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A Digital Twin Application: Climate Extremes Detection and Characterization using Deep Learning

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Climate Extreme Events and their impacts are getting a lot of attention lately, because their occurrence, severity and spatial coverage are increasing and will likely increase further toward mid and end of century. Many countries are experimenting significant impact of those climate extremes. It becomes more and more important to better assess the change of characteristics of climate extremes, according to users and society needs.

However, it is not straightforward to correctly assess and quantify uncertainties. It is also a challenge to find and characterize climate extremes in all available and relevant climate simulations. This is mainly due to the very large number of simulations, along with significant data volumes. It is unfortunate to limit the number of climate simulations used in a climate change assessment study, only because of those technical and time constraints, as we should use all available information.

A novel approach and methodology is being developed to detect and characterize the changes in climate extreme events using Artificial Intelligence (AI). This is a generic method based on Convolutional Variational Autoencoders (CVAE). This deep learning technique, that uses neural networks, can process large climate datasets much faster than traditional analytical methods, and also use efficient hardware architecture like GPUs. It has the potential to better assess and quantify uncertainties associated with the various projected IPCC (Intergovernmental Panel on Climate Change) scenarios. This has been integrated in a Digital Twin Engine (DTE) architecture provided by Core Components and a Data Lake within the interTwin projects.

In this presentation, first results of the method applied on Global Coupled Climate Model datasets will be shown for several greenhouse gas scenarios, over Western Europe. A comparison to analytical methods will also be presented to assess the robustness of the method.

In summary, this DT application will enable end users to perform on-demand what-if scenarios in order to better evaluate the impact of climate change on several real-world applications in specific regions to better adapt and prepare the society.

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Topic

Needs and solutions in scientific computing: Digital Twins

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