

WG S/I

Massimo Milelli, Gabriella Ceci and colleagues

15 September 2026, 28th COSMO General Meeting, Rome

Outlook

- ICON-LEPS
- NWP-TS
- Documentation
- AI topic
- Fieldextra/data distribution @MCH
- GPU porting
- New COSMO web site

Icon-LEPS updates

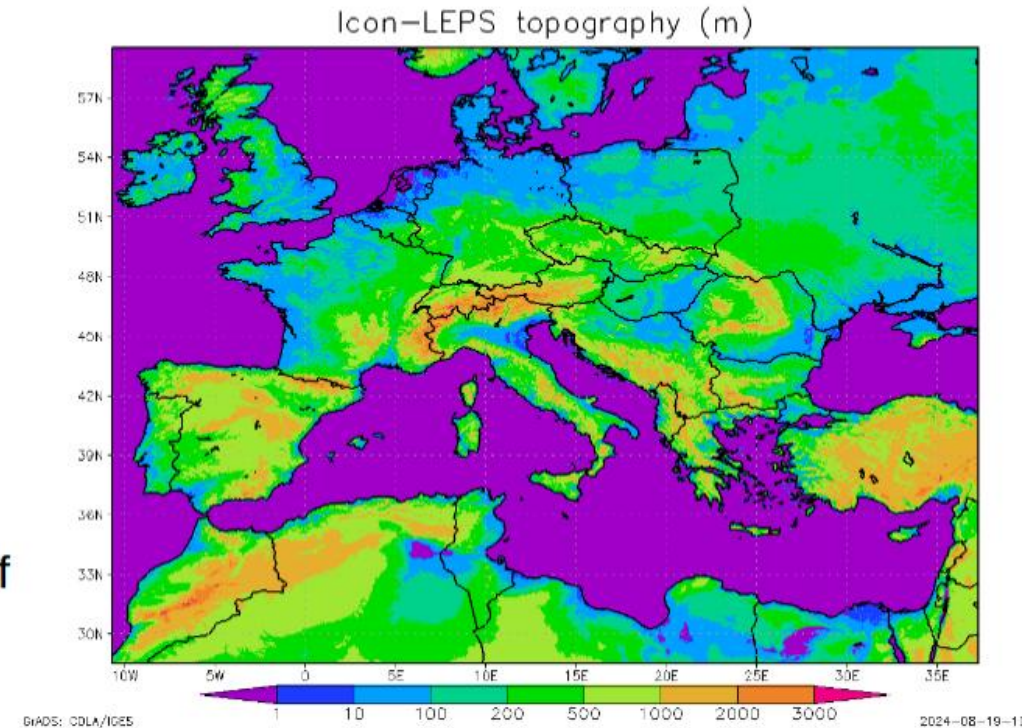
Enrico Minguzzi and the Numerical Modelling group

ARPAE-SIMC Emilia Romagna

COSMO General Meeting, September 14th-19th 2026, Rome

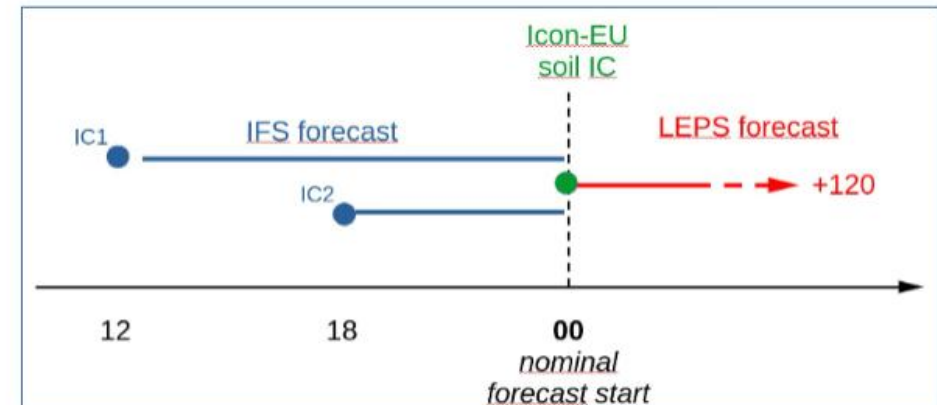
Main features:

- Domain: Europe + Mediterranean
- Resolution 2.5 km (R8B8)
- 20 members + “control run” (*deterministic*)
- Atmospheric IC/BC from selected IFS-EPS members
- Icon version 2026-04; DWD perturbations; namelists as ICON-D2, but “greyzone tuning” off

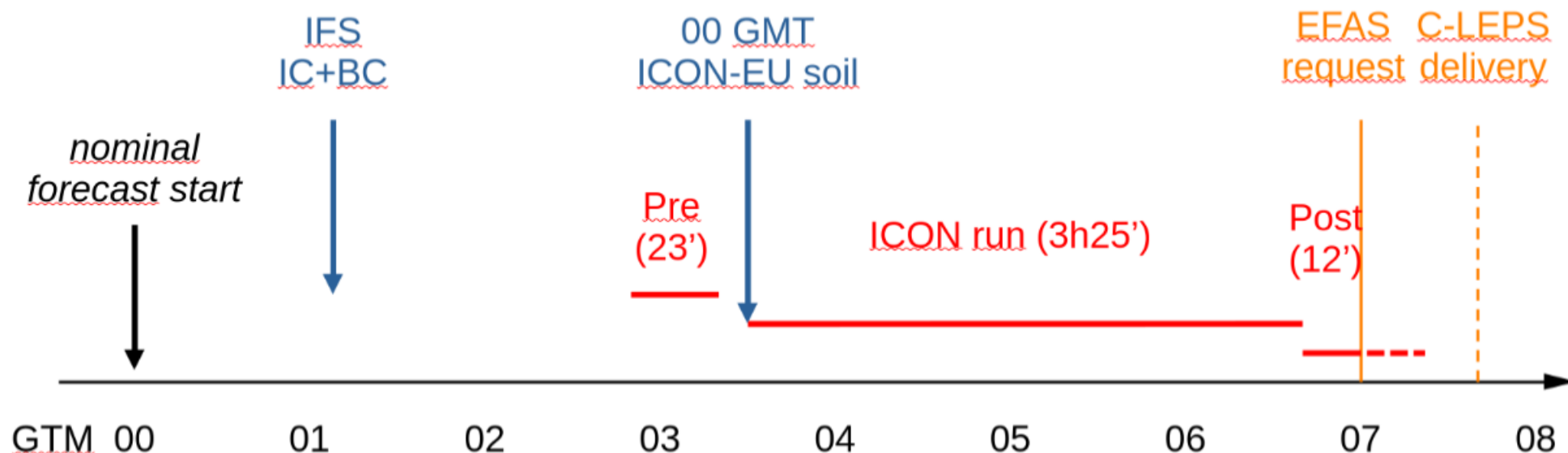


Pre-operational setup:

- One run per day, starting at 00 GMT, up to +120 hours
- Lagged ensemble, using IFS runs at -6 and -12 hours
- Soil IC from Icon-EU at forecast start (*same for all members*)



Pre-operational schedule



- The system is running once a day (00 GMT) since August 2nd
- Products are expected to be delivered around 07 GMT (*maybe slightly earlier with timecritical resources*): this is compliant with EFAS requests, and $\approx 30'$ earlier than C-LEPS.
- Earlier dissemination time may be possible using more nodes to run Icon (*is it worth?*)

The production of feedback files has been implemented as a separate suite, that can run either in NRT or a posteriori. Observations taken from Carma (4 days delay) or directly from MARS

Verification activities proposed:

- 1) Common verification (Dimitra, HNMS): all members, 3 hours frequency, subdomain, up to +48h; delivered every 3 months. *CARMA observations (Amalia); LEPS FF upladed to NMA ftp server*
- 2) Deterministic verification (Flora and Keloniki, HNMS): only “control” run, 3 hours frequency, full domain, up to +120h. *CARMA observations (Amalia); LEPS grib output made available on ATOS*
- 3) Scientific verification on subdomains
 - ARPAE: comparison with IFS-ENS and ARPAE-ENS on Italy. *Spatial verification of precipitation. Overlap with PP KAOS*
 - ARPA Piemonte (Naima): *fuzzy verification of precipitation, for ensemble mean and percentiles*
 - Greece, Poland (PP Kaos, task 3.1)
- 4) Comparison with IFS-ENS
Include ICON-LEPS in the operational ENS verification at DWD? Contact person: Harald Anlauf
- 5) *Alternative software by Michael Hoff, for spatial verification etc.*
- 6) *Production of “light” FF (hourly resolution, only surface) for comparison high res. observations (?)*

Still to complete

- Archiving, deleting temporary files
- Products: contact every user and review their requests. Priority to: meteograms, EFAS, HNMS, DWD, ARPAE, AIM
- Dissemination (ectransfer for all disseminations?)
- Get ready for time-critical standard (suite activation, documentation; STC decisions)
- Check all post-processing, products and archives

Official switch from Cosmo-LEPS to Icon-LEPS now expected first half of 2027 (?)

Extra SBU available in 2026 will be used to test the 12UTC workflow

NWP TS UPDATES

Contributors:

- *Run the test suite for S24icon202410 and S24icon202504 (E. Minguzzi)*
- *Perform model evaluation with MEC/FFV2 for S24icon202410 and S24icon202504 (A. Iriza-Burcă, S. Gabrian, M. Bogdan)*
- *MEC and Rfdbk support and debugging (F. Fundel)*
- *Evaluation report for the SMC (E. Minguzzi, U. Schattler, C. Gebhardt, D. Rieger, A. Iriza-Burcă)*

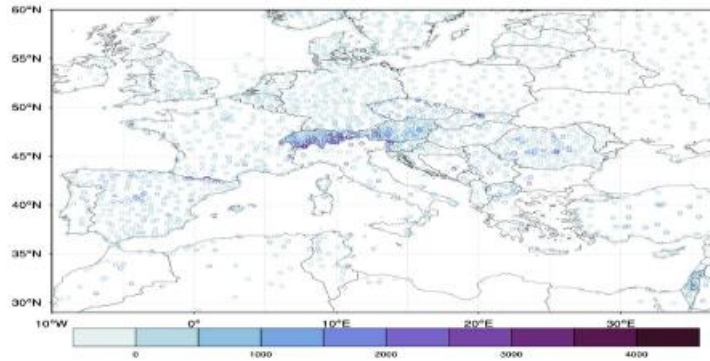
NWP Test Suite – new/ current project

**ECMWF Special Project / European Meteorological Infrastructure
Research and Development Projects (EMI R&D Projects) / EMI R&D**

***"TESTBED FOR THE EVALUATION OF ICON MODEL VERSIONS"
(2027 – 2029)***

It has the following resources:

- **B.Us on ATOS (yearly): 5 000 000.00**
- **Accumulated data storage GB (total archive volume): 30 000**



Overview of meteorological observations used for the verification.

➤ **ICON v2024.10 vs. ICON v2025.04** verification module:

- ➔ NWP Test Suite Report **completed**
- ➔ Will be uploaded on the COSMO web page

The statistical scores do not show overall significant differences in favour of one model. Based on the mixed results obtained from the evaluation of **ICON version 2025.04 (new)** against **version 2024.10 (operational)**, it is recommended to **keep the current operational version (v2024.10) as a reference** for the evaluation of the next model version (**v2026.04**) and investigate this further on.

Recent experiments

Additional experiments with version 2026-04 to test urban parametrisation (Terra-Urb)

- S24icon202604: Icon version 2026-04; base case, with default Terra-URB setup (run Jul+Dec, verification in progress)
- S24icon202604r: Same as base case, with Terra-URB off (run only Jul)
- S24icon202604i: Same as base case, with “traditional” Terra-URB setup (same setup as ARPA Piemonte experiments; run only Jul)

Synergy with other Cosmo activities on urban areas (contact person: Valeria Garbero)?

Experiment ID	Completed by	Icon version	Simulation periods	Namelist	Soil IC + domain	Top boundary nudging	BC frequency	Experiment objectives
S24icon202410	31/01/2025 04/02/2025	2024.10	Jul 2021 Dec 2021	2024	ICON-EU	Yes	1 hour	Same as S23icon202410, but upper boundary nudging and hourly BC from IFS
S24icon202504	20/07/2025 13/07/2025	2025.04-1	Jul 2021 Dec 2021	2025	ICON-EU	Yes	1 hour	Same as S24icon202410, but new model version and updated convection setup (DWD+IMS)
S24icon202604	25/07/2026 31/07/2026	2026.04 (cmp. TS)	Jul 2021 Dec 2021	2026	ICON-EU	Yes	1 hour	Same as S24icon202410, but new model version; urban model ON (DWD setup); sscds compression ON
S24icon202604r	20/07/2026	2026.04 (cmp. TS)	Jul 2021	2026	ICON-EU	Yes	1 hour	Same as S24icon202410, but new model version; urban model OFF; sscds compression ON
S24icon202604i	08/08/2026	2026.04 (cmp. TS)	Jul 2021	2026	ICON-EU	Yes	1 hour	Same as S24icon202410, but new model version; urban model ON (Italian setup); sscds compression ON

- The core of the suite and the setup of experiments hasn't been changed in the last year
- Outputs now use CCSDS compression
- Request to use NWP-TS as a test suite for Icon-LEPS: Icon namelists and software versions has been moved to external files, and are now directly comparable with LEPS
- The source codes of the suite have been moved to DKRZ gitlab server (access on request)

- Standard verification of S24icon202604



- Special verification focused on urban heat island (?).

- Should experiments S24icon202604r and S24icon202604i be completed with the winter season?

- *Special experiment for summer 2026 heat waves (?)*



- *Add to standard verification a spatial verification of precipitation (vs radar), at least in specific areas (?)*





Documentation

The documentation is (almost) updated:

- PP CAIR -> TR published
- Still expected TRs during **THIS** COSMO year (09/2025-08/2026): PP PROPHECY, PP CARMENs, PP CITTA', PP KENDAScope (unless there are papers out of them)

AI-LAM-IT

A km-scale, fully AI-based limited-area model for Italy
in the Anemoi framework

Gabriele Franch, Uladzislau Azhel, Elena Tomasi (FBK) · Luca Monaco (CIMA Research Foundation) · Valerio Capecchi (Consorzio LaMMA) · Edoardo Raparelli (Agenzia ItaliaMeteo) · Eleonora Bergamaschi (CINECA)

28th COSMO General Meeting · WG S/I parallel session · Rome, 14 September 2026

The project in one slide



What

The first fully AI-based km-scale weather model for Italy, built entirely in ECMWF's Anemoi framework: a stretched-grid model with a 2 km Italian cutout inside a global ERA5 grid, trained on Italian reanalyses.



Who

A small, operational working group started in January 2026: FBK (AI pipeline and training), CIMA (CHAPTER reanalysis), ItaliaMeteo and LaMMA (ICON-2I analyses, ITINERE reanalysis), CINECA (Leonardo, AI Factory). MeteoSwiss shares know-how and a pre-trained checkpoint.



Why now

Km-scale Italian reanalyses are becoming available, Anemoi makes regional AI models a configuration problem, and the IT4LIA AI Factory provides the GPUs. AI-LAM-IT is one of the Italian AI Factory use cases.



Data: two Italian km-scale reanalyses

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CHAPTER (CIMA)

- Dynamical downscaling of ERA5 with WRF at 3 km over the whole of Europe, hourly
- 10 years planned for AI-LAM-IT; produced at LRZ, being transferred to Leonardo and converted to GRIB for Anemoi
- About one year processed so far (Oct 2024 to Apr 2025); the LRZ to CINECA transfer is the bottleneck

ITINERE (Agenzia ItaliaMeteo/LAMMA/UniBo)

- ICON-2I reanalysis for Italy: 2.2 km, 65 levels, 2010-2025 with near-real-time extension
- KENDA / LETKF assimilation of conventional and radar observations, 20-member ensemble
- Produced with Arpae, University of Bologna and LaMMA; in production, first test periods being evaluated

Meanwhile: one year of operational ICON-2I analyses

2.2 km, 761 x 761 grid, 6-hourly, 12 pressure levels + surface, converted to zarr with anemoi-datasets. Used for all the tests shown next, with ERA5 N320 as global boundary.



Next steps

1 Bring in the reanalyses

Finish the CHAPTER transfer and conversion; ingest the first ITINERE periods as they are released. Same variable list, same recipes.

2 Train on Italy

Fine-tune the stretched-grid model on CHAPTER and ITINERE instead of one year of analyses; longer rollouts; hourly steps where the data allow.

3 Evaluate properly

Scores against ICON-2I analyses and station observations, case studies on recent floods, comparison with the operational ICON-2I forecast.

4 Share

Recipes, graph configs and checkpoints through the IT4LIA AI Factory; we are keen to compare notes with other COSMO / ICON AI efforts.





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Fieldextra

Toolbox for pre-and post-processing of gridded fields
Designed for production

SCA: Petra Baumann / MeteoSwiss

COSMO-Web: <https://www.cosmo-model.org/content/support/software/default.htm>

GitHub: <https://github.com/COSMO-ORG/fieldextra>

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Recalling COSMO GM 2025



- Resources for fieldextra will be **reduced by 50 percent** after Jean-Marie Bettems' retirement in July 2026
- MeteoSwiss expects to run fieldextra operationally **for ~5 more years**

More on that in the second part!

- MeteoSwiss is building an NWP data processing framework in Python, and exploring new workflows
- MeteoSwiss does not yet have a clear strategy on how to migrate entirely away from fieldextra

More on that now!

- MeteoSwiss will focus on the stabilization of the fieldextra code
- Bug fixes, support of new GRIB codes, eccodes updates, and similar can be expected
- No huge effort on adding new features

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Status September 2026



Two fieldextra releases since COSMO GM 2025

- **v16.0.0**, released on **31.12.2025**
 - Consolidation of **build process, and applications** (fx_transform)
 - Comprehensive **documentation** (README.developer)
- **v16.1.0**, released on **31.07.2026, Jean-Marie's last working day**
 - Alternate installation procedure using the **spack** package manager
 - Support building, loading and running fieldextra as a **container image**
 - Support new GRIB2 codings for ECMWF's migration to GRIB2 with IFS cycle 50r2



Just to let you know, where Jean-Marie is now...

Thanks to Simon Bolt for these two developments!

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Outlook



- **v16.2.0**, planned for **December 2026**
 - Consolidate **container support** (for operational introduction at MeteoSwiss)
 - **Performance** optimizations
 - Update to **eccodes 2.47.0 / eccodes-cosmo-resources 2.47.0.2**
- **Beyond**
 - Have a look at **issues** and **milestones** on <https://github.com/COSMO-ORG/fieldextra>

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Workflow Modernization for Open and Scalable Access to Operational NWP Data

From product dissemination to semantic, on-demand access to operational ICON data

Nina Burgdorfer, Christian Kanesan, Lasse Meinen, Simon Bolt,

Victoria Cherkas, Noemi Nellen, Carlos Osuna, Katrin Ehlert, Oliver Fuhrer

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From Push to Pull

Data as a Service



CURRENT WORKFLOW

PUSH: Product dissemination

- Predefined products
- Custom processing jobs
- Files delivered to users
- High duplication



MODERNIZED WORKFLOW

PULL: API-based access

- Semantic requests
- On-demand extraction
- Users retrieve only needed data
- Less redundant processing/storage

Product-centric



Data-centric



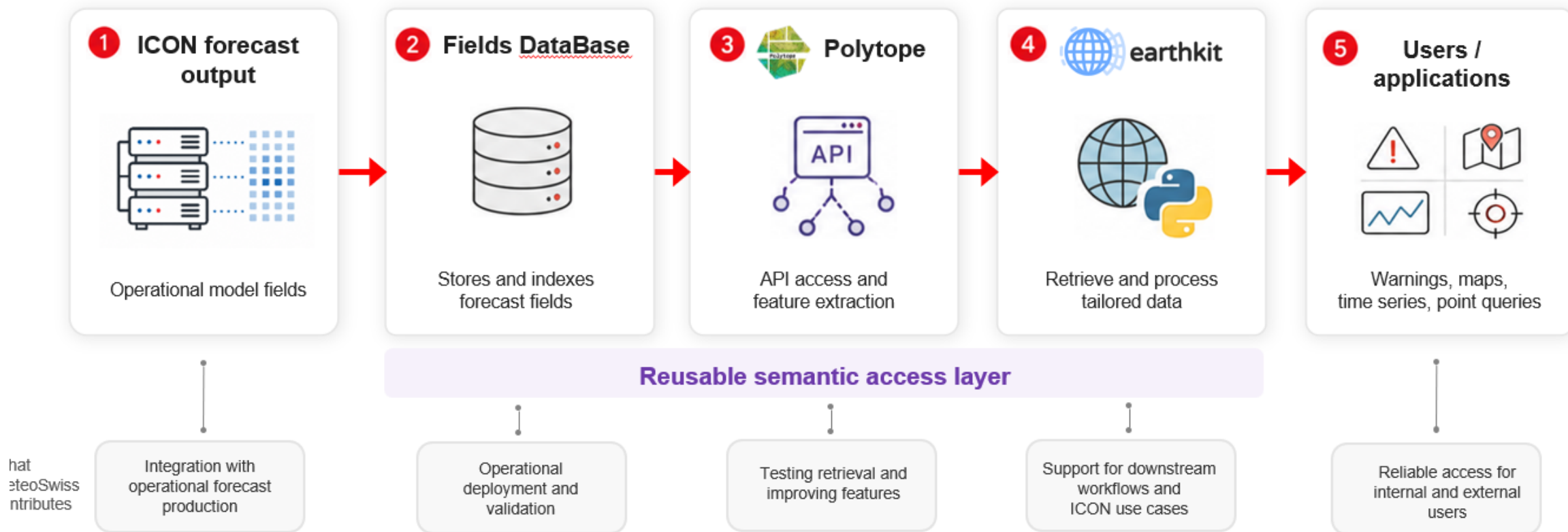
The core shift is from **pre-defined products** to **reusable, on-demand data access**.

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What enables on-demand access?

Modernized access layer based on ECMWF-developed technologies: FDB, Polytope and Earthkit



MeteoSwiss is not only adopting the stack - we are validating, improving and operationalizing it.

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ICON on GPU / Kokkos / GT4py

X. Lapillonne

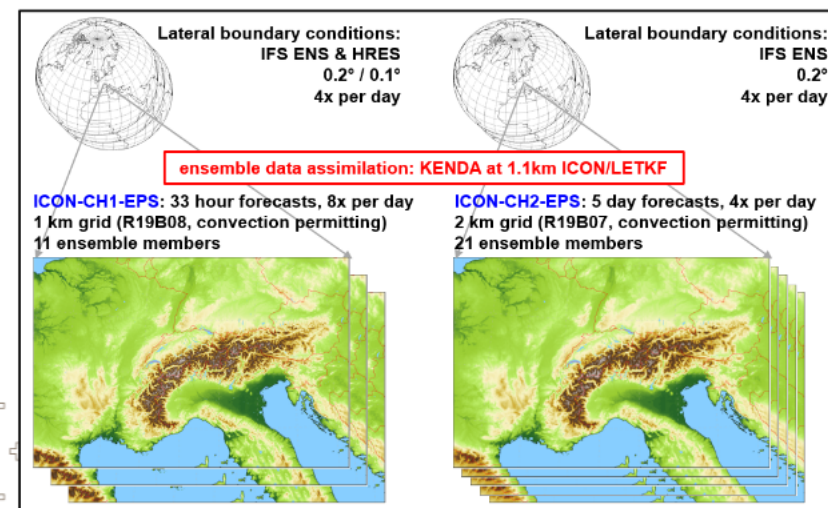
COSMO-GM 2026 WG Infrastructure

xavier.lapillonne@meteoswiss.ch



ICON GPU port with OpenACC

- Many configurations are ported to GPU using OpenACC compiler directives, these are available in the open source ICON release
 - MeteoSwiss: in production for NWP forecast
 - ETH/C2SM: used for climate simulations on Alps at CSCS
 - MPI-M/DKRZ: used for climate simulations on Levante, Lumi, Jupiter
- OpenACC: mostly maintenance work, notable exception is the port of EMVORADO to GPU by MeteoSwiss.



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ICON production setup on GPU system at MeteoSwiss



Modernization and GPU port efforts

Two main efforts are currently ongoing in the community:

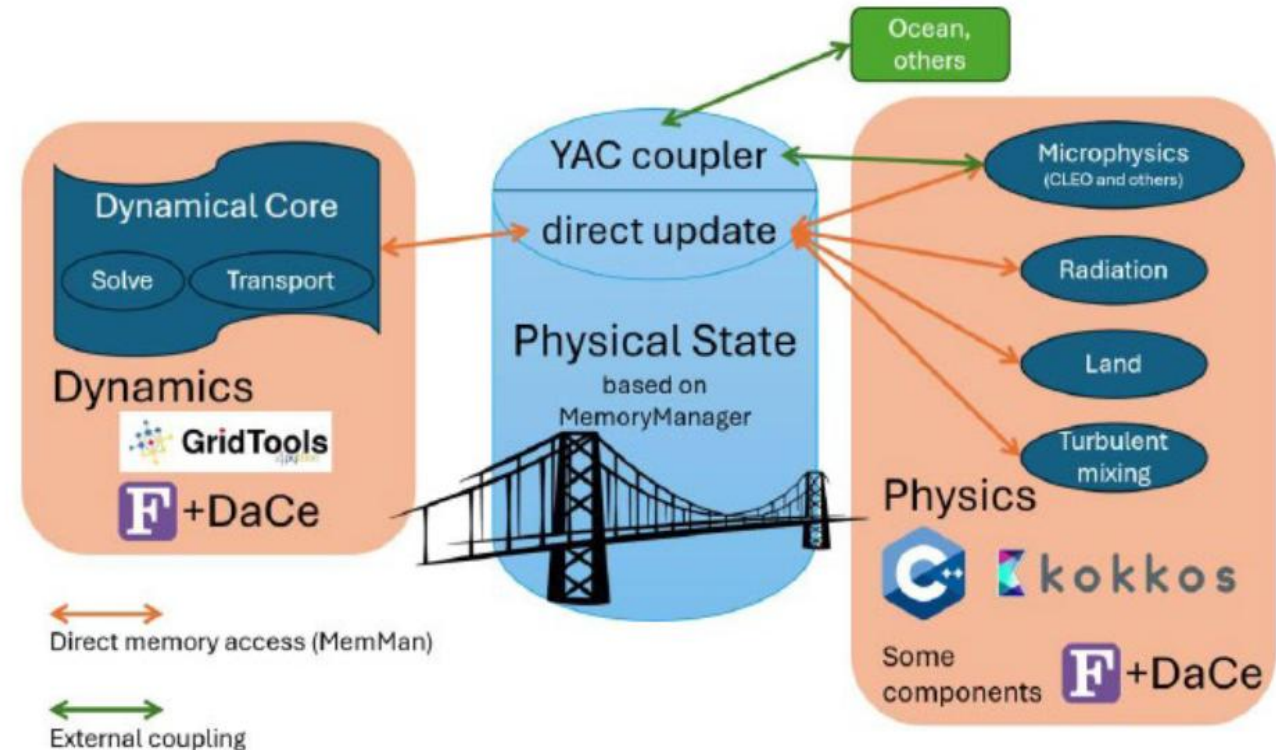
- Kokkos/C++ re-write: using a performance portable library in C/C++ that can run on multiple hardware
 - Low level, handwritten optimization
 - DRKZ, MPI, DWD
- Gt4py : python based domain specific language (DSL) , performance portable on multiple hardware
 - Abstraction and separation of concern : optimizations in the backend at compile time
 - ETH/C2SM, MeteoSwiss



Phoenix project

Combine GT4py dycore, Kokkos aes physics and other approaches to get a a full ICON version that can run without OpenACC on multiple GPU types in particular AMD GPUs

Note : Some missing features of the gt4py dycore will be ported such as nesting.



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Thank you for the attention