



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:

D7.2: Radiative forcing and feedback analysis for CMIP5 simulations achieved

Lead work package for this milestone: WP7

Organization name of lead contractor for this milestone: MPG

Due date of milestone: 31 October 2011

Actual submission date: 10 January 2012

This milestone documents the achievement of the radiative forcing and feedback analysis for the CMIP5 simulations (i.e., the COMBINE phase I climate simulations). This involved the implementation of the partial-radiative-perturbation (PRP) tool, by which a radiative transfer model has been isolated and set up to compute the perturbation of the radiative energy budget at the top of the atmosphere between a control simulation and a perturbed simulation.

For this milestone, the +1% CO₂ / year simulations, in which the atmospheric carbon dioxide concentration is increased by 1% per year in a coupled model integration, has been chosen. A main reason is that the radiative forcing for this simulation is well-defined.

The Max Planck Institute for Meteorology (MPG) has developed and provided this tool to the COMBINE partners. MF-CNRM has developed and applied a tool based on the radiation code of the CNRM-CM. The two PRP tools were then applied to separately analyse the contributions of the water vapour-, lapse rate-, cloud- and surface albedo feedbacks to the climate sensitivity for a given radiative forcing.

In addition, a redundant method to quantify the overall climate forcing and feedback has been applied from the experiments with instantaneously quadrupled atmospheric CO₂ concentrations applying the regression method (“Gregory method”).

Table 1. Summary of analyses performed.

| Model system | Partner | Radiative forcing and feedbacks from Gregory regression method | Detailed feedback analysis from PRP method | Remarks |
|---------------------|----------------|---|---|--|
| CMCC | CMCC | √ | √ | |
| MPI-ESM/ | MPI-M | √ | √ | |
| NorESM | UiB | √ | (*) | |
| HadGEM | METO | √ | (*) | |
| IPSL-CM | IPSL | √ | delayed | The analysis is expected to be finalised by February 2012. |
| CNRM-CM | MF-CNRM | √ | √ | A PRP tool consistent with the CNRM-CM radiative transfer code was developed and applied |

(*) This partner did not aim at a full feedback analysis for this milestone.