Monte Carlo Analysis of Uncertainties in the Netherlands' Greenhouse Gas Inventory for 1990-2004

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Abstract

The Netherlands annually report uncertainties in its National Inventory Report (NIR), using IPCC's Tier 1 method. The IPCC guidelines have, however, recommended that a more detailed analysis should be performed when possible. In this research, we therefore carried out a Monte Carlo analysis of the uncertainties in the Dutch NIR at the Tier 1 aggregation level. We accounted for all known correlations in the inventory and took into account non-Gaussian probability distribution functions where appropriate.

The goal of the research is two-fold. Firstly, to assess whether a Monte Carlo analysis of the uncertainties in the Dutch NIR would result in different levels of uncertainties compared to those provided by the Tier 1 analysis. Secondly, to assess which parameters contribute the most to the total uncertainty in the emissions, in order to identify areas of high priority for the further improvement of the overall accuracy of the inventory. The analysis was performed for the Kyoto base year (1990/1995) and for 2004.

The data for the emission calculations were extracted from detailed background information of the Dutch NIR as provided by the Netherlands Environmental Assessment Agency (MNP). The software package @Risk was used to assess the propagation of uncertainties in the emission model for the greenhouse gas emissions of each sub sector, sector and the country by greenhouse gas type. The probability density functions assumed for the emission factors and activity data were based on the uncertainty ranges used in the existing Tier 1 analysis, complemented with expert judgment by experts from the MNP. The expert judgments and assumptions taken into account in this research have been compared to the uncertainty assumptions (and their underpinnings) used in Tier 2 studies by other European countries[1]. Finally, a pedigree assessment has been carried out for the most sensitive emission factors and activity data to systematically assess strengths and weaknesses in their knowledge base.

The main results can be summarized as follows:

[1] C. de Keizer *et al* (2007), Comparison of uncertainty ranges and correlations assumed in TIER-2 studies of several European countries, abstract also submitted to this conference.

- The resulting uncertainties of the Monte Carlo analysis for the total emissions and for each type of greenhouse gas are in the same order of magnitude as those obtained by the Tier 1 analysis, although a somewhat higher trend uncertainty was found.
- For the Netherlands inventory, accounting for correlations has a larger impact on the uncertainty in the trend than on the uncertainty in the total greenhouse gas emission.
- Uncertainty assumptions in the Netherlands are well in the range of European studies.
- Resulting uncertainty in total Netherlands greenhouse gas emissions is in the lower range compared to other European countries.
- A ranking of uncertain inputs of the emission model according to their contribution to variance reveals that the main contributors to overall uncertainty are related to N_2O emissions from agricultural soils (especially indirect N_2O emissions), the N_2O implied emission factor of Nitric Acid Production, CH_4 from managed solid waste disposal on land, and the implied emission factor of CH_4 from manure management from cattle.
- Results of the pedigree analysis indicates that for the uncertainty in total GHG emission improvements in our knowledge of emission factors for the categories 4D3 (indirect N_2O emissions from agricultural soils), 4D1 (direct N_2O emissions from agricultural soils), 2G (indirect N_2O from NO_2 from combustion and industrial processes) and 4B1 (Emissions from manure management: cattle) might be given the highest priority.
- For future years, as long as the emission model does not change substantially and the share of CO_2 and non-CO_2 gases is not substantially different from 2004, it seems justified to use Tier 1 as main method for uncertainty analysis in the NIR. However, because of ongoing emission reduction efforts and changes over time in the fuel mix as well as in the shares of non-CO2 greenhouse gases, we recommend repeating the Monte Carlo analysis regularly (every 4 years) as part of the QA/QC procedures.