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AQUA: a novel quality assessment tool for km-scale simulations in the Destination Earth Climate Digital Twin - the diagnostics suite

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Destination Earth (DestinE) is a major initiative by the European Commission aiming to create a highly accurate global digital twin of Earth. This model, supported by advanced high-performance computing and artificial intelligence, will monitor and simulate interactions between natural phenomena and human activities with unprecedented accuracy. Developed within the Climate Adaptation Digital Twin of the Destination Earth project, AQUA (Application for Quality assessment and Uncertainty quAntification) is a specialized model evaluation framework for running climate data diagnostics.

While existing diagnostic suites for global climate model data are already available, AQUA stands out by specifically addressing extensive kilometer-scale datasets, to simplify climate data access for all possible users. AQUA features two diagnostic families:

- "state-of-the-art" diagnostics, which compare low-resolution data with observations to assess general model performance and to identify biases and drifts (performance indices, radiation budget, atmospheric global mean time series and biases, teleconnection indices, ocean circulation evaluation, tropical cyclones detection, tracking and zoom-in)
- "frontier" diagnostics, which exploit new high-resolution (i.e., km-scale hourly) climate data to provide insight at climatological scales of physical/dynamical processes that could not be investigated before (sea surface height variability, tropical rainfall)

Beyond offering a flexible and efficient framework for processing and analyzing large volumes of

climate data, AQUA's modular design offers the possibility of seamless integration of new diagnostic tools, with plans for further expansion in the future phases of the project.
In this contribution, we will introduce the current suite of AQUA diagnostics and outline its planned future developments.