

How can society benefit from the DestinE digital twins in view of air pollution extreme events?

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Introduction: The Destination Earth air quality use case DE370C couples air quality models with the DestinE Extremes digital twin to advice stakeholders like environment agencies with air quality forecasts and analysis. Here, results and benefits of numerical and machine learning models are explored for air quality decision making.

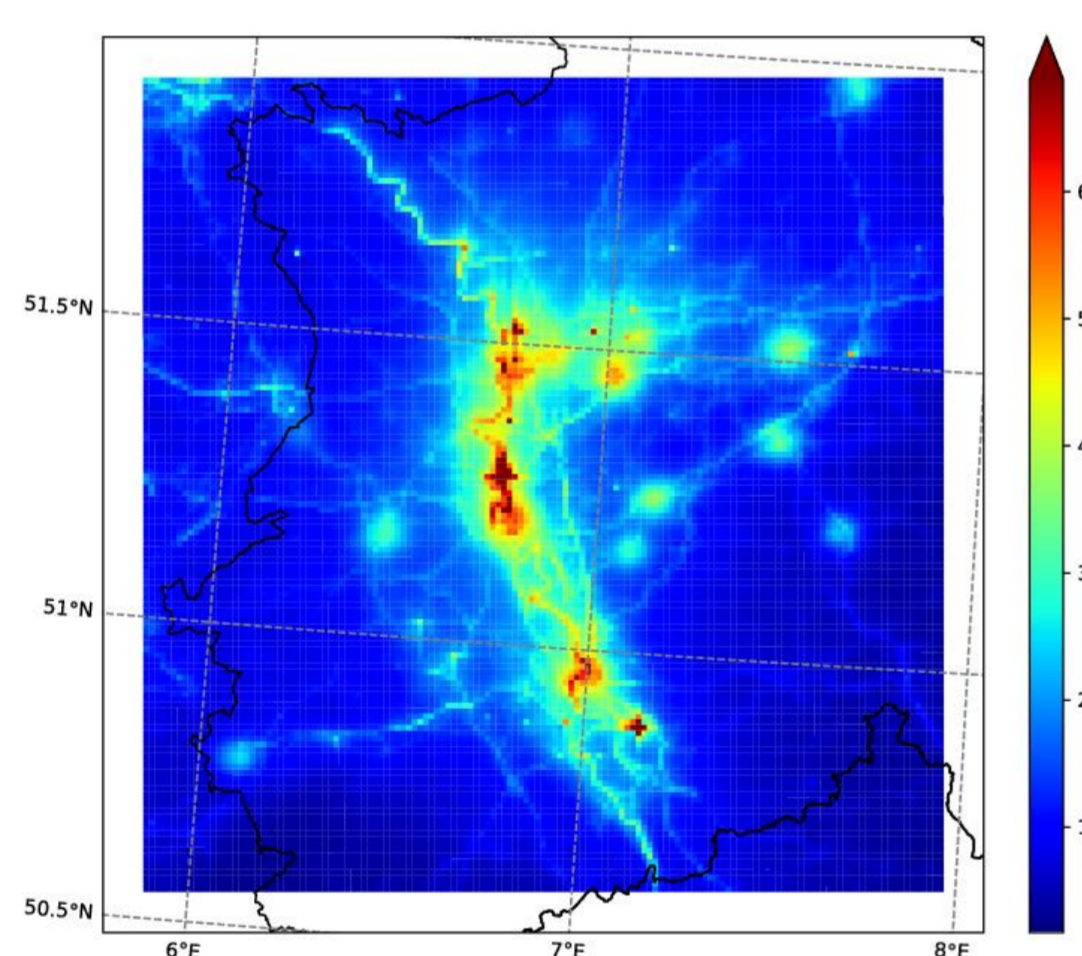
The user interface:

The central component being developed in the air quality use case is a user interface, which allows stakeholders to issue air quality forecasts for selected areas in Europe, for the location of European observation sites, or to generate emission scenario simulations.



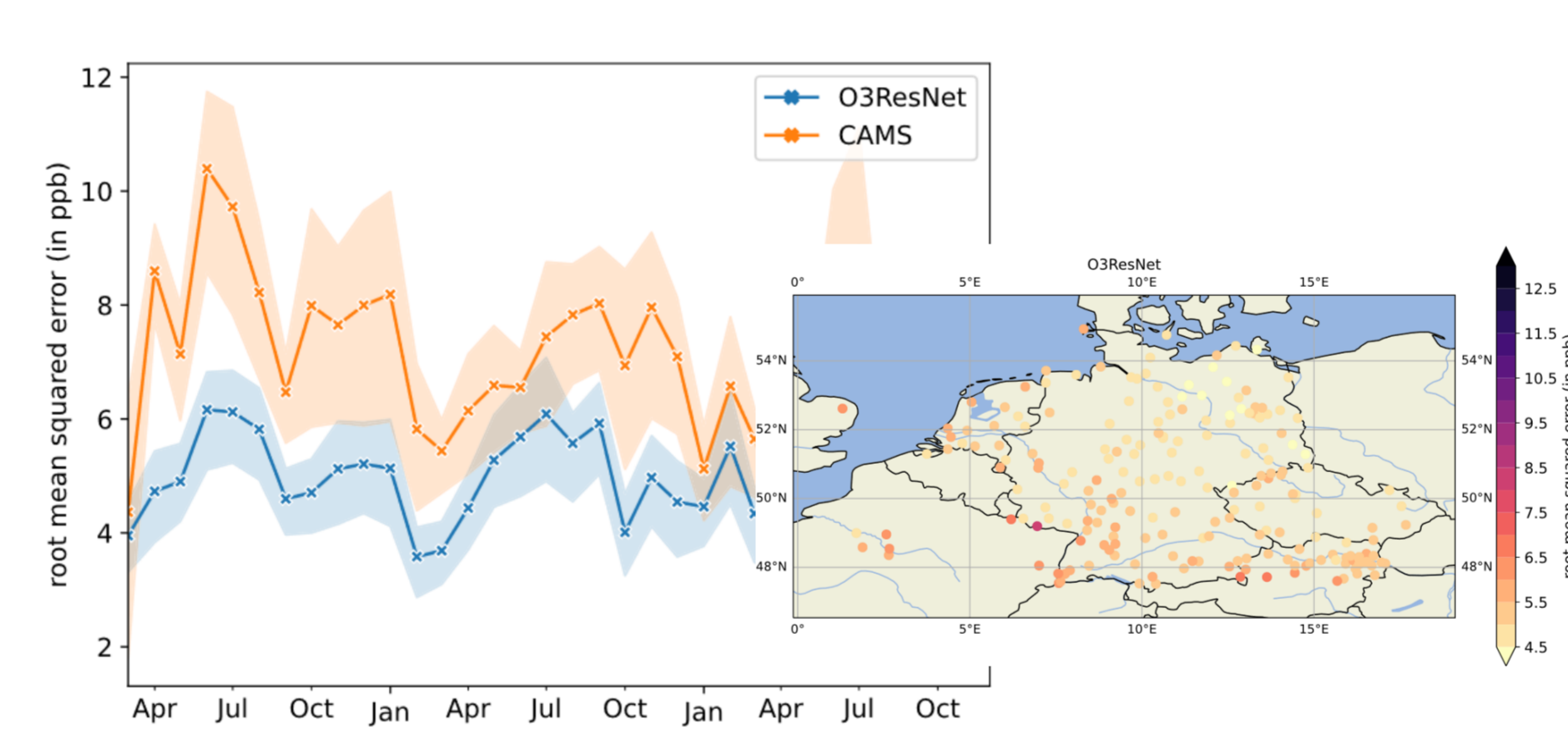
Field forecasting with EURAD-IM:

The European Air pollution Dispersion – Inverse Model (EURAD-IM), driven by meteorological data of the DestinE Extremes digital twin, will provide high resolution forecasts of multiple air pollutants.



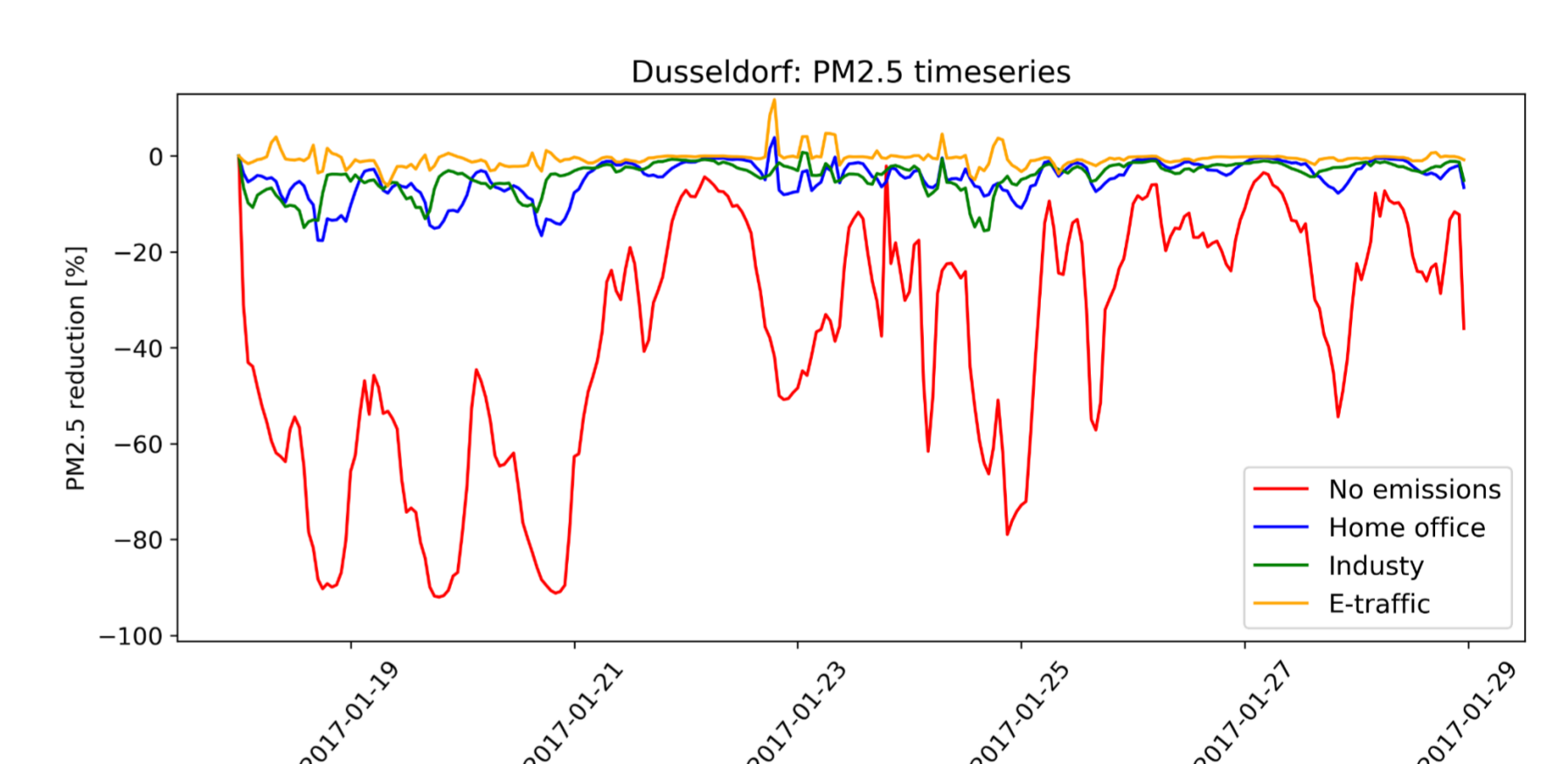
Point forecasting with MLair:

The machine learning based forecasting tool MLair provides computationally cheap and fast predictions for locations corresponding to ground-based monitoring stations.



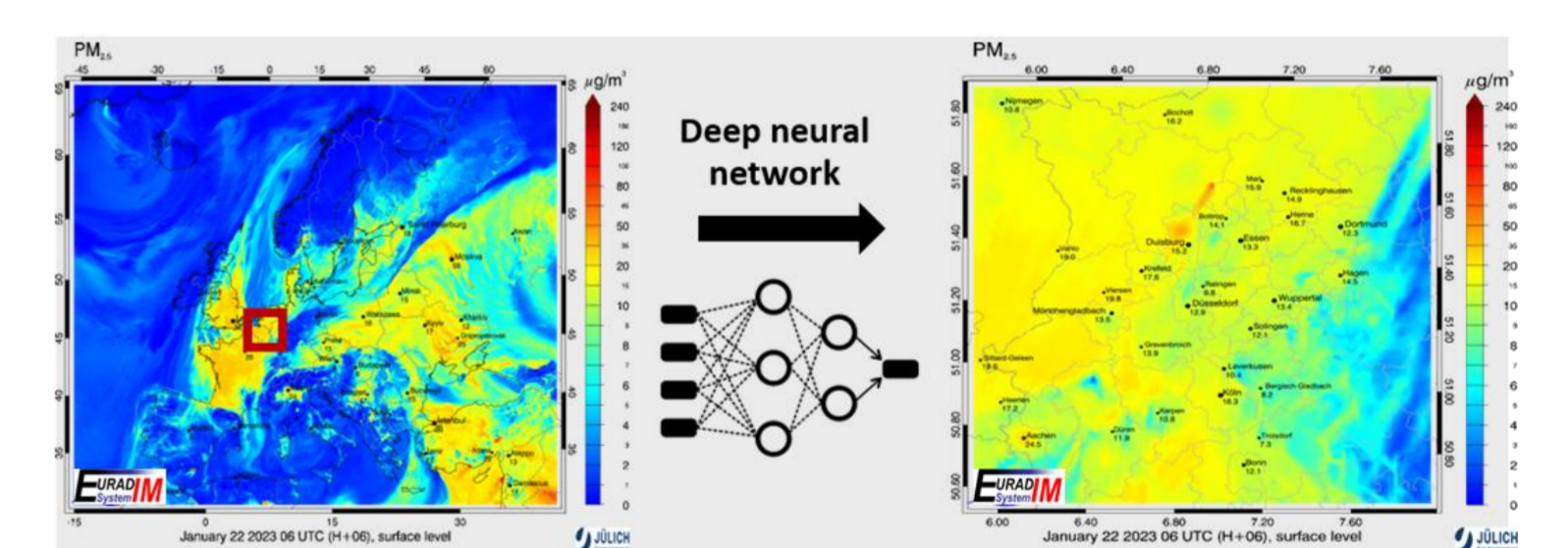
EURAD-IM emission scenarios:

With six predefined emission scenarios (standard, no-emissions, home-office and energy saving, industry, e-traffic, fireplace), the potential of local air pollution mitigation strategies can be evaluated.



Machine learning downscaling:

As an alternative to computationally expensive field forecasts with EURAD-IM at a one-kilometer scale, statistical downscaling trained from decade-long EURAD-IM air quality forecasts will enable fast provision of highly resolved air pollutant predictions.



User engagement: All developments of the use case are discussed, supported, and approved by the two core users the German Environment Agency (UBA) and the North Rhine-Westphalia Office of Nature, Environment and Consumer Protection (LANUV). The demonstrator targets episodes in January/February 2017 and July/August 2018 for North Rhine-Westphalia and Berlin-Brandenburg.



Societal benefits: The DestinE air quality use case will monitor air pollution in high resolution. Therewith it will advice environmental actions and support mitigation strategies to protect Europe's society from hazardous air pollution events. The developed system will fully be integrated into the DestinE core system and thus be accessible for the whole DestinE community.

"Destination Earth is a European Union funded initiative launched in 2022, with the aim to build a digital replica of the Earth system by 2030. The initiative will be jointly implemented by three entrusted entities: the European Centre for Medium-Range Weather Forecasts (ECMWF) responsible for the creation of the first two 'digital twins' and the 'Digital Twin Engine', the European Space Agency (ESA) responsible for building the 'Core Service Platform', and the European Organisation for the Exploitation of Meteorological Satellites (EUMETSAT), responsible for the creation of the 'Data Lake'."



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