Land Cloud Update, 1997 – 2009, Appended to:

Cloud climatology for land stations worldwide, 1971-1996.

NDP-026D

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History

This climatology is created exclusively from surface synoptic weather reports. These reports are contained in an updated version of the Extended Edited Cloud Reports Archive (EECRA, Hahn et al., 2009). Only reports made in the WMO "synoptic code" (WMO, 1974) are used. The land-based climatology (Hahn & Warren 2003) and EECRA, which previously spanned from 1971 to 1996, are now updated through 2009. The update uses new source data from the Integrated Surface Database (ISD, Smith et al. (2011)). Only yearly averages of monthly and seasonal data (amounts, frequencies, non-overlapped amounts) are updated; multi-year averages are not changed. Base heights are not updated because of the scarcity of base-height reports in the new source data. The same 5388 weather stations that are used in the original climatology are used in the update. The climatology contains information on 9 cloud types (5 low, 3 middle, 1 high), total cloud cover, and frequency of clear sky.

Some countries (most notably the USA, Canada, and New Zealand) have phased out human cloud observations in favor of automated systems (laser ceilometers). Cloud reports from automated observations are not compatible with human-made synoptic observations, so are not used in the update. This change has contributed to an overall decline of approximately 20% in the number of observations per year over the 13-year span of the update.

Format

The data format is nearly identical to previous data, with two notable changes. First, an extra

space is added between columns of amounts or frequencies and Nobs. This makes the files easier to load into processing programs such as MATLAB. Second, the year column now contains four-digit years in monthly files. Since the structure of the files is not changed, the old data formats still apply (Formats 126, 127, 162). The updated versions of the formats are shown in Table 6u. An additional file-type has been created combining the updated data with the original data. This new file (called Combined) has a similar format to the original files, identical in all columns, but with the addition of a years column. The new data format is Format 128 for seasonal amounts and frequencies, and Format 129 for non-overlapped amounts. The monthly format is unchanged in the combined files.

Details of the data organization are shown in Table 4u. Details of file formats are shown in Table 6u. These are both updates of Tables 4 and 6 in Hahn and Warren (2003).

Data Problems

The new source data was occasionally missing observations at certain hours at certain stations, and in some cases had observations at hours not present in the previous version of the EECRA. This did not appear to be a systematic problem; however, the differing hours have the potential to create a diurnal bias. To account for this, only hours that were previously used for averages at each station were allowed to contribute to the updated averages. ISD-based averages with fewer hours were allowed to contribute, but biases were tested for by comparing time series of 10 overlapping years of ISD and EECRA data (1987-1996). Any station-month that showed a consistent difference in cloud amount for any type was given a “missing” value. Specifically, if two-thirds or more of the overlapping years had cloud cover at least one percent greater in one time series versus the other, the station-month was rejected for all subsequent years (1997-2009).

As explained in the description of the update of the EECRA (Eastman & Warren 2012), some stations in Australia have discrepancies in report times between the ISD and the earlier version of the EECRA in years where they overlapped. The ISD data shows observations one or two hours earlier than the EECRA. To remedy this, these stations had an hour correction applied to bring the report times in line with the EECRA. It is not known which of these data sources has 'true' hours, but to keep the dataset consistent, the EECRA hours are used.

Examples of new data

Monthly amount, frequency, and amounts when present (updated years):

49_MNYD.07.st

StaID	Year	Nobs	AMT	FQ	AWP	NC
68512	1997	28	357	357	10000	1
68512	1998	27	602	741	8125	2
68512	1999	32	0	0	-90000	0
68512	2000	37	1115	1351	8250	5
68512	2001	29	1681	2069	8125	6
68512	2002	32	1406	1562	9000	5
68512	2003	37	0	0	-90000	0
68512	2004	118	731	932	7841	11
68512	2005	120	365	583	6250	7
68512	2006	124	1613	2419	6667	30
68512	2007	124	897	1210	7417	15
68512	2008	123	1311	1870	7011	23
68512	2009	123	772	1138	6786	14

Seasonal amount (updated years only)

57_SMCA.43.hi

StaID	Dnobs	Damt	Nnobs	Namt	DNnobs	DNamt	Acode
29631	170	2107	106	2159	276	2133	2
29631	48	2768	27	2603	75	2686	2
29631	267	2541	195	2740	462	2641	2
29631	276	2653	188	2404	464	2529	2
29631	256	2518	159	2529	415	2524	2

29631	233	2439	157	2755	390	2597	2
29631	292	2893	190	2796	482	2845	2
29631	260	2807	166	2724	426	2765	2
29631	260	2255	172	2858	432	2556	2
29631	280	2896	170	2734	450	2815	2
29631	262	2533	198	2386	460	2460	2
29631	280	3147	176	2878	456	3012	2
29631	268	2641	180	2743	448	2692	2

Seasonal Frequency (Combined)

84_SMCFC.42.cr

StaID	Year	Dnobs	Dfq	Nnobs	Nfq	DNnobs	DNfq	Acode
1160	1971	335	1343	239	1297	574	1320	2
1160	1972	329	881	229	830	558	856	2
1160	1973	352	540	232	474	584	507	2
1160	1974	297	673	208	673	505	673	2
1160	1975	342	88	233	43	575	65	2
1160	1976	324	772	227	793	551	782	2
1160	1977	347	259	240	167	587	213	2
1160	1978	361	693	241	622	602	657	2
1160	1979	357	224	251	359	608	291	2
1160	1980	364	302	251	319	615	310	2
1160	1981	354	621	258	465	612	543	2
1160	1982	352	313	257	506	609	409	2
1160	1983	354	28	240	42	594	35	2
1160	1984	345	87	241	166	586	126	2
1160	1985	355	282	257	233	612	258	2
1160	1986	359	84	242	165	601	124	2
1160	1987	357	896	244	820	601	858	2
1160	1988	358	447	266	301	624	374	2
1160	1989	361	111	245	204	606	157	2
1160	1990	361	388	253	316	614	352	2
1160	1991	361	471	244	574	605	522	2
1160	1992	359	836	249	843	608	840	2
1160	1993	363	579	261	1073	624	826	2
1160	1994	360	361	245	286	605	323	2
1160	1995	360	500	256	547	616	523	2
1160	1996	360	1361	261	1188	621	1274	2
1160	1997	337	653	237	844	574	748	2
1160	1998	337	623	247	648	584	635	2
1160	1999	344	959	242	1612	586	1285	2
1160	2000	342	409	240	333	582	371	2
1160	2001	353	481	262	458	615	470	2
1160	2002	342	819	244	942	586	880	2
1160	2003	345	290	253	356	598	323	2
1160	2004	352	852	267	711	619	782	2
1160	2005	351	85	250	80	601	83	2

1160	2006	124	2500	101	2970	225	2735	2
1160	2007	131	611	110	818	241	714	2
1160	2008	89	1348	58	2414	147	1881	2
1160	2009	156	1025	114	1316	270	1171	2

References

Hahn, C. J., S. G. Warren, and R. Eastman, 2009 (updated 2012): Extended Edited Cloud Reports from Ships and Land Stations over the Globe, 1952-1996 (updated to 2009). Carbon Dioxide Information Analysis Center Numerical Data Package NDP-026C, 79pp.

Hahn, C. J., and S. G. Warren, 2003: Cloud Climatology for Land Stations Worldwide, 1971-1996. Carbon Dioxide Information Analysis Center Numerical Data Package NDP-026D, 35pp.

Smith, A., N. Lott, and R. Vose, 2011: The Integrated Surface Database: Recent developments and partnerships. *Bull. Amer. Meteor. Soc.*, **92**, 704-708.

WMO, 1974: Manual on Codes. Vol. 1., World Meteorological Organization Publication 306, 348 pp.

Table 4u. Organization of the updated data files.

File Cat.	Num of SCDGs	SCDG numbers	Contents (File Category name abbreviation)	Data Format
MONTHLY-MEAN AVERAGES, DAY				
		each MONTH: 11 TYPES, 5388 Stations, 13 Yrs (MNYD)		
43	11	43001-11	Monthly-Mean Daytime Cloud AMT, FQ, AWP, JAN	162
44	11	44001-11	Monthly-Mean Daytime Cloud AMT, FQ, AWP, FEB	162
45	11	45001-11	Monthly-Mean Daytime Cloud AMT, FQ, AWP, MAR	162
46	11	46001-11	Monthly-Mean Daytime Cloud AMT, FQ, AWP, APR	162
47	11	47001-11	Monthly-Mean Daytime Cloud AMT, FQ, AWP, MAY	162
48	11	48001-11	Monthly-Mean Daytime Cloud AMT, FQ, AWP, JUN	162
49	11	49001-11	Monthly-Mean Daytime Cloud AMT, FQ, AWP, JUL	162
50	11	50001-11	Monthly-Mean Daytime Cloud AMT, FQ, AWP, AUG	162
51	11	51001-11	Monthly-Mean Daytime Cloud AMT, FQ, AWP, SEP	162
52	11	52001-11	Monthly-Mean Daytime Cloud AMT, FQ, AWP, OCT	162
53	11	53001-11	Monthly-Mean Daytime Cloud AMT, FQ, AWP, NOV	162
54	11	54001-11	Monthly-Mean Daytime Cloud AMT, FQ, AWP, DEC	162
SEASONAL-MEAN AVERAGES				
		each SEASON: 10 TYPES, 5388 Stations, 13 Yrs (SMCA)		
55	10	55001-10	Seasonal-Mean CLOUD AMOUNT, DJF	126
56	10	56001-10	Seasonal-Mean CLOUD AMOUNT, MAM	126
57	10	57001-10	Seasonal-Mean CLOUD AMOUNT, JJA	126
58	10	58001-10	Seasonal-Mean CLOUD AMOUNT, SON	126
		each SEASON: 10 TYPES, 5388 Stations, 13 Yrs (SMCF)		
59	10	59001-10	Seasonal-Mean CLOUD FREQUENCY, DJF	126
60	10	60001-10	Seasonal-Mean CLOUD FREQUENCY, MAM	126
61	10	61001-10	Seasonal-Mean CLOUD FREQUENCY, JJA	126
62	10	62001-10	Seasonal-Mean CLOUD FREQUENCY, SON	126
		each SEASON: 4 TYPES, 5388 Stations, 13 Yrs (SMUU)		
63	4	63001-4	Seasonal-Mean NOL Upper Clouds, DJF	127
64	4	64001-4	Seasonal-Mean NOL Upper Clouds, MAM	127
65	4	65001-4	Seasonal-Mean NOL Upper Clouds, JJA	127
66	4	66001-4	Seasonal-Mean NOL Upper Clouds, SON	127

Table 4u continued

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COMBINED MONTHLY-MEAN AVERAGES
                  each MONTH: 11 TYPES, 5388 Stations, 39 Yrs (MNYDC)
   67       11    67001-11   Monthly-Mean Daytime Cloud AMT, FQ, AWP,  JAN      162
   68       11    68001-11   Monthly-Mean Daytime Cloud AMT, FQ, AWP,  FEB      162
   69       11    69001-11   Monthly-Mean Daytime Cloud AMT, FQ, AWP,  MAR      162
   70       11    70001-11   Monthly-Mean Daytime Cloud AMT, FQ, AWP,  APR      162
   71       11    71001-11   Monthly-Mean Daytime Cloud AMT, FQ, AWP,  MAY      162
   72       11    72001-11   Monthly-Mean Daytime Cloud AMT, FQ, AWP,  JUN      162
   73       11    73001-11   Monthly-Mean Daytime Cloud AMT, FQ, AWP,  JUL      162
   74       11    74001-11   Monthly-Mean Daytime Cloud AMT, FQ, AWP,  AUG      162
   75       11    75001-11   Monthly-Mean Daytime Cloud AMT, FQ, AWP,  SEP      162
   76       11    76001-11   Monthly-Mean Daytime Cloud AMT, FQ, AWP,  OCT      162
   77       11    77001-11   Monthly-Mean Daytime Cloud AMT, FQ, AWP,  NOV      162
   78       11    78001-11   Monthly-Mean Daytime Cloud AMT, FQ, AWP,  DEC      162

COMBINED SEASONAL-MEAN AVERAGES
                  each SEASON: 10 TYPES, 5388 Stations, 39 Yrs (SMCAC)
   79       10    79001-10   Seasonal-Mean CLOUD AMOUNT,  DJF                  128
   80       10    80001-10   Seasonal-Mean CLOUD AMOUNT,  MAM                  128
   81       10    81001-10   Seasonal-Mean CLOUD AMOUNT,  JJA                  128
   82       10    82001-10   Seasonal-Mean CLOUD AMOUNT,  SON                  128

                  each SEASON: 10 types, 5388 STATIONS, 39 YRS (SMCFC)
   83       10    83001-10   Seasonal-Mean CLOUD FREQUENCY,  DJF               128
   84       10    84001-10   Seasonal-Mean CLOUD FREQUENCY,  MAM               128
   85       10    85001-10   Seasonal-Mean CLOUD FREQUENCY,  JJA               128
   86       10    86001-10   Seasonal-Mean CLOUD FREQUENCY,  SON               128

                  each SEASON: 4 types, 5388 STATIONS, 39 YRS (SMUUC)
   87        4    87001-4    Seasonal-Mean NOL Upper Clouds,  DJF              129
   88        4    88001-4    Seasonal-Mean NOL Upper Clouds,  MAM              129
   89        4    89001-4    Seasonal-Mean NOL Upper Clouds,  JJA              129
   90        4    90001-4    Seasonal-Mean NOL Upper Clouds,  SON              129
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Table 6u. Description of the updated data formats

Format number	Variables & Format	(Num of characters in record)	Files in which used
126	13(I5 I7 F7.2 I7 F7.2 I7 F7.2 I2) Staid NobD AvgDy NobN AvgNt NobDN AvgDN Acode	(26x49)	F55-62
127	13(I5 I7 F7.0 I7 F7.0 I7 F7.0 I2)		F63-66
128	39(I5 I5 I7 F7.2 I7 F7.2 I7 F7.2 I2) Staid Yr NobD AvgDy NobN AvgNt NobDN AvgDN Acode	(26x54)	F79-86
129	39(I5 I5 I7 F7.0 I7 F7.0 I7 F7.0 I2)	(26x54)	F87-90
162	13 OR 39(I5 I5 I4 F7.2 F7.2 F7.2 I4) Staid Yr Nobs Amt Fq AWP NC	(13x39)/ (39x39)	F67-78