SEVENTH FRAMEWORK PROGRAMME
Capacities Specific Programme
Research Infrastructures

Grant Agreement for:
Integrating Activity - Combination of Collaborative Project and Coordination and Support Action

Annex 1 - "Description of Work"

Project Acronym: **IS-ENES**

Project Full Title: **I**nfra**S**tructure for the **E**uropean **N**etwork for **E**arth **S**ystem Modelling

Grant Agreement: **n°: 228203**

Date of Preparation of Annex 1: **20th March 2009**
Date of Approval of Annex 1 by Commission: *(to be completed by Commission)*

PART A

A.1 Project summary

IS-ENES will develop a virtual Earth System Modelling Resource Centre (v.E.R.C.), integrating the European Earth system models (ESMs) and their hardware, software, and data environments. The overarching goal of this e-infrastructure is to further integrate the European climate modelling community, to help the definition of a common future strategy, to ease the development of full ESMs, to foster the execution and exploitation of high-end simulations, and to support the dissemination of model results and the interaction with the climate change impact community. The v.E.R.C. encompasses models, the tools to prepare, evaluate, run, store and exploit model simulations, the access to model results and to the European high-performance computing ecosystem – in particular the EU large infrastructures DEISA2 and PRACE. The v.E.R.C. developed by IS-ENES is based on generic ICT, Grid technology and subject-specific simulation codes and software environments.

IS-ENES is the infrastructure project of the European Network for Earth System Modelling (ENES). ENES gathers the European climate and Earth system modelling community working on understanding and prediction of future climate change. This community is strongly involved in the assessments of the Intergovernmental Panel on Climate Change and provides the predictions on which EU mitigation and adaptation policies are elaborated.

IS-ENES combines expertise in Earth system modelling, in computational science, and in studies of climate change impacts. IS-ENES will provide a service on models and model results both to modelling groups and to the users of model results, especially the impact community. Joint research activities will improve the efficient use of high-performance computers, model evaluation tool sets, access to model results, and prototype climate services for the impact community. Networking activities will increase the cohesion of the European ESM community and advance a coherent European Network for Earth System modelling.

A.2 List of beneficiaries

Beneficiary Number	Beneficiary Name	Beneficiary short name	Country	Date enter project	Date exit project
1 (coordinator)	Centre National de la Recherche Scientifique	CNRS-IPSL	France	1	48
2	Max-Planck-Gesellschaft zur Förderung der Wissenschaften e.V	MPG	Germany	1	48
3	Centre Européen de Recherche et de Formation Avancée en Calcul Scientifique	CERFACS	France	1	48
4	Deutsches Klimarechenzentrum GmbH	DKRZ	Germany	1	48
5	Finnish Meteorological Institute - Ilmatieteen Laitos	FMI	Finland	1	48
6	University of Manchester	UNIMAN	United Kingdom	1	48
7	Academy of Athens	AA	Greece	1	48
8	Science and Technology Facilities Council	SFTC	United Kingdom	1	48
9	Centro Euro-Mediterraneo per i Cambiamenti Climatici	CMCC	Italy	1	48
10	The Met Office, For and on behalf of the Secretary of State for the Defence of the United Kingdom of Great Britain and Northern Ireland	METOFFICE	United Kingdom	1	48
11	Koninklijk Nederlands Meteorologisch Instituut	KNMI	Netherlands	1	48
12	Météo France - Centre National de Recherches Météorologiques	MF - CNRM	France	1	48
13	Sveriges Meteorologiska och Hydrologiska Institut	SMHI	Sweden	1	48
15	Linköpings Universitet	LIU	Sweden	1	48
16	Barcelona Supercomputing Centre	BSC	Spain	1	48
17	Wageningen Universiteit	WU	Netherlands	1	48
18	Institutul National de Hidroligie si Gospodarire a Apelor	INHGA	Romania	1	48
19	Deutsches Zentrum für Luft - und Raumfahrt in der Helmholtz Gemeinshaft	DLR	Germany	1	48

A.3 Overall budget breakdown for the project

Participant number in this project [9]	Participant short name	Estimated eligible costs (whole duration of the project)						Total receipts	Requested EC contribution
		RTD (A)	Coordination (B)	Support (C)	Management (D)	Other (E)	Total A+B+C+D+E		
1	CNRS-IPSL	662,364.88	520,242.02	138,385.00	609,914.18	0.00	1,930,906.08	0.00	1,591,659.68
2	MPG	417,402.50	1,050,312.50	356,331.00	90,590.00	0.00	1,914,636.00	0.00	1,170,181.63
3	CERFACS	678,160.00	501,527.02	11,363.00	0.00	0.00	1,191,050.02	0.00	660,636.01
4	DKRZ	409,923.92	470,474.66	72,699.00	0.00	0.00	953,097.58	0.00	693,446.87
5	FMI	182,030.20	115,628.84	54,781.00	0.00	0.00	352,440.04	0.00	247,723.95
6	UNIMAN	395,300.00	0.00	0.00	0.00	0.00	395,300.00	0.00	296,475.00
7	AA	192,600.00	11,770.00	0.00	0.00	0.00	204,370.00	0.00	156,220.00
8	STFC	453,767.29	0.00	104,181.10	0.00	0.00	557,948.39	0.00	438,278.61
9	CMCC	304,000.00	539,343.20	0.00	0.00	0.00	843,343.20	0.00	608,560.77
10	METOFFICE	179,151.00	80,499.05	0.00	0.00	0.00	259,650.05	0.00	146,529.46
11	KNMI	337,410.00	40,158.00	0.00	0.00	0.00	377,568.00	0.00	273,815.50
12	MF - CNRM	34,320.00	30,720.00	0.00	0.00	0.00	65,040.00	0.00	53,132.00
13	SMHI	328,184.00	36,400.00	0.00	0.00	0.00	364,584.00	0.00	266,147.00
15	LIU	286,163.20	37,208.00	105,296.00	0.00	0.00	428,667.20	0.00	342,151.25
16	BSC	172,790.00	39,960.00	61,665.00	0.00	0.00	274,415.00	0.00	212,341.50
17	WU	198,853.90	117,774.70	0.00	0.00	0.00	316,628.60	0.00	257,071.32
18	INHGA	100,000.00	0.00	0.00	0.00	0.00	100,000.00	0.00	75,000.00
19	DLR	136,640.00	0.00	0.00	0.00	0.00	136,640.00	0.00	102,480.00
TOTAL		5,469,060.89	3,592,017.99	904,701.10	700,504.18	0.00	10,666,284.16	0.00	7,591,850.55

PART B

B1. Concept and objectives, progress beyond state-of-the-art, S/T methodology and work plan

B.1.1 Concept and project objective(s)

IS-ENES will develop a common climate and Earth system modelling distributed research infrastructure in Europe, following the general strategy of the World Climate Modelling Program (see B1.2), to facilitate the development and exploitation of climate models and better fulfil the societal needs with regards to climate change issues.

IS-ENES will follow four main general objectives:

Foster the integration of the European climate and Earth system modelling community

- Further integrate the European ESM community, through networking activities focusing on the development of the future ENES strategy, the exchange of expertise and the development of training activities (NA1 and NA3)
- Develop a virtual Earth System Modelling Resource Centre (v.E.R.C.), using ICT technologies to integrate the different distributed facilities currently existing or developed during this project (NA2)

Foster the development of Earth System Models for the understanding of climate change

- Increase the services around ESMs, by enhancing model documentation and developing a service on common tools and model components (NA3 and SA1)
- Foster the joint development and common evaluation of the European ESMs through networking activities and joint research activities on ESM software environment (i.e. the tools to prepare, run, store, evaluate and exploit model simulations) and ESM components (NA2, JRA1 and JRA3)

Foster high-end simulations enabling to better understand and predict future climate change

- Ensure an efficient access and execution of ESMs on high-performance computing facilities, by developing a common strategy, by enhancing the interface with and access to the EU large infrastructures DEISA2 and PRACE, by improving model performance on different computer architectures (NA1 and JRA2)

Foster the application of Earth system model simulations to better predict and understand future climate change impacts

- Enhance the dissemination of model results, by enhancing the service around model results following the INSPIRE EU directive and developing more efficient tools to access data (SA2 and JRA4)
- Enhance the interaction with decision makers and user communities, mainly concerned by climate change impact studies, through service activity and joint research development on data access as well as more adapted indicators. This will help Europe prepare for adaptation as recommended by the 2007 EU Green paper “Adapting to climate change in Europe” (NA1 and JRA5)

Central to the project, IS-ENES will develop a virtual Earth System Modelling Resource Centre (v.E.R.C.) integrating Earth system models (ESMs) and their software environment, access to the European high-performance computing ecosystem, and access to ESM results. The v.E.R.C. will be based on the integration of generic Information & Communication Technology (ICT), Grid technology and subject-specific simulation codes and software environments. The v.E.R.C. will ensure an integration and dissemination of all tools and data for the sake of the ENES community as

well as potential external users, e.g. the impact community. IS-ENES will start from the existing distributed infrastructure of European ESMs and the existing service access to model results provided for the last IPCC reports.

IS-ENES is a project of the European Network for Earth System Modelling (ENES) (http://www.enes.org), which gathers, by means of a Memorandum of Understanding, about 45 institutions comprising the European climate and Earth system modelling community. This community is working on understanding and predicting future climate change. It is strongly involved in the assessments of the Intergovernmental Panel on Climate Change (IPCC) (http://www.ipcc.ch) and such provides the predictions on which EU mitigation and adaptation policies are based.

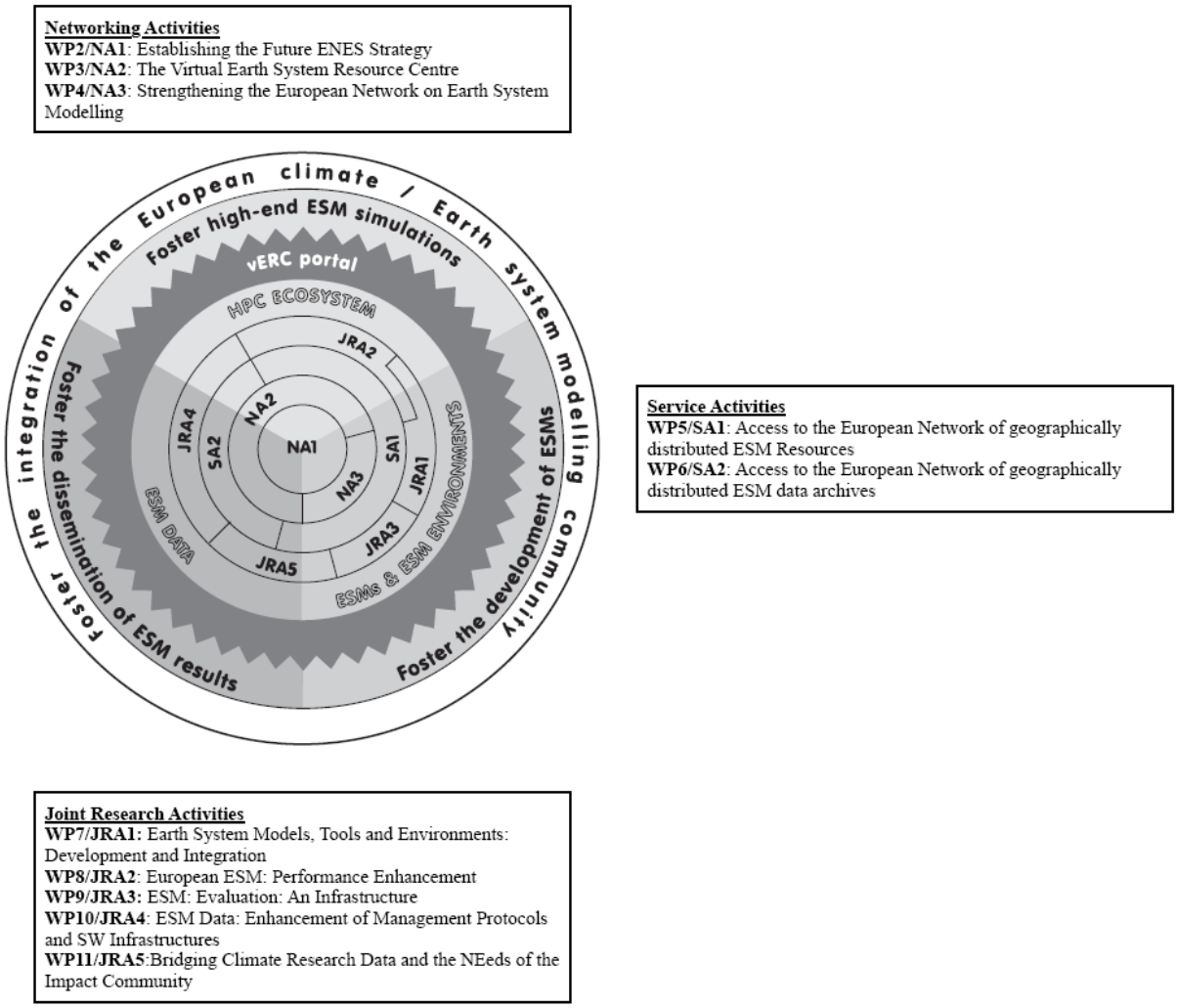

Figure 1. Schematic representation of the IS-ENES concept:
There are four major objectives: foster

- the integration of the European ESM community
- the development of ESMs,
- high-end ESM simulations,
- the application of ESMs for future climate change by the dissemination of ESM results,

in relation to three main areas for activities:

- the ESMs and their environments,
- the HPC ecosystem and
- the ESM data (different grey shadings).

B.1.2 Progress beyond the state of the art

B.1.2.1 State of the art

Challenges

Climate change raises several challenges for the ENES scientific community:

- To improve our understanding and prediction of future climate changes requires the analysis of the full complexity of the Earth system, i.e., the physical, biological and chemical dimensions coupled together.
- To improve our understanding and prediction of climate change impacts in all their socio-economic dimensions requires to better account for climate change on regional scales and to enhance interactions with the climate change impact community. This will be particularly required to prepare for adaptation to climate change.

In order to improve European competitiveness and expertise, there is also a need to:

- Better integrate countries new to the subject that want to be involved in the study of climate change. Indeed, with the increasing threat of climate change, these countries want to develop their own expertise on climate change prediction to prepare for adaptation.
- Perform the most up-to-date and accurate climate simulations. This requires sophisticated models, world-class high-performance computers, and state-of-the-art software infrastructures to make efficient use of the models and the hardware.

General international background

Challenges about climate change are shared by the international climate community and endorsed by the World Climate Research Program (WCRP) (http://www.wmo.ch/pages/prog/wcrp) and the International Geosphere Biosphere Programme (IGBP) (http://www.igbp.kva.se/). An important effort is driven at the international level by WCRP to develop the research necessary to prepare the IPCC assessments on future climate change. Twenty-three models have contributed to the last IPCC assessment report "IPCC AR4" (2007, http://www.ipcc.ch) and have provided projections of future climate change. In Europe, six models have contributed, from the UK, France, Germany and Norway. Climate projections and model evaluation are coordinated at the international level by the WCRP Working Group on Coupled Models (WGCM) with the support of the US Program for Climate Modeling Diagnosis and Intercomparison (PCMDI).
The strategic framework of WCRP and the conclusions of the 2008 World Modelling Summit, both emphasized the need to move towards a common climate and Earth system modelling infrastructure. "*This will help centres develop their own models, exchange model components, perform multi-model experiments and generally improve collaboration and efficiency.*" (WCRP Strategy)

European background

The European climate modelling groups have a long-lasting experience of collaboration developed since the first framework programs. In the 1990s, the concerted action "Euroclivar" led the unique foresight conducted in Europe in the field of climate research. Its final conclusions issued in 1998 (http://www.knmi.nl/euroclivar/frsum.html) recommended "*a better integration of the European modelling effort with respect to human potential, hardware and software*". More specifically, Euroclivar recommended to develop collaboration, to establish a European climate computing facility, and to enhance the exchange of software and model results.
These recommendations led to the establishment of ENES, as the European Climate Modelling Group advocated by Euroclivar. ENES set up the FP5 infrastructure project "Program for Integrated Earth

System Modelling" (PRISM, http://prism.enes.org/). PRISM carried out a successful first step towards the Euroclivar recommendations, establishing a network of expertise around ESM software environments and promoting a standard technical coupling interface now used world-wide, the OASIS coupler. The PRISM Support Initiative, gathering 16 institutions committing their own resources, currently ensures continued support of PRISM results. This continued effort has helped to build the IS-ENES project. Recently, ENES has launched an FP7 e-Infrastructure project, METAFOR, "Common Metadata for Climate Modelling Digital repositories" (http://ncas-cms.nerc.ac.uk/METAFOR/). METAFOR will develop a common information model to describe in a standard way climate data and climate models. These metadata standards will be disseminated and implemented in IS-ENES. PRISM has also established working contacts with the US-led Earth System Modeling Framework (ESMF, http://www.esmf.ucar.edu/) which also aims at a better integration of modelling efforts, IS-ENES will also benefit from collaborations developed through projects funded within the Environment Program, such as the ENES FP7 COMBINE project (proposal number 226520) on the development of Earth system models for climate change predictions and projections, as well as the large FP6 Integrated Project ENSEMBLES (http://ensembles-eu.metoffice.com/) on future climate scenarios and impact studies.
It is noteworthy that in 2008 the Euroclivar 1998 recommendations are still valid and apply to the IS-ENES project as described below.

B.1.2.2 Expected results of IS-ENES

Within IS-ENES, networking activities will increase the cohesion of the European ESM community and advance a coherent European Network for Earth System modelling. Joint research activities will improve the efficient use of ESMs, high-performance computers, model evaluation tool sets, access to model results, and will develop prototype climate services for the impact community. Finally, IS-ENES will provide services on models and model results both to modelling groups and to the users of model results, including the impact community. To achieve these objectives, IS-ENES will combine expertise in climate and Earth system modelling, in computational science, and in studies of climate change impacts. **The v.E.R.C.-portal** will be the key-component to communicate and deliver the results of the different work packages to the climate community and to users of climate model results.

Networking Activities

NA1 will define the future ENES strategy concerning the development, dissemination and application of climate and Earth system models. It will establish the strategy concerning the use of the European high-performance computing ecosystem and help the ESM community to prepare for the European large research infrastructures in computing. NA1 will develop the ENES strategy in ESM training and will provide a first prototype for a series of IS-ENES summer schools. It will also establish a first experimental interface between the climate modelling community and decision makers.

NA2 will develop and deploy a "virtual Earth System Modelling Resource Centre (v.E.R.C.)". The v.E.R.C. will set up and deploy an e-infrastructure providing climate scientists with the needed virtual proximity to distributed data and distributed compute resources. It will provide information on and giving access to models, tools, data and computing resources, i.e. integrating most of the work done in the different workpackages. This e-infrastructure will take advantage of the ESM community own distributed service infrastructure and will leverage the external services offered within the European HPC ecosystem, e.g., today by DEISA2 and in the future by PRACE. Information and services offered through the v.E.R.C. portal will not only be useful for ENES and the Earth System Modelling community but also for users of climate model results such as regional climate modelling groups or the climate change impact community.

NA3 will strengthen the network of expertise around existing European ESMs. NA3 will establish standardized information about existing ESMs in Europe that will be included in the v.E.R.C. It will also promote the use of "de facto" standard tools and component model by helping the groups developing those tools to integrate community developments and to set-up the services around those tools that will be offered in SA1.

Networking activities will involve the partners of IS-ENES but also members of the ENES Consortium.

Service Activities

SA1 will provide a unified access to European ESM information and software.
SA1 will provide access to common software tools and one component model of interest for a large community. SA1 will also, through the v.E.R.C. portal, provide access to model documentation and a network of experts. This service will enhance the visibility of the European ESMs, it will improve the interpretation of model results by a wide range of users and will help the development of collaboration between modelling groups.

SA2 will provide a unified access to the ENES distributed data network. This will constitute the main service activity provided by IS-ENES. This service will deliver model simulation results, mainly future climate change scenarios performed for the IPCC assessment reports. It will rely on the already existing European nodes of the IPCC Data Distribution Centre (DDC) that distribute observational datasets and model results for a wide community of users. During the course of the project, the service will be expanded to more data nodes in order to fulfil the larger storage required for the model results of the next IPCC assessment report (AR5). SA2 will also provide support and tools to users, in order to both help the provision of data and the access to model results

Joint Research Activities

IS-ENES proposes 5 joint research activities dedicated to improve the e-infrastructure of Earth system models and their environment.

JRA1 and JRA2 will both improve ESM integration and environment software. They will particularly prepare models for the future generations of computer architectures which will be highly parallel architectures.
JRA1 will focus on the optimization of the coupler and the input-output systems which are crucial elements of ESMs. This will improve ESM performance on highly parallel computer architectures.
JRA2 will focus on the performance and development of ESMs. It will test the portability and improve the performance of a range of key models on different architectures. It will also develop a more flexible tool to construct new future ESMs.JRA1 and JRA2 will help the ENES community prepare for the European computing facilities PRACE and DEISA2.

JRA3 will create, as part of the v.E.R.C., an infrastructure for model evaluation against observations. Model evaluation is an important part of all model development activity. It has strongly increased over the last two decades with the increasing pressure to ensure the reliability of projections of future climate. This will further be systematized in the future with the emerging idea discussed at the international level to develop metrics for model evaluation. Through a 'one-stop-shop' on the v.E.R.C., modellers will be able to perform scientific evaluations of ESM components and obtain information on potential sources of model errors.
JRA4 will develop protocols and software to provide efficient access to data services: The amount of model data required and produced to study climate change is strongly increasing with the increasing resolution of models, the increasing number of simulations and the increasing request from different users. By developing software tools that will enhance the efficiency of the data access service and by establishing a distributed archive database, JRA4 will help the European climate

modelling community to prepare for the next IPCC assessment AR5 and improve the dissemination of ESM results in general.

JRA5 will prototype services to the climate impact community. Facing climate change and preparing for adaptation, many stakeholders, such as the scientific community working on impacts, end-users in different economic sectors as well as decision makers, ask for diagnostics based on future climate change projections. These are in Europe provided by the ENES community. However, model results are in general not directly usable by this large community and an interface concerning the spatial and temporal resolution as well as the choice of variables used, is needed. In JRA5, IS-ENES will develop, a prototype portal to be included in the v.E.R.C. addressing this issue. JRA5 will increase the dissemination of ENES results and help ENES prepare for future developments that should happen in the framework of the GMES (Global Monitoring for Environment and Security) European initiative.

Developments performed in JRA4 and JRA5 will be implemented in SA2 service activities during the course of the project.

B.1.2.3 Baseline of the project

Where does the project work start	**Criteria/performance indicators**
Foster the integration of the European climate and Earth system modelling community	
- The ENES Consortium has been established in 2001 and has fostered EU projects - A first foresight was done within Euroclivar - Some training on ESMs, concentrating on specific models, has been done at a national, but not on the European level - Distributed conglomerate of web sites on ESM	- Developing a European strategy in earth system modelling- Developing a strategy for ESM education with a first prototype summer school - Establishing the v.E.R.C. portal as a tool for the integration
Foster the development of Earth System Models for the understanding of climate change	
- Collaborative work within EU FP projects - PRISM development of the OASIS coupler - open access to CDO and NEMO but no service activity - Smaller visibility of and more difficult access to European models compared to the US - Distributed information on model evaluation	- Open a service activity on model components and tools - Increase visibility of European models through ESM documentation accessible from v.E.R.C. - Develop tools to ease distributed access to model results - Develop a web service on model evaluation
Foster high-end simulations enabling to better understand and predict future climate change	
- Access to HPC on a national basis s - ENES letter of support to PRACE and DEISA2 - Limited performance of ESMs on highly parallel machines	- Establish a unified HPC environment for ESMs - ENES strategy on HPC - Develop formal interactions between ENES and PRACE / DEISA2 - Improved ESM performance
Foster the dissemination of Earth system model simulations to better predict and understand future climate change impacts	
- European IPCC Data Distribution Centre - Collaboration within EU FP projects with the impact community	- User access to ENES data network - Develop a prototype of a web portal for impact studies - Develop the interface with policy makers: Executive meetings for 2 ENES policy papers

B.1.3 S/T methodology and associated work plan

B.1.3.1 Overall strategy and general description

Strategy to foster the integration of the ESM community
To develop this strategy, **NA1** will concentrate on the development of the ENES strategy concerning models and computing aspects. Training in **NA1** is expected to help integrate future generations of young researchers. A key contribution of IS-ENES will be the establishment of a "virtual Earth System Modelling Resource Centre" (v.E.R.C.) in **NA2**. The v.E.R.C. will improve the efficiency of the collaboration in the community by providing a coherent view upon ESM services, tools and data, including interfaces to the Grid community and the HPC ecosystem.

Strategy to foster the development of ESMs
IS-ENES will concentrate on crucial technical aspects of ESM development such as coupling and I/O in **JRA1**. While scientific development of ESMs are dealt with on a more national level and/or in other calls, IS-ENES proposes to address the evaluation of scientific performances of ESMs by including the fragmented existing efforts of the community into an integrated infrastructure in **JRA3.** Services on ESMs and ESMs environments (e.g. access to standard ESM documentation) will be offered by **SA1** through the v.E.R.C. portal set-up in WP3/NA2, while integration of joint developments and maintenance of common software tools and components used in European ESMs will be ensured by **NA3.**

Strategy to foster high-end ESM simulations
For this objective, ESM computing performance is again a crucial aspect: ESM portability and performance, and research on flexible and fast construction of ESMs will be covered in **JRA2**. The access to the v.E.R.C. helpdesk offered by **SA1** providing guidance to find expertise on ESMs among the IS-ENES partner network, the preparation of a common HPC strategy ensuring a proper integration of IS-ENES in the European HPC ecosystem and the definition of a common strategy for Earth System Modelling in Europe in **NA1** are also essential for the realisation of useful high-end ESM simulations.

Strategy to foster the dissemination of ESM results
The essential elements of IS-ENES in this respect are **JRA4** and **JRA5**: They will, respectively, deliver the software required to establish an efficient distributed database of ESM results and provide for the climate impact community, decision makers and politicians a prototype for a web interface to ESM results. This web interface and distributed database will be accessible via the v.E.R.C. portal, which will be provided by **SA2**. The dissemination of ESM results forming the scientific basis on climate change to decision makers and to the public in general will also be ensured by a position paper written in **NA1** by communication specialists.

Significant risks and contingency plans

The Coordinator with the Management Team (MT) and the Executive Board (EB) will follow the execution of the project and ensure that risks identified below as well as risks that may appear during the course of the project will be identified at their earliest possible stage, so that efficient countermeasures will be taken well in time. Severe risks for the project are listed below :

Risk	Impact	Occurrence Probability	Mitigation
Foster the integration of the European climate and Earth system modelling community			
No convergence on a common European strategy (NA1)	weakening of the ENES European community	Medium	The on-going European collaborations and international Programs will give a common minimum background. The MT with the Scientific Advisory Board will adapt the scope of the foresight to take benefit of the work done by working groups.
v.E.R.C. in NA2: the input of the other WPs to the portal will be delayed	delivery of the fully operational portal would be delayed	Medium	The portal will be set up in a highly modular way, i.e. contents and services can be integrated and usable as they are produced.
Foster the development of Earth System Models			
Metadata format developed by METAFOR project is delayed or too complex (NA3)	Delivery of ESM documentation is delayed or too difficult to produce for the modelling groups.	Medium	Interact with METAFOR (which partners are also in IS-ENES) to define a subset of the metadata format that still provides a good general ESM description.
Delays in enabling the SA1 service on models	Delays certain services	Medium	Modular step by step implem-entation: those features are activated, which are accepted and agreed upon.
The content of the evaluation toolkit (JRA3) will not be deemed useful for model evaluation.	Would limit the usage	Medium	The project makes careful links with current model inter-comparison projects that include numerous ESM participants. Collaboration with PCMDI will be developed to help streamline the project.
Foster high-end simulations			
No agreement on a common strategy on HPC-ecosystem, i.e. with regards to PRACE (NA1)	The ENES community will not benefit from the full potential of the European HPC-ecosystem	Low	The ENES community will at least use national facilities and their integration through the develop-ment of the unified HPC environment developed in NA2.
The unified HPC environment is not fully feasible for all different centres and platforms (NA2)	This would imply that not all differences could be hidden by such an environment	Medium	During the definition phase potential political and techno-logical incompatibilities between different centres and platforms will be evaluated and addressed as much as possible. The unified

Risk	Impact	Occurrence Probability	Mitigation
			environment will then be realised through mandatory core services and optional add-ons
Porting applications to existing supercomputers is either very difficult or not possible with the effort allocated (JRA2)	Performance analysis and improvement work will be limited and restricted to applications that have been ported.	Medium	The performance analysis will be restricted to the models and/or component models that are already ported on different platforms. Transfer of this expertise will at least advice the other groups.

Foster the dissemination of ESM results			
New ESMs data coming from the AR5 exercise is delayed and not present at the end of the project (SA2, JRA4 and JRA5)	SA2 and JRA4: Will unable the provision of the distributed AR5 database JRA5: Uncertainty cannot be fully tackled due to the absence of a multi-ESM database.	Medium	SA2, JRA4 and JRA5: other multi-model ensembles do exist and can be used: SA2 and JRA5: use of ENSEMBLES FP6 results. JRA4: use of CCMval as an initial testcase
Tools developed in JRA4 are delayed or not enough efficient (SA2 and JRA5)	SA2: Seamless ingestion of IPCC AR5 data into ENES data network cannot be implemented JRA5: Can not be used to implement use cases;	Low	SA2: Existing data processing and interfaces are used with less functionality and performance JRA5: Part of specific needs is covered within the WP, and several partners already have a large experience in these specific developments.
Delayed position papers by JRA5 (NA1)	Will limit dissemination particularly to policy makers	Low	The MT with the Scientific Advisory Board will decide alternative dissemination. The work done to prepare the ENES strategy will be a source of alternate position papers.

B.1.3.2 Timing of work packages and their components

WP/YEAR	YEAR 1						YEAR 2						YEAR 3						YEAR 4					
	2	4	6	8	10	12	14	16	18	20	22	24	26	28	30	32	34	36	38	40	42	44	46	48
Reporting Periods	Period 1							G.A	Rep. Period	Period 2							G.A	Rep. Period	Period 3				G.A	Rep. Period
WP1/MNGT	2	4	6	8	10	12	14	16	18	20	22	24	26	28	30	32	34	36	38	40	42	44	46	48
T1	M1.1							M1.3									M1.4						M1.5	
T2									D1.1									D1.2						D1.3
T3		M1.2																						
WP2/NA1	2	4	6	8	10	12	14	16	18	20	22	24	26	28	30	32	34	36	38	40	42	44	46	48
T0																								
T1			M2.1															D2.4						
T2			M2.2												M2.4									
T3								M2.3							D2.3									
T4			D2.1								D2.2										D2.5			D2.6
WP3/NA2	2	4	6	8	10	12	14	16	18	20	22	24	26	28	30	32	34	36	38	40	42	44	46	48
T0																								
T1								M3.1	D3.1								M3.2						M3.3	D3.7
T2									D3.2									D3.5						
T3									D3.3									D3.6						
T4									D3.4															D3.8
WP4/NA3	2	4	6	8	10	12	14	16	18	20	22	24	26	28	30	32	34	36	38	40	42	44	46	48
T0																								
T1						D4.1		M4.2	D4.2					M4.3				D4.6						
T2						M4.1						D4.3 D4.4 D4.5												D4.7 D4.8
WP5/SA1	2	4	6	8	10	12	14	16	18	20	22	24	26	28	30	32	34	36	38	40	42	44	46	48
T1			M5.1																					
T2								M5.2	M5.3			M5.4												
T3															M5.6									
T4												M5.5												M5.7
WP6/SA2	2	4	6	8	10	12	14	16	18	20	22	24	26	28	30	32	34	36	38	40	42	44	46	48
T1						M6.1						M6.3												M6.7
T2						M6.2						M6.4												
T3												M6.5												M6.8
T4												M6.6												M6.9
WP7/JRA1	2	4	6	8	10	12	14	16	18	20	22	24	26	28	30	32	34	36	38	40	42	44	46	48
T0																								
T1		M7.1															M7.3							
T2												D7.2												D7.4
T3								M7.2	D7.1									D7.3						D7.5
WP8/JRA2	2	4	6	8	10	12	14	16	18	20	22	24	26	28	30	32	34	36	38	40	42	44	46	48
T0																								
T1		M8.1	D8.1		M8.2												M8.6							
T2								M8.3	D8.2								M8.5						M8.7	D8.4
T3									D8.3								M8.4						M8.8	D8.5
WP9/JRA3	2	4	6	8	10	12	14	16	18	20	22	24	26	28	30	32	34	36	38	40	42	44	46	48
T0																								
T1						M9.1		D9.1																
T2															D9.2									
T3															D9.3 M9.2									
T4																								D9.4
WP10/JRA4	2	4	6	8	10	12	14	16	18	20	22	24	26	28	30	32	34	36	38	40	42	44	46	48
T0																								
T1		M10.1			M10.2				D10.2															
T2					D10.1																			
T3						M10.3 M10.4											M10.6	D10.3						
T4								M10.5												M10.7				D10.4
WP11/JRA5	2	4	6	8	10	12	14	16	18	20	22	24	26	28	30	32	34	36	38	40	42	44	46	48
T0																								
T1			M11.1			M11.3		D11.1																
T2					M11.2				D11.2															
T3												D11.3 M11.4								D11.4 M11.5			M11.6	D11.5

B.1.3.3 Work package list / overview

Work Package no.	Work Package Title	Type of Activity	Lead Beneficiary no.	Person-months	Start Month	End Month
WP1	Scientific and Technical Coordination of IS-ENES	MGT	1	58	1	48
WP2	The Future ENES Strategy	COORD	1	32	1	48
WP3	"The virtual Earth system Ressource Centre	COORD	4	133	1	48
WP4	Strengthening the European Network on Earth System Modelling	COORD	3	132	1	48
WP5	Access to the European Network of Geographically Distributed ESM Ressources	SUPP	5	0	1	48
WP6	Access to the European Network of Geographically Distributed ESM Data Archives	SUPP	2	0	1	48
WP7	Earth System Models, Tools and Environments: Development and Integration	RTD	10	98	1	48
WP8	European ESM: Performance Enhancement	RTD	6	99	1	48
WP9	ESM Evaluation: developing an Infrastructure	RTD	7	99	1	48
WP10	ESM Data: Enhancement of Management Protocols and SW Infrastructures	RTD	8	100	1	48
WP11	Bridging Climate Research Data and the Needs of the Impact Community	RTD	3	149	1	48
	TOTAL			**900**		

B.1.3.4 Deliverables list

Del. no.	Deliverable name	WP no.	Lead beneficiary	*Estimated indicative person-months*	Nature	Dissemi-nation level	Delivery date (proj. month)
D2.1	Setting of the IS-ENES web site : first version	2	MPG (2)	3	O	PU	**6**
D8.1	Report on the definition of the Evaluation Suite	8	CMCC (9)	6	R	PU	**6**
D10.1	Report on CIM dependencies	10	STFC (8)	6	R	PU	**10**
D4.1	ESMs current documentation, including a description of associated tools and specific "assembling guide"	4	CERFACS (3)	10	O	PU	**12**
D9.1	Report on differences, synergies and methodology transfers between the surveyed model intercomparison projects	9	AA (7)	26	R	PU	**15**
D11.1	Final description of selected Use Cases including user requirements specification	11	CERFACS (3)	34	R	PU	**15**
D1.1	First period report	1	CNRS-IPSL (1)	1	R	CO	**18**
D3.1	Report on v.E.R.C. Portal Setup and Status	3	DKRZ (4)	18	R	PU	**18**
D3.2	Description of basic ESM workflows and best practices	3	MPG/M&D (2)	9	R	PU	**18**
D3.3	Report on design and status of Unified HPC Environment	3	DKRZ (4)	18	R	PU	**18**
D3.4	Report on design and deployment of Grid portal and development environment	3	CMCC (9)	18	R	PU	**18**
D4.2	ESM documentation following a subset of CIM metadata.	4	CERFACS (3)	10	O	PU	**18**
D7.1	Documentation and tutorial on parallel I/O and I/O servers, and their benefits.	7	DKRZ (4)	2	R	PU	**18**
D8.2	Initial report describing the evaluation suite and base-case results	8	BSC (16)	20	R	PU	**18**
D8.3	Report on prototype BFG applications and examples	8	UNIMAN (6)	9	R	PU	**18**
D10.2	Data policy and software review	10	STFC (8)	19	R	PU	**18**
D11.2	Baseline documents on e-ressources/tools and transverse themes	11	CNRS-IPSL (1)	35	R	PU	**18**
End 1rst reporting period							

Del. no.	Deliverable name	WP no.	Lead beneficiary	*Estimated indicative person-months*	Nature	Dissemi-nation level	Delivery date (proj. month)
D2.2	First policy position paper on "Climate data needs in support of the EU Climate Adaptation Strategy"	2	WU (17)	2	O	PU	**22**
D4.3	OASIS complete web site accessible via the v.E.R.C. portal (WP3)	4	CERFACS (3)	12	O	PU	**24**
D4.4	CDO complete web site accessible via the v.E.R.C. portal (WP3)	4	MPG (2)	12	O	PU	**24**
D4.5	web NEMO configurations data base filled up by NEMO team	4	CNRS-IPSL (1)	18	O	PU	**24**
D7.2	fully parallelised and optimised version of OASIS4 answering current coupled climate models.	7	CERFACS (3)	29	D	PU	**24**
D11.3	The e-impact-portal Software Requirements/Architectural Design/IO Specification	11	CERFACS (3)	30	R	PU	**24**
D2.3	ENES first prototype Summer School on Earth System Modelling	2	MPG (2)	5	O	PU	**30**
D9.2	Listings of required model fields and interface software	9	DLR (19)	27	O	PU	**30**
D9.3	Listings and access services to observational datasets	9	AA (7)	20	O	PU	**30**
D1.2	Second period report	1	CNRS-IPSL (1)	1	R	CO	**36**
D2.4	Foresight position paper on "The ENES strategy and its implementation plan"	2	MPG (2)	10	R	PU	**36**
D3.5	Description of suite of reference workflows	3	MPG/M&D (2)	6	R	PU	**36**
D3.6	Document describing functionality and usage of Unified HPC Environment in its Beta Version	3	DKRZ (4)	15	R	PU	**36**
D4.6	ESM revised documentation following the full CIM metadata	4	CERFACS (3)	14	O	PU	**36**
D7.3	Reference implementations of Parallel I/O and of I/O server	7	CNRS-IPSL (1)	8	P	PU	**36**
D10.3	Operational services package	10	STFC (8)	39	D	PU	**36**
End 2nd reporting period							

Del. no.	Deliverable name	WP no.	Lead beneficiary	*Estimated indicative person-months*	Nature	Dissemi-nation level	Delivery date (proj. month)
D11.4	Software Code and e-impact-portal full documentation	11	CERFACS (3)	30	R	PU	**40**
D2.5	Second policy position paper on "The ENES strategy and its implementation plan"	2	WU (17)	2	R	PU	**42**
D1.3	Final project report	1	CNRS-IPSL (1)	2	R	CO	**48**
D2.6	Final plan for the use and dissemination of foreground	2	CNRS-IPSL (1)	2	R	PU	**48**
D3.7	Final and comprehensive report on virtual ESM Resource Center	3	DKRZ (4)	47	R	PU	**48**
D3.8	Report on Training Sessions	3	CMCC (9)	8	R	PU	**48**
D4.7	General coupled model assembling guide	4	CERFACS (3)	12	R	PU	**48**
D4.8	web NEMO configurations data base filled up by NEMO team and partners	4	CNRS-IPSL (1)	18	O	PU	**48**
D7.4	OASIS4 includes high priority developments as identified in the User Survey.	7	CERFACS (3)	29	D	PU	**48**
D7.5	Reference implementation of I/O server combined with parallel I/O support	7	CNRS-IPSL (1)	8	D	PU	**48**
D8.4	Final report describing work with the evaluation suite	8	BSC (16)	45	R	PU	**48**
D8.5	Final report on Flexible ESM construction using BFG	8	UNIMAN (6)	15	R	PU	**48**
D9.4	Report on pilot study for the evaluation of CNRS-IPSL ESM output using the collected toolkits and datasets	9	CNRS-IPSL (1)	22	R	PU	**48**
D10.4	User service package	10	STFC (8)	31	D	PU	**48**
D11.5	Report and manuscript journal paper on key characteristics for a prototype of an e-based pan-European climate data service network	11	CERFACS (3)	23	R	PU	**48**
End of project							
			TOTAL	**786**			

Summary of service provision

Participant number	Organisation short name	Short name of the infrastructure	Installation			Operator country code	Access costs charged to the GA
			Number	Short name	Estimated costs		
5	FMI	ESMResources	1	v.E.R.C	488 920	FI	35 691
4	DKRZ	ESMResources	2	v.E.R.C	1 717 478	DE	68 699
3	CERFACS	ESMResources	3	Services on OASIS	56 817	FR	11363
1	CNRS-IPSL	ESMResources	4	NEMO	410 376	FR	77972
2	MPG	ESMResources	5	CDO	1 087 126	DE	45366
2	MPG	ENES ESM Data Network	1	MPG ENES DataNet	5 265 542	DE	242 215
8	STFC	ENES ESM Data Network	2	STFC ENES DataNet	970 870	UK	91 262
16	BSC	ENES ESM Data Network	3	BSC ENES DataNet	2 861 905	ES	56 855
15	LIU	ENES ESM Data Network	4	LIU ENES DataNet	486 482	SE	97 296
1	CNRS-IPSL	ENES ESM Data Network	5	IPSL ENES DataNet	296 910	FR	56 413

B.1.3.5 Work package descriptions

WP1/Coord: Scientific and technical coordination of IS-ENES

Work package number	**1/ Coord**	**Start date or starting event:**				**1**
Work package title	**Scientific and technical coordination of IS-ENES**					
Activity Type	**MGT**					
Participant number	1	2				
Participant short name	CNRS-IPSL	MPG				Total
Person-months per participant:	54	4				58

Objectives
The coordination work package encompasses the consortium management, the scientific and technical coordination of the overall project.

Description of work

IS-ENES organisation is described in section 2.1. The coordination work package is under the responsibility of the Management Team composed of the Coordinator, the Technical Coordinator and the European project Manager.

Main tasks are :

Task 1: Ensure the overall management of the consortium
CNRS-IPSL (1) (50 pm) Total: 50 pm

The Coordinator with the assistance of the European Project Manager will ensure :

- Daily management tasks, like financial and contractual issues, management of the budget and time
- Organisation of the kick-off and annual general assembly meeting
- Communication between the European Commission and IS-ENES including all forms of reporting specified in the Consortium Contract Agreement.
- Management of the budget kept to develop international collaboration with scientific groups outside the IS-ENES consortium
- External communication in order to disseminate information through the IS-ENES web portal using both e-technologies and leaflets (task 3).
- Implementation and Monitoring the Gender Action Plan

Task2: Ensure the scientific coordination of IS-ENES
CNRS-IPSL (1) (4 pm) Total: 4 pm

- Ensure management of the executive board gathering work package leaders and the Management Team, mainly using communication technologies (see Task 3), in order to follow the execution of the work plan.
- Ensure regular interaction with the Scientific Advisory Board.
- Deliver the progress reports and final report of the project.

Task 3: Ensure the technical coordination of IS-ENES
MPG (2) (MPIMET, see section 2.2) (4 pm) Total: 4 pm

- Coordination of technical activities like Web-conferences, e-collaboration tools etc.

- Coordination of the technical aspects of the infrastructure such as the IS-ENES v.E.R.C. portal, the interaction with supercomputing centres and industry, and the use of ICT technologies.

Deliverables

D1.1 (Task 2, mo 18)	First period report
D1.2 (Task 2, mo 36)	Second period report
D1.3 (Task 2, mo 48)	Final project report

Milestones

M1.1 (Task 1, mo 1)	Kick-off meeting
M1.2 (Task 3, mo 3)	Setting of collaboration environment using e-technologies
M1.3 (Task 1, mo 16)	First general assembly meeting
M1.4 (Task 1, mo 34)	Second general assembly meeting
M1.5 (Task 1, mo 46)	Final general assembly meeting

WP2/NA1: The future ENES strategy

Work package number	**2 / NA1**		**Start date or starting event:**		**1**			
Work package title	**The future ENES Strategy**							
Activity Type	**COORD**							
Participant number	1	2	9	10	3	17	7	
Participant short name	CNRS -IPSL	MPG	CM-CC	MET OFFICE	CER-FACS	WU	AA	Total
Person-months per participant:	5	14	4	2	2	3	2	32

Objectives

This workpackage will establish the strategy of the ENES consortium with regards to the future organisation of the climate and Earth system modelling community in Europe, concerning:

- Development, dissemination, and application of climate and Earth system models
- Use of the European high-performance computing (HPC) ecosystem
- Development of education on ESM
- Interface with decision makers.

Strategy in climate and Earth system modelling

Climate modelling has strongly evolved over the last 10 years with the development of "Earth system models". The increased realism of the models brought with it the increasing possibility, but also the increasing need, to study the societal impacts of climate change. Moreover, new countries all over Europe are now becoming involved in climate and Earth system modelling. It is the right time to revisit the European modelling strategy, by answering the following questions :

- What does Europe need in terms of climate and Earth system modelling and prediction?
- How is Europe going to face the increasing demand for information on societal impacts?
- What will be the status of European climate and Earth system models 10 year from now?
- What kind of infrastructures are required ?

European HPC ecosystem

An effective European computing infrastructure for climate and Earth system modelling requires a full HPC-ecosystem: from Tier-0 world-class facilities allowing high-end simulations at the top to properly nested and scaled Tier-1 national facilities to develop and optimise models and to run many lighter experiments.

ENES expects the European project PRACE "Partnership for Advanced Computing in Europe" to provide the top of the pyramid of the HPC-ecosystem. ENES has participated in the elaboration of the scientific case for PRACE in 2006. IS-ENES will organise the interface with PRACE and help the community prepare fro PRACE. IS-ENES will also interact closely with the European DEISA2 project, which will organise a significant portion of the Tier-1 facilities, including their relationship with PRACE.

The ENES strategy for the HPC-ecosystem must also account for the preparation for the future generation of computing architectures and facilities. To benefit from the increasing number of processors will very likely require a profound revisit of the basis of most of the actual numerical models. Such research and development is on-going in the USA and Japan but has not yet been organised in Europe for climate and Earth system models. IS-ENES will develop a network of experts on this issue.

ESM education

Training on Earth system models is important to better understand and master the complexity of the system and improve the use of such models. It will help scientists face the large range of expertise needed in ESM, including both multi-disciplinary aspects of Earth system sciences and the large range of numeric and algorithmic tools. Moreover, gathering the young generation of scientists will help them develop collaboration and will improve the level of integration within and across the various European modelling groups.

Dissemination towards policy makers
In international context, EU is currently mounting on an ambitious and in many aspects, "cutting edge" climate policies, with respect to both mitigation (30 % emission cut by 2020) and adaptation (EU Climate Adaptation Strategy Green Paper, which is expected to turn into a binding EU directive in 2009/2010). Although, in several EU countries, the community is already strongly involved in the elaboration of *national* policies with regard to climate change, limited interactions have been organised at the *European level* between the Climate and Earth System modelling community and the European executive levels, involved in a process of developing and implementing climate relevant European policies. A process of setting up these policies and verifying of implementation strategies need to be well imbedded in the latest scientific results, and as such it requires a tailor-made, effective dialogue between with the top-edge European climate research community, and the relevant climate policy making European Directorates and related institutions.

Description of work

Task 0: Work package coordination
CNRS-IPSL (1) (3 pm) in collaboration with the ENES Steering Board (SB) Total: 3 pm

This work package will strongly rely on the involvement of the ENES Steering Board in preparing the ENES strategy. The Coordinator will ensure that the various tasks will all be done in synergy and that the achievements within IS-ENES feed back into the ENES strategy.

Task 1: Define the European strategy in climate and Earth system modelling
MPG (2) (MPIMET) (5 pm), METOFFICE (10) (2 pm), with the help of the ENES SB Total: 7 pm

Task 1 will establish the European strategy of the ENES community through workshops and working groups:

- At the beginning of the task, a large workshop will gather scientists from the ENES community in order to brainstorm and define the key questions to be addressed by dedicated working groups.
- Small dedicated working groups will elaborate elements of strategy following guidelines defined at the large workshop at the beginning of the task.
- At the end of the task, a large workshop will gather scientists from the ENES community in order to discuss and synthesise conclusions from the working groups and to establish the Foresight position paper on "The ENES strategy and its Implementation".

This latter workshop is considered to be combined with the second IS-ENES General Assembly.
Workshops will involve the partners of IS-ENES as well as other European parts of the ENES community.

Task 2: Prepare the ENES strategy with regards to the HPC-ecosystem
CMCC (9) (3pm), CERFACS (3) (2 pm), with all partners from NA1 Total 5 pm

Prepare the ENES community for PRACE and DEISA2
Task 2 will define the needs of the climate community, define climate benchmarks, organise the interface between PRACE and the climate scientific community, will update the scientific case in the field of climate science and, when facilities will be available, will organise the most advanced and adapted experiments to benefit from such facilities.

Prepare for future HPC architectures
The community will be assembled in workshops to survey on-going activities, share expertise and establish the European strategy to develop the next generation of climate and Earth system models, allowing the community to benefit from the most powerful computing facilities as they become available.

Elaborate the ENES strategy with regards to the HPC-ecosystem
Task 2 will organise small workshops of experts to design the contributions to PRACE and DEISA2. These workshops will also prepare a contribution to the Task 1 Foresight for both the ENES strategy for the HPC-

ecosystem and the preparation of climate models for the next generation of high performance computer architectures.

Task 3: ESM Education - Developing a strategy
MPG (2) (MPIMET) (3 pm), CMCC (9) (1 pm), AA (7) (2 pm), with the ENES SB Total 6 pm

IS-ENES will, in a coordinated effort with other ENES projects like COMBINE (FP7), METAFOR (FP7) and PRISM consortium :

- Edit a catalogue of information on educational activities possible for a research institution or a modelling group, including hands-on workshops on tools and components, ways to find funding, field reports from past schools, etc.
- Establish a (in the long-run, third-party funded) series of summer schools (freq. 3-5 years) on Earth system modelling, including a first project-funded "prototype Summer School on Earth System Modelling" during the project
- Establish a web site under the IS-ENES portal, where the information on these educational activities is made available to interested parties

Task 4: Dissemination
CNRS-IPSL (1) (2 pm), MPG (2) (MPIMET) (6 pm), WU (17) (3 pm) with the ENES SB Total 11 pm

Project general dissemination
IS-ENES will develop and maintain a web site to provide general information on on-going activities of the project. This web site will in particular advertise the IS-ENES service activities. IS-ENES web site will be accessible through the existing ENES web site to ensure a wide dissemination of IS-ENES results in the ESM community.

Dissemination to policy makers
IS-ENES will elaborate two position papers on key topics related to results derived from this project and that may be of policy relevance:

- JRA5 will deliver a draft inventory /position paper on "Climate data needs in support of the EU Climate Adaptation Strategy" (month 12)
- NA1 task 1 will deliver the Foresight position paper on "The ENES strategy and its Implementation"(month 36)

The work prepared in these WPs will be rewritten by specialists of communication in order to provide advice to decision and policy makers on key issues related to climate research. Task 4 will deliver these policy position papers through the organisation of meetings with European executives, such as members of the EU Parliament, EC executives.

Deliverables

D2.1 (Task 4, mo 6)	Setting of the IS-ENES web site : first version (upgrade during the project)
D2.2 (Task 4, mo 22)	First policy position paper on "Climate Data Needs in Support of the EU Climate Adaptation Strategy"
D2.3 (Task 3, mo 30)	ENES first prototype "Summer School on Earth System Modelling"
D2.4 (Task 1, mo 36)	Foresight position paper on "The ENES Strategy and its Implementation Plan"
D2.5 (Task 4, mo 42)	Second policy position paper on "The ENES Strategy and its Implementation Plan"
D2.6 (Task 4, mo 48)	Final plan for the use and dissemination of foreground

Milestones

M2.1 (Task 1, mo 6)	First community workshop to define working groups and the contour of the foresight
M2.2 (Task 2, mo 6)	First list of requirements for PRACE
M2.3 (Task 3, mo 15)	Establishing a web site for ESM educational information
M2.4 (Task 2, mo 30)	Elements for the ENES strategy on the HPC-ecosystem to feedback in Task 1

WP3/NA2: The virtual ESM Resource Centre

Work package number	**3 / NA2**			**Start date or starting event:**			**1**
Work package title	**"The virtual ESM Resource Centre"**						
Activity Type	**COORD**						
Participant number	4	9	2	16	5	3	15	
Participant short name	DK-RZ	CM-CC	MPG	BSC	FMI	CER-FACS	LIU	Total
Person-months per participant:	53	41	17	5	11	3	3	133

Objectives:

Integration of the Earth System Modelling Infrastructure and the HPC Ecosystem in Europe

Users as well as developers of Earth System (ES) Models rely on an infrastructure, consisting of high-end computing, data storage and network resources to perform complex and demanding simulations. In the past , mainly local resources and infrastructures were used. However, the increasing requirements on computing capability and capacity as well as on data storage facilities often exceed the possibilities of single centres. Today, a typical workflow in ES modelling consists of many individual steps, from source code archiving, model documentation, data pre and post-processing, that are performed on different machines, potentially at different sites, and often by different scientists. In Europe, there is the need to deploy and, where needed, to develop technologies in order to provide climate scientists with virtual proximity to distributed data and distributed compute resources.

In this work package we will set up and foster the deployment of an e-Infrastructure within the ESM community that will take advantage of its own distributed service infrastructure and that will leverage the external services offered within the European HPC ecosystem, e.g. today by DEISA2 and in the future by PRACE, This infrastructure or "*virtual Earth-System modelling Resource Centre* (v.E.R.C.)" will consist of:

- **The ENES v.E.R.C. Portal: An information and collaboration portal** to present all the services, tools and data available to the community in a coherent way to foster the exchange of information and the collaboration within the community. At the same time this portal will build the basis to disseminate the services provided by SA1 and SA2 to a broader audience.
- **A unified HPC environment for Earth System Modelling** to ease and improve the utilization of existing and upcoming High Performance Computing (HPC) environments by the ESM community.
- **A prototype grid infrastructure** used for training and for prototyping and testing complex distributed workflows used by the ESM scientists, e.g., in ensemble experiments and model inter comparison studies.

This workpackage will also seek for common elements in the workflows of the different ESMs in order to develop reference workflows that will ease the use of a unified HPC environment for ESMs.

Description of work

Task 0: Work package coordination
DKRZ (4) (3pm) and CMCC (9) (3 pm) **Total 6 pm**

Task 1: The ENES v.E.R.C. Portal
DKRZ (4) (24 pm), FMI (5) (11 pm) **Total 35 pm**

This task will develop a single central portal, which will act not only as a common entrance point to the ESM infrastructure built within IS-ENES, but also as a presentation and virtual meeting point of the ESM community.
The portal will collect, integrate and present the services and information provided by all WPs and from the

community at large to make them available to the community and/or public in a coherent fashion. The platform will be based on available and approved technology. Content will only be added to unite and coherently present the collected material, in order to ease communication and collaboration with the project WPs, the ENES community, and with other communities to learn from their experiences with similar portals (e.g. the EuroPlanet portal); the ENES v.E.R.C. portal will consist at least of the following components:

Models (input from NA3)

- Overview of models and their capabilities and references where to download models (link collection)
- Model documentations based on CIM standard
- Help pages, FAQs, mailing lists, wikis, forums for exchange on how to run models

Data (input from JRA4 and SA2)

- Access to relevant ESM data
- Basic processing of data before download (e.g. reduction, averaging or simple visualisations)
- Specific access guidelines for impact and adaptation community

Computing infrastructure

- Information and support to access v.E.R.C.
- Benchmarks
- Access to prototype grid-infrastructure
- Access and support for prototype workflows

Community building (input from NA1 and NA3)

- Information and online registration for community activities such as
- Training events , Summer schools, Relevant conference calls
- e-collaboration tools (VCs etc.), Testbed for new collaboration tools/platforms

Support layer (input from SA1), access to:

- Administrative and technical support to access data, models, HPC infrastructures etc.
- Support for tools and components
- Support to integrate new sub-communities, models and data in the portal framework

Task 2: ESM Workflows.
MPG (2) (M&D) (6 pm) DKRZ (4) (6 pm), CMCC (9) (3 pm), CERFACS (3)(3 pm) Total: 18 pm

In this task, we will analyze the workflows implemented today at ES modelling centres by the scientific community and identify common elements. This will be done in cooperation between the WP partners and all modelling groups involved in the project (input from /NA3). The outcome of that survey will be contrasted with the situation found in terms of platforms and services provided at the computing centers, today, as well as in the future.
Based on the survey, strategies to generalize the existing workflows will be developed, and reference workflows will be defined with a focus on characteristic use cases, e.g. scenario runs for IPCC, scientific or performance benchmark suites, data-assimilation, model inter comparisons or ensemble runs. The reference workflows will be adapted to the Unified HPC environment developed in Task 3 of this WP. Sub workflows will be identified that can make use of the GRID technologies proposed in Task 4. The reference workflows will be implemented at the participating computing centers ported to new HPC platforms.

Task 3: Unified HPC Environment for ESM:
DKRZ (4) (15 pm), CMCC (9) (7 pm), LIU (15) (3 pm), MPG (2) (M&D) (7 pm) Total: 32 pm

In this task we will improve the conceptual and technical integration of HPC centers to better serve the Earth System Modelling workflows. This extends from exchange of expertise and sharing of best practices over definition of common strategies and policies to actual technical integration of resources.
In close cooperation with DEISA2 a specific unified environment for ESM will be provided that can be "loaded" when using a local, DEISA2 or remote high performance computer. This unified environment includes common modules, libraries, tools and policies (such as staging and transfer tools between different file systems, license management, distributed accounting management, co-allocation) as well as

standardized path names, environment variables and the setup of a common username space. For the user, this "virtualization" will considerably facilitate the task of porting his or her applications to a new facility and of using several facilities in one workflow: He or she will not have to master the different working environments of all the different centres but will be able to use everywhere the same environment. In particular we will provide a road map of the efforts needed to efficiently port ESM workflows to PRACE using our unified environment.
As an intrinsic part of the unified HPC environment comfortable access to the distributed data archive developed in JRA4 will be provided. In a first step read access interfaces for data and metadata provided by SA2 will be integrated. Write access for data and metadata will be included stepwise by providing tool support to ease the appropriate metadata annotation and data formatting for data products generated by ESM workflows. Feedback on concrete experiences and requirements for archive access as part of the HPC environment will be provided to JRA4 and SA2.
Documentation and tutorials related to all components of the unified environment will be provided in an integrated and coherent way via the ENES portal

Task4: "Prototype ESM Grid environment"
CMCC (9) (28 pm), DKRZ (4) (5 pm), BSC (16) (5 pm), MPG (2) (M&D) (4 pm) Total: 42 pm

This task will implement a "prototype" Grid Environment to test if the sub workflows identified in Task 2 can take advantage of the use of Grid technologies. This will concern two types of applications: running ensembles of multi-model experiments and access to ESM data. This task will also look at possibilities for making the interaction with and configuration of Grid environments straightforward and thus to improve the uptake of Grid technology on a larger scale.
The prototype ESM Grid Environment will exploit already available grid services, namely: GRB services, GridSuperscalar, Globus middleware. On top of the test Grid, NA2 will then provide an integrated workbench framework to access the power of existing Grid infrastructures independent of the Grid middleware employed. The frameworkwill provide tools to customize Grid users' applications, to manage Grid resources and to support the development cycle of new Grid applications. With the help of this workbench not only Grid application users but also resource providers and application developers will be supported in their interactions with the Grid environment. The key-task of this activity will be also the organization of training events for the different classes of users. NA2 plans to organize a total of 8 events, two per year; the training sessions will be held in June and December, approximately every 6 months. A small number of attendees (5-10) is expected from each participating institution, together with additional attendees from other interested institutions. The main outcomes of this task are the prototype ESM Grid Environment and the growth of interest and knowledge related to grid technologies. The training sessions, will allow familiarizing users with the Grid Environment and its features through an active hands-on approach.

Deliverables

D3.1 (Task 1, mo 18)	Report on v.E.R.C. Portal Setup and Status
D3.2 (Task 2, mo 18)	Document describing basic ESM workflows and best practices
D3.3 (Task 3, mo 18)	Report on design and status of Unified HPC Environment
D3.4 (Task 4, mo 18)	Document describing design and deployment of Grid portal and development environment
D3.5 (Task 2, mo 36)	Document describing the suite of reference workflows
D3.6 (Task 3, mo 36)	Document describing functionality and usage of Unified HPC Environment in its Beta Version
D3.7 (Task 1, mo 48)	Final and comprehensive report on virtual ESM Resource Center
D3.8 (Task 4, mo 48)	Report on training sessions

Milestones

M3.1 (Task 1, mo 15)	v.E.R.C., Generation 0 (basic setup of all components)
M3.2 (Task 1, mo 33)	v.E.R.C., Generation 1 (Beta Version including all functionality)
M3.3 (Task 1, mo 45)	v.E.R.C., Generation2 (stable and sustainable production environment)

WP4/NA3: Strengthening the European Network on Earth System Modelling

Work package number	**4 / NA3**	**Start date or starting event:**		**1**
Work package title	**Strengthening the European Network on Earth System Modelling**			
Activity Type	**COORD**			
Participant number	3	1	12	2	10
Participant short name	CERFACS	CNRS-IPSL	MF-CNRM	MPG	MET-OFFICE
Person-months per participant:	48	43	3	22	6
Participant number	13	11	9		
Participant short name	SMHI	KNMI	CMCC	Total	
Person-months per participant:	3	3	4	132	

Objectives

Numerical modelling is the most appropriate approach to study and experiment with the Earth climate. The most sophisticated Earth System Models (ESMs) today include components representing the ocean including its biogeochemistry, the atmosphere with its chemistry and aerosol microphysics, the sea-ice, the land and its vegetation. In Europe, different ESMs (some of them only in the form of ocean-atmosphere Coupled General Circulation Models (CGCM)) are being developed by different climate research groups (see Appendix 1). Fortunately, those groups already share today some software tools and component models becoming "de facto" standards for the benefit of the whole community. The 2 common software tools identified are the OASIS coupler and the CDO processing tool, while NEMO is an ocean component model used by a large majority of partners in the project (see Appendix 2). Strengthening even further the scientific and technical interactions between those groups is today essential, as the individual groups are no longer capable of mastering the entire complexity of the system.

In this respect, IS-ENES will establish standardized information about existing ESMs in Europe. As each ESM is a complex system gathering components that can be configured in different ways with different parameter values, a proper and standard-compliant documentation of ESMs is absolutely essential to ensure the full exploitation of the results not only by their developers, but also by other scientific groups in the community. The Common Information Model (CIM) developed in the METAFOR project that proposes a standard way to document climate models will be used.

IS-ENES will also promote the use of the "de facto" standard software tools and component model by helping the groups developing those tools to integrate community developments and to set-up the services around those tools that will be offered in SA1.

Description of work

Task 0; Work package coordination
CERFACS (3) (6 pm), CNRS-IPSL (1) (1 pm) Total 7 pm

This task will coordinate the activities in the work package and the interaction with the other work packages, especially NA2 developing the v.E.R.C. portal presenting the services on the IS-ENES modelling network deployed in SA1.

Task 1: ESM documentation:
CERFACS (3) (6 pm), MF-CNRM (12) (3 pm), MPG (2) (MPIMET) (6 pm), CNRS-IPSL (1) (6 pm), METOFFICE (10) (6 pm), SMHI (13) (3 pm), KNMI (11) (3 pm), CMCC (9) (4 pm) Total: 37 pm

This task will produce a proper documentation of the ESMs currently developed in Europe (see Appendix 1), including a description of their component models and their software technical environment, based on a specific standard, the Common Information Model (CIM) developed in the METAFOR project.

As the full documentation of an ESM is a task of great complexity we will follow an incremental approach. Each group will first provide the documentation of their ESM and associated tools in the form currently available, and write an "assembling guide" describing the different steps of its coupled set-up. Then, each group will extract the appropriate information to constitute a subset of the standard metadata defined in the CIM, going progressively to a more and more complex and full CIM based documentation. This standard CIM documentation will be accessible to the entire climate modelling community via the v.E.R.C. portal in SA1.

Task 2: Networking on common tools and components:
CERFACS (3) (36 pm), MPG (2) (MPIMET) (16 pm), CNRS-IPSL (1) (36 pm) Total 88 pm

IS-ENES will ensure integration of user developments in "de facto" standard software tools and component model used in the climate modelling community (OASIS, CDO, NEMO); each new release of those software will therefore include developments done outside the developer groups themselves

IS-ENES will develop and implement the services around those tools and component that will be offered by SA1. For OASIS and CDO, comprehensive web sites, including documentation, user guides, tutorial, FAQs, user forum and tips for best practices will be set up. For OASIS, IS-ENES wants to go further regarding user support and proposes to provide personal help to different partners assembling a new model coupled through the OASIS coupler or migrating from OASIS3 to the fully parallel OASIS4. For NEMO, user support also includes consulting on model configuration, physical options and key scientific choices that must be done when building an ESM. Therefore, a database of experiment results and key diagnostics, illustrating the different aspects and impacts of the main physical packages and helping the users to select the most appropriate ones for their ESM will be set-up The database will be designed in a way that NEMO team as well as partners can fill it during the projects duration, and later on. Access to this database will be ensured by SA1 via the v.E.R.C. portal.

Deliverables
D4.1 (Task 1, mo 12): ESMs current documentation, including a description of associated tools and specific "assembling guide".
D4.2 (Task 1, mo 18): ESM documentation following a subset of CIM metadata.
D4.3 (Task 2, mo 24): OASIS complete web site accessible via the v.E.R.C. portal (WP3)
D4.4 (Task 2, mo 24): CDO complete web site accessible via the v.E.R.C. portal (WP3)
D4.5 (Task 2, mo 24) web NEMO configurations data base filled up by NEMO team
D4.6 (Task 1, mo 36): ESM revised documentation following the full CIM metadata.
D4.7 (Task 2, mo 48): General coupled model assembling guide based on practical experience gained when providing dedicated user support
D4.8 (Task 2, mo 48): web NEMO configurations data base filled up by NEMO team and partners

Milestones
M4.1 (Task 2, mo 12): Expression of interest from the different partners for dedicated user support.
M4.2 (Task 1, mo 15): Definition of a suitable subset of CIM metadata
M4.3 (Task 1, mo 27): Full CIM metadata ready (interaction with METAFOR project)

WP5/SA1: Access to the European Network of geographically distributed ESM Resources

Work package number	**5 / SA1**	**Start date or starting event:**		**1**	
Work package title	**Access to the European Network of geographically distributed ESM Resources**				
Activity Type	**SUPP**				
Participant number	5	4	3	1	2	
Participant short name	FMI	DKRZ	CERFACS	CNRS-IPSL	MPG	Total
Person-months per participant:	0	0	0	0	0	0

Description of the infrastructure

Name of the infrastructure: **ESM Resources**

Location (town, country):
The ESM Resources infrastructure is a distributed service on ESM models and tools. The service is made available via the extension of existing Help-Desk facilities at FMI (5) and DKRZ (4), including expert services available from CERFACS (3), CNRS-IPSL (1) and MPG (2) (MPIMET).
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Web site addresses:

The entry point of SA1 will be the IS-ENES web site http://is-enes.enes.org/.
At the beginning of the project, this web site will give links to the web sites for OASIS, CDO and NEMO :
https://oasistrac.cerfacs.fr/ for OASIS, initially
http://www.mpimet.mpg.de/cdo for CDO, initially
http://www.lodyc.jussieu.fr/NEMO for NEMO, initially
In the course of the project, entry point will use the v.E.R.C. portal when ready (version 0 at month 15)

Legal name of organisation operating the infrastructure:
The infrastructure will be jointly operated by FMI and DKRZ. They will run the v.E.R.C and the help-desk support units.
CERFACS, CNRS-IPSL and MPG (MPIMET) will run the service to software tools and model component.

Location of organisation (town, country):
Helsinki, Finland (FMI (5)); Hamburg, Germany (DKRZ (4)); Toulouse, France (CERFACS (3)); Paris, France (CNRS-IPSL (1)); Hamburg, Germany (MPG (2)-MPIMET).

Annual operating costs (excl. investment costs) of the infrastructure (€):

The total operating cost of the infrastructure for the 4 years is estimated at **3 761 k€** with 2 206.4 k€ for user support at FMI (5) and DKRZ (4) and 1554.3 k€ for user support around software tools and model component at CERFACS (3), CNRS-IPSL (1) and MPG (2) (MPIMET). Operating costs essentially include scientific and technical support staff with a limited amount of consumables and maintenance cost.

The service cost requested to EU for SA1 is estimated at **239 k€** which corresponds to only **6.4%** of the total operating cost. Percentages of the total operating cost for each partner are respectively: 7.3% for FMI (5), 4% for DKRZ (4), 20% for CERFACS (3), 19% for CNRS-IPSL (1) and 4.2% for MPG (2) (MPIMET). About 50 % of the cost is devoted to the service to common tools and model component. The other 50% is devoted to operating the v.E.R.C and providing support to users around the v.E.R.C

Description of the infrastructure:

The ESM Resources service will provide a service offering an access to tools, model components and expertise in the field of Earth System Models (ESM). Users are expected to come from the ESM community itself, from in- or outside IS-ENES, and from external groups being interested in the community research results, such as users of model results for IPCC assessments which need to better understand ESMs or oceanographers using NEMO.
Users will find in the infrastructure a service providing :

- access to software and competence with respect to some of the most important common tools

(OASIS and CDO) and a model component (NEMO),
- an unified and homogeneous access to expert knowledge, documentation, software, availability of computer resources and data archives in Earth System Modelling.

The service will develop stepwise through the course of the project. Following the results obtained in the NA and JRA research activities, the services will be activated in phases. The milestones represent these phases. The service will be operated and maintained by existing operational HelpDesks at FMI (5) and DKRZ (4). The v.E.R.C., once developed in NA2 in the form of an information and collaboration portal, will act as the entry point to these services. Meanwhile, the ENES web site will serve as entry point to the OASIS, CDO and NEMO web sites.

Service on common tools and components :
Users will benefit from this service by having access to the OASIS (coupler), NEMO (ocean model component) and CDO (handling and analysing data) software packages as well as to support relevant for these. Users will be able to download up-to-date versions of the software as well as relevant information about download, installation and use of common tools and components. Downloads and information retrieval will be freely available on the web and will include, for example, documentation, user guides, tutorial, FAQs, user forums and hints for best practices. For OASIS, NEMO and CDO, direct user support via a web based helpdesk will be offered. The NEMO reference database of experiment results assembled in NA3 in a well maintained and documented format, will also be easily accessible.
The relevant information will be mainly gathered in NA3 and presented in a user friendly way through the v.E.R.C. portal. Nevertheless, the services on those tools and components will start at the beginning of the project, using the information already available on the respective existing web sites (https://oasistrac.cerfacs.fr/ for OASIS, http://www.mpimet.mpg.de/cdo for CDO, and http://www.locean-ipsl.upmc.fr/NEMO/ for NEMO).

v.E.R.C and support service:
The ESM Resources service will also provide the v.E.R.C portal developed in NA3 to the users. The v.E.R.C will offer access to up-to-date information on ESM models, on the procedures to access computer resources, on the availability of federated data repositories (not limited to SA2 ESM data service), and other topics relevant for Earth System Modelling. A help-desk, operating as level 1 support to users, will ensure inviting appearance and efficient use of the v.E.R.C. It will use professional means of interaction with the users.
Users will be able to utilize a level 2 service enabling access to a “network of experts” and information resources. These will be based on the existing support structures of the ESM modelling groups, the data repositories and the HPC centers. Via guidance material on the v.E.R.C. portal or direct help from our helpdesk, users will be pointed to the expert(s) or existing support structure(s) corresponding to their request.
SA1 will also provide support to users and communities, who wish to integrate services, share new models and newsworthy results or promote discussions via the IS-ENES v.E.R.C. portal. This service will foster the community using the portal as a flexible collaboration and exchange platform.

Description of work

Modality of access under this project:
The service will be free of charge and opened to all users interested in ESM activities. Access will be provided through a unified web-based interface. OASIS, NEMO and CDO are open source codes. When downloading OASIS and NEMO, registration is required.

Support offered under this project:
SA1 will provide support to users mainly through helpdesk as described above. The support for common tools and model component will be given by experts. Level 2 support will have to rely on the existing support frameworks in participating organizations, to guarantee quality of support and cut costs to a minimum.

Outreach to new users:
The service will be promoted to new users employing the ENES community portal, which is already established in the community. The service will also offer to include additional and/or new services and, such, extend the number and quality of functions in the portal. Cooperation with the EuroPlanet community run at FMI (5) (http://www.europlanet-idis.fi), aiming at similar goals in a different context will also be promoted.
The present service has the potential of becoming a key in supplying knowledge on models, observations and software techniques in the Earth System Modelling context to both the research communities and the general public.

Review procedure under this project:
A review procedure will be established during the first year of IS-ENES. It will include experts in the field of ESM. It will be based on user communities for the model tools and components. It will be complemented by representatives of modelling groups not belonging to the list of IS-ENES partners, but mainly from the ENES network. The review will be carried out at months 18 and 36 of the project.

Milestones:

M5.1 (mo 6):	Activate portal and support help desk.
M5.2 (mo 15):	Policy agreements (MoU) between level 2 service provider partners
M5.3 (mo 18)	Service design document
M5.4 (mo 24):	Policy agreements for level 1 and 2 services.
M5.5 (mo 24):	Completed service web sites for OASIS, CDO and NEMO (NA3)
M5.6 (mo 30):	Distributed level-2 services activated
M5.7 (mo 48):	Report of v.E.R.C. services on OASIS, CDO and NEMO

WP6/SA2: Access to the European Network of geographically distributed ESM Data Archives

Work package number	**6 / SA2**	**Start date or starting event:**		**1**	
Work package title	**Access to the European Network of geographically distributed ESM data archives**				
Activity Type	**SUPP**				
Participant number	2	8	16	15	1	
Participant short name	MPG	STFC	BSC	LIU	CNRS-IPSL	Total
Person-months per participant:	0	0	0	0	0	0

Description of the infrastructure

Name of the infrastructure: **ENES ESM Data Network**

Location (town, country):

SA2 is a European distributed infrastructure providing to the interested public access to data from ESM simulations produced in the context of the IPCC assessment reports. As such it is devoted to deliver model results produced for the IPCC assessments of future climate change.

The SA2 infrastructure will start with existing networked data archives presently acting as European data nodes for the IPCC Data Distribution Centre (DDC) and will operate the European data nodes for the next IPCC assessment report (AR5). The DDC is composed of two archives: The **ICSU World Data Centre Climate** (WDCC) at Model and Data (MPG (2) (M&D)) and at the German Climate Computing Centre (DKRZ) in Hamburg, Germany and the STFC (8) **British Atmospheric Data Centre** (BADC) in Rutherford, United Kingdom.

During the project three additional ESM data nodes will start to provide services within the SA2 infrastructure. These will be the National Supercomputing Centre (LIU, 15) in Linköping, Sweden, the Barcelona Supercomputing Centre (16) in Barcelona, Spain and CNRS-IPSL (1) in Paris, France.

Web site addresses:

The entry point of SA2 will be the IS-ENES web site http://is-enes.enes.org/.
At the start of the project, IS-ENES web site will provide with a direct access to the European nodes :

WDCC: http://cera.wdc-climate.de
STFC: http://badc.nerc.ac.uk/
IPCC DDC: http://www.ipcc-data.org/

During the course of the project, entry point will use the v.E.R.C. portal when ready (version 0 at month 15). Access to three additional nodes will be added for AR5 results (web sites to be determined later).

Legal name of organisation operating the infrastructure:

Initially the ICSU WDCC and the STFC BADC; later completed by Institute Pierre Simon Laplace, Barcelona Supercomputing Centre and National Supercomputing Centre (LIU); see above.

Location of organisation (town, country):

Hamburg, Germany; Rutherford, United Kingdom; Paris, France; Barcelona, Spain; Linköping, Sweden

Annual operating costs (excl. investment costs) of the infrastructure (€):

Operating costs over the four years of the project are estimated at **9 882 k€.** Operating costs include technical and scientific staff running the infrastructure as well as consumables such as tapes and maintenance of hardware.
Operating costs for the existing services WDCC and STFC are respectively estimated at 5 266 k€ and 971 k€ for the 4 years of operation.
Operating costs for the three new additional data nodes are 297 k€ for IPSL, 486 k€ for LIU and 2 862 k€ for BSC. IPSL and LIU, which already operate model results, are expected to start after the first year and the cost includes 3 years of operation. BSC is expected to start after 2 years, providing access to additional results for AR5, and the cost includes 2 years of operation.

Service cost requested to EU is estimated at **544 k€**, which is only 4.3% of the total operating costs, and more specifically :

- 4,6% for WDCC, 9,4% for STFC, which are already running infrastructure
- 19% and 20% for IPSL and LIU which are newly developed data nodes within this project
- 2% for BSC already running a large storage facility for simulation results.

Integral part of the project will be the development of a business model to foster sustainability of the ENES Data Network

As an indication, ca 50% of Service cost is devoted to the service to data and ca 50% of service access cost is devoted to provide tools and assistance to the modelling community and the IPCC user community.

Description of the infrastructure:

This service activity will provide to the interested public access to the European distributed network of ESM data archives. It will provide assistance to users as well as to providers of data. It will also provide software tools to use the data. This service will support Earth system research as well as provide data to the large user community expected to be working on IPCC results. It will focus on simulation results for future climate studies. As a precursor for AR5, it will start with results from the IPCC Fourth Assessment report (AR4) complemented by results from the FP6 ENSEMBLES project. During the course of IS-ENES, simulation results for the IPCC AR5will be added. Simulations for AR5 are expected for the end of 2009/beginning of 2010; data access will start approximately one year later, around mid-term of IS-ENES.

Provision of data access :

The infrastructure will start from the existing IPCC DDC, currently operated by WDCC (MPG, 2) and STFC (8), complemented by a list of available European model archives. During the course of the project, the infrastructure will incorporate three additional nodes at CNRS-IPSL (1), BSC (16) and LIU (15). STFC, WDCC and CNRS-IPSL will mainly serve the requirements for the international IPCC AR5 data management. The additional data nodes, BSC and LIU, will provide additional data storage space for the European IPCC evaluation process requiring more data such as data to run regional climate models or impact models.

Provision of data access will be implemented gradually:

- Version 0 of the ENES ESM data network (month 12) will provide web access points to existing archived data together with comments on content. Entry point will be provided on the web site http://is-enes.enes.org.
- The pilot version of the service (month 24) will provide to the users pointers to real data together with their catalogue information (metadata). The local archives will disseminate these metadata as XML files typically via Open Archive Initiative metadata harvesting. Developments are performed in JRA4 and METAFOR. Access will be available through the v.E.R.C. portal 'one-stop-shop' approach.
- Gradual stepwise inclusion of transparent access to more and more ESM data from geographically distributed data archives will result in the revised version of the web-based user access planned for month 48. The user will be able to access these data through the v.E.R.C. portal.

The service will provide access control to the data using developments performed within the C3-Grid (http://c3grid.de) and UK NERC Data Grid (hhtp://ndg.nerc.ac.uk) projects as well as within the international IPCC AR5 data management provided by the Program for Climate Modeling Diagnosis and Intercomparison (PCMDI) in the USA.

Provision of tools:

For the modelling community protruding over the IS-ENES consortium partners, the service will provide support to European modelling groups to populate the IPCC AR5 data base. The service will include communication of agreements on data structure, data formats, requested variables and metadata. It will also provide interfacing tools to create and disseminate metadata and requested ESM data which are developed in METAFOR, JRA4 and by PCMDI.

The IPCC data evaluation process needs network integrated tools and workflows for efficient data processing and visualisation. This is why the service will also provide tools and workflows to handle the IPCC AR5 data. Special emphasis is here on the handling of results from multi-model-multi-ensemble runs. JRA4 will provide the necessary developments to match IPCC AR5 requirements.

For the users of ESM data for impact and adaptation studies, the service will provide higher level data products (maps, pictures, extremes, GIS input …) allowing for direct integration into their scientific context. These data product services are developed in JRA5 and will be integrated in the IS-ENES ESM data network (pilot version at month 24, final version at month 48).

Services currently offered by the infrastructure:
Currently STFC (8) and WDCC (MPG, 2) offer their web-based data catalogues and access interfaces. Access to UK and German IPCC AR4 ESM data is provided as well as access to the IPCC Data Distribution Centre (DDC). The IPCC DDC is the IPCC reference data archive and stores time series of selected monthly means of the last 3 assessment reports.
WDCC statistics in terms of database size and data downloads can be obtained from http://www.mad.zmaw.de/wdc-for-climate/wdcc-statistics/ The WDCC provides Internet access to 340 TB climate (model) data and counts 1500 registered users, 2/3 of them are from Europe. The numbers from STFC are comparable to those from WDCC which demonstrates that the project starts from active and well accepted, but presently isolated data infrastructures. These infrastructures are available to users from the beginning of the Project (M0).

Description of work

Modality of access under this project:
Normal access to the ENES ESM data network will be a web-based graphical user interface included in the v.E.R.C. Data access is controlled by protocols agreed with the data suppliers. For the ESM data, registration is required, with an agreement to use the data for academic purposes only. Some derived data products, such as climatologies, are available without restriction. Additional services (e.g. data re-processing or data dissemination on hardware media), which are requested beyond this standard data service level, will be charged individually according to the requested effort. It is not included in the service of IS-ENES.

Support offered under this project:
User assistance will be offered via help-desk, training and guidance material. In particular data service user support will be provided by the already existing user support service at STFC, WDCC and IPCC DDC (Start: M1).

Outreach of new users:
The project focus on climate impact and adaptation enlarges the user community beyond the traditional ESM community. The ENES ESM data network opens its framework for these new requirements and puts special emphasis on interdisciplinary usage including the general public and decisions makers. Especially partners from the national climate mitigation and adaptation research programs (scientists, local authorities and business) are expected as new users.

Review procedure under this project:
A review procedure will be defined during the first year of the project. It will include representatives of the service assessment from WDCC and STFC, complemented by international experts in the field of IPCC data distribution. The STFC service is assessed through quarterly reports to their primary funder, the Natural Environment Research Council (NERC). In addition, the IPCC Data Distribution Centre is assessed through biennial reports to the Task Group on Data and Scenario Support for Impact and Climate Analysis (TGICA). The WDCC assessment is biannual by the scientific steering board of WDCC and DKRZ. The review will be carried out at months 18 and 36 of the project.

Milestones

M6.0 (mo 1)	Data access via operational data archives of project partners
M6.1 (mo 12)	Version 0 of ESM Data Network
M6.2 (mo 12)	Alpha version of operational service package (from JRA4)
M6.3 (mo 24)	Pilot version of access to ENES ESM Data Network
M6.4 (mo 24)	Final version of operational service package (from JRA4)
M6.5 (mo 24)	Pilot implementation of data processing tools from JRA4 available

M6.6 (mo 24)	Pilot implementation of tools for adaptation community (from JRA5)
M6.7 (mo 48)	Revised version of access to ENES ESM Data Network
M6.8 (mo 48)	Advanced Implementation of data processing workflows (available from JRA4)
M6.9 (mo 48)	Advanced implementation of workflows for adaptation community (in cooperation with and available from JRA5)

WP7/JRA1: Earth System Models, Tools and Environments: Development and Integration

Work package number	**7 / JRA1**	**Start date or starting event:**			**Month 1**
Work package title	**Earth System Models, Tools and Environments: Development and Integration**				
Activity Type	**RTD**				
Participant number	10	6	3	4	1	
Participant short name	MET-OFFICE	UNI-MAN	CERFACS	DKRZ	CNRS-IPSL	Total
Person-months per participant.	9	5	22	47	15	98

Objectives :

The work package focuses on two key parts of the infrastructure of an earth system model, **the coupler and the input-output (I/O) systems**. The work is closely associated with JRA2 which looks at the performance of the models themselves. The user survey to be carried out in Task 1 seeks to ensure the requirements of climate scientists are fully accounted for in both JRA1 and JRA2.

Three issues complicate the development of ESMs, and require a community response to the problem. The increasing parallelisation of supercomputers means that the coupler and I/O systems require significant development to prevent them becoming bottlenecks to model performance. The scientific need to couple more models and have more choice of diagnostic output means that the coupler and I/O infrastructure have to be more flexible. Shared use of community models and model subsystems means that they have to be portable, and they have to perform well on a variety of computer platforms.

The OASIS coupler is a software tool currently used by approximately 25 climate modelling groups internationally for exchanging coupling information between numerical codes representing different components of the climate system. As the climate modelling community is progressively targeting higher resolution climate simulations run on massively parallel platforms, a new fully parallel version of the coupler, OASIS4, is currently being developed; in addition to the 2D fields supported by OASIS3, OASIS4 supports 3D coupling. OASIS4 is currently in a beta testing phase. Task 2 will complete development of the fully parallel coupler, test it in partnership with the main users and undertake further developments prioritised according to the user survey.

A number of different strategies are appropriate for optimising the I/O infrastructure on parallel computers which depend on the platform, the application and the model configuration. Task 3 will undertake the developments of parallel I/O systems and I/O servers focussed on a range of platforms and applications. The benefits of each will be compared and generic solutions targeted at all models will be developed.

The results of the user survey will provide the focus for bringing together the infrastructure developments in this WP and in JRA2. The user survey will also deliver a comprehensive overview of climate science requirements within Europe.

Description of work

Task 0: Work package coordination
METOFFICE (10) (3 pm), UNIMAN (6) (3 pm). Total 6 pm

Coordinate the activities of the work package and ensure requirements obtained from User Survey task are reflected in the priorities of other tasks.

Task 1: User Survey. Ensuring scientific requirements are identified and met.
METOFFICE (10) (2 pm), UNIMAN (6) (2 pm) Total 4 pm

A comprehensive understanding of the requirements of this scientific community will be gathered through questionnaires and face-to-face interviews with scientists and ESM computing support staff. The user survey will focus mainly on requirements of this WP and JRA2, but the results will be important to a number of other WPs. The end users of the products from JRA1 and JRA2 are most of the European climate science community and some users outside of Europe. The survey will paint a picture of the European climate science community, identifying which models are used where, and in what configurations, finding out what scientists find difficult or easy to do, what their needs are for their future developments, and what aspects of their existing software infrastructure are restricting their work.

Results of the survey will be reported to all relevant project partners ensuring that they can identify their key users and highest priorities. Users may then be given the opportunity to get involved in testing and using the developments, and the chance to share the best practices that evolve.

Two surveys will take place; one at the start of the project (M7.1) and one mid-way through (M7.3).

Task 2: OASIS 4 Development.
CERFACS (3) (22 pm), DKRZ (4) (35 pm) Total 57 pm

The main purpose of this task is to deliver a fully parallelised and optimized version of OASIS4 supporting 2D/3D linear and cubic interpolations and 2D conservative remapping for current coupled climate models. To achieve this, the following main developments are targeted:

- validation of the parallel global search for Gaussian Reduced grids
- implementation of the global parallel search for the 2D conservative remapping
- possibility of running more than one component models sequentially within one executable
- support of regional model specificities

The user survey (see Task 1) will also help prioritise the different longer term developments needed to support future requirements of climate modelling organisations. The possible longer term developments to be covered could be (but are not limited to): 3D conservative remapping, support of unstructured grids, more flexible coupling algorithms (such as conditional coupling or variable frequency), combination and reduction of coupling fields, support for grids evolving with time, etc.

Assessment of performance and scalability of the OASIS4 neighbourhood search, data exchange, and I/O will also be realized in a pseudo coupled model (i.e. a coupled model with “empty” components containing no dynamics and no physics but reproducing realistic coupling exchanges). Analogous performance tests in a real ESM will be done in JRA2 Task 2.

Task 3: Parallel I/O Improvements
DKRZ (4) (12 pm), CNRS-IPSL (1) (15 pm), METOFFICE (10) (4 pm) Total 30 pm

This WP will develop and implement new I/O architectures. Developments include parallel I/O and improved algorithms (including the use of I/O servers), and improved flexibility in I/O configuration (using XML configuration files).

DKRZ (4) will evaluate the different techniques available to implement parallel IO in the climate applications, implement these techniques for a few codes which are central to the Climate community and measure the improvement of parallel IO on a few parallel systems with large number of cores.

CNRS-IPSL (1) and the METOFFICE (10) are currently exploring I/O server technologies and techniques for flexible definition and deployment of model data post-processing and I/O for their own models. The server design will allow the use of different I/O library as the lower layer of the I/O system. Some I/O libraries, including NetCDF4/NetCDF parallel and others will be tested, based on the evaluation made by DKRZ (4). CNRS-IPSL (1) and the METOFFICE (10) will share their experience together and with other

partners. The user survey (task 1 of this WP) will give us a full insight of the community needs for the I/O system. This will be used to redefine the I/O software development. References implementation of the I/O systems developed by the METOFFICE (10) and CNRS-IPSL (1) will be used to compare performances and flexibility. The I/O systems will be proposed to the modeler community, with documentation for model developers and model users.

Tutorial documentation will be created describing the different options for I/O and the likely benefits for each. These will assist software support staff at individual sites to assess the appropriate technologies and techniques to evaluate.

Deliverables

D7.1 (Task 3, mo 18)	Documentation and tutorial on parallel I/O and I/O servers, and their benefits.
D7.2 (Task 2, mo 24)	fully parallelised and optimised version of OASIS4 answering current coupled climate models.
D7.3 (Task 3, mo 36)	Reference implementations of Parallel I/O and of I/O server
D7.4 (Task 2, mo 48)	OASIS4 includes high priority developments as identified in the User Survey.
D7.5 (Task 3, mo 48)	Reference implementation of I/O server combined with parallel I/O support

Milestones

M7.1 (Task 1, mo 3)	Initial user survey report available
M7.2 (Task 3, mo 15)	Strategy for development and deployment of IO technology agreed
M7.3 (Task 1, mo 33)	Final user survey report available

WP8/JRA2: European ESM: Performance Enhancement

Work package number	**8 / JRA2**	**Start date or starting event:**			**Month 1**
Work package title	**European ESM: Performance Enhancement**				
Activity Type	**RTD**				
Participant number	6	10	3	5	1	13
Participant short name	UNI-MAN	MET OFFICE	CERFACS	FMI	CNRS-IPSL	SMHI
Person-months per participant.	30	8	14	0	2	5
Participant number	15	16	9	2		
Participant short name	LIU	BSC	CMCC	MPG		Total
Person-months per participant:	12	8	18	2		99

Objectives

The work package will undertake research into the performance aspects of configuring, deploying and running Earth System Models (ESMs). This work package covers a number of key areas relating to model performance including: researching portability and performance of key models on a range of platforms to provide improved models; to improve the links between model support initiatives and to ensure the European climate science community is better prepared to work together on the petascale machines that are imminent; to develop tools to ease the composition of new ESMs from existing model components and coupler technologies which will lower the technical hurdle for small climate research organisations.

The work package is structured into three complementary tasks, each of which is strongly application-led:
Evaluation Suite, will gather key existing and developing ESMs, as examples of ESM infrastructure, and provide an application-focussed lead to the other tasks, ensuring cross-fertilisation of effort and knowledge.
Portability, performance analysis and improvement, seeks to understand and improve the performance of the ESM models for current state-of-the-art computing systems and prepare for future architectures such as PRACE and DEISA. The applications work in this project will complement PRACE.
Flexible construction of ESMs, will undertake research into future coupling systems, seeking to provide flexibility in the construction and deployment of future, community-based, ESMs based on a clear understanding of the strengths and weaknesses of the best practice coupling technologies in Europe (OASIS) and the US (ESMF).

The results of the User Survey in JRA1 will be used to drive the application lead in this work package and help determine the specific interactions between the application holders and other partners.

Description of work

Task 0: Work package coordination.
UNIMAN (6) (3 pm), METOFFICE (10) (3 pm) Total 6 pm

Coordinate the activities of the work package and ensure requirements obtained from the User Survey task in WP7 are reflected in the priorities of other tasks.

Task 1: Evaluation suite and Application-holders Effort Application focus.
CERFACS (3) (2 pm), CMCC (9) (4 pm), CNRS-IPSL (1) (2 pm), METOFFICE (10) (5 pm), MPG (2) (M&D) (2 pm), SMHI (13) (5 pm). Total: 20 pm

This task will define, co-ordinate and manage the IS-ENES application suite**.** Each task in the work package will have a strong application focus with the METOFFICE (10), supported by the results of the User Survey

in JRA1, providing a co-ordinating role of how the application holders' effort in this task is to be deployed in this task *and* across tasks T2 and T3.

The initial set of ESM applications in this project is listed below. Further details of the applications can be found in Appendix 1. This list is not a closed list; it will be reviewed as part of the User Survey in JRA1 and, as the project evolves, by the management group.

- ARPEGE-NEMO/OASIS, MF-CNRM (12).
- C-ESM, CMCC (9).
- COSMOS/OASIS, MPG (2) (MPIMET) and M&D, MPI-CH, MPI-BGC.
- EC-Earth/OASIS, EC-Earth consortium.
- HadGEM3, Hadley Centre at the METOFFICE (10).
- IPSLCM, CNRS-IPSL (1).

Task 2: Portability, Performance Analysis and Improvement.
BSC (16) (8 pm), CERFACS (3) (12 pm), CMCC (9) (14 pm), LIU (15) (12 pm), UNIMAN (6) (6 pm), FMI (5) (0 pm) Total: 52 pm

This task focuses on the performance aspects of both individual component models and ESMs constructed from them with the purpose of ensuring the ESMs can execute efficiently on existing large-scale computing facilities and also that the models are prepared for execution on future facilities. Particular attention will be given to ensuring models can take advantage of the PRACE initiative and DEISA2. The project will have access to current state-of-the-art computing systems at BSC (16) and FMI (5). BSC (16) hosts the Marenostrum supercomputer; Marenostrum is a node of DEISA2 consortium and BSC (16) is currently a partner in the PRACE project. In this sense, Marenostrum will be targeted as one of the first DEISA2 and PRACE HPC facilities to test ESMs models. FMI (5) (through sub-contractor) will provide expertise in CRAY technology and will make available their Altix system.

The work in this task will be led by BSC (16) and supported by the application owners, as appropriate (i.e. METOFFICE (10), MPG (2) (M&D), CERFACS (3), SMHI (13) and CNRS-IPSL (1)), with their effort from task T1. BSC (16), CERFACS (3), FMI (5), LIU (15) and CMCC (9) will provide the main effort to port and test applications from the Evaluation suite of ESM. Advanced analysis software available to the partners (through BSC (16), FMI (5), LIU (15) and CMCC (9)) will be applied to obtain detailed information from raw performance traces of the ESMs. Effort to improve the performance of ESMs based on the results of the performance analysis undertaken (including scalable communications techniques, flexible I/O strategies, the use of flexible coupling rates etc.) will be provided by LIU (15), CMCC (9) and UNIMAN (6), in conjunction with the application partners.

Task 3: Flexible Construction of ESMs.
UNIMAN (6) (21 pm), in conjunction with application owners. Total 21 pm

This task will look at the future of coupling technologies, with the aims of:
Allowing scientists to be able to rapidly configure coupled models built from the growing choice of models available, some of which may be 'hard coded' to use specific coupling technologies;
Enabling subsets of component models to be configured together into a *composite model* ready to be coupled to other component models using a choice of coupling technologies (for example, OASIS or ESMF) resulting in an ESM which executes efficiently on the target computing system;
Seeking to develop a long term road map for the development of coupling technologies; integrating the best of existing technologies, where appropriate, and clarifying the role of the coupling technologies that are in development.

In this task, we will extract a number of existing scientific models which are currently internal to applications in the ESM Evaluation Suite. We will further develop the Bespoke Framework Generator (BFG), developed at the University of Manchester, to enable these models to be composed together either as an OASIS4 or an ESMF-compliant component (i.e. as a composite model). Such a component will then be

able to be incorporated into existing, and developing, ESMs along with other models which may have been coded specifically to use either coupling technology. Scientists will then be able to more rapidly configure and deploy complete and efficient ESMs consisting of models of their choice, using an appropriate coupling technology. This work will also inform future developments for coupling technology and provide a framework for their evaluation.

Deliverables

D8.1 (Task 1, mo 6)	Report on the definition of the Evaluation Suite.
D8.2 (Task 2, mo 18)	Initial report describing the evaluation suite and base-case results
D8.3 (Task 3, mo 18)	Report on prototype BFG applications and examples
D8.4 (Task 2, mo 48)	Final report describing work with the evaluation suite.
D8.5 (Task 3, mo 48)	Final report on Flexible ESM construction using BFG

Milestones

M8.1 (Task 1, mo 3)	User Survey results available from WP7
M8.2 (Task 1, mo 9)	Initial Evaluation Suite available
M8.3 (Task 2, mo 15)	Initial performance analyses of the Evaluation Suite complete
M8.4 (Task 3, mo 33)	Prototype BFG applications available
M8.5 (Task 2, mo 33)	Improved ESM models and applications available
M8.6 (Task 1, mo 33)	Update on User Survey available from WP7
M8.7 (Task 2, mo 45)	Final improved ESM models and applications available
M8.8 (Task 3, mo 45)	Improved BFG applications available

WP9/JRA3: ESM Evaluation: developing an Infrastructure

Work package number	**9/ JRA3**	**Start date or starting event:**			**1**	
Work package title	**ESM Evaluation: developing an Infrastructure**					
Activity Type	**RTD**					
Participant number	7	1	19	5	13	2	
Participant short name	AA	CNRS-IPSL	DLR	FMI	SMHI	MPG	Total
Person-months per participant:	36	27	12	4	8	12	99

Objectives

The objective of JRA3 is to create an interdisciplinary infrastructure that will facilitate the scientific evaluation of complex ESMs. This infrastructure aims to standardize, harmonize and simplify - where possible - the tools and methodologies used in existing or past model intercomparison projects to evaluate the basic quality of an ESM model. This infrastructure will be a public archive of easy-to-use toolkits. It will include software to prepare required model diagnostics as well as links to pre-assembled most recent state-of-the-art observational datasets. This infrastructure development will add to the IS-ENES portal and evaluation component that can be used as a 'one-stop-shop' for modellers who want to evaluate the performance of their ESM.

The sequence of tasks that will lead to the fulfilment of the JRA3 objective is as follows:

1. Identify synergies among the different established model intercomparisons in the field (CFMIP, AEROCOM, PMIP, CCMVal, C4MIP). Investigate the common problems involved in documenting model quality and model progress. Evaluate recent efforts made to create compatible model and observational output, and to judge model performance through model intercomparisons. Develop a joint implementation plan to improve the functioning of these intercomparisons. Organize workshops to examine the implementation plan in collaboration with international groups outside the IS-ENES consortium such as PCMDI, NASA, and NCAR.

2. Provide support structures to ESM modelling teams to implement the appropriate model diagnostics and formatting tools (including CMOR, instrument simulators, variable meaning and unit standards), so that standard evaluation tests can be easily applied. Develop interfaces to bridge the format gaps between model and observational output.

3. Provide catalogue and access services for the evaluation toolkits together with the corresponding observational datasets. Define standards for documentation of a toolkit. Implement these documentation standards for a set of previously used evaluation procedures in the above mentioned intercomparisons.

4. Perform a pilot study of the application of the evaluation toolkits to one ESM.

Description of work

Task 0: Work package coordination
AA (7) (2 pm), CNRS-IPSL (1) (2 pm) Total 4 pm

Task 1. Survey of methods and problems in model intercomparison projects
AA (7) (Leader, 10 pm), CNRS-IPSL (1) (8 pm), SMHI (13) (2 pm), DLR (19) (2 pm), MPG (2) (MPIMET) (4 pm) Total: 26 pm

During the first year of the project a survey of ongoing and past intercomparison projects will take place that will document the problems that were faced in each project and the methodologies that were applied to

resolve them. Each group will focus on one or more disciplines, with AA (7) examining projects related to clouds, radiation and precipitation (e.g. CFMIP), CNRS-IPSL (1) focusing on aerosols (e.g. AEROCOM) and paleoclimate studies (e.g. PMIP) as well as carbon-climate couplings (e.g. C4MIP), SMHI (13) focusing on ocean property and circulation projects (e.g. OMIP, AOMIP), MPG (2) (MPIMET) focusing on surface fluxes (e.g. SEAFLUX), and DLR (19) focusing on atmospheric chemistry projects (e.g. CCMVal). Larger interdisciplinary model evaluation projects such as CMIP and CCMVal will be surveyed in collaboration with international groups like PCMDI and NCAR.

At the end of year one of the project a workshop will take place with the participation of international partners. In the meeting each partner will present the outcome of its particular survey. Synergies and differences between the projects will be identified and documented, and the possibilities for methodology transfers between the projects will be explored. The relationships between the methodologies followed by the interdisciplinary projects and those of the more focused disciplinary ones will be a particular focus, with the objective to use methodology transfers to enrich the evaluation potential of projects like CMIP and through that to facilitate the evaluation of IPCC AR5 models.

Task 2. Creation of support structure to facilitate model evaluation tests
DLR (19) (Leader, 6 pm), CNRS-IPSL (1) (5 pm), AA (7) (6 pm) Total 17 pm

This task will begin at the start of year two of the project, and will build on the outcome of Task 1. Listings of the model output parameters required by each intercomparison project will be created, including the physical meaning, naming conventions and the units of each parameter, and the spatial and temporal resolutions of the required model fields. In addition, listings will be made for any instrument simulator software that can be applied to the model output along with details of the content and format of the required model input. Those two listings will be used to identify areas of overlap in the parameters or synergies in the applied methodologies. The objective is to create a listing of the requirements for an interdisciplinary evaluation project that uses the expertise obtained from the disciplinary model intercomparison project. Such a listing can contribute to the evaluation of the IPCC AR5 model output. The task will then develop support structures (guideline, expert network, software examples) to help ESM modelling teams to implement the appropriate model diagnostics and formatting tools (including CMOR, instrument simulators, variable meaning and unit standards), so that standard evaluation tests can be easily applied. The formatting tools shall constitute interfaces to bridge the format gaps between model and observational output. The task will be performed in close collaboration with PCMDI.

Task 3. Provision of cataloguing and access services to observational datasets and evaluation tools
AA (7) (Leader, 10 pm), CNRS-IPSL (1) (2 pm), SMHI (13) (6 pm), DLR (19) (2 pm), MPG (2) (MPIMET) (6 pm), FMI (5) (4 pm) Total : 30 pm

This task will unfold in parallel with Task 2 with the objective to list the major datasets used in model intercomparison projects and provide easy access to them, but also to provide listing and access services to more recent datasets that could form the basis for future intercomparisons. Listings of available data will first be created, including both traditional datasets such as reanalysis output and surface temperature data as well as more recent datasets like the vertical cloud profiles of CloudSat and CALIPSO. Emphasis will be given to global datasets, but regional data with climatological time scales, such as the data produced by the Atmospheric Radiation Measurement (ARM) sites, will also be considered. Special care will be given to link to European satellite retrievals.

For those observational datasets for which instrument simulators or interface software have already been created, combined listings and access to the data and the corresponding software will be provided. In addition, interface software will be developed that will translate model output into the quantities calculated by observational surface flux data programs that use multi-platform observations as their input (e.g. surface flux dataset from HOAPS). For ocean observational datasets at near global scales that are taken at irregular time and space intervals, such as ocean property measurements from the ARGO floats, an effort will be made to review and collect all data in a single pool. Then, tools will be created that feature the functionalities to analyse the input of observation-based fields (O-input) and compare it to a second input of

climate model fields (M-input) on different numerical grids. This requires use of interpolation methods, simple field comparison and statistics and more sophisticated statistics such as the analysis of principal components, extreme events, probability distributions, etc., at least on a monthly mean basis. The result could be a universally usable tool for all kinds of field-based input. For the practical realization of the scientific evaluation tools, existing software components will be utilized when feasible (e.g. OASIS4 or CDO). Both OASIS4 and CDO will be further developed within this project.

The evaluation tools assembled from the different model intercomparisons and the list of the observational datasets will be provided to the IS-ENES web portal. The harmonized documentation of the tools shall facilitate the use of the portal by European ESM groups and by all scientists involved in model evaluation studies. For this purpose standards need to be defined for the documentation of a toolkit. These documentation standards shall be put in place for a pilot-set of previously used evaluation procedures in the above mentioned intercomparisons.

Task 4. Pilot study on the implementation of evaluation toolkits on ESM output
CNRS-IPSL (1) (Leader, 10 pm), AA (7) (8 pm), DLR (19) (2 pm), MPG (2) (MPIMET) (2 pm) Total: 22 pm

In the final year of the project (year 4), output from the CNRS-IPSL (1) ESM will be used to test the collection of toolkits and observational datasets included in the evaluation portal. Output from a history run of the model will be passed through the collected evaluation software tools and will be compared to the collection of observational datasets. The objective is to test the functionality of the assembled software tools and to iron out any potential problems before releasing the evaluation portal to the ESM community.

Deliverables
D9.1 (Task 1, mo 15) Report on differences, synergies and potential methodology transfers between the surveyed model intercomparison projects (from M9.1)
D9.2 (Task 2, mo 30) Listings of required model fields and interface software
D9.3 (Task 3, mo 30) Listings and access services to observational datasets
D9.4 (Task 4, mo 48) Report on pilot study for the evaluation of CNRS-IPSL (1) ESM output using the collected toolkits and datasets

Milestones
M9.1 (Task 1, mo 12) Workshop on synergies and differences between model intercomparison projects
M9.2 (Task 3, mo 30) Release to IS-ENES web portal of beta version of the evaluation toolkits

WP10/JRA4: ESM Data: Enhancement of Management Protocols and SW Infrastructures

Work package number	**10 / JRA4**		**Start date or starting event:**			**1**		
Work package title	**ESM Data: Enhancement of Management Protocols and SW Infrastructures**							
Activity Type	**RTD**							
Participant number	8	2	15	5	9	16	1	
Participant short name	STFC	MPG	LIU	FMI	CM-CC	BSC	CNRS-IPSL	Tot-al
Person-months per participant:	34	15	10	2	8	14	17	100

Objectives

JRA4 will deliver software infrastructure and a management framework to:

- create a distributed archive capability and
- enhance the services beyond those provided by existing archives.

The distributed archive will benefit from the resources of diverse institutions but will provide a service which is transparent to the user.

Management protocols and software developed in JRA4 will facilitate the provision of transparent and efficient data services from distributed Earth System Archives using independently funded and maintained hardware. These services will complement and work with the Common Information Model and single sign-on packages delivered by METAFOR and build them into a comprehensive resource management system, with the necessary workflows at all levels of operation, from the institutional level, ensuring that all resources which are available can be exploited without compromising the integrity of the archive, down to the `bit-level' ensuring that data is secure and data movements are managed efficiently. The package will also add higher level services to the basic geospatial processing provided by METAFOR. METAFOR will provide a structure for the archive catalogue and software to allow users to browse through that catalogue. Once the user has identified the data they need, they will click on a link. What happens after that click is the business of this WP.

The utilisation of distributed resources avoids the massive expense of a centralised archive and utilises the distributed national expertise in running data archives. The work package will deliver a suite of management protocols and software tested on a prototype distributed archive. A smooth transition between the development work here and the service provision in SA2 the software will be packaged into alpha, beta and production versions.

The objectives of this package will be shaped by the challenge of providing a distributed archive for the IPCC 5th Assessment Report (AR5) climate projections, but the software and protocols will be designed to be flexible and extensible for use with other European and international Earth System Model data archives. The functionality of the system will also be tested on the CCMVal project. The AR5 archive development will be led by PCMDI (USA), but in a departure from previous IPCC reports, this will be a collaborative effort with European Data Centres providing an essential contribution to the archive. JRA4 will coordinate European input into the archive development of the protocols and standards. JRA4 will ensure that European Data Centres are in a position to meet the technical requirements and will provide additional support for modelling groups which intend to exceed the AR5 requirements by, for instance, providing sufficient data to drive regional models for downscaling experiments. The GO-ESSP framework will be used to ensure that developments within this package exploit synergies with developments outside Europe.

Description of work

Task 0: Management of the work package
STFC (8) (5 pm) **Total: 5 pm**

This work package will deliver software which is essential to the performance of the distributed data service managed in SA2, so that coordination with SA2 will be a high priority. Workshops, telephone and video conferences will be organised to coordinate developments, and annual reports will be delivered. This task will also ensure that resources are deployed to exploit opportunities, such as software developed by 3rd parties, and contain problems. Reports will be delivered to GO-ESSP meetings to ensure smooth integration of this work with work outside Europe.

Task 1: Archive Management and Core Services
STFC (8) (8 pm), MPG (2) (M&D) (3 pm), LIU (15) (10 pm), FMI (5) (2 pm), BSC (16) (2 pm), CNRS-IPSL (1) (2 pm) **Total: 27 pm**

Task 1 will deal with the institutional agreements required to ensure smooth running of distributed data archives. The agreements between institutions will be framed to ensure the prompt reporting and efficient resolution of problems. A comprehensive data policy, including workflows, will be developed, which will encompass the IPCC AR5 policy (set by the WCRP/CLIVAR Working Group on Coupled Modelling (WGCM) and implemented by PCMDI) and will also cover such additional data handled by the European archive as lies outside the scope of the IPCC project. Reports on the potential synergies with planetary atmospheres data services will be prepared in the first and final year of the project.

Software options will be reviewed and assessed in the light of the resulting data policy. The single-sign-on security model from METAFOR will be adopted. The key issues to be reviewed will be data discovery, data security, performance monitoring and data handling environments. In order to facilitate the management of a distributed archive with volunteer data nodes which may have varying capacities a protocol for nodes to advertise their capabilities, including dynamic performance information, through an Open Geospatial Consortium (OGC) web service will be designed.

Task 2: Common Information Model and Standard Names
MPI-M/M&D (3 pm), STFC (8) (3 pm), CNRS-IPSL (1) (3 pm) **Total: 9 pm**

The Common Information Model (CIM) will be at the core of the archive. This is being developed in the METAFOR project (starting early 2008). As data management protocols and software are developed, interaction with METAFOR will ensure that no inconsistencies develop. This task will prepare a list of dependencies and ensure that the METAFOR data discovery portal interfaces cleanly with the data archive to give web access.

The software suite will depend, as in the AR4 intercomparison, on submitted data conforming to the Climate and Forecast (CF) Metadata Convention (http://cf-pcmdi.llnl.gov/). In Task 2, a comprehensive list of ESM variables which EU modelling groups would like to have stored on the distributed archive will be collected and, where necessary, added to the CF convention.

Task 3: Development of the Operational Services Package.
STFC (8) (6 pm), MPG (2) (M&D) (4 pm), BSC (16) (11 pm), CMCC (9) (8 pm), CNRS-IPSL (1) (3 pm) **Total: 32 pm**

The operational services will underpin the user services. This task will complete in the first half of the project.

Because of the large volume of data being handled it will be essential to have a reliable procedure for validating data transfers. A check-summing protocol (following the workflow developed in task 1) will be

implemented for use both by users and archive managers to ensure check the integrity of data both after transfer and after extended residence on the archive.

Resource management procedures will be explored, to ensure optimal use of distributed resources and ensure that operational problems can be rapidly identified. This sub-task should ensure that the link between the METAFOR discovery service and the data works efficiently and reliably.

The distributed nature of the archive creates a risk that user services will be slowed by the overhead of transferring data between different nodes. This risk will be addressed by extending the GRID superscalar framework to optimise resource usage in execution of user services by means of file replication, distribution of portions of the file and reordering of computations to optimize the data transfer. Current version of GRID superscalar (http://www.bsc.es/plantillaG.php?cat_id=69) is able to locate files transparently regardless of their physical location and to schedule computations taking into account the location of the files. These features will be extended by tailoring the data management to the requirements of the project and by implementing the commutativity and reduction operators in the application tasks. Task 3 will improve the link between the data services provided within the Grid Relational Catalog project (GRelC), developed in Italy to manage databases on the Grid, with the OGC web services, in particular the Catalogue Service Web standard interface (CSW). A new driver taking into account OGC CSW interfaces will be designed and implemented as part and extension of the Grid system GRelC Data Access Service (DAS).

Task 4: Development of the User Services Package.
STFC (8) (12 pm), MPG (2) (M&D) (5 pm), BSC (16) (1 pm), CNRS-IPSL (1) (9 pm)

Total: 27 pm

User services to be run in SA2 will be broken into three components to facilitate parallel development and reuse of subcomponents: the user interface, the web service, and the server side data handling. The user interface will typically be a dynamic web page or site, though software libraries will also be able to access the web services directly. Web services will follow the Open Geospatial Consortium (OGC) standards where applicable, providing a clear and well characterised interface to the server side data handling code. The server side code will exploit existing software libraries to provide a range of data transformations. The software for these services will be developed in 4 sub-packages covering: access support, visualisation, data manipulation and efficiency, regional model support designed for running in the users' computational environment. The 4 software sub-packages will be bundled together into a user service package which will be delivered in stages.

Access support: Support for 3rd party software accessing the archive will be provided, to ensure that users accessing large volumes of data can do so conveniently. The initial focus will be on wget and OPeNDAP, to complement the services developed in Task 3. JRA4will not develop new data access tools, but will ensure that a range of existing tools widely used in our ESM user community can be exploited to access our data. These tools will also be used by some of the other software components. Particular emphasis will be on ensuring that login and authorisation procedures work smoothly.

Visualisation: A package to visualise the data and generate a standard set of diagnostics for preliminary evaluation of the data will be developed and prepared for deployment. This will include time series of global means and decadal climatologies, and pre-computed ensemble means. The visualisation user interface will allow users to browse the catalogue (which is expected to contain of the order 10^8 entries) and select display options, the server side image generation software will generate a range of products from the archived data. The visualisation will be based on www.ipcc-data.org/maps/ which provides access to order 10^5 distinct fields.

Data manipulation and efficiency: A service to carry out basic data manipulation will be provided in order to give users flexibility about the data they transfer. The service will provide for data sub-setting and aggregation, and interpolation to a predefined common grid. Where possible, existing software libraries will be exploited and put behind a common web service interface.

Regional model support: An interface to facilitate running regional models forced by archived climate model projections will also be developed. The interface will allow regional models running on remote machines to extract forcing fields from the archive and transfer only those grid points which are actually required, avoiding the unnecessary overhead of downloading global fields. The interface will exploit the OASIS coupler.

Deliverables

D10.1 (Task 2, mo 10) Report on CIM dependencies
D10.2 (Task 1, mo 18) Data policy and software review
D10.3 (Task 3, mo 36) Operational services package
D10.4 (Task 4, mo 48) User service package

Milestones

M10.1 (Task 1, mo 3) Project roadmap
M10.2 (Task 1, mo 9) Draft data policy and software review
M10.3 (Task 3, mo 12) Operational services package alpha version
M10.4 (Task 3, mo 12) Design of grid data access system enabled
M10.5 (Task 4, mo 15) User services package beta version
M10.6 (Task 3, mo 33) Operational service review
M10.7 (Task 4, mo 39) User service package, V1.0 (for delivery to SA2)

WP11/JRA5: Bridging Climate Research Data and the Needs of the Impact Community

Work package number	**11 / JRA5**		**Start date or starting event:**				**1**	
Work package title	**Bridging Climate Research Data and the Needs of the Impact Community**							
Activity Type	**RTD**							
Participant number	3	9	1	11	13	12	18	17	
Participant short name	CER-FACS	CMCC	CNRS-IPSL	KN-MI	SMHI	MF-CNRM	INH-GA	WU	Total
Person-months per participant:	32	8	24	24	11	3	32	15	149

Objectives

The central objective of JRA5 is to **provide a prototype for a web service interface** (the e-impact-portal thereafter) to bridge the gap between the climate modelling community, the climate impact community and decision makers (the users or stakeholders thereafter) for developing adaptation and mitigation policies. The e-impact-portal will be integrated in IS-ENES v.E.R.C.

The development process, based on participative user consultations, will provide valuable insights into the needs of the impact community and decision makers. For that purpose a number of selected and representative Use Cases for climate data will be selected in several EU member states and worked out and prototype services will be built. In addition, we will start a dialogue with the upcoming EU Climate Adaptation Strategy process (EU Green Paper on Adaptation), and will provide an input to climate data frameworks and trans-national networks which will be needed to support implementation of this strategy at pan-European scale. Similar types of activities are currently being developed in Europe for *observational* data in the framework of GMES but for *climate model* data, initiatives only exist at a national level in some EU countries. Because of the user diversity, it is important that the provided services comply with the European INSPIRE (Infrastructure for Spatial information in Europe) directive to guarantee an optimal and transparent access to the data and associated metadata and related tools. Because policy makers as well as individual sectors often are interested in national/local climate effects, including climate extremes, the services will need to provide *tailored products* that can be either directly used or easily adapted to new studies and requirements. The process of employing Use Cases will guarantee this. We will cover a broad range of stakeholders and sectors with the selected Use Cases: water resources, agro- and ecosystems, forestry, spatial planning and energy management. In addition, we also want to identify and document a common set of e-ressources/tools and cross-cutting themes, including the key notion of uncertainty propagation. To achieve this objective, JRA5 will be phased according to:

Use Case description and user requirement definition: The partners will combine existing national Use Cases into a draft of selected Use Cases which will be presented to national stakeholders for review and feedback. The Use Cases will then be modified and validated following user requirements. This process will have the beneficial effect that impact communities and decision makers in different countries and sectors will share information on their own needs and working methods.

The European Green Paper on Climate Adaptation, which is expected to be adopted by the EU in 2008/9 as binding EU Climate Adaptation Strategy, will be a basis for our exploratory analysis of pan-European climate data needs for successful implementation of this strategy.

Transverse themes and general tools identification: the partners will work to implement sets of simple and general common tools tailored to the user needs as well as robust methodologies for the quantification and incorporation of the cascade of uncertainty, including those uncertainties related to climate data (in both observations and simulations), transfer functions and impact/decision model used, in order to construct probabilistic impact scenarios or projections.

Based on the user requirements, the detailed design, implementation, integration and test of the prototype services will take place using INSPIRE compliant standards and technologies. This implies that the services have to be developed according to the mandatory INSPIRE Publish-Find-Bind principle. These services will retrieve their information from the infrastructure developed in WP6 of SA2. The software will have a high degree of portability to make it easy to install in various countries. The services will be evaluated by the user's community.

Description of work

Task 0: Work package coordination **Total 6 pm**
CERFACS (3) (3 pm), CNRS-IPSL (1) (3 pm)

This task aims to implement and maintain an efficient management structure that enables 1) a fast and timely information flow between the different JRA5 partners and with other WP's of IS-ENES, as well as with a broad range of stakeholders 2) a full and comprehensive dissemination of the JRA5 results beyond the project boundaries. The latter includes a delivery of quality controlled reporting to the commission as well as maintaining a continuous information flow to stakeholders, the public, and the scientific community. This task is also responsible for managing risks and responding to external stimuli which may have the potential to impact upon the work schedule.

Task 1: Impact community and decision maker consultation and dialog **Total 35 pm**
CERFACS (3) (8 pm), CNRS-IPSL (1) (6 pm), KNMI (11) (4 pm), CMCC (9) (2 pm), INHGA (18) (6 pm), SMHI (13) (2 pm), WU (17) (5 pm), MF-CNRM (12) (2 pm)

JRA5 will engage in a pro-active consultation with the impact community. Based on existing results from national programs, JRA5 will define several Use Cases for a selected number of themes and regions, which include water resources, agro and ecosystems, forestry, spatial planning and energy sector. A Use Case is a document that describes the type of information needed, the intended use of the information, the way the end-users want to access the information and the requested flexibility. The Use Case also provides the mapping (the so-called transfer function, or tailoring) between the climate parameters provided by the climate community and the parameters used by the stakeholder community (the input of their own impact/decision models). The Use Case must also detail the treatment of the different sources of uncertainty. The different Use Cases have to be structured according to a common workflow methodology including the transfer function part (see Task 2). Once the draft Use Cases has been compiled we will start a dialog with the stakeholders. Based on this dialog the Use Cases will be adjusted to reflect the requested changes. The consultations about the Use Cases will mainly be document reviews in the same way as the INSPIRE stakeholder consultations are conducted in Europe. After this phase of stakeholder consultation the selected Use Cases will be frozen and ready for the implementation phase.

Task 2: Setting a suite of e-ressources/tools and guidance/expertise on transverse themes to foster interaction between climate and impact/decision maker communities
CNRS-IPSL (1) (10 pm), CERFACS (3) (9 pm), KNMI (11) (8 pm), CMCC (9) (2 pm), INHGA (18) (14 pm), SMHI (13) (1 pm) **Total 44 pm**

This task will identify, investigate and implement as a service on the prototype e-impact-portal, cross-cutting themes and e-resources/tools. The relevant questions will also be part of the user consultation and survey performed in Task 1. This task will provide the necessary ingredients relevant to the user services which have to be installed on the prototype e-impact-portal in addition to the selected Use Cases.

The tools may include for instance a portable library of simple and general transformations (spatial and temporal interpolation, standard statistical downscaling techniques, interface with GIS tools,…), These tools may be the initial core ingredients of the Transformation and Invoke Spatial Data services of the INSPIRE directive (see Task 3).

The transverse themes include the description of the framework and common workflow to analyze, design and understand the sequence of tasks involved in the transfer functions as well as the necessary ingredients to feed the expertise needs within the SA2 Help-desk. It also includes the problem of uncertainty, including its propagation from the greenhouse gases emission scenarios, the climate models, the transfer functions and the impact models down to the results of impact and adaptation studies. The various types of uncertainties involved in any impact study and/or decision making process need to be clearly established, precisely defined and eventually quantified using the appropriate approaches for each type. This activity clearly relies upon a strong interaction with the users as their expertise is absolutely needed to come up with a hierarchy of the various sources of uncertainty. The main objective here is to provide expertise and guidance as to the rationale behind the tackling of uncertainty in impact studies and decision making process.

Task 3: The e-impact-portal prototype: design, implement, integrate and test of use case-related services
CERFACS (3) (12 pm), CNRS-IPSL (1) (5 pm), KNMI (11) (12 pm), CMCC (9) (4 pm), INHGA (18) (12 pm), SMHI (13) (8 pm), WU (17) (10 pm), MF-CNRM (12) (1 pm) Total 64 pm

Task 3 will develop the e-impact-portal. This portal will include information on selected climate adaptation projects for specific sectors or regions (the Use Cases) and examples of tailoring climate information to information that meets stakeholder's needs.

This task will develop the related services according to well accepted and widely-used standards such as the ESA PSS05-lite standard. This will guarantee that the developed service is well-documented and properly tested. The associated software must be easily shared by the partners and users, which sets stringent requirements for the portability. Next to the application server software, the partners will generate the following documentation: 1) User Requirements Specification, 2) Software specification/Architectural Design Document, 3) Input/output specification, 4) Software User Manual, 5) Software verification and Validation Plan, 6) Test reports.

In this phase all specific requirements from the stakeholders and agreed by the partners have to be implemented and tested. The developed services have to be in line with other developments, e.g. the European standardization of metadata. It is foreseen that the portal various services will be developed to eventually comply with the INSPIRE standards: the discovery service, view service, and download service interact directly with the user and will form the minimal basis. The discovery service allows searching and identifying climate data and climate data services based on metadata content. The view service allows navigating, browsing and graphically displaying the climate data and associated metadata. The download service allows the users to obtain the digital data in various formats according to their specifications and using standard protocols (http, ftp). Other optional services such as the Transformation Service and Invoke Spatial Data Service can run in the background to perform, e.g., pre- or post-processing tasks on climate data (see Task 2). The input (the climate data) to the service is delivered at the end by the infrastructure systems developed under SA2.

For The European Climate Adaptation case, JRA5 will carry out exploratory analysis of pan-European climate data needs for successful implementation of this strategy. We will seek collaboration with the EEA and with the EU Joint Research Center (JRC), to contribute to a development of a *position paper* about the need for distributed, e-based pan-European climate data service network in support of the EU Adaptation Strategy, both across the key sectors and European regions. In a broad consultation process with key climate modelling centres, national climate data services, and climate adaptation initiatives, and relying on the Use Case work, we will define key *characteristics and potential architecture for a prototype of an e-based pan European climate data service network.*

The e-impact-portal service will be made available in the countries of the different partners and the parties involved in the original Use Case evaluation will be asked to actively use the service thereby checking whether it meets the original requirements. The resulting feedbacks will be collected in an evaluation report that can serve as a guide for further enhancements of the system and the development of the European Adaptation Case. An important aspect of the report will be the lessons-learned from developing these

services. These will include transnational cultural aspects as well as cultural difference between the climate science community and the impact and decision-makers communities.

Deliverables

D11.1 (Task 1, mo 15) Final description of selected Use Cases including user requirements specification
D11.2 (Task 2, mo 18) Baseline documents on e-ressources/tools and transverse themes
D11.3 (Task 3, mo 24) The e-impact-portal Software Requirements/Architectural Design/IO Specification
D11.4 (Task 3, mo 40) Software Code and e-impact-portal full documentation
D11.5 (Task 3, mo 48) Report and manuscript journal paper on key characteristics for a prototype of an e-based pan-European climate data service network

Milestones

M11.1 (Task 1, mo 6) Release of draft Use Cases for user consultation
M11.2 (Task 2, mo 9) Release of draft e-ressources/tools and transverse themes
M11.3 (Task1, mo 12) Draft inventory paper on climate data needs in support of the EU Climate Adaptation Strategy (input to NA1)
M11.4 (Task 3, mo 24) Interoperability of the portal design with JRA4 and SA2
M11.5 (Task 3, mo 40) Release of prototype web portal services for user feedback
M11.6 (Task 3, mo 46) End of user feedback and consultation phase

B.1.3.6 Efforts for the full duration of the project

Indicative efforts per beneficiary per WP
Project number (IS-ENES) : 228203

Workpackage	WP1	WP2	WP3	WP4	WP5	WP6	WP7	WP8	WP9	WP10	WP11	Total per Beneficiary
CNRS	54	5	0	43	0	0	15	2	27	17	24	**187**
MPG	4	14	17	22	0	0	0	2	12	15	0	**86**
CERFACS	0	2	3	48	0	0	22	14	0	0	32	**121**
DKRZ	0	0	53	0	0	0	47	0	0	0	0	**100**
FMI	0	0	11	0	0	0	0	0	4	2	0	**17**
UNIMAN	0	0	0	0	0	0	5	30	0	0	0	**35**
AA	0	2	0	0	0	0	0	0	36	0	0	**38**
SFTC	0	0	0	0	0	0	0	0	0	34	0	**34**
CMCC	0	4	41	4	0	0	0	18	0	8	8	**83**
METOFFICE	0	2	0	6	0	0	9	8	0	0	0	**25**
KNMI	0	0	0	3	0	0	0	0	0	0	24	**27**
MF - CNRM	0	0	0	3	0	0	0	0	0	0	3	**6**
SMHI	0	0	0	3	0	0	0	5	8	0	11	**27**
LIU	0	0	3	0	0	0	0	12	0	10	0	**25**
BSC	0	0	5	0	0	0	0	8	0	14	0	**27**
WU	0	3	0	0	0	0	0	0	0	0	15	**18**
INHGA	0	0	0	0	0	0	0	0	0	0	32	**32**
DLR	0	0	0	0	0	0	0	0	12	0	0	**12**
TOTAL	**58**	**32**	**133**	**132**	**0**	**0**	**98**	**99**	**99**	**100**	**149**	**900**

Indicative efforts per activity type per beneficiary
Project number (IS-ENES): 228203

Activity Type	CNRS-IPSL (1)	MPG (2)	CER-FACS (3)	DKRZ (4)	FMI (5)	UNI-MAN (6)	AA (7)	SFTC (8)	CMCC (9)	MET-OFFICE (10)	KNMI (11)	MF-CNRM (12)	SMHI (13)	LIU (15)	BSC (16)	WU (17)	INHGA (18)	DLR (19)
RTD																		
WP7: Earth System Models, Tools and Environments: Development and Integration	15	0	22	47	0	5	0	0	0	9	0	0	0	0	0	0	0	0
WP8: European ESM: Performance Enhancement	2	2	14	0	0	30	0	0	18	8	0	0	5	12	8	0	0	0
WP9: ESM Evaluation: developing An Infrastructure	27	12	0	0	4	0	36	0	0	0	0	0	8	0	0	0	0	12
WP10: ESM Data: Enhancement of Management Protocols and SW Infrastructures	17	15	0	0	2	0	0	34	8	0	0	0	0	10	14	0	0	0
WP11: Bridging Climate Research Data and the Needs of the Impact Community	24	0	32	0	0	0	0	0	8	0	24	3	11	0	0	15	32	0
TOTAL RTD	**85**	**29**	**68**	**47**	**6**	**35**	**36**	**34**	**34**	**17**	**24**	**3**	**24**	**22**	**22**	**15**	**32**	**12**
COORD																		
WP2: The Future ENES Strategy	5	14	2	0	0	0	2	0	4	2	0	0	0	0	0	3	0	0
WP3: "The virtual Earth system Ressource Centre	0	17	3	53	11	0	0	0	41	0	0	0	0	3	5	0	0	0
WP4: Strengthening the European Network on Earth System Modelling	43	22	48	0	0	0	0	0	4	6	3	3	3	0	0	0	0	0
TOTAL COORD	**48**	**53**	**53**	**53**	**11**	**0**	**2**	**0**	**49**	**8**	**3**	**3**	**3**	**3**	**5**	**3**	**0**	**0**
MGT																		
WP1: Scientific and Technical Coordination of IS-ENES	54	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TOTAL MGT	**54**	**4**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
SUPP																		
WP5: Access to the European Network of Geographically Distributed ESM Ressources	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
WP6: Access to the European Network of Geographically Distributed ESM Data Archives	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TOTAL SUPP	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
TOTAL BENEFICIARIES	**187**	**86**	**121**	**100**	**17**	**35**	**38**	**34**	**83**	**25**	**27**	**6**	**27**	**25**	**27**	**18**	**32**	**12**

B.1.3.7 List of milestones and planning of review

Milestone no.	Milestone name	WPs no's	Lead beneficiary	Delivery date from Annex I (1)	*Comments*
M1.1	Kick-off meeting	1	CNRS-IPSL (1)	**1**	
M1.2	Setting of collaboration environment using e-technologies	1	MPG (2)	**3**	
M7.1	Initial user survey report available	7	METOFFICE (10)	**3**	
M8.1	User Survey results available from WP7	8	METOFFICE (10)	**3**	*Input from WP7/JRA1*
M10.1	Project roadmap	10	STFC (8)	**3**	
M2.1	first community workshop to define working groups and the contour of the foresight	2	MPG (2)	**6**	
M2.2	first list of requirements for PRACE	2	CMCC (9)	**6**	
M5.1	Activate portal and support helpdesk	5	DKRZ (4)	**6**	
M11.1	Release of draft Use Cases for user consultation	11	CERFACS (3)	**6**	
M8.2	Initial Evaluation Suite available	8	CMCC (9)	**9**	
M10.2	Draft data policy and software review	10	STFC (8)	**9**	
M11.2	Release of draft e-ressources/tools and transverse themes	11	CERFACS (3)	**9**	
M4.1	Expression of interest from the different partners for dedicated user support.	4	CERFACS (3)	**12**	
M6.1	Version 0 of ESM data access	6	MPG (2)	**12**	
M6.2	Alpha version of operational service package	6	MPG (2)	**12**	*Operational service package provided by WP10/JRA4*
M9.1	Workshop on synergies and differences between model intercomparison projects	9	AA (7)	**12**	
M10.3	Operational services package alpha version	10	STFC (8)	**12**	
M10.4	Design of grid data access system enabled	10	STFC (8)	**12**	
M11.3	Draft inventory paper on climate data needs in support of the EU Climate Adaptation Strategy	11	WU (17)	**12**	*Input to WP2/NA1*
M3.1	v.E.R.C., Generation 0	3	DKRZ (4)	**15**	*Basic setup of all components*
M4.2	Definition of a suitable subset of CIM metadata	4	CERFACS (3)	**15**	*Interaction with METAFOR project*
M5.2	Policy agreements (MoU) between level 2 service provider partners	5	FMI (5)	**15**	
M7.2	Strategy for development and deployment of IO technology agreed	7	DKRZ (4)	**15**	
M8.3	Initial performance analyses of the Evaluation Suite complete	8	BSC (16)	**15**	
M10.5	User services package beta version	10	STFC (8)	**15**	
M2.3	Establishing a web site for ESM educational information	2	MPG (2)	**15**	
M1.3	First general assembly meeting	1	CNRS-IPSL (1)	**16**	
M5.3	Service design document	5	FMI (5)	**18**	
End of 1rst reporting period					

Milestone no.	Milestone name	WPs no's	Lead beneficiary	Delivery date from Annex I (1)	*Comments*
M5.4	Policy agreements for level 1 and 2 services.	5	DKRZ (4)	**24**	
M5.5	Completed service web sites for OASIS, CDO and NEMO	5	DKRZ (4)	**24**	*After delivery of D4.3, D4.4 and D4.5*
M6.3	Pilot version of access to ENES ESM Data Network	6	MPG (2)	**24**	
M6.4	Final version of operational services package	6	MPG (2)	**24**	*In interaction with WP10/JRA4*
M6.5	Pilot implementation of data processing tools	6	MPG (2)	**24**	*Tools developed within WP10/JRA4*
M6.6	Pilot implementation of tools for adaptation community	6	MPG (2)	**24**	*Tools developed within WP11/JRA5*
M11.4	Interoperability of the portal design	11	KNMI (11)	**24**	*In collaboration with WP10/JRA4 and WP6/SA2*
M4.3	Full CIM metadata ready	4	CERFACS (3)	**27**	*Interaction with METAFOR project*
M2.4	Elements for the ENES strategy on the HPC-ecosystem	2	CMCC (9)	**30**	*important to feedback in the ENES strategy*
M5.6	Distributed level-2 services activated	5	FMI (5)	**30**	
M9.2	Release to IS-ENES web portal of beta version of the evaluation toolkits	9	AA (7)	**30**	
M3.2	v.E.R.C., Generation 1	3	DKRZ (4)	**33**	*Beta Version including all functionality*
M7.3	Final user survey report available	7	METOFFICE (10)	**33**	
M8.4	Prototype BFG applications available	8	UNIMAN (6)	**33**	
M8.5	Improved ESM models and applications available	8	BSC (16)	**33**	
M8.6	Update on User Survey available from WP7	8	METOFFICE (10)	**33**	*Input from WP7/JRA1*
M10.6	Operational service review	10	STFC (8)	**33**	
M1.4	Second general assembly meeting	1	CNRS-IPSL (1)	**34**	
End of 2nd reporting period					
M10.7	User service package, V1.0	10	STFC (8)	**39**	*for delivery to WP6/SA2*
M11.5	Release of prototype web portal services for user feedback	11	KNMI (11)	**40**	
M3.3	v.E.R.C., Generation 2	3	DKRZ (4)	**45**	*Stable and sustainable production environment*
M8.7	Final improved ESM models and applications available	8	BSC (16)	**45**	
M8.8	Improved BFG applications available	8	UNIMAN (6)	**45**	
M1.5	Final general assembly meeting	1	CNRS-IPSL (1)	**46**	
M11.6	End of user feedback and consultation phase	11	CERFACS (3)	**46**	
M5.7	Report of v.E.R.C. services on OASIS, CDO and NEMO	5	DKRZ (4)	**48**	
M6.7	Revised version of access to ENES ESM Data Network	6	MPG (2)	**48**	
M6.8	Advanced implementation of data processing workflows	6	MPG (2)	**48**	*Input from WP10/JRA4*
M6.9	Advanced implementation of workflows for adaptation community	6	MPG (2)	**48**	*in cooperation with and available from WP11/JRA5*
End of project					

Tentative schedule of Project Review			
Review no.	**Tentative timing**	**Planned venue of review**	**Comments, if any**
1	After project month: 18 **1rst Reporting Period**	**mo 24** **Mid-term Review**	**Period 1 is crucial to establish the grounds of the project** : - user surveys - setting web site - basis for the V.E.R.C. - launch of foresight **After mo 24, will also be available**: - first version of full service activity on model components and tools - improved data service and v.E.R.C - e-portal for impact specifications

B.1.3.8 List of planned workshops

WP	Workshops / meetings	Approximate date or period	Milestone/ Deliverable associated
1	Kick-off meeting	**mo 01**	**M1.1**
3	Training sessions on ESM Grid environment (2/year)	**mo 01 - mo 48**	**D3.8**
2	Expert working groups on HPC ecosystem	**mo 01- mo 30**	**M2.4**
2	First community workshop to define working groups and the contour of the foresight	**mo 06**	**M2.1**
2	Expert working groups to discuss elements of ENES strategy	**mo 06 - mo 34**	**D2.4**
9	Workshop on synergies and differences between model intercomparison projects	**mo 12**	**M9.1**
1	First general assembly meeting	**mo 16**	**M1.3**
2	Executive meeting for the first policy position paper on "Climate Data Needs in Support of the EU Climate Adaptation Strategy"	**mo 22**	**D2.2**
2	ENES first prototype "Summer School on Earth System Modelling"	**mo 30**	**D2.3**
1	Second general assembly meeting	**mo 34**	**M1.4**
2	Executive meeting for the second policy position paper on "The ENES Strategy and its Implementation Plan"	**mo 42**	**D2.5**
1	Final general assembly meeting	**mo 46**	**M1.5**

B2. Implementation

B.2.1 Management structure and procedures

B.2.1.1 Management structures

The IS-ENES consortium is composed of 20 partners from 10 European countries and the United States.

The organisational structure of the Consortium will comprise the following Consortium bodies:

The **Coordinator** is the legal entity acting as the intermediary between the Parties and the European Commission. The Coordinator will, in addition to its responsibilities as a Party, perform the tasks assigned to it as it is described in the Grant Agreement and the Consortium Agreement.
The **Technical Coordinator** will coordinate the technical aspects of the infrastructure.
The **Work Package Leaders** are in charge of the coordination of activities inside their Work Package and achieving the goals set in the work plan.
The **Executive Board** is the supervisory body for the execution of the Project which will report to and be accountable to the General Assembly.
The **Scientific Advisory Board** will advise the General Assembly and the Coordinator on scientific issues.
The **General Assembly** will be the ultimate decision-making body of the Consortium.
The **European Project Manager** will help the Coordinator in its coordination tasks.

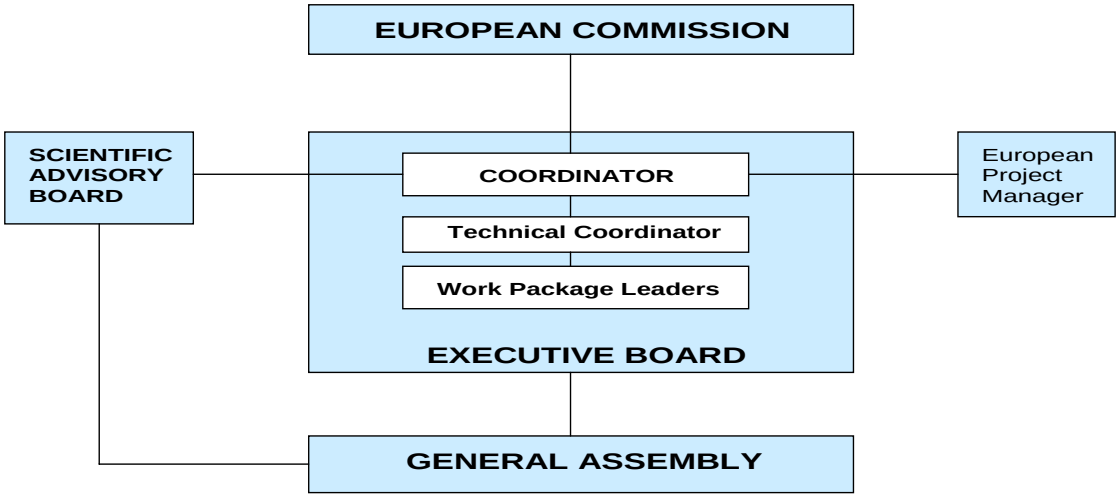


Figure 2: Overview of IS-ENES Management structure

The Coordinator

Responsibility: The Coordinator is responsible for the adherence to the contractual obligations in all activities of the Project, including prompt delivery of all reports and deliverables required by the European Commission.

In particular, the Coordinator will be responsible for: monitoring compliance by the Parties with their obligations keeping the address list of members and other contact persons updated and available collecting, reviewing to verify consistency and submitting reports and other deliverables (including financial statements and related certifications) to the European Commission, transmitting documents and information connected with the Project. The Coordinator will take care of changes in contact information, and any other Parties concerned administering the Community financial contribution and fulfilling the financial tasks providing, upon request, the Parties with official copies or originals of documents which are in the sole possession of the Coordinator when such copies or originals are necessary for the Parties to present claims. The Coordinator will implement and monitor the Gender Action Plan described in section 5.

The Coordinator will represent the Consortium in the outside world.

The Technical coordinator

The Coordinator has proposed to strengthen the coordination by defining a Technical Coordination.

Responsibility: The technical coordinator will coordinate the technical aspects of the infrastructure such as the IS-ENES portal, the interaction with supercomputing centres and industry, and the use of ICT technologies. He will also help implementing the IS-ENES web site and develop the use of e-collaboration tools.

The Executive Board

Responsibility: The Executive Board will prepare the meetings, propose decisions and prepare the agenda of the General Assembly. The Executive Board will be responsible for the proper execution and implementation of the decisions of the General Assembly. It shall seek a consensus among the Parties. The Executive Board will monitor the effective and efficient implementation of the Project. In addition, the Executive Board will collect information at least every 6 months on the progress of the Project, examine that information to assess the compliance of the Project with the work plan and, if necessary, propose modifications of the work plan to the General Assembly.

The Executive Board will:

- Initiate and coordinate the Work Packages
- Support the Coordinator and the European Project Manager in preparing meetings with the European Commission and in preparing related data and deliverables
- Prepare the content and timing of press releases and joint publications by the Consortium or proposed by the European Commission

In the case of abolished tasks as a result of a decision of the General Assembly, the Executive Board will advise the General Assembly on ways to rearrange tasks and budgets of the Parties concerned. Such rearrangement will take into consideration the legitimate commitments taken prior to the decisions, which cannot be cancelled.

Composition: The Executive Board will consist of the Coordinator, the Technical Coordinator, and all of the Work Package Leaders as appointed by the General Assembly. The Coordinator will chair all meetings of the Executive Board, unless decided otherwise.

The Work Package Leaders

Responsibilities: Each Work Package Leader is in charge of the coordination of activities inside their Work Package and achieving the goals set in the work plan.

IS-ENES has also designated WP Co-Leaders that will help the Work Package leaders in the coordination of their activities. They will also supplement the WP leaders at meetings or teleconference if they are available. They will help with the reports. They will also ensure the link between the different WP activities.

WP number	WP Leader short name	WP Co-Leader Short name
1	CNRS-IPSL (1)	MPG (2) (MPIMET)
2	CNRS-IPSL (1)	MPG (2) (MPIMET)
3	DKRZ (4)	CMCC (9)
4	CERFACS (3)	CNRS-IPSL (1)
5	FMI (5)	DKRZ (4)
6	MPG (2) (M&D)	STFC (8)
7	METOFFICE (10)	UNIMAN (6)
8	UNIMAN (6)	METOFFICE (10)
9	AA (7)	CNRS-IPSL (1)
10	STFC (8)	MPG (2) (M&D)
11	CERFACS (3)	CNRS-IPSL (1)

The Scientific Advisory Board

Responsibility: The Scientific Advisory Board will provide a general guidance to the project. In particular, it will advise the General Assembly and the Coordinator on the overall programme of activities and on its insertion in the international programmes (WCRP and IGBP). The Scientific Advisory Board will be involved in the WP2 on the strategy aspects of the ENES community.

Composition: The Scientific Advisory Board shall consist of senior individuals with relevant technical and scientific expertise and experience in the field. IS-ENES will look for synergy with the ENES Scientific Board.

The General Assembly

Responsibility: The General Assembly is the decision-making body of the Consortium. Decision power will extend to all important issues, in particular:

- Research strategies, in cooperation with the Scientific Advisory Board
- Significant modification of the work plan such as the rescheduling or abandon of a task
- All budget-related matters
- Acceptance and/or exclusion of new participants
- Implementation or modification of the consortium agreement
- Approval of reports of the Coordinator

Composition: The General Assembly will consist of one representative of each Party. The Coordinator will chair all meetings of the General Assembly, unless otherwise decided by the General Assembly.

B.2.1.2 Preparation, organisation and representation in meetings

All of the issues concerning the preparation, organisation and representation in meetings will be regulated by the Consortium Agreement signed by each of the beneficiaries.

B.2.1.3 Decision making procedures

All of the issues concerning the Decision making procedures (which regroup voting rules and quorum, veto rights and minutes of meetings) will be regulated by the Consortium Agreement signed by each of the beneficiaries.

B.2.1.4 Consortium agreement

The Consortium Agreement will define more specifically the general administrative and legal aspects: management structure, decision process, liabilities of the Contractors, defaults and remedies, confidentiality, severability, disputes, intellectual property rights provisions. Through specific annexes, it will address the specific technical and financial content of the project (list of affiliates, project plan, allocation of resources and background).

B.2.2 Beneficiaries

CNRS-IPSL (1) / http://www.cnrs.fr
CNRS, Centre National de la Recherche Scientifique, is the main French research institution. CNRS acts here in the name of the Institut Pierre Simon Laplace.

IPSL is a federative institute located in Paris composed of 5 research laboratories working on global environmental and climate studies. It gathers about 750 scientists (280 researchers, 240 engineers) and represents more than a third of the national research potential in atmospheric and oceanic sciences. Main laboratories involved in IS-ENES are Laboratoire des Sciences du Climat et de l'Environnement, Laboratoire de Météorologie Dynamique and Laboratoire d'Océanographie et du Climat. One of the main objectives of IPSL is to understand climate variability, both natural and anthropogenic. IPSL has developed an Earth system climate model and was one of the first groups to simulate the coupled climate-carbon system. IPSL has been strongly involved in the last IPCC report with 11 lead authors in Working Group 1. IPSL has also been involved in several European projects such as ENSEMBLES, PRISM, and METAFOR. CNRS-IPSL (1) will also bring expertise on the NEMO component, in model evaluation through the coordination of several international modelling intercomparison projects, in high-performance computing as well as in data handling.

Tasks assigned:
Coordination of IS-ENES and leader of WP1 and NA1; Co-leader of NA3 and JRA3, JRA5; Participates to SA1, SA2, JRA1 and JRA2

MPG (2) / http://www.mpimet.mpg.de
Max Planck Institute for Meteorology (MPIMET)'s overall mission is to understand how physical, chemical, and biological processes, as well as human behaviour, contribute to the dynamics of the Earth system, and specifically how they relate to global and regional climate changes. MPIMET has made major contributions to the simulation and analysis of a human influence on climate in detection and attribution studies. MPIMET, together with the COSMOS community, has developed a comprehensive Earth system model (ESM), the COSMOS model, in which the physical aspects of the climate system are coupled with biogeochemical cycles, and makes this model available to the scientific community in Europe and elsewhere. MPIMET will also bring expertise in IT in the field of climate models as well as on the CDO software. MPIMET is committed to informing decision-makers and the public on questions related to Climate Change and Global Change. Finally, MPIMET is managing the International Max Planck Research School on Earth System Modelling, which hosts approximately 50 PhD students.

The Model and Data group (M&D) is hosted at the Max-Planck-Institute for Meteorology in Hamburg. Group's mission is to provide central support for the German and European climate research community. Emphasis is on application of climate models and scientific climate data management. Together with the German Climate Computing DKRZ (4), M&D operates the ICSU World Data Centre for Climate which archives and disseminates more than 340 TB climate model data and related observations. All WDCC data are accessible by a standard web-interface (cera.wdc-climate.de). Developments of networking and archive federation are currently performed in research projects and international cooperation.

Tasks assigned:
Technical coordination of IS-ENES, co-coordination of NA1, coordination of SA2 and co-coordination of JRA4. Also contributes to the other WPs

CERFACS (3) / http://www.cerfacs.fr
CERFACS (3), established in 1987 in Toulouse (France), is currently one of the world's leading research institutes working on efficient algorithms for solving large scale scientific problems. The CERFACS (3) Climate Modelling and Global Change team conducts basic scientific research and high-level technical developments in the field of climate studies. In particular, the team develops the OASIS coupler software, currently used by more than 25 climate modelling groups around the world, and that naturally emerged as an essential element of the PRISM project. Assembling Coupled General Circulation Models, using state-of-art component models, porting and optimising them on a variety of platforms, complement CERFACS (3) mission in performing high resolution climate simulations. Recent scientific projects focus on the impacts due to anthropogenic climate change at regional scale with specific interest in the changes of extreme events distribution and hydrological cycle properties.

Tasks assigned:
Leads NA3 and JRA5, participates to NA2 (Scientific workflows), JRA1 (OASIS4) and JRA2 (Performance), JRA4 (User Services).

DKRZ (4) / http://www.dkrz.de/
DKRZ (4) is a national German facility, providing state-of-the-art super-computing data service and other associated services to the German and also the international scientific community to conduct top of the line Earth System and Climate Modelling. DKRZ (4) operates a fully scalable supercomputing system designed for and dedicated to earth system modelling. During the year 2008, DKRZ (4) will replace its current high performance computing system with a new 7640 core IBM Power6 supercomputer with a peak performance of 140 TeraFlops and will upgrade its mass storage system to a capacity of several tens of PetaByte. Associated services provided by DKRZ (4) include general user support as well as specific support in scientific computing. DKRZ (4) plays an active role within the German e-science initiative and is a leading partner within the Collaborative Climate Community Data and Processing Grid (C3-Grid, see also http://www.c3grid.de/). DKRZ (4) has been partner of EGEE (I to III) since the beginning.

Tasks assigned:
DKRZ (4) is coordinator of NA2, co-coordinator of SA1 and contributes to the parallel I/O task of JRA1

FMI (5) / http://www.fmi.fi
Finnish Meteorological Institute (FMI (5)) is a research and service organisation under the Ministry of Transport and Communications of Finland. The main objective of FMI (5) is to provide the Finnish society with the best possible information about the atmosphere in and around Finland. FMI (5) has about 550 employees of which about 250 in the “Research and Development” sector. Climate change research at FMI (5) covers both measurements and modelling. Aerosol research of FMI (5) is of special interest. It covers measurements and modelling on research topics such as biogenic emissions, new particle formation and growth processes, size-segregated aerosol characteristics and aerosol cloud activation. New schemes are developed in a box-model context and tested in the COSMOS-ESM, especially those regarding aerosol microphysics, cloud-aerosol interactions and subgrid-scale cloud radiative effects.

Tasks assigned :
Coordination of SA1, subtasks in JRA1, JRA2 and NA2.

UNIMAN (6) / http://www.manchester.ac.uk
The Centre for Novel Computing (CNC) is an interdisciplinary research group located in the RAE 5* rated School of Computer Science at the University of Manchester. CNC's research is application motivated with a mission to investigate techniques, and develop associated tools, for support of high performance computing. CNC aims to mediate between the increasingly challenging applications found in Computational Science and Engineering (CS&E) and the increasingly complex base

technologies for high performance computing. The CNC was established in 1990 with foundation funding from the then SERC's Novel Architecture Computing Committee. To date, the Centre has been awarded around 8M pounds worth of research grants from the EPSRC and other UK Research Councils, the EU Framework Programmes, UK government and other sources. Its accumulated experience in the field exceeds 100 person-years.

Tasks assigned:
Leader of JRA2 and co-leader of JRA1.

AA (7) / http://www.academyofathens.gr
The Research Centre for Atmospheric Physics and Climatology of the Academy of Athens is addressing both global and regional climate changes in different space and time scales. The Centre is collaborating with international Research Institutions (University of Oslo, NASA/GISS, University of Bern) as well as other Universities and Institutions in Greece. The Centre focuses on climate processes through both observational analyses from satellite and surface platforms and climate modelling studies. In particular, the Centre is developing a strategy to expand its activities in studies of the global water and energy cycles, the carbon cycle, and the ocean circulation, with the objective to understand the operation of the main physical processes and to predict their change with climate warming. The Centre will be involved in studies not only of future but also of past and present climate variability, trends and extreme events on time scales from years to centuries. Finally, Centre affiliated scientists have long been working in studies of changes in the ozone layer and climate changes resulting from ozone-climate interactions.

Tasks assigned:
Leader of JRA3 and for the evaluation of cloud, radiation, precipitation, and ocean circulation changes simulated by Earth System Models.

STFC (8) / http://www.scitech.ac.uk
The British Atmospheric Data Centre (BADC) and the NERC Earth Observation Data Centre together form the core of the Centre for Environmental Data Archival (CEDA) at the UK Science and Technology Facilities Council (STFC (8)). Both data centres are core funded by the UK Natural Environment Research Council (NERC). BADC currently has in excess of 10,000 registered users, 1700 of whom were active in 2006, downloading a total of 10 TB from 128 distinct datasets. Approximately 25% of the users are from outside the UK. BADC is the contract holder for the UK Department of Environment and Rural Affairs (DEFRA) support for (1) the Intergovernmental Panel on Climate Change (IPCC) data centre (www.ipcc-data.org), (2) providing METOFFICE (10) Hadley Centre model data to the research community, and (3) a new website (under construction) to provide the UK Climate Impacts 2008 regional climate information (UKCIP08). BADC is a partner in METAFOR developing a Common Information Model for Earth System Model data and will host a node of the distributed model intercomparison archive for the 5th Assessment Report of the IPCC.

Tasks assigned:
Leading JRA4, co-leading SA2

CMCC (9) / http://www.cmcc.it
CMCC (9) (Centro Euro-Mediterraneo per i Cambiamenti Climatici) is a Ltd Company with its registered office and administration in Lecce and local units in Lecce, Bologna, Venice, Capua and Sassari. The society doesn't pursue profitable ends and aims to realize and manage the Centre, its promotion, and research coordination and different scientific and applied activities in the field of climate change study. CMCC (9) favours collaboration among Universities, national and international research bodies, territorial bodies and the industrial sector. It operates in these circles in the name and on behalf of its consortium partners. The hardware equipment concerns both IBM (parallel scalar) and NEC SX9 (parallel vector) machines. Moreover SPACI, as CMCC (9) associate centre, will provide IA64 Itanium2-based cluster. More info on CMCC (9) and the research activities developed by its six Divisions can be found at http://www.cmcc.it. CMCC (9) will bring expertise in ESM modelling with

the CMCC (9) model as well as on grid-technology. CMCC (9) also coordinates the CIRCE FP 6 project on the impacts of climate change in the Mediterranean region.

Tasks assigned:
CMCC (9) will contribute to NA1, NA2, NA3, JRA2, JRA4, JRA5.

METOFFICE (10) / http://www.metoffice.gov.uk
The UK Met Office is one of the world's leading providers of environmental and weather-related services. Within the Met Office, the Hadley Centre studies the global and regional climate using state-of-the-art computer models developed by its staff. Additionally these models, in particular the Hadley ESM, are used extensively by the wider climate research community. The Hadley Centre is partly funded by DEFRA, and provides in-depth information to, and advises, the UK government on climate change issues. The Met Office sits in the PRISM Steering Board and participates to the METAFOR project. The Met Office was one of 20 worldwide groups which contributed to the IPCC AR4 model data base. The Hadley Centre will also bring expertise in climate model infrastructure. The Hadley Centre coordinates the EU FP6 project ENSEMBLE.

Tasks assigned:
Leading JRA1 and co-leading JRA2, participation in NA1.

KNMI (11) / http://www.knmi.nl
The KNMI (11) (Royal Netherlands Meteorological Institute) is the Dutch national weather service and centre for climate research. Climate research at KNMI (11) is aimed at observing, understanding and predicting changes in the climate system. KNMI (11) produces climate scenarios for use by stakeholders for developing adaptation and mitigation strategies. Climate research is carried out in various divisions: Global Climate Division (global climate change, coupled modelling, changes in extremes, ocean circulation, sea level rise), Regional Climate Division, Chemistry and Climate Division, Earth Observation and Climate Division and Climate Advice and Analysis Division. Climate research is supported by an Infrastructure sector in which the Research & Development division carries out innovative research. KNMI (11) is also chair of the Steering Committee of EC-EARTH and coordinates the international effort to develop EC-EARTH.

Tasks assigned:
KNMI (11) contributes to NA3 as a representant of EC-EARTH and to JRA5 through its expertise on impact studies.

MF-CNRM (12) / http://www.cnrm.meteo.fr/
Meteo-France is the French weather service. In IS-ENES, Meteo-France is represented by its research centre, the «Centre National de Recherches Météorologiques» (CNRM). The CNRM is the department responsible for conducting the largest part of the meteorological research activities, and for coordinating research/development undertakings conducted within other departments. The climate group is in charge of the studies of present climate variability and of the impact of human activities on climate. Its main specific research activities concern the development of climate models, mainly the ARPEGE climate model, the studies of climate variability, of the projection of climate at global and regional scales, of long-range forecasting, of atmospheric chemistry and of ocean-air interactions. CNRM is also currently involved in the ENSEMBLES European project for the development and analysis of regional climate change scenarios

Tasks assigned:
Contribution to NA3 (documentation and training on ESM) and JRA5 (prototype).

SMHI (13) / http://www.smhi.se
SMHI (13) is a governmental institute under the auspices of the Swedish Ministry of the Environment, providing operational services and long-term research in the fields of climate, oceanography, meteorology and hydrology. The Rossby Centre at SMHI (13) is conducting both

model development and modeling applications for climate change research and impact studies since 1997. SMHI (13) is/was active partner in climate related EU projects such as PRUDENCE, ENSEMBLES, PRISM, GLIMPSE and DAMOCLES. SMHI (13) is also involved in the development of the EC-Earth model.

Tasks assigned:
Contribution to JRA3, JRA5 (impact portal), JRA1 (OASIS), JRA2 (optimization).

LIU (15) / http://www.nsc.liu.se
LIU (15) is one of the major HPC centres in Sweden with extensive experience in delivering service to the Swedish academic community and participation in international projects. The recently installed large-scale HPC system at the National Supercomputer Centre (**NSC)** reached position 23 on the TOP500 list in November 2007, the highest position ever for a Swedish academic system. LIU (15) also delivers substantial computing resources and support to specific application groups, such as SMHI (13) (Swedish Meteorological and Hydrological Institute) for weather forecast and climate research. Furthermore LIU (15) has been active in previous EC framework programmes.

Tasks assigned:
Contribution to NA2, SA2, JRA2, JRA4.

BSC (16) / http://www.bsc.es
The Barcelona Supercomputing Center (BSC (16)), established in 2005, serves as the National Supercomputing Facility in Spain. The Center hosts MareNostrum, one of the most powerful supercomputer in Europe. The mission of the BSC (16) is to support research, develop and manage information technologies in order to facilitate scientific progress. The BSC (16) not only strives to become a first-class research center in supercomputing, but also in scientific fields that demand high performance computing resources such as the Life and Earth Sciences. Following this approach, the BSC (16) has brought together a critical mass of top-notch researchers, high performance computing experts and cutting-edge supercomputing technologies in order to foster multidisciplinary scientific collaboration and innovation. The BSC (16) has been particularly active in the 6th and 7th Framework Programme of the European Commission.

Tasks assigned:
Contribution to NA2 (ESM workflows, future HPC facilities); SA2, JRA2 (Port and performance to Marenostrum); JRA4 (Extend the GRIDsuperscalar).

WU (17) / http://www.dpw.wau.nl
Wageningen University & Research Centre is a cluster of internationally-leading knowledge institutions offering applied and scientific research to promote the sustainable use of our environment. Research focuses on land use, water management and environment in rural and semi-urban areas and is implemented in close collaboration with stakeholders and private and public research partners. WU (17) has a longstanding record of successfully conducting and coordinating large European projects. The Earth System Sciences and Climate Change (ESS-CC) of the Environmental Science Group of WU (17) is expert on land-atmosphere interactions, land use change and climate change and is one the leading groups on Regional scale climate studies including impacts and adaptation. Issues at large scale are studied with integrated assessment models. The group conducted and coordinated more than 20 large EU project consortia during the last 10 years (WATCH and CarboEurope are among the more recent ones).

Tasks assigned:
Contribution to JRA5 (position paper on climate data needs in support of the EU Climate Adaptation Strategy) and NA1 (dissemination to stakeholders).

INHGA (18) / http://www.inhga.ro
INHGA (18) is the national authority in hydrology, hydrogeology and water management; develops research activities and provides operational services of national and international public interest for the protection and socio-economic well-being of people; achieves the studies regarding the hydro-climatic variability of the Danube River and the Black Sea area; provides technical assistance and scientific guidance in the following areas: hydrologic forecasts, warnings of dangerous hydrologic events, hydrologic network and for the implementation of modernization programs of the national hydrological system. Also INHGA (18) has extensive experience in achieving research-development programs and projects managed and/or financed by the International Hydrological Program–UNESCO, Operational Hydrological Program–World Meteorological Organization (WMO), European Union (EU), and NATO. INHGA (18) is Romania's representative in the hydrology domain at WMO.

Tasks assigned:
Contribution to JRA5 (tasks 1, 2 and 3).

DLR (19) / http://www.dlr.de
The Deutsches Zentrum für Luft- und Raumfahrt e.V. (DLR (19)) is the German national research establishment for aeronautics, astronautics, and energy technology within the Helmholtz-Gemeinschaft der Forschungszentren (HGF). The Institut für Physik der Atmosphäre performs research in several areas that qualifies DLR (19) for the needs of the project: large-scale, meso-scale, and micro-scale modelling of atmospheric dynamics and chemistry, in situ air-borne measurements of chemical species, aerosols, and meteorological quantities, radiative transfer modelling, and processing of satellite output. The institute has many years experience in co-ordinating and participating in research projects, including many EC funded projects (e.g., SCOUT-O3, QUANTIFY, ATTICA). DLR (19) also coordinates the CCMVal project.

Tasks assigned:
DLR (19) will contribute to JRA2 focusing on the Chemistry-Climate Model Validation Activity (CCMVal).

B.2.3 Consortium as a whole

B.2.3.1 Partners

IS-ENES gathers expertise in climate and Earth system modelling, computational science and technology, and impact studies.

Climate and Earth system modelling

IS-ENES gathers the main climate and Earth System modelling groups in Europe. These groups have a long tradition of closely working together since the beginning of the European Research Framework Programmes on Environment. IS-ENES was proposed by the ENES consortium, established in 2001 as a consequence of the Euroclivar Concerted Action in the late 1990s. More recently, many of the European ESM groups are cooperating in the large FP6 Integrated Project "ENSEMBLES" project. It is coordinated by UK Meteorological Office and aims at developing the science of future climate change predictions.

The MPG (2) (MPIMET) (Germany), METOFFICE (10) (UK), CNRS-IPSL (1) (France) and MF-CNRM (12) (France) modelling groups have a long tradition in developing climate models. All have participated in the simulations for the last IPCC report.

CMCC (9) (Italy) is a new consortium on climate change. They have been working with the above mentioned groups since a long time, but have more recently started to develop an Earth system model.

CERFACS (3) plays an important role in the development of coupled models through the provision of the coupler tool OASIS. CERFACS (3) is fully integrated into the European modelling community thanks to the FP5 I3 project PRISM.

Several partners of IS-ENES are linked through formal institutional agreements:
PRISM Support Initiative, following the PRISM FP5 Project, associates several IS-ENES partners with the general goal to foster common developments and exchange of expertise. CERFACS (3), CNRS-IPSL (1), METOFFICE (10) and MPG (2) (MPIMET) are full partners of this initiative. MF-CNRM (12), SMHI (13) are associated.
CNRS-IPSL (1) and METOFFICE (10) have a common agreement to develop the NEMO platform for ocean modelling.
IS-ENES will also benefit from the COSMOS Initiative (http://cosmos.enes.org/) which is a community network gathering several partners of IS-ENES: MPG (2), FMI (5), SMHI (13), DLR (19) and KNMI (11), with the objective to develop an Earth system model based on a flexible and portable model infrastructure.

With the increasing threat of climate change, additional countries are getting involved in the development of climate models. IS-ENES is an opportunity to integrate these emerging model development groups into the main European climate modelling groups.

KNMI (11) (Netherlands) and SMHI (13) (Sweden) have both been active in climate model application for a long time. In IS-ENES, they represent a new European initiative called "EC-Earth". EC-Earth was founded by a consortium of national weather services and universities from 11 EU countries. They are developing an Earth system model based on the ECMWF weather prediction model. KNMI (11) and SMHI (13) will link the EC-Earth consortium and the whole ENES consortium. This collaboration will continue the long tradition of collaboration with KNMI (11), who was a co-leader with MPG (2) (MPIMET) of the Euroclivar Concerted Action and the PRISM project.

IS-ENES is also an opportunity to integrate groups intending to start using and possibly later assembling climate and Earth system models. The project will help these groups to aggregate knowledge about the European ESMs, before building their own version of an ESM. This is the case for AA (7) and BSC (16). They will help the IS-ENES consortium to test the usefulness and usability of the v.E.R.C. for new users.

Most of the modelling groups are either included in IS-ENES or represented through the link with EC-Earth, or COSMOS. The few others that may have been omitted (like Norway) are partners of the ENES Consortium and will be invited to participate in workshops, in particular to prepare the future ENES strategy.

Computational Science and Technology

The second objective of IS-ENES is to foster high-end simulations. This objective requires interaction with the community working in computational science and technology.

IS-ENES project benefits from the PRISM initiative, which has already established interactions between computing experts and scientists within the main modelling groups and also between these groups and experts at CERFACS (3) and UNIMAN (6). This interaction has already been successful, mainly with respect to the software development of the OASIS coupler.

IS-ENES also gathers experts from supercomputing centres. Two national supercomputing centres dedicated to climate research issues are involved: DKRZ (4) (Germany) and CMCC (9) (Italy). This expertise will be complemented by knowledgeable staff from more general purpose centres having a strong interest in climate research: BSC (16) (Spain), LIU (15) (Sweden). BSC (16) is involved in DEISA and will help to integrate the ENES community into DEISA. It will also help disseminate tools to the ENES community. BSC (16) is also member of the PRACE project. It is also expected that Sub-contractor 1 will bring an additional link with DEISA and/or PRACE.

Impact Community

The third objective of IS-ENES is to help develop the interface with the impact community and disseminate results from the climate modelling community to users. It is clearly beyond the scope of IS-ENES to include many partners from the impact community. However, IS-ENES gathers complementary expertise in order to help develop a prototype for climate services (WP11).

The modelling groups themselves can provide an interface to the impact community due to their experience within national programs. Netherlands in particular has for long developed research on the impacts of climate change. WU (17) will complement KNMI (11) to provide a good expertise on this respect. CMCC (9) coordinates the European project CIRCE “Climate change and Impact Research: the Mediterranean Environment” (http://www.circeproject.eu/) which has just begun in 2007 and will be a good link to the community concerned by the Mediterranean region.

In order to better cover the European different climate types and help integrate the new European eastern countries, INHGA (18) from Romania has been included as partner of the project. INHGA (18) is indeed a member of the ENES Consortium and works with the ENES community within the IP ENSEMBLES project. INHGA (18) will bring their expertise in hydrology and will ensure the link with the CECILIA “Central and Eastern Europe Climate Change Impact and Assessment Vulnerability” FP6 project (http://www.cecilia-eu.org/).

The service on data dissemination will rely on the long experience of MPG (M&D) (2) (Germany) and STFC (8) (UK) in providing model results for a wide range of users in the context of IPCC assessments.

B.2.3.2 Sub-contracting

Subcontracting will only concern a limited part of the work carried out in the Project. The subcontractors will be identified during the project, according to the principles of best value for money, transparency and equal treatment. They will bring additional specific experience in activities that the Consortium will have difficulties to manage.

Sub-contractor 1 for NA2

Expertise is requested to design the unified HPC environment, to structure ESM targeted HPC-services in a consistent architectural framework, and to implement, to test and to support such services. Expertise in DEISA is recommended in order to benefit from on-going developments to unify access to different European computing centers.
The responsibility of sub-contractor 1 is given to CMCC (9).

Sub-contractor 2 for JRA2

Expertise and resources are required to access CRAY computers in order to complement the types of architectures available from the partners of IS-ENES. The sub-contractor will evaluate the performance of some of the IS-ENES ESMs on this type of architecture (JRA2). Experience in running one of the ESM of the 6 IS-ENES models is required. Participation to the DEISA or PRACE consortia is strongly recommended.
The responsibility of sub-contractor 2 is given to FMI (5) according to their experience to run the COSMOS model on a CRAY platform.

B.2.3.3 Third-parties (others than sub-contractors)

CEA and UVSQ, third parties from CNRS-IPSL (1)

Two third-parties are associated with CNRS-IPSL (1): Commissariat à l'Energie Atomique (CEA) and Université Versailles Saint Quentin en Yvelines (UVSQ) that are linked by special clause 10 of the Grant Agreement as they are partners of a joined research unit, IPSL.
CEA will contribute to JRA1, JRA3 and JRA5 through the involvement of permanent staff.
UVSQ will contribute to service access cost of SA1 through the involvement of permanent staff.

CIRA, third party from CMCC (9)

CIRA, the Italian Aerospace Research Center, is third party associated with CMCC. CIRA is one of the CMCC shareholders so it is linked by special clause 10 of the Grant Agreement.

CIRA will contribute to JRA2 and JRA5 through the involvement of permanent staff.

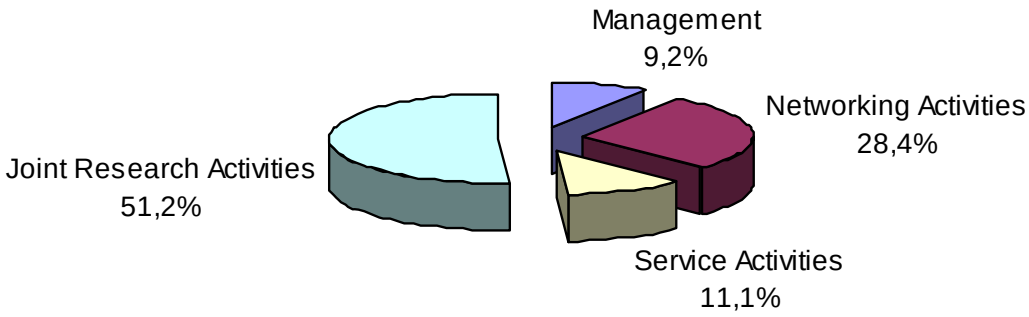
B.2.3.4 Associated partners

IS-ENES will collaborate with groups outside the IS-ENES consortium. In particular, IS-ENES plans to associate PCMDI (USA) in order to help fulfil international standards and assure compatibility between software developed in Europe and under separate funding in the USA.

PCMDI (USA) http://www-pcmdi.llnl.gov
The Program for Climate Model diagnosis and Intercomparison (PCMDI), located at Lawrence Livermore National Laboratory in the U.S.A. plays a key role at the international level in the development of tools and methods for the evaluation of Earth system/climate models. They also have the responsibility to support modelling studies for IPCC assessments under the World Climate Research Program Working Group on Coupled Models (WGCM). Their association will ensure that IS-ENES will contribute to the international effort in Earth system/climate modelling.

B.2.4 Resources to be committed

Distribution of the total EU funding requested for IS-ENES: **7 591 850, 55 €** for Management, NA, SA and JRA. The figure shows the percentage for each type of activity. As is displayed in the breakdown table below, most of the budget is allocated to personal costs except in NA, where 24% is devoted to workshops and training.



Subcontracting will only concern a limited amount of the total requested EU funding, i.e., about **2.2%** of the total amount.

Description by work package

WP1/Management
The personnel resources cover the costs associated to the Management team: the Coordinator, the European Project Manager and the Technical coordinator. Funding also covers costs for the General Assembly meetings (except travel costs and lodging for the partners included in their own budget) and travel for the Advisory Board. Provision for General Assembly meetings will allow to invite some members of the ENES consortium that are not partners of IS-ENES in order to help integration of the European scientific community. Management funding also includes a provision for audit costs of the partners and funds for collaboration with groups outside the IS-ENES consortium, including collaboration outside Europe.

WP2/NA1
The Strategy work package funding is mainly planned for workshops, working groups and training school. It also includes funds for dissemination of IS-ENES results in particular to policy makers. As for WP1, provision for workshops will allow to invite some members of the ENES community to join the IS-ENES consortium to prepare the ENES future strategy. Task includes a provision of 40 k€ to invite about 20 to 25 non IS-ENES partner scientists.

WP3/NA2
A joint and coordinated effort of groups having experience in set up and support of ESMs, HPC-centres and groups having excellent expertise in grid technology will achieve the goals of NA2. The majority of funding will be used to employ software engineers in these institutions. Additionally some money will be used for Subcontractor 1. All of the participating computing centres will implement at least a subset of the reference workflows defined in this WP and will provide a limited amount of computing time for test and demonstration runs. DKRZ (4) will host the IS-ENES portal; operational costs such as web-server administration, hardware and maintenance will not be charged to the project. Furthermore, DKRZ (4) will transfer implemented components of the unified v.E.R.C. environment into its standard portfolio and will provide related support through its established support group to all users in a sustainable way.

WP4/NA3
The major part of this budget covers personnel costs. Tasks T0 and T1 will be achieved by permanent scientists and engineers mastering the details of the ESMs. Task T2 will partly be done by research engineers hired for the project and partly by engineers or scientists with a permanent position in the different partner organisations.

WP5/SA1
The implementation adds new functionality to already existing infrastructure of the partners. In this way a good support service level can be achieved at moderate costs. The operating costs can therefore be fulfilled by the stated very modest manpower expenses.

WP6/SA2
The implementation and test operation of the ENES ESM Data Network will be built on existing data archive and network implementations as described in the work package. The majority of the WP cost is in staff time, including management and software engineering. For coordination with JRA4, 4 joint workshops are planned. The costs are in addition to the travel budget.

WP7/JRA1 and WP8/JRA2
The majority of funding will be used to employ researchers and software engineers in the institutions of the project partners. There is also funding for subcontractor 2, as justified in the subcontractor section of the project. Many of the partners have supercomputing resources which will be used for development and testing, without charge to the project. The supercomputing centre BSC (16) intends to also provide access to performance monitoring and analysis tools, and expertise in their use.

WP9/JRA3
Resources in JRA3 will be used primarily for salary support for the scientists that will collect the modelling and observational information and will create the evaluation toolkit. Part of the resources will be used to organize a large international workshop at the end of year one: It will examine synergies and differences between model intercomparison projects. Another part will go into the organization of annual meetings in years 2 and 3 of the project. The implementation of the WP will build on considerable resources accumulated in the different intercomparison projects mentioned in the WP description and available at the partner institutes.

WP10/JRA4
The majority of the WP cost is in staff time, including management and software engineers. In addition there will be 4 workshops to be held jointly with SA2. Two will be hosted by SA2 and two by JRA4. The costs will be met out of the travel budget.

WP11/JRA5
Use Cases constitute a major activity of the project with roughly 90 out of the 184 pm of the WP. This includes the user consultation leading to the selection of Use Cases as well as the design and development of the prototype e-impact-portal. The relatively important travel budget of several partners is strongly linked to Task 1 and to the user consultation and dialog. The coordinator, CERFACS (3), demand includes computing equipment (20 k€) necessary to set up the e-impact-portal (server + storage space).

Breakdown of budget per beneficiary

			1	2	3	4	5	6	7	8	9	10	11	12	13	15	16	17	18	19
WPG's / PARTNERS		TOTAL	CNRS-IPSL	MPG	CERFACS	DKRZ	FMI	UNIMAN	AA	STFC	CMCC	MET OFFICE	KNMI	MF-CNRM	SMHI	LIU	BSC	WU	INHGA	DLR
	Personnel costs	227,4	206,2	21,2																
	Kick Off & GA	*70,0*	*70,0*																	
	Travel Costs	*30,0*	*15,0*	*15,0*																
	Board Meetings	*30,0*	*30,0*																	
	PCMDI	*40,0*	*40,0*																	
	Audit	*20,0*	*20,0*																	
	Other direct costs	190,0	175,0	15,0																
WP1	Indirect costs	283,1	228,7	54,4																
Management	**EU FUNDING**	**700,5**	**610,0**	**90,6**																
	Personnel costs	217,8	48,6	74,3	9,0				9,0		36,0	20,1						20,9		
	Travels	*6,5*			*4,5*				*2,0*											
	Workshops Tasks 1, 3, 4	*180,0*		*60,0*							*40,0*							*80,0*		
	Summer school	*70,0*		*70,0*																
	Dissemination	*30,0*	*30,0*																	
	Other direct costs	286,5	30,0	130,0	4,5				2,0		40,0	0,0						80,0		
	Indirect costs	35,3	5,5	14,3	0,9				0,8		5,3	1,4						7,1		
WP2	**EU FUNDING**	**539,7**	**84,1**	**218,6**	**14,4**				**11,8**		**81,3**	**21,5**						**107,9**		
	Personnel costs	676,0		90,3	13,5	281,4	57,6				191,6					22,8	19,0			
	Other direct costs (travel)	32,8		4,0		12,7	3,0				10,0					0,5	2,6			
	Indirect costs	49,6		6,6	0,9	20,6	4,2				14,1					1,6	1,5			
	Subcontractor	60,0									60,0									
WP3	**EU FUNDING**	**818,4**		**100,9**	**14,4**	**314,6**	**64,8**				**275,7**					**24,9**	**23,1**			
	Personnel costs	679,8	217,5	116,6	233,9						20,0	31,1	18,4	24,6	17,7					
	Other direct costs	70,0	29,0	5,0	29,0						2,0	2,0	1,0	1,0	1,0					
	Indirect costs	52,5	17,3	8,5	18,4						1,5	2,3	1,4	1,8	1,3					
WP4	**EU FUNDING**	**802,3**	**263,8**	**130,1**	**281,3**						**23,5**	**35,4**	**20,8**	**27,4**	**20,0**					
	Personnel costs	1573,7	266,1	281,1	256,4	281,4	57,6		9,0		247,6	51,2	18,4	24,6	17,7	22,8	19,0	20,9		
	Other direct costs	389,3	59,0	139,0	33,5	12,7	3,0		2,0		52,0	2,0	1,0	1,0	1,0	0,5	2,6	80,0		
	Indirect costs	137,4	22,8	29,4	20,3	20,6	4,2		0,8		21,0	3,7	1,4	1,8	1,3	1,6	1,5	7,1		
	Subcontract	60,0									60,0									
Coordination	**EU FUNDING**	**2160,4**	**347,9**	**449,5**	**310,2**	**314,6**	**64,8**		**11,8**		**380,6**	**57,0**	**20,8**	**27,4**	**20,0**	**24,9**	**23,1**	**107,9**		
	Access costs	239,1	78,0	45,4	11,4	68,7	35,7													
	Other direct costs	12,5				2,5	10,0													
	Travels indirect costs	0,9				0,2	0,7													
WP5	**EU FUNDING**	**252,5**	**78,0**	**45,4**	**11,4**	**71,4**	**46,4**													
	Access Costs	544,0	56,4	242,2						91,2						97,3	56,9			
	Other direct costs	43,9	2,5	27,5						6,3						5,0	2,6			
	Travels indirect Costs	3,1	0,2	1,9						0,4						0,4	0,2			
WP6	**EU FUNDING**	**591,0**	**59,1**	**271,6**						**98,0**						**102,6**	**59,6**			
	Access Costs	783,1	134,4	287,6	11,4	68,7	35,7			91,2						97,3	56,9			
	Other direct costs	56,4	2,5	27,5		2,5	10,0			6,3						5,0	2,6			
	Indirect costs	3,9	0,2	1,9		0,2	0,7			0,4						0,4	0,2			
Service	**EU FUNDING**	**843,4**	**137,1**	**317,0**	**11,4**	**71,4**	**46,4**			**98,0**						**102,6**	**59,6**			
	Personnel costs	504,7	65,6		99,0	249,5		32,4				58,1								
	Other direct costs	30,7	2,0		4,0	6,7		8,0				10,0								
	Indirect costs	324,5	40,6		75,2	153,7		24,3				30,7								
	TOTAL BUDGET	859,8	108,2		178,2	409,9		64,7				98,8								
WP7	**EU FUNDING**	**575,6**	**81,2**		**89,1**	**307,4**		**48,5**				**49,4**								
	Personnel costs	588,3	16,0	10,6	63,0			194,6			90,0	48,3			44,2	91,0	30,4			
	Other direct costs	49,6	2,0	1,0	4,0			12,0			14,0	5,0			3,0	6,0	2,6			
	Indirect costs	421,1	10,8	17,4	48,9			124,0			62,4	27,0			44,2	58,2	28,1			
	Sub-contractor 1	109,9					109,9													
	TOTAL BUDGET	1168,8	28,9	29,0	115,9		109,9	330,6			166,4	80,4			91,5	155,2	61,1			
WP8	**EU FUNDING**	**827,5**	**21,6**	**21,8**	**58,0**		**82,4**	**248,0**			**124,8**	**40,2**			**68,6**	**116,4**	**45,8**			
	Personnel costs	491,5	119,8	63,7			18,4		162,0						47,2					80,4
	Other direct costs	40,0	3,0	4,0			4,0		18,0						6,0					5,0
	Indirect costs	306,6	73,7	101,6			20,4		12,6						47,2					51,2
	TOTAL BUDGET	838,1	196,4	169,3			42,8		192,6						100,4					136,6
WP9	**EU FUNDING**	**628,6**	**147,3**	**127,0**			**32,1**		**144,5**						**75,3**					**102,5**
	Personnel costs	552,4	75,8	79,6			13,4			214,5	40,0					75,8	53,2			
	Other direct costs	51,2	12,0	8,0			2,0			14,0	2,0					6,0	7,2			
	Indirect costs	549,0	52,7	131,5			14,0			225,2	25,2					49,1	51,3			
	TOTAL BUDGET	1152,6	140,4	219,1			29,4			453,8	67,2					130,9	111,7			
WP10	**EU FUNDING**	**864,4**	**105,3**	**164,3**			**22,0**			**340,3**	**50,4**					**98,2**	**83,8**			
	Personnel costs	762,1	107,8		192,0						40,0		148,5	24,6	64,9			104,3	80,0	
	Other direct costs	88,5	10,0		30,0						4,0		14,5		6,5			10,0	13,5	
	Indirect costs	595,2	70,7		162,1						26,4		174,4	5,7	64,9			84,5	6,5	
	TOTAL BUDGET	1449,8	188,4		384,1						70,4		337,4	34,3	136,3			198,9	100,0	
WP11	**EU FUNDING**	**991,3**	**141,3**		**192,0**						**52,8**		**253,1**	**25,7**	**102,2**			**149,1**	**75,0**	
	Personnel costs	2898,9	385,0	154,0	354,0	249,5	31,8	227,1	162,0	214,5	170,0	106,4	148,5	24,6	156,3	166,9	83,6	104,3	80,0	80,4
	Other direct costs	264,0	29,0	13,0	38,0	6,7	6,0	20,0	18,0	14,0	20,0	15,0	14,5	4,0	15,5	12,0	9,8	10,0	13,5	5,0
	Indirect costs	2196,3	248,4	250,4	286,2	153,7	34,4	148,2	12,6	225,2	114,0	57,7	174,4	5,7	156,3	107,3	79,4	84,5	6,5	51,2
	Subcontractors	109,9					109,9													
	TOTAL BUDGET	5469,1	662,4	417,4	678,2	409,9	182,0	395,3	192,6	453,8	304,0	179,2	337,4	34,3	328,2	286,2	172,8	198,9	100,0	136,6
RTD	**EU FUNDING**	**3887,5**	**496,8**	**313,1**	**339,1**	**307,4**	**136,5**	**296,5**	**144,5**	**340,3**	**228,0**	**89,6**	**253,1**	**25,7**	**246,1**	**214,6**	**129,6**	**149,1**	**75,0**	**102,5**
	GRAND TOTAL	**7591,9**	**1591,7**	**1170,2**	**660,6**	**693,4**	**247,7**	**296,5**	**156,2**	**438,3**	**608,6**	**146,5**	**273,8**	**53,1**	**266,1**	**342,2**	**212,3**	**257,1**	**75,0**	**102,5**

B3. Potential impact

B.3.1 Strategic impact

B.3.1.1 Impact on the Earth system modelling community in Europe

Through IS-ENES, the Earth system modelling community in Europe will, for the first time, establish a comprehensive e-infrastructure providing an easy-to-use and centralized access to the different (possibly distributed) resources needed for Earth system modelling. This virtual Earth system modelling Resource Centre (v.E.R.C.) will cover 4 important dimensions of the required infrastructure: The ENES community, Earth system models and their associated software tools, High-Performance Computing (HPC) platforms, and ESM data archives. Thereby, IS-ENES will foster the integration the European Earth system modelling community, will improve its infrastructure, and will thus ensure that Europe remains at the forefront of the advancement of climate and Earth system modelling. IS-ENES will naturally benefit from the establishment of the ENES Consortium in 2001 (see 1.2) and from the experience gained through previous EC funded projects.

IS-ENES will lead to the establishment of a common future ENES strategy for science and HPC

IS-ENES will lead, through NA1, the effort toward the definition of a common Earth system modelling strategy in Europe, and its implementation. This will force the scientific community - to define main priorities, - to explore possibilities to share (parts of) the work, and – to complement national strategies by a European dimension. The IS-ENES foresight exercise will come in time to respond to the increasing pressure due to the involvement of countries new to climate change issues at the European level.

Another important aspect of NA1 is the preparation of a common strategy with regards to the European HPC ecosystem. This effort will ensure that specific computing needs of the Earth system modelling community are taken into account in European HPC initiatives such as PRACE, and that IS-ENES is well integrated with those initiatives. This is absolutely crucial for Earth system modelling as the amount of HPC resources available determines the range and complexity of problems that can be addressed by the scientists.

IS-ENES will optimise the visibility and accessibility of European Earth system modelling resources by suitable services

IS-ENES will use ICT technologies to establish in NA2 a virtual Earth system modelling Resource Centre (v.E.R.C.). The establishment of the v.E.R.C. will be a crucial step to enhance accessibility and visibility of the Earth system modelling resources (already existing or developed during the project) in Europe.

In particular, the standard model documentation available via the v.E.R.C. will strongly strengthen the visibility of European ESMs. Currently, European ESM documentation tends to be under-developed compared to US models. This means that new European users may be tempted to implement US rather than European models. The documentation of European ESMs developed in NA3, based on METAFOR standards, will allow potential users to better understand the diversity and complexity of European ESMs, thereby re-establishing the balance between European and US ESMs. Moreover, this standard documentation will ease model intercomparison, a key element for addressing climate projection uncertainties. The access to European ESM documentation will be established as a service in SA1 after 2 years, ensuring that the documentation is freely and widely available through the Internet for the benefit of the community of European and world-wide researchers.

Another service offered by SA1 is the v.E.R.C. helpdesk that will provide guidance on where to find appropriate help among the IS-ENES partners for specific requests regarding Earth system modelling; this helpdesk will ensure that the climate modelling community as a whole effectively benefits from the ESM expertise of the IS-ENES network. Through the v.E.R.C., IS-ENES will also ensure that adequate

information about download and use of European common tools and components (for example OASIS, CDO and NEMO) is available and maintained up-to-date. This genuine service activity offered for the first time on OASIS, CDO and NEMO will give even more visibility to those tools and component and will help their even wider diffusion for the benefit of the community. In fact, it is well known that the use of common standards and tools reduces the technical development efforts of each individual research team.

Visibility on the European ESMs will be also re-enforced by the ESM evaluation infrastructure developed in JRA3. The JRA3 evaluation infrastructure will help to better understand the validity and limitations of ESMs, thereby enhancing their global relevance and increasing the level of trust and confidence in the ESM results.

IS-ENES will increase collaboration and exchange among researchers and engineers

An important impact of IS-ENES networking activities (especially NA1 training school, NA2 v.E.R.C. portal set-up) will be to foster a culture of collaboration among European researchers and engineers. The training school will attract young people to Earth system modelling. It will help the next generation of researchers to naturally exchange on the science around ESMs - even more so when researchers very early in their education start to they are used from very early on in their education to share their knowledge and experience through the v.E.R.C., and become used to this type of cooperation. From a technical point of view, activities within IS-ENES will allow Earth system model developers to share their technical expertise and gradually lead them, following the PRISM approach, to share the development, maintenance and support of Earth system modelling software tools.

IS-ENES will optimise the development of ESMs

The project will foster joint technical developments of ESMs needed to address the scientific challenges raised by climate change to humankind today. In particular, IS-ENES JRA1 will ensure common development of software used to couple the different components of European ESMs, and evaluate jointly techniques to achieve higher performance for parallel I/O. Enhanced efficiency in ESM development will also arise from the use of common tools and components as promoted in NA3. This structuring effect of IS-ENES at the European level, first recommended by Euroclivar, is essential to optimise the development of ESMs; in fact, because of the complexity of climate system, no single research group can pretend today to adequately model the climate by relying on its own resources only. This optimisation in the use of technical resources will reduce the heavy technical burden arising from the increasing complexity of both Earth system models and HPC architectures. It will make the different research groups more efficient in their research, thereby encouraging model diversity, a key element to address uncertainties in climate projections.

IS-ENES will facilitate the access to and optimised use of HPC resources

Access to world-class supercomputing facilities is recognised as an important objective for European scientific research. This was emphasized by the ESFRI 2006 roadmap and the launch of the preparatory phase of the PRACE initiative (2008). The DEISA2 European initiative is also a way to optimise, and to integrate the European supercomputing facilities into a common HPC-ecosystem. The ESM community is recognized as one of the more important target communities of the DEISA and PRACE infrastructures. NA2 will propose a unified HPC environment, thereby improving the integration of IS-ENES into the European HPC-ecosystem. Preparing for supercomputers on the scales of petaflops and beyond needs improvement in model performance, scalability and I/O efficiency; this will be addressed in NA1 and JRA2.

IS-ENES will foster the interaction between ESM and e-technologies communities

IS-ENES will further facilitate the integration between climate scientists and e-technology scientists. This will favour the emergence of “communities of practice” between these communities. The dissemination of developments achieved in DEISA and EGEE, the practical training on grid-technology as proposed in NA2 will cover this aspect.

IS-ENES will optimise use and dissemination of climate data

The SA2 services on model data will be based on the existing IPCC Data Distribution Centre operated in Europe by STFC (8) (BADC) and MPG (2) (M&D). IS-ENES will expand this service during the course of the project to a more widely distributed data archive allowing a more integrated, but also larger facility. IS-ENES will also enhance the use of a common standard for metadata, as developed by the METAFOR project, which will further ease the dissemination of European results to a wide community. Therefore, complementing the data discovery aspect of the METAFOR project, the innovations realised in IS-ENES JRA4 and JRA5 and the services offered in SA2 completely responds to the INSPIRE directive involving the provision of network services that enable View Services, Download Services, and Transformation Services.

IS-ENES will optimise the consistency of actions between "Capacities" and "Cooperation" programs

Climate change is one of the main political priorities of the Commission. IS-ENES results from the collaboration that has been fostered by the various EC framework programs on climate change, among which the FP5 Concerted Action "Euroclivar" and the on-going large IP "ENSEMBLES".

IS-ENES includes several partners also working in the ENSEMBLES (2003-2009) large IP project. Even though the tools developed by IS-ENES will be available only after the end of ENSEMBLES, this interaction will ensure that the infrastructure set and developed within IS-ENES will feed the needs of following projects dealing with climate change issues similar to ENSEMBLES. As an example, the development of tools in JRA4 to improve and ease data access was felt as an important need by the modelling community involved in ENSEMBLES. Similarly, the documentation of European models that will be accessible after 2 years in SA1 will be very useful for all the European projects dealing with the use of model results and climate change impact studies, e.g. the CECILIA and CIRCE projects.

The development of ESMs is beyond the scope of IS-ENES, which focuses on the infrastructure aspect of the model developments. IS-ENES however will complement and give tools to the "COMBINE" project lead by the ENES community under negotiation within the Environment program on the introduction of new Earth system model components for climate change studies.

Moreover, IS-ENES will provide a support to the infrastructure needed to prepare the next IPCC assessment report. This objective is clearly one major priority for the ESM community. It is strongly supported by the Environment Program in order to sustain the European contribution to the UN Framework Convention on Climate Change.

B.3.1.2 Impact on the regional climate modelling community

IS-ENES will serve a much larger community than global climate modellers. Researchers involved in regional climate modelling are a more dispersed community but have a strong interaction with global climate modellers. Model results produced by global climate models are indeed used as boundary and forcing data for regional climate models that are used to predict future climate change at a regional scale. Some of the regional climate modelling groups are either in the same institutions as the IS-ENES partners or in the ENES consortium, some others are participating in the ENSEMBLES and EU impact projects. IS-ENES services will also address this community since their tools and models are generally derived from global models and since they are users of climate model results. JRA4 in particular will ensure that European Data Centres are in a position to meet the technical requirements and provide additional support for modelling groups which intend to exceed the AR5 requirements by, for instance, providing sufficient data to drive regional models for downscaling experiments.

B.3.1.3 Impact on the climate change impact community

Hitherto, the climate and Earth system modelling community was mainly involved in the IPCC Working Group (WG) I providing the basic simulations for future climate change. Studies on the impacts of climate change on ecosystems, water resources, or food, developed by the IPCC WG II rely on the projections produced by WG I. Similarly, studies on mitigation and adaptation policies developed by the IPCC WG III also rely on WG I results. WG II and WG III therefore imply various different scientific disciplines that need to have access to ESM results and to better understand the relevance and limitations of those data.

IS-ENES will bring an essential contribution to cover these needs of the impact community by offering a unified and easier access to the federation of geographically distributed archives of ESM results (in SA2 based on JRA4 developments) and by providing standard ESM documentation and information on ESM validity and limitations (following JRA3 ESM evaluation techniques) through the v.E.R.C. portal (SA1). Furthermore, IS-ENES will address, with JRA5 prototype web-service interface specific to the impact community, one of the most commonly expressed weaknesses in European climate change impact studies: this web-service interface will provide easy methodology and workflow as well as some common tools and guidance to perform the climate to impact mapping chain, thereby bridging the gap between the climate data providers and a wide range of users in a very systematic and interactive way.

B.3.1.4 Impact on society

It is crucial to foster the *development of Earth System Models* and *high-end climate simulations* to better investigate future climate change, the impact of model spatial resolution on climate change characteristics e.g. climate extremes, the impact of various processes on climate change, and the role of feedbacks and related uncertainties (e.g. permafrost or Greenland melting). IS-ENES actions will therefore ensure that the European community remains at the forefront of climate change science and that Europe keeps its best expertise in international negotiations on climate change. *Fostering the interface with the impact community* and thereby with policy makers, stakeholders and the public in general, is also essential to raise awareness on climate change and prepare for adaptation. The actual Use Case results of JRA5, such as for water resources, which may include specific vulnerability maps, ranges of likelihood of large catchment discharge, extreme worst case (drought/flood) hydrology scenarios, or adaptation scenarios, will form an important knowledge basis for policy and management of the considered systems. The stakeholder consultation and dialogue will also allow IS-ENES to produce scientific methodologies and data that are scientifically credible, legitimate in the eyes of stakeholders, and relevant, thereby creating a common understanding of the issues in question, and forming the basis for sustainable development and locally-adapted policies. *Fostering the integration of the scientific community* will further help all these objectives and will enable more European countries to get expertise on the climate change issue.

B.3.1.5 European Level Added Value

Member states remain central in the development and financing of the ESM infrastructure and integration is in general well developed at the national level. Establishing IS-ENES will ensure a stronger integration and efficiency of model developments. It will stimulate coordinated developments. The gathering under a common consortium of experts from 10 countries will take advantage of complementarities in competence and of the diversity of perspectives from their different scientific and cultural backgrounds. Such collaboration will increase the knowledge transfer and the cohesion of scientific and technical development between different regions in Europe. Impact of IS-ENES will go beyond the partners of this consortium thanks to the ENES Consortium involving more than 40 institutions in Europe (http://www.enes.org). Moreover, as mentioned above, IS-ENES will help Europe to keep its climate modelling research at the forefront of science. This will be essential to keep Europe its best expertise on the political issue of climate change.

IS-ENES will strengthen the European research on climate at the international level and will therefore bring a substantial contribution to the international programmes on climate change WCRP and IGBP.

B.3.2 Plan for the use and dissemination of foreground

Dissemination of IS-ENES results is a central focus of its activities. Indeed the v.E.R.C. web portal is devoted to give public access to the results from IS-ENES. It will gather the results from several work packages and make them accessible through the SA1 and SA2 service activities. This will be complemented by dissemination of on-going activities of through IS-ENES web site.

IS-ENES proposes to go beyond in NA1 Task 4, by disseminating position papers from the work done in NAs and JRAs to advice decision and policy makers on key issues related to climate research.

No dissemination of knowledge generated by IS-ENES may take place without consent of the Executive Board. Each work package leader will be responsible for fast and thorough transfer of scientific knowledge and results to the Coordinator and appropriate partners.

All the developments done in IS-ENES aim to be Public Access. Restricted access among partners will be limited to development phases and networking activities. Networking activities will whenever possible be open to the ENES Consortium and EC programme participants. All the tools developed or enhanced in IS-ENES (coupling, I/O, etc.) will a priori be available with the LGPL licensing system allowing any development to be used freely by the research community. Specific commercial agreements will be put in place if required but are not expected at this stage. IS-ENES v.E.R.C. does not aim at delivering ESM sources directly but only information and expertise about ESMs. If after receiving appropriate information and training on a specific ESM, a user from the community wants to obtain the ESM sources, he/she will have to ask directly the ESM developer and follow licensing procedure in place at the developer site.

The management of intellectual property generated within IS-ENES will be regulated by the Consortium Agreement. All partners have agreed to establish a comprehensive Consortium Agreement overseeing the structure, function, and management of the Project that will be signed by all partners before the Grant Agreement is signed.

B4. Consideration of gender aspects

The gender balance in the IS-ENES project involves about **25% of women in the leadership team.** This is a good score when compared to the overall balance for the partners which shows a proportion of **only 18%** among the 74 participants to the project.

IS-ENES will contribute to the EU recommendation to promote the basic principle of equality between women and men. Gender issues will be considered and promoted in every work package of the Project. The IS-ENES Gender Action Plan will:

- Encourage the recruitment of women at equal scientific or technical merit, especially in the fields of computational science. All job announcements will encourage women to apply by including a statement that demonstrates an “equal opportunities policy”.
- Help the participation of women by developing e-conference tools to limit travel, which is more difficult for women and men with young children. Organize child care at meetings and conferences upon request
- Create a good working environment by encouraging working-time flexibility
- Raise awareness in the Consortium due to the involvement of women in the leadership team, through workshops and training.
- Communicate within the consortium/user communities regarding current EU gender legislation.
- Advertise on gender equality on the project website: links to relevant European web pages, highlighting FP6 initiatives

These initiatives will be monitored by the Management Team and the Executive Board.

Appendix

Appendix 1 List of Earth System Models involved in IS-ENES

ARPEGE-NEMO: ARPEGE-NEMO coupled with OASIS is the atmosphere-ocean core of the ESM developed at MF-CNRM (12) that includes also components such as sea ice, continental surfaces, land hydrology and chemistry with a specific treatment for ozone evolution. The atmospheric component, ARPEGE, is a specific version of the French weather forecast model developed in collaboration between ECMWF and MF-CNRM (12), adapted for climate simulations. ARPEGE is available for the scientific community with an exclusive aim of research, within the framework of the "Community Climate Model" project. ARPEGE coupling to the ocean component NEMO and the realisation of decadal to centennial simulation of the Earth climate is done in collaboration with CERFACS (3).

C-ESM: The physical core model of CMCC (9) ESM is a newly coupled atmosphere ocean general circulation model, composed of ECHAM5 atmosphere, NEMO for ocean, and LIM for sea-ice models. The OASIS coupler is used to exchange the relevant fields. The carbon cycle module includes the SILVA terrestrial vegetation model and the PELAGOS marine biogeochemistry model. The next configuration of C-ESM will include dynamical and chemical stratospheric processes within the current physical core. The extension of the carbon cycle to include nitrogen limitation is also a research topic under our consideration.

COSMOS (see http://cosmos.enes.org) is a community effort towards the development of a full Earth System Model. The current developers are MPG (2) (MPIMET), MPI-CH, MPI-BGC and FMI (5). The COSMOSv1 package integrates in a flexible and modular way models for the circulation of the atmosphere (ECHAM5), the ocean and sea ice (MPIOM), and optionally includes processes for aerosols (HAM), dynamical land vegetation (JSBACH), and marine biogeochemistry (HAMOCC), which are coupled by OASIS. The integration of atmospheric chemistry will lead to the next generation COSMOSv2. More than 40 different research groups around the world currently use the COSMOSv1 package.

EC-Earth (see http://ecearth.knmi.nl) is developed by the EC-Earth consortium, gathering a number of national weather services and universities from currently 11 countries in Europe. EC-Earth component models are IFS for the atmosphere, NEMO for the ocean, and LIM for the sea-ice, coupled through OASIS. More components and plans for incorporation are under development. EC-Earth current users include KNMI (11) (The Netherland), SMHI (13) (Sweden), MetÉireann (Ireland), DMI (Denmark), Meteorologisk Institutt (Norway), and ETH Zurich (Switzerland).

HadGEM3 from the METOFFICE (10)/Hadley Centre is currently under development but is intended to be ready for the next IPCC assessment report. Its main components are METOFFICE (10) Unified Model atmosphere coupled to the NEMO ocean model and CICE sea ice model. Other components include the JULES land-surface scheme and the UKCA chemistry model which are being developed in collaboration with the UK academic community. The main model components will be coupled using the OASIS4 coupler. In addition, coupling to a comprehensive diagnostic post-processor will be implemented through the METOFFICE (10) FLUME system.

IPSLCM, developed by CNRS-IPSL (1), includes 5 component models representing the Earth System climate and its carbon cycle: LMDz (atmosphere), NEMO (ocean and oceanic biogeochemistry), LIM (sea-ice), ORCHIDEE (continental surfaces and vegetation), and INCA (atmospheric chemistry), coupled through OASIS. IPSL modelling system also includes an I/O library, a compiling environment, an execution environment and a set of post-processing tools. IPSLCM, available in different configurations at different resolutions, is in permanent evolution to reflect state-of-the-art numerical climate science. 80 IPSLCM users are registered in IPSL and associates laboratories while about 200 persons use one or more components separately. IPSLCM is used in about 50 European projects and more than 550 projects access its IPCC result database.

Appendix 2: Acronyms & glossary

AI: Authentication and Authorization Infrastructure: A service allowing access to restricted information in distributed centres based on permissions of the user kept in a database distributed amongst these centres
AEROCOM: (http://nansen.ipsl.jussieu.fr/AEROCOM/) Aerosol Comparisons between Observations and Models -International project devoted to evaluate the aerosol component of ESMs.
AOMIP: (http://efdl.cims.nyu.edu/projectaomip/overview.html)Arctic Ocean Model Inter-comparison Project,
ARn: Assesment report number n – see **IPCC**
BFG: Bespoke Framework Generator (http://intranet.cs.man.ac.uk/cnc/projects/bfg.php) - a prototype technology supporting the flexible and rapid coupling of model components at a relatively high level, independent of specific coupling technology. Developed at the University of Manchester,
C4MIP: Coupled Climate-Carbon Cycle Model Inter-comparison Project (http://c4mip.lsce.ipsl.fr/) - International project devoted to run and evaluate coupled climate-carbon models as part of ESMs.
CCMVal: Chemistry-Climate Model Validation Activity (http://www.pa.op.dlr.de/CCMVal/) - International project devoted to evaluate the chemistry component of ESMs.
CDO: Climate Data Operators (http://www.mpimet.mpg.de/cdo) - collection of about 100 functions developed by the MPI-M for handling and analyzing data produced by a variety of climate and NWP models - e.g. for file operations, simple statistics, or the calculation of climate indices. The code is used by around 150 groups (220 users) world-wide, including some of the project partners, calling the CDO around 200000 times per day.
CECILIA: The project's primary mission is to improve the understanding of local climate change in Central and Eastern Europe and its impacts into forestry, agriculture, hydrology and air quality **(**From: http://www.cecilia-eu.org/)
CF: Climate and Forecast Metadata Convention (http://cf-pcmdi.llnl.gov/) - International standard for model data files format. .
CFMIP: Cloud Feedback Model Inter-comparison Project (http://cfmip.metoffice.com/) -International project devoted to investigate cloud feedbacks in climate models and compare with available satellite data.
CGCM: Coupled global circulation model
CICLE: Calcul Intensif pour le CLimat et l'Environnement (http://dods.ipsl.jussieu.fr/omamce/ CICLE/) - A French project funded by Agence National de la Recherche to improve the portability and performance of French climate models.
CIM: Common Information Model - The FP7 METAFOR project develops this standard.
CLIVAR: Climate Variability and Predictability (http://www.clivar.org/) - CLIVAR is one of the WCRP programs, and aims to understand the physical processes responsible for climate variability and predictability on different scales
CMOR: Climate Model Output Rewriter (http://www2-pcmdi.llnl.gov/cmor) – Comprises a set of FORTRAN 90 functions that can be used to produce CF-compliant netCDF files that fulfill the requirements of many of the climate community's standard model experiments. The output resulting from CMOR is "self-describing" and facilitates analysis of results across models.
COMBINE: Project applied for within FP7 developing component models
CSW: OGC Catalogue Service for Web interface standard
DDC: Data Distribution Centre (http://www.ipcc-data.org/) - Distributes observational datasets and model results for a wide community of users involved in IPCC.
DEISA: Distributed European Infrastructure for Supercomputing Applications - an EC infrastructure project to optimise the access to high-performance computers for European users (http://www.deisa.org). After a first phase during FP6, a second phase, DEISA2, is funded under FP7.
EB: IS-ENES Executive Board
EC:European Commission
EGEE: Enabling Grids for E-sciencE (http://www.eu-egee.org/) - A European infrastructure project to help the development and dissemination of the use of Grid-technology for both computing and data access purposes.
ENES: European Network for Earth System Modelling (http://www.enes.org) - A consortium of European institutions aiming at helping the development of use of ESMs for climate and Earth System studies.

ENSEMBLES: EU FP6 funded Integrated Project (http://ensembles-eu.metoffice.com/) -Provides future climate change projections in Europe.
EPM: IS-ENES European Project Manager
ESM(s): Earth System Model(s). These models are developed to simulate the climate system in its full complexity, i.e. atmosphere, ocean and land which are the basic components included in climate models together with biogeochemical cycles, i.e., carbon cycle, vegetation, aerosol and chemistry processes.
ESMF: Earth System Modelling Framework (http://www.esmf.ucar.edu/)- Devoted to define standards in the designing of climate model components for easier exchange and coupling, US-led
EUROCLIVAR: European Climate Variability and Predictability (http://www.knmi.nl/euroclivar/) - A concerted action under FP4 Environment program devoted to prepare the European implementation plan of the international WCRP CLIVAR programme
EuroPlanet: A European Network for the Development of Planetary Sciences in Europe (http://europlanet.cesr.fr/) - FP6 integrated project for planetary sciences
FPn: Framework program number n – FPs are the funding programs for Research and Science of the EC
g-Eclipse: Access the power of the Grid (http://www.geclipse.eu/) – Grid extension of the well-known ECLIPSE programming environment
GEMS: Global and regional Earth-system (Atmosphere) Monitoring using Satellite and in-situ data (http://gems.ecmwf.int) - This EU-funded project is developing comprehensive data analysis and modelling systems for monitoring the global distributions of atmospheric constituents important for climate, air quality and ultra-violet radiation, with a focus on Europe.
GMES: Global Monitoring for Environment and Security (http://www.gmes.info/) - European initiative for the implementation of information services dealing with environment and security. Will be based on observation data received from Earth Observation satellites and ground based information. These data will be coordinated, analysed and prepared for end-users.
GO-ESSP: Global Organization for Earth System Science Portal (http://go-essp.gfdl.noaa.gov/) - Addresses the development and dissemination of standards for exchange of datasets in the field of Earth system science.
GRB: Grid Resource Broker
GRelC: The Grid Relational Catalog project (http://grelc.unile.it/) - Developed in Italy to manage databases on the Grid
HPC: High Performance Computing
I/O: Input/Output is the generic process of exchanging data during a simulation, either as input to the model or as output of model simulations
ICSU: International Council for Science (http://www.icsu.org)
ICT: Information & Communication Technology
IGBP: International Geosphere Biosphere Programme (http://www.igbp.kva.se/).
INSPIRE: Infrastructure for Spatial Information in the European Community (http://www.ec-gis.org/inspire)
IPCC: Intergovernmental Panel on Climate Change (http://www.ipcc.ch) - Provides regular scientific assessments reports (AR) on climate change issue under the auspices of UNEP and ICSU. The last one is the AR4 produced in 2007; the next one is AR5 to be issued in 2013…
IS-ENES: Infra**S**tructure for the **E**uropean **N**etwork for **E**arth **S**ystem Modelling
LIM: Louvain-la-Neuve sea ice model (http://www.astr.ucl.ac.be/index.php?page=LIM_Description) – A Sea Ice Model
METAFOR: Common Metadata for Climate Modelling Digital repositories (http://ncas-cms.nerc.ac.uk/METAFOR/) - FP7 infrastructure project under ENES, which focuses on developing common standards for data and model information exchange that will be implemented in IS-ENES.
MPI: Message Passing Interface (http://www.mpi-forum.org/)– A library for parallel programs
MT: IS-ENES Management Team
NASA: National Aeronautics and Space Administration (http://www.nasa.gov/home/)
NCAR: National Center for Atmospheric Research in Boulder, USA (http://www.ncar.ucar.edu/)
NERC: National Environmental Research Council - Funding agency in the UK (http://www.nerc.ac.uk/)
NEMO: Nucleus for European Modelling of the Ocean (http://www.locean-ipsl.upmc.fr/NEMO/) - State-of-the-art modelling framework including 3 components: an ocean general circulation model (OPA), a sea-ice

model (LIM) and a biogeochemistry model (TOP); NEMO is interfaced with all European atmospheric models via the OASIS coupler.
netCDF: network Common Data Form (http://www.unidata.ucar.edu/software/netcdf/) - A set of software libraries and machine-independent data formats that support the creation, access, and sharing of array-oriented scientific data
NWP: Numerical Weather Prediction (http://en.wikipedia.org/wiki/Numerical_weather_prediction or http://www.ecmwf.int) – The prediction of the development of the weather up to 14 days ahead; mostly by national meteorological services, or private companies
OASIS: Ocean Atmosphere Sea Ice and Soil coupler (http://www.cerfacs.fr/globc/software/oasis/) – A software component allowing synchronized exchanges of coupling information between numerical codes representing different components of the climate system. The latest versions, OASIS3 and OASIS4, were developed in the framework of the EU FP5 PRISM project, and are now supported and developed further by CERFACS (3) and CNRS (1) within the PRISM Support Initiative. Approximately 25 groups use the OASIS coupler internationally.
OGC: Open Geospatial Consortium - The OGC Catalog Service defines common interfaces to publish, discover, browse, and query metadata about geospatial data, services, and related resource information. It is applicable to the implementation of interfaces on catalogues of a variety of information resources.
OMIP: Ocean Model Inter-comparison Project - An international project devoted to investigate the ocean component of ESMs.
OPA: An ocean model (http://www.locean-ipsl.upmc.fr/opa/) - An Ocean General Circulation modelling System shared by projects (research and operational) in oceanography and Climate change studies
PCMDI : Program for Climate Modeling Diagnosis and Intercomparison at Lawrence Livermore National Laboratory in the USA (http://www-pcmdi.llnl.gov/) develops improved methods and tools for the diagnosis and intercomparison of general circulation models.
PMIP: Paleoclimate Modelling Inter-comparison Project (http://pmip.lsce.ipsl.fr/) - An international project devoted to the evaluation of climate models under past conditions.
PRACE: Partnership for Advanced Computing in Europe (http://www.prace-project.eu/) - An FP7 infrastructure project devoted to prepare the implementation of world-class high-performance computers in Europe.
PRISM: Program for Integrated Earth System Modelling (http://prism.enes.org/) - An FP5 project on the development of common interfaces. The PRISM Support Initiative now continues the goals of PRISM, associating several IS-ENES partners with the general goal to foster common developments and exchange of expertise.
RAPS: Real Application on Parallel Systems (http://ecmwf.int/newsevents/meetings/workshops/2007/RAPS/index.html) - A network of experts discussing benchmarks for high-performance computers in the field of weather forecast and climate modelling.
SAB: Scientific Advisory Board (IS-ENES)
SB: Steering Board of ENES
SW: Software
TGICA: Task Group on Data and Scenario Support for Impact and Climate Analysis
TOP: An ocean biogeochemistry model consisting of a transport component based on OPA9 tracer advection-diffusion equation and a biogeochemistry model
UNEP: United Nations Environment Programme (http://www.unep.org/)
v.E.R.C.: virtual Earth System Modelling Resource Centre
WCRP: World Climate Research Programme (http://www.wmo.ch/pages/prog/wcrp)
WDCC: World Data Centre for Climate (http://www.mad.zmaw.de/wdc-for-climate/) - Provides observational and model results datasets to a wide community of users.
WGCM: Working Group on Coupled Models (http://www.clivar.org/organization/ wgcm/wgcm.php) - Under WCRP defines the international strategy for climate model evaluation and simulations for IPCC reports
Workflow: A workflow is a depiction of a sequence of operations, declared as work of a person, work of a simple or complex mechanism, work of a group of persons,[1] work of an organization of staff, or machines. Workflow may be seen as any abstraction of real work, segregated in workshare, work split or whatever types of ordering. For control purposes, workflow may be a view on real work under a chosen aspect, [2] thus serving as a virtual representation of actual work (from: http://en.wikipedia.org/wiki/Workflow)

WP: Work package
XML: Extensible Markup Language