High-resolution COSMO-Ru1 model
and its application for the meteorological support
of Sochi-2014 Olympics and Paralympics

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A new version of COSMO model with grid spacing of 1.1 km named COSMO-Ru1 was developed for the weather forecasting during the Sochi Olympics and Paralympics in 2014 as a part of the Priority Project *CORSO* (cosmo-model.org/content/tasks/priorityProjects/corso/default.htm) of the COSMO consortium (www.cosmo-model.org). The main goal of this project was to demonstrate the capabilities of COSMO-based systems for short-range numerical weather prediction in winter conditions over mountainous terrain.The results of the CORSO project are summarized in the presentation (cosmo-model.org/content/tasks/achievements/docs/2014_CORSO.pdf)

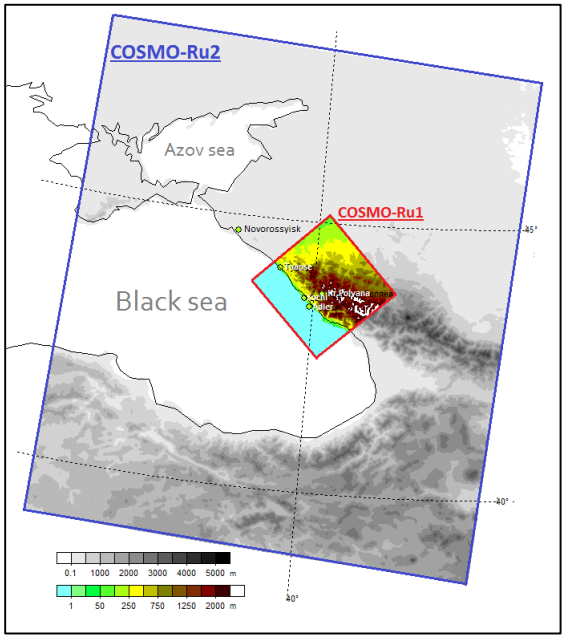

Fig. 1. COSMO-Ru1 and COSMO-Ru2 models domains and models orography.

COSMO-Ru1 model domain with dimension 210 x 210 km was nested into the greater domain of COSMO-Ru2 version with grid spacing of 2.2 km (Fig.1) used as a driving model. At the first step (Shatunova, Rivin, 2014), the impact of external parameters on the simulation results of the high resolution model for the region with complicated topography was examined. The influence of the model integration domain size and model orography on temperature and precipitation forecast was studied. Numerical experiments with model domain with grids of 100 x 100, 190 x 190 and 400 x 400 nodes were conducted. Domain 190 x 190 was considered optimal in terms of the ratio of computation time and accuracy of forecast.

The operational version of COSMO-Ru1 has a grid with 190 x 190 nodes and there are 50 vertical levels up to 22 km. The time step was set to five seconds to prevent possible failures of the run in case of strong convection. Such cases have been reported with the south-west wind carrying warm humid air from the Black Sea to the Caucasus Range during autumn and early winter.

Initially COSMO-Ru1 model was designed as a research version. Based on the verification and case studies results it was decided to run COSMO-Ru1 model in operational mode. For the period of Olympic and Paralympic games the model ran 4 times per day starting from the COSMO-Ru2 previous forecast (- 6 h). That was made in order to meet forecaster's requirements and to provide them with forecasts (model output) at 4 a.m. local time.

The model provided forecast charts for the whole model domain and for two "subdomains" where the fields of meteorological elements were presented in more detail – the coastal region and the mountain valley region. Complex charts "relative humidity & streamlines" and charts of streamlines within the valley were most popular among forecasters. Meteograms for several location were also provided.

COSMO-Ru1 model forecasts were verified using VERSUS software and some first results were presented by A. Bundel et al. (2014).

Before the Olympic games, during a so-call trial period, the weather monitoring network was extended in the Sochi region and a wide variety of observation data including profilers, radars, satellites and even web-cameras became available. This allowed to do not only standard verification procedures but to perform several case studies in order to understand the model behavior and to evaluate 1 km grid-spacing model advantages for weather forecasting in mountainous terrains against coarser-resolution models. Two low visibility case studies (Shatunova et al., 2015) demonstrate the capabilities of COSMO-Ru1 model very well. It is shown that the use of COSMO-Ru1 model output allowed to give a detailed forecast of visibility changes with a leadtime of 24 hours .

Bundel A. Yu., A.A. Kirsanov, A.V. Muraviev, G.S. Rivin, I.A. Rozinkina, D.V. Blinov, 2014: First verification results for COSMO-Ru mesoscale numerical weather forecasts issued for the Soch-2014 Olympics. Proceedings of Hydrometcenter of Russia, vol. 352, 37-54 pp. (*in Russian*).

Shatunova M.V., G.S. Rivin, 2014: High resolution model COSMO-Ru1SFO: influence of the external parameters on model output. Proceedings of Hydrometcenter of Russia, vol. 352, 150-167 pp. (*in Russian*).

Shatunova M.V., G.S. Rivin, I.A. Rozinkina, 2015: Visibility forecast for February 16-18, 2014 for the region of Sochi-2014 Olympics by means of high-resolution COSMO-Ru1 model. Meteorology and Hydrology, № 8 (*in press*).