

COSMO-Model Episode VI.0

The Last Unification

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The Story so Far

Current (public) Versions

- After some struggling we could release the following versions last August to the public
 - COSMO-Model 5.05 (from 23rd February 2018)
 - INT2LM 2.05 (from 26th February 2018)

- In the meantime work went on and we have some preliminary versions for the COSMO-Model (not yet officially distributed to the public)
 - 5.05a: 22nd June 2018
 - 5.05b: 14th December 2018
 - 5.06: 27th February 2019

- Tests with the COSMO NWP Test Suite are going on. A public release can be expected soon.

The Latest Versions

Version	Date	Contents (Highlights)	Results Changes
5.05a	22.06.18	<ul style="list-style-type: none"> • Dynamics: 2nd order Bott scheme together with deformational correction method • Porting additional parts to GPU: diagnostics, output • Changes to prepare implementation of Radar Forward Operator 	<p>if used</p> <p>no</p> <p>no</p>

The new Bott scheme is activated with `y_scalar_advect = 'BOTTD2'`
 Stability behaviour is similar to `'BOTT2_STRANG'`, but with less computing time.

The Latest Versions

Version	Date	Contents (Highlights)	Results Changes
5.05b	14.12.18	<ul style="list-style-type: none"> Porting additional parts to GPU: LHN, nudging, lbdclim, fixes in physics Bug fix in turb_tran (also implemented in 5.05_1 and 5.05a_1). This fix avoids some crashes. 	<p>no</p> <p>slightly</p>

Where We are Now

The Current Version

Version	Date	Contents (Highlights)	Results Changes
5.06	27.02.19	<ul style="list-style-type: none"> • COSMO-Model in single precision • GPU: CLAW directives for turbulence; some more fixes • Mire parameterization • Data assimilation (technical; GNSS; LHN) • New wind gust tuning (itype_diag_gusts=5) • Lockfile mechanism 	<p>no</p> <p>no</p> <p>yes</p> <p>no</p> <p>no</p> <p>no</p>

Changes of results are only numerically!

→ Mire: the expression $eai(i) / sai(i)$ is replaced with a local variable, which is 1.0 in case of mires. This changes order of evaluation in the next expression (even if mire param. is not used)

$a * b * eai(i) / sai(i)$ vs. $a * b * zloc$

COSMO-Model in Single Precision

→ Fixes in sfc_terra:

- A climate run for 1999 has been performed in single and in double precision (Erwan Brisson, Uni Frankfurt)
- Large differences in snow variables in mountainous areas and in the beginning of spring

- Replaced some occurrences of `eps_soil` (= `1.0E-6_wp`) by

```
eps_temp = MAX(1.0E-6_wp, 500.0_wp*EPSILON(1.0_wp))
```

with

```
EPSILON(1.0_sp)=1.192E-7 and EPSILON(1.0_dp)=2.2E-16
```

- Work done by MCH some years ago was lost when implementing ICON Version into COSMO
- Replaced now all EPS where necessary

COSMO-Model in Single Precision

- Interface to RTTOV: RTTOV and libradiance require double precision variables
 - Modified interface to libradiance accordingly
 - But only for synthetic satellite images (lsynsat); not for use within data assimilation (lobsrad)
- Computation of lightning potential index (LPI)
 - modified convergence criterion for Newton-method to find zeros of a function $f(p)$ from
$$\text{ABS}(f/f') < 1.0\text{E-}2 \quad \text{to} \quad f(p) < 1.0\text{E-}6$$
- Clipping for cloud variables in `radiation_utilities.f90`: negative values occurred in single precision computations!
- Using the single precision version still is on your own risk!

Physical Parameterizations

- Mire: The approach of Alla Yurova et al. has been implemented (technical work and tests done by Jürgen Helmert: see WG3b presentation on Thursday!)
 - `itype_mire`
 - 0: no parameterization (default)
 - 1: Approach from Alla Yurova
- Turbulence: some technical modifications due to implementing the COSMO modules back to ICON
 - Bug fix for `itype_vdif=+1` (vertical diffusion after physics): pass correct values of a blocked variable to vertical diffusion.
 - Note that only `itype_vdif=-1` is recommended to use! We still cannot guarantee that `itype_vdif = 0/1` are working correct!

Status of 5.06

- Version implemented in DWD VCS on February 27th
- Problems with the Technical Test Suite (a compiler bug!) can now be avoided
- Documentation (Release Notes; update of User Guide) has to be finished (delayed because of investigating problems with TTS)
- Test binaries on cca (EMCWF) are installed and the NWP Test Suite is now running
- The only change to version 5.05 is the usage of the new Bott scheme (`y_scalar_advect='BOTTD2'`)
- We do have a good hope that the results will be ok and we can release version 5.06 soon.

There will also be a new version of INT2LM:

Version	Date	Contents (Highlights)	Results Changes
2.06	29.03.19 (most probably)	<ul style="list-style-type: none"> • Introduce external parameter field for skin conductivity • Introduce option to read slope of orography (S_ORO) • Interpolate all levels from hhl_in to hhl_gl (avoids crashes when going from COSMO-D2 to a finer grid) • Option to use of NETCDF4 for writing 	<p>no no</p> <p>for GRIB2</p> <p>no</p>

The Last Unification

Ongoing Developments in COSMO

- Integration of the Radar forward operator (EMVORADO)
- Higher order horizontal discretizations (WG 2)
- COSMO-EULAG: new dynamical core based on EULAG
- Urban module: tests in PT AEVUS are still ongoing
- Introducing a skin temperature formulation
- Including work from PP T²(RC)² (new cloud optics, new aerosol inputs, ...)
- Ground water runoff (by Linda Schlemmer)
- GPU port of Tiedtke-Bechtold convection

and more technical adaptations and issues

Work Done by CLM

COSMO (NWP) and COSMO (CLM) will be re-unified once again for 6.0.

Highlights of the CLM developments are:

- Restart files in NetCDF format
- Additional diagnostics in the output
- Work in TERRA (fixes in multi-layer snow model)
- More tuning parameters
- Additional fixes and technical changes

- Contributions from COSMO-crCLIM (GPU/CPU version by ETH Zürich)

"Project Schedule"

- Implementing COSMO Episode VI.0 will be done in several substeps (5.06a, 5.06b, etc.). A precise plan is not yet available.
- There will be a discussion in the CLM SUPTECH meeting on Friday.
- If we say "Autumn 2019" you can expect it for ICCARUS 2020 (hopefully).
- After this version we will only do "perfective maintenance" (bug fixes, technical optimizations, etc.)
- DWD will replace the COSMO-Model during 2020 by ICON-LAM. It could be that we never will implement COSMO Episode VI.0
- But support will go on until all users have migrated to ICON-LAM

Future of COSMO and ICON

Going to The Dark Side of the Force ?

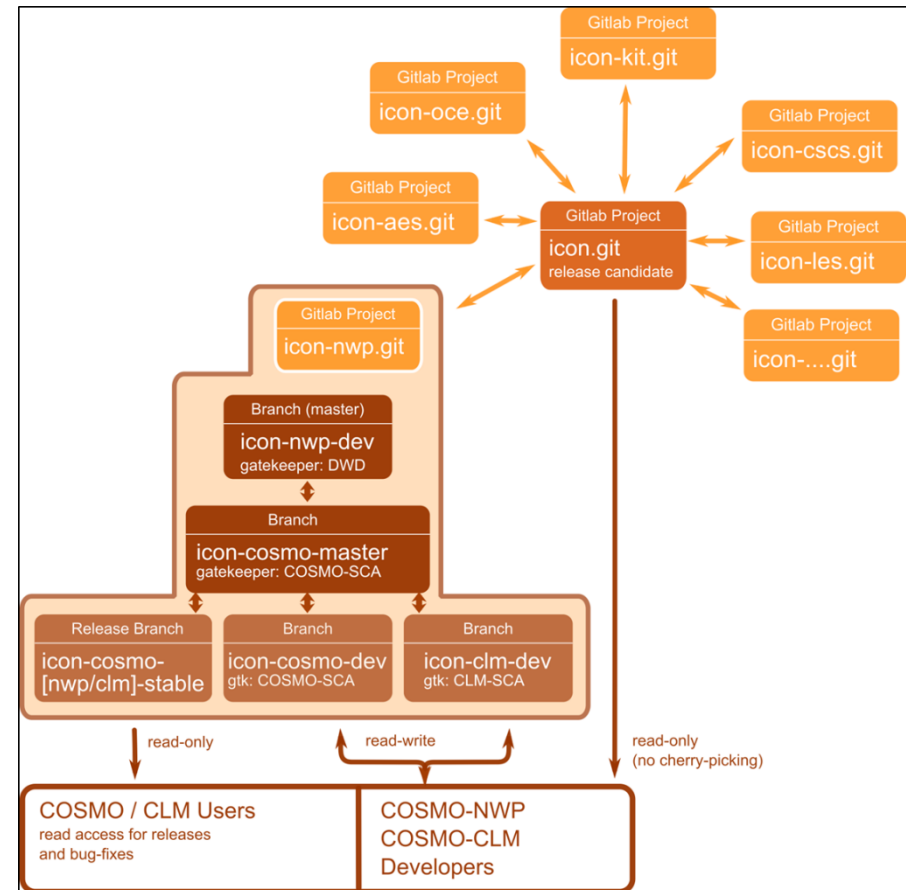
A domain of evil, it is.
In, you must go.

The COSMO and ICON Communities (as I see it)

- Infrastructure is rather different (groups, models, workflows)
- Two (separate) groups with a common interface at DWD
- Taking a look to the early meetings / discussions, I had the opinion there was fear of a hostile takeover on both sides
- Worlds are not clashing! There is the chance to take the best of both worlds!
For example:
 - ICON is the more powerful (and better) simulation model
 - COSMO has the better documentation (model documentation, release notes)
- ICCARUS and ICON Developer Meeting (spring) will be joined next year

Proposal: Changes to the (COSMO) Workflow

- ➔ All development work will be organized by a common git repository
- ➔ There is an **icon-cosmo-master** below the **icon-nwp-dev** (for global mode)
- ➔ It is investigated whether a gitlab server can be put up at DKRZ to organize the common developments
- ➔ Note: All these things are still under discussion!



*CALM YOU
SHALL KEEP
and
MAY THE
FORCE
BE WITH YOU*