurrence of plant species (PROPS model) on a European scale. Typical species in habitats classified under the European Nature Information System (EUNIS) are identified and tested in the context of new indicator development. More details of the modelling background are provided under ECLAIRE C14 in general and WP15 and WP16 in particular.

Finally the HSI is derived from a relationship between the probability of occurrence and abiotic variables, i.e. pH, N concentration in the top soil, temperature and precipitation (illustrated in Figure 1)

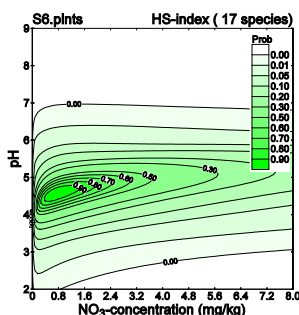


Figure 1: Illustration of isolines of the Habitat Suitability index as function of NO_3 concentration in the soil and pH (left) Temperature and precipitation is assumed constant in this illustration (C4 deliverable in collaboration with CCE workshops organized under C5)

The HSI can, at this stage of the project only illustratively, be mapped on a European scale for all European Nature Information System classes. This is illustrated in Figure 2. This kind of map can be made for each GAINS emission abatement scenario. The habitat suitability index completes other GAINS system impact indicators (i.e. computed critical loads, empirical critical loads, plant species richness of acid grasslands) as a basis for the comparison between GAINS scenario-specific impacts.

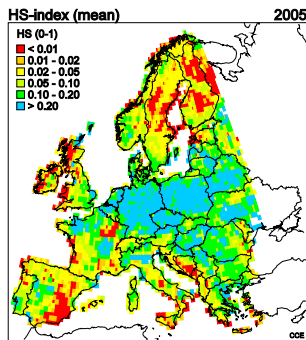


Figure 2: Tentative map showing the spatial distribution in 2005 of values for the habitat suitability index of EUNIS classes in EMEP grid cells; a preliminary Gains scenario implementation of methodology developed in C4 in collaboration with CCE workshops under C5).

The habitat suitability index can further be made operational in a GAINS context by expressing it as a function of sulphur and nitrogen deposition (WP16) to obtain a critical load of habitat suitability. This critical load can then be compared to atmospheric deposition of reactive nitrogen in a way similar as other critical loads (see above) were used to compute Average Accumulated Exceedances in European grid cells (eco-)regions or countries.

4. Milestones achieved:

CCE workshops including their reporting were successfully held in Copenhagen (8-11 April 2013; [MS88](#)) and in Rome (7-10 April 2014; [MS89](#)). Results and minutes of these meetings were presented at the 32nd (Geneva, 12-13 September 2013; [MS83](#)) and 33rd session of the Working Group on Effects (Geneva, 17-19 September 2014; [MS84](#)) respectively. MS90 (Modelling Framework in place) was completed in collaboration with C4 and presented at various meetings under the Convention on LRTAP (see above). It included the design and use of a novel threshold (Dose-Response relationship) in the GAINS system. [MS92](#), the first complete set of scenario specific adverse effects has been completed and illustrations were presented in C5 and C4-C5 cross component meetings at the General ECLAIRE Assembly (Budapest, 29 September – 2 October 2014). A core set of scenarios for use under ECLAIRE in 2015 is being finalized under WP20 for use under C5 and C4.

The modelling system ([D19.2](#)) was applied in support of a technical EEA report, submitted in September 2013 to the EEA, which finally appeared as EEA Technical Report 11/2014 (<http://www.eea.europa.eu/publications/effects-of-air-pollution-on>)

Deliverable [D19.3](#) (Report on the magnitude, location and robustness) was presented in the C5 component meeting of the General ECLAIRE Assembly (Budapest, 29 September – 2 October 2014).

Progress of the collaboration between components C4 and C5 will also be reflected in chapters of the CCE Status Report 2014 (Slootweg *et al.*, 2014, *in prep.*).

5. Deviations and reasons:

N.A.

6. Publications:

2013 publications (including C5 in collaboration with C4)

Hettelingh J-P, Posch M, Velders GJM, Ruysenaars P, Adams M, De Leeuw F, Lükewille A, Maas R, Sliggers J, Slootweg J, 2013. Assessing interim objectives for acidification, eutrophication and ground-level ozone of the EU National Emission Ceilings Directive with 2001 and 2012 knowledge. *Atmospheric Environment* 75: 129-140; DOI: [10.1016/j.atmosenv.2013.03.060](https://doi.org/10.1016/j.atmosenv.2013.03.060)

Holmberg M, Vuorenmaa J, Posch M, Forsius M, Lundin L, Kleemola S, Augustaitis A, Beudert B, De Wit HA, Dirnböck T, Evans CD, Frey J, Grandin U, Indriksone I, Krám P, Pompei E, Schulte-Bisping H, Srybny A, Váňa M, 2013. Relationship between critical load exceedances and empirical impact indicators at Integrated Monitoring sites across Europe. *Ecological Indicators* 24: 256-265; DOI: [10.1016/j.ecolind.2012.06.013](https://doi.org/10.1016/j.ecolind.2012.06.013)

2014 publications (including C5 in collaboration with C4)

European Environment Agency: Hettelingh J-P, Posch M, 2014. Effects of Air Pollution on European Ecosystems: Past and future exposure of European freshwater and terrestrial habitats to acidifying and eutrophying air pollutants, European Environment Agency, Technical report 11/2014 prepared by the CCE with contributions from the ETC-ACM and the EEA, <http://www.eea.europa.eu/publications/effects-of-air-pollution-on>

De Vries W, Hettelingh J-P, Posch M (eds.) several chapters in: "Critical Loads and Dynamic Risk Assessments of Nitrogen, Acidity and Metals for Terrestrial and Aquatic Ecosystems", submitted to Springer, *in prep.*

7. Meetings:

ECLAIRE results have been presented as follows, in 2013 and 2014 respectively::

2013 presentations of C5 and C4 components by the RIVM-CCE:

29th Session of the Task Force on the Modelling and Mapping of Critical Loads and Levels and Air pollution Effects, Risks and Trends under the Convention on Long-range Transboundary Air Pollution (Copenhagen, 8-11 April 2013)

EU Greenweek (Brussels, 4-8 June 2013) entitled "Air quality and ecosystems: Benefits of air pollution control for biodiversity and ecosystem services and use in integrated assessment"

JNCC conference "Nitrogen deposition and the habitat Directive Impacts & Responses: Our shared Experience (Peterborough, UK, 2-4 December 2013), entitled "Regional (Incl. Natura 2000 areas) scenario assessments of nitrogen critical load exceedances and of tentative impacts on species richness".

32nd Session of the Working Group on Effects (Geneva, 12-13 September 2013)

ECLAIRE General Assemble (Zagreb, October 2013)

Task Force on Integrated Assessment Modelling under the Convention on Long-range Transboundary Air Pollution (Zagreb, 2013)

32nd Meeting of the Executive Body under the Convention on Long-range Transboundary Air Pollution, entitled "Guidance document on health and environmental improvements using new knowledge, methods and data"

2014 presentations

30th Session of the Task Force on the Modelling and Mapping of Critical Loads and Levels and Air pollution Effects, Risks and Trends under the Convention on Long-range Transboundary Air Pollution (Rome, 7-10 April 2014)

33rd Session of the Working Group on Effects (Geneva, 17-19 September 2014)

ECLAIRE General Assemble, October 2014.

8. List of Documents/Annexes:

2013 Reports under the Convention on Long-range Transboundary Air Pollution:

Minutes of the 23rd CCE workshop and 29th Task Force on modelling and Mapping of critical loads and levels and air pollution effects risks and trends, held in Copenhagen (8-11 April 2013), <http://www.wge-cce.org/dsresource?type=pdf&disposition=inline&objectid=rivmp:214391&versionid=&subjectname=>

32nd session of the Working Group on Effects (Geneva, 12-13 September 2013)

- ECE/EB.AIR/WG.1/2013/10 – Technical Report of the Coordination Centre for Effects and the Task Force on Modelling and Mapping, http://www.unece.org/fileadmin/DAM/env/documents/2013/air/wge/ECE_EB.AIR_WG.1_2013_10_ENG.pdf
- Informal document No. 4: DRAFT Guidance document VII on health and environmental improvements using new knowledge, methods and data, Room document.
- ECE/EB.AIR/WG.1/2013/14 – CCE contribution to ICP-V (eds.): Benefits of Air Pollution Control for Biodiversity and Ecosystem Service, and related:
 - o informal document 1, full report, http://www.unece.org/fileadmin/DAM/env/documents/2013/air/wge/No.1__Benefits_of_air_pollution_control_for_biodiversity_and_ecosystem_services.pdf
 - o informal document 7, brochure, http://www.unece.org/fileadmin/DAM/env/documents/2013/air/wge/No.7__Benefits_of_air_pollution_control_for_biodiversity_and_ecosystem_services_-_Brochure.pdf
 - o EB 32 version of the document
- ECE/EB.AIR/WG.1/2013/3 – CCE contribution to WGE-extended Bureau (eds.): 2013 joint report on activities of the International Cooperative Programs and the Joint Task Force on the health aspects of Air Pollution

32nd Session of the Executive Body (Geneva, 09-13 December 2013)

ECE/EB.AIR/WG.1/2013/8 , Guidance document VII on health and environmental improvements using new knowledge, methods and data

2014 Reports under the Convention on Long-range Transboundary Air Pollution:

Minutes of the 24rd CCE workshop and 30th Task Force on modelling and Mapping of critical loads and levels and air pollution effects risks and trends, held in Rome (7-10 April 2014), http://www.rivm.nl/media/documenten/cce/Workshops/Rome/ICPMM_CCE_Minutes_2014-06-02.pdf

33rd session of the Working Group on Effects (Geneva, 17-19 September 2014):

- ECE/EB.AIR/WG.1/2014/10 – Technical report of the CCE and TF M&M, http://www.unece.org/fileadmin/DAM/env/documents/2014/AIR/WGE/ECE_EB.AIR_WG.1_2014_10_ENG.pdf

Slootweg J, Posch M, Hettelingh J-P, Mathijssen L. (2014), Modelling and Mapping of Atmospherically-induced plant species diversity impacts in Europe, CCE Status Report 2014 (*in prep.*)