

HP-SEE DISSEMINATION & TRAINING

Tirana, 17 November 2011

GIM

GEOPHYSICAL INVERSION IN PARALLEL SYSTEMS

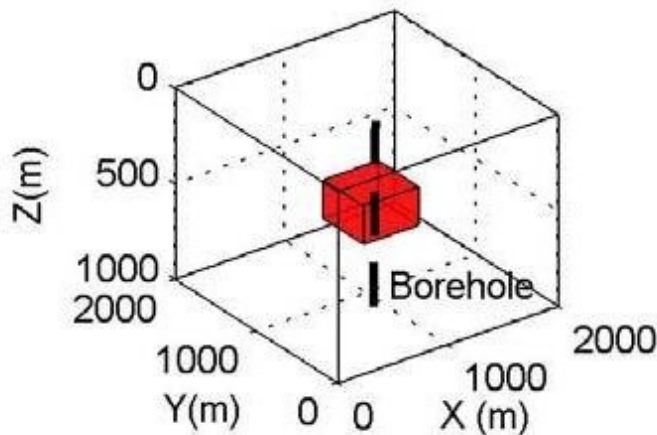
EC FP7 Project HP-SEE
<http://www.hp-see.eu/>

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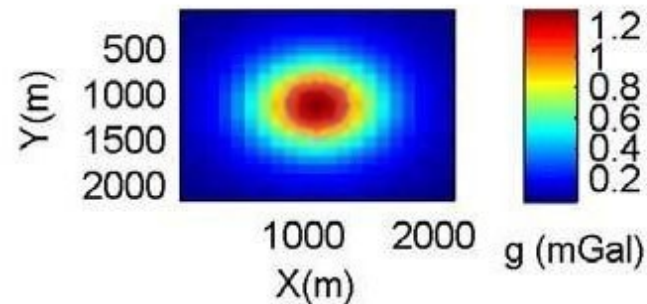
Inversion – An Ill Posed Problem

- Extrapolation from a 2D grid to a 3D one
- Example:

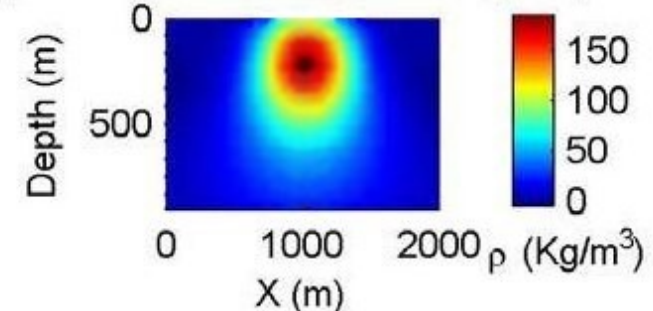
(a) Initial model



(b) Gravity observations at the surface



(c) Inverted data using surface gravity



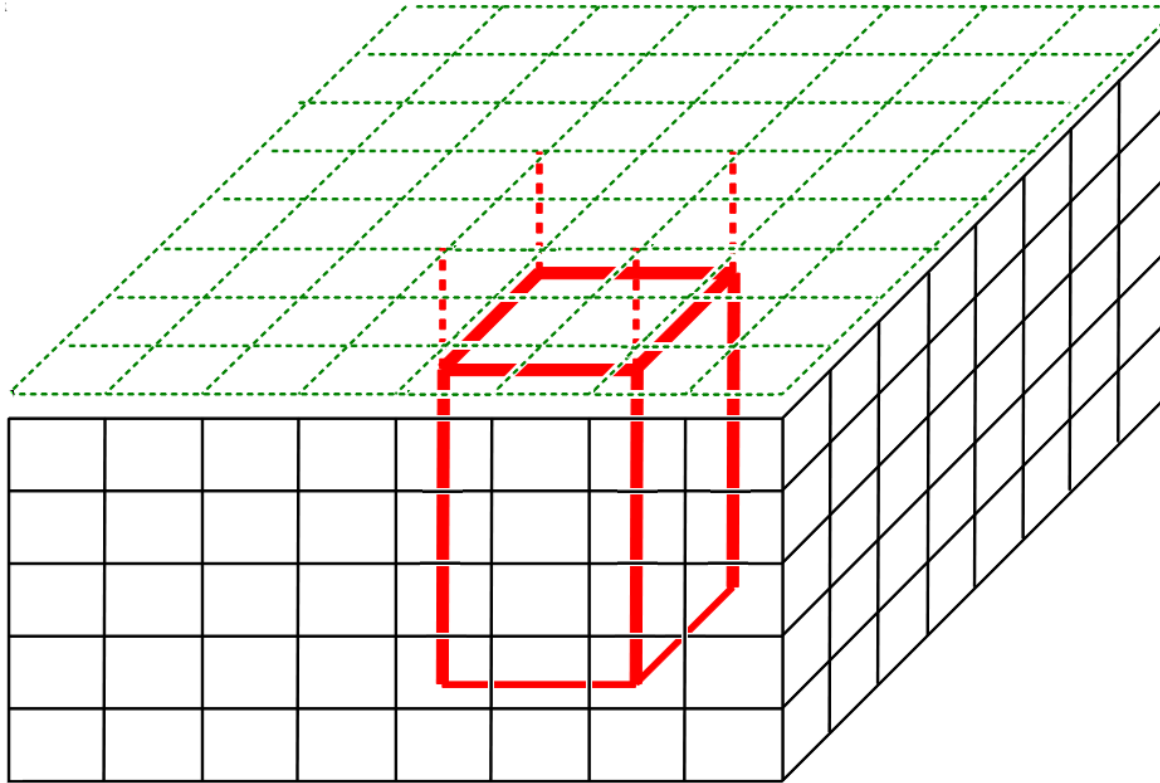
P. Shamsipour, M. Chouteau, D. Marcotte, P. Keating. 3D stochastic inversion of borehole and surface gravity data using Geostatistics. EGM 2010 International Workshop, Adding new value to Electromagnetic, Gravity and Magnetic Methods for Exploration Capri, Italy, April 11-14, 2010

Objectives of GMI

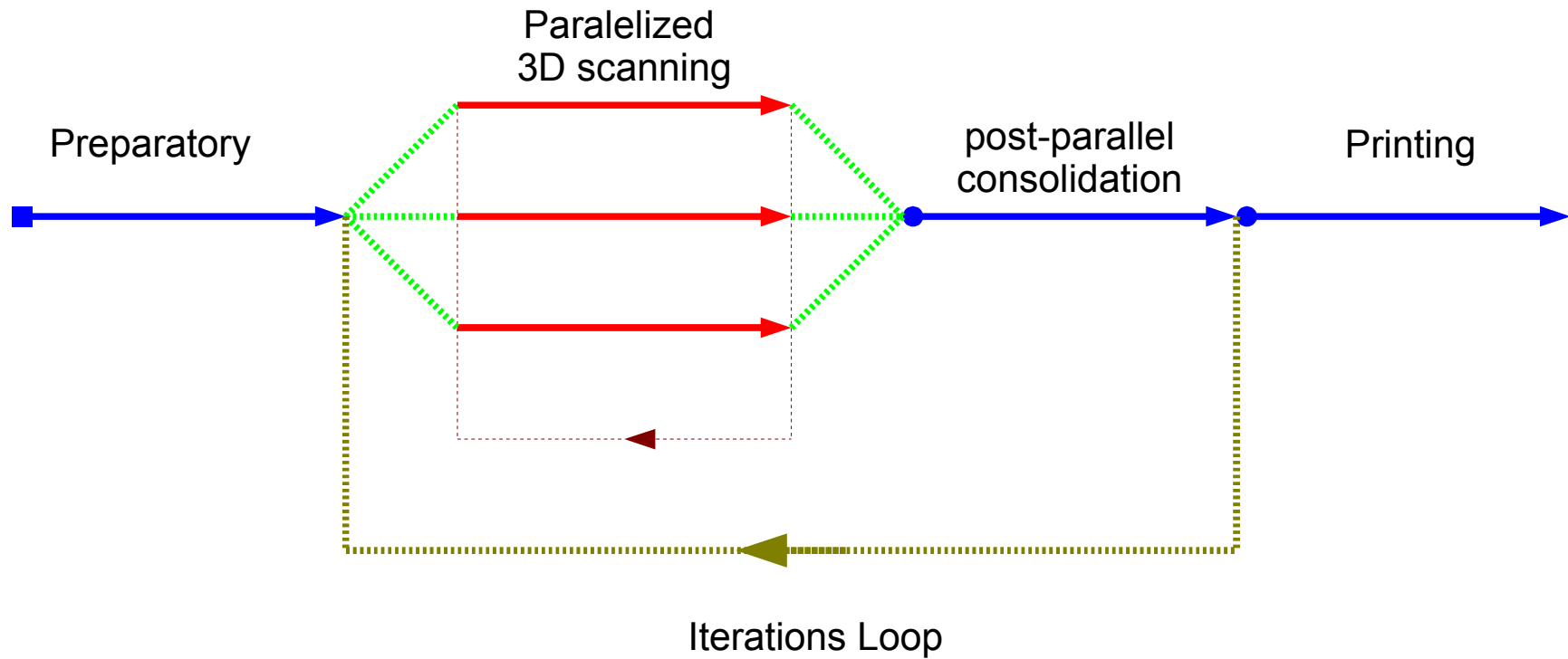
- To analyse
 - Convergence rates and runtime in parallel systems
 - Qualitative aspects of the “ill – posed” convergence
 - Compare results from field data
- Actual convergence results are
 - Based in OpenMP parallelization
 - 16 – 1024 cores in HPC of IICT (BG) and NFII (HU)
- Case of Gravity – the simplest

The Model

- 3D nodes $11 \times 11 \times 6$, $21 \times 21 \times 11$, $41 \times 41 \times 21$, $81 \times 81 \times 41$ (and $161 \times 161 \times 81$???)

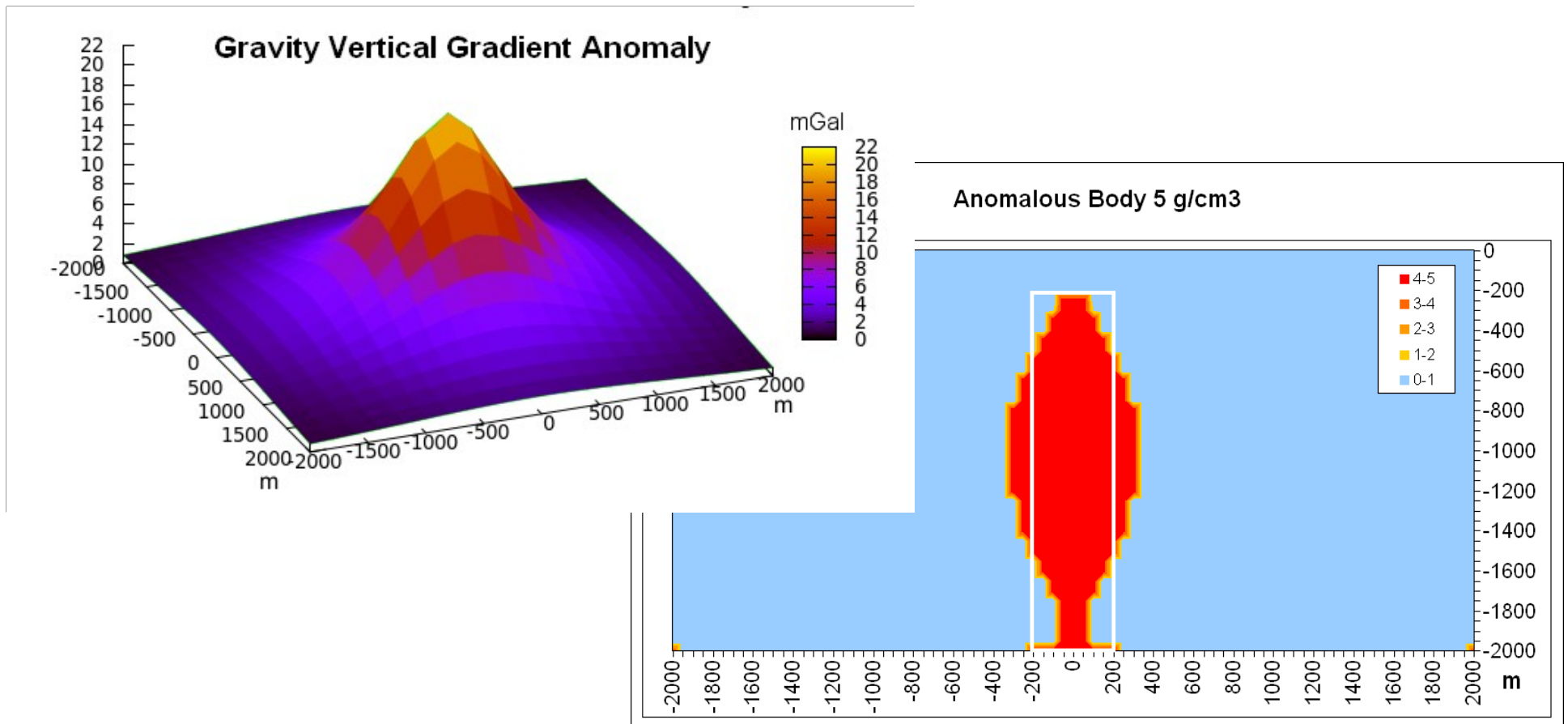


Parallelization ~ OpenMP



Typical Inversion Results

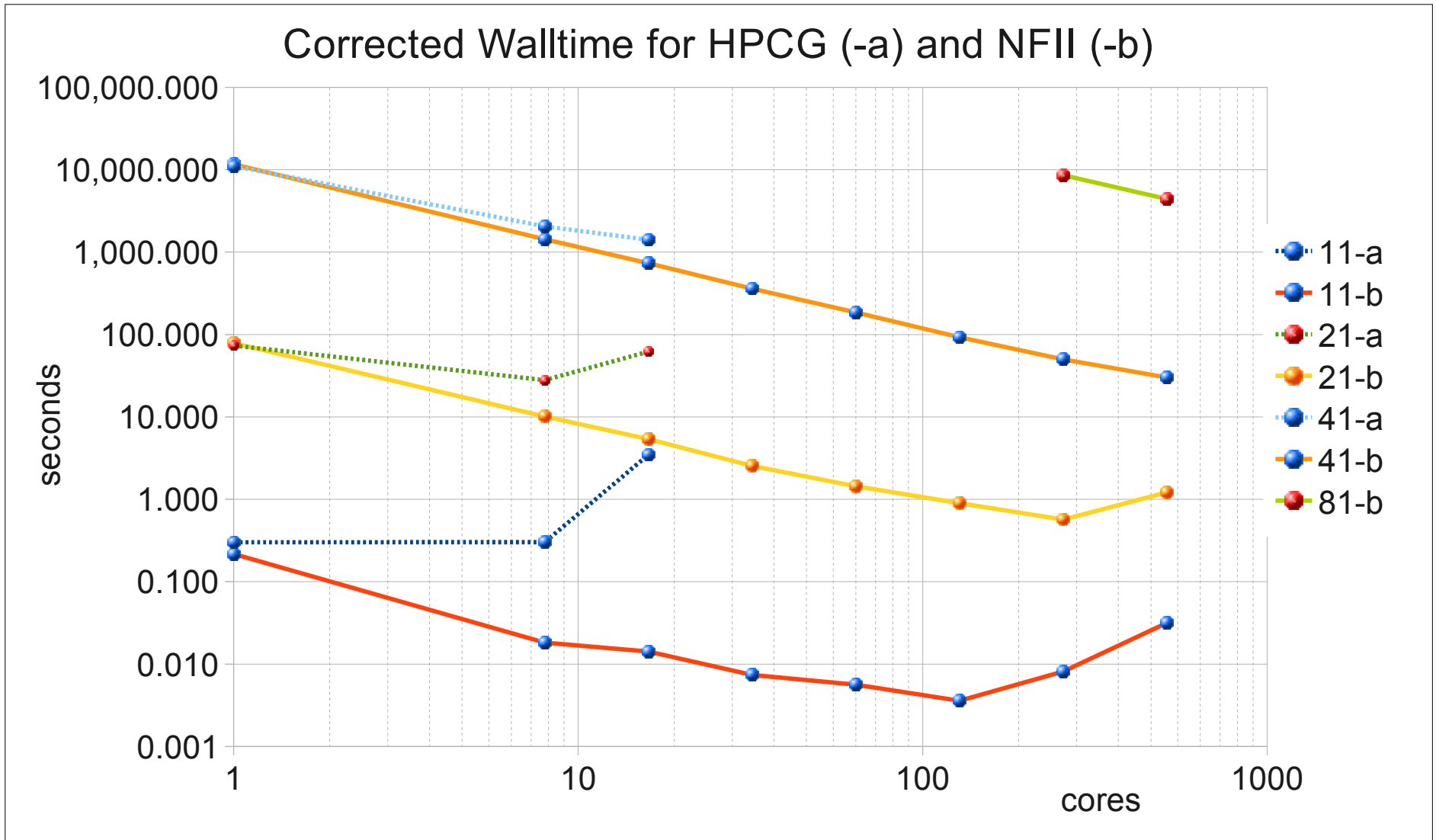
- A case of gravity anomaly and its inversion



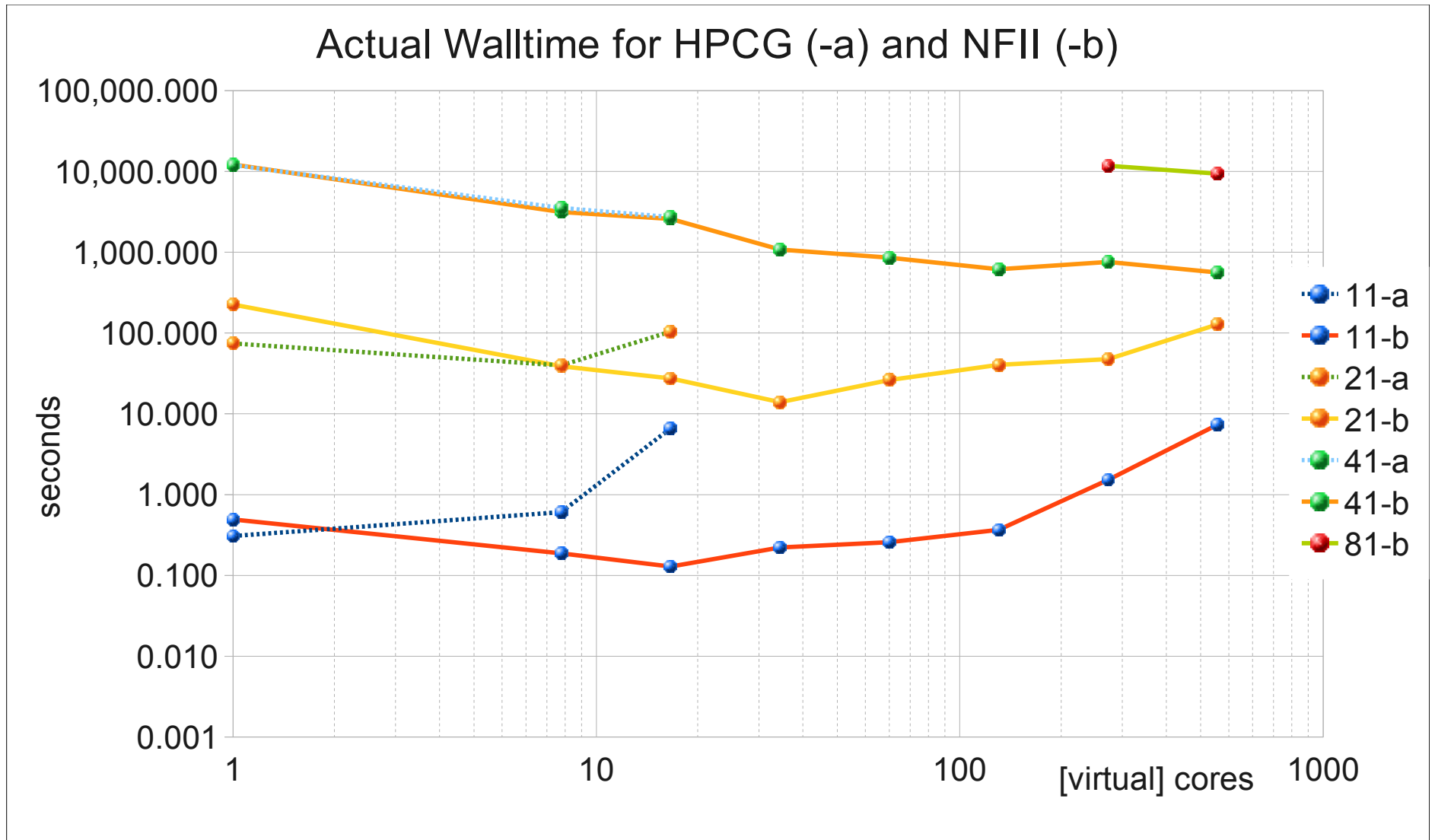
Iterations & Errors



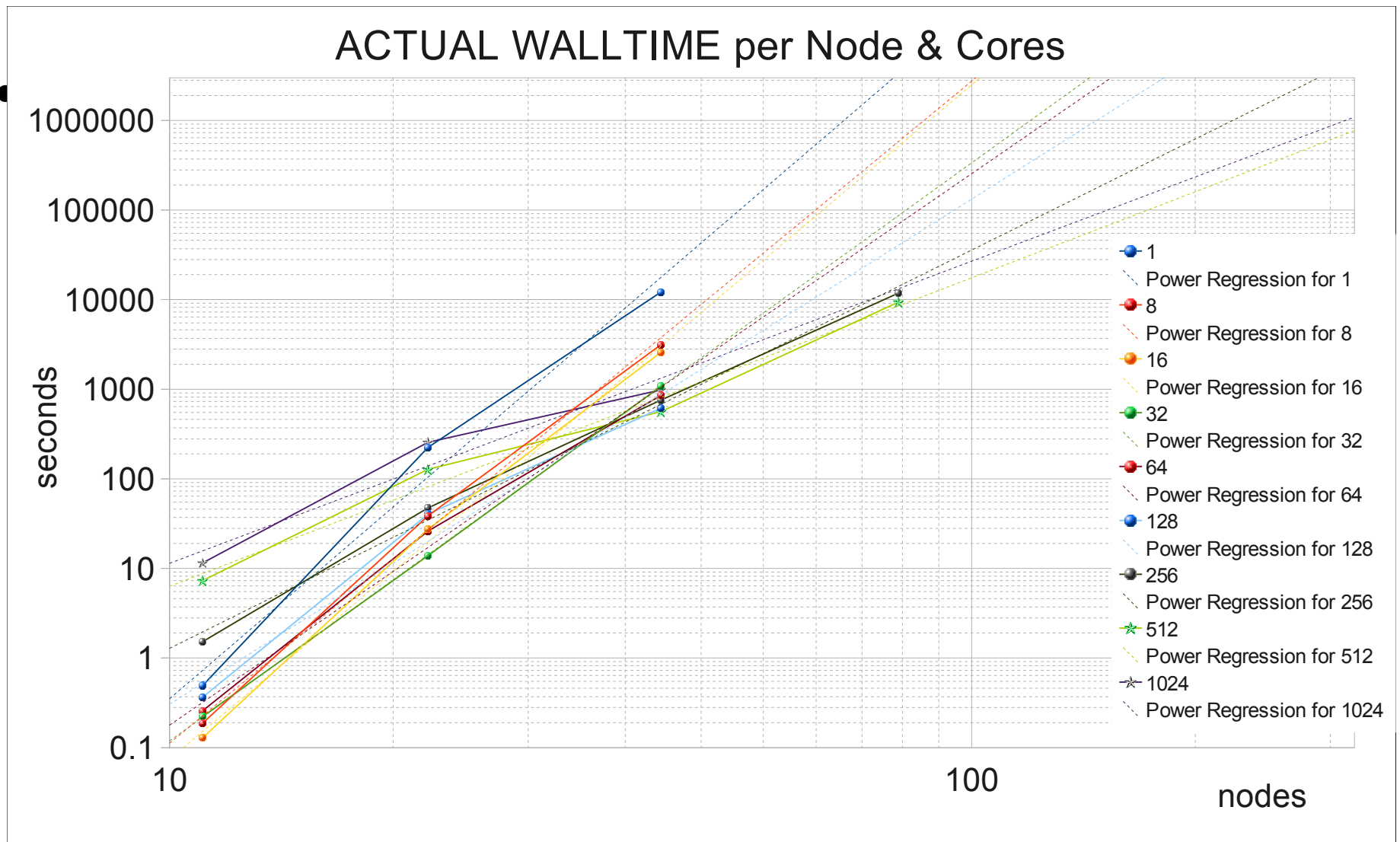
Convergence



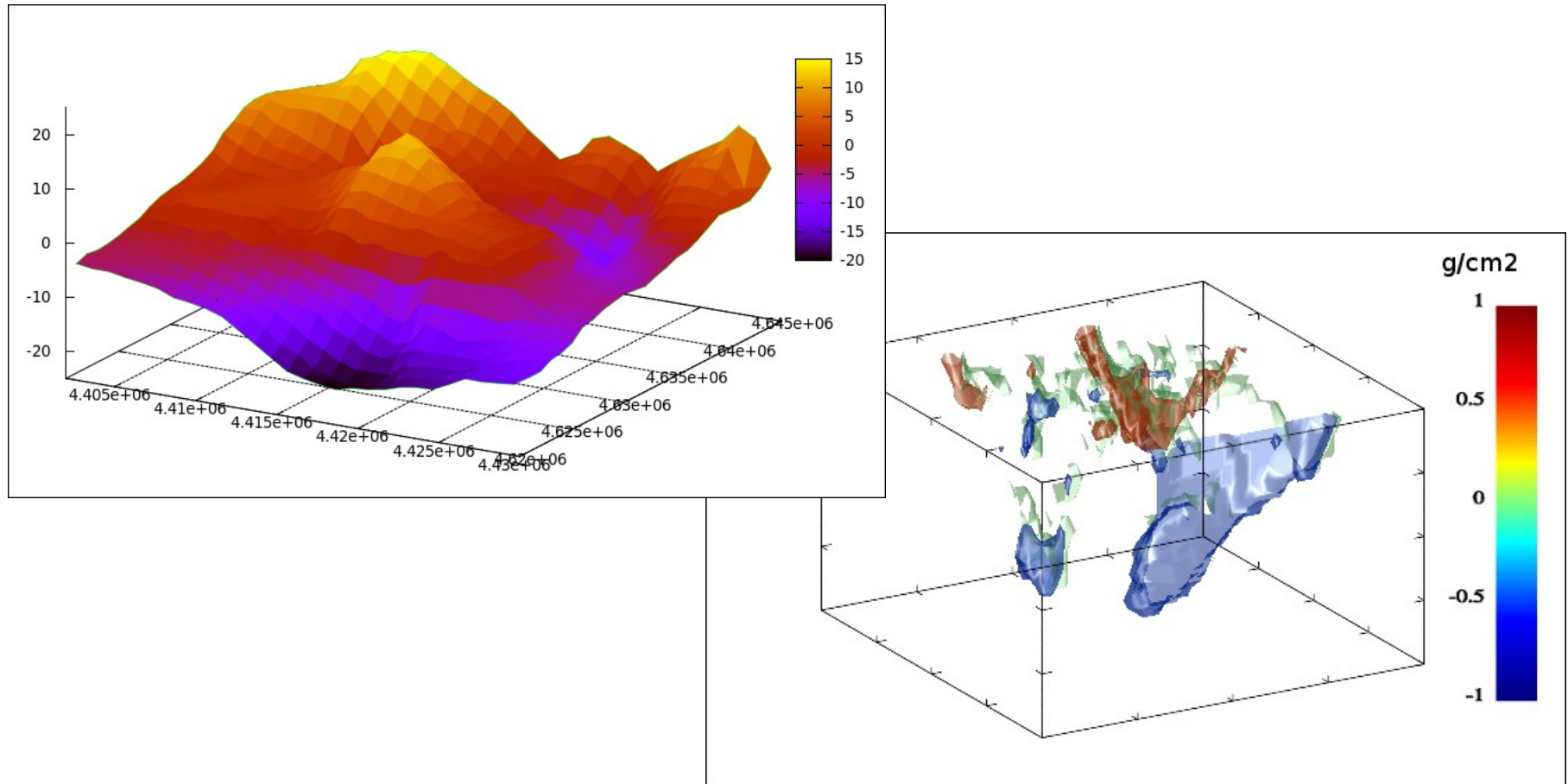
Real Walltime



Prediction for Actual Walltime



A Case from the Field



Conclusions

- Gravity case
 - When density N of linear nodes increases by $O(N)$
 - Theoretical calculations per iteration factor $O(N^{3+2})$
 - Trend of number of iterations is $\sim O(N^3)$
 - Runtime increases with factor of $\sim O(N^7)$
 - And magnetism, electrometry ?
 - Inversion remains a problem ;-0

• **THANK YOU**