

## A source origin and physico-chemical properties of ambient Particulate Matter studied by Stable Isotope Mass Spectrometry, PM SIMS

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### Introduction and motivation

The effects of aerosol particles on air quality, climate, and public health are the central topics in current environmental research nowadays [Poschl, 2005]. Differentiating natural and anthropogenic particles in the atmospheric aerosol becomes increasingly difficult because environmental changes caused by human activities on a global scale affect main aerosol source processes [Heintzenberg, 2003]. Carbonaceous aerosols reflect the isotopic signature of their source precursors (e.g., biogenic marine or terrestrial and fossil fuel hydrocarbons) and, consequently, their  $\delta^{13}\text{C}$  value can be used as an indicator of the specific source [Gaffney *et al.*, 1984; Ceburnis *et al.*, 2011]. Similarly, isotopes of sulphur and nitrogen can help to further apportion between biogenic and anthropogenic sources [Charlson *et al.*, 1987; Betti *et al.*, 2011; Lin *et al.*, 2012].

### Scientific objectives

The main scientific object of the project was feasibility of quantification of aerosol organic matter at Mace Head by combining aerosol mass spectrometry (AMS), stable isotope mass spectroscopy (SIMS) and ion chromatography (IC) methods. First, an active sector-controlled sampling in subtropical and polar air masses at Mace Head during high biological activity period was done. Second, source apportionment of carbon, nitrogen and sulphur containing particles at different sites will be made. Finally quantification of the marine and terrestrial sources at Mace Head and other locations (Preila, Vilnius, Rugsteliskis) will be performed.

### Method and experimental set-up

The combination of few methods( AMS, SIMS and IC)will be used to evaluate the composition of organic and inorganic matter in the ambient aerosol particles. The maritime air masses were characterised during the sampling programme at Mace Head. More specifically, subtropical and polar air masses were characterised which have never been differentiated before, however, carbonaceous and sulphurous particulate matter differs substantially in the above air masses. Therefore the design and use of a dual channel active sector control sampling system at Mace Head (and later at Preila) along with the continuous measurements by HR-ToF-AMS at Mace Head was done. The samples for isotope analysis were obtained by PM1 samplers and thus comparable to HR-ToF-AMS.

Combining knowledge of marine aerosol research through the use of advanced High Resolution Time-of-Flight mass spectrometer with Stable Isotope Mass Spectrometry gives unique insights into particulate matter sources, especially when applying multi-isotope (S, N, C) approach.

### Reason for choosing station

Geographical location of Mace Head - ACTRIS station, uniquely exposed to maritime air masses allows apportioning between marine and terrestrial particulate matter sources. The measurements at Mace Head will be performed in parallel at several locations in Lithuania: Preila-ACTRIS site (coastal area), Vilnius (urban area) and Rugsteliskis (rural area). The access to clean marine samples at Mace Head will allow a better source apportionment of particulate matter sources.

### Preliminary results and conclusions

The collection of particulate matter was made during the project time and will be continued beyond. Analytical development of the method was done during discussions and knowledge transfer from the researchers at National University of Ireland Galway which have acquired significant knowledge of marine

aerosol research. The method was further developed which will allow to make a sulphur analysis of the aerosol samples in Lithuania.

At the same time the research article was prepared for the publication after examination of marine aerosol samples collected during austral summer of 2007 in Amsterdam Island. The article "Temperature and trophic level induced fractionation of stable carbon in marine organic aerosol" was drafted and currently is under review by co-authors and will be submitted to a journal as soon as possible.

### **Outcome and future studies**

The experimental data will allow solving isotope mixing equation and to identify the origin of particulate matter at marine-continental boundaries as well as to show how the fluctuation of stable carbon isotopic ratio reflects the evolution of properties of aerosol particles. However, stable isotope analysis of collected samples will be performed at the State Research Institute Center for Physical Sciences and Technology (Lithuania). The results will be published after the data analysis and will be acknowledged as follows: "The research leading to these results has received funding from the European Union Seventh Framework Programme (FP7/2007-2013) under grant agreement n° 262254."

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