COSMO overview

Christoph Gebhardt (COSMO, DWD)

CONSORTIUM FOR SMALL SCALE MODELING
COSMO

COSMO "Consortium for small-scale modeling"

- 7 national meteorological services with active cooperation
- Roshydromet temporarily suspended
- 6 regional and military services
- Close cooperation with
  - CLM (regional climate modelling)
  - KIT (ICON-ART)
  - ICON community

- 25th COSMO General Meeting in Gdansk, Poland, 11-15 September 2023
- Focus on two aspects
  - Scientific developments and progress in operational regional NWP
  - Position and cooperation of COSMO in/with the ICON community

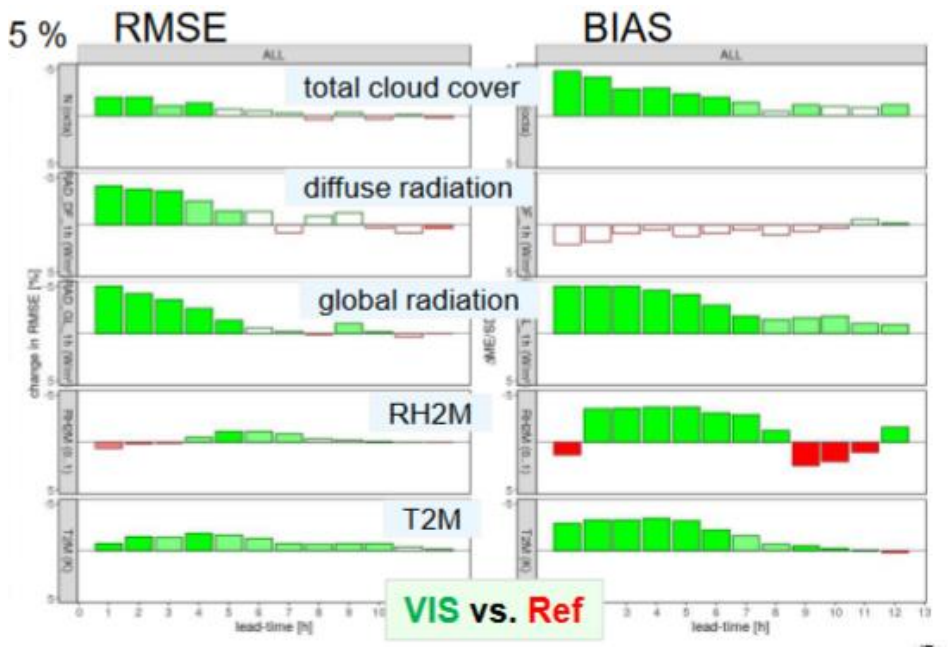
Data assimilation

- SEVIRI VIS channels operationally (DWD, WV channels in preparation)
- Final steps towards KENDA (LETKF) with ICON (MeteoSwiss & ARPAE)
  → part of the full transition to operational ICON LAM deterministic and EPS at MeteoSwiss (project ICON 22) including GPU port (openACC)
- Parameter perturbations included in DA (DWD)
- Further developments in DA of 3D radar reflectivities (several COSMO members)
- Further development of variational DA → EnVar (DWD)

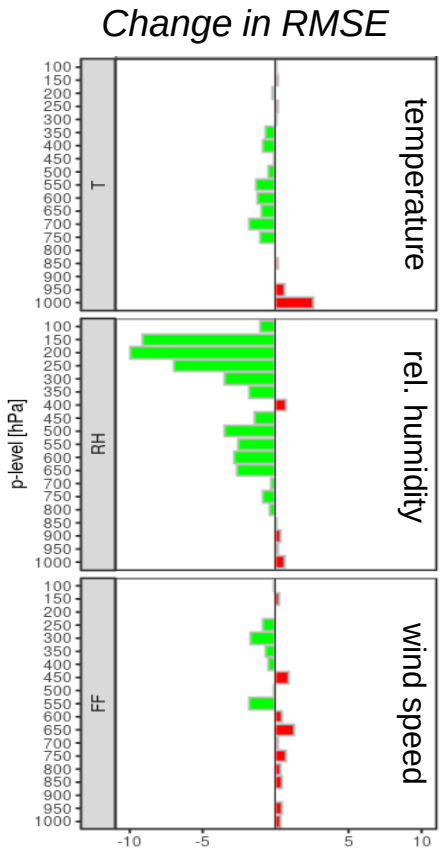
C. Schraff, Data Assimilation, Tue 10:25

Data assimilation

SEVIRI VIS vs reference



SEVIRI VIS+WV vs SEVIRI VIS



Physics & Parametrizations

- Implementation of urban surface parameterization TERRA_URB in ICON (several COSMO members)
  → operational at IMS since 30th July 2023

- Improvements in radiation scheme (clouds, aerosols), i.e. warm-phase spectral bin microphysics (IMS), implementation of CAMS forecast & climatological aerosols (IMS & DWD)

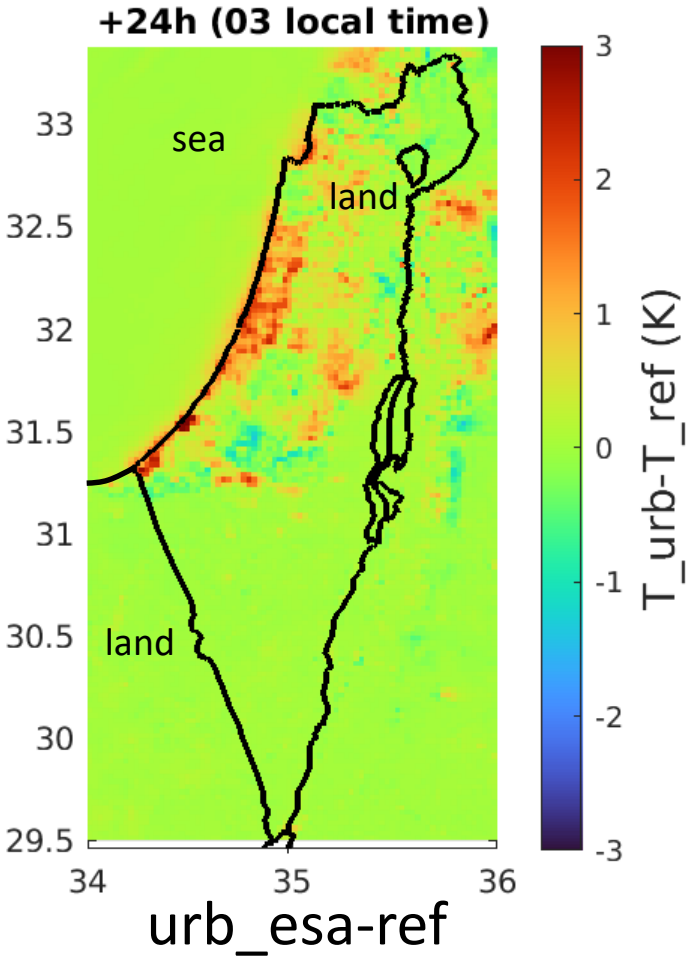
- Further development of multi-layer snow treatment (MeteoSwiss) and coupling to land model (DWD & MeteoSwiss)

JP. Schulz, Surface Aspects, Tue 8:30
M. Raschendorfer, Upper-Air Physics, Tue 15:10
JP. Schulz et al., parallel session on surface aspects, Wed

Physics & Parametrizations

Pavel Khain, Ron Drori, IMS

Night: heat island. The heat capacity of the cities keeps the daytime heat during the night



Numerical aspects & Dynamics

- develop a prototype for a Discontinuous Galerkin (DG) discretization of the 3D Euler equations (‚DG-HEVI* on the sphere‘) using ICON infrastructure
- Currently: BRIDGE project as intermediate step to a full–fledged ICON implementation as ICON-DG model
- Recent achievement: speed-up of HEVI solver → 10 times faster
- Challenges ahead: coupling to turbulence and boundary-layer scheme
  overall efficiency

M. Baldauf, Dynamics, Thu 10:30

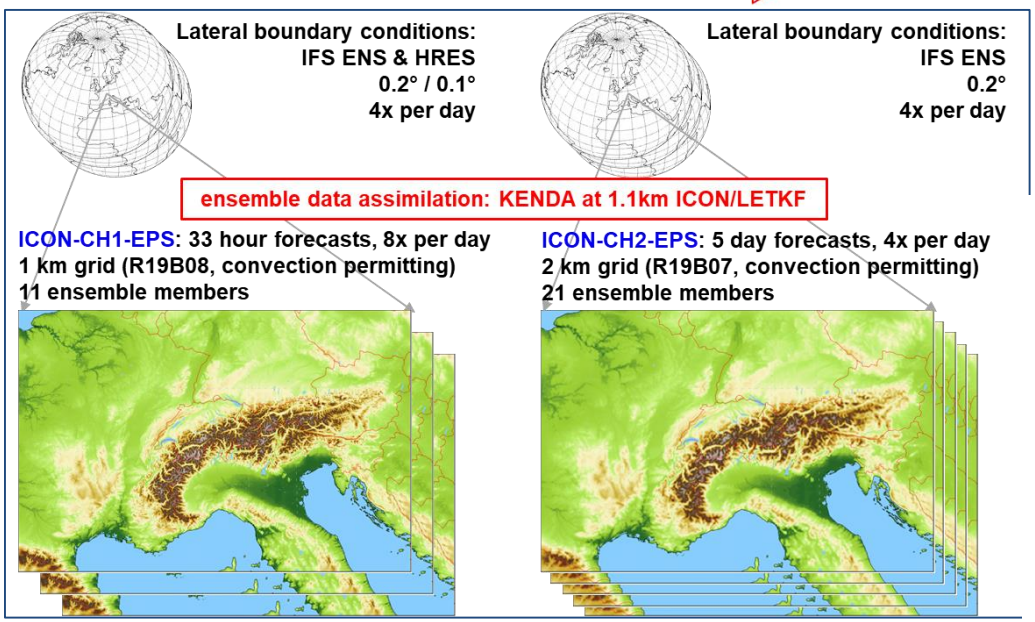
* ‘HEVI’ – horizontally explicit, vertically implicit

EPS developments

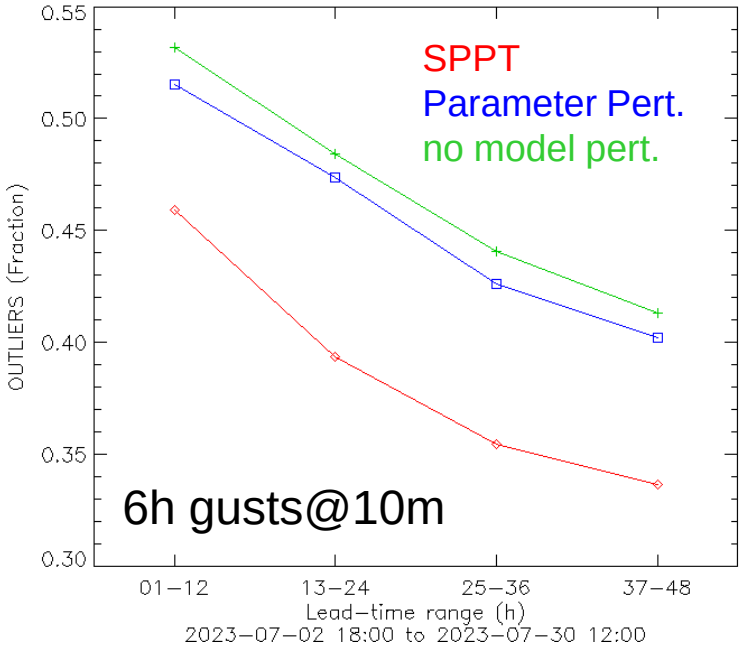
- Development of ICON EPS forecasts on the convective scale at MeteoSwiss including SPPT and PP (pre-operational Oct 2023, operational early Q2 2024)
- Test suite of ICON-EPS @2.5km with SPPT/PP running at IMS
- Sensitivity tests for parameter perturbations in ICON at HNMS (towards ICON-LEPS on 2.5km replacing COSMO-LEPS)
- Soil temperature perturbations tested at IMGW-PIB
- Plans for SPP at DWD

C. Marsigli, Predictability, Wed 11:40
A. Mazur, parallel session on pred., Wed

EPS developments



Reduction of outliers



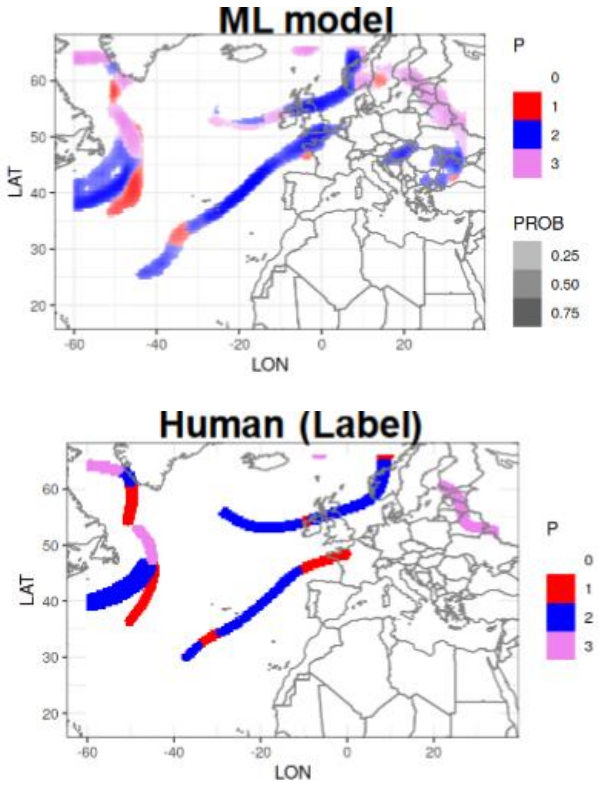
Verification and observations

- Quality control and potential use of crowd sourced data (IMGW, CNMCA, CIMA)
- Further developments of common software & file formats for common verification activities (NMA, HNMS, DWD)
- Progress in neighbourhood verification (DWD)
- Verification studies on events, e.g. flood events in May 2023 in Emilia-Romagna, Italy (ARPAE)
- Identification of fronts in forecasts with machine learning (DWD)

F. Gofa, Verification, Mon 15:30

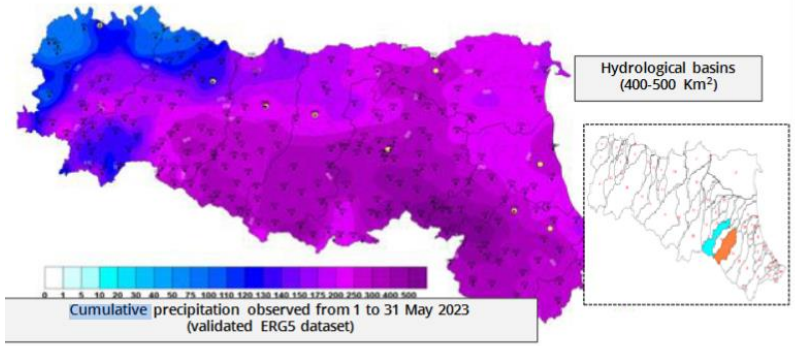
Verification and observations

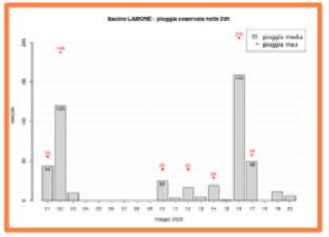
Convolutional encoder-decoder NN



Models perfomance during the flood events of May 2023 in Emilia-Romagna region

Maria Stefania Tesini





Maximum amounts in the period 1-17 May:

- Trebbio (Lamone basin) 609 mm
- Le Taverne (Santerno basin) 563 mm
- Historical records for most rain gauges in the central-eastern sector with values over 300-400 mm (some with 100 or more years of data)
- The rain that has fallen in these areas over the entire period represents about a quarter of the annual cumulative climate value, while in each of the two main events (1-3 May and 16-17 May) it clearly exceeded the monthly cumulative climate value.

Transition to ICON in COSMO

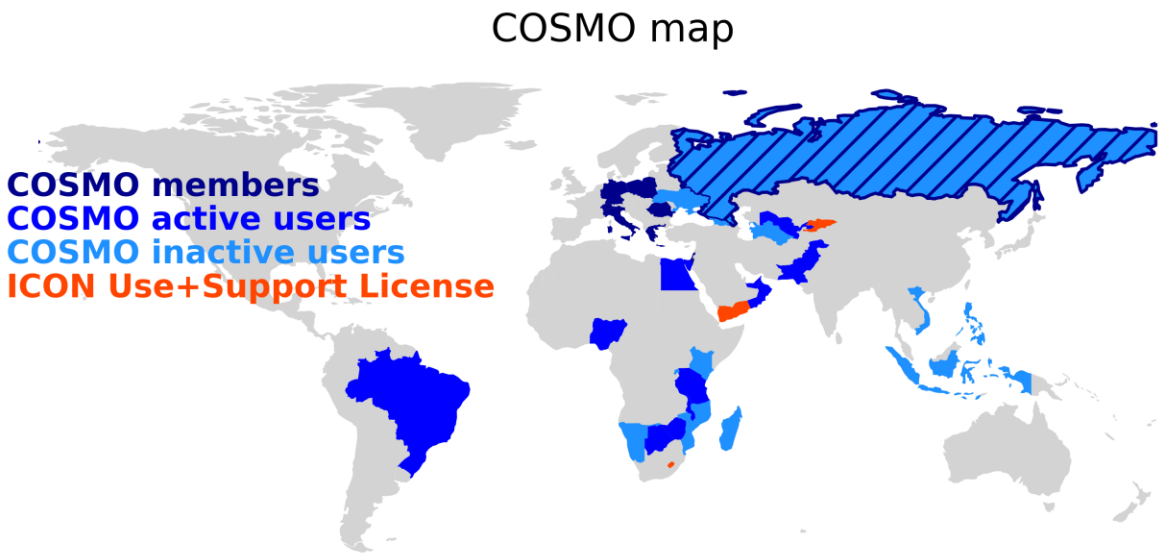
- With the transition to the NWP component of the ICON modelling framework, COSMO entered the ICON community
- The ICON community is rapidly evolving both in terms of scientific development as well as organizational structures
- We continue to build and strengthen the COSMO Consortium as the consortium of NHMS' developing and employing ICON for operational NWP
- We recognize the need for a change of COSMO and a strengthening of its relationship with ICON
- COSMO's current governance and organizational structure needs adjustments
- Transition in terms of scientific collaboration, organization, and governance

Science and cooperation

- COSMO scientists to engage in on-going ICON development projects and vice versa (e.g. ICON-Seamless, GLORI, TEAMx)

C. Marsigli, GLORI, Thu 8:50

- Link COSMO development to the coupled model development for atmosphere, ocean, land, environment
- Strengthen the link to climate communities for operational (regional) climate forecasting
- Integrate AI / ML techniques in the development work
- Foster interaction of ICON development streams and COSMO working groups at ICCARUS meeting by organizing open group meetings along scientific topics
- Transition of COSMO (model & support) licensees to ICON (support) licensees including single-point of contact for support requests (dedicated project led by NMA), training courses, provision of boundary data etc.



ICON licences

- 3 new licensees
- 6 contracts being processed
- 5 research contracts
- New structure of fees based on gross domestic product (GDP)

Model software development

- Engage with activities to evolve our model codes into a set of modern, modular, and re-usable components which are capable of efficiently leveraging current and emerging hardware architectures

- ICON-C -- ICON community infrastructure project to consolidate the ICON code (modularization and encapsulation of different components with defined interfaces) → first Minimal Release Product (MRP) in Jan 2024

- Majority of licensees is in favour of cloud solutions for running the model

- open ETH/C2SM project EXCLAIM: exascale computing and data platform for weather and climate modelling based on ICON

- Explore options and potentials of alternative coding environments (DSL, python,…)

O. Fuhrer, Expert Teams,Thu 9:10

CONSORTIUM FOR SMALL SCALE MODELING
COSMO

- F. Gofa: *Overview of consortium verification activities* Mon 15:30
- J.-P. Schulz: *Surface activities in the COSMO Consortium* Tue 08:30
- Ch. Schraff: *Assim. of all-sky SEVIRI data and other news on KENDA* Tue 10:25
- M. Raschendorfer: *About recent physics development in COSMO for ICON* Wed12:00
- J.-P. Schulz et al.: *A new urban parameterization for the ICON atmospheric model* Parallel session on surface aspects Wed
- C. Marsigli: *Ensemble activities in COSMO* Tue 11:40
- A. Mazur: *EPS-skill based on the values of selected precentiles* Parallel session on predictability Wed
- C. Marsigli: *GLORI: Digital twin based on ICON* Thu 08:50
- O. Fuhrer: *Enabling erformance, productivity and portability by implementing weather and climate models in Python* Thu 09:10
- Michael Baldauf: *Further development in the Discontinuous Galerkin based dynamical core fir ICON (BRIDGE)* Thu 10:30