Load-balancing in Large Machines Applied to Weather Forecast: a Preliminary Study

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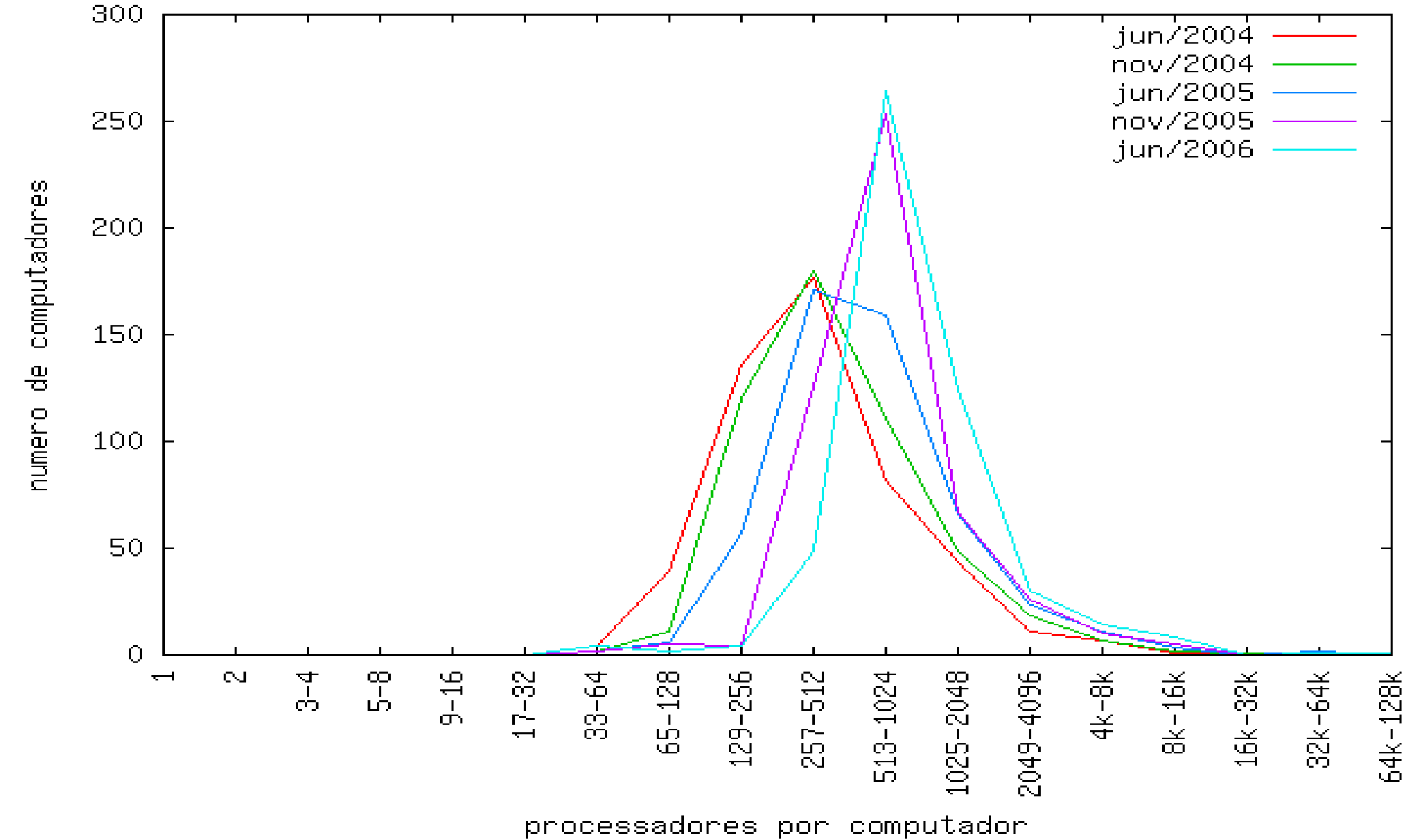
Presentation Overview

- Scalability
- Sources of load imbalance in weather forecasts
- Grid nesting
- Experiment
- Ongoing work

TOP500

Computers with thousands of processors are becoming common



Scalability

- The main objective of the increase in the number of processors used to perform a computation is the reduction of the execution time.
- Ideally, the efficiency is equal to 1, but usually it tends to saturate as the number of processors increases [8].

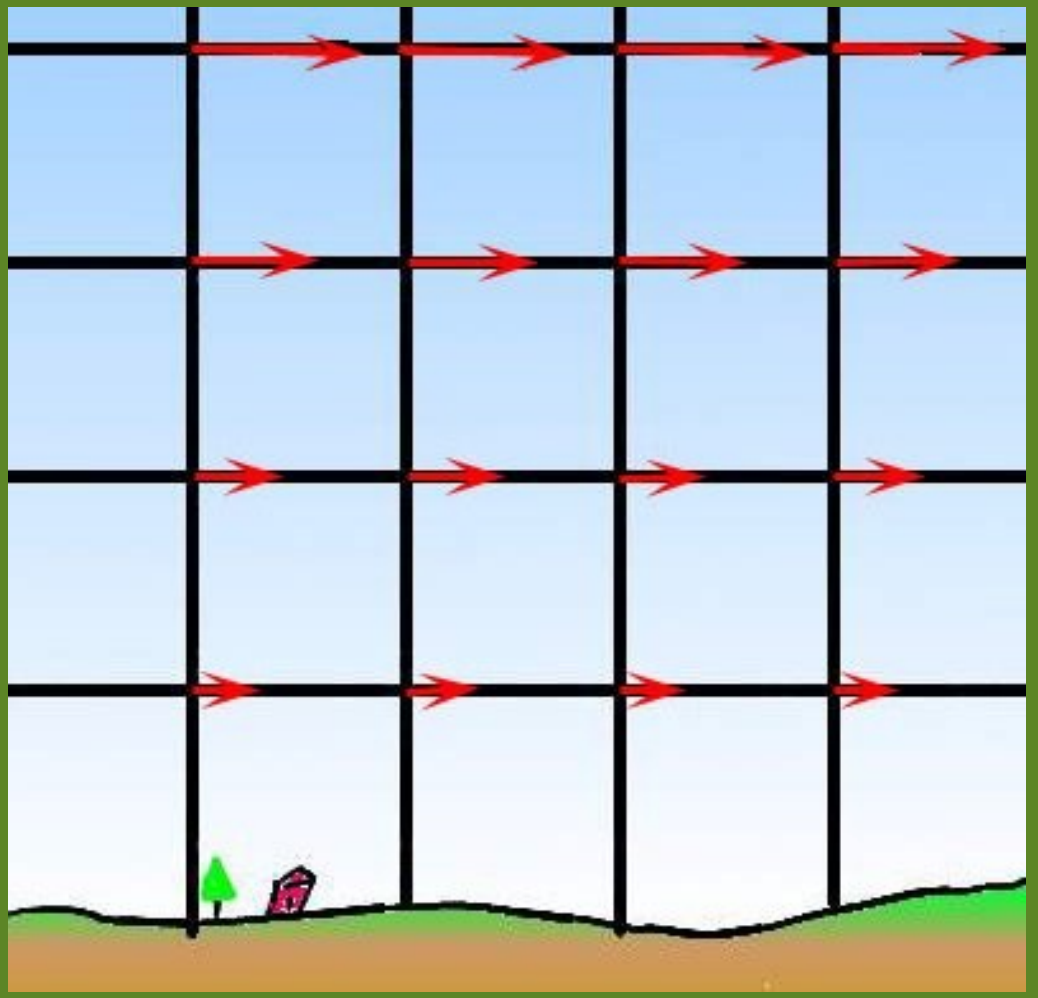
Why the scalability is not achieved?

- There are mainly three reasons for this [6]:
  - Amdahl law;
  - Communication;
  - **Load imbalance**.

Load Balancing

- Directly implemented [7] [18] [20]
- Load balancing toolkits [4] [10] [12]

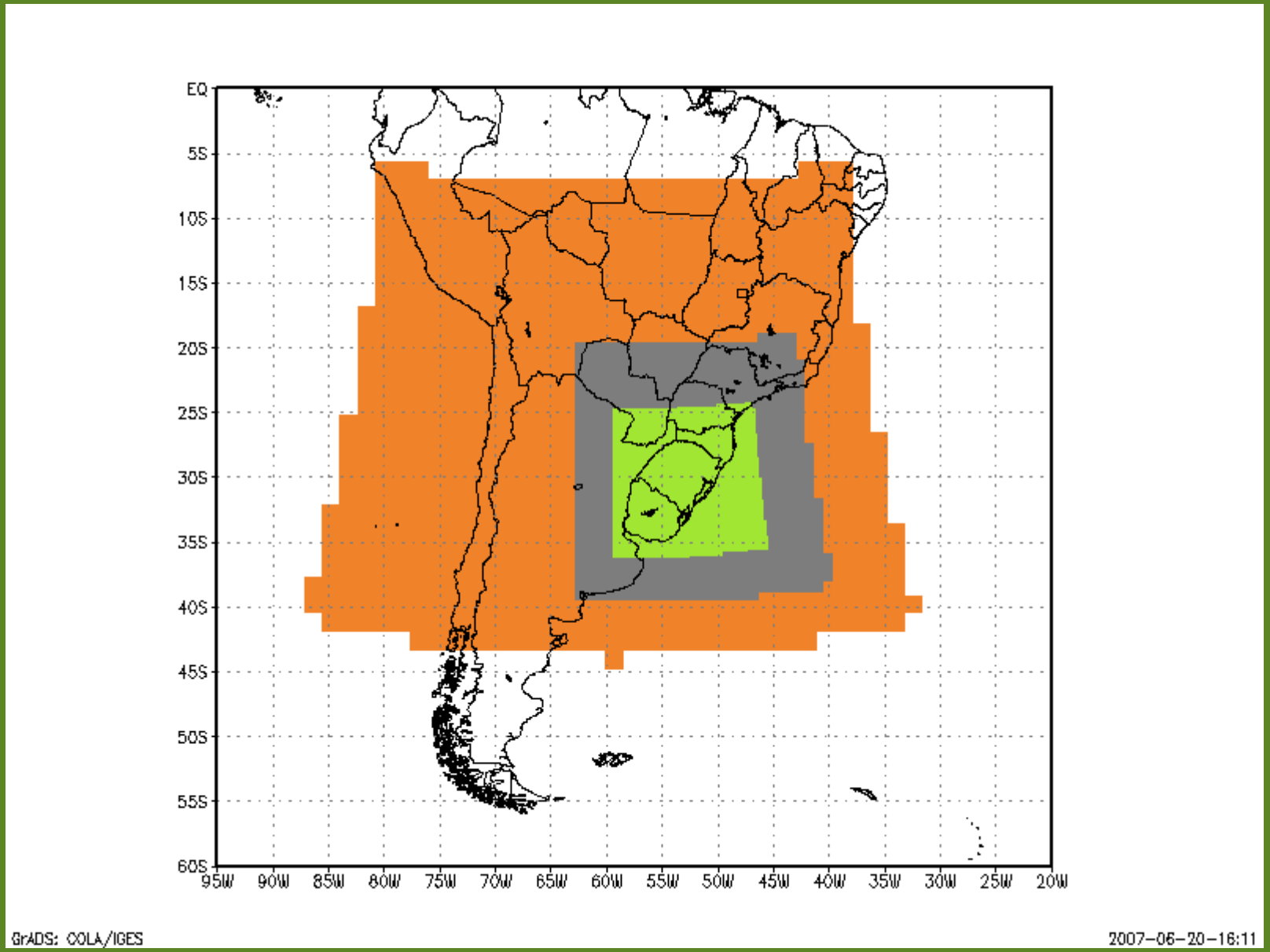
Weather Forecast



Sources of load imbalance in weather forecast models

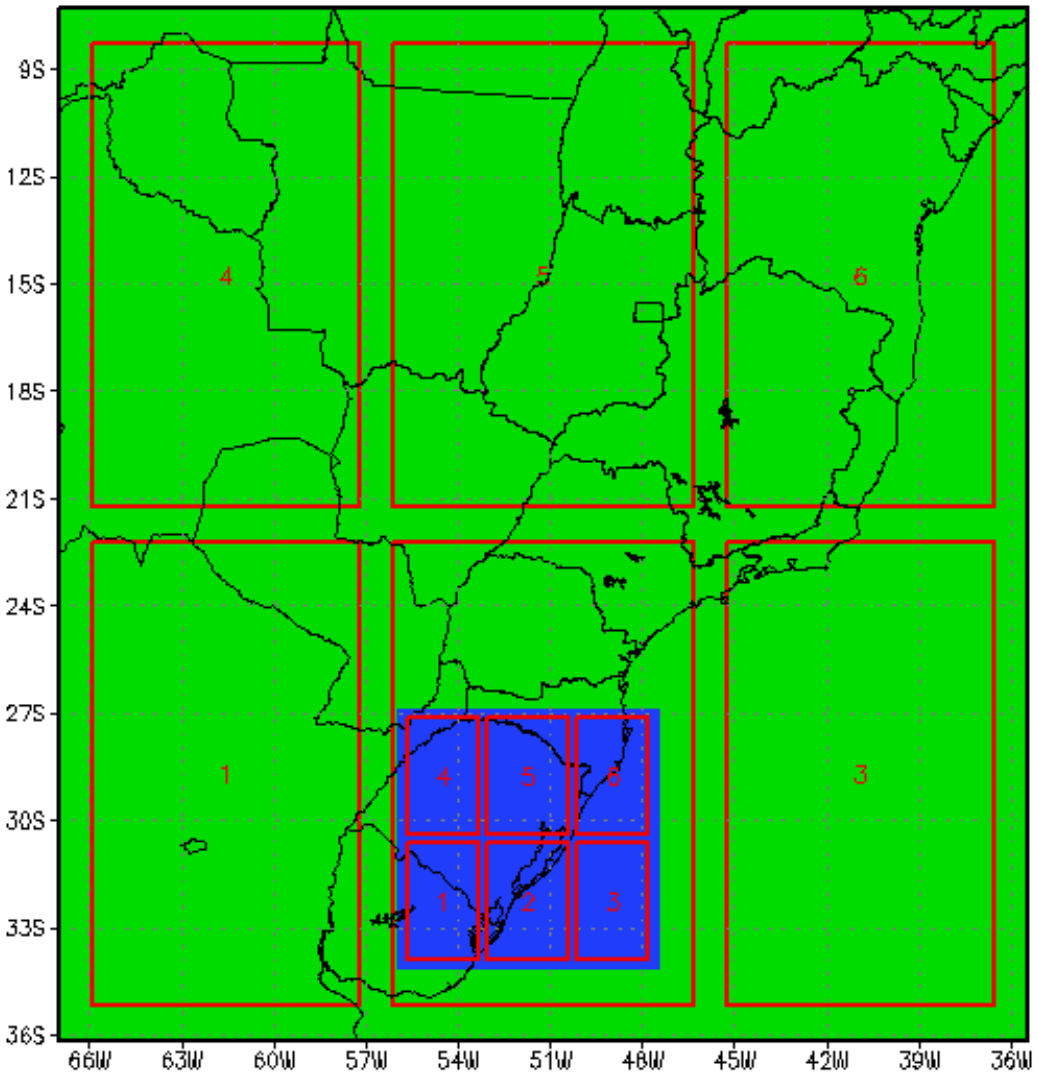
- Microphysics [13];
- Dynamically localized emission sources on environmental models;
- Grid nesting.

Grid Nesting



Binary Reproducibility

Brams



Execution Time (seconds)

Section	Sequential	Parallel					
		processor 1	processor 2	processor 3	processor 4	processor 5	processor 6
Init	5.0744	5.2841	5.2839	5.2840	5.2841	5.2839	5.2822
outerBeforeInner	20.7467	93.6903	22.6495	79.5858	66.6019	52.4408	38.8769
TS	1,619.0143	353.5216	328.7484	346.9930	340.8613	335.0797	326.6488
CoarseToFine	10.8653	9.2350	34.3023	15.9393	22.1928	28.1787	36.6182
FineToCoarse	33.0197	21.4158	93.0999	35.5287	48.5392	62.5785	76.3586
CLF	2.5818	0.5469	0.4221	0.5302	0.5306	0.5954	0.5315
DomainsToMaster	6.1528	7.8200	7.0224	7.6625	7.5140	7.3544	7.2041
TOTAL	1,697.5511	491.5949	491.5960	491.5963	491.5978	491.5844	491.5908

Ongoing Work

- Run these experiments on the Charm/BigSim in order to compare with the presented results;
- Run on more virtual and real processors;
- Study others sources of load imbalances;
- Develop a model to deal with these sources of load imbalances.

Sugestões