BIOSOL

Formation mechanisms, marker compounds, and source apportionment for biogenic atmospheric aerosols

DURATION OF THE PROJECT
Phase 1: 15/12/2005 – 14/12/2007
Phase 2: 15/12/2007 – 31/01/2010

BUDGET
1.045.872 €

KEYWORDS
Isoprene, Biogenic, Secondary Organic Aerosol, Formation Processes, Indicator Compounds, Source Apportionment

CONTEXT

Biogenic volatile organic compounds (BVOCs) play an important role in atmospheric chemistry and give rise to secondary aerosols, which have effects on climate and human health. Increased temperature and CO_2 concentrations will lead to increased plant photosynthesis and growth rates and higher emissions of BVOCs, which in turn result in a higher aerosol load from natural sources and partly offset the decreased cooling from anthropogenic aerosols. A considerable lack of knowledge exists concerning the formation of new particles from BVOCs and the organic chemical composition of natural aerosols.

PROJECT DESCRIPTION

Objectives

The objectives of the current project include (1) study of the formation mechanisms of secondary organic aerosol (SOA) from isoprene and other BVOCs, assessing their role in particle formation and growth, examining the relative importance of homogeneous photo-oxidation and multi-phase processes, and modelling of the processes involved; (2) identification of particulate-phase oxidation products of isoprene and other BVOCs, which can be used as indicator compounds for source apportionment, and development/deployment of novel analytical techniques thereby; and (3) determination of the contribution from the BVOCs to the organic aerosol for various sites in Europe.
The results of the project are used for advice to policy advisers/makers at international (IPCC, EU, EMEP) and at federal and Flemish levels, for valorisation work through the Follow-up committee, and as input for the SSD project IBOOT (Impact of Biogenic emissions on Organic aerosols and Oxidants in the Troposphere). Whereas the Belgian partners of BIOSOL concentrate on laboratory and field experiments, the Belgian partners of IBOOT focus on modelling of SOA and its compounds.

Methodology

For objective (1), experiments are performed in the laboratory, at three forested European sites, and during two oceanic cruises. The BVOCs, their volatile organic oxidation products and critical inorganic trace gases are determined, and aerosol samples are collected and subjected to comprehensive analyses; in addition, in-situ measurements of particle number concentrations and size distributions, of ion spectra, and of the particulate mass (PM) and particulate organic carbon (OC) are made, and radiation and standard meteorological measurements are performed. The data sets are used for modelling the formation and growth of the fine biogenic atmospheric aerosol. As to objective (2), aerosol samples from laboratory experiments and field campaigns are examined. Unknown important compounds are structurally characterised using mass spectrometric techniques. It will be attempted to construct appropriate source profiles for source apportionment. As to objective (3), particulate-phase indicator compounds will be used for quantitative calculation of the contribution of the SOA from isoprene and other BVOCs to the OC and the PM. In addition, the contribution from biomass burning and, if possible, also that from primary biological aerosols will be determined.
Project valorisation is done through meetings of (and E-mail correspondence with) the Follow-up Committee and workshops (the latter jointly with IBOOT), writing of progress reports and scientific publications, conference presentations, and contributions to activities organised within SSD and by international programmes.

INTERACTIONS BETWEEN THE DIFFERENT PARTNERS

The project has 4 Work Packages (WPs). WP1, which deals with objective (1), is the most extensive. Laboratory experiments with smog chambers is done by partners P2 and C (for details on the partners see below) in strong cooperation with Caltech and US EPA; in other laboratory experiments use is made of the plant growth chambers of P3 and the work is done together with P2 and C. Several joint field ex-

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periments are performed: a campaign took place in summer 2006 at K-puszta (Hungary); all 4 partners worked closely together at the site, they also do so in various data analyses, and the analysis of the aerosol samples is a joint activity of C and P2; the work at a forest in Brasschaat is a co-operation of P3, P2, and C; and that at Hyytiälä (Finland), is jointly undertaken by P4, P2, and C. Data analyses and interpretation is a joint activity of the partners involved. Modelling is done by P4 (and also within IBOOT), but with experimental data input from all partners.
WP2, which deals with objective (2), is a co-operative effort of P2 and C, and WP3, dealing with objective (3), will be done by C and P2, with a contribution from P4. Finally, all 4 partners work closely together for WP4, Valorisation activities.

Link with International Programmes

The project addresses issues raised by the Intergovernmental Panel on Climate Change (IPCC) and contributes to the objectives and work plan of (and has links with) the European Network for Atmospheric Composition Change (ACCENT), the European Science Foundation (ESF) programmes Volatile Organic Compounds in the Biosphere-Atmosphere System (VOCBAS) and Interdisciplinary Tropospheric Research: from the Laboratory to Global Change (INTROP), and several International Geosphere and Biosphere Programme (IGBP) projects, including the Integrated Land Ecosystem - Atmosphere Processes Study (iLEAPS),International Global Atmospheric Chemistry (IGAC) and Surface-Ocean-Lower Atmosphere Study (SOLAS). The project involves close cooperation with the University of Helsinki (non-Belgian partner in the project), with the teams of Prof. J.H. Seinfeld from California Institute of Technology and of Dr. T. Kleindienst from US Environmental Protection Agency, and with research teams of Hungary, Austria, Finland, France, Germany, and Greece.

EXPECTED RESULTS AND/OR PRODUCTS

They include various chemical data sets, results of data analyses/interpretation, modelling results of fine particle and biogenic aerosol formation and growth, new particulate oxidation products from BVOCs useful for source apportionment, assessment of the contribution from BVOCs to the organic aerosol, reports of the workshops, peer-reviewed publications, conference presentations, a Website, and a CD with data sets and list of publications.

PARTNERS - ACTIVITIES

The Coordinator
has over 30 years of experience in physico-chemical aerosol characterisation and he is/was coordinator, promoter or contractor of several nationally and EC funded projects. His team has ample experience within intensive field campaigns.

Partner 2
is an expert in mass spectrometry. She works on the detailed organic characterisation of atmospheric aerosols, which is an essential complement of the work of the coordinator.

Partner 3
is an expert in ecosystem carbon cycling. He contributes with plant growth chambers, coordinating the work in Brasschaat, and measurements for BVOCs and their volatile oxidation products.

Among the main research subjects of **Partner 4** are aerosol dynamics, formation and growth of atmospheric aerosol particles, and forest-atmosphere interactions. His team has expertise in physical aerosol measurements and aerosol modelling.

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Follow-up Committee

For the complete and most up-to-date composition of the Follow-up Committee, please consult our Federal Research Actions Database (FEDRA) by visiting http://www.belspo.be/fedra or http://www.belspo.be/ssd

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