WG3b activities at Roshydromet

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Outlook

- Implementation of FLAKE parameterization into COSMO-Ru2: Summer and winter
- Aspects of description of snow effects:

  - preprocessing (initialization of SWE)

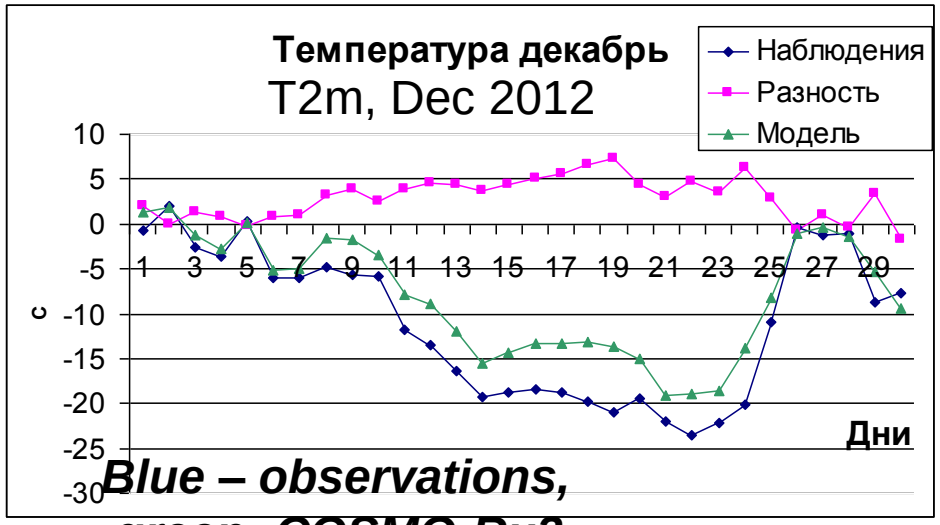
  - model (positive T2m over snow-covered surface)

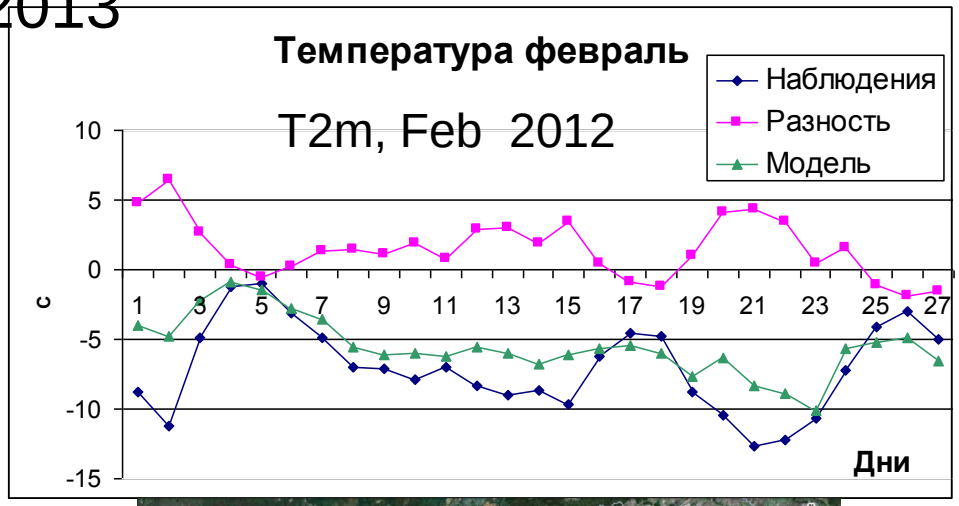
  -postprocessing (Fresh snow calculations)
- Proposal for new PT

1. Implementation of FLAKE in COSMO-Ru

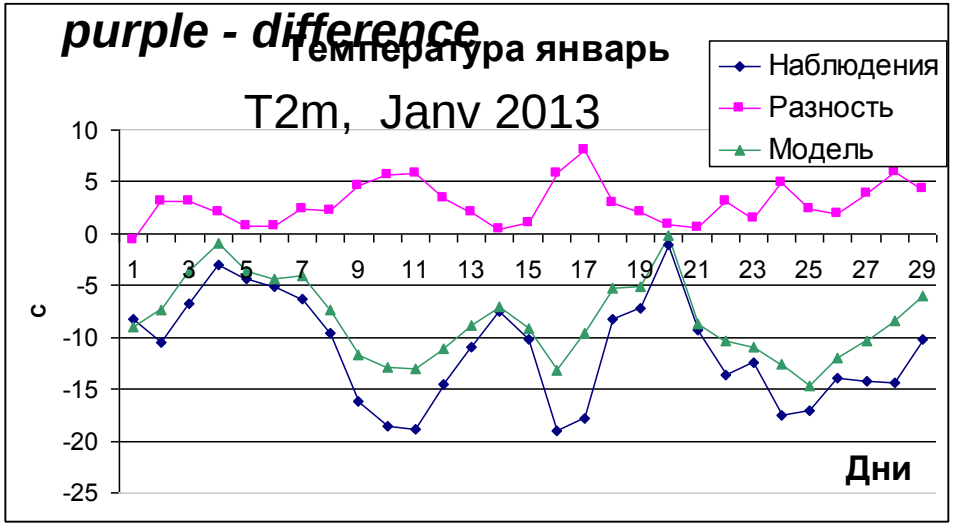
Motivation

T2m forecasts for Kazan, Kuybyshev reservoir, winter 2012-2013





Blue – observations, green- COSMO-Ru2, purple - difference



FLAKE parameterization was used in the COSMO-Ru7 (European part of Russia) in testing mode (Cold start from the 1 july 2013) and in COSMO-Ru2 (central Volga region) in operational mode with cold start the 15 Apr 2013 ..

New structure of COSMO-Ru preprocessing:
Initialisation of all lake data by cyclic mode on the base of 6-h COSMO-RU forecasts (with included FLAKE) .

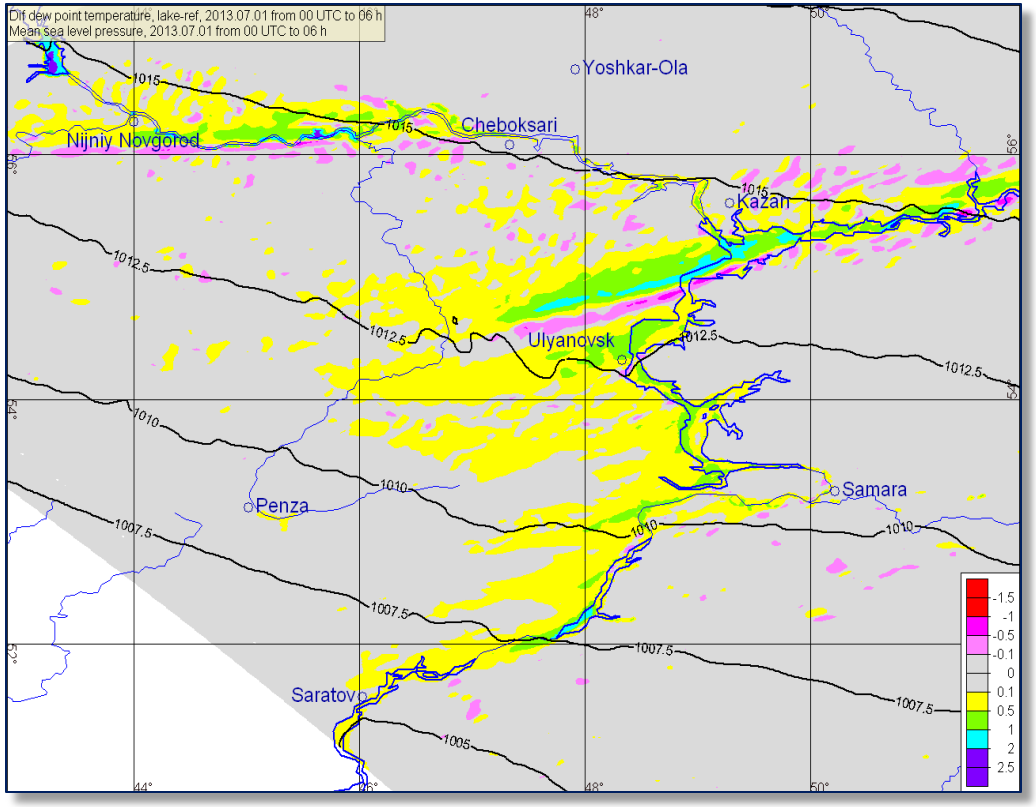
Products from global modeling
surface temperature T_S,
ice height H_ICE, ice fraction A_ICE,
ice temperature T_ICE
are replaced

+

FLAKE products
mean water temperature,
temperature of water mixed layer
……

During the tests for large possibility of atmospheric conditions of COSMO-Ru area some COSMO codes were adapted with feed- back from authors

Summer



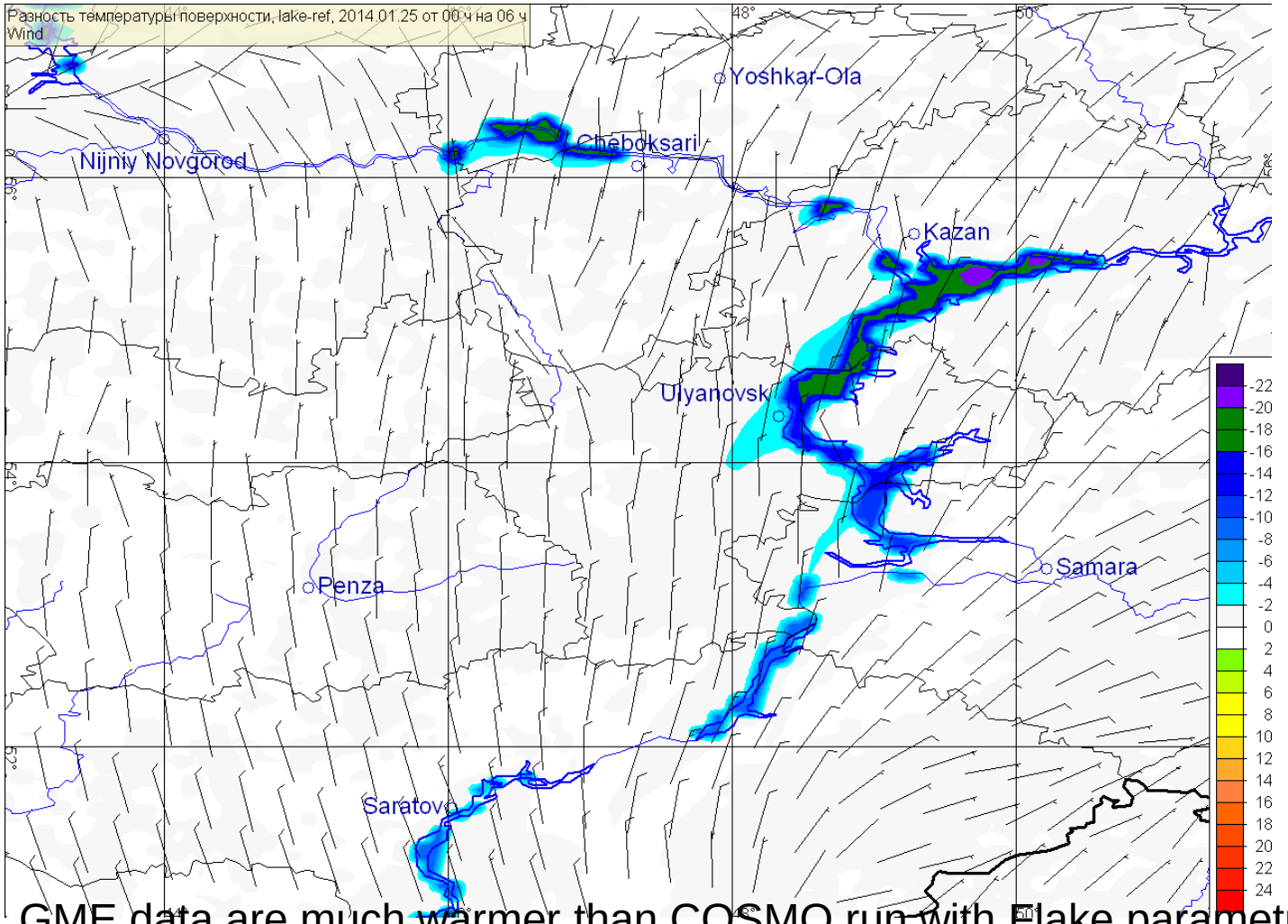
More sensitive:

fields of air wetness of bottom levels

Td2m flake – Td2m ref
00.01.07.2013

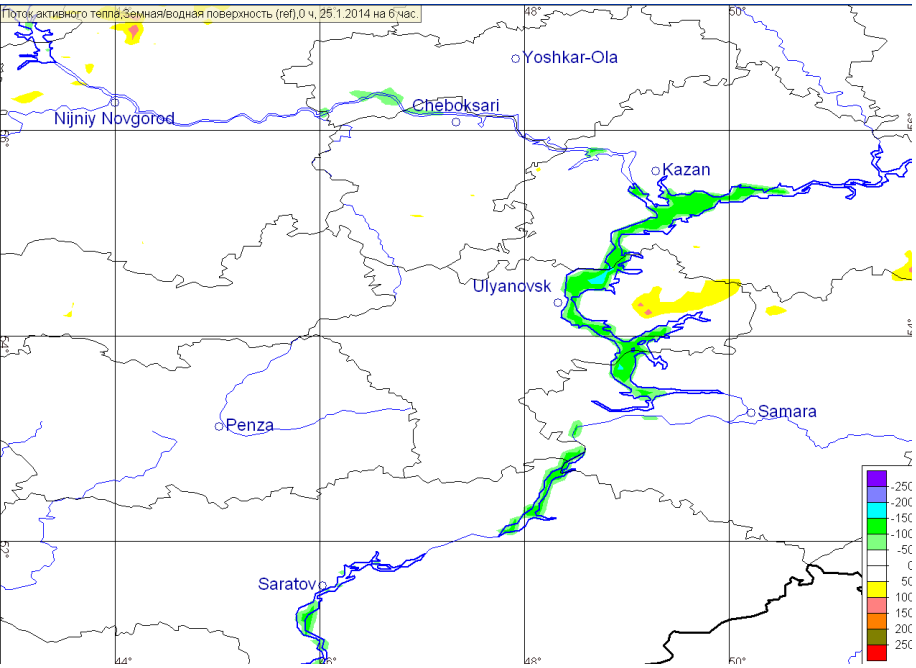
Winter

Difference of Tg between Flake and reference experiments, from 00 UTC 2013.06.24, for 06 h.

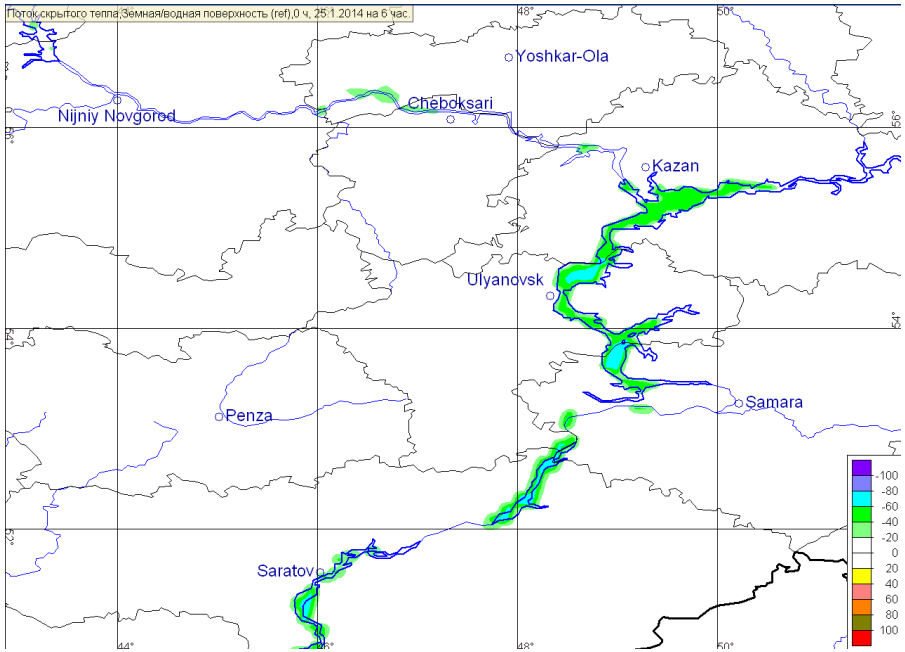


GME data are much warmer than COSMO run with Flake parametrization

Heat fluxes at the surface, reference experiment, 2014.01.25 from 00 UTC on 06 h



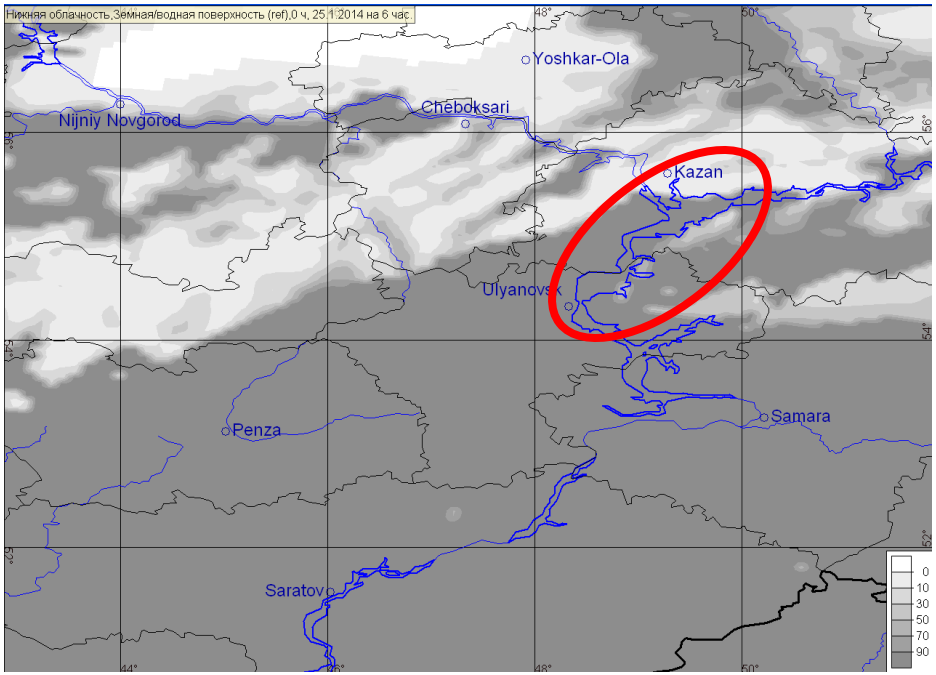
Sensible heat flux



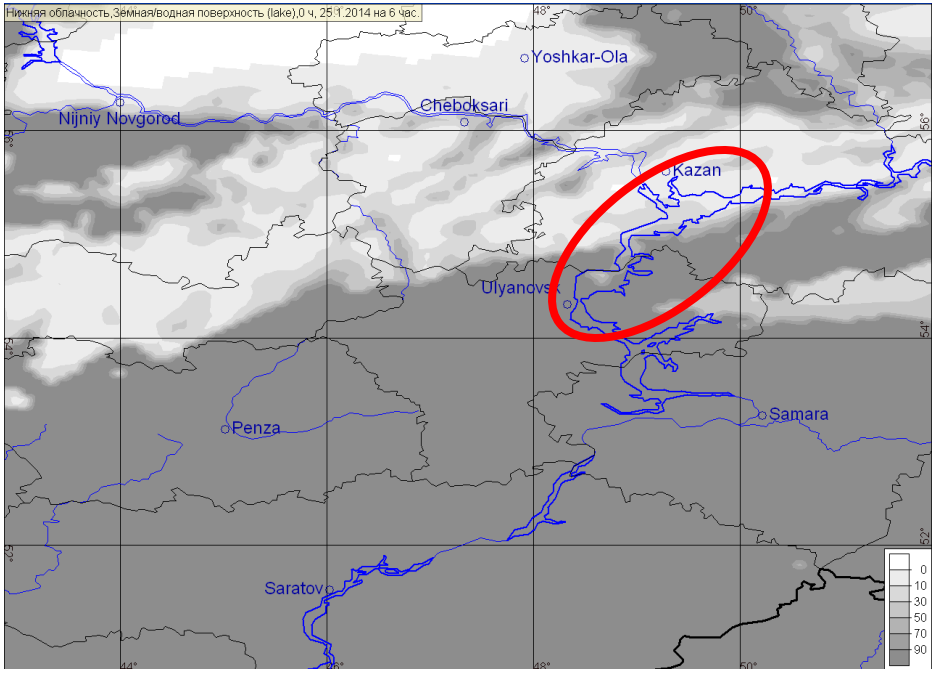
Latent heat flux

Without flake parameterization high surface causes anomaly large heat fluxes. Warm surface of lakes heats atmosphere.

Forecast of low clouds, 2014.01.25 from 00 UTC on 06 h



Reference experiment



Flake experiment

High heat fluxes lead to the convection in the lower atmosphere. Fraction of low clouds is a good test field for the Flake parameterization.

2. Snow aspects

- preprocessing:

  initialisation of SWE

- TERRA :

  the parameterization addition for simplified calocalations of T2m in snow conditions

- postprocessing:

  Fresh snow depth

2.1. Snow water equivalent (SWE) initialization

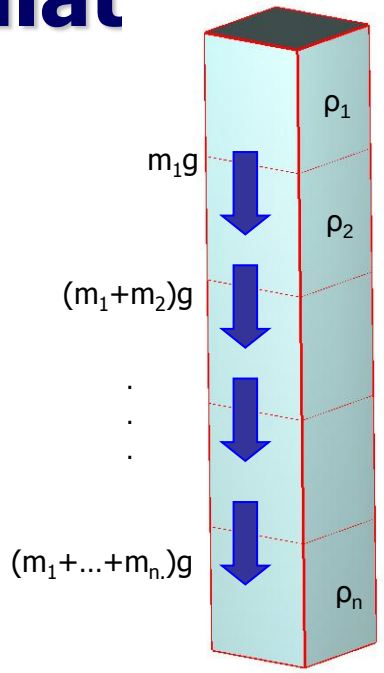
Preparation of SWE fields: results for the current moment

- Part of snow season October, 1 2013 –March,1 2014) was studied for several stations situated at the European part of Russia

- Comparison between observational data of snow water equivalent (SWE) and results of SMFE (Snow Model Finite Element, Kazakova E., Chumakov M., Rozinkina I., COSMO Newsletter No.13, 2013) was done.

- Maps of SWE were produced with the use of interpolated model results and satellite data (4 km NOAA composite images).

The proposed algorithm for calculations of snow values



- Snow column is represented as the set of some elementary layers , which are in mechanical and thermal interaction with each other. The number of finite elements depends on the height of the snow column. One layer has height equal to 1 cm

Number of layers depend from the accumulation, pressing and melting od snow

The density can be obtained as function of temrperature and weight of uppers layers + increasing in case of melting

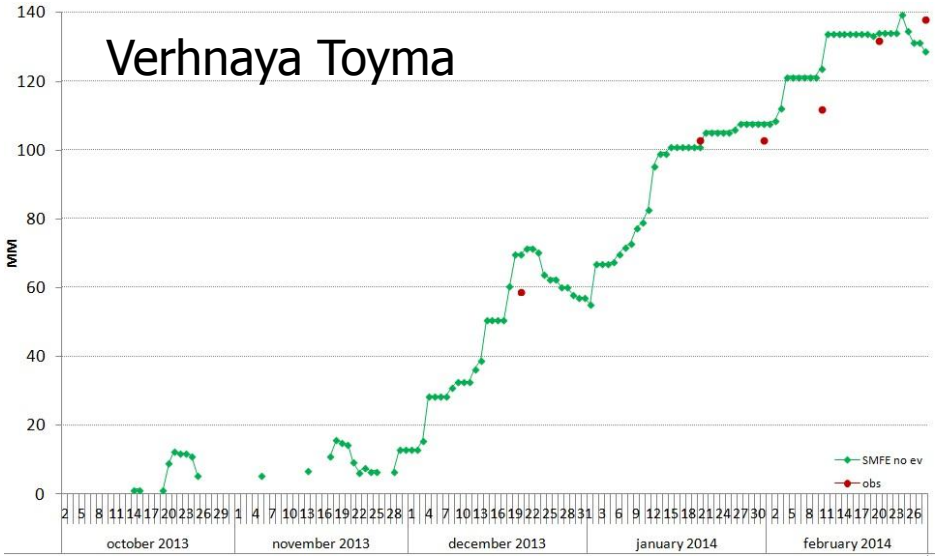
$$E = (0{,}0167\rho - 1{,}86)\cdot 10^6, -3 < T_a < -1 \qquad E = (0{,}059\rho - 10{,}8)\cdot 10^6, -13 < T_a < -5$$

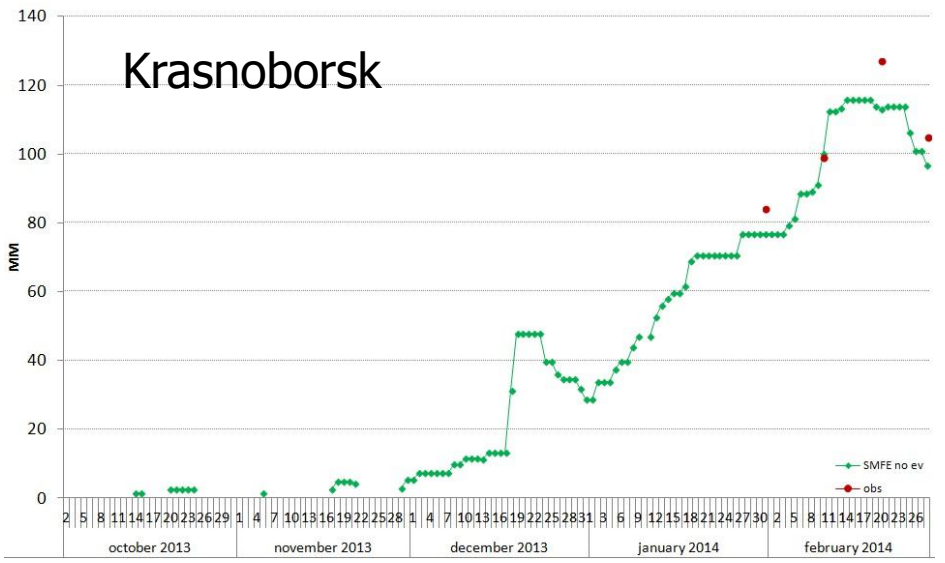
- We suppose that finite elements of the snow column undergo only elastic deformation, so it can be written (example for T_a>-5°C):

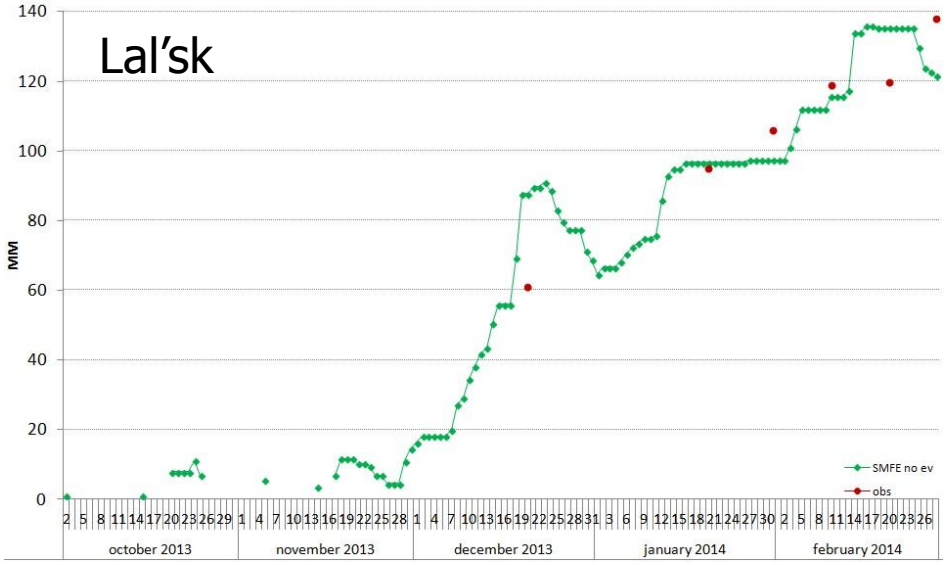
$$\rho = \frac{\left(\frac{mg}{10^6(1-\sigma_{02})} + 1{,}86\right)}{0{,}0167}, \quad m = (\rho_1 + \rho_2 + \ldots)H, H = 0{,}01m$$

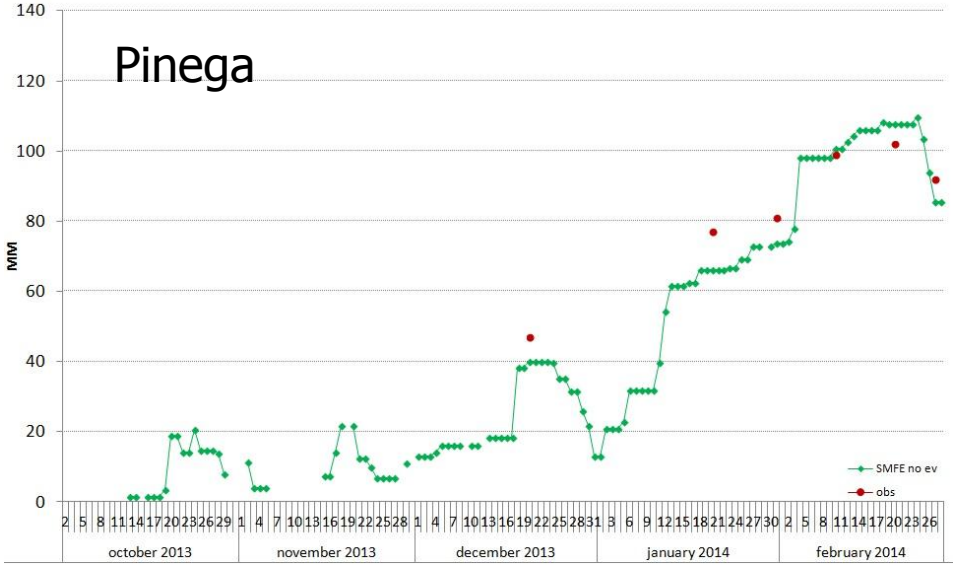
$$\frac{l_n}{l_0} = (1-\sigma_{02}) = 1 - 0{,}002$$

SWE(north, forest). 1 October 2013 – 1 March 2014

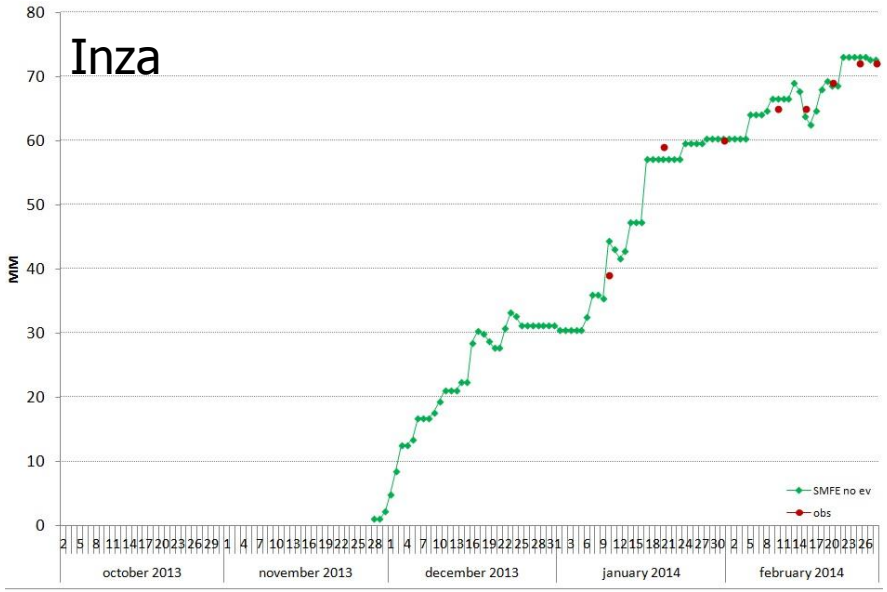


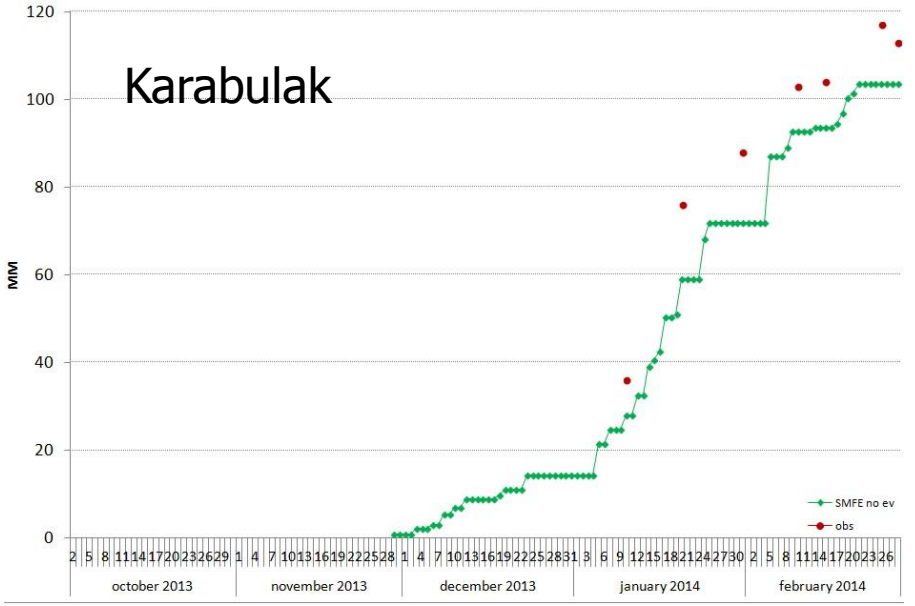


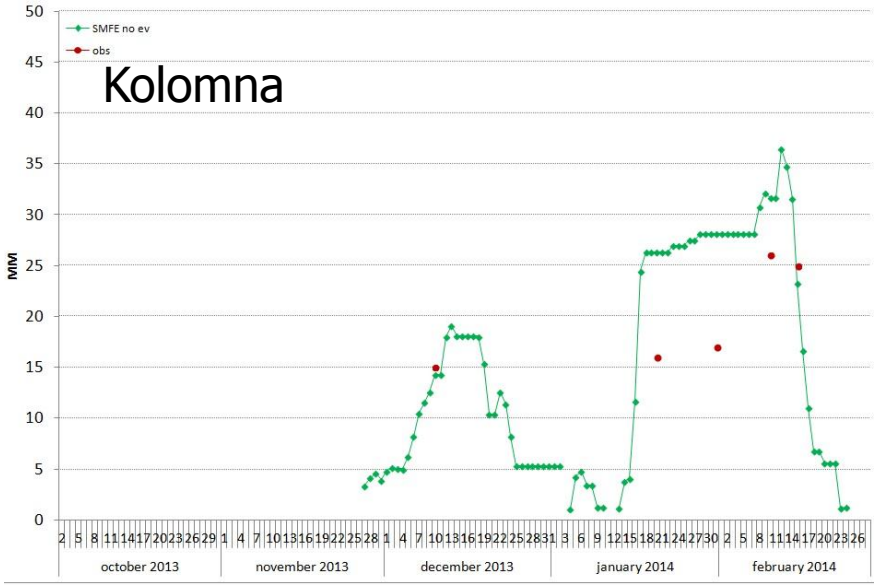




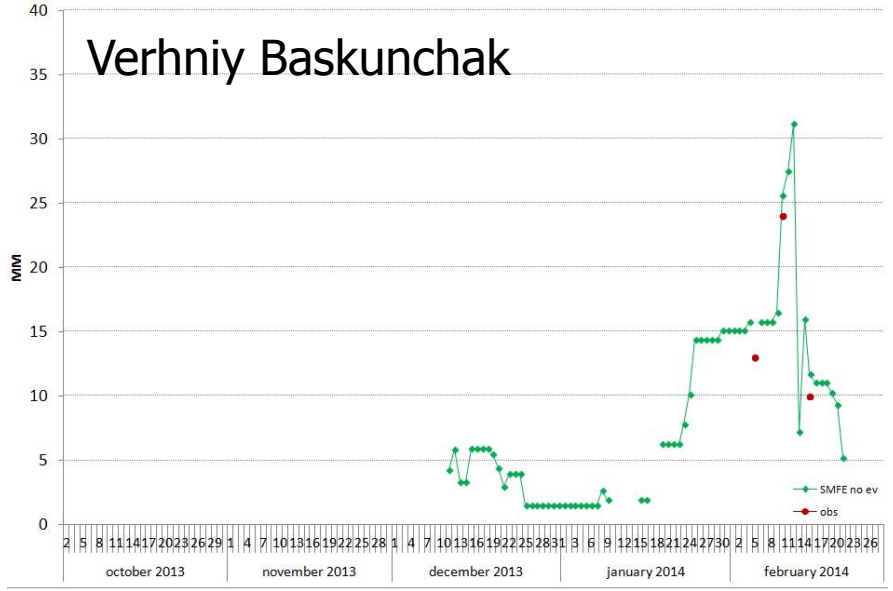
SWE(center, field). 1 October 2013 – 1 March 2014

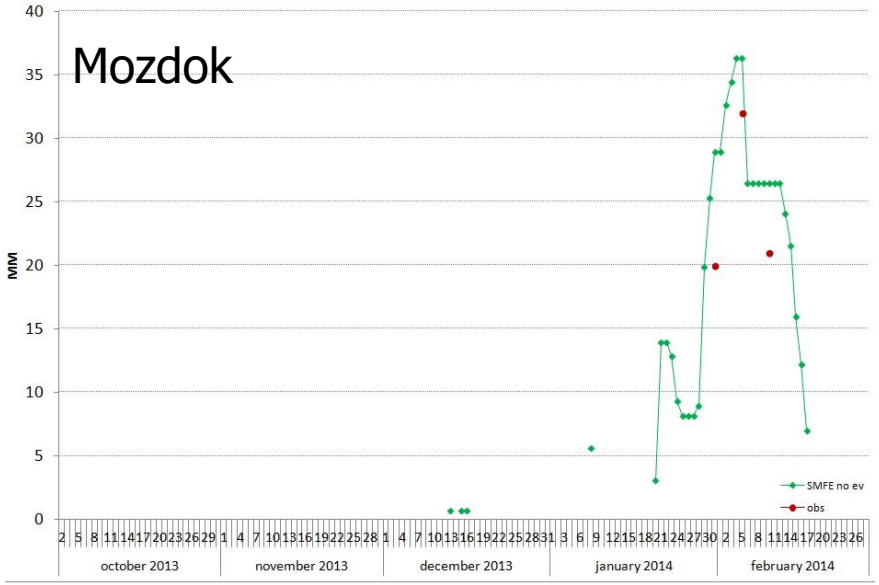


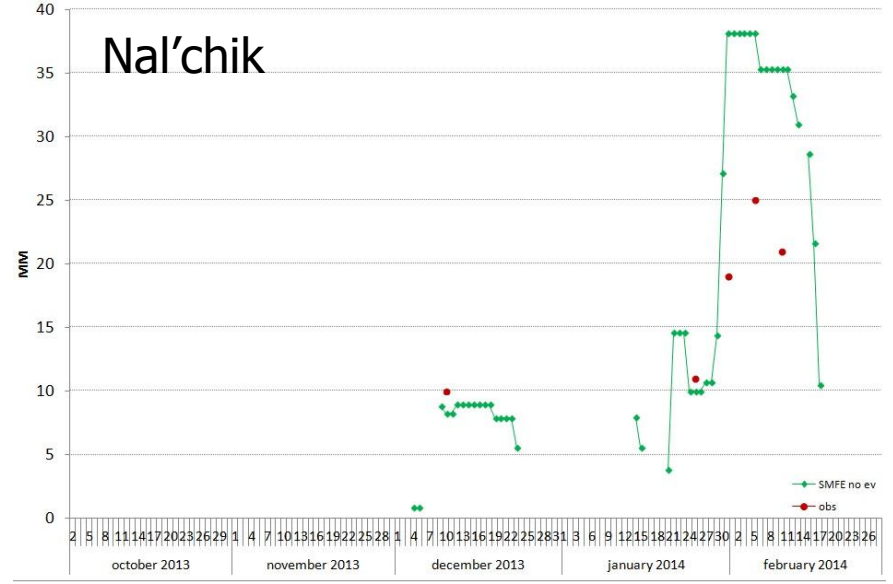


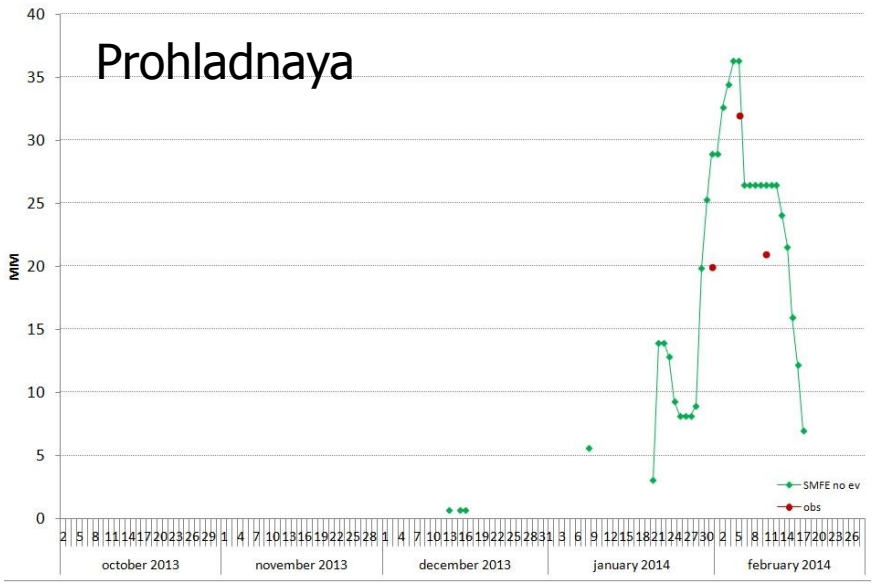


SWE(south, field). 1 October 2013 – 1 March 2014



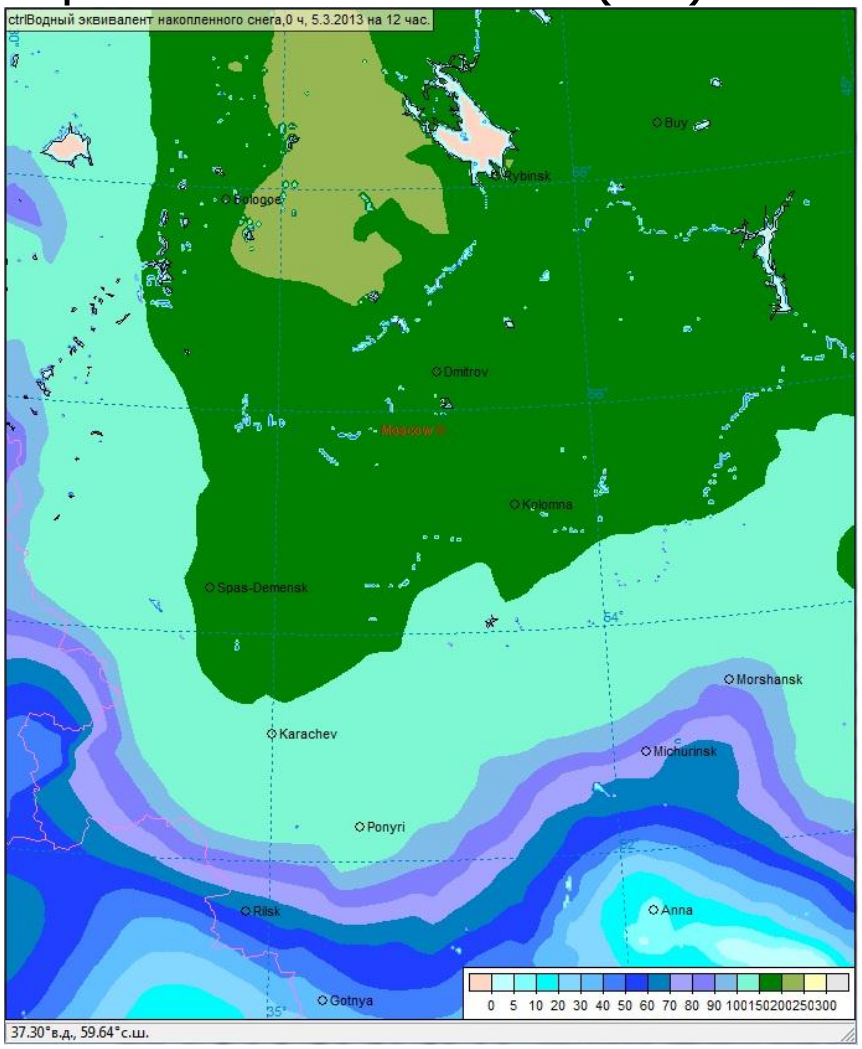




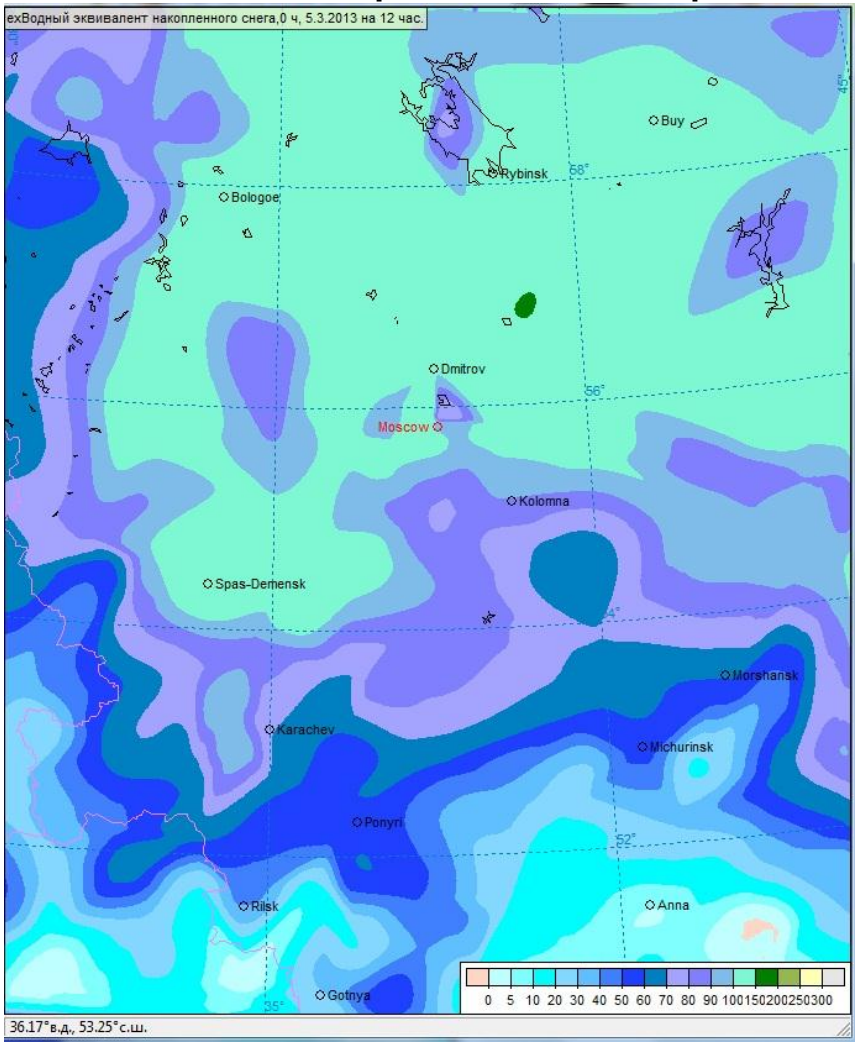


The SWE calculations, example for 5 March 2013

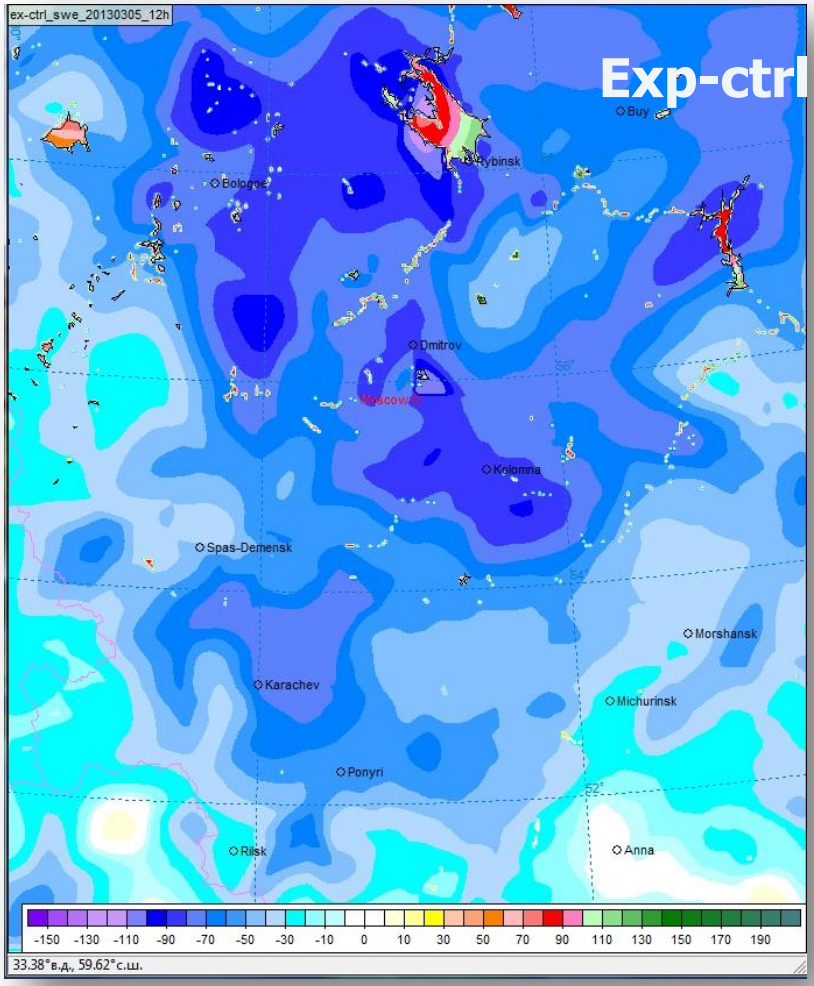
Operational COSMO-RU (ctrl)



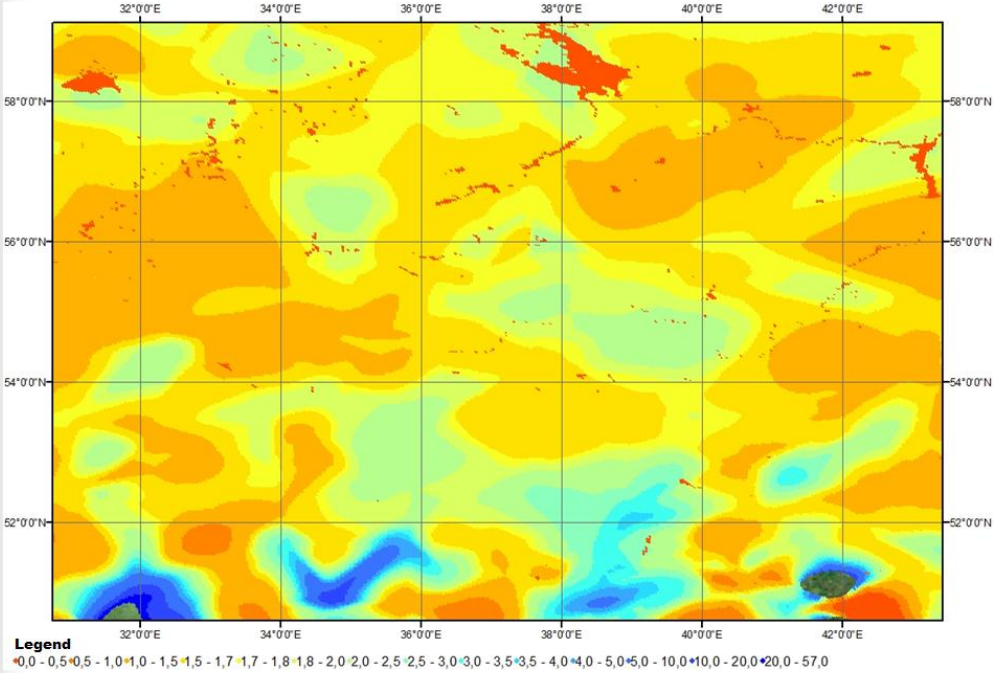
Proposed technique



The SWE calculations, example for 5 March 2013



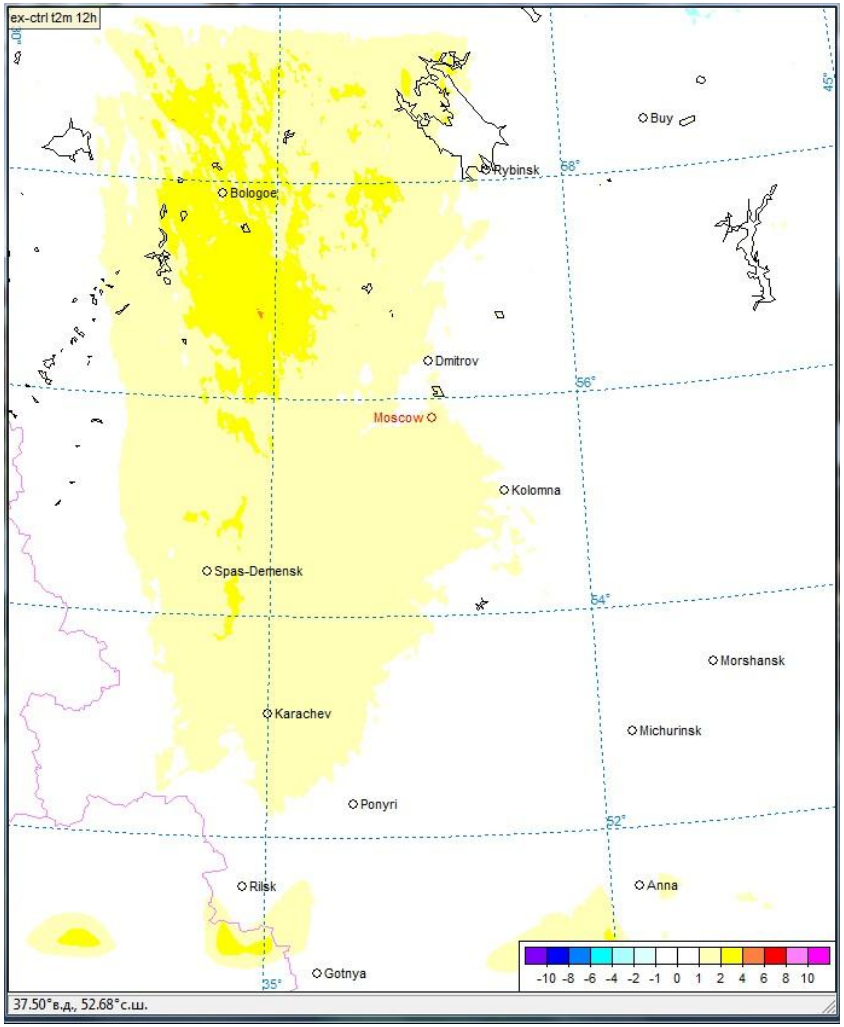
Exp/ctrl

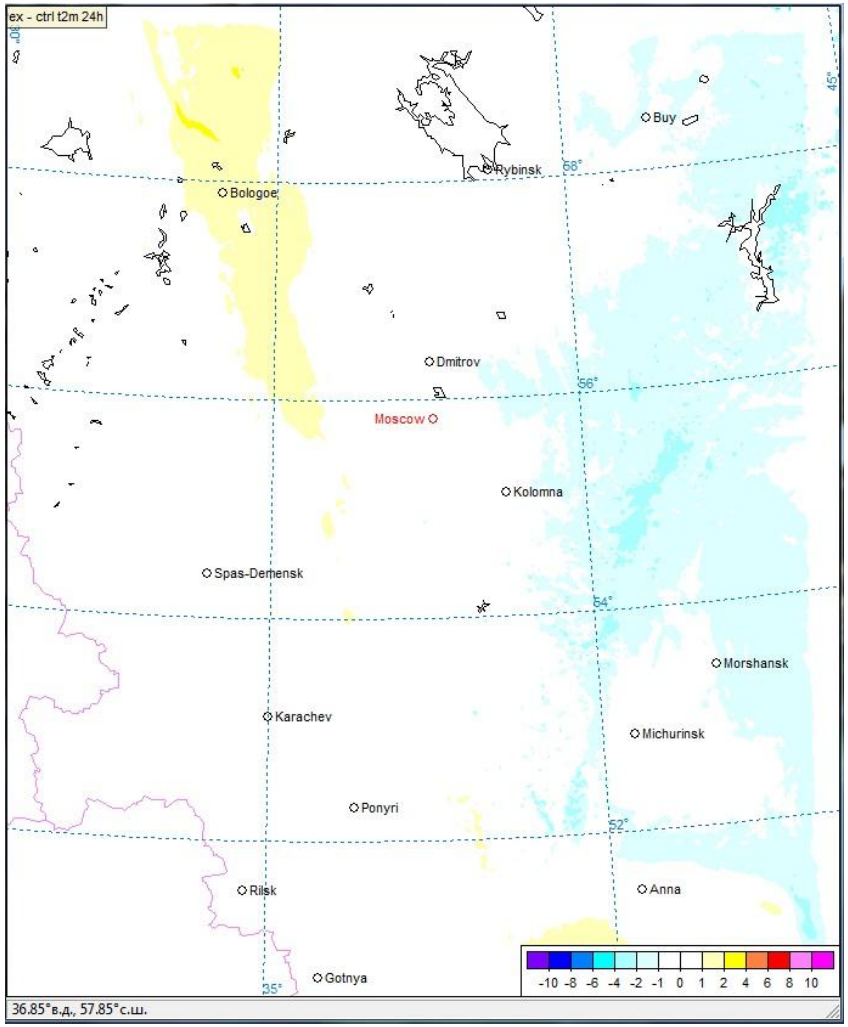


Fields differs in 1,5-2,0 times

The biggest differences in SWE between Ctrl and Exp fields are observed for territory with maximum SWE and on lakes – in COSMO lakes are not covered with snow

T2m, ex-ctrl, 12h (left) and 24h(right) forecast, 00.05.03 2013

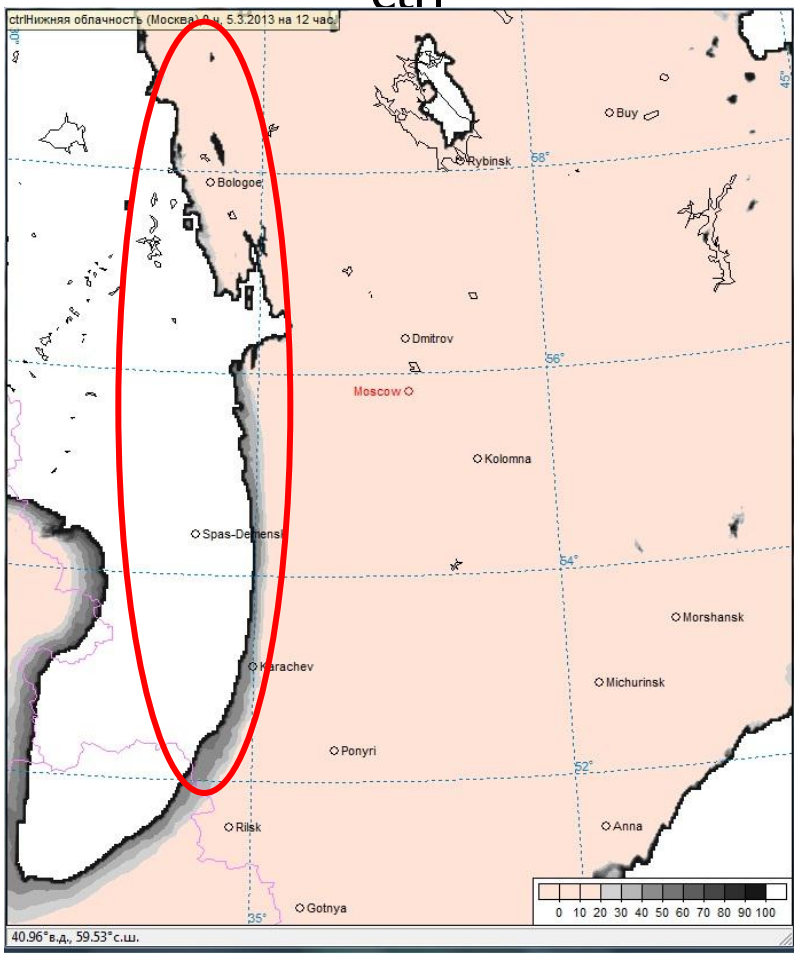




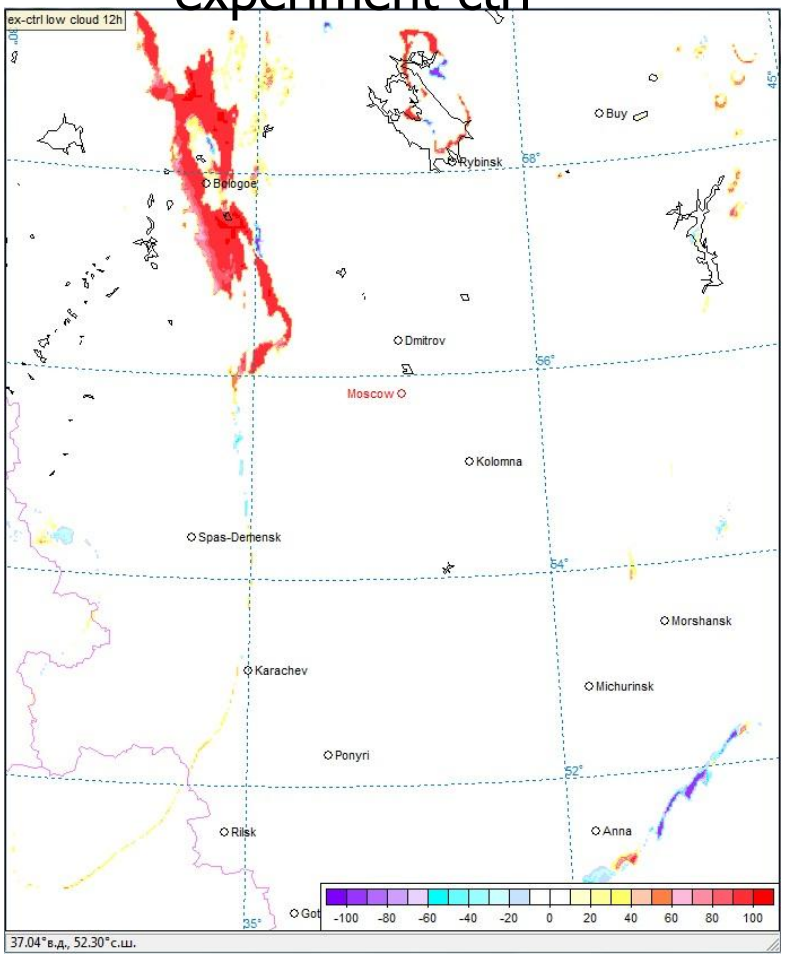
Changes in T2m are regulated by cloudiness and snow density.

Low cloudiness, 12h forecast, 5 March 2013

ctrl



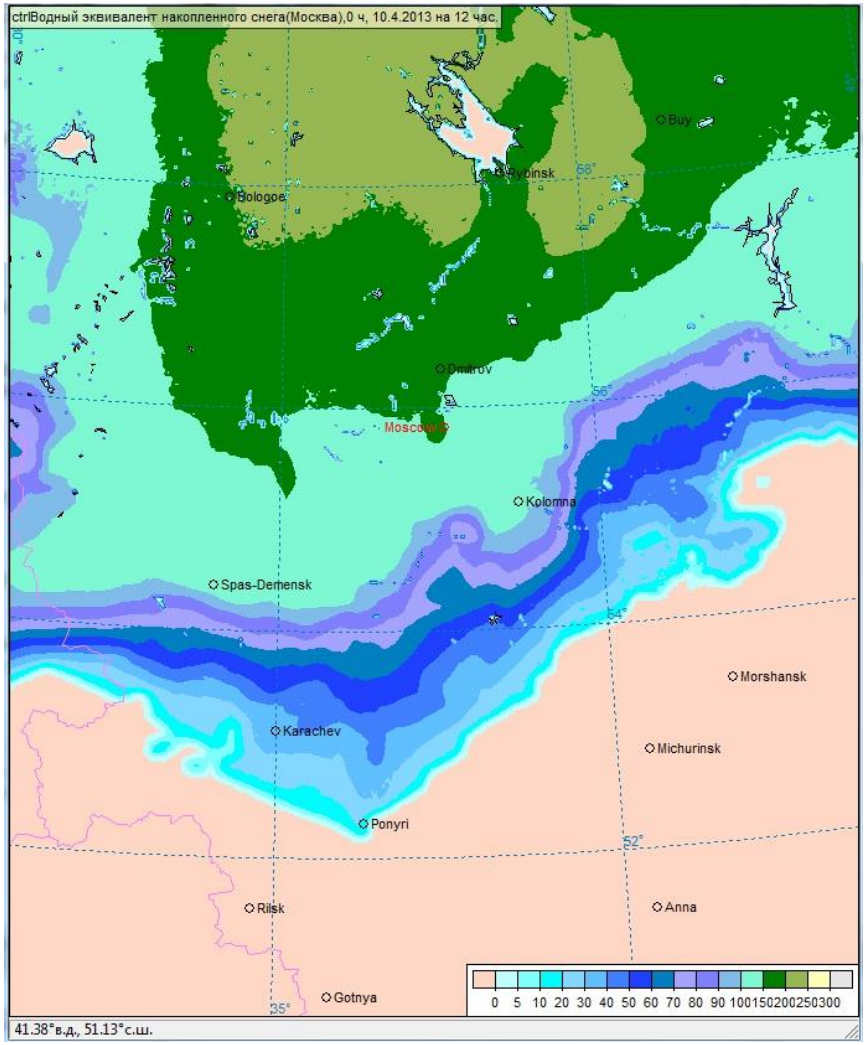
experiment-ctrl



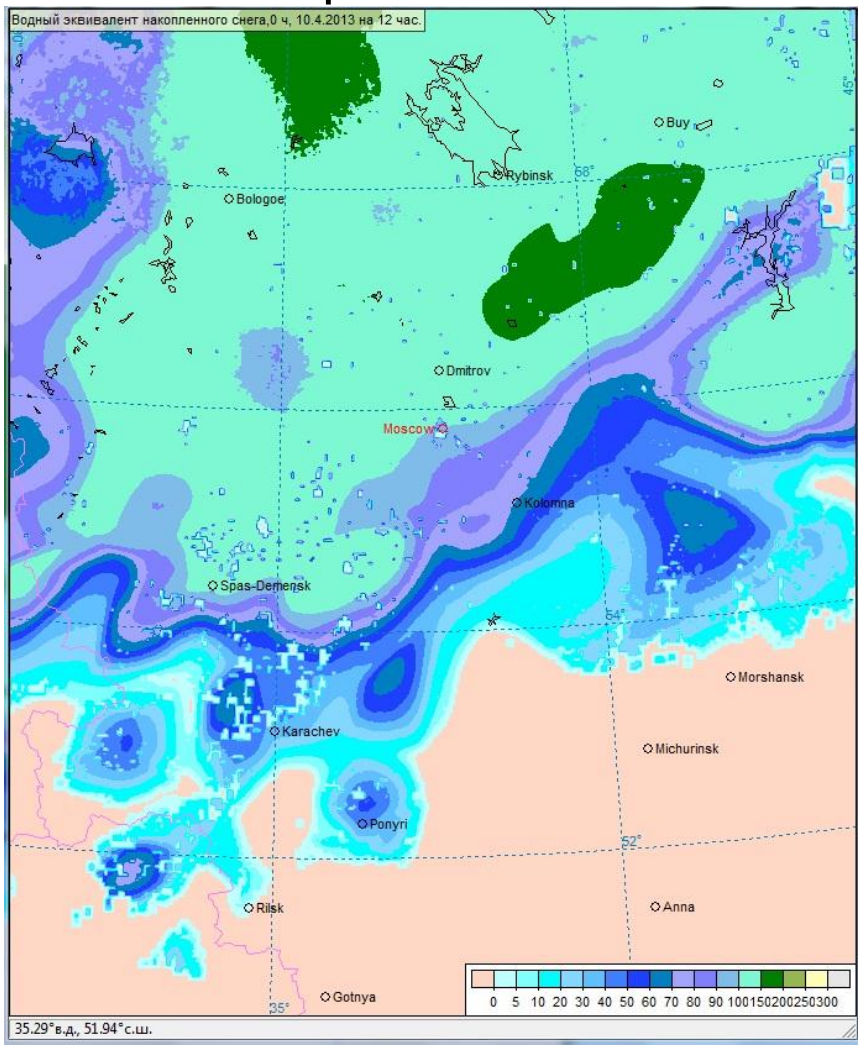
The maximum differences in low cloudiness are observed on the boundary of the cloud in the place, where there are the greatest changes in SWE between ctrl and experiment

SWE, 12h forecast, 10 April 2013

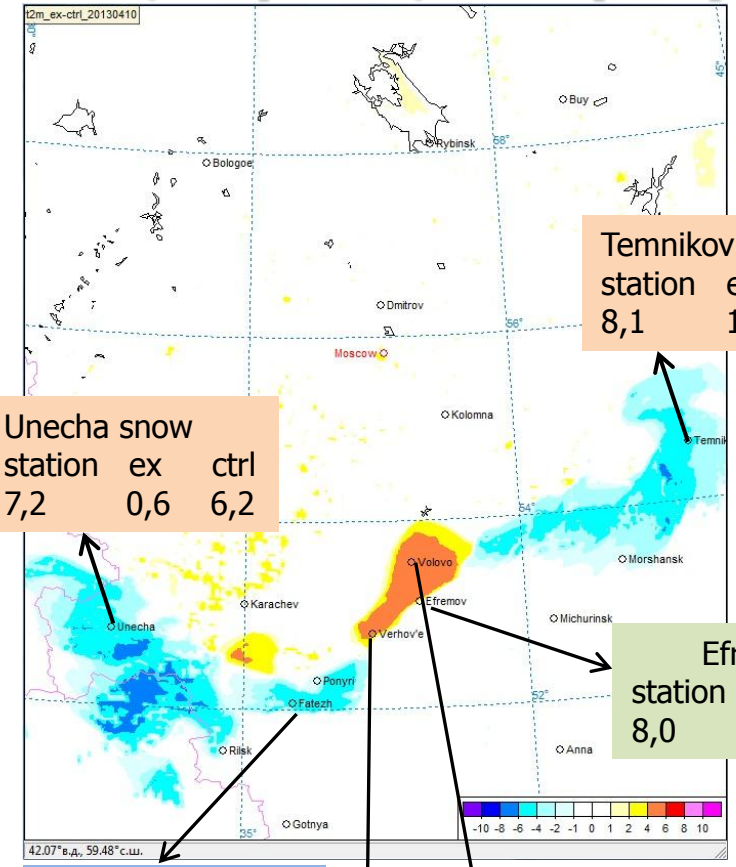
Ctrl



Exp



T2m, exp-ctrl, 12h (left) and 24h(right) forecast, 10 April 2013



Temnikov snow

station	ex	ctrl
8,1	1,1	5,6

Unecha snow

station	ex	ctrl
7,2	0,6	6,2

Efremov

station	ex	ctrl
8,0	6,6	4,3

Fatezh snow 9 Apr

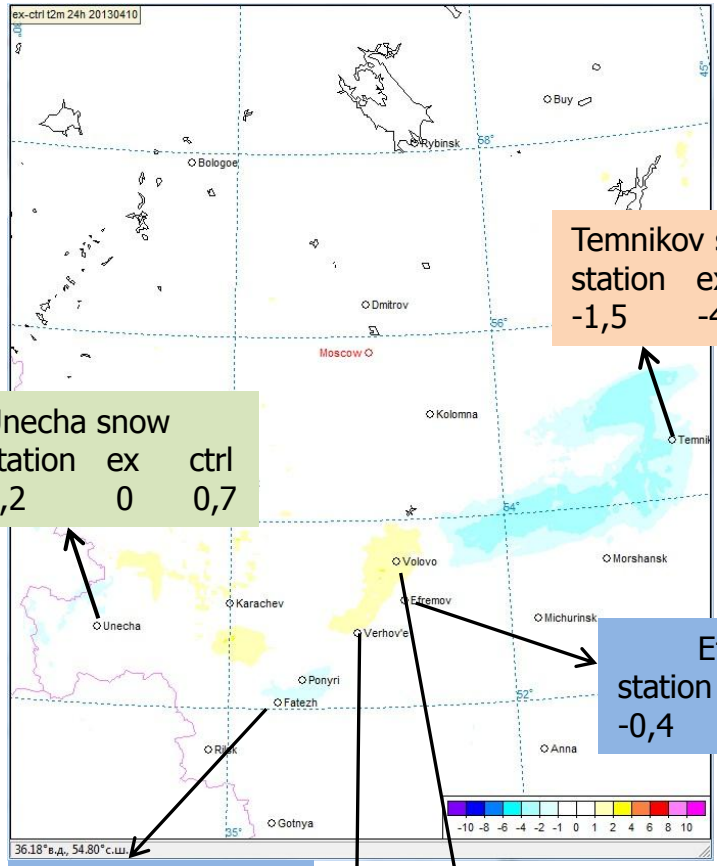
station	ex	ctrl
7,1	1,3	6,6

Volovo

station	ex	ctrl
6,9	5,7	0,6

Verhov'e

station	ex	ctrl
7,0	6,0	1,2



Temnikov snow

station	ex	ctrl
-1,5	-4,9	-3,0

Unecha snow

station	ex	ctrl
0,2	0	0,7

Efremov

station	ex	ctrl
-0,4	-0,9	-0,5

Fatezh snow 9 Apr

station	ex	ctrl
1,0	-0,3	0,4

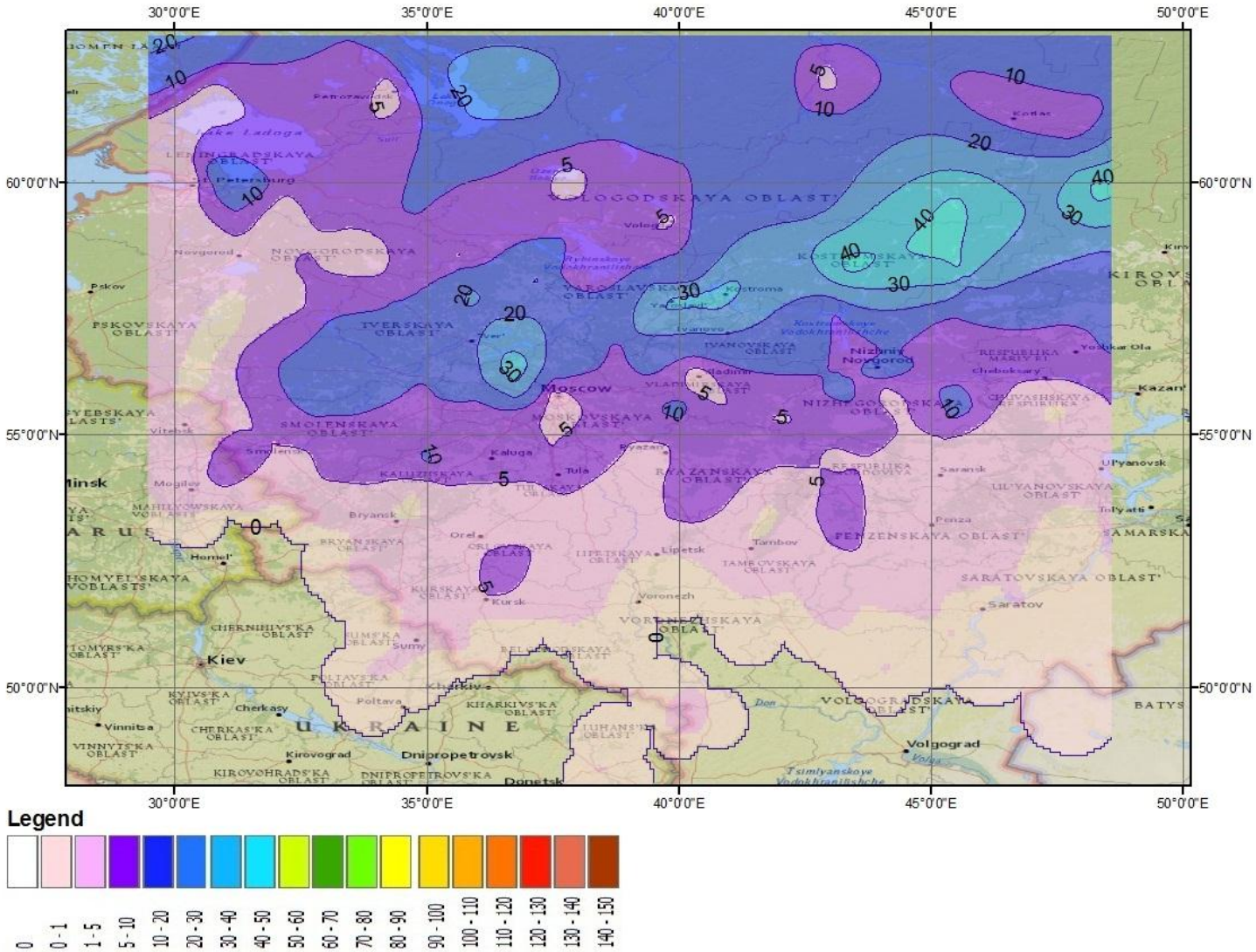
Volovo

station	ex	ctrl
-1,1	-2,1	-3,6

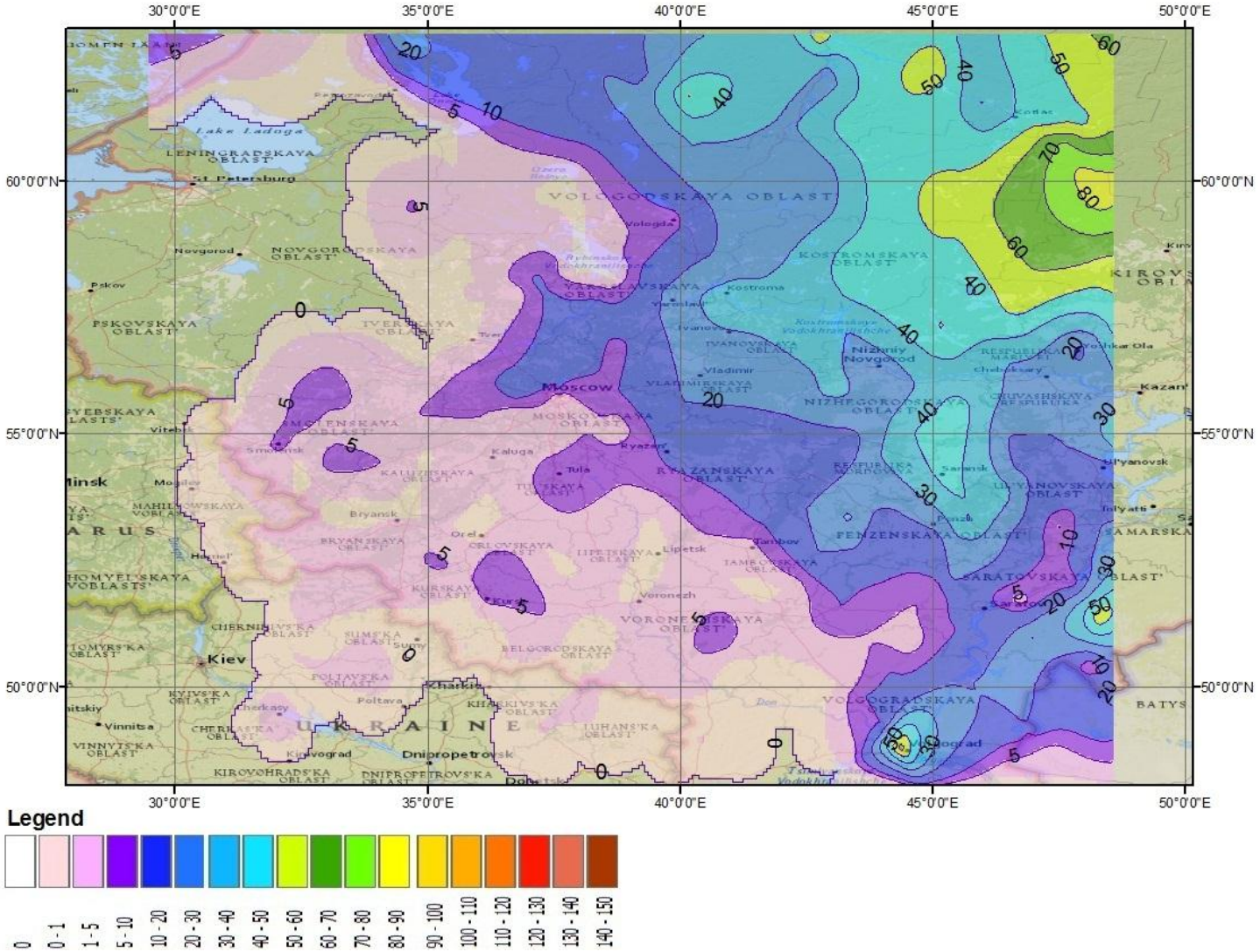
Verhov'e

station	ex	ctrl
0,8	-0,2	-1,2

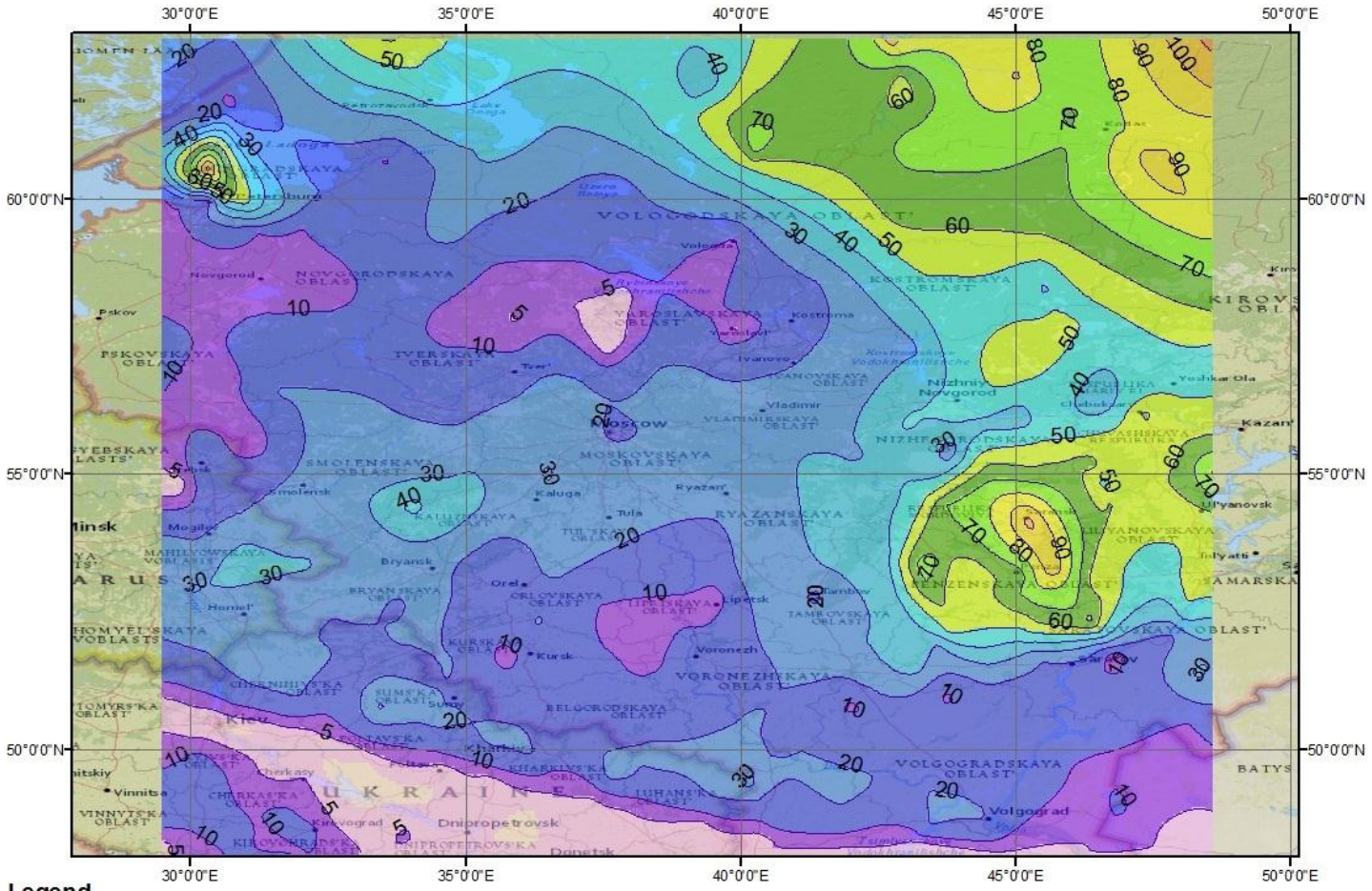
SWE field for winter period 2013-2014. 1 December 2013



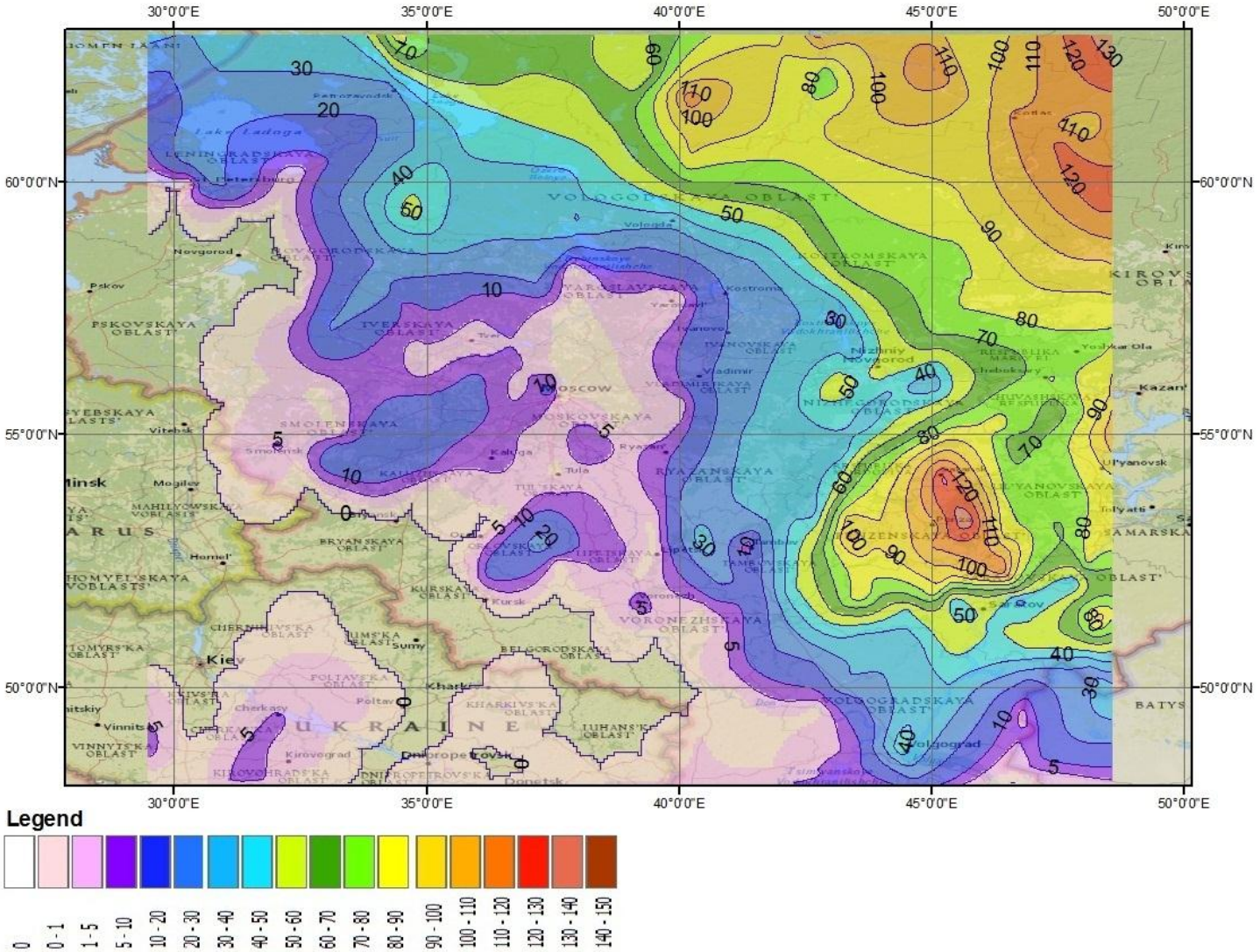
SWE field for winter period 2013-2014. 31 December 2013



SWE field for winter period 2013-2014. 20 January 2014



SWE field for winter period 2013-2014. 28 February 2014



Future plans

- Implementation of SWE calculation into COSMO-Ru operational system in order to:

- make correction of initial fields of SWE and snow density (T2m improvement on snow boundary)
- Improve the T2m forecast skill
- provide COSMO- production for the hydrologic calculations

2.2. TERRA tuning for snow conditions


CONSORTIUM FOR SMALL SCALE MODELING
COSMO

Motivation

• When snowfalls occur it’s necessary for different services to have information about the amount of fallen snow. Such an information could be especially useful for transportation, public utilities and for planning evens such as Olympic Games.

• For the present moment operational system with fresh snow postprocessing didn’t exist.

Algorithm of fresh snow depth calculation

Fresh snow depth calculation is based on the dependency on air temperature and precipitation sums. The basic equations are the following:

$$\rho_{s,f} = 67{,}92 + 51{,}25e^{\frac{T_a}{2.59}},\ T_a \le 0^0 C;\ \rho_{s,f} = \min(200{,}119{,}2 + 20T_a), T_a > 0^0 C$$

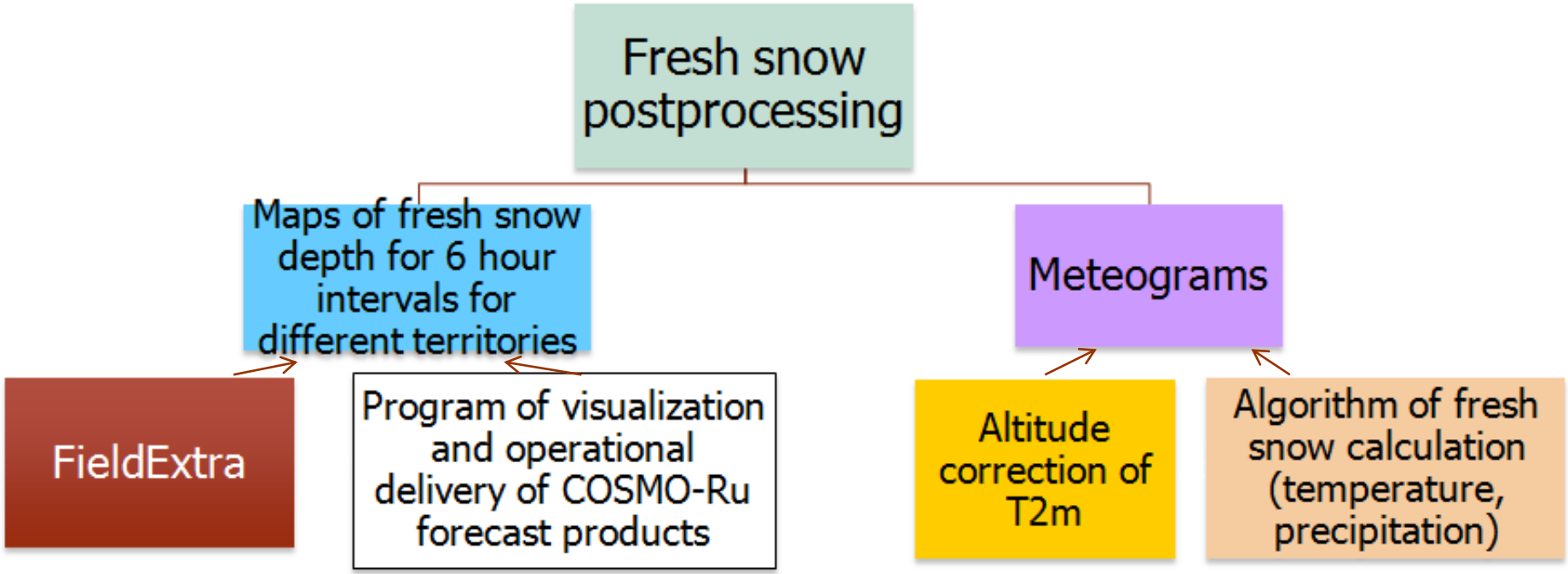
$$h_{s,f} = \frac{p_s \cdot \rho_w}{\rho_{s,f}}$$

$\rho_{s,f}$ - fresh snow density (kg/m^3), T_a - air temperature ($\circ$C), p_s - sum of precipitation (mm)

ρ_w =1000kg/m^3 – density of water

In November 2013 the algorithm was implemented in FieldExtra (release 11.2.0) by Jean-Marie Bettems (for details see http://www.cosmo-model.org/content/support/software/default.htm#fieldextra)

Scheme of fresh snow postprocessing at Roshydromet



Fresh snow postprocessing is done for COSMO-Ru output with the resolution of 7, 2.2 and 1.1 km four times a day for each prognostic hour

Results of implemented technology

- During Sochi Olympic Games 7-21 February 2014 there were 2 events with snowfalls

- Comparison between different versions of COSMO-model (7 km, 2.2 km and 1 km) was done

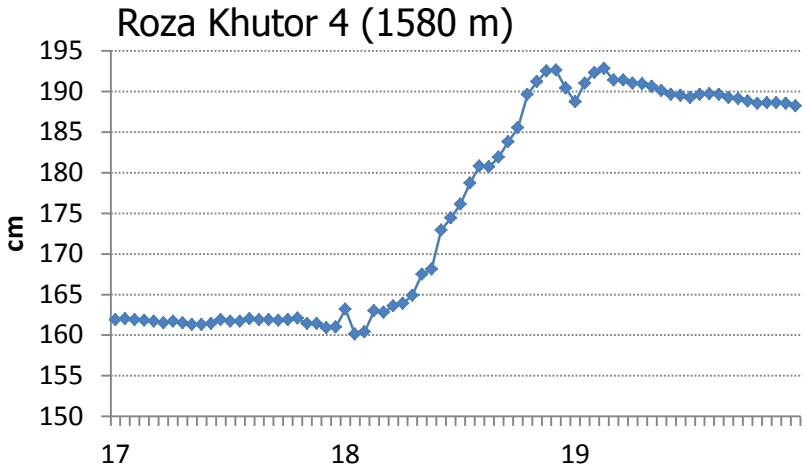
Snow depth measurements

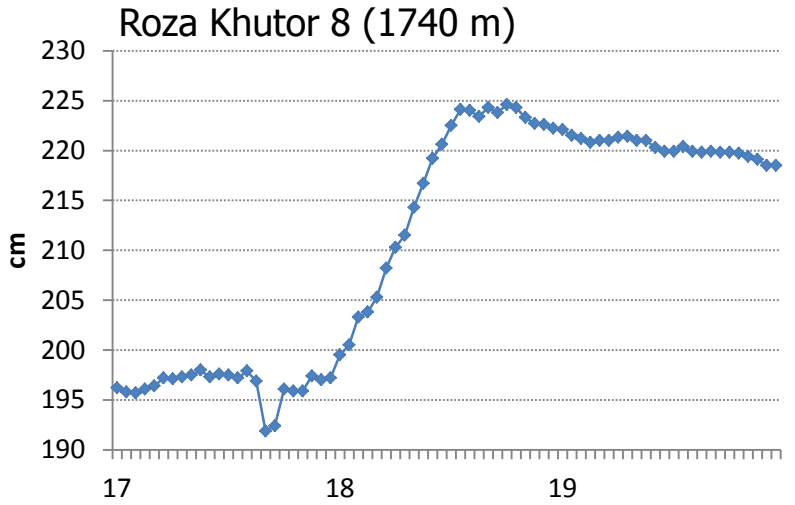
- There are 4 automatic meteorological stations (AMS) situated in Roza Khutor Alpine resort, which send snow depth data regularly (each 10 minutes)

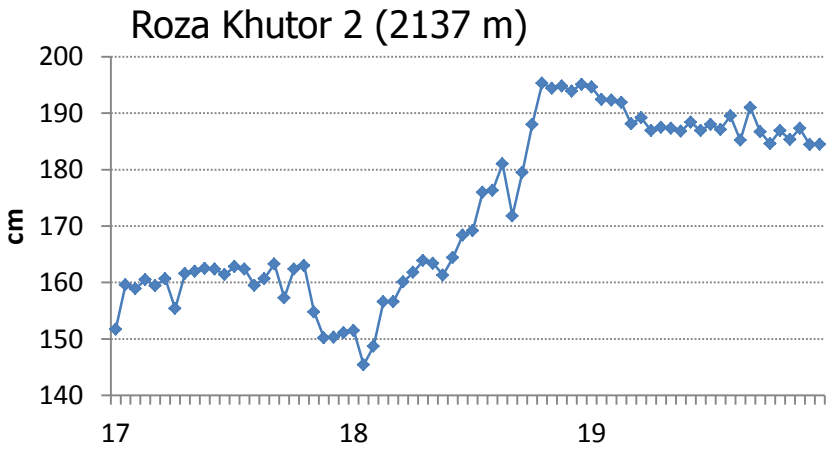
- Also there are 3 meteorological stations sending information about snow once a day

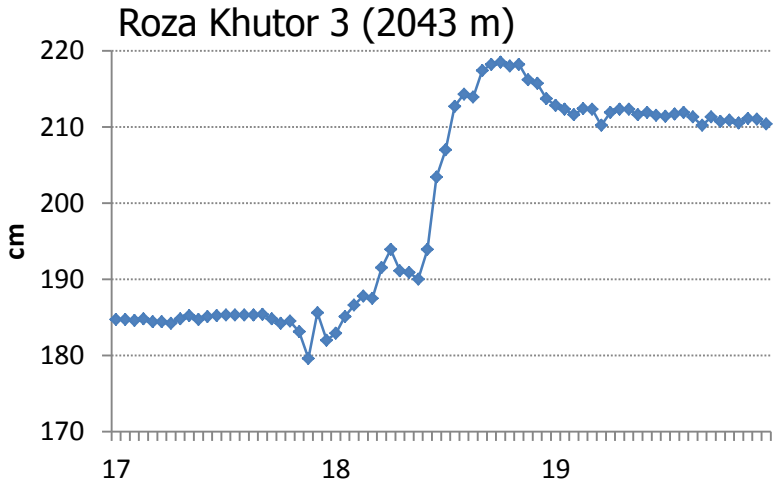
Case study 1: snowfall 17-19 February 2014

Hourly snow depth measurements on stations









Case study 1: snowfall 17-19 February 2014

- From the AMS data one can see, that during the maximum intensity of snowfall was 18 February. Snow increments on stations were about 25-30 cm.

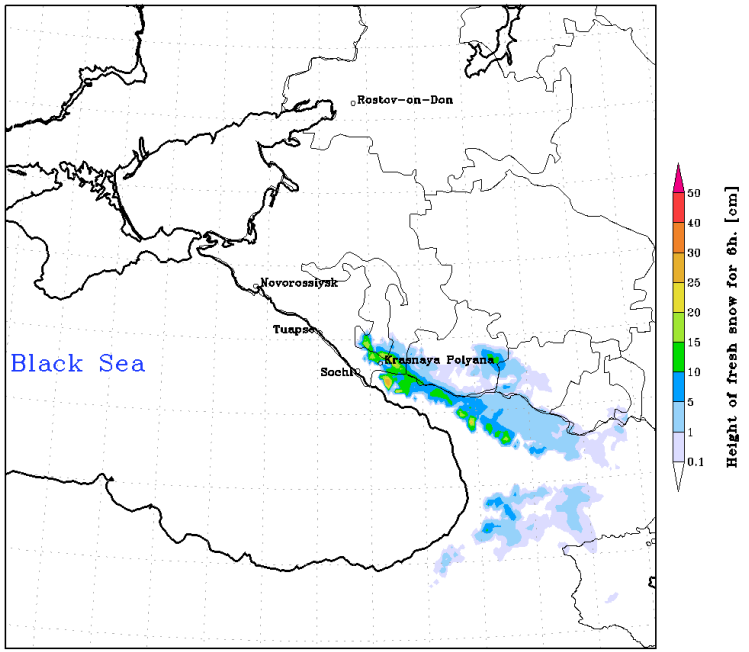
- Meteorological stations also fixed snow growth, but not in details. On station Kordon Laura snow decreasing was connected with positive air temperatures and mixed precipitation in 17-19 February.

Snow depth, cm

February 2014	Aibga	Kordon Laura	Gornaya Karusel 1500 m
17	101	10	36
18	105	7	39
19	120	5	51

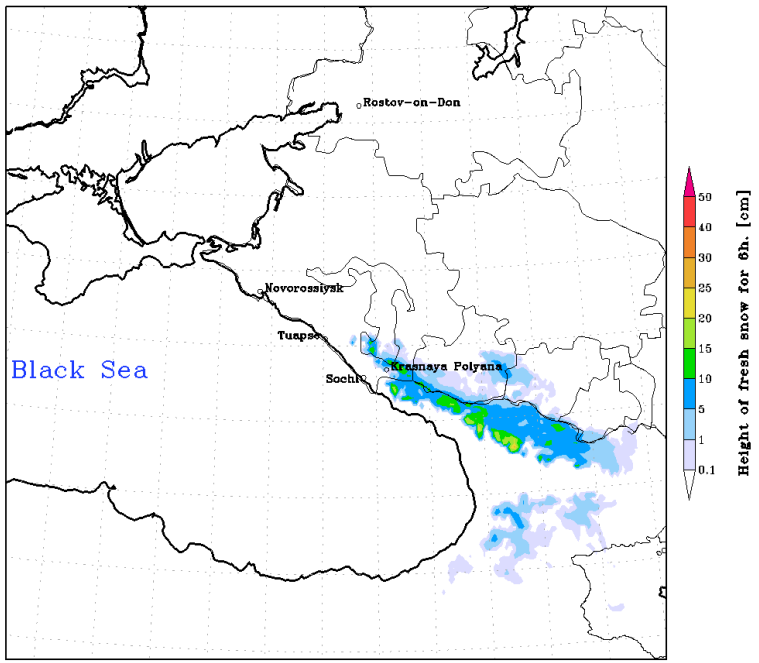
Map of fresh snow depth (cm). COSMO-Ru 2.2 36-hour forecast (left) and 42-hour (right) from 00 UTC 17 February 2014

16:00 18FEB 2014 (MSK): Height of fresh snow for 6h.



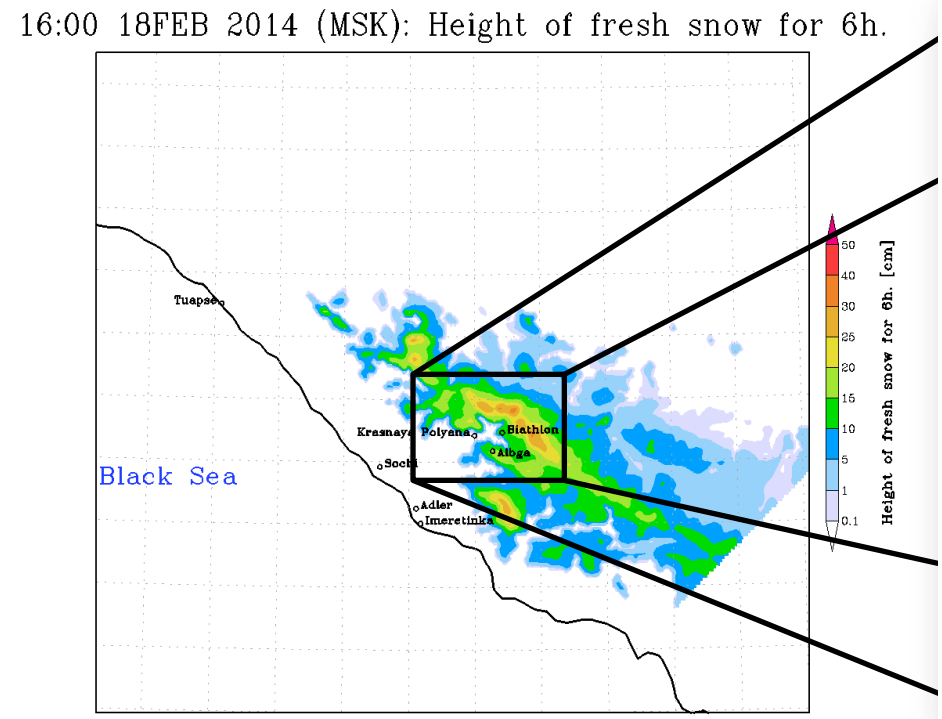
Forecast on 36 hours from 04h 17FEB 2014 (Msk)
Postprocessing of COSMO-RU 2.2km

22:00 18FEB 2014 (MSK): Height of fresh snow for 6h.

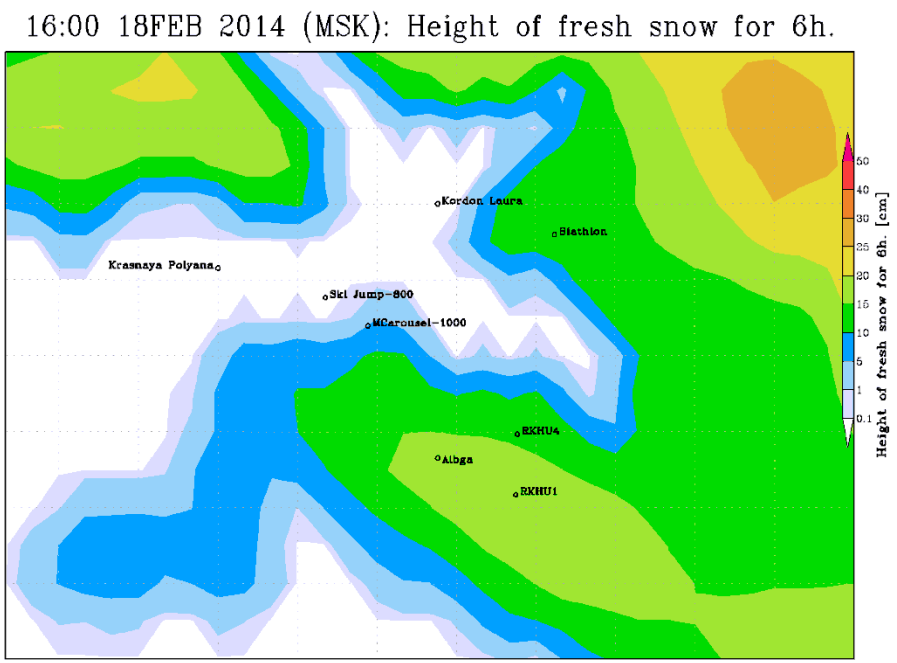


Forecast on 42 hours from 04h 17FEB 2014 (Msk)
Postprocessing of COSMO-RU 2.2km

Map of fresh snow depth (cm). COSMO-Ru 1.1 36-hour forecast from 00 UTC 17 February 2014. Territory detalization



Forecast on 36 hours from 04h 17FEB 2014 (Msk)
Postprocessing of COSMO-RU 1.1km



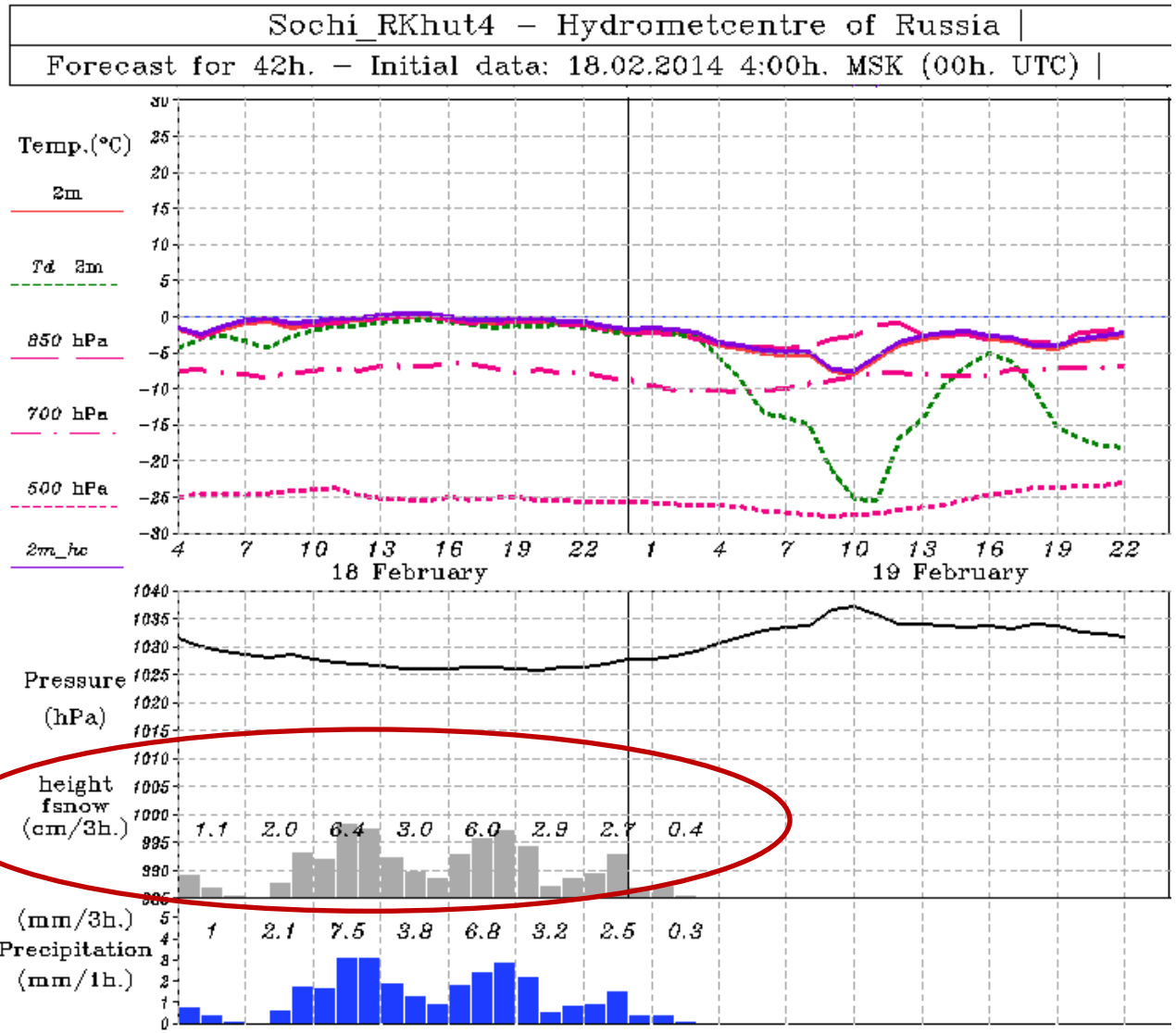
Forecast on 36 hours from 04h 17FEB 2014 (Msk)
Postprocessing of COSMO-RU 1.1km

Case study 1: snowfall 17-19 February 2014

Fresh snow depth results (example for Roza Khutor 4)

- According to formula mentioned above, fresh snow depth strongly depends on precipitation sums and air temperature
- Maps of fresh snow are prepared under the model standard output
- For each station (meteograms) fresh snow depth is calculated according to output improvements done for altitude correction of T2m and some redistribution within model precipitation types (rain/snow, especially for temperatures close to zero)
- As we could research only some episodes of fallen snow, well-known statistical processing of results (MAE, RMSE…) couldn't be representative. So comparison was done for the accuracy of fresh snow and precipitation amount forecasts.

Some sections of meteogram (example for AMS Roza Khutor 4)



Case study 1: snowfall 17-19 February 2014

Fresh snow depth results (example for Roza Khutor 4)

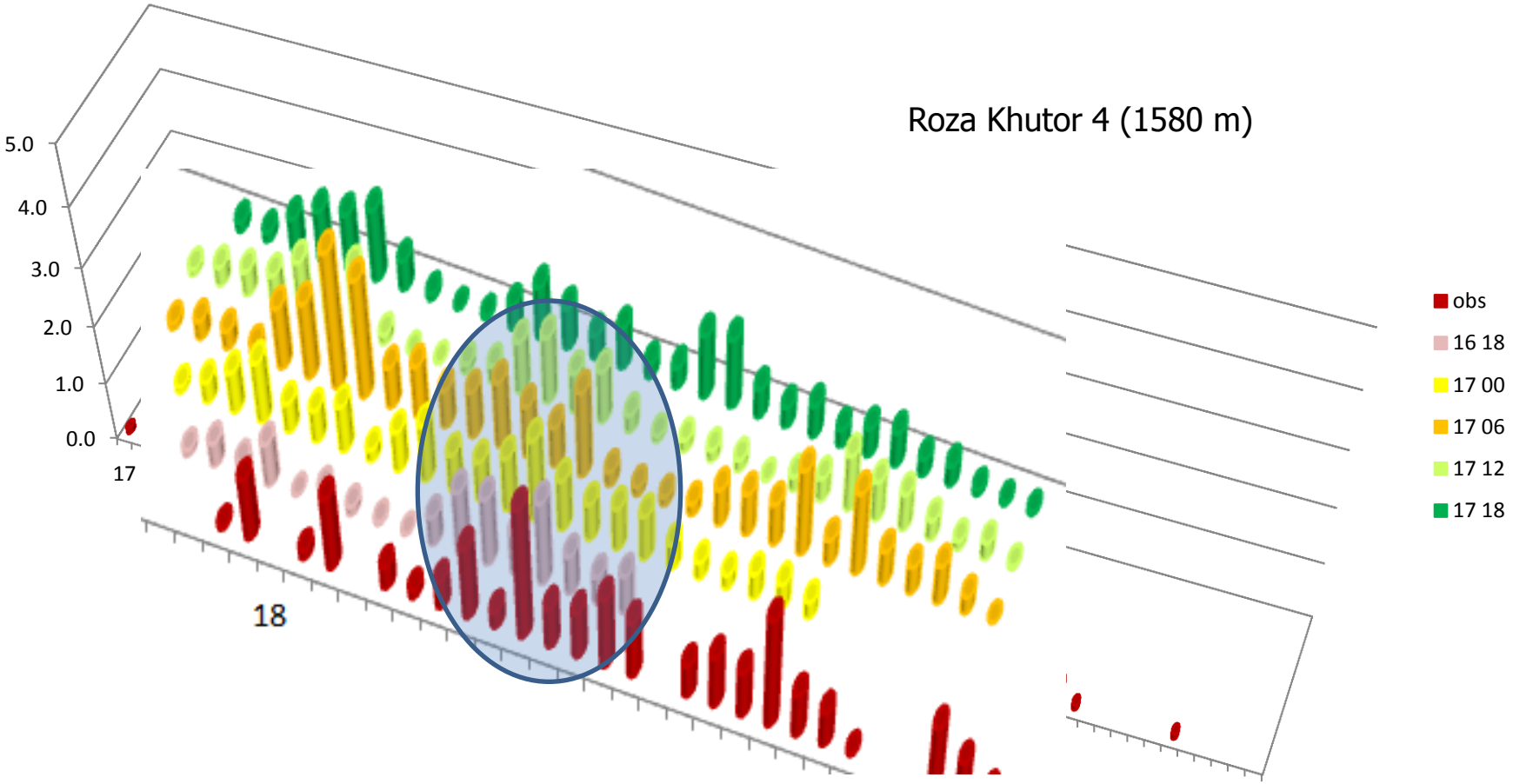
- Maximum intensity of snowfall was observed during February 18. The best precipitation sums (forecast till 48 hours) were predicted from start 18 UTC February 16, 00 UTC February 17 and 06 UTC February 17 (error is up to 25%), so the most accurate fresh snow depth forecasts were done while using these forecasts (also with an error up to 25%, both for resolution 2.2 and 1 km). Further in time – the worse precipitation sums (and hence, fresh snow depth) forecasts. It's more significant for 1 km resolution COSMO version (errors could be up to 4 times for forecast with start 12 and 18 UTC February 18).

16 February 18 UTC	-11%
17 February 00 UTC	2%
17 February 06 UTC	23%
17 February 12 UTC	-49%
17 February 18 UTC	-41%
18 February 00 UTC	-54%
18 February 06 UTC	-98%
18 February 12 UTC	-54%
18 February 18 UTC	-174%

Errors in fresh snow depth forecasts (6-hour sums) based on COSMO-model 2.2 km (for 48 hours):
+ : overestimation
- : underestimation

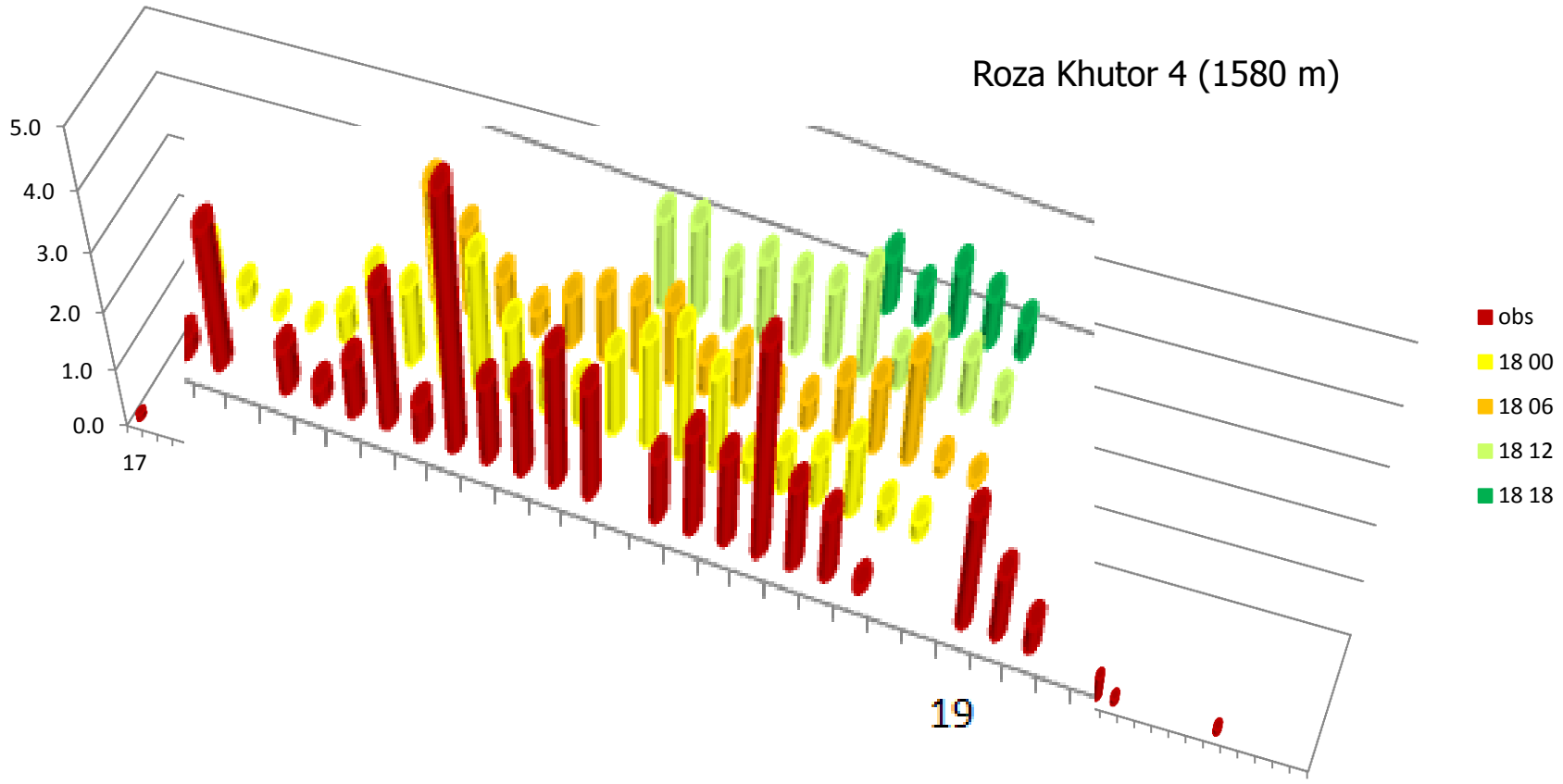
underestimation

Hourly fresh snow depth (cm). Different colours – COSMO-Ru 2.2 different forecasts (42-hour duration)



Obs – observations
Numbers – date and hour of forecast start

Hourly fresh snow depth (cm). Different colours – COSMO-Ru 2.2 different forecasts (42-hour duration)



Obs – observations
Numbers – date and hour of forecast start

Case study 1: snowfall 17-19 February 2014

12-hour precipitation sums at meteorological stations and COSMO-Ru 2.2 forecasts

The most accurate

date	station	forecast (start date)								
	Aibga									
	obs, mm	16 18	17 00	17 06	17 12	17 18	18 00	18 06	18 12	18 18
17 03	0									
17 15	0	0	0							
18 03	2	4	10	19	8					
18 15	5		21	18	11	15	20			
19 03	4				7	6	6	7	9	
19 15	0						0	0	0	0
	Gornaya Karusel									
	obs, mm	16 18	17 00	17 06	17 12	17 18	18 00	18 06	18 12	18 18
17 03	7									
17 15	4	0	0							
18 03	3	3	9	17	7					
18 15	16		18	15	8	11	16			
19 03	7		good		6	4	5	7	7	
19 15	0,9						0	0	0	0
	Kordon Laura									
	obs, mm	16 18	17 00	17 06	17 12	17 18	18 00	18 06	18 12	18 18
17 03	0									
17 15	0	1	0							
18 03	2	4	14	24	10					
18 15	14		33	26	16	15	21			
19 03	17				9	14	12	11	19	
19 15	0						0	0	0	0

Often the COSMO-model overestimate precipitation sums

Case study 1: snowfall 17-19 February 2014

Fresh snow depth results (example for Roza Khutor 4)

- The studied region is the complex mountain region. Recommendations can't be exact because of process difficulty and the variety of different estimations. Besides, only some cases were studied – that's not enough for making generalization.

- When working with amount of fresh snow for the whole integration period (42-48 hours), one can see that intensity of precipitation is well observed: the earlier start of forecast calculation – the better. Peaks are also reproduced not badly.

- Forecast calculated at later start hours produce less amount of fresh snow and short precipitation period (on station snow is still observed).

- If we compare the common intervals for different fresh snow forecasts (6-hour sums) COSMO-Ru 2.2 km, we'll get:

obs	16 18	17 00	17 06	17 12	17 18
20	18	25,6	31	18,2	18,6

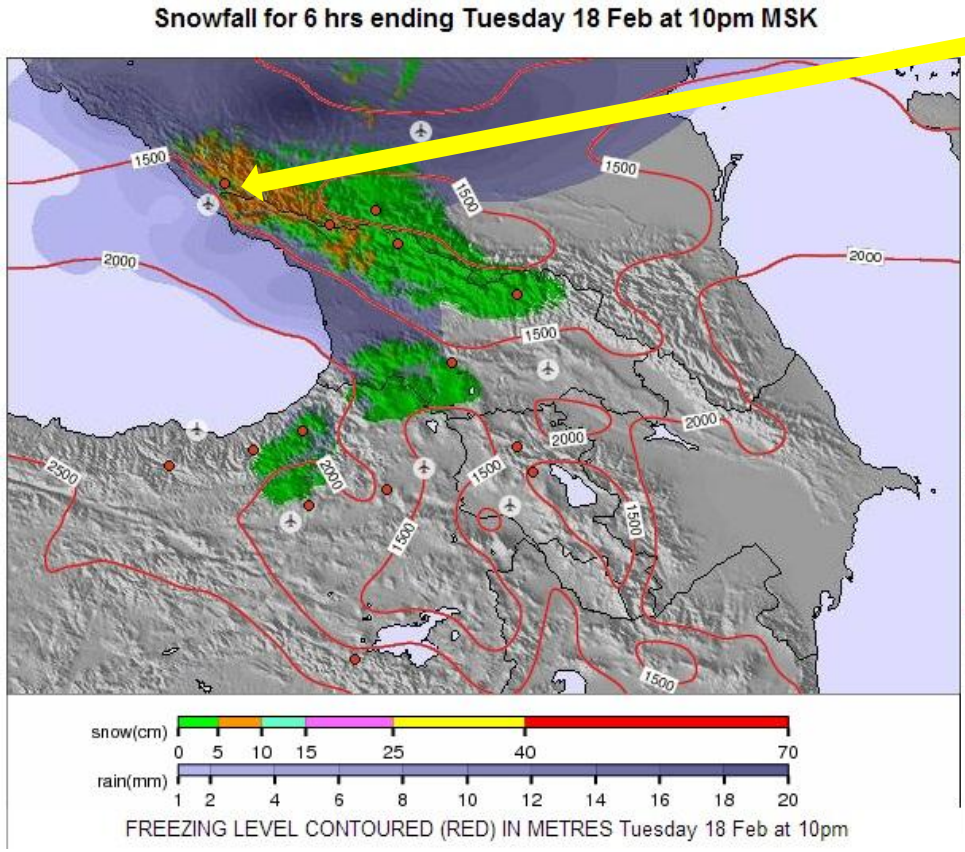
obs	18 00	18 06	18 12
16,6	11,8	10	13,8

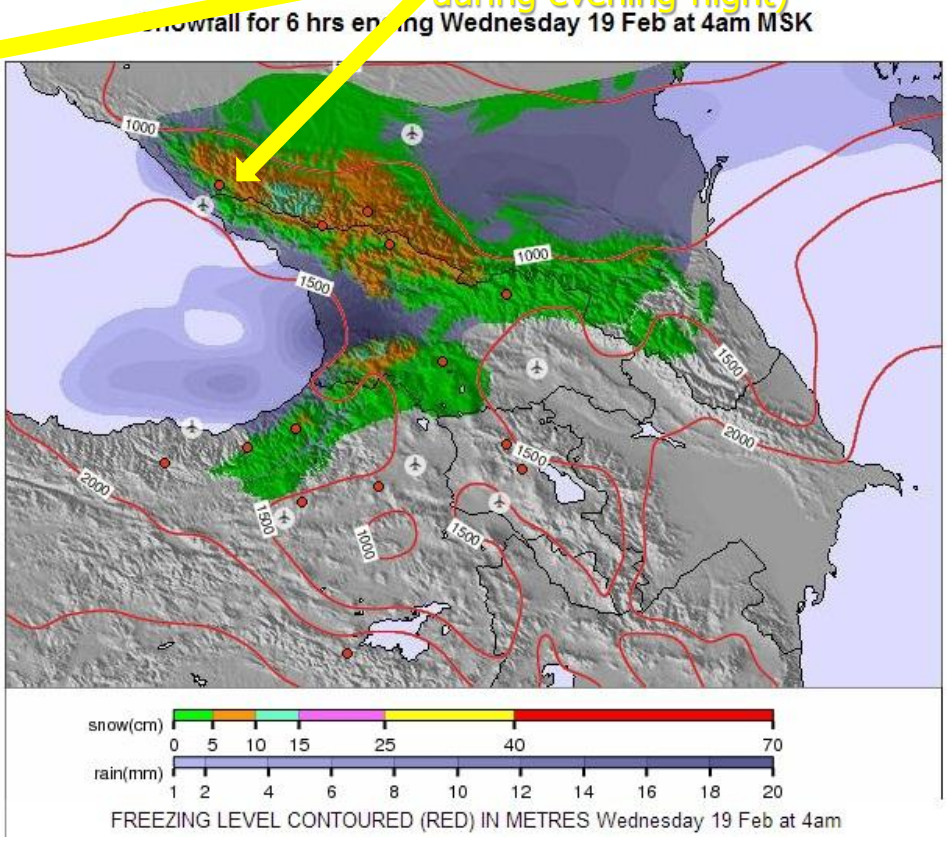
The whole results are ambiguous. Yet the fact of precipitation occasion is reproduced by the COSMO-model in mountain region

Fresh snow depth forecasts could also be available on the site

www.snow-forecast.com

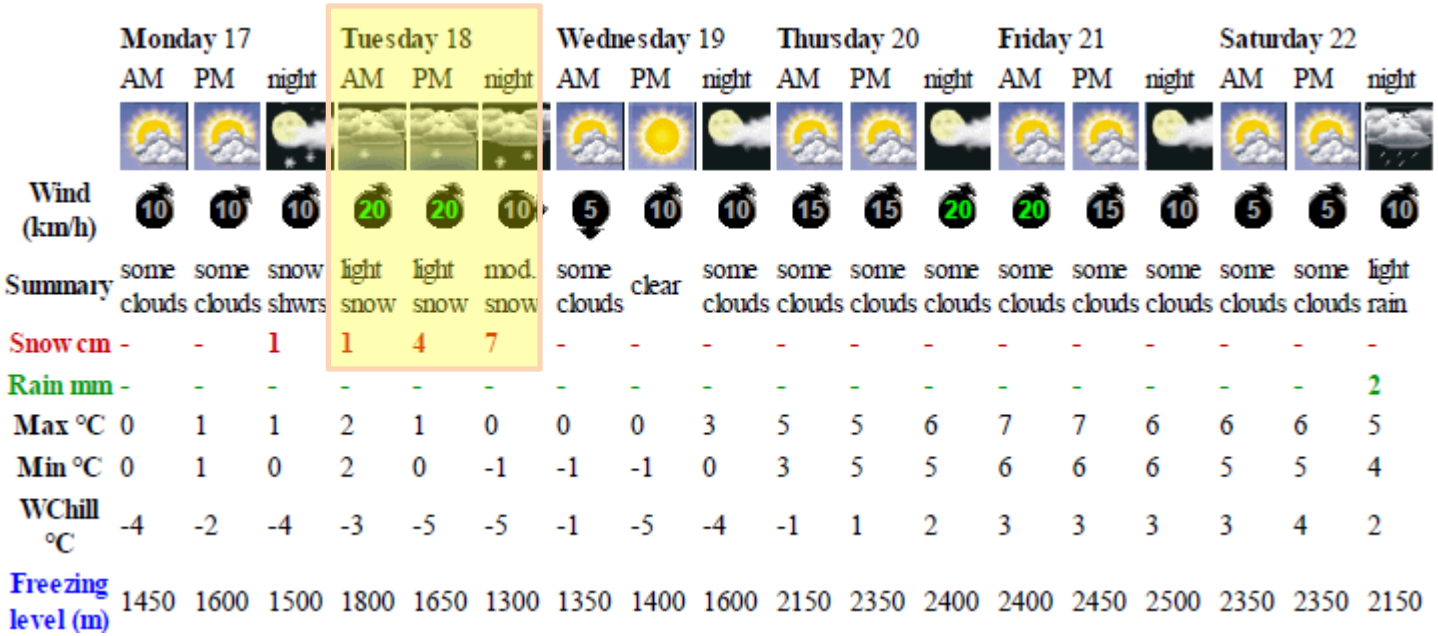
Maximum was observed in the middle of the day (not during evening-night)





Maps are generated only for four main hours: 00, 06, 12, 18 UTC (COSMO-Ru – for each prognostic hour from 6 hours during 00, 06, 12 and 18 UTC calculations of versions 7, 2.2 and 1.1 km)

Forecast for Roza Khutor Alpine resort (1448 m) from www.snow-forecast.com



	Monday 17			Tuesday 18			Wednesday 19			Thursday 20			Friday 21			Saturday 22		
	AM	PM	night	AM	PM	night	AM	PM	night	AM	PM	night	AM	PM	night	AM	PM	night
Wind (km/h)	10	10	10	20	20	10	5	10	10	15	15	20	20	15	10	5	5	10
Summary	some clouds	some clouds	snow shwrs	light snow	light snow	mod. snow	some clouds	clear	some clouds	some clouds	some clouds	some clouds	some clouds	some clouds	some clouds	some clouds	some clouds	light rain
Snow cm	-	-	1	1	4	7	-	-	-	-	-	-	-	-	-	-	-	-
Rain mm	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2
Max °C	0	1	1	2	1	0	0	0	3	5	5	6	7	7	6	6	6	5
Min °C	0	1	0	2	0	-1	-1	-1	0	3	5	5	6	6	6	5	5	4
WChill °C	-4	-2	-4	-3	-5	-5	-1	-5	-4	-1	1	2	3	3	3	3	4	2
Freezing level (m)	1450	1600	1500	1800	1650	1300	1350	1400	1600	2150	2350	2400	2400	2450	2500	2350	2350	2150

Amount of fresh snow (cm) during 18 February 2014

obs	16 18	17 00	17 06	17 12	17 18	18 00
28,2	30	30	39,5	22,1	25,4	21,3

COSMO-Ru 2.2 forecasts with start 18 UTC 16 February and 00 UTC 18 February doesn't include one 6-hour interval

Information for 4 mountain stations in Sochi region is available (output COSMO-Ru 2.2 km – 53 stations, 1.1 km – 24 stations).

- If we compare results for February 18 between COSMO-Ru 2.2 and COSMO-Ru 1.1 forecasts, then numbers will be close

Amount of fresh snow (cm) during 18 February 2014

obs	16 18	17 00	17 06	17 12	17 18	18 00
28,2	30	30	39,5	22,1	25,4	21,3

COSMO-Ru 2.2 forecasts with start 18 UTC February 16 and 00 UTC February 18 doesn't include one 6-hour interval

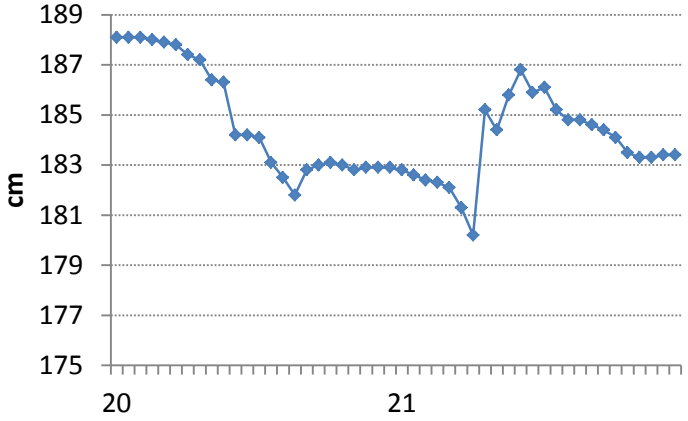
obs	17 00	17 06	17 12	17 18	18 00
28,2	17	24,9	40,8	19,9	16,8

COSMO-Ru 1.1 forecasts with start 00 UTC February 17 and 00 UTC February 18 doesn't include one 6-hour interval

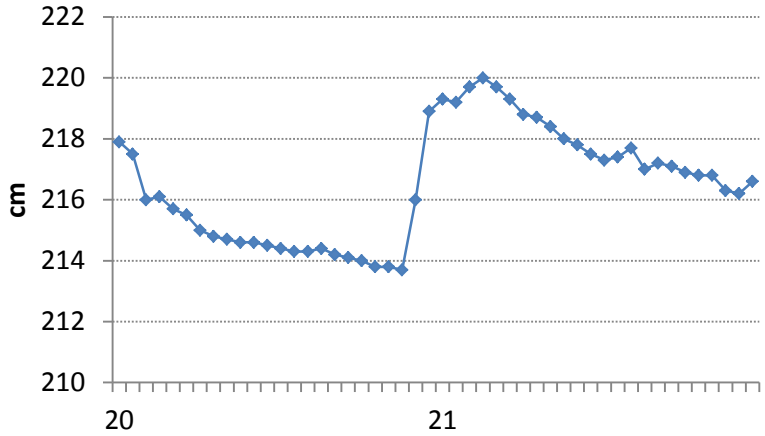
Case study 2: snowfall 21 February 2014

Hourly snow depth measurements on stations

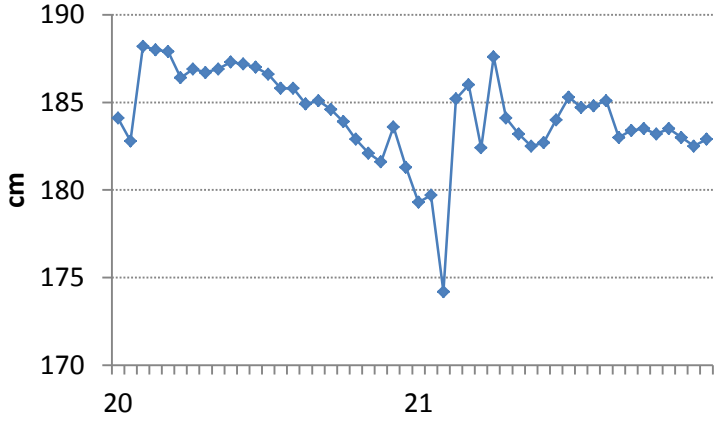
Roza Khutor 4 (1580 m)



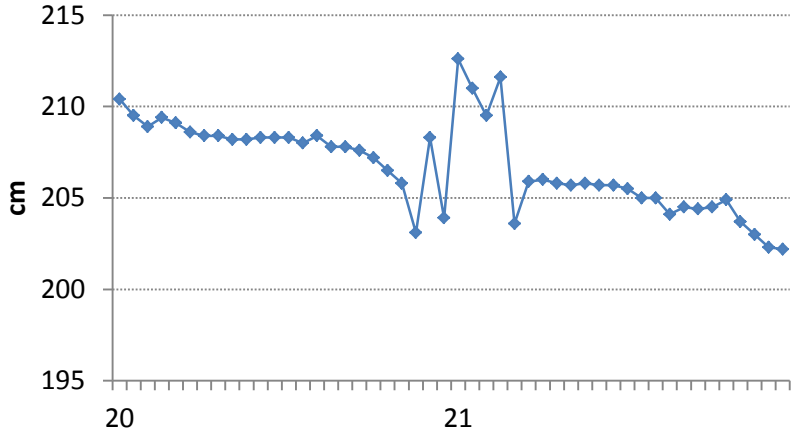
Roza Khutor 8 (1740 m)



Roza Khutor 2 (2137 m)



Roza Khutor 3 (2043 m)



Case study 2: snowfall 21 February 2014

- This snowfall was not so intensive than the previous one and lasted for several hours during February 21 2014, in the first half of the day.

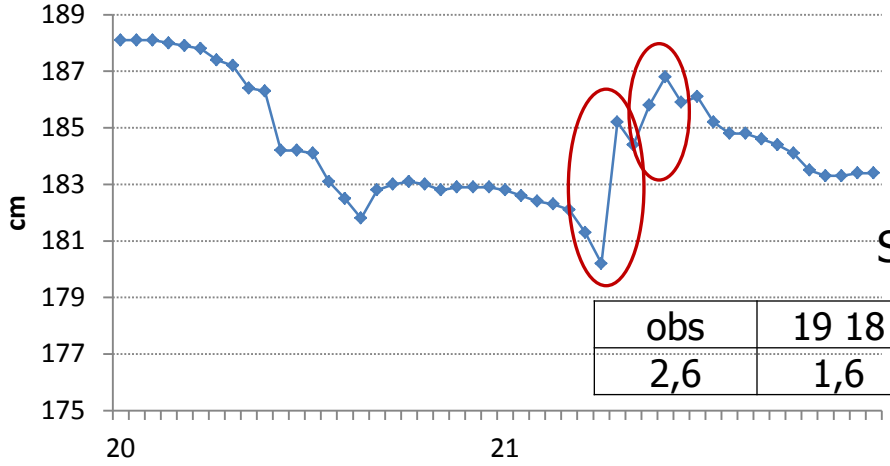
- Meteorological stations also fixed snow growth, but not in details. On station Kordon Laura snow cover melted 21 February.

Snow depth, cm

February 2014	Aibga	Kordon Laura	Gornaya Karusel 1500 m
21	119	-	65
22	124	-	68

Case study 2: snowfall 21 February 2014

- On station Roza Khutor 4 there were 2 peaks of falling snow. The first peak was reproduced only by forecast started at 12 UTC February 19 by COSMO-Ru 2.2 km.



First peak, fresh snow depth (cm), 6-hour sums

obs	19 06	19 12	19 18	20 00
5,0	0,0	3,1	0,0	0,0

Second peak, fresh snow depth (cm), 6-hour sums

obs	19 18	20 00	20 06	20 12	20 18	21 00	21 06
2,6	1,6	0,0	1,5	1,8	0,0	0,5	0,8

First peak, fresh snow depth (cm), 6-hour sums

obs	19 12	19 18	20 00	20 06	20 12	20 18	21 00	21 06
5,0	0,0	2,2	0,0	0,0	0,0	0,7	0,0	0,0

Second peak, fresh snow depth (cm), 6-hour sums

obs	20 00	20 06	20 12	20 18	21 00	21 06
2,6	2,1	0,0	0,0	1,2	0,0	0,0

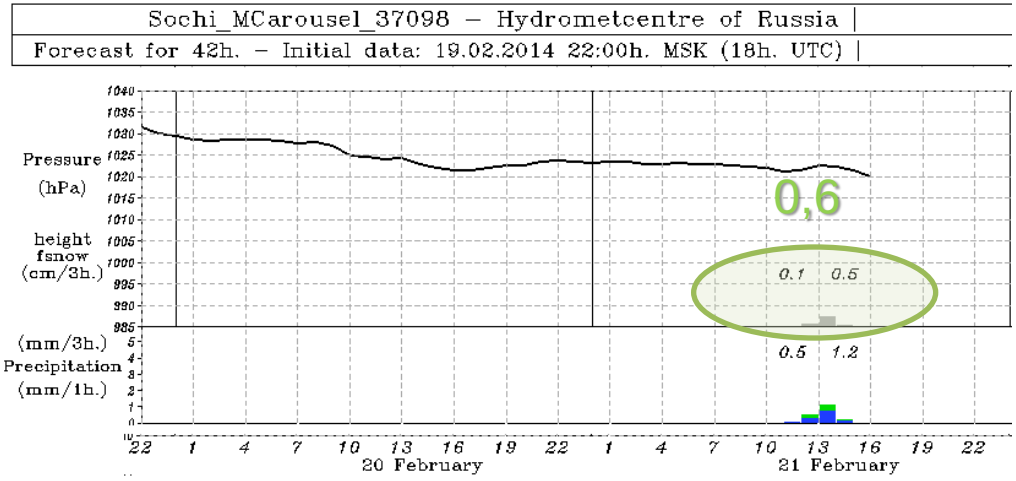
COSMO-Ru 1.1 km

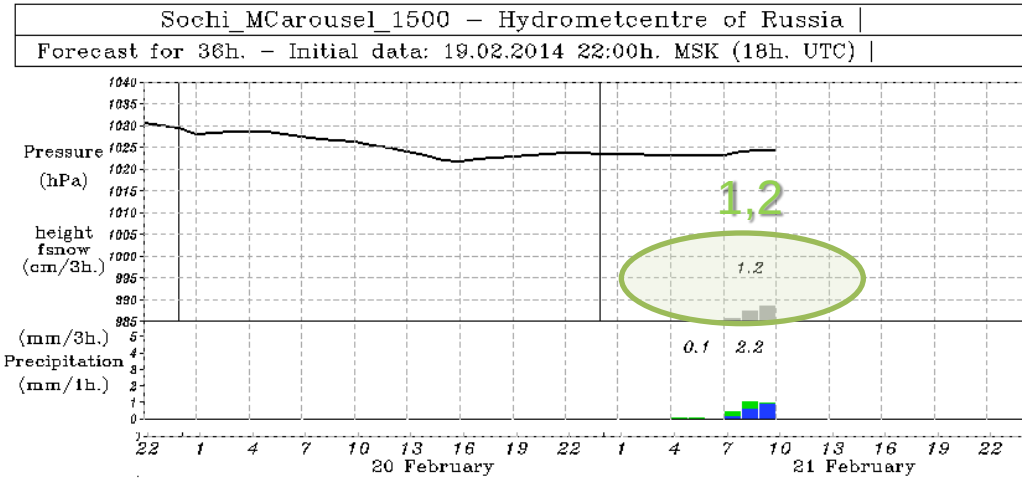
Forecasts for some dates didn't produce any precipitation

Case study 2: snowfall 21 February 2014

Gornaya Karusel

COSMO-Ru 2.2 (up) and 1.1 (bottom) forecast, start 19 February 18 UTC





Observation: 3 cm change from 21 to 22 February

	Thursday 20			Friday 21		
	AM	PM	night	AM	PM	night
Wind (km/h)	20	20	25	20	15	5
Summary	some clouds	some clouds	rain shwrs	light snow	snow shwrs	snow shwrs
Snow cm	-	-	-	2	-	-
Rain mm	-	-	1	-	-	-
Max °C	5	5	3	1	2	2
Min °C	3	3	2	1	1	1
WChill °C	-1	-2	-3	-4	-2	0
Freezing level (m)	2200	2350	2150	1750	1900	1800

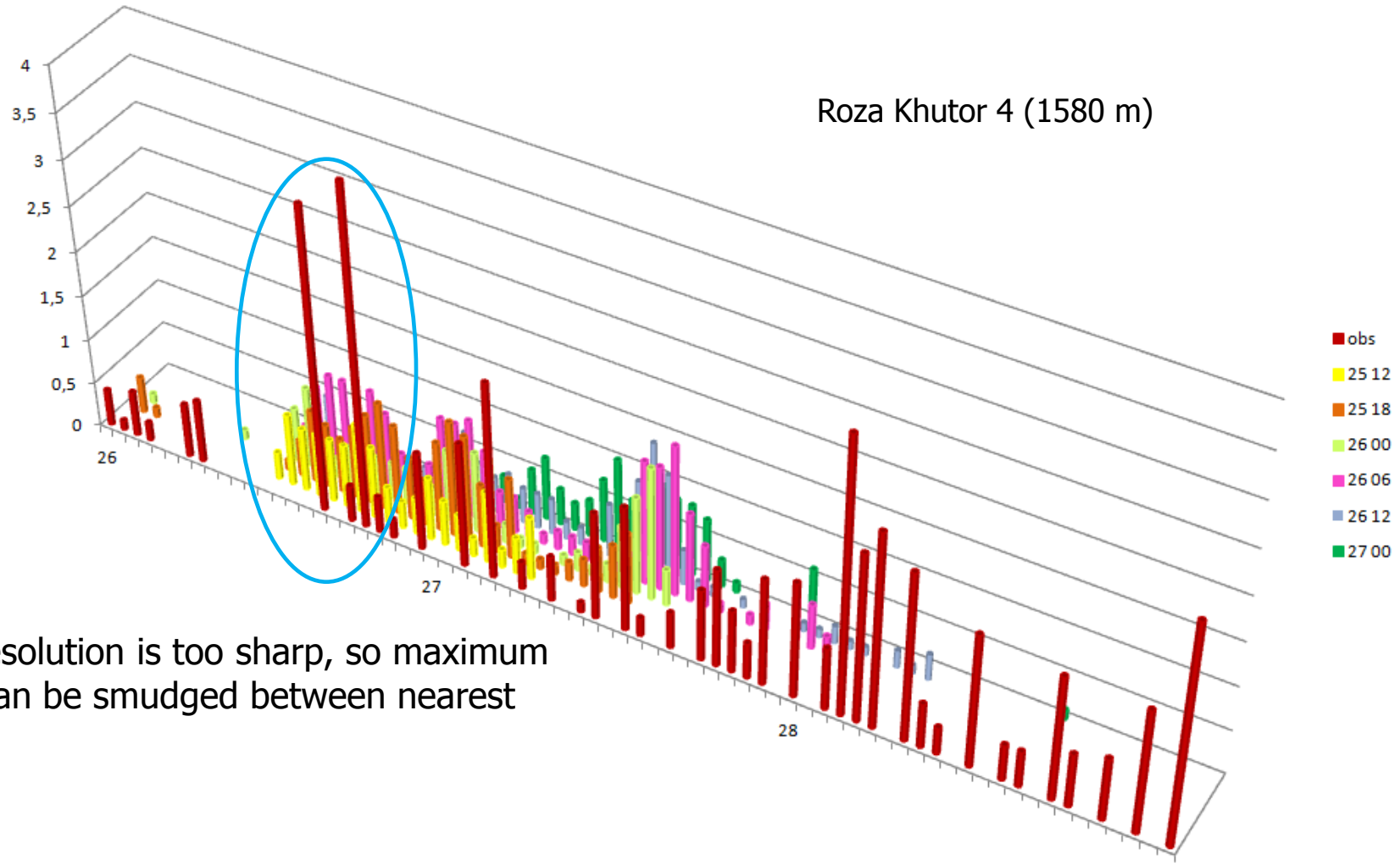
Forecast for Roza Khutor Alpine resort (1448 m) from www.snow-forecast.com

	Thursday 20			Friday 21			Saturday 22			Sunday 23			Monday 24			Tuesday 25		
	AM	PM	night	AM	PM	night	AM	PM	night	AM	PM	night	AM	PM	night	AM	PM	night
Wind (km/h)	20	20	20	20	10	5	5	0	10	5	5	5	5	5	5	5	0	5
Summary	some clouds	some clouds	rain shwrs	light snow	rain shwrs	snow shwrs	some clouds	some clouds	some clouds	some clouds	some clouds	some clouds	some clouds	clear	some clouds	some clouds	clear	clear
Snow cm	-	-	-	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Rain mm	-	-	1	-	2	-	-	-	-	-	-	-	-	-	-	-	-	-
Max °C	6	6	4	2	3	2	4	5	5	6	6	6	7	7	7	8	8	8
Min °C	4	4	3	1	2	2	3	4	5	5	5	5	6	6	7	7	7	7
WChill °C	0	0	-1	-4	0	2	3	4	4	4	4	3	5	5	6	6	7	7
Freezing level (m)	2200	2350	2150	1750	1900	1800	2150	2400	2350	2300	2350	2350	2350	2450	2500	2500	2550	2550

Again, underestimation of fresh snow depth in comparison with observations (7,6 cm). As well as according to COSMO-model forecasts for February 21.

Case study 3: snowfall 26-28 February 2014

Hourly fresh snow depth (cm). Different colours – COSMO-Ru 2.2 different forecasts (42-hour duration)



Hour resolution is too sharp, so maximum value can be smudged between nearest hours

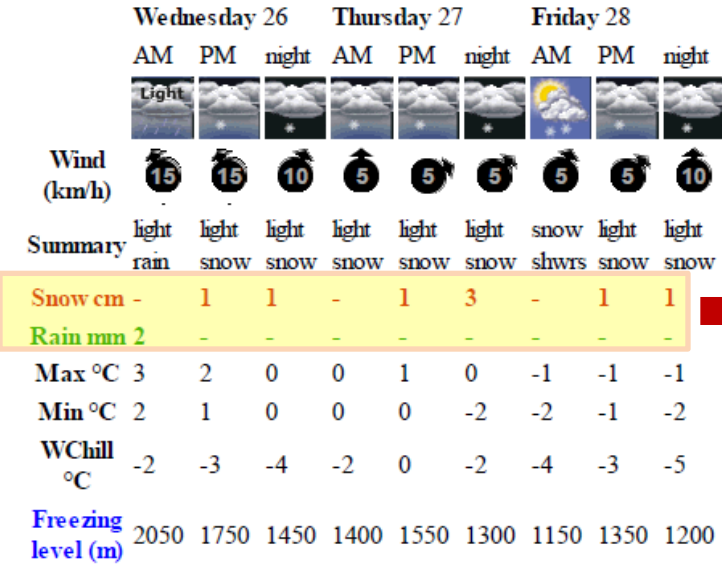
Case study 3: snowfall 26-28 February 2014

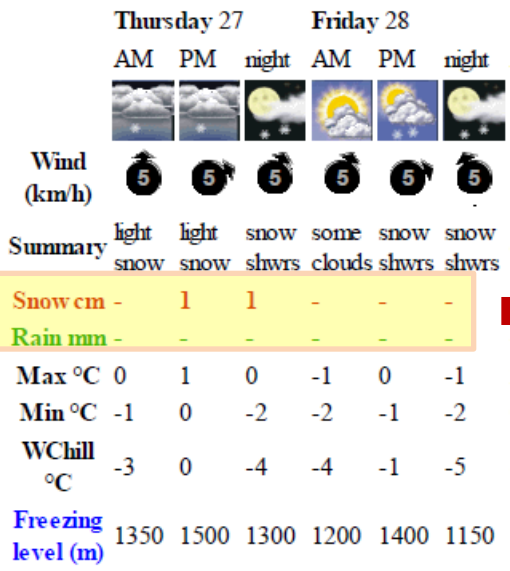
Roza Khutor 4 (AMS)

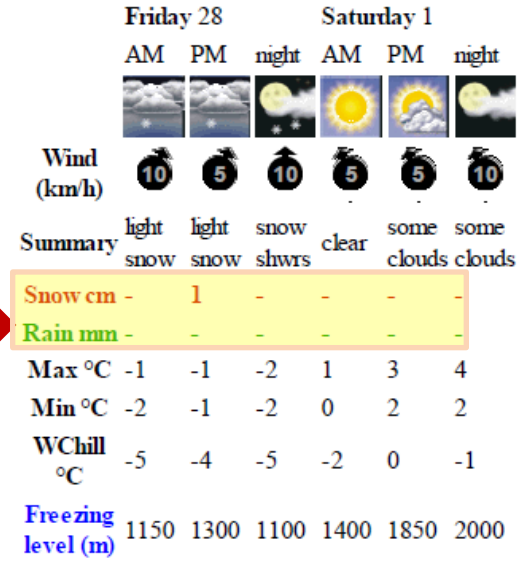
Fresh snow depth (cm), 6-hour sums: observations and COSMO-Ru 2.2 forecasts

February	obs	25 12	25 18	26 00	26 06	26 12	26 18	27 00	27 06	27 12	27 18
26	11,8	8,0	10,6	6,5	10,3						
27	13,2	2,7	5,8	6,5	10,9	8,7	12,7	9,8	9,4		
28	19,5							0,1	4,7	5,3	5,0

strong underestimation





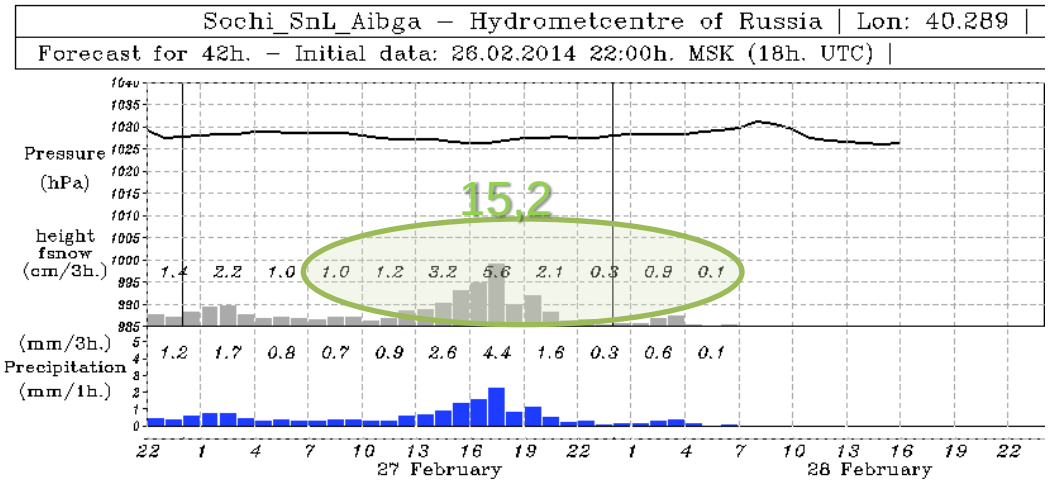


Available forecasts at February 26, 27 and 28 on www.snow-forecast.com

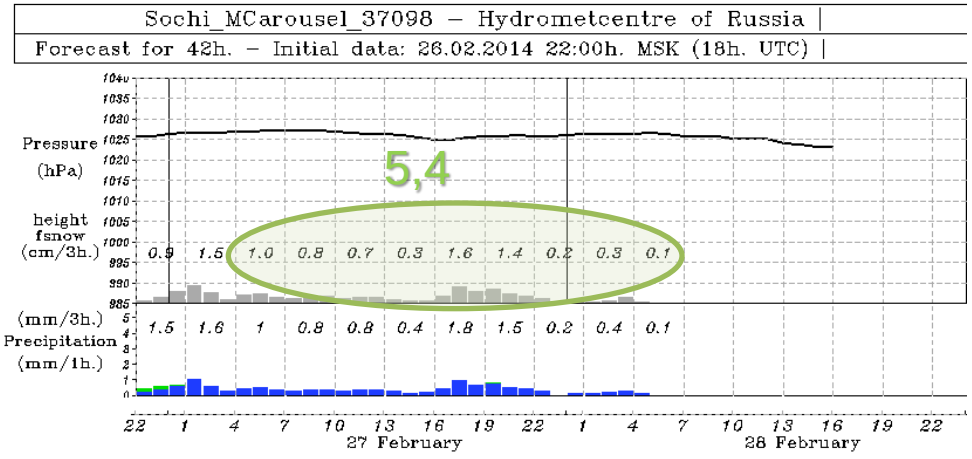
Case study 3: snowfall 26-28 February 2014

Aibga and Gornaya Karusel

COSMO-Ru 2.2 forecast, start 26 February 18 UTC



Observation: 6 cm change from 27 to 28 February



Observation: 4 cm change from 27 to 28 February

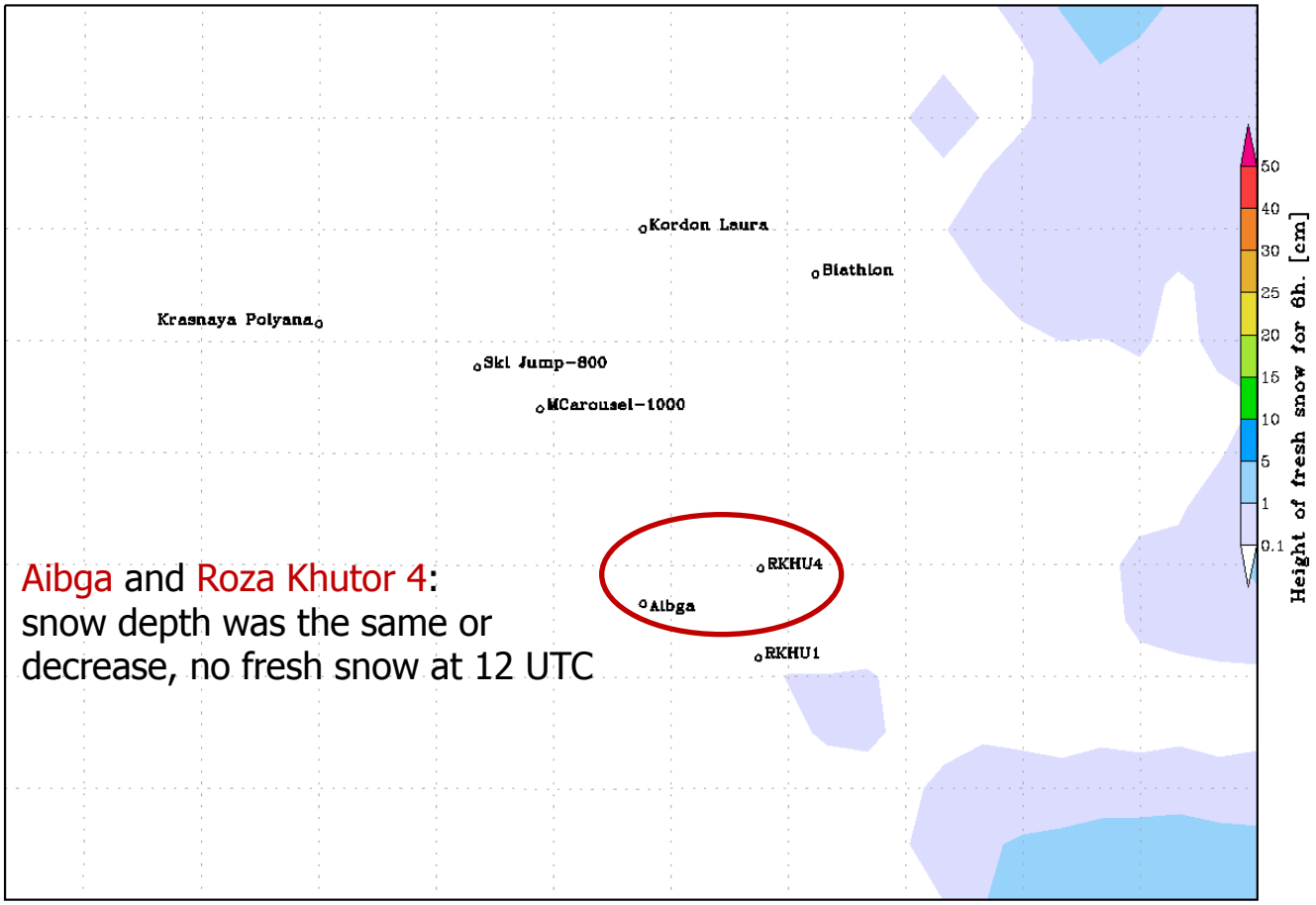
	Thursday 27			Friday 28		
	AM	PM	night	AM	PM	night
Wind (km/h)	5	5	5	5	5	5
Summary	snow shwrs	light snow	snow shwrs	some clouds	snow shwrs	snow shwrs
Snow cm	-	1	1	-	-	-
Rain mm	-	-	-	-	-	-
Max °C	-1	0	-1	-2	-1	-2
Min °C	-1	-1	-3	-3	-2	-3
WChill °C	-3	-1	-5	-6	-2	-6
Freezing level (m)	1350	1500	1300	1200	1400	1200

Series of COSMO-Ru fresh snow depth postprocessing system

7 km → 2.2. km → 1.1 km

16:00 05MAR 2014 (MSK): Height of fresh snow for 6h.

	Wednesday 5		
	AM	PM	night
Wind (km/h)	10	10	5
Summary	rain shwrs	rain shwrs	some clouds
Snow cm	-	-	-
Rain mm	3	2	-
Max °C	6	6	7
Min °C	4	5	5
WChill °C	1	5	4
Rel. hum. %	83	70	47
Freezing level (m)	2100	2250	2350

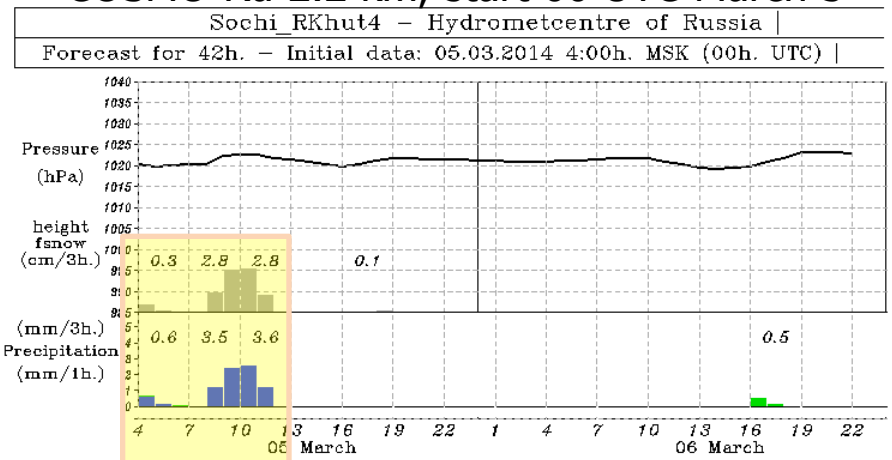


Aibga and Roza Khutor 4:
snow depth was the same or decrease, no fresh snow at 12 UTC

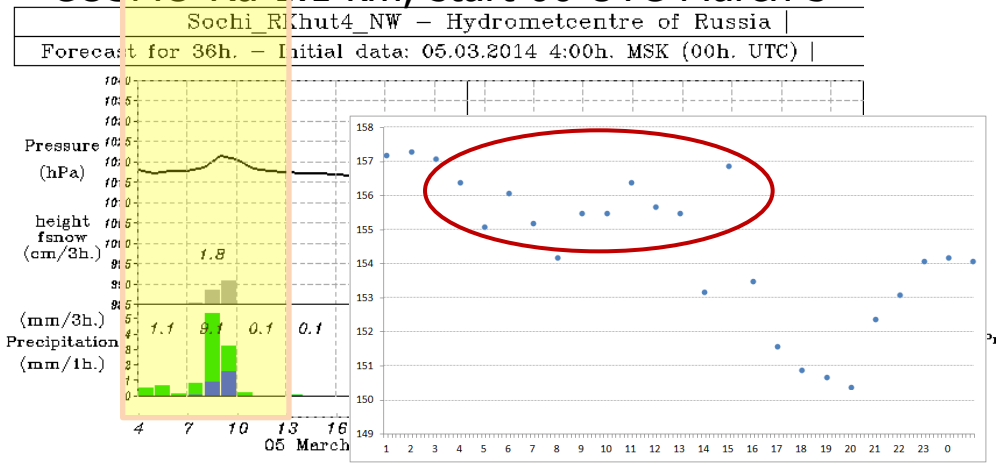
Forecast on 12 hours from 04h 05MAR 2014 (Msk)
Postprocessing of COSMO-RU 1.1km

Roza Khutor 4 (AMS)

COSMO-Ru 2.2 km, start 00 UTC March 5



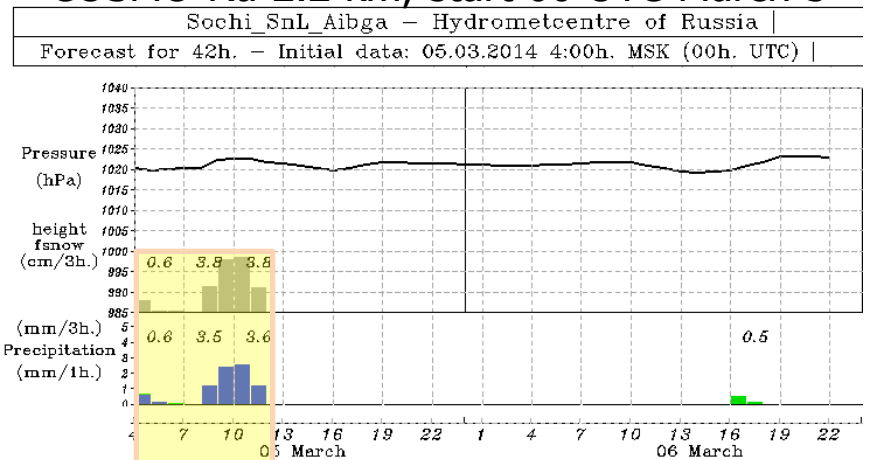
COSMO-Ru 1.1 km, start 00 UTC March 5



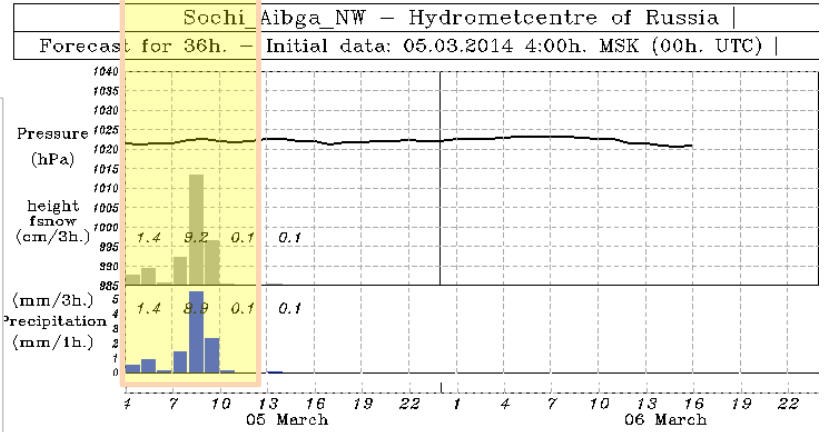
During March 5 fresh snow depth was 10,8 cm, precipitation was mostly in the first part of the day

Aibga

COSMO-Ru 2.2 km, start 00 UTC March 5



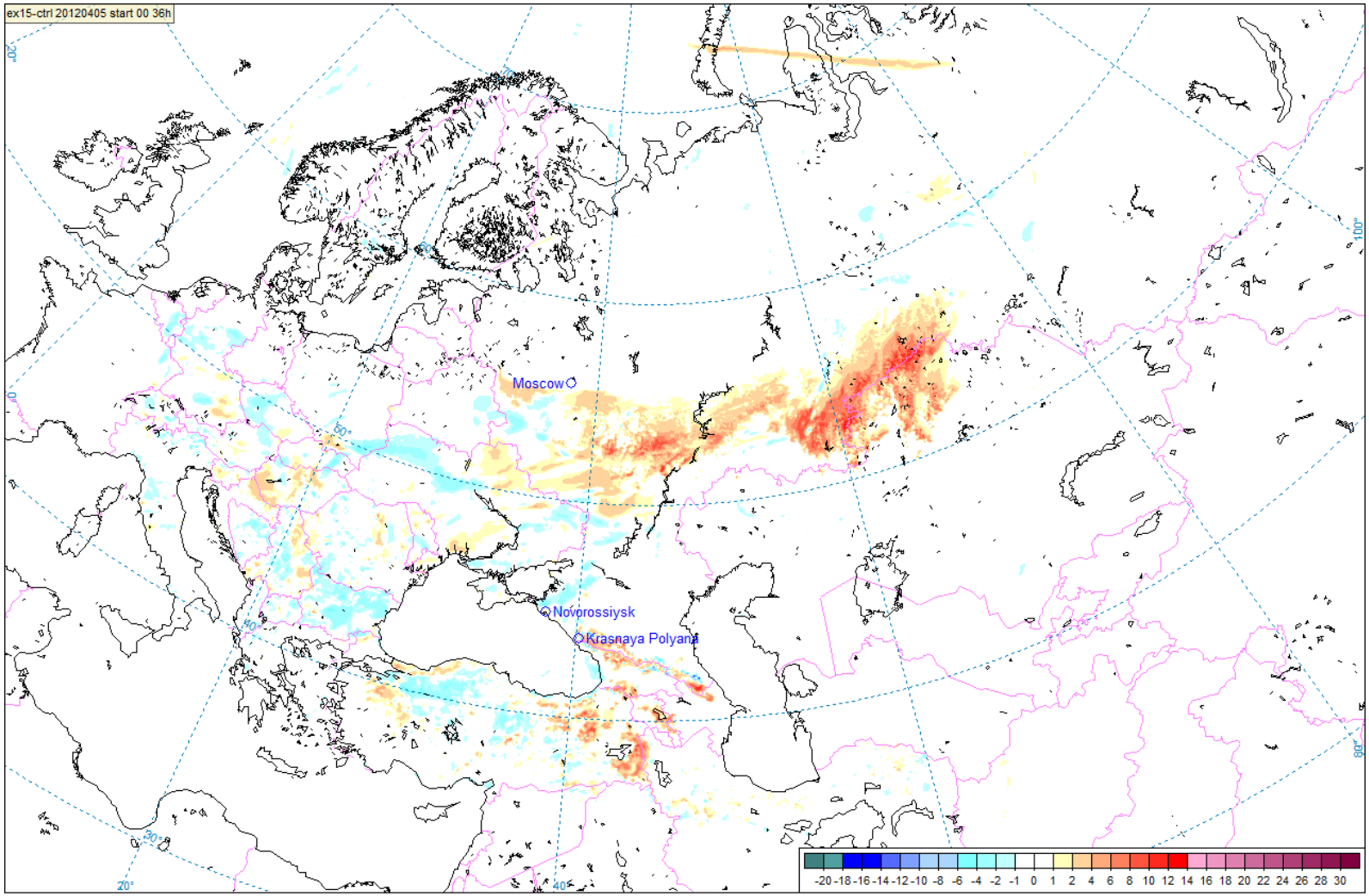
COSMO-Ru 1.1 km, start 00 UTC March 5



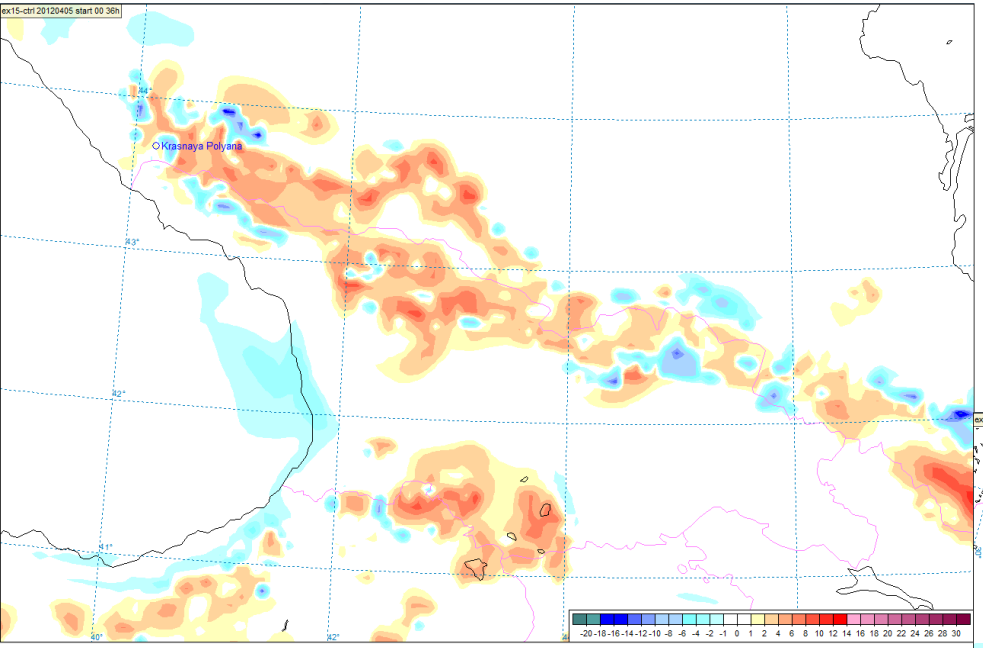
Obs: snow depth increase on 2 cm (but: precipitation at positive temperature). 3 UTC March 5 12-hour precipitation 4 mm

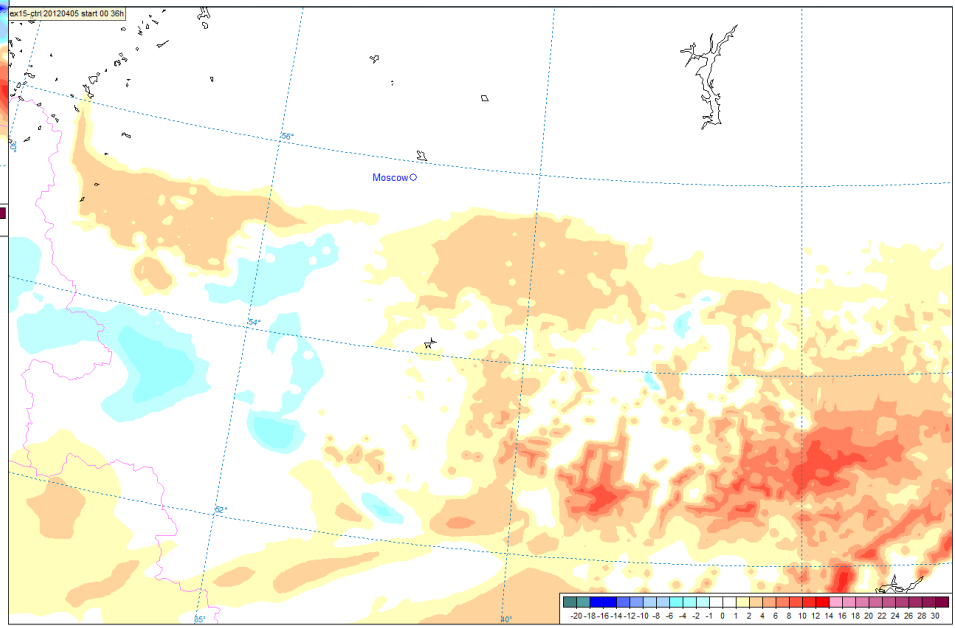
Differences are connected with type of precipitation and its amount

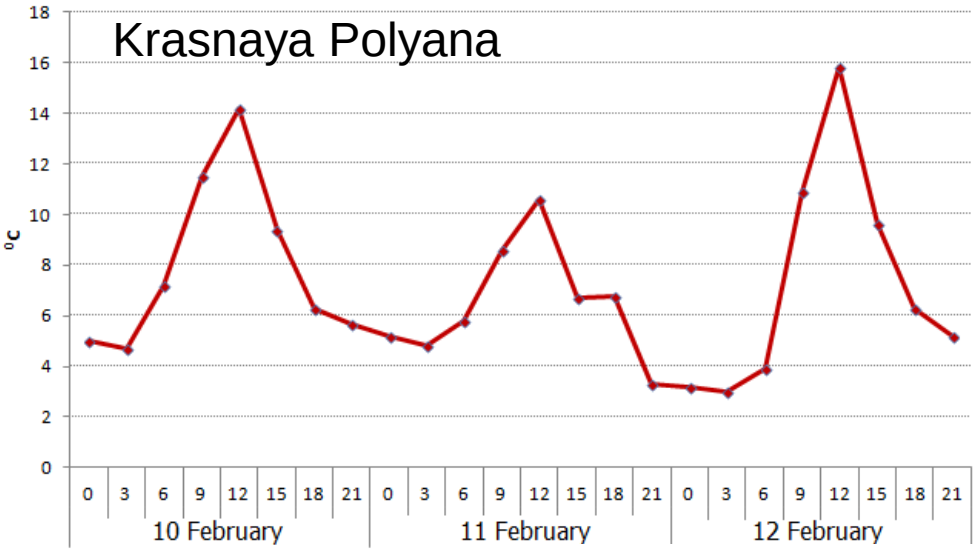
Experiment - COSMO-Ru 7 forecast. T2m. 5 April 2012. Start – 00 UTC



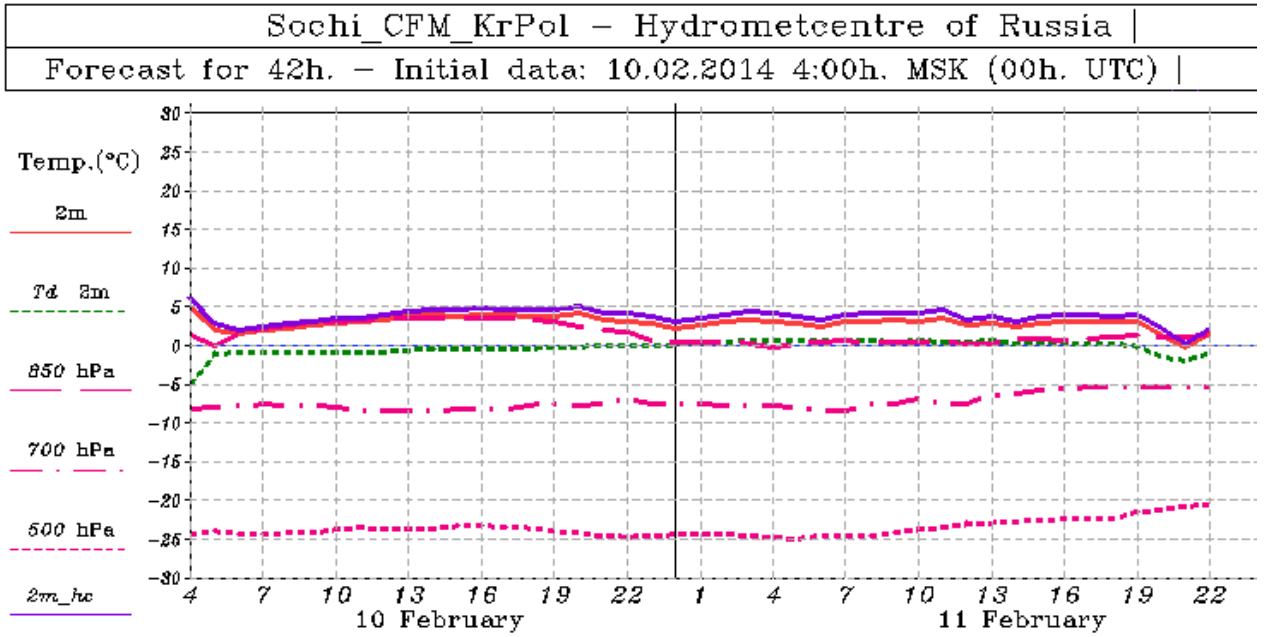
Experiment - COSMO-Ru 7 forecast. T2m. 5 April 2012. Start – 00 UTC



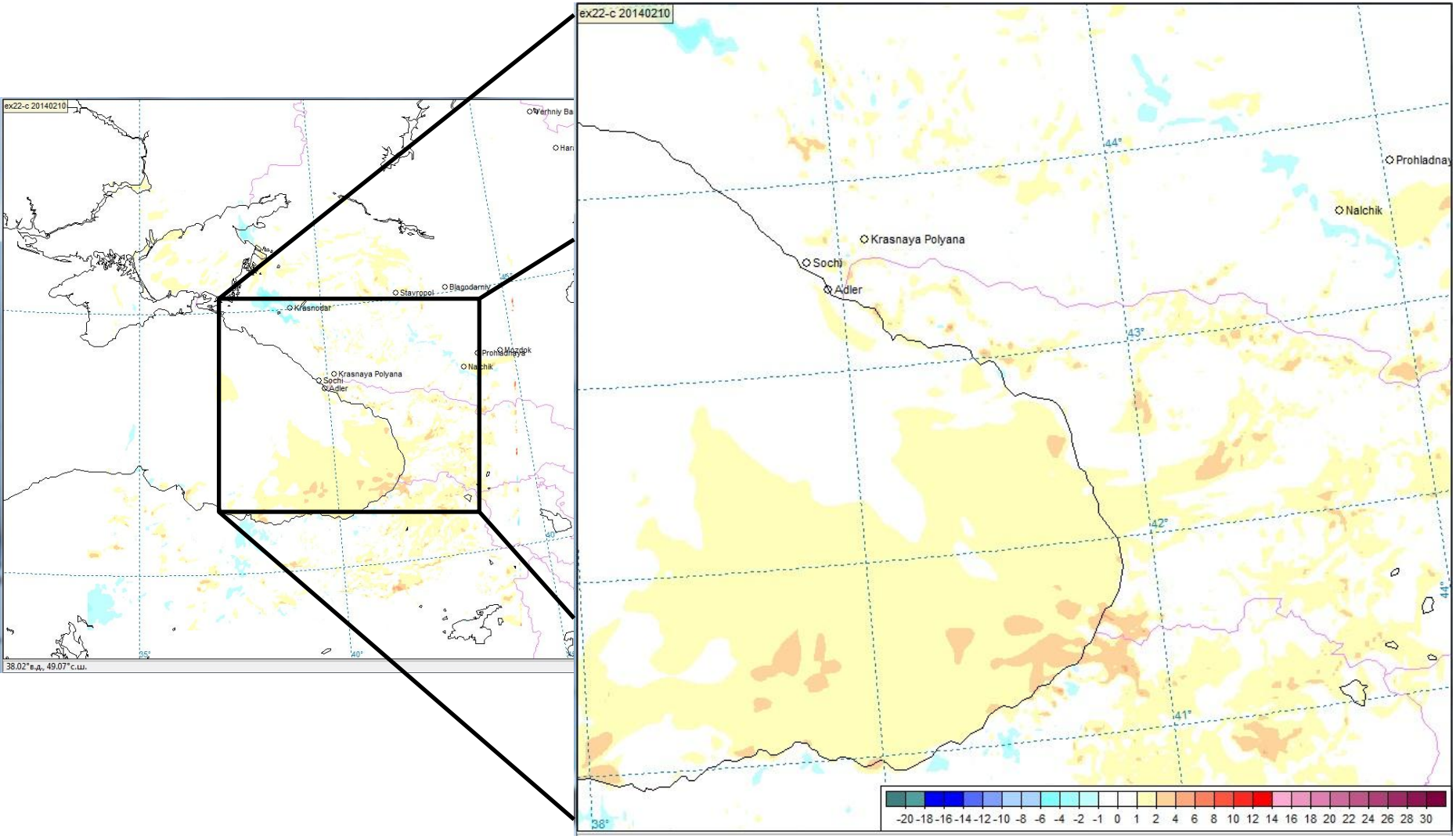




COSMO-Ru 2.2 forecast, start
10 February 2014 00 UTC



Experiment - COSMO-Ru 2 forecast. T2m. 10 February 2014. Start – 00 UTC



Conclusions

- Fresh snow depth postprocessing was implemented in the operational system of COSMO-Ru forecast preparation and visualization with different resolutions (7, 2.2 and 1.1 km).

- Preliminary results were studied. It was shown that COSMO-Ru fresh snow depth forecasts could be used by different services.

- As there were only some case studies, it's hard to say which forecast is better (with start at 00 or 06 or 12 or 18 and with resolution 2.2 km or 1.1 km).

New PT **SNOWE p**roposal:

Goal – to couple and test the technology of initialisation of SWE based the standard measurements of the WMO network

Development and implementation of technique of SWE initialization: 0.6 FTE, S 2014- M 2015

SONDJF (***02 FTE***) - Analisys of results for 2013-2014 winter and tuning for 1-d Snow model

MAMJJA (***02 FTE***) - coupling with COSMO technologies and analysis for large terrains and phases of snow periods for different climate zones

SON (***02 FTE***) - Finalize of preparing of new software with description codes

Thank you for your attention!