

## Overview of Atmospheric Chemistry Studies in Europe

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### **EU-Research Western Europe:**

At the workshop you will hear about the European photoreactor EUPHORE which has been built within an EU project before 1995. The following overview is related to programmes after 1995.

### **Projects within the 4<sup>th</sup> Framework Programme of the EU Tropospheric Research:**

1995 - 1999: 50 Projects with 35 Mill. EURO (approx. 35 Mill Dollars)

The projects were grouped in the following clusters, each cluster was guided by two rapporteurs. Cluster reports are available from the European Commission. A cluster consists of several projects which are listed below. Each project is carried out by 5 – 10 European laboratories consisting of a reasonable cross-section of European research. The project is guided by a project coordinator. Upon request I can give the names of the co-ordinators.

### **Cluster 1: Oxidising Capacity of the Atmosphere and Transport of Photooxidants**

- HALOTROP (The contribution of reactive halogen species to the oxidation capacity of the troposphere)
- FORMONA (Formation and occurrence of nitrous acid in the atmosphere)
- CO-OH-EUROPE (Development and application of <sup>14</sup>C methodolgy for validating OH distribution incorporating a stable isotope of Europe's CO budget)
- VOTALP (Vertical ozone transports in the Alps)
- HALOTROP-SALT (The contribution of reactive halogen species: sea salt aerosols: laboratory investigations of heterogeneous halogen activation in the troposphere)
- TACIA (Testing atmospheric chemistry in anticyclones)
- RIFTOZ (Regional differences in tropospheric ozone in Europe - an analysis of its controlling phenomena)
- MARATHON (Marine atmosphere oxidation capacity experiment)
- CATOME (Carbonyls in tropospheric oxidation mechanisms)
- VOTALP II (Vertical Ozone transport in the Alps)
- FIRETRACC / 100 (Firn record of trace gases relevant to atmospheric chemical change over 100 years)
- MAXOX (Maximum oxidation rates in the free troposphere)
- HAMLET (Halogens in the marine environment: Laboratory investigation of heterogeneous chemistry)

### **Cluster 2: Aerosols and Clouds in the Troposphere**

- HILLCLOUD (Use of a hill cap cloud to study cloud aerosol interactions in ACE-2)

- FREETROPE (Free tropospheric aerosols and their mixing with the marine boundary layer in ACE-2)
- LAGRANGIAN (North Atlantic regional aerosol characterisation experiment (ACE-2): continental air mass evolution in the marine boundary layer)
- SOAP (Speciation of the organic fraction of atmospheric aerosol particles related to cloud formation)
- CIME (Cloud ice mountain experiment)
- MODAC (Model development for tropospheric aerosol and cloud chemistry)
- HECONOS (Heterogeneous conversion of nitrogen on aerosol surfaces)
- PARFORCE (New particle formation and fate in the coastal environment)
- INTACC (An investigation into the interaction of aerosols and cold clouds)
- NUCVOC (Nucleation processes from oxidation of biogenic volatile organic compounds)

### **Cluster 3: VOC, NO<sub>x</sub> and Greenhouse Gases contributions from Different Sources**

- BIPHOREP (Biogenic VOC emissions and photochemistry in the boreal regions of Europe)
- MEDFLUX (Quantification of pollutant dry deposition fluxes over Mediterranean ecosystems)
- BEMA (Biogenic emissions in the Mediterranean area)
- GEFOS (Greenhouse gas emissions from farmed organic soils)
- FOREXNOX (European Forest, as a source of atmospheric nitrogen oxides)
- 14 C- VOC (Biogenic and anthropogenic contribution to ambient volatile organic compounds)
- ECOVOC (Parametrisation of environmental and physiological controls of VOC emissions from Europe forests)
- VOCAMOD (Biogenic VOC emission modelling for European forest canopies)
- RICEOTOPES (Methane from rice paddies: isotopic signals, microbial pathways and fluxes)
- BIOFOR (Biogenic aerosol formation in the boreal forest)
- EULINOX (European lightning nitrogen oxides project)

### **Cluster 4: Chemical Processes and Mechanisms**

- INFORMATEX (Influence of fuel formulation on atmospheric reactivity of exhaust gases)
- BIOVOC (Degradation mechanisms of biogenic VOCs)
- SARBVOC (Structure-Activity relationships for reactions in the degradation of biogenic volatile organic compounds)
- EUROVOC (Control strategies for European air quality based on the tropospheric oxidation characteristics of volatile organic compounds)
- RINOXA 2 (Removal and interconversions of oxidants in the atmospheric aqueous phase)
- AEROBIC (Aerosol formation from biogenic organic carbon)
- RADICAL (Evaluation of radical sources in atmospheric chemistry through chamber and laboratory studies)
- DOMAC (DMS: Oxidation mechanisms in relation to aerosol and climate)
- DIFUSO (Diesel fuel and soot: fuel formulation and its atmospheric implications)
- HALOBUD (An investigation of the tropospheric budget of halogenated compounds)

- UNARO (Uptake and nitration of aromatics in the tropospheric aqueous phase)
- AFCAR (Atmospheric fate of carbonyl radicals)
- EUROSOLV (Reduction of tropospheric ozone formation in Europe by the employment of alternative industrial solvents)

Cluster 4 essentially represents the laboratory studies. The outcome of the work is regularly published:

“Chemical Mechanisms of Atmospheric Processes“

(edit.: K. H. Becker and G. Angeletti)

Air Pollution Research Report 67, European Commission, EUR 18765, Brussels 1999

(Proceedings of the Workshop 1998, Copenhagen)

“ Chemical Processes and Mechanisms (EU) and Chemical Mechanism Development“

EC/EUROTRAC 2 Joint Workshop

Sept. 20-22, 1999, Ford Research Center Aachen, Germany

(Proceedings will be published)

### **Cluster 5: Measurement Techniques**

- EUPHORAM (In situ EUPHORE radical measurement)
- MEDUSE (Monitoring and prediction of the atmospheric transport and deposition of desert dust in the Mediterranean Region)
- PRICE II (Peroxy radical intercomparison Exercise II)
- DCHOR (Development of a compact transportable instrument for the measurement of tropospheric OH and HO<sub>2</sub> on remote and airborne platforms)
- HRDLCDEM (High resolution diode laser carbon dioxide environmental monitor)
- PRIME (Peroxy radical initiative for measurements in the troposphere)
- SAMPLER (Sampling device for the measurement of peroxy radicals in atmospheric systems)

### **Future EU-Research:**

#### **New European Research Programme 5<sup>th</sup> Framework Programme, Part for the Troposphere First Phase (2000-2003)**

Key Action “Global Change, Climate and Biodiversity“

- Atmospheric Composition  
(12 Projects: 10 Mill. EURO)

Key Action “City of Tomorrow and Cultural Heritage“

- Local Air Pollution / Air Quality and Instrumental Developments (approx. 10 Mill. EURO)

New EU Clusters which are problem orientated (atmospheric composition)

### **Cluster 1: Ozone Budget**

- POET (Precursors of ozone and their effects in the troposphere)
- FUTURE-VOC (BVOV emissions of European forests under future CO<sub>2</sub> levels: influence on compound composition and source strength)
- TROTREP (Tropospheric ozone and precursors – trends, budget and policy)
- SUB-AERO (Subgrid scale investigations of factors determining the occurrence of ozone and fine particles)
- EXACT (Effects of the oxidation of aromatic compounds in the troposphere)

### **Cluster 2: Aerosols**

- MINATROC (Mineral dust aerosol and tropospheric chemistry)
- OSOA (Origin and formation of secondary organic aerosol)
- NITROCAT (Nitrous acid and its influence on the oxidation capacity of the atmosphere)
- NICE (The nitrogen cycle and effects on the oxidation of atmospheric trace species at high) latitudes)

### **Cluster 3: Climatic Impact Gases**

- CUT-ICE (Chemistry of the upper troposphere: Laboratory studies of heterogeneous processes on ice)
- IAFAEE (Impact of alternative fluorinated alcohols and ethers on the environment. A laboratory and modelling study)
- EL CID (Evaluation of the climatic impact of dimethyl sulphide)

### **Cluster 4: European Component of Global Observing Systems**

- ERA-40 (A forty-year European re-analysis of the global atmosphere)
- MAGPROX (Screening and monitoring of anthropogenic pollution over Central Europe by using magnetic proxies)

### **Support for Research Infrastructures**

- (EARLINET (A European aerosol research LIDAR network to establish an aerosol climatology))

The cluster “Chemical Processes and Mechanisms“ will not continue. Laboratory based projects will receive less support in the future!

## **Germany:**

### **German Research Programme (BMBF) on-going:**

- Tropospheric Research (mid 1996-mid 2000: 40 Mill. DM/23 Mill. \$)
- Aerosol Research (1997 - 2000: 20 Mill. DM/11.5 Mill. \$)

- Stratospheric Research (1989 - 1999: 100 Mill. DM/58 Mill. \$)

The structure of the research programmes were differently organised, between single projects, weakly co-ordinated (no financial support for co-ordination) and co-ordinated with significant financial support.

The Tropospheric Research Programme (TFS) is well co-ordinated in three parts: with nearly equal financial support:

- CT Modelling and Model Developments
- Emission Studies
- Process Analysis (Laboratory studies and the field campaign BERLIOZ-Berlin Ozone)

### **Future Atmospheric Research in Germany (BMBF):**

#### **Atmospheric Research AFO 2000 (2000-2005): 100 Mill. DM (approx. 58 Mill. \$)**

- Improvement of the Understanding of the Atmospheric System (mainly world-wide field campaigns)
- Development and Provision of Tools for Environmental Policy (mainly model evaluation and developments, studies of biogenic emissions, studies and vertical transport processes)
- Generous Support of Young Scientists in the Field of Atmospheric Research

Laboratory based projects will not be supported within the new BMBF-Programme; laboratory work should be supported by the German National Science Foundation (DFG).

In the USA a similar discussion took place as reported in Nature, Vol. 400, 492 (1999).

### **Conclusions:**

During the last 10 years atmospheric science has been quite well supported by the EU as well as by Germany (BMBF). In particular, kinetic and mechanistic studies in the laboratory, during the first stage mainly in the gas phase but in the second stage also in the aqueous phase and heterogeneous phase (multi-phase) received significant support. During the coming years the support for atmospheric science seems to be reasonable, however, other areas like soil and water pollution and biodiversity is also attracting a larger proportion of the available resources.

Laboratory studies of atmospheric chemical systems will certainly receive less support in the future by the EU as well as by Germany (BMBF). At present it is still an open question how much support can be provided by the National Science Foundation (DFG) in Germany. In France laboratory studies are regularly supported by CNRS, however, on a low level. In the UK a new programme has been submitted to NERC, the outcome remains open. European Chemical Industry represented by CEFIC does not see it as a priority to support atmospheric science; ecotoxicological studies have higher priorities.

At present integrated research projects combining laboratory work, field studies and modelling might attract further support. The knowledge on reaction kinetics and product yields of atmospheric processes seems to be sufficiently developed, at least as viewed outside from of chemistry circles.