Research Technical Completion Report

MEAN ANNUAL PRECIPITATION MAP FOR IDAHO

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Agricultural Engineering

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Department of Geography

WATER for IDAHO

Idaho Water Resources Research Institute
University of Idaho
Moscow, Idaho 83843

July, 1988

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ABSTRACT

Sound estimates of the amounts and distributions of mean annual precipitation in Idaho have become increasingly important in recent years because of stringent design requirements and increasingly tighter supplies of water. Agriculture, hydropower, wildlife, recreation and others are putting forth claims to a scarce resource.

The current mean annual precipitation (MAP) map of Idaho was prepared in 1965. Since then, more data have been collected, particularly in the higher elevation zones where the previous map had to rely on models to provide estimates. The Soil Conservation Service's SNOTEL system provides data for these very important high elevation zones where the majority of Idaho's water originates. Lower elevation data are obtained primarily from the National Weather Service Cooperative network. Monthly data were compiled for the base period of 1961 to 1985. Missing data were estimated by using an average system surrounding stations.

All of these data were then plotted using a contouring package. For this report, no manual smoothing was done as the primary objective was to prove out the mapping technique. For the next phase of the project, various interpolation techniques will be used as well as regression models in areas of sparse or uncertain data. The coefficient of variation of the annual precipitation was also plotted. This resulted in a very smooth contour suggesting that lines of equal C_v could be overlayed upon the (MAP) map giving users an idea of the variation in precipitation as well as the mean value.

INTRODUCTION

Sound estimates of the amounts and distribution of Idaho's precipitation have become increasingly important in the past few years. In order to properly plan for the use of Idaho's water for agriculture, hydropower, recreation, wildlife, and a host of other uses, an estimate of mean annual precipitation (MAP) is essential. Currently in Idaho, there are many projects underway to which detailed precipitation data would be helpful. An example is in estimating streamflow. Without sound estimates of precipitation and its distribution, this is very difficult. MAP values and patterns are also needed to evaluate forest and range productivity. Detailed, accurate maps of MAP would greatly aid in ecologic and economic analysis of many processes for which precipitation is a factor.

The current map of MAP was compiled by the National Weather Service (NWS) in 1965. It was based primarily on data from low lying weather stations using models for estimates in the higher elevations. In the years since its completion additional data in the higher elevations and more low level stations have shown this map to be inaccurate, especially in higher elevations. High elevation precipitation values are vitally important as they represent a large percentage of Idaho's available water.

In the mid seventies, the Soil Conservation Service began the SNOTEL program, designed to collect climatic data in remote areas. Enough data have been collected to greatly increase the accuracy of precipitation estimation in high elevation areas. In the twenty nine years since the current MAP map was produced, the NWS has continued to collect climatic data. The Bureau of Land Management and the Forest Service have also begun programs to collect climatic data in remote areas. Data from all of these sources in Idaho and surrounding states can be utilized in the compilation of the new MAP map.

LITERATURE REVIEW

Peck and Schaake(1987) developed a model to estimate orographic precipitation in the Colorado River Basin above Lake Powell. A system called DATANET developed through regression analysis was used to adjust the model and quantify errors in the precipitation estimation process. Statistical analysis of orographic parameters and precipitation was done by Russeller and Spreen (1947) in western Colorado. They reported that thirty three percent of the variation in winter precipitation correlated with elevation by itself. Other parameters such as rise, exposure, and orientation were found to be important. Houghton (1979) developed regression equations relating mountain to valley precipitation as a function of relief, location and synoptic patterns. Equations were developed for each month, two seasons and year totals. Sixty-five percent of the variation in precipitation could be explained by the annual equation. Anderson (1972) correlated the rise, air flow separation, spillover, and barrier height to precipitation. These variables explained 99 percent of the variance in precipitation in the lee of major mountains in the Sierra Nevada range.

Anderson (1972) described the work of Linsley (1958). He studied the relationship of precipitation to elevation, slope, aspect and barriers to wind and geographical environmental zones in northern California. Hjermstad (1970) also studied precipitation total on mountainous terrain with various exposure and elevation, and gave comparative measures for these types of areas. He used the relationship of the 500 mb wind direction, orientation of passes, temperature, and elevation.

Court (1960), Thornthwaite (1961) and Bergeron (1965) found that small differences in elevation between nearby stations influence precipitation totals much more than expected.

Elliot (1977) devised procedures to estimate precipitation totals in California catchments using physical and atmospheric variables combined with some nearby known precipitation totals. Chang (1973) in his study of the effect of both small and large scale topographic features on precipitation totals, found that the correlations could be greatly improved by taking specific gage site characteristics into account.

Farnes (1971) computed MAP for snow course stations without storage gages by correlating values of accumulated precipitation from gages located at snow course sights with maximum annual snow water equivalent. Doesken and others (1984) used newly available high elevation data to manually adjust the existing MAP map for Colorado.

METHODOLOGY

Since most of the time spent to make the preliminary map was in the database assembly and correction, not many steps had to be followed. The following is an outline of those steps.

1. All known National Weather Service (NWS) monthly precipitation data were assembled from NHIMS (Bluske and others,1986) and other sources for the period 1961 to 1985.

2. MAP values from the Soil Conservation Service (SCS) SNOTEL sites were obtained from the Snow Survey Office in Boise.

3. Missing values were verified as actually missing and then estimated using mean values from the surrounding stations.

4. All annual values were used to develop the preliminary map that accompanies this report (Appendix A). This map is the result of using the mapping program only with no additional manual changes. Such changes are to be done in the second half of the project (Appendix A).

5. A few graphs of monthly precipitation normalized with respect to MAP were made to see how the monthly precipitation varied in various regions of the state (Appendix B).

6. The coefficient of variation (Cv) was computed for all Idaho climate divisions as well as all individual stations. The original climatic division Cv values were computed by the National Climate Data Center and supplied by the Oregon State Climatologist (Appendix C).

DATA COMPILATION AND SOURCES

In the preparation of the preliminary map, data were compiled from both the NWS records as well as SNOTEL sites. The NWS stations used are listed in Table 1 while the SCS stations are listed in Table 2. The period of record used was 1961 - 1985.

Table 1. National Weather Service stations used to develop the preliminary mean annual precipitation map.

Number	Station Name	MAP Value	Elevation
100010	ABERDEEN EXP STA	9.96	4441
100227	AMERICAN FALLS 1 SW	12.42	4320
100282	ANDERSON DAM	21.76	3880
100375	ARCO 3 SW	11.55	5330
100448	ARROWROCK DAM	19.45	3280
100470	ASHTON	21.38	5260
100667	BAYVIEW MODEL BASIN	25.09	2080
100915	BLACKFOOT 2 SSW	11.92	4490
101002	BLISS 4 NW	10.83	3280
101018	BOISE LUCKY PEAK DAM	14.66	2840
101022	BOISE WSFO	12.26	2838
101079	BONNERS FERRY 1 SW	23.69	1860
101195	BRUNEAU	8.28	2530
101303	BURLEY FAA AP	10.02	4160
101363	CABINET GORGE	32.35	2260
101380	CALDWELL	32.35	2370
101408	CAMBRIDGE	20.24	2650
101514	CASCADE 1 NW	22.74	4900
101636	CENTERVILLE ARB RCH	27.33	4300
101663	CHALLIS	7.93	5175
101671	CHILLY BARTON FLAT	8.32	6260
101831	CLARKIA	38.33	2840
101932	COBALT	17.90	5010
101956	COEUR D' ALENE R S	26.12	2160
102159	COTTONWOOD 2 WSW	22.45	3950
102187	COUNCIL	26.76	2950
102246	CRAIGMONT (REUBENS)	23.25	3750
102260	CRATERS OF THE MOON	17.08	5900
102444	DEER FLAT DAM	10.37	2510
102575	DIXIE	31.23	5620
102676	DRIGGS	16.96	6120
102707	DUBOIS EXP STA	13.09	5450
102875	ELK CITY R S	30.09	4060
102892	ELK RIVER 1 S	37.27	2920
102942	EMMETT 2 E	13.43	2370
103108	FAIRFIELD R S	16.73	5070
103143	FENN RANGER STN	39.18	1590
103297	FORT HALL IND AGENCY	12.56	4460
103448	GARDEN VALLEY R S	23.63	3134
103554	GIBBONSVILLE	15.33	4480
103631	GLENNS FERRY	10.34	2510
103732	GRACE	15.54	5550

103760	GRAND VIEW 2 W	7.36	2400
103771	GRANGEVILLE	23.76	3360
103882	GROUSE	14.18	6100
103942	HAILEY AP	17.65	5310
103964	HAMER 4 NW	9.63	4790
104140	HAZELTON	10.42	4060
104150	HEADQUARTERS	39.57	3140
104268	HILL CITY 1 W	15.23	5090
104295	HOLLISTER	10.79	4550
104384	HOWE	9.83	4820
104442	IDAHO CITY	25.64	3970
104455	IDAHO FALLS 2 ESE	12.89	4770
104456	IDAHO FALLS 16 SE	16.60	5850
104457	IDAHO FALLS FAA AP	11.33	4730
104460	IDAHO FALLS 46 W	9.47	4940
104598	ISLAND PARK	31.75	6300
104670	JEROME	10.93	3740
104793	KAMIAH	24.11	1210
104831	KELLOGG	29.82	2320
105011	KOOSKIA	24.74	1260
105038	KUNA 2 NNE	10.29	2680
105241	LEWISTON WSO AP	12.69	1413
105275	LIFTON PUMPING STA	11.13	5930
105414	LOWMAN	26.67	3920
105426	LOWMAN 3 E #2	10.05	3980
105544	MALAD	15.81	4552
105559	MALAD CITY	15.01	4470
105685	MAY	8.39	5110
105708	MCCALL	28.39	5025
105980	MINIDOKA DAM	10.35	4210
106053	MONTPELIER R S	15.09	5943
106152	MOSCOW UNIV OF IDAHO	25.44	2660
106174	MOUNTAIN HOME AFB	11.31	3190
106388	NEW MEADOWS R S	25.54	3870
106424	NEZ PERCE	21.77	3150
106542	OAKLEY	12.09	4600
106590	OLA 4 S	20.08	2990
106681	OROFINO	25.40	1030
106764	PALISADES	20.71	5385
106844	PARMA EXP STA	12.23	2220
106877	PAUL 1 ENE	9.86	4210
106891	PAYETTE	11.59	2150
107040	PICABO	13.97	4880
107046	PIERCE	42.39	3190
107211	POCATELLO WSO AP	12.56	4450
107264	PORTHILL	20.73	1775
107301	POTLATCH 3 NNE	25.47	2600
107386	PRIEST RIVER EXP STA	31.93	2380
107648	REYNOLDS	11.57	3930
107673	RICHFIELD	12.24	4310
107706	RIGGINS	17.61	1800
108022	ST ANTHONY 1 WNW	14.58	4950
108062	SAINT MARIES	29.87	2220
108137	SANDPOINT EXP STA	33.49	2120
108380	SHOSHONE 1 WNW	10.31	3950
108786	STREVELL	11.78	5280

108928	SWAN FALLS PWR HOUSE	8.45	2330
108937	SWAN VALLEY 2 E	17.36	5270
109065	TETONIA EXP STA	17.32	6170
109119	THREE CREEK	12.74	5460
109498	WALLACE WOODLAND PRK	39.41	2940
109560	WARREN	28.78	5899
109638	WEISER 2 SE	11.96	2103

Mean annual precipitation values for 1961-1985 were estimated for SNOTEL sites. Since these sites had data that started at widely varying dates, some method had to be devised to compute a MAP value compatible with those from the NWS stations. Most stations had at least six years of record with many also having a much longer period of manual snow course observation. In addition, while some sites also had precipitation storage gages. Regression equations were developed by the SCS Snow Survey Office for Idaho to relate annual precipitation for shorter SNOTEL records with nearby NWS stations with complete long term records. These records were included in the compilation of the preliminary map, and are listed in Table 2.

Table 2. Soil Conservation Service SNOTEL sites used to develop the mean annual precipitation MAP.

Number	Station Name	MAP Value	Elevation
15F04	ATLANTA SUMMIT	46.5	7580
15E11	BANNER SUMMIT	41.2	7040
10F02	BASE CAMP	33.4	7030
16E11	BEAR BASIN	37.9	5350
13F03	BEAR CANYON	28.4	7900
15H01	BEAR CREEK	38.7	8040
16A08	BEAR MOUNTAIN	86.7	5400
16E10	BEAR SADDLE	37.3	6180
15F07	BENNETT MOUNTAIN	31.6	6560
15E02	BIG CREEK SUMMIT	48.6	6580
09G09	BIG SANDY OPENING	33.2	
10G02	BLIND BULL SUM	38.2	8650
10E10	COULTER CREEK	42.7	7020
15E08	COZY COVE	33.0	5380
11E37	CRAB CREEK	28.8	6860
15E04	DEADWOOD SUMMIT	62.0	6860
14F08	DOLLARHIDE SUMMIT	38.4	8420

16C15	ELK BUTTE	67.1	5550
	ELKHART PARK G.S.	22.2	
11G06	EMIGRANT SUMMIT	41.3	7390
14F01	GALENA	30.0	7440
14F12	GALENA SUMMIT	34.0	8780
13F04	GARFIELD R.S.	23.0	6560
11G16	GIVEOUT	21.0	6840
15H13	GOAT CREEK	36.6	8880
15F14	GRAHAM GUARD STA.	32.7	5690
10E15	GRASSY LAKE	58.2	7265
15C06	HEMLOCK BUTTE	72.7	5810
13E27	HILTS CREEK	25.8	8000
13G01	HOWELL CANYON	37.6	7980
15B21	HUMBOLDT GULCH	50.0	4250
13F16	HYNDMAN	26.8	7440
	INDIAN CREEK	34.7	
11E10	ISLAND PARK	34.0	6290
15E09	JACKSON PEAK	47.0	7070
10E09	LEWIS LAKE DIVIDE	56.3	7850
14C05	LOLO PASS	53.1	5240
15B02	LOOKOUT	54.5	5140
10F16	LOOMIS PARK	35.7	8240
15B14	LOST LAKE	88.0	6110
14F03	LOST-WOOD DIVIDE	36.4	7900
14G02	MAGIC MOUNTAIN	31.3	6880
13E18	MEADOW LAKE	34.9	9150
14E01	MILL CREEK SUMMIT	31.0	8800
13E06	MOONSHINE	24.8	7440
15F01	MOORES CREEK SUMM	43.3	6100
13D16	MOOSE CREEK	30.4	6200
14E04	MORGAN CREEK	30.5	7600
16A04	MOSQUITO RIDGE	58.8	5200
15D06	MOUNTAIN MEADOWS	51.6	6360
16G07	MUD FLAT	21.6	5730
12G18	OXFORD SPRING	28.8	6740
10F23	PHILLIPS BENCH	41.9	8200
15H14	POLE CREEK R.S.	24.5	8330
15F06	PRAIRIE	24.4	4800
10G08	SALT RIVER SUMMIT	26.3	7700
14C04	SAVAGE PASS	49.3	6170
16A10	SCHWEITZER BASIN	68.5	6090
15D01	SECESH SUMMIT	52.2	6520
11F11	SHEEP MTN.	27.8	6570
16C01	SHERWIN	43.5	3200
11G05	SLUG CREEK DIVIDE	31.5	7225
10G13	SNIDER BASIN	20.9	8060
11G01	SOMSEN RANCH	29.2	6800
16G01	SOUTH MTN.	35.0	6500
10G20	SPRING CREEK DIVI	31.2	9000
16E05	SQUAW FLAT	46.1	6240
14F02	STICKNEY MILL	21.2	7430
13F09	SWEDE PEAK	28.6	7640
10F09	TOGWOTEE PASS	40.7	9580
15F05	TRINITY MTN.	52.4	7770
10E17	TWO OCEAN PLATEAU	48.6	9160
14F04	VIENNA MINE	48.8	8960

16D08	WEST BRANCH	44.2	5560
15F11	WILLOW CREEK	48.0	4710

MISSING DATA

The NWS data which were downloaded from the NHIMS system contained some records with missing monthly values. All data flagged with an "M" were checked by verifying the data in the published records, both paper and microfiche, kept in the State Climatologist's Office. Most of the records which were thought to be missing had actual recorded values of 0.0 inches or trace precipitation. These records were flagged accordingly and a value of 0.0 inches was saved. Other records were replaced with recorded values from late records. About one percent of the monthly records had to be estimated as the values were unavailable. These estimations were done by giving the missing monthly record the mean value for that particular month for its surrounding stations in its division. These estimated fields were given a different flag so they can be reestimated later using different criteria. It was felt that this technique was adequate for a preliminary map. Regression techniques will be tried later if it appears that the mean value method is inadequate.

RESULTS

Precipitation Map

The preliminary MAP map was generated using the Topo program which is part of the Surfer graphics package by Golden Software Co. The map was printed in three pieces and then redrafted and scribed to be placed over an Idaho base map. No attempt was made to adjust isohyets through this process. The map was produced at a scale of 1:2,000,000 and reduced to an 8.5 inch x 11 inch format. A polyconic map projection was used. One contour interval (two inch) was used to avoid the confusion caused when more than one interval appears on the same map. Several intervals were considered depending upon the precipitation gradient as was discussed with several state and federal agencies but this was abandoned when the map appeared to be too cluttered. The use of one contour interval also enhances the communicative power of the map. A user should obtain an idea of the general precipitation patterns in the state with just a quick glance. This would not be possible if four different contour intervals were put on a single sheet (as discussed in the Boise MAP map meeting). The contour interval selected for this map was two inches. It was found that this interval was adequate to convey the overall MAP variability on the preliminary map. The final maps at 1:250,000 can be produced with one continuous contour interval without the loss of detail. This will make the maps much more readable.

The preliminary map included in this report was produced through computer interpolation of NWS and SNOTEL data only. It is intended to show the general distribution of the data and test the feasibility of the method, but not the true precipitation pattern. Several other factors will be considered in order to delineate precipitation values on the final map. The accuracy and detail of the final map is expected to be a substantial improvement over the current 1965 map. Isohyets will be generated using a computer mapping package and be manually adjusted. Some of the values and guides to be used in the manual adjustment include:

1) The results of a multiple regression model to estimate precipitation values where no data have been collected.
2) Base map will be USGS topographic quadrangles @ 1:250,000
3) Graphs of elevation vs. MAP for various regions
4) Possibly Landsat imagery @ 1:250,000.
5) Precipitation maps drawn for individual National Forests or other areas of the state.

Please note... None of the above were used in the preparation of the preliminary map. This preliminary map was drawn to be sure that there were no problems with the mapping package and that the database did not have any errors in it. It is intended to be illustrative only, not a final product.

By looking at specific areas, it can be seen that using data in a mapping package with no manual intervention results in a map that is much too smooth. It does not account for the variation of precipitation over the mountain ranges and valleys except in a gross sense. A good example of this is the Selway and Lochsa drainages on the Montana border. In order to account for this variation due to topography, distance to barriers, wind, etc., models will have to be developed in the next phase of this project.

Appendix B shows plots of monthly precipitation normalized with respect to the MAP at a site. One site in each of the ten divisions was chosen so as to obtain a representative distribution around the state. There does not appear to be any sort of pattern except that some stations have a very distinct winter peak (Priest River and Lewiston) while others have either a spring peak (Nez Perce, Hamer and Malad City) or a double peak such as Hollister. Such a variation seems to preclude the use of some sort of distribution function to determine the monthly precipitation given only the MAP.

Coefficient of Variation

The spatial and temporal distribution of the variation in precipitation may be as important as the pattern of MAP. Along with the MAP map, the coefficient of variation (Cv) will be delineated. Depending upon its pattern, it may be shown on the final MAP map or on a separate sheet. The pattern of Cv may be a parameter to consider for future delineation of climatic divisions.

Graphs of Cv were plotted for each month and year totals for twenty three climatic divisions: ten from Idaho and thirteen from all of the surrounding divisions in neighboring states. Similar graphs will be prepared for individual station for comparison and grouping. These graphs (for Idaho only)are shown in Appendix D.

In general, the pattern of the Cv of the monthly precipitation for Divisions 1,2 and 3 is higher in the summer months and lower in the spring months. The pattern for all other divisions is quite varied not being subject to simple interpretation. As expected, the areas and months with low precipitation have a higher variation (e.g., the month of August in Divisions 5 and 7).

The Cv for Divisions 2,3,5,6 and 7 do not vary greatly from the station Cv as can be seen in a comparison of the values from Appendix C and Appendix B. There is a possibility that a divisional average could be used for those divisions while some other scheme will have to be devised for the other divisions.

A map of Cv for the annual precipitation (25 years) was also compiled from the NWS station records which were used for the preliminary MAP map. This map of Cv is also just a preliminary depiction of the pattern. It is shown in Appendix E. It was also produced in the 1:2,000,000 scale and reduced to an 8.5 inch x 11 inch format. More work is to be done in delineating this pattern throughout the state. It is still undecided exactly how Cv will be displayed with the final maps. The two options are to display it as a regional value or pattern for each climate division or as a contour map to accompany the MAP map. The preliminary map shown in Appendix E does show a strong possibility of developing a regional value of Cv, perhaps based on counties or a smoothed map similar to that shown in Appendix E.

CONCLUSIONS

The work completed with the database of monthly precipitation values has shown that there is adequate coverage of the state to attempt to make a new mean annual precipitation map for Idaho. No major problems have been found in assembling and quality controlling the data. The data were successfully used in a mapping package to draw an isohyetal map which, while it is not usable in its present form, does show reasonable general trends.

The trends of the coefficient of variation of annual precipitation for the ten climatic regions of Idaho show a general pattern indicating that it may be possible to use some type of regionalization to determine the variability of the annual precipitation.

Using the work completed in this phase of the project, it is feasible to use the assembled database and experience gained thus far to complete a mean annual precipitation map showing both the precipitation and the coefficient of variation of that precipitation.

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Appendix A

Mean Annual Precipitation Map

PRELIMINARY MAP FOR
ILLUSTRATIVE PURPOSES ONLY

IDAHO

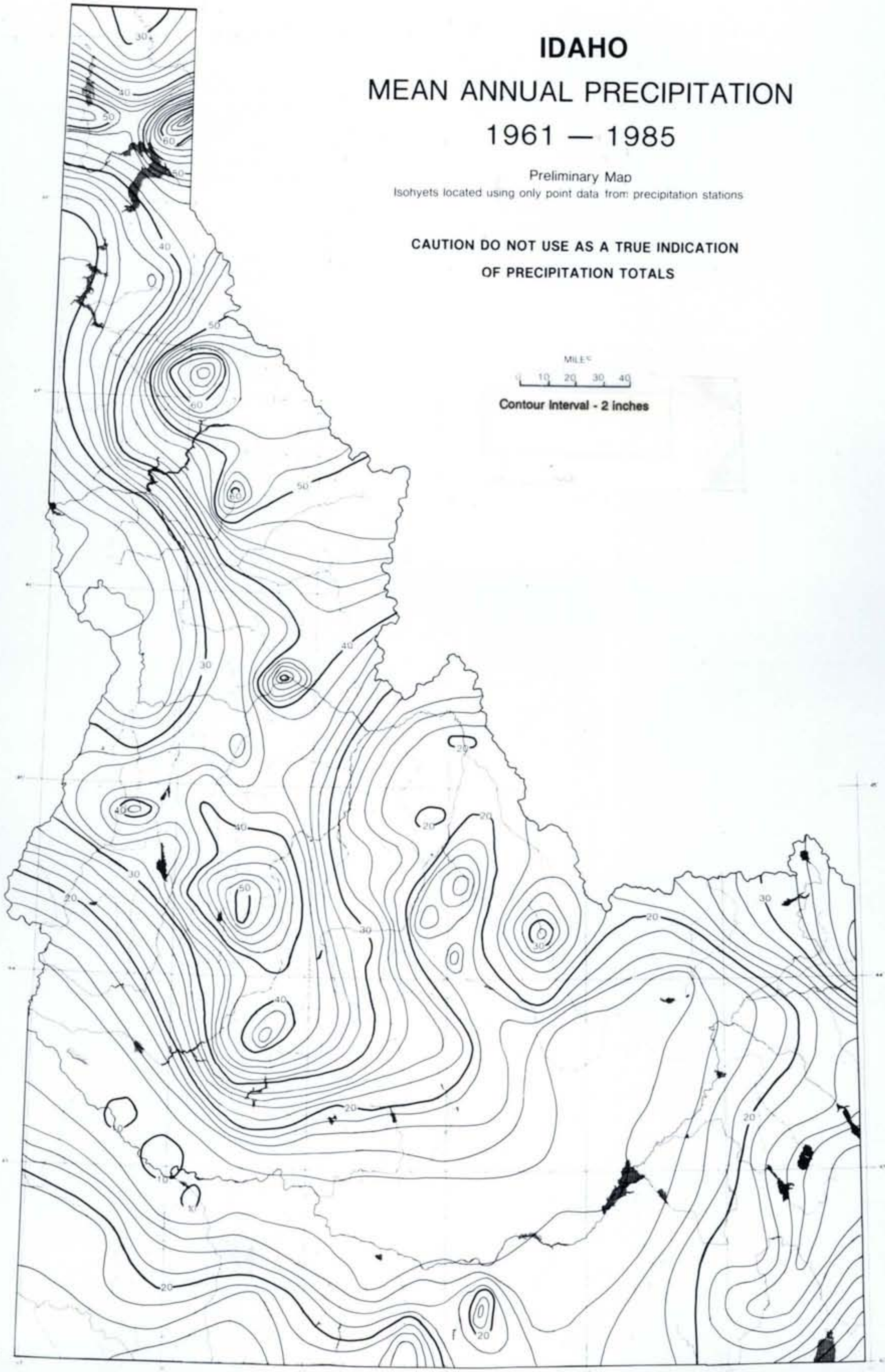
MEAN ANNUAL PRECIPITATION

1961 — 1985

Preliminary Map

Isohyets located using only point data from precipitation stations

CAUTION DO NOT USE AS A TRUE INDICATION OF PRECIPITATION TOTALS

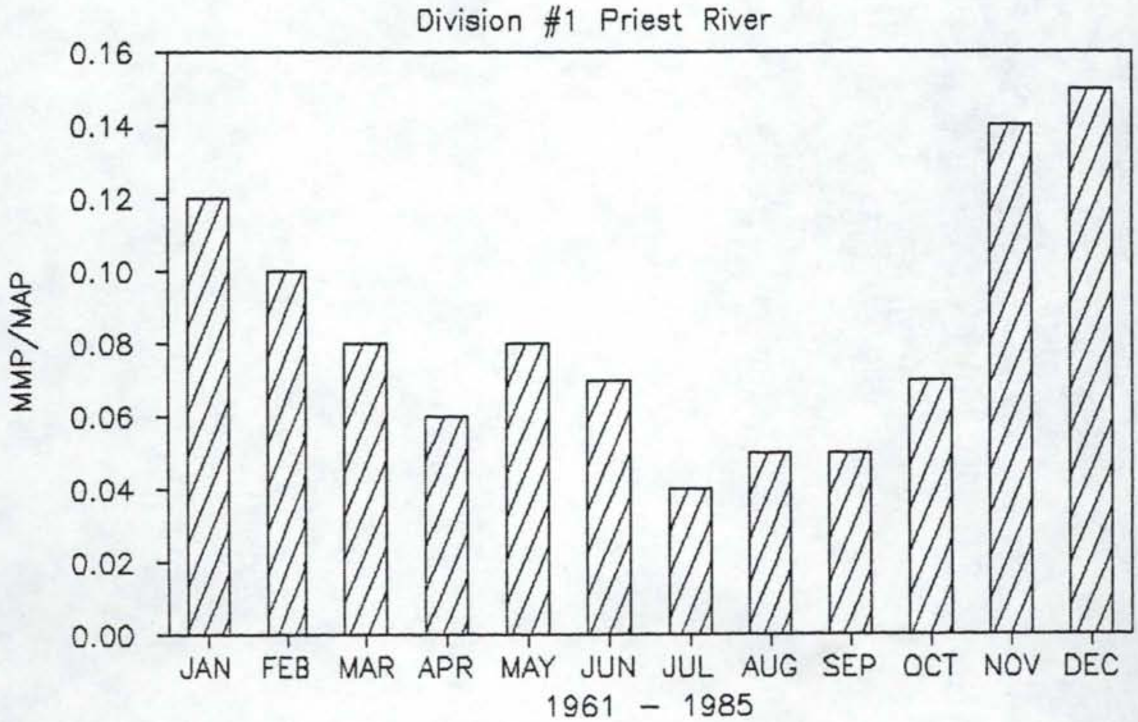


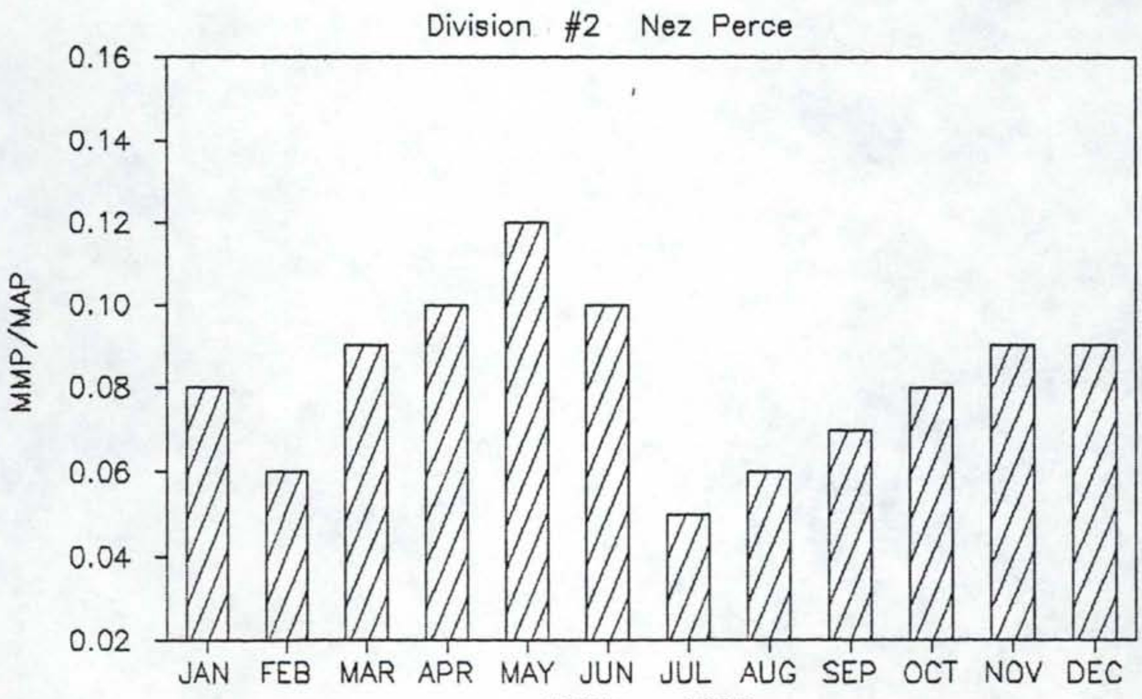
Winters

Appendix B

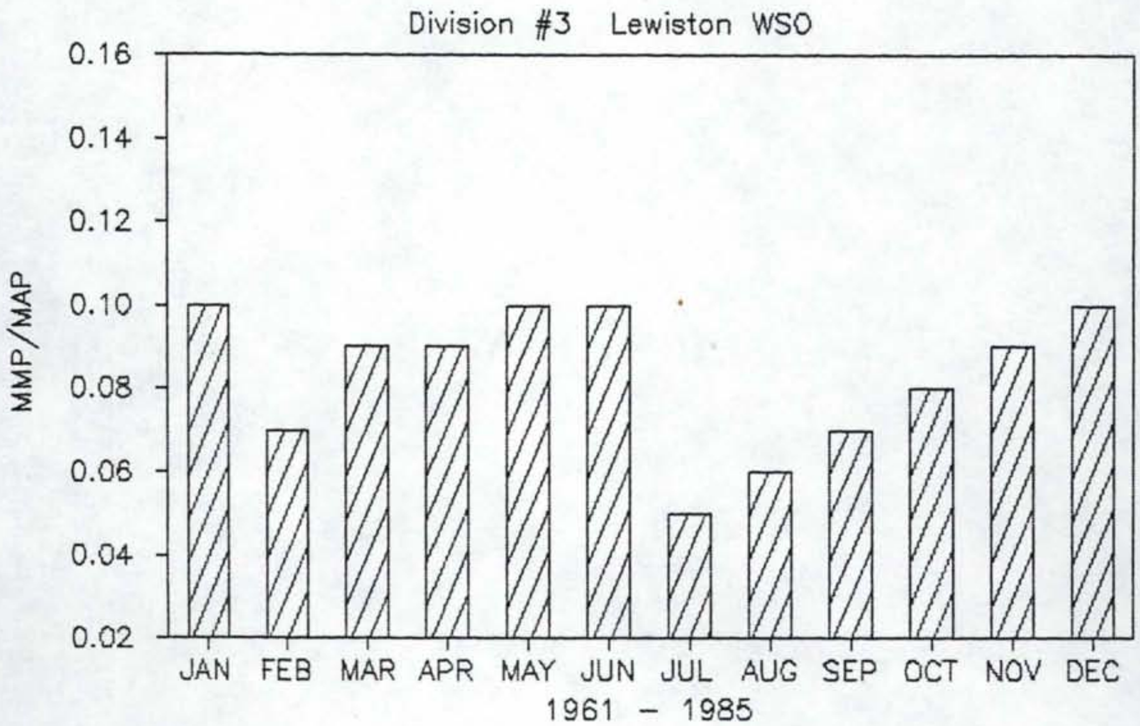
Fraction of annual precipitation occurring in each month for representative stations

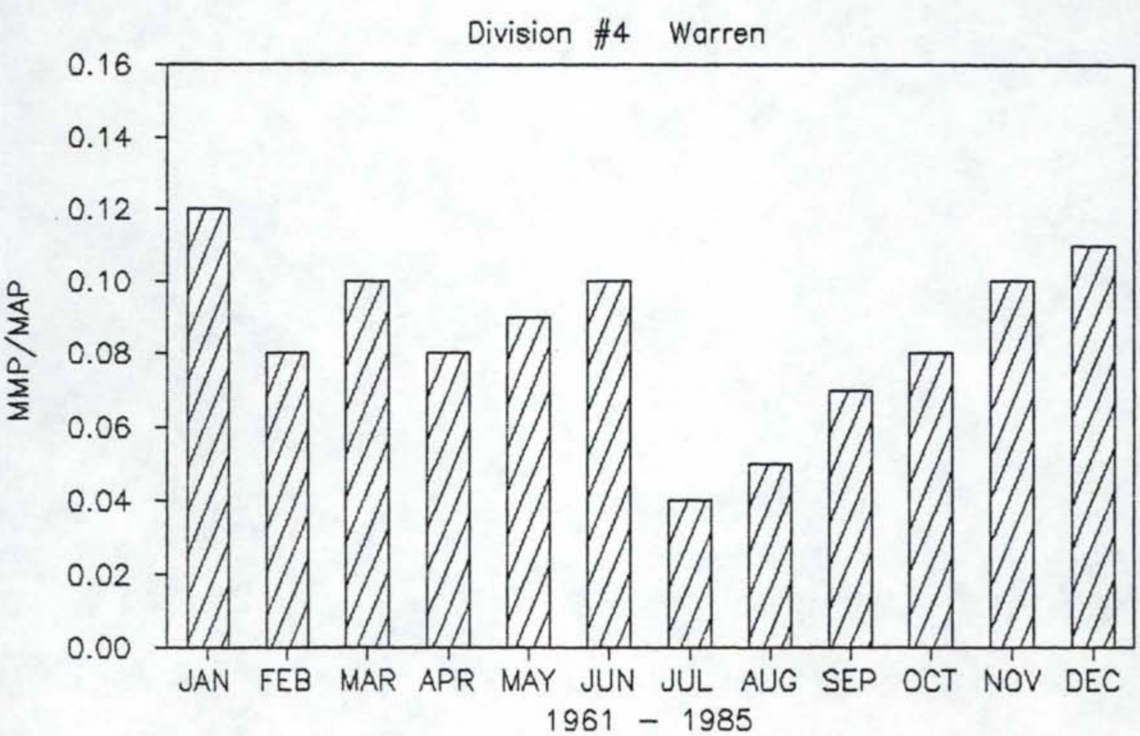
Fraction of annual precipitation occurring in each month for representative stations



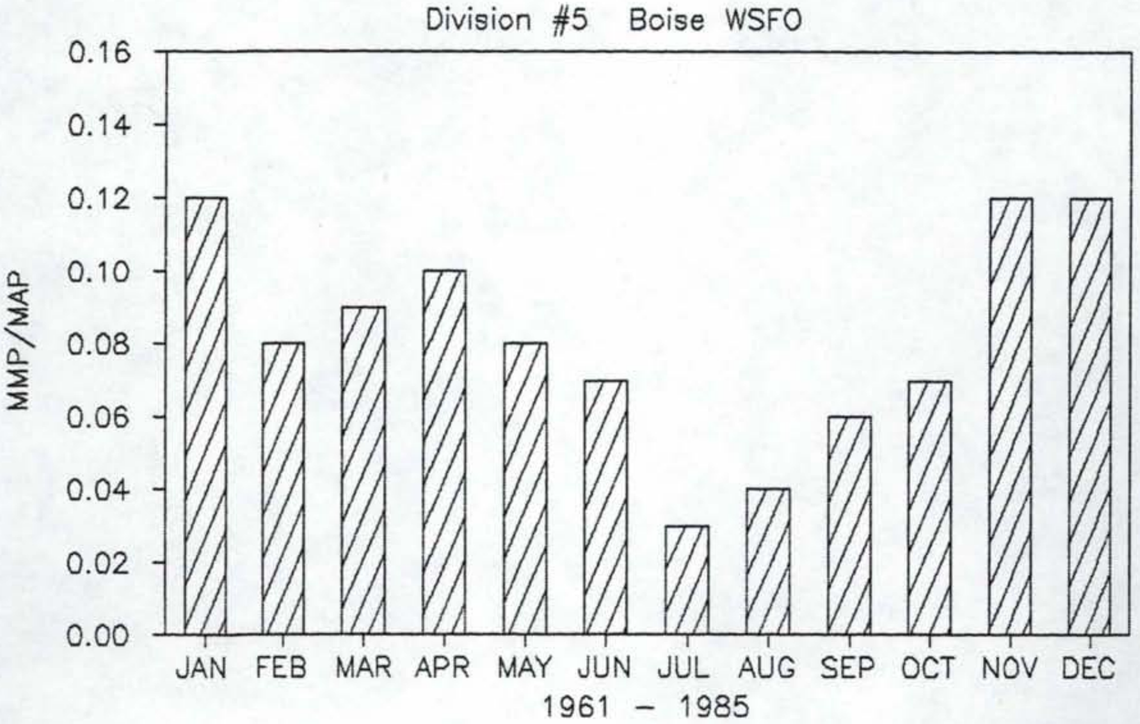


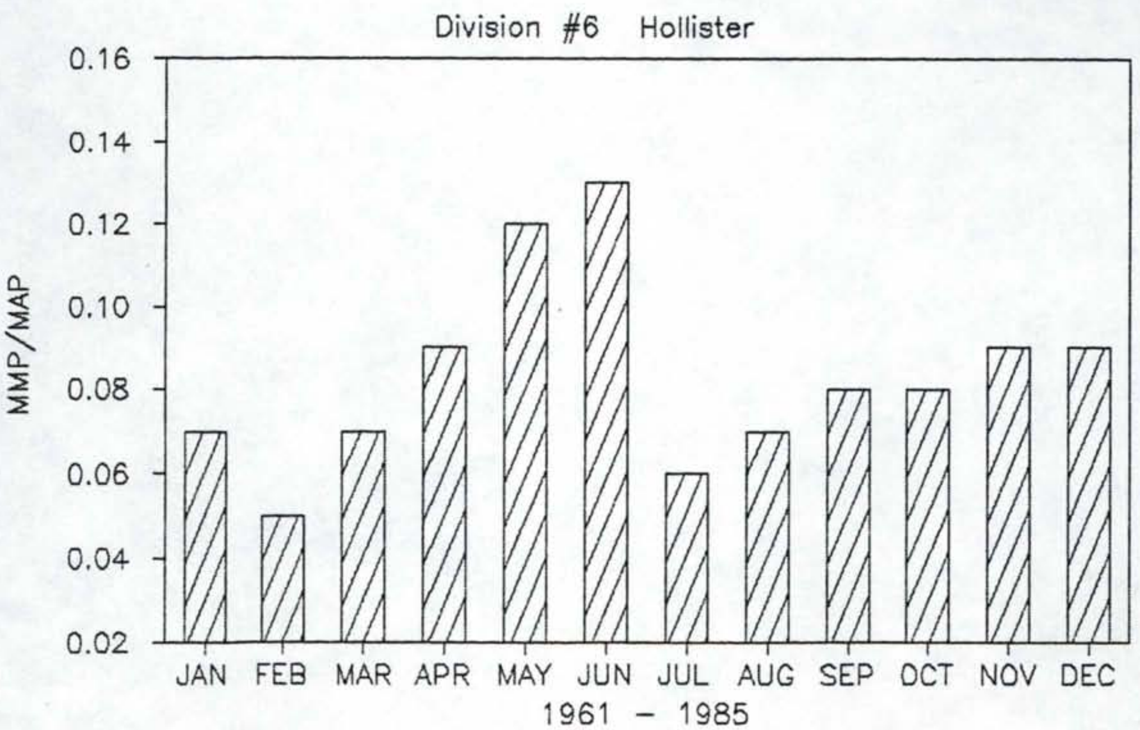
Fraction of annual precipitation occurring in each month for representative stations



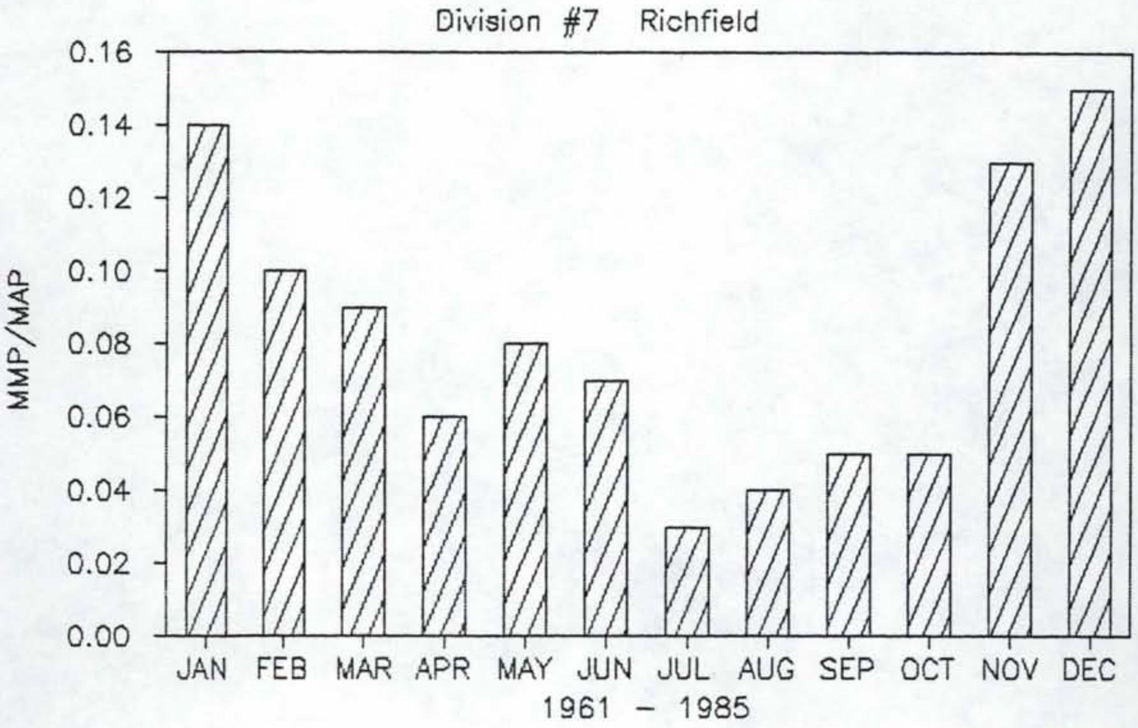


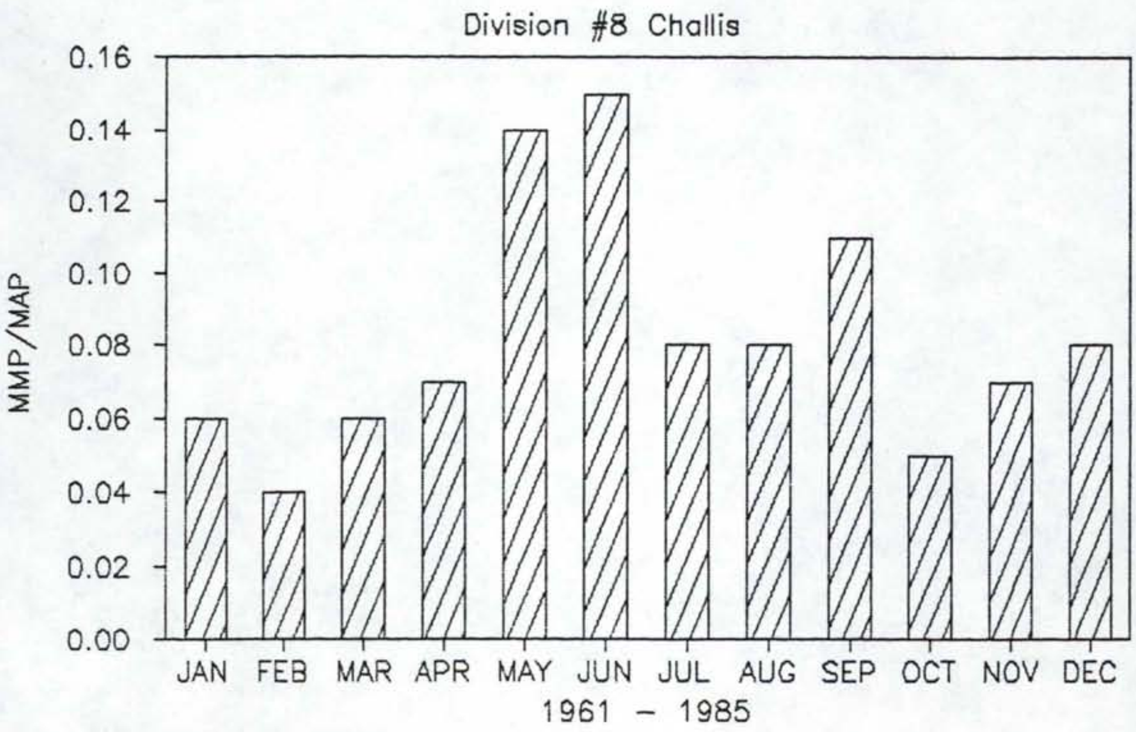
Fraction of annual precipitation occurring in each month for representative stations



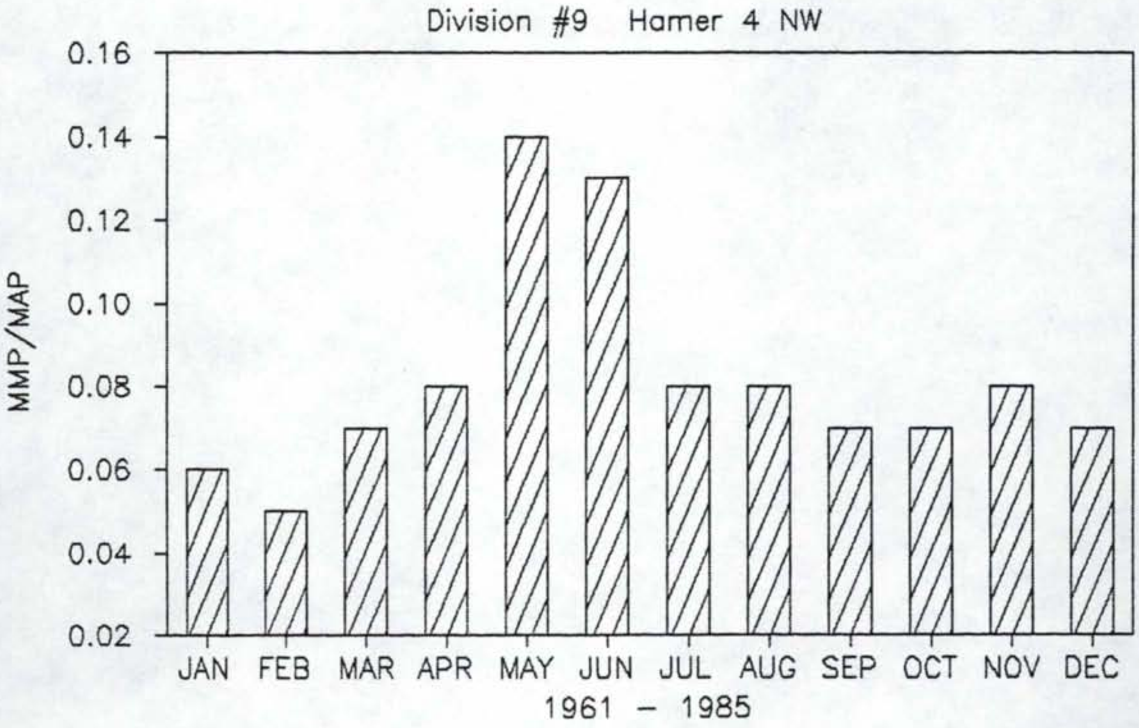


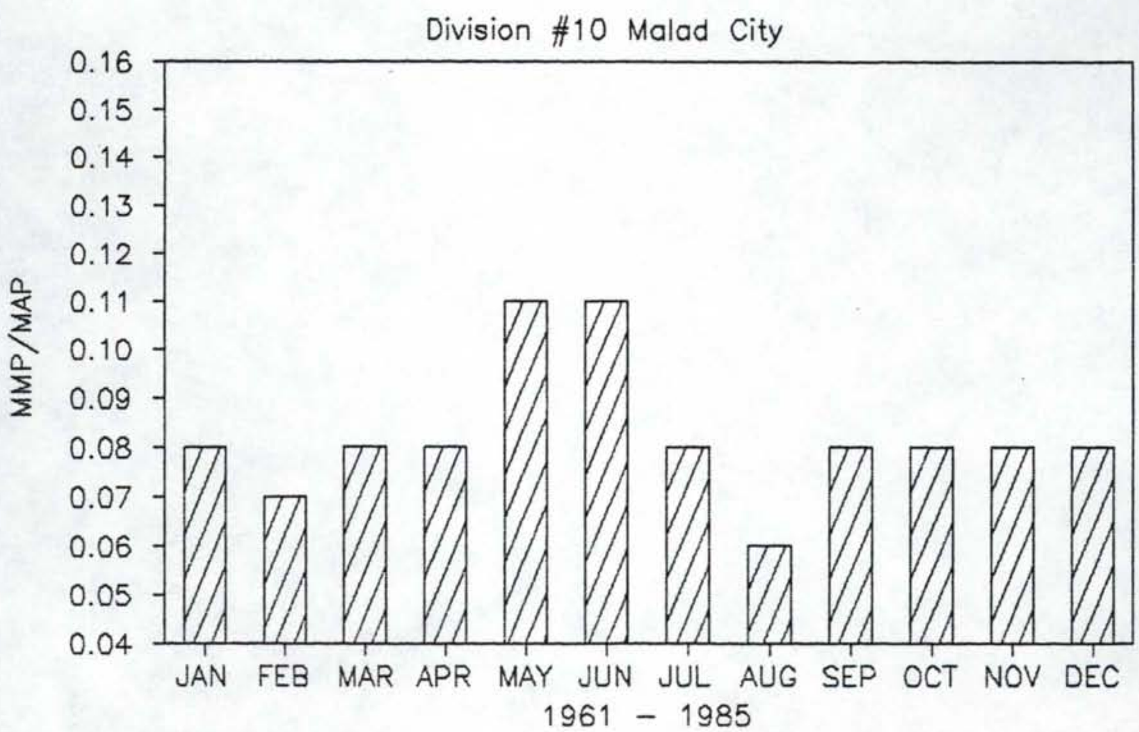
Fraction of annual precipitation occurring in each month for representative stations





Fraction of annual precipitation occurring in each month for representative stations





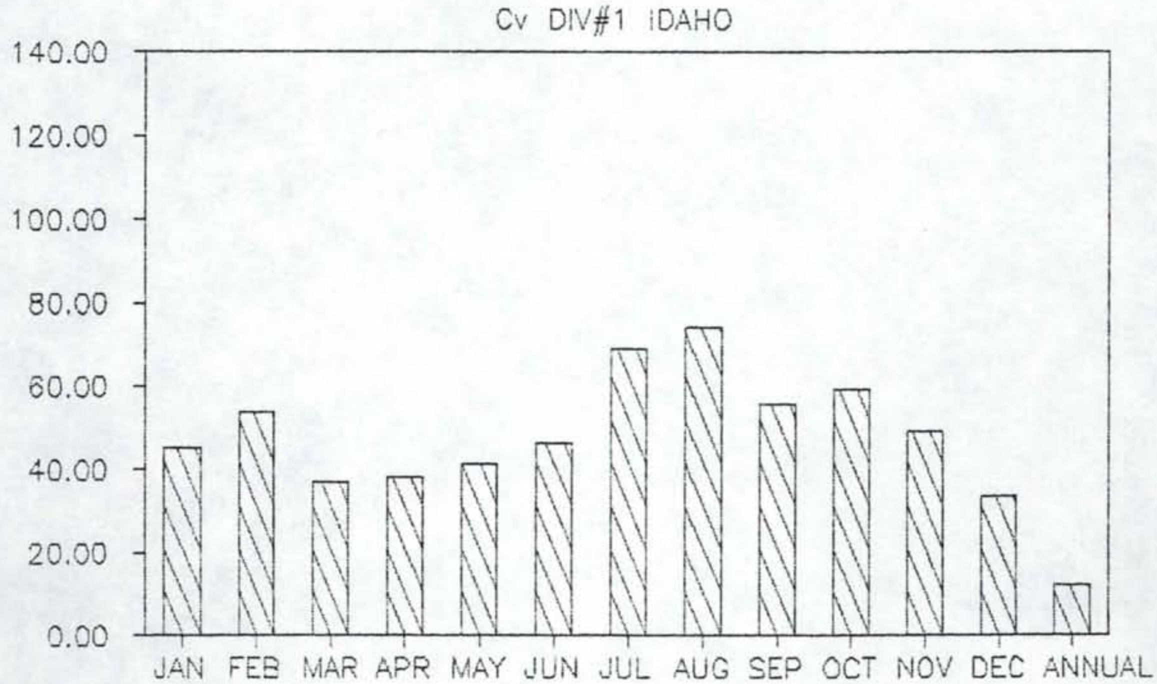
Appendix C

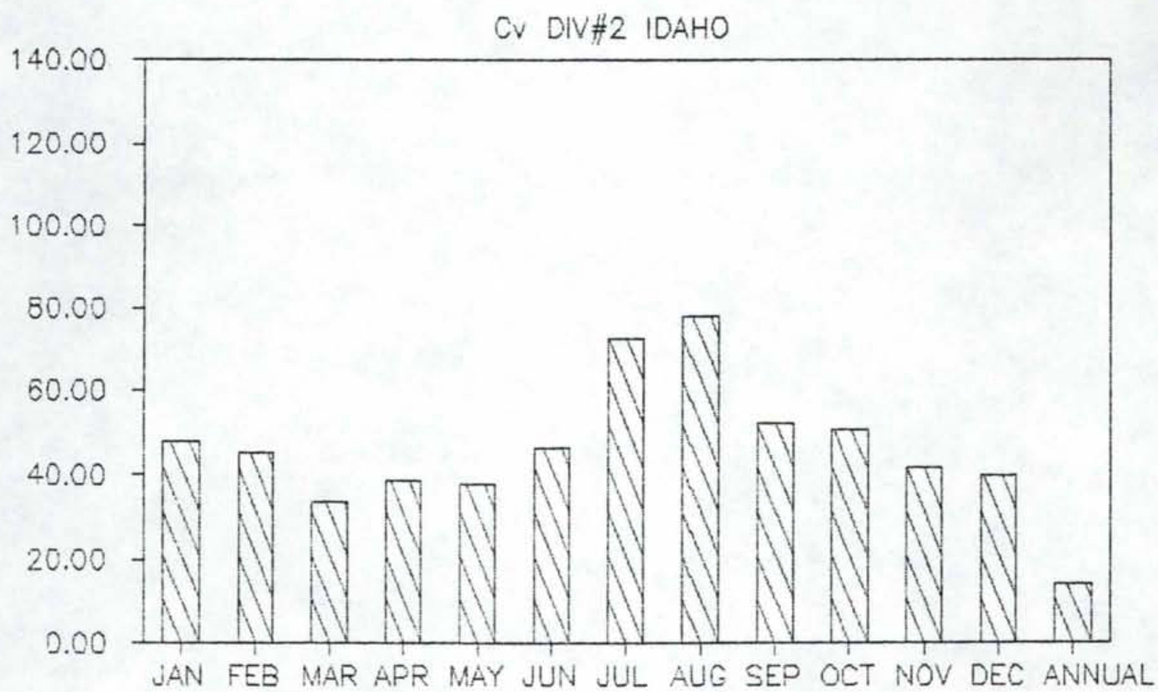
Map of the coefficient of variation of annual precipitation

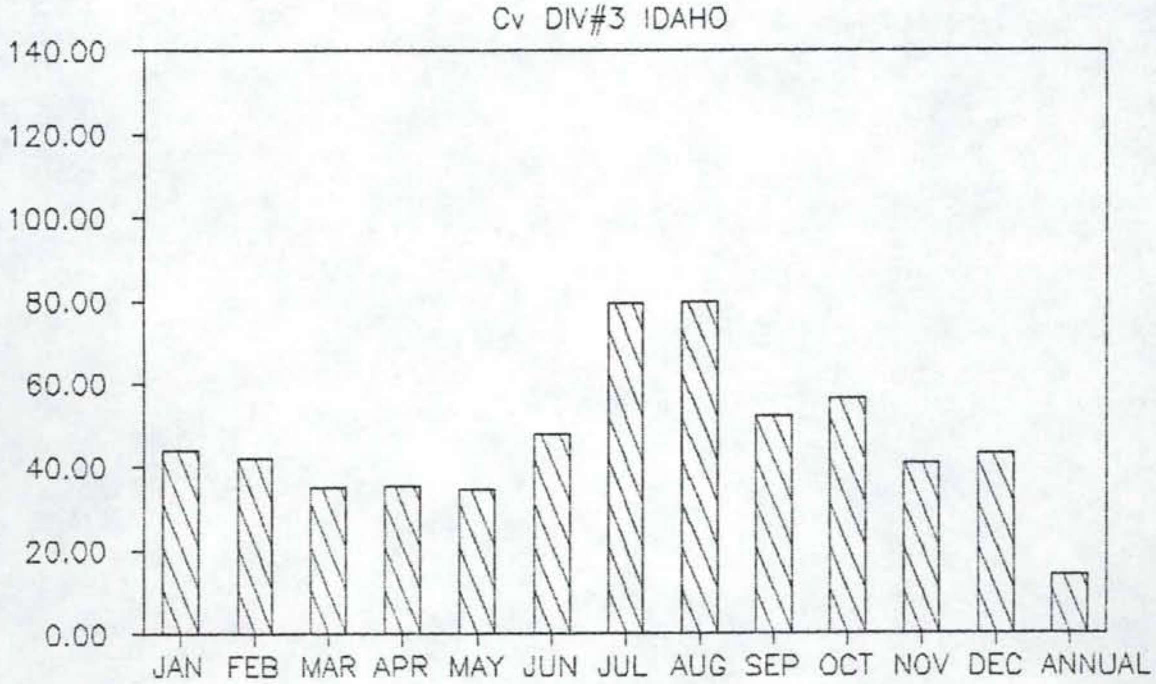
IDAHO
COEFFICIENT OF VARIATION
Preliminary Map
MILES
0 10 20 30 40
16
16
16
12
14
18
20
28
26
22
20
22
24
24
24
28
30
26
26
24
24
20
20
22
26
22
28
24
26
28
28
24
24
26
28
26
Winters

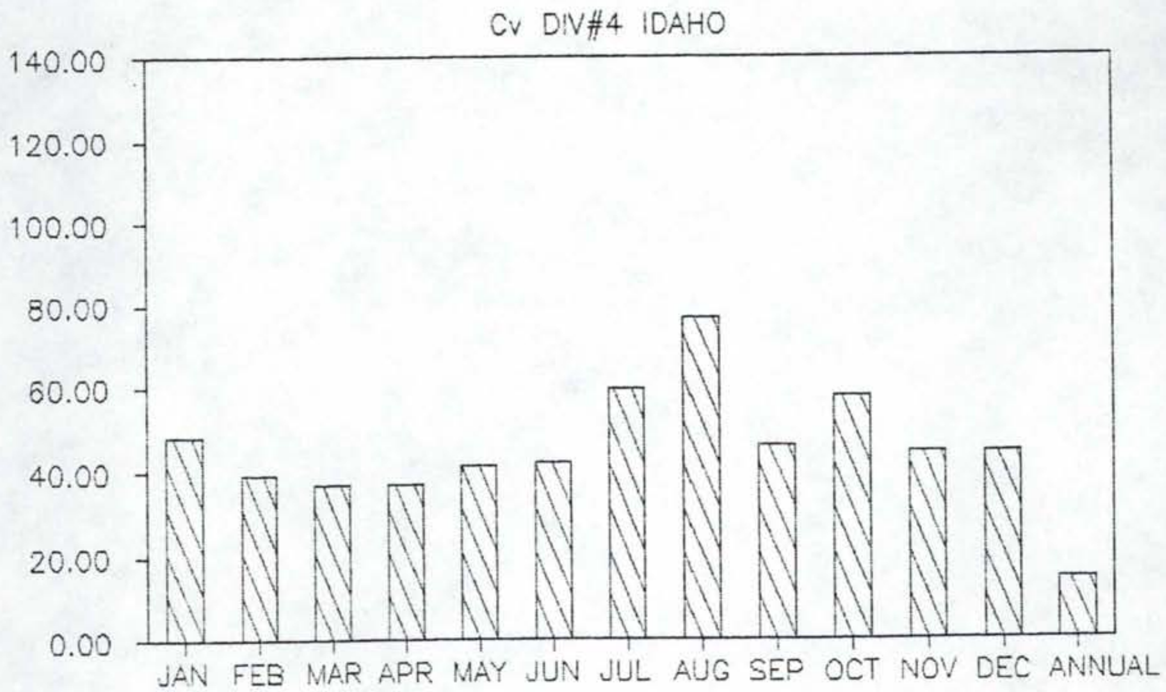
Appendix D

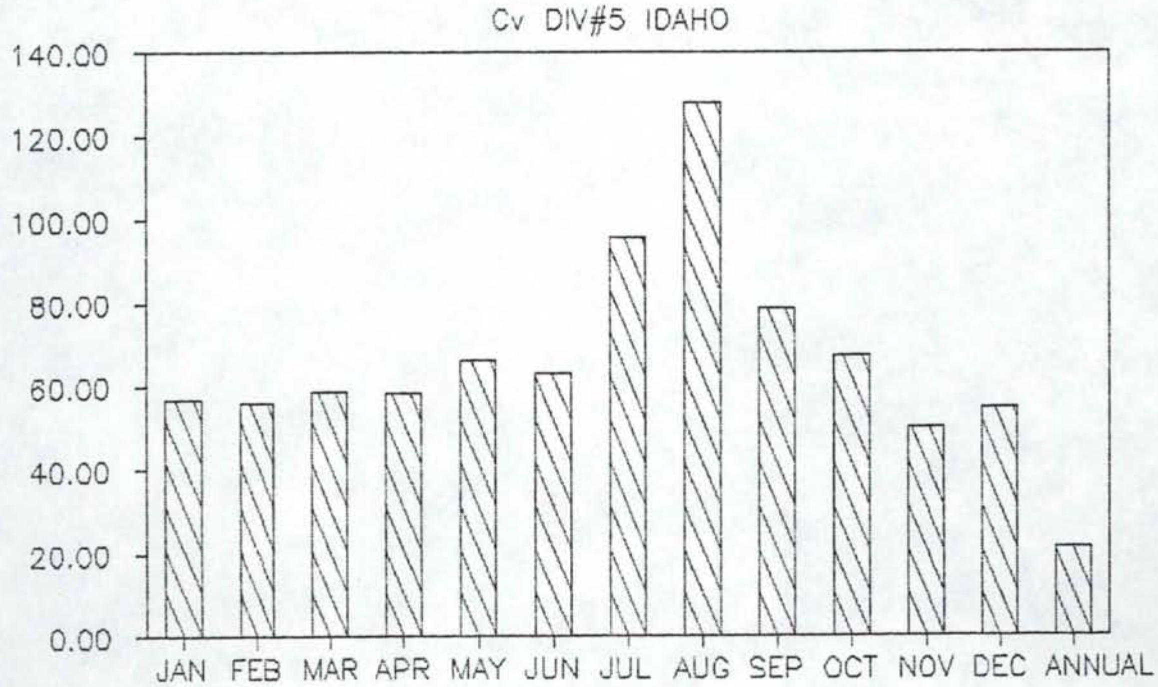
Coefficient of variation for monthly and annual divisional precipitation for Idaho

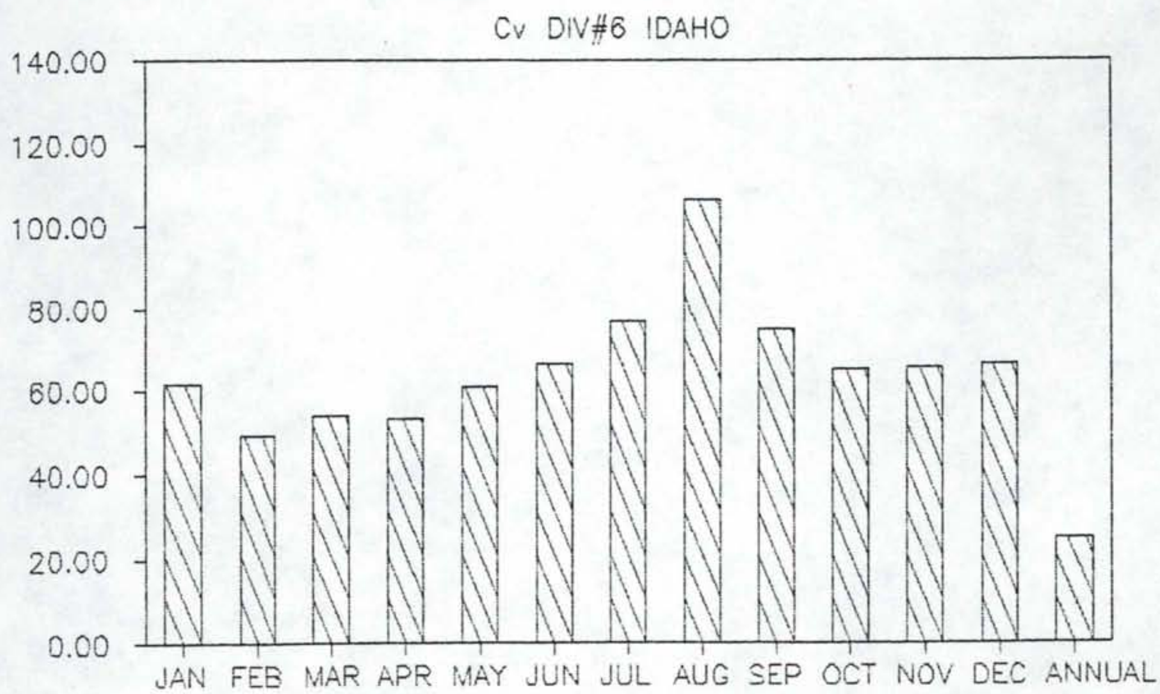

Cv DIV#1 IDAHO
140.00
120.00
100.00
80.00
60.00
40.00
20.00
0.00
JAN FEB MAR APR MAY JUN JUL AUG SEP OCT NOV DEC ANNUAL

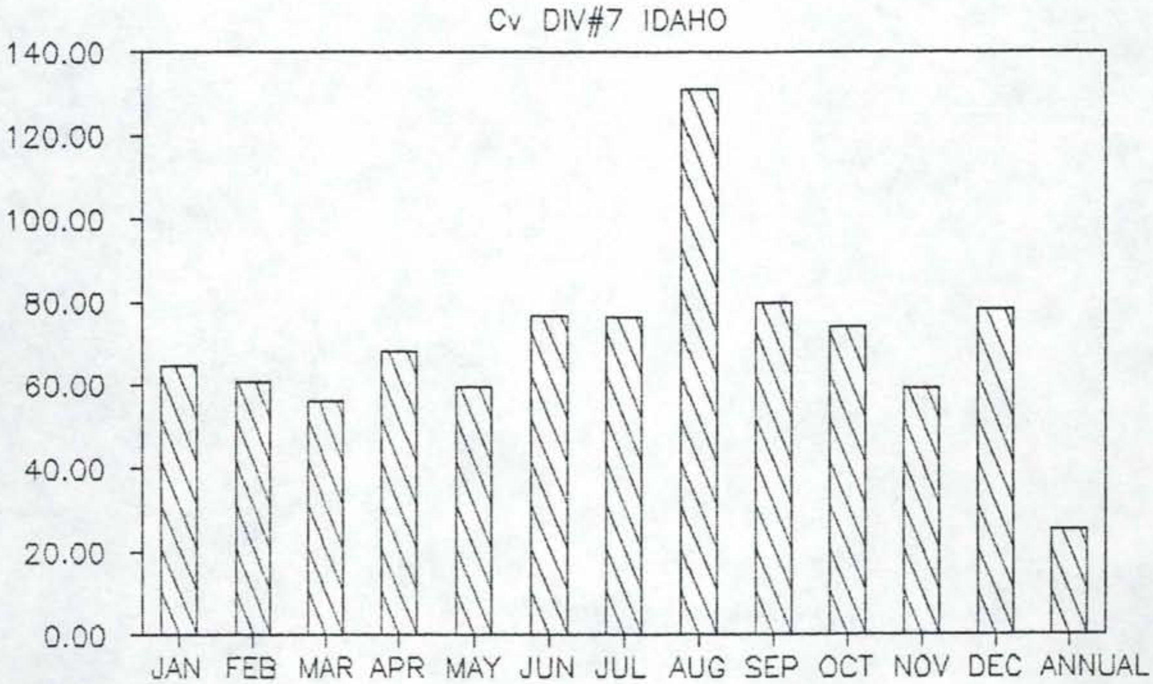

Cv DIV#2 IDAHO
140.00
120.00
100.00
80.00
60.00
40.00
20.00
0.00
JAN FEB MAR APR MAY JUN JUL AUG SEP OCT NOV DEC ANNUAL


Cv DIV#3 IDAHO
140.00
120.00
100.00
80.00
60.00
40.00
20.00
0.00
JAN FEB MAR APR MAY JUN JUL AUG SEP OCT NOV DEC ANNUAL

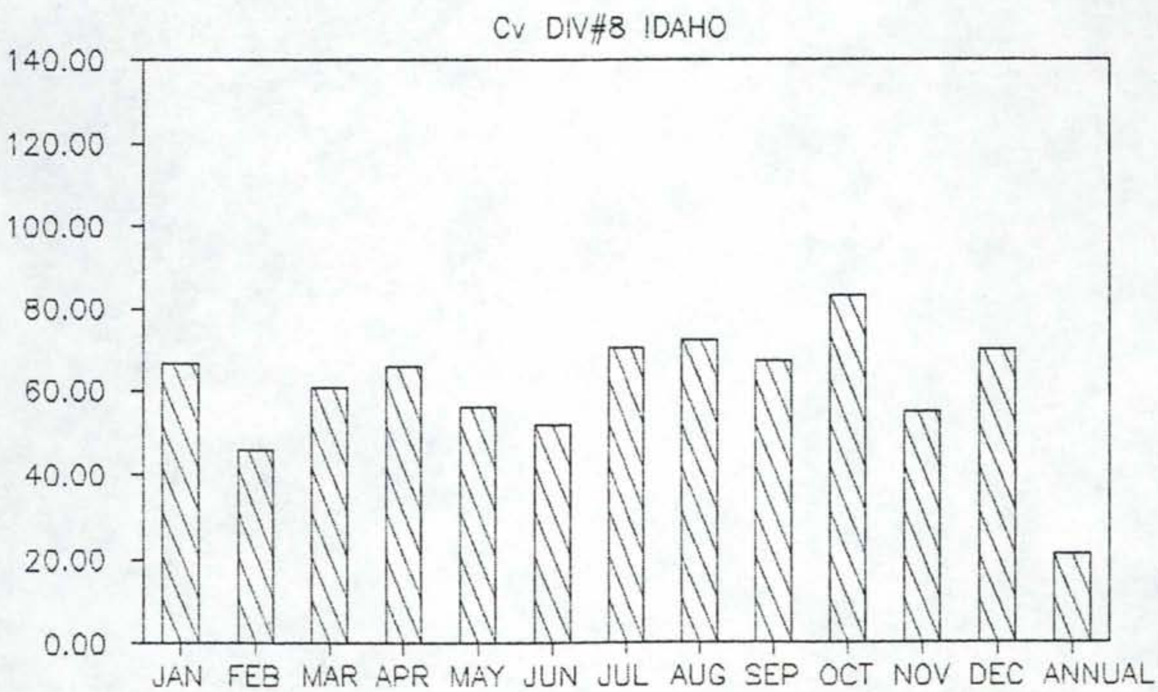

Cv DIV#4 IDAHO
140.00
120.00
100.00
80.00
60.00
40.00
20.00
0.00
JAN FEB MAR APR MAY JUN JUL AUG SEP OCT NOV DEC ANNUAL


Cv DIV#5 IDAHO
140.00
120.00
100.00
80.00
60.00
40.00
20.00
0.00
JAN FEB MAR APR MAY JUN JUL AUG SEP OCT NOV DEC ANNUAL

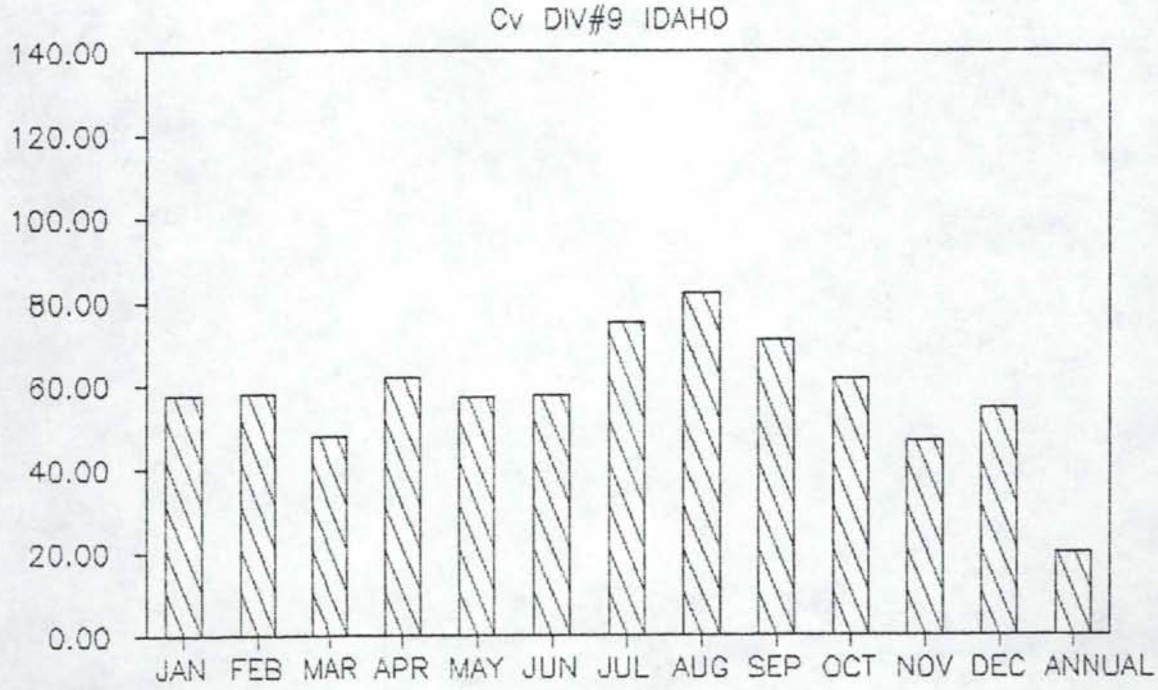

Cv DIV#6 IDAHO
140.00
120.00
100.00
80.00
60.00
40.00
20.00
0.00
JAN FEB MAR APR MAY JUN JUL AUG SEP OCT NOV DEC ANNUAL

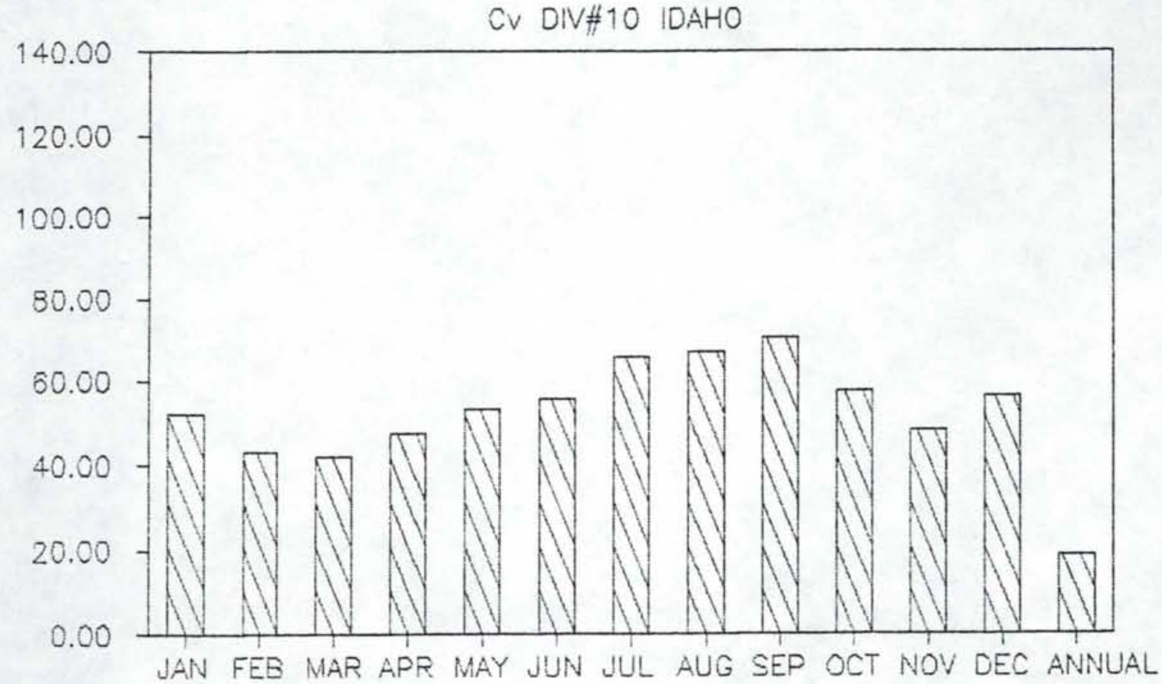


Cv DIV#7 IDAHO
140.00
120.00
100.00
80.00
60.00
40.00
20.00
0.00
JAN FEB MAR APR MAY JUN JUL AUG SEP OCT NOV DEC ANNUAL



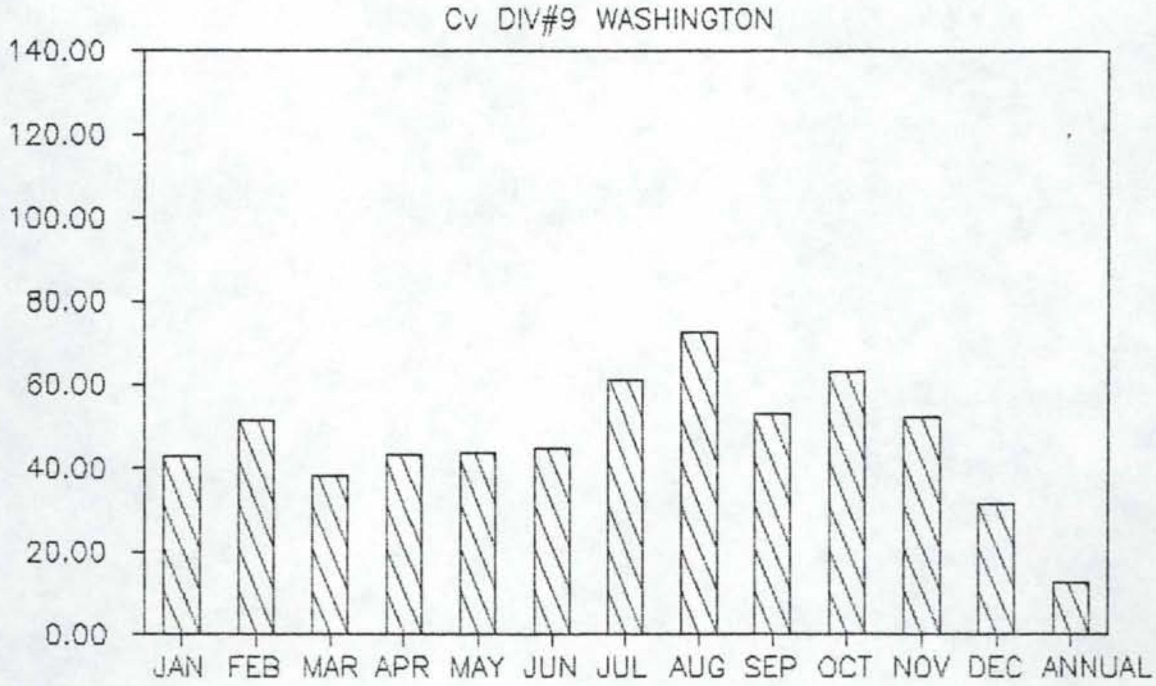
Cv DIV#8 IDAHO
140.00
120.00
100.00
80.00
60.00
40.00
20.00
0.00
JAN FEB MAR APR MAY JUN JUL AUG SEP OCT NOV DEC ANNUAL

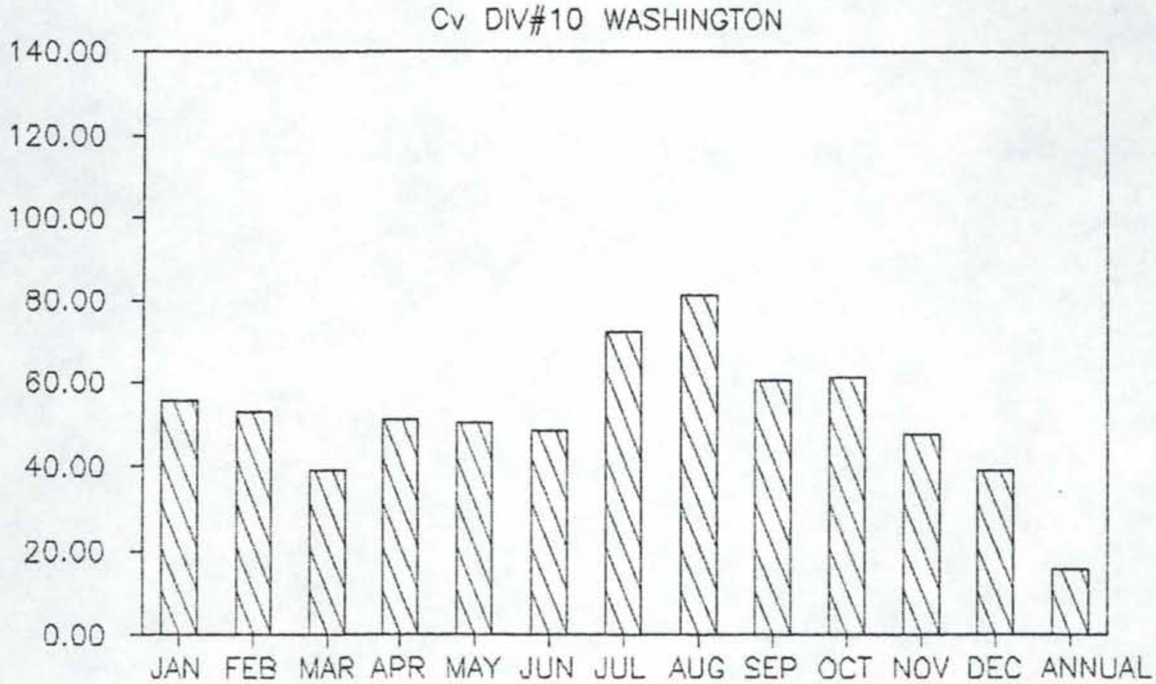

Cv DIV#9 IDAHO
140.00
120.00
100.00
80.00
60.00
40.00
20.00
0.00
JAN FEB MAR APR MAY JUN JUL AUG SEP OCT NOV DEC ANNUAL

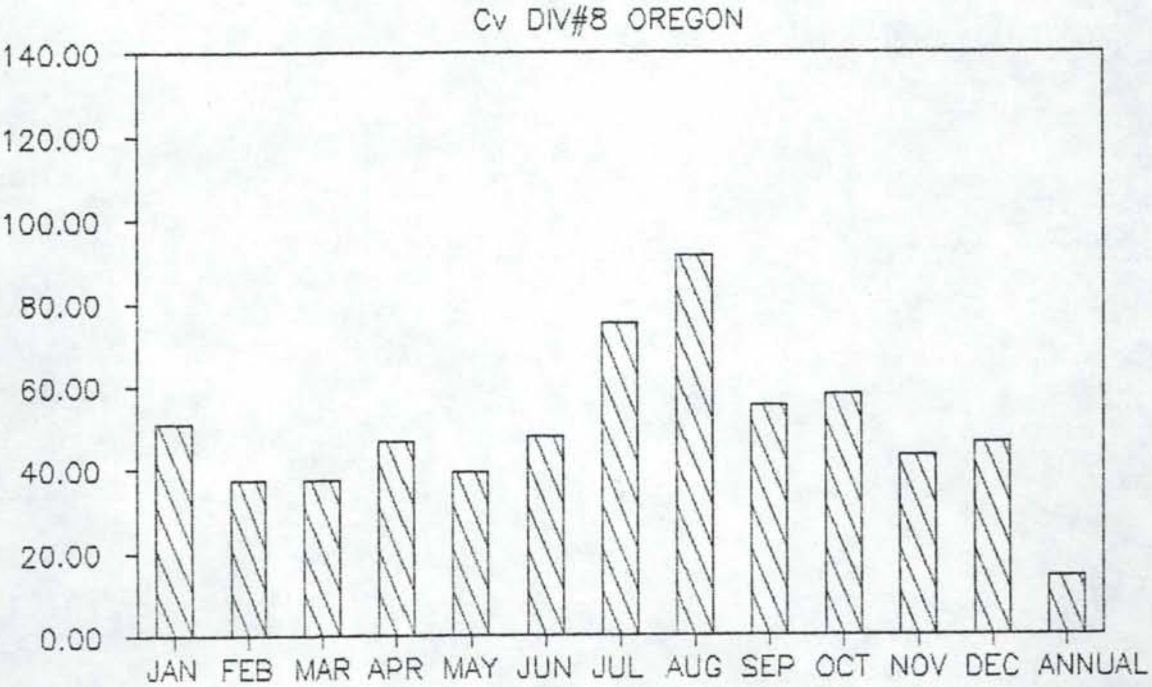

Cv DIV#10 IDAHO
140.00
120.00
100.00
80.00
60.00
40.00
20.00
0.00
JAN FEB MAR APR MAY JUN JUL AUG SEP OCT NOV DEC ANNUAL

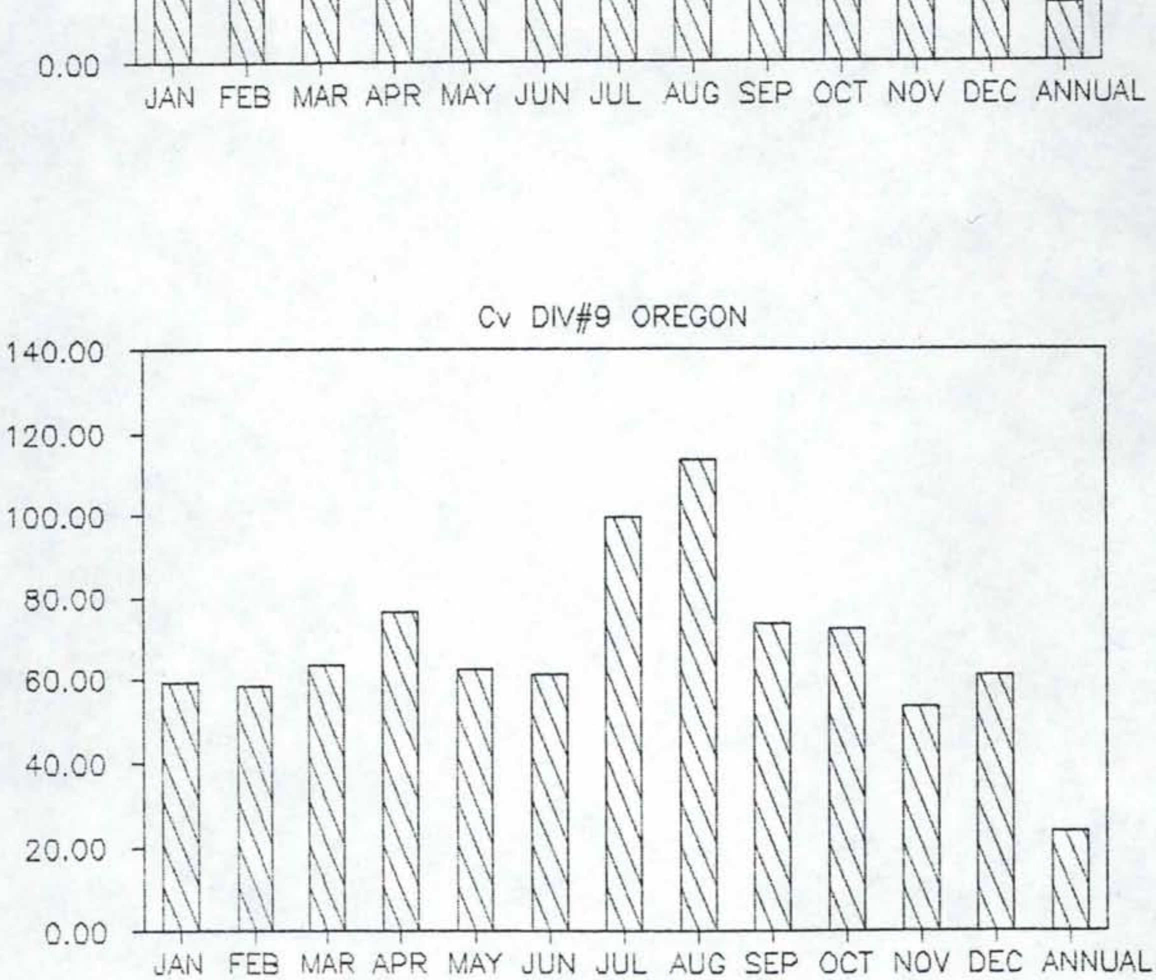
Appendix E

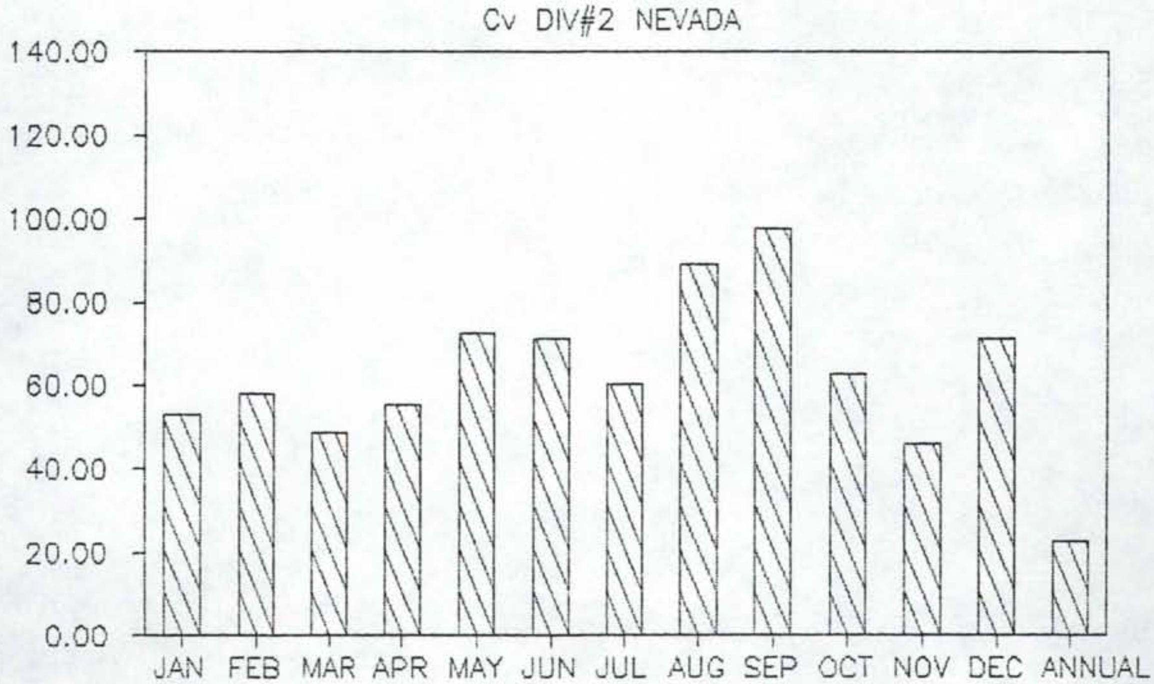
Coefficient of variation for monthly
and annual divisional precipitation
for climate divisions adjacent to Idaho

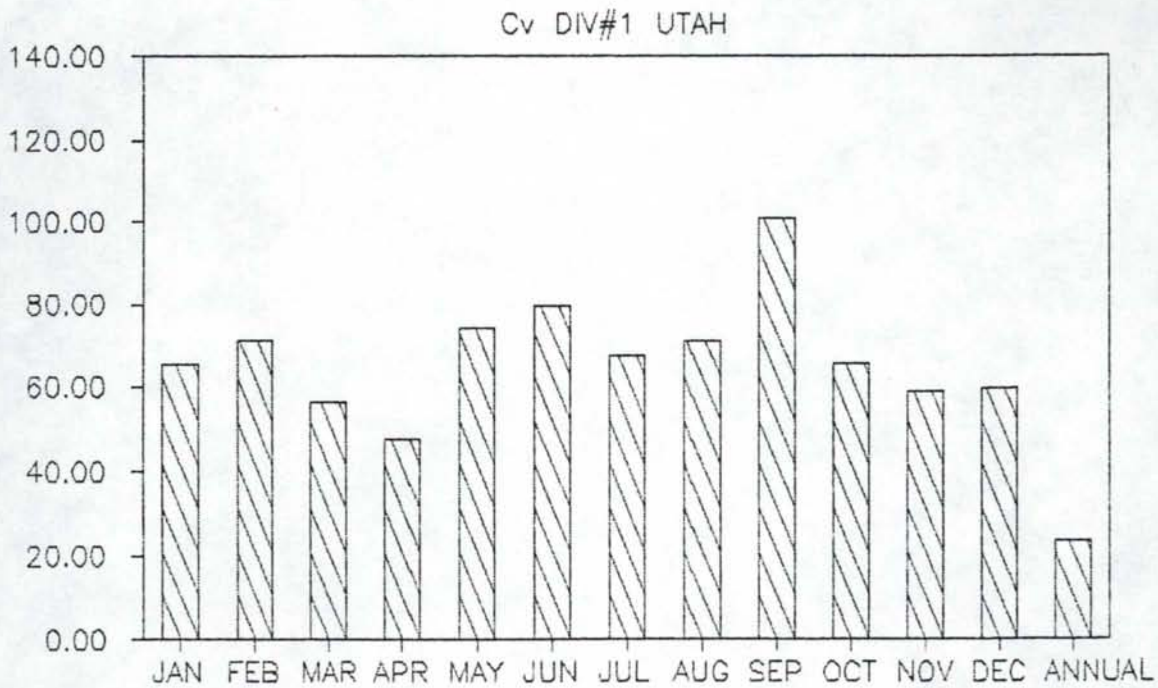

Cv DIV#9 WASHINGTON
140.00
120.00
100.00
80.00
60.00
40.00
20.00
0.00
JAN FEB MAR APR MAY JUN JUL AUG SEP OCT NOV DEC ANNUAL

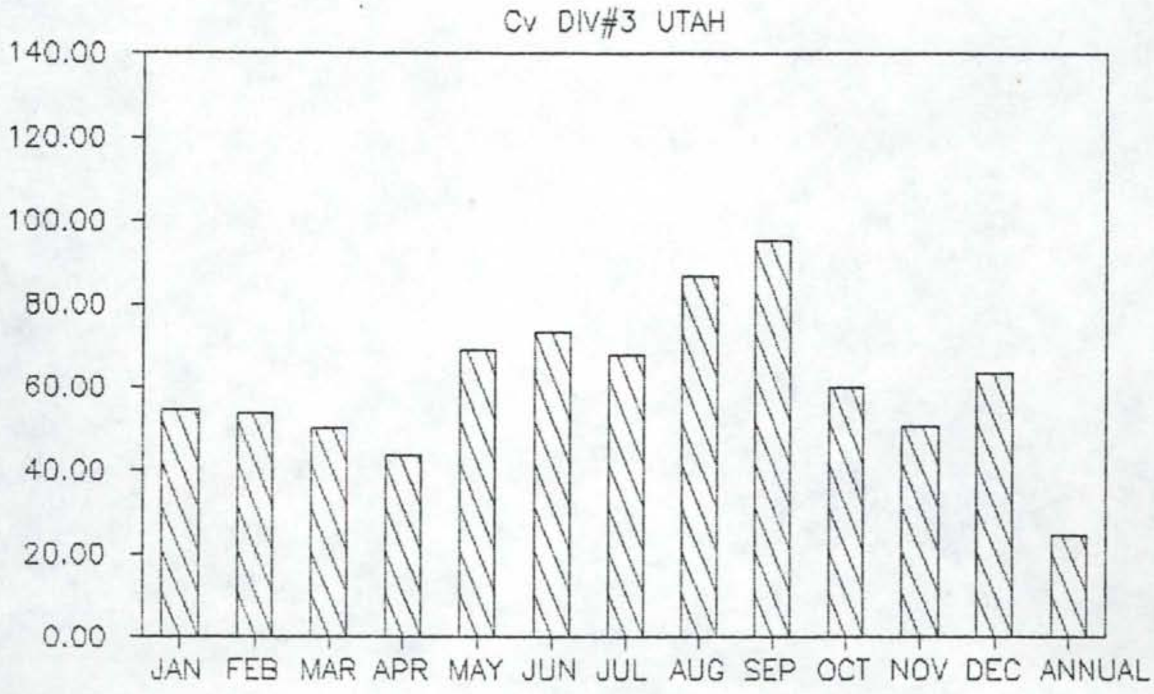

Cv DIV#10 WASHINGTON
140.00
120.00
100.00
80.00
60.00
40.00
20.00
0.00
JAN FEB MAR APR MAY JUN JUL AUG SEP OCT NOV DEC ANNUAL


Cv DIV#8 OREGON
140.00
120.00
100.00
80.00
60.00
40.00
20.00
0.00
JAN FEB MAR APR MAY JUN JUL AUG SEP OCT NOV DEC ANNUAL

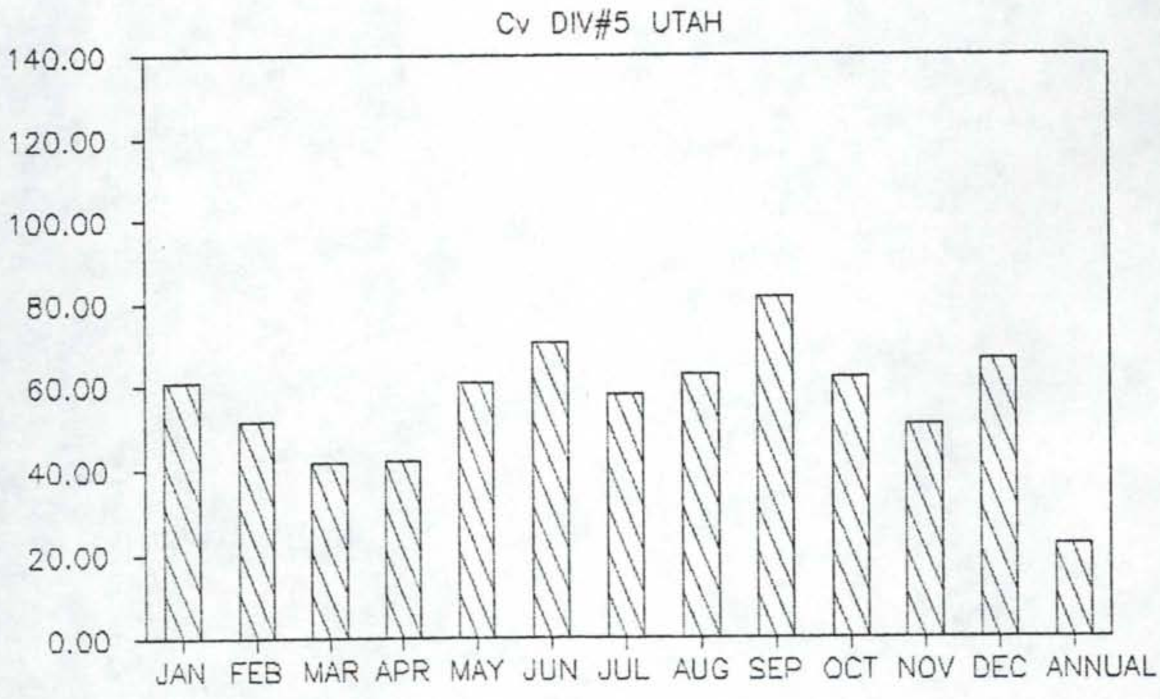

Cv DIV#9 OREGON
140.00
120.00
100.00
80.00
60.00
40.00
20.00
0.00
JAN FEB MAR APR MAY JUN JUL AUG SEP OCT NOV DEC ANNUAL


Cv DIV#2 NEVADA
140.00
120.00
100.00
80.00
60.00
40.00
20.00
0.00
JAN FEB MAR APR MAY JUN JUL AUG SEP OCT NOV DEC ANNUAL

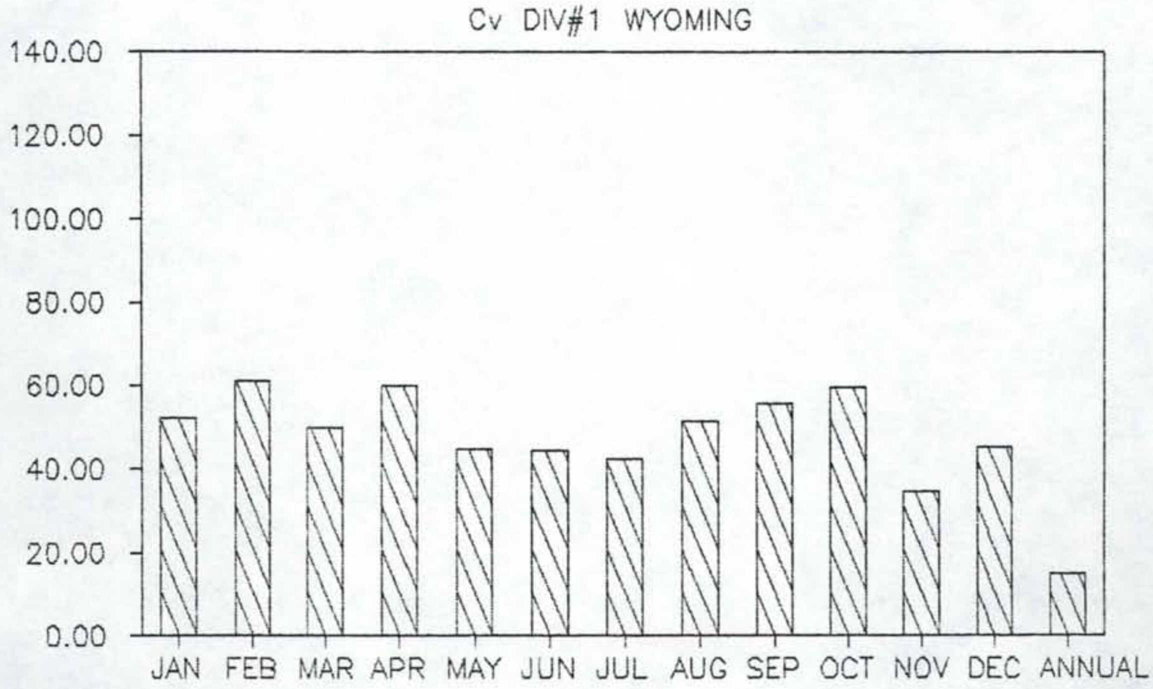

Cv DIV#1 UTAH
140.00
120.00
100.00
80.00
60.00
40.00
20.00
0.00
JAN FEB MAR APR MAY JUN JUL AUG SEP OCT NOV DEC ANNUAL

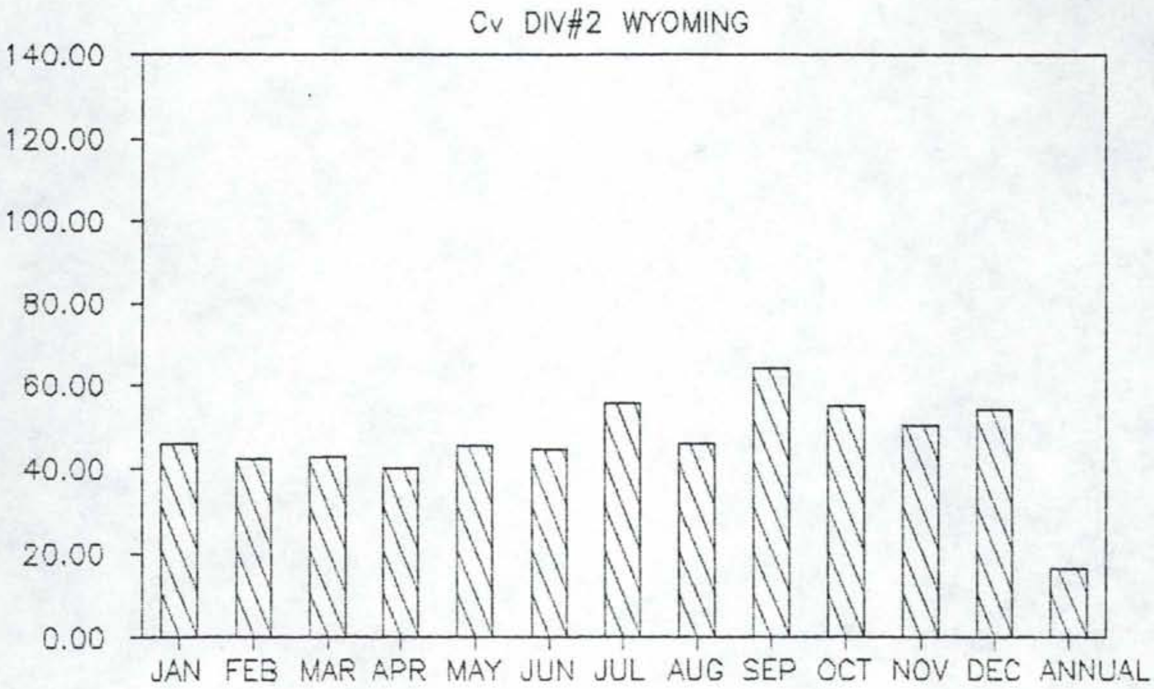


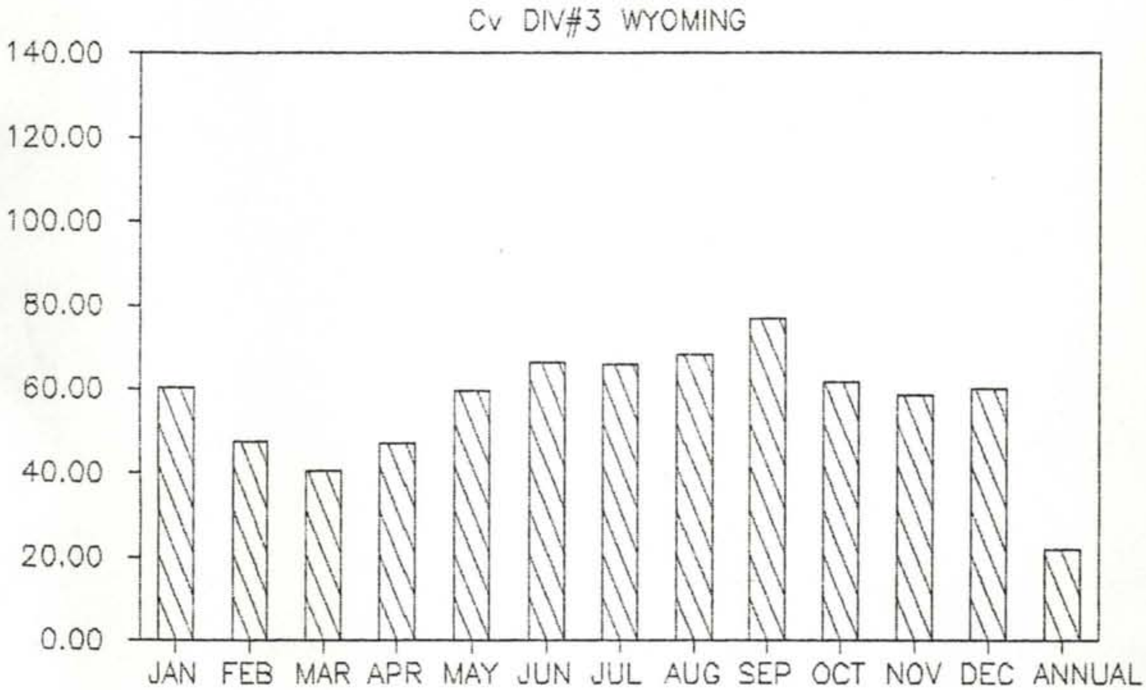
Cv DIV#3 UTAH
140.00
120.00
100.00
80.00
60.00
40.00
20.00
0.00
JAN FEB MAR APR MAY JUN JUL AUG SEP OCT NOV DEC ANNUAL

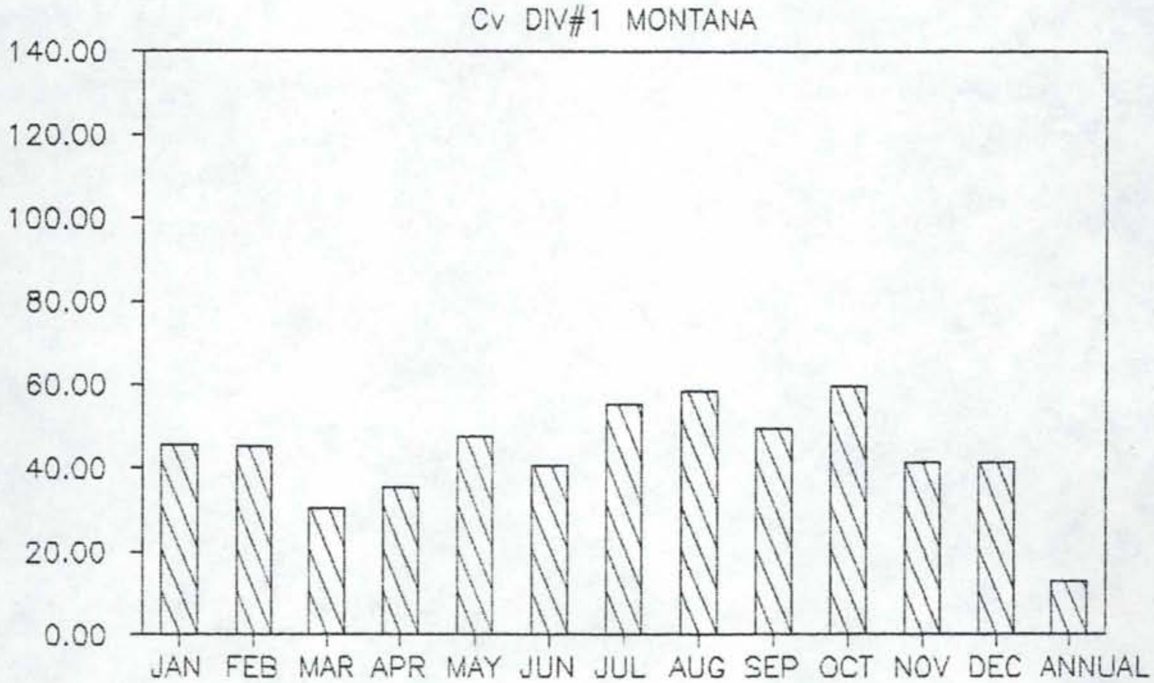


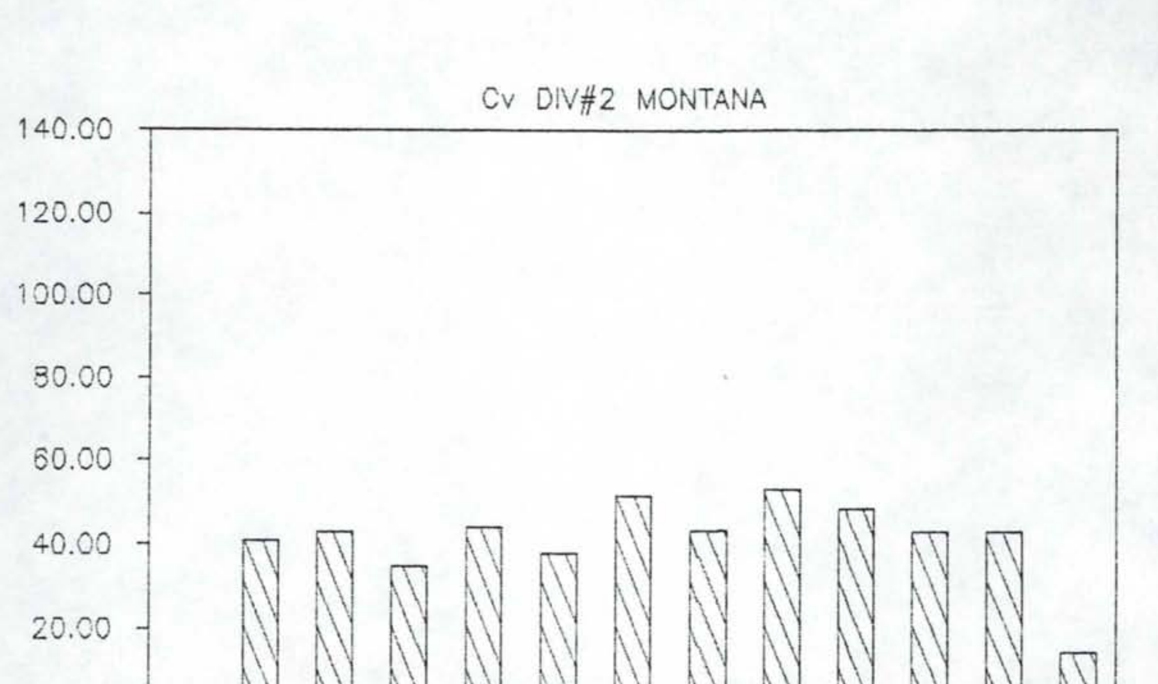
Cv DIV#5 UTAH
140.00
120.00
100.00
80.00
60.00
40.00
20.00
0.00
JAN FEB MAR APR MAY JUN JUL AUG SEP OCT NOV DEC ANNUAL


Cv DIV#1 WYOMING
140.00
120.00
100.00
80.00
60.00
40.00
20.00
0.00
JAN FEB MAR APR MAY JUN JUL AUG SEP OCT NOV DEC ANNUAL


Cv DIV#2 WYOMING
140.00
120.00
100.00
80.00
60.00
40.00
20.00
0.00
JAN FEB MAR APR MAY JUN JUL AUG SEP OCT NOV DEC ANNUAL

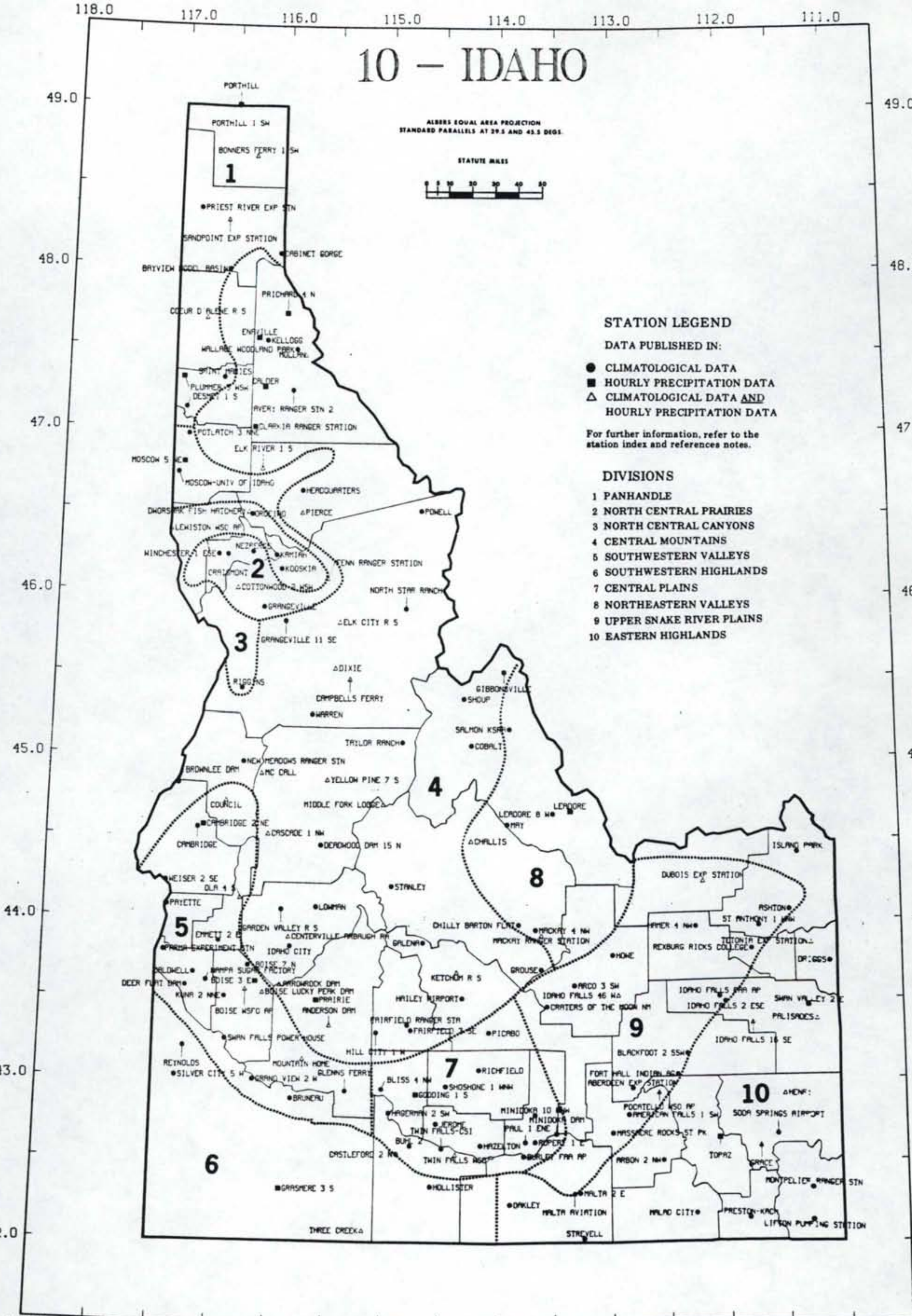

Cv DIV#3 WYOMING
140.00
120.00
100.00
80.00
60.00
40.00
20.00
0.00
JAN FEB MAR APR MAY JUN JUL AUG SEP OCT NOV DEC ANNUAL


Cv DIV#1 MONTANA
140.00
120.00
100.00
80.00
60.00
40.00
20.00
0.00
JAN FEB MAR APR MAY JUN JUL AUG SEP OCT NOV DEC ANNUAL


Cv DIV#2 MONTANA
140.00
120.00
100.00
80.00
60.00
40.00
20.00
0.00
xxx FEB MAR APR MAY JUN JUL AUG SEP OCT NOV DEC ANNUAL

Appendix F

Map of Idaho climate division


10 — IDAHO
ALBERS EQUAL AREA PROJECTION
STANDARD PARALLELS AT 29.5 AND 45.5 DEGS.
STATUTE MILES
STATION LEGEND
DATA PUBLISHED IN:
● CLIMATOLOGICAL DATA
■ HOURLY PRECIPITATION DATA
△ CLIMATOLOGICAL DATA AND HOURLY PRECIPITATION DATA
For further information, refer to the station index and references notes.
DIVISIONS
1 PANHANDLE
2 NORTH CENTRAL PRAIRIES
3 NORTH CENTRAL CANYONS
4 CENTRAL MOUNTAINS
5 SOUTHWESTERN VALLEYS
6 SOUTHWESTERN HIGHLANDS
7 CENTRAL PLAINS
8 NORTHEASTERN VALLEYS
9 UPPER SNAKE RIVER PLAINS
10 EASTERN HIGHLANDS