European Commission's 7th Framework Programme
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Project acronym: **COMBINE**

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

Instrument: Collaborative Project & Large-scale Intergrating 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: M2.3 ESM with coupled aerosol-cloud-chemistry to vegetation, carbon and nitrogen cycles

Lead work package for this milestone: WP2

Organization name of lead contractor for this milestone: ETHZ

Due date of milestone: April 2012
Actual submission date: 31 October 2013

Milestone M2.3 ”ESM with coupled aerosol-cloud-chemistry to vegetation, carbon and nitrogen cycles”

Aerosol-cloud-chemistry & carbon-nitrogen coupling. The inclusion of biogenic volatile organic compound (BVOC) emissions of monoterpenes and isoprene has been implemented in the coupled JSBACH and ECHAM6-HAMMOZ model, both being part of the MPI-ESM, as described in Deliverable 2.6. The resulting model can be used to study the interactions between biosphere and atmosphere in a changing climate. The improved routines have been made available as modular parts for the MPI-ESM modelling system.

Aerosol-cloud-chemistry coupling - IPSL. The ammonia cycle as well as nitrate formation have been introduced in the LSCE-IPSL model and the results have been extensively compared with the measurements that were available up to 2012. This model was used to contribute to the COMBINE stream 2 runs (see Deliverable 7.4), and simulate the evolution of the future atmospheric chemical composition and compute the radiative forcings of the different aerosols for the years 2030, 2050 and 2100 based upon the four future RCP scenarios. Results are presented in the 3rd interim report, work-packages 2 and 7. Part of the work leading to the new LSCE-IPSL model has been presented in Deliverables 2.3 and 2.4.

Aerosol-cloud-chemistry coupling – ETHZ & MPG. The MPI-ESM has been coupled to the fully interactive aerosol model HAM2, and used to contribute to the COMBINE stream 2 runs (see Deliverable 7.4). Part of the work leading to the MPI-ESM-HAM2 model was reported in Deliverable 2.2. Results are presented in the 3rd interim report, work-packages 2 and 7.

Aerosol-cloud-chemistry & carbon-nitrogen coupling. A canopy model to simulate explicitly atmosphere-biosphere reactive trace gas and aerosol exchanges has been coupled to the representation of energy, water and CO_2 exchanges in a single column model ESM, the 1-D chemistry and climate model SCM. The SCM has been further coupled to the dynamical global vegetation model (DGVM) LPJGUESS to simulate biogenic emissions of Volatile Organic Compounds (VOC). The coupled SCM-LPJGUESS system has been deployed for a first analysis the significance of these interactions between atmospheric- and biogeochemistry (see Deliverable 2.5).