

ENES & IS-ENES

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European coordination

Scientific Objectives

Infrastructure Strategy

Implementing the strategy

Conclusions

European coordination

ENES

European Network for Earth System modelling

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



<http://is.enes.org/>



InfraStructure for Earth System modelling

IS-ENES & IS-ENES2 EU projects

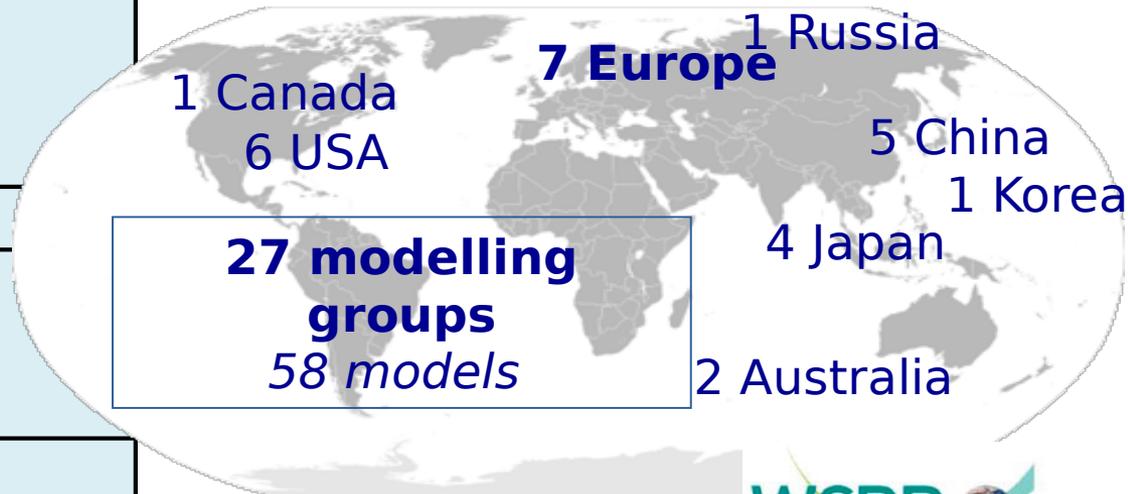
1st phase - 03/2009 to 02/2011
18 partners

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



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



27 modelling groups
58 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”

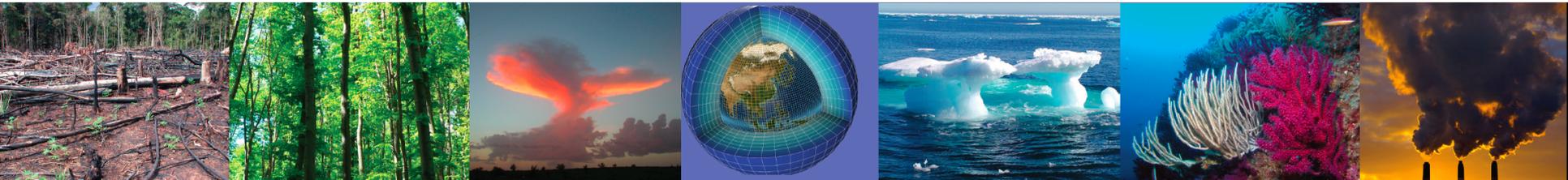
Key science questions

- 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



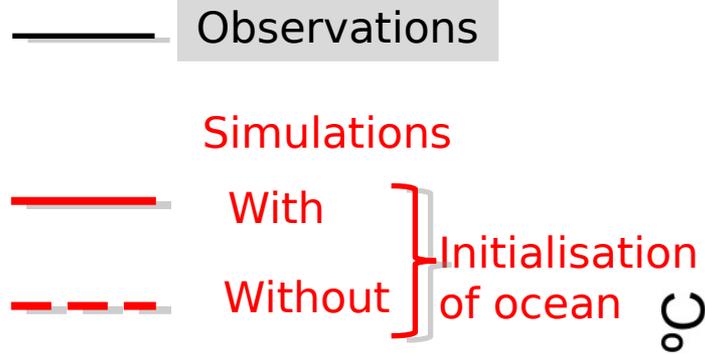
Q1. How predictable is climate at different time scales ?

HPC :

Data assimilation
Large ensemble runs
Resolution

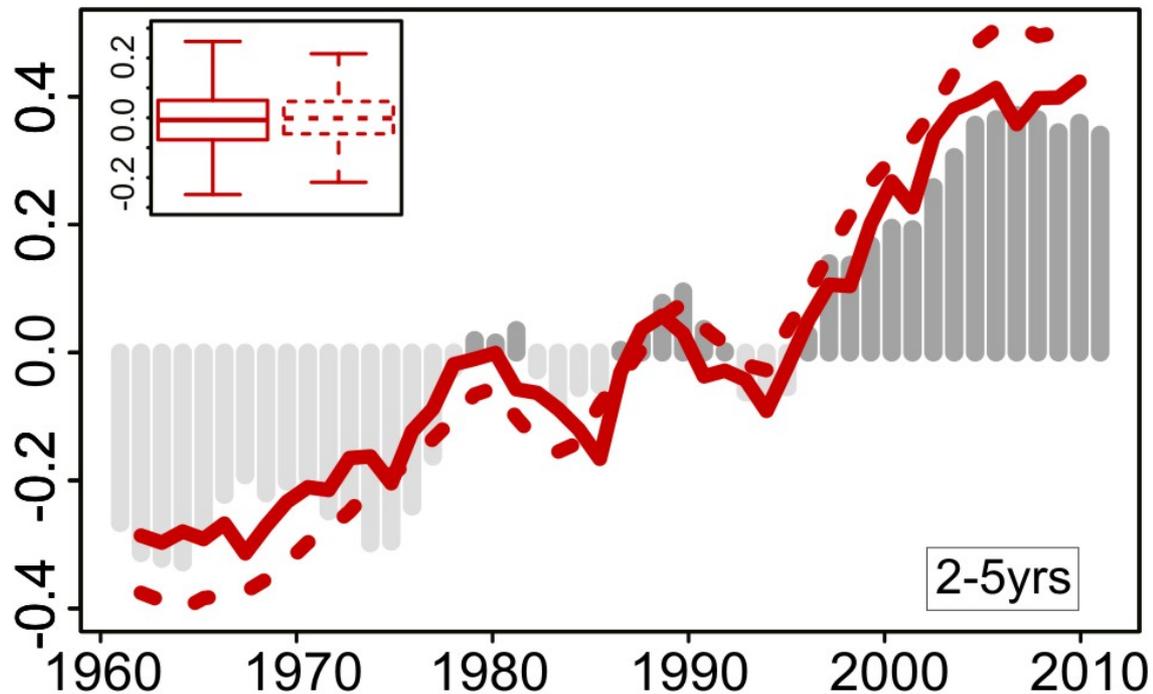
Multi-model decadal predictions

10 yr simulations starting every 5 years
With ocean initial conditions



Doblas-Reyes (2013)

Surface Air Temperature Anomaly



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

HPC :

Ensemble experiments
(eg. process studies)

CMIP3 (AR4)

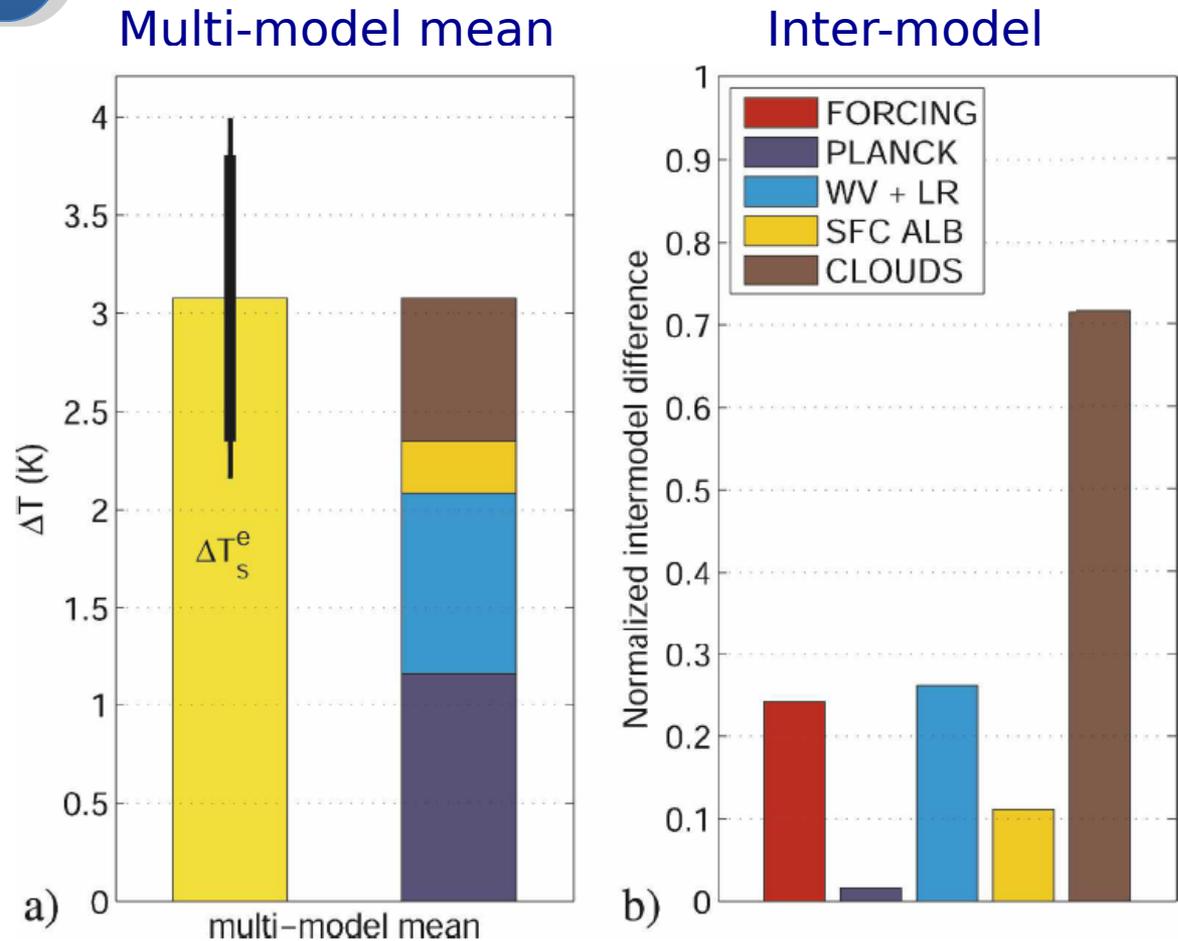
Mean: **3°C**

Uncertainty range:
2 to 4.5 °C

*Dufresne & Bony
J. Climate, 2008*

Temperature change to 2 x CO₂

Uncertainty to cloud feedbacks



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

HPC :

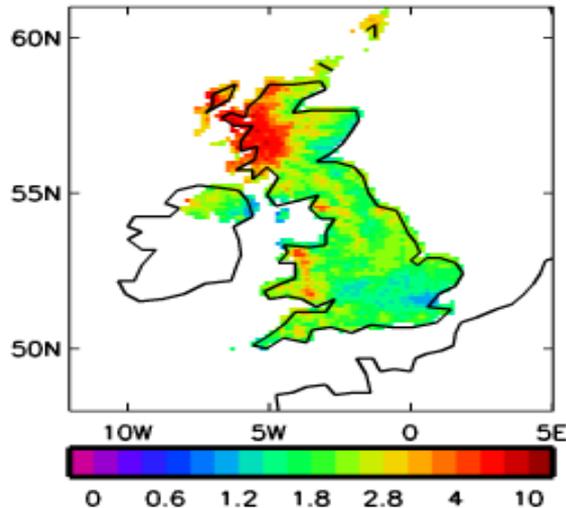
Spatial Resolution
Ensemble runs
(internal variability,
parameterisations)

Summer precipitation 2005 Simulations

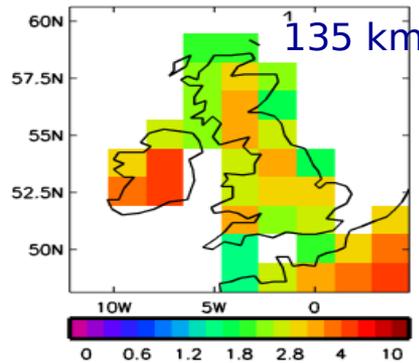
global climate model HADGEM3
Resolutions 135km → 12km
PRACE UPSCALE project

Observations

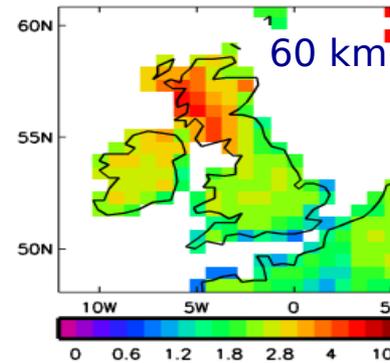
Summer JJA rainfall (mm/day)
for Observations (Met Office, 5km)



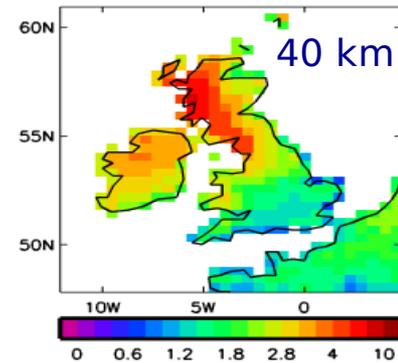
Summer JJA rainfall (mm/day)
for 135km resolution



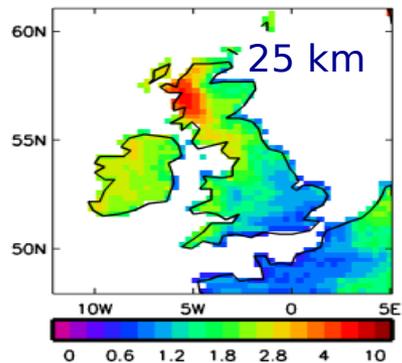
Summer JJA rainfall (mm/day)
for 60km resolution



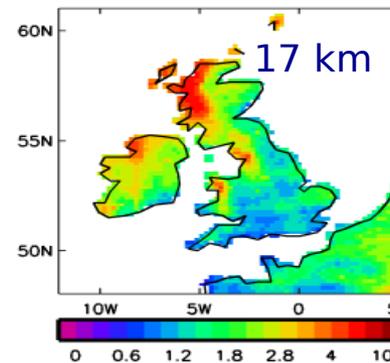
Summer JJA rainfall (mm/day)
for 40km resolution



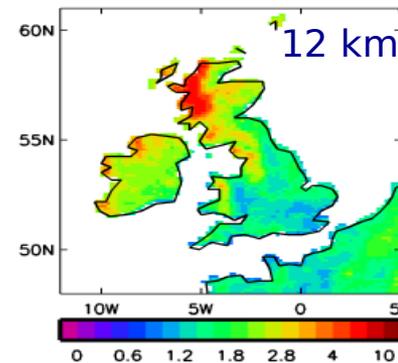
Summer JJA rainfall (mm/day)
for 25km resolution



Summer JJA rainfall (mm/day)
for 17km resolution



Summer JJA rainfall (mm/day)
for 12km resolution



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

Infrastructure Strategy

Global & Regional climate models

Key role of infrastructure : models, data & computing

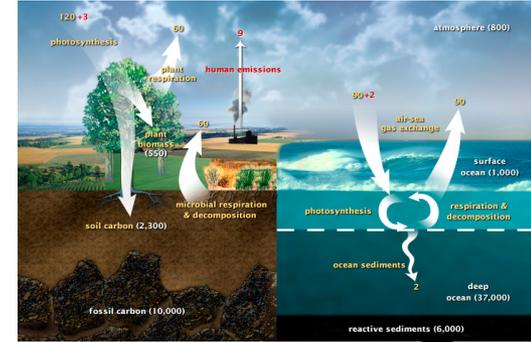
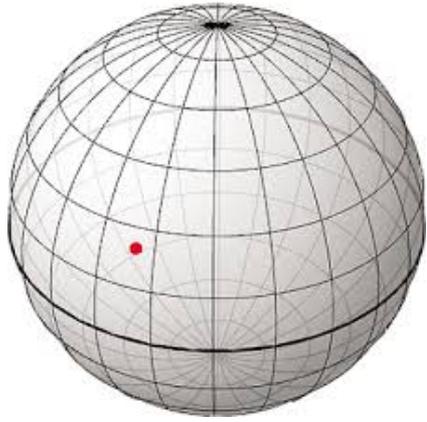
Recommendations:

- 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**



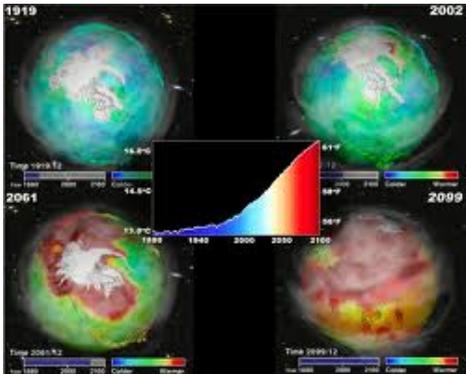
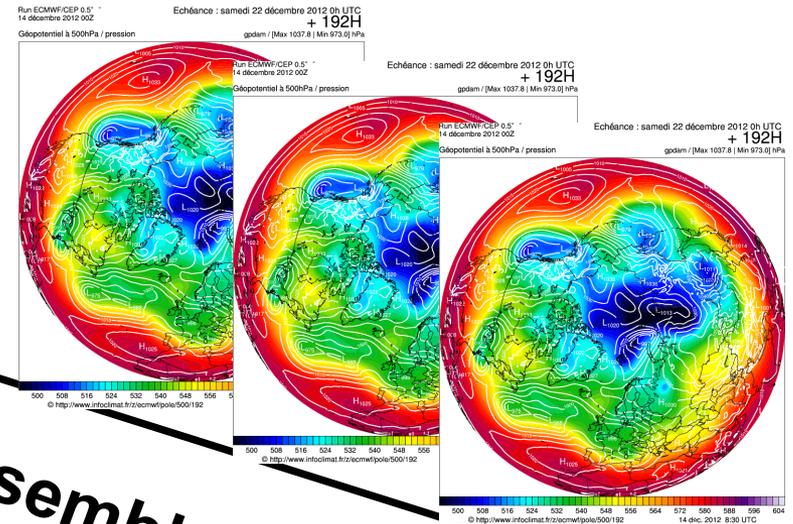
Earth Observations

Complexity

Resolution

Enhanced computing resources produce MORE DATA

Duration and ensemble size

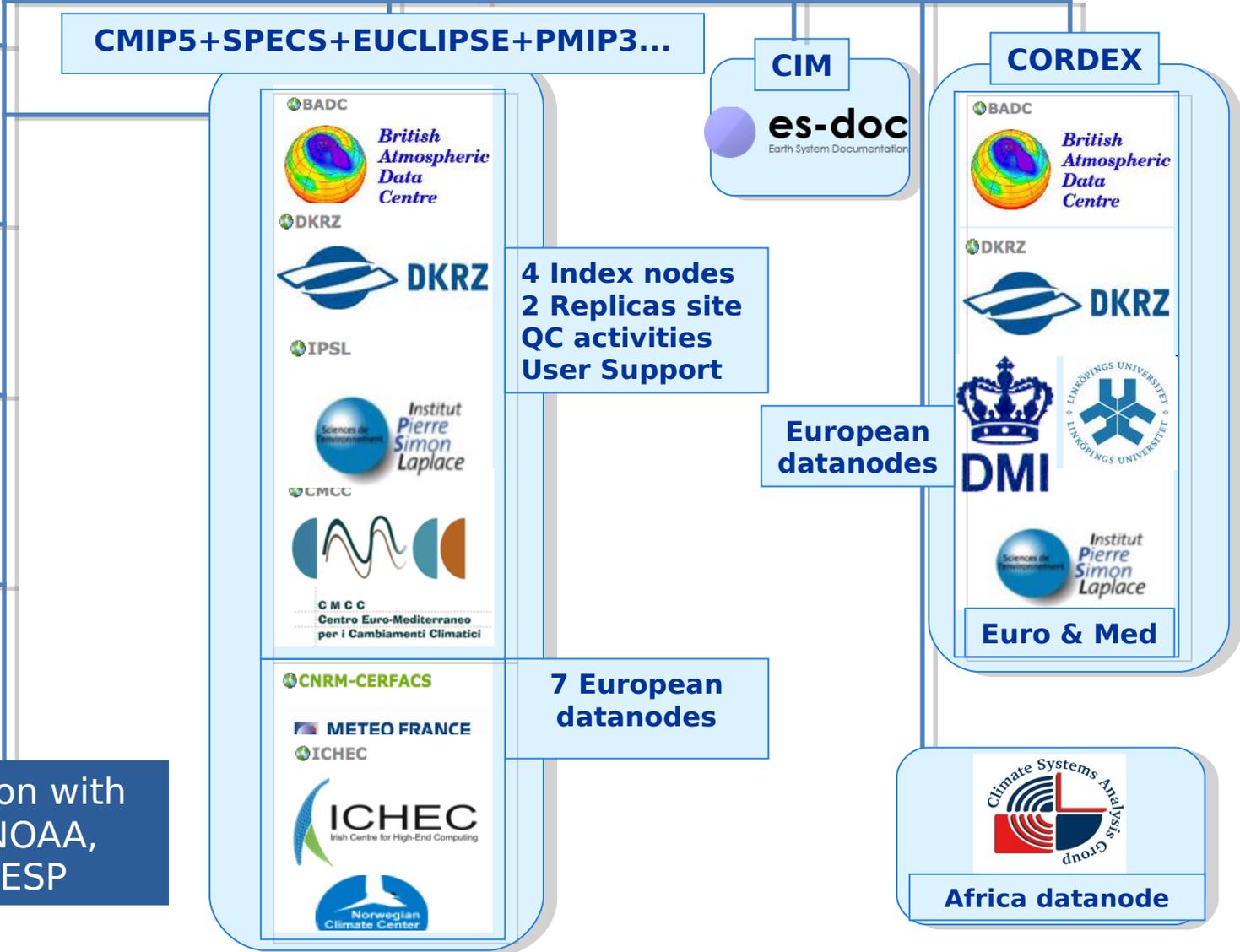


Implementing the Strategy

Contribution to ESGF related operations

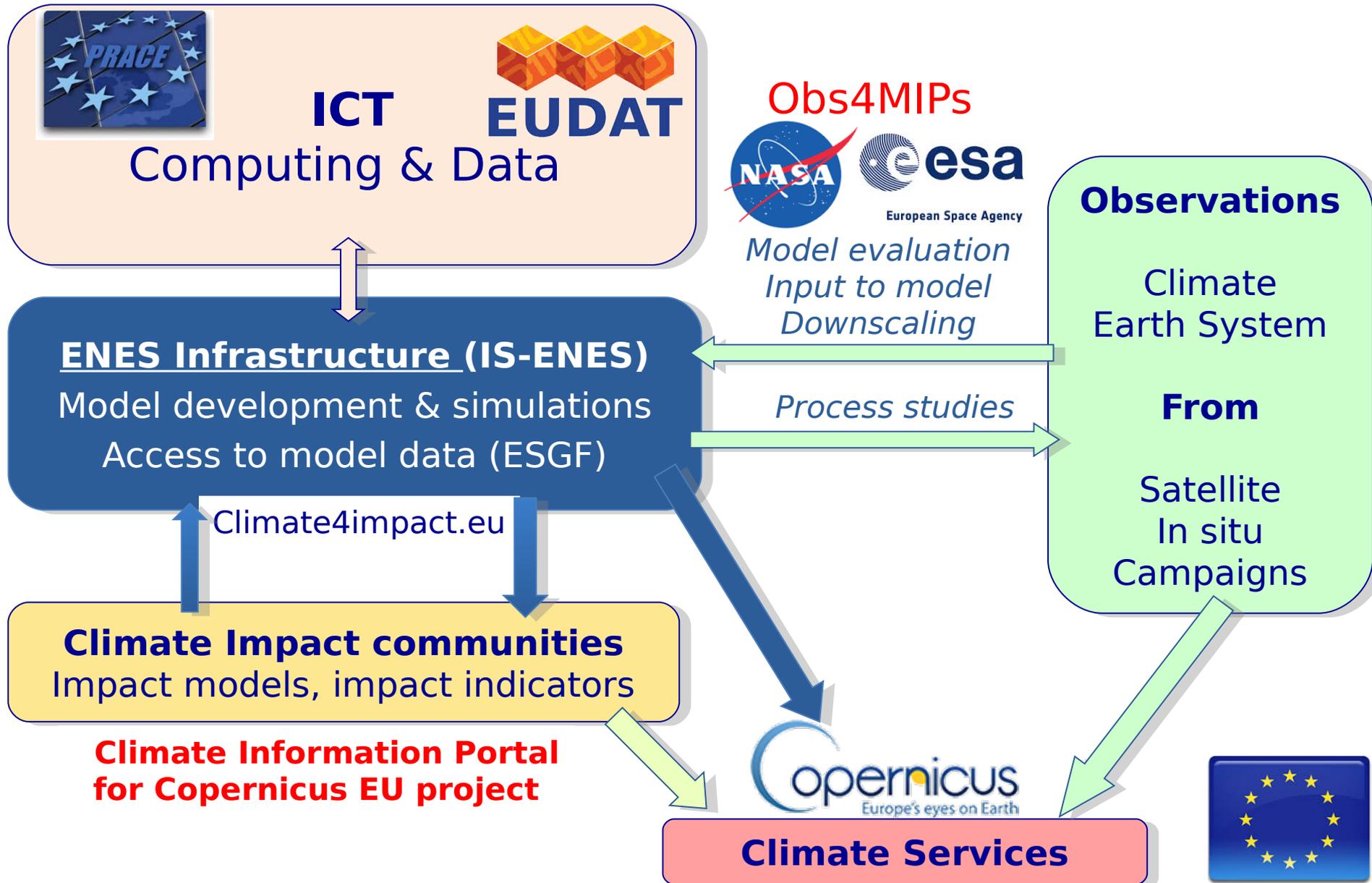


ENES collaboration with
ESGF, PCMDI, NOAA,
NASA & GO-EESP



- 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

SeaWIFS Project (NASA/GSFC et Orbimage)

- 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)