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Debrecen Photoheliographic Data for 1986 with image supplements

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Abstract

The Debrecen Photoheliographic Data (DPD) is a catalogue of daily positions and areas of sunspots compiled by using white-light full-disk observations taken at the Heliophysical Observatory (Debrecen, Hungary) and its Gyula Observing Station as well as at Kislovodsk (Russia). The present material is divided in two parts. The numerical part contains the measured data and the other part contains the CCD scans of all the active regions on the photographic plates. Every measured spot is marked with the same number in the picture as in the numerical catalogue. The images along with the measured data allow more complex analyses, morphological studies and the comparison with magnetic, Hα and other observations.

1 Introduction

The positions and areas of sunspot groups for every day were published in Greenwich (Greenwich Photoheliographic Results) until 1976. After that date, Debrecen Heliophysical Observatory took over this responsibility and L. Dezsϕ, A. Kovács and O. Gerlei started to publish the Debrecen Photoheliographic Results (DPR, Dezsϕ et al. 1987). They aimed at enriching the basic data with the identification of larger spots, magnetic polarity data, position of the leading and following parts and other important information. The volumes of DPR contain very useful material, but its methodology is extremely time-consuming. Therefore, a separate team has decided to compile a more restricted photospheric database, the Debrecen Photoheliographic Data (DPD), in order to speed up the procedure. The DPD contains only the basic data, but this information is available for each spot. The starting year of DPD is 1986 and the edition of the DPR is also continued simultaneously by the original team. Concerning the basic data, differences between procedures of DPR and DPD do not result in any inconsistencies between the two types of catalogue.

The present material is an extended version of DPD that was published previously in printed form (Gyori et al. 1996) and also made available electronically (ftp). The original ASCII catalogue is extended with the CCD scans of the photographic plates.

2 The DPD catalogue

The history and description of the Debrecen Observatory as well as its observational material can be found in the printed volume DPR 1977 (Dezsϕ et. al. 1987). For general information, see also Dezsϕ (1967, 1982). The daily photospheric observations are taken both in Debrecen and at the Gyula

Table 1: Number of observations per observing station.

Observatory	n
Gyula	257
Debrecen	52
Kislovodsk	30
Boulder	18
Ramey	5
Holloman	3

Observing Station (150 km from Debrecen) which officially belongs to Debrecen Observatory. The Debrecen-Gyula archive comprises about 100,000 plates covering almost four decades.

For those days in which no observations were taken in Hungary we use foreign observations. In 1986 these were received exclusively from the archives of the Kislovodsk Observatory in Russia. In some cases, when there were gaps in our observations but when no spots were reported by the observatories involved in the Solar Geophysical Data 1986, we decided that there was no need to request plates for these spotless days. In these cases we refer to the station (Boulder, Holloman or Ramey) and time of observation indicated in the SGD as reporting on a spotless disc. Table 1 gives the number of observations in the catalogue.

In our observatory several series of observations are taken each day, a series usually consisting of three photographic plates exposed within 15 minutes. We choose the best triplet (the best pair or single plate if no complete triplet is available) for every day. The area measurement is based on the best of the plates and the method is the same as described in the mentioned papers. The method of position measurements is based on the software and procedure developed by L. Gyri, which is basically similar to that used in DPR. The time of observations and the positions measured on the used plates are averaged. The mean precision of the positions in DPD is 0.1 heliographic degrees. The precision of the positions is better than 0.1 heliographic degrees in case of Gyula and it is slightly worse in case of Debrecen and Kislovodsk.

We measured every spot which could be recognized as such, depending on the quality of the observation. The numbering of spots was made arbitrarily on each plate so the number of a specific spot usually changes from one day to the following. For numbering the groups we used the NOAA sunspot group numbers published in the Solar Geophysical Data Nos. 499–510. If there was no data in the SGD for a group found by us, we created a new number by attaching the letters m, n, ... to a NOAA number existing at the given time.

The position of a spot means the position of the centre of the umbra if we could separate the umbra from the penumbra. If we could not identify any umbrae in the penumbra, we measured the position of the centre of the penumbra.

The DPD is published as an ASCII file and it contains the following data for each spot: time of observation, the NOAA number of its group, the measured (projected) and the corrected (for the foreshortening) areas of umbrae (U) and the whole spot (U+P), latitude, longitude, distance in longitude from the central meridian, position angle (measured eastward from the north pole of the Sun's axis) and distance from the disc's center in terms of Sun's radius.

The catalogue also contains the total areas and the mean position data of the sunspot groups. The total areas are the sums of the areas of each spot in the group. The mean position data of the group were calculated by multiplying the position data of each separately measured component of the group by its corrected U+P areas, and by dividing the sums of the products by the sum of the areas. If there were more than one umbra in a penumbra, the position data of the centre of gravity of

this component were computed by weighting the positions of the umbrae with the corrected U areas before calculating the mean position data of the whole group. If a group was intermittent then zero areas are indicated and no position data are given.

The sums of areas and the Julian Date are also included in the table in order to facilitate the usage of the long time-series.

3 The images

We cannot undertake to publish more information than is available in the DPD. However, we want to put all information contained by our observations at the disposal of any interested member of the solar community. This is why we also publish the CCD scans of the sunspot groups with the marks of the measured spots. This supplement allows the completion of any additional observational data (magnetic polarities, etc.) from other sources.

The images are given in FITS format. Their sizes are either 512×512 or 768×576 pixels. Each file name is created from the NOAA number (without the first figure) and the date. For example 710-0115 means that the file contains the image of the group 4710 on 15th of January. If the group number has a letter extension, then it is inserted in place of the "-" mark, as in the case of 4710b on January 21 (710b0121).

The header contains the size of the image, the date (day/month/year) and the time of the observation (hour:min:sec), the NOAA number of the group, the name of the observing station, the resolution in the sky in arcsec/pixel in the direction of the rows and the columns.

The vertical edges of the images are oriented to the North direction within one degree. More precisely, the columns of the arrays are in the North direction to within a few tenths of a degree in the case of Kislovodsk. In the other cases they lay in a direction which deviates from the North direction to the West by an angle of about one degree.

The large umbrae are often overexposed so that the smaller spots could be recognized. On account of the limit of 256 grey levels the dynamics of the original images cannot be maintained so the quality of CCD scans is lower than that of the original observations and the CCD scans are not suitable for photometric measurements.

Sometimes there are some features in the pictures which do not belong to the Sun. These are the cross-wires, the dark segment of the second exposition (it helps to measure the geocentric North direction) and inhomogeneities or defects on the plate. These features should be neglected.

Acknowledgements

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Appendix

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                    Explanations to the data file


The file contains three kinds of rows, they are explained separately.

Rows beginning with character "d" (day):

================================================================================
Column  Fmt   Description
--------------------------------------------------------------------------------
 2- 5   I4    Year
 6- 7   I2    Month
 8- 9   I2    Day of month
10-13   F4.3  Time in thousandths of a day
                       (by convention .500 represents 1200 UT)
14      A1    Blank
15-18   A4    Origin of the observation: GYUL: Gyula,
                                         DEBR: Debrecen,
                                         KISL: Kislovodsk,
                                         BOUL: Boulder,
                                         HOLL: Holloman,
                                         RAME: Ramey,
19-23   A5    Blank
24-28   I5    Daily sum of projected U (umbral) area in millionths of the
                       solar disc
29-33   I5    Daily sum of projected U+P (umbral+penumbral) area in
                       millionths of the solar disc
34-38   I5    Daily sum of corrected U in millionths of the solar hemisphere
39-43   I5    Daily sum of corrected U+P in millionths of the solar hemisphere
44-49   A6    Blank
50-60   F11.3 Julian Date (by convention .500 represents 0000 UT)

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Rows beginning with character "g" (group)

================================================================================
Column  Fmt   Description
--------------------------------------------------------------------------------
 2- 5   I4    Year
 6- 7   I2    Month
 8- 9   I2    Day of month
10-13   F4.3  Time in thousandths of a day
```

14-20	A7	NOAA sunspot group number; if no NOAA number was assigned then a number close to another NOAA number was given with an additional letter ("m" or "n")
21-23	A3	Blank
24-28	I5	Total projected U (umbra) area of the group in millionths of the solar disc
29-33	I5	Total projected U+P (umbral+penumbral) area of the group in millionths of the solar disc. Zero figure means that the given group is in an intermittent phase.
34-38	I5	Total corrected U of the group in millionths of the solar hemisphere
39-43	I5	Total corrected U+P of the group in millionths of the solar hemisphere

If all the total areas are equal to zero it means an intermittent phase of the group.

44	A1	Blank

The following entries refer to the position of the given sunspot group, which is the mean position of its spots weighted by the U+P areas of the single spots. In the case of several umbras within the same penumbra the mean weighted umbra position was calculated within their common penumbra prior to the calculation of group mean position.

45-50	F6.2	Heliographic latitude B; positive: North, negative: South
51	A1	Blank
52-57	F6.2	Heliographic longitude L
58	A1	Blank
59-64	F6.2	Longitudinal distance from the Sun’s central meridian
65	A1	Blank
66-71	F6.2	Position angle
72	A1	Blank
73-77	F6.4	Distance from the centre of the Sun’s disc measured in units of the solar radius

Rows beginning with character "s" (spot)

Column	Fmt	Description
2- 5	I4	Year
6- 7	I2	Month
8- 9	I2	Day of month
10-13	F4.3	Time in thousandths of a day
14-20	A7	NOAA sunspot group number; if no NOAA number was assigned then a number close to another NOAA number was given with an additional letter (e.g. "m" or "n")
21-23	I3	No. of spot within the group
24-28	I5	Projected U (umbra) area in millionths of the solar disc
29-33	I5	Projected U+P (umbral+penumbral) area in millionths of the solar disc; negative values indicate that several

		umbras have a common penumbra, e.g. −7 means that the given umbra shares a penumbra with umbra No.7, and the U+P value is indicated at No.7.
34–38	I5	Corrected U in millionths of the solar hemisphere
39–43	I5	Corrected U+P in millionths of the solar hemisphere, for negative values see Column 29–33.
44	A1	Blank
45–50	F6.2	Heliographic latitude B; positive: North, negative: South
51	A1	Blank
52–57	F6.2	Heliographic longitude L
58	A1	Blank
59–64	F6.2	Longitudinal distance from the Sun’s central meridian
65	A1	Blank
66–71	F6.2	Position angle
72	A1	Blank
73–77	F6.4	Distance from the centre of Sun’s disc measured in units of the solar radius