

ENES & IS-ENES

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Monterey, 08/12/2015



European coordination

Scientific Objectives

Infrastructure Strategy

Implementing the strategy

Conclusions

European coordination

A network of European groups in
climate/Earth system modelling
Launched in 2001 (MOU)

50 groups from academic, public
and industrial world

Main focus :
discuss strategy
to accelerate progress in
climate/Earth system modelling
and understanding

Several EU projects
ENSEMBLES, COMBINE, EUCLIPSE, EMBRACE,
SPECS, PRISM, METAFOR, IS-ENES (1& 2)
Collaboration with other European
Research Infrastructure (PRACE, ENVRI,...)

IS-ENES **Infrastructure for ENES**

FP7 European projects
IS-ENES 2009-2013
IS-ENES2 2013-2017

Infrastructure
Models & their environment
Model data (ESGF)
Interface with HPC ecosystem

Users :
Climate modelling community
(Global & regional)
Impact studies



InfraStructure for Earth System modelling

IS-ENES & IS-ENES2 EU projects

1rst phase - 03/2009 to 02/2011
18 partners

2nd phase - 04/2013 to 03/2017
23 partners

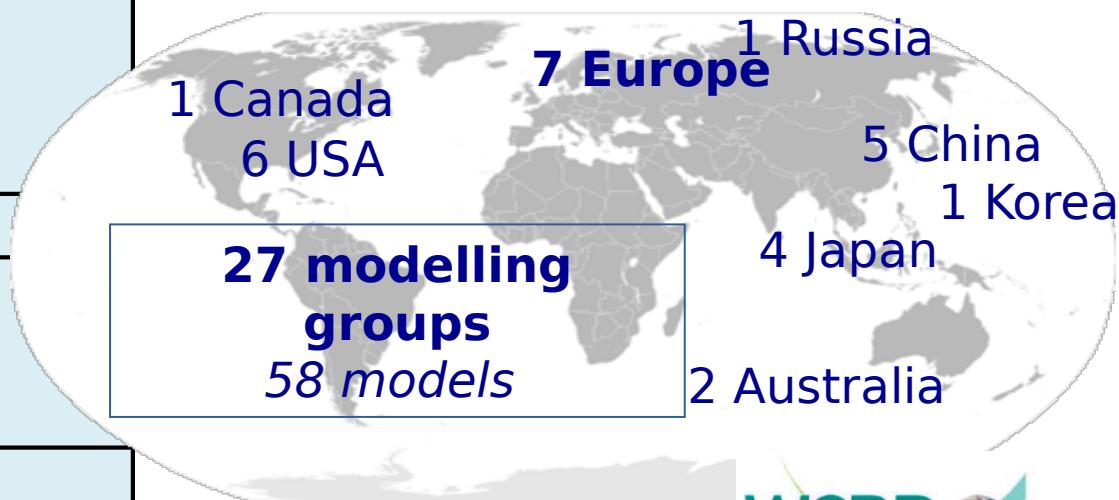


Climate modelling in Europe

NCC	NorESM1-M NorESM1-ME
MPI-M	MPI-ESM-LR MPI-ESM-MR MPI-ESM-P
MOHC	HadCM3 HadGEM2-A HadGEM2-CC HadGEM2-ES
EC-EARTH	EC-EARTH
IPSL	IPSL-CM5A-LR IPSL-CM5A-MR IPSL-CM5B-LR
CNRM-CERFACS	CNRM-CM5
CMCC	CMCC-CESM CMCC-CM CMCC-CMS

CMIP5 in Europe

7 European modelling groups
17 models



CMIP5
Evaluate/Understand/Project

- **National** funding :
Examples: UK (NERC); France (INSU,ANR); Germany (BMBF, MPG)
- **European Commission** funding : over the last 30 years, 3-4 year projects
Environment projects: ENSEMBLES; COMBINE
Infrastructure projects: IS-ENES, METAFOR
- **NEW: Joint Programming Initiative (JPI)**
Long-term coordination and programming between countries for societal challenges



JPI Climate :
Integrate knowledge on climate change for society

Moving towards decadal prediction
Developing climate services
Understanding societal transformation
Tools for decision-making (impact/vulnerability/adaptation)

Scientific objectives

Drivers : Science & Society

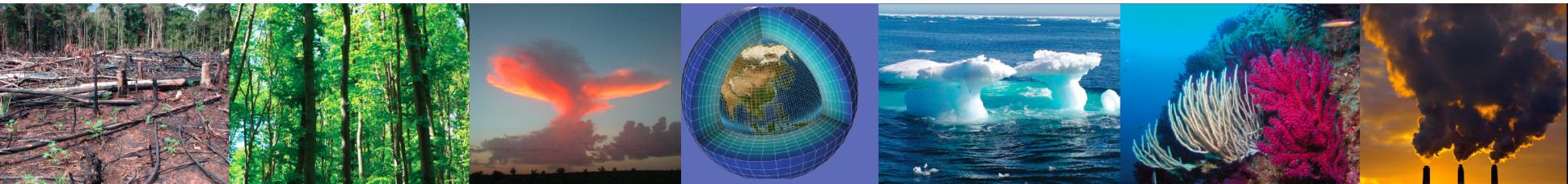
From understanding to development of “Climate Services”

Key science questions

- Q1. How predictable is climate on a range of timescales ?
- Q2. What is the sensitivity of climate and how can we reduce uncertainties?
- Q3. What is needed to provide reliable predictions of regional climate changes ?
- Q4. Can we model and understand glacial-interglacial cycles ?
- Q5. Can we attribute observed signals to known physical processes ?

Writing team:

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52 contributors from BE, CZ, DE, DK, FI, FR, IT, NO, SE, SP, UK



Q1. How predictable is climate at different time scales ?

HPC :

Data assimilation
Large ensemble runs
Resolution

Multi-model decadal predictions
10 yr simulations starting every 5 years
With ocean initial conditions

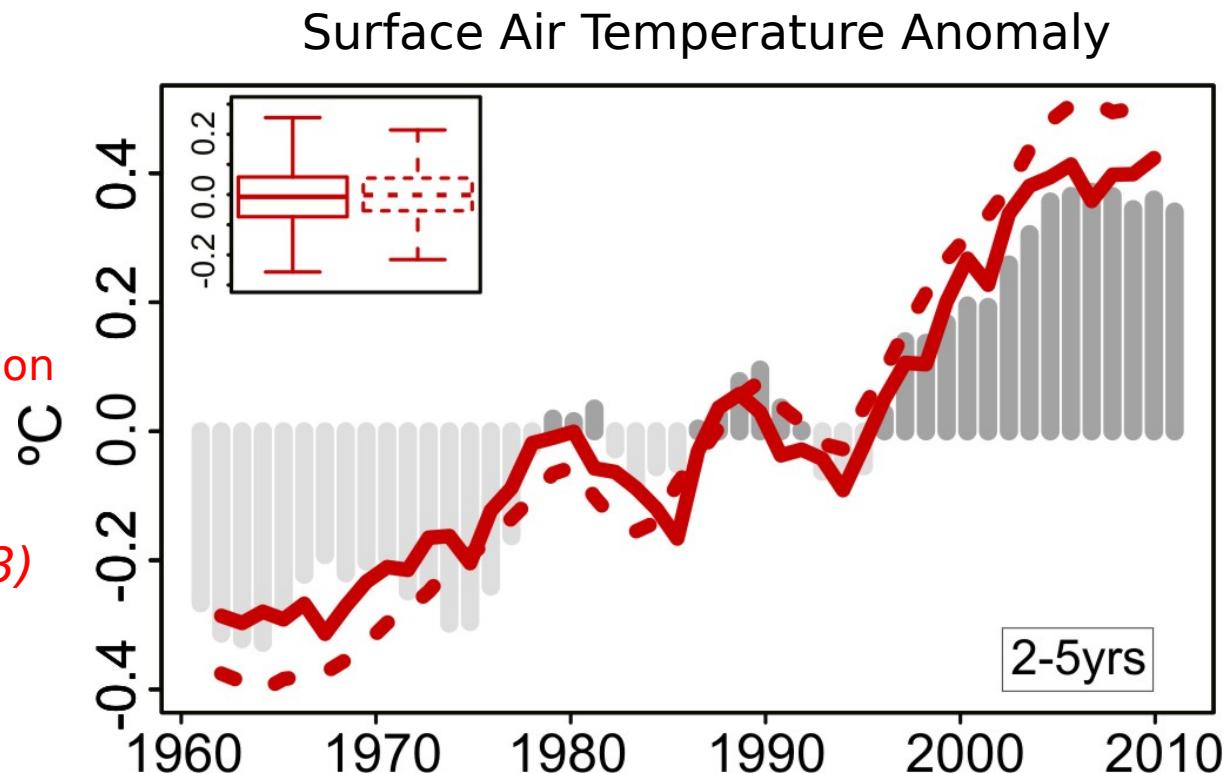
— Observations

Simulations

With

} Initialisation
Without } of ocean

Doblas-Reyes (2013)



Q2. What is the climate sensitivity and can we reduce uncertainties ?

HPC :

Ensemble experiments
(eg. process studies)

CMIP3 (AR4)

Mean: **3°C**

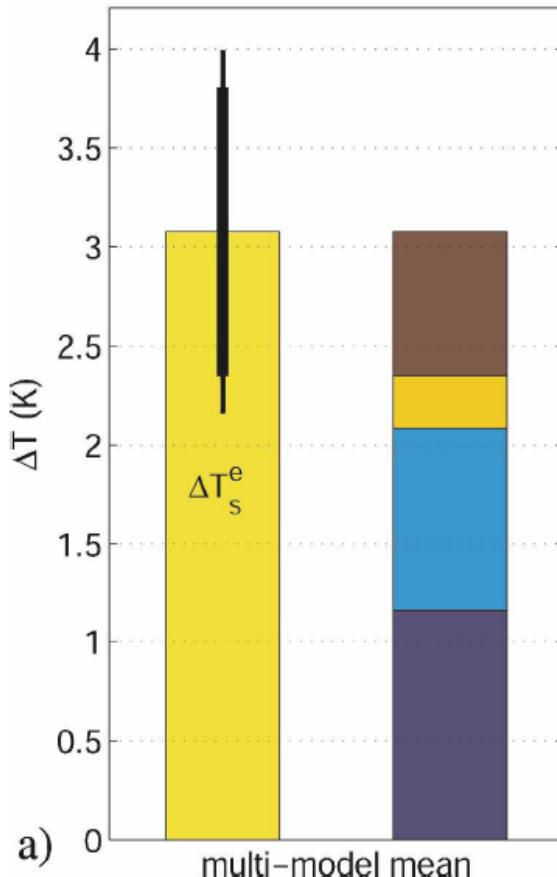
Uncertainty range:
2 to 4.5 °C

*Dufresne & Bony
J. Climate, 2008*

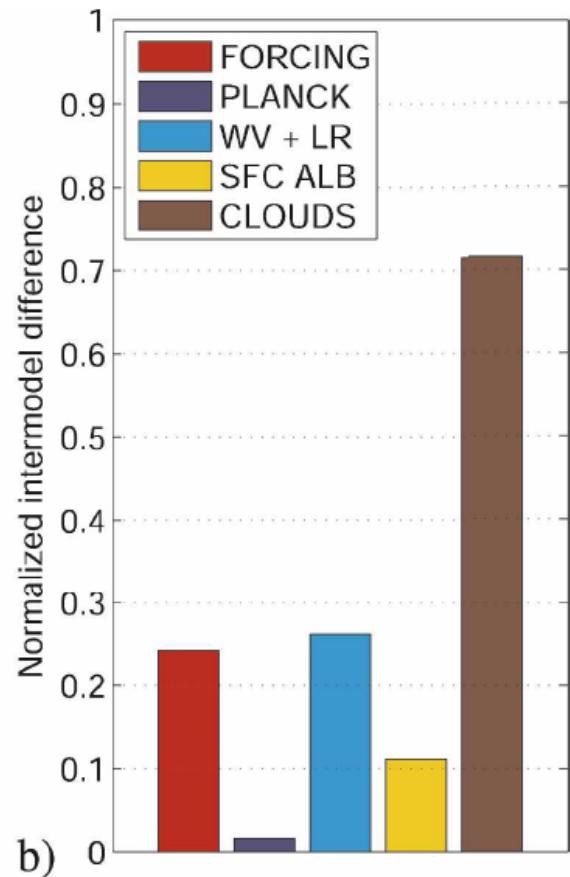
Temperature change to 2 x CO₂

Uncertainty to cloud feedbacks

Multi-model mean



Inter-model

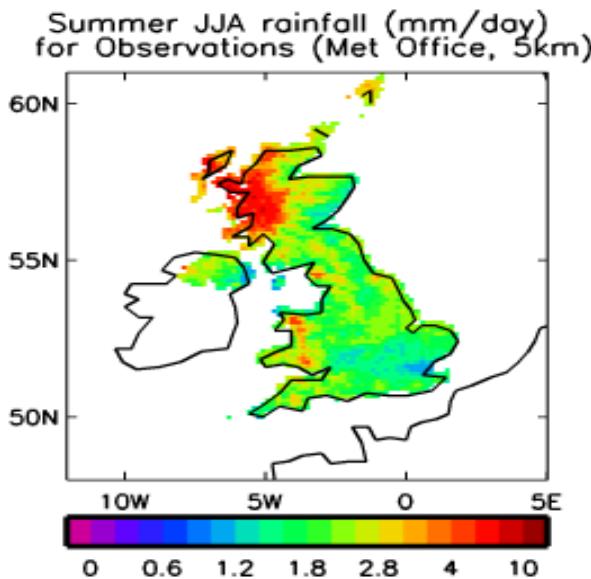


Q3. What is needed to provide reliable predictions/projections of regional climate changes ?

HPC :

Spatial Resolution
Ensemble runs
(internal variability,
parameterisations)

Observations

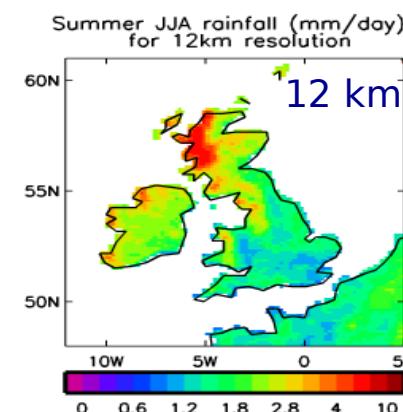
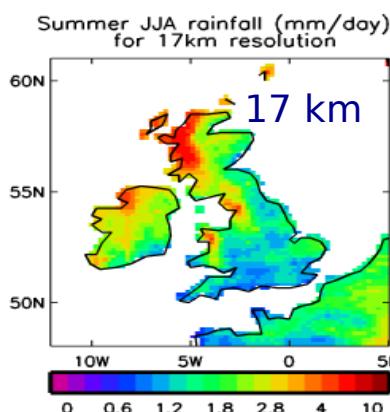
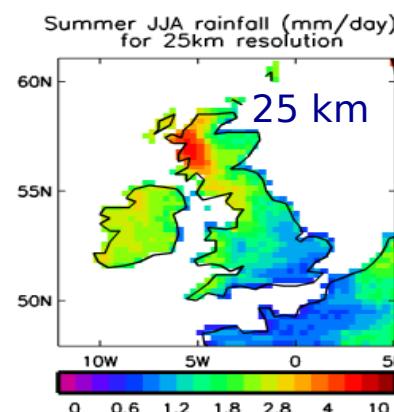
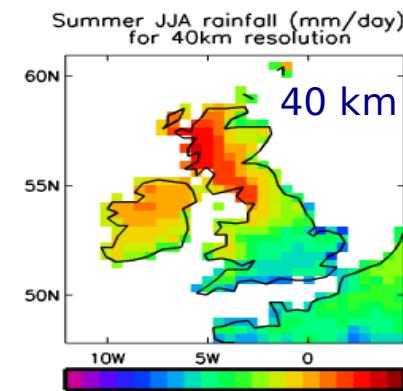
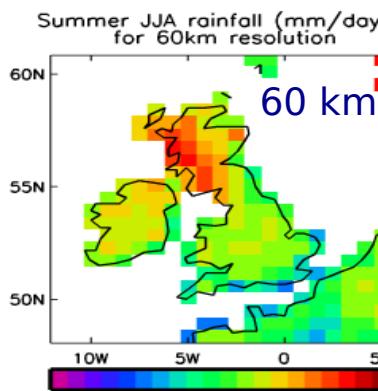
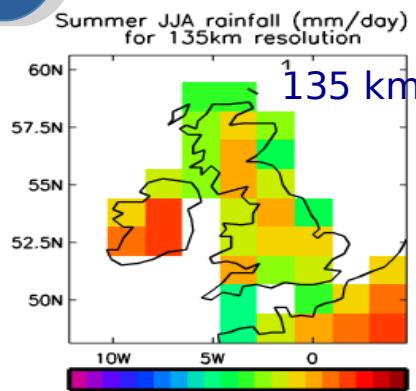


Summer precipitation 2005 Simulations

global climate model HADGEM3

Resolutions 135km → 12km

PRACE UPSCALE project



Courtesy of PL Vidale (NCAS) & M. Roberts (MOHC)

Infrastructure Strategy

Global & Regional climate models

Key role of infrastructure : models, data & computing

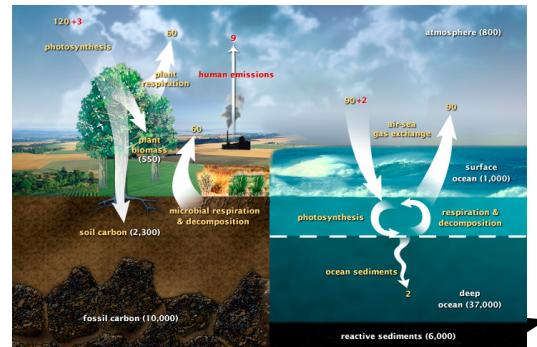
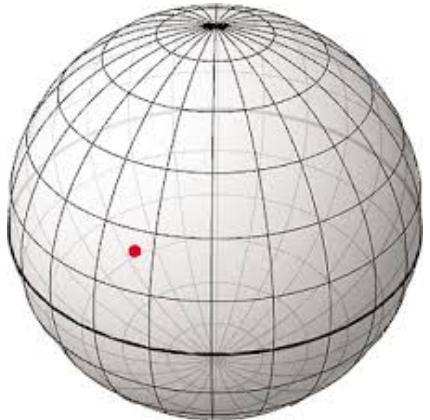
Recommendations:

- 1) Access to world-class HPC for climate at least «tailored » for climate up to « dedicated »
- 2) Develop the next generation of climate models
- 3) Set up data infrastructure (global and regional models) for large range of users from impact community
- 4) Improve physical network (e.g. link national archives)
- 5) Strengthen European expertise and networking

Input to IS-ENES2

ENES

Towards an European Climate Infrastructure Initiative :
a sustainable virtual laboratory



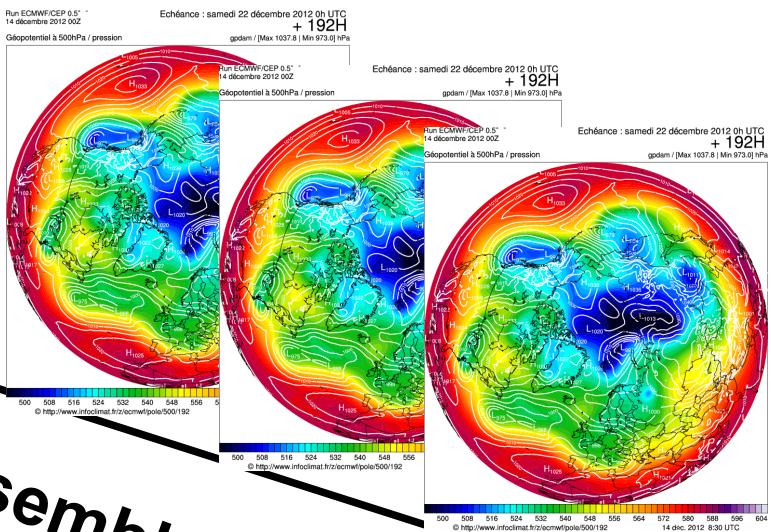
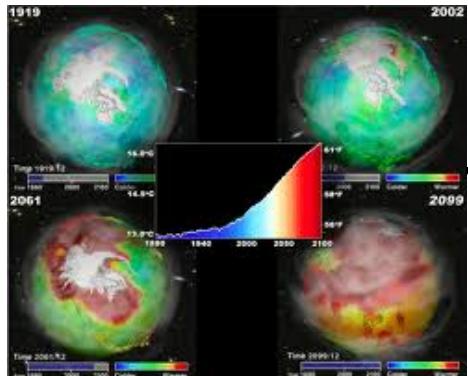
Resolution

Earth
Observations

Enhanced computing
resources produce
MORE DATA

Complexity

Duration and ensemble
size



Implementing the Strategy

Contribution to ESGF related operations



ENES collaboration with
ESGF, PCMDI, NOAA,
NASA & GO-EESP

CMIP5+SPECS+EUCLIPSE+PMIP3...



4 Index nodes
2 Replicas site
QC activities
User Support

European datanodes

7 European datanodes

CORDEX

DMI

Euro & Med

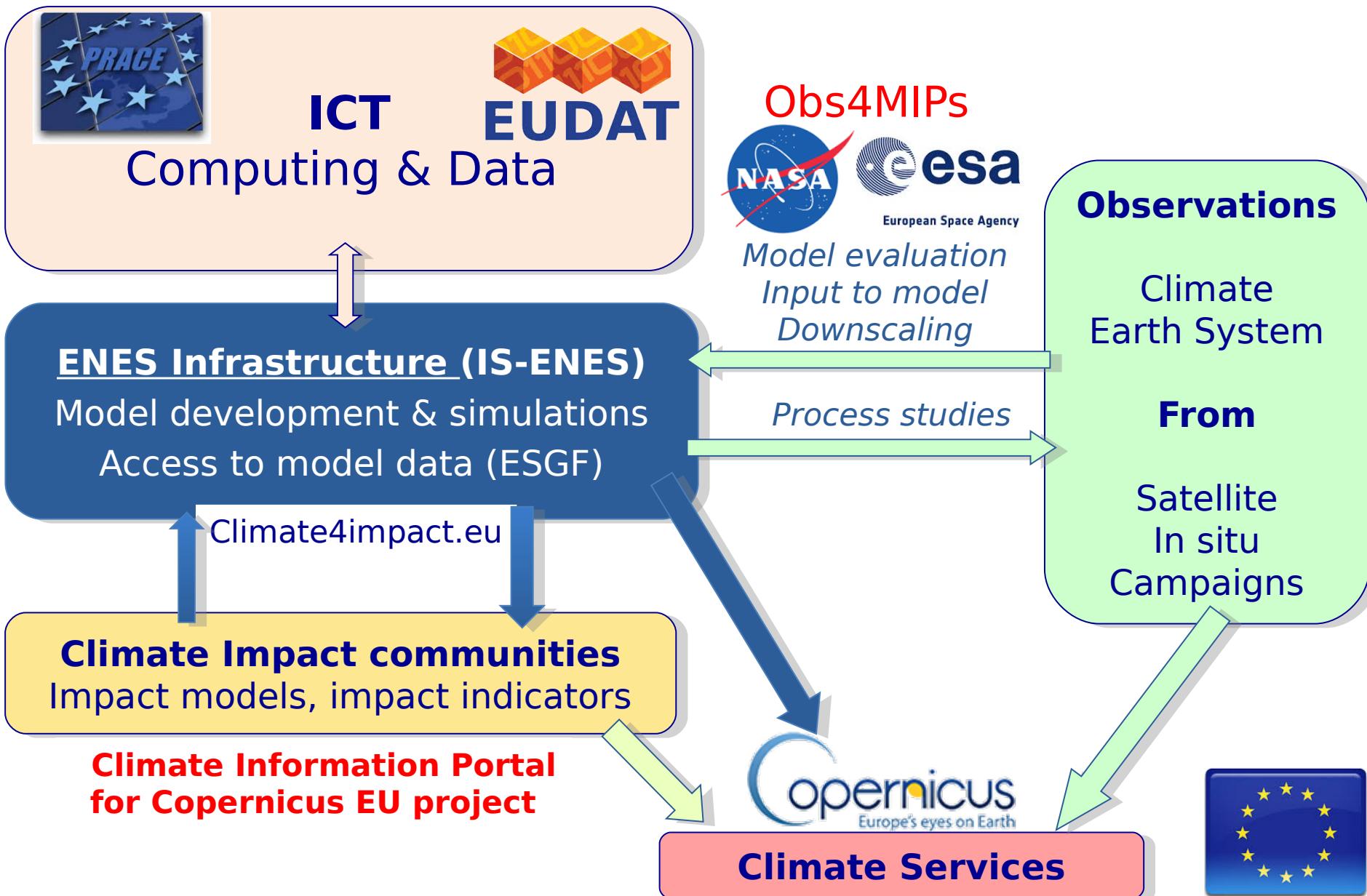


Africa datanode

Contribution to ESGF Working teams

- There are 15 working teams
- 13 working team have leaders
- There are 19 different leaders
- 6 leaders have responsibilities in two working teams
- 1 leader have responsibilities in three working teams
- 10 leaders are affiliated to IS-ENES

Interoperability, International Standards



- **Infrastructure for climate modelling: growing need**
- IS-ENES1 & 2: **building a long-term European Research Infrastructure**
Sharing: increase efficiency & increase dissemination
- Long term **European Research Infrastructure** means that :
 - Operations need to demonstrate of **very high level of maturity**
 - 6 months **shutdown** should **never** happen **again**.
- **International dimension is very important**
Contribute to WCRP experiments
Data : participate to ESGF and its governance
Models, computing and data : share expertise to better face technological challenges



Thank you

- Installation Working Team (Nicolas Carenton and Prashanth Dwarakanath)
- Compute Working Team (Dan Duffy and Charles Doutriaux)
- Publication Working Team (Rachana Ananthakrishnan and Sasha Ames)
- International Climate Network Working Group (Eli Dart and Mary Hester)
- Identity Entitlement Access (Philip Kershaw and Rachana Ananthakrishnan)
- Support Working Team (Torsten Rathman and Matthew Harris)
- Replication and Versioning Working Team (Tobias Weigel and Stephan Kindermann)
- User Interface Working Team (Luca Cinquini)
- Data Transfer Working Team (Rachana Ananthakrishnan and Eric Blau)
- Dashboard Working Team (Sandro Fiore)
- Node Manager Working Team (Prashanth Dwarakanath and Sasha Ames)
- Quality Control Working Team (Martina Stockhause and Katharina Berger)
- Tracking and Feedback Notification Working Team (NO TEAM LEADER UP TO NOW)
- Workflow and Provenance Working Team (NO TEAM LEADER UP TO NOW)
- Metadata and Search Working Team (Luca Cinquini)