SOME MEASUREMENTS OF WIND PARAMETERS AS A PART OF THE JABEX-89 PROGRAM

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Comparative measurements of wind velocity with the help of IVA–4, Sensitron, and Ekho-2 sodars, M–47 sensors, a DAT–310 acoustic anemometer, and pilot balloons have been performed as a part of the JABEX–89 program. It is shown that the bistatic sodars and a continuous sounding signal are very promising.

In May–June, 1989 international investigations of the parameters of the surface atmospheric layer were carried out over the territory of Slovakian meteorological observatory as a part of the JABEX–89 program with the help of local sensors, mounted on a 200–m meteorological mast, and remote means (sodars) of different types, including an IVA–4 sodar for measuring the wind velocity developed at Institute of Radioelectronics, Khar'kov.[1] The purpose of the international program was intercomparison of the simultaneous experimental measurements of the velocity and direction of wind as well as the study of the noiseproof characteristics of sodars of different–types.

For simultaneous measurements of the velocity and direction of wind, along with the IVA–4 sodar, the following devices were used: M–47 sensors, mounted on the meteorological mast (at altitudes of 60 and 85 m), pilot balloons (Czechoslovakia), DAT–310 acoustic anemometers (made by Kaijo–Denky, Japan, and belonging to GDR), mounted on the mast at an altitude of 25 m, a Sensitron sodar (made in Sweden, the property of Czechoslovakia), and an Ekho–2 sodar (GDR).

The transmitting antenna of the IVA–4 sodar was located at a distance of 90 m from the base of the mast. The place of launching the pilot balloons and the first point of observation was located at a distance of 15 m, the second point observation was located at a distance of 20 m from the transmitting antenna of the sodar. The Sensitron and IVA–4 sodars were located at a distance of 87 m and the distance between the IVA–4 and Ekho–2 sodars was 300 m.

The observatory was situated among agricultural lands on a plain surrounded by a mountain range. The peculiarity of the experimental conditions was the relative constancy of mean parameters of the air mass during long (for several hours) experimental runs.

In processing the simultaneous measurements, the following parameters were calculated:

1) mean absolute deviations of the velocity and direction of wind $\Delta\overline{V}$ and $\Delta\overline{\varphi}$ measured by different means;

2) rms errors $\sigma_{\Delta V}$ and $\sigma_{\Delta\varphi}$;

3) correlation coefficients for the simultaneously measured quantities ρ_V; and,

4) regression coefficients b_0 and b_1.

In processing the data of simultaneous measurements with the help of the M–47 sensors (the averaging interval T_{av} was equal to 10 min) we obtained the following values: $0.93 \le \rho_V \le 0.96$, $|\Delta\overline{V}| \le 0.65$ ms^{-1}, $\sigma_{\Delta V} \le 0.43$ ms^{-1}, $-.03 \le b_0 \le 0.55$, and $0.85 \le b_1 \le 1.04$. For T_{av} = 1 h, we obtained $0.97 \le \rho_V$, $|\Delta\overline{V}| \le 0.68$ ms^{-1}, $\sigma_{\Delta V} \le 0.43$ ms^{-1}, $-0.66 \le b_0 \le 0.91$, and $0.92 \le b_1 \le 1.04$. Quantitative intercomparision of measurements of the wind direction were not made, since anomalous overshoots of readings of the M–47 sensors of wind direction were found which were evidently caused by short–time "hovering" of the sensors due to wind gusts.

Simultaneous measurements of wind velocity with the use of the IVA–4 sodar and the pilot–balloons yielded the following results: $0.7 \le \rho_V \le 0.86$, $|\Delta\overline{V}| \le 0.42$ ms^{-1}, $\sigma_{\Delta V} \le 1$ ms^{-1}, $|\Delta\overline{\varphi}| \le 2.8°$, and $\sigma_{\Delta\varphi} \le 6.9°$.

When measuring the wind velocity simultaneously with the DAT–310 anemometer (T_{av} = 40 min), we obtain $\rho_V = 0.97$, $|\Delta\overline{V}| = 0.14$ ms^{-1}, $\sigma_{\Delta V} = 0.31$ ms^{-1}, $b_0 = -0.52$, and $b_1 = 1.07$.

As a result of simultaneous measurements with the Sensitron sodar (T_{av} = 15 min), we obtained $0.76 \le \rho_V \le 0.91$, $|\Delta\overline{V}| = 0.46$ ms^{-1}, $\sigma_{\Delta V} \le 0.75$ ms^{-1}, $|\Delta\overline{\varphi}| \le 3.4°$, and $\sigma_{\Delta\varphi} \le 5.5°$. In testing a significant decrease of the sensing range of the Sensitron sodar was observed for the wind velocity larger than 10 ms^{-1}.

When testing the noiseproof characteristics, we used a source of acoustic noise, which imitated the actual noise in an airport. During the tests, we observed the failure of the Sensitron sodar at a noise level of 34–38 dB in the 2 kHz octave frequency band (71–72 dB in the frequency range up to 15 kHz). The IVA–4 sodar still could operate under conditions of maximum intensity of the noise generated by the imitator (58 dB in the 4 kHz octave frequency band and 8–83 dB in the frequency range up to 15 kHz), with slightly less statistics of the estimates.

In conclusion it should be noted that analysis of the experiments performed as a part of the JABEX–89 program enabled us to regard the chosen direction of design of acoustic meters for measuring the velocity and direction of wind using the bistatic sodar and the continuous sensing signal as the promising. This sodar provides reliable estimates under different meteorological and difficult noise conditions.

REFERENCES

1. V.I. Alekhin, A.I. Ryzhenko, and V.I. Sid'ko, in: *Official Record of the Conference of Specialists of the Member Countries of the Council for Mutual Economic Aid on the KAS–METEO Problems,* Appendix 3, Leningrad, 1989, pp. 50–52.

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