AD-A037 148 AIR FORCE ENVIRONMENTAL TECHNICAL APPLICATIONS CENTER--ETC F/G 4/2

MODEL OUTPUT STATISTICS FORECAST GUIDANCE.(U)

SEP 76 H HUGHES

UNCLASSIFIED USAFETAC-TN-76-3 NL

1 OF 1

AD A037148

END

DATE FILMED

4-77

USAFETAC TN 76-3

MODEL OUTPUT STATISTICS FORECAST GUIDANCE

by

Capt Harry Hughes

5th Weather Wing

Approved For Public Release; Distribution Unlimited

SEPTEMBER 1976

UNITED STATES AIR FORCE
AIR WEATHER SERVICE (MAC)

USAF ENVIRONMENTAL
TECHNICAL APPLICATIONS CENTER

SCOTT AIR FORCE BASE, ILLINOIS 62225

<u>Review and Approval Statement</u>

This report approved for public release. There is no objection to unlimited distribution of this report to the public at large, or by DDC to the National Technical Information Service (NTIS).

This technical report has been reviewed and is approved for publication.

John W. Louer

JOHN W. LOUER
Chief, Editorial Support Section

FOR THE COMMANDER

Walter S. Burgmann

WALTER S. BURGMANN
Scientific & Technical Information Officer (STINFO)

UNCLASSIFIED

SECURITY CLASSIFICATION OF THIS PAGE (When Data Entered)

REPORT DOCUMENTATION PAGE		READ INSTRUCTIONS BEFORE COMPLETING FORM
1. REPORT NUMBER (14) USAFETAC-TN-76-3	2. GOVT ACCESSION NO.	3. RECIPIENT'S CATALOG NUMBER
4. TITLE (and Subtitle) (6) Model Output Statistics Forecast Guidance		5. TYPE OF REPORT & PERIOD COVERED (9) Technical rept.
		6. PERFORMING ORG. REPORT NUMBER
7. AUTHOR(s) (10) Harry Hughes, Captain, USAF 5th Weather Wing		8. CONTRACT OR GRANT NUMBER(s)
9. PERFORMING ORGANIZATION NAME AND ADDRESS USAF Environmental Technical Applications Center Scott AFB, Illinois 62225		10. PROGRAM ELEMENT, PROJECT, TASK AREA & WORK UNIT NUMBERS
11. CONTROLLING OFFICE NAME AND ADDRESS USAFETAC Scott AFB, Illinois 62225	(11)	12. REPORT DATE September 1976
		13. NUMBER OF PAGES 15 (12) 20p.
14. MONITORING AGENCY NAME & ADDRESS (if different from Controlling Office)		15. SECURITY CLASS. (of this report) Unclassified
		15a. DECLASSIFICATION/DOWNGRADING SCHEDULE

16. DISTRIBUTION STATEMENT (of this Report)

Approved for public release; distribution unlimited.

17. DISTRIBUTION STATEMENT (of the abstract entered in Block 20, if different from Report)

18. SUPPLEMENTARY NOTES

Prepared in cooperation with 5th Weather Wing, Langley AFB, VA.

19. KEY WORDS (Continue on reverse side if necessary and identify by block number)

Meteorological Models	Primitive Equation Model
Model Output Statistics	Trajectory Model
Limited Fine Mesh Model	Probability Forecasts

400 945

20. ABSTRACT (Continue on reverse side if necessary and identify by block number)

This publication describes data in the National Weather Service's Model Output Statistics Final Forecast Guidance teletype bulletins. It is intended to serve as a comprehensive guide to the interpretation and use of the forecast bulletins by AWS forecasting units.

DD FORM 1 JAN 73 1473 EDITION OF 1 NOV 65 IS OBSOLETE

UNCLASSIFIED

SECURITY CLASSIFICATION OF THIS PAGE (When Data Entered)

6pg

PREFACE

The 5th Weather Wing originally intended to publish this report, but because of its wide applicability to Air Weather Service (AWS) detachments, USAFETAC is publishing it as a Technical Note.

TABLE OF CONTENTS

MODEL OUTPUT STATISTICS FORECAST GUIDANCE

Introduction

The National Weather Service (NWS) Model Output Statistics (MOS) Final Forecast Guidance is now available on COMET III for selected US cities. Some of the cities are near enough to AWS forecasting units that the MOS data for the cities are useful for detachment forecasting purposes. Forecast outputs from the NWS Limited Fine Mesh Model (LFM), Primitive Equation Model (PE), and Trajectory Model, along with surface observations from 0500 GMT and 1700 GMT are used in the MOS approach to produce probability forecasts of precipitation, frozen precipitation, clouds, ceilings, visibilities, and direct forecasts of wind speed and direction.

Since the information in the MOS bulletins needs no adaptation and is immediately useable, it can be particularly important to AWS forecasters who have become increasingly concerned with "doing more with less." Unlike other forecast aids, it does not require the forecaster to build a data base and then develop correlations between forecast parameters and observed weather elements. The information in the bulletin is directly applicable, starting from the first day it is received. But even more important, the guidance in the MOS bulletins tells the forecaster explicitly what he needs to know: the likelihood of precipitation, the type of precipitation, the most likely ceiling and visibility, and the wind direction and speed. In "Bulletin Description," below, an outline is given of the type of information contained in the bulletins, and in the "Interpretation and Application" section, guidance is provided on how the information can be used.

Bulletin Description

The Forecast Guidance Bulletin is prepared twice daily, based primarily on 0000 GMT and 1200 GMT data. Forecasts are valid 12, 18, 24, 36, 42, and 48 hours after data base time. A final probability of precipitation forecast is valid 60 hours after data base time. Bulletin contents are as follows:

a. POP 06. The first line in the bulletin is labeled POP 06. The four numbers on this line are forecasts of the probability of precipitation for 6-hour periods with the first number representing the probability for the period ending 18 hours after data base time. The forecast is valid for a 6-hour time period ending at the time indicated on the bulletin. For example, a POP 06 forecast of "2" valid at 31/06Z (see example bulletin on Appendix A), indicates there is a 2% chance of precipitation during the 00Z to 06Z period. Forecasts are made through 36 hours after data base time. In making POP forecasts, the conterminous United States is divided into various areas depending on the season. Regionalized equations based on past model output are then derived for these areas and applied to different inputs at each station.

b. POP 12. The second line of the bulletin is labeled POP 12. Four forecasts of precipitation probability for 12-hour periods are given with the first number representing the probability for the period ending 24 hour after data base time. The forecast is valid for a 12-hour time period ending at the time indicated on the bulletin. For example, a POP 12 forecast of "20" valid at 31/12Z means there is a 20% chance of precipitation from 00Z to 12Z (see Appendix A). Forecasts are provided through 60 hours after data base time. Occasionally, an inconsistency occurs in the POP 06 and POP 12 forecasts when one or the other of the two 6-hour POPs exceeds the associated 12-hour POP. The reason this sometimes happens is that the 6- and 12-hour MOS POP equations were developed independently. The 6-hour POPs should be used in a relative sense to determine the more likely 6-hour period for precipitation within the inclusive 12-hour period. As of publication date, the NWS Technique Development Laboratory (TDL) is working to correct this problem.

c. POF. The third line is labeled POF. Conditional probabilities of frozen precipitation are presented through 48 hours after data base time. These forecasts are valid at the time indicated on the bulletin (as opposed to the POP which is valid for a 6- or 12-hour period). For example, a POF forecast of "10" valid at 31/00Z would mean there is a 10% chance of precipitation being frozen if precipitation occurs. In developing forecast equations for POF, the United States is not divided into regions as with POP, but rather a combination of single station and generalized operator approaches is used. All developmental data for the United States is pooled together, but 50% values of thickness and temperatures are also used at each station to produce the probability of frozen percipitation.

d. CLDS. The fourth line is labeled CLDS. Probabilities of the occurrence of four categories of cloud cover are forecast through 48 hours. The forecasts here are for general cloud cover and not any specific cloud heights. Forecasts are valid at the time indicated on the bulletin. Probabilities are given in tens of percent for the categories below. The four numbers representing the four categories are printed on the bulletin from left to right for each forecast time.

Category 1 - Clear, thin scatter, thin broken, thin overcast

Category 2 - Scattered

Category 3 - Broken

Category 4 - Overcast, obscured

The four probability figures are followed by a slash (/) and a fifth number (not a probability) which indicates which category is the "best" forecast category, i.e., Category 1, 2, 3, or 4. For example, a cloud forecast of 0127/4 valid at 31/00Z means there is a 0% chance of Category 1 sky cover, a 10% chance of Category 2, a 20% chance of Category 3, and a 70% chance of Category 4, while the "best" category forecast is Category 4. The percentages are rounded to the nearest ten percent, so probabilities will not always sum to 100. An exception to this is that 84% is transmitted as a "9". When a forecast is missing, the group 9999/9 will be transmitted. The single-station approach is used in developing equations for this forecast. Each station has a set of equations which changes with the season.

e. CIG. The fifth line is labeled CIG and contains probability forecasts for the occurrence of each of five ceiling categories through 30 hours after data base time. The categories are defined in paragraph f, below. Probabilities are listed in tens of percent as with CLDS, but for CIG and VIS there are five categories rather than four. As with the CLDS forecast, the "best" category follows the slash (/). For example, a CIG forecast of 01225/4 valid at 31/00Z means there is a 0% chance of ceiling Category 1, a 10% chance of Category 2, a 20% chance of Category 3, a 20% chance of Category 4, and a 50% chance of Category 5, while the "best" category forecast is Category 4. Different programs are used for the CLDS and CIG forecasts. This results in infrequent inconsistencies which NWS TDL is working to correct. Regionalized equations are used for both CIG and VIS forecasts.

f. VIS. The sixth line is labeled VIS and contains forecasts of the probabilities of the occurrence of each of five visibility categories through 30 hours after data base time. The format is the same as for CIG forecasts. The categories for CIG and VIS are:

	CIG	VIS
Category 1	<200 ft	<1/2 NM
Category 2	200 to < 500 ft	1/2 to <1 NM
Category 3	500 to <1000 ft	1 to <3 NM
Category 4	1000 to <2000 ft	3 to <5 NM
Category 5	≥2000 ft	≥5 NM

g. WIND. The seventh line is labeled WIND and contains direct forecasts of wind speed (knots) and direction (tens of degrees) through 48 hours after data base time. These are not probability forecasts. The standard "ddff" format is used. The wind-speed forecast does not include gusts. Forecasts are valid at the time indicated on the bulletin. Single-station equations are used to produce the wind forecasts.

Interpretation and Application

This section provides general comments on how the forecast guidance may be interpreted and a specific example of its application.

a. At present, only NWS locations are used as end points for the guidance bulletin. There are tentative plans to include some AWS locations at a future date. The MOS method involves archiving output from numerical models and matching this output with observations of local weather. Forecast equations are then derived using a variety of statistical techniques. Numerical model bias, as well as local climatology, are automatically built into this system.

b. There are no specific rules for determining when an AWS detachment is "close enough" to a NWS end point to use the forecast guidance. When the weather at the NWS end point is representative of weather at a nearby AWS detachment, the guidance can be used. Whether or not the city guidance is useful for the nearby detachment will vary with both the synoptic situation and time of year, and will depend on local effects and direction of the mean flow (see Appendix B). Even when weather at the two points (NWS and AWS) is not similar, the guidance may still be used if some relationship is known. For example, an upstream end-point station may be known to pick up stratus a few hours earlier or at a height which is a few hundred feet lower than a down-stream AWS location.

c. In order to use the forecast information, forecasters must know how to interpret the probabilities. The category with the highest probability may be selected as the categorical forecast, or the "best" category may be selected. The "best" category is not necessary the one with the highest probability. The "best" category is arrived at for the CLDS forecast by a method NWS calls "Inflation-Minimum Bias," and for the CIG and VIS forecasts through use of a "NWS Scoring Matrix." Briefly, these methods involve altering the original probability forecasts to either produce favorable bias (number of forecasts divided by number of observations), or to emphasize a forecast of certain categories over others. The best way for AWS forecasters to use the probabilities at this time is to use a method similar to that used with conditional climatology tables. That is, add the probabilities from left to right and forecast that category where the total first equals or exceeds 50%. For example, with a CIG forecast of 01225/4, Category 4 would be forecast because the probabilities sum to 50% (0+10+20+20) in Category 4. In this example, the "best" category is also Category 4, but the category with the highest probability (50%) is Category 5. This "conditional climatology method" (summation) is the method suggested for determining a categorical forecast. A comparison of the three methods for determining a categorical forecast, i.e., 1) highest probability, 2) "best" category, or 3) 50% method, may prove interesting for forecasters. If two or three of the methods produce the same categorical forecast, the forecaster can have increased confidence in the forecast.

d. At some time in the future, when customer "utility matrices" have been developed, these probabilities can be multiplied by values in the utility matrix. A categorical forecast can then be made based upon both the forecast probabilities and each particular customer's needs represented by his utility matrix. If customers are being supplied probability forecasts, they might want to know not only what ceiling and visibility are expected, but also what the likelihood is of lower conditions. This information is provided in the forecast guidance and can be passed to customers if the forecaster agrees with the guidance.

e. Plotting the data in the bulletin, as illustrated in Appendix C, simplifies presentation of the information and helps organize forecast reasoning. A graphic display of the bulletin information also provides an excellent shift-change briefing aid. The oncoming forecaster can quickly check the plotted forecast guidance and be prepared to answer that first phone call asking, "What's it going to be like tomorrow?" The headings can be typed on an appropriate general purpose worksheet and information written on an acetate overlay or a local form can be prepared. In the example, POP 06, POP 12, and POF have been copied directly from the bulletin shown in Appendix A. The CLDS and WIND figures have been combined into a one-line presentation in Appendix B, and CIG and VIS have been copied directly (don't forget to add a zero to CIG and VIS figures). Inclement weather periods may be emphasized by 1) shading in green POP 06 and POP 12 greater than 50%, 2) shading in blue POF greater than 50%, 3) connecting the 50% probabilities in each ceiling and visibility category with a dashed black line, 4) circling the "best" category for each time period, and 5) shading in red when probabilities sum to 30% in the lowest two categories. Both 12Z and 00Z bulletins can be plotted on the same worksheet (see Appendix C). This simplifies comparisons of forecasts for the same valid time and highlights major changes which the models have picked up in the intervening 12 hours.

f. The following forecast applications have been noted during verification of the FOUS 6 KNKA bulletin for Norfolk, VA (ORF). The list is not all-inclusive and other applications may be developed for other locations.

(1) The 50% category should usually be the one selected as the forecast. However, if probabilities are "shifting" to the lower categories, e.g., from 00118/5 to 11116/5 in consecutive forecast periods, the forecaster should look to other aids and thoroughly evaluate the possibility of forecasting a lower category.

(2) Forecasts of Norfolk wind direction and speed have been excellent for Langley. Forecasts of winds with westerly components have been particularly good in both speed and direction. The guidance, however, has been typically six hours slow in picking up winds shifting to an easterly direction, but easterly component wind speeds have been good. Gradient gusts have been accurately forecast by multiplying the forecast wind speed by 1.4.

(3) A rapid increase in probability of precipitation (e.g., from 5 to 50% or 30 to 70%) over a 6- or 12-hour period is a good indicator of precipitation in the second period.

g. The following applications are general in nature:

(1) For purposes of interpreting POF: snow, ice pellets, snow grains, etc., are considered frozen precipitation; mixed precipitation is not included in the forecast; freezing rain is considered liquid precipitation.

(2) POF is the probability of frozen precipitation based on the assumption that precipitation will occur. If the forecaster is confident that precipitation will occur, he can use the POF figure directly as forecast in the bulletin. If the forecaster is not entirely confident that precipitation will occur, probability of frozen precipitation is given by the product of the POF times the POP (e.g., .10×.50=.05=5%). The POP 06 should be used in this formula for periods through 36 hours.

(3) Category 1 is the same as AWS Category G. For ceiling only, the <u>sum</u> of the probabilities of Categories 2 and 3 is the probability of AWS Category I.

Conclusion

The MOS Forecast Guidance bulletin provides computed forecast information for many US cities that is useful for some AWS forecast units. Appendix D contains a list of NWS end points. Those marked with an asterisk are available via COMET III at the time of this publication. The forecasts are primarily in probabilistic terms and are based on correlations of the output of NWS models with actual observed weather. The MOS guidance offers no panacea for forecasters, but it does contain valuable forecast information in a compact form that should be considered by all units close to a city for which data are available.

Bibliography

[1] National Weather Service: "Cloud Amount Forecasts Based on Model Output Statistics MOS," NWS TPB #124, November 5, 1974.

[2] National Weather Service: "Cloud Amount Forecasts Based on Model Output Statistics--No. 2," NWS TPB #125, December 4, 1974.

[3] National Weather Service: "Warm Season Surface Wind Forecasts Based on MOS--No. 4," NWS TPB #137, April 25, 1975.

[4] National Weather Service: "Revisions of FOUS 12 and FOUS 22," NWS TPB #150, December 19, 1975.

[5] National Weather Service: "Surface Wind Forecasts Based on Model Output Statistics (MOS)--No. 7," NWS TPB #161, March 12, 1976.

[6] Air Weather Service: Operations Digest No. 3, AWSRP 105-1, Paragraph 18.062, March 1976.

[7] National Weather Service: NWS Eastern Region Technical Attachment, No. 76-7A, March 15, 1976.

Appendix A

Example Forecast Guidance Bulletins
(Norfolk, Virginia)

30/1200Z Mar 76

FOUS6 KNKA	31/00Z	31/06Z	31/12Z	31/18Z	01/00Z	01/06Z	01/12Z	02/00Z
ORF POP06		2	20	50	80			
POP12			20		90		60/40	
POF	0	0	0	0	0	0	0	
CLDS	0127/4	1117/4	0118/4	0118/4	0119/4	0019/4	1117/4	
CIG	01225/4	11115/5	12213/3	02322/3				
VIS	00118/5	00216/5	11322/3	11323/3				
WIND	1504	1603	1205	1009	0810	3417	3220	

31/0000Z Mar 76

FOUS6 KNKA	31/12Z	31/18Z	01/00Z	01/06Z	01/12Z	01/18Z	02/00Z	02/12Z
ORF POP06		30	70	100	60			
POP12			70		100		60/30	
POF	0	0	0	0	0	0	0	
CLDS	0018/4	1018/4	0109/4	0019/4	1019/4	2126/4	2116/4	
CIG	11323/3	01225/4	01116/5	12213/2				
VIS	00225/4	11215/4	00226/5	11224/3				
WIND	1406	1507	1410	2013	2114	2515	3214	

Appendix B

OBJECTIVE VERIFICATION OF FORECAST GUIDANCE

For forecasters who desire an analytic answer to the question, "How good is this product for my station?", the following procedure is suggested:

1. Choose the category which is closest to an important operational threshold for your station, e.g., Category 3, ceiling less than 1000 feet.

2. Choose a forecast period--12 or 18 hours after data base time.

3. Record the forecast probabilities for ceiling less than 1000 feet (sum of probabilities for Categories 1, 2, and 3) from the 00Z or 12Z data base on a work-sheet as illustrated below.

4. Record opposite each forecast, whether or not a ceiling less than 1000 feet occurred.

Month______	Day	Fcst Probability	CIG <1000
	1	20	Yes
	2	20	No
	3	10	No
	4	0	No
	5	0	No
	.	.	.
	.	.	.
	.	.	.

5. At the end of the test period (2 or 3 months or more) plot the data on a forecast reliability graph. The test period should include only summer (Apr-Sep) or only winter (Oct-Mar) data. Do not include data from both summer and winter equations.

6. Opposite each forecast probability, plot the observed percent correct. For example, if there were 40 forecasts of 20% probability of which 10 occurred, the point plotted would have "Y" coordinate 20% and "X" coordinate 10/40 = .25 = 25%. Perfect reliability is represented by the straight line where "X" and "Y" coordinates are equal.

7. In order to judge how significant departures from perfect reliability are, the distribution of forecast probabilities can also be graphed. Then, for example, if the least reliable forecast is found to be that for a probability of 40%, but 40% is forecast only 1% of the time, the deviation is not significant.

Appendix C

Plot of Data From the Two Norfolk MOS Forecast Guidance Bulletins in Appendix A

	31 Mar 00Z	06Z	12Z	18Z	01 Apr 00Z	06Z	12Z	18Z	02 Apr 00Z	06Z	12Z	
DTG 30 Mar 1200Z POP06		2	20	50	80							
POP12			20		90		60		40			
POF	0	0	0	0	0	0	0					
CLD/WND	⊕ 5	⊕ 6	⊕ 2	⊕ 0	⊕ 8	⊕ 4	⊕ 2					
(5) CIG≥20	50	50	30	20								
(4) 10<20	20	10	10	20								
(3) 05<10	20	10	20	30								
(2) 02<05	10	10	20	20								
(1) <02	0	10	10	0								
(5) VIS≥5	80	60	20	30								
(4) 3<5	10	10	20	20								
(3) 1<3	10	20	30	30								
(2) 1/2<1	0	0	10	10								
(1) <1/2	0	0	10	10								
DTG 31 Mar 000Z POP06				30	70	100	60					
POP12					70		100		60		30	
POF			0	0	0	0	0	0	0			
CLD/WND			⊕ 4	⊕ 5	⊕ 4	⊕ 10	⊕ 1	⊕ 3	⊕ 2			
(5) CIG≥20			30	50	60	30						
(4) 10<20			20	20	10	10						
(3) 05<10			30	20	10	20						
(2) 02<05			10	10	10	20						
(1) <02			10	0	0	10						
(5) VIS≥5			50	50	60	40						
(4) 3<5			20	10	20	20						
(3) 1<3			20	20	20	20						
(2) 1/2<1			0	10	0	10						
(1) <1/2			0	10	0	10						

MAC FORM OCT 67 36g GENERAL PURPOSE WORK SHEET 68-01456

Appendix D

NWS END POINTS

STATIONS WITH ALL (MAX/MIN POP/POF CLD/WND CIG/VIS):

ABE	ABI*	ABQ*	ABR	ACT	ACY	AGS	AHN	ALB	ALO	AMA	APN	AST	ATL*	AUS*	AVL	AVP	BAL*
BCE	BDL	BDR	BFD	BFF	BFL	BGM	BGR	BHM	BIL	BIS	BKW	BNA	BNO	BOI*	BOS	BRO	BTR
BTV*	BUF	BVE	CAE*	CAK	CAR*	CDC	CHA	CHS	CLE	CLT	CMH*	CNK	CON	COS*	COU	CPR	CRP
CRW	CVG	CYS*	DAB	DAG*	DAL	DAY*	DBQ	DCA*	DDC	DEN*	DFW*	DLH*	DRT*	DSM	DTW*	EAU	EKN
ELP	ELY	ENV	ERI	EUG	EVV	EWR	EYW	FAR	FAT	FCA	FLG	FMY	FNT	FSD	FSM	FWA*	GEG*
GGW	GJT	GLD	GRB	GRI	GRR	GSO	GSP	GTF*	HAR	HAT	HLN	HON	HSV	HTL	HTS	HVR	IAD
IAH*	ICT*	ILG	ILM	IND	INL	INW	IPT	ISN	JAN	JAX	JFK	LAN	LAS*	LAX	LBB*	LBF	LCH
LEX	LFK	LGA	LGB	LIT*	LND	LOL	LSE	LYH	MAF*	MCI*	MCN*	MCW	MDW	MEI	MEM	MFR	MGM*
MIA*	MKE	MKG	MLI	MOB	MOT*	MSN	MSO	MSP	MSS	MSY	OAK	OKC*	OLM	OMA*	ORD	ORF*	ORL
OTH	PBI	PDT	PDX	PHL*	PHX*	PIA	PIH	PIR	PIT	PUB	PVD	PWM	RAP*	RBL	RDU*	RDM	RFD
RIC	RKS	RNO	ROA	ROC	RSL	RST	SAC*	SAN	SAT*	SAV*	SBN	SCK	SDF*	SEA*	SFO	SGF	SHR
SHV*	SJT	SLC*	SLE	SMX*	SPI	SPS*	SSM*	STL*	SUX	SYR	TCC	TCS	TLH	TOL	TOP	TPA*	TPH
TRI	TUL	TUS*	TVC	TYS	UIL	VCT	WMC	YKM	YNG	YUM	ZUN						

STATIONS WITH POP/POF CLD/WND CIG/VIS ONLY:

ACV BRL FMN STJ WAL

STATIONS WITH POP ONLY:

ALS ALW AQQ BIH BPT CAO CIR CSG DMN EKA EKO ESF GAG GLS GWO HBR ISP JBR
LAL LNK LWS MCB MLC MQT OFK PNS POM PSB ROW SBA STC TXK VTN

STATIONS WITH POP/POF ONLY:

ACK

* Data currently available on COMET III.

LIST OF TECHNICAL NOTES

Number	Title	Date
74-1	Atmospheric Moisture Parameterization (AD-784814)	Jan 74
74-2	Development of a Gridded Data Base ( ) (Publication delayed)	Apr 74
74-3	A Precipitating Convective Cloud Model (ADA-002117)	May 74
74-4	A Synoptic-Scale Model for Simulating Condensed Atmospheric Moisture (ADA-002118)	Jun 74
75-1	Estimated Improvement in Forecasts of the SANBAR Hurricane Model Using the Airborne Weather Reconnaissance System (ADA-004097)	Jan 75
75-2	Spring Weather Patterns of the Western United States (Reprints) (ADA-006691)	Mar 75
75-3	Summer Weather Patterns of the Western United States (Reprints) (ADA-009860)	May 75
75-4	Autumn Weather Patterns of the Western United States (Reprints) (ADA-013801)	Jul 75
75-6	Winter Weather Patterns of the Western United States (Reprints) (Publication delayed)	Sep 75
76-1	Listing of Seminars Available at Hq AWS, AWS Wings, and AFGWC (Publication delayed)	Mar 76
76-2	Some Aspects of Estimating the Probability of Cloud-Free Lines-of-Sight in Synamic Situations ( )	Mar 76
76-3	Model Output Statistics Forecast Guidance ( )	Sep 76