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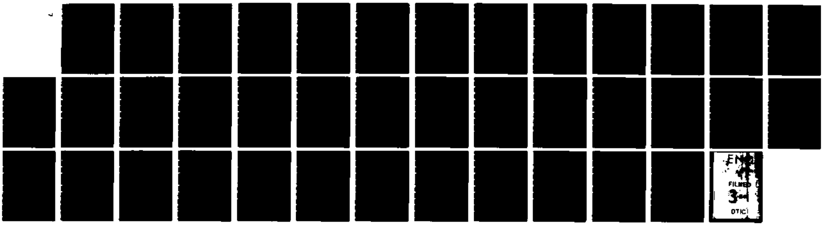

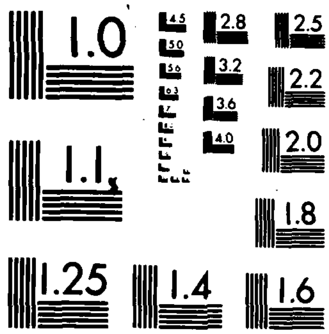

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INVESTIGATE AND VERIFY THE VALIDITY OF MATHEMATICAL FORMULAS IN RELATION TO DATA OBTAINED FROM THEORETICAL INVESTIGATIONS & EXPERIMENTAL OBSERVATIONS

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Final Report
May 1980 - September 1983

28 October 1983

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AIR FORCE GEOPHYSICS LABORATORY
AIR FORCE SYSTEMS COMMAND
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This report presents a summary of analyses and mathematical modelling done in support of some AFGL atmospheric research projects. In particular, work on the problems of C_n^2 studies, estimating one-minute rainfall rates, interactive system for "J4" data base, and interactive system for "IE" data base are discussed.

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C_n^2 (OPTICAL) STUDIES IN THE FREE ATMOSPHERE BASED ON RAWINSONDE DATA

1. INTRODUCTION

For the past year and one-half, we have been investigating the effects of clear air turbulence on optical beam propagation. In particular, we have used several models, especially that developed by VanZandt et al [1981], to calculate the refractive index structure constant, C_n^2, from rawinsonde data. Our goal is to study this parameter as a long-term function of time and as a function of latitude and longitude. In that we are interested in C_n^2 at optical frequencies, humidity effects have been neglected throughout.

2. DATA BASE

The rawinsonde data which we used in our investigations is the same as that used in earlier studies by BEDFORD RESEARCH on patterns of occurrences of Richardson numbers of less than unity [Murphy et al, 1982 and Murphy and Scharr, 1981]. This data base consists of twice daily "upper air observations" of winds, temperature and pressure taken at 0000 and 1200 h GMT at some 144 stations, mainly in the United States and South America, and dates from the 1950's to the present. Curve-fitting algorithms developed for the above-mentioned research are used to smooth the data and to facilitate calculating the gradients of the potential temperature and wind speed. The various atmospheric parameters needed are then stored in 1 kilometer bins for altitudes from 1km to 25km, for future use. For more details, see the above-cited references.

Although C_n^2 can be measured via radar or stellar interferometers, for example, there is a tremendous advantage in using the rawinsonde data base. It provides the only data base which (a) dates back over a period of years; other methods of measurement have become feasible only recently and have yet to be done systematically over an extended period of time; and (b) covers a wide range of latitude and longitude. These two features are essential in developing a climatology for any atmospheric variable. The disadvantage in using the rawinsonde data base is that C_n^2 is not directly calculable; a model is needed.

3. A MODEL FOR C_n^2

The well-known work of Tatarskii [1971] leads to an equation which relates C_n^2 to the values of pressure, the outer scale length of turbulence, temperature, and the gradient of the potential temperature. It is important to note that these values must be measured "in situ" and that the above-mentioned formula holds only in the presence of mechanical turbulence. It is the model of VanZandt et al [1981] which deals with these two problems and allows us to model C_n^2 from rawinsonde data which has been smoothed over kilometer intervals and which may or may not have been taken in a mechanically turbulent layer.

Stripped of its rich detail, this model uses the values of the required parameters obtained from rawinsonde data and, hence, values averaged over 1 kilometer, to estimate the fraction of the kilometer level which is turbulent. Probability distribution functions are assumed for the outer scale length of turbulence, and the gradients of potential temperature and wind velocity. Tatarskii's formula is then integrated with weighting determined from these distribution functions. In the integration, only points for which the Richardson number is less than 1/4 (the usual criteria for mechanical turbulence) are kept. Good agreement between this model and simultaneous measurements by radar [VanZandt et al, 1981; Crane, 1980] and stellar interferometer [Good et al] has been obtained. At present, we are also making comparisons of this model with thermosonde measurements.

4. RESULTS

For no special reason, we did all of our calculations for the year 1974. For stations of varying latitude and longitude (see Table 1 for a listing), C_n^2 was calculated from VanZandt's model at each kilometer level from 1 to 25 kilometers for each of the 2 daily balloon launches. For each of the four seasons, the median value at each altitude was then calculated.

A series of plots were drawn examining seasonal and latitudinal variations of C_n^2 as a function of altitude. Different combinations of stations and seasons were overlaid to examine the structure of the median C_n^2 values over 1-25 km. For examples of typical results, see Figures 1 and 2. Note that these are semilog plots.

The results of graphical analysis include the following:

1) All four stations were overlaid (for the four seasons). As latitude increases, there is a distinct decrease in C_n^2 between 10 and 20 km, although summer plots were less distinct.

2) Seasonal differences were also noted when plotting winter/summer for each station. The winter curve was fairly linear from 1 to 25 km, while the summer curve had an inflection point around 10 km.

A non-parametric test called a median test was selected to measure the distributional differences between the four (latitude or season) groups. Tables 2 and 3 summarize the results of seasonal and latitudinal analysis for each kilometer. As apparent from Tables 2 and 3, there is significant evidence to show that statistically different median C_n^2 values exist season to season or latitude to latitude.

One noticeable feature of all the graphs of C_n^2 versus z on a semilog plot is a linear drop-off above (approximately) 15 km. This phenomenon has also been noticed in radar measurements [Balsley and Peterson, 1981] and has led to the definition of the drop-off rate of C_n^2 (in dB/km) as

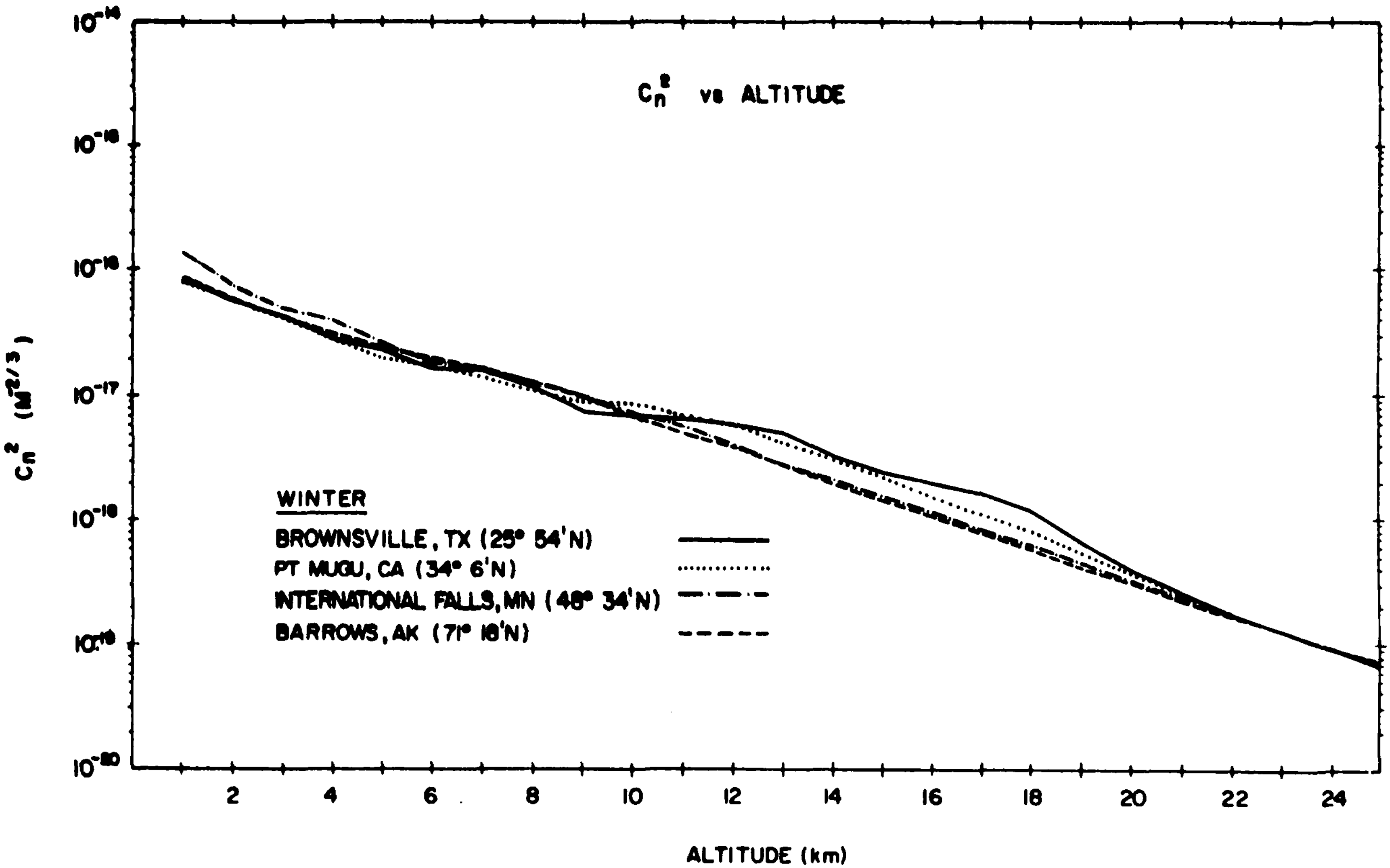
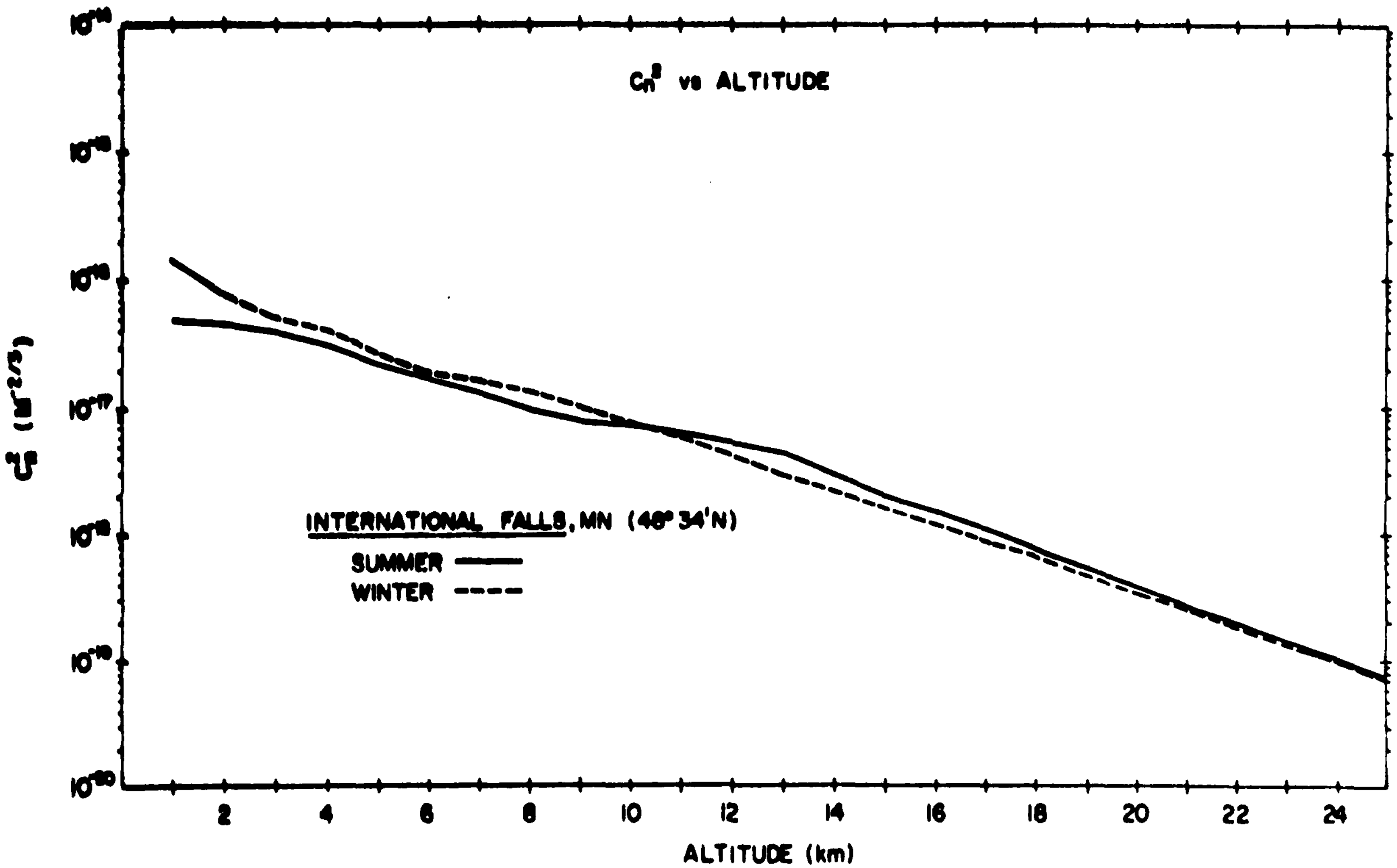

Cn² vs ALTITUDE
WINTER
BROWNSVILLE, TX (25° 54'N)
PT MUGU, CA (34° 6'N)
INTERNATIONAL FALLS, MN (48° 34'N)
BARROWS, AK (71° 18'N)
Cn² (M^-2/3)
10^-14
10^-15
10^-16
10^-17
10^-18
10^-19
10^-20
2
4
6
8
10
12
14
16
18
20
22
24
ALTITUDE (km)

FIGURE 1



C_n^2 vs ALTITUDE
INTERNATIONAL FALLS, MN (48°34'N)
SUMMER
WINTER
C_n^2 ($m^{-2/3}$)
10^{-14}
10^{-15}
10^{-16}
10^{-17}
10^{-18}
10^{-19}
10^{-20}
2
4
6
8
10
12
14
16
18
20
22
24
ALTITUDE (km)

FIGURE 2

$-10 \log[C_n^2(z_2)/C_n^2(z_1)]/z_2-z)$ where $C_n^2(z_1)$ is the value of C_n^2 at altitude z_1. For z_1 greater than about 15 km, we expect this rate to be a constant. This parameter was verified to be a constant from 15 km up to 25 km as calculated for each of the stations studied for each season. See Table 1. We observed very little seasonal and longitudinal variation and a systematic increase with decreasing latitude, results which are consistent with radar observations. We have also calculated the drop-off rate for the atmospheric density in dB/km since we expect this to be the major contribution to the drop-off in C_n^2. See Table 1.

One of the typical uses of C_n^2 is in calculating the coherence length, r_0, of an optical beam. r_0 is a measure of the transverse distance over which a beam remains coherent in the presence of clear air turbulence. For propagation down through the atmosphere,

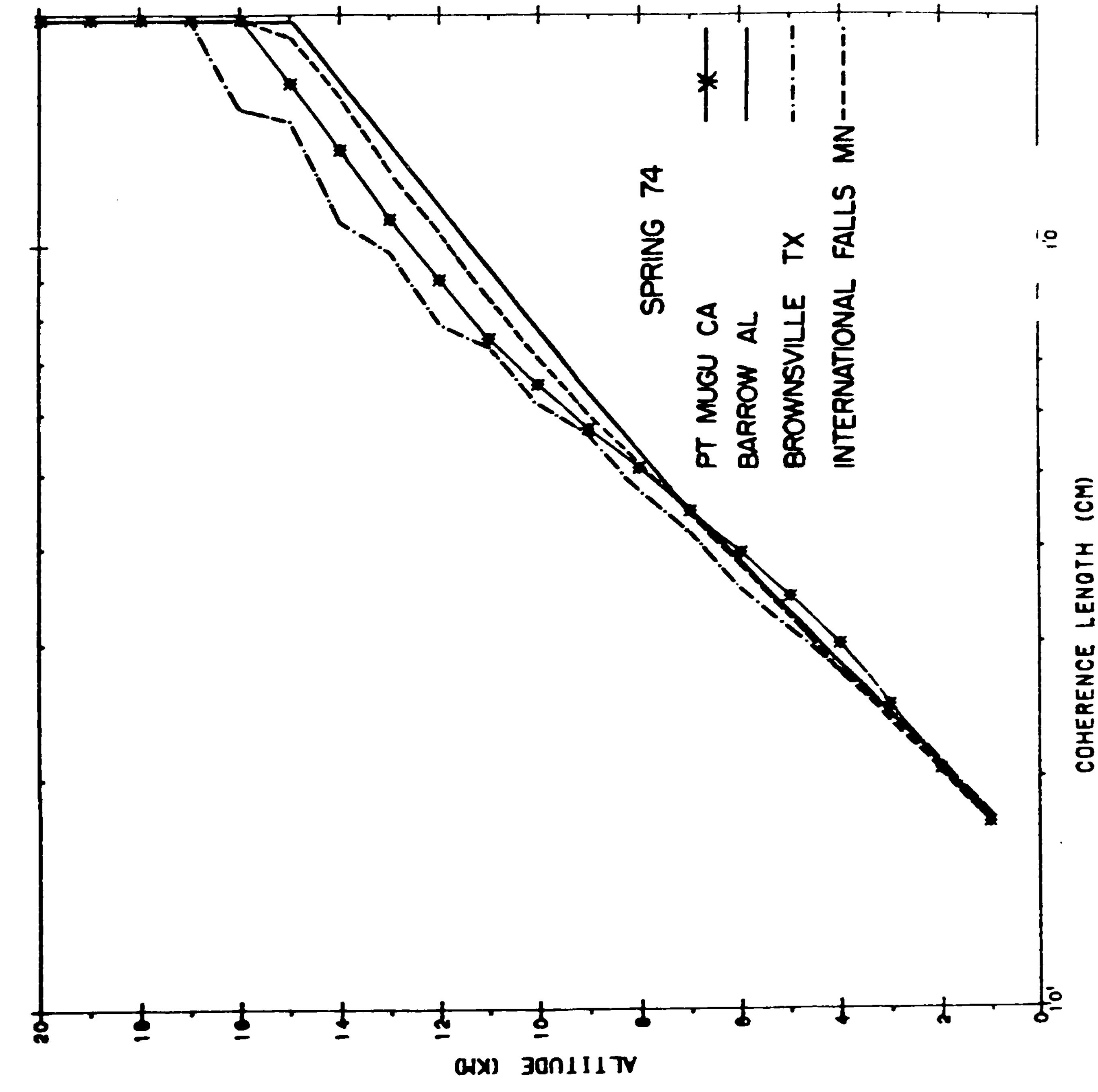
$$r_0(z) = [\ .06\ \lambda^2 / \int_{z_0}^{\infty} C_n^2(z)\ dz\ ]^{3/5}$$

Here, λ is the optical wavelength (which we take as 500 nm in calculations), and z is the altitude above MSL. Using our results for C_n^2 from VanZandt's model, we have calculated r_0 for the various stations sampled. See Figure 3 for typical results.

We have also used a model created by Hufnagel [1974] for C_n^2 which is basically an empirical formula with input of z and the rms wind speed from z=5 to 20 km. Rather poor agreement for calculated values of r_0 between this model and VanZandt's has been obtained, except for moderate wind speeds.

5. CONCLUSIONS

The model of VanZandt et al [1981] provides a viable method of using rawinsonde data to develop a climatological study of C_n^2 for various locations in this country. We have used this model to calculate C_n^2 at various stations of differing longitude and latitude for each season of



SPRING 74
PT MUGU CA
BARROW AL
BROWNSVILLE TX
INTERNATIONAL FALLS MN
ALTITUDE (KM)
COHERENCE LENGTH (CM)

FIGURE 3

1974. The results were then used to calculate the drop-off rate of C_n^2 and the coherence length r_0, as typical applications.

In the future, we plan to:

a. Look at comparisons of VanZandt's model and direct measurements of C_n^2 by thermosonde and scintillometer,

b. Systematically compare the drop-off rate in density with that of C_n^2, and

c. Use VanZandt's model to investigate what value of the Richardson number, based on rawinsonde data, should be used as an indication of turbulence in an observed layer. (The usual choice of 1/4 is for "in situ" measurements and is probably much too stringent for measurements averaged over a kilometer.)

TABLE 1

C_n^2 Drop-Off Rate (In db/km) for the Four Seasons at Various Latitudes, 1974

Station	Latitude	Winter	Spring	Summer	Fall
Barrow, AK	71° 28N	1.30	1.30	1.31	1.32
International Falls, MN	48° 34N	1.36	1.40	1.44	1.42
Great Falls, MT	111° 21W	1.37	1.43	1.45	1.45
Sault Sainte Marie, MI	84° 22W	1.37	1.43	1.45	1.43
Chatham, MA	41° 40N	1.49	1.54	1.52	1.48
Pt. Mugu, CA	34° 06N	1.52	1.54	1.54	1.53
Brownsville, TX	25° 54N	1.68	1.69	1.55	1.63
San Andres, Columbia	12° 35N	1.71	1.58	1.59	1.69

TABLE 2

Results of Median Test

$\chi^2_{critical}$ = 7.81, Degrees of Freedom = 3

* Indicates non-rejection of differing distributions

ALT	WINTER	SPRING	SUMMER	FALL
1	16.77	13.68	22.77	6.93*
2	13.20	3.96*	13.96	4.75*
3	8.80	9.27	25.28	0.94*
4	26.75	12.11	52.09	2.73*
5	25.25	49.59	6.29*	23.47
6	12.69	39.42	11.78	13.13
7	6.59*	35.20	11.08	9.41
8	9.21	39.16	7.64*	18.59
9	9.50	28.38	9.63	15.41
10	18.83	28.20	22.60	7.41*
11	82.63	43.92	94.29	75.33
12	140.19	90.54	26.70	136.30
13	213.70	160.14	70.33	168.21
14	229.28	230.14	171.19	216.50
15	242.40	363.35	209.91	243.52
16	270.83	404.65	260.06	345.92
17	261.89	388.56	221.85	312.08
18	188.40	287.23	193.36	169.55
19	154.28	262.32	163.49	132.57
20	102.97	174.87	140.62	109.73
21	44.71	117.13	105.86	46.64
22	27.15	39.98	42.93	63.89
23	7.55*	20.66	7.49*	26.60
24	9.11	28.46	84.48	9.85
25	14.38	30.29	27.97	13.01

TABLE 3

Results of Median Test

$\chi^2_{critical} = 7.18$, Degrees of Freedom = 3

* Indicates non-rejection of differing distributions

ALT	BARROW	INTNL. FALLS	PT. MUGU	BROWNSVILLE
1	26.71	67.24	16.98	47.17
2	46.73	28.65	13.05	47.57
3	31.15	16.66	29.78	28.55
4	8.27	13.75	31.29	18.08
5	21.64	20.22	4.03*	11.20
6	10.21	10.53	8.44	12.64
7	39.77	6.38*	9.94	18.21
8	44.38	31.73	7.01*	28.62
9	26.68	19.45	5.69*	29.31
10	9.82	4.97*	11.15	15.76
11	72.44	8.28	59.39	30.37
12	81.95	35.29	60.03	54.95
13	125.30	92.43	11.42	30.97
14	128.77	63.91	4.74*	26.59
15	188.14	74.44	19.93	18.22
16	207.15	118.09	45.32	28.90
17	182.60	105.92	8.41	78.08
18	141.02	74.05	6.61*	88.15
19	144.50	65.92	3.63*	34.73
20	188.07	94.95	23.59	4.49*
21	161.49	90.86	45.84	29.70
22	136.62	145.68	87.43	70.58

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A MODEL FOR ESTIMATING ONE-MINUTE RAINFALL RATES

1. ABSTRACT

A model for examining one-minute rainfall rates has been developed using stepwise regression analysis. The model is made up of six regression equations to estimate rates that equalled or exceeded 0.01, 0.05, 0.10, 0.50, 1.0 and 2.0 percent of the time during a month at a given location. Information required to make the estimates consisted of monthly mean temperature, monthly mean precipitation, number of days a month with precipitation (based on any of three threshold values that define a rainy day), and latitude. The model is not valid when the mean monthly temperature is $\leq 0^{o}$C (32^{o}F), when there is less than one rainy day in the month, or when a precipitation index (the ratio of monthly precipitation to the number of rainy days) is less than 2mm day^{-1}; precipitation rates are not usually of concern during these cold or dry months, since they are likely to be quite low.

2. INTRODUCTION

Rain is a major cause of attenuation of radio waves (frequencies > 10 GHz) traversing the troposphere. Knowledge of the frequency distribution of short-duration rainfall rates is needed to estimate signal loss for the design and operation of systems that utilize these frequencies (e.g., communications, surveillance). One-minute rainfall rates, commonly referred to as "instantaneous" rates, have been recognized as the most practical for these calculations. Instantaneous rainfall-rate statistics also have applications in other areas, such as the design and operation of aerospace vehicles and radar systems.

3. DATA ANALYSIS

Monthly frequency distributions of instantaneous rates for 12 locations were available. The locations were Flagstaff AZ, Franklin NC, IL Gauge (20 miles NW of Urbana,IL) Island Beach NJ, Majuro Marshall Islands, Miami FL, Panama Canal Zone, Paris France, Preston England, Reading England, Urbana IL, and Woody Island AK. The type of rain gauge varied with location but all were modified to allow determination of one-minute rates. A precipitation index was developed that expresses the total monthly precipitation divided by the number of days with "precipitation" (where "precipitation" is defined using threshold levels). The minimum threshold amount of precipitation to define a rainy day varies with country. Three of the most common threshold values used worldwide to define a rainy day are 0.25 mm, 1 mm, and 2.54 mm. The number of rainy days during the month, based on each of these threshold amounts, as well as monthly precipitation and monthly mean temperature, were observed coincident with the rain-rate frequencies. Therefore, the primary independent variables used to develop the rain-rate model were :

T monthly mean temperature

I precipitation index (mm day^{-1})

L latitude

It has been established that the contribution of temperature to estimating rates in the tropics is minimal (due to high constant temperatures), but becomes substantial at middle latitudes. A variable was created that weighs the importance of temperature given the variables:

$$f(L,T) = \begin{cases} 0 & L \leq 23.5^{\circ} \\ (L - 23.5), & 23.5^{\circ} < L \leq 40^{\circ} \\ (40 - 23.5), & L > 40^{\circ} \end{cases}$$

The variables T, I, L, f(L,T) were determined to best represent the six exceedence levels (p = 0.01, 0.05, 0.10, 0.50, 1.0, 2.0% of the time during the month) available for our limited data source of rainfall rates. The equation is expressed by

$$R_p = A_p + B_pT + C_pI + D_pf(L,T) \qquad (1)$$

where R_p is the estimated precipitation rate (mm min^{-1}) for exceedence level p; A_p is the constant; and B_p, C_p and D_p are multiple regression coefficients for T, I and f(L,T), respectively, for exceedence level p.

Multiple stepwise regression analysis was chosen as the method to select the best set of the above-mentioned candidate variables for modeling rainfall rates. The procedure works by first selecting the variable having the highest correlation with the dependent variable (rain-rate). It then proceeds to couple each of the remaining candidate variables with the one selected to get the highest joint correlation with rainfall rate, thus improving the estimation of rain-rate. A .05 level of significance was selected; therefore, variables must make a signficant contribution (95 percentile) to be entered into the model. The regression package that was used also has an option called a "backwards glance" which removes a variable if it becomes insignificant after adding other terms. The cut-off level for the backwards glance option was given as .10.

Results of the stepwise multiple regression analysis for each of the six exceedence levels are given in Tables 1, 2, and 3 for indices based on rainy day threshold values of 2.54 mm, 1 mm, 0.25 mm, respectively. The t-statistic is used to determine if there is a significant reduction in variation between the estimated and actual rates for each of the independent variables. The larger the absolute value of the t-statistic, the greater the reduction in variance. An absolute value greater than 1.96 indicates the variable is significant at the 5 percent level. All of the independent variables significantly reduce the variance of the estimated rates except for T at p=2.0%. Since T significantly reduces the variance at five of the exceedence levels, its use in the model, in addition to the f(L,T) term, is justified. The regression coefficients and constants to be used to estimate rates in Eq. (1) are provided in Tables 1, 2, and 3.

An alternative model was developed allowing exceedence level (p) to be an independent variable. Analysis of scatter diagrams found a linear transformation of p to rain-rate was accomplished by ln(p). The set of independent variables therefore, consisted of ln(p), T, I, f(L,T):

$$R_p = b_o + b_1T + b_2I + b_3f(L,T) + b_4\ln(p) \qquad (2)$$

where b_o is a constant, b_1, b_2, b_3 and b_4 are multiple regression coefficients, and p is the exceedence level.

Results of the stepwise multiple regression analysis including the coefficients and constants for estimating rates in Eq. (2) were done for a threshold value of 2.54 mm for I. The SEE's for the comprehensive model calculated for each exceedence level based on a threshold of 2.54 mm for I are 0.61, 0.30, 0.21, 0.25, 0.32, 0.39 for p = 0.01, 0.05, 0.10, 0.50, 1.0, and 2.0%, respectively. Comparisons with the SEE's for the models in Tables 1, 2 and 3 indicate a substantial loss in precision using the comprehensive model. When estimates of rates are required at other than the six exceedence levels used for the improved model, better results would be obtained by interpolating between exceedence levels rather than by using the comprehensive model.

TABLE 1 Results of stepwise multiple regression for exceedence levels p = 0.01, 0.05, 0.10, 0.50, 1.0, 2.0% based on a threshold value of 2.54 mm for I. The regression coefficients are given for each independent variable. The t-statistic corresponding to the variable is shown in parenthesis.

p	Constant A_p	T B_p	$I_{2.54}$ C_p	f(L,T) D_p	R	SEE (mm min^{-1})
0.01	−0.91	2.8×10^{-2} (10.7)	2.3×10^{-2} (5.3)	-3.4×10^{-4} (−3.1)	0.83	0.43
0.50	−0.50	1.6×10^{-2} (10.7)	1.9×10^{-3} (6.7)	-3.1×10^{-4} (−5.2)	0.86	0.24
0.10	−0.31	1.1×10^{-2} (9.5)	1.4×10^{-2} (6.7)	-3.0×10^{-4} (−6.2)	0.85	0.19
0.50	−0.01	2.5×10^{-3} (4.5)	5.4×10^{-3} (5.1)	-1.5×10^{-4} (−6.4)	0.76	0.09
1.0	0.03	7.4×10^{-4} (2.2)	2.9×10^{-3} (4.7)	-7.6×10^{-5} (−5.5)	0.67	0.06
2.0	0.04	-2.0×10^{-4} (−1.2)	1.5×10^{-3} (5.6)	-3.2×10^{-5} (−5.4)	0.64	0.02

TABLE 2 Results of stepwise multiple regression for exceedence levels $p = 0.01, 0.05, 0.10, 0.50, 1.0, 2.0\%$ based on a threshold value of 1 mm for I. The regression coefficients are given for each independent variable. The t-statistic corresponding to the variable is shown in parenthesis.

p	Constant A_p	T B_p	$I_{1.00}$ C_p	f(L,T) D_p	R	SEE ($mm\ min^{-1}$)
0.01	-1.00	2.8×10^{-2} (11.2)	3.6×10^{-2} (6.5)	-2.2×10^{-4} (-2.1)	0.84	0.41
0.50	-0.56	1.6×10^{-2} (11.5)	2.5×10^{-2} (8.1)	-2.4×10^{-4} (-4.0)	0.88	0.23
0.10	-0.36	1.1×10^{-2} (10.2)	2.0×10^{-2} (8.2)	-2.4×10^{-4} (-5.1)	0.87	0.18
0.50	-0.03	2.4×10^{-3} (4.7)	7.8×10^{-3} (6.7)	-1.2×10^{-4} (-5.4)	0.79	0.09
1.0	0.02	6.9×10^{-4} (2.2)	4.2×10^{-3} (6.0)	-6.2×10^{-5} (-4.5)	0.71	0.05
2.0	0.04	-1.8×10^{-4} (-1.3)	2.0×10^{-3} (6.4)	-2.6×10^{-5} (-4.4)	0.67	0.02

TABLE 3 Results of stepwise multiple regression for exceedence levels p = 0.01, 0.05, 0.10, 0.50, 1.0, 2.0% based on a threshold value of 0.25 mm for I. The regression coefficients are given for each independent variable. The t-statistic corresponding to the variable is shown in parenthesis.

p	Constant A_p	T B_p	$I_{0.25}$ C_p	f(L,T) D_p	R	SEE (mm min^{-1})
0.01	-1.00	2.8×10^{-2} (11.4)	4.2×10^{-2} (6.8)	-2.2×10^{-4} (-2.2)	0.85	0.41
0.50	-0.56	1.6×10^{-2} (11.9)	3.0×10^{-2} (8.9)	-2.3×10^{-4} (-4.1)	0.88	0.22
0.10	-0.36	1.1×10^{-2} (10.6)	2.4×10^{-2} (9.2)	-2.3×10^{-4} (-5.2)	0.88	0.17
0.50	-0.03	2.3×10^{-3} (4.8)	1.0×10^{-2} (8.6)	-1.2×10^{-4} (-5.6)	0.82	0.08
1.0	0.01	5.6×10^{-4} (2.0)	6.0×10^{-3} (8.3)	-5.6×10^{-5} (-4.5)	0.77	0.05
2.0	0.03	-2.3×10^{-4} (-1.9)	2.8×10^{-3} (8.8)	-2.4×10^{-5} (-4.4)	0.74	0.02

INTERACTIVE SYSTEM FOR "J4" DATA BASE CREATION (J.4.D.B.C.)

At the present time there is an "F6" satellite circling the earth. On board is an electronic box containing 40 probes which record ion and electron count values. Every second, approximately 400 bits (50 bytes) of information are recorded and transmitted to a ground station. There it is collected and sent to Offutt Air Force Base in Nebraska where the data is archived on tape. One tape holds approximately one day of data. After the tape has been created, it is sent to AFGL for processing.

The purpose of the interactive system for "J4" data base creation (J4DBC) is to create a data base from the raw data tapes received from Offutt. The data base consists of raw data which has been edited, corrected, and packed onto high density tapes.

The aim of J4DBC is to create this data base with a minimum of clerical effort. The user is prompted for such things as processing option desired, input and output tapes to be used, etc. The various batch jobs for creation of the data base are then generated automatically. The user merely answers the prompts, then batches the created job onto the computer input queue.

All data is processed in units of half a calendar month (approximately 15 days). Either the first or second half of a calendar month is processed (e.g, 1-15 January or 16-31 January, etc.).

Four different options (batch jobs) can be created. They are as follows:

1) Merging of raw data tapes.

Since the raw data tapes contain only one day of data, it is necessary to reduce the number of tapes for the production runs which process approximately 15 days of data. Six raw data tapes are concatenated onto one output tape.

2) The creation of a raw data base.

One half a calendar month is processed. Output is put onto a scratch tape for future copying to a data base tape.

3) Copy the output of (2) onto a data base tape.

Approximately six to seven half-month outputs from (2) can be put onto one data base tape. The production runs do not put data directly onto a data base tape because too many problems occur, such as dead starts in the system or partial labels being put on the data base multi-file tapes. Several jobs can be run simultaneously without affecting one another.

4) Create back-up tape for a given tape.

Exact copy is made including file names.

OPERATIONAL PROCEDURES

The following procedures should be done in the specified order to create the "J4" data base.

1) As soon as an integral multiple of six tapes are received from Offutt, they can be concatenated onto one output tape.

2) As soon as a complete half-month of data is on the output tapes of (1), the data base can be created for this half-month. This output tape should be a temporary scratch tape.

3) Add the data of the output from (2) onto a data base tape. Approximately 6 or 7 half-months of output from (2) can be put onto one data base tape.

HOW TO USE THE INTERACTIVE SYSTEM (J4DBC)

Anyone with a valid password for the CDC6600 computer at AFGL may utilize this interactive software system (J4DBC). The user merely logs into the computer which responds with

COMMAND

The user response is

ATTACH,BJG,BJGHARDY,ID=MEEHAN1(return)

System response is

COMMAND

User response is

BJG (return)

The user is now prompted for such things as full or short prompting, name of job, accounting number of job, processing option desired, tapes needed, etc. All these prompts should be self-explanatory. Upon exit from J4DBC, the system responds with

COMMAND

The batch job created by 'J4DBC' is now on file 'XX'. The user response should be

BATCH,XX,INPUT,91

The batch job to do the particular processing option specified by the prompts is now on the input queue of the CDC computer and its output will be sent to terminal AC.

INTERACTIVE SYSTEM FOR "J4" DATA RETRIEVAL (J.4.D.R.)

At the present time there is an "F6" satellite circling the earth. On board is an electronic box containing 40 probes which record ion and electron count values. Every second, approximately 400 bits (50 bytes) of information are recorded and transmitted to a ground station. There it is collected and sent to Offutt Air Force Base in Nebraska where the data is tagged with ephemeris data (that is, data that shows position of the satellite with respect to Earth — altitude, geographic latitude, etc.) This tagged "J4" data is then archived onto magnetic tape.

The above tapes are then sent to AFGL for further processing. This processing consists of editing, correcting and packing the J4 data onto high density tapes. The data is organized into files of half-calendar months (i.e., there are two files for January: the first is January 1-15; the second, January 16-31). These packed half-month files of J4 data are the data base for which the J4 data base retrieval system (J4DBR) is written.

The purpose of J4DBR is to enable anyone who logs in via intercom to the CDC 6600 computer at AFGL to retrieve any part of the created data base of J4 data. This system includes utility programs to enable the user to print out, graphically display, and further analyze the J4 data.

The system is completely interactive. That is, once access is gained, a running conversation can take place between the user and the system. At the termination of an interactive session, a batch job is created. This job reflects the processing desired by the user after answering various prompts.

HOW TO USE THE INTERACTIVE SYSTEM J4DBR

Anyone with a valid password for the CDC 6600 computer at AFGL may utilize this interactive software system (J4DBR). The user merely logs into the computer which then responds with

COMMAND

The user response is

ATTACH,BJG,BJGHAPP,ID=MEEHAN1,MR=1

System response is

COMMAND

User response is

BJG (return)

The user is now prompted for such things as

1. Full or short prompting

2. Do you want a listing of data base files
   and the tapes they are on

3. Processing option desired

4. etc.

.

.

.

.

All these prompts should be self-explanatory. Upon exit from J4DBR, the system responds with

COMMAND

The batch job created by J4DBR is now on file "XX". The user response should be

BATCH,XX,INPUT,91

The batch job to do the particular processing option (specified in the above interactive session) is now on the input queue of the CDC computer and its output will be sent to terminal AC.

INTERACTIVE SYSTEM FOR "IE" DATA BASE CREATION (I.E.D.B.C.)

At the present time there is an "F6" satellite circling the earth. On board is an electronic box containing 20 probes which record ion and electron count values. Every second, approximately 200 bits (25 bytes) of information are recorded and transmitted to a ground station. There it is collected and sent to Offutt Air Force Base in Nebraska where the data is archived on tape. One tape holds approximately one day of data. After the tape has been created, it is sent to AFGL for processing.

The purpose of the interactive system for "IE" data base creation (IEDBC) is to create two data bases from the raw data tapes received from Offutt. The first data base consists of raw data which has been edited, corrected, and packed onto high density tapes. This is known as Phase 1. The second data base consists of raw data separated into what is known as "sweep" and "non-sweep" data and converted into current and density values. This is known as Phase II.

The aim of IEDBC is to create these two data bases with a minimum of clerical effort. The user is prompted for such things as processing option desired, input and output tapes to be used, etc. The various batch jobs for creation of the data bases are then generated automatically. The user merely answers the prompts, then batches the created job onto the computer input queue.

All data is processed in units of half a calendar month (approximately 15 days). Either the first or second half of a calendar month is processed (e.g, 1-15 January or 16-31 January, etc.).

Five different options (batch jobs) can be created. They are as follows:

1) Merging of raw data tapes.

Since the raw data tapes contain only one day of data, it is necessary to reduce the number of tapes for the production runs which process approximately 15 days of data. Six raw data tapes are concatenated onto one output tape.

2) Phase 1 - The creation of a raw data base.

One half a calendar month is processed. Output is put onto a scratch tape for future copying to a data base tape.

3) Phase II - The creation of a reduced data base with "sweep" and "non-sweep" separated.

A half-month of Phase I output is processed. Output is put onto a scratch tape for future copying to a data base tape.

4) Copy the output of a Phase I or Phase II production run onto a data base tape.

Six half-month outputs of Phase I or Phase II can be put onto one data base tape. The production runs do not put data directly onto a data base tape because too many problems occur, such as dead starts in the system or partial labels being put on the data base multi-file tapes. Several jobs can be run simultaneously without affecting one another.

4) Create back-up tape for a given tape.

Exact copy is made including file names.

OPERATIONAL PROCEDURES

The following procedures should be done in the specified order to create the "IE" data base.

1) As soon as an integral multiple of six tapes are received from Offutt, they can be concatenated onto one output tape.

2) As soon as a complete half-month of data is on the output tapes of (1), Phase I can be run for this half-month. This output tape should be a temporary scratch tape.

3) Add the data of the output from (2) onto a data base tape ("cc" tape). Six half-months of output from Phase I can be put onto one data base tape.

4) Run Phase II with the output of (3) which was recently added to the data base. This output should be put onto a temporary scratch tape.

5) Add the data of the output from (4) onto a data base tape ("cc" tape). Six half-months of Phase II output can be put onto one data base tape.

6) If six Phase I or Phase II exist on a tape, then a back-up should be created by means of the tape copying option. After the tape is successfully copied, the "DMS" tapes can then be re-used for further processing.

7) The following relates to the interactive retrieval system.

When procedures 3 or 5 (above) have run successfully, add a line to the file MULLENSTAPES,ID=MEEHAN3 to indicate the addition of a new half-month to the data base. These lines should be added to the file in chronological order, i.e., April 83 data should follow March 83 and precede May 83. A new file with a higher cycle can be created.

HOW TO USE THE INTERACTIVE SYSTEM (IEDBC)

Anyone with a valid password for the CDC6600 computer at AFGL may utilize this interactive software system (IEDBC). The user merely logs into the computer which responds with

COMMAND

The user response is

ATTACH,BJG,BJGPROCEDURE,ID=MEEHAN3(return)

System response is

COMMAND

User response is

BJG (return)

The user is now prompted for such things as full or short prompting, name of job, accounting number of job, processing option desired, tapes needed, etc. All these prompts should be self-explanatory. Upon exit from IEDBC, the system responds with

COMMAND

The batch job created by IEDBC is now on file 'XX'. The user response should be

BATCH,XX,INPUT,91

The batch job to do the particular processing option specified by the prompts is now on the input queue of the CDC computer and its output will be sent to terminal AC.

INTERACTIVE SYSTEM FOR "SSIE" DATA RETRIEVAL (I.E.D.B.R.)

At the present time there is an "F6" satellite circling the earth. On board is an electronic box containing 20 probes which record ion and electron count values. Every second, approximately 200 bits (25 bytes) of information are recorded and transmitted to a ground station. There it is collected and sent to Offutt Air Force Base in Nebraska where the data is tagged with ephemeris data (that is, data that shows position of the satellite with respect to Earth -- altitude, geographic latitude, etc.) This tagged "IE" data is then archived onto magnetic tape.

The above tapes are then sent to AFGL for further processing. This processing consists of editing, correcting and packing the IE data onto high density tapes. The data is organized into files of half-calendar months (i.e., there are two files for January: the first is January 1-15; the second, January 16-31). These packed half-month files of IE data are the data base for which the IE data base retrieval system (IEDBR) is written.

The purpose of IEDBR is to enable anyone who logs in via intercom to the CDC 6600 computer at AFGL to retrieve any part of the created data base of IE data. This system includes utility programs to enable the user to print out, graphically display, and further analyze the IE data.

The system is completely interactive. That is, once access is gained, a running conversation can take place between the user and the system. At the termination of an interactive session, a batch job is created. This job reflects the processing desired by the user after answering various prompts.

HOW TO USE THE INTERACTIVE SYSTEM IEDBR

Anyone with a valid password for the CDC 6600 computer at AFGL may utilize this interactive software system (IEDBR). The user merely logs into the computer which then responds with

COMMAND

The user response is

ATTACH,BJG,BJGMAPP,ID=MEEHAN3,MR=1

System response is

COMMAND

User response is

BJG (return)

The user is now prompted for such things as

1. Full or short prompting
2. Do you want a listing of data base files and the tapes they are on
3. Processing option desired
4. etc.

.
.
.
.

All these prompts should be self-explanatory. Upon exit from IEDBR, the system responds with

COMMAND

The batch job created by IEDBR is now on file "XX". The user response should be

BATCH,XX,INPUT,91

The batch job to do the particular processing option (specified in the above interactive session) is now on the input queue of the CDC computer and its output will be sent to terminal AC.

END

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