

Source Code Management (COSMO / INT2LM)

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COSMO-Model / INT2LM

Last Years Versions

Version	Date	Contents (Highlights)	Results Changes
INT2LM 2.01	25.11.14	<ul style="list-style-type: none"> • ICON to COSMO interpolation • GRIB2 and grib_api 	no
COSMO 5.01	28.11.14	<ul style="list-style-type: none"> • COSMO-ICON microphysics • Stoch. Perturbation of Physics Tend. • POMPA contributions 	numerical changes
COSMO 5.02	21.05.15	<ul style="list-style-type: none"> • Revision of using MPI datatypes • fix in computation of kflat 	numerical changes
INT2LM 2.02	11.06.15	<ul style="list-style-type: none"> • GRIB2 for centers \neq DWD • fix for computing PP when adjusting the reference atmosphere 	numerical changes
COSMO 5.03	???.???.15	<ul style="list-style-type: none"> • COSMO-ICON physics • Further POMPA work 	yes

COSMO-Model 5.1 and INT2LM 2.1

- Developments have been presented last year with the hope to have releases until end of September 2014.
- But things always take longer than you expect:
 - cross-checking by all contributors
 - testing
 - documentation
- New versions could only be released end of November 2014.

Contents of COSMO 5.2

- Corrected computation of `kflat` for GRIB2 input:
 - `kflat` (height, where COSMO levels become flat) is not contained in GRIB2 meta data and has to be constructed when starting the model.
 - has erroneously been done in every subdomain without information on full domain and was not reproducible
- Revision of using MPI datatypes:
 - Boundary exchange is done for groups of variables. For each group an MPI datatype can be defined. But it is absolutely necessary that the memory layout of all variables in the group does not change during the simulation!
 - Due to some developments in the last time the proper association of the data types to the groups has been lost. Depending on the compiler, this could lead to erroneous message passing and wrong results!

An Interesting Background Story

- On Sunday, Feb. 1st, 6 UTC, there was a crash of the COSMO-EU operational forecast run with the following error message (during output of hour 27)

```
GRIB_API ERROR:  grib_set: iDirectionIncrement Invalid grib id
*** Error in grib_clone: from outblock sample  -28
```

- Similar crashes happened more often in the next months, but when restarting the model with a different processor configuration, the run could be completed without problems.
- There is no error in GRIB_API, but the data structure (the sample), which should be cloned, was corrupted at that time: some other action destroyed the corresponding area of memory.
- We reported the problem to Cray and started an extensive debugging and model investigation (all kinds of checking; reducing compiler optimizations; memory debugging).

An Interesting Background Story (II)

- Through memory debugging we could find and repair several problems:
 - using wrong MPI datatypes
 - using uninitialized variables
 - multiple allocation of a pointer in `mpe_io2.f90` without deallocation
- Some of the crashes could be cured with these fixes, but not all.
- Then Cray accepted the official compiler bug report (mid of May)
- Beginning of August, a beta version of the new compiler was available, which cured the problem at last. The official release of this version is end of September!
- Estimated time to investigate that problem: 8-10 weeks!

Contents of INT2LM 2.2

- Modifications of `grib_api` implementation for centers \neq DWD:
- Bugfix in computing the pressure deviation when changing values of the reference atmosphere (`t0sl`, `p0sl`, `delta_t`, `h_scal`). It was only checked whether `irefatm` changed, but not whether these values changed.
- Determination of boundary layer height for ICON. A general procedure to calculate the boundary layer height for ICON has been implemented.
- Specification of the ICON representative grid distance as a scaling parameter for the radius of influence in the RBF-interpolation:
- Bugfix in computation of `QV_S` for partially and fully snow covered areas: use `t_g` and not `t_s`
- Bugfix in writing ready files for asynchronous IO: A missing synchronization between compute and I/O processors has been added.
- Some technical changes regarding treatment of ICON data.

Developments for COSMO-Model 5.3

The Scientific Management Committee approved the following contributions for COSMO-Model 5.3:

→ Assimilation

- feedback files and extended reading of scatterometer and AMDAR data
- change of calling sequence of assimilation and relaxation (POMPA)

→ Dynamics

- Redesign of 3D diffusion to improve stability
- Implement interface to C++ dynamical core and serialization (POMPA)
- Implement possibility to switch on/off the Euler dynamics
- Implement possibility to switch off the tracer advection
- several bug fixes from POMPA

Developments for COSMO-Model 5.3

- COSMO-ICON Physics (contributions from POMPA)
 - Microphysics: implement possibility to run the microphysics at the beginning of the time loop
 - Radiation:
 - implement a blocked version of Ritter-Geleyn radiation and the corresponding interface
 - this version also supports the possibility to work on a coarser grid
 - Turbulence: a first version has been implemented, but is not activated yet
 - there is still a consolidation process between the current COSMO version and the modified ICON version. For that, much more tests have to be performed.
 - much time has been spent to investigate the changes for the ICON version (by introducing hard coded switches for all changes)

Developments for COSMO-Model 5.3

→ Technical Changes

- Modification of `grib_api` implementation for centers other than DWD
- Computation of pure diabatic temperature tendencies (new output variable `TTENS_DIAB`)
- Computation of Lightning Potential Index (LPI) after Lynn et al. (2010) (new output variable `LPI`)

→ Technical Test Suite:

- Starting with COSMO 5.3, the Technical Test Suite will be provided together with the model
- It contains two sets of tests: `testlist_mch.xml` and `testlist_dwd.xml` and a script (`get_data.sh`) to get the binary data to run these tests from a MCH ftp-server , so really everybody can run these tests.
- Users are encouraged to develop their own tests.

Status of COSMO-Model 5.3

- A beta version has been given to the contributors (for cross-checking) and the COSMO beta testers.
- Feedback expected until end of September
- After the COSMO GM the NWP test suite will be started. Results are expected beginning of October.
- Then the version can be released

Plans for the next Version(s)

- Assimilation
 - Removal of AOF interface
 - Radar operator (but still to be decided)
 - Code Re-Factoring (POMPA)
 - Work on LHN (POMPA, improvement of communications)
- Dynamics
 - Integration of new boundary condition module `src_lbc.f90`
 - Code Re-Factoring of Fortran dynamical core

Plans for the next Version(s)

- COSMO-ICON Physics
 - Turbulence
 - Surface schemes: src_soil_multlay, src_seaice, src_flake
 - Remove src_soil (old 2/3 layer soil model)
 - SSO scheme: src_sso
 - Convection (if time allows)
 - Microphysics, Radiation: „wrap-up“
- Further POMPA work
 - OpenACC and GPU utilities

Benefit of Documentation, TTS

Why is it necessary to document, test and talk to fellow developers?
Strange things could happen otherwise!
Have a look!



How the customer explained it

Benefit of Documentation, TTS



How the Project Leader understood it

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How the Business Consultant described it

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How the Analyst designed it

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How the Programmer wrote it

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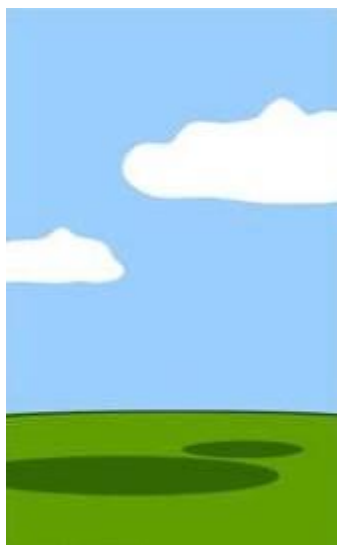
What Operations installed

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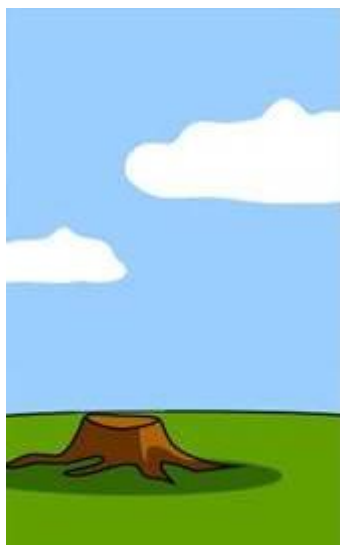
How it performed under load

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How it was documented

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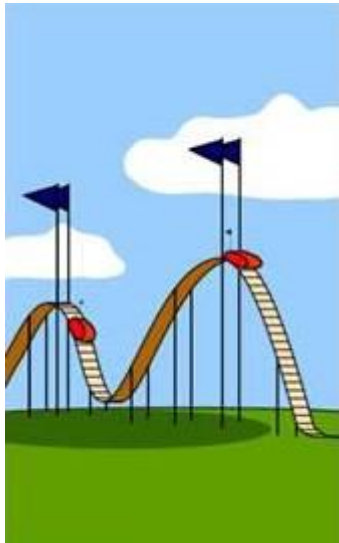
How it was supported

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What Marketing advertised

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How the Customer was billed

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What the Customer really needed

Try to find problems and errors early in the process!



Thank you
very much
for your
attention