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WIND AND CLOUDS ON MAUNA KEA

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Regarding wind-induced pointing errors with open door, I mentioned in Memo 111 (Nov. 17, 1978) that a positive correlation between wind velocity and cloudiness would relax the problem. For an investigation we would need a whole year of data, preferably at night.

Mark Gordon got and sent me the Reports of the British Royal Observatory. They give many data for every hour of the night, also averages for each night and for each month. In Table 1, I have collected a short summary of some monthly data.

The most striking feature in these Reports is the fact that the wind blows mostly from the same direction, East; occasionally West and very little else, see Fig. 1. This directionality does not depend on the wind velocity nor on the time of the year. It is a fairly general, constant feature.

Regarding shielding and symmetry, it seems that the open-door pointing errors can be greatly reduced if the observer does his schedule such that he avoids SE pointings as much as possible, and makes SW and W pointings the preferred directions. For most observations he has this choice; except for VLBI observations, but there the pointing errors are less critical.

As to wind velocity and cloudiness, we see immediately from Table 1 that there is not much correlation between velocity and cloudiness or precipitation. In order to obtain a more detailed picture, I selected a whole year of the data, as indicated in Table 1. During this year, observations are available

for 344 nights. I divided them into two groups: 144 nights where no obscuration at all was seen all night above 30° elevation, and the remaining 200 nights where at least some obscuration had occurred some time. For each of the two groups, I counted the night-average wind velocities v in six bins. Figure 2 shows the resulting cumulative distribution $F(v)$, with and without clouds. Not only is a positive correlation missing, we even see a small negative one: clear skies have slightly higher winds, by 20 - 30%.

Table 2 shows some values of the velocity distribution with clear sky. Where should we draw the line? My suggestion is to compromise by using the third quartile. Closing the door, for the very shortest wavelengths, on 1/4 of all clear nights may still be acceptable to the observers. On the other side, demanding small pointing errors up to $v = 25$ mph of wind outside the dome is (hopefully) not asking too much regarding our design.

But before trying to change anything with our telescope design, we first should answer two questions, if possible. All data given so far have been measured on top of Mauna Kea; but what is the wind distribution $F(v)$ at our 25-m location which is somewhat shielded? Second, as opposed to my guesses of Memo 11: how much shielding is actually provided by the open astrodome?

Table 1. Mauna Kea Weather Data.
(British Royal Observatory)

Report No.	Period	Temperature (°C)			Sun % of day	days with some precipit.	Wind (meter/sec) nights only		
		day max.	night min.	night avg.			max.	avg.	
57	Feb. 1974	11.5	-8.0	-3.8	85	1	13	7	
58	Mar.	11.0	-9.8	-2.8	70	11	24	8	
59	Apr.	11.0	-7.3	-2.6	65	11	15	7	Used for Figs. 1 & 2 ↕
60	May	13.0	-6.0	-1.2	81	6	16	6	
61	June	13.0	-3.5	+0.4	85	2	18	6	
62	July	14.5	-6.6	-0.9	87	5	22	7	
63	Aug.	15.1	-5.1	+0.7	89	4	14	6	
64	Sept.	14.0	-3.5	+0.6	85	6	12	4	
65	Oct.	12.3	-6.0	-0.4	79	3	20	6	
66	Nov.	10.0	-9.0	-2.6	75	5	18	9	
67	Dec.	8.8	-9.0	-3.3	84	6	26	12	
68	Jan. 1975	1.6	-9.8	-4.4	77	5	22	8	
69	Feb.	4.0	-8.3	-3.6	80	6	22	8	
70	Mar.	6.5	-6.9	-2.3	82	6	12	5	
Averages Rep. 59....70		10.3	-6.8	-1.6	81	5.4	18.1	7.0	

Table 2. Cumulative distribution F(v) on top of Mauna Kea, during nights with clear sky.

F(v)		m/sec	mph
	95%	19.1	42.7
	90%	16.0	35.8
3rd quarter	75%	11.1	24.8
median	50%	6.5	14.5
1st quarter	25%	3.5	7.8

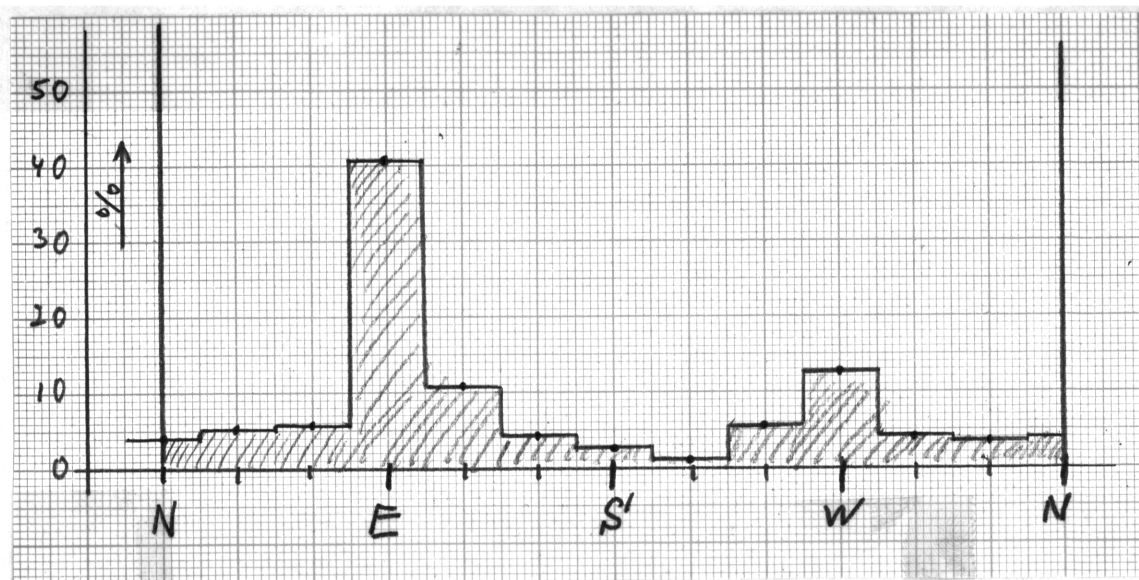


Fig. 1. Wind direction on Mauna Kea; April 1974 through March 1975. Nights only.

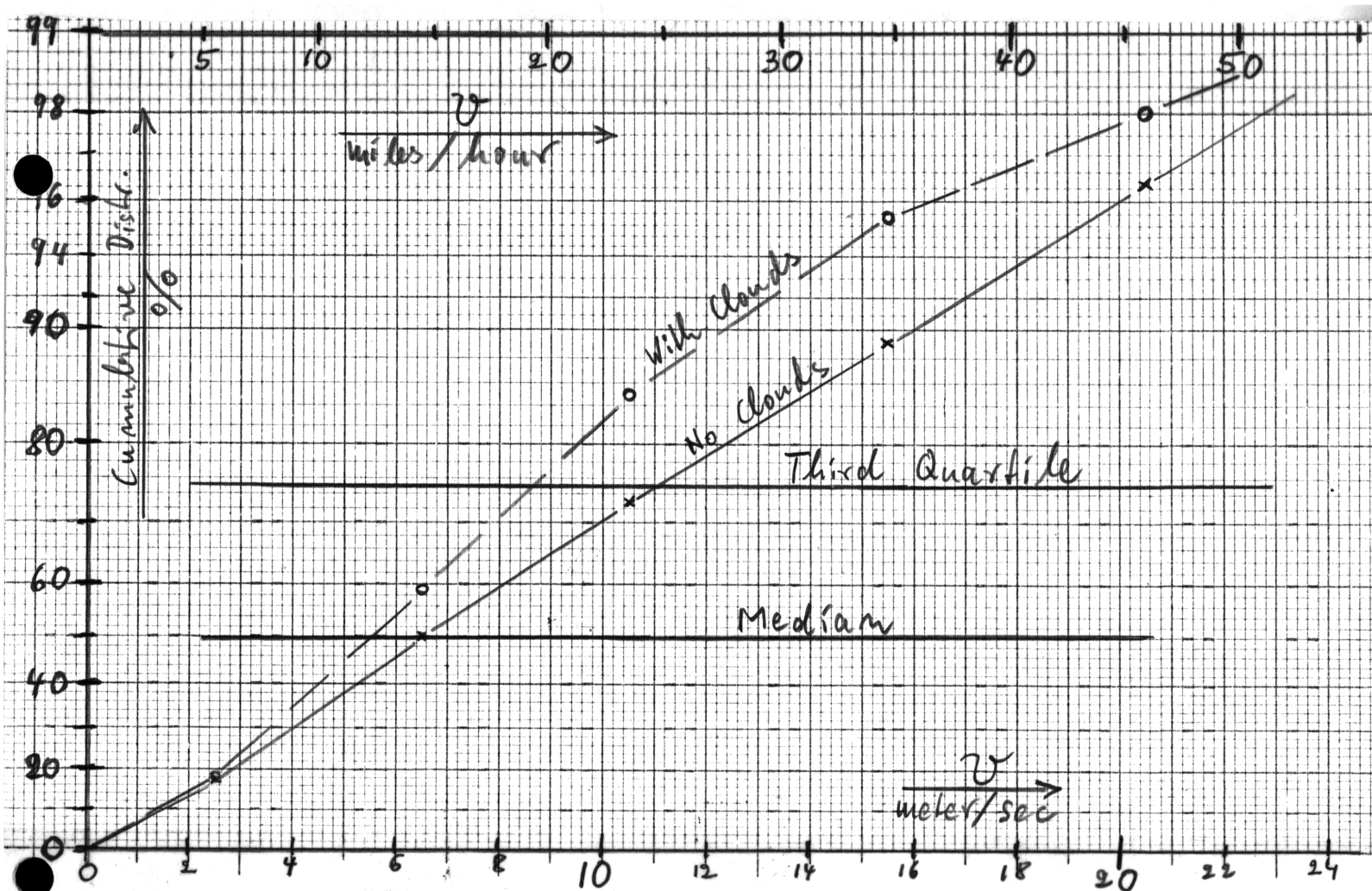


Fig. 2. Wind velocity, cumulative distribution; with and without clouds. Same set of data as for Fig. 1.