PACIFIC REGION TECHNICAL NOTES

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AN EXAMPLE OF HARLEYS METHOD OF FORECASTING QUANTITATIVE PRECIPITATION AMOUNTS

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INTRODUCTION

Harleys procedure for determining precipitation amounts makes use of an initial set of conditions centred on radiosonde data (moisture) and vertical velocity (pressure tendency). Rain days or snow/water equivalent at Vancouver Airport and Grouse Mountain were considered for the period December, 1976 to March, 1977 inclusive.

PROCEDURE

The 24 hours of data used were from 12Z to 12Z of the following day. The technique uses the overlay (figure 1) with the nearest (most representative) radiosonde data, i.e., from Quillayute. The precipitable water (Wp) is determined for each of the three layers: 1000mb - 850mb; 850mb - 700mb; 700mb - 500mb, then summed. The other parameter is vertical velocity which correlates directly with the pressure tendency (-w), the pressure fall in the period 09Z-12Z was used. Using the precipitable water determined at 12Z, the 12Z pressure tendency and table I, the 6 hourly precipitation rate can be determined. This rate can be projected through the period rain is expected and the total fall determined. Realistically, the later pressure tendencies should be forecast (every 6 hours), along with moisture (Td) changes and a new precipitation rate calculated for each 6 or 12 hour period. In this procedure, the calculation was done at 12Z, projected through the following 12 hours, then repeated at 00Z, using the new sounding. Operationally for determining a 24 hour forecast amount of precipitation from the morning data, the 12Z data (once received) would be used, then projected through 24 hours using forecast changes of pressure tendency and moisture.

TO USE THE NOMOGRAM OVERLAY (FIG. 1)

a. For each layer, i.e., 1000mb - 850mb, etc., using the dew point (Td) curve, substitute a straight line such that there are equal areas to the right and left of the Td curve;

b. At the intersection of the straight line drawn with the mid point of the layer, read off the Wp value (inches) by interpolation of the overlay values shown. Sum the values for each layer.

If moisture is increasing and expected to saturate the airmass or a particular layer, can compute using the temperature curve, i.e., Wps - the saturation precipitable water.

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The results in Table 2 were the calculated values using the 12Z and 00Z tephigrams, the Td curve, and corresponding pressure tendencies against the actual 24 hour precipitation total at Vancouver Airport and Grouse Mountain.

RESULTS

At Vancouver Airport, sixty examples were calculated and only 7 results could be considered excellent, i.e., 50% either side of calculated value, excluding zero values.

In applying the procedure to Grouse Mountain (elevation 1050 metres), precipitable water was determined for only 2 layers, i.e., 850mb - 700mb and 700mb - 500mb. In this case 15 results, of 60, could be considered excellent as shown in Table 3, with another 11 very close to limits.

CONCLUSION

In most cases, both at the Vancouver Airport and at Grouse Mountain, the Harley Technique overforecasts the amount. This is more evident with the Vancouver results (47 overforecast), than at Grouse Mountain (35 overforecast). It would be interesting to take another season plus the one used here, and re-calculate but using forecast pressure tendencies and adjusted moisture values for each 6 hour block after 18Z.

It should also be noted that Harleys paper does not consider orographic effects or instability. On this basis, it would seem that in calculating for Grouse Mountain, values could be adjusted upwards when the low level winds (850mb) are from the direction 160° to 220°, such that upslope is a factor. These may be the cases when computed values were low, i.e., a minus difference.

REFERENCES

H.L. Ferguson, 1962 - "A Tephigram Overlay for Computing Precipitable Water" - Tec 409

W.S. Harley, 1963 - "Quantitative Precipitation Forecasting" - Tec 456

W.S. Harley, 1963 - "An Operational Method for Quantitative Precipitation Forecasting" - Tec 471

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TABLE 1

Tabular Method for Precip. Computations

(Inches/6 hr.) after Harley

W_p = Precipitable Water (Inches)

-w = Vertical Velocity (10^{-3} mb/sec.)

-w \ W_p	0.2	0.4	0.6	0.8	1.0	1.2	1.4	1.6	1.8	2.0			
2	0.03	0.05	0.06	0.08	0.09	0.10	0.11	0.12	0.13	0.13			
4	0.06	0.10	0.13	0.16	0.18	0.20	0.22	0.24	0.26	0.27			
6	0.09	0.15	0.19	0.23	0.27	0.30	0.33	0.36	0.38	0.40			
8	0.12	0.20	0.26	0.31	0.36	0.40	0.44	0.48	0.51	0.54			
10	0.15	0.25	0.32	0.39	0.45	0.50	0.55	0.60	0.64	0.67			
12	0.18	0.30	0.38	0.47	0.54	0.60	0.66	0.72	0.77	0.80			
14	0.21	0.35	0.45	0.55	0.63	0.70	0.76	0.84	0.90	0.94			
16	0.26	0.40	0.51	0.62	0.72	0.80	0.88	0.96	1.02	1.08			
18	0.28	0.45	0.58	0.70	0.81	0.90	0.99	1.08	1.16	1.20			
20	0.31	0.50	0.64	0.78	0.90	1.00	1.10	1.20	1.28	1.34			
24	0.37	0.60	0.77	0.94	1.08	1.20	1.32	1.44	1.54	1.61			
28	0.43	0.70	0.90	1.09	1.26	1.40	1.54	1.68	1.79	1.89			
32	0.49	0.80	1.02	1.25	1.44	1.60	1.76	1.92	2.05	2.14			

TABLE 2

COMPUTED PRECIPITATION AMOUNTS VS ACTUALS FOR VANCOUVER AIRPORT

Calculated	24 hour	Difference	Calculated	24 hour	Difference
1.08	.99	.09	.56	.37	.19
2.16	.54	1.62	0	.05	- .05
2.04	.15	1.89	.70	.64	.06
0	TR	- 0	1.40	.28	1.12
.80	.12	.68	.62	.03	.59
0	.10	- .10	1.60	.25	1.35
2.34	.05	2.29	.60	.18	.42
.50	.04	.46	.62	.13	.49
.74	.27	.47	2.54	.02	2.52
2.26	.01	2.25	.04	.05	- .01
2.50	.11	2.39	.80	.14	.66
0	.04	- .04	1.14	.16	.98
.20	.12	.08	1.40	.34	1.06
.80	.01	.79	1.80	.21	1.59
.08	0	.08	2.42	.66	1.76
1.56	.06	1.50	.58	.13	.45
2.04	.69	1.33	1.14	.15	.99
.40	.22	.18	1.84	.36	1.48
1.36	.12	1.24	1.74	.34	1.40
2.58	.36	2.22	1.80	.30	1.50
0	.39	- .39	.32	.10	.22
1.42	.18	1.24	.22	.13	.09
0	.24	- .24	.58	.07	.51
.10	.63	- .53	.60	.24	.56
0	.85	- .85	1.32	.03	1.29
0	.20	- .20	0	.20	- .20
.09	.02	.07	0	.03	- .03
0	.01	- .01	.66	.03	.63
.07	TR	.07	2.00	.09	1.91
.17	.02	.15			
.28	.04	.24			

TABLE 3

COMPUTED PRECIPITATION AMOUNTS VS ACTUALS FOR GROUSE MOUNTAIN

Calculated	24 hour	Difference	Calculated	24 hour	Difference
1.08	3.36	-2.28	.62	.31	.31
2.16	3.78	-1.62	1.12	1.11	.01
2.04	.20	1.84	0+	.22	- .22
0	.15	- .15	1.40+	2.32	- .92
.80	.70	.10	1.40	.60	.80
0	.70	- .70	.62	.32	.30
2.34	.30	2.04	1.60	.44	1.16
.50	.75	- .25	.60	.17	.43
.74	1.14	- .40	.62	.65	- .03
2.26	1.54	.72	2.54	.35	2.19
2.50	.66	1.84	.04	.30	- .26
0	.17	- .17	.80	1.00	- .20
.20	.10	.10	1.14	.60	.54
.80	.10	.70	1.40	.40	1.00
.08	.15	- .07	1.80	.10	1.70
1.56	.90	.66	2.42	.60	1.88
2.04	2.64	- .60	.58	.30	.28
.40	.90	- .50	1.14+	.20	.94
1.36	.25	1.11	1.84	1.10	.74
2.58	.50	2.08	1.74	.80	.94
0	.25	- .25	1.80	.60	1.20
1.42	.89	.53	.32	.50	- .18
0	.65	- .65	.22	.10	.12
.10	1.14	-1.04	.58	.20	.38
0	4.37	-4.37	.60	.15	.45
0	.20	- .20	1.32	.25	1.07
.18	.06	.12	0	.30	- .30
.22	.10	.12	0	.20	- .20
.14+	.25	- .11	.66	.70	- .04
.34+	.15	.19	2.00	.40	1.60

FIGURE 1.

TEPHIGRAM OVERLAY FOR COMPUTING PRECIPITABLE AND SATURATION PRECIPITABLE WATER

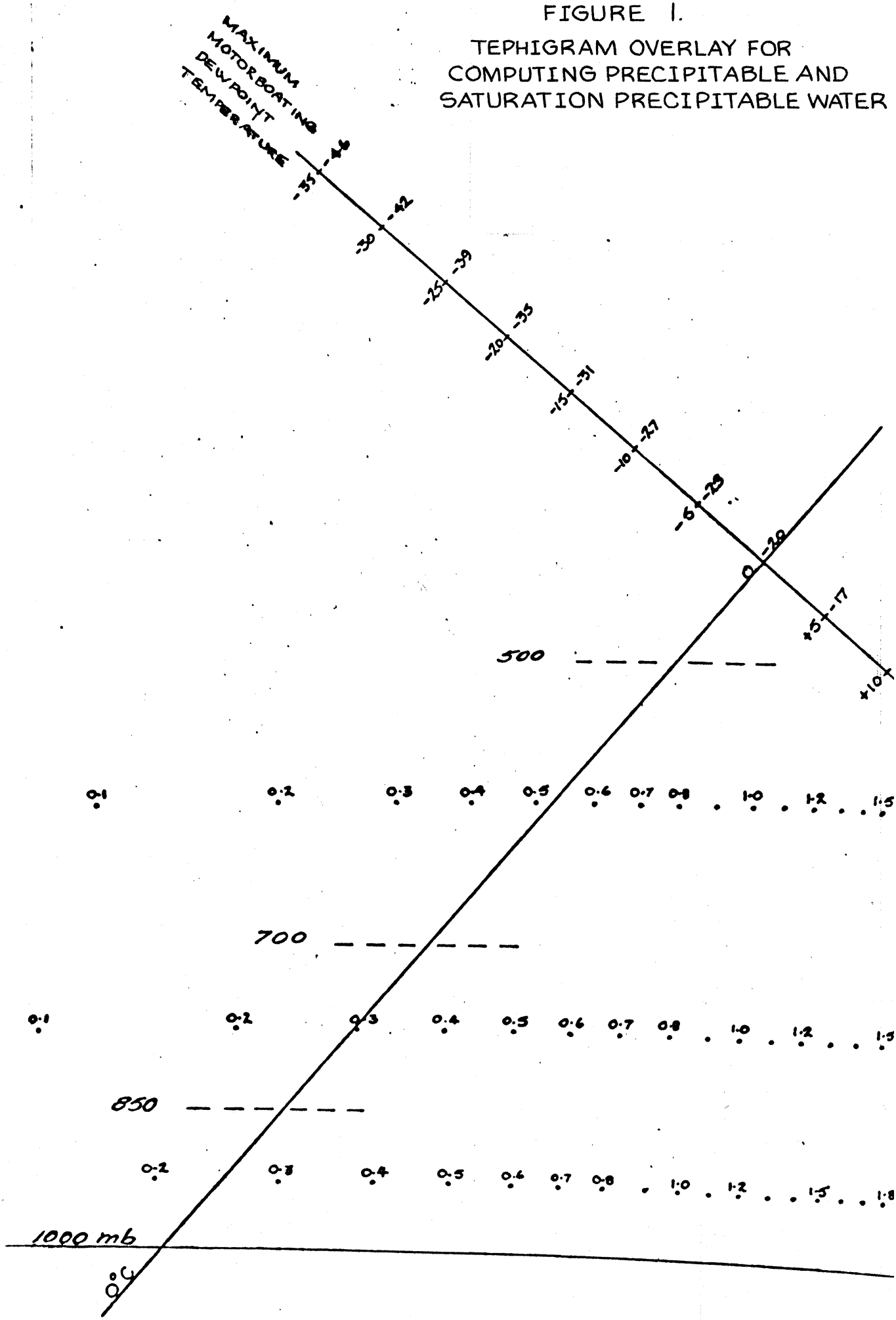
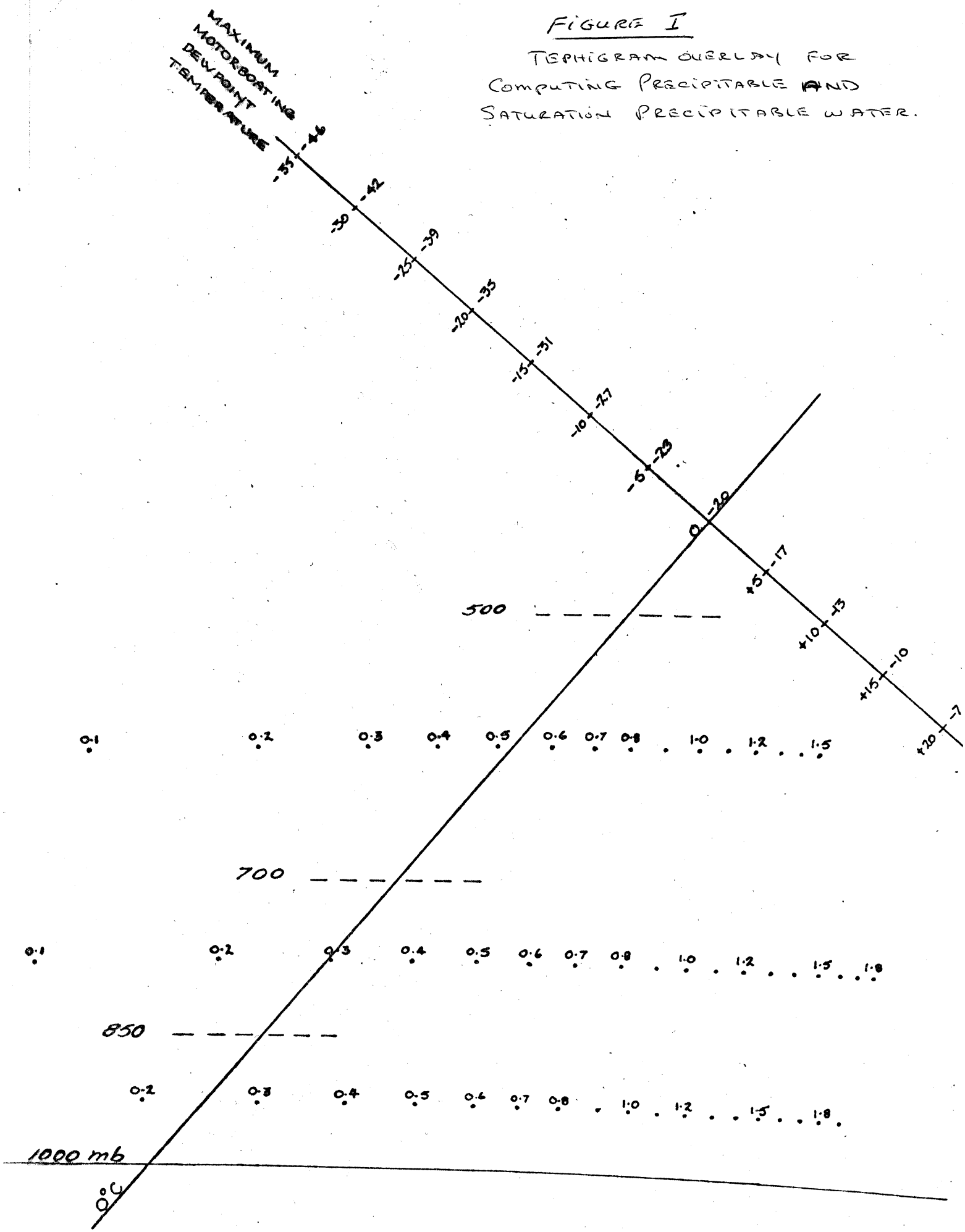


FIGURE I

TEPHIGRAM OVERLAY FOR COMPUTING PRECIPITABLE AND SATURATION PRECIPITABLE WATER.



PAC REG TECH NOTES

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A brief examination of the FOUS76 output

TNT

INTRO The PWC has been receiving the NMC FOUS76 output (based on the LFM model) since the Fall of 1976. The messages gives a number of parameters, forecast out to 48 hours, in 6 hour blocks. The period (first season) Dec. 10, 1976 to APRIL 23, 1977 was considered. The first 24 hour forecast period only was checked (of the morning message only -16Z) against occurrence or non occurrence. To be considered an occurrence, the precipitation had to be measurable ie a Trace did not count.

The sites checked were: Vancouver Airport
Castlegar
Cranbrook
Revelstoke
Prince George

VANCOUVER AIRPORT

	FORECAST	NOT FORECAST	TOTAL
OCCURRED	49	2	51
DID NOT OCCUR	30	27	57
TOTAL	79	29	108

CORRECT: 76

WRONG: 32

CASTLEGAR

	FORECAST	NOT FORECAST	TOTAL
OCCURRED	37	1	38
DID NOT OCCUR	22	46	68
TOTAL	59	47	106

CORRECT: 83
WRONG: 23

CRANBROOK

	FORECAST	NOT FORECAST	TOTAL
OCCURRED	18	7	25
DID NOT OCCUR	29	52	81
TOTAL	47	59	106

CORRECT: 70
WRONG: 36

REVELSTOKE

	FORECAST	NOT FORECAST	TOTAL
OCCURRED	47	5	52
DID NOT OCCUR	17	38	55
TOTAL	64	43	107

CORRECT: 85
WRONG: 22

PRINCE GEORGE

	FORECAST	NOT FORECAST	TOTAL
OCCURRED	39	2	41
DID NOT OCCUR	34	31	65
TOTAL	73	33	106

CORRECT: 70
WRONG: 36

SUMMARY

	Samples	CORRECT	WRONG	NOT FORECAST OCCURRED	FORECAST DID NOT OCCUR
VR	108	76	32	2	30
CG	106	83	23	1	22
XC	106	70	36	7	29
RV	107	85	22	5	17
XS	106	70	36	2	34

CONCLUDING REMARKS

More reliability on occasions when does not forecast precipitation. The next step would likely be to consider the latest season 79/80, in terms of occurrence/no occurrence and when occurring, to verify amounts.