MGO state-of-the-art remote atmospheric humidity MW sounding network construction research

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Abstract

Basis theory for remote atmospheric humidity sensing states that continuous observation is necessary for efficient weather forecast.
Microwave radiometers provide measurements of cumulative water vapor of pure atmosphere and absorption water vapor line (22.235 GHz) and “oxygen transparency” (30-38 GHz).

1. Description of atmospheric humidity sensoring radiometric complex AHS RC

1. Microwave block (left)
2. Electronical block (right)

Figure 1 AHS RC (main view)

Figure 2 Antennas of AHS RC (19-24 and 36-38 GHz)

MW radiometer designed by MGO is operating on following three frequencies: 37 GHz, 22.5 and 19 GHz. Network radiometer (Atmospheric Humidity Sensoring Radiometric Complex – AHS RC) design is based on modified modulated Dicke radiometer. Antenna is a corrugated conic horns with lense. Receiver is designed on a single microchip. Bandwidth is limited by stripline filters. Low-frequency circuits use stable zero-drift amplifiers. Radiometer is powered by stabilized power sources. Peltier thermoelectric modules are used for temperature stabilization with 0.1 degree C. System of remote operational control is based on pin-attenuator diodes and active “noise” sources.

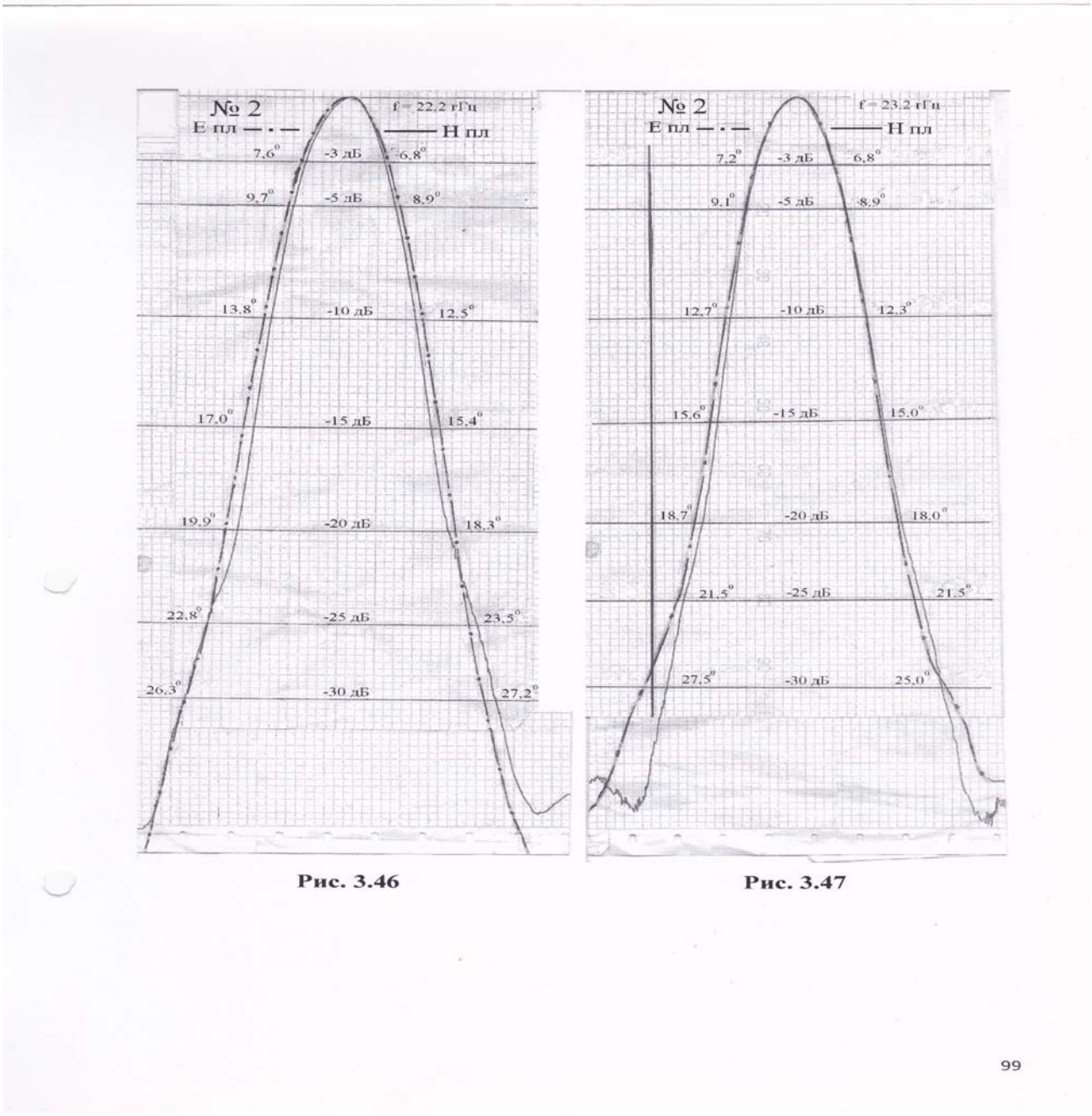

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Figure 3 Typical diagrams for 19-24 GHz band

Figure 4 Microwave receiver with isolator

3. AHS RC : results for ground station

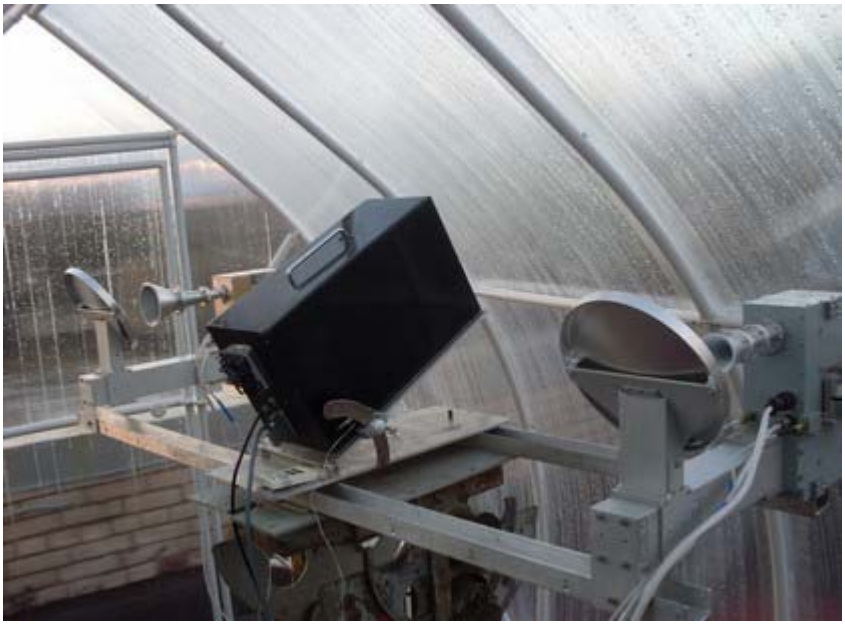

Figure 5 AHS RS in Voeikovo Network center

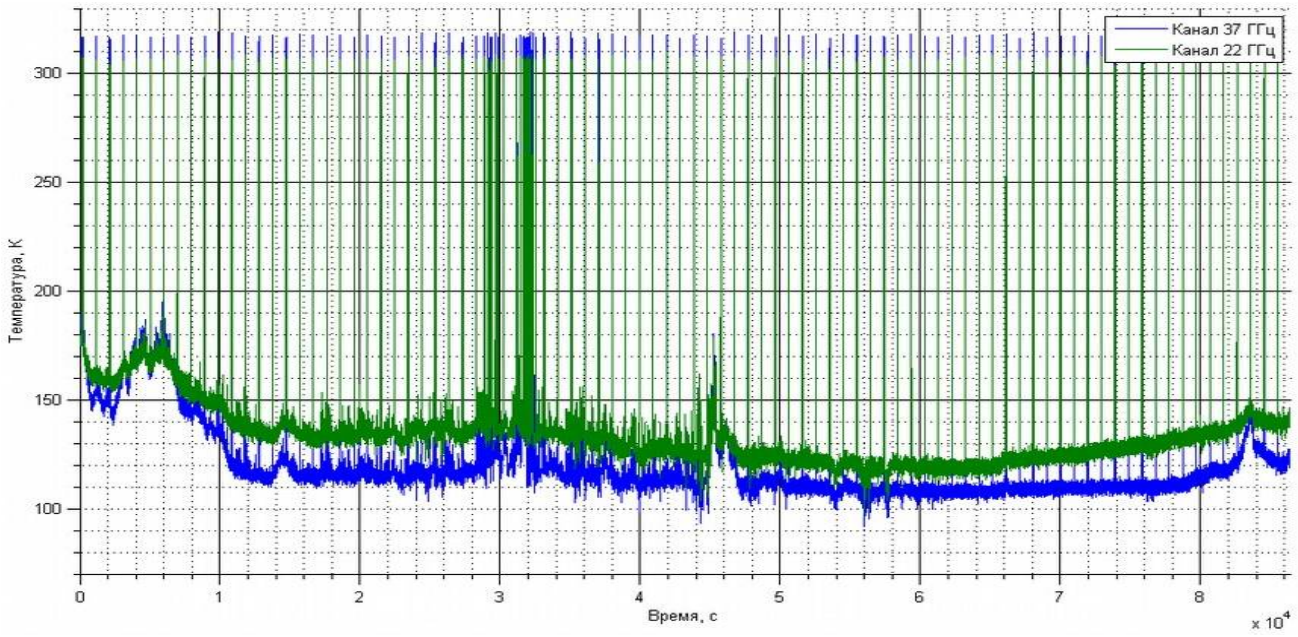

Figure 6 Pure atmosphere

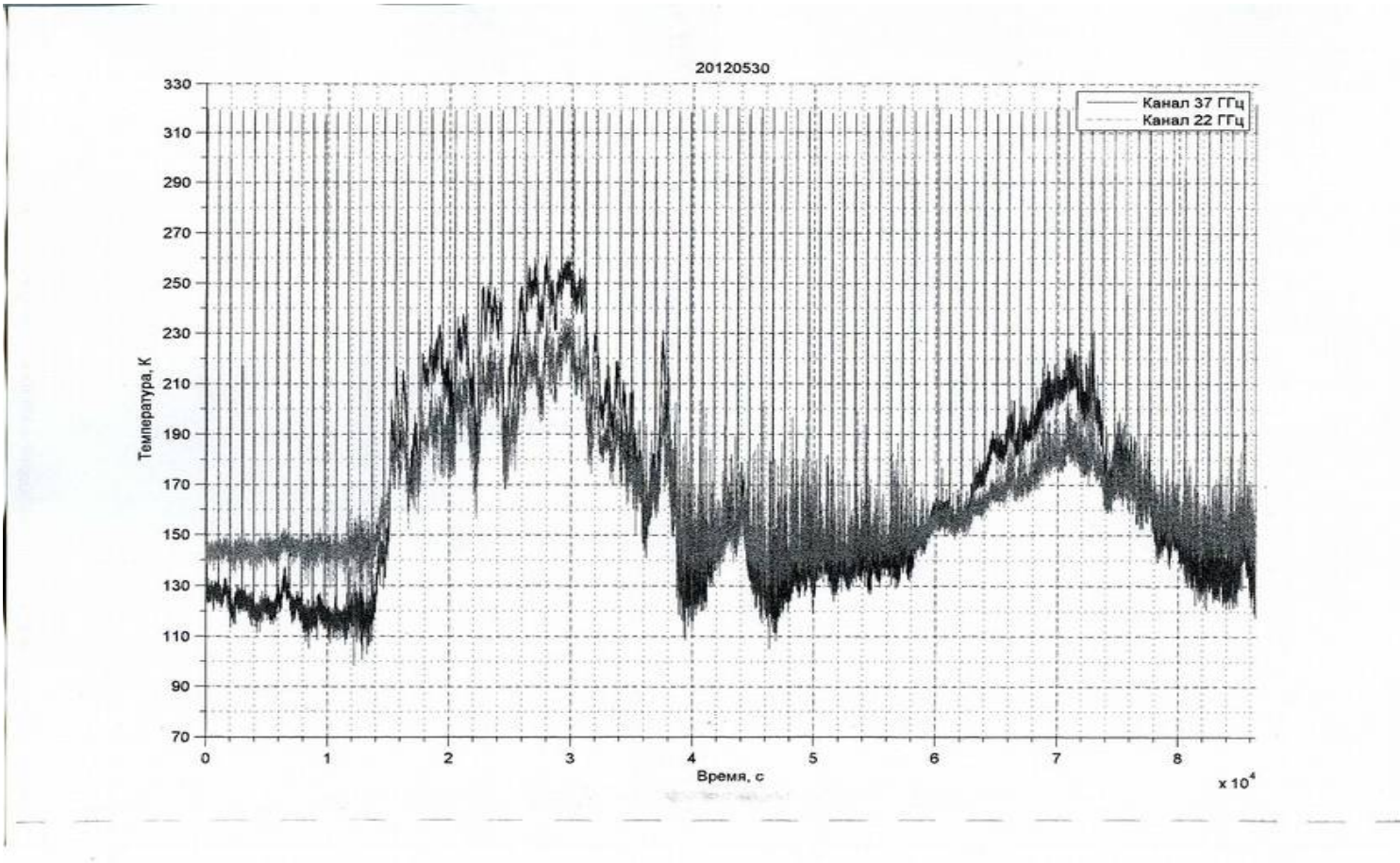

Figure 7 Atmosphere with large integrated cloud liquid

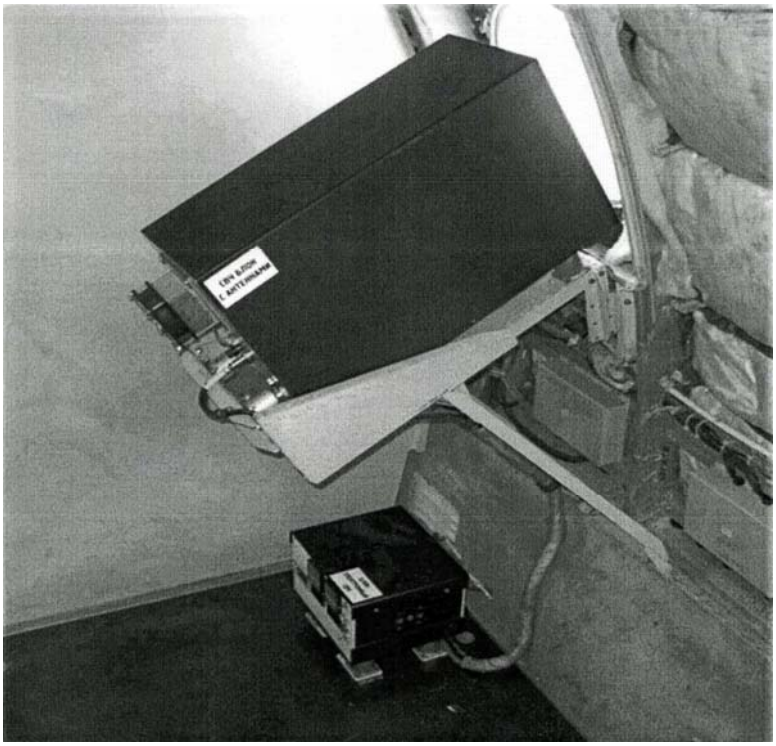

Figure 8 AHS RC on the board of YAK-42D

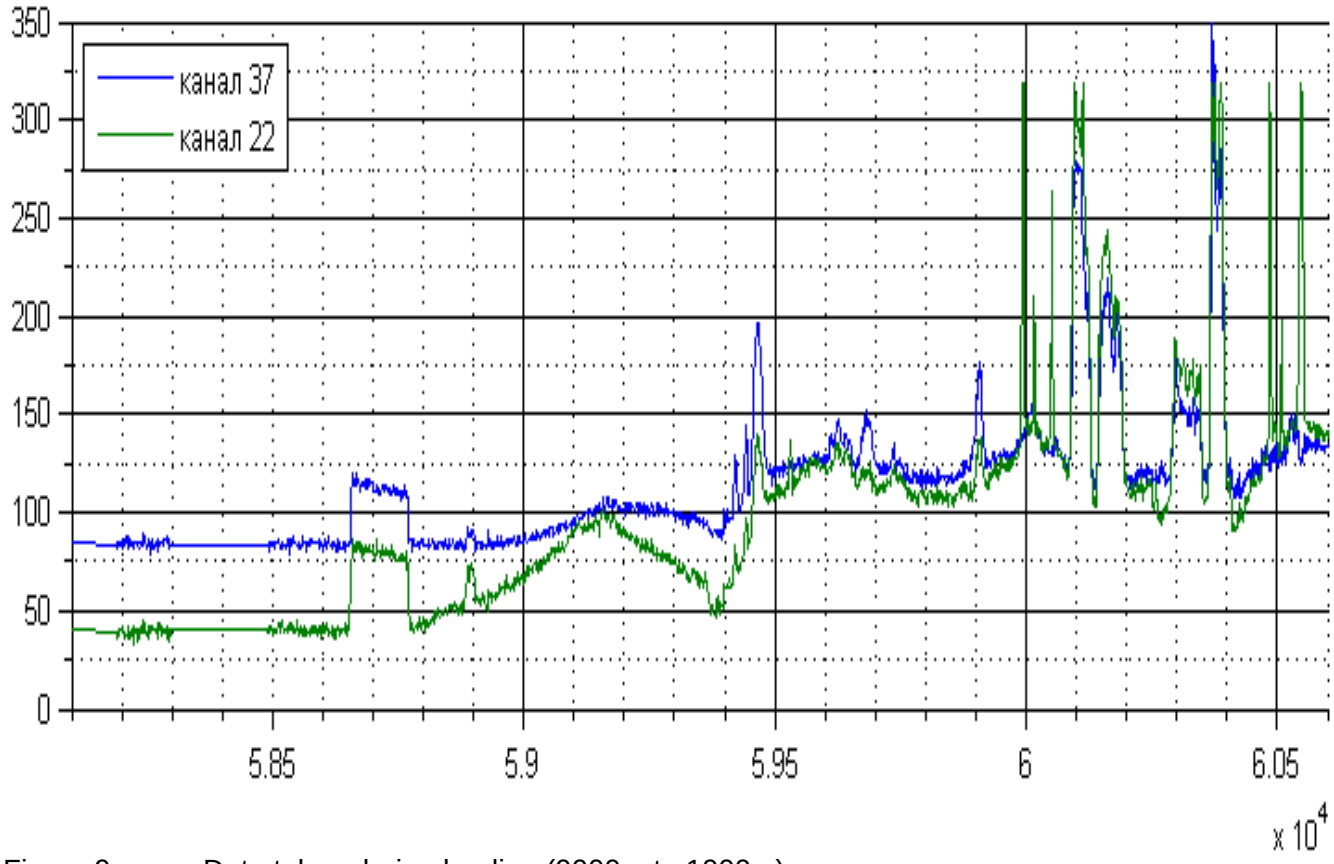

Figure 9 Data taken during landing (9000m to 1000m)

3. Next step : creation of lowcost AHS RC

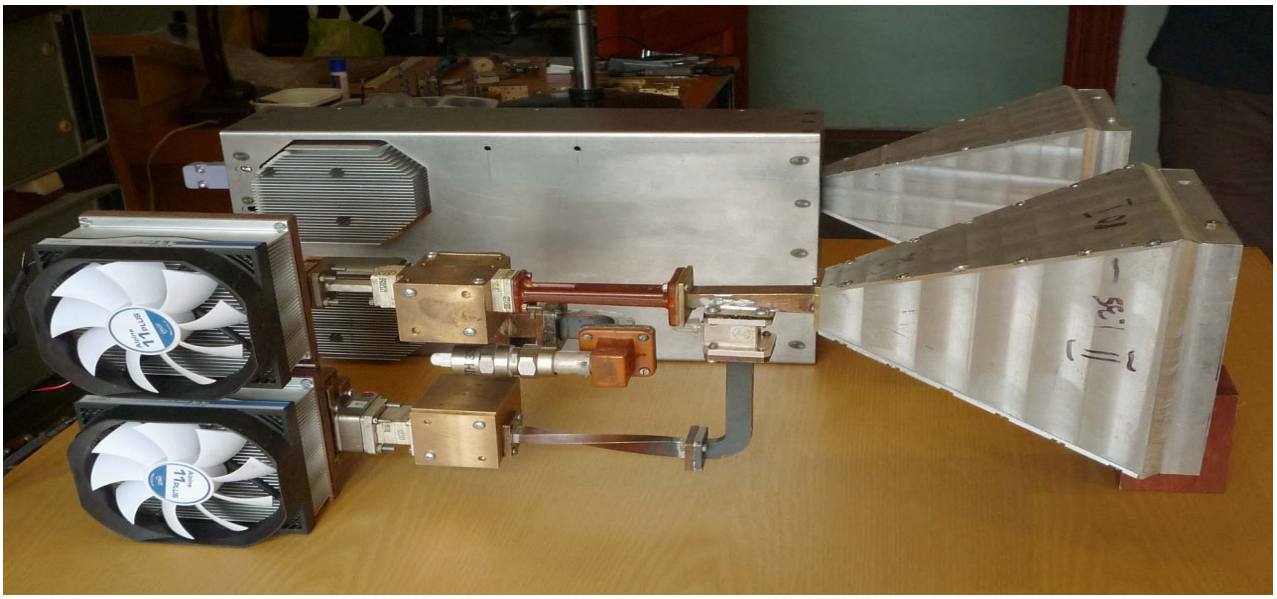

Figure 10 AHS RC with one antenna for two polarizations

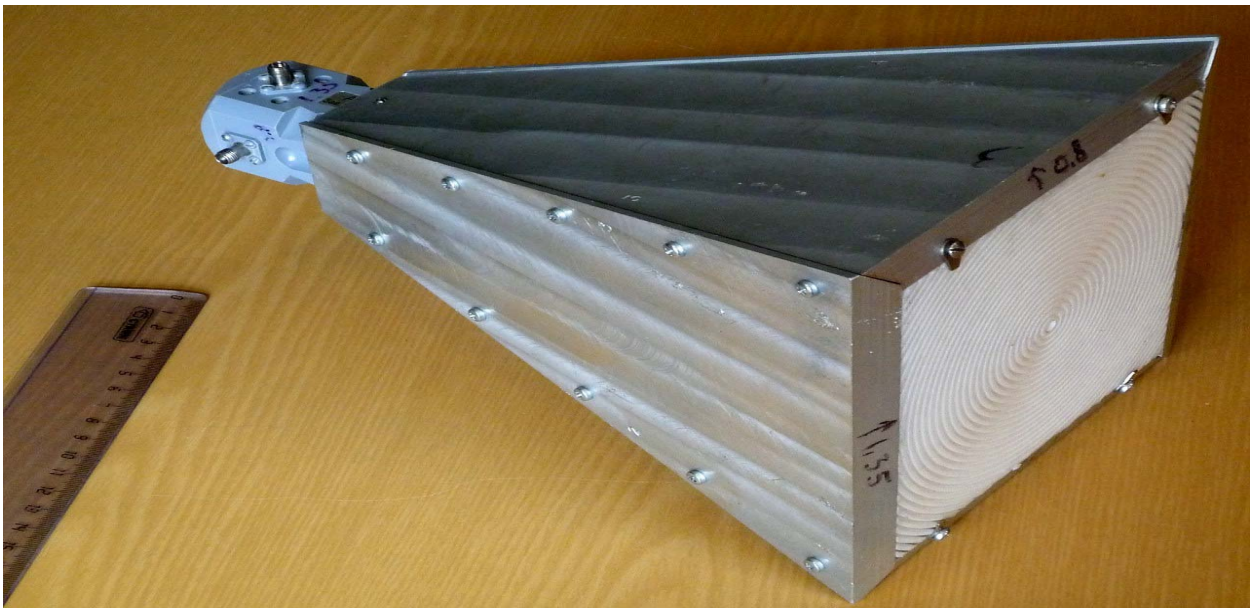

Figure 11 Corrugated pyramidal horn with lense and coaxial exits

4. Creation of regional network

Future network is based on 100 km grid. By 2015 a total number of 7 observation stations are to be deployed. Two AHS RCs (Voeikovo, Tiksi) are operating since 2012 (2013). All radiometers are fully automated. Primary observation data is transmitted over the Internet to Voeikovo Network Center for further processing. Data is stored on a server database. Using special client software user can connect to server database to view AHM network data for selected station. Online connection to AHS RC allows monitoring its state and deploying remote operational control manually, if necessary.