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MODERN METEOROLOGICAL RADAR “WRM200” IN KUTAISI (GEORGIA)

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Summary: *The description and technical characteristics of the new meteorological radar “WRM200”, installed in Kutaisi (Georgia) in 2021, in order to monitor the weather in Western Georgia, are provided. The technical characteristics of this radar were compared with the “Meteor 735CDP 10” radar installed earlier in 2015 in the village Chotori (Kakheti) for the needs of anti-hail service.*

Key Words: *meteorological radar, radar observation.*

Introduction

At present, meteorological radars are widely used all over the world. They have a wide range of capabilities and are tailored to the needs of a particular country. In addition to storm warning and meteorological support, these radars are also an effective means of obtaining information about the state of cloud cover after physical and chemical impact on its in order to prevent showers and hail, or increase precipitation in arid regions. In particular, in the sixties-eighties of the last century in Georgia, a large number of meteorological radars were used when carrying out anti-hail work [1,2]. These works continued until 1989 and were renewed using newest technologies in Kakheti region of Georgia in 2015 [3-5]. Accordingly, radar observations were also discontinued.

The anti-hail service is equipped with a modern meteorological radar “METEOR 735 CDP 10” [6,7], which in the future, in addition to anti-hail activities, is planned to be used for operational monitoring of different dangerous hydro-meteorological processes in eastern Georgia and adjacent territories [8].

In parallel with this, the National Environmental Agency of Georgia also began to be equipped with modern meteorological radars. In 2021, the Vaisala Weather Radar "WRM200" made in Finland was launched in Kutaisi (Western Georgia) [9,10]. It is a dual polarization Doppler weather radar with real-time hydrometeor classification software. Its location allows you to monitor changes in weather and precipitation within a radius of up to 200 km. The distance to the Black Sea coast (Poti) does not exceed 95 km, and the distance to Anaklia and Batumi is 115 and 125 km, respectively. This is already the second modern weather radar in Georgia (if we do not take into account specialized aviation weather radars).

The brief technical characteristics of the "WRM200" meteorological radar are presented below [9,10]. Comparison of the technical characteristics of the radars "WRM200" and "Meteor 735CDP10" is also given.

Results

Results in fig. 1-2 and table 1 are presented.

With new solutions and innovative designs, Finnish Vaisala has become a leading supplier of C meteorological radars. A high quality, high performance antenna with the world's best ”

Sigmet" signal processor and IRIS software guarantee high quality radar data that meets even the most stringent dual polarization requirements for the most demanding clients. The state-of-the-art design and high quality fabrication of the antenna and rack also contribute to low maintenance costs throughout the life of the system [9,10]. Appearance of the radar "WRM200" in Kutaisi in fig. 1 is presented.

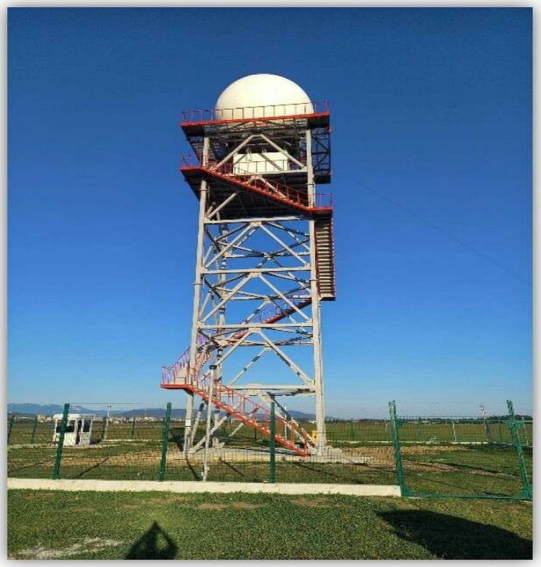

Fig. 1. Appearance of the radar "WRM200" in Kutaisi.

The radar data are telemetrically sent to Tbilisi, where they are continuously analyzed in the National Environmental Agency of Georgia. In fig. 2 shows one of the images from the monitor of this radar as an example.

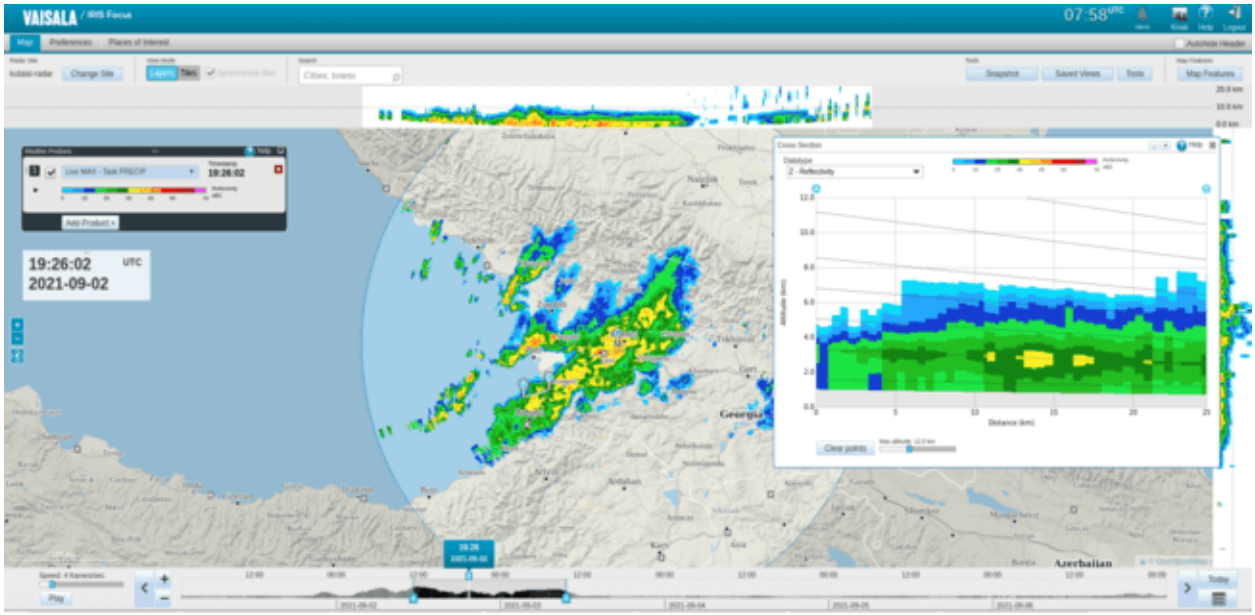

Fig. 2. Screenshot of the monitor of the "WRM200" radar in the National Environmental Agency of Georgia in Tbilisi.

Dual Polarization Adds New Dimension The WRM200 [9] is Vaisala's new dual polarization C-band magnetron Doppler Weather Radar. The radar operates in either STAR mode (simultaneous transmit and receive of H and V) or LDR mode (linear depolarization mode, during which H alone is transmitted and

both are received). STAR mode enables use of the high sensitivity power estimator increasing detectability by up to 10 dB versus the competition. The polarization variables, depending on the mode, are ZDR, RHOHV, PHIDP, KDP and LDR. However, the goal of a polarization radar is not only to produce and display these outputs; rather it is to expand the capabilities of the radar for the operational forecaster. The WRM200 provides the following benefits: Hydrometeor identification; Attenuation correction; Data quality improvement; Improved rainfall estimates HydroClass™ - Seeing much More HydroClass™ software uses polarization measurements in a proven fuzzy logic algorithm to classify targets into categories. i.e. hail, graupel, rain, snow, wet snow or non-meteorological targets (such as sea clutter, birds, insects, wind turbines, interference, or military chaff). While traditional Doppler clutter filtering can remove stationary targets, HydroClass™ can also remove moving non-meteorological targets like sea clutter. The benefit is improved data quality and more accurate warnings for hazardous weather such as hail.

Attenuation by intervening heavy precipitation has been a long-standing problem with C-band weather radars, making S-band radars preferable, especially in tropical environments where heavy rain is common. However, with dual polarization, a radar performs accurate, real-time attenuation corrections. The benefit is that you can obtain the same precipitation measurement accuracy using the WRM200 as with an S-band system that typically costs two or three times more. Experience, Innovation and Dependability Vaisala Sigmet Product line has three decades of experience in providing signal and data processing systems for dual polarization applications, and delivers more dual polarization processing systems than any other manufacturer. Vaisala and Sigmet, as a part of Vaisala, continue developing the dual polarization applications with respected consultants in the research community [9].

In table 1 information about comparison of the technical characteristics of "WRM200" (Kutaisi) and "Meteor 735CDP10" (Chotori, Kakheti) radars are presented.

Table 1. Comparison of the technical characteristics of "WRM200" and "Meteor 735CDP10" radars.

Technical characteristics	WRM200 (Kutisi)	Meteor 735CDP10 (Chotori)
Working frequency range	5.5-5.7 GHz	5.43 – 5.80 GHz
Peak power	250 kw	400 kw
Pulse width	0.5; 0.8; 1.0; 2.0 μs	0.5 – 3.3 μs
Pulse repetition rate	200 - 2000 Hz	250 – 2000 Hz
Working range	200 km	100 - 300 km
Resolution	15 m	15 m
Resolution elements	3096	20000
Antenna diameter	4.5 m	4.3 m
Beam width	<1 degree	<1 degree
Elevation range	from -3 to 110 degrees	from -2 to 182 degrees
Max. scanning speed	40 deg/sec	36 deg/sec
Acceleration	20 deg/sec²	20 deg/sec²
Positioning accuracy	0.1 deg	0.1 deg
Antenna gain	45 dB	44.5 dB
Cap diameter	6.7 m	6.5 m
Cap material	Fiberglass + polyurethane	Fiberglass + polyurethane
Losses in the cap	Less than 2 dB	Less than 0.3 dB
Receiver dynamic range	95 dB	105 dB

As follows from Table 1, many technical characteristics of these radars are close to each other (working frequency range, pulse repetition rate, resolution etc.). There are some differences though. For example, peak power, working range, elevation range etc.

Below are the distinctive features of the WRM200 meteorological radar [10]:

- 250 KW magnetron transmitter with low-maintenance solidstate modulator
- High sensitivity mode processing to recover sensitivity loss in STAR mode. - Vaisala's lightweight, semi-yoke style pedestal
- 1 degree beamwidth low side lobe antenna
- >35 dB integrated crosspolarization isolation
- Precision horizontal and vertical beam matching

- Modular single cabinet design containing transmitter, receiver, controller, processor, dehydrator, polarization waveguide assembly
- Built around Sigmet RVP900, RCP8, IRIS software
- Dual channel digital IF receiver
- Built-in automatic dual channel calibration
- Image rejection >80 dB (>100dB with Vaisala WG filters)
- Dynamic range >99 dB (2μs pulse)
- Integral flat screen display for local maintenance
- Remote control/monitoring
- HydroClass™ for real-time target identification (hail, graupel, rain, snow, wet snow, non-met)
- Accurate attenuation correction
- Rainfall estimation based on KDP
- Option: Low-loss, random

Conclusion

The commissioning of the meteorological radar "WRM200" in Kutaisi will provide the ability to timely detect, observe and predict in real time adverse atmospheric phenomena, such as severe hurricanes, hail, rainstorms and floods in Western Georgia.

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