CONSORTIUM FOR SMALL SCALE MODELING

COSMO

Deutscher Wetterdienst

Wetter und Klima aus einer Hand

DWD

SCA Reports for the

COSMO-Model and INT2LM

Ulrich Schättler, Daniel Rieger

Source Code Administrators

Contents

- COSMO Versions implemented since September 2020
- INT2LM Versions implemented since September 2020
- COSMO 6.0
- COSMO ICON

COSMO Versions Implemented since September 2020

Version	Date	Contents (Highlights)	Results Changes
5.08	23.10.20	• Changes in Data Assimilation • Re-Unification with CLM / crCLIM • Implementation of EULAG • Changes in SPPT • Remove the coarse radiation grid • Modified Hailcast variable names • Update of cpp-dycore to GRIDTOOLS 2.0 • Update of OpenACC implementation to PGI compiler 20.4 • Bug fix in interpolation to p-levels	if used no no if used no no no no no

Version	Date	Contents (Highlights)	Results Changes
5.09	25.02.21	• Implementation of a tile-approach for TERRA_URB • Additional green-house gas emission scenarios • CPP Dycore: Support for tracers with lbc=0 • NetCDF I/O: adapted asynchronous output for large netcdf files • Fix for running the seaice scheme	no no no no possible, if used

Version	Date	Contents (Highlights)	Results Changes
5.09a	18.05.21	• Preparations for the new multi-layer snow scheme SNOWPOLINO • Preparations for TERRA_URB • Additional adaptations for MESSy • Added a new internal switch lcalc_wmaxtrack	no no no no

Version	Date	Contents (Highlights)	Results Changes
5.09b	02.06.21	• Fix in TERRA for sub-surface runoff • Added new diagnostic for soil water budget • Fixes for diagnostic variables related to new hydrology scheme	no no no

Version	Date	Contents (Highlights)	Results Changes
5.10	21.07.21	• Implemented TERRA_URB • NetCDF I/O: restart in single precision; compression with zlib	no no
5.11	28.07.21	• Implemented SNOWPOLINO • asynchronous prefetching of NetCDF boundary data	no no
5.12	09.09.21	• Update for TERRA_URB • Update of radar forward operator EMVORADO • Bug Fix for SNOWPOLINO	no if used if used

INT2LM Versions Implemented since September 2020

Version	Date	Contents (Highlights)	Results Changes
2.08	30.10.20	• CLM unification (input of W_SNOW, T_SNOW is optional) • Several technical fixes for Kinne aerosol climatology • pack HSURF also with 24 bits (as HHL)	no no no
2.09	02.06.21	• Added new external parameters for TERRA_URB • Unification between COSMO and INT2LM utility modules	no no

COSMO 6.0

Status of COSMO 6.0

- The last commit for the „bigger developments“ to the github master has been done on Sept. 06th.
- Version 5.12 has been tagged this week (Sept. 13th).
- Latest news (Sept. 13th, 14th) on technical issues:
  - Model does not compile with –DRADARFWO and without –DGRIBAPI (missing ifdef)
  - Missing adaptations to tile-approach in EULAG and COSMO-ART
  - Which makes some more technical modifications necessary.

- A version 6.0 will be released once the validation runs of CLM and crCLIM are successful and no more changes are necessary.

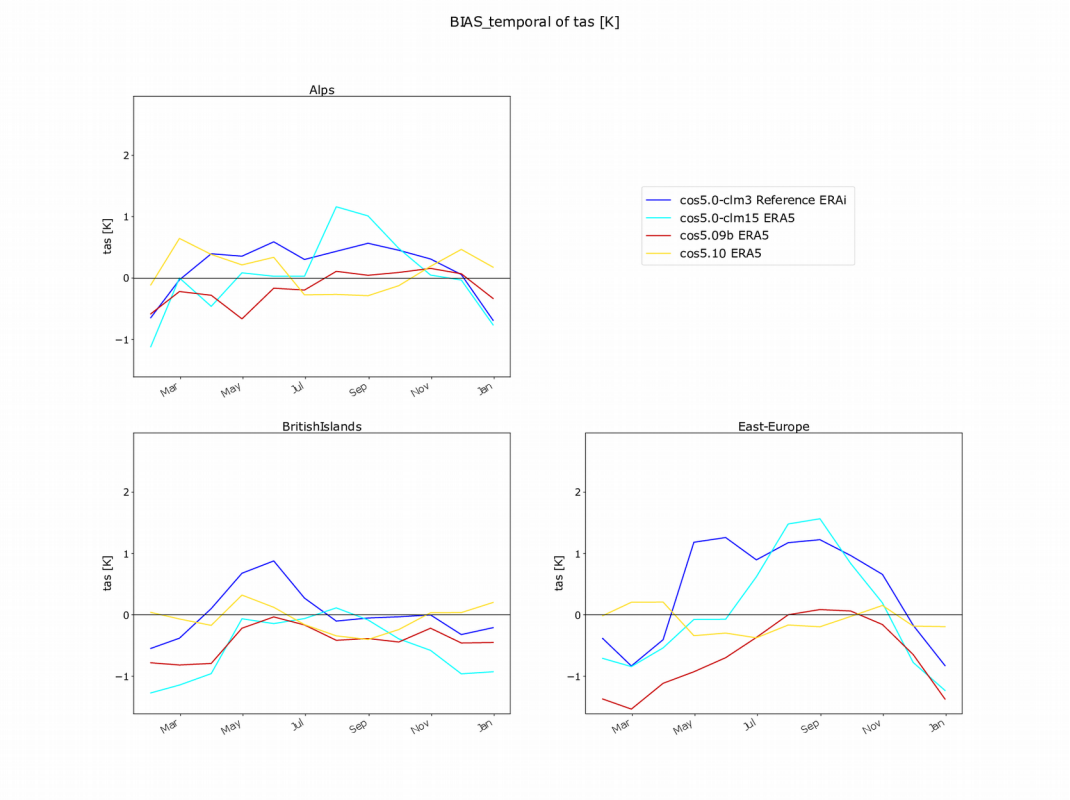
Status of COSMO 6.0

- The NWP Testsuite has been run for Version 5.08. For the NWP Testsuite configuration the results between 5.08 and 5.12 do not change.
  - The NWP Testsuite team came to the following conclusion (full text on: http://cosmo-model.org/content/model/documentation/NWPSuiteReports.priv/default.htm)

  The analysis of the relative performance of the two model versions: 5.06 (operational version) and 5.08 (test version), the newer version of the model, on the whole, exhibits no significant changes in the performance, while in a few cases outperforms its predecessor.

News from CLM

Error in 2m temperature for 1981-1985



COSMO 5.10 seems to be really good.

Differences between 5.09b and 5.10 in namelist configuration.

CONSORTIUM FOR SMALL SCALE MODELING

COSMO

Deutscher Wetterdienst

Wetter und Klima aus einer Hand

DWD

Evaluation of COSMO 6.0

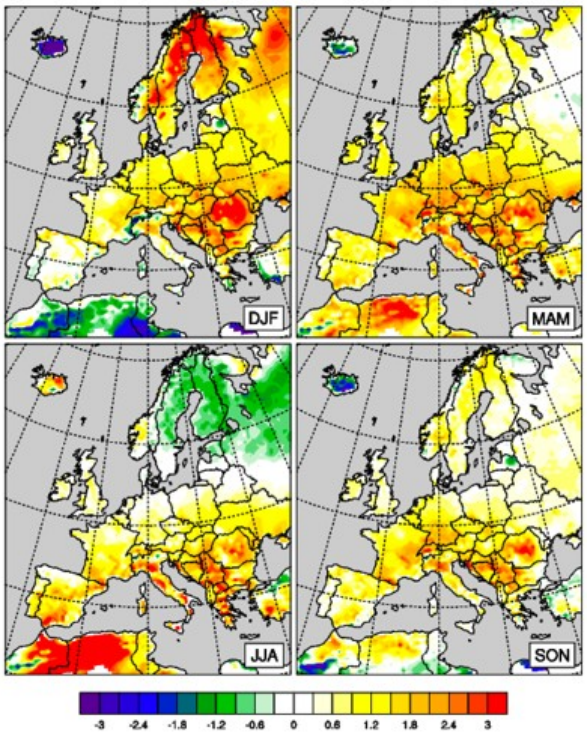
ETH, Christoph Schär's group

Validation over EURO-CORDEX – 12 km

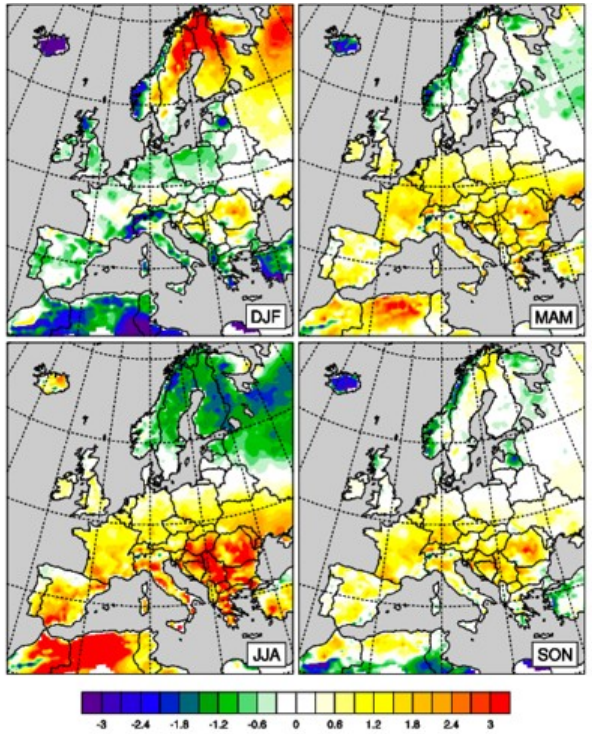
1980-1987

Seasonal mean temperature at 2m

COSMO-ORG – E-OBS



COSMO-crCLIM – E-OBS



COSMO6 generally too warm compared to COSMO-crCLIM: may be related to changes in TERRA

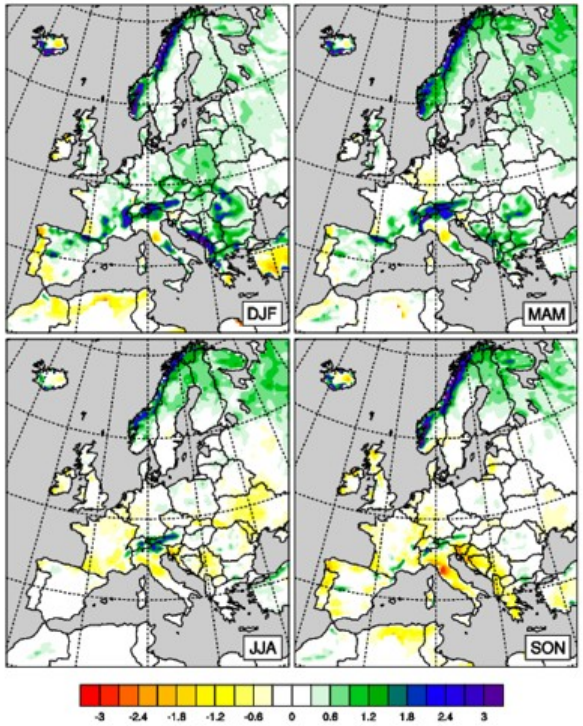
Marie-Estelle Demory

Validation over EURO-CORDEX – 12 km

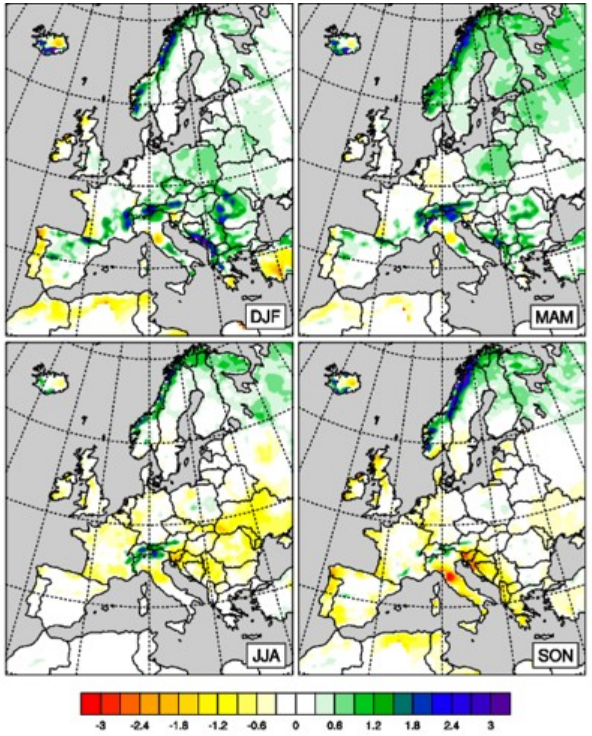
1980-1987

Seasonal mean precipitation biases

COSMO-ORG – E-OBS



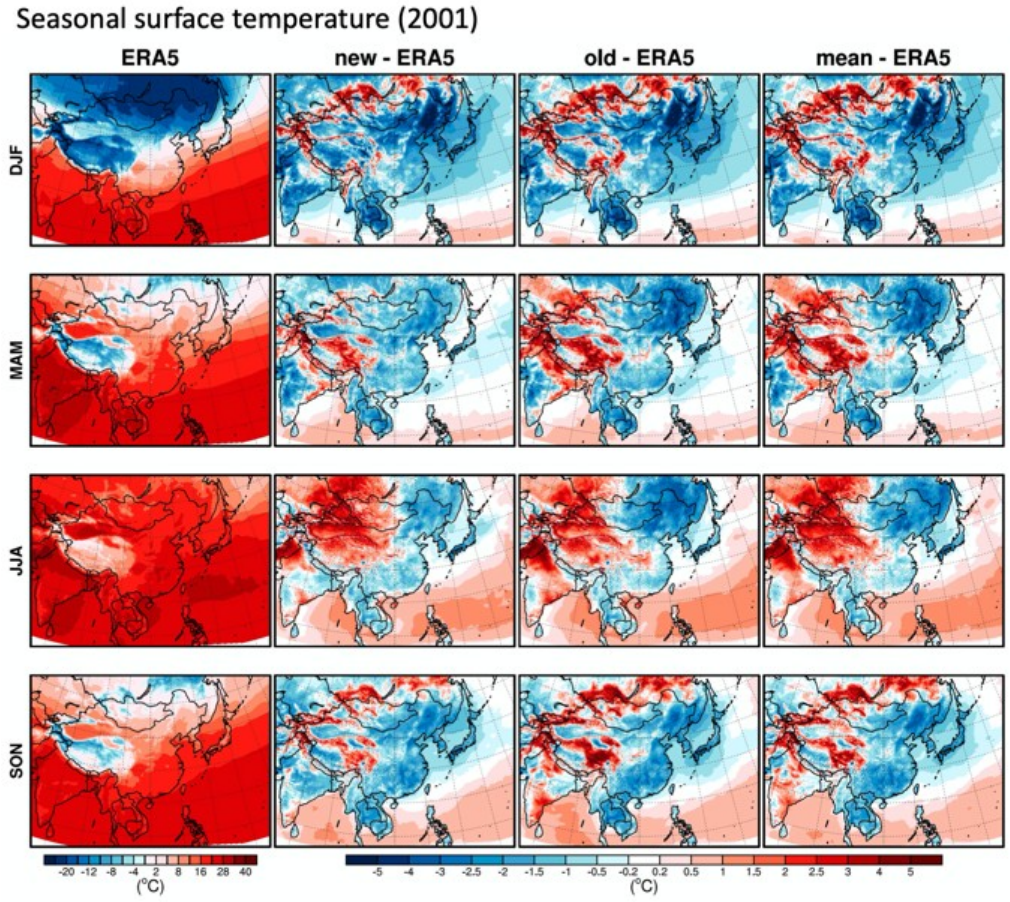
COSMO-crCLIM – E-OBS



COSMO6 slightly wetter over orography and coast lines compared to COSMO-crCLIM, but same bias patterns

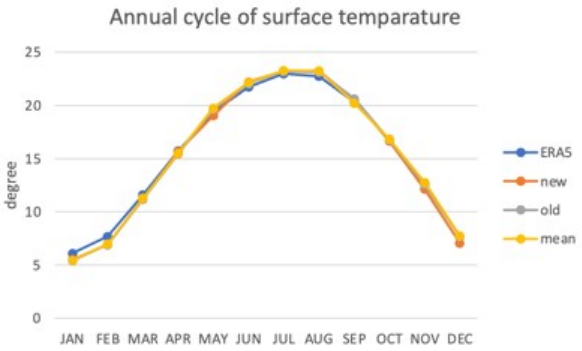
Marie-Estelle Demory

Validation over CORDEX-EAST ASIA – 12 km



Sensitivity to surface albedo

Domain: CORDEX-EA
Δx: 12 km
Simulation period: year 2001
Soil spin-up: year 2001-2010

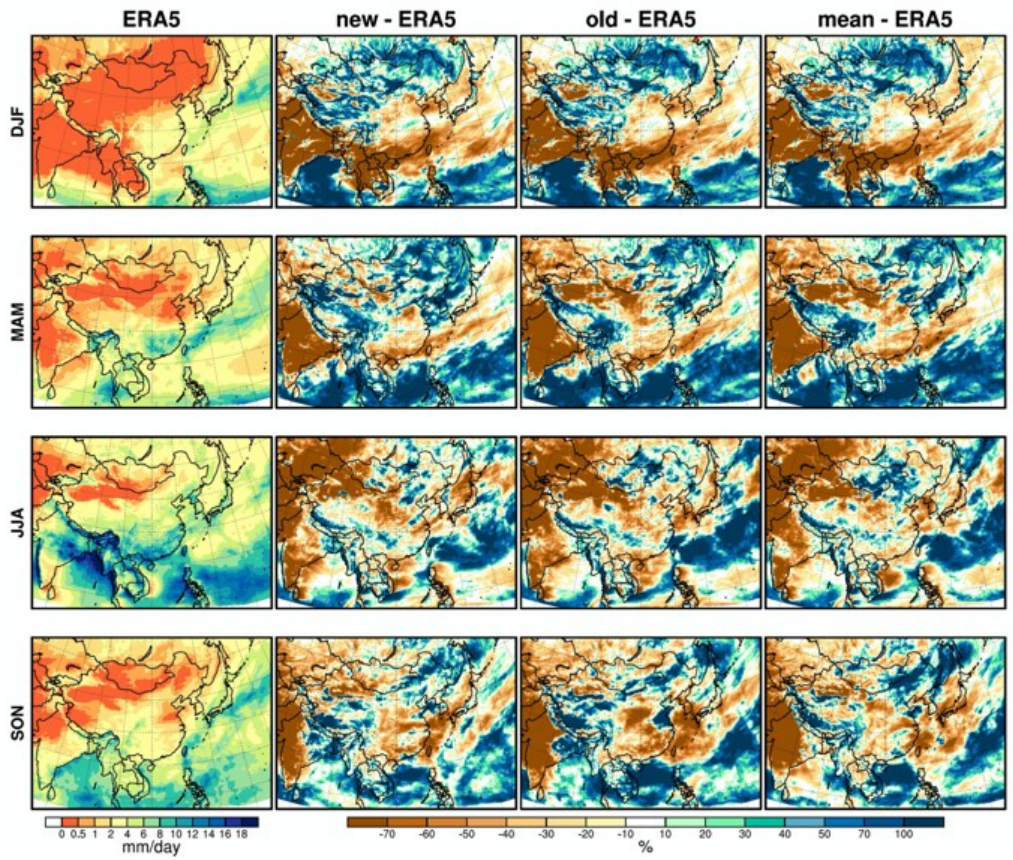


new: monthly values of total albedo derived from MODIS satellite data
old: soil albedo only in dry and saturated conditions
mean: monthly values of total albedo derived from MODIS satellite data averaged over 12 months

Ruolan Xiang

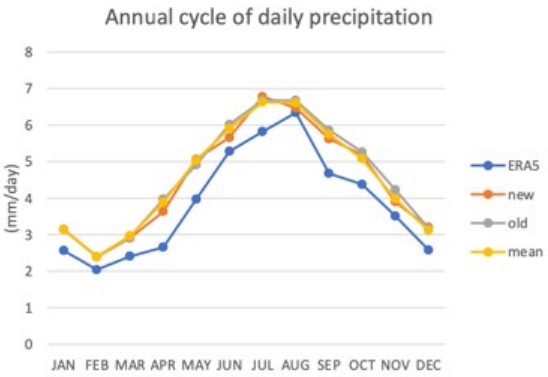
Validation over CORDEX-EAST ASIA – 12 km

Seasonal daily precipitation (2001)



Sensitivity to surface albedo

Domain: CORDEX-EA
Δx: 12 km
Simulation period: year 2001
Soil spin-up: year 2001-2010



new: monthly values of total albedo derived from MODIS satellite data
old: soil albedo only in dry and saturated conditions
mean: monthly values of total albedo derived from MODIS satellite data averaged over 12 months

Ruolan Xiang

Calibration over South Atlantic – test August 2016

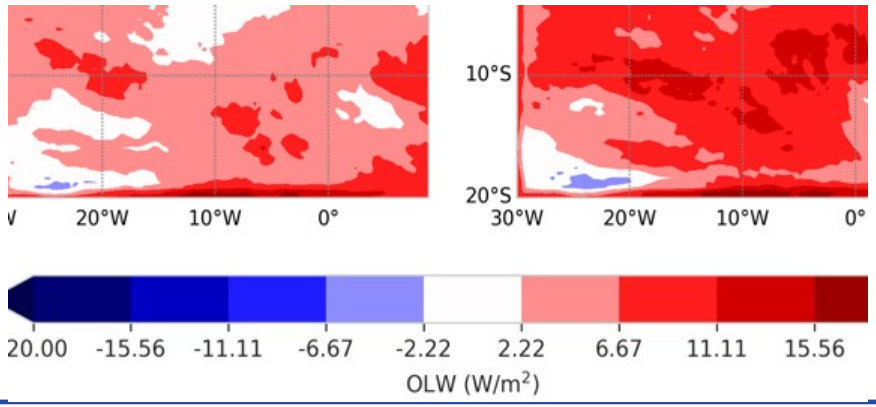
Calibration of 2-km resolution simulation over tropical Atlantic following Bellprat et al. (2012, 2016)

- Objective calibration with 5 parameters
- Methodology mostly based on satellite data (CM-SAF)
- Strong bias in outgoing SW: large improvement with optimum parameter values, at expense of outgoing LW radiation (but note that scale is more sensitive for OLR)

Parameter setting	qi0	tur_len	clc_diag	rat_sea	cloud_num
Optimum values	1.46E-05	79.6	0.938	7.03	1.03E+07
Default values	5E-6	100	0.5	20	5E8

Outgoing longwave radiation

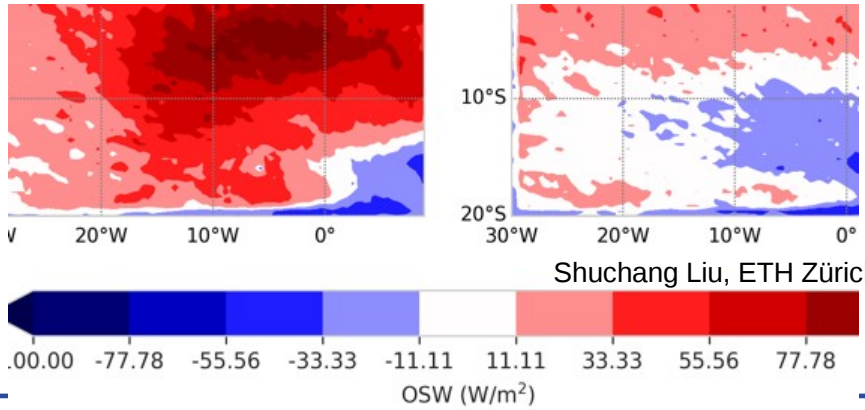
Before calibration



After

Outgoing shortwave radiation

Before calibration



After

Shuchang Liu, ETH Zürich

Update of Documentation

- Release Notes for the latest versions are available.
- Documentation has been updated and 6.0-Version is already available on the COSMO Web Page.
- All parts of the documentation for 6.0 on the COSMO web page do not have DOIs at the moment.
  - Once Version 6.0 is released, the documentation for this version will get DOIs.
  - In the meantime you have the chance to check the documentations for correctness, missing pieces, etc.

COSMO ICON

Actions in the Last Year

- Modified the organization of branches in the ICON Repository:
  - icon-nwp-dev is no longer in use; main icon-nwp branch now is „master“
  - icon-cosmo-master, icon-cosmo-dev, and icon-clm-dev are no longer available
  - all developments (also from COSMO partners) can now branch from the master
- How to start with ICON? You can find useful information and links on:
  - http://cosmo-model.org/content/support/icon/default.htm
  - accessible from the main page
  - For example: Link to a document „ICON for Developers“

ICON on new ECMWF Computer

- Some of the COSMO partners use ECMWF resources to run the models. Therefore it is of interest, how ICON performs on the new ECWMF system.
- TEMS: Test and Early Migration System: 60 compute nodes, consisting of 2 x AMD EPYC Rome 7H12 processors with 128 cores per node.
- Daniel and Sascha made some first steps and put up configuration files to compile and link ICON.
- IMS colleagues made tests to compare performance to ccb.
- I did some tests with ICON-D2.

Tests by IMS and DWD

IMS (from Yoav)

platform	Nodes	tasks/node	threads	N tasks	time sec	SBU	Time TEMS/CCB	SBU TEMS/CCB	
CCB	10	36	2	360	370	597	1	1	reference
TEMS	3	128	2	384	424	866	1.22	1.45	with HyperThreading
TEMS	3	64	4	192	412	841	1.19	1.41	with HyperThreading
TEMS	3	64	4	192	410	837	1.18	1.40	with HyperThreading
TEMS	**3**	**32**	**8**	**96**	**396**	**809**	**1.14**	**1.35**	**with HyperThreading**
TEMS	3	16	16	48	454	927	1.31	1.55	with HyperThreading
TEMS	3	128	1	384	425	868	1.23	1.45	no HyperThreading
TEMS	3	64	2	192	874	1784	2.52	2.99	no HyperThreading
TEMS	3	32	4	96	801	1665	2.31	2.79	no HyperThreading
TEMS	3	16	8	48	793	1619	2.29	2.71	no HyperThreading
TEMS	12	32	4	384	315	2573	**0.91**	**4.31**	**Sparce runs**
TEMS	24	16	8	384	291	4753	**0.84**	**7.96**	**Sparce runs**

DWD:

ICON-D2 (1 h forecast)	CCA (Cray) 4 nodes (128 cores)	TEMS (Intel) 1 node (128 cores)	Factor
Total	277.847	348.907	1.256
nh_solve	134.890	192.099	1.424
physics	76.083	80.794	1.062
model init	27.715	16.077	0.580

Summary of Problems

- **Memory-bandwidth**, mainly in the dynamics: Can that be resolved by a proper „memory-binding“ or compiler options?
- Or are there some code bottlenecks? Need to do a profiling.
- Timings in the physics or other model parts are comparable.
- **Communication** times have to be investigated more closely. I see some differences between IMS tests and my tests with ICON-D2 (which I do not yet understand).


Thank you
very much
for your
attention!