



Wind Movement

Wind movement was measured at various agroclimate stations for various periods of time. Those stations equipped with anemometers for measuring wind movement are noted in Table 1. The relatively high cost of anemometers limited the number of sites where wind movement was measured.

A recording anemometer was installed and operated at the Arvin-Frick site from 1960 to 1965. That same instrument was moved to the Old River 3-S station in the fall of 1965 and operated there until January 1968.

The anemometer was mounted with the cups 2 meters above ground. That small electrical-contact-type anemometer was a component of the California Spot Climate Recorder. Wind movement was continuously recorded on a circular chart with one "pip" for each 3 miles of wind.

From March to September 1965, a USWB-type, 3-cup totalizing anemometer was also operated at the Arvin-Frick station. The anemometer cups were at 0.5 meter above ground.

Wind movement measured at 2-meter height near Bakersfield is presented in Table 44. Wind was also measured for 33 months at 0.5 meter at the two master station locations near Bakersfield. Those data are listed in Table 45.

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*U.S. Weather
Bureau type
3-cup Anemometer.
Several outlying
agroclimate
stations were
equipped with
these
instruments.*

TABLE 44

Monthly Wind Movement at Various Locations Near Bakersfield 1960-1991¹
(miles per month measured at 2 meters above ground)

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
1960	2,208	1,977	2,045	2,396	2,701	1,891	1,667	1,635	1,392	1,497	1,545	1,463	22,417
1961	1,595	1,961	2,382	2,483	2,804	2,132	1,733	1,614	1,623	1,527	1,746	1,542	23,142
1962	1,848	2,245	2,720	2,554	2,882	2,539	1,872	1,474	1,305	1,470	1,202	1,398	23,509
1963	1,841	1,769	3,070	2,828	2,772	2,540	1,723	1,318	1,078	1,046	1,066	1,318	22,369
1964	1,576	1,946	2,477	2,458	2,766	2,589	1,577	1,410	1,352	1,229	1,324	1,835	22,539
1965	1,696	1,802	2,552	2,252	2,660	2,423	2,119	1,745	1,577		1,710	1,230	
1966	1,913	2,035	1,871	1,739	2,071	2,030	1,953	1,670	1,838	1,451	1,226	1,290	21,087
1967	1,605	1,270	2,458	2,135	2,202	2,376	1,687	1,520	1,879	1,911	1,307	1,600	21,950
1970		1,744	2,012	2,235	2,416	2,389							
1975			3,944	3,041	3,030	2,792	2,183	1,973	1,825	2,198	1,799	1,622	28,802
1976	795	2,366	2,712	2,911	2,600	2,264	1,815	2,327	1,876	1,492	1,266	1,314	23,738
1977	1,780	2,089	2,809	2,722	2,865	2,230	1,561	1,660	1,780	1,290	1,304	2,367	24,457
1978	1,838	1,999	1,865	2,264	2,598	2,132	1,505	1,621	1,620	1,285	1,279	1,585	21,591
1979	2,110	1,826	2,006	2,535	2,715	1,827	1,756	1,825	1,468	1,581	1,242	1,458	22,349
1980	1,786	2,011	2,495	2,239	2,898	2,014	1,534	1,472	1,161	1,269	1,086	1,155	21,120
1981	3,890	3,533	3,344	2,305	3,094	3,470	2,812	2,599	2,469	2,624	2,390	2,170	34,700
1982	2,634	1,991	2,621	2,420	2,938	2,412	2,047	2,107	2,091	1,991	1,836	2,073	27,161
1983	2,604	2,926	2,935	3,895	3,450	3,004	2,842	2,496	2,272	2,413	2,295	2,258	33,390
1984	2,244	2,645	3,134	3,550	3,013	3,113	2,822	2,428	2,000	1,939	2,106	2,326	31,320
1985	1,896	1,891	2,698	2,850	2,781	2,540	2,239	2,265	2,165	2,149	1,828	1,594	26,896
1986	1,988	2,047	2,203	2,785	2,761	2,615	2,778	2,210	2,251	1,956	1,844	1,906	27,344
1987	2,419	2,248	2,886	2,737	2,601	2,467	2,309	2,210	1,905	1,878	1,653	2,816	28,129
1988	2,161	2,159	2,413	2,497	2,780	2,754	2,409	2,228	2,025	1,676	1,663	2,159	26,924
1989	1,811	2,284	2,590	2,478	2,477	2,465	2,314	2,441	2,216	2,454	1,737	1,664	26,931
1990	1,992	1,955	2,374	2,380	2,757	2,542	2,568	2,524	2,053	2,022			26,754
Average	2,130	2,265	2,689	2,726	2,835	2,540	2,218	2,149	1,949	1,889	1,689	1,898	26,975
Std. Dev.	631	442	495	446	231	409	462	335	320	414	381	444	3,759
Std. Error	131	91	99	89	48	82	99	69	70	88	79	93	783
1986				1,962	2,073	1,744	1,530	1,336	1,559	1,167	1,001	1,224	17,550
1987	1,459	1,769	2,634	1,794	2,217	1,694	2,135	1,405	1,235	598	719	1,547	19,206
1988	636	1,613	949	1,175	979	1,730	1,213	1,142	973	871	1,004	1,519	13,804
1989	1,181	1,254	1,693	1,337	1,382	1,301	1,068	953	847	1,103	550	557	13,226
1990	789	874	1,100	1,246	1,463	1,096	943	949	1,776	707	597	568	12,108
1991	673	747	2,400	1,618	2,002	1,401	1,275	1,196	848	717	751	1,494	15,122
Average	948	1,251	1,755	1,522	1,686	1,494	1,361	1,164	1,206	861	770	1,152	15,169
Std. Dev.	321	399	674	291	442	246	391	173	356	211	178	430	2,483
Std. Error	143	177	300	119	180	100	160	71	149	88	73	180	1,013
1990	1,400	1,706	1,816	1,985	2,485	2,227	1,964	1,847	1,670	1,642	1,386	1,380	21,508
1991	1,390	1,650	2,652	2,005	2,718	2,081	1,888	1,915	1,474	1,496	1,481	1,841	22,591
Average	1,395	1,678	2,234	1,995	2,602	2,154	1,926	1,881	1,572	1,569	1,434	1,610	22,050
All Years													
Average	1,792	1,986	2,434	2,381	2,561	2,294	1,954	1,817	1,702	1,598	1,440	1,626	23,584
Std. Dev.	643	482	599	573	507	487	493	463	402	498	446	487	5,522
Std. Error	119	88	109	101	90	86	88	83	72	91	81	89	1,023

¹ Stations: Arvin-Frick 1/60-9/65; Old River 3-S 11/65-12/67; Bakersfield 10-S 2/70-6/70; Wasco 8-SW 3/75-12/80; Bakersfield 10-NW 1/81-10/90; Bakersfield 12-S 4/86-12/91; Lamont 2-NW 1/90-12/91.

TABLE 45

Monthly Wind Movement at Two Agroclimate Stations Near Bakersfield 1965-1967
(miles per month measured at 0.5 meter above ground)

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
1965 ¹			876	568	1,288	1,318	1,217	1,147	1,075				
1965 ²											812	783	
1966 ²	899	788	656	531	817	735	618	436	716	419	387	712	7,714
1967 ²	1,005	870	1,554	1,410	1,441	1,390	1,001	789	874	658	834	733	12,559
Average	952	829	1,029	836	1,182	1,148	945	791	888	538	678	743	10,559

¹ Arvin-Frick.

² Old River 3-S.

TABLE 46

Monthly Wind Movement at Fresno State/DWR Agroclimate Station 1973-1991
(miles per month measured at 2 meters above ground)

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
1973	1,860	1,935	3,102	2,696	2,960	3,113	2,902	2,862	2,460	1,833	1,963	2,141	29,827
1974	2,481	2,036	2,639	2,758	3,738	3,327	3,036	2,224	2,231	1,320	1,288	1,360	28,438
1975	1,724	1,861	3,181	3,146	3,471	3,349	2,867	2,353	1,904	2,327	1,727	1,210	29,120
1976	1,041	1,915	3,143	3,609	3,875	2,777	3,768	3,374	2,019	1,054	777	536	27,888
1977	1,399	1,823	2,826	2,891	2,163	3,071	2,896	2,587	1,914	1,097	1,072	1,664	25,403
1978	1,855	1,823	2,014	2,150	3,255	3,644	2,597	2,795	1,908	988	992	890	24,911
1979	1,559	1,274	1,730	2,339	2,865	2,955	2,954	2,879	2,179	2,113	1,410	1,448	25,705
1980	2,020	1,950	2,870	3,710	4,553	2,670	3,321	3,018	3,282	2,975	1,359	2,121	33,849
1981	2,320	2,223	3,295	2,870	4,609	4,615	3,004	2,615	2,739	2,287	2,030	1,889	34,496
1982	2,400	1,869	2,885	2,973	3,923	3,808	3,452	2,789	2,322	2,211	1,960	1,963	32,555
1983	2,130	2,583	3,027	3,145	3,693	3,604	3,512	2,664	2,006	1,868	2,104	2,407	32,743
1984	1,670	2,181	2,831	3,451	4,343	3,653	3,355	3,875	3,085	2,290	3,043	2,377	36,154
1985	1,676	1,613	2,895	3,077	5,009	3,109	3,073	2,741	2,415	2,181	2,019	1,892	31,700
1986	1,758	2,443	3,462	3,205	3,646	3,434	2,709	2,538	2,369	1,723	1,118	1,731	30,136
1987	2,091	2,216	2,744	2,859	3,446	3,670	3,525	2,398	1,829	1,149	1,239	2,018	29,184
1988	1,780	1,211	3,082	2,610	3,378	3,462	2,805	2,373	1,924	1,499	1,490	1,710	27,324
1989	583	1,598	2,391	2,608	3,266	3,423	3,319	1,855	2,071	1,702	1,049	1,126	24,991
1990	1,718	2,390	2,308	2,858	-	-	-	-	-	-	-	-	-
1991	-	1,310	2,794	1,522	3,632	2,954	2,094	2,367	1,425	1,617	1,383	1,454	-
Average	1,781	1,908	2,801	2,867	3,657	3,369	3,066	2,684	2,227	1,791	1,557	1,663	29,371
Std. Dev.	451	378	423	498	665	439	390	436	444	530	537	493	3,379
Std. Error	106	87	97	114	156	103	92	103	104	125	126	116	795

TABLE 47

Monthly Wind Movement at Fresno State/DWR Agroclimate Station 1972-1988
(miles per month measured at 0.5 meter above ground)

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
1972	782	830	1,153	1,938	1,944	1,387	863	1,132	739	702	1,027	1,002	13,499
1973	1,172	970	1,135	1,082	967	1,273	1,169	842	808	655	849	712	11,634
1974	1,266	1,547	1,036	942	947	1,167	841	448	499	436	628	784	10,541
1975	1,062	1,140	1,600	1,536	1,090	1,258	1,304	796	424	1,041	834	597	12,682
1976	470	987	1,168	1,879	2,082	1,827	1,359	1,469	844	371	360	313	13,129
1977	848	994	1,488	1,348	1,131	975	1,066	1,175	894	622	530	1,056	12,127
1978	957	1,046	634	751	1,338	1,466	1,059	1,108	856	478	597	628	10,918
1979	1,215	898	916	2,579	1,049	1,242	1,355	1,296	754	913	665	703	13,585
1980	1,017	1,119	1,477	979	1,481	1,885	1,245	1,134	966	780	540	788	13,411
1981	929	736	984	1,130	2,082	2,504	1,758	1,233	1,137	982	877	788	15,140
1982	1,214	940	1,377	1,426	1,903	1,867	1,692	1,367	1,138	1,084	1,117	1,161	16,286
1983	1,187	1,430	1,131	1,542	2,082	2,505	2,013	1,307	716	723	1,138	1,146	16,920
1984	293	569	1,639	1,806	2,062	1,391	888	1,205	1,234	955	1,067	1,067	14,176
1985	590	710	1,281	1,492	1,936	1,396	1,686	870	962	960	1,051	653	13,587
1986	783	1,099	847	1,527	1,570	1,392	608	931	1,172	726	508	451	11,614
1987	569	1,052	1,240	1,173	1,542	1,743	1,136	515	822	578	496	875	11,741
1988	972	474	1,199	766	1,057	1,510	1,059	1,625	553	431	459		10,900 ¹
Average	902	973	1,194	1,406	1,545	1,576	1,241	1,085	854	732	750	795	13,053
Std. Dev.	279	263	262	459	432	419	363	307	227	222	253	237	1,786
Std. Error	68	64	64	112	105	102	88	75	55	54	62	59	436

¹ Includes estimate for December.

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Similarly, monthly wind movement measured at 2-meter height at the Fresno State/DWR station is listed in Table 46. Wind measured at 0.5 meter at Fresno State/DWR is shown in Table 47.

In late 1964, six additional USWB-type, 3-cup totalizing anemometers were obtained in addition to the one installed at

0.5 meter at the Arvin-Frick location. The other six were installed at selected outlying agroclimate stations (see Table 1). Those instruments were also mounted with the cups at 0.5 meter height. Measured total monthly wind movement for those outlying agroclimate stations is listed in Table 48.

TABLE 48

**Monthly Wind Movement at Several Agroclimate Stations
in the San Joaquin Valley 1965-1968
(miles per month measured at 0.5 meter above ground)**

Station	Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
Buttonwillow 1-S	1965						932	746	402	652	594	809	1,004	
	1966	1,062	1,116	1,077	1,058	1,019								
Maze Bridge 2-SS	1965	1,615	2,025	1,964	2,172	2,987	2,083							
Merced 5-SE #2	1965	1,359	1,349	1,880	2,401	2,410	2,354	982	1,737	1,913	1,547	1,613	1,399	20,944
	1966	1,458	1,677	1,876	1,685	1,680	1,932	1,891	922	1,505	1,221	1,380	1,240	18,467
	1967	607	915	1,178	1,461	1,039	1,128	1,026	600	665	949	722	1,269	11,559
	1968	1,312	954	1,678	1,770	2,481	2,589	1,528						
Newman 1-SE	1965	1,320	2,047	1,897	2,266	2,456								
Pond 1-N	1965	1,206	1,274	1,786	1,913	2,018	1,831	1,217	880	887	669	1,104	1,028	15,813
Traver 4-ESE	1965	984	928	1,246	1,242	1,475	1,526	1,082	1,004	835	512	944	835	12,613
Average	All	1,214	1,365	1,620	1,774	1,952	1,797	1,210	924	1,076	915	1,095	1,129	16,071

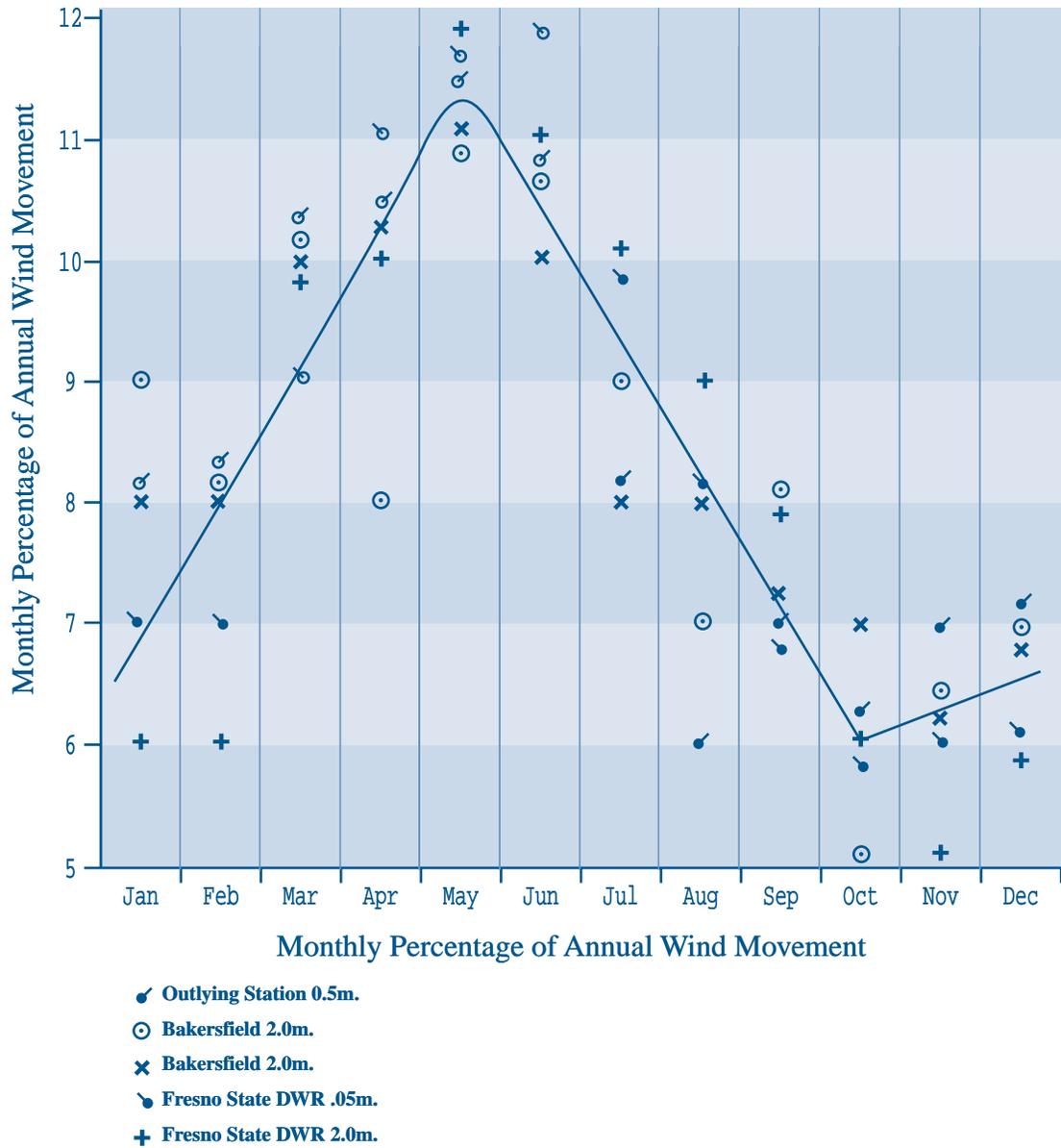
STANDARDIZATION OF ANEMOMETERS

Unlike the other instruments operated at the agroclimate stations, there was no objective method for evaluating the accuracy of wind data collected with the anemometers.

Instrument calibration in wind tunnels was investigated and found to be so costly that it could not be considered. In lieu of an objective calibration standardization method, the anemometers were cleaned, oiled, and checked frequently to assure the cups and vertical shaft were rotating freely.

FIGURE 34

Monthly Pattern of Wind Movement Measured at Various Heights for Various Periods at Several Agroclimate Stations



Note: Percentage of annual wind movement for each month.
Average for 6 stations; monthly averages from tables 44- 48.

GENERAL WIND PATTERNS

Examination of monthly wind movement data indicates two general patterns:

1. Wind movement at 2-meter height is about twice that at 0.5-meter height.

At Arvin-Frick and Old River 3-S, there were 33 months of common record for the two anemometer heights. The ratio of wind at 2 meters divided by wind at 0.5 meter averaged 2.04.

For 16 years of record (1973 to 1988) at the Fresno State/DWR station, the ratio of wind movement at 2 meters to that at 0.5 meter averaged 2.32.

2. The monthly pattern of wind was remarkably similar for all locations and for both 2-meter and 0.5-meter heights. Although the measured annual total wind movement spanned nearly a threefold range, the monthly percentages of annual totals were similar for all locations and for the two heights (see Figure 34).