



MAGIQUE-3D

Modélisation Avancée en Géophysique 3D

Advanced Modeling in Geophysics 3D

Inria Bordeaux Sud-Ouest Research Center

Joint team with the University of Pau and Pays de l'Adour (LMA UMR CNRS 5142)

Composition of the team (May 2015)

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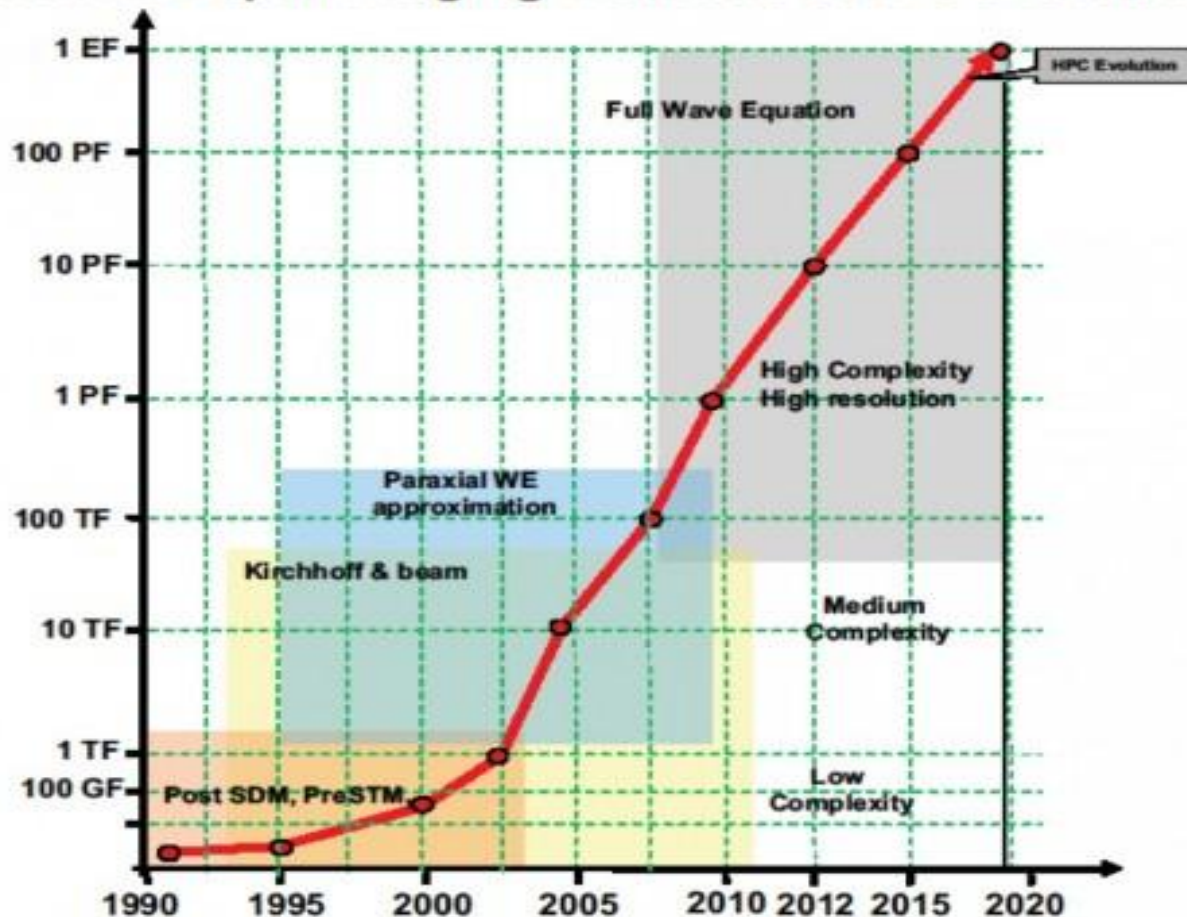
Keywords of our research activities

- **Advanced numerical methods for wave problems**
 - DG Finite elements
 - High-order explicit time schemes
- **Asymptotic modeling**
 - Boundary conditions
 - Asymptotic models
- **Inverse problems**
 - Seismic imaging
 - Inverse scattering problems
- **High Performance Computing**

Numerical approximation of waves

- **Efficiency:** any algorithm must be elaborated for **High-Performance Computing (HPC)**

Seismic Depth Imaging Methods & HPC evolution

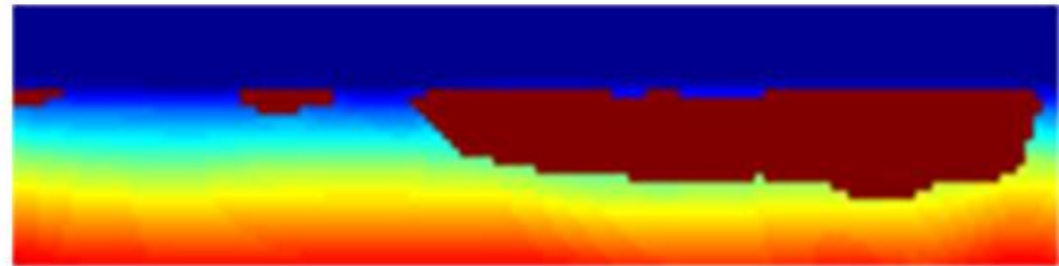
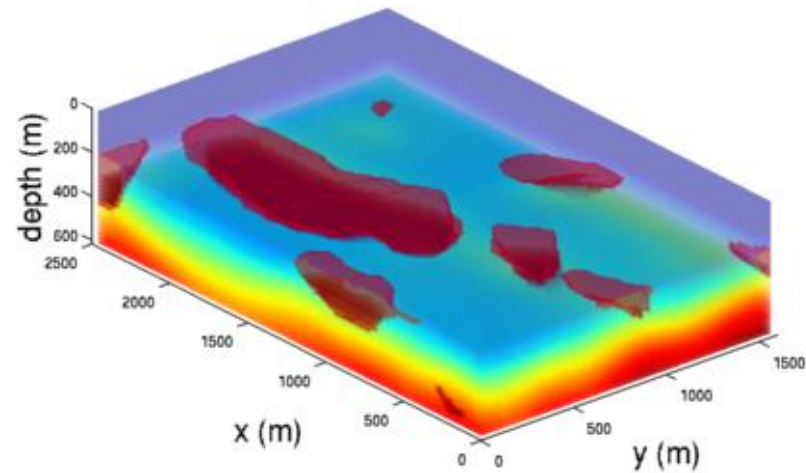


High Performance Computing

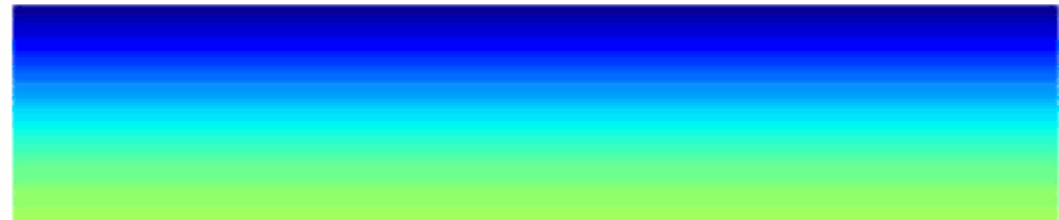
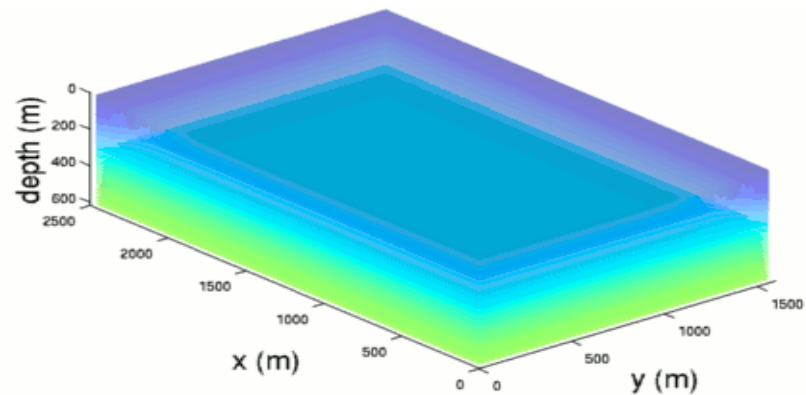
- **Time-dependent problems:**
 - Sparse matrix-vector product at each time step
 - Target: reduce the communications between processors
- **Harmonic problems:**
 - Inversion of very large linear system
 - Target: reduce memory costs

Full Waveform Inversion

Acoustic Louro 3D model: 2.46km x 1.56km x 0.6m



True velocity model and vertical slice at y=400m



Starting velocity model guess for inversion ; vertical slice at y=400m

Full Waveform Inversion

- **9 000 000** unknowns on a **regular** grid
- Cluster of **1024** nodes : 2x8-Core Intel Xeon-E5
16000 Cores
- About **50** mn for one iteration!

There is an obvious need in reducing the computational time and limiting the occupation of memory

Focus on asymptotic modeling

- Why? **HPC** is not **self-sufficient** to solve realistic inverse problems in Geophysics
- We are not just waiting for architecture evolutions. Anticipation is needed and working on the modeling is mandatory
- Some prospecting projects gathering mathematicians and computer scientists: **HPC-GA IRSES** and **GEAGAM Rise** projects