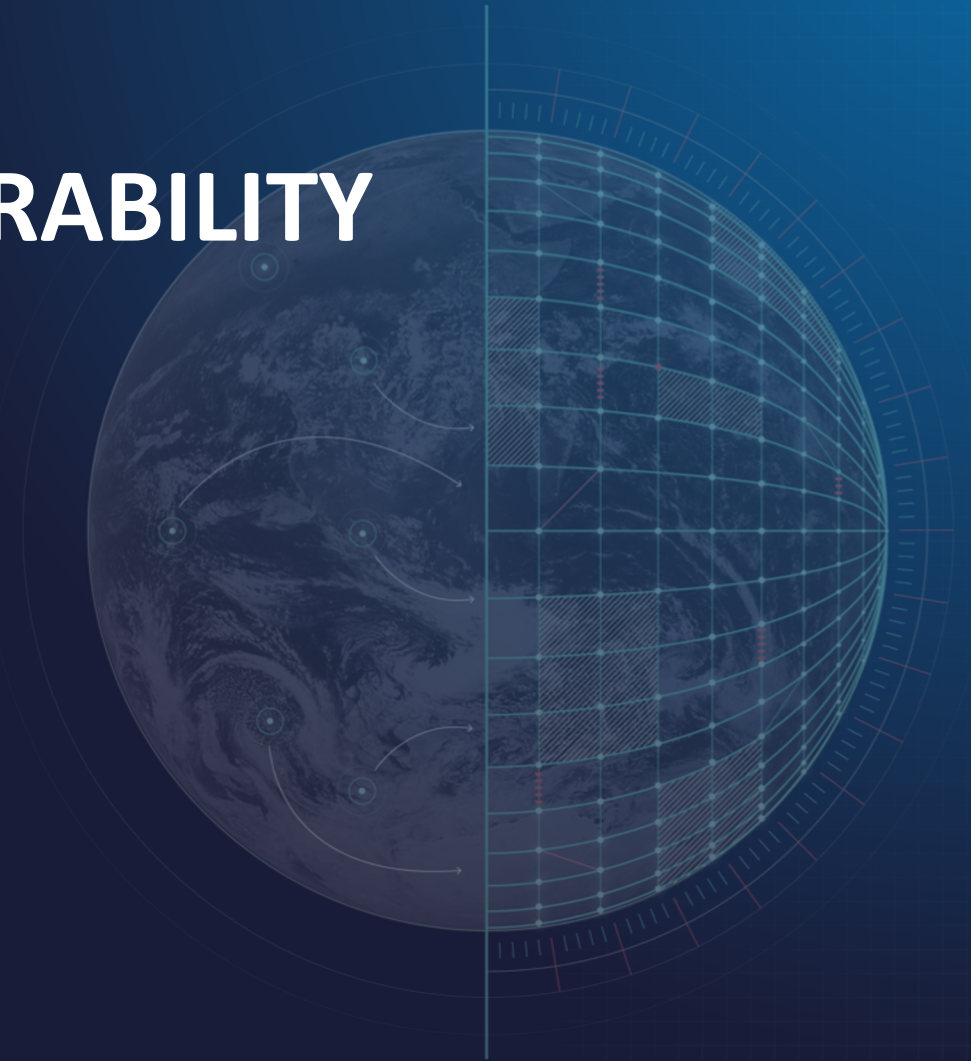


# DESTINATION EARTH INTEROPERABILITY

## The digital twin engine DTE

Thomas Geenen and many many others

[thomas.geenen@ecmwf.int](mailto:thomas.geenen@ecmwf.int)



Funded by  
the European Union

**Destination Earth**

implemented by



# Implementation: Phasing and Responsibility

**2022**

Launch of Destination Earth (DestinE) initiative

**2024**

Development of the core service platform (ESA), the data lake (EUMETSAT), the digital twin engine and the first two digital twins on weather-induced extreme events and climate change adaptation (ECMWF).

**2027**

Initial and ramp-up operations, consolidation, maintenance, continuous evolution of the DestinE System.

**2030**

Transition to long-term operations.

Observations

Simulations

PRESENT

FUTURE

2022

2024

2027

2030

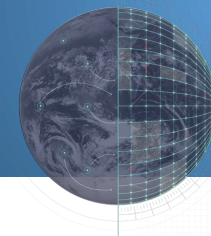
## Entrusted entities



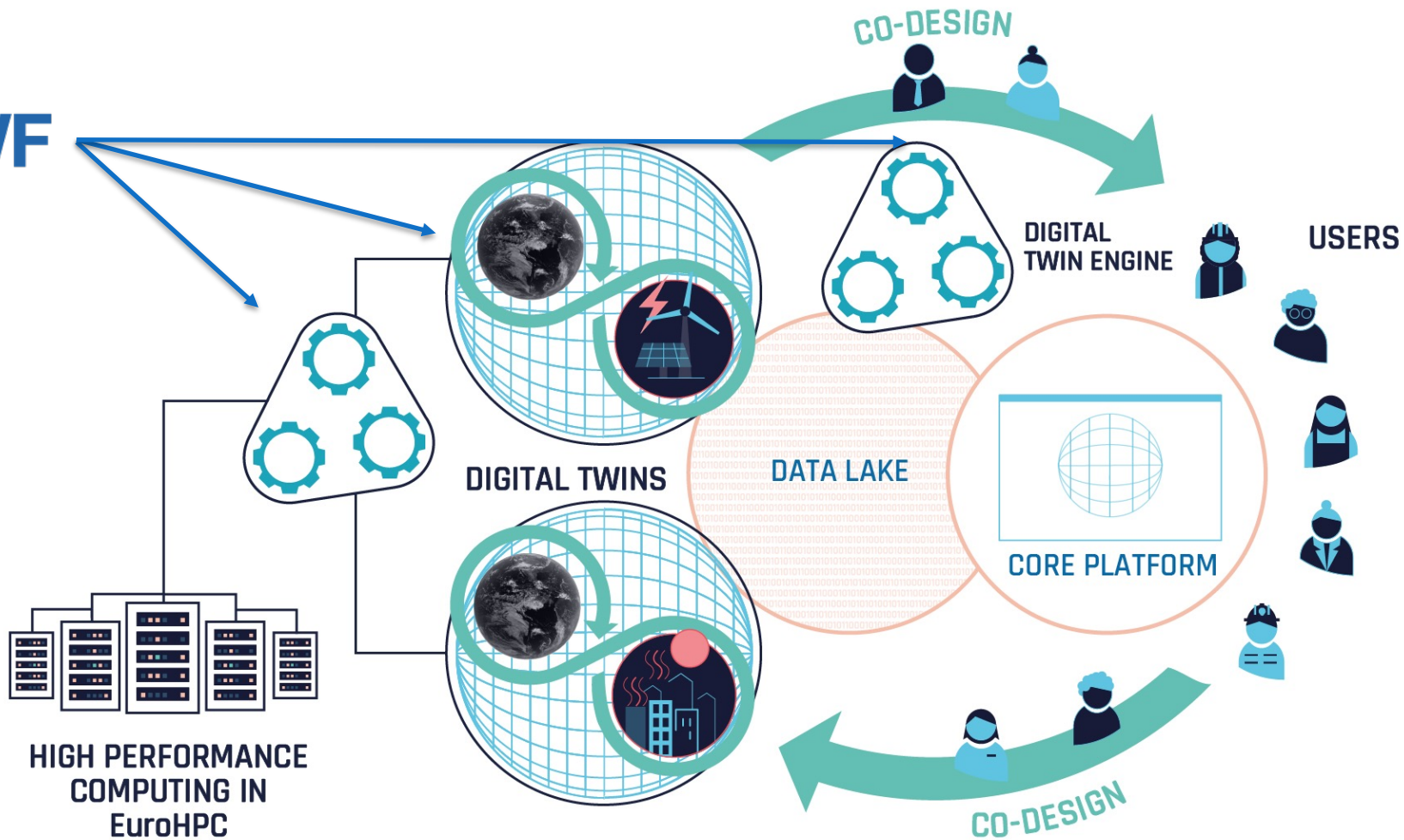
EUMETSAT

## Key elements

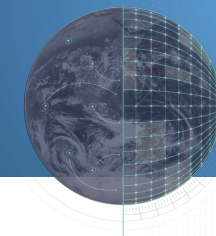
- Digital Twin Engine
- Digital Twins
- Data lake
- Core platform



# KEY COMPONENTS OF DESTINE, ECMWF ROLE

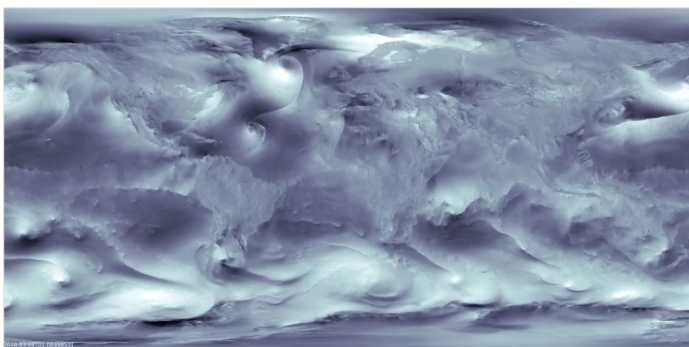


# **DIGITAL TWINS**

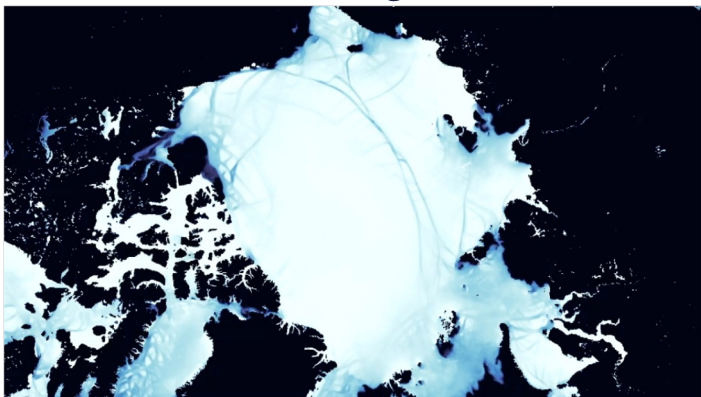


# DIGITAL TWIN FEATURES

## QUALITY

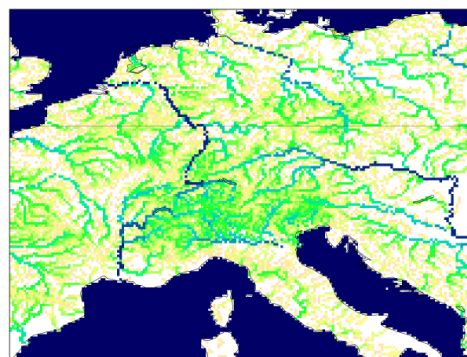
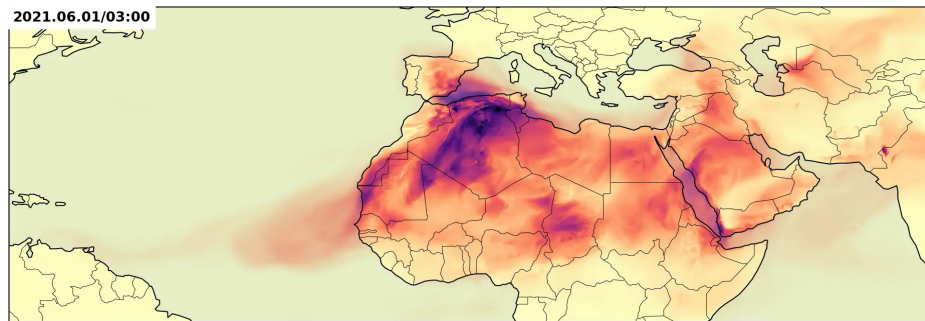


*More realistic at global scale*



*More realistic at local scale*

## IMPACTS

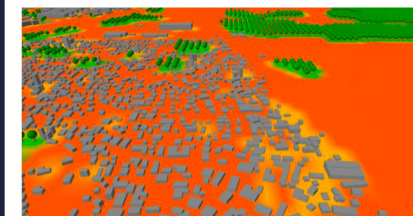


*Include impacts where they matter*

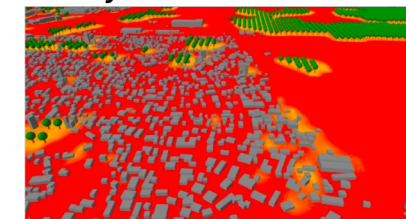
## INTERACTIVITY



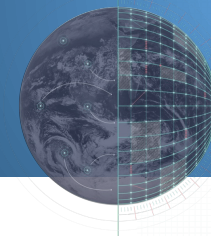
*City A in a +2 world*



*City A in a +4 world*

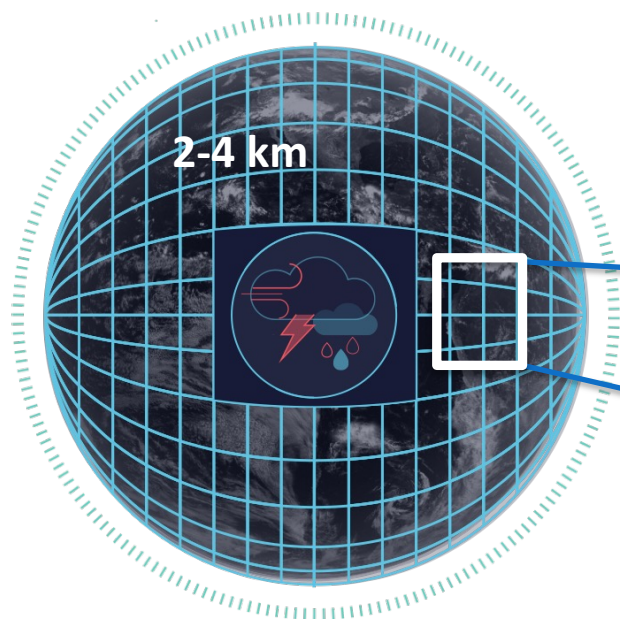


*Trial different scenarios*

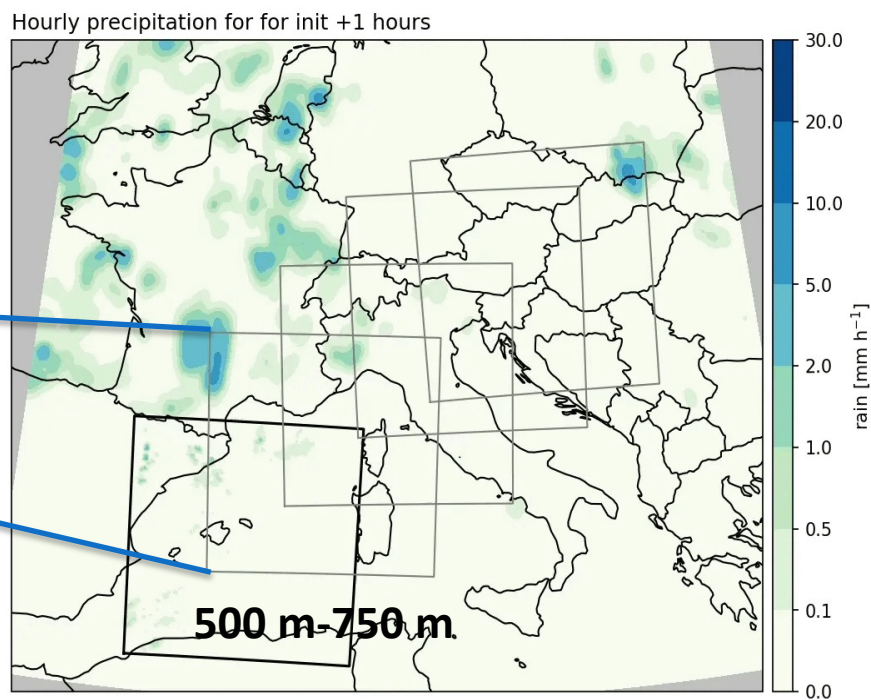


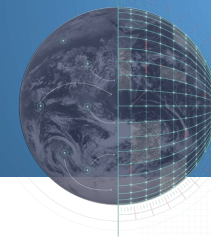
# EXTREMES DT: CONTINUOUS AND ON DEMAND

Continuous global component

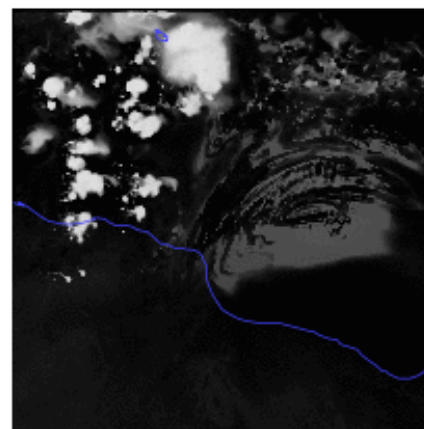
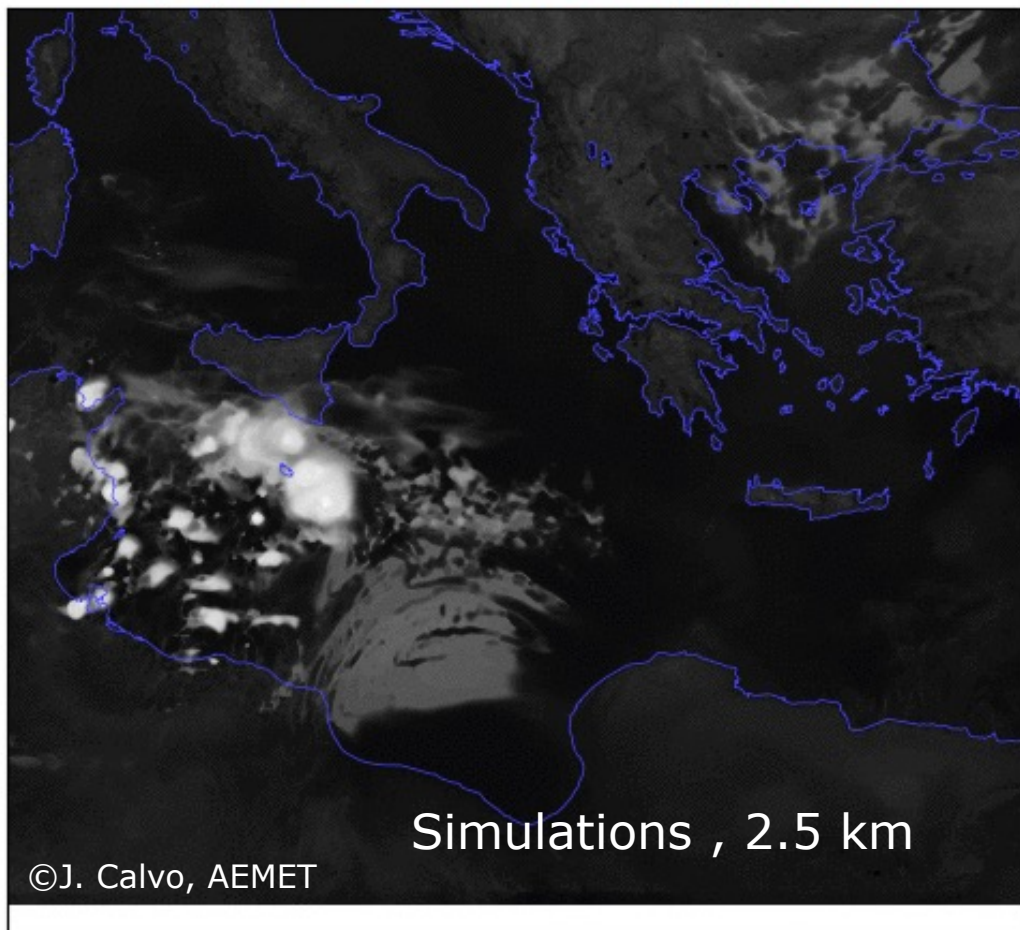


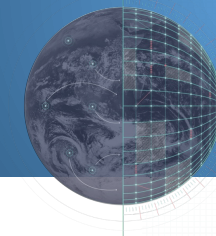
On-demand regional component





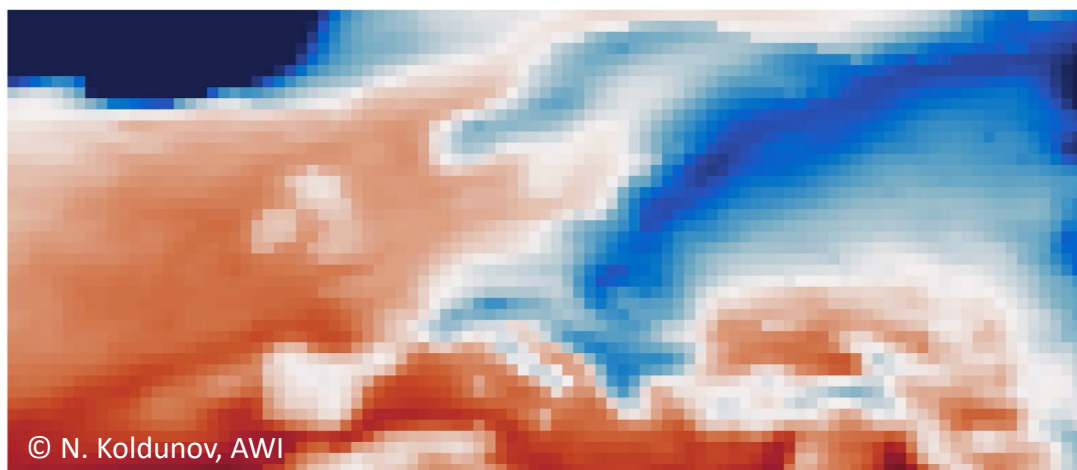
# ON-DEMAND EXTREMES DT



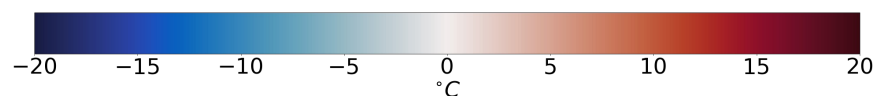
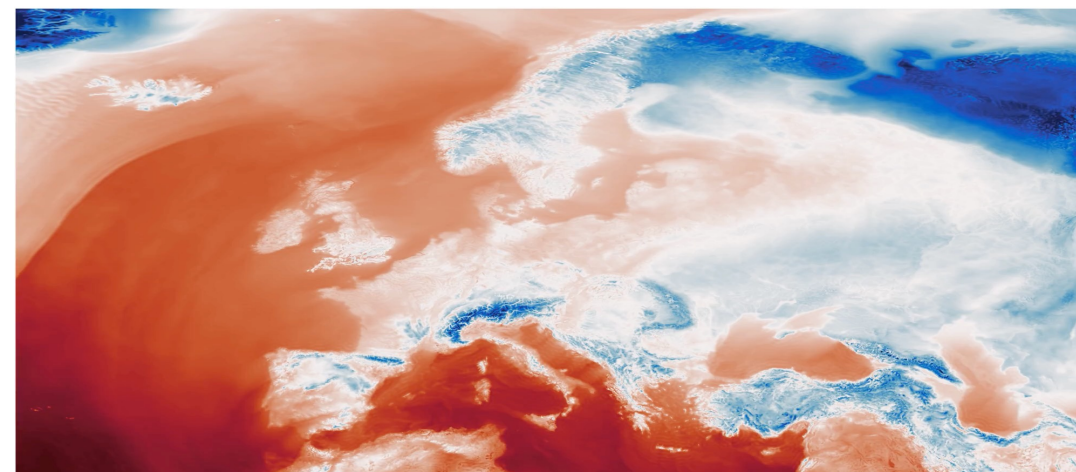


# GLOBAL INFORMATION WITH LOCAL GRANULARITY

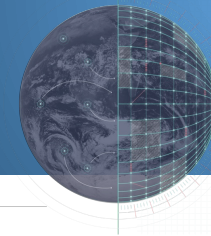
IPCC AR6 (2021), 100km



Digital Twin, 5km

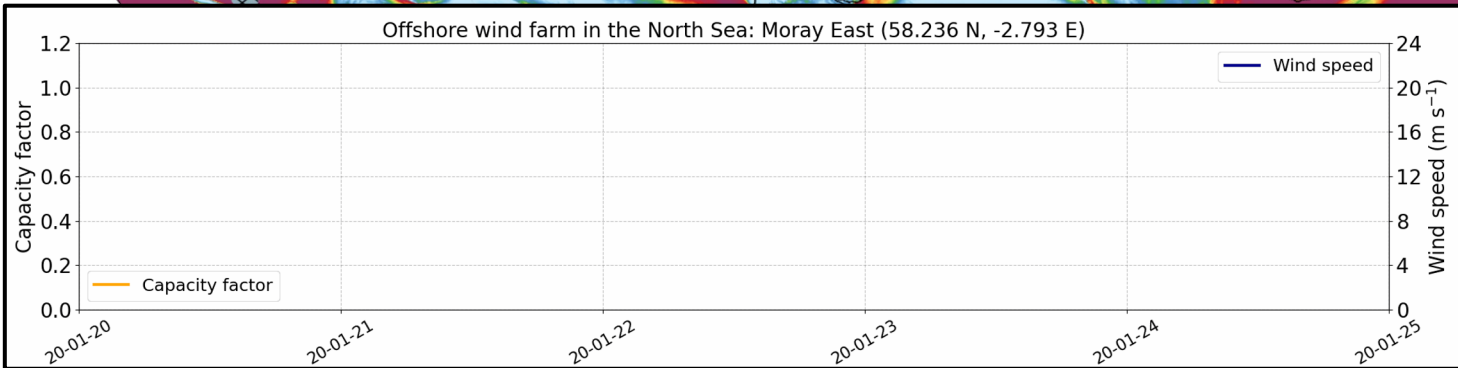
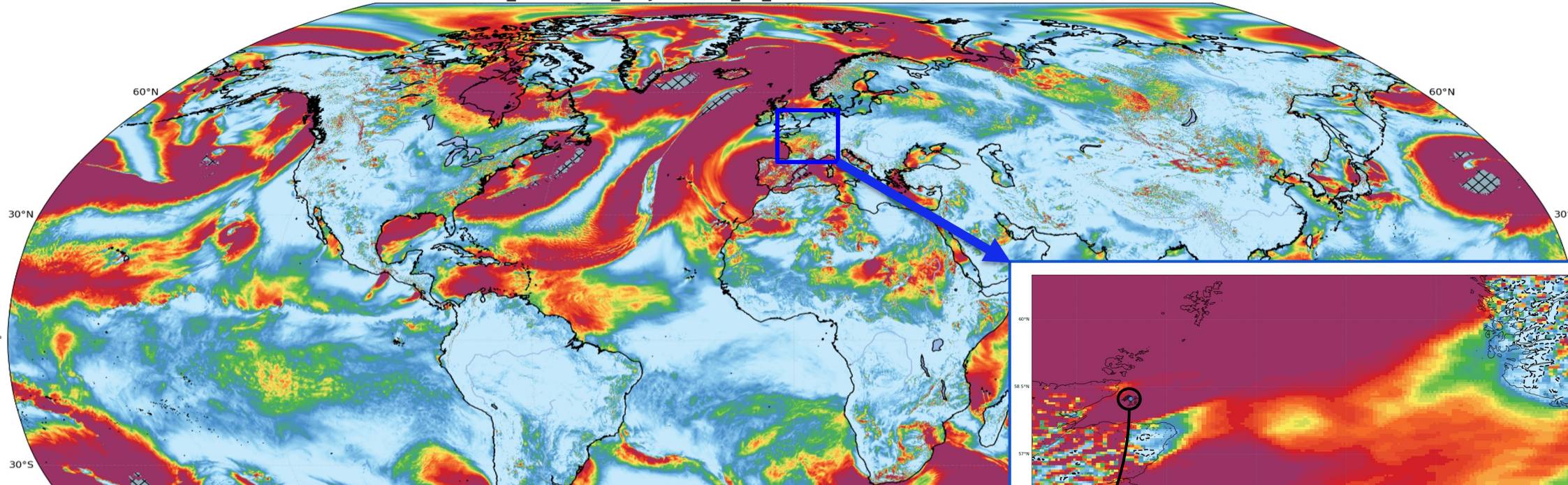




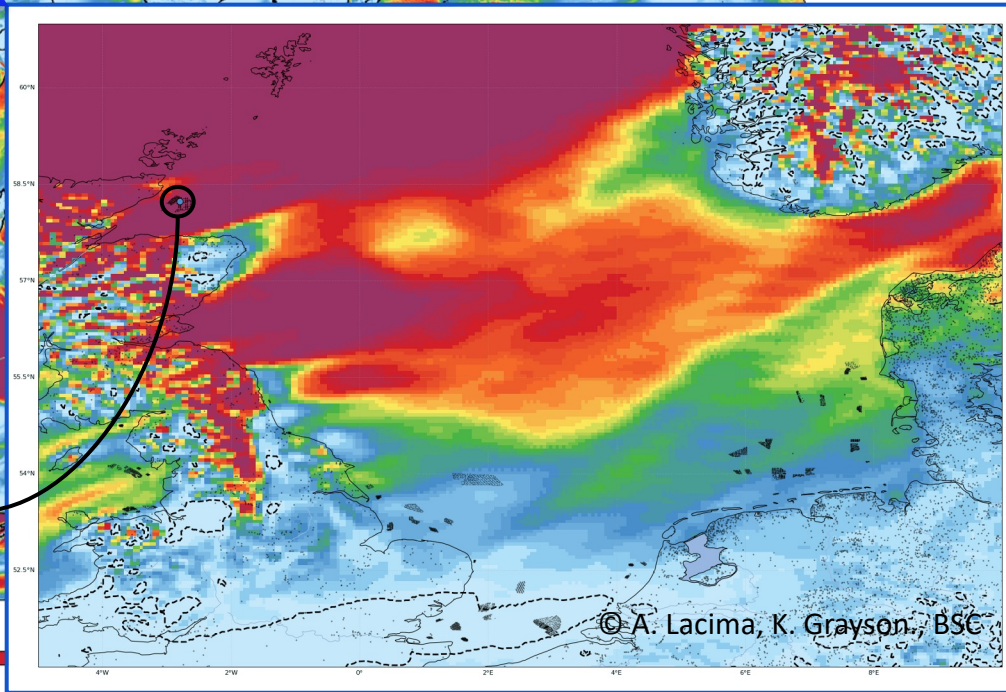


# Tailoring the information to user needs

IFS\_4.4-FESOM\_5-cycle3 (2D\_1h\_native) - Class S (Vestas V164/9.5MW)

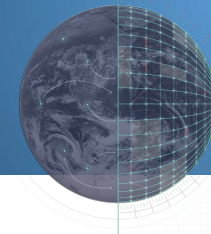


Capacity factor for 2020-01-20T00

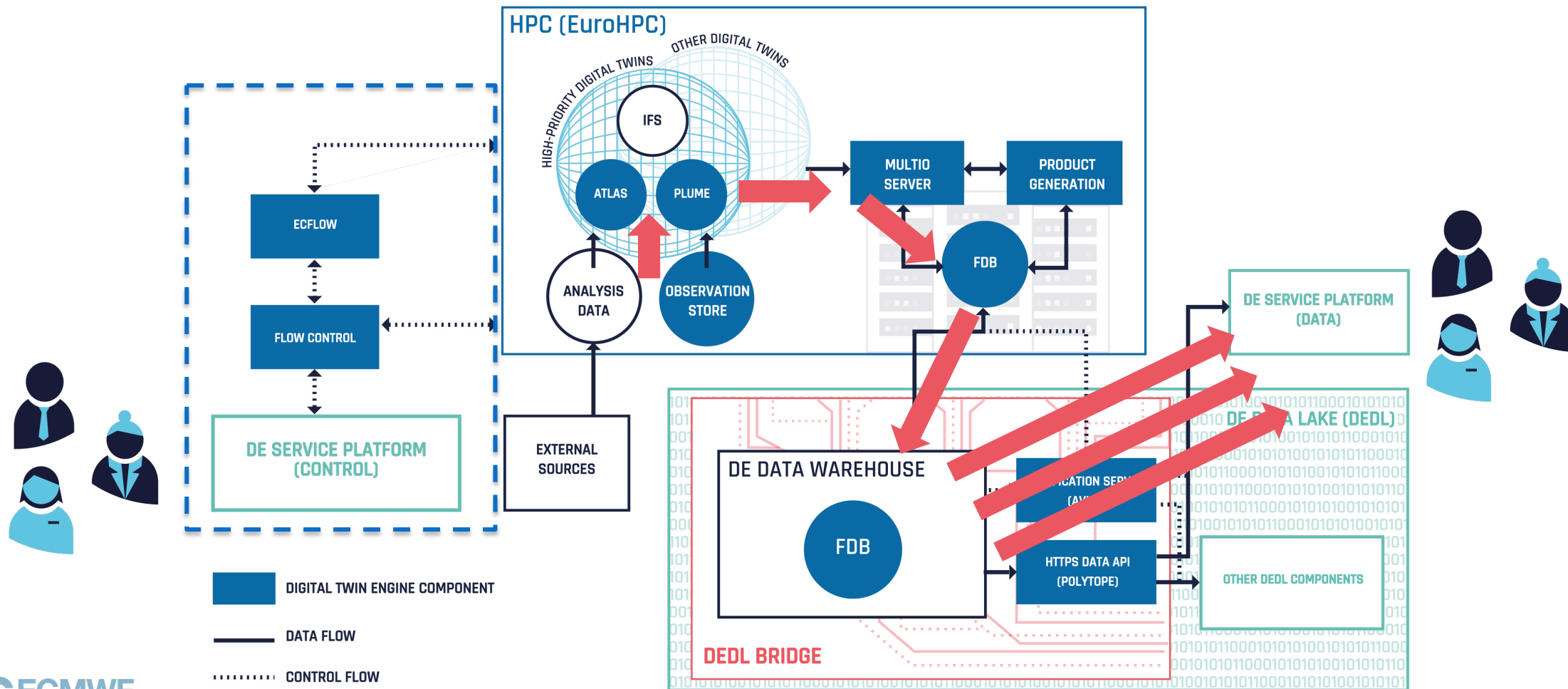


© A. Lacima, K. Grayson, BSC

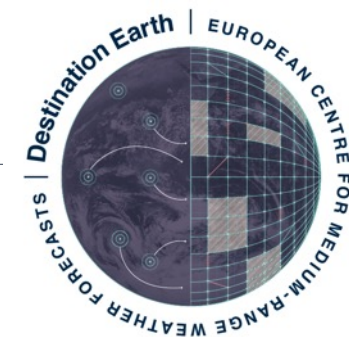
# **DIGITAL TWIN ENGINE INTEROPERABILITY**



# RUNNING DTS & MANAGING BIG DATA



# Different types of Integration



## Full Integration mode

Directly integrated in the DestinE simulation and data handling system

## Coupling mode

Integrated in a workflow where Digital Twins have their own simulation and data fusion tasks interfacing with DestinE

## Post-processing mode

Integrated as data post-processing application without own Earth-system simulation



## Integration continuum

### Use DTE

Workflow management, HPC and data handling software infrastructures

### Compatible with DTE

Workflow management, HPC and data handling software infrastructures

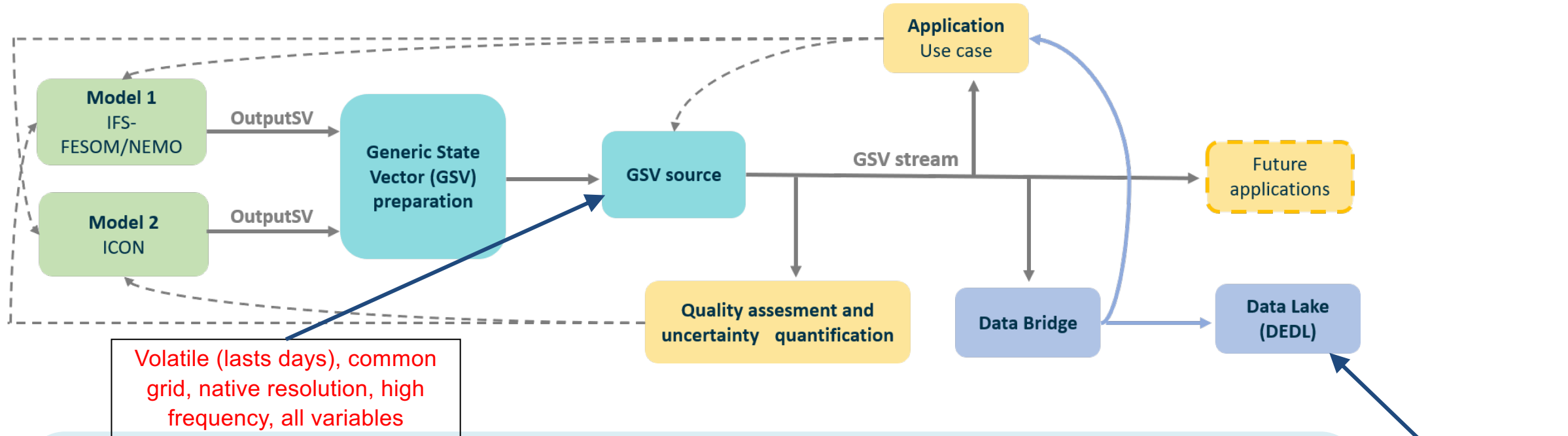
### Weak DTE coupling

independent  
Workflow management, data management

### DTE in the background

implicit data handling software infrastructure use By the end user from the DESP

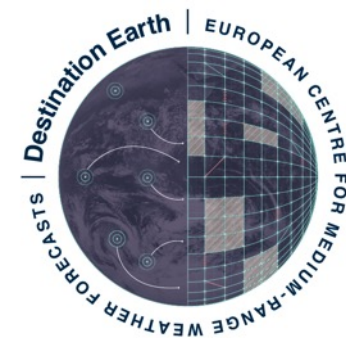
# Climate DT – a novel workflow



Streaming of climate model output in standardized form (*Generic State Vector, GSV*):

- **access the full model state** as soon as it is available
- **scalability** – new applications can be added
- **(interactivity** – in future phases users may request simulations based on their needs)

# Common architecture language



## Technology transfer between DT projects

Driven by the European commission  
DG-CNECT (Digital Europe program)

Work with Horizon Europe funded projects

To allow for

- Integration
- Interoperability

Select a use-case for each project

**Run integration and interoperability pilots**

**Intertwin: Coastal hazard**

**BioDT: Agriculture**

**DT-Geo: Tsunami**



## Draw solutions in the landscape

### In the process of drawing solution paths

- Write a common/shared DTE glossary
- Identify integration and interface points
- Identify gaps in the landscape
- Identify opportunities to converge on components

Work

workflows, data, platform,  
infrastructure  
Preparing the platform/infrastructure for  
applications and executions



Funded by the  
European Union

# Second Destination Earth User eXchange

13–14 November  
Bonn, Germany

Registration open  
[destination-earth.eu/event/2nd-destination-earth-user-exchange/](https://destination-earth.eu/event/2nd-destination-earth-user-exchange/)



Funded by  
the European Union

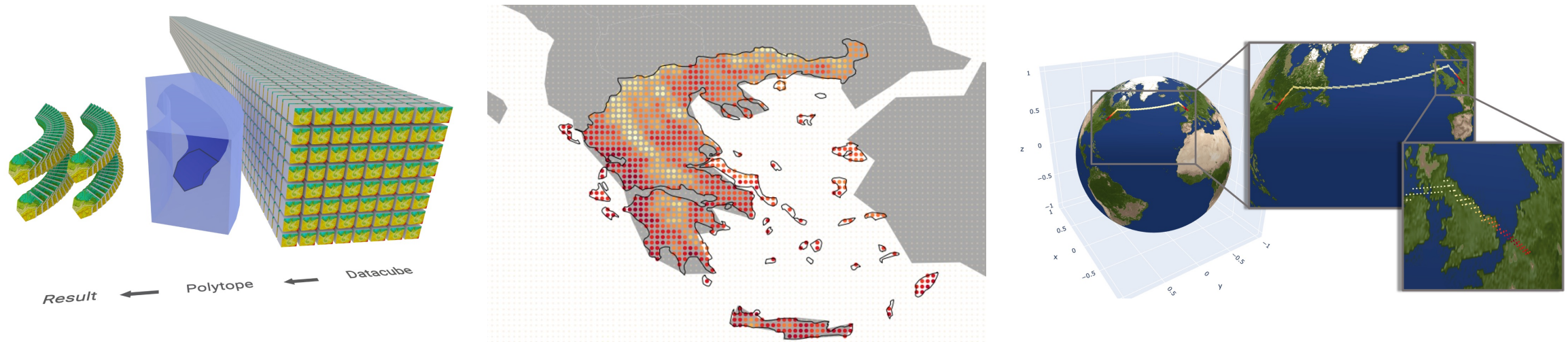
**Destination Earth**

implemented by



## An example on data interoperability: Polytope EDR

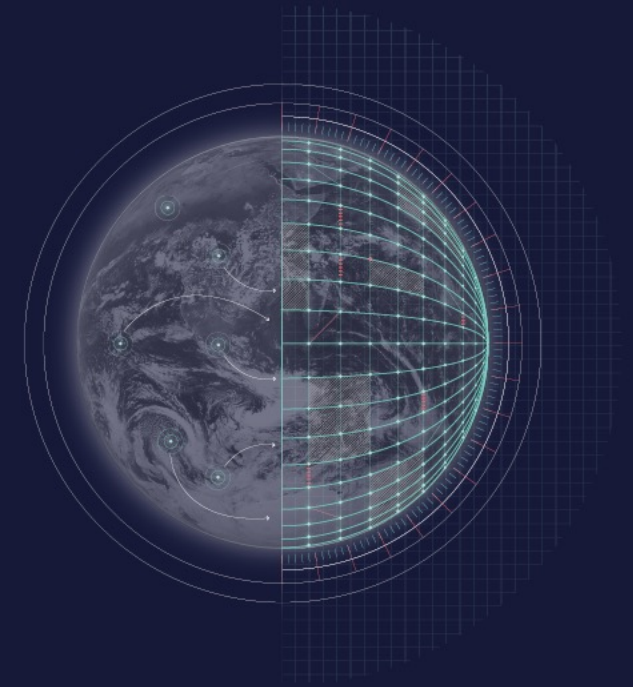
- EDR is an OGC standard (environmental data retrieval API)
- Polytope allows for semantic extraction of complex data structures



- As an exercise/blueprint to implement interoperability layer “on top”



# Thank you



[thomas.geenen@ecmwf.int](mailto:thomas.geenen@ecmwf.int)

