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Reading, 2nd November 2016

Barcelona Supercomputing Center
Centro Nacional de Supercomputación

OpenIFS Session

EC-Earth Meeting
November 2016

Outline

- Introduction (5’)
- BSC current activities and plans (10’)
- SMHI development status (15’)
- Discussion (60’)

Discussion

- The main points discussed will be reported back to the plenary tomorrow
- Some topics are already defined. But feel free to add new ones during the discussion
- Mix of topics:
  - Scientific
  - Technical
  - Planning
- The main goal is provide and generate engagement
  - Ask for and coordinate commitments
  - Define a communication strategy (telcos, F2F, portal, …)

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BSC activities and plans with OpenIFS

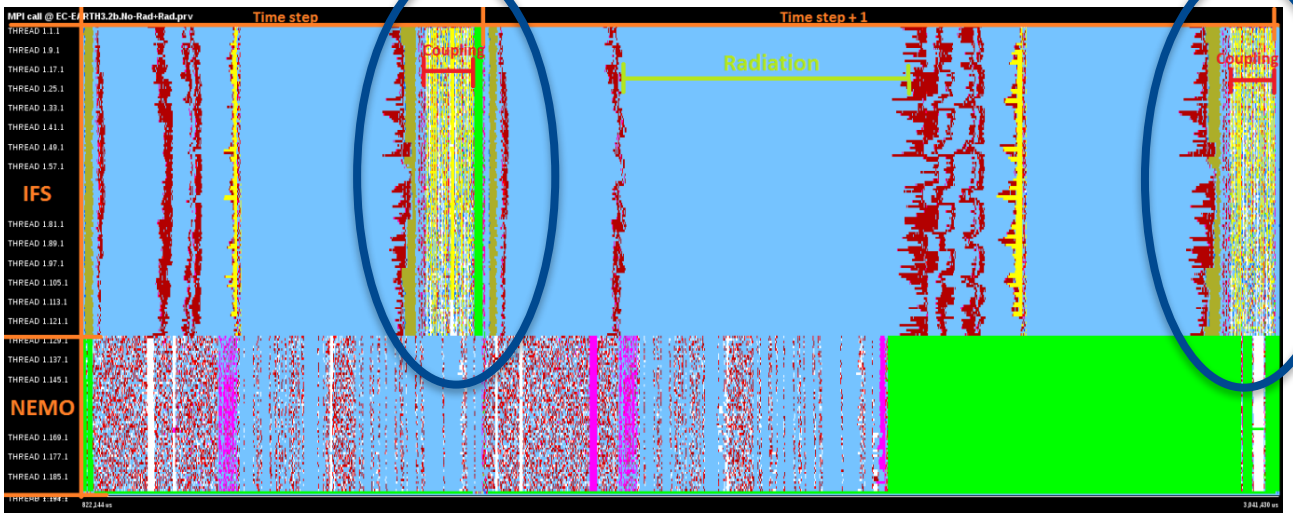
M. Acosta, M. Castrillo, F. Doblas-Reyes,
K. Serradell, O. Tintó, X. Yepes

Performance analysis & optimizations

- We used to think coupling (IFS-NEMO) was not a big issue

IFS: 128 cores

NEMO: 128 cores



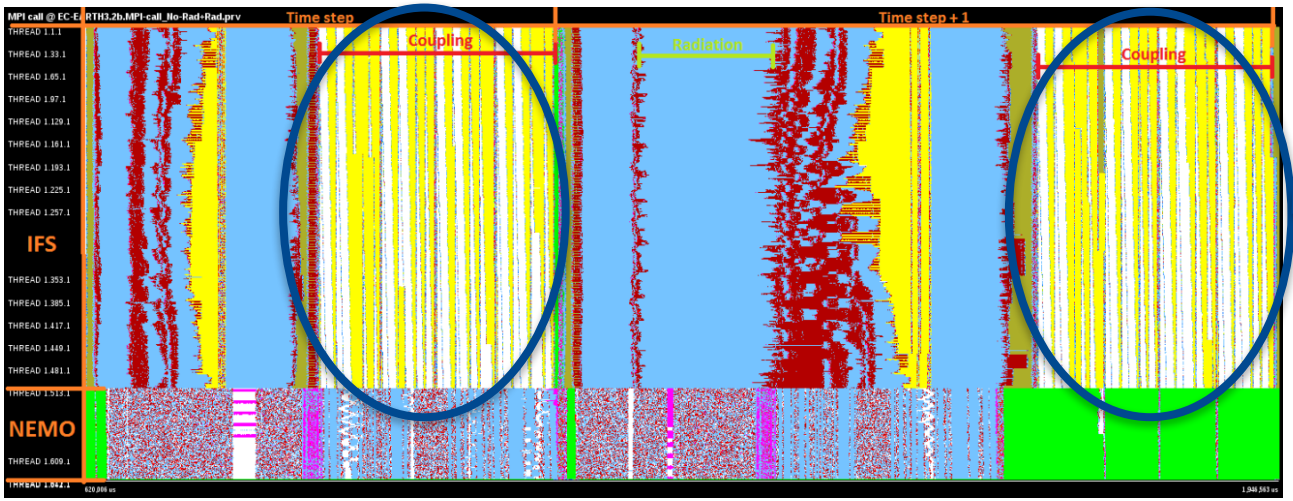
Coupling time is increased

TIME

- But it seems that it is when increasing number of cores

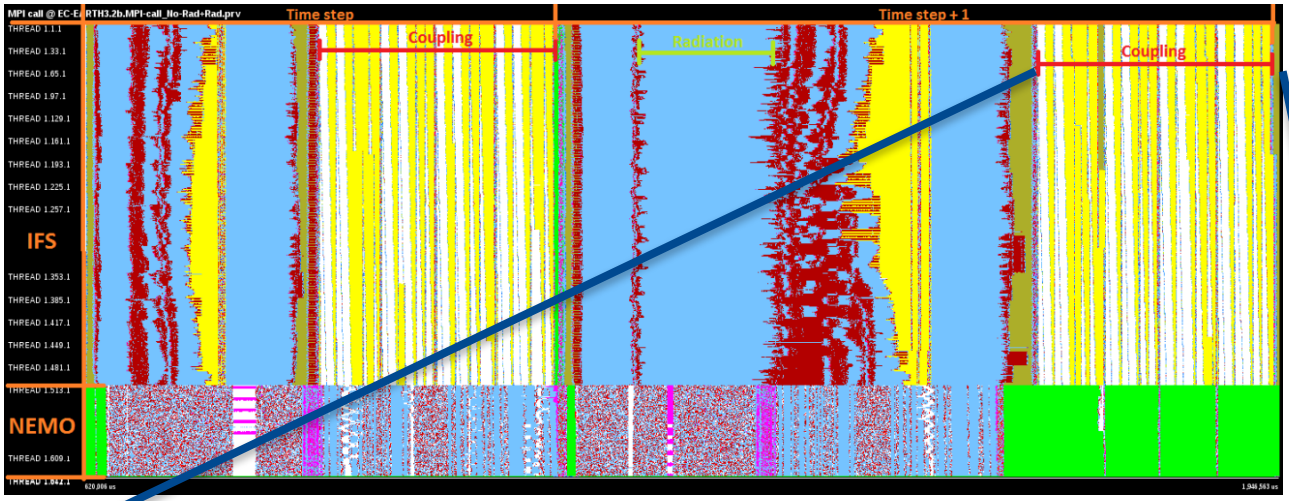
IFS: 512 cores

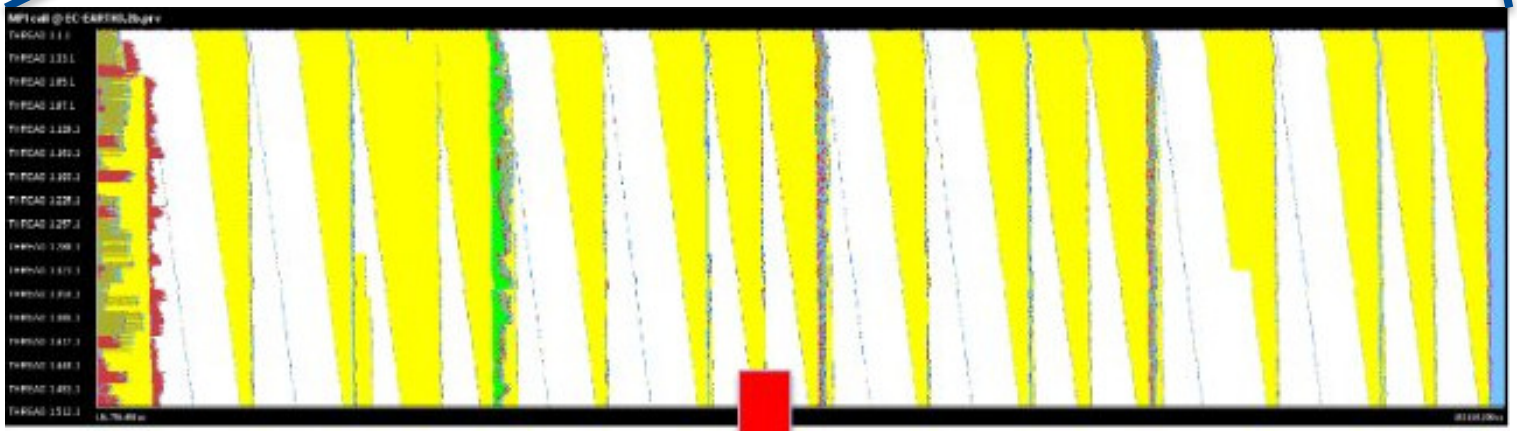
NEMO: 128 cores



Performance analysis & optimizations

- Let's see what happens inside the coupling





Performance analysis & optimizations

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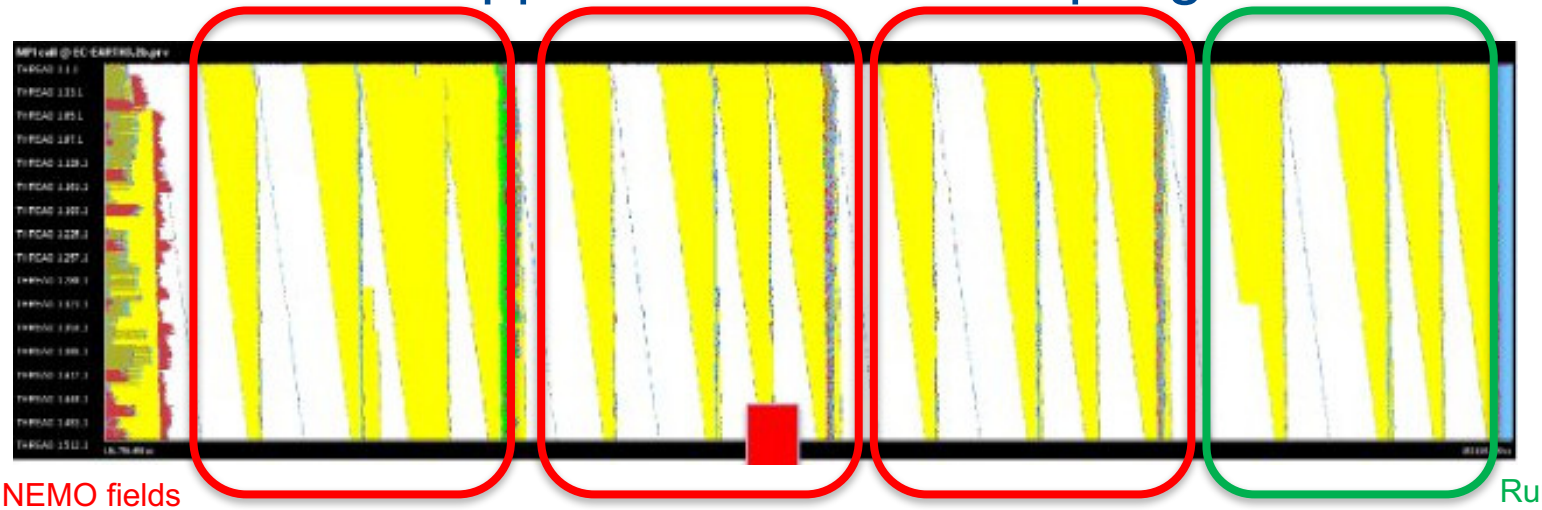


NEMO fields

Runoffmapper fields

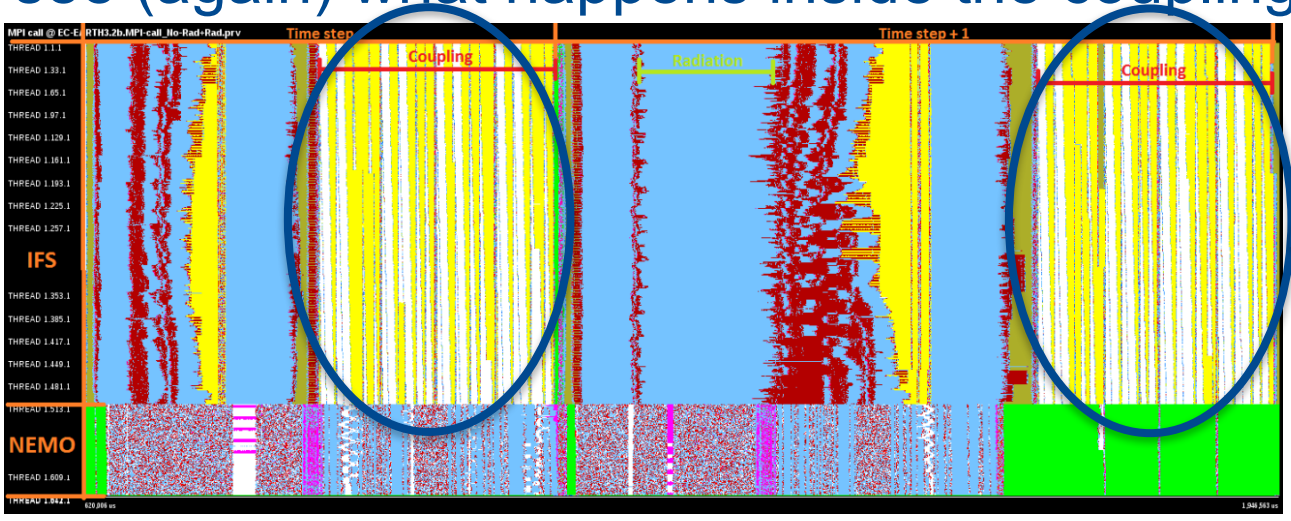
1st Group 2nd Group 3rd Group 4th Group

- Why 4 groups of variables? Why not packing in only 2?

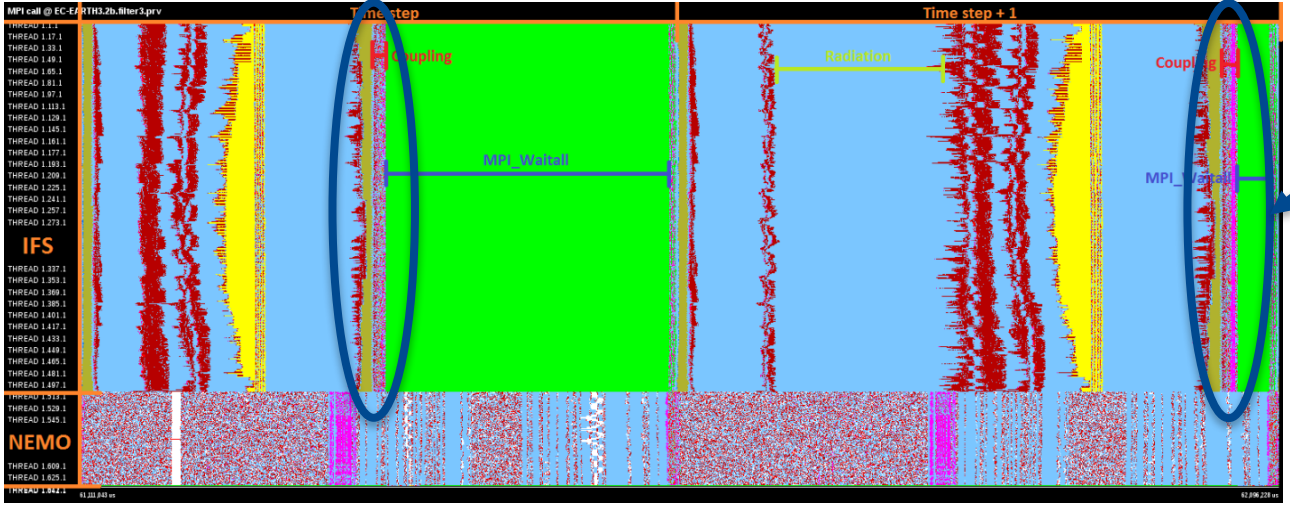
1st Group 2nd Group

Performance analysis & optimizations

- Let's see (again) what happens inside the coupling



- Working with OASIS developers, we explored another implementation for coupling (called OPT)



Coupling time is reduced by 90%

Performance analysis & optimizations

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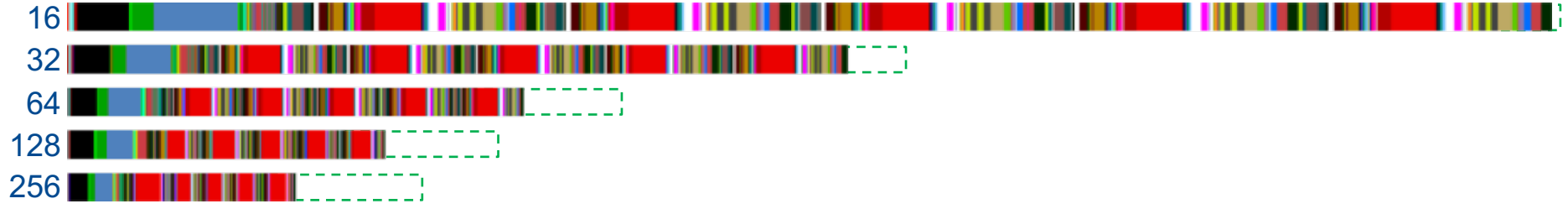
- BSC has been working successfully with the NEMO development team to improve NEMO model
- Could a similar collaboration be established with ECMWF?

Original code (ORCA2-LIM3)

- A success case: message packing, reordering and convergence check reduction have been applied

Optimized code



- With these optimizations, **40% improvement in model speed** is achieved
- These improvements are now in both NEMO3.6 STABLE and EC-Earth 3.2, substantially benefiting our CMIP6 simulations

OpenIFS to test future technologies

- New programming models are been developed and ported to weather and climate models
  - BSC is developing OmpSs (an extension to OpenMP with new directives to support asynchronous parallelism and heterogeneity)
    - It allows the overlap of communication and computation
    - Apply the Dynamic Load Balancing library (to reduce load balancing)
  - WIP. Since 01/11, OpenIFS compiled and runs with OmpSs!

- We strongly believe in **energy efficient computing** (more cores but cheaper ones consuming less energy)
  - Testing new architectures to run our model
    - ARM technology (CPU's used in your smartphones and tablets)
      - EC-Earth 3.2 ported and executed in ARMv8-64bit Cluster
      - Successful run but 10x slower than MareNostrum 3
      - Next test: OpenIFS 40r1

Future plans

- OpenIFS 43r1
  - Why is BSC is so interested in this cycle?
    - Single precision
    - Improved performance
    - Expect large performance impact using octahedral grid in high resolution
    - More relevant interaction with ECMWF (both technical and scientific)

- BSC is interested in these topics but this work is also in the long-term interest of the EC-Earth community

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SMHI development status

Discussion

List of potential topics

- To what point is important for EC-Earth to follow the OpenIFS cycles?
  - Could we define a planning timeline?
  - EC-Earth is expected to be driving the request for 43r1
- Potential collaborations between EC-Earth, OpenIFS, ECMWF (both scientific and technical)
- Scientific evaluation (how, when, who)
- Optimization and performance analysis (how, when, who)
- Initial condition generation
- Resolutions targeted
  - T255ORCA1
  - T511ORCA025
  - TCo1279ORCA012 (ESiWACE 2nd demonstrator)
- C-IFS and the wave model
- XIOS in OpenIFS?

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Thank you!