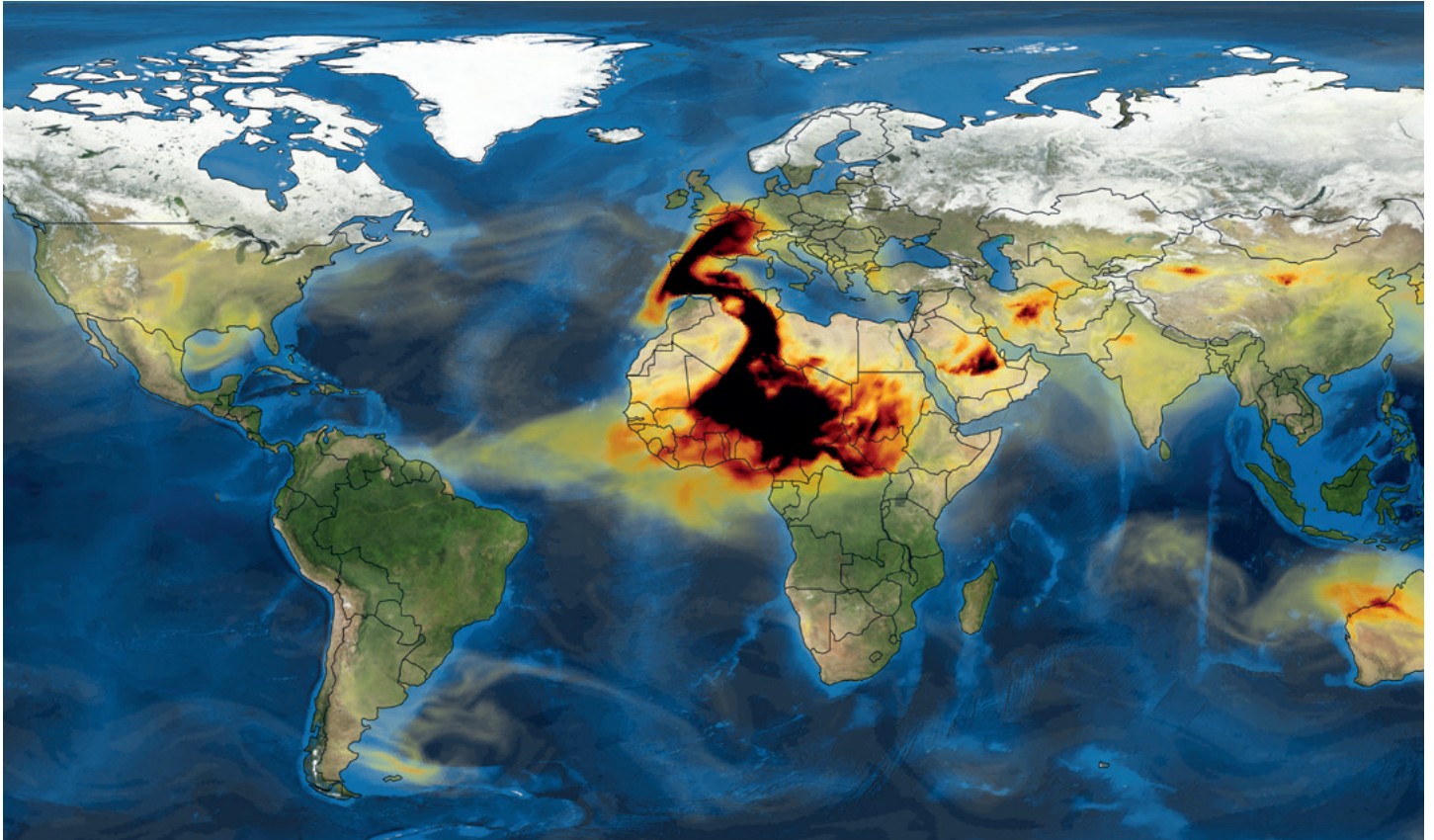


ICON-ART

Open Source License for the Combined Weather and Climate Model



ICON-ART enables forecasting of the spreading and transport of aerosols around the globe. (Image: IMKTRO/KIT, data: DWD)

Precise weather and environmental forecasts are important for both short and longer terms in order to develop better strategies to counteract the climate catastrophe. To this end, researchers of KIT's Institute of Meteorology and Climate Research (IMK) have optimized ICON-ART (ICOsahedral Non-hydrostatic – Aerosols and Reactive Trace gases) for operational weather forecasts. ICON-ART is a component of the ICON climate and weather model. One goal of ICON-ART is a better understanding of the interactions between atmospheric chemistry and physical climate processes. Now, it can also be used to forecast air quality, the range of vision, and other important aerosol and chemistry variables.

For this purpose, researchers integrated interactive gaseous and particulate substances in the model. With them, movements of atmospheric air masses and

chemical conversion processes in the atmosphere can be pursued. These tracers, such as ozone or smoke particles, react to natural and anthropogenic emissions and influence the temperature of the atmosphere by absorption of sunlight, for instance.

Initially, ICON was developed for weather forecasts and climate simulations by the German Weather Service (DWD) and Max Planck Institute for Meteorology (MPI-M). Then, both institutions and the ICON consortium partners, including KIT, the German Climate Computing Center (DKRZ), and the Swiss Center for Climate Systems Modeling (C2SM), integrated models of numerous other components of the Earth's system in ICON.

The result was a fully coupled climate and Earth system model. Apart from the KIT-developed model component ART for aerosols and reactive trace gases,

it also includes components for ocean circulation, marine biogeochemistry, for the land surface, and for hydrological processes.

ICON uses an icosahedral lattice, a form made of 20 equilateral triangles, to divide the globe. These 20 triangles are subdivided into lattice widths of up to 1 km or smaller. In this way, the lattice allows for a homogeneous coverage of the Earth's surface with very high resolution. The ICON model seamlessly combines short-term weather forecasts with long-term climate prognoses. "This makes it one of the best weather models worldwide," says Corinna Hoose, Professor for Theoretical Meteorology at IMKTRO and member of the ICON Board.

ICON-ART now is capable of forecasting aerosols and atmospheric chemistry as well as their interactions with the phy-

sical state of the atmosphere. In ICON-ART, these constituents of the air are simulated by prognostic equations for all relevant processes and compared regularly with direct measurements by ground stations, satellites, and aircraft sensors. "In this way, it was possible to precisely model the dynamics of the atmosphere and the distribution of tracers in atmospheric layers," Hoose says.

Since late January 2024, ICON, including ICON-ART, has been available to the public under an open source license. "This makes science and scientific services more transparent and allows to achieve quicker progress in an area that is particularly relevant to the society in times of climate change," Corinna Hoose says. ICON model quality is guaranteed by regular updates and tests. All model improvements correspond to scientific standards and yield robust results. ■