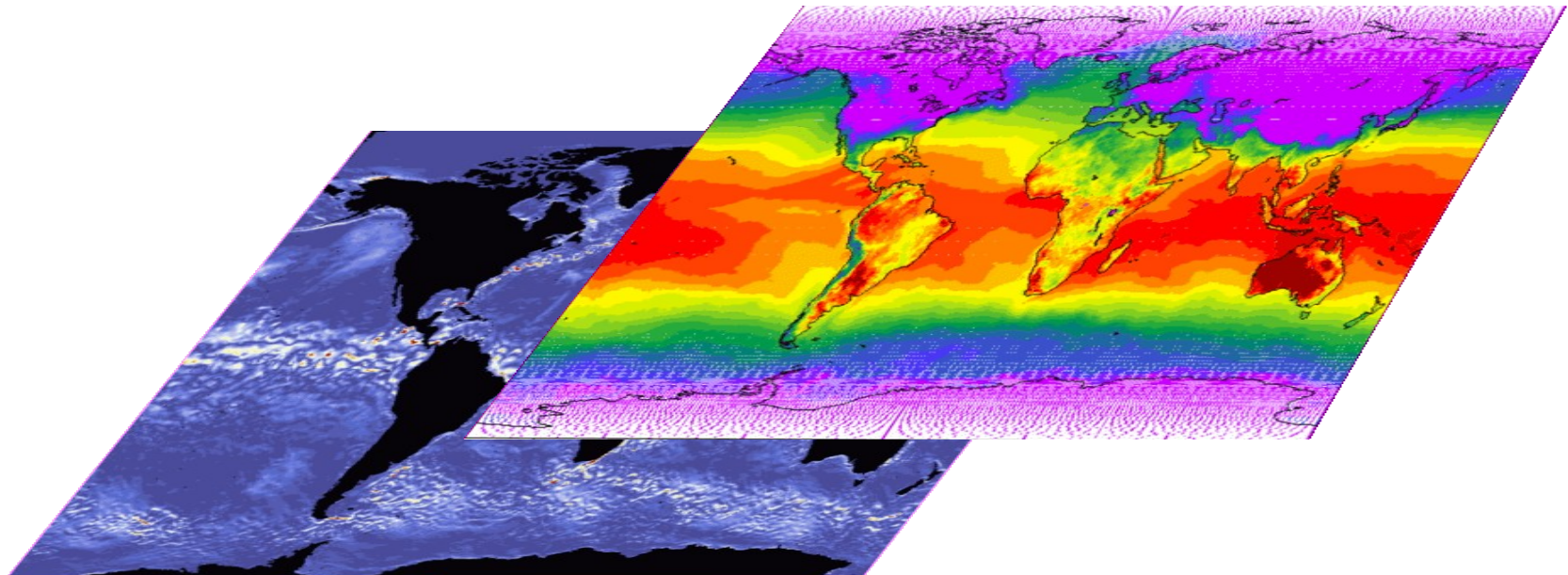


# **OASIS High End Computing on NEC SX9**



# When should I switch from Oasis3 to Oasis4 on a vector machine?

- Configuration/ Machine
- Coupling technique
- Load balancing
- Sequential coupling impact
- Pseudo-parallel coupling impact
- Oasis3 crash test ...

# High end computing Coupled Model configuration



Versions

ARPEGE v4 (CNRM) – NEMO v2 (Mercator)

OASIS

v3

Resolution

T359 (50Km), 31 vertical levels –  $\frac{1}{4}$  degree, 50 vertical levels

Comparable to highest european configurations  
(HiGEM, ECMWF Monthly Forecast System ...)

# OASIS-3 on NEC SX9



## Machine:

6+7 SX9 nodes (16 processors)

Rpeak/proc: 102 Gflops

1Tb / node

Global File System

## Code porting:

basic optimization

no Assignable Data Buffer (ADB)

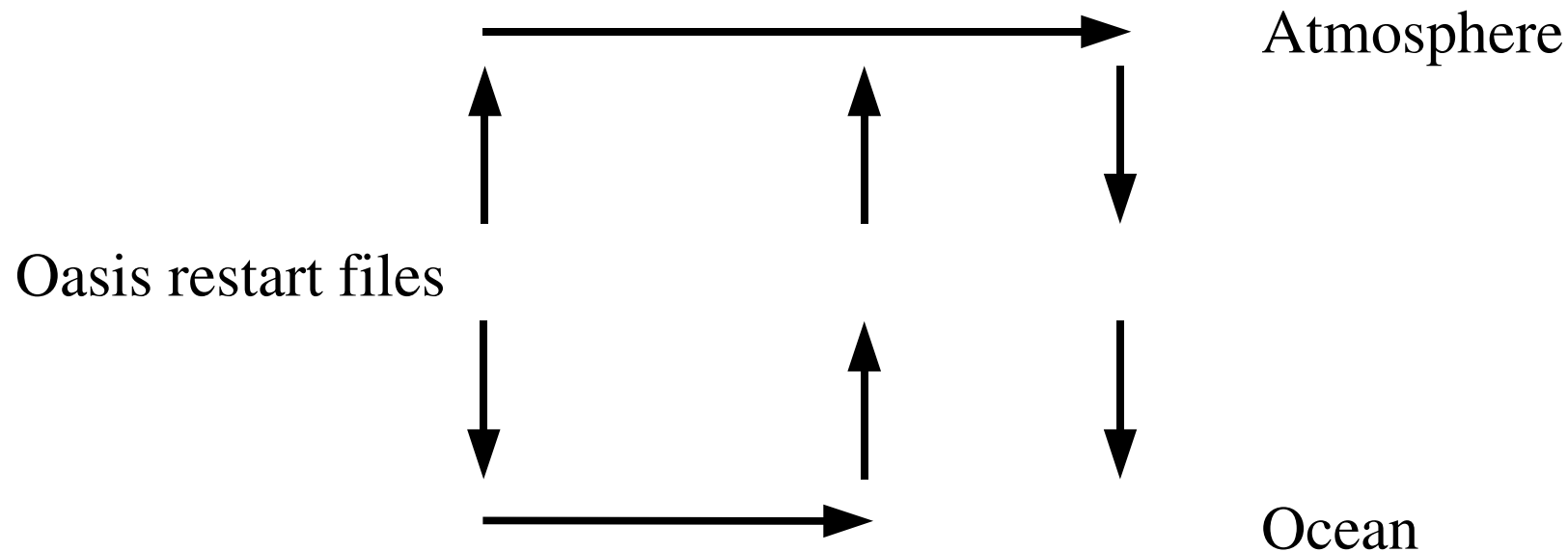
directives



## Coupling technique

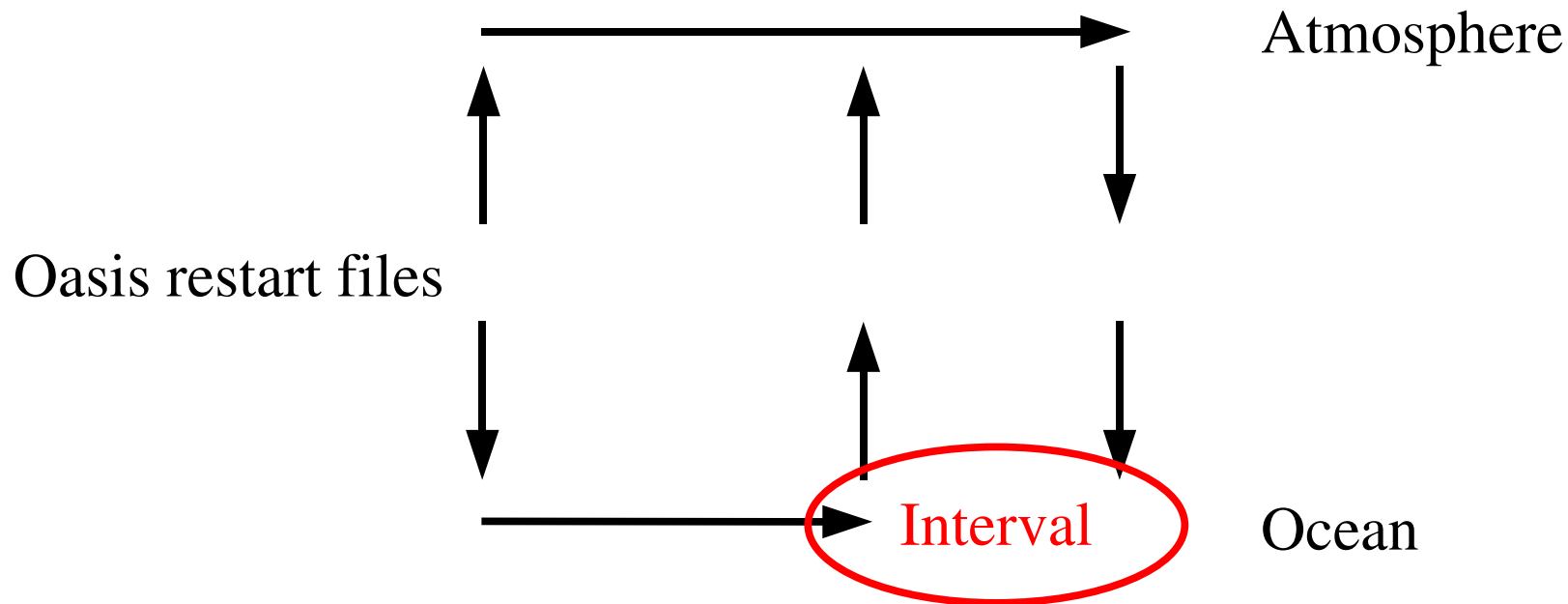
Experimental conditions:

- Ocean and Atmosphere running simultaneously (LAG option)
- MPI bufferized send (~~NOBSEND~~)



## Coupling technique

Due to vector processor efficiency (parallelization on less than 10 processors), a model still remains significantly slower than the other



Could Oasis calculations and communications duration be smaller than this interval ?

## Time counting

Minor Oasis code modification before and after prism\_get / prism\_put

Elapsed time measured (CPU is constant ...)

Several measures needed to estimate uncertainty (machine load dependent)

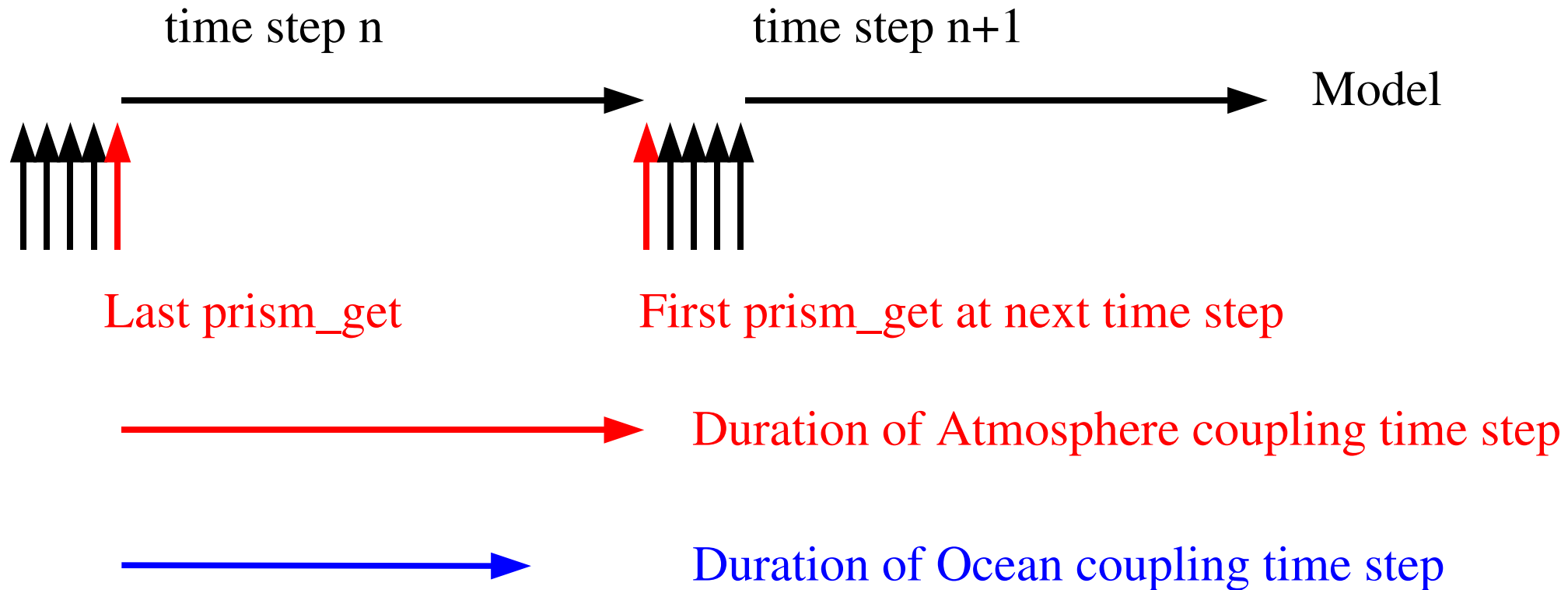
### Within Oasis:

Before very first Oasis prism\_get and after very last Oasis prism\_put:

**Total time (without NEMO restart duration)**

### Within model:

After prism\_get of last coupling field and before prism\_get of first coupling field but at next time step

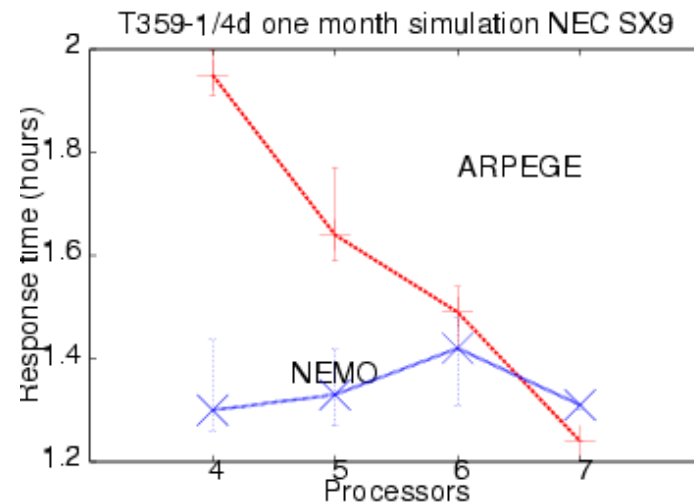
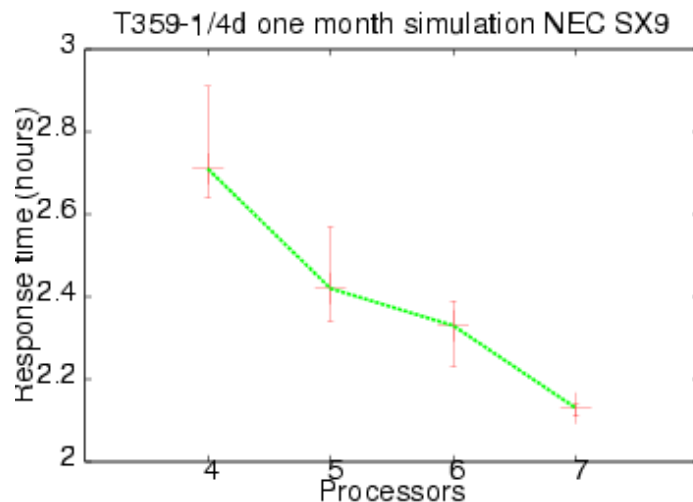


A measure of model duration (mostly) excluding coupling operations  
A tool to tune load balancing



## Load balancing

4 processors for NEMO, 4 to 7 for ARPEGE, no extra processor for Oasis  
For each test simulating 4 days of climate, 9 members ensemble  
Ensemble mean plotted below, with errors bars (min/max)



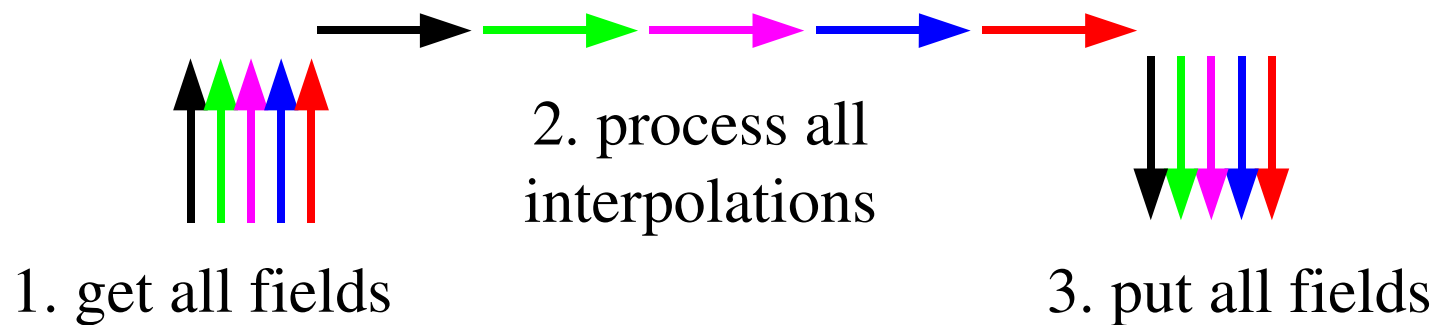
Good balance for 6-7 processors (with reasonable speedup)

Difference between CM and slowest model: **communications + interpolations + oasis process slowing down ARPEGE/NEMO processors**

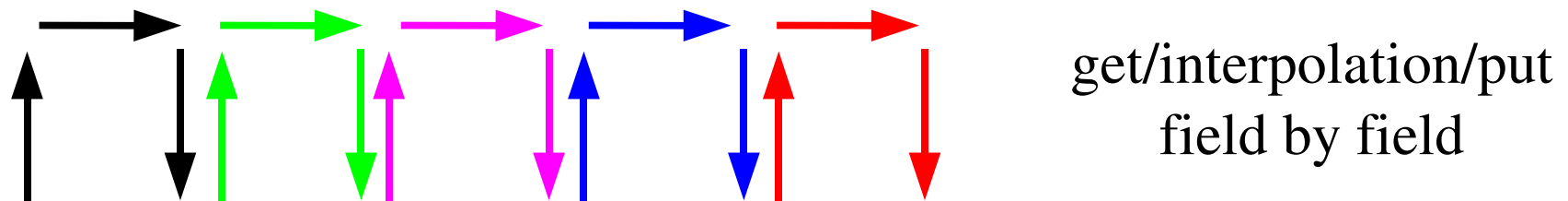
Difference with total elapsed time: model initialisation and restart writing

# Sequential coupling impact

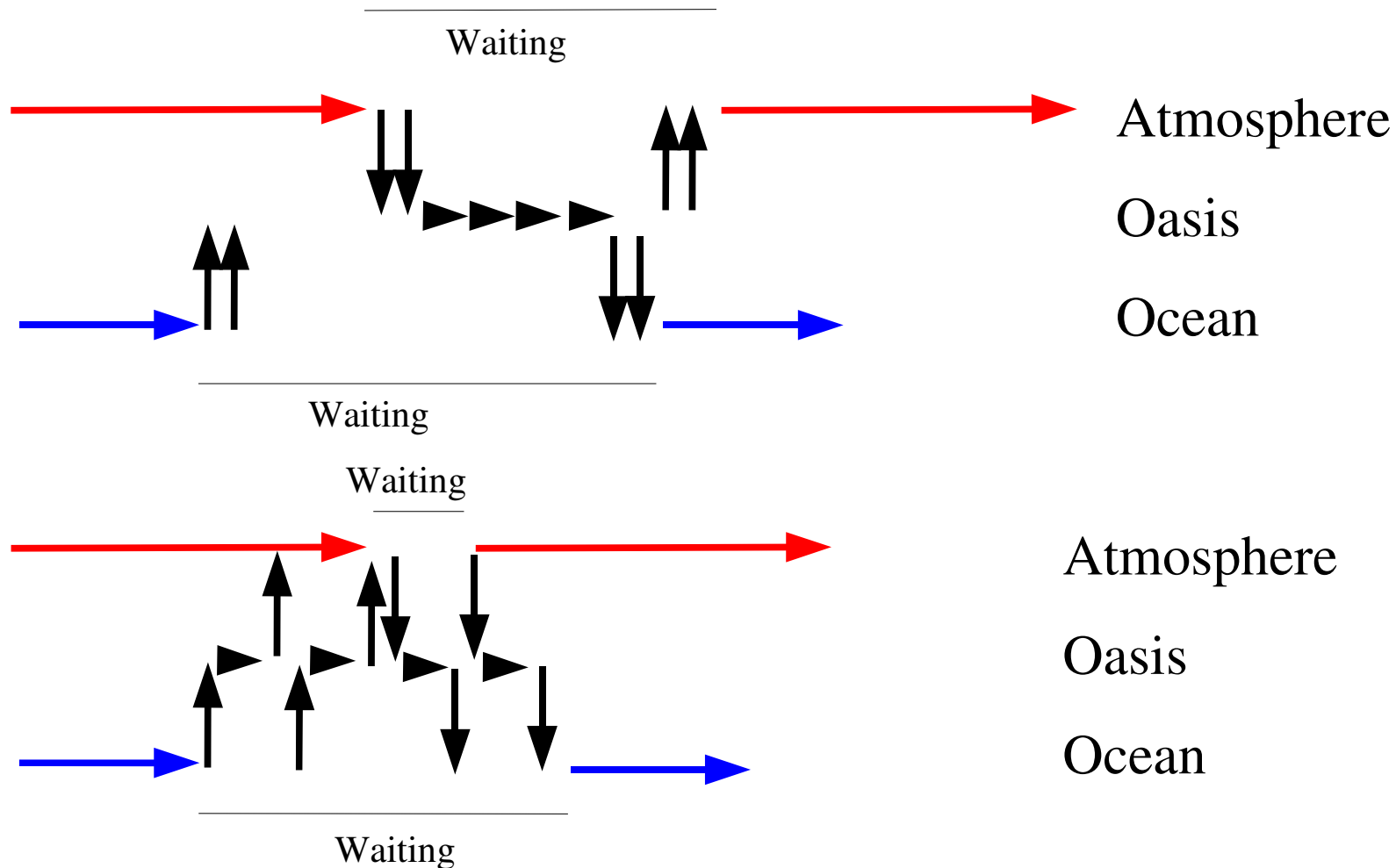
## Standard Oasis mode



## SEQuential Oasis mode (namcouple option)

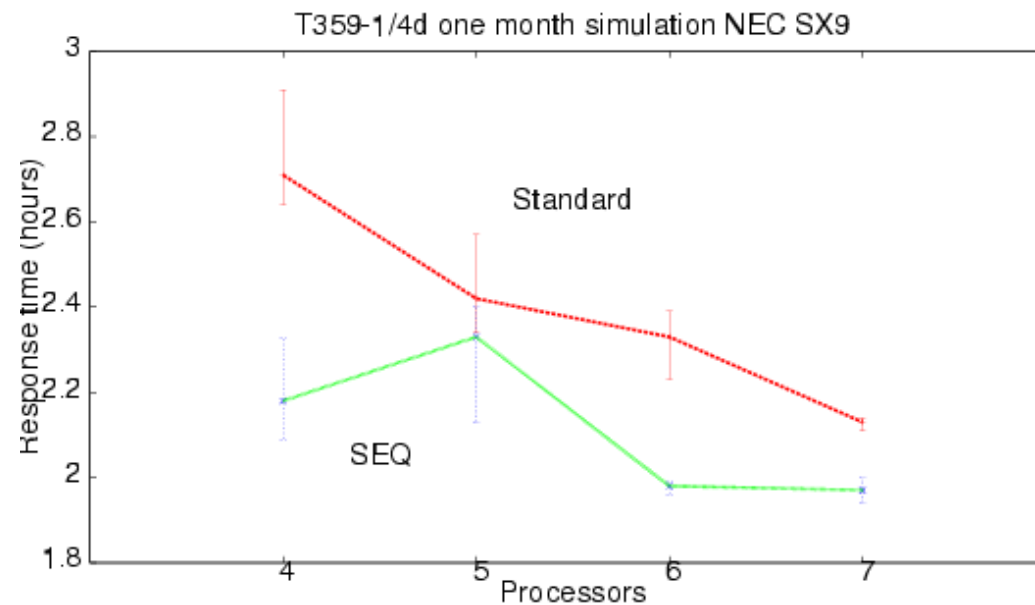


## Sequential coupling impact



SEQ technique reduces waiting time

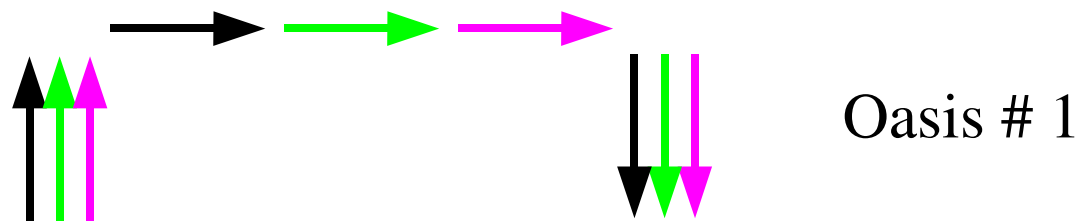
## Sequential coupling impact



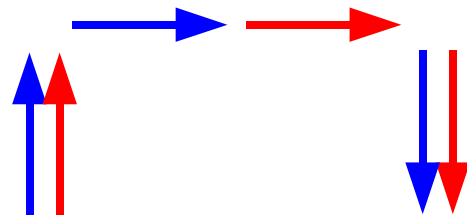
SEQ optimized configuration between 4 and 20% faster

## Pseudo parallel coupling impact

Pseudo-parallel Oasis mode (compilation option + script + namcouple)



Oasis # 1



Oasis # 2

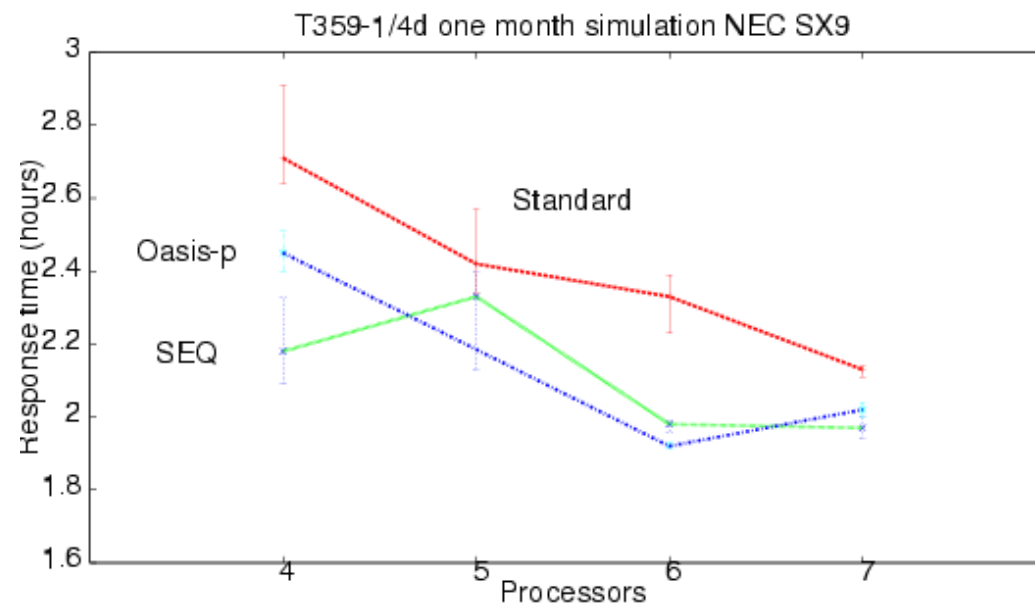
Oasis # ...

Several Oasis executables

Each Oasis process a subset of coupled fields

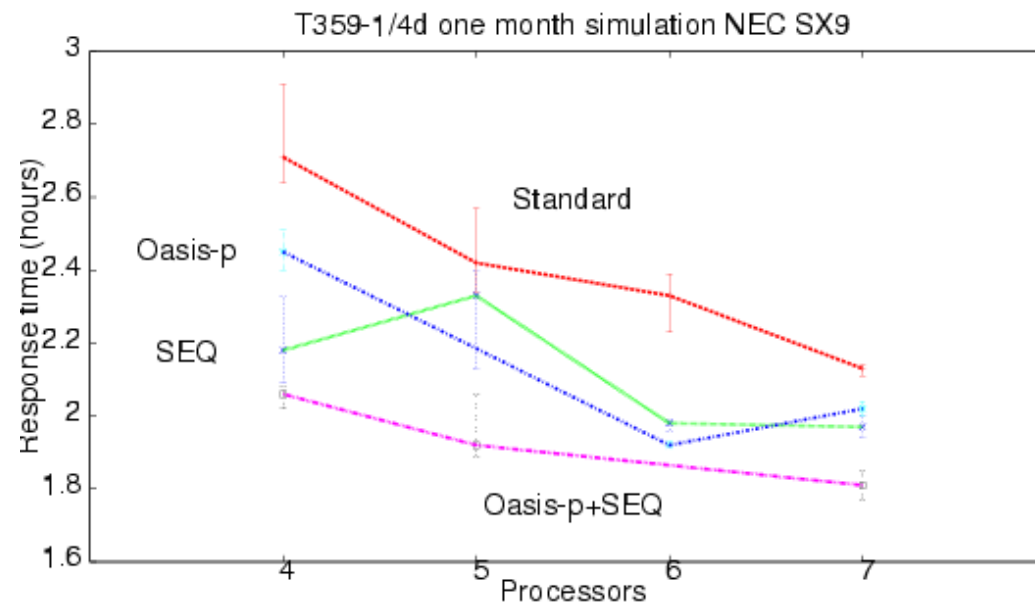


## Pseudo-parallel coupling impact



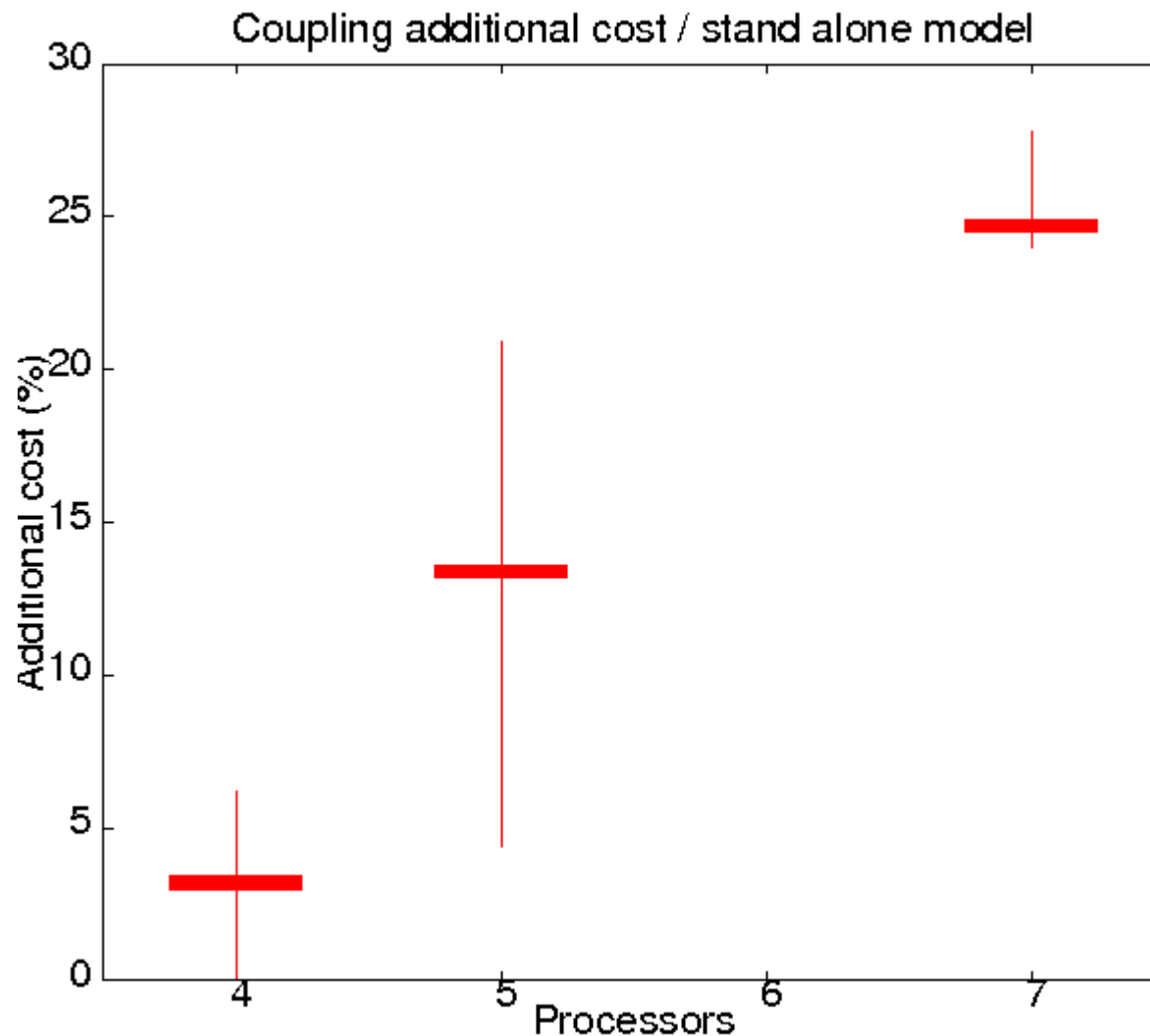
Pseudo-parallel configuration between 5 and 18% faster  
~ same gain than SEQuential mode

## SEQ + Pseudo-parallel coupling impact



Cumulated gain: between 16 and 25 %

## Coupled vs stand alone simulation time



Difficult to estimate because of restart writing time uncertainty

Without any optimization:  
> 50 % additional cost vs stand alone mode

With both presented optimizations:

- no additional cost for models with unbalanced duration
- could reach 25% with balanced models

It is possible to reduce even more additional cost, dedicating a processor to Oasis

## «Japanese style»

# ~~High end computing~~ Coupled Model configuration



Versions

ARPEGEv4 (CNRM) – NEMOv2 (Mercator)

OASIS

v3

Resolution

T359 (50Km), 31 vertical levels – 1/12 degree, 50 vertical levels

Tests are made possible by participation to operational health check of new MF SX9 (CPU hours for free)



## OASIS3 crash test with NEMO 1/12

44 processors for NEMO, 4 for ARPEGE,  
3 SX9 nodes (only !)

Model response times unbalanced  
(not really a crash test !)

9 members / test (2 simulated days)

Without any optimization:

**8 hours** ( $\pm 1\%$ ) per simulated month

With SEQ+pseudo parallel:

**4h40** ( $\pm 1\%$ ) per simulated month

NEMO 1/12 forced mode:

**4h10** (additional cost :10%)





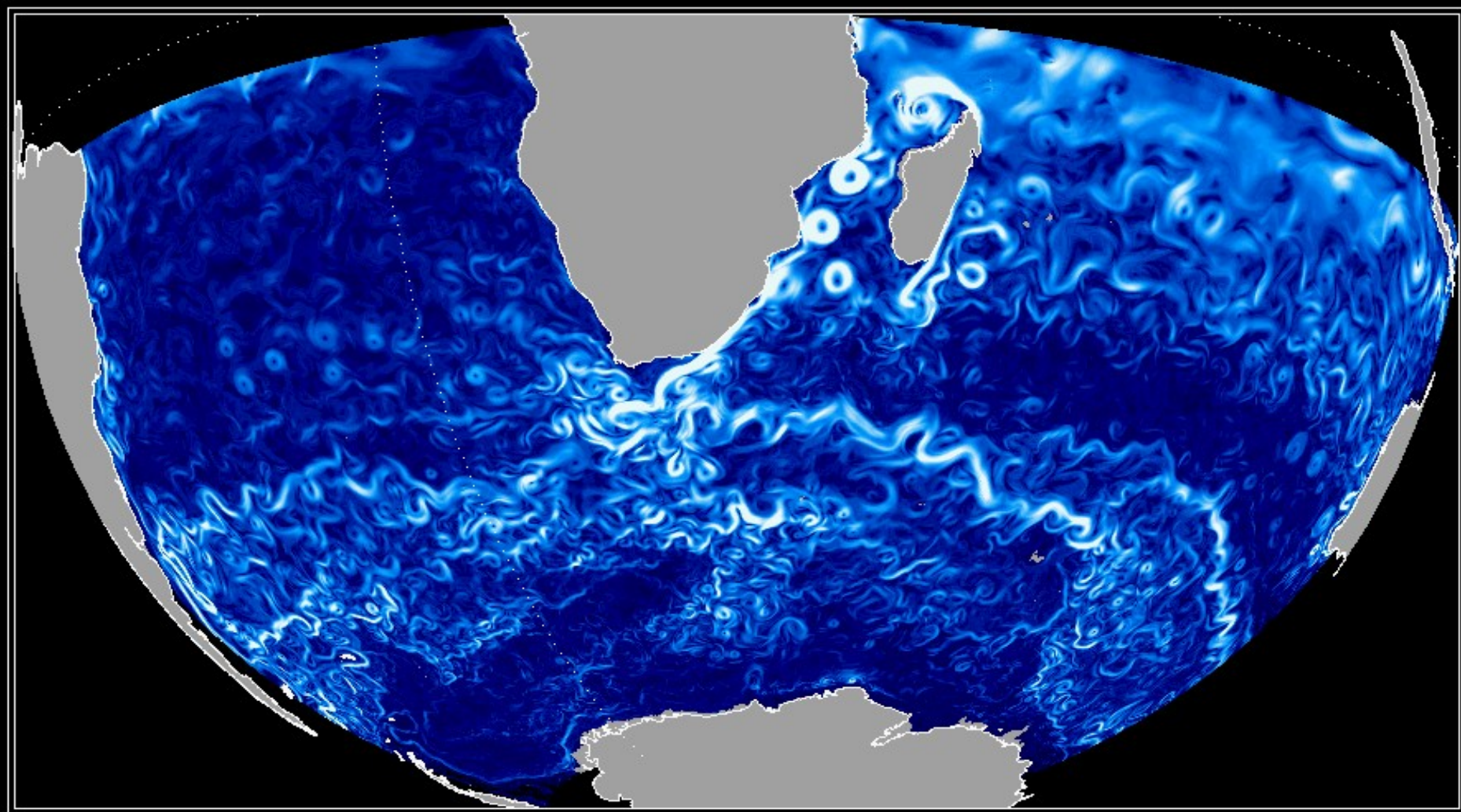
## Conclusion

Additional cost due to OASIS3 coupling almost annulable if model response times are unbalanced (even with an 1/12° coupled model): it is rewarding to optimize your coupling !

With balanced durations, our high end computing coupled model is 25% slower than the slower stand alone component

Can those results be valid for smaller models on scalar machines ?  
⇒ tests on IBM BG/P, SGI Altix ICE to come soon

ORCA012-T103 y2005m06d09 velocity 18 m



Thanks to R. Bourdallé-Badie, O. Le Galloudec (MERCATOR),  
M. Pithon, M. Déqué (Météo-France), I. D'Ast, N. Monnier, S. Valcke (CERFACS)

