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ÉCLAIRE

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

Seventh Framework Programme

Theme: Environment

D19.2
Report on the modelling system
for the impact assessment under ECLAIRE,
in collaboration with C4, WPs 15 and 16

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PU	Public	x
PP	Restricted to other programme participants (including the Commission Services)	☐
RE	Restricted to a group specified by the consortium (including the Commission Services)	☐
CO	Confidential, only for members of the consortium (including the Commission Services)	☐

1. Executive Summary

Component 5 includes the assessment of adverse effects to biodiversity, defined by the Convention on Biological Diversity as "…the variability among living organisms from all sources including, inter alia, terrestrial, marine and other aquatic ecosystems and the ecological complexes of which they are part; this includes diversity within species, between species and of ecosystem". The focus under ECLAIRE-C5 is on indicators and dose-response functions by which the target of the EC biodiversity strategy, i.e. "no net loss of biodiversity", can be compared between scenarios depicted in C5 and analyzed through the Greenhouse Gas and Air Pollution Interaction and Synergies (GAINS) system.

The GAINS-system assessment of adverse effects of air pollution under climate change can be endogenised within the GAINS model or performed exogenously. The latter is appropriate when the analysis of impacts requires the use of models or databases that are too complex or bulky to ensure practical interactivity of the GAINS model. For example, critical thresholds, such as critical loads of acidity or eutrophication are part of the GAINS-model. However, dynamic models to enable the assessment of delayed responses of ecosystems to the change of air pollution and climate are not. Both are part of the GAINS-system.
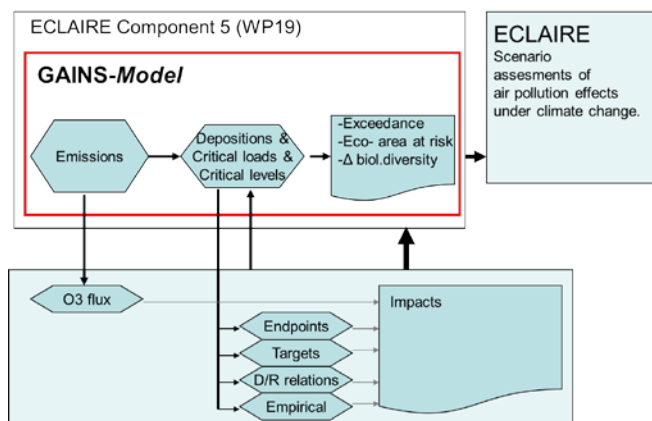

Figure 1: Flow chart of the GAINS system for the assessment of adverse effects of air pollution under climate change either within, as an endogenous part of, the GAINS model or outside depending on the complexity of impact assessment models and data.

The GAINS model already includes critical loads for acidification and eutrophication, while under ECLAIRE also a nitrogen dose-response relationship for EUNIS class E1, E2 and E3 has been made operational on a regional scale (CCE Status Report 2012 at www.wge-cce.org; EEA *in prep.*). Deliverable 19.2. includes the use of test-results of the VSD+-PROPS model being developed under C4. Recent results of the model include the illustrative exploration of two new possible GAINS impact indicators:

a. Indicator values that can result from a 'forward run' of the VSD+/PROPS dynamic soil-vegetation model, i.e. simulating impacts from a reference to a future year.
b. Thresholds for indicators that can result from a backward run of VSD+/PROPS, i.e. identifying required indicator values in a reference year as derived from air/climate targets set in a future year. For example, a chosen occurrence probability for multiple species in a target year can be computed to be achievable when (threshold) requirements for soil chemistry (e.g. pH) or vegetation (i.e. a diversity index) are met in a reference year.

Figure 2, illustrates the use of the Bray-Curtis and Simpson indicator, as could result from a GAINS-system scenario analysis of adverse effects of air pollution under climate change. The Bray-Curtis indicator is a measure for dissimilarity between two species compositions, e.g. comparing two years within or between scenarios. A bray-Curtis index of 1 means the species composition does not vary between years. The Simpson index is a similarity index, which decreases (between 1 and 0) when species become more dominant or fewer species occur. The air pollution abatement and climate change scenario is illustrated to be based on a version of the Current Legislation (CLE) and Maximum Feasible Reduction of air pollutants (MFR) (under the Convention on LRTAP) under constant climate (CON) and A1 climate change scenario (under IPCC) respectively.
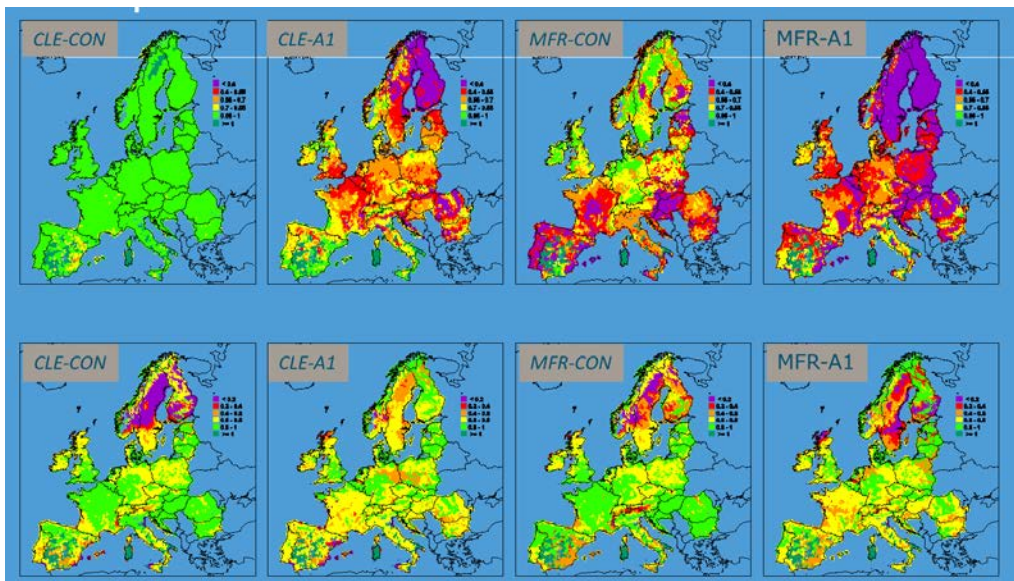

Figure 2: Bray Curtis indicator (top) comparing the species composition in 2050 to 2010, and the Simpson indicator in 2050 under CLE-CON (left), CLE-A1 (centre left), MFR-CON (centre right) and MFR-A1 (right) and Simpson indicator (bottom) in 2050 (this Figure is produced in collaboration with C4)..

Figure 2 illustrates that the choice of a reference case for either the Bray-Curtis as Simpson indicator is important for the interpretation of impacts of air pollution under climate change, but at the same time prone to policy judgement; 'biodiversity' targets that policy analysts may wish to include in scenario assessments with the GAINS model could focus on one or more ecosystem services, on red-list species or more generic conceptions (change of diversity, abundance…). The latter is illustrated in Figure 2. A judgement of the geographical pattern of the values of indicator depends on a 'target' geographical distribution that would follow from the (policy) target included in GAINS. For example, it is seen that the geographical pattern of the Simpson indicator is closer to 1 under CLE-A1 than MFR-A1 in Sweden, and that the two scenarios do not differ much in the Alpine region. In that region the diversity seems closer to 1 under CLE-A1 or MFR-A1 than under CLE-CON or MFR-CON, tentatively suggesting – in this illustration which should not be interpreted for use in any policy or research context – that the Simpson indicator is affected more under climate policy than under air pollution abatement policy.

The following phase of WP19 includes the further development, in collaboration with C4, of indicators that are suitable for use in the GAINS-system. The logic of using VSD+/PROPS in a forward or backward mode (see above) is key.

Objectives:

1. To Operationalize novel critical thresholds (or comparable parameters) for GAINS assessment of adverse effects of air pollution under climate change to geo-chemistry, plant species diversity and ecosystem services
2. To provide operational indicators for the assessment of scenario specific adverse effects [for policy support]
3. To analyse the robustness, the magnitudes and location of scenario specific adverse effects under climate change on a regional and European scale

2. Activities:

a. Application of impact indicators in support of publications (see list) and meetings (see list)
b. Exploring applicability for GAINS-system scenario analysis of new impact indicators in collaboration with ECLAIRE-C4.

3. Results:

Assessment of adverse effects of selected air pollution abatement scenarios for use under the Convention on Long-range Transboundary Air Pollution, under the EC Thematic Strategy on Air Pollution, and for the assessment of "Core Set Indicator 005" of the European Environmental Agency.

4. Milestones achieved:

MS 83: Working Group on Effects under the Convention on Long-range Transboundary Air Pollution, 32nd session, Geneva 12-13 September 2013, ECE/EB.AIR/WG.1/2013/10.
MS 87: CCE workshop, Warsaw, 16-19 April 2012
MS 88: CCE workshop, Copenhagen, 8-11 April 2013
MS 90: Model System in Place: presentations of the use of impact indicators in the GAINS system in place at MS83 and MS88 meetings and at (a) Informal workshop with EC representatives "Clean air for Nature", Brussels, (b) "Greenweek", Brussels, 4-7 June 2013, (c) ECLAIRE Assembly, Zagreb 22-24 October 2013.

5. Deviations and reasons:

This report was delayed because collaboration with C4 counterparts addressing the development of indicators that meet both C4 and C5 requirements, and the related review and adaptation of the C4 VSD+-PROPS model, took more time than expected.

6. Publications:

WGE (2013a), Benefits of Air pollution control for biodiversity and ecosystem services, Document (and brochure and informal document) prepared including the use of ECLAIRE deliverables from C3, C4 and C5 for the 32nd session of the Working Group on Effects, 12-13 September 2013, ECE/EB.AIR/WG.1/2013/14.
Green Week, presentations including ECLAIRE deliverables, Brussels, 4-7 June 2013
WGE, (2013b). Report by the Coordination Centre for Effects and the Task Force of the International Cooperative Programme on Modelling and Mapping Critical Loads and Levels and Air Pollution Effects, Risks and Trends, presented at the 32nd session of the Working Group on Effects, Geneva 12-13 September 2013, ECE/EB.AIR/WG.1/2013/10
EEA (Technical Report *in prep*.), Exposure of ecosystems to acidification and eutrophication: An update of Core Set Indicator 005 and an illustration of a nitrogen impact-related biodiversity indicator in Europe

Hettelingh, J-P, Stevens C.J., Posch M, Bobbink R, de Vries W (in prep), Assessing the impacts of nitrogen deposition on indicator values of plant species in Europe, Chapter 23 in: de Vries W, Hettelingh J-P, Posch M (eds.)

Hettelingh J-P, Posch M, Velders GJM, Ruyssenaars 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

7. Meetings:

- Clean Air for Nature workshop, Brussels 20 March 2013
- CCE workshop, Copenhagen, 8-11 April 2013 (**MS 87**)
- EC "Green Week", Brussels, 4-7 June 2013
- Working Group on Effects under the Convention on Long-range Transboundary Air Pollution, 32nd session, Geneva 12-13 September 2013, ECE/EB.AIR/WG.1/2013/10 (**MS 83**)
- FP7-EnerGEO Summerschool,15-23 October 2013, Utrecht, The Netherlands

8. List of Documents/Annexes:

- WGE (2013a), http://www.unece.org/fileadmin/DAM/env/documents/2013/air/wge/ECE_EB.AIR_WG.1_2013_ 14_ENG_01.pdf
- Informal document in support of WGE (2013a), the "Clean Air for Nature" and the EC "Green Week" meeting presentations: http://www.unece.org/fileadmin/DAM/env/documents/2013/air/wge/No.1__Benefits_of_air_pollu tion_control_for_biodiversity_and_ecosystem_services.pdf
- Summary of the minutes of the CCE workshop and Task Force of the International Co-operative Programme on Modelling and Mapping, http://www.unece.org/fileadmin/DAM/env/documents/2013/air/wge/ECE_EB.AIR_WG.1_2013_ 10_ENG.pdf

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