

SCA Report for ICON-NWP

and still: COSMO-Model and INT2LM

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Gatekeepers for ICON

COSMO 6.01 and INT2LM 3.01

Versions Implemented on 24.08.23

- COSMO 6.01 and INT2LM 3.01 have been implemented on github master collecting a couple of small fixes.
- Fixes coming mainly from CLM and do not affect standard operational setups.
- These versions will not be distributed officially

- COSMO 6.01 and INT2LM 3.01 have been implemented on ECMWF computer ATOS (on Sept. 05th)
 - `/ec/res4/hpcperm/dwg/cosmo/cosmo_230824_6.01`
 - `/ec/res4/hpcperm/dwg/int2lm/int2lm_230824_3.01`

COSMO 6.01 implemented on 24.08.23

04.03.22	GPU	Removed vector index lists in Tiedtke-Bechtold convection (conv_cuascn.f90) due to a compiler problem with some NVIDIA compiler versions.
30.05.22	URB	Variable tcm in turb_transfer.f90 has to be INTENT(INOUT) instead of INTENT(OUT). Important for itype_kbmo_uf > 0 or lurbfab.
31.08.22	LEPS	Reading GRIB 2 meta data for special local section 28: global communication problem in src_input.f90.
08.11.22	C2SM	Fix distribution of rlon/rlat values for grid point output (meteographs).
11.11.22	C2SM	Fix tracer recycling for spinup runs with GHG extensions.
14.11.22	MCH	Corrections and updates for snowpolino.
23.11.22	C2SM	Fix compression of NetCDF restart files (option „nc-4“ only).
23.11.22	GPU	Fix issues related to GPU arrays in output
15.05.23	CLM	Add SP_AV to list of fields for statistical processing (was forgotten before).

Note: This version is only available on github. It will not be distributed.

INT2LM 3.01 implemented on 24.08.23

22.08.23	CLM	src_read_coarse_grid.f90: write variable zvcflat_in (read from NetCDF files) to internal structure vcoord_in (was forgotten before).
22.08.23	ICON	Problem when reading ICON data set containing synthetic satellite images: leveltyp unknown. Just ignore this leveltyp

Note: This version is only available on github. It will not be distributed.

Latest ICON Releases

Where to Find Information

→ Protocol of Release Commits

→ <https://gitlab.dkrz.de/icon/wiki/-/wikis/Protocol-of-Release-Commits>

→ From gitlab: → icon / ICON developer wiki → Protocol of Release Commits (in: Source Code Management)

→ icon-nwp commits:

→ <https://gitlab.dkrz.de/icon/icon-nwp/-/commits/master>

→ From gitlab: → icon / icon-nwp → Commits

Informations following on the next slides have been compiled by Daniel Rieger.

ICON Release 2.6.6 (09.02.23)

Ensemble:

- Stochastic Perturbation of Physics Tendencies (SPPT)

TERRA-URB:

- Albedo of urban surface tiles

Microphysics:

- New two-moment cloud ice scheme `inwp_gscp=3`

GPU:

- ACC port of ecRad, two-moment microphysics scheme, 3D Smagorinsky turbulence scheme, NWP seaice module, diagnostics

Radiation:

- Update to ecRad version 1.5

Land:

- Added jsbach/vdiff from former ICON echam-physics

ICON Release *Candidate 2.6.7*

Tuning:

- Additional namelist options for improved SSO/gravity-wave tuning
- Set of changes to allow numerically stable integrations at mesh sizes below about 100 m

Land:

- Add interface between NWP physics package and vdiff

Dynamics:

- Integrate separate deep-atmosphere dycore into standard dycore

Coupling:

- Update from YAC2 to YAC3

Microphysics:

- Two-moment scheme changes for rapid update cycle and cloud cover
- Implementation of warm-rain spectral bin microphysics (SBM)
- Option to modify diagnostic cloud scheme to enhance cloud cover in stratocumulus regions

Radiation:

- Generic hydrometeors for ecRad
- Latitude-dependent decorrelation length scale for cloud overlap
- New gas optics option available (ecckd)

Waves:

- Implement full suite of parameterizations

ICON-Seamless:

- Finalized prototype 2 (coupled atmosphere-ocean)

TERRA-URB:

- Prevent evaporation from bare soil; "Puddles" on impervious surface areas; anthropogenic heat flux

GPU:

- OpenACC port of totint, synsat and albedo_type=3; optimized port of LHN and two-moment microphysics; vertical output interpolation; 3D turbulence scheme; diagnostics; SPPT; sstice_mode=6

ART:

- Enable reduced radiation grid for ART+ecRad

News for ICON Developers

Developing for ICON

- First steps for ICON developers: see <https://www.cosmo-model.org/content/support/icon/default.htm> and my presentation from last year.
- To contribute to the ICON development, you need access to the git repository (<https://gitlab.dkrz.de>) and have to be familiar with basic git commands:
 - `git clone --recursive git@gitlab.dkrz.de:icon/icon-nwp.git`
- After successful implementation of your contribution you can open a „merge request“ on the gitlab page.

Then the work for the reviewers and the gatekeepers starts!

An Improved Gatekeeping Workflow for icon-nwp

See: <https://gitlab.dkrz.de/icon/icon-nwp/-/wikis/home> → ICON-NWP Workflow

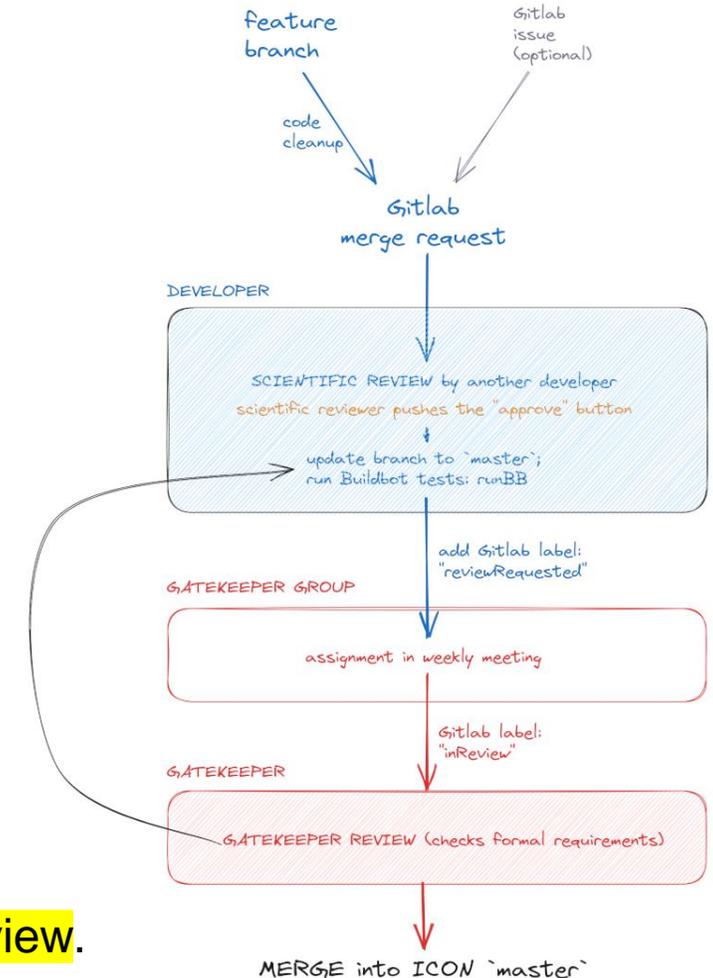
→ Please read these instructions carefully! Here are some highlights:

- Only one feature per merge request is allowed!
- Provide a short, but precise description of the changes.
- Each merge request needs a scientific review.
- Other mandatory requirements:
 - clean code up-to-date with the master, green buildbot tests.
- When a merge request is ready, the developer adds the label **reviewRequested**.

→ The gatekeepers decide on the assignee in a weekly meeting.

→ When your branch has been assigned to a gatekeeper it gets the label **inReview**.

MERGE REQUEST LIFECYCLE



Troubles You Might Experience

- Unify your branch with the master (git merge master) can lead to conflicts, if several contributors modify the same file. This might need coordination.
- Running buildbot can be problematic: sometimes machines are not available, leading to red buildbot tests. Or you need to update the reference data, if your changes do modify the results of the simulation.
- For machine availability see: <https://gitlab.dkrz.de/icon/icon-nwp/-/wikis/Buildbot-Maintenance-Calendar>
- Buildbot tests on GPU machines are red: this might involve a GPU expert.
- Furthermore: ICON-C plan is that all code parts must be covered by buildbot tests or they are removed.
- The gatekeeper complains about a „lousy code“: Then you have no chance but to clean up your code. E.g.
 - use proper indentation in the ICON style.
 - do not list variables in USE statements, which are not used in the code.
 - do not use: debugging print statements; private comments; markers with developer's initials, etc.

But always keep in mind:

The gatekeeper is your friend!

License and Support Issues

New ICON Licenses

Licenses for NMHS available since December 2022:

→ Using ICON is for free now:

ICON_License_Use_NMHS

→ Support License for NHMS requires a license fee:

ICON_License_Support_NMHS

New formula to compute the license fee depends on GDPpc (gross domestic product per capita):

$$\text{Fee} = \text{MIN} (20000.00 ; 4800.00 + \text{MAX} (0.0 , \frac{\text{GDPpc} - c1}{c2}))$$

→ $c1 = 4256$ (2023): limit of GDPpc for lower-middle income countries. This value is adapted yearly.

→ $c1 = 4465$ (2024)

→ Countries with $\text{GDPpc} < c1$ do not have to pay the fee: $\text{Fee} = 0.0$

→ $c2 = 0.5$: arbitrarily chosen factor for adapting increase of fee.

→ Will be rounded down to 100 Euro level.

COSMO Money 2023 and Beyond (Using World Bank Data from 2023)

Country	Future ICON Fee	COSMO Fee 2023	GDPpc ⁴
Botswana	10900	20000	7347.6
Brazil (INMET)	11300	60000 ¹	7518.8
Brazil (Navy)	11300	20000	7518.8
Georgia	6300	0	5042.4
Namibia	5700	20000 ²	4729.3
Oman	20000	20000	16439.3
Turkmenistan	11500	20000 ³	7612.0
Ukraine	5900	0	4835.6
UAE	20000	20000	36284.6

- 1) Missing money from 2021/2022 has been paid this year
- 2) Namibia cannot pay at the moment and does not get ICON data.
- 3) Missing money from 2022. Invoice has now been waved by DWD. See next slides.
- 4) GDPpc taken from <https://data.worldbank.org/indicator/NY.GDP.PCAP.CD> (2023)

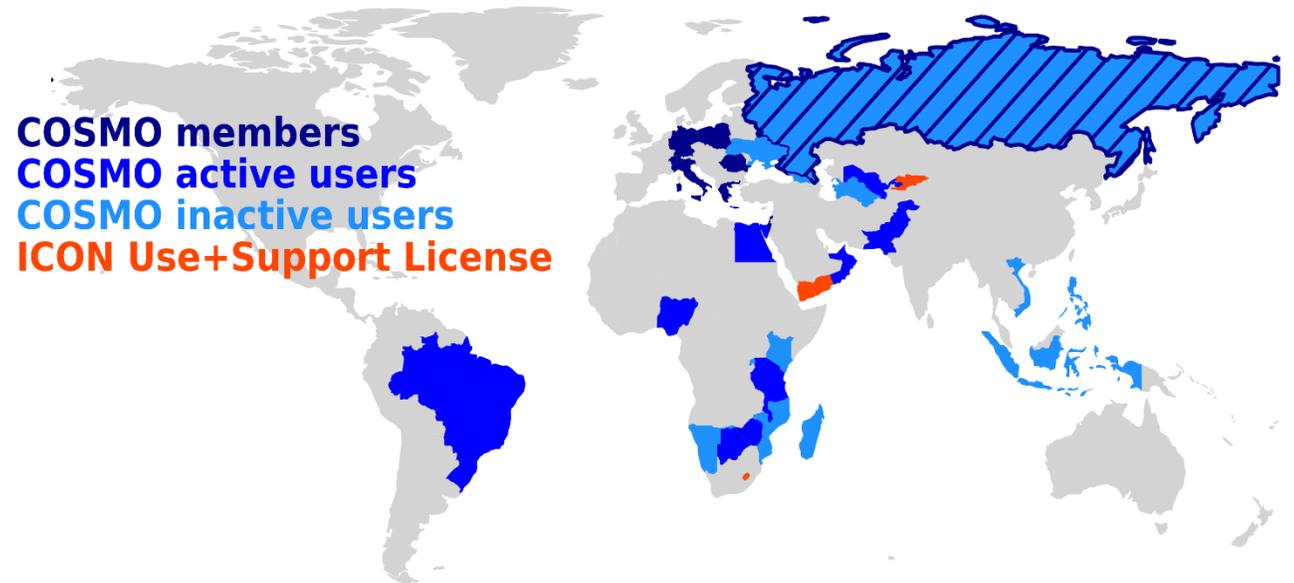
First ICON Licensees

- ➔ Jemen, Kyrgyzstan, Lesotho
- ➔ Contracts sent to: Niger, Oman, Tanzania, Mauritius, Brazil, Zimbabwe
- ➔ Research contracts: Brazil, Kenya, UAE, Malawi, Pakistan

Specialities

- ➔ Turkmenistan could not pay the COSMO fee for 2022, but wants to continue collaboration with ICON-LAM.
- ➔ License fee will be paid for 2 years by GIZ¹ through a project „Climate Risk Management in Central Asia“.
- ➔ Oman and UAE are asking for data assimilation (CEnVar) and for ICON-ART.

COSMO map



1) Gesellschaft für internationale Zusammenarbeit (Society for international collaborations)

Consequences for PP C2I4LC and the Support Group

- GIZ asks for an online workshop to give information on ICON-LAM and the migration from COSMO to ICON-LAM. This will be interesting for all our partners!
- Activities to support new ICON-LAM licensees already started (via: icon.support@dwd.de). The Request Tracker should go online as soon as possible!
- Components still missing:
 - Scheduling
 - Verification
 - Data Assimilation
- And next step is: ICONIC
 - Working in the cloud, with containers, ...

Numerical Model Training

NWP Model Training 27-31 March

- Took place at the headquarters of DWD in Offenbach.
- 71 participants from 19 countries in 3 different classes:
 - Academia
 - CLM
 - MetServices: for the first time we had an extra class for the Meteorological Services to train ICON-LAM. (16 participants present; 10 did not show up; 2 participants from Malawi were hosted 3 weeks later, because they did not get their visa in time).
- Theoretical lessons for all have been given in the mornings (streamed from one room to the others).
- Practical exercises tailored for each class in the afternoons.
- Practical exercises for the MetService group have been conducted on ECMWF's HPC ATOS in Bologna!



Preparation of Exercises was Joint COSMO Development!

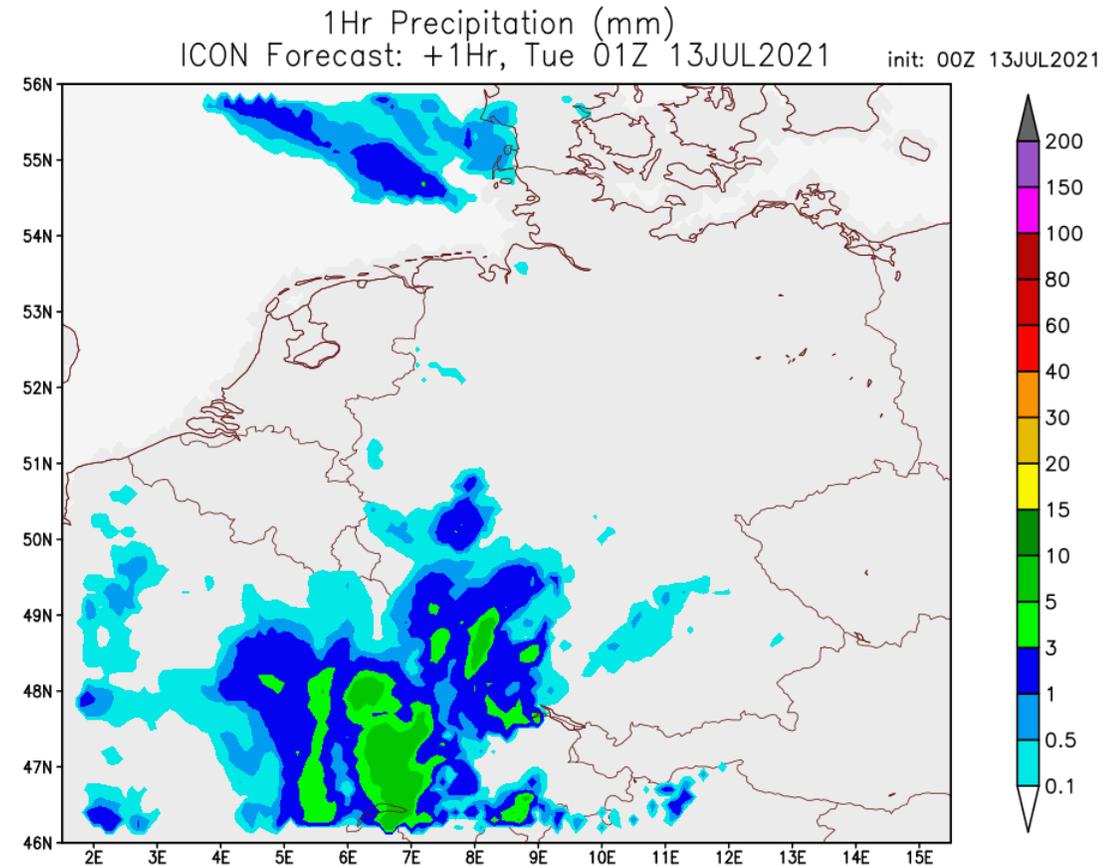
- 9 Videoconferences between Dec. 08 and Mar. 23
- 0.1 FTEs per person attributed for Support Activities
 - DWD: Jan-Niklas Weiß, Daniel Rieger, Uli Schättler (General Info, Installation)
 - IMGW: Witold Interewicz, Damian Wojcek (Preprocessing, Grid Generator Web Interface)
 - NMA: Rodica Dumitrache, Stefan Dinicila, Stefan Gabrian (present during the Training) (ICON-LAM)
 - IMS: Alon Stivelman (Graphics)
- General strategy of the exercises:
 - Perform an ICON-LAM forecast on a given grid guided by the tutors.
 - Transform what you have learned to a grid prepared by your own.
- Material for the exercises available on <https://gitlab.dkrz.de/icon-training/exercises-metservices>

A Slide from the Introduction Talk

This week we want you to do a numerical simulation of a weather event and visualize the output.

To do so, you have to perform the following steps:

1. Install the necessary source codes: ICON and DWD ICON Tools.
2. Prepare a grid file and external parameters for the computational domain.
3. Prepare initial and boundary data for this domain (running the tools iconremap, iconsub).
4. Run ICON in limited area mode on the computational domain.
5. Visualize the results.
6. For operational duties all steps have to be done automatically. For that you need a scheduler.



ICON on ATOS (ECMWF)

Running ICON on ATOS with

Intel Compiler shows several problems:

- Running the same experiment can give different results (rerunnability or repeatability).
- Running ecRad with different OMP_NUM_THREADS does not give reproducible results (reproducibility).

GNU compiler is about 15-20% slower.

- A new version GCC 12.2.0 is available and can be tested.

Latest News:

- ECMWF User Support could not help earlier this year. To get an update, I contacted also colleagues from the HPC group, who gave some recommendations for helpful compiler options. This has to be tested now.

Buildbot

Only few actions taken up to now:

- Running buildbot tests on ATOS is not impossible. Details have to be discussed between DKRZ and ECMWF. Tests will run using DWD SBUs.
- To run buildbot tests we need an automatic build and run-system for ATOS:
 - Modify scripts `collect.set-up.info.in` and `create_target_header` to include ATOS information:
I worked on that lately.
 - Define tests that can be run by buildbot:
Who can contribute such tests? What do we want to test?



It is difficult
to predict

especially
the future.

And we have
only just begun...