



IS-ENES2 DELIVERABLE (D -N°:11.2)

Report on Climate4impact portal, version 1

File name: {IS-ENES2_D11_2.pdf}

Reporting period: *01/04/2013 – 30/09/2014*

Author(s): **Christian Pagé**
Wim Som de Cerff, Maarten Plieger
Manuel Vega, Antonio Cofiño

Reviewer(s):
Nils Hempelmann
Stephen Pascoe

Revision table			
Version	Date	Name	Comments
0.1	June 17	Som de Cerff	Initial document
0.2	June 27	Christian Pagé	Review of all sections. Added 3.3, 3.4, 4.1.
0.3	July 15	Vega & Cofiño	Contribution to 3.3 and 3.6
0.4	August 12	Plieger	Contribution to 3.2, 3.5 and 3.6
0.5	August 12	Christian Pagé	Full review + Contributions mainly to 3.4
0.6	Nov. 4	Stephen Pascoe	Full review, small corrections and comments.
0.7	Nov. 6	Christian Pagé	Addressed comments of Stephen Pascoe review.

Abstract

This report describes the functionality and commissioning of version 1 of the CLIMATE4IMPACT portal, including its acceptance into the operational services run under SA2. This release of the portal will be based on the prototype deployed in ISENES1. It allows users to explore data held at distributed archive nodes using a range of plotting options. In addition to the services deployed in the prototype, plotting of time-series is made available.

Project co-funded by the European Commission's Seventh Framework Programme (FP7; 2007-2013) under the grant agreement n°312979		
Dissemination Level		
PU	Public	X
PP	Restricted to other programme participants including the Commission Services	
RE	Restricted to a group specified by the partners of the IS-ENES2 project	
C	Confidential, only for partners of the IS-ENES2 project	

Table of contents

1.	Introduction	4
2.	Reference documentation	6
3.	First Operational release climate4impact	6
3.1	Summary of improvements.....	6
3.2	Search.....	7
3.3	Online Computation.....	8
3.4	Guidance and documentation.....	11
3.5	Security	12
3.6	Outlook to next release of climate4impact	13

Executive Summary

On April 15, 2014 the IS-ENES climate4impact portal status changed from prototype to operational. The prototype version was created during the FP7 IS-ENES project (2009-2013).

Key features of climate4impact are:

- Dissemination of model results from both global and regional model experiments
- Extensive documentation for impact modellers: guidelines, warnings, do's and don'ts
- Facilitates interaction between climate modellers, companies and climate services
- Search, visualize and compute: from petabyte to megabyte size reduction, drill down to the information needed, downscaling and indices on-the-fly calculations

Summary of improvements of the first operational release:

- Improved site entrance, documentation and styling
- Improved login and security
- Simplified interface for search and download
- Functionality organized in a simpler accessible way, streamlining the workflow and reducing amount of mouse clicks
- Improved error interface
- Online processing: indices and downscaling (prototype)

The portal will be further improved by enhancing existing features like search and login usability, use case documentation and user guidance and exploring new ones such as improved user support, indices calculation and downscaling in close cooperation with the impact user community within the FP7 IS-ENES2 project as well as the FP7 CLIPC regarding users' needs and the Copernicus platform.

The climate4impact portal will be further developed and improved during the course of the IS-ENES2 project.

1. Introduction

The prototype version was created in the FP7 IS-ENES project (2009-2013). In this project the initial design and architecture was setup [D11.3]. The main goal for climate4impact is the dissemination of model results from both global and regional model experiments to a wider user community, closing the gap between climate scientists and the climate change impact research community.

The portal is dedicated to the climate impact research community. This target community was set at a user workshop in Copenhagen (2010). Therefore much effort was invested in gathering the user requirements from this large community [D11.1, D11.2]. The requirements are based on 21 use cases from different countries and different sectors (Agriculture/Forestry, Energy, Health, Infrastructure/Urban, Marine/Coastal, Nature/Biodiversity, Tourism, Water Management). The use cases were setup by interviewing users from the different sectors.

Targeting the impact research community has lead to the extensive documentation aimed at the impact community (guidelines, warnings, do's and don'ts). The strong needs for accessible and concise documentation became clear as the use cases were gathered. What also became clear is that for further guidance expert knowledge is required, therefore it is possible to contact a climate model expert through the climate4impact portal support service using an email form or by posting questions on the climate4impact AskBot. The questions are forwarded to experts in the climate4impact team (CERFACS, KNMI, SMHI, WU)

The climate4impact portal is built on top of the Earth System Grid Federation, the worldwide distributed infrastructure providing access to global and regional climate model data. It also provides access to climate4impact specific archives (containing e.g., E-Obs dataset), but it also allows you to connect to any OpenDAP accessible archive and use the functionality provided by climate4impact.

In IS-ENES2, the work done in IS-ENES is being continued by making the prototype operational and expanding its functionality as driven by the impact research community users' needs. Dissemination of climate4impact, started in IS-ENES, is done through numerous presentations, workshops and tutorials at various locations along with popular articles [GeoQ]. Dissemination will continue to expand the use of climate4impact.

The number of users has grown significantly since the release of the 1st climate4impact operational version: from 500 to 1500 unique users per month. The aim is to expand and increase the number of unique users and also address the needs of more diverse impact communities.

2. Reference documentation

- [D11.1] IS-ENES1 / D11.1 – Final description of selected Use Cases including user requirements specification
- [D11.2] IS-ENES1 / D11.2 – Baseline documents on e-resources/tools and transverse themes
- [D11.3] IS-ENES1 / D11.3 – The e-Impact portal Software Requirements/Architectural Design/
IO Specification
- [D11.4] IS-ENES1 / D11.4 – Software Code and e-impact-portal full documentation
- [D11.5] IS-ENES1 / D11.5 – Report and manuscript journal paper on key characteristics for a prototype of an e-based pan-European climate data service network
- [D11.7] IS-ENES1 / D11.7 – Software Verification, Validation Plan and Test Data Sets
- [GeoQ] Climate4impact: a new gateway for the global climate impact community

3. First Operational release climate4impact

3.1 Summary of improvements

Based on a user survey conducted near the end of IS-ENES, a roadmap for development of climate4impact was decided. This and the DoW of IS-ENES2 describe the development objectives.

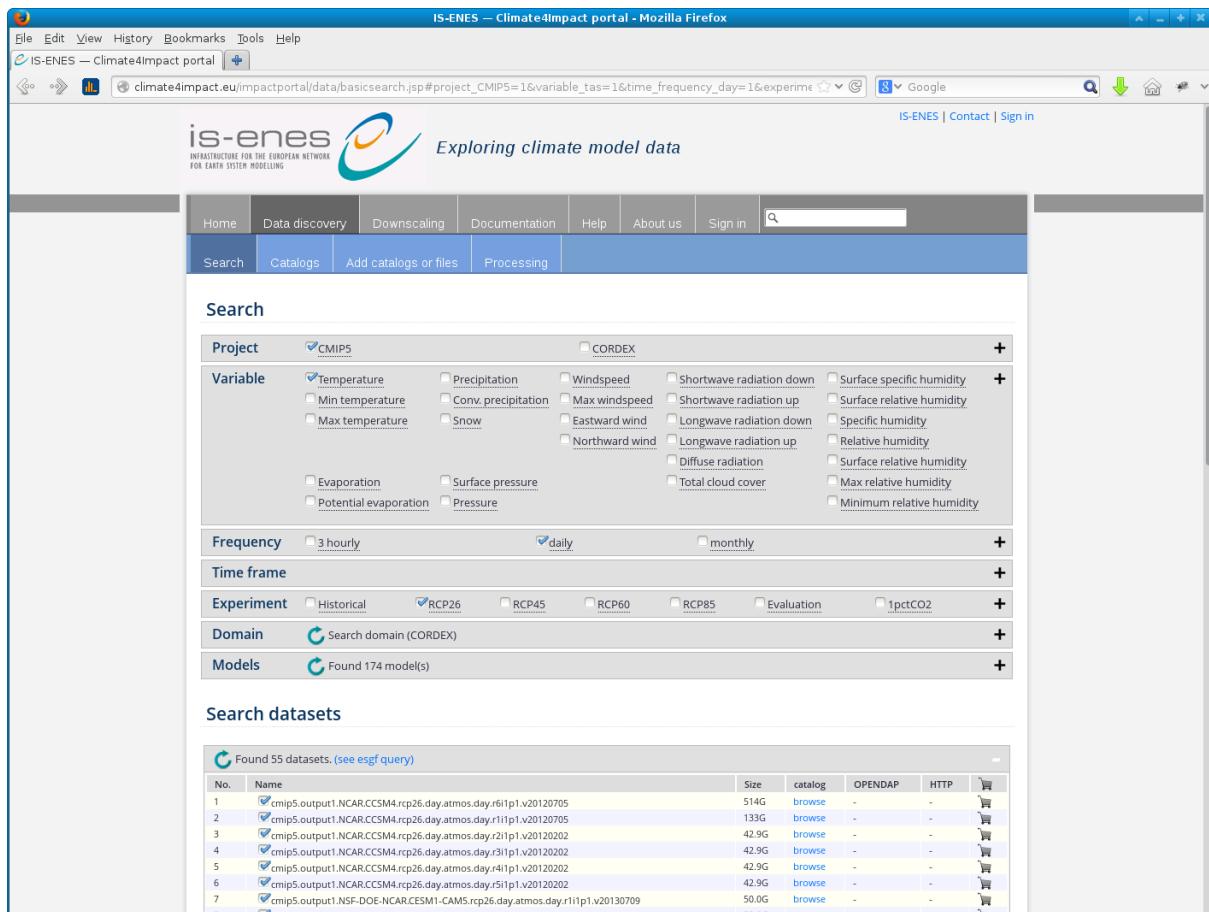
The summary of improvements are mentioned below:

- Improved site entrance, documentation and styling
- Improved login and security
- Simplified interface for search and download
- Functionality organized in a simpler accessible way, streamlining the workflow and reducing amount of mouse clicks
- Improved error interface
- Online processing: indices and downscaling (prototype)

In the following sections the improvements are described in more detail.

3.2 Search

Searching through the petabyte (and soon expanding to exascale) climate model archives is enabled through the ESGF facet search API. But only providing these facet options to the users is not sufficient and far from user friendly: there are, for example, 2981 variables, 37 time frequencies, 167 experiments. Where and how to begin a search? Therefore a preset filter is tailored to the user. This preset was designed in consultation with the impact users, see Figure 1.



The screenshot shows a Mozilla Firefox browser window displaying the 'IS-ENES — Climate4Impact portal - Mozilla Firefox' page. The URL is 'climate4impact.eu/impactportal/data/basicsearch.jsp#project_CMIP5=1&variable_tas=1&time_frequency_day=1&experiment_rcp=2.6'. The page features the IS-ENES logo and navigation links for Home, Data discovery, Downscaling, Documentation, Help, About us, Sign in, and a search bar. Below the navigation is a blue header bar with links for Search, Catalogs, Add catalogs or files, and Processing. The main content area is titled 'Search' and contains several facets for filtering datasets:

- Project:** CMIP5 (selected), CORDEX (unchecked)
- Variable:** Temperature (selected), Min temperature, Max temperature, Precipitation, Conv. precipitation, Snow, Wind speed, Max windspeed, Shortwave radiation down, Shortwave radiation up, Longwave radiation down, Longwave radiation up, Diffuse radiation, Total cloud cover, Surface pressure, Pressure, Surface specific humidity, Surface relative humidity, Specific humidity, Relative humidity, Surface relative humidity, Max relative humidity, Minimum relative humidity
- Frequency:** 3 hourly (unchecked), daily (selected), monthly (unchecked)
- Time frame:** Historical (unchecked), RCP26 (selected), RCP45, RCP60, RCP85, Evaluation, 1pctCO2
- Experiment:** Historical, RCP26, RCP45, RCP60, RCP85, Evaluation, 1pctCO2
- Domain:** Search domain (CORDEX)
- Models:** Found 174 model(s)

Below the facets is a section titled 'Search datasets' with the message 'Found 55 datasets. (see esgf query)'. A table lists the datasets with columns for No., Name, Size, catalog, OPENDAP, HTTP, and a download icon. The first few rows are:

No.	Name	Size	catalog	OPENDAP	HTTP	Download
1	cmip5.output1.NCAR.CCSM4.rcp26.day.atmos.day.r6i1p1.v20120705	514G	browse	-	-	
2	cmip5.output1.NCAR.CCSM4.rcp26.day.atmos.day.r1i1p1.v20120705	133G	browse	-	-	
3	cmip5.output1.NCAR.CCSM4.rcp26.day.atmos.day.r2i1p1.v20120202	42.9G	browse	-	-	
4	cmip5.output1.NCAR.CCSM4.rcp26.day.atmos.day.r3i1p1.v20120202	42.9G	browse	-	-	
5	cmip5.output1.NCAR.CCSM4.rcp26.day.atmos.day.r4i1p1.v20120202	42.9G	browse	-	-	
6	cmip5.output1.NCAR.CCSM4.rcp26.day.atmos.day.r5i1p1.v20120202	42.9G	browse	-	-	
7	cmip5.output1.NSF-DOE-NCAR.CESM1-CAMS.rcp26.day.atmos.day.r1i1p1.v20130709	50.0G	browse	-	-	

Figure 1 The new search interface which has been integrated in the climate4impact portal. Subsets of all options for Variable, Frequency and Experiment are presented to the user.

When changing one of the search parameters in the interface, the search settings are directly translated to the browser URL. This enables the browser history buttons back and forward to be used, and it allows to copy and store search URLs for later use. In the future this functionality can be used, e.g. within the CLIPC portal, to open a search page at climate4impact directly, with all search parameters already being set. This feature is very important for users and also for interoperability with other portals, such as CLIPC.

3.3 Online Computation

The online computation can be divided into these categories:

1. Climate indices and simple statistical calculations
2. Statistical Downscaling

Most of the work that has been done with respect to online calculation has been in the underlying infrastructure of the portal and therefore is not yet much visible to the users. These additions are very important and will be able to support advance online calculations for the climate4impact portal, put also to other portals with web services accessible through an API.

Climate indices

Climate indices calculations within climate4impact will be done using *icclim*¹ (Index Calculation CLIMate). *icclim* is a Python library designed for calculation of climate indices and indicators. While there already exists several climate indices calculation software, none of them could fulfil or be adapted in time for all climate4impact needs:

- Input and output using strict CF-Convention, metadata propagation from input to output, and provenance data
- Efficient handling of very large distributed datasets and datafiles
- Calculations fully done in memory without intermediate files
- Easy chaining of operations
- Accessible through *pyWPS*²
- Standalone python library for tight integration with *pyWPS* and in-memory calculations
- Easy to add more indices (building blocks approach, with basic functions that can be called separately)
- Very fast calculations on heterogeneous systems for online on-demand calculations
- Support the future architecture of ESGF computing nodes as well as EUDAT GEF to offload some calculations to be done near the data storage
- Be ready for use by April 2014, for the 1st climate4impact operational release

However, a package named OpenClimateGIS (*ocgis*) was already developed by NCAR NCPP and could at least fulfil some of the input and output needs. Currently *icclim* is

¹ <http://icclim.readthedocs.org/en/latest/>

² <http://pywps.readthedocs.org/en/latest/>

being called by *ocgis* to perform climate indices calculations. Also, *ocgis* has implemented part of *icclim* code:

- Dynamic data chunking for efficient in-memory calculations using large datafiles
- Percentile calculations basic functions

The portal climate4impact will perform online calculations of climate indices through a native *pyWPS* interface to *ocgis/icclim*. The user interface is not built yet, but it will be a climate indices wizard to guide users in selecting all needed parameters and inputs to the climate indices calculations.

With keeping OCG standards, connection to other OCG-based WPS systems is possible for enlarging process options.

Statistical Downscaling

The climate4impact portal is also providing statistical downscaling services. For the 1st operational version, a *Downscaling Tab* has been added on the main climate4impact page (see Figure 2). This is the first step in the integration of the University of Cantabria (UC) *Ensembles Downscaling Portal*³ into climate4impact. Although the integration is just at the beginning, significant work has been taking place to prepare this tight integration, in which climate4impact services will access the UC Portal through web services and delegated Open ID certificates authentication. It will be a seamless and transparent access for climate4impact users.

The *Downscaling Tab* will contain more tabs inside to guide users to complete a downscaling. The first one is the *Subscription tab* which contains an agreement and a subscription button. Users have to accept the terms of use to access to *UC Downscaling Services*. When users click the subscription button, a request is sent to the *Downscaling Portal* that registers the user using retrieved user details by climate4impact. This process allows them to have their own account as well as their own downscaling data.

Home	Data discovery	Downscaling	Documentation	Help	About us	Sign in
Documentation	Subscription	Create				

[Background & topics](#) » [Climate model data](#) » [Downscaling](#) » [Downscaling documentation](#)

Downscaling documentation

This page will very soon provide users access to statistically downscaled CMIP5 experiments.

These datasets will be dynamically generated by the users, using services from the Downscaling Portal developed and hosted by University of Cantabria. You can find more details about the Downscaling Portal on this link (<http://meteo.unican.es/downscaling>).

While this integration is being done between the Climate4Impact and the Downscaling Portal, users can access and generate their own downscaling by accessing directly the Downscaling Portal (<http://meteo.unican.es/downscaling>).

Figure 2: Preview of the *Downscaling Tab* integration with climate4impact portal. The *Documentation*, *Subscription* and *Create* sub-tabs are shown.

In terms of available downscaling methods, one documented method and one documented training dataset will be available. The second tab (“Create”) guides users to configure their downscaling. The downscaling configuration has these steps:

1. Select a geographical coverage of interest: i.e. predefined countries
2. Select a temporal coverage of interest: i.e. 1970-2050
3. Select a predictand of interest: i.e. *Daily average Temperature* or *Daily Total Precipitation Accumulation*
4. Select a model projection and scenario: i.e. A1B + one GCM model.

After the downscaling is configured, the temporal coverage will be validated. It is not possible to submit the query if the period of interest is not validated. The User Interface implementation of the *Downscaling Tab* will be very similar to the *Data Discovery Tab* and will allow users to load and save their pre-configured downscaling.

Climate4Impact portal sends requests to the *Downscaling Portal* through a *RESTful API* which is token access secured. Climate4Impact uses for this a special user that is allowed to get valid *tokens* from the *Downscaling Portal*. Climate4Impact background services

use this *token* to gain access to the Downscaling RESTFul API. The following services are now available:

1. Subscribe users
2. Retrieve a list of users
3. Delete a subscribed user
4. Get user stored data
5. Retrieve a list of Predictors

The next goal is to complete the implementation of the *Downscaling Tab* and connect it to the *Downscaling Portal RESTFul API*.

3.4 Guidance and documentation

The guidance and documentation of the portal is static, but it is driven by the Use Cases that have been written in the first phase of the IS-ENES project. There is not yet any dynamic documentation (or contextual). The main entrance to the documentation, using the Documentation tab, is the theme selection, which is the same as in the main landing page (see Figure 3). The Background & Topics as well as the Glossary tabs are to introduce general information about the climate system and climate scenarios, along with specific vocabulary. These sections are not meant to explain everything related to climate science, but rather to summarize for impact users as well as providing useful links to get more in-depth information. In the portal the documentation is really tailored for users' needs. The technical documentation about how to use the portal is described in the Map&Plot, and Processing tabs.

The screenshot shows the 'Exploring climate model data' section of the is-enes website. At the top, there's a navigation bar with links for Home, Data discovery, Downscaling, Documentation, Help, About us, Sign in, and a search bar. Below the navigation is a secondary menu with sub-links: Guidance & use cases, Background & topics, Glossary, Map & Plot, Processing, and Publications. The main content area is titled 'Use climate model data'. It contains two paragraphs of text explaining the context of use cases and their relevance to various sectors. Below the text are eight thumbnail images representing different themes: Agriculture/Forestry (green fields), Energy (wind turbines), Health (person with umbrella), Infrastructure/Urban (city street), Marine/Coastal (rocky coastline), Nature/Biodiversity (yellow field), Tourism (city skyline), and Water Management (waterfront buildings). Each thumbnail has its category name below it.

Figure 3: *Documentation Tab* with the themes landing page and with the sub-tabs.
Basket

The basket is a personal space where links to files and resources, results of processing, and personal data files can be stored. The basket is accessible anywhere when logged in. By default there are two folders, ‘Remote data’ and ‘My data’. Links from Catalogues like OPeNDAP links or file links are stored here. ‘My data’ contains processing results. In the next release ‘My data’ will offer secured OpenDAP in order to visualize and re-use datasets in further processing. Upload functionality will be added as well, this allows processing of your own files in climate4impact. One can think of uploading a point dataset and extract timeseries for this point dataset.

3.5 Security

Climate4impact and Downscaling Portal RESTful API communication will be based on secure tokens issued. These tokens will expire in a short period of time (48 hours) according to the PKI X509 proxies issued by the climate4impact. The access to model projections will be based on ESGF services and therefore a delegation mechanism will be required. Due to this delegation mechanism missing on ESGF and interim solution will involve a secure transmission of the users X509 proxies issued by climate4impact to the Downscaling Portal. This interim solution will imply some security risks that it will be solved by a more appropriate delegation mechanism (i.e. SAML2.0) to be implemented by the security working team.

A first attempt was made with the EUDAT project work package AAI (Authentication and Authorization Infrastructure) to enable access to EUDAT services from climate4impact. The goal was to login at EUDAT infrastructure using an ESGF OpenID, and retrieve a credential from EUDAT AAI to gain access to EUDAT services. It turned out that OpenID is deprecated and being followed up by OAuth 2.0/OpenID connect protocol. OpenID Connect is a simple identity layer on top of the OAuth 2.0 protocol. The EUDAT AAI prototype currently supports OpenID Connect but not OpenID. Climate4impact uses the OpenId4Java as library to support OpenID which has no support for OpenID Connect, so attempts were momentary stopped here. Climate4Impact has to upgrade its identity layer to support both OpenID and OpenID Connect, but is looking for the latest developments at the ESGF infrastructure first.

3.6 Outlook to next release of climate4impact

Release 2.0

climate4impact 2.0 will be released at the end of October 2014, and it will offer:

- A set of Web Services (WS) tailored for impact users and accessible to other portals and web applications, with proper authentication and authorization
- A portal with extensive documentation, common use cases and guidance for impact users, built on top of the climate4impact WS

The following major new features will be available:

- Seamless and transparent integration of the *UC Downscaling Portal*
- A large set of climate indices on-demand calculations with a wizard to guide users
- A user space accessible through authenticated OpenDAP to store results and share those to other users
- Dynamic guidance to users as they browse, search and display data