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THE VALUE OF STATIC AND TREND PERSISTENCE

IN THE

ONE-HOUR PREDICTION OF CEILING AND VISIBILITY

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THE VALUE OF STATIC AND TREND PERSISTENCE
IN THE
ONE-HOUR PREDICTION OF CEILING AND VISIBILITY

by

Mr. Joe S. Restivo
and
Capt Franklin R. Hartranft

February 1970

Aerospace Sciences Division
Headquarters 4th Weather Wing
Ent Air Force Base, Colorado 80912

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PREFACE

One of the most popular forecasting tools employed in the preparation of one-hour ceiling and visibility forecasts is "persistence forecasting." The popularity of this tool stems from the fact that it is a purely mechanical method, and requires a minimum amount of meteorological skill and time in its application. Impetus for employing this tool is frequently supplied by results from various verification studies where general conclusions are made that the highest verification scores are always obtained with persistence forecasts. Usually, these conclusions refer only to the overall percent correct scores for all ceilings (or visibilities) combined, which are indeed high due to the inclusion of the large number of cases with high ceilings and visibilities which are very persistent. Few verification studies contain a comprehensive evaluation of persistence forecasts for a complete spectrum of initial ceiling and visibility conditions, and those that do are limited to only a few years data. In addition, difficulties in the interpretation of results from verification studies are created due to the vague definition of the term "persistence forecast." The term actually has different meanings to different meteorologists.

It is felt therefore that a need exists for clarifying the term "persistence forecast" and for a comprehensive quantitative evaluation utilizing a large sample of data over a wide spectrum of initial ceiling and visibility conditions. The purpose of this paper is to contribute to this need.

In addition to the authors, others involved in conducting this study included Capt A. Cotton who prepared the original computer program, and MSgt R. Helms and SSgt V. Medina who performed many of the machine printout analyses. The helpful suggestions provided by members of the 4th Weather Wing Aerospace Sciences Division are also gratefully acknowledged. The authors are also grateful to Mrs. M. Jasmund for the editorial preparation of this paper.

JOE S. RESTIVO
Scientific Services Branch (4VS)
Aerospace Sciences Division
February 1970

FRANKLIN R. HARTRANFT, Capt, USAF
Automation Branch (4VA)
Aerospace Sciences Division
February 1970

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SECTION I - INTRODUCTION AND DEFINITION OF TERMS

For many years, much attention has been directed toward developing uses of persistence in applied meteorology. In general, these efforts can be classified into two groups. In one, attention has been directed toward uses of persistence as a forecast evaluation tool, and in the second, toward uses of persistence as a forecasting aid. As an evaluation tool, "persistence forecasts" are frequently used as a standard of comparison in evaluating newly developed forecast methods or in measuring the skill of forecasters. In this application, the persistence forecast is considered as a professionally unskilled forecast which should be surpassed if any degree of skill is claimed. Most of the published literature dealing with forecast evaluation studies include a discussion on the comparison of a particular technique against persistence. Some comprehensive evaluation studies of this type include those conducted by Travelers Research Center [1] and others [2], [3]. Illustrations of the use of persistence forecasts as a yardstick in measuring forecaster skill are studies such as [4], and the Air Weather Service Product Evaluation Program [5]. As a forecasting tool, persistence is often incorporated into objective forecast studies as one of the predictors as described in [6]. In recent years the most popular application of persistence as a forecast aid has been through "persistence probability" tables [7], onset-duration tables [8], and other statistical tables derived from climatological data. These aids are designed to encourage the most intelligent and effective utilization of persistence in the daily forecast routine.

Although a variety of literature is available on uses of persistence it should be noted that the term "persistence forecast" apparently has different meanings to different meteorologists. The basic definition [9] of this term is "...a forecast that the future weather condition will be the same as the present condition." Although this definition appears simple, it is surprising to note the many different ways in which it is applied and the different interpretations made from conclusions in published studies, particularly those dealing with ceiling and visibility. Some of the confusion stems from different choices of the "initial weather condition." Some use individual ceiling and visibility values; some use individual ceiling and visibility categories; and others use combined ceiling/visibility categories. Additional confusion is introduced by some forecasters who apply the term "persistence forecast" to the continuation (or persistence) of an established trend in ceiling and visibility values (or categories). The term "persistence" is indeed an equivocal term.

In order to simplify further discussion in this paper, certain definitions will be introduced periodically. At this point, it would be well to introduce the term, STATIC PERSISTENCE, which is

defined as the repetition of an initial value (or category) for a given forecast period, regardless of any previous trends. In this paper, the forecast period is one hour. TREND PERSISTENCE is defined as the continuation of an established trend in values (or categories) as determined from the initial condition and previously recorded observations.

1. Static Persistence of Ceiling and Visibility Values vs Categories. To some meteorologists, the term "persistence forecast" means simply a "no change" forecast of the initial ceiling or visibility category to which the initial value was originally assigned. For example, consider a particular ceiling category which is defined as ceilings between 500-900 feet. Suppose the initial ceiling value is 500 feet and the one-hour forecast calls for a 900-foot ceiling. This is a static persistence forecast of the ceiling category, but is certainly not a static persistence forecast of the ceiling value. There is a distinction, therefore, between category-persistence and value-persistence. Studies which deal with category-persistence will naturally yield higher verification scores than those dealing with value-persistence and therefore, tend to overestimate the value of persistence. This tendency is further amplified by defining broader categories and using combined ceiling/visibility categories. Quite often, the reader is not aware of these differences in definitions by different investigators and may blindly accept certain conclusions without any qualification. To illustrate a few of these differences:

a. Travelers Research Center [1] used persistence forecasts in categorical form using five ceiling categories and five visibility categories. Some of the ceiling categories were rather broad (e.g., Category 4: ≥ 1000 feet but < 3000 feet and Category 5 included the extremely broad category of all ceilings ≥ 3000 feet).

b. Melpar Inc. [2] also shred out their data separately by ceiling and visibility, but instead of fixed categories, used variable tolerance limits to define persistence forecasts. For a given initial ceiling value, the ceiling was said to "persist" if the ceiling remained within certain limits (e.g., for initial ceiling values > 1000 feet but ≤ 2000 feet, the ceiling was said to persist if it remained within ± 300 feet of the initial value; however, for initial ceiling values > 500 feet but ≤ 1000 feet, a ceiling persisted if it remained within ± 200 feet of the initial value).

c. In [4] and [5], the ceiling and visibility data are lumped together into combined ceiling/visibility categories. In the AWS Product Evaluation Program [5], the initial ceiling and visibility values are grouped into five initial ceiling and/or visibility categories (e.g., category VL includes ceilings ≥ 1000 feet but < 3000 feet and/or visibility ≥ 2 miles but < 3 miles). Using this scheme, a "persistence forecast" is defined as a forecast that the future ceiling/visibility

category will be the same as the initial ceiling/visibility category. In [4] a similar scheme is employed using combined ceiling/visibility categories but the limits are much broader than those in [5]. For example, category III in [4] includes ceilings ≥ 1500 feet but < 5000 feet and all visibilities ≥ 3 miles.

2. Static Persistence of Ceiling vs Cloud Height. In studies dealing with cloud forecasts, the distinction is made by the author (but may be missed by the reader) that verification figures on "persistence" refer to cloud forecasts which include heights of scattered clouds as well as ceiling heights. In such studies [3], results concerning the value of persistence forecasts cannot be compared directly with results from studies dealing only with ceilings. The authors of this paper feel that there is a difference in the cloud height variability between scattered clouds and ceilings. Results from a separate investigation indicate that the one-hour cloud height variability of scattered clouds is less than the variability of ceilings at the same height, and therefore, the inclusion of scattered clouds in the data groupings would produce higher verification scores for this type of persistence forecast.

3. Trend Persistence. Verification scores from trend persistence forecasts represent the percent accuracy attained by assuming "no-change" in an established trend in values (or categories) as determined by comparing the initial observation with a series of previously recorded observations. It is recognized that trend persistence is referred to by other names in the literature, such as "extrapolation" in [10] or simply "trend" in [3]. The fact remains, however, that many forecasters who do use this forecast tool refer to the technique as "persistence." It certainly differs from static persistence, but it is another type of a no-change forecast. For example, if the ceiling has been lifting at a certain rate for a period of time, say for the past two hours, many forecasters will predict a higher ceiling during the next hour and the reason often given is that they are using "persistence." Trend persistence has been used both as an evaluation tool and forecast aid. In [3] it is described as an evaluation tool, where it is compared with static persistence and other techniques. In [10] and [11], it is applied as a forecast aid. The results from [10] and [11], however, are based on extremely limited samples of data.

It is apparent from the previous discussion that one must accept conclusions from the variety of published studies with a certain degree of qualification. If a particular evaluation study draws the general conclusion that "persistence is the best forecast," the investigator may have been referring to a comparison with static category-persistence using exceptionally broad combined ceiling/visibility categories, and/or the comparison may have been made only between overall

percent-correct scores. Persistence may not have been the best forecast for certain restricted ceiling or visibility conditions. The following conclusion, published a few years ago in a widely disseminated publication [12], is a typical example of an unqualified statement concerning persistence forecasts, without any explanation concerning the specific type of persistence forecast, amount of data used, or method of evaluation. On the other hand, the statement may actually be only an expression of personal opinion without support of results from any investigation. The statement in "...it is generally acknowledged that forecasts of 0 to 2 hours can usually not be made which are more accurate than persistence. This means if knowledge about elements in this short time range is needed it is best to use the current observation for the forecast." Most forecasters are aware of this statement since this publication is available in every forecasting detachment. It has special interest in 4 Wea Wg since the preparation of 1-2 hour forecasts is a routine forecast responsibility. As a result of such unqualified statements in the literature, it is not surprising, therefore, to find many forecasters who blindly accept the premise that persistence forecasting cannot be surpassed, and tend to rely excessively upon persistence while ignoring other meteorological tools.

A need exists for a comprehensive analysis on the value of all types of persistence forecasts, in which a complete spectrum of initial ceiling and visibility conditions are investigated using a large sample of data. An attempt is made in this paper to provide reliable quantitative estimates on the value of static persistence and trend persistence of separate ceiling and visibility values and categories using a long period of record.

SECTION II - DATA

In order to keep the study to a manageable size, an attempt was made to obtain the most representative data for the study. A series of stations was chosen across the country which not only had a long period of record of surface observations on magnetic tape, but were also representative of the weather regimes of their particular locations. A total of seven stations were chosen. These are listed in Table i. Surface weather observations on magnetic tape were obtained from the Environmental Technical Applications Center (ETAC) for each station. This data consisted of card images of hourly surface observations. The total number of observations for a given station varied from 100,000 to 175,000, depending on the period of record. It must be emphasized that only hourly observations were considered in the study. No special or local surface observations were available on magnetic tape.

Values of ceiling and visibility were reported in accordance with the Manual of Surface

Observations (WBAN), Circular N. Minor changes in reportable values of visibility were made through the years, but these are inconsequential to the study. Ceiling values have always followed a standard reporting format.

TABLE 1: List of stations and period of record used in study.

Location Identifier	Station Name	Period of Record
COS	Colorado Springs, Colorado	July 1948-December 1964
OAF	Oxnard AFB, California	April 1944-June 1965
FMH	Otis AFB, Massachusetts	October 1942-June 1965
PAM	Tyndall AFB, Florida	August 1945-July 1965
DLH	Duluth IAP, Minnesota	January 1948-December 1963
SRF	Hamilton AFB, California	July 1945-June 1965
GVW	Richards-Gebaur AFB, Missouri	April 1954-June 1965

SECTION III - METHOD OF DEVELOPMENT

A. Ceiling and Visibility Values.

1. To evaluate static persistence, each initial hourly observation was compared to the observation one hour later.

2. To evaluate trend persistence, each initial hourly observation was compared to the two hourly observations immediately preceding and the observation one hour later.

a. One-hour ceiling value trends were computed by subtracting the ceiling height of the previous hour from the initial ceiling height. In this way, a one-hour ceiling trend was established. This is referred to as one-hour trend of ceiling values. The direction of the trend was verified by comparing the initial ceiling value with the ceiling value one hour later. The one-hour trend of visibility values was calculated in the same manner.

b. Two-hour ceiling trends were computed by further subtracting the two-hour previous

ceiling height from the one-hour previous ceiling height. Together with the one-hour trend, this is referred to as two-hour trend of ceiling values. This was again compared to the ceiling observation one hour after initial time. The two-hour trend of visibility values was calculated in the same manner.

Ceiling and Visibility Categories.

Prior to analysis, all ceiling values were classed into eight ceiling categories (A-H) and all visibility values were classed into eight visibility categories (J-Q).

1. To evaluate static persistence of ceiling categories and visibility categories, the initial category was compared to the category one hour later.

2. The one-hour and two-hour trend of ceiling categories and visibility categories was computed using the technique described earlier.

Processing of ceiling and visibility data was accomplished through computer techniques. Data were sequence checked to insure that the hourly trends were valid. The trend computation was omitted when either one or two hours of data was missing prior to the initial observation, or missing one hour following the initial observation. For this reason, minor differences occur between the total number of ceiling observations and the total number of visibility observations for the same station. However, the percentage values are correctly calculated, based upon the actual number of observations considered.

SECTION IV - RESULTS

A. General.

With any statistical study, the question arises concerning the size of the data base. Tables 2 and 3 list the frequency of initial hourly ceiling heights and the number of initial hourly visibility values respectively for each station used in the study. From these values the computations of static persistence, one-hour trend persistence and two-hour trend persistence were made. These two tables are also an indication of the ceiling/visibility climatology of the station. Given the total number of observations during the indicated period of record, the percentage frequency of occurrence of specified hourly observations is tabulated.

Depiction of results in a statistical study is a major problem. With large amounts of data,

TABLE 2: Frequency of specified ceilings reported on hourly observations during period of record at selected terminals.

Ceiling (feet)	COS		QAF		FMH		PAM		DLH		SRF		GVW	
	Cases	%	Cases	%	Cases	%	Cases	%	Cases	%	Cases	%	Cases	%
0-100	816	0.6	2843	2.4	6126	3.9	3150	1.8	4593	3.3	2522	1.4	968	1.0
200-400	2104	1.5	3665	3.0	10944	6.9	3437	2.0	6344	4.5	2814	1.6	2457	2.5
500-900	3038	2.1	7751	6.4	10461	6.5	5175	3.0	8666	6.2	8852	5.1	4005	4.0
1000-1400	2152	1.5	5471	4.5	5079	3.2	3715	2.1	7125	5.1	7081	4.0	2815	2.9
1500-2900	4669	3.2	7990	6.6	9124	5.7	9811	5.6	11389	8.1	12164	7.0	6134	6.2
3000-4900	4882	3.4	4161	3.4	9174	5.8	6183	3.5	10033	7.2	6140	3.5	4946	5.0
5000-9500	11782	8.1	2284	1.9	12228	7.7	9177	5.3	10070	7.2	4352	2.5	8461	8.6
≥ 10000	114986	79.6	87034	71.8	95772	60.3	133947	76.7	81794	58.4	131223	74.9	68810	69.8
TOTAL	144429	100%	121198	100%	158908	100%	174595	100%	140014	100%	175148	100%	98596	100%
Period of Record	7/48-12/64		4/44-6/65		10/42-6/65		8/45-7/65		1/48-12/63		7/45-6/65		4/54-6/65	

TABLE 3: Frequency of specified visibilities reported on hourly observations during period of record at selected terminals.

Visibility (st. miles)	COS		QAF		FMH		PAM		DLH		SRF		GVW	
	Cases	%	Cases	%	Cases	%	Cases	%	Cases	%	Cases	%	Cases	%
0-3/8	995	0.7	2658	2.2	5835	3.7	3230	1.9	4218	3.0	3427	2.0	1150	1.2
1/2-7/8	1049	0.7	1995	1.7	4596	2.9	1288	0.7	2270	1.6	1339	0.8	988	1.0
1-1 7/8	1266	0.9	4828	4.0	7302	4.6	1629	0.9	3579	2.6	3394	1.9	1932	2.0
2-2 1/2	943	0.7	5496	4.5	6271	4.0	1474	0.8	2997	2.1	3205	1.8	1626	1.7
3-4	1722	1.2	11391	9.4	12212	7.7	4278	2.4	4657	3.3	8160	4.7	3446	3.5
5-6	1786	1.2	13533	11.2	12130	7.6	7900	4.5	3427	2.5	7628	4.3	3290	3.3
7-9	1936	1.3	24917	20.5	14843	9.3	40481	23.2	4781	3.4	20946	12.0	6748	6.8
≥10	134724	93.3	56351	46.5	95739	60.2	114307	65.6	114081	81.5	127053	72.5	79416	80.5
TOTAL	144421	100%	121169	100%	158928	100%	174587	100%	140010	100%	175152	100%	98596	100%
Period of Record	7/48-12/64		4/44-6/65		10/42-6/65		8/45-7/65		1/48-12/63		7/45-6/65		4/54-6/65	

some method of display must be chosen to best illustrate the main points of the study. In this study, a total of six types of persistence are considered, namely: static persistence, one-hour and two-hour trend persistence of ceiling values and visibility values, and static persistence, one-hour and two-hour trend persistence of ceiling categories and visibility categories. This results in 12 sets of computation for each of the seven stations considered. It was decided to portray the results both graphically and on special tables to best answer the question, "Given an initial ceiling or visibility condition, or an established one-hour or two-hour trend, what percentage of the time will this condition (or trend) persist for the next hour?"

However, a discussion of 84 individual graphs and 28 tables is prohibitive, so it was decided to construct composite graphs and tables of each type of persistence. This resulted in 12 mean graphs (six covering ceiling and six covering visibility) and four mean tables (two covering ceiling and two covering visibility). All of these were computed from over one million hourly observations. The discussion will center on these mean charts with comments directed to individual stations only when there are significant deviations. The graphs and tables for each individual station are found in the Appendices.

B. Description of Tables 4 Through 7.

1. Table 4 shows for all stations combined, the percentage frequency of one-hour changes in ceiling values from an initial ceiling value. Given an initial ceiling value and the previous hourly trends (viz., no trend, U-up, S-same, D-down), this table shows the percentage of time that the ceiling value one hour later was at least 100 feet higher, the same value, or at least 100 feet lower than the initial value. To facilitate the portrayal of data, the initial ceiling values have been grouped by certain ranges. For example, the column labeled 1000-1400 feet is used to summarize the results from individual initial ceiling values of 1000 feet, 1100 feet, 1200 feet, 1300 feet or 1400 feet.

a. NO TREND. This section of the table shows for each initial ceiling value, the percentage of time that the ceiling value one hour later was higher (U), the same (S) and lower (D), regardless of the previous ceiling trend. The row labeled "S" therefore represents the STATIC PERSISTENCE of ceiling values. The number of cases processed are shown in the last row of the section. For example, consider the column "1500-2900." There were a total of 61,281 initial hourly observations in which the initial ceiling value was 1500 feet, 1600 feet, ... or 2900 feet. In 43% of these cases, the ceiling one hour later was at least 100 feet higher, the ceiling value one hour later was exactly the same in 29% of the cases, and during the remaining 28% of the time, the

TABLE 5: Percentage frequency of one-hour changes in visibility values from an initial visibility value. Given an initial visibility value and the previous hourly visibility trends (U-up, S-same, D-down) this table shows the percentage of time that the visibility value one hour later is higher, the same, or lower than the initial value.

STATION: ALL STATIONS	PREVIOUS TRENDS	FUTURE 1-HR CHANGES	INITIAL VISIBILITY VALUE (ST. MILES)										All Visibilities
			0-3/8	1/2-7/8	1-1 7/8	2-2 1/2	3-4	5-6	7-9	≥ 10			
NO TREND		U S D	43	48	47	42	39	37	28	6		13	
			44	28	29	33	38	38	52	84		74	
			13	24	24	25	23	25	20	10		13	
1-HR UP TREND		U S D	21513	13525	23930	22012	45866	49694	114652	721671		1012863	
			54	57	56	51	49	49	39	16		31	
			28	22	22	28	32	31	43	70		53	
1-HR STEADY TREND		U S D	18	21	22	21	19	20	18	14		16	
			2910	3468	6694	6470	11837	12825	20392	70678		135274	
			37	42	41	35	32	31	24	4		8	
1-HR DOWN TREND		U S D	54	38	39	43	47	47	59	87		82	
			9	20	20	22	21	22	17	9		10	
			9383	3923	7390	7707	19765	21888	73878	607741		751675	
2-HR UP TREND		U S D	46	47	42	40	37	34	27	16		29	
			38	26	31	28	46	32	45	56		45	
			16	27	27	32	17	34	28	28		26	
2-HR STEADY TREND		U S D	9220	6134	9846	7835	14264	14981	20382	43252		125914	
			57	59	60	56	54	53	43	19		35	
			19	17	19	24	30	29	42	68		51	
2-HR DOWN TREND		U S D	24	24	21	20	16	18	15	13		14	
			300	720	1884	2249	4166	4487	7057	20574		41437	
			35	34	38	29	30	26	21	4		6	
2-HR DOWN TREND		U S D	59	48	45	50	52	54	63	88		85	
			6	18	17	21	18	20	16	8		9	
			5098	1569	3121	3534	10499	11957	53353	531876		621007	
2-HR DOWN TREND		U S D	46	47	45	40	36	34	26	15		34	
			37	26	26	27	32	33	43	59		38	
			17	27	29	33	32	33	31	26		28	
			4746	2902	4192	3019	4878	3969	3630	5734		33070	

ceiling value one hour later was at least 100 feet lower.

b. ONE-HOUR TREND. Three sections of the table show the results of including the one-hour trend in ceiling values from the previous hour (t_{-1}) to the initial hour (t_0). The "1-HR Up Trend" section shows for each initial ceiling value, the percentage of time that the ceiling value one hour after initial time (t_{+1}) was higher (U), the same (S), and lower (D) than the initial value during all conditions when the ceiling had improved at least 100 feet during the past hour (from t_{-1} to t_0). The "1-HR Steady Trend" section shows for each initial ceiling value, the percentage of the time that the ceiling value one hour later was U, S, and D during all conditions when the ceiling value remained exactly the same during the past hour. The "1-HR Down Trend" section shows for each initial ceiling value, the percentage of time that the ceiling value one hour later was U, S, or D during all conditions when the ceiling had lowered at least 100 feet during the past hour. Since all initial ceiling conditions are preceded by a U, S, or D trend, the sum of the initial cases from the three one-hour trend sections will be equal to the total number of cases in the "NO TREND" section for each initial ceiling value.

c. TWO-HOUR TREND. Three sections of the table show the results of including the two-hour trend in ceiling values as determined from t_{-2} to t_{-1} and from t_{-1} to t_0 . Although nine combinations of two-hour trends (viz., UU, US, UD, SU, SS, SD, DU, DS and DD) were computed in this study, only three of these trends are included in Table 4 in order to evaluate trend persistence. Those listed in Table 4 are UU, SS, and DD, or situations where the direction of the trend was the same during the previous two hours.

2. Table 5 shows for all stations combined, the percentage frequency of one-hour changes in visibility values from an initial visibility value. This table is interpreted in the same manner as Table 4.

3. Table 6 shows for all stations combined, the percentage frequency of one-hour changes in ceiling categories from an initial ceiling category. Given an initial ceiling category and the previous hourly trends, this table shows the percentage of time that the ceiling category one hour later improved to at least one category higher (U), remained the same (S), or lowered to at least one category lower. The interpretation of Table 6 is similar to Table 4 except that ceiling categories are used instead of ceiling values. In the "NO TREND" section, the row of percentages in the row labeled "S" represents the STATIC PERSISTENCE of ceiling categories. In order to appreciate the differences between Table 6 and Table 4, consider the following example from the "NO TREND"

TABLE 6: Percentage frequency of one-hour changes in ceiling categories from an initial ceiling category. Given an initial ceiling category and the previous hourly trends in ceiling categories (U-up, S-same, D-down) this table shows the percentage of time that the ceiling category one hour later is higher, the same, or lower than the initial category.

STATION: ALL STATIONS	PREVIOUS TRENDS	FUTURE 1-HR CHANGES	INITIAL CEILING CATEGORY (FEET)										All Categories
			A 0-100	B 200-400	C 500-900	D 1000-1400	E 1500-2900	F 3000-4900	G 5000-9500	H ≥ 10000			
NO TREND		INITIAL CASES	28	30	26	32	26	25	21	--	8		
			72	61	62	52	62	58	63	95	85		
			--	9	12	16	12	17	16	5	7		
1-HR UP TREND		INITIAL CASES	21018	31765	47948	33438	61281	45519	58354	713566	1012889		
			--	32	28	35	24	24	21	--	13		
			--	56	58	48	57	52	54	81	67		
1-HR STEADY TREND		INITIAL CASES	--	12	14	17	19	24	25	19	20		
			--	3364	5801	6284	8439	7837	7530	37270	76525		
			25	27	24	29	23	23	20	--	5		
1-HR DOWN TREND		INITIAL CASES	75	65	66	57	66	62	67	95	90		
			--	8	10	14	11	15	13	5	5		
			15325	19831	30497	17979	38030	26043	37216	676296	861217		
2-HR UP TREND		INITIAL CASES	35	34	32	34	33	30	26	--	31		
			65	55	54	46	54	54	61	--	56		
			--	11	14	20	13	16	13	--	13		
2-HR STEADY TREND		INITIAL CASES	5693	8570	11650	9175	14812	11639	13608	--	75147		
			--	--	35	45	29	26	23	--	13		
			--	--	55	37	54	46	51	82	68		
2-HR DOWN TREND		INITIAL CASES	--	--	10	18	17	28	26	18	19		
			--	--	536	640	1338	857	1201	5562	10134		
			24	26	22	27	21	22	18	--	4		
2-HR STEADY TREND		INITIAL CASES	76	67	69	60	68	64	68	96	96		
			--	7	9	13	11	14	14	4	4		
			11503	13097	20391	10509	25210	15469	25127	642929	764235		
2-HR DOWN TREND		INITIAL CASES	34	34	31	35	31	27	--	--	32		
			66	56	56	43	54	54	--	--	55		
			--	10	13	22	15	19	--	--	13		
INITIAL CASES			1298	1868	2418	1407	1819	964	--	--	9774		

TABLE 7: Percentage frequency of one-hour changes in visibility categories from an initial visibility category. Given an initial visibility category and the previous hourly trends in visibility categories (U-up, S-same, D-down), this table shows the percentage of time that the visibility category one hour later is higher, the same, or lower than the initial category.

INITIAL VISIBILITY CATEGORY (ST. MILES)													
STATION: ALL STATIONS	PREVIOUS TRENDS	FUTURE 1-HR CHANGES	J 0-3/8	K 1/2-7/8	L 1-1 7/8	M 2-2 1/2	N 3-4	O 5-6	P 7-9	Q ≥10	All Categories		
NO TREND		U S D	30	42	39	38	32	32	24	--	7		
			70	40	45	40	50	47	60	96	86		
			--	18	16	22	18	21	16	4	7		
1-HR UP TREND		U S D	21513	13525	23930	22012	45866	49694	114652	721671	1012863		
			--	52	46	46	40	41	31	--	23		
			--	32	37	34	43	41	53	88	62		
1-HR STEADY TREND		U S D	--	16	17	20	17	18	16	12	15		
			--	2565	4398	5155	8772	9833	15837	29140	75700		
			26	36	35	32	28	27	21	--	4		
1-HR DOWN TREND		U S D	74	48	51	49	56	55	65	96	91		
			--	16	14	19	16	18	14	4	5		
			14888	5580	11452	9600	25194	27000	81994	692531	868239		
2-HR UP TREND		U S D	39	42	39	39	34	33	24	--	33		
			61	37	40	34	43	41	53	--	47		
			--	21	21	27	23	26	23	--	20		
2-HR STEADY TREND		U S D	6625	5380	8000	7257	11900	12861	16821	--	68924		
			--	--	46	53	43	47	34	--	24		
			--	--	18	15	13	15	14	11	13		
2-HR DOWN TREND		U S D	--	--	567	982	2200	2388	4130	6098	16365		
			25	32	32	28	26	24	19	--	3		
			75	55	56	54	59	58	68	96	93		
2-HR DOWN TREND		U S D	--	13	12	18	15	18	13	4	4		
			10612	2725	6243	5097	15634	16863	62404	659285	778863		
			38	42	39	39	31	30	--	--	36		
2-HR DOWN TREND		U S D	62	38	41	35	45	42	--	--	45		
			--	20	20	26	24	28	--	--	19		
			2676	1947	2584	1926	2707	1704	--	--	13544		

sections of the tables. Suppose the initial ceiling was 600 feet and one hour later the ceiling increased to 800 feet. In Table 6, this individual case was included in the "S" row (62% figure) or STATIC PERSISTENCE of ceiling categories, since the initial category was category C and remained category C. In Table 4, however, this individual case was included in the "U" row (42% figure) since the ceiling value was at least 100 feet higher one hour later. Throughout Table 6, the reader must remember that the frequency of one-hour changes refer specifically to category changes.

4. Table 7 shows for all stations combined, the percentage frequency of one-hour changes in visibility categories from an initial visibility category. It is interpreted in the same manner as Table 6.

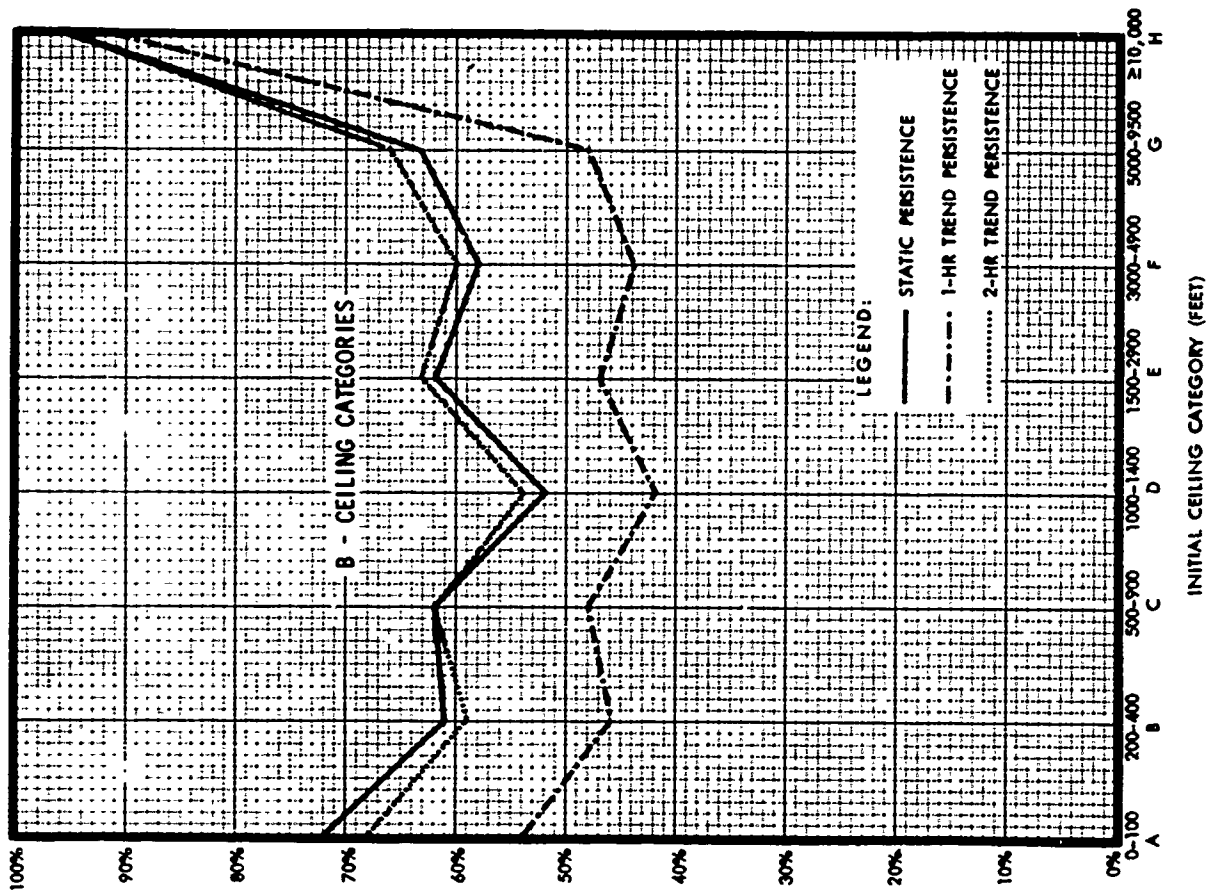
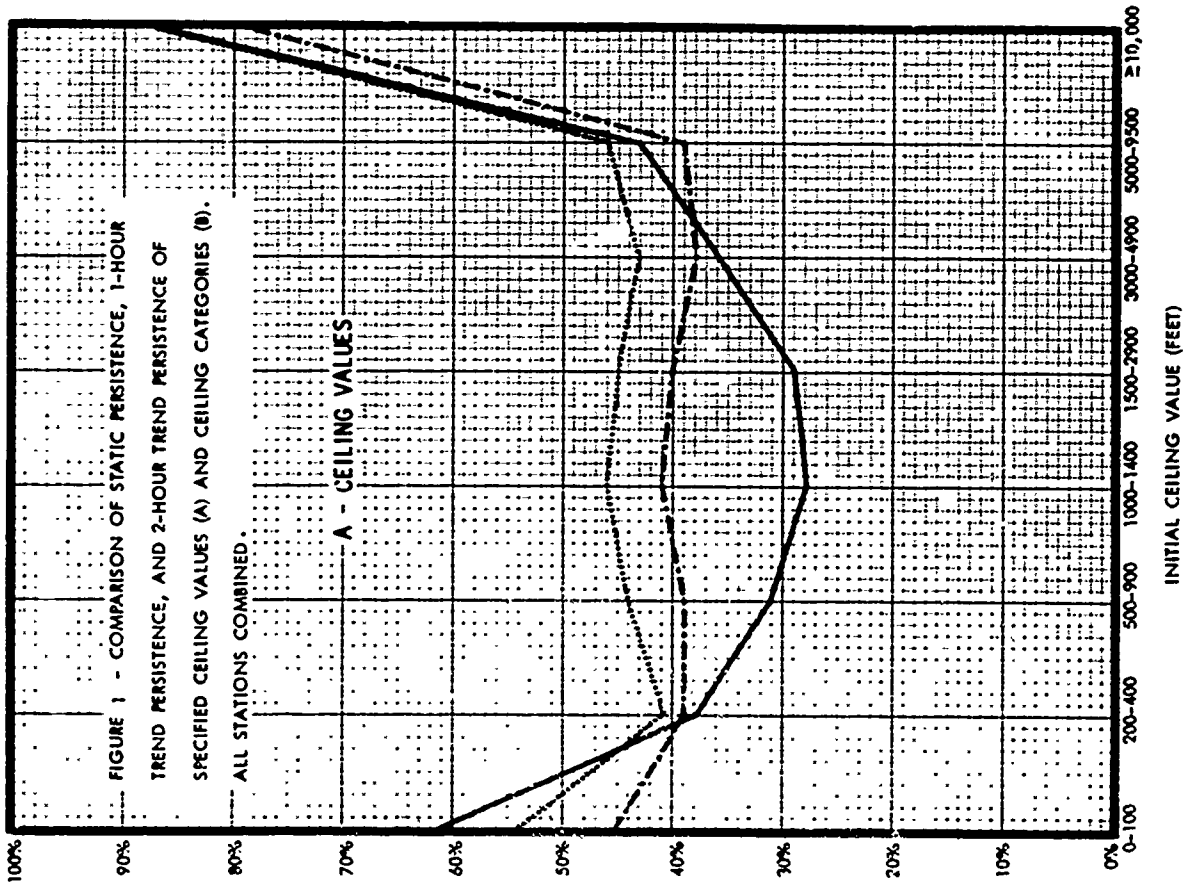
C. Description of Figures 1 and 2.

1. Figure 1 shows graphically for all stations combined, a comparison of Static Persistence, Overall 1-Hour Trend Persistence, and Overall 2-Hour Trend Persistence for ceiling values (Figure 1A) and ceiling categories (Figure 1B). This figure summarizes in graphical form, much of the ceiling information found in Table 4 and Table 6.

a. The "Static Persistence" curves in Figures 1A and 1B are simply a plot of the percentage values from the "S" row of the "NO TREND" sections of Table 4 and Table 6 respectively. Both curves provide a reliable quantitative estimate of the value of static persistence of ceiling values and ceiling categories for different initial ceiling conditions.

b. The "1-Hour Trend Persistence" curves were constructed using an overall "percent agreement" value computed from the three 1-Hour Trend sections of Table 4 and Table 6. The values plotted in Figure 1 are not readily apparent in Table 4 and Table 6, therefore, some further discussion is warranted. A specific value on the curves represents the percentage of time that the past one-hour trend (U, S, or D) continued for one hour (e.g., U→U, S→S and D→D). An example will illustrate the computation of the plotted values. Consider the value of 40% in Figure 1A for initial ceiling values between 1500 feet-2900 feet. From Table 4, 48% of the 1-Hour Up Trends continued up; 37% of the 1-Hour Steady Trends continued steady; and 31% of the 1-Hour Down Trends continued down. Combining these three values yields the 40% (overall agreement) value plotted in Figure 1A. The values in Figure 1B were computed in the same manner.

c. The "2-Hour Trend Persistence" curves were computed from the three 2-Hour Trend sections of Table 4 and Table 6. A specific value on the curves represents the percentage of time that the past two-hour trend (UU, SS, or DD) continued for one hour (e.g., UU→U, SS→S, and DD→D).



2. Figure 2 shows graphically for all stations combined, a comparison of Static Persistence, Overall 1-Hour Trend Persistence, and Overall 2-Hour Trend Persistence for visibility values (Figure 2A) and visibility categories (Figure 2B). Figure 2 summarizes much of the visibility information found in Table 5 and Table 7. The same techniques were used in constructing Figure 2 as used in Figure 1.

D. Discussion of Results.

An attempt to discuss in detail each of the individual graphs and tables in the Appendices is beyond the scope of this paper. Small scale variations occur among individual stations due primarily to local influences. These in themselves are interesting but only the results common to most stations will be discussed in this section.

1. Ceiling Persistence (Figure 1, Table 4, and Table 6).

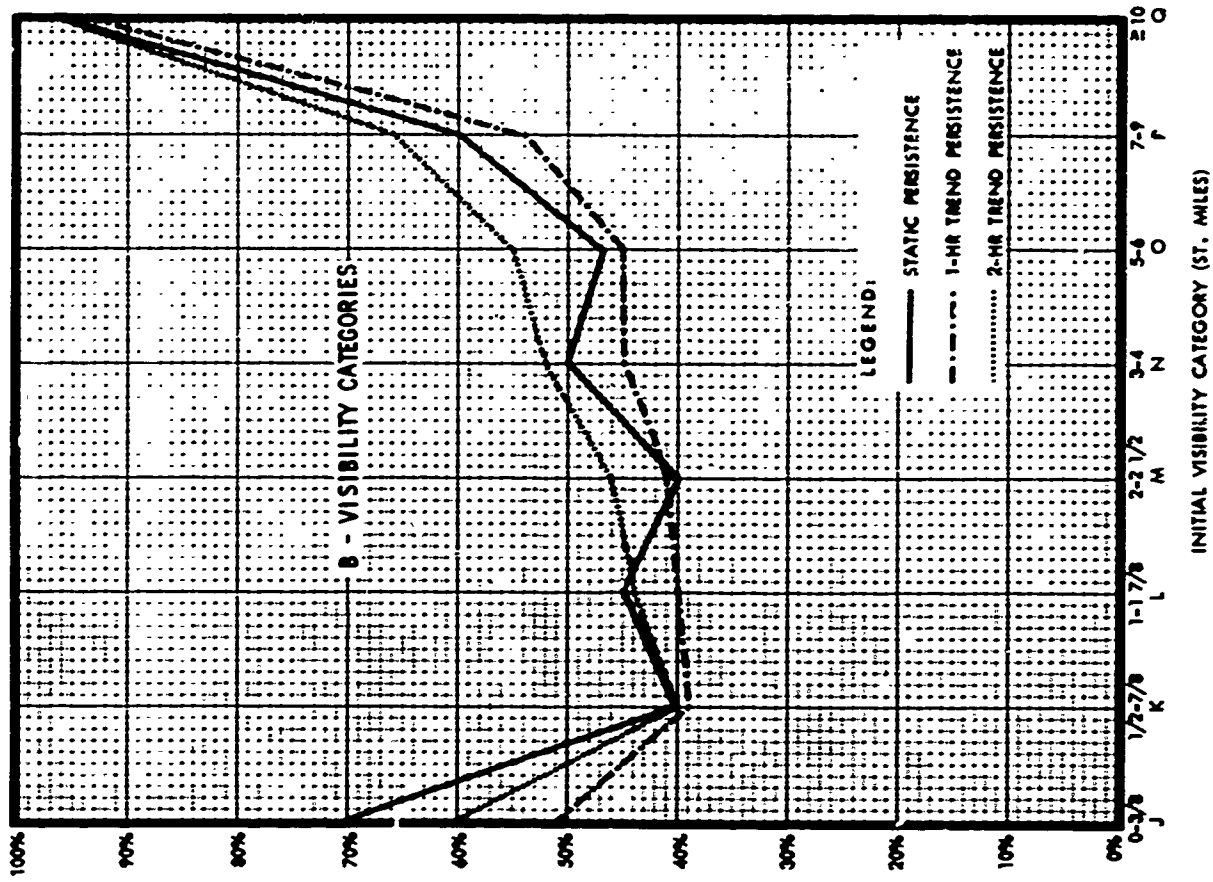
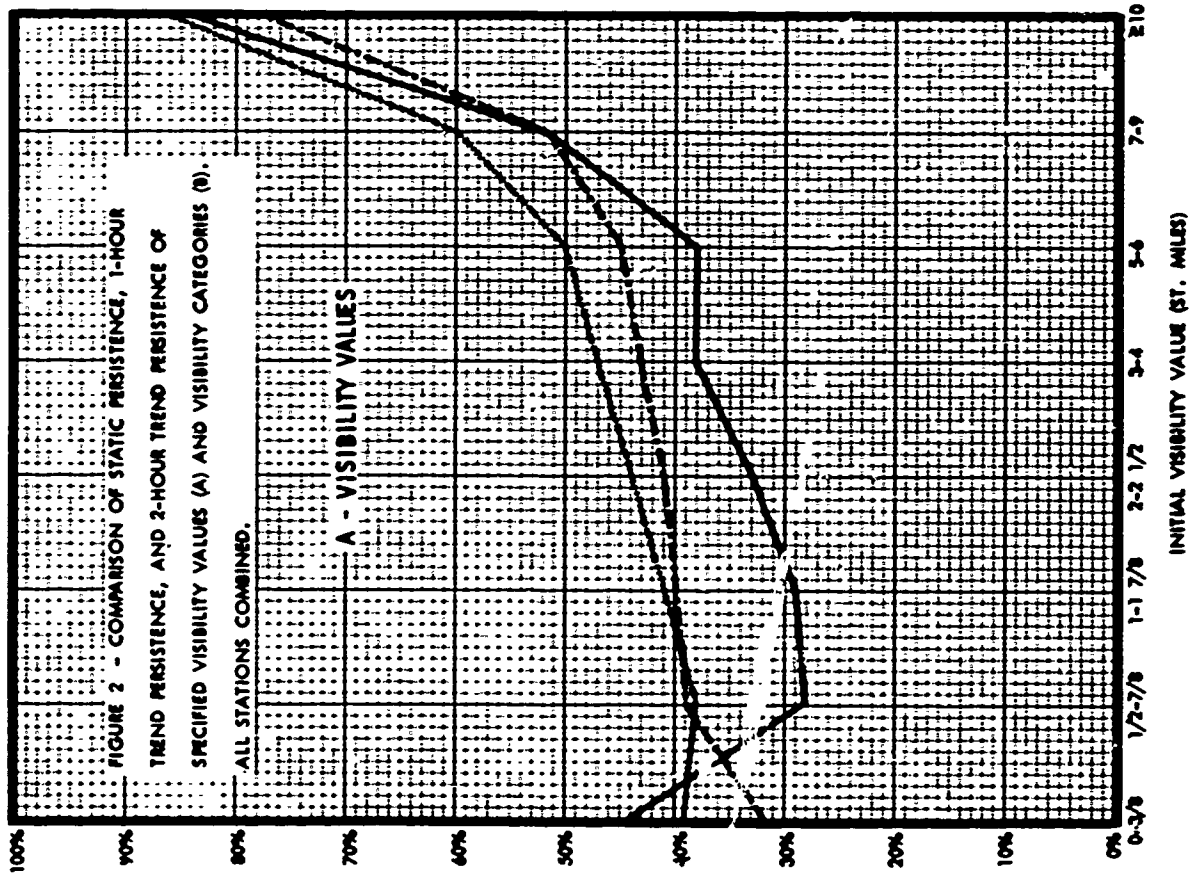
a. Static persistence of ceiling values is below 50% between 200 feet and 10,000 feet for all stations. The minimum persistence probability appears to be around 1000-1400 feet. The very low percentage (less than 20%) in the 1000-2900 foot range at both Colorado Springs and Duluth was an unexpected result, since the climatic regimes of the two stations are so different. In comparison, static persistence of ceiling categories is about 60% between 200 feet and 10,000 feet. This illustrates the higher verification scores obtained when ceiling categories are used. The scores would be even higher if the categories were broader.

b. The one-hour trend persistence for initial ceiling values between 200 feet and 10,000 feet is much higher than static persistence, but the two-hour trend does not offer much improvement over the one-hour trend. All trends for initial ceiling values between 200 feet and 10,000 feet, however, show less than 50% persistence probability.

c. For ceiling categories, one-hour trend persistence is worse than static persistence for all initial ceiling categories. The two-hour trend persistence is approximately the same as static persistence.

d. It is worthwhile to note the similarity in all the graphs of ceiling persistence probability regardless of geographic location.

e. In Table 4 and Table 6, the last column shows the overall results of combining all initial ceiling values (or categories). Note the overall static persistence scores. For ceiling values the overall score is 71%, and for ceiling categories it is 85%. In many studies these are



the only scores used for evaluating persistence forecasts. Note the significant decrease in scores for ceilings below 10,000 feet.

2. Visibility Persistence (Figure 2, Table 5, and Table 7).

a. As might be expected, the highest static persistence of visibility values occurs for initial visibilities greater than 10 miles. With the exception of Colorado Springs and Duluth (where the least static persistence occurs between 5 and 6 miles), the lowest static persistence scores occur between 1/2 mile and 7/8 mile. In nearly all cases, static persistence of visibility values is less than 50% for all initial visibilities less than seven miles.

b. Both the one-hour and two-hour trends of visibility values are generally greater than static persistence, but the two-hour trend is not significantly higher than the one-hour trend.

c. Considering visibility categories, there are, in general, small differences among static, one-hour trend, and two-hour trend. As might be expected, the static persistence of visibility categories is higher than the static persistence of visibility values, but the difference is not so striking as that between ceiling values and ceiling categories.

d. From Table 5 and Table 7, the overall static persistence is 74% for visibility values and 86% for visibility categories. Note the significant decrease in scores for visibilities below 10 miles.

SECTION V - SUMMARY AND CONCLUSIONS

In this paper an attempt has been made to describe some of the various applications of persistence by different meteorological agencies, to identify areas of confusion and clarify the definition of the general term "persistence," and finally to present a statistical evaluation of the value of persistence in one-hour forecasting based upon a large sample of data. Over a million hourly observations from seven terminals were processed through computer techniques in order to obtain a reliable evaluation of static and trend persistence for a wide spectrum of initial ceiling and visibility conditions. The results for each individual station were practically identical, therefore, the results portrayed in the composite graphs and tables may be used as a reliable measure of the value of persistence.

Concerning static persistence forecasts, results of this study confirm prior conclusions that the overall percent accuracy is rather high when all ceilings and all visibilities are grouped

together. However, for initial ceilings between 200-10000 feet and for initial visibilities between 1/2-9 miles, the percent accuracy for static persistence is exceptionally low. The lowest one-hour ceiling persistence probability occurs with initial ceilings between 1000-2900 feet, where the persistence probability is approximately 30% for ceiling values and about 50% for ceiling categories. The lowest one-hour visibility persistence probability occurs with initial visibilities primarily between 1/2-7/8 mile, and secondarily between 5-6 miles, where the persistence probability is again about 30% for values and near 40% for categories.

The inclusion of one-hour past trends is an improvement over static persistence when dealing with ceiling and visibility values but it should be noted that the inclusion of two-hour trends does not offer much additional improvement. When dealing with categories instead of values, the inclusion of past trends offers little if any improvement over static persistence. It is interesting to note that if only the one-hour ceiling category trend is considered, the verification scores are actually worse than static persistence.

The fact that previous forecast verification studies have drawn conclusions that the skill of forecasters, or of a particular method, was worse than persistence may be explained by any or all of the following reasons. Some investigators, in an attempt to simplify the number of statistical manipulations, may possibly have selected ceiling and visibility categories which were too broad, thereby masking out the fine differences between certain ranges of ceiling and visibility. The use of combined ceiling and/or visibility categories causes a further increase in persistence scores making it increasingly difficult to surpass persistence. Some investigators may have compared only the general overall percent accuracy for all ceilings and all visibilities combined. The use of such general verification scores will seldom show any significant improvement over persistence because of the majority of high ceilings and visibilities which indeed have high persistence probabilities.

In light of the results from this study, it is difficult to accept the premise that persistence is always the "best" forecast in short period forecasting, particularly during the periods of highly variable ceilings and visibilities such as those found when ceilings are below 3000 feet or visibilities below 3 miles. It is true that these weather conditions occur less than 25% of the time (see Table 2 and Table 3), but on the other hand, these are periods of greater importance for air operations, and are periods where the greatest forecast skill is needed. The results from this study show that the blind use of persistence (either static or trend) during these periods will yield exceptionally poor results in the one-hour prediction of ceiling or visibility.

Perhaps sufficient attention has not been directed toward the use of other forecast tools (e.g., local analysis and met-watch procedures) or toward the development of new one-hour prediction methods because of mistaken beliefs on the value of persistence. If this is the case, it is hoped that this paper will help restore interest in other existing tools and create an incentive to search for new one-hour prediction techniques.

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APPENDIX A

ANALYSIS OF STATIC AND TREND PERSISTENCE
FOR
COLORADO SPRINGS, COLORADO

TABLE 8: Percentage frequency of one-hour changes in ceiling values from an initial ceiling value. Given an initial ceiling value and the previous hourly ceiling trends (U-up, S-same D-down), this table shows the percentage of time that the ceiling value one hour later is higher, the same, or lower than the initial value.

STATION: COS	PREVIOUS TRENDS	FUTURE 1-HR CHANGES	INITIAL CEILING VALUE (FEET)										All Ceilings
			0-100	200-400	500-900	1000-1400	1500-2900	3000-4900	5000-9500	≥ 10000			
NO TREND		INITIAL CASES	38	46	48	49	45	40	38	6	13		
			56	33	22	18	19	29	43	84	73		
			6	21	30	33	36	31	19	11	14		
1-HR UP TREND		INITIAL CASES	816	2104	3038	2152	4669	4882	11782	114986	144429		
			36	51	54	56	51	45	44	13	27		
			51	28	20	17	16	26	34	64	49		
1-HR STEADY TREND		INITIAL CASES	13	21	26	27	33	29	22	23	24		
			45	423	966	752	1567	1391	1982	11649	18775		
			33	40	43	50	43	37	37	3	6		
1-HR DOWN TREND		INITIAL CASES	62	41	30	22	28	37	49	89	85		
			5	19	27	28	29	26	14	8	9		
			458	693	679	389	906	1445	5075	96173	105818		
2-HR UP TREND		INITIAL CASES	45	47	47	44	42	38	37	29	36		
			48	30	20	17	18	27	41	44	35		
			7	23	33	39	40	35	22	27	29		
2-HR STEADY TREND		INITIAL CASES	313	988	1393	1011	2196	2046	4725	7164	19836		
			--	57	56	61	54	46	46	12	30		
			--	28	16	16	17	24	30	65	45		
2-HR DOWN TREND		INITIAL CASES	--	15	28	23	29	30	24	23	25		
			--	68	289	268	607	601	454	2787	5074		
			30	35	40	42	39	34	37	2	3		
2-HR DOWN TREND		INITIAL CASES	67	45	38	22	33	41	51	91	90		
			3	20	22	36	28	25	12	7	7		
			286	282	205	86	259	665	2209	85491	89483		
		INITIAL CASES	48	43	44	47	40	38	36	27	38		
			47	30	19	12	16	26	39	46	30		
			5	27	37	41	44	36	25	27	32		
INITIAL CASES			133	452	665	449	914	887	1095	1141	5736		

TABLE 9: Percentage frequency of one-hour changes in visibility values from an initial visibility value. Given an initial visibility value and the previous hourly visibility trends (U-up, S-same, D-down), this table shows the percentage of time that the visibility value one hour later is higher, the same, or lower than the initial value.

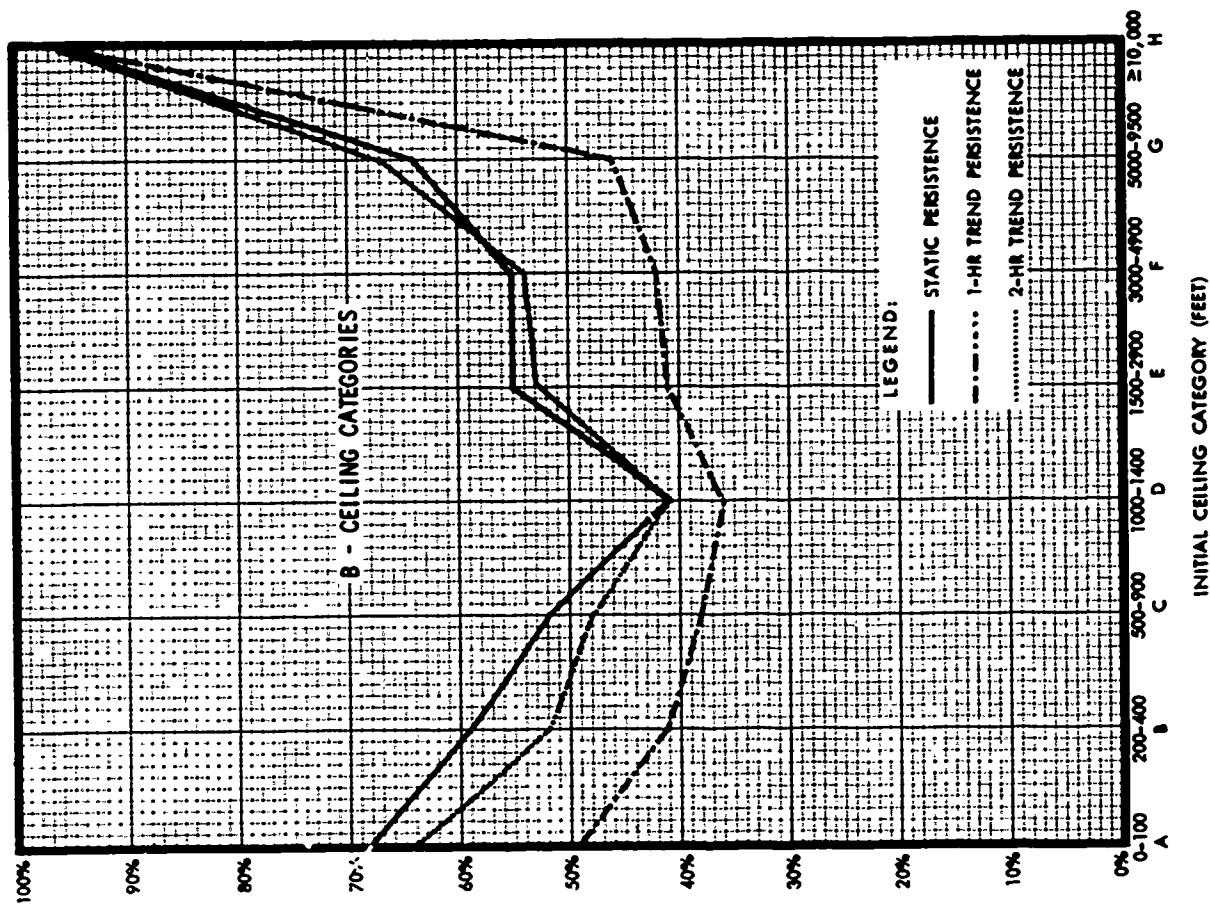
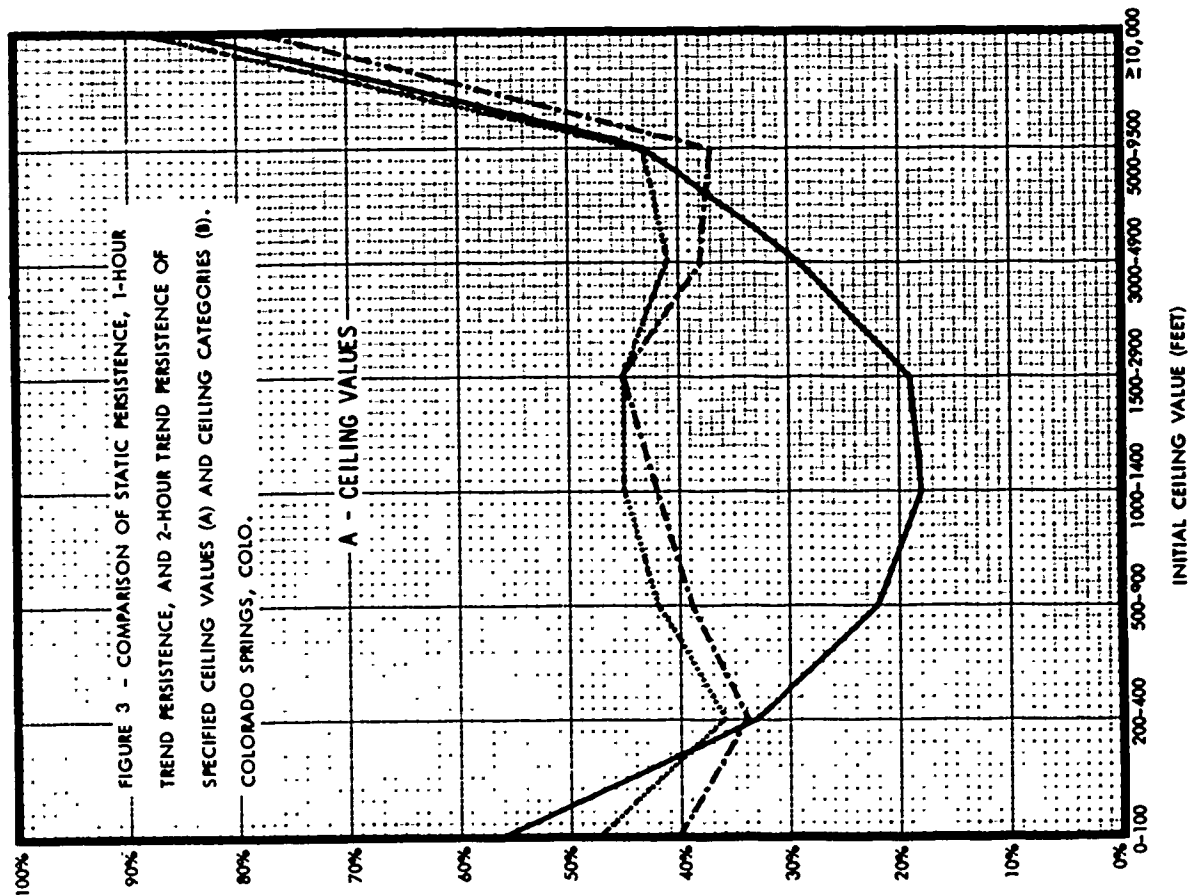
STATION:	PREVIOUS TRENDS	FUTURE 1-HR CHANGES	INITIAL VISIBILITY VALUE (ST. MILES)										All Visibilities
			0-3/8	1/2-7/8	1-1 7/8	2-2 1/2	3-4	5-6	7-9	≥ 10			
COS			43	47	50	45	50	49	47	11	13		
NO TREND			47	36	28	29	23	20	24	76	73		
			10	17	22	26	27	31	29	13	14		
1-HR UP TREND			995	1049	1266	943	1722	1786	1936	134724	144421		
			57	49	52	50	53	52	54	23	27		
			29	30	25	27	22	18	22	59	54		
			14	21	23	23	25	30	24	18	19		
			94	186	292	244	613	744	772	16513	19458		
1-HR STEADY TREND			34	38	45	38	46	44	43	9	10		
			59	47	36	38	28	27	31	81	79		
			7	15	19	24	26	29	36	10	11		
			468	378	357	269	391	363	469	103017	105712		
1-HR DOWN TREND			50	53	51	47	49	47	42	12	20		
			38	30	25	24	20	19	22	67	58		
			12	17	24	29	31	34	36	21	22		
			433	485	617	430	718	679	695	15194	19251		
2-HR UP TREND			50	50	53	61	55	57	57	26	31		
			12	22	18	24	24	19	21	56	50		
			38	28	29	15	21	24	22	18	19		
			8	18	55	54	159	259	310	4493	5356		
2-HR STEADY TREND			33	24	43	33	52	36	32	9	9		
			62	61	41	39	31	36	40	82	81		
			5	15	16	28	17	28	28	9	10		
			276	175	130	101	108	98	145	83034	84067		
2-HR DOWN TREND			49	53	55	46	47	47	38	16	28		
			36	30	23	22	18	22	26	59	47		
			15	17	22	32	35	31	36	25	25		
			207	217	289	170	275	240	199	2698	4295		

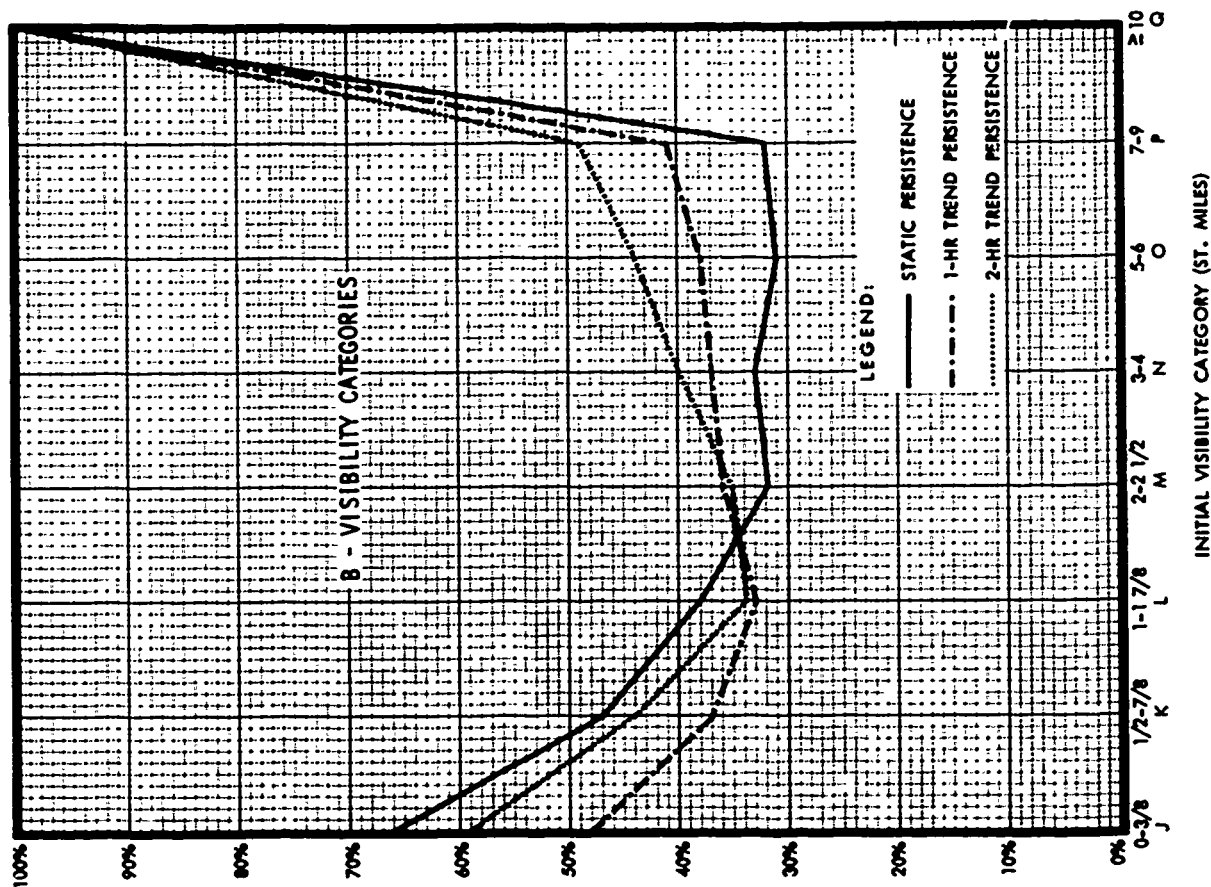
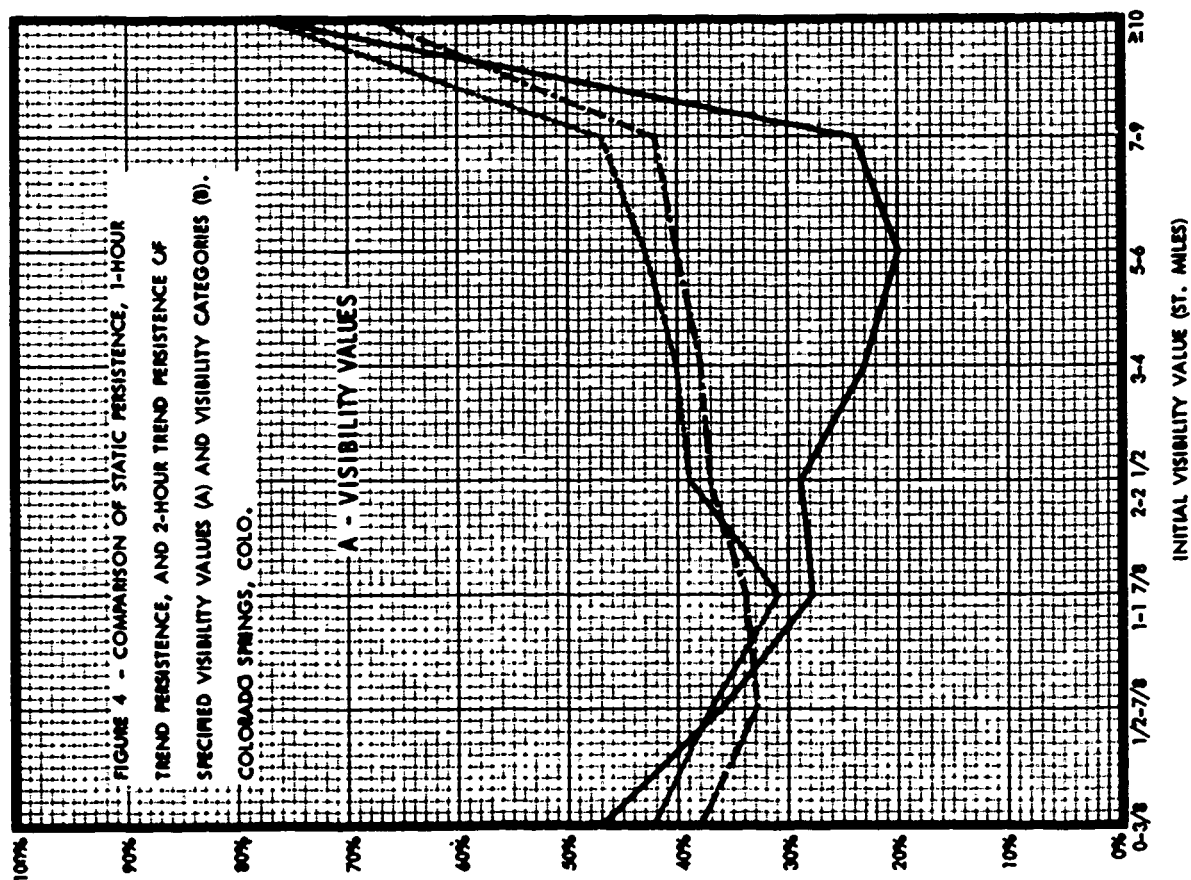
TABLE 10: Percentage frequency of one-hour changes in ceiling categories from an initial ceiling category. Given an initial ceiling category and the previous hourly trends in ceiling categories (U-up, S-same, D-down), this table shows the percentage of time that the ceiling category one hour later is higher, the same, or lower than the initial category.

STATION:	PREVIOUS TRENDS	FUTURE 1-HR CHANGES	INITIAL CEILING CATEGORY (FEET)											H ≥ 10000	All Categories
			A 0-100	B 200-400	C 500-900	D 1000-1400	E 1500-2900	F 3000-4900	G 5000-9500						
COS															
NO TREND		INITIAL CASES	32	33	33	37	28	27	28	27	28	28	--	6	
			68	59	52	41	55	55	64	96	88				
			--	8	15	22	17	18	8	4	6				
1-HR UP TREND		INITIAL CASES	816	2104	3038	2152	4669	4882	11782	114986	144429	12	144429		
			--	29	31	40	27	26	27	--	68				
			--	59	51	39	50	49	51	81	20				
1-HR STEADY TREND		INITIAL CASES	--	12	18	21	23	25	22	19	8576	4	92		
			28	166	501	483	755	776	822	5073	4				
			30	30	31	35	26	24	27	--	96				
1-HR DOWN TREND		INITIAL CASES	--	8	14	20	16	17	7	4	127023	32	55		
			42	40	37	36	32	32	28	--	13				
			58	52	49	39	52	50	65	--	8830				
2-HR UP TREND		INITIAL CASES	--	8	14	25	16	18	7	--	15	65			
			265	708	949	782	1333	1417	3376	--	20				
			--	--	25	42	36	25	35	--	1023				
2-HR STEADY TREND		INITIAL CASES	--	--	67	36	50	47	37	81	2	94			
			--	--	8	22	14	28	28	19	4				
			25	29	31	34	24	24	27	--	116354				
2-HR DOWN TREND		INITIAL CASES	75	63	59	46	60	60	67	97	35	49			
			--	8	10	20	16	16	6	3	16				
			398	762	870	399	1509	1595	4993	105828	1112				
			38	41	34	37	30	32	--	--	--	--	--		
			62	52	48	36	52	49	--	--	--	--	--		
			--	7	18	27	18	19	--	--	--	--	--		
			72	192	273	166	231	178	--	--	--	--	--		

TABLE 11: Percentage frequency of one-hour changes in visibility categories from an initial visibility category. Given an initial visibility category and the previous hourly trends in visibility categories (U-up, S-same, D-down), this table shows the percentage of time that the visibility category one hour later is higher, the same, or lower than the initial category.

STATION:	COS	INITIAL VISIBILITY CATEGORY (ST. MILES)										All Categories
		PREVIOUS TRENDS	FUTURE 1-HR CHANGES	J 0-3/8	K 1/2-7/8	L 1-1 7/8	M 2-2 1/2	N 3-4	O 5-6	P 7-9	Q ≥ 10	
NO TREND			INITIAL CASES	34	41	45	44	44	42	42	--	3
				66	47	38	32	33	31	32	99	95
				--	12	17	24	23	27	26	1	2
1-HR UP TREND			INITIAL CASES	995	1049	1266	943	1722	1786	1936	134724	144421
				--	46	44	49	48	45	48	--	28
				--	36	34	30	31	29	29	86	53
1-HR STEADY TREND			INITIAL CASES	--	18	22	21	21	26	23	14	19
				--	121	232	231	516	625	684	1665	4074
				28	35	41	37	39	36	38	--	1
1-HR DOWN TREND			INITIAL CASES	72	55	44	39	40	39	40	99	98
				--	10	15	24	21	25	22	1	1
				660	494	477	302	570	560	623	133059	136745
2-HR UP TREND			INITIAL CASES	45	47	48	46	46	44	40	--	45
				55	40	34	28	28	27	27	--	33
				--	13	18	26	26	29	33	--	22
2-HR STEADY TREND			INITIAL CASES	335	434	537	410	636	601	629	--	3602
				--	--	33	61	49	53	51	--	25
				--	--	33	29	33	28	29	87	59
2-HR DOWN TREND			INITIAL CASES	--	--	34	10	18	19	20	13	16
				--	--	18	31	103	167	224	589	1132
				26	28	38	35	42	34	32	--	1
2-HR STEADY TREND			INITIAL CASES	74	62	49	41	42	40	47	99	98
				--	10	13	24	16	26	21	1	1
				475	275	211	119	229	216	252	131635	133412
2-HR DOWN TREND			INITIAL CASES	41	48	50	47	41	35	--	--	45
				59	39	34	31	31	30	--	--	37
				--	13	16	22	28	35	--	--	18
INITIAL CASES				120	154	199	116	127	89	--	--	805





APPENDIX B

ANALYSIS OF STATIC AND TREND PERSISTENCE
FOR
OXNARD AFB, CALIFORNIA

TABLE 12: Percentage frequency of one-hour changes in ceiling values from an initial ceiling value. Given an initial ceiling value and the previous hourly ceiling trends (U-up, S-same, D-down), this table shows the percentage of time that the ceiling value one hour later is higher, the same, or lower than the initial value.

STATION:	PREVIOUS TRENDS	FUTURE 1-HR CHANGES	INITIAL CEILING VALUE (FEET)										All Ceilings	
			0-100	200-400	500-900	1000-1400	1500-2900	3000-4900	5000-9500	≥ 10000				
OAP														
NO TREND			33	39	39	42	43	32	26	2	12			
			62	40	38	36	35	42	48	91	77			
			5	21	23	22	22	26	26	7	11			
1-HR UP TREND			2843	3665	7751	5471	7990	4161	2284	87034	121199			
			51	60	57	54	48	34	27	4	32			
			37	30	29	29	30	38	41	79	49			
1-HR STEADY TREND			12	10	14	17	22	28	32	17	19			
			163	858	2036	722	2620	1304	456	5538	147717			
			32	36	33	36	39	29	27	1	6			
1-HR DOWN TREND			65	47	45	46	42	47	53	93	86			
			3	17	22	18	19	24	20	6	8			
			1747	1484	2978	1982	2759	1773	1103	79471	93297			
2-HR UP TREND			31	28	30	37	43	33	25	25	33			
			60	40	39	33	31	39	45	29	41			
			9	32	31	30	26	28	30	16	26			
2-HR STEADY TREND			933	1323	2717	1767	2611	1084	725	2025	13185			
			--	68	68	61	52	36	22	4	38			
			--	27	24	26	27	38	47	83	46			
2-HR DOWN TREND			--	5	8	13	21	26	31	13	16			
			--	186	720	684	1036	486	111	1566	4789			
			32	34	30	32	34	28	25	1	3			
2-HR STEADY TREND			67	49	49	52	49	51	56	94	91			
			1	17	21	16	17	21	19	5	6			
			1134	697	1330	916	1170	896	480	73907	80530			
2-HR DOWN TREND			26	28	30	36	40	28	25	25	32			
			24	42	40	32	28	38	43	53	40			
			10	30	30	32	32	34	33	22	28			
2-HR DOWN TREND			374	484	877	480	671	259	120	157	3422			

TABLE 13: Percentage frequency of one-hour changes in visibility values from an initial visibility value. Given an initial visibility value and the previous hourly visibility trends (U-up, S-same, D-down), this table shows the percentage of time that the visibility value one hour later is higher, the same, or lower than the initial value.

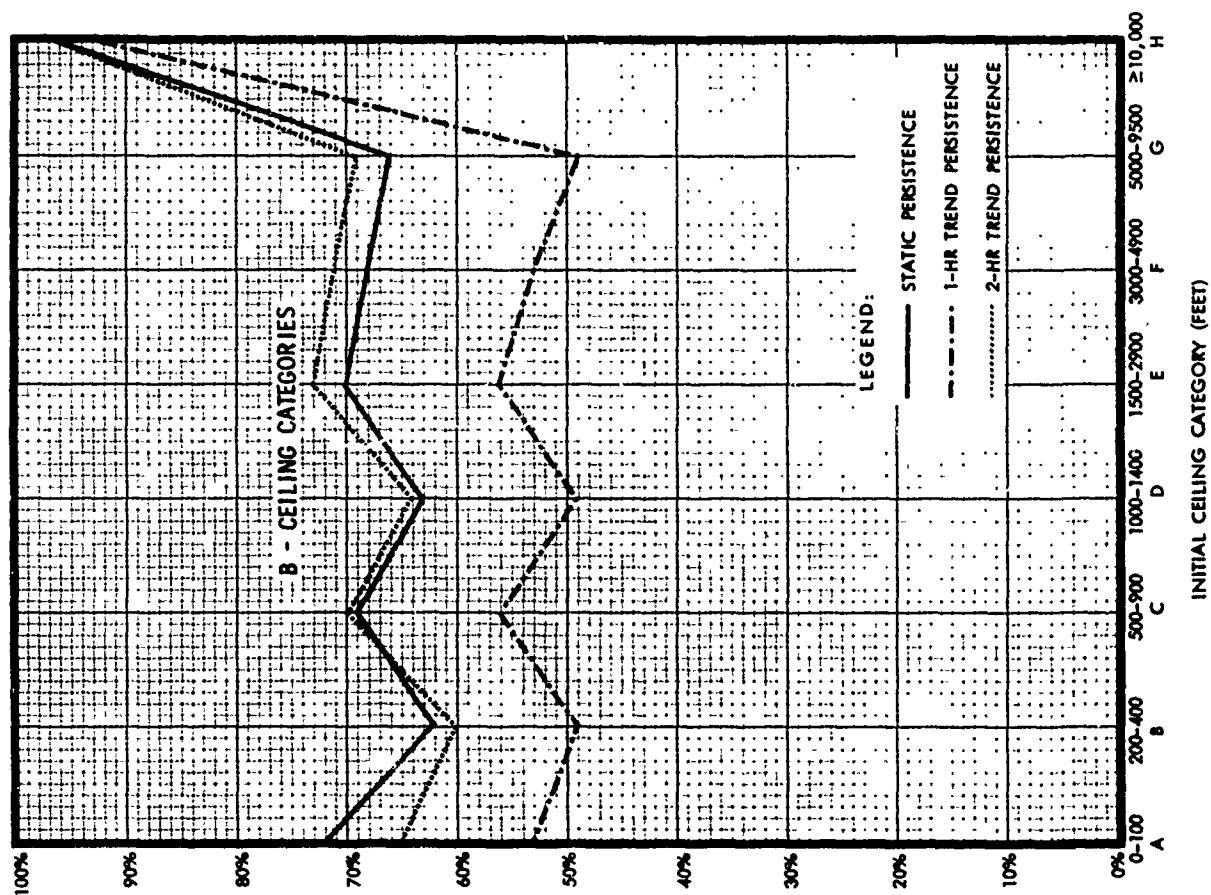
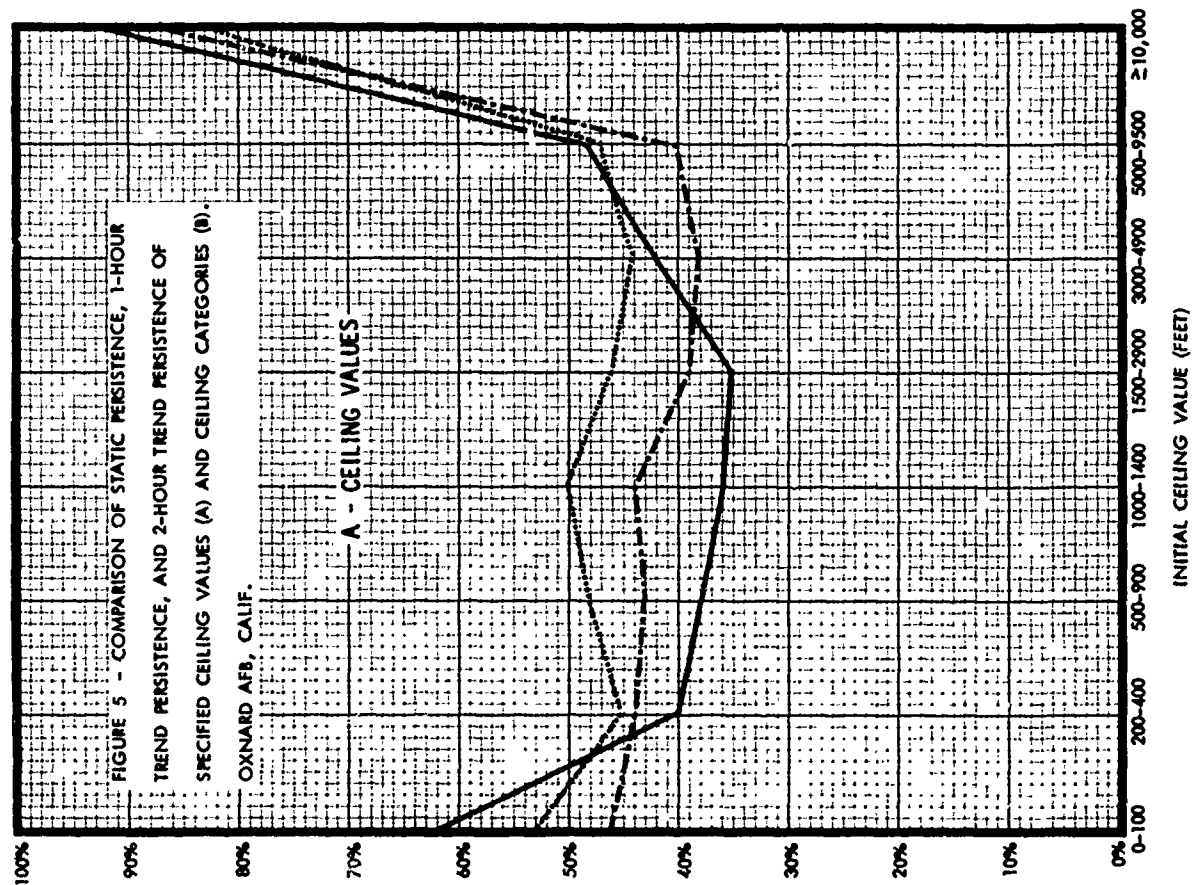
STATION: OAF	PREVIOUS TRENDS	FUTURE 1-HR CHANGES	INITIAL VISIBILITY VALUE (ST. MILES)										All Visibilities
			0-3/8	1/2-7/8	1-1 7/8	2-2 1/2	3-4	5-6	7-9	≥ 10			
NO TREND		U	47	47	44	38	30	26	13	8	17		
		S	41	32	33	40	51	53	74	77			
		D	12	21	23	22	19	21	13	15			
1-HR UP TREND		U	2658	1995	4828	5496	11391	13533	24917	56351	121169		
		S	58	62	63	55	43	41	26	18			
		D	25	23	21	33	45	48	61	68			
1-HR STEADY TREND		U	17	15	16	12	12	11	13	14	13		
		S	409	560	1498	1701	2803	3096	3460	7776			
		D	42	43	37	34	27	23	11	7			
1-HR DOWN TREND		U	52	40	43	47	56	58	77	80	73		
		S	6	17	20	19	17	19	12	13			
		D	1099	633	1578	2179	5787	7201	18322	43419			
2-HR UP TREND		U	47	40	35	28	21	19	13	7	20		
		S	37	30	33	36	46	48	66	66			
		D	16	30	32	36	33	33	21	27			
2-HR STEADY TREND		U	1150	802	1752	1616	2801	3236	3135	5156	19648		
		S	59	64	69	62	49	46	30	18			
		D	18	25	18	29	41	44	59	69			
2-HR DOWN TREND		U	23	11	13	9	10	10	11	13	11		
		S	51	138	516	752	142	1110	1281	2240			
		D	40	41	31	29	25	20	10	6			
2-HR UP TREND		U	3	13	19	19	17	19	11	13	13		
		S	571	255	685	1033	3245	4176	14145	34662			
		D	44	42	35	26	23	21	14	7			
2-HR STEADY TREND		U	39	30	32	37	45	48	62	64	46		
		S	17	28	33	37	32	31	24	29			
		D	664	409	813	635	917	732	627	808			
2-HR DOWN TREND		U	57	46	50	52	58	61	79	81	77		
		S	3	13	19	19	17	19	11	13			
		D	571	255	685	1033	3245	4176	14145	34662			
2-HR UP TREND		U	44	42	35	26	23	21	14	7	25		
		S	39	30	32	37	45	48	62	64			
		D	17	28	33	37	32	31	24	29			
2-HR STEADY TREND		U	664	409	813	635	917	732	627	808	5605		
		S	57	46	50	52	58	61	79	81			
		D	3	13	19	19	17	19	11	13			

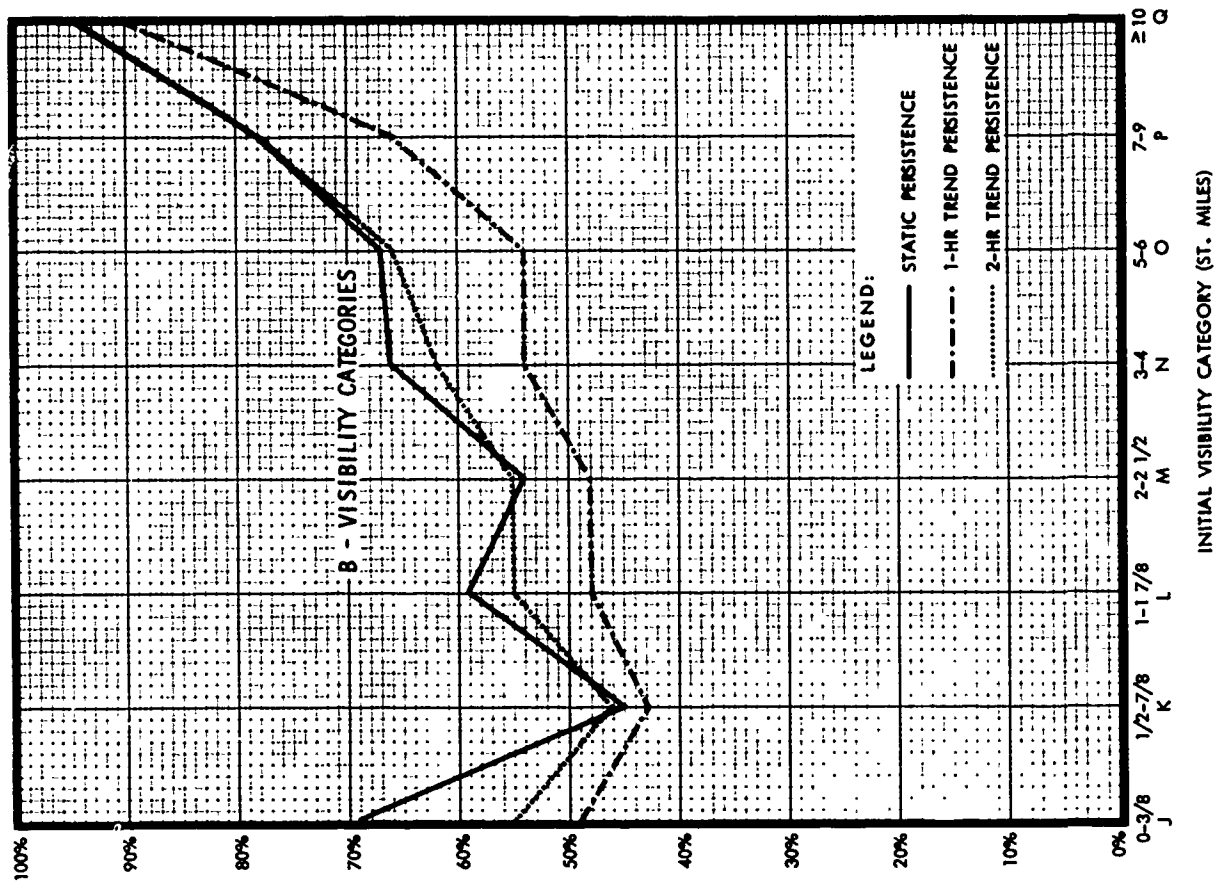
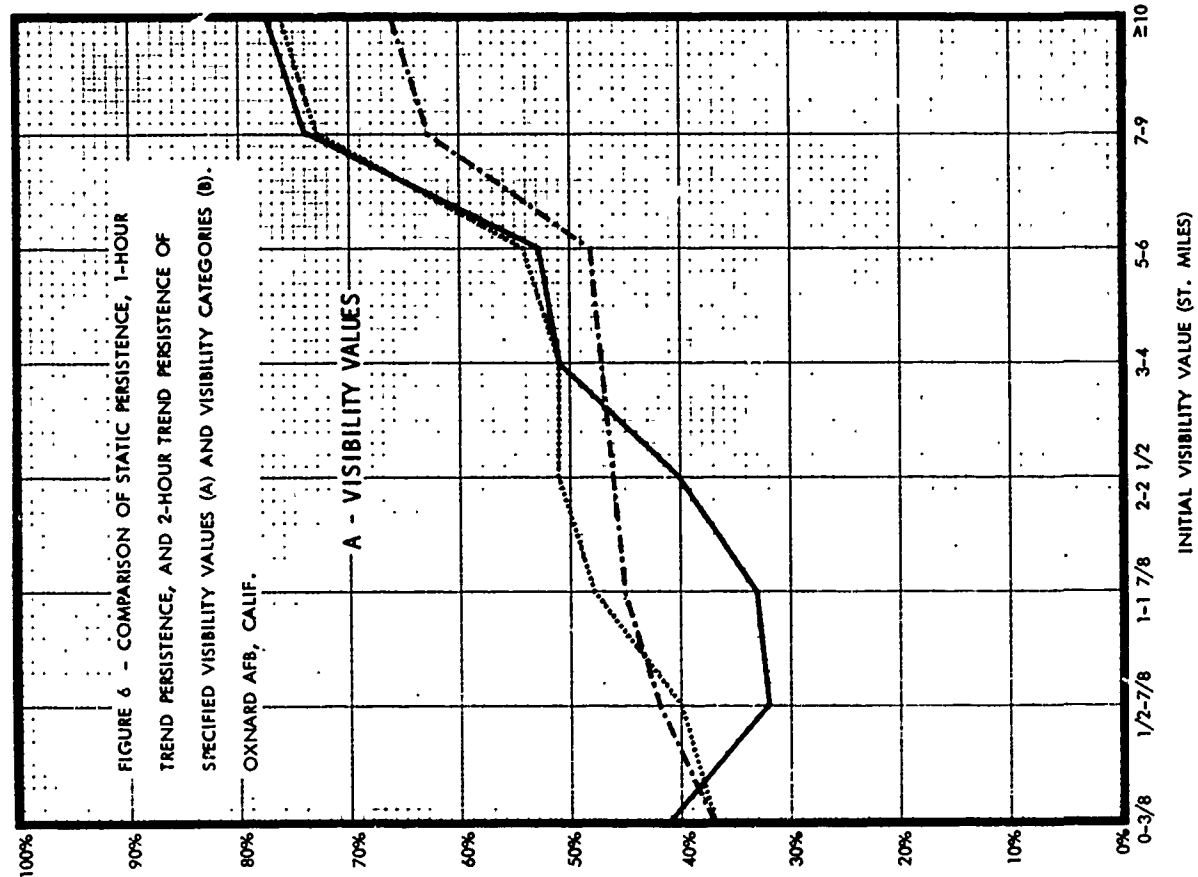
TABLE 14: Percentage frequency of one-hour changes in ceiling categories from an initial ceiling category. Given an initial ceiling category and the previous hourly trends in ceiling categories (U-up, S-same, D-down), this table shows the percentage of time that the ceiling category one hour later is higher, the same, or lower than the initial category.

STATION: OAF	PREVIOUS TRENDS	FUTURE 1-HR CHANGES	INITIAL CEILING CATEGORY (FEET)								H ≥ 10000	All Categories
			A 0-100	B 200-400	C 500-900	D 1000-1400	E 1500-2900	F 3000-4900	G 5000-9500			
NO TREND		INITIAL CASES	28	28	23	27	22	18	18	--	--	7
			72	62	69	63	70	68	66	96	96	88
			--	10	8	10	8	14	16	4	4	5
1-HR UP TREND		INITIAL CASES	2843	3665	7751	5471	7990	4161	2284	87034	87034	121199
			--	38	33	32	20	18	14	--	--	14
			--	55	61	59	67	63	61	86	86	73
1-HR STEADY TREND		INITIAL CASES	--	7	6	9	13	19	25	14	14	13
			--	426	773	893	942	722	324	3811	3811	7891
			28	28	21	25	20	16	18	--	--	5
1-HR DOWN TREND		INITIAL CASES	72	64	72	66	74	71	68	96	96	90
			--	8	7	9	6	13	14	4	4	5
			2062	2291	5444	3426	5603	2829	1510	83223	83223	106388
2-HR UP TREND		INITIAL CASES	29	23	22	30	32	25	22	--	--	27
			71	60	66	56	59	62	65	--	--	62
			--	17	12	14	9	13	13	--	--	11
2-HR UP TREND		INITIAL CASES	781	948	1534	1152	1445	610	450	--	--	6920
			--	--	41	53	23	21	11	--	--	11
			--	--	56	40	61	50	59	92	92	79
2-HR STEADY TREND		INITIAL CASES	--	--	3	7	16	29	30	8	8	10
			--	--	89	78	115	44	37	677	677	1040
			28	27	20	24	19	16	16	--	--	4
2-HR STEADY TREND		INITIAL CASES	72	66	74	67	76	73	71	96	96	92
			--	7	6	9	5	11	13	4	4	4
			1441	1404	3699	2128	3989	1927	982	76626	76626	92196
2-HR DOWN TREND		INITIAL CASES	30	22	25	26	39	17	--	--	--	27
			70	68	68	57	53	70	--	--	--	65
			--	10	7	17	8	13	--	--	--	8
2-HR DOWN TREND		INITIAL CASES	169	153	177	106	88	30	--	--	--	723
			--	--	--	--	--	--	--	--	--	--
			--	--	--	--	--	--	--	--	--	--

TABLE 15: Percentage frequency of one-hour changes in visibility categories from an initial visibility category. Given an initial visibility category and the previous hourly trends in visibility categories (U-up, S-same, D-down), this table shows the percentage of time that the visibility category one hour later is higher, the same, or lower than the initial category.

STATION:	OAF	INITIAL VISIBILITY CATEGORY (ST. MILES)											All Categories
		PREVIOUS TRENDS	FUTURE 1-HR CHANGES	J 0-3/8	K 1/2-7/8	L 1-1 7/8	M 2-2 1/2	N 3-4	O 5-6	P 7-9	Q ≥ 10		
NO TREND				31	39	29	30	21	19	11	--	10	
				69	45	59	54	66	67	78	94	81	
				--	16	12	16	13	14	11	6	9	
1-HR UP TREND				2658	1995	4828	5496	11391	13533	24917	56351	121169	
				--	54	42	42	26	27	17	--	21	
				--	33	47	48	65	63	72	90	69	
1-HR STEADY TREND				--	13	11	10	9	10	11	10	10	
				--	398	771	1204	1777	2076	2861	3095	12182	
				25	36	28	28	20	18	10	--	7	
1-HR DOWN TREND				71	52	62	58	68	69	80	95	85	
				--	12	10	14	12	13	10	5	8	
				1829	904	2836	2946	7526	9040	19469	53256	97806	
2-HR UP TREND				35	34	24	22	18	16	11	--	20	
				65	43	58	48	59	61	74	--	61	
				--	23	18	30	23	23	15	--	19	
2-HR STEADY TREND				829	693	1221	1346	2088	2417	2587	--	11181	
				--	--	47	50	33	35	20	--	24	
				--	--	41	45	61	56	71	90	67	
2-HR DOWN TREND				--	--	12	5	6	9	9	10	9	
				--	--	133	238	523	423	623	620	2560	
				28	35	26	26	19	16	9	--	6	
2-HR STEADY TREND				72	55	64	60	69	70	80	95	87	
				--	10	10	14	12	14	11	5	7	
				1291	475	1761	1720	5157	6248	15501	50483	82636	
2-HR DOWN TREND				32	35	25	22	20	19	--	--	25	
				58	37	57	47	57	56	--	--	55	
				--	28	18	31	23	25	--	--	20	
		INITIAL CASES	INITIAL CASES	401	246	434	357	475	268	--	--	2181	





APPENDIX C

ANALYSIS OF STATIC AND TREND PERSISTENCE

FOR

OTIS AFB, MASSACHUSETTS

TABLE 16: Percentage frequency of one-hour changes in ceiling values from an initial ceiling value. Given an initial ceiling value and the previous hourly ceiling trends (U-up, S-same, D-down), this table shows the percentage of time that the ceiling value one hour later is higher, the same, or lower than the initial value.

STATION: FMH	PREVIOUS TRENDS	FUTURE 1-HR CHANGES	INITIAL CEILING VALUE (FEET)										All Ceilings
			0-100	200-400	500-900	1000-1400	1500-2900	3000-4900	5000-9500	≥ 10000			
NO TREND			33	32	34	35	36	32	25	4	15		
			60	46	36	35	36	42	47	84	68		
			7	22	30	30	28	26	28	12	17		
1-HR UP TREND			6126	10944	10461	5079	9124	9174	12228	9572	158908		
			48	43	43	42	41	35	28	7	26		
			38	37	29	30	32	36	42	70	49		
1-HR STEADY TREND			14	20	28	28	27	29	30	23	25		
			409	2145	2920	1543	2468	2123	2522	9537	23667		
			30	29	29	31	32	31	22	2	9		
1-HR DOWN TREND			65	53	45	45	45	49	51	88	79		
			5	18	26	24	23	20	27	10	12		
			3694	5072	3779	1765	3306	3889	5788	80933	108226		
2-HR UP TREND			35	31	32	34	35	33	25	22	30		
			56	42	32	28	31	38	45	53	42		
			9	27	36	38	34	29	30	25	28		
2-HR UP TREND			2023	3727	3762	1771	3350	3162	3918	5302	27015		
			--	52	48	47	47	39	33	7	31		
			--	30	25	28	27	32	39	69	44		
2-HR STEADY TREND			--	18	27	25	26	29	28	24	25		
			--	386	889	550	855	581	667	2200	6128		
			29	27	26	28	30	29	21	2	5		
2-HR STEADY TREND			68	57	52	50	49	53	55	90	85		
			3	16	22	22	21	18	24	8	10		
			2414	2707	1711	794	1484	1913	2938	71431	85392		
2-HR DOWN TREND			33	29	28	31	32	29	21	20	28		
			56	41	30	23	30	37	42	50	38		
			11	30	42	46	38	34	37	30	34		
			799	1450	1412	634	1111	816	964	565	7751		

TABLE 17: Percentage frequency of one-hour changes in visibility values from an initial visibility value. Given an initial visibility value and the previous hourly visibility trends (U-up, S-same, D-down), this table shows the percentage of time that the visibility value one hour later is higher, the same, or lower than the initial value.

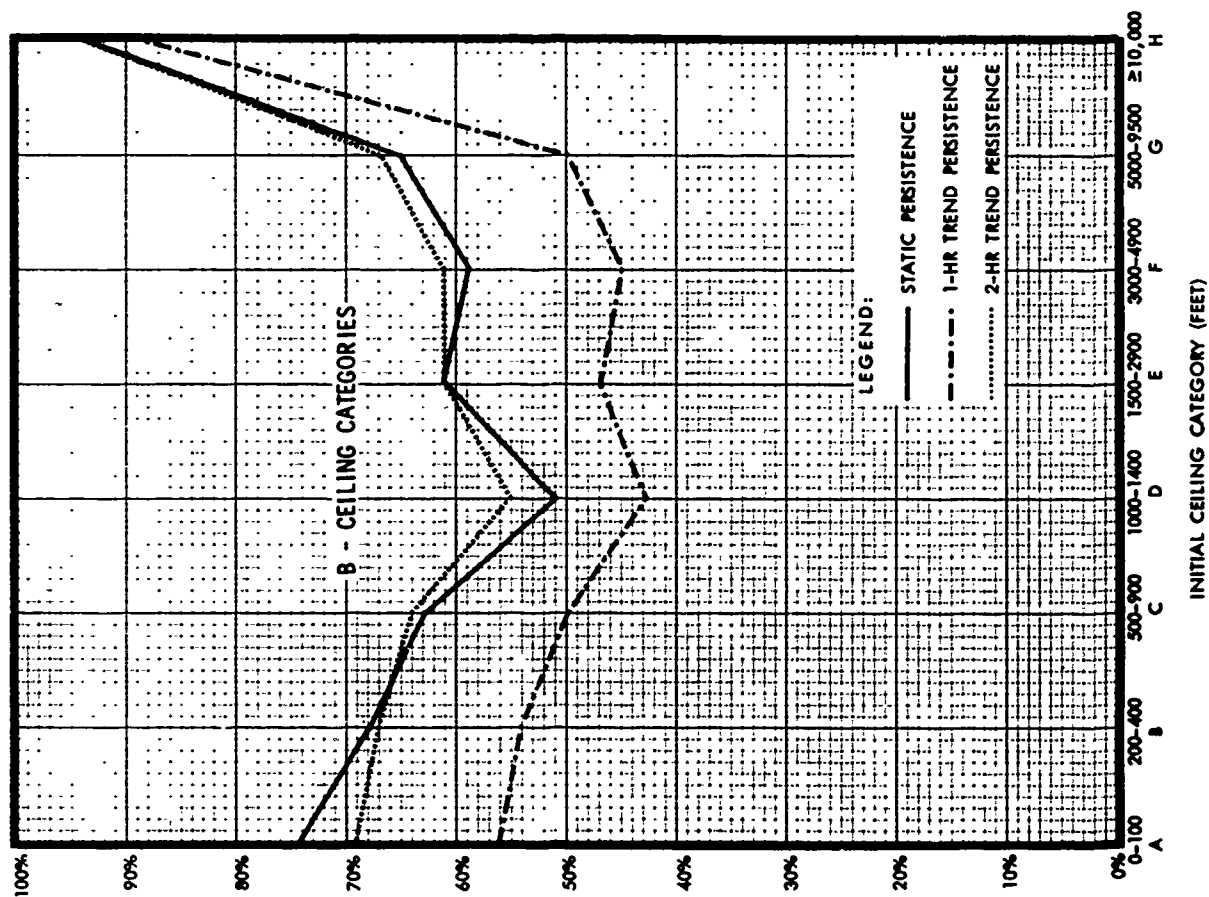
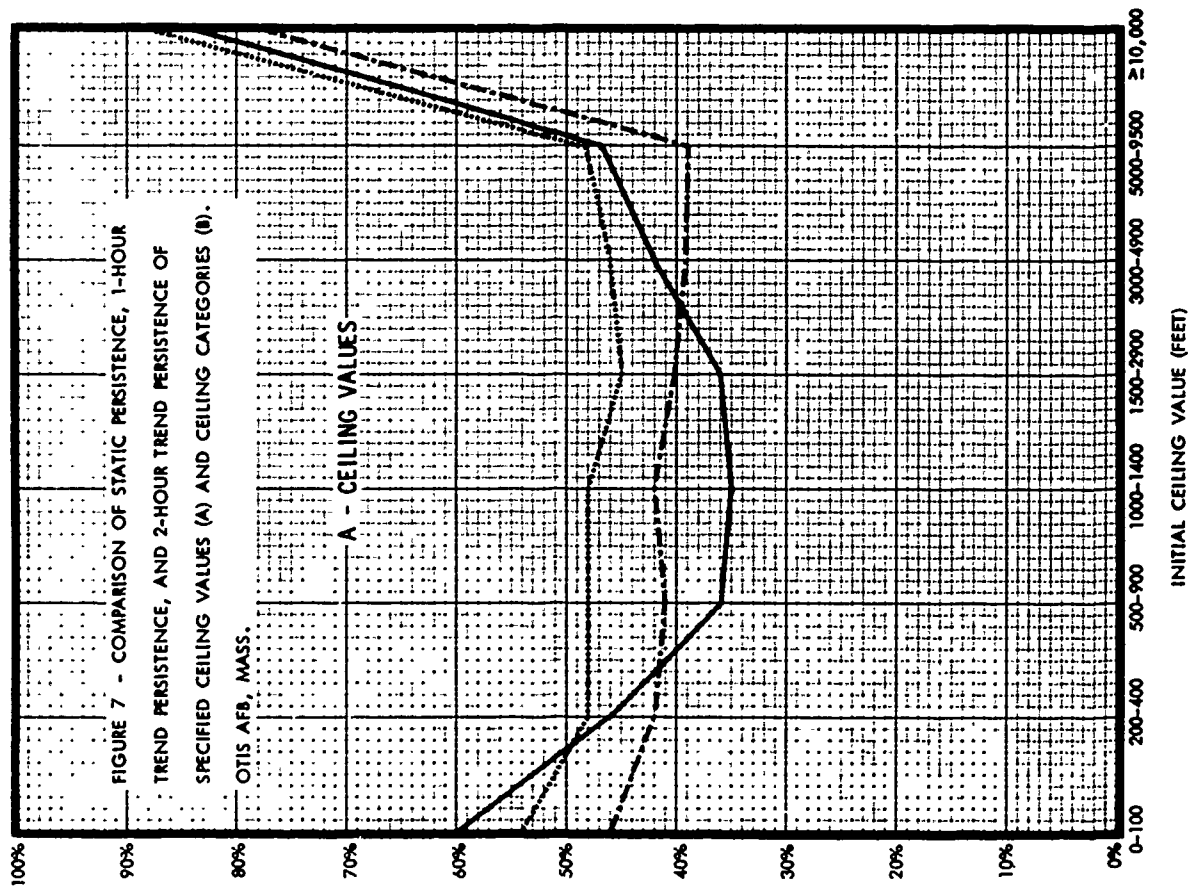
STATION:	FMR	PREVIOUS TRENDS	FUTURE 1-HR CHANGES	INITIAL VISIBILITY VALUE (ST. MILES)										All Visibilities
				0-3/8	1/2-7/8	1-1 7/8	2-2 1/2	3-4	5-6	7-9	≥ 10			
NO TREND				43	42	40	36	30	27	24	4	15		
				43	32	35	36	46	47	54	88	71		
				14	26	25	28	24	26	22	8	14		
1-HR UP TREND			INITIAL CASES	5835	4596	7302	6271	12212	12130	14843	95739	158928		
				54	54	50	47	47	42	36	14	34		
				27	23	28	28	34	38	45	74	48		
1-HR STEADY TREND			INITIAL CASES	19	23	22	25	19	20	19	12	18		
				762	1139	1939	1815	3005	3205	3779	8200	23844		
				37	36	35	30	24	21	20	2	8		
1-HR DOWN TREND			INITIAL CASES	54	43	45	47	55	57	61	91	82		
				9	21	20	23	21	22	19	7	10		
				2496	1485	2539	2283	5650	5722	8002	84303	112480		
2-HR UP TREND			INITIAL CASES	46	40	39	32	26	23	19	14	29		
				37	30	30	32	43	40	46	57	40		
				17	30	31	36	31	37	35	29	31		
2-HR STEADY TREND			INITIAL CASES	2577	1972	2824	2173	3557	3203	3062	3236	22604		
				64	60	54	50	51	47	42	17	37		
				20	20	22	25	32	34	43	72	47		
2-HR DOWN TREND			INITIAL CASES	16	20	24	25	17	19	15	11	16		
				74	221	491	578	1062	1176	1520	2972	8094		
				35	31	29	26	22	18	17	2	5		
2-HR DOWN TREND			INITIAL CASES	58	51	53	53	59	61	65	92	87		
				7	18	18	21	19	21	18	6	8		
				1335	636	1145	1079	3112	3240	4903	76391	91841		
2-HR DOWN TREND			INITIAL CASES	44	39	38	31	23	24	17	14	32		
				38	31	31	32	43	39	42	56	37		
				18	30	31	37	34	37	41	30	31		
				1297	903	1148	782	1184	894	589	195	6992		

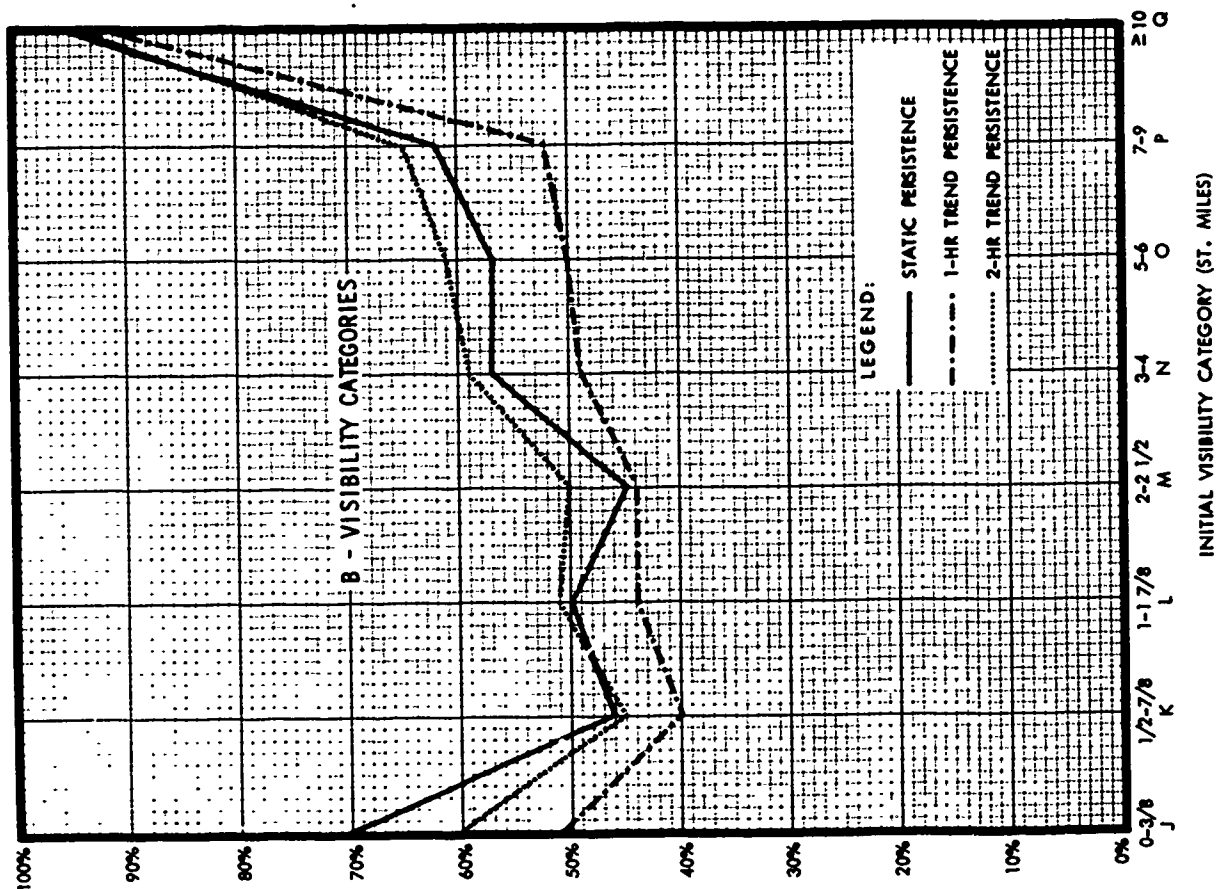
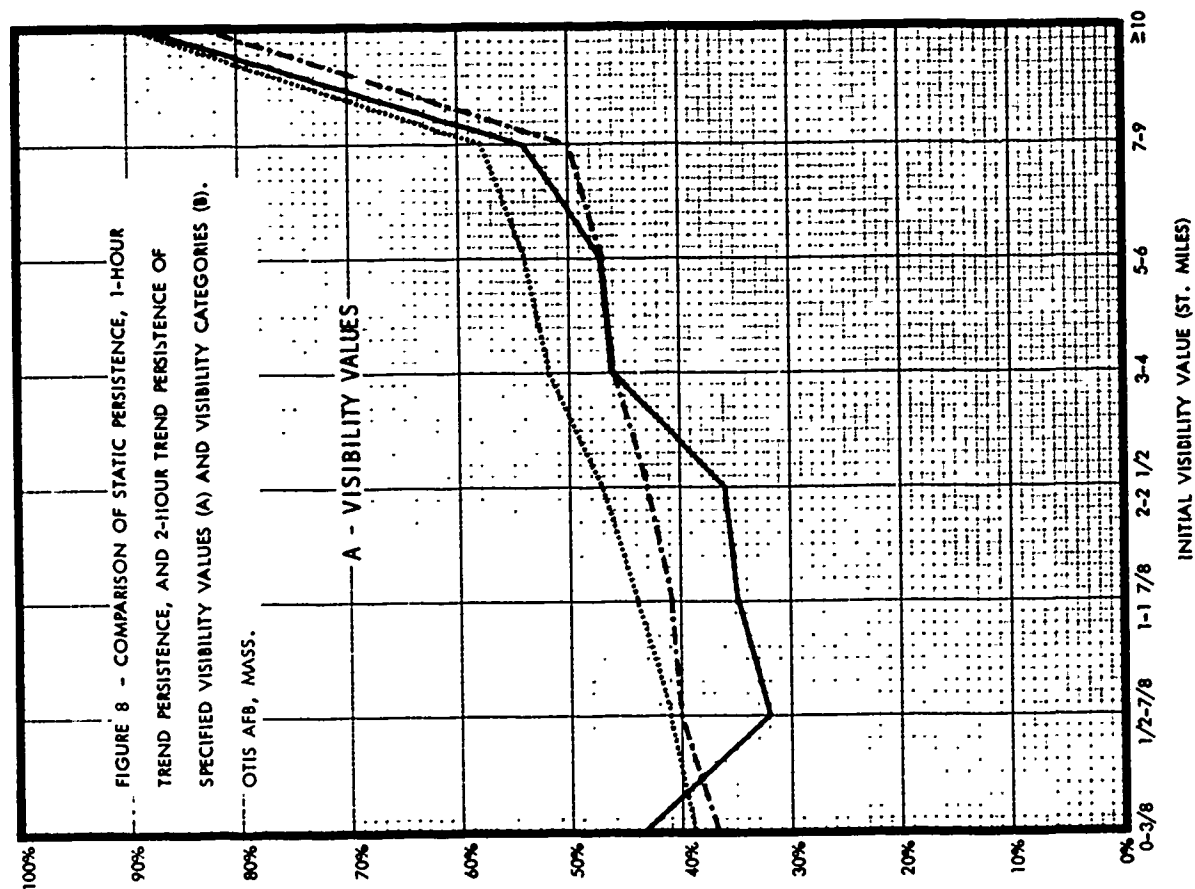
TABLE 18: Percentage frequency of one-hour changes in ceiling categories from an initial ceiling category. Given an initial ceiling category and the previous hourly trends in ceiling categories (U-up, S-same, D-down), this table shows the percentage of time that the ceiling category one hour later is higher, the same, or lower than the initial category.

STATION:	FMR	PREVIOUS TRENDS	N ↑ T ↓ A ↓	FUTURE 1-HR CHANGES	INITIAL CEILING CATEGORY (FEET)								All Categories
					A 0-100	B 200-400	C 500-900	D 1000-1400	E 1500-2900	F 3000-4900	G 5000-9500	H ≥ 10000	
NO TREND					26	22	21	27	23	24	18	--	9
					74	68	63	51	61	59	65	94	82
					--	10	16	22	16	17	17	6	9
1-HR UP TREND					6126	10944	10461	5079	9124	9174	12228	95772	158908
					--	29	24	31	24	24	19	--	14
					--	56	56	46	54	52	55	81	65
1-HR STEADY TREND					--	15	20	23	22	24	26	19	21
					--	1027	1544	1107	1356	1363	1710	5929	14036
					24	20	18	24	21	23	16	--	6
1-HR DOWN TREND					76	71	67	57	65	62	68	95	86
					--	9	15	19	14	15	16	5	8
					4521	7440	6590	2605	5534	5430	7973	89843	129936
2-HR UP TREND					31	25	26	29	29	26	23	--	27
					69	63	55	44	53	56	64	--	58
					--	12	19	27	18	18	13	--	15
2-HR STEADY TREND					1605	2477	2327	1367	2234	2381	2545	--	14936
					--	--	30	40	29	32	23	--	15
					--	--	51	38	51	46	54	82	65
2-HR DOWN TREND					--	--	19	22	20	22	23	18	20
					--	--	138	146	258	207	256	982	1987
					24	19	17	23	19	22	15	--	5
2-HR STEADY TREND					76	73	70	60	68	65	69	95	89
					--	8	13	17	13	13	16	5	6
					3417	5291	4434	1484	3606	3386	5397	85043	112058
2-HR DOWN TREND					26	23	21	26	22	22	--	--	23
					74	64	56	40	57	59	--	--	59
					--	13	23	34	21	19	--	--	18
					362	549	544	258	359	179	--	--	2251

TABLE 19: Percentage frequency of one-hour changes in visibility categories from an initial visibility category. Given an initial visibility category and the previous hourly trends in visibility categories (U-up, S-same, D-down), this table shows the percentage of time that the visibility category one hour later is higher, the same, or lower than the initial category.

STATION: FTH	PREVIOUS TRENDS	FUTURE 1-HR CHANGES	INITIAL VISIBILITY CATEGORY (ST. MILES)											All Categories 10
			J 0-3/8	K 1/2-7/8	L 1-1 7/8	M 2-2 1/2	N 3-4	O 5-6	P 7-9	Q ≥ 10				
NO TREND			30	36	32	31	25	22	19	--	10			
			70	46	50	45	57	57	62	95		80		
			--	18	18	24	18	21	19	5		10		
1-HR UP TREND			5835	4596	7302	6271	12212	12130	14843	95739	158928			
			--	47	44	43	38	35	29	--	26			
			--	33	38	35	44	46	54	88	57			
1-HR STEADY TREND			--	836	1352	1549	2320	2617	3150	4512	16336			
			27	33	28	27	21	19	17	--	6			
			73	52	57	53	63	63	67	96	87			
1-HR DOWN TREND			4066	2099	3670	2796	6992	6853	9180	91227	126883			
			38	34	32	29	23	21	17	--	27			
			62	44	46	40	54	50	54	--	50			
2-HR UP TREND			--	22	22	31	23	29	29	--	23			
			1769	1661	2280	1926	2900	2660	2513	--	15709			
			--	--	47	47	40	43	35	--	26			
2-HR UP TREND			--	--	31	33	44	40	51	89	59			
			--	--	22	20	16	17	14	11	15			
			--	--	170	320	614	729	1003	1502	4338			
2-HR STEADY TREND			26	30	25	24	18	16	15	--	4			
			74	58	61	57	67	66	70	96	90			
			--	12	14	19	15	18	15	4	6			
2-HR DOWN TREND			2961	1095	2100	1471	4419	4329	6110	87254	109739			
			37	33	29	30	19	23	--	--	29			
			63	47	46	40	55	48	--	--	50			
2-HR DOWN TREND			--	20	25	30	26	29	--	--	21			
			712	602	729	512	688	404	--	--	3647			





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APPENDIX D

ANALYSIS OF STATIC AND TREND PERSISTENCE

FOR

TYNDALL AFB, FLORIDA

TABLE 20: Percentage frequency of one-hour changes in ceiling values from an initial ceiling value. Given an initial ceiling value and the previous hourly ceiling trends (U-up, S-same, D-down), this table shows the percentage of time that the ceiling value one hour later is higher, the same, or lower than the initial value.

STATION: PAM	PREVIOUS TRENDS	FUTURE 1-HR CHANGES	INITIAL CEILING VALUE (FEET)										All Ceilings
			0-100	200-400	500-900	1000-1400	1500-2900	3000-4900	5000-9500	≥ 10000			
NO TREND		INITIAL CASES	37	49	46	49	46	32	25	4		14	
			57	31	31	29	34	45	47	.85		73	
			6	20	23	22	20	23	28	11		13	
1-HR UP TREND		INITIAL CASES	3150	3437	5175	3715	3211	5183	9177	133947		174595	
			47	58	51	52	46	37	32	7		23	
			34	24	25	25	29	38	38	70		54	
1-HR STEADY TREND		INITIAL CASES	19	18	24	23	25	25	30	23		23	
			203	789	1286	992	2263	1402	2052	14016		23003	
			32	40	41	42	41	29	23	2		7	
1-HR DOWN TREND		INITIAL CASES	65	42	39	41	41	51	52	89		83	
			3	18	20	17	18	20	25	9		10	
			1808	1074	1575	1083	3281	2579	4411	113357		129168	
2-HR UP TREND		INITIAL CASES	43	50	48	52	50	33	25	20		40	
			50	28	27	24	30	41	45	53		39	
			7	22	25	24	20	26	30	27		21	
2-HR STEADY TREND		INITIAL CASES	1139	1574	2314	1640	4267	2202	2714	6574		22424	
			--	65	56	56	49	39	39	9		27	
			--	22	24	20	27	38	37	66		50	
2-HR DOWN TREND		INITIAL CASES	--	13	20	24	24	23	24	25		23	
			--	169	340	288	661	465	431	2833		5187	
			29	37	37	34	37	31	25	2		4	
2-HR STEADY TREND		INITIAL CASES	69	46	44	50	48	52	56	91		88	
			2	17	19	16	15	17	19	7		8	
			1169	455	622	445	1347	1605	1938	100182		107763	
2-HR DOWN TREND		INITIAL CASES	39	51	46	50	49	37	31	30		43	
			52	27	26	24	27	36	46	49		34	
			9	22	28	26	24	27	23	21		23	
			401	565	780	499	984	558	444	509		4740	

TABLE 21: Percentage frequency of one-hour changes in visibility values from an initial visibility value. Given an initial visibility value and the previous hourly visibility trends (U-up, S-same, D-down) this table shows the percentage of time that the visibility value one hour later is higher, the same, or lower than the initial value.

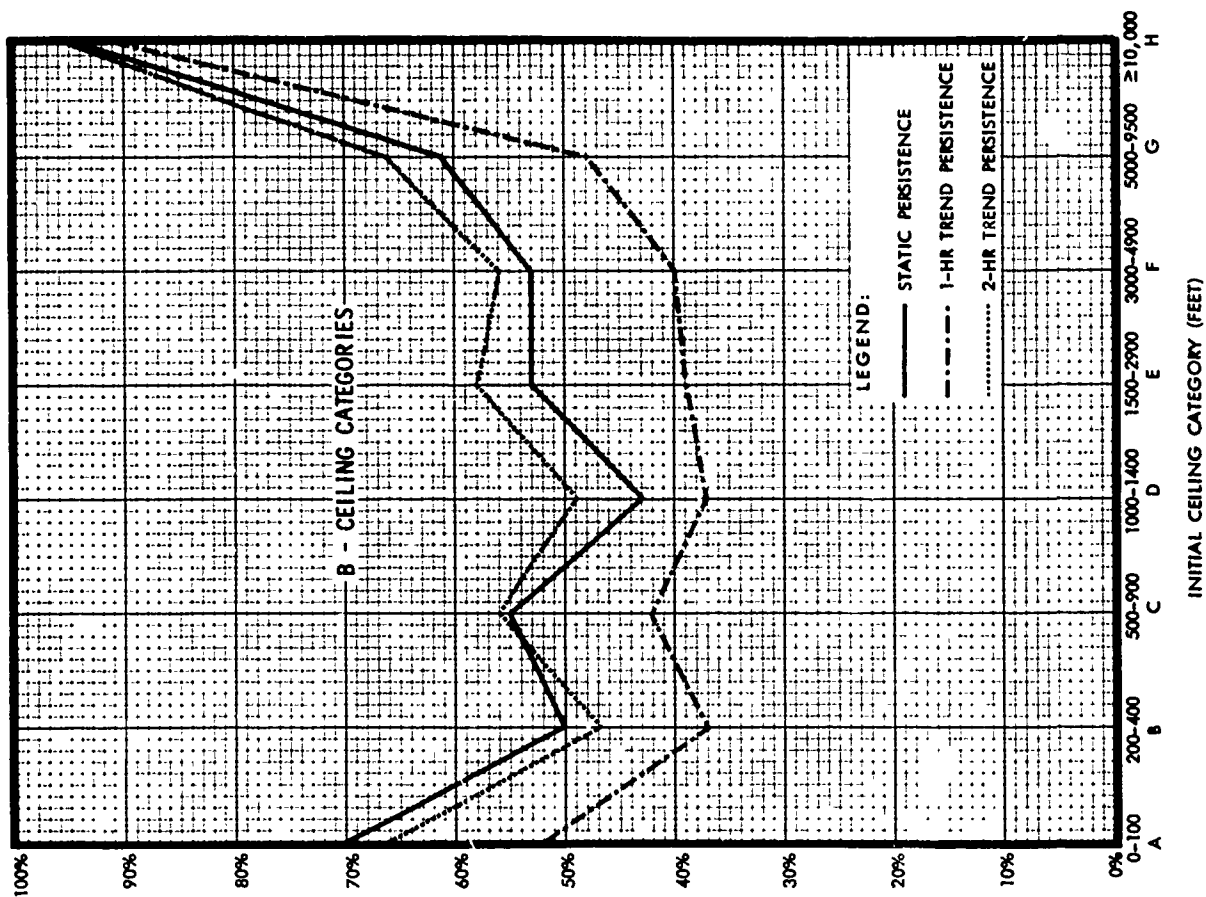
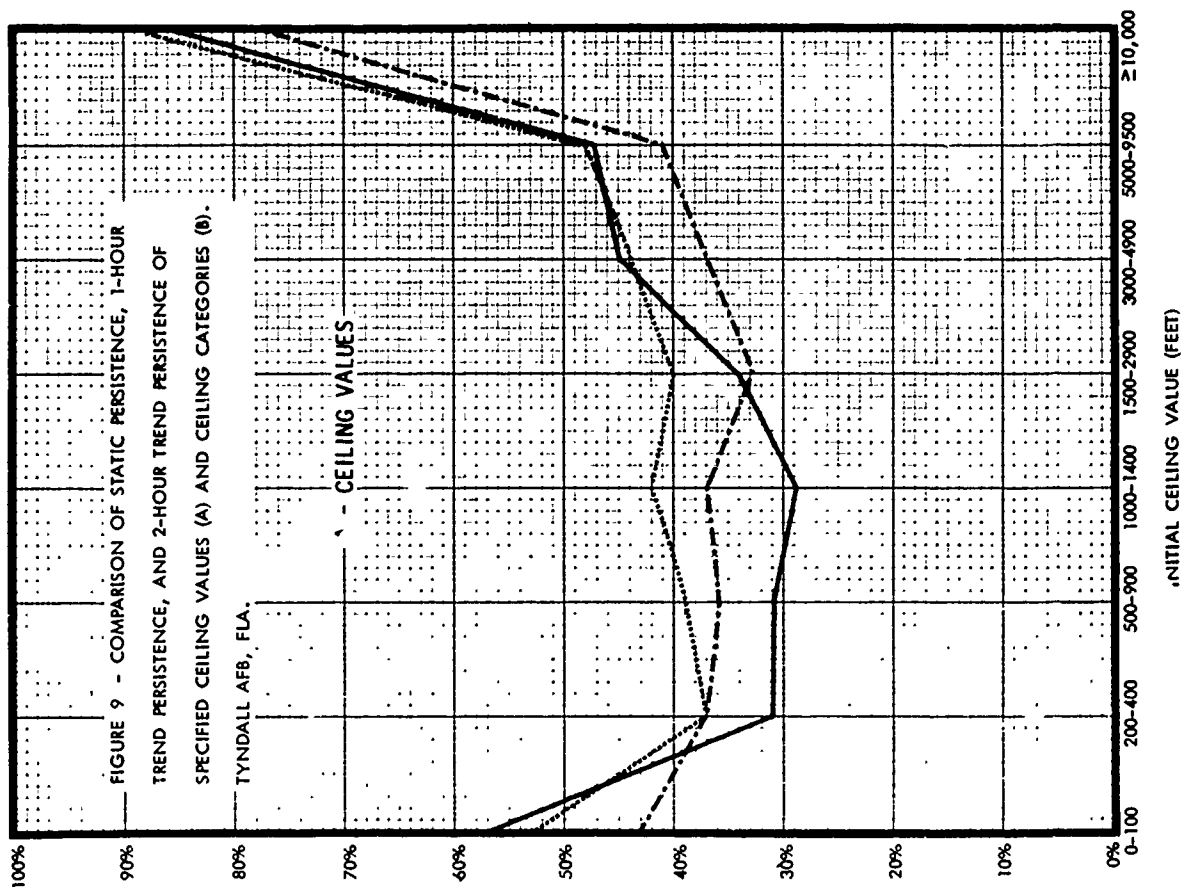
STATION: PAM	PREVIOUS TRENDS	FUTURE 1-HR CHANGES	INITIAL VISIBILITY VALUE (ST. MILES)										All Visibilities
			0-3/8	1/2-7/8	1-1 7/8	2-2 1/2	3-4	5-6	7-9	≥ 10			
NO TREND			46	53	57	52	48	43	17	2		10	
			41	19	19	25	29	36	72	91		80	
			13	28	24	23	23	21	11	7		10	
1-HR UP TREND	INITIAL CASES		3230	1288	1629	1474	4278	7900	40481	114307		174587	
			54	64	63	59	60	51	29	5		26	
			27	13	14	19	23	29	56	84		60	
1-HR STEADY TREND	INITIAL CASES		19	23	43	22	17	20	15	11		14	
			470	347	479	394	1077	1853	5552	8181		18353	
			39	46	53	42	37	57	14	2		6	
1-HR DOWN TREND	INITIAL CASES		52	32	28	40	42	46	77	92		87	
			9	22	19	18	21	17	9	6		7	
			1329	247	300	368	1247	2886	29140	104106		139623	
2-HR UP TREND	INITIAL CASES		49	51	56	54	48	43	22	6		34	
			36	18	27	20	25	32	60	79		45	
			15	31	27	26	27	25	18	15		21	
2-HR STEADY TREND	INITIAL CASES		1431	694	850	712	1954	3161	5789	2020		16611	
			60	61	73	66	64	58	35	9		32	
			21	10	9	11	19	24	53	82		56	
2-HR DOWN TREND	INITIAL CASES		19	29	18	23	17	18	12	9		12	
			47	77	130	109	319	546	1612	1838		4678	
			37	27	57	31	31	31	12	2		4	
2-HR DOWN TREND	INITIAL CASES		56	49	30	53	50	55	80	92		89	
			7	24	13	16	19	14	8	6		7	
			687	80	84	147	518	1337	22576	95641		121070	
2-HR DOWN TREND	INITIAL CASES		45	49	54	52	48	41	22	3		42	
			39	19	19	23	24	32	55	78		33	
			16	32	27	25	28	27	23	19		25	
			716	324	364	294	624	638	450	121		3531	

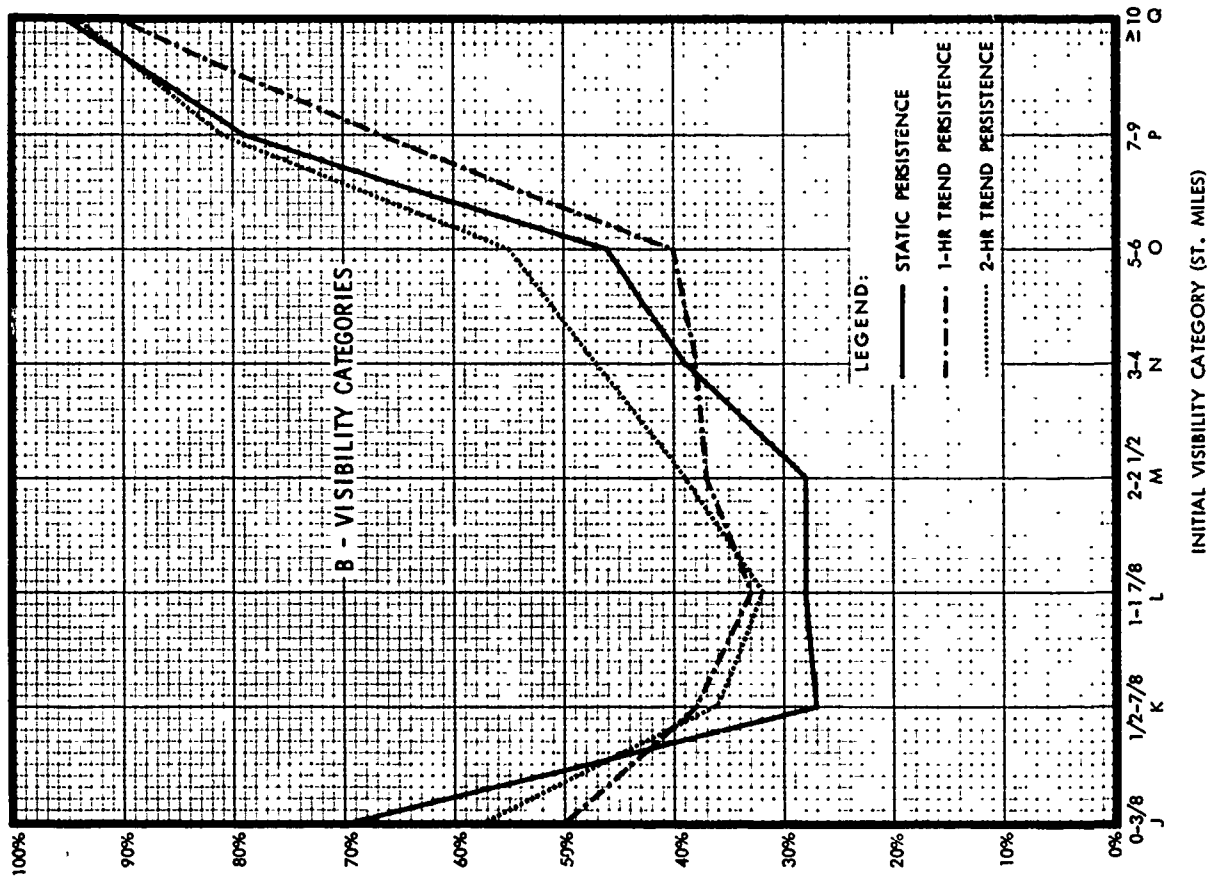
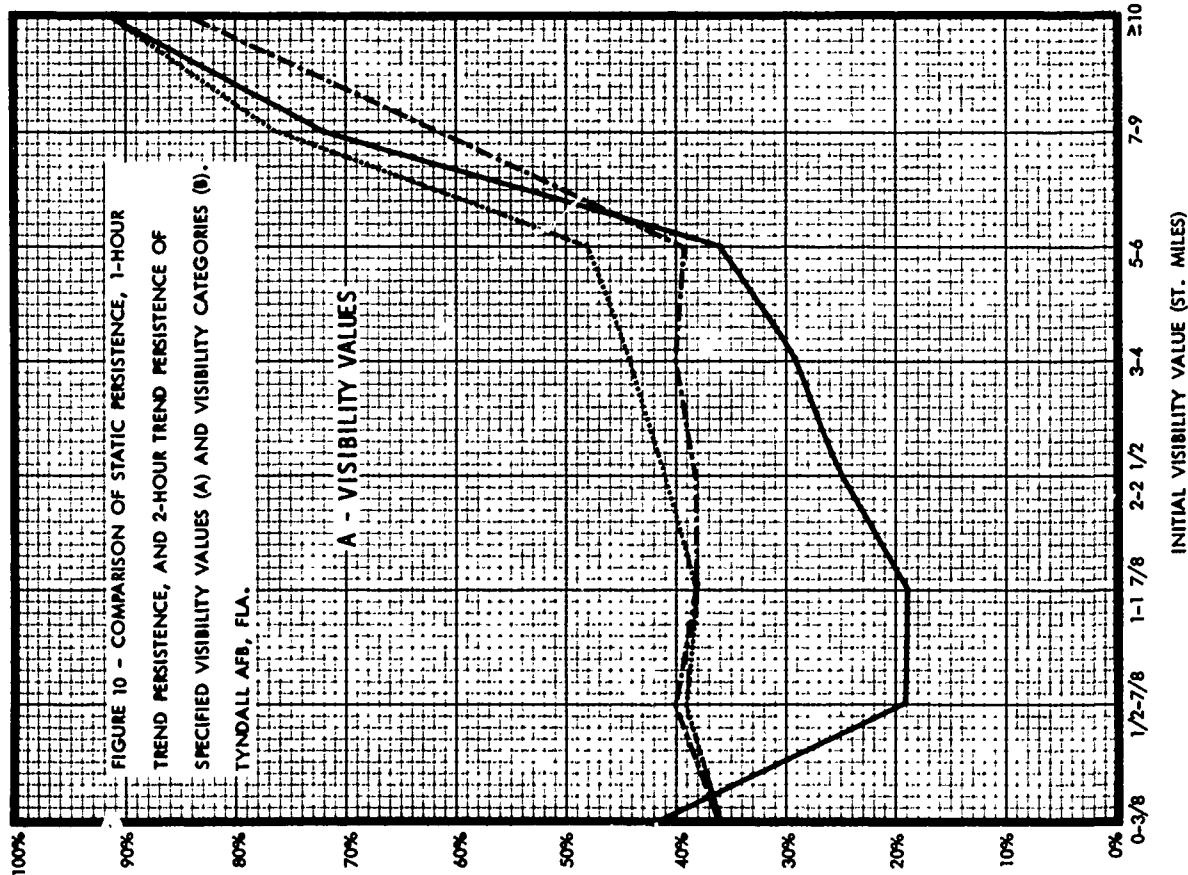
TABLE 22: Percentage frequency of one-hour changes in ceiling categories from an initial ceiling category. Given an initial ceiling category and the previous hourly trends in ceiling categories (U-up, S-same, D-down), this table shows the percentage of time that the ceiling category one hour later is higher, the same, or lower than the initial category.

STATION:	PREVIOUS TRENDS	FUTURE 1-HR CHANGES	INITIAL CEILING CATEGORY (FEET)								All Categories
			A 0-100	B 200-400	C 500-900	D 1000-1400	E 1500-2900	F 3000-4900	G 5000-9900	H ≥ 10000	
PAM			30	38	34	41	36	32	24	--	8
NO TREND		U S D	70	50	55	43	53	53	61	94	85
		●	--	12	11	16	11	15	15	6	7
		INITIAL CASES	3150	3437	5175	3715	9811	6183	9177	133947	174595
1-HR UP TREND		U S D	--	36	35	42	32	30	27	--	13
		U ●	--	49	50	41	49	49	51	79	66
		INITIAL CASES	--	15	15	17	19	21	22	21	21
1-HR STEADY TREND		U S D	--	435	631	711	1202	1020	1506	7644	13149
		S ●	26	33	28	35	30	28	21	--	4
		INITIAL CASES	74	56	61	51	60	58	66	95	90
1-HR DOWN TREND		U S D	--	11	11	14	10	14	13	5	6
		D ●	2195	1716	2832	1594	5230	3275	5616	126303	148761
		INITIAL CASES	41	46	43	48	45	38	30	--	41
2-HR UP TREND		U S D	--	42	45	34	45	47	56	--	47
		U ●	--	12	12	18	10	15	14	--	12
		INITIAL CASES	955	1286	1712	1410	3379	1888	2055	--	12685
2-HR STEADY TREND		U S D	--	--	47	50	37	34	32	--	15
		U ●	--	--	38	27	44	46	51	77	64
		INITIAL CASES	--	--	15	23	19	20	17	23	21
2-HR DOWN TREND		U S D	--	--	55	74	207	143	231	1042	1752
		S ●	25	33	25	31	27	27	19	--	3
		INITIAL CASES	75	57	65	57	64	60	68	96	93
		U S D	--	10	10	12	9	13	13	4	4
		D ●	1630	961	1740	816	3109	1888	3697	120267	134108
		INITIAL CASES	38	52	47	49	38	37	--	--	44
		U S D	62	38	43	30	46	45	--	--	44
		D ●	--	10	10	21	16	18	--	--	12
		INITIAL CASES	226	283	360	228	295	115	--	--	1507

TABLE 23: Percentage frequency of one-hour changes in visibility categories from an initial visibility category. Given an initial visibility category and the previous hourly trends in visibility categories (U-up, S-same, D-down), this table shows the percentage of time that the visibility category one hour later is higher, the same, or lower than the initial category.

STATION:	PREVIOUS TRENDS	FUTURE 1-HR CHANGES	INITIAL VISIBILITY CATEGORY (ST. MILES)										Categories
			J 0-3/8	K 1/2-7/8	L 1-1 7/8	M 2-2 1/2	N 3-4	O 5-6	P 7-9	Q ≥ 10			
NO TREND	INITIAL CASES		31	49	52	50	43	38	13	--			8
			69	27	28	28	39	46	79	95			85
			--	24	20	22	18	16	8	5			7
1-HR UP TREND	INITIAL CASES		3230	1288	1629	1474	4278	7900	40481	114307			174587
			--	61	55	57	55	45	18	--			18
			--	19	24	22	30	37	69	91			69
1-HR STEADY TREND	INITIAL CASES		--	20	21	21	15	18	13	9			13
			--	289	396	372	850	1427	3969	5977			13280
			27	42	49	41	36	33	12	--			4
1-HR DOWN TREND	INITIAL CASES		73	37	35	41	48	54	81	95			90
			--	21	16	18	16	13	7	5			6
			2222	350	455	407	1670	3651	31879	108330			148964
2-HR UP TREND	INITIAL CASES		40	47	52	53	44	40	18	--			34
			60	26	26	23	34	41	70	--			50
			--	27	22	24	22	19	12	--			16
2-HR STEADY TREND	INITIAL CASES		1008	649	778	695	1758	2822	4633	--			12343
			--	--	61	72	56	54	23	--			24
			--	--	24	14	31	32	65	92			65
2-HR DOWN TREND	INITIAL CASES		--	--	15	14	13	14	12	8			11
			--	--	54	63	184	335	911	379			2426
			27	32	47	35	29	28	10	--			3
2-HR STEADY TREND	INITIAL CASES		73	51	43	51	56	60	83	95			92
			--	17	10	14	15	12	7	5			5
			1618	130	158	166	806	1974	25898	102918			133668
2-HR DOWN TREND	INITIAL CASES		34	44	54	52	41	40	--	--			42
			66	28	26	26	34	37	--	--			40
			--	28	20	22	22	23	--	--			18
	INITIAL CASES		461	265	276	248	409	311	--	--			1970





APPENDIX E

ANALYSIS OF STATIC AND TREND PERSISTENCE

FOR

DULUTH IAP, MINNESOTA

TABLE 24: Percentage frequency of one-hour changes in ceiling values from an initial ceiling value. Given an initial ceiling value and the previous hourly ceiling trends (U-up, S-same, D-down), this table shows the percentage of time that the ceiling value one hour later is higher, the same, or lower than the initial value.

STATION: DLH	PREVIOUS TRENDS	FUTURE 1-HR CHANGES	INITIAL CEILING VALUE (FEET)										All Ceilings
			0-100	200-400	500-900	1000-1400	1500-2900	3000-4900	5000-9500	≥10000			
NO TREND		INITIAL CASES	31	41	46	47	48	46	39	5	21		
			62	33	22	18	15	17	24	80	57		
			7	26	32	35	37	37	37	15	22		
1-HR UP TREND		INITIAL CASES	4593	6344	8666	7125	11389	10033	10070	81794	140014		
			37	47	51	52	52	48	40	10	35		
			48	30	20	17	13	14	21	60	33		
1-HR STEADY TREND		INITIAL CASES	15	23	29	31	35	38	39	30	32		
			270	1622	2887	2694	4608	3792	3155	10764	29792		
			28	38	44	45	45	42	38	2	9		
1-HR DOWN TREND		INITIAL CASES	67	38	28	24	22	26	30	87	78		
			5	24	28	31	33	32	32	11	13		
			2828	2062	1897	1287	1668	1668	2369	65562	79341		
2-HR UP TREND		INITIAL CASES	38	40	44	43	46	46	40	28	40		
			53	30	20	17	14	15	22	39	24		
			9	30	36	40	40	39	38	33	36		
2-HR STEADY TREND		INITIAL CASES	1495	2660	3882	3144	5113	4573	4546	5468	30881		
			--	53	53	58	55	50	41	10	38		
			--	26	20	17	12	15	21	62	31		
2-HR DOWN TREND		INITIAL CASES	--	21	27	25	33	35	38	28	31		
			--	304	932	1044	2026	1559	1039	3436	10340		
			24	36	39	46	37	38	35	1	4		
2-HR DOWN TREND		INITIAL CASES	72	44	30	30	28	36	34	90	86		
			4	20	31	24	35	26	31	9	10		
			1904	785	531	305	373	436	706	57009	62049		
2-HR DOWN TREND		INITIAL CASES	36	38	40	40	42	42	37	27	39		
			9	30	19	16	14	13	21	29	21		
			55	32	41	44	44	45	42	44	40		
2-HR DOWN TREND		INITIAL CASES	637	1218	1745	1346	2007	1668	1490	858	10469		

TABLE 25: Percentage frequency of one-hour changes in visibility values from an initial visibility value. Given an initial visibility value and the previous hourly visibility trends (U-up, S-same, D-down), this table shows the percentage of time that the visibility value one hour later is higher, the same, or lower than the initial value.

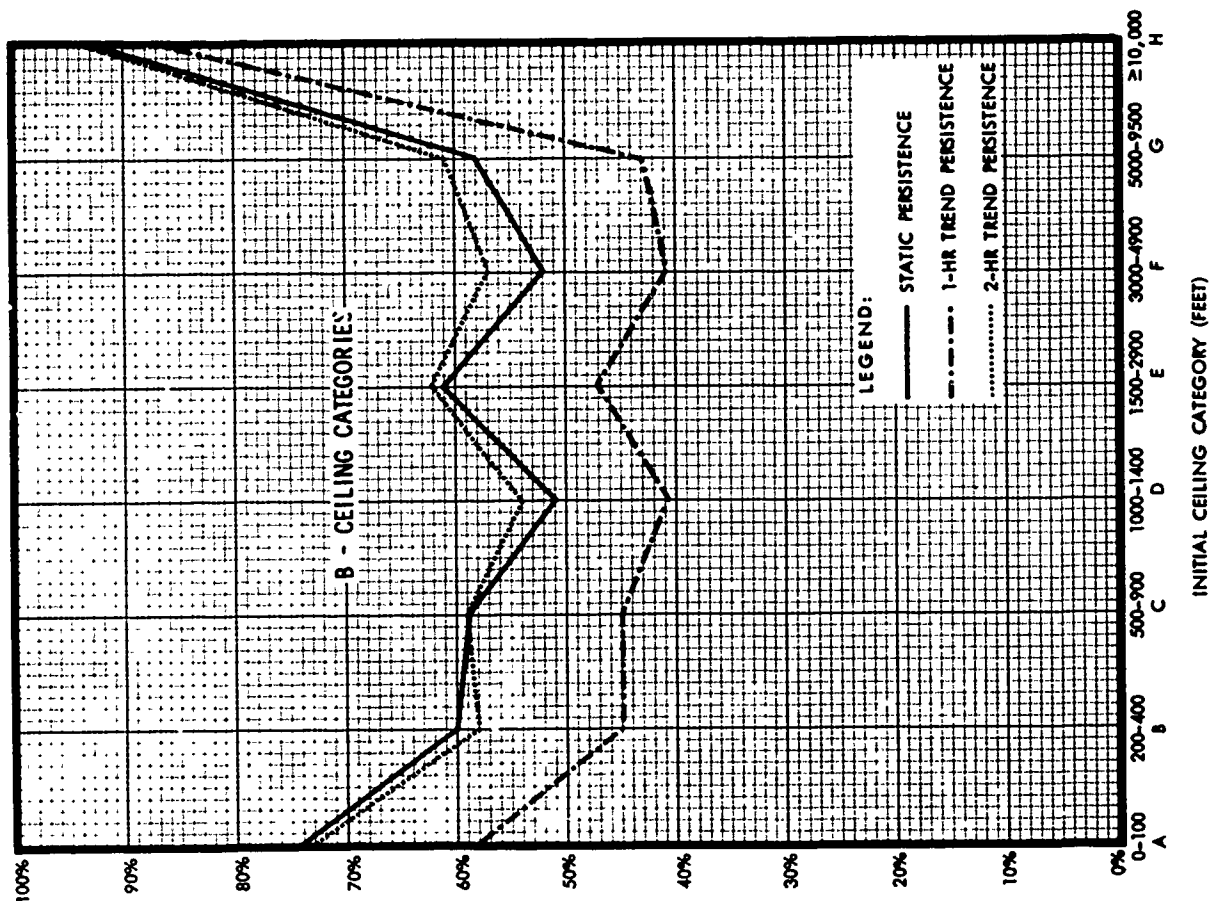
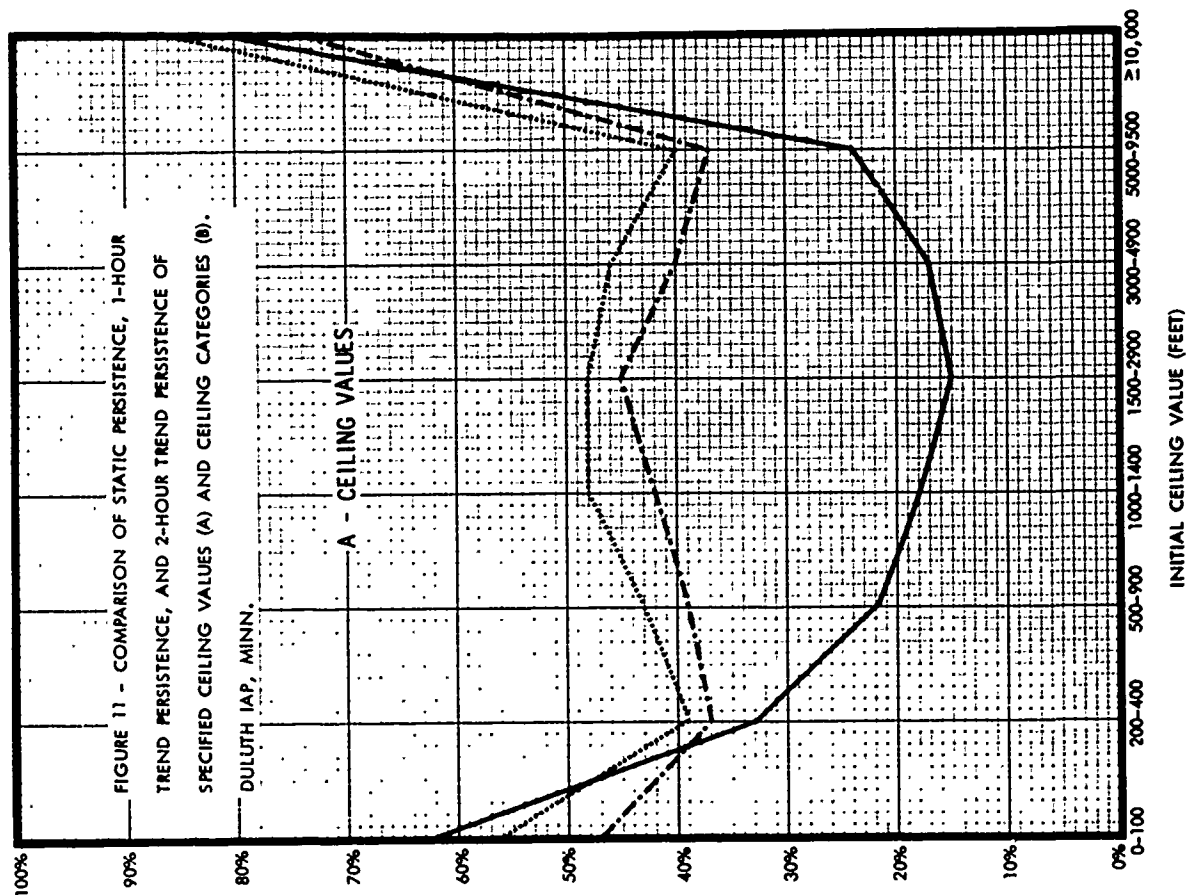
STATION: DLH	PREVIOUS TRENDS	FUTURE 1-HR CHANGES	INITIAL VISIBILITY VALUE (ST. MILES)										All Visibilities
			0-3/8	1/2-7/8	1-1 7/8	2-2 1/2	3-4	5-6	7-9	≥ 10			
NO TREND			39	49	47	42	45	48	45	4	11		
			47	26	26	28	26	21	26	90	79		
			14	24	27	30	29	31	29	6	10		
1-HR UP TREND			4218	2270	3579	2997	4657	3427	4781	114081	140010		
			50	54	53	45	51	55	56	21	37		
			31	21	21	38	24	17	20	61	42		
1-HR STEADY TREND			19	25	26	25	25	28	24	18	21		
			503	586	991	913	1528	1366	1828	7907	15622		
			33	44	42	38	38	39	35	1	4		
1-HR DOWN TREND			57	36	38	37	37	33	39	94	91		
			10	20	20	25	25	28	26	5	5		
			1978	579	936	846	1216	713	1232	103058	110558		
2-HR UP TREND			42	50	46	43	45	46	41	37	43		
			40	22	22	23	21	18	23	32	26		
			18	28	32	34	34	36	36	31	31		
2-HR STEADY TREND			1737	1105	1652	1238	1913	1348	1721	3116	13830		
			53	49	53	48	57	57	58	23	37		
			22	21	21	23	23	18	19	61	44		
2-HR DOWN TREND			25	30	26	29	20	25	23	16	19		
			40	122	232	272	514	478	731	3356	5745		
			30	36	36	33	34	30	30	1	2		
2-HR DOWN TREND			63	43	44	45	45	43	47	95	94		
			7	21	20	22	21	27	23	4	4		
			1128	208	359	315	455	239	475	97238	100417		
2-HR DOWN TREND			45	49	46	44	43	42	41	35	44		
			36	23	23	23	23	20	24	33	26		
			19	20	31	33	34	38	35	31	30		
2-HR DOWN TREND			881	534	714	502	674	405	409	199	4318		

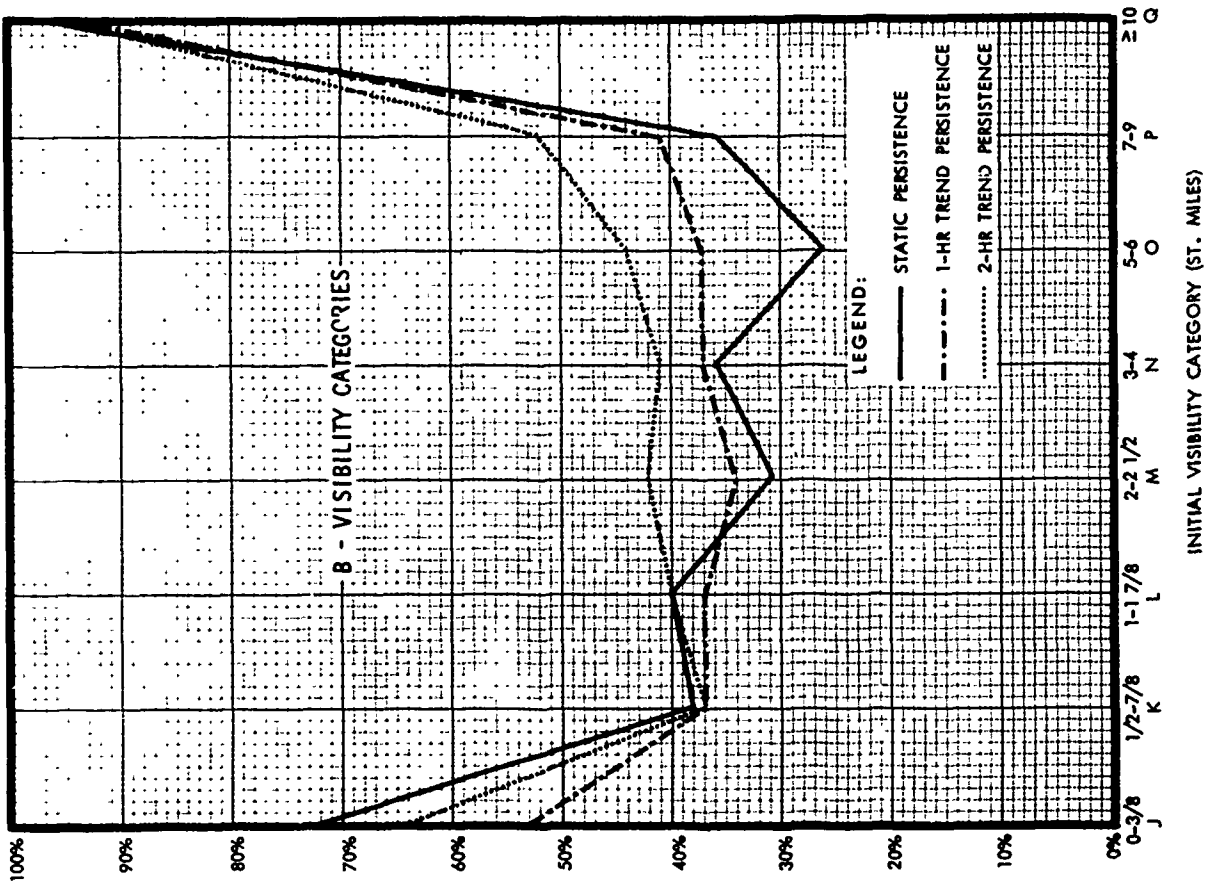
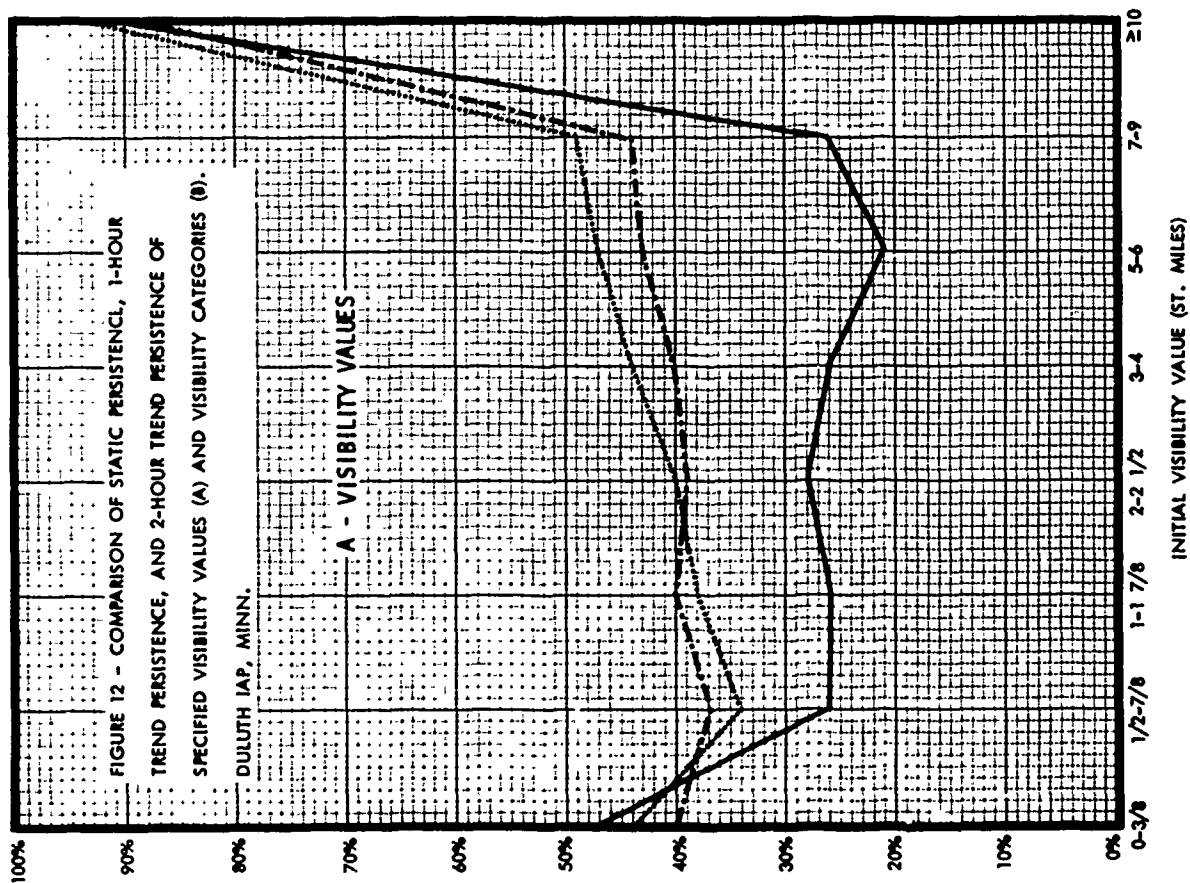
TABLE 26: Percentage frequency of one-hour changes in ceiling categories from an initial ceiling category. Given an initial ceiling category and the previous hourly trends in ceiling categories (U-up, S-same, D-down), this table shows the percentage of time that the ceiling category one hour later is higher, the same, or lower than the initial category.

STATION: DLH	PREVIOUS TRENDS	FUTURE 1-HR CHANGES	INITIAL CEILING CATEGORY (FEET)										All Categories
			A 0-100	B 200-400	C 500-900	D 1000-1400	E 1500-2900	F 3000-4900	G 5000-9500	H ≥ 10000			
NO TREND		INITIAL CASES	26	28	27	30	24	28	24	--	11		
			74	60	59	51	61	52	58	92	78		
			--	12	14	19	15	20	18	8	11		
1-HR UP TREND		INITIAL CASES	4593	6344	8666	7125	11389	10033	10070	81794	140014		
			--	27	25	30	20	23	20	--	14		
			--	57	56	48	57	44	49	76	61		
1-HR STEADY TREND		INITIAL CASES	--	16	19	22	23	33	31	24	25		
			--	782	1231	1487	1891	1975	1474	6499	15339		
			22	25	25	28	22	25	22	--	8		
1-HR DOWN TREND		INITIAL CASES	78	63	63	56	65	59	62	93	84		
			--	12	12	16	13	16	16	7	8		
			3413	3789	5136	3650	6890	5228	6072	75295	109473		
2-HR UP TREND		INITIAL CASES	37	34	34	33	33	35	31	--	33		
			63	54	52	46	51	47	55	--	52		
			--	12	14	21	16	18	14	--	15		
2-HR UP TREND		INITIAL CASES	1180	1773	2299	1988	2608	2830	2524	--	15202		
			--	--	31	37	24	21	20	--	14		
			--	--	50	45	55	40	46	73	59		
2-HR STEADY TREND		INITIAL CASES	--	--	19	18	21	39	34	27	27		
			--	--	113	172	322	211	299	966	2083		
			19	24	22	26	20	23	20	--	5		
2-HR STEADY TREND		INITIAL CASES	81	66	67	61	68	63	64	94	88		
			--	10	11	13	12	14	16	6	7		
			2662	2392	3257	2033	4494	2565	4198	70295	91896		
2-HR DOWN TREND		INITIAL CASES	35	32	30	34	27	38	--	--	32		
			65	58	51	40	51	40	--	--	51		
			--	10	19	26	22	22	--	--	17		
INITIAL CASES			289	420	544	345	385	262	--	--	2245		

TABLE 27: Percentage frequency of one-hour changes in visibility categories from an initial visibility category. Given an initial visibility category and the previous hourly trends in visibility categories (U-up, S-same, D-down) this table shows the percentage of time that the visibility category one hour later is higher, the same, or lower than the initial category.

STATION: DLH	PREVIOUS TRENDS	FUTURE 1-HR CHANGES	INITIAL VISIBILITY CATEGORY (ST. MILES)											All Categories
			J 0-3/8	K 1/2-7/8	L 1-1 7/8	M 2-2 1/2	N 3-4	O 5-6	P 7-9	Q ≥ 10				
NO TREND		U S D	28	43	41	45	41	48	40	--			7	
			72	38	40	31	36	26	36	96			86	
			--	19	19	24	23	26	24	4			7	
1-HR UP TREND		U S D	4218	2270	3579	2997	4657	3427	4781	114081			140010	
			--	48	46	41	45	49	49	--			26	
			--	32	34	32	34	25	30	86			55	
1-HR STEADY TREND		U S D	--	20	20	27	21	26	21	14			19	
			--	428	693	674	1278	1060	1550	6954			12637	
			23	35	35	35	36	33	--			2		
1-HR DOWN TREND		U S D	77	50	49	44	43	39	45	96			93	
			--	15	16	21	22	25	22	4			5	
			2819	845	1398	896	1606	898	1628	107127			117217	
2-HR UP TREND		U S D	38	47	43	53	43	53	39	--			45	
			62	32	35	23	31	20	31	--			33	
			--	21	22	24	26	27	30	--			22	
2-HR STEADY TREND		U S D	1399	997	1488	1427	1773	1469	1603	--			10156	
			--	--	46	49	50	51	52	--			24	
			--	--	39	28	33	28	28	87			59	
2-HR DOWN TREND		U S D	--	--	15	23	17	21	20	13			17	
			--	--	52	115	243	245	405	1147			2207	
			21	32	30	32	34	31	29	--			1	
2-HR DOWN TREND		U S D	79	55	55	50	47	45	51	96			95	
			--	13	15	18	19	24	20	4			4	
			1772	336	537	364	562	326	595	93656			98148	
2-HR DOWN TREND		U S D	42	46	45	42	42	41	--	--			43	
			58	36	36	28	34	27	--	--			39	
			--	18	19	30	24	32	--	--			18	
2-HR DOWN TREND		U S D	414	323	399	291	302	151	--	--			1880	





APPENDIX F

ANALYSIS OF STATIC AND TREND PERSISTENCE

FOR

HAMILTON AFB, CALIFORNIA

TABLE 28: Percentage frequency of one-hour changes in ceiling values from an initial ceiling value. Given an initial ceiling value and the previous hourly ceiling trends (U-up, S-same, D-down), this table shows the percentage of time that the ceiling value one hour later is higher, the same, or lower than the initial value.

STATION: SRF	PREVIOUS TRENDS	N FUTURE 1-HR CHANGES	INITIAL CEILING VALUE (FEET)								All Ceilings
			0-100	200-400	500-900	1000-1400	1500-2900	3000-4900	5000-9500	≥ 10000	
NO TREND		INITIAL CASES	31	44	42	44	42	33	25	2	12
			65	40	37	32	31	37	44	91	77
			4	16	21	24	27	30	31	7	11
1-HR UP TREND		INITIAL CASES	2322	2814	8852	7081	12164	6140	4352	131223	175148
			48	53	52	55	47	35	25	6	30
			38	34	29	24	27	33	41	74	47
1-HR STEADY TREND		INITIAL CASES	14	13	19	21	26	32	34	20	23
			126	681	2266	2169	3911	1591	1116	7959	20219
			29	39	38	39	38	30	25	2	6
1-HR DOWN TREND		INITIAL CASES	70	48	43	42	40	44	49	93	87
			1	13	19	19	22	26	26	5	7
			1647	1135	3267	2297	3802	2241	1915	119437	135741
2-HR UP TREND		INITIAL CASES	33	42	39	35	41	34	26	22	35
			60	36	36	31	28	33	40	57	38
			7	22	25	30	31	33	34	21	27
2-HR STEADY TREND		INITIAL CASES	749	998	3319	2615	4451	1908	1321	3827	19188
			--	57	59	64	54	34	29	6	34
			--	31	25	19	24	35	37	78	46
2-HR DOWN TREND		INITIAL CASES	--	12	16	17	22	31	34	16	20
			--	129	611	659	1435	713	277	2306	6130
			28	34	36	37	36	29	22	1	3
2-HR STEADY TREND		INITIAL CASES	71	55	46	49	46	47	54	95	92
			1	11	18	14	18	24	24	4	5
			1147	545	1398	953	1516	1114	785	111361	118819
2-HR DOWN TREND		INITIAL CASES	38	42	40	41	37	28	24	18	36
			57	38	36	28	27	33	42	50	35
			5	20	24	31	36	39	34	32	29
			220	355	1142	843	1373	498	245	461	5137

TABLE 29: Percentage frequency of one-hour changes in visibility values from an initial visibility value. Given an initial visibility value and the previous hourly visibility trends (U-up, S-same, D-down), this table shows the percentage of time that the visibility value one hour later is higher, the same, or lower than the initial value.

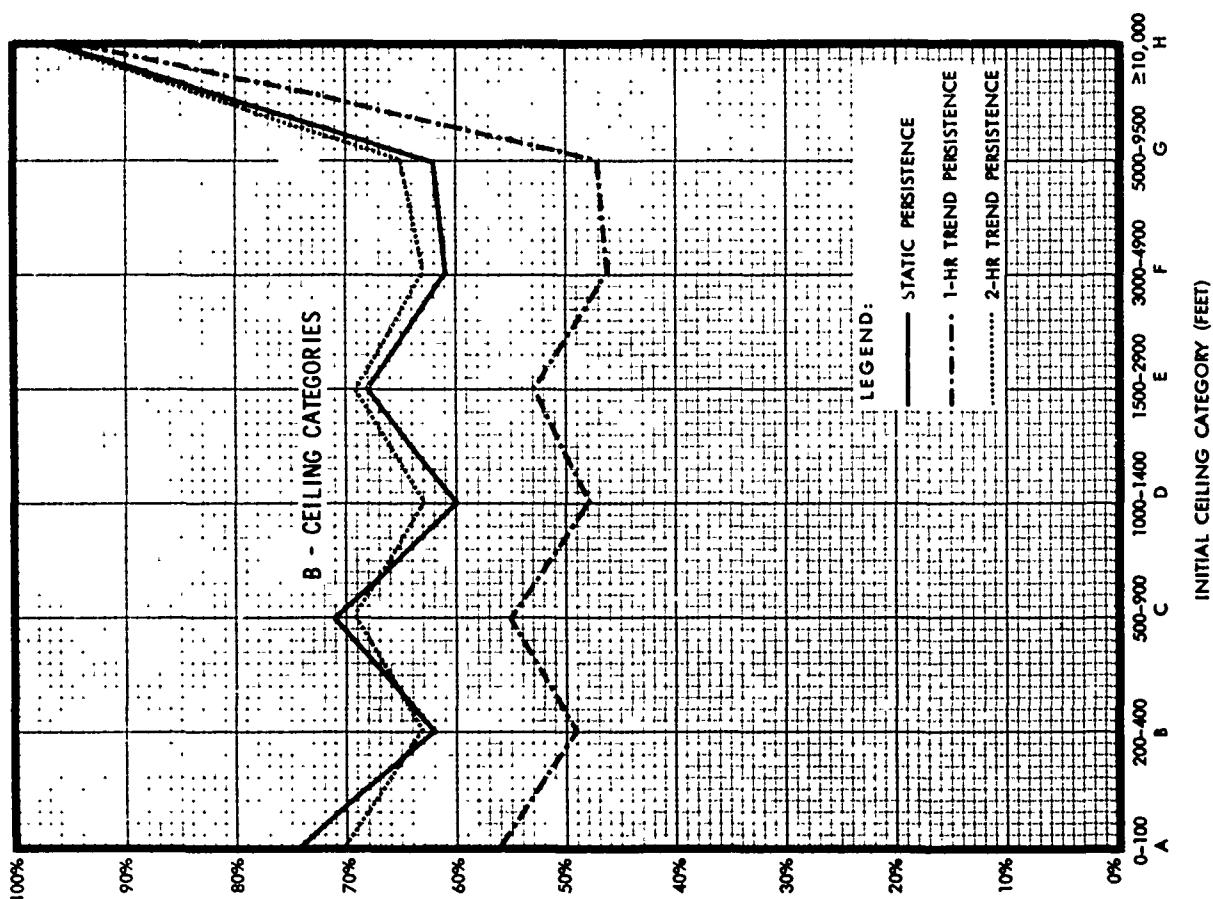
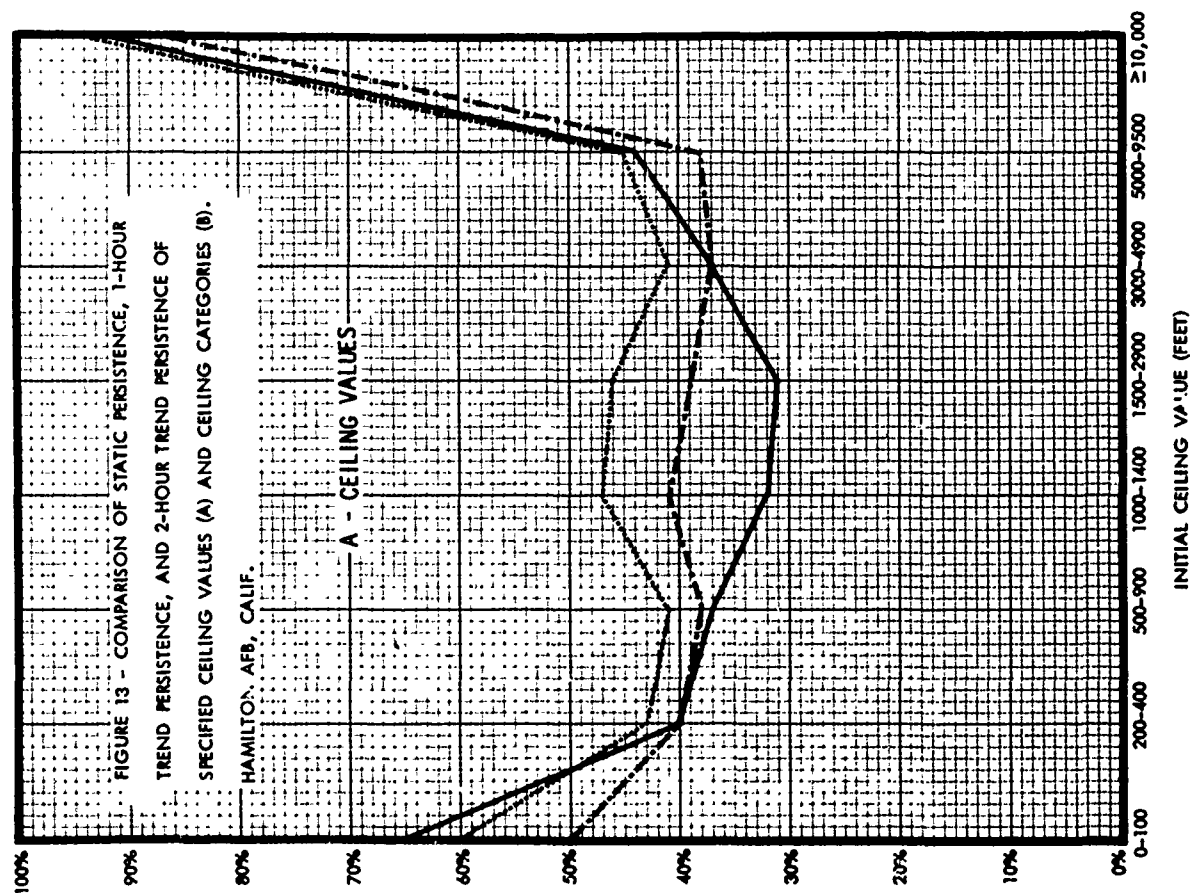
STATION: SRF	PREVIOUS TRENDS	FUTURE 1-HR CHANGES	INITIAL VISIBILITY VALUE (ST. MILES)										All Visibilities
			0-3/8	1/2-7/8	1-1 7/8	2-2 1/2	3-4	5-6	7-9	≥ 10			
NO TREND			42	53	45	37	32	29	23	10		15	
			45	22	34	39	49	50	63	77		70	
			13	25	21	24	19	21	14	13		15	
1-HR UP TREND			3427	1339	3394	3205	8160	7628	20946	127053		175152	
			55	65	56	52	45	46	32	18		27	
			25	17	24	30	40	38	54	68		58	
1-HR STEADY TREND			20	18	20	18	15	16	14	14		15	
			490	427	906	907	1871	1686	3500	17108		26895	
			36	49	38	28	25	22	20	8		11	
1-HR DOWN TREND			7	22	17	20	18	18	11	12		13	
			1545	294	1160	1263	4017	3798	13255	97763		123095	
			44	47	42	35	32	29	23	12		22	
2-HR UP TREND			17	31	26	32	26	30	23	21		23	
			1392	618	1328	1035	2272	2144	4191	12182		25162	
			66	69	60	55	51	51	36	22		33	
2-HR STEADY TREND			16	9	25	31	39	35	53	65		54	
			18	22	15	16	10	14	11	13		13	
			55	105	291	320	630	587	1104	4230		7322	
2-HR DOWN TREND			33	47	31	19	21	19	19	7		10	
			63	36	54	62	61	64	71	81		78	
			4	17	15	19	18	17	10	12		12	
			876	86	515	650	2297	2281	9072	77868		93645	
			44	46	43	37	33	29	24	10		28	
			38	22	29	31	38	41	51	72		48	
			18	32	28	32	29	30	25	18		24	
			709	304	526	391	727	652	972	1556		5837	

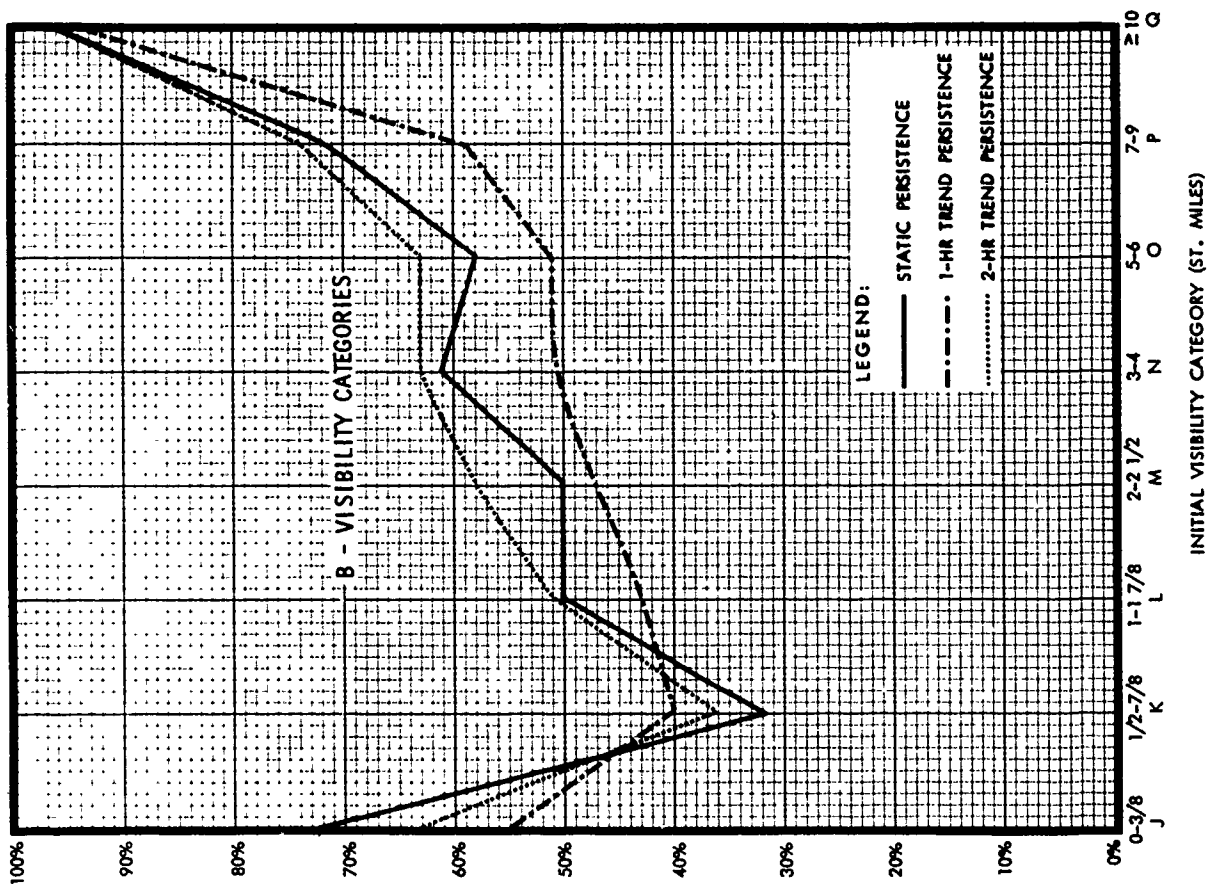
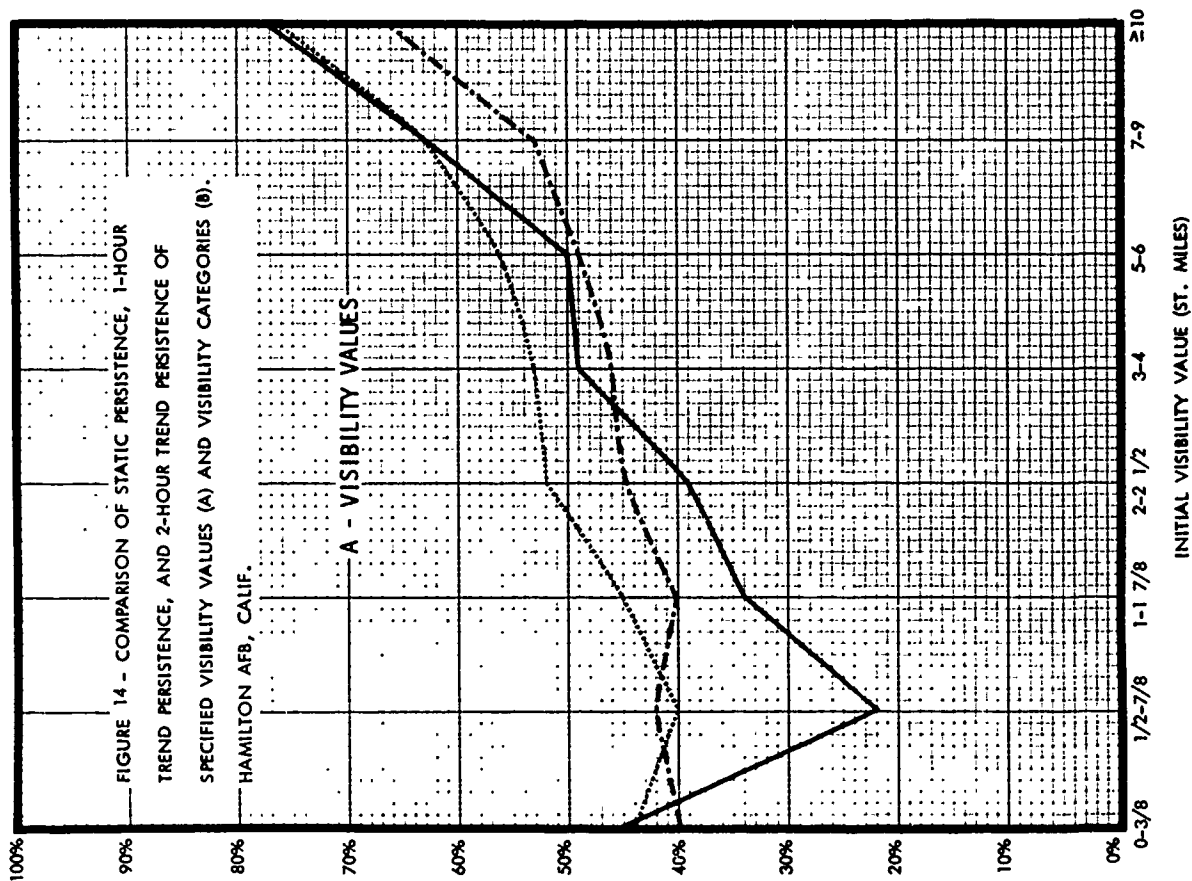
TABLE 30: Percentage frequency of one-hour changes in ceiling categories from an initial ceiling category. Given an initial ceiling category and the previous hourly trends in ceiling categories (U-up, S-same, D-down), this table shows the percentage of time that the ceiling category one hour later is higher, the same, or lower than the initial category.

STATION: SRF	PREVIOUS TRENDS	FUTURE 1-HR CHANGES	INITIAL CEILING CATEGORY (FEET)										All Categories
			A 0-100	B 200-400	C 500-900	D 1000-1400	E 1500-2900	F 3000-4900	G 5000-9500	H ≥ 10000			
NO TREND		INITIAL CASES	26	31	24	28	22	21	18	--	6		
			74	62	71	60	68	61	62	96	89		
			--	7	5	12	10	18	20	4	5		
1-HR UP TREND		INITIAL CASES	2522	2814	8852	7081	12164	6140	4352	131223	175148		
			--	36	27	36	22	20	18	--	13		
			--	54	62	50	62	54	54	83	69		
1-HR STEADY TREND		INITIAL CASES	--	10	11	14	16	26	28	17	18		
			--	330	644	1045	1494	1215	787	4880	10395		
			24	28	22	26	20	20	17	--	4		
1-HR DOWN TREND		INITIAL CASES	76	67	73	64	71	64	65	97	92		
			--	5	5	10	9	16	18	3	4		
			1869	1732	6273	4289	6232	3726	2699	126343	155163		
2-HR UP TREND		INITIAL CASES	30	35	27	27	30	23	23	--	28		
			70	52	67	58	60	59	59	--	61		
			--	13	6	15	10	18	18	--	11		
2-HR UP TREND		INITIAL CASES	653	752	1935	1747	2438	1199	866	--	9590		
			--	--	32	48	29	24	15	--	10		
			--	--	64	29	52	52	52	89	75		
2-HR STEADY TREND		INITIAL CASES	--	--	4	23	19	24	33	11	15		
			--	--	66	52	161	89	128	889	1'85		
			24	27	22	26	18	19	15	--	3		
2-HR DOWN TREND		INITIAL CASES	76	69	74	67	73	66	68	97	93		
			--	4	4	7	9	15	17	3	4		
			1412	1164	4574	2749	5836	2372	1763	122306	142176		
2-HR DOWN TREND		INITIAL CASES	38	36	24	29	30	12	--	--	28		
			62	55	74	57	60	67	--	--	64		
			--	9	2	14	10	21	--	--	8		
2-HR DOWN TREND		INITIAL CASES	125	121	313	190	262	69	--	--	1080		
			--	--	--	--	--	--	--	--	--		
			--	--	--	--	--	--	--	--	--		

TABLE 31: Percentage frequency of one-hour changes in visibility categories from an initial visibility category. Given an initial visibility category and the previous hourly trends in visibility categories (U-up, S-same, D-down), this table shows the percentage of time that the visibility category one hour later is higher, the same, or lower than the initial category.

STATION: SRF	INITIAL VISIBILITY CATEGORY (ST. MILES)										All Categories
	PREVIOUS TRENDS	FUTURE 1-HR CHANGES	J 0-3/8	K 1/2-7/8	L 1-1 7/8	M 2-2 1/2	N 3-4	O 5-6	P 7-9	Q ≥ 10	
NO TREND			28	47	36	31	25	25	18	--	7
			72	32	50	50	61	58	72	96	87
			--	21	14	19	14	17	10	4	6
1-HR UP TREND			3427	1339	3394	3205	8160	7628	20946	127053	175152
			--	60	46	45	36	40	23	--	21
			--	23	36	38	50	45	66	89	66
			--	17	18	17	14	15	11	11	13
1-HR STEADY TREND			--	345	606	717	1347	1323	2504	4637	11479
			24	43	32	25	21	20	16	--	4
			76	40	57	59	67	66	75	97	91
			--	17	11	16	12	14	9	3	5
1-HR DOWN TREND			2472	428	1683	1596	4935	4465	15077	122416	153072
			38	43	37	32	29	26	21	--	29
			62	31	42	42	51	50	63	--	53
			--	26	21	26	20	24	16	--	18
			955	566	1105	892	1878	1840	3365	--	10601
			--	--	47	51	41	45	24	--	23
2-HR UP TREND			--	--	42	35	51	43	66	87	65
			--	--	11	14	8	12	10	13	12
			--	--	98	134	367	312	667	818	2396
			23	40	29	17	18	18	16	--	3
2-HR STEADY TREND			77	47	61	68	70	68	76	97	93
			--	13	10	15	12	14	8	3	4
			1878	174	969	944	3303	2953	11304	118281	139806
			38	42	37	36	28	23	--	--	34
2-HR DOWN TREND			62	31	42	38	51	56	--	--	48
			--	27	21	26	21	21	--	--	18
			414	222	338	247	415	293	--	--	1929





APPENDIX G

ANALYSIS OF STATIC AND TREND PERSISTENCE

FOR

RICHARDS-GEBAUR AFB, MISSOURI

TABLE 32: Percentage frequency of one-hour changes in ceiling values from an initial ceiling value. Given an initial ceiling value and the previous hourly ceiling trends (U-up, S-same, D-down), this table shows the percentage of time that the ceiling value one hour later is higher, the same, or lower than the initial value.

STATION: GVW	PREVIOUS TRENDS	N ↑ F ↓ A	FUTURE 1-HR CHANGES	INITIAL CEILING VALUE (FEET)										All Ceilings
				0-100	200-400	500-900	1000-1400	1500-2900	3000-4900	5000-9500	≥ 10000			
NO TREND		INITIAL CASES		33	39	41	44	43	37	26	4	14		
				62	44	34	30	32	39	51	86	72		
				5	17	25	26	25	24	23	10	14		
1-HR UP TREND		INITIAL CASES		968	2457	4005	2815	6134	4946	8461	68810	98596		
				34	49	48	50	48	38	35	9	28		
				60	36	32	27	29	35	41	70	50		
1-HR STEADY TREND		INITIAL CASES		6	15	20	23	23	27	24	21	22		
				62	499	1168	942	1968	1352	1550	6228	13769		
				32	35	37	39	42	35	25	2	8		
1-HR DOWN TREND		INITIAL CASES		64	50	39	38	39	45	54	90	82		
				4	15	24	23	19	20	21	8	10		
				602	1092	1356	844	1918	1851	4218	59109	70990		
2-HR UP TREND		INITIAL CASES		34	38	39	42	41	36	24	22	32		
				59	43	30	26	27	37	50	53	41		
				7	19	31	32	32	27	26	25	27		
2-HR UP TREND		INITIAL CASES		304	866	1481	1029	2248	1743	2693	3473	13837		
				--	48	52	56	51	43	36	9	33		
				--	41	31	25	29	31	40	68	45		
2-HR STEADY TREND		INITIAL CASES		--	11	17	19	20	26	24	23	22		
				--	91	370	348	766	477	357	1475	3884		
				30	31	29	31	39	33	23	2	4		
2-HR DOWN TREND		INITIAL CASES		66	54	47	47	42	49	56	91	88		
				4	15	24	22	18	18	21	7	8		
				384	542	535	320	743	1101	1966	52927	58518		
2-HR DOWN TREND		INITIAL CASES		31	40	37	41	38	36	21	20	34		
				63	38	29	25	23	35	48	48	35		
				6	22	34	34	39	29	31	32	31		
				117	371	588	380	762	662	535	327	3742		

TABLE 33: Percentage frequency of one-hour changes in visibility values from an initial visibility value. Given an initial visibility value and the previous hourly visibility trends (U-up, S-same, D-down), this table shows the percentage of time that the visibility value one hour later is higher, the same, or lower than the initial value.

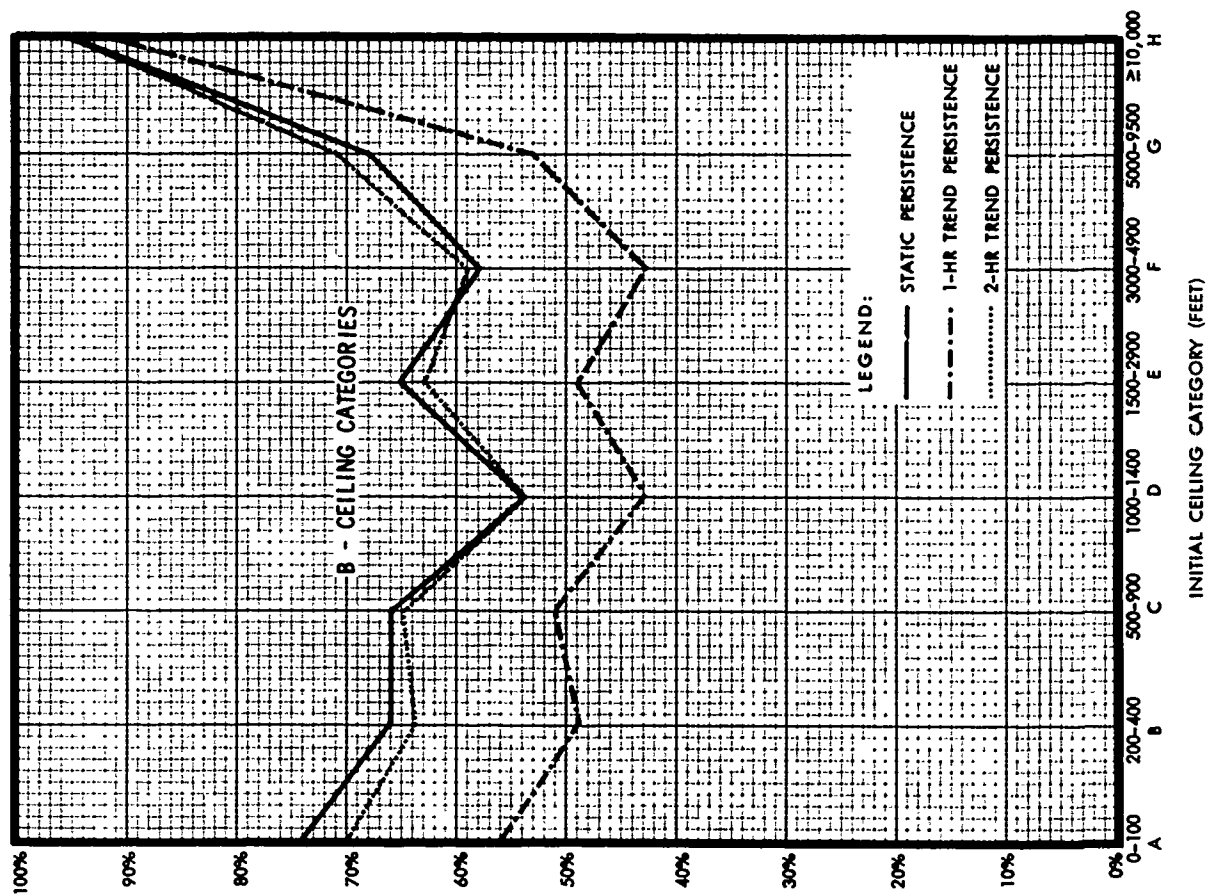
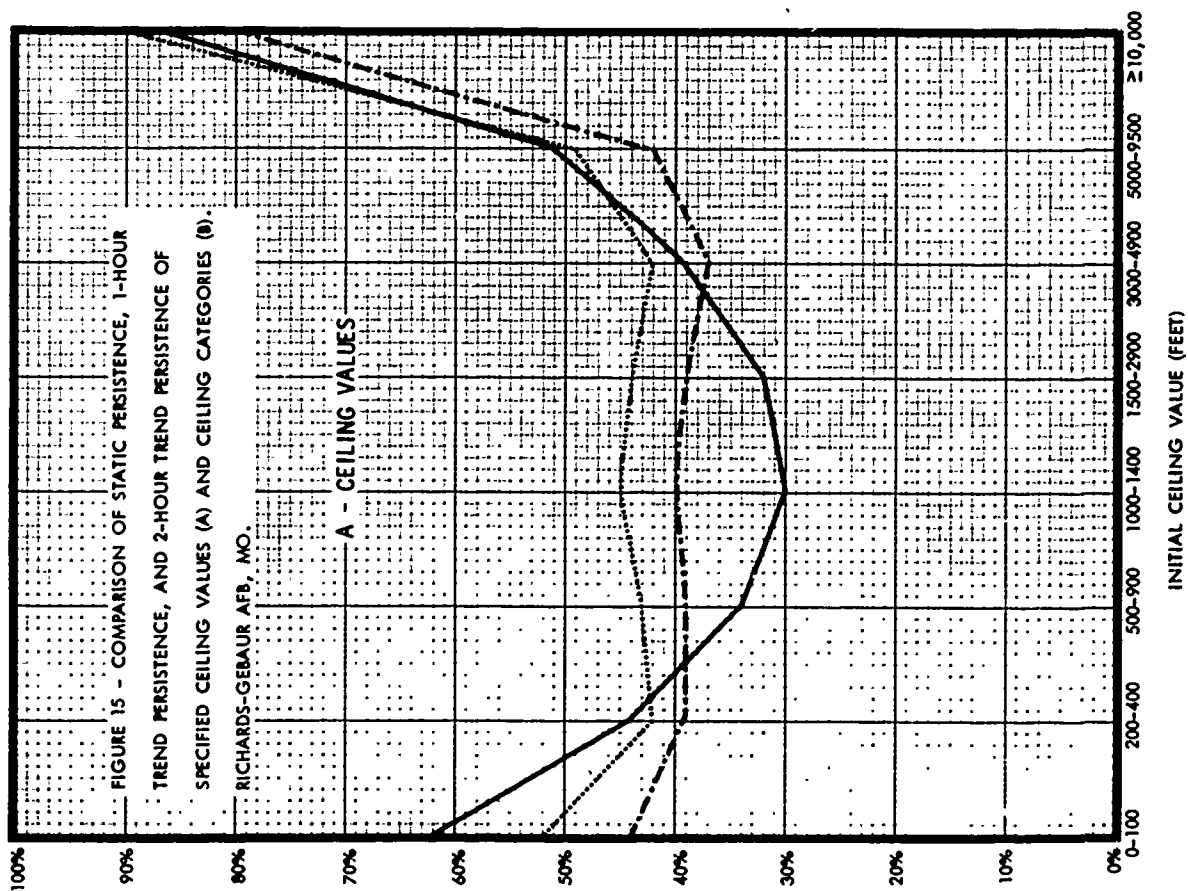
STATION: GVW	PREVIOUS TRENDS	FUTURE 1-HR CHANGES	INITIAL VISIBILITY VALUE (ST. MILES)										All Visibilities																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																							
			0-3/8	1/2-7/8	1-1 7/8	2-2 1/2	3-4	5-6	7-9	≥ 10																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																										
NO TREND		U S D	44	45	49	43	35	38	30	3	10																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																									
			41	31	27	31	43	37	51	91	81																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																									
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1-HR UP TREND		U S D	1150	988	1932	1626	3446	3290	6748	79416	98596																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																									
			49	53	57	52	46	53	42	14	31																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																									
			33	26	20	24	36	31	44	76	55																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																									
1-HR STEADY TREND		U S D	18	21	23	24	18	16	14	10	14																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																									
			182	223	589	496	940	875	1501	4993	9799																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																									
			40	35	40	35	28	32	26	2	5																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																									
1-HR DOWN TREND		U S D	48	42	39	42	52	49	59	93	89																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																									
			12	23	21	23	20	19	15	5	6																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																									
			468	307	520	499	1457	1205	3458	72075	79989																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																									
2-HR UP TREND		U S D	47	47	24	44	37	34	28	22	33																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																									
			36	27	48	27	34	29	42	25	38																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																									
			17	26	28	29	29	37	30	53	29																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																									
2-HR STEADY TREND		U S D	500	458	823	631	1049	1210	1789	2348	8808																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																									
			44	59	56	50	48	55	46	16	34																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																									
			24	13	20	27	34	30	43	74	53																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																									
2-HR DOWN TREND		U S D	32	28	24	23	18	15	11	10	13																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																									
			25	39	169	164	340	331	499	1445	3012																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																									
			38	35	37	32	23	26	24	1	3																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																									
2-HR UP TREND		U S D	54	47	46	44	58	56	62	94	92																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																									
			8	18	17	24	19	18	14	5	5																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																									
			225	129	203	209	764	586	2037	67042	71195																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																									
2-HR DOWN TREND		U S D	50	51	46	47	35	34	27	20	38																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																									
			36	26	23	24	33	26	42	52	32																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																									
			14	23	31	29	32	40	31	28	30																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																									

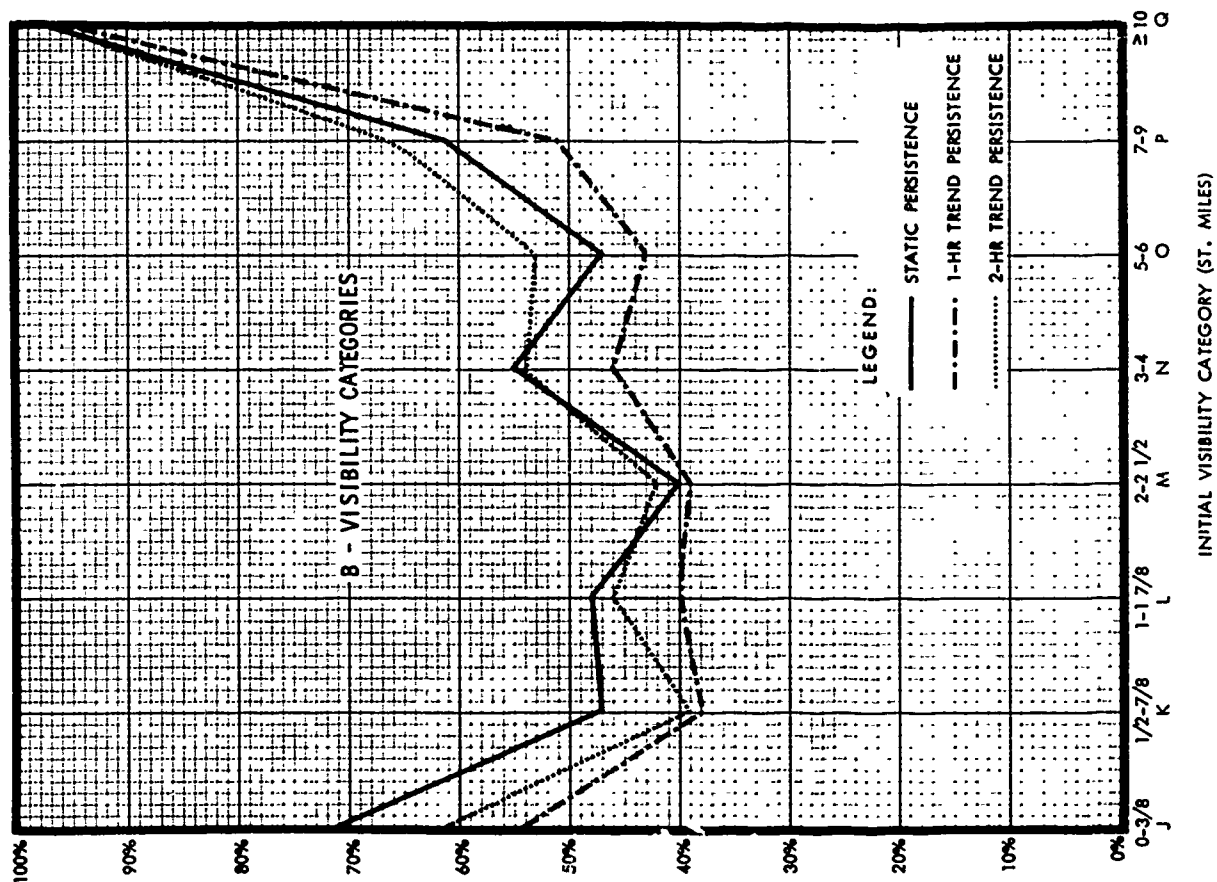
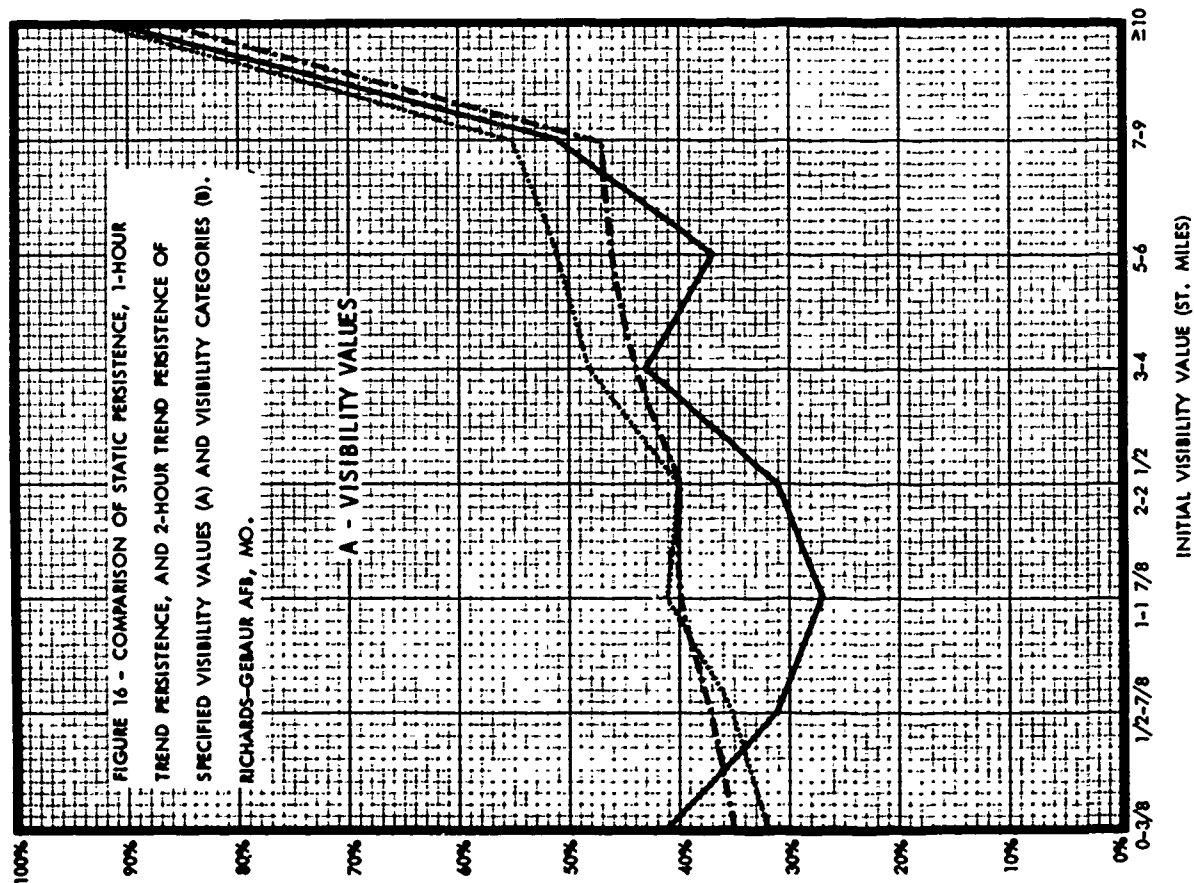
TABLE 34: Percentage frequency of one-hour changes in ceiling categories from an initial ceiling category. Given an initial ceiling category and the previous hourly trends in ceiling categories (U-up, S-same, D-down), this table shows the percentage of time that the ceiling category one hour later is higher, the same, or lower than the initial category.

STATION:	PREVIOUS TRENDS	FUTURE 1-HR CHANGES	INITIAL CEILING CATEGORY (FEET)										All Categories
			A 0-100	B 200-400	C 500-900	D 1000-1400	E 1500-2900	F 3000-4900	G 5000-9500	H ≥ 10000			
GVW			26	27	23	31	24	26	19	--		7	
NO TREND		U S D	74	66	66	54	65	58	68	95		86	
			--	7	11	15	11	16	13	5		7	
			968	2457	4005	2815	6134	4947	8461	68809		98596	
1-HR UP TREND		U S D	--	27	19	31	21	24	21	--		12	
			--	64	67	52	62	51	56	82		69	
			--	9	14	17	17	25	23	18		19	
1-HR STEADY TREND		U S D	--	198	477	558	799	767	907	3433		7139	
			24	24	21	27	23	26	18	--		5	
			76	69	69	59	67	61	71	96		89	
1-HR DOWN TREND		U S D	--	7	10	14	10	13	11	4		6	
			714	1633	2634	1528	3960	2866	5762	65376		84473	
			33	33	32	36	31	28	23	--		29	
2-HR UP TREND		U S D	67	61	55	46	58	57	65	--		59	
			--	6	13	18	11	15	12	--		12	
			254	626	894	729	1375	1314	1792	--		6984	
2-HR STEADY TREND		U S D	--	--	36	45	23	25	23	--		13	
			--	--	56	44	66	39	55	82		69	
			--	--	8	11	11	36	22	18		18	
2-HR DOWN TREND		U S D	--	--	39	54	129	67	127	448		864	
			22	22	20	26	22	24	17	--		3	
			78	72	71	60	69	64	72	96		92	
2-HR STEADY TREND		U S D	--	6	9	14	9	12	11	4		5	
			543	1123	1817	900	2667	1736	4097	62564		75447	
			33	33	33	42	29	33	--	--		33	
2-HR DOWN TREND		U S D	67	59	52	43	58	50	--	--		54	
			--	8	15	15	13	17	--	--		13	
			55	150	207	114	199	131	--	--		856	

TABLE 35: Percentage frequency of one-hour changes in visibility categories from an initial visibility category. Given an initial visibility category and the previous hourly trends in visibility categories (U-up, S-same, D-down), this table shows the percentage of time that the visibility category one hour later is higher, the same, or lower than the initial category.

STATION:	PREVIOUS TRENDS	FUTURE 1-HR CHANGES	INITIAL VISIBILITY CATEGORY (ST. MILES)										All Categories
			J 0-3/8	K 1/2-7/8	L 1-1 7/8	M 2-2 1/2	N 3-4	O 5-6	P 7-9	Q ≥ 10			
NO TREND			29	37	36	38	28	33	24	--	6		
			71	47	48	40	55	47	61	97	89		
			--	16	16	22	17	20	15	3	5		
1-HR UP TREND			1150	988	1932	1626	3446	3290	6748	79416	98596		
			--	45	42	45	34	44	33	--	23		
			--	45	44	35	49	42	54	89	64		
1-HR STEADY TREND			--	10	14	20	17	14	13	11	13		
			--	148	348	408	684	705	1119	2300	5712		
			25	31	32	32	24	29	22	--	3		
1-HR DOWN TREND			75	52	54	48	61	53	66	97	93		
			--	17	14	20	15	18	12	3	4		
			820	460	933	657	1895	1533	4138	77116	87552		
2-HR UP TREND			38	42	40	40	33	32	25	--	33		
			62	40	42	36	46	40	53	--	46		
			--	18	18	24	21	28	22	--	21		
2-HR STEADY TREND			330	380	651	561	867	1052	1491	--	5332		
			--	--	43	38	32	48	35	--	22		
			--	--	40	40	52	40	54	89	65		
2-HR DOWN TREND			--	--	17	22	16	12	11	11	13		
			--	--	42	81	166	177	297	543	1306		
			23	28	31	26	19	23	20	--	2		
2-HR UP TREND			77	56	57	52	65	60	69	97	95		
			--	16	12	22	16	17	11	3	3		
			617	240	507	313	1158	817	2744	75058	81454		
2-HR STEADY TREND			44	44	35	46	26	31	--	--	36		
			56	45	43	32	52	43	--	--	46		
			--	11	22	22	22	26	--	--	18		
2-HR DOWN TREND			154	135	209	155	291	188	--	--	1132		
			--	--	22	22	22	26	--	--	18		
			--	--	22	22	22	26	--	--	18		





UNCLASSIFIED

Security Classification

DOCUMENT CONTROL DATA - R & D

(Security classification of title, body of abstract and indexing annotation must be entered when the overall report is classified)

1. ORIGINATING ACTIVITY (Corporate author) Hq 4th Weather Wing Aerospace Sciences Division Ent Air Force Base, Colorado 80912		2a. REPORT SECURITY CLASSIFICATION Unclassified	
		2b. GROUP N/A	
3. REPORT TITLE The Value of Static and Trend Persistence in the One-Hour Prediction of Ceiling and Visibility.			
4. DESCRIPTIVE NOTES (Type of report and inclusive dates) Technical report on the use of persistence as a forecast tool.			
5. AUTHOR(S) (First name, middle initial, last name) Joe S. Restivo and Franklin R. Hartranft			
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8a. CONTRACT OR GRANT NO. N/A		9a. ORIGINATOR'S REPORT NUMBER(S) 4th Weather Wing Technical Paper 70-1	
b. PROJECT NO. N/A		9b. OTHER REPORT NO(S) (Any other numbers that may be assigned to this report) N/A	
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11. SUPPLEMENTARY NOTES None		12. SPONSORING MILITARY ACTIVITY Hq 4th Weather Wing Ent Air Force Base, Colorado 80912	
13. ABSTRACT This paper describes some of the various applications of persistence by different meteorological agencies; identifies certain areas of confusion; clarifies the definition of the general term "persistence;" and presents a full-scale statistical evaluation of static and trend persistence based upon the period of record at seven terminals. The results of this evaluation provide a reliable estimate of the value of static and trend persistence in the one-hour prediction of ceiling and visibility.			

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Security Classification

14.	KEY WORDS	LINK A		LINK B		LINK C	
		ROLE	WT	ROLE	WT	ROLE	WT
1.	Meteorology						
2.	Persistence						
3.	Persistence Probability						
4.	Ceiling and Visibility Forecasting						