



esiwace
CENTRE OF EXCELLENCE IN SIMULATION OF WEATHER
AND CLIMATE IN EUROPE

Joachim Biercamp
(Deutsches Klimarechenzentrum (DKRZ))

& the ESIWACE partners

The ESIWACE project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 675191

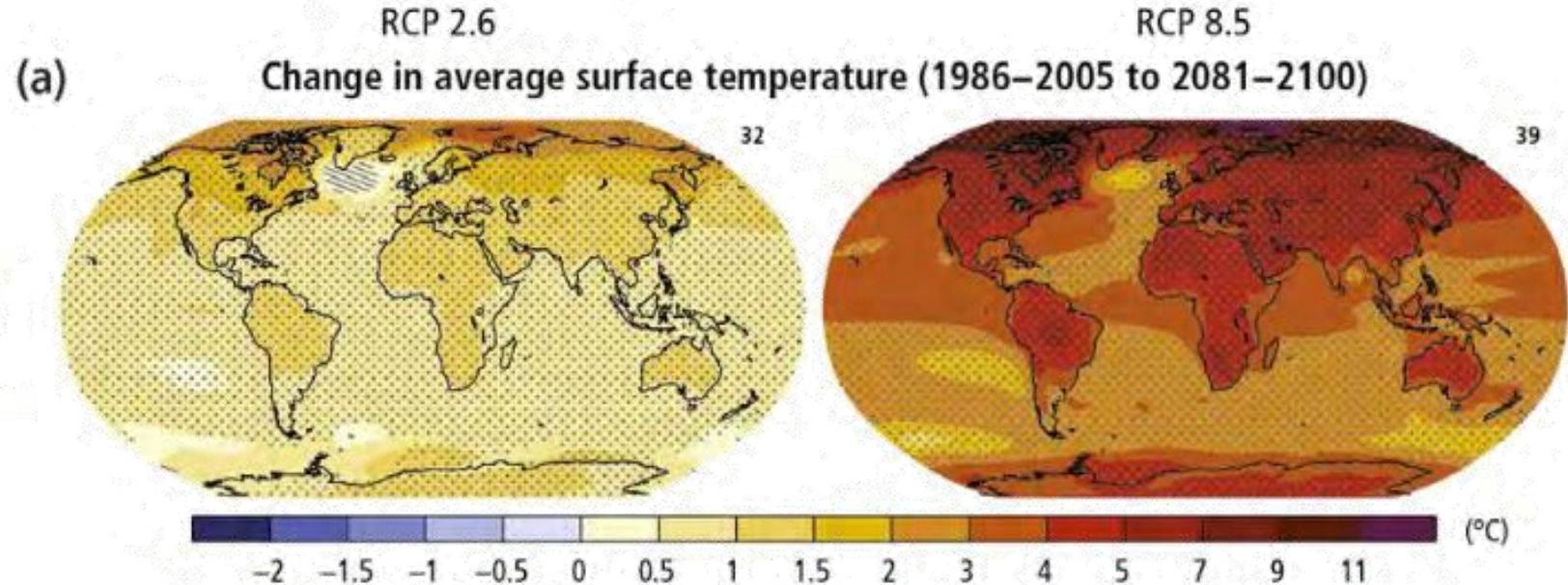
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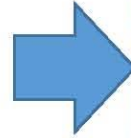
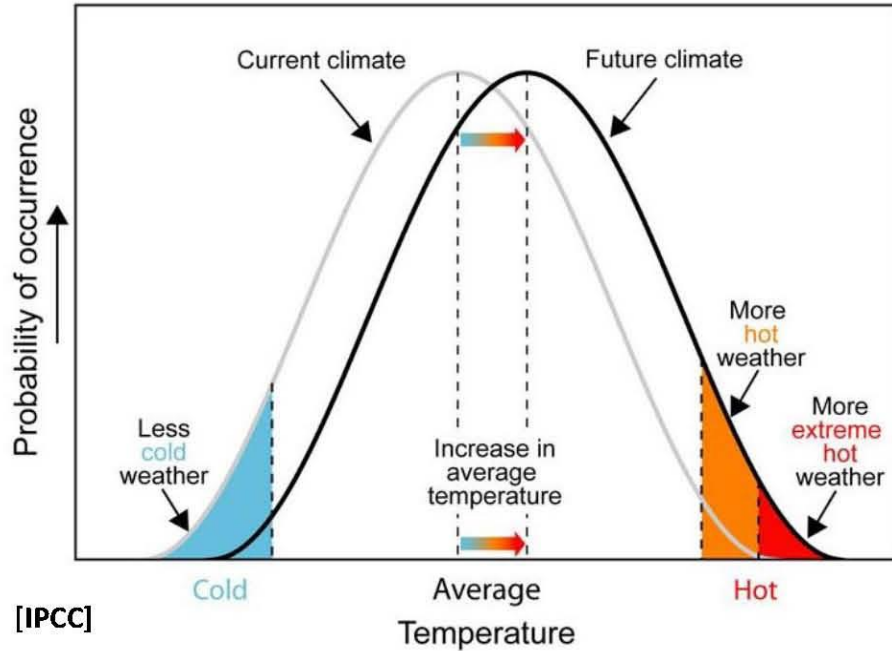
**Join weather and climate communities
to provide support, training, services
for efficient Earth System Modelling *)
using High Performance Computing**

*) We are using the term „Earth System Modelling“ (ESM) as short for „Earth System Modelling for weather and climate science“.

Rational

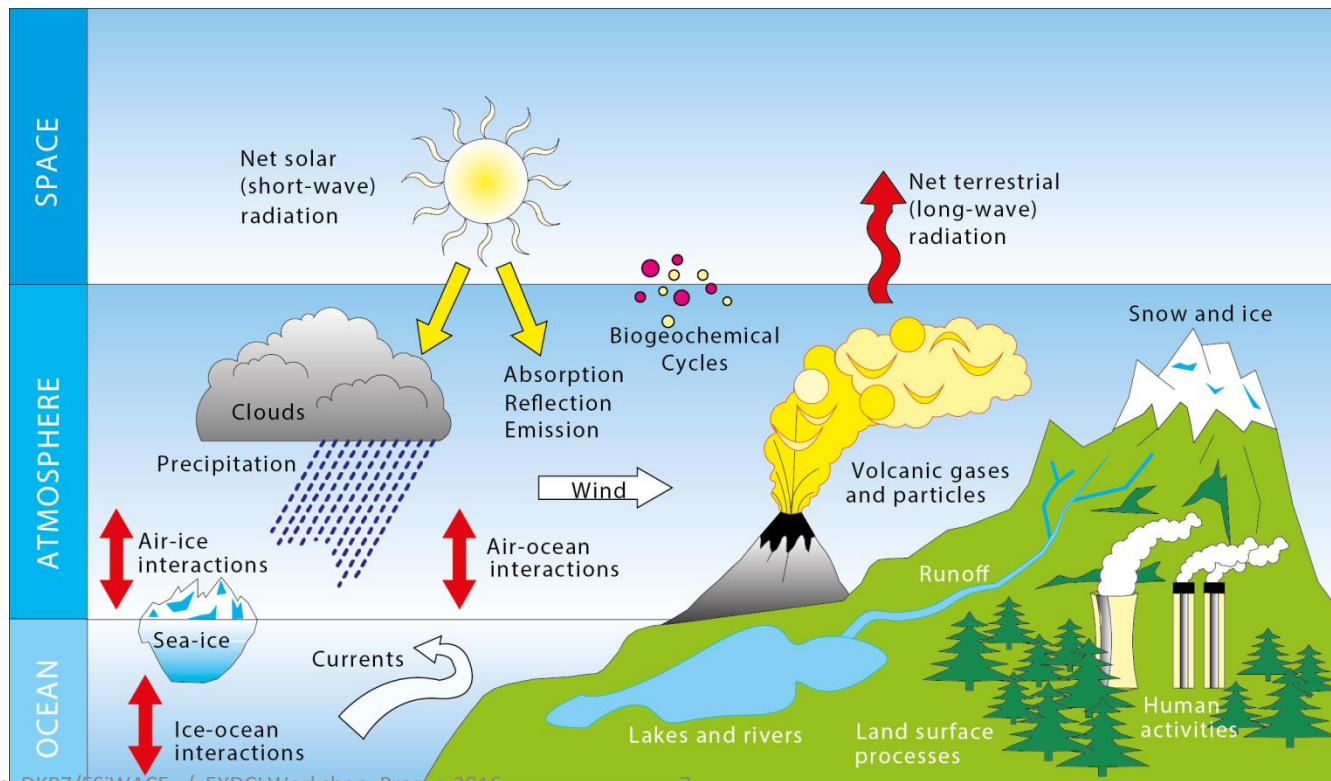


Changing the climate changes weather

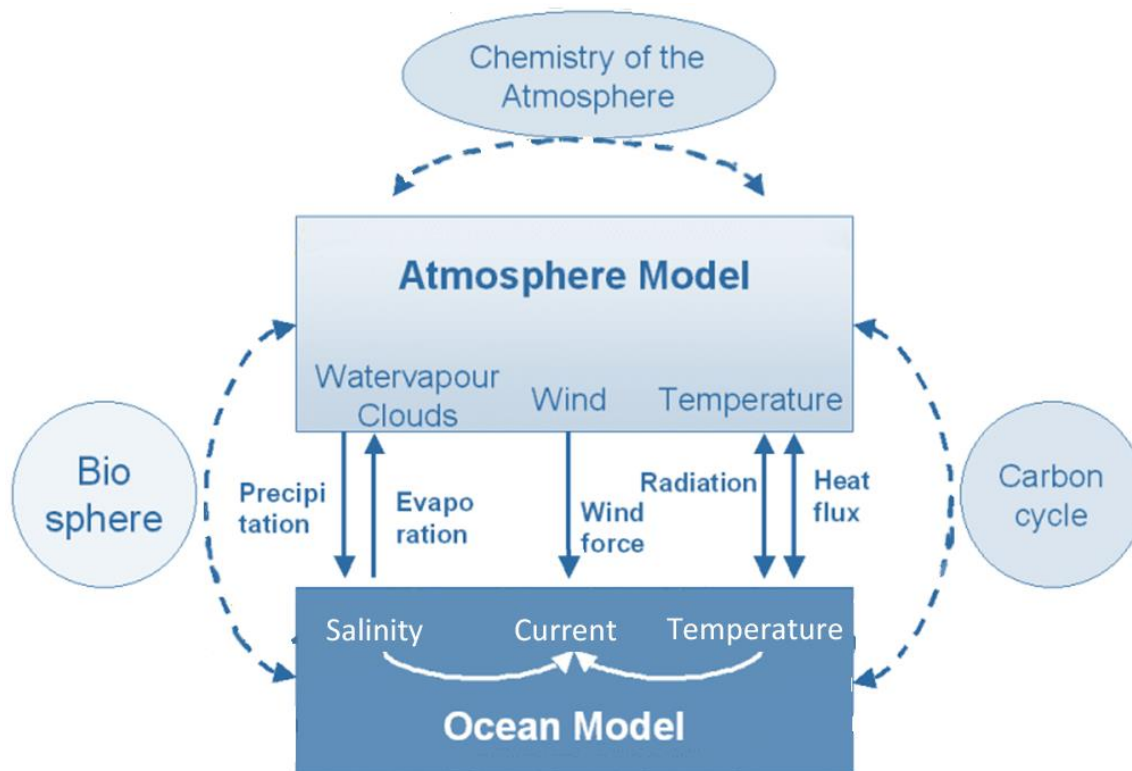


Application

The “Earth System” as seen by climate and weather modelers

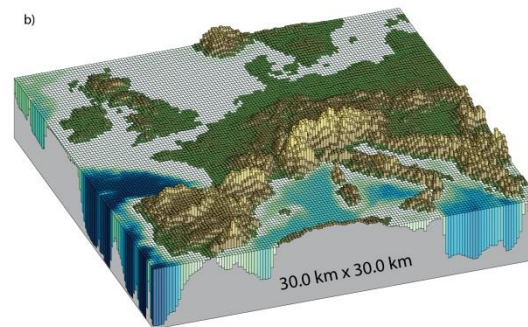
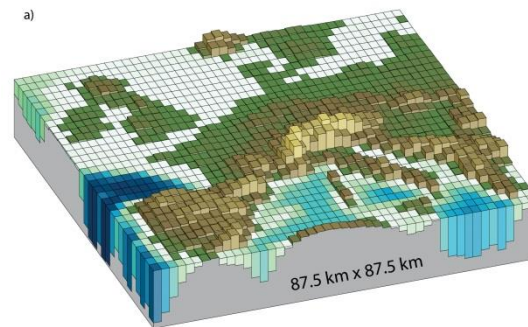
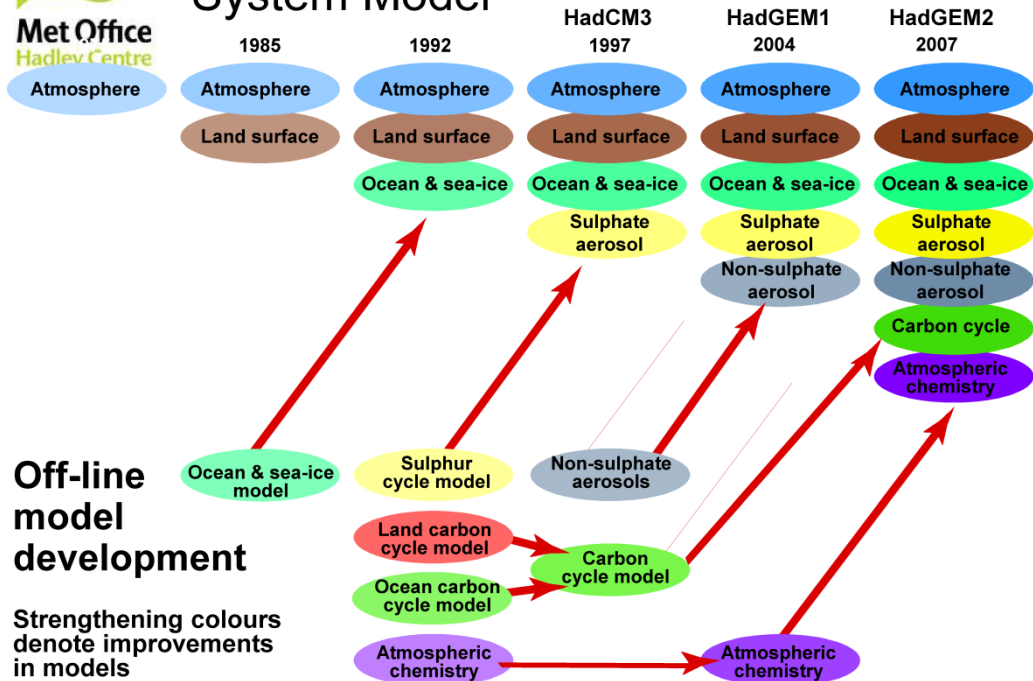


The “Earth System” as seen by climate and weather modelers





Development of the Hadley Centre Earth System Model



© Intergovernmental Panel on Climate Change
From Fifth Assessment report. Climate Change 2013:
The Physical Science Basis, Chapter 1, Fig. 1-14

Recommendations:

enes
EUROPEAN NETWORK
FOR EARTH SYSTEM MODELLING

- 1) Access to world-class HPC for climate - « **tailored** » 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



The expertise

Weather



Met Office



Deutscher Wetterdienst
Wetter und Klima aus einer Hand

Climate



Max-Planck-Institut
für Meteorologie



Institut
Pierre
Simon
Laplace



Centro euro-Mediterraneo
sui Cambiamenti Climatici



National Centre for
Atmospheric Science
NATURAL ENVIRONMENT RESEARCH COUNCIL

HPC



DKRZ

DEUTSCHES
KLIMARECHENZENTRUM



CERFACS



Science & Technology
Facilities Council



ICHEC
Irish Centre for High-End Computing

Climate Modelling:

- Six of the seven European Models used for climate projection (IPCC reports) are developed and supported by members of the consortium

Numerical Weather Prediction:

- Major European NWP systems are represented by members of the consortium

HPC:

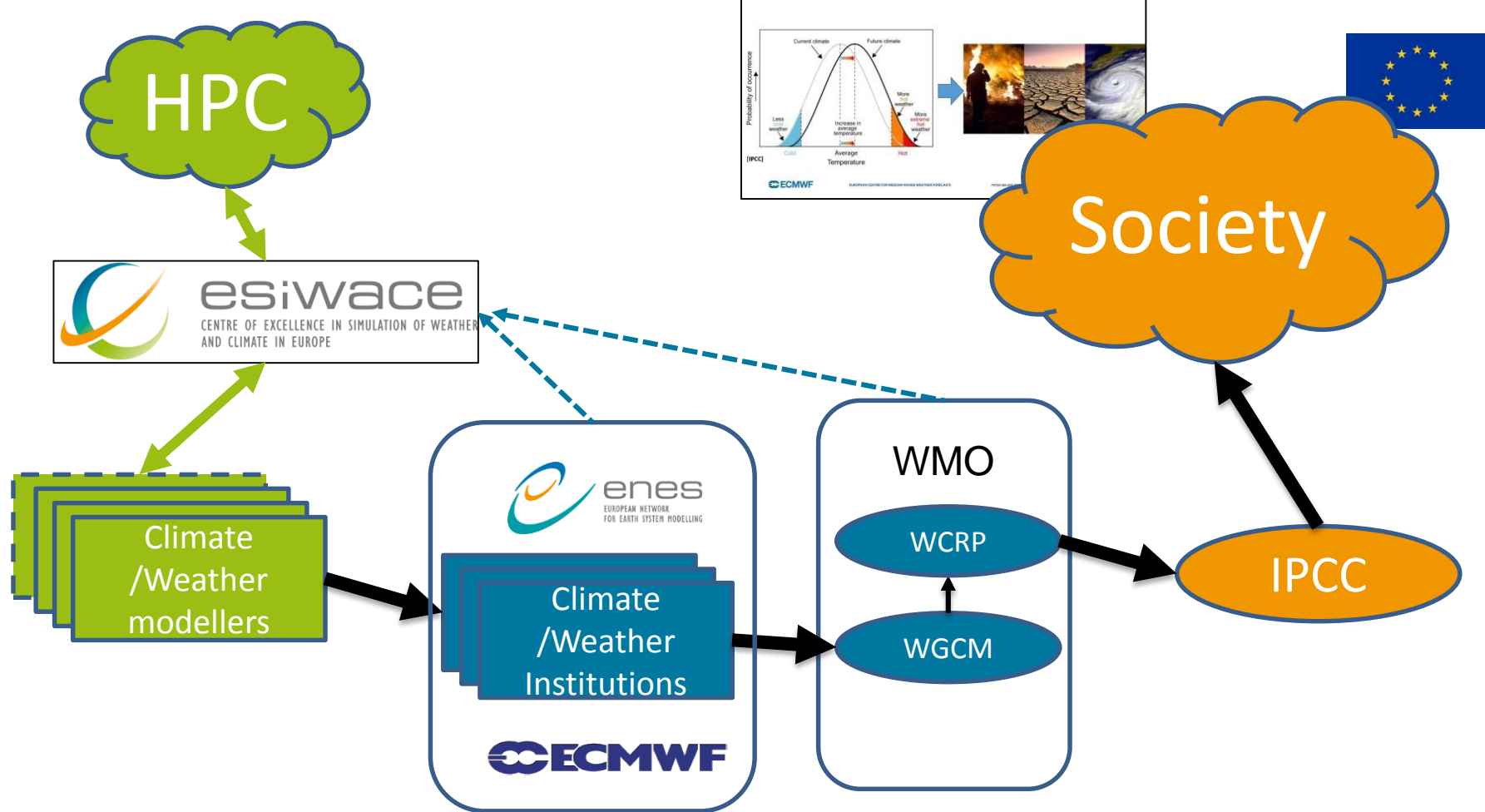
- Significant HPC resources (~ 20 PFLOPS, 100 PBYTE Disk) dedicated to Climate & Weather are operated by members of the consortium

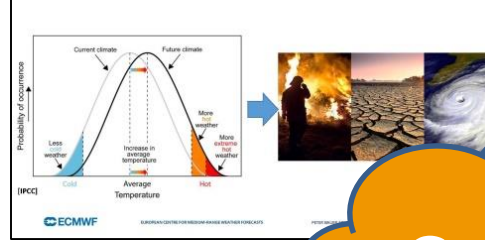
cPPP:

- Three industry partners within the consortium are core members of ETP4HPC

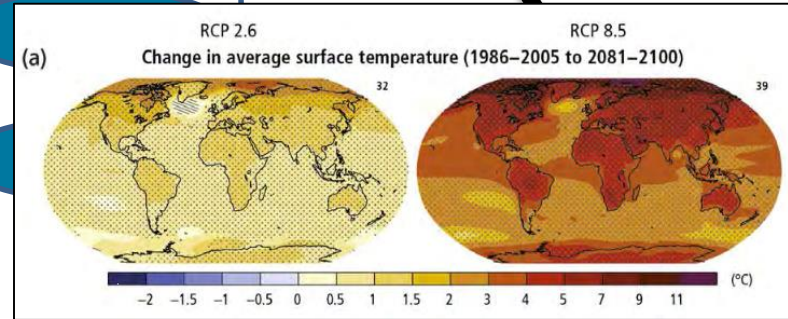
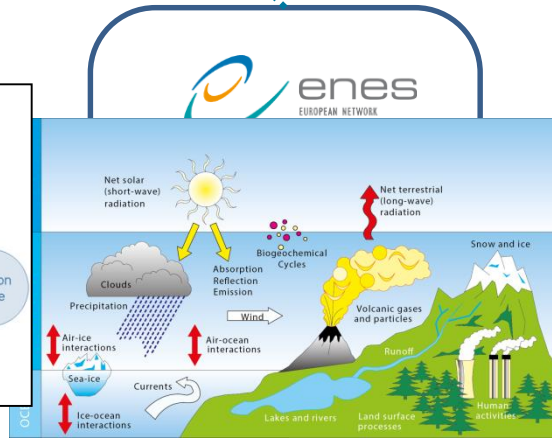


Who are the users

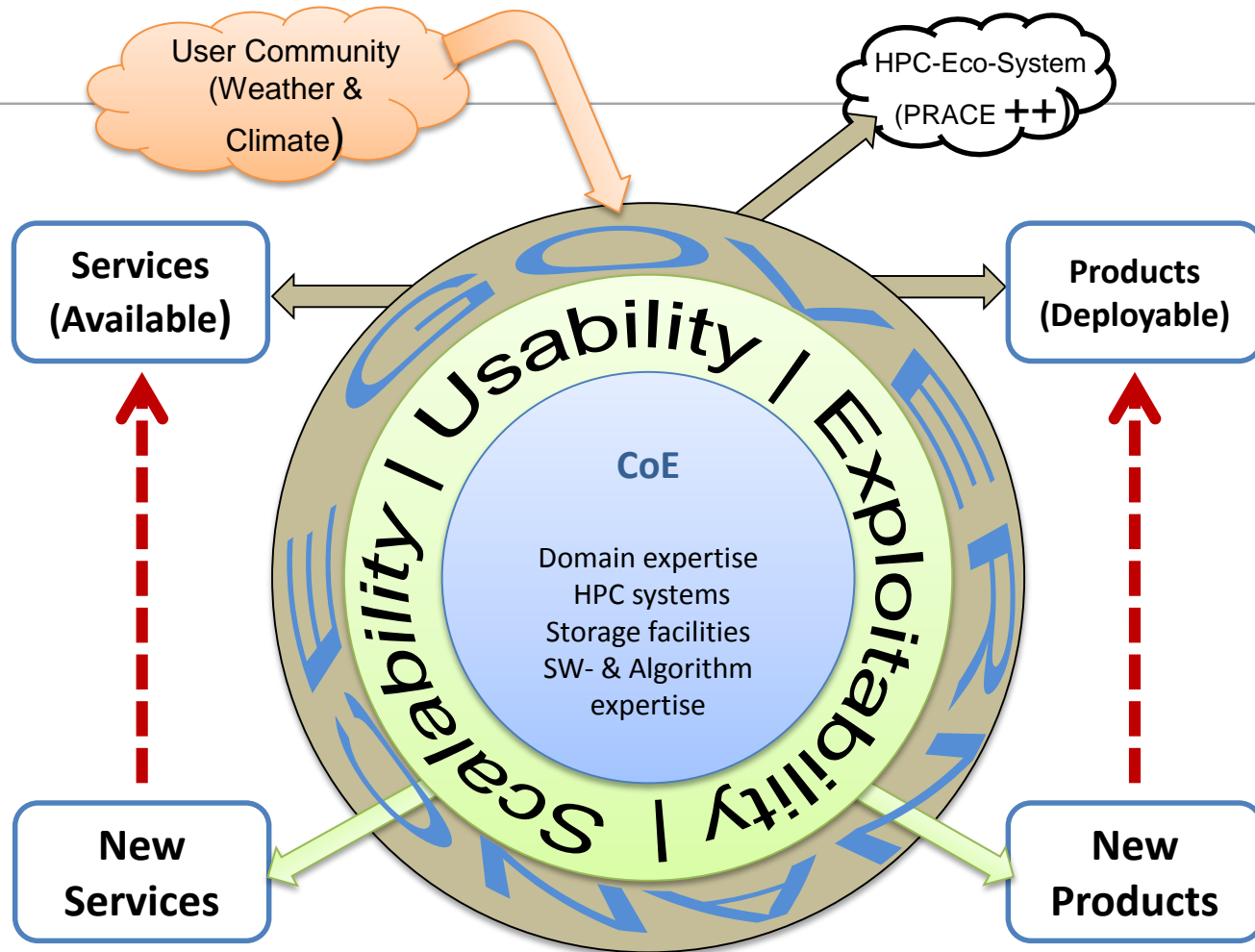




WMO

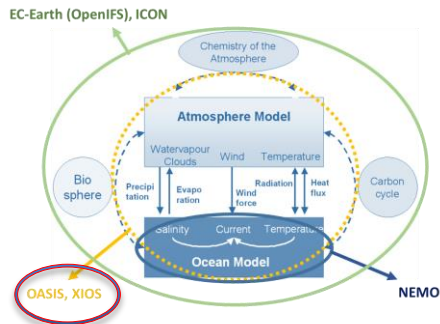


Services



1. Direct Services (= support) -> www.esiwace.eu





User services

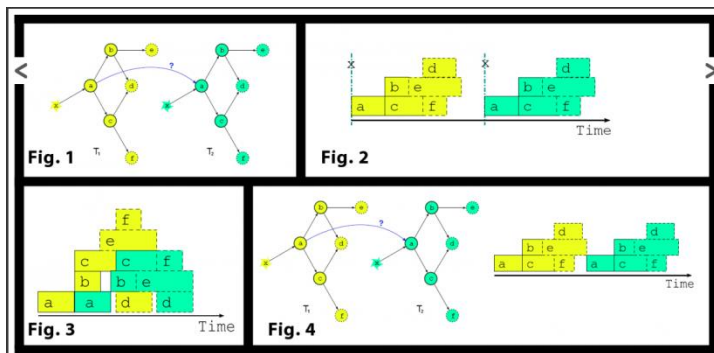
- Code access under version control
- Tutorial, training, best practices
- On-line forums
- Bug fixes
- User-driven evolutions (governance - link with WP1)

- ✧ Software developed by CERFACS since 1991 with CNRS since 2006
- ✧ Ensures coupling exchanges between the component codes of climate models
- ✧ Used by ~70 groups in the world, with ~40 groups in Europe, and in 5 of the 7 European ESMs in CMIP5

OASIS optimization (months 12-24)

- Performance analysis and improvement
- Multi-threading and/or thread-safe

CYLC is a meta-scheduler world-leading to better manage the dependencies of the many interdependent tasks that make up computer simulations of weather and climate.



Support approach

- Phase 1:
 - Support evaluation and decision making
 - Bespoke and personal interaction offered
- Phase 2:
 - Training and advice
 - Assume local first-level support
 - Responsive to feedback
- Leading to further software development

ESM System Software Stack & ESM end-to-end workflow recommendations

- methodology for maintaining a portable HPC system software stack for ESM application
- enable portability of complex climate modelling experiments (multi model, multi member ensembles)

➔ Enable efficient usability of Prace-typ infrastructures for Earth System Modeling

Business model for storing and exploiting high volume climate data

- Create models to reduce the design space/understand expected performance
- Identifying beneficial storage architecture candidates for the entire workflow.

New storage layout for Earth system data

- Overcome performance limitations of shared I/O during simulation workflows from multiple PEs.
- Address performance issues for alternatives to traditional parallel file systems
- Achieve performance portability (with no changes to applications)

COMMUNITY BUILDING / ENHANCING COMMUNITY CAPACITY IN HPC

- **HPC task force**
 - Coordinate HPC related activities of the modeling groups and interaction with industry (-> cPPP)
- **HPC-Workshops**
 - ENES Series on HPC for Climate (<https://www.esiwace.eu/events/4th-hpc-ws>)
 - ECMWF Series on HPC for Meteorology
- **Other events**
 - ISC16, Frankfurt: Session on climate and weather coordinated by Thomas Ludwig
 - PASC16, Lausanne: “Climate&Weather contributions” coordinated by Peter Bauer



Toulouse April 2016

„HPC ecosystem
meets
Earth System
Modeling“

~ 100 participants
from 4 continents

INTEGRATION:

ESiWACE will drive a longer term strategy and vision aiming at getting adequate recognition of the requirements of Earth-System-Modelers in the evolving hpc-ecosystem

- by fostering integration of weather & climate
- by exploiting synergies between that community and the HPC ecosystem
- by exploring and filling gaps (ETP4HPC -> SRA)

➔ **“Business model” to be developed with industry partners**

NEXT STEP:

Contribute actively to the Extreme Scale Demonstrator discussion (and also to the upcoming co-design proposals)

To achieve a quantum leap in science performance, we need:

- Global coupled & uncoupled simulations at **1 km** spatial resolution; as ensembles to characterize forecast uncertainty
 - Weather forecasts: target O (10 days per hour wallclock)
 - Climate predictions: target O (100 days per hour wallclock)
- } E (2-5 exaFLOP)

→ **EsD applications:**

- Full-sized 1 km models
- Tailor-made, cost-driving model components (to be highly optimized and made scalable) for both computing and data handling

... to be provided by **ESiWACE (CoE) and ESCAPE, NextGenIO and others (FET)**

Thank you

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