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Where are the limits? (in FTRT Tsunami computations)

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Only a decade ago, providing medium-size resolution tsunami propagation simulations in large domains was a computational challenge and wallclock times expanded up to many hours. At that time, thinking of using numerical models and on the fly computed solutions in the framework of TEWS was unthinkable. Then, and still today, decision matrices or, eventually, precomputed solutions are the tools used in these systems when response times are too short. In the other hand, building up huge precomputed tsunami scenario databases was a task that required many months of massive computing resources. The access to these resources was limited only to a few researchers and institutions.
Nevertheless, in recent years a number of tsunami numerical models have been implemented to run in GPU and multi-GPU architectures, a topic in which our group has been pioneering. This technological approach has changed the rules of the game in TEWS and numerical models are at present day able to simulate a single event in just a few minutes and they have made it possible to achieve one of the main challenges in nowadays Tsunami Science: producing accurate assessments of the tsunami waves impact, mainly in populated areas, and just some minutes after the generating earthquake is triggered.

In 2014, EDANYA Group was challenged by CAT-INGV at Rome. The challenge consisted in performing an 8h simulation in a 30 arc-sec resolution mesh of the whole Mediterranean Sea (10 million cells) in less than 6 min. This was achieved (in 352 sec) with a multi-GPU implementation of Tsunami-HySEA model using 10 nVIDIA Titan Black GPUs (2012 Kepler architecture). Then, in 2017, using only two Tesla P100 (2016 Pascal architecture) the same simulation was performed in 257 sec. The use of the newest Tesla V100 graphic cards (2018 Volta architecture, released 7 Dec 2017) further increased the speed-up, and the resources available at the BSC allowed us to used up to 64 Tesla V100 graphic cards for multi-GPU simulations. This allowed us to reduce computational times up to unthinkable limits. Limits that have moved the time required for this kind of simulations from hours, to few minutes and now to seconds. Through several examples, in the Mediterranean, Atlantic, Pacific and Caribbean, we explore the figures provided by Tsunami-HySEA model run in this cutting-edge computing technology. Where are the limits? or can we compute high-resolution inundation at a target area on the fly FTRT if sufficient computing resources are available? are questions that will we address to light of the figure presented.

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