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A PROCEDURE FOR FORECASTING PRECIPITATION TYPE USING NGM LOW LEVEL TEMPERATURE FORECASTS

Joseph A. Ronco, Jr.
National Weather Service Forecast Office
Portland, ME

Editor's Note: This is another outstanding example of our best hope for improving on objective guidance beyond the short-range. All WSFOs should be attempting to use NGM output to improve upon MOS forecast parameters.

Two items of clarification--all 6-hourly output (0-48 hours) of the NGM were combined for this study. The use of T5=0 in Tables 1,2 and 4 was for the purpose of determining the proper thresholds for T1 and T3.

ABSTRACT

NESTED GRID MODEL (NGM) FORECASTS ARE AVAILABLE TO FORECASTERS PRIMARILY IN CHART FORM AND SECONDARILY AS A FOUS MESSAGE AT SELECTED LOCATIONS. NO MODEL OUPUT STATISTICS (MOS) IS AVAILABLE FROM THE NGM AND WON'T BE IN THE NEAR FUTURE. A TECHNIQUE IS PRESENTED FOR USING NGM LOW LEVEL TEMPERATURE FORECASTS TO DETERMINE PRECIPITATION TYPE.

INTRODUCTION

THE NGM HAS BEEN PRODUCING OPERATIONAL 0-48 HOUR NUMERICAL FORECASTS FOR THE NORTH AMERICAN CONTINENT TWICE DAILY SINCE LATE MARCH 1985. EVALUATIONS, OBJECTIVE AND SUBJECTIVE, DEMONSTRATED THAT THE REGIONAL ANALYSIS AND FORECAST SYSTEM (RAFS) TAKEN FROM THE NGM CONTAINED BOTH AN IMPROVED OBJECTIVE ANALYSIS AND AN IMPROVED MODEL. A FULL COMPLEMENT OF RAFS PROGNOSTIC CHARTS WERE MADE AVAILABLE TO FIELD FORECASTERS IN NOVEMBER 1985. THE NGM FOUS MESSAGE HAD BECOME AVAILABLE IN OCTOBER 1985.

SINCE IT WILL TAKE A FEW YEARS TO DEVELOP MOS GUIDANCE FROM THE NGM, SOME METHOD OF USING THE NGM FOUS MESSAGE TO MAKE OBJECTIVE FORECASTS WAS NEEDED IN ORDER TO HAVE BETTER USE OF THAT MODEL NOW. ALSO, ANY TECHNIQUES OR PROCEDURES DEVELOPED WILL GIVE A MEASURE OF GOODNESS OF THE MODEL AND ALLOW A MEANS TO MEASURE CHANGES THAT MAY BE MADE TO THE MODEL.

PRECIPITATION TYPE IS DEPENDENT ON THE TEMPERATURE OF THE ATMOSPHERE, ESPECIALLY IN THE LOWER LEVELS. SINCE THE NGM FOUS MESSAGE FORECASTS THE TEMPERATURE AT THREE OF THOSE LOWER LEVELS, IT WAS DECIDED TO USE THESE FORECAST TEMPERATURES TO DEVELOP A METHOD TO FORECAST PRECIPITATION TYPE OUT TO 48 HOURS.

RESULTS

THE RESULTS ARE SHOWN IN TABLE 5. SOME SUBJECTIVITY WAS NECESSARY IN DEVELOPING THE TABLE ESPECIALLY WHERE LITTLE OR NO DATA WERE AVAILABLE. NOTE THAT THE FREQUENCY OF LIQUID (RAIN) PRECIPITATION IS HIGHEST AT THE TOP OF EACH CATEGORY AND LOWEST AT THE BOTTOM. ALSO, THE FREQUENCY OF LIQUID (RAIN) PRECIPITATION IS HIGHEST IN CATEGORY ONE AND THE LOWEST IN CATEGORY FOUR. THE OPPOSITE IS TRUE OF FROZEN (SNOW) PRECIPITATION.

HOW WELL DID THE MOS POPT PREFERRED TYPE FORECAST PERFORM IN COMPARISON TO THE NGM FOUS TEMPERATURE METHOD OF FORECASTING PRECIPITATION TYPE? THE USE OF THE NGM FOUS MESSAGE LOWER LEVEL TEMPERATURES IN FORECASTING PRECIPITATION TYPE WAS SUPERIOR TO THE MOS POPT PREFERRED CATEGORY FORECASTS. THE PRECIPITATION TYPE FORECASTS FROM THE NGM FOUS MESSAGE WERE CONVERTED TO CATEGORICAL FORECASTS AND VERIFIED (TABLE 6). A FREQUENCY GREATER THAN OR EQUAL TO 50 PERCENT FOR FROZEN PRECIPITATION WAS TREATED AS A CATEGORICAL FORECAST OF FROZEN PRECIPITATION. A FREQUENCY LESS THAN 50 PERCENT WAS CONSIDERED A CATEGORICAL FORECAST OF LIQUID PRECIPITATION. REGARDLESS OF SCORE USED, THE NGM FOUS TEMPERATURE METHOD FOR TYPING PRECIPITATION WAS SUPERIOR TO MOS POPT PREFERRED CATEGORY FORECASTS.

CONCLUSION

THIS STUDY HAS DEVELOPED A TECHNIQUE FOR IMPROVING PRECIPITATION TYPE FORECASTS BY OBJECTIVELY USING NGM FOUS LOWER LEVEL TEMPERATURES TO FORECAST PRECIPITATION TYPE. EVEN THOUGH THE DATA SAMPLE IS SMALL AND FOR A PARTICULAR AREA, IT CLEARLY POINTS THE WAY TOWARD FURTHER STUDIES. AS A MATTER OF FACT, A STUDY USING THE PREFERRED POPT CATEGORY FROM MOS AND THE NGM FOUS PRECIPITATION TYPE AS VARIABLES IS PLANNED FOR THIS WINTER SEASON.

SCIENTIFIC SERVICES DIVISION, ERH
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Attachments (Tables 1 through 6)

T1	FROZEN	LIQUID	MIXED
>09	.000	1.000	.000
09	.038	.962	.000
08	.051	.949	.000
07	.066	.934	.000
06	.075	.925	.000
05	.095	.889	.016
04	.109	.848	.043
03	.167	.729	.104
02	.227	.681	.092
01	.328	.590	.082
00	.527	.400	.073
99	.638	.297	.065
98	.778	.162	.060
97	.807	.136	.057
96	.818	.128	.054
95	.833	.116	.051
94	.876	.038	.032
93	.937	.018	.025
92	.959	.018	.023
91	.965	.015	.020
90	.970	.006	.015
89	.987	.000	.013
88	.988	.000	.012
87	.988	.000	.012
86	.997	.000	.003
<86	1.000	.000	.000

TABLE 1. RELATIVE FREQUENCY OF PRECIPITATION TYPE FOR TEMPERATURE T1 FROM NGM FOUS MESSAGES.

T3	FROZEN	LIQUID	MIXED
>10	.000	1.000	.000
10	.027	.973	.000
09	.037	.963	.000
08	.041	.945	.014
07	.045	.940	.015
06	.052	.928	.020
05	.067	.905	.028
04	.085	.880	.035
03	.163	.764	.073
02	.250	.629	.121
01	.297	.578	.125
00	.577	.338	.085
99	.591	.333	.076
98	.748	.178	.074
97	.834	.115	.051
96	.919	.041	.040
95	.945	.033	.022
94	.970	.014	.016
93	.988	.000	.012
92	.990	.000	.010
91	.996	.000	.004
90	.997	.000	.003
<90	1.000	.000	.000

TABLE 2. RELATIVE FREQUENCY OF PRECIPITATION TYPE FOR TEMPERATURE
T3 FROM NGM FOUS MESSAGES.

T5	FROZEN	LIQUID	MIXED
>06	.000	1.000	.000
06	.045	.955	.000
05	.047	.953	.000
04	.049	.941	.010
03	.093	.874	.033
02	.188	.770	.042
01	.213	.705	.082
00	.391	.522	.087
99	.460	.448	.092
98	.719	.205	.076
97	.799	.127	.074
96	.809	.124	.067
95	.859	.101	.040
94	.925	.053	.022
93	.959	.030	.011
92	.968	.022	.010
<92	1.000	.000	.000

TABLE 3. RELATIVE FREQUENCY OF PRECIPITATION TYPE FOR TEMPERATURE T5 FROM NGM FOUS MESSAGES.

T1	T3>01 RAIN	SNOW	02>T3>99 RAIN	SNOW	00>T3>97 RAIN	SNOW	98>T3>95 RAIN	SNOW	96>T3>93 RAIN	SNOW	T3<94 RAIN	SNOW
>09	2	0	0	0	0	0	0	0	0	0	0	0
09	7	0	0	0	0	0	0	0	0	0	0	0
08	4	0	0	0	0	0	0	0	0	0	0	0
07	7	0	0	0	0	0	0	0	0	0	0	0
06	13	1	0	0	0	0	0	0	0	0	0	0
05	11	0	0	0	1	0	0	0	0	0	0	0
04	6	0	1	0	1	0	0	0	0	0	2	1
03	11	0	0	0	2	3	0	0	0	0	2	0
02	11	0	0	0	2	0	0	0	0	0	4	0
01	5	0	1	1	1	0	1	0	0	0	0	3
00	3	1	2	0	0	3	2	3	0	0	1	3
99	1	1	1	2	2	2	0	1	0	0	1	1
98	1	0	0	2	3	3	2	4	0	0	0	3
97	1	0	0	0	1	0	0	1	0	0	0	0
96	0	0	1	2	2	0	0	2	0	1	0	1
95	1	0	0	0	0	3	0	0	0	0	0	1
94	0	1	0	0	1	0	0	0	0	0	0	0
93	0	0	0	0	1	1	0	0	0	0	0	0
92	0	0	0	0	0	0	0	0	0	0	1	0
91	1	0	1	0	0	0	0	2	0	0	0	0
90	0	0	1	0	0	1	0	0	0	1	0	0
89	0	0	0	0	0	0	0	0	0	0	0	0
88	0	0	0	0	0	0	0	0	0	0	0	0
87	0	0	0	0	0	1	0	0	0	1	0	0
<87	0	0	0	0	0	0	0	0	0	0	0	0

TABLE 4. NUMBER OF PRECIPITATION EVENTS BY TYPE (RAIN=LIQUID AND SNOW=FROZEN) FOR TEMPERATURE T1 AND RANGES OF T3 FROM ALL NGM FOUS MESSAGES WHERE T5 EQUALS ZERO.

CATEGORY ONE FREQUENCIES.....RAIN .935, SNOW .054, MIXED .011
CATEGORY TWO FREQUENCIES.....RAIN .538, SNOW .231, MIXED .231
CATEGORY THREE FREQUENCIES...RAIN .384, SNOW .548, MIXED .068
CATEGORY FOUR FREQUENCIES....RAIN .067, SNOW .800, MIXED .133

	T1>1			T1=1 1>T1>95 & T3>1			1>T1>97 & T3<2 98>T1>95 & 2>T3>97 96>T1>89 & T3>97			98>T1>89 & T3<98 T1<90		
T5	RAIN	SNOW	MIX	RAIN	SNOW	MIX	RAIN	SNOW	MIX	RAIN	SNOW	MIX
>06	1.000	.000	.000	1.000	.000	.000	1.000	.000	.000	1.000	.000	.000
06	.981	.019	.000	.967	.032	.000	.750	.250	.000	.700	.300	.000
05	.977	.023	.000	.952	.048	.000	.727	.273	.000	.600	.400	.000
04	.975	.025	.000	.929	.071	.000	.500	.340	.160	.450	.500	.050
03	.973	.027	.000	.925	.075	.000	.463	.370	.167	.300	.600	.100
02	.968	.032	.000	.810	.095	.095	.409	.409	.182	.100	.700	.200
01	.871	.072	.049	.720	.160	.120	.361	.532	.107	.096	.793	.111
00	.861	.082	.057	.662	.200	.138	.317	.578	.105	.060	.877	.063
99	.650	.200	.150	.625	.214	.161	.258	.638	.104	.043	.922	.035
98	.587	.288	.125	.564	.295	.131	.183	.714	.103	.032	.936	.032
97	.556	.344	.100	.529	.353	.118	.168	.736	.096	.022	.948	.030
96	.521	.399	.080	.364	.545	.091	.136	.775	.089	.019	.954	.027
95	.500	.467	.033	.214	.714	.072	.113	.825	.062	.017	.961	.022
94	.450	.550	.000	.156	.783	.061	.099	.844	.057	.014	.967	.019
93	.333	.667	.000	.080	.866	.054	.071	.881	.048	.012	.971	.017
92	.200	.800	.000	.038	.925	.033	.033	.926	.041	.011	.989	.000
<92	.000	1.000	.000	.000	1.000	.000	.000	1.000	.000	.000	1.000	.000

TABLE 5.   RELATIVE FREQUENCY OF PRECIPITATION TYPE FOR TEMPERATURE
T5 FROM NGM FOUS MESSAGES BY CATEGORY OF T1 AND T3.

	NGM	POPT
P.O.D.	.920	.858
F.A.R.	.111	.171
C.S.I.	.825	.729
PERCENT VERIFIED	88.9	82.9
BIAS	1.035	1.036

TABLE 6. SKILL OF PRECIPITATION TYPE FORECASTS FROM NGM LOWER LEVEL TEMPERATURE FORECASTS AND MOS POPT PREFERRED CATEGORY.