A 360 YEAR TEMPERATURE AND
PRECIPITATION RECORD FOR
THE PASCO BASIN DERIVED
FROM TREE-RING DATA

J. P. Cropper
H. C. Fritts

Laboratory of Tree-Ring Research
University of Arizona
Tuscon, Arizona

M. G. Foley, PNL Project Manager

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FOREWORD

This report was written by John P. Cropper and Harold C. Fritts of the University of Arizona in November 1984, and it was revised in January 1985. The report is now being published at the request of the Basalt Waste Isolation Project to make available to the public background information that is referenced in their Environmental Assessment. New data or changes of interpretation since January 1985 are not reflected in this report.

M. G. Foley
PNL Project Manager

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ABSTRACT

Dendroclimatology, the study of past climatic variations by means of tree-ring analysis, is used to produce estimates of seasonal and annual temperature and precipitation from the 17th through 20th centuries. In this study these estimates, reconstructions, are derived in five different ways for regions that each include the Pasco Basin of south central Washington. The best of five sets of results were selected, based on the verification of the reconstructions with independent instrumental data.

The highest quality reconstructions were determined by evaluating primarily their verification statistics. They were a subset of 77 temperature and 96 precipitation reconstructions derived from a network of 65 tree-ring chronologies from western North America, reconstructions which had been obtained in an earlier research effort (Fritts, Lofgren and Gordon, 1979). The explained variance due to calibration averaged 0.309 for seasonal data and 0.333 for annual data. The verification results show that 40% of the statistics applied to seasonal and annual data passed the significance tests. Three new sets of reconstructions were obtained using a new set of 10 chronologies located near the

Pasco Basin and the reconstructions from the best of these passed only 21% of the verification tests.

The reconstructed annual temperature of the Pasco Basin for the last three centuries was on the average 0.17 degrees Fahrenheit higher and had a standard deviation which was 4% larger than for the 20th century. The greatest reconstructed difference in the average temperature was in winter and the greatest reconstructed difference in the variance (standard deviation) was reconstructed in autumn. The average annual precipitation reconstructed for 1502-1900 was 0.32 inches higher than it has been in the 20th century. The change in average and standard deviation of reconstructed precipitation was greatest in autumn. Both the seasonal and annual reconstructions for temperature and precipitation exhibit large and persistent variations from the mean which are often most pronounced in the 17th century. Droughts were more common starting with the last half of the 17th century, with values that sometimes exceeded the 20th-century maximum amounts and duration. While there are some similarities among the four seasons and two variables, many differences between the seasonal reconstructions exist.

INTRODUCTION

One important aspect in selecting a site for the long-term underground storage of nuclear waste is to evaluate the long-term climatic variability in the region. Meteorological records are short compared to the anticipated duration of the containment period of some 10,000 years. Thus, the longest possible record of climate is needed in order to obtain a realistic measure of the true climatic variability for the Pasco Basin of south central Washington. Proxy records, substitutes for climatic data such as tree rings or palynological evidence, can be used to extend the instrumental data backward in time (Barry et al., 1979), although the extended portion of the record can never be as accurate as an instrumental record. Nevertheless, the lengthened record can provide new data on past climatic variations, thus allowing the relatively short 20th-century record of climate to be placed in the perspective of longer time periods.

This study represents an application of dendroclimatology, a discipline which uses the annual growth layers of tree rings to study past climate. The purpose of the study is to extend our knowledge of past climate conditions for the Pasco Basin as far back in time as allowed by the ages of climate-sensitive trees. The general methodologies presented

below, are described in greater detail elsewhere (Fritts, 1976; Fritts, Lofgren, and Gordon, 1979).

This application of dendroclimatology to the Pasco Basin problem involves 1)selecting and analyzing those tree rings that will serve as the best proxies of climatic variations, 2)transforming these data into homogeneous time series represented by the indices of a site chronology, 3)calibrating the tree-ring indices with available meteorological measurements and 4) verifying the reconstructed information with meteorological records independent of those records used for the calibration period.

TREE RINGS AS PROXIES OF CLIMATIC VARIATIONS

Temperate-climate trees normally produce one layer or growth ring for each year. The size, structure, and chemical composition of these rings can provide climatic information only when some of the tree-growth variation has been limited by one or more factors of climate occurring during part of the year (Fritts, 1976; LaMarche, 1974, 1978; Stockton and Meko, 1975).

It is the job of a skilled dendroclimatologist to recognize and select trees with potential climatic information based upon the structure of the tree crown and trunk and from the

appearance of the rings. The rings of the selected trees are usually sampled by means of a coring tool which extracts a soda-straw-sized (4mm) cylinder of wood from the trunk at about breast height. A complete sample often includes cores from 10 to 25 climate-stressed trees growing on similar sites in a local area. The number of trees that are required to make up a sufficient sample depends to a large degree on the severity of the limiting factors, the more severe the factors the fewer cores that are required for a relatively reliable site chronology (Fritts, 1976; Cropper, 1982; DeWitt and Ames, 1978). The cores are processed to determine the width and detailed structure of the annual growth layers. The potential presence of growth anomalies caused by non-climatic factors (insects, fire or man) requires that the rings be carefully examined and screened for such problems before they are dated, measured and compiled into a site chronology.

The procedure of assigning a calendar date to each ring within a core is made difficult by the occasional occurrence of a limiting factor so severe that no growth increment is formed for that year at a particular location (locally absent or missing ring) or that the growth is interrupted causing two layers to form in a year (false ring). Only by matching the patterns of wide and narrow rings from a representative sample of many trees (crossdating) can dates be assigned to such materials with any degree of confidence (Fritts, 1976; Baillie, 1982). The procedure

of crossdating is one of the most important aspects of dendroclimatology, as all subsequent analyses depend upon the quality of this aspect of the work. In recent years computer tools have been utilized to aid this whole process (Cropper, 1979; Robinson and Evans, 1980; Holmes, 1983).

Once reliable dates have been assigned by crossdating, and poor quality specimens are identified and either corrected or discarded, the ring-width data from the individual core samples are standardized. Standardization removes the well-recognized non-climatic phenomenon of decreasing ring-width with increasing age and changing status of the tree within the stand over time (Fritts, 1976, 1983; Kickert et al., 1983). It also makes the ring width variance homogeneous over time. A negative exponential, or polynomial curve or regression line is fitted to the tree ring width data as a function of time. The ring width for each year is divided by the value of the curve for that year to form an index of ring-width growth (Fritts, 1963). These standardized values are then arithmetically averaged for each year with the indices from other trees at the same site to obtain the mean yearly values making up the chronology of the site (Fritts, 1976; LaMarche, 1974; Stockton and Meko, 1975). These values are then used as predictors of climate.

More than a thousand chronologies have been developed from North American conifers. A network of 65 high-quality chronologies were selected from these chronologies in 1975

(Fritts and Shatz, 1975), (See Figure 1). This set of 65 chronologies has been the subject of extensive analysis (Fritts and Shatz, 1975; Fritts, Lofgen and Gordon 1979; Cropper and Fritts, 1982). Each of these chronologies covering the time period 1600 to 1963 represents a sample of two cores from 10 or more trees, of one of the following species: Douglas-fir (*Pseudotsuga menziesii*), bigcone-spruce (*P. macrocarpa*), ponderosa pine (*Pinus ponderosa*), pinyon pine (*P. edulis*), limber pine (*P. flexilis*), bristlecone pine (*P. longaeva*), Jeffrey pine (*P. jeffreyi*), and white fir (*Abies concolor*).

More recently an intensive sampling effort of Douglas-fir and ponderosa pine was launched in the Washington and northern Oregon region by L. B. Brubaker and L. Graumlich of the University of Washington, Seattle and Terry Mazany, of the University of Arizona. As a result, a new set of chronologies have become available from sites closer to the Pasco Basin (Figure 2) than those used in the 65-chronology grid (Figure 1). There were a sufficient number of new chronologies to bring the reconstructions up to 1975, but they extend back only to 1640.

CALIBRATION

The relationship between climate and tree growth is highly complex. Many of the details are poorly understood. It is known that tree growth is affected by many factors and that as these factors vary in intensity and importance the tree-ring widths vary accordingly (Fritts, 1974; 1976). Trees of different species or those on different sites often respond differently to the same macroclimatic factors. In North American conifers the growth layer is formed in the spring and summer seasons and may be directly affected by climate during that time. During autumn and winter, climatic factors have important effects on soil moisture, soil temperature, production and storage of food in the tree, and root growth. In addition there may be a variety of carry over effects in succeeding years. For example the amount of food stored in one year is somewhat related to the formation of leaves in the next year. This in turn affects the food-production efficiency in the next year which then influences processes affecting ring width. In species that hold their needles for a number of years (e.g. 15 years for bristlecone pine) the interrelation between the growth of different years can be spread over a long period of time. These biological features produce autocorrelation in the chronologies where narrow rings tend to be followed by narrow rings and wide rings followed by wide rings, even though there was a change in climate from the

first to the second year. All of these interrelationships should be considered when climatic information for a particular year is extracted from tree-ring chronology set.

As a means of deciphering the complexities of the climate-growth relationship, multivariate regression techniques are employed to obtain estimates of climatic parameters. This procedure is called calibration. In essence, ring-width measurements are compared to climatic observations, and from these comparisons, multivariate coefficients are obtained. The products of the coefficients and ring widths are then summed to produce the estimate of the climatic parameter. The resulting calibration equation can then be applied to ring-width measurement variation for past years to reconstruct the climatic variations associated with the observed patterns in growth (Blasing, 1978; Fritts, 1976; Fritts, Lofgren, and Gordon, 1979).

VERIFICATION

Independent climatic information (information not included in the calibration procedure) is used for verification. This information usually consists of meteorological measurements, but independent proxy data including tree-ring chronologies and various types of historical evidence can also provide a type of verification. Each type of information has its strengths and

weaknesses, and all three can be used to verify different features of the reconstructions (Gordon, 1982).

Verification with independent meteorological measurements is the most objective and precise method available for testing reconstruction reliability, and for that reason it has the greatest scientific value (Gordon, 1982). Independent meteorological measurements are compared directly with the reconstructions on a station-by-station basis and the similarity between the two sets of data are measured with five objective statistics that are tested for significance from random results at the 95% confidence level. These statistics are (1) correlation coefficient, (2) correlation coefficient of first differences, (3) sign agreement of departures from the mean, (4) sign agreement of first differences and, (5) product means test (Fritts, 1976). It should be noted, however, that these five statistics measure only the similarity in the temporal patterns of variation and do not take into account the magnitude of some types of errors. A sixth statistic, the reduction of error (Lorenz, 1956; Fritts, 1976), reflects the magnitude of the errors or differences between the estimates and the actual measurements. A value greater than zero indicates that the reconstructions contain some information on climate.

The statistics from the independent period are usually lower (and less often significant) than those for the calibration period. This is undoubtedly the result of overspecification in

the calibration period, but other sources of error also exist. One such source could be the existence of errors in the meteorological data used for verification. These errors can result from differences in the time of day of observation, the instruments used for measurement, the location of instruments (e.g. northfacing vs. southfacing) and a general lack of quality control (Kennedy and Gordon, 1980). A careful screening and checking of all meteorological data used to calibrate the 65 western tree-ring chronology grid was made by DeWitt (1978), but adequate records, time, or resources were not available to review the nineteenth-century data used for the independent set. Therefore, errors are likely to be present in these early data. Some failures of independent verification tests might be attributed to these types of errors as well as to unreliability in the climatic reconstructions derived from the 65-chronology analysis.

STRATEGY FOR SELECTING THE BEST RECONSTRUCTIONS

A number of different sets of reconstructions were produced for temperature and precipitation in the vicinity of the Pasco Basin, Washington. Four sets were regionally averaged climatic estimates derived from the 65-chronology grid. Of the four, two were associated with reconstructions made at a large

number of climatic stations throughout the entire U. S. and southwestern Canada (large grid). The other two were associated with reconstructions at a smaller set of climatic stations confined to the North American West (the small grid). Three additional reconstructions were obtained in this particular study using the best 10 recently developed chronologies in the general locality of the Pasco Basin.

(a) Reconstructions for the Columbia Basin from the
65-chronology grid

The data used for the first four sets of reconstructions were produced in the following way. The set of 65 western tree-ring chronologies (Figure 1) was calibrated with two climatic variables for four seasons and over two grids. The large grids included: i) 77 temperature stations and ii) 96 precipitation stations in the United States and southwestern Canada. Seasonal temperature (averages) and seasonal precipitation (totals) were generated by combining the monthly data as follows: winter, December-February; spring, March-June; summer, July-August; and autumn, September-November. The data for 1901-1963 were used for calibration. All data prior to 1901 were used for verification. Data after 1963 could not be used because some of the selected chronologies did not extend beyond this date.

The large number of variables in both the predictor and predictand sets was reduced by calculating the eigenvectors and using the first 10 to 15 principal components. The calibrations were optimized for each season by a canonical stepwise multiple regression procedure applied to the principal components of tree growth and principal components of climate (Blasing, 1978, Fritts, Lofgren, and Gordon, 1979). The model used in the calibration was varied by using different numbers of predictand principal components. A variety of approaches were tried to help determine which of the models had the best structure. Principal components were sometimes lagged to portray moving average effects. The predictor data were also modeled for first-order autocorrelation features before taking the principal components. Reconstructions were made of the same variables and seasons using calibration models of different structure. All results were then verified using the nineteenth-century independent data and the nineteenth-century reconstructions. Only those which verified, ie. had less than a 0.05 probability of being a result of chance, were used in subsequent analyses.

The best data sets for each season were assembled by examining and selecting the reconstructions from models which gave the best calibration and verification statistics. The results from two to three of the best models were combined by averaging the respective reconstructions, and new calibration and verification statistics were calculated. There was generally

more improvement after averaging than would be expected from the statistics of the individual reconstructed sets. Enough of the error in the different reconstructions was reduced by the averaging to make the values of the combined series noticeably more accurate. These were the final models chosen for each season.

The four combined reconstructions for seasonal temperature were weighted according to the number of months included, and then were averaged to obtain the annual December-November values. The seasonal reconstructions for precipitation were summed to obtain annual totals. Each annual reconstruction was assigned the year of the January month. The annual reconstructions formed by combining the seasonal reconstructions were verified with annual instrumental climatic data.

The seasonal and annual reconstructions for each variable were averaged for all stations in the Columbia Basin area. Table 1 shows the 8 temperature stations and 9 precipitation stations used for this purpose (Figure 3). As mentioned before, calculations were made for data from both the small and large grids.

(b) Reconstruction for the Pasco Basin from the 65-chronology grid

Based upon the same individual climate station reconstructions developed from the 65-chronology western North American tree-ring grid, a Pasco Basin regional reconstruction was formed. This regional reconstruction was produced by averaging the seasonal reconstructions and annual reconstructions of the three climate stations closest to the Pasco Basin. For the temperature reconstruction these sites were Baker, Walla Walla and Spokane. For the precipitation reconstruction the sites used were Lewiston, Baker and Collville (Table 1).

(c) Reconstructions for the Pasco Basin Region from 10 new chronologies

The tree-ring measurements available from the International Tree-Ring Data Bank (Brubaker and Graumlich, 1984) and from the Laboratory of Tree-Ring Research for sites in Washington and Oregon were examined for their dating quality using recently developed computer program COFECHA (Holmes, 1983). Several measured core data sets were found to be of marginal quality. Since the specimens from which the measurements came could not be examined, the series with questionable data were deleted and a new tree-ring chronology was computed.

Computer program ARSTAN (Cook and Holmes, 1984) was used to generate the chronologies. ARSTAN is a newly developed program designed to extract a maximum of climatic information from series of ring-width measurements of a core collection from a sampled site. Individual measurement series are first detrended by fitting a negative exponential curve, or a least squares regression line if the exponential cannot be fit, then dividing the measured (observed) values by the corresponding (expected) values of the curve. This yields a series with a large part of the biological growth trend removed. Then a second detrending is done using a stiff cubic smoothing spline (Cook and Peters, 1981) to remove only the very low frequency variance on the order of the length of the series itself. The result of this two-step detrending is an assembly of indexed tree-growth series, well crossdated, which contain a minimum of trends resulting from biological processes in the trees.

Individual series are then combined into a chronology by deriving a biweight robust mean of the indices for each year, a technique which reduces the effect of disturbances and trauma suffered by individual trees. This is called the "STNDRD" chronology.

Multivariate autoregressive modeling is done on the detrended series, and a pooled autoregressive model is derived. Each series is "whitened" by using its own coefficients for univariate autoregressive modeling, carried out to the order of

the pooled model. These residual series are combined into a chronology, again by means of biweight robust mean estimation.

Finally, the coefficients from the pooled modeling are used to add the persistence common among the series back into the residual chronology, giving the "ARSTAN" chronology.

The error variances of the "STNDRD" and "ARSTAN" chronologies are computed, and the chronology with the lower error variance is selected. In other words, if the ratio of error variance of the "ARSTAN" to the "STNDRD" chronologies is less than 1.0, the autoregressive modeling has produced a chronology with lower error variance. For each site, the chronology with the lower error variance was selected.

A subset of chronologies from 10 sites were chosen for subsequent use, based primarily on the maximum time period that could be covered by the maximum number of chronology series. The aim was to obtain a spatial network of chronologies that encompassed the Pasco Basin and had the longest common time period possible. The resulting data grid of 10 sites covered a common period of 1640 to 1975 (Figure 2). The mean sensitivity and standard deviation of these 10 chronologies averaged 0.20 and 0.28 while the signal-to-noise ratios averaged 10.7. These chronologies were generally of poorer quality than those used for the 65 selected station set.

Four climatic stations were available for the Pasco Basin

region against which the new tree-ring grid could be calibrated (Table 1). The monthly climate data were seasonalized in the same manner as above, and the seasonalized data were subsequently combined to form regional averages for the different seasons. These averaged seasonal time series were used as the predictands in the calibration process while the 10 tree-ring chronologies were the predictors. (The smaller number of chronologies allowed the analysis to be performed without reducing the data to principal components.) The data from 1901-1961 were used in the calibration, and those from 1962-1975 were used in the verification.

The four seasonal time series of temperature or precipitation and a second set that was lagged by one year were used as predictands (forming an eight variable data set). These were used in the stepwise canonical regression analysis with the 10 selected tree ring chronologies. Thus the tree-ring indices for current calendar year t were calibrated with climate data for winter, spring, summer, and autumn of both the calendar year t and the next year $t+1$. Reconstructions were obtained for the eight climatic series representing both the unlagged and lagged data. The reconstruction with the best verification and calibration statistics was selected from each of the 4 seasons for subsequent analysis.

Autocorrelation within the tree-ring data may obscure the climatic information to some extent. This would reduce the

calibration and add error to the subsequent reconstruction. Thus, each of the 10 chronologies was modeled as a Box-Jenkins autoregressive moving average (ARMA) series and the residuals of the model were obtained. These 10 ARMA residual series were used with the above unlagged and lagged climatic data in the canonical regression analysis to obtain another set of reconstructions. A third reconstruction was generated by using both the original 10 chronologies and the ARMA residuals together in a 20 predictand variable analysis. This would hopefully allow for certain mixed-model effects to be used in calibrating the transfer function.

RESULTS

A summary of the overall calibration and verification results for the different reconstructions is presented in Table 2. The New Pasco Basin reconstructions using both the original and ARMA modeled chronology data had the highest explained calibration variance. However, when the verification results are examined, those reconstructions derived from the 65-chronology tree-ring grid are the best. The differences are so great that little doubt remains as to the most accurate result, even though the 65 sites of the trees that were used were sometimes 1000 or more Km distant from the Pasco region. The multivariate

calibration appeared to weight the information contained in the 65 chronologies appropriately to obtain the necessary information on the local Pasco Basin climate. We conclude that the reconstructions from the 10 chronology tree-ring data used with the Pasco region climate verified insufficiently for our purposes. We therefore abandoned them and extracted the necessary information from the reconstructions of the large climatic grid made with the 65-chronology grid.

The data were analyzed from only the three reconstructions immediately surrounding Pasco Basin. When these data were considered (Table 2), the large grid reconstructions appeared slightly more reliable than those of the small one, although the differences were not large. We therefore concluded that the data from the large grid were most suitable for the analysis.

The only remaining comparison to be made was an evaluation of the averages from the eight reconstructions for the Columbia Basin and the averages of the three reconstructions for the Pasco Basin. The correlations between these reconstructions are shown in Table three for the entire 360-year period. Correlations between the two series were also obtained for 20-year subsets. The degree of correlation between the series varied from a perfect 1.0 for the whole series down to a value of 0.63 for one 20-year period. The highest correlations were found among the temperature series (Table 3). They indicate that either

set of reconstructions would provide essentially the same result. However the lower correlations for spring, summer and annual precipitation indicate that the averages from the three reconstructions immediately surrounding the Pasco Basin are different estimates and since they are from stations closest to the area, they should be used for this analysis. In addition, Table 2 shows that the Pasco Basin large-grid subset has the best overall verification statistics. Therefore, these reconstructions were chosen for the climatic evaluation.

The annual and seasonal reconstructions of temperature and precipitation for the Pasco Basin region are presented in Figures 4 to 6. These time-series plots are the annual and seasonal values averaged over the three stations from the large grid. These yearly values have been treated by multiplying a 13-weight low-pass filter (Julian and Fritts, 1968) that passes 50% of the variance at a period of eight years. Thus the plots emphasize long-term variations with periods from infinity to about 8 years. The untreated data are included in Appendix 3.

In each of the plots (Figures 4 to 6) the zero line is the mean for the 1901 to 1961 calibration period and the time series plotted is the low pass filtered series of departures from that mean. Each of the filtered seasonal reconstructions shows that some periods depart markedly from the 20th-century mean value (see Table 4).

In Table 4 the 20th century means and standard deviations are compared to the means and standard deviations in the reconstructions for the prior three centuries. Column 2 in Table 4 includes the means for 1901-1970, which is for a longer period than that used for calibration, and the standard deviations of the reconstructions for 1901-1961, which is for data within the interval used for calibration. The standard deviation of the reconstruction estimates was used in order to avoid the variance difference between the predictand data and the estimates. Column 3 includes the means or standard deviations for the reconstructions for 1602-1900. The column on the right includes the differences or ratios between values in columns 2 and 3 expressed as 20th century anomalies from the 1602-1900 reconstructed climate. It should be pointed out that these data are regression estimates with error terms. They generally have less variance than the original climatic data. As such they must be considered as lower estimates of the actual conditions that probably existed.

The calculations in Table 4 indicate that the 20th century conditions [those up through 1970 for the mean and those up through 1961 for the variance (standard deviation)] were cooler and somewhat dryer than those reconstructed for the three prior centuries. The low temperature anomalies of the 20th century were found to be primarily in the winter and spring measurements. In the case of precipitation the average anomaly

was found to be primarily in the measurements for the winter and autumn seasons.

The variance follows different patterns. The variances of the spring, summer and autumn temperatures were lower in the 20th century compared to the prior centuries while those of winter, spring and autumn precipitation were lower.

The variations within each time series were analyzed statistically to help with the interpretations of the plots (Tables 5 and 6). The overall means and standard deviations of the departure values are included in Table 5. These data can be compared with the differences shown in Table 4. In addition, 20-year overlapping running means were calculated and ranked from the highest and lowest. The five highest and five lowest means from non-overlapping periods are shown in Table 5 along with the dates for the first year of each period. The differences in mean and variance between all adjacent pairs of the overlapping mean series also were tested using the t and the F statistics, respectively. As expected, significant mean departures clustered only in periods of highest and lowest values. The 20-year period with the most significant statistic was selected from the cluster for inclusion in Table 6. The highest and lowest ranking mean values coincide with many of the peaks and troughs in the plots, while significant changes in the mean appear as rapid changes in the plots.

ANNUAL RESULTS

The analysis of the 20-year means of annual temperature show that the five warmest non-overlapping 20-year means were confined to the three earlier centuries. The first and third warmest (the ones starting in 1647 and 1674) were reconstructed in the 17th century. The second, fourth and fifth ranking were reconstructed beginning in 1790, 1850 and 1704. Some of the mean values include intervals with two maxima on the plots. This occurs because the filtered plots include more high-frequency information than is available from the series of 20-year overlapping values.

The coldest 20-year interval (the one listed on the far right) was reconstructed beginning in 1611. The second coldest began in 1898 and included early 20th century data. The third fourth and fifth coldest were reconstructed to have begun in 1871, 1750 and 1828. The plot of the departures shows a gradual decline from the late 17th to early 20th century. This latter century is a time of sharply rising temperatures for many areas of Europe, Asia and eastern North America, but the trend was not as pronounced in the Pacific Northwest of North America (Jones and Kelly, 1983). This same pattern of falling temperatures from the 17th to early 20th century also was reconstructed for the Pacific and Great Basin states by Fritts (1981), but did not occur over the Rocky Mountains and areas to the east.

Excursions from this trend of up to a degree F. can be noted in Figure 4. The data from Table 6 show that the rise in annual temperature around 1634 was more marked (had the highest rank) than during any other 20-year period. Marked declines in temperature can be noted in 1667, 1695, 1724, 1811 and 1870. The last was second in rank. There are two periods with significant rises in annual temperature near or during the 20th century. One was noted in 1891 and the other in 1926. These rank among the smallest that were found to be significant.

The variance of annual temperature is characterized by a sharp rise occurring in 1654. This change in 20-year variance is the highest ranking variance change noted in the analysis. It is followed by a marked decline in variance in 1677. The next most important variance change can be noted in 1765. A modest decrease in variance was noted in 1883, but no significant departure in 20-year variance was found in the 20th-century annual temperature reconstructions.

The annual precipitation plot in Figure 6 suggests that the Pasco Basin was consistently wet in the first half of the 17th century with departures often 2 or more inches above the 20th-century values. The intervals starting in 1604 and 1629 were the two wettest 20-year periods. Periods in the 18th and 19th century were also moist, as were the 20 years from 1890-1909 with a mean ranking fifth highest. The most marked 20-year drought was reconstructed to have started around 1676. The second

most severe drought was reconstructed to have begun around 1843. Other dry 20-year periods begin in 1917, 1755 and 1699 (Table 5). There was less variation in the 20th century and the excursions from normal were about half those reconstructed in earlier centuries.

The greatest 20-year change in annual precipitation was reconstructed in 1841 and amounted to a decline of about 2 inches (Table 6). The second and third important changes reconstructed in 1652 and 1917 were also represent declines. With the exception of 1741, all other subsequent changes in the mean indicated warming. The dates and ranks are: 1940-fourth, 1696-fifth, 1719-sixth and 1863-eighth. The most significant change in variance was the decline reconstructed around 1857 while the second most significant change was a decline reconstructed around 1645. The third through sixth-ranking changes in variance were reconstructed in 1665, 1914, 1696 and 1756. Two significant changes corresponding to decreases in variance are indicated in 1894 and 1940. One can see from these data that the 20-year precipitation varied from period to period exhibiting mean changes of from 1 to 2 inches and standard deviation changes of 0.7 inches or more.

SEASONAL RESULTS

The filtered plots of seasonal temperatures (Figure 5) show the general character indicated by the data in Table 4. With the exception of autumn the 20th-century seasonal temperatures were cooler than they were in the earlier three centuries. The autumn plot indicates a general rise in temperatures during this season. The highest 20-year mean temperatures for winter were reconstructed for 1656-1675 and the next highest in 1634-1653. The coldest began in 1611; the 1898-1917 period was the next coldest. The highest 20-year temperatures for spring were found in the interval beginning in 1851, the second highest were reconstructed to begin in 1647 which coincides with the high temperatures in winter. The 20 years beginning in 1609 were reconstructed to have been the coldest. This coincides with the third-ranking lowest period in winter. The second and third coldest were reconstructed to begin in 1874 and 1770. The intervals 1898-1917 and 1941-1960 were the fourth and fifth coldest for the spring season.

The warmest 20 years for summer were reconstructed in the period beginning in 1627. The next four warmest periods for summer began with 1782, 1917, 1647 and 1706; the coldest began in 1806, 1861, 1897, 1696 and 1735. The four warmest 20-year periods in autumn began in 1873, 1934 and 1900, all in the 19th and 20th centuries. The period beginning with 1676 had the fifth-ranking high temperatures. The periods beginning in 1622 and 1643 were

the two coldest in autumn, the ones beginning in 1784 and 1735 were ranked third and fourth. The mean for 1809-1829 was the fifth-ranking cold period. While some periods of maximum or minimum temperatures coincided between seasons, there were considerable differences among the seasons for temperature.

The first and fourth wettest 20-year periods that were reconstructed for winter began in 1623 and in 1656. The second-ranking began in 1878 while the third- and fifth-ranking were reconstructed to have begun in 1771 and 1749. The driest 20-year average period in winter began in 1855 and the second-ranking dry period began in 1827. The third and fourth-ranking dry periods began in 1709 and 1675. The drought beginning in 1917 ranked fifth. The plots indicate that dry conditions appeared to have been as common, if not more so, in the 19th and 20th centuries in winter for the Pasco Basin area than in the 17th and 18th centuries.

The trend in precipitation was not as pronounced in the reconstructions for the spring season, but there were droughts in every century. The wettest 20-year intervals began in 1602, 1940, 1821, 1873 and 1897. The driest began in 1623, 1846, 1741, 1645 and 1917.

The reconstructions for summer precipitation reveal relatively short wet periods compared to longer dry periods. The wettest 20-year mean for precipitation was reconstructed for the

period beginning in 1897. The periods starting in 1631, 1818, 1749 and 1608 rank as the second to fifth wettest. Droughts appeared to have been severe and extended in the summer reconstructions. The 20-year period beginning with 1676 was reconstructed to have been the driest. It was followed by the fourth-ranking drought beginning in 1703. The 1769 period was the second driest and these dry conditions were reconstructed to persist into the 1810s. The period beginning in 1843 was third ranking in importance. The drought beginning in 1926 was fifth in importance and it was preceded by a number of years of low moisture.

The precipitation reconstructions for autumn indicate wet conditions persisted through the first half of this century. Averages for the 20-year periods beginning in 1643 and 1611 were first and second ranking. The average for the period beginning in 1808 was third ranking while those for the periods 1720 and 1788 were fourth and fifth ranking. The five driest 20-year reconstructed periods for autumn are listed in order of their importance as beginning in 1675, 1885, 1755, 1841 and 1928. In general, the autumn precipitation was reconstructed to have been considerably less variable during the 20th century than during the three prior centuries.

CONCLUSIONS

To aid in the assessment of climatic effects on ground water recharge, and ultimately on the future performance of the proposed nuclear waste repository in the Pasco Basin, the techniques described herein have been applied to reconstructing the climate of Pasco Basin region of the Pacific Northwest. The best reconstructions of temperature and precipitation are those derived from an analysis of 65 tree-ring chronologies from sites throughout western North America. The reconstructed annual temperature for the last 3 centuries was on the average higher and more variable than for the 20th century.

The average temperature for 1602-1900 amounts to a departure of 0.17 degrees F which is 22% of the standard deviation shown for the 20th century. The standard deviation of the annual value for 1602-1900 is approximately 4% higher than the reconstructions for the 20th century. The greatest difference in the average was reconstructed for winter and the greatest difference in the variance (standard deviation) was reconstructed for autumn.

The average annual precipitation reconstructed for 1602-1900 was 0.32 inches higher than it was in the 20th century. The standard deviation reconstructed for the same period was 29% higher. The change in the average and standard

deviation of the reconstructed precipitation was greatest for autumn.

The reconstructions for both temperature and precipitation exhibit large and persistent variations from the mean in the 17th century, beginning with cool moist conditions and ending with relatively average conditions. The temperatures were generally higher than in the 20th century. A cold period around 1915 was as severe as periods in prior centuries but did not persist as long. Starting with the last half of the 17th century, droughts were common and sometimes more extensive than those found in the 20th century.

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TABLE 1
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The climatic stations used in the analysis of this study

Map #	Site	Columbia Basin		Pasco Basin		new Pasco Basin	
		Tem	Ppt	Tem	Ppt	Tem	Ppt
a	Aberdeen	X	X				
b	Baker	X	X	X	X	X	X
c	Kalispell	X	X				
d	Kamloops	X	X				
e	Roseburg	X	X				
f	Spokane	X		X		X	X
g	Vancouver	X					
h	Walla Walla	X		X		X	X
i	Colville		X		X		
j	Lewiston		X		X		
k	Port Angeles		X				
l	Porthill		X				
m	Waterville					X	X

TABLE 2

Summary of calibration and verification results

RECONSTRUCTION		EXPLAINED VARIANCE	PROPORTIONS OF TESTS PASSING STATISTICAL TESTS	STAT. TESTS + R.E. > 0
<hr/>				
COLUMBIA BASIN				
	LARGE	0.308	91/320 = 0.284	137/384 = 0.357
	SMALL	0.352	96/320 = 0.300	136/384 = 0.354
PASCO BASIN				
	LARGE	0.313	51/150 = 0.340	73/180 = 0.406
	SMALL	0.369	48/150 = 0.320	63/180 = 0.350
NEW PASCO BASIN				
	UNMODELED	0.305	4/40 = 0.100	6/48 = 0.125
	ARMA MODELED	0.288	7/40 = 0.175	10/48 = 0.208
	UNMODELED + ARMA	0.411	6/40 = 0.150	7/48 = 0.146

TABLE A

Statistical comparison of the 20th century record
with the reconstruction for 1602-1902

TABLE 3

=====

Correlation between the reconstructions generated for
the Columbia Basin and those generated for the Pasco
Basin from the large 65-chronology temperature and
precipitation grids

Variable	TEMPERATURE (°F)		
	SEASON	TEMPERATURE	PRECIPITATION
Annual	ANNUAL	0.991	0.837
Winter	Winter	0.979	0.940
Spring	Spring	0.995	0.853
Summer	Summer	0.998	0.949
Autumn	Autumn	1.000	0.993

STANDARD DEVIATION

Variable	Reconstruction (1901-1951)	Reconstruction (1602-1902)	(1901-1951) / (1602-1902)
TEMPERATURE (°F)			
Annual	0.742	0.771	0.952
Winter	1.024	1.074	0.976
Spring	1.173	1.441	0.814
Summer	1.251	1.295	0.972
Autumn	0.936	0.940	0.993
PRECIPITATION (inches)			
Annual	1.152	1.495	0.777
Winter	0.703	0.942	0.749
Spring	0.816	0.953	0.860
Summer	0.327	0.407	0.809
Autumn	0.543	0.591	0.921

TABLE 3

=====

Correlation between the reconstructions generated for the Columbia Basin and those generated for the Pasco Basin from the large 65-chronology temperature and precipitation grids

SEASON	TEMPERATURE	PRECIPITATION
ANNUAL	0.991	0.837
Winter	0.979	0.940
Spring	0.995	0.853
Summer	0.998	0.949
Autumn	1.000	0.993

TABLE 4

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Statistical comparison of the 20th century record
with the reconstructed record for 1602-1900

MEAN

Variable	Instrumental 1901-1970	Reconstruction 1602-1900	(1901-1970) - (1602-1900)
----------	---------------------------	-----------------------------	---------------------------

TEMPERATURE (F)

ANNUAL	49.485	49.657	-.172
Winter	31.399	32.018	-.619
Spring	52.208	52.530	-.322
Summer	70.298	70.245	0.053
Autumn	50.065	49.741	0.324

PRECIPITATION (inches)

ANNUAL	13.730	14.051	-.321
Winter	4.145	4.212	-.067
Spring	4.991	4.841	0.150
Summer	1.180	1.067	0.113
Autumn	3.414	3.931	-.517

STANDARD DEVIATION

Variable	Reconstruction 1901-1961	Reconstruction 1602-1900	(1901-1961) / (1602-1900)
----------	-----------------------------	-----------------------------	---------------------------

TEMPERATURE (F)

ANNUAL	0.742	0.771	0.962
Winter	1.904	1.768	1.076
Spring	1.173	1.441	0.814
Summer	1.051	1.205	0.872
Autumn	0.436	0.600	0.727

PRECIPITATION (inches)

ANNUAL	1.162	1.495	0.777
Winter	0.358	0.443	0.808
Spring	0.818	0.883	0.926
Summer	0.327	0.300	1.090
Autumn	0.643	1.035	0.621

TABLE 5

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ANALYSIS OF THE INDIVIDUAL RECONSTRUCTED TIME SERIES

The overall mean and standard deviation of the full 360 years of the reconstructed time series and the 5 highest and 5 lowest nonoverlapping 20-year periods. The beginning year and the mean departure value associated with each 20-year period is indicated. Temperature departures are measured in degrees F, precipitation departures are measured in inches.

TEMPERATURE

	Highest					Lowest				
ANNUAL	Overall Mean = 0.139					Overall S.D. = 0.769				
Beginning year	1647	1790	1674	1850	1704	1828	1750	1871	1898	1611
Mean value	1.02	0.67	0.56	0.53	0.43	-0.17	-0.26	-0.28	-0.34	-0.61
WINTER	Overall Mean = 0.493					Overall S.D. = 1.810				
Beginning year	1656	1634	1705	1785	1891	1811	1751	1614	1839	1913
Mean value	2.13	1.87	1.45	1.37	1.34	-0.27	-0.27	-0.54	-0.79	-1.09
SPRING	Overall Mean = 0.273					Overall S.D. = 1.401				
Beginning year	1851	1647	1808	1923	1788	1941	1898	1770	1874	1609
Mean value	1.79	1.76	1.32	0.95	0.93	-0.43	-0.65	-0.75	-0.95	-1.30
SUMMER	Overall Mean = -0.040					Overall S.D. = 1.178				
Beginning year	1627	1782	1917	1647	1706	1737	1696	1897	1861	1806
Mean value	1.39	0.98	0.82	0.69	0.56	-0.56	-0.57	-0.94	-1.09	-1.35
AUTUMN	Overall Mean = -0.281					Overall S.D. = 0.583				
Beginning year	1873	1839	1934	1900	1676	1809	1735	1784	1643	1622
Mean value	0.24	0.18	0.06	0.01	-0.02	-0.45	-0.46	-0.50	-0.75	-1.29

TABLE 5 (CONTINUED)

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PRECIPITATION

	Highest					Lowest				
ANNUAL	Overall Mean = 0.258					Overall S.D. = 1.448				
Beginning year	1604	1629	1816	1719	1890	1699	1755	1917	1843	1676
Mean value	2.02	1.92	1.17	0.68	0.52	-0.33	-0.45	-0.86	-1.07	-1.07
WINTER	Overall Mean = 0.049					Overall S.D. = 0.431				
Beginning year	1623	1878	1771	1656	1749	1912	1675	1709	1827	1855
Mean value	0.68	0.27	0.26	0.21	0.19	-0.16	-0.17	-0.17	-0.17	-0.20
SPRING	Overall Mean = -0.116					Overall S.D. = 0.873				
Beginning year	1602	1940	1821	1873	1897	1917	1645	1741	1846	1623
Mean value	0.75	0.48	0.40	0.33	0.32	-0.59	-0.61	-0.68	-0.71	-0.82
SUMMER	Overall Mean = -0.099					Overall S.D. = 0.306				
Beginning year	1897	1631	1818	1749	1608	1926	1703	1843	1769	1676
Mean value	0.22	0.17	0.09	0.05	0.04	-0.25	-0.30	-0.31	-0.32	-0.38
AUTUMN	Overall Mean = 0.424					Overall S.D. = 1.001				
Beginning year	1634	1611	1808	1720	1788	1928	1841	1755	1885	1675
Mean value	2.01	1.59	1.13	0.82	0.67	-0.11	-0.17	-0.23	-0.27	-0.31

TABLE 6
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Dates, differences and rank of most significant 20-year change
and variance of the annual reconstructions

ANNUAL TEMPERATURE

Beginning Year of Decade	Mean			Mean		
	Year	Difference	Rank	Year	Difference	Rank
1602						
1610						
1620						
1630	1634	1.112	1	1639	-0.254	7
1640						
1650				1654	0.396	1
1660	1667	-0.693	4			
1670				1677	-0.328	2
1680						
1690	1695	-0.692	5			
1700						
1710						
1720	1724	-0.516	9			
1730						
1740						
1750						
1760				1765	-0.303	3
1770						
1780	1782	0.603	8			
1790						
1800						
1810	1811	-0.708	3			
1820				1821	-0.268	6
1830						
1840				1841	0.289	4/5
1850	1850	0.688	6			
1860						
1870	1870	-0.824	2			
1880				1883	-0.289	4/5
1890	1891	0.425	10			
1900						
1910						
1920	1926	0.616	7			

Table 6 (Continued)

ANNUAL PRECIPITATION

Beginning Year of Decade	Mean			Mean		
	Year	Difference	Rank	Year	Difference	Rank
1602						
1610						
1620						
1630						
1640				1645	-0.710	2
1650	1652	-1.501	2	1665	0.593	3
1660						
1670						
1680						
1690	1696	1.196	5	1696	0.563	5
1700						
1710	1719	1.010	6			
1720						
1730						
1740	1741	-0.988	7			
1750				1756	0.548	6
1760						
1770						
1780						
1790						
1800						
1810						
1820						
1830						
1840	1841	-1.998	1			
1850				1857	-0.718	1
1860	1863	0.890	8			
1870						
1880						
1890				1894	-0.403	8
1900						
1910	1917	-1.320	3	1914	0.577	4
1920						
1930						
1940	1940	1.205	4	1940	-0.532	7

Figure 1

The locations of the 65 tree-ring chronology sites used in reconstructing temperature and precipitation in the United States and southwestern Canada.

Figure 2

The locations of the 10 tree-ring chronology sites recently collected from the Washington and Oregon area, which were calibrated with the four temperature and precipitation records in the Pasco Basin area.

Figure 3

The locations of climatic stations whose records were used during various aspects of this research. The station names are included in Table 1, with the letters 'a' through 'm' as shown on the map.

Figure 4

The low pass filtered annual reconstructions of temperature and precipitation departures for the Pasco Basin region. Each reconstruction is formed by averaging the reconstructions from the three climatic stations [Baker, Spokane and Walla Walla (temperature) or Baker, Colville and Lewiston (precipitation)].

DATE: 10/09/84 MODEL: ANNUAL TEMPERATURE DEPARTURES.
 PASCO BASIN OF WASHINGTON STATE. BASED ON SITES 62, 68 AND 69
 BOUNDARY MONTHS FOR THE SEASON ARE 12 AND 11
 BASED ON 77-POINT 65-CHRONOLOGY TEMPERATURE MODEL ANNREC679

°F

DATE: 10/09/84 MODEL: ANNUAL PRECIPITATION DEPARTURES.
 PASCO BASIN OF WASHINGTON STATE. BASED ON SITES 27, 64 AND 84
 BOUNDARY MONTHS FOR THE SEASON ARE 12 AND 11
 BASED ON 96-POINT 65-CHRONOLOGY PRECIPITATION MODEL ANNRECS79

inches

Figure 5

The low pass filtered reconstructions of seasonal temperature departures from the 1901-1961 calibration mean for the Pasco Basin. Each reconstruction is formed by averaging the reconstructions from the three climatic stations (Baker, Spokane and Walla Walla).

DATE: 10/09/84 MODEL: WINTER TEMPERATURE DEPARTURES.
 PASCO BASIN OF WASHINGTON STATE. BASED ON SITES 62, 68 AND 69
 BOUNDARY MONTHS FOR THE SEASON ARE 12 AND 2
 BASED ON 77-POINT 65-CHRONOLOGY TEMPERATURE MODEL 5TI16TIM

DATE: 10/09/84 MODEL: SPRING TEMPERATURE DEPARTURES.
 PASCO BASIN OF WASHINGTON STATE. BASED ON SITES 62, 68 AND 69
 BOUNDARY MONTHS FOR THE SEASON ARE 3 AND 6
 BASED ON 77-POINT 65-CHRONOLOGY TEMPERATURE MODEL 16BM16IIM

DATE: 10/09/84 MODEL: SUMMER TEMPERATURE DEPARTURES.
 PASCO BASIN OF WASHINGTON STATE. BASED ON SITES 62, 68 AND 69
 BOUNDARY MONTHS FOR THE SEASON ARE 7 AND 8
 BASED ON 77-POINT 65-CHRONOLOGY TEMPERATURE MODEL 7IF9F8FMF

DATE: 10/09/84 MODEL: AUTUMN TEMPERATURE DEPARTURES.
 PASCO BASIN OF WASHINGTON STATE. BASED ON SITES 62, 68 AND 69
 BOUNDARY MONTHS FOR THE SEASON ARE 9 AND 11
 BASED ON 77-POINT 65-CHRONOLOGY TEMPERATURE MODEL 18IM17FMF

Figure 6

The low pass filtered reconstructions of seasonal precipitation departures from the 1901-1961 calibration mean for the Pasco Basin. Each reconstruction is formed by averaging the individual reconstructions from the three climatic stations (Baker, Colville and Lewiston).

DATE: 10/09/84 MODEL: WINTER PRECIPITATION DEPARTURES.
 PASCO BASIN OF WASHINGTON STATE. BASED ON SITES 27, 64 AND 84
 BOUNDARY MONTHS FOR THE SEASON ARE 12 AND 2
 BASED ON 96 POINT 65 CHRONOLOGY PRECIPITATION MODEL 516IM

DATE: 10/09/84 MODEL: SPRING PRECIPITATION DEPARTURES.
 PASCO BASIN OF WASHINGTON STATE. BASED ON SITES 27, 64 AND 84
 BOUNDARY MONTHS FOR THE SEASON ARE 3 AND 6
 BASED ON 96-POINT 65-CHRONOLOGY PRECIPITATION MODEL 10MB1F9IM

DATE: 10/09/84 MODEL: SUMMER PRECIPITATION DEPARTURES.
 PASCO BASIN OF WASHINGTON STATE. BASED ON SITES 27, 64 AND 84
 BOUNDARY MONTHS FOR THE SEASON ARE 7 AND 8
 BASED ON 96-POINT 65-CHRONOLOGY PRECIPITATION MODEL 16F6FFF

DATE: 10/09/84 MODEL: AUTUMN PRECIPITATION DEPARTURES.
 PASCO BASIN OF WASHINGTON STATE. BASED ON SITES 27, 64 AND 84
 BOUNDARY MONTHS FOR THE SEASON ARE 9 AND 11
 BASED ON 96-POINT 65-CHRONOLOGY PRECIPITATION MODEL 31MF3FMF

inches

APPENDIX 1

The Contract

"Under the Department of Energy Hanford Defense Waste (HDW) Environmental Impact Statement project, the natural event and human-induced release scenarios must be brought up to date with the latest scientific knowledge of the Pasco Basin geology and hydrology. As part of this updating, it will be necessary to estimate the changes in precipitation that are likely to occur within the 10,000 year containment period. Estimates of such changes cannot be made by extrapolating the historical climatic record; examination of paleohydrologic indicators must be made to obtain surrogate measures of past precipitation for a period at least as long as the required containment period.

At present the information necessary to make reasonable estimates of precipitation and temperature for south-central Washington for the last 10,000 years or longer is not available because there are no continuous records that cover the time period of interest." [Statement of Work B-G5323-A-E April 1984]

The tasks attributed to the study described here are:

1. Calibrate and verify climatic reconstructions based on tree-ring chronology data and seasonal climatic data sets.
2. Review, interpret, and analyze the climatic reconstructions based on independent data, (i.e., palynological studies etc.).

1
APPENDIX 2: TABLE 1

=====

Verification results for the individual temperature
stations that make up the Columbia Basin Region

	N	R	R fd	R.E.	SIGN + -	SIGN fd + -	PROD MEAN	# df
MODEL WINTER 16BI 8MBI								
21 Kalispell								
29 Roseburg	22	0.37*	0.47*	0.04*	11 11	13 8	3.07*	10 3
35 Baker	11	0.24	0.60*	-.07	6 5	8 2	1.08	5 1
39 Spokane	19	0.42*	0.49*	0.15*	12 7	10 8	0.91	7 2
40 Walla Walla	28	0.35*	0.26	0.19*	17 11	14 12	2.27*	14 2
45 Kamloops	8	0.62*	0.72*	0.09*	6 2	6 1	1.61	5 2
46 Vancouver								
MODEL SPRING 131510345								
21 Kalispell								
29 Roseburg	23	0.49*	0.55*	0.29*	14 9	16 6*	1.60	11 3
35 Baker	11	0.05	0.13	-.14	6 5	6 4	1.42	5 0
39 Spokane	20	0.41*	0.60*	0.10*	13 7	14 5*	0.86	9 3
40 Walla Walla	29	0.24	0.48*	-.00	18 11	18 9	0.73	13 1
45 Kamloops	5	0.65	0.71	0.54*	3 2	3 1	1.22	2 0
46 Vancouver								
MODEL SUMMER 1633 134								
21 Kalispell								
29 Roseburg	23	0.53*	0.37*	0.41*	20 3*	13 9	3.23*	16 4
35 Baker	12	0.65*	0.70*	0.37*	8 4	8 3	1.63	6 2
39 Spokane	20	0.30	0.36	0.15*	13 5*	13 6	0.88	10 1
40 Walla Walla	29	0.50*	0.35*	0.37*	22 7*	17 11	3.23*	18 4
45 Kamloops	7	0.47	0.51	0.21*	5 2	3 3	1.16	3 0
46 Vancouver								
MODEL AUTUMN 13IM 4FMF								
21 Kalispell								
29 Roseburg	23	0.05	-.04	-.03	11 12	9 13	0.31	11 0
35 Baker	12	0.50*	0.40	0.17*	7 5	8 2	1.17	6 1
39 Spokane	20	0.12	0.21	-.28	11 9	12 7	-1.84	8 0
40 Walla Walla	29	0.14	0.20	-.15	13 16	14 12	-1.20	14 0
45 Kamloops	8	0.40	0.25	0.09*	4 4	4 3	0.75	3 0
46 Vancouver								
MODEL ANNUAL ANNREC679								
21 Kalispell								
29 Roseburg	22	0.71*	0.73*	0.44*	17 5*	18 3*	2.60*	15 5
35 Baker	11	0.77*	0.90*	0.70*	10 1*	9 1*	2.40*	9 5
39 Spokane	19	0.58*	0.67*	0.26*	12 6	12 6	2.31*	10 3
40 Walla Walla	28	0.51*	0.53*	0.31*	21 7*	19 7*	2.60*	16 5
45 Kamloops								
46 Vancouver								

TABLE 1 (CONTINUED)

1.

LEGEND

*	= Significant result
N	= Number of years of independent data used
R fd	= Correlation Coefficient of first differences
R.E.	= Reduction of Error statistic
SIGN	= Sign Test. + = agreements; - = disagreements
SIGN fd	= Sign Test on first diff. + = agreements; - = disagreements
PROD MEAN	= Product Mean Statistic.
df	= Degrees of Freedom on Product Mean statistic.
#	= Number of statistical tests passed (excluding RE) at the 95% test level.

1
APPENDIX 2: TABLE 2

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Verification results for the individual precipitation
stations that make up the Columbia Basin Region

	N	R	R fd	R.E.	SIGN		SIGN fd		PROD	
					+	-	+	-	MEAN	df

MODEL	WINTER 19I 18MBM	52 Precipitation Grid							Region 1	
22 Lewiston	34	0.17	0.38*	0.08*	17	17	22	11*	1.76*	32 3
23 Porthill	11	-.17	-.38	0.12*	9	2*	5	5	-.30	1 1
26 Kalispell	--- INSUFFICIENT DATA FOR VERIFICATION ---									
33 Baker	11	0.16	-.08	0.40*	9	2*	4	6	1.69	1 1
34 Roseburg	22	0.42*	0.41*	0.27*	17	5*	15	6*	1.84	8 4
42 Aberdeen	9	-.05	0.23	-.28	4	5	4	4	0.10	3 0
43 Colville	17	0.14	0.46*	-.07	11	6	10	6	-.14	6 1
44 Port Angeles	22	-.00	0.00	0.24*	19	3*	11	9	0.01	2 1
52 Kamloops	8	0.47	0.67*	-.14	4	4	5	2	0.78	3 1

MODEL	SPRING 11I7IM8IF	52 Precipitation Grid							Region 1	
22 Lewiston	34	0.15	0.16	-.05	22	11*	18	14	-.87	31 1
23 Porthill	11	0.04	-.36	-.25	8	3	1	8	-1.44	2 0
26 Kalispell	--- INSUFFICIENT DATA FOR VERIFICATION ---									
33 Baker	11	0.22	0.15	-.18	5	6	5	5	-.16	4 0
34 Roseburg	23	0.05	0.06	0.15*	18	5*	10	12	0.93	11 1
42 Aberdeen	10	-.34	-.35	-.41	3	7	4	5	-.05	3 0
43 Colville	19	0.55*	0.57*	0.25*	11	8	14	4*	2.04*	10 4
44 Port Angeles	23	0.28	-.01	0.30*	16	6*	10	12	3.43*	8 2
52 Kamloops	7	0.57	0.50	0.15*	5	2	4	1	0.25	1 0

MODEL	SUMMER 4F 4FFF	52 Precipitation Grid							Region 1	
22 Lewiston	35	0.38*	0.44*	0.17*	27	8*	23	11*	1.05	33 4
23 Porthill	11	0.41	0.38	0.13*	9	2*	6	4	-.16	1 1
26 Kalispell	--- INSUFFICIENT DATA FOR VERIFICATION ---									
33 Baker	12	0.60*	0.57*	0.36*	11	1*	8	3	-.02	10 3
34 Roseburg	23	0.20	0.32	-.06	12	11	11	10	0.08	10 0
42 Aberdeen	10	0.70*	0.80*	0.37*	10	0*	6	3	3.07*	9 4
43 Colville	20	0.02	0.24	-.09	10	10	13	6	0.37	9 0
44 Port Angeles	23	0.52*	0.57*	0.14*	17	6*	15	7	1.12	11 3
52 Kamloops	8	0.50	0.61	0.12*	7	1*	5	1	-3.27	6 1

MODEL	AUTUMN 5IM 5FMF	52 Precipitation Grid							Region 1	
22 Lewiston	33	0.13	-.09	-.25	15	18	14	17	0.32	31 0
23 Porthill	11	0.02	-.01	-.08	2	9	5	5	-1.03	2 0
26 Kalispell	--- INSUFFICIENT DATA FOR VERIFICATION ---									
33 Baker	12	-.02	-.03	-.19	6	6	5	6	-1.15	5 0
34 Roseburg	23	0.17	0.25	0.01*	13	10	13	8	1.47	12 0
42 Aberdeen	10	-.32	-.08	-.16	7	3	4	4	-5.78	2 0
43 Colville	19	-.17	0.00	-.24	8	11	10	8	-.55	9 0
44 Port Angeles	23	-.03	-.20	-.02	11	11	10	12	0.55	10 0
52 Kamloops	8	0.62*	0.48	0.16*	5	3	6	1	0.71	3 1

TABLE 2 (CONTINUED)

MODEL	ANNUAL	ANNREC679	52 Precipitation Grid						Region 1		
22 Lewiston	31	0.29	0.44*	-.05	18	12	19	11	-1.25	28	1
23 Porthill	11	0.17	0.17	-.01	6	4	6	4	-.52	3	0
26 Kalispell	--- INSUFFICIENT DATA FOR VERIFICATION ---										
33 Baker	11	0.45	0.54	0.00*	5	5	8	2	0.68	4	0
34 Roseburg	22	0.48*	0.41*	0.33*	16	6*	12	9	2.40*	8	4
42 Aberdeen	9	0.72*	0.79*	0.34*	8	1*	7	1*	1.02	7	4
43 Colville	15	-.22	0.14	-.14	7	8	6	8	-.76	7	0
44 Port Angeles	22	0.19	0.19	0.39*	16	6*	16	5*	4.56*	14	3
52 Kamloops	5	0.06	0.62	0.04*	3	2	4	0	0.89	1	0

1.
LEGEND

- * = Significant result
- N = Number of years of independent data used
- R fd = Correlation Coefficient of first differences
- R.E. = Reduction of Error statistic
- SIGN = Sign Test. + = agreements; - = disagreements
- SIGN fd = Sign Test on first diff. + = agreements; - = disagreements
- PROD MEAN = Product Mean Statistic.
- df = Degrees of Freedom on Product Mean statistic.
- # = Number of statistical tests passed (excluding RE)
at the 95% test level.

1
APPENDIX 2: TABLE 3
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Verification results for the 3 individual temperature
stations that make up the Pasco Basin Region

	N	R	R fd	R.E.	SIGN + -	SIGN fd + -	PROD MEAN	df	#
MODEL WINTER 5I 16IM									
77 Temperature Grid									
Region 1									
62 Baker	11	0.02	0.62*	-1.19	5 6	7 3	-.70	4	1
68 Spokane	19	0.50*	0.45*	0.11*	13 6	9 9	0.67	6	2
69 Walla Walla	28	0.36*	0.13	0.10*	19 9*	12 14	1.30	11	2
MODEL SPRING 16BM 16I 16IM									
77 Temperature Grid									
Region 1									
62 Baker	11	0.15	0.24	0.02*	6 5	5 5	2.37*	5	1
68 Spokane	20	0.18	0.52*	-.21	10 10	15 4*	0.90	9	2
69 Walla Walla	29	0.20	0.54*	-.16	16 12	21 7*	1.16	14	2
MODEL SUMMER 9T15F 7T15F15F 8T15FMF									
77 Temp. Grid									
Region 1									
62 Baker	12	0.60*	0.69*	0.35*	7 5	9 2*	1.87	6	3
68 Spokane	20	0.38*	0.46*	-.00	13 7	15 4*	0.67	10	3
69 Walla Walla	29	0.54*	0.38*	0.33*	22 7*	19 9*	2.74*	17	5
MODEL AUTUMN 18IM17FMF									
77 Temperature Grid									
Region 1									
62 Baker	12	0.66*	0.63*	0.32*	7 5	8 2	2.16*	6	3
68 Spokane	20	0.51*	0.53*	0.07*	14 6	11 7	0.41	7	2
69 Walla Walla	29	0.35*	0.34*	0.02*	17 12	16 9	0.43	13	2
MODEL ANNUAL ANNREC679									
77 Temperature Grid									
Region 1									
62 Baker	11	0.48	0.75*	0.09*	7 4	9 1*	1.36	6	2
68 Spokane	19	0.52*	0.60*	0.05*	13 6	14 4*	1.26	9	3
69 Walla Walla	28	0.52*	0.42*	0.32*	20 8*	19 7*	2.95*	17	5

1.
LEGEND

- * = Significant result
- N = Number of years of independent data used
- R fd = Correlation Coefficient of first differences
- R.E. = Reduction of Error statistic
- SIGN = Sign Test. + = agreements; - = disagreements
- SIGN fd = Sign Test on first diff. + = agreements; - = disagreements
- PROD MEAN = Product Mean Statistic.
- df = Degrees of Freedom on Product Mean statistic.
- # = Number of statistical tests passed (excluding RE)
at the 95% test level.

1
APPENDIX 2: TABLE 4
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Verification results for the 3 individual precipitation
stations that make up the Pasco Basin Region

	N	R	R fd	R.E.	SIGN + -	SIGN fd + -	PROD MEAN	df	#
MODEL	WINTER	SI	6IM		96 Precipitation Grid		Region 1		
27 Lewiston	34	0.08	-.05	0.06*	18 16	17 16	1.97*	32	1
64 Baker	11	0.48	-.08	0.26*	10 1*	5 5	3.01*	9	2
84 Colville	17	0.32	0.45*	0.09*	12 5	10 6	0.43	7	1
MODEL	SPRING	9IM	10MBIF		96 Precipitation Grid		Region 1		
27 Lewiston	34	0.24	0.27	0.02*	23 11*	20 12	-.28	32	1
64 Baker	11	0.36	0.39	0.06*	7 4	6 4	0.52	5	0
84 Colville	19	0.46*	0.39*	0.19*	11 8	11 7	1.80	10	2
MODEL	SUMMER	16F	6FFF		96 Precipitation Grid		Region 1		
27 Lewiston	35	0.33*	0.27	0.12*	25 10*	18 16	1.24	33	2
64 Baker	12	0.54*	0.49	0.27*	9 3	8 3	2.49*	6	2
84 Colville	20	-.05	-.14	-.15	11 9	10 9	-1.04	8	0
MODEL	AUTUMN	3IMF	3FMF		96 Precipitation Grid		Region 1		
27 Lewiston	33	0.10	-.30	-.15	19 14	10 22	0.34	31	0
64 Baker	12	-.04	-.35	-.07	7 5	3 8	-.53	4	0
84 Colville	19	0.21	0.18	-.14	9 10	9 9	0.36	8	0
MODEL	ANNUAL	ANNREC	679		96 Precipitation Grid		Region 1		
27 Lewiston	31	0.34*	0.40*	0.11*	20 11	16 14	1.29	29	2
64 Baker	11	-.10	-.17	0.09*	8 3	5 5	0.22	3	0
84 Colville	15	0.12	0.10	0.01*	10 5	6 8	-.02	5	0

1.
LEGEND

- * = Significant result
- N = Number of years of independent data used
- R fd = Correlation Coefficient of first differences
- R.E. = Reduction of Error statistic
- SIGN = Sign Test. + = agreements; - = disagreements
- SIGN fd = Sign Test on first diff. + = agreements; - = disagreements
- PROD MEAN = Product Mean Statistic.
- df = Degrees of Freedom on Product Mean statistic.
- # = Number of statistical tests passed (excluding RE)
at the 95% test level.

Winter temperature

10/89/8489.25.48			REGION	WINTER	DEPART	775TI+16TIM	1	12	2	45	1482	361
1600-999.99-999.99			1.75	-0.51	0.09	1.24	3.00	0.28	1.84	-0.68		
1610	3.88	1.79	0.01	1.38	-3.24	0.89	-0.30	1.14	0.88	-1.06		
1620	0.17	-1.31	-2.33	-0.68	-2.87	-1.33	-0.62	-0.35	-1.69	-0.51		
1630	-0.27	2.00	2.25	-1.51	1.21	0.75	-0.35	2.31	1.51	2.63		
1640	0.90	3.15	1.72	2.24	1.51	2.63	2.42	2.29	3.79	1.84		
1650	3.68	1.84	-0.67	1.98	-0.49	-2.92	0.03	0.28	2.43	3.11		
1660	3.02	4.63	1.20	5.06	2.39	2.93	3.35	0.65	8.35	1.78		
1670	1.75	2.45	-0.18	1.37	1.96	4.00	-0.34	-0.09	0.73	2.07		
1680	0.94	2.43	1.88	1.88	1.08	2.07	2.65	-0.14	1.53	2.11		
1690	3.17	-2.24	0.74	0.35	-0.72	-0.02	0.03	0.29	-1.10	0.03		
1700	-1.55	-2.97	0.27	-0.51	-0.83	1.35	1.39	1.14	2.63	-0.49		
1710	2.59	-1.08	1.08	0.51	-0.43	1.08	0.50	2.90	1.11	2.25		
1720	2.07	3.46	2.93	3.68	0.34	-0.30	1.03	1.15	-0.91	-1.79		
1730	0.98	0.46	1.23	-2.77	-2.11	3.23	-0.62	0.95	-1.55	1.22		
1740	1.60	1.12	1.58	-0.46	4.01	4.37	2.84	1.87	0.65	2.21		
1750	1.98	0.51	0.19	-3.17	-0.31	1.04	-1.31	-1.91	1.00	1.40		
1760	0.41	1.68	-1.35	-1.07	-1.11	1.14	-2.04	-2.56	1.14	-0.59		
1770	1.45	1.91	3.40	1.84	1.99	0.95	0.10	-0.63	1.90	-1.52		
1780	2.16	0.44	0.48	0.38	0.80	1.91	2.69	-0.19	1.62	1.42		
1790	0.32	0.47	0.73	2.14	0.33	0.08	-2.17	0.05	3.46	1.00		
1800	2.54	4.24	-0.33	1.90	4.38	-0.65	2.37	-1.52	1.58	0.40		
1810	0.58	-2.86	0.60	1.72	0.08	-3.66	1.24	-1.13	1.27	-1.27		
1820	-0.78	-1.14	-1.33	0.83	1.47	1.96	0.25	0.72	0.97	-2.85		
1830	-1.55	-1.27	1.71	0.60	0.35	0.22	0.38	0.73	0.28	-1.42		
1840	0.09	-3.30	1.28	-2.95	-3.54	1.06	-3.11	-0.38	-0.76	-4.18		
1850	-0.30	1.89	-0.40	-0.25	-0.55	3.22	-3.22	3.12	-2.27	-0.96		
1860	1.11	2.20	-3.49	1.23	2.33	0.03	-0.81	-0.77	-0.64	4.35		
1870	-2.26	-0.21	-0.74	0.61	-2.10	1.30	-0.06	0.14	1.46	2.31		
1880	-2.84	0.28	-0.02	-1.22	-0.55	2.63	2.18	2.70	-0.73	-0.79		
1890	-0.51	4.04	1.90	0.85	2.94	-0.57	1.50	2.17	-0.62	-1.00		
1900	1.73	1.08	3.68	0.12	1.98	2.53	0.25	2.29	2.04	-0.53		
1910	0.14	-0.59	-0.66	-2.14	-2.31	-0.15	-2.47	-4.65	-0.15	2.25		
1920	-0.68	-0.86	-1.74	-0.71	-0.72	-2.36	1.05	-0.75	0.03	-3.75		
1930	-0.07	-0.04	-1.60	-1.72	1.40	-0.23	1.14	-2.15	-0.36	-0.44		
1940	0.41	1.95	0.74	2.22	-0.10	1.11	2.21	2.03	-1.27	-4.55		
1950	-3.14	2.39	-2.45	1.16	-0.39	-3.17	2.39	-1.69	2.21	2.37		
1960	-0.32	2.09	-1.75	-999.99-999.99-999.99-999.99-999.99-999.99-999.99-999.99								

Spring temperature

10/09/8409.27.27.REGION SPRINGTDEPART 7716BM16IIM	1	3	6	65	1602	361				
1600-999.99-999.99	-1.41	-1.18	0.46	2.27	3.25	2.05	-0.34	-0.87		
1610	-0.41	-2.58	-1.89	-1.04	-0.11	-2.37	-2.95	-3.51	-1.85	-3.86
1620	-1.18	-1.17	-0.85	0.26	0.42	-0.41	-0.53	0.32	-1.32	-0.63
1630	1.73	0.47	0.39	-0.39	0.90	0.43	1.02	2.12	3.12	0.64
1640	-0.44	0.47	2.00	-0.54	-1.23	0.02	-0.05	1.87	1.33	0.52
1650	2.93	0.35	1.85	1.51	0.28	1.64	2.16	0.77	1.01	2.55
1660	2.25	2.77	0.59	2.60	3.70	2.69	1.76	0.17	2.12	0.96
1670	-0.25	0.14	-1.32	-2.47	0.50	-1.99	-1.96	1.53	-1.35	0.57
1680	-0.12	1.36	1.09	1.40	0.70	1.02	0.64	3.03	1.20	1.83
1690	1.69	-0.18	1.40	1.00	0.39	-1.43	-0.90	0.57	-0.97	0.79
1700	-1.51	0.66	0.59	1.32	1.02	1.57	1.19	1.37	2.12	-0.61
1710	-1.66	-1.58	-0.89	-1.42	-2.47	-2.15	-0.50	2.07	2.57	-0.13
1720	1.99	-0.33	-0.41	1.41	-1.70	0.87	-0.01	-0.91	-0.38	0.00
1730	0.39	-0.04	-1.08	-2.09	0.02	-1.02	-0.82	-0.39	1.44	1.53
1740	1.13	1.45	0.20	0.07	2.12	1.74	0.39	-0.67	1.45	1.06
1750	-0.94	-0.33	-1.64	-0.70	-1.37	0.55	0.75	0.85	0.94	3.28
1760	0.83	-1.03	-1.89	-1.06	-0.09	-0.92	-0.26	-0.24	0.76	0.66
1770	-0.06	-1.43	0.31	-1.16	0.47	-1.84	0.30	1.00	-2.03	-1.87
1780	0.10	-0.53	-0.76	-0.54	-1.08	-1.06	-0.30	-2.52	-1.26	-0.75
1790	0.39	2.79	1.76	2.34	1.53	1.83	1.54	0.29	1.52	0.94
1800	2.88	0.13	0.09	1.99	0.23	-0.57	0.20	0.22	2.86	2.49
1810	0.68	0.68	2.82	1.77	0.57	1.76	0.69	0.51	0.99	1.10
1820	0.43	1.42	1.06	2.13	2.15	1.68	0.12	0.49	1.05	-0.80
1830	-0.54	0.33	0.22	-0.08	0.08	0.43	1.59	1.04	0.75	-0.45
1840	-0.05	0.05	0.67	0.45	0.37	-0.53	-1.71	0.20	2.25	-1.32
1850	1.05	0.47	0.98	-0.42	0.45	1.45	-0.38	1.29	0.38	1.41
1860	2.01	2.51	3.11	3.87	3.00	4.95	2.23	2.30	2.44	2.20
1870	1.61	-0.56	0.08	0.15	-0.57	-0.15	0.01	0.05	-0.33	-2.30
1880	-2.21	-0.84	-1.93	-0.70	0.88	-0.86	-1.99	-3.24	-2.07	0.28
1890	-0.61	-1.35	-0.82	-0.17	-0.27	0.37	0.74	2.22	-1.67	-1.81
1900	-0.22	-0.85	-1.86	-0.95	-0.39	-0.11	-0.30	-0.49	-0.20	-0.92
1910	1.49	0.48	-0.96	0.45	-0.33	-0.28	-2.54	-1.62	0.47	1.99
1920	-1.76	-0.23	0.10	1.53	0.11	1.31	2.35	0.14	0.92	0.52
1930	1.98	1.37	-0.07	0.00	2.85	-0.55	0.35	0.98	0.57	1.97
1940	1.28	1.28	-0.44	-0.34	-0.55	-0.04	-0.13	0.97	-0.98	-0.47
1950	-1.50	-0.68	-0.49	-1.85	-1.23	-2.79	0.52	0.33	-0.42	0.32
1960	-0.04	1.74	-0.25	-999.99-999.99-999.99-999.99-999.99-999.99-999.99-999.99-999.99-999.99						

Summer temperature

10/09/8409.29.26.REGION	SUMMERTDEPART	7771F9F8FMF	1	7	8	65	1602	361
1610-999.99-999.99	-0.03	0.78	0.89	-0.49	-1.07	-1.20	-1.59	-0.13
1610	-0.21	-1.44	-1.97	-1.50	0.47	0.88	0.92	1.03
1620	1.70	0.06	1.08	-0.23	0.34	0.09	0.78	1.11
1630	1.12	1.98	1.06	0.72	1.86	1.67	0.49	1.53
1640	1.17	0.53	0.85	3.08	1.47	0.33	1.75	-0.14
1650	0.72	0.74	0.46	-2.01	-0.71	0.87	1.47	1.43
1660	1.87	0.99	2.61	1.08	0.22	0.83	-0.72	-2.65
1670	-0.88	0.04	-0.04	-0.35	0.32	0.10	-0.21	1.01
1680	-0.57	-0.05	0.66	-0.40	-1.10	-0.53	0.14	0.79
1690	0.28	0.88	-0.73	0.91	0.99	1.13	-0.18	-1.51
1700	-1.65	-1.10	-1.69	-0.17	1.09	-0.27	0.41	0.08
1710	-0.66	-0.83	-0.54	-0.37	-0.84	-0.81	0.35	1.59
1720	2.33	1.93	2.31	0.69	-0.49	1.75	-0.25	-1.18
1730	-0.34	0.26	-1.05	-1.40	-0.48	-0.44	0.49	-1.44
1740	-0.24	-0.80	-1.13	-0.55	0.66	-0.26	-0.60	-0.13
1750	-1.21	-0.42	-1.66	-1.14	-1.71	-0.50	0.04	-0.65
1760	-0.24	-1.36	-0.75	0.27	-0.49	0.70	-1.62	0.07
1770	1.96	2.53	0.85	1.53	0.09	-0.34	-0.57	2.10
1780	0.44	-1.27	2.38	2.62	1.02	1.62	0.88	-0.50
1790	-0.62	1.65	0.95	1.78	1.45	1.85	1.65	0.92
1800	1.59	0.28	-0.44	1.42	-0.78	-0.48	-2.51	-0.60
1810	-1.79	-1.50	-0.81	-1.06	-1.12	-0.11	-0.35	0.26
1820	-1.65	-2.03	-2.86	-1.16	-0.06	-1.42	-1.53	-0.29
1830	-0.77	-0.16	-1.20	-0.21	0.57	0.24	0.72	1.35
1840	-1.18	-0.30	0.49	1.44	-1.69	0.04	-0.82	-1.36
1850	-0.17	0.26	0.08	-1.36	-1.19	-2.29	-0.50	0.33
1860	-2.36	-1.34	-1.79	-0.69	-1.35	-0.45	-1.43	-0.55
1870	-1.83	-0.48	-1.79	-1.96	-0.54	-1.15	-2.10	0.72
1880	-2.43	-1.06	-1.37	0.13	0.15	0.62	0.23	-0.25
1890	1.01	1.32	-0.10	-1.09	-0.09	-0.28	0.48	-1.18
1900	-0.72	-1.04	-1.16	-0.81	-0.36	0.63	0.26	-0.99
1910	-0.51	-2.06	-2.77	-2.11	-1.00	-0.75	-1.64	1.96
1920	0.76	0.16	0.22	1.35	0.29	0.79	1.27	0.43
1930	1.72	1.16	-0.19	0.68	1.42	0.07	1.28	0.32
1940	1.01	0.57	0.45	-0.86	1.21	0.31	0.97	-1.15
1950	0.94	-0.19	0.23	-0.72	-1.94	-1.17	-0.36	0.43
1960	-0.41	1.30	-0.40	-999.99	-999.99	-999.99	-999.99	-999.99

Autumn temperature

10/09/8409.33.36.REGION AUTUMTDEPART 7718IM17FMF										1	9	11	65	1682	360
1600	-999.99	-999.99	-0.43	-0.27	-0.67	-0.86	0.46	0.12	-0.18	-0.50					
1610	0.60	-1.04	-1.17	-0.23	-0.27	-0.46	-0.12	-0.33	-0.05	-0.78					
1620	-0.85	0.27	-2.25	-0.51	-0.96	-0.94	-0.80	-0.35	-1.15	-0.96					
1630	-1.02	-1.89	-0.93	-1.08	-2.67	-0.89	-1.87	-0.68	-1.93	-1.15					
1640	-2.22	-1.47	-1.15	-0.99	-0.98	-0.69	-0.58	-0.75	-1.48	-0.26					
1650	-1.40	-0.04	-0.90	-0.88	-1.46	-0.11	-0.46	-0.51	-0.56	-0.25					
1660	-0.50	-0.45	-1.72	-0.54	-0.77	-0.08	-0.80	-0.69	-0.07	0.30					
1670	-0.60	-0.01	0.38	0.01	-0.77	-0.46	0.05	-0.21	0.09	-0.38					
1680	0.21	0.43	0.75	0.19	0.24	-1.91	-0.01	-0.12	-0.54	-0.07					
1690	0.44	-0.87	0.02	0.53	0.83	-0.16	-0.47	-0.56	-1.08	-0.25					
1700	-0.42	-0.96	-0.72	0.40	0.09	-0.98	-0.49	-0.78	0.37	0.08					
1710	0.63	-0.31	0.17	0.67	-0.56	-0.38	-0.54	-0.34	-0.12	-0.94					
1720	-0.97	-0.79	0.45	-0.43	-0.26	-0.20	-0.19	-0.21	0.25	-0.41					
1730	-0.47	0.03	-0.03	-0.76	0.44	0.25	-1.17	-0.16	-0.61	-0.60					
1740	-0.48	-0.03	-0.02	-0.42	0.14	-0.40	-0.87	-0.23	-0.80	-0.48					
1750	-0.81	-1.26	-0.32	-0.36	-0.51	0.32	0.40	-0.74	-0.28	0.82					
1760	-0.79	-0.76	0.25	-0.49	-0.87	-0.30	-0.93	-0.35	-0.07	0.88					
1770	-0.41	-0.46	-0.65	-0.14	0.06	-0.64	0.12	-0.15	-0.39	-0.46					
1780	-0.63	-0.34	0.04	0.05	-0.84	-0.21	0.28	0.11	-0.01	-1.37					
1790	-0.53	-0.57	-0.51	-0.73	-0.89	-0.96	-0.71	-0.47	-0.62	-0.60					
1800	-0.04	-0.85	-0.19	-0.19	0.25	-0.88	0.57	-0.21	0.50	-0.39					
1810	-0.17	-0.36	-0.26	-0.99	0.12	-0.94	0.03	-0.80	-0.28	-0.61					
1820	-0.84	-0.86	-0.42	-0.61	-0.77	-0.15	-0.06	-0.82	0.09	0.64					
1830	0.21	0.03	0.73	0.47	-1.06	-0.44	-0.28	-1.83	-0.51	0.05					
1840	0.63	-0.58	-0.04	0.32	0.25	0.18	0.75	0.26	0.57	0.36					
1850	0.49	0.62	-0.05	0.43	0.33	-0.28	-0.08	0.05	0.20	-0.92					
1860	-0.32	-0.14	0.12	-0.89	-0.84	-0.49	0.12	0.02	-0.23	0.87					
1870	-0.01	-0.28	0.56	0.92	0.39	-0.31	0.57	-0.44	0.50	-0.70					
1880	0.48	-0.36	-0.34	-0.12	0.10	0.87	0.26	0.22	0.44	0.94					
1890	0.37	0.47	0.59	-0.70	0.34	-0.78	-0.57	0.28	-0.46	-0.23					
1900	0.31	0.33	-0.25	0.31	0.69	0.16	-0.73	0.27	0.04	0.69					
1910	-0.50	-0.89	0.46	-0.02	0.32	-0.46	-0.16	0.16	-0.37	-0.87					
1920	0.12	-0.31	0.14	-0.14	-0.14	-1.01	-0.54	-0.88	-0.21	-0.12					
1930	-0.28	0.19	-0.70	0.45	0.53	-0.05	-0.14	0.25	0.37	0.08					
1940	-0.15	0.13	0.11	0.47	0.28	-0.13	-0.79	-0.13	0.11	0.08					
1950	-1.09	-0.86	0.28	1.11	0.30	-0.45	-0.31	-0.23	-0.89	-0.34					
1960	-0.59	-0.28	-999.99	-999.99	-999.99	-999.99	-999.99	-999.99	-999.99	-999.99					

Annual temperature

18/09/84	09.35.13	REGION	ANNUAL	TDEPART	77	ANN	REC	679	1	12	11	65	1602	360
1600	-999.99	-999.99	-0.14	-0.46	0.03	0.77	1.77	0.58	0.03	-0.61				
1610	0.95	-0.92	-1.25	-0.31	-0.83	-0.53	-0.93	-0.79	-0.13	-1.54				
1620	-0.28	-0.65	-1.25	-0.25	-0.74	-0.69	-0.40	0.12	-0.90	-0.26				
1630	0.44	0.52	0.64	-0.66	0.23	0.38	-0.13	1.37	1.28	0.86				
1640	-0.29	0.67	0.95	0.64	-0.04	0.54	0.74	0.99	1.08	0.72				
1650	1.66	0.69	0.31	0.45	-0.51	-0.07	0.85	0.44	1.08	1.78				
1660	1.69	2.14	0.50	2.17	1.67	1.74	1.10	-0.40	0.45	0.57				
1670	0.06	0.66	-0.39	-0.54	0.51	0.23	-0.76	0.60	-0.09	0.01				
1680	0.14	1.16	1.13	0.92	0.37	0.29	0.90	1.07	0.61	1.19				
1690	1.51	-0.69	0.54	0.70	0.33	-0.34	-0.25	-0.12	-0.95	-0.07				
1700	-1.27	-0.95	-0.21	0.38	0.33	0.57	0.68	0.56	1.48	-0.34				
1710	0.15	-1.01	-0.07	-0.24	-1.21	-0.68	-0.12	1.60	1.53	0.60				
1720	1.32	0.88	1.09	1.40	-0.63	0.46	0.17	-0.27	-0.35	-0.62				
1730	0.36	0.16	-0.24	-1.81	-0.49	0.46	-0.64	-0.17	-0.17	0.76				
1740	0.62	0.62	0.28	-0.29	1.85	1.53	0.52	0.16	0.49	0.74				
1750	-0.22	-0.36	-0.86	-1.30	-0.95	0.43	0.03	-0.49	0.43	1.77				
1760	0.15	-0.34	-1.03	-0.70	-0.61	0.01	-1.10	-0.80	0.55	0.27				
1770	0.56	0.30	0.93	0.29	0.69	-0.59	0.06	0.53	-0.42	-1.06				
1780	0.49	-0.36	0.26	0.36	-0.20	0.35	0.79	-0.94	-0.15	-0.59				
1790	0.14	1.19	0.80	1.43	0.61	0.69	0.07	0.15	1.55	0.77				
1800	1.85	0.94	-0.18	1.33	1.09	-0.66	0.39	-0.46	0.98	0.78				
1810	0.03	-0.82	0.89	0.60	0.05	-0.57	0.49	-0.27	0.32	-0.77				
1820	-0.53	-0.36	-0.42	0.57	0.87	0.77	-0.17	0.10	-0.01	-0.90				
1830	-0.64	-0.22	0.49	0.21	-0.06	0.13	0.68	0.29	0.29	-0.39				
1840	-0.03	-1.01	0.41	-0.25	-0.98	0.14	-1.30	-0.19	0.71	-1.44				
1850	0.37	0.83	0.23	-0.33	-0.10	0.83	-1.04	1.28	-0.33	-0.10				
1860	0.47	1.13	-0.11	1.26	1.15	1.46	0.34	0.48	0.65	2.12				
1870	-0.33	-0.38	-0.32	0.11	-0.71	0.01	-0.22	0.07	0.13	-0.72				
1880	-1.74	-0.47	-0.96	-0.55	0.22	0.70	-0.01	-0.39	-0.71	0.39				
1890	-0.07	0.90	0.34	-0.20	0.71	-0.26	0.56	1.16	-0.96	-1.22				
1900	0.32	-0.11	0.10	-0.35	0.48	0.74	-0.17	0.32	0.50	-0.31				
1910	0.32	-0.55	-0.83	-0.74	-0.77	-0.37	-1.77	-1.34	-0.09	1.43				
1920	-0.60	-0.34	-0.34	0.52	-0.14	-0.27	1.12	-0.28	0.32	-0.45				
1930	0.86	0.85	-0.63	-0.21	1.67	-0.24	0.58	-0.10	0.07	0.62				
1940	0.66	1.01	0.15	0.42	0.07	0.29	0.45	0.61	-0.72	-1.37				
1950	-1.41	0.33	-0.67	-0.17	-0.75	-2.83	0.63	-0.29	0.54	0.54				
1960	-0.31	1.25	-999.99	-999.99	-999.99	-999.99	-999.99	-999.99	-999.99	-999.99				

Winter precipitation

10/09/8409.12.50.REGION WINTERRDEPART 965I 6IM						1	12	2	65	1602	361		
1600-999.99-999.99						0.27	-0.13	0.25	0.53	-0.23	-0.61	-0.04	-J.38
1610	0.16	0.00	-0.24	-0.44	0.19	-0.02	-0.02	0.30	-0.26	-0.17			
1620	-0.05	0.12	0.14	1.09	0.65	0.98	0.81	0.33	0.84	0.23			
1630	0.83	0.62	0.85	0.50	0.32	0.56	1.27	0.81	1.01	0.49			
1640	0.14	0.67	0.54	0.27	0.46	0.53	-0.34	0.37	-0.22	-0.35			
1650	-0.80	-0.92	0.18	-0.30	-0.51	-0.59	0.07	0.77	0.48	0.40			
1660	0.08	0.02	0.51	0.38	0.65	-0.54	-0.10	-0.82	1.07	-0.43			
1670	-0.20	0.21	0.52	0.24	0.12	-0.01	-0.04	-0.35	0.32	0.60			
1680	-0.83	-0.07	-0.68	-0.76	-0.15	0.77	-0.27	-0.28	0.37	-0.44			
1690	-0.52	-0.42	-0.40	0.06	-0.28	0.15	1.05	0.59	0.26	0.48			
1700	0.78	-0.43	0.68	-0.39	0.60	0.20	-1.01	0.18	0.29	-0.06			
1710	-0.50	-0.36	-0.22	-0.14	-0.16	0.41	0.26	-0.02	-0.46	0.01			
1720	-0.40	-0.54	-0.23	-0.12	0.16	-0.35	-0.50	-0.37	0.19	0.14			
1730	0.63	0.17	0.13	0.59	0.16	0.20	-0.51	-0.25	0.03	0.00			
1740	0.58	0.32	0.36	0.20	0.22	0.23	-0.27	-0.80	0.11	0.08			
1750	0.29	-0.01	0.95	0.64	-0.23	0.13	0.14	0.41	0.33	-0.47			
1760	0.03	-0.19	0.00	0.40	0.15	0.40	-0.30	0.47	0.53	-0.28			
1770	-0.57	-0.11	0.70	0.66	0.55	0.64	-0.37	-0.26	0.85	0.47			
1780	0.19	0.38	0.03	-0.02	0.35	0.51	0.35	0.02	-0.05	0.12			
1790	0.13	-0.17	-0.26	-0.39	0.19	0.22	0.31	0.78	0.46	0.16			
1800	-0.10	0.57	-0.15	0.14	0.65	0.15	0.87	-0.63	-0.25	-0.78			
1810	0.16	-0.06	-0.40	0.23	0.15	-0.28	-0.34	-0.15	0.72	0.50			
1820	-0.28	-0.21	0.13	-0.15	0.00	-0.29	0.26	-0.66	-0.25	-1.18			
1830	-0.32	0.30	0.69	-0.43	-0.51	-0.14	0.42	-0.18	-0.07	-0.09			
1840	-0.07	-0.83	0.55	-0.15	-0.29	-0.08	-0.18	0.33	-0.36	-0.52			
1850	-0.13	0.09	0.25	0.34	-0.30	-0.55	-0.87	-0.32	-0.54	0.05			
1860	0.54	0.50	-0.22	0.03	-0.07	-0.09	-0.12	-0.31	-0.21	-0.67			
1870	-0.33	0.01	0.43	-0.51	-0.79	0.08	-0.19	-1.03	0.09	0.10			
1880	0.04	0.02	-0.09	0.04	0.16	0.21	0.14	0.31	-0.14	-0.19			
1890	1.01	0.31	0.26	1.07	0.28	0.30	0.36	0.35	-0.69	0.39			
1900	0.16	0.34	0.28	-0.42	0.51	-0.56	-0.13	0.12	0.07	0.45			
1910	0.02	-0.17	-0.68	-0.39	-0.16	-0.71	0.38	0.05	0.46	-0.37			
1920	-0.48	0.18	-0.17	0.12	-0.42	0.28	-0.28	-0.24	-0.10	-0.16			
1930	0.05	-0.56	0.14	-0.10	0.34	-0.02	0.37	0.02	0.42	-0.05			
1940	0.12	-0.73	-0.16	0.16	-0.68	0.04	0.10	-0.03	-0.07	-0.78			
1950	0.11	0.54	0.23	0.42	0.06	-0.03	0.33	0.45	0.18	0.10			
1960	-0.28	-0.38	0.32-999.99-999.99-999.99-999.99-999.99-999.99-999.99-999.99-999.99										

Spring precipitation

10/09/8409.18.24.REGION SPRINGRDEPART 9610MBIF9IM	1	3	6	65	1682	361		
1600-999.99-999.99	2.04	-0.53	0.41	-0.47	0.64	-0.26	0.78	0.30
1610	1.50	1.23	0.30	1.67	-0.41	1.52	0.92	2.55
1620	-0.81	0.60	-0.93	-2.65	-0.94	-0.75	-1.57	-1.00
1630	-1.03	0.85	-0.64	0.79	-0.73	0.19	-0.70	-1.36
1640	-0.42	-0.45	-1.38	-0.55	-0.02	-0.93	-0.19	-1.52
1650	-0.18	0.22	-2.08	-0.50	-0.43	-0.72	-0.17	-0.80
1660	-0.17	-0.38	-0.14	-1.10	-2.14	-0.69	0.76	-1.28
1670	0.02	-0.16	0.79	1.20	-0.16	1.34	0.10	0.06
1680	0.89	1.19	-0.80	0.04	-1.26	-1.94	-0.94	-0.44
1690	0.86	-0.42	-0.55	0.20	0.47	-0.51	-0.13	0.30
1700	1.39	-1.15	0.70	-0.66	-0.49	-1.03	-0.06	-0.12
1710	-0.03	0.37	-0.02	0.96	-0.24	-0.02	-0.08	-1.52
1720	-0.11	1.09	1.42	0.82	0.06	-0.14	0.53	1.27
1730	-1.43	0.56	0.60	-0.06	-0.47	0.64	-0.94	0.38
1740	-0.39	-1.38	-0.57	-0.70	-1.41	0.00	-0.60	0.25
1750	0.38	-1.77	0.60	-0.85	0.11	0.40	-1.71	-1.86
1760	-0.45	1.86	0.30	0.36	-1.27	0.45	-0.13	-0.54
1770	0.13	0.52	-0.26	0.38	0.01	1.20	-1.25	-0.69
1780	0.51	-0.30	0.52	-0.39	0.63	0.52	0.00	0.20
1790	-1.58	0.26	0.31	-0.45	-0.70	-0.86	-1.12	-0.03
1800	-1.64	1.51	-0.23	0.35	0.08	-0.88	0.44	0.23
1810	-0.40	-1.41	-0.54	-0.60	0.46	-1.53	1.11	-0.15
1820	0.14	0.84	-0.45	-0.49	-0.84	0.52	0.63	-0.10
1830	0.43	-0.85	2.65	-0.55	-0.20	0.53	0.62	0.35
1840	0.72	0.35	-1.04	-0.57	0.15	0.36	-0.11	-1.56
1850	-0.69	-0.35	-1.09	-0.20	-0.74	0.41	-0.89	-0.30
1860	-0.34	-0.64	-1.81	-1.62	-0.96	-1.37	0.36	-0.44
1870	-1.22	-0.56	-0.47	0.21	-0.19	-0.16	-0.12	1.37
1880	-1.19	1.07	-0.12	0.60	-0.42	1.86	0.26	0.62
1890	0.40	0.53	1.07	-1.41	0.27	-0.54	-1.05	0.32
1900	0.86	0.10	1.19	0.04	1.19	0.82	0.52	0.50
1910	-1.09	-0.45	0.72	0.41	-0.51	1.10	0.69	-1.20
1920	0.06	0.18	-1.13	0.30	-1.65	-0.72	-0.59	0.52
1930	-0.55	-0.94	0.06	-1.54	-1.23	0.39	-1.39	-0.25
1940	-0.21	0.88	2.78	0.26	0.50	0.77	0.29	0.72
1950	0.06	0.16	0.53	0.13	-0.16	0.16	-0.19	0.64
1960	-0.25	0.11	-0.02	-999.99	-999.99	-999.99	-999.99	-999.99

Summer precipitation

10/09/8409.19.45.REGION SUMMERRDEPART 9616F 6FFF 1 7 3 65 1602 360										
1600-999.99-999.99	-0.12	-0.18	0.07	0.09	-0.17	-0.31	-0.15	0.11		
1610	-0.45	-0.02	0.27	0.31	0.14	0.21	0.28	-0.10	0.12	-0.37
1620	0.41	0.09	-0.06	0.12	0.20	-0.14	-0.08	-0.16	-0.44	-0.39
1630	-0.16	0.47	0.42	0.13	0.35	0.24	0.44	-0.19	0.29	0.03
1640	0.19	0.72	0.30	0.21	-0.07	0.09	-0.06	0.16	-0.01	-0.18
1650	-0.11	-0.66	-0.36	-0.17	-0.10	0.08	-0.02	-0.11	-0.03	-0.29
1660	-0.12	-0.27	-0.34	-0.25	-0.34	-0.41	-0.01	0.24	0.28	0.00
1670	0.06	0.29	-0.33	-0.02	-0.03	0.10	-0.21	0.18	-0.27	-0.30
1680	0.10	-0.54	-0.61	-0.66	-0.62	-0.46	-0.39	-0.48	-0.26	-0.58
1690	-0.47	-0.55	-0.05	-0.61	-0.69	-0.22	-0.02	0.17	-0.27	0.09
1700	-0.24	0.29	-0.08	-0.25	-0.71	-0.73	-0.26	-0.03	-0.50	-0.45
1710	-0.40	-0.15	0.06	-0.45	-0.17	0.06	-0.51	-0.31	-0.18	-0.06
1720	-0.14	-0.10	-0.69	0.06	-0.06	-0.53	-0.08	0.01	-0.46	-0.40
1730	0.04	-0.26	0.02	0.07	-0.23	-0.62	-0.45	0.13	0.09	0.06
1740	-0.22	-0.22	0.07	-0.20	-0.25	-0.09	-0.16	0.05	-0.21	0.22
1750	0.06	0.40	0.60	0.02	0.32	-0.20	-0.43	-0.03	-0.39	-0.27
1760	0.48	0.50	0.05	-0.32	0.26	-0.43	0.15	0.06	-0.08	-0.28
1770	-0.24	-0.52	-0.23	-0.43	-0.32	-0.41	-0.26	-0.32	-0.34	-0.19
1780	-0.34	0.44	-0.54	-0.06	0.27	-0.38	-0.65	-0.11	-0.59	0.35
1790	-0.35	-0.24	-0.72	-0.34	-0.22	-0.16	0.12	-0.19	-0.30	-0.06
1800	-0.17	-0.15	0.21	-0.19	-0.51	0.25	-0.03	-0.19	-0.13	-0.26
1810	-0.12	0.06	-0.32	0.02	-0.33	-0.20	-0.13	-0.04	0.58	0.29
1820	0.08	0.42	0.30	-0.11	0.10	0.22	-0.07	0.16	0.57	-0.45
1830	-0.04	0.04	-0.11	-0.59	-0.12	0.26	-0.05	0.32	0.43	-0.15
1840	0.20	-0.55	0.44	-0.41	-0.34	-0.35	-0.42	-0.26	-0.40	-0.42
1850	-0.61	-0.69	-0.27	-0.28	-0.78	-0.05	0.12	-0.42	-0.30	-0.02
1860	0.13	-0.12	-0.23	0.29	0.11	0.33	0.47	-0.31	-0.35	-0.49
1870	-0.42	-0.07	-0.04	-0.50	-0.33	0.10	-0.15	0.07	-0.05	0.20
1880	0.27	-0.21	-0.07	-0.38	0.06	-0.20	-0.39	-0.52	-0.24	-0.19
1890	-0.27	0.15	-0.35	0.19	-0.02	-0.13	0.01	0.31	-0.33	0.06
1900	0.20	0.01	0.29	0.77	-0.24	-0.03	0.06	0.06	0.09	-0.31
1910	-0.10	0.36	0.00	0.71	0.13	0.34	0.41	-0.39	-0.22	-0.41
1920	0.42	-0.43	0.05	-0.13	-0.20	-0.14	-0.28	0.39	-0.08	-0.64
1930	-0.38	-0.51	-0.02	-0.07	-0.66	-0.44	-0.15	-0.29	-0.13	-0.39
1940	-0.41	0.03	-0.31	-0.18	-0.22	-0.29	-0.02	0.26	0.05	0.01
1950	0.28	0.35	0.07	-0.33	0.05	0.39	0.25	-0.21	-0.12	-0.05
1960	0.45	0.10-999.99-999.99-999.99-999.99-999.99-999.99-999.99-999.99-999.99								

Autumn precipitation

10/09/8409.21.04.REGION AUTUMNRDEPART 963IMF 3FMF	1	9	11	65	1682	360
1600-999.99-999.99	0.38	0.71	2.23	0.68	-0.32	1.25 0.43 0.44
1610	0.52	3.31	1.94	2.38	0.40	1.77 1.58 2.18 -0.13 2.07
1620	1.88	1.88	3.00	2.17	1.43	0.61 1.40 0.57 0.34 1.57
1630	1.35	2.48	1.68	2.22	1.84	2.89 2.03 1.12 0.47 2.55
1640	3.65	2.79	2.03	0.93	1.63	1.36 1.39 1.91 2.49 0.68
1650	1.78	2.89	2.67	3.02	0.85	0.53 0.16 0.20 -0.52 0.45
1660	0.57	0.36	1.87	1.53	1.99	0.32 1.65 1.83 0.46 -0.43
1670	-0.42	-0.84	0.01	-0.31	1.56	-0.12 -0.67 -1.68 -1.01 -0.25
1680	-0.62	-0.73	-0.65	-0.53	-0.19	1.40 0.31 -0.06 1.18 0.58
1690	-1.09	0.16	-0.04	-0.89	-1.37	0.04 0.44 0.30 1.90 -0.35
1700	0.64	0.90	-0.05	-0.80	-0.98	1.12 0.63 0.45 -0.44 -0.79
1710	-0.41	1.49	-0.60	-0.63	1.72	0.05 -0.04 -0.06 -0.39 1.89
1720	1.16	1.10	0.62	0.42	0.59	0.66 1.33 1.24 -0.59 1.32
1730	-0.26	-0.10	0.94	1.04	0.43	1.29 1.10 1.68 0.94 1.44
1740	1.13	-0.08	0.08	-0.14	-0.22	-0.43 2.39 -0.15 0.62 0.06
1750	0.78	2.11	-0.59	1.28	0.44	-0.85 -0.97 0.50 -0.28 -0.23
1760	-0.70	0.98	-0.11	0.80	-1.30	0.41 1.17 -0.40 -0.47 -1.19
1770	-0.42	0.01	-0.87	-0.31	-0.29	1.04 -1.20 -0.61 0.08 0.36
1780	1.52	-0.59	-1.61	0.91	0.07	-0.18 1.21 -0.16 2.36 1.01
1790	0.29	-1.18	0.85	0.05	-0.30	0.75 0.04 0.70 0.66 1.11
1800	0.44	1.95	0.62	-0.07	1.15	1.26 0.19 1.46 0.86 0.58
1810	1.08	0.58	0.63	-0.72	-0.07	0.73 1.09 1.80 1.79 2.26
1820	2.25	2.42	1.37	1.02	0.84	0.83 1.17 2.15 0.61 -0.27
1830	-0.42	-0.43	-0.50	0.06	0.98	0.53 -0.67 1.27 -0.36 1.42
1840	0.41	1.50	-1.05	-0.63	-0.21	-0.22 -0.59 -0.30 -1.31 -0.48
1850	-0.95	-1.43	0.28	-0.80	0.42	1.94 -0.43 -0.63 0.14 1.24
1860	0.04	0.66	0.79	1.08	1.19	0.40 -0.96 0.64 -0.59 -0.40
1870	0.17	0.73	-1.14	0.62	0.43	1.02 0.18 0.62 0.41 0.55
1880	-0.26	1.22	0.03	0.90	0.17	-1.10 -1.00 -0.43 -2.17 -1.60
1890	-0.24	-1.19	0.28	-0.43	0.04	0.94 0.71 -0.15 1.04 0.78
1900	0.27	-0.25	0.60	-0.18	-1.35	-0.59 0.75 0.31 -0.84 -0.60
1910	0.22	1.12	-0.40	-0.71	-0.50	0.49 -0.69 -0.59 0.12 0.46
1920	-0.23	0.61	-1.05	-0.21	0.28	0.26 1.21 1.85 -0.96 0.15
1930	-0.86	0.10	0.76	-0.42	-0.18	-0.70 -0.80 0.25 0.21 -0.70
1940	0.32	0.18	-0.03	0.12	-0.92	0.64 0.52 0.09 0.34 0.44
1950	0.46	-0.09	-1.46	-0.70	0.08	0.54 -0.11 -0.01 -0.37 1.04
1960	-0.14	0.17-999.99-999.99-999.99-999.99-999.99-999.99-999.99-999.99-999.99				

Annual precipitation

10/89/8489.22.21.REGION ANNUALDEPART 96ANNREC679											1	12	11	65	1602	360
1600	-99.99	-99.99	-99.99	2.56	-0.13	2.95	0.83	-0.08	0.08	1.02	0.45					
1610	1.73	4.52	2.26	3.93	0.32	3.49	2.75	4.92	0.64	3.56						
1620	1.42	2.68	2.15	0.72	1.34	0.70	0.57	-0.26	0.49	0.49						
1630	0.99	4.41	2.31	3.64	1.79	3.89	3.05	0.38	-0.09	1.55						
1640	3.56	3.72	1.49	0.85	2.00	1.05	0.81	0.91	1.64	0.15						
1650	0.68	1.54	0.41	2.85	-0.18	-0.69	0.03	0.06	0.36	-0.18						
1660	0.36	-0.27	1.90	0.58	0.15	-1.34	2.30	0.79	0.29	-0.68						
1670	-0.55	-0.49	0.99	1.12	1.49	1.32	-0.82	-1.79	0.11	-1.08						
1680	-0.47	-0.15	-2.73	-1.91	-2.22	-0.22	-1.28	-1.26	0.53	-0.24						
1690	-2.02	-1.23	-1.05	-1.24	-1.87	-0.55	1.33	1.37	2.81	-0.16						
1700	2.57	-0.40	1.25	-2.10	-1.59	-0.45	-0.71	0.48	-2.15	-0.44						
1710	-1.34	1.35	-0.78	-0.27	1.16	0.49	-0.37	-1.91	-1.32	2.04						
1720	0.52	1.55	1.12	1.19	0.75	-0.36	1.29	2.15	-2.07	-0.26						
1730	-1.03	0.38	1.68	1.63	-0.10	1.52	-0.79	1.95	0.35	0.22						
1740	1.09	-1.35	-0.07	-0.83	-1.65	-0.29	1.36	-0.66	-0.77	0.30						
1750	1.50	0.71	1.57	1.08	0.64	-0.52	-2.96	-0.90	-0.79	-3.15						
1760	-0.64	3.15	0.25	1.24	-2.17	0.84	0.89	-0.40	-0.46	-1.69						
1770	-1.09	-0.10	-0.66	0.30	-0.04	2.47	-3.08	-1.88	1.28	0.06						
1780	1.88	-0.07	-1.59	-0.36	1.32	0.47	1.73	-0.06	1.77	1.88						
1790	-1.51	-1.33	0.18	-1.12	-1.03	-0.05	-0.66	1.27	0.54	1.96						
1800	-1.47	3.90	0.44	0.23	1.36	0.78	1.46	0.88	-0.80	-0.89						
1810	0.71	-0.84	-0.63	-1.07	0.21	-1.28	1.74	1.46	3.08	3.15						
1820	2.18	3.47	1.35	0.27	0.09	1.27	1.99	1.55	1.27	-0.82						
1830	-0.35	-0.93	2.71	-1.51	0.14	1.19	0.34	1.75	1.33	2.65						
1840	1.26	0.48	-1.11	-1.75	-0.69	-0.29	-1.29	-1.80	-2.92	-1.04						
1850	-2.37	-2.38	-0.83	-0.95	-1.38	1.75	-2.07	-1.67	-1.36	0.36						
1860	0.37	0.40	-1.46	-0.22	0.26	-0.72	-0.23	-0.41	-1.55	-1.97						
1870	-1.81	0.15	-1.22	-0.17	-0.88	1.04	-0.28	1.04	0.34	1.56						
1880	-0.34	2.09	-0.26	1.16	-0.02	0.78	-0.97	-0.01	-1.54	-2.77						
1890	0.91	-0.21	1.26	-0.59	0.56	0.57	0.04	0.84	0.61	0.80						
1900	1.50	0.19	2.36	0.21	0.11	-0.36	1.21	1.00	0.03	-0.75						
1910	-0.96	0.84	0.44	0.03	-1.05	1.21	0.80	-2.13	-0.51	-1.49						
1920	-0.22	0.54	-2.30	0.08	-1.99	-0.31	0.07	2.50	-0.98	-1.24						
1930	-1.75	-1.92	0.96	-2.13	-1.73	-0.77	-1.96	-0.26	1.10	-1.83						
1940	-0.18	0.36	2.28	0.36	-1.31	1.17	0.89	1.04	1.01	0.19						
1950	0.91	0.97	-0.64	-0.47	0.04	1.07	0.28	0.88	0.52	0.59						
1960	-0.22	0.00	-999.99	-999.99	-999.99	-999.99	-999.99	-999.99	-999.99	-999.99						

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