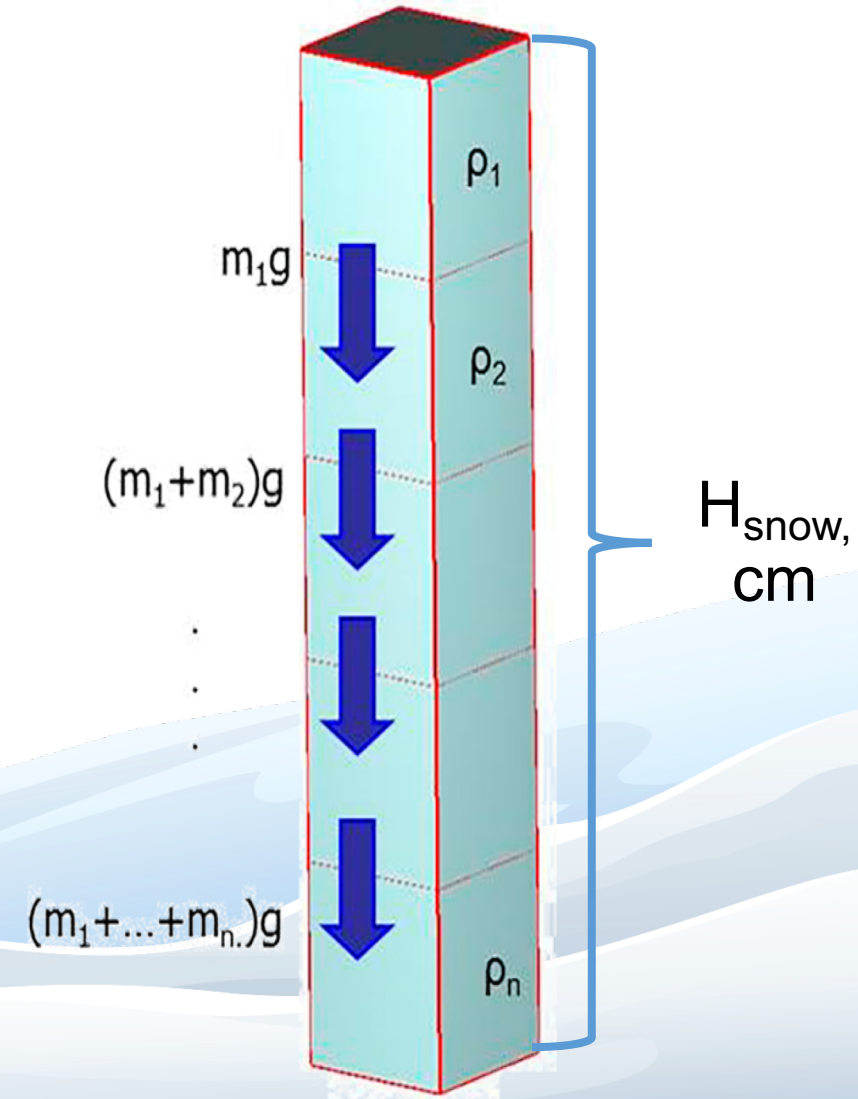


# The latest news about SnoWE 2020

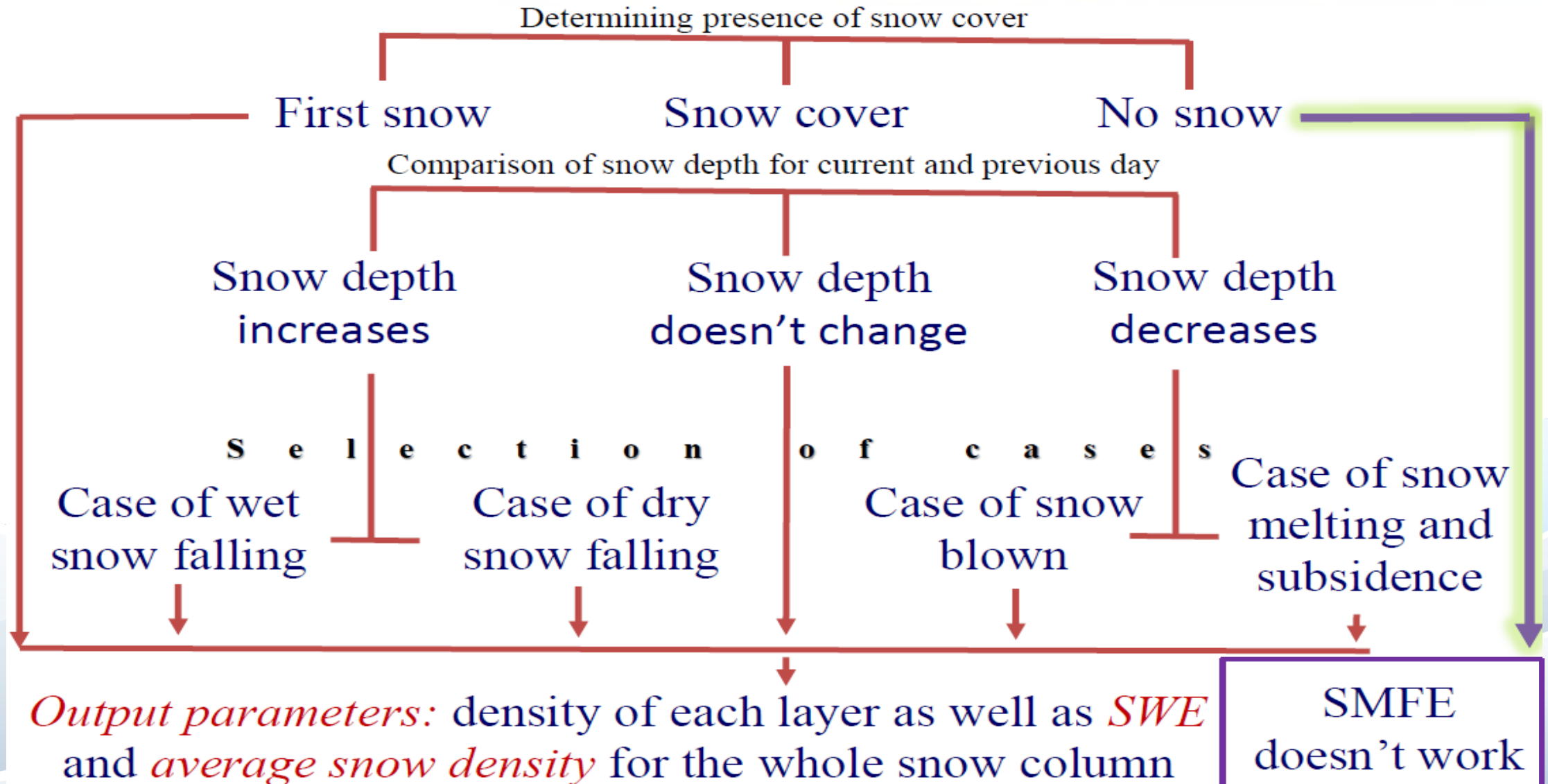
E. Churiulin, V. Kopeykin, I. Rozinkina, I. Volkov

## General information:

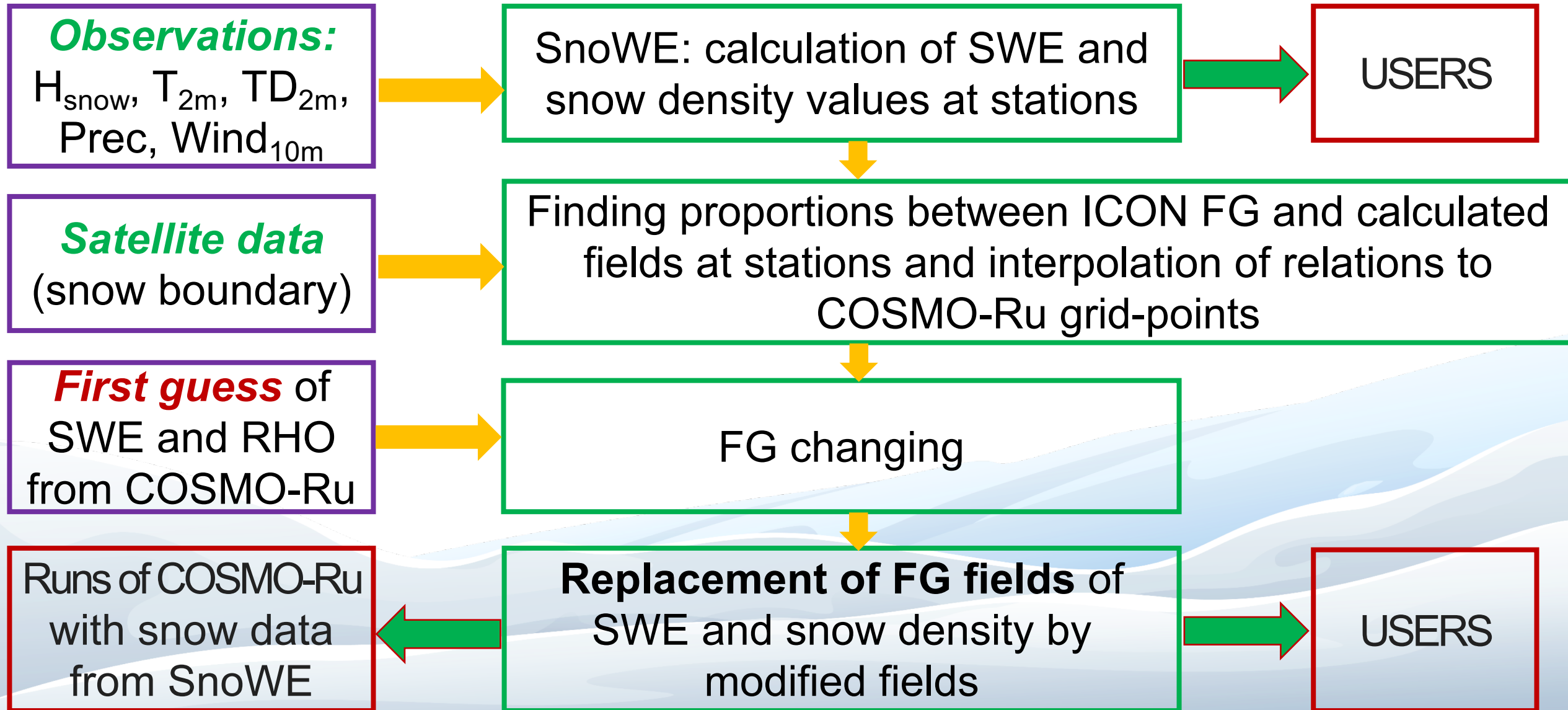
- **SnoWE** – have been developing since 2012 by E.Kuzmina, M. Chumakov, I. Rozinkina, V. Kopeikin, E. Churiulin and I. Volkov
- **SnoWE** – is the multilayer model of snow, where each layer of snow depth is equal – 1 cm
- **SnoWE** – initial data for model is daily  $H_{\text{snow}}$ ,  $T_{2m}$ ,  $TD_{2m}$ , Precipitation,  $\text{Wind}_{10m}$
- **SnoWE** – can calculates of SWE and RHO at meteorological stations or COSMO-Ru grid points
- **SnoWE** – doesn't work for mountain regions and for mountain regions applied data from global model as a boarder conditions



## Available math algorithms for *SWE* and *RHO* calculations



## General principle of SnoWE work





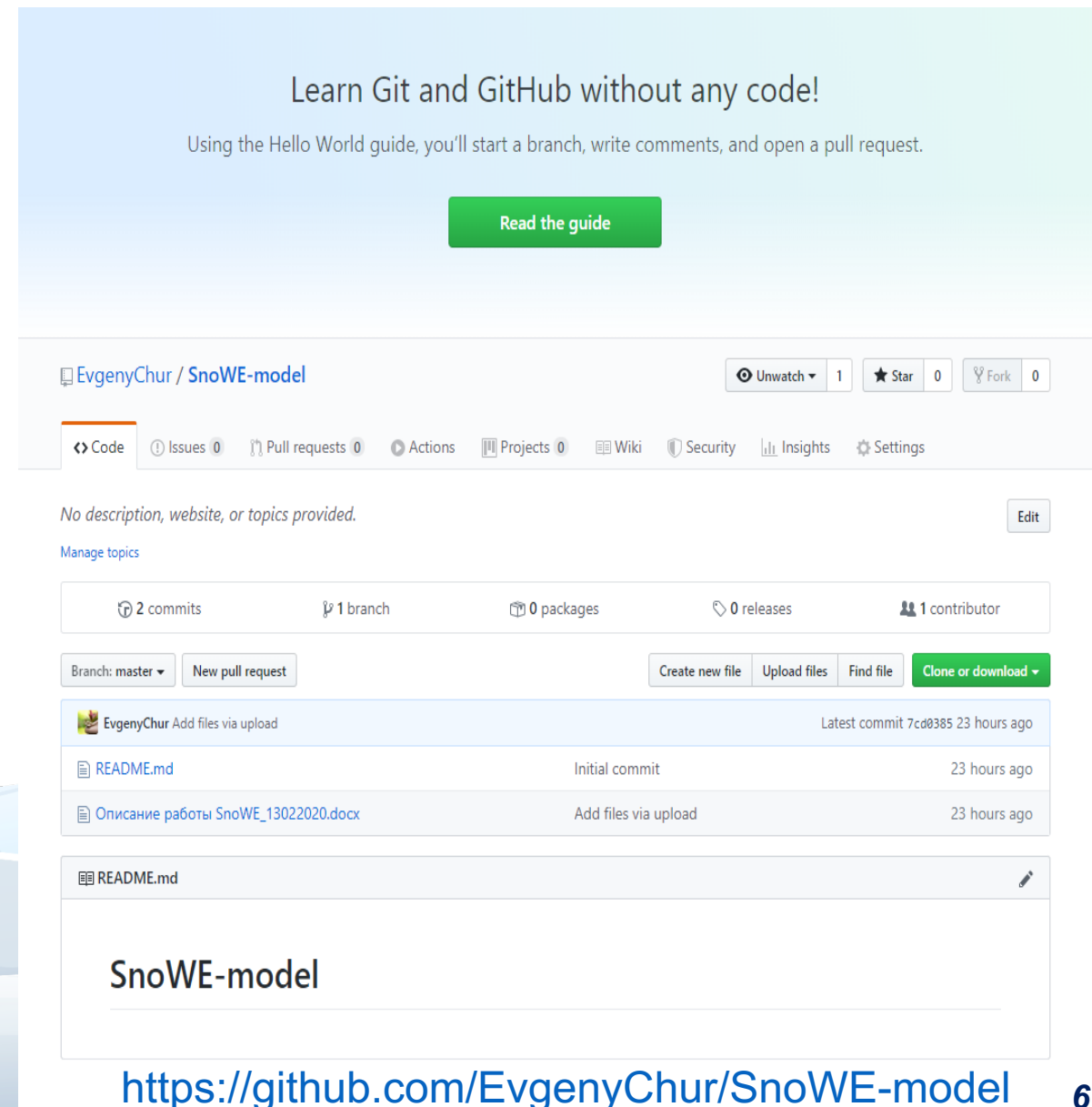
# Latest directions of work with **SnoWE**

- **The first direction** – is a creation of an official documentation for snow cover model **SnoWE** model and uploading it to the GitHub web-page <https://github.com/EvgenyChur/SnoWE-model>
- **The second direction** – is the monitoring of snow cover characteristics on the territory of the Russian Federation and interaction with hydrology specialists
- **The third direction** – is a creation of the new forest snow math algorithms for detection of snow cover in forest and on tree crowns
- **The forth direction** – is creation of the regional snow data assimilation system based on **SnoWE** for the **COSMO-Ru**. The creation of the new snow DAS suggests conducting the numerical experiments with **COSMO-Ru** and their analysis

## Creation of the official SnoWE documentation

### Table of contents:

1. General information about SnoWE
2. How to work with SnoWE: first steps
  - 2.1 How to assemble SnoWE
3. Preprocessing module of SnoWE
  - 3.1 Constant configuration files
  - 3.2 Satellite data
  - 3.3 In-situ data (SYNOP)
  - 3.4 COSMO-Ru data
  - 3.5 Quality control
4. The main calculation module of SnoWE
  - 4.1 Schemes of physical parametrization of SnoWE
    - 4.1.1 – 4.1.7 Different options of snow schemes
5. Postprocessing module of SnoWE
6. Visualization in SnoWE
7. The archive version of SnoWE
8. The future plans for developing SnoWE
9. Conclusions
10. Applications



Learn Git and GitHub without any code!

Using the Hello World guide, you'll start a branch, write comments, and open a pull request.

[Read the guide](#)

EvgenyChur / SnoWE-model

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Branch: master New pull request

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EvgenyChur Add files via upload Latest commit 7cd0385 23 hours ago

File	Commit	Time
README.md	Initial commit	23 hours ago
Описание работы SnoWE_13022020.docx	Add files via upload	23 hours ago

README.md

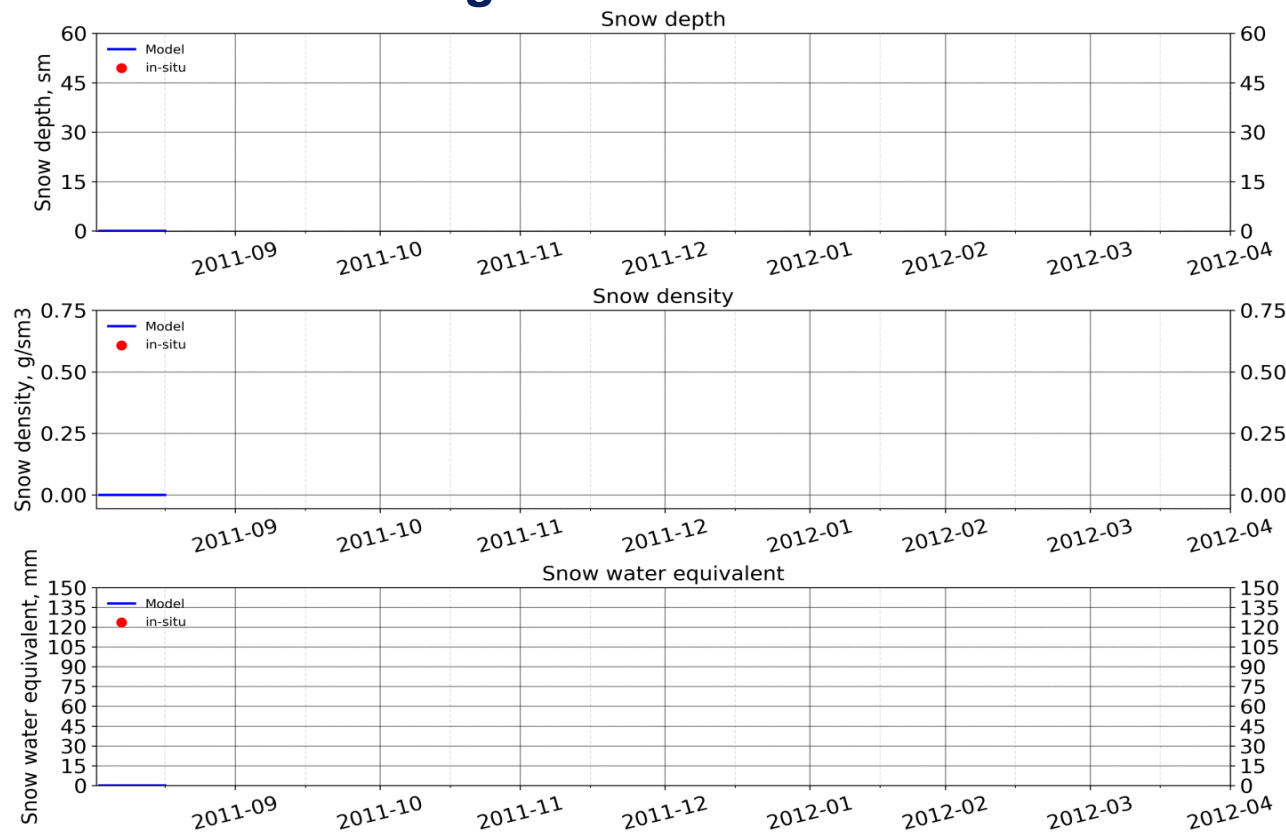
SnoWE-model

<https://github.com/EvgenyChur/SnoWE-model>

# The second direction

## Monitoring of the SWE changes on the territory of the Russia

### Meteorological station – Vel'sk



I – snow depth, cm

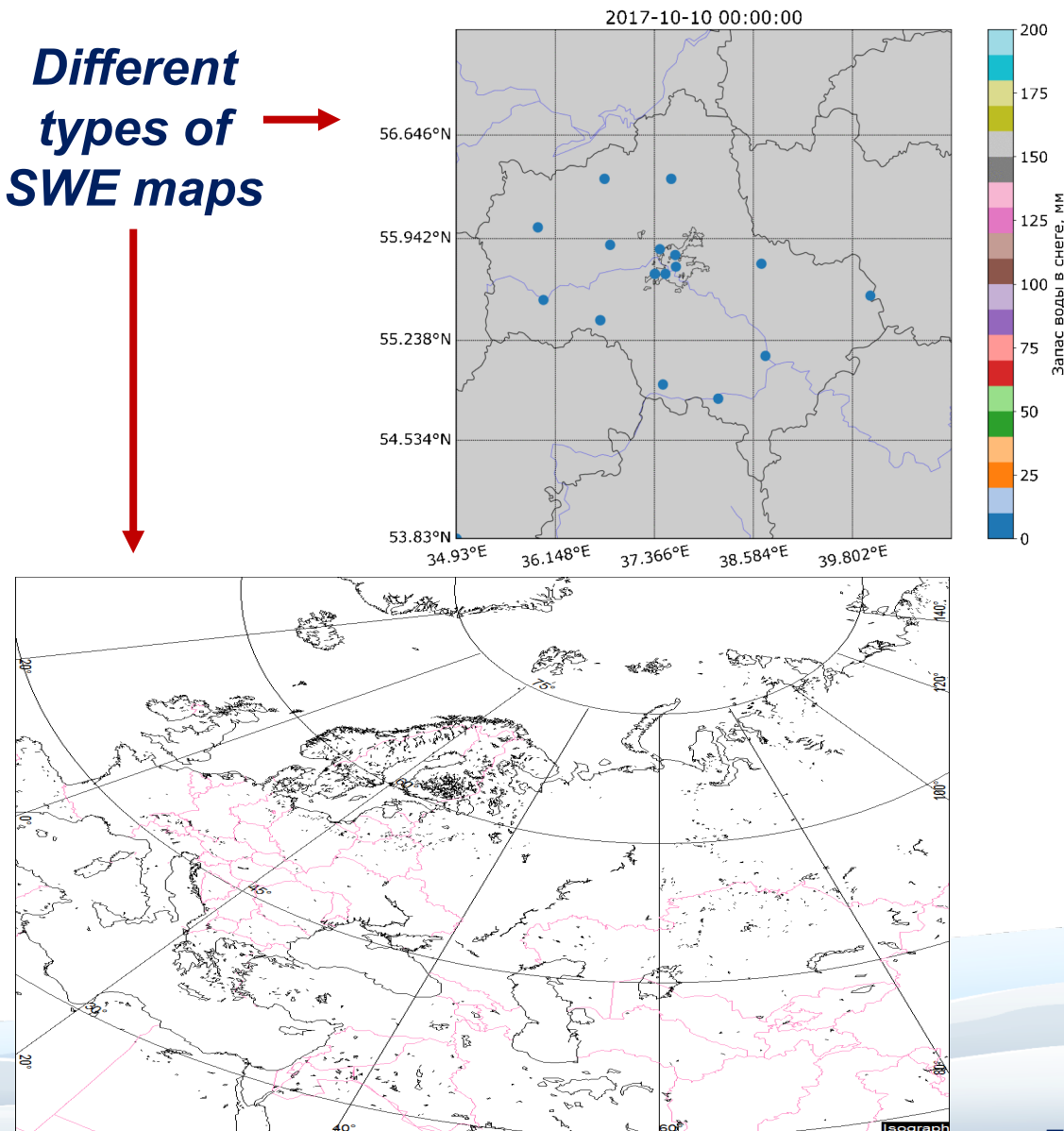
SnoWE

II – snow density, g/cm<sup>3</sup>

field snow  
surveys

III – snow water equivalent, mm

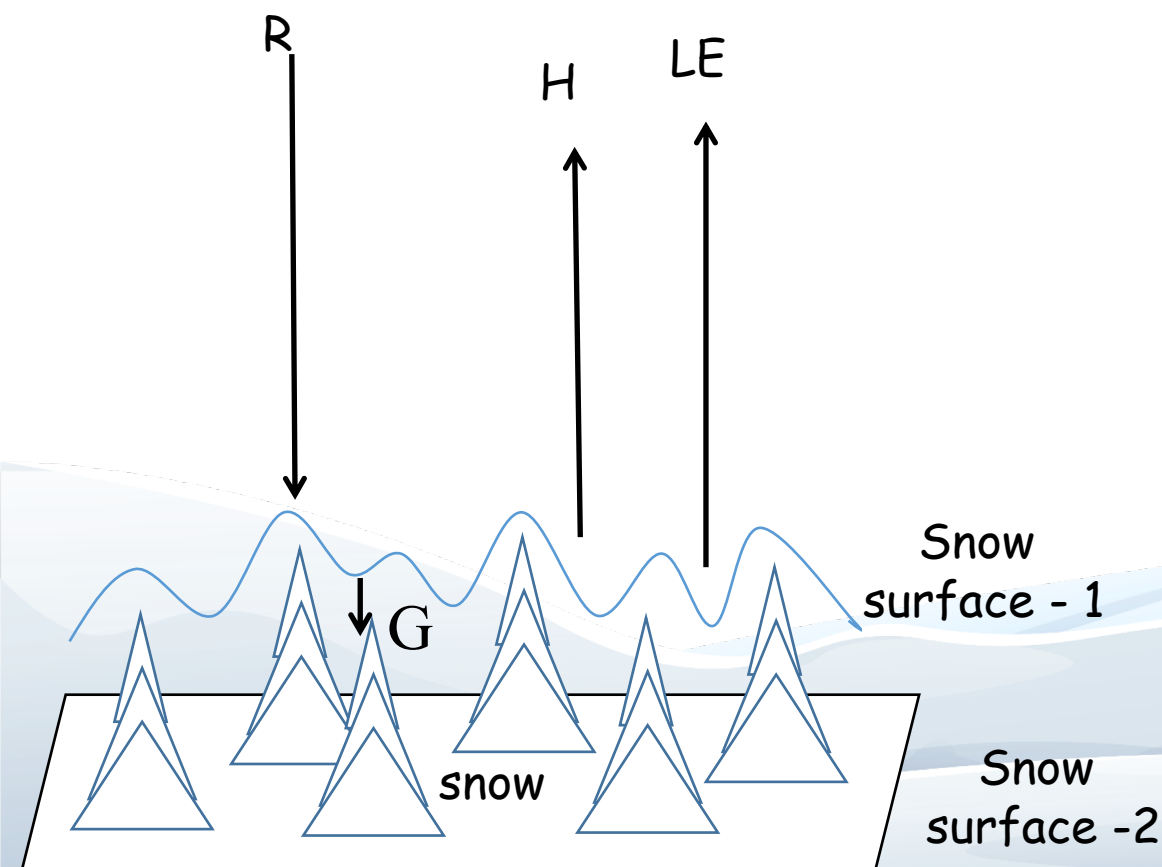
Different  
types of  
SWE maps



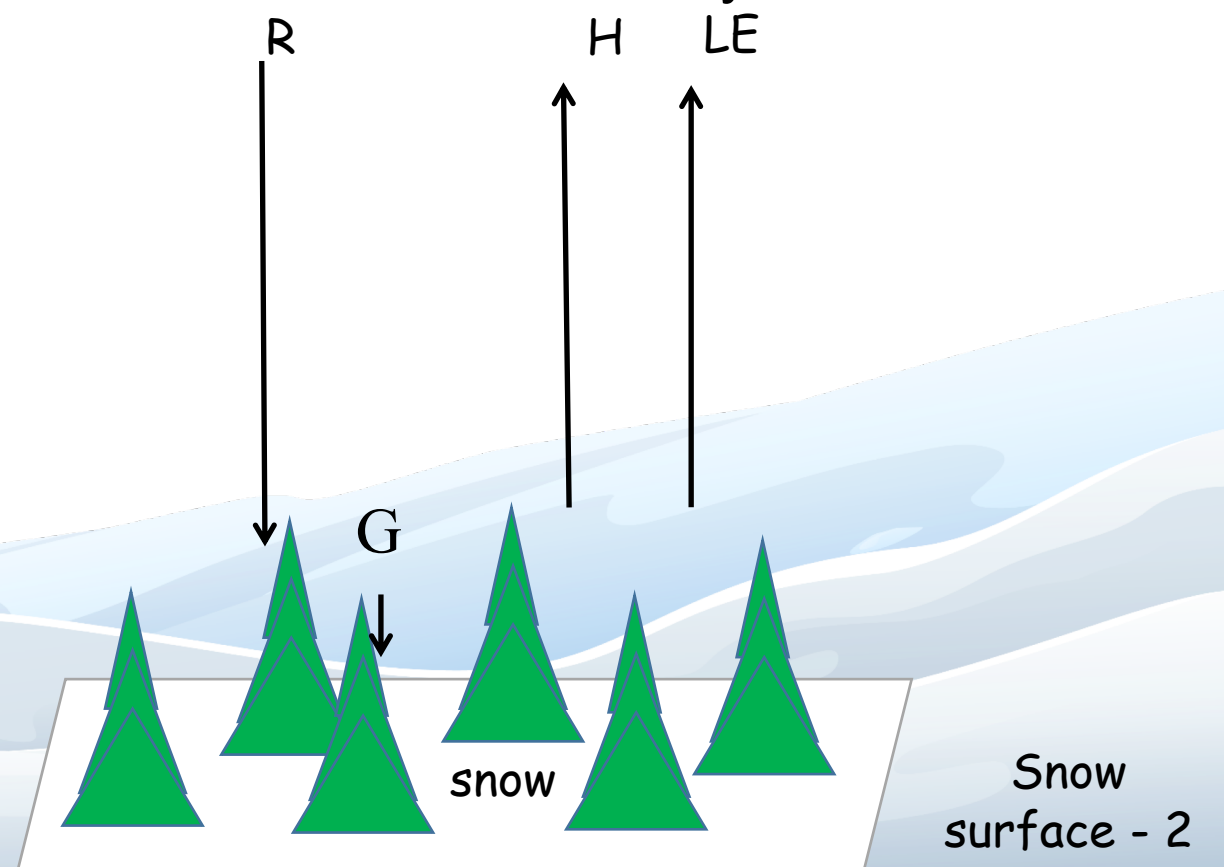
# The third direction

## Creation of the new forest snow math algorithms based on the different heat balance equations

The heat fluxes in the air surface layer is commonly determined by snow on the tree crowns

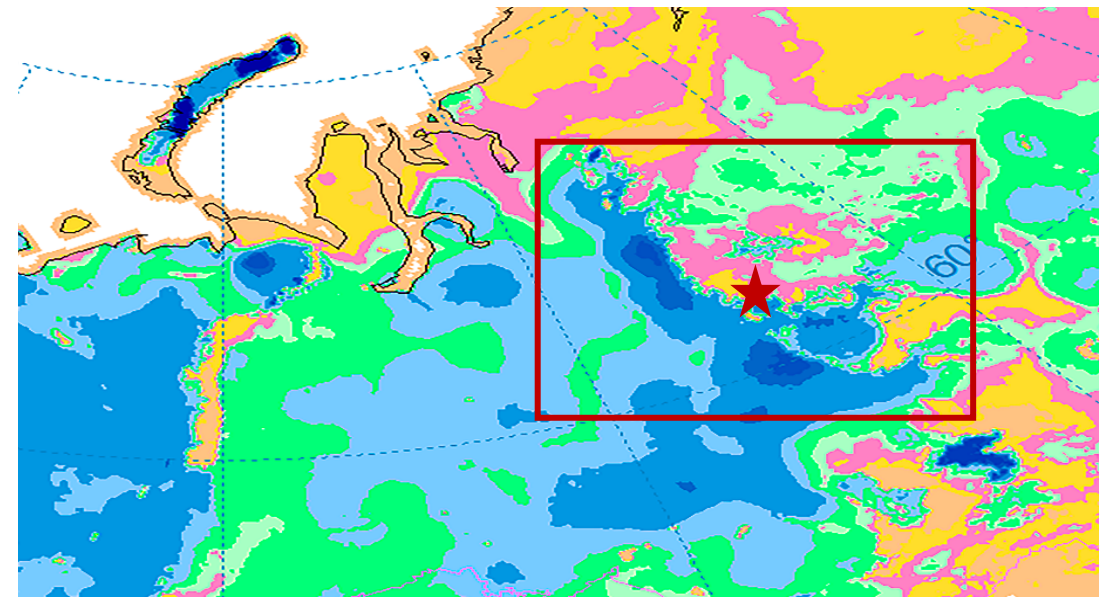
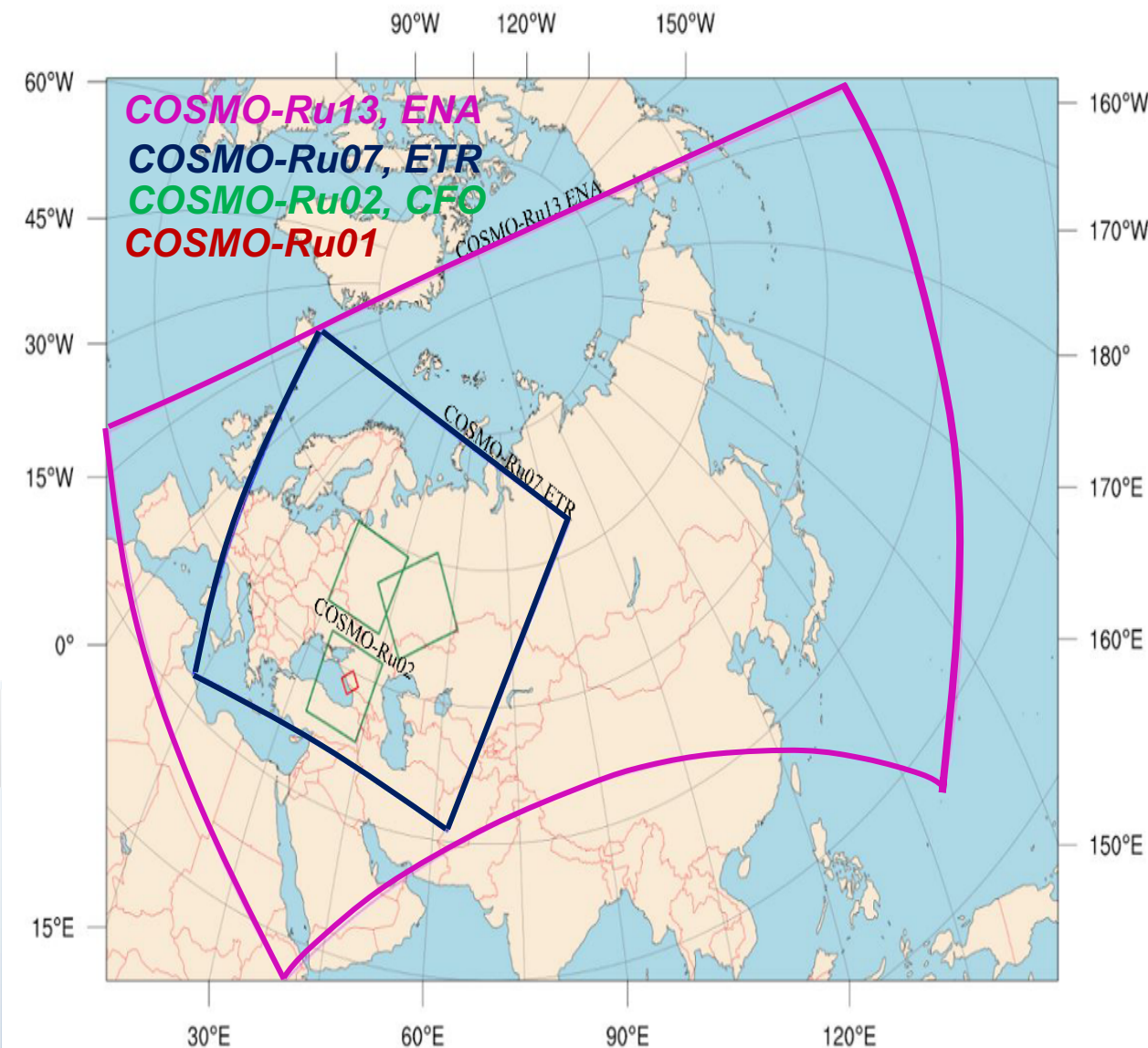


Snow under the tree crowns is isolated from active interaction with the air surface layer





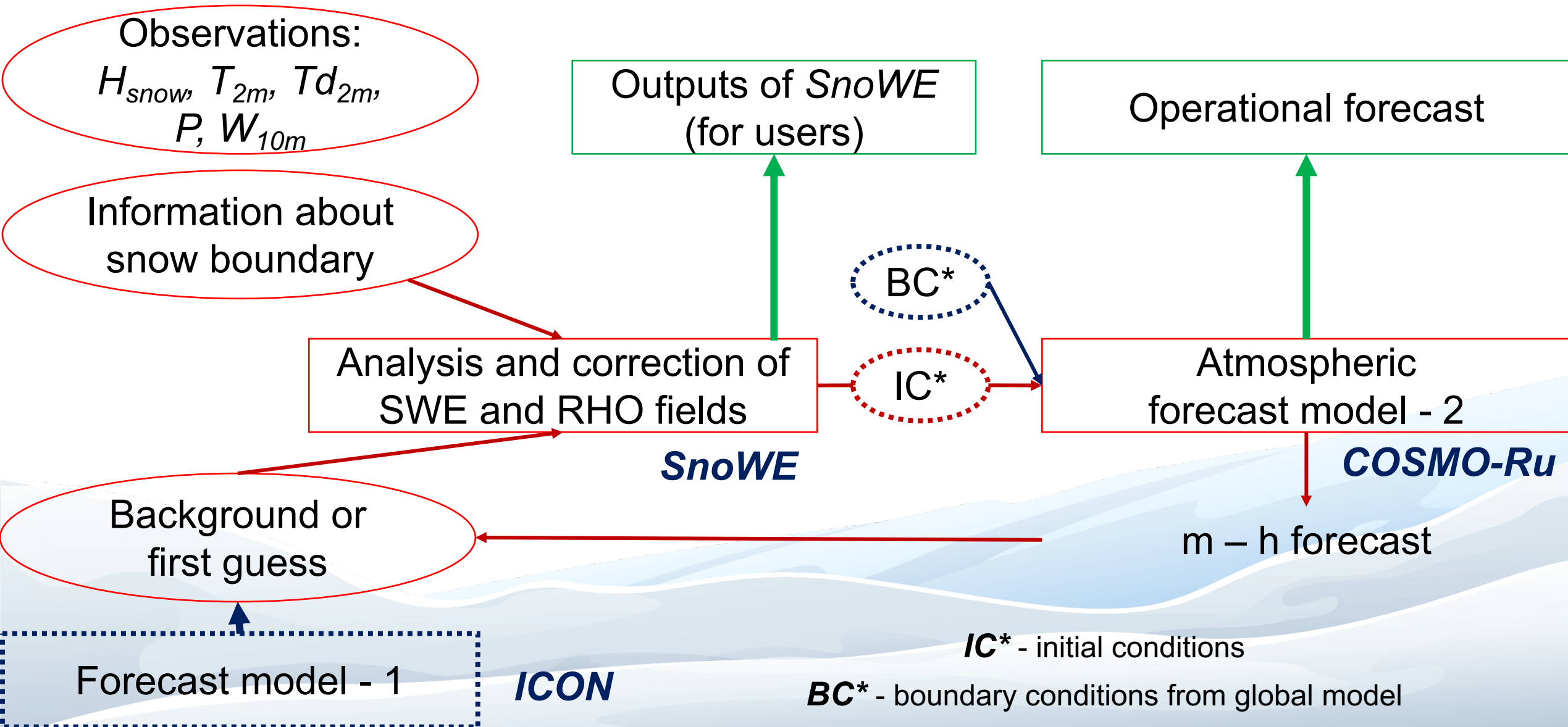
## Creation of the regional snow data assimilation system



### Causes of errors:

- Insufficient volume of meteorological stations available for international data exchange
- Snow calculation mathematical algorithms which are applied in global data assimilation system for ICON NWP system

# The block scheme of the regional snow data assimilation system (**DAS**)

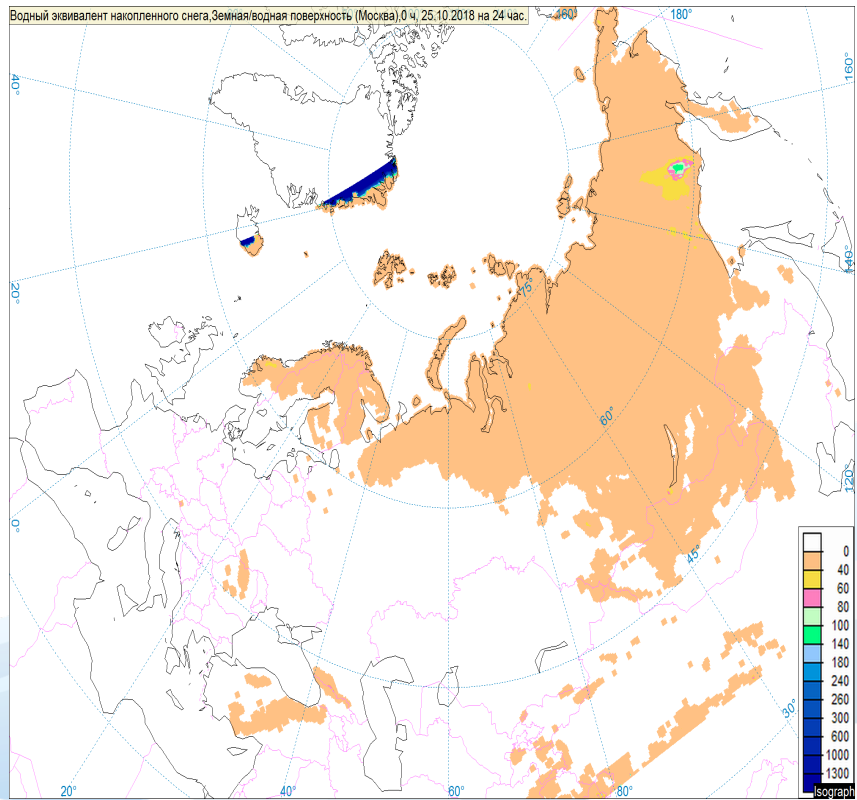
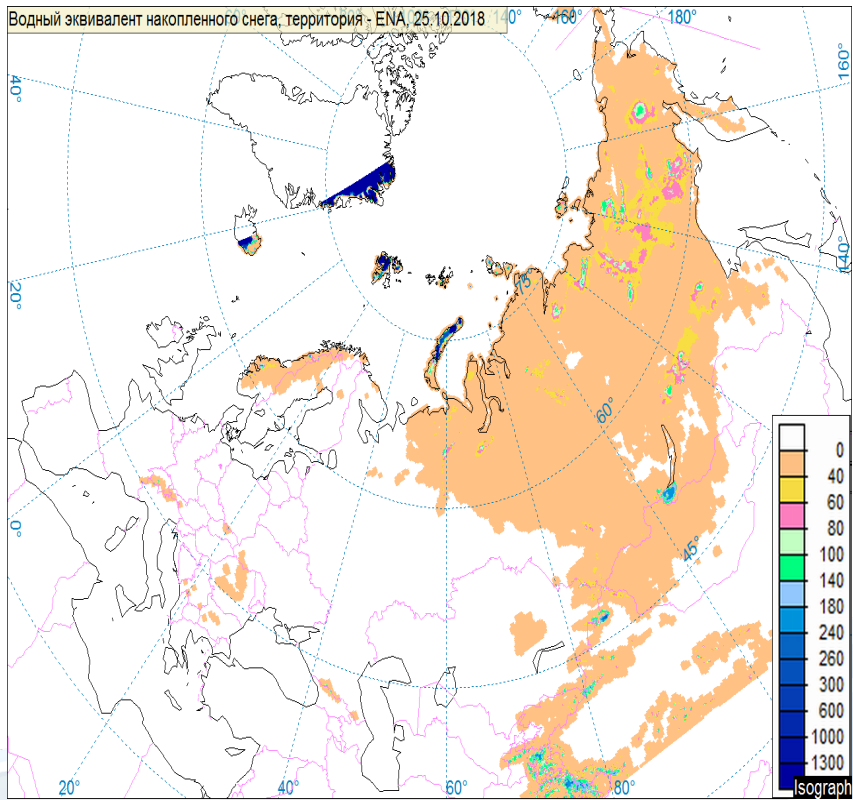
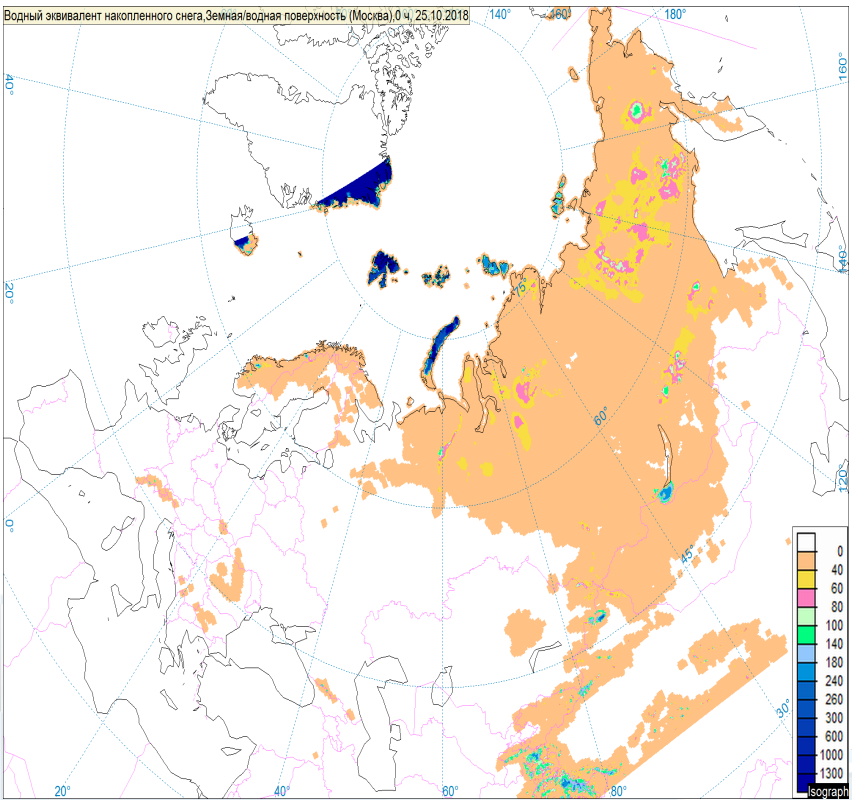




# The regional snow data assimilation system

The example of the numerical experiment on the calculation of *snow water equivalent (mm)* for the territory of the Russian Federation by **COSMO-Ru** on **25.10.2018**

Period of investigation – **winter season 2018/2019 years** Grid step – **13 km**



The real-time version of **COSMO-Ru** system with **ICON** data

Quasi real-time version of snow cover model **SnoWE** based on in-situ data

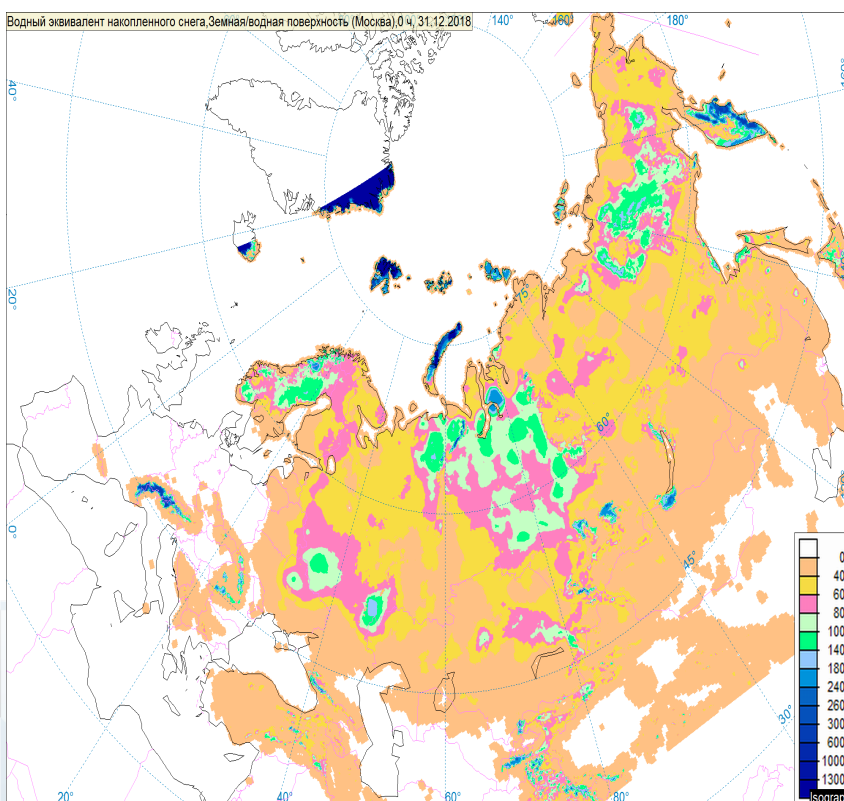
The hybrid version of **COSMO-Ru** system with the regional snow **DAS**

# The regional snow data assimilation system

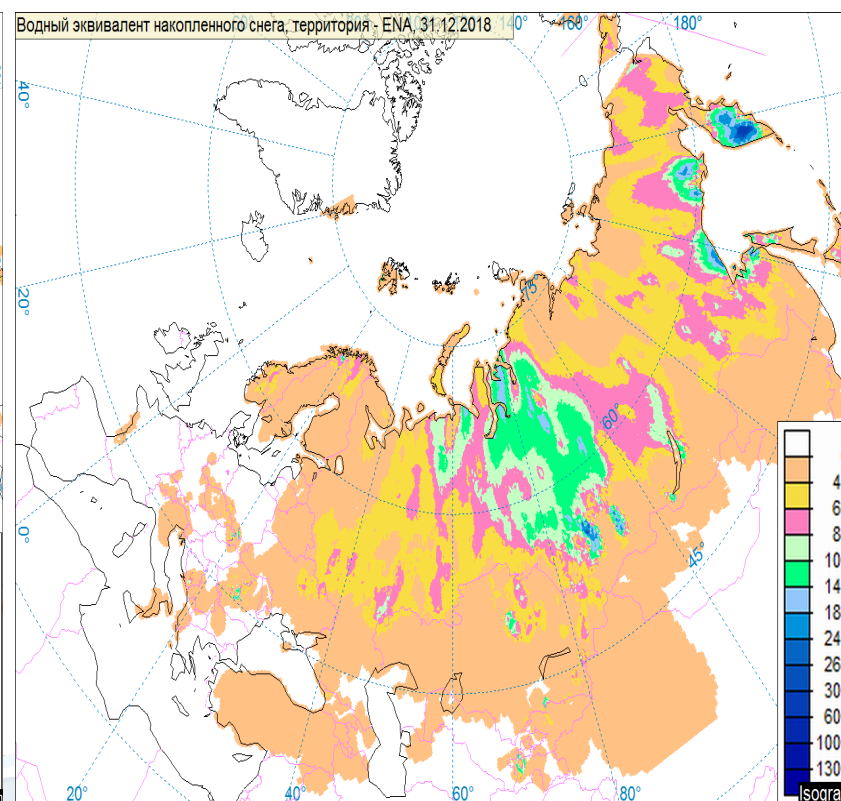
The example of the numerical experiment on the calculation of **snow water equivalent (mm)** for the territory of the Russian Federation by **COSMO-Ru** on **31.12.2018**

Period of investigation – **winter season 2018/2019 years**

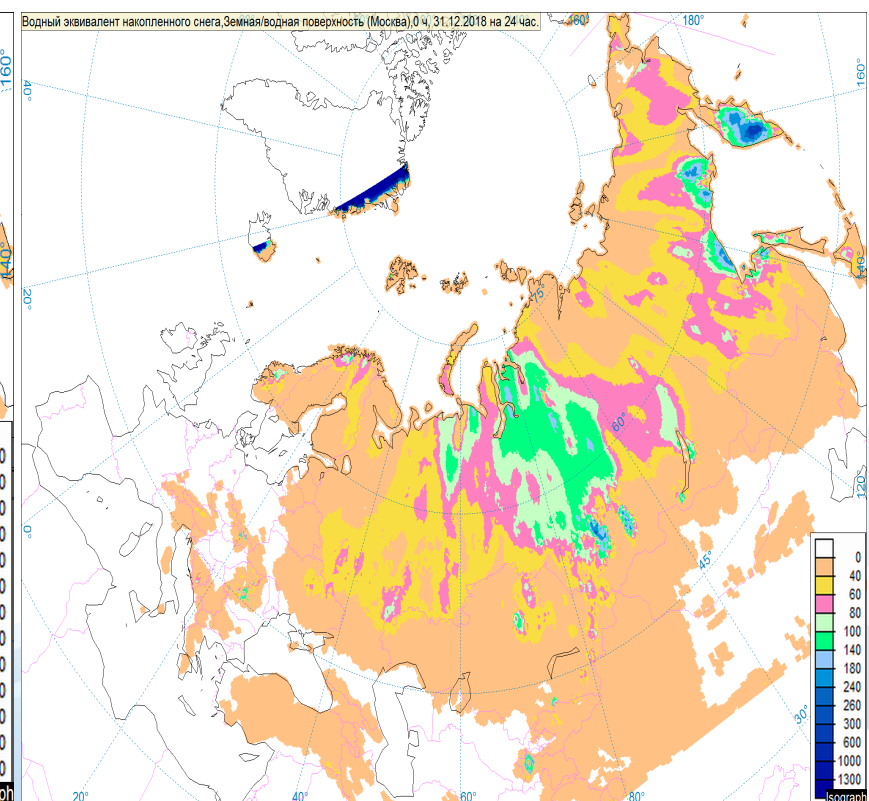
Grid step – **13 km**



The real-time version of  
**COSMO-Ru** system  
with **ICON** data



Quasi real-time version of  
snow cover model **SnoWE**  
based on in-situ data



The hybrid version of  
**COSMO-Ru** system  
with the regional snow **DAS**

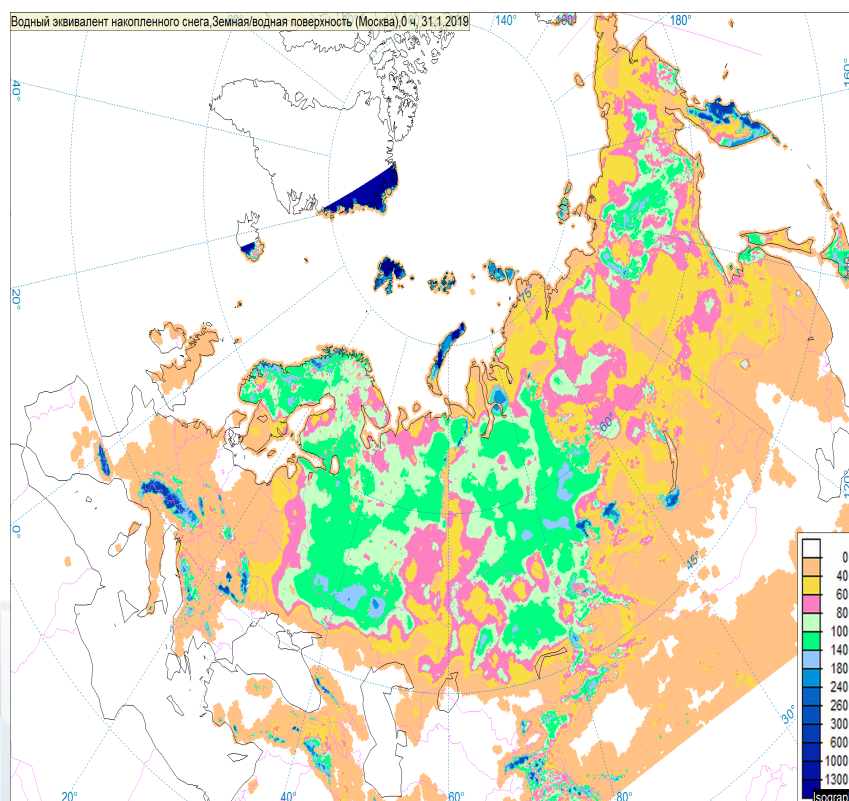


# The regional snow data assimilation system

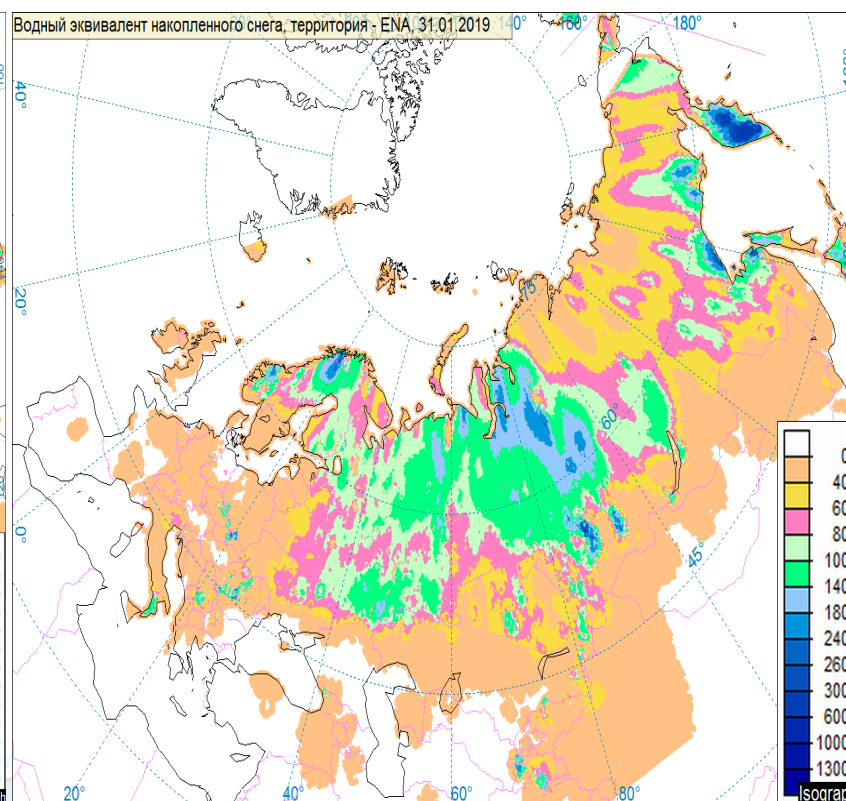
The example of the numerical experiment on the calculation of **snow water equivalent (mm)** for the territory of the Russian Federation by **COSMO-Ru** on **31.01.2019**

Period of investigation – **winter season 2018/2019 years**

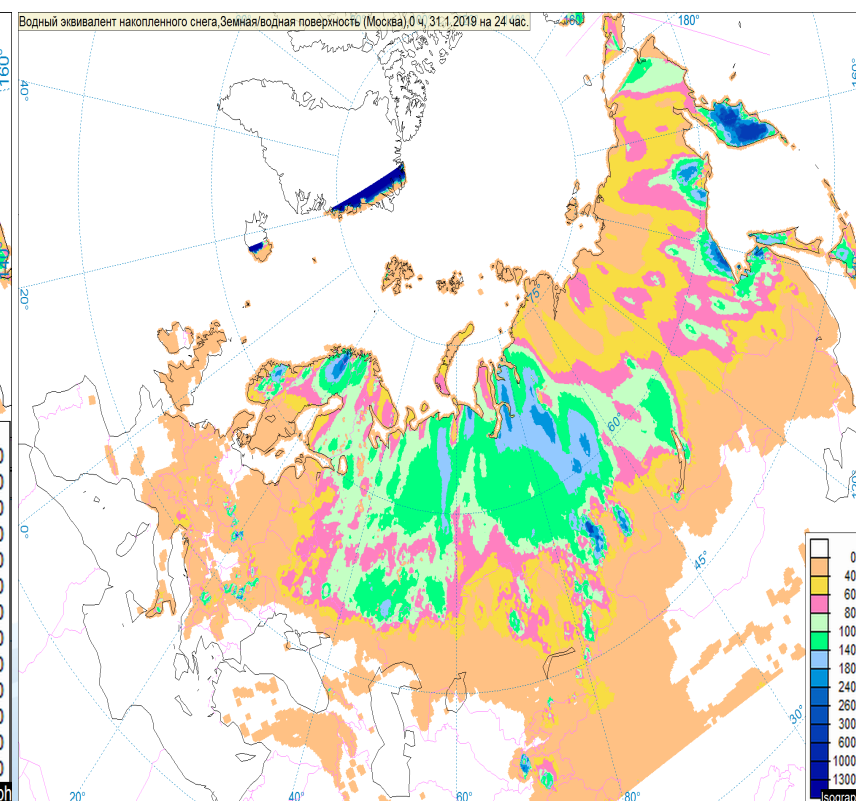
Grid step – **13 km**



The real-time version of  
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with **ICON** data



Quasi real-time version of  
snow cover model **SnoWE**  
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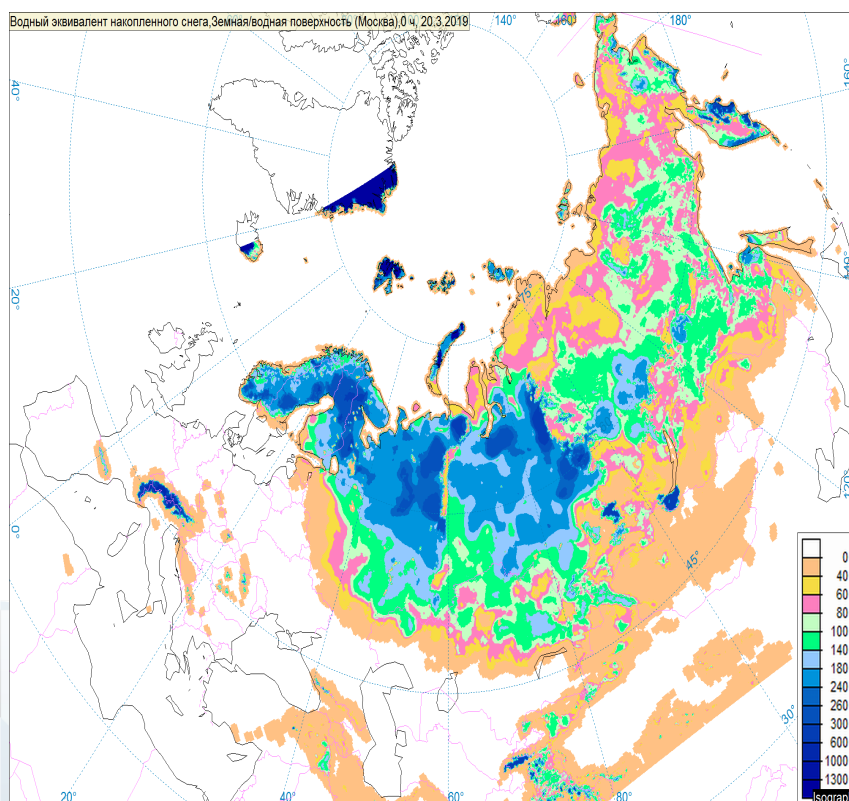
The hybrid version of  
**COSMO-Ru** system  
with the regional snow **DAS**

# The regional snow data assimilation system

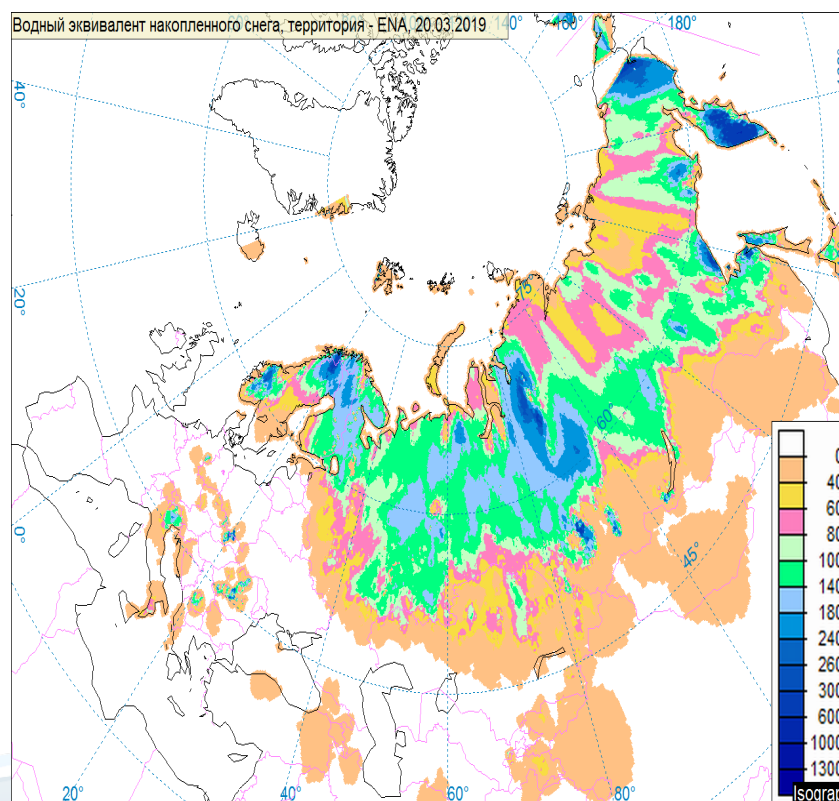
The example of the numerical experiment on the calculation of **snow water equivalent (mm)** for the territory of the Russian Federation by **COSMO-Ru** on **20.03.2019**

Period of investigation – **winter season 2018/2019 years**

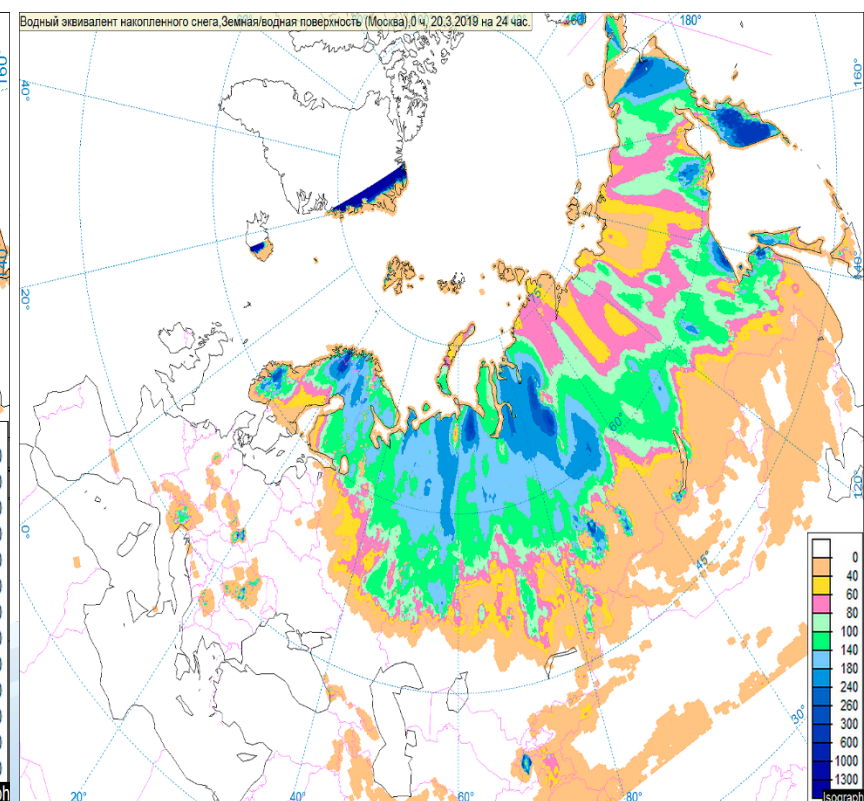
Grid step – **13 km**



The real-time version of  
**COSMO-Ru** system  
with **ICON** data



Quasi real-time version of  
snow cover model **SnoWE**  
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The hybrid version of  
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with the regional snow **DAS**

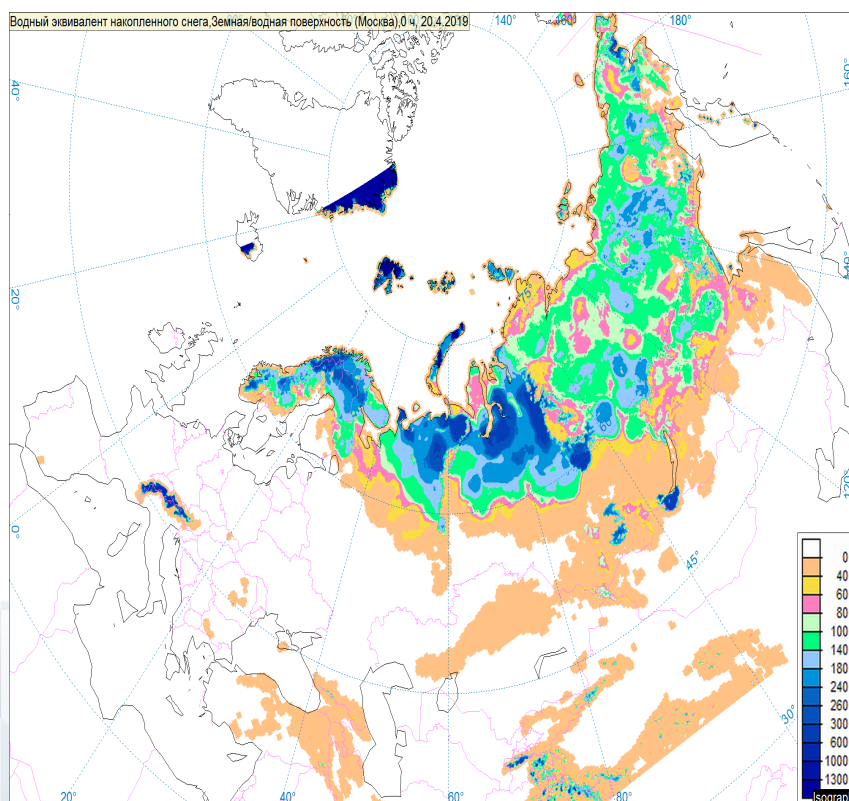


# The regional snow data assimilation system

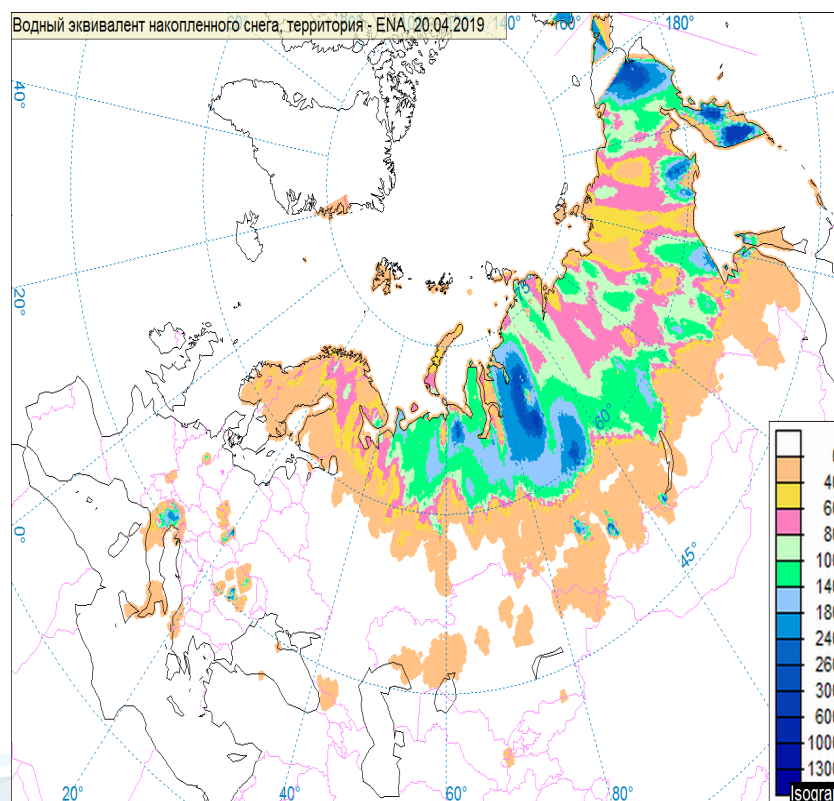
The example of the numerical experiment on the calculation of **snow water equivalent (mm)** for the territory of the Russian Federation by **COSMO-Ru** on **20.04.2019**

Period of investigation – **winter season 2018/2019 years**

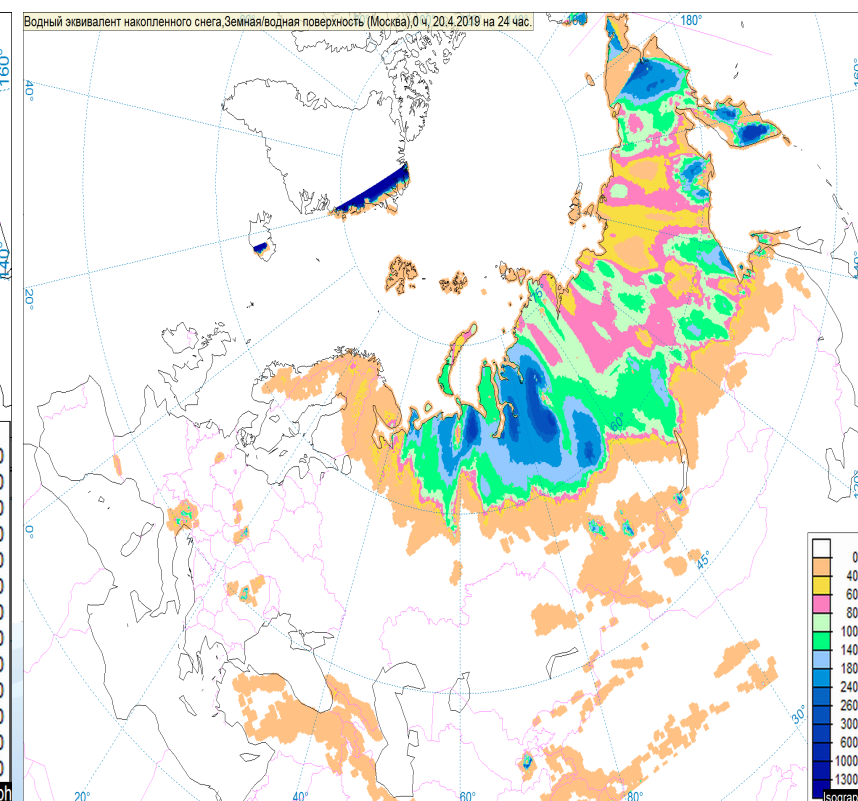
Grid step – **13 km**



The real-time version of  
**COSMO-Ru** system  
with **ICON** data

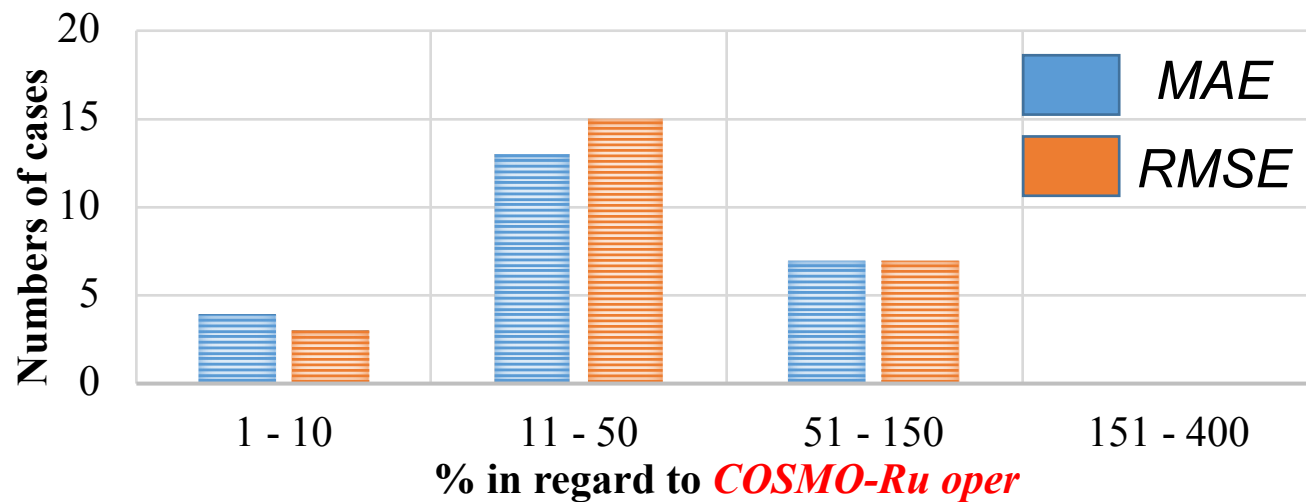


Quasi real-time version of  
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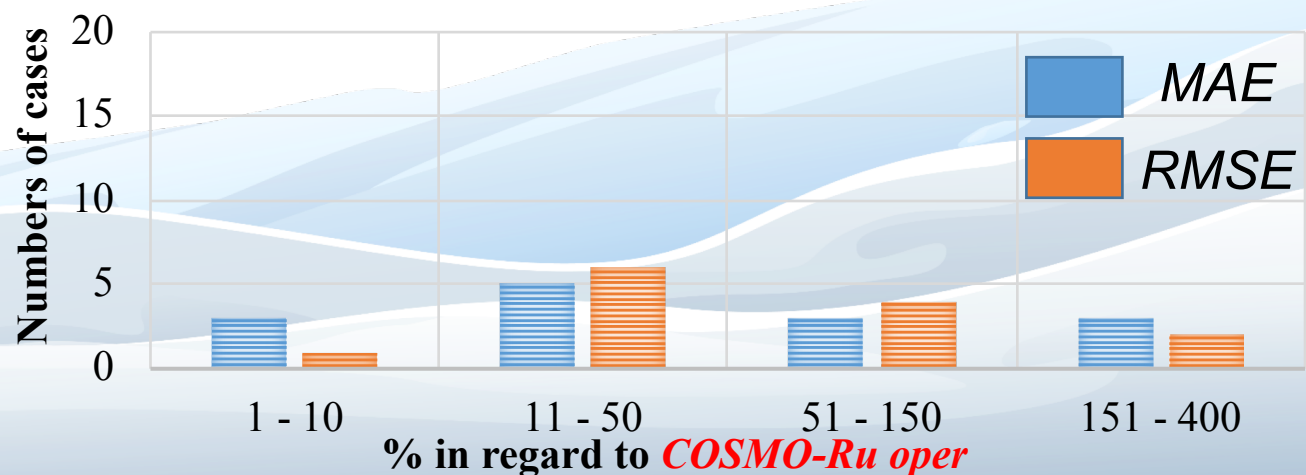


The hybrid version of  
**COSMO-Ru** system  
with the regional snow **DAS**

## The diagram of SWE forecast improvements



## The diagram of SWE forecast worsening





1. The **SnoWE** documentation have been written and loaded at GitHub page. We are going to modify this documentation and translate it in English
2. We works with hydrology specialists and we have the positive results, in particular:
  - a) The new method of synthesizing models of hydrometeorological cycle was developed. The combined use of **COSMO-Ru**, **SnoWE** and **ECOMAG** allows to carry out a quantitative assessment of the flood characteristics with a lack time of data from hydrometeorological observations
  - b) Hydrologists are using our snow data for their tasks (modelling and forecasting spring floods);
  - c) Snow maps consist an actual information

**3.** Interceptions of precipitation by vegetation were analyzed based on the paired snow surveys. We established that the main factors, which affect snow volume on the tree crowns are solar radiation and air temperature in the surface layer. At the same time, regression equations were constructed for receiving estimation algorithms of snow volume equalization period in field and forest;

**4.** The results of **COSMO-Ru** numerical experiments with the regional snow DAS were compared with independent in-situ materials. The statistical analysis of experiments shown that in 71% cases of the regional snow DAS application allowed to improve results of **COSMO-Ru** calculations on 41 – 50%, that it is a positive result. Moreover, in 29% cases of experiments the statistical analysis shown that the final result of **COSMO-Ru** snow calculations was worsened, especially in the South regions of Russia;

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*email:* [evgenychur@gmail.com](mailto:evgenychur@gmail.com)

*Best regards, Churiulin E.*

