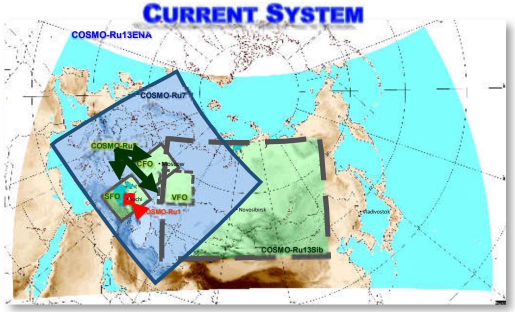
Gdaly.Rivin@mail.ru Inna.Rozinkina@mail.ru

THE MESOSCALE SHORT-RANGE WEATHER FORECASTING SYSTEM COSMO-RU

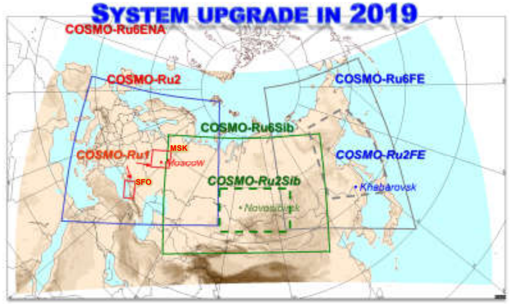
Hydrometeorological Center of Russia, Roshydromet
www.meteoinfo.ru Gdaly.Rivin@mail.ru Inna.Rozinkina@mail.ru

THE UPGRADE OF OPERATIONAL WEATHER FORECASTING SYSTEM

CURRENT SYSTEM



SYSTEM UPGRADE IN 2019



	Current Version	New Version	Domain	Grid spacing	Timestep	Forecast range*	Lateral Boundary Conditions
1.	COSMO-Ru13ENA	COSMO-Ru06ENA	13200 x 6100 km	6.6 km	60 s	78-120 h	ICON*
2.	COSMO-Ru7 COSMO-Ru2CFO/VFO/SFO	COSMO-Ru2	6000 x 6000 km	2.2 km	20 s	48-78 h	COSMO-Ru06ENA
3.	COSMO-Ru1	COSMO-Ru1SFO COSMO-Ru1MSK (new domain)	210 x 210 km	1.1 km	6 s	36 h	COSMO-Ru2

*ICON is a global ICOsahedral Nonhydrostatic model, joint development of DWD and Max-Plank-Institute for Meteorology (MPI-M), in operational use for NWP at DWD from January 2015.

** forecast range depends upon start time

WINTER UNIVERSIADE 2019 METEOROLOGICAL SUPPORT

krsk2019.ru

The 29th Winter Universiade 2019 will take place in the city of Krasnoyarsk on March 2-12, 2019.

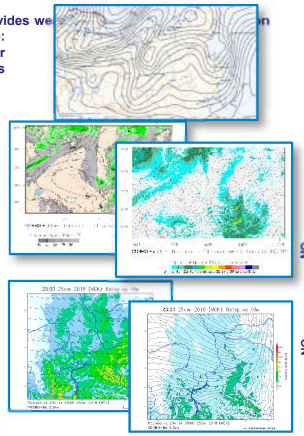
Competitions will be held in 11 sports:

- open air sports (alpine skiing, biathlon, cross-country skiing, freestyle skiing, snowboard, ski orienteering) and
- indoor sports (bandy, curling, figure skating, ice hockey, short track speed skating).

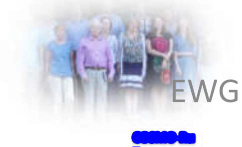
The Hydrometeorological Center of Russia provides weather forecasts from COSMO-based NWP system with several spatial resolutions from 13 km to 2.2 km.

A cascade forecasting system provides weather information about phenomena of different scale:

- COSMO-Ru13ENA - forecasts for PMSL and H500 with lead times up to 120 h
- COSMO-Ru6 - forecasts for the air temperature at 2 m and 850 hPa, cloudiness, precipitation amount, accompanied by PMSL and H500 forecasts with lead times up to 120h for the Middle Siberian district
- COSMO-Ru2 - forecasts for the precipitation, wind and wind gust, T2m with lead times up to 48h for the Universiade area



krsk2019.ru



COSMO-RU-ART

COSMO-Ru7-ART is a fully on-line coupled regional model system consisting of the non-hydrostatic model COSMO-Ru7 (grid spacing 7 km) combined with the chemical model ART (Aerosols and Reactive Traces Gases).

CURRENT ACTIVITIES

- Daily products: 48h forecast of CO, SO2, NO, NO2, O3, PM10, PM2.5 concentrations (maps and vertical profiles) for the center of the European part of Russia;
- Forecast verification;
- Forecast of pollutant concentrations during forest fires;
- Forecasts are provided to the Ecological Department of the Hydrometcenter, EMERCOM of Russia and other interested organizations.

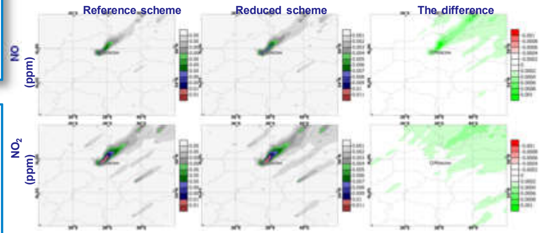
RESEARCH ACTIVITIES

- Revision of the chemical reaction scheme – reduction the number of chemical reactions – *16 instead of 172 in the reference scheme* (*see first assessments below*);
- New version with 2.2 km grid spacing for Moscow region.

Comparison of the forecast with the reduced scheme of chemical reactions with reference scheme revealed the following:

- *the reduced reaction scheme produces less distinct daily cycle;*
- *the differences of mean concentrations values averaged over one week are 0.3% (for carbon monoxide), 2-4% (for NO_x) and 7% (for ozone).*

Forecast of trace gases concentration



RECENT PUBLICATIONS:

Rivin G. et al., 2018: COSMO-Ru: operational mesoscale numerical weather prediction system of the Hydrometcenter of Russia. Current status and recent developments. WMO/WGNE Research Activities in atmospheric and oceanic modeling, WCRP Report No. Report No.18/2018, pp. 5-11-5-12

Chubarova N. et al., 2018: Clear-Sky Radiative And Temperature Effects Of Different Aerosol Climatologies In The Cosmo Model. Geography, Environment, Sustainability, Vol.11, No 1, p. 74-84, DOI-10.24057/2071-9388-2018-11-1-74-84.

Rivin G. et al., 2018: Numerical Weather Prediction for Arctic Region. Geophysical Research Abstracts (2018), vol. 20, EGU2018- 5505-1. EGU General Assembly 2018.

COSMO-Ru Team

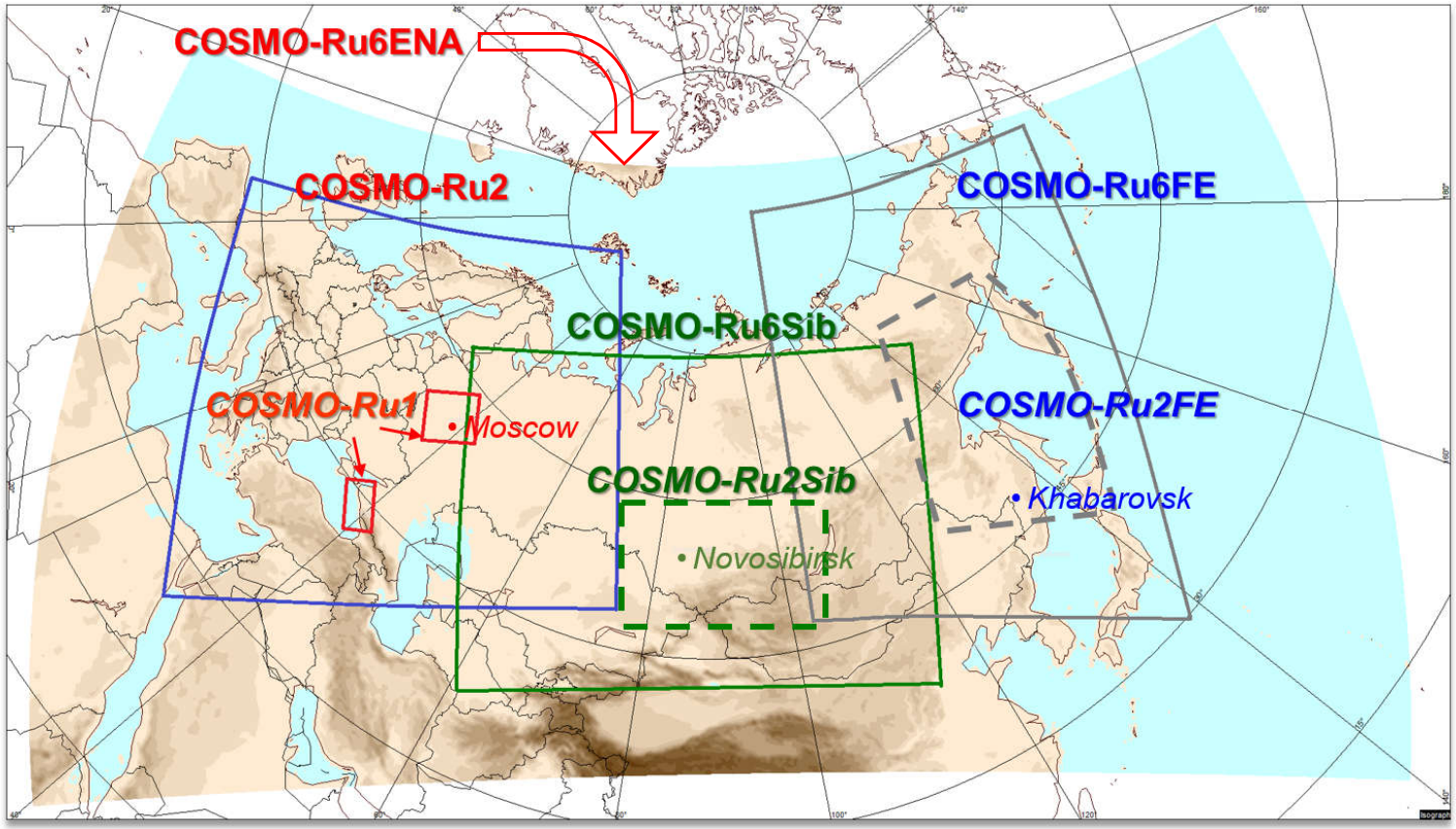
SUPERCOMPUTER CRAY XC40-LC

1. Nodes : 976 (node - 2 processors & 128Gb memory)
2. Processors: 1 952 (processor - 18 cores)
3. Cores : 35 136
4. Linpack : 1 .2 Pflops/s

1 Pflops /s = 10^{15} fixed point operations / sec =
billion millions operations / sec.

RUSSIAN FEDERATION (COSMO-Ru)

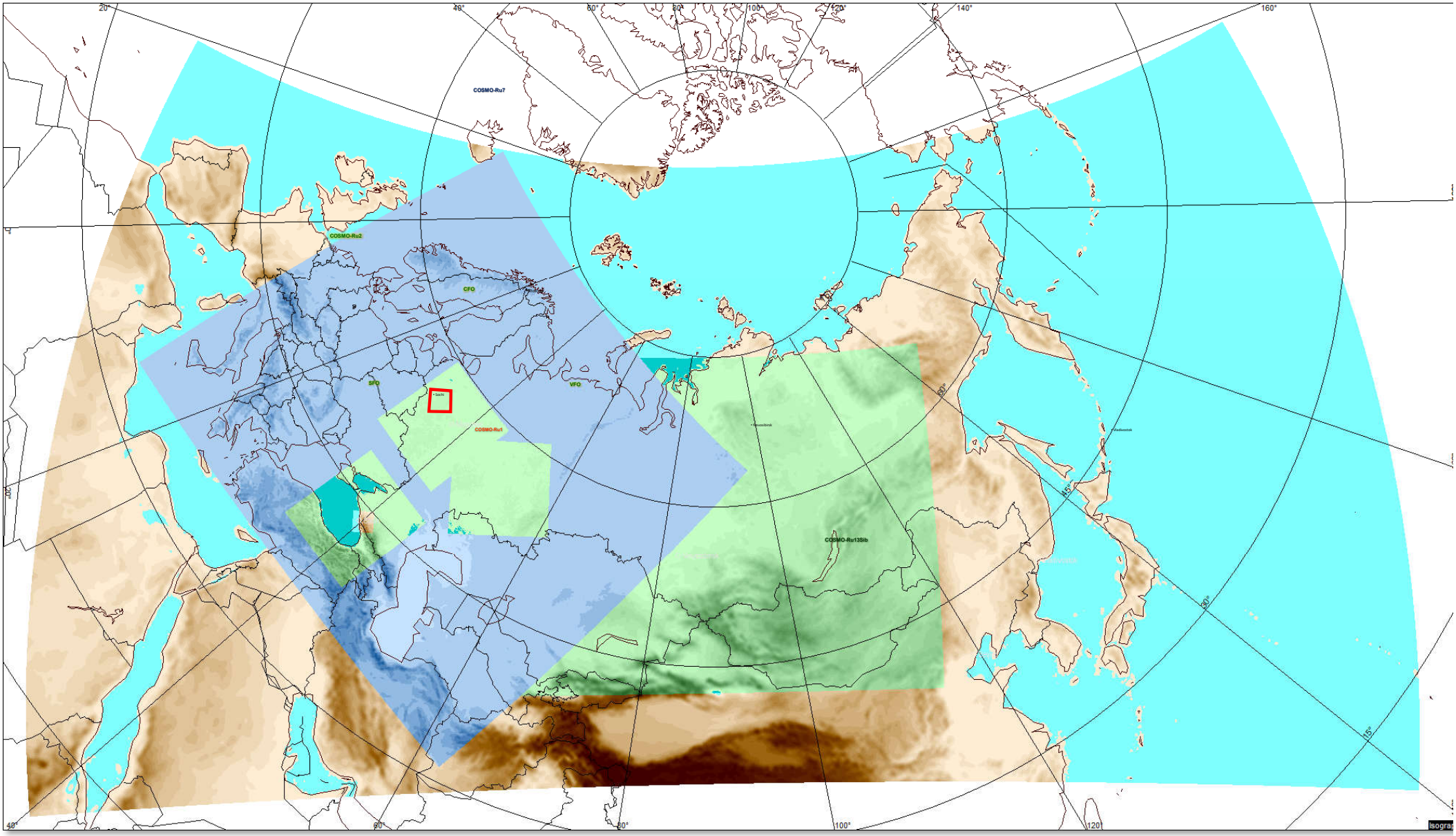
1. Operational forecast system COSMO-Ru:
   - ❑ 4 times per day for 7 area (Moscow);
   - ❑ 2018: COSMO-Ru to Cray.
2. COSMO-Ru to ICON-LAM-Ru.
3. Preparing to Winter Universiada 2019 (Krasnoyarsk).



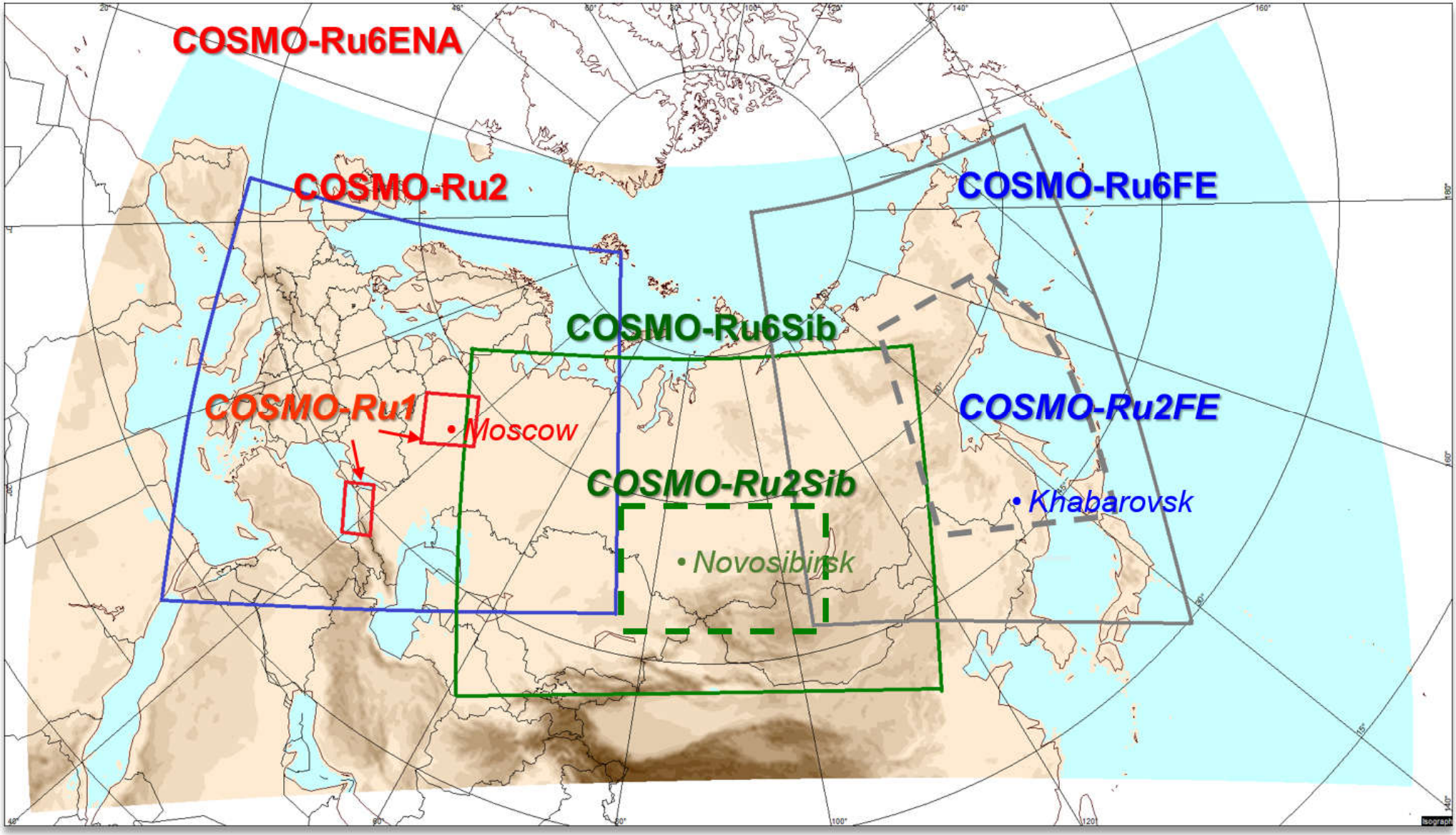
Moscow: COSMO-Ru6ENA, COSMO-Ru2, COSMO-Ru1
Novosibirsk: COSMO-Ru6Sib, COSMO-Ru2Sib
Khabarovsk: COSMO-Ru6FE, COSMO-Ru2FE

CURRENT COSMO-RU SYSTEM

(DOMAINS WITH GRID SPACES 13.2, 7, 2.2, 1.1 KM)



UPRADE COSMO-RU SYSTEM TO CRAY

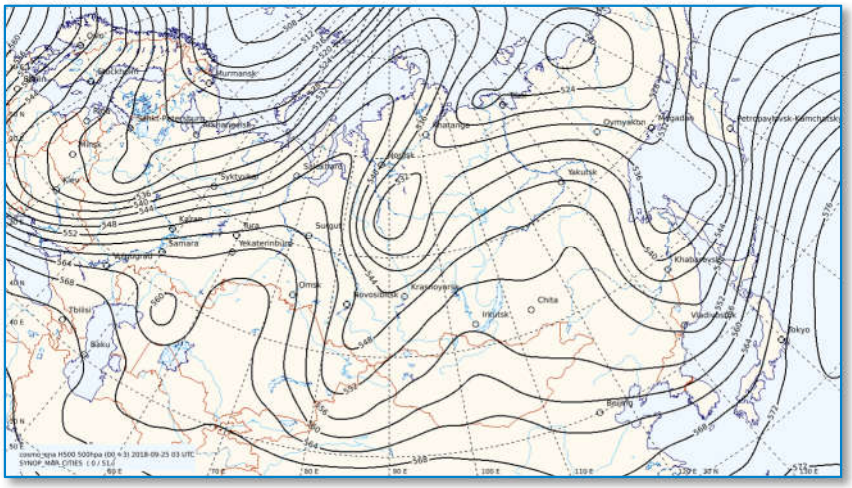


	Current Version	New Version	Domain	Grid spacing	Time step	Forecast range**	Lateral Boundary Conditions
1.	COSMO-Ru13ENA	COSMO-Ru06ENA	13200 x 6100 km	6.6 km	60 s	78-120 h	ICON*
2.	COSMO-Ru7 COSMO-Ru2 CFO/ VFO/ SFO	COSMO-Ru2	6000 x 6000 km	2.2 km	20 s	48-78 h	COSMO-Ru06ENA
3.	COSMO-Ru1	COSMO-Ru1SFO COSMO-Ru1MSK (new domain)	210 x 210 km	1.1 km	6 s	36 h	COSMO-Ru2

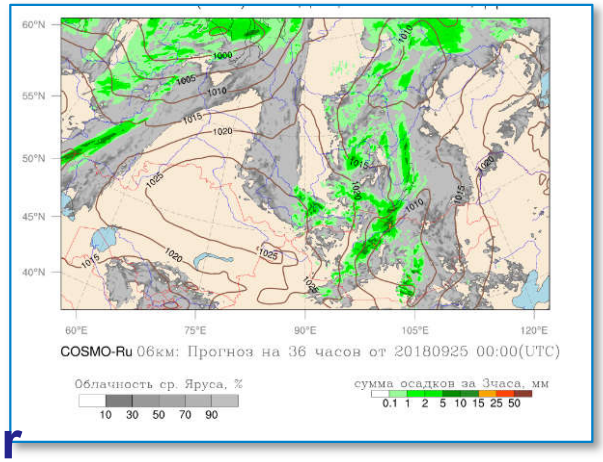
The 29th Winter Universiade 2019 will take place in the city of Krasnoyarsk on March 2-12, 2019.
Competitions will be held in 11 sports.

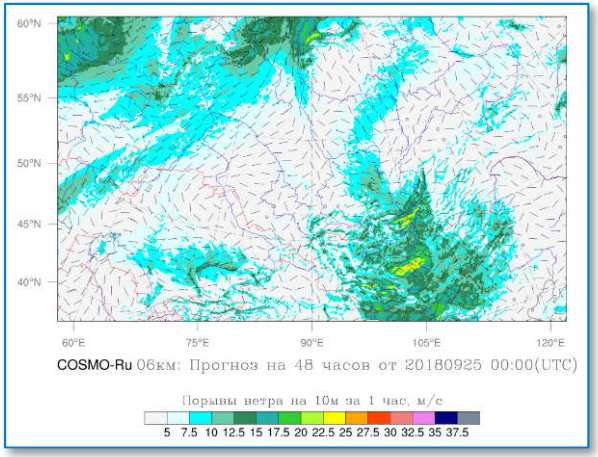
Forecasts for PMSL and H500 with lead times up to 120 h

13.2 km



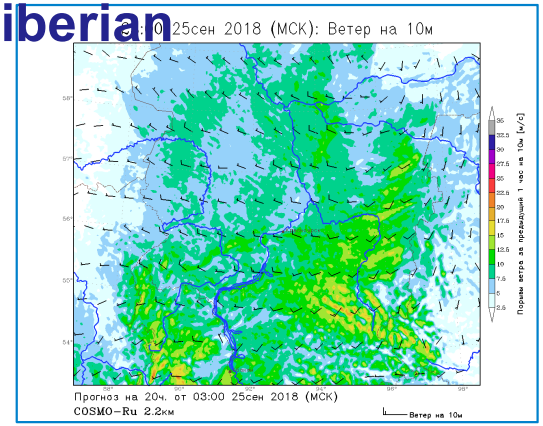
Forecasts for the air temperature at 2 m and 850 hPa, cloudiness, precipitation amount, accompanied by PMSL and H500 forecasts with lead times up to 120h for the Middle Siberian district

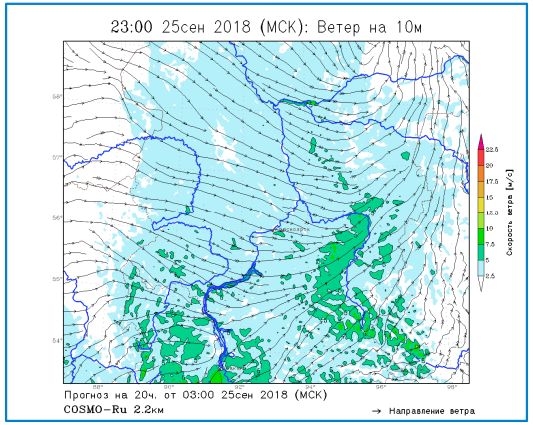




6.6 km

2.2 km





Forecasts for the precipitation, wind and wind gust, T2m with lead times up to 48h for the Universiade area.

COSMO-Ru7-ART is a fully on-line coupled regional model system consisting of the non-hydrostatic configuration COSMO-Ru7 (grid spacing 7 km) combined with the chemical model ART (Aerosols and Reactive Traces Gases)).

CURRENT ACTIVITIES

- **Daily products: 48h forecast of CO, SO2, NO, NO2, O3, PM10, PM2.5 concentrations (maps and vertical profiles) for the center of the European part of Russia;**
- **Forecast verification;**
- **Forecast of pollutant concentrations during forest fires;**
- **Forecasts are provided to the Ecological Department of the Hydrometcenter, EMERCOM of Russia and other interested organizations.**

RESEARCH ACTIVITIES

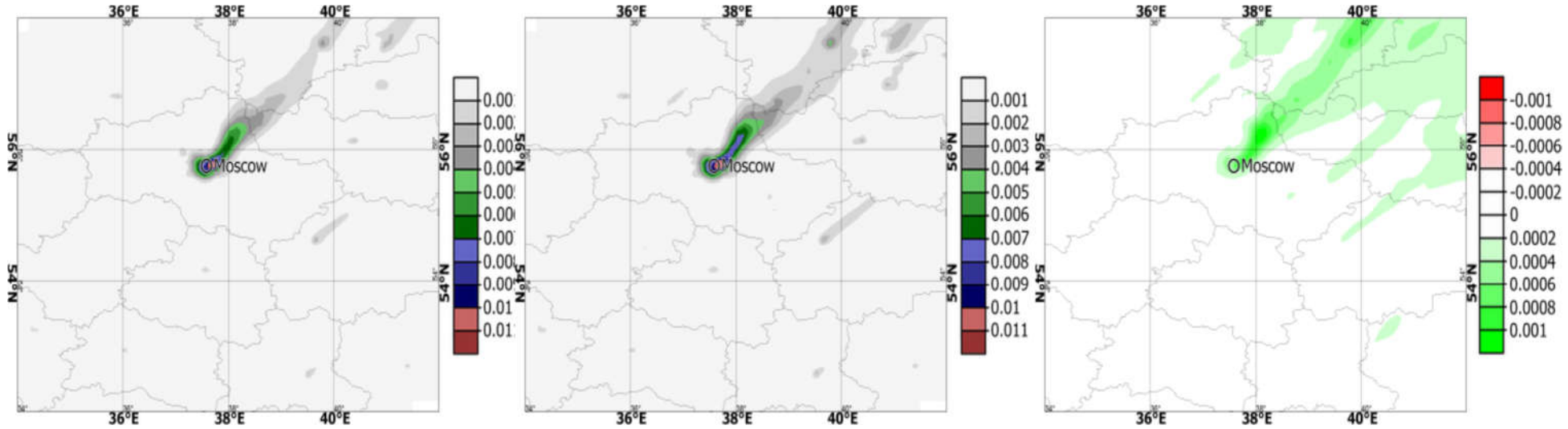
- **Revision of the chemical reaction scheme – reduction the number of chemical reactions – *16 instead of 172 in the reference scheme* (*see first assessments below*);**
- **New version with 2.2 km grid spacing for Moscow region.**

Reference scheme

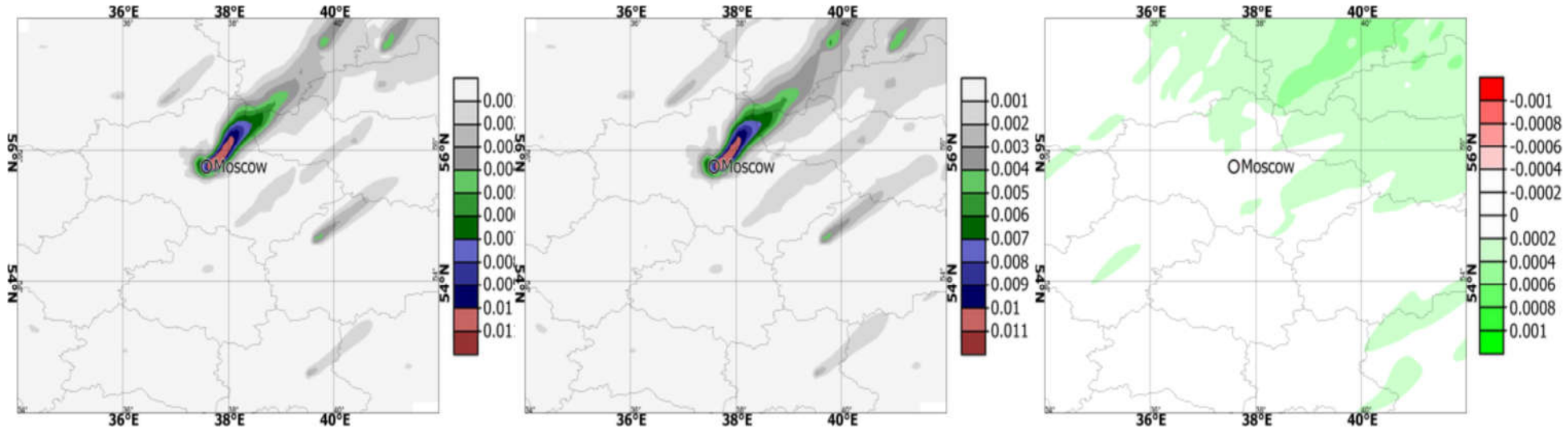
Reduced scheme

The difference

NO (ppm)



NO_2 (ppm)



THANKS!

Gdaly.Rivin@mail.ru Inna.Rozinkina@mail.ru