European Commission's 7th Framework Programme
Grant Agreement No. **226520**

Project acronym: **COMBINE**

Project full title: **Comprehensive Modelling of the Earth System for Better Climate Prediction and Projection**

Instrument: Collaborative Project & Large-scale Integrating Project

Theme 6: *Environment* Area 6.1.1.4: *Future Climate*

ENV.2008.1.1.4.1: *New components in Earth System modelling for better climate projections*

Start date of project: 1 May 2009 Duration: 48 Months

Milestone Reference Number and Title:

M2.2 Prototype of vegetation-chemistry-interactions included in ESMs

Lead work package for this milestone: WP2

Organization name of lead contractor for this milestone: WUR (L Ganzeveld)

Due date of milestone: April 2011
Actual submission date: April 2011

A multi-layer canopy exchange model to simulate explicitly atmosphere-biosphere exchange of reactive trace gases and biogenic aerosols as a function of vegetation properties and micrometeorological parameters has been coupled to the dynamical global vegetation model (DGVM) LPJ-GUESS. LPJ-GUESS is currently already implemented in the Earth system model EC_Earth to consider the online simulation of biogenic Volatile Organic Compound (VOC) emissions as a function of the dynamical representation of the vegetation canopy. These biogenic VOC emissions will provide one of the essential natural sources of reactive compounds involved in atmospheric chemistry being simulated with the atmospheric chemistry model TM5. The coupling of the multi-layer canopy exchange model to LPJ_GUESS has resulted in a prototype system that can be applied to consider a number of relevant vegetation-chemistry interactions, e.g. the impact of ozone deposition on photosynthesis and VOC emissions which in turn effect ozone production and deposition. The prototype system is currently implemented in a single column chemistry-climate model, which has shown its merits to conduct process and feedback studies as well as evaluation and campaign analysis studies for specific locations. For example we are currently conducting an extensive evaluation of the performance of the coupled system relying on the observations of an intensive field campaign conducted at the Finish boreal forest site Hyytiala. One of the features that must be still included is the inclusion of the NH_4^+/NO_3^- aerosol production terms where the multi-layer exchange model already contains an explicit representation of size resolved in-canopy aerosol dry deposition.

Ultimately, the multi-layer canopy exchange model for reactive compounds and biogenic aerosol exchange will also be implemented in the global modelling system EC_Earth/TM5/LPJ-GUESS. This will result in the explicit treatment of the interactions between biogenic VOC emissions, in-canopy chemistry, biogenic aerosol formation and removal by dry deposition in Earth system models such as EC-Earth.