



Digital Twin Engine & High-priority Digital Twins

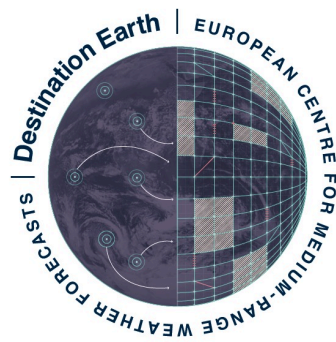
ECMWF

Delivers a digital-twin system framework through a Digital Twin Engine (DTE) for DestinE

Delivers two high-priority Digital Twins on Extremes and Climate Change Adaptation

Procures key components for Extremes and Climate Digital Twins, use cases and visualization/virtualization in phase 1

Destination Earth (DestinE) - ECMWF's role



The DestinE **Digital Twin Engine (DTE)**:

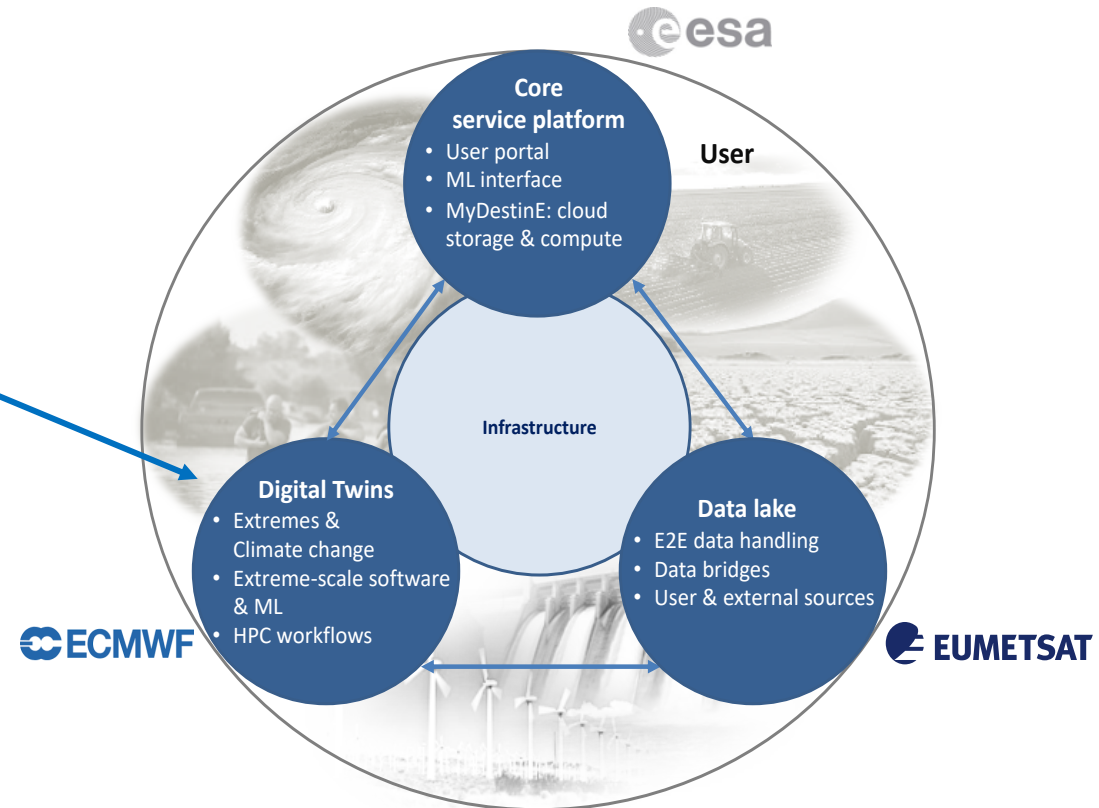
- common system approach to a unified orchestration of Earth-system simulations requiring large-scale HPC resources and the fusion of observations with models

Weather-induced and Geophysical **Extremes Digital Twin**:

- capabilities and services for the assessment and prediction of environmental extremes

Climate Change Adaptation Digital Twin:

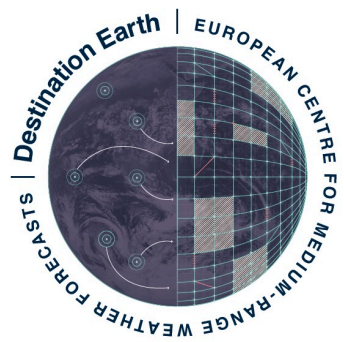
- capabilities and services in support of climate change adaptation policies and mitigation scenario testing



Phase 1 (2021-2024): Delivery of 1st digital twin generation; demonstration of new capabilities at scale

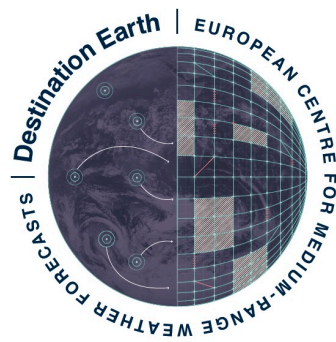
Phase 2+ (2024-): Extend to new applications; fully integrate components; widen DTE scope

Turning requirements into practice



1. Much **better simulations** based on **more realistic models**
2. Better ways of **combining all observed and simulated information** from entire (physical + food/water/energy/health) Earth system
3. An information system that provides **convenient access to all data, models and workflows**

Turning requirements into practice

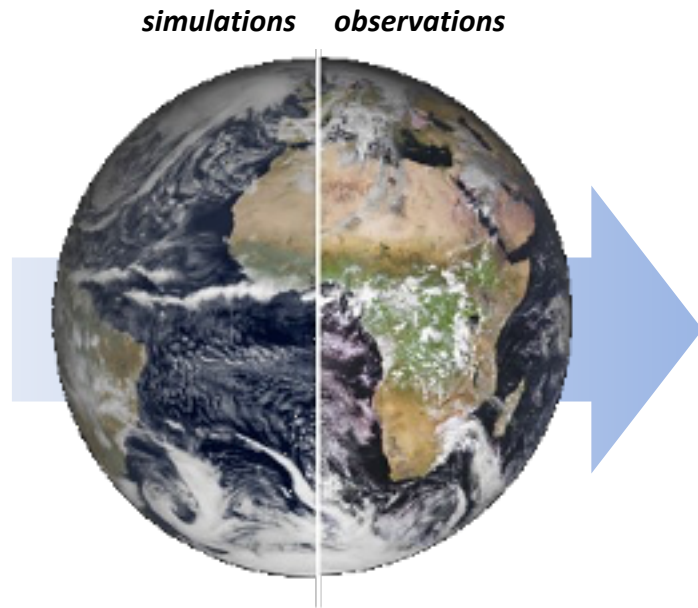
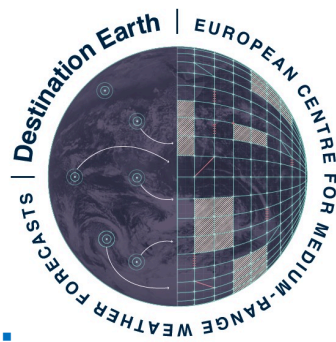


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Digital Twin Engine and Digital Twins:

- A. Create reference simulation system based on **much enhanced Earth system models**
- B. Create reference **simulation-observation fusion system**
- C. Extend (A) & (B) to **impact sectors** and select **use cases/applications** for unique capability demonstration
- D. Implement underlying, **generic software infrastructures**:
 - a. demonstrate (A)-(C) at scale on wide range of **novel digital technology**
 - b. connect with **DESP and DEDL** and demonstrate overall functionality
 - c. prepare for **emerging digital twin applications and more users (in phase 2)**

Production modes

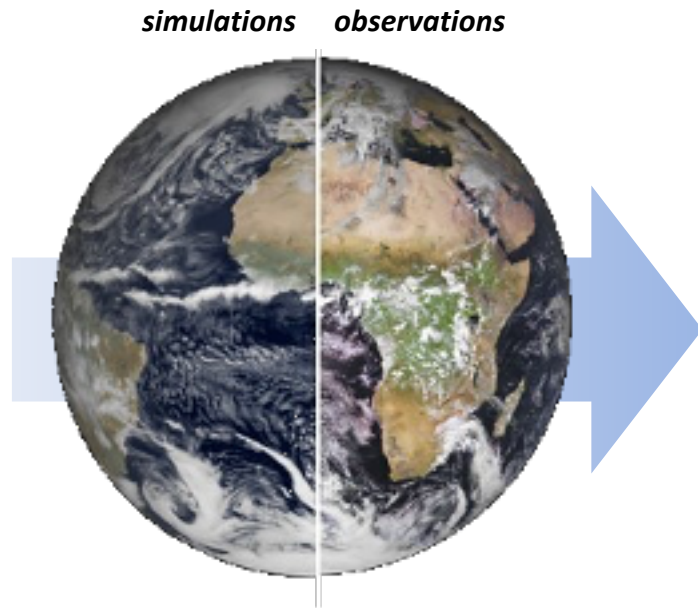
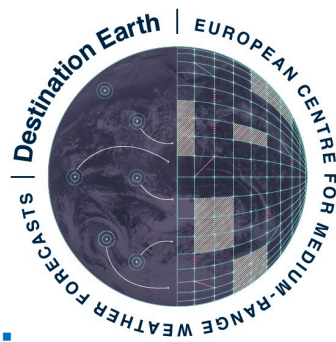


Reference workflows; continuous production mode:

- global storm resolving scale simulations
- leading models, extended and scaled up
- observational data streams (initialization; evaluation)
- built-in applications where beneficial
- uncertainty estimation
- frequent innovation uptake
- driving digital twin engine software developments
- benefiting from EuroHPC technology

*Lists not exhaustive;
not all capabilities fully
developed in phase 1*

Production modes



Reference workflows; continuous production mode:

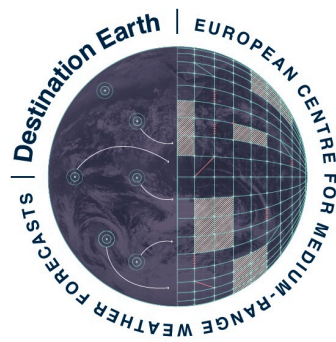
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Configurable workflows; on-demand production mode:

- (above)
- options for global/regional focus, hyper-resolution
- options for added data
- options for added impact sector models
- options for adaptation/mitigation scenario testing

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Main tasks



HPC resource provision, in kind

ECMWF

- **Digital Twin Engine**
- **Digital Twin**
- **Extremes continuous**
- **Use cases**

Extremes (on-demand) procured

- **Digital Twin**
- **Use cases**
- **Digital Twin Engine support**

Climate (both) procured

- **Digital Twin**
- **Use cases**
- **Digital Twin Engine support**

Visualisation procured

Use cases procured

Main tasks – Digital Twin Engine

ECMWF:

Digital Twin Engine

- Code adaptation and optimization for HPC
- Performance evaluation and monitoring
- High-performance data access API
- Control flows and management
- Flexible data interaction tools
- DEDL interfaces and Cloud ML toolkits
- DESP and HPC data interface

EuroHPC (provided in kind):

Resource provision

- Pan-European connectivity
- Continuous/on-demand production node-hour/data handling allocations
- Access protocols and monitoring
- Benchmarking and operations
- Technical support

Procured (Q1 2022) as part of Digital Twins:

Digital Twin Engine support

- Code adaptation and optimization for HPC
- Performance evaluation and monitoring
- High-performance data access API
- Control flows and management
- Flexible data interaction tools

Procured (Q1 2022) separately:

Visualization/immersive platform

- Interactive data & tool workspace
- Generic data visualization
- Virtual reality

Main tasks – Digital Twins

ECMWF:

Extremes Digital Twin (continuous)

- Earth-system observation fusion/assimilation and initialization
- Earth-system modelling and simulations
- Evaluation and uncertainty quantification
- Workflow set-up and monitoring
- End-to-end demonstration at scale with timely delivery

lists not exhaustive

Procured (Q1 2022) Extremes Digital Twin:

(on-demand)

- Earth-system observation fusion/assimilation and initialization
- Earth-system modelling and simulations
- Evaluation and uncertainty quantification
- Workflow set-up and monitoring
- End-to-end demonstration at scale with timely delivery
- Configurability for geographical and extremes types, spatial resolution, coverage, temporal refresh, ensembles

Procured (Q1 2022) Climate Digital Twin:

(continuous & on-demand)

- Earth-system observation fusion and monitoring for model assessment
- Earth-system modelling and simulations
- Multi-model framework
- Evaluation and uncertainty quantification
- Workflow set-up and monitoring
- Continuous and on-demand simulation/interactivity options
- End-to-end demonstration at scale with timely delivery

Main tasks – Use cases

ECMWF, as part of Digital Twin

Extremes Digital Twin (continuous)

- Selected impact model integration and demonstration

Procured (Q1 2022) as part of Extremes Digital Twin:

(on-demand)

- Selected impact model integration and demonstration

Procured (Q2 2022) separately:

Use-case demonstration

- Novel workflow/model/data development in support of decision making
- Demonstration with existing service output
- Demonstration with Digital Twin output

Procured (Q1 2022) as part of Climate Digital Twin:

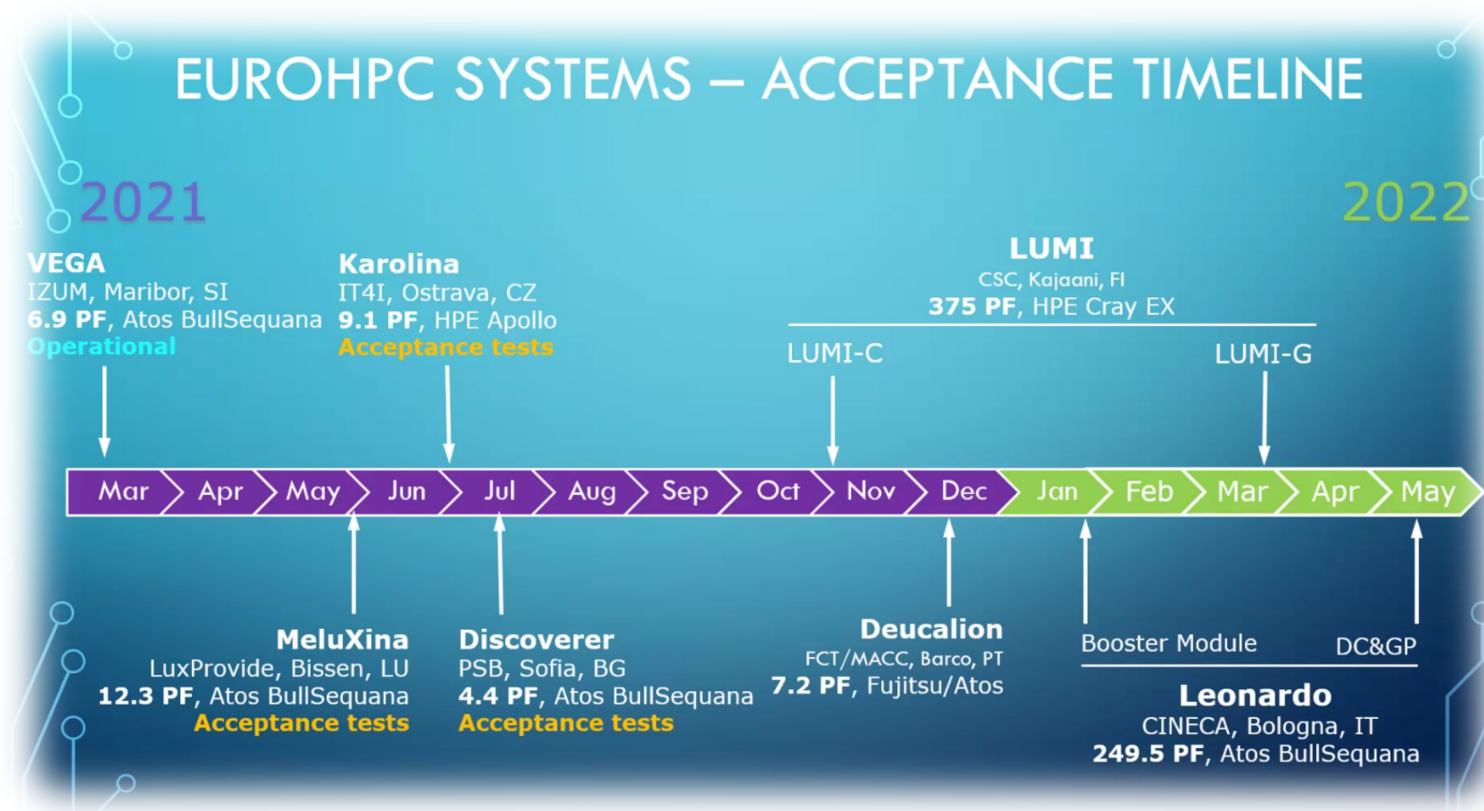
(continuous & on-demand)

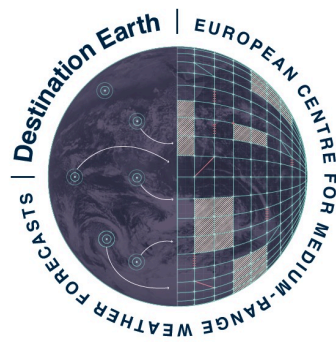
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DestinE support by EuroHPC Joint Undertaking

- By 10-11 March, the EuroHPC JU governing board is expected to adopt the access policy for **initiatives considered strategic for the Union**. The EuroHPC Regulation foresees access for such initiatives without having to undergo the competitive selection process of the 'normal' access requests. **DestinE belongs to this type of initiatives.**
- The current proposal is to set aside **10% of the Union's access time for the strategic initiatives**, to be confirmed by the governing board. For 2022, this would be of the order of 3,000,000 node hours, for 2023 this would be 5,500,000 node hours across all systems.
- Specific access to individual systems to be negotiated.





Procurement process and rules

Procurements for the Destination Earth Programme (DestinE) implemented by ECMWF are done under ECMWF procurement rules – similar but not identical to EU public Procurement Directives

Invitations to Tender (ITT) for DestinE:

- Official Journal of the European Union (OJEU) (<https://ted.europa.eu/>)
ECMWF publishes Prior Information Notices and Contract Notices
- **ECMWF's DestinE procurement web pages (<https://www.ecmwf.int/en/about/suppliers/destine-procurement>) Regular update on published procurement processes**
- ECMWF's eProcurement Portal (<https://procurement.ecmwf.int> or <https://procontract.due-north.com>)
ECMWF platform to manage procurement processes

Process for responding to ITTs:

- Register on the Portal – free; managed by the Portal provider (**Do not leave registration to the last minute!**)
- Express an interest in an opportunity (ITT)
- Complete the Online ITT Questionnaire and submit bid online (**Do not leave questionnaire to the last minute!**)
- Guidance for suppliers is available (<https://supplierhelp.due-north.com>)

Contracts and budget

Contracting approach:

- Single legal person or entity which may choose to subcontract parts of the contract requirements; no multiple contracts with individual members of consortia or groups of service providers

Eligibility to participate in tenders/contracts:

- EU Member States and Digital Europe Programme Associated Countries (EU's Regulation 2021/694)

Estimated procurement timeline for 2022:

Description	Competition	Selection	Contract start
On-demand Extremes DT (est. €12M)	Q1-2022	Q2-2022	by end Q2-2022
Climate Adaptation DT (est. €14M)	Q1-2022	Q2-2022	by end Q2-2022
Visualisation and immersive technologies (est. €1M)	Q1-2022	Q2-2022	by end Q2-2022
Use cases (est. €1.9M)	Q2-2022	Q3-2022	by end Q3-2022



<https://www.ecmwf.int/en/about/suppliers/destine-procurement>