

#### Digital Twin Components for Geophysical Extreme Phenomena



### The example of Volcanic Hazards within the DT-GEO project

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Cacciaguerra et al. – INGV, CSIC, IMO

# DT-GEO in a nutshell





#### **DT-GEO Consortium Composition**



26 From 10 different countries

8

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**Beneficiary Partners** 

CSIC, INGV, IGF, CIN, BSC, NGI, UMA, GFZ, LMU, IMO, UHAM, LIP, CNRS, EPOS, ACK

**Affiliated Entities** 

UPV (affiliated to CSIC) UNISTRA, UGA, IRD, OCA, UCA, IPGP, UP (all affiliated to CNRS)

#### **Associated Partners**

2 from Switzerland (ETH and MON) 1 from U.K. (UKRI)

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#### **Data Architecture, Workflows and RI**



A Digital Twin on geophysical extremes to be integrated in the **Destination Earth initiative** provided that:

- datasets, data products, web-services considere a qualitybased ecosystem for data and metadata;
- data and workflows architecture enable the deployment and execution of data-driven workflows in HPC and cloud environments;
- seamless access is provided to the EuroHPC RI, with the containerization of DTCs, from quality-based repositories of software and containers;
- a flexible ecosystem ensures an EOSC-enabled data quality management through an automatic FAIR validation and interoperability among the DTCs.















FALL3D (HPC: yes, GPU-enabled) ChEESE CoE flagship code for modelling of atmospheric dispersal of particles, aerosols and radionuclides. etc... **PyCOMPSs** (HPC: yes) workflow framework to ease the development and execution of parallel applications for distributed infrastructures, such as Clusters, Clouds workflow and containerized platforms. udocker (HPC: yes, GPU-enabled) workflow for the execution of Linux containers in user space without requiring root privileges in HPC clusters, interactive clusters, grid infrastructures and cloud resources. dislib (HPC: yes) machine learning library parallelized with PyCOMPSs dealing with large amounts of data distributed in HPC systems. **DSpace-CRIS** (HPC: no) system using DSpace with the (richer) **CERIF metadata** model for Current Research Information Systems data **FAIR evaluator** (HPC: no) programmatic implementation of the RDA requirements list to test the integrity of data in accordance with FAIR principles. **EPOS-ICS-C** (HPC: no) core software providing access to the **EPOS metadata catalog** 



model



#### Volcanic Ash and Gases Diffusion in Atmosphere



Raikoke, Kuril Islands, 22 June 2019 plume of ash and volcanic gases https://earthobservatory.nasa.gov/images/145226/raikoke-erupts



after Aubry et al. 2021, J. Volcan.Geoph. Res., 417



# Digital Twin Component for Volcanic Ash Diffusion in Atmosphere





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## Case Study: Volcanic Ash Diffusion in Atmosphere







# Work in progress

#### Further test through site demonstrators:

Fagradalsfjall (Iceland)



Grímsvötn (Iceland)



...ready to change on-the-fly if a new volcano erupts during the project!

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