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GROUP SUNSPOT NUMBERS: FILE DESCRIPTIONS

1. OVERVIEW (*This write-up is based on original text provided by D.V. Hoyt*)

This file documents on all the files associated with the construction of the Group Sunspot Numbers (*Rg*) as provided by D.V. Hoyt. *Rg* values were derived to provide a homogeneous record of solar activity from 1610 to 1995. Care was taken that the long-term changes are more self-consistent than are the changes using the Wolf Sunspot Numbers. Procedures used to develop this dataset are described in Hoyt and Schatten [*1998*]. The files can be grouped to five categories as listed below. More descriptive filenames are currently used although references to the original filenames are parenthetically included in the current filenames. The file contents and formats are unchanged. (WFD, 21Aug13)

1.a. Daily input data:

"*group-sunspot-numbers_raw-daily-input-data(alldata)*"

Raw daily input data for 463 observers.

"*group-sunspot-numbers_fill-daily-input data(filldata)*"

Raw daily data with some missing days filled by linear interpolation.

1.b. Daily value and means:

"*group-sunspot-numbers_daily-values(dailyrg)*"

Daily values of the Group Sunspot Numbers (*Rg*)for 1610 to 1995.

"*group-sunspot-numbers_monthly-means(monthrg)*"

Monthly means of *Rg* with the number of days used to form the means and the standard deviation of the means.

"*group-sunspot-numbers_yearly-means(yearrg)*"

Yearly means of *Rg* with the number of days used to form the means and the standard deviation of the means.

1.c. Standard deviations:

"*group-sunspot-numbers_standard-deviation_daily-values(dailysd)*"

Daily standard deviations of *Rg* for 1610 to 1995. These numbers represent the random errors in the daily means.

"*group-sunspot-numbers_standard-deviation_monthly-means(monthsd)*"

Monthly means of daily standard deviations as listed in dailysd.

"*group-sunspot-numbers_standard-deviation_yearly-means(yearsd)*"

Yearly means of monthly standard deviations as listed in monthsd.

1.d. Number of observations:

"*group-sunspot-numbers_number-of-observers_daily-values(dailynum)*"

Daily average number of observations per day used in forming the daily means.

"*group-sunspot-numbers_number-of-observers_monthly-means(monthnum)*"

Monthly average number of observations per day used in forming the daily means.

"*group-sunspot-numbers_number_of-observers_yearly-means(yearnum)*"

Yearly average number of observations per day used in forming the daily means.

1.e. Documentation files:

"*group-sunspot-numbers_inventory-of-observers(invent)*"

An inventory file listing the observer number, his observation year, and number of days of observations.

"*group-sunspot-numbers_listing-of-observers(list1)*"

A summary of the 463 observers used to reconstruct solar activity.

"*group-sunspot-numbers_bibliography(bibliogr)*"

A bibliography listing the literature source of each observer used along with appropriate comments. Also listed are some observers identified but not used for one reason or another.

"*group-sunspot-numbers_observer-correction-factors(alllevel)*"

A list of the calculated observer correction factors used to place the observer on the Royal Greenwich Observatory (RGO) scale. These factors make all the observers as self-consistent as possible.

The next few sections give more information on the files, such as their formats.

2. INPUT FILES – File Contents and Formats

2a. alldata – Tables of raw daily number of groups by each observer.

Sample: The data are grouped in the form of observer years and a sample table for 1830 is shown below:

```
      NUMBER OF SUNSPOT GROUPS FOR THE YEAR: 1830
      AS OBSERVED BY: SCHWABE, H., DESSAU
```

Day	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1	-99	-99	5	-99	7	2	5	-99	-99	5	-99	-99
2	-99	3	7	4	-99	2	4	-99	-99	-99	-99	-99
3	-99	4	8	7	5	2	4	-99	4	5	5	-99
4	-99	-99	7	7	3	2	4	-99	4	6	5	-99
5	-99	-99	5	7	3	5	5	-99	-99	6	6	-99
6	-99	-99	-99	6	-99	5	4	-99	-99	-99	5	-99
7	-99	-99	4	8	4	5	-99	-99	5	6	6	-99
8	-99	-99	4	7	4	5	-99	-99	-99	3	-99	-99
9	2	-99	6	-99	-99	5	-99	-99	3	4	-99	4
10	2	8	8	7	-99	6	-99	-99	-99	3	-99	4
11	-99	-99	-99	8	5	4	-99	-99	4	5	5	7
12	-99	7	-99	-99	6	3	-99	-99	-99	6	5	-99
13	3	7	8	6	6	3	-99	-99	-99	7	8	4
14	-99	7	-99	-99	-99	4	-99	-99	4	8	8	-99

```
    15  -99  -99    7    7    7    5  -99  -99    4  -99    5  -99
    16  -99  -99    7  -99  -99    5  -99  -99    5  -99    4  -99
    17  -99    5  -99    6  -99  -99  -99  -99    5    5  -99  -99
    18  -99  -99  -99    7    3    4  -99  -99    6    7    6  -99
    19  -99    4  -99    5    6  -99  -99  -99    4   10  -99    6
    20    4    4  -99    5    5    4  -99    2    5    5  -99    6
    21    2    5  -99    7    4    4  -99    2    5    7    5    6
    22  -99    3    4  -99    4    5  -99    3    3    8    6    4
    23    3  -99    4  -99    4    5  -99    3    3  -99    5    6
    24    0    4  -99   12    4    6  -99    3    4  -99    5    6
    25    2  -99  -99   11    4    5  -99    3    4    4    5  -99
    26    3    4  -99    9    4    4  -99    4    4  -99  -99  -99
    27    2    5    3  -99    4    5  -99    4    3    4  -99    4
    28  -99    5  -99    8    6    5  -99    5    2  -99  -99    6
    29  -99  -99    6    9    3    5  -99    5  -99    5  -99  -99
    30    2  -99    7    8    2    5  -99    6  -99    5  -99  -99
    31    3  -99  -99  -99    1  -99  -99    6  -99    5  -99    6

means:  2.3  5.0  5.9  7.3  4.3  4.3  4.3  3.8  4.1  5.6  5.5  5.3
```

Format: The first line is blank. At the end of the second line, the year is specified. The third line gives the observer name and his location. The fourth line is blank. The fifth line gives the names of the months and the sixth line is a divider. The next 31 lines give the day of the month followed by the number of reported sunspot groups. The table is followed by a blank line and then the monthly means.

If a day was not observed, the fill value of -99 is used. If the monthly mean cannot be formed, a fill value of -9. is used. There are 3010 consecutive tables in *alldata*. A sample portion of the Fortran code to read them is:

```
      do 2000 kk = 1,3010
      read(5,99,end=999) dummy
      read(5,100) iyear
   99 format(a79)
  100 format(47x,i4)
      read(5,101) name
  101 format(23x,a30)
      read(5,99) dummy
      read(5,99) dummy
      read(5,99) dummy
      do 2 i = 1, 31
       read(5,102) iday(i),(array(i,j),j=1,12)
  102 format(i6,12i5)
    2 continue
      read(5,99) dummy
      read(5,103) (mnmeans(j), j=1,12)
  103 format(6x,12f5.1)
 2000 continue
  999 continue
```

Comments: This format was chosen to make the data easy to read by people, even though it is not a compact format.

2b. filldata – The raw daily data with some missing days filled by linear interpolation.

Sample: The raw observation table is shown below as it appears after filling some missing days:

NUMBER OF SUNSPOT GROUPS FOR THE YEAR: 1830
AS OBSERVED BY: SCHWABE, H., DESSAU

Day	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1	-99	3	5	5	7	2	5	-99	5	5	5	-99
2	-99	3	7	4	6	2	4	-99	4	5	5	-99
3	-99	4	8	7	5	2	4	-99	4	5	5	-99
4	-99	-99	7	7	3	2	4	-99	4	6	5	-99
5	-99	-99	5	7	3	5	5	-99	4	6	6	-99
6	-99	-99	4	6	3	5	4	-99	4	6	5	-99
7	-99	-99	4	8	4	5	-99	-99	5	6	6	-99
8	-99	-99	4	7	4	5	-99	-99	4	3	5	-99
9	2	-99	6	7	4	5	-99	-99	3	4	5	4
10	2	8	8	7	4	6	-99	-99	3	3	5	4
11	2	7	8	8	5	4	-99	-99	4	5	5	7
12	2	7	8	7	6	3	-99	-99	4	6	5	5
13	3	7	8	6	6	3	-99	-99	4	7	8	4
14	-99	7	7	6	6	4	-99	-99	4	8	8	4
15	-99	6	7	7	7	5	-99	-99	4	7	5	4
16	-99	5	7	6	5	5	-99	-99	5	6	4	5
17	-99	5	6	6	4	4	-99	-99	5	5	5	5
18	-99	4	6	7	3	4	-99	-99	6	7	6	5
19	-99	4	5	5	6	4	-99	-99	4	10	5	6
20	4	4	5	5	5	4	-99	2	5	5	5	6
21	2	5	4	7	4	4	-99	2	5	7	5	6
22	2	3	4	8	4	5	-99	3	3	8	6	4
23	3	3	4	10	4	5	-99	3	3	6	5	6
24	0	4	3	12	4	6	-99	3	4	5	5	6
25	2	4	3	11	4	5	-99	3	4	4	5	5
26	3	4	3	9	4	4	-99	4	4	4	-99	4
27	2	5	3	8	4	5	-99	4	3	4	-99	4
28	2	5	4	8	6	5	-99	5	2	4	-99	6
29	2	-99	6	9	3	5	-99	5	3	5	-99	6
30	2	-99	7	8	2	5	-99	6	4	5	-99	6
31	3	-99	6	-99	1	-99	-99	6	-99	5	-99	6
means:	2.3	5.0	5.9	7.3	4.3	4.3	4.3	3.8	4.1	5.6	5.5	5.3

Format: The format is identical to that of *alldata*.

Comments: The numbers listed above are the number of groups the observer (here Schwabe) reported each day. The format was chosen to make the data easy to read by people, even though it is not a compact format.

3. VALUES and MEANS – File Contents and Formats

3a. dailyrg – Daily values of the Group Sunspot Numbers, *Rg*, for 1610 to 1995.

Sample: A sample output table is listed below:

GROUP SUNSPOT NUMBERS FOR THE YEAR: 1830
AS OBSERVED BY: 10 OBSERVERS

Day	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1	53	38	81	74	99	26	68	20	95	76	66	-99
2	46	44	95	79	84	26	63	20	92	73	66	-99
3	40	47	117	108	62	19	63	16	62	75	71	-99
4	33	71	92	106	40	37	58	39	62	75	72	-99
5	26	75	61	117	52	69	66	40	62	84	84	49
6	26	75	52	90	63	55	51	40	91	76	84	49
7	26	75	62	97	59	55	30	55	112	71	95	49
8	34	89	62	99	63	63	30	69	89	62	94	49
9	31	89	83	89	64	72	37	61	46	61	94	62
10	33	89	113	94	64	55	58	55	49	62	77	77
11	45	99	113	113	69	45	65	49	53	79	69	71
12	42	99	119	128	81	39	46	52	59	85	85	71
13	43	99	125	98	86	52	44	28	59	104	107	64
14	49	96	117	86	81	65	44	26	59	114	40	64
15	55	87	108	92	88	70	27	4	53	108	40	58
16	61	69	104	42	69	70	50	24	55	83	56	72
17	76	67	98	36	67	59	32	20	72	85	72	72
18	49	58	90	57	55	58	20	28	55	100	63	77
19	32	55	71	72	56	56	14	28	67	81	77	86
20	54	54	70	72	75	53	14	31	54	80	77	80
21	28	58	50	110	52	52	15	26	42	89	77	63
22	7	40	55	114	52	32	15	39	46	116	85	62
23	0	39	46	136	52	57	34	40	49	119	77	76
24	0	53	44	145	59	65	42	46	49	84	72	85
25	15	49	43	144	59	73	33	40	39	83	77	85
26	16	48	47	143	59	69	33	53	20	76	98	47
27	28	72	49	139	53	83	47	59	40	83	115	47
28	25	76	66	129	34	76	26	77	34	77	115	85
29	25	-99	87	130	20	75	20	72	47	72	-99	84
30	25	-99	90	105	8	76	20	83	62	77	-99	85
31	35	-99	90	-99	19	-99	14	86	-99	66	-99	98
means:	34.	68.	81.	101.	59.	57.	38.	43.	59.	83.	79.	69.

Format: The format is very close to that used by *alldata* and *filldata* except the number of observers used for the year replaces the individual observer's name and the monthly mean.

File format: `(i6,12f5.0)`

Missing daily or monthly means have a fill value of -99. The code to read *alldata* may be used with these small changes made.

Comments: Here is a copy of the abstract of Hoyt and Schatten [*1998*] which summarizes the dataset: "Abstract. In this paper, we construct a time series known as the Group Sunspot Number. The Group Sunspot Number is more internally self-consistent and less noisy then the Wolf Sunspot Number. It uses the number of sunspot groups observed, rather than groups and individual sunspots. Daily, monthly, and yearly means are derived from 1610 to the present.

The Group Sunspot Numbers use 65,941 observations from 117 observers active before 1874 that were not used by Wolf in constructing his time series. Hence, we have calculated daily values of solar activity on 111,358 days for 1610-1995, compared to 66,168 days for the Wolf Sunspot Numbers. The Group Sunspot Numbers have estimates of their random and systematic errors tabulated. The generation and preliminary analysis of the Group Sunspot Numbers allow us to make several conclusions: 1) Solar activity before 1882 is lower than generally assumed and consequently solar activity in the last few decades is higher than it has been for several centuries, 2) There was a solar activity peak in 1801 and not 1805 so there is no long anomalous cycle of 17 years as reported in the Wolf Sunspot Numbers. The longest cycle now lasts no more than 15 years. 3) The Wolf Sunspot Numbers have many inhomogeneities arising from observer noise which affects the daily, monthly and yearly means. The Group Sunspot Numbers also have observer noise, but it is considerably less than the noise in the Wolf Sunspot Numbers."

Users are cautioned that the observations before 1653 are not very reliable and should be used with caution.

There are 386 tables from 1610 to 1995 in *dailyrg*.

3b. monthrg – Monthly means of *Rg* with the number of days used to form the means and the standard deviation of the means.

Sample: Here is a sample portion of the file:

```
 1830  1 31    34.1    17.2
 1830  2 28    68.2    19.9
 1830  3 31    80.6    26.1
 1830  4 30   101.5    29.1
 1830  5 31    59.5    20.3
 1830  6 30    56.7    16.5
 1830  7 31    38.0    17.6
 1830  8 31    42.8    20.7
 1830  9 30    59.1    19.9
 1830 10 31    83.1    15.4
 1830 11 28    78.8    18.3
 1830 12 27    69.1    14.6
```

File format: `(i5,2i3,2f8.1)`

The file gives the year, the number of the month from 1 to 12, the monthly mean, and the standard deviation of the monthly mean. The standard deviation represents the variability in the Group Sunspot Numbers and not their uncertainty.

Comments: The file has 4632 lines.

3c. yearrg – Yearly means of *Rg with the number of days used to form the means and the standard deviation of the means [TBD?].*

Sample: Here is a sample portion of the file:

```
 1825   14.4
 1826   28.6
 1827   44.4
```

```
1828   57.0
1829   59.2
1830   64.3
1831   39.2
1832   22.7
1833    6.5
1834    9.8
```

Data format: `(i6,f7.1)`

The first column gives the year and the second column gives the yearly mean Group Sunspot Number formed by averaging the monthly means.

Comments: The file contains 386 lines.

4. STANDARD DEVIATIONS – File Contents and Formats

4a. *dailysd* – Contains daily standard deviations of the Group Sunspot Numbers for 1610 to 1995. These numbers represent the random errors in the daily means.

Sample:

```
      DAILY STANDARD DEVIATIONS FOR THE YEAR: 1830
      AS OBSERVED BY: 10 OBSERVERS
```

Day	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1	26	5	15	9	2	3	3	3	16	5	6	-99
2	0	3	9	19	2	3	3	3	8	1	6	-99
3	0	8	17	20	16	8	3	0	5	6	1	-99
4	4	1	18	13	5	6	2	4	5	12	0	-99
5	2	3	11	14	11	4	6	7	5	2	0	0
6	2	9	5	7	3	7	6	7	9	9	0	0
7	2	9	5	19	1	7	3	5	4	10	6	0
8	2	7	5	2	3	3	3	3	10	6	21	0
9	3	7	1	9	8	0	6	11	4	5	21	5
10	5	10	5	8	6	7	3	5	6	6	6	10
11	4	3	5	5	4	17	6	0	6	6	3	1
12	13	2	3	23	7	5	13	5	1	3	12	1
13	0	3	11	15	1	17	28	6	1	7	8	5
14	9	16	21	1	6	10	28	2	1	14	11	5
15	0	15	9	13	7	4	15	8	6	9	11	0
16	0	3	7	9	3	4	34	0	7	1	5	0
17	0	7	8	17	7	1	16	3	0	12	0	0
18	0	2	7	12	7	2	3	4	7	15	3	4
19	0	4	1	0	12	5	2	4	13	22	6	1
20	5	5	13	0	6	6	2	2	25	6	6	10
21	0	19	8	6	5	5	1	3	9	10	6	3
22	9	5	12	2	5	4	0	5	4	4	3	5
23	0	3	10	13	5	12	2	5	0	18	6	15
24	0	5	3	27	1	4	9	4	0	12	0	3
25	1	0	5	17	1	2	3	5	4	1	4	18
26	3	9	3	11	1	8	3	6	5	8	0	15
27	0	10	6	12	6	9	2	1	5	1	0	15

```
     28    5    5    6   17    2    4    2    6    2    6    0    3
     29    5  -99    6   20    5    4    3    0    3    0  -99    2
     30    5  -99   16    9   14   13    3    1    5    6  -99    3
     31   11  -99   18  -99    6  -99    2    1  -99    6  -99   10

 means:  3.5  6.9  9.1 12.2  6.0  6.7  7.4  4.3  6.3  7.9  5.8  5.4
```

Format: The format is identical to that of *dailyrg*.

Comments: The file contains 386 tables from 1610 to 1995. The daily standard deviations provide a measure of how well the daily means are formed. Typically the ratio of the standard deviation to the mean is about 12% which gives a measure of the uncertainty in the daily values.

4b. monthsd – Monthly means of the daily standard deviations in *dailysd*.

Sample:

```
 1830  1 25     3.5     3.7
 1830  2 28     6.9     4.6
 1830  3 31     9.1     5.3
 1830  4 30    12.2     7.0
 1830  5 31     6.0     3.7
 1830  6 30     6.7     4.3
 1830  7 31     7.4     8.5
 1830  8 31     4.3     2.7
 1830  9 30     6.3     5.3
 1830 10 31     7.9     5.2
 1830 11 28     5.8     5.7
 1830 12 27     5.4     5.6
```

File format: `(i5,2i3,2f8.1)`

The file gives the year, the number of the month from 1 to 12, the monthly mean standard deviation and the standard deviation of the monthly mean standard deviation. The monthly mean standard deviations (column 4) provide a measure of the variability of solar activity for that month.

Comments: The file has 4632 lines.

4c. yearsd – Yearly means of monthly standard deviations in *monthsd*.

Sample:

```
 1825    2.9
 1826    5.1
 1827    6.4
 1828    8.4
 1829    6.5
 1830    6.8
 1831    5.7
 1832    3.8
 1833    1.0
 1834    1.2
```

File format: `(i6,f7.1)`

The first column gives the year and the second column gives the average yearly Group Sunspot Number standard deviations (from monthsd.dat) formed by averaging the monthly means. The numbers provide a rough measure of the day-to-day variability of the sun each year.

Comments: The file contains 386 lines.

5. NUMBER OF OBSERVATIONS

5a. dailynum

Contents: The daily average number of observations per day used in forming the daily means.

Sample:

```
      NUMBER OF OBSERVERS EACH DAY FOR THE YEAR: 1830
      AS OBSERVED BY: 10 OBSERVERS
```

Day	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1	0	3	3	3	3	2	2	2	3	3	2	0
2	0	3	3	3	3	2	2	2	3	3	2	0
3	0	3	4	4	4	3	2	1	2	3	2	0
4	0	2	4	4	2	2	3	2	2	4	2	0
5	2	2	3	4	2	2	3	2	2	3	2	1
6	2	2	3	3	2	2	3	2	2	3	2	1
7	2	2	2	3	2	2	2	2	2	3	3	1
8	2	2	2	3	2	2	2	2	2	3	2	1
9	4	2	2	2	2	2	2	2	2	4	2	2
10	4	2	2	3	3	2	2	2	3	3	2	2
11	2	2	2	2	2	2	2	2	2	3	2	2
12	2	3	2	3	3	3	2	2	2	2	2	2
13	1	2	2	2	2	3	2	2	2	3	2	2
14	0	3	2	2	4	2	2	2	2	3	2	2
15	0	4	2	2	3	3	2	3	2	2	2	1
16	1	3	3	2	3	3	2	1	2	2	3	1
17	1	4	4	2	3	2	2	2	2	3	2	1
18	1	3	3	2	2	3	2	2	2	3	2	2
19	1	4	2	2	3	3	2	2	2	2	2	2
20	3	3	3	2	3	2	2	2	2	3	2	2
21	2	3	3	3	3	3	2	2	2	3	2	2
22	2	2	3	2	3	3	2	3	2	3	2	2
23	3	3	3	2	3	2	2	2	2	3	2	2
24	4	4	3	3	2	3	2	2	2	3	2	2
25	2	2	3	4	2	4	2	2	2	2	2	2
26	2	3	3	5	2	3	2	2	2	2	1	2
27	2	3	3	3	2	3	2	2	2	2	1	2
28	3	3	4	4	2	4	2	2	2	2	1	2
29	3	-99	4	4	2	5	2	2	3	2	0	3
30	3	-99	4	4	3	4	2	2	2	2	0	2
31	2	-99	4	-99	2	-99	2	2	-99	2	-99	2

```
means:  1.8  2.8  2.9  2.9  2.5  2.7  2.1  2.0  2.1  2.7  1.8  1.5
```

The file format is identical to that of *dailyrg*.

Comments: The file contains 386 tables from 1610 to 1995. The daily number of observations used to form the daily means in *dailyrg* are tabulated. A value of 0 means the daily mean was formed by interpolation.

5b. monthnum – Monthly average number of observations per day used in forming the daily means.

Sample:

```
1830  1 31     1.8     1.2
1830  2 28     2.8      .7
1830  3 31     2.9      .7
1830  4 30     2.9      .9
1830  5 31     2.5      .6
1830  6 30     2.7      .8
1830  7 31     2.1      .3
1830  8 31     2.0      .4
1830  9 30     2.1      .3
1830 10 31     2.7      .6
1830 11 30     1.8      .6
1830 12 31     1.5      .8
```

File format: `(i5,2i3,2f8.1)`

The file gives the year, the number of the month from 1 to 12, the daily mean number of observations for that month, and the standard deviation of the column 4 means. The monthly means provide a measure of how actively the sun was observed each month.

Comments: The file has 4632 lines.

5c. yearnum – Yearly average number of observations per day used in forming the daily means.

Sample:

```
1825    2.7
1826    2.6
1827    2.8
1828    2.9
1829    2.7
1830    2.3
1831    2.3
1832    2.9
1833    2.8
1834    2.5
```

File format: `(i6,f7.1)`

The first column gives the year and the second column gives the average yearly number of observations made each day for that year. The numbers provide a measure of how actively the sun was observed each year.

Comments: The file contains 386 lines.

6. DOCUMENTATION

6a. invent - An inventory file listing the observer number, his observation year and number of days of observations.

Sample:

```
1174 1830   209 SCHWABE, H., DESSAU
1175 1830    10 SCHWARZENBRUNNER, KREMS.
1176 1830    44 ARAGO, F.D., PARIS
1177 1830    11 TEVEL, C., MIDDELBURG
1178 1830     5 FLAUGERGUES, H., VIVIERS
1179 1830   206 HUSSEY, T.J., ENGLAND
1180 1830     2 STARK, AUGSBURG, ZERO DAYS
1181 1830    66 STARK, J.M., AUGSBURG
1182 1830   165 PASTORFF, J.W., DROSSEN
1183 1830   171 PASTORFF/WOLF, DROSSEN
```

File format: `(2i5,i6,a30)`

The first column is the observer number from 1 to 3010, the second column is the year of observation, the third column is the number of observations made that year, and the last column is the name and location of the observer.

Comments: This file provides an inventory of the observations in *alldata*. There are 3010 lines in this file.

6b. list1 – A summary of the 463 observers used to reconstruct solar activity.

Sample:

```
274 1822 1837   122 HERSCHEL, J., LONDON
275 1823 1823     9 LORENZ, WITTENBURG
276 1823 1824    16 BIELA, J., PRAGUE
277 1825 1830   364 SCHWARZENBRUNNER, KREMS.
278 1825 1826   183 VON BOTH, G., BRESLAU
279 1826 1867 11945 SCHWABE, H., DESSAU
280 1826 1837  1207 HUSSEY, T.J., ENGLAND
281 1826 1826     1 BEAUFOY, G., BUSHEY HEATH
282 1831 1832   200 LAWSON, H., HEREFORD
283 1832 1832    39 RUPRECHT, H., ZIEGENHAIN
```

File format: `(i8,2i5,i6,a30)`

The first column gives the observer number from 1 to 463, the second and third columns give the first and last years of observations by that observer, the fourth column lists the total number

of observations by that observer and the last column gives the name and location of the observer.

Comments: There are 463 lines in this file and at the end is appended the grand total of the number of observations; i.e., "Grand total of observations = 455242 455242", which were summed two different ways.

6c. bibliogr – A bibliography listing the literature source of each observer along with appropriate comments. Also listed are some observers identified but not used for one reason or another.

Format: This a free form text document meant to be read by a person instead of a computer.

Comments: The references are reasonably complete but not fully, particularly for some of the earlier papers. These omissions arise because the bibliography was constructed rather late in the project. The omissions are felt to be minor and should not hinder one in locating the source material.

6d. *allevel* – A list of the calculated observer correction factors used to place the observer on the Royal Greenwich Observatory (RGO) scale. These factors make all the observers as self-consistent as possible.

Sample:

```
274   1.203    .017    5 HERSCHEL, J., LONDON
275   1.073    .098    4 LORENZ, WITTENBURG
276   1.064    .064    6 BIELA, J., PRAGUE
277   1.280    .089    6 SCHWARZENBRUNNER, KREMS.
278   1.121    .091    6 VON BOTH, G., BRESLAU
279   1.208    .058    9 SCHWABE, H., DESSAU
280   1.365    .042    7 HUSSEY, T.J., ENGLAND
281   1.255    .112    1 BEAUFOY, G., BUSHEY HEATH
282   1.528    .112    3 LAWSON, H., HEREFORD
283   1.027    .139    2 RUPRECHT, H., ZIEGENHAIN
```

File format: `(i5,2f8.3,i5,a30)`

The first column gives the observer number, the second column gives the multiplying factor by which observations must be multiplied to put him on the same scale as RGO, the third column provides the one standard deviation of this correction factor, the fourth column provides the number of pathways used to derive the correction factor, and last column gives the observer's name and location.

Comments: There are 463 lines in this file.

REFERENCES

Here are list of references to papers written about this project. The first paper provides the best overview of the methods and results.

Hoyt, D.V. and K.H. Schatten (1998), Group Sunspot Numbers: A New Solar Activity Reconstruction, *Solar Physics, 181*, pp. 491-512.

Hoyt, D.V. and K.H. Schatten (1996), How well was the Maunder Minimum observed? *Solar Physics, 165*, 181-192.

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Hoyt, D.V. and K.H. Schatten (1995), A new interpretation of Christian Horrebow's sunspot observations from 1761 to 1777, *Solar Physics, 160*, 387-392.

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Hoyt, D.V. and K.H. Schatten (1995), A new reconstruction of solar activity based upon telescopic observations, IUGG Assembly,Boulder, CO.

Hoyt, D.V. and K.H. Schatten (1994), The one hundredth year of Rudolf Wolf's death: Do we have the correct reconstruction of solar activity? *Geophys. Res. Lett., 21*, 2067-2070.

Hoyt, D.V. K.H. Schatten and E. Nesme-Ribes (1994), A new reconstruction of solar activity – 1610-1993. NATO Advanced Research Workshop Proceedings, The Solar Engine and Its Influence on Terrestrial Atmosphere and Climate.

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Hoyt, D.V. and K.H. Schatten (1992), A new look at the Wolf sunspot numbers in the late 1700's, *Solar Physics, 138*, 387-397.

Hoyt, D.V. and K.H. Schatten (1992), New information on solar activity – 1779-1818, from Sir William Herschel's unpublished notebooks, *Ap.J., 384*, 361-384.

Hoyt, D.V. and K.H. Schatten (1992), Sir William Herschel's notebooks: Abstracts of solar observations, *Ap.J. Supplements, 78*, 301-340.