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Barcelona Supercomputing Center
Centro Nacional de Supercomputación

EXCELENCIA SEVERO OCHOA

THE MULTIFACETED ASPECTS OF MODEL PERFORMANCE

IS-ENES2: Crossing the Chasm Workshop

Francisco Doblas-Reyes
Kim Serradell

MODEL PERFORMANCE

“Castells” Contest at Tàrraco Arena Plaça de Tarragona (October 2016)

Small and “trivial” modifications

Big Projects and challenges

BSC Performance tools

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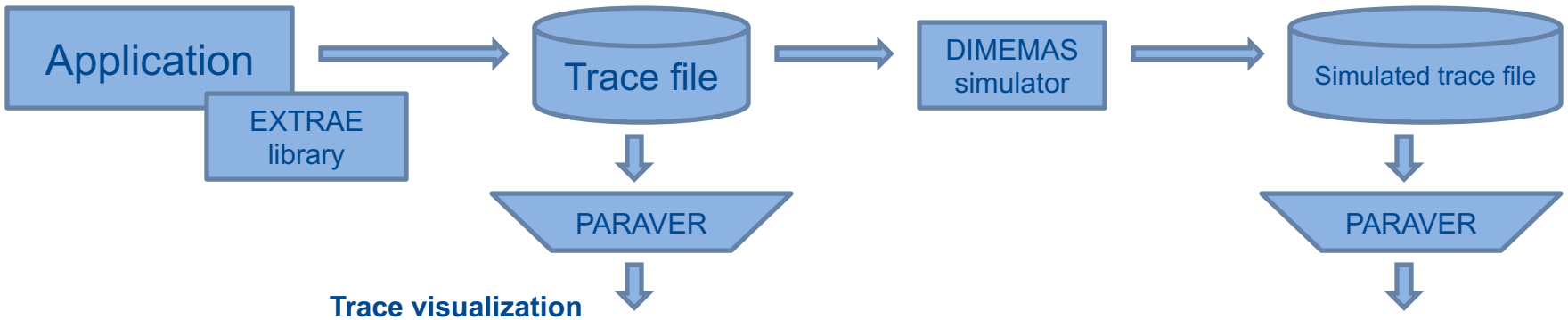
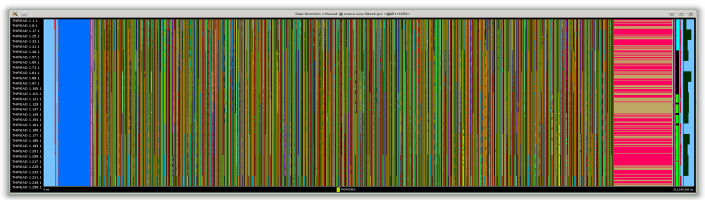
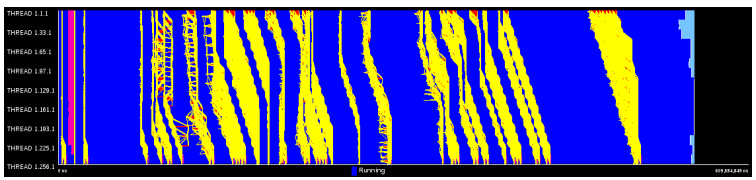
BSC-CNS performance tools:

- EXTRAE: Trace generation package.
- PARAVER: Trace visualization and analysis tool.
- DIMEMAS: Simulation tool for analysis on a configurable target platform.

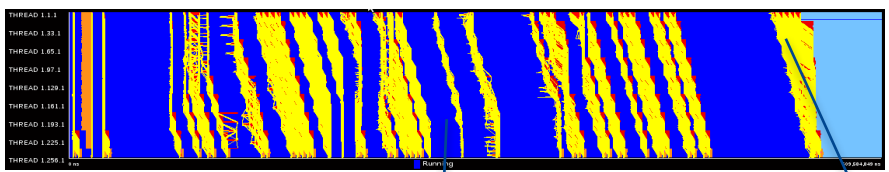


Trace visualization





DIMEMAS generated trace. Target = ideal machine

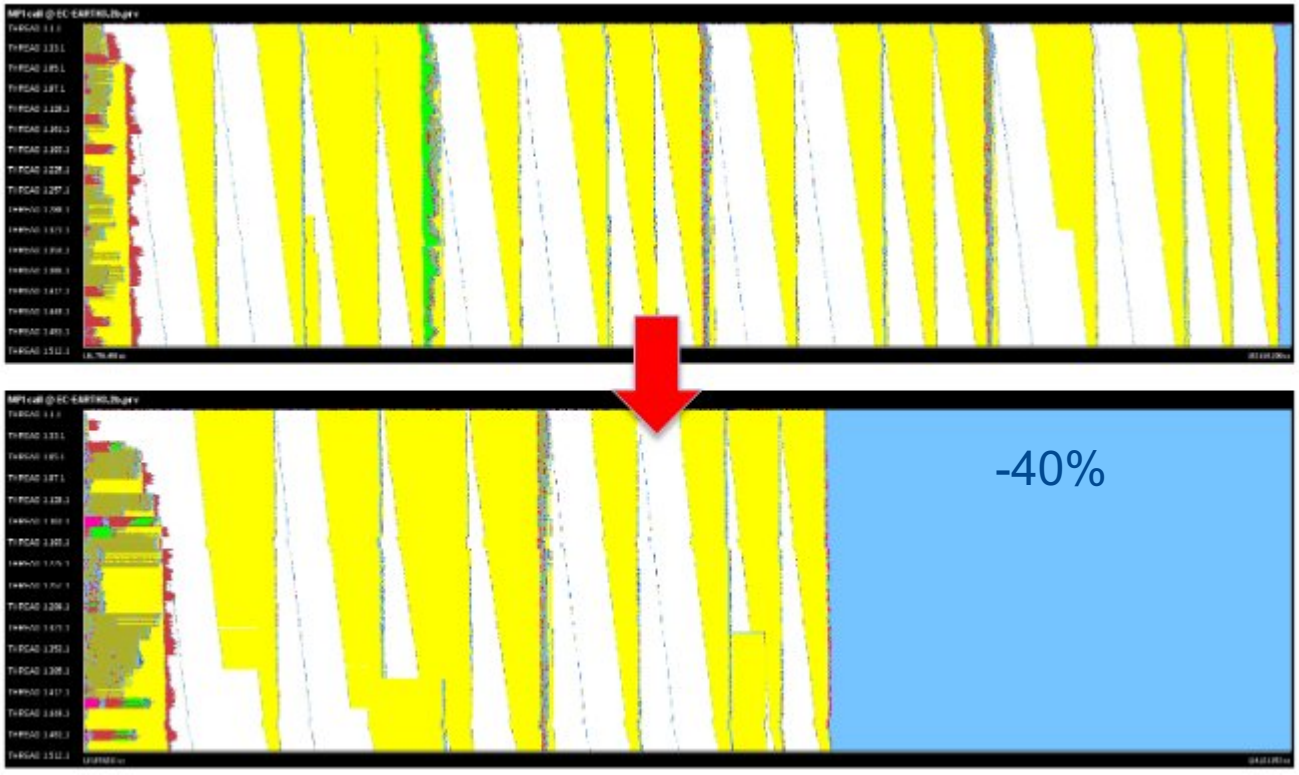


Blue regions = computation

Yellow lines = comunication

Performance analysis

- Optimize coupling strategy between IFS and NEMO
  - Analysing the coupling strategy between IFS and NEMO Aggregation of message and calculations (by default IFS passes variables to NEMO in several instances)



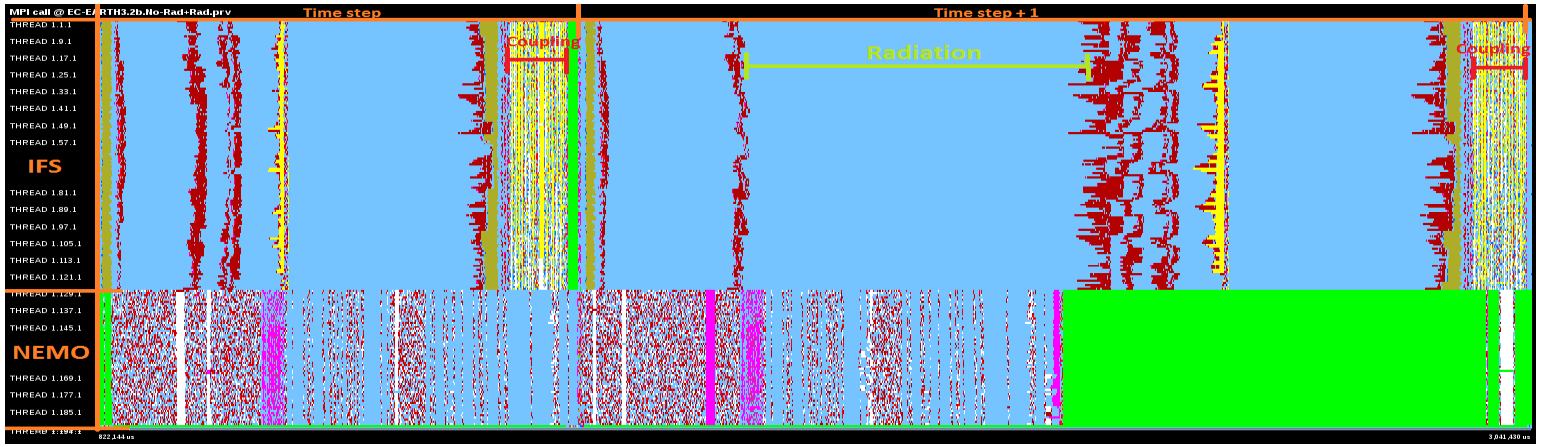
4 groups of variables

2 groups of variables

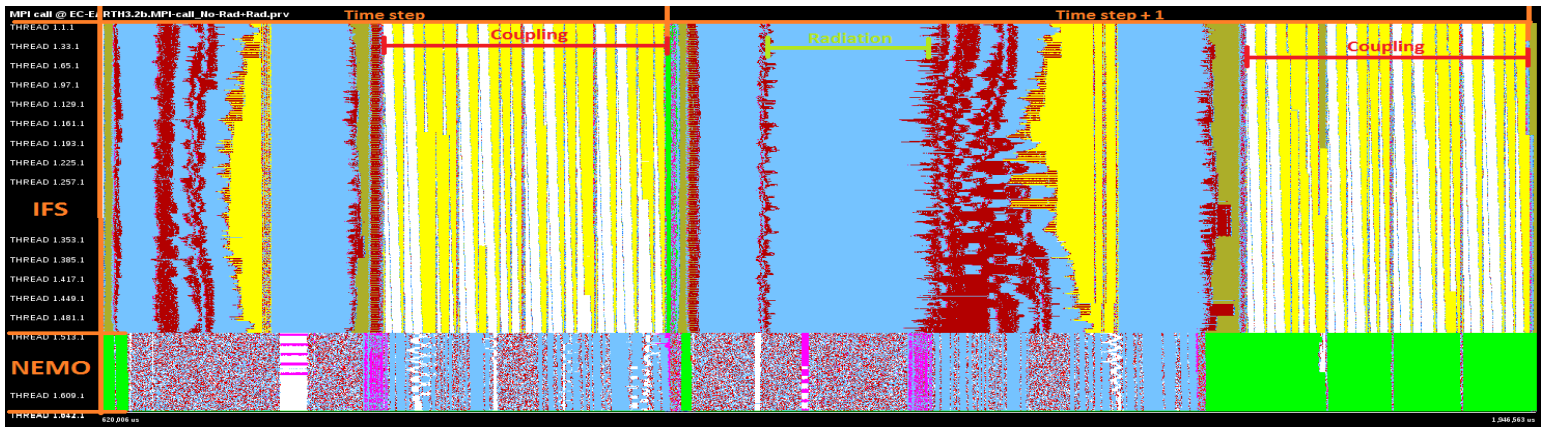
Top: using default namcouple file
Bottom: using an optimized namcouple file (pack variable groups with similar type of coupling together)

Coupling in high resolution

128 MPI processes for IFS

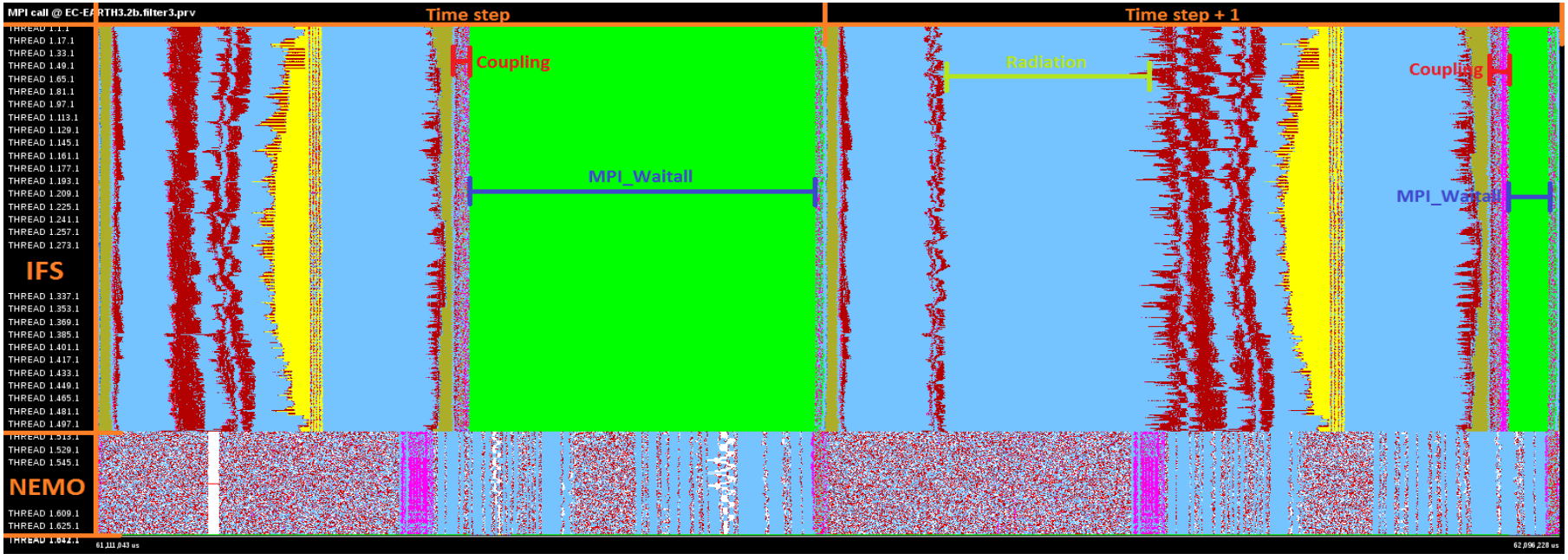


512 MPI processes for IFS



- Different traces to see the impact when scaling the number of cores
  - We can see with more cores the coupler phase is not scaling and takes longer to complete

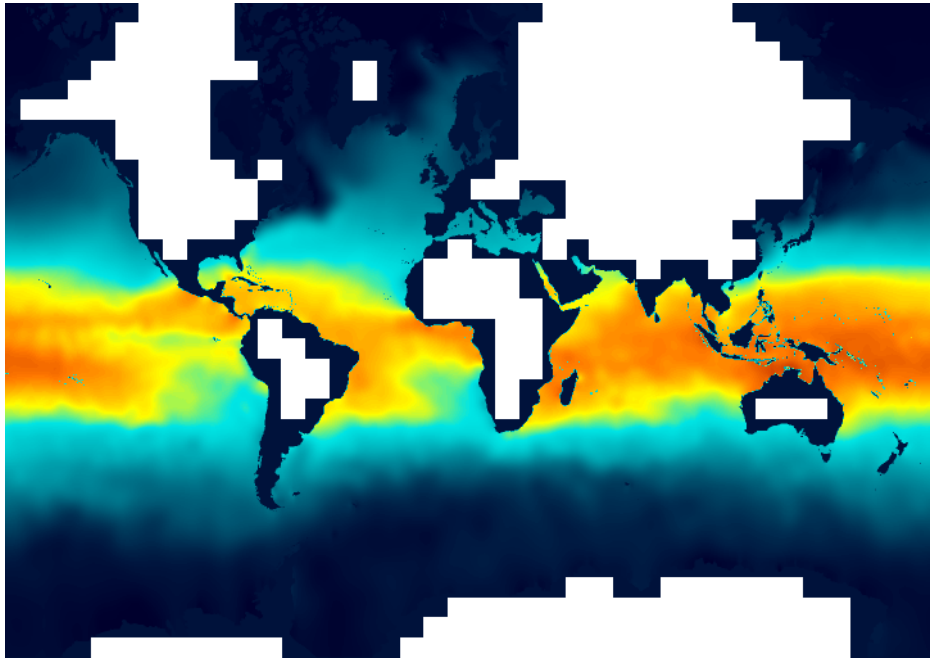
Optimizing coupling in high resolution



- Option for CONSERV operation has two implementations
  - communications all-to-one/one-to-all using MPI_send/MPI_irecv
  - collective and non-blocking communications MPI_igather/MPI_iscatter

Exclude land-only processes in NEMO

- ELPiN: A tool that allows finding adequate namelist parameters to exclude land-only processes in NEMO simulations
- NEMO decomposes automatically the domain
  - Computes and communicates in land-only processes and then discards the result
- Currently performing an evaluation of the results produced

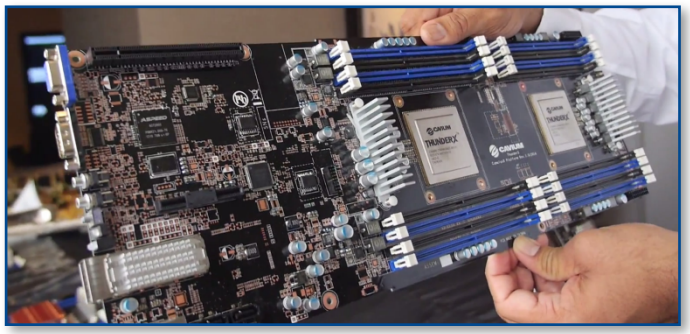


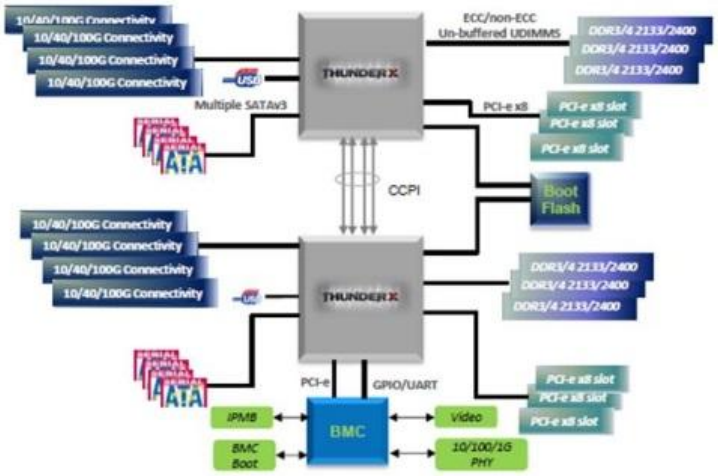
- ORCA025 domain decomposed in 1287 sub-domains
- 312 are land-only and therefore removed (24% of the total grid)

EC-Earth in ThunderX

- One of the Mont-Blanc mini-clusters.
  - Small clusters including ARMv8 (64 bit) platforms.

- 4 nodes devoted to computation, each equipped with:
  - 2x sockets Cavium ThunderX
    - 48x ARMv8-A cores each (i.e. 96 cores with shared mem each node) @ 1.8 GHz
  - 128 GB memory
  - 2x 10GbE (data network)
  - 1x 40GbE (not connected)
  - 1x 128GB SSD





EC-Earth in ThunderX

- EC-Earth 3.2 built with:
  - GCC 4.8.4, SZIP 2.1, OPENMPI 1.10.2, NETCDF 4.4.0, HDF5 1.8.17, LAPACK 3.6.0
  - T255L91-ORCA1 configuration
- Successful run of one month of simulation (output included)
- First execution times needs to be improved
  - 10.508 seconds using 258 cores (128 IFS, 128 NEMO, 1 XIOS, 1 runoff)
  - 923 seconds using the same number of cores in MN3
  - Work required to improve these numbers

OmpSs programming model

- Extend OpenMP with new directives to support asynchronous parallelism and heterogeneity
  - Overlap communication and computation
  - Apply Dynamic Load Balancing library

- Two stages compilation
  - Mercurium compiler which introduces OmpSs runtime
  - Usual compiler (gcc, intel, ibm) to generate the executable

- Previous work done
  - EC-Earth 3.1 compiled and executed with OmpSs
    - NEMO is not OpenMP ready so not really useful
  - Moved to OpenIFS 40r1
    - Bugs with mercurium compiler not yet solved
    - Some corrections reported to OpenIFS developers to make the code ready for Mercurium

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Thank you!

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