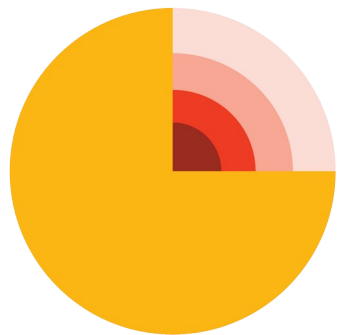


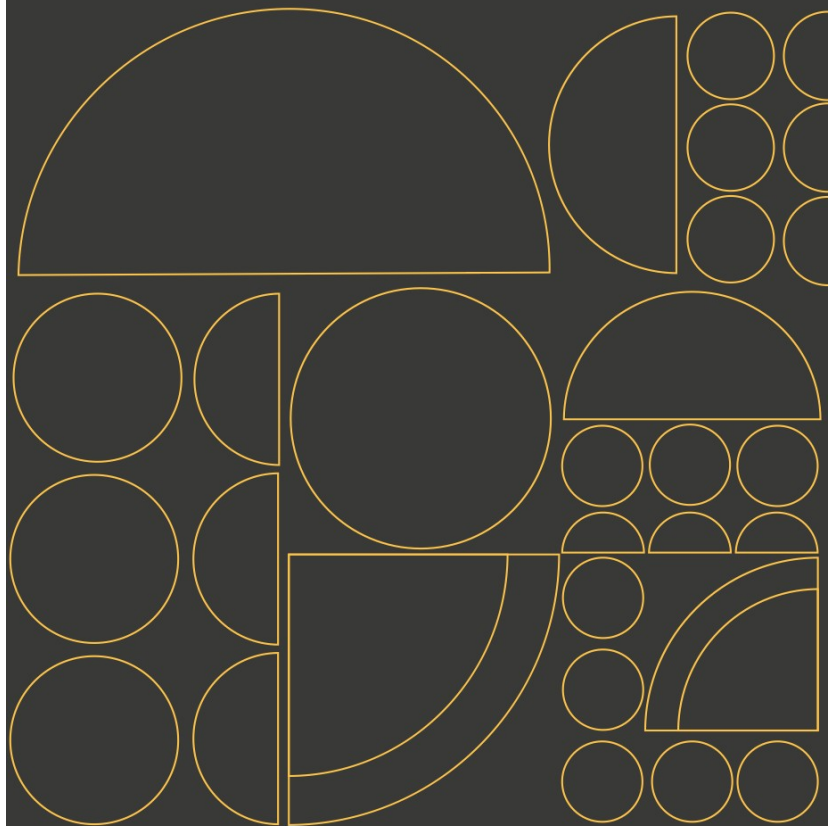


ChEese

SPEC⁺⁺FEM

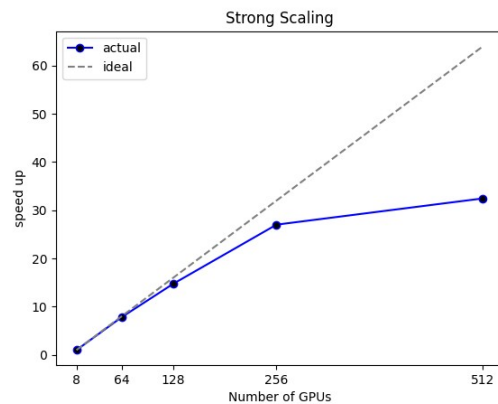
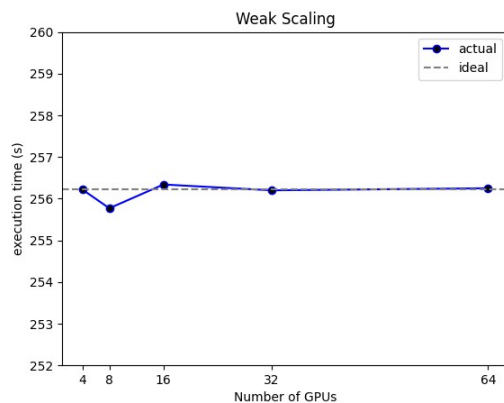


Project funded by EuroHPC under the grant agreement No 101093038.



Contributions to WP2

T2.1 : **Audit**: Leonardo GPU Nvidia A100 Weak and Strong scaling



T2.2 : **Performance portability** : mini-specfem3D

CPU : fortran + MPI

GPU Nvidia : fortran + MPI + C/C++ + cuda

GPU AMD : fortran + MPI + C/C++ + HIP

Contributions to WP2

T2.3 : **optimization for exa-scale** (Work in collaboration with EVIDEN)

specfem is memory bound code → Data compression/decompression in memory to increase memory throughput

Constants arrays stored in memory : 13 → 30 float per grid point
(model parameter, mesh geometry)

Several codecs are currently being tested on those arrays:

- JPEG inspired techniques
- wavelet
- fixed point
- interpolation

Next step : test codecs in
mini-specfem3D

bits	Mean Compression error	Compression rate
8	1,83E-03	4,0
9	9,55E-04	3,5
10	4,85E-04	3,2
12	1,24E-04	2,6
16	7,78E-06	2,0

Contributions to WP3

T3.1 : Preparation of mini-specfem3d (Work in collaboration with EVIDEN)

- Vectorization optimization on x86: Add !OMP SIMD directive before the calculation loop
- Test run on AMD Milan 7763 (1 socket with 64c):

Mini app	Execution time	Speedup	Compute bound	Memory bound	Vectorized
acoustic_iso_mpi	48 s	-	7%	93%	Yes
elastic_aniso_mpi	166 s	1,6	61%	39%	Yes
elastic_iso_mpi	116 s	1,2	40%	60%	Yes
elastic_iso_att_mpi	240 s	1,1	37%	63%	Yes
elastic_iso_vecto_mpi	102 s	-	6%	94%	Yes

Conclusion :

- To take advantage of the SVE it is important to have vectorized mini-apps
- As every mini-app have a non-negligible % of memory bound, we expect HBM will be effective for all applications

Task T5.1.2 SPECFEM3D

Computational Seismology

Objectives :

Multiphysics : attenuation and gravity kernels

SEM-DK : versatile spectral element method library for future version of specfem3D

Status :

Implementation of gravity kernels :

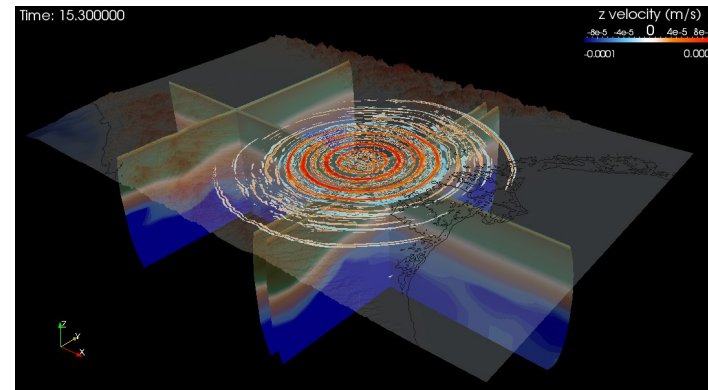
Meshes for a part of WGS84 ellipsoid Earth with topography

Cuda kernel to compute gravity field perturbation

New version of specfem3D :

Kokkos based SEM-DK in 2D and 3D working on both CPU and GPU.

Acoustic/Elastic. Custom Mesher. MPI support. Multiple time scheme.



SC1.1 Anthropogenic noise and seismicity, wave propagation at higher frequencies in Rade d'Hyères

PD1 Extreme-scale modeling of seismic hazards

Goal

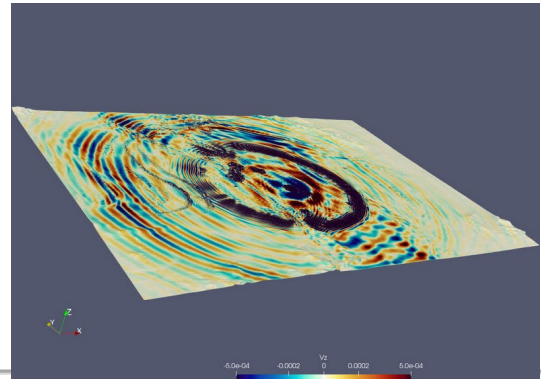
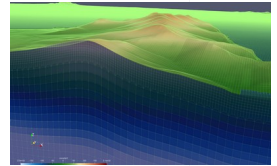
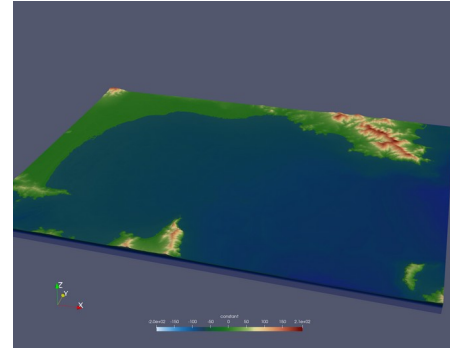
Assessment of noise pollution in the marine environment and seismic risks induced by anthropogenic activity.

How

High frequency sismo-acoustic modeling in costal zone (Rade d'Hyères)

Tool

- SPECFEM3D



PD2 High-resolution seismic inversion and tomography

SC2.1 Seismic tomography of the Adriatic-Ionian region

Goal

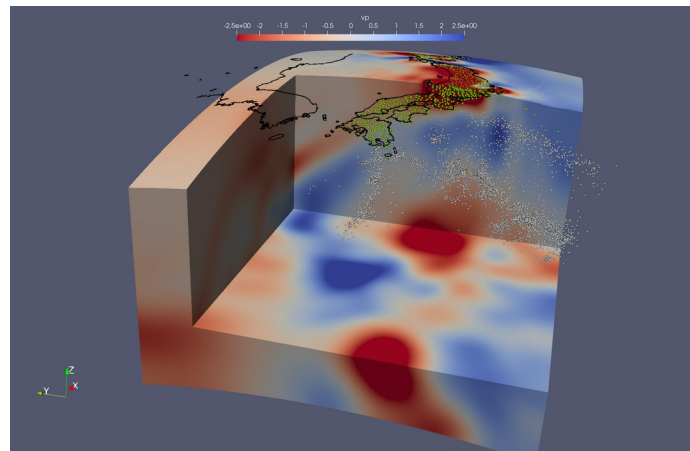
High-resolution subsurface imaging

How

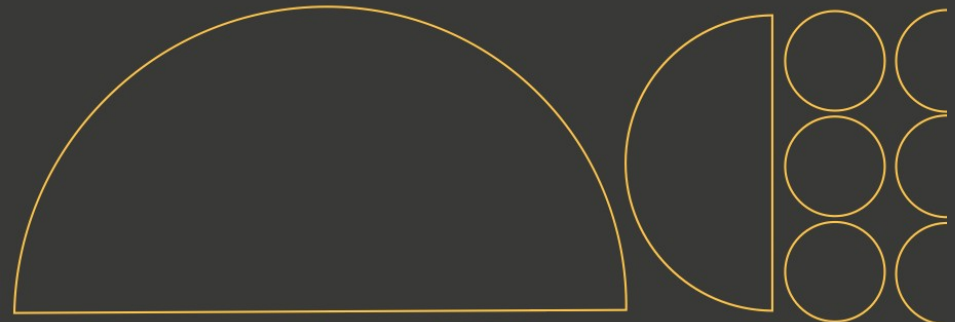
Multi-objective and multi-parameter optimization: adjoint tomo, full waveform inversion, gravimetry, travel-time, body and surface waves. Local earthquake relocation, source estimation.

Tools

- SPECFEM3D
- 2nd order optimization methods



Thank you!



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