DEBRECEN PHOTOHELIOGRAPHIC DATA AND ITS COMPARISON WITH OTHER SUNSPOT DATABASES

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Abstract. We compared the corrected sunspot area data of the Debrecen Photoheliographic Data (DPD) with the data of the Solar Optical Observing Network (SOON) and with the data of Rome and of Catania for the year 1988. The results of comparison were similar to the previous results of the years of 1986 and 1987. To facilitate the identification of the spot groups we made a new HTML presentation of DPD. We investigate the possibility of making a composite sunspot area database.

1. Introduction

Sunspot area measurements play an important role in the studies of sunspot groups and variations in solar irradiance. However, the measured areas may be burdened with systematic and random errors, which may affect the results in these fields. Mainly the total solar irradiance models can be improved by using more precise area data. In order to choose the most appropriate area data for a given study or create a homogeneous composite area database, there is a need to compare the sunspot areas provided by different observatories. While determining the sunspot area one has to cope with many difficulties which result in random and systematic errors (Győri 1998; Baranyi et al. 2001). These errors may affect the results of the study in which they are used. The random errors only cause scatter in the related data but the systematic errors can distort the main results. The systematic errors may vary in time because of the variation of the observing and measuring facilities, variation of the seeing on the site of the observatory, and so on. Therefore the comparison of the data of different observatories has to be repeated from time to time.

2. Observational Data

The Debrecen Photoheliographic Data (DPD) catalogue (Győri et al. 2001, 2003) contains daily data for the whole group as well as each spot in it. These data are measured on daily white-light full-disk photographic plates as it was carried out in Greenwich. DPD achieves full yearly coverage with the help of several cooperating observatories.

The catalogue of the Rome Observatory is also based on photographic plates. It contains the area of the whole group but in some cases some groups are omitted from the area measurements. Its coverage is limited by the local weather.

The SOON is a worldwide network of solar Observatories. Namely these observatories are Boulder, Holloman, Learmonth, Palehua, Ramey and San Vito. Culgoora also provides data for this network. The SOON makes 24-hour synoptic solar patrol and operates in a real time mode. Sunspot drawings are made daily, and the observing telescopes and measurement procedures are the same at all of these sites. It is the only sunspot catalogue that gives relatively complete (80 per cent) daily coverage.

In the Catania Astrophysical Observatory are also made sunspot drawings daily. The yearly coverage is very good but limited by the local weather.

The DPD data can be downloaded from http://fenyi.solarobs.unideb.hu and the other data are available from http://www.ngdc.noaa.gov/stp.

3. HTML Presentation of DPD

Parallel to the measurements we created a user friendly web-presentation of DPD. The aim is to create a site which facilitate to survey the daily full-disc observations as well as the group and sunspot data. With the help of this presentation one can browse among the data in the DPD graphically. After choosing the date one can find the computer drawing of the sun disk. The spots are plotted as ellipses with the same areas as the spots have. The NOAA sunspot group number of the sunspot groups on these drawings are clickable and after clicking it the digitalized photographic image of the sunspot group appears with its numerical data of the DPD. It can be used via internet connection (http://fenyi.solarobs.unideb.hu/DPD/index.html) or in off-line mode after retrieving the files from this site.

4. Comparison of Databases

At first a relational database has been made from the catalogues. Then, by using the Structured Query Language, the sunspot groups from each catalogue corresponding to those contained by the DPD have been selected

TABLE I. *Results of the linear regression for the area of the whole group.*

Database	Number of cases in 1988	a	b	Std. Error of the Estimate
Boulder	1321	-1.56	0.628	87.81
Catania	1630	-0.5	0.865	66.07
Culgoora	1542	-6.02	0.563	71.78
Holloman	1870	-4.23	0.725	74.94
Learmonth	1937	9.9	0.631	73.64
Palehua	1628	2.8	0.696	74.46
Ramey	1725	5.14	0.756	65.04
Rome	661	12.3	0.990	91.51
San Vito	1581	-1.49	0.739	91.31

for each day with the help of their position data. The groups close to the limb were omitted from the selection. In the problematic cases of the selection we checked this mutual correspondence by means of the HTML presentation of DPD. Sometimes a given group of one of the catalogues was separated into two groups in the other catalogue. In these cases the areas of the separated groups have to be added. Finally we obtained tables in which there were data pairs. One member of the data pair was the sunspot group area measured in Debrecen and the other member of it was the area of the corresponding group measured in the other sites on the same day.

We made linear regression analysis for these data sets in the form: dependent = a + b * independent. The independent variable was the area U+P published in DPD. The dependent variables were the areas of the areas published in the other catalogues (see Table 1).

The results of Table 1 are similar to those which were published earlier by Baranyi et al. (2001) for 1986-87. It is important result because the measuring method of DPD was different before and after July 1987.

5. Composite Sunspot Area Database

If the different databases are compared and the results of the linear regression is known, one can create a composite database. Because there is no systematic difference between the photographic databases ($b \sim 1$), it is plausible to accept the DPD as a standard for the graphical databases by dividing all the area data with the related b value. This procedure allows the homogenization of different databases giving an internal consistency after screening for outliers or errors. This method also allows the increase of the

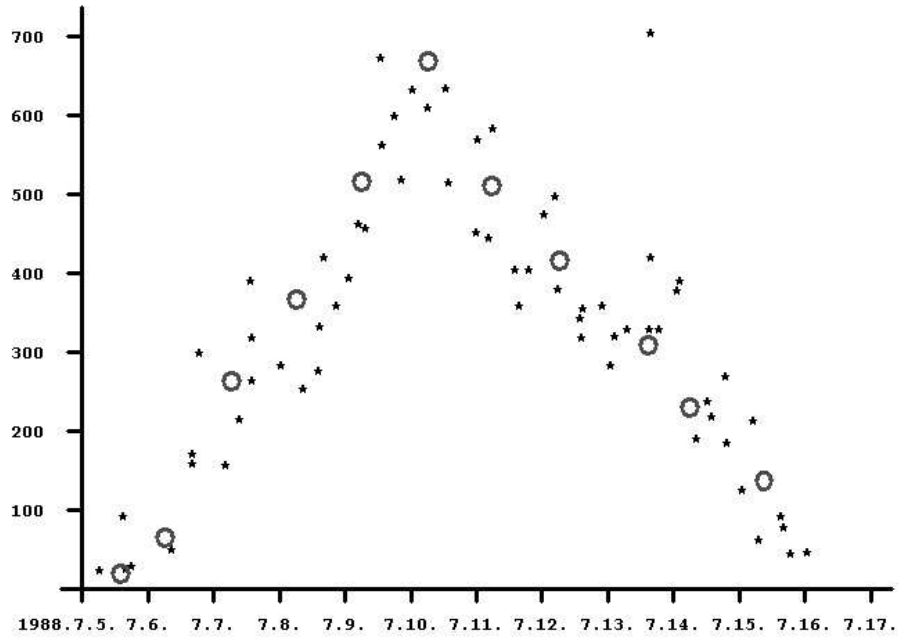

Figure 1. Development of the whole area of group NOAA 5069 on the basis of DPD (circle) and recalibrated SOON data (stars).

time resolution of the area data. By using the set of daily data, one can obtain hourly area data. Figure 1 shows an example for the area evolution of a sunspot group on the basis of a composite database.

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