THE "CYCLONE" METEOR RADAR SYSTEM FOR ROUTINE WIND MEASUREMENTS IN THE LOWER THERMOSPHERE

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A new meteor wind radar system called "Cyclone" has been devised at the Institute of Experimental Meteorology to extend and update the meteor radar network under the Sate Committee for Hydrometeorology and Control of the Natural Environment of the USSR. The system is designed for unattended operation.

The "Cyclone" meteor radar system obtains information from four directions simultaneously. Four transceiving aerials switched by a computerized commutator serve to emit transmitter pulses and and receive radio echoes. The commutator connects a series of transmitter pulses with each of the aerials at a frequency of 100 Hz and breaks scanning to record individual echoes.

The transmitter pulse output is 10 kw, with a pulse duration of 200 μs and a repetition frequency of 300 Hz. Thus, transmitter pulse energy is 2 J, i.e., the same as most meteor radar transmitters of moderate sensitivity (PORTNYAGIN and SHPRENGER, 1978). The "Cyclone" radar has the potential of recording 6-10 thousand wind velocity values a day.

To automate data processing a special digital device has been developed. The slant ranges are determined using an algorithm which first tests their authenticity and then, on the basis of a number of measurement results, calculates the mean range.

To determine the Doppler shifts the measurement algorithm proposed in PETERSON and NOWAK (1975) was adopted, which involves a displacement of the measured Doppler shift by a few tens of hertz. This algorithm makes it possible to eliminate selectivity with respect to slow velocity meteor drifts (see Fig. 1).

Fig. 2 is a block diagram of the "Cyclone" wind meteor radar system. In "transmitting" mode, the transmitter pulses are passed through one of four controlled gas-discharge arrestors (GDA) to the corresponding aerial while the input of the commuted HFA-receiver cascades is blocked by a segment of $\lambda/4$ line and diodes.

In the "receive" mode, the meteor echo is conveyed through the sensitive HFA receiver to the digital processor.

The "response" output signal is delivered to the input of the preprocessing unit (PPU) which matches the received signals by amplitude, duration and repetition frequency.

If a signal proves useful, a range gate is shaped in the PPU and conveyed to the digital range measurement unit (DRMU). This circuit in

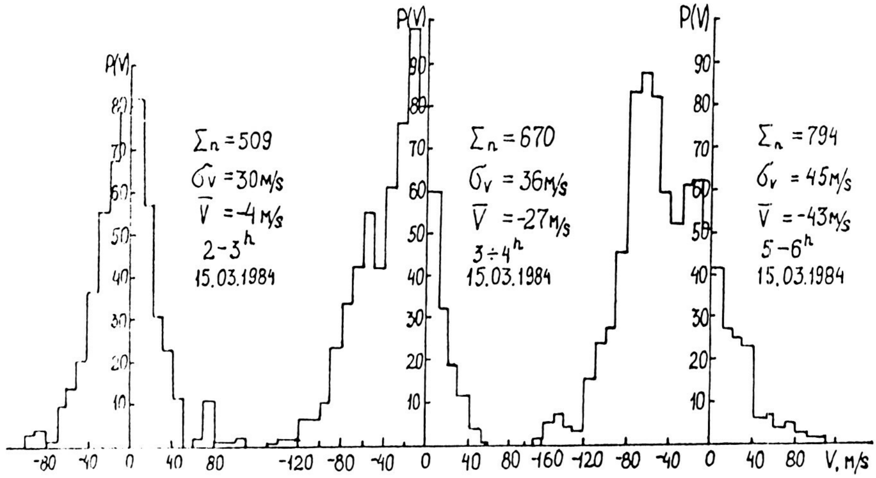

Fig. 1 Distribution of individual wind velocity values as revealed from "Cyclone" measurements of one-hour duration.

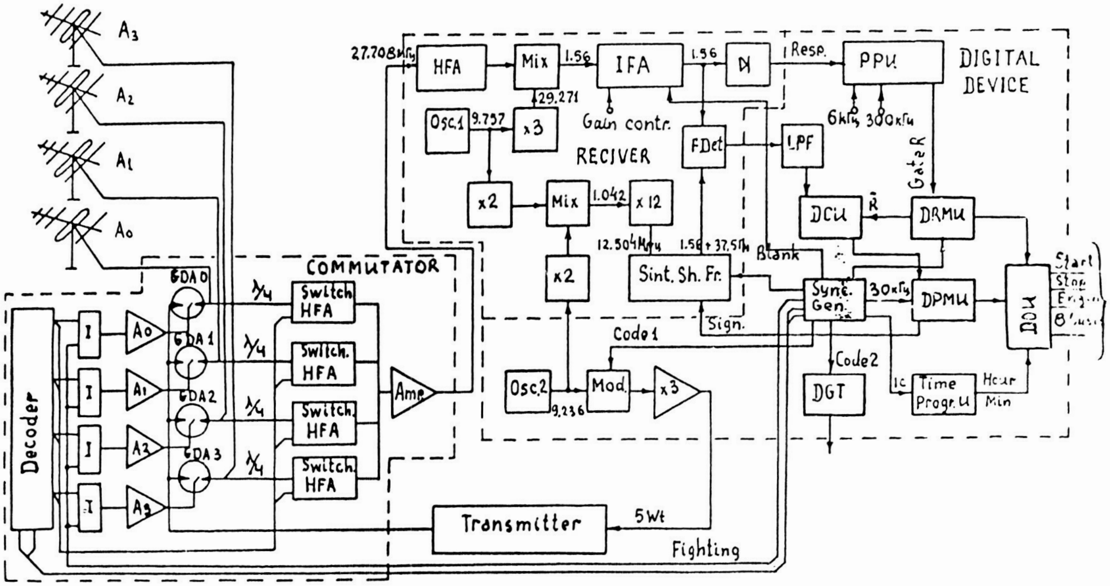

Fig. 2   Functional circuit of the "Cyclone" meteor radar system.

turn shapes a mean range signal which is then used in the data conversion unit (DCU) as a gate.

The value of Doppler beat period is deduced from the DCU output signals.

The data output unit (DOU) records range, Doppler beat period and sounding direction values on the punched tape. In addition, the DOU conveys echo information averages to the microcomputer "Electronics-C5-12" which averages wind data obtained during ten minute measurement intervals.

The experimental measurements on the "Cyclone" system showed that the instrumental errors for range with a signal-to-noise ratio of 2 equal ±3 km and ±(4-8) mps for wind velocities ranging from 0 to 150 mps.

The "Cyclone" experimental prototype has been operating in Khabarovsk practically non-stop since 1982. An example of results obtained in Khabarovsk is shown in Fig. 3.

It is pertinent to note the good agreement of diurnal variations in hourly mean values of wind velocities for zonal and meridional wind components as observed in opposite directions. Some discrepancy in the variations can be attributed to instrumental errors, but more particularly, to the spatial inhomogeneity of the wind field.

References

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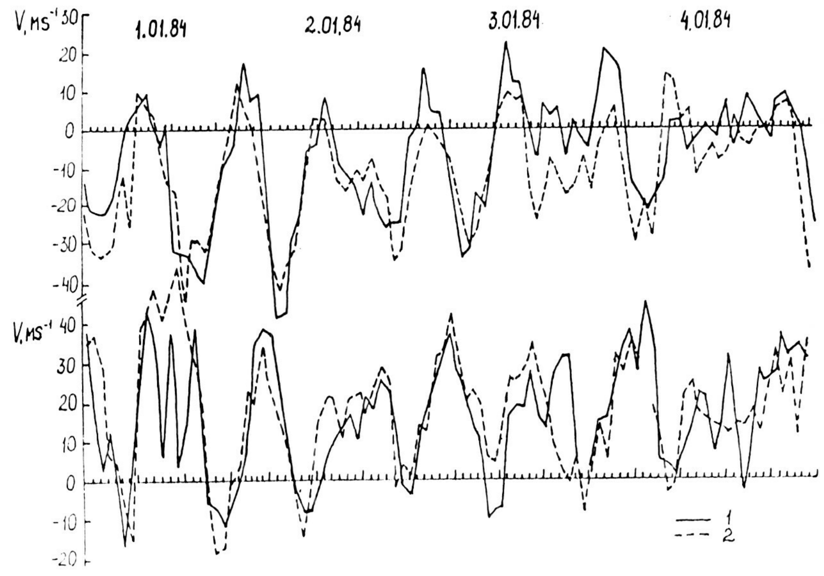

Fig. 3 Diurnal variations in zonal and meridional components of hourly mean wind velocity values as follow from observations in Khabarovsk conducted in four directions simultaneously. 1) N and E components, 2) W and S components.