The Volcano Dynamic Computational Centre (INGV)

1. Infrastructure offered for the first call

Name and acronym of RI	**Name**: Volcano Dynamics Computational Centre
	Acronym: VDCC
Main contact person	**Name**: Chiara Montagna
	Email: chiara.montagna@ingv.it
List of individual installations	**1. Transient Multi-Dimensional Transport Models (TDMod).** This installation includes 3 High Performance Computing numerical codes (GALES, PDAC, ASHEE). **2. Fast Performing Models (FPMod).** This installation includes three numerical codes (CONDUIT4, MrLavaLoba, PLUME-MoM) requiring small computational time.

2. Information of the installations offered for the first call

Name of the installation	**1. Transient Multi-Dimensional Transport Models (TDMod)**
Contact person	Name: Matteo Cerminara
	Email: matteo.cerminara@ingv.it
Location	Address: INGV, Sezione di Pisa, via Della Faggiola 32, 56126 Pisa
	Country: Italy
Description of the installation	**Transient Multi-Dimensional Transport Models (TDMod).** This installation includes three numerical codes (**GALES**, **PDAC**, **ASHEE**) to solve the magma and volcano dynamics from magma chamber level into the atmosphere. Individual access is provided for each code, as it will be specified in the related calls. All codes are documented in the INGV VMSG (Volcano Modelling and Simulation Gateway) http://vmsg.pi.ingv.it/index.php/en/software. **GALES**: (GAlerkin Least Squares) HPC finite element C++ code for 1 to 3D simulations of compressible-to-incompressible multicomponent magma dynamics within underground reservoirs, dykes, and conduits with user-defined geometries. It includes space-time-dependent properties as a function of local physical and chemical conditions, non-ideal multi-component volatile saturation modelling (SOLWCAD), and user-defined non-Newtonian rheology. Equipped with data processing and visualization routines in MATLAB and ParaView. **PDAC**: Pyroclastic Dispersal Analysis Code, 3D model for the multiphase flow simulation of explosive eruption scenarios (volcanic plumes and pyroclastic density currents). **ASHEE**: (ASH Equilibrium Eulerian) Finite volume code based on the C++ libraries of OpenFOAM. It solves the compressible transient 3D transport equations for a multiphase gas-particle mixture. The code is fully parallel (tested up to 4000 cores). Sub-grid turbulence is treated with dynamic LES models. Kinematic non-equilibrium between the gas and the particle phases is solved accurate and

	efficient up to Stokes number 0.2 (1 mm for volcanological applications). The code can be used to model explosive eruptions, from the buoyant plume column down to the turbulent dilute part of pyroclastic density currents. Pyroclasts coarser than 1 mm can be treated with the Lagrangian approach (up to 10 Mparcels). A series of bash, python and paraview scripts are available for pre and post processing.
Scientific support offered	Training for the use of the installation: Training is ensured by close interaction with code developers and expert users at INGV Pisa, for the entire duration of the access.
	Number of scientist supporting the activity: 6.
	Type of scientific support: For code adaptation/development; for set up of initial and boundary conditions; for compiling and running the code; for real-time verification of numerical results; for post-processing, analysis and interpretation.
Technical support offered	Training for the use of the installation: Training is ensured by the technical staff at INGV Pisa.
	Number of technicians supporting the activity: 2.
	Type of technical support: HPC and internet access rights, code compilation, data storage, etc.
Safety	Training offered: There are no safety issues different from those associated with standard computer work.
Available accommodation facilities at infrastructure or nearby	The INGV facilities are located in the main building at INGV Pisa, in the city centre offering a variety of accommodation facilities (hotels, hostels, and apartments).
Available space/electricity/internet connection access for external users	External users will have full availability to standard facilities required for project development, including dedicated working space such as personal desk, PC, access rights to the HPC facility, internet connection including online journals accessed at INGV, electricity, etc.)
Administrative support offered	The administration section at INGV Pisa will provide full administrative support.

Name of the installation	**2. Fast Performing Models (FPMod)**
Contact person	Name: Mattia De' Michieli Vittur
	Email: mattia.demichielivitturi@ingv.it
Location	Address: INGV, Sezione di Pisa, via Della Faggiola 32, 56126 Pisa
	Country: Italy
Description of the installation	**Fast Performing Models (FPMod).** This installation includes three numerical codes (CONDUIT4, MrLavaLobe, PLUME-MoM) to solve the dynamics of magma ascent and eruption for specific volcanic phenomena and under simplifying assumptions which guarantee sufficient accuracy for a large range of applications, with small computational times. Individual access is provided for each

	code, as it will be specified in the related calls. All codes are documented in the INGV VMSG (Volcano Modelling and Simulation Gateway) http://vmsg.pi.ingv.it/index.php/en/software. **CONDUIT4**. Fast and versatile FORTRAN77 software that solves the fluid dynamics of magma ascent along volcanic conduits. It is a steady-state, 1D model which includes volatile exsolution as a function of magma composition, pressure and temperature. It includes strain-induced fragmentation as a consequence of gas exsolution as the magmatic mixture ascends towards the surface at decreasing pressures. Recently the code has been extended to 1.5D by computing the radial distribution of vertical velocity due to non-Newtonian rheology. **MrLavaLoba**. Python code that can be ascribed to the "probabilistic family" of lava flow simulation codes. Nevertheless, in contrast with other probabilistic codes, this code explicitly tackles not only the direction of expansion of the growing flow and the area covered, but also the volume of the emplaced lava over time, and hence the supply rate. The developer of the model will support users in the installation of the code, the setup of simulations and in the post-processing of model results. In addition, it will be shown how to use the model to perform sensitivity and uncertainty quantification analysis. **PLUME-MoM**. FORTRAN90 code designed to solve the equations for a steady-state integral volcanic plume model, describing the rise in the atmosphere of a mixture of gas and volcanic ash during an eruption. Either a finite number of particle sizes, or a continuous distribution of particles size described with the method of moments, can be assumed. A suite of Python scripts to integrate PLUME-MoM with existing dispersal code and to perform uncertainty quantification and sensitivity analysis is provided.
Scientific support offered	Training for the use of the installation: Training is ensured by close interaction with code developers and expert users at INGV Pisa, for the entire duration of the access.
	Number of scientist supporting the activity: 6.
	Type of scientific support: For code adaptation/development; for set up of initial and boundary conditions; for compiling and running the code; for real-time verification of numerical results; for post-processing, analysis and interpretation.
Technical support offered	Training for the use of the installation: Training is ensured by the technical staff at INGV Pisa.
	Number of technicians supporting the activity: 2.
	Type of technical support: HPC and internet access rights, code compilation, data storage, etc.
Safety	Training offered: There are no safety issues different from those associated with standard computer work.
Available accommodation facilities at infrastructure or nearby	The INGV facilities are located in the main building at INGV Pisa, in the city centre offering a variety of accommodation facilities (hotels, hostels, and apartments).
Available space/electricity/internet	External users will have full availability to standard facilities required for project development, including dedicated working space

connection access for external users	such as personal desk, PC, access rights to the HPC facility, internet connection including online journals accessed at INGV, electricity, etc.)
Administrative support offered	The administration section at INGV Pisa will provide full administrative support

3. Access modalities and call parameters of the services offered only for the first call

Installation	Accesses per call (in unit)	Max n. of users per project	Max n. of projects per call
1. FPMod	8 weeks	1	6
2. TDMod	8 weeks	1	4

4. Financial support offered to the users

Installation	Max reimbursable travel cost (in euro)	Max reimbursable daily subsistence cost (in euro)
1. FPMod	700	120
2. TDMod	700	120

5. Risk management

a. **Expected conditions that can make the installation unavailable/inaccessible: B**reakage of HPC or other computational components (very unlikely).
b. **Functionality of the installations offered, before the access:** The facility is permanently operating H24, and has been operating regularly for its entire life span (about 15 years from first installations at INGV Pisa). It is maintained operating and efficient by dedicated technical staff.
c. **Conditions to re-schedule the access to the same installation due to force majeure:** In the unlikely case that a force majeure may require postponing the access, the same foreseen access with identical conditions will be ensured immediately after cessation of the force majeure.
d. **Conditions to plan the access to another location in case the access must be moved due to force majeure:** In case the access will be moved to another location, the same access conditions will be ensured at the new location.