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Helmholtz Virtual Institute of Complex
Molecular Systems in Environmental Health (HICE)
www.hice-vi.eu

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Structure

The Helmholtz Virtual Institute of Complex Molecular Systems in Environmental Health (HICE) structures its interdisciplinary research in four well-defined interrelated work packages. The joint management structure consists of the Virtual Institute Scientific Steering Board (VISB) and the Virtual Institute Management and Administration Unit (VIMA).

Virtual Institute Scientific Steering Board (VISB)

Spokesperson HICE: Prof. Dr. Ralf Zimmermann
(Helmholtz Zentrum München, University of Rostock)

Work Packages Spokespersons

Work Package I

Aerosol Characterisation

1. Prof. Jorma Jokiniemi (University of Eastern Finland)
2. Dr. Thorsten Streibel (University of Rostock)

Work Package II

Exposure and Toxicology

1. Dr. Hanns-Rudolf Paur (Karlsruhe Institute of Technology)
2. Prof. Dr. Jeroen Buters (Technische Universität München)

Work Package III

Small Molecules and Stable Isotope Labelling

1. Dr. Gunnar Dittmar (Max Delbrück Center)
2. Thomas Gröger (Helmholtz Zentrum München)

Work Package IV

Chemometry and Biostatistics

1. Prof. Dr. Olaf Wolkenhauer (University of Rostock)
2. Dr. Manuel Arteaga (Helmholtz Zentrum München)

Virtual Institute Management and Administration (VIMA)

Project Management: Sorana Scholtes
(Helmholtz Zentrum München)

Education

HICE provides excellent education opportunities for graduate students by offering a joint interdisciplinary Graduate School for Complex Molecular Systems in Environmental Health.

Lectures and Seminars

Internal and external experts give survey lectures on science and technology topics on a weekly basis during the academic term. These lectures are transmitted to all partner institutions via video conferencing.

Interlaboratory Exchange

The young scientists participate in different exchanges between the laboratories of the partner institutions.

Regular Workshops

The scientists of all involved institutions come together for periodic meetings. Here young scientists can practise presenting their scientific results.

Summer Schools

Each year HICE organizes summer schools at partner institutions. Depending on the expertise of the respective host institution, different key issues are covered. The courses consist of practical work as well as expert lectures.

Mentoring

PhD students are supported by thesis committees, consisting of two mentors chosen by the student and the doctoral thesis supervisor. In addition, mentors offer career counseling to postdoctoral fellows.

HICE students take part in a lab training course at the University of Luxembourg.

HICE › Aerosols and Health
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HelmholtzZentrum münchen
Deutsches Forschungszentrum für Gesundheit und Umwelt

About HICE

The Helmholtz Virtual Institute HICE (Helmholtz Virtual Institute of Complex Molecular Systems in Environmental Health – Aerosols and Health) strives for a deeper understanding of the adverse effects of anthropogenic aerosols on human health. Current research is focusing on combustion aerosols such as emissions from house heating (e.g. stoves for wood combustion) and land- and sea-based traffic (e.g. cars, trucks, ships).

Based on current hypotheses, reactive organic compounds in particle emissions as well as in the gas phase of aerosol emissions are particularly relevant. Furthermore, atmospheric aging could diversify the toxicological potential of combustion aerosols. The research on this highly complex environmental health topic benefits from the expertise and contributions from various scientific disciplines, including analytical chemistry, physics, biochemistry, biology, medicine, engineering, statistics and informatics. The HICE consortium consists of leading European scientists, non-university research institutions and commercial business partners with complementary expertise and cutting-edge technology. The Helmholtz Virtual Institute HICE represents a perfect instrument for building and strengthening this strategic partnership.

Aerosols are chemically characterized by using mass spectrometry methods.

Research Goals

Ambient aerosols are known to cause considerable adverse health effects: According to the Clean Air for Europe (CAFE) steering group of the EU, in 2000 the average decline in life expectancy in Germany attributable to fine particles ranged between six and more than twelve months. Although the association between ambient aerosols and adverse health effects is well established, it is still not completely understood which aerosol fraction or property is responsible for the observed effects. This knowledge gap is addressed by the research activities of HICE.

- Elucidation of the molecular mechanisms and relevant agents in combustion aerosols relevant for the observed adverse health effects
- Identification of biomarkers for exposure and health effects
- Evaluation of the relative toxicological potential of different anthropogenic aerosol sources

Partners

HICE is represented by its spokesperson Prof. Dr. Ralf Zimmermann (Helmholtz Zentrum München and the University of Rostock) and is comprised of funded working groups from eight partner institutions.

- Helmholtz Zentrum München, DE
- University of Rostock, DE
- Technische Universität München: ZAUM – Center for Allergy and Environment, DE
- Karlsruhe Institute of Technology, DE
- Max Delbrück Center, Berlin Buch, DE
- University of Luxembourg, LU
- Cardiff University, GB
- University of Eastern Finland, Kuopio, FI

Further associated partners supporting HICE research activities:

ASG Analytik-Service Gesellschaft mbH, Augsburg, DE; Decodon GmbH, Greifswald, DE; European Commission: Joint Research Centre, Ispra, IT; Leibniz Institute for Baltic Sea Research, Warnemünde, DE; Photonion GmbH, Schwerin, DE; Vitrocell Systems GmbH, Waldkirch, DE

Hypotheses

HICE combines national and international expertise in analytical chemistry, aerosol science, physics, engineering, molecular biology, chemical toxicology, statistics and informatics within a common, new concept. This concept is driven by scientific and methodical hypotheses.

Scientific hypotheses:

1. Reactive chemical compounds in anthropogenic ambient aerosols present either in the gas phase or the particle phase or in both phases are relevant for inducing the observed adverse health effects.
2. Synergistic effects of reactive organic or inorganic compounds in the gas phase and in the particulate phase play an important role in causing these health effects.
3. The expected strong increase in the use of biomass and biofuels (boosted by the Energiewende in Germany) will change the composition and properties of (urban) aerosols and may lead to more or other aerosol-related health effect implications.

Methodical hypotheses:

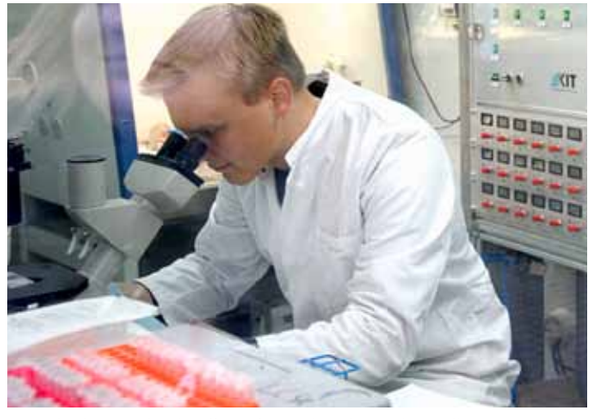
1. Toxicological effects and health effect mechanisms can be studied by exposing human lung cell cultures to gases, particles and aerosols and by subsequently determining the comprehensive molecular-biological response on the different biological hierarchical levels (metabolome, proteome, transcriptome) in conjunction with a comprehensive chemical and physical characterization of the aerosol and a joint statistical network data analysis of the biological and environmental data.
2. Application and improvement of isotope-labeling methods in molecular biological analyses ensure the required sensitivity and selectivity to elucidate the underlying molecular-biological health effect mechanisms.
3. New and improved concepts of exposure of human lung cell models at the air-liquid interface (ALI) with mobile ALI exposure units enable simulating the relevant primary effects in the lung tissue and can reduce/replace animal tests.

Approach

Concept description:

A comprehensive chemical and physical characterization of anthropogenic combustion aerosol is performed. For this task, state-of-the art online methods such as aerosol mass spectrometry (AMS/ATOF) for particle analysis or photo-ionization mass spectrometry for the identification and determination of reactive gas-phase compounds are used. Comprehensive multidimensional chromatographic and high resolution mass spectrometric techniques are used for offline analysis of collected particles and gas-phase samples.

The application of innovative, mobile air-liquid interface (ALI) cell exposure technology allows the controlled differentiated exposure of biological systems (human lung cell tissue models, including simple and highly differentiated human lung cell cultures, simulating the surface of the human lung) with either freshly emitted whole aerosols, e.g. from engines or solely the reactive gas or particle phase in order to differentiate particle- and gas phase-induced health effects and to elucidate synergistic effects.



HICE scientists examine the effects of aerosols on human lung cells.