



CNRS/ IPGP (affiliated entity)

Vadim Monteiller



ChEESE



Main roles in ChEESE-2P

- **WP5** : lead (T5.1, T5.2)
- **Area** : Computational Seismology and Magnetohydrodynamics
- **Flagship codes** : SPECfEM3D and xSHELLS
 - 2 Pilot demonstrators (PD2, PD7)
 - 2 Simulation Cases (SC1.1, SC7.1)



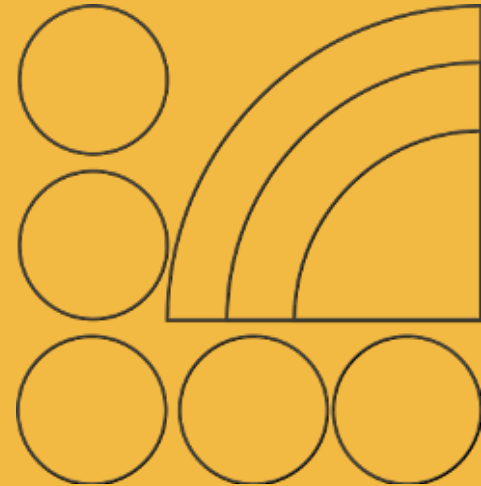
Participation in 22 tasks:

- **WP1** : T1.1→T1.5
- **WP2** : T2.1→T2.4
Codes audits, optimization on GPUs, optimization for exascale.
Performance monitoring
- **WP3** : T3.1→T3.3
mini-apps : mini-specfem, mini-xHSELLS
- **WP4** : T4.1 → T4.3
- **WP5** : PD1, PD2, PD7
- **WP6** : T6.1, T6.3, T6.4
- **WP7** : T7.1→ T7.4, T7.6



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

PD1 Extreme-scale modeling of seismic hazards



Goal

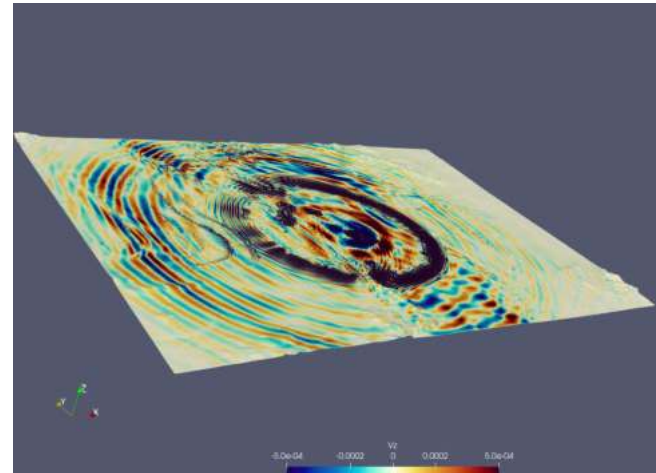
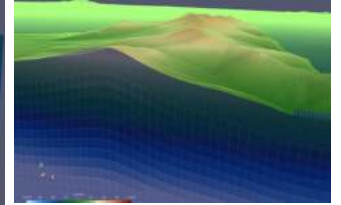
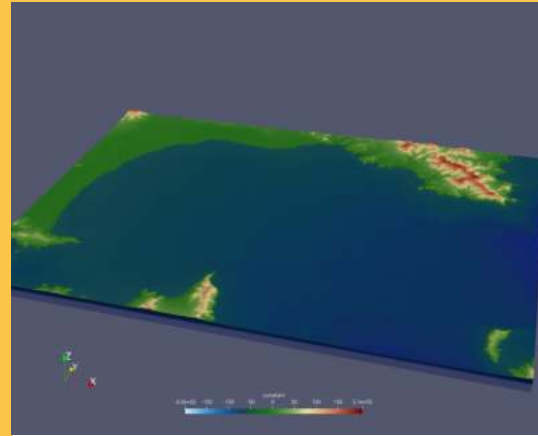
Assessment of noise pollution in the marine environment and seismic risks induced by anthropogenic activity.

How

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

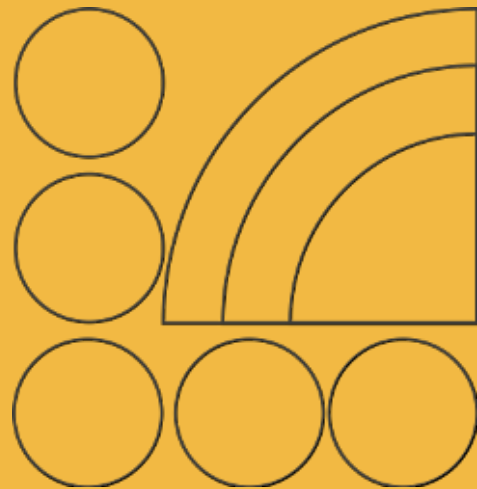
Tool

- SPECFEM3D



PD2 High-resolution seismic inversion and tomography

SC2.1 Seismic tomography of the Adriatic-Ionian region



Goal

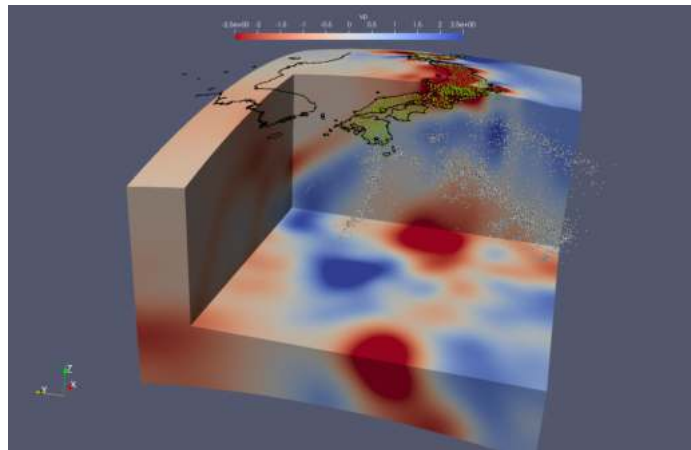
High-resolution subsurface imaging

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

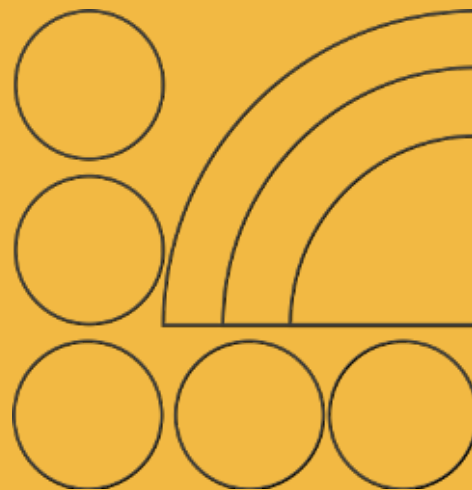


PD7 The Earth's dynamo model

SC7.1 MHD turbulence closure models in planetary cores using AI

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Fournier / T. Gastine / N. Schaeffer / ChEESA-2 Postdoc (24 months)



Goal

To capitalize on progress made over the course of ChEESE-1P to produce more realistic models of the geodynamo that embrace the full spectrum of motion at stake

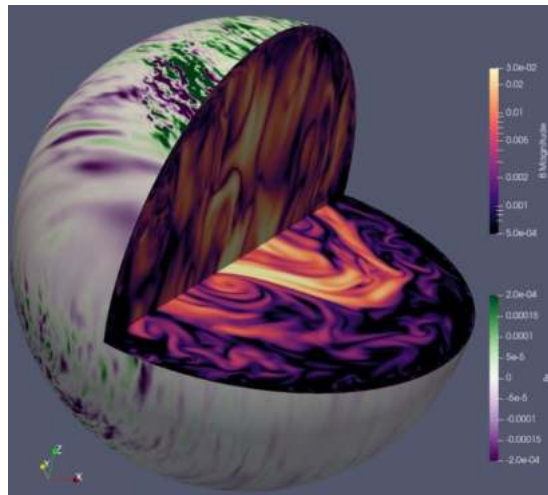
How

By designing dedicated subgrid-scale models based on neural networks (NN)

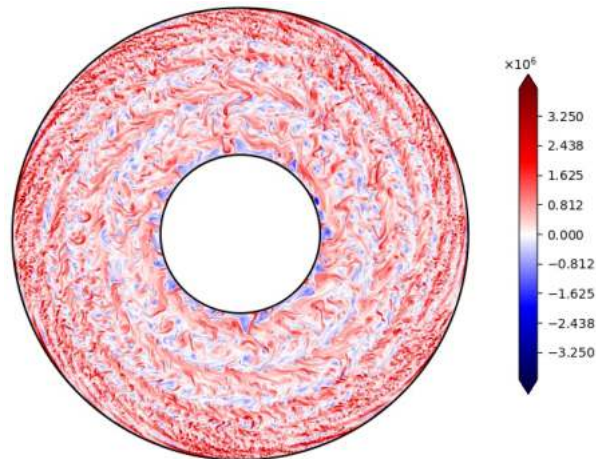
Tools

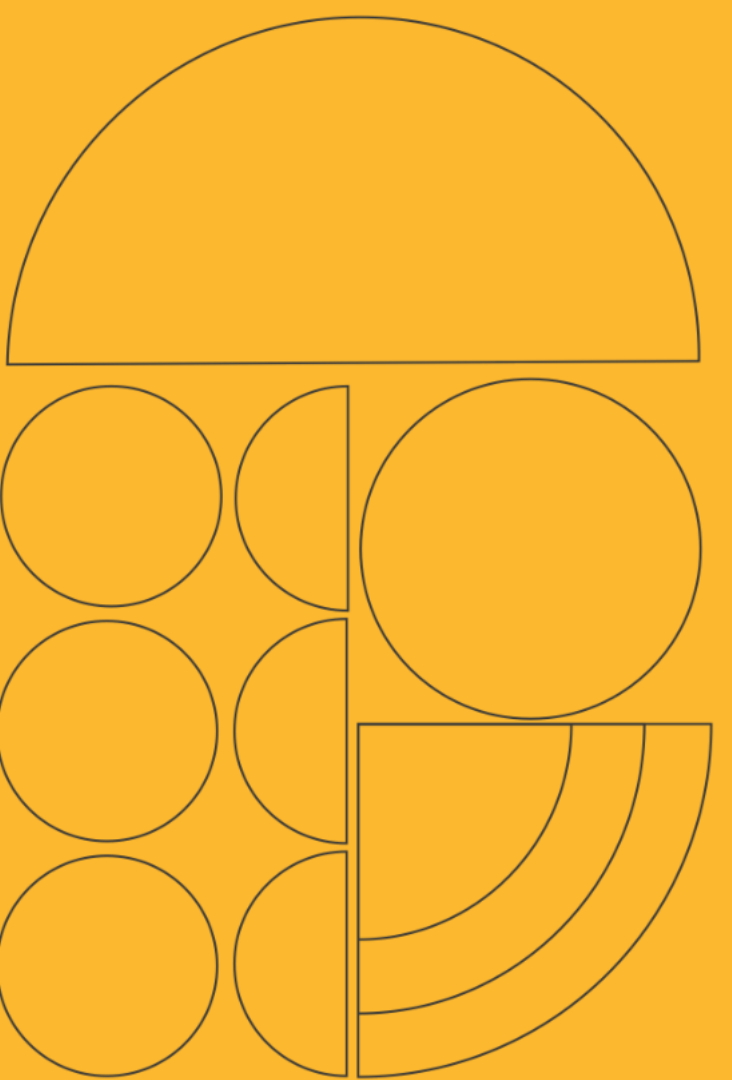
- 3D dynamo code: xshells
- 2D quasi-geostrophic convection code: pizza (prototyping of NN)

xshells



pizza





Thank you



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<http://cheese2.eu>



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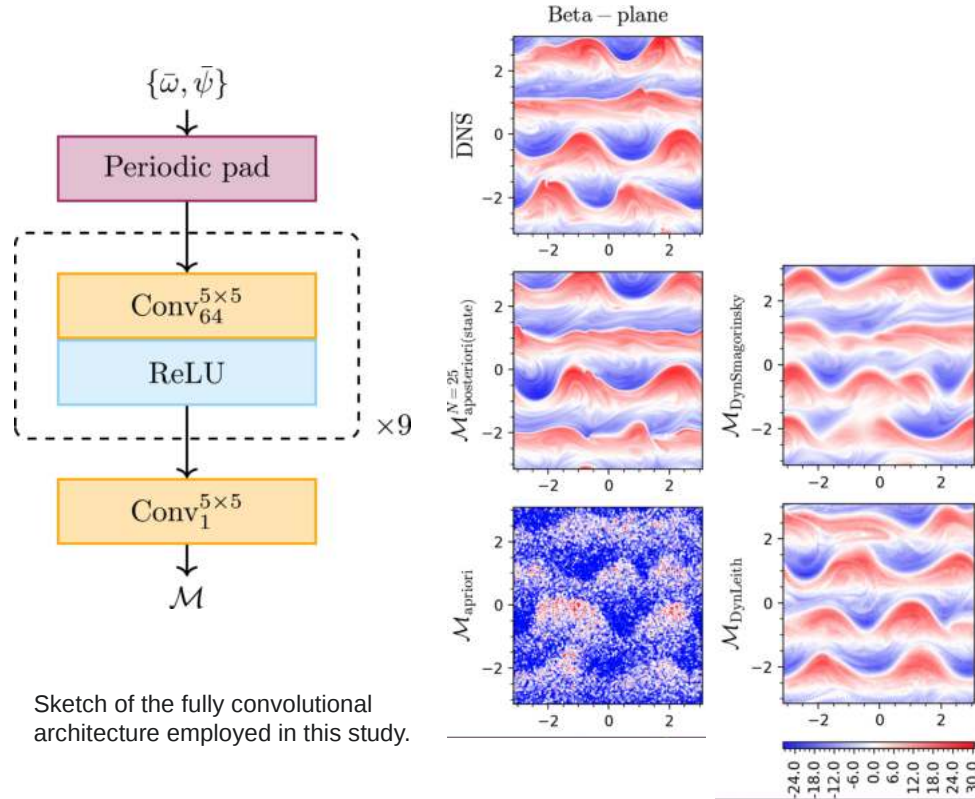


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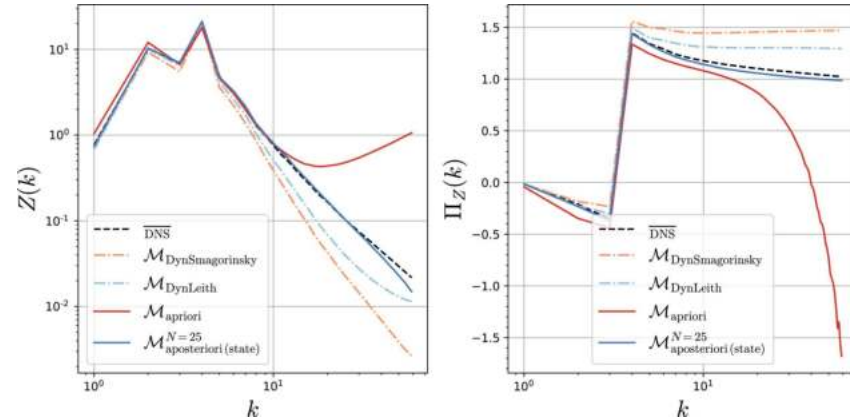


Inspiration: Subgrid-scale models for beta-plane turbulence

Frezat, H., Le Sommer, J., Fablet, R., Balarac, G., & Lguensat, R. (2022). A posteriori learning for quasi-geostrophic turbulence parametrization. *Journal of Advances in Modeling Earth Systems*, 14, e2022MS003124. <https://doi.org/10.1029/2022MS003124>



Sketch of the fully convolutional architecture employed in this study.



Time-averaged enstrophy spectrum (left) and enstrophy flux (right) describing statistical performance of the models in beta-plane turbulence.

