
Latest News from the COSMO-Model System

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COSMO-Model System Today

→ Current Releases are:

- COSMO-Model 5.03 from 24th November 2015
- (5.04 from 08th March 2016)
- INT2LM 2.02 from 11th June 2015

→ From then on we did NOT STOP the development work, but major changes required a longer testing phase for the new releases. Because of that we only implemented "Test Versions", which were not officially released.

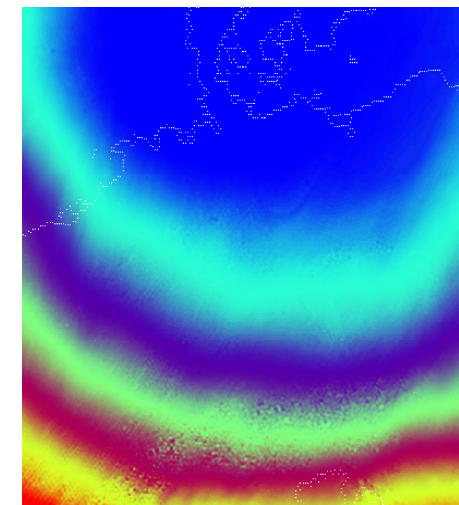
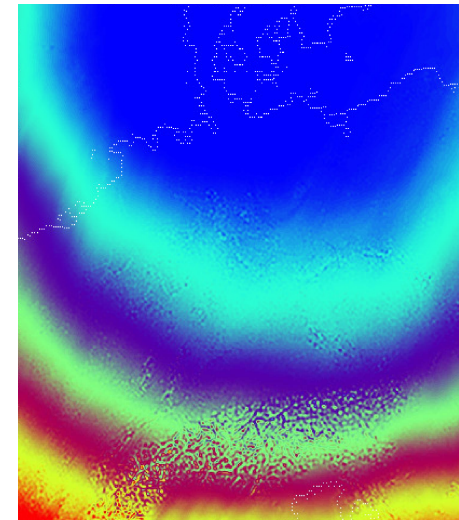
→ New Releases:

- INT2LM 2.03 from 27th January 2017 and 2.04 from 15th February 2017
- COSMO-Model 5.05: can be expected in April 2017

INT2LM

Highlights of the Changes to INT2LM

- For non-hydrostatic input models (COSMO, ICON, UM):
 - New methods of adapting vertical profiles to fine orography (deeper valleys, higher mountains in COSMO orography)
 - Profiles of W blended to „terrain following“ values (according to U and V) near the surface
 - Computation of (hydrostatically balanced) pressure (instead of doing an interpolation)
- These changes lead to less initial noise when starting the COSMO-Model from interpolated data.



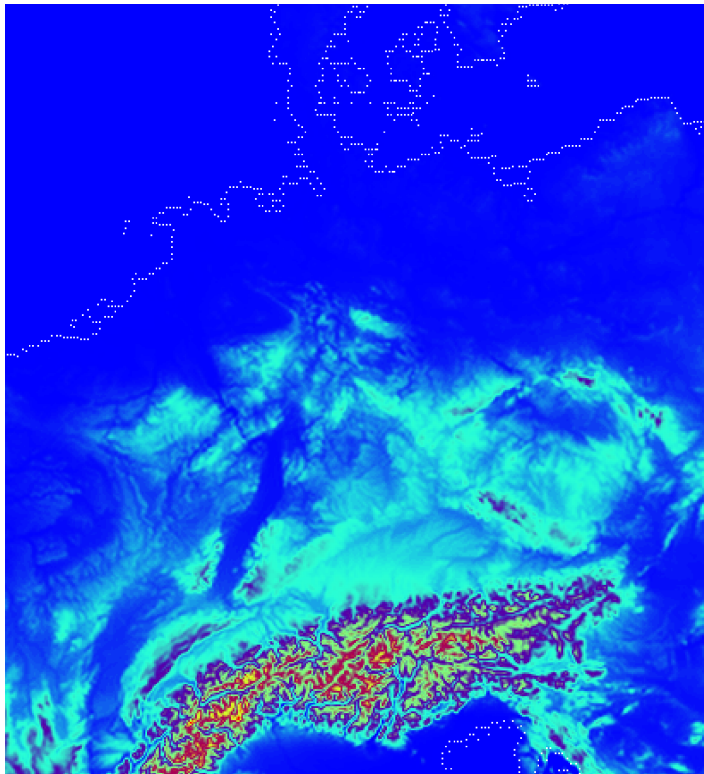
pressure deviation on level 4 (height ~ 18 km): old (above) and new (below)

Highlights of the Changes to INT2LM (II)

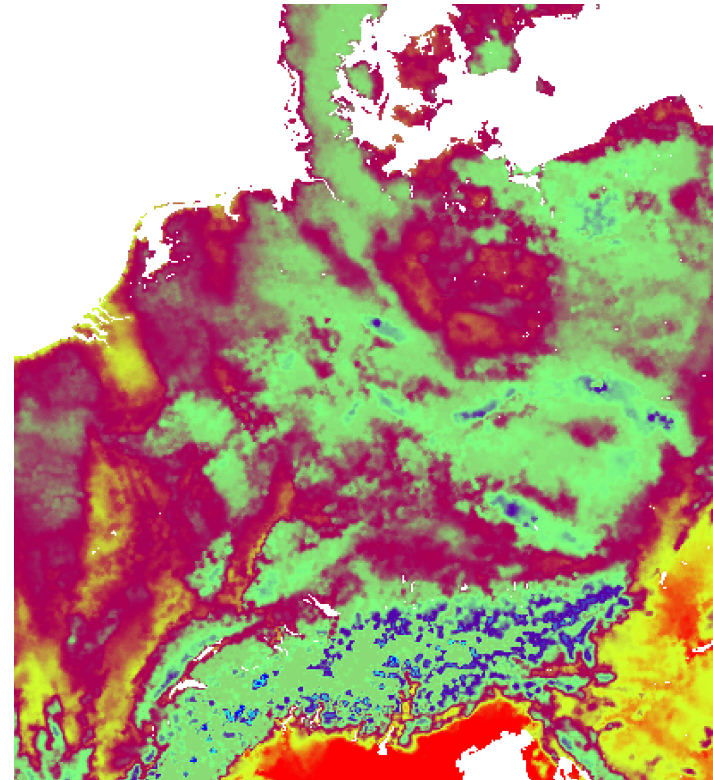
- Concerning ICON input only:
 - Bugfix:
 - Soil temperature T_{SO} (initial data) should be adapted to the new orography by way of conservation of differences to near-surface atmospheric temperature T_{ke} .
 - For ICON input it was done wrong, so that effectively T_{SO} was not adapted in the vertical, but only horizontally interpolated!
 - Adaptation to high-resolution near-surface T_{ke} only near the soil surface. At deeper layers blending to a climatological height correction
- Concerning IFS input only for initial data (implemented in 2.04)
 - Fix regarding inconsistent landmask and soiltypes in IFS external parameters from analysis files (which might be due to interpolation procedures in MARS)

Soil temperature bug

COSMO orography



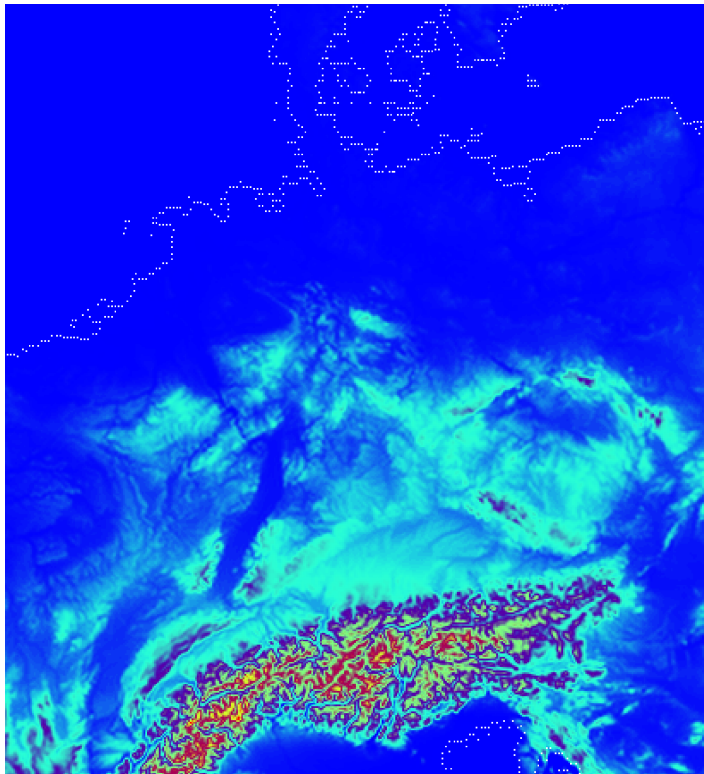
Soil Temperature (first layer)



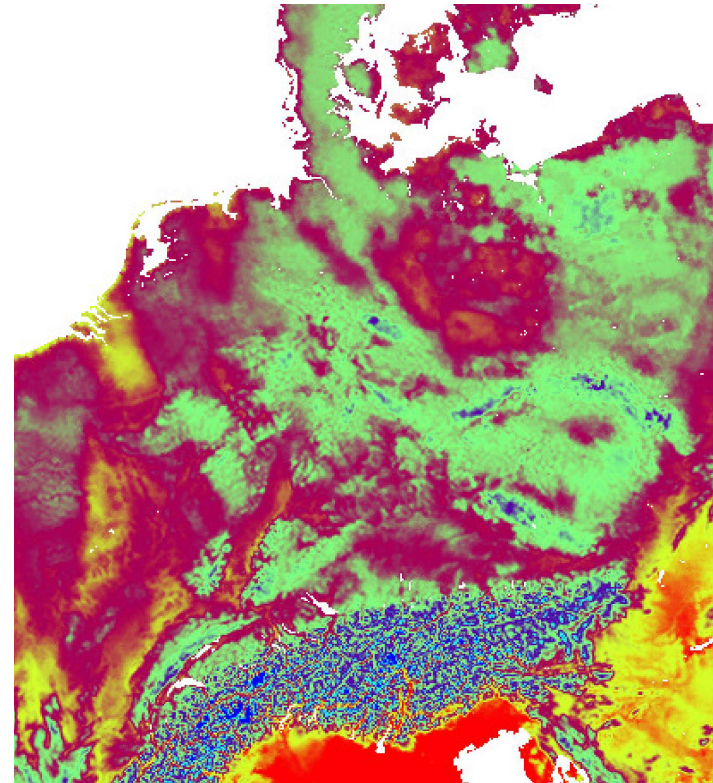
??? rather smooth!

Soil temperature bug

COSMO orography



Soil Temperature (first layer)



Fixed!!!

Changes to the Namelist Parameters (/CTRL/)

PARAMETER	DEFAULT	TYPE	MEANING
itype_profiles_vert_interp	2	INT	1 = old method 2 = new method
itype_balance_pp	2	INT	1 = old method (for Leapfrog) 2 = new method (for RK-core)
itype_fast_waves_lm	2	INT	If itype_balance_pp = 2: 1 = „old“ RK fast waves solver 2 = „new“ RK fast waves solver (SC-form)
lmultlay_deepsoil_clim_hcorr	.TRUE.	L	Whether or not to blend the T _{SO} height adaption from conservation of vertical differences to the T _{ke} near the surface towards a climatological height correction (-0.007 K/m) at deeper layers.

Eliminated: lbalance_pp (because this has to be done always!)

COSMO-Model

Highlights of the Changes to the COSMO-Model

- COSMO-ICON Physics:
 - All parameterizations now in blocked format with new interfaces
 - Vertical diffusion at the end of the physics
- Dynamics:
 - Bug fix in the slope dependent divergence damping coefficient
 - New boundary condition module
 - Integration of C++ dynamical core
- Data Assimilation:
 - Option for incremental analysis update (IAU)
 - New GNSS operator (Global Navigation Satellite System)
 - Technical adaptations and bug fixes

Highlights of the Changes to the COSMO-Model (II)

- GPU Developments
 - Already available: radiation, shallow convection, SSO scheme
 - Work in progress: all the rest
 - A fully GPU supported COSMO-Version hopefully available by the end of the year
- Updates for COSMO-ART and the two-moment microphysics scheme
- Several technical changes and updates
 - One important change when using GRIB:
 - T_SO values in the soil do not contain 0-values over water (reduces range of values for packing)
 - In GRIB2 we use 24 bits for packing to get a higher precision
 - Results in a mitigation of the cold bias when running in data assimilation mode, because soil ice can now really melt!

Different Model Versions

Ver- sion	Date	Contents	Changes to Results
5.04	08.03.16	Technical Changes (already reported last year)	no
5.04a	12.05.16	COSMO-ICON Version of prognostic TKE (optional) Bug fix in slope dependent divergence damping coefficient	(yes) yes
5.04b	12.07.16	Convection schemes in blocked data format and new (optional) closure for shallow convection after Boeing New boundary condition module	no (yes) numerical
5.04c	06.10.16	Minor adaptations / updates	no
5.04d	12.12.16	Changes to data assimilation (including bug fixes) Modifications to prognostic TKE (but still an option)	yes (yes)

Different Model Versions

Ver- sion	Date	Contents	Changes to Results
5.04e	17.03.17	More COSMO-ICON schemes: <ul style="list-style-type: none"> • surface: TERRA (with new bare soil evaporation), FLake, Sealce; • SSO; • prognostic TKE (now as default) Removal of old parameterization schemes Adaptations for COSMO-ART and two-moment scheme	yes no yes (yes)

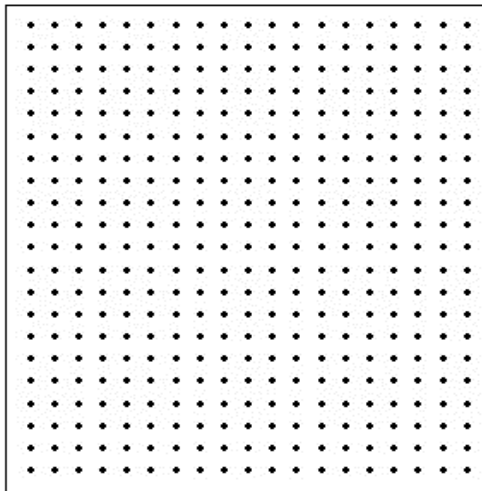
→ For more informations please refer to:

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

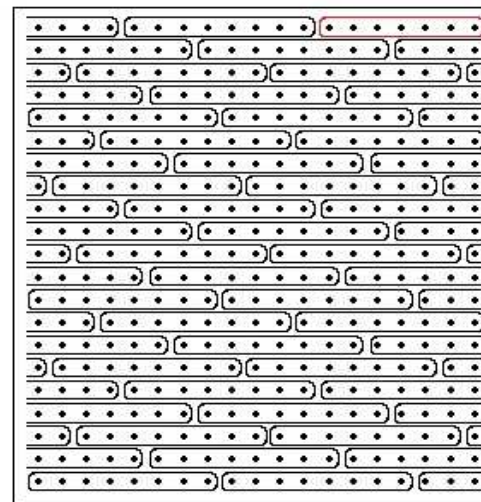
COSMO-ICON Physics: Background

- Before calling the parameterizations, data in the COSMO-Model **will be copied from (i, j, k) to the $(nproma, k)$** structure.

Grid points in the $ij(k)$ -data structure



Grouped together in the blocked data structure



- Every model has its own **interface routines** 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)

Which Packages are used where?

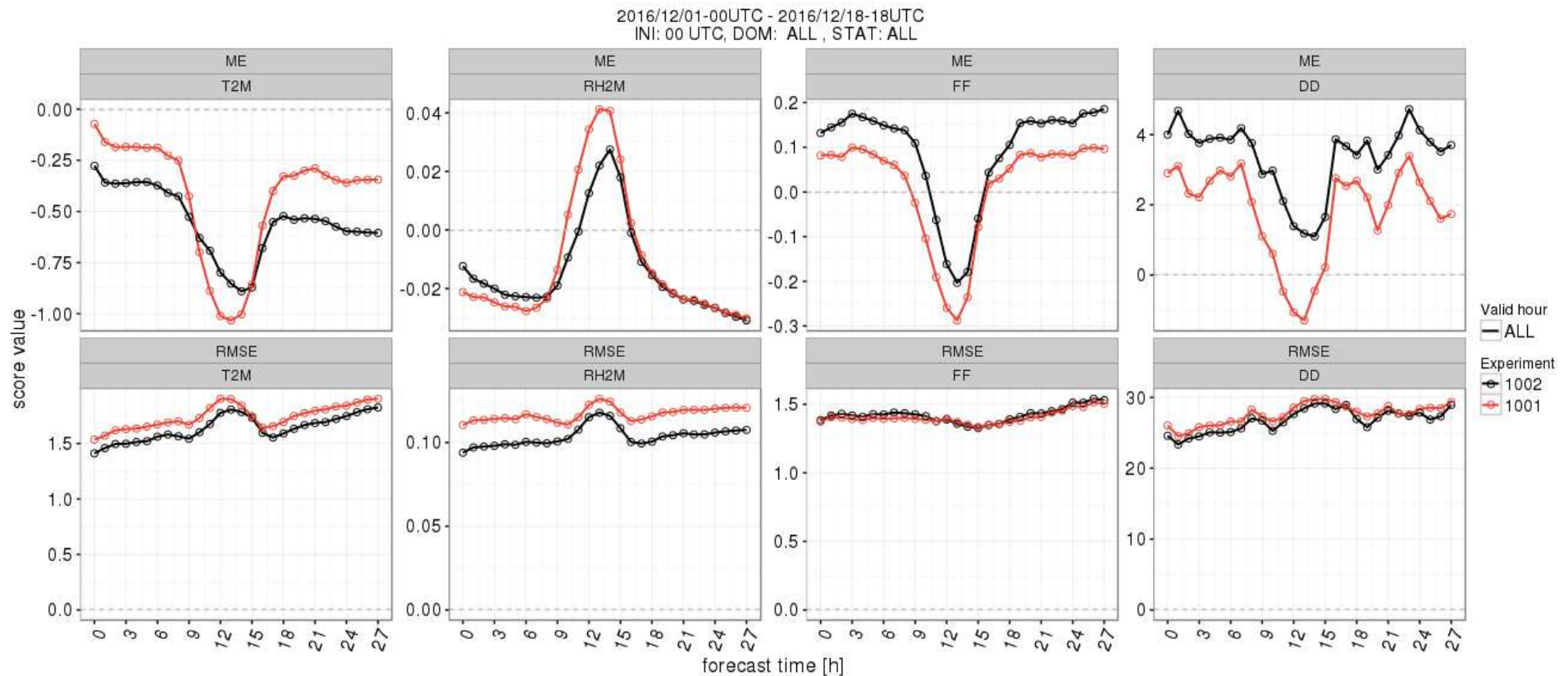
Scheme	COSMO	ICON
Microphysics	prognostic water vapour, cloud water, ice, rain, snow, graupel (Doms, 2004; Seifert, 2010)	
Radiation	Ritter-Geleyn δ two-stream	RRTM
Subgrid scale orography	Lott and Miller (1997)	
Turbulence	prognostic TKE scheme (Raschendorfer)	
Surface Schemes	TERRA (Heise and Schrodin, 2002) FLake (Mironov) Sealce (from IFS)	
Convection	Tiedtke or shallow	Tiedtke-Bechtold
	Tiedtke-Bechtold (optional)	

Testing the New Version

- Differences to the results (compared to 5.03) are mainly due to
 - Bug fix in dynamics (slope dependent divergence damping coefficients)
 - Data assimilation (also mainly bug fixes)
 - Modified surface schemes and prognostic TKE scheme (in 5.04e)
- Variants of a beta-version of 5.04e were tested for COSMO-DE with hindcast experiments (February 2016 and June 2016).
- But this beta-version contained a (severe?) bug: ground temperature t_g was not updated properly.
- This beta-version was also used for the COSMO NWP meteorological test suite.
- Version 5.04e (without this bug) is running now in a COSMO-DE experiment vs 5.04d using new KENDA assimilation (for December 2016).

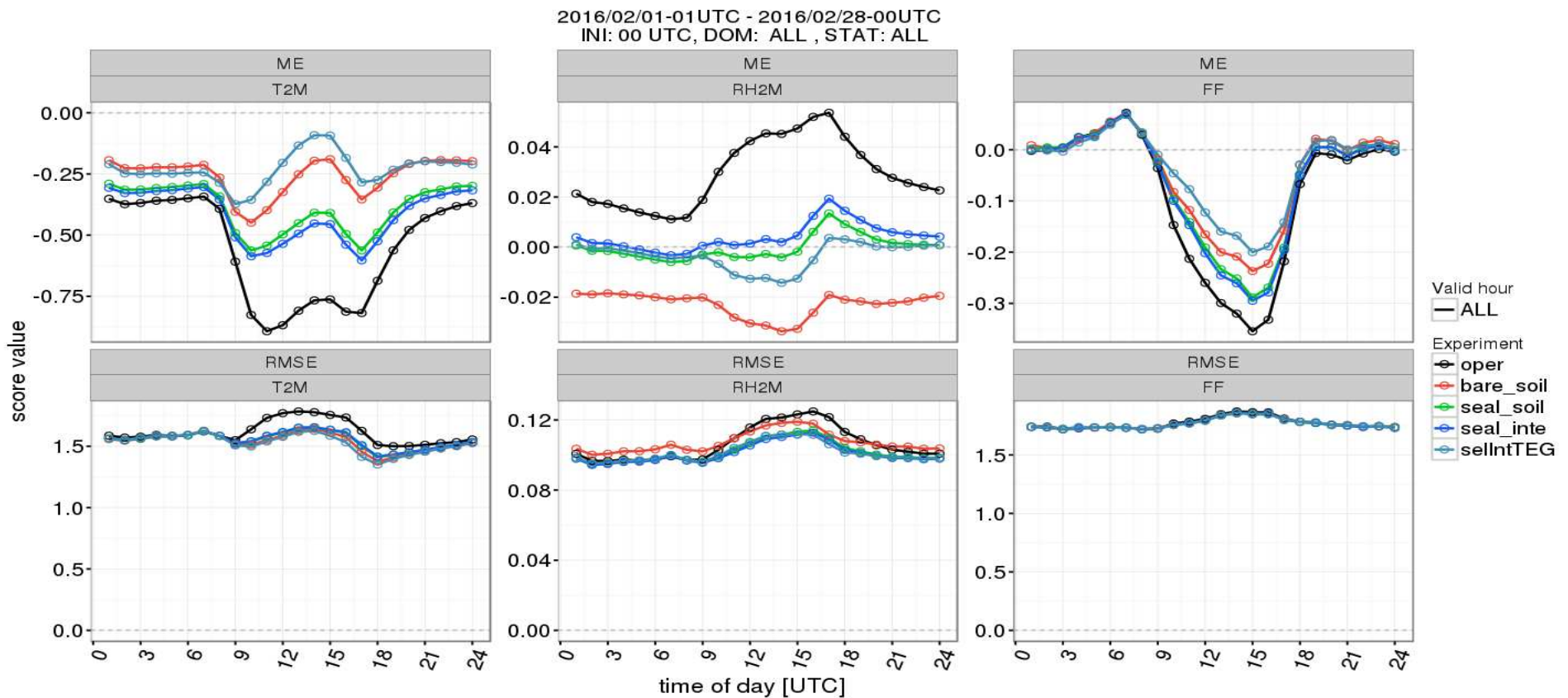
Experiment Verification

→ 5.04d (without modified surface, TKE schemes; red) vs. 5.04e (with all modified schemes; black):



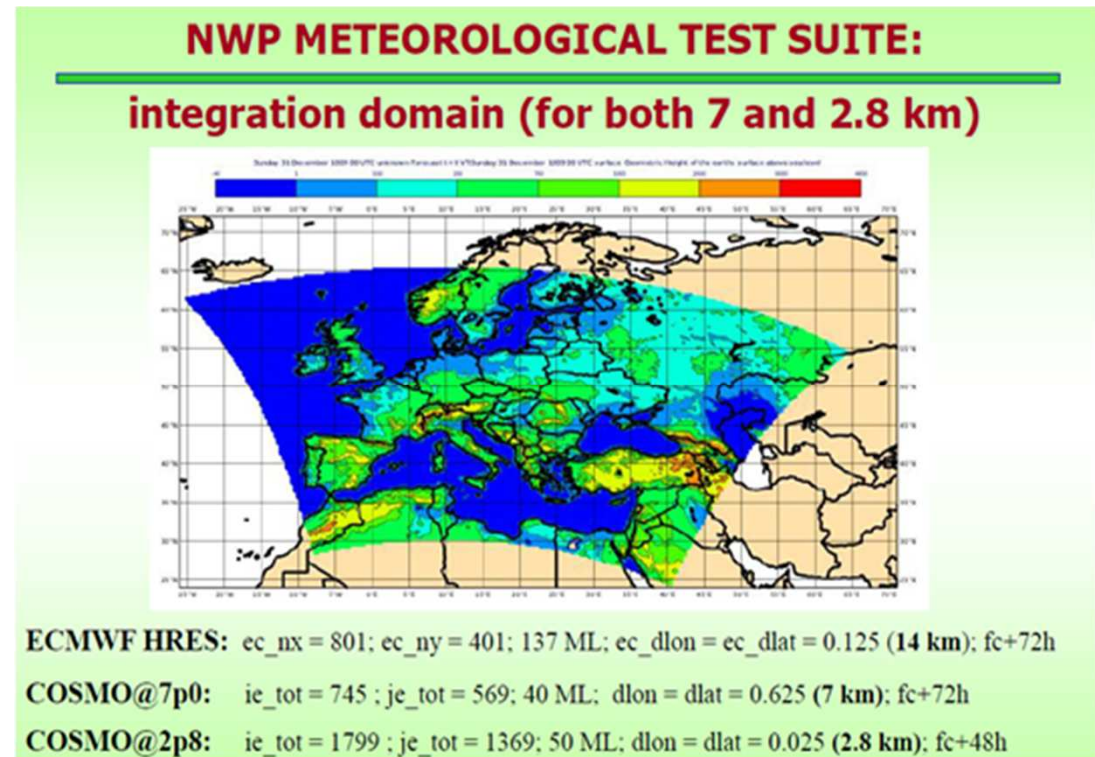
Hindcasts Verification

➔ Operational version (by that time 5.04c) vs. variants of a beta version of 5.04e:

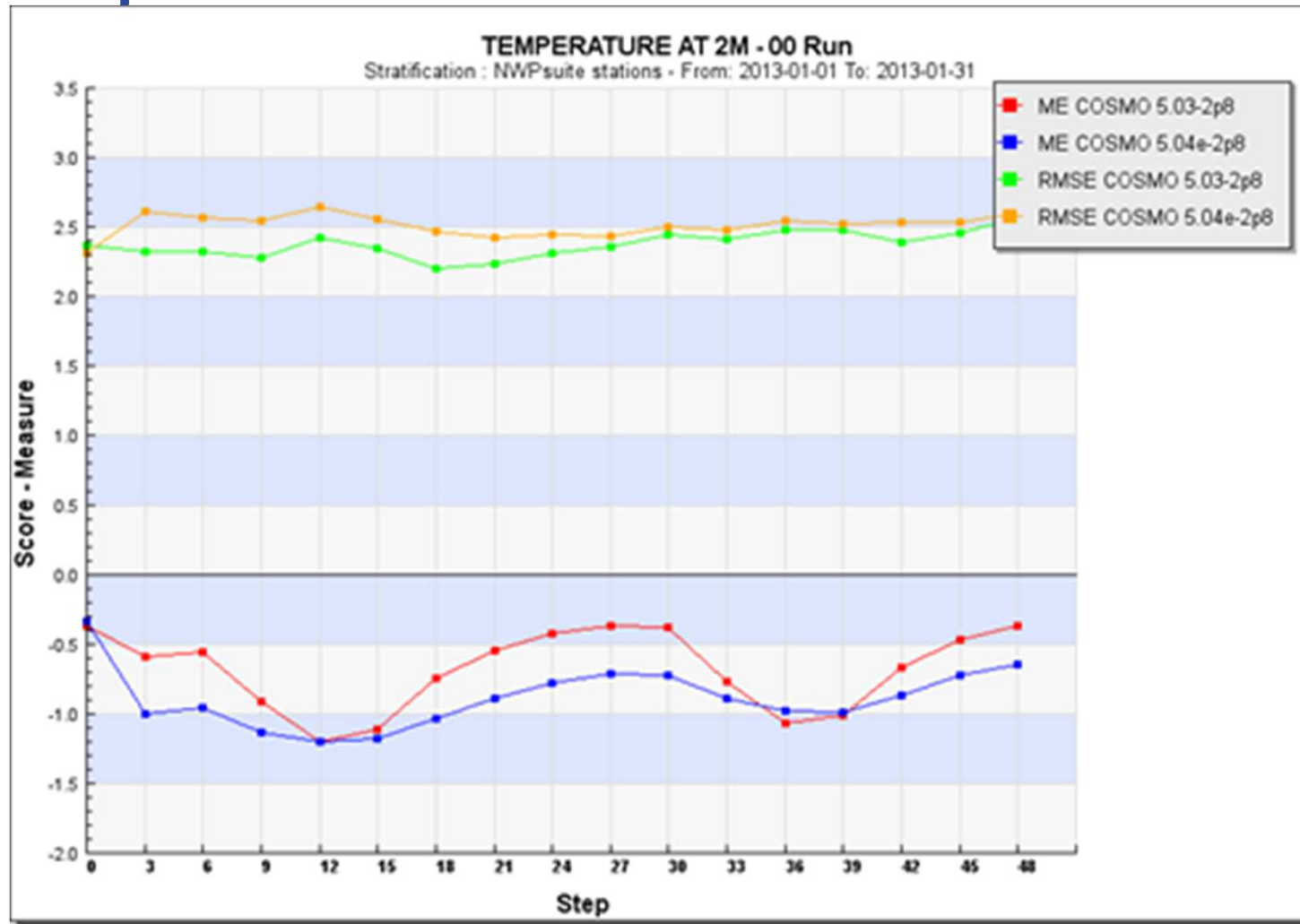


COSMO NWP Meteorological Test Suite

- Performs forecasts for a summer and a winter month based on IFS initial and boundary data.
- Forecasts are done for a 7 km and a 2.8 km domain (see right).
- **Some results are worse than for version 5.03!**



2m Temperature ME and RMSE



COSMO-Model 5.05

- The next official released COSMO version will be 5.05
 - There will only be a few technical adaptations compared to 5.04e, no further modifications that will change results (only bug fixing, if necessary).
 - But before an official release we have to understand the results of the COSMO NWP meteorological test suite.
 - We hope to be able to release it in April!

Outlook on Further Developments

- Data assimilation: Integration of radar forward operator
- Dynamics: higher order discretization
- Atmospheric physics:
 - Bug fixes in the SPPT scheme
 - Two-moment microphysics (ICON version in blocked format)
- Soil and surface physics:
 - TERRA-URB: work in progress
 - TERRA-Mire: optional implementation
- POMPA: GPU developments

- Implementation can be expected in sub-versions 5.05a, 5.05b, etc.



Thank you
very much
for your
attention