# Performance of the COSMO-based ensemble systems during Sochi-2014 pre-Olympics

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## Introduction

The Winter Olympics and Paralympic Games took place in Sochi, Russia, from 7 to 23 February 2014 and from 7 to 16 March 2014. In the framework of these events, WMO WWRP initiated a dedicated blended Forecast Demonstration/Research and Development Project (FDP/RDP). **FROST-2014** (**F**orecast and **R**esearch in the **O**lympic **S**ochi **T**estbed; `http://frost2014.meteoinfo.ru/`) aimed at advancing the understanding of nowcasting and short-range prediction processes over complex terrain (Kiktev, 2011). In the framework of probabilistic forecasting, the following actions were undertaken by the COSMO consortium (`http://www.cosmo-model.org`) to support NWP aspects of FROST-2014:

(1) FDP part: relocation of COSMO-LEPS (Montani et al., 2011) over the Sochi area, generating a new system named COSMO-S14-EPS ("S14" stands for Sochi2014);
(2) RDP part: development of a convective-scale ensemble system for the Sochi area, referred to as COSMO-Ru2-EPS ("Ru2" stands for Russian 2.2 km).

As for (1), COSMO-S14-EPS, the convection-parameterized ensemble prediction system based on COSMO model and targeted for the Sochi-area, was implemented on ECMWF super–computers and ran on a regular basis from 19 December 2011 to 30 April 2014. The forecast fields were used to generate a set of standard probabilistic products, including probability of surpassing a threshold, ensemble mean and ensemble standard-deviation for several surface and upper-air variables. The individual forecast members were also transferred to the Hydrometcenter of Russia, where the epsgrams for predetermined points (mainly, locations of outdoor and indoor competitions) were prepared. All these products were used in real time by the Sochi forecasters via the FROST-2014 Web-site (`http://frost2014.meteoinfo.ru/forecast/goomap` and `http://frost2014.meteoinfo.ru/forecast/arpa-new/`). In addition to the probabilistic guidance for the prediction of high–impact weather over the Olympic areas up to day 3, COSMO-S14-EPS provided initial and boundary conditions for activity (2), linked to the generation of the convective-permitting ensemble COSMO-Ru2-EPS, which ran in Moscow on a quasi-operational basis between January and February 2013 as well as from November 2013 to April 2014. Table 1 summarises the main features of both systems.

Table 1: Main characteristics of COSMO-S14-EPS and COSMO-Ru2-EPS.

| | COSMO-S14-EPS | COSMO-Ru2-EPS |
|---|---|---|
| Horizontal/vertical resolution | 7 km /40 ML | 2.2 km / 50 ML |
| Forecast length | 72h | 48h |
| Ensemble size | 10 | 10 |
| Initial time | 00/12 UTC | 00/12 UTC |
| Convection | Parameterized | Resolved |

## Verification results

The skills of COSMO-S14-EPS and COSMO-Ru2-EPS are assessed over the period January-February 2013. For both systems, we considered the probabilistic prediction of 2-metre temperature exceeding a number of thresholds for several forecast ranges. As for observations, the data obtained from the SYNOP reports available on the Global Telecommunication System

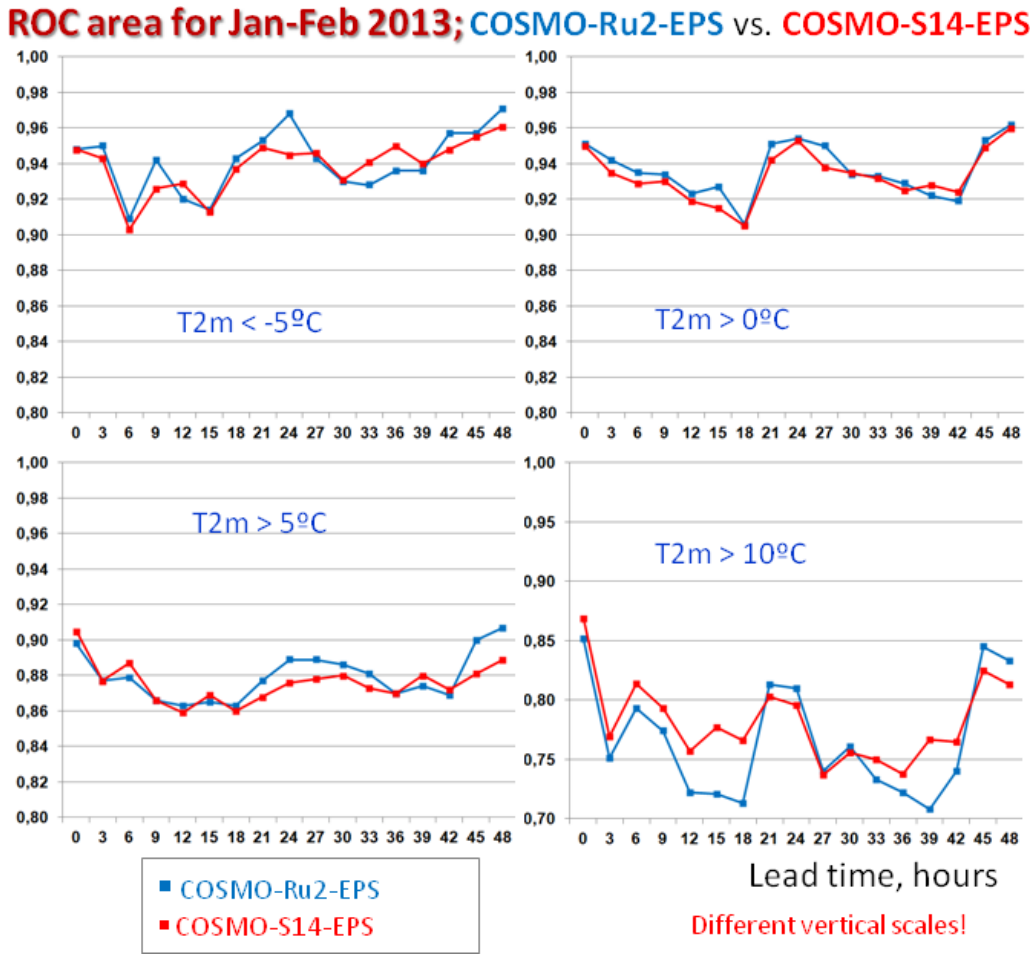


Figure 1: ROC area values as a function of forecast range for four different weather events: T2M below -5$^o$C (top-left panel), above 0$^o$C (top right), above +5$^o$C (bottom left) and above +10$^o$C (bottom-right with different vertical scales). The scores are calculated over the period January-February 2013. Red (blue) lines refer to COSMO-S14-EPS (COSMO-Ru2-EPS).

(GTS) as well as from a number of non-GTS local stations were used in an area centred on the Olympic venue (42.5-45N, 37.5-41.5E). The performance was examined for 4 different thresholds: -5, 0, +5 and +10 $^o$C. The skill of two systems in terms of probabilistic prediction of 2-metre temperature is summarised in Fig. 1, where the values of the Relative Operating Characteristic (ROC) area are plotted against the forecast range for the above-mentioned weather events. The ROC area values are well above 0.8 for three out of the four thresholds, indicating that both COSMO-S14-EPS and COSMO-Ru2-EPS manage to discriminate these events. The performance of two systems is quite similar, with a slight predominance of COSMO-Ru2-EPS which has higher scores for most of the thresholds/forecast ranges. Worse scores are obtained by both systems for the highest threshold (bottom-right panel), where COSMO-S14-EPS outperforms COSMO-Ru2-EPS. It is worth pointing out that this is the rarest event with few observations; therefore, the statistical significance of this result needs to be confirmed by a more detailed investigation over a longer verification period.

## References

Kiktev D., 2011. Forecast and Research: the Olympic Sochi Testbed (FROST-2014). Concept paper. Available at http://frost2014.meteoinfo.ru

Montani A., Cesari D., Marsigli C., Paccagnella T., 2011. Seven years of activity in the field of mesoscale ensemble forecasting by the COSMO-LEPS system: main achievements and open challenges. *Tellus*, **63A**, 605-624. DOI: 10.1111/j.1600-0870.2010.00499.x