Les défis de la modélisation full-wave HPC en environnement marin – Exemple de la propagation sismo-acoustique générée par l'explosion d'engins explosifs historiques à forte charge en eau peu profonde

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Résumé

Unexploded historical ordnance (UXO) from World War II must be destroyed quickly after discovery to ensure the safety of divers and ships. The favored destruction method is countermining, *i.e.* the use of a high-order detonation conducted by exploding an additional donor charge placed adjacent to the UXO. In contrast to the risks for people in charge of the UXO countermining, that are well known by the Mine Warfare experts, the possible consequences of underwater explosions on the marine environment and biodiversity and on the buildings located on the shore are more difficult to evaluate. However, a decision support tool for the risk assessment that would rely on reliable wave propagation modeling would be useful.

3D numerical modeling of seismo-acoustic wave propagation in coastal environments with variable geometrical and physical properties induces significant challenges in terms of meshing and computational resources. We discuss here these challenges for the case of wave simulation in the Bay of Hyères (Mediterranean Sea, France) conducted using a 3D spectral-element method. The 3D mesh of the Bay accounts for the variable topography and bathymetry, as well as the sedimentary layers that can be as thin as one meter. The simulations were performed up to 30 Hz on a GPU supercomputer. The limit of 30 Hz is conditioned by both the small thickness of sedimentary layers and the weak shear-wave velocities of unconsolidated sediments (200 m/s). This requires refining the sedimentary elements and results in meshes containing hundreds of millions of elements. This work is a first step towards our objective to generate meshes with a billion elements on the future pre-exascale infrastructures that will allow to simulate propagation beyond 100 Hz.

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