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CLOUD INFORMATION FOR FIRE FROM SURFACE WEATHER REPORTS

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We have analyzed surface weather observations of clouds to obtain a global cloud climatology (Warren et al, 1986; 1988). The form of the synoptic weather code limits the types of cloud information which are available from these reports. Comparison of surface weather reports with instrumental observations during the FIRE field experiments can help to clarify the operational definitions which we have had to make in our climatology because of the nature of the synoptic code. The long-term climatology from surface weather observations can also be useful background for planning the location and timing of intensive field experiments.

1. Wisconsin cirrus experiment

As shown in Figure 2 of Warren et al (1985), cirrus occurs alone more often over the continents than over the ocean, and more often in winter than in summer. It was therefore appropriate to plan the field experiment for autumn in Wisconsin, and cases of cirrus-alone were indeed encountered.

Comparison of surface weather observations with the observations from aircraft and lidar may be used to estimate the minimum optical thickness that ground observers can detect. We collected the observations from surface observing stations made during the intensive field program October–November 1986. There are four stations in the area, but only two (Madison and Green Bay) include cloud type information in their weather reports. The observations are listed in Table 1 and summarized in Tables 2 and 3.

Based on the reports in which the presence or absence of cirrus could be ascertained, the frequency of occurrence of cirrus during the field experiment was 42% at Madison and 37% at Green Bay. Table 2 shows that cirrus was reported to be present alone in the weather observations from 22 October, 27-28 October, 31 October, and 1-3 November (after converting from GMT to local time), both at Madison and Green Bay. These are the same days that were chosen for intensive case-studies of cirrus in the field experiment. Three of these four cases were immediately preceded by reports of "clear sky". When the quantitative lidar results become available, we will therefore be able to determine at what optical thickness the cirrus was first detectable by the weather observers, as the cloud thickened from subvisible to visible.

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Table 1. Cloud reports for Madison (station number 72641) and Green Bay
(72645), 13 October - 3 November 1986. Symbols are defined in Table 4.

YR	MN	DY	HRZ	STA	WW	N	NH	CL	CM	CH
86	10	13	6	72641	**	8	8	8	*	*
86	10	13	6	72645	**	8	8	5	*	*
86	10	13	12	72641	2	8	8	5	*	*
86	10	13	12	72645	**	8	8	5	*	*
86	10	13	18	72641	**	8	8	5	*	*
86	10	13	18	72645	**	8	8	5	*	*
86	10	14	0	72641	61	8	8	5	*	*
86	10	14	0	72645	80	8	8	5	*	*
86	10	14	6	72641	1	8	5	5	5	*
86.	10	14	6	72645	25	8	8	5	*	*
86	10	14	12	72641	51	8	6	7	*	*
86	10	14	12	72645	61	8	8	7	*	*
86	10	14	18	72641	71	8	8	.5	*	*
86	10	14	18	72645	68	8	8	7	*	*
86	10	15	0	72641	1	7	5	5	0	8
86	10	15	0	72645	2	8	3	5	3	1
86	10	15	6	72641	**	1	1	0	5	0
86	10	15	6	72645	1	2	2	5	0	0
86	10	15	12	72641	**	0	*	*	*	*
86	10	15	12	72645	**	0	*	*	*	*
86	10	15	18	72641	**	1	1	1	0	0
86	10	15	18	72645	**	6	6	5	0	0
86	10	16	0	72641	**	0	*	*	*	*
86	10	16	0	72645	**	8	2	0	7	1
86	10	16	6	72641	**	8	2	0	5	7
86	10	16	6	72645	**	8	5	0	7	7
86	10	16	12	72641	**	8	8	0	5	*
86	10	16	12	72645	21	8	8	5	*	*
86	10	16	18	72641	**	1	1	5	0	0
86	10	16	18	72645	**	8	8	5	*	*
86	10	17	0	72641	**	8	8	6	*	*
86	10	17	0	72645	**	8	8	5	*	*
86	10	17	6	72641	**	8	8	6	*	*
86	10	17	6	72645	**	8	0	5	*	*
86	10	17	12	72641	**	8	5	5	*	*
86	10	17	12	72645	**	8	8	5	*	*
86	10	17	18	72641	**	6	6	5	0	0
86	10	17	18	72645	**	8	8	5	*	*
86	10	18	0	72641	**	2	2	5	0	0
86	10	18	0	72645	**	2	2	5	0	0
86	10	18	6	72641	**	0	*	*	*	*
86	10	18	6	72645	**	0	*	*	*	*
86	10	18	12	72641	**	6	6	5	0	0
86	10	18	12	72645	**	5	5	5	0	0
86	10	18	18	72641	**	4	4	5	0	0
86	10	18	18	72645	**	7	7	5	0	0
86	10	19	0	72641	**	0	*	*	*	*
86	10	19	0	72645	**	0	*	*	*	*
86	10	19	6	72641	**	0	*	*	*	*
86	10	19	6	72645	**	0	*	*	*	*
86	10	19	12	72641	48	0	*	*	*	*
86	10	19	12	72645	11	0	*	*	*	*
86	10	19	18	72641	2	0	*	*	*	*
86	10	19	18	72645	2	0	*	*	*	*
86	10	20	0	72641	**	0	*	*	*	*
86	10	20	0	72645	**	0	*	*	*	*
86	10	20	6	72641	10	0	*	*	*	*
86	10	20	6	72645	44	0	*	*	*	*
86	10	20	12	72641	**	6	3	5	7	0
86	10	20	12	72645	42	3	3	0	3	0
86	10	20	18	72641	**	0	*	*	*	*
86	10	20	18	72645	5	3	2	1	0	1
86	10	21	0	72641	**	3	1	0	5	1
86	10	21	0	72645	5	3	3	4	6	0
86	10	21	6	72641	**	0	*	*	*	*
86	10	21	6	72645	10	0	*	*	*	*
86	10	21	12	72641	11	1	1	5	0	0
86	10	21	12	72645	44	0	*	*	*	*
86	10	21	18	72641	5	0	*	*	*	*
86	10	21	18	72645	42	0	*	*	*	*
86	10	22	0	72641	**	0	*	*	*	*
86	10	22	0	72645	5	5	*	*	*	*
86	10	22	6	72641	**	0	*	*	*	*
86	10	22	6	72645	**	0	*	*	*	*
86	10	22	12	72641	10	6	0	0	0	6
86	10	22	12	72645	**	6	0	0	0	1
86	10	22	18	72645	**	8	6	0	1	7
86	10	23	0	72641	61	8	3	5	5	*
86	10	23	0	72645	5	8	8	0	2	*
86	10	23	6	72641	21	8	8	5	*	*
86	10	23	6	72645	**	8	8	0	2	*
86	10	23	12	72641	10	8	8	5	*	*
86	10	23	12	72645	46	8	8	5	*	*
86	10	23	18	72641	20	8	8	7	*	*
86	10	23	18	72645	**	8	8	6	*	*
86	10	24	0	72641	**	8	8	5	*	*
86	10	24	0	72645	**	8	8	5	*	*
86	10	24	6	72641	10	8	8	6	*	*
86	10	24	6	72645	**	7	6	5	7	0
86	10	24	12	72641	**	8	8	6	*	*
86	10	24	12	72645	**	8	8	5	*	*
86	10	24	18	72641	10	8	8	6	*	*
86	10	24	18	72645	**	8	2	5	0	7
86	10	25	0	72641	**	8	8	6	*	*
86	10	25	0	72645	**	8	8	5	*	*
86	10	25	6	72641	61	8	8	7	*	*
86	10	25	6	72645	**	8	8	5	*	*
86	10	25	12	72641	10	8	5	6	7	*
86	10	25	12	72645	**	6	6	5	0	0
86	10	25	18	72641	2	8	8	5	*	*
86	10	25	18	72645	**	8	8	5	*	*
86	10	26	0	72641	61	8	8	7	*	*
86	10	26	0	72645	**	8	8	5	7	*
86	10	26	6	72641	61	8	8	7	*	*
86	10	26	6	72645	**	8	8	5	*	*
86	10	26	12	72641	61	8	8	7	*	*
86	10	26	12	72645	51	8	8	7	*	*
86	10	26	18	72641	60	8	8	7	*	*
86	10	26	18	72645	51	8	8	7	*	*
86	10	27	0	72641	51	8	8	7	*	*
86	10	27	0	72645	10	8	8	6	*	*
86	10	27	6	72641	10	8	8	6	*	*
86	10	27	6	72645	42	8	8	6	*	*
86	10	27	12	72641	10	1	1	5	0	0
86	10	27	12	72645	10	7	7	5	0	0
86	10	27	18	72641	**	1	1	1	0	0
86	10	27	18	72645	5	2	2	1	0	0
86	10	28	0	72641	**	3	0	0	0	1
86	10	28	0	72645	**	2	0	0	0	1
86	10	28	6	72641	**	0	*	*	*	*
86	10	28	6	72645	**	0	*	*	*	*
86	10	28	12	72641	**	1	0	0	0	1
86	10	28	12	72645	10	0	*	*	*	*
86	10	28	18	72641	**	8	0	0	0	7
86	10	28	18	72645	**	8	0	0	0	7
86	10	29	0	72641	**	8	0	0	0	7
86	10	29	0	72645	**	6	0	0	0	8
86	10	29	6	72641	**	2	0	0	0	8
86	10	29	6	72645	**	4	1	0	7	8
86	10	29	12	72641	**	8	8	5	*	*
86	10	29	12	72645	**	8	8	5	*	*
86	10	29	18	72641	**	8	8	5	*	*
86	10	29	18	72645	**	3	3	5	0	0
86	10	30	0	72641	**	0	*	*	*	*
86	10	30	0	72645	**	0	*	*	*	*
86	10	30	6	72641	**	0	*	*	*	*
86	10	30	6	72645	**	4	4	0	3	0
86	10	30	12	72641	**	0	*	*	*	*
86	10	30	12	72645	**	7	7	5	0	0
86	10	30	18	72641	**	1	1	1	0	0
86	10	30	18	72645	**	7	7	5	0	0
86	10	31	0	72641	**	2	0	0	0	1
86	10	31	0	72645	**	3	3	5	0	0
86	10	31	6	72641	**	8	0	0	0	7
86	10	31	6	72645	**	6	0	0	0	6
86	10	31	12	72641	**	2	0	0	0	8
86	10	31	12	72645	**	7	3	0	7	8
86	10	31	18	72641	**	8	3	5	0	7
86	10	31	18	72645	**	8	3	5	7	7
86	11	1	0	72641	**	8	8	5	*	*
86	11	1	0	72645	**	8	8	5	*	*
86	11	1	6	72641	61	8	8	7	*	*
86	11	1	6	72645	61	8	8	7	*	*
86	11	1	12	72641	2	8	8	6	*	*
86	11	1	12	72645	1	8	8	5	*	*
86	11	1	18	72641	**	8	1	5	5	*
86	11	1	18	72645	**	3	2	1	0	1
86	11	2	0	72641	**	7	5	0	7	7
86	11	2	0	72645	**	8	8	0	1	*
86	11	2	6	72641	**	3	0	0	0	2
86	11	2	6	72645	**	2	0	0	0	7
86	11	2	12	72641	**	2	0	0	0	5
86	11	2	12	72645	**	0	*	*	*	*
86	11	2	18	72641	**	1	0	0	0	2
86	11	2	18	72645	**	0	*	*	*	*
86	11	3	0	72641	**	6	0	0	0	6
86	11	3	0	72645	**	7	0	0	0	8
86	11	3	6	72641	**	8	0	0	2	*
86	11	3	6	72645	**	8	0	0	0	7
86	11	3	12	72641	**	8	0	0	0	7
86	11	3	12	72645	**	8	8	5	*	*
86	11	3	18	72641	**	8	1	0	5	7
86	11	3	18	72645	**	8	6	0	3	2
86	11	4	0	72641	**	8	8	5	*	*
86	11	4	0	72645	**	3	8	5	*	*

Table 2. Analysis of cloud observations for cirrus at Madison and Green Bay, 13 October – 3 November 1986. Symbols are defined in Table 4.

	MADISON				GREEN BAY			
YRMNDYHRZ	N	CH	A	CH=0 N/O	N	CH	A	CH=0 N/O
86101306	8	*			8	*		
86101312	8	*			8	*		
86101318	8	*			8	*		
86101400	8	*			8	*		
86101406	8	*			8	*		
86101412	8	*			8	*		
86101418	8	*			8	*		
86101500	7	8			8	1		
86101506	1			Y	2			Y
86101512	0				0			
86101518	1			Y	6			Y
86101600	0				8	1		
86101606	8	7			8	7		
86101612	8	*			8	*		
86101618	1			Y	8	*		
86101700	8	*			8	*		
86101706	8	*			8	*		
86101712	8	*			8	*		
86101718	6			Y	8	*		
86101800	2			Y	2			Y
86101806	0				0			
86101812	6			Y	5			Y
86101818	4			Y	7			Y
86101900	0				0			
86101906	0				0			
86101912	0				0			
86101918	0				0			
86102000	0				0			
86102006	0				0			
86102012	6			Y	3			Y
86102018	0				3	1		
86102100	3	1			3			Y
86102106	0				0			
86102112	1			Y	0			
86102118	0				0			
86102200	0				5	*		
86102206	0				0			
86102212	6	6	A		6	1	A	
86102218	*				8	7		
86102300	8	*			8	*		
86102306	8	*			8	*		
86102312	8	*			8	*		
86102318	8	*			8	*		
86102400	8	*			8	*		

	MADISON				GREEN BAY			
YRMNDYHRZ	N	CH	A	CH=0 N/O	N	CH	A	CH=0 N/O
86102406	8	*			7			Y
86102412	8	*			8	*		
86102418	8	*			8	7		
86102500	8	*			8	*		
86102506	8	*			8	*		
86102512	8	*			6			Y
86102518	8	*			8	*		
86102600	8	*			8	*		
86102606	8	*			8	*		
86102612	8	*			8	*		
86102618	8	*			8	*		
86102700	8	*			8	*		
86102706	8	*			8	*		
86102712	1			Y	7			Y
86102718	1			Y	2			Y
86102800	3	1	A		2	1	A	
86102806	0				0			
86102812	1	1	A		0			
86102818	8	7	A		8	7	A	
86102900	8	7	A		6	8	A	
86102906	2	8	A		4	8		
86102912	8	*			8	*		
86102918	8	*			3			Y
86103000	0				0			
86103006	0				4			Y
86103012	0				7			Y
86103018	1	1			7			Y
86103100	2	1	A		3			Y
86103106	8	7	A		6	6	A	
86103112	2	8	A		7	8		
86103118	8	7			8	7		
86110100	8	*			8	*		
86110106	8	*			8	*		
86110112	8	*			8	*		
86110118	8	*			3	1		
86110200	7	7			8	*		
86110206	3	2	A		2	7	A	
86110212	2	5	A		0			
86110218	1	2	A		0			
86110300	6	6	A		7	8	A	
86110306	8	*			8	7	A	
86110312	8	7	A		8	*		
86110318	8	7			8	2		
86110400	8	*			3	*		

Table 3. Summary of cirrus reports for Madison and Green Bay, 13 October–3 November 1986. Symbols are defined in Table 4.

	Number of reports	
	Madison	Green Bay
Total	87	88
N = 0	18	17
CH = *	37	36
Cirrus present	21	19
Cirrus alone	14	8
Cirrus absent, other clouds present	11	16

2. San Nicolas Island stratocumulus experiment

Our proposed contribution to this experiment was in support of the long-term monitoring study by remote-sensing instruments located on San Nicolas Island (SNI), which was begun during the intensive field program but continuing after it. Our proposed work was to evaluate the extent to which the island could influence the cloud patterns directly above, with the possibility that the measurements might not be representative of the surrounding ocean.

We acquired ship observations for the area from the California coast to the open ocean beyond SNI and analyzed them. We also obtained the weather observations from the station at the airport on the island. This station stopped making routine reports in 1986. Unfortunately, the island observations were made only in the Airways Code, whereas the ship reports were made only in the Synoptic Code. This precluded a comparison of the island station with the ships for cloud types, but a comparison of total cloud cover was possible.

This particular analysis turned out not to be useful because the site of the remote-sensing instruments, on the windward (northwest) tip of the island, experiences cloud conditions very similar to the ocean upwind and quite different from the airport (S. Cox, personal communication).

Ship observations show a strong increase in annual average cloud cover from land to ocean. The gradient is largest along the coast but is still evident out to 130°W (as much as 1000 km off shore). SNI is approximately 100 km from the shore and the gradients in this region can be locally quite large. Figure 1 shows an analysis of only a restricted set of these observations: the cloud reports from ships and land stations made during the time of the intensive field study.

References

Warren, S.G., C.J. Hahn, J. London, R.M. Chervin and R.L. Jenne, 1986: Global Distribution of Total Cloud Cover and Cloud Type Amounts Over Land. NCAR Technical Note TN-273+STR, 29 pp + 200 maps.

Warren, S.G., C.J. Hahn, J. London, R.M. Chervin and R.L. Jenne, 1988: Global Distribution of Total Cloud Cover and Cloud Type Amounts over the Ocean. NCAR Technical Note in preparation.

Warren, S.G., C.J. Hahn and J. London, 1985: Simultaneous occurrence of different cloud types. J. Clim. Appl. Meteor., 24, 658-667.

Table 4. Symbols used in the tables

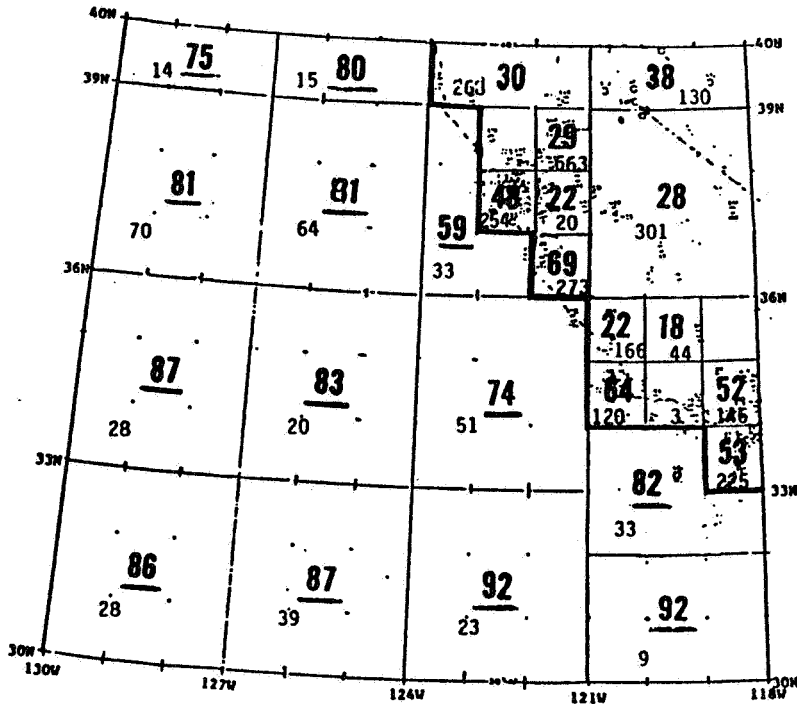|			
A	cirrus present alone	N	total cloud cover code
CH	high cloud type code	NH	low or middle cloud amount code
CL	low cloud type code	STA	station identification code
CM	middle cloud type code	WLON	west longitude
DY	day	WW	present weather code
HRZ	hour GMT	Y	cirrus absent but other clouds present
LAT	latitude	YR	year
MN	month	*	not reported

Figure 1a. Average total cloud cover for FIRE study area, 29 June - 20 July 1987. Bold face numbers in center of boxes are total cloud cover, numbers in smaller type are number of observations. The analysis was done for 1°x1° or 3°x3° grid boxes. The heavy line separates boxes with land-data pre-dominating from boxes with ship data predominating.
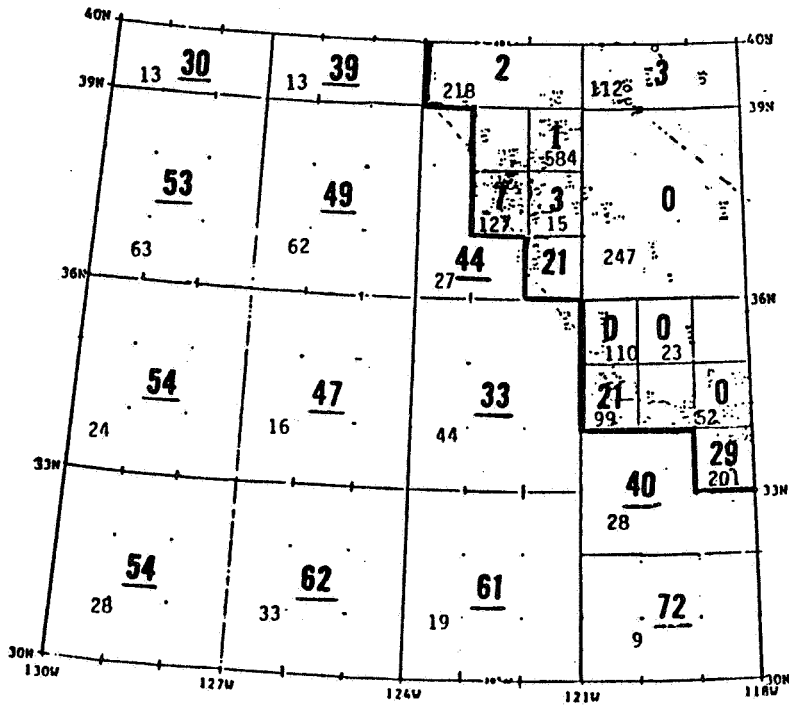
Figure 1b. Average amount of stratocumulus for FIRE study area, 29 June - 20 July 1987.