

# SPECIAL PROJECT INTERIM REPORT

Interim Reports should be 2 to 10 pages in length, depending on importance of the project. All the following mandatory information needs to be provided.

**Reporting year** 2014

**Project Title:** Land surface interaction and climate change over Africa by means of a coupled Regional climate Model to a biogeochemical land-surface scheme.

**Computer Project Account:** SPJRCFIR

**Principal Investigator(s):** Alessandro Dosio  
Abdulla Sakalli

**Affiliation:** European Commission – DG Joint Research Centre,  
Institute for Environment and Sustainability (IES)  
Climate Risk Management Unit- TP100  
Via E. Fermi, 2749, I-21027 Ispra (VA), ITALY

**Name of ECMWF scientist(s) collaborating to the project** .....  
(if applicable) .....

**Start date of the project:** 2014

**Expected end date:** 2016

**Computer resources allocated/used for the current year and the previous one**  
(if applicable)

**Please answer for all project resources**

		Previous year		Current year	
		Allocated	Used	Allocated	Used
<b>High Performance Computing Facility</b>	(units)			300000	~98%. Expect to use full allocation
<b>Data storage capacity</b>	(Gbytes)			100	~40 Gb Expect to use full allocation

## Summary of project objectives

(10 lines max)

The main objective of the project is to couple the regional model COSMO-CLM to the biogeophysical land surface scheme CLM4.0 and to assess the performances of the new coupled model over Africa. The main objective of the first phase of the project is the technical implementation of the models (both COSMO-CLM and CLM4.0) and the coupler OASIS.

In addition, before running climate simulations, a long spin-up needs to be run in order to get the biospheric carbon pools in equilibrium.

Planned simulations include a 20 year evaluation run with perfect boundary conditions (ERA-Interim) over the period 1989-2008, following the CORDEX guidelines.

Focus will be on the analysis of the differences between the new coupled model and the standard COSMO-CLM, on the reproduction of the present African climate.

## Summary of problems encountered (if any)

(20 lines max)

No serious technical problems were encountered, although some time and efforts have been required to adapt the model (scripts, libraries, compiling etc) to the system. We had problem to install the Earth System Modelling Framework (ESMF) and CLM4.0 on c2a, since the xlf library on the IBM machine was build with -qextname by default. Therefore we encountered some troubles when using flush and chdir intrinsic functions. We had to spent some time to change name of the flush and chdir in the model code, since the -brename flag did not solve the problem.

## Summary of results of the current year (from July of previous year to June of current year)

During the first months of the project, the Community Land Model (CLM4.0) has been uploaded and implemented on hpce.

A description of the model system as well as the work done so far is given below.

### *Description of the model system:*

The Community Land Model (CLM) is a series of global land models developed by the CESM (Climate-Earth System Model) Land Model Working Group (LMWG) and maintained at the National Center for Atmospheric Research (NCAR). The version CLM4.0 in CESM1.0.3 is available for download from the public release subversion repository (link available at this address: <http://www.cesm.ucar.edu/models/cesm1.0/clm/>). The latest version of CLM4.5 in CESM1.2.1 was released but is not ready to simulate the processes on regional scale. Therefore, we used the pre-version (CLM4.0) of the model.

CLM4.0 simulates a variety of biogeophysical processes such as solar and longwave radiation interactions with vegetation canopy and soil, momentum and turbulent fluxes from canopy and soil, heat transfer in soil and snow, hydrology of canopy, soil, and snow, and stomatal physiology and photosynthesis.

As a community model, CLM4.0 benefits from continual and extensive evaluation, criticism, and improvement by CLM4.0 users and developers. The model has been extended with a carbon and nitrogen cycle model that includes prognostic vegetation phenology, the capability to apply transient land cover and land use change.

The technical description of CLM4.0 is available online

([www.cesm.ucar.edu/models/cesm1.0/clm/CLM4\\_Tech\\_Note.pdf](http://www.cesm.ucar.edu/models/cesm1.0/clm/CLM4_Tech_Note.pdf); Oleson et al. 2010).

CLM4.0 is released with a suite of tools necessary to run the model. More in detail the model system includes:

- a) There are several tools provided with CLM that allow you to create your own input datasets at resolutions you choose, or to interpolate initial conditions to a different resolution, or used to compare CLM history files between different cases. The tools are all available in the models/Ind/clm/tools directory. Most of the tools are FORTRAN stand-alone programs in their own directory, but there is also a suite of NCL scripts in the ncl\_scripts directory. The list of generally important scripts and programs are:
  1. cprnc to compare NetCDF files with a time axis.
  2. interpinic to interpolate initial condition files.
  3. mkgriddata to create grid datasets.
  4. mkdatadomain to create domain files from grid datasets used by datm or docn.
  5. mksurfdata to create surface datasets from grid datasets.
  6. ncl\_scripts/getregional\_datasets.pl script to extract a region or a single-point from global input datasets. See the single-point chapter for more information on this.
  7. ncl\_scripts/npdepregrid.ncl interpolate the Nitrogen deposition datasets to a new resolution.
  8. ncl\_scripts/aerdepregrid.ncl interpolate the Aerosol deposition datasets to a new resolution. These tools are needed for the creation of all input files needed by CLM for running the model at a particular resolution or for a particular observational sites.
  9. ESMF (Eart System Model Framework) to generate required initial data for the regional case (i.e. pan-European scale) from global database.
- b) The source code of CLM4.0.
- c) The post-processing tools for displaying model results and visualization.

*Implementation on ECMWF hpce:*

The necessary tools (e.g. ESMF) were installed by ECWF support team, since the installation of ESMF required administrative access on the system of hpce.

A spin-up run was needed to ensure to get the biosphere in equilibrium with the simulated climate. We needed to run the model for 800 simulation years to reach the steady state for required carbon pools (e.g. soil, vegetation and ecosystem carbon pools) in the biosphere. The spin up was run in de-coupled mode, i.e. using already completed climate simulations to force CLM4.0. This run consumed nearly 80% of the SBUs allocated for 2014.

**List of publications/reports from the project with complete references**

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**Summary of plans for the continuation of the project**

(10 lines max)

*Planned runs and validation:*

We plan to port COSMO-CLM, CLM4.0 and OASIS code on the new CRAY machine. A series of tests will be conducted to check the successful implementation of the coupled model and the plausibility of results. Given the very small amount of SBUs left for 2014, these tests may be conducted in 2015.

A 20 year evaluation simulation with perfect boundary conditions (ERA-Interim) over the period 1989-2008, will be run following the CORDEX guidelines.

Focus will be on the analysis of the differences between the new coupled model and the standard COSMO-CLM, on the reproduction of the present African climate.