CONSORTIUM FOR SMALL SCALE MODELING

COSMO

Deutscher Wetterdienst

Wetter und Klima aus einer Hand

DWD

COSMO-ICON Physics

Current Status and Plans

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COSMO-Model

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Framework for copy to / from block data structure

- The data structure for the parameterizations is 2D (nproma, nlevel), while the COSMO-Model has a 3D data structure (i,j,nlevel)
- In a first version, a rather simple framework for copying data was implemented: just DO-loops including all necessary variables:
  - variable_b (iv, ik) = variable (i,j,ik) (and vice versa after the physics)
- In spring 2014, MCH implemented a more sophisticated strategy (now used in COSMO-Model 5.1):
  - CALL register_copy (variable, variable_b)
  - CALL copy_to_block (…), CALL copy_from_block (…)

Common COSMO-ICON Microphysics

- Combined latest changes in COSMO microphysics and ICON microphysics:
  - cloud ice sedimentation
  - sticking efficiency and evaporation
  - supercooled liquid water and reducing freezing rate
- Changes tested and verified in COSMO and ICON. Supercooled liquid water effects are not positive in ICON, therefore implemented a namelist switch.
- But some recent modifications not yet activated in either application (e.g. treatment of cirrus clouds)
- Removed NEC-optimizations for better vectorizations („index loops“): But this was not beneficial in ICON, where a slow-down of about 5 % was observed.
- Implemented interface routine gscp_interface.f90 to call all 4 microphysics versions now in blocked data structure (kessler and hydor not yet tested, but only used in idealized simulations)

Status of the Other Packages: Turbulence

- Prognostic TKE scheme
  - ICON code will be implemented in COSMO as part of PT ConSAT by the end of 2014
  - ICON code contains (active) modifications/extensions which influence the results compared to COSMO considerable (e.g. stability dependent minimum diffusion coeffcient)
- What about (old) diagnostic scheme?

Status of the Other Packages: Cloud Cover Scheme

- Partíal cloud cover scheme
  - ICON employs a recent development by M.Köhler, whereas COSMO operates actually two schemes depending on the ‚target parameterisation'
  - for radiative transfer partial cloud cover is determined on the basis of layer mean relative humdity and/or convective activity
  - for turbulence partial cloud cover is derived from a statistical approach based on Sommeria&Deardorf
  - no efforts have been made or ressources allocated to transfer the ICON approach to COSMO (or vice versa)

Status of the Other Packages: Convection

- Tiedtke Scheme
- Shallow convection scheme
- ICON convection scheme (Bechtold)
  - differs considerably from COSMO Tiedtke scheme (although based on the later)
  - no efforts have been made or resources allocated to transfer Bechtold scheme to COSMO (a CCLM implementation exists, but not in blocked data structure)

Status of the Other Packages: Radiation

- Ritter-Geleyn Scheme
  - usage of coarser grid does not fit into the actual “copy to / from” implementation
  - major developments regarding the interaction between cloud microphysics and the RT scheme have been done in COSMO (U.Blahak) using the RG92 scheme as basis (but not yet operational)
- RRTM
  - ICON employs RRTM as default radiation scheme
  - no efforts have been made or resources allocated to transfer the RRTM scheme to COSMO

Status of the Other Packages: Surface Schemes

- Soil Model, including lake and sea ice model:
  - ICON and COSMO employ the same schemes for the simulation of soil processes, lakes and sea ice.
  - but soil model TERRA (incl. multi-layer snow model) modified in ICON
  - code structure of ICON versions closely linked to the tile approach, i.e. routines are only called for those grid points with the corresponding soil state.
  - This requires an adaptation (or additional copy) for the „copy to / from“ implementation.

Status of the Other Packages: SSO Scheme

➔ ICON and COSMO use an identical scheme based on Lott & Miller

Work to Integrate the next Packages into COSMO

- Generic work to do:
  - include necessary variables in the „copy to / from“ framework
  - develop and implement the COSMO interface routines. This includes the option to choose between existing schemes used in COSMO and those that are so far only present in ICON.
  - compute non-1d-contributions to physics input in the interface routines.
  - thorough testing of pure technical adaptations in the COSMO environment (e.g. with regard to result neutrality, performance, etc.) in conjunction with the new interface
- provide a concept for future COMMON source code maintenance
- solve potential coding rule and source code management conflicts

Work to Integrate the next Packages into COSMO

- Specific work to do:
  - evaluate modified (turbulence) or new (convection/radiation) schemes in COSMO applications (NWP, CLM)
  - transfer developments in the COSMO branch (e.g. U.Blahaks cloud-radiation modifications) to ‚new' physics schemes (e.g. RRTM)

Problematic Issues

- For which architecture, processor, compiler do we optimize?
- „copy to / from“ framework:
  - copy one line of grid points and call all schemes for these grid points.
  - Cannot work on a coarser radiation grid or on the surface grids in that way.
  - Could we also copy the whole fields and then call the schemes one after the other? This way it is done in ICON.

And more Issues to Consider

- How to handle the source code for the common COSMO-ICON physics:
  - As a stand-alone library?
  - With implementations in both repositories?
- Provide a concept for future COMMON source code maintenance.
- Solve potential coding rule and source code management conflicts.
- There are more things to unify:
  - Mathematical and physical constants
  - Meteorological functions
  - KIND parameters (already started with KIND parameters for real variables)

About Resource Planning

We definitely need Horst!


Thank you
very much
for your
attention