Risks dealing with data preparation of sunshine duration for homogenization process

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Budapest, 24.-27. October 2011

SHMI Bratislava
Sunshine duration measurement during the period 1961-2010 (and in many cases continue, except automatic weather stations) has been provided by Campbell-Stokes heliograph at 102 climatological stations of Slovakia, but only 40 have been taken in to account for climatological normal preparation for the period 1961 – 1990.

We focused on risks connected with daily data completion of sunshine duration time series and its characteristics based on accessible information on measurement method, station location, heliograph position, but what to emphasize are a big problems with relocation of instrument and inaccuracy of horizont measurement for terrain and obstacles elimination in sunshine duration data.
During the measurements of sunshine occurred following risks:

- Precision targeting horizont
- Setting accuracy heliograph
- Burn-out tape below the horizont
- Heliograph is not set to the south (eg, angle 188 °)
- When installing the heliograph was used level (oblique burn-out tape)
- Out of date horizont orientation to time measurements (from history to the present)
- Move heliograph from the roof into the garden and against
- Point focus theodolite was lower than the heliograph (focus burn-out)
- Liquidation of old heliographic tapes because of their fading
- Very schematic horizont focus (often without indicating the beginning or end of the building, etc.).
- Sensitivity solar tape
- Condensation solar balls
- Watering solar tape
Carrying out calculations of sunshine for the station Poprad - Airport for the years 1961-2010 yielded the following knowledge:

If the station to calculate the astronomical sunshine (Ass) and measured on the horizont at this station calculated effective sunshine (ESS) and comparing these values with the daily amount of sunshine obtained by quantifying the heliographic tape (HSS), is reached through an singular cases formally correct results, so for that day shall inequality

\[ \text{Ass} \geq \text{Ess} \geq \text{HSS} \]
Analysis of the daily values of HSS rare (about 1%) when HSS > Ess showed that the rule was a mistake in the work of the observer, auditor or editor report.

a. Wrong sum of hourly values of heliographic tape.
b. Incorrect seated in the heliograph tape (at 12:00 the sun was in the south)
c. An incorrect entry in a monthly statement of climate observations
d. Error when editing the statement to the database

These errors were corrected in the database.
Many discover the short coming when compared to time sunrise and sunset according to the calculation of the effective sunshine with sunrise and sunset according to the first and last record on the tape heliographic.

A. Incorrect set north in targeting horizont.
If we have one station aimed at longer-term horizont and ignore several changes of vegetation around the building and the like, the basic geographical points such as the horizont mountain ridges and peaks, should be the same throughout the azimuth.

When comparing the four azimuth measurements in Poprad is evident that in each measurement was set up north of the measuring device otherwise.

Determining the correct azimuth between the measurement points and unchanging point of the horizont (in the case of Poprad is the peak Gerlach), these horizonts can move to a single setting north.
If we have only one measurement the horizont is possible to check the correctness of its control height of sun above the horizont at the moment of the beginning and end burn-out heliographic tape.

The following two figures demonstrates that horizont for the period 1961-1965 was measured shifted by 2°. Yellow dots show the beginning and end of each tape burn-out days of that period.
At this picture, where the horizont with the original azimuth, we see that the especially in the sunset sometimes burn-out tape in times when that calculation was already below the horizont.
At this picture we move on horizon and +2 ° sunrise and sunset sun by burn-out heliographic tapes are always above the horizon or on the line.
B. Timeliness aimed the horizon

We have dates available, although focusing horizon, but often do not know when this measurement before or after, the building was built, and the tower extending into the horizon station.
C. Detail orientation the horizont

From the list of horizonts can be seen that the density of points of the horizont, which was focused on elevation varies.

When directed, where it was used an oversimplification of the horizont line may be a linear combination of aiming points to come in some parts of the calculation of an incorrect amount.
D. Height of the horizont

If the measuring device was not placed at the same height as the heliograph, the resulting focused the horizont does not correspond to heliograph height and the length calculated from the effective sunshine follows the measured the horizont will be equal to the maximum possible sunshine duration measured heliograph
E. Incorrect setting heliograph

In the analyzed period was probably set incorrectly also heliograph.

His axis not directed exactly to the south, which resulted in that the beginning and end views burn-out heliographic tapes - at sunrise high above the horizont and - at sunset deeply below the horizont as shown in the following chart
The goal of our effort is (after a QA/QC and probably homogenization process) to prepare a map of sunshine duration or other derived characteristics for the territory of Slovakia.
Thank you for your attention