Work package 6.4 – Verification of official inventories and improvement of IPCC methodology

Start: Month 3
Reporting period: May 2006 – Apr 2011
Lead contractor: IIASA (involved since June 2009)
Contributors: IIASA, WU, ALTERRA, NERC, ECN, JRC, FZK

Wilfried Winiwarter, June 7, 2011

1 Work package objectives

1.To review the current status of verification methodologies for N_r and GHG emissions officially submitted by national parties and the EU to the UNFCCC and UNECE-CLRTAP.
2.To initiate the refinement of approaches by which scientific uncertainty can be interfaced with the legal requirements of the verification process.
3.To demonstrate a concept to stakeholders (FCCC, CLRTAP) for incorporating uncertainty into the verification process, with feedback providing the basis for further development.
4.To establish the basis for interpretation of NEU C1 and C2 datasets according to the IPCC emissions calculation approach for GHGs leading to improvement of these approaches and emission estimates.

2 Progress towards the project objectives

Review of verification methodologies:
A first intercomparison of the outputs from NitroEurope IP (NEU) to the official national submissions of inventory data (**Deliverable D-6.4.2**) allows establishing the priorities of further work. First of all, the comparison indicates a general agreement and reasonable understanding, which may at least in part derive from the general similarity of approaches that have been used so far. Moreover, considering the potential applications of biophysical models as developed in NEU with respect to the national inventories, we recommend to test both approaches with respect to their uncertainties. As uncertainties are large and their immediate application may cause variability to become too large to provide meaningful advice to policy, we recommend focusing on those areas of models that may still provide useful and robust results. These results may not be available for absolute quantities of greenhouse gas emissions, but rather regarding changes as a consequence of general agricultural developments or progress in terms of nitrogen use efficiency, or as a consequence on purposeful interventions in agricultural systems to abate emissions (mitigation measures). In order to support the further development of NEU models we provide a template for guidance of evaluations.

Important publications:

A review of the methodologies was also used in a paper of the European Nitrogen Assessment:

de Vries, W., Leip, A., Reinds, G. J., Kros, J., Lesschen, J. P., Bouwman, A.F, Butterbach Bahl, K., Bergamaschi, P. and Winiwarter, W.. (2011). Geographic variation in terrestrial nitrogen budgets over Europe. Chapter 15. In: The European Nitrogen Assessment. Eds. Sutton MA, Howard CM, Erisman JW, Billen G, Bleeker A, Grennfelt P, van Grinsven H and Grizzetti B. Cambridge University Press, pp. 317-344, Cambridge, UK

Moreover, a data comparison of European Nitrogen fluxes was provided by:

Wilfried Winiwarter, Michael Obersteiner, Keith A Smith and Mark A Sutton. The European nitrogen cycle: Response. Global Change Biology, in press, doi: 10.1111/j.1365-2486.2010.02353.x (2011)

The final nitrogen balance for European Nitrogen balances has been published by

Leip, A., de Vries, W., Achermann, B., Billen, G., Bleeker, A., Bouwman, L., Döring, U., Geupel, M., Johnes, P., Le Gall, A.C., Monni, S., Orlandini, L., Prud'homme, M., Simpson, D., Spranger, T., van Aardenne, J., Winiwarter, W. (2011). Integrating nitrogen fluxes at the European scale. Chapter 16. In: The European Nitrogen Assessment. Eds. Sutton MA, Howard CM, Erisman JW, Billen G, Bleeker A, Grennfelt P, van Grinsven H and Grizzetti B. Cambridge University Press, pp. 345-376, Cambridge, UK.

Scientific uncertainty, stakeholders and legal requirements:

The Nitro-Europe project intends to tune its outputs to be useful in the policy process. In order to better understand which topics of the project may be most useful in this respect, interviews with people directly involved in the policy process were held (**Deliverable D-6.4.4**). A concept was developed to obtain interview results in a structured form. The exercise comprised a total of twelve interviews. Depending on the background, the personal preference, and the position and the responsibilities taken, interview partners provided an interesting set of often consistent, sometimes conflicting views on certain topics. While there was a general understanding of the importance of integrated treatment of nitrogen in the environment, the perception how this integration is facilitated within the respective own structures differed. In some but not all institutions covered large structural obstacles still seem to exist which prevent overarching treatment. Sometimes such obstacles are being defended as an option to maintain control within an overall policy process, while they are being challenged from areas that are less important (with climate change being recognized as the issue currently dominating European environmental policies rather than air pollution or water pollution). Policy makers also observe the interest and perceptions of groups they keep contact with. It may seem somewhat surprising that, in addition to the scientists, often end users expressed the strongest interest in integration of all issues regarding to nitrogen (like farmers' interest groups). An explanation was given that the constituents of these interest groups are most strongly affected by potentially conflicting legislation, and thus need to make sure that integration really happens. Very different views were also expressed regarding the level of interference of policy. On one end of the scale was a very formal view, expressed from representatives of international bodies, which basically allowed no interference (policy making) but merely coordination of interests of the actors, in this case countries. The opposing view, also characterized by the different position of its representative, highlighted the competition of different policy processes leading to implementation of certain action or legislation. According to this view, there clearly is a "policy making", i.e. a purposeful intervention set, once it is possible to represent the own position strongly enough. These different views definitely derive from the different responsibilities of

the interview partners in the respective processes of elaborating environmental guidelines. A very general request of policy makers to science regarded, in general, to further advance basic scientific understanding on the multiple effects of nitrogen compounds on different compartments of the environment. Transparent algorithms which drive detailed models are desired to describe the release of nitrogen compounds. Regarding N_2O, a "tier 2" approach could fulfill such a demand – positioned between the current IPCC method based on N-input only, and complex models that will not allow to set clear relationships between abatement options and effects. Such an approach should allow the accounting of emission reductions beyond a mere input reduction. While currently it could be used in national inventories only when it can be shown to be more reliable than the current IPCC method, development of a "tier 2" approach may feed into a process of future IPCC guidelines in the relatively near future.

Important publications:

An overview of the work has been presented as:

Winiwarter, W. Structured stakeholder interviews to support dissemination of NitroEurope results. Paper presented at the International Science Conference Nitrogen and Global Change: Key findings – future challenges. Edinburgh, UK, April 11-14.

The significance of nitrogen work to policy also has been discussed by:

M.A. Sutton, O. Oenema, J.W. Erisman, A. Leip, H. van Grinsven, W. Winiwarter. Too much of a good thing - Curbing nitrogen emissions is a central environmental challenge for the twenty-first century. Nature 472, pp. 159-161 (2011).

Improvement of IPCC based emission calculations as a consequence of NitroEurope results

Deliverable D-6.4.3 explores the potential of NitroEurope results to be used for improving national greenhouse gas inventories. N_2O emissions from soils are poorly represented in current inventories, and any improvement is highly desirable. While a full-scale evaluation of the individual flux measurements performed in NitroEurope is beyond the scope of this work, a screening of the publications available so far indicates that little evaluation useful for this work has been performed yet. Instead, several modelling approaches exist that focus on incremental emissions with respect to the change of certain input parameters. Further work to establish improved inventories should take advantage of these model developments.

Three independent modeling methods were used in NitroEurope that allow assessing the emissions of N_2O as a function of certain external parameters. Statistical analysis of measured data, plot scale modelling in combination with results of field measurements and European scale modelling all provide responses in terms of common influencing parameters. **Deliverable D-6.4.5** analyzes to which extent responses of independent methods point into the same direction, providing confirmation on recommending measures. In addition to the established parameters of nitrogen input and soil organic carbon, all three approaches indicate increased N_2O emissions at high summer precipitation (at least for mineral fertilizer) and at a low share of manure (at least for grassland and high summer temperatures). Further investigation is needed, specifically regarding interdependence of the respective influences.

Important publications:

The development of a meta-model to describe N2O emissions has been presented in the following papers:

Adrian Leip, Wilfried Winiwarter, Developing stratified N2O emission factors for Europe. Poster presented at the NEU open conference, Solothurn (CH), Feb 1-5, 2010

Adrian Leip, Mirko Busto, Wilfried Winiwarter. Developing stratified N2O emission factors for Europe. Environmental Pollution, in press, doi: 10.1016/j.envpol.2010.11.024 (2011).

The model intercomparison has been made available to the NitroEurope community:

Winiwarter, W., de Vries, W., Leip, A., Lesschen, J.P., Yeluripati, J. Soil N2O emissions in national greenhouse gas inventories: potential for improvement. Paper presented at the International Science Conference Nitrogen and Global Change: Key findings – future challenges. Edinburgh, UK, April 11-14.

3 Progress towards the milestones and deliverables

D-6.4.2 presents the concepts and prepares methods for a comparison of models to the official data submitted to UNFCCC and UNECE. With NEU models not fully available at the time of this deliverable, the framework was set to integrate results when they would become available.

D-6.4.3 on the "Preliminary comparison of IPCC approach with flux datasets" has been completed. It documents the exploration efforts to understand what results are available from which component of NitroEurope.

D-6.4.4 has been made available as a documentation of the interview series with stakeholders and policy makers. Entitled "Policy needs to the outcome of Nitro Europe – results of polling policy makers", it contains a detailed motivation of the structure and background of the work, and contains the transcripts of all the interviews as agreed with the participants.

D-6.4.5, the report on "Soil N_2O emissions in national greenhouse gas inventories: potential for improvement" now covers all final results of the activity, merging the planned deliverables D-6.4.5 and D-6.4.6. So the report also contains the information originally set out as a separate report, but now not needed. It provides the current status as achievable in the project framework, and it is a foundation for further work, whether within an IPCC-targeted project or an otherwise funded activity.

All milestones as set out in the most recent implementation plan were observed, albeit with marginal time delays. Communication with stakeholders (interviews) was held during months 50-52 instead of month 50, the kick-off meeting to the "nitrogen and climate" report occurred in month 52 (not 51), and the "integration workshop" with modelers was moved to month 58 (not 54), while at the same time the project duration was extended from 60 to 63 months.

4 Delays, problems and approaches to resolve these

The transfer of responsibilities to IIASA, which became lead contractor for this activity quite late in the process, caused some challenge. As action necessarily

started with a considerable delay, efforts had to focus on optimizing processes to make up for that.

Overall, at the end of the project, an impressive list of achievements can be presented. Opportunities, offered by the Task Force on Reactive Nitrogen, were used to disseminate, beyond the originally planned extent, NitroEurope results regarding air pollutants (ammonia). Still, due to the extended chain of activities, it proved difficult to obtain interim results early enough to fully take advantage of them during the project's lifetime. Delays in measurement setup, typical for all experimental work, were compensated by increased efforts but led to delayed outputs, such that the delay propagated to the models and finally to verification/improvement (this activity). As a result, the final deliverable describes the status of work, but does not provide a detailed guidance how to improve the IPCC methodology.

While such an improvement has been a challenging task from the beginning, there is not even a need to provide full guidance at this stage. Dissemination of NitroEurope results, especially to scientific literature, will continue. The even more important requirement to make use of the results in a revision of IPCC guidelines is that NitroEurope participants are delegated to that process (via nomination by their countries as national representatives) – a condition that never could be determined by NitroEurope other than by supporting the scientific qualifications of the project team.