Determination of the optimal lateral boundary conditions for AROME: verification results using radar (SAL) and synop measurements

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Outline

- AROME experiments
  - ALADIN vs IFS coupling
  - Domain size
- Objective verification
  - SAL
  - Radar gridpoint
  - Veral
- Initialization problem
- Summary

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AROME experiments

Test period: 2010-07-17 – 2010-08-17

36h forecasts started at 00 UTC

ALADIN coupling

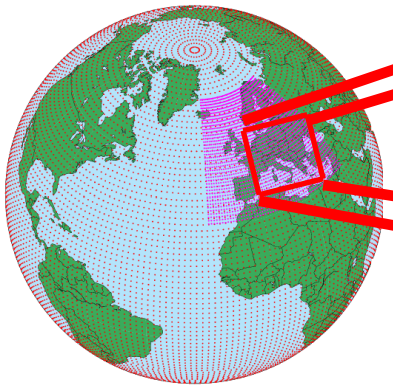
- Cycle 35
- 1 hour coupling frequency
- Dynamical adaptation (atmosphere and surface)
- 6 hourly cycling of hydrometeors and TKE

IFS coupling

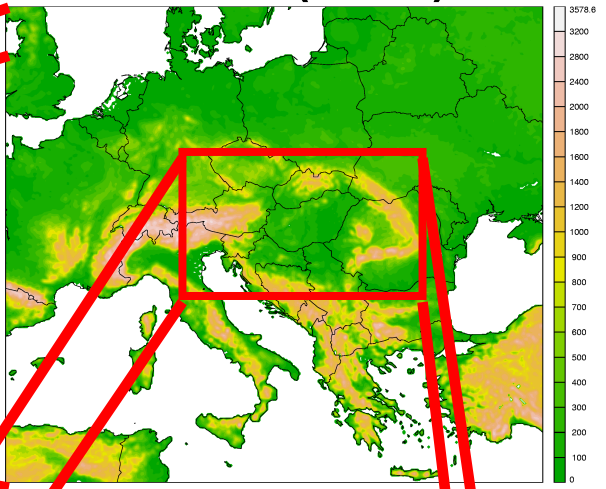
- Cycle 35
- 3 hour coupling frequency
- Atmospheric IC from IFS
- Surface IC from ALADIN
- 6 hourly cycling of hydrometeors and TKE

Model domains

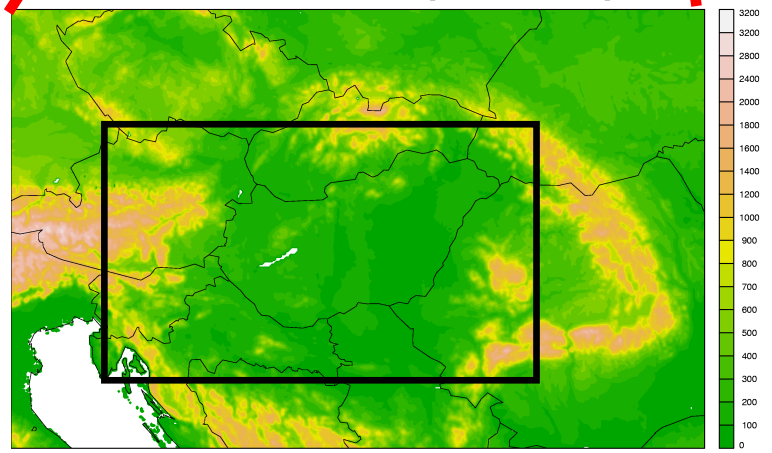
IFS



ALADIN (8 km)



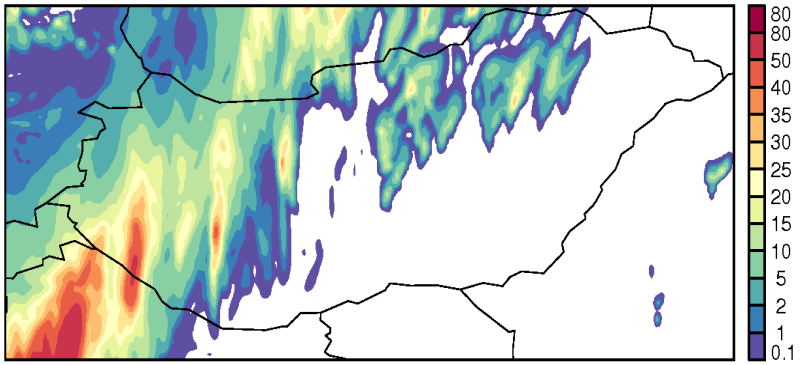
AROME (2.5 km)



Case study I. – 24h acc. precip. 2010-07-30, frontal passage

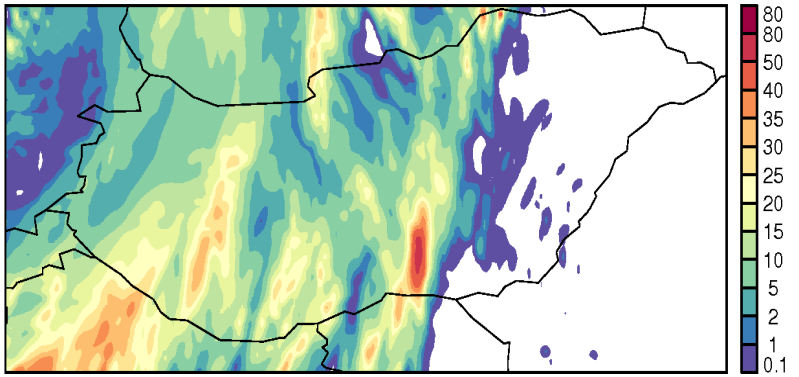
ALADIN coupling

min: –0.10, max: 72.36



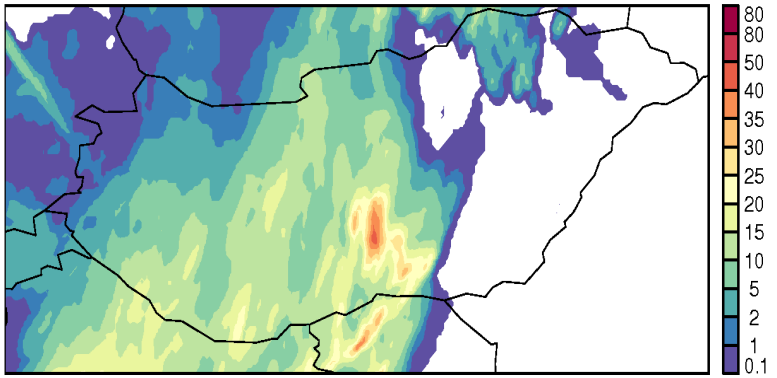
IFS coupling

min: –0.023, max: 56.40



Radar

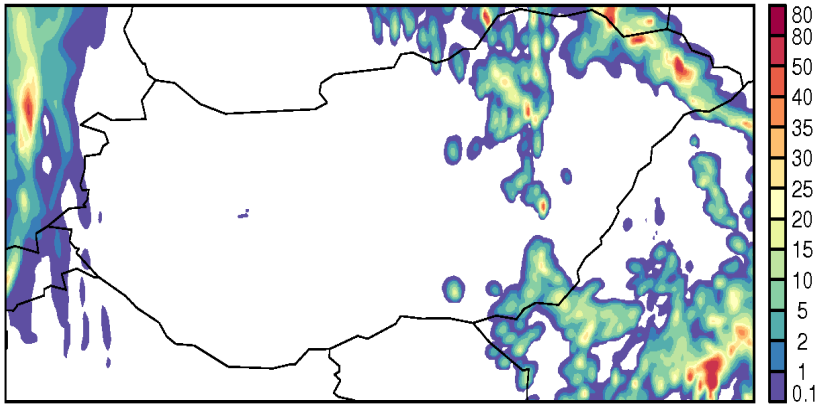
min: 0.00, max: 45.00



Case study II. – 24h acc. precip. 2010-08-14, flat situation

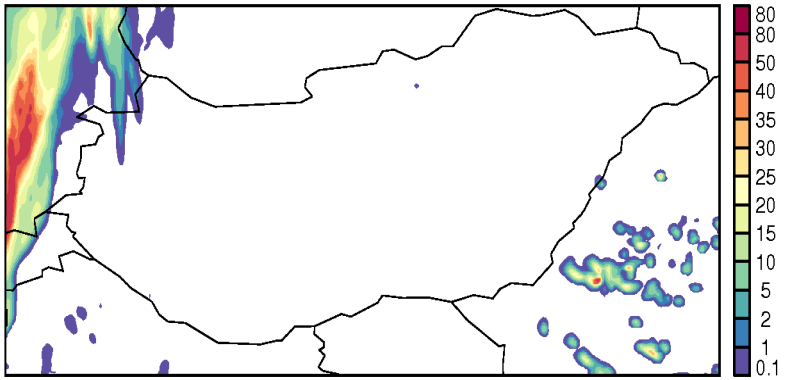
ALADIN coupling

min: –0.022, max: 79.86



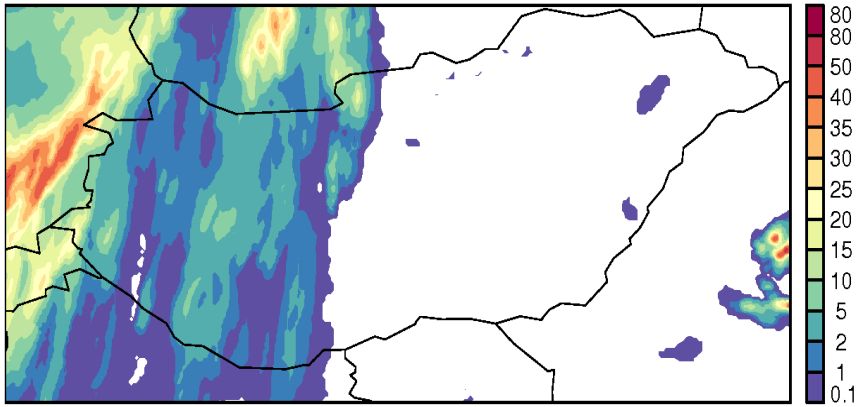
IFS coupling

min: –0.043, max: 73.82



Radar

min: 0.00, max: 55.00



SAL-verification

- Objective verification using radar precipitation
- Defining objects both at the model and the radar field
- Dynamical threshold ($P_{max}/15$)
- No association of objects
- Three independent components:
  - **S** – Structure
  - **A** – Amplitude
  - **L** – Location
- Verification:
  - SAL-plot
  - Central statistics

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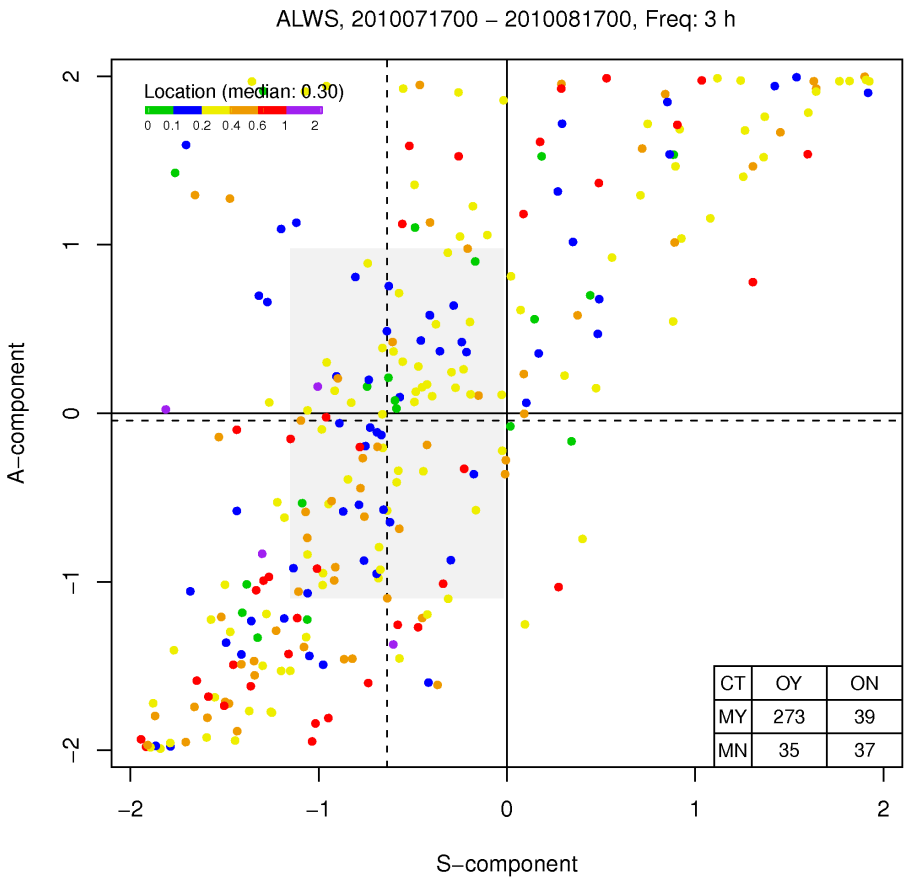
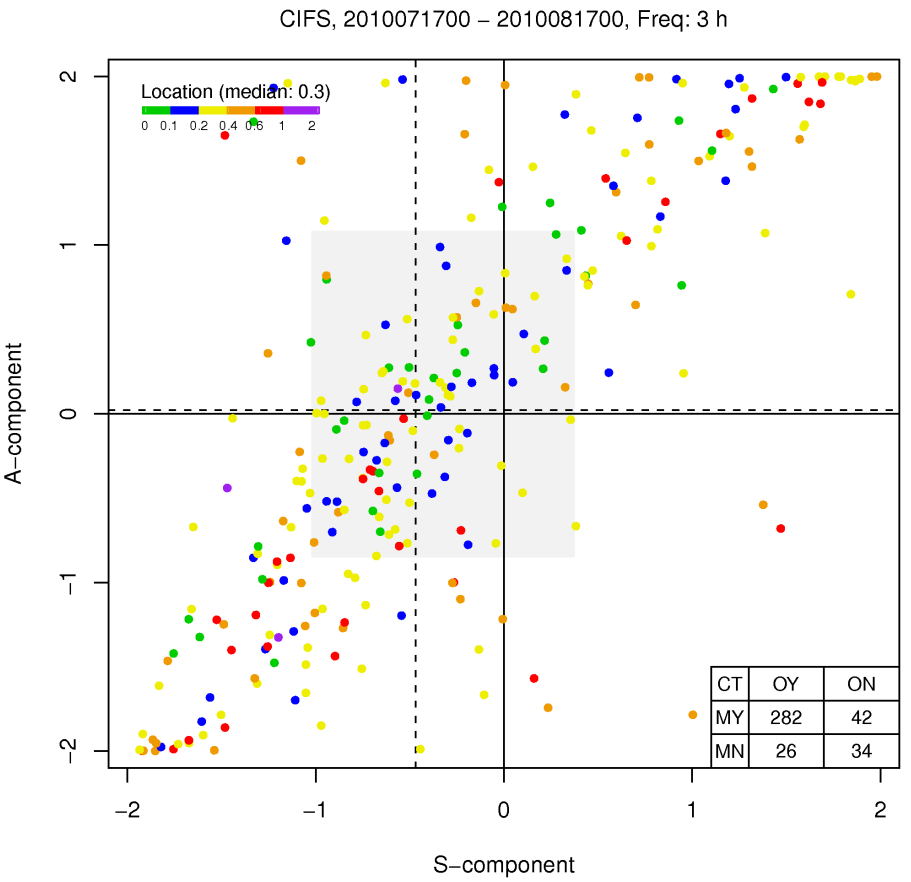
SAL results I.

ALADIN coupling



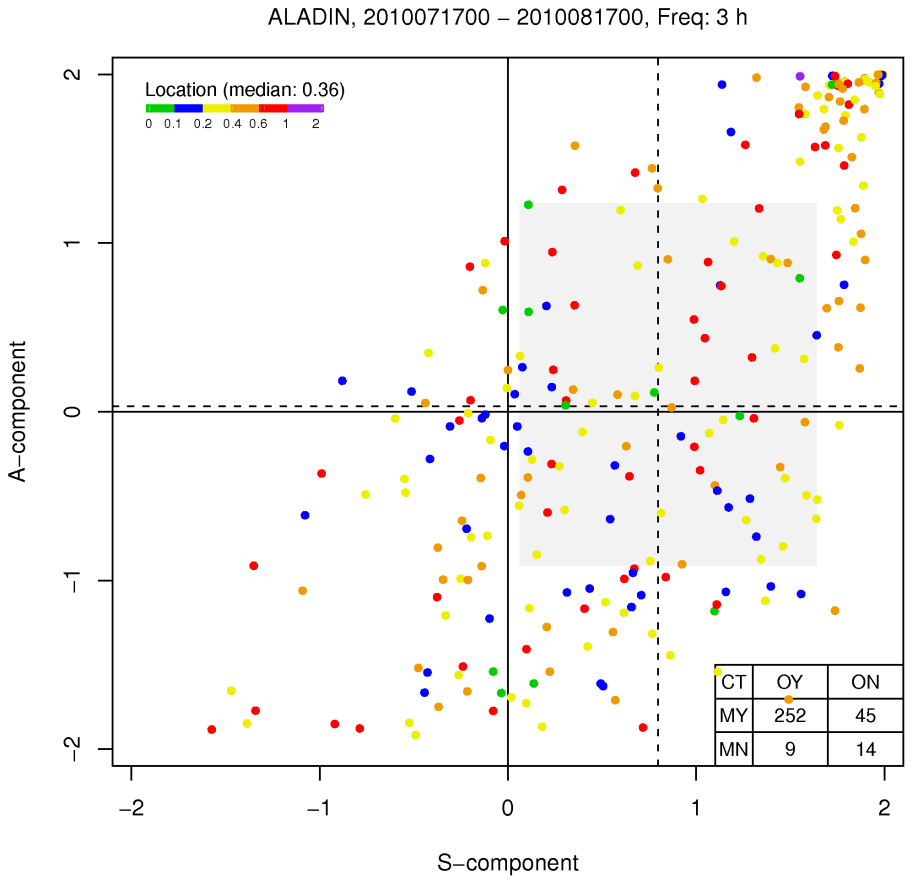
IFS coupling



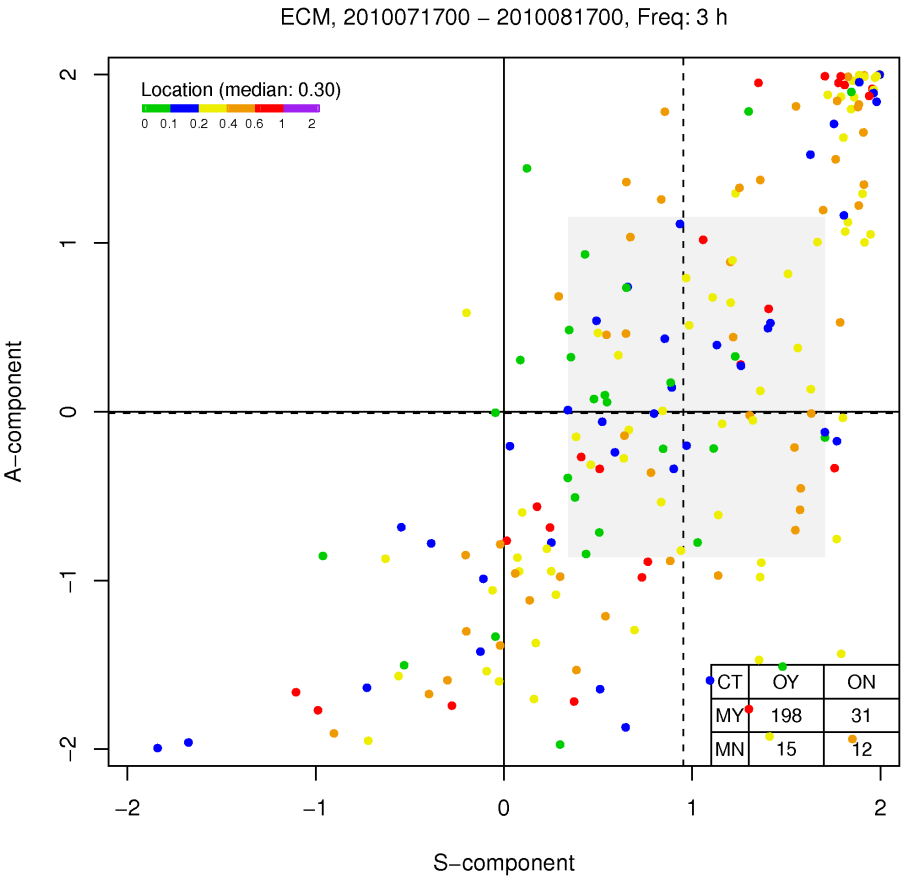
- 3 hourly accumulated precipitation
- Dynamical threshold (P_{max}/15)
- IFS coupling: better Structure component

SAL results II.

ALADIN



IFS



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SAL results III.

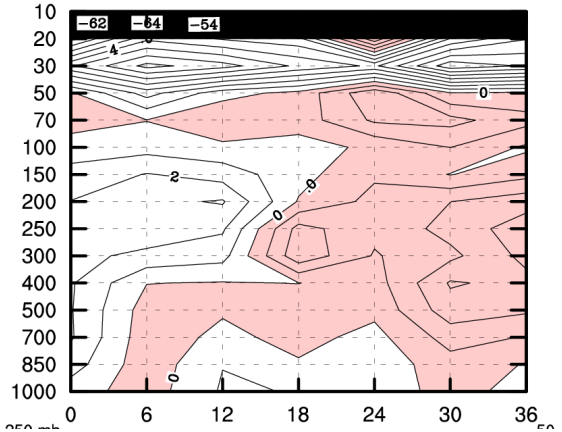
Central statistics

3 horly acc. precip., dynamical threshold (P_{max}/15)

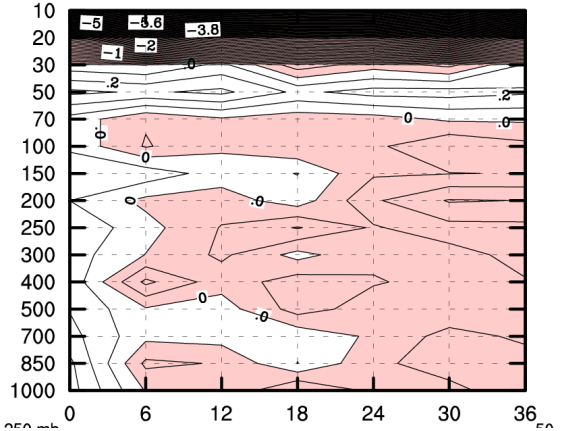
	5%	10%	20%	50%
ALADIN coupling	0.49	0.59	0.77	1.47
IFS coupling	0.43	0.56	0.77	1.40
ALADIN	0.35	0.64	0.88	1.60
IFS	0.54	0.71	0.94	1.59
Persistence	0.45	0.65	1.05	2.00

Grid-point verification (Veral)
Upper Air – RMSE difference

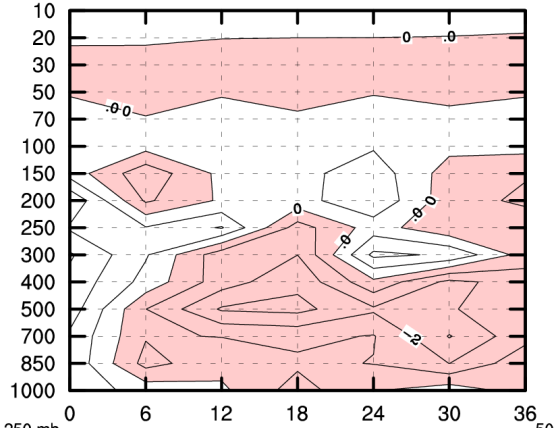
Geopotential



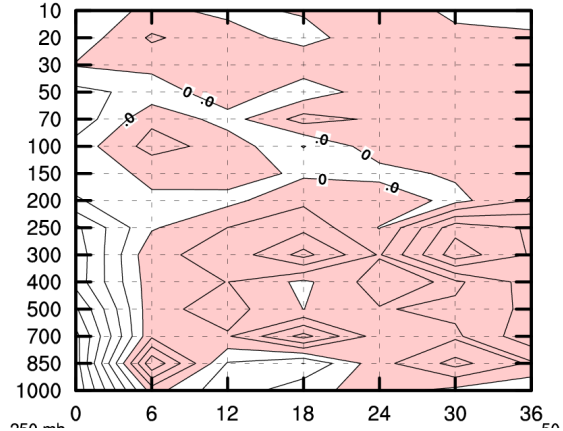
Relative humidity



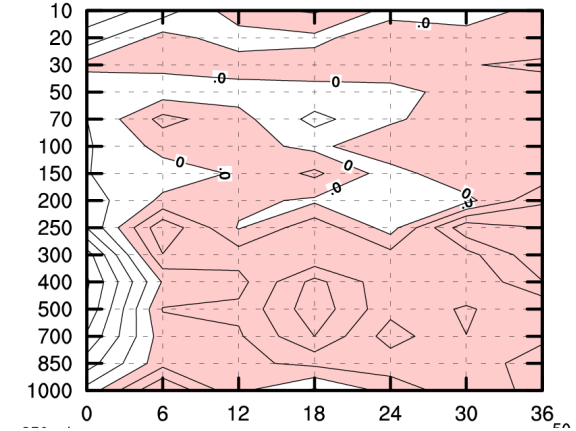
Temperature



Wind direction

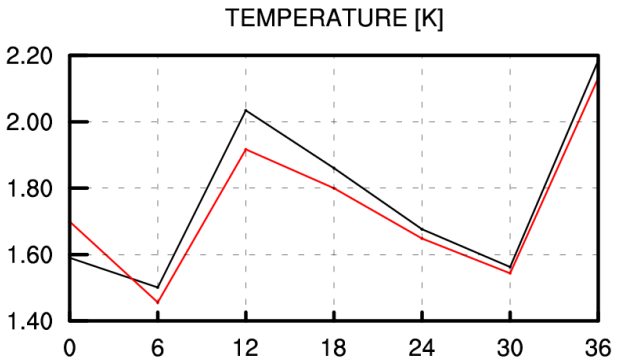


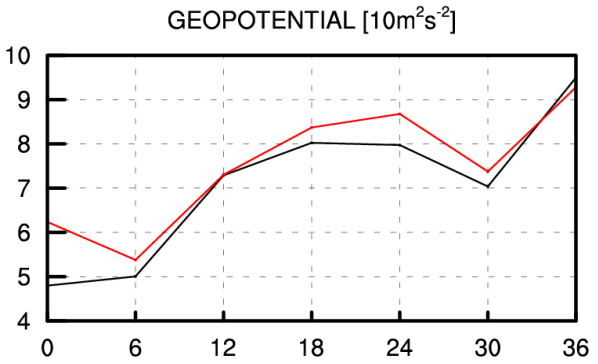
Wind speed

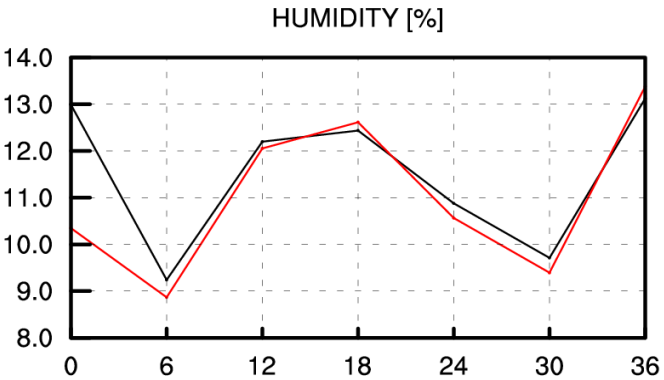


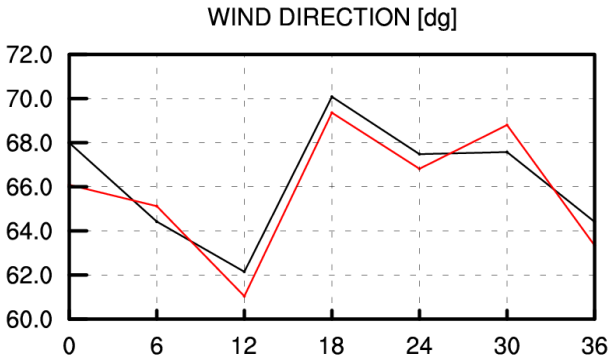
Red: IFS coupling better
White: ALADIN coupling better

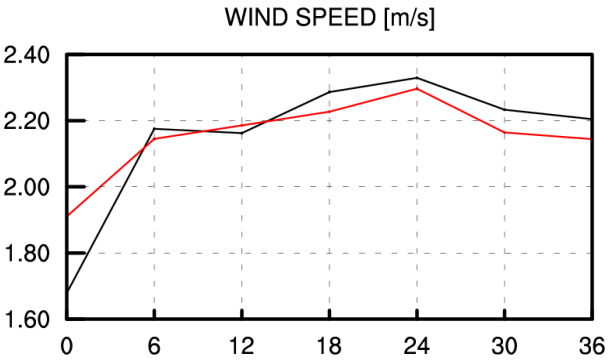
Grid-point verification (Veral)
Surface – RMSE











– IFS coupling
– ALADIN coupling

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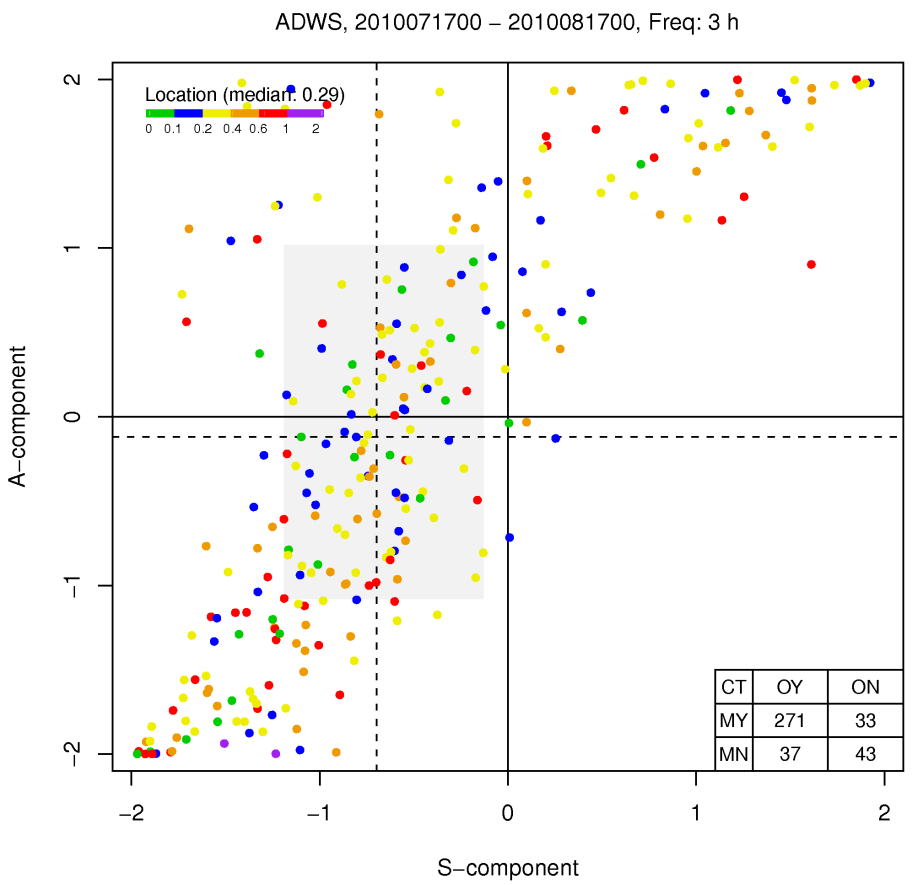
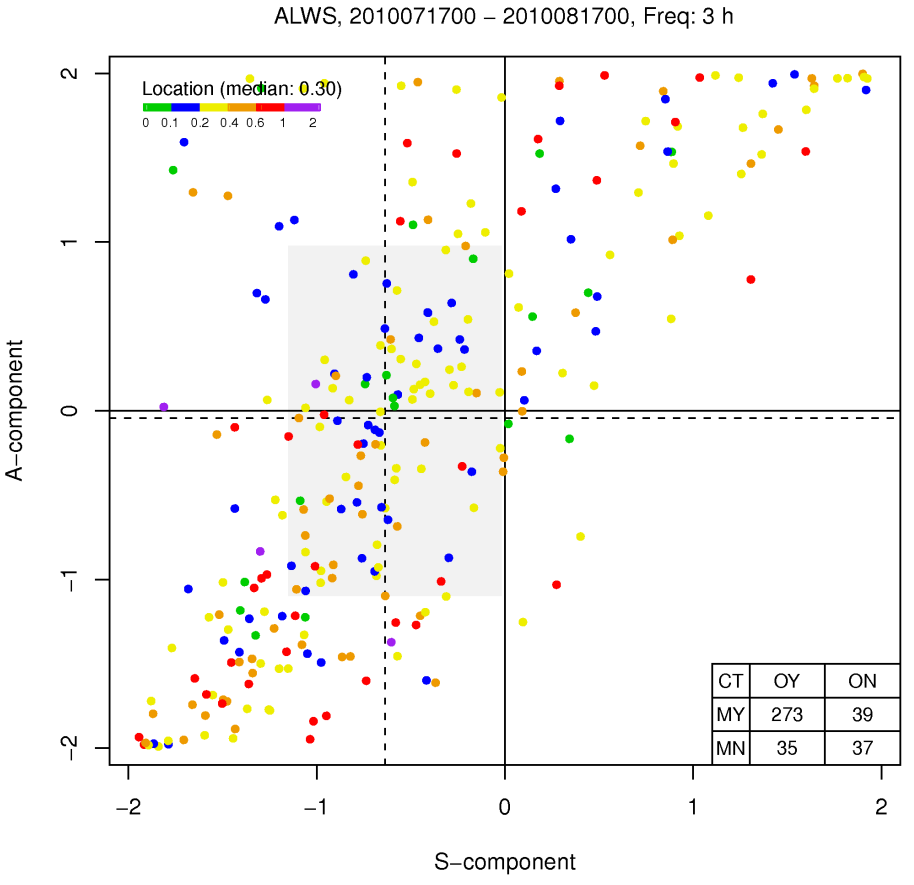
AROME domain – SAL

Small domain

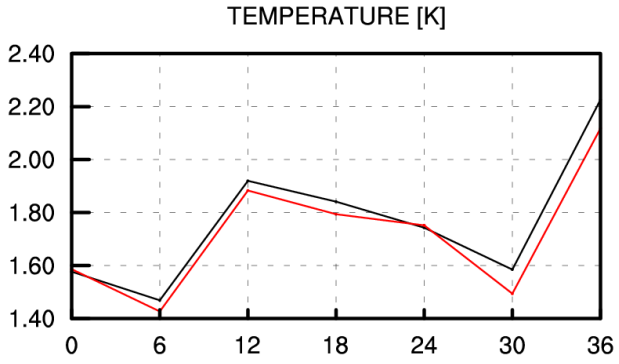


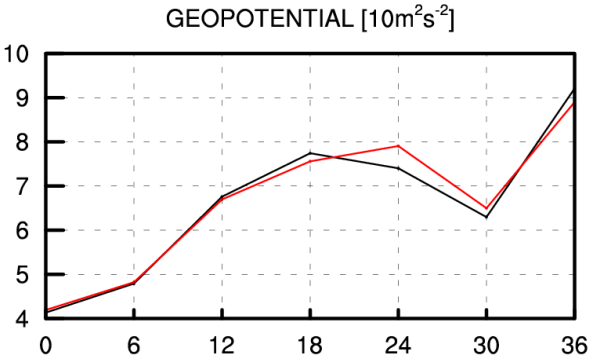
Large domain

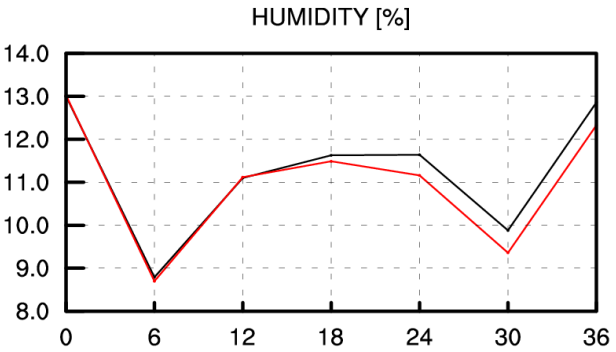


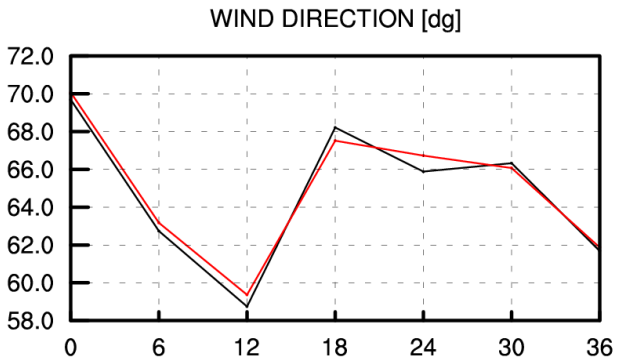
	5%	10%	20%	50%
Large domain	0.49	0.59	0.77	1.47
Small domain	0.56	0.69	0.86	1.47

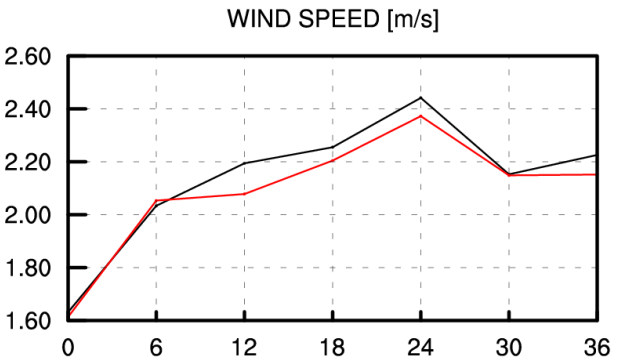
AROME domain
Veral (Surface, RMSE)











– Large domain
– Small domain

Grid point verification – Radar

- Nearest grid point
- Average of neighbouring grid point for model/radar
  - radar: 6 neighbour --> 13km
  - model: 1 neighbour --> 13 km
- Standard scores for a given lead time averaged over the one month period

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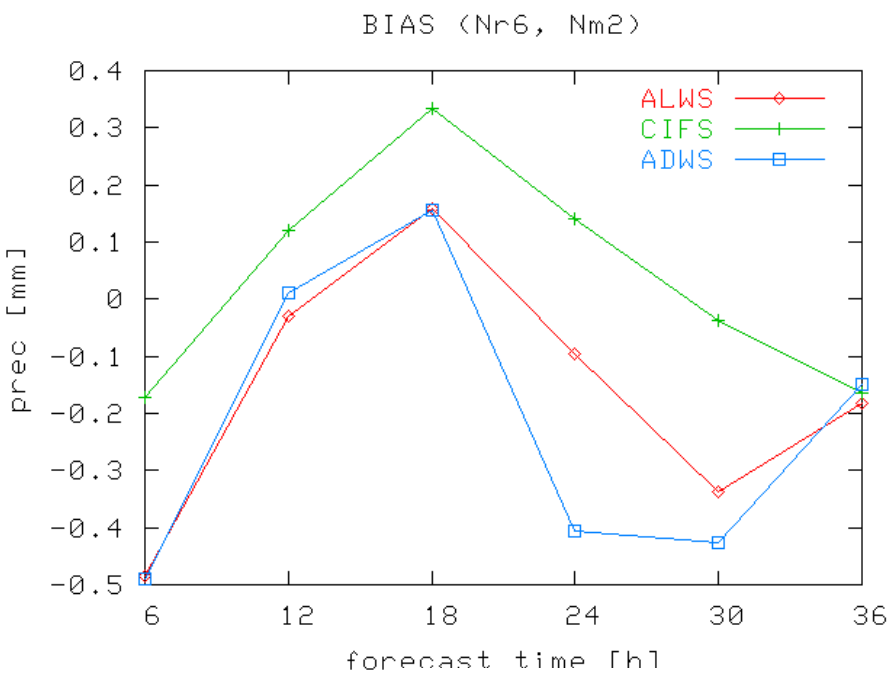
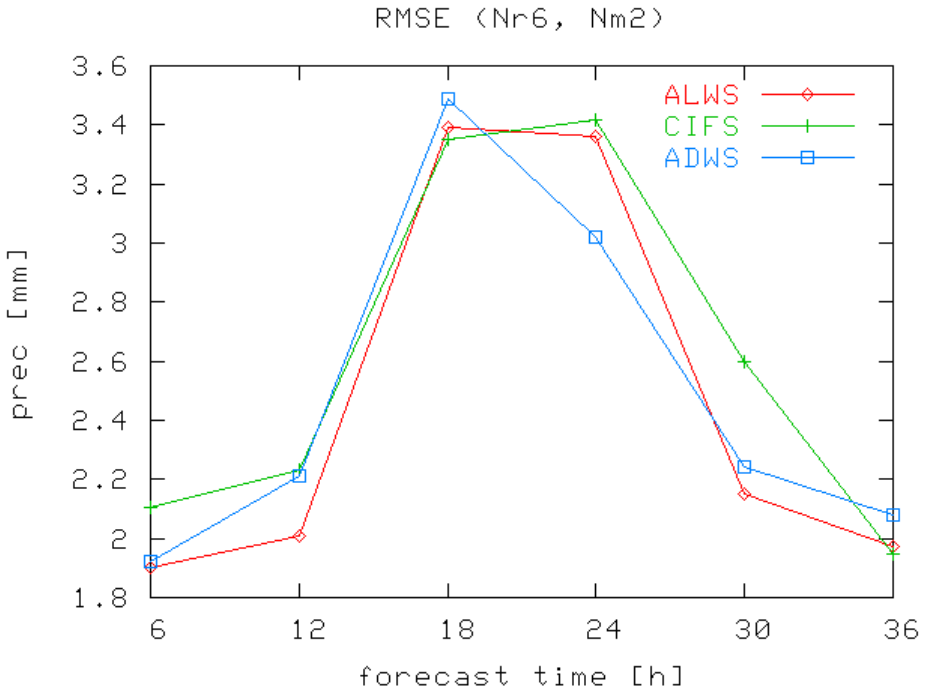
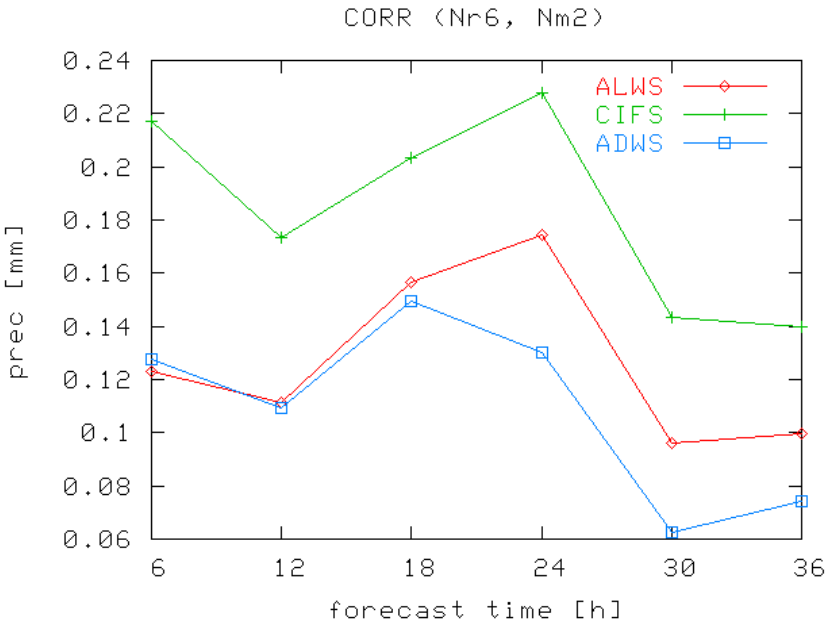
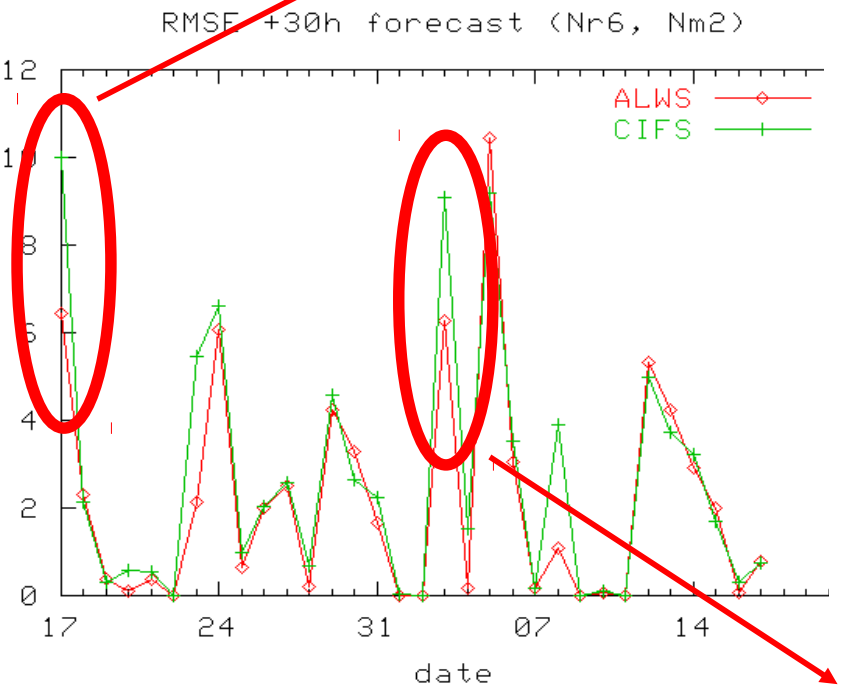
Grid point verification – Radar

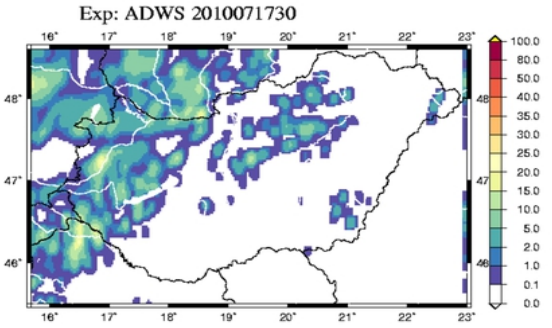


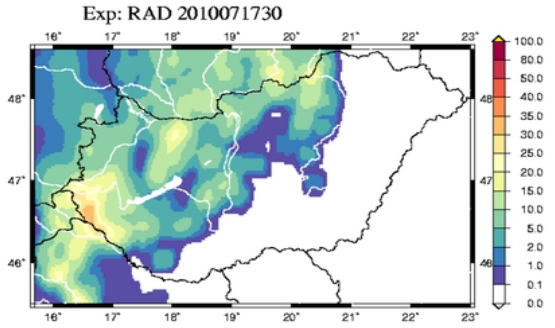


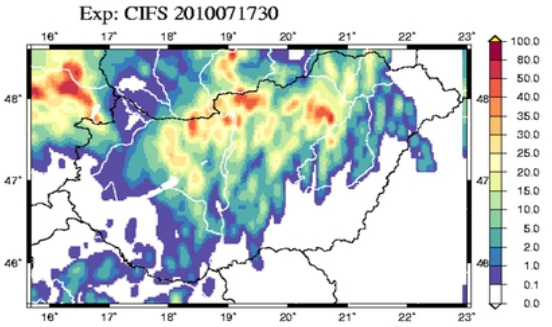


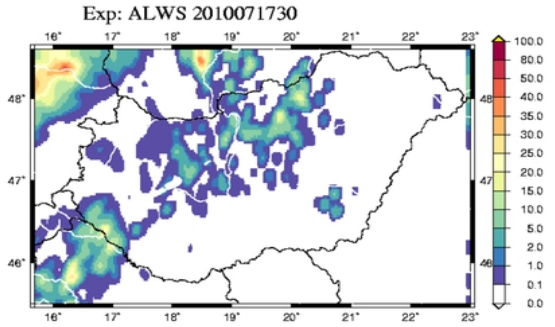
– ALADIN coupl. – Large dom.
– ALADIN coupl. – Small dom.
– IFS coupl. – Large dom.

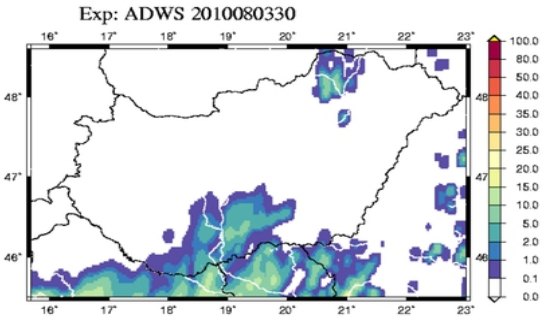


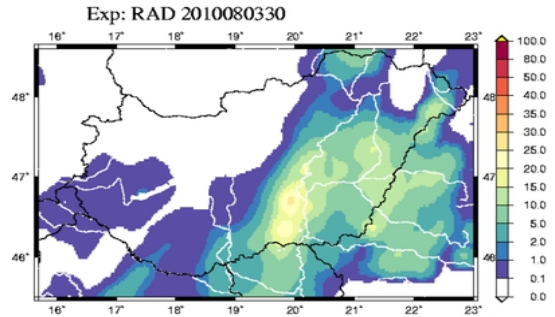


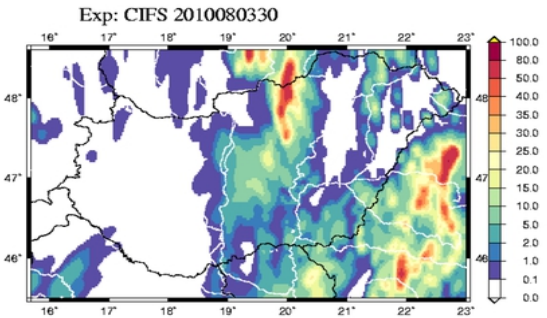


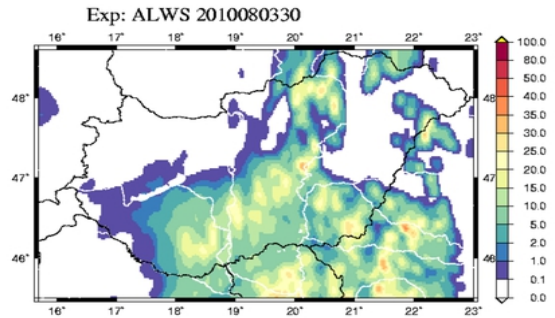












Determination of the optimal lateral boundary co

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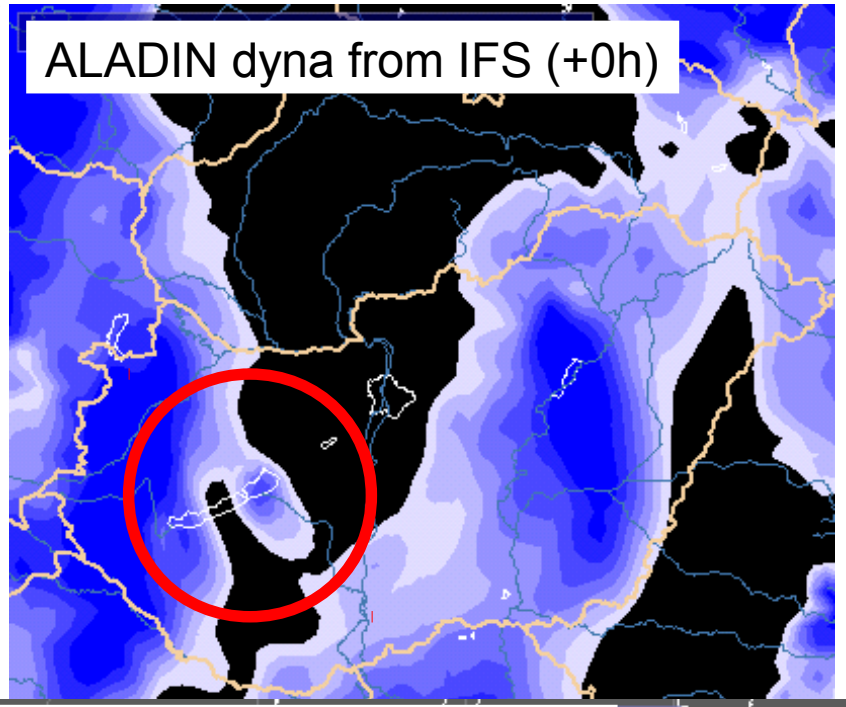
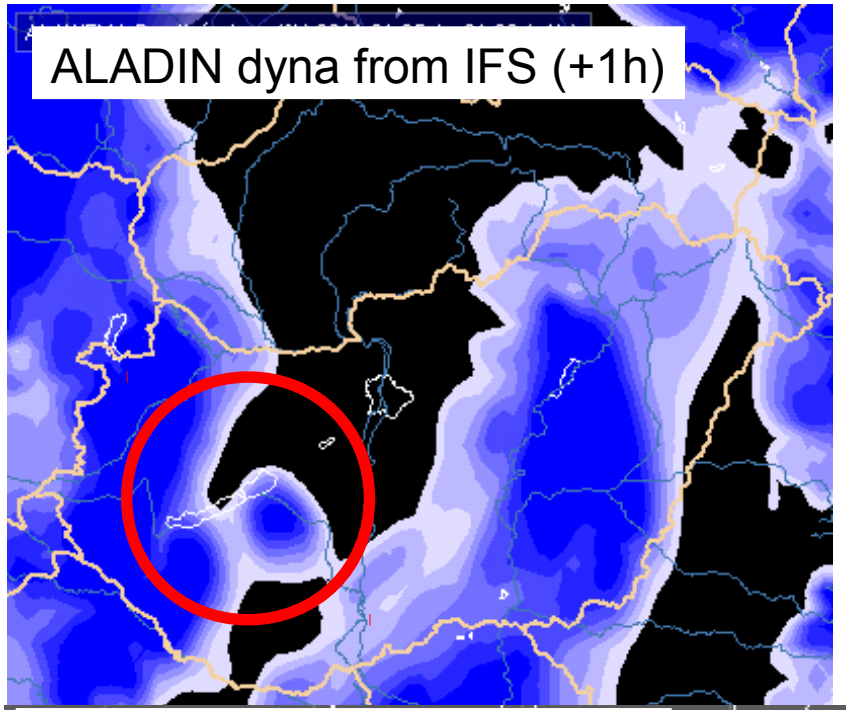
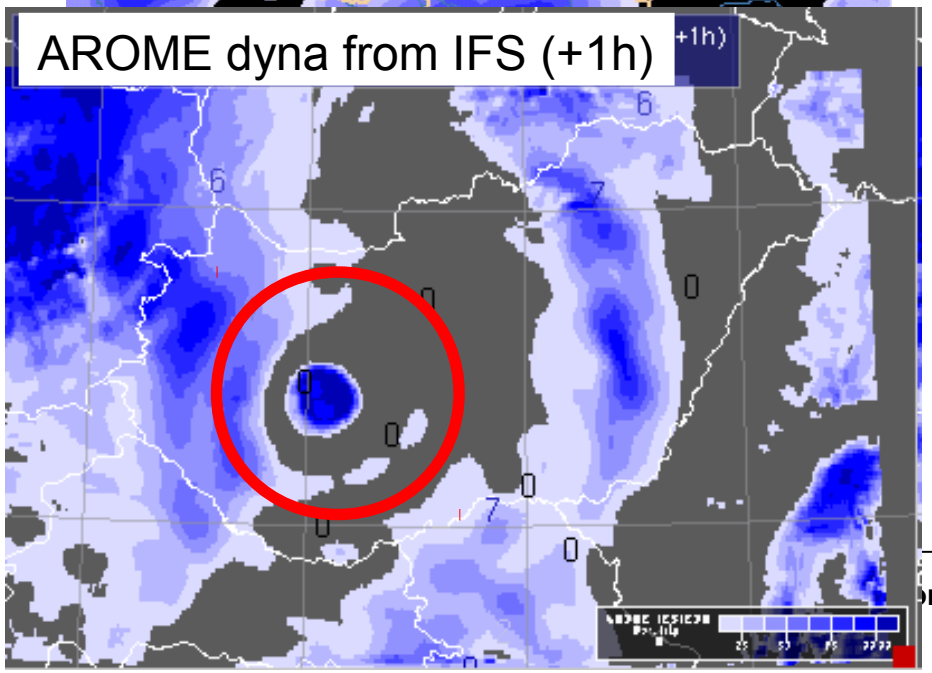
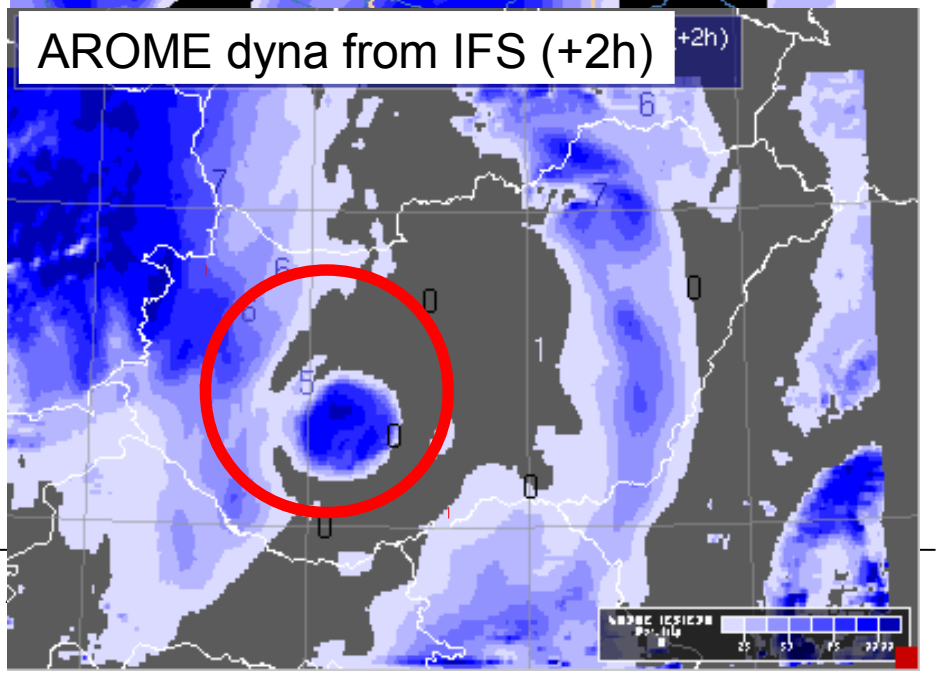
Initialization problem





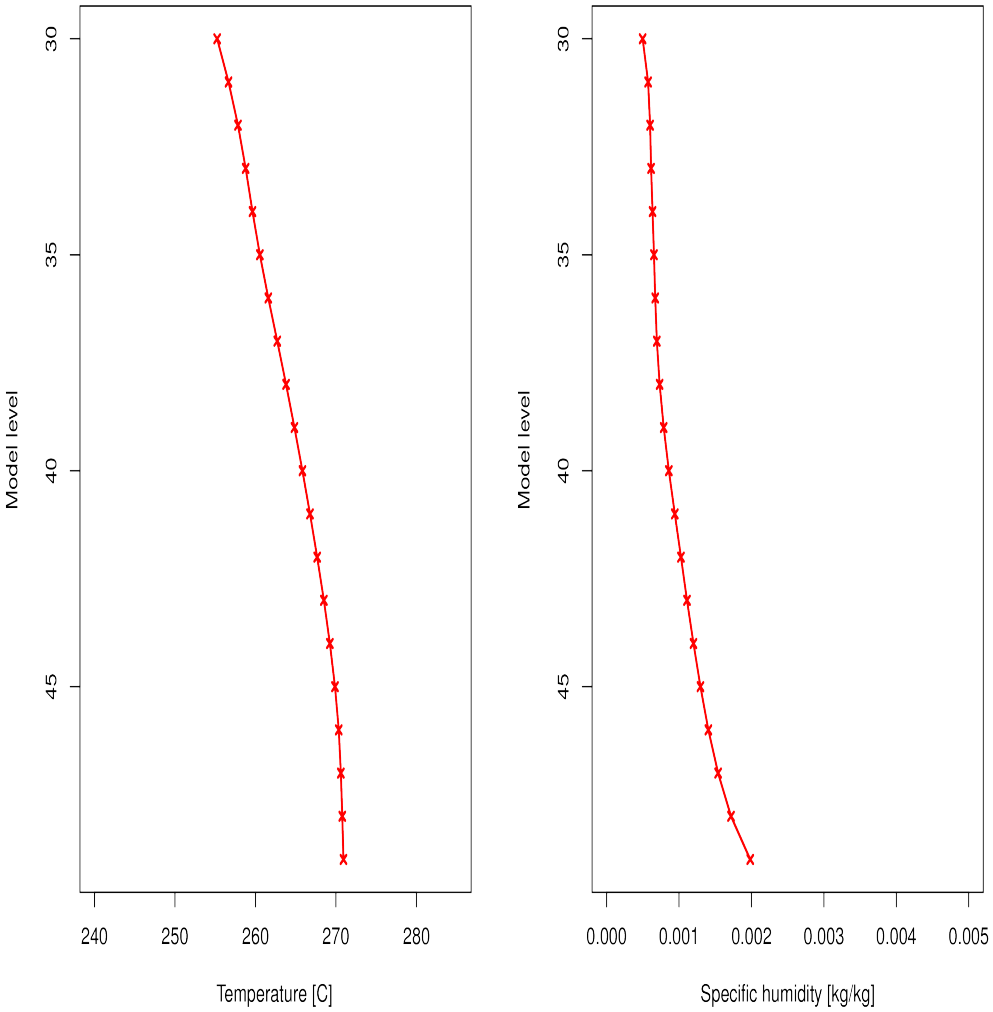




Initialization problem

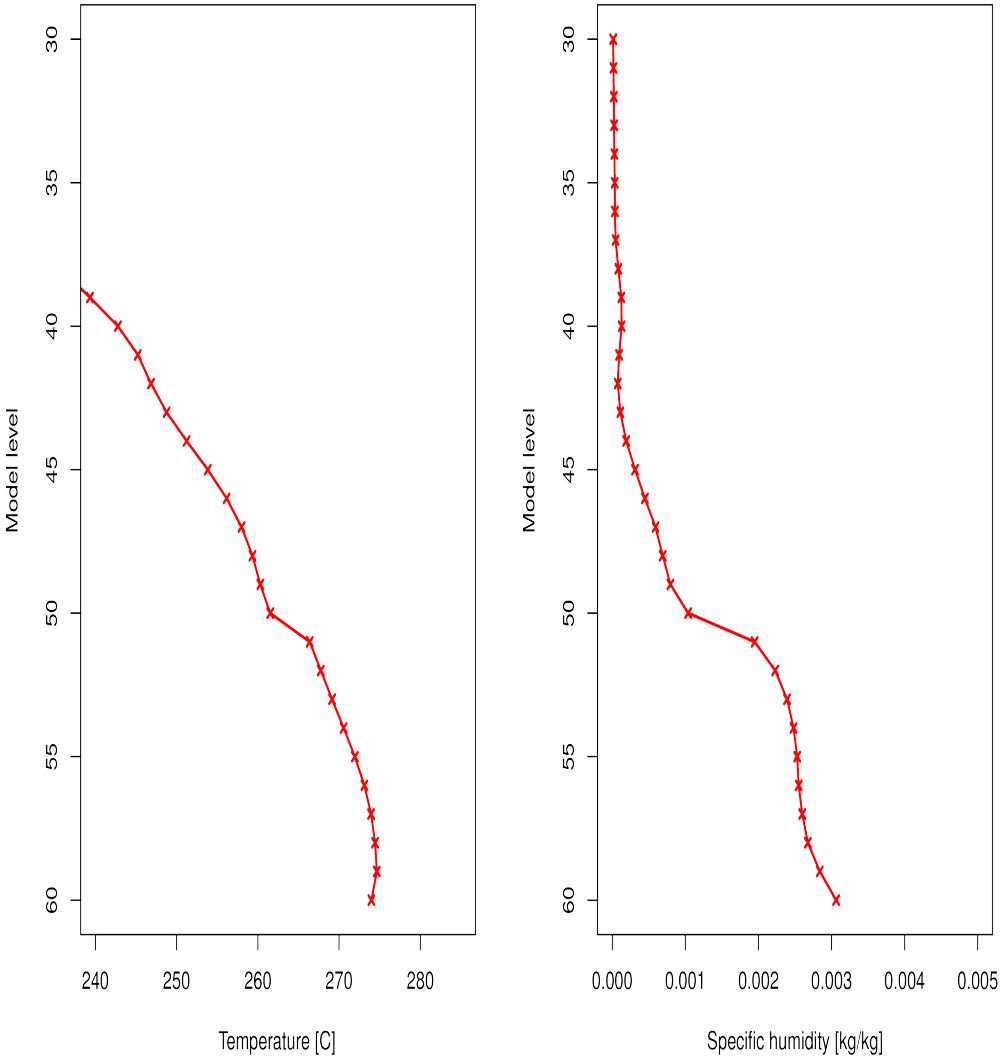
Vertical profiles for 20110125_00 UTC , Station: 12843, Run: alad, Location: loc_lake

ALADIN profile



Vertical profiles for 20110125_00 UTC , Station: 12843, Run: ecmw, Location: loc_lake

IFS profile



Summary

- IFS coupling results in more precipitation
- Larger domain improves the forecast
- SAL: IFS coupling better
- Veral: IFS coupling better (apart from geopot.)
- Radar grid point:
  - Similar scores (IFS coupling positive bias)
  - 1-2 cases largely influence the scores
- Initialization problem -> data assimilation

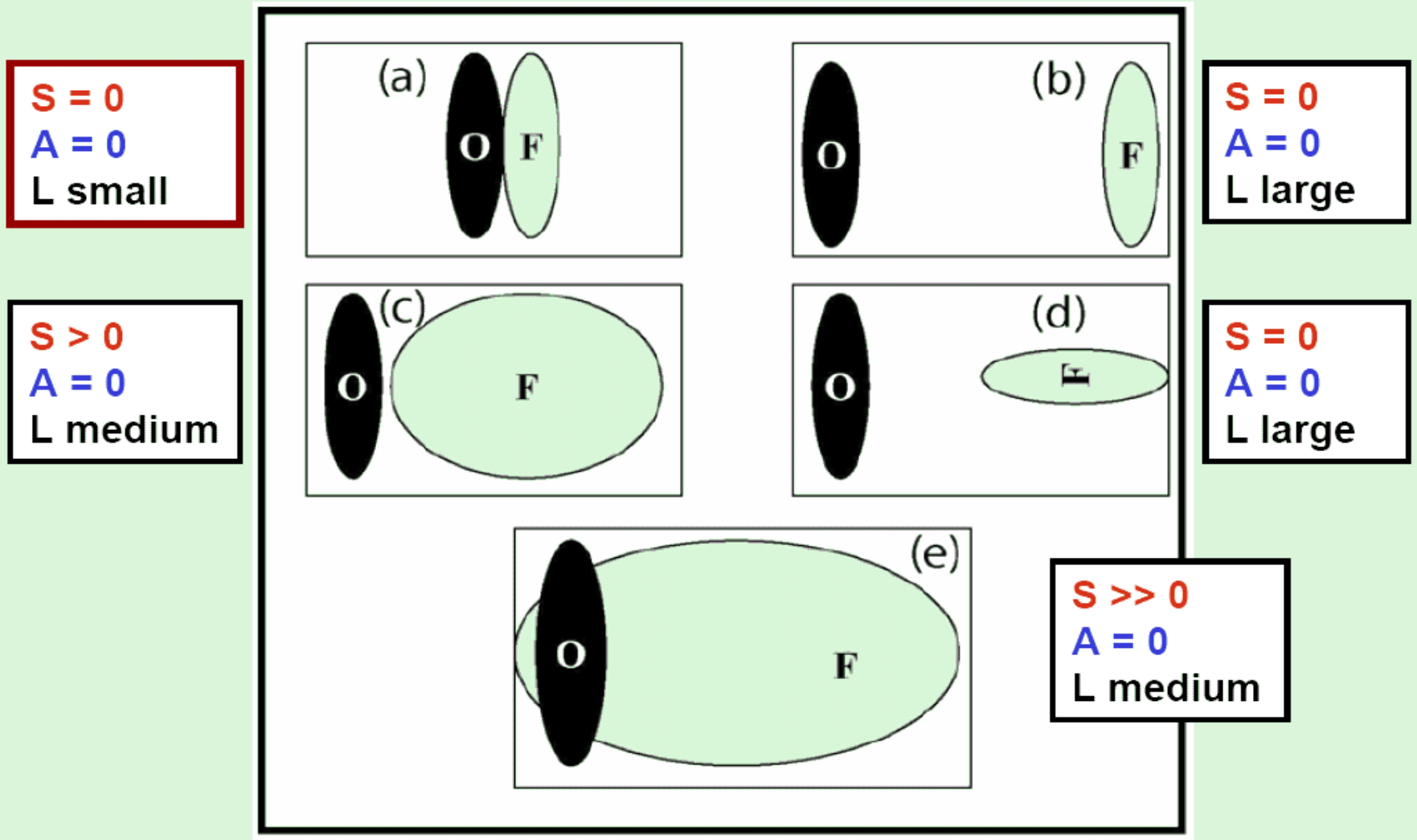
Outlook

- Redo experiments with data assimilation
- Winter period
- Test the ALARO coupling

Thank you for your attention!

Spare slides

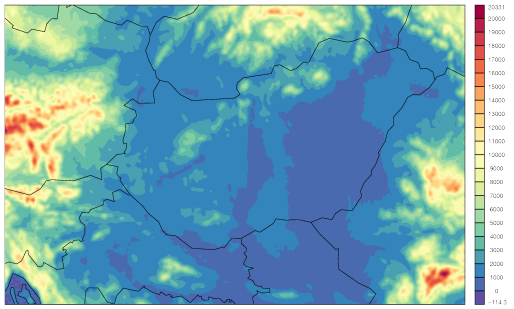
SAL-verifikáció III.



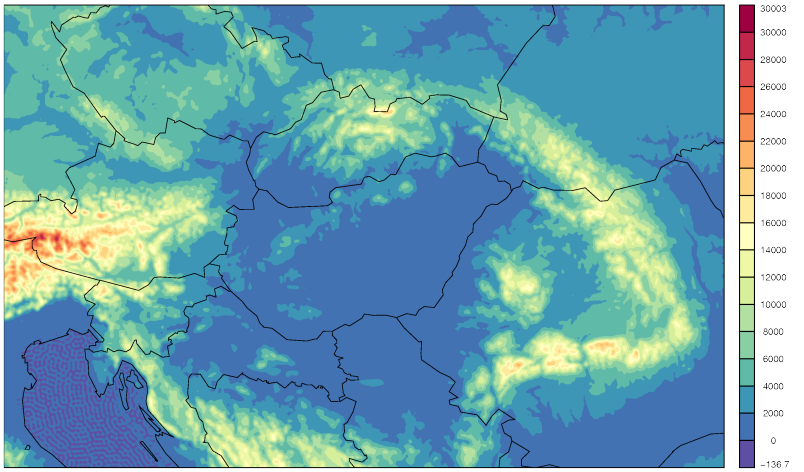
Paulat et al, 2007

AROME tartomány

ADWS



ALWS



- ALADIN csatolás
- 300 x 192 pont

- ALADIN csatolás
- 500 x 320 pont

13 régiós objektív SYNOP verifikáció

T+06 - T+18 (day time)

	T-MAX		PREC										WSPEED		WGUST					CLOUD		COMPLEX		NUMBER	
MODEL	ME	RE	FBI-ex	PC-ex	ETS-ex	ME-mm	RE-mm	ME-cat	RE-cat	FBI-2	PC-2	ETS-2	ME	RE	ME	RE	FBI-12	PC-12	ETS-12	ME	RE	C-75	C-100	FcNo	Max
CIFS.00	-0.6	1.49	1.2	0.77	0.34	0.6	4.13	0.1	1.22	1.1	0.89	0.43	0.7	1.01	0.9	2.60	1.8	0.86	0.40	**0.5**	**1.12**	57.1	77.4	416	416
ALWS.00	-0.3	1.45	1.1	0.78	0.37	0.3	3.97	0.1	1.26	1.1	0.87	0.36	0.7	1.00	1.2	3.30	1.9	0.84	0.34	-0.1	0.83	56.0	77.6	416	416
ADWS.00	-0.2	1.43	1.1	0.78	0.37	0.3	3.95	0.1	1.23	1.1	0.87	0.37	0.7	1.02	1.0	2.82	1.8	0.85	0.35	-0.1	0.83	56.9	78.4	416	416
ARO.00	0.2	1.52	1.5	0.67	0.14	0.5	4.50	0.4	1.29	1.2	0.86	0.36	0.6	0.94	1.4	3.11	1.9	0.83	0.32	-0.1	0.87	55.9	77.3	416	416
MM5.00	-1.3	1.94	1.4	0.73	0.25	0.9	4.40	0.4	1.29	1.3	0.87	0.39	0.5	0.91	-0.1	2.06	1.2	0.88	0.38	-0.8	1.31	56.3	75.8	416	416
WRF.00	-0.3	1.63	1.1	0.80	0.40	0.8	4.66	0.1	1.24	1.2	0.87	0.38	0.9	1.33	-0.2	2.58	1.5	0.87	0.37			56.1		416	416
ALA.00	-1.0	1.82	1.4	0.72	0.22	0.4	4.18	0.4	1.31	1.3	0.84	0.32	0.3	0.81	-1.1	2.69	0.8	0.90	0.38	0.0	1.02	55.8	76.5	416	416
ECM.00	-0.6	1.65	1.4	0.71	0.21	0.4	2.94	0.4	1.17	1.4	0.85	0.34	0.5	0.95	0.0	2.28	1.1	0.87	0.30	-0.1	0.75	57.5	79.4	416	416
EPS.00	-0.6	1.62	1.3	0.75	0.28	0.5	2.67	0.5	1.14	1.5	0.83	0.31	0.6	0.97	0.1	2.28	1.0	0.88	0.31	0.0	0.72	57.8	79.8	416	416
PERSI.	0.3	3.55	1.0	0.55	0.04	0.0	5.24	0.0	2.00	1.0	0.74	0.01	0.0	1.32	0.0	4.13	1.3	0.77	0.06	-0.1	1.65	43.0	61.2	416	416

T+18 - T+30 (night time)

	T-MAX		PREC										WSPEED		WGUST					CLOUD		COMPLEX		NUMBER	
MODEL	ME	RE	FBI-ex	PC-ex	ETS-ex	ME-mm	RE-mm	ME-cat	RE-cat	FBI-2	PC-2	ETS-2	ME	RE	ME	RE	FBI-12	PC-12	ETS-12	ME	RE	C-75	C-100	FcNo	Max
CIFS.00	1.1	1.53	1.2	0.75	0.32	0.1	4.36	0.1	1.40	1.0	0.84	0.34	0.9	1.18	1.0	2.58	1.3	0.92	0.48	**1.2**	**1.96**	55.7	72.5	416	416
ALWS.00	1.0	1.55	1.2	0.72	0.26	-0.6	3.84	-0.2	1.33	0.8	0.85	0.34	0.9	1.21	1.0	2.51	1.2	0.90	0.38	0.4	1.20	56.1	76.1	416	416
ADWS.00	0.9	1.56	1.1	0.72	0.27	-1.0	4.10	-0.4	1.43	0.6	0.82	0.22	1.0	1.28	0.8	2.80	1.4	0.88	0.36	0.2	1.13	54.8	75.1	416	416
ARO.00	0.8	1.48	1.0	0.73	0.29	-0.9	4.31	-0.4	1.46	0.6	0.83	0.26	0.9	1.26	0.6	2.75	1.3	0.87	0.28	0.1	1.11	55.0	75.4	416	416
MM5.00	1.0	1.63	1.3	0.66	0.16	0.0	3.95	0.1	1.40	0.9	0.85	0.36	0.8	1.13	0.0	2.38	0.6	0.92	0.36	0.2	1.75	55.7	73.4	416	416
WRF.00	0.9	1.64	0.9	0.76	0.35	-0.8	3.93	-0.4	1.33	0.6	0.88	0.39	1.1	1.43	0.4	3.04	1.0	0.88	0.26			54.7		416	416
ALA.00	1.5	2.05	1.2	0.74	0.29	-0.7	5.58	-0.2	1.52	0.5	0.83	0.23	0.8	1.31	-0.3	3.33	0.8	0.90	0.30	0.1	1.21	51.9	71.9	416	416
ECM.00	0.7	1.35	0.9	0.79	0.41	-0.7	3.82	-0.3	1.26	0.8	0.87	0.39	0.9	1.25	-0.1	2.74	0.6	0.90	0.30	-0.4	1.17	56.8	76.9	416	416
EPS.00	0.5	1.27	0.8	0.76	0.36	-0.6	3.71	-0.3	1.31	0.9	0.86	0.38	0.9	1.24	-0.4	2.87	0.5	0.90	0.22	-0.3	1.13	56.5	76.8	416	416
PERSI.	0.2	2.11	1.0	0.61	0.12	0.0	6.26	0.0	2.21	1.0	0.65	-0.02	0.0	1.16	-0.1	4.75	1.1	0.81	0.06	-0.1	2.21	45.5	61.3	416	416

TEMP: Neutrális/kis pozitív hatás. Tmax-ban javítás, tmin-ben rontás (órás szélsőértékekkel jobb lehetne az eredmény). A 3 új változat összességében hasonló hatású.

PREC: Egzisztenciában nappal nagy javulás. Egyébként neutrális/kis pozitív hatás. A 3 új változat közül nem látszik egyértelműen kiemelkedő. A CIFS szisztematikusan több csapadékot ad.

WIND: Átlagszélben neutrális hatás(nappal romlás, éjjel javulás). Széllökésben jelentősebb javulás, a CIFS egyértelműen kiemelkedik a 3 új változatból.

CLOUD: A CIFS drasztikusan fönt, nagyon fölé becsül. A másik két változat neutrális, nappal kis javulás, éjjel kis romlás.