FROST-2014 : FORECAST AND RESEARCH IN THE OLYMPIC SOCHI TESTBED

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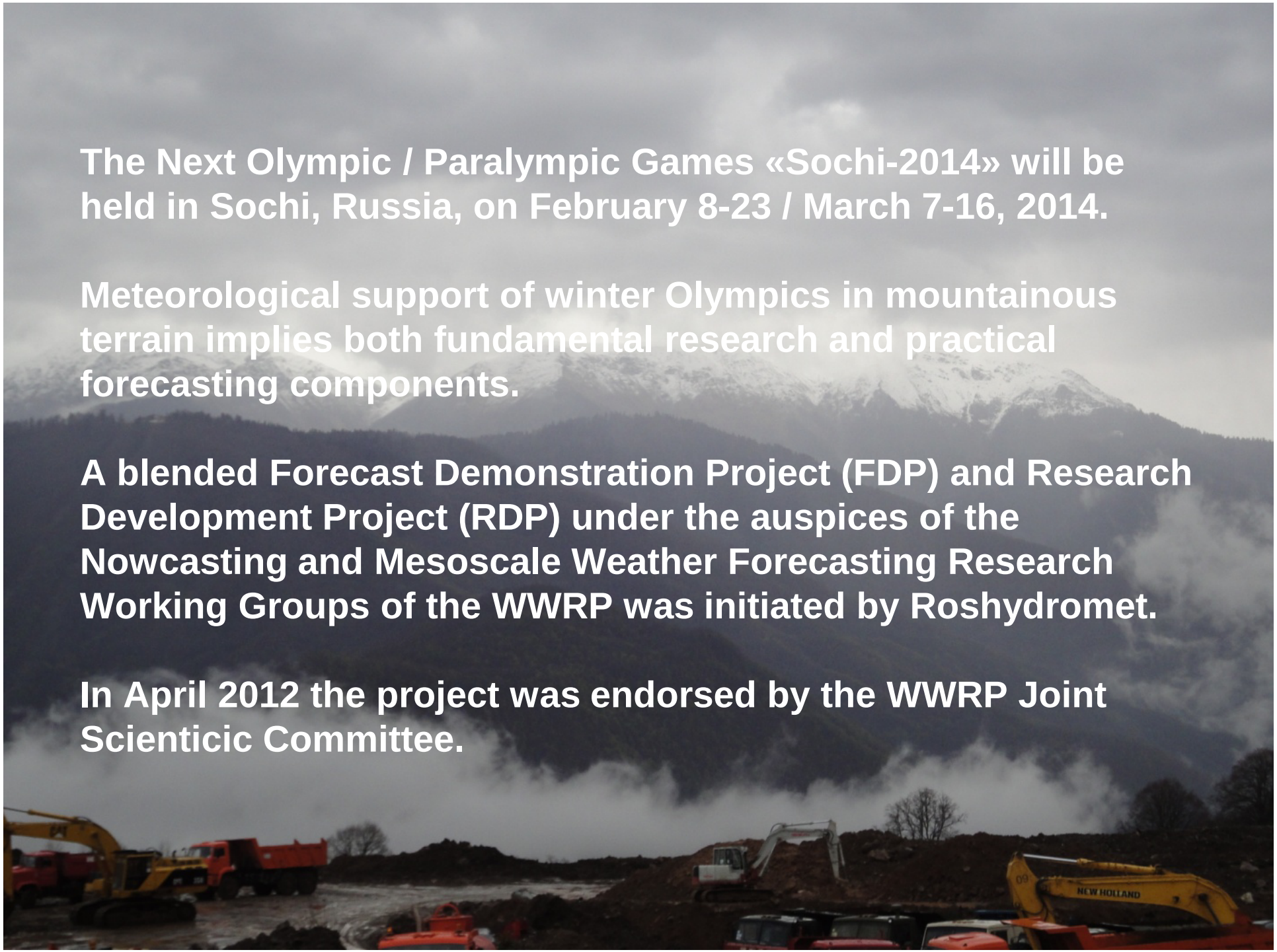
6-10 August 2012

WSN12, Rio de Janeiro, Brazil

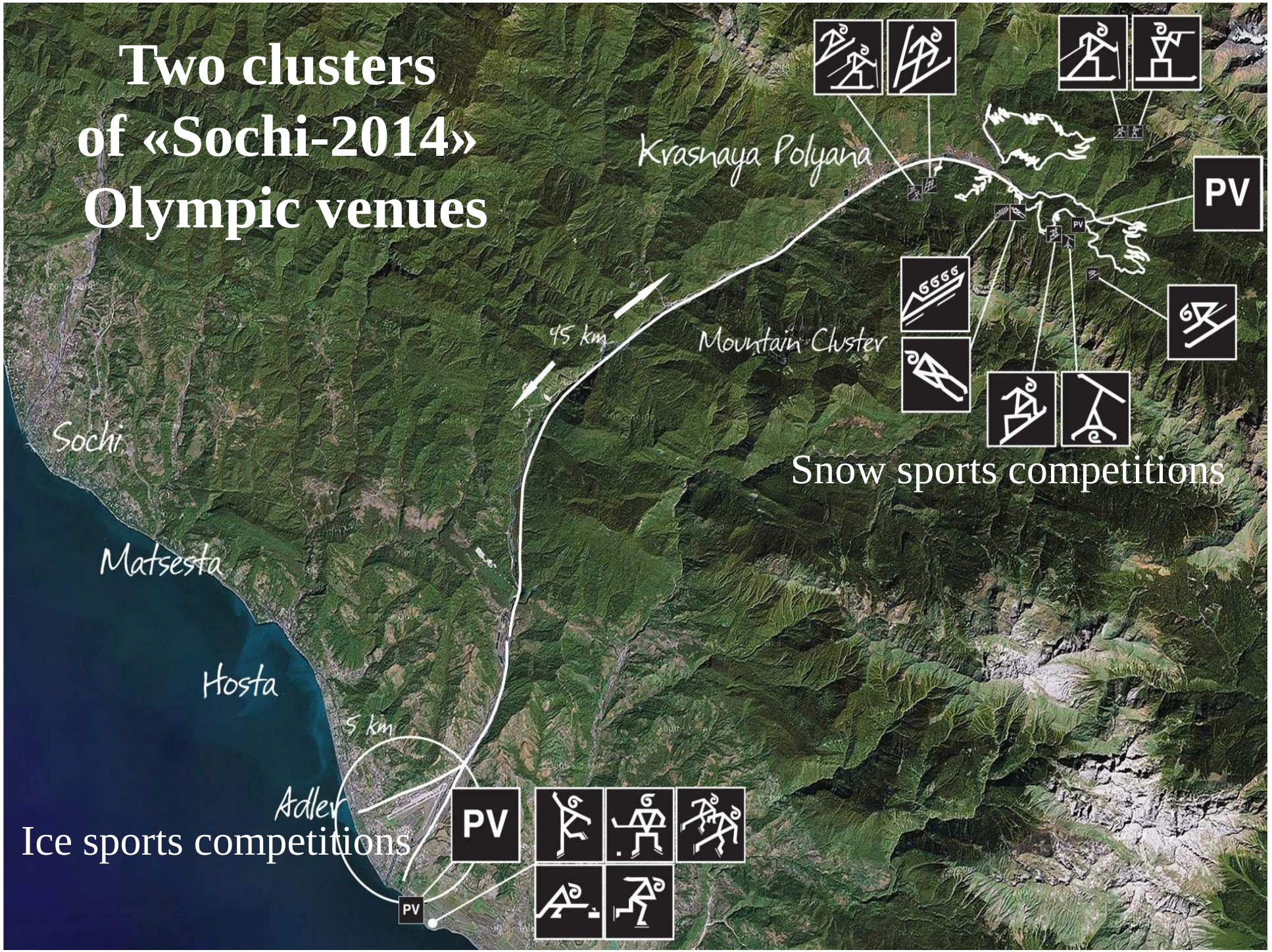


The Next Olympic / Paralympic Games «Sochi-2014» will be held in Sochi, Russia, on February 8-23 / March 7-16, 2014.

Meteorological support of winter Olympics in mountainous terrain implies both fundamental research and practical forecasting components.

A blended Forecast Demonstration Project (FDP) and Research Development Project (RDP) under the auspices of the Nowcasting and Mesoscale Weather Forecasting Research Working Groups of the WWRP was initiated by Roshydromet.

In April 2012 the project was endorsed by the WWRP Joint Scienticic Committee.


Two clusters
of «Sochi-2014»
Olympic venues
Krasnaya Polyana
PV
45 km
Mountain Cluster
Sochi
Matsesta
Hosta
5 km
Adler
PV
PV
Snow sports competitions
Ice sports competitions

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 sub-tropical and Alpine environments make weather forecasting in this region extremely 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.

Goals of RDP/FDP FROST-2014:

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

• To improve and exploit:
- nowcasting systems of high impact weather phenomena (snow levels, wind, visibility, precipitation type and intensity) in complex terrain;
-high-resolution deterministic and ensemble mesoscale forecasts in winter complex terrain environment;

• 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 and assess benefits of forecast improvement.

As the project evolves these goals will be detailed.

The outputs of the project will be used to enhance nowcasting and mesoscale services for the Olympics.

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.

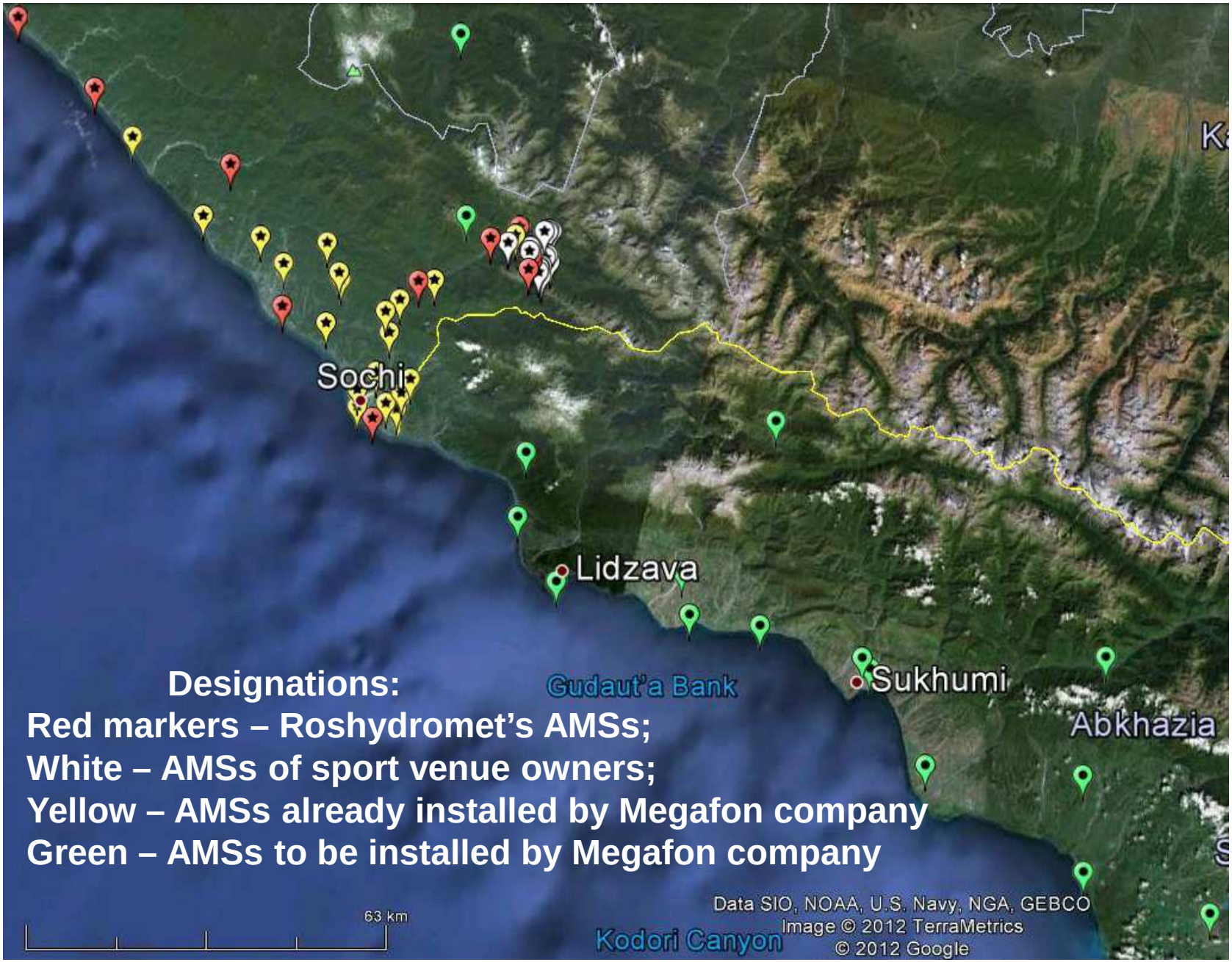
Nevertheless, today situation is substantially better than 1-2 years ago, and enhancement of the network will continue.

+ 46 near-surface automatic stations have been installed to enhance the observational network in the region.

+ Wind profiler, temperature/humidity profiler and two Micro Rain Radars (MRR) will supplement the network by winter 2012/2013.

+ More frequent sounding data at the nearest aerological stations will be available

Current network of AMSs in the region of Sochi and its foreseen enhancement



Supplementary network of AMS on the towers of mobile communication is being developed in the region in cooperation with Megafon company

Some AMS are accompanied by web-cameras.

Current Instrumentul Setup (AMSs and Sensors Installed)

Station Name	WMO index	Coordinates		H Above sea lev., m	Measured parameters											
					Air temperature	Rel. humidity	Wind Direction	Wind Speed	Liquid Precip. Amount	Solid Precip. Amount	Snow Height	Snow surface T	Snow T	Visibility	Atm. Pressure	Cloud base height
Roshydromet's AMSs																
Aviation station «Adler»	37171	43°26'20,83"	39°55'50,80"		+	+	+	+	+					+	+	+
Automated AMK «Sochi»	37099	43°34'23,76"	39°45'21,00"	142	+	+	+	+	+					+	+	
Krasnaya Polyana	37107	43°40'56,10"	40°12'10,52"	565	+	+	+	+	+					+	+	+
Kordon Laura	37090	43°41'59,15"	40°15'54,56"	575	+	+	+	+	+					+	+	+
Aibga	37108	43°38'5,29"	40°17'4,69"	2225	+	+	+	+	+					+	+	
Alpica-1000	37106	43°39'50,61"	40°17'33,74"	1124	+	+	+	+	+	+	+			+	+	
Alpica-1500	37105	43°38'20,83"	40°17'35,73"	1465	+	+	+	+	+	+	+			+	+	
Kepsha	37100	43°36'54,18"	40°2'56,60"	180	+	+	+	+	+	+	+			+	+	+
Solokh-Aul	37092	43°48'	39°38'	230	+	+	+	+	+	+	+			+	+	+
Lazarevskoye	37093	43°54'	39°20'	20	+	+	+	+	+	+	+			+	+	
Magry	37015	43°01'	39°10'	25	+	+	+	+	+						+	
Imeretinka	37095	43°24'05"	39°57'14"	60	+	+	+	+	+					+	+	
Biathlon + Skiing Venue																
Biathlon-1400	39042	43°41'35,32"	40°19'6,73"	1405	+	+					+	+	+			
Biathlon Stadium	39044	43°41'31,63"	40°19'36,05"	1455	+	+	+	+	+		+	+	+	+	+	+
Skiing Stadium	39043	43°41'40,52"	40°19'43,69"	1480	+	+		+			+	+	+		+	
Biathlon-1500	39045	43°41'34,90"	40°20'6,70"	1495	+	+					+	+	+			
Ski Jumping																
Ski Jumping-800	39041	43°40'27,10"	40°14'24,30"	781	+	+	+	+	+	+	+	+	+	+	+	
Ski Jumping-650	39040	43°40'38,30"	40°14'24,30"	628	+	+	+	+	+	+	+	+	+	+	+	+
Sledge																
Sledge-830	39046	43°39'45,30"	40°17'10,02"	830	+	+	+	+	+	+	+	+		+		
Sledge-700	39047	43°40'7,33"	40°17'19,97"	700	+	+	+	+	+	+	+	+	+	+	+	+
«Roza-Khutor»																
11Sr (Aibga)		43°37'24"	40°18'45"	2320	+	+	+	+							+	
12Sr				2137	+	+	+	+			+		+			
13Sr (Men's start)		43°37'47"	40°18'25"	2040	+	+					+		+			
18Sr (Women's start)		43°38'08"	40°18'32"	1740	+	+	+	+			+		+		+	
14Sr(Super-Giant)		43°38'22"	40°18'47"	1580	+	+	+	+			+		+			
17Sr(Finish)		43°38'43"	40°19'53"	980	+	+	+	+					+		+	
Snowboard		43°39'22,12"	40°19'42,59"	1020	+	+	+	+	+	+	+	+	+	+	+	+
Freestyle		43°39'12,46"	40°19'14,02"	1130	+	+	+	+	+	+	+	+		+		

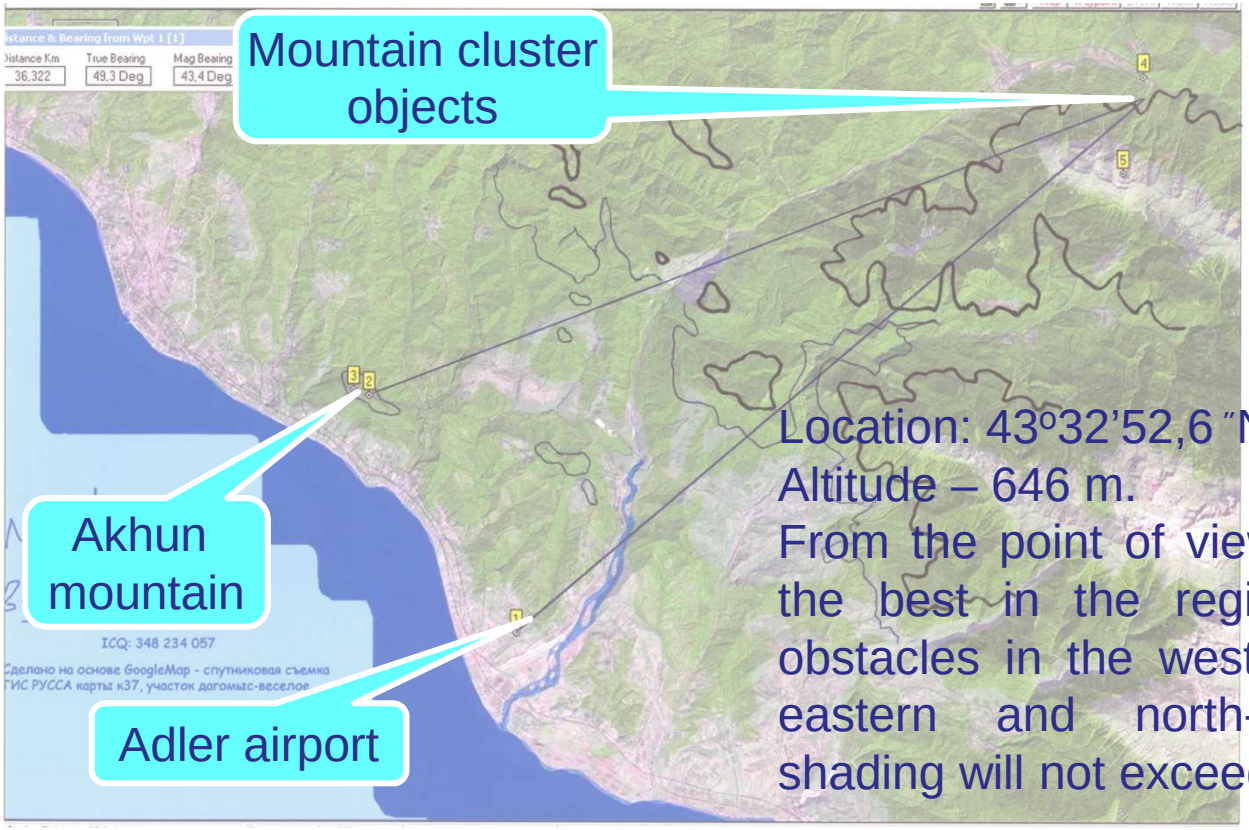
Current Instrumentul Setup (AMSs and Sensors Installed) - continuation

Station Name	WMO index	Coordinates		H Aboves ea lev., m	Measured parameters (Vaisala WXT-520)											
					Air temperatu re	Rel. humidity	Wind Direction	Wind Speed	Liquid Precip. Amount	Solid Precip. Amount	Snow Height	Snow surface T	Snow T	Visibility	Atm. Pressure	Cloud base height
«Meteofon» stations at the towers of mobile communication																
Sochi-Plastunka	39003	43°38'23"	39°45'26"	152	+	+	+	+	+						+	
Adler-Galitsino	39016	43°32'03"	39°59'15"	485	+	+	+	+	+						+	
Esto-Sadok	39021	43°41'14"	40°15'23"	525	+	+	+	+	+						+	
Matsesta-Chai	39024	43°37'36"	39°52'39"	421	+	+	+	+	+						+	
Akhun mountain	39022	43°32'53"	39°51'03"	693	+	+	+	+	+						+	
Krasnaya Polyana	39025	43°40'23"	40°12'03"	503	+	+	+	+	+						+	
Kalinovo lake	39002	43°36'58"	39°52'55"	403	+	+	+	+	+						+	
Adler-Airport	39013	43°26'42"	39°55'12"	146	+	+	+	+	+						+	
Veseloye	39012	43°26'24"	40°00'36"	124	+	+	+	+	+						+	
Ermolovka	39014	43°27'36"	40°01'48"	346	+	+	+	+	+						+	
Lesnoye	39017	43°34'12"	39°58'48"	339	+	+	+	+	+						+	
Pogranichnik	39010	43°25'12"	39°55'12"	12	+	+	+	+	+						+	
Loo	39026	43°42'36"	39°34'48"	180	+	+	+	+	+						+	
Pikhtinka	39023	43°37'12"	40°04'48"	720	+	+	+	+	+						+	
Zubova shel	39005	43°49'48"	39°25'12"	215	+	+	+	+	+						+	
Adler-Norluis	39011	43°25'28"	39°58'54"	173	+	+	+	+	+						+	
Adler-Moldovka	39015	43°28'21"	39°57'36"	205	+	+	+	+	+						+	
Sochi-Obzornaya	39004	43°40'53"	39°42'23"	381	+	+	+	+	+						+	
Sochi-Verbliud	39001	43°35'08"	40°00'34"	285	+	+	+	+	+						+	
Veseloye-Mirra	39020	43°24'54"	40°00'18"	28	+	+	+	+	+						+	

Doppler radar in Sochi

- Vaisala Doppler radar WRM200 was installed on Akhun mountain in Summer 2012.

- Data flow from the radar is expected in Autumn 2012.



Thin lines designate 500 m topography level; Bold brown lines – 1000 m topography level.

Location: 43º32’52,6 ″N, 39º51′05,0″E,
Altitude – 646 m.
From the point of view of coverage this position is the best in the region of Sochi. There are no obstacles in the western and southern sectors. In eastern and north-eastern directions horizon shading will not exceed 1-2 degrees in vertical.

Nowcasting

Many issues should be tackled within this project component, e.g.:

- Winter nowcasting of multi-weather elements (wind speed and wind gust, visibility, precipitation intensity and time);
- Improvement of blending procedures for NWP and extrapolated observations for winter;
- Radar retrieval of precipitation type and intensity;
- Assessment and account for observational uncertainty (WGNR mandate).

The project gives a chance to develop mesoscale NWP to fill the gap in 4-6 hour and, probably, up to 12 hour range. Nowcasting potential of participating NWP models (COSMO, HARMONIE, AROME, GEM, GRAPES, WRF) should be assessed for direct and post-processed (e.g. Kalman filter, 1-D model, MOS) model forecasts.

Besides the meso-scale models, the specialized nowcasting systems are expected to be used in the project – ABOM, CARDS, INTW, STEPS, INCA, WSDDM, GRAPES.

Numerical weather prediction

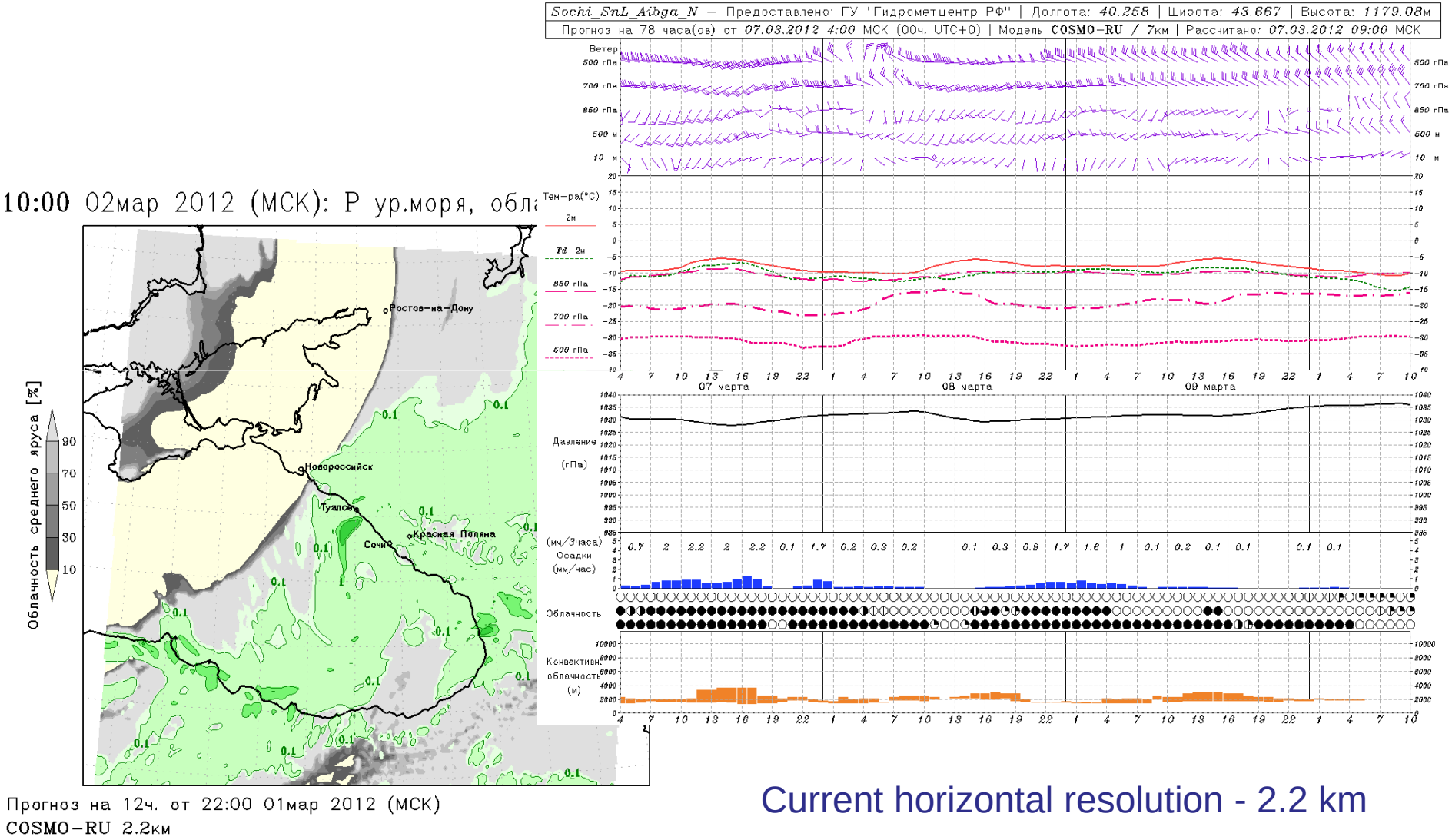
- Complexity of Sochi region stimulates application of high-resolution modeling.

- 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

Roshydromet's basic mesoscale forecasting system - COSMO-RU02

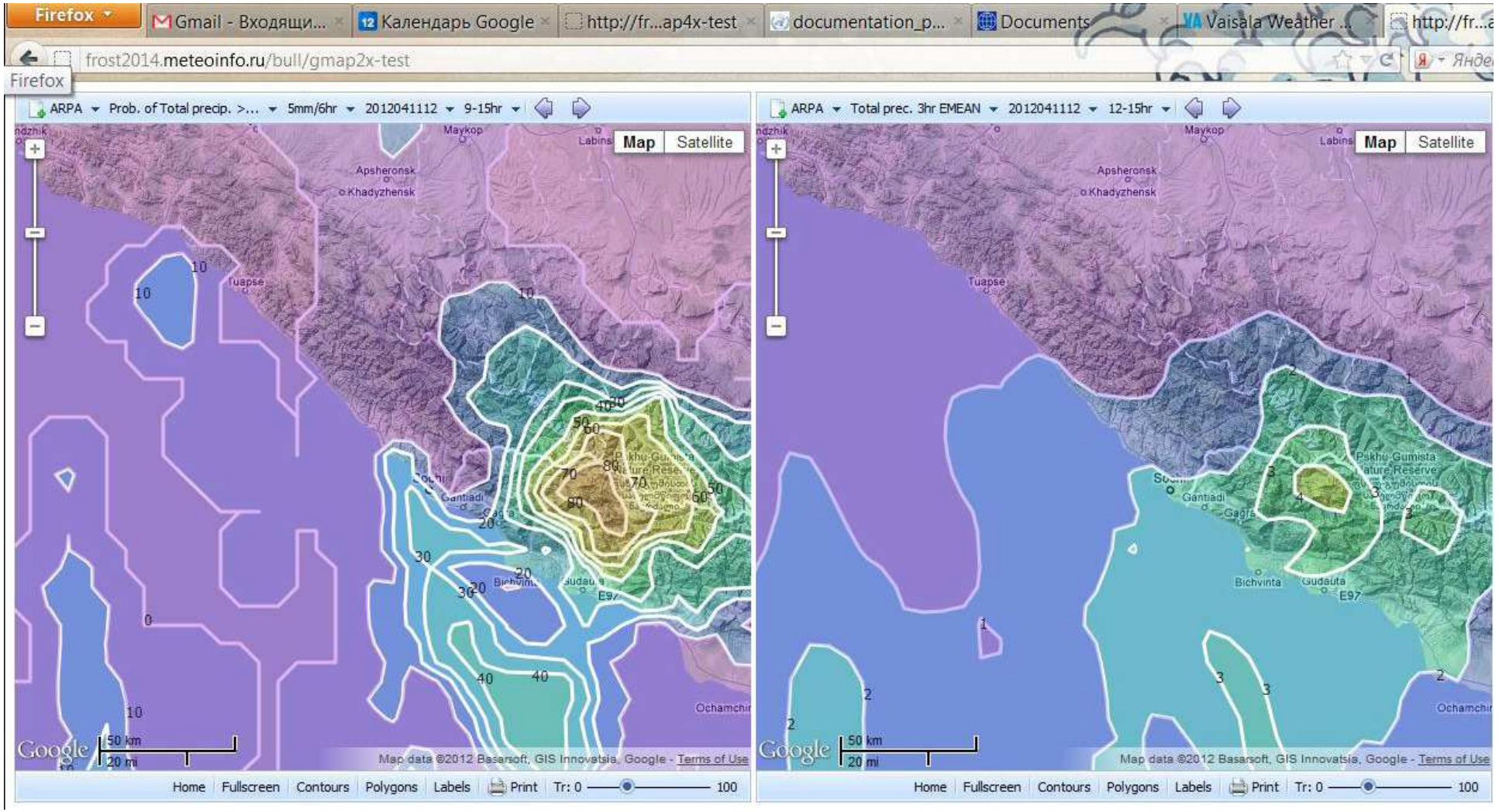


Current horizontal resolution - 2.2 km

"- Forecasters do not always like probabilities (at any scale!)
- End-users "hate" probabilities."

Andrea Montani, Michael Ttsyrulnikov (1st FROST-2014 meeting)

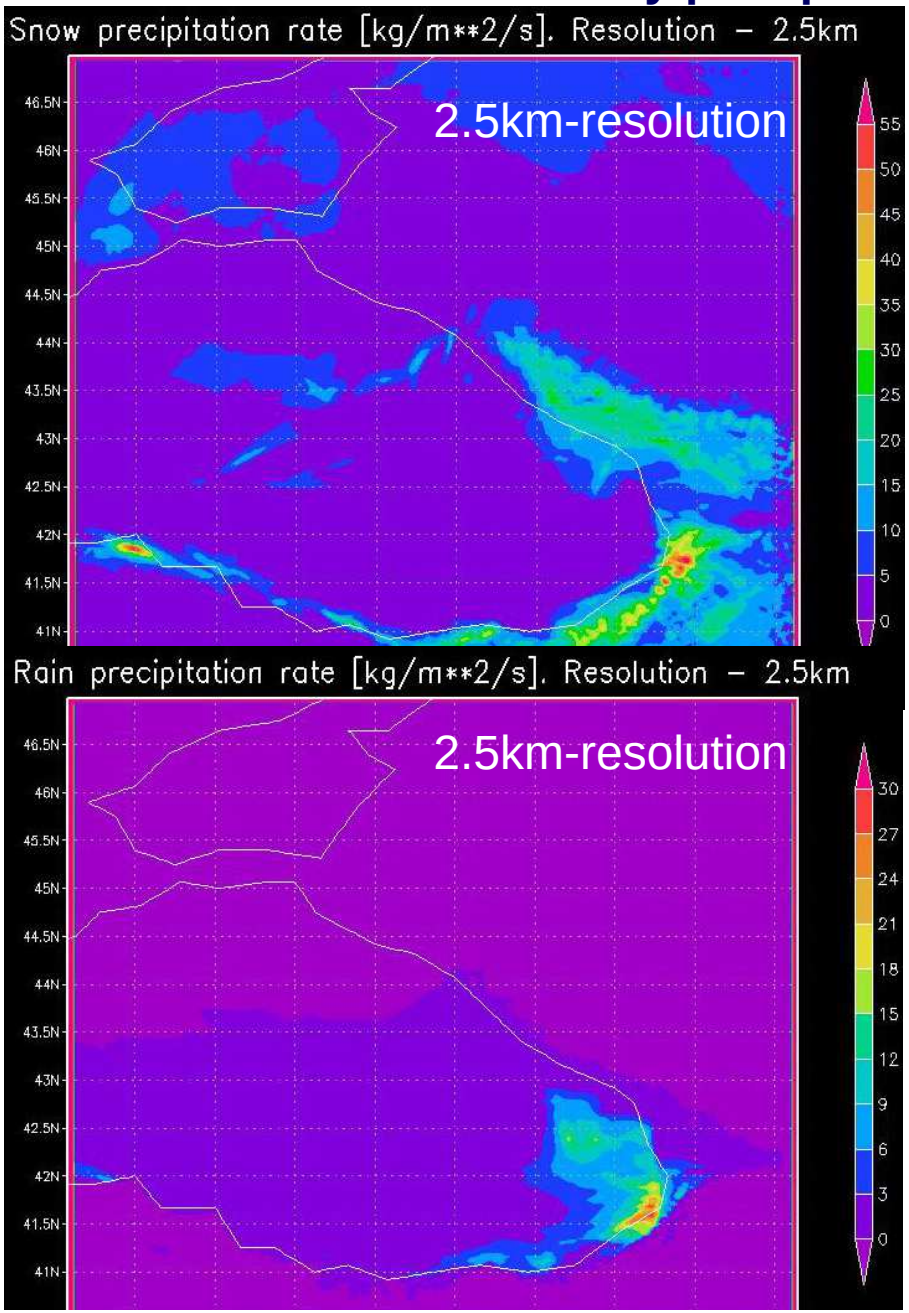
TIGGE-LAM / ARPA-SIM probabilistic forecasts for Sochi region

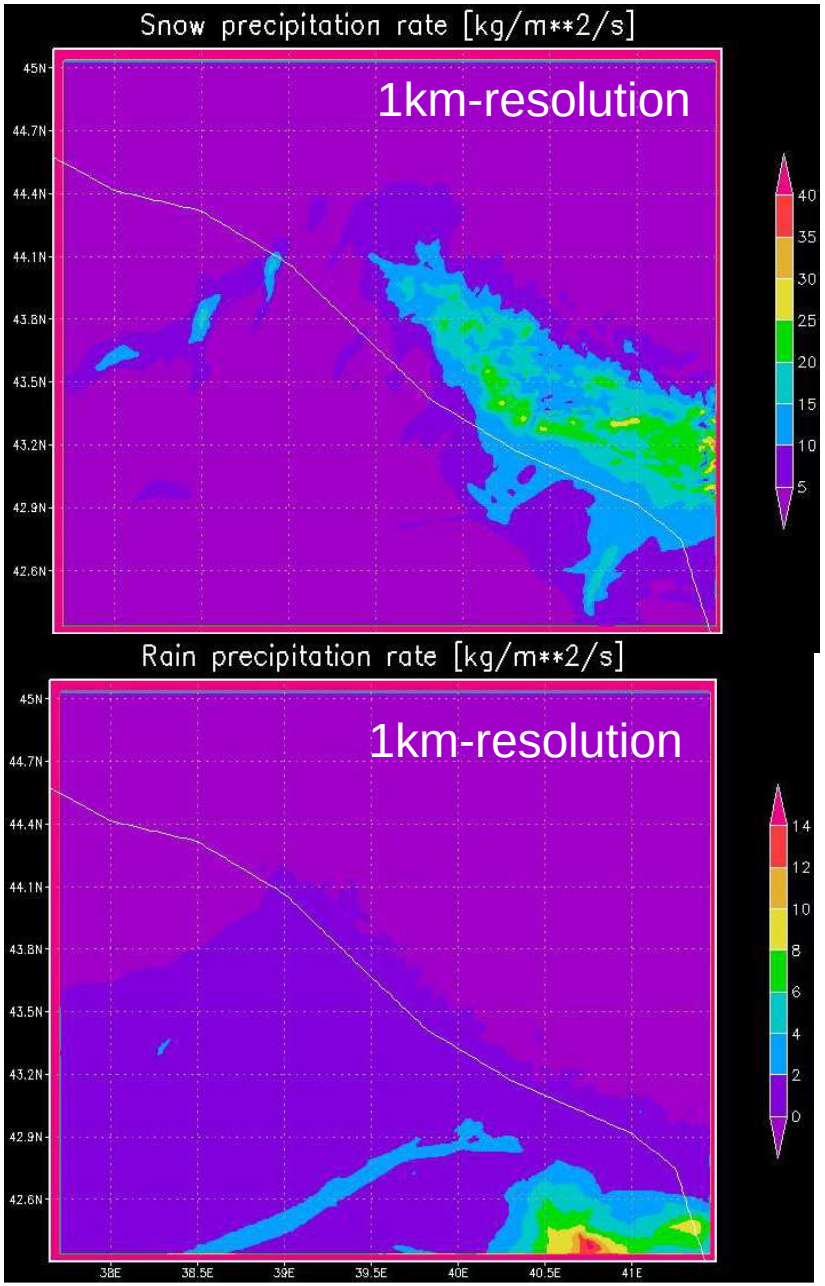


http://frost2014.meteoinfo.ru – MAP D-Phase-like interface is being developed

GEM (Environment Canada):

Simulation of heavy precipitation case in Sochi 31.1-1.2.2012





Verification and impact assessment

• Data storage with Internet-access for the project participants is already in place;

• As for SNOW-V10, it is of interest to quantify the added value of forecast refinement between:
- Global model;
- Regional model without and with its own data assimilation;
- High-resolution model with and without data assimilation;
- Post-processed model output (Kalman filter, MOS, 1D-model etc.);
- Nowcasting (based on latest observations and blended with NWP).

• Distributed verification activity : Roshydromet – FMI (JWG on Verification Research)

• Impact assessment - some first steps are tried
(Target group – Olympic forecasters)

Tentative list of the project participants :

- COSMO;
- Environment Canada;
- FMI and Helsinki University;
- HIRLAM;
- Korean Meteorological Administration;
- NOAA;
- ARPA-SIM / TIGGE-LAM;
- Vaisala (via local Russian representative);
- ZAMG;
- WMO Secretariat and CAS/WWRP WGs on Nowcasting, Mesoscale Forecasting, Verification Research

- -

Potential participants: CMA, NCAR, Basel University

CONCLUSION

SNOW-V10 was the first WWRP winter complex terrain nowcasting project. It remains to be demonstrated whether its results are universally applied and can be demonstrated in a different environment or with different observating network.

FROST-2014 provides an excellent opportunity to extend the experience of SNOW-V10 project in the scientifically challenging area of winter nowcasting in a region with complex terrain.

The project is open for new interested participants. Additional information is available at http://frost2014.meteoinfo.ru.

Thank you!

http://frost2014.meteoinfo.ru