



# Status Report COSMO & ICON

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# COSMO Developments

Highlights of the developments in the last year



## 5.08 (23.10.20)

- Re-Unification with CLM / crCLIM (ETH Zürich)
- Implementation of EULAG
- Update of CPP DyCore to GRIDTOOLS 2.0

## 5.09 (25.02.21)

- Implementation of tile-approach for TERRA\_URB
- Implementation of additional green-house gas emission scenarios
- NetCDF I/O: adaptations for large output files

## 5.09a (18.05.21)

- Preparations for SNOWPOLINO and TERRA\_URB

## 5.09b (02.06.21)

- Some fixes for TERRA diagnostics

## 5.10 (21.07.21)

- Implementation of TERRA\_URB
- NetCDF: Restart in single precision; compression with zlib

## 5.11 (28.07.21)

- Implementation of SNOWPOLINO
- Prefetching of NetCDF boundary data

## 5.12 (to be expected 06.09.21)

- Update of EMVORADO

**Once the CLM and crCLIM validation runs are finished, the last version 5.12 will be renamed to  
COSMO-Model 6.0**

## 2.08 (30.10.20)

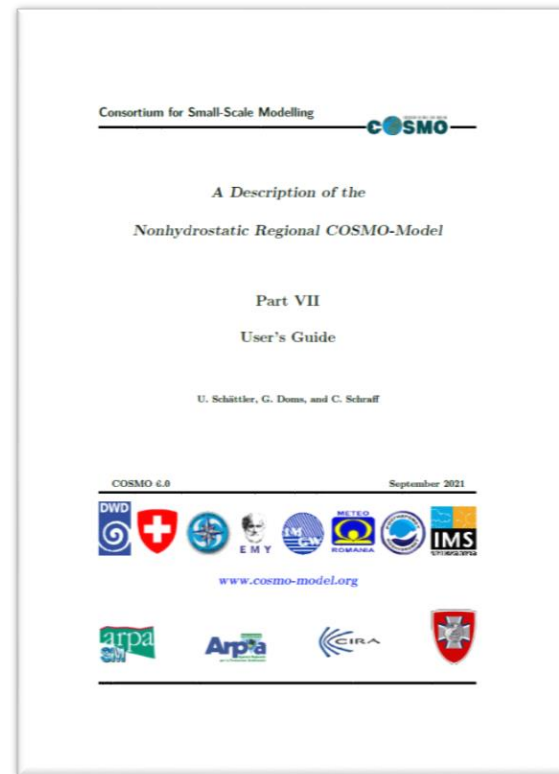
- Unification with CLM / crCLIM

## 2.09 (02.06.21)

- Additional external parameters for TERRA\_URB
- Unification between COSMO and INT2LM utility modules

# Documentation for Model Version 6.0

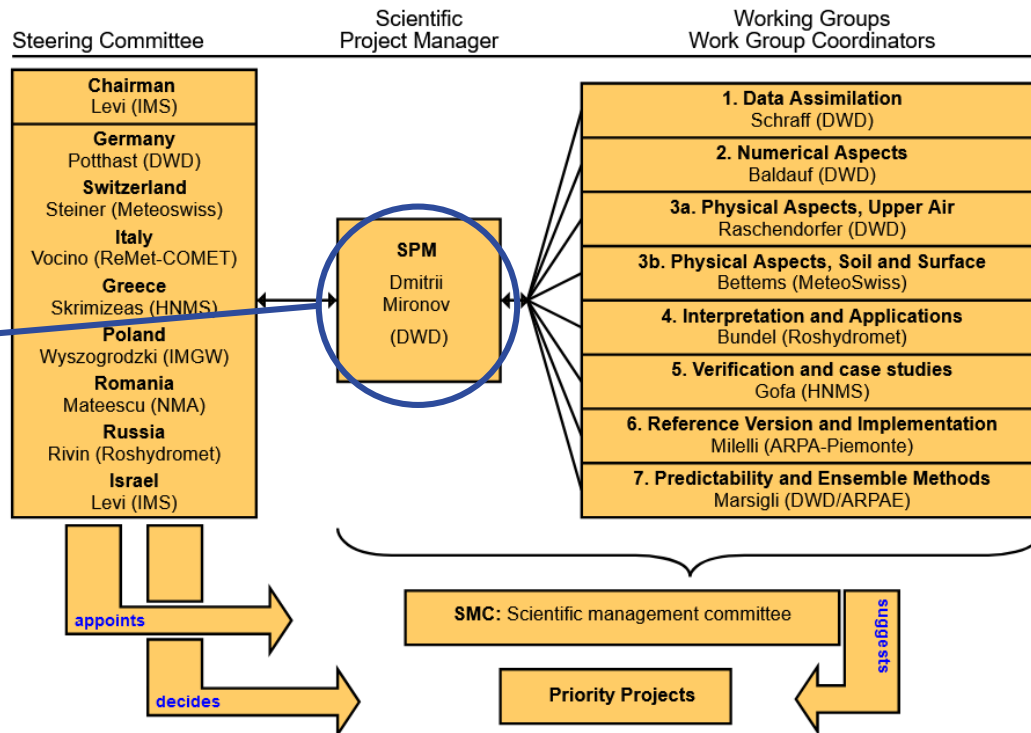
- Release Notes: for all versions available
- Model Documentation: update has started and will be finished in the next weeks
- Final Version 6.0 will also get DOIs



# New Scientific Project Manager



**Christoph Gebhardt (DWD)**  
will become COSMO SPM  
starting from January 2022



# COSMO Activities

Overview priority projects and priority tasks





**KENDAScope:** KENDA from Surface to Cloud Observations Progressive Extension. Further improve and extend the KENDA data assimilation system and use of observations in view of better convective-scale deterministic and ensemble forecasts with ICON-LAM particularly for weather-related quantities.

*Project lead: C. Schraff (DWD)*

**CAIR:** New developments regarding cloud optics and related aerosols-radiation or aerosols-cloud interaction into ICON. Testing of new sources of aerosol data not yet accessible in ICON. Investigate to what extent the statistical information of a stochastic shallow convection scheme can be integrated into the formulation of cloud-radiation interaction.

*Project lead: H. Muskatel (IMS Israel)*

**VAINT:** Improving the current phenology of vegetation and photosynthesis in the COSMO model

*Project lead: M. Tölle (Uni Kassel, Germany)*

**AWARE:** How to objectively to evaluate forecasts of extreme weather. The main weather phenomena of interest are: thunderstorms (heavy precipitation, lightning), severe wind (and wind gusts), min-max temperature (persistence), visibility (fog), and other extreme phenomena like tornadoes, dust devils, clear-air turbulence (CAT), etc.

*Project lead: F. Gofa (HNMS Greece) and A. Bundel (RHM Russia)*

**C2I:** Ensure a smooth transition from the COSMO model to the ICON model

*Project lead: D. Rieger (DWD)*

**IMPACT:** The aim of this project is to adapt the ICON model to run on various architectures such as x86 multicore CPUs and GPU accelerators, focusing in the LAM mode for NWP applications.

*Project lead: C. Osuna (MeteoSwiss)*

# New Priority Project & Task Overview

**PROPHECY:** Developing, in a well-coordinated manner, the future generation of convection-permitting ensemble systems based on the ICON(-LAM) model; the scientific focus being on the development and testing of model perturbation methods

*Project lead: C. Marsigli (DWD)*

**MILEPOST:** Providing the COSMO community with new and/or advanced and elaborated methods of post-processing based on artificial intelligence and machine learning ideas

*Project lead: A. Mazur (IMGW Poland)*

**CITTA:** City Induced Temperature change Through Advanced modelling: Transfer the achievements of the COSMO PTs AEVUS and AEVUS2 with respect to the urban canopy parameterisation TERRA\_URB and its external parameters from the COSMO to ICON.

*Project lead: J.-P. Schulz (DWD)*

# COSMO-ICON Transition

## Status of the Priority Project C2I



# SON Verification Report

## Report was published!

[https://doi.org/10.5676/DWD\\_pub/nwv/icon\\_006](https://doi.org/10.5676/DWD_pub/nwv/icon_006)

- 55 pages, 7 contributions
  - Greece
  - Israel
  - Italy
  - Poland
  - Romania
  - Russia
  - Common Area



## Report was published!

- Verification results mostly positive
  - Especially for surface
- Upper air shows slightly better results for COSMO
  - First results with new ICON versions are promising
- Precipitation
  - Improvements for Poland, Romania and Common Area
  - Neutral for Greece, Italy and Israel

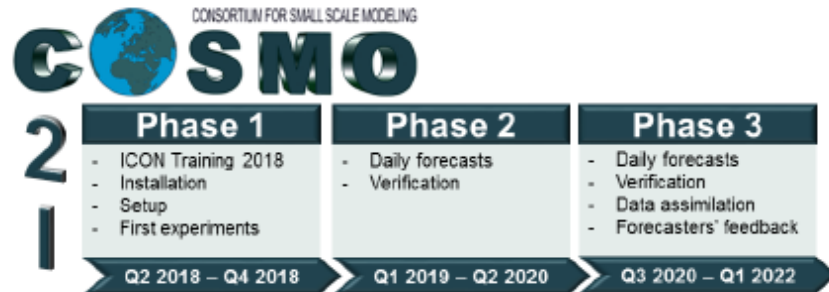


- Verification results look better, or at least neutral, as compared to COSMO results; runtime is mostly better
- With cp/cv bugfix and the ecRad radiation scheme results will likely improve even more
- COSMO partners should now be able to switch their deterministic forecasting system to ICON
  - This was the major goal of PP C2I!

**In summary:**

**The focus of the COSMO partners has shifted to ICON;  
The aims of PP C2I have been fulfilled**

**Further steps will be made through dedicated projects, where problems are solved in a more target-oriented manner**



# ICON-Seamless & Governance





## Goals

- ❖ pre-operational climate prediction system ICON-Seamless for seasonal and decadal climate prediction by **2024**
- ❖ NWP on scales **0-10d**
- ❖ computing performance of ICON-Seamless approx. **100y/d**
- ❖ first steps of consolidated **long-term development**





## ICON-Seamless Expert groups



Fotos Pixabay

- formed with participants from DWD, MPI-M, KIT, DKRZ, MeteoSwiss, and UHH
- intention:
  - work in parallel as much as possible,
  - allow experiments as early as possible
  - meet regularly
  - detail the tasks necessary for the development of ICON-Seamless: a climate prediction system based on ICON-NWP and ICON-O



Deutscher Wetterdienst  
Wetter und Klima aus einer Hand



- **ICON Directors Meeting (D5)**, 3-monthly  
Sarah Jones (DWD), Jochem Marotzke (MPI-M),  
Thomas Ludwig (DKRZ), Corinna Hoose (KIT), Nicolas  
Gruber (C2SM)
- **ICON Coordination (C5)**, bi-weekly  
Roland Potthast (DWD), Daniel Klocke (MPI-M),  
Hendryk Bockelmann (DKRZ), Bernhard Vogel (KIT),  
Xavier Lapillonne (MCH)
- **ICON Seamless Coordination**, 4/6 weekly  
Roland Potthast (DWD), Barbara Früh (DWD),  
Wolfgang Müller (MPI-M), Peter Korn (MPI-M)  
with **ICON NWP** led by Günther Zängl (DWD)
- **ICON Consolidated (C5 plus working groups)**

# ICON Releases

## Overview icon-2.6.3 and outlook icon-2.6.4

# Release icon-2.6.3 (7 June 2021)

- A large number of bugfixes, refactorings, and optimizations for the models infrastructure
- Bugfixes and improvements in the build environment
- Many add-ons for the sapphire physics port to GPUs based on OpenACC and many further steps on porting the NWP physics to GPUs
- ART has made its first step to an git submodule external (draft implementation not to be used yet- no warranty)
- Fixes and improvements in the ocean code including HAMOCC
- Improvements in the data assimilation NWP physics coupling
- Tuning of data assimilation
- Much progress on CDI-PIO (parallel I/O) use in many ICON components
- Refactoring of MPI communication library (with a focus on GPU to GPU communication)
- Sapphire-physics changes
  - Added RRTM-GP as radiation scheme on GPU
  - Consolidation of all QUBICC based enhancements and bugfixes



# Release icon-2.6.4 (expected soon)

- Large refactoring of infrastructure modules by DKRZ
- Cleanup: Removal of Hydrostatic Core, PSRAD and RG radiation, `#ifdef COSMO`
- Synchronize effective radius calculation between radiation and microphysics
- Improved description of gravity waves emission in SSO scheme
- Optional diagnostics of lightning potential index (LPI)
- Reintroduce an optimized reading of Kinne aerosols
- Update to ocean icon-oes-1.3.06
- Major JSBACH update (including the introduction of a JSBACH standalone mode)
- Usage of netcdf instead of CDI for restart I/O (old restart files with new version works, but not vice versa)
- Update to YAC2
- Fix for the soil water budget and runoff with snow tiles