GICC Climate Change Impacts and Management Programme

2003 Call for Research Proposals
GES Bio 3

Summary of Final Report

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The aim of the GESBiO3[2] project was to take ozone into account when calculating the contribution of agricultural and forest ecosystems to the greenhouse effect at a regional scale. This involves looking both at ozone deposition to vegetation and farmland and emissions of ozone precursors (NO_x, COV) by farmland and vegetation cover. Since ozone fields vary considerably both in space and in time, this research needed to be done at a regional scale and required a high level of modelling backup (regional or continental-scale chemistry-transport models). To address these questions, GESBiO3 comprised:

- an experimental strand (monitoring fluxes of ozone and its precursors and CO_2 and N_2O in different ecosystems) aimed at improving parameterisation of biogenic sources and sinks in the Chemistry-Transport models and obtaining model output checkpoints.
- a modelling strand, which consisted of coupling the CHIMERE Chemistry-Transport model with ecosystem models and a vegetation-atmosphere interaction.

The GICC-2 programme chose to support the GESBiO3 project's first, experimental strand only, for a 12 month period.

The outcomes of the GESBiO3 project can be grouped into 4 categories:

- The main problem we encountered was the lack of availability of reliable commercial fast-response ozone analyzers with which to measure deposition using the eddy correlation method. In the end, we were obliged to devote a considerable amount of work both to inspecting, repairing and updating the analyzers we already had, which had been provided by a US research laboratory, and to contacting a company to design and manufacture new commercial analysers with superior technical features to ours. This operation is in progress and the prototype will be available in October 2006.
- Automatic data processing procedures were established to facilitate and standardise the flux calculation methods. We concentrated in particular on correcting the radio frequency attenuation of data that occurs in remote sensors such as fast-response ozone analyzers.
- Continuous measurements of ozone deposition over several months was only possible in two laboratories which already had fast-response analyzers (INRA Bordeaux and Grignon).

[1] INRA – Institut National de la Recherche Agronomique – National Agronomic Research Institute
[2] GESBiO3 - **G**az à **E**ffet de **S**erre (greenhouse gases), **Bi**osphère, **O3**

At two other sites (meadow at Lusignan and oak forest at Fontainebleau), the time was used in 2005 to set up the infrastructures and devices for baseline measurements of fluxes and associated variables. In Grignon, continuous ozone deposition readings have been taken on a corn/wheat/winter barley rotation since Summer 2004 with a highly satisfactory operational rate. At Bordeaux, readings were taken in different ecosystems: maritime pine forest above and below the canopy, corn and bean crops (on the fringes of the CarboEurope-IP CERES2005 project). Various problems with the instruments obliged us to spend a considerable amount of time comparing and repairing sensors. We are now equipped (since 2006) with 5 analysers in satisfactory working order.

- This data was used to continue our work on parameterising deposition, especially non-stomatal deposition. This work had already been started within the framework of the ***BIOPOLLATM*** project, but GESBiO3 made a decisive contribution by providing long run data series for different ecosystems. By using a land-vegetation-atmosphere exchange model, we were able to quantify monthly changes in ozone deposition to the vegetation, and to the stomatal portion in particular, which has the greatest impact on the vegetation.

Apart from the problem of availability of reliable commercial fast-response ozone analyzers, which meant that not all the measurement sites could be equipped as originally planned, the GESBiO3 project established the basis for a network for measuring ozone flux and processing the resulting data (procedures for processing raw data to calculate deposition according to standardised procedures and processing flux data in order to establish parameterisation and models of ozone deposition to vegetation cover). In addition to continuing the work currently underway (measuring fluxes, processing data, modelling deposition), the next stage is the assessment of new fast-response ozone analyzers from late 2006 onwards, with a view to equipping three additional sites (meadow in Lusignan and forest in Fontainebleau and Hesse).

Key words

Greenhouse effect, ozone, vegetation-atmosphere exchanges, agriculture, forest, nitrogen oxides, chemistry-transport model

Participating teams

Teams which actually took part in the GICC-2-funded portion of the project

INRA UMR INRA / INA P-G Environnement et Grandes Cultures (EGC – Environment & Major Crops Unit), BP1, 78850 Thiverval-Grignon

INRA UR Écologie Fonctionnelle et Physique de l'Environnement (EPHYSE – Functional Ecology and Environmental Physics research unit), 71 avenue Edouard Bourlaux, BP 81, 33883 Villenave d'Ornon Cedex

Université Paris-Sud CNRS (UMR 8079), Unité Ecologie, Systématique et Evolution (ESE – Ecology, Systematics and Evolution Unit)

INRA UMR Ecologie et Ecophysiologie Forestière (EEF – Forest Ecology and Ecophysiology), Nancy (Hesse beech wood testing site)

INRA UR Ecophysiologie des Plantes Fourragères (EPF – Forage Plant Ecophysiology), Lusignan (meadow testing site)

Other teams present in the initial proposal (not funded)

INRA UMR Université Paris 6 / CNRS / INRA BioEMCo, Thiverval-Grignon
IPSL Laboratoire de Météorologie Dynamique (LMD – Dynamic Meteorology Laboratory), Paris
Laboratoire des Sciences du Climat et de l'Environnement (LSCE – Climate and Environmental Science Laboratory), Saclay

Université Paris 12, Laboratoire Interuniversitaire des Systèmes Atmosphériques (LISA – Joint Universities Atmospheric Systems Laboratory)

CNRS/OMP/Université de Toulouse: Laboratoire d'Aérologie (LA – Aerology Laboratory)

AirParif (data from the air quality monitoring network, inventory of anthropogenic sources for the Ile de France region).