COSMO overview

Christoph Gebhardt (COSMO, DWD)

COSMO "Consortium for small-scale modeling"

- 7 active national meteorological services
- 7 additional partners and military services
- Close cooperation with
  - KIT (ICON-ART)
  - CLM (regional climate modelling)

- 26th COSMO General Meeting in Offenbach, Germany, 2-6 September 2024
  - Scientific developments and progress in operational regional NWP with ICON
  - Active participation of projects/activities beyond standard COSMO priority projects
  - COSMO in the ICON community: further adjustments and plans

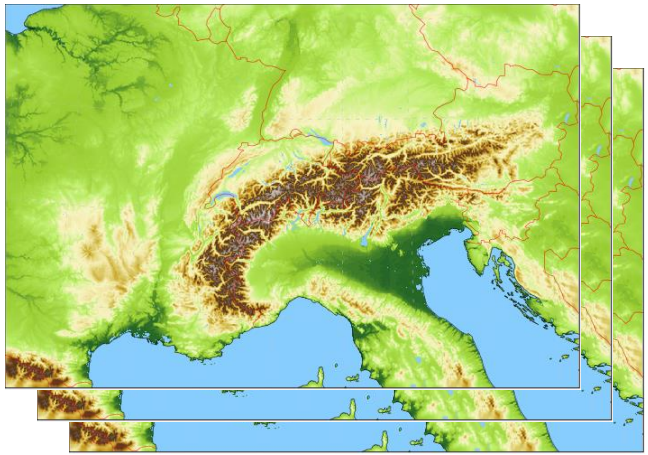
Forecasting System based on ICON

operational since 28 May 2024

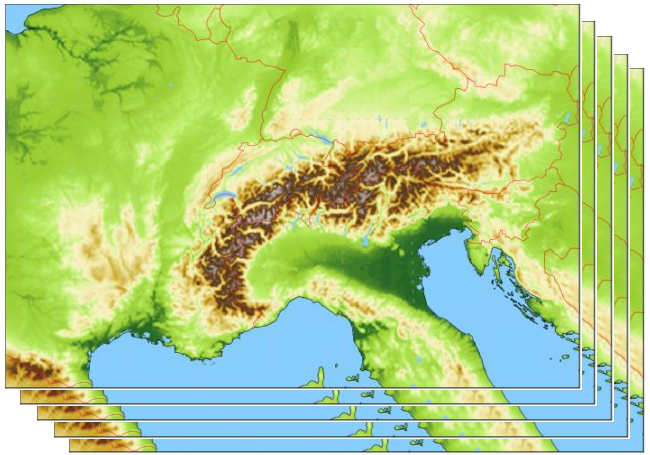
Ensemble Data Assimilation:
KENDA-CH1 with LETKF
40+1 members at 1.0 km grid size
with ICON-CH1 setup (SPPT)
hourly cycling

Lateral boundary conditions:
IFS ENS
9 (18) km
4x per day

ICON-CH1-EPS: 33 hour forecasts, 8x per day
1.0 km grid size (R19B08), 80L
11 ensemble members



ICON-CH2-EPS: 5 day forecasts, 4x per day
2.1 km grid size (R19B07), 80L
21 ensemble members



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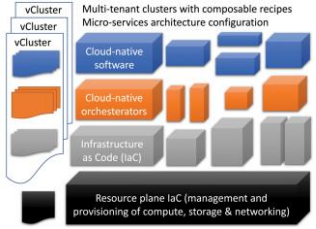
HPC Systeme ICON-22



- Use of HPC Services on ALPS Platform @ CSCS
- Versatile clusters (IaC)
- Elasticity
- 2 locations: Lugano and Lausanne
- Annual service costs

runs operationally on GPUs

Production: vCluster tasna
- 168 A100 GPUs
- 28 CPUs

Failover and R&D: vCluster balfrin
- 120 – 216 A100 GPUs (elastic)
- 36 CPUs

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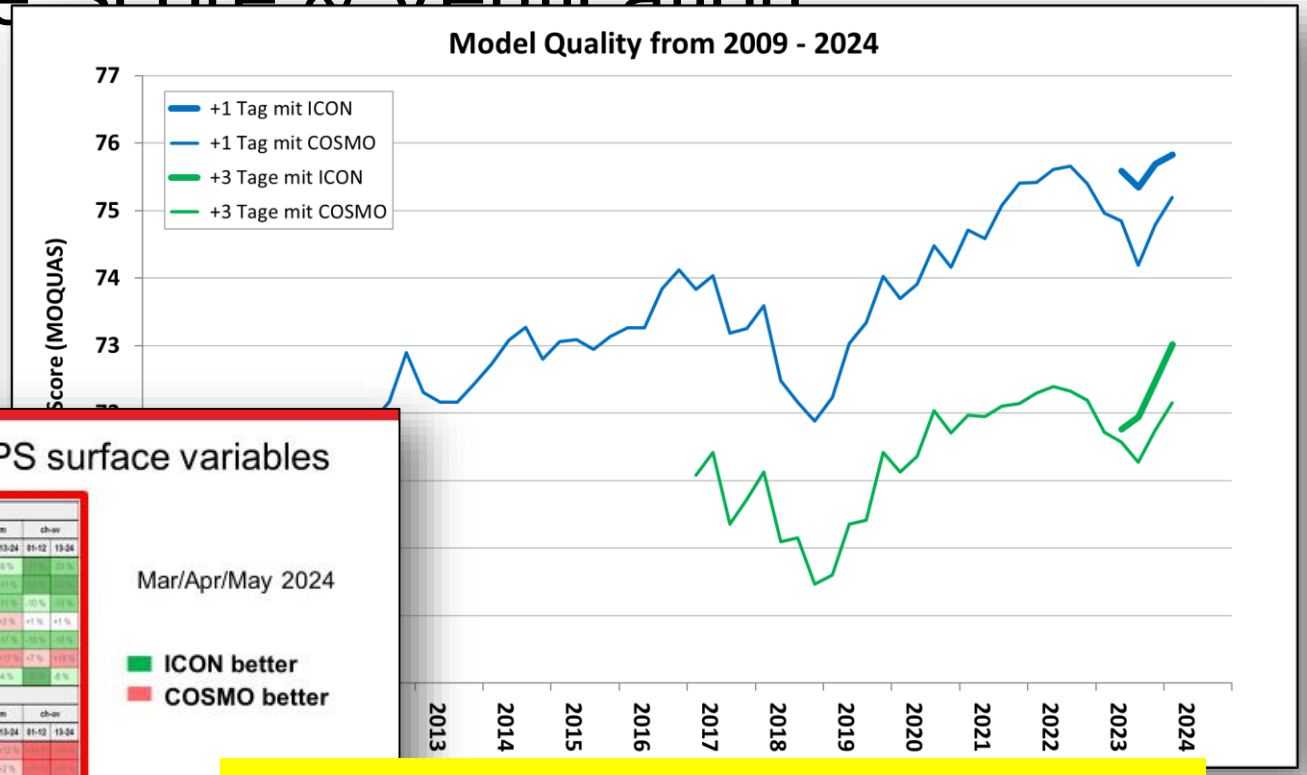
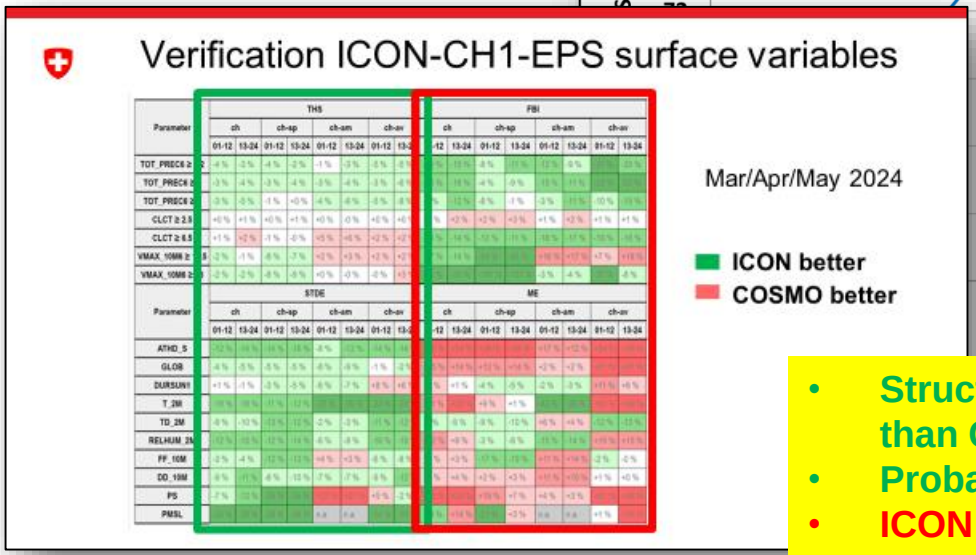
Headline Score & Verification



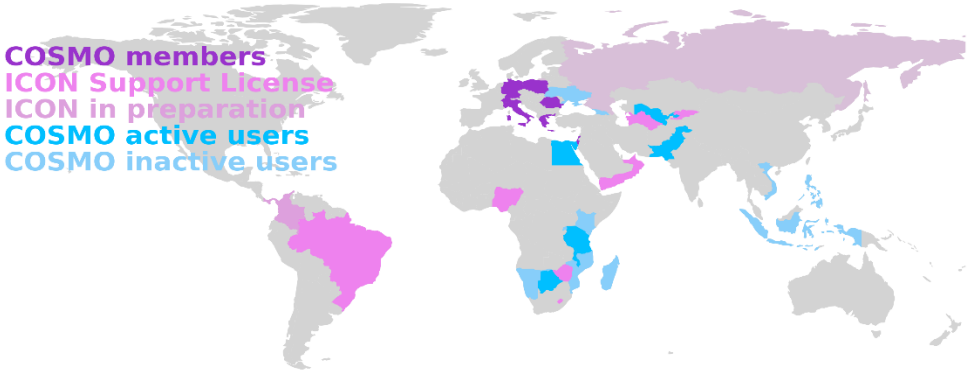


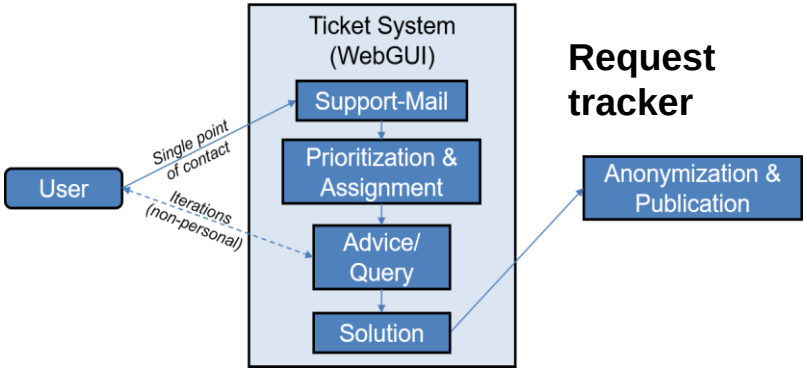
- **Structure (spatial and temporal) better in ICON than COSMO**
- **Probabilities better in ICON than COSMO**
- **ICON has larger biases for some parameters**

O. Fuhrer, MeteoSwiss

ICON open source / COSMO support licenses

- ICON was released as open source code in January 2024 (BSD-3C license)
- www.icon-model.org
- Ca. 2 updates per year planned
- COSMO licensees are encouraged to move from COSMO model to ICON
- ICON support licenses provided by COSMO consortium





Operationalization of SINFONY-RUC

- SINFONY: Seamless INtegrated FOrecastiNg sYstem; project led by Uli Blahak (DWD)
- SINFONY-RUC: Rapid-Update-Cycle variant of ICON-D2
- full two-moment cloud microphysics including hail
- Hourly analyses and forecasts with 14 h lead time, much shorter data cutoff than standard ICON-D2 (~ 15 min), forecasts are completed 35-40 min after analysis time
- RUC became operational on July 10, 2024, after ~ 6 years of intensive development work

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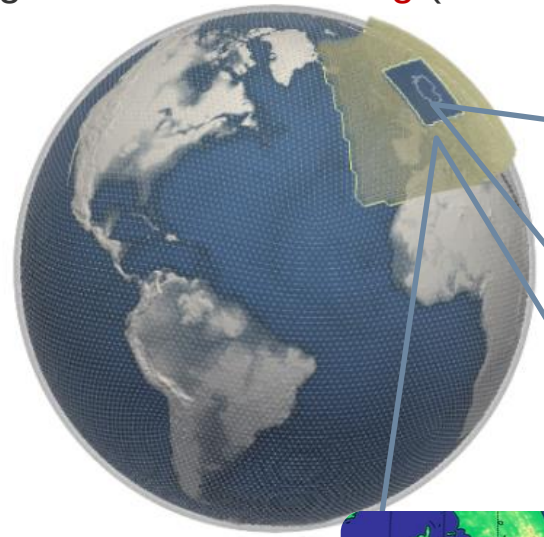
- Further RUC activities in COSMO
  - 50 members ICON-IL RUC test suite ready at Israeli MetService
  - COSMO-RUC at Polish MetService with 30 min update frequency and 3h forecasts

Towards higher resolutions

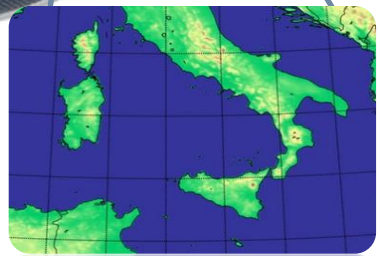
- Close cooperation of COSMO with GLORI activities

The GLORI Digital Twin

global storm-resolving (~3km)



Tri-lateral Cooperation
Germany, Italy, Switzerland



regional
km-scale
(down to 500 m)

global-to-regional short-range high resolution Digital Twin

configurable & on-demand

enhanced DA (high-resolution,high-impact weather)

physical parameterization development

parameterization of surface and subsurface flow and coupling to the land surface (ParFlow)

Towards higher resolutions

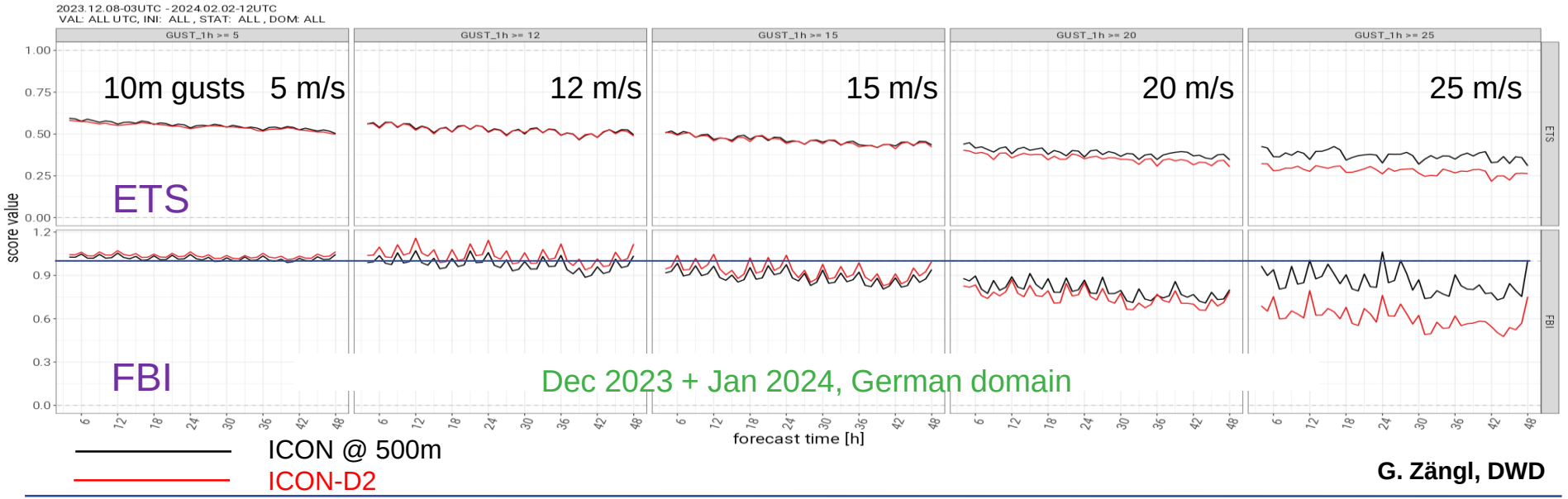
- Close cooperation of COSMO with GLORI activities
- Project CITTA: implementation of an urban canopy parametrization TERRA_URB in ICON (DWD, CIMA, CIRA, CMCC, IMS, IMGW-PIB, KIT, NMA)
- Project EPOCS/APOCS: evaluation and application of Personal Weather Station and Crowd Sourcing Data (IMGW-PIB, CIMA, CIRA, ITAF, HNMS, APRA Piemonte)
- ICON-LAM @ 500m at DWD; cooperation with TEAMx (www.teamx-programme.org)
- Experimental ICON @ 500m at Italian Airforce, hectrometric scale nesting at CETEMPS , ICON @ 600m tests at IMS

TEAMx: Multi-scale transport and exchange processes in the atmosphere over mountains – programme and experiment

ICON @ 500 m for the Alps / Germany

Deutscher Wetterdienst
Wetter und Klima aus einer Hand

➔ **Envisaged configuration: start from operational ICON-D2 analysis and spawn two nested domains (1 km, 500 m)**



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Cooperation of COSMO with ‘external’ activities

- Active participation of research institutes and academia in COSMO working group meetings
- GLORI

  Daniela-Christin Littmann: “The Study of High-Resolution modelling over the complex AlpineTerrain” (Tue 11:00am)

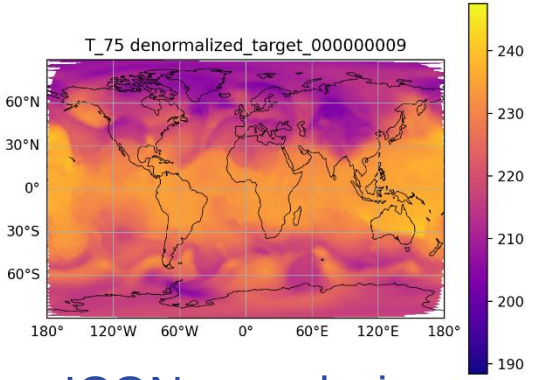
  Zahra Parsakhoo: “Studies of Convection-Permitting Ensemble Forecasting for ICON-D2 with a 1km Nest over the Alps” (online presentation Thu 9:10am)
- ESM-W (‚Earth System Modelling at the Weather Scale’), ICON-O-LAM + ICON-WAVES

  Alija Bevrnja: “Regionalisation of ICON-O-LAM” (presentation Wed 12:15pm)

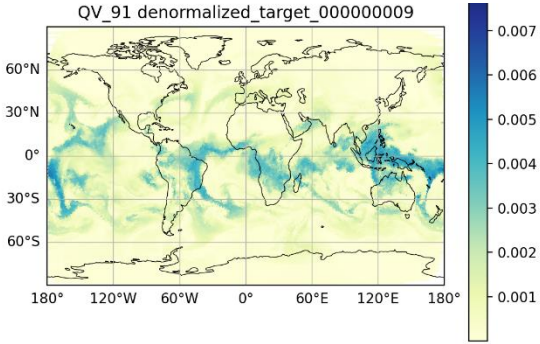
  Aamir Nadeem: “ICON-Waves Regionalization” (poster)
- Concept of COSMO priority projects and tasks will be complemented with cooperative tasks/activities within the broader ICON community

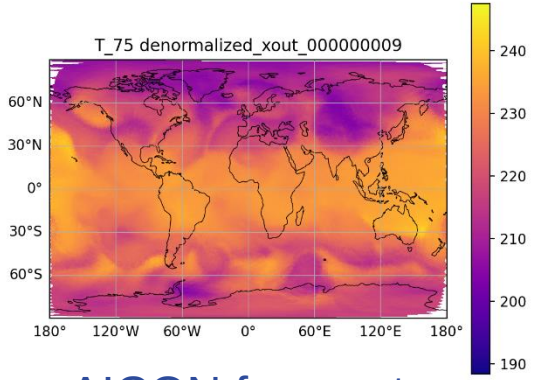
AI

- AICON under development since 10/2023
- graph NN, encoder-decoder
- *Roland Potthast: "The E-AI EUMETNET Programme" (presentation Mon 12:30pm)*

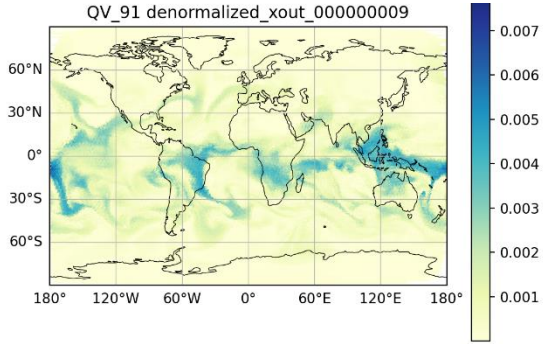


ICON reanalysis





AICON forecast



COSMO presentations at EWGLAM 2024

- *Flora Gofa: “COSMO update on verification”*
- *Jürgen Helmert: „Surface activities in the COSMO Consortium”*
- *Christoph Schraff: “News on KENDA”*
- *Jürgen Helmert: "Towards implementation of HiHydroSoil v2.0 in the ICON-(ART) system at DWD: Global Maps of Soil Hydraulic Properties at 250m Resolution”*
- *Jan-Peter Schulz et al.: “A new urban parameterisation for the ICON atmospheric model”*
- *Michael Baldauf: “Further developments in the Discontinuous Galerkin based dynamical core for ICON”*
- *Chiara Marsigli: “Ensemble activities in COSMO”*
- *Matthias Raschendorfer: "Recent developments in ICON physics“*
- *Andrzej Mazur: “Early Warning systems (EWAs) - operational use of results of meteorological model(s) to provide information on the atmospheric dispersion of contaminants and pollutants”*
- *Stefan Dinicila: “Numerical Weather Prediction using ICON-LAM-2.8km for Romanian territory”*