A Center of Excellence for Exascale in Solid Earth

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A new Center of Excellence on HPC has been funded (2019-2021) under Horizon 2020 Research and Innovation Programme to promote the use of upcoming Exascale and extreme performance computing capabilities in the area of Solid Earth. The Center of Excellence for Exascale in Solid Earth (ChEESE; https://cheese-coe.eu) will address extreme computing scientific and societal challenges by harnessing European institutions in charge of operational monitoring networks, tier-0 supercomputing centers, academia, hardware developers and third-parties from SMEs, Industry and public-governance. The scientific challenging ambition is to prepare 10 open-source flagship codes to solve Exascale problems on computational seismology, magnetohydrodynamics, physical volcanology, tsunamis, and data analysis and predictive techniques, including machine learning and predictive techniques from monitoring earthquake and volcanic activity. The codes will be optimized at both intranode level (including heterogeneous computing nodes) and internode level on heterogeneous hardware prototypes for the upcoming Exascale architectures, thereby ensuring commitment with a co-design approach. Preparation to Exascale will consider also code inter-kernel aspects of simulation workflows like data management and sharing, I/O, post-process and visualization. The ChEESE Center of Excellence builds on three pillars: pilot demonstrators, services and training. First, the project will develop pilot demonstrators for scientific challenging problems requiring of Exascale computing in alignment with the vision of European Exascale roadmaps. This includes near real-time seismic simulations and full-wave inversion, ensemble-based volcanic ash dispersal forecasts, faster than real-time tsunami simulations and physics-based hazard assessments for seismics, volcanoes and tsunamis. Second, pilots are also intended for enabling of operational services requiring of extreme HPC on urgent computing, early warning forecast of geohazards, hazard assessment and data analytics. Selected pilots will be tested in an operational environment to make them available to a broader user community. Additionally, and in collaboration with the European Plate Observing System (EPOS), ChEESE will promote and facilitate the integration of HPC services to widen the access to codes and fostering transfer of know-how to Solid Earth user communities. Finally, the third pillar of ChEESE aims at acting as a hub to foster HPC across the Solid Earth Community and related stakeholders and to provide specialised training on services and capacity building measures.