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TDL Office Note 75-4

AUTOMATED PREDICTION OF THUNDERSTORMS, DRIZZLE, RAIN, AND SHOWERS--NO. 2

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We now have cool season (October-March) equations that predict the probability of thunderstorms and the conditional probability of drizzle, rain, and showers. These equations were derived as part of the Techniques Development Laboratory's (TDL's) project to develop a complete computer-worded forecast of public weather.

The cool season equations are similar to those for the warm season (April-September) we described earlier in TDL Office Note 74-7 (Carter, 1974). We used the Model Output Statistics (MOS) approach (Klein and Glahn, 1974) to relate predictand data from the National Climatic Center in Asheville to the same forecast fields from the PE and trajectory models as before. Our data sample covered the cool seasons of 1972-73 and 1973-74. We derived twelve-term, generalized operator equations using data from 233 stations for projections of 18, 30, and 42 hours from 0000 GMT.

Our new equations for the probability of thunderstorms or severe weather are for only one region covering the entire conterminous United States, in contrast to the warm season equations which are for two regions. We used this approach because of the scarcity of winter-time thunderstorms over the western half of the United States. As before, our predictand (the occurrence of a thunderstorm, squall, hail, or tornado) was obtained by using 3-hourly surface observations during a 12-hour period centered at the nominal valid time.

Table 1 shows our new thunderstorm probability equations for the 30-hour projection. Once again, all the predictors are binary in form. Since thunderstorms occur so infrequently (approximately one percent of the time) during the cool season, the cumulative reduction of variance and hence the overall predictability is very small.

We applied the same scheme we used for the warm season to develop cool season equations for the conditional probability of precipitation type (conditional on the occurrence of liquid precipitation). Only predictand data at the valid time of each projection were used, and the three equations for drizzle, rain, and showers were required to use the same twelve predictors for any given projection.

Table 2 shows the three new equations for the 30-hour projection. The equations for rain and showers have much smaller reductions of variance than those associated with the corresponding equations for the warm season.

We'll be using estimates of thunderstorm probability and conditional probability of precipitation type from these equations during the coming winter in the development of our AFOS applications package.

REFERENCES

Carter, G. M., 1974, "Automated Prediction of Thunderstorms, Drizzle, Rain, and Showers," Office Note 74-7, Techniques Development Laboratory, Silver Spring, MD, 8 pp.

Klein, W. H., and H. R. Glahn, 1974, "Forecasting Local Weather by Means of Model Output Statistics," Bull. Amer. Meteor. Soc., 55, 1217-1227.

Table 1. Cool season probability of thunderstorms equation--
30-hour forecast from 0000 GMT.

Predictor	Smoothing (Points)	Valid Time (GMT)	Threshold Value	Cumulative RV	Coefficients
TJ CONVECTIVE INSTABILITY	S9	24	$-5^{o}K$	.01	.017
PE 650 VERT. VELOCITY	S9	36	-.0005 mb/sec	.02	.013
TJ TOTAL TOTALS INDEX	S9	24	45	.03	-.021
STN. LONGITUDE	--	--	104^{o}	.03	.012
PE 850 TEMP	S9	36	$283^{o}K$	.03	-.012
COS DOY	--	--	.5	.04	.010
PE MEAN RH	S9	30	50%	.04	-.008
PE 500 TEMP	S9	36	$253^{o}K$	.04	-.007
PE 500 TEMP	S9	36	$258^{o}K$	.04	.014
PE 700 TEMP	S9	36	$273^{o}K$	.04	-.012
PE PRECIP. AMOUNT	S9	42	.0025 M	.04	-.010
STN LONGITUDE	--	--	118^{o}	.04	.009
CONSTANT					.023

Maximum Probability: .098

Minimum Probability: -.047

Table 2. Cool season conditional probability of liquid precipitation equations--30-hour forecast from 0000 GMT.

Predictor	Smoothing (Points)	Valid Time (GMT)	Threshold Value	Drizzle Cumulative RV	Drizzle Coefficients	Rain Cumulative RV	Rain Coefficients	Showers Cumulative RV	Showers Coefficients
PE MEAN RH	S9	36	70%	.03	.050	.06	-.099	.01	.048
TJ TOTAL TOTALS INDEX	S9	24	42	.04	.050	.06	.089	.05	-.139
STN LONGITUDE	--	--	104°	.06	.123	.07	-.055	.05	-.068
PE 650 VERT VEL	S9	36	-.0005 mb/sec	.09	-.118	.08	.029	.05	.089
PE MEAN RH	S9	42	90%	.09	.026	.09	-.128	.07	.102
COS DOY	--	--	.5	.09	-.059	.09	-.047	.07	.107
TJ 700 NET VERT DISP	None	24	-5 mb	.11	.141	.10	-.096	.08	-.046
SIN DOY	--	--	-.5	.11	-.104	.10	.049	.08	.055
PE G INDEX	S9	36	2860 M	.12	.099	.11	-.103	.08	.004
PE BL U	S9	36	-4 m/sec	.13	-.139	.11	.117	.08	.022
PE MEAN RH	S9	30	70%	.13	-.033	.12	-.093	.09	.126
PE 850 U	S9	24	4 m/sec	.13	-.052	.12	.015	.09	-.067
CONSTANT					.132		.734		.135

Note: G Index = 1000 Ht + 500 Ht - 2 x 850 HT

	Drizzle		Rain		Showers
Max Probability	.673	Max Probability	1.033	Max Probability	.6
Min Probability	-.321	Min Probability	-.113	Min Probability	-.