Emission and CHemical Transformation of Biogenic Volatile Organic Compounds
Investigation in and Above a Mixed Forest Stand
An Overview

Forschungszentrum Jülich – Max-Planck-Institut für Chemie Mainz – Institut für Spektrochemie und Angewandte Spektroskopie Dortmund – Meteorologisches Institut Universität Hamburg

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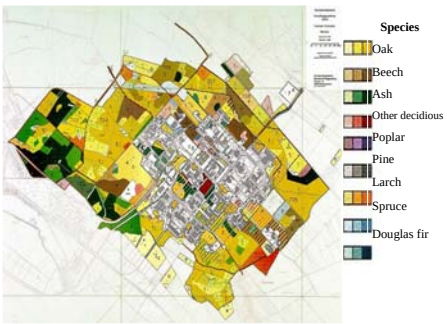
Objective of ECHO

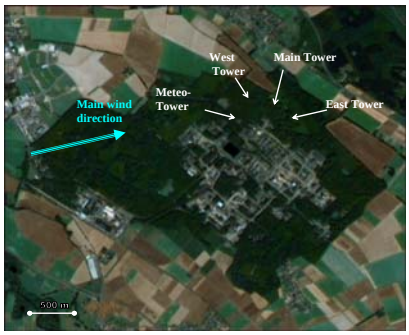
The objective of ECHO is to provide a better understanding of forest stands as a complex source of reactive trace gases into the troposphere. As a speciality of this project, important aspects of different processes determining the net emission from forest stands are investigated in laboratory and simulation experiments. The chemical processing of the trace gas mixtures observed in the forest stand is investigated in the atmosphere simulation chamber SAPHIR. Emission and uptake of VOC by plants are investigated in plant chambers, the soil as a source of trace gases in a lysimeter experiment. The flow dynamics of the forest site is investigated in wind tunnel experiments. These investigations address the following topics:

- Sources of reactive trace gases in a forest stand
- The forest stand as a chemical reactor
- Quantification of the net trace gas emission

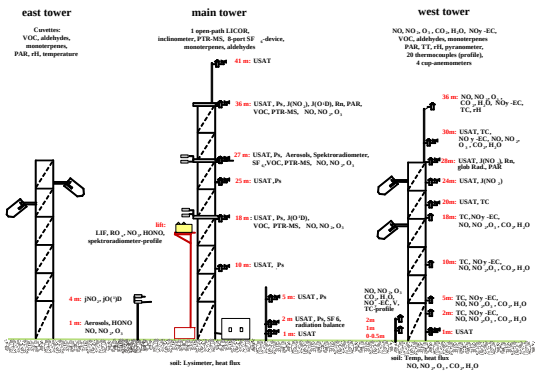
Map of the Forest Site



The field site (Research Center Juelich)

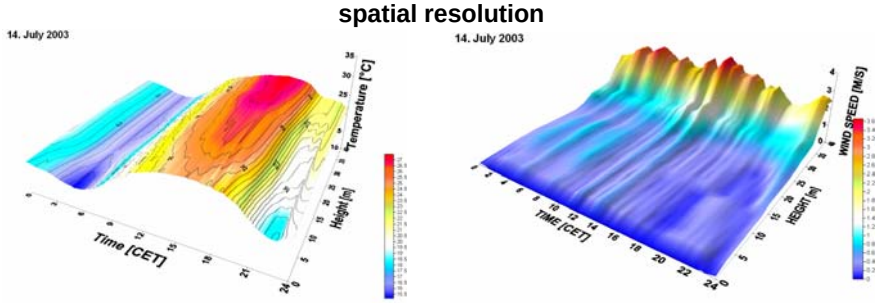


Instrumentation at the field site



Measurement of VOC emissions and uptake in plant chambers

Continuous measurements of micrometeorological data with high temporal and spatial resolution



Example for the distribution of temperature and wind speed on a typical summer day in and above a forest canopy during the second ECHO campaign

Simulation of the photochemistry of biogenic VOC in SAPHIR

Achievements of ECHO

- Emissions and ambient concentrations of biogenic VOC and their oxidation products have been measured over two vegetation periods
- Radiation transfer through the canopy has been measured spectrally resolved over two years
- For the first time vertical profiles of the OH and HO_2 radical concentrations have been measured between 2 m and 38 m
- Diurnal cycles of OH, HO_2 and RO_2 radicals have been measured below, in, and above canopy allowing a detailed study of photochemical processes in a forest stand
- Micrometeorological parameters have been measured at 10 Hz time resolution over two vegetation periods allowing a determination of turbulent exchange parameters with high temporal and spatial resolution

Additional Project Partners

Arbeitsgruppe Atmosphärische Prozesse, München
Data Acquisition, Data bank, Micrometeorology

Bergische Universität Wuppertal, Fachbereich Phys. Chem.
HONO measurements

Universität Bayreuth, Department für Mikrometeorologie
SODAR measurements

Agroscope FAL-Reckenholz, Zürich, Switzerland
PTR-MS measurements

Universität Innsbruck, Institut für Ionenphysik, Austria
PTR-MS measurements, Disjunct Eddy Correlation

Universität Leipzig, Institut für Meteorologie
Radiative transfer modelling

Paul-Scherrer-Institut, Villigen, Switzerland
PTR-MS measurements

MetAir AG, Menzingen,Switzerland
Flux measurements, trace gases, energy balance

Simulation of the canopy flow dynamics in a wind tunnel

Emission of biogenic VOC

BVOC emissions from tree species at the measurement sites were studied under controlled conditions in plant chambers. Based on these data and stock data for the surrounding of the main tower and the west tower (area with 75 m radius) the source strength of BVOC was estimated. Data are given in units of $\mu mol \cdot s^{-1}$ @ T = 30 °C and PAR > 800 $\mu mol \cdot m^{-2} \cdot s^{-1}$.

BVOC	Main tower	Main tower rel. abundance	West tower	West tower rel. abundance
Isoprene	49	44 %	71	61 %
Methanol	45	40 %	33	29 %
Σ monoterpenes	18	16 %	12	11 %
Σ BVOC	112		116	