



European Commission's 7<sup>th</sup> 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

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**Milestone Reference Number and Title:**

**M4.1 Prototype of coupling Greenland ice sheet models to ESMs using new coupling  
method**

**Lead work package for this milestone: WP4**

**Organization name of lead contractor for this milestone: DMI**

**Due date of milestone: June 30, 2011**

**Actual submission date: September 1, 2011**

## M4.1 Prototype of coupling Greenland ice sheet models to ESMs using new coupling method

Milestone M4.1 is about the establishment of ESMs incorporated with Greenland ice sheet models (ISMs) with consideration of mass and energy balance on the ice sheet surface. The milestone M4.1 has been completed in two parts. First the mass and energy balance on the Greenland ice sheet surface in ESMs were verified and improved by the partners, as reported at the COMBINE General Assembly 2010. The methodology of coupling the ESMs with Greenland ISMs was developed accordingly. Second, prototype models that coupled ESMs and Greenland ISMs have been established<sup>1</sup>. Short runs testing the coupled system were performed. Improvements of the coupling are ongoing and long simulations will follow.

Table 1 reports the basic information of the ESM-ISM coupled systems including coupling method used in WP4

**Table 1.** ESMs and the incorporated ice sheet models (ISM) for Greenland ice sheet

Partner	CNRS	DMI	METO	MF-CNRM	MPG
ESM	IPSL-CM5	EC-EARTH	HadCM3	CNRM-CM5	MPI-ESM
Resolution in ESM	96x95L39 or 144x143L39	A:T159L62 O:1°x1°L42	A: N48L19 O:1.25x1.25°L20	A: 127L31 O: 1°x1°L42	A: T63L47 O: GR1.5L40*
ISM	GRISLI	PISM	Huybrechts	GRISLI	PISM
Resolution in ISM	20 x 20km	20 x 20 km	20 x 20 km	20 x 20 km	20 x 20 km
Coupling method	PDD (first) then Energy Balance	Energy Balance	Energy Balance	PDD (first) then Energy Balance	Energy balance
Snow scheme over land ice	CROCUS multilayer scheme as used in SISVAT/MAR, including refreezing, percolation, snow aging, etc.	Single explicit snow layer scheme with liquid water reservoir and conductivity at ice/snow interface, etc.	Single implicit layer	CROCUS multilayer scheme as used in SURFEX surface scheme, including refreezing, percolation, snow aging, etc.	Explicit snow-layer scheme
ISM interaction with Ocean	Fresh water flux linked to melting	No.	Fresh water flux linked to melting	Fresh water flux linked to melting	No

\* The ocean model has a nominal resolution of 1.5°x1.5° where the northpole is placed over Greenland

<sup>1</sup> One partner (MF-CNRM) has reported delay of the work and will deliver the prototype in early 2012.