New Priority Task - SNOWE

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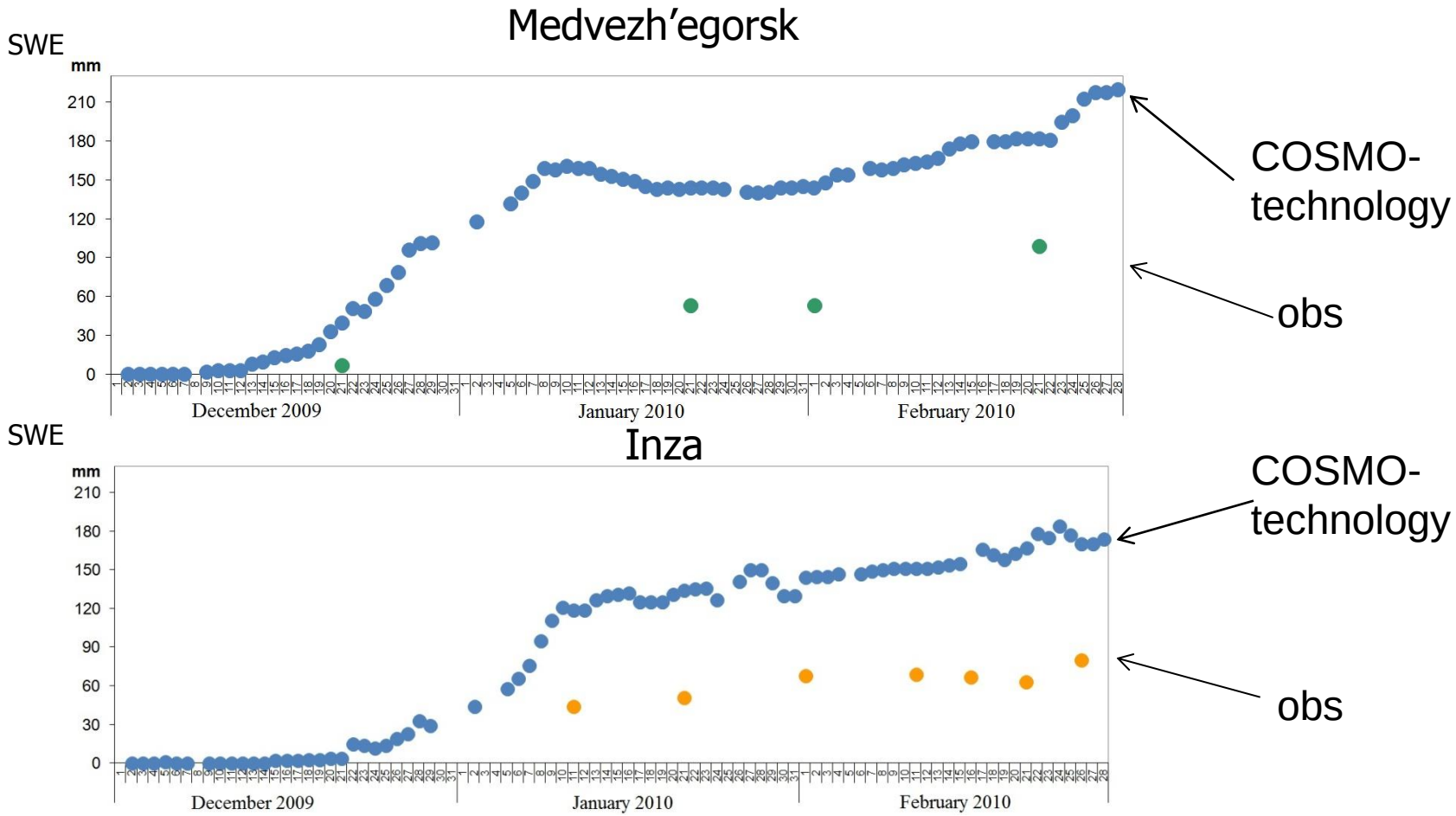
SNOWE (09.2014 – 08.2015)

The priority task SNOWE means SNOw Water Equivalent activities

The goal is to create the system of initialization of snow water equivalent (SWE) fields based on coupling of first guess of COSMO fields with the results of continuous calculations of SWE values for full snow period with the use of information of standard (SYNOP) meteorological measurements (1-D algorithm SWECALC based on snow model SMFE)

Motivation-1

Initial GME-fields of snow water equivalent (SWE) and snow density have discrepancies in comparison with hydrological snow survey measurements up to 100-200%



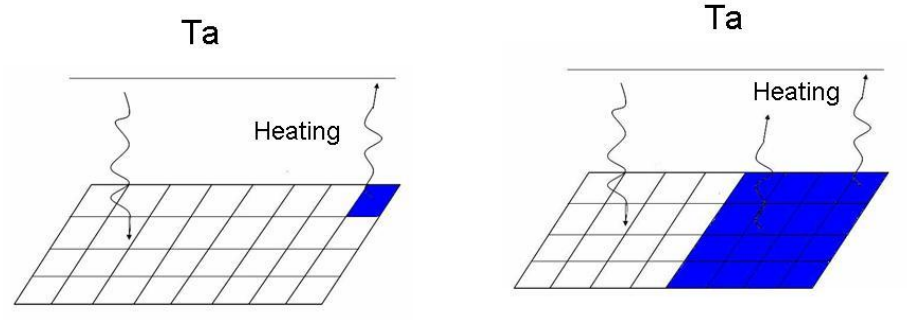
Motivation-2

Snow has impact on the calculation of surface heat budget and hence different meteorological elements (first of all, air and surface temperature, then wind speed, cloudiness…)

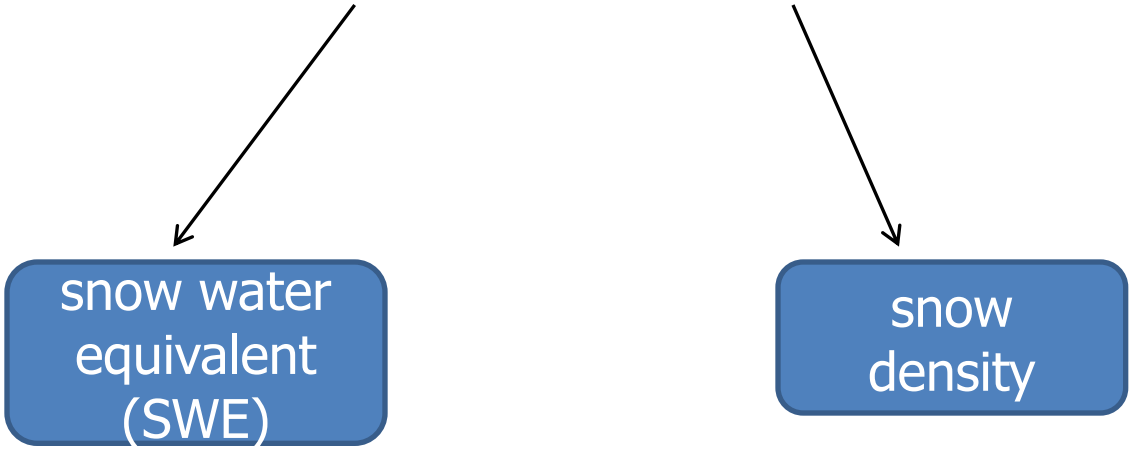
The most significant changes are observed in many meteorological elements during snowmelt period: the zone of partial snow coverage could extend for some hundreds km. Temperature differences between T2m model values and observations could be up to 10-12ºC here.

$$zrss = \max\left(0.01, \min\left(1.0, \frac{SWE}{0.015}\right)\right)$$

zrss – part of the model cell covered with snow



Initial data for numerical models



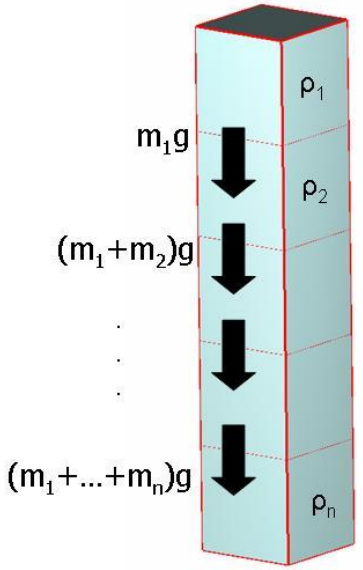
Available measurements of snow and possibility of their use in NWP:

- meteorological stations (snow depth), SYNOP-code; ✚
- AMS (snow depth, SWE, snow surface temperature), there are few of them; ▬
- satellite data (for snow boundary correction); ✚
- specialized hydrological snow surveys (all snow characteristics), once in 5-10 days on Russian territory ▬

Multilayer snow model SMFE (E. Kazakova, M. Chumakov, Roshydromet)

- input data - meteorological stations data (Hsnow, Tair, Td, Wind, Prec);
- output data – SWE and snow density
- daily calculations
- the whole snow period

- preliminary tests at stations of the European part of Russia are successful

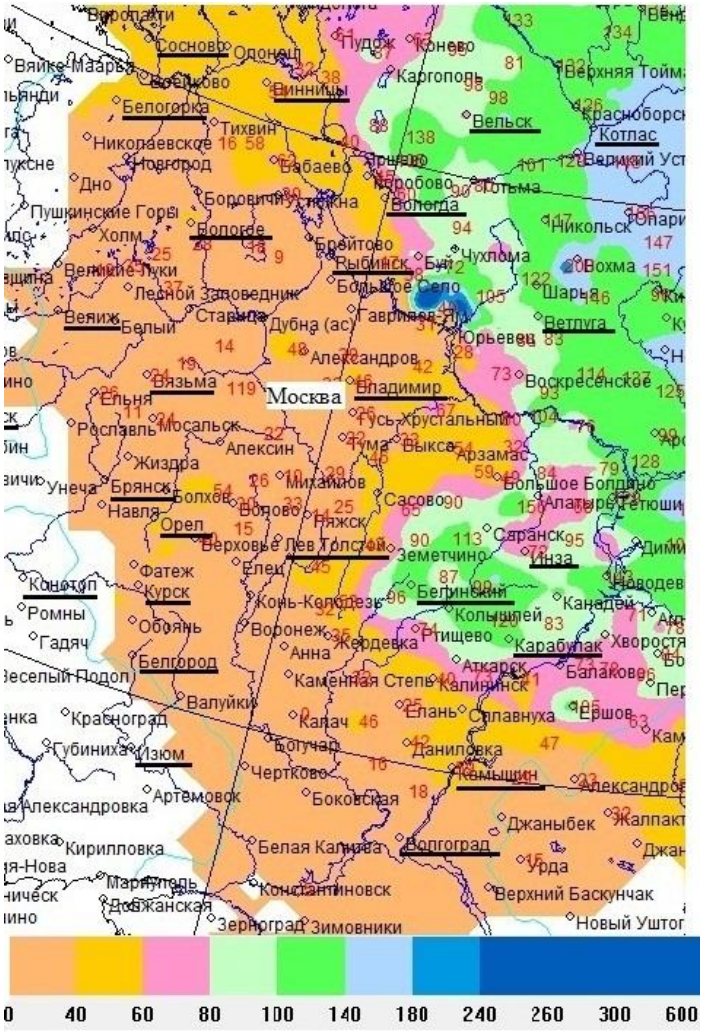


Kazakova E., Chumakov M., Rozinkina I. Initial fields of snow cover characteristics preparation for COSMO-Ru // COSMO Newsletter No.14, 2014, pp.37-42

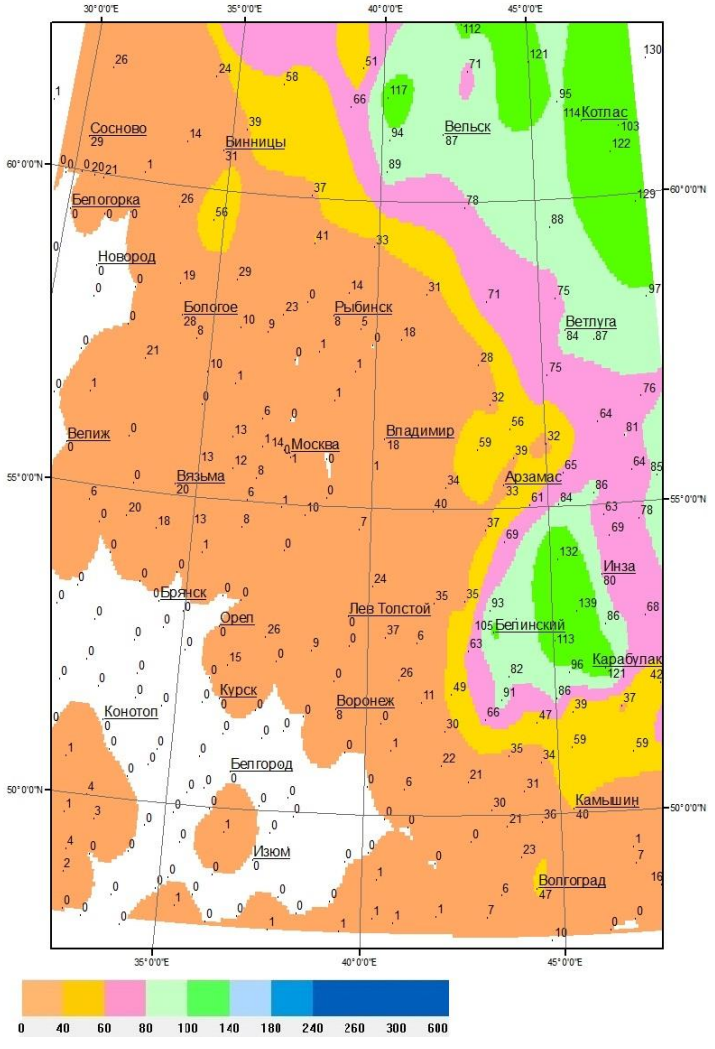
Kazakova E., Chumakov M., Rozinkina I. Realization of the parametric snow cover model SMFE for snow characteristics calculation according to standard net meteorological observations // COSMO Newsletter No.13, 2013, pp.39-49

Maps of SWE for 28 February 2014

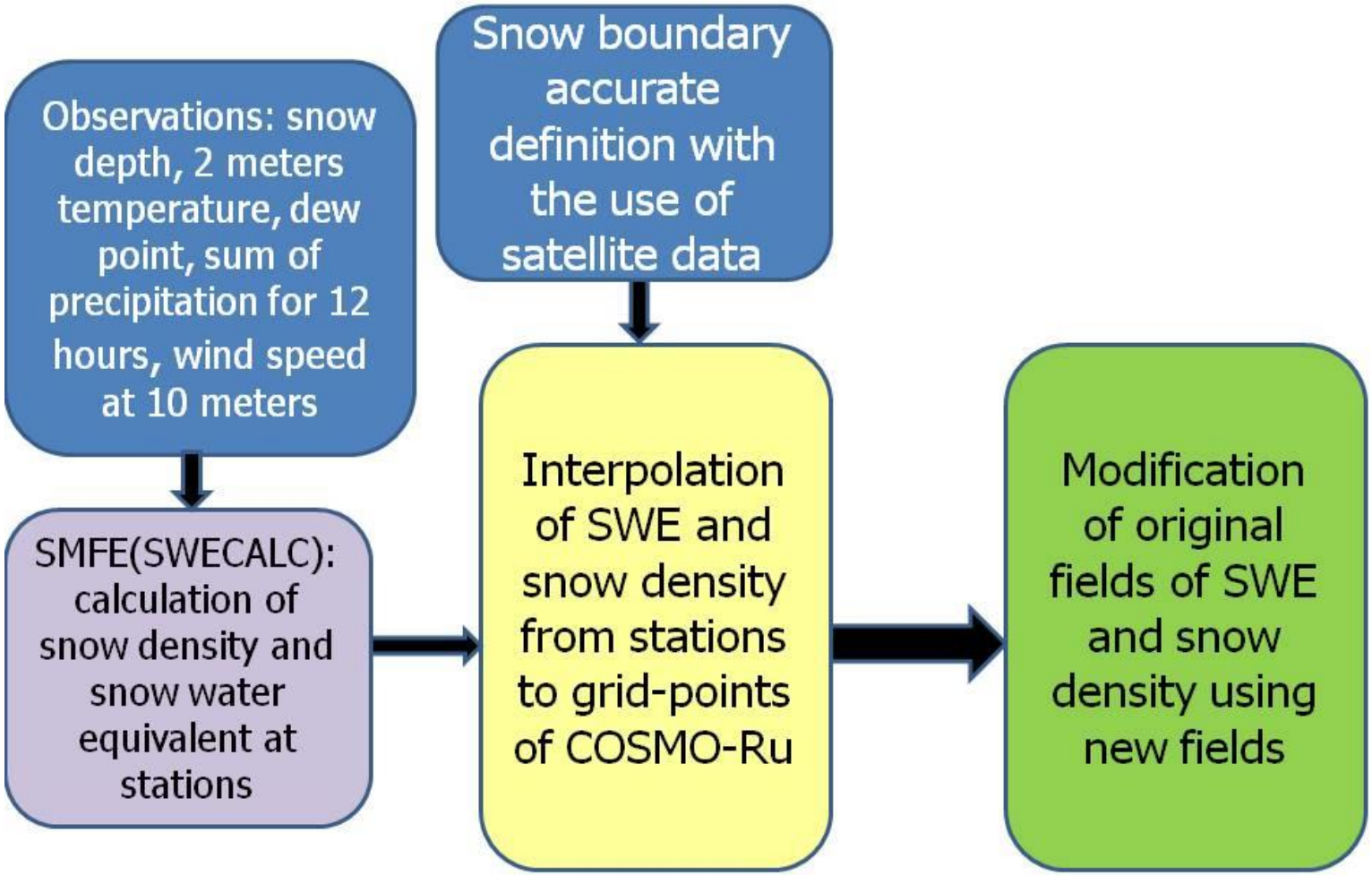
Map based on hydrological observations



Interpolated values from SMFE



Algorithm of initial fields forming

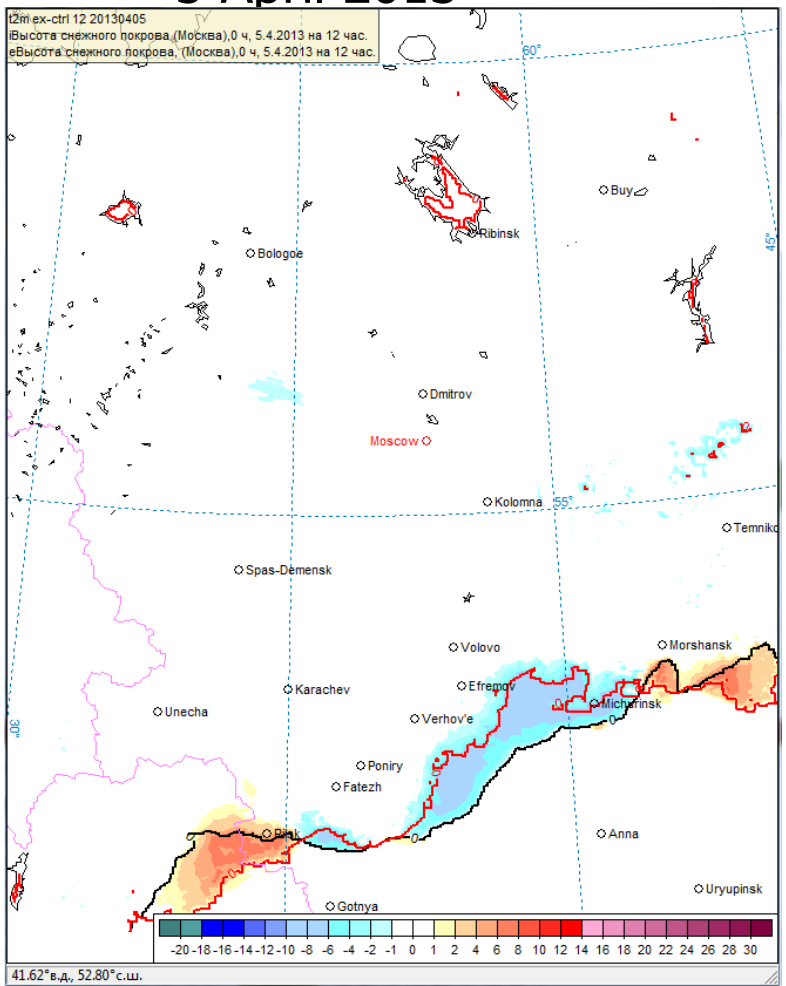


Impact of snow initial fields replacement

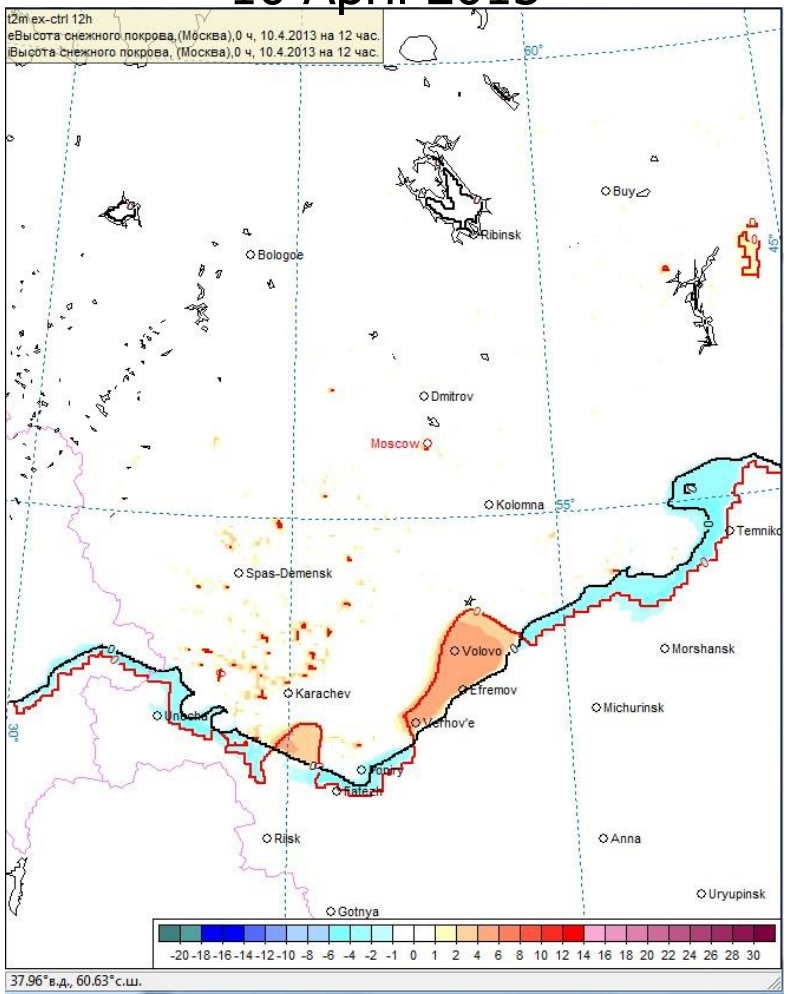
ΔT2m (ex – oper) forecast at 12 UTC. Start – 00 UTC

Lines – snow boundary forecast at 12 UTC: black– operational version, red– experiment

5 April 2013



10 April 2013



Impact of snow initial fields replacement

Station	10 April 2013, 12 UTC			11 April 2013, 00 UTC		
	Obs, t◦C	Oper, t◦C/ Abs. error, ◦C/accuracy, %	Ex, t◦C/ Abs. error, ◦C/accuracy, %	Obs, t◦C	Oper, t◦C/ Abs. error, ◦C/accuracy, %	Ex, t◦C/ Abs. error, ◦C/accuracy, %
Efremov	8,0	4,3/3,7/0	6,6/1,4/100	-0,4	-0,5/0,1/100	-0,6/0,2/100
Volovo	6,9	0,6/6,3/100	5,8/1,1/100	-1,1	-3,6/2,5/100	-1,7/0,6/100
Verhov'e	7,0	1,2/5,8/0	6,0/1,0/100	0,8	-1,2/2,0/100	-0,2/1,0/100
Temnikov	7,2	6,2/1,0/100	5,6/1,6/100	0,2	0,7/0,5/100	-3,0/2,8/100
Unecha	7,1	6,6/0,5/100	5,4/1,7/100	1,0	0,4/0,6/100	0,7/0,3/100
Fatezh	8,1	5,6/2,5/100	6,7/1,4/100	-1,5	-3,0/1,5/100	0,3/1,8/100
	Mean abs. error, ◦C/Mean accuracy, %	3,3◦/67%	1,37◦/100%		1,2◦/100%	1,11◦/100%

SNOWE (09.2014 – 08.2015)

Required FTE: 0.5

Planned activities:

•Tests for different climatic and landscape conditions. Tuning of 1-D algorithm SWECALC for calculation of accumulated SWE based on regular network measurements (0,05 FTE)

•Software of 1-D algorithm SWECALC and estimates of reliability for periods of snow melting and accumulation (0,05 FTE)

SNOWE (09.2014 – 08.2015)

- Technology for coupling of SWE calculation with COSMO operational technology (1-D → 2-D) (0,1 FTE)

- Numerical experiments with COSMO-model for understanding the sensitivity of T2m forecasts on changes in initial SWE values and tuning of 2-D system (0,2 FTE)

- Proposed new software for inclusion into operational COSMO technologies and its description (0,1 FTE)

Thank you for your attention!