Geophysical Research Abstracts
Vol. 20, EGU2018-14325, 2018
EGU General Assembly 2018

High performance computing for seismic metamaterials

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The high complexity of the seismic wave propagation in heterogeneous soils with realistic geological structures makes the development of seismic metamaterials a fertile ground for parallel, high-performance computational elastodynamics. In this talk we review some computational intensive studies used to explore the control capacities of metamaterials on seismic waves and groundborne vibrations and to prepare large-scale experiments.
In the first example I will discuss the preparatory phase that has preceded the field experiment (https://metaforet.osug.fr) on a forest where trees, acting as local resonators, give rise to a metamaterial like behavior for Rayleigh waves propagating in the ground surface at a frequencies between 20 and 80 Hz. Soil layering, velocity-depth profiles and the coupling between soil and trees, together with several other parameters have been analyzed.
The second example deals with a complex arrangement of 3D resonators (inertial resonators) embedded in a soft sedimentary basin that, if appropriately designed and optimized, may offer possibility to shield low frequency seismic waves generated by earthquakes. This particularly challenging problem mixes the long scale typical of earthquake-generated seismic waves propagation with the small-scale structure of the metamaterial and the presence of buildings on the soil surface.