

Uncertainties and Sensitivities within NatAir

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Introduction:

In NatAir, previously existing methods to assess natural and biogenic emissions have been evaluated and improvements have been suggested. The Work Package 04 assesses uncertainties and sensitivities of these improved methods. Work proceeded interactively during the development of the methods in cooperation with the sector experts. The involvement of these experts consisted of two stages: telephone interviews on the basis of questionnaires helped understanding the process related uncertainties, and uncertainty tables allowed a partial quantification of uncertainties. At this stage, the respective key parameters to contribute to the sources have been identified for each source sector. In the current analysis, due to lack of final data on emission results itself, surrogate information from previous assessments (mainly: Simpson et al., 1999) has been used instead.

Questionnaires:

After analysing each method, specific questionnaires were prepared for each source group and sent to the expert. After a few days preparation time, a scheduled telephone interview was performed.

Purpose of questionnaires:

- Identify **key parameters**.
- Spot **“sub-sources”** that are more uncertain.
- Register the **upgrades** of methods purposed.
- List **future improvements** recommended.
- Catalogue **data available** and its **quality** - differentiation of regions in domain.
- Identify other sources of uncertainties: **missing information or unknown phenomena**.

Uncertainty tables:

Tables were created to allow a semi-quantitative analysis of uncertainty. Tables were to be filled by sector experts with a “reasonable” high/low values and best estimates of the key parameters and the total emissions; and uncertainties in form of “letter code” according to Pulles & van Aardenne (2004), used for posterior quantification.

Approach:

Uncertainty analysis was performed in two stages:

1. Specific analysis for each source / identification of the key parameters
2. Comparison of sources (analysis of total emissions of a specific compound)

Example: source comparison

Contribution of source sectors to overall uncertainty for a specific pollutant follows the same procedure as within the sector. Within the NatAir framework, no key parameter exists that influences more than one source sector for the same pollutant. So a simplified analysis will be sufficient – comparing the individual source sectors.

To determine the sensitivity of each in the overall uncertainties one can use the method proposed by Leneman et al. (1998)

$$sens = \left[\frac{E(S_{max}, O) - E(S_{min}, O)}{E(S_{bt}, O)} \right] \times 100$$

Example: analysis of source:

Assuming that the uncertainty here is a representative of standard deviation one can use the error propagation equation:

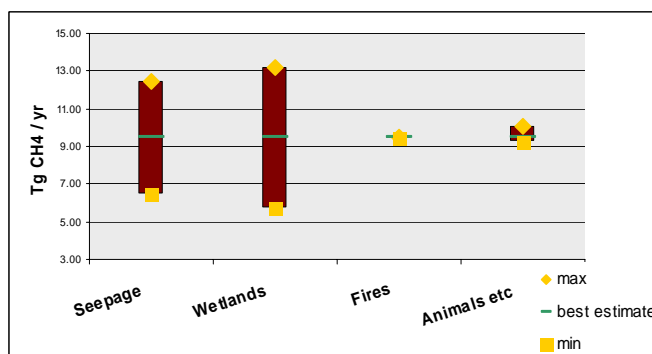
$$e_T = \sqrt{\sum (e_i^2)}$$

The relative error then is: $e = \frac{e_T}{E_T} \times 100$

Ranking of parameters can be performed according to their uncertainty measured in absolute terms.

In the Wetlands example presented above no key parameter could be identified so a comparison between “sub-sources” is performed.

	uncertainty (%)	uncertainty (abs)
Ombrotrophic mires	198.48	1.17
Minerotrophic mires	191.59	3.30
Freshwater marshes	94.95	0.33
Saltwater marshes	1395.68	0.14
Small lakes	77.13	0.29
Big lakes	80.04	0.94
Rivers	391.85	0.43
Propagated error	85.46	3.67



Conclusion:

- Uncertainty analysis of emission data requires emission expertise – a strategy for collection information in a homogeneous format is essential
- Higher uncertainties do not stand for higher sensitivity – important to identify both
- The overall uncertainty is made up only by a few parameters – exclusion of non-key sources simplifies calculations
- Uncertainty of European CH4 inventory is dominated by the large uncertainty in the data of Minerotrophic mires

Literature:

- Leneman et al. (1998); “Focus on emission factors: a sensitivity analysis of ammonia emission modelling in the Netherlands”; Environmental Pollution, 102, 205-210
- Pulles, van Aardenne (eds.), “Good Practice for CLRTAP Emission Inventories”. In: EMEP/CORINAIR Emission Inventory Guidebook.
- Simpson et al. (1999); Inventorying emissions from Nature in Europe. J. Geophys. Res 104, 8113-8152.

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