New version int2lm 2.03

U. Blahak

DWD, Offenbach

Changes

➔ Linear vertical interpolation for some variables can now be chosen more easily in the code (src_vert_inter_lm.f90) by new internal switch in subroutine call:
vert_interp (qr_lm, 'qr', ... --> vert_interp (qr_lm, 'qr', 'linear', … (or ‚ctspline‘)
but no actual change yet (I'm thinking about changing it for moisture variables and tracers in the future). **No change of the results yet, because not activated!**

➔ In case of GFS input data: Possibility for input of RELHUM data (previously only QV was read, but since 01/2015 GFS data has switched to RELHUM). **Huge change of results, because before, qv_lm was set to the value for 1 % relative humidity, if no QV present in input data.**

➔ Added ensemble types 1-4, 101-104 for ICON-EDA-to-EPS interpolations (relevant for internal checking of grib2 meta data). **No change of results.**

➔ **Technical**: implemented general 4D "tracer" field to hold new 3D fields for easier integration into the code. Works a bit like the tracer structure in COSMO, but much more rudimentary. It is meant to simplify the addition of new "normal" 3D variables which just have to be interpolated without any special treatment in the rest of the code. Just add their definition and meta data to subroutine "**tracer_define()**" in "**src_gribtabs.f90**" and the "rest" will be handled automatically. **Purely technical, does not change results.**

➔ **src_gribtabs.f90, subroutine tracer_define(): Add a block at indicated position**

```
!   ADD NEW 3D FIELDS HERE ALONG THE LINES OF THE ABOVE:

ntracer                             = ntracer + 1
IF (ntracer > ntracer_max) STOP
trcr_meta(ntracer)%shortname        = 'PRR_CON'
trcr_meta(ntracer)%grbtab           = 201
trcr_meta(ntracer)%grbnr            = 112
trcr_meta(ntracer)%unit             = 'kg/(m^2 s)'
trcr_meta(ntracer)%description      = 'Rainrate from convection scheme (3D)'
trcr_meta(ntracer)%short_description = 'rainrate_from_convection_scheme_3D'
trcr_meta(ntracer)%ilevtyp          = 109
trcr_meta(ntracer)%clevtyp          = 'hybrid'
```
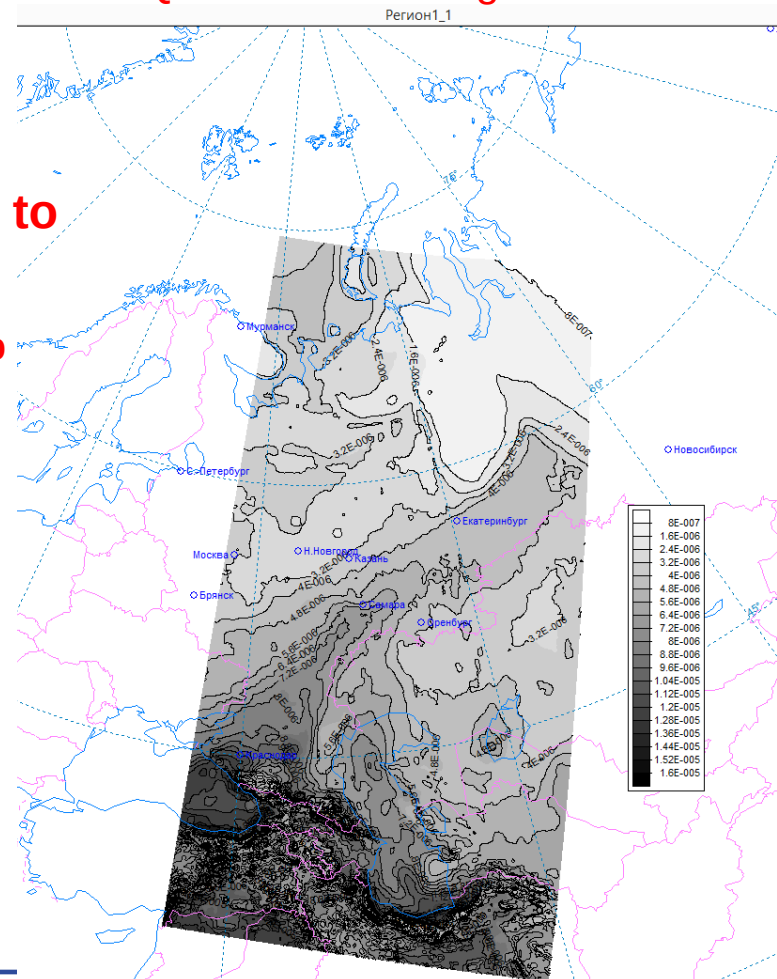
COSMO moisture from IFS

➔ **without** RELHUM input, when missing IFS QV (starting from some date in 2015):

QV in some near-ground level

Values < 1E-5 down to 1E-7 kg/kg!

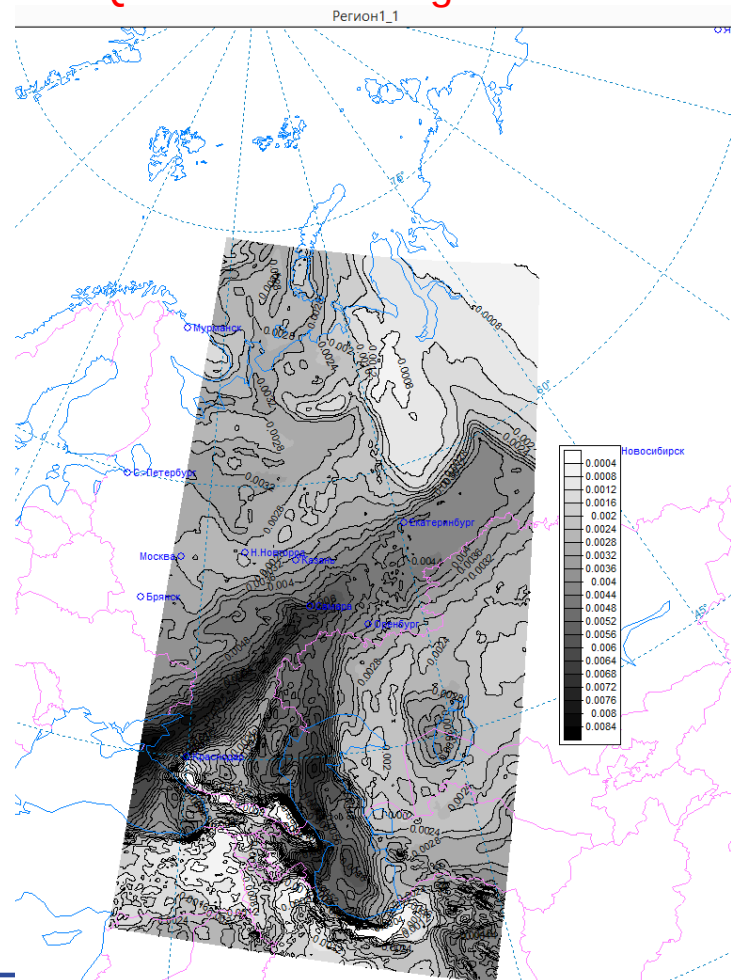**Corresponds to 1 % relative humidity everywhere!**

(© Denis Blinov)

COSMO moisture from IFS

Deutscher Wetterdienst
Wetter und Klima aus einer Hand

➔ **with** RELHUM input, when missing IFS QV (starting from some date in 2015):

QV in some near-ground level

Realistic values up to 0.0084 kg/kg

(© Denis Blinov)

➔ Implemented interpolation of MACC aerosol data to COSMO grid with the help of the new 4D field. 11 new fields (for PP T2RC2).

➔ Implemented use of Kinne (2015) climatology (for PP T2RC2)

➔ Interpolation of PRR_CON („rain_con_rate_3d" in ICON namelist) and PRS_CON („snow_con_rate_3d") for ICON input (based on new int2lm 4D field) to be able to convert the convective precipitation rate profile to QR and QS for input to a COSMO-Model without convection parameterization. New namelist parameter *lprog_prrcon_prscon*.

➔ For TERRA_URB: copying of the fields AHF and FR_PAVED/ISA from the COSMO external parameters to the analysis. New namelist switch *lterra_urb*

➔ For the new blocked turbulence code, the field SSO_STDH is needed. This field is now required in any case and must be present in the external parameter files. Therefore, new external parameter files should be generated (from ASTER orography).
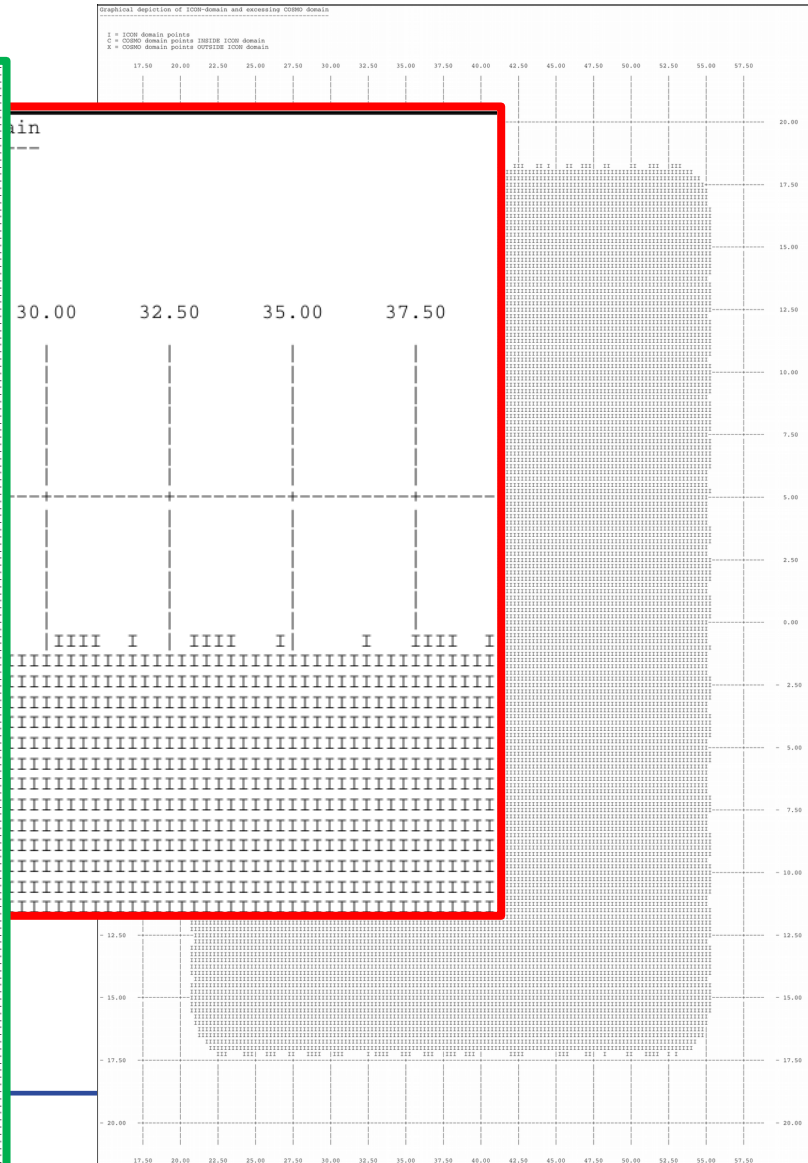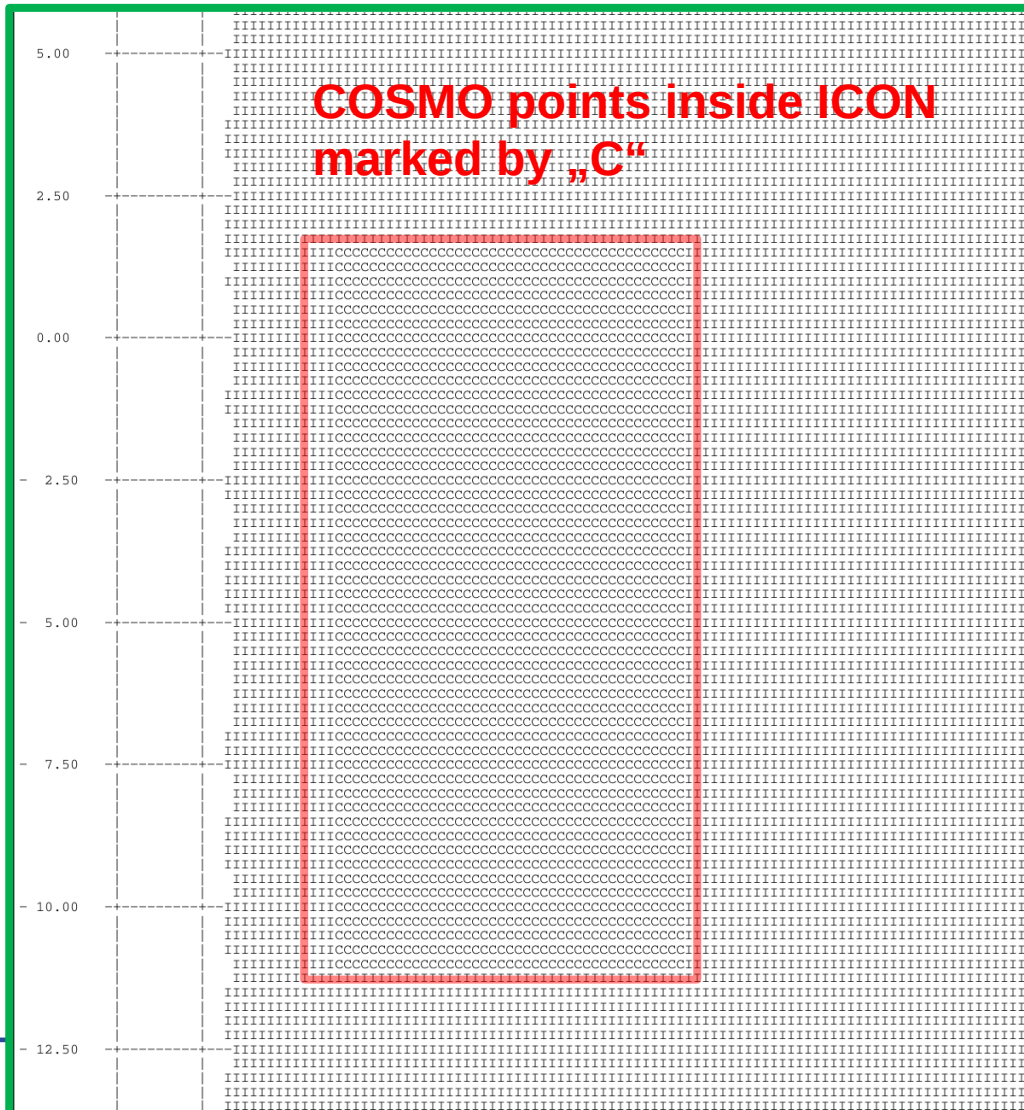
Changes

➔ **Technical:** in case of BCs on a frame, use a bitmap to reduce compressed file sizes (L. Torrisi). **Does not change results.**

➔ Not implemented: reduction of the number of required extra grid halos in the coarse model domain from 2 to 1. **Request by Lucio, but not implemented because it does not work in general. The problem arises when a fine gridpoint at the fine domain boundary (either total domain or processor subdomain) hits exactly a coarse grid point.**

➔ Grib coding of ensemble data: now iepsmem, iepstot and iepstyp are also written to the analysis file, not only to the boundary files. This is needed for interpolation of KENDA ensemble for initial conditions. For this, the existing namelist parameters *leps_bc, iepsmem_bc, iepstot_bc, iepstyp_bc* are complemented by new parameters *leps_ana, iepsmem_ana, iepstot_ana, iepstyp_ana .* **NOTE: DWD-grib use only, i.e., localDefinitionNumber = 253!**

Changes

Deutscher Wetterdienst
Wetter und Klima aus einer Hand

➔ Domain check for ICON input data implemented. If debug level „high enough", new ASCII output files „YUICON_COSMO_DOMAINS_[suv]", showing the ICON- and overlapping COSMO domains as ASCII-ART map. In case of not fully overlapping domains, a similar file „YUERROR_ICON_COSMO_DOMAINs_MISMATCH_s" is generated. Additionally, for ICONSUB generated data sets, the parameters of the rotated lat/lon grid are checked and additional diagnostic error messages are generated. **Otherwise, no change of results!**

➔ Format of namelist parameter output (file OUTPUT) has been adapted for the namelist tool. **No change of results!**

➔ MESSy interface implemented, depends on #ifdef I2CINC and #ifdef MESSYTWOWAY. **If these switches are not set, no change of results!**

➔ ASCII file **YUICON_COSMO_DOMAINS_s**
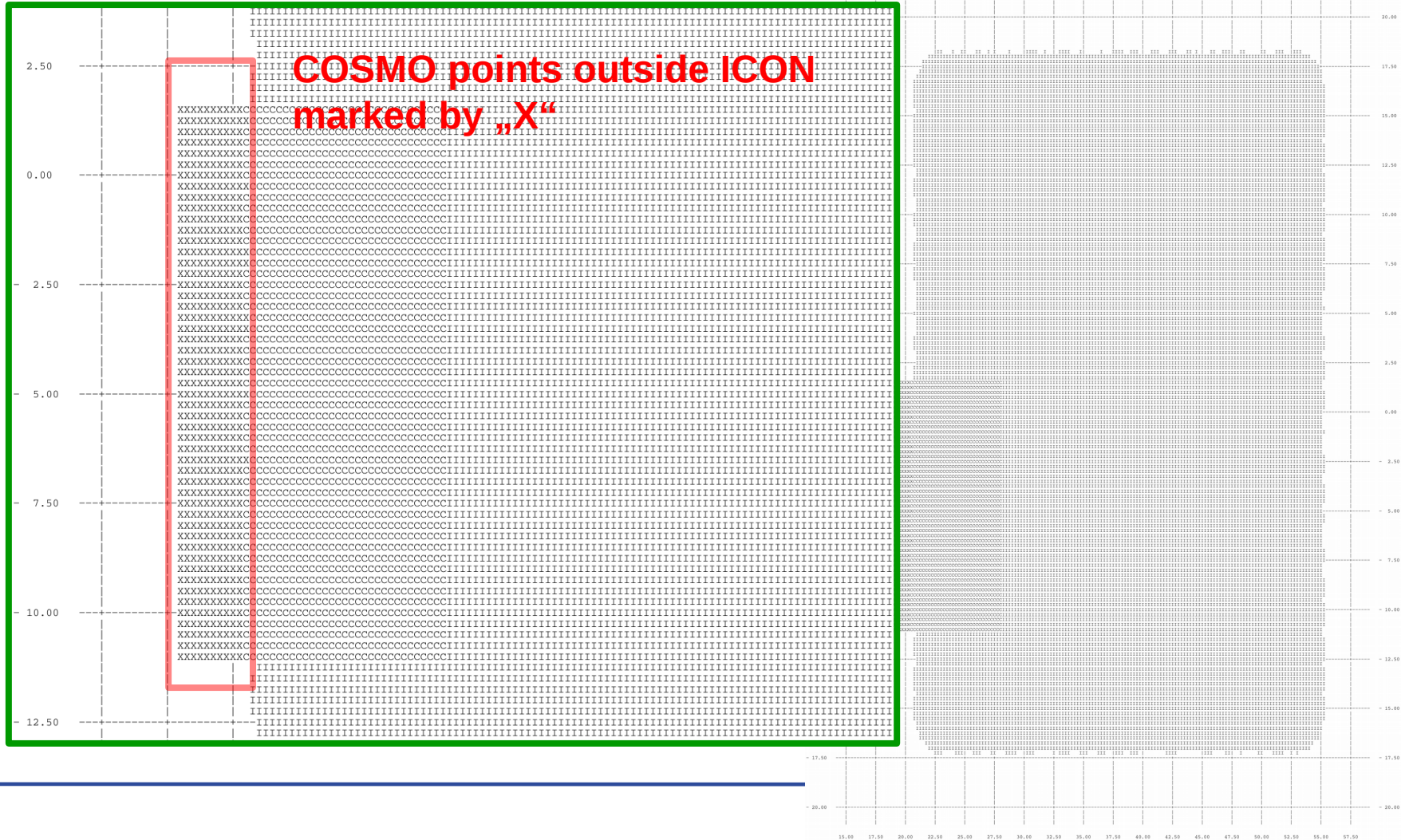

COSMO points inside ICON marked by „C"

ICON DOMAIN CHECK

➜ ASCII error file **YUERROR_ICON_COSMO_DOMAINs_MISMATCH_s**

COSMO points outside ICON marked by „X"

➔ Domain corner check in read_nc_gdefs_ext_lm() for reading NetCDF data (src_read_ext.f90), in case of NetCDF input. **No change of results.**

➔ src_gme_interpol.f90, src_read_coarse_grid.f90: The existence check for ready-files was within an #ifdef GRIBDWD, which has nothing to do with grib1 input. This was because of a call *to **fsleep()** from LIBDWD. Now an own *lm_sleep()* has been created in utilities.f90, which is called instead. It replaces the already present *dosleep()* function (same functionality, but explicit integer type conversion to/from C unsigned int). **No change of results.**

➔ Some bug fixes from CLM overtaken from CLM RedC Tickets. **Slight change of results depending on location.**

➔ src_read_ext.f90: added missing initialization of field_in_file. **Normally no change of results.**

Bug fixes

➔ Changed/fixed determination of boundary layer height for ICON. Previously, the PBL height was determined by the minimum layer index k over all PE domains for which the PE domain max P is just above 850 hPa. This is problematic for elevated domains without sea points and surely fails if the entire domain is a high plain. Now this is has been changed: Now we search for the highest level below the pressure ps-150 hPa*(1-min(hsurf)/vcflat_icon) at the point(s) with the domain minimum orography. If more than one such points exists, the one(s) with the maximum surface pressure over these points are chosen. If again more than one such points exists, the point with the lowest level index wins.
For this: new namelist parameter *vcflat_icon* (default 16000 m). **This changes the results because of the max(ps)-150 hPa instead of fixed 850 hPa value.**

➔ Fixed subroutine *make_fn()*, so that now also ICON analyses can be interpolated and used as initial and boundary conditions for COSMO**. Note: Currently does not work for ICON analyses from DWD, because some fields are missing there (W, QV_S, T_G). Here, the forecast fields from vv=0 should be used instead: rename manually to igafYYYYMMDDhh and set yinput_type='analysis'. Does not change results!**

➔ For nonhydrostatic input data (ICON and COSMO): updated vertical hydrostatic pressure computation (*lbalance_pp=.true.*) to be consistent with the RK-dynamics with its two different fast-waves solvers. Have overtaken routine *calc_p_hydrostat_psts()* from COSMO 5.3 *src_artifdata.f90*. New namlist parameters **itype_balance_pp (1=old, 2=new)** and **itype_fast_waves_lm (same as itype_fastwaves in COSMO)**. **Changes the results for p respectively pp, qv and qc!**

➔ Fixed copying of yvarbd_d(:) to youtlist_bd(:), where an erroneous nzmxini_d instead of nzmxbd_d was used to specify the copy-range. **Does not change results!**

➔ Fixed problems with nlevskip if some of the skipped levels do appear in the coarse input files (added some „return" in src_read_coarse_grid.f90). **Does not change results!**

➔ Introduced some tolerance in refatm check for COSMO2COSMO, because there could be a loss of accuracy in grib coding. **Does not change results!**

➔ For ICON2COSMO, ncdf dimension name of „cell" in grid file was „ncells" for older grid files. Now both names are possible. **Does not change results!**

→ New namelist parameter *vcflat_icon* (default 16000 m), because this is needed in the determination of the correct PBL height index ("850 hPa layer" = "ground minimum minus 150 hPa") for ICON input data in src_vert_inter_lm.f90, because of the terrain following coordinate. **May change results**

→ New namelist parameters *itype_balance_pp* (1=old, 2=new=default) and *itype_fastwaves_lm* (same as itype_fast_waves in COSMO) for consistent hydrostatic pressure balancing relative to the applied fast waves solver in COSMO. **Changes the pressure**

→ New namelist parameter *lprog_prrcon_prscon* for interpolation of PRR_CON and PRS_CON. Only effective in case of ICON input so far. **No change of other results**

New namelist parameter

➔ New namelist switch *lterra_urb* for copying the fields AHF and FR_PAVED/ISA from the COSMO external parameters to the analysis. **No change of other results.**

➔ Grib-coding of initial condition ensembles: *leps_ana, iepsmem_ana, iepstyp_ana, iepstot_ana, lchk_ana_typ* have been added.
Now EPS grib meta data are also written to the analysis file in case of leps_ana=.TRUE.
NOTE: DWD-grib use only, i.e., localDefinitionNumber = 253!

➔ For IFS input: problems with land-sea-mask and soil properties for coastal points, if IFS input is much coarser than COSMO grid. Lead to INT2LM crashes in the past.

Erklärung: Wenn durch Interpolation von Küstenpunkten   auf einmal keine Bodenfeuchte mehr da ist, weil ein COSMO Landpunkt   durch Interpolation seitens IFS aufs geograph. Gitter ins Meer gefallen ist, dann wird im int2lm ein Seepunkt gesetzt. Das ist aber inkonsistent zu den anderen externen Daten und kann absturzen. Hier die Bodenfeuchte des benachbarten Landpunkts benutzen.

Plans for next version

➔ (Option for separate soil and snow interpolation could not be realized with reasonable efforts, because some methods/corrections for surface- and snow temperature interpolation use pressure and temperature from the lowest atmospheric level, which ultimately requires to read the entire atmosphere from the input data. In the end, this does not decrease the data amount and the runtime much and does therefore not make much sense. One could have tried to read only the „needed" lower atmospheric levels, but the coding would have been a nightmare.)

➔ Changes of A. Will related to PBL extrapolation in case of fine model oro < coarse model oro for hydrostatic input. Would improve the pressure field and reduce the initial noise in COSMO.

➔ Cold start for FLAKE from climatology instead of freezing point. **TBD with DM**

➔ grib2 input from COSMO with 15' intervals: Fix internal nunit_of_time in int2lm for grib2; overtake nunit_of_time from input data set. Ingo Sölch has hardcoded nunit_of_time=0 for his COSMO-MUC application.