NWP ICON - Test Suite

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The ICON - Test Suite

Goal:

- Prepare a new NWP suite based on the ICON model in hindcast mode over the same periods and using the same configuration of COSMO Test Suite, so that we can fairly compare ICON vs COSMO performances for the firstly tested ICON version and for every new ICON version against the old ones in the next years.

NWP - Test Suite

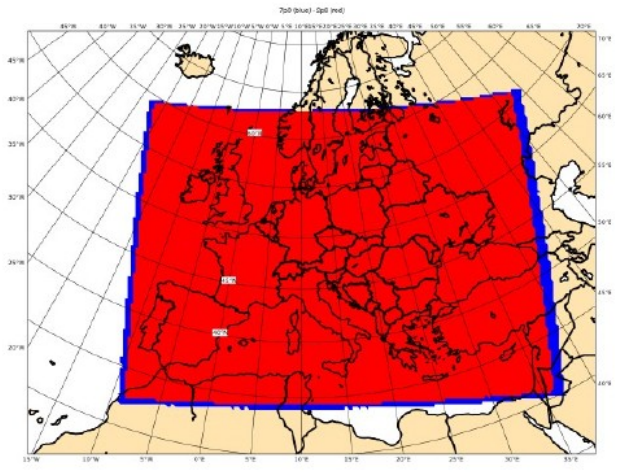
Basic configuration

- Coarse and fine resolutions at 7km and 2.8km respectively
- Initial and Boundary Conditions for the atmosphere from ECMWF HRES, while soil initialized from ICON-EU
- Simulation period: July and December 2017
- Domain: full Mediterranean area and Central Europe

From COSMO to ICON - Test Suite

	COSMO	***ICON***
Horizontal and Vertical Resolution		
Coarse Res.	H: 7km, V: 40 levels	H: R3B7 (6.6km), V: 40 levels
Fine Res.	H: 2.8km, V: 50 levels	H: R2B9 (2.5km), 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 with 3 and 9 hours forecast-range
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

	COSMO	***ICON***
Lead time		
	+24h starting daily at 00UTC using warm initialization	+31days using a restart file every 5 days
Domain, Output and Post process		
File format	Grib1	Grib2
Coordinates	Rotated lat-lon and structured grid	Unstructured grid (main option), As COSMO (alternative option)
Domain		

Preparation of the ICON-Test Suite

Source Codes	
Access to ICON-LAM • from gitlab (version 2.5.0): need registration, use user guide • from dwd ftp (version 2.6.1)	
Compilation of ICON-LAM and ICONTOOL codes at ECMWF • Detailed description of needed setup for compiling ICON-LAMv2.5.0 at ECMWF are available: just ask me • For ICON-LAMv2.6.1 a configuration wrapper was already been prepared for compiling at ECMWF	

Preparation of the ICON-Test Suite

Initial and Boundary conditions	
Download of ECMWF HRES analyses and forecasts over a reduced domain: • through mars2icon_smi for the analyses • as a mars request for the forecasts (or need to modify mars2icon_smi, because ‘z’ is not available at model level=1)	
Remap ECMWF initial data and boundary data (with 3-hour update)	
Soil initialization: • Download and remap ICON-EU data (ICON grid 26, R3B7) • Use of init_mode=3 to join IFS and ICON remapped data (ICON-LAM reads both files and uses IFS for the atmosphere and ICON for the soil)	

Preparation of the ICON-Test Suite

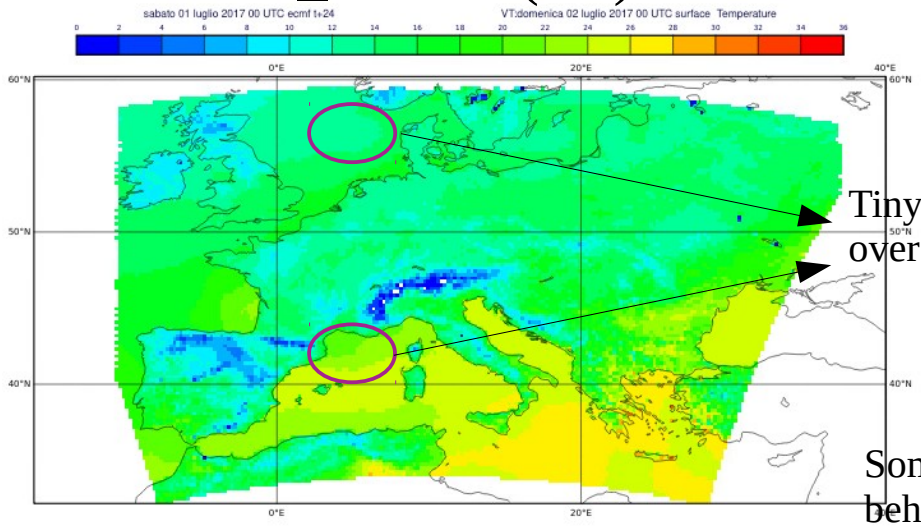
Initial and Boundary conditions

Daily update of SST:

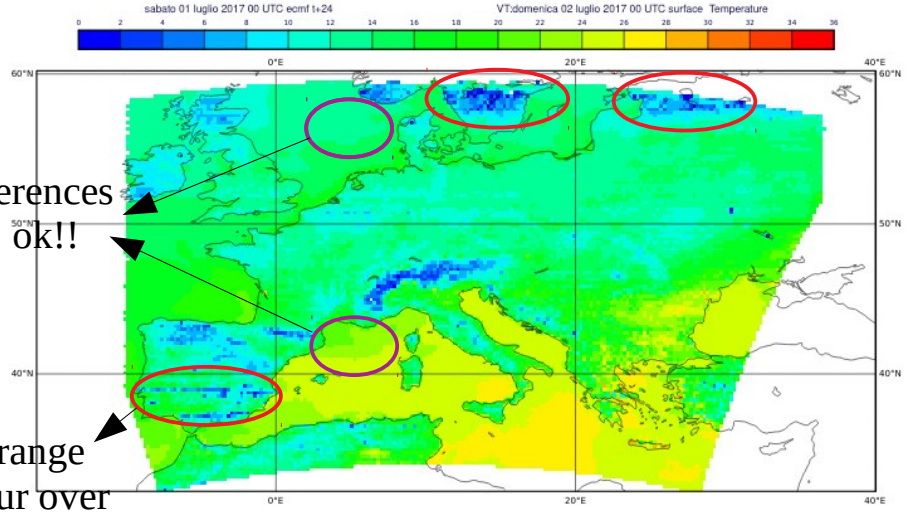
- remap SST and Fraction Ice from ECMWF analysis at 00UTC
- use ICON-LAM option imode_sstice=6 (available only from ICONv2.6.1)

Surface temperature at +24h

imode_sstice=1(def)



imode_sstice=6(test)

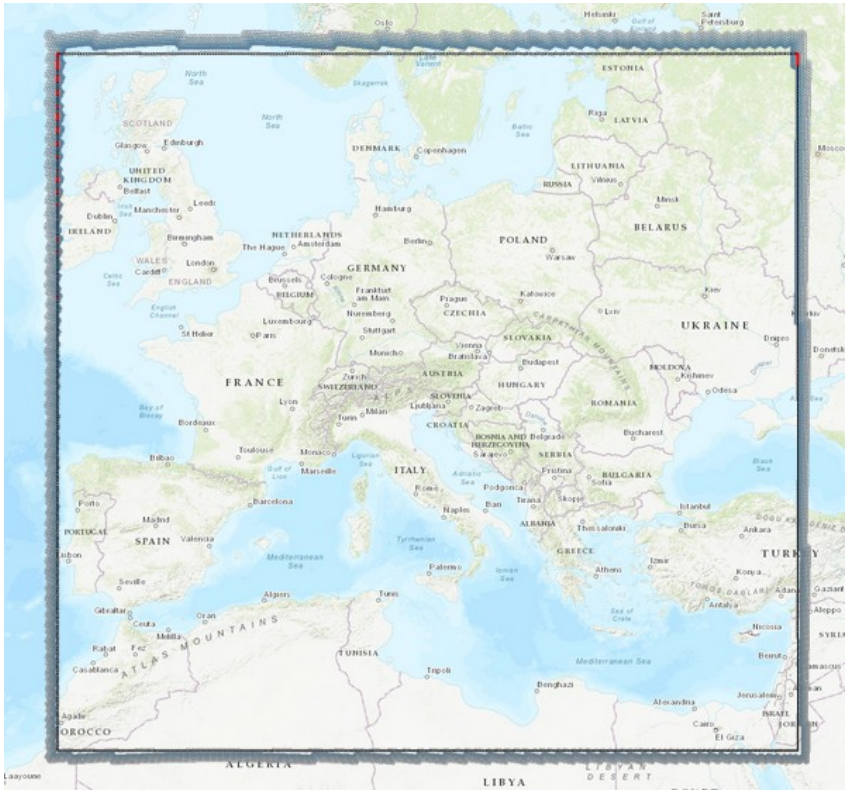


Tiny differences over Sea: ok!!

Some strange behaviour over land

Preparation of the ICON-Test Suite

Nest of Fine Resolution ICON-LAM	
Remap ICON-LAM@6.6km output over the 2.5km domain	☺
Run ICON-LAM@2.5km	☺



Main problem:

ICON-LAM@2.5km in the initial passages reported a strange statistics of the input fields (the maximum was correct, while mean and minimum were wrong) and the simulation crashes with a floating point exception at timestep 0

Preparation of the ICON-Test Suite

Nest of Fine Resolution ICON-LAM	
Remap ICON-LAM@6.6km output over the 2.5km domain	☺
Run ICON-LAM@2.5km	☺

Preparation of the ICON-Test Suite

Model chain	
Restart mode (every 5 days)	
New ECFLOW suite at ECMWF HPC for the ICON-LAM Test Suite	
Check ICON-LAM output with the verification group	

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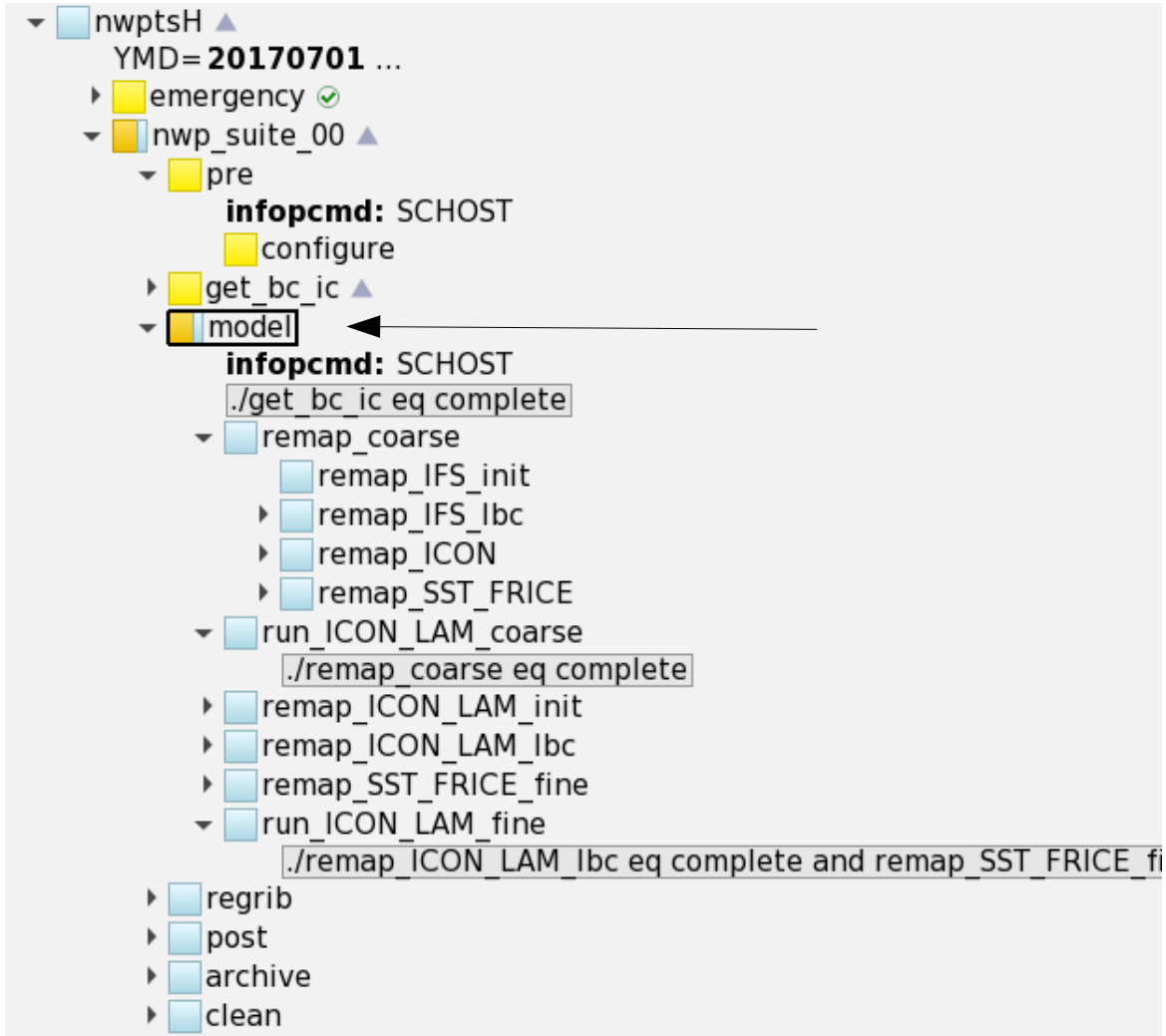

Conclusion

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?

CONSORTIUM FOR SMALL SCALE MODELING

COSMO

arpae

agenzia prevenzione ambiente energia emilia-romagna

Thank you for your attention!

Issues

Grib keys	COSMO output	After regrib
centre	78	80
subcentre	255	98
GeneratingProcessIdentifier	131	123
P1	0	**hour**
TimeRangeIndicator	13	**1**
setLocalDefinition		1
localDefinitionNumber		1
marsClass		co
marsType		fc
MarsStream		oper
experimentVersionNumber		0001
perturbationNumber		0
NumberOfForecastInEnsemble		0

Modification introduced due to an error with TimeRangeIndicator=13

timeRangeIndicator = 13
[local use: Fields from analyses valid at reference time for P1 = 0]

timeRangeIndicator = 1
[Initialized analysis product for reference time (P1=0)

Towards ICON-LAM test suite

Preparation steps

1) Grid definition: published as official COSMO ICON-LAM Testsuite grid files

	ICON-LAM-CTS7	ICON-LAM-CTS2
H.RESOLUTION	R3B7 (6.576km)	R4B8(2.466km)
CENTER	13.65625W, 48.58875N	13.4125W, 48.6625N
ROTATION	0	0
HALF WIDTH	20.65625	19.8375
HALF HEIGHT	14.71875	14.3375
lwrite_parent	ON	ON
CENTRE, SUBCENTRE	250, 0	250, 0
NUMBER GRID USED	10001	10002