Mobile System for Atmosphere Remote Sensing (MS ARS):
Results of 24/7 mode of operation during Olympic and Paralympics Games «Sochi- 2014»

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Presented by
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1. Introduction
1.1 General overview

- Micro Rain Radar (MRR-2)
- Operator cabin
- Trailer
- Microwave temperature/humidity profiler
- Side lobe suppression screen
- Electric power engines (gasoline operated)
1. Introduction

1.2. External sensors

- Scintec 3000
- RPG
- MRR-2
1. Introduction

1.3. Operator cabin.

- Diagnostic monitor
- Digital decoder- controller of azimuth
- ENIGMA signal Processor
- Data processing notebook
- Special Monitor full internal diagnostics
- Wind profiler processing system
- DC power supply
1. Introduction

1.4. Supplement Equipment

- Electric power engines
- Azimuth rotator
- Data processing notebook
- GPS
- GSM
- Mini-weather station
2. Preliminary inter comparisons of the data
2.1. System testing in Dolgoprudny
2. Preliminary inter comparisons of the data

2.2. Comparison in Dolgoprudny
2. Preliminary inter comparisons of the data

2.3. Comparison in Dolgoprudny
2. Preliminary inter comparisons of the data
2.4. Comparison in Dolgoprudny
3. System location during Olympic and Paralympics Games

3.1. Radar wind profiler. Scintec 3000

<table>
<thead>
<tr>
<th>Operating Frequency</th>
<th>800 to 1400 MHz, typically 915, 924, 1280, 1290, 1299, or 1357.5 MHz.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Maximum Average RF</td>
<td>100 W avg.</td>
</tr>
<tr>
<td>Power</td>
<td></td>
</tr>
<tr>
<td>Antenna type</td>
<td>Electrically steerable phased array</td>
</tr>
<tr>
<td>Aperture</td>
<td>Nominally 3.0 m²</td>
</tr>
<tr>
<td>Direction</td>
<td>Zenith and ± 15.5°</td>
</tr>
<tr>
<td>Gain</td>
<td>~26 dBi</td>
</tr>
<tr>
<td>Beam width</td>
<td>~9°</td>
</tr>
<tr>
<td>Minimum measurement height(1)</td>
<td>120 m</td>
</tr>
<tr>
<td>Maximum measurement height(2)</td>
<td>2 to 5 km</td>
</tr>
<tr>
<td>Wind speed accuracy</td>
<td>&lt; 1 m/s</td>
</tr>
<tr>
<td>Wind direction accuracy</td>
<td>&lt; 10°</td>
</tr>
</tbody>
</table>
3. System location during Olympic and Paralympics Games

3.2. Microwave temperature-humidity profiler. RPG

Red dot – installation site

Green Arrow - direction of scanning by RPG

TEKO 2014
4. Measurements configuration

Common view of the MS ARS system at the “Kordon Laura”

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Wind Radar</th>
<th>Microwave Radiometer</th>
</tr>
</thead>
<tbody>
<tr>
<td>Vertical range (m)</td>
<td>Up to 3500</td>
<td>Up to 10000</td>
</tr>
<tr>
<td>Vertical resolution (m)</td>
<td>100</td>
<td>50</td>
</tr>
<tr>
<td>Rate of measurements (min)</td>
<td>5</td>
<td>5</td>
</tr>
<tr>
<td>Integration time (min)</td>
<td>30</td>
<td>-</td>
</tr>
<tr>
<td>Data transfer rate (min)</td>
<td>30</td>
<td>15</td>
</tr>
</tbody>
</table>
5. Organization of 24/7 duty measurements and data transfer

5.1 Radar wind profiler. Scintec 3000

Wind speed height / time diagram

Wind speed Vertical profile
5. Organization of 24/7 duty measurements and data transfer

5.2. Radar wind profiler. Scintec 3000

Wind speed
Vertical profile

24 hours wind speed field (height is above the installation level=650m)
5. Organization of 24/7 duty measurements and data transfer

5.3. Microwave temperature-humidity profiler. RPG
5. Organization of 24/7 duty measurements and data transfer


Original software delivered by manufacturer is not convenient at all.

The original data file is not appropriate for normal archiving on the remote ftp.

The substitution of software on developed by Paul Joe use to be done.
24 hours temperature field constructed on the basis of “in situ” data.

Example of azimuth non homogeneity of the temperature field of boundary layer in valley.

RPG data about temperature field for the same date as on Fig 11.
Full temperature profile (to the troposphere)
Boundary layer temperature profile
Wind speed profile
Summary

1. Validation: We have intended just to verify the type of profiles and their main characteristics as the height of specific points like max/min, inversion and so on.

2. The “in situ” temperatures measured at the same (within 50m range) height were simply averaged to get one temperature for one height with the step 50m. It is easy to see, that the MS ARS data for the same period are very similar (Fig 12), but has much more details in the structure.

3. The wind fields measured at the ground based stations were not corresponding in general to the wind measured by MS ARS. Just extreme max data were more or less close one to other. But the wind data from radiozonds released in Sochi were close to the MS ARS data when it can feel the signal from the height above 2000m over sea level (1350 above installation site).

4. The integrated water vapor has very serious meaning for forecasts of cloudy conditions. The absolute value of IWV increased in 3-4 times during the potentially perceptible clouds with respect of non cloudy. The cloudy conditions have a special interest for mountain cluster. As we know the height of condensation, we could easy predict decrees in visibility caused by low clouds.

5. The Liquid Water Path time series demonstrates very good ability to diagnose the originations of clouds. If the shape of LWP time series is very smooth with very long time wave structure, it corresponds to orographic clouds, which generated by the up flow in the nearest mountains and are quays stable. If the shape of LWP has short time big variation, thus it is frontal clouds.
Summary

6. Unfortunately all microwave radiometer data were not available during snow storm and rain on the ground. The system of precipitation protection delivered by RPG is not suitable for mountain conditions, where the precipitation has very heavy character.

7. The development of wind during the air mass change has absolutely different structure then ILW and LWP. It looks like that the wind field more close to the temperature field: both of them has very sharp change while the air mass change and then very slow drop of the values with time at each individual height.

8. If to summarize the experience of MS ARS usage at mountain cluster during the Olympic and Paralympics Games “Sochi-2014”, we should say, that it was very positive and productive. The proper knowledge about limitation of each individual technology allows escaping miss interpreting of the data. But the main period of time (>80%) the remote sensing sensors of MS ARS provides reliable and very useful data.

9. So at the end of Olympic season it was decided by Roshydromet authority, that the system will be moved to Moscow region for the servicing of Hydrometcenter of Russian Federation for evaluation of the new NWP models with very high time and space resolution.
«Thanks for your attention!»

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