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REFORGER 77 SUPPORT -- PART A. AN INDEPENDENT TEST OF THE REFOR--ETC(U)
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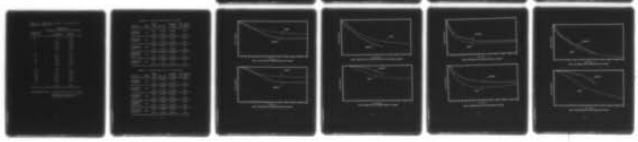

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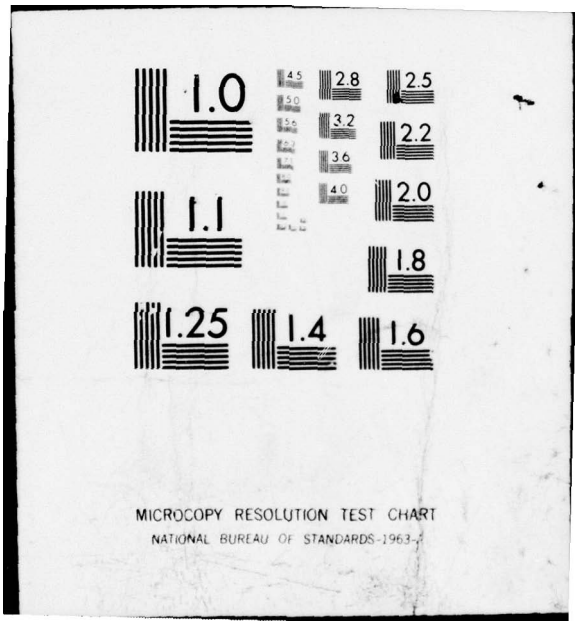
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USAF ENVIRONMENTAL
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SCOTT AIR FORCE BASE, ILLINOIS 62225

Report 8065A (Revised)

REFORGER 77 SUPPORT

PART A

AN INDEPENDENT TEST OF THE REFORGER 76 SUPPORT CLIMO PROGRAM

by

Murray J. Young

January 1977

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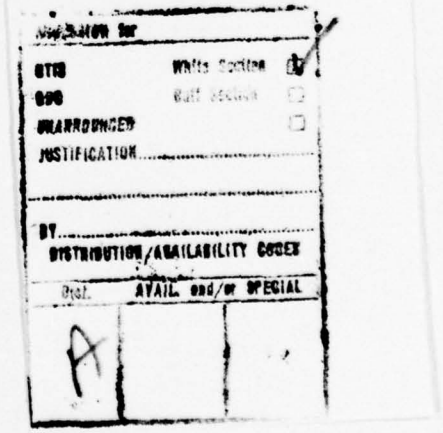

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The maximum difference between a modeled climatology and the observed climatology is used to determine whether the modeled and observed are the same. Statistically significant differences were found, suggesting further development and study are needed.

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Preface

In response to a request from the Air Force Global Weather Central (AFGWC) the USAF Environmental Technical Applications Center (USAFETAC), developed a computerized climatology model (CLIMO) to "spread" climatology to grid points in Germany. This author described the development of the CLIMO model in USAFETAC Report 7966. This report revises the original Report 8065A in which a wrong statistical test was used to evaluate a model climatology and presents some of the results of the evaluation.

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This study was prepared to answer a specific question; how good is CLIMO? Therefore, this report is not expected to have any application beyond answering this question. Department of Defense (DoD) agencies and DoD contractors should refer any questions on this specific climatological study to USAFETAC for consultation.

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AN INDEPENDENT TEST OF THE REFORGER 76 SUPPORT CLIMO PROGRAM

Introduction

The computerized climatology model (CLIMO) program described by Young [1] can be tested by reproducing the cumulative probability distributions of selected weather parameters at a selected station. For this test, the program was set to reproduce the cumulative percentage frequencies of the ceiling and the visibility in the format of Section D of the Air Weather Service Revised Uniform Summary of Surface Weather Observations (RUSSWO). Three nearby stations with different elevations were used for the independent test. This report describes the test and discusses the results.

Discussion

Ceiling, visibility, and wind data from 23 stations were used in the CLIMO dependent study. Of these 23 stations, only 20 stations were used for the ceiling and visibility. The additional three stations were used for the wind. These wind statistics failed to produce any realistic results. The additional three independent nearby stations were selected from the RUSSWO's to represent a range of heights and are indicated in Figure 1 by circles. The test stations are:

WMO NO.	STATION	ELEVATION (above MSL)
107295	Sandhofen, Germany	108 m (334 ft)
106870	Grafenwohr, Germany	415 m (1360 ft)
109710	Bad Tolz, Germany	716 m (2360 ft)

In the independent study, the hours of 0700 and 1600 LST were tested for the months of September, October, and November.

Test Procedures

Assuming that the observed frequencies and the model frequencies were the same, a test was made using the Kolmogorov-Smirnov One-Sample Test described by Siegel [2].

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Figure 1. Stations Used in Study.

Table 1a shows the results of one test for a specific month, time of day, and test station. This table is described in detail because it shows the format for all other months, hours, and parameters tested.

The ceiling summaries in Table 1a contain 31 categories of heights ranging downward from 20,000 feet to zero feet. The largest difference between categories of the observed and modeled is used in the Kolmogorov-Smirnov One-Sample Test. For example, the maximum difference is at the 12,000-ft category (16.7% or 0.1670). This difference is greater than the critical value, 0.0553; thus, the difference is considered significant. Figure 2 is a plot of the observed data and model output. Three more of these detailed breakdowns of the test are included in Table 1b and Figure 3, Table 2a and Figure 4, and Table 2b and Figure 5. To reduce the amount of table preparation, only the significance test portions and a limited amount of data for the remaining months, hours, and stations are shown. Tables 3 and 4 show ceilings and visibilities, respectively. The differences in the values for the observed data and the model output for Bad Tolz were so great that a significance test was not needed.

Conclusions

Statistically, the observed and the modeled summaries were shown to be significantly different for all of the cases.

While the model seemed to work, it still needs further study. Possibly a different distribution equation (from DISFIT [1]) should be used. We need dependent sample data that includes, if available, stations at higher elevations. In any event, further development studies are needed if this concept of prediction or spreading is to be used.

References

[1] Young, Murray J.: "Reforger 76 Support," USAFETAC Report 7966, 6 p.

[2] Siegel, Sidney: Nonparametric Statistics, McGraw-Hill Book Co., Inc., New York, 1956, pp. 46-136.

Table 1a. Sandhofen, Germany: Observed- and Model-Produced Cumulative Summaries of Ceiling Heights (RUSSWO format) for September, 0700 LST.

CEILING HEIGHT (100's of feet)	FREQUENCIES (Cumulative Percent ≥ Ceiling Height) OBSERVED	MODEL
200	50.8	63.7
180	50.8	64.4
160	50.8	65.3
140	50.8	66.4
120	51.2	67.9
100	54.9	69.8
90	57.2	71.0
80	61.3	72.4
70	66.1	74.0
60	71.3	75.9
50	75.9	78.2
45	78.7	79.5
40	81.2	80.9
35	82.7	82.5
30	85.5	84.3
25	89.7	86.3
20	91.3	88.6
18	91.5	89.6
15	92.9	91.2
12	94.1	92.9
10	94.3	94.1
9	94.3	94.7
8	94.3	95.3
7	94.3	95.9
6	94.9	96.5
5	95.2	97.2
4	95.5	97.8
3	96.5	98.3
2	97.5	98.9
1	98.6	99.4
0	100.0	100.0

SIGNIFICANCE TEST: Critical value (.01) = 0.0553

Observed and model are significantly different

Table 1b. Sandhofen, Germany: Ceiling Heights for September, 1600 LST.

CEILING HEIGHT (100's of feet)	FREQUENCIES (Cumulative Percent ≥ Ceiling Height) OBSERVED	MODEL
200	56.3	72.4
180	56.3	72.1
160	56.3	72.1
140	56.6	72.4
120	57.5	73.1
100	60.6	74.5
90	64.3	75.6
80	69.4	76.9
70	73.3	78.5
60	78.0	80.6
50	81.6	83.1
45	86.1	84.6
40	88.6	86.3
35	92.6	88.1
30	95.0	90.1
25	97.3	92.2
20	97.9	94.4
18	98.2	95.3
15	99.0	96.5
12	99.4	97.7
10	99.8	98.4
9	99.8	98.7
8	99.8	99.0
7	99.8	99.2
6	99.8	99.4
5	99.8	99.6
4	100.0	99.7
3	100.0	99.8
2	100.0	99.9
1	100.0	100.0
0	100.0	100.0

SIGNIFICANCE TEST: Critical value (.01) = 0.0536

Observed and model are significantly different

Table 2a. Sandhofen, Germany: Observed- and Model-Produced Cumulative Summaries of Visibility (RUSSWO format) for September, 0700 LST.

VISIBILITY (miles)	FREQUENCIES (Cumulative Percent ≥ Visibility) OBSERVED	MODEL
10	--	28.9
6	21.8	37.7
5	28.5	42.0
4	36.9	48.0
3	48.2	56.3
$2\frac{1}{2}$	51.8	61.8
2	62.0	68.4
$1\frac{1}{2}$	69.6	76.1
$1\frac{1}{4}$	71.4	80.4
1	79.2	84.8
3/4	82.0	89.4
5/8	83.1	91.5
1/2	84.5	93.6
5/16	87.1	96.2
1/4	87.5	96.8
0	100.0	100.0

SIGNIFICANCE TEST: Critical value (.01) = 0.0539

Observed and model are significantly different

Table 2b. Sandhofen, Germany: Visibility for September, 1600 LST.

VISIBILITY (miles)	FREQUENCIES (Cumulative Percent ≥ Visibility) OBSERVED	MODEL
10	--	61.6
6	73.1	66.2
5	81.2	69.8
4	89.6	75.0
3	94.0	82.2
$2\frac{1}{2}$	95.3	86.4
2	97.1	90.8
$1\frac{1}{2}$	98.5	95.0
$1\frac{1}{4}$	98.7	96.7
1	98.8	98.1
3/4	99.0	99.1
5/8	99.5	99.4
1/2	99.6	99.7
5/16	100.0	99.8
1/4	100.0	99.9
0	100.0	100.0

SIGNIFICANCE TEST: Critical value (.01) = 0.0536

Observed and model are significantly different

Table 3. Significance Test — Ceiling.

STATION	MONTH	HOUR LST	MAX DIF	CRITICAL VALUE	SIG DIF AT .01 LEVEL
Sandhofen (107295)	OCT	0700	0.2670	0.0526	Yes
		1600	0.2460	0.0525	Yes
Sandhofen (107295)	NOV	0700	0.3190	0.0545	Yes
		1600	0.4120	0.0539	Yes
Grafenwohr (106870)	SEP	0700	0.1970	0.0513	Yes
		1600	0.2260	0.0515	Yes
Grafenwohr (106870) Figs 6 & 7	OCT	0700	0.1000	0.0504	Yes
		1600	0.1860	0.0507	Yes
Grafenwohr (106870)	NOV	0700	0.1380	0.0516	Yes
		1600	0.1290	0.0519	Yes

Table 4. Significance Test — Visibility.

STATION	MONTH	HOUR LST	MAX DIF	CRITICAL VALUE	SIG DIF AT .01 LEVEL
Sandhofen (107295)	OCT	0700	0.0850	0.0526	Yes
		1600	0.0650	0.0525	Yes
Sandhofen (107295)	NOV	0700	0.2980	0.0545	Yes
		1600	0.0700	0.0539	Yes
Grafenwohr (106870)	SEP	0700	0.1480	0.0513	Yes
		1600	0.2930	0.0515	Yes
Grafenwohr (106870) Figs 8 & 9	OCT	0700	0.1280	0.0504	Yes
		1600	0.2820	0.0501	Yes
Grafenwohr (106870)	NOV	0700	0.3060	0.0516	Yes
		1600	0.2100	0.0519	Yes

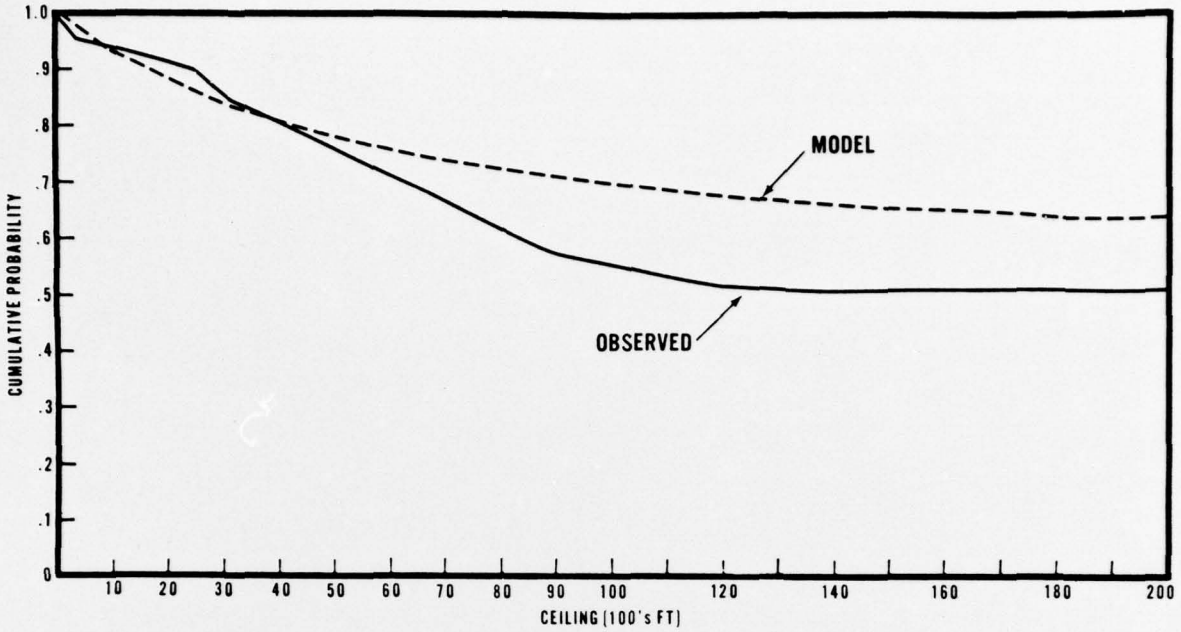

FIGURE 2. SANDHOFEN 0700L SEPTEMBER SIGNIFICANTLY DIFFERENT

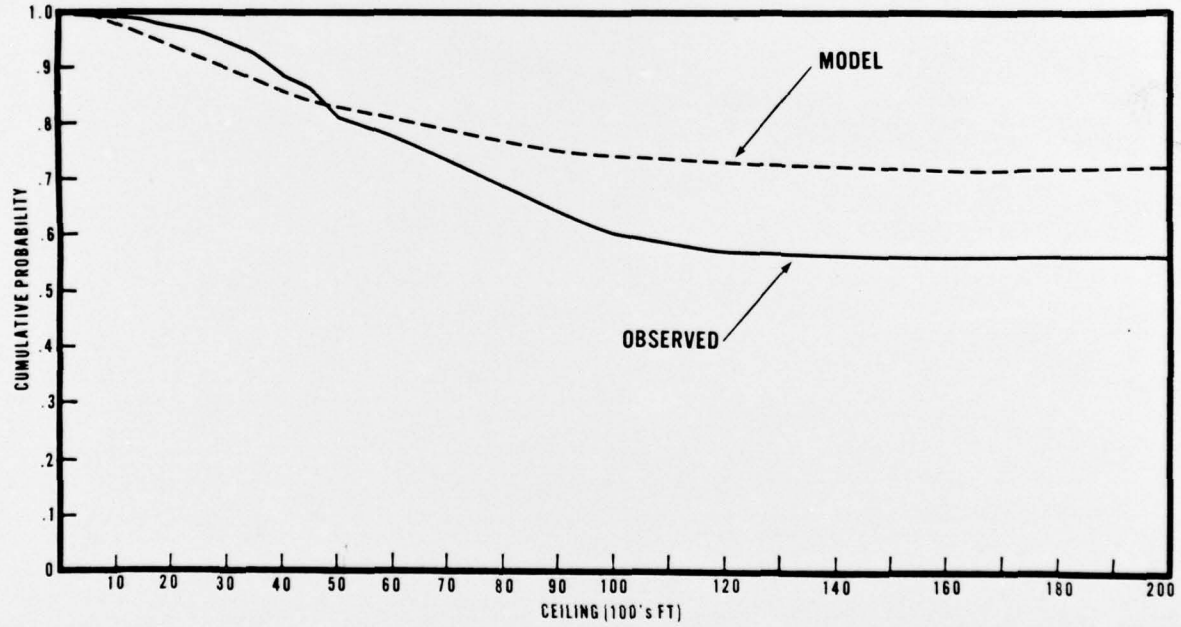

FIGURE 3. SANDHOFEN 1600L SEPTEMBER SIGNIFICANTLY DIFFERENT

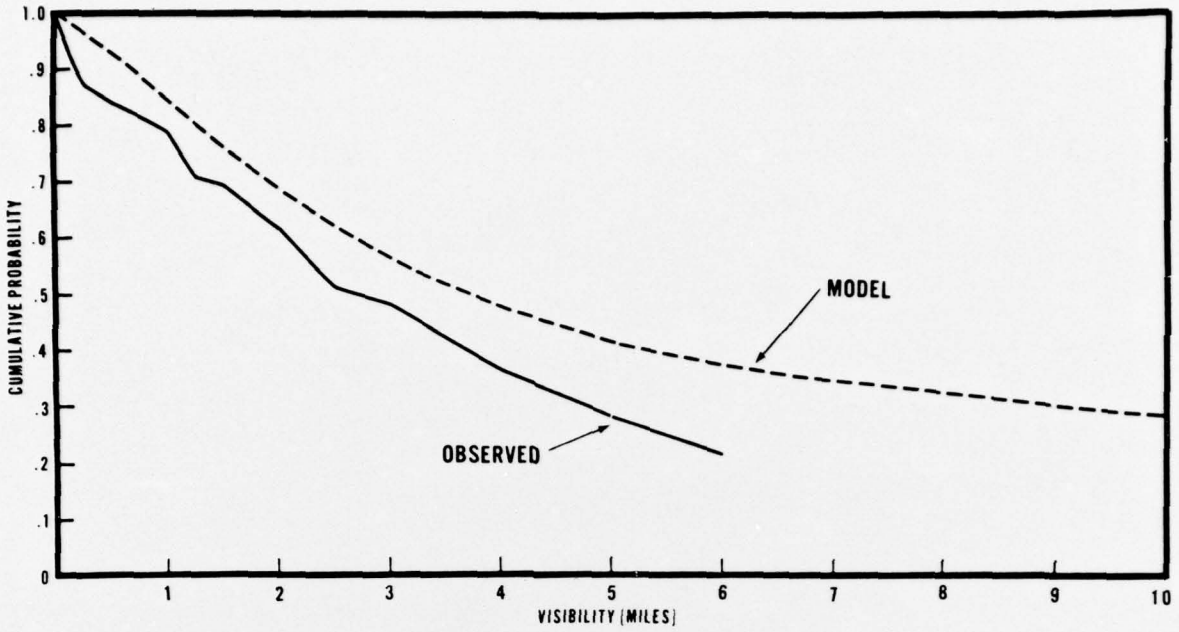

FIGURE 4. SANDHOFEN 0700L SEPTEMBER SIGNIFICANTLY DIFFERENT MODEL OBSERVED

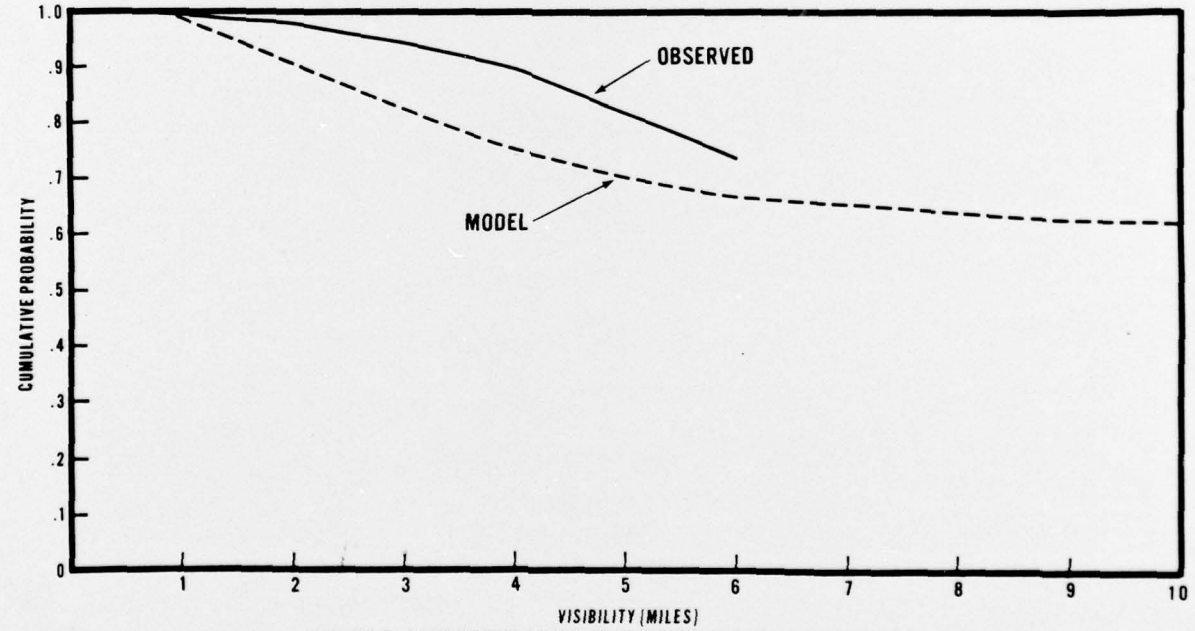

FIGURE 5. SANDHOFEN 1600L SEPTEMBER SIGNIFICNTLY DIFFERENT

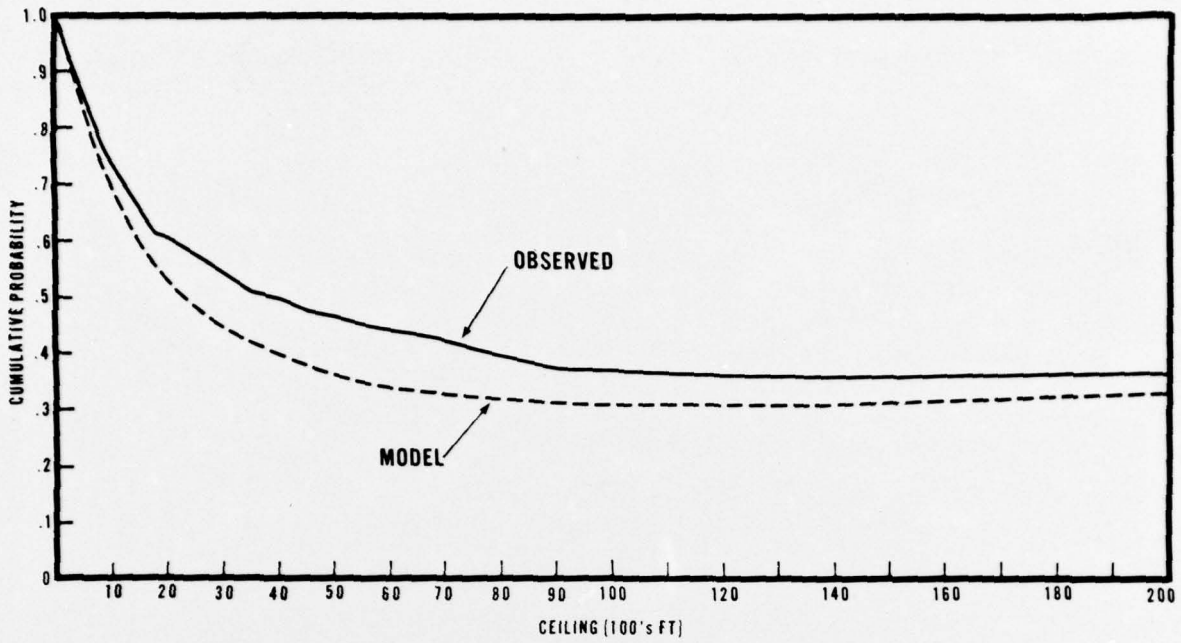

FIGURE 6. GRAFENWOHR 0700L OCTOBER SIGNIFICANTLY DIFFERENT

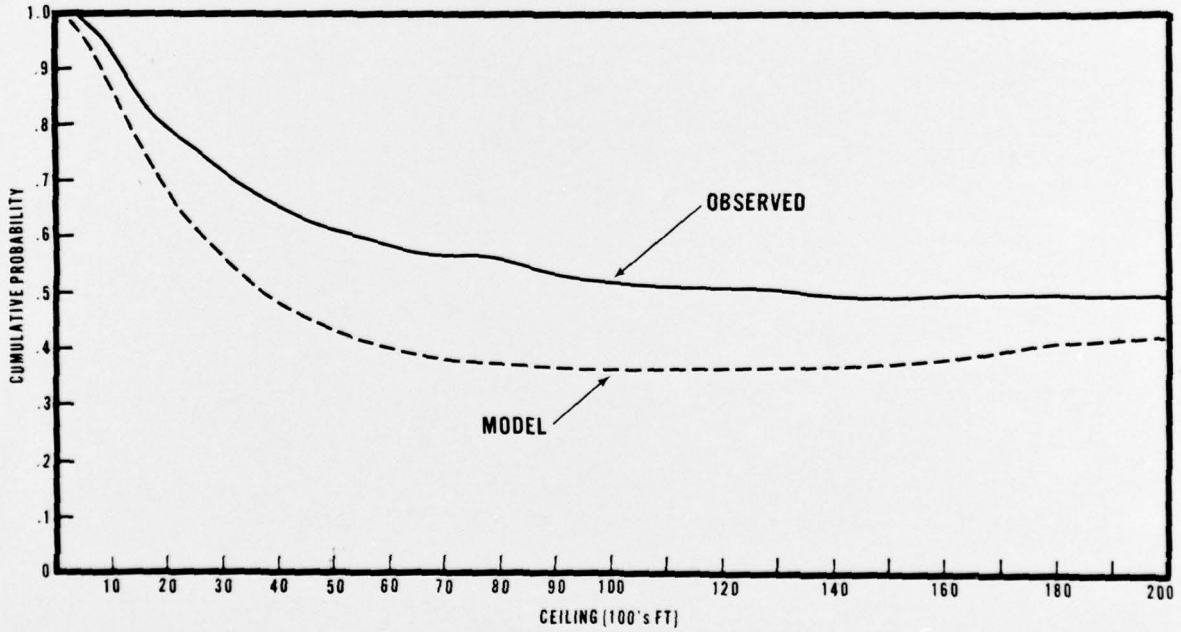

FIGURE 7. GRAFENWOHR 1600L OCTOBER SIGNIFICANTLY DIFFERENT

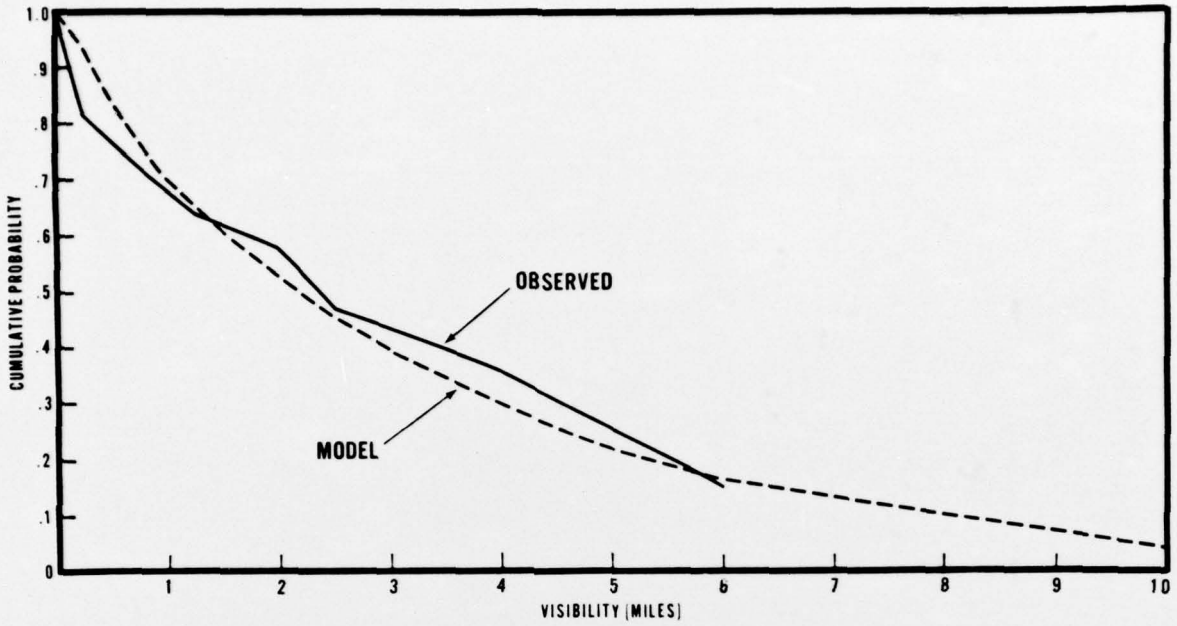

FIGURE 8. GRAFENWOHR 0700L OCTOBER SIGNIFICANTLY DIFFERENT

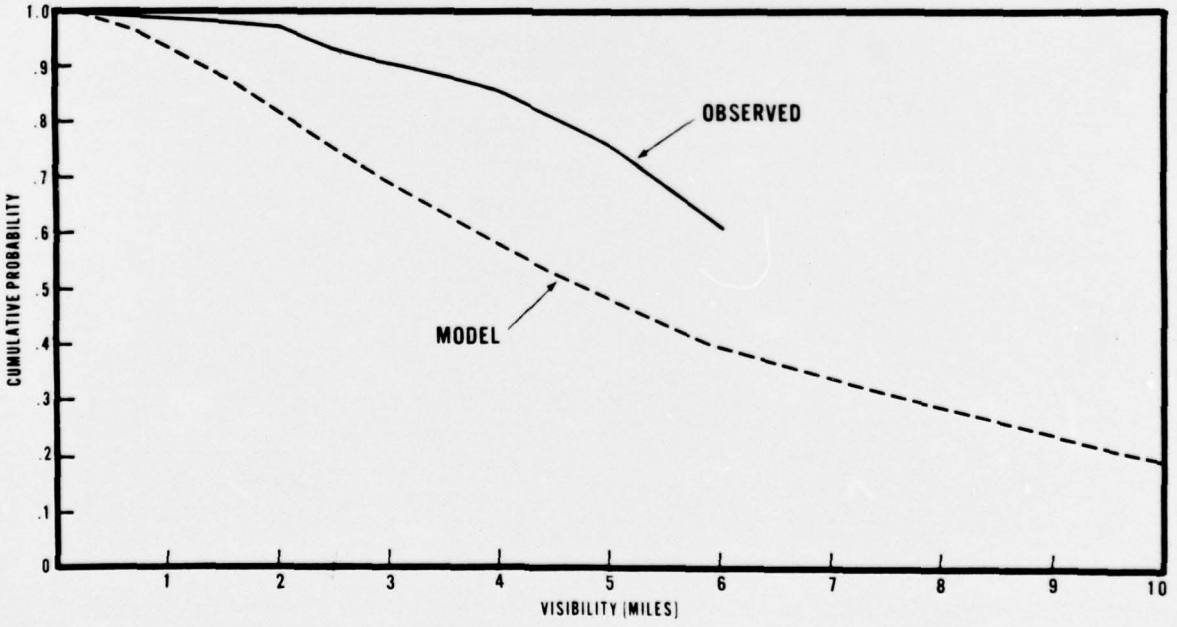

FIGURE 9. GRAFENWOHR 1600L OCTOBER SIGNIFICANTLY DIFFERENT