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Probabilistic Tephra Hazard Assessment of Campi Flegrei, Italy

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Campi Flegrei is an active volcano located in one of the most densely inhabited areas in Europe and under high-traffic air routes. There, the Vesuvius Observatory's surveillance system, which continuously monitors volcanic seismicity, soil deformations and gas emissions, highlights some variations in the state of the volcanic activity. It is well known that fragmented magma injected into the atmosphere during an explosive volcanic eruption poses a threat to human lives and air-traffic. For this reason, powerful tools and computational resources to generate extensive and high-resolution hazard maps taking into account a wide spectrum of events, including those of low probability but high impact, are important to provide decision makers with quality information to develop short- and long- term emergency plans. To this end, in the framework of the Center of Excellence for Exascale in Solid Earth (ChEESE), we show the potential of HPC in Probabilistic Volcanic Hazard Assessment. On the one hand, using the ChEESE's flagship Fall3D numerical code and taking advance of the PRACE-awarded resources at CEA/TGCC-HPC facility in France, we perform thousands of simulations of tephra deposition and airborne ash concentration at different flight levels exploring the natural variability and uncertainty on the eruptive conditions on a 3D-grid covering a 2 km-resolution 2000 km x 2000 km computational domain. On the other hand, we create short- and long-term workflows, by updating current Bayesian-Event-Tree-Analysis-based prototype tools, to make them capable of analyze the large amount of information generated by the Fall3D simulations that finally gives rise to the hazard maps for Campi Flegrei.