COSMO-CLM^2 / OASIS

OASIS coupling between COSMO-CLM and CLM (Community Land Model)

IS-ENES dedicated user support

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OASIS

- First version in 1990
- Open source, LGCL licence
- Public domain external libraries (Netcdf, MPI, SCRIP, MCT …)
- Users community of ~40 groups (5 continents !)
- Developed and supported by CERFACS
- European collaborations:
  ENES board, PRISM, IS-ENES FP7 EU project, IS-ENES2 to follow
  Software targeted by PRACE IP2

Main concept: separate executables, non intrusive interface

OASIS = 1 communication library to be linked to models + 1 extra executable

COSMO-CLM^2
An example of OASIS coupling implementation

Starting from an existing coupling

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Initial configuration

COSMO regional atmospheric model

Call to subroutine TERRA land model
Same grid
Same timestep

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ETH coupling « per subroutine »

COSMO regional atmospheric model

+ CLM model (NCAR)

COSMO-CLM^2 / OASIS

ETH coupling « per subroutine »

COSMO-CLM^2 model

Split model into 3 parts: initialization, run, ending
Call them within COSMO
Adapt grid, mapping and time step to COSMO

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OASIS coupling

COSMO model

OASIS coupler

CLM model

COSMO-CLM^2 / OASIS

OASIS coupling: model interface

COSMO model

CLM model

Implement 5 OASIS basic operations
1- Init phase: use OASIS created local communicator
2- Define phase: communicate gridding/mapping to OASIS
3- Unplug forcing reading and plug OASIS cpl field receiving
4- Plug OASIS cpl field sending
5- Let OASIS switch off MPI

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OASIS coupling: coupler parametrization

OASIS coupler

Write the OASIS parameter file (ASCII)
(choose coupling fields and interpolation type)

Launch 3 executables with a single aprun/mpiexec command

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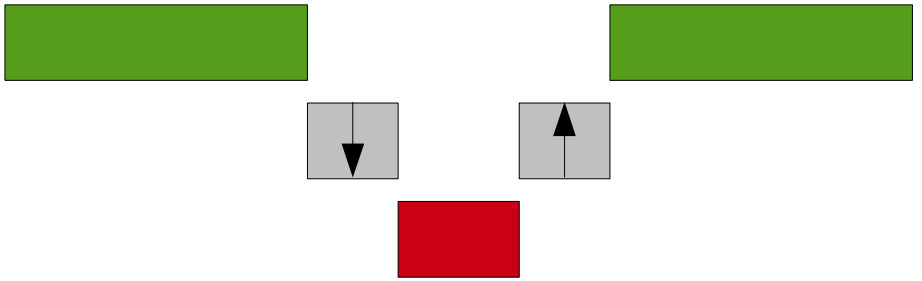
OASIS coupling



COSMO model

OASIS coupler

CLM model

Drawbacks:

- 3 executables: models (and coupler) need computing resources
- Need more inter-node and collective communications
- Different grids: interpolation needed (additional time)

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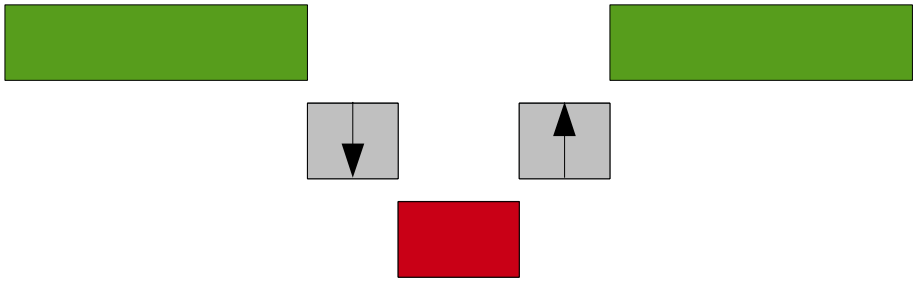
OASIS coupling



COSMO model

OASIS coupler

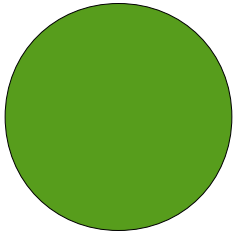
CLM model

Advantages:

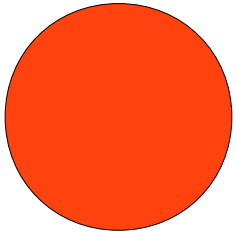
- Modular: quick implementation (not too much version dependant)
- Models gridding, partitioning and time stepping could be $\neq$

COSMO-CLM^2 / OASIS

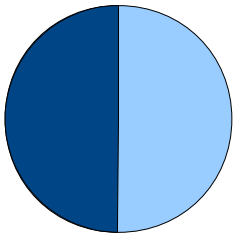
Configurations



COSMO-TERRA (single executable)



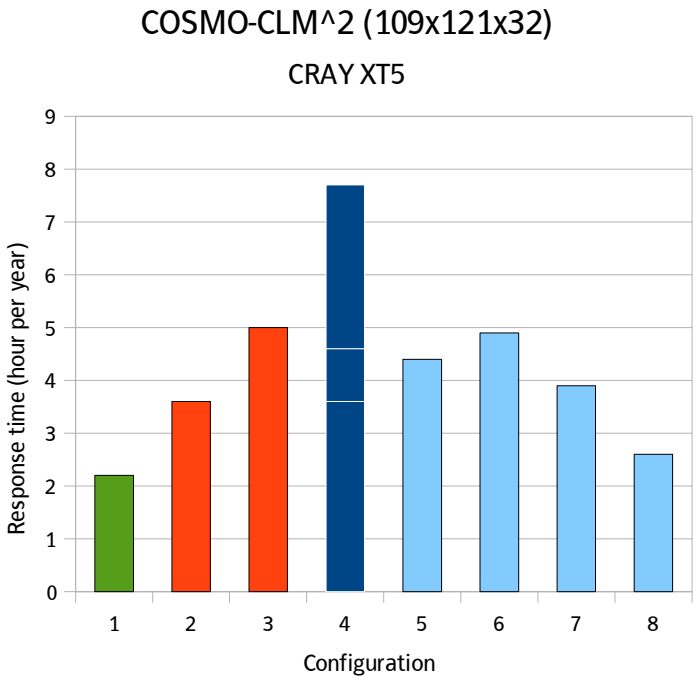
COSMO-CLM^2 (single executable)



COSMO-CLM^2-OASIS (3 executables)

COSMO-CLM^2 / OASIS

Compared performances (CLM version 3.5)



1: cosmo-terra, 132 cores
2: cosmo-clm^2 per subroutine, initial config, 132 cores
3: cosmo-clm^2 per subroutine, initial config, 60 cores
4: cosmo-clm^2-oasis3, 132 (60+60+12) cores,
coupling tstep = 240s
5: idem but, coupling step = 1h
6: idem but 132 (84+36+12) cores,
coupling step = 240s, models // call
7: idem but coupling step = 1h
8: idem but 204 (132+60+12) cores

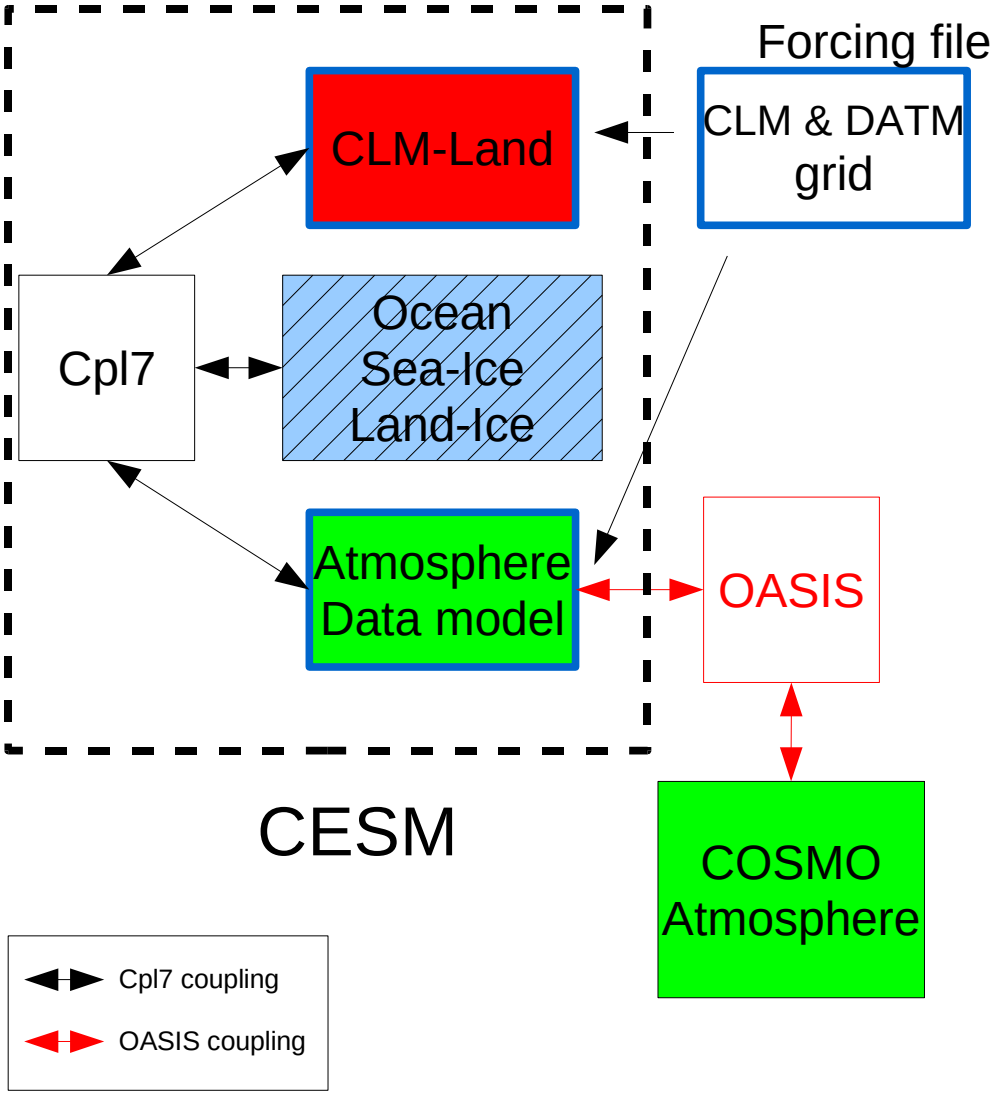
COSMO-CLM^2 / OASIS

CLM4

Nothing to change on COSMO interface

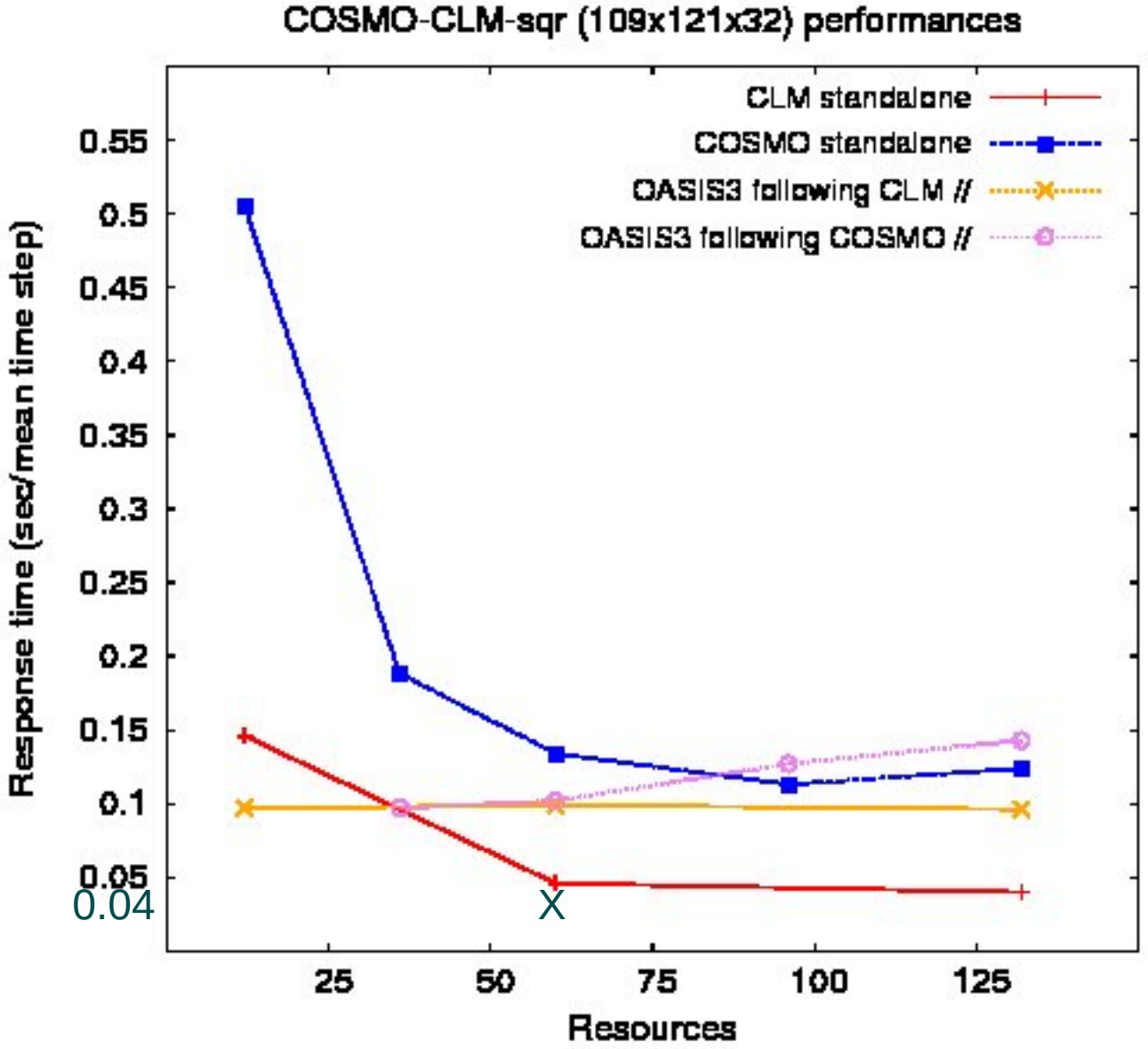
General OASIS interface on CESM
(possible coupling of other components)

Better performances coupling every
CLM subdomain (PE) with OASIS but
coupling on master PE possible
(mainly due to DATM
reading on “strdata_advance”
and read data scattering on “datm_scatter”)



COSMO-CLM^2 / OASIS

CLM4



CLM 4	0.04	X

COSMO-CLM^2 / OASIS

Conclusion
COSMO-CLM^2 with OASIS

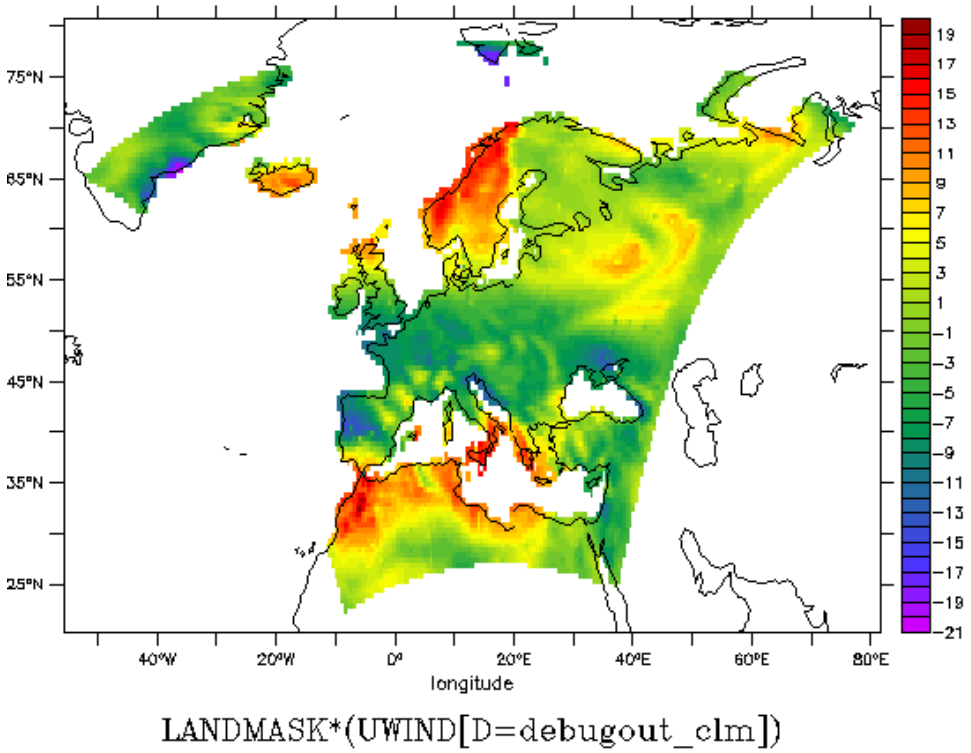
Non intrusive OASIS interface for COSMO (released), CLM3.5, CLM4 implemented ...

- Possibility to connect other CESM models (runoff, sea, sea-ice …) with existing interface
- Possibility to couple other models via OASIS (NEMO)
  Ex: IS-ENES2 proposal CAM-NEMO coupled model (with OASIS, CPL7 or ESMF)

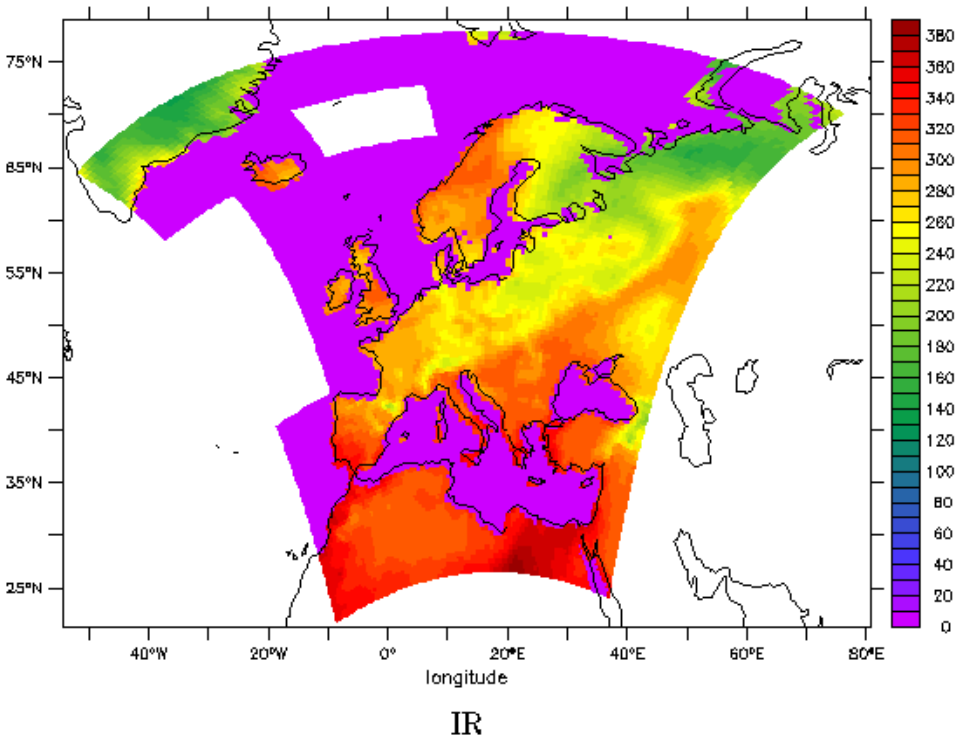
… and validated: Similarity of ETH and OASIS coupled simulations

- Possibility to test impact of other CLM gridding, mapping and time stepping

COSMO-CLM^2 / OASIS

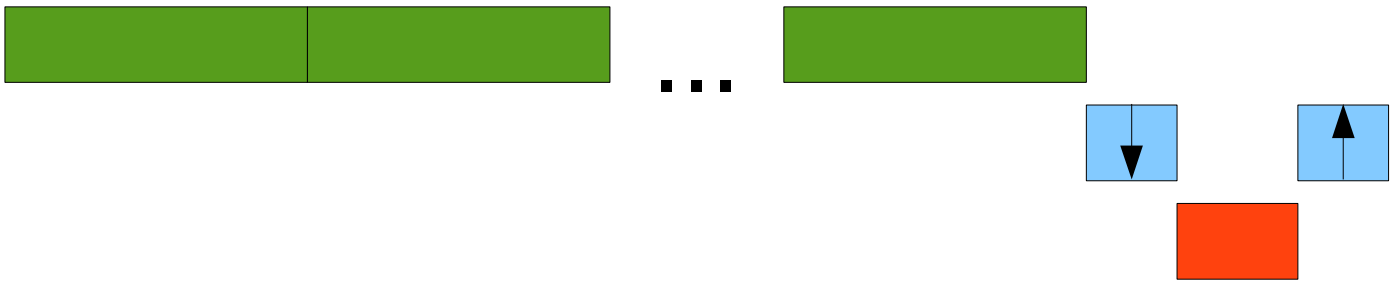


CLM grid



COSMO grid

COSMO-CLM^2 / OASIS



Different time stepping

COSMO: 240s, CLM: 3600s, coupling: 3600s

- CLM and OASIS coupling call less often
- Different physics

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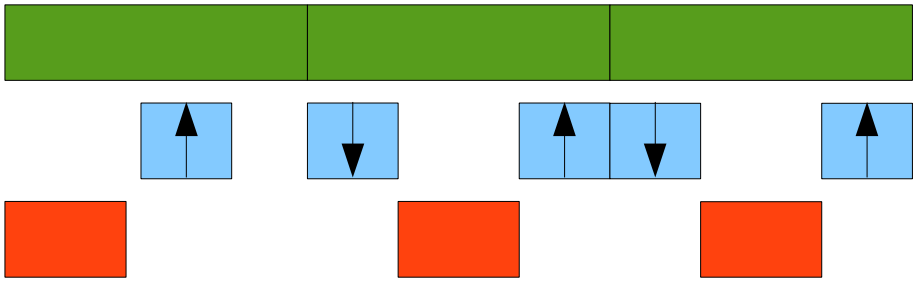

COSMO model

OASIS coupler

CLM model

Same time stepping but different sequence than config. 3

COSMO and CLM computes at the same time
Both COSMO and CLM uses cpl fields from previous time step

- Depending on parallelism, OASIS cost could be hidden
- Not the same physics

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Configuration 7 and 8

Different time stepping and different sequence than config. 3

- No extra cost (could be as fast as COSMO-TERRA)
- Different physics

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