International project
FROST-2014
(FROST = Forecast and Research
in the Olympic Sochi Testbed)

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WEATHER CHALLENGES

• Sharp weather contrasts and high spatial and temporal variability are typical for the region of the Sochi-2014 Olympics.
• Steep mountainous terrain and intricate mixture of maritime subtropical and Alpine environments make weather forecasting in this region very challenging.
• Northern Caucasus is one of the most affected regions on the territory of Russia.
• Precipitation intensity and type, visibility, cloud ceiling and gusting winds are the primary critical weather elements for the Sochi Olympics.
• High-Impact Weather (HIW) in the context of winter Olympics is not necessarily linked with very intense or extreme meteorological phenomena. E.g. for outdoor sport events HIW forecasting also includes accurate representation of cross-zero temperature transitions, precipitation type and other sensible weather changes with respect to the prescribed decision-making thresholds.
Two clusters of the «Sochi-2014» Olympic venues

Ice sports competitions

Snow sports competitions
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)
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)
Today’s network of meteorological stations in the region of Sochi
The Olympic sport venues

Each venue has 1 basic station and 1-5 supplementary sport stations
Vaisala C-band Doppler WRM200 is installed on Akhun mountain in Sochi
Profilers

- Temperature/Humidity – HATPRO (RPG GmBh, Germany);
- Wind – Scintec-3000 Radar Wind Profiler (Scintec Corp, USA);
- Two METEK Micro Rain vertically pointing Radars (MRR-2)

+ 4 times/day upper air sounding in Sochi
Nowcasting project component

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

- COSMO-RU with grid spacing 2.2 km, 1 km;
- GEM with grid spacing 2.5 km, 1 km, 0.25 km;
- NMMB – 1 km;
- HARMONIE - 2.5 km
- INCA
- ...
Ensemble project component

COSMO-S14-EPS, Aladin LAEF, GLAMEPS, NNMB-7km EPS, COSMO-RU2-EPS, 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 is needed.
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

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

\( F(t) \) – 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
FROST-2014 On-line Forecast Verification

Model | Init time | MEAN ABS ERROR
--- | --- | ---
COSMO2 | 00 | 12.5.2013
COSMO7 | 00 | 15.5.2013
NMMB | 00 | 11.5.2013

024 h

Temperature (COSMO2 00h): 0.9  (frc. 2, obs: 2, pairs: 2(50%))
Wind dir (COSMO2 00h): 157  (frc. 2, obs: 2, pairs: 2(50%))
Wind speed (COSMO2 00h): 1  (frc. 2, obs: 2, pairs: 2(50%))
Pressure (COSMO2 00h): 64.44  (frc. 2, obs: 2, pairs: 2(50%))
Prec. (COSMO2 00h): 0  (frc. 2, obs: 2, pairs: 2(50%))

Temperature (COSMO7 00h): 1.45  (frc. 2, obs: 2, pairs: 2(40%))
Wind dir (COSMO7 00h): 238  (frc. 2, obs: 2, pairs: 2(40%))
Wind speed (COSMO7 00h): 0.5  (frc. 2, obs: 2, pairs: 2(40%))
Pressure (COSMO7 00h): 65.88  (frc. 2, obs: 2, pairs: 2(40%))
Prec. (COSMO7 00h): 0  (frc. 2, obs: 2, pairs: 2(40%))

Temperature (NMMB 00h): 2.04  (frc. 5, obs: 4, pairs: 4(80%))
Wind dir (NMMB 00h): 2.39  (frc. 5, obs: 4, pairs: 4(80%))
Wind speed (NMMB 00h): 0.16  (frc. 5, obs: 4, pairs: 4(80%))

RH

0  5  10  15  20  25  30  35  40  45  50  55  60  65  70  75

0  5  10  15  20  25  30  35  40  45  50  55  60  65  70  75  80  85  90  95  100
Project Social and Economic Impacts

Socially significant project application areas:
- Education
- Understanding
- Transfer of technologies
- Practical forecasting – first guess for operational official forecasts.

Integrated project forecasts are used as a first guess for the data feed to the Olympic information system (supported by IOC partner Atos Origin) and Olympic Broadcasting Services (OBS).
• FROST-2014 is intended as an ‘end-to-end’ project. Its products will be used by local forecasters for meteorological support of the Olympics and preceding test sport events.
• Training on the new project forecast products is of utmost importance.

Forecasters training

• Forecasters trainings were held on regular basis;
• Participants were involved into provision of meteorological services for sport test events.
Weather data feed for the Olympic information system

Requirements:
- 1-hour update frequency;
- Temporal resolution:
  for a current day – 1 hour;
  for subsequent days – 3 hours;
- Forecast outlooks for a current day and next 5 days;
- Alert Warnings
Thank you!

http://frost2014.meteoinfo.ru