



**4th International Workshop
on Uncertainty in Atmospheric Emissions**
7-9 October 2015, Krakow, Poland

PROCEEDINGS



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About the Workshop

The assessment of greenhouse gases and air pollutants (indirect GHGs) emitted to and removed from the atmosphere is high on the political and scientific agendas. Building on the UN climate process, the international community strives to address the long-term challenge of climate change collectively and comprehensively, and to take concrete and timely action that proves sustainable and robust in the future. Under the umbrella of the UN Framework Convention on Climate Change, mainly developed country parties to the Convention have, since the mid-1990s, published annual or periodic inventories of emissions and removals, and continued to do so after the Kyoto Protocol to the Convention ceased in 2012. Policymakers use these inventories to develop strategies and policies for emission reductions and to track the progress of those strategies and policies. Where formal commitments to limit emissions exist, regulatory agencies and corporations rely on emission inventories to establish compliance records.

However, as increasing international concern and cooperation aim at policy-oriented solutions to the climate change problem, a number of issues circulating around uncertainty have come to the fore, which were undervalued or left unmentioned at the time of the Kyoto Protocol but require adequate recognition under a workable and legislated successor agreement. Accounting and verification of emissions in space and time, compliance with emission reduction commitments, risk of exceeding future temperature targets, evaluating effects of mitigation versus adaptation versus intensity of induced impacts at home and elsewhere, and accounting of traded emission permits are to name but a few.

The *4th International Workshop on Uncertainty in Atmospheric Emissions* is jointly organized by the *Systems Research Institute of the Polish Academy of Sciences*, the Austrian-based *International Institute for Applied Systems Analysis*, and the *Lviv Polytechnic National University*. The 4th Uncertainty Workshop follows up and expands on the scope of the earlier Uncertainty Workshops – the *1st Workshop* in 2004 in Warsaw, Poland; the *2nd Workshop* in 2007 in Laxenburg, Austria; and the *3rd Workshop* in 2010 in Lviv, Ukraine.

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On the possibility of selenium air emission inventory from small domestic sources

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Abstract

The main purpose of this paper will be examining the possibility of effective selenium (Se) air emission inventory from small domestic combustion sources. Authors would like to raise issues connected with data collection, its consistency and also stress the context of uncertainty analysis of air emission from small geographically scattered sources.

Although emission inventory of selenium is covered by UN ECE LRTAP Convention, the selenium emission inventory has not been performed so far nor in Poland, neither in its part. Data derived from working paper [1] suggested underestimation of selenium air emission from domestic stoves. Moreover official emission inventory guidelines [2] reported significant difference between Tier 1 Se emission factors for energy industries (NFR: 1A1a) and residential combustion (1A4bi). This data hinder emission inventory and may significantly affect results of uncertainty analysis.

Keywords: selenium, air emission, uncertainty analysis

1. Introduction

This paper presents using scarce, incomplete and uncertain data in air emission inventory. Due to many lacks in estimation of selenium air emission such as: using data derived from simplified official guidelines (Tier 1) [2], lacks in measurements, no data on economical or any other national dependencies, lacks of data on uncertainties the official data for international submission is still under preparation and analysis [1].

The main task of presented analysis is to merge pieces of information from various sources and determine range of uncertainty of Se air emission from domestic (small) combustion sources (included in NFR 1A4bi category).

As initial analysis authors would like to present quantitative assessment of uncertainty according to previous works [3,4] in particular using *mixture model with two components* [3], expressed as:

$$f(x) = wf_1(x) + (1 - w)f_2(x), \quad (1)$$

where:

$f(x)$, probability density function (PDF) of emitted air pollutant;

$0 \leq w \leq 1$, weight of component PDF;

$f_1(x), f_2(x)$, PDFs of components.

Methodology presented in this paper considers results of selenium content analysis in Polish coals, due to their importance in national economy. Also introduced selected methods of data integration due to small amount of direct measurements available. Due to its volatility in combustion process Se content in fuel could be treated as an emission factor. Moreover, the lack of measurements of selenium content in coal makes impossible straightforward analysis of selenium air emission.

According to formula (1), functions $f1(x)$ and $f2(x)$ could be treated as PDFs of emission source activity and also emission factor respectively. For determining of total uncertainty of emission, assumptions of partial uncertainties are needed.

Case of incomplete data forced use of bootstrapping or maximum likelihood estimation. Basing on assumptions from [3], considered distributions were: lognormal, Weibull and Gamma. Apart from adjusting distributions technical aspect of independent distributions combination was considered.

In second step, authors would like to analyze spatial aspects of estimated emission considering disaggregation of *top-down* emission estimation by surrogates.

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