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ALADIN in Poland - operational and R&D activities

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Current status of the operational suite

Computer characteristics

SGI Altix 4700, system SUSE Linux Enterprise Server 10, configuration: 32 processors Intel Itanium 2, clock 1.66 GHz, RAM 64 GB, disk space – 1.8TB, peak performance - 212 Gflops

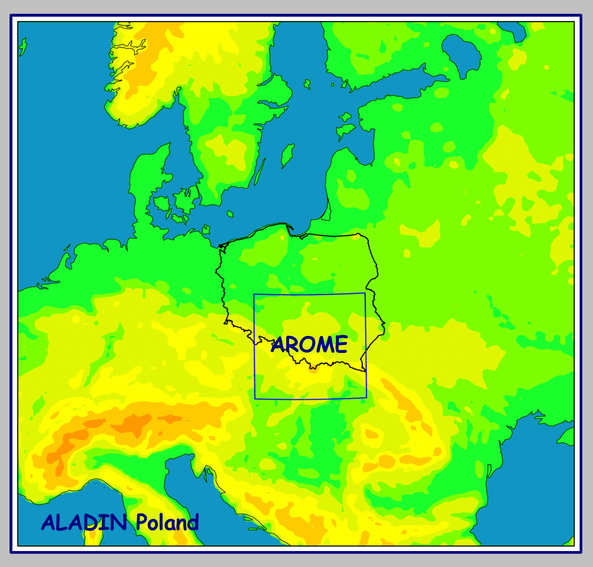
Operational status

Model geometry:

- 13.5km horizontal resolution
- 169x169 grid points
- 31 vertical model levels
- Lambert projection

Forecast settings:

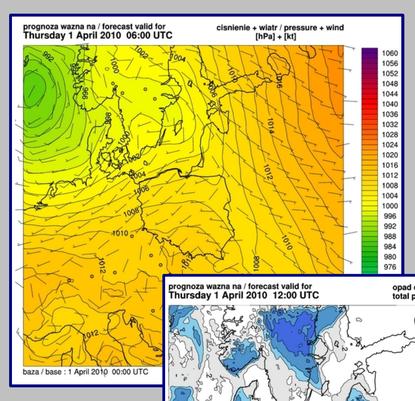
- 2 runs per day (00 and 12UTC) with 54 hours forecast range
- LBC from ARPEGE (3h coupling frequency)
- on-line Fpos on model grid, every 3h – for operational database
- off-line Fpos on geographical regular grid, every 3h – for LEADS system

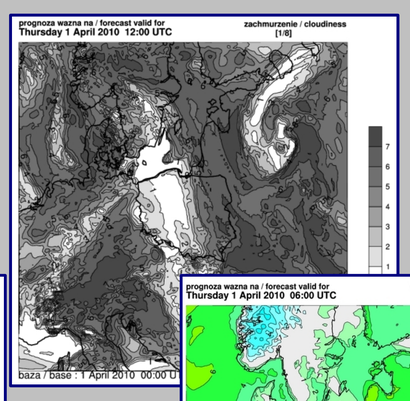


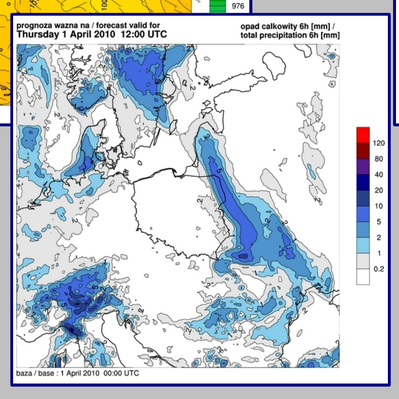
Products

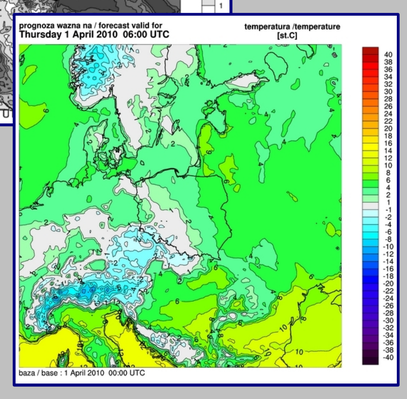
Graphical products of forecast for standard levels (maps), for surface (maps, locations, meteograms, tables) are presented on the Aladin intranet web site. Additionally we prepare sets of model forecast data for nowcasting system INCA, avalanche model CROCUS (test mode), Areology Department, Satellite Department and others.

Lately we ran in test mode new system for graphical presentation of results based on NCAR Graphics/NCL tools. Examples of them you can see below.









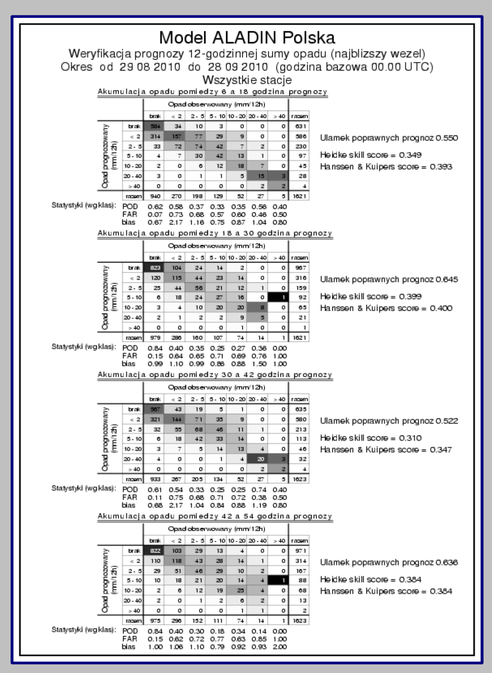
Verification

Operationally, few times per day we run verification of ALADIN model numerical weather forecast: BIAS and RMSE and MEDIAN and MAD. Outputs of model are verified on basis of observational data (SYNOP reports) from Polish synoptic stations.

Observational values from each station are compared with model values at the grid point which is nearest to the given station. Verification is carried out for both runs of model (initial time 00.00 and 12.00 UTC respectively). The forecasts of following meteorological elements are evaluated:

- MSL pressure,
- air temperatury at 2 m AGL,
- wind speed at 10 m AGL,
- wind direction at 10 m AGL,
- relative humidity at 2 m AGL,
- air maximum temperature at 2 m AGL,
- air minimum temperature at 2 m AGL,
- accumulated precipitation,
- cloud cover.

Quality of forecasts of cloud cover and accumulated precipitation is evaluated using contingency tables, and for others elements the differences between model and observed values are counted.



Model ALADIN Polska
Weryfikacja prognozy 12-godzinnej sumy opadu (najblizszy wezel)
Okres od 29.08.2010 do 28.09.2010 (godzina bazowa 00.00 UTC)
Wszystkie stacje

Akumulacja opadu pomiedzy 6 a 18 godzina prognozy

Opad prognozowany (mm/12h) \ Opad obserwowany (mm/12h)	brak	< 2	2 - 5	5 - 10	10 - 20	20 - 40	> 40	razem
brak	284	34	10	3	0	0	0	331
< 2	314	157	77	29	9	0	0	586
2 - 5	33	72	74	42	7	2	0	230
5 - 10	4	7	30	42	13	1	0	97
10 - 20	2	0	6	12	18	7	0	45
20 - 40	3	0	1	1	5	15	3	28
> 40	0	0	0	0	0	2	2	4
razem	940	270	198	129	52	27	5	1621

Ulamek poprawnych prognoz 0.550
Heidke skill score = 0.349
Hanssen & Kuipers score = 0.393

Statystyki (wg klas): POD 0.62 0.58 0.37 0.33 0.35 0.56 0.40; FAR 0.07 0.73 0.68 0.57 0.60 0.46 0.50; bias 0.67 2.17 1.16 0.75 0.87 1.04 0.80

Akumulacja opadu pomiedzy 18 a 30 godzina prognozy

Opad prognozowany (mm/12h) \ Opad obserwowany (mm/12h)	brak	< 2	2 - 5	5 - 10	10 - 20	20 - 40	> 40	razem
brak	823	104	24	14	2	0	0	967
< 2	120	115	44	23	14	0	0	316
2 - 5	25	44	56	21	12	1	0	159
5 - 10	6	18	24	27	16	0	1	92
10 - 20	3	4	10	20	20	8	0	65
20 - 40	2	1	2	2	9	5	0	21
> 40	0	0	0	0	1	0	0	1
razem	979	286	160	107	74	14	1	1621

Ulamek poprawnych prognoz 0.645
Heidke skill score = 0.399
Hanssen & Kuipers score = 0.400

Statystyki (wg klas): POD 0.84 0.40 0.35 0.25 0.27 0.36 0.00; FAR 0.15 0.64 0.65 0.71 0.69 0.78 1.00; bias 0.99 1.10 0.99 0.88 0.88 1.50 1.00

Akumulacja opadu pomiedzy 30 a 42 godzina prognozy

Opad prognozowany (mm/12h) \ Opad obserwowany (mm/12h)	brak	< 2	2 - 5	5 - 10	10 - 20	20 - 40	> 40	razem
brak	567	43	19	5	1	0	0	635
< 2	321	144	71	35	9	0	0	580
2 - 5	32	55	68	46	11	1	0	213
5 - 10	6	18	42	33	14	0	0	113
10 - 20	3	7	5	14	13	4	0	46
20 - 40	4	0	0	1	4	20	3	32
> 40	0	0	0	0	0	2	2	4
razem	933	267	205	134	52	27	5	1623

Ulamek poprawnych prognoz 0.522
Heidke skill score = 0.310
Hanssen & Kuipers score = 0.347

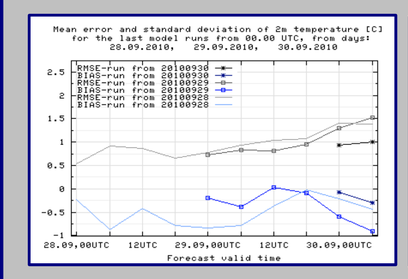
Statystyki (wg klas): POD 0.61 0.54 0.33 0.25 0.25 0.74 0.40; FAR 0.11 0.75 0.68 0.71 0.72 0.38 0.50; bias 0.68 2.17 1.04 0.84 0.88 1.19 0.80

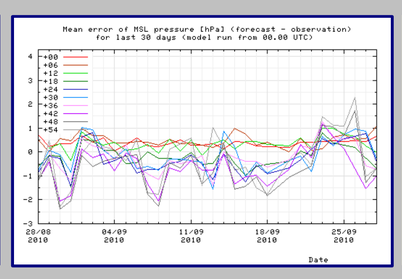
Akumulacja opadu pomiedzy 42 a 54 godzina prognozy

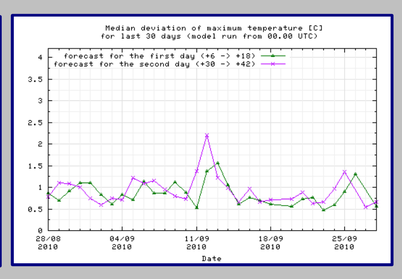
Opad prognozowany (mm/12h) \ Opad obserwowany (mm/12h)	brak	< 2	2 - 5	5 - 10	10 - 20	20 - 40	> 40	razem
brak	822	103	29	13	4	0	0	971
< 2	110	118	43	28	14	1	0	314
2 - 5	29	51	46	29	10	2	0	167
5 - 10	10	18	21	20	14	4	1	88
10 - 20	2	6	12	19	25	4	0	68
20 - 40	2	0	1	2	6	2	0	13
> 40	0	0	0	0	1	1	0	2
razem	975	296	152	111	74	14	1	1623

Ulamek poprawnych prognoz 0.636
Heidke skill score = 0.354
Hanssen & Kuipers score = 0.354

Statystyki (wg klas): POD 0.84 0.40 0.30 0.18 0.34 0.14 0.00; FAR 0.15 0.62 0.72 0.77 0.83 0.85 1.00; bias 1.00 1.06 1.10 0.79 0.92 0.93 2.00



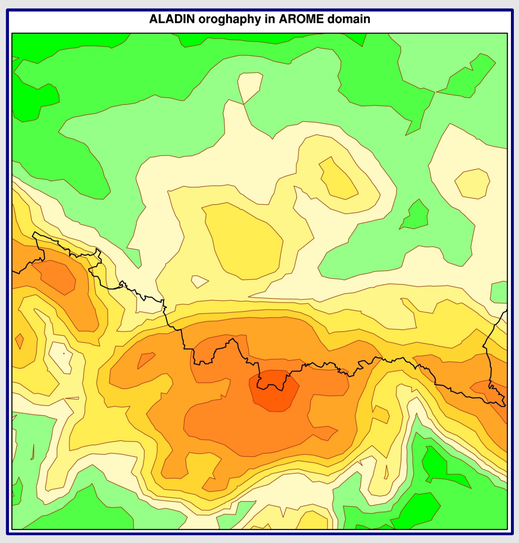


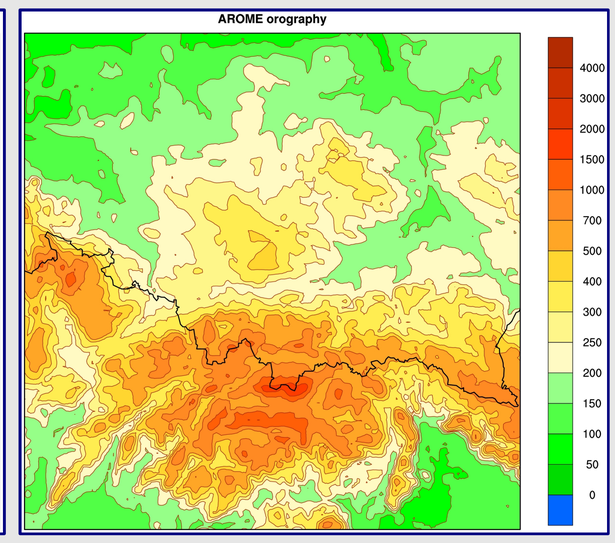


Research activities

AROME – preliminary tests

Domain: 169x169 points, horizontal resolution 2.7km, 49 veritcal levels. Time step of the model is 60s. We run forecast with 1 hour output interval.

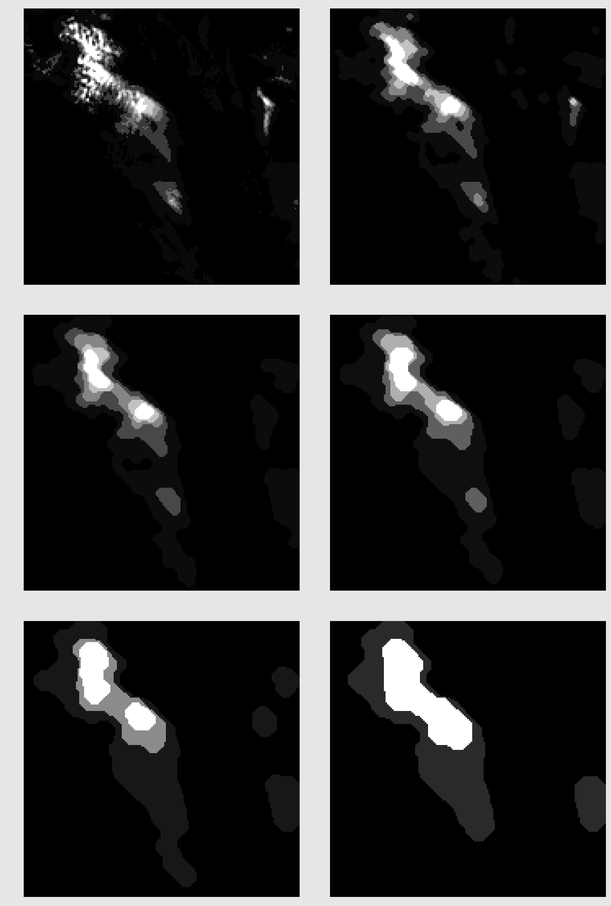


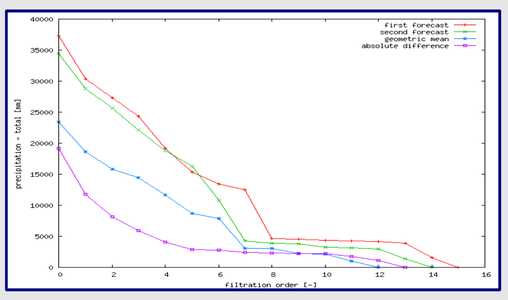


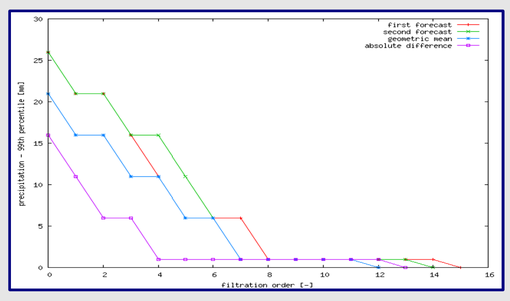
2-D ICWM Filters

Median filters, widely applied in image processing for noise removal, has appeared good basis for development of a new scale-separation tool applicable to non - smooth meteorological fields (e.g. precipitation or cloud cover) given at regular grids. The proposed currently tool is a set of **Iterative Four - Directional Composite Weighted Median Filters.** 2-D ICWM filters are superpositions of 1-D weighted median filters with different sizes and weights applied for iterative smoothing in consecutive directions. Such 2-D filters show interesting features, among them robustness and idempotence (the last proven only by practice).

At right there are examples of precipitation field filtration - 2 - D ICWM filter with two-parameter field quantization is applied. Attached images are normalized. It can be noticed that precipitation area preserves its boundaries really well.







At left there are examples of scale-by-scale comparison of two precipitation forecasts. Simple statistics are applied to filtered fields and some their derivatives.

Fuzzy Methods

There were performed first tests of use of fuzzy methods in verification and comparison of high resolution forecasts of AROME and ALADIN vs. SYNOP observations. First, tests were used for the forecast of precipitation. Fuzzy methods rely on the comparison of one single prognosis (or one domain of prognoses) with the set of observations. For example, we take into account the upscaling, minimum coverage, fuzzy logic and multi-event contingency table:

Upscaling matches neighborhood of observations and the neighborhood of forecast. Useful forecast in this case resembles the observations when averaged to coarser scales.

Minimum coverage method matches also both neighborhoods (of observation and of forecast) and the forecast is useful when predicts the event over a minimum fraction of the region of interest.

Multi-event contingency table compares single observation with the neighborhood of forecast. Useful forecast predicts at least one event close to an observed event.

Fuzzy logic method matches also both neighborhoods (of observation and of forecast) and the forecast is useful when is more correct than incorrect over the region of interest.

FAR fuzzy logic — cum 24h

	0.1	0.2	0.5	1.0	2.0	5.0	10.0	20.0	50.0
165km	0.28	0.33	0.42	0.52	0.64	0.84	0.96	0.98	NaN
85km	0.33	0.38	0.46	0.55	0.65	0.83	0.94	0.98	0.99
45km	0.43	0.47	0.53	0.58	0.66	0.81	0.92	0.97	0.99
25km	0.43	0.46	0.53	0.58	0.67	0.82	0.92	0.97	0.99
10km	0.43	0.46	0.53	0.58	0.66	0.81	0.91	0.97	0.99

FAR fuzzy logic — cum 24h

	0.1	0.2	0.5	1.0	2.0	5.0	10.0	20.0	50.0
165km	0.26	0.3	0.41	0.51	0.64	0.83	0.96	0.98	NaN
85km	0.32	0.37	0.45	0.54	0.65	0.82	0.94	0.98	NaN
45km	0.41	0.45	0.52	0.57	0.66	0.81	0.92	0.97	0.99
25km	0.41	0.45	0.52	0.57	0.66	0.81	0.92	0.97	0.99
10km	0.41	0.44	0.52	0.57	0.65	0.81	0.91	0.97	0.99

ALADIN
AROME
The example of results for the precipitation thresholds [in the units of mm / 24 hours]