

Numerical modelling at DWD: Operational status and selected R&D activities

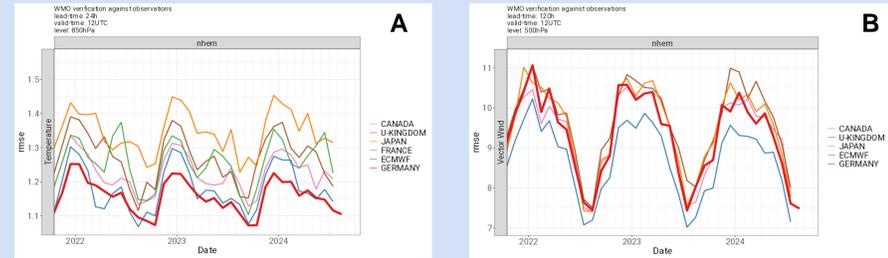
Department of Meteorological Analysis & Modelling, Business area Research & Development

Operational NWP

ICON Global Non-Hydrostatic	ICON-EU 2-way-nest	ICON D2 LAM Convective Scale	ICON-D2 RUC Convective Scale
Det 13 km Resolution EPS 26 km Resolution 120 level	Det 6.5 km Resolution EPS 13 km Resolution 74 level	Det 2 km Resolution EPS 2 km Resolution 65 level	Det 2 km Resolution EPS 2 km Resolution 65 level
40 member	40 member	40/20 member	40/20 member
Analysis every 3h	Analysis every 3h	Analysis every 1h	Analysis every 1h
EnVAR + LETKF	EnVAR + LETKF	KENDA: 4D-LETKF	KENDA: 4D-LETKF
Forecasts 180h: 00, 12 UTC 120h: 06, 18 UTC 51h: 03, 09, 15, 21 UTC	Forecasts 120h: 00, 06, 12, 18 UTC 51h: 03, 09, 15, 21 UTC	Forecasts 48h: 00, 03, 06, 09, 12, 15, 21 UTC	Forecasts 8h: 06, 07, 08, ..., 17, 18 UTC



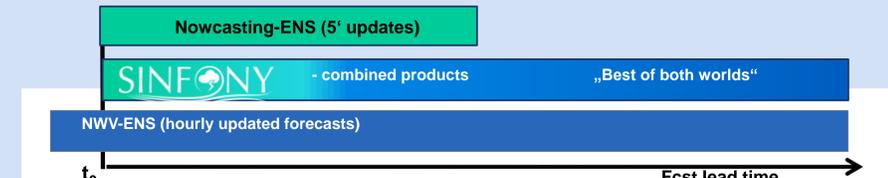
Rapid Update Operational 6/2024
ICON-ART Ensemble Operational 11/2023



Time series of RMSE for the northern hemisphere by a selection of global models.
 A: Temperature at 850hPa for 24 hrs fcst.
 B: horizontal wind at 500hPa for 120 hrs fcst.
 C: 2 meter temperature for 48 hrs fcst.
 The global run of ICON is well positioned within the top group of 14 centres with global models.

SINFONY RUC

- NWP component of the Seamless INtegrated FOrecasting sYstem
- operational since 10 July 2024
- hourly analyses and forecasts for 14 hrs with short data cut-off of 15 minutes
- forecast completed after 35-40 minutes
- Two-moment microphysics to the benefit of radar reflectivity forecasts



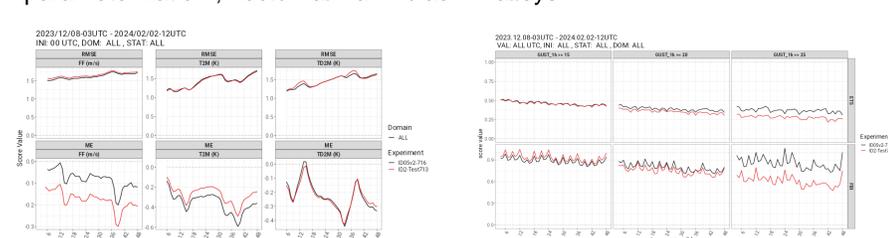
ICON-ART EPS

- ICON-ART deterministic run and 10 members
- ICON-Art 3D-VAR/EnVar
- 26km global with 13 km ART-NEST
- operational since 24 November 2023



ICON @ 500m

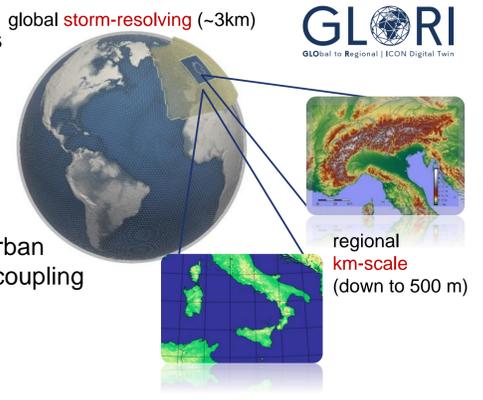
- Envisaged configuration: start from operational ICON-D2 analysis and spawn two nested domains (1 km, 500 m)
- Good first test results
- Summer: wind gusts require a tuning of the gust parameterization ; nocturnal warm bias in valleys



RMSE and bias for 10m wind, 2m temperature and 2m dewpoint (left) and ETS & FBI for wind gusts comparing ICON-D2 (red) with ICON @ 500m (black) for winter 2023/24

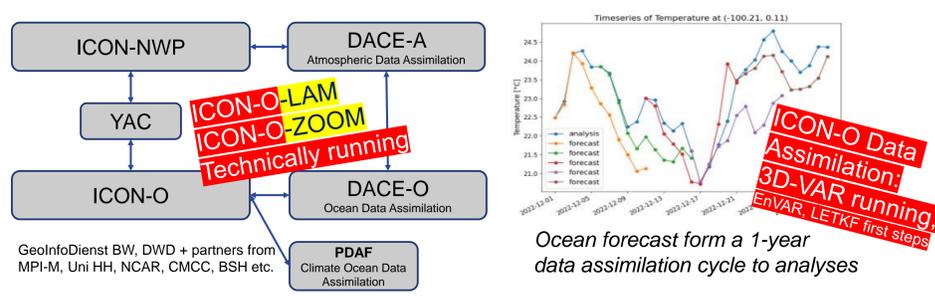
GLORI Digital twin

- global-to-regional short-range high resolution Digital Twin
- based on the prediction capability ICON earth system model and the Data Assimilation Coding Environment DACE
- configurable** and **on-demand**
- Tri-lateral cooperation of met services from Germany, Italy, Switzerland
- Enhanced high-resolution DA with frequent updates (e.g. OPERA, radial winds, 3D radar reflectivities data, crowd-sourced data, remote sensing)
- Improved parametrization including urban parametrization, groundwater flow & coupling (ParFlow)



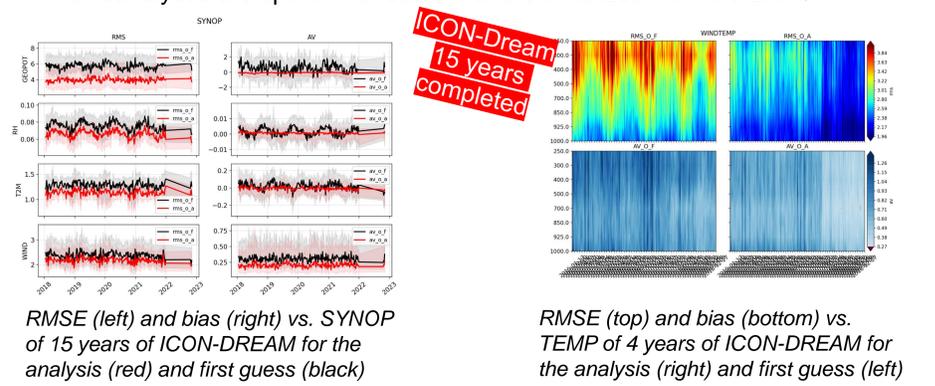
Earth System Modelling at the Weather Scale: ESM-W

- cooperation of DWD and the GeoInfoDienst of German army
- develop a coupled ocean-atmosphere forecasting system based on ICON-O for the ocean model and ICON-NWP for the atmosphere
- includes a atmosphere-ocean data assimilation
- development of a limited area model ICON-O-LAM
- refinement integrated into the global ocean model ICON-O-Zoom



ICON-DREAM Dual-Resolution Reanalysis

- Globally deterministic at 13km and 20 ensemble members at 40 km
- EU-nest with a deterministic run at 6.5 km and a 20km EPS
- The reanalyses are split in 4 streams that are initialized from the ERA5



AICON

- AI based Model AICON technically running
- development started in 10/2023
- AI-VAR: AI Based Data Assimilation Concept Demonstrator (Keller & Potthast: <https://doi.org/10.48550/arXiv.2406.00390>)

