

Comparative analysis of the meteorological data acquired on standard equipment and by automatic weather station of “CAMPBELL SCIENTIFIC, INC” Company

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Introduction

The automatic weather station, which sets up in Almaty Integrated Hydrometeorological Network by “CAMPBELL SCIENTIFIC, INC” Company has the following sensors as a unit:

- air temperature and humidity HMP45C (platinum resistance thermometer and capacitive humidity-sensitive element by Vaisala firm);
- wind speed and direction (monitor-anemometer R.M. YOUNG. 05103 and 05305);
- tipping-bucket precipitation gauge TE 525 MM;
- pressure sensor CS105 (capacitive silicone pressure gauge by Vaisala firm)
- total solar radiation (Kipp & Zonnen)
- soil temperature at a depth of ten centimeters.

The convergence analysis of rows by air temperature and humidity, wind speed and direction, precipitations and atmospheric pressure, acquired by the automatic weather station (AWS) and on standard meteorological equipment (MS) is carried out by the result of comparative observations for the period from September 2002 till August 2003.

1. Air temperature

Mean deviation values between air temperature by AWS and weather shelter of MS are ranged within the interval from -0.8 to 0.4 °C (Figures 1,2). On carrying out spatial check-up of the air temperature values the validity criterion is ± 0.5 °C , that indicates the received deviation value is within tolerance limit.

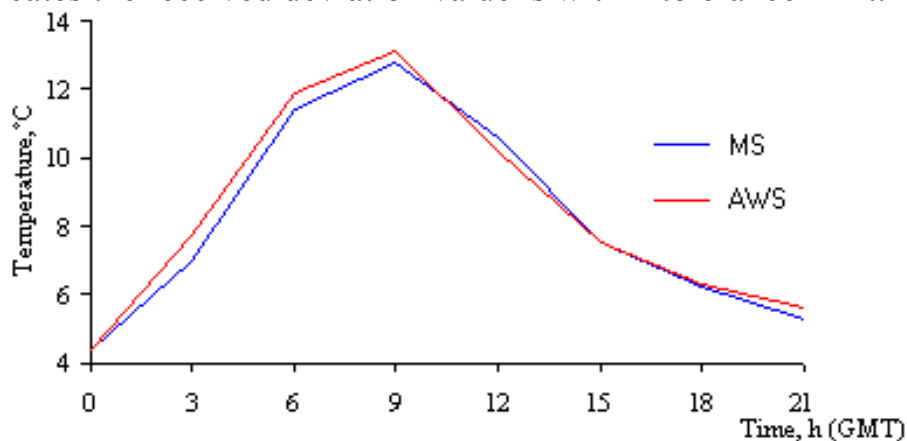


Figure 1. Daily variation of air temperature

The maximum deviation is observed in day hours and reaches 3,2°C by absolute value. The air temperature determined by AWS, in most cases exceeds (taking into account a sign) the air temperature values in the weather shelter. In the sunset a deviation value changes its sign to an opposite one, i.e. the indications of temperature gauges of AWS are lower than the air temperature readings by thermometers in the weather shelter.

The reason of discrepancy between indications of thermometers, which installed in the weather shelter and temperature gauges of AWS are differences in their sensitivity and in design of their thermal shelter. Therefore in clear or low-clouded days heating of AWS temperature gauges occurs to a greater extent than the thermometers in the weather shelter. In overcast days these differences are sufficiently decreased and reach sometimes 0°C. To exclude the reasons, influencing the reading difference it is advisable to install temperature gauge in a standard weather shelter.

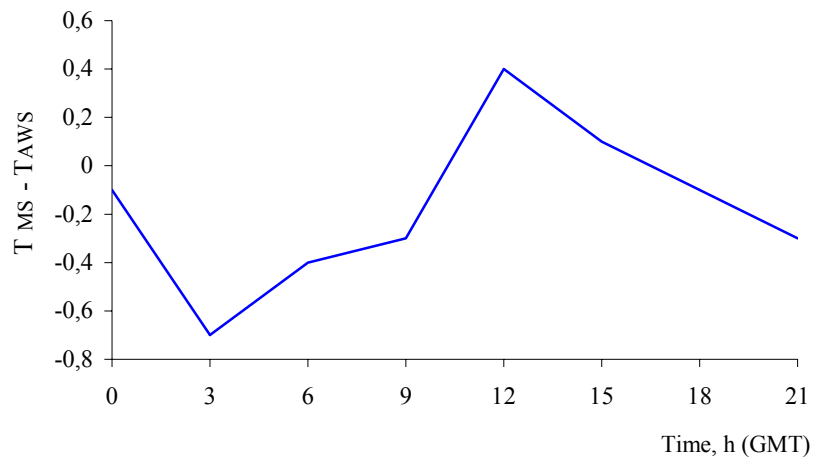


Fig. 2. Air temperature deviation

2. Air humidity

The air humidity measured in the meteorological station by psychrometric method (at air temperature above -10°C), is higher than the humidity value, determined by the humidity-sensitive element of AWS (Fig. 3 b).

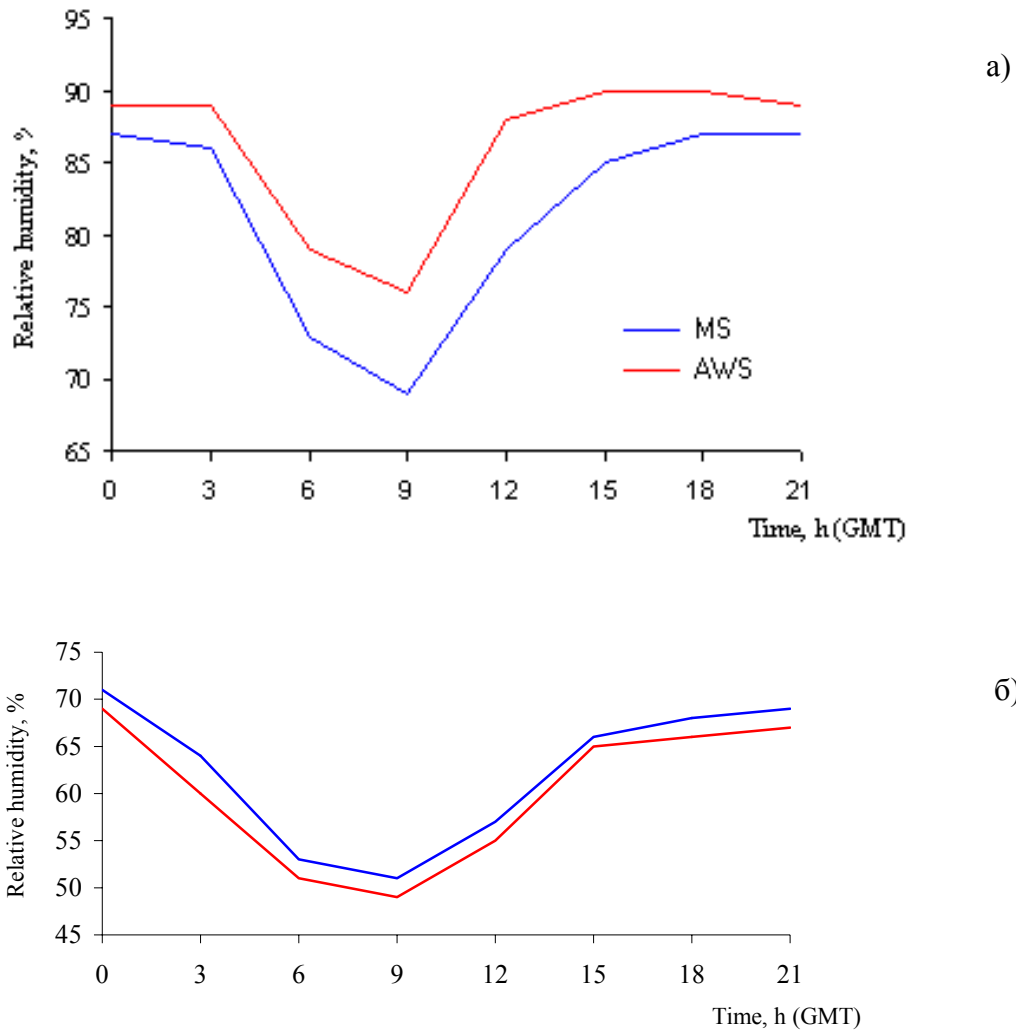


Figure 3. Daily variation of relative humidity

- a) at temperature below -10°C ,
 b) estimated by psychrometric method

In the cases when the air temperature reaches or becomes lower than -10°C , the observations in weather shelter are carried out by hair hygrometer and the relative humidity measured by AWS, becomes higher than the humidity recordings of MS' hygrometer installed in the weather shelter (Fig. 3a). Maximum deviation of humidity parameters is marked in clear, cloudless days and reaches 23%. The discrepancies are decreased in overcast weather and during evening, night hours.

On carrying out spatial check-up of measured humidity values the validity criterion is made by hygrometer 10 %, psychrometer 5 %. The deviations of humidity values (AWS and MS), determined by psychrometric method are changed from 1 to 3%, and by hair hygrometer are varied within the interval from -8 to -3 % that meets the acceptable value.

3. Wind velocity and direction

Analysis of the chart of the daily variation of wind velocity, drawn up by data of AWS and MS, indicates to coincidence of wind velocity values.

Wind velocity, averaged by anemometer of AWS and M-63, has a great difference equals to 50° on the average. In some periods the difference reaches 100 and above. This connected with the fact that wind velocity averaging by anemometer of AWS takes place in 10-minute interval of every hour, starting from the 50th -minute and finishing at 00 minutes. Wind velocity averaging by M-63, according to the “Manual to hydrometric stations and posts. Part 1. Meteorological observations in stations”, takes place from the 45th-minute. Since the wind vector is a value that subject to frequent changes (especially at low wind velocities), averaging the values by different even if overlapping intervals result in considerable discrepancies.

4. Atmospheric pressure

Atmospheric pressure values measured by AWS pressure gauge and by station barometer are identical. At bringing the pressure value of AWS to sea level it is necessary to take into consideration a height of the meteorological ground above the sea level.

5. Atmospheric precipitation

Precipitation is one of the most changeable meteorological elements. Precipitation gauge of AWS registers only rain precipitation. Data analysis has shown that in the cases when amounts of precipitation determined by Tretyakov's precipitation gauge are not exceed 10 mm, differences between MS and AWS recordings are varied within interval $\pm 0,5$ mm. With raising of precipitation amount and intensity the differences are sharply increased and can reach in some cases 10,8 mm. It being known that precipitation measured by Tretyakov's precipitation gauge exceeds the amount of precipitation determined by AWS.

A principle of operation of AWS precipitation gauge is based on contact lock up for each bucket tipping. The amount of precipitation for each tipping is 0,1 mm. In short, intense rain showers not all precipitations are measured since at the moment of tipping some amount of water mass are not registered. This result in lowering the amount of precipitation measured by AWS.

At small precipitation amounts the discrepancies are not great but the deviations are increased with the raise of precipitation amounts and especially their intensity. Therefore at high frequency of low intensity rains and small precipitation amount the correlation ratio is 0,9. On approach the precipitation amount to critical parameters (dangerous meteorological phenomena, severe weather) the convergence of precipitation amounts will be much lower. It is difficult to determine the corrective ratio at low frequency of high intensity rains because of insufficient number of comparative observations in critical values of the precipitation amount.

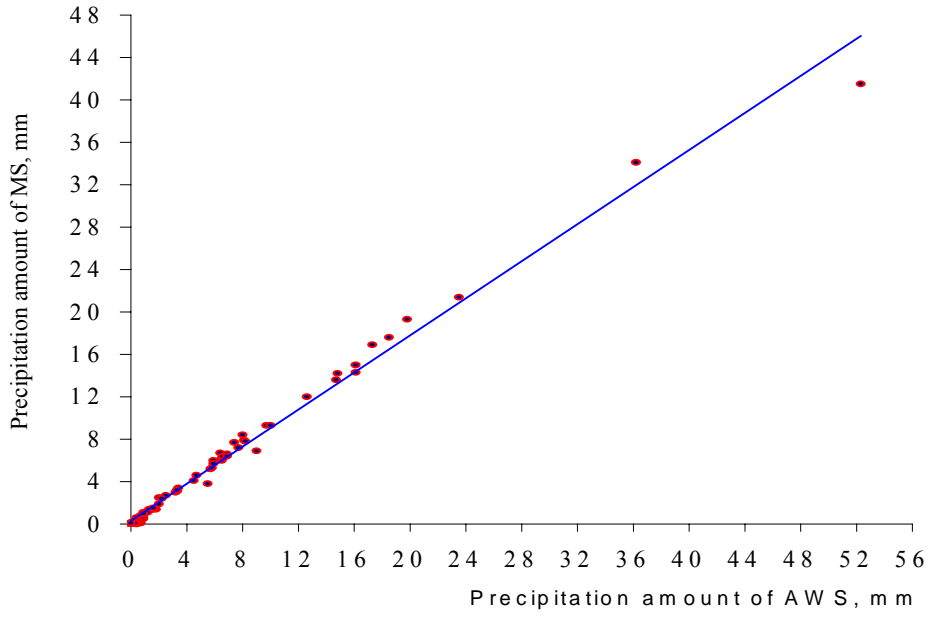


Fig. 4 Convergence of precipitation amounts

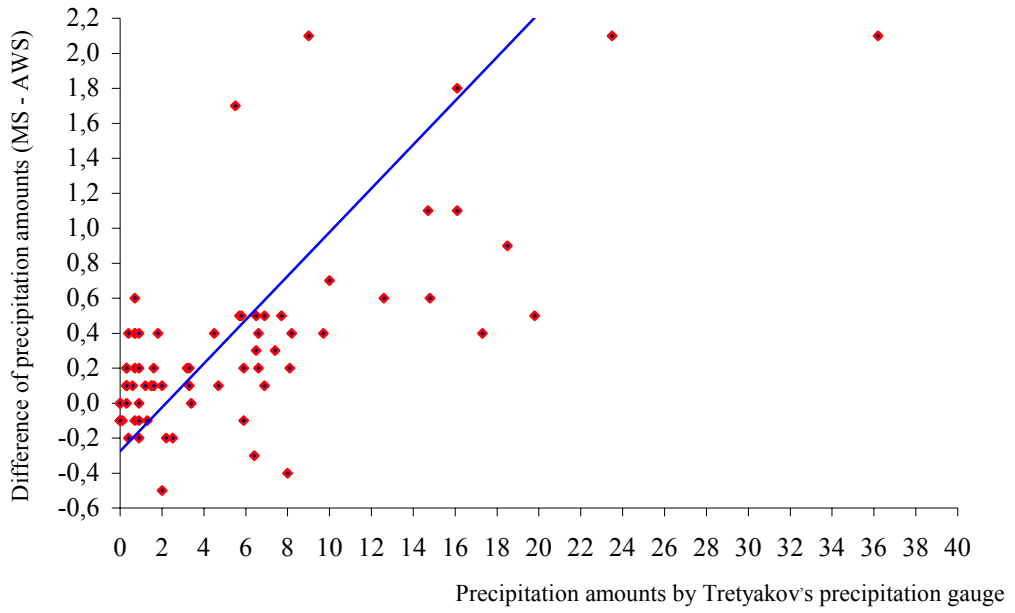


Fig. 5 Deviations of precipitation amounts