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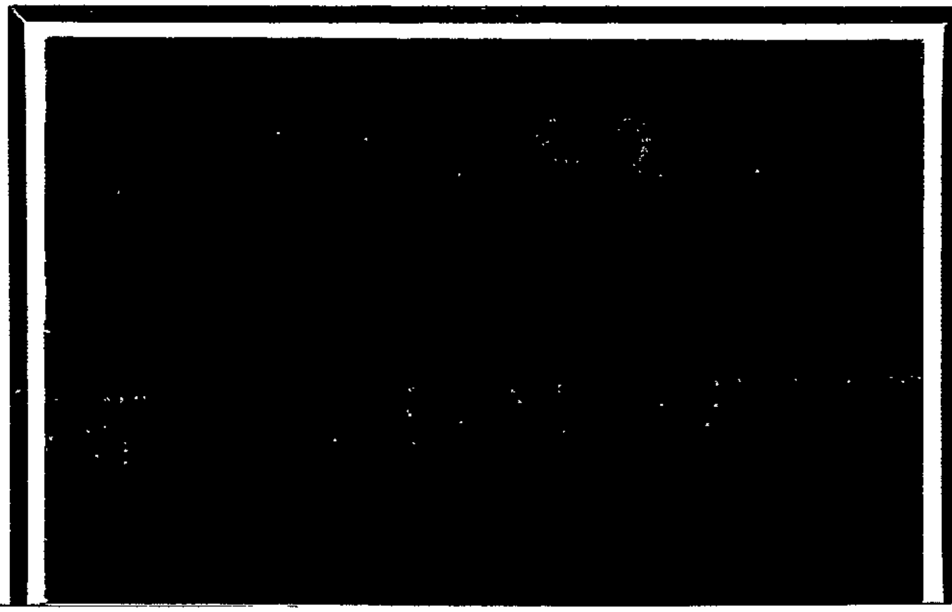

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Electrical Engineering

BLACKSBURG, VIRGINIA 24061

Final Report (Second Year of Work)

on

A DEPOLARIZATION AND ATTENUATION EXPERIMENT USING THE COMSTAR AND CTS SATELLITES

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15. Supplementary Notes

16. Abstract

This report describes an experiment for measuring precipitation attenuation and depolarization on the CTS 11.7 and the COMSTAR 19.04 and 28.56 GHz downlinks. It discusses attenuation scaling, effective path length, and the relationship between isolation and attenuation. Attenuation and effective path data are presented for the months of July, August, and September, 1977.

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1. INTRODUCTION

1.1 Report Description

This report presents data and preliminary conclusions from the last quarter (July, August, and September, 1977) of the second year of work on Contract NAS5-22577. (Data from the earlier months were published in the appropriate quarterly technical reports for this contract.) Although it is submitted to fulfill the contractual requirement of a final report for the second year's funding the report is not the last for the contract and a third year of work is now in progress. During late 1978 a multivolume report will be prepared summarizing our findings from the entire three-year effort.

1.2 Summary of Findings

Listed below are the major findings presented in the following chapters.

1. If attenuation values are computed from monthly mean signal levels rather than from monthly peak signal levels, the effects of spacecraft motion are suppressed and the accuracy of the data is enhanced. (Chapter 4)
2. Equations giving isolation as a linear function of the logarithm of attenuation provide an acceptable fit to the data. (Chapter 5)
3. Along the COMSTAR D2 path attenuation at 28 GHz is essentially twice the attenuation at 19 GHz. (Chapter 6)
4. Although the process of comparing attenuations at 11 and 19 GHz is complicated by the path elevation and azimuth differences, first indications are that the

effective path length at 11 GHz is usually greater than the effective path length at 19 GHz. The difference is larger than can be accounted for by geometry alone and may be a consequence of local terrain features. (Chapter 8)

5. There seems to be little correlation between isolation values measured simultaneously on two frequencies or on two polarizations at the same frequency. (Chapter 9)

2. DISCUSSION OF OPERATIONS DURING THE REPORT PERIOD

2.1 CTS 11.7 GHz Systems

The ground equipment operated normally during the quarter except for an antenna pedestal malfunction during the last two weeks of August. The computer-controlled pedestal went into standby mode (halting CTS data collection) without giving any outward sign of trouble. For statistical purposes the missed attenuation data were filled in by scaling from the COMSTAR link but it was not possible to compare isolation and attenuation values while the pedestal was malfunctioning. The pedestal has since been repaired and the warning light system modified to give a fail-safe indication of the pedestal's status.

During September the CTS beacon was switched off and on daily to prevent damage to the spacecraft power system during eclipse. This complicated the data reduction problem, but we were able to remove from the attenuation statistics those errors caused by the resulting signal fluctuations.

2.2 COMSTAR 19.05 GHZ System

Both vertical channels and the horizontal co-polarized channel performed correctly. The horizontal cross-polarized channel was degraded by cross-talk which was not eliminated until September.

2.3 COMSTAR 28.56 GHz System

The receiver performance during the quarter was nominal. The antenna cross-polarized channel response deteriorated badly during June because (1) a piece of electrical tape apparently left inside during manufacture worked its way into the ortho-mode transducer (OMT) and (2) a cracked waveguide in the co-polarized channel reflected a significant signal back through the OMT and into the cross-polarized channel. We corrected these problems in June and the system operated normally during July and August.

3. DATA ANALYSIS BY SAS-76

3.1 What SAS-76 Is

During the report period we began using SAS-76 (abbreviated SAS) for data analysis and display. SAS (an acronym for Statistical Analysis System) is an integrated software package developed for managing large-scale data bases which is available on-line at the VPI&SU IBM 370 Computing Center. It is used at approximately 90 locations, including Goddard Spaceflight Center. For a description of SAS, the reader should consult two references:

1. Anthony J. Barr, James H. Goodnight, John P. Sall, and Jane T. Helwig, A User's Guide to SAS-76, Raleigh, N.C.: SAS Institute, Inc., 1976.
2. Jane T. Helwig, Editor, SAS Supplemental Library User's Guide, Raleigh, N.C.: SAS Institute, Inc., 1977.

3.2 Use of SAS in DATA Processing and Display

As described in earlier reports, our IBM 370 data reduction software is based on what is called the process file. This is a memory storage scheme that provides the value of any recorded data input at any instant of time. Utilizing a group of subroutines developed by S. R. Kauffman, a user specifies the date, time, and identification number of the variable that he wants and receives from core the instantaneous value recorded for the variable at that time.

SAS is designed to work with what are called observations; an observation is a set of simultaneous values for a group of variables. At its present state of development, the SAS procedure used in data processing for this report extracts nine values from the process file for each observation. These are the co- and cross-polarized signal amplitudes at 11.7, 19.04 (horizontal and vertical transmitted polarizations), and 28.56 GHz and the rain rate at the gauge nearest the antennas. The values are generated by a Fortran program which interrogates the process file for times spaced 30 seconds apart, starting just after midnight on the first day of a month and ending just before midnight on the last day of a month. The result is a set of all received signal values and the ground rain rate at 30-second intervals for a month; this constitutes the basic set of SAS observations. From these data we may calculate attenuation and isolation and perform various statistical analyses. .

It is important to note that each signal observation in the SAS data set is an instantaneous value; no time averaging is performed by the computer. However, each signal is the output of a detector having a time constant of 10 seconds and the signals are effectively averaged by the detectors before any sample values are taken. The rain gauge has an integration time longer than 10 seconds at rain rates less than 91.37 mm/hr, and a similar argument can be made in support of representing the rain rate by samples taken once each 30 seconds.

In later work we intend to explore the effects of using instantaneous signal and rain rate values spaced 15 seconds apart for SAS and also to investigate the utility of using 30-second or 15-second time-averaging values in place of the instantaneous ones. The decision on which method to use is partly economic; a

30-day month generates 86,400 30-second observations. Processing this many points requires extensive computer time and storing them consumes large amounts of magnetic tape.

4. MINIMIZING ATTENUATION ERRORS CAUSED BY SPACECRAFT MOTION

A recurrent problem in this project has been finding a way to maintain a consistent reference signal level from which to calculate the rain attenuation on each co-polarized receiver channel. Ideally the clear-weather received signal would remain constant, but in practice variations are introduced by spacecraft motion (as much as several dB peak-to-peak) and by gain changes in the receivers (no more than one dB peak-to-peak). About the same variation is noted on each system. The CTS antenna is program directed, but the antenna pointing accuracy depends on orbital elements whose timeliness and accuracy has not always been satisfactory, and the spacecraft station-keeping is relatively loose. COMSTAR maintains a more constant position relative to a fixed point on the earth, but our COMSTAR antennas are only manually adjustable and some diurnal signal variation necessarily occurs.

These signal variations are unimportant in the analysis of most storms because of the short time period involved. Attenuation is calculated from the last clear-weather level logged before fading began. Also the relationship between the reference levels for different storms is immaterial.

However, problems arise when attenuation statistics are computed or when attenuations for different frequencies are compared for a longer time such as one month. If, as in our initial approach, attenuation is measured with respect to the peak signal logged during the month, then diurnal variations can produce false attenuations of as much as 4 dB during clear weather.* Further, if the peak signal resulted from an unusual sequence of events that occurred only once during the month, then a statistical analysis would indicate that non-zero attenuation occurred for the entire month. If signals are compared from two satellites whose diurnal variations are 180 degrees out of phase, spacecraft motions may cause as much as 8 dB of apparent differential attenuation (attenuation at one frequency minus attenuation at the other frequency) in clear weather. The latter is an extreme case that we have not observed, but it points out the potential magnitude of the problem.

After a detailed consideration of the matter, we decided to use the monthly mean signal on each channel as the reference or clear-weather value. While the mean signal calculation includes all of the data taken during significant rain fades, these constitute something less than 1% of the observations for any one month. They introduce negligible error into the attenuation calculations and in any case, they bias the attenuation statistics very slightly toward more pessimistic values.

To avoid the problem of assigning negative attenuation to signals stronger than the monthly mean, signal levels between the peak and the monthly mean signal are treated as having zero attenuation. This procedure is equivalent to the one followed routinely in calculating attenuation for an individual storm.

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* This number was computed by assuming that the peak signal was recorded when the antenna pointing was perfect and when the receiver gain was at its maximum value. If the time of worst antenna pointing and minimum receiver gain coincide, then the signal could drop 3 dB with antenna pointing and 1 dB with the change in receiver gain for a total of 4 dB.

The effects of calculating attenuation from the mean instead of the peak signal are dramatic. The problem of significant attenuation for zero rain rates is alleviated. The performance of regression routines used to extract signal relationships from the data also improves dramatically when the new attenuation references are used. This is illustrated in Table 4-1, which compares the R-squared values for equations involving attenuations calculated both ways.*

The peak and monthly mean signal values for the months of July, August, and September, 1977, are summarized in Table 4-2. Note the generally good reproducibility of the data from month to month.

R-squared is the portion of the total variation accounted for by the fitted equation. (C. Daniel and F. S. Wood, Fitting Equations to Data. New York: Wiley Interscience, 1971. Page 266) A value of 1 is optimum and a value of zero means that the fitted equation is meaningless.

Equation Form	Month Used	R-Squared	
		Attenuation from Peak	Attenuation from Mean
CTS Isolation = Linear Function of the Logarithm of CTS Attenuation	July, 1977	0.1660	0.7457
28 GHz Attenuation = A Constant Times 19 GHz V Attenuation	July, 1977	0.4963	0.6461
19 GHz V Isolation = Linear Function of the Logarithm of 19 GHz vs. Attenuation	August, 1977	0.1418	0.7087
CTS Isolation = Linear Function of the Logarithm of CTS Attenuation	August, 1977	0.1658	0.7596
28 GHz Isolation = Linear Function of the Logarithm of 28 GHz Attenuation	September, 1977	0.2871	0.4968

Table 4-1. Some examples of how regressions are improved when signal attenuation is calculated from the monthly mean signal.

	11.7 GHz			19 GHz V			19 GHz H			28 GHz		
Month	Peak	Mean	Diff.	Peak	Mean	Diff.	Peak	Mean	Diff.	Peak	Mean	Diff.
July 77	-77.47	-81.69	4.22	-82.88	-85.96	3.08	-85.08	-86.92	1.84	-79.47	-81.70	2.23
August 77	-78.47	-80.16	1.69	-82.48	-85.74	3.26	-85.28	-86.87	1.59	-80.08	-83.03	2.95
Sept. 77	-78.67	-81.51	2.84	-83.28	-85.29	2.01	-85.48	-86.92	1.44	-78.47	-81.39	2.92

Table 4-2. Representative peak and average signal values in dBm at IF.

5. RELATING ISOLATION TO ATTENUATION

5.1 Introduction

In the last year several investigators have suggested that isolation can be calculated from attenuation through equations of the form

$$I = U - V \log_{10} (A) \quad \text{dB} \qquad (5-1)$$

where I is the isolation and A is the co-polar attenuation in dB. The constants U and V are positive. Nowland, Olsen, and Shkarofsky (1977) recently proposed a theoretical justification for this equation.

If reliable U and V values can be determined for arbitrary earth station locations, then equation (5-1) could be used to calculate isolation statistics from existing attenuation data. This would enable communications engineers to predict the performance that would be available if an existing single-polarized link were replaced by a dual polarized link, for example. Such a prediction technique has been proposed in CCIR Doc. 5/206-E (1974-78) by Canada. One of our objectives in this project is to determine values of U and V appropriate to our downlinks and to assess the degree to which equations containing these coefficients predict isolation statistics which match those measured directly.

5.2 Regression Procedure Followed

Equation (5-1) breaks down at small attenuations, because the isolation approaches infinity and this does not occur in practice with real antennas. In order to avoid this problem and to enhance the accuracy of the equations developed at higher attenuations, we decided to fit equation (5-1) to our data for attenuations greater than 3 dB. Our procedure follows.

To determine the monthly U and V coefficients for a given link, we first select all pairs of I and A values (measured simultaneously) for which A exceeded 3 dB. Each pair of values constitutes one sample. We then take the logarithm of each A value and feed the set of I, log(A) values to a SAS linear regression procedure called GLM which determines the values for U and V that best fit the data. (Here 'best fit' means minimum mean-square error.)

The equations providing best fits to the data for each channel and each month of the report period appear in Tables 5-1 through 5-4. In subsequent reports we will present similar equations for all months in which we have data.

To illustrate the agreement between the equations and the data, Figures 5-1 through 5-3 compare scatter plots and the curves for one frequency and one month each. Note that the scatter is much greater at 28 GHz than at the two lower frequencies.

The only month for which we have good equations for all three frequencies is August, 1977. Figure 5-4 compares the isolation: attenuation relationships for that month. In examining Figure 5-4 the reader should remember that the polarization of the 11.7 GHz signal is circular and the other two are linear. A curve for an 11.7 GHz linearly polarized system would show better isolation at a given attenuation level than the circularly polarized one does.

Month	Number of Samples	11 GHz Isol.		11 GHz Atten.		Equation	R-Squared
		minimum	maximum	minimum	maximum		
July 77	1712	10.87	27.69	3.38	20.22	$I = 34.27 - 16.69 \log_{10}(A)$	.8174
Aug. 77	127	17.68	34.49	3.32	13.53	$I = 44.74 - 22.57 \log_{10}(A)$	.7596
Sept. 77*	2972	14.48	38.09	3.17	15.38	$I = 26.67 - 6.79 \log_{10}(A)$ *	.0296 *

* Many invalid attenuation values were introduced when satellite was turned on and off during eclipse period.

Table 5-1. Equations fit to 11.7 GHz CP data.

		19 GHz V Isol.		19 GHz V Atten.			
Month	Number of Samples	minimum	maximum	minimum	maximum	Equation	R-Squared
July 77	242	13.51	38.14	3.32	17.54	$I = 50.83 - 31.38 \log_{10}(A)$	.6632
Aug. 77	181	5.71	34.33	3.14	23.96	$I = 46.56 - 24.48 \log_{10}(A)$	.7087
Sept. 77	285	9.91	34.74	3.19	25.42	$I = 49.42 - 26.09 \log_{10}(A)$	.8618

Table 5-2. Equations fit to 19.04 GHz VP data.

Month	Number of Samples	19 GHz H Isol. minimum	19 GHz H Isol. maximum	19 GHz H Atten. minimum	19 GHz H Atten. maximum	Equation	R-Squared
July 77*	242	19.52	39.33	3.17	17.58	$I = 26.49 - 4.26 \log_{10}(A)$	.0655 *
Aug. 77*	181	4.71	25.32	3.14	23.96	$I = 25.58 - 7.67 \log_{10}(A)$	.1005 *
Sept. 77	285	2.89	25.12	3.17	25.39	$I = 37.12 - 20.01 \log_{10}(A)$	.8988

* These results are invalid because of cross-talk problems.

Table 5-3. Equations fit to 19.04 GHz HP data.

Month	Number of Samples	28 GHz Isol.		28 GHz Atten.		Equation	R-Squared
		minimum	maximum	minimum	maximum		
July 77*	1770	11.71	33.54	3.18	33.41	$I = 19.17 + 3.06 \log_{10}(A)$ *	.020 *
Aug. 77	2243	12.11	42.15	3.05	32.90	$I = 39.38 - 15.36 \log_{10}(A)$	.2469
Sept. 77	3092	12.11	33.93	3.09	34.12	$I = 33.68 - 12.50 \log_{10}(A)$	.4968

* Cross channel was defective during this month.

Table 5-4. Equations fit to 28.56 GHz VP data.

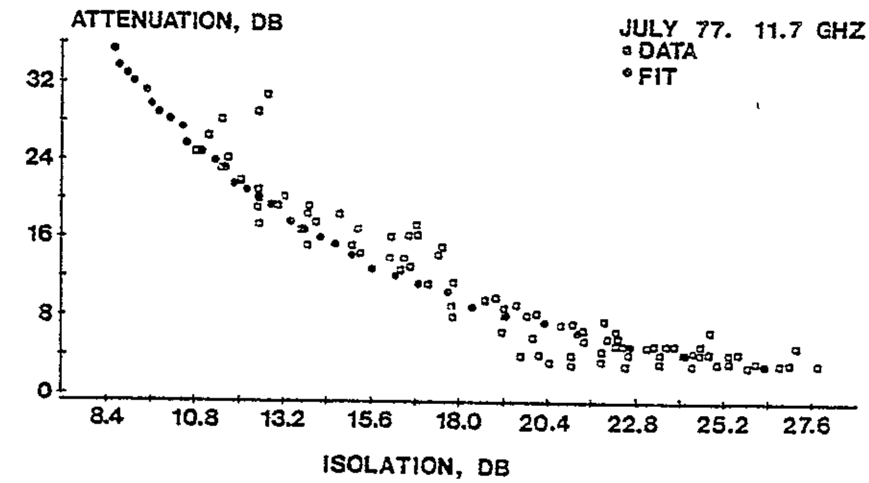

Figure 5-1. A comparison of measured data to the least-square fit for 11.7 GHz during July, 1977. Multiple points are not indicated.

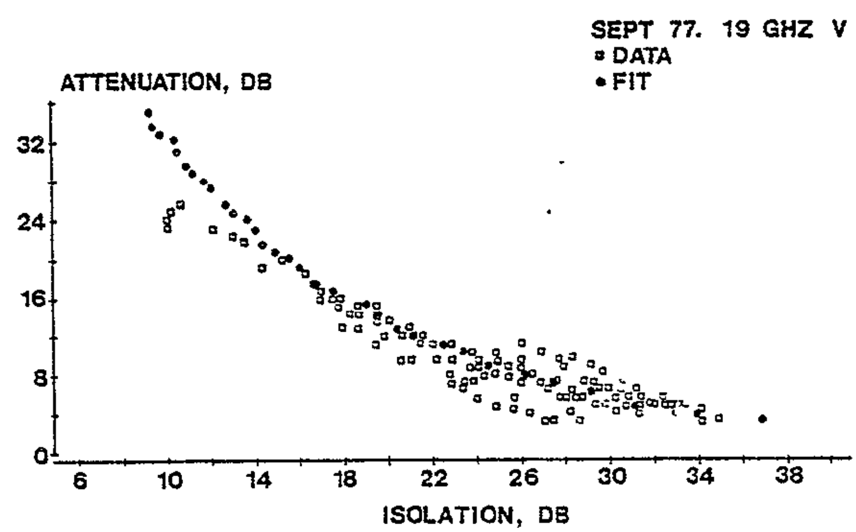

Figure 5-2. A comparison of measured data to the least-square fit for 19 GHz during September, 1977. Multiple points are not indicated.

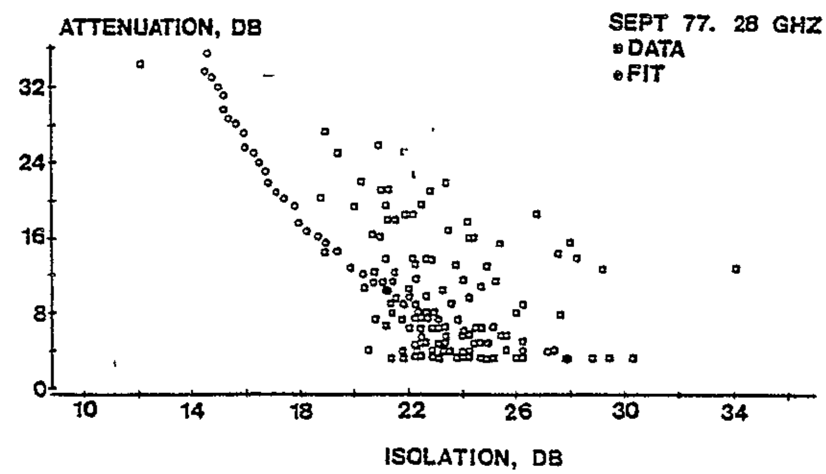

Figure 5-3. A comparison of measured data to the least-square fit for 28 GHz during September, 1977. Multiple points are not indicated.

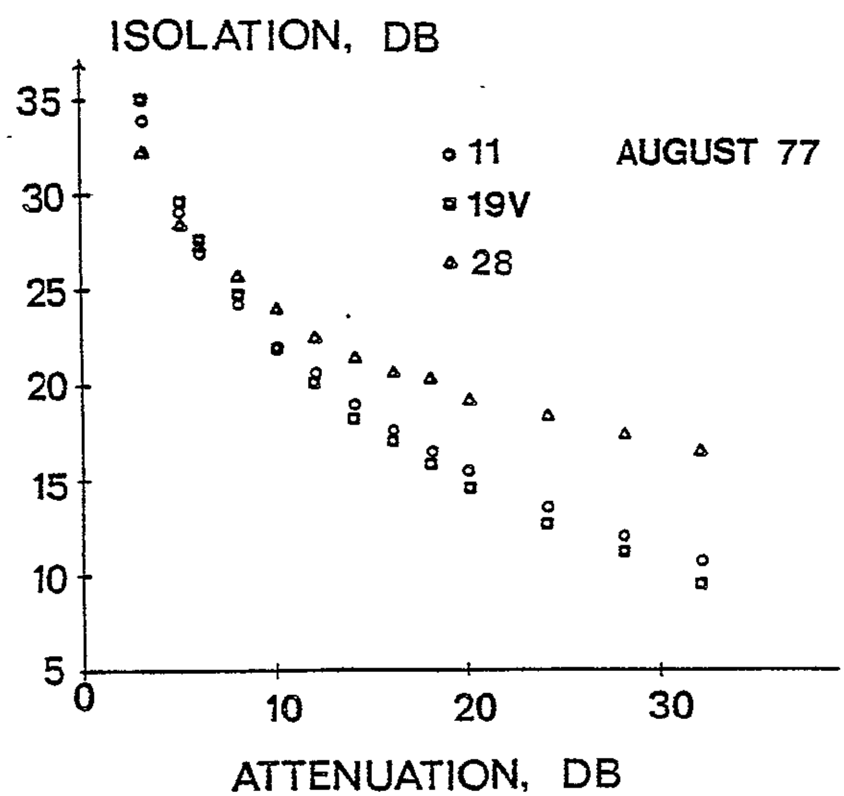

Figure 5-4. Comparison of August, 1977, isolation: log attenuation curves for all three frequencies.

6. RELATING SIMULTANEOUS VALUES OF ATTENUATION

6.1 Introduction

Another principal goal of this investigation is the development and verification of equations to scale attenuation with frequency. There are two ways to approach the problem: matching simultaneous attenuations on an event-by-event basis and matching attenuation values observed for equal percentages of time. This chapter discusses the first approach.

6.2 Comparing 19 and 28 GHz Attenuation

Both the 19 and 28 GHz signals follow the same path and, if the rain were uniform and the drop size distribution did not change with rain rate and time, the ratio of rain attenuation at 28 GHz to rain attenuation at 19 GHz should remain constant. In practice we observe some variation in this ratio from storm to storm and during individual storms, but the fluctuations are probably not as large as those reported by earlier investigators on similar frequency pairs with ATS-5 and ATS-6. (Ippolito, 1971) (Ippolito, 1976). This is assumed to be a consequence of the longer averaging times used in our receivers.

To compare rain attenuation at 19 and 28 GHz for each month we collected simultaneous values of the two signals for all cases when the 28 GHz attenuation exceeded 3 dB. The number pairs so generated were passed to the SAS procedure GLM to determine the value of C1 which minimized the least square error in a fit of the form

$$A(28) = C1 * AV(19) \quad . \qquad (6-1)$$

Here A(28) and AV(19) are the rain attenuations in dB at 28 and 19 GHz for vertical polarization.

Table 6-1 presents the result of fitting the data to equation (6-1) for the reporting period. When the computations for Table 6-1 were made, values of AV(19) for signal levels above the monthly mean were not set to zero. This introduced a few negative 19 GHz attenuations into the regression, but the effects on C1 are negligible. For example, when the July data in Table 6-1 were rerun with negative attenuations set to zero the coefficient changed by about 0.5%.

The numbers in Table 6-1 indicate that a reasonable value to use for C1 in attenuation scaling is 2; i.e.

$$A(28) = 2 * AV(19) . \qquad (6\text{-}2)$$

The average of 1.94, 2.70, and 1.42 is 2.02, and a scatter plot of the points for the individual months clusters nicely around a straight line with a slope of 2. This is illustrated by Figures 6-1 and 6-2 which compare a scatter plot of the data with the equations.*

Figures 6-1 and 6-2 display each unique pair of values observed during the month. Most points in the figure represent multiple data values. Negative attenuations were plotted as 0. While the curve fitting was done for A(28) > 3, the plots show all recorded values of A(28).

Month	Number of Samples	28 GHz Atten.		19 GHz V Atten.		Equation	R-Squared
		minimum	maximum	minimum	maximum		
July 77	1771	3.18	33.41	.32	12.33	A(28) = 1.94 AV(19)	.6461
Aug. 77	2243	3.05	32.90	- .66	10.15	A(28) = 2.70 AV(19)	.5821
Sept. 77	3093	3.09	34.12	-1.21	16.01	A(28) = 1.42 AV(19)	.2750

Table 6-1. Regression Equations Relating Rain Attenuation on 28.56 and 19.04 GHz Vertically Polarized Signals.

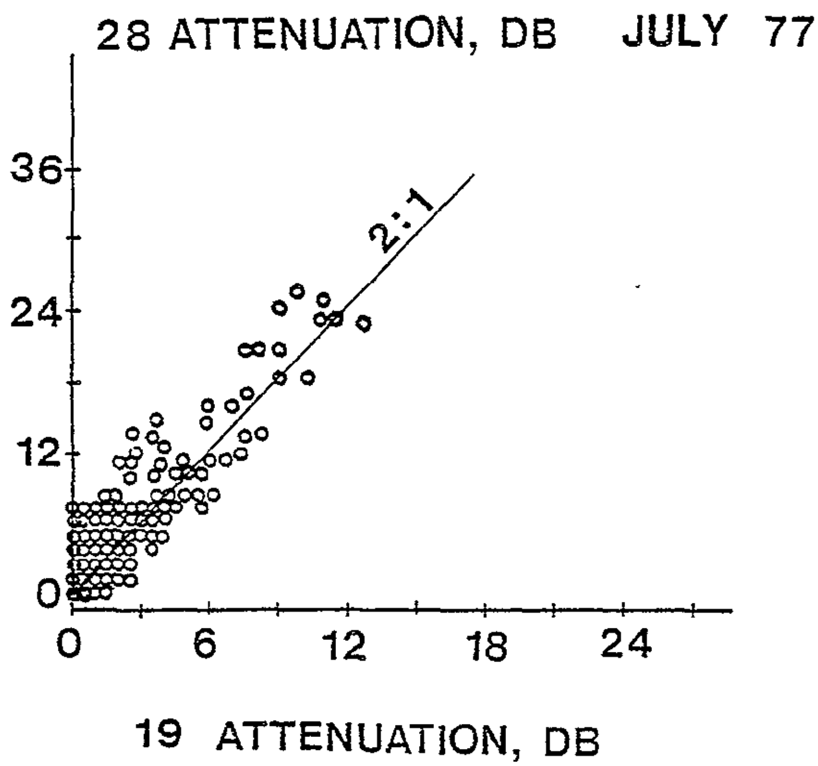

Figure 6-1. A scatter plot of 28 versus 19 GHz (V) attenuation for July, 1977.

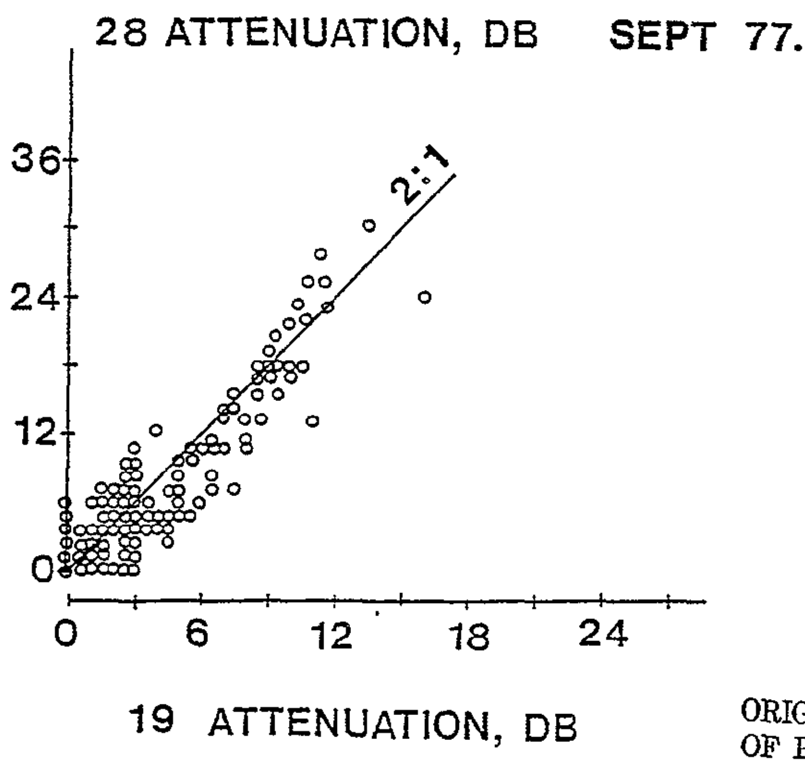

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Figure 6-2. A scatter plot of 28 versus 19 GHz (V) attenuation for September, 1977.

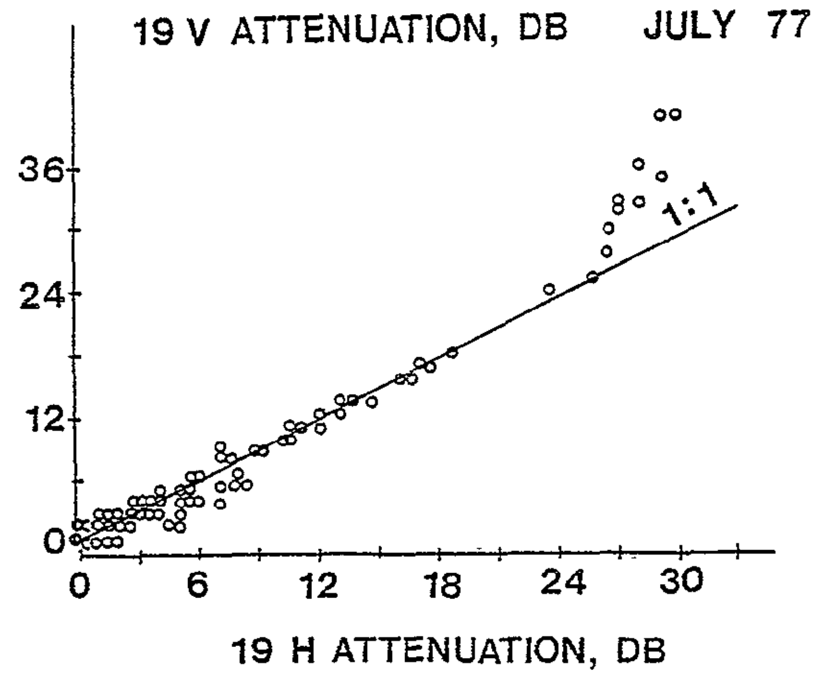

Figure 6-3. A scatter plot of 19.04 GHz attenuation with vertical polarization versus attenuation with horizontal polarization for July, 1977.

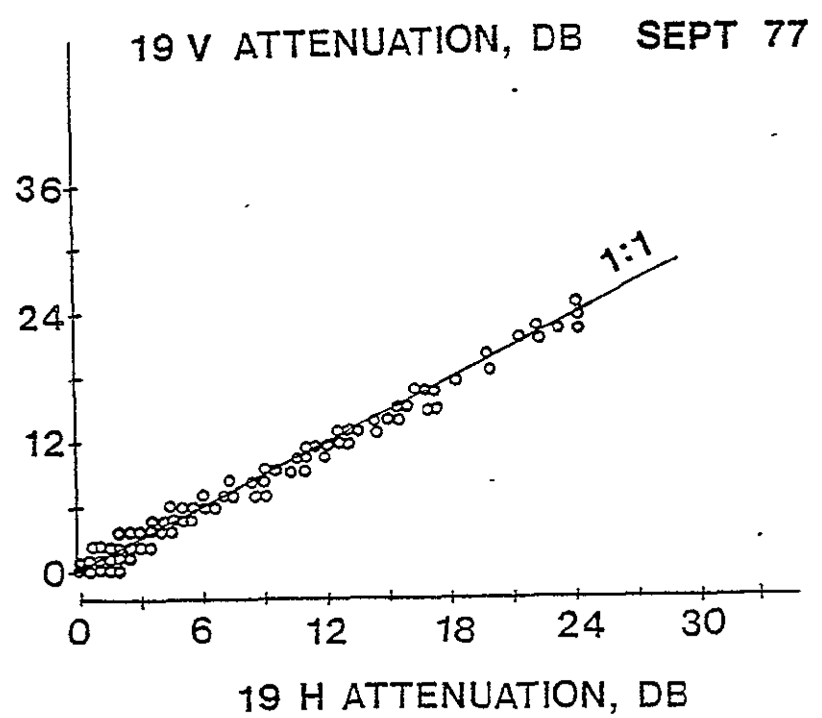

Figure 6-4. A scatter plot of 19.04 GHz attenuation with vertical polarization versus attenuation with horizontal polarization for September, 1977.

6.3 Comparing Attenuation at 19 GHz for Horizontally and Vertically Polarized Signals

If a vertically polarized signal and a horizontally polarized signal pass through the same rain (at least on a terrestrial path), the oblateness of the raindrops should cause the horizontal signal to be attenuated more than the vertical. Our data show this to be true for a downlink as well, but the difference is not large enough to be significant. To investigate the relationship between rain attenuation at the two polarizations, we used SAS to determine a coefficient C2 that would provide the best fit to the data for the relationship

$$AV(19) = C2 * AH(19) . \qquad (6-3)$$

Here AV(19) and AH(19) are the rain attenuation in dB for 19 GHz vertical and horizontal polarizations. The results are summarized in Table 6-2 for the months of July, August, and September, 1977.

For all practical purposes, C2 is unity. Figures 6-3 and 6-4 compare the measured data points to straight lines with unity slope. In Figure 6-3 the deviation at the high end of the line is thought to be a receiver effect caused by momentary loss of phaselock. The points involved were excluded from the regression.

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6.4 Scaling from 11.7 to 19.04 GHz: The Path-Difference Problem

Scaling attenuations between 11.7 GHz and either of the COMSTAR frequencies is complicated by the two satellites not being in the same place. From our station we see CTS at 33

Month	Number of Samples	19 GHz V Atten.		19 GHz H Atten.		Equation	R-Squared
		minimum	maximum	minimum	maximum		
July 77	243	3.32	17.54	3.17	17.58	AV(19) = 0.8304*AH(19)	.9667
Aug. 77	182	3.01	23.43	3.14	23.96	AV(19) = 0.9935*AH(19)	.9957
Sept. 77	285	3.19	25.42	3.17	25.39	AV(19) = 0.9793*AH(19)	.9965

Table 6-2. Regression Equations Relating Rain Attenuation at 19.04 GHz for Horizontally and Vertically Polarized Signals.

degrees elevation and COMSTAR at 44 degrees elevation; the azimuth difference is 27 degrees. Most storms move from west to east and intersect the CTS path before they enter the COMSTAR path. This means that at the beginning of most storms the 11.7 GHz attenuation is greater than the 19 GHz attenuation because rain is falling through one path and not through the other.

This effect is illustrated by data taken during a storm that occurred on August 9, 1977. Figure 6-5 shows the rain rate recorded beside the antennas; note that the ground rainfall began just after time = 45 minutes. Figure 6-6 illustrates the behavior of the 11.7 GHz co-polarized signal; it began to fade 20 minutes in advance of the onset of rain and faded about 15 dB before recovering. The 19 GHz vertical signal faded later; see Figure 6-7. It began to drop at time = 36, nine minutes after the 11.7 GHz signal. This means that for at least nine minutes the attenuation at 11.7 GHz was greater than the attenuation at 19 GHz.

The effects of the time lag between the 11.7 and 19 GHz signals are apparent in Figure 6-8, a scatter plot of one attenuation versus the other. The straight line shown has a slope of 2:1; this is the attenuation ratio ultimately adopted for our scaling program. Some of the points lie on the line, but many do not. Like the time history, this plot indicates that the 11.7 GHz signal faded first. Then while it remainded more or less constant at about 14 dB below clear weather, the 19 GHz signal faded from 8 to 40 dB. Thereafter both signals recovered together, maintaining about a 2:1 attenuation ratio until the storm ended.

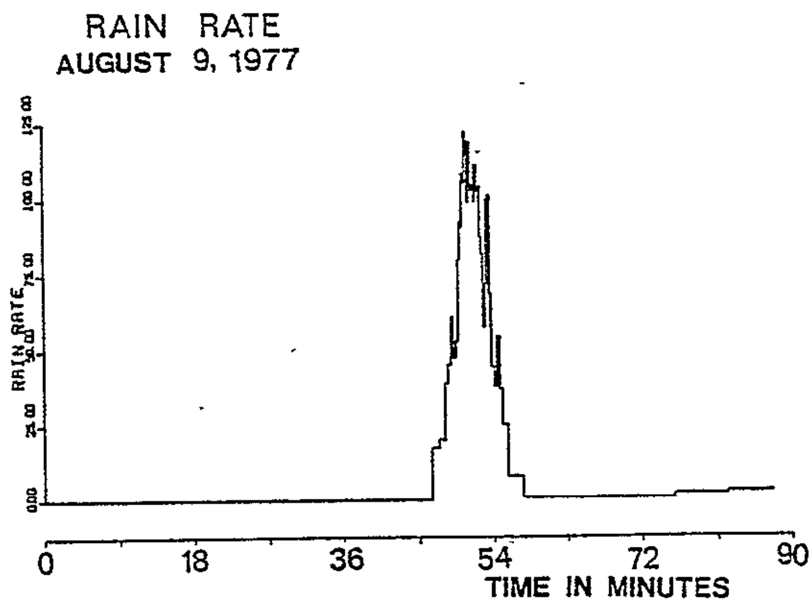

Figure 6-5. Ground rainfall rate on August 9, 1977.

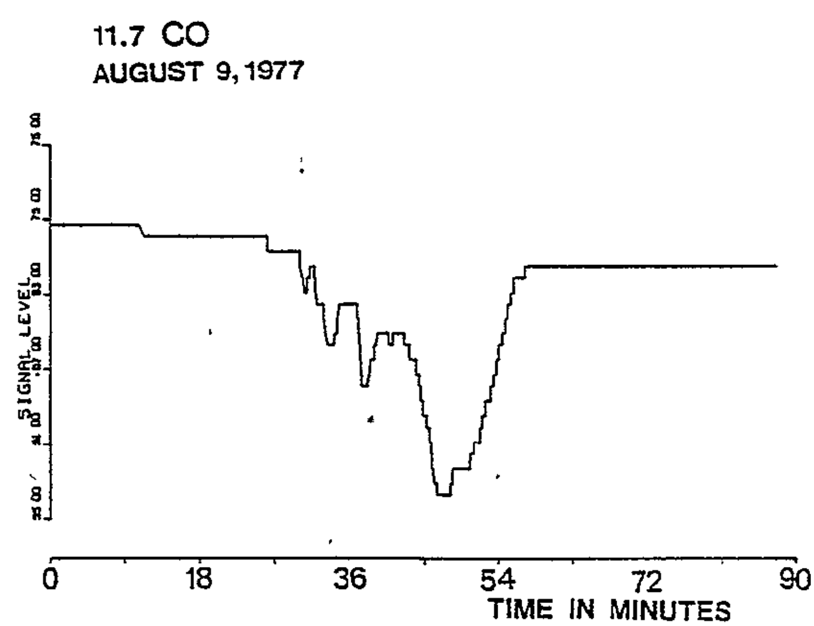

Figure 6-6. CTS 11.7 GHz co-polarized signal behavior on August 9, 1977.

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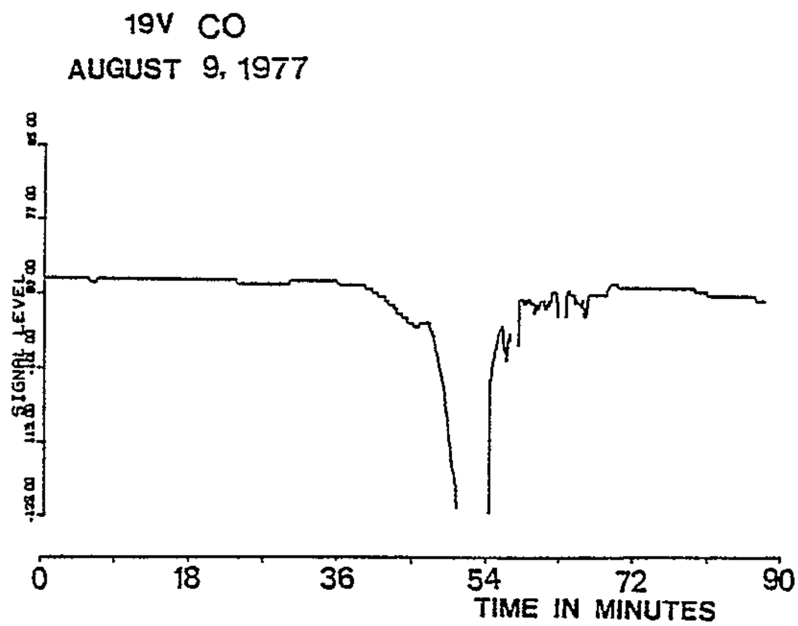

Figure 6-7. A scatter plot of 28 versus 11 GHz (V) attenuation for July, 1977.

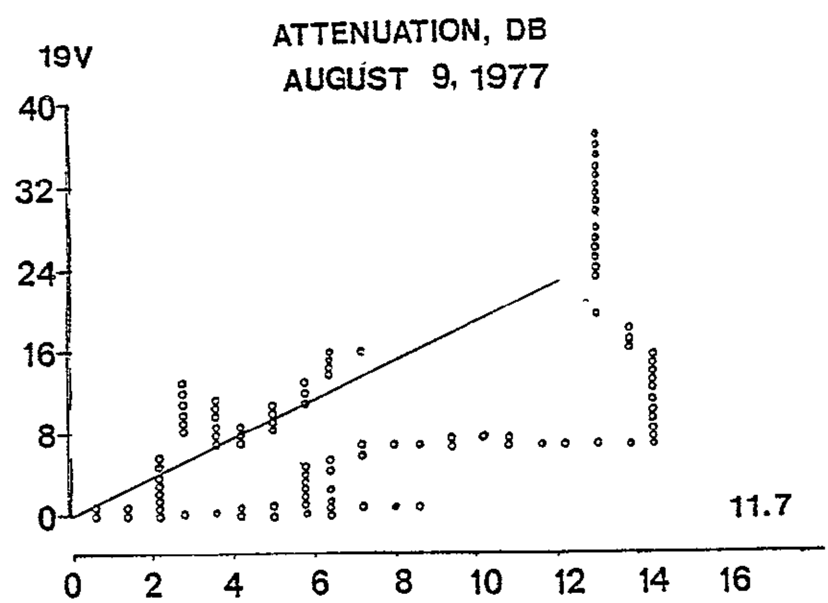

Figure 6-8. A comparison of attenuation on the 19 GHz vertical and the 11.7 GHz circular channels during the storm of August 9, 1977.

Events like this indicate that regression analyses of pairs of simultaneous data values will be of little use in determining attenuation scaling coefficients when the path difference is important. This conclusion is supported by the results summarized in Table 6-3. In this case even a reasonablly large value of R-squared is not an indication of success. Figure 6-9, for example, compares all of the data taken in July, 1977, with the regression equation and with a line drawn for a 2:1 ratio. A better fit could be gained by a straight line having a 2:1 slope and a non-zero intercept on the 11.7 GHz axis. A statistical approach to attenuation scaling will have to be taken for these two frequencies.

6.5 Scaling from 11.7 to 28.56 GHz

Regression equations relating simultaneous attenuation data at these two frequencies consistently produce R-squared values approaching zero. The cause is evident from Figure 6-10 which presents the two-frequency data for the month of September, 1977. The frequency and path difference is too great for an event-by-event comparison and statistical methods must be used.

Month	Number of Samples	19 GHz V Atten. minimum	19 GHz V Atten. maximum	11 GHz Atten. minimum	11 GHz Atten. maximum	Equation	R-Squared
July 77	241	3.32	17.54	-1.01	19.41	AV(19) = .7875 A(11)	.6714
Aug. 77	100	3.01	23.43	- .89	13.53	AV(19) = 1.3810 A(11)	.7966
* Sept. 77	285	3.19	25.42	-1.43	15.38	AV(19) = * 1.28 A(11)	.4362

* Many invalid attenuation values were introduced when CTS satellite was turned on and off during eclipse period.

Table 6-3. Regression Equations Relating Rain Attenuation on 19.04 GHz Vertically Polarized Signals and 11.7 GHz Circularly Polarized Signals.

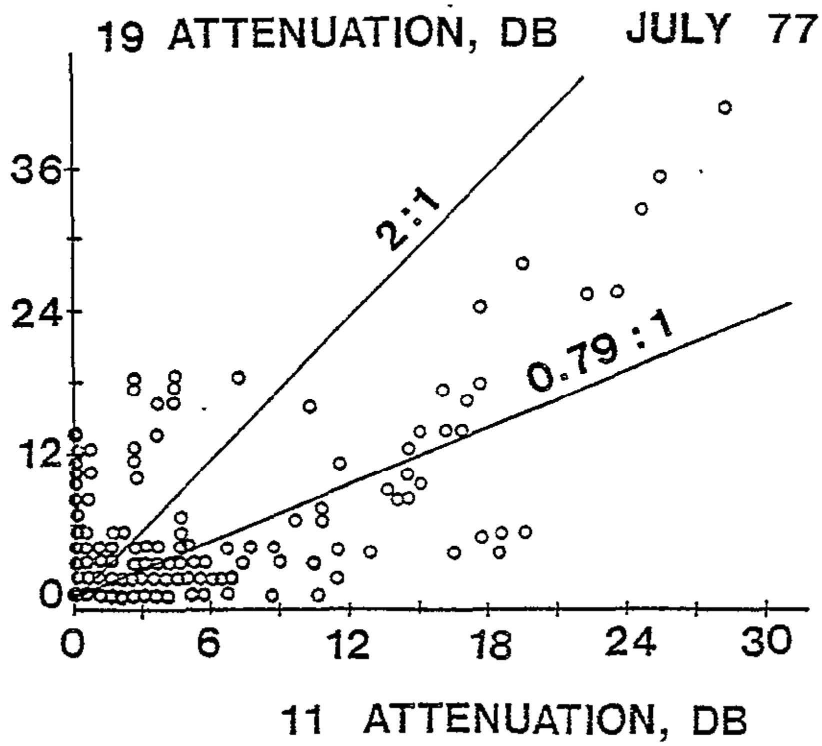

Figure 6-9. A scatter plot of 19 versus 11 GHz (V) attenuation for July, 1977.

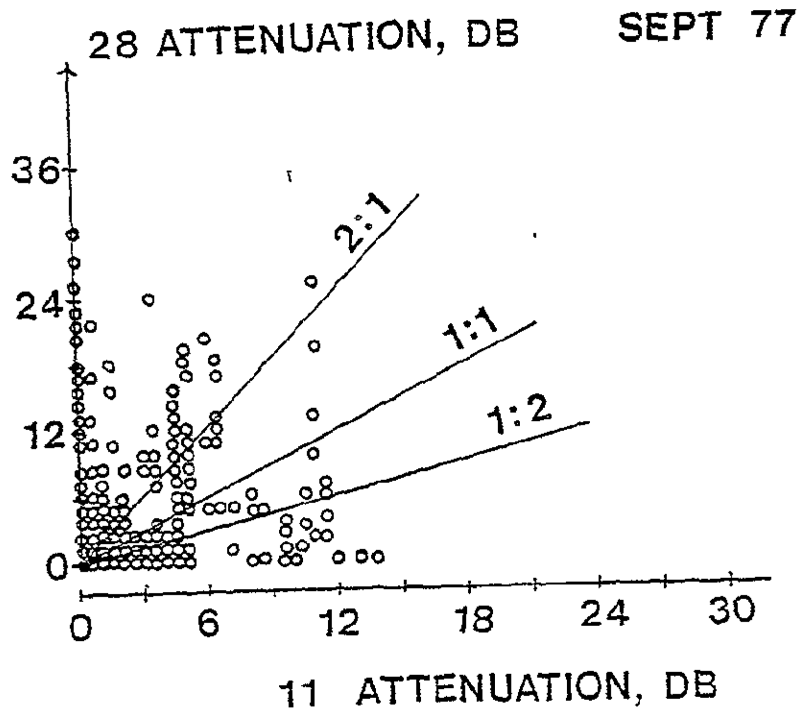

Figure 6-10. A scatter plot of 28 versus 11 GHz (V) attenuation for September, 1977.

7. DEVELOPING ATTENUATION STATISTICS

7.1 Introduction

Previous reports have presented monthly percentage-of-time plots and tables for ground rain rate and for attenuation on the CTS 11.7 GHz downlink. These were generated by dividing the attenuation range observed for the month into discrete segments (called bins after radar range bins) and calculating the total time that the observed attenuation fell within each bin. The percentage of time that the attenuation equalled or exceeded the mean attenuation of a given bin was then (approximately) the total time that the observed attenuation fell either within the given bin or into bins with higher attenuation values divided by the total time for which attenuation data were collected. (The last quantity is the so-called time base for the monthly attenuation data.) To illustrate the process symbolically, assume that there are N attenuation bins centered around attention values A(1), A(2) ... A(N). If each bin has a width 2DA, then attenuation values A in the range A(i) - DA < A < A(i) + DA fall into the i-th bin. Let the elapsed time that the observed attenuation falls into the i-th bin be t(i). The total time T for which data are available is then the sum of the times for which the attenuation fell into each bin, i.e.

$$T = \sum_{j=1}^{N} t(j) \quad . \qquad (7-1)$$

the percentage of time p(i) that the observed attenuation A equalled or exceeded A(i) is then given by

$$p(A \geq \bar{A}_i) = \frac{100 \sum_{j=i}^{N} t_j}{\sum_{j=1}^{N}} = 100 \sum_{j=i}^{N} \frac{t_j}{T} \qquad (7-2)$$

To calculate rain rate statistics a similar process was used. Rain rate bins replaced attenuation bins.

7.2 Treating Cases for Which CTS 11.7 GHz Data are Missing

In generating attenuation statistics it is necessary to account for those times when the receiver involved is not in normal operation or when data are not being collected. This can happen when the receiver is disconnected for maintenance or calibration (during which our data collection system reports the receiver in test mode), when the receiver has lost phaselock, or when the computer has been halted. These can be treated by excluding such times from the attenuation time base - in which case care must be taken to insure that the same time bases are used for attenuation and rain rate calculations - or by assuming appropriate signal levels for those times when data are unavailable. Since the receiver and the computer are not normally disabled when rain is expected or occurring, clear weather (0 dB attenuation) can be assumed safely for all non-data times except those when the receiver is out of phaselock. An artificial value outside the range of interest (say 50 dB) can be assumed during loss of lock.

Since the CTS receiver has never malfunctioned during a rain event and since it almost never loses lock, times in which data are unavailable are so infrequent that (for CTS) it makes no material difference whether they are excluded from the time base (treated as dead time) or whether appropriate attenuation values are assumed.

7.3 Problems with COMSTAR 19 and 28 GHz Statistics: The Need to Scale

With COMSTAR the situation is different. Fades at 19 and 28 GHz are much more severe than those at 11 GHz, and for our receiving system loss of lock at 28 GHz may be expected during rainfalls exceeding about 30 mm/hr. Rain rates higher than about 60 mm/hr will take the 19 GHz system out of lock. When either receiver loses lock it cannot regain it until the signal rises above the acquisition threshold AND the receiver again sweeps through the beacon frequency. This means that for a particular fade the time out of lock may be substantially greater than the time that the signal fell below the dynamic range of the receiver.

Given that the 19 GHz and 28 GHz receivers will lose lock for a significant fraction of the time, what do we do about it? Excluding time out of lock from the time base is misleading for this reason: rain occupies the COMSTAR propagation path significantly earlier than it reaches the ground rain gauges. Typically the COMSTAR signals will be well down in a fade and the receivers may be out of lock before any ground precipitation is recorded. Lock will usually not be reacquired until all but the least intense part of the ground rainfall is over. If we exclude time out of lock from the time base for attenuation, or from the time base for rain rate, or from the time base for both, we will be excluding the time during which most of the rain fell. This will lead to a set of statistics showing incorrectly high attenuations at low ground rainfall rates. If, on the other hand, we assume 50 dB attenuation for the time out of lock, the statistics may indicate that this high level of attenuation was observed during ANY significant rainfall. (This is primarily a result of the time lag between the end of a fade and the re-establishment of phase lock.) Clearly a procedure for scaling attenuation data is needed for those times when signal levels are unavailable.

7.4 The Scaling Procedure

7.4.1 Rationale

In the procedure described here, attenuation values are scaled only when (1) a receiver is in test mode AND the ground rain rate is at least 1 mm/hr or (2) a receiver is out of phaselock. Under these conditions scaled attenuation values should be closer to the true attenuation values than are assumptions of either clear weather signals or loss of lock.

A detailed comparison of 19 and 28 GHz attenuations on a point-by-point basis for single events and on a statistical basis for equal percentages of time indicates that a 2:1 ratio was a good fit to the observed data, i.e.

$$A(28) \text{ in dB} = 2 * A(19) \text{ in dB} .$$

(See Chapter 6 for details of the attenuation scaling study.) Attenuation at 28 GHz and attenuation at 19 GHz are always well correlated with each other at our site.

While attenuation at 11 GHz was more closely correlated with attenuation at 19 GHz than it was with attenuation at 28 GHz, the path difference made the relationship between attenuation and frequency less clear. Simultaneous fades at 11 and 19 seem to reflect a 2:1 attenuation ratio:

A(19) in dB = 2 *A(11) in dB .

The observed data show quite a wide scatter (see Chapter 6) and the relationship is adopted with some uncertainty.

At this point several supporting comments are in order. First, attenuation scaling should be necessary primarily when the 19 GHz receiver has lost lock, and thus the scaling equation should have relatively little effect on 19 GHz attenuation data falling within the dynamic range of the 19 GHz receiver. This is clearly the primary range of interest for attenuation comparisons. Second, Hodge's (1976) work indicates that the correct ratio is approximately 2. Hodge is concerned with relating the attenuation at two frequencies on a single path. To compare attenuations on different paths a correction for elevation angle must be made; for horizontally stratified rain the correction factor is the ratio of the sines of the two elevation angles. For the paths reported here the elevation angle at 11.7 GHz is 33 degrees while the angle at 19 GHz is 44 degrees. The ratio of the two sines is 1.28. Same-path ratios of 19 to 11.7 GHz attenuation calculated by Hodge's model range from about 2.9 at low rain rates to 2.6 at high rain rates. When the correction is applied the range is 2.27 to 2.04 indicating that a factor of about 2 is appropriate.

In any case, it is rarely necessary to scale 11 GHz attenuation from 19 GHz attenuation, so at least at the lower frequency the error introduced should be negligible. Rain attenuations calculated at 19 GHz by the above formula should be closer to the true values than values assumed for clear weather or for loss of lock.

7.4.2 The Process

The first step in the process of generating monthly scaled statistics (Figure 7.4-1) is a Fortran program which produces a magnetic tape containing all co-polarized signal levels and the rain rate recorded by the station gauge at 30-second intervals for a calendar month. The set of signal levels and the rain rate at one instant of time is called an observation. One observation is generated for each 30-second period. The tape is passed to a SAS (Statistical Analysis System) program which puts the data into a SAS dataset and calculates the mean signal for each receiver channel. (See Chapter 4 for a discussion of the reasons for using the mean signal value.) This calculation uses all valid signal levels on the tape; test mode or loss-of-lock values are ignored. In the SAS dataset a valid signal level is represented by a number giving its value in dBm. Test mode is indicated by a single decimal point (.) in place of the number. Receiver out of lock is indicated by a .B and data which are invalid for any other reason use a .A in place of the number. The ., .A, and .B are standard SAS symbols for missing data and for programming purposes

any number > .B > .A > .

A second SAS program (SAS Program 2) then determines the attenuation values by a two-pass procedure. Table 7.4-1 presents a complete listing of the program; Figures 7.4-2 through 7.4-6 are flow charts which diagram how it works. In the listing CTS, V19, and C28 are the levels (in dBm at IF) of the 11.7 GHz, 19 GHz vertical, and 28 GHz co-polarized signals. ACTS, AV19, and AC28 are the corresponding attenuations with respect to the

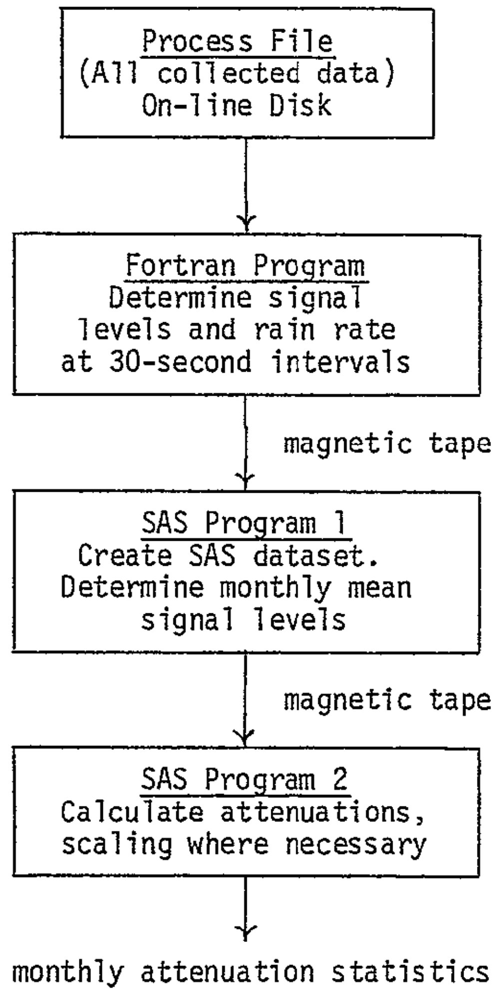

Figure 7.4-1. Steps in generating monthly attenuation statistics.

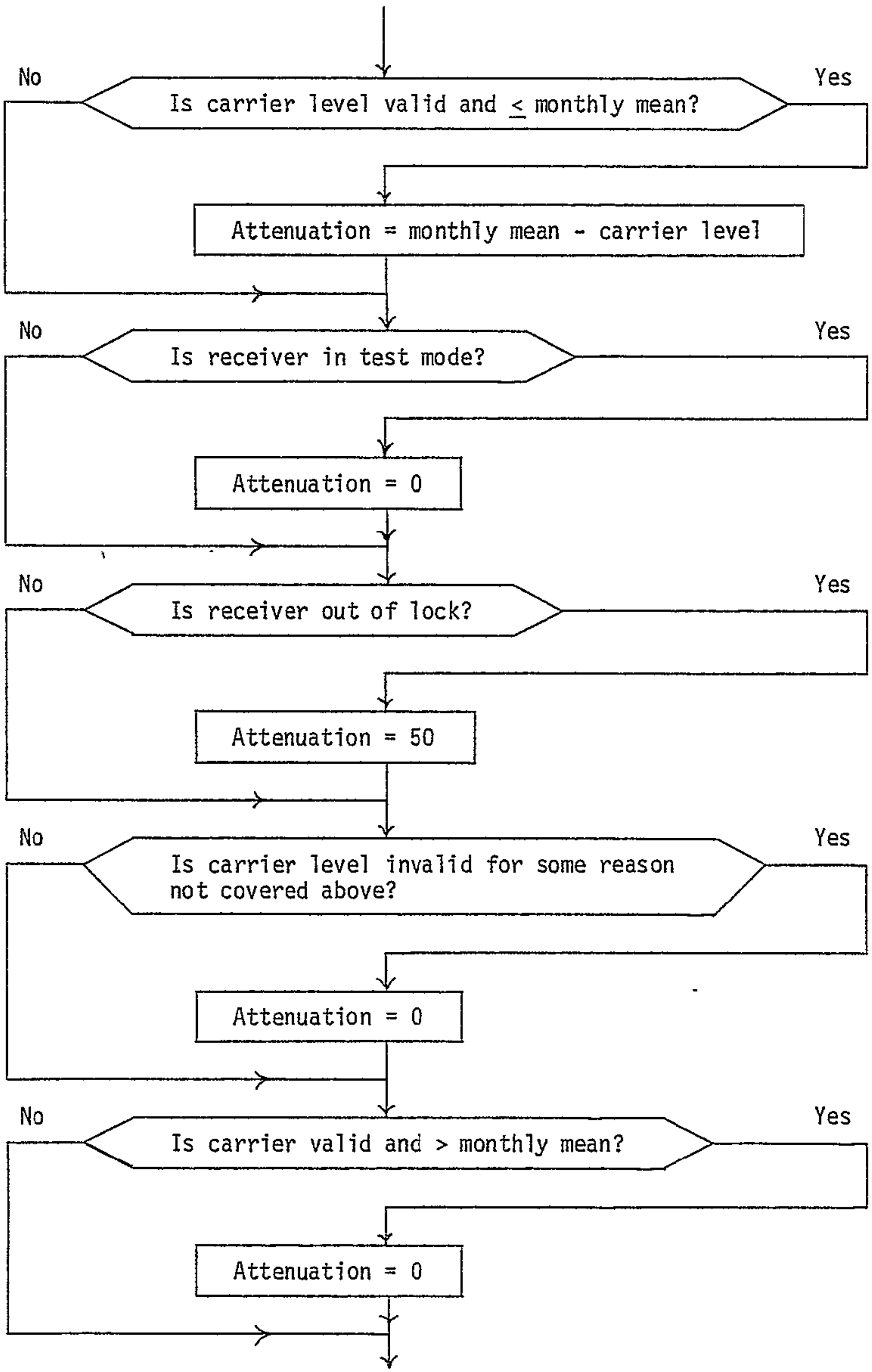

Figure 7.4-2. Flow chart for first pass (lines 1-20) of SAS Program 2.

Table 7.4-1. SAS Program 2

```
DATA EDTAPE.SR77SC;
SET SSTAPE.SEP77;
* THE VALUES SHOWN ARE FOR SEPTEMBER 1977;
* INPUT TAPE DI89H OS DSN=SEPT77;
* OUTPUT TAPE DK30E OS DSN=JY77S SAS DSN=SR77SC;
IF CTS<=-81.63 THEN ACTS =-CTS-81.63;
IF CTS=. THEN ACTS = 0;
IF CTS=.B THEN ACTS = 50;
IF CTS=.A THEN ACTS = 0;
IF CTS>-81.63 THEN ACTS = 0;
IF V19<=-85.42 THEN AV19 =-V19-85.42;
IF V19=. THEN AV19 = 0;
IF V19=.B THEN AV19 = 50;
IF V19=.A THEN AV19 = 0;
IF V19>-85.42 THEN AV19 =0;
IF C28<=-81.51 THEN AC28 =-C28-81.51;
IF C28=. THEN AC28 =0;
IF C28=.B THEN AC28 =50;
IF C28=.A THEN AC28 =0;
IF C28>-81.51 THEN AC28 =0;
IF CTS>.B OR V19>.B OR C28>.B THEN GO TO ATNCTS;
IF RAIN>1 THEN GO TO STORM;
ACTS=0;
AV19=0;
AC28=0;
GO TO LAST;
STORM: ACTS=50;
       AV19=50;
       AC28=50;
       GO TO LAST;
ATNCTS: IF CTS>.B THEN GO TO ATNV19;
    IF CTS<.B AND RAIN<1 THEN GO TO ATNV19;
    IF V19<=.B THEN GO TO ATNCTS1;
    ACTS=.5*AV19;
    GO TO ATNV19;
ATNCTS1: IF C28<=.B THEN GO TO ATNV19;
      ACTS=.25*AC28;
ATNV19: IF V19>.B THEN GO TO ATN28;
    IF V19<.B AND RAIN<1 THEN GO TO ATN28;
    IF C28<=.B THEN GO TO ATNV191;
    AV19=.5*AC28;
    GO TO ATN28;
ATNV191: IF CTS<=.B THEN GO TO ATN28;
      AV19=2*ACTS;
ATN28: IF C28>.B THEN GO TO LAST;
    IF C28<.B AND RAIN<1 THEN GO TO LAST;
    IF V19<=.B THEN GO TO ATN281;
    AC28=2.*AV19;
    GO TO LAST;
 ATN281: IF CTS <=.B THEN GO TO LAST;
      AC28=4*ACTS;
LAST: KEEP ACTS AV19 AC28 RAIN;
```

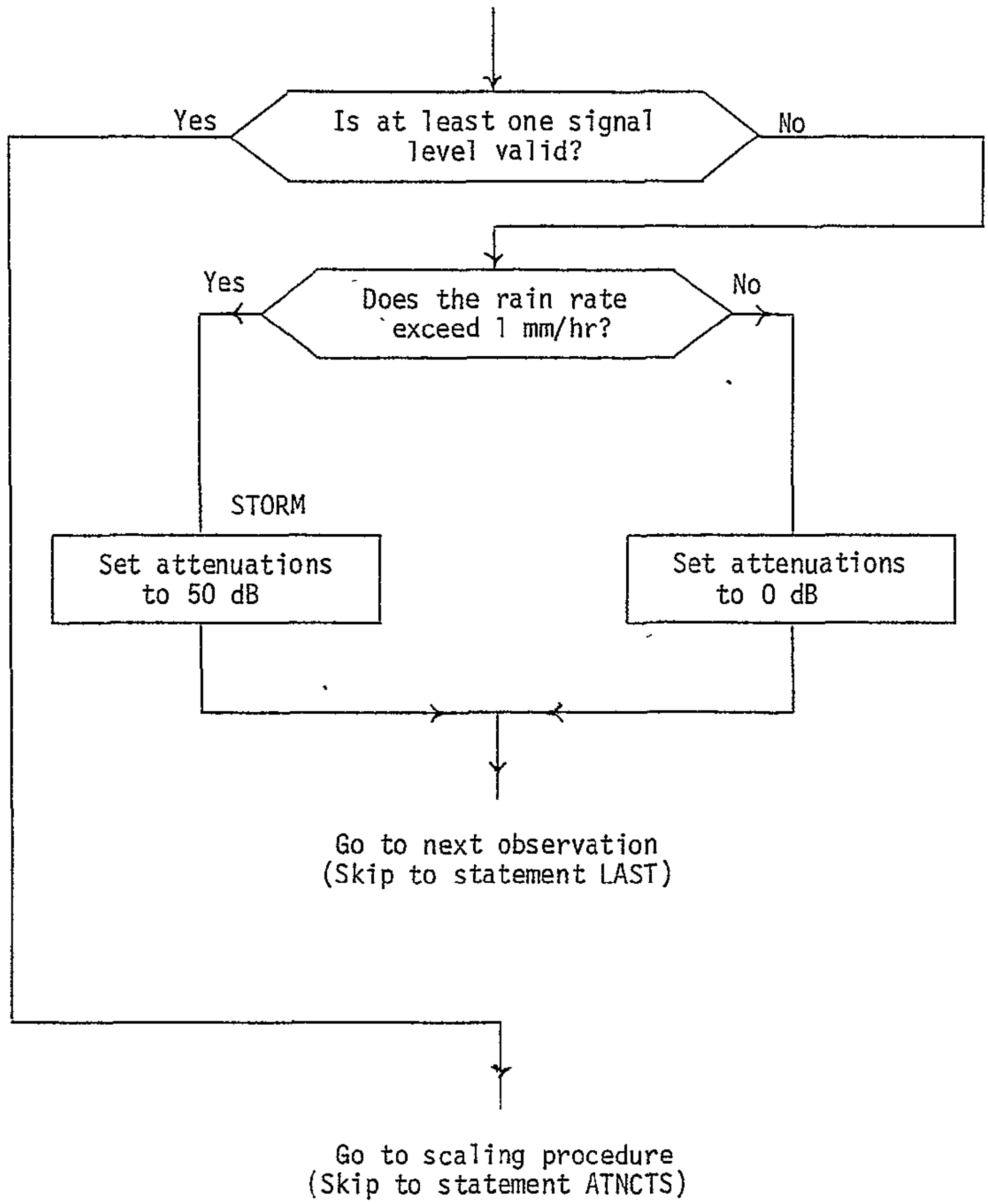

Figure 7.4-3. Flow chart indicating operation of SAS Program 2 when scaling is impossible.

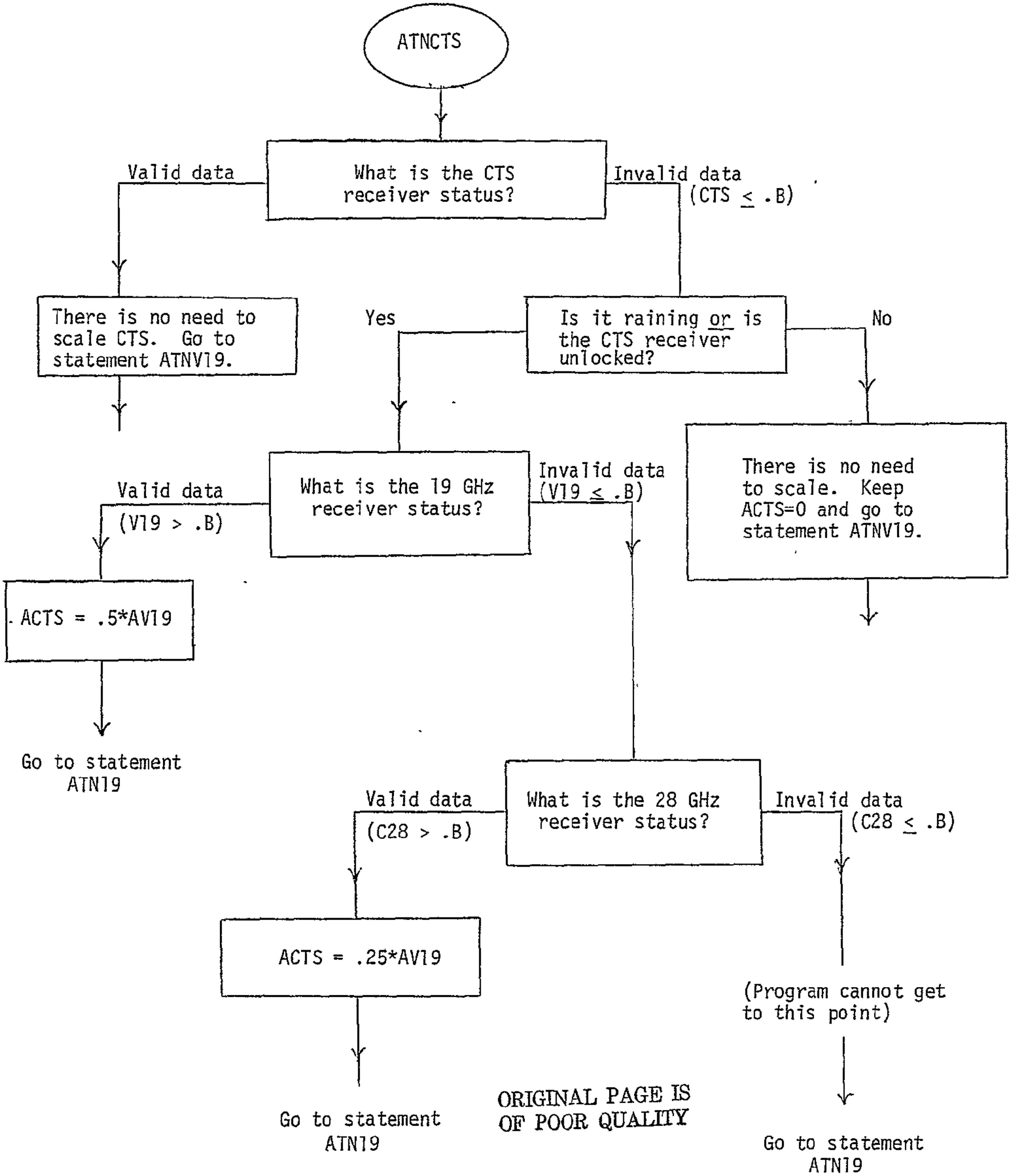

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Figure 7.4-4. 11 GHz attenuation scaling procedure.

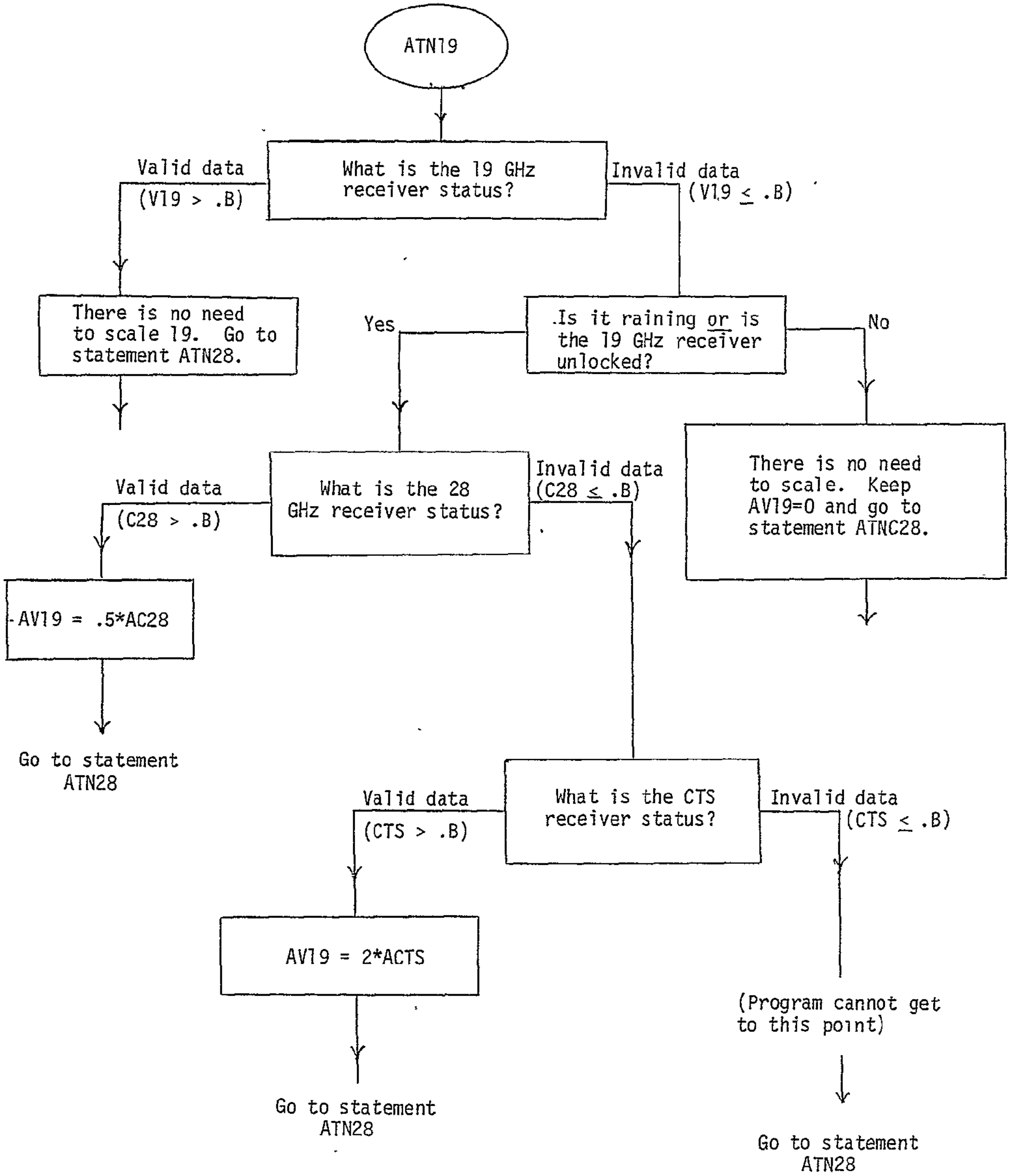

Figure 7.4-5. 19 GHz scaling procedure.

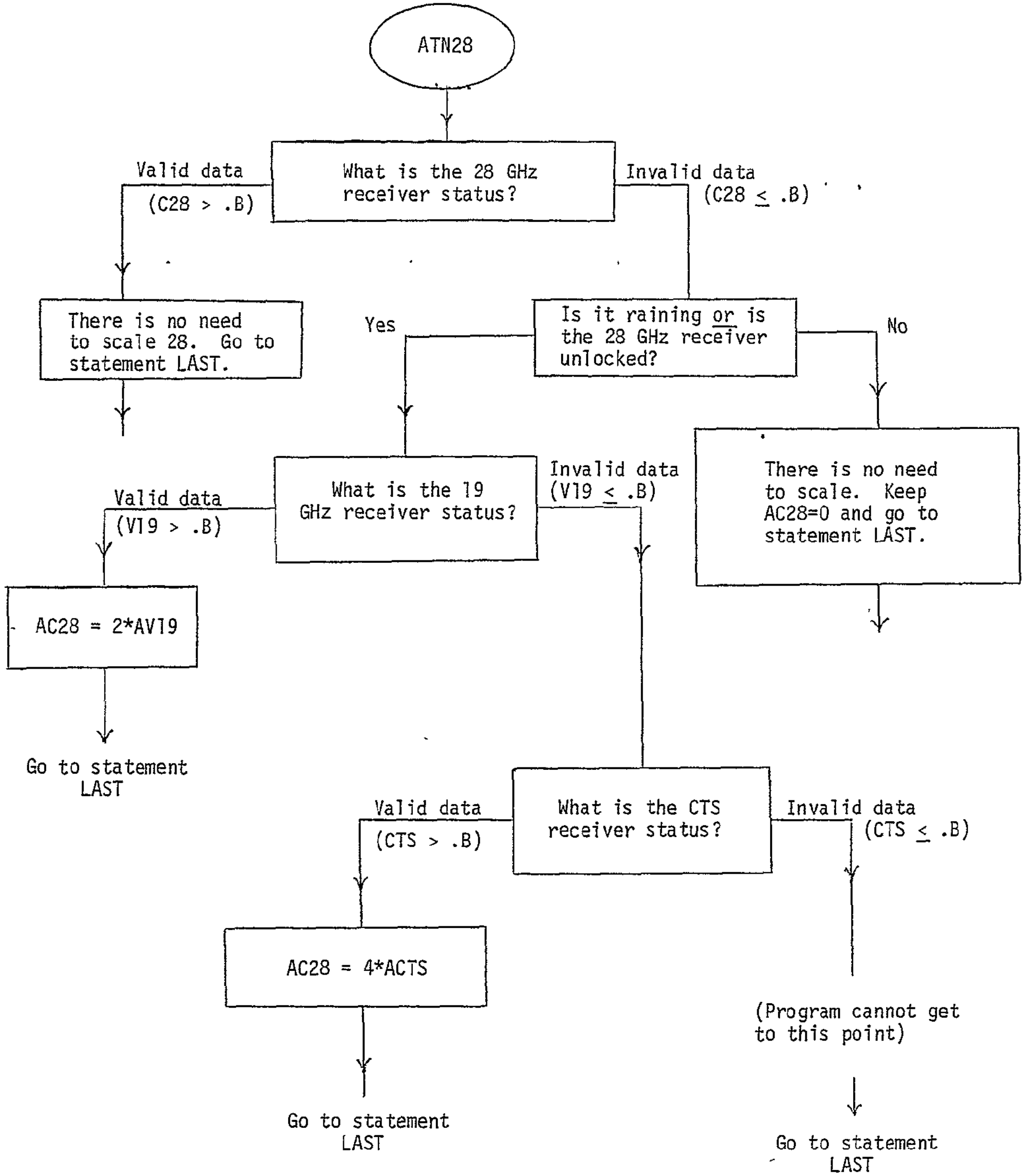

Figure 7.4-6. 28 GHz scaling procedure.

monthly mean signal levels.

In the first pass (Figure 7.4-2) data for each frequency are handled in the same way. If the signal level is below the monthly mean, the attenuation is equal to the difference between the two. If the signal level is above the monthly mean, the attenuation is zero. If the signal value is invalid because the receiver was out of lock, the attenuation is arbitrarily set to 50 dB. If the signal level is invalid for any other reason, the attenuation is set to 0.

The second pass of SAS Program 2 is the frequency scaling routine. When frequency scaling begins, the program has already calculated attenuation values for each instant for those signals which were present and valid. The program is also holding the observation from which those attenuations were calculated, and to each missing attenuation there corresponds a ., a .A, or a .B in the observation. If at least one signal level is valid, the program can scale and does so. If no signal level is valid then there is nothing from which to scale. In this case the program sets all attenuations to 50 dB if the rain rate exceeds 1 mm/hr; otherwise all attenuations are set to 0 dB. The process is diagrammed in Figure 7.4-3.

There are three instances when invalid data may be present for all three signal levels. These are (1) all receivers in test mode - which should never occur during rain - , (2) all receivers out of lock during a rain fade - which has never happened in the absence of a significant rain rate on the station gauge - or (3) a computer or receiver malfunction, as has occasionally been caused by lightning strokes and power line transients. In case

(3) the assumption of loss of lock in the presence of rain may be challenged, but it is probably the best choice to make in that situation. Fortunately such events have been rare.

The scaling process itself is best described by flow charts; see Figures 7.4-4 through 7.4-6. Basically the program scales only if it is raining or if a receiver has lost lock. If possible it tries to scale the 19 and 28 GHz attenuations from each other since these signals occupy the same path. When possible 11 GHz attenuations are scaled from the 19 vertical GHz data rather than from 28. As Table 7.4-1 indicates, the program scales 11 GHz (lines 31-37) then 19 (lines 38-44) and then 28 GHz (lines 45-51).

7.4.3 Results

Table 7.4-2 presents the scaled and unscaled 11.7 GHz attenuation statistics for the month of July, 1977. The differences are quite minor (since the CTS receiver rarely loses lock) and represent the conversion of one loss-of-lock point and 20 invalid-data points to scaled values. This and the following statistical tables were generated by a SAS procedure that assigns one bin to each unique attenuation value present.

The effect of scaling is more dramatic at 19 GHz, as Table 7.4-3 indicates. A percent-of-time plot based on the unscaled data would flatten out at 1.6%, whereas a plot based on the scaled data will indicate the expected behavior. Similar results are noted at 28 GHz, but the curves are not reproduced here.

Chapter 8 will present attenuation data generated by the techniques described here.

Table 7.4-2. Comparison of July, 1977, 11.7 GHz Attenuation Statistics

Attenuation	Percentage of Time Exceeded	
	Unscaled	Scaled
0.00	40.660	40.683
0.27	30.156	30.178
0.67	23.893	23.912
1.27	14.641	14.660
1.67	6.915	6.928
2.27	4.520	4.533
2.67	2.291	2.303
3.07	1.934	1.944
3.67	1.167	1.177
4.07	0.968	0.977
4.67	0.869	0.878
5.27	0.139	0.147
5.07	0.112	0.119
6.87	0.105	0.111
7.47	0.100	0.105
8.27	0.097	0.103
9.08	0.091	0.096
9.68	0.088	0.094
10.68	0.081	0.086
12.08	0.075	0.081
13.28	0.073	0.078
14.08	0.071	0.076
14.88	0.065	0.069
15.88	0.062	0.064
17.08	0.057	0.058
17.68	0.054	0.055
19.29	0.049	0.049
20.09	0.044	0.044
22.09	0.038	0.037
24.29	0.036	0.035
27.89	0.034	0.032

Table 7.4-3. Comparison of July, 1977, 19 GHz Attenuation Statistics

Attenuation	Percentage of Time Exceeded	
	Unscaled	Scaled
0.00	45.110	44.328
0.35	26.878	25.565
0.75	16.614	15.207
1.15	10.422	8.955
1.55	6.109	4.611
1.95	4.513	3.002
2.75	2.014	0.494
3.75	1.729	0.208
4.56	1.683	0.162
5.56	1.652	0.132
6.56	1.648	0.128
8.76	1.638	0.115
10.56	1.631	0.104
11.56	1.625	0.095
13.56	1.619	0.085
16.17	1.610	0.074
17.37	1.604	0.067
25.58	1.599	0.057
30.78	1.594	0.052
34.59	1.590	0.046

8. STATISTICAL DATA FOR THE QUARTER

8.1 Introduction

This chapter presents tabular percent-of-time data on attenuation and rainfall rate at 11.7, 19.04, and 28.56 GHz for the months of July, August, and September, 1977, considered both separately and together. Because of their length, the tables are grouped at the end of the chapter. For reasons outlined in Section 8.4, at this time isolation data are given only for 11.7 GHz in July.

The tables were generated by SAS (Chapter 3) using a procedure called FREQ. FREQ searches the monthly dataset for a specified variable (e.g. rain rate or attenuation) and counts the number of times that the variable took on each unique value found in the dataset. In the terminology of Chapter 7 this means that it assigns a bin to each unique value. The bins are then ranked in numerical order and for each bin the number of data points having values less than the bin value is determined. This number is divided by the total number of data points to yield the percentage of the data points that have a value smaller than the bin value. When this first percentage is subtracted from 100, the result is a second percentage which indicates the number of data points that have values larger than the bin values. Since one data point is stored in the input dataset for each half minute of time, the first and second percentages also give the percentage of time that the variable in question was less than or greater than the bin value. Hence both exceedance and lessence tables result.

While the practice of assigning a bin to each unique value in the dataset enhances accuracy, it introduces a minor inconvenience into the process of comparing the values of two variables (e.g. rain rate and attenuation) that were exceeded for the same percentage of time: at a given percentage of time bin values may not be present for both variables. As an illustration, consider this example. In July, 1977, our 11.7 GHz attenuation exceeded 8.47 dB for exactly 0.1% of the time. But no measured rain rate value was exceeded for exactly 0.1% of the time; the closest were 7.69 mm/hr at 0.099% and 6.57 mm/hr at 0.103% of the time. To determine the rain rate exceeded 0.1% of the time it would be necessary to interpolate between the last two values.

8.2 The Data

The tables which follow present percent-of-time exceeded data for the rain rate (RAIN) and the rain attenuations for 11.7 GHz circular (ACTS), 19.04 GHz vertical (AV19), and 28.56 GHz (AC28) polarizations for each month and for the quarter. The column headed PER gives the percentage of time that the rain rate or the attenuation exceeded the tabulated value. A dot (.) in a column means a bin value which the variable exceeded for exactly that percentage of time was not in the data set.

The data in the tables were generated by the scaling process outlined in Chapter 7. The reader should keep this in mind; any attenuations exceeding 30 dB were probably scaled and may not accurately represent the physical phenomena involved.

A point of interest is the degree to which our tipping-bucket rain gauge data match those recorded by the U.S. Weather Service for the report period. Here are the comparisons.

Accumulations in mm

Month	VPI&SU	USWS
July	50.46	50.80
August	56.61	161.54
September	46.56	104.90

Except for July the agreement is not good. However a detailed comparison of our records with those provided by the USWS indicates that in August and September the USWS site received heavy rains while little or no rain reached the VPI&SU campus. On August 13, for example, 67.3 mm of rain fell on the USWS site while our site received 5.84 mm. The difference in rain accumulations is apparently a feature of the local terrain and the separation between the gauges (7.2 km or 4.5 miles), and does not reflect a malfunction in our equipment.

8.3 Implications of the Data: Effective Path Lengths.

For a uniform rain falling with rain rate R mm/hr along a path of length L km the attenuation A in dB is given by

$$A = g(R)L \quad (8-1)$$

Here g is the so-called specific attenuation in dB/km or, equivalently, the attenuation that would be observed along an 1 km path for rain rate R.

For satellite paths a statistical effective path length L ef may be defined as the ratio of the attenuation A(T) exceeded for a given percentage of time to the specific attenuation calculated from the rainfall rate R(T) exceeded for that percentage of time.

$$Lef = \frac{A(T)}{g[R(T)]} \quad (8-2)$$

The tables that follow present effective path length data for each month in the quarter and for the quarter as a whole. These were calculated from the following equations for g(R).

$$11.7 \text{ GHz: } g = 0.04641 * R \quad (8-3)$$

$$19.04 \text{ GHz: } g = 0.0949 * R + 0.122 \quad (8-4)$$

$$28.56 \text{ GHz: } g = 0.1234 * R + 1.9416 \quad (8-5)$$

Equations (8-3) through (8-5) represent curve fits to theoretical values of attenuation (g) versus rain rate (R) for a 1 km path for rain rates greater than 10 mm/hr. For rain rates of 10 mm/hr or more these equations provide as good a fit to the theory as the more common aR expressions. A linear formulation was used to speed up the computation

For the entire quarter's data a regression of Lef on R at 11.7 GHz for $10 \leq R \leq 50$ mm/hr yields

$$Lef = 19.4943 - 0.56399 * R + 0.005718 * R * R \qquad (8-6)$$

with an R-squared of 0.9955. Equation (8-6) follows the general trend of Hogg and Chu's Figure 38 (1975), although our path lengths are greater.

At meaningful rain rates our effective pathlengths for the COMSTAR frequencies are smaller than those for CTS. If the rain were horizontally stratified, the look angle difference would make

$$Lef(11 \text{ GHz}) = 1.28 * Lef(19 \text{ GHz}) \qquad (8-7).$$

Differences larger than those given by equations (8-7) may arise from pecularities of the local terrain or from some artifact of the theoretical model.

The terrain difference is particularly intriguing. The CTS 11.7 GHz path runs almost directly above a valley while the COMSTAR 19 and 28 GHz paths follow rising ground until they pass directly over the peak of a nearby mountain. An argument can be made for rain cells being channeled and squeezed by the valley and presenting an elongated cross section (and hence a longer Lef) to the CTS signals than they do to the COMSTAR signals. This question will be considered in later work.

8.4 Isolation Statistics

Table 8.4 presents percentage of time plots for the 11.7 GHz isolation during the month of July, 1977. CTS isolation statistics for July and August are unavailable because of the antenna and spacecraft problems discussed earlier. At this time we are unable to present isolation statistics for the other frequencies because of uncertainties in how best to handle periods when the receivers lost phaselock. Treating time out of lock as dead time invalidates any comparisons of isolation and rain rate; apparently an isolation scaling program similar to that presented for attenuation in Chapter 7 will have to be developed. This will be discussed in future reports.

Table 8.2-1. Attenuation Data for July, 1977.

OBS	RAIN	ACTS	AV19	AC28	PER
1	.	.	0.00000	.	44.328
2	.	.	0.06999	.	43.826
3	.	0.00000	.	.	40.683
4	.	.	0.14999	.	37.541
5	.	.	0.16999	.	37.514
6	.	.	.	0.00000	34.896
7	.	0.05999	.	.	34.697
8	.	.	.	0.13999	31.027
9	.	0.25999	.	.	30.178
10	.	0.27500	.	.	30.177
11	.	.	.	0.33999	29.881
12	.	.	0.35000	.	25.565
13	.	.	0.37000	.	25.538
14	.	0.45999	.	.	25.521
15	.	0.57499	.	.	25.519
16	.	.	0.47000	.	25.486
17	.	.	.	0.74000	24.083
18	.	0.66000	.	.	23.912
19	.	.	.	0.93999	21.005
20	.	.	.	1.13999	20.125
21	.	.	0.55000	.	18.217
22	.	.	0.56999	.	18.203
23	.	.	.	1.54000	17.303
24	.	1.05999	.	.	16.097
25	.	.	0.74999	.	15.207
26	.	.	0.77000	.	15.196
27	.	.	0.87000	.	15.164
28	.	1.25999	.	.	14.660
29	.	1.37500	.	.	14.653
30	.	.	0.94999	.	14.447
31	.	.	0.97000	.	14.439
32	.	.	1.06999	.	14.431
33	0.00	.	.	.	12.506
34	.	1.45999	.	.	11.284
35	0.01	.	.	.	10.196
36	.	.	.	1.74000	10.015
37	.	.	.	1.93999	9.260
38	.	.	1.14999	.	8.955
39	.	.	1.27000	.	8.943
40	0.02	.	.	.	8.273
41	.	1.66000	.	.	6.928
42	.	.	.	2.13999	6.596
43	.	.	1.35000	.	5.626
44	.	.	1.37000	.	5.614
45	.	.	1.47000	.	5.607
46	.	.	.	2.54000	5.353
47	.	.	.	2.70000	5.351
48	.	1.86000	.	.	5.261
49	.	.	1.55000	.	4.611
50	.	.	1.56999	.	4.602
51	.	2.25999	.	.	4.533
52	.	.	1.74999	.	4.451
53	.	.	1.77000	.	4.447

Table 8.2-1 (continued). Attenuation Data for July, 1977.

OBS	RAIN	ACTS	AV19	AC28	PER
54	.	.	1.87000	.	4.442
55	.	.	.	2.74000	4.040
56	0.03	.	.	.	3.525
57	.	.	.	2.93999	3.317
58	.	.	.	3.13999	3.158
59	.	.	1.94999	.	3.002
60	.	.	1.97000	.	2.999
61	.	2.45999	.	.	2.794
62	0.04	.	.	.	2.673
63	.	.	2.14999	.	2.653
64	.	.	2.35000	.	2.572
65	.	.	2.37000	.	2.571
66	0.10	.	.	.	2.326
67	.	2.66000	.	.	2.303
68	.	2.68000	.	.	2.302
69	.	2.77999	.	.	2.301
70	.	2.86000	.	.	2.165
71	0.11	.	.	.	2.004
72	.	.	.	3.54000	1.968
73	.	3.05999	.	.	1.944
74	.	.	.	3.74000	1.901
75	.	.	2.55000	.	1.669
76	.	3.45999	.	.	1.591
77	0.12	.	.	.	1.454
78	0.13	.	.	.	1.193
79	.	3.66000	.	.	1.177
80	.	3.86000	.	.	1.175
81	.	3.98000	.	.	1.174
82	0.17	.	.	.	0.997
83	.	4.05999	.	.	0.977
84	.	.	.	3.93999	0.925
85	.	4.45999	.	.	0.889
86	0.29	4.66000	.	.	0.878
87	0.38	.	.	.	0.789
88	.	.	.	4.33999	0.771
89	.	.	.	4.54000	0.719
90	0.43	.	.	.	0.630
91	0.58	.	.	.	0.571
92	0.83	.	.	.	0.531
93	1.09	.	.	.	0.500
94	.	.	.	4.74000	0.499
95	.	.	2.74999	.	0.494
96	1.21	.	.	.	0.472
97	.	.	.	4.93999	0.459
98	.	.	2.94999	.	0.451
99	1.23	.	.	.	0.444
100	.	.	.	5.33999	0.423
101	.	.	3.35000	.	0.420
102	1.25	.	.	.	0.417
103	1.65	.	.	.	0.397
104	1.74	.	.	.	0.378
105	1.90	.	.	.	0.360
106	.	.	.	5.54000	0.357

Table 8.2-1 (continued). Attenuation Data for July, 1977.

OBS	RAIN	ACTS	AV19	AC28	PER
107	.	.	.	5.74	0.353
108	2.16	.	.	.	0.344
109	2.28	.	.	6.14	0.328
110	2.51	.	.	.	0.315
111	2.78	.	.	.	0.302
112	2.79	.	.	.	0.290
113	2.81	.	.	.	0.279
114	.	.	.	6.34	0.277
115	3.21	.	.	.	0.268
116	.	.	.	6.54	0.263
117	3.30	.	.	.	0.258
118	.	.	.	6.74	0.250
119	3.39	.	.	.	0.248
120	3.45	.	.	.	0.237
121	3.48	.	.	.	0.227
122	.	.	3.55000	.	0.226
123	3.52	.	.	.	0.217
124	.	.	.	7.14	0.216
125	3.70	.	3.74999	.	0.208
126	.	.	.	7.34	0.206
127	.	.	.	7.54	0.201
128	3.96	.	.	.	0.199
129	.	.	3.94999	.	0.198
130	4.02	.	.	.	0.190
131	.	.	.	7.94	0.189
132	.	.	.	8.14	0.186
133	.	.	.	8.35	0.183
134	4.13	.	.	.	0.181
135	.	.	.	8.75	0.176
136	4.19	.	.	.	0.173
137	.	.	.	8.95	0.171
138	.	.	4.16000	.	0.168
139	.	.	.	9.15	0.167
140	4.31	.	.	.	0.165
141	.	.	4.35999	.	0.164
142	.	.	4.55999	.	0.162
143	4.44	.	.	.	0.157
144	.	.	.	9.35	0.151
145	.	4.86000	.	9.92	0.150
146	4.46	4.87999	.	.	0.149
147	.	5.25999	.	9.95	0.147
148	.	.	.	10.15	0.146
149	.	.	.	10.55	0.143
150	.	.	4.75999	.	0.142
151	.	.	4.96000	.	0.140
152	.	.	.	10.75	0.138
153	.	.	.	11.12	0.137
154	4.62	.	5.35999	11.55	0.134
155	.	.	.	11.75	0.133
156	.	.	5.55999	13.15	0.132
157	.	.	5.75999	.	0.131
158	.	.	5.96000	13.35	0.130
159	.	.	6.16000	13.55	0.129

Table 8.2-1 (continued). Attenuation Data for July, 1977.

OBS	RAIN	ACTS	AV19	AC28	PER
160	.	.	6.56	.	0.128
161	4.64	.	6.96	14.15	0.127
162	.	.	.	14.35	0.125
163	.	.	.	15.15	0.124
164	.	.	.	15.55	0.123
165	.	.	7.36	.	0.122
166	.	5.66	.	16.24	0.121
167	4.75	5.78	7.96	17.15	0.120
168	.	6.06	.	17.75	0.119
169	.	.	8.12	17.95	0.118
170	.	.	.	18.32	0.117
171	.	.	8.76	.	0.115
172	5.16	6.26	9.16	.	0.113
173	.	6.58	.	19.44	0.112
174	.	6.86	.	19.52	0.111
175	.	7.06	9.72	20.16	0.109
176	6.20	.	9.76	20.96	0.108
177	.	.	.	21.12	0.106
178	.	7.46	10.16	22.36	0.105
179	.	7.86	10.56	.	0.104
180	6.57	8.26	10.96	.	0.103
181	.	.	11.16	22.64	0.102
182	.	.	.	22.72	0.101
183	.	8.47	.	23.12	0.100
184	7.69	.	11.32	.	0.099
185	.	.	11.36	23.16	0.097
186	.	9.07	.	23.56	0.096
187	.	9.27	11.56	23.96	0.095
188	8.20	9.67	12.16	24.32	0.094
189	.	.	.	24.72	0.093
190	.	9.87	12.36	24.76	0.092
191	8.40	.	.	.	0.090
192	.	.	12.52	25.04	0.088
193	.	10.67	13.16	26.32	0.086
194	8.51	.	13.56	27.12	0.085
195	10.15	11.47	13.76	27.52	0.082
196	.	12.07	14.12	28.24	0.081
197	.	12.87	.	.	0.080
198	10.91	13.27	.	.	0.078
199	.	13.67	15.17	30.34	0.077
200	.	14.07	15.57	31.14	0.076
201	13.33	.	15.72	31.44	0.075
202	.	.	16.17	32.34	0.074
203	13.47	14.27	16.57	33.14	0.073
204	15.50	14.79	16.94	33.88	0.072
205	15.85	14.87	16.97	33.94	0.069
206	24.63	15.07	17.17	34.34	0.068
207	27.06	15.39	17.37	34.74	0.067
208	29.22	15.79	17.97	35.94	0.066
209	31.12	.	.	.	0.065
210	34.38	15.87	18.17	36.34	0.064
211	36.38	16.19	18.54	37.08	0.063
212	38.94	.	19.74	39.48	0.062

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Table 8.2-1 (continued). Attenuation Data for July, 1977.

OBS	RAIN	ACTS	AV19	AC28	PER
213	39.75	.	22.94	45.8800	0.060
214	41.34	16.470	23.77	47.5400	0.059
215	42.39	17.070	24.14	48.2799	0.058
216	43.50	17.270	25.58	.	0.057
217	43.96	.	25.78	.	0.056
218	46.29	17.670	27.18	.	0.055
219	46.33	18.095	27.34	.	0.054
220	46.41	.	29.58	.	0.053
221	47.70	.	30.78	.	0.052
222	48.63	18.680	31.58	.	0.050
223	48.71	19.280	32.18	.	0.049
224	49.59	.	32.38	.	0.048
225	50.41	.	32.94	.	0.047
226	50.97	.	34.59	.	0.046
227	51.26	19.480	36.19	.	0.045
228	53.88	20.080	37.36	.	0.044
229	56.31	20.495	.	.	0.043
230	56.66	.	.	.	0.041
231	57.25	.	38.96	.	0.040
232	57.91	.	40.16	.	0.039
233	58.40	20.880	40.39	.	0.038
234	58.59	22.080	40.99	.	0.037
235	59.93	23.480	.	.	0.036
236	60.00	24.280	.	.	0.035
237	60.26	25.680	.	.	0.034
238	61.14	27.880	41.76	.	0.032
239	63.47	29.290	.	.	0.031
240	64.97	.	.	.	0.030
241	68.03	.	.	.	0.029
242	69.67	.	.	.	0.028
243	70.11	.	.	50.0000	0.027
244	70.75	.	.	51.1600	0.026
245	70.93	.	.	51.5600	0.025
246	71.11	.	.	54.3600	0.024
247	72.62	.	.	54.6800	0.022
248	75.10	.	.	59.1600	0.021
249	75.41	.	.	61.5600	0.020
250	76.25	.	.	63.1600	0.019
251	76.68	.	.	64.3600	0.018
252	77.00	.	.	64.7600	0.017
253	80.26	.	.	65.8800	0.016
254	80.38	.	.	69.1800	0.015
255	80.97	.	.	72.3800	0.013
256	81.45	.	.	74.7199	0.012
257	81.94	.	.	.	0.011
258	82.68	.	.	.	0.010
259	83.94	.	.	77.9200	0.009
260	85.92	.	.	80.3200	0.008
261	86.46	.	.	80.7800	0.007
262	86.59	.	.	81.9800	0.006
263	94.01	.	.	.	0.004
264	94.66	.	.	.	0.003
265	103.00	.	.	.	0.002

Table 8.2-2. Attenuation Data for August, 1977.

OBS	RAIN	ACTS	AV19	AC28	PER
1	.	.	0.00000	.	33.908
2	.	.	0.34999	.	32.065
3	.	.	.	0.00000	31.439
4	.	.	.	0.24000	25.082
5	.	.	0.55000	.	24.824
6	.	.	0.75000	.	21.011
7	.	0.00000	.	.	17.839
8	.	0.27500	.	.	17.755
9	.	.	0.94999	.	17.517
10	.	.	.	0.44000	14.910
11	.	.	.	0.63999	14.646
12	.	.	.	0.69997	14.644
13	.	.	.	0.83999	14.287
14	.	.	.	1.10000	14.253
15	.	0.30000	.	.	11.482
16	0.00	.	.	.	10.764
17	.	.	1.14999	.	9.731
18	.	0.49999	.	.	8.929
19	.	0.57499	.	.	8.832
20	.	.	.	1.24000	8.764
21	.	.	.	1.44000	8.530
22	.	.	.	1.49999	8.522
23	.	.	.	1.63999	8.375
24	.	.	1.34999	.	7.852
25	.	.	1.55000	.	5.722
26	.	0.69999	.	.	4.888
27	.	0.87500	.	.	4.856
28	.	0.89999	.	.	4.565
29	.	1.17499	.	.	4.540
30	.	.	.	1.83999	4.397
31	.	.	.	1.89998	4.393
32	.	.	.	2.24000	4.086
33	.	.	.	2.29998	4.083
34	.	.	.	2.44000	3.802
35	.	1.30000	.	.	3.330
36	.	1.47500	.	.	3.321
37	.	.	1.75000	.	3.295
38	.	.	1.94999	.	3.195
39	.	.	2.14999	.	2.822
40	.	.	.	2.63999	2.810
41	.	.	.	2.69997	2.805
42	.	.	.	3.03999	2.155
43	.	.	.	3.10000	2.148
44	0.01	.	.	.	2.127
45	.	1.49999	.	.	2.116
46	.	1.69999	.	.	1.651
47	.	1.87500	.	.	1.641
48	.	1.89999	.	.	1.637
49	.	1.97500	.	.	1.635
50	.	.	.	3.24000	1.458
51	0.05	.	.	.	1.376
52	.	.	.	3.44000	1.292
53	.	.	.	3.49999	1.289

Table 8.2-2 (continued). Attenuation Data for August, 1977.

OBS	RAIN	ACTS	AV19	AC28	PER
54	0.16	.	.	.	1.163
55	.	2.10000	.	.	1.117
56	.	2.18000	.	.	1.101
57	.	2.28000	.	.	1.100
58	.	2.47999	.	.	1.092
59	.	2.58000	.	.	1.091
60	.	2.69999	.	.	1.090
61	.	2.87999	.	.	1.080
62	.	.	.	3.63999	1.067
63	.	.	2.34999	.	1.063
64	.	.	.	3.89998	1.061
65	.	.	2.55000	.	1.006
66	.	.	2.59999	.	1.003
67	0.21	.	.	.	0.998
68	.	.	.	4.03999	0.964
69	.	.	2.75000	.	0.953
70	0.32	.	.	.	0.892
71	.	.	.	4.24000	0.833
72	.	.	.	4.29998	0.832
73	0.45	.	.	.	0.815
74	.	.	.	4.44000	0.782
75	.	.	.	4.69997	0.775
76	0.53	.	.	.	0.752
77	.	.	.	4.83999	0.726
78	0.59	.	.	.	0.693
79	0.84	.	.	.	0.653
80	.	.	.	5.03999	0.645
81	.	.	.	5.10000	0.637
82	.	.	.	5.19998	0.634
83	1.02	.	.	.	0.619
84	1.27	.	.	.	0.593
85	.	.	.	5.24000	0.590
86	1.48	.	.	.	0.570
87	.	.	.	5.44000	0.567
88	1.64	.	.	.	0.549
89	.	.	.	5.49999	0.548
90	1.75	.	.	.	0.529
91	1.82	.	.	.	0.511
92	.	.	.	5.83999	0.502
93	.	.	.	5.89998	0.495
94	1.92	.	.	.	0.493
95	1.93	.	.	.	0.475
96	.	.	.	6.03999	0.467
97	1.95	.	.	.	0.457
98	.	.	.	6.24000*	0.447
99	.	.	.	6.29998	0.446
100	2.15	.	.	.	0.441
101	2.28	.	.	.	0.427
102	2.42	.	.	.	0.412
103	.	.	.	6.63999	0.401
104	2.70	.	.	.	0.400
105	2.77	.	.	.	0.388
106	3.01	.	.	.	0.376

Table 8.2-2 (continued). Attenuation Data for August, 1977.

OBS	RAIN	ACTS	AV19	AC28	PER
107	.	.	.	6.8400	0.365
108	3.02	.	.	.	0.364
109	3.09	.	.	7.0500	0.353
110	.	.	.	7.1000	0.348
111	3.17	.	.	.	0.343
112	3.26	.	.	.	0.333
113	.	.	.	7.4500	0.326
114	.	.	.	7.5000	0.324
115	3.38	.	.	7.5999	0.323
116	3.45	.	.	.	0.313
117	.	.	.	7.6500	0.311
118	.	.	2.94999	.	0.310
119	.	.	2.99998	.	0.308
120	3.68	.	.	7.8500	0.304
121	.	.	.	7.9000	0.301
122	.	.	3.14999	.	0.300
123	3.95	.	.	.	0.295
124	4.00	.	.	8.0500	0.286
125	.	.	.	8.3000	0.282
126	4.15	.	.	8.4500	0.278
127	4.22	.	3.55000	.	0.269
128	.	.	.	8.6500	0.265
129	4.24	.	.	8.7200	0.261
130	4.35	.	.	.	0.253
131	.	.	3.75000	.	0.250
132	.	.	3.79997	8.8500	0.249
133	.	.	.	9.1200	0.248
134	4.55	.	.	9.2500	0.245
135	.	.	3.94999	.	0.243
136	.	.	4.14999	.	0.240
137	4.70	.	.	9.4500	0.237
138	4.74	.	.	.	0.231
139	.	.	.	9.5200	0.229
140	.	.	.	9.6500	0.225
141	4.92	.	.	9.9200	0.224
142	.	.	.	10.0500	0.221
143	4.95	.	.	.	0.217
144	.	.	.	10.2500	0.215
145	.	.	4.36000	.	0.213
146	5.65	.	.	.	0.212
147	.	.	.	10.4500	0.211
148	.	.	.	10.8500	0.209
149	.	.	4.55999	11.0500	0.207
150	5.71	.	.	11.1200	0.206
151	.	.	.	11.2500	0.204
152	.	.	.	11.5200	0.202
153	6.45	.	.	.	0.201
154	.	.	4.75999	11.6500	0.198
155	.	.	.	11.8500	0.196
156	6.55	.	.	11.9200	0.195
157	6.74	.	.	.	0.189
158	.	.	4.95999	.	0.187
159	.	.	.	12.0500	0.186

Table 8.2-2 (continued). Attenuation Data for August, 1977.

OBS	RAIN	ACTS	AV19	AC28	PER
160	7.11	.	.	.	0.185
161	.	.	.	12.25	0.184
162	.	.	.	12.32	0.181
163	7.71	.	5.16000	12.65	0.180
164	.	.	5.55999	12.72	0.179
165	.	2.89999	.	.	0.173
166	8.02	2.97999	.	.	0.171
167	.	.	.	12.85	0.169
168	.	3.18000	.	.	0.168
169	8.69	3.28000	.	.	0.167
170	.	.	5.75999	13.05	0.166
171	.	.	.	13.12	0.165
172	9.42	.	.	.	0.162
173	.	.	.	13.52	0.161
174	9.66	3.30000	.	.	0.159
175	.	.	5.95999	.	0.157
176	.	3.58000	.	.	0.156
177	9.77	.	6.16000	.	0.155
178	.	.	.	13.65	0.153
179	10.02	.	6.36000	13.85	0.151
180	.	.	.	14.25	0.149
181	10.24	.	.	.	0.148
182	.	.	.	14.32	0.147
183	11.25	3.69999	.	14.45	0.146
184	.	3.87999	.	.	0.144
185	11.68	3.97999	6.55999	14.65	0.142
186	.	.	.	15.05	0.141
187	11.88	.	.	15.12	0.140
188	.	4.10000	6.75999	15.25	0.139
189	.	.	.	15.52	0.138
190	12.25	.	.	.	0.137
191	12.44	.	.	15.65	0.134
192	.	.	.	15.85	0.133
193	.	.	7.16000	.	0.132
194	13.56	.	.	16.05	0.131
195	.	.	.	16.32	0.130
196	13.81	.	.	16.45	0.129
197	.	.	.	16.65	0.128
198	14.01	.	.	17.26	0.127
199	.	4.30000	.	.	0.125
200	14.35	.	7.36000	17.92	0.124
201	.	.	7.55999	.	0.123
202	14.78	4.58000	.	.	0.122
203	15.00	.	7.75999	18.06	0.120
204	.	.	.	18.26	0.119
205	15.23	.	.	.	0.118
206	16.33	.	.	.	0.116
207	.	.	.	18.32	0.115
208	16.41	.	7.95999	.	0.114
209	.	4.89999	8.16000	18.46	0.113
210	16.51	4.97999	.	18.72	0.112
211	16.72	.	.	19.06	0.111
212	.	.	8.75999	.	0.110

Table 8.2-2 (continued). Attenuation Data for August, 1977.

OBS	RAIN	ACTS	AV19	AC28	PEP
213	17.53	.	.	19.12	0.109
214	17.66	.	8.96	19.66	0.108
215	17.96	.	.	19.86	0.106
216	18.20	.	.	19.92	0.104
217	18.23	5.10000	9.16	20.06	0.103
218	19.00	5.37999	.	.	0.102
219	.	.	.	20.66	0.101
220	20.14	.	9.36	.	0.100
221	20.43	.	9.56	21.06	0.097
222	.	5.49999	.	21.26	0.096
223	20.45	.	.	21.46	0.095
224	21.28	5.68000	9.96	.	0.094
225	21.65	.	10.16	21.52	0.093
226	21.86	.	10.36	.	0.092
227	22.07	.	.	21.86	0.091
228	22.10	.	10.76	.	0.088
229	22.20	.	.	22.72	0.087
230	22.92	5.89999	11.36	.	0.085
231	23.26	.	.	22.86	0.084
232	24.54	5.97999	.	.	0.083
233	25.20	.	.	.	0.082
234	25.31	.	.	.	0.081
235	25.40	6.30000	11.56	.	0.080
236	25.42	6.47999	.	23.12	0.078
237	27.44	.	.	.	0.077
238	27.84	.	.	.	0.076
239	28.08	.	11.96	.	0.075
240	28.49	.	.	23.92	0.074
241	28.73	.	.	24.06	0.073
242	28.77	.	.	24.26	0.072
243	29.33	.	12.36	24.46	0.071
244	29.82	.	.	.	0.069
245	30.30	.	12.56	.	0.068
246	31.34	6.49999	12.60	.	0.067
247	32.03	.	12.96	24.72	0.066
248	32.91	7.10000	.	25.06	0.065
249	34.77	.	.	.	0.064
250	34.88	.	13.36	25.12	0.063
251	35.40	.	.	25.20	0.062
252	36.82	.	13.56	25.86	0.060
253	37.20	.	13.76	25.92	0.059
254	39.21	.	.	.	0.058
255	39.84	.	13.96	.	0.057
256	40.07	.	14.20	26.72	0.056
257	40.10	.	14.57	.	0.055
258	40.34	7.30000	14.77	27.12	0.054
259	40.43	.	14.97	27.52	0.053
260	42.59	.	15.57	.	0.052
261	42.72	7.69999	.	27.67	0.050
262	42.86	.	15.97	.	0.049
263	43.71	.	16.37	27.92	0.048
264	44.13	.	.	28.40	0.047
265	44.78	.	.	29.14	0.046

Table 8.2-2 (continued). Attenuation Data for August, 1977.

OBS	RAIN	ACTS	AV19	AC28	PER
266	46.41	.	16.77	29.54	0.045
267	46.45	.	.	29.94	0.044
268	48.80	.	17.00	30.07	0.043
269	49.15	.	17.17	.	0.041
270	49.55	.	17.77	31.94	0.040
271	51.02	.	18.17	32.67	0.039
272	51.79	.	18.37	32.74	0.038
273	52.04	.	.	.	0.037
274	53.35	7.900	.	33.54	0.036
275	54.25	7.985	18.57	.	0.035
276	54.36	.	.	34.00	0.034
277	54.90	8.500	19.17	35.54	0.032
278	55.74	8.700	.	36.34	0.031
279	56.66	9.300	19.37	38.34	0.030
280	58.53	.	19.82	39.64	0.029
281	58.78	9.500	.	.	0.028
282	59.48	.	20.57	41.14	0.027
283	59.54	9.910	20.77	41.54	0.026
284	60.20	.	.	.	0.025
285	60.86	.	21.42	42.84	0.024
286	61.27	.	21.57	43.14	0.022
287	61.69	10.110	22.17	44.34	0.021
288	61.82	.	23.77	47.54	0.020
289	62.67	10.710	.	.	0.019
290	65.91	.	.	.	0.018
291	69.14	.	.	.	0.017
292	69.85	.	.	.	0.016
293	70.29	.	23.97	47.94	0.015
294	72.33	10.910	24.22	48.44	0.013
295	74.19	.	24.58	49.16	0.012
296	85.92	11.710	.	.	0.011
297	88.12	.	.	.	0.010
298	93.05	.	25.38	50.76	0.009
299	97.34	.	.	.	0.008
300	100.00	.	.	.	0.007
301	102.04	.	.	.	0.006
302	103.58	12.110	27.18	54.36	0.004
303	106.40	12.910	30.58	61.16	0.003
304	112.04	.	30.98	61.96	0.002
305	112.73	.	33.78	67.56	0.001
306	121.73	13.510	36.59	73.18	0.000

Table 8.2-3. Attenuation Data for September, 1977.

OBS	RAIN	ACTS	AV19	AC28	PER
1	.	.	0.00000	.	33.908
2	.	.	0.34999	.	32.065
3	.	.	.	0.00000	31.439
4	.	.	.	0.24000	25.082
5	.	.	0.55000	.	24.824
6	.	.	0.75000	.	21.011
7	.	0.00000	.	.	17.839
8	.	0.27500	.	.	17.755
9	.	.	0.94999	.	17.517
10	.	.	.	0.44000	14.910
11	.	.	.	0.63999	14.646
12	.	.	.	0.69997	14.644
13	.	.	.	0.83999	14.287
14	.	.	.	1.10000	14.253
15	.	0.30000	.	.	11.482
16	0.00	.	.	.	10.764
17	.	.	1.14999	.	9.731
18	.	0.49999	.	.	8.929
19	.	0.57499	.	.	8.832
20	.	.	.	1.24000	8.764
21	.	.	.	1.44000	8.530
22	.	.	.	1.49999	8.522
23	.	.	.	1.63999	8.375
24	.	.	1.34999	.	7.852
25	.	.	1.55000	.	5.722
26	.	0.69999	.	.	4.888
27	.	0.87500	.	.	4.856
28	.	0.89999	.	.	4.565
29	.	1.17499	.	.	4.540
30	.	.	.	1.83999	4.397
31	.	.	.	1.89998	4.393
32	.	.	.	2.24000	4.086
33	.	.	.	2.29998	4.083
34	.	.	.	2.44000	3.802
35	.	1.30000	.	.	3.330
36	.	1.47500	.	.	3.321
37	.	.	1.75000	.	3.295
38	.	.	1.94999	.	3.195
39	.	.	2.14999	.	2.822
40	.	.	.	2.63999	2.810
41	.	.	.	2.69997	2.805
42	.	.	.	3.03999	2.155
43	.	.	.	3.10000	2.148
44	0.01	.	.	.	2.127
45	.	1.49999	.	.	2.116
46	.	1.69999	.	.	1.651
47	.	1.87500	.	.	1.641
48	.	1.89999	.	.	1.637
49	.	1.97500	.	.	1.635
50	.	.	.	3.24000	1.458
51	0.05	.	.	.	1.376
52	.	.	.	3.44000	1.292
53	.	.	.	3.49999	1.289

Table 8.2-3 (continued). Attenuation Data for September, 1977.

OBS	RAIN	ACTS	AV19	AC28	PER
54	0.16	.	.	.	1.163
55	.	2.10000	.	.	1.117
56	.	2.18000	.	.	1.101
57	.	2.28000	.	.	1.100
58	.	2.47999	.	.	1.092
59	.	2.58000	.	.	1.091
60	.	2.69999	.	.	1.090
61	.	2.87999	.	.	1.080
62	.	.	.	3.63999	1.067
63	.	.	2.34999	.	1.063
64	.	.	.	3.89998	1.061
65	.	.	2.55000	.	1.006
66	.	.	2.59999	.	1.003
67	0.21	.	.	.	0.998
68	.	.	.	4.03999	0.964
69	.	.	2.75000	.	0.953
70	0.32	.	.	.	0.892
71	.	.	.	4.24000	0.833
72	.	.	.	4.29998	0.832
73	0.45	.	.	.	0.815
74	.	.	.	4.44000	0.782
75	.	.	.	4.69997	0.775
76	0.53	.	.	.	0.757
77	.	.	.	4.83999	0.726
78	0.59	.	.	.	0.693
79	0.84	.	.	.	0.653
80	.	.	.	5.03999	0.645
81	.	.	.	5.10000	0.637
82	.	.	.	5.19998	0.634
83	1.02	.	.	.	0.619
84	1.27	.	.	.	0.593
85	.	.	.	5.24000	0.590
86	1.48	.	.	.	0.570
87	.	.	.	5.44000	0.567
88	1.64	.	.	.	0.549
89	.	.	.	5.49999	0.548
90	1.75	.	.	.	0.529
91	1.82	.	.	.	0.511
92	.	.	.	5.83999	0.502
93	.	.	.	5.89998	0.495
94	1.92	.	.	.	0.493
95	1.93	.	.	.	0.475
96	.	.	.	6.03999	0.467
97	1.95	.	.	.	0.457
98	.	.	.	6.24000	0.447
99	.	.	.	6.29998	0.446
100	2.15	.	.	.	0.441
101	2.28	.	.	.	0.427
102	2.42	.	.	.	0.412
103	.	.	.	6.63999	0.401
104	2.70	.	.	.	0.400
105	2.77	.	.	.	0.388
106	3.01	.	.	.	0.376

Table 8.2-3 (continued). Attenuation Data for September, 1977.

OBS	RAIN	ACTS	AV19	AC28	PFR
107	.	.	.	6.8400	0.365
108	3.02	.	.	.	0.364
109	3.09	.	.	7.0500	0.353
110	.	.	.	7.1000	0.348
111	3.17	.	.	.	0.343
112	3.26	.	.	.	0.333
113	.	.	.	7.4500	0.326
114	.	.	.	7.5000	0.324
115	3.38	.	.	7.5999	0.323
116	3.45	.	.	.	0.313
117	.	.	.	7.6500	0.311
118	.	.	2.94999	.	0.310
119	.	.	2.99998	.	0.308
120	3.68	.	.	7.8500	0.304
121	.	.	.	7.9000	0.301
122	.	.	3.14999	.	0.300
123	3.95	.	.	.	0.295
124	4.00	.	.	8.0500	0.286
125	.	.	.	8.3000	0.282
126	4.15	.	.	8.4500	0.278
127	4.22	.	3.55000	.	0.269
128	.	.	.	8.6500	0.265
129	4.24	.	.	8.7200	0.261
130	4.35	.	.	.	0.253
131	.	.	3.75000	.	0.250
132	.	.	3.79997	8.8500	0.249
133	.	.	.	9.1200	0.248
134	4.55	.	.	9.2500	0.245
135	.	.	3.94999	.	0.243
136	.	.	4.14999	.	0.240
137	4.70	.	.	9.4500	0.237
138	4.74	.	.	.	0.231
139	.	.	.	9.5200	0.229
140	.	.	.	9.6500	0.225
141	4.92	.	.	9.9200	0.224
142	.	.	.	10.0500	0.221
143	4.95	.	.	.	0.217
144	.	.	.	10.2500	0.215
145	.	.	4.36000	.	0.213
146	5.65	.	.	.	0.212
147	.	.	.	10.4500	0.211
148	.	.	.	10.8500	0.209
149	.	.	4.55999	11.0500	0.207
150	5.71	.	.	11.1200	0.206
151	.	.	.	11.2500	0.204
152	.	.	.	11.5200	0.202
153	6.45	.	.	.	0.201
154	.	.	4.75999	11.6500	0.198
155	.	.	.	11.8500	0.196
156	6.55	.	.	11.9200	0.195
157	6.74	.	.	.	0.189
158	.	.	4.95999	.	0.187
159	.	.	.	12.0500	0.186

Table 8.2-3 (continued). Attenuation Data for September, 1977.

OBS	RAIN	ACTS	AV19	AC28	PER
160	7.11	.	.	.	0.185
161	.	.	.	12.25	0.184
162	.	.	.	12.32	0.181
163	7.71	.	5.16000	12.65	0.180
164	.	.	5.55999	12.72	0.179
165	.	2.89999	.	.	0.173
166	8.02	2.97999	.	.	0.171
167	.	.	.	12.85	0.169
168	.	3.18000	.	.	0.168
169	8.69	3.28000	.	.	0.167
170	.	.	5.75999	13.05	0.166
171	.	.	.	13.12	0.165
172	9.42	.	.	.	0.162
173	.	.	.	13.52	0.161
174	9.66	3.30000	.	.	0.159
175	.	.	5.95999	.	0.157
176	.	3.58000	.	.	0.156
177	9.77	.	6.16000	.	0.155
178	.	.	.	13.65	0.153
179	10.02	.	6.36000	13.85	0.151
180	.	.	.	14.25	0.149
181	10.24	.	.	.	0.148
182	.	.	.	14.32	0.147
183	11.25	3.69999	.	14.45	0.146
184	.	3.87999	.	.	0.144
185	11.68	3.97999	6.55999	14.65	0.142
186	.	.	.	15.05	0.141
187	11.88	.	.	15.12	0.140
188	.	4.10000	6.75999	15.25	0.139
189	.	.	.	15.52	0.138
190	12.25	.	.	.	0.137
191	12.44	.	.	15.65	0.134
192	.	.	.	15.85	0.133
193	.	.	7.16000	.	0.132
194	13.56	.	.	16.05	0.131
195	.	.	.	16.32	0.130
196	13.81	.	.	16.45	0.129
197	.	.	.	16.65	0.128
198	14.01	.	.	17.26	0.127
199	.	4.30000	.	.	0.125
200	14.35	.	7.36000	17.92	0.124
201	.	.	7.55999	.	0.123
202	14.78	4.58000	.	.	0.122
203	15.00	.	7.75999	18.06	0.120
204	.	.	.	18.26	0.119
205	15.23	.	.	.	0.118
206	16.33	.	.	.	0.116
207	.	.	.	18.32	0.115
208	16.41	.	7.95999	.	0.114
209	.	4.89999	8.16000	18.46	0.113
210	16.51	4.97999	.	18.72	0.112
211	16.72	.	.	19.06	0.111
212	.	.	8.75999	.	0.110

Table 8.2-3 (continued). Attenuation Data for September, 1977.

OBS	RAIN	ACTS	AV19	AC28	PER
213	17.53	.	.	19.12	0.109
214	17.66	.	8.96	19.66	0.108
215	17.96	.	.	19.86	0.106
216	18.20	.	.	19.92	0.104
217	18.23	5.10000	9.16	20.06	0.103
218	19.00	5.37999	.	.	0.102
219	.	.	.	20.66	0.101
220	20.14	.	9.36	.	0.100
221	20.43	.	9.56	21.06	0.097
222	.	5.49999	.	21.26	0.096
223	20.45	.	.	21.46	0.095
224	21.28	5.68000	9.96	.	0.094
225	21.65	.	10.16	21.52	0.093
226	21.86	.	10.36	.	0.092
227	22.07	.	.	21.86	0.091
228	22.10	.	10.76	.	0.088
229	22.20	.	.	22.72	0.087
230	22.92	5.89999	11.36	.	0.085
231	23.26	.	.	22.86	0.084
232	24.54	5.97999	.	.	0.083
233	25.20	.	.	.	0.082
234	25.31	.	.	.	0.081
235	25.40	6.30000	11.56	.	0.080
236	25.42	6.47999	.	23.12	0.078
237	27.44	.	.	.	0.077
238	27.84	.	.	.	0.076
239	28.08	.	11.96	.	0.075
240	28.49	.	.	23.92	0.074
241	28.73	.	.	24.06	0.073
242	28.77	.	.	24.26	0.072
243	29.33	.	12.36	24.46	0.071
244	29.82	.	.	.	0.069
245	30.30	.	12.56	.	0.068
246	31.34	6.49999	12.60	.	0.067
247	32.03	.	12.96	24.72	0.066
248	32.91	7.10000	.	25.06	0.065
249	34.77	.	.	.	0.064
250	34.88	.	13.36	25.12	0.063
251	35.40	.	.	25.20	0.062
252	36.82	.	13.56	25.86	0.060
253	37.20	.	13.76	25.92	0.059
254	39.21	.	.	.	0.058
255	39.84	.	13.96	.	0.057
256	40.07	.	14.20	26.72	0.056
257	40.10	.	14.57	.	0.055
258	40.34	7.30000	14.77	27.12	0.054
259	40.43	.	14.97	27.52	0.053
260	42.59	.	15.57	.	0.052
261	42.72	7.69999	.	27.67	0.050
262	42.86	.	15.97	.	0.049
263	43.71	.	16.37	27.92	0.048
264	44.13	.	.	28.40	0.047
265	44.78	.	.	29.14	0.046

Table 8.2-3 (continued). Attenuation Data for September, 1977.

OBS	RAIN	ACTS	AV19	AC28	PER
266	46.41	.	16.77	29.54	0.045
267	46.45	.	.	29.94	0.044
268	48.80	.	17.00	30.07	0.043
269	49.15	.	17.17	.	0.041
270	49.55	.	17.77	31.94	0.040
271	51.02	.	18.17	32.67	0.039
272	51.79	.	18.37	32.74	0.038
273	52.04	.	.	.	0.037
274	53.35	7.900	.	33.54	0.036
275	54.25	7.985	18.57	.	0.035
276	54.36	.	.	34.00	0.034
277	54.90	8.500	19.17	35.54	0.032
278	55.74	8.700	.	36.34	0.031
279	56.66	9.300	19.37	38.34	0.030
280	58.53	.	19.82	39.64	0.029
281	58.78	9.500	.	.	0.028
282	59.48	.	20.57	41.14	0.027
283	59.54	9.910	20.77	41.54	0.026
284	60.20	.	.	.	0.025
285	60.86	.	21.42	42.84	0.024
286	61.27	.	21.57	43.14	0.022
287	61.69	10.110	22.17	44.34	0.021
288	61.82	.	23.77	47.54	0.020
289	62.67	10.710	.	.	0.019
290	65.91	.	.	.	0.018
291	69.14	.	.	.	0.017
292	69.65	.	.	.	0.016
293	70.29	.	23.97	47.94	0.015
294	72.33	10.910	24.22	48.44	0.013
295	74.19	.	24.58	49.16	0.012
296	85.92	11.710	.	.	0.011
297	88.12	.	.	.	0.010
298	93.05	.	25.38	50.76	0.009
299	97.34	.	.	.	0.008
300	100.00	.	.	.	0.007
301	102.04	.	.	.	0.006
302	103.58	12.110	27.18	54.36	0.004
303	106.40	12.910	30.58	61.16	0.003
304	112.04	.	30.98	61.96	0.002
305	112.73	.	33.78	67.56	0.001
306	121.73	13.510	36.59	73.18	0.000

Table 8.2-4. Combined Attenuation Data for July, August, and September, 1977.

OBS	RAIN	ACTS	AV19	AC28	PER
1	.	.	0.000000	.	34.650
2	.	.	0.059996	.	33.638
3	.	.	0.069995	.	33.469
4	.	.	0.084996	.	33.190
5	.	.	.	0.000000	32.499
6	.	.	.	0.139990	31.195
7	.	.	0.149987	.	31.072
8	.	.	0.169993	.	31.003
9	.	.	.	0.169993	30.164
10	.	.	0.259993	.	29.215
11	.	.	0.284993	.	29.137
12	.	0.000000	.	.	28.714
13	.	0.029998	.	.	28.649
14	.	.	0.349987	.	28.516
15	.	.	.	0.239999	28.022
16	.	.	.	0.339987	27.636
17	.	0.049993	.	.	27.609
18	.	0.059993	.	.	25.592
19	.	0.092497	.	.	25.528
20	.	0.129996	.	.	25.426
21	.	.	.	0.369990	25.090
22	.	0.249990	.	.	24.776
23	.	.	0.349999	.	24.490
24	.	.	0.369998	.	24.481
25	.	.	0.469996	.	24.464
26	.	.	0.484998	.	24.459
27	.	0.259990	.	.	23.254
28	.	0.274998	.	.	23.253
29	.	0.274999	.	.	23.225
30	.	.	0.549996	.	22.010
31	.	.	.	0.439996	21.663
32	.	0.299996	.	.	21.111
33	.	0.329993	.	.	21.029
34	.	0.429999	.	.	20.964
35	.	0.449987	.	.	20.182
36	.	.	0.549999	.	19.570
37	.	.	0.569995	.	19.565
38	.	.	.	0.569987	19.269
39	.	.	.	0.639993	19.180
40	.	.	.	0.699973	19.179
41	.	.	0.659987	.	18.639
42	.	.	0.684995	.	18.636
43	.	0.459987	.	.	18.613
44	.	0.499993	.	.	17.753
45	.	0.529998	.	.	17.746
46	.	0.574993	.	.	17.745
47	.	0.574995	.	.	17.713
48	.	.	0.749993	.	17.627
49	.	0.649999	.	.	17.324
50	.	.	.	0.739996	17.226
51	.	.	.	0.839990	17.106
52	.	0.659999	.	.	16.782
53	.	.	0.749996	.	16.342

Table 8.2-4 (continued). Combined Attenuation Data for July, August, and September, 1977.

OBS	RAIN	ACTS	AV19	AC28	PER
54	.	.	0.77000	.	16.338
55	.	.	.	0.93999	16.068
56	.	.	.	0.97000	15.677
57	.	.	.	1.10000	15.665
58	.	0.69999	.	.	15.453
59	.	0.72999	.	.	15.388
60	.	.	.	1.13999	15.369
61	.	0.82999	.	.	15.322
62	.	0.87500	.	.	15.311
63	.	0.89999	.	.	15.213
64	.	1.04999	.	.	14.846
65	.	.	0.86000	.	14.843
66	.	.	0.87000	.	14.832
67	.	.	0.94999	.	14.590
68	.	.	.	1.16999	14.121
69	0.00	.	.	.	13.796
70	.	.	0.94999	.	13.413
71	.	.	0.97000	.	13.410
72	.	.	1.06000	.	12.705
73	.	.	1.06999	.	12.702
74	.	.	.	1.24000	12.271
75	.	1.05999	.	.	12.213
76	.	1.17499	.	.	12.204
77	.	1.24999	.	.	11.908
78	.	.	.	1.36999	11.629
79	.	.	.	1.44000	11.550
80	.	.	.	1.49999	11.547
81	.	1.25999	.	.	11.474
82	.	1.30000	.	.	11.016
83	.	1.37500	.	.	11.014
84	.	.	1.14999	.	10.858
85	.	.	.	1.54000	10.596
86	.	.	.	1.63999	10.547
87	.	1.44999	.	.	10.180
88	0.01	.	.	.	9.355
89	.	1.45999	.	.	9.045
90	.	1.47500	.	.	9.042
91	.	1.49999	.	.	8.636
92	.	1.65000	.	.	8.381
93	.	.	1.14999	.	8.234
94	.	.	.	1.74000	8.091
95	.	.	.	1.77000	8.051
96	.	.	1.25999	.	7.389
97	.	.	1.27000	.	7.385
98	.	1.66000	.	.	6.913
99	.	1.69999	.	.	6.757
100	.	.	1.34999	.	6.752
101	.	.	.	1.83999	6.710
102	.	.	.	1.89998	6.709
103	.	.	.	1.93999	6.455
104	.	.	.	1.97000	6.345
105	0.02	.	.	.	5.985
106	.	1.85000	.	.	5.948

Table 8.2-4 (continued). Combined Attenuation Data for July, August, and September, 1977.

OBS	RAIN	ACTS	AV19	AC28	PER
107	.	.	1.35000	.	5.634
108	.	.	1.37000	.	5.630
109	.	.	.	2.13999	5.447
110	.	1.86000	.	.	5.387
111	.	1.87500	.	.	5.383
112	.	1.89999	.	.	5.382
113	.	1.97500	.	.	5.382
114	.	.	1.45999	.	5.326
115	.	.	1.47000	.	5.325
116	.	.	.	2.16999	5.316
117	.	.	.	2.24000	5.212
118	.	.	.	2.29998	5.211
119	.	.	.	2.36999	5.210
120	.	2.10000	.	.	5.207
121	.	2.18000	.	.	5.202
122	.	.	.	2.44000	5.115
123	.	.	1.55000	.	4.988
124	.	.	.	2.54000	4.697
125	0.03	.	.	.	4.386
126	.	.	.	2.63999	4.362
127	.	.	.	2.69997	4.361
128	.	.	.	2.70000	4.360
129	.	2.24999	.	.	4.320
130	.	.	1.55000	.	4.270
131	.	.	1.56999	.	4.267
132	0.04	.	.	.	4.099
133	.	2.75999	.	.	4.075
134	.	2.28000	.	.	4.074
135	.	.	.	2.74000	3.918
136	.	.	.	2.77000	3.905
137	.	2.44999	.	.	3.899
138	.	.	1.65999	.	3.746
139	.	.	1.74999	.	3.695
140	.	.	.	2.93999	3.661
141	0.05	.	.	.	3.631
142	.	.	.	2.97000	3.608
143	0.06	.	.	.	3.450
144	.	.	.	3.03999	3.389
145	.	.	.	3.10000	3.387
146	.	.	.	3.13999	3.333
147	.	2.45999	.	.	3.313
148	.	2.47999	.	.	3.311
149	.	2.58000	.	.	3.310
150	0.07	.	.	.	3.276
151	0.08	.	.	.	3.130
152	.	.	1.75000	.	2.877
153	.	.	1.77000	.	2.876
154	.	2.65000	.	.	2.794
155	.	.	1.86000	.	2.774
156	.	.	1.87000	.	2.772
157	0.09	.	.	.	2.752
158	.	.	.	3.16999	2.730
159	0.10	.	.	.	2.635

Table 8.2-4 (continued). Combined Attenuation Data for July, August, and September, 1977.

OBS	RAIN	ACTS	AV19	AC28	PER
160	.	2.66000	.	.	2.629
161	.	2.68000	.	.	2.629
162	.	2.69999	.	.	2.628
163	.	2.77999	.	.	2.628
164	0.11	.	.	.	2.527
165	.	.	.	3.24000	2.497
166	.	.	.	3.36999	2.493
167	.	.	.	3.44000	2.436
168	.	.	.	3.49999	2.436
169	.	.	1.94999	.	2.287
170	.	2.85000	.	.	2.269
171	.	.	1.94999	.	2.253
172	.	.	1.97000	.	2.252
173	0.12	.	.	.	2.243
174	.	2.86000	.	.	2.224
175	.	2.87999	.	.	2.220
176	0.13	.	.	.	2.155
177	.	.	2.14999	.	2.135
178	.	.	.	3.54000	2.035
179	.	.	2.14999	.	2.010
180	0.16	.	.	.	2.009
181	.	.	2.25999	.	2.004
182	.	.	.	3.63999	1.960
183	0.17	.	.	.	1.943
184	.	.	.	3.74000	1.937
185	.	.	.	3.77000	1.920
186	.	.	.	3.89998	1.918
187	.	2.89999	.	.	1.914
188	.	2.97999	.	.	1.914
189	0.19	.	.	.	1.883
190	0.20	.	.	.	1.825
191	0.21	.	.	.	1.716
192	.	3.04999	.	.	1.686
193	0.22	.	.	.	1.663
194	0.23	.	.	.	1.612
195	.	3.05999	.	.	1.611
196	.	3.18000	.	.	1.610
197	.	3.28000	.	.	1.609
198	.	3.30000	.	.	1.607
199	.	.	.	3.93999	1.589
200	0.24	.	.	.	1.563
201	0.26	.	.	.	1.520
202	.	3.44999	.	.	1.482
203	0.29	.	.	.	1.480
204	0.32	.	.	.	1.444
205	0.38	.	.	.	1.414
206	.	.	2.34999	.	1.411
207	0.41	.	.	.	1.386
208	.	.	2.35000	.	1.384
209	.	.	2.37000	.	1.384
210	.	.	2.45999	.	1.366
211	.	3.45999	.	.	1.363
212	.	3.58000	.	.	1.362

Table 8.2-4 (continued). Combined Attenuation Data for July, August, and September, 1977.

OBS	RAIN	ACTS	AV19	AC28	PER
213	0.43	.	.	.	1.305
214	0.45	.	.	.	1.280
215	0.51	.	.	.	1.257
216	.	.	.	3.97000	1.239
217	0.53	.	.	.	1.236
218	.	3.65000	.	.	1.230
219	.	.	.	4.03999	1.206
220	.	.	.	4.16999	1.203
221	0.56	.	.	.	1.195
222	0.58	.	.	.	1.175
223	.	.	.	4.24000	1.159
224	.	.	.	4.29998	1.159
225	0.59	.	.	.	1.136
226	0.62	.	.	.	1.118
227	.	.	.	4.33999	1.107
228	.	3.66000	.	.	1.091
229	.	.	.	4.44000	1.090
230	.	3.69999	.	.	1.088
231	.	.	.	4.54000	1.072
232	.	.	.	4.56999	1.064
233	0.63	.	.	.	1.063
234	.	.	2.55000	4.69997	1.062
235	0.74	.	.	.	1.047
236	.	.	2.55000	.	1.043
237	.	.	2.59999	.	1.042
238	0.76	.	.	.	1.016
239	0.80	.	.	4.74000	0.988
240	0.82	.	.	.	0.973
241	0.83	.	.	.	0.960
242	.	3.85000	.	.	0.952
243	.	3.86000	.	.	0.952
244	.	3.87999	.	.	0.951
245	.	3.97999	.	.	0.950
246	.	3.98000	.	.	0.950
247	0.84	.	.	.	0.933
248	0.86	.	.	.	0.906
249	0.90	.	.	.	0.893
250	0.91	.	.	.	0.881
251	0.95	.	.	.	0.868
252	.	.	.	4.77000	0.867
253	.	.	.	4.83999	0.851
254	0.97	.	.	.	0.845
255	.	.	.	4.93999	0.838
256	.	.	.	4.97000	0.835
257	1.02	.	.	.	0.833
258	1.09	.	.	.	0.823
259	1.10	.	.	.	0.812
260	.	.	.	5.03999	0.808
261	.	.	.	5.10000	0.805
262	1.11	.	.	5.16999	0.802
263	.	.	.	5.19998	0.801
264	1.12	.	.	.	0.792
265	.	.	.	5.24000	0.786

Table 8.2-4 (continued). Combined Attenuation Data for July, August, and September, 1977.

OBS	RAIN	ACTS	AV19	AC28	PER
266	.	4.04999	.	.	0.783
267	1.13	.	.	.	0.782
268	.	.	.	5.33999	0.774
269	.	.	.	5.44000	0.766
270	1.17	.	.	.	0.762
271	.	.	.	5.49999	0.759
272	1.20	.	.	.	0.753
273	1.21	.	.	.	0.743
274	.	.	.	5.54000	0.737
275	1.23	.	.	.	0.734
276	1.25	.	.	.	0.725
277	1.26	4.05999	.	.	0.716
278	.	4.10000	.	.	0.715
279	.	4.30000	.	.	0.711
280	1.27	.	.	.	0.707
281	1.35	.	.	.	0.698
282	1.37	.	.	.	0.689
283	1.38	.	.	.	0.681
284	1.43	.	.	.	0.673
285	1.46	.	.	.	0.665
286	1.48	.	.	.	0.656
287	1.49	.	.	.	0.650
288	.	.	2.74999	.	0.646
289	1.51	.	.	.	0.642
290	1.54	.	.	.	0.634
291	.	.	2.75000	.	0.629
292	1.55	.	.	.	0.627
293	.	.	.	5.56999	0.624
294	.	.	.	5.74000	0.623
295	.	.	2.86000	.	0.621
296	1.58	.	.	.	0.620
297	.	.	.	5.77000	0.618
298	1.60	.	.	.	0.613
299	.	.	2.94999	.	0.607
300	1.62	.	.	.	0.606
301	.	.	.	5.83999	0.602
302	.	.	.	5.89998	0.600
303	.	.	.	5.97000	0.596
304	1.63	.	.	.	0.592
305	.	.	.	6.03999	0.587
306	1.64	.	.	6.11999	0.585
307	1.65	.	.	.	0.578
308	.	.	.	6.13999	0.577
309	1.74	.	.	.	0.571
310	.	.	.	6.24000	0.570
311	.	.	.	6.29998	0.570
312	1.75	.	.	.	0.565
313	.	4.44999	.	.	0.561
314	1.77	.	.	6.33999	0.552
315	1.78	.	.	.	0.545
316	.	4.45999	.	.	0.531
317	.	4.58000	.	.	0.530
318	1.80	.	.	.	0.526

Table 8.2-4 (continued). Combined Attenuation Data for July, August, and September, 1977.

OBS	RAIN	ACTS	AV19	AC28	PER
319	1.81	.	.	.	0.520
320	1.82	.	.	.	0.514
321	1.83	.	.	.	0.501
322	1.87	.	.	.	0.495
323	1.90	.	.	.	0.483
324	1.92	.	.	.	0.477
325	1.93	.	.	.	0.471
326	1.94	.	.	.	0.459
327	1.95	.	.	.	0.453
328	1.98	.	.	.	0.447
329	1.99	.	.	.	0.441
330	2.00	.	.	.	0.435
331	2.02	.	.	.	0.430
332	2.09	.	.	.	0.424
333	.	4.65	.	.	0.415
334	.	4.66	.	.	0.411
335	2.15	.	.	.	0.407
336	2.16	.	.	.	0.402
337	2.19	.	.	.	0.397
338	.	.	.	6.36999	0.394
339	.	4.85	.	.	0.392
340	2.21	.	.	.	0.391
341	.	.	2.94999	6.54000	0.390
342	.	.	2.99998	.	0.389
343	2.23	.	.	.	0.387
344	.	.	3.06000	6.56999	0.381
345	.	.	3.14999	.	0.378
346	2.28	.	.	.	0.376
347	2.42	.	.	.	0.371
348	.	.	3.35000	.	0.368
349	2.51	.	.	.	0.367
350	.	.	.	6.63999	0.366
351	2.53	.	.	6.74000	0.362
352	.	.	.	6.77000	0.360
353	2.54	.	.	.	0.358
354	2.57	.	3.45999	.	0.354
355	2.64	.	.	.	0.350
356	.	.	.	6.83999	0.348
357	2.70	.	.	.	0.341
358	2.77	.	.	.	0.337
359	2.78	.	.	.	0.333
360	2.79	.	.	.	0.329
361	2.81	.	.	.	0.325
362	2.84	.	.	.	0.321
363	2.93	.	.	.	0.317
364	2.94	.	.	.	0.313
365	2.96	.	.	.	0.309
366	3.01	.	.	.	0.305
367	3.02	.	.	.	0.301
368	3.06	.	.	.	0.297
369	3.08	.	.	.	0.294
370	.	.	3.55000	.	0.288
371	3.09	.	.	.	0.286

Table 8.2-4 (continued). Combined Attenuation Data for July, August, and September, 1977.

OBS	RAIN	ACTS	AV19	AC28	PER
372	.	.	.	6.97000	0.285
373	3.17	.	.	.	0.283
374	.	.	.	7.05000	0.281
375	.	.	.	7.10000	0.280
376	3.21	.	.	.	0.279
377	.	.	3.55000	.	0.278
378	3.26	.	.	.	0.276
379	3.30	.	3.74999	.	0.272
380	3.33	.	.	.	0.269
381	.	.	.	7.13999	0.268
382	3.38	.	3.75000	7.33999	0.265
383	3.38	.	3.79997	7.33999	0.265
384	.	.	.	7.36999	0.261
385	3.39	.	.	.	0.259
386	.	.	3.86000	.	0.257
387	.	.	3.94999	.	0.254
388	.	.	.	7.44999	0.253
389	.	.	.	7.49999	0.253
390	3.45	.	3.94999	.	0.252
391	.	.	4.14999	7.54000	0.251
392	.	.	.	7.56999	0.250
393	.	.	.	7.59995	0.249
394	3.48	.	.	.	0.248
395	.	.	.	7.64999	0.246
396	3.49	.	.	.	0.245
397	3.52	.	.	.	0.242
398	.	.	4.16000	.	0.241
399	.	.	.	7.72000	0.240
400	3.57	.	.	7.85000	0.238
401	.	.	.	7.89998	0.237
402	3.68	.	.	.	0.235
403	.	.	.	7.93999	0.233
404	3.70	.	.	.	0.232
405	3.80	.	.	.	0.229
406	.	.	.	8.05000	0.228
407	.	.	.	8.13999	0.227
408	3.95	.	.	8.16999	0.226
409	.	.	.	8.29998	0.225
410	3.96	.	.	8.35000	0.223
411	.	.	.	8.36999	0.221
412	4.00	.	.	.	0.220
413	.	.	.	8.44999	0.219
414	4.02	.	.	.	0.217
415	.	.	.	8.64999	0.215
416	4.13	.	.	8.71999	0.214
417	.	.	4.25999	.	0.213
418	4.15	.	4.35999	8.74999	0.211
419	4.19	.	.	.	0.208
420	.	.	.	8.85000	0.207
421	4.22	.	.	.	0.205
422	4.24	.	.	.	0.203
423	.	.	4.36000	8.91998	0.202
424	4.31	.	.	8.94999	0.200

Table 8.2-4 (continued). Combined Attenuation Data for July, August, and September, 1977.

OBS	RAIN	ACTS	AV19	AC28	PER
425	4.31	.	.	8.98	0.200
426	.	.	.	9.12	0.199
427	.	.	.	9.15	0.198
428	4.35	.	.	.	0.197
429	.	.	.	9.18	0.196
430	4.42	.	4.45999	9.25	0.195
431	4.42	.	4.55999	9.25	0.195
432	.	.	4.55999	.	0.193
433	4.44	.	.	.	0.192
434	4.46	.	.	9.35	0.189
435	4.55	.	.	9.45	0.187
436	.	.	4.75999	.	0.186
437	.	.	.	9.52	0.184
438	.	.	4.75999	9.65	0.183
439	4.62	.	.	9.92	0.182
440	4.62	.	.	9.92	0.182
441	.	.	.	9.95	0.181
442	4.64	.	.	.	0.179
443	.	.	.	9.98	0.178
444	.	.	.	10.05	0.177
445	.	.	.	10.14	0.175
446	4.70	.	4.86999	10.15	0.174
447	4.74	.	.	10.25	0.172
448	4.74	.	.	10.38	0.172
449	4.75	.	4.95999	10.45	0.170
450	.	.	4.96000	10.55	0.169
451	4.92	.	.	10.75	0.168
452	.	.	5.06999	10.78	0.166
453	4.95	.	.	10.85	0.165
454	4.95	.	.	10.98	0.165
455	.	.	5.16000	11.05	0.164
456	.	.	5.16000	11.12	0.164
457	5.00	.	.	11.12	0.163
458	.	.	5.35999	11.18	0.162
459	.	.	.	11.25	0.161
460	5.16	.	.	11.52	0.160
461	5.16	.	.	11.55	0.160
462	5.17	.	.	.	0.159
463	.	.	.	11.58	0.158
464	.	.	5.47000	11.65	0.157
465	.	.	5.55999	11.65	0.157
466	5.28	.	5.55999	11.74	0.156
467	5.28	.	5.75999	11.75	0.156
468	.	.	.	11.85	0.155
469	.	.	.	11.92	0.155
470	5.65	.	.	11.98	0.154
471	5.71	.	.	.	0.152
472	5.74	.	5.75999	12.05	0.151
473	5.74	.	5.75999	12.25	0.151
474	.	.	.	12.32	0.150
475	.	.	5.86999	12.38	0.149
476	5.88	.	.	12.65	0.148
477	5.88	.	.	12.72	0.148

Table 8.2-4 (continued). Combined Attenuation Data for July, August, and September, 1977.

OBS	RAIN	ACTS	AV19	AC28	PER
478	5.88	.	.	12.78	0.148
479	.	4.86000	.	.	0.147
480	6.17	4.87999	5.95999	.	0.146
481	6.20	.	5.96000	.	0.145
482	6.20	.	6.16000	.	0.145
483	.	.	6.16000	12.85	0.144
484	6.33	4.89999	.	12.94	0.143
485	6.33	4.97999	.	12.94	0.143
486	.	.	6.26999	13.05	0.142
487	.	.	6.26999	13.12	0.142
488	.	.	6.26999	13.15	0.142
489	6.37	.	6.36000	.	0.141
490	.	.	.	13.18	0.140
491	.	.	.	13.35	0.140
492	6.45	.	6.47000	13.38	0.139
493	.	.	6.55999	13.52	0.138
494	.	.	6.55999	13.55	0.138
495	6.55	.	.	13.58	0.137
496	6.57	.	.	.	0.136
497	.	.	6.55999	13.65	0.135
498	6.74	5.04999	6.75999	13.74	0.134
499	6.74	5.04999	6.75999	13.78	0.134
500	.	.	.	13.85	0.133
501	6.76	.	6.86999	14.14	0.132
502	6.76	.	6.96000	14.14	0.132
503	7.11	5.10000	.	14.15	0.131
504	7.11	5.24999	.	14.25	0.131
505	.	5.25999	.	14.32	0.130
506	7.31	5.37999	7.06999	14.35	0.129
507	7.31	5.37999	7.06999	14.38	0.129
508	7.42	5.49999	.	14.45	0.128
509	7.42	5.49999	.	14.58	0.128
510	.	.	7.16000	14.65	0.127
511	7.69	.	7.35999	15.05	0.126
512	7.69	.	7.35999	15.12	0.126
513	7.69	.	7.35999	15.15	0.126
514	7.71	.	.	15.18	0.125
515	7.71	.	.	15.25	0.125
516	.	.	.	15.34	0.124
517	7.98	.	7.36000	15.38	0.123
518	7.98	.	7.55999	15.52	0.123
519	8.01	.	.	15.55	0.122
520	.	.	7.67000	15.65	0.121
521	.	.	7.67000	15.74	0.121
522	.	.	7.75999	15.85	0.120
523	.	.	7.75999	16.05	0.120
524	8.02	5.66000	.	16.18	0.119
525	.	5.68000	.	16.24	0.118
526	.	5.77999	.	16.32	0.118
527	8.05	.	7.86999	16.45	0.117
528	8.05	.	7.86999	16.65	0.117
529	8.05	.	7.86999	16.78	0.117
530	8.20	5.85000	.	.	0.116

Table 8.2-4 (continued). Combined Attenuation Data for July, August, and September, 1977.

OBS	RAIN	ACTS	AV19	AC28	PER
531	.	.	7.96	16.94	0.115
532	.	.	7.96	17.15	0.115
533	8.40	.	8.12	.	0.114
534	8.40	.	8.16	.	0.114
535	8.51	5.89999	.	17.18	0.113
536	8.51	5.89999	.	17.26	0.113
537	.	5.97999	8.27	17.58	0.112
538	.	6.05999	8.27	17.75	0.112
539	8.69	.	.	17.92	0.111
540	8.69	.	.	17.95	0.111
541	9.42	6.25999	.	.	0.110
542	9.66	6.30000	8.47	17.98	0.109
543	.	.	8.76	18.06	0.108
544	.	.	8.76	18.26	0.108
545	9.77	.	8.76	18.32	0.107
546	9.88	6.44999	8.96	18.32	0.106
547	9.88	6.47999	8.96	18.32	0.106
548	10.02	.	9.07	18.46	0.105
549	10.15	.	9.16	.	0.104
550	10.24	.	9.16	18.54	0.103
551	10.24	.	9.16	18.72	0.103
552	10.24	.	9.16	18.79	0.103
553	10.29	6.49999	.	19.06	0.102
554	10.29	6.58000	.	19.12	0.102
555	10.29	6.86000	.	19.12	0.102
556	.	7.05999	.	19.19	0.101
557	10.91	7.10000	9.27	19.44	0.100
558	11.25	7.10000	9.27	19.44	0.100
559	.	7.24999	9.36	19.52	0.099
560	.	7.24999	9.36	19.66	0.099
561	.	7.24999	9.36	19.74	0.099
562	.	.	9.56	19.86	0.098
563	11.46	.	9.67	19.92	0.097
564	11.46	.	9.67	19.99	0.097
565	11.46	.	9.67	20.06	0.097
566	11.68	.	.	20.16	0.096
567	11.77	7.30000	9.72	20.39	0.095
568	11.77	7.30000	9.76	20.39	0.095
569	11.88	7.45999	.	20.66	0.094
570	11.88	7.45999	.	20.94	0.094
571	11.88	7.45999	.	20.96	0.094
572	12.25	7.69999	9.87	.	0.093
573	12.25	7.86000	9.87	.	0.093
574	12.44	.	9.96	21.06	0.092
575	12.85	.	9.96	21.12	0.092
576	12.85	.	9.96	21.19	0.092
577	13.33	.	10.16	21.26	0.091
578	13.33	.	10.36	21.46	0.091
579	.	.	10.47	21.52	0.090
580	.	.	10.56	21.59	0.090
581	13.35	.	10.67	21.86	0.089
582	13.47	.	10.67	22.14	0.089
583	13.56	7.89999	10.76	22.36	0.088

Table 8.2-4 (continued). Combined Attenuation Data for July, August, and September, 1977.

OBS	RAIN	ACTS	AV19	AC28	PER
584	13.56	7.985	10.76	22.59	0.088
585	13.61	.	10.96	22.64	0.087
586	13.81	8.050	11.07	.	0.086
587	13.81	8.250	11.16	.	0.086
588	14.01	8.260	11.32	22.72	0.085
589	14.27	8.260	11.32	22.72	0.085
590	14.35	8.470	11.36	22.86	0.084
591	14.78	8.500	11.36	22.94	0.083
592	14.78	8.500	11.36	22.99	0.083
593	14.81	.	.	23.12	0.082
594	15.00	.	.	23.12	0.082
595	15.23	8.660	.	.	0.081
596	15.23	8.700	.	.	0.081
597	15.50	9.070	11.47	23.12	0.080
598	15.85	9.070	11.47	23.16	0.080
599	16.33	9.270	.	23.39	0.079
600	16.41	9.300	.	23.56	0.079
601	16.51	.	.	23.74	0.078
602	16.72	.	11.56	23.92	0.077
603	17.53	.	11.87	23.92	0.077
604	17.66	9.460	.	23.96	0.076
605	17.96	9.460	.	24.06	0.076
606	18.20	9.500	11.96	24.14	0.075
607	18.23	9.500	12.07	24.26	0.075
608	18.23	9.500	12.07	24.32	0.075
609	19.00	9.660	12.16	24.39	0.074
610	19.30	9.660	12.36	24.46	0.074
611	19.39	9.670	.	.	0.073
612	19.76	9.670	.	.	0.073
613	20.14	.	12.36	24.72	0.072
614	20.14	.	12.36	24.76	0.072
615	20.43	.	12.52	24.99	0.071
616	20.45	.	12.52	24.99	0.071
617	20.72	.	12.56	25.04	0.070
618	21.28	.	12.60	25.06	0.070
619	21.46	.	12.67	25.12	0.069
620	21.62	.	12.87	25.19	0.069
621	21.65	.	12.96	25.20	0.068
622	21.86	.	13.16	25.34	0.068
623	22.07	.	13.16	25.34	0.068
624	22.10	.	.	25.74	0.067
625	22.10	.	.	25.79	0.067
626	22.19	.	13.27	25.86	0.066
627	22.20	.	13.27	25.92	0.066
628	22.30	9.860	13.36	26.32	0.065
629	22.47	9.870	13.56	26.54	0.064
630	22.92	9.910	13.67	26.72	0.063
631	23.26	9.910	13.67	27.12	0.063
632	23.77	9.910	13.67	27.12	0.063
633	24.31	10.110	13.76	27.12	0.062
634	24.54	10.110	13.76	27.19	0.062
635	24.63	10.110	13.76	27.19	0.062
636	25.20	10.260	13.96	27.34	0.061

Table 8.2-4 (continued). Combined Attenuation Data for July, August, and September, 1977.

OBS	RAIN	ACTS	AV19	AC28	PFR
637	25.31	10.26	13.96	27.34	0.061
638	25.40	.	14.07	27.52	0.060
639	25.42	.	14.12	27.52	0.060
640	25.85	.	14.12	27.52	0.060
641	26.64	.	14.20	27.52	0.059
642	27.06	.	14.20	27.67	0.059
643	27.44	.	14.20	27.67	0.059
644	27.84	10.46	14.27	27.92	0.058
645	28.08	10.46	14.57	27.92	0.058
646	28.49	.	14.77	28.14	0.057
647	28.73	.	14.77	28.24	0.057
648	28.77	.	14.77	28.24	0.057
649	29.22	10.67	14.88	28.40	0.056
650	29.33	10.67	14.88	28.40	0.056
651	29.82	10.71	14.97	28.54	0.055
652	30.08	10.71	14.97	29.14	0.055
653	30.30	10.71	14.97	29.14	0.055
654	31.02	.	15.08	29.54	0.054
655	31.12	.	15.08	29.54	0.054
656	31.34	.	15.08	29.54	0.054
657	31.66	.	15.17	29.76	0.053
658	32.03	.	15.57	29.76	0.053
659	32.80	.	15.57	29.94	0.052
660	32.91	.	15.68	30.07	0.052
661	33.13	.	15.72	30.07	0.052
662	34.38	.	15.88	30.16	0.051
663	34.77	.	15.88	30.16	0.051
664	34.88	.	15.88	30.16	0.051
665	35.15	10.86	15.97	30.34	0.050
666	35.40	10.86	16.17	30.34	0.050
667	36.00	.	16.28	30.60	0.049
668	36.38	.	16.37	31.14	0.049
669	36.82	.	16.37	31.36	0.049
670	37.20	10.91	16.57	31.44	0.048
671	37.55	10.91	16.68	31.76	0.048
672	37.97	10.91	16.68	31.76	0.048
673	38.85	11.47	16.77	31.94	0.047
674	38.94	11.47	16.77	32.34	0.047
675	39.21	.	16.94	32.56	0.046
676	39.75	.	16.97	32.67	0.046
677	39.84	.	16.97	32.67	0.046
678	39.93	.	17.00	32.74	0.045
679	39.99	.	17.00	33.14	0.045
680	40.07	.	17.00	33.36	0.045
681	40.10	11.66	17.17	33.54	0.044
682	40.34	11.66	17.37	33.54	0.044
683	40.43	11.71	17.48	33.88	0.043
684	40.73	11.71	17.77	33.94	0.043
685	41.34	11.71	17.88	33.94	0.043
686	41.47	.	17.97	34.00	0.042
687	42.39	.	17.97	34.34	0.042
688	42.59	.	17.97	34.34	0.042
689	42.72	.	18.17	34.74	0.041

Table 8.2-4 (continued). Combined Attenuation Data for July, August, and September, 1977.

OBS	RAIN	ACTS	AV19	AC28	PFR
690	42.86	.	18.37	34.9600	0.041
691	43.50	12.06	18.54	35.5400	0.040
692	43.71	12.07	18.54	35.7600	0.040
693	43.96	12.07	18.54	35.9400	0.040
694	44.13	.	18.57	36.3400	0.039
695	44.78	.	18.68	36.3400	0.039
696	45.15	.	18.88	36.3400	0.038
697	45.22	.	19.17	37.0800	0.038
698	45.48	.	19.17	37.3600	0.038
699	46.13	12.11	19.37	37.7600	0.037
700	46.29	12.11	19.74	38.3400	0.037
701	46.33	12.11	19.74	39.4800	0.037
702	46.41	12.46	19.82	39.6400	0.036
703	46.41	12.86	20.28	40.5600	0.036
704	46.45	12.87	20.57	41.1400	0.035
705	47.04	12.91	20.77	41.5400	0.035
706	47.70	12.91	20.77	41.5400	0.035
707	48.63	.	21.08	42.1600	0.034
708	48.71	.	21.08	42.1600	0.034
709	48.80	.	21.08	42.1600	0.034
710	49.15	.	21.42	42.8400	0.033
711	49.55	.	21.57	43.1400	0.033
712	49.59	13.06	21.88	43.7600	0.032
713	50.18	13.06	22.17	44.3400	0.032
714	50.41	13.06	22.17	44.3400	0.032
715	50.93	13.26	.	.	0.031
716	50.97	13.27	.	.	0.031
717	51.02	13.27	.	.	0.031
718	51.26	13.51	22.68	45.3600	0.030
719	51.31	13.51	22.68	45.3600	0.030
720	51.79	13.67	22.94	45.8800	0.029
721	52.04	13.86	23.48	46.9600	0.029
722	52.84	13.86	23.48	46.9600	0.029
723	53.04	14.07	23.77	47.5400	0.028
724	53.35	14.07	23.77	47.5400	0.028
725	53.88	14.07	23.77	47.5400	0.028
726	54.25	14.27	.	.	0.027
727	54.36	14.27	.	.	0.027
728	54.90	14.46	23.97	47.9400	0.026
729	55.74	14.79	24.14	48.2799	0.026
730	56.31	14.79	24.14	48.2799	0.026
731	56.66	14.87	24.22	48.4400	0.025
732	57.25	15.07	24.28	48.5600	0.025
733	57.91	.	24.58	49.1600	0.024
734	58.40	.	25.29	49.1600	0.024
735	58.53	15.26	25.38	.	0.023
736	58.59	15.39	25.38	.	0.023
737	58.78	15.79	25.58	.	0.022
738	59.48	15.87	25.78	.	0.022
739	59.54	15.87	25.78	.	0.022
740	59.93	16.19	.	.	0.021
741	60.00	16.19	.	.	0.021
742	60.20	16.47	27.18	.	0.020

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Table 8.2-4 (continued). Combined Attenuation Data for July, August, and September, 1977.

OBS	RAIN	ACTS	AV19	AC28	PER
743	60.26	17.070	27.34	.	0.020
744	60.80	17.070	27.34	.	0.020
745	60.86	17.270	29.58	.	0.019
746	61.14	17.270	30.58	.	0.019
747	61.27	17.670	30.78	.	0.018
748	61.69	18.095	30.98	.	0.018
749	61.82	18.095	31.58	.	0.018
750	62.67	18.680	32.18	.	0.017
751	63.47	19.280	32.38	.	0.017
752	64.97	19.280	32.94	.	0.017
753	65.91	.	33.78	.	0.016
754	68.03	.	34.59	.	0.016
755	69.14	19.480	36.19	.	0.015
756	69.67	20.080	36.59	.	0.015
757	69.85	20.080	37.36	.	0.015
758	70.11	20.495	38.96	50.0000	0.014
759	70.29	20.495	38.96	50.0000	0.014
760	70.75	20.495	38.96	50.0000	0.014
761	70.93	20.880	40.16	50.5800	0.013
762	71.11	20.880	40.39	50.5800	0.013
763	72.33	22.080	40.99	50.7600	0.012
764	72.62	23.480	40.99	51.1600	0.012
765	74.19	24.280	40.99	51.1600	0.012
766	75.10	25.680	41.76	51.5600	0.011
767	75.41	27.880	41.76	54.3600	0.011
768	76.25	29.290	41.76	54.3600	0.011
769	76.68	.	.	.	0.010
770	77.00	.	.	.	0.010
771	80.26	.	.	54.3600	0.009
772	80.38	.	.	54.6800	0.009
773	80.97	.	.	59.1600	0.009
774	81.45	.	.	61.1600	0.008
775	81.94	.	.	61.5600	0.008
776	82.68	.	.	61.9600	0.008
777	83.94	.	.	63.1600	0.007
778	83.94	.	.	64.3600	0.007
779	85.92	.	.	64.7600	0.006
780	86.46	.	.	65.8800	0.006
781	86.59	.	.	67.5600	0.006
782	88.12	.	.	69.1800	0.005
783	93.05	.	.	72.3800	0.005
784	94.01	.	.	73.1800	0.005
785	94.66	.	.	74.7199	0.004
786	97.34	.	.	74.7199	0.004
787	100.00	.	.	77.9200	0.003
788	102.04	.	.	80.3200	0.003
789	103.00	.	.	80.3200	0.003
790	103.58	.	.	80.7800	0.002
791	106.40	.	.	81.9800	0.002
792	112.04	.	.	81.9800	0.002
793	112.73	.	.	.	0.001
794	121.73	.	.	.	0.001
795	172.64	50.000	50.00	83.5200	0.000

Table 8.3-1. Effective Path Length Values for July, 1977.

OBS	RAIN	ACTS	AV19	AC28	PATH11	PATH19	PATH28
107	.	.	.	5.74	.	.	.
108	2.16	.	.	.	.	.	.
109	2.28	.	.	6.14	.	.	2.76209
110	2.51	.	.	.	.	.	.
111	2.78	.	.	.	.	.	.
112	2.79	.	.	.	.	.	.
113	2.81	.	.	.	.	.	.
114	.	.	.	6.34	.	.	.
115	3.21	.	.	.	.	.	.
116	.	.	.	6.54	.	.	.
117	3.30	.	.	.	.	.	.
118	.	.	.	6.74	.	.	.
119	3.39	.	.	.	.	.	.
120	3.45	.	.	.	.	.	.
121	3.48	.	.	.	.	.	.
122	.	.	3.55000	.	.	.	.
123	3.52	.	.	.	.	.	.
124	.	.	.	7.14	.	.	.
125	3.70	.	3.74999	.	.	7.92593	.
126	.	.	.	7.34	.	.	.
127	.	.	.	7.54	.	.	.
128	3.96	.	.	.	.	.	.
129	.	.	3.94999	.	.	.	.
130	4.02	.	.	.	.	.	.
131	.	.	.	7.94	.	.	.
132	.	.	.	8.14	.	.	.
133	.	.	.	8.35	.	.	.
134	4.13	.	.	.	.	.	.
135	.	.	.	8.75	.	.	.
136	4.19	.	.	.	.	.	.
137	.	.	.	8.95	.	.	.
138	.	.	4.16000	.	.	.	.
139	.	.	.	9.15	.	.	.
140	4.31	.	.	.	.	.	.
141	.	.	4.35999	.	.	.	.
142	.	.	4.55999	.	.	.	.
143	4.44	.	.	.	.	.	.
144	.	.	.	9.35	.	.	.
145	.	4.86000	.	9.92	.	.	.
146	4.46	4.87999	.	.	23.5762	.	.
147	.	5.25999	.	9.95	.	.	.
148	.	.	.	10.15	.	.	.
149	.	.	.	10.55	.	.	.
150	.	.	4.75999	.	.	.	.
151	.	.	4.96000	.	.	.	.
152	.	.	.	10.75	.	.	.
153	.	.	.	11.12	.	.	.
154	4.62	.	5.35999	11.55	.	9.56394	4.59846
155	.	.	.	11.75	.	.	.
156	.	.	5.55999	13.15	.	.	.
157	.	.	5.75999	.	.	.	.
158	.	.	5.96000	13.35	.	.	.
159	.	.	6.16000	13.55	.	.	.

Table 8.3-1 (continued). Effective Path Length Values for July, 1977.

OBS	RAIN	ACTS	AV19	AC28	PATH11	PATH19	PATH28
160	.	.	6.56	.	.	.	.
161	4.64	.	6.96	14.15	.	12.3769	5.62809
162	.	.	.	14.35	.	.	.
163	.	.	.	15.15	.	.	.
164	.	.	.	15.55	.	.	.
165	.	.	7.36	.	.	.	.
166	.	5.66	.	16.24	.	.	.
167	4.75	5.78	7.96	17.15	26.2194	13.8973	6.78469
168	.	6.06	.	17.75	.	.	.
169	.	.	8.12	17.95	.	.	.
170	.	.	.	18.32	.	.	.
171	.	.	8.76	.	.	.	.
172	5.16	6.26	9.16	.	26.1404	14.9750	.
173	.	6.58	.	19.44	.	.	.
174	.	6.86	.	19.52	.	.	.
175	.	7.06	9.72	20.16	.	.	.
176	6.20	.	9.76	20.96	.	13.7391	7.74380
177	.	.	.	21.12	.	.	.
178	.	7.46	10.16	22.36	.	.	.
179	.	7.86	10.56	.	.	.	.
180	6.57	8.26	10.96	.	27.0896	14.7017	.
181	.	.	11.16	22.64	.	.	.
182	.	.	.	22.72	.	.	.
183	.	8.47	.	23.12	.	.	.
184	7.69	.	11.32	.	.	13.2898	.
185	.	.	11.36	23.16	.	.	.
186	.	9.07	.	23.56	.	.	.
187	.	9.27	11.56	23.96	.	.	.
188	8.20	9.67	12.16	24.32	25.4098	13.5084	8.23435
189	.	.	.	24.72	.	.	.
190	.	9.87	12.36	24.76	.	.	.
191	8.40	.	.	.	.	.	.
192	.	.	12.52	25.04	.	.	.
193	.	10.67	13.16	26.32	.	.	.
194	8.51	.	13.56	27.12	.	14.5869	9.06497
195	10.15	11.47	13.76	27.52	24.3493	12.6793	8.61585
196	.	12.07	14.12	28.24	.	.	.
197	.	12.87	.	.	.	.	.
198	10.91	13.27	.	.	26.2080	.	.
199	.	13.67	15.17	30.34	.	.	.
200	.	14.07	15.57	31.14	.	.	.
201	13.33	.	15.72	31.44	.	11.3337	8.76615
202	.	.	16.17	32.34	.	.	.
203	13.47	14.27	16.57	33.14	22.8268	11.8332	9.19585
204	15.50	14.79	16.94	33.88	20.5601	10.6344	8.79018
205	15.85	14.87	16.97	33.94	20.2148	10.4356	8.70817
206	24.63	15.07	17.17	34.34	13.1837	6.9814	6.89428
207	27.06	15.39	17.37	34.74	12.2546	6.4573	6.57854
208	29.22	15.79	17.97	35.94	11.6437	6.2073	6.47877
209	31.12	.	.	.	.	.	.
210	34.38	15.87	18.17	36.34	9.9462	5.3683	5.87637
211	36.38	16.19	18.54	37.08	9.5890	5.1868	5.76592
212	38.94	.	19.74	39.48	.	5.1710	5.85166

Table 8.3-1 (continued). Effective Path Length Values for July, 1977.

OBS	RAIN	ACTS	AV19	AC28	PATH11	PATH19	PATH28
213	39.75	.	22.94	45.8800	.	5.89070	6.70099
214	41.34	16.470	23.77	47.5400	8.58443	5.87615	6.75001
215	42.39	17.070	24.14	48.2799	8.67677	5.82414	6.73123
216	43.50	17.270	25.58	.	8.55444	6.01861	.
217	43.96	.	25.78	.	.	6.00400	.
218	46.29	17.670	27.18	.	8.22503	6.02004	.
219	46.33	18.095	27.34	.	8.41559	6.05039	.
220	46.41	.	29.58	.	.	6.53513	.
221	47.70	.	30.78	.	.	6.62116	.
222	48.63	18.680	31.58	.	8.27677	6.66668	.
223	48.71	19.280	32.18	.	8.52859	6.78248	.
224	49.59	.	32.38	.	.	6.70658	.
225	50.41	.	32.94	.	.	6.71435	.
226	50.97	.	34.59	.	.	6.97512	.
227	51.26	19.480	36.19	.	8.18839	7.25749	.
228	53.88	20.080	37.36	.	8.03017	7.13629	.
229	56.31	20.495	.	.	7.84243	.	.
230	56.66	.	.	.	.	.	.
231	57.25	.	38.96	.	.	7.01347	.
232	57.91	.	40.16	.	.	7.14888	.
233	58.40	20.880	40.39	.	7.70382	7.13080	.
234	58.59	22.080	40.99	.	8.12015	7.21377	.
235	59.93	23.480	.	.	8.44194	.	.
236	60.00	24.280	.	.	8.71938	.	.
237	60.26	25.680	.	.	9.18236	.	.
238	61.14	27.880	41.76	.	9.82553	7.04907	.
239	63.47	29.290	.	.	9.94350	.	.
240	64.97	.	.	.	.	.	.
241	68.03	.	.	.	.	.	.
242	69.67	.	.	.	.	.	.
243	70.11	.	.	50.0000	.	.	4.72002
244	70.75	.	.	51.1600	.	.	4.79378
245	70.93	.	.	51.5600	.	.	4.82123
246	71.11	.	.	54.3600	.	.	5.07251
247	72.62	.	.	54.6800	.	.	5.01517
248	75.10	.	.	59.1600	.	.	5.27793
249	75.41	.	.	61.5600	.	.	5.47336
250	76.25	.	.	63.1600	.	.	5.56434
251	76.68	.	.	64.3600	.	.	5.64368
252	77.00	.	.	64.7600	.	.	5.65916
253	80.26	.	.	65.8800	.	.	5.56152
254	80.38	.	.	69.1800	.	.	5.83281
255	80.97	.	.	72.3800	.	.	6.06538
256	81.45	.	.	74.7199	.	.	6.23054
257	81.94	.	.	.	.	.	.
258	82.68	.	.	.	.	.	.
259	83.94	.	.	77.9200	.	.	6.33506
260	85.92	.	.	80.3200	.	.	6.40300
261	86.46	.	.	80.7800	.	.	6.40564
262	86.59	.	.	81.9600	.	.	6.49254
263	94.01	.	.	.	.	.	.
264	94.66	.	.	.	.	.	.
265	103.00	.	.	.	.	.	.

Table 8.3-2. Effective Path Length Values for August, 1977.

OBS	RAIN	ACTS	AV19	AC28	PATH11	PATH19	PATH28
107	.	.	.	6.8400	.	.	.
108	3.02	.	.	.	.	.	.
109	3.09	.	.	7.0500	.	.	3.03499
110	.	.	.	7.1000	.	.	.
111	3.17	.	.	.	.	.	.
112	3.26	.	.	.	.	.	.
113	.	.	.	7.4500	.	.	.
114	.	.	.	7.5000	.	.	.
115	3.38	.	.	7.5999	.	.	3.22210
116	3.45	.	.	.	.	.	.
117	.	.	.	7.6500	.	.	.
118	.	.	2.94999	.	.	.	.
119	.	.	2.99998	.	.	.	.
120	3.68	.	.	7.8500	.	.	3.27669
121	.	.	.	7.9000	.	.	.
122	.	.	3.14999	.	.	.	.
123	3.95	.	.	.	.	.	.
124	4.00	.	.	8.0500	.	.	3.30568
125	.	.	.	8.3000	.	.	.
126	4.15	.	.	8.4500	.	.	3.44376
127	4.22	.	3.55000	.	.	6.79454	.
128	.	.	.	8.6500	.	.	.
129	4.24	.	.	8.7200	.	.	3.53779
130	4.35	.	.	.	.	.	.
131	.	.	3.75000	.	.	.	.
132	.	.	3.79997	8.8500	.	.	.
133	.	.	.	9.1200	.	.	.
134	4.55	.	.	9.2500	.	.	3.69546
135	.	.	3.94999	.	.	.	.
136	.	.	4.14999	.	.	.	.
137	4.70	.	.	9.4500	.	.	3.74765
138	4.74	.	.	.	.	.	.
139	.	.	.	9.5200	.	.	.
140	.	.	.	9.6500	.	.	.
141	4.92	.	.	9.9200	.	.	3.89213
142	.	.	.	10.0500	.	.	.
143	4.95	.	.	.	.	.	.
144	.	.	.	10.2500	.	.	.
145	.	.	4.36000	.	.	.	.
146	5.65	.	.	.	.	.	.
147	.	.	.	10.4500	.	.	.
148	.	.	.	10.8500	.	.	.
149	.	.	4.55999	11.0500	.	.	.
150	5.71	.	.	11.1200	.	.	4.20223
151	.	.	.	11.2500	.	.	.
152	.	.	.	11.5200	.	.	.
153	6.45	.	.	.	.	.	.
154	.	.	4.75999	11.6500	.	.	.
155	.	.	.	11.8500	.	.	.
156	6.55	.	.	11.9200	.	.	4.33474
157	6.74	.	.	.	.	.	.
158	.	.	4.95999	.	.	.	.
159	.	.	.	12.0500	.	.	.

Table 8.3-2 (continued). Effective Path Length Values for August, 1977.

OBS	RAIN	ACTS	AV19	AC28	PATH11	PATH19	PATH28
160	7.11	.	.	.	.	.	.
161	.	.	.	12.25	.	.	.
162	.	.	.	12.32	.	.	.
163	7.71	.	5.16000	12.65	.	6.04443	4.37260
164	.	.	5.55999	12.72	.	.	.
165	.	2.89999	.	.	.	.	.
166	8.02	2.97999	.	.	8.00626	.	.
167	.	.	.	12.85	.	.	.
168	.	3.18000	.	.	.	.	.
169	8.69	3.28000	.	.	8.13284	.	.
170	.	.	5.75999	13.05	.	.	.
171	.	.	.	13.12	.	.	.
172	9.42	.	.	.	.	.	.
173	.	.	.	13.52	.	.	.
174	9.66	3.30000	.	.	7.36079	.	.
175	.	.	5.95999	.	.	.	.
176	.	3.58000	.	.	.	.	.
177	9.77	.	6.16000	.	.	5.87129	.
178	.	.	.	13.65	.	.	.
179	10.02	.	6.36000	13.85	.	5.92787	4.35799
180	.	.	.	14.25	.	.	.
181	10.24	.	.	.	.	.	.
182	.	.	.	14.32	.	.	.
183	11.25	3.69999	.	14.45	7.08658	.	4.33953
184	.	3.87999	.	.	.	.	.
185	11.68	3.97999	6.55999	14.65	7.34223	5.33146	4.33059
186	.	.	.	15.05	.	.	.
187	11.88	.	.	15.12	.	.	4.43715
188	.	4.10000	6.75999	15.25	.	.	.
189	.	.	.	15.52	.	.	.
190	12.25	.	.	.	.	.	.
191	12.44	.	.	15.65	.	.	4.50140
192	.	.	.	15.85	.	.	.
193	.	.	7.16000	.	.	.	.
194	13.56	.	.	16.05	.	.	4.43995
195	.	.	.	16.32	.	.	.
196	13.81	.	.	16.45	.	.	4.51210
197	.	.	.	16.65	.	.	.
198	14.01	.	.	17.26	.	.	4.70244
199	.	4.30000	.	.	.	.	.
200	14.35	.	7.36000	17.92	.	4.96018	4.82707
201	.	.	7.55999	.	.	.	.
202	14.78	4.58000	.	.	6.67697	.	.
203	15.00	.	7.75999	18.06	.	5.02102	4.76190
204	.	.	.	18.26	.	.	.
205	15.23	.	.	.	.	.	.
206	16.33	.	.	.	.	.	.
207	.	.	.	18.32	.	.	.
208	16.41	.	7.95999	.	.	4.74004	.
209	.	4.89999	8.16000	18.46	.	.	.
210	16.51	4.97999	.	18.72	6.49936	.	4.70478
211	16.72	.	.	19.06	.	.	4.75923
212	.	.	8.75999	.	.	.	.

Table 8.3-2 (continued). Effective Path Length Values for August, 1977.

OBS	RAIN	ACTS	AV19	AC28	PATH11	PATH19	PATH28
213	17.53	.	.	19.12	.	.	4.65796
214	17.66	.	8.96	19.66	.	4.98349	4.77087
215	17.96	.	.	19.86	.	.	4.77649
216	18.20	.	.	19.92	.	.	4.75703
217	18.23	5.10000	9.16	20.06	6.02798	4.94593	4.78624
218	19.00	5.37999	.	.	6.10122	.	.
219	.	.	.	20.66	.	.	.
220	20.14	.	9.36	.	.	4.60338	.
221	20.43	.	9.56	21.06	.	4.63896	4.71916
222	.	5.49999	.	21.26	.	.	.
223	20.45	.	.	21.46	.	.	4.80613
224	21.28	5.68000	9.96	.	5.75129	4.65100	.
225	21.65	.	10.16	21.52	.	4.66786	4.66486
226	21.86	.	10.36	.	.	4.71657	.
227	22.07	.	.	21.86	.	.	4.68592
228	22.10	.	10.76	.	.	4.84840	.
229	22.20	.	.	22.72	.	.	4.85358
230	22.92	5.89999	11.36	.	5.54657	4.94535	.
231	23.26	.	.	22.86	.	.	4.75074
232	24.54	5.97999	.	.	5.25067	.	.
233	25.20	.	.	.	.	.	.
234	25.31	.	.	.	.	.	.
235	25.40	6.30000	11.56	.	5.34435	4.56473	.
236	25.42	6.47999	.	23.12	5.49272	.	4.55259
237	27.44	.	.	.	.	.	.
238	27.84	.	.	.	.	.	.
239	28.08	.	11.96	.	.	4.29167	.
240	28.49	.	.	23.92	.	.	4.38314
241	28.73	.	.	24.06	.	.	4.38500
242	28.77	.	.	24.26	.	.	4.41748
243	29.33	.	12.36	24.46	.	4.25412	4.39855
244	29.82	.	.	.	.	.	.
245	30.30	.	12.56	.	.	4.19020	.
246	31.34	6.49999	12.60	.	4.46892	4.06955	.
247	32.03	.	12.96	24.72	.	4.09913	4.19402
248	32.91	7.10000	.	25.06	4.64857	.	4.17479
249	34.77	.	.	.	.	.	.
250	34.88	.	13.36	25.12	.	3.89265	4.02191
251	35.40	.	.	25.20	.	.	3.99368
252	36.82	.	13.56	25.86	.	3.74977	3.98755
253	37.20	.	13.76	25.92	.	3.76751	3.96810
254	39.21	.	.	.	.	.	.
255	39.84	.	13.96	.	.	3.57690	.
256	40.07	.	14.20	26.72	.	3.61816	3.88020
257	40.10	.	14.57	.	.	3.70975	.
258	40.34	7.30000	14.77	27.12	3.89920	3.73899	3.91933
259	40.43	.	14.97	27.52	.	3.78144	3.97076
260	42.59	.	15.57	.	.	3.73938	.
261	42.72	7.69999	.	27.67	3.88372	.	3.83600
262	42.86	.	15.97	.	.	3.81199	.
263	43.71	.	16.37	27.92	.	3.83365	3.80619
264	44.13	.	.	28.40	.	.	3.84447
265	44.78	.	.	29.14	.	.	3.90227

Table 8.3-2 (continued). Effective Path Length Values for August, 1977.

OBS	RAIN	ACTS	AV19	AC28	PATH11	PATH19	PATH28
266	46.41	.	16.77	29.54	.	3.70501	3.85208
267	46.45	.	.	29.94	.	.	3.90172
268	48.80	.	17.00	30.07	.	3.57660	3.77597
269	49.15	.	17.17	.	.	3.58729	.
270	49.55	.	17.77	31.94	.	3.68344	3.96471
271	51.02	.	18.17	32.67	.	3.66050	3.96602
272	51.79	.	18.37	32.74	.	3.64710	3.92920
273	52.04	.	.	.	.	.	.
274	53.35	7.900	.	33.54	3.19066	.	3.93432
275	54.25	7.985	18.57	.	3.17149	3.52350	.
276	54.36	.	.	34.00	.	.	3.93080
277	54.90	8.500	19.17	35.54	3.33607	3.59527	4.07744
278	55.74	8.700	.	36.34	3.36310	.	4.12022
279	56.66	9.300	19.37	38.34	3.53667	3.52244	4.29174
280	58.53	.	19.82	39.64	.	3.49159	4.32553
281	58.78	9.500	.	.	3.48243	.	.
282	59.48	.	20.57	41.14	.	3.56706	4.43250
283	59.54	9.910	20.77	41.54	3.58635	3.59819	4.47204
284	60.20	.	.	.	.	.	.
285	60.86	.	21.42	42.84	.	3.63198	4.53251
286	61.27	.	21.57	43.14	.	3.63344	4.53994
287	61.69	10.110	22.17	44.34	3.53122	3.70960	4.64092
288	61.82	.	23.77	47.54	.	3.96913	4.96751
289	62.67	10.710	.	.	3.68229	.	.
290	65.91	.	.	.	.	.	.
291	69.14	.	.	.	.	.	.
292	69.85	.	.	.	.	.	.
293	70.29	.	23.97	47.94	.	3.52888	4.51609
294	72.33	10.910	24.22	48.44	3.25009	3.46687	4.45748
295	74.19	.	24.58	49.16	.	3.43170	4.43017
296	85.92	11.710	.	.	2.93664	.	.
297	88.12	.	.	.	.	.	.
298	93.05	.	25.38	50.76	.	2.83498	3.78129
299	97.34	.	.	.	.	.	.
300	100.00	.	.	.	.	.	.
301	102.04	.	.	.	.	.	.
302	103.58	12.110	27.18	54.36	2.51916	2.73118	3.69209
303	106.40	12.910	30.58	61.16	2.61441	2.99236	4.05803
304	112.04	.	30.98	61.96	.	2.88063	3.92964
305	112.73	.	33.78	67.56	.	3.12197	4.26179
306	121.73	13.510	36.59	73.18	2.39136	3.13427	4.31407

Table 8.3-3. Effective Path Length Values for September, 1977.

OBS	RAIN	ACTS	AV19	AC28	PATH11	PATH19	PATH28
107	.	.	.	6.8400	.	.	.
108	3.02	.	.	.	.	.	.
109	3.09	.	.	7.0500	.	.	3.03499
110	.	.	.	7.1000	.	.	.
111	3.17	.	.	.	.	.	.
112	3.26	.	.	.	.	.	.
113	.	.	.	7.4500	.	.	.
114	.	.	.	7.5000	.	.	.
115	3.38	.	.	7.5999	.	.	3.22210
116	3.45	.	.	.	.	.	.
117	.	.	.	7.6500	.	.	.
118	.	.	2.94999	.	.	.	.
119	.	.	2.99998	.	.	.	.
120	3.68	.	.	7.8500	.	.	3.27669
121	.	.	.	7.9000	.	.	.
122	.	.	3.14999	.	.	.	.
123	3.95	.	.	.	.	.	.
124	4.00	.	.	8.0500	.	.	3.30568
125	.	.	.	8.3000	.	.	.
126	4.15	.	.	8.4500	.	.	3.44376
127	4.22	.	3.55000	.	.	6.79454	.
128	.	.	.	8.6500	.	.	.
129	4.24	.	.	8.7200	.	.	3.53779
130	4.35	.	.	.	.	.	.
131	.	.	3.75000	.	.	.	.
132	.	.	3.79997	8.8500	.	.	.
133	.	.	.	9.1200	.	.	.
134	4.55	.	.	9.2500	.	.	3.69546
135	.	.	3.94999	.	.	.	.
136	.	.	4.14999	.	.	.	.
137	4.70	.	.	9.4500	.	.	3.74765
138	4.74	.	.	.	.	.	.
139	.	.	.	9.5200	.	.	.
140	.	.	.	9.6500	.	.	.
141	4.92	.	.	9.9200	.	.	3.89213
142	.	.	.	10.0500	.	.	.
143	4.95	.	.	.	.	.	.
144	.	.	.	10.2500	.	.	.
145	.	.	4.36000	.	.	.	.
146	5.65	.	.	.	.	.	.
147	.	.	.	10.4500	.	.	.
148	.	.	.	10.8500	.	.	.
149	.	.	4.55999	11.0500	.	.	.
150	5.71	.	.	11.1200	.	.	4.20223
151	.	.	.	11.2500	.	.	.
152	.	.	.	11.5200	.	.	.
153	6.45	.	.	.	.	.	.
154	.	.	4.75999	11.6500	.	.	.
155	.	.	.	11.8500	.	.	.
156	6.55	.	.	11.9200	.	.	4.33474
157	6.74	.	.	.	.	.	.
158	.	.	4.95999	.	.	.	.
159	.	.	.	12.0500	.	.	.

Table 8.3-3 (continued). Effective Path Length Values for September, 1977.

OBS	RAIN	ACIS	AV19	AC28	PATH11	PATH19	PATH28
160	7.11	.	.	.	.	.	.
161	.	.	.	12.25	.	.	.
162	.	.	.	12.32	.	.	.
163	7.71	.	5.16000	12.65	.	6.04443	4.37260
164	.	.	5.55999	12.72	.	.	.
165	.	2.89999	.	.	.	.	.
166	8.02	2.97999	.	.	8.00626	.	.
167	.	.	.	12.85	.	.	.
168	.	3.18000	.	.	.	.	.
169	8.69	3.28000	.	.	8.13284	.	.
170	.	.	5.75999	13.05	.	.	.
171	.	.	.	13.12	.	.	.
172	9.42	.	.	.	.	.	.
173	.	.	.	13.52	.	.	.
174	9.66	3.30000	.	.	7.36079	.	.
175	.	.	5.95999	.	.	.	.
176	.	3.58000	.	.	.	.	.
177	9.77	.	6.16000	.	.	5.87129	.
178	.	.	.	13.65	.	.	.
179	10.02	.	6.36000	13.85	.	5.92787	4.35799
180	.	.	.	14.25	.	.	.
181	10.24	.	.	.	.	.	.
182	.	.	.	14.32	.	.	.
183	11.25	3.69999	.	14.45	7.08658	.	4.33953
184	.	3.87999	.	.	.	.	.
185	11.68	3.97999	6.55999	14.65	7.34223	5.33146	4.33059
186	.	.	.	15.05	.	.	.
187	11.88	.	.	15.12	.	.	4.43715
188	.	4.10000	6.75999	15.25	.	.	.
189	.	.	.	15.52	.	.	.
190	12.25	.	.	.	.	.	.
191	12.44	.	.	15.65	.	.	4.50140
192	.	.	.	15.85	.	.	.
193	.	.	7.16000	.	.	.	.
194	13.56	.	.	16.05	.	.	4.43995
195	.	.	.	16.32	.	.	.
196	13.81	.	.	16.45	.	.	4.51210
197	.	.	.	16.65	.	.	.
198	14.01	.	.	17.26	.	.	4.70244
199	.	4.30000	.	.	.	.	.
200	14.35	.	7.36000	17.92	.	4.96018	4.82707
201	.	.	7.55999	.	.	.	.
202	14.78	4.58000	.	.	6.67697	.	.
203	15.00	.	7.75999	18.06	.	5.02102	4.76190
204	.	.	.	18.26	.	.	.
205	15.23	.	.	.	.	.	.
206	16.33	.	.	.	.	.	.
207	.	.	.	18.32	.	.	.
208	16.41	.	7.95999	.	.	4.74004	.
209	.	4.89999	8.16000	18.46	.	.	.
210	16.51	4.97999	.	18.72	6.49936	.	4.70478
211	16.72	.	.	19.06	.	.	4.75923
212	.	.	8.75999	.	.	.	.

Table 8.3-3 (continued). Effective Path Length Values for September, 1977.

OBS	RAIN	ACTS	AV19	AC28	PATH11	PATH19	PATH28
213	17.53	.	.	19.12	.	.	4.65796
214	17.66	.	8.96	19.66	.	4.98349	4.77087
215	17.96	.	.	19.86	.	.	4.77649
216	18.20	.	.	19.92	.	.	4.75703
217	18.23	5.10000	9.16	20.06	6.02798	4.94593	4.78624
218	19.00	5.37999	.	.	6.10122	.	.
219	.	.	.	20.66	.	.	.
220	20.14	.	9.36	.	.	4.60338	.
221	20.43	.	9.56	21.06	.	4.63896	4.71916
222	.	5.49999	.	21.26	.	.	.
223	20.45	.	.	21.46	.	.	4.80613
224	21.28	5.68000	9.96	.	5.75129	4.65100	.
225	21.65	.	10.16	21.52	.	4.66786	4.66486
226	21.86	.	10.36	.	.	4.71657	.
227	22.07	.	.	21.86	.	.	4.68592
228	22.10	.	10.76	.	.	4.84840	.
229	22.20	.	.	22.72	.	.	4.85358
230	22.92	5.89999	11.36	.	5.54657	4.94535	.
231	23.26	.	.	22.86	.	.	4.75074
232	24.54	5.97999	.	.	5.25067	.	.
233	25.20	.	.	.	.	.	.
234	25.31	.	.	.	.	.	.
235	25.40	6.30000	11.56	.	5.34435	4.56473	.
236	25.42	6.47999	.	23.12	5.49272	.	4.55255
237	27.44	.	.	.	.	.	.
238	27.84	.	.	.	.	.	.
239	28.08	.	11.96	.	.	4.29167	.
240	28.49	.	.	23.92	.	.	4.38314
241	28.73	.	.	24.06	.	.	4.38500
242	28.77	.	.	24.26	.	.	4.41748
243	29.33	.	12.36	24.46	.	4.25412	4.39855
244	29.82	.	.	.	.	.	.
245	30.30	.	12.56	.	.	4.19020	.
246	31.34	6.49999	12.60	.	4.46892	4.06955	.
247	32.03	.	12.96	24.72	.	4.09913	4.19402
248	32.91	7.10000	.	25.06	4.64657	.	4.17479
249	34.77	.	.	.	.	.	.
250	34.88	.	13.36	25.12	.	3.89265	4.02191
251	35.40	.	.	25.20	.	.	3.99368
252	36.82	.	13.56	25.86	.	3.74977	3.98755
253	37.20	.	13.76	25.92	.	3.76751	3.96810
254	39.21	.	.	.	.	.	.
255	39.84	.	13.96	.	.	3.57690	.
256	40.07	.	14.20	26.72	.	3.61816	3.88020
257	40.10	.	14.57	.	.	3.70975	.
258	40.34	7.30000	14.77	27.12	3.89920	3.73899	3.91933
259	40.43	.	14.97	27.52	.	3.78144	3.97076
260	42.59	.	15.57	.	.	3.73938	.
261	42.72	7.69999	.	27.67	3.88372	.	3.83600
262	42.86	.	15.97	.	.	3.81199	.
263	43.71	.	16.37	27.92	.	3.83365	3.80619
264	44.13	.	.	28.40	.	.	3.84447
265	44.78	.	.	29.14	.	.	3.90227

Table 8.3-3 (continued). Effective Path Length Values for September, 1977.

OBS	RAIN	ACTS	AV19	AC28	PATH11	PATH19	PATH28
266	46.41	.	16.77	29.54	.	3.70501	3.85208
267	46.45	.	.	29.94	.	.	3.90172
268	48.80	.	17.00	30.07	.	3.57660	3.77597
269	49.15	.	17.17	.	.	3.58729	.
270	49.55	.	17.77	31.94	.	3.68344	3.96471
271	51.02	.	18.17	32.67	.	3.66050	3.96602
272	51.79	.	18.37	32.74	.	3.64710	3.92920
273	52.04	.	.	.	.	.	.
274	53.35	7.900	.	33.54	3.19066	.	3.93432
275	54.25	7.985	18.57	.	3.17149	3.52350	.
276	54.36	.	.	34.00	.	.	3.93080
277	54.90	8.500	19.17	35.54	3.33607	3.59527	4.07744
278	55.74	8.700	.	36.34	3.36310	.	4.12022
279	56.66	9.300	19.37	38.34	3.53667	3.52244	4.29174
280	58.53	.	19.82	39.64	.	3.49159	4.32553
281	58.78	9.500	.	.	3.48243	.	.
282	59.48	.	20.57	41.14	.	3.56706	4.43250
283	59.54	9.910	20.77	41.54	3.58035	3.59819	4.47204
284	60.20	.	.	.	.	.	.
285	60.86	.	21.42	42.84	.	3.63198	4.53251
286	61.27	.	21.57	43.14	.	3.63344	4.53994
287	61.69	10.110	22.17	44.34	3.53122	3.70960	4.64092
288	61.82	.	23.77	47.54	.	3.96913	4.96751
289	62.67	10.710	.	.	3.68229	.	.
290	65.91	.	.	.	.	.	.
291	69.14	.	.	.	.	.	.
292	69.85	.	.	.	.	.	.
293	70.29	.	23.97	47.94	.	3.52888	4.51609
294	72.33	10.910	24.22	48.44	3.25009	3.46687	4.45748
295	74.19	.	24.58	49.16	.	3.43170	4.43017
296	85.92	11.710	.	.	2.93664	.	.
297	88.12	.	.	.	.	.	.
298	93.05	.	25.38	50.76	.	2.83498	3.78129
299	97.34	.	.	.	.	.	.
300	100.00	.	.	.	.	.	.
301	102.04	.	.	.	.	.	.
302	103.58	12.110	27.18	54.36	2.51916	2.73118	3.69209
303	106.40	12.910	30.58	61.16	2.61441	2.99236	4.05803
304	112.04	.	30.98	61.96	.	2.88063	3.92964
305	112.73	.	33.78	67.56	.	3.12197	4.26179
306	121.73	13.510	36.59	73.18	2.39136	3.13427	4.31407

Table 8.3-4. Effective Path Length Values for the Combined Months of July, August, and September, 1977.

OBS	RAIN	ACTS	AV19	AC28	PATH11	PATH19	PATH28
379	3.30	.	3.74999	.	.	8.61731	.
380	3.33	.	.	.	.	.	.
381	.	.	.	7.13999	.	.	.
382	3.38	.	3.75000	7.33999	.	8.46955	3.11189
383	3.38	.	3.79997	7.33999	.	8.58243	3.11189
384	.	.	.	7.36999	.	.	.
385	3.39	.	.	.	.	.	.
386	.	.	3.86000	.	.	.	.
387	.	.	3.94999	.	.	.	.
388	.	.	.	7.44999	.	.	.
389	.	.	.	7.49999	.	.	.
390	3.45	.	3.94999	.	.	8.78938	.
391	.	.	4.14999	7.54000	.	.	.
392	.	.	.	7.56999	.	.	.
393	.	.	.	7.59995	.	.	.
394	3.48	.	.	.	.	.	.
395	.	.	.	7.64999	.	.	.
396	3.49	.	.	.	.	.	.
397	3.52	.	.	.	.	.	.
398	.	.	4.16000	.	.	.	.
399	.	.	.	7.72000	.	.	.
400	3.57	.	.	7.85000	.	.	3.29536
401	.	.	.	7.89998	.	.	.
402	3.68	.	.	.	.	.	.
403	.	.	.	7.93999	.	.	.
404	3.70	.	.	.	.	.	.
405	3.80	.	.	.	.	.	.
406	.	.	.	8.05000	.	.	.
407	.	.	.	8.13999	.	.	.
408	3.95	.	.	8.16999	.	.	3.36348
409	.	.	.	8.29998	.	.	.
410	3.96	.	.	8.35000	.	.	3.43584
411	.	.	.	8.36999	.	.	.
412	4.00	.	.	.	.	.	.
413	.	.	.	8.44999	.	.	.
414	4.02	.	.	.	.	.	.
415	.	.	.	8.64999	.	.	.
416	4.13	.	.	8.71999	.	.	3.55738
417	.	.	4.25999	.	.	.	.
418	4.15	.	4.35999	8.74999	.	8.45230	3.56602
419	4.19	.	.	.	.	.	.
420	.	.	.	8.85000	.	.	.
421	4.22	.	.	.	.	.	.
422	4.24	.	.	.	.	.	.
423	.	.	4.36000	8.91998	.	.	.
424	4.31	.	.	8.94999	.	.	3.61842
425	4.31	.	.	8.97999	.	.	3.63055
426	.	.	.	9.11999	.	.	.
427	.	.	.	9.15000	.	.	.
428	4.35	.	.	.	.	.	.
429	.	.	.	9.17999	.	.	.
430	4.42	.	4.45999	9.24999	.	8.23700	3.71930
431	4.42	.	4.55999	9.24999	.	8.42169	3.71930
432	.	.	4.55999	.	.	.	.

Table 8.3-4 (continued). Effective Path Length Values for the Combined Months of July, August, and September, 1977.

OBS	RAIN	ACTS	AV19	AC28	PATH11	PATH19	PATH28
433	4.44	.	.	.	.	.	.
434	4.46	.	.	9.35	.	.	3.75206
435	4.55	.	.	9.45	.	.	3.77536
436	.	.	4.75999	.	.	.	.
437	.	.	.	9.52	.	.	.
438	.	.	4.75999	9.65	.	.	.
439	4.62	.	.	9.92	.	.	3.94949
440	4.62	.	.	9.92	.	.	3.9495(
441	.	.	.	9.95	.	.	.
442	4.64	.	.	.	.	.	.
443	.	.	.	9.98	.	.	.
444	.	.	.	10.05	.	.	.
445	.	.	.	10.14	.	.	.
446	4.70	.	4.86999	10.15	.	8.57348	4.0252
447	4.74	.	.	10.25	.	.	4.0569
448	4.74	.	.	10.38	.	.	4.1084
449	4.75	.	4.95999	10.45	.	8.65957	4.1341
450	.	.	4.96000	10.55	.	.	.
451	4.92	.	.	10.75	.	.	4.2177
452	.	.	5.06999	10.78	.	.	.
453	4.95	.	.	10.85	.	.	4.2508
454	4.95	.	.	10.98	.	.	4.3017
455	.	.	5.16000	11.05	.	.	.
456	.	.	5.16000	11.12	.	.	.
457	5.00	.	.	11.12	.	.	4.3461
458	.	.	5.35999	11.18	.	.	.
459	.	.	.	11.25	.	.	.
460	5.16	.	.	11.52	.	.	4.4679
461	5.16	.	.	11.55	.	.	4.4796
462	5.17	.	.	.	.	.	.
463	.	.	.	11.58	.	.	.
464	.	.	5.47000	11.65	.	.	.
465	.	.	5.55999	11.65	.	.	.
466	5.28	.	5.55999	11.74	.	8.92352	4.5273
467	5.28	.	5.75999	11.75	.	9.24450	4.5311
468	.	.	.	11.85	.	.	.
469	.	.	.	11.92	.	.	.
470	5.65	.	.	11.98	.	.	4.539
471	5.71	.	.	.	.	.	.
472	5.74	.	5.75999	12.05	.	8.63922	4.547
473	5.74	.	5.75999	12.25	.	8.63922	4.622
474	.	.	.	12.32	.	.	.
475	.	.	5.86999	12.38	.	.	.
476	5.88	.	.	12.65	.	.	4.742
477	5.88	.	.	12.72	.	.	4.769
478	5.88	.	.	12.78	.	.	4.791
479	.	4.86000	.	.	.	.	.
480	6.17	4.87999	5.95999	.	17.0421	8.42362	.
481	6.20	.	5.96000	.	.	8.38987	.
482	6.20	.	6.16000	.	.	8.67141	.
483	.	.	6.16000	12.85	.	.	.
484	6.33	4.89999	.	12.94	16.6794	.	4.752
485	6.33	4.97999	.	12.94	16.9517	.	4.752
486	.	.	6.26999	13.05	.	.	.

Table 8.3-4 (continued). Effective Path Length Values for the Combined Months of July, August, and September, 1977.

OBS	RAIN	ACTS	AV19	AC28	PATH11	PATH19	PATH28
487	.	.	6.26999	13.12	.	.	.
488	.	.	6.26999	13.15	.	.	.
489	6.37	.	6.36000	.	.	8.75414	.
490	.	.	.	13.18	.	.	.
491	.	.	.	13.35	.	.	.
492	6.45	.	6.47000	13.38	.	8.81345	4.88762
493	.	.	6.55999	13.52	.	.	.
494	.	.	6.55999	13.55	.	.	.
495	6.55	.	.	13.58	.	.	4.93842
496	6.57	.	.	.	.	.	.
497	.	.	6.55999	13.65	.	.	.
498	6.74	5.04999	6.75999	13.74	16.1443	8.87573	4.95435
499	6.74	5.04999	6.75999	13.78	16.1443	8.87573	4.96878
500	.	.	.	13.85	.	.	.
501	6.76	.	6.86999	14.14	.	8.99774	5.09405
502	6.76	.	6.96000	14.14	.	9.11563	5.09405
503	7.11	5.10000	.	14.15	15.4557	.	5.01956
504	7.11	5.24999	.	14.25	15.9103	.	5.05503
505	.	5.25999	.	14.32	.	.	.
506	7.31	5.37999	7.06999	14.35	15.8582	8.66719	5.04632
507	7.31	5.37999	7.06999	14.38	15.8582	8.66719	5.05687
508	7.42	5.49999	.	14.45	15.9715	.	5.05735
509	7.42	5.49999	.	14.58	15.9715	.	5.10285
510	.	.	7.16000	14.65	.	.	.
511	7.69	.	7.35999	15.05	.	8.64071	5.20663
512	7.69	.	7.35999	15.12	.	8.64071	5.23084
513	7.69	.	7.35999	15.15	.	8.64071	5.24122
514	7.71	.	.	15.18	.	.	5.24712
515	7.71	.	.	15.25	.	.	5.27132
516	.	.	.	15.34	.	.	.
517	7.98	.	7.36000	15.38	.	8.37027	5.25573
518	7.98	.	7.55999	15.52	.	8.59772	5.30356
519	8.01	.	.	15.55	.	.	5.30710
520	.	.	7.67000	15.65	.	.	.
521	.	.	7.67000	15.74	.	.	.
522	.	.	7.75999	15.85	.	.	.
523	.	.	7.75999	16.05	.	.	.
524	8.02	5.66000	.	16.18	15.2065	.	5.51979
525	.	5.68000	.	16.24	.	.	.
526	.	5.77999	.	16.32	.	.	.
527	8.05	.	7.86999	16.45	.	8.88316	5.60482
528	8.05	.	7.86999	16.65	.	8.88316	5.67297
529	8.05	.	7.86999	16.78	.	8.88316	5.71726
530	8.20	5.85000	.	.	15.3720	.	.
531	.	.	7.95999	16.94	.	.	.
532	.	.	7.96000	17.15	.	.	.
533	8.40	.	8.11998	.	.	8.83414	.
534	8.40	.	8.16000	.	.	8.87767	.
535	8.51	5.89999	.	17.18	14.9386	.	5.74249
536	8.51	5.89999	.	17.26	14.9386	.	5.76923
537	.	5.97999	8.26999	17.58	.	.	.
538	.	6.05999	8.26999	17.75	.	.	.
539	8.69	.	.	17.92	.	.	5.94568
540	8.69	.	.	17.95	.	.	5.95564

Table 8.3-4 (continued). Effective Path Length Values for the Combined Months of July, August, and September, 1977.

OBS	RAIN	ACTS	AV19	AC28	PATH11	PATH19	PATH28
541	9.42	6.25999	.	.	14.3190	.	.
542	9.66	6.30000	8.47	17.98	14.0524	8.15416	5.73773
543	.	.	8.76	18.06	.	.	.
544	.	.	8.76	18.26	.	.	.
545	9.77	.	8.76	18.32	.	8.34942	5.82101
546	9.88	6.44999	8.96	18.32	14.0666	8.45591	5.79602
547	9.88	6.47999	8.96	18.32	14.1321	8.45591	5.79602
548	10.02	.	9.07	18.46	.	8.45373	5.80856
549	10.15	.	9.16	.	.	8.44056	.
550	10.24	.	9.16	18.54	.	8.37466	5.78431
551	10.24	.	9.16	18.72	.	8.37466	5.84048
552	10.24	.	9.16	18.79	.	8.37466	5.86232
553	10.29	6.49999	.	19.06	13.6109	.	5.93513
554	10.29	6.58000	.	19.12	13.7784	.	5.95381
555	10.29	6.86000	.	19.12	14.3647	.	5.95381
556	.	7.05999	.	19.19	.	.	.
557	10.91	7.10000	9.27	19.44	14.0224	8.00960	5.91259
558	11.25	7.10000	9.27	19.44	13.5986	7.79236	5.83809
559	.	7.24999	9.36	19.52	.	.	.
560	.	7.24999	9.36	19.66	.	.	.
561	.	7.24999	9.36	19.74	.	.	.
562	.	.	9.56	19.86	.	.	.
563	11.46	.	9.67	19.92	.	7.99468	5.93605
564	11.46	.	9.67	19.99	.	7.99468	5.95691
565	11.46	.	9.67	20.06	.	7.99468	5.97777
566	11.68	.	.	20.16	.	.	5.9593
567	11.77	7.30000	9.72	20.39	13.3639	7.84520	6.0076
568	11.77	7.30000	9.76	20.39	13.3639	7.87748	6.0076
569	11.88	7.45999	.	20.66	13.5304	.	6.0629
570	11.88	7.45999	.	20.94	13.5304	.	6.1451
571	11.88	7.45999	.	20.96	13.5304	.	6.1509
572	12.25	7.69999	9.87	.	13.5439	7.68377	.
573	12.25	7.86000	9.87	.	13.8253	7.68377	.
574	12.44	.	9.96	21.06	.	7.64649	6.0574
575	12.85	.	9.96	21.12	.	7.42471	5.9875
576	12.85	.	9.96	21.19	.	7.42471	6.0074
577	13.33	.	10.16	21.26	.	7.32507	5.9277
578	13.33	.	10.36	21.46	.	7.46927	5.9835
579	.	.	10.47	21.52	.	.	.
580	.	.	10.56	21.59	.	.	.
581	13.35	.	10.67	21.86	.	7.68226	6.0908
582	13.47	.	10.67	22.14	.	7.61978	6.143
583	13.56	7.89999	10.76	22.36	12.5532	7.63746	6.185
584	13.56	7.98500	10.76	22.59	12.6883	7.63746	6.249
585	13.61	.	10.96	22.64	.	7.75331	6.252
586	13.81	8.04999	11.07	.	12.5600	7.72737	.
587	13.81	8.24999	11.16	.	12.8721	7.79020	.
588	14.01	8.25999	11.32	22.72	12.7037	7.79857	6.190
589	14.27	8.25999	11.32	22.72	12.4722	7.66822	6.136
590	14.35	8.47000	11.36	22.86	12.7180	7.65593	6.157
591	14.78	8.49999	11.36	22.94	12.3917	7.45103	6.092
592	14.78	8.49999	11.36	22.99	12.3917	7.45103	6.105
593	14.81	.	.	23.12	.	.	6.134
594	15.00	.	.	23.12	.	.	6.096

Table 8.3-4 (continued). Effective Path Length Values for the Combined Months of July, August, and September, 1977.

OBS	RAIN	ACTS	AV19	AC28	PATH11	PATH19	PATH28
595	15.23	8.66	.	.	12.2520	.	.
596	15.23	8.70	.	.	12.3086	.	.
597	15.50	9.07	11.47	23.12	12.6085	7.20048	5.99849
598	15.85	9.07	11.47	23.16	12.3301	7.05340	5.94228
599	16.33	9.27	.	23.39	12.2316	.	5.91146
600	16.41	9.30	.	23.56	12.2113	.	5.93960
601	16.51	.	.	23.74	.	.	5.96642
602	16.72	.	11.56	23.92	.	6.76526	5.97276
603	17.53	.	11.87	23.92	.	6.64763	5.82731
604	17.66	9.46	.	23.96	11.5422	.	5.81434
605	17.96	9.46	.	24.06	11.3494	.	5.78662
606	18.20	9.50	11.96	24.14	11.2471	6.46773	5.76480
607	18.23	9.50	12.07	24.26	11.2286	6.51718	5.78834
608	18.23	9.50	12.07	24.32	11.2286	6.51718	5.80266
609	19.00	9.66	12.16	24.39	10.9550	6.31655	5.69035
610	19.30	9.66	12.36	24.46	10.7847	6.32688	5.65782
611	19.39	9.67	.	.	10.7458	.	.
612	19.76	9.67	.	.	10.5445	.	.
613	20.14	.	12.36	24.72	.	6.07883	5.58407
614	20.14	.	12.36	24.76	.	6.07883	5.59311
615	20.43	.	12.52	24.99	.	6.07528	5.59980
616	20.45	.	12.52	24.99	.	6.06969	5.59670
617	20.72	.	12.56	25.04	.	6.01438	5.56636
618	21.28	.	12.60	25.06	.	5.88380	5.48653
619	21.46	.	12.67	25.12	.	5.86967	5.47305
620	21.62	.	12.87	25.19	.	5.92067	5.46479
621	21.65	.	12.96	25.20	.	5.95428	5.46257
622	21.86	.	13.16	25.34	.	5.99131	5.46224
623	22.07	.	13.16	25.34	.	5.93744	5.43190
624	22.10	.	.	25.74	.	.	5.51326
625	22.10	.	.	25.79	.	.	5.52397
626	22.19	.	13.27	25.86	.	5.95646	5.52582
627	22.20	.	13.27	25.92	.	5.95393	5.53718
628	22.30	9.86	13.36	26.32	9.5271	5.96890	5.60785
629	22.47	9.87	13.56	26.54	9.4646	6.01489	5.62956
630	22.92	9.91	13.67	26.72	9.3164	5.95096	5.60176
631	23.26	9.91	13.67	27.12	9.1802	5.86853	5.63604
632	23.77	9.91	13.67	27.12	8.9832	5.74908	5.56328
633	24.31	10.11	13.76	27.12	8.9610	5.66483	5.48826
634	24.54	10.11	13.76	27.19	8.8770	5.61439	5.47101
635	24.63	10.11	13.76	27.19	8.8445	5.59489	5.45881
636	25.20	10.26	13.96	27.34	8.7727	5.55405	5.41249
637	25.31	10.26	13.96	27.34	8.7346	5.53108	5.39798
638	25.40	.	14.07	27.52	.	5.55586	5.42163
639	25.42	.	14.12	27.52	.	5.57143	5.41899
640	25.85	.	14.12	27.52	.	5.48314	5.36296
641	26.64	.	14.20	27.52	.	5.35822	5.26298
642	27.06	.	14.20	27.67	.	5.27882	5.23973
643	27.44	.	14.20	27.67	.	5.20899	5.19361
644	27.84	10.46	14.27	27.92	8.0956	5.16277	5.19243
645	28.08	10.46	14.57	27.92	8.0264	5.22823	5.16399
646	28.49	.	14.77	28.14	.	5.22702	5.15643
647	28.73	.	14.77	28.24	.	5.18523	5.14682
648	28.77	.	14.77	28.24	.	5.17833	5.14219

Table 8.3-4 (continued). Effective Path Length Values for the Combined Months of July, August, and September, 1977.

OBS	RAIN	ACTS	AV19	AC28	PATH11	PATH19	PATH28
649	29.22	10.67	14.88	28.40	7.86815	5.13993	5.11956
650	29.33	10.67	14.88	28.40	7.83864	5.12147	5.10707
651	29.82	10.71	14.97	28.54	7.73874	5.07128	5.07703
652	30.08	10.71	14.97	29.14	7.67185	5.02924	5.15435
653	30.30	10.71	14.97	29.14	7.61615	4.99421	5.12972
654	31.02	.	15.08	29.54	.	4.91879	5.12006
655	31.12	.	15.08	29.54	.	4.90361	5.10913
656	31.34	.	15.08	29.54	.	4.87054	5.08525
657	31.66	.	15.17	29.76	.	4.85202	5.08853
658	32.03	.	15.57	29.76	.	4.92465	5.04911
659	32.80	.	15.57	29.94	.	4.81340	4.99906
660	32.91	.	15.68	30.07	.	4.83181	5.00942
661	33.13	.	15.72	30.07	.	4.81317	4.98686
662	34.38	.	15.88	30.16	.	4.69175	4.87703
663	34.77	.	15.88	30.16	.	4.64100	4.83937
664	34.88	.	15.88	30.16	.	4.62689	4.82885
665	35.15	10.86	15.97	30.34	6.65722	4.61863	4.83189
666	35.40	10.86	16.17	30.34	6.61020	4.64460	4.80827
667	36.00	.	16.28	30.60	.	4.60095	4.79323
668	36.38	.	16.37	31.14	.	4.57971	4.84225
669	36.82	.	16.37	31.36	.	4.52683	4.83563
670	37.20	10.91	16.57	31.44	6.31932	4.53689	4.81317
671	37.55	10.91	16.68	31.76	6.26042	4.52585	4.83022
672	37.97	10.91	16.68	31.76	6.19117	4.47743	4.79244
673	38.85	11.47	16.77	31.94	6.36152	4.40289	4.74190
674	38.94	11.47	16.77	32.34	6.34682	4.39304	4.79338
675	39.21	.	16.94	32.56	.	4.40798	4.80228
676	39.75	.	16.97	32.67	.	4.35768	4.77161
677	39.84	.	16.97	32.67	.	4.34814	4.76388
678	39.93	.	17.00	32.74	.	4.34632	4.76637
679	39.99	.	17.00	33.14	.	4.34000	4.81941
680	40.07	.	17.00	33.36	.	4.33160	4.84444
681	40.10	11.66	17.17	33.54	6.26531	4.37175	4.86797
682	40.34	11.66	17.37	33.54	6.22803	4.39717	4.84713
683	40.43	11.71	17.48	33.88	6.24082	4.41547	4.88842
684	40.73	11.71	17.77	33.94	6.19485	4.45668	4.87106
685	41.34	11.71	17.88	33.94	6.10344	4.42009	4.81900
686	41.47	.	17.97	34.00	.	4.42883	4.81654
687	42.39	.	17.97	34.34	.	4.33554	4.78771
688	42.59	.	17.97	34.34	.	4.31578	4.77129
689	42.72	.	18.17	34.74	.	4.35092	4.81614
690	42.86	.	18.37	34.96	.	4.38486	4.83506
691	43.50	12.06	18.54	35.54	5.97374	4.36220	4.86217
692	43.71	12.07	18.54	35.76	5.94997	4.34184	4.87498
693	43.96	12.07	18.54	35.94	5.91613	4.31785	4.87900
694	44.13	.	18.57	36.34	.	4.30865	4.91929
695	44.78	.	18.68	36.34	.	4.27301	4.86645
696	45.15	.	18.88	36.34	.	4.28435	4.83688
697	45.22	.	19.17	37.08	.	4.34361	4.92971
698	45.48	.	19.17	37.36	.	4.31946	4.94583
699	46.13	12.11	19.37	37.76	5.65651	4.30469	4.94626
700	46.29	12.11	19.74	38.34	5.63696	4.37217	5.00929
701	46.33	12.11	19.74	39.48	5.63210	4.36849	5.15490
702	46.41	12.46	19.82	39.64	5.78489	4.37884	5.16913

Table 8.3-4 (continued). Effective Path Length Values for the Combined Months of July, August, and September, 1977.

OBS	RAIN	ACTS	AV19	AC28	PATH11	PATH19	PATH28
703	46.41	12.860	20.28	40.5600	5.97059	4.48047	5.28910
704	46.45	12.870	20.57	41.1400	5.97009	4.54073	5.36178
705	47.04	12.910	20.77	41.5400	5.91354	4.52891	5.36254
706	47.70	12.910	20.77	41.5400	5.83172	4.46789	5.30674
707	48.63	.	21.08	42.1600	.	4.45009	5.30813
708	48.71	.	21.08	42.1600	.	4.44297	5.30154
709	48.80	.	21.08	42.1600	.	4.43498	5.29414
710	49.15	.	21.42	42.8400	.	4.47524	5.35051
711	49.55	.	21.57	43.1400	.	4.47112	5.35497
712	49.59	13.060	21.88	43.7600	5.67463	4.53181	5.42860
713	50.18	13.060	22.17	44.3400	5.60791	4.53923	5.45132
714	50.41	13.060	22.17	44.3400	5.58232	4.51904	5.43236
715	50.93	13.260	.	.	5.60994	.	.
716	50.97	13.270	.	.	5.60977	.	.
717	51.02	13.270	.	.	5.60427	.	.
718	51.26	13.510	22.68	45.3600	5.67891	4.54821	5.48682
719	51.31	13.510	22.68	45.3600	5.67337	4.54389	5.48273
720	51.79	13.670	22.94	45.8800	5.68736	4.55441	5.50616
721	52.04	13.860	23.48	46.9600	5.73871	4.63977	5.61498
722	52.84	13.860	23.48	46.9600	5.65182	4.57119	5.54948
723	53.04	14.070	23.77	47.5400	5.71582	4.61061	5.60168
724	53.35	14.070	23.77	47.5400	5.68261	4.58445	5.57655
725	53.88	14.070	23.77	47.5400	5.62671	4.54041	5.53409
726	54.25	14.270	.	.	5.66778	.	.
727	54.36	14.270	.	.	5.65631	.	.
728	54.90	14.460	23.97	47.9400	5.67524	4.49549	5.50007
729	55.74	14.790	24.14	48.2799	5.71728	4.46068	5.47397
730	56.31	14.790	24.14	48.2799	5.65941	4.41653	5.43066
731	56.66	14.870	24.22	48.4400	5.65487	4.40441	5.42232
732	57.25	15.070	24.28	48.5600	5.67187	4.37082	5.39181
733	57.91	.	24.58	49.1600	.	4.37549	5.40951
734	58.40	.	25.29	49.1600	.	4.46492	5.37376
735	58.54	15.260	25.38	.	5.61778	4.47107	.
736	58.59	15.390	25.38	.	5.65983	4.46659	.
737	58.78	15.790	25.58	.	5.78817	4.48754	.
738	59.48	15.870	25.78	.	5.74902	4.47053	.
739	59.54	15.870	25.78	.	5.74323	4.46612	.
740	59.93	16.190	.	.	5.82091	.	.
741	60.00	16.190	.	.	5.81412	.	.
742	60.20	16.470	27.18	.	5.89502	4.65811	.
743	60.26	17.070	27.34	.	6.10369	4.68097	.
744	60.80	17.070	27.34	.	6.04948	4.64025	.
745	60.86	17.270	29.58	.	6.11433	5.01559	.
746	61.14	17.270	30.58	.	6.08633	5.16189	.
747	61.27	17.670	30.78	.	6.21408	5.18485	.
748	61.69	18.095	30.98	.	6.32022	5.18374	.
749	61.82	18.095	31.58	.	6.30693	5.27325	.
750	62.67	18.680	32.18	.	6.42252	5.30202	.
751	63.47	19.280	32.38	.	6.54526	5.26907	.
752	64.97	19.280	32.94	.	6.39414	5.23884	.
753	65.91	.	33.78	.	.	5.29728	.
754	68.03	.	34.59	.	.	5.25840	.
755	69.14	19.480	36.19	.	6.07083	5.41492	.
756	69.67	20.080	36.59	.	6.21021	5.43387	.

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Table 8.3-4 (continued). Effective Path Length Values for the Combined Months of July, August, and September, 1977.

OBS	RAIN	ACTS	AV19	AC28	PATH11	PATH19	PATH28
757	69.85	20.080	37.36	.	6.19421	5.53419	.
758	70.11	20.495	38.96	50.00	6.29878	5.75018	4.72002
759	70.29	20.495	38.96	50.00	6.28265	5.73572	4.71014
760	70.75	20.495	38.96	50.00	6.24180	5.69909	4.68509
761	70.93	20.880	40.16	50.58	6.34292	5.85999	4.72959
762	71.11	20.880	40.39	50.58	6.32686	5.87889	4.71979
763	72.33	22.080	40.99	50.76	6.57762	5.86735	4.67097
764	72.62	23.480	40.99	51.16	6.96675	5.84433	4.69233
765	74.19	24.280	40.99	51.16	7.05166	5.72276	4.61040
766	75.10	25.680	41.76	51.56	7.36789	5.76080	4.59990
767	75.41	27.880	41.76	54.36	7.96622	5.73752	4.83320
768	76.25	29.290	41.76	54.36	8.27690	5.67536	4.78907
769	76.68	.	.	.	.	.	.
770	77.00	.	.	.	.	.	.
771	80.26	.	.	54.36	.	.	4.58901
772	80.38	.	.	54.68	.	.	4.61026
773	80.97	.	.	59.16	.	.	4.95756
774	81.45	.	.	61.16	.	.	5.09984
775	81.94	.	.	61.56	.	.	5.10744
776	82.68	.	.	61.96	.	.	5.10198
777	83.94	.	.	63.16	.	.	5.13504
778	83.94	.	.	64.36	.	.	5.23261
779	85.92	.	.	64.76	.	.	5.16257
780	86.46	.	.	65.88	.	.	5.22411
781	86.59	.	.	67.56	.	.	5.35052
782	88.12	.	.	69.18	.	.	5.39810
783	93.05	.	.	72.38	.	.	5.39185
784	94.01	.	.	73.18	.	.	5.40375
785	94.66	.	.	74.72	.	.	5.48498
786	97.34	.	.	74.72	.	.	5.35498
787	100.00	.	.	77.92	.	.	5.45597
788	102.04	.	.	80.32	.	.	5.52660
789	103.00	.	.	80.32	.	.	5.48192
790	103.58	.	.	80.78	.	.	5.48651
791	106.40	.	.	81.98	.	.	5.43946
792	112.04	.	.	81.98	.	.	5.19936
793	112.73	.	.	.	.	.	.
794	121.73	.	.	.	.	.	.
795	172.64	50.000	50.00	83.52	6.24047	3.02929	3.59297
796	273.13	50.000	58.58	117.16	3.94447	2.24944	3.28678

Table 8-4. Percentage of Time that 11.7 GHz Isolation was Less than the Indicated Value for July, 1977.

OBS	ICTS	PERCENT
1	.	.
2	0.00	0.051
3	11.48	0.052
4	11.67	0.053
5	11.87	0.054
6	12.07	0.055
7	12.28	0.056
8	12.47	0.063
9	12.47	0.064
10	12.87	0.065
11	13.07	0.070
12	13.28	0.071
13	13.87	0.072
14	14.08	0.073
15	14.48	0.074
16	14.67	0.077
17	15.28	0.079
18	15.28	0.081
19	16.08	0.083
20	16.08	0.085
21	16.48	0.086
22	16.68	0.088
23	17.07	0.089
24	17.08	0.090
25	17.28	0.092
26	17.48	0.096
27	17.48	0.097
28	17.97	0.098
29	17.88	0.099
30	17.88	0.100
31	18.47	0.101
32	18.68	0.103
33	18.88	0.104
34	19.27	0.105
35	19.28	0.106
36	19.48	0.107
37	19.68	0.131
38	19.88	0.132
39	20.08	0.134
40	20.28	0.139
41	20.48	0.140
42	20.68	0.141
43	21.08	0.143
44	21.08	0.150
45	21.09	0.151
46	21.48	0.167
47	21.48	0.169
48	21.68	0.176
49	21.88	0.179
50	21.88	0.188
51	21.89	0.191
52	22.08	0.194
53	22.28	0.637
54	22.29	0.638

Table 8-4 (continued). Percentage of Time that 11.7 GHz Isolation was Less than the Indicated Value for July, 1977.

OBS	ICTS	PERCENT
55	22.48	0.640
56	22.68	0.661
57	23.08	0.930
58	23.08	0.932
59	23.48	1.033
60	23.48	1.064
61	23.69	1.068
62	23.88	1.148
63	23.89	1.178
64	24.28	1.263
65	24.29	1.273
66	24.49	1.276
67	24.68	1.894
68	24.69	2.076
69	24.89	2.078
70	25.08	2.111
71	25.09	2.262
72	25.28	2.277
73	25.28	2.279
74	25.29	2.324
75	25.48	2.584
76	25.48	2.854
77	25.49	2.864
78	25.89	3.001
79	25.89	3.002
80	26.08	3.218
81	26.08	3.220
82	26.09	3.394
83	26.28	3.758
84	26.28	3.908
85	26.29	3.913
86	26.68	4.047
87	26.69	4.067
88	26.88	4.691
89	26.89	4.708
90	26.89	4.814
91	27.09	5.189
92	27.09	5.354
93	27.28	5.420
94	27.29	5.455
95	27.48	5.903
96	27.49	6.013
97	27.69	6.536
98	27.69	6.563
99	27.89	6.860
100	27.89	7.214
101	28.08	7.640
102	28.09	7.692
103	28.28	7.760
104	28.28	7.761
105	28.29	7.970
106	28.48	8.005
107	28.49	8.667
108	28.49	8.867

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Table 8-4 (continued). Percentage of Time that 11.7 GHz Isolation was Less than the Indicated Value for July, 1977.

OBS	ICTS	PERCENT
109	28.68	8.868
110	28.69	9.553
111	28.69	9.956
112	28.88	10.136
113	28.89	10.322
114	28.89	10.431
115	29.08	10.579
116	29.09	10.900
117	29.29	13.362
118	29.49	13.727
119	29.49	13.741
120	29.69	14.383
121	29.69	14.392
122	29.89	15.266
123	29.89	16.132
124	30.09	16.911
125	30.09	18.851
126	30.29	19.282
127	30.30	19.313
128	30.49	19.918
129	30.49	19.955
130	30.69	21.021
131	30.69	21.171
132	30.89	21.840
133	30.89	22.636
134	30.90	23.565
135	31.09	23.710
136	31.09	23.790
137	31.10	23.925
138	31.29	24.372
139	31.49	25.001
140	31.49	25.144
141	31.50	25.377
142	31.69	26.007
143	31.69	26.885
144	31.70	27.189
145	31.89	27.693
146	31.89	28.192
147	31.90	29.104
148	32.09	29.110
149	32.09	29.703
150	32.29	30.534
151	32.30	30.803
152	32.49	31.579
153	32.49	31.665
154	32.50	32.090
155	32.50	32.376
156	32.69	33.225
157	32.69	33.945
158	32.70	34.972
159	32.89	35.405
160	32.89	36.081
161	32.90	36.134
162	33.09	37.166

Table 8-4 (continued). Percentage of Time that 11.7 GHz Isolation was Less than the Indicated Value for July, 1977.

OBS	ICTS	PERCENT
163	33.10	37.643
164	33.29	38.561
165	33.30	38.688
166	33.30	38.781
167	33.49	40.668
168	33.49	41.291
169	33.50	41.759
170	33.50	41.793
171	33.69	42.777
172	33.69	43.148
173	33.70	43.161
174	33.89	43.431
175	33.89	44.180
176	33.90	44.316
177	34.09	45.538
178	34.10	45.592
179	34.10	45.666
180	34.29	47.300
181	34.30	47.458
182	34.30	47.465
183	34.40	59.240
184	34.49	59.963
185	34.49	60.075
186	34.69	60.544
187	34.69	60.988
188	34.70	61.020
189	34.70	61.064
190	34.89	61.369
191	34.89	62.255
192	34.90	62.258
193	35.09	62.391
194	35.09	63.632
195	35.10	63.679
196	35.29	64.419
197	35.30	64.523
198	35.49	65.441
199	35.49	66.006
200	35.50	66.022
201	35.50	66.110
202	35.69	66.665
203	35.69	67.141
204	35.89	67.287
205	35.89	67.856
206	35.90	67.865
207	36.09	67.889
208	36.09	69.261
209	36.10	69.290
210	36.29	70.473
211	36.49	70.953
212	36.49	71.163
213	36.50	71.193
214	36.50	71.240
215	36.69	71.884
216	36.69	72.137

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Table 8-4 (continued). Percentage of Time that 11.7 GHz Isolation was Less than the Indicated Value for July, 1977.

OBS	ICTS	PERCENT
217	36.89	72.408
218	36.89	73.306
219	36.90	73.353
220	37.09	74.169
221	37.10	74.196
222	37.29	74.887
223	37.30	74.903
224	37.30	75.052
225	37.49	76.283
226	37.49	76.291
227	37.50	76.445
228	37.69	76.921
229	37.69	77.114
230	37.70	77.137
231	37.70	77.345
232	37.89	77.349
233	37.89	77.792
234	37.90	77.833
235	38.09	78.676
236	38.10	78.766
237	38.10	78.783
238	38.29	79.755
239	38.30	79.932
240	38.30	80.570
241	38.49	80.736
242	38.50	80.987
243	38.69	80.990
244	38.69	81.494
245	38.70	81.500
246	38.70	82.504
247	38.89	82.681
248	38.90	83.124
249	39.09	83.333
250	39.10	84.193
251	39.10	84.505
252	39.30	85.106
253	39.30	85.249
254	39.50	85.907
255	39.50	86.670
256	39.70	87.345
257	39.90	88.463
258	40.10	89.272
259	40.10	89.418
260	40.30	89.610
261	40.30	89.735
262	40.50	90.297
263	40.50	91.266
264	40.70	91.604
265	40.90	92.458
266	41.10	92.859
267	41.10	92.880
268	41.11	92.892
269	41.30	93.543
270	41.30	93.818

9. COMPARING ISOLATION DATA FOR DIFFERENT POLARIZATIONS AND FREQUENCIES

The previous chapters indicated a close relationship between the attenuations of 19 GHz horizontally and vertically polarized signals and between the attenuations of vertically polarized signals at 19 and 28 GHz. Apparently the corresponding isolations are not nearly so well correlated. Figure 9-1, for example, presents one month of 19 GHz vertical and horizontal attenuation data; there is little correlation at low isolation levels (say below 20 dB) and none at high values. Isolations on two different frequencies on a common path show even less correlation. See Figure 9-2 which compares 28 and 19 GHz vertical isolation for September, 1977. Future reports will discuss the problem in more detail.

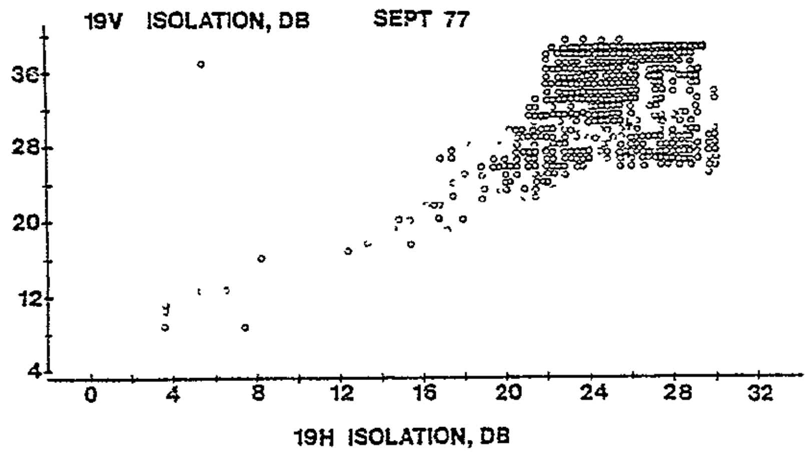

Figure 9-1. Comparison of measured polarization isolations during September, 1977, for vertically and horizontally polarized 19 GHz signals

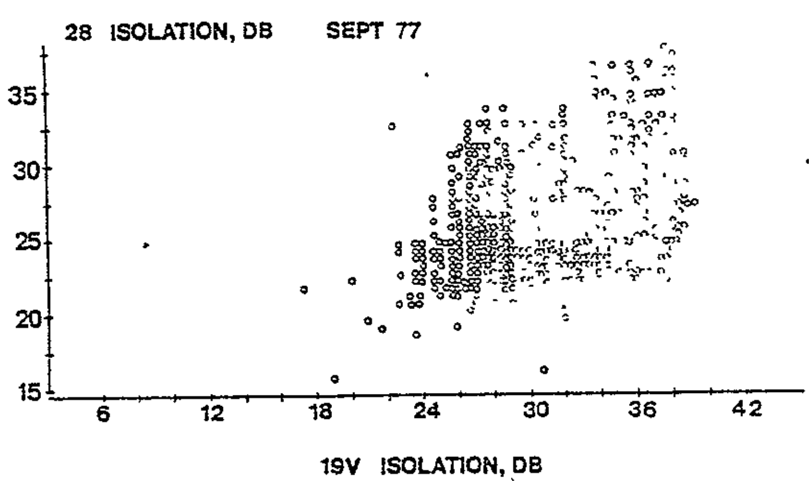

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Figure 9-2. Comparison of measured polarization isolations during September, 1977, for 28 and 19 GHz signals.

10. REFERENCES

1. D. C. Hogg and T. S. Chu, "The Role of Rain in Satellite Communications," Proceedings of the IEEE, Vol. 63., No. 9, pp. 1308-1331, September 1975.

2. D. B. Hodge, "Frequency Scaling of Rain Attenuation", IEEE Transactions on Antennas and Propagation, Vol. AP-25, No. 3, pp. 446-447, May 1977.

3. L. J. Ippolito, 20 and 30-GHz Millimeter Wave Experiments with the ATS-6 Satellite, Technical Note D-8197, National Aeronautics and Space Administration, Washington, D.C., 20546, April, 1976.

4. L. J. Ippolito, "Effects of Precipitation on 15.3 and 31.65 GHz Earth-Space Transmissions with the ATS-V Satellite", Proc. IEEE, Vol. 59, No. 2, pp. 189-205, February, 1971.

5. W. L. Nowland, R. L. Olsen, and I. P. Shkarofsky, "Theoretical Relationship Between Rain Depolarization and Attenuation", Electronics Letters, Vol. 23, No. 22, pp. 676-678, October 2, 1977.