



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
Climate*

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: 54 Months

**Milestone Reference Number and Title: M8.5: Downscaling runs with RCAO
including new permafrost submodel completed**

Lead work package for this milestone: WP8

Organization name of lead contractor for this milestone:

Due date of milestone: 31 October 2013

Actual submission date: 31 October 2013

M8.5: Downscaling runs with RCAO including new permafrost submodel completed

An ensemble of RCA and RCAO downscalings have been performed. An overview of the simulation is provided in table 1. The results from these simulations are described in the deliverable 8.5.

In contrast to what has been stated in the proposal, no simulations with permafrost model have been done. Instead, a new version of RCA (RCA4) and RCAO has been developed. The new RCAO version includes the newest RCA4 as atmospheric component and a new version of RCO as ocean component. In RCO, a new sea ice model HELMI has been implemented and replaces the old ice model. HELMI is a state of the art sea ice model, includes 7 ice thickness categories and allows for simulations of ridged and rafted ice. Since the Arctic climate and possible future changes are strongly governed by the sea ice, we prioritized the development of the new RCAO version before including a permafrost model.

Since, the Stream 2 versions of the COMBINE ESMs were substantially delayed, it was not possible to perform an ensemble of downscalings from these improved global model versions within this WP8. However, we performed regional downscaling simulations with at least one Stream 2 model, EC-Earth. In addition, a large ensemble of regional Arctic downscaling simulations with RCA has been performed, which is the world-largest ensemble of regional Arctic future simulations.

The regional downscaling simulations will be made available for the general public at the ESGF-node of the National Super Computing Centre in Linköping/ Sweden.

	ERA-interim	EC-Earth	EC-Earth +melt ponds	MPI-ESM-LR	Can ESM2	Nor ESM1-M	MIROC5
RCA	yes	hist rcp26 rcp45 rcp85	hist rcp45 rcp85	hist rcp45 rcp85	hist rcp45 rcp85	hist rcp45 rcp85	
RCA-SN	yes	hist rcp8.5		hist rcp85			
RCAO	yes	hist rcp85		hist rcp8.5			hist rcp85
RCAO-SN	yes	hist rcp85		hist rcp85			

Table 1: RCA and RCAO downscalings with and without spectral nudging (SN) of global models and reanalysis.