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Applying the DestinE Extremes digital twin to air quality forecasts and emission scenario simulations

Anne Caroline Lange[1], Sabine Schröder[2], Philipp Franke[1], Michael Langguth[2], Elmar Friese[1], and Martin G. Schultz[2]

[1]Forschungszentrum Jülich GmbH, Institute of Energy and Climate Research Troposphere, IEK-8, Jülich, Germany (ann.lange@fz-juelich.de)

[2]Forschungszentrum Jülich GmbH, Jülich Supercomputing Centre, JSC, Jülich, Germany

Events of extreme air pollution pose threats to humans and the environment. To investigate air quality under extreme atmospheric situations, the DestinE air quality use case developed a comprehensive user interface that enables high-resolution air quality forecasts with diverse analysis options. The user interface encapsulates the two state-of-the-art approaches that are physics-based numerical simulations with the chemistry transport model EURAD-IM (European Air pollution Dispersion – Inverse Model) and data-driven machine learning forecasts with MLAir (Machine Learning on Air data). The EURAD-IM simulations are coupled to the meteorological output of the DestinE digital twin for weather extremes, which provides high-resolution information (~4.4 km). An additionally implemented machine learning based postprocessing even allows for the downscaling of the EURAD-IM forecast output to a resolution of 1 km. MLAir produces 4-day point forecasts at station sites using data from the Tropospheric Ozone Assessment Report (TOAR) data base. The developed system is complemented by an efficient module that enables emission scenario simulations to investigate and develop air pollution mitigation strategies for future extreme events under realistic conditions.
The established user interface is demonstrated by two selected air quality extreme events in early 2017 and summer 2018. It aims to provide a new quality of air pollution information that supports the core users, i.e., environment agencies, in decision making. For the near future, it is planned to fully embed the system to the Destination Earth Service Platform (DESP) such that it will be available to a wider community. Besides assisting policy making, the air quality products help to answer scientific questions on air quality and atmospheric chemical processes under extreme weather conditions that are expected to increase in future.