Digital Twins for Decision Support in a Changing Climate: A new way to combine Models with Satellite Data using Machine Learning

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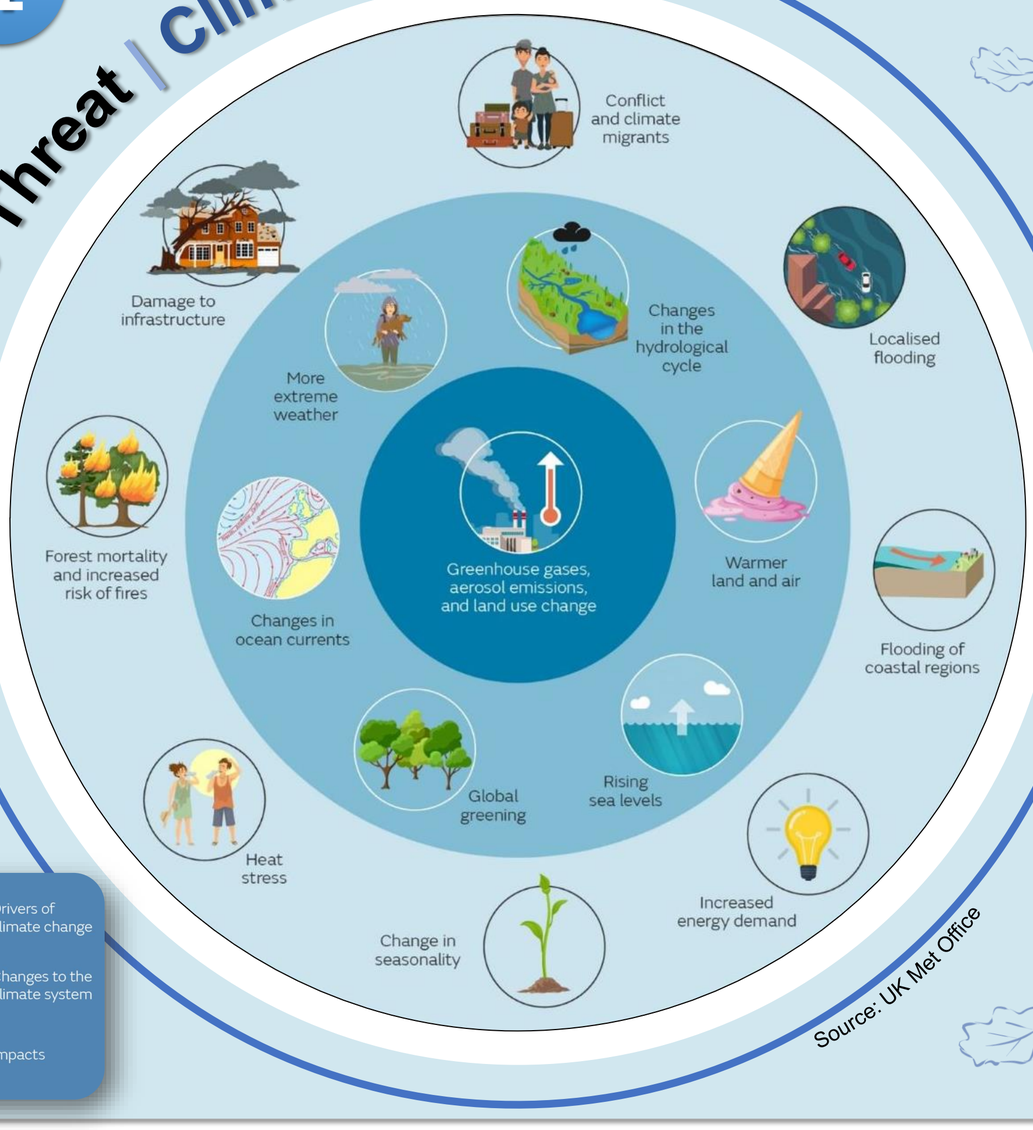
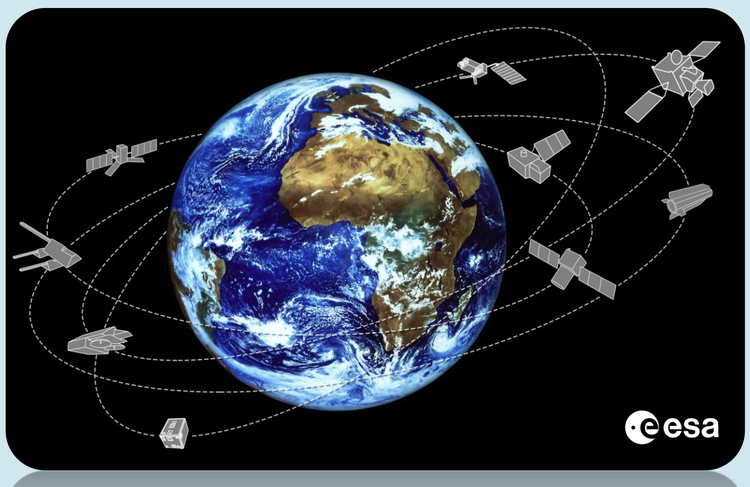
1 The Threat | Climate Change



2 The Challenge | Data vs Information

We have a **wealth of data** from climate models, satellites and other sources, which can help us understand and predict the effects of climate change.



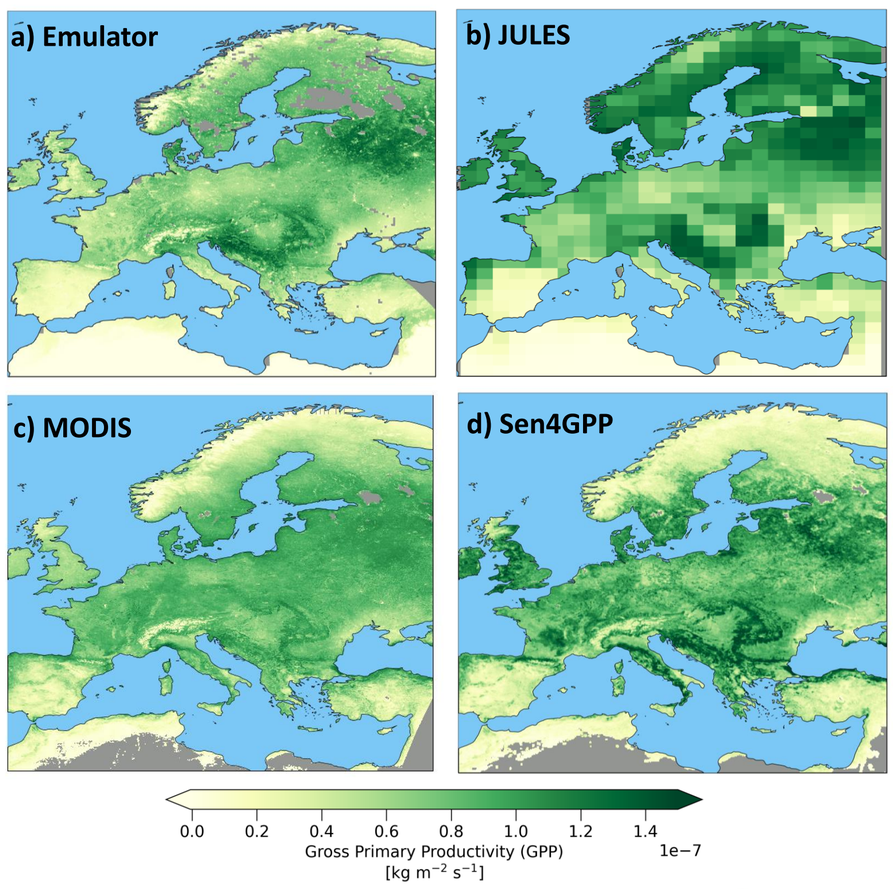
However, the large volumes of data, and the need for expert knowledge to interpret them, make it **hard to translate** them into **actionable information** that allows people to make decisions.

3 The Solution | Digital Twins

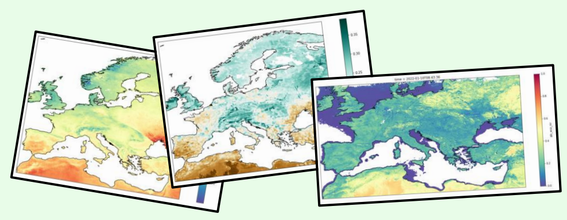
A **Digital Twin (DT)** is a digital representation of a physical system (for example, the Earth) that can:

- Make **predictions** → model.
- Interact with the real system → **observations** + **interventions**.
- Provide **decision support** → user interface to test **'what-if' scenarios** and interventions.

Emulator results compare well with existing GPP datasets (MODIS and Sen4GPP), are an improvement over JULES and run in a fraction of the time ⏱



Our approach to building DTs

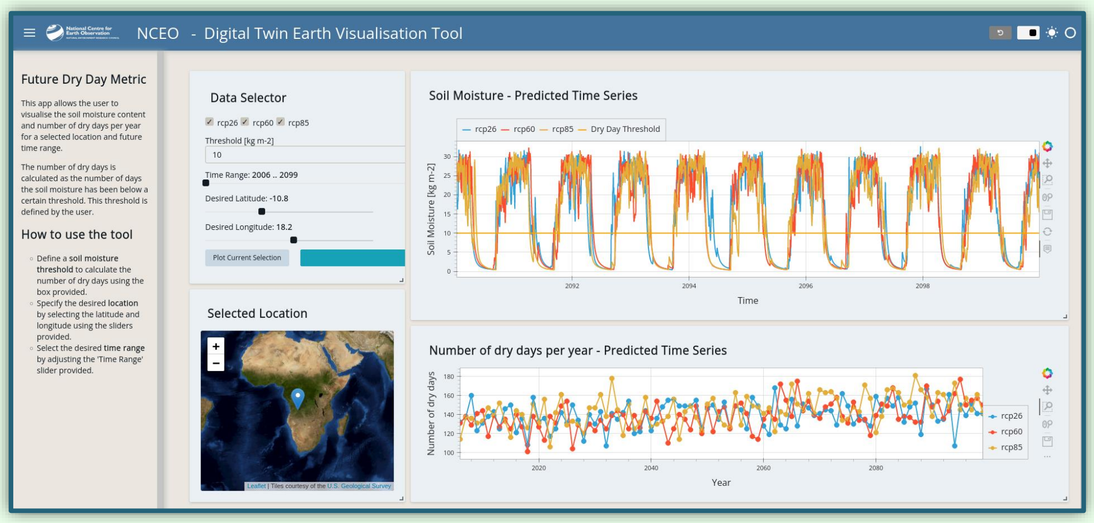
STEPS	IN THIS EXAMPLE
1. Select a **model** and **target** variable.	Gross Primary Productivity (GPP) *(a measure of the rate of photosynthesis in plants)* — *A land surface model* JULES Joint UK Land Environment Simulator
2. Create a **fast**, lightweight version of the model (the '***emulator***') for our target variable using Machine Learning (ML).	 ML algorithm based on decision trees
3. Run emulator with satellite **observations**.	Temperature Soil Moisture Solar Radiation Etc. 

Advantages of emulators

✓ We can run many simulations very fast	✓ We can derive useful metrics for users
✓ No need for expert knowledge	✓ They can be deployed on web platforms
✓ No need for expensive supercomputers	✓ They can integrate many types of data

Data Visualisation and **User Interaction** are really important in Digital Twins.

Here's an example of an **interactive dashboard** to explore soil moisture information in Africa.



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