COSMO NEWSLETTER

Editor: Mihaela Bogdan

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Consortium for Small-scale Modeling
www.cosmo-model.org

EDITORIAL

This 23rd issue of the COSMO Newsletter is presented to you in a new format with a revised focus of its content and a modified layout. The editorial team implemented the new concept of the COSMO NL as a collection of short and summarizing teaser-like contributions with links to further in-depth information. The intention is to provide an overview of COSMO-related news, projects, research and support activities, publications, events, and cooperations. I am grateful towards all contributors and in particular Mihaela Bogdan and Massimo Milelli for their efforts to realize this newsletter. I hope that you will like the new format, any feedback is very much welcome!

A further important change with relevance for COSMO is the release of the modelling framework ICON as open source code in January 2024. It is a an important step underlining and even further advancing the recognized importance of ICON for weather, climate, and environmental prediction. Our consortium as user of ICON and contributor to its development has mostly finalized its transition from COSMO model to ICON for operational forecasting. Currently, the COSMO strategy, working group structure, and formal terms of references are under review to optimally align and cooperate within the broader ICON community while serving our basic scope as consortium of national meteorological services.

One of our core tasks is to provide support to met services worldwide using ICON based on support licenses. The COSMO priority project C2I4LC ("Establishing COSMO to ICON migration for Licensees' Countries") implemented a request tracking software for the support which runs in testing mode since 1st of May 2024 and can be addressed via email at `icon-support@cosmo-model.org`. We plan to move from testing to fully operational status within the next months.
Enjoy reading the COSMO Newsletter!!

Christoph Gebhardt
COSMO Scientific Project Manager
Christoph.Gebhardt@dwd.de

Participants of the 25th COSMO General Meeting in Gdansk, Poland

Priority Task: EPOCS (Evaluate Personal Weather Station and Opportunistic Sensor Data CrowdSourcing)

Joanna Linkowska, Marcin Grzelczyk, Anna Jurczyk,Katarzyna Ośródka,
Jan Szturc(IMGW-PIB)
Massimo Milelli, Elena Oberto, Umberto Pellegrini, Francesco Uboldi(CIMA)
Francesco Sudati(CNMCA)

Data from Personal Weather Station (PWS) and other Opportunistic Sensors (OS) have great potential to enhance standard weather observation networks and are therefore of interest for potential applications in convective-scale and hectometric-scale NWP, such as nowcasting and model forecast verification. Improved warnings and weather forecasts of severe and hazardous weather can save lives and property and can benefit numerous consumer applications in the agriculture, energy, health and transportation sectors. The Priority Task EPOCS (PT-EPOCS) was a one-year project that ran from March 2023 until February 2024 and involved three COSMO partners: CIMA, CNMCA and IMGW-PIB.

The aim of the project was to assess whether alternative PWS and OS weather data could be potentially used in National Weather Service (NWS) research and operations activities. As part of this, an exploration of available data and their legal terms and conditions was made. The two main scientific aims were to develop and test data Quality Control (QC) algorithms and to evaluate the quality and usefulness of this data for NWP applications.

At IMGW-PIB, the RainGaugeQC scheme was extended by adding some extra algorithms. These were tested with Netatmo data and are now implemented operationally using Polish State Forest data. The Polish State Forest data are one of the components of the nowcasting product RainGRS +. At CIMA and CNMCA, mobile PWS MeteoTracker (MT) data were evaluated. The MT data were analysed at a fixed location (roof of CIMA building) and compared with professional weather station data (Figure 1). In addition, MT data were tested along a route taken by a bicycle (Figure 2).

The results showed that while the accuracy of MT temperature data are comparable with professional weather station data (0.2 to 0.4°C), the Relative Humidity (RH) accuracy are poorer, with MT tending to overestimate RH by 5% to 10%. The MT data also show larger errors when rain, wet snow or thick fog conditions are present.

Evaluation of precipitation data based on commercial microwave links (CMLs) showed superior quality compared to satellite-based estimates of precipitation, but lower quality than radar and professional rain gauges.

Whilst PWS/OS data are not always correct, with suitable QC, these data can be used for research and operational purposes. A potential follow-up project could carry out further work to look at the wider applicability of PWS data, for example data assimilation case studies and verification of the urban parametrization.

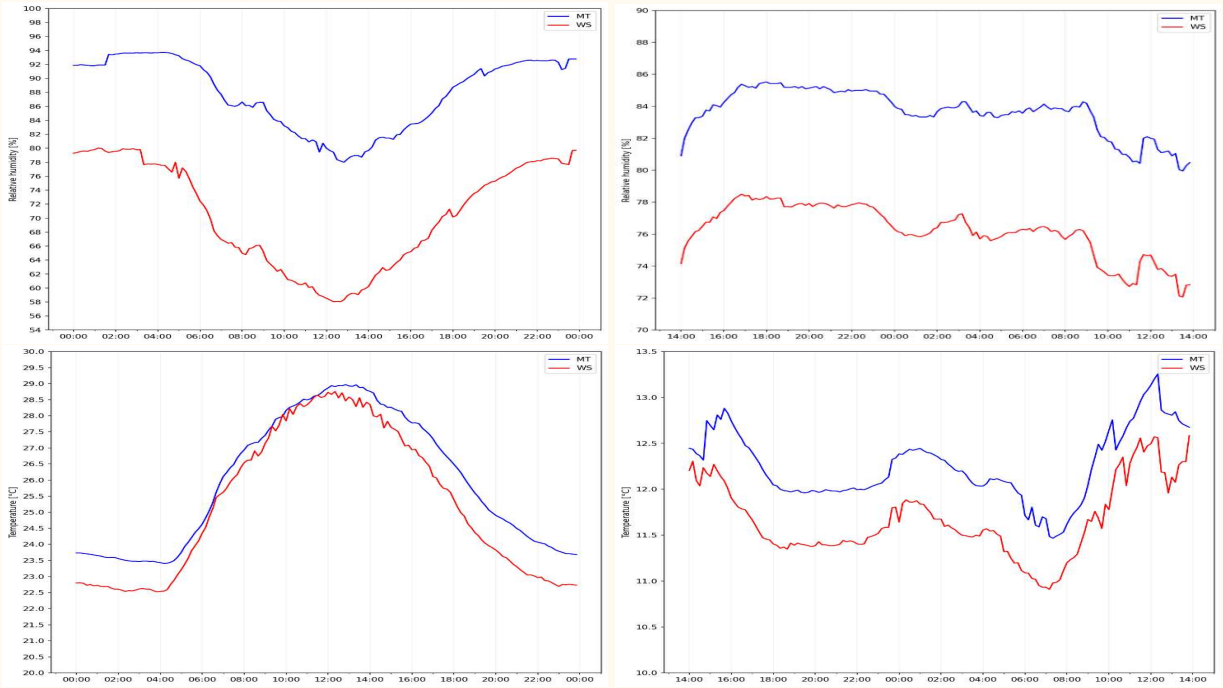


Figure 1. Relative humidity (top) and temperature (bottom) for summer period 10/07/2023 - 03/08/2023 (left) and winter period 19/12/2022 - 10/01/2023 (right) and for MeteoTracker data (blue) and professional weather station data (red) (images courtesy of Massimo Milelli).

Figure 2. Analysis of the mobile PWS sensor Meteo Tracker showing the sensor attached to a bicycle (left) and a map showing the meteorological data gathered along the route taken (right), (images courtesy of Francesco Sudati).

More information on the COSMO website:
https://www.cosmo-model.org/content/tasks/priorityTasks/default.htm
https://www.cosmo-model.org/view/repository/wg5/PT-EPOCS

Development of precipitation fields for the COSMO-PL 2.5 km domain: processing of multi-source precipitation data, quality control, and quality-based combination

Jan Szturc, Katarzyna Ośródka, Anna Jurczyk, Magdalena Pasierb (IMGW-PIB)

The work described below was carried out in the Institute of Meteorology and Water Management – National Research Institute (IMGW) as part of the EPOCS PT "Evaluate Personal Weather Station and Opportunistic Sensor Data CrowdSourcing". The two subtasks were focused on adaptation of the precipitation estimation for assimilation into the COSMO-PL 2.8 km numerical weather prediction models.

Processing different precipitation data sources based on RainGRS system

Development of RainGRS system for multi-source precipitation estimation in the COSMO-PL 2.8-km domain version (RainGRS+)

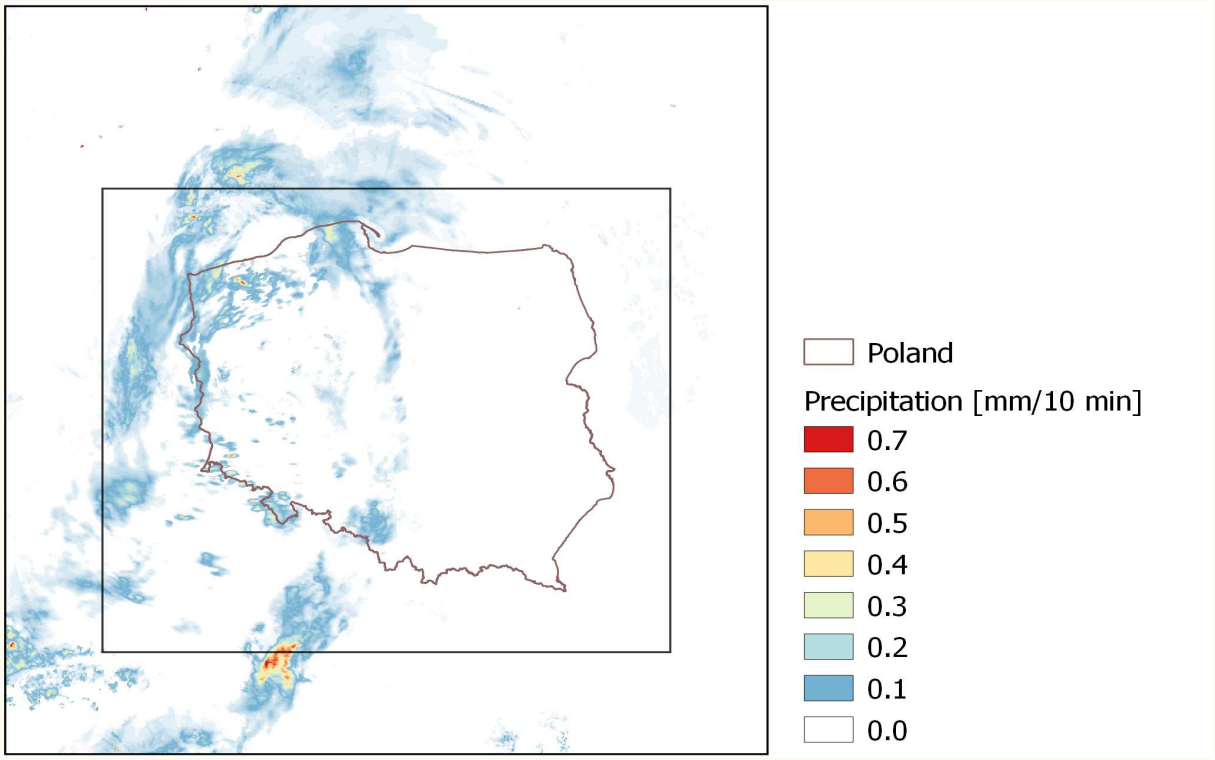
At IMGW multi-source precipitation field estimates are produced by the RainGRS system, which combines data from: (i) telemetric rain gauges, (ii) weather radar network from Poland (POLRAD) and from neighbouring countries, and (iii) satellite data (Meteosat) processed by EUMETSAT NWC-SAF software. The RainGRS+ is a version of RainGRS, which is working on larger domain required by the COSMO-PL 2.8 km model which leads to including new input data from: (i) networks of non-professional telemetric rain gauges, (ii) EUMETNET OPERA radar precipitation operational data for the area outside of Poland where the radar data are not available directly. The temporal resolution of the RainGRS system is 10 min while the spatial resolution is 1 km. The domain size is 1200 km x 1300 km.

Development of a new precipitation input based on signal attenuation on commercial microwave links

The aim was to develop a basis for the operational use of data from opportunistic measurements based on commercial microwave links (CMLs). The network contains more than 2,500 links within the territory of Poland, and is particularly dense in large urban areas, for which radar precipitation observations are subject to high uncertainty. It was analysed to what extent the precipitation derived from CML attenuation data is useful in estimation of the precipitation field with the high temporal and spatial resolution. Preliminary results showed that precipitation data from the CMLs have a quality lower than radar and rain gauge (professional) measurements, but higher than satellite ones.

Development and automatic quality control methods for rain gauge data based on the RainGaugeQC algorithms

Within the framework of the COSMO PT EPOCS, the RainGaugeQC has been extended with sub-algorithms, which have been designed especially taking into account the specific characteristics of non-professional weather stations. This category includes rain gauges such as private weather stations and other gauges not maintained and supervised by a national meteorological or hydrological service. The first sub-algorithm is designed to eliminate erroneous rain gauge measurements from non-professional networks by analysing the correlation with weather radar observations on long time series. The second one is applied for unbiasing rain gauge measurements obtained from non-professional networks based on their quantitative comparison with weather radar observations.



Domains of the systems used: RainGRS (internal) and RainGRS+ (external).

More information on the COSMO website:
https://www.cosmo-model.org/content/tasks/priorityTasks/default.htm
https://www.cosmo-model.org/view/repository/wg5/PT-EPOCS

Strengthening the Italian partnership in COSMO

Antonio Vocino (ITAF-Met)

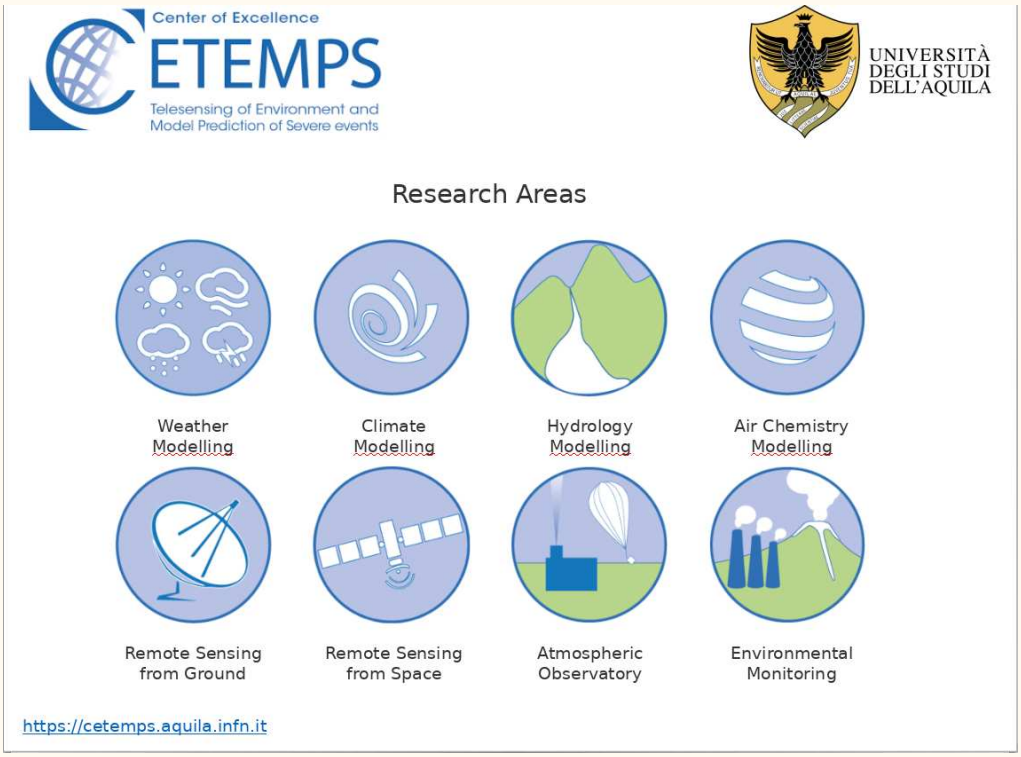
At the 53rd COSMO Steering Committee meeting (7-8 March 2024) the CETEMPS – the acronym standing for: Center of Excellence for Telesensing of Environment and Model Prediction of Severe events, based at the premises of the University of L'Aquila – has been formally introduced to COSMO by the Italian delegate, according to the procedure for the proposal of new scientific partnerships within the consortium.

As outcome of the meeting, with the endorsement of STC to include CETEMPS as COSMO "Additional Partner", the Italian partnership in COSMO strengthens thanks to a scientific hub lasting more than 20 years in the fields of Numerical Weather Prediction and Remote Sensing.

The Center of Excellence was established in 2001, funded by the MUR (the Italian Ministry of University and Research) and partly by the University of L'Aquila, as a structure pursuing four distinct research activities, namely meteorological and hydrological modelling, land and satellite remote sensing. Today the research fields have doubled including climatology, atmospheric chemical modelling and observation, and finally the observatory (for more details, see CETEMPS).

The scientific roadmap for CETEMPS, highlighted in the letter of agreement with the Italian Air Force Met Service, aims at developing ICON model through the active participation in some of the research activities and priority projects carried out by the Working Groups within the COSMO Consortium itself, with particular focus on data assimilation, interpretation and applications, verification and case studies.

Keep in touch for the follow up and welcome onboard to CETEMPS!



https://cetemps.aquila.infn.it/

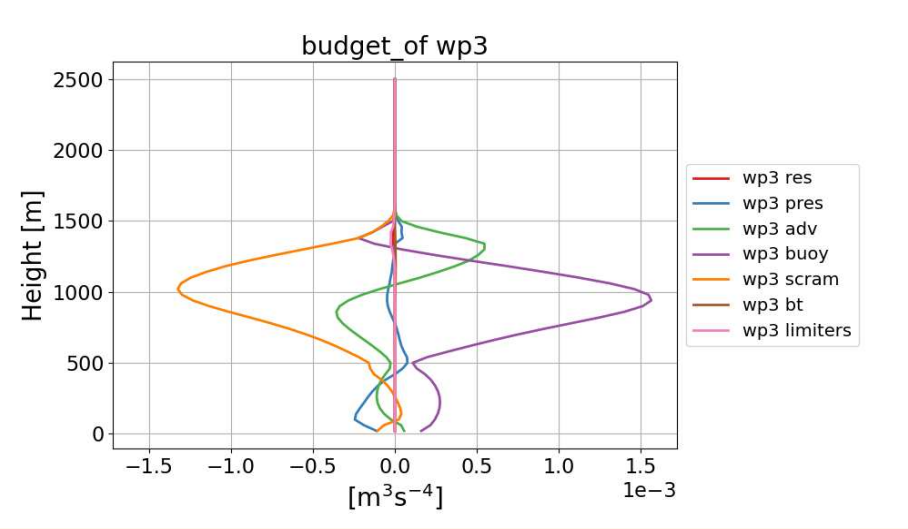
Visit of Vincent Larson of University of Wisconsin-Milwaukee, USA, to DWD in Spring 2023

Dmitrii V. Mironov (DWD)

Professor Vincent E. Larson (Department of Mathematical Sciences, University of Wisconsin) visited the R&D Department of the German Weather Service over the period from 6 March through 24 March 2023. This visit received funding by a COSMO activity proposal.

Vincent Larson shared his experience, exchanged ideas, and discussed with the COSMO/DWD colleagues as to modelling and parameterizing physical processes in numerical weather prediction (NWP) models, the focus being on parameterizing cloud cover in NWP and climate models and the interaction between cloud, turbulence, convection, and microphysics schemes.
Among other issues, the inconsistencies between the cloud-cover representation within various physical parameterization schemes (radiation, microphysics, turbulence) and the treatment of mixed-phase cloud condensate were scrutinized. The discussions held so far did not result in a specific road-map towards improved and more self-consistent cloud-cover parameterizations, but a few important points were elucidated.

During Vincent's visit to DWD, work progressed on the development of improved parameterizations of pressure-transport terms in turbulence closure schemes. The focus of this effort is on advanced higher-order closures, where some third-order moments are treated in much detail (e.g., skewness of the vertical velocity and/or scalar fields; knowledge of skewness is essential to model cumulus clouds).
An example of such closure schemes is CLUBB. CLUBB was developed by Vincent Larson and his co-workers who mount considerable effort to further improve the scheme. CLUBB enjoys increasing popularity as a unified turbulence and convection parameterization scheme in numerical models of the atmosphere. Results from the study of the pressure-transport terms will be reported in Stephens et al. (2024).



A budget of the third-order moment of vertical velocity, wp3, for the BOMEX shallow cumulus case. The profiles indicate how wp3 is influencedby various turbulent processes, including non-hydrostatic pressure fluctuations (yellow and blue lines), which were the topic of the visit to DWD.

During his stay at DWD, Vincent made two presentations on the above subjects (for details, please contact dmitrii.mironov@dwd.de) :

- 'Can boundary-layer parameterizations go deep?' as contribution to the meeting of the physics Working group during ICCARUS 2023
- 'Can we trust the climate sensitivities simulated by CESM2 and E3SMv1?'

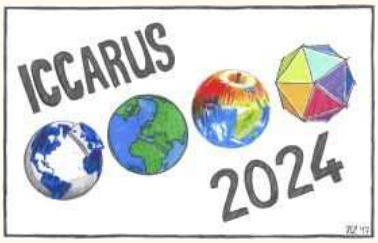
Future collaboration between the COSMO/DWD scientists and the members of Vincent Larson's research groups is foreseen.

Stephens, B. A., V. E. Larson, and D Mironov, 2024: A parameterization of non- hydrostatic pressure transport terms in second- and third-order turbulence equations. In preparation.

ICCARUS 2024

Daniel Rieger and Christian Steger (DWD)

The ICCARUS (ICON/COSMO/CLM/ART User Seminar) is an international conference that brings together users and developers of the ICON model developed at DWD. Over the last two decades, ICCARUS has established itself as a hub for the exchange of information on model development, physical parameterisation, data assimilation, ensemble generation, verification and applications of the model systems (co-)developed by DWD. It thus provides an important link between COSMO as consortium using the ICON model, the CLM Community and ICON and ART developers. Prof. Sarah Jones opened the event for the first time as President of DWD, having previously given an overview of the most important activities relating to the ICON model at the beginning of the event in her former role as R&D Board Member. Roland Potthast then used his introductory speech to give a brief overview of current and planned projects for the use of artificial intelligence at DWD.



The scientific programme of the first three days comprised a total of 42 lectures, which were divided into the thematic units "NWP Case Studies", "Clouds and Radiation", "Data Assimilation", "Community Interface ComIn", "Dynamics and Numerics", "SINFONY: Seamless INtegrated FOrecastiNg sYstem", "Upper Atmosphere", "Model Development", "Boundary Layer and Turbulence", "Earth System Modelling", "Regional Climate" and "Aerosol and Chemistry". The programme was enriched by four keynote lectures by Ali Hoshyaripour (KIT) on "Updates and Vision for ICON" and "ICON-ART", Günther Zängl (DWD) on "ICON-NWP: Recent advances in our operational model configurations and plans for 2024", Oliver Fuhrer (MeteoSwiss) and Christoph Gebhardt (DWD/COSMO) on "COSMO and ICON: news and highlights from MeteoSwiss and the consortium" and Wolfgang Müller (MPI-M) on "ICON-Seamless: Climate Configuration (ICON-XPP)". A highlight of the event was the invited talk by Thibaut Montmerle (Météo-France) entitled "The AROME model for NWP and Nowcasting at Météo-France", in which he explained the interaction of model-based weather forecasting and nowcasting at Météo-France, the counterpart, to the developments and objectives of the DWD's SINFONY project.

The poster session took place entirely online on Monday 11 March to give also participants, who were not present on site, the opportunity to present and view posters. During the ICCARUS week, the posters could be presented in short pitches in dedicated sessions in the plenary on Monday and Tuesday. On Monday evening, after the scientific programme, there was a small reception for the participants in Offenbach.

When planning the working group sessions this year, the main aim was to bring the developers and users of the ICON model from the different, traditionally grown communities (COSMO, CLM and ICON) closer together in order to facilitate a better exchange and intensify cooperation. To this end, the working group meetings were no longer organised in internal community groups, but sessions on various topics were offered that were open to all interested parties.

For example, there was an exchange across the traditional communities on "Soil, Vegetation & Land Surface", "ICON AI", "Radiation, Cloud, Aerosol, Chemistry", "Earth System Model", "Verification & Evaluation" and "Atmospheric Boundary Layer". The working groups were organized either as hybrid meetings on Thursday and Friday during the ICCARUS week, or as purely virtual meetings in the two following weeks.

A total of 280 people were registered for ICCARUS 2024, which was just short of the record number of participants set last year (286). 151 people were on-site in Offenbach. There was a total of 97 scientific contributions (42 presentations, 55 posters). These figures impressively demonstrate the great interest in ICCARUS and its importance for the exchange between developers and users of ICON at universities, research institutes and national weather services. Following the release of the ICON code under an open source licence in January 2024, interest in ICCARUS is expected to increase further in the future.

The date for ICCARUS 2025 will not be announced until later in the year due to the availability of space in Offenbach and the need to avoid weeks with major trade fairs in Frankfurt. However, it will most likely be in March 2025. The conference was organised by DWD colleagues Anja Thomas, Daniel Egerer, Bernd Kress, Daniel Rieger, and Christian Steger using the proven tools Webex, Gather.Town and Nextcloud. The organisation team was supported by Alexander Schreiner, Yvonne Schmidt-Reiter and other colleagues from all DWD business units. Many thanks for this!

Group picture on-site participants (Source: Michael Kügler, DWD)

25th COSMO General Meeting 2023

Christoph Gebhardt (DWD)

The General Meeting of COSMO is held once a year to present results, deliverables and progress reports from the Priority Projects and Working Groups.

The 25th "silver" edition of the COSMO GM took place between the 11th and 15th September 2023 in Gdansk, Poland. The event had been organized by the Polish Met service IMGW-PIB. The COSMO community is very grateful to Andrzej Wyszogrodzki and the team of colleagues of IMGW-PIB for the excellent preparation and realization of the meeting with approximately 70 participants in the historical venue of Dwór Uphagena Arche in Gdansk.

As in recent years, the programme of the meeting was composed of parallel working group meetings of the 8 COSMO WGs on the first two days and plenary sessions from Tuesday to Thursday. The WG meetings focussed on in-depth scientific discussions of WG tasks and the COSMO Priority Projects & Priority Tasks. The meeting was officially opened by the deputy director and head of science of IMGW-PIB Prof. Mirosław Miętus who presented a lecture on the history of meteorology in Gdańsk - the birthplace of Daniel Fahrenheit. After presentations of the chairman of the COSMO STC Panagiotis Skrimizeas and the STC member of the hosting met service Andrzej Wyszogrodzki, the plenary sessions provided an overview of developments in the COSMO WGs and information about activities closely linked to COSMO (ICON-ART, CLM, GLORI, TEAMx, ICON-Seamless, ICON-C). Balázs Szintai of the Hungarian Met service gave an overview of current C-SRNWP EUMETNET activities as invited contribution. At the beginning and the end of the GM, there were the meetings by the COSMO Steering Committee and the COSMO Scientific Management Committee, respectively.

The scientific focus of the meeting programme was closely linked to the transition to the ICON modelling framework by the COSMO members. Beyond the aspects of scientific development and operational application of ICON as well as user support for ICON via COSMO license agreements, this transition has implications for the organization of our consortium. This includes activities to strengthen the cooperation with the ICON community beyond COSMO (in the areas of science, IT architectures, coding, governance). Related options and prospects have been discussed during the GM with the aim to broaden the scope and working procedures of COSMO emerging from the new and enhanced cooperation and from progressive methods in atmospheric modelling (focusing on coupled atmosphere-ocean modelling, regional climate simulations, and AI developments).

The meeting excursion was an informative and entertaining event, which started with a presentation by Prof. Mirosław Miętus "With meteorology through centuries" giving insight to impressive observational records of temperature and pressure in Gdansk dating back to the first half of 18th century, followed by a guided city tour through Gdansk and its history including a visit of the antique Fahrenheit thermometer, a galeon boat trip towards the Westerplatte and the dinner at Brovarnia restaurant.

The agenda and selected presentations can be found on the COSMO GM 2023 web page.

We are looking forward to meet for the next COSMO GM in Offenbach am Main, Germany, from 2nd to 6th September 2024.

EVENTS 2024

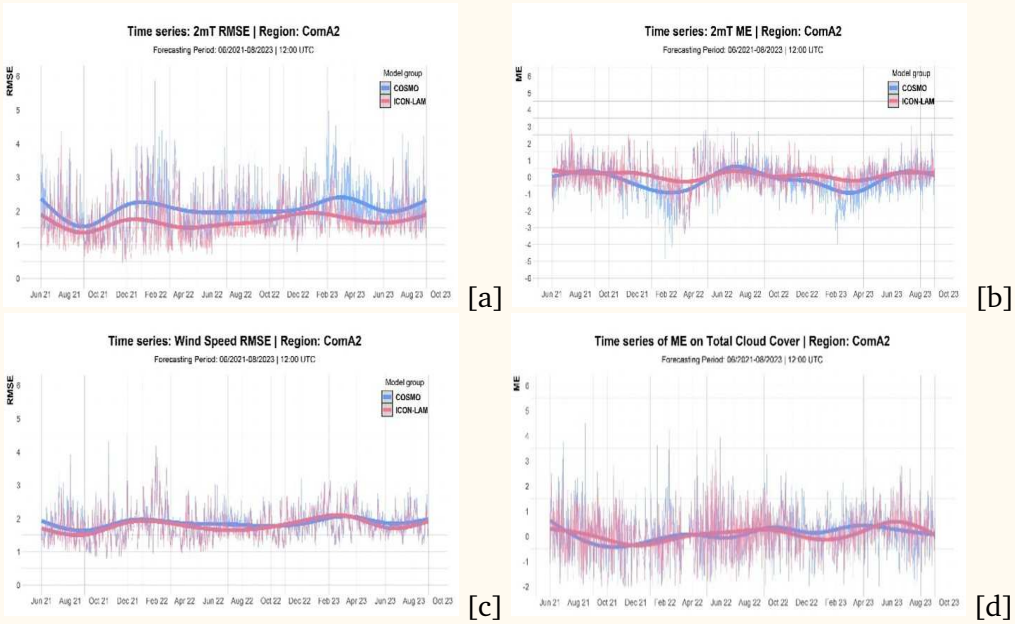
We would like to draw your attention to the following events:

- **26th COSMO General Meeting**
  2nd – 6th September 2024 in Offenbach am Main, Germany.
  Please visit the **event page** for registration and more information.
- **Numerical Model Training Course 2024** for the ICON modelling framework;
  10th – 14th June 2024 in Offenbach am Main, Germany.
  Please check the **seminar page** for information.
- **46th EWGLAM** & **31st SRNWP meetings**
  30th September – 3rd October 2024 in Prague, Czech Republic, hosted by the Czech Hydrometeorological Institute (CHMI).
  Comprehensive information including the registration form is available on the **meeting page**.
- The **2024 Annual Meeting of the European Meteorological Society** (EMS)
  2nd – 6th September 2024, in Barcelona, Spain.
  Please check the **meeting page** for all details.
- The **18th Plinius Conference on Mediterranean Risks** will take place from 30th September to 3rd October 2024 at Chania, Greece.
  All information including the registration can be found on the **conference page**.
- The **ICCARUS 2025** (ICON/COSMO/CLM/ART USER Seminar) will take place in March 2025 in Offenbach am Main, Germany. To avoid high costs for accomodation, the exact dates are to be specified in the coming weeks depending on the schedule of fairs in Frankfurt. Announcement will be done via the usual channels.
  Please check on the **DWD homepage** regularly as well.

Verification in COSMO consortium

Flora Gofa (HNMS)

Statistical performance evaluation for main weather parameters is derived using the operational COSMO and ICON-LAM model implementations in each service. The domains (common), the resolution, the statistical scores/methods and the graphical representation approaches, are described in the Annual Guidelines. Common verification software is used for both point wise and neighborhood approach verification which allows for a homogeneous, standardized and objective way to apply, calculate and present statistical scores. Since the introduction of ICON-LAM in the operational forecast chains, special focus is given to the relative performance of the two models. The verification approach is performed with the use of Feedback Files generated by MEC software and analyzed with FFV2 R-based libraries. Conditional verification is also applied, capturing the interdependency of temperature and cloudiness model performance. The complete seasonal statistical plots can be viewed interactively at COSMO shiny server.
Time series (TS) plos of ME/RMSE for the last two years is given below for selective continuous parameters. The performance of all COSMO and ICON-LAMs models over Common Area 2 (see guidelines) is summarized with the thick lines. The overall error of 2mT is generally decreased with ICON-LAMs while the warm hours underestimation that is present mainly in the winter months, is also reduced.



TS based on all COSMO/ICON models in common region A2. [a] 2mT RMSE at 12:00 UTC, [b] 2mT ME at 12UTC, [c] WindSp RMSE at 12UTC, [d] TCC ME at 12UTC.

Wind speed error range exhibits no significance change in the last two years, which was not altered with the introduction of ICON-LAMs. Total Cloud Cover on the other hand is a parameter with a ambiguous performance that is varying over warm/cold months.

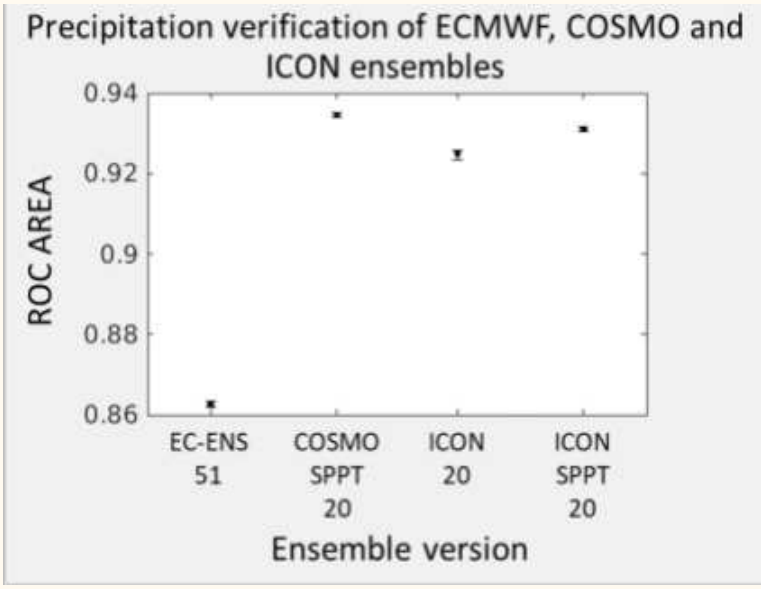
News/Meetings: An online meeting on Model Errors based on Common Verification results took place on 24.01.2024. The focus was given to the relative performance of COSMO/ICON implementations, reporting on systematic errors (dependence on season, hour, geographical location, weather type, etc.), and tuning performed based on systematic model errors.
The presentations are available at: Model Errors.

Optimizing COSMO and ICON convection-permitting ensembles

Pavel Khain, Anat Baharad, Yoav Levi(IMS)
Alon Shtivelman(ECMWF)
Sascha Bellaire and André Walser(MCH)

A reliable regional convection-permitting ensemble (RCPE) should strive for correct representation of the uncertainties in the initial and boundary conditions as well as in the physics parametrizations. We used ECMWF 51-members ("EC-ENS 51") global ensemble (GE) to represent the variability in the initial and boundary conditions. To account for model parametrization uncertainty, we analyze stochastically perturbed physical tendencies (SPPT) and parameter perturbations (PP) methods. In the recently published paper titled "Optimizing convection-permitting ensemble via selection of the coarse ensemble driving members", COSMO 2.5 km resolution 20-members RCPE was optimized. We showed that "random" is the preferable method for selection of the driving GE members, which generally leads to the optimal performance of the driven RCPE. Moreover, we showed that SPPT is strongly beneficial for its performance.
Following this study, we have analyzed ICON 2.5 km resolution 20 members RCPE using a random selection of the driving ECMWF members. Two versions were tested with and without the recently implemented SPPT scheme ("ICON 20" and "ICON SPPT 20", respectively). The figure shows precipitation verification using the ROC area of these two ICON RCPE versions in comparison to "EC-ENS 51" and COSMO 20-members ensemble with SPPT ("COSMO SPPT 20"). The verification was performed versus the Israel Meteorological Service (IMS) radar over a continuously precipitation period 22/12/2019-10/1/2020, 5/2/2020-16/2/2020. The ROC area was averaged over the 6-hourly accumulated precipitation thresholds of 0.5, 1, 2, 5 and 10 mm.

One can see that all RCPE versions are better than "EC-ENS 51" (ROC area around 0.863). Although SPPT is beneficial for ICON RCPE (0.931 versus 0.925), it is still slightly worse than COSMO RCPE (0.934).



Pavel Khain, Anat Baharad, Yoav Levi, Alon Shtivelman, Sascha Bellaire and André Walser: Optimizing COSMO and ICON convection-permitting ensembles. Meteorol Appl. 2023;30:e2137.

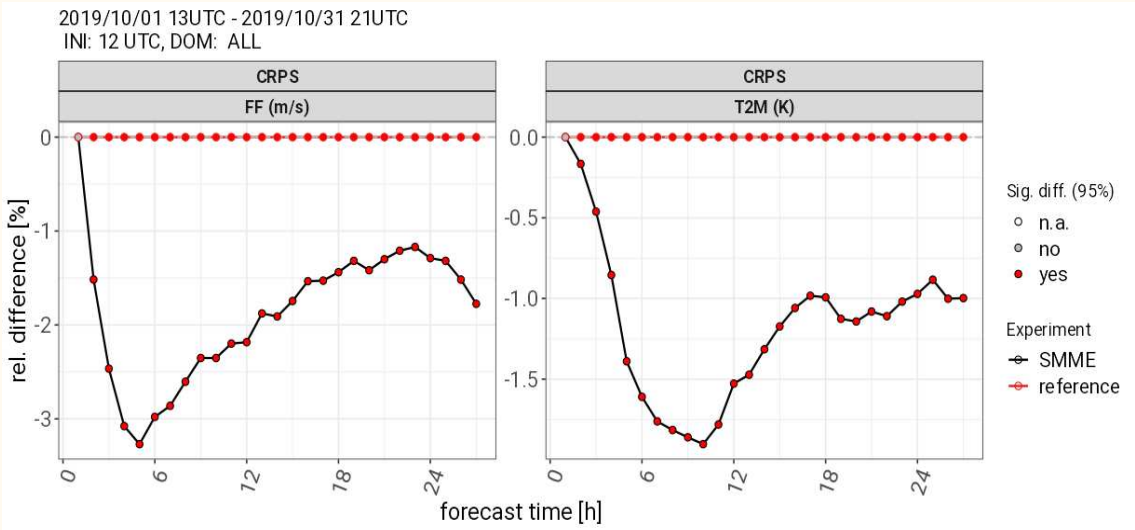
A stochastic model of the model error to improve the ICON-D2-EPS ensemble forecasts

Martin Sprengel and Christoph Gebhardt (DWD)

An accurate representation of the forecast error adds significant value for the customers. Such an estimate of the forecast error can be obtained from ensemble prediction systems (EPS). To achieve a high-quality estimate, it is necessary to have a reliable ensemble forecast. We propose a new scheme to account better for the model error of an EPS, the Stochastic Model of the Model Error (SMME). The SMME adds perturbations η_X to the tendencies of certain prognostic model variables X (in our implementation temperature and the wind components), $\frac{\Delta X}{\Delta t}(x,t) = \left[\frac{\Delta X}{\Delta t}(x,t)\right]_{\text{phys}} - \eta_X(x,t)$.The perturbations η are realizations (different in each member of the EPS) of the solution of the stochastic partial differential equation

$$\mathrm{d}\eta_X(x,t) = -\gamma\eta_X(x,t)\mathrm{d}t + \gamma\nabla\cdot\left(\lambda^2\nabla\eta_X(x,t)\right)\mathrm{d}t + \sigma\mathrm{d}\xi(x,t). \tag{1}$$

The first term is a damping term that controls the temporal correlation of the random field, the second term is a diffusion term that determines the spatial correlations, and the third term governs the amplitude of the perturbation. ξ is a Gaussian random variable. To account for the weather dependence of the model error, the parameters γ, *lambda*, and σ depend on the current tendencies of the respective variables T, U, and V. We have successfully implemented the SMME scheme into the regional model ICON-D2-EPS and verified its performance in a full-month forecast experiment against the operational system. The SMME improves the CRPS, RMSE, and spread of the EPS for wind speed, temperature, and humidity whereas the surface pressure is not significantly changed.



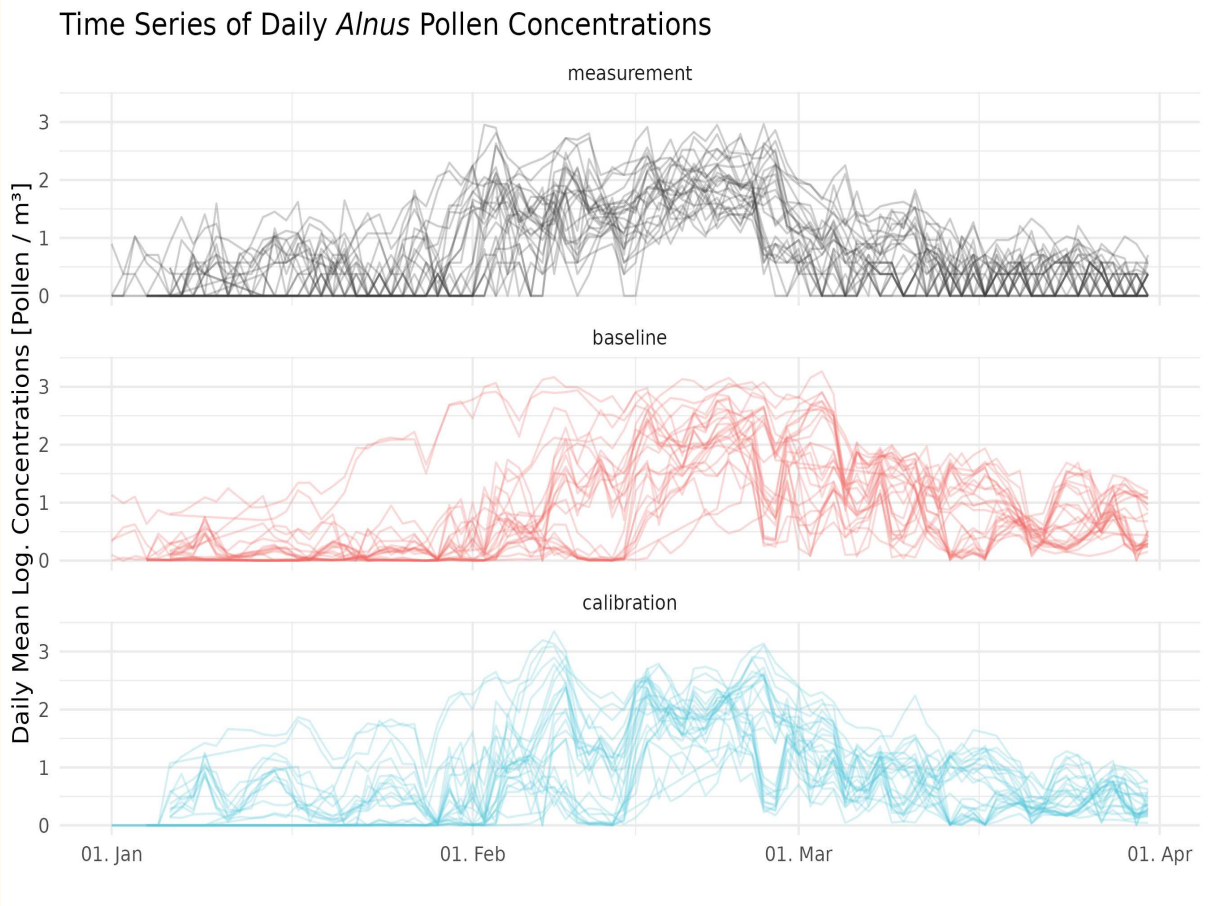
The CRPS improves more than 3% for 10m wind speed (left) and nearly 2% for 2m temperature (right) with the SMME compared to the operational system.

Martin Sprengel and Christoph Gebhardt: A stochastic model of the model error to improve the ICON-D2-EPS ensemble forecasts. Meteorologische Zeitschrift Vol. 32 No. 5 (2023).

A real-time calibration method for the numerical pollen forecast model COSMO-ART

Simon Adamov and Andreas Pauling (MCH)

The study presents a novel approach to improve numerical pollen forecasts by calibrating model parameterizations in real-time using actual pollen concentration measurements. The increasing availability of real-time pollen monitoring technologies opens the possibility to make a significant step forward in pollen forecast quality. Our method adapts both the model phenology scheme and the overall tuning factor based on the latest pollen observations. To test this approach, we used the numerical pollen forecast model COSMO-ART covering the greater Alpine domain at 1.1 km resolution. Test runs included Corylus, Alnus, Betula and Poaceae pollen during two pollen seasons. Comparison with daily measurements from 13 Swiss pollen stations revealed substantial model improvements, although fine-tuning the method remains challenging. We conclude that real-time calibration of numerical pollen forecast models based on the latest pollen observations is a promising approach to enhance forecast quality throughout the entire forecast period. This study represents a valuable first step towards comprehensive real-time calibration of numerical pollen dispersion models.



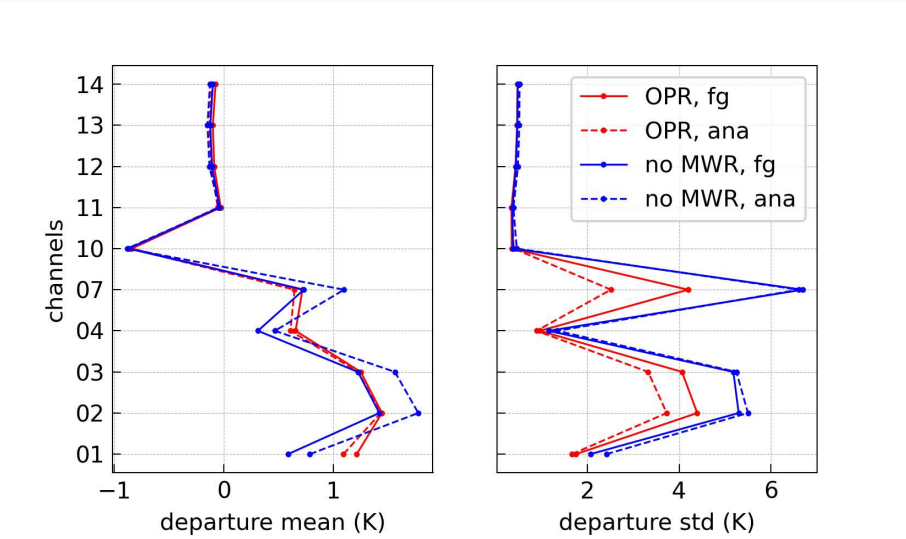
Time series of daily Alnus pollen concentrations 2020 and 2021. Each line shows the data for one of the 13 stations in one of the observed years of the study.

Simon Adamov and Andreas Pauling: A real-time calibration method for the numerical pollen forecast model COSMO-ART. Aerobiologia 39, 327–344 (2023).

Improving the representation of the atmospheric boundary layer by direct assimilation of ground-based microwave radiometer observations

Jasmin Vural[1], Claire Merker[2], Moritz Löffler[1,3], Daniel Leuenberger[2], Christoph Schraff[1], Olaf Stiller[1], Annika Schomburg[1], Christine Knist[1], Alexander Haefele[2], Maxime Hervo[2]
([1]DWD, [2]MCH, [3]Univ. of Cologne)

In a joint effort, MeteoSwiss and Deutscher Wetterdienst (DWD) address the need for improving the initial state of the atmospheric boundary layer (ABL) by exploiting ground-based profiling observations that aim to fill the existing observational gap in the ABL. We implemented brightness-temperature observations from ground-based microwave radiometers (MWRs) in our data assimilation systems using a local ensemble transform Kalman filter (LETKF) with Radiative Transfer for TIROS Operational Vertical Sounder, ground-based (RTTOV-gb) as a forward operator. We were able to obtain a positive impact on the brightness temperature first guess and analysis, as well as a slight impact on the ABL humidity, using two MWRs at MeteoSwiss. These results led to a subsequent operational implementation of the observing system at MeteoSwiss. Furthermore, we performed an extensive set of assimilation experiments at DWD to investigate further various aspects such as the vertical localisation of selected single channels. We obtained a positive impact on the 6-hr forecast of ABL temperature and humidity by assimilating two channels employing a dynamical localisation based on the sensitivity functions of RTTOV-gb but also with a static localisation in a single-channel setup. Our experiments indicate the importance of vertical localisation when using more than one channel, although reliable improvements are challenging to obtain without a larger number of observations for both assimilation and verification.



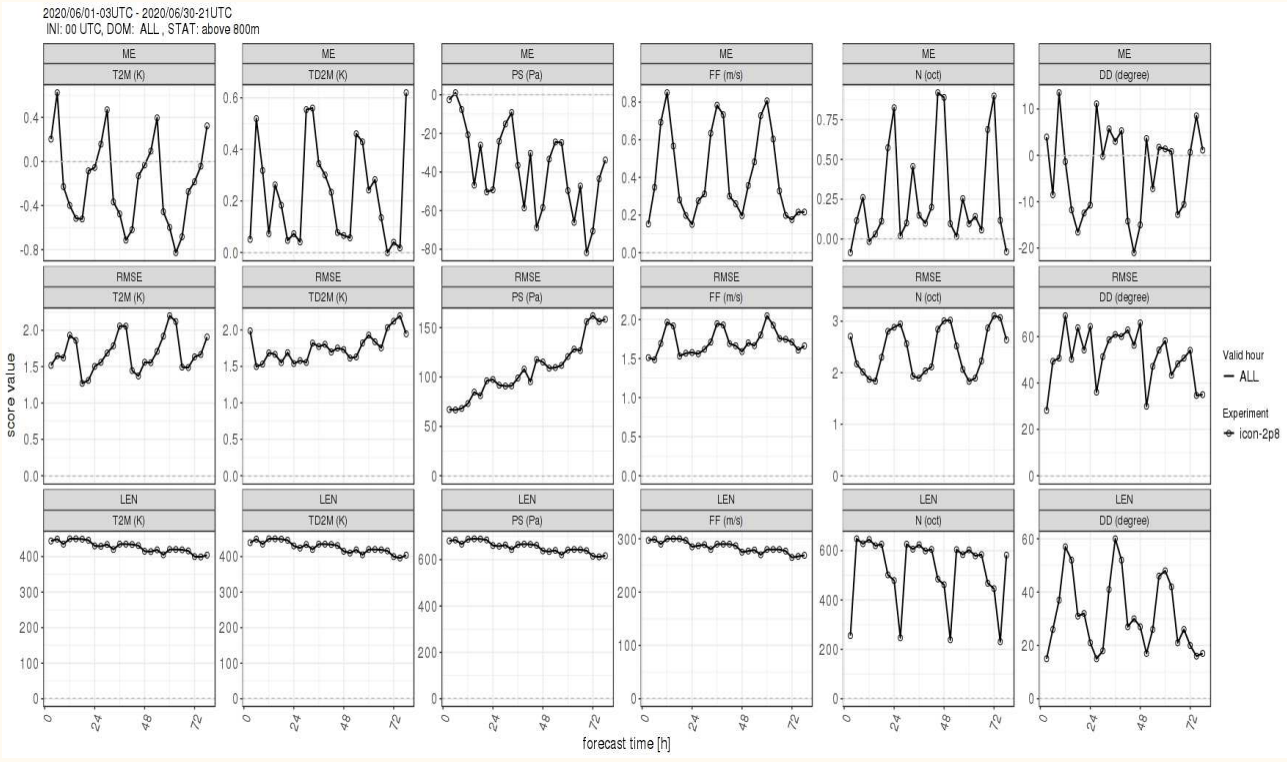
First guess (fg) and analysis (ana) departures in observation space for the MWR in Payerne, for the configuration with MWR assimilation (OPR; red lines) and the experiment without MWR assimilation (no MWR; blue lines). The left panel shows the mean and the right panel the standard deviation of the departures for the brightness temperatures of each assimilated channel. The statistics are sampled for all active hourly MWR measurements in the two-week period April 24–May 7, 2023.

Jasmin Vural, Claire Merker, Moritz Löffler, Daniel Leuenberger, Christoph Schraff, Olaf Stiller, Annika Schomburg, Christine Knist, Alexander Haefele and Maxime Hervo: Improving the representation of the atmospheric boundary layer by direct assimilation of ground-based microwave radiometer observations Q J R Meteorol Soc. 2024; 150:1012–1028.

Comparison of COSMO and ICON-LAM high-resolution numerical forecast for Romanian territory: Case studies and evaluation

A.Iriza-Burca, R.C. Dumitrache, B.A. Maco, M.Hustiu (NMA)
F.Fundel, D.Riger and R.Potthast (DWD)

Given the context of the migration from the COSMO numerical weather prediction model to the ICON modelling framework, a thorough analysis of the behaviour of the two models is carried out for two cases of interest for Romanian territory (severe weather characterized by atmospheric instability, heavy precipitation, significant snow height and strong wind). The study is also extended to the summer season 2020. The evaluation of model performance is carried out using the MEC+Rfdbk (FFV) technical suite to compute statistical scores, employing observation from all Romanian stations available for the periods of interest. Various stratification areas are selected, in accordance with the evolution of the two cases and the synoptic regime for the season of interest. The comparison is carried out between the COSMO and ICON models integrated at 2.8km horizontal resolution for the Romanian territory, in operational configurations, respectively. The intercomparison shows good results from both models, with ICON generally outperforming COSMO for most surface parameters, consistent with the less extensive results presented in the Priority Project C2I. Results for the precipitation forecast require further investigation.



Scores for June 2020: ME (top), RMSE (middle) and number of observations (bottom) for T2M (K), TD2M (K), PS (Pa) FF (m s–1), N (octa) and DD (deg) from left to right for ICON-2.8 km in red up to 78 h forecast.

Amalia Iriza-Burca, Rodica C. Dumitrache, Bogdan A. Maco, Mihaita Huştiu, Felix Fundel, Daniel Rieger, and Roland Potthast: Comparison of COSMO and ICON-LAM high-resolution numerical forecast for Romanian territory: Case studies and evaluation. Atmósfera, 38, 421–451. Abstract and figure modified from https://doi.org/10.20937/ATM.53305 *published under* CC BY-NC 4.0 Deed*;* © *2024 Universidad Nacional Autónoma de México, Instituto de Ciencias de la Atmósfera y Cambio Climático.*

Further publications

- Fosser, G., Gaetani, M., Kendon, E.J. et al.: Convection-permitting climate models offer more certain extreme rainfall projections. npj Clim Atmos Sci 7, 51 (2024). https://doi.org/10.1038/s41612-024-00600-w
- Bottazzi, M., Rodriguez_Muñoz, L., Chiavarini, B., Caroli, C., Trotta, G., Dellacasa, C.,& Scipione, G. (2024): High performance computing to support land, climate, and user_oriented services:The HIGHLANDER Data Portal. Meteorological Applications,31(2), e2166. https://doi.org/10.1002/met.2166
- Campanale, Angelo and Adinolfi, Marianna and Raffa, Mario and Schulz, Jan-Peter and Mercogliano, Paola: Investigating Urban Heat Island Dynamics Over Rome and Milan Through the Urban Parameterization Terra_Urb Implemented in the Icon Atmospheric Model. Available at SSRN: https://dx.doi.org/10.2139/ssrn.4756850
- Matjaz Puh, Christian Keil, Christoph Gebhardt, Chiara Marsigli, Mirjam Hirt, Fabian Jakub, George C. Craig: Physically based stochastic perturbations improve a high-resolution forecast of convection. J R Meteorol Soc. 2023;149:3582–3592. https://doi.org/10.1002/qj.4574

- ISDA 2023 contribution:
  - "Benefit and challenges in assimilating near-surface temperature and humidity observations in complex terrain" by Claire Merker, Daniel Leuenberger, Bas Crezee, Daniel Regenass and Marco Arpagaus MeteoSwiss, Zurich,Switzerland https://eventi.unibo.it/isda2023/contributions

- Contribution to EMS 2023 and EGU 2023:
  - "An integrated meteorological forecasting system for emergency response by Maxime Hervo, Alexander Haefele, Philipp Bättig, Daniel Leuenberger, Claire Merker, Daniel Regenass, Pirmin Kaufmann, and Marco Arpagaus https://meetingorganizer.copernicus.org/EMS2023/EMS2023-573.html
  - "An integrated meteorological forecasting system for emergency response" by Alexander Haefele, Maxime Hervo, Philipp Bättig, Daniel Leuenberger, Claire Merker, Daniel Regenass, Pirmin Kaufmann, and Marco Arpagaus https://meetingorganizer.copernicus.org/EGU23/EGU23-16779.html

COSMO activity proposals

COSMO grants funding for activities related to the scope of COSMO following an approval process. The funds for approved **COSMO activity proposals** are provided by the COSMO licence fees (COSMO support license to be decommissioned, new: ICON support license)

In recent months, the following activities have been supported:

- Visit by Prof. Vincent E. Larson, University of Wisconsin, at DWD (6-24 March 2023; see short report in this COSMO NL)
- Seed funding of **TEAMx** ('Multi-scale transport and exchange processes in the atmosphere over mountains – programme and experiment')
- Evaluation of ICON forecasts products during the two-weeks Testbed of the European Severe Stroms Laboratory (**ESSL**)
- Financial support of the 9th International Symposium on Data Assimilation (**ISDA**) in Bologna, Italy, 16-20 October 2023
- Financial support of **ICCARUS 2023** in Offenbach, Germany, 6-9 March 2023
- Financial support of the **Numerical Model Training course 2023** for ICON in Offenbach, Germany, 27-31 March 2023
- Journal publication fees (see short note on the publication by Khain et al. in this COSMO NL)
- Travel support for participation in the **EWGLAM 2023** in Reykjavik, Iceland, 25-28 September 2023
- Travel support for participation in the **IDEA-S4S** kick-off meeting in Bonn, Germany, 19-22 November 2023
- Travel support for participation in the **25th COSMO General Meeting** in Gdansk, Poland, 11-15 September 2023 (see short report in this COSMO NL)

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