

ChEESE

Center of Excellence for Exascale in Solid Earth (second phase)

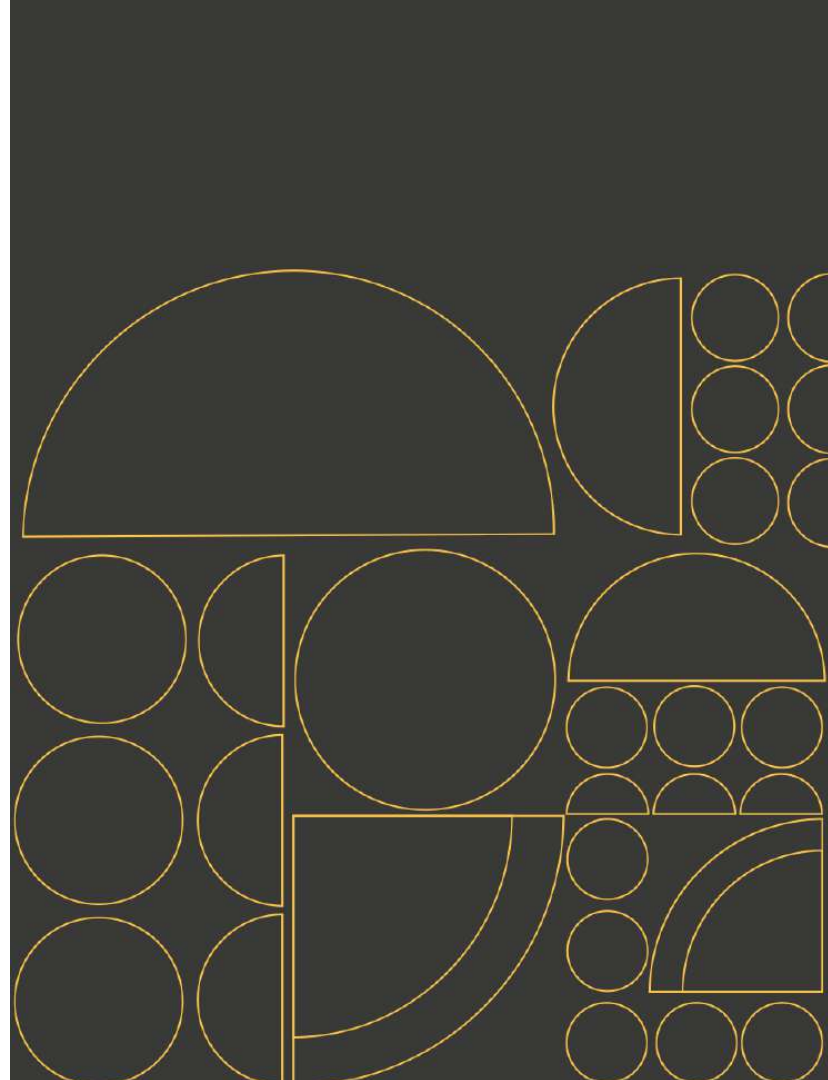
Lessons from ChEESE-1P and new aspects

Project kick-off meeting
Barcelona, 19-20 January 2023

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ChEESE-1P: summary and highlights

Codes

01

- 10 flagship codes
- 2 POP audit rounds
- 4 mini-apps for co-design
- All codes ended at scalability levels of 1-2 (*)
- 7 codes ported to GPU environments (CUDA/OpenACC)

PDs and simulations

02

- 12 Pilot Demonstrators (PDs)
- TRL increase from +2 to +6
- 8 PDs went to service enabling
- Workflow Management System (WMS-light)
- Awarded with 217M core/hour (4 PRACE + 2 National)
- 5 large-scale testbed executions
- Capability: up to 3000 nodes (@MN4)
- Capacity: up to 3200 GPUs (@M100)

Service enabling and community building

03

- 14 use cases and 6 user-driven live exercises
- 2 services operational (TRL=9)
- Code collection (Zenodo)
- Efforts towards a unified PHA netCDF format (CF extension)
- Frontiers Research Topic
- Galileo conference
- Reference in Urgent Computing (UC)
- 34 IUB members

(*) Level 1: petascale codes (strong scalability at 10^4 - 10^5 cores); level 2: pre-petascale codes (strong scalability at 10^3 - 10^4 cores)





Future Generation Computer Systems

Supports open access

18.7

CiteScore

7.307

Impact Factor

Action	Manuscript Number	Title	Initial Date Submitted	Status Date	Current Status
Action Links	FGCS-D-22-01902	The EU Center of Excellence for Exascale in Solid Earth (ChEESE): implementation, results, and roadmap for the second phase	Oct 05, 2022	Jan 05, 2023	Under Review

The EU Center of Excellence for Exascale in Solid Earth (ChEESE): implementation, results, and roadmap for the second phase

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ChEESE-IP nomination to the 2022 Horizon Impact Award



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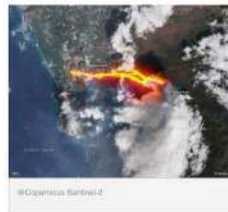
[EU Centre of Excellence in High Performance Computing: ChEESE's urgent computing in the service of Cumbre Vieja volcanic eruption](#)

NEWS ARTICLE | Publication 15 November 2021

EU Centre of Excellence in High Performance Computing: ChEESE's urgent computing in the service of Cumbre Vieja volcanic eruption

The EU-funded ChEESE Centre of Excellence uses supercomputers to predict the behaviour of volcanic ash clouds and aerosols, helping crisis management of the Cumbre Vieja eruption in La Palma, Canary Islands

The Cumbre Vieja's eruption, which began in September 2021, has produced devastating lava flows and emissions, resulting in the evacuation of more than 6000 people, the destruction of dozens of houses, and the disruption of aerial navigation. In response to this, the "urgent computing" capacities (emergency use of computing resources to deal with disaster situations) of the ChEESE EU Centre of Excellence at the Barcelona Supercomputing Center have been vital. ChEESE scientists have been running simulations of the ash clouds and aerosols triggered by the ongoing volcanic activity, using the MareNostrum-4 pre-exascale supercomputer. These simulations provide forecasts for the eruption's evolution and cover the Canary Islands at a 1 km resolution and the wider region at a 5 km resolution. As a result, the PEVOCLA committee composed of



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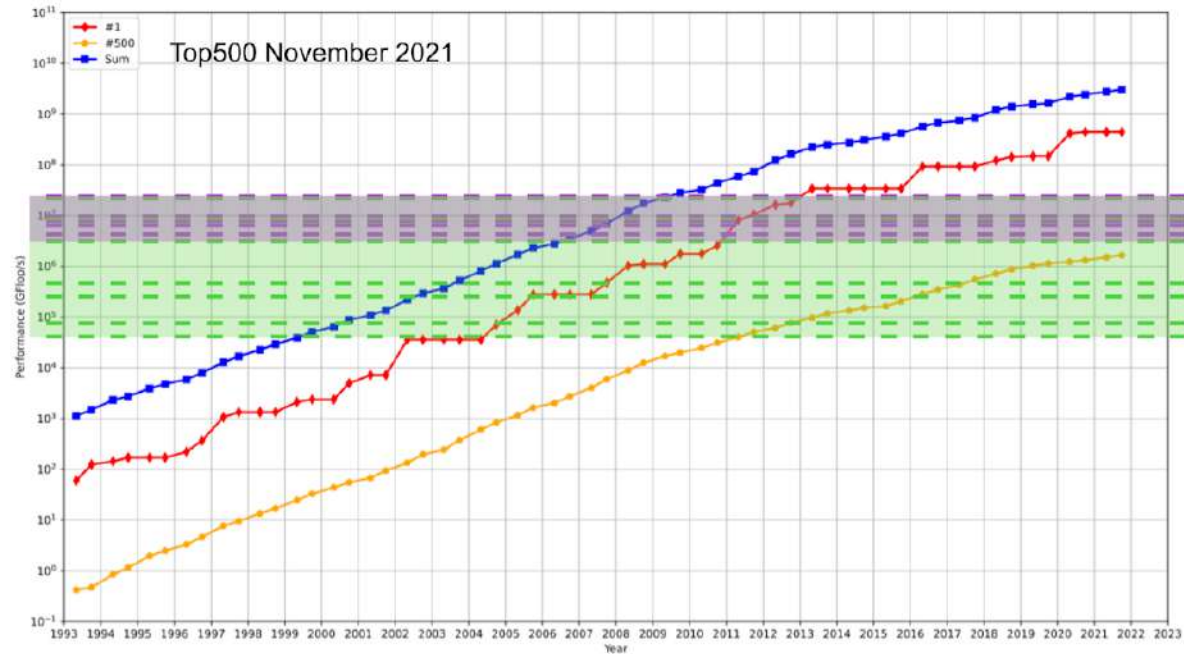


Natural disasters threaten citizens around the world with disruption to essential services, damage to property and infrastructure, and the loss of life. The EU-funded ChEESE project uses supercomputing to help forecast accurate disaster scenarios. As a result, authorities in La Palma were able to make informed decisions and save lives when the Cumbre Vieja volcano erupted.



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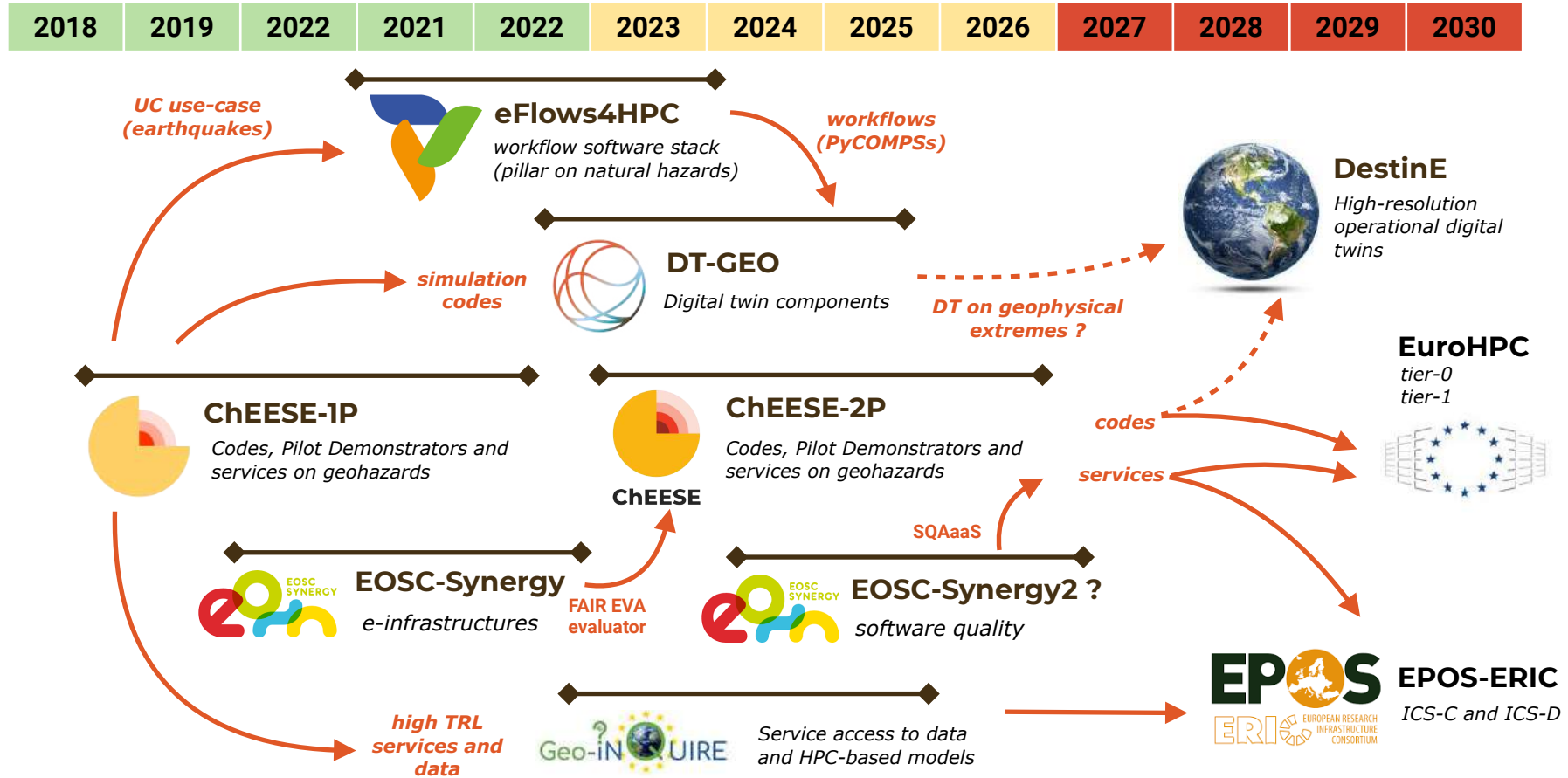
ChEESE-IP aftermath: where are we ?



Grand challenges
Services



ChEESE-IP aftermath: project ecosystem



ChEESE-1P: lessons learnt

Strong	<i>"Project has delivered exceptional results with significant immediate or potential impact"</i> • Implication of Consortium members • Good interaction with POP • Almost all codes were accelerated • PDs and related runs were very successful • Live exercises; high TRL and impact of some services (innovation radar) • High training demand (PATC and others) • Publications (90+) and scientific impact • Galileo conference • The ShEESE initiative
Final Review	"These concerns should be on the agenda for future development of ChEESE:" • "The project should consider whether an evolutionary approach will still be successful, or whether a more disruptive approach should be considered" • "Interactions with EPOS and ERIC to provide the geophysical community with Software and Workflows as a Services (SaaS and WaaS) are of major importance" • "Destination Earth also appears to be an opportunity to foster the emergence of this e-infrastructure" • "Access to developed services requires policy definition, including intellectual property rights and defining a plan for long-term sustainability"
Need attention	• Code repository (need to go beyond Zenodo, NVIDIA collection did non progress) • DMP (more relevance) • Provision and management of computational resources (in-kind, assigned to CoEs, and PRACE/EuroHPC calls) • Effective link with EPOS • Probably too large number of IUBs, some gave little feedback received



ChEESE-1P versus ChEESE-2P

	ChEESE-1P	ChEESE-2P	Comments
Funding	RIA (H2020)	EuroHPC	national co-funding
Duration	3 years (extended)	4 years	
Budget	7.6 M€	7.7 M€	
PMs	972	976	
Partners	13	16 (+1)	+CSIC, +CSC, +RBI, +UM, +SU - ETH
Countries	7	8	+Finland, +Croatia - Switzerland
WPs	6	7	+co-design WP
Deliverables	42	46	
Milestones	5	10	
Reporting periods	2	3	at months M12, M30, M48

ChEESE-1P versus ChEESE-2P

	ChEESE-1P	ChEESE-2P	Comments
Codes	10 (4 areas)	11 (6 areas)	+geodynamics, +glacier hazards
Code preparation	audit-driven	audit-driven	+code resilience, +fault-tolerance, +(run-time) load balancing, +energy efficiency
Code deployment	no	yes	portability and containerisation for deployment on EuroHPC systems (CI/CD?)
mini-apps	4	7	EuPEX
PDs	12	9	underpinned by multiphysics, multiscale, multisource, and multihazard
Simulation Cases (Scs)	1-to-1 mapping	15	6 capability, 9 capacity
Service enabling	8 PDs (TRL>5)	6 SCs	



ChEESE-1P versus ChEESE-2P (codes and mini-apps)

ChEESE-1P			ChEESE-2P	
Area	Code		Code	Area
Computational Seismology	SeisSol	→	SeisSol	Computational Seismology
	SPECFEM3D	→	SPECFEM3D	
	ExaHyPE	→	ExaHyPE	
	Salvus		Tandem	
MHD	xSHELLS	→	xSHELLS	MHD
	PARODY			
tsunamis	T/L-HySEA	→	HySEA	tsunamis
Volcanology	FALL3D	→	FALL3D	Volcanology
	ASHEE		OpenPDAC	
			LaMEM	Geodynamics
			pTatin3D	
			Elmer/ICE	Glacier hazards

ChEESE-1P		ChEESE-2P
mini-app		mini-app
mini-SeisSol	→	mini-SeisSol
mini-SPECFEM3D	→	mini-SPECFEM3D
mini-FALL3D	→	mini-FALL3D
mini-ASHEE		mini-Tandem
		mini-xSHELLS
		mini-HySEA
		mini-pTatin3D



ChEESE-1P versus ChEESE-2P (PDs)

Transfer		PD	ChEESE-1P		PD	ChEESE-2P
eFlows4HPC	←	PD1	Urgent seismic simulations		PD6	Multiphase 3D volcanic explosion modeling
eFlows4HPC / Geo-INQ	←	PD2	Faster than real-time tsunami simulations		PD8	Geodynamics to geohazards
		PD3	High-resolution volcanic plume simulation		PD9	Glacial outburst floods
		PD4	Physics-based tsunami-earthquake interaction	→	PD4	Complex multi-source tsunami modeling
		PD5	Physics-based PSHA	→	PD1	Extreme-scale modeling of seismic hazards
		PD6	Probabilistic volcanic hazard assessment (PVHA)	→	PD5	Ensemble-based volcanic dispersal at scales
		PD7	Probabilistic tsunami hazard assessment (PTHA)	→	PD3	Global tsunami hazard and UQ
DT-GEO	←	PD8	Probabilistic Tsunami Forecast (PTF) for EWS			
		PD9	Seismic tomography	→	PD2	Joint seismic inversion and tomography
		PD10	Seismic source detection and restoration			
		PD11	Geomagnetic forecasts	→	PD7	The Earth's dynamo model
DT-GEO	←	PD12	High-resolution volcanic ash dispersal forecast			





ChEESE-2P and DT-GEO



Common partners	9	CSIC, BSC, INVG, IMO, CIN, LMU, UMA, NGI, CNRS
Coordination	ChEESE-2P (CSIC); DT-GEO (CSIC)	
Main concept	ChEESE-2P is about codes, DT-GEO is about workflows	
Objectives	ChEESE-2P	Code preparation and deployment, service enabling, research
	DT-GEO	Deploy a pre-operational DT (model-data fusion)
Synergies	• 5 codes shared (SeisSol, SPECfem3D, ExaHyPE, HySEA, FALL3D) • 2-way feedback: ChEESE-2P code developments can be transferred to DT-GEO and DT-GEO workflows can benefit some ChEESE-2P PDs (PD1 to PD5) • No overlap between the DT-GEO Site Demonstrators (SDs) and the ChEESE-2P Simulation Cases (SCs)	
Common goals	Same Community and long-term ambition (DestinE)	
EPOS	ChEESE-2P	Enabling of 2 services (TCS-TSU and TCS-VO)
	DT-GEO	Integration of DT-GEO components in ICS-D



ChEESE-2P and Geo-INQUIRE



Common partners	9	CSIC, BSC, INVG, IMO, CIN, LMU, UMA, NGI, CNRS
Coordination	ChEESE-2P (CSIC); Geo-INQUIRE (GFZ)	
Main concept	ChEESE-2P is about codes, Geo-INQUIRE is about access to existing products	
Objectives	ChEESE-2P	Code preparation and deployment, service enabling, research
	Geo-INQUIRE	Portfolio of Virtual Access (VA) and Transnational Access (TA)
Synergies	- ChEESE-CoE services (SaaS and WaaS based on ChEESE-1P) 4 codes shared (SeisSol, ExaHyPE, HySEA, FALL3D) 1-way feedback: ChEESE-1P code developments transferred to Geo-INQUIRE for SaaS (VA4/TA2-531). Also, some ChEESE-1P PDs (workflows) transferred for WaaS (TA2-541)	
Common goals	Same Community and long-term ambition (EPOS TCS and ICS)	
EPOS	ChEESE-2P	Enabling of 2 services (TCS-TSU and TCS-VO)
	Geo-INQUIRE	Deployment and interoperability of datasets/products of the RIs EPOS-ERIC

ChEESE-2P: changes from proposal to Grant Agreement

Consortium		2 more partners. The former staff effort of partner CNRS (107 PM) has been modified and split between CNRS (77,6 PM), IPGP (7,4 PM), and US (22 PM)
New tasks	WP7	Added Task T7.6 (collaboration task with complementary projects)
New deliverables	WP1	DMP split in 2: D1.2 (M6) and D1.4 (M34)
	WP5	Deliverables D5.2 to D5.10 (one per PD), at M30 and M36
	WP6	Deliverables D6.2 D6.10 (SCs for each PD), all at M46
	WP7	- D7.3 Collaboration plan with complementary projects (M6) - Exploitation plan split in 2: D7.5 (M30) and D7.7 (M47)
Objectives	SO15	To complement with the CASTIEL2 CSA
New milestones	MS9	Complementary Grants (CASTIEL-2 collaboration agreement) at M6
	MS10	Application deployment (codes available) at M12
New KPIs		- No of applications deployed to JU systems incl. breakdown by partition - No of EuroHPC systems supported by application incl. breakdown by partition - No of errors (failed deployments/regression tests) and average time from failed application test to deployment of corrected application
Budget categories		- Equipment and other cost categories to accommodate to EuroHPC requirements - Travel: activities are constrained to EuroHPC eligible countries only 10 k€ flat rate for open source publications removed

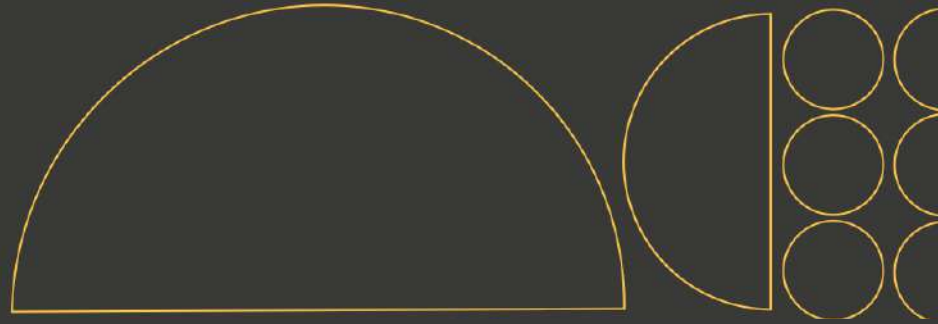


What EuroHPC expects from us?

- Advances of targeted HPC applications towards highly scalable, optimised flagship codes and exascale performance
- Collaboration plan with CASTIEL-2 CSA (and NCCs)
- Provision of software, algorithms and relevant information to use and validate applications. This includes CI/CD at EuroHPC systems and related KPIs (metrics defined)
- Co-design activities and collaboration with European HPC technologies initiatives (e.g. EPI, RISC- V, EuroHPC JU Pilots)
- Avoid technological dependency on non-EU sources



Thank you!



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