ICON-NWP: Test Suite

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CONSORTIUM FOR SMALL SCALE MODELING
COSMO

COSMO GM 2023
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NWP-TS: current status

The suite is implemented on Atos (ECMWF); 3 full experiments has been performed in 2023

The request to renew ECMWF special project for years 2024-26 has been submitted

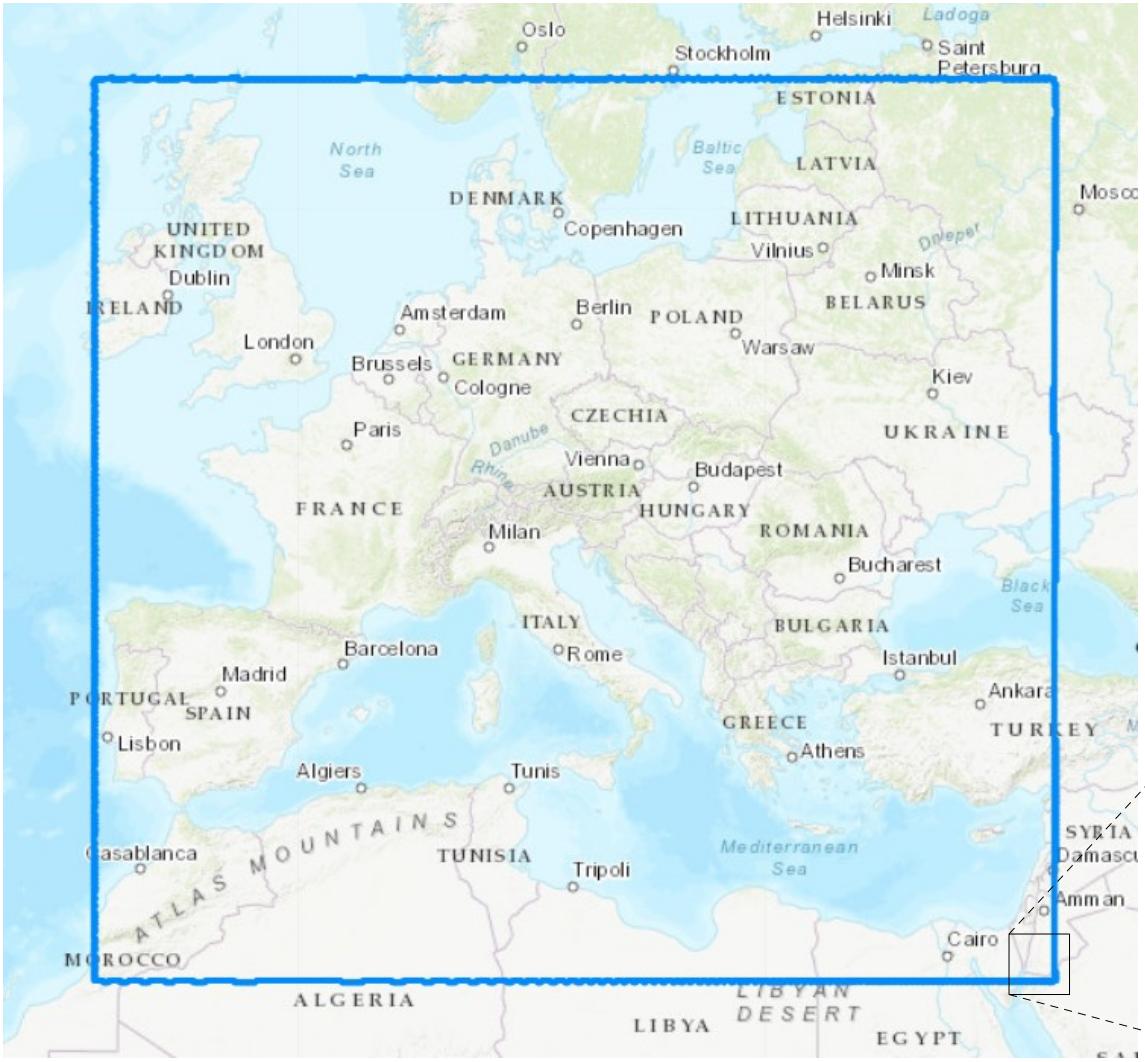
SBUs are almost terminated (*remaining 150k of 5M; in the new project 7.5M per year*)

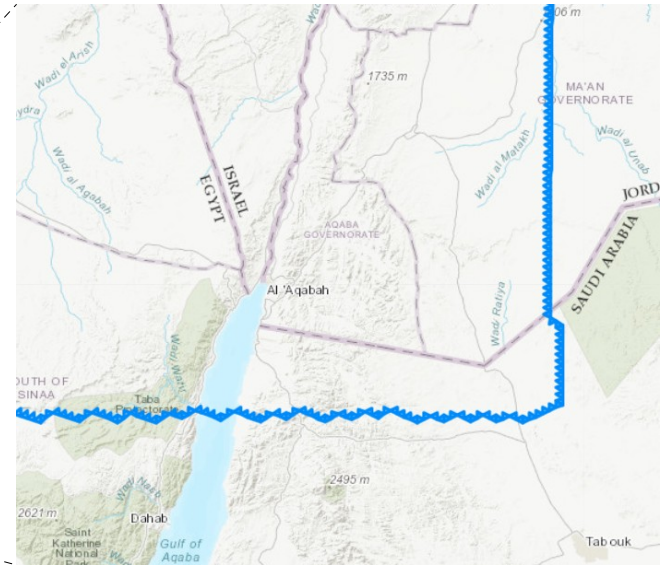
A new setup has been implemented, with:
- new reference periods (Jul-Dec 2021)
- soil IC from ICON-EU
- new namelist (suited for icon versions ≥ 2.6.5)
- several small upgrades to the suite

A couple of possible improvements have been postponed:
- top boundary nudging
- hourly BC from IFS

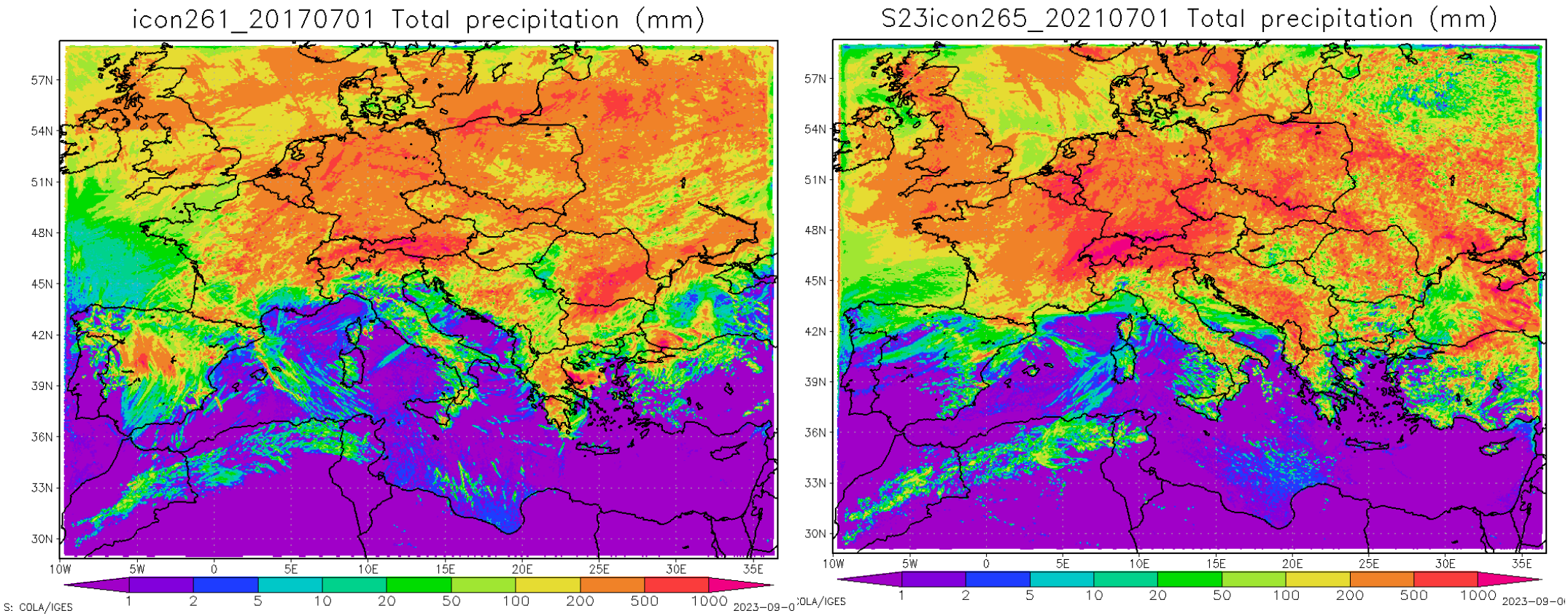
New setup: domain

In order to use soil IC from Icon-Eu, the integration domain has been slightly reduced (0.1° on South boundary, number of cells -0.4%)



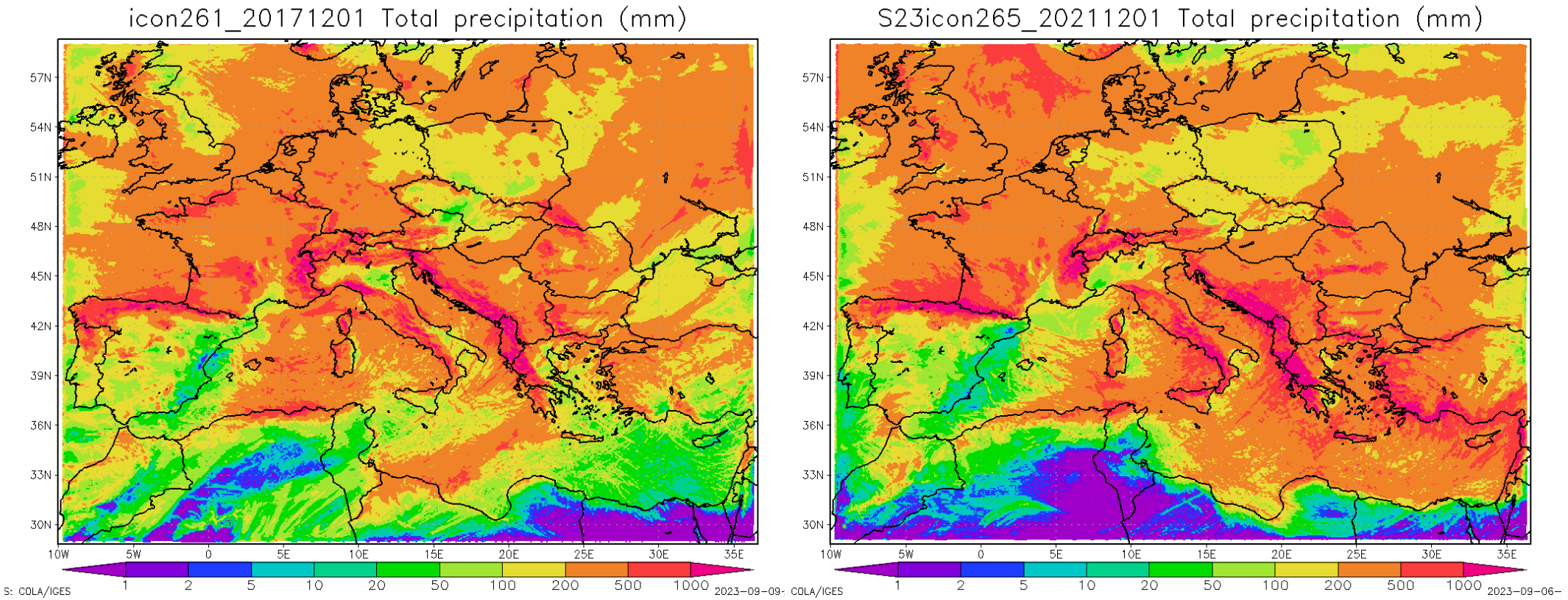


New setup: reference periods



Total precipitation in July (mm): 2017 (icon 2.6.1, old setup, left) and 2021 (icon 2.6.5, new setup, right)

New setup: reference periods (2)



Total precipitation in December (mm): 2017 (icon 2.6.1, old setup, left) and 2021 (icon 2.6.5, new setup, right)

Similar patterns, significant differences in specific areas

New setup: namelist

Keyword	2.6.1 (old)	2.6.5 (new)
icpl_turb_clc	1	2
max_calibfac_clcl	-	2
itune_gust_diag	-	3
direct_albedo_water	4	3
albedo_whitecap	0	1
rat_sea	7	0.8
frcsmot	0.2	0
alpha1	0.75	0.125
rlam_heat	1	10

Keyword	2.6.1 (old)	2.6.5 (new)
itype_lwemiss	1	2
itype_vegetation_cycle	1	2
exner_expol	0.333	0.6
inwp_radiation	1	4
tune_zvz0i	1.25	0.85
tune_box_liq	0.05	0.04
tune_rhebc_land	0.75	0.825
tune_rcucov	0.05	0.075
tune_box_liq_asy	3.5	4

- The new namelists are very similar to those used ad DWD for Icon-D2
- A remarkable exception: NWP-TS uses `lshallowconv_only=T`, `lgrayzone_deepconv=F`

Experiments already run on Atos

Experiment ID	Icon version	Simulation periods	Namelists	Soil IC	Experiment objectives
icon261	2.6.1	Jul 2017 Dec 2017	261-2021	ICON-GL	Same as icon261_65lev, but: run on Atos; direct nesting in IFS (Icon resolution R2B10); reviewed output format
icon265	2.6.5.1	Jul 2017 Dec 2017	261-2021	ICON-GL	Same as icon261 except for model version
S23icon265	2.6.5.1	Jul 2021 Dec 2021	265-2023	ICON-EU	Same model version as icon265, but: new simulation periods; updated namelists; new soil IC (ICON-EU); slightly smaller domanin (SE corner); ecflow suite reviewed

Three experiments (2 months each) have been performed, in order to evaluate:

1) new model version (2.6.5 vs 2.6.1)

2) new configuration (year 2021 + soil Icon-EU + new namelist)

Results for experiment icon265 are significantly worse than for icon261 (*Flora*)

The most likely explanation is that exp. icon265 uses an old setup, devised to compensate the cp/cv bug of version 2.6.1, no longer needed for 2.6.5 (*Daniel*)

Future experiments

Experiment ID	Icon version	Simulation periods	Namelists	Soil IC	Experiment objectives
icon261	2.6.1	Jul 2017 Dec 2017	261-2021	ICON-GL	Same as icon261_65lev, but: run on Atos; direct nesting in IFS (Icon resolution R2B10); reviewed output format
icon265	2.6.5.1	Jul 2017 Dec 2017	261-2021	ICON-GL	Same as icon261 except for model version
S23icon265	2.6.5.1	Jul 2021 Dec 2021	265-2023	ICON-EU	Same model version as icon265, but: new simulation periods; updated namelists; new soil IC (ICON-EU); slightly smaller domanin (SE corner); ecflow suite reviewed
S23icon261	*2.6.1*	*Jul 2021 Dec 2021*	265-2023	ICON-EU	*Same as S23icon265, but: ICON version 2.6.1, namelists as icon261*
icon265b	*2.6.5.1*	*Jul 2017 Dec 2017*	265-2023	*ICON-GL*	*Replace icon265: same as icon261, but with version 2.6.5 and namelists 2023*
S23icon266	*2.6.6*	*Jul 2021 Dec 2021*	*265-2023*	*ICON-EU*	*Same as S23icon265 except for model version*

The “bridge” experiment icon265 is probably “unusable”

1) Directly compare icon261 with S23icon265 (4 changes: version, year, soil, namelist)

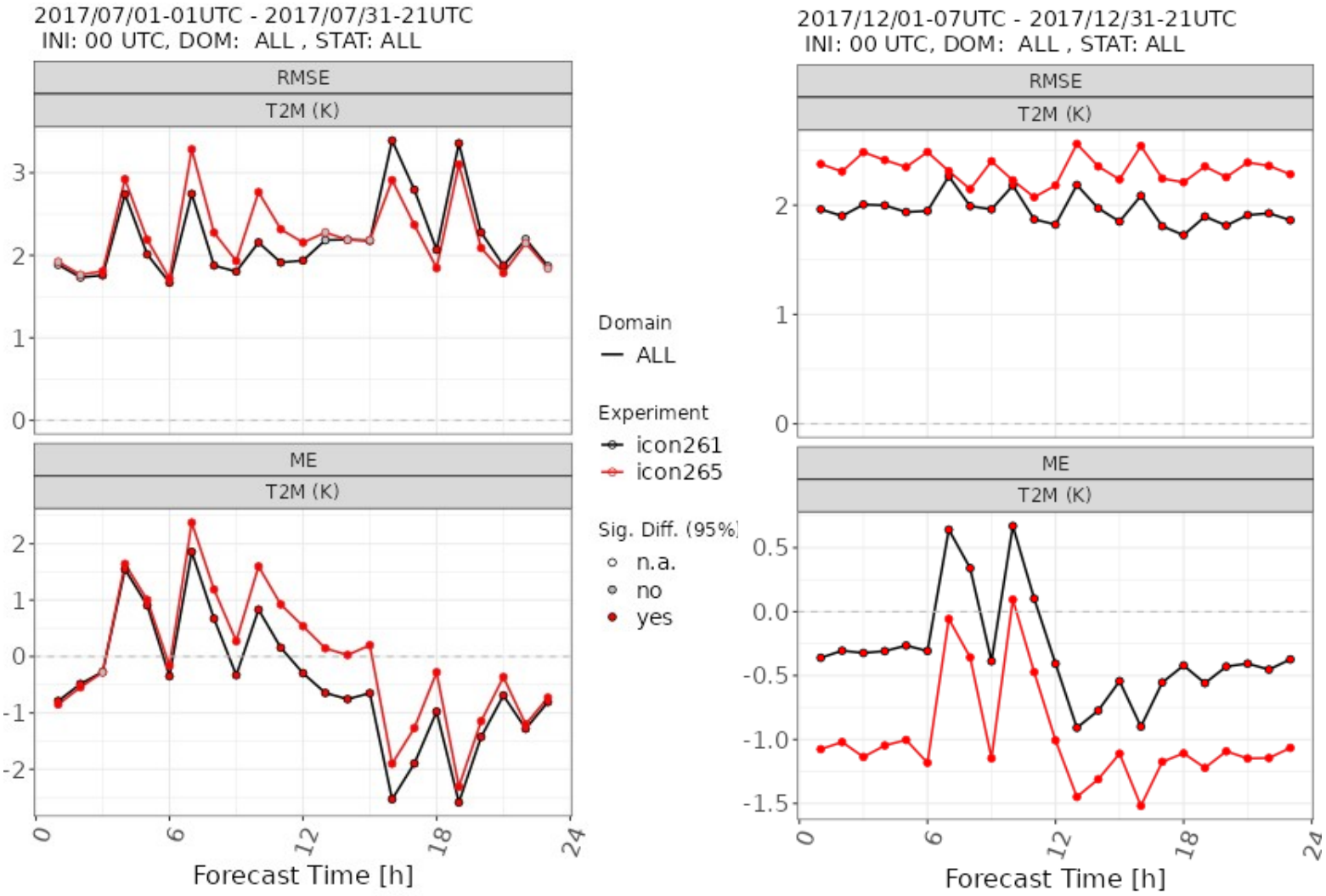
2) Run a new experiment, to separately assess the changes in model+namelist and year+soil *(requires ≈ 1.5M extra SBU)*

2a): run Icon 2.6.1 for 2021 (S23icon261)

2b): run Icon 2.6.5 for 2017 with the new namelist (icon265b)

Riserve

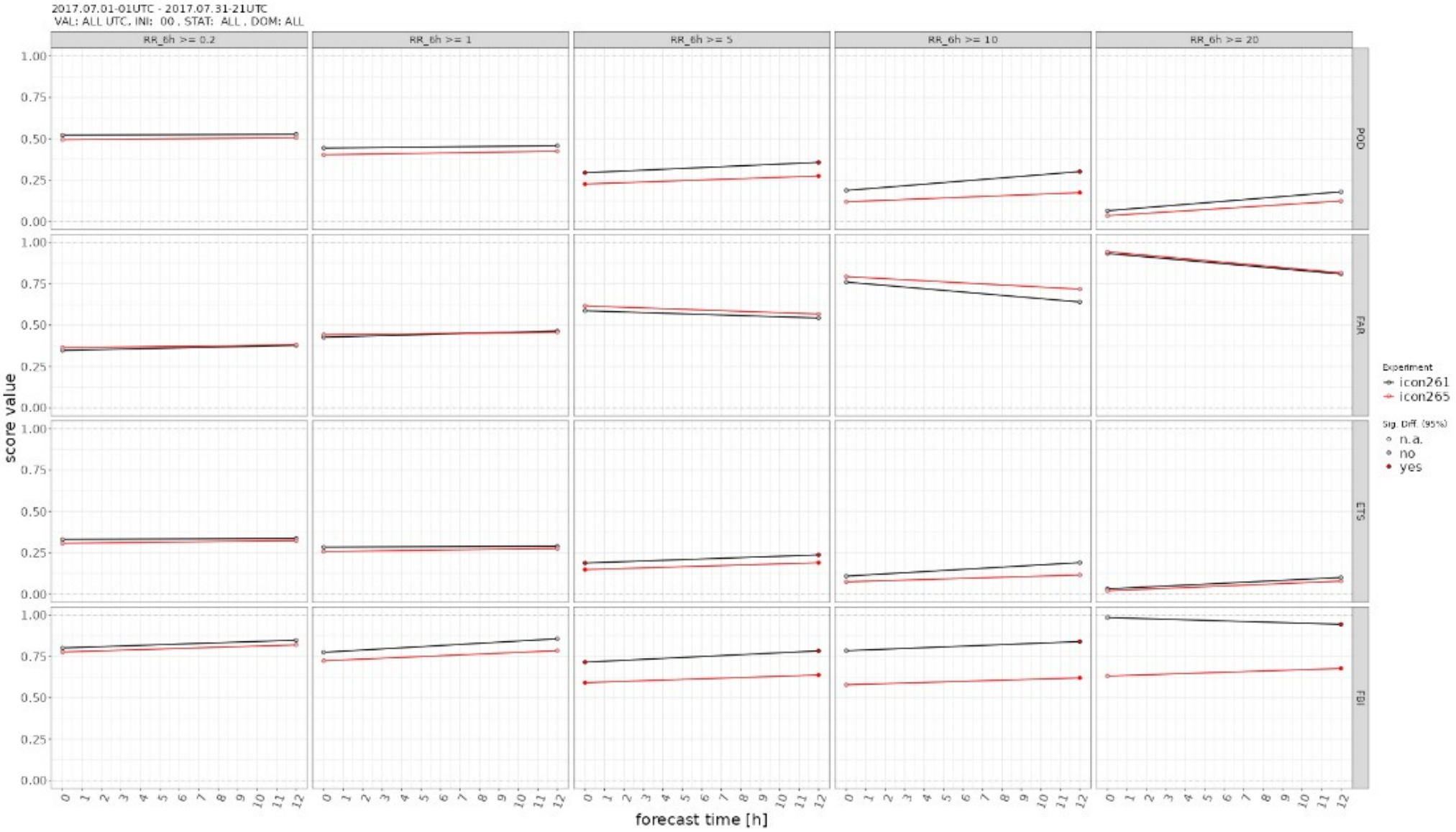
Verification: experiment icon265 vs icon261 (1)



T2m, RMSE and Mean Error: Jul 2017 (left) and Dec 2017 (right)

B. Maco, F. Gofa, F. Fundel, E.Minguzzi

Verification: experiment icon265 vs icon261 (2)



Total precipitation, Jul 2017: icon261 (black) and icon265 (red)

B. Maco, F. Gofa, F. Fundel, E.Minguzzi

New setup: soil water

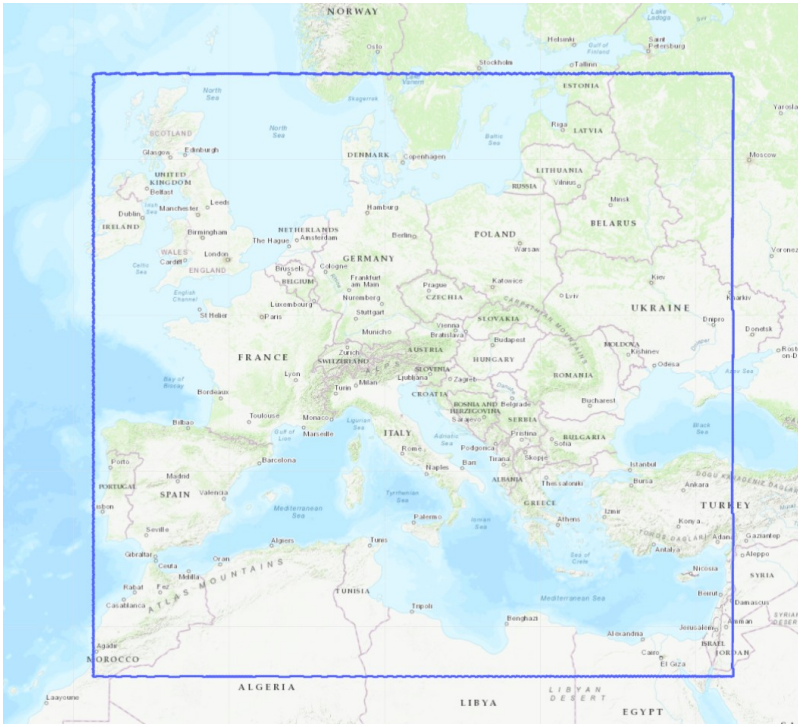
Bla

Old configuration (Reading)

Coarse domain : 6.6 km (R3B8); W = -10.9, S = 28.3, E = 37.5, N = 59.7 (310k cells)
dtime=60”, 65 levels *(50 for comparison with Cosmo test suite)*

Fine domain : 2.5 km (R2B10); W = -9.8, S = 28.9, E = 36.4, N = 59.1 (2M cells)
dtime=24”, 65 levels *(40 for comparison with Cosmo test suite)*

Coarse domain



Fine domain

New configuration (Reading)

Continuous run (with 5-daily restarts) for two one-month periods: July + December 2017

Domain covers Mediterranean sea and most Europe

“Coarse” run (6.6 km):

IC: atmosphere by IFS, soil by Icon-global;

BC: 3 hourly IFS analysis and forecast

“Fine” run (2.5 km):

1-way nesting in coarse; SST and Sea Ice daily updated from IFS analysis

One test performed, with Icon version 2.6.1

New configuration (Bologna)

Changes to Icon test suite on Atos

- Coarse run (6.5 km) will no longer be performed (direct nesting of Icon in IFS)
- The runs with a reduced number of vertical levels will no longer be performed
- IC: atmosphere + SST by IFS, soil by Icon-global (as in the coarse run in old conf.)
- Output only on unstructured grid

- *Should we make a test to check the impact of the direct nesting of ICON in IFS?*
- *Is the integration domain sufficient for Israel?*
  (SE corner at 36.4E, 28.9S; Israel is about 75-100 km from Icon boundary region)
- *Should the test periods be more recent or more extended (eg. adding spring / fall months)?*

Slide

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