

[ESCAPE-2: Energy-efficient SCalable Algorithms for weather and climate Prediction at Exascale](#)

Description

ESCAPE-2 will develop world-class, extreme-scale computing capabilities for European operational numerical weather and climate prediction, and provide the key components for weather and climate domain benchmarks to be deployed on extreme-scale demonstrators and beyond. This will be achieved by developing bespoke and novel mathematical and algorithmic concepts, combining them with proven methods, and thereby reassessing the mathematical foundations forming the basis of Earth system models. ESCAPE-2 also invests in significantly more productive programming models for the weather-climate community through which novel algorithm development will be accelerated and future-proofed. Eventually, the project aims at providing exascale-ready production benchmarks to be operated on extreme-scale demonstrators (EsD) and beyond. ESCAPE-2 combines cross-disciplinary uncertainty quantification tools (URANIE) for high-performance computing, originating from the energy sector, with ensemble based weather and climate models to quantify the effect of model and data related uncertainties on forecasting a capability, which weather and climate prediction has pioneered since the 1960s. The mathematics and algorithmic research in ESCAPE-2 will focus on implementing data structures and tools supporting parallel computation of dynamics and physics on multiple scales and multiple levels. Highly-scalable spatial discretization will be combined with proven large time-stepping techniques to optimize both time-to-solution and energy-to-solution. Connecting multi-grid tools, iterative solvers, and overlapping computations with flexible-order spatial discretization will strengthen algorithm resilience against soft or hard failure. In addition, machine learning techniques will be applied for accelerating complex sub-components. The sum of these efforts will aim at achieving at the same time: performance, resilience, accuracy and portability.

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