esiwace

CENTRE OF EXCELLENCE IN SIMULATION OF WEATHER AND CLIMATE IN EUROPE

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Barcelona Supercomputing Center
Centro Nacional de Supercomputación

Outline

- Description
- Goals
- Issues addressed
- An example of research activities

Description

- *Call*: EINFRA-5-2015: Centres of excellence for computing applications
- *Kick-off*: 1st December 2015 (two reviews done)
- *Duration*: 48 months
- *Partners (in PM order):* DKRZ (leader), ECMWF, CNRS-IPSL, MPG, CERFACS, BSC, STFC, MET Office, U. Reading, SMHI, ICHEC, CMCC, DWD, SEAGATE, Bull and ALLINEA.
- https://www.esiwace.eu/

Community Issues

- The weather & climate community has a “nearly infinite“ need for computing capability and computing capacity:
  - We could (and would) do better science if we had faster (better) HPC

- But this community has a growing problem with HPC
  - Systems get broader not faster (in fact the may get slower)
  - It is increasingly difficult to make progress in leveraging new systems
  - The market is driven by cell phones and deep learning

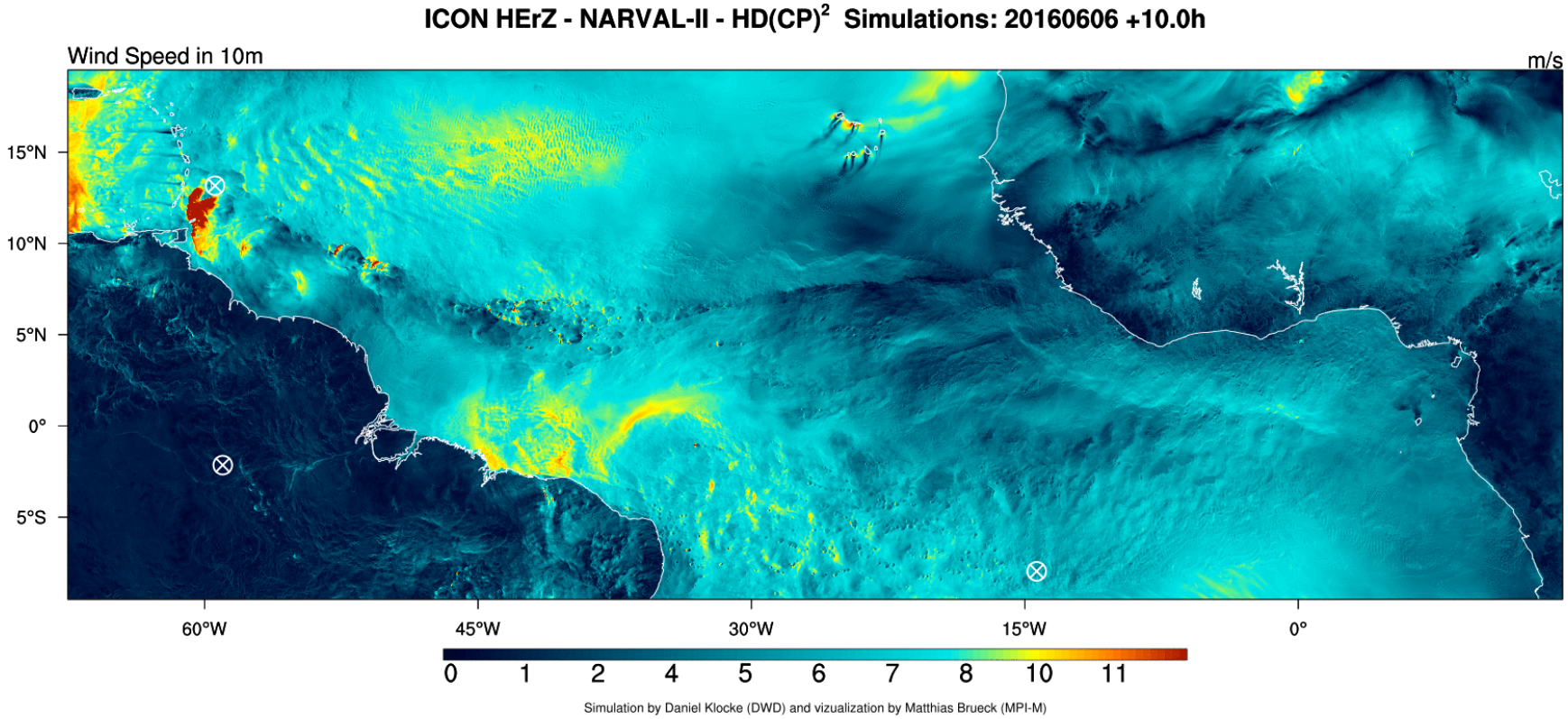
Scientific Focus:

Cloud resolving global model

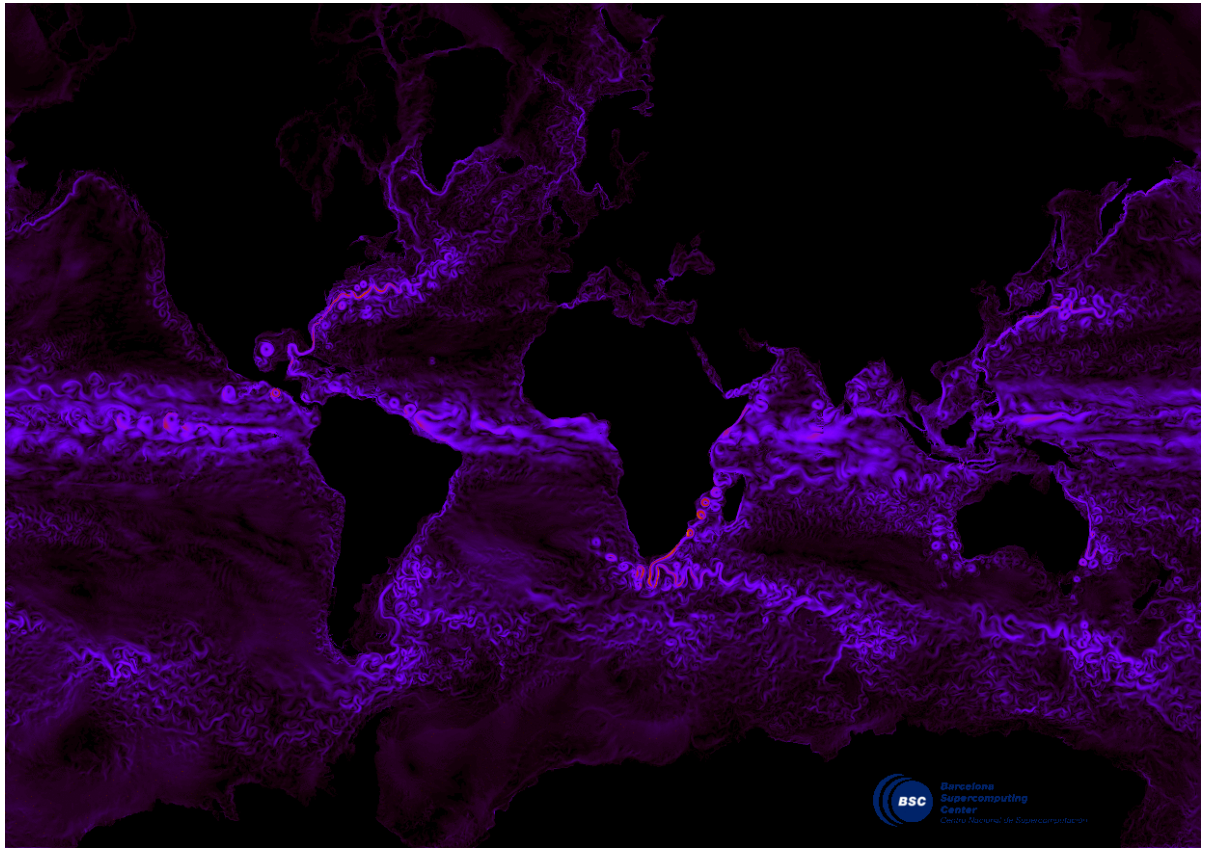
Technical Focus:

1 km resolution with sufficient throughput

ICON Model 1km



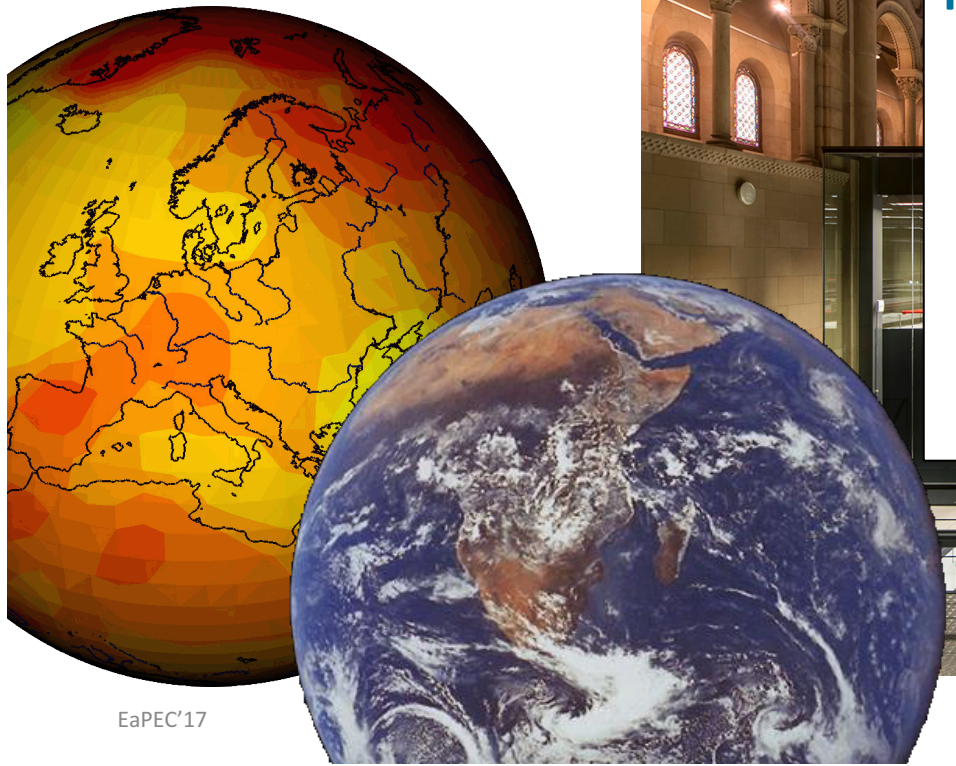
EC-Earth coupled at 10km



First global, coupled 12 km - 10 km simulations (TL1279 – ORCA12):

- EC-Earth 3.2 (IFS36r4 + NEMO 3.6 + OASIS3-MCT)
- 2,035 MPI tasks (1,170 NEMO + 848 IFS + 16 XIOS + 1 runoffmapper: 60 days / day
- Mare Nostrum 3 at BSC

Complex systems

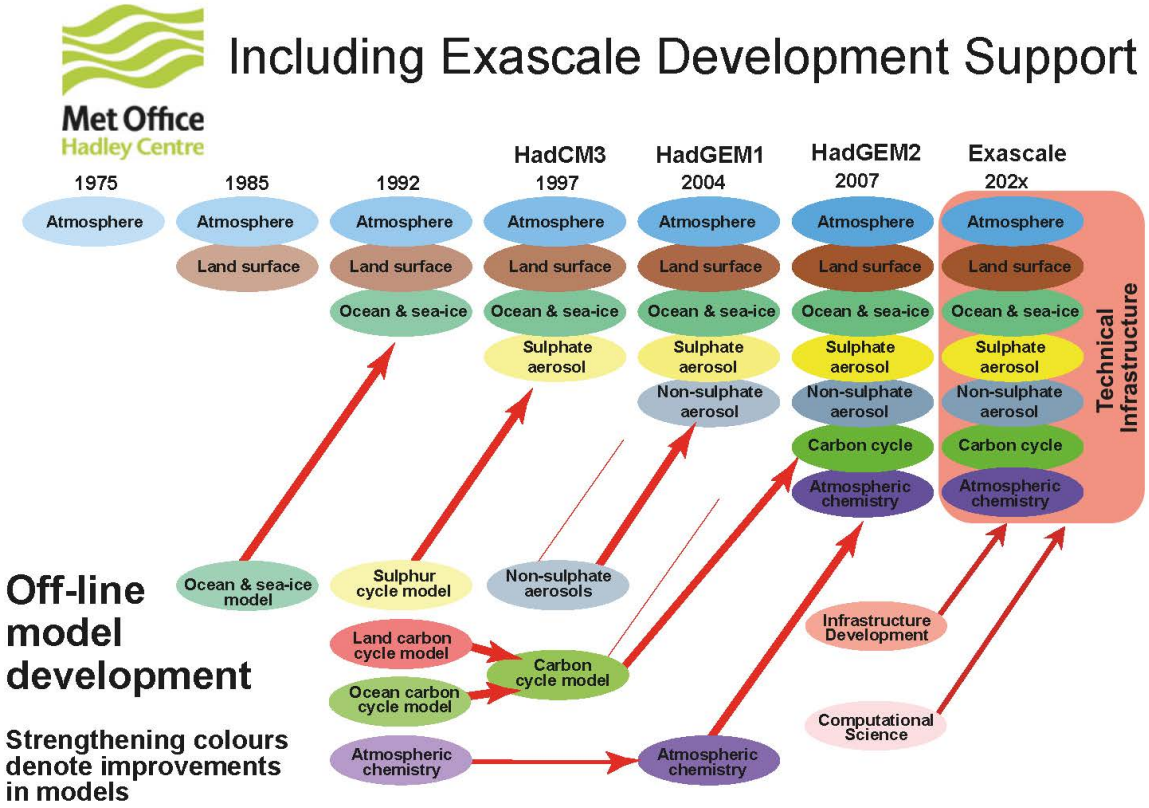


HPC clusters in different Top500 list:

- UK Met Office: Rank 11
- BSC: Rank 13
- ECMWF: Rank 23 and 24
- DKRZ: Rank 34

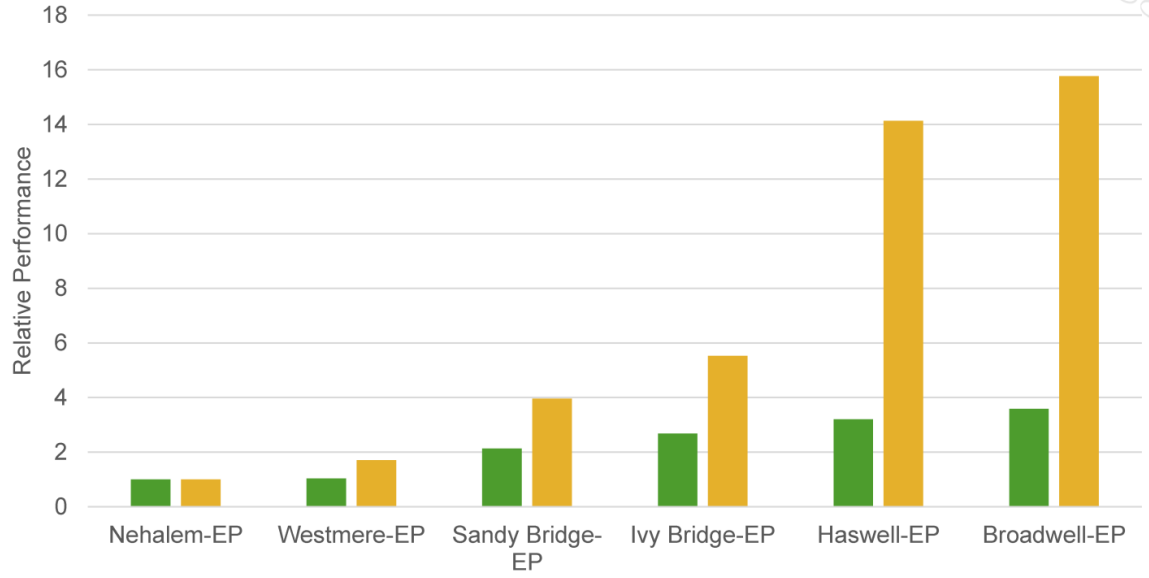
- Nevertheless operational models are **far away from 1 km**

Complex models



Not as efficient as we would like

FLOPs aren't the bottleneck!



WRF Data from SPEC-FP-2006-rate:
https://www.spec.org/cgi-bin/osgresults?conf=rfp2006

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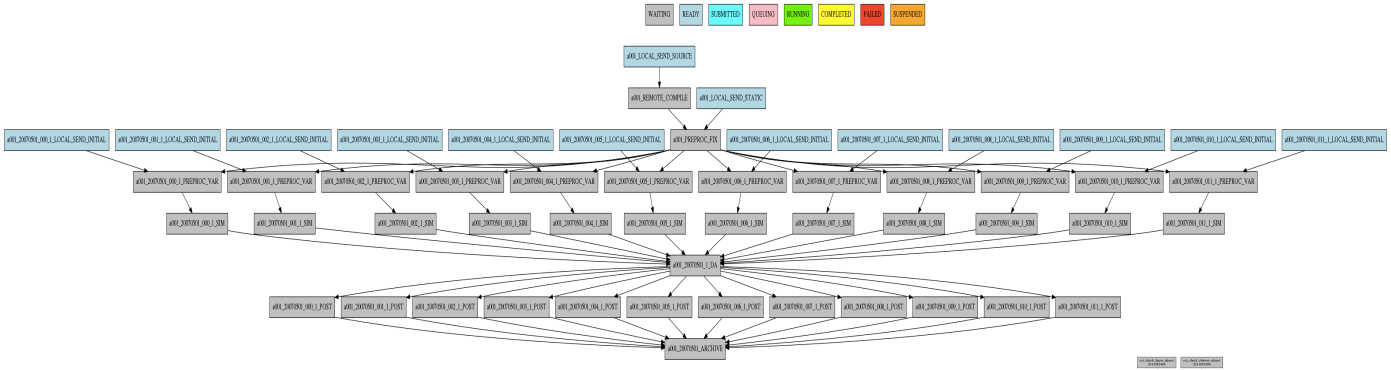
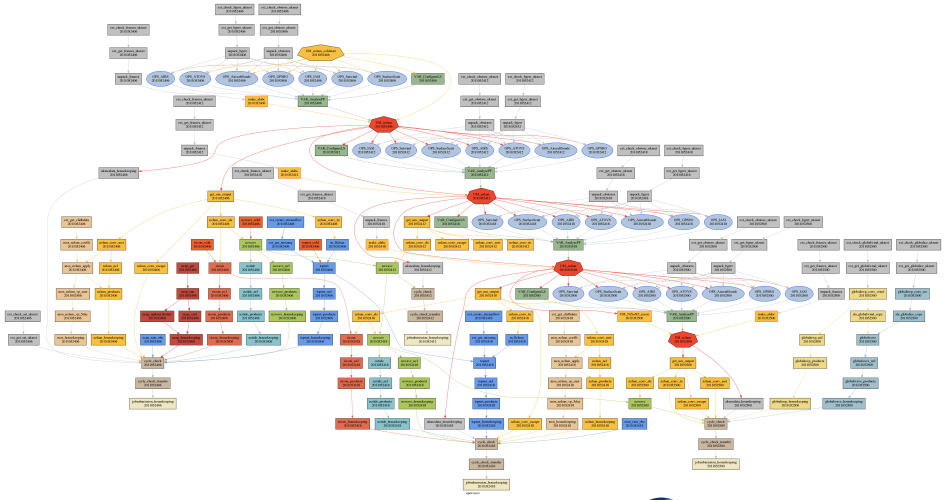
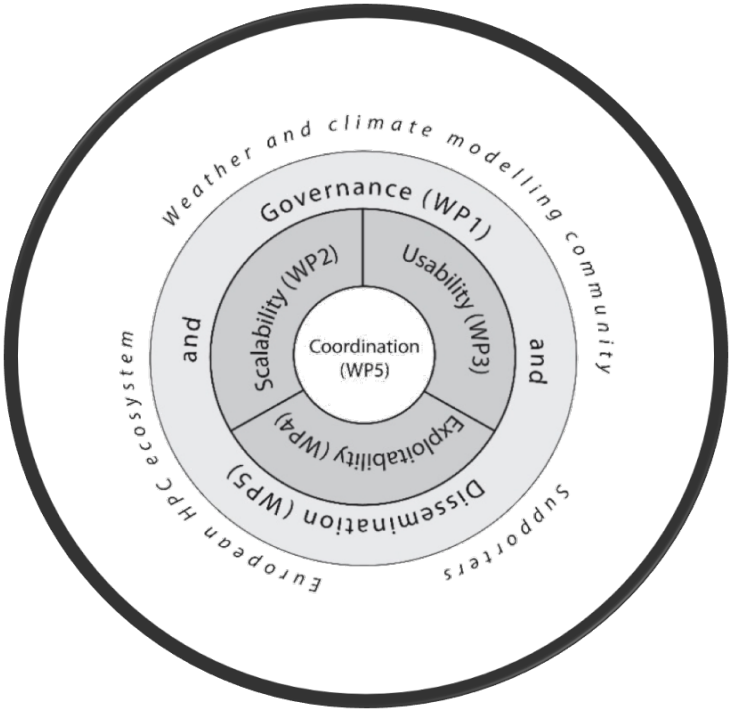
Not easy to run





Structure



WP1 Governance and engagement

- Engagement and governance
- Enhancing community capacity in HPC
- Strategic interaction with HPC ecosystem and HPC industry
- Sustainability and business planning

WP2 Scalability

- Support, training and integration of state of-the-art community models and tools
- Performance analysis and inter-comparison
- Efficiency enhancement of models and tools
- Preparing for exascale

WP3 Usability

- ESM end-to-end workflows recommendations
- ESM system software stack recommendations
- ESM scheduling
- Co-Design for Usability

WP4 Exploitability

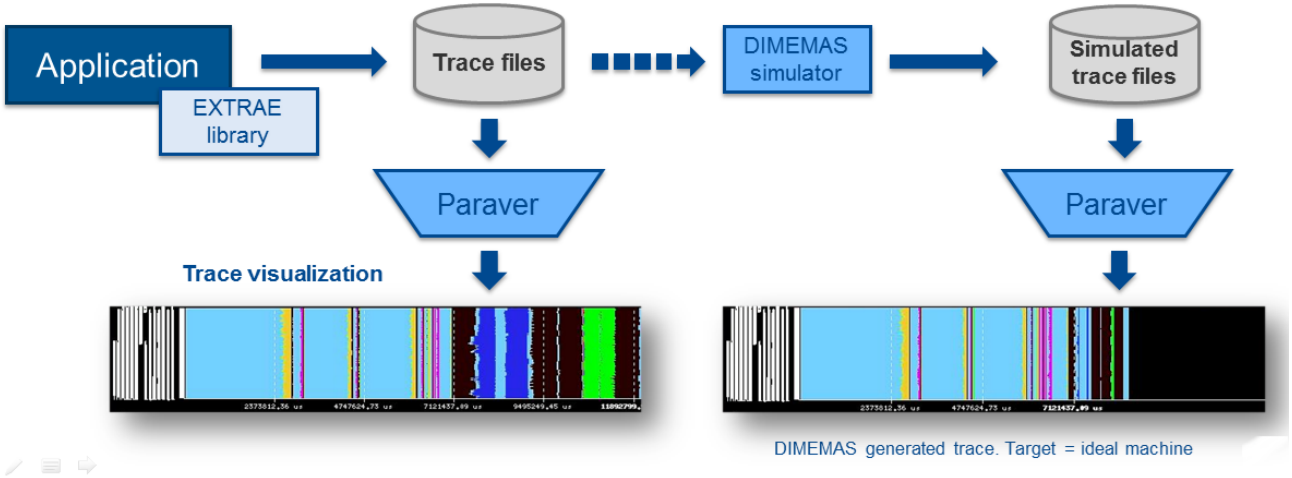
- The business of storing and exploiting high volume climate data
- New storage layout for Earth system data
- New methods of exploiting tape
- Semantic mapping between netCDF and GRIB

WP5 Management and Dissemination

An example of our research activities

Performance analysis

- Since 1991
- Based on traces
- Open Source: http://www.bsc.es/paraver
- **Extrae**: Package that generates Paraver trace-files for a post-mortem analysis
- **Paraver**: Trace visualization and analysis browser
  - Includes trace manipulation: Filter, cut traces
- **Dimemas**: Message passing simulator



DIMEMAS generated trace. Target = ideal machine

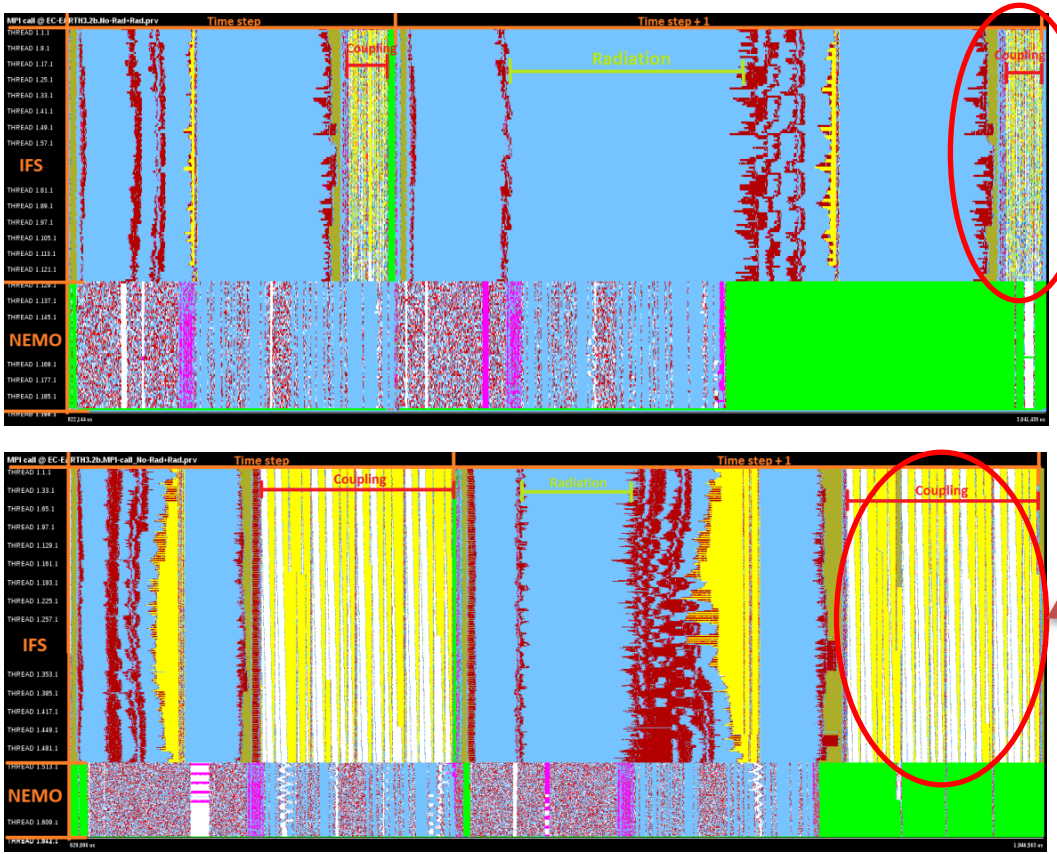
Performance analysis (II)

IFS: 128 cores

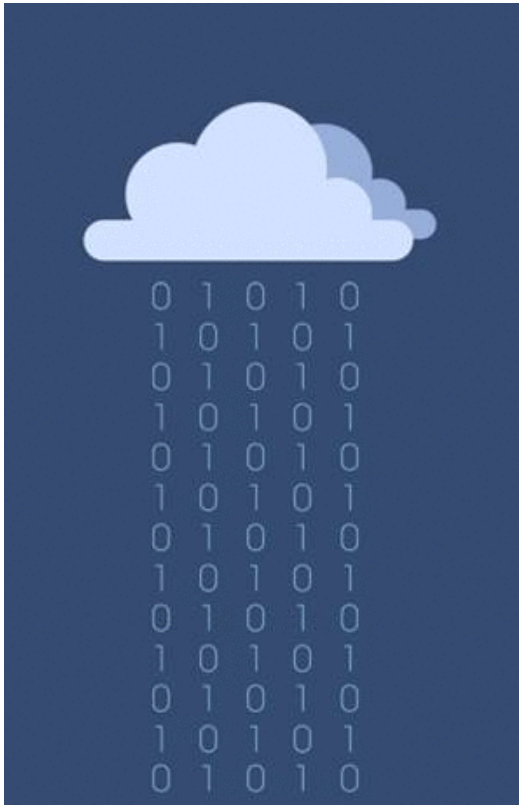
NEMO: 128 cores

IFS: 512 cores

NEMO: 128 cores



Increase of coupling time

THANK YOU

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