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Precipitation forecast enhancements in Destination Earth: advancing toward km-scale Global simulations

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The European Commission's Destination Earth initiative is developing several digital replicas (digital twins) of the Earth system, combining state-of-the-art Earth system models and observations. One such digital twin focuses on weather-induced extremes and has two main components: daily global high-resolution forecasts developed by ECMWF, and on-demand regional simulations developed by a consortium led by Météo-France.

The Global Extremes Digital Twin (Global DT) is designed to forecast extreme weather events worldwide with unprecedented precision, offering continuous, kilometre-scale global high-resolution forecasts. Currently, the Global DT uses ECMWF's Integrated Forecasting System (IFS) cycle 48r1 with a grid spacing of approximately 4.4 km (TCo2559).

This presentation highlights the significant improvements of global km-scale simulations performance for precipitation, especially in complex orographic regions, compared to the current operational IFS 9 km resolution forecasts. The Global DT reduces both the overestimation of small 24-hour precipitation values and the underestimation of extreme precipitation amounts observed in the 9 km forecasts, resulting in a smaller absolute bias. However, challenges in simulating convective precipitation remain, such as the failure to propagate marine convective systems further inland, to simulate localised convective events in flat areas and squall lines with realistic structures in tropical areas. Adjusting the cloud base convective mass flux within the convective parameterization shows potential in addressing some of these issues. However, further investigation is required before these changes can be applied operationally, as they may lead to a decrease in forecast skill in certain regions. Additionally, several case studies of extreme precipitation events have been explored at even higher resolutions to assess their potential for improving the detection of extreme weather.

Finally, we evaluated the benefit of km-scale information for flood forecasting with simulations using the river routing model CaMa-Flood, which is directly integrated in the Global DT workflow.

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Session

Precipitation and Hydrological Models: Extreme precipitation events

Preferred Contribution Type

Oral Presentation

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