PP C2I

System COSMO-Ru:
(Sept. 2019 – Aug. 2020)

2 Sept 2020, C2I,

Blinov D., Bundel A., Kirsanov A., Rivin G.
and HMC COSMO team

5.1 Phase 1 - Preparation & Installation

Phase 1 starts with the ICON-LAM training course in April 2018 and lasts until December 2018.

In this phase, the participating institutions install ICON on their HPC systems and gain experience in running the model.

At the end of Phase 1, setups that are similar to the institutions' current deterministic COSMO-model setups are defined and tested.

5.2 Phase 2 - Basic Forecasting System

In Phase 2 starting from January 2019, the participating institutions perform at least one daily deterministic ICON-LAM forecast without data assimilation.

For this, the setups from phase 1 are used. Considering the capacities of the participating institutions' HPC systems, only one additional deterministic forecast per day is required within this project.

Although desirable, this does not have to be in real time. In this phase, the verification can be adapted to ICON-LAM products and surveys for the feedback from the forecasting departments are prepared.

Furthermore, due to the similarity with the COSMO setups, the computational efficiency of ICON and COSMO can be compared as well.

With regard to phase 3, data assimilation systems are prepared.

5.3. Phase 3 – Deterministic Forecasting System Including Data Assimilation

Starting in July 2020, data assimilation cycles are added in Phase 3 to the ICON-LAM forecasting systems.

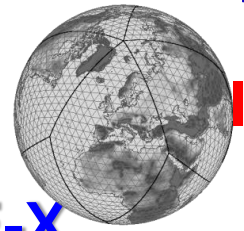
In this last phase, the most important goals are the verification of the ICON-LAM results, the retrieving of feedback from the forecasting departments and the tuning of the setups.

With the **end of the project in March 2022**, each participating institution has a working deterministic ICON-LAM forecasting system.

As stated previously, **ICON-LAM ensemble prediction systems** are covered within the PP APSU where a strong collaboration with the PP C2I will be established

Stage 1 COSMO

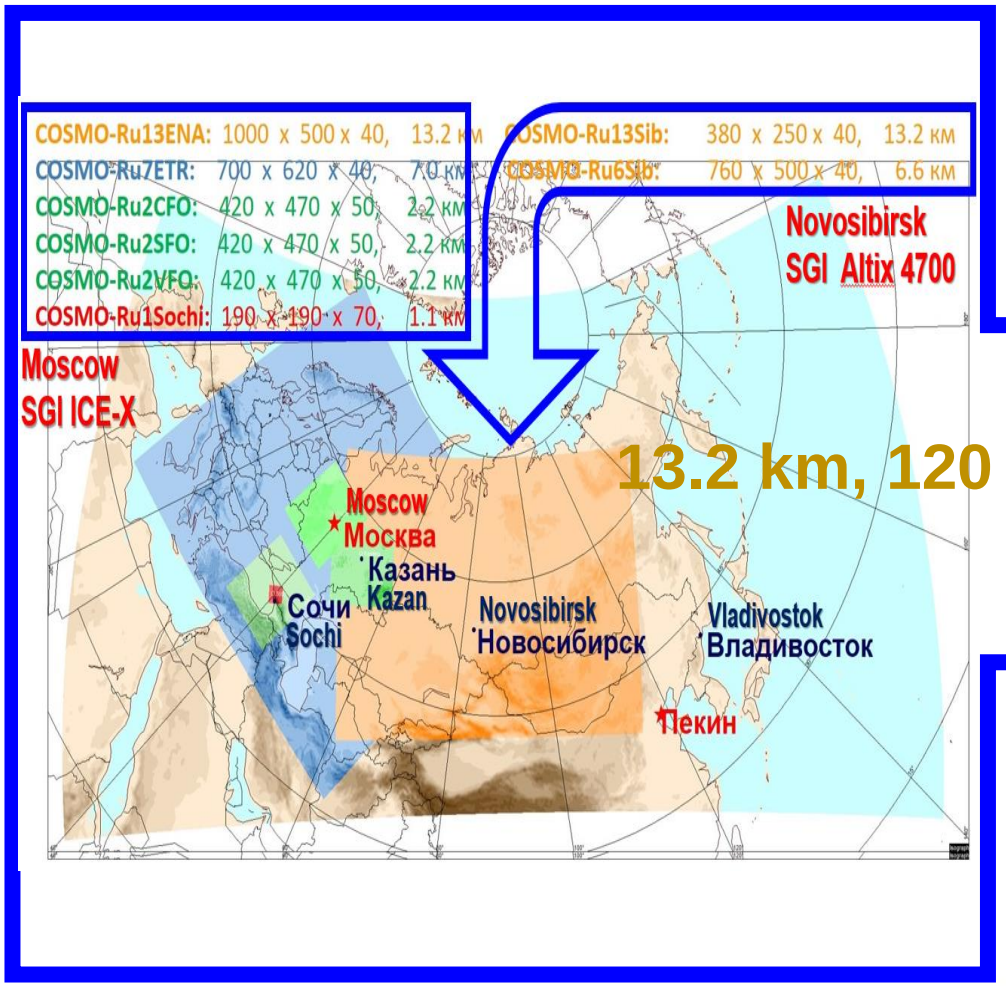
System COSMO-Ru/cosmo

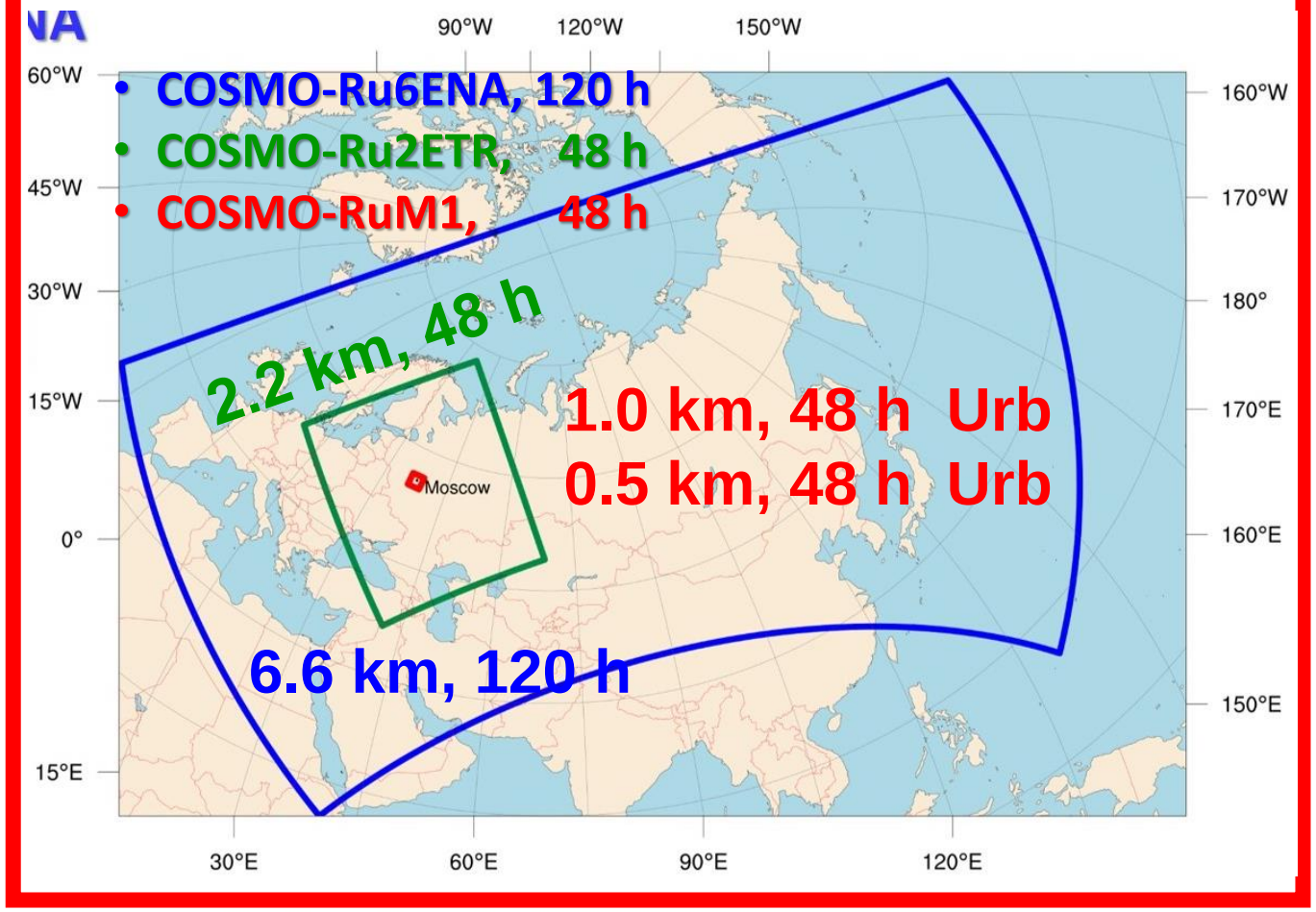


ICON DWD: initial and boundary data

SGI ICE-X

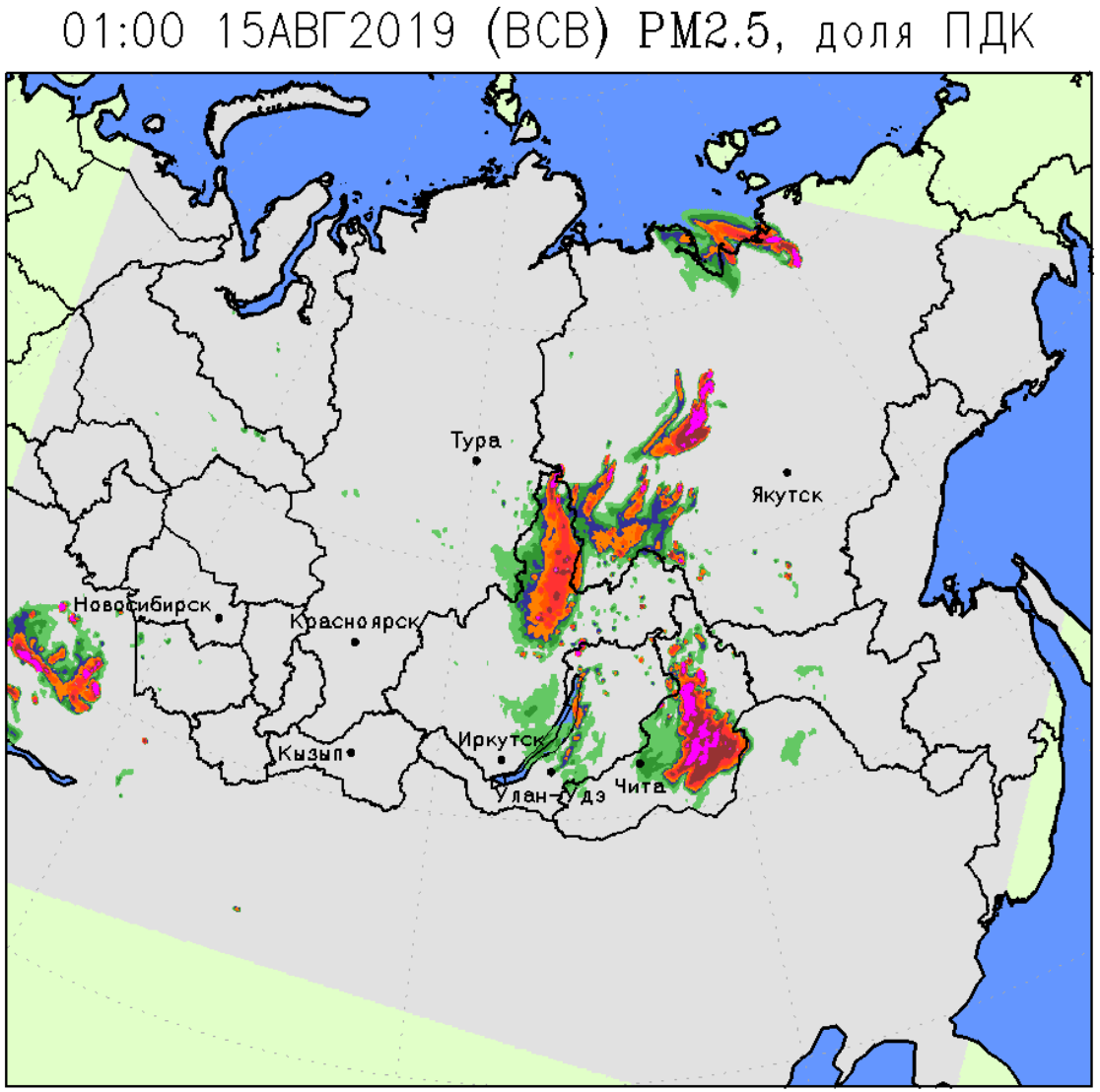
Cray XC40-LC





Operational weather forecasting technology

15.10.2019 UTC, Part of MPCmax



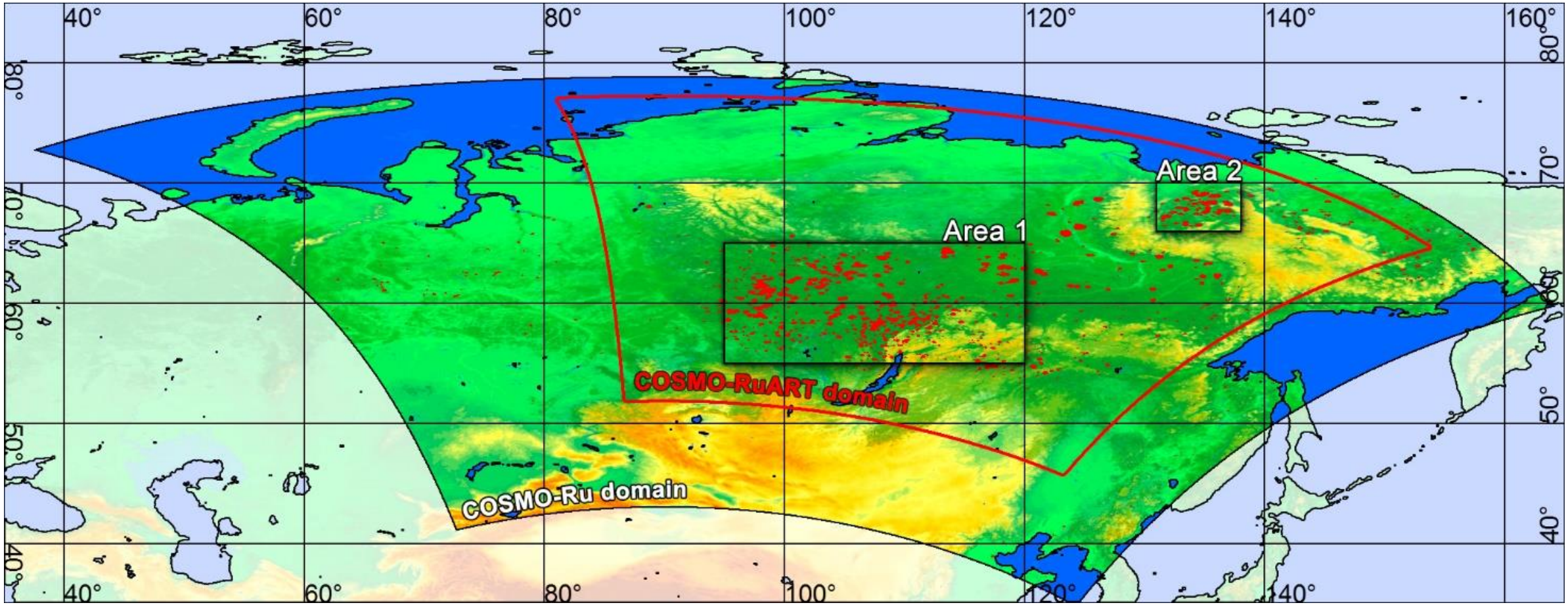
Summer 2019 forest fires.

Dangerous concentrations

MPCmax (maximum permissible concentration)

Warnings were issued

1. COSMO-Ru 5.0 COSMO-RuART 5.0 6.6 km



2. Москва: COSMO-RuM 1км, 500 м.

System COSMO-Ru/icon, Global ICON-Ru, 120 h
C2I-2020, Cray XC40-LC, Version 2

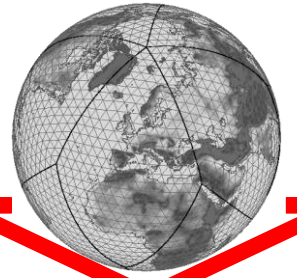
Stage 2 ICON

System COSMO-Ru/cosmo

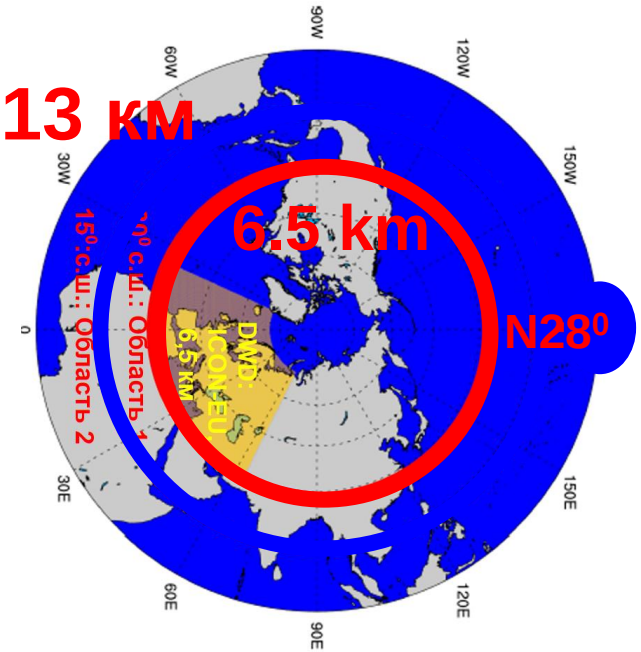
?

ICON-RuN28^0 Initial data:

DA DWD:



First guess (-1.5 h) & Increments



Run time (13 км and N28 - 6.5 km): 34 min / 120 h, Cores: 9216 - 32 (output)

Run time Global ICON (13 km and N28 - 6.5 km):

Cores: 2880 - 32 (output) 1751 c / 048 h → 75 min / 120 h
Cores: 5760 - 32 (output) 1012 c / 048 h → 42 min / 120 h
Cores: 8640 - 32 (output) 0794 c / 048 h → 33 min / 120 h
Cores: 9216 - 32 (output) 34 min / 120 h

DONE
00 and 12

Run time Global ICON (13 km):

Cores: 2880 + 32 (output) 2h 50 min / 31 days

Run time ICON-LAM for Eastern Europe (EE, 2 km):

Cores: 2880 - 4 (output) 3189 c / 048 h 53 min / 048 h
Cores: 2880 - 4 (output) → 60 min / 054 h
Cores: 2880 - 4 (output) 4598 c / 072 h 74 min / 072 h
Cores: 2880 - 4 (output) 7575 c / 120 h 126 min / 120 h
Cores: 5760 - 32 (output) 3916 c / 120 h 65 min / 120 h

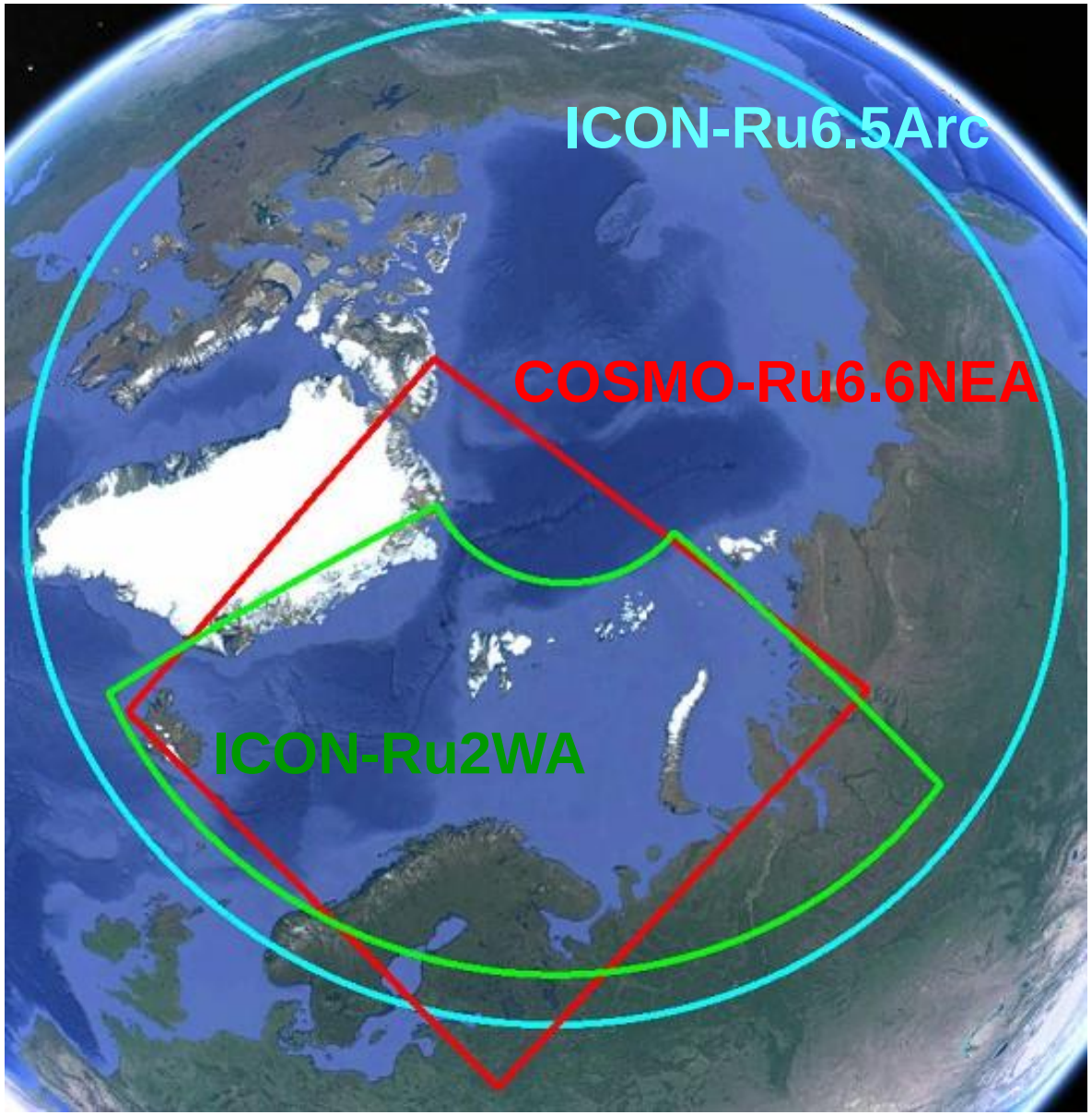
BEGIN

Run time ICON-LAM for Eastern Europe (2 km and 1 km):

Cores: 2880 - 4 (output) XXXX c / 054 h XXX min / 048 h

Run time ICON-LAM for Arctic (3.2 km and 1.6 km):

Cores: 2880 - 4 (output) XXXX c / 054 h XXX min / 048 h



ICON-Ru6.5Arc (ICON-Ru - Init +Boundary)

ICON-Ru2WA (ICON-Ru: Init +Boundary)

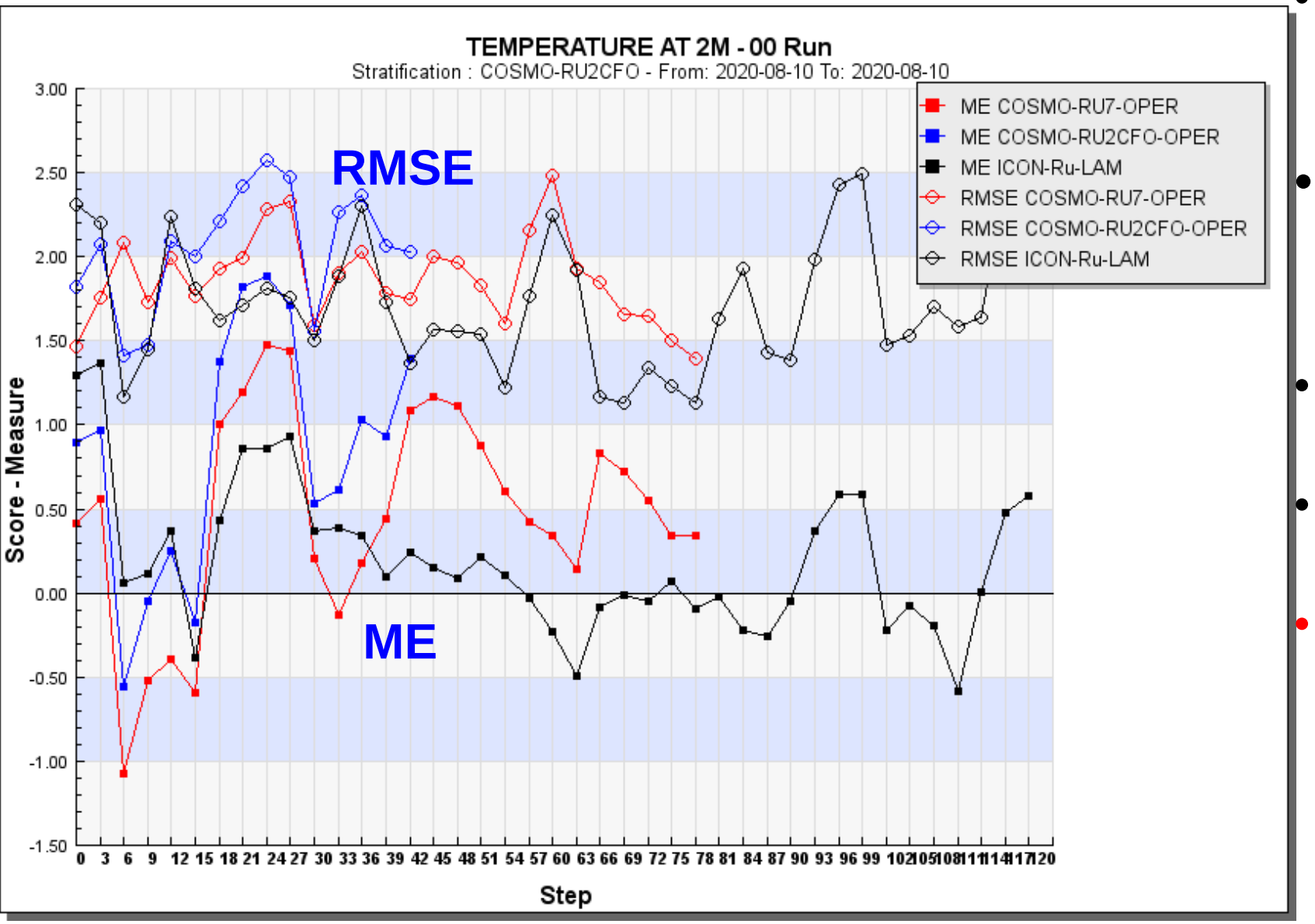
COSMO-Ru6.6NEA (DWD: Init +Boundary)

Добавить

1. Сайт COSMO-Ru

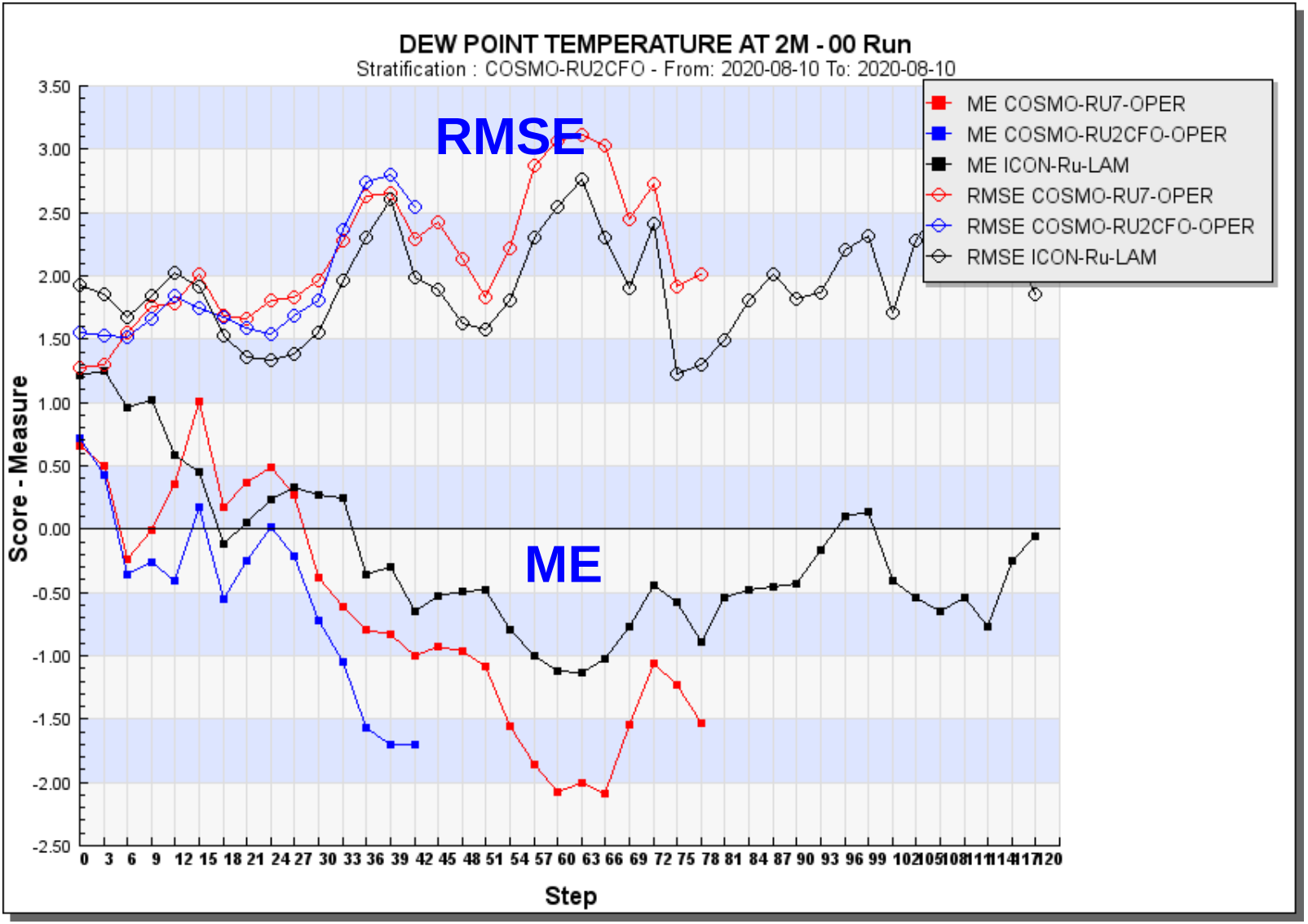

ICON-Ru2EE
ICON-Ru1M
ICON-Ru1S
SWEDEN
FINLAND
NORWAY
Oslo
Helsinki
Stockholm
Saint Petersburg
ESTONIA
LATVIA
LITHUANIA
Vilnius
Minsk
BELARUS
Moscow
Yekaterinburg
URAL MOUNTAINS
DENMARK
Copenhagen
Amsterdam
Berlin
POLAND
Warsaw
Brussels
GERMANY
Cologne
Paris
CZECHIA
Vienna
AUSTRIA
Budapest
HUNGARY
Milan
ROMANIA
Bucharest
Kiev
UKRAINE
Volgograd
KAZAKHSTAN
Astana
ITALY
Rome
Barcelona
BULGARIA
Istanbul
Ankara
GREECE
Athens
TURKEY
Black Sea
Caspian Sea
Aral Sea
GEORGIA
Baku
UZBEKISTAN
Tashkent
KYRGYZSTAN
TURKMENISTAN
TAJIKISTAN
Tehran
SYRIA
Damascus
AFGHANISTAN
Kabul
Islamabad
Tunis
TUNISIA
Tripoli
Mediterranean Sea
North Sea
Baltic Sea
Norwegian Sea
Lake Ladoga
Volga
Kama
Ural
Tobol
Irtysh
Ob
Pechora
Dnieper
Don
Danube
Rhine
Amu Darya
Syr Darya
ZAGROS

COSMO-Ru7, COSMO-Ru2, ICON-Ru2EE – T2m



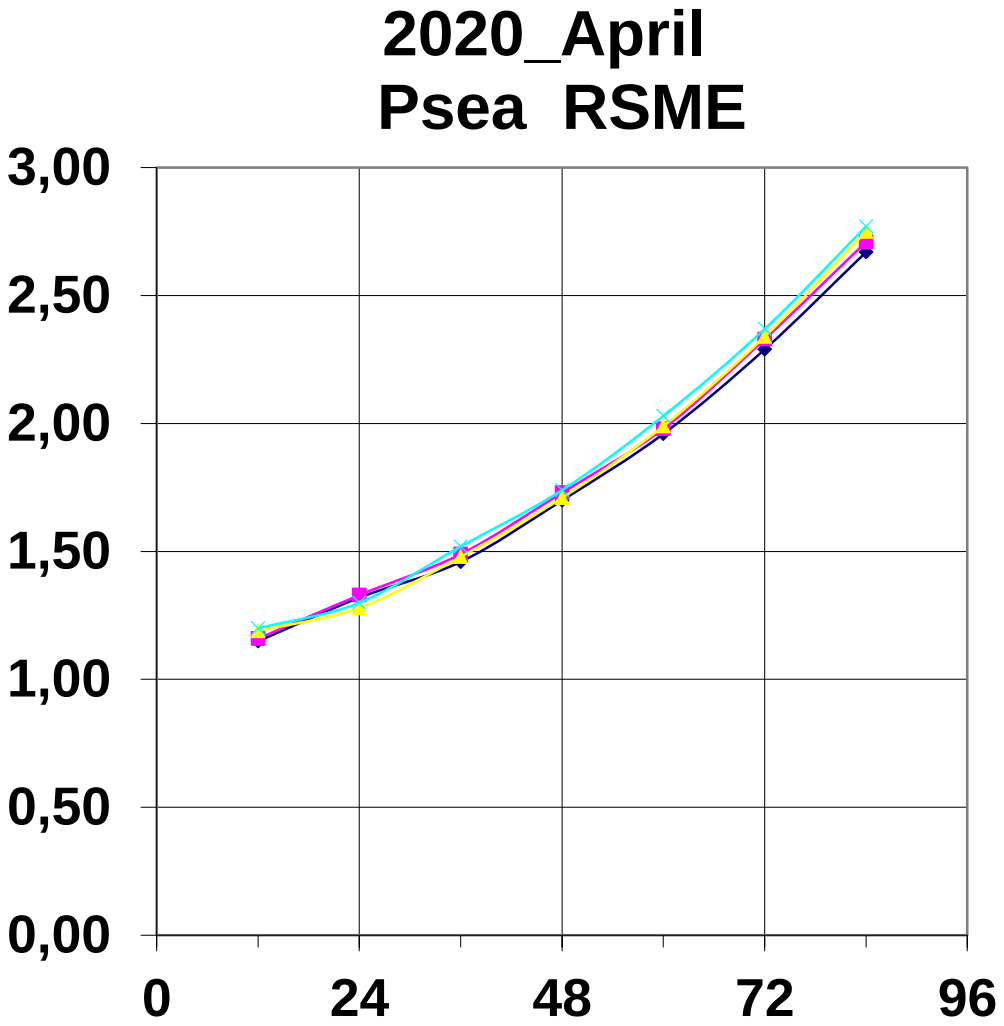
- Scores for 152 stations in Central Federal District (including Moscow)
- **ICON-Ru-LAM run on 5 days from 10.08.2020**
- Only first test scores obtained in VERSUS
- Comparison with operational COSMO-Ru
- ICON-Ru-LAM has lower RMSE after the first hours of forecast (similar results are observed for ICON-COSMO verification in Common Plot WG5 activity)

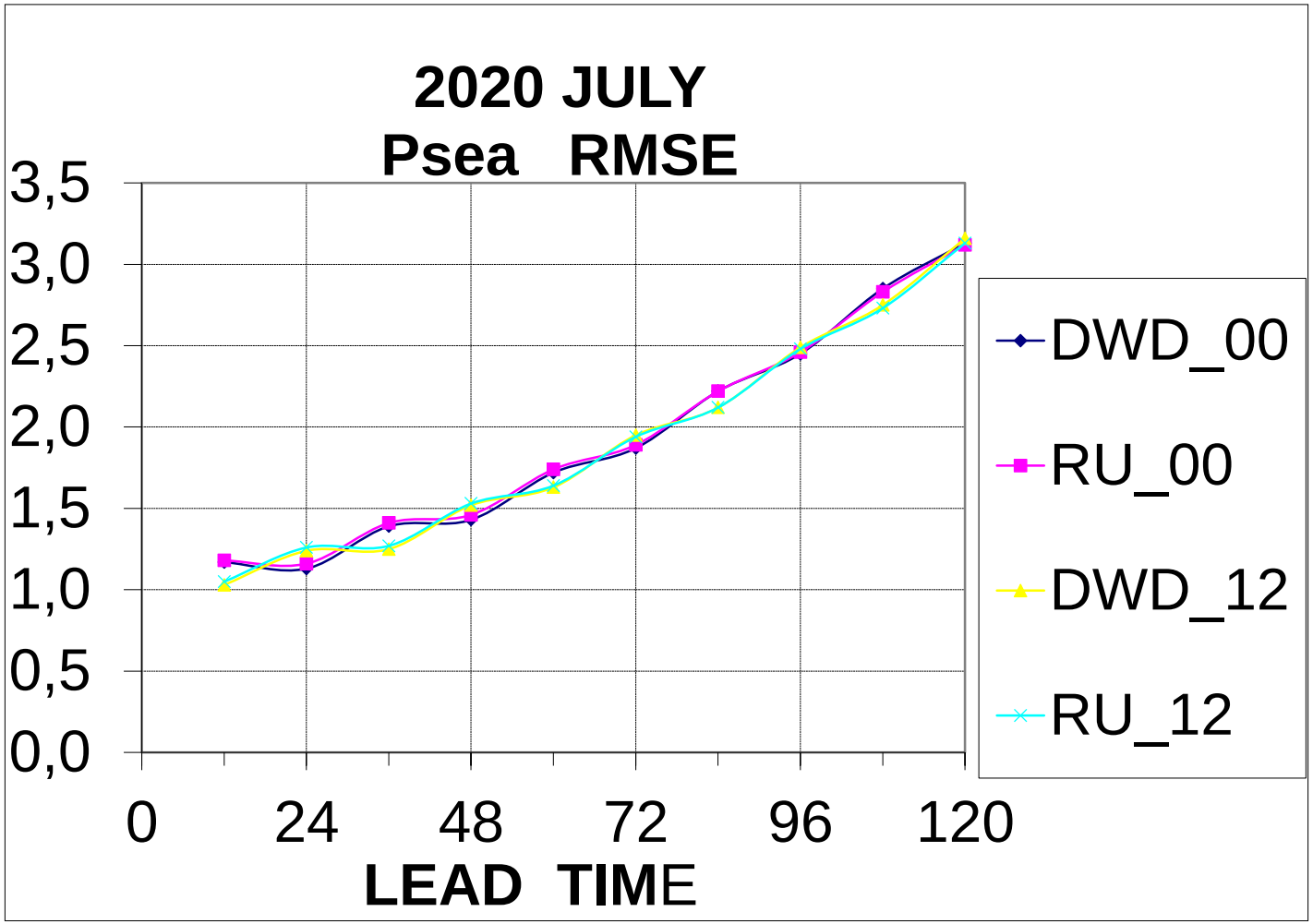
COSMO-Ru7, COSMO-Ru2, ICON-Ru2EE – DEW POINT



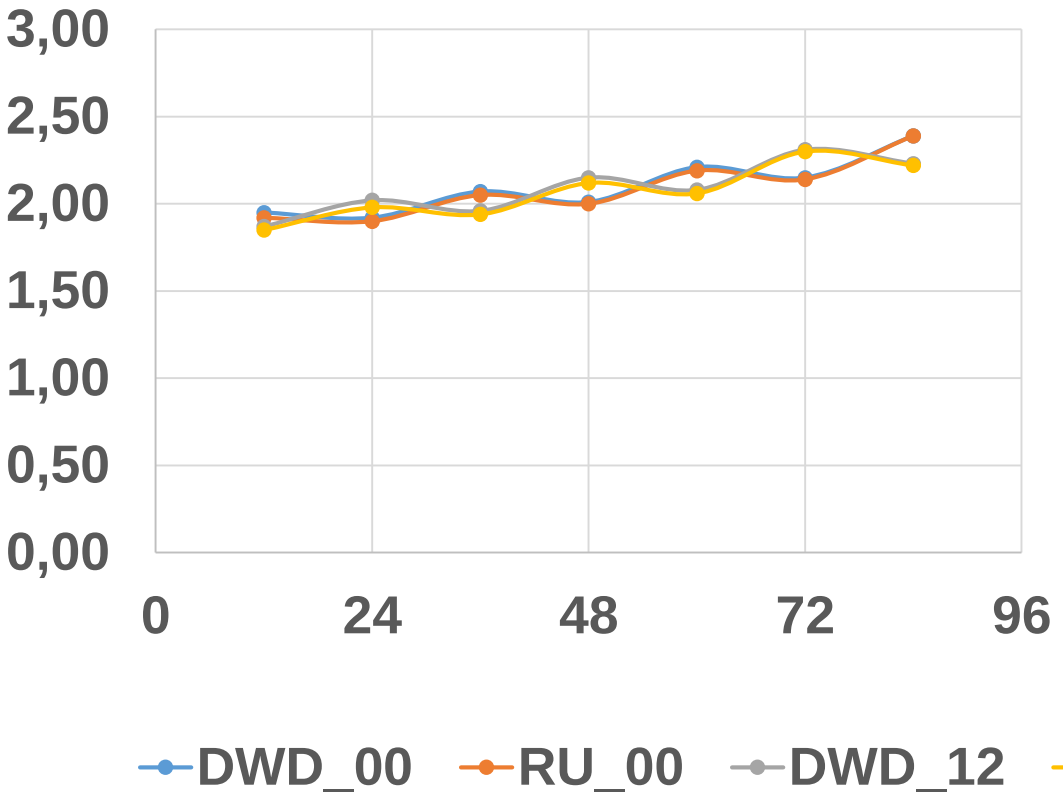
- Scores for 152 stations in Central Federal District (including Moscow)
- **ICON-Ru2EE run on 5 days from 10.08.2020**
- Only first test scores obtained in VERSUS
- Comparison with operational COSMO-Ru
- ICON-Ru2EE has lower RMSE after the first hours of forecast
  (similar results are observed for ICON-COSMO verification in Common Plot WG5 activity)

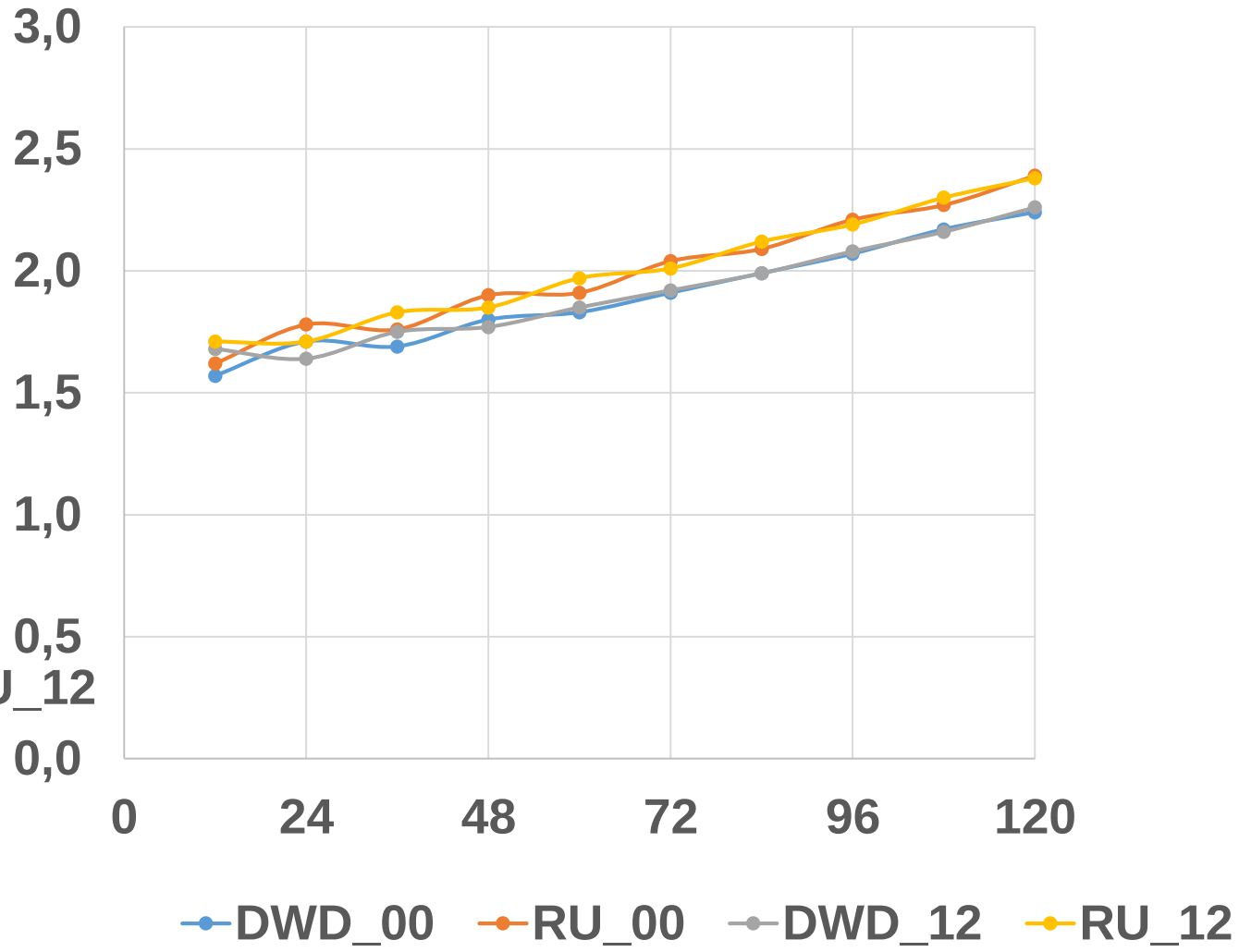
DWD ICON and ICON-Ru, Ponomareva T.





DWD ICON and ICON-Ru, Ponomareva T.





Kiktev D., Smirnov A., Abs Error, 28feb-28aug2020

CONSORTIUM FOR SMALL SCALE MODELING COSMO

Мониторинг качества прогноза

0-6ч | 0-12ч | 0-24ч | 0-48ч | 0-72ч | Макс | Средняя абсолютная ошибка | Москва Балчуг

T2m BALCHUG

Humidity (%)

V (grad)

|V|

Psea

Модель | Старт(час)

COSMO1 | COSMO2ETR | COSMO7 | COSMO13 | GFS | GEM | ICON7 | ICON | ECMWF | JMA

COSMO-Ru1

GFS

ICON

ECMWF

JMA

Lead Time 24 h

0-6ч | 0-12ч | 0-24ч | 0-48ч | 0-72ч | Макс | Средняя абсолютная ошибка | Москва ВДНХ

T2m VDNKH

Humidity (%)

V (grad)

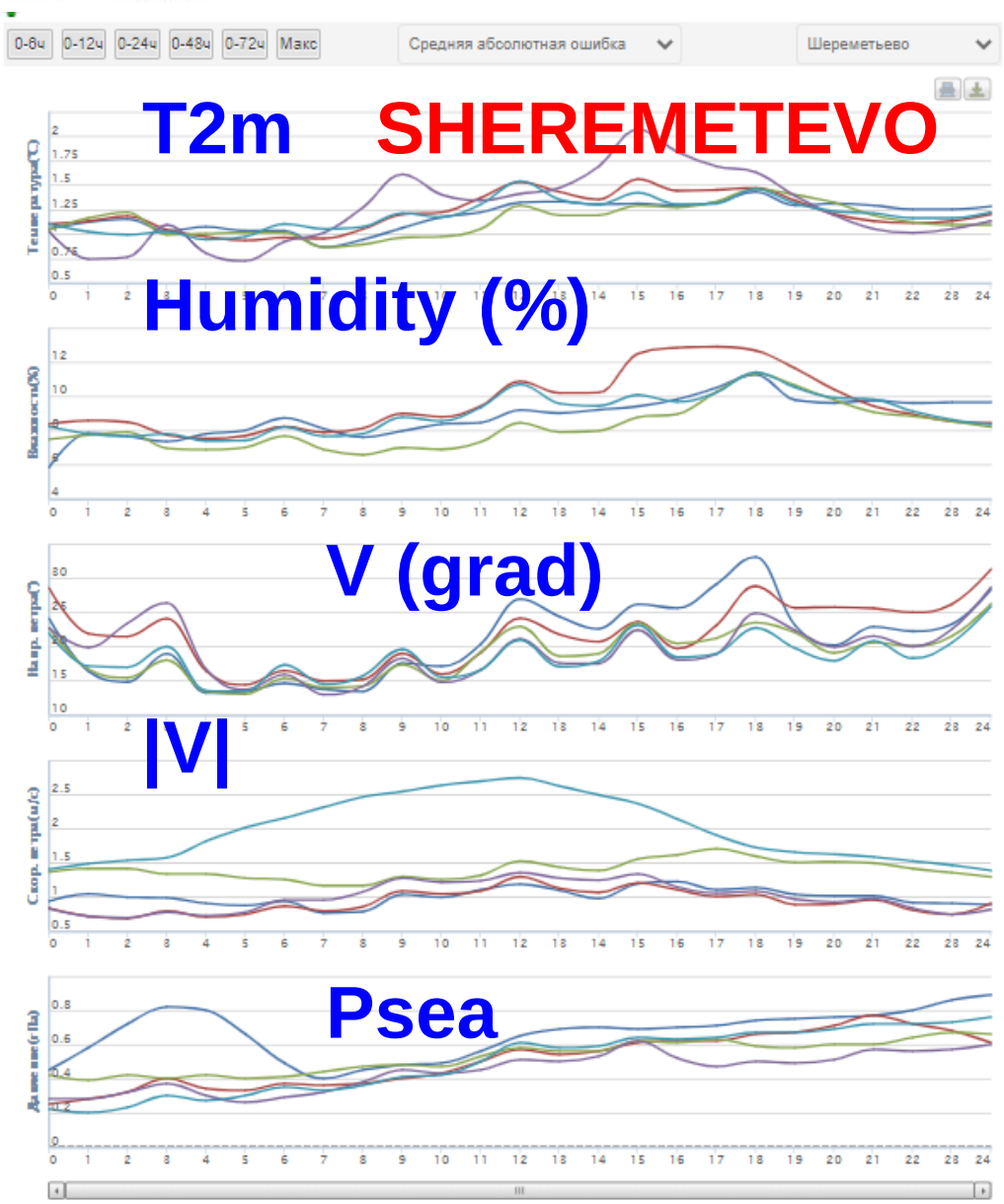
|V|

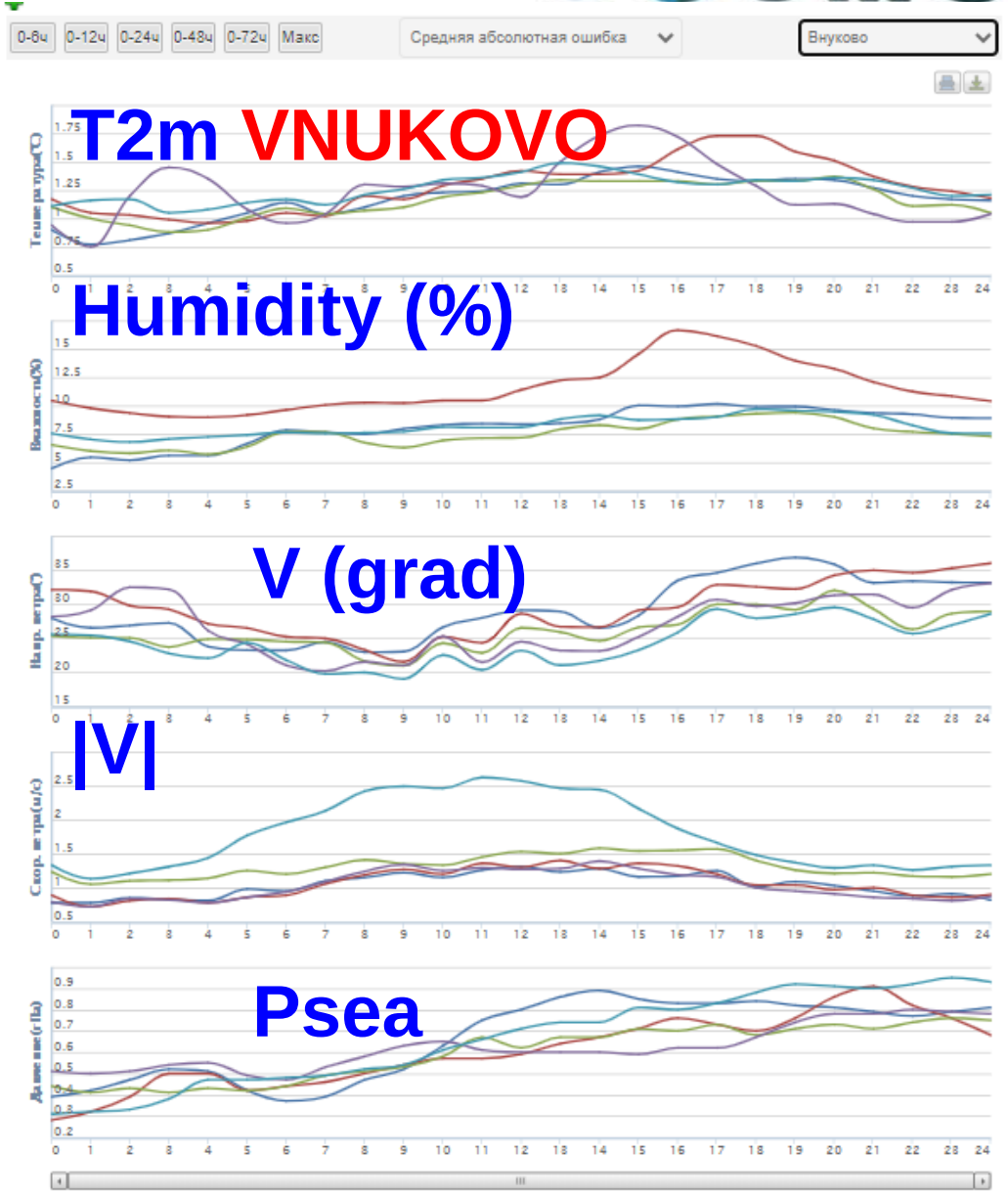
Psea

2020-02-26 — 2020-08-28

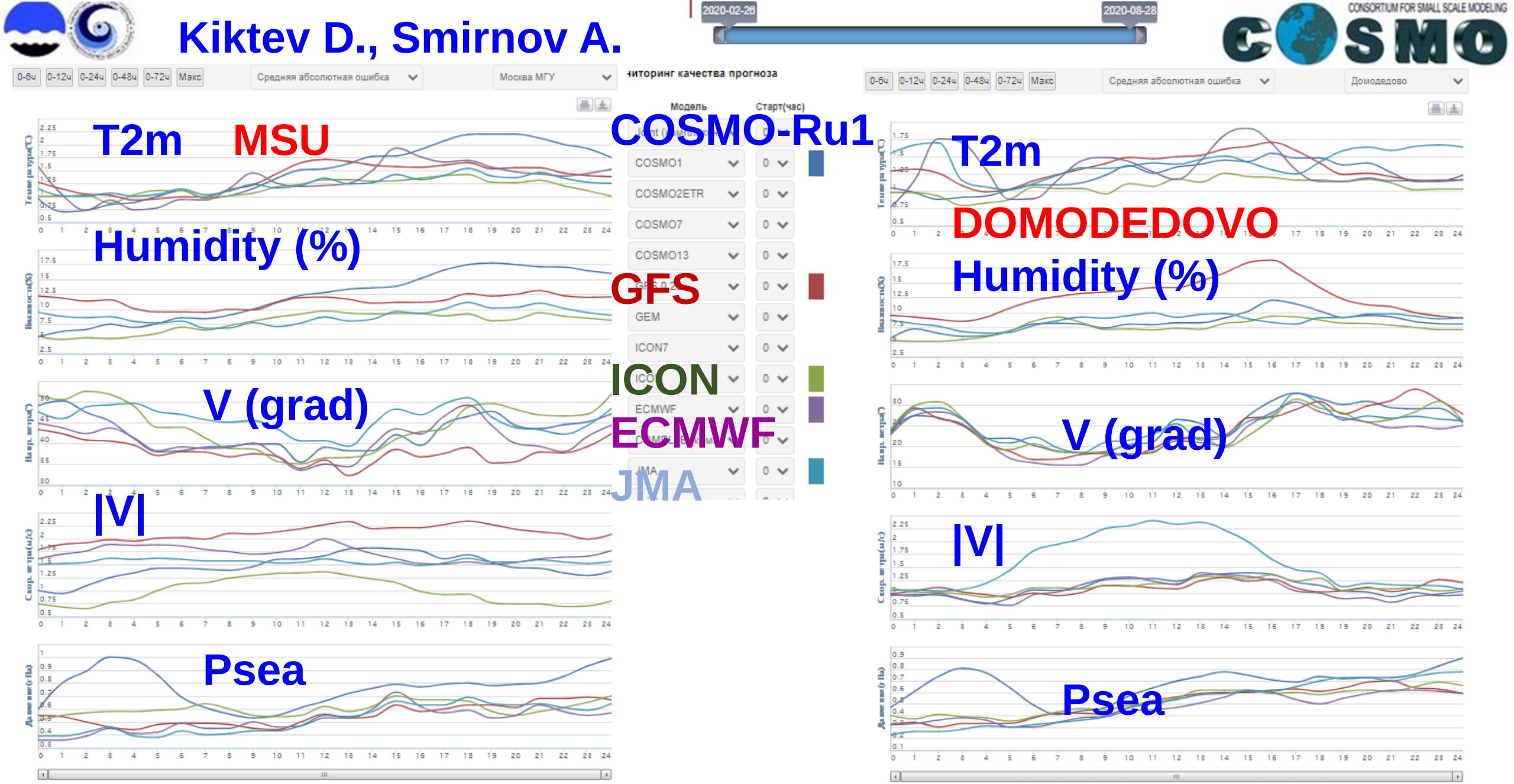
Kiktev D., Smirnov A.

CONSORTIUM FOR SMALL SCALE MODELING
COSMO





Kiktev D., Smirnov A.



ICON-LAM for Eastern Europe (2 km and 1 km):

Cores: 2880 + 4 (output) XXXX c / 054 h XXX min / 048 h

Run time ICON-LAM for Arctic (3.2 km and 1.6 km):

Cores: 2880 + 4 (output) XXXX c / 054 h XXX min / 048 h

FIRST RESULTS

The computational efficiency and forecasts

ICON-Ru better COSMO-Ru

Thanks you and ICON!

task 4: Computational aspects

As stated in the previous sections, the setup (re.\ domain size and grid spacing) of the ICON-LAM forecasts is similar to the setup of the operational COSMO-model forecasts. Using the same number of processors, this allows for a simple comparison of the wall clock time of the two models. For this comparison, technical features of the individual models that decrease the computational costs in forecasts should be used when possible.

This simple wall clock time comparison covers the computational aspects between the two models only on a very basic level. A more rigorous comparison is beyond the scope of this already work-intensive priority project. However, with the sum of tests at the different institutions, some first conclusions can be drawn.

Nevertheless, the individual institutions are encouraged to perform more detailed tests with ICON-LAM. Especially strong scaling, weak scaling, memory consumption and peak performance ratio have the potential to provide a valuable insight into the performance of ICON-LAM compared to the COSMO model. If a dedicated GPU version is available within the scope of PP C2I, a summary on CPU/GPU computational aspects is highly desirable.

Deliverables:

A report (preferably a COSMO newsletter article) about the outcome of the tests.

task 5: Verification

With the daily deterministic ICON-LAM forecasts starting in Phase 2 of PP C2I (January 2019) one of the major tasks will be to validate the results. ICON offers the possibility to provide output on a regular longitude-latitude grid. Hence, the post-processing and validation tools used by the individual participating institutions for the COSMO-model (e.g. VERSUS) can be relatively easily adapted to work with ICON results. The usage of the same validation software for the COSMO model and ICON-LAM eases the intercomparison of the models' performance as well. It has to be pointed out that ICON does not offer the possibility of GRIB1 output. The available output formats are NetCDF and GRIB2. However, a conversion from GRIB2 to GRIB1 is supported by the official COSMO post-processing software fieldextra. The overarching goal of this task is the identification of systematic biases and to gain an objective comparison between the COSMO model and ICON-LAM. Strictly speaking, the latter requires a similar data assimilation procedure to be used by both models.

WG5 will provide verification guidelines that can be followed by the partners. For example, in the hindcast mode analysis of an extreme event the validation of precipitation could provide much more information in terms of performance ability if it is based on spatial methods (both neighborhood and feature-based) rather than on traditional point verification. However, for a longer term validation of performance (seasonal), simple scores based on point verification can be more appropriate and easy to follow.

In a long-term perspective, it is desirable to have a unified verication system for station-based verification within COSMO. This should be achieved with the Rfdbk software developed at DWD. The use of Rfdbk requires the creation of model feedback files at each participating institution. This includes providing the observations in a specific format and installing the model equivalent calculator (MEC). This will be supported by a currently planned PT/PP on Rfdbk (to be approved in September 2018). It should be easier to set up and use this software once a data assimilation has been established. Rfdbk is about to be tested for the verification of the COSMO test suite at ECMWF. The decision whether it might also be beneficial to use an Rfdbk-MEC based verification system at each national center can be made after reviewing the outcome. However, building up the capacities for a unified verification software within COSMO requires major resources from the COSMO members. Therefore, it is left to a PP or PT within the framework of WG5 where a strong cross-link to PP C2I could be established.

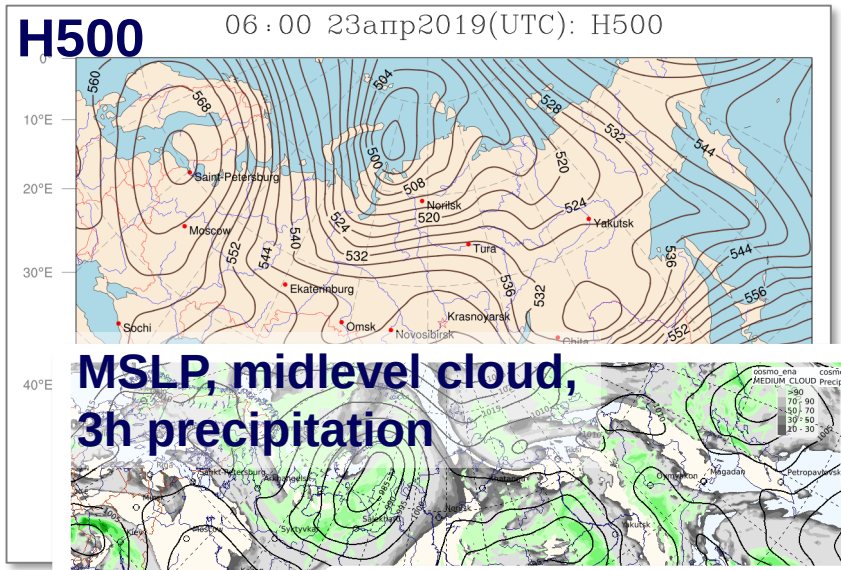
The CLM community follows a similar approach. As ICON data can be provided on a regular longitude-latitude grid, the existing validation software packages (e.g., ETOOL) can be used to compare the results to measurements. In addition, a standardization of the model output should take place before any further post-processing. Therefore, the existing CMOR (Climate Model Output Rewriter) tools have to be adjusted for ICON-LAM output and included in the runtime environment.

Deliverables:

Verification reports based on individual reports from each participating institution at the end of Phase 3.

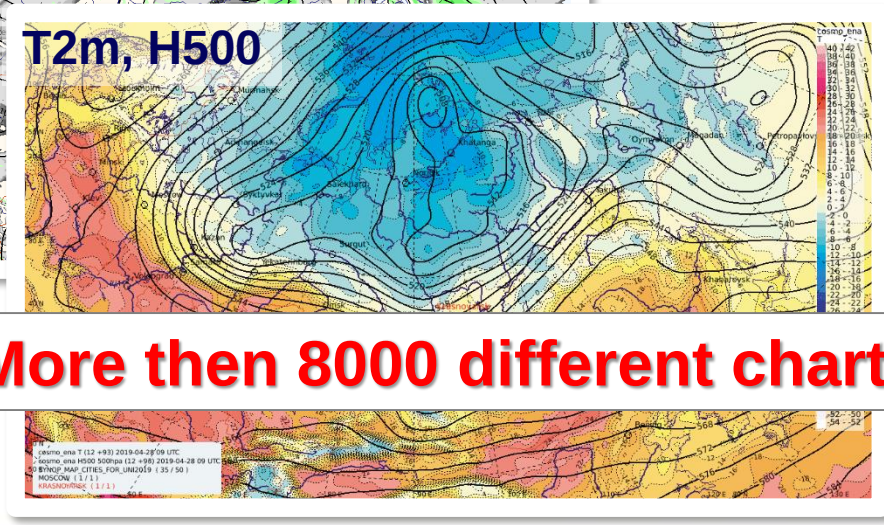
Operational weather forecasting technology

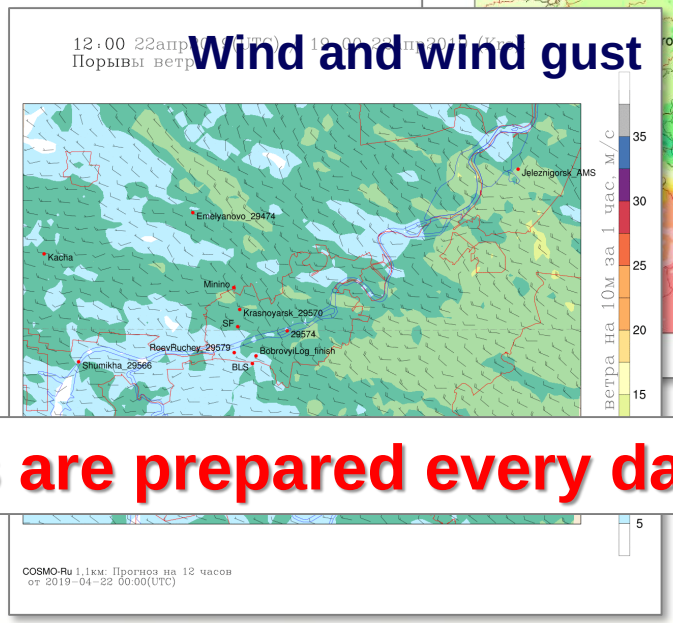
Products

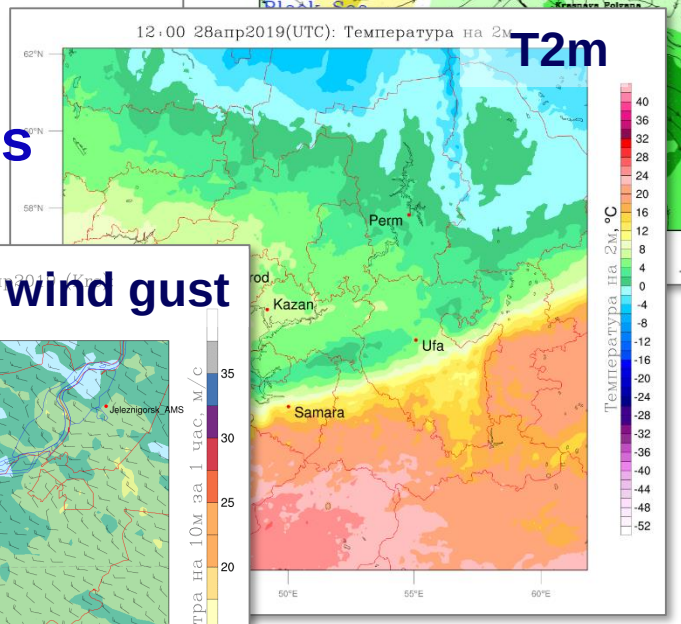


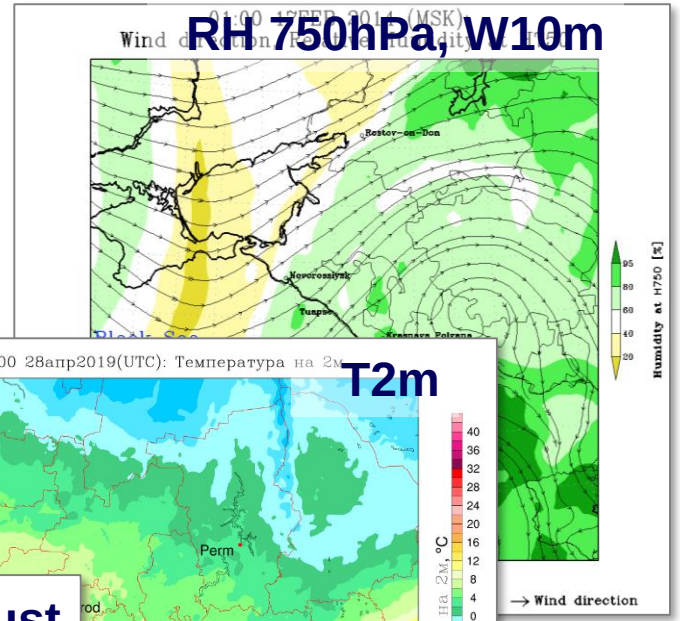
Forecast charts:

- different domains
- region of interest
- single parameter
- combination of parameters







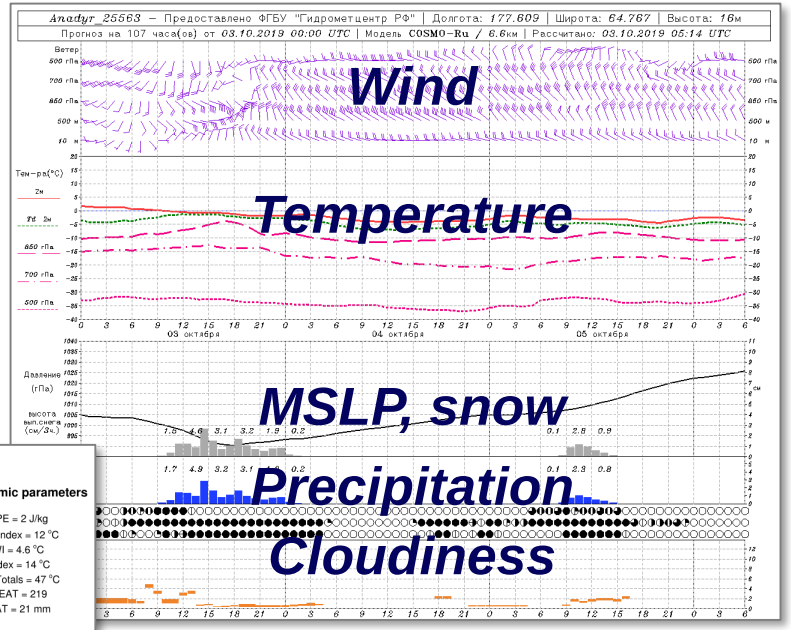


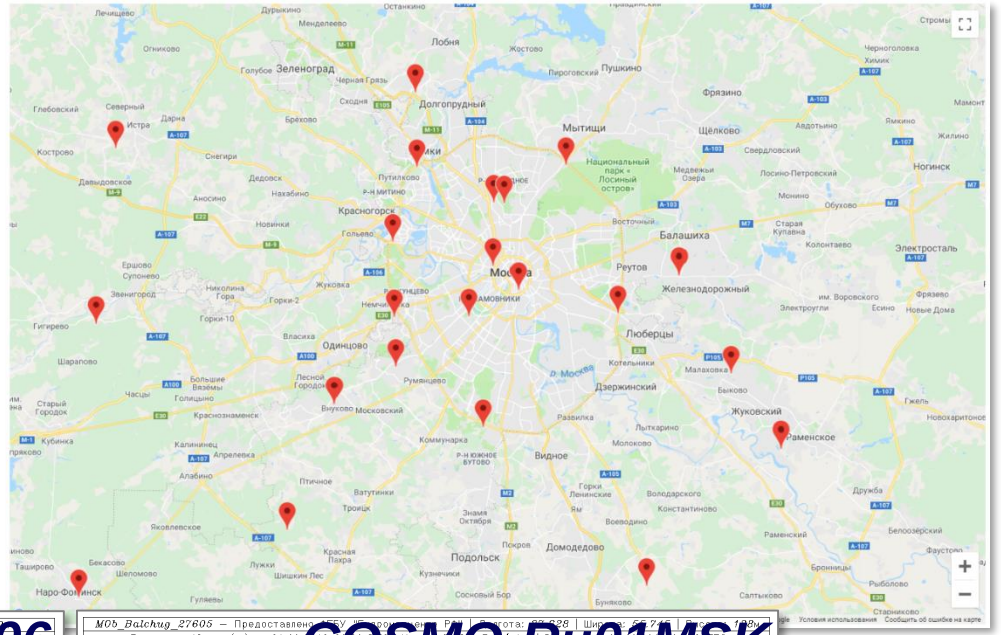
More then 8000 different charts are prepared every day

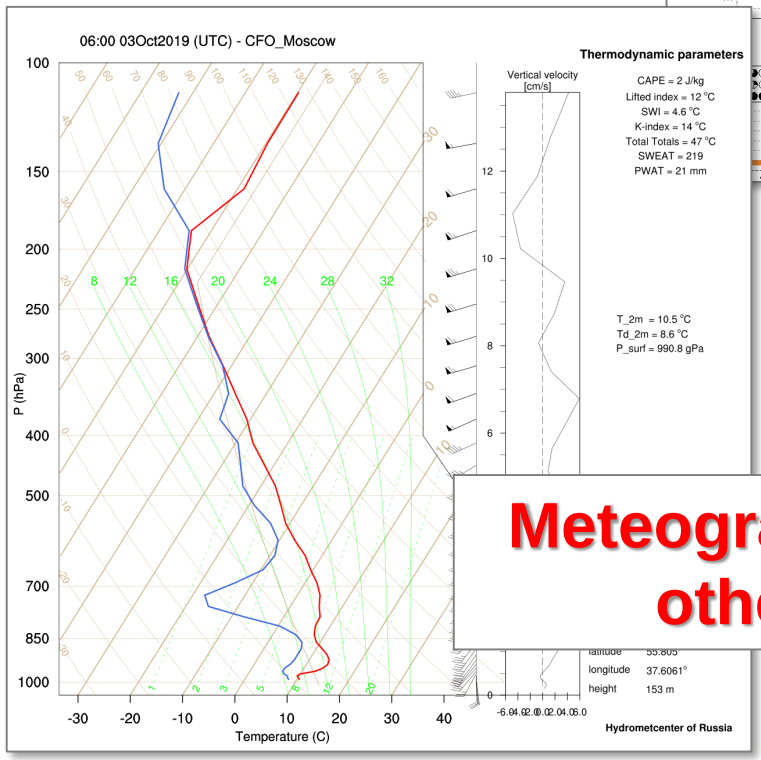
Operational weather forecasting technology

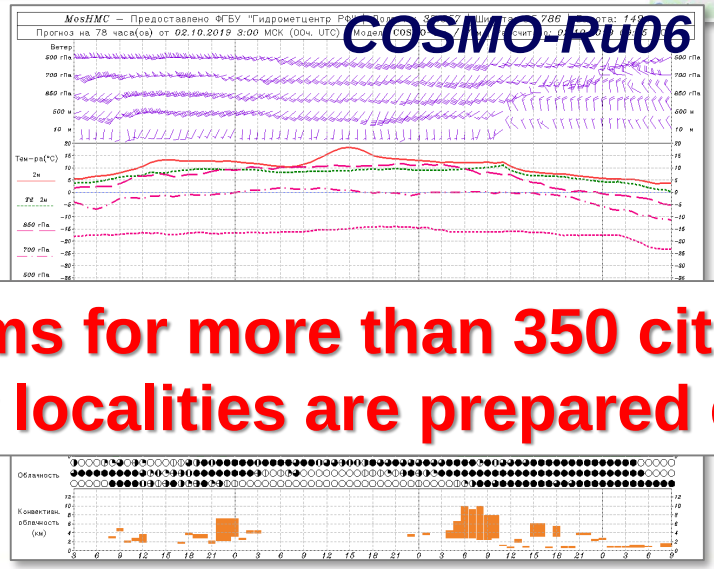
Products

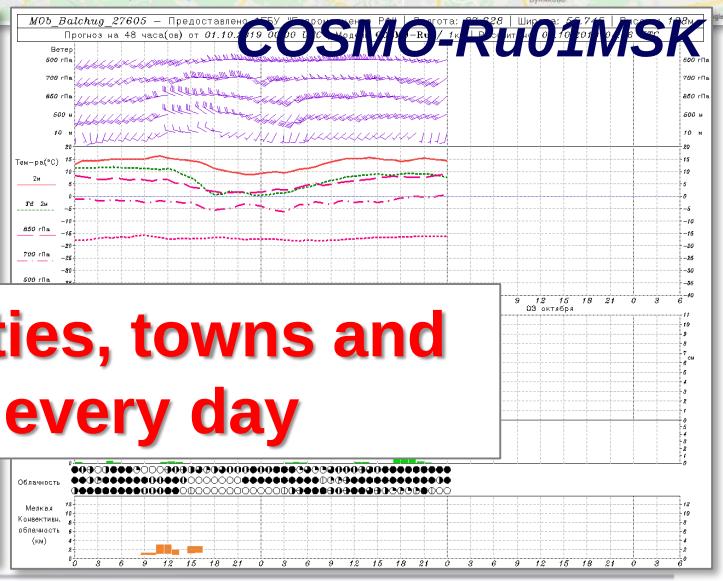
- meteogram
- T-skew diagram











Meteograms for more than 350 cities, towns and other localities are prepared every day