

# Le calcul distribué : un outil pour l'imagerie médicale

**Tristan Glatard**

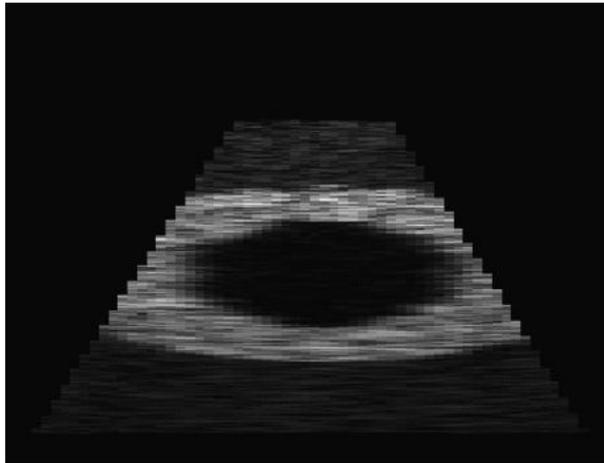
Creatis, CNRS, INSERM, Université de Lyon

**14 avril 2011**

*Creatis*

# Simulation

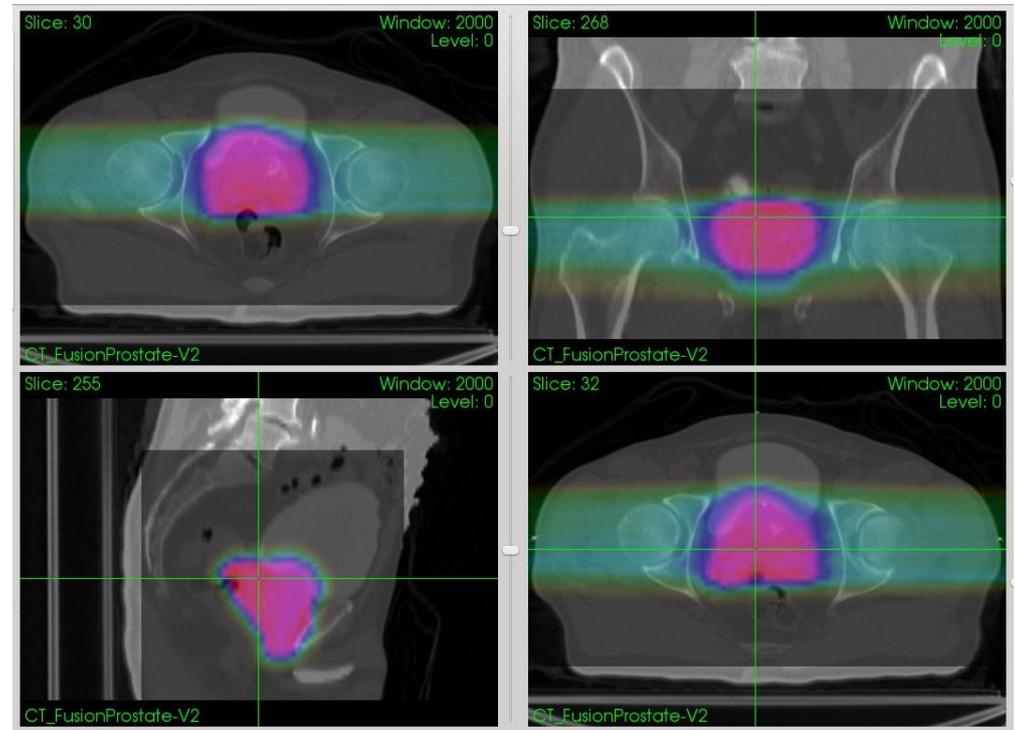
- **Imagerie**



Exemple : simulation 2D+t ultrasons  
[O. Bernard]

**Calcul: 16h**

- **Traitement**



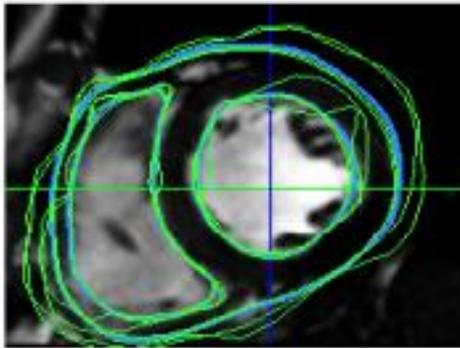
Exemple : plan de traitement de prostate en  
protonthérapie.  
[L. Grevillot, D. Sarrut]

**Calcul: 2 mois**

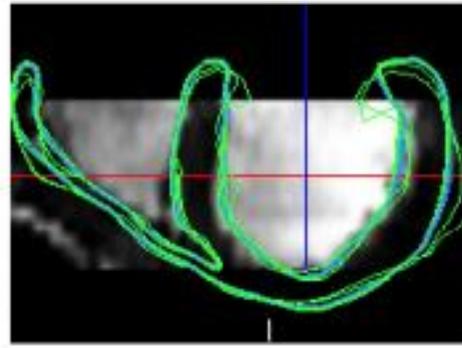
# Etudes de paramètres

- **Segmentation**

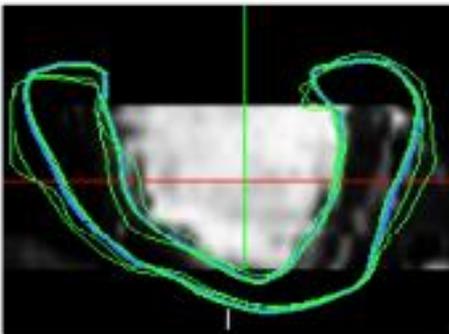
Exemple : 972 segmentations IRM cardiaque 3D



(a) C1, z=30



(b) C1, y=70



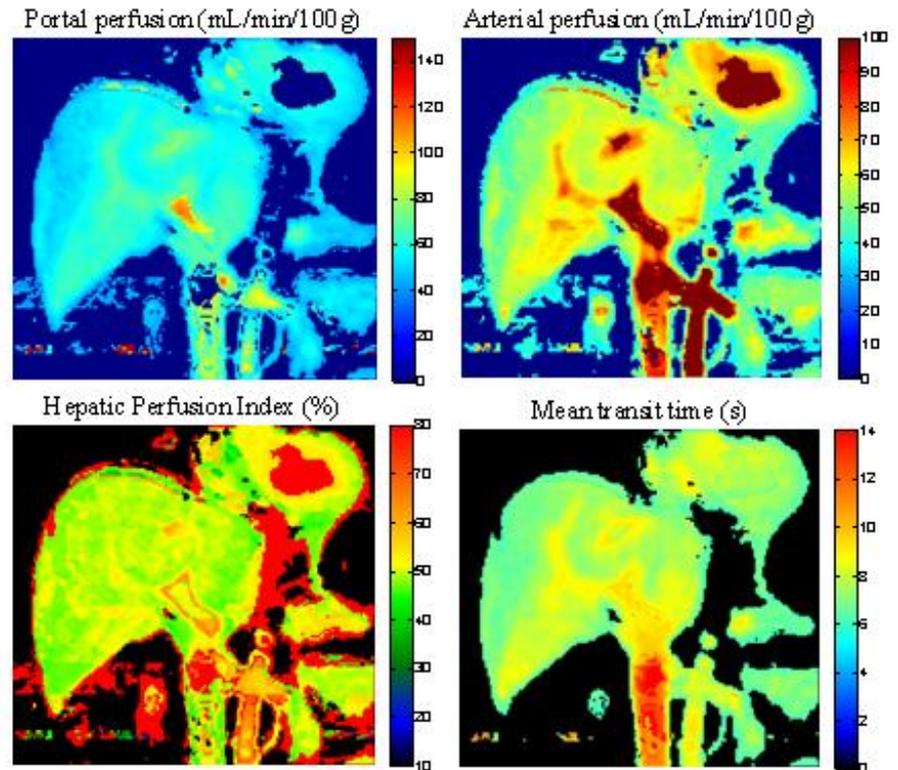
(c) C2, x=88

**2.2 jours**

[S. Ben Fredj, P. Clarysse, C. Casta]

- **Estimation de paramètres**

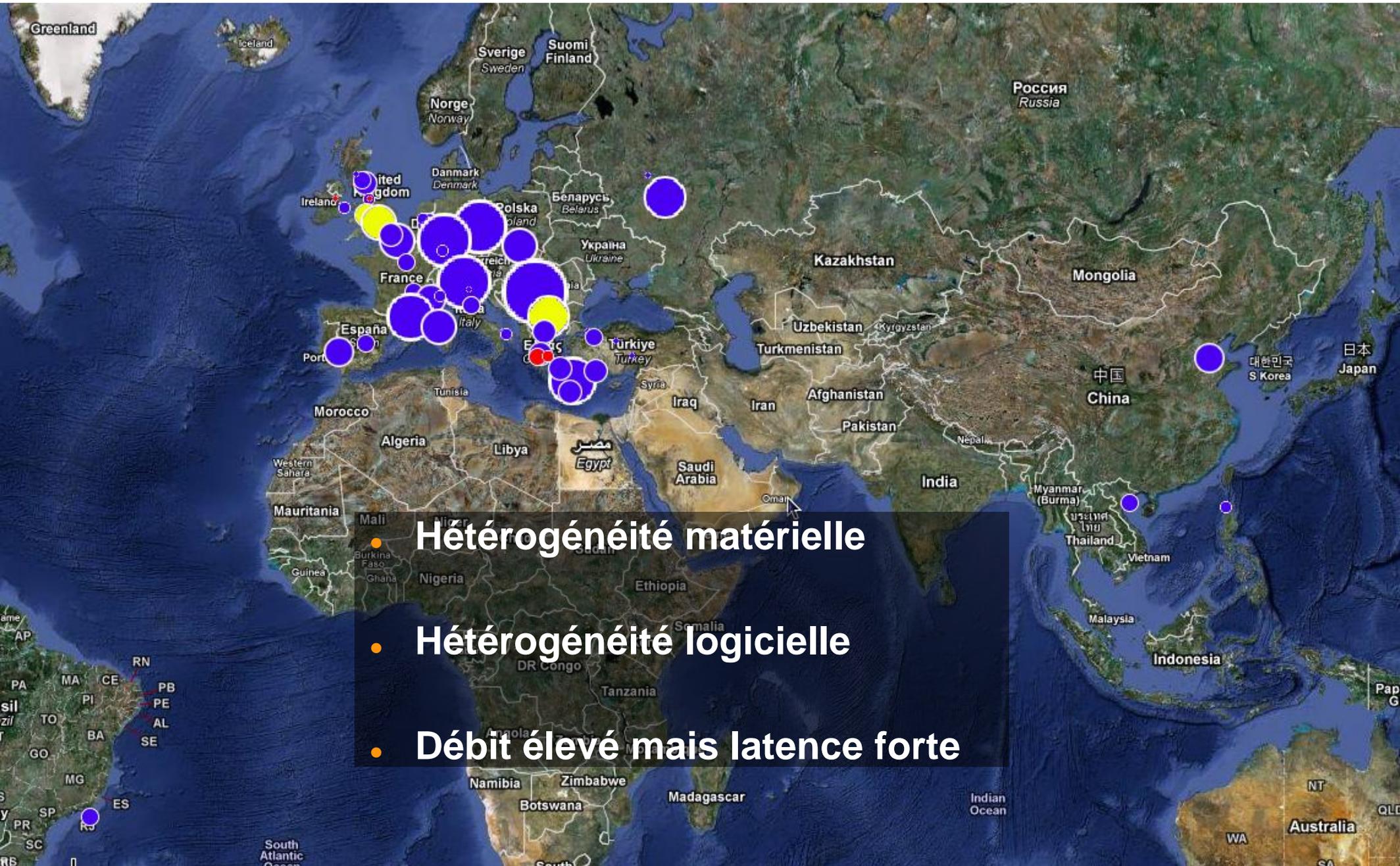
Exemple : paramètres de perfusion hépatique



**18 jours / volume**

[B. Leporq, F. Pilleul, O. Boeuf]

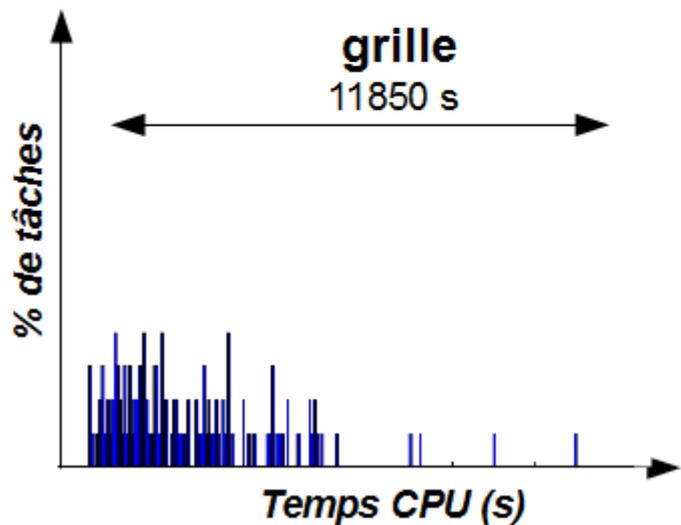
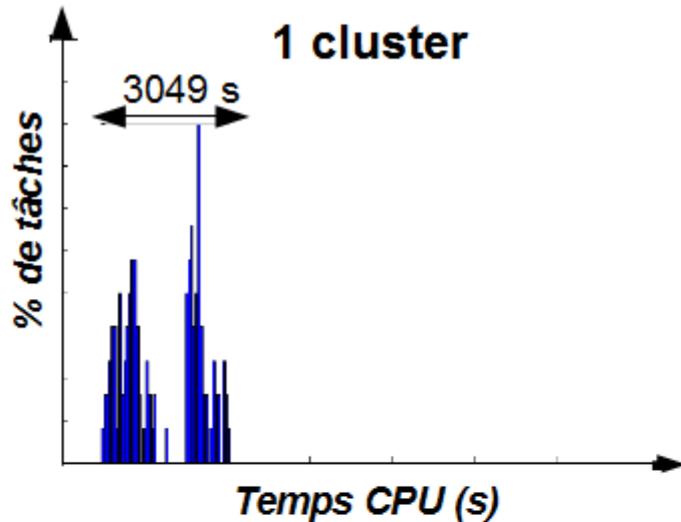
# Exécution distribuée



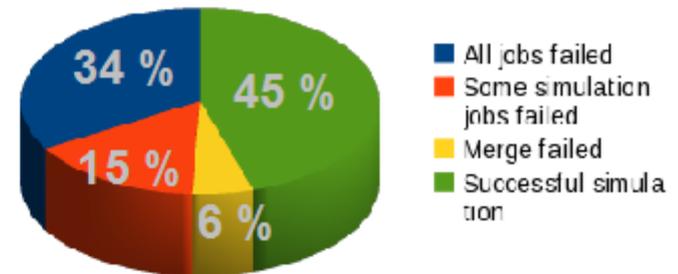
- Hétérogénéité matérielle
- Hétérogénéité logicielle
- Débit élevé mais latence forte

# Enjeux

- **Hétérogénéité matérielle**

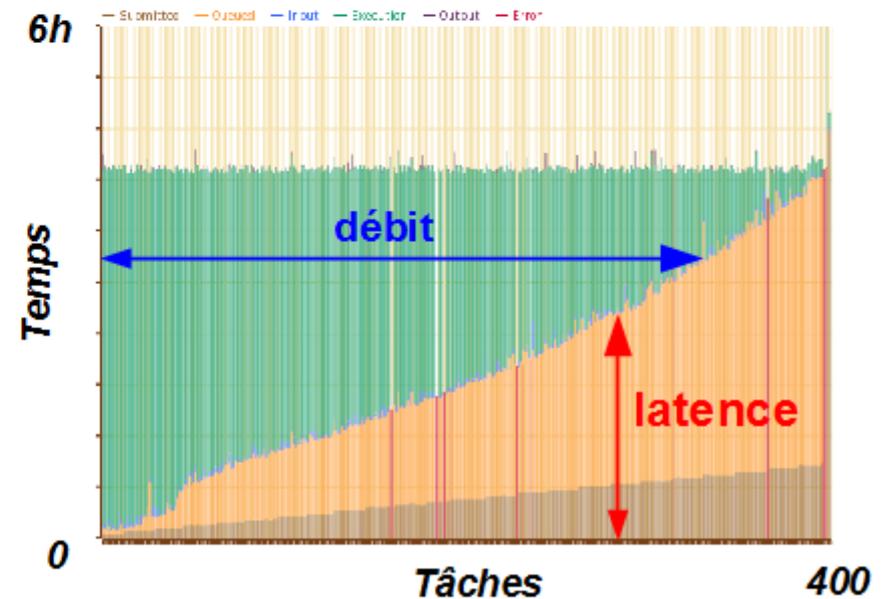


- **Hétérogénéité logicielle**

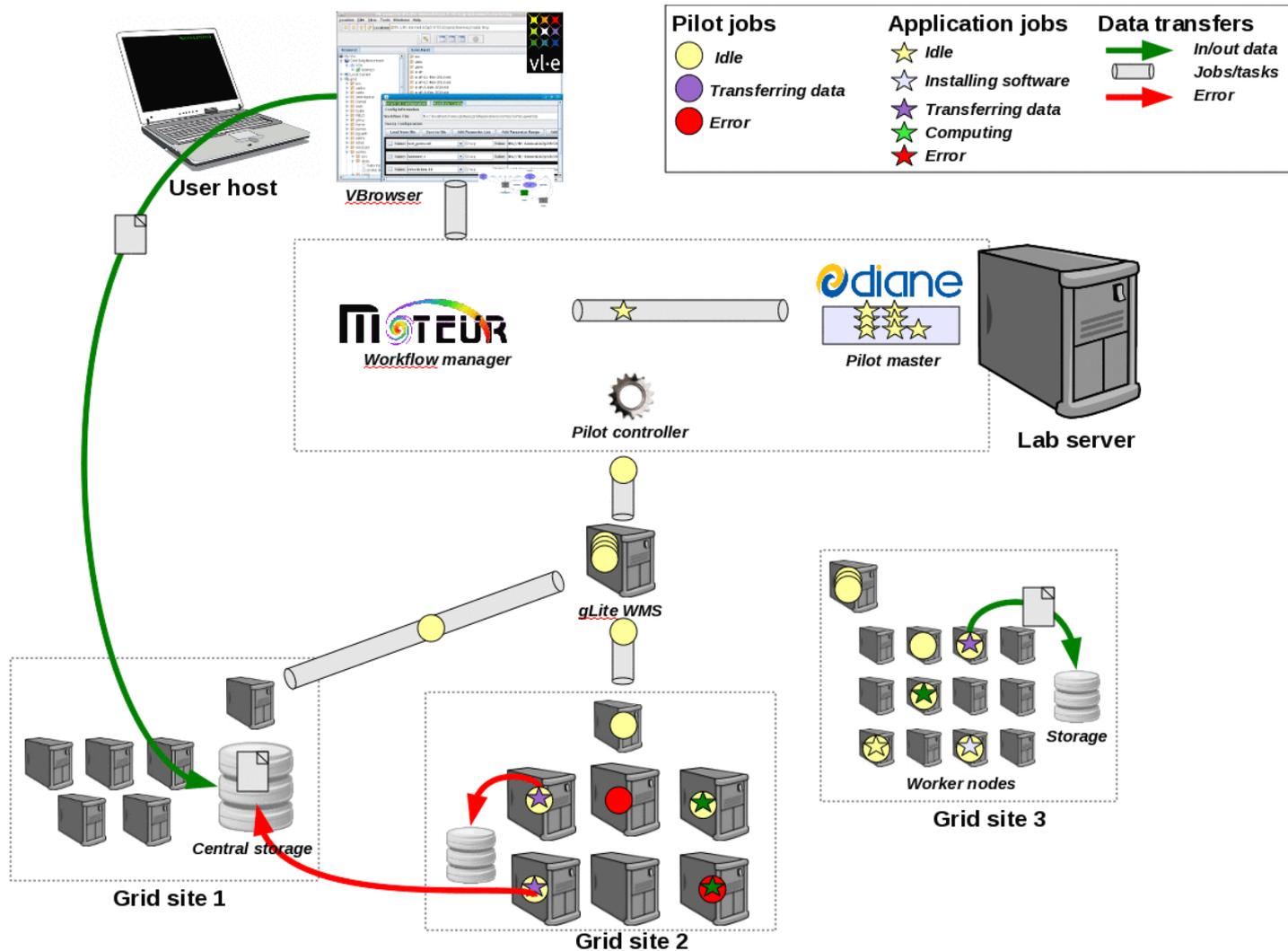


(total: 197 simulations, avril – septembre 2010)

- **Débit VS latence**

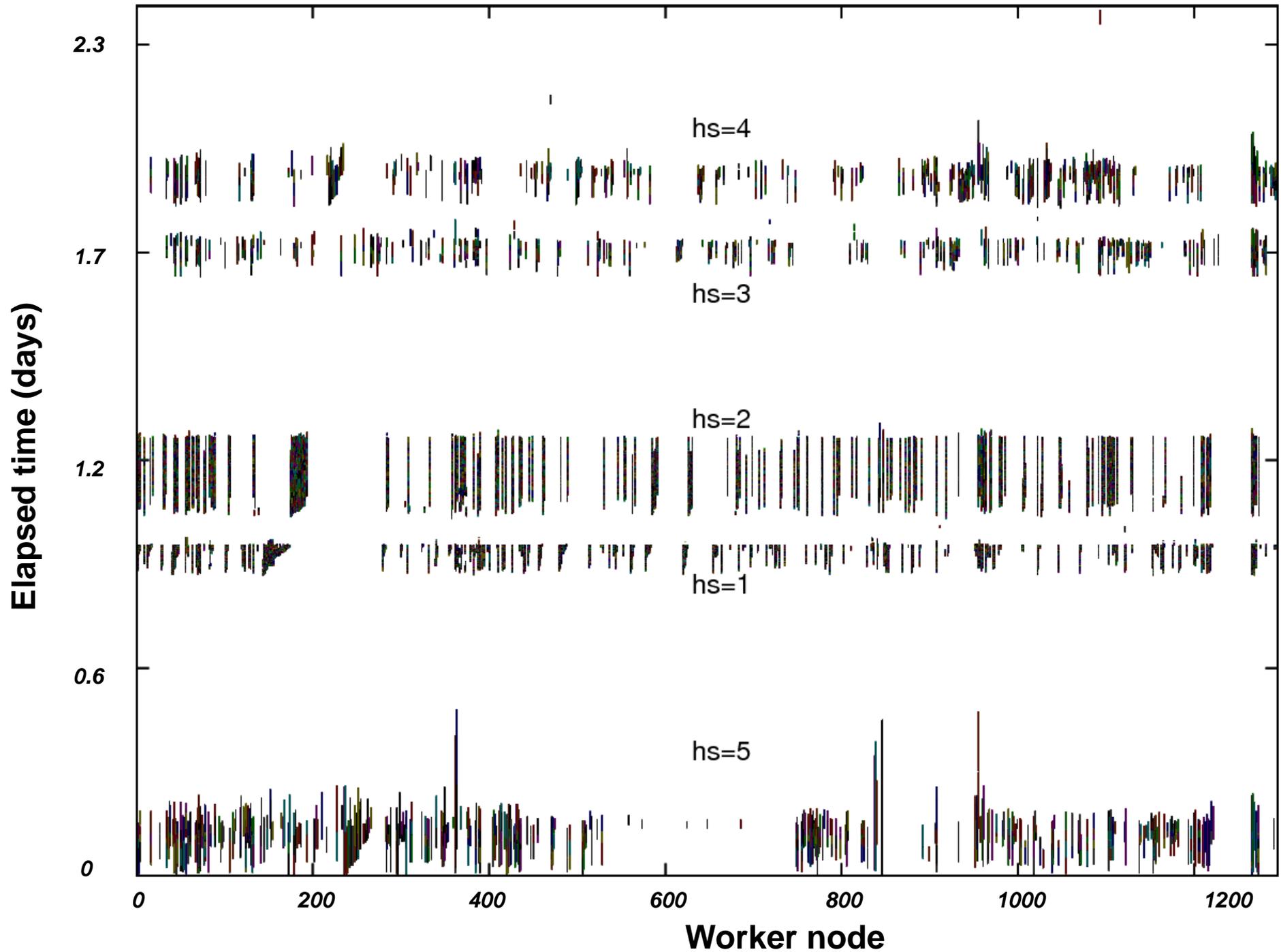


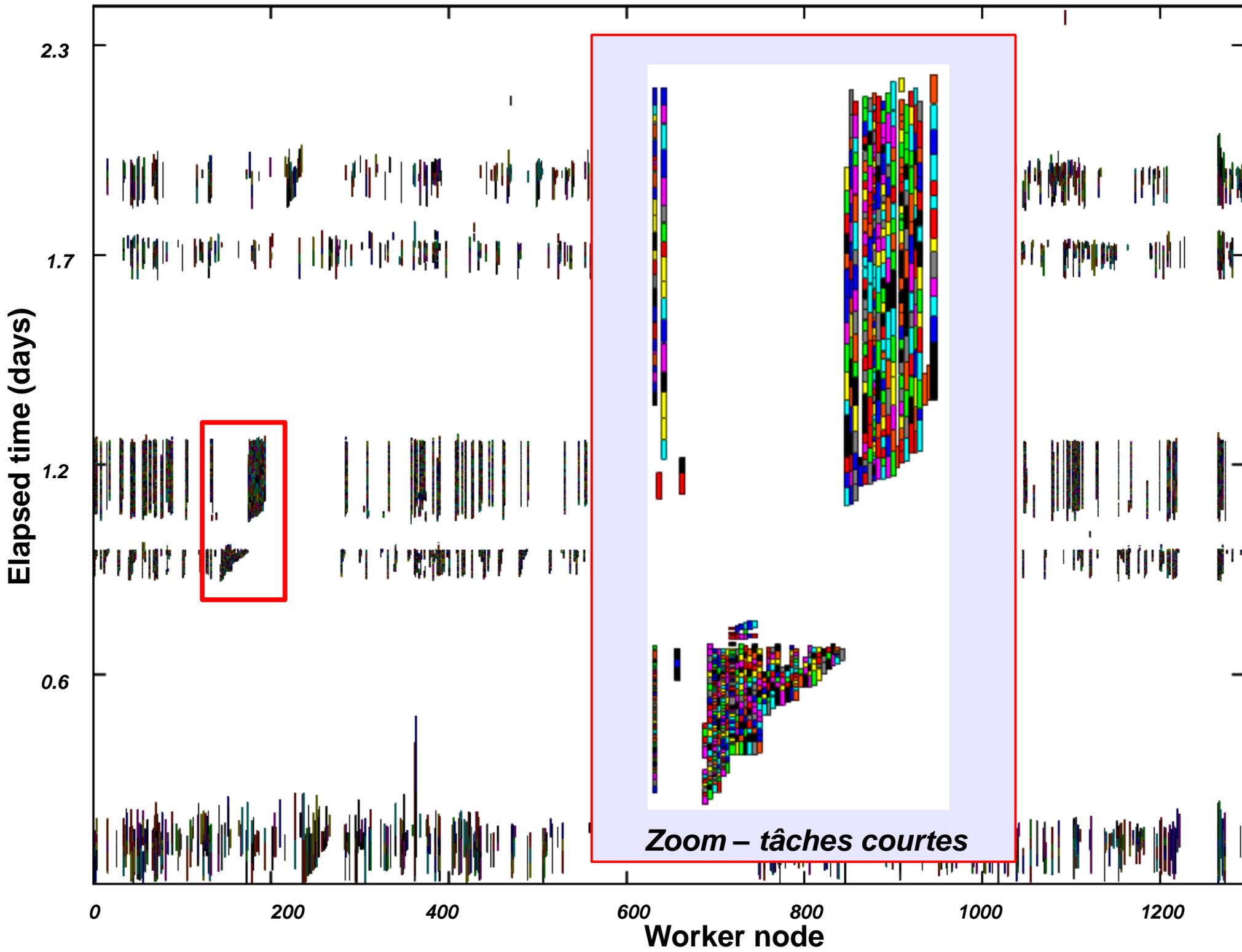
# Architecture logicielle



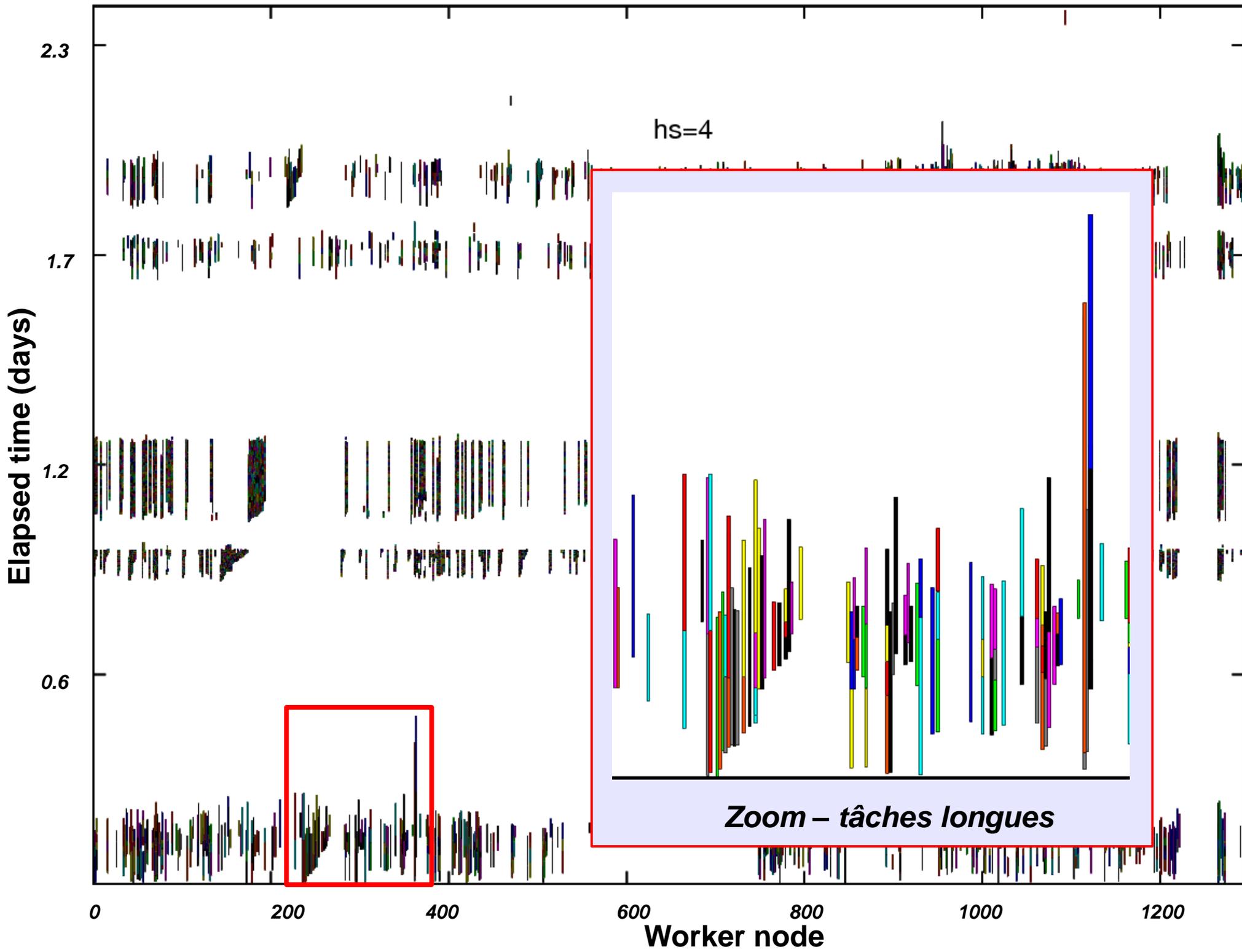
- Résilience
- Passage à l'échelle

# Equilibrage de charge





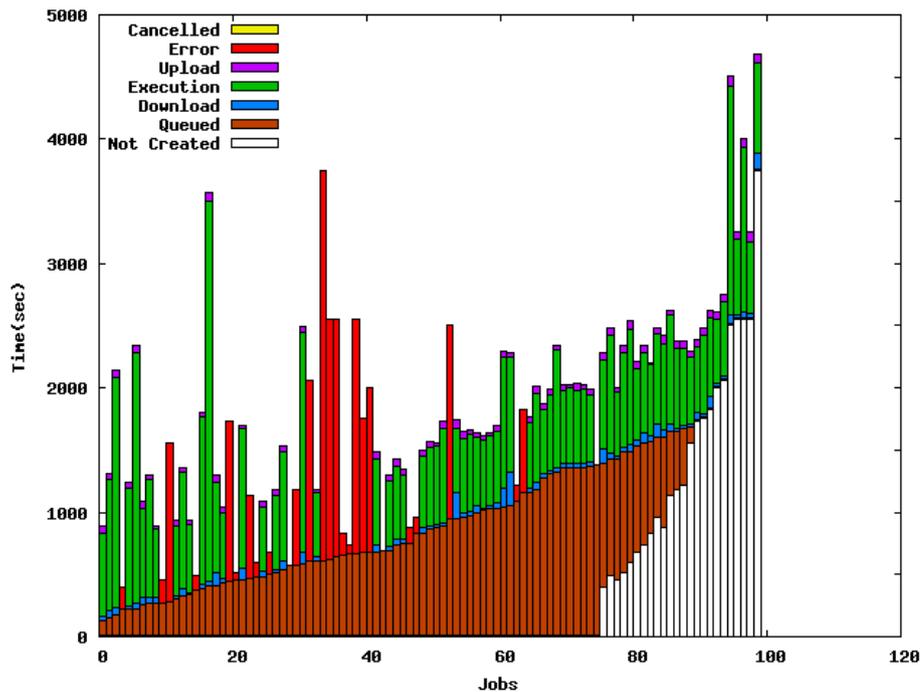
*Zoom - tâches courtes*



# Cas des simulations Monte-Carlo

## Statique

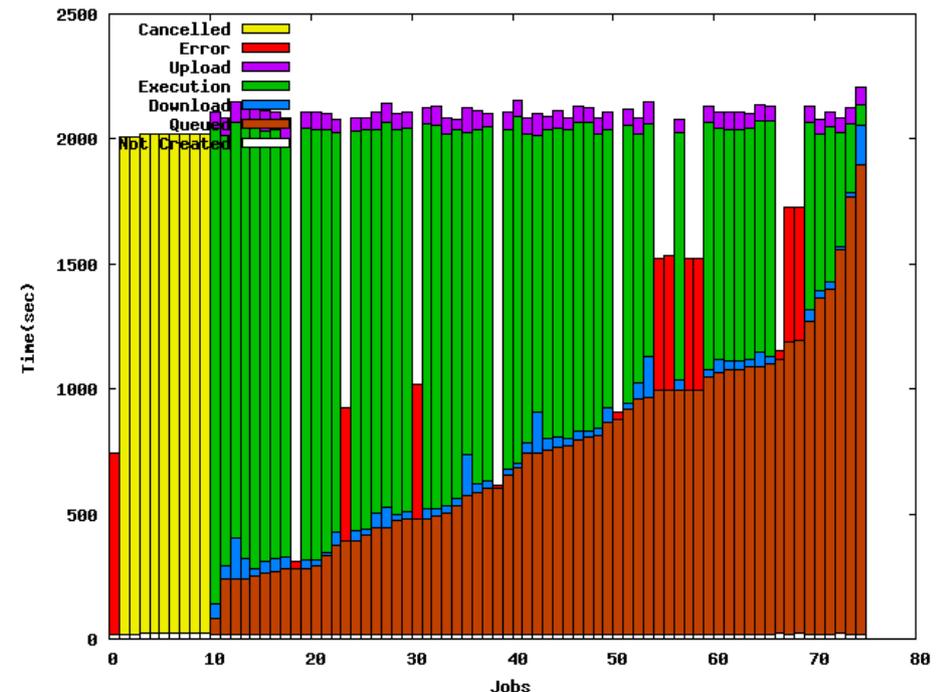
**Worker:**  
Simule  $p/n$  particules



## Dynamique

**Worker:**  
Tant que "stop" non reçu:  
Simule 1 particule  
Fin tant que

**Master:**  
Tant que  $p \neq P$   
 $p \leftarrow \#$  particules simulées  
Fin tant que  
Stoppe tous les workers



# Plate-formes de calcul

- **Grilles de volontaires**

Active: 307,337 volunteers, 513,662 computers.  
24-hour average: 5,114.85 TeraFLOPS.

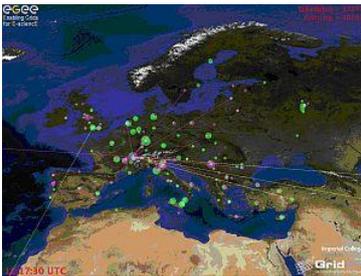
**Jiri Kovar** is contributing 6,093 GFLOPS.  
Country: Czech Republic; Team: LITOMYSL Boinc Team  
Czech Republic



**< 500,000  
PCs**

Ex: BOINC  
5 PFlop/s

- **Grilles**



**< 80,000 PCs**

Ex: EGI  
1 PFlop/s

- **Cluster**



**< 5,000 PCs**

Ex: CREATIS cluster  
700 GFlop/s

- **Supercalculateur**



**< 23,000 coeurs**

Ex: Tianhe-1A  
2500 PFlop/s

- **GPU**



**< 1024 coeurs**

Ex: NVIDIA Quadro NVS 160M  
34.8 GFlop/s

- **CPU Multicoeur**



**2 – 80 coeurs**

Ex: Intel Core2 Duo  
20 GFlop/s

# Vers une intégration transparente ?

- Grilles de volontaires

Active: 307,337 volunteers, 513,662 computers.  
24-hour average: 5,114.85 TeraFLOPS.

Jiri Kovar is contributing 6,093 GFLOPS.  
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Czech Republic



- Déploiement d'applications simple

- Grilles



- Exécution fiable

- Exécution efficace

1 PFlop/s

- Cluster



Ex: CREATIS cluster

- Supercalculateur



Ex: Tianhe-1A  
2500 PFlop/s

- GPU



Ex: NVIDIA Quadro NVS 160M  
34.8 GFlop/s

- CPU Multicoeur



Ex: Intel Core2 Duo

# Questions ?

Crédits : S. Camarasu-Pop, R. Silva, D. Sarrut, L.Grevillot, O. Bernard, P. Clarysse, C. Casta, S. Ben-Fredj, B. Leporq, F. Pilleul, O. Boeuf,

*Creatis*