Combining multi-system forecasts of the FROST-2014 project for meteorological support of the Olympic Games «Sochi-2014»

D.Kiktev, E.Astakhova, R.Zaripov, A.Smirnov
Hydrometcentre of Russia / Roshydromet

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Goals of WMO WWRP RDP/FDP FROST-2014:

• To develop a comprehensive information resource of alpine winter weather observations;

• To improve and exploit:
  – high-resolution deterministic mesoscale forecasts of meteorological conditions in winter complex terrain environment;
  – regional meso-scale ensemble forecast products in winter complex terrain environment;
  – nowcast systems of high impact weather phenomena (wind, precipitation type and intensity, visibility, etc.) in complex terrain.

• To improve the understanding of physics of high impact weather phenomena in the region;

• To deliver deterministic and probabilistic forecasts in real time to Olympic weather forecasters and decision makers.

• To assess benefits of forecast improvement (verification and societal impacts)
Two clusters of the «Sochi-2014» Olympic venues

Ice sports competitions

Snow sports competitions
FROST-2014 Observational Set-up for the Sochi Olympics

- About 50 automatic meteorological stations;
- Temperature/Humidity Profiler HATPRO;
- Wind Profiler Scintec LAP3000;
- Two METEK Micro Rain Radars (MRR-2);
- 4 times/day upper air sounding in Sochi;
- Vaisala C-band Doppler radar WRM200 in Sochi
Sport venues of the mountain cluster

- Each venue has 1 basic automatic meteorological station and 1-5 supplementary stations;

- Basic frequency of observations - 10-minutes;

- 1-minute observations for prec intensity, visibility, cloud base, wind gusts.
Vaisala C-band Doppler WRM200 is installed on Akhun mountain in Sochi.
International participants of the FROST-2014 project

- COSMO,
- EC,
- FMI,
- HIRLAM,
- KMA,
- NOAA,
- ZAMG

under supervision of the WWRP WGs on Nowcasting, Mesoscale Forecasting, Verification Research

3rd meeting of the project participants (10-12 April 2013)
Nowcasting project component

Participating systems:

- ABOM,
- CARDS,
- INCA,
- INTW,
- MeteoExpert,
- + Multi-system integration (HMC);
- + Nowcasting potential of participating NWP systems to be assessed
Deterministic NWP project component

- COSMO-RU with grid spacing 2.2 km, 1 km (new);
- GEM with grid spacing 2.5km, 1km, 0.25km;
- NMMB – 1 km;
- HARMONIE - 2.5km
- KMA’s 1km version of UM
- …
**Ensemble project component**

**Current state:** COSMO-S14-EPS, GLAMEPS, NOAA-7km EPS, Aladin LAEF, COSMO-RU2

**Expected:** HARMON-EPS

KMA’s downscaling of probabilistic forecasts.
Poor man’s ensemble of deterministic high-resolution models
It is not simple for forecasters to deal with such an amount of information under the operational time constraints => compression of information data feeds
Integrated Forecast

• F. Woodcock and C. Engel: Operational Consensus Forecasts, Weather and Forecasting, 2005;

• L.X. Huang and G.A. Isaac: Integrating NWP Forecasts and Observation Data to Improve Nowcasting Accuracy, Weather and Forecasting, 2012

\[ F(t) = \alpha(t) \cdot O + (1 - \alpha(t)) \sum_{i=1}^{N} \beta_i(t) \cdot (f_i(t) - b_i(t)) \]

- \( F(t) \) – integrated forecast (t – forecast time);
- \( O \) – last available observation;
- \( f_i(t) \) – forecast of \( i \)-th participating forecasting system;
- \( \alpha(t), \beta_i(t) \) - weights;
- \( b_i(t) \) - bias for \( i \)-th forecasting system
Concluding remarks

- Quite few systematic intercomparisons of multiple mesoscale forecasting systems in mountains are known so far due to the lack of appropriate observations and coordinated forecasting activities. The “Sochi-2014” Olympic testbed provides a good opportunity to advance the meteorological science and technologies in the area of winter nowcasting and mesoscale forecasting in a region with complex terrain.

- Preliminary tests shows that in general multi-system forecasts add value wrt single-system forecasts and their equal weighting. However, more representative assessments are needed. Results of intercomparison to be presented after the formal evaluation period (from mid-January to mid-March 2014).
Thank you!

http://frost2014.meteoinfo.ru