

Past year activities in System Aspects at Meteo-France

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Aladin workshop & Hirlam all staff meeting
Krakow, 13-16 April 2010

Overview

■ **Computational optimisations**

- Performances evolution from cycle 35T2 to 36T1
- Optimisation of Arome 3DVar
- Optimisations of Surfex
- Profilers and profiling reports : status
- Recent optimisations of Arome Forecast

■ **Report on other activities**

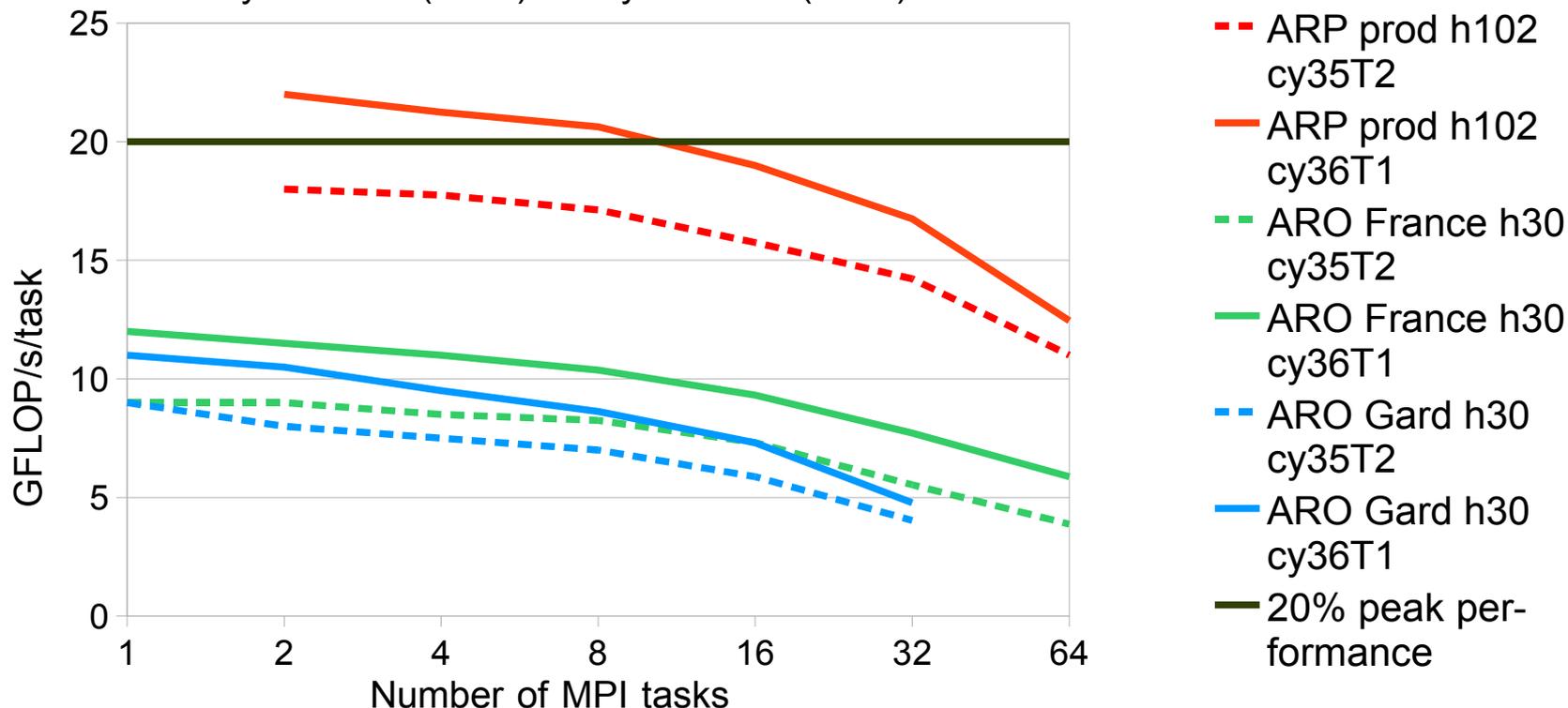
- Progress with compilation tools
- Interoperability project (SRNWP)
- RAPS a benchmark suite for vendor
- The new EMMA project

– **Conclusions**

Performances evolution from cycle 35T2 to 36T1

Evolution of performances for ARPEGE and AROME on SX9

Cycle 35T2 (2008) vs Cycle 36T1 (2010)



Mostly
vectorisation

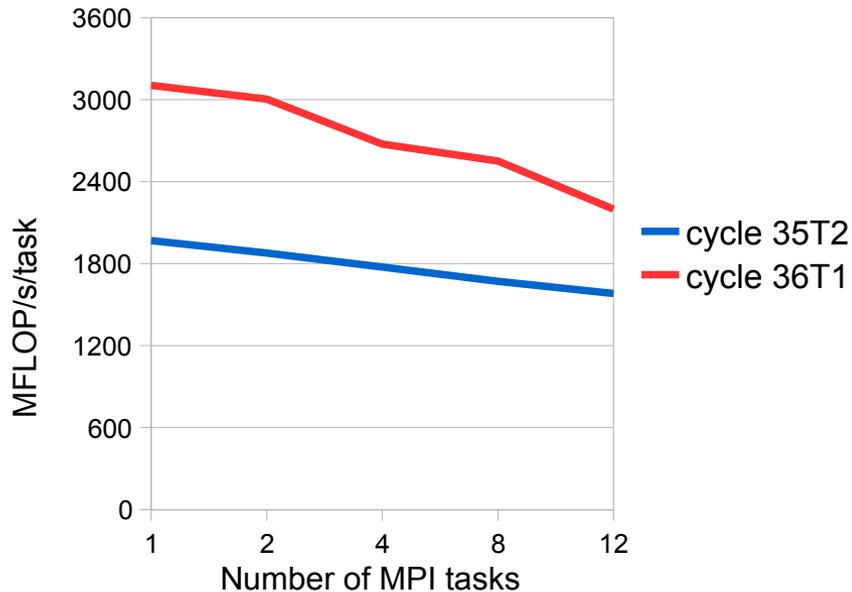
=> ARPEGE : **20 % faster**

=> AROME : **30-40 % faster**

Optimisation of Arome 3DVar

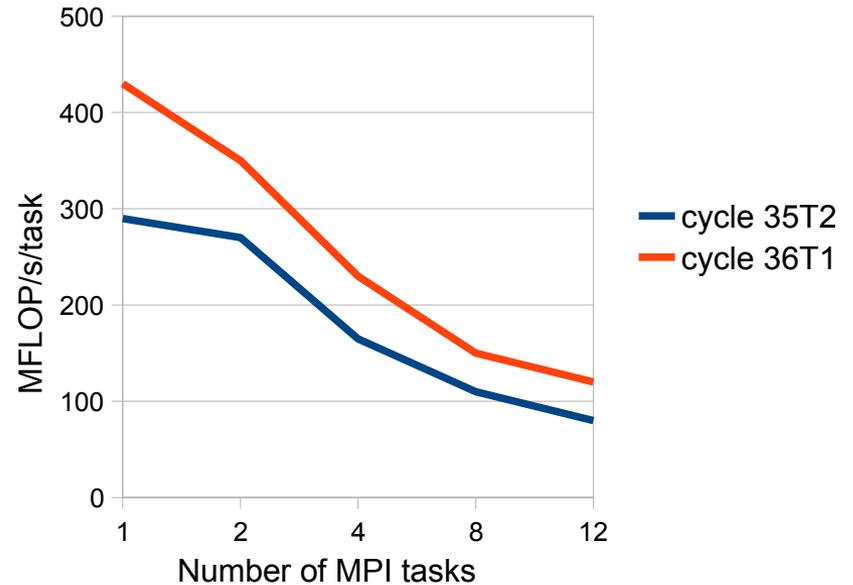
Evolution of performances on SX9

AROME Minimisation



Evolution of performances on SX9

AROME Screening



Vectorisation, in-lining, optimisations

=> **Minimisation : 35 % faster**

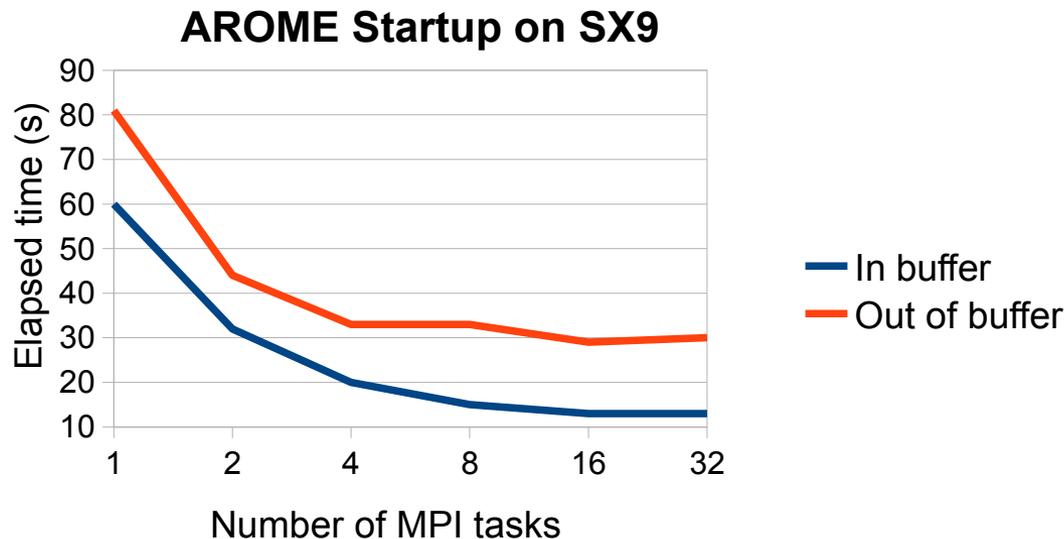
=> **Screening : 12 % faster**

Optimisation of Surfex

- **Support for Open-MP**

is planned to be coded by CERFACS
between May and June 2010

- **Optimisation of startup** (reading Surfex init. file) :
preliminary step (split mse/ and Surfex/ projects) **done**.
Next step planned with Open MP support (CERFACS)



Profilers and profiling reports : status

■ DrHook profiler :

- will be implemented in cycle 36T2 and maintained for the projects **bip/ xrd/ mpa/ mse/ surfex/** (P. Marguinaud)

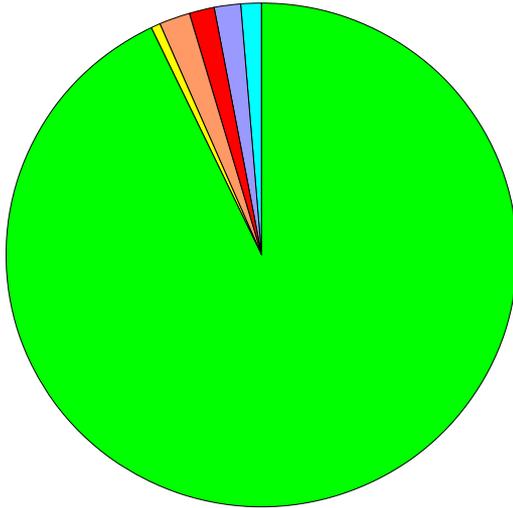
■ Benchmarkers' « Mitraillette » :

- Profiling reports have been monitored from the suite on SX9, since cy33T1
- Model dimensions and namelists have been updated :
 - AROME-France (L60)
 - ARPEGE (T798)
- New domains added :
 - AROME-France « XXL » (next e-suite)
 - ARPEGE T1200
- ***The suite needs to be a bit more flexible to make dimensionning and namelists upgrades easier.***

Profiling analysis of Elapsed time : ALADIN vs AROME

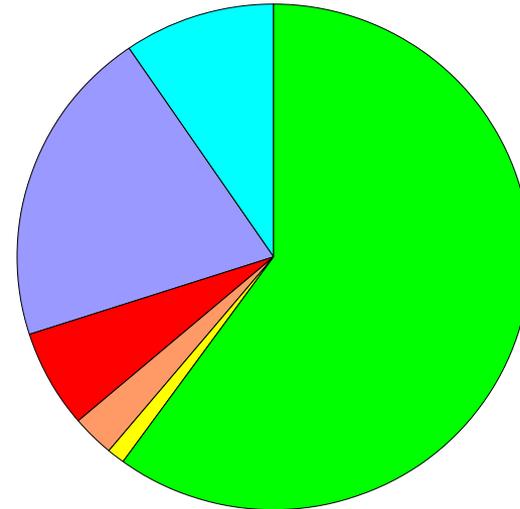
ALADIN Réunion Forecast (production) H84

8 MPI-tasks, Global File System



AROME Forecast (production) H30

32 MPI-tasks, Global File System

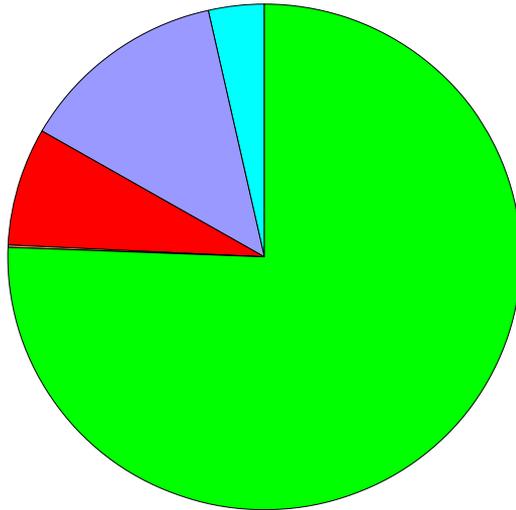


... As seen from task #1 which performs the physical I/Os

Profiling analysis of Elapsed time : extreme tasks

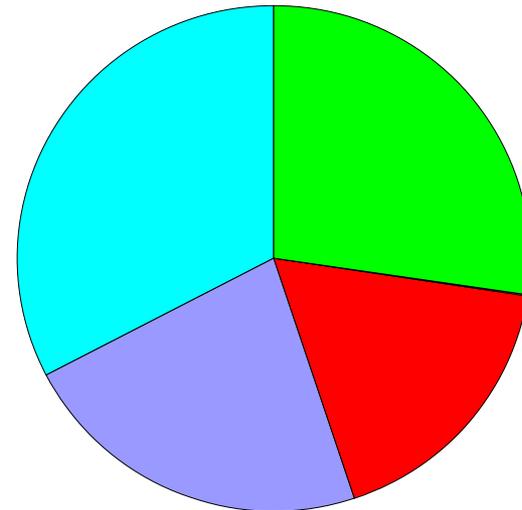
AROME Forecast H30 - task #8

32 MPI-tasks, Global File System



AROME Forecast H30 - task #32

32 MPI-tasks, Global File System

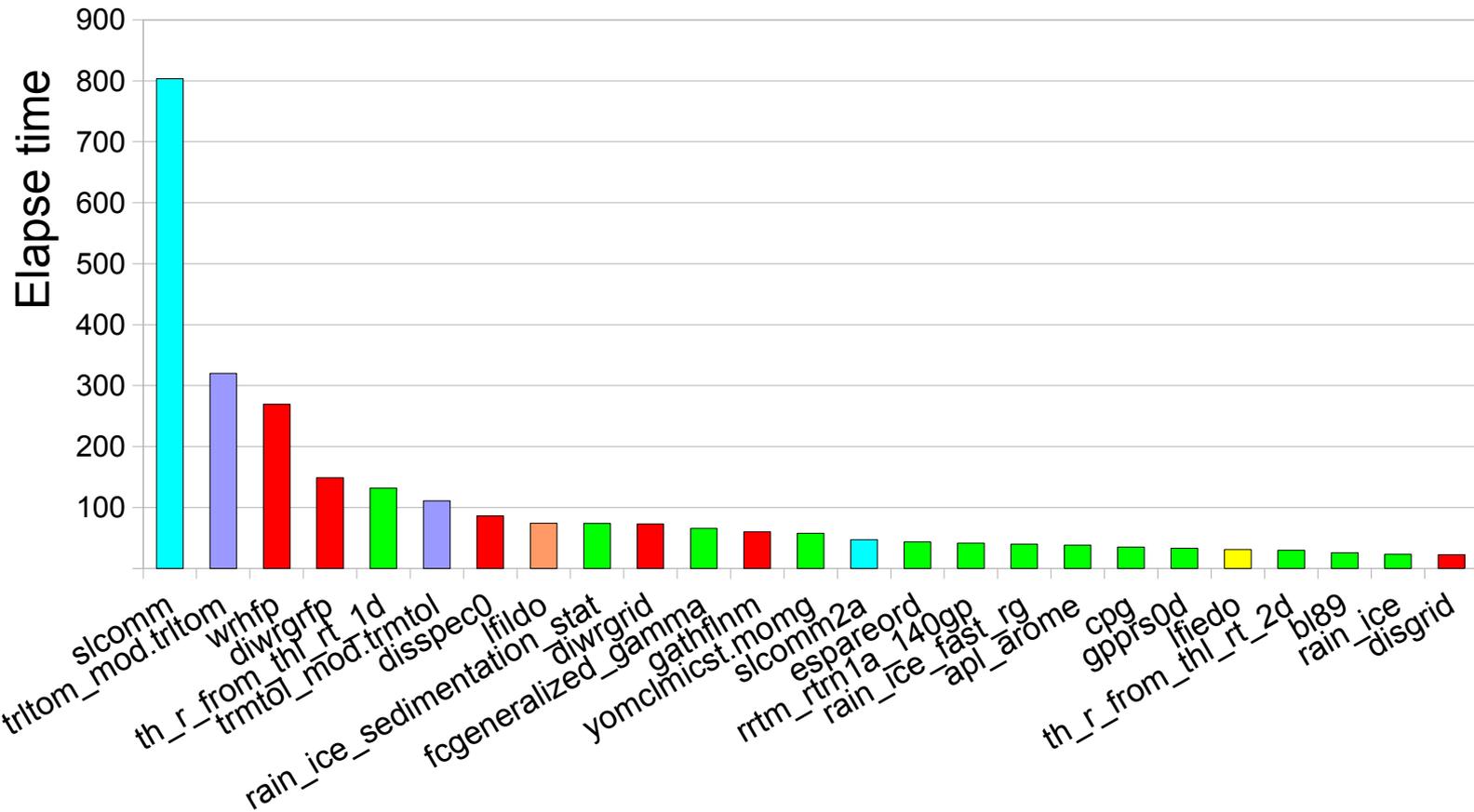


■ SL comm. ■ TRANS comm. ■ I/Os comm.
■ Physical inputs ■ Physical outputs ■ Others

=> Much load imbalance

Elapsed time analysis : load imbalance per subroutine

AROME Forecast H30 Load imbalance

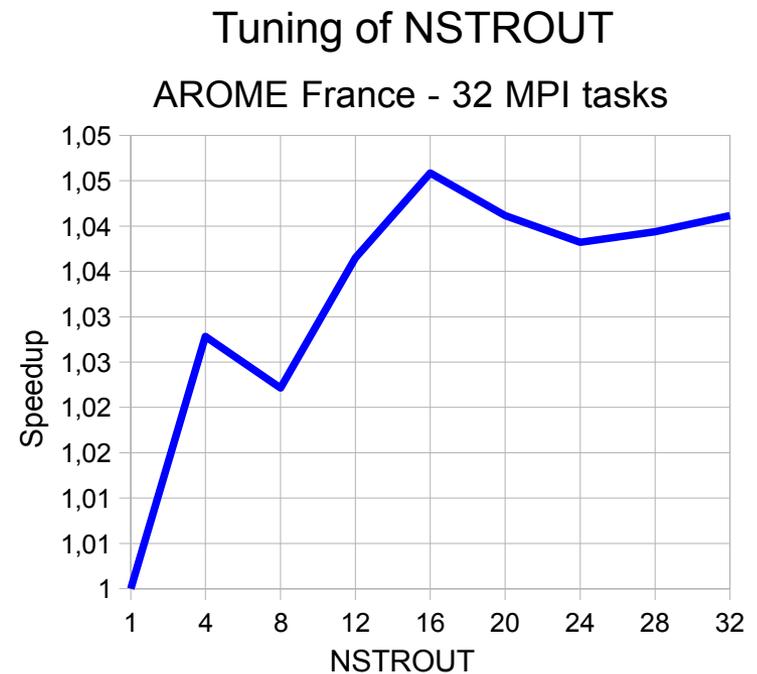


How to reduce the load imbalance ?

How to reduce partly *but quickly* some load imbalance ?

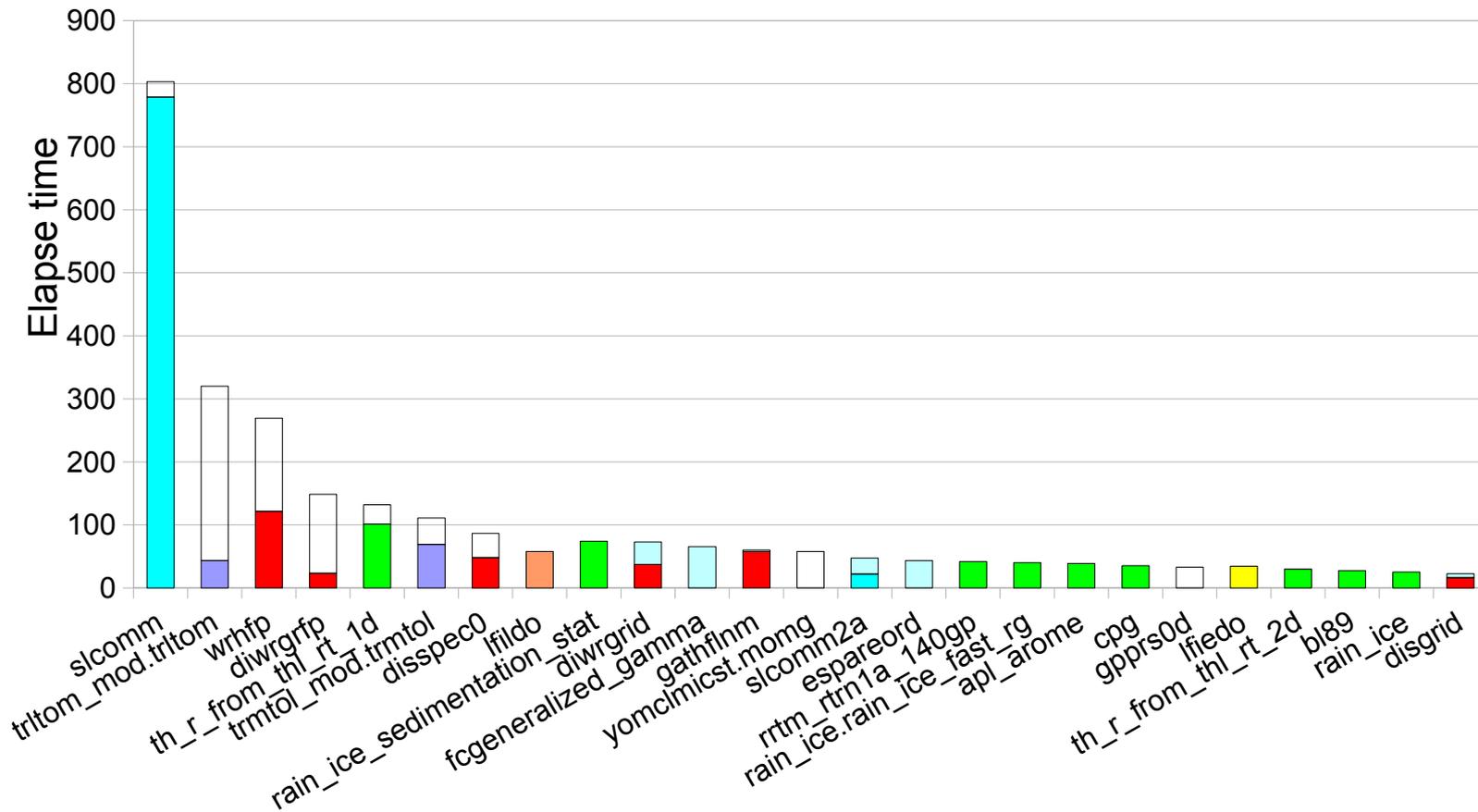
- Aggressive optimisations on the imbalanced subroutines :
- Improve vectorisation
- Perform minimum calculations
- Save constant values instead of recomputing them
- Reduce communication overhead by grouping messages

Namelists fine tuning
(NSTROUT, ...)

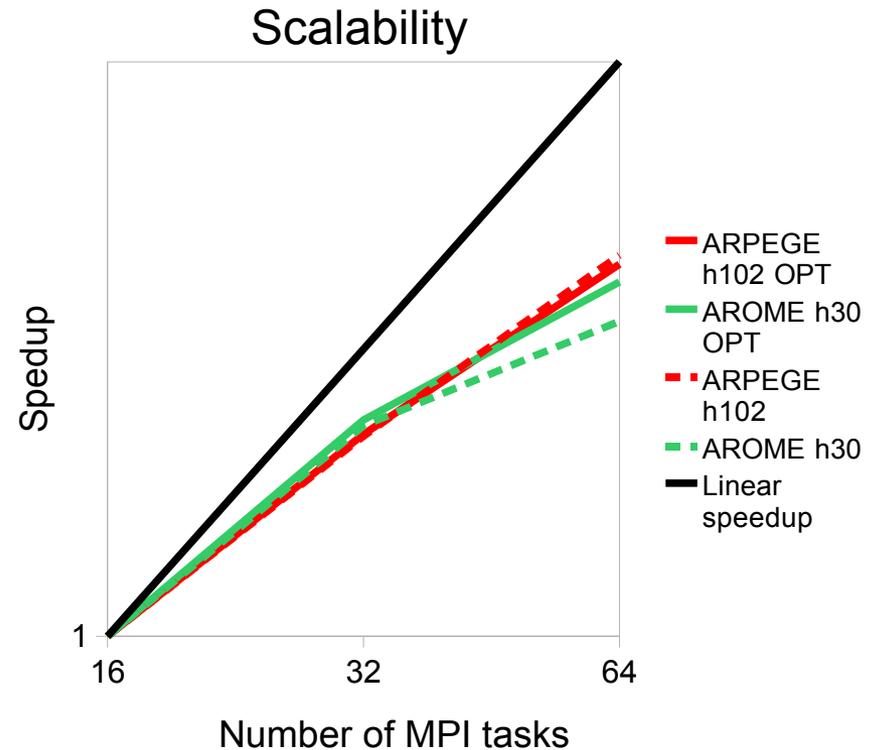
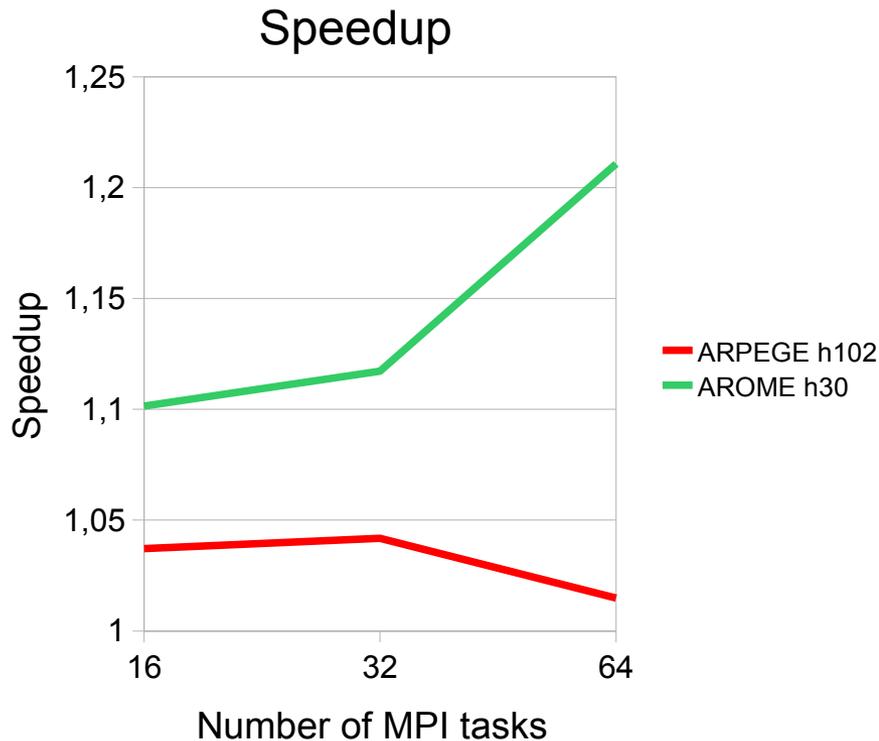


Profiling analysis of Elapsed time : load imbalance reduction

AROME Forecast H30 Load imbalance reduction



Impact of load imbalance reduction



AROME : 10-20 % faster + better scalability

ARPEGE : 3-4 % faster

Progress with compilation tools (1/2)

■ Gmckpack 6.4.* :

- Limitation in the number of include/module directories highly alleviated
- Specific compilation options per project
- More flexible with source code, and faster

=>

- Surfex project now imported without pre-treatment
- Obt/ project now compilable
- Better prepared for OOPS project

Next :

- improve independency with software specificities
- improve parallelism

Progress with compilation tools (2/2)

- **Gmckpack tools, libraries and pre-compiled packs are now available from any individual PC in GMAP :**
 - Gmckpack + miscellaneous libraries pre-installed
 - Pre-compiled pack to be individually downloaded
- **Precompiled packs include :**
 - With compilers Gfortran 4.4.2 and PGF90 8.0.4
 - MPI and Open-MP supports (already running with Arpege and Aladin)
- *List of precompiled pack : % catpack*
- *Download a pre-compiled pack : % getpack -r36t1 -b bf -v04*
- *Build a pack on top of a pre-compiled pack : % gmckpack ...*

RAPS project

- A Benchmark suite for vendors will be released before the end of 2010 :
- Should be based on top of cycle **36T1** or **36T2**
- Gussed applications :
 - **Bator** pre-processing of observations
 - **Minimisation** from **Arome 3DVar** suite
 - **Arome Forecast**
- On extended domain FRANCE (aka « XXL »)

The new EMMA project

Environmental Modelling on Massively parallel Architectures

- **A joint project between** (CNRM-GMAP, Laboratoire d'Aérodynamique, Institut Pierre Simon Laplace, CERFACS)
- **Purpose** : port and adapt NWP models to state of the art of machines
- **Funded** by the ANR (Agence Nationale de la Recherche)
- Acceptance by the end of June 2010 ; if accepted the project should start in 2011 and last 3 years
 - *Examine bottlenecks, Improve the scalability of NWP models*
 - *Look at new programming techniques*
 - *Develop a framework to run NWP software on MMP platforms*
 - *Get some experience on MMP architectures*

Interoperability project (SRNWP)

- Update of test files in GRIB 2 (all in native format)
- Grib_api to be fixed/optimised (with help from ECMWF) on NEC SX9
- Roadmap for 2010 has been established with visitors from Aladin countries
- Convertors conception has been revisited :
 - conf. 901 remains 'as is' for continuity of operations
 - new conf 903 for back-end Interoperability post-processing
 - new conf 902 for front-end Interoperability preprocessing

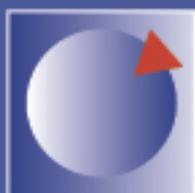
Conclusion

- **Optimisation of AROME :**
 - significant progress have been realized both on the 3DVar and the forecasting model
 - The 2 mains sources of load imbalance have been identified as I/Os and upper air physical parameterisations
 - Surfex optimisation and portability is now scheduled
 - Profilings are now regularly monitored
- **Toward scalar and next generation machines :**
 - Working support improved (DrHook, tools)
 - RAPS and EMMA projects onway

Annoucement : Maintenance training

- **Will be held in Toulouse : 20-22 September 2010**
- **Dedicated to**
 - **HIRLAM and ALADIN-LACE newcomers** (any people unfamiliar with Aladin phasings and coding customs)
- **Content :**
 - Phasing procedures & tools
 - Coding standards
 - Basic optimisations handling
 - Compilation hints

Including lectures and sessions for practice



METEO FRANCE

Toujours un temps d'avance