

# COSMO-Model 5.0 and Beyond

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## Contents

- Main Changes contained in COSMO-Model 5.0
- New Developments and Ongoing Work for
  - Assimilation
  - Dynamics and Numerics
  - Physical Parameterizations
  - Technical Issues
- Release Plans

# COSMO-Model 5.0

## Main Changes in COSMO-Model 5.0

- New fast waves solver in the dynamics: major step forward to go to resolutions from 1-2 km!
  - Improvement of accuracy of all vertical derivatives and averages
  - Use of divergence operator in strong conservation form
  - Isotropic treatment of artificial divergence damping
- Revision of nudging code with extension of quality control for surface pressure observations
- „Consolidation“ of most schemes (which means: smaller improvements, bug fixes, etc.)
- See presentation from last years User Seminar for a more complete list of all the changes or take a look to

<http://www.cosmo-model.org/content/model/releases/developments.htm>

## Main Changes in COSMO-Model 5.0 (II)

- Implementation of a new tracer structure
- Unified NWP-CLM Version
  - Implemented an interface to the OASIS coupler (Version 3)
  - Introduction of prescribed surface albedo based on MODIS
  - Introduction of new GHG concentration scenarios
  - Introduction of time-dependent aerosol optical depths
  - Implementation of an asynchronous NetCDF Strategy
- Updated COSMO-ART (3.0) Version
- Implementation of interfaces for MESSy
- Implementation of interfaces for the 2-Moment Microphysics
- Implementation of grib\_api for reading / writing GRIB data; preparation for GRIB2

# Current Construction AREAS

## Work in Assimilation

- Stochastic perturbations of physical tendencies (SPPT: needed for KENDA)
- Radar observations forward operator

## Work in Dynamics and Numerics

- Consolidation of the tracer module
- Adaptation of the Runge-Kutta dynamical core for SPPT
- Targeted diffusion to avoid cold pools in narrow valleys
- Reformulated divergence damping coefficients in the new fast waves solver and further consolidation of that scheme



## Work in Physical Parameterizations: COSMO-ICON Physics

- All physical parameterizations shall be written in a way that they can be used in the COSMO-Model as well as in ICON.
- But the packages shall NOT be implemented twice: both models shall use the same sources!
- In the first step there are technical issues to be clarified:
  - Memory layout and data structure to use
    - COSMO:  $(i, j, k)$
    - ICON:  $(n_{proma}, k)$
  - Design of the interfaces: USE vs. Parameter lists
  - Write interface routines for each model to access the parameterizations and provide the proper data (For example, the COSMO-Model has to interpolate the horizontal wind speeds to the mass grid point)

## Work in Physical Parameterizations: COSMO-ICON Physics (II)

- And then there are still differences in the contents of the schemes:
  - Nearly all schemes have been modified to properly work in ICON, e.g.
    - Microphysics:
      - ice sedimentation, autoconversion cloud ice → snow
      - option for a 2-moment cloud ice scheme (Ph.D. thesis C. Köhler)
    - Turbulence: encapsulated vertical diffusion routine with the option to handle additional passive tracers
    - TERRA: consolidated scheme and multi-layer snow model
      - numerical stability improvement for heat conduction through thin snow cover
      - tile approach
  - These modifications have to be tested now in the COSMO-Model

## Work in Physical Parameterizations: COSMO-ICON Physics (III)

- There is the possibility now to integrate different schemes rather easily. We just have to write the proper interface. E.g for
  - ECMWF convection scheme from P. Bechtold
  - RRTM radiation scheme

## Technical Issues

- Implementation of POMPA results and optimizations into the official version
  - Implementation of COSMO on GPUs:
    - STELLA: Rewrite of the dynamical Runge-Kutta core with C++ and meta template programming using a stencil library: during the next years, this will be offered as an option in addition to the Fortran code.
    - Porting of Fortran Code to GPUs using OpenACC
  - Single Precision Version: User has to choose before compiling the model, whether to run in single or in double precision (double will be default)
  - Cache optimizations for several modules (also from DWD's procurement: work done by Cray)
- Online Trajectory Module developed at the ETH Zürich
- GRIB2: DWD will switch to GRIB2 in 2./3.Q2014

## Release Plans: The Next Versions

- It is not yet decided, when and with which changes a model version 5.1 will be released. There are meetings of the Scientific Management Committee in April and in June, where this will be discussed.
  
- You can get informations from:
  - <http://www.cosmo-model.org/content/model/releases/default.htm>



Thank you  
very much  
for your  
attention