



**interTwin**

# Climate Change Future Projections of Extreme Events

Andrea Manzi (EGI Foundation)  
Donatello Elia (CMCC)

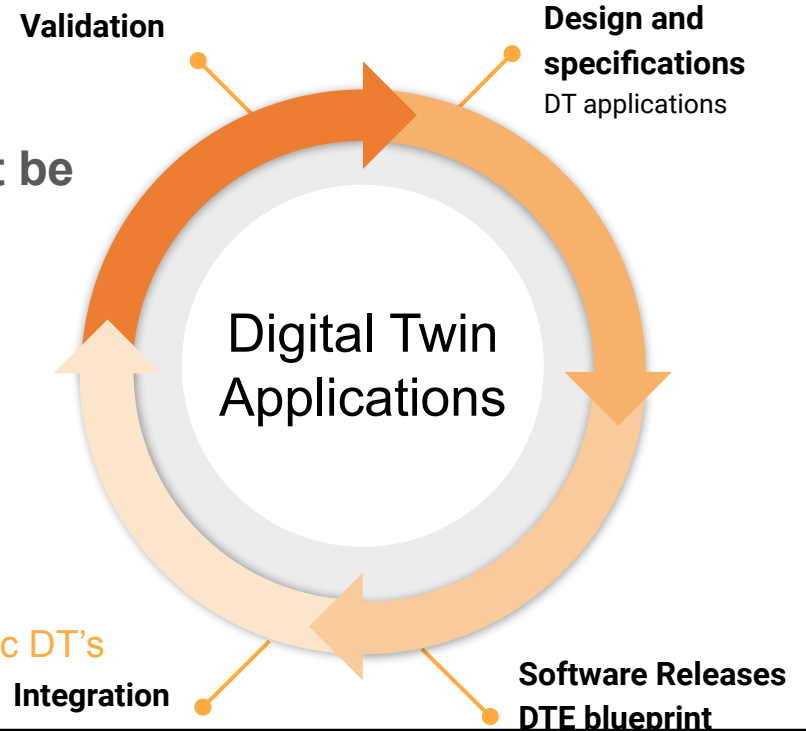


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# High level overview

## Creation of a **Prototype Digital Twin engine**:

- Resulting **DTE Blueprint Architecture** must be
  - Interdisciplinary
  - Co-Designed (Providers and Communities)
- Resulting **Platform** must be
  - Open Source with
  - TRL 6 (prototype model) to 7 (prototype pilot)
- And be based on
  - **Open Standards**
  - with the capability to integrate with **application specific DT's**





# Consortium



## EGI Foundation as coordinator

29

Participants, including 1 affiliated entity and 2 associated partners

## Consortium at a glance

10  
Providers

cloud, HTC, HPC  
resources and  
access to  
Quantum systems

11  
Technology  
providers

delivering the  
DTE infrastructure  
and horizontal  
capabilities

14  
Community  
representants

from 5 scientific  
areas;  
requirements and  
developing DT  
applications and  
thematic modules

1.09.22 - 31.08.25

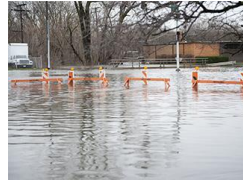
Budget 11,7 M euro

# Climate change EWEs DT Motivation

Climate Change is leading to the exacerbation of Extreme Weather Events (EWEs). As highlighted by the **IPCC 6 Assessment Report** EWE will increase in severity and frequency.



Global temperatures will continue to rise



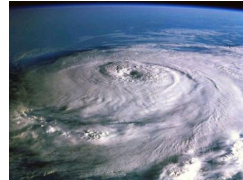
Changes in Precipitation patterns



More droughts and heat waves



Sea Level will rise up to over 2m by 2100

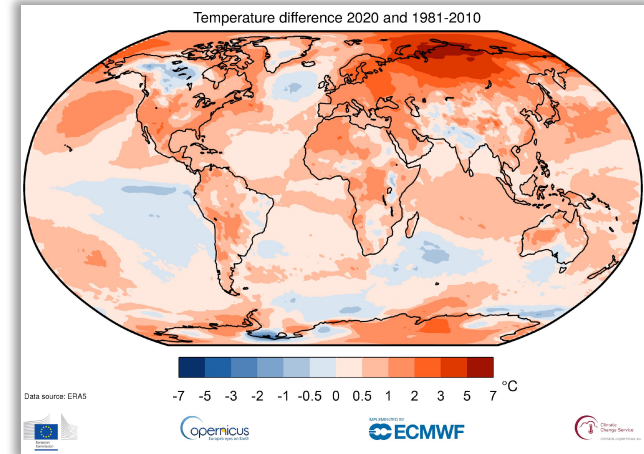


Hurricanes will become stronger and more intense



Longer wildfire season

Source: <https://climate.nasa.gov/effects/>



Year 2020 +1,25 °C  
WRT PRE-INDUSTRIAL ERA (1850–1900)

Source: <https://climate.copernicus.eu/copernicus-2020-warmest-year-re-cord-europe-globally-2020-ties-2016-warmest-year-recorded>



# Data-driven approach for EWEs analysis

We now have **huge amounts** of **climate and weather data** to analyze (observations, ESM simulations)

Observation provide evidence of EWEs once verified, how to understand how these change in the future?

Exploit **data-driven models** to provide solutions for analyzing EWEs based on climate projections in place of traditional approaches

## Benefits:

- ➔ After training, predictions of EWEs in few seconds (cost-effective)
- ➔ High accuracy, but the fine tuning is time consuming
- ➔ Data-driven without model equation (no physical knowledge of the underlying phenomena is required)
- ➔ Provide solutions generalizable to different geographic areas



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## Challenges:

- ➔ Data downloading, pre-processing and augmentation of big amounts of data is time consuming
- ➔ Access to diverse compute infrastructures (i.e., Cloud/HPC) required
- ➔ Automate ML model workflows to speedup training
- ➔ Enable re-use and reproducibility of ML models (FAIR)

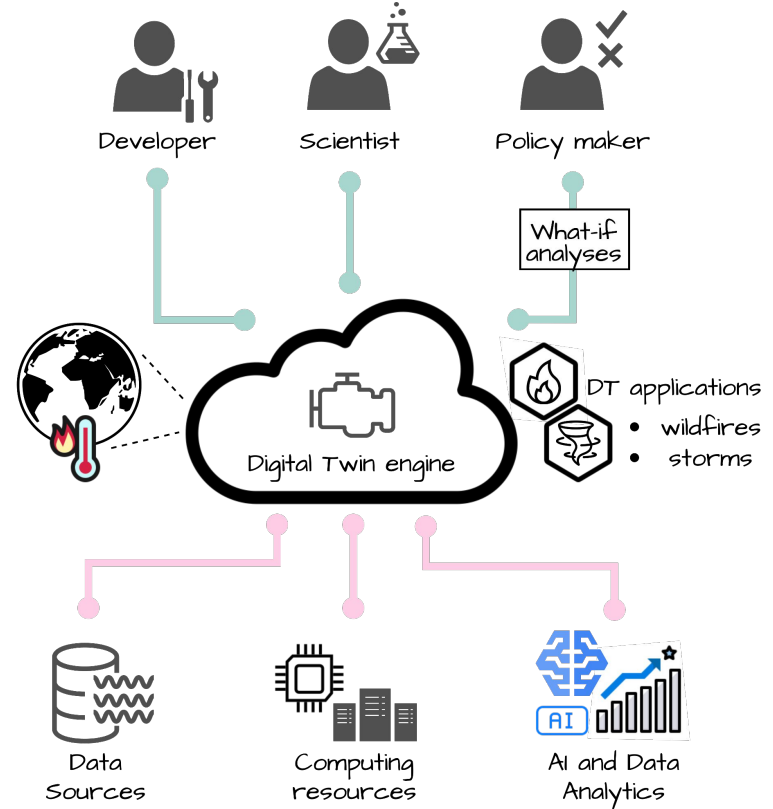


# Digital Twin applications in interTwin

**GOAL:** Develop digital twin applications exploiting the DTE for supporting analysis of large-scale, multi-model climate projections of EWEs (i.e., **Tropical Storms** and **Wildfire risks**).

Users will benefit from these applications for:

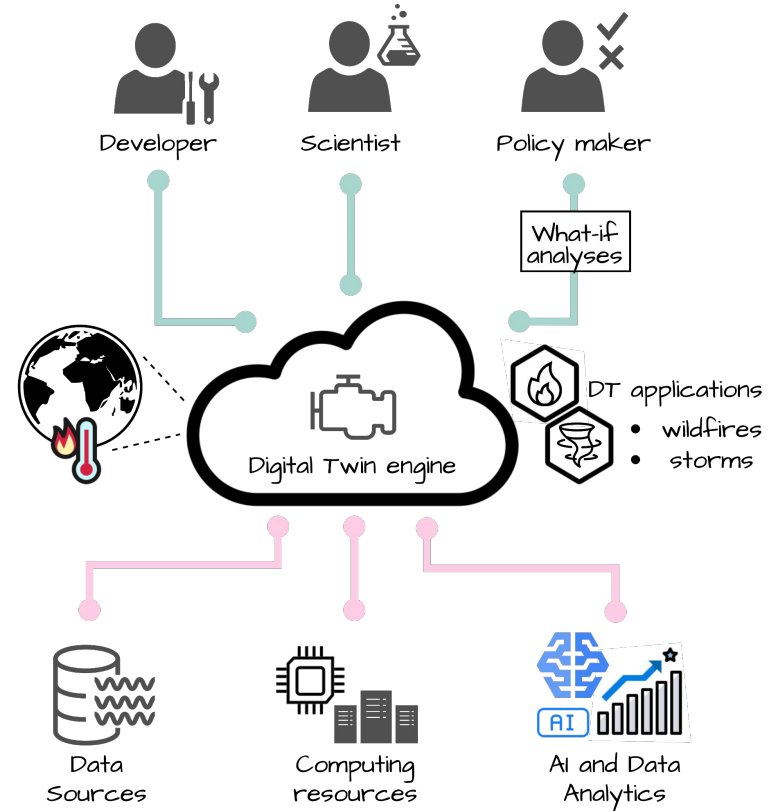
- Easily adapting the application to different climate scenarios
- Generating results in a timely and efficient manner
- Running configurable what-if analyses
- Deliver added-value products for supporting new downstream services



# Digital Twin applications in interTwin

The interTwin Digital Twin Engine will:

- Support **integration** of heterogenous climate and weather data from **multiple sources**
- Enable transparent access to **federated compute infrastructures** (HPC and Cloud)
- Provide a complete platform joining general **scientific data analytics** and **ML** with thematic software modules for **climate** data management
- Support **complex** data processing and ML **workflows** as well as track model/data **provenance**





# Climate Change Future Projections of Extreme Events (storms & fire)

## Tropical Cyclones (TCs) detection

*Data-driven approach* (Convolutional/Graph Neural Networks) for *detecting* the presence of TCs and potentially *track* its evolutions using cyclogenesis variables. The DT will be used for understanding TCs occurrences and frequency in future projection scenarios.



## Wildfire danger prediction

*Deep Neural Networks* used for the generation of synthetic *Wildfire danger maps* (burned areas) that closely resemble the original fire distribution.

The DT aims to give an indication about the areas that are more likely to experience wildfires according to future climate scenarios.



# Thank you!



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[info@intertwin.eu](mailto:info@intertwin.eu)



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