New Priority Task - SNOWE

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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.

\[ z_{rss} = \max \left( 0.01, \min \left( 1.0, \frac{SWE}{0.015} \right) \right) \]

\( z_{rss} \) – part of the model cell covered with snow
Initial data for numerical models

- snow water equivalent (SWE)
- snow density

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. 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

Observations: snow depth, 2 meters temperature, dew point, sum of precipitation for 12 hours, wind speed at 10 meters

SMFE(SWECALC): calculation of snow density and snow water equivalent at stations

Snow boundary accurate definition with the use of satellite data

Interpolation of SWE and snow density from stations to grid-points of COSMO-Ru

Modification of original fields of SWE and snow density using new fields
Impact of snow initial fields replacement

$\Delta T_{2m}$ (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

<table>
<thead>
<tr>
<th>Station</th>
<th>10 April 2013, 12 UTC</th>
<th>11 April 2013, 00 UTC</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Obs, t°C</td>
<td>Oper, t°C/ Abs. error, t°C/accuracy, %</td>
</tr>
<tr>
<td>Efremov</td>
<td>8,0</td>
<td>4,3/3,7/0</td>
</tr>
<tr>
<td>Volovo</td>
<td>6,9</td>
<td>0,6/6,3/100</td>
</tr>
<tr>
<td>Verhov’e</td>
<td>7,0</td>
<td>1,2/5,8/0</td>
</tr>
<tr>
<td>Temnikov</td>
<td>7,2</td>
<td>6,2/1,0/100</td>
</tr>
<tr>
<td>Unecha</td>
<td>7,1</td>
<td>6,6/0,5/100</td>
</tr>
<tr>
<td>Fatezh</td>
<td>8,1</td>
<td>5,6/2,5/100</td>
</tr>
<tr>
<td></td>
<td>Mean abs. error, t°C/accuracy, %</td>
<td>3,3°/67%</td>
</tr>
</tbody>
</table>
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 $\rightarrow$ 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!