Roshydromet plans for "Sochi-2014" Olympic and Paralimpic Games

(February 8-23 and March 7-16, 2014)

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Hydrometcentre of Russia, Roshydromet

«Sochi-2014» Kick-off Meeting, 1-3 March 2011
Sochi, Russia
PRESENTATION OUTLINE

• Sport venues;
• Observational network;
• Forecasting technologies;
• Project vision and kick-off meeting
Two clusters of «Sochi-2014» Olympic venues

Ice sports competitions

Snow sports competitions
The range of altitudes for various sport events is broad:

- Alpine skiing tracks 960-1945 m - topmost
- Ski jumping 600-900 m - lowermost
Temperature in February/March at the mountain cluster:

\[ T_{\text{min}} < 0^\circ \text{C} \] - any altitude,
\[ T_{\text{daily\ average}} < 0^\circ \text{C} \] - altitude over 700 m,
\[ T_{\text{max.}} < 0^\circ \text{C} \] - altitude over 1600 m

Weather contrasts:
two photos taken on March 2–3, 2010 at the coastal and mountain clusters

<table>
<thead>
<tr>
<th>Month</th>
<th>Average</th>
<th>Estimated temperature characteristics at 1500-1800 m heights</th>
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<tbody>
<tr>
<td></td>
<td>Monthly</td>
<td>Mean Min</td>
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<tr>
<td>January</td>
<td>-5.6</td>
<td>-8.1</td>
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<td>February</td>
<td>-5.6</td>
<td>-8.2</td>
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<tr>
<td>March</td>
<td>-2.6</td>
<td>-5.7</td>
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Microclimate of «Sochi-2014» sport venues

Achishkho station
Krasnaya Polyana
Sochi

Precipitation (mm)

Months
Observational network in the region of the Games

None of practically realizable near-surface atmospheric monitoring networks can be representative enough given the complexity of the region and high Olympic demands. In situ observations are mostly concentrated along the coast. Vast sea area from one side and nearby high mountains (up to 3 km and more) on another side of Krasnaya Polyana are data sparse areas.

Nevertheless, today situation is substantially better than 1-2 years ago, and enhancement of the network will continue.
+ In general about 30 near-surface automatic stations to be added to enhance the observational network in the region.

+ New Doppler radars in Sochi and other parts of the region;

+ Other ways to enhance the observational network are looked into (wind and temperature profilers; moored sea buoys; more frequent sounding at the nearest aerological stations; etc)
Supplementary network of AMS on the towers of mobile communication should be developed in the region in cooperation with private companies.

AMS should be accompanied by rotatable web-cameras.
Development of comprehensive set of observational data for purposes of forecasting, data assimilation and forecast validation is one of the key elements of meteorological support of the Games.

Roshydromet plans to provide Internet-access to the enhanced set of regional weather observations for the partners involved in the meteorological support of the Games.
Requirements of Sport Federations:
Bobsleigh, Luge & Skeleton

List of sensors for AMS recommended for «Sochi-2014» services:

• Atmospheric pressure;
• Precipitation gauge (liquid and solid);
• Snow height;
• Wind speed and direction;
• Temperature and humidity;
• Snow surface temperature;
• Video camera.

Extra-sensors for basic AMS:

• Visibility;
• Ceilometer.

+ 1-2 mobile handheld stations for each sport venue
Requirements of Sport Federations: Alpine skiing
Requirements of Sport Federations: Skiing & Biathlon
The coastal cluster will include an Olympic Park located only 10 minutes from Sochi international airport.

Coastal cluster will include all ice venues (Figure Skating, Short track Skating, Speed Skating, Ice Hockey, Curling, Ice training); Opening and Closing Ceremonies;

Requirements of Sport Federations:
Ski Jumping & Nordic Combined
Requirements of Sport Federations: Freestyle & Snowboard
AMSSs in the area of Krasnaya Poliana
From the point of view of meteorological needs and goals Sochi-2014 Olympic project has much in common with Canadian Vancouver-2010 Olympic project SNOW-V10.

In comparison with Whistler the mountain cluster in Krasnaya Polyana is situated substantially closer to the sea and there is less space for deployment of upstream land-based observational network.
Radar network modernization

In September 2008 Russian government approved the Federal task program "Modernization of the unified system of air traffic organization of the Russian Federation (2009-2015)".

According to the program about 140 new-generation Russian-made Doppler radars should be installed in various parts of the country, including Sochi region, and replace МРЛ-5 radars.

In 2011 new Dopplers should replace МРЛ-5 radars in the airports of Anapa, Krasnodar and Adler.

In 2012 new radar should be installed in the area of Gelendjik airport.
Doppler radar in Sochi: state of affairs

At the end of 2010 there were field tests of the new radar equipment developed and produced in the framework of the Federal task program "Modernization of the unified system of air traffic organization of the Russian Federation (2009-2015)".

Although the test results are quite good, in general this process has been evolving with delays.

To not put the preparations to the Olympics under the threat of delays it was decided at least for Sochi to buy a radar of external vendor.

Vaisala Doppler radar WRM200 was bought in December 2010.

This new radar will be installed on Akhun mountain in Sochi. The radar is expected to be ready for operations by the winter 2011/2012.
Profilers

Wind - AP1000 Radar Wind Profiler (Scintec Corporation, U.S.A.);

Temperature/Humidity – to be decided (negotiations with RPG GmBh, Germany)

Roshydromet plans to station the profilers on mobile platform. Some flexibility in location of profilers (e.g. their location up-stream of the venue) might enhance their forecasting capabilities.
ELECTRO-L  General Design

- Three-axis high-precision stabilization
- In-orbit mass - 1500 kg
- Payload mass - 370 kg
- Lifetime - 10 years
- Longitude - 76E
- Data dissemination format - HRIT/LRIT
- Image update cycle – 30/15 min

Mission objectives

- Operational observation of the atmosphere and the Earth surface (MSU-GS)
- Heliogeophysical measurements (GGAK-E)
- Maintaining Data Collection System and COSPAS/SARSAT Service
# MSU-GS Basic Performance Characteristics

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<tr>
<th></th>
<th>Number of channels</th>
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<tr>
<td>1.</td>
<td>VIS</td>
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<td>IR</td>
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<td>7</td>
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<th></th>
<th>Spectral range at half maximum of spectral response function (µm)</th>
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<td>2.</td>
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<td>0.5-0.65; 0.65-0.80; 0.8-0.9; 3.5-4.0; 5.7-7.0; 7.5-8.5; 8.2-9.2; 9.2-10.2; 10.2-11.2; 11.2-12.5</td>
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<th>Image frame (deg x deg)</th>
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<td>3.</td>
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<td>20 ± 0.5 x 20 ± 0.5</td>
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<th>HRIT ground resolution in subsatellite point (km)</th>
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<td>1.0 (VIS); 4.0 (IR)</td>
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<th>S/N ratio for VIS channels</th>
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<th>NEΔT at 300K (K)</th>
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<td>in the band</td>
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<td>3.5-4.0 µm</td>
<td>0.8</td>
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<td></td>
<td>5.7-7.0 µm</td>
<td>0.4</td>
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<tr>
<td></td>
<td>7.5-12.5 µm</td>
<td>0.1-0.2</td>
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<th>Power (W)</th>
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<td>≤ 150</td>
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<th>Weight (kg)</th>
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<td>8.</td>
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<td>≤ 88</td>
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<th></th>
<th>Lifetime of basic and reserve units (years)</th>
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<tr>
<td>9.</td>
<td></td>
<td>10</td>
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</table>

**Instruments for intercalibration:** SEVIRI/METEOSAT8,9; AVHRR/NOAA

**Position:** 76°E
Nowcasting tools for Sochi

Current experience of nowcasting in Russia is very limited and associated with plain areas (as in general observational coverage is quite modest). Mountain nowcasting is a brand-new area for Roshydromet (High requirements for the weak point of the Service).

By now Roshydromet does not have firmly established nowcasting graphical tools for nowcasting.

Options: GIS-Meteo, Ninjo, Meteocell ….
NWP: Global forecasting technology of the Hydrometcentre of Russia

- Semi-Lagrangian vorticity-divergence dynamical core of own development
- ALADIN/LACE parameterizations with some own add-ons
- Currently, 0.9°x0.72° lon/lat, 28 levels, runs on Altix 4700
- Version with the resolution 0.45°x0.37°, 50 levels, ALARO microphysics under testing
- Mass-conservative semi-Lagrangian advection, reduced lat-lon grid (probably, 2012)
- Version with the resolution 0.22°x0.18°, 60 levels expected in 2013

- 3D-Var scheme of own development. Hybrid ensemble scheme on the basis of existed 3D-Var to be developed (2012-2014)
Numerical weather prediction - continued

• Complexity of Sochi region stimulates application of high-resolution modeling. By 2014 horizontal grid step about 1 km seems to be a realistic level of model resolution.

• Key areas to be addressed: data assimilation; physics, validation and numerical challenges at high resolution; predictability and uncertainty.

• High-resolution data assimilation is a necessary prerequisite for meso-scale forecasting. The remote sounding is the main source of meso-scale structures in the initial data for such a modeling. Potential input for assimilation: Doppler radars; Wind and temperature/humidity profilers; Satellite radiances (AMSU-A, AMSU-B, AVHRR, IASI, SSMIS); Satellite winds (AMV, ASCAT).

• Convective-scale multi-model ensemble forecasting might be a new experience of Sochi-2014
Basic model: COSMO

For the period up to 2014 the COSMO goal is to develop a model-system for the short to very short range with a convective-scale resolution to be used for operational forecasting of mesoscale weather, especially high impact weather.

The strategic elements to achieve this goal are:
– an ensemble prediction system for the convective scale;
– an ensemble-based data assimilation system for the convective scale (LETKF);
– a verification and validation tool for the convective scale;
– an intermediate resolution COSMO version for the provision of boundary conditions;
– etc.
FORECAST SYSTEM COSMO-RU

GME (DWD):
368 * 642 * 60 grid nodes
Grid step: 20 km (from 2011)
Time step: 110 sec
Forecast range: 7 days

COSMO-RU07:
700 * 620 * 40 grid nodes
Grid step: 7 km
Time step: 40 sec
Forecast range: 78 hr
Runtime: 19 min on 1024 cores of Altix-4700.
At 00 and 12 UTC

COSMO-RU02:
420 * 470 * 50 grid nodes
Grid step: 2.2 km
Time step: 15 sec
Forecast range: 24 hours
COSMO-RU02

Horizontal resolution – 2.2 km

15:00 27 дек 2010 (МСК): T2m, P ур.моря, H500

Top right: T2m + MSLP;
Left: Precipitation (green), MSLP, Mid-layer cloudiness (blue)
COSMO contributions to the «Sochi -2014» project

• A COSMO-LEPS (7-km grid spacing) centered around Sochi for a dynamical downscaling of the ECMWF EPS with a forecast range of up to 5 days. The idea is to run the COSMO-LEPS-Sochi for a test period during winter 2012/2013 and in production mode during winter 2013/2014.

• Deterministic, high resolution COSMO model (2.2 km grid spacing; forecast range up to 24 hours; rapid update cycle) nested into the 7-km COSMO-RU model in Moscow. The model runs should include data assimilation using all available data, including the Doppler radar in Sochi.

• Extensive work on development of convection-permitting model version is on the way (Some COSMO members already have a substantial experience at convection-permitting resolutions).
Telecommunication system in the region of Olympics

Roshydromet’s telecommunication system consists of ground-based and satellite components.

**Ground-based component** = Departmental network + Automated System of Data Transfer.

**Satellite component** – supported by “Meteolnfor” system (“Mitra” technology) via “Express-AM1” satellite.

Today in the region of the Olympics “Mitra” terminals are installed at Roshydromet’s regional offices in Sochi, Rostov, Krasnodar + at the airports Adler (Sochi), Rostov, Krasnodar, Gelendjik. “Mitra” terminals to be installed at local meteorological offices at sport venues.

Bandwidth between the centres and Internet links to be upgraded up to at least 2 Mb/sec.
Forecaster role: Best nowcasts include a forecaster with conceptual models of local process evolution and access to automated tools.

First training course for Olympic meteorologists (November 2010)

- Training will be held on regular basis;
- Participants will be involved into provision of meteorological services for test events;
- Work with volunteers is planned to start in 2012.
MINISTRY OF NATURAL RESOURCES AND ECOLOGY OF THE RUSSIAN FEDERATION
FEDERAL SERVICE FOR HYDROMETEOROLOGY AND
ENVIRONMENTAL MONITORING (ROSHHYDROMET)
Weather Bulletin Rosa Khutor Alpine Resort

Night: Partly cloudy. Mostly without precipitation. South-east wind, at the Start 4-9 mps, at the Finish 2-5 mps. Temperature at the Start -4...-2°C, at the Finish -2...0°C.
Day: Partly cloudy. Sometimes light snow with rain. South-east wind, at the Start 3-8 mps, at the Finish 1-4 mps. Temperature at the Start 0...+2°C, at the Finish +2...+4°C.

Weather forecast for the track February 23, 2011

<table>
<thead>
<tr>
<th>Start zone (H=1590m)</th>
<th>09:00</th>
<th>10:00</th>
<th>11:00</th>
<th>12:00</th>
<th>13:00</th>
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<th>15:00</th>
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<td>Weather phenomenon</td>
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<tr>
<td>snow</td>
<td>snow</td>
<td>snow with rain</td>
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<tr>
<td>Precipitation, mm</td>
<td>0.1</td>
<td>0.1</td>
<td>0.1</td>
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<td>New snow, cm</td>
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<td>Visibility, km</td>
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<td>1-2</td>
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<td>2-4</td>
<td>2-4</td>
<td>4-6</td>
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<tr>
<td>Temperature, °C</td>
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<td>-1</td>
<td>0</td>
<td>+1</td>
<td>+2</td>
<td>+2</td>
<td>+2</td>
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<tr>
<td>Relative humidity,%</td>
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<td>90</td>
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<td>85</td>
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<td>Weather phenomenon</td>
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<td>snow with rain</td>
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<td>rain</td>
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<tr>
<td>Precipitation, mm</td>
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<td>New snow, cm</td>
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<td>2</td>
<td>2</td>
<td>1</td>
<td>2</td>
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</table>

Weather forecast: February 24, 2011
Partly cloudy. Without precipitation. South-east wind 5-10 mps at the Start, at the Finish 2-7 mps. Minimum temperature at the Start -2...-0°C, at the Finish -1...+1°C. Maximum temperature at the Start 0...+2°C, at the Finish +3...+5°C.

Weather forecast: February 25, 2011
Partly cloudy. Mostly without precipitation. South-east wind 5-10 mps at the Start, at the Finish 2-7 mps. Minimum temperature at the Start -2...-0°C, at the Finish -1...+1°C. Maximum temperature at the Start 0...+2°C, at the Finish +3...+5°C.

Weather forecast: February 26, 2011
Partly cloudy. After noon light snow with rain. South-east wind 5-10 mps at the Start, at the Finish 2-7 mps. Daily temperature at the Start -2...+3°C, at the Finish 0...+5°C.

Chief Meteorologist of the Olympic Games 2014
V. Lukjanov
Forecasters
E. Shapetko, S. Mostamandi
22.02.11
Roshydromet is very interested in an international collaboration around «Sochi-2014» Olympic Games within the framework of WWRP activity.

Meteorological support of the Games implies both research and practical forecasting.

Various types of WWRP projects (mixed RDP/FDP or FDP) could be relevant.
Potential content of “Sochi-2014” project

General goal: To enhance and demonstrate capabilities of modern systems of short-range NWP and nowcasting in winter conditions for mountain terrain and to assess effect of practical use of this information.

Subgoals – development of:
- Nowcasting of multi-weather elements (wind speed/gust, visibility, precipitation intensity/type/time) in a region with complex terrain in winter season;
- High resolution remote sensing data assimilation;
  High resolution modeling for a region with mountain terrain;
- High resolution ensemble forecasting for a region with mountain terrain;
- High-resolution forecast/nowcast verification using remote sensing data.
Kick-off meeting of potential participants, 1-3/3/2011

International Participants:

- CMA;
- COSMO;
- Environment Canada;
- Helsinki University;
- NCAR;
- NOAA;
- TIGGE-LAM / ARPA-SIMC;
- Vaisala (via IRAM - local Russian representative);
- ZAMG;
- WMO Secretariat and WWRP WGs on Nowcasting, Mesoscale Forecasting, Verification Research
Thank you!

http://webcam.grandhotelpolyana.ru:8080/