



COSMO Priority Project C2I

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Status ICON transition of September 2020





Phase 1	Phase 2	Phase 3
 ICON Training 2018 Installation Setup First experiments 	Daily forecastsVerification	 Daily forecasts Verification Data assimilation Forecasters' feedback
Q2 2018 – Q4 2018	Q1 2019 – Q2 2020	Q3 2020 – Q1 2022





PP C2I – Status 09/2020









Configuration Overview

DWD

	Resolution	Layers	IC	BC	Range	Issued
NMA	2.8 km	65	ICON	ICON	+78h	0 UTC
IMGW	2.5 km	65	ICON	ICON	+48h	0, 12 UTC
COMET	2.2 km	65	KENDA	IFS	+48h	0, 12 UTC
IMS	2.5 km	65	IFS	IFS	+78h	0, 12 UTC
HNMS	2.5 km	50	IFS	IFS	+48h	0, 12 UTC
RHM	13, 6.5, 2 km	90, 65, 65	ICON IAU, ICON-RU	ICON	+120,+120,+48h	0, 12 UTC
ARPAE	2.5 km (plan)	65	IFS+ICON	IFS/ICON	+72h	0, 12 UTC
ARPAP	5, 2.5 km	65	ICON	ICON	+48h	Case Studies
CIRA	6.5 km	65	ICON	ICON	+24h	Case Studies
INMET	6.5 km	50	ICON	ICON	+174h	0, 12 UTC
CLM	10 km	70	ERA-I	ERA-I	+10y	Evaluation
Testsuite	6.6, 2.5 km	40, 50	IFS+ICON	IFS	+31days	July & Dec `17







Selected Results



Outcome of C2I task 5 - verification













Verification Scores 3-6 February 2020



COSMO-2.8 (black) vs. ICON-2.8 (red) Forecast 30h

SYNOP observations All Romanian stations



TEMPERATURE at 2 m, April - July 2020 ME RMSE



ICON PL COSMO PL



ICON PL COSMO PL





o step 6 o step 12 o step 18 o step 24 o step 30 o step 36 o step 42 o step 48



Td2m: Bias diurnal cycle similar to IFS , slight overestimation night – close to zero noon. ICON RMSE lower than COSMO models ICON-GR

ICON-GR IFS-ECMWF **TCC**: ICON bias similar diurnal cycle with COSMO, with night time overestimation. RMSE slightly higher than COSMO models

COSMO1 COSMO4



12h Precipitation (step 12)



Thresholds 0.2 to 20mm

Frequency Bias (FBI)

ICON-GR **FBI** satisfactory (slightly less than 1number of events slightly underestimated) Less variability with thresholds ICON-GR IFS-ECMWF COSMO4 COSMO1



6	Run time Glo	bal ICON (13 kn	n and N28 - 6.5 km)	
Core	s: 2880 - 32 (output)	1751 c / 048 h 🚃	75 min / 120 h	
Core	s: 5760 - 32 (output)	1012 c / 048 h 💳	42 min / 120 h	
Core	s: 8640 - 32 (output)	0794 c / 048 h 💳	33 min / 120 h	DONE
Core	s: 9216 - 32 (output)		34 min / 120 h	10 and 1 2
	Run	time Global ICC	DN (13 km):	
Core	s: 2880 + 32 (output) 2	2h 50 min / 31 days	
	Run time ICON	-LAM for Easter	m Europe (EE, 2 kı	n):
Core	s: 2880 - 4 (output)	3189 c / 048 h	53 min / 048 h	
<u>Core</u>	<u>s: 2880 - 4 (output</u>		🛑 <u>60 min / 054 h</u>	
Core	s: 2880 - 4 (output)	4598 c / 072 h	74 min / 072 h	
Core	s: 2880 - 4 (output)	7575 c / 120 h	126 min / 120 h	
Core	s: 5760 - 32 (output)	3916 c / 120 h	65 min / 120 h	
				K BEGIN
R	un time ICON-LA	M for Eastern E	Europe (2 km and ²	1 km):
<u>Core</u>	<u>s: 2880 - 4 (output)</u>	XXXX c / 054 h	XXX min / 048 h	
	Due time IOON		(2.0 km and 4.0 km	
	Run time ICON	-LAW TOP APCTIC	(3.2 Km and 1.6 Kh	n):
Core	<u>s: 2880 - 4 (output)</u>	XXXX c / 054 h	<u>XXX min / 048 h</u>	C ai
2.09.202	Fede	ral Service for Hydrometeorology and E Hydrometeorological Research	Environmental Monitoring (Roshydromet) Centre of Russian Federation	$\mathbf{\nabla} \mathbf{Z}$

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😓 🛇 COSMO-Ru7, COSMO-Ru2, ICON-Ru2EE – DEW POINTE 🔵 S 🕅 💽



Scores for 152 stations in Central Federal District (including Moscow)

- ICON-Ru2EE run on 5 days from 10.08.2020
- Only first test scores obtained in VERSUS
- Comparison with operational COSMO-Ru
- ICON-Ru2EE has lower <u>RMSE</u> after the first hours of forecast

(similar results are observed for ICON-COSMO verification in Common Plot WG5 activity)



ITAF-Remet /COMet NWP System



Upper-air Temperature









Phase 2: Verification: rain

FUZZY VERIFICATION by the COSMO software VAST

Fractions skill score ICON - FSS - 20181029 - 3 Tsteps

Fractions skill score COSMO-OT - FSS - 20181029 - 3 Tsteps







In bold **FSS**_{useful} indicates at what scale and at what intensity the forecast is useful

1.0

8.0

0.6

0.4

0.2

0.0

ICON behaves better than COSMO for lower thresholds







ECMWF - mean RMSE: 1.79 m/s

COSMO - mean RMSE: 1.72 m/s

20/07 23/07 26/07 29/07 01/08 04/08 07/08 10/08

mean RMSE: 1/58 m/s

Date (summer 2020)

13/08 16/08 19/08

ICON -

0.5



Last month verification (all stations, all times)

Encouraging results for ICON-LAM

Comparison: ICON x COSMO x Automatic Stations (more than 500)





Precipitação (mm/h) Local: Porto Alegre Validade: 06.08.2019 01:00 - 13.08.2019 06:00

Pressão Reduzida (hPa) Local: Porto Alegre Validade: 06.08.2019 00:00 - 13.08.2019 06:00













Part of C2I task 8 – technical framework





From COSMO to ICON - Test Suite

	<u>COSMO</u>	<u>ICON</u>			
Horizontal and Vertical Resolution					
Coarse Res.	H: <u>7km</u> , V: 40 levels	H: R3B 8 (<u>6.6km</u>), V: 40 levels			
Fine Res.	H: <u>2.8km</u> , V: 50 levels	H: R2B10(<u>2.5km</u>), V: 50 levels			
Initial and Boundary conditions					
Model levels	from ECMWF HRES analyses at 00, 06, 12, 18UTC and forecasts at 03, 09, 15, 21UTC with 3 hours forecast-range	from ECMWF HRES analyses at 00, 06, 12, 18UTC and forecasts at 03, 09, 15, 21UTC <u>with 3 and 9 hours forecast-</u> <u>range</u>			
Soil levels	Initial Condition fom ICON- EU, then free soil (both at 7km and 2.8km)	Initial Condition fom ICON-EU, then free soil (both at 6.6km and 2.5km)			
Sea surface	From ECMWF HRES analysis (daily update at 00UTC)				



From COSMO to ICON - Test Suite

	<u>COSMO</u>	<u>ICON</u>		
Lead time				
	<u>+24h starting daily at 00UTC</u> <u>using warm initialization</u>	<u>+31days using a restart file</u> <u>every 5 days</u>		
Domain, Output and Post process				
File format	<u>Grib1</u>	<u>Grib2</u>		
Coordinates	<u>Rotated</u> lat-lon and <u>structured</u> grid	<u>Unstructured</u> grid (main option), As COSMO (alternative option)		
Domain		V 8° 0W 0° 0' 8° 0'E 16° 0'E 24° 0'E 32° CE 40° 0'E UNITED ININGDOM CERMANY VINCRAINE FRANCE ITALS SPAIN CREECE TURLEY N ALGERIA LIBYA EGYPT SAUDI		



CONSTITUT FOR SMALLSCALE MODELING SMO ar

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Conclusion

The ICON-Test Suite is almost ready:

 some few things need to be checked (post processing for verification and imode_sstice) and completed (ecflow suite)

We need to define:

- Which will be the first ICON version to test against COSMO?
- Which ICON configuration should be tested (closest one to COSMO or more "aggressive"?)
- ICON runs in mixed precision only at ECMWF, is that enough for the Test Suite purpose?
- Are we ok with the (small) differences between ICON and COSMO test suites?







New ECMWF Special Project request submitted, available on the ECMWF SP web page

"COSMO and ICON Numerical Weather Prediction Test Suite" (2021 – 2023)

Resources		2021	2022	2023
HPC	B.U.	5.000.000	5.000.000	5.000.000
Storage	G.B.	2000	4000	6000

Scientific plan

Phase I: Set-up of the COSMO and ICON models

- 1. Set-up of the NWP Test Suite for the COSMO model
- 2. Set-up of the NWP Test Suite for the ICON model

Phase II: Configuration and Execution of Runs

- 1. Configuration and Execution of COSMO Runs
- 2. Target configuration of ICON-LAM and Execution of ICON-LAM runs

Phase III: Model Output Verification (MEC+Rfdbk)

Phase IV: Additional steps and further actions (additional verification act., dep. on user requirements)





Summary & Outlook



What are the next steps for PP C2I?



Summary & Outlook

Task 5: Verification

- → Many results for longer periods presented in the parallel session
 - → Mostly improved scores using ICON compared with the COSMO model
 - → Cloud cover overestimation in the Mediterranean reported by IMS and COMET
- → Common verification summary for the upcoming season
 - → Publication of SON verifications in a joint COSMO-Newsletter Article or Report on ICON
 - → Create a basis for the final report

Task 6: Forecasters' feedback

- WG4 is currently preparing a survey
 - Assessment of the added value of ICON
 - ➔ Are there discrepancies between forecasters' opinions and verification scores?
 - ➔ Ready for distribution soon







Too high cloud cover in the Mediterranean

- → Seen in COMET, IMS and HNMS verification
 - → Requires detailed investigation using various data (satellite, SYNOP,...) (WG5?)
 - → Probably connected to cloud cover scheme, turbulence, shallow convection,... (WG3a?)
- Solving this issue is beyond the PP C2I scope
 - > Nevertheless, the consortium benefits from a coordinated effort here!

Start a new PT to solve this issue?

→ Italy, Israel or Greece taking the lead?



