



ALARO experiences@SHMU

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with contributions from
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ALARO-1 working days, Bratislava, 11-13/03/2019

Outline

- Operational setup and milestones
- Validation and verification
- Experiments with the high resolution models
- Case studies
- Plans

ALARO installations (1)

	September 2016	
	(mirror) e-suite	
HPC	old/new HPC	
model	CY38T1bf03_export	
horizontal resolution	4.5km	
number of grid points	625 x 576	
spectral resolution	312x287 (linear)	
number of levels	63	
time-step	180s	
coupling model	ARPEGE (long- & short cut off), 3h	
assimilation initialization	Upper air spectral blending with CANARI surface assimilation no initialization	
forecast ranges	78/72/72/60 (a' 1h)	
physics	ALARO-0 baseline	

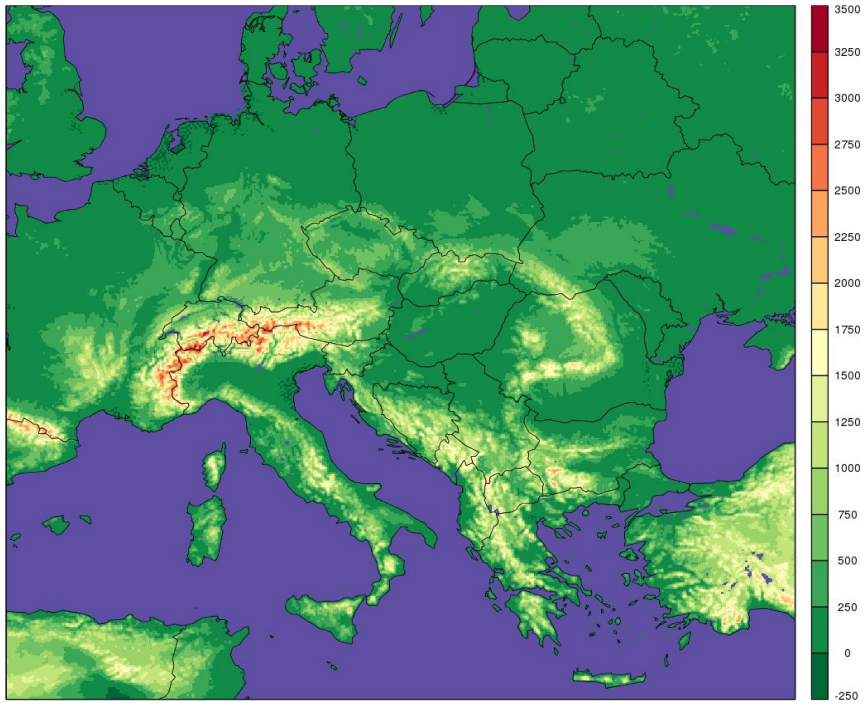
ALARO installations (2)

	September 2016	September 2016
	(mirror) e-suite	quasi-operational
HPC	old/new HPC	new HPC
model	CY38T1bf03_export	CY40T1bf05_export + local future bf06
horizontal resolution	4.5km	4.5km (exactly)
number of grid points	625 x 576	
spectral resolution	312x287 (linear)	
number of levels	63	
time-step	180s	
coupling model	ARPEGE (long- & short cut off), 3h	
assimilation initialization	Upper air spectral blending with CANARI surface assimilation no initialization	
forecast ranges	78/72/72/60 (a' 1h)	
physics	ALARO-0 baseline	ALARO-1vA

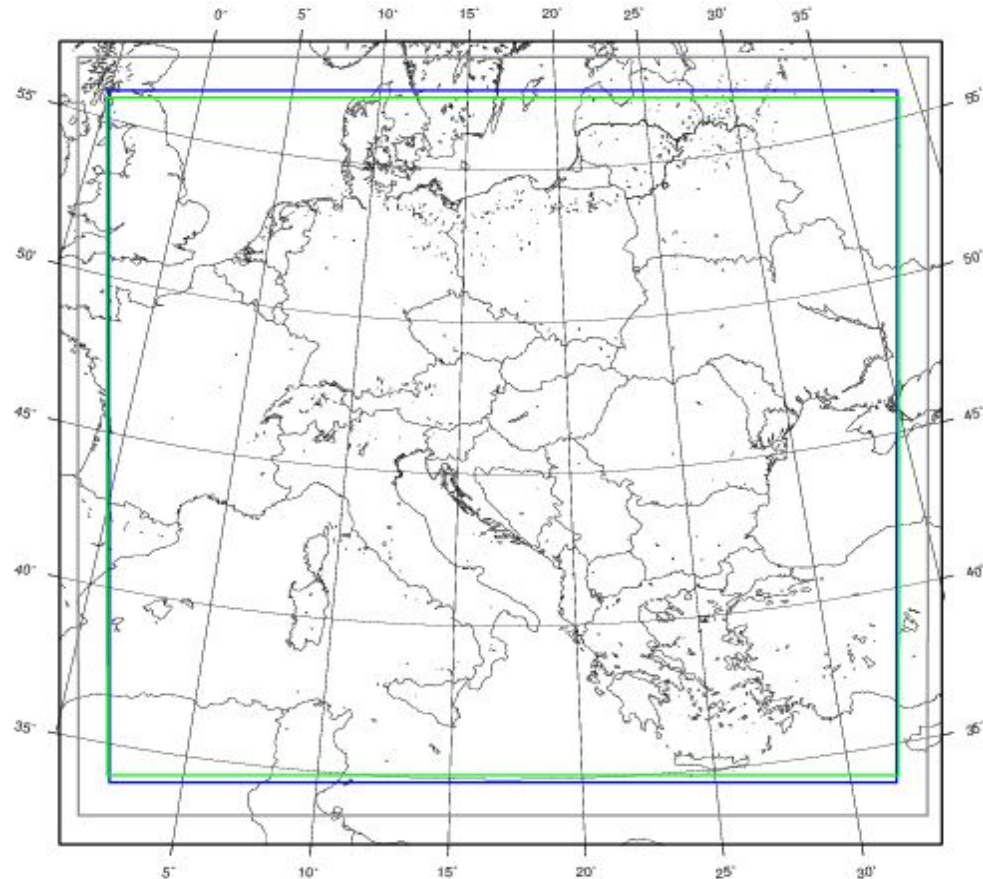
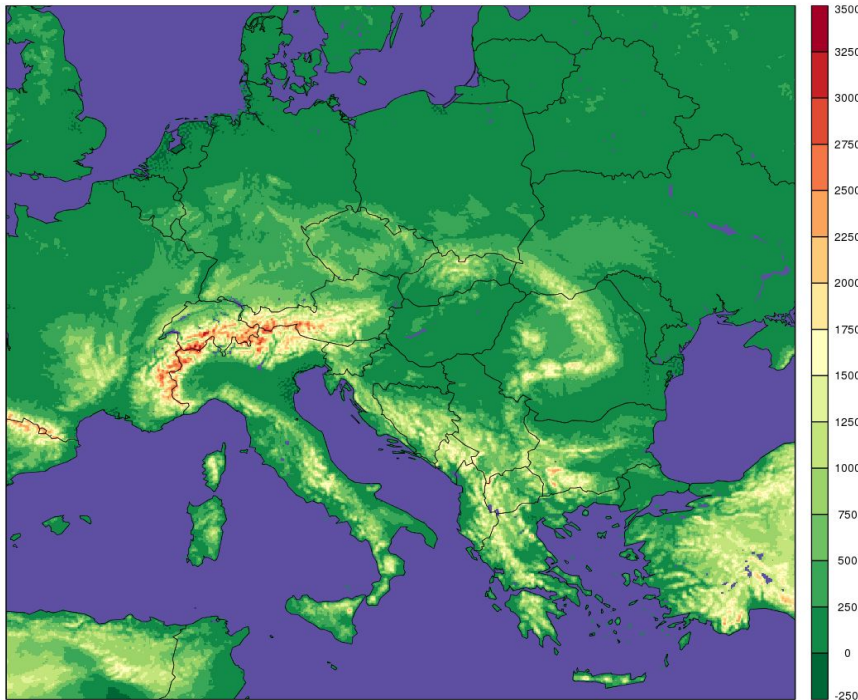
ALARO installations (3)

	September 2016	March 2019 (since April 2017)
	(mirror) e-suite	operational
HPC	old/new HPC	new HPC
model	CY38T1bf03_export	CY40T1bf07_export
horizontal resolution	4.5km	4.5km (exactly)
number of grid points	625 x 576	
spectral resolution	312x287 (linear)	
number of levels	63	
time-step	180s	
coupling model	ARPEGE (long- & short cut off), 3h	
assimilation initialization	Upper air spectral blending with CANARI surface assimilation no initialization	
forecast ranges	78/72/72/60 (a' 1h)	
physics	ALARO-0 baseline	ALARO-1vB

ALARO/SHMU operational domain



ALARO/SHMU operational domain



old & new domains borders

Operational milestones

April 2016	ALARO-1vA CY38t1bf03	Mirror e-suite on new HPC
July 2016	CY40t1_pre.bf06	
February 2017	CY40t1.bf07	LQCPL bug fixed + ventilation index
20/03/2017	ALARO-1vB	operational status declared

Operational milestones

April 2016	ALARO-1vA CY38t1bf03	Mirror e-suite on new HPC
July 2016	CY40t1_pre.bf06	
February 2017	CY40t1.bf07	LQCPL bug fixed + ventilation index
20/03/2017	ALARO-1vB	operational status declared
January 2017	1 new HPC node crashed	Replaced in frame of warranty
Q1/2018	4 new HPC nodes crashed	2 replaced

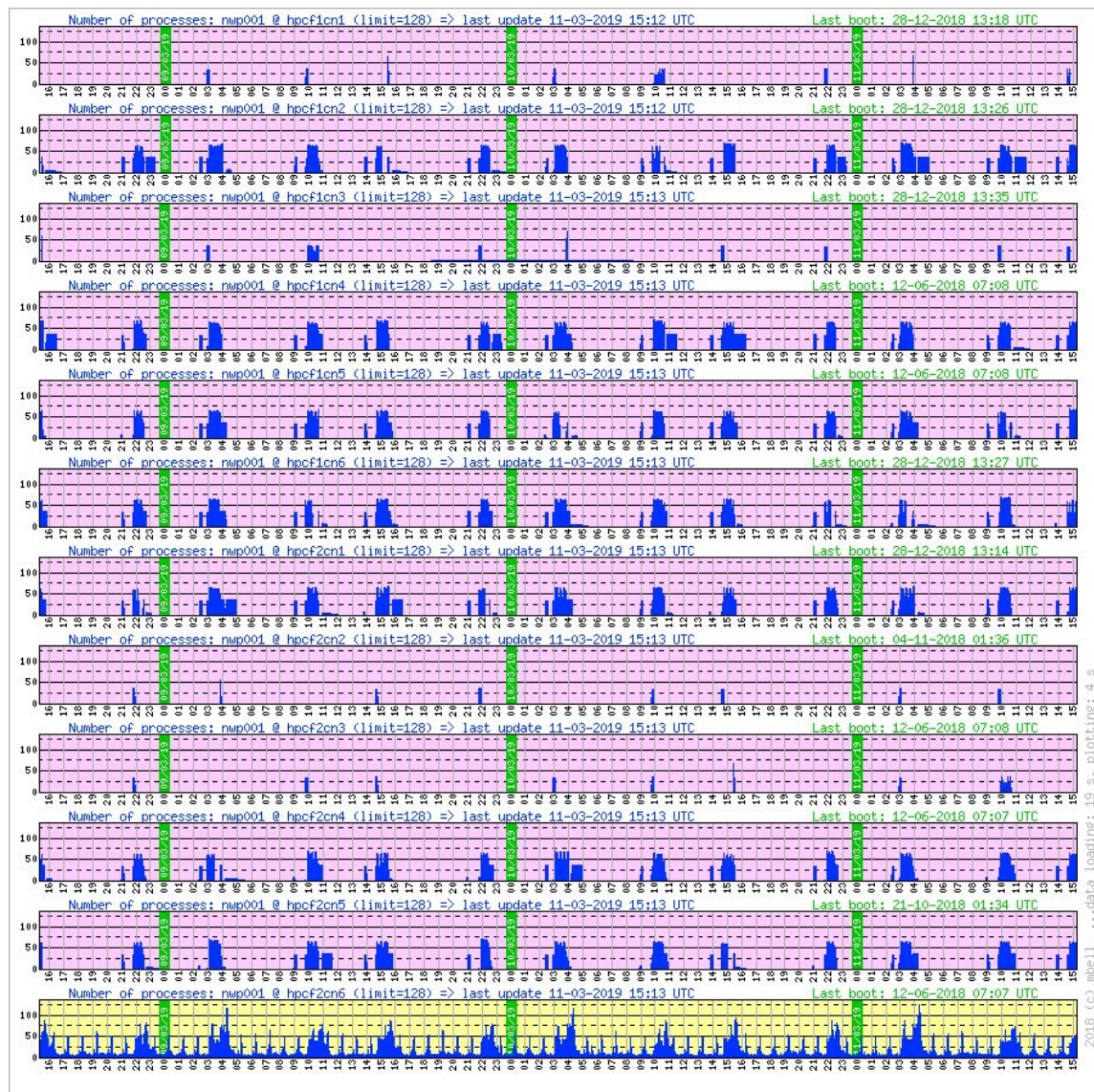
Operational milestones

April 2016	ALARO-1vA CY38t1bf03	Mirror e-suite on new HPC
July 2016	CY40t1_pre.bf06	
February 2017	CY40t1.bf07	LQCPL bug fixed + ventilation index
20/03/2017	ALARO-1vB	operational status declared
January 2017	1 new HPC node crashed	Replaced in frame of warranty
Q1/2018	4 new HPC nodes crashed	2 replaced
Q2/2018	5 old HPC nodes reconfigured	and plugged into a cluster with new HPC in unified load leveller queueing system

Operational milestones

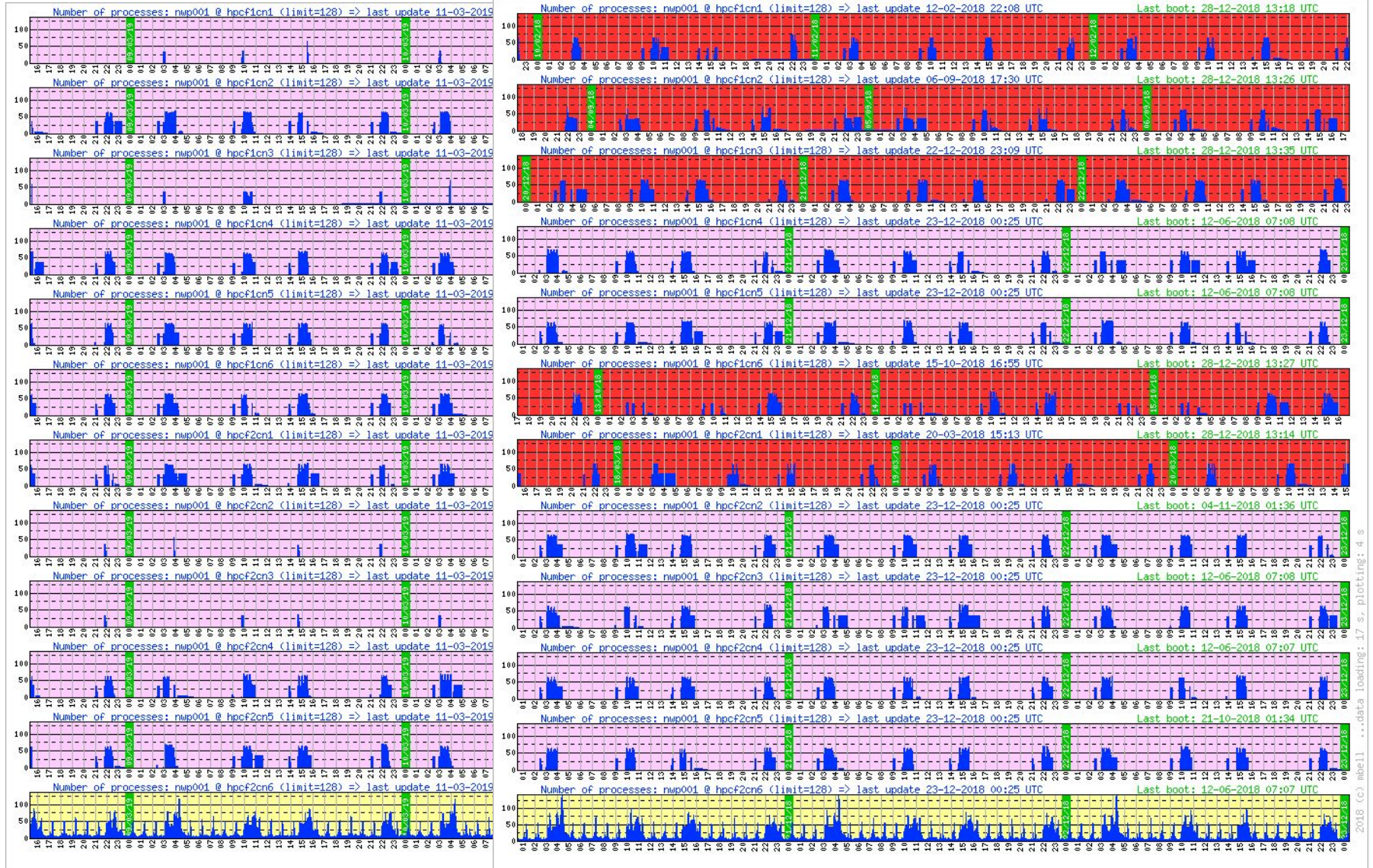
April 2016	ALARO-1vA CY38t1bf03	Mirror e-suite on new HPC
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20/03/2017	ALARO-1vB	operational status declared
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Q1/2018	4 new HPC nodes crashed	2 replaced
Q2/2018	5 old HPC nodes reconfigured	and plugged into a cluster with new HPC in unified load leveller queueing system
September 2018	1 new HPC node crashed	
Late December 2018	3 crashed nodes replaced	

No. of processes on HPC nodes



2018 (c) mbell ...data loading: 19 s, plotting: 4 s

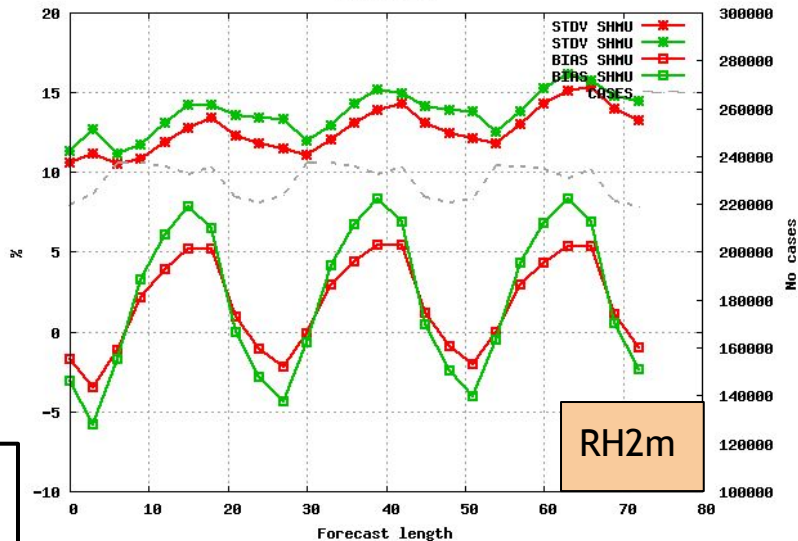
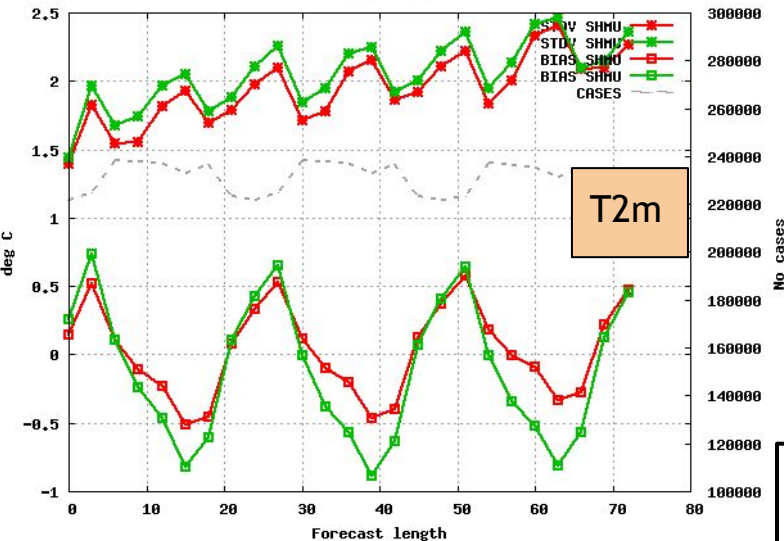
No. of processes on HPC nodes



Verification/validation over 5 months

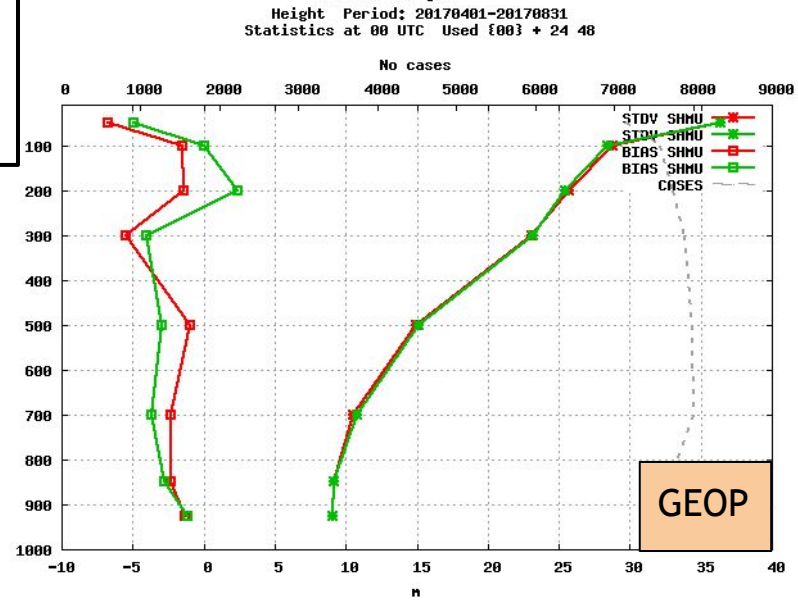
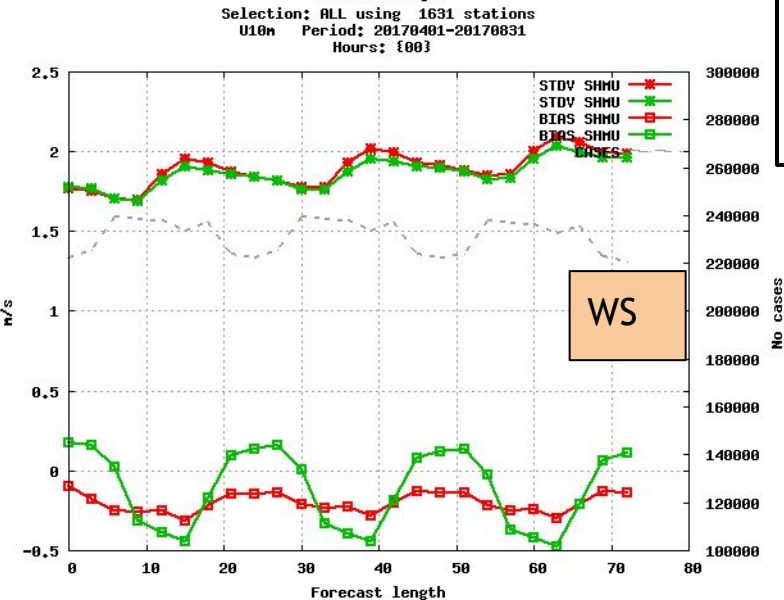
Selection: ALL using 1603 stations
T2m, height adjusted Period: 20170401-20170831
Hours: {00}

Selection: ALL using 1598 stations
Rh2m Period: 20170401-20170831
Hours: {00}



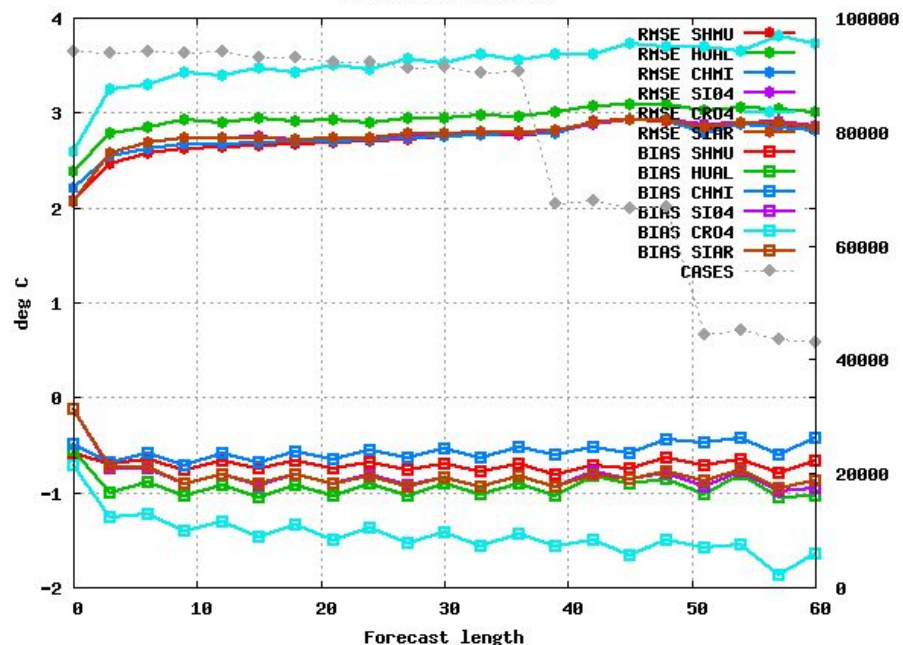
ALARO-1vB
(4.5 km/L63)

ALARO-0
(9 km/L37)

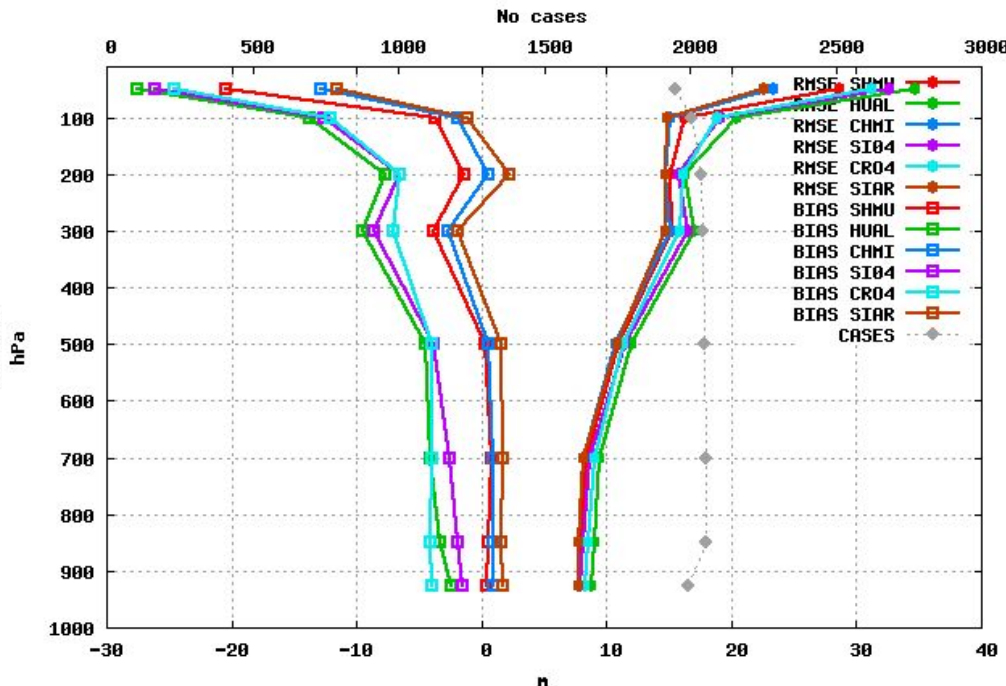


Verification/validation wrt RC LACE

Selection: ALL using 876 stations
 T2m, height adjusted Period: 201902
 Hours: {00,06,12,18}



25 stations Selection: ALL
 Height Period: 201902
 Statistics at 00 UTC Used {00,12} + 12 24 36 48



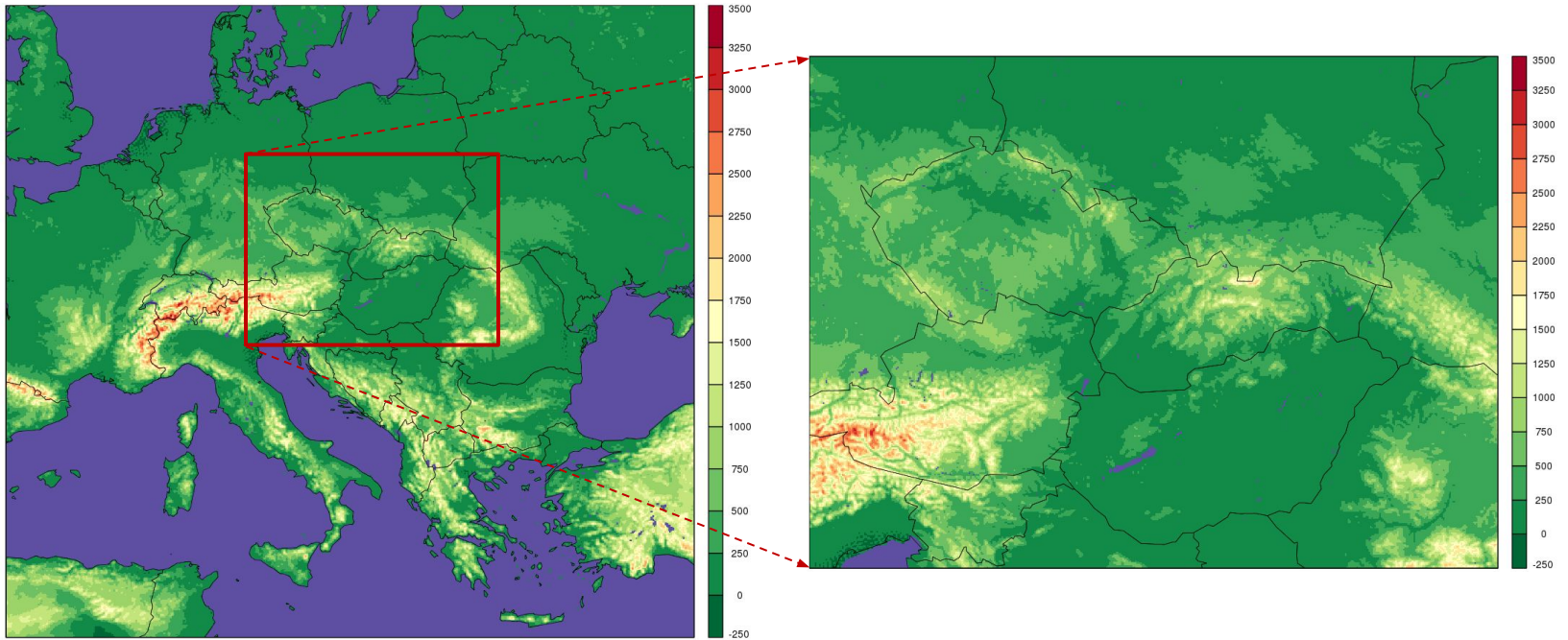
BIAS and RMSE of T2m height adjusted (left) and geopotential (right) for Feb 2019 (www.rclace.eu).
ALARO/SHMU (in red) with satisfactory performance compared to other ALAROs.
 Interesting to note a grouping of scores for models coupled to AROME and to ECMWF (right fig).

HR experiments - highlights

HR models run in experimental mode, supervised and checked by Martin Dian and consulted by (young) forecasters.

- AROME CMC 2 km resolution setup on new HPC
- ALARO CMC 1 km resolution setup
- ALARO & AROME 2 km/L73 over identical domain setup (covering LACE radars)
- ALARO+DFI to avoid frequent model crashes
- ALARO on old HPC due to new HPC node crashes
- Nodes from old HPC reconfigured and plugged into new HPC under specific load leveller queues => both HR models run on that system
- ALARO CY43T2_pre.bf10 (new LZOTHER treatment in e923 and e001) exploited

Operational & HR models domains



ALADIN/SHMU systems

<i>CMC</i>	ALARO/SHMU
<i>status</i>	operational
<i>code version</i>	CY40T1bf07_export
<i>physics</i>	ALARO-1vB
<i>dx</i>	4.5 km
<i>pts</i>	625 x 576
<i>vertical levels</i>	63
<i>tstep</i>	180 s
<i>forecast ranges</i>	78/72/72/60 (a' 1h)
<i>coupling model</i>	ARPEGE (long- & short cut off), 3h
<i>assimilation</i>	upper air spectral blending with CANARI surface assimilation
<i>initialization</i>	no initialization
<i>HPC</i>	IBM Flex System p460, linux

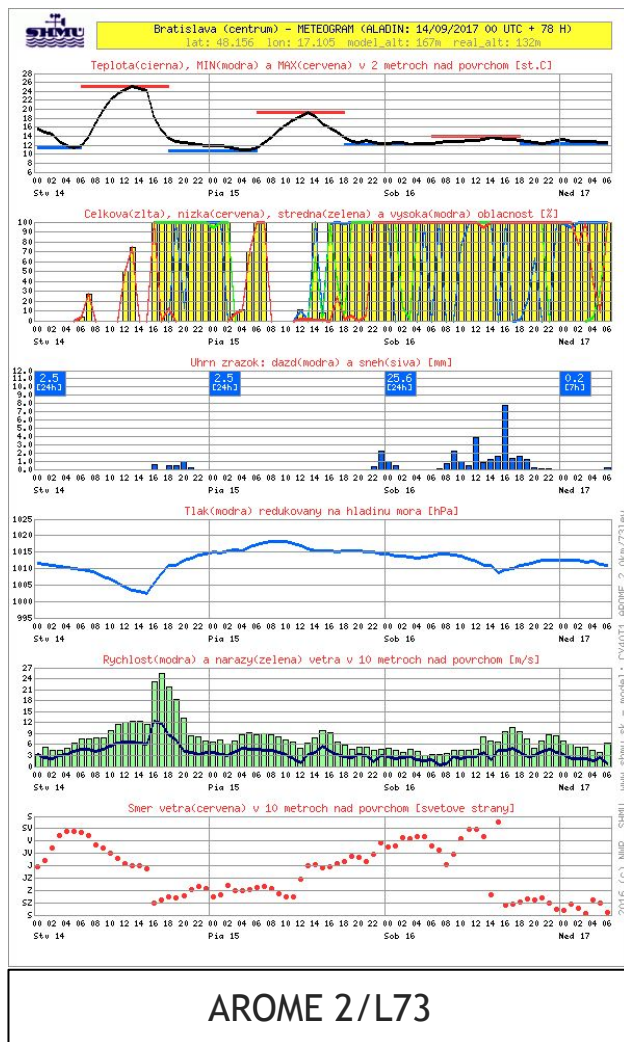
ALADIN/SHMU systems

CMC	ALARO/SHMU	ALARO/2km	AROME/2km
<i>status</i>	operational	experimental	
<i>code version</i>	CY40T1bf07_export		
<i>physics</i>	ALARO-1vB		
<i>dx</i>	4.5 km	2.0 km	
<i>pts</i>	625 x 576	512 x 384	
<i>vertical levels</i>	63	73	
<i>tstep</i>	180 s		
<i>forecast ranges</i>	78/72/72/60 (a' 1h)	+78h at 00UTC/+72h at 12UTC (a' 1h)	
<i>coupling model</i>	ARPEGE (long- & short cut off), 3h	ALARO-1vB (4.5 km), 1h	
<i>assimilation</i>	upper air spectral blending with CANARI surface assimilation	downscaling	
<i>initialization</i>	no initialization		
<i>HPC</i>	IBM Flex System p460, linux	IBM p755 running with IBM Flex System p460, linux	

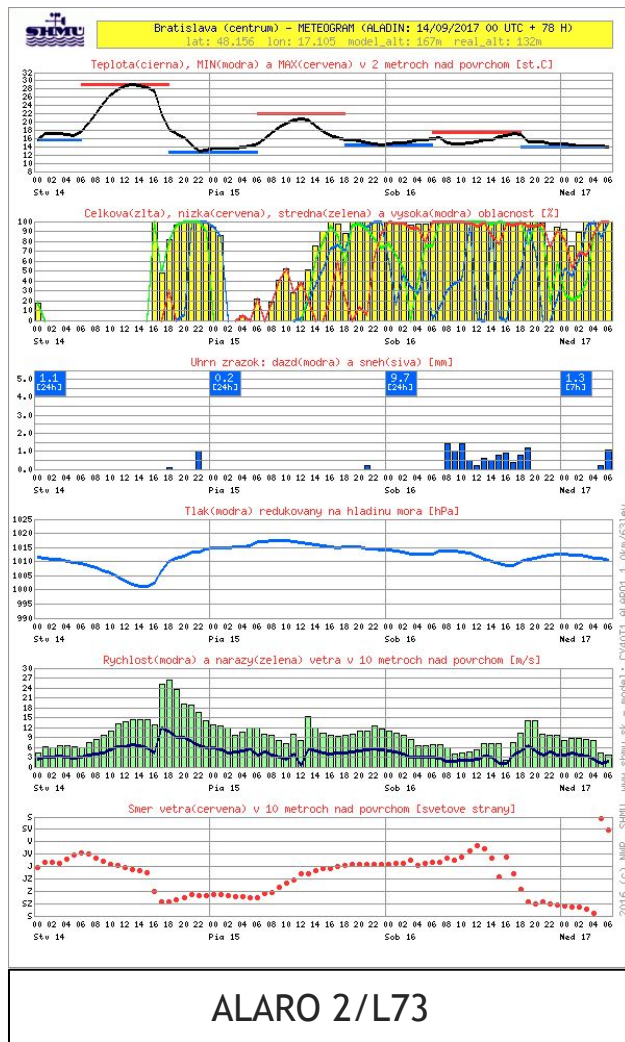
ALADIN/SHMU systems

<i>CMC</i>	ALARO/SHMU	ALARO/2km	AROME/2km
<i>status</i>	operational	experimental	
<i>code version</i>	CY40T1bf07_export	CY43T2_pre.bf10	CY40T1bf07_export
<i>physics</i>	ALARO-1vB	ALARO-1vB	AROME-FRANCE
<i>dx</i>	4.5 km	2.0 km	
<i>pts</i>	625 x 576	512 x 384	
<i>vertical levels</i>	63	73	
<i>tstep</i>	180 s	120 s	144 s
<i>forecast ranges</i>	78/72/72/60 (a' 1h)	+78h at 00UTC/+72h at 12UTC (a' 1h)	
<i>coupling model</i>	ARPEGE (long- & short cut off), 3h	ALARO-1vB (4.5 km), 1h	
<i>assimilation</i>	upper air spectral blending with CANARI surface assimilation	downscaling	
<i>initialization</i>	no initialization	DFI	no initialization
<i>HPC</i>	IBM Flex System p460, linux	IBM p755 running with IBM Flex System p460, linux	

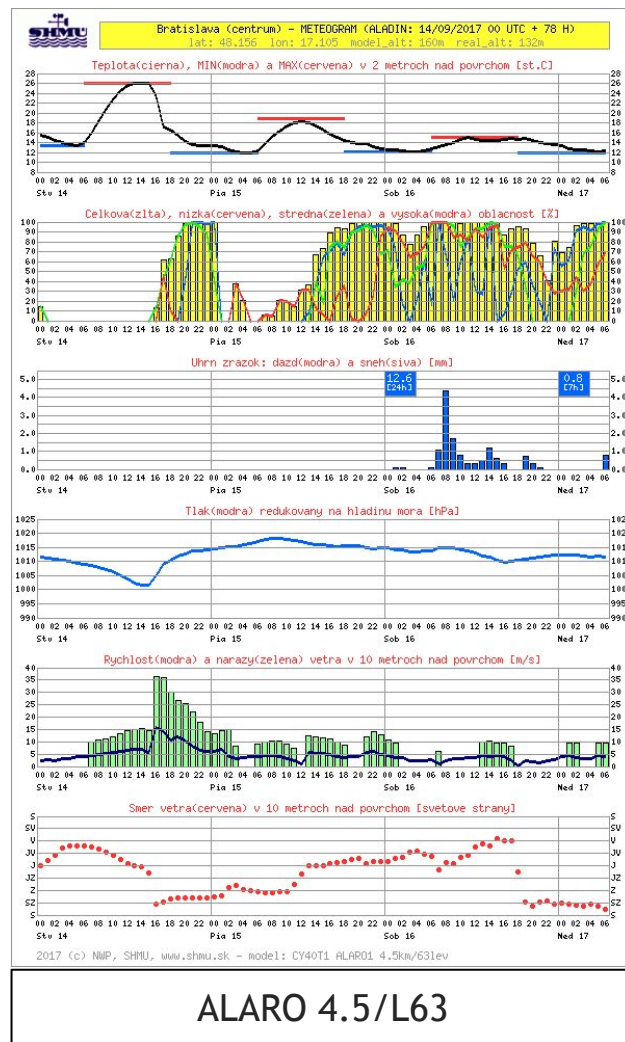
HR models - meteograms example



AROME 2/L73



ALARO 2/L73



ALARO 4.5/L63

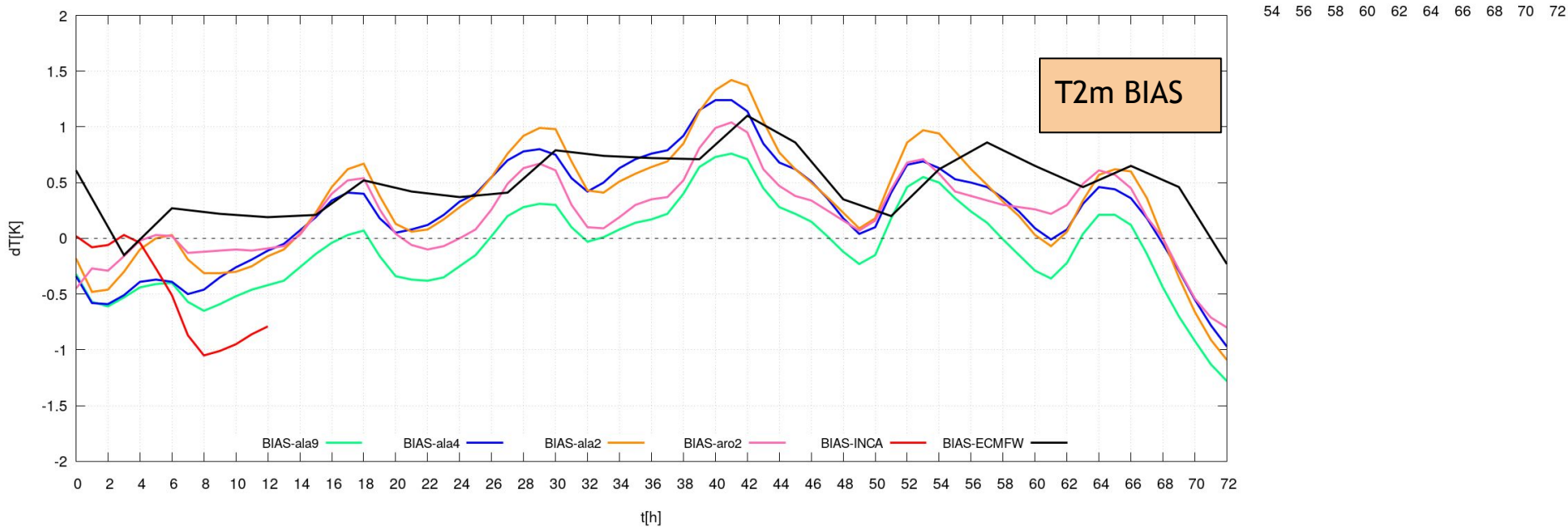
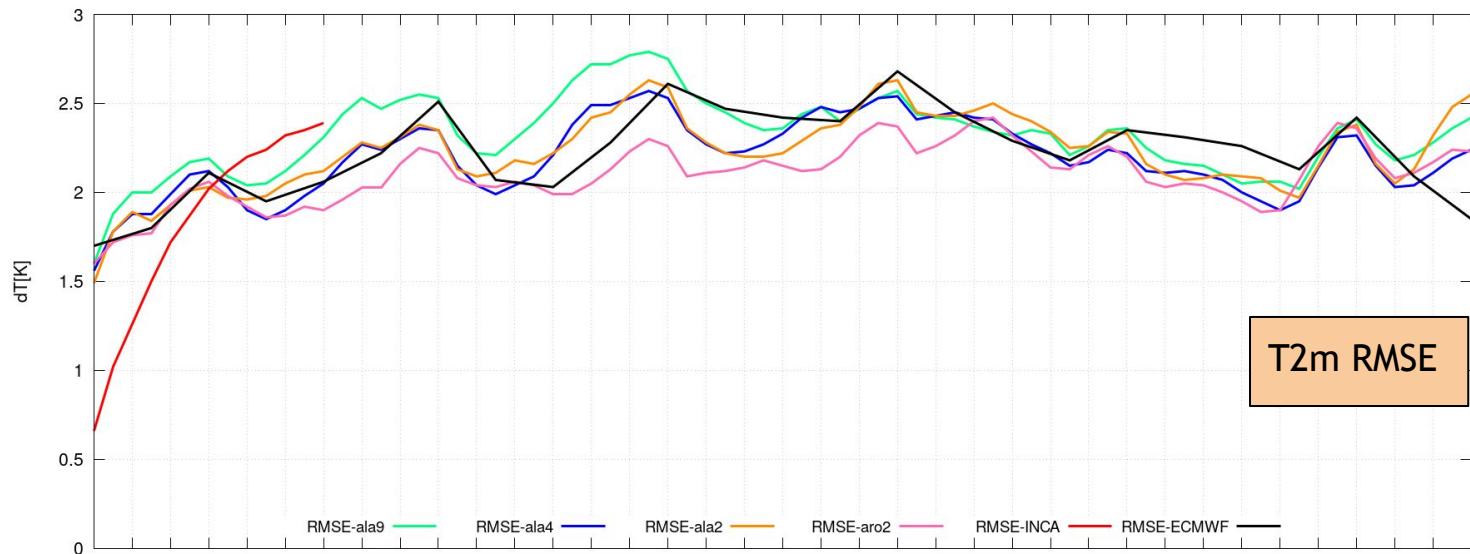
Verification of HR models (1) - SHMU

ALARO/SHMU
4.5 km/L63

ALARO/SHMU
2 km/L73

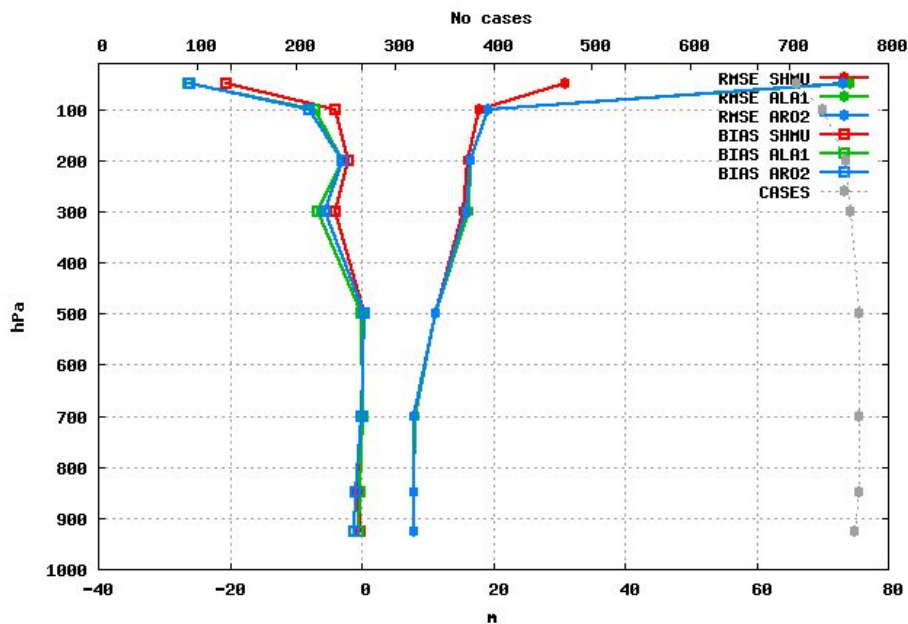
AROME
2 km/L73

October 2018

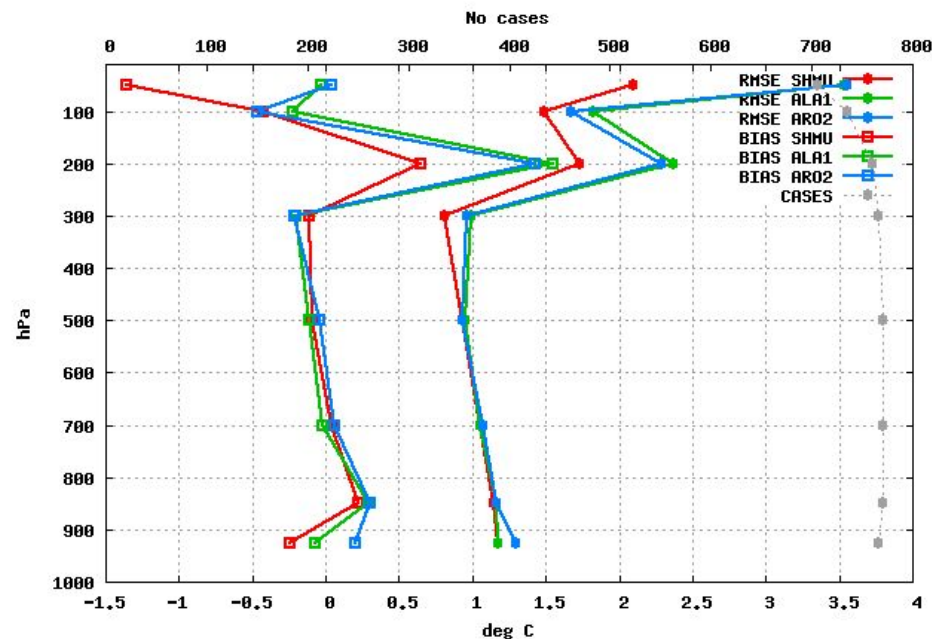


Verification of HR models (2)-domain

11 stations Selection: ALL
Height Period: 201902
Statistics at 00 UTC Used {00,12} + 12 24 36 48



11 stations Selection: ALL
Temperature Period: 201902
Statistics at 00 UTC Used {00,12} + 12 24 36 48

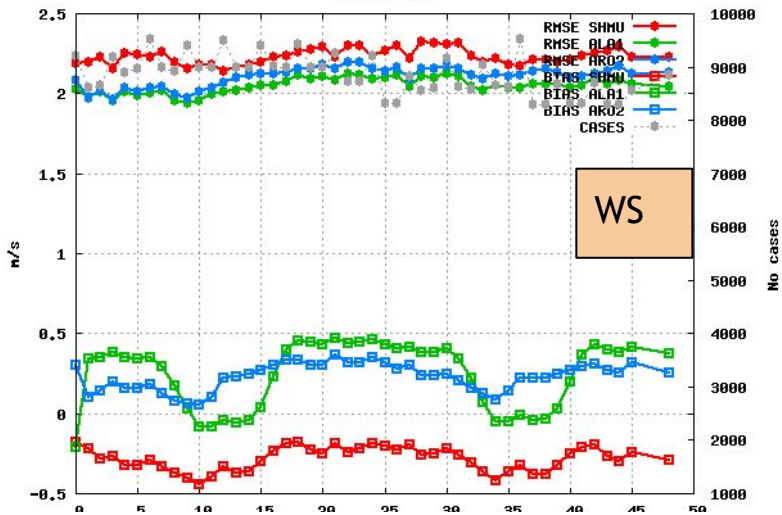


ALARO/SHMU 4.5 km/L63, ALARO/SHMU 2 km/L73, AROME 2 km/L73

BIAS and RMSE of GEOP (left) and T (right), February 2019

Verification of HR models (3)-domain

Selection: ALL using 371 stations
U10m Period: 201902
Hours: {00}



WS

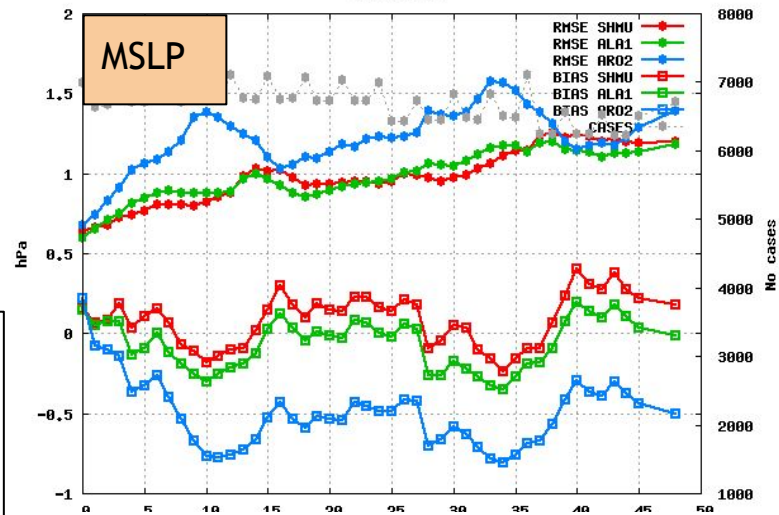
ALARO/SHMU
4.5 km/L63

ALARO/SHMU
2 km/L73

AROME
2 km/L73

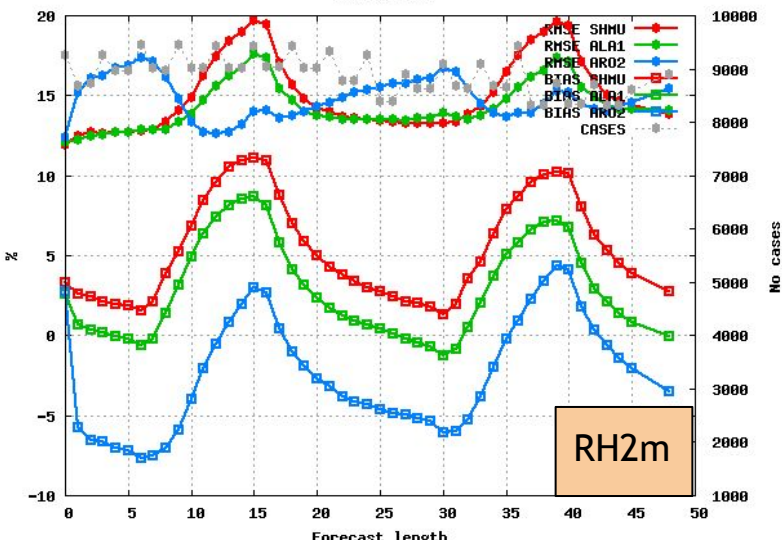
February 2019

Selection: ALL using 274 stations
Mslp Period: 201902
Hours: {00}



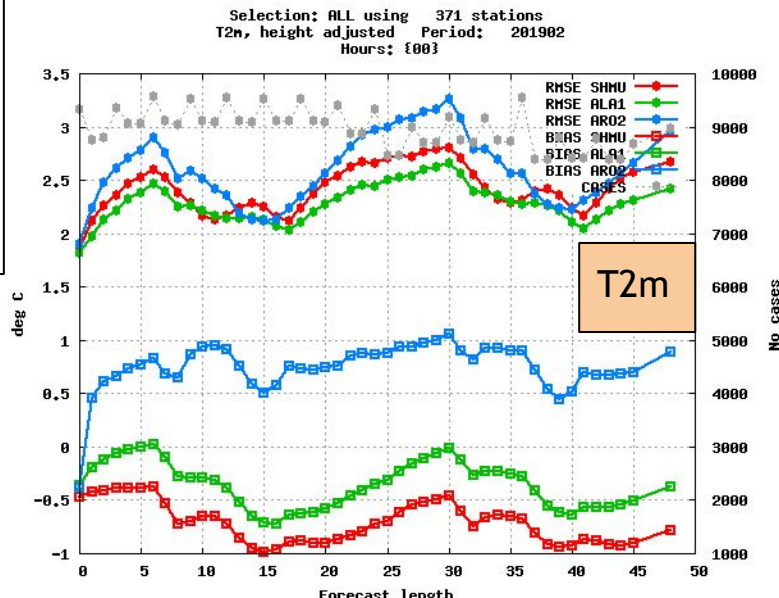
MSLP

Selection: ALL using 371 stations
Rh2m Period: 201902
Hours: {00}



RH2m

Forecast length

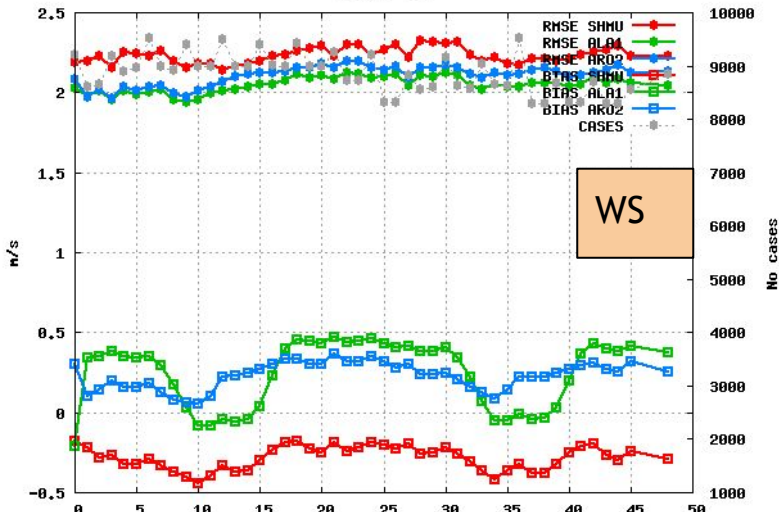


T2m

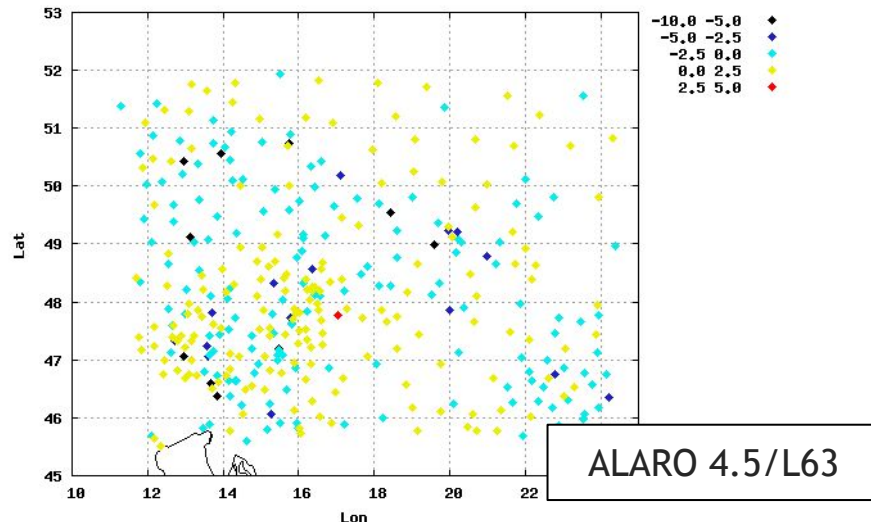
Forecast length

Verification of HR models (4) - WS

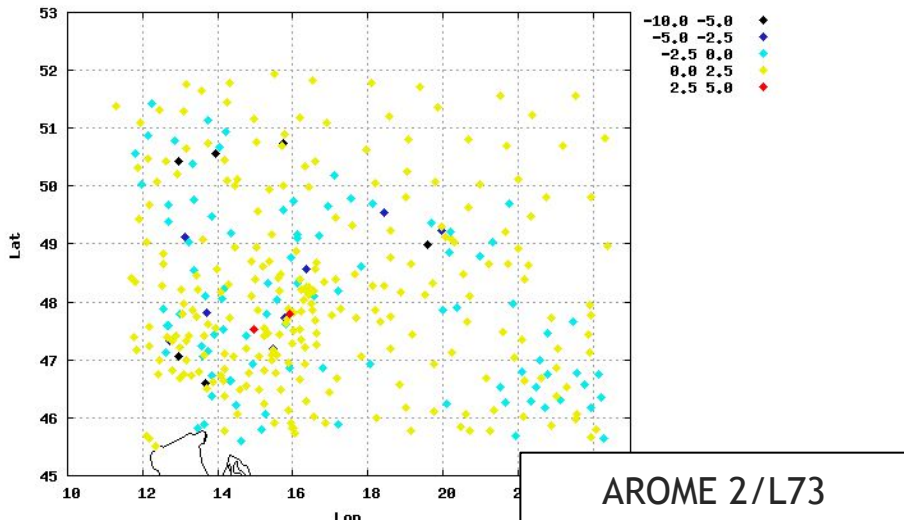
Selection: ALL using 371 stations
 U10m Period: 201902
 Hours: {00}



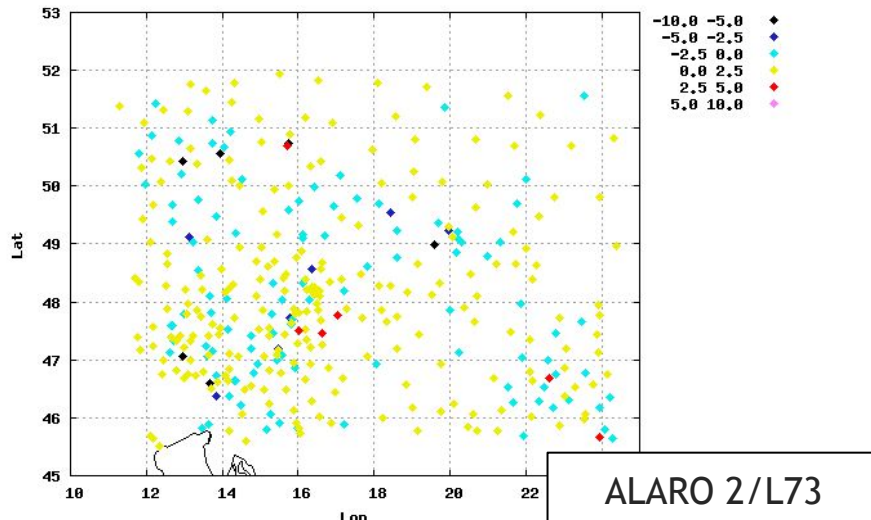
Exp: SHMU Selection: ALL 358 stations
 Period: 201902
 U10m bias [m/s] at 00 UTC
 Used {00,12} + 00 12 24 36 48



Exp: AR02 Selection: ALL 358 stations
 Period: 201902
 U10m bias [m/s] at 00 UTC
 Used {00,12} + 00 12 24 36 48

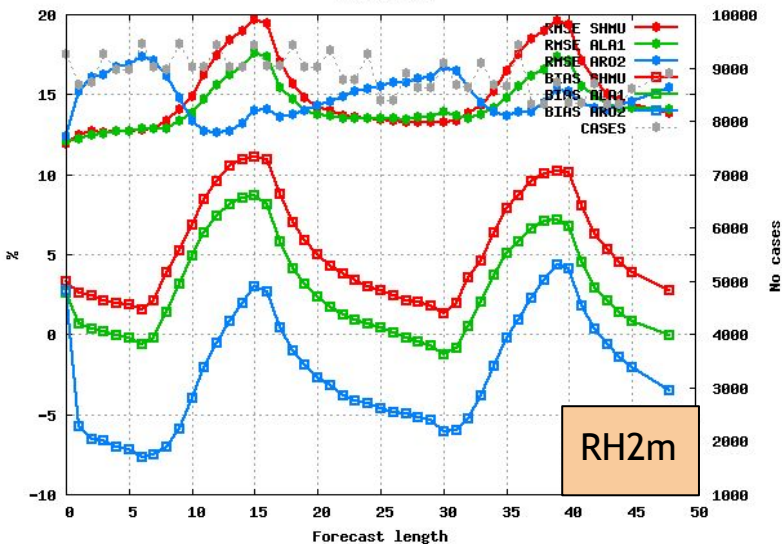


Exp: ALA1 Selection: ALL 358 stations
 Period: 201902
 U10m bias [m/s] at 00 UTC
 Used {00,12} + 00 12 24 36 48

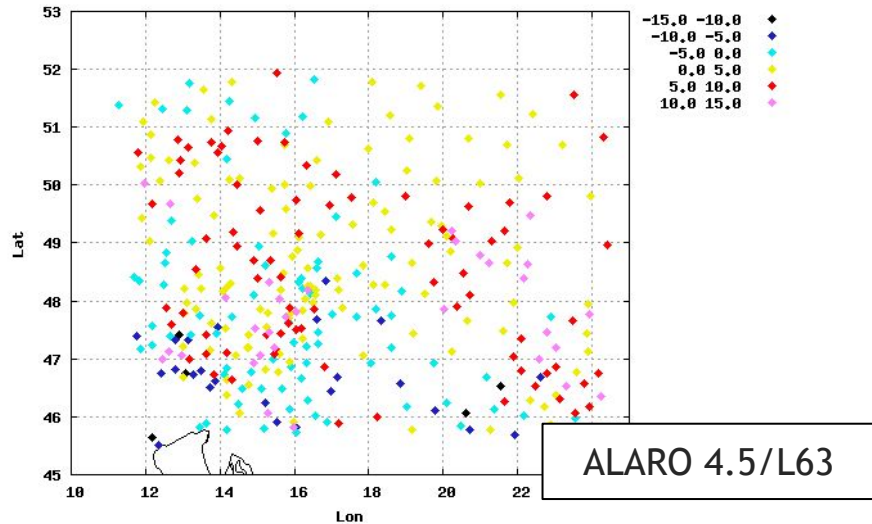


Verification of HR models (5) - RH2m

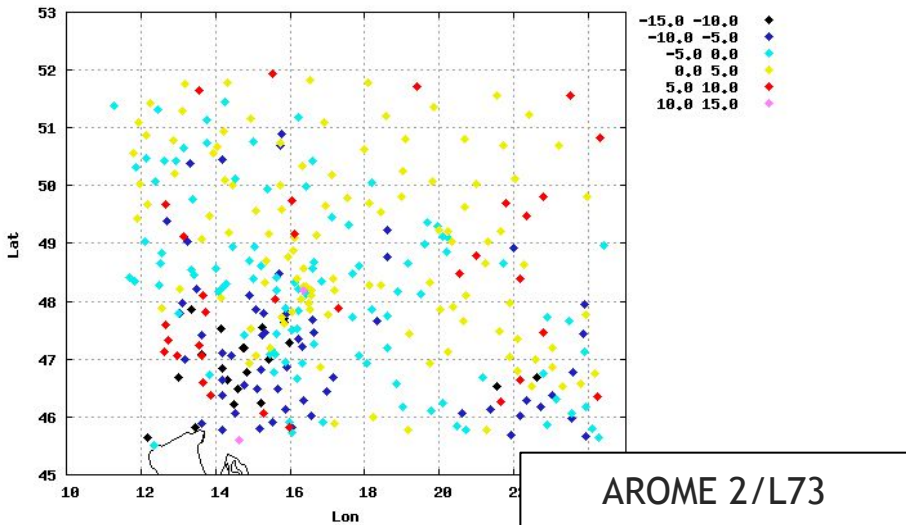
Selection: ALL using 367 stations
 Rh2m Period: 201902
 Hours: {00}



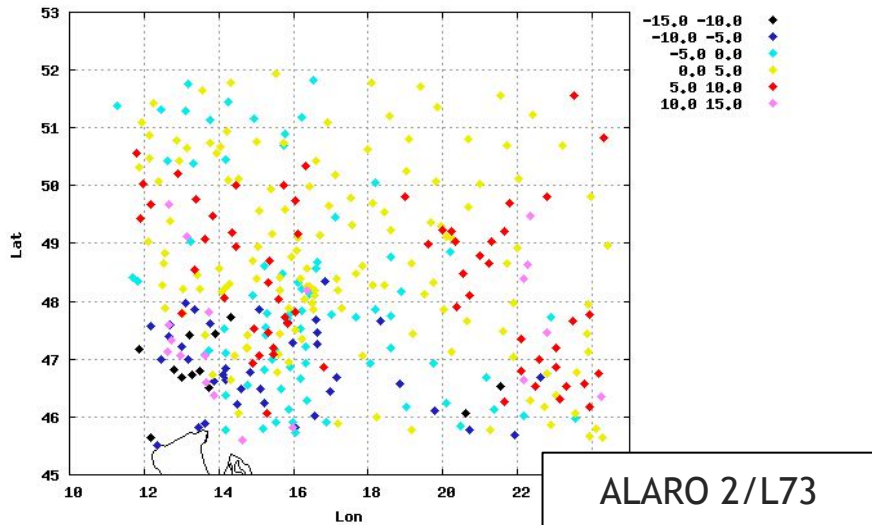
Exp: SHMU Selection: ALL 358 stations
 Period: 201902
 Rh2m bias [%] at 00 UTC
 Used {00,12} + 00 12 24 36 48



Exp: AR02 Selection: ALL 358 stations
 Period: 201902
 Rh2m bias [%] at 00 UTC
 Used {00,12} + 00 12 24 36 48

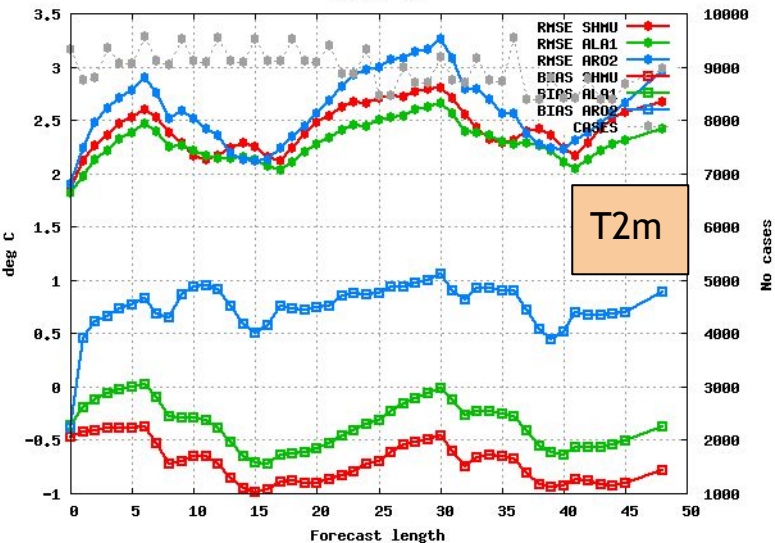


Exp: ALA1 Selection: ALL 358 stations
 Period: 201902
 Rh2m bias [%] at 00 UTC
 Used {00,12} + 00 12 24 36 48

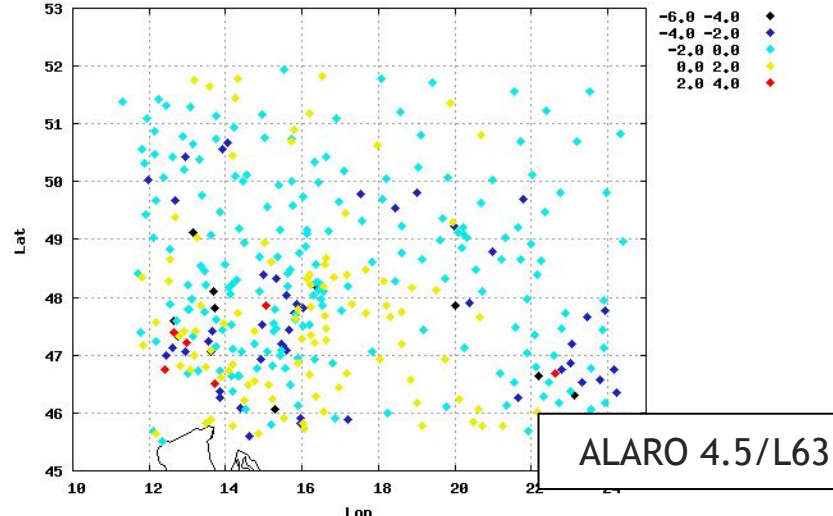


Verification of HR models (6) - T2m

Selection: ALL using 371 stations
T2m, height adjusted Period: 201902
Hours: {00}

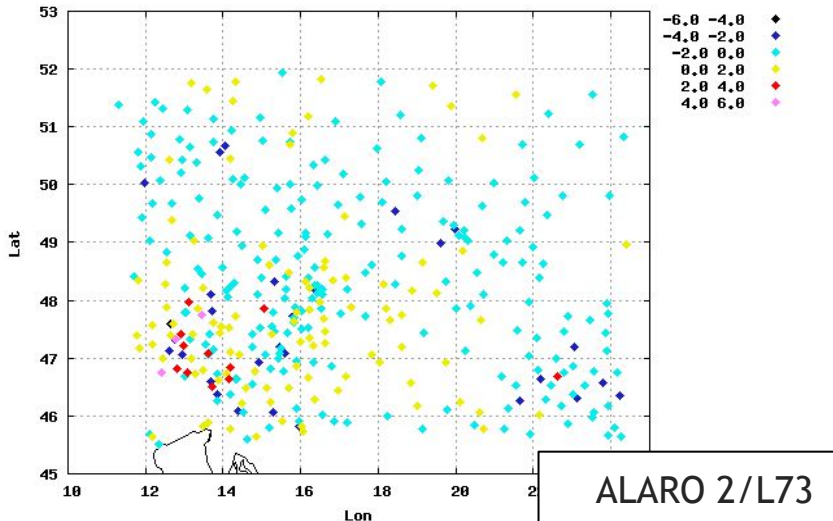
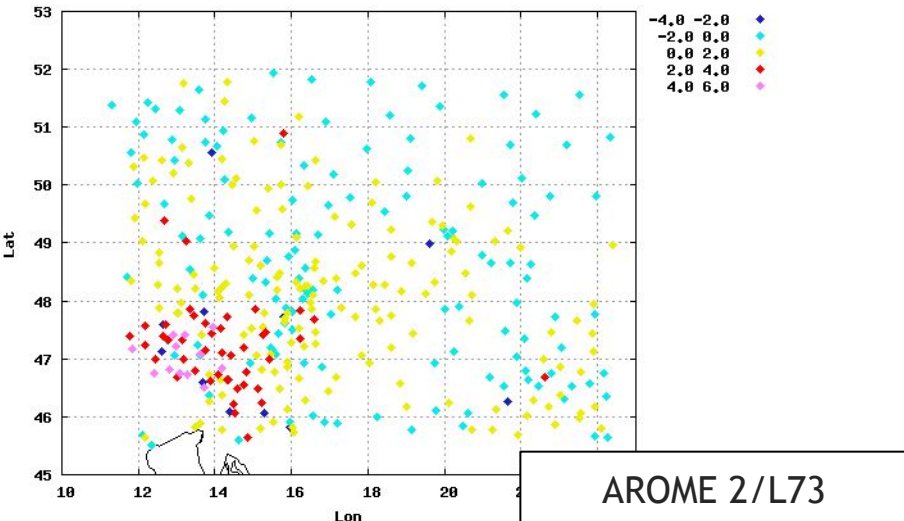


Exp: SHMU Selection: ALL 361 stations
Period: 201902
T2m, height adjusted bias [deg C] at 00 UTC
Used {00,12} + 00 12 24 36 48

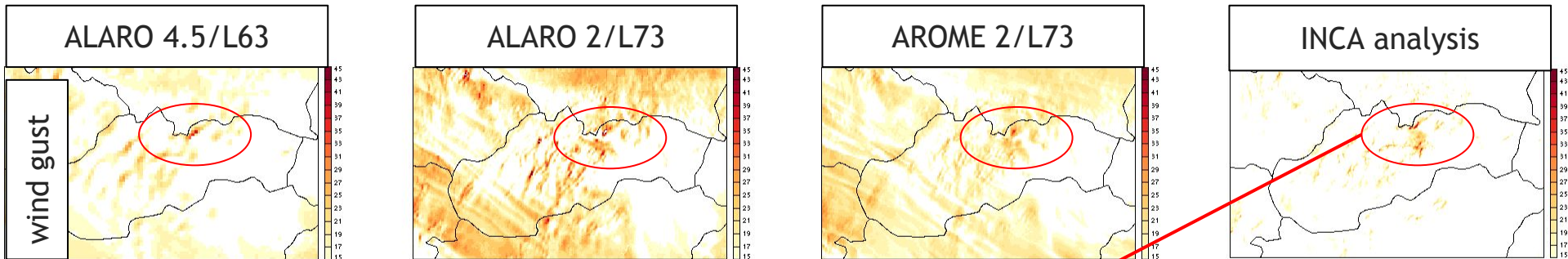


Exp: AR02 Selection: ALL 361 stations
Period: 201902
T2m, height adjusted bias [deg C] at 00 UTC
Used {00,12} + 00 12 24 36 48

Exp: ALA1 Selection: ALL 361 stations
Period: 201902
T2m, height adjusted bias [deg C] at 00 UTC
Used {00,12} + 00 12 24 36 48

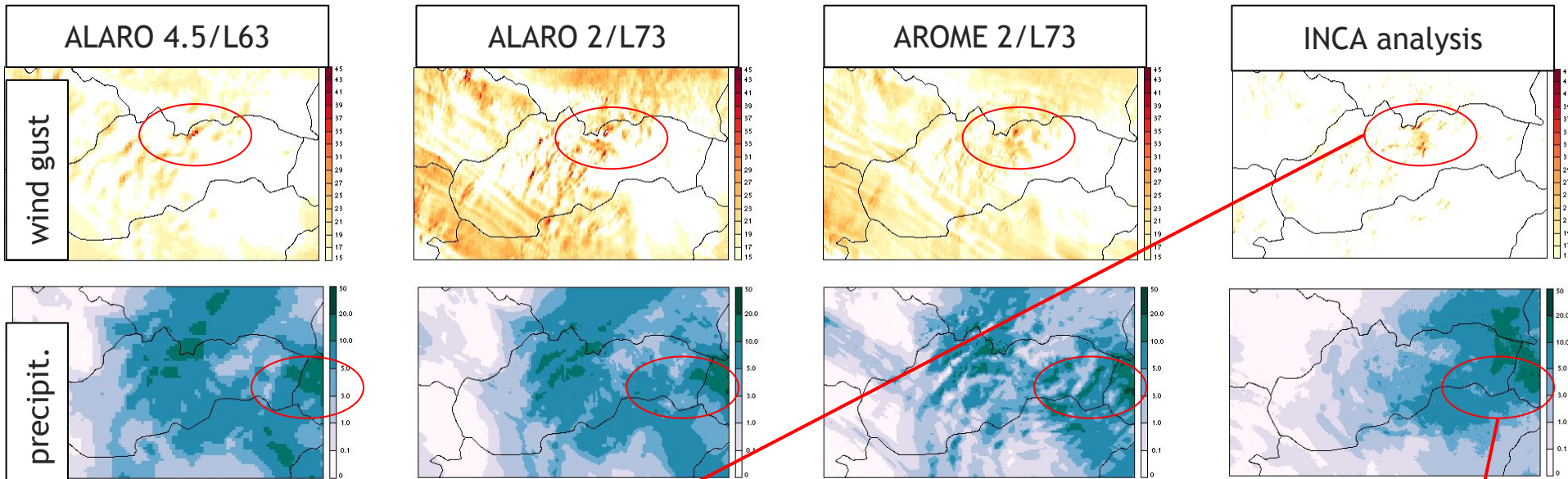


Case study of 01/04/2018



Meteorological warning

Case study of 01/04/2018



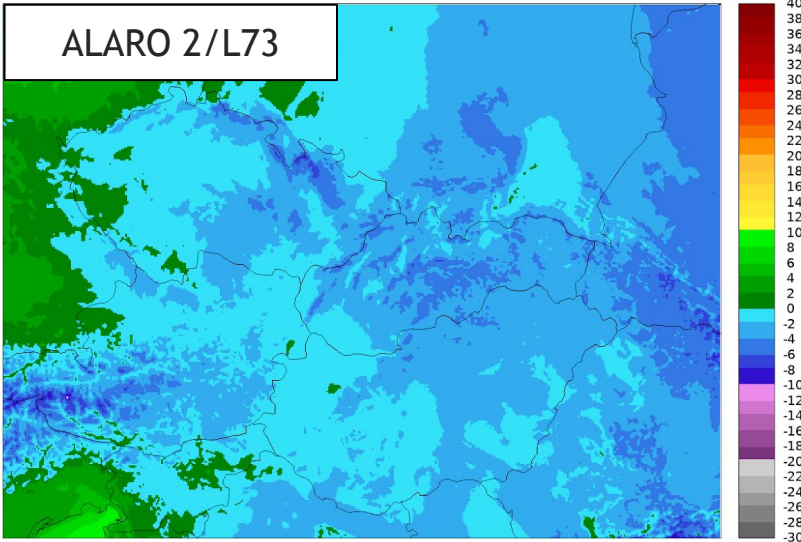
Meteorological warning



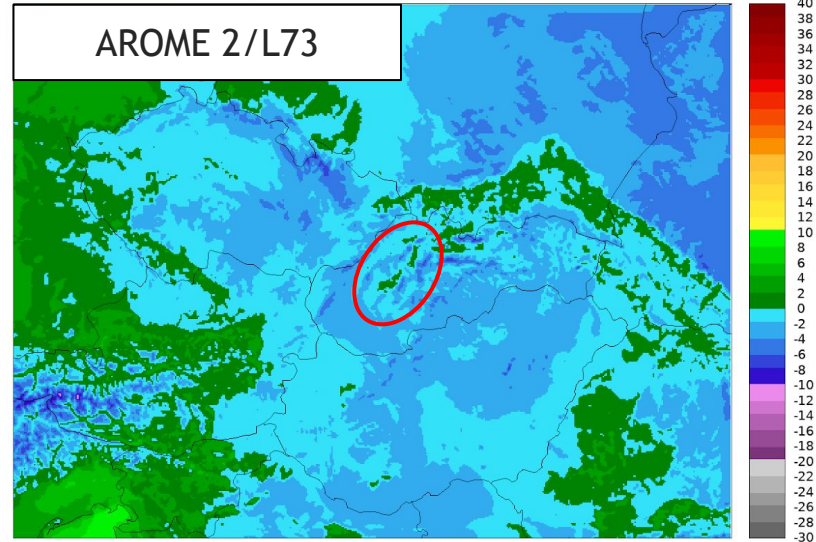
Hydrological warning

Case study of 19/12/2018 (T2m +33h)

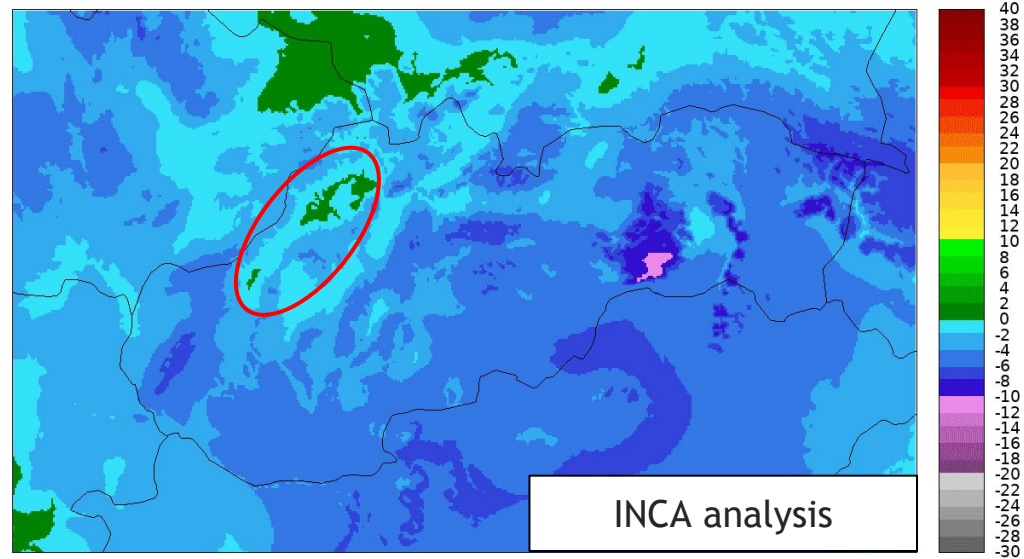
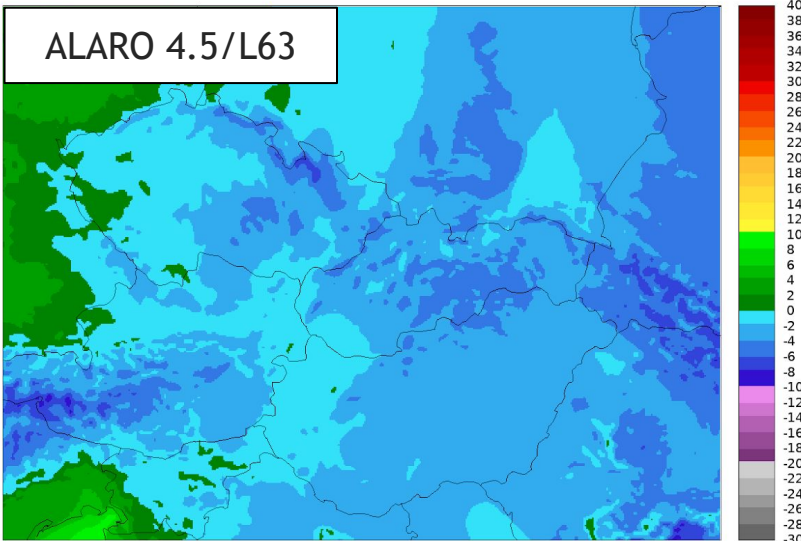
model: ALADIN_2km temperature 2m base: 2018-12-19_00 (Wednesday) range: +33 valid: 2018-12-20_09 (Thursday)



model: AROME_2km temperature 2m base: 2018-12-19_00 (Wednesday) range: +33 valid: 2018-12-20_09 (Thursday)

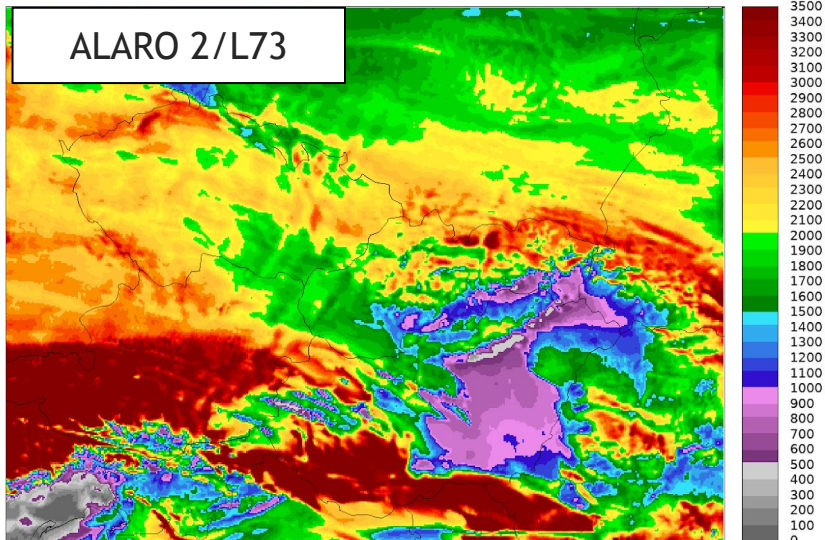


model: ALADIN_4.5km temperature 2m base: 2018-12-19_00 (Wednesday) range: +33 valid: 2018-12-20_09 (Thursday)

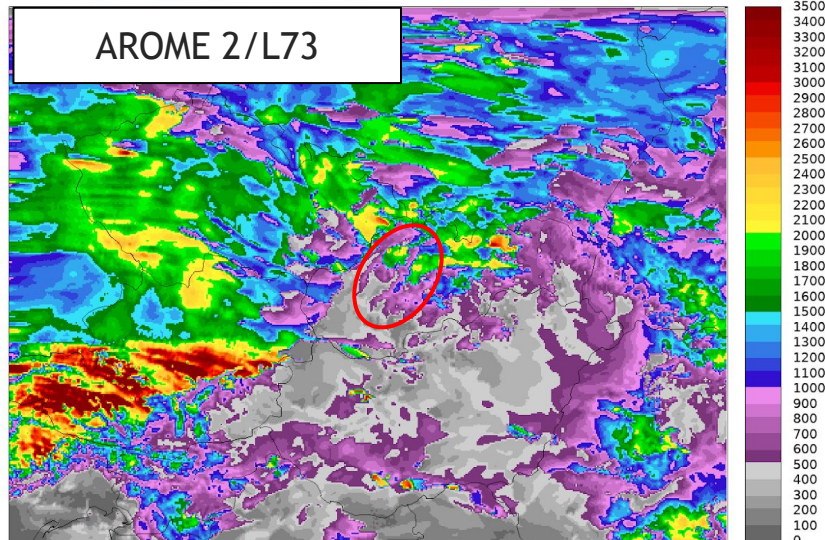


Case study of 19/12/2018 (PBL +33h)

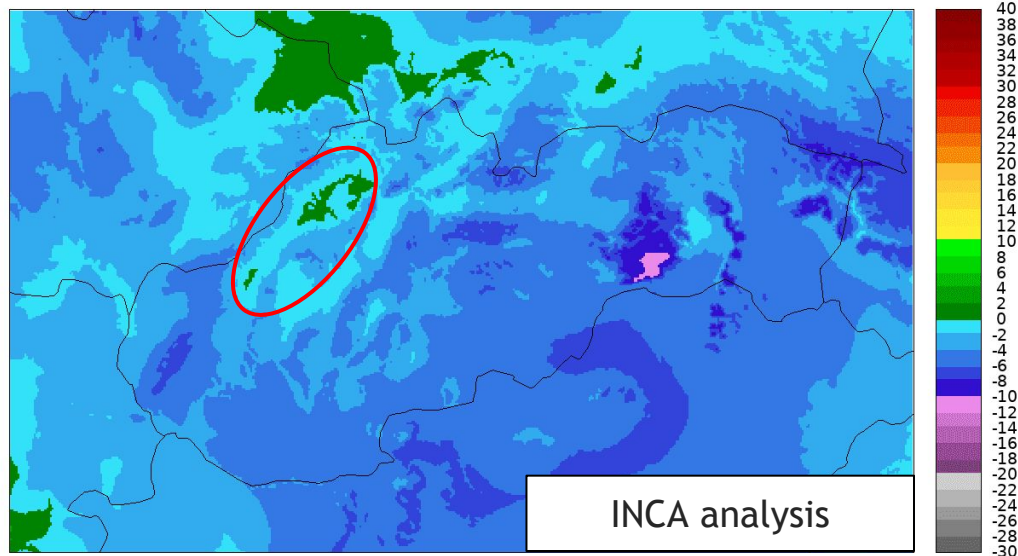
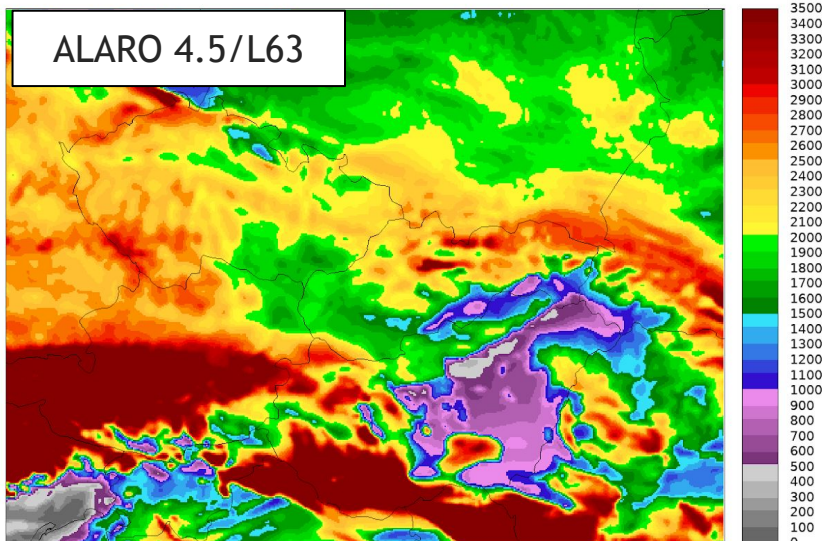
model: ALADIN_2km PBL (masl) base: 2018-12-21_12 (Friday) range: +21 valid: 2018-12-22_09 (Saturday)



model: AROME_2km PBL (masl) base: 2018-12-21_12 (Friday) range: +21 valid: 2018-12-22_09 (Saturday)

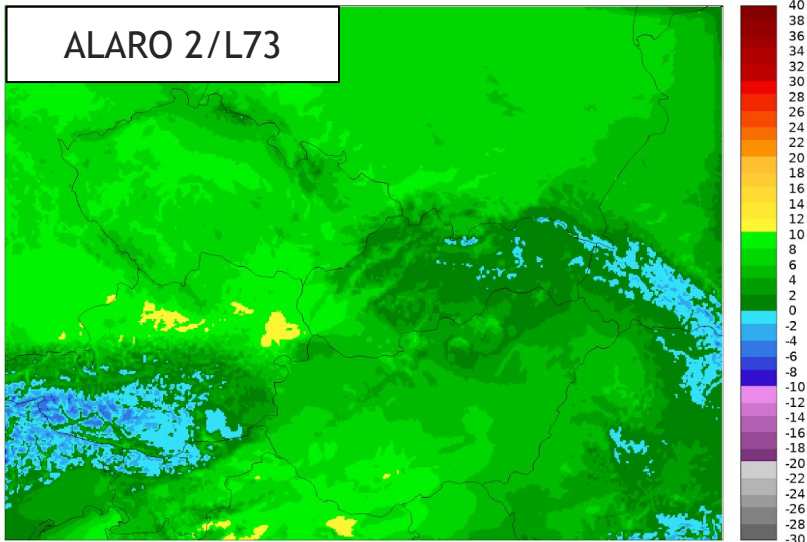


model: ALADIN_4.5km PBL (masl) base: 2018-12-21_12 (Friday) range: +21 valid: 2018-12-22_09 (Saturday)

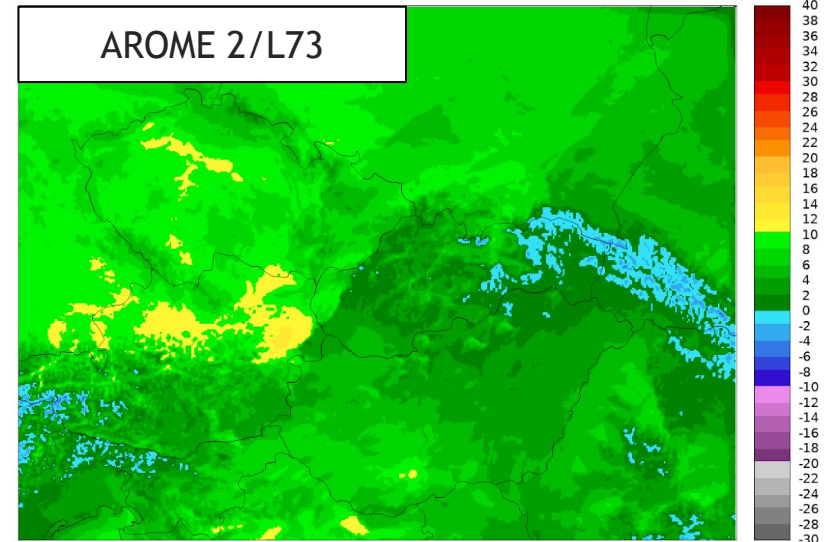


Case study of 28/12/2018 (T2m +21h)

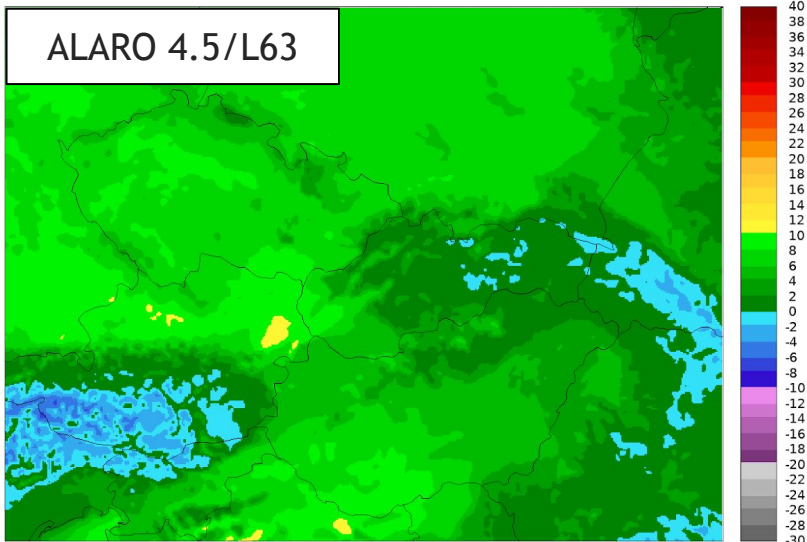
model: ALADIN_2km temperature 2m base: 2018-12-21_12 (Friday) range: +21 valid: 2018-12-22_09 (Saturday)



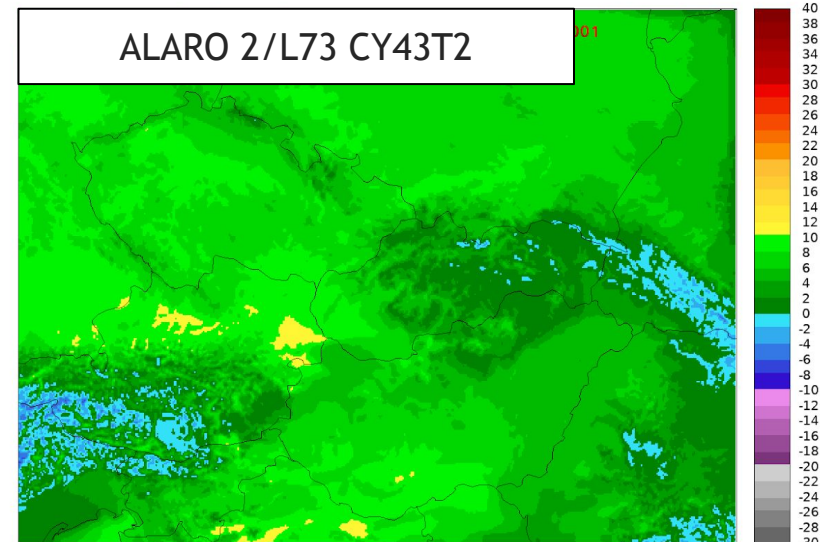
model: AROME_2km temperature 2m base: 2018-12-21_12 (Friday) range: +21 valid: 2018-12-22_09 (Saturday)



model: ALADIN_4.5km temperature 2m base: 2018-12-21_12 (Friday) range: +21 valid: 2018-12-22_09 (Saturday)

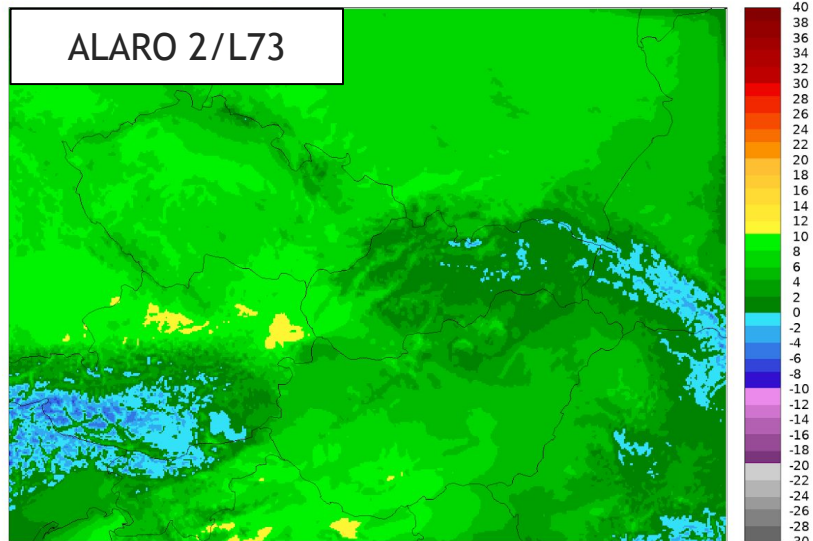


model: ALADIN_2km temperature 2m base: 2018-12-21_12 (Friday) range: +21 valid: 2018-12-22_09 (Saturday)

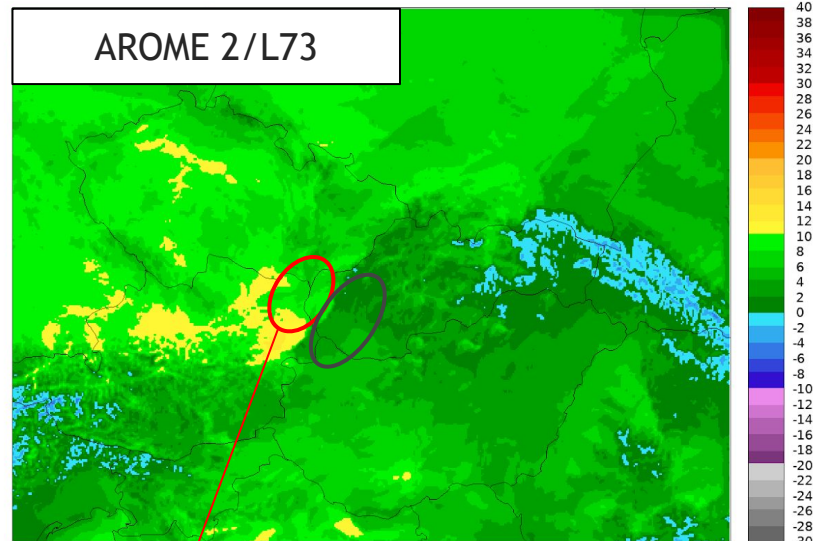


Case study of 28/12/2018 (T2m +21h)

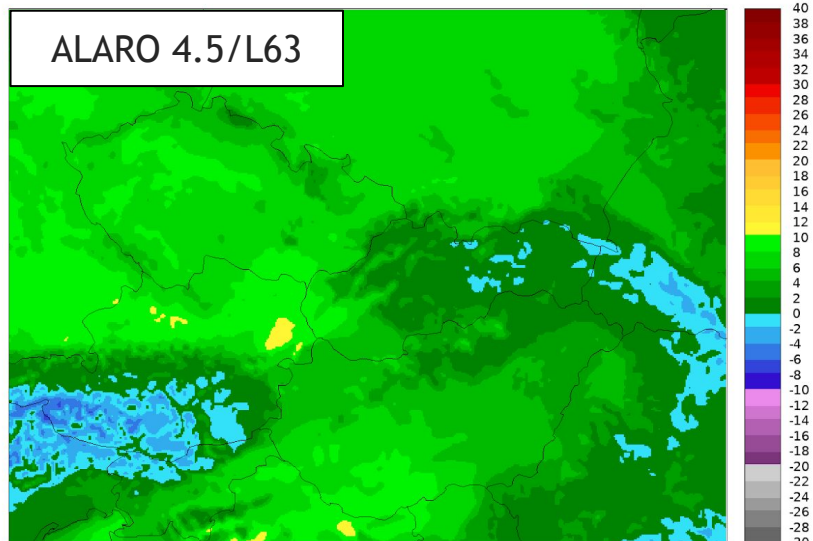
model: ALADIN_2km temperature 2m base: 2018-12-21_12 (Friday) range: +21 valid: 2018-12-22_09 (Saturday)



model: AROME_2km temperature 2m base: 2018-12-21_12 (Friday) range: +21 valid: 2018-12-22_09 (Saturday)



model: ALADIN_4.5km temperature 2m base: 2018-12-21_12 (Friday) range: +21 valid: 2018-12-22_09 (Saturday)



BRATISLAVA - LETISKO	0	
KRALOVA PRI SENCI	0.2	
PIESTANY	0.3	
JASLOVSKE BOHUNICE	0.3	
NITRA	0.6	
BRATISLAVA - MLYNSKA DOLINA	1.9	
BRATISLAVA - KOLIBA	2.7	
DOBRA VODA	0.2	
BIELY KOSTOL	0.5	
SLADKOVICOVO	1	
MALY JAVORNIK	6.1	
MODRA - PIESOK	6.4	
PLAVECKY PETER	8.6	
SOLOSNICA	9.5	

Conclusions & plans

Plans from Sept 2016:

- declare ALARO-1 operational
- SURFEX offline
- AROME

Conclusions & plans

~~Plans from Sept 2016:~~

- ~~• declare ALARO 1 operational~~
- ~~• SURFEX offline~~
- ~~• AROME~~

Future plans:

??? new HPC