Challenges and perspectives in the creation of a reference numerical Global Volcano Model

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Volcanoes are extremely complex systems controlled by a huge variety of physical processes that include multiphase, multi-component flows with phase changes and flow regimes spanning from laminar to largely turbulent and from essentially incompressible to compressible with supersonic flow transitions and shock waves; solid system dynamics with complex rheology and large heterogeneities, with fracture propagation and gravity controlled collapses; space-time scales extending from the milliseconds of bursts to the centuries and millennia of magma chamber evolution, and from the microns characterizing phase nucleation and growth to the several km of the magmatic systems and the hundreds or thousands of km of gas and ash dispersion in the atmosphere; and pressure-temperature conditions from the extreme values inside the crust to those of the Earth surface. Further complicating the overall picture, most of a volcanic system is out of any direct observation, and can only be inferred indirectly. Those extreme challenges contribute to explain why the volcanological community has not developed yet global numerical reference models similar to those employed in seismicity or in meteorology. Nonetheless, the need for widely accepted and accessible computational codes is increasingly growing, as it is testified by the success of initiatives like VHub that provide wide access to advanced calculation resources. Here the challenges and perspectives for the creation of a reference numerical Global Volcano Model are discussed, together with some of the characteristics that such a new breaking-through resource in volcanology should possess.