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Defining the Regional and Seasonal Climatic Response of Long Douglas-Fir Tree-Ring Chronologies in Central Mexico

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By

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ABSTRACT

Problems with instrumental climate data and difficulties arising from the distribution of sensitive, long-term tree-ring chronologies across Mexico's complex terrain have made it difficult to model the climate signal of tree-rings in Mexico. The objective of this research is to utilize the improved long-term, high-resolution, gridded instrumental climate dataset for Mexico recently developed by Zhu and Lettenmaier (2007) to document the climate signal of Douglas-fir in central Mexico. Through correlation analysis between five Douglas-fir tree-ring chronologies created by the University of Arkansas-Fayetteville Tree-Ring Laboratory and Zhu and Lettenmaier's (2007) gridded historical climate dataset, this research aims to define the regional and seasonal precipitation signal of earlywood (EW) and latewood (LW) tree-ring chronologies and to create a regionally averaged time series that could be considered as a proxy of seasonal climate for specific regions of central Mexico.

Monthly and seasonal analyses between the gridded data and the EW and LW tree-ring chronologies show that spring precipitation signal in EW is the strongest, especially at Cuauhtémoc la Fragua. Summer precipitation signal in LW is apparent, though the region of strong signal is smaller than for EW and spring. Cuauhtémoc la Fragua again displayed the best results for modeling regional climate signal in the LW. There was a modest amount of seasonal overlap in climate signal between EW and LW. Also, because the tree-ring chronologies come from sites at remote, high elevations, more high-elevation climate data might contribute to better overall modeling of precipitation signal in the Douglas-fir of central Mexico.

This thesis is approved for
Recommendation to the
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DEDICATION

This thesis would be incomplete without reference to the many teachers, formal or otherwise, who always saw my potential, showed me ways to explore it, and made learning fun in a way that has allowed me to continue enjoying knowledge for its own sake. I dedicate this to all of you, though it could never be enough to say thank you.

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TABLE OF ABBREVIATIONS AND ACRONYMS

DEM- Digital Elevation Model

ENSO- El Niño/Southern Oscillation

EW- Earlywood

GIS- Geographic Information System

GRASS- Geographic Resources Analysis Support System

ITCZ- Inter-Tropical Convergence Zone

LW- Latewood

NAMS- North American Monsoon System

PCA- Principal Components Analysis

PDSI- Palmer Drought Severity Index

PRISM- Parameter-elevation regressions on independent slopes model

SMN- ServicioMeteorologicoNacional of Mexico

SMO- Sierra Madre Occidental

SOI- Southern Oscillation Index

SST- Sea-surface temperature

SYMAP- Synographic Mapping System

UAF-TRL- University of Arkansas Tree-Ring Laboratory

CHAPTER 1

INTRODUCTION

PALEOCLIMATOLOGY IN MEXICO

Paleoclimatic information available for Mexico is limited, especially compared to temperate North America. Practitioners of established methods of studying past climate through proxies such as lake sediments and tree-rings have begun obtaining and developing meaningful paleoclimatic data for Mexico and the tropics. Early tree-ring collection and chronology development in Mexico began as a part of archaeological surveys in Chihuahua. Sayles (1936) collected 51 cross sections of wood from construction beams at a remote cliff dwelling site. A joint archaeological expedition to Casas Grandes in 1958 resulted in over 400 prehistorical wood and charcoal specimens that have contributed vital data to the tree-ring record in the region (Scott 1966).

Modern tree-ring chronologies in Mexico were developed in the 1940's by Edmund Schulman of the Laboratory of Tree-Ring Research at the University of Arizona. In his 1944 article, *Dendrochronology in Mexico,* Schulman reported a tree-ring chronology from Durango, Mexico, using Douglas-fir (*Pseudotsugamenziesii*). He recorded specific problems encountered during dendrochronological pursuits in Mexico related to tree physiology and climate dynamics, and also evaluated future prospects for expanding dendrochronology in Mexico. Thomas Harlan continued work in the Sierra Madre Occidental in the 1960's (Scott 1966). The next generation of dendrochronologists and dendroclimatologists has made some progress on expanding the tree-ring records of past climate variability in Mexico. Villanueva-Diaz and McPherson (1996) developed a tree-ring chronology in Sonora, Mexico, from which they reconstructed precipitation and the Palmer Drought Severity Index (PDSI). Diaz (2001) developed a rare chronology for the Baja California peninsula, and Biondi (2001) created a 400-year tree-ring chronology at Nevado de Colima in Mexico from Mexican mountain pine (*Pinushartwegii*).

The University of Arkansas-Fayetteville Tree-Ring Laboratory (UAF-TRL) has developed a modest network of tree-ring chronologies in Mexico from Douglas-fir, Montezuma pine (*Pinusmontezumae*), and Montezuma bald cypress(*Taxodiummucronatum*). Stahle and Cleaveland (1993) and Stahle et al. (1998) used Mexican tree-ring chronologies to study and reconstruct the El Nino-Southern Oscillation (ENSO) and find that northern Mexico and the southern United States display the strongest ENSO signal. Stahle et al. (1999) reconstructed winter precipitation in Durango, Mexico, for 600 years and detected an ENSO signal.

Therrell et al. (2002) used a network of 18 tree-ring chronologies to examine the history of warm-season tree growth over Mexico from 1780 to 1992. Their principal components analysis (PCA) revealed that the primary modes of tree growth variability are divided approximately north and south by the Tropic of Cancer. The tree-ring data in northern Mexico are most sensitive to June-August rainfall, whereas the data from southern Mexico are most sensitive to rainfall in April-June (Therrell et al. 2002).

Additional paleoclimate methods and proxies have been applied in Mexico on a limited scale. Whitmore and Brenner et al. (1996) studied sediment cores, speleothems, and diatoms from three lakes of the Yucatan Peninsula to reconstruct past climate variability near former Maya settlements. Lake sediment cores from Lake Chichancanab in Yucatan, Mexico, reveal a record of past drought recurrence with a periodicity of 208 years, evidenced by gypsum deposited in the sediment during drought conditions (Hodell et al. 2001, Hodell et al. 2005). The 208-year cycle aligns very closely with a recorded 206-year cycle of increased solar energy, possibly explaining the droughts as solar activity magnified dry conditions over Yucatan (Hodell et al. 2005). Davies and Metcalfe et al. (2005) analyzed diatoms, magnetic susceptibility, and metal concentrations from sediment cores taken from two lakes in the highlands of central Mexico: Lago de Zirahuén in Michoacán and Laguna de Juanacatlán in Jalisco.The two lakes proved sensitive to past variability in climate, though Metcalfe (2006) notes that great complexity in limnological records in central Mexico have hindered thorough reconstructions of the changing environment there. Metcalfe (1987) also acknowledged that much of the work published on the Mexican climate based on historical data has been in Spanish and is not widely available in English or to English-speaking scholars.

Paleoclimate proxies are of great importance in Mexico. ENSO is proven to influence the modern climatology of Mexico and needs to be examined over long paleoclimatic time scales (Stahle and Cleaveland 1993, Stahle et al. 1998). Mexico is an arid environment home to a human population of over 106 million (Europa World online, 2010). Drought conditions there can severely diminish the water supply and put heavy stress on affected populations and the country's social safety net. Proxies for past climate help to provide long-term information on the variability of climatic conditions such as drought. In light of the possible role played by drought in the decline of Maya civilization in the region chronicled by Hodell et al. (2001), it can be agreed there is a demand for paleoclimate proxies in Mexico.

MODELING TREE-RING CLIMATE SIGNAL IN MEXICO

There are problems that have made it difficult to model the climate signal of tree-ring chronologies in Mexico. Instrumental climate data are often short, discontinuous, unreliable, and sparse. Furthermore, the stations where instrumental data are collected are often located far from the tree-ring chronologies that are modeled against them. Most tree-ring chronologies are developed from undisturbed stands in high-elevation forests. Local precipitation at these sites could conceivably be quite different from that recorded by a weather station in a near-by settlement at lower elevation. According to Dave Stahle, Mexico's complex topography interacts with numerous climate-forcing mechanisms to produce a highly variable distribution of precipitation and temperature (Personal communications).

Recently, Zhu and Lettenmaier (2007) developed a long-term, gridded, observation-based climate dataset for Mexico spanning the period of January 1925 through October 2004 at a spatial resolution of 1/8 degree. This made it possible, using correlation analysis, to model the seasonal and spatial precipitation signal in earlywood (EW) and latewood (LW) chronologies recently developed from old-growth Douglas-fir stands in central Mexico. The dataset also makes it possible to examine the distribution and severity of 20th century climate extremes in Mexico, and to document the seasonal and spatial climate signal in the available tree-ring chronologies from Mexico.

Cook et al. (1996, 1999) used most North American tree-ring chronologies to reconstruct the summer PDSI first across a 2° latitude by 3° longitude grid, and then over a 2.5° x 2.5° grid (Cook et al. 2004). The gridded tree-ring reconstruction provided an excellent opportunity to search for decadal drought and moisture anomaly patterns in the preinstrumental period (Fye et al. 2003). By compositing the tree-ring reconstructed PDSI data at each grid point for a defined time period, maps of the spatial distribution of past drought severity convey the data clearly. Past and current droughts can be compared.

Therrell et al. (2002) used correlation analysis between a network of 18 tree-ring chronologies and monthly historical precipitation data that were extracted for 31 grid boxes over Mexico from a global land precipitation data set arranged in a 2.5° latitude by 3.5° longitude grid (Hulme 1994, Hulme et al. 1998). Low-resolution maps of the correlation distribution suggested differences in the seasonal and spatial pattern of precipitation response might be responsible for the north-south modes of tree growth variability determined by PCA. This analysis will further explore these seasonal and spatial patterns of precipitation response in Douglas-fir of central Mexico.

Examining the relationships between high-resolution tree-ring chronologies from Mexico and global sea surface temperatures (SSTs) has provided a good understanding of large-scale ocean-atmospheric processes forcing climate over Mexico during different parts of the growing season such as ENSO, the North American Monsoon System (NAMS), and the Inter-Tropical Convergence Zone (ITCZ) (D'Arrigo and Jacoby 1991, Cleaveland et al. 1992, Stahle and Cleaveland 1993). There is still a need to understand the more regional or localized seasonal response of tree-rings in Mexico to precipitation to determine if there is a distinct seasonal signal between the growth of EW and LW in Douglas-fir and to identify and map the variation in geographic distribution between the available chronologies' precipitation response. Proving there is a distinct seasonal response will allow for more detailed climate studies using seasonal tree-ring chronologies in Mexico, and defining the spatial response by comparing a gridded dataset will allow for more accurate modeling of the precipitation signal present in the relatively isolated and sparse tree-ring chronologies of central Mexico. The gridded data of Zhu and Lettenmaier (2007) open up new avenues to make this possible.

The joint spatial and seasonal analysis of climate signal in central Mexican tree-ring chronologies for this thesis was based on several hypotheses. First, correlations between existing Douglas-fir tree-ring chronologies and gridded, independent time-series representing observational climate data might reveal regions of central Mexico exhibiting strong tree-ring response to precipitation. Second, the seasonal response in EW growth might differ from that of LW growth as a result of variable systems of climate forcing exerting influence at different times in the growing season. Also, the spatial distribution of climatic response could be different between EW and LW chronologies due to varying influence of several climate forcing mechanisms, notably the subtropical high pressure belt, Trade Winds, westerlies, ITCZ, and the NAMS.

Furthermore, Stahle et al. (2009) have already examined composites of the gridded precipitation and maximum temperature data compiled by Zhu and Lettenmaier (2007) to provide both a time series and spatial perspective on winter-spring and summer season drought during the 1950's and early 21st century. Ideally, using the gridded data in conjunction with EW and LW chronologies from Douglas-fir in central Mexico will allow one to more accurately model and define the seasonal precipitation signal of the tree-ring chronologies. Using Zhu and Lettenmaier's data to validate tree-ring precipitation response will allow gridded pre-instrumental reconstructions of the spatial and seasonal distribution of past drought in Mexico.

The goals of this project were: 1) to define the regional and seasonal precipitation signal of EW and LW chronologies from Douglas-fir in central Mexico; and 2) to create a regionally averaged time-series from important tree-ring chronologies that could be considered as a proxy of seasonal climate for specific regions of central Mexico. This paper will address the results of correlation analysis between five Douglas-fir chronologies in central Mexico, created by Dave Stahle and the UAF-TRL, and the gridded precipitation data for Mexico provided by Zhu and Lettenmaier (2007). Addressing the seasonal signal of precipitation in sensitive tree-ring chronologies from central Mexico could help to develop a more accurate record of the summer precipitation maximum in this topographically diverse region of the country.

CLIMATE DYNAMICS AND FORCING IN MEXICO

Making meaningful inferences in the data analysis between tree-rings and precipitation requires an understanding of the systems that govern climate over Mexico. The nation lies between 14º 30’ N and 32º 42’ N and has two long coast lines: on the West with the Pacific Ocean and the East with the Gulf of Mexico and Caribbean. Along with a large, high-elevation plateau in the center of the country, these serve to alleviate the extreme temperatures which otherwise might be found in a land area at tropical and subtropical latitudes (Tannehill 1943).

It is notable that Mexico occupies a latitudinal band that encompasses both tropical and temperate climates, and is therefore highly sensitive to changes in large-scale atmospheric circulation (Metcalfe 1987). The Tropic of Cancer marks the southern limit of Mexico's dry region, while wet areas are concentrated south of the line in places like Veracruz, northeastern Chiapas, and the Gulf coastal plains of Tabasco (Tannehill 1943, Kottek et al. 2006, and Flores 2008). Climate on the southern coast of the Gulf of Mexico is tropical and continuously humid. According to the Koppen-Geiger Climate Classification the area is comprised of tropical humid and tropical dry-winter climates, Af and Aw classes, respectively (Kottek et al. 2006). The Mesa Central has mild temperatures with dry winters and a wet season powered by convective activity of moisture supplied from the Pacific and Gulf of Mexico during the boreal summer months (Cwa Koppen-Geiger class) (Cavazos and Hastenrath 1990, Kottek et al. 2006). The southern Pacific coast is humid and tropical, a humid A-type climate (Kottek et al. 2006).

During northern hemisphere winter when the ITCZ is displaced equatorward, Mexican climate, especially north of the Tropic of Cancer, is dominated by the subtropical high pressure belt with westerly flow and generally stable, dry conditions. The dominant westerlies generate winter precipitation primarily in northwestern Mexico over the Sierra Madre Occidental (SMO). Sometimes in the winter, when a cold air mass and high pressure occupy the Rocky Mountains and Great Plains regions of the United States, meridional flow pulls cold air down over northeastern Mexico and the Gulf coast region (Tannehill 1943). These *nortes*, as the phenomenon is called, are a primary component in winter precipitation over Mexico.

High pressure and generally stable conditions persist through spring until the summer rainy season begins in May or June (Magaña et al. 2003). A strong subtropical High in the Atlantic forces easterly Trade Winds that bring moist air and precipitation to central Mexico. Precipitation associated with the ITCZ, mostly along the southwest Pacific coast, is characterized by convection and is driven by the position and strength of the subtropical Highs and enhanced by warm SSTs. *Temporales* is a term commonly used to refer to the overcast and rainy weather conditions that accompany episodic surges of the ITCZ over Mexico (Peña and Douglas 2002). *Temporales* originate from the eastern Pacific ITCZ while southwesterly flow provides moisture for precipitation (Portig 1958; Fernandez and Barrantes 1996; and Galo et al. 1996). Typically, *Temporales* occur when the ITCZ makes its northward migration in June, and again when it reaches its northernmost latitude in September (Hastenrath 2002).

Another driving force in summer precipitation over Mexico is the NAMS. Intense warming over the North American continent during the summer creates a low-level low pressure zone that brings in moisture from the eastern Pacific and the Gulf of California (Gochis et al. 2005). According to Gochis et al. (2005) and supported by Berbery (2001) and Anderson et al. (2000), there is a strong diurnal pulsing of low-level moisture flux that helps to drive a diurnal precipitation pattern in the NAMS region covering central and northern Mexico and the southwestern United States. Precipitation associated with the NAMS is subject to considerable spatial and temporal variability as the air interacts with the topography of the land (Gochis et al. 2005). Mexico's warm-season precipitation distribution is bimodal, with maxima in June and September and a relative minimum in July or August called the *Canicula* (Mosino and Garcia 1966, Douglas et al. 1993, Magaña 1998, Higgins et al. 1999). The *Canicula* brings dry conditions over Mexico that result from a weakening of the Trade Winds and a temporary disruption of moist easterly flow.

The climate phenomenon, ENSO, has been shown to influence cool-season climate in Mexico and the southern United States (Ropelewski and Halpert 1986). Numerous tree-ring chronologies in Mexico are significantly correlated with the winter Southern Oscillation Index (SOI) despite the fact that the growing season of the sample trees does not begin until spring or early summer (Stahle et al. 1998). During El Nino winter there is a southward shift of the ITCZ, and the jet stream is displaced southward allowing mid-latitude cyclonic systems to penetrate farther south than in non-El Nino years (Pavia et al. 2006). This results in a relative increase in winter precipitation for northwestern and northeastern regions of Mexico, as well as for Yucatan, though a relative decrease for most parts of central and southern Mexico, especially during summer (Galindo and Mosino 1992, Pavia et al. 2006). Peralta-Hernandez et al. (2008) examined spatial and temporal behavior of climatic conditions during the *Canicula* under El Nino conditions. Intensified Trade Winds and anticyclonic circulation contribute to lower-than-average precipitation during El Nino summer. However, Magaña et al. (1999), Magaña et al. (2003), and Peralta-Hernandez et al. (2008) all found that the *Canicula* is weak during El Nino years in central and northern Mexico, and that the effects of the *Canicula* decrease or even disappear for most of Veracruz state. La Nina winters tend to result in precipitation anomalies roughly opposite to those produced by El Nino, though slightly less well defined (Pavia et al. 2006).

Because Mexico occupies the zones of influence of two major atmospheric circulations, the Trade Winds and the subtropical high pressure belt, in many places the country experiences stark seasonal differences in precipitation governed by distinct forcing. Northern Mexico is mainly arid, and some places, particularly in northwestern

Mexico, exhibit a winter precipitation maximum. Central and southern Mexico enjoy a wet season lasting from May through October with relative maxima in June and September. The seasonal and spatial distribution of precipitation in Mexico is a result of the interplay between the two circulations noted above, the westerlies, the ITCZ, the NAMS, and the topography of the land. ENSO has also been shown to modulate precipitation over Mexico. With this background in the precipitation climatology of Mexico there is context to meaningfully interpret the results of climate modeling between Douglas-fir tree-ring chronologies of central Mexico and the gridded precipitation data from Zhu and Lettenmaier (2007).

CHAPTER 2

METHODS

STUDY AREA AND TREE-RING DATA

Mexico is home to numerous tree species suitable for reconstructing climate. The coniferous Douglas-fir has been used most extensively in dendrochronological studies. Old Douglas-fir are sensitive monitors of environmental variability, and their annual growth rings can be dated to the exact calendar year of formation (Stahle et al. 2003). With the possible exceptions of Montezuma bald cypress and some pine species, no other tree species in central Mexico is known to produce such sensitive, reliable, and long chronologies of environmental history (D. Stahle, personal communication, 2009).The natural distribution of Douglas-fir ranges across western North America from Canada to Mexico. In Mexico, Douglas-fir is most commonly found in the higher-elevation conifer woodlands of the Sierra Madre Occidental, though more isolated populations are scattered across the Sierra Madre Oriental and Sierra Madre del Sur as far south as Oaxaca (Martinez 1963, Fowells 1965, Debreczy and Racz 1995). The sites selected for analysis in this study are distributed in the high and rugged terrain of central Mexico between the states of Queretaro and Hidalgo in the north and Oaxaca in the south (Figure 1).

Recent efforts of the UAF-TRL have also yielded climate sensitive chronologies in Mexico from Montezuma bald cypress reaching back a millennium (D. Stahle, personal communication, 2010). Montezuma bald cypress is the national tree of Mexico and is found along streams and rivers throughout Mexico and into Guatemala (Martinez 1963, Fowells 1965, also reported by Therrell et al. 2002). Douglas-fir was selected for analysis in this study because of its known climate sensitivity at tropical Mexican sites, its distribution across central Mexico, and because of the potential to extract distinct seasonal climate information from EW and LW width.

Five Douglas-fir chronologies from central Mexico were selected for analysis, including both EW and LW chronologies. Several of these are among the first precipitation sensitive tree-ring chronologies created for tropical Mexico. The five chronologies are roughly distributed across central Mexico, the southern margin of Douglas-fir's natural range (Martinez 1963, Fowells 1965, Debreczy and Racz 1995). The site at Cerro la Peña (17.163° N, 96.632° W) represents the southernmost known stand of this species that has been so valuable for climate reconstruction elsewhere in North America, although another small stand may exist in southern Oaxaca (Jose Villanueva-Diaz, personal communication, 2009). The other tree-ring study sites selected for this study were El Malpaso, Veracruz (20.404° N, 98.467° W); Pinal de Amole, Queretaro (21.172° N, 99.702° W); Villareal, Tlaxcala (19.538° N, 97.881° W); and Cuauhtémoc la Fragua, Puebla (19.208° N, 97.308° W) (Figure 1). All chronologies were developed at these five sites by the UAF-TRL with the collaboration and assistance of Dr. Jose Villanueva-Diaz at the InstitutoNacional de InvestigacionesForestales y Agropecuaria (INIFAP) in Torreon, Mexico.

Both EW and LW chronologies used in this analysis are residual chronologies, meaning biological growth trend and year-to-year persistence have been removed from the individual dated radii used to compute the mean chronology for each site. The climate in a given year (t) influences growth in that year, but can also influence growth in succeeding years due to the physiology of tree growth (e.g., depletion of stored photosynthate during severe drought). This low order persistence is removed with autoregressive modeling before compiling the residual, or "whitened," chronology (Cook and Kairiukstus 1990). Preliminary analysis indicated a modest amount of common signal between the residual EW and LW chronologies, so adjusted LW chronologies were also examined which had attempted to remove the early-growing season signal apparent in the residual LW by using the residuals from a regression of LW on EW (Meko and Baisan 2001). Unfortunately, the climate signal that had been apparent between the gridded precipitation data and the residual LW was largely lost when using the adjusted LW. For this reason, residual EW and unadjusted LW chronologies were used in this analysis.

GRIDDED PRECIPITATION DATA

Zhu and Lettenmaier (2007) created the gridded historical dataset of temperature, precipitation, and other hydrological conditions such as soil moisture balance in order to support analyses of land-atmosphere interactions in Mexico. Understanding the genesis of warm-season rainfall in Mexico, for instance, has strong implications for warm-season precipitation predictability over the NAMS region as well as much of the southern portion of the United States (Zhu and Lettenmaier 2007). The dataset was designed to be compatible with previous work by Maurer et al. (2002), whose dataset domain includes the coterminous United States and portions of Canada and Mexico, although it only extends south as far as 25° N. Maurer et al. (2002) treated the Mexican domain as a buffer zone, owing to the fact that station source data used outside the continental United States were not as carefully quality controlled as the U.S. data. In light of the importance of the NAMS region and central and southern Mexico, Zhu and Lettenmaier sought to expand the utility of the gridded dataset further south.

Developing a long-term, observation-based meteorological dataset proved particularly challenging for Mexico because of the discontinuity and scarcity of raw station data, as well as quality-control problems (Zhu and Lettenmaier 2007). According to Zhu and Lettenmaier (2007), several datasets that recently became available have helped to alleviate the difficulty. The ServicioMeteorologicoNacional of Mexico (SMN) in 2005 released a long-term improved surface-station dataset that includes precipitation and daily maximum and minimum temperatures for all of Mexico from the mid-1920's through present (Zhu and Lettenmaier 2007). This served to update the Extractor Rapido de la Informacion de Climatologic (ERIC II) dataset (Zhu and Lettenmaier, 2007; Quintas, 2000). Approximately 5000 stations from the updated dataset covering all of Mexico from the 1920's to 2004 were used with other datasets to provide more reliable Mexican instrumental climate data than what was available to Mauer et al. 2002. Daily precipitation from northwestern Mexico between 2002-2005, courtesy of the North American Monsoon Experiment (NAME), provided some information about high-elevation precipitation, though not in the same region as this study's tree-ring chronologies (Zhu and Lettenmaier 2007). An additional dataset used included SMN daily precipitation data from 1995-2003 for 1000 stations in Mexico (Zhu and Lettenmaier 2007). These quality-controlled station data were then gridded using the Synographic Mapping System (SYMAP) method (Shepard 1984, Maurer et al. 2002), which uses the weighted average of all records in the neighborhood of a grid cell, to produce a long-term gridded daily precipitation and temperature dataset (1925-October 2004) at 1/8° spatial resolution over all of Mexico (Zhu and Lettenmaier 2007).

SEASONAL AND SPATIAL ANALYSIS

A computer program was written by Dr. Falko Fye of the UAF-TRL allowing the gridded dataset to interface with an open source Geographic Information System (GIS) called the Geographic Resources Analysis Support System (GRASS) (F. Fye, personal communications, April, 2010). Fye et al. (2003, 2004, and 2006) did spatial analyses over North America that required similar capabilities as in this research. Dr. Fye was able to tailor the program to Mexico and the Zhu and Lettenmaier (2007) dataset. Software was developed to perform correlation analysis with independent time series, and the GIS was used to create color coded maps representing correlation coefficients at each of the 11,575 individual grid points of the Zhu and Lettenmaier (2007) dataset. Further capabilities were programmed to allow the operator to delineate boundaries for an extraction zone from which the independent time series at each grid point within the zone are averaged together into a single regional time series for the extraction area. The operator can designate a threshold value for correlation coefficients, and grid points falling below the threshold are omitted from the regional average. The purpose of the threshold is to eliminate extracted precipitation data which exhibit minimal agreement with the respective tree-ring chronologies. The spatial distribution of a strong precipitation signal is dependent on the prevailing climate forcing mechanisms as well as local-scale topographic effects, which can vary rapidly in central Mexico.

A primary goal of this research was to identify the seasonal precipitation signal of the EW and LW chronologies, determining which months' precipitation contribute most strongly to tree growth and also whether there exists a separate seasonal signal apparent in the growth of EW compared to LW. For this analysis the EW and LW chronologies from each of the five sites were correlated with monthly precipitation at all 11,575 grid points in the Zhu and Lettenmaier (2007) dataset. Three overlapping 26-year subsets of the data were used initially and compared to check for consistency. Monthly and spatial correlation patterns were understandably similar between the subsets of 1950-1975, 1955-1980, and 1960-1985, but correlation values were highest for the earliest subset. Final correlations were run on the subset of data from 1950-1975. Data prior to 1950 are somewhat less reliable as fewer stations were available for interpolating across the grid (Zhu and Lettenmaier 2007). Zhu and Lettenmaier (2007) note specifically a decreasing density in station data for northern Mexico from the 1990's to the present. Maps of the chronologies' correlations with gridded precipitation during each individual month were output. The resulting maps of monthly correlation patterns suggested there may be a separate seasonal signal in the growth of EW and LW, and the data were then composited seasonally for correlations to be run again as the patterns indicated (e.g. spring signal beginning in March or April through June, and summer signal beginning in June through September). The seasonal pattern is discussed further in the results section.

Another goal of this research was to use the gridded precipitation data in conjunction with the independent tree-ring chronologies to analyze the spatial distribution of precipitation response and identify regions correlating most strongly with respect to location and season. Thus, regionally averaged time-series from important tree-ring chronologies could be considered as proxies of seasonal climate for specific regions of central Mexico and add important spatial information to the historical climate record. This becomes possible because of the Zhu and Lettenmaier (2007) dataset, and it is the spatial component to analyzing tree growth response to climate that makes this research unique and important.

From the resulting maps of correlation between EW and LW chronologies at all five tree-ring sites and the seasonalized gridded data, regions of strong tree-ring response were identified. Responses were compared both seasonally and spatially, and similar time series were averaged for the purposes of creating a regional average from multiple tree-ring chronologies that might be considered an accurate record of precipitation for central Mexico.

The resulting averaged time series was correlated with the gridded data, and the region of strong tree-ring response was identified again. An extraction zone was delineated around the region, and a minimum correlation coefficient threshold was designated at $r = 0.40$. The single time series averaged from all qualifying grid points within the extraction region and spanning the entire length of the gridded data, 1925-2004, was compared with the time series averaged from multiple tree-ring chronologies for verification and analysis.

CHAPTER 3

RESULTS AND DISCUSSION

MONTHLY ANALYSIS

All monthly and seasonal correlation maps for each EW and LW chronology are presented in Figures 2-6, Figure 9, or Appendix A. Several of the tree-ring sites exhibited a stronger, more coherent, and more distinct seasonal precipitation signal than others over the time period analyzed from 1950-1975. The differences arise primarily in the LW analysis. All EW chronologies appear to exhibit strong response to March and April precipitation across most of Mexico.

May and June precipitation signal with EW also remains fairly consistent across analyses of all five chronologies. The strong precipitation response in these months is centered further south over Morelos and covers most of central and southern Mexico. This signal early in the wet season may reflect precipitation brought by the *temporales* and the northward migration of the ITCZ. Supplied by moisture from the Pacific, the southern and southwestern coasts of Mexico experience the most precipitation from the ITCZ during these months (Pena and Douglas, 2002)

Analysis of monthly LW correlation results illuminates several differences among the five tree-ring sites. Cerro la Pena, Villareal, and El Malpaso (Appendix A) show very little response to late-summer precipitation in central Mexico, with LW signal essentially nonexistent until September, when a small region of precipitation response emerges over the east-central coast and the Sierra Madre Oriental. Villareal most strongly exhibits signal with September precipitation in this region. Pinal de Amole (Appendix A) exhibits almost no late-summer precipitation signal and does not even respond to September precipitation.

The tree-ring chronologies from Cuauhtémoc la Fragua were the best for defining seasonal and spatial precipitation signal from EW and LW. The data from the site at Cuauhtémoc la Fragua demonstrate the most seasonal segregation in growth response to precipitation between EW and LW, and seasonal analysis produced maps with broad areas of strong response over central Mexico, particularly for the EW correlations with spring precipitation when composited across April, May, and June (Figures 2, 3, 4, 5 and 6a). Late-summer precipitation response with LW was present in the region between July and August, while the September precipitation signal matched those exhibited by Cerro la Pena, Villareal, and El Malpaso.

Because Cuauhtémoc la Fragua so clearly demonstrates better LW response to late-summer precipitation and owing to the many maps created as a part of this analysis, extensive results and figures reported in the body of this section focus mainly on that site in Puebla. Again, monthly and seasonal correlation maps created for EW and LW chronologies from each site are reported in Appendix A.

Significant areas of central and southern Mexico exhibit strong positive correlations with the EW chronology at Cuauhtémoc la Fragua beginning in February (Figure 2). High correlations are centered more over northern Mexico during the month of March, but positive correlations appear over central Mexico and are consistently strong during the late-spring months of April through June (Figures 2 and 3). Correlations with LW data, conversely, exhibit lower correlations over much of central and southern Mexico during these months, but the spatial pattern is similar to EW during March, April, and May (Figures 2 and 3). The LW data correlate very strongly with May precipitation over southern Mexico. This is not overly surprising, as Therrell et al.

(2002) demonstrated that some individual chronologies significantly correlated with the onset date of the monsoon in southwest Mexico, usually sometime in May. Therrell used Douglas-fir LW chronologies from central Mexico in his study. As noted previously, there is also some positive correlation between the EW and LW chronologies that may be contributing to the similar signals between EW and LW in spring and early summer (D.W. Stahle, personal communications, June, 2010).

Gridded correlations with EW at Cuauhtémoc la Fragua dip sharply negative over central and southern Mexico beginning in July and remain low throughout the rest of the year (Figure 4). This late in the growing season it stands to reason that precipitation in the region is contributing to the formation of LW cells in Douglas-fir rather than EW cells. The data here tentatively support that idea as strong positive correlations with LW begin to take shape in the area of Cuauhtémoc la Fragua in central Mexico during June (Figure 3), and the pattern becomes more pronounced in July (Figure 4). Correlations subside somewhat in August, possibly as a result of the wet-season interruption by the *Canicula*. A very strong and distinct region of LW tree-ring response to precipitation persists in September (Figure 4).

Areas of strong correlation between the gridded data and LW at Cuauhtémoc la Fragua during the summer months appear less contiguous than the regions of strong correlation with EW during the spring. This might partly reflect the less organized convective nature of precipitation during the summer months. Central Mexico's diverse topography may contribute to a disjoint pattern of precipitation, and this is one reason why using a spatial approach to modeling the precipitation signal of tree-rings in central Mexico is important.

The monthly analysis conducted at Cuauhtémoc la Fragua demonstrates some significant overlap in monthly signal between EW and LW in Douglas-fir of central Mexico. EW correlations, though, are much stronger in the early-growing season, while LW correlations are stronger during the late summer. Compositing the gridded precipitation data seasonally and correlating again with the EW and LW tree-ring chronologies better highlighted a seasonal segregation in climate signal. From these maps, regional and seasonal average time series could be extracted.

SEASONAL ANALYSIS

After experimenting with several monthly combinations to define the best seasonal correlation pattern for the EW chronology from Cuauhtémoc la Fragua, gridded data for spring were composited for the months of April, May, and June. Correlation patterns exhibited in the monthly analysis support the seasonal configuration (Figure 3). The composited spring data (for April, May, and June) were then correlated with the EW chronology from Cuauhtémoc la Fragua (Figure 6a).

The resulting map for EW correlated with spring precipitation shows strong positive correlation over nearly all of central and southern Mexico as far south as Oaxaca (Fig. 6a). The Douglas-fir at Cuauhtémoc la Fragua appear to be experiencing similar spring rainfall as the rest of central and southern Mexico, and the EW signal is strong. An extraction zone was delineated around the region of strong positive correlation from which to create a regional spring precipitation average that represents the entire extraction region for spring. A threshold correlation coefficient value was designated at r = 0.40 so that poorly correlated grid points within the region of strong positive correlation were excluded from the average. Individual time series from each of the grid points within the extraction region whose correlation coefficient met the threshold were averaged together for the 80-year period that the data span from 1925-2004. Appendix B lists all grid points that were used in creating extracted time series from the gridded data. Regional averages from Spring (EW) and Summer (LW) were extracted for the Douglas-fir site with the strongest regional correlations, Cuauhtémoc la Fragua, and for the Douglas-fir series averaged between Cuauhtémoc and Villareal. Alone, the four other Douglas-fir sites provided low seasonal and regional correlation with the gridded dataset. Geographic coordinates for each grid point in the extractions are listed and the inter-series correlation between each point and the respective tree-ring chronologies are reported.

The resulting regional average time series correlates with the EW chronology from Cuauhtémoc la Fragua r = 0.60 for the entire length of the data (1925-2004), explaining some 36% of the variance across a large region of central and southern Mexico (Figure 6c, Figure 7). The regional average utilized 612 individual grid points whose correlation coefficients met the threshold. It was noted by Zhu and Lettenmaier (2007) that the instrumental data used prior to 1950 were sparse and unreliable, possibly contributing to lower overall correlation values. Reliability of the instrumental data beginning in the mid-1980's might also be brought into question as the financial crisis afflicting Mexico may have impacted climate data collection (Stahle, personal communication). When compared only over the period of 1950 to 1984 that correlation increases to r = 0.70 (Figure 7).

The gridded precipitation data for summer were composited across the months of June, July, August, and September and then correlated with the LW chronology from Cuauhtémoc la Fragua (Figure 6c,d). Although September may be somewhat late in the season for Douglas-fir LW to still be responding, the monthly data in this analysis demonstrate positive precipitation signal in the LW persisting through the late summer in September (Figure 4F).

The summer precipitation signal in LW from Cuauhtémoc la Fragua is weaker than exhibited between spring precipitation and EW, and regions of strong positive response are limited to the eastern half of central Mexico as opposed to the entirety of the region represented by strong EW correlations during spring. An extraction zone was likewise defined and a correlation threshold of $r = 0.40$ imposed. Though meaningful spatial patterns are apparent in the seasonal responses of EW and LW, the extracted time-series results for LW correlated with summer precipitation exhibited much lower overall correlation with the Cuauhtémoc LW chronology when compared over the entire 80 years of the data, approximately $r = 0.18$ (Figure 8). Further examination of the two time series reveals they correlate higher from 1950 to 1984 ($r = 0.53$, Figure 8). Significantly fewer grid points met the threshold for the LW regional average than for the EW, with 142 individual time series from qualifying grid points contributing to the LW average.

The summer precipitation signal in LW remains substantially lower than the spring precipitation signal in EW, though previous indicators make this a somewhat unexpected outcome. Inter-series correlation statistics for the LW at Cuauhtémoc la Fragua are high and LW cross-dating was strong, both indicators of strong climate signal. Also, Therrell (2006) used Douglas-fir LW from central Mexico to reconstruct maize yield and obtained very high levels of correlation, further indicating strong climate signal. Nonetheless, Cuauhtémoc la Fragua is located at approximately 3200m elevation, and there are no stations measuring precipitation at that elevation near-by. That is a possible explanation for the weak correlation between the LW from Cuauhtémoc la Fragua and summer precipitation over central Mexico. Some precipitation data included in Zhu and Lettenmaier's (2007) dataset was at high-elevation, but only for a limited time-period at the beginning of the 21st century, and only in northwestern Mexico far from the chronologies used in this analysis. The elevation-climate relationship in Mexico needs to be examined further before making reliable conclusions based on lower-elevation instrumental climate data (Flores 2008).

The SYMAP method of interpolation employed by Zhu and Lettenmaier (2007) does not take into account topography in the weighting factors used to calculate the grid points from station data. Another method known as the "parameter-elevation regressions on independent slopes model" (PRISM) employs a digital elevation model (DEM) to help apply orographic effects and lapse rate information to the interpolation of data across a grid (Daly et al. 1994). Adding such characteristics to the Zhu and Lettenmaier (2007) dataset might improve the seasonal precipitation signal in the LW chronology from Cuauhtémoc la Fragua by better approximating precipitation at the elevations where the Douglas-fir tree-ring sites are located.

A TWO-CHRONOLOGY REGIONAL AVERAGE

Averaging a second tree-ring chronology, Villareal, together with Cuauhtémoc la Fragua and correlating with seasonal precipitation results in strengthened seasonal climate signals in both EW and LW over central Mexico. Monthly correlation patterns (Villareal, Appendix A; Cuauhtémoc la Fragua, Figures 2-5) for spring correlated with EW are almost identical between the two tree-ring sites. Villareal loses significant climate signal between LW and July and August precipitation, while Cuauhtémoc la Fragua shows strong correlation during the same months. Both, however, display strong correlation between LW and September precipitation. The two tree-ring sites correlate with one another quite well, especially for the period from 1925-2004 covered by Zhu and Lettenmaier's (2007) gridded precipitation dataset (EW $r = 0.62$, LW $r = 0.58$). Villareal and Cuauhtémoc la Fragua chronologies were averaged together for analysis with the gridded precipitation data in an effort to strengthen the seasonal tree-ring responses for making a regional average.

The EW chronology averaged from the two sites and correlated with spring precipitation (April, May, June) exhibits even broader and stronger correlation over central and southern Mexico than either chronology alone displayed. The average time series from the imposed extraction region and threshold explains approximately 41% ($r = 0.64$) of the variance of the two-tree-ring-chronology average, up from 36% for Cuauhtémoc alone and representing an even broader region of central Mexico (Figures 6a and 9a). When the series were compared over the 1950-1984 time period, correlations increased to $r = 0.75$ for spring (Figure 10).

The LW chronology averaged from the two sites is correlated with summer precipitation (June, July, August, September) over central Mexico (Figures 9c), though again, pockets of strong LW correlation were disjoint throughout the region and the spatial pattern of correlation is weaker than computed for the Cuauhtémoc chronology alone (Figure 6c). Note that in both cases (Figures 6c and 9c) the highest correlations with summer precipitation are located over northern Yucatan, which might be related to the advection of moisture into central Mexico on the easterly Trade Winds. The average time series extracted from LW results and correlated with the average tree-ring chronology resulted in values much lower than for EW (r = 0.13 for LW between 1925 and 2004, Figure 11). When compared between 1950 and 1984, correlations improve drastically (r = 0.62, Figure 11). Between 1925 and 1949 there is almost no correlation (r= 0.07), and after 1984 there is negative correlation (r = -0.29). These results at the beginning and end years of the record may be related to spatial inconsistency in summer precipitation over central Mexico before 1950 and after 1984 that lowered the tree-rings' efficacy in recording regional summer precipitation.

Using EW and LW chronologies averaged from Cuauhtémoc la Fragua and Villareal improves results modeling precipitation in both spring and summer, respectively, compared to using Cuauhtémoc la Fragua alone. EW correlations with spring precipitation over the strongest period (1950-1984) increase from r = 0.70 to r = 0.75, while LW correlations with summer precipitation over the same period increase from r = 0.53 to r = 0.63. The average of Cuauhtémoc la Fragua and Villareal appears to better represent climate variability over central Mexico than any singular tree-ring chronology in the region.

CHAPTER 4

SUMMARY AND CONCLUSIONS

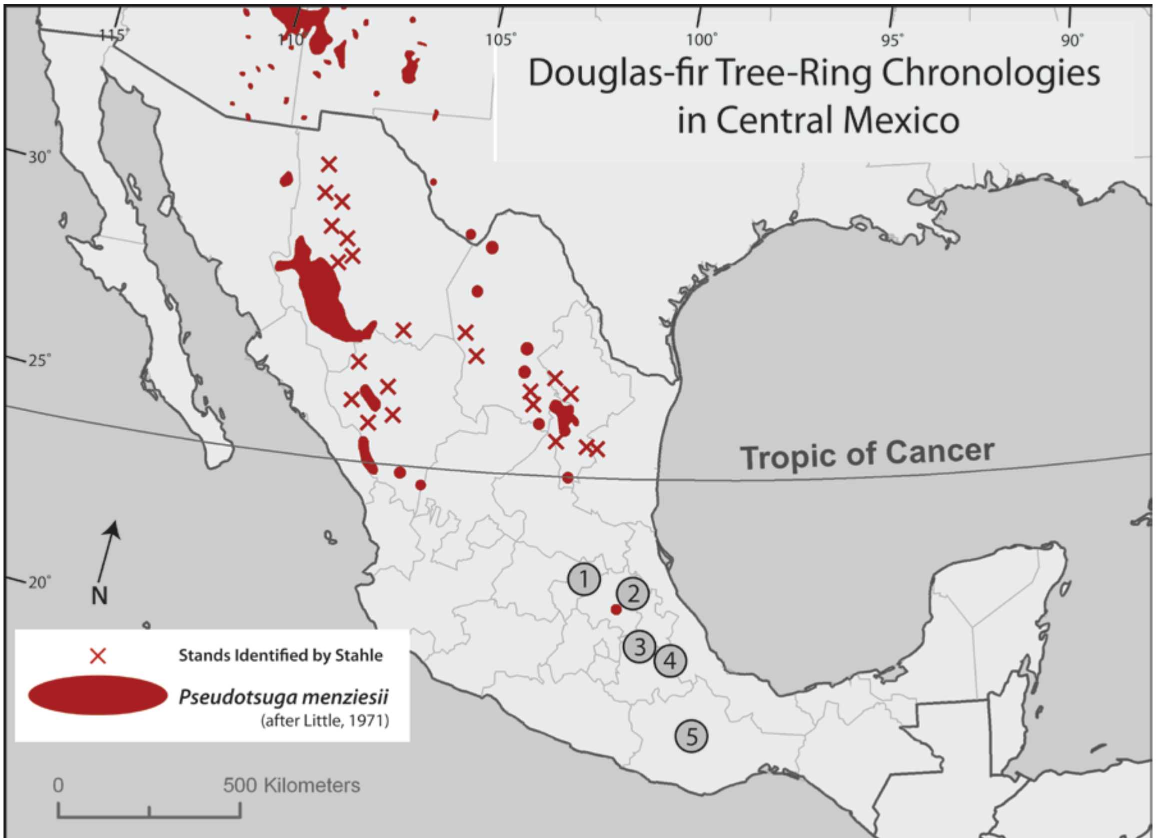
The gridded instrumental dataset of precipitation that recently became available on a 1/8 degree grid (Zhu and Lettenmaier 2007) made it possible to model the seasonal and spatial precipitation signal in EW and LW chronologies in Mexico. The creators of the dataset took steps to improve the quality of the instrumental precipitation data from Mexico and to interpolate it across a fine spatial grid superimposed over the country. Using the gridded data served to circumvent some of the problems encountered when modeling the precipitation signal in tree-ring chronologies in Mexico, notably that station precipitation data are collected far away from remote tree-ring sites. But because the tree-ring study sites in central Mexico are located at high-elevation, a lack of high-elevation instrumental climate data for the region in the Zhu and Lettenmaier (2007) dataset suggests that seasonal climate modeling of tree growth could still be improved, especially perhaps between LW and summer precipitation.

Monthly correlation analyses between the gridded data and EW and LW tree-ring chronologies from five Douglas-fir sites in Mexico display some significant seasonal overlap in climate signal between EW and LW, though the spring signal is stronger in EW and the summer signal is stronger in LW. Seasonal correlation analyses demonstrate a better segregation in seasonal signal apparent in the growth of EW compared to LW, especially at Cuauhtémoc la Fragua and when using an average of Cuauhtémoc la Fragua and Villareal. EW responds very strongly with spring precipitation (April-June) in central Mexico while LW responds to summer precipitation over east-central Mexico (June-September).

Comparing the results from analyses using the two-chronology average and using only Cuauhtémoc la Fragua, spring precipitation correlated with EW displayed an enhanced precipitation signal, both in area and intensity. Summer precipitation correlated with LW showed an increased intensity in the regionally-averaged precipitation signal from 1950 to 1984, but the spatial pattern was weaker and rather disjoint over central Mexico compared with the summer signal in the Cuauhtémoc chronology alone.

The extracted time series from the two-chronology analyses might be suitable for creating a transfer function by which seasonal reconstructions could be possible for the defined regions. The results here demonstrate the unique utility of a spatial perspective in modeling paleoclimate proxies in a place with complex terrain where numerous climate forcing mechanisms interact. The gridded instrumental climate data from Zhu and Lettenmaier (2007), as well as the programming tools created by Dr. Falko Fye, allowed this to be done.

FIGURES



	Site Name	Lat.	Long.	Elev. (m)	Chron. Dating
1	Pinal de Amole	21.172	99.702	2560	1731-1998
2	El Malpaso	20.404	98.467	2580	1726-1998
3	Villareal	19.538	97.881	3120	1699-2000
4	Cuauhtemoc la Fragua	19.208	97.308	3200	1474-2001
5	Cerro la Peña	17.163	96.632	2550	1561-2000

Figure 1. Site locations and elevations for the five sets of EW and LW chronologies from Douglas-fir in central Mexico are mapped above (numbered circles). The dating, geographic coordinates (decimal degrees), and elevation (meters) are reported for each chronology. Sites are superimposed on a map of the distribution of Douglas-fir in Mexico (Little 1971). The map was modified from (Little 1971).

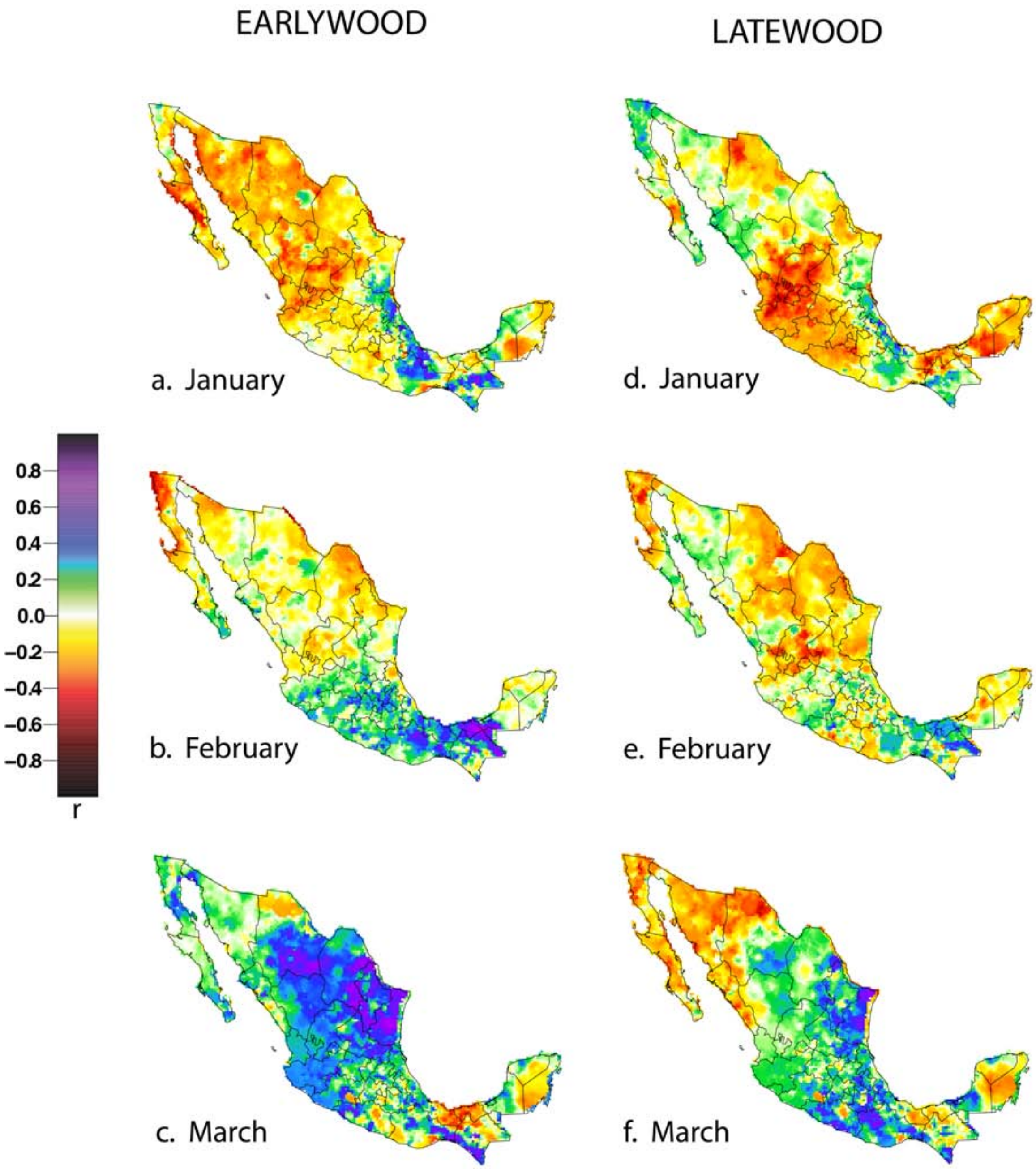


Figure 2. Monthly correlation patterns for January-March between Cuauhtemoc la Fragua [EW (left) and LW (right)] and the gridded data from Zhu and Lettenmaier (2007) for the period 1950-1975 are displayed. A strong and widespread precipitation signal over central Mexico becomes apparent in the EW chronology starting in February. Positive correlation between EW and March precipitation centers more over northeastern Mexico. Some common signal between EW and LW is apparent in each of these months.

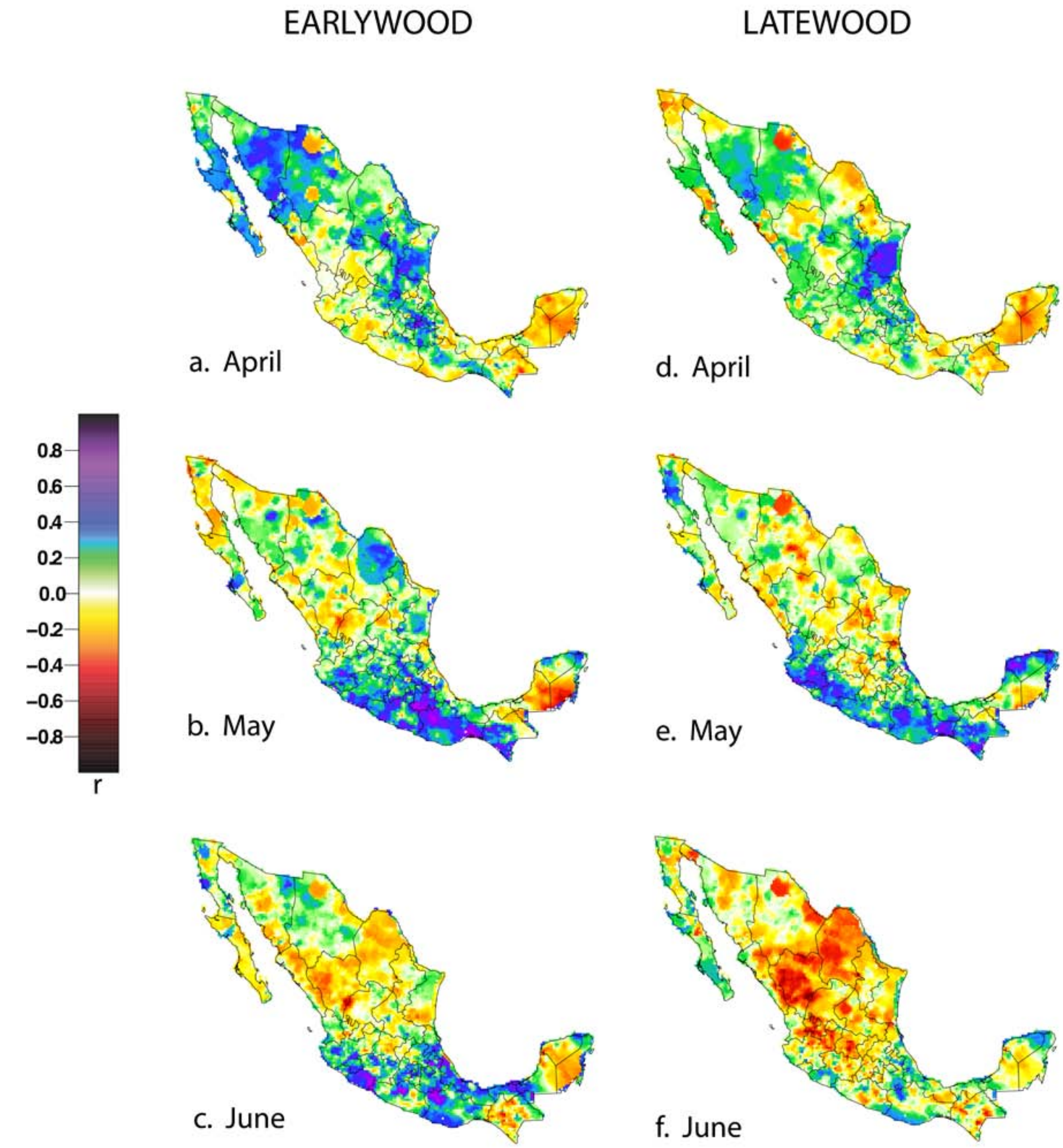


Figure 3. Same as Figure 2 for April-June. Strong correlation between EW and spring precipitation over central Mexico picks up again in April, and a pattern of positive regional correlation persists through June. LW correlates well with May precipitation in the southern Mexico, though June precipitation shows weak and only extremely localized signal over the states of Puebla, Veracruz, and northern Oaxaca.

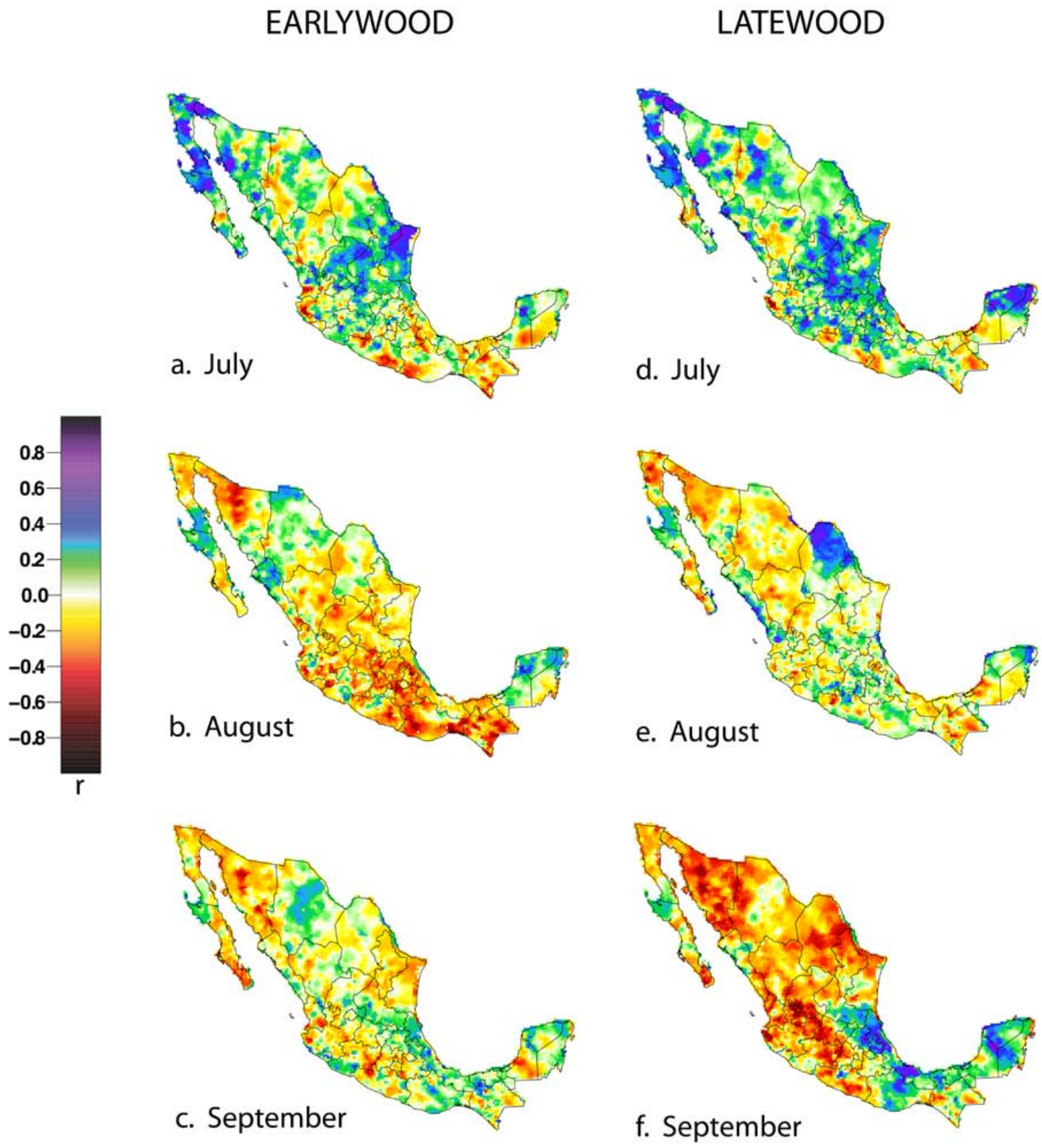


Figure 4. Same as Figure 2 for July-September. The positive correlation with EW in central Mexico subsides beginning in July, and correlations remain low or negative throughout the remainder of the year for EW. A summer precipitation signal in LW over the region takes form clearly in July, and a region of strong precipitation response persists in September. Strong late-season correlations with LW are concentrated in the eastern half of central Mexico.

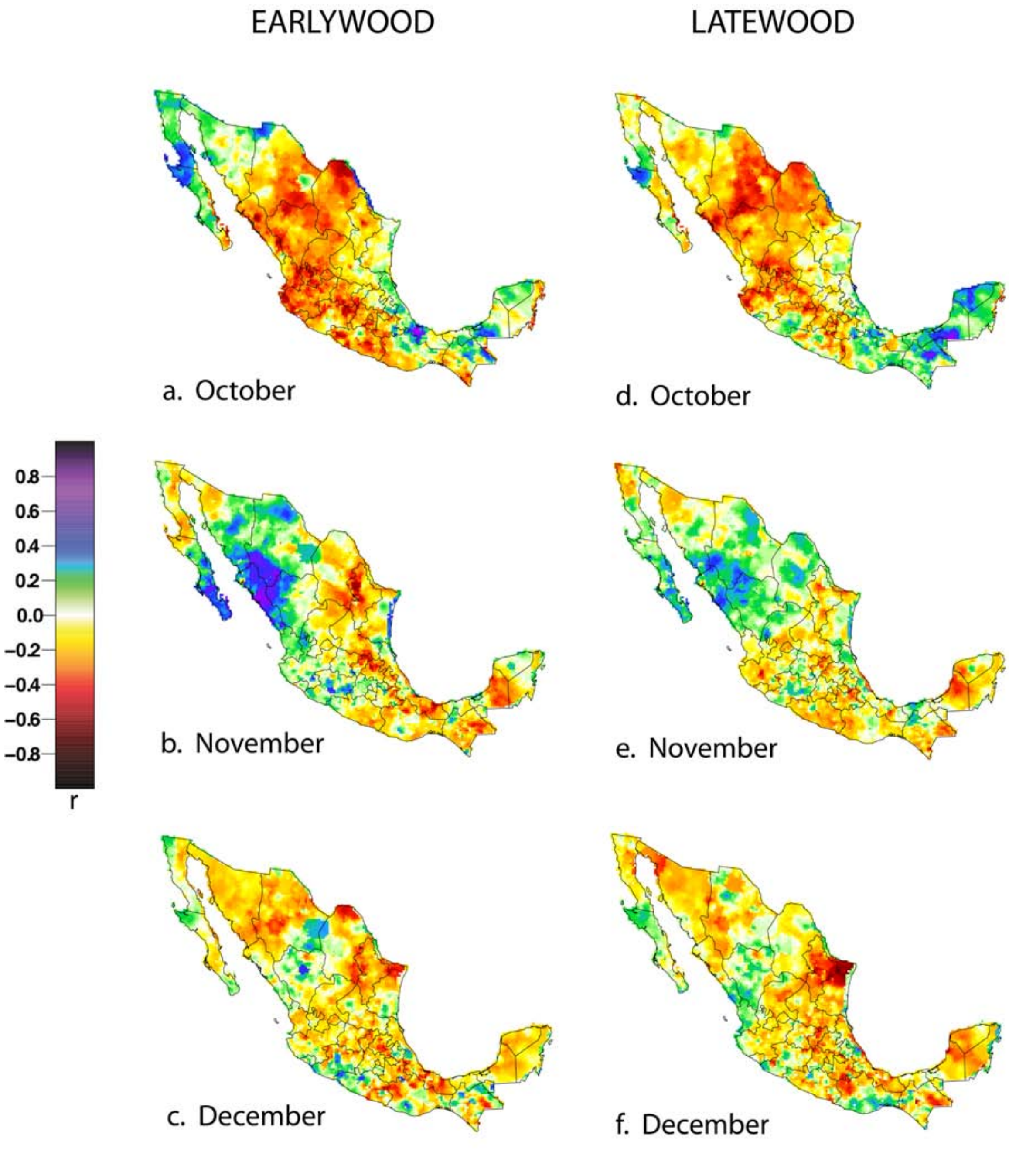


Figure 5. Same as Figure 2 for October-December. Douglas-fir in central Mexico are probably dormant during these months, so the precipitation signal is weak.

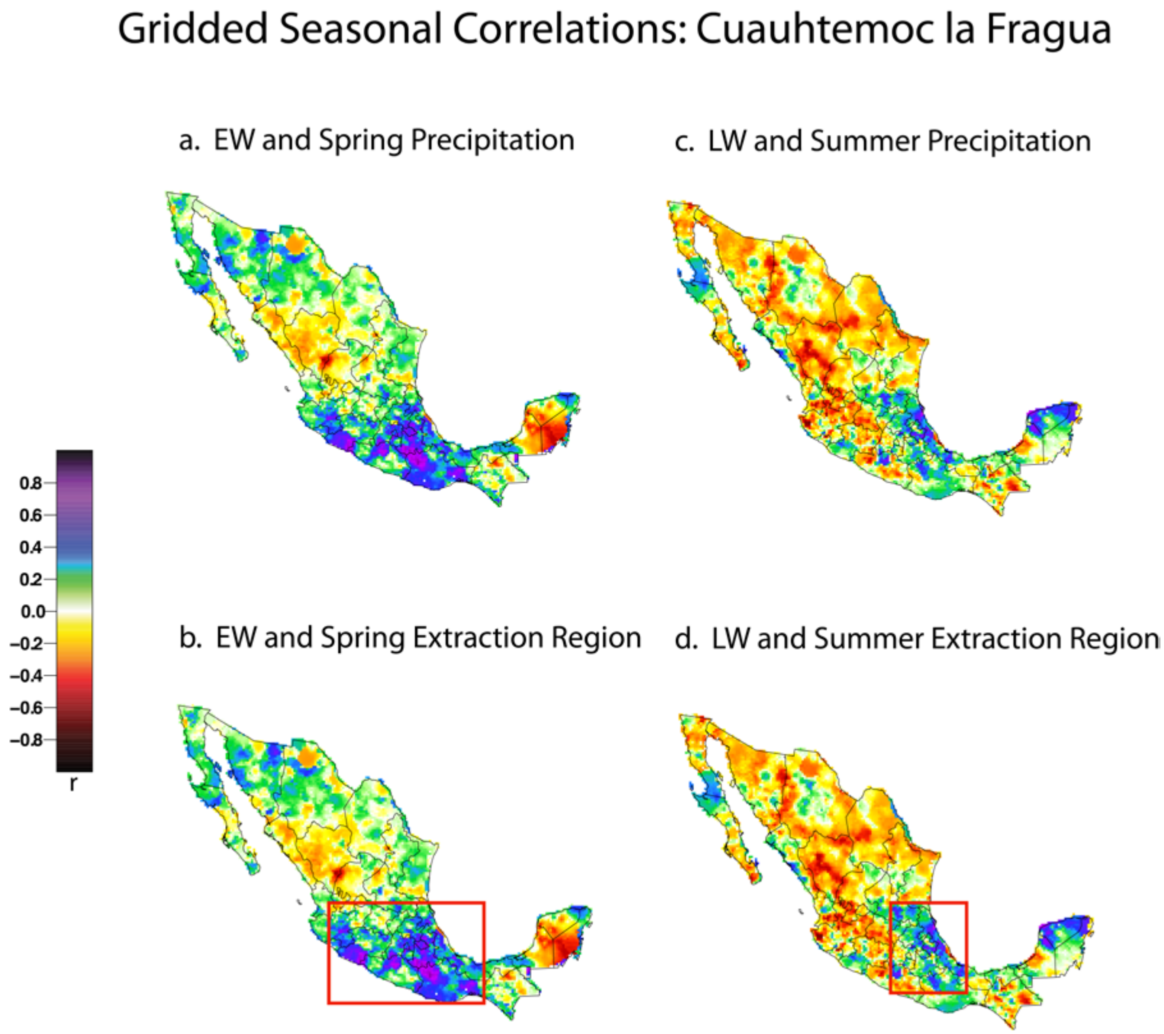


Figure 6. Correlations between Cuauhtémoc la Fragua and the gridded data from Zhu and Lettenmaier (2007) that were first seasonally averaged are displayed for the period 1950-1975. Spring precipitation data were composited for April-June (a) while summer data were composited for June-September (c). Notice the regions of strong correlation. Cuauhtémoc la Fragua has a strong spring signal in the EW across all of central and southern Mexico. The summer signal in the LW is more localized to east-central Mexico, perhaps as a result of more convective and localized summer precipitation. Extraction regions were delineated (b,d) and a correlation threshold of 0.40 imposed to average the gridded time series into seasonalized regional averages.

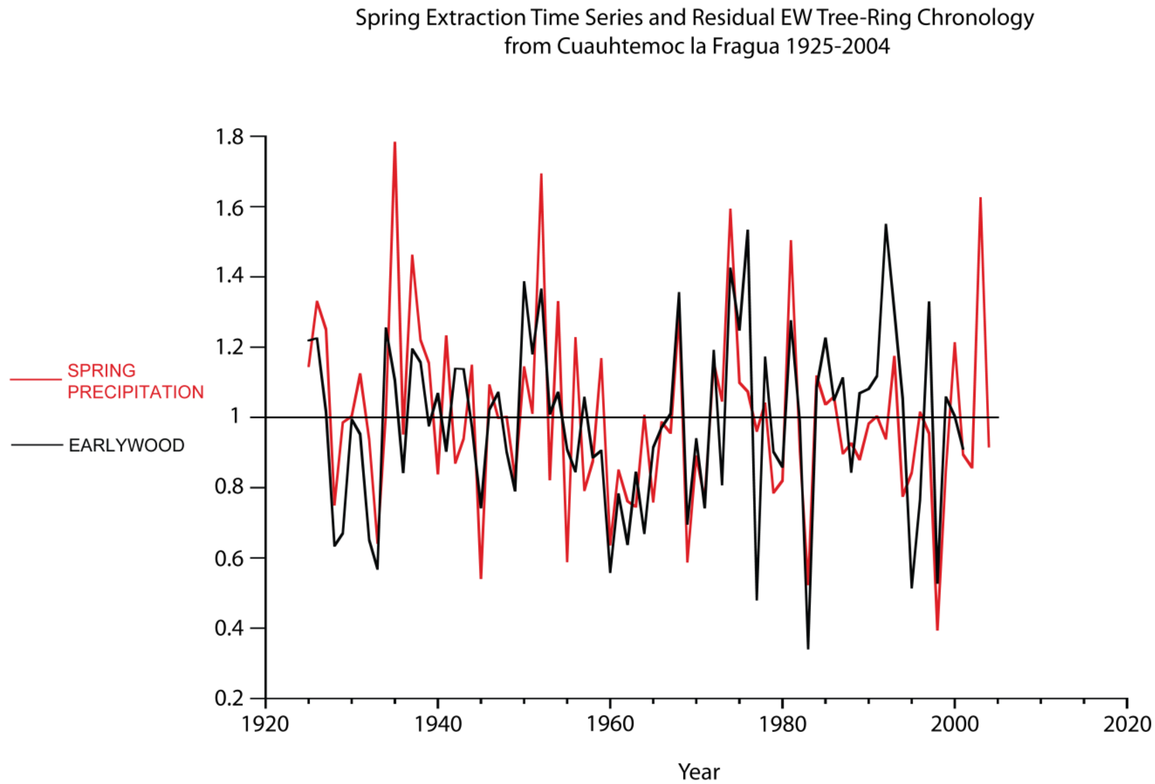


Figure 7. The time series extracted from the gridded data for spring (April-June) (red) spans 1925-2004, and the EW tree-ring chronology from Douglas-fir at Cuauhtémoc la Fragua (black) ends in 2001. The extraction was initially in units of total precipitation but was standardized for comparison with the EW indices (i.e., $-\bar{x}/sd$). The extracted record of precipitation represents a large region of central and southern Mexico (Fig. 6b). A high percentage of grid boxes within that region met the extraction threshold. For the entire 80 years of the data, the extracted spring precipitation time series correlates r = 0.60 with the EW chronology from Cuauhtémoc la Fragua, explaining some 36% of the variance. The agreement between the two jumps significantly if pre-1950 and post-1984 data are omitted (r = 0.70).

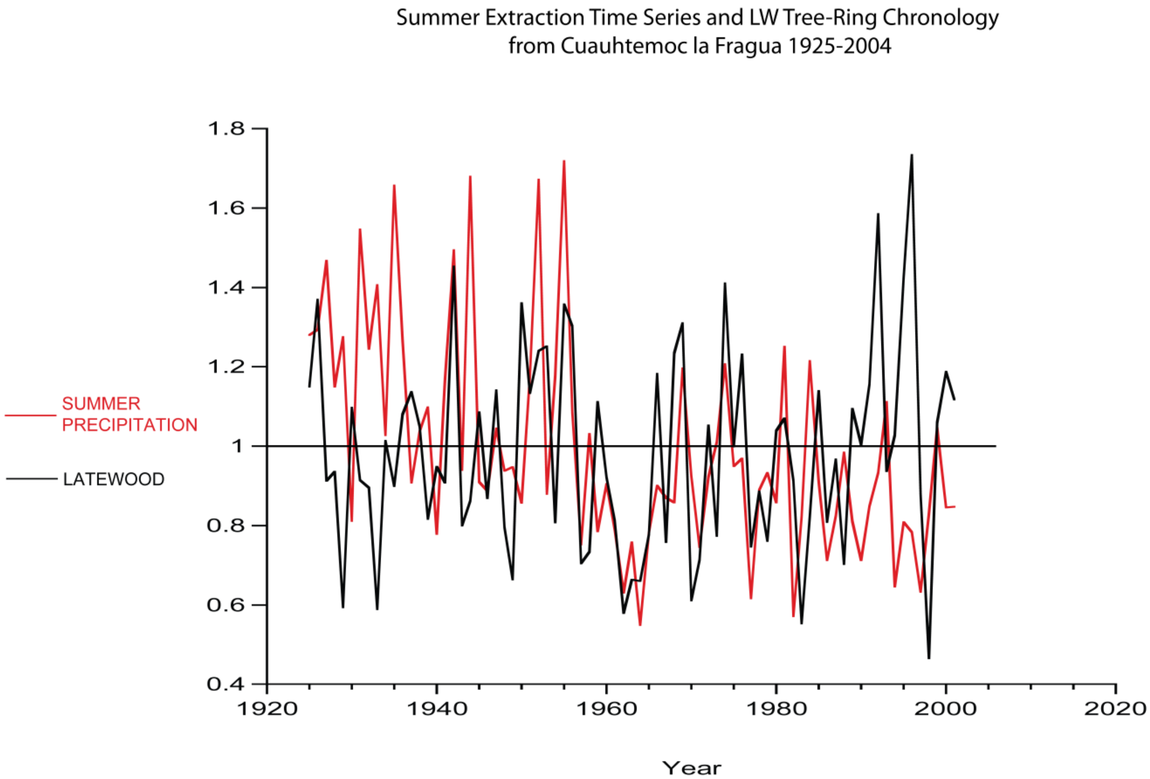


Figure 8. The time series extracted from the gridded data for summer (June-September) (red) spanning 1925-2004, and the LW tree-ring chronology from Douglas-fir at Cuauhtémoc la Fragua (black) are compared. The extraction was initially in units of total precipitation but was standardized for comparison with the LW indices. There is almost no summer precipitation signal in the LW before 1940, which causes overall correlation (r = .18) to be very low. The agreement between the data is poor near the end of the time series as well. The correlation jumps significantly between the two if pre-1950 and post-1984 data are omitted (r = .53). The summer extraction represents a much smaller area of central Mexico than the spring extraction as LW responded more locally to summer precipitation (Figure 6d).

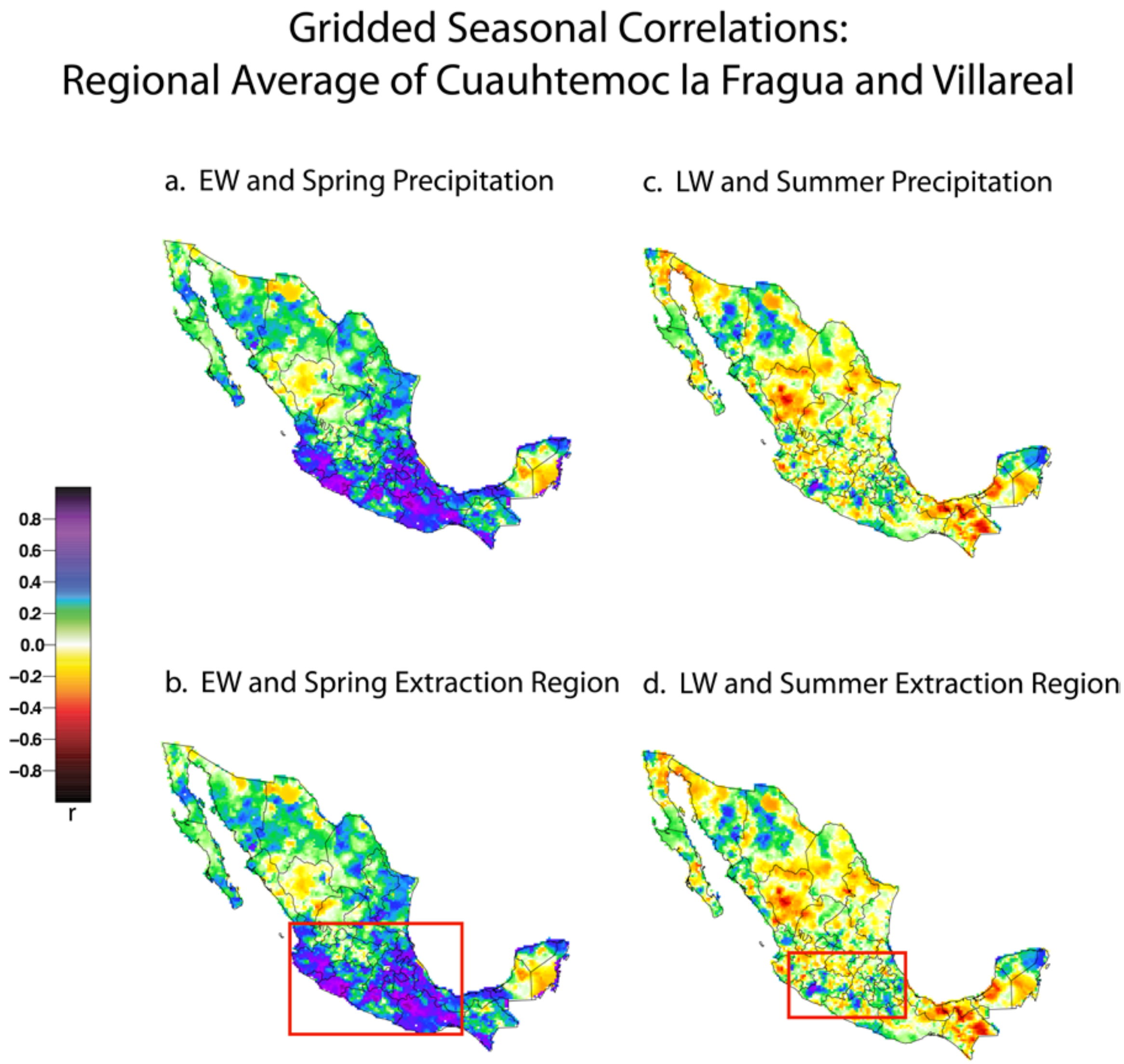


Figure 9. Correlations between the regional tree-ring chronology averaged from Cuauhtémoc la Fragua and Villareal and the gridded precipitation data from Zhu and Lettenmaier (2007) that were first seasonally averaged are displayed for the period 1950-1975. Spring precipitation data were averaged for April-June (a) while summer data were averaged for June-September (c). The two-chronology average displays an even stronger spring signal in the EW across all of central Mexico than exhibited using only Cuauhtémoc la Fragua. The summer signal in the LW strengthened in some areas, though correlations were more disjoint. The two-chronology average improves results from those attained with any single tree-ring chronology from the region. Extraction regions were delineated (b,d) and a correlation threshold of 0.40 imposed to average the gridded time series and create seasonalized regional averages.

Regional Average Spring Extraction Time Series and
EW Tree-Ring Chronology from Cuauhtemoc-Villareal Average 1925-2004

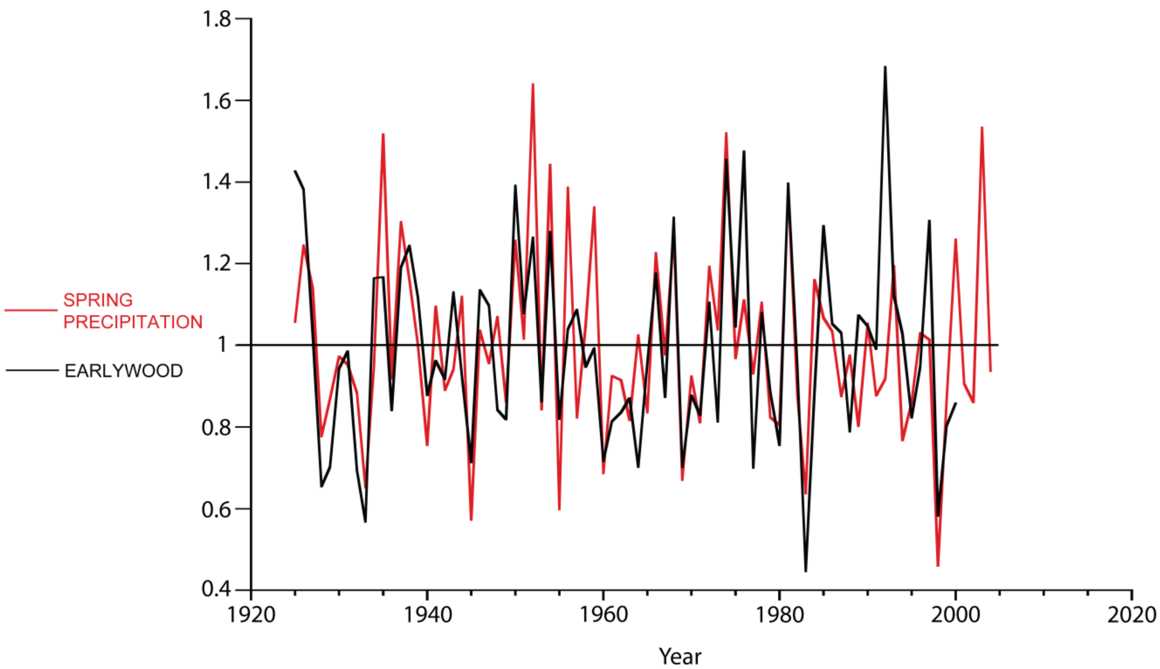


Figure 10. The time series extracted from the gridded data for EW averaged from Cuauhtémoc and Villareal correlated with spring precipitation (red) is compared here to the EW chronology averaged from the two sites (black). Again the extraction was standardized for comparison with the EW indices. The extracted record of precipitation represents an even larger region of central and southern Mexico than for the EW from Cuauhtémoc alone. Correlations are magnified as well by averaging the two sites. For the entire 80 years of the data, the extracted time series for spring precipitation over central Mexico correlates r = .64 with the EW chronology from Cuauhtémoc la Fragua and Villareal, explaining 41% of the variance. The agreement between the two jumps significantly if pre-1950 and post-1984 data are omitted (r = .75).

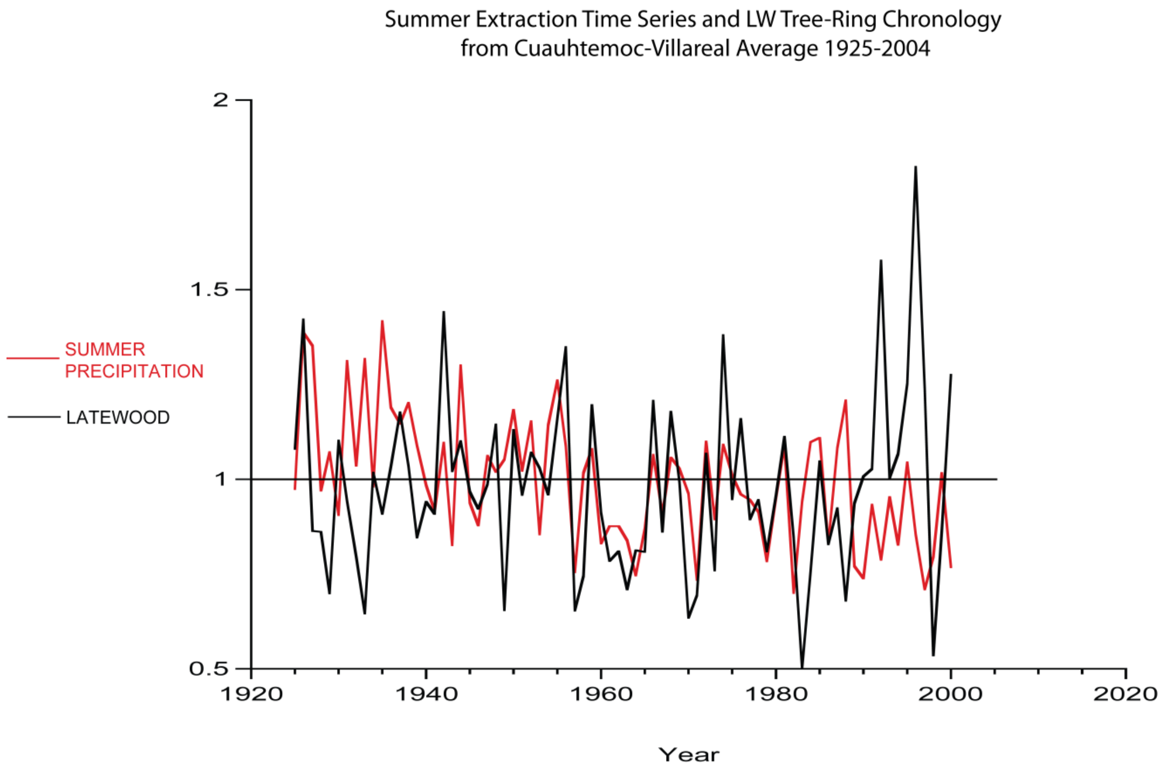


Figure 11. The regional LW chronology (black) from Cuauhtémoc la Fragua and Villareal is compared with summer precipitation (red) for central Mexico. The extracted precipitation (June-September) was standardized for comparison with the LW indices. Again the LW data before 1940 and after 1984 display poor response to summer precipitation. Overall correlation is surprisingly low (r = .13). The correlation jumps significantly between the two if pre-1950 and post-1984 data are omitted (r = .62).

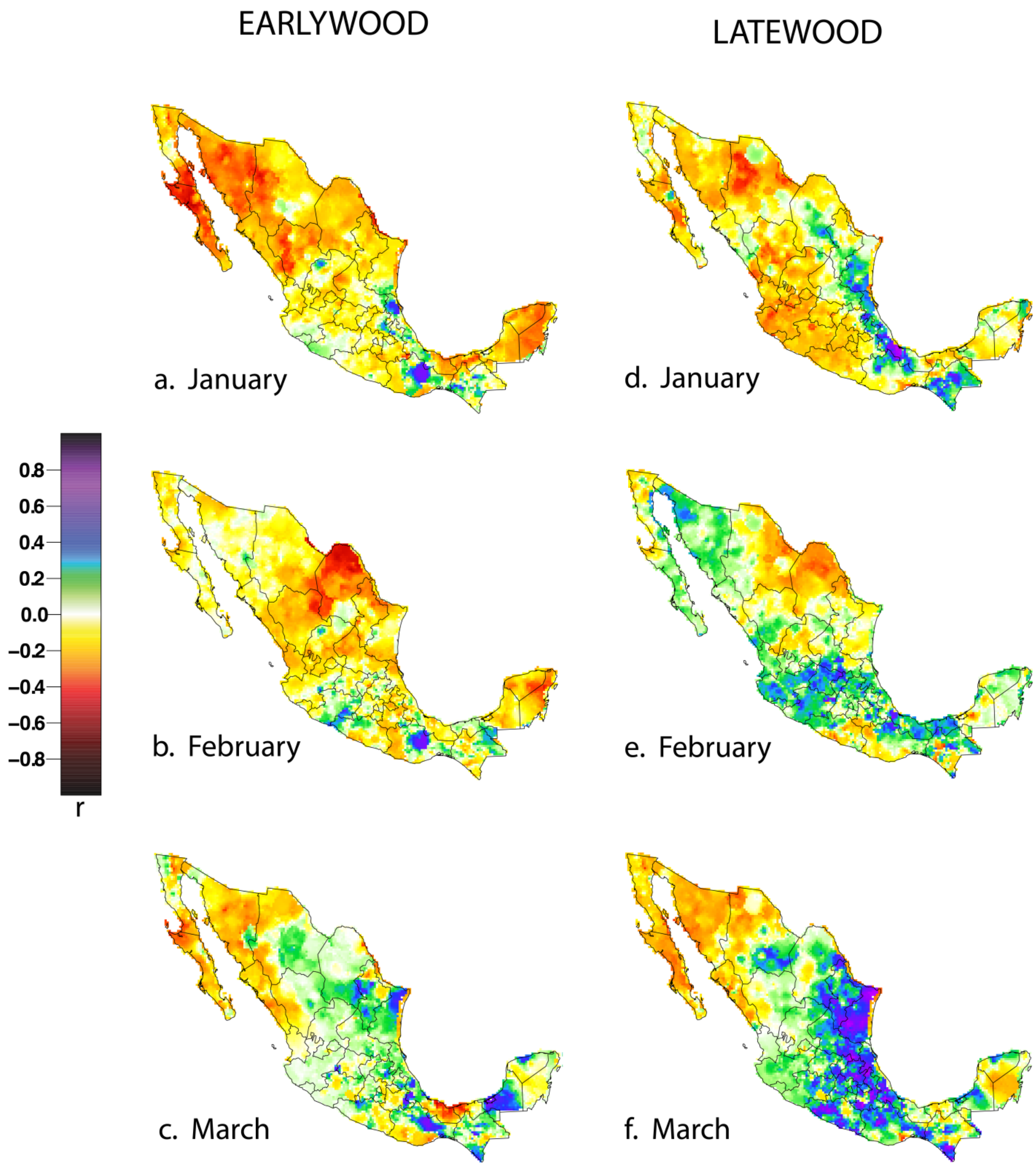
APPENDICES

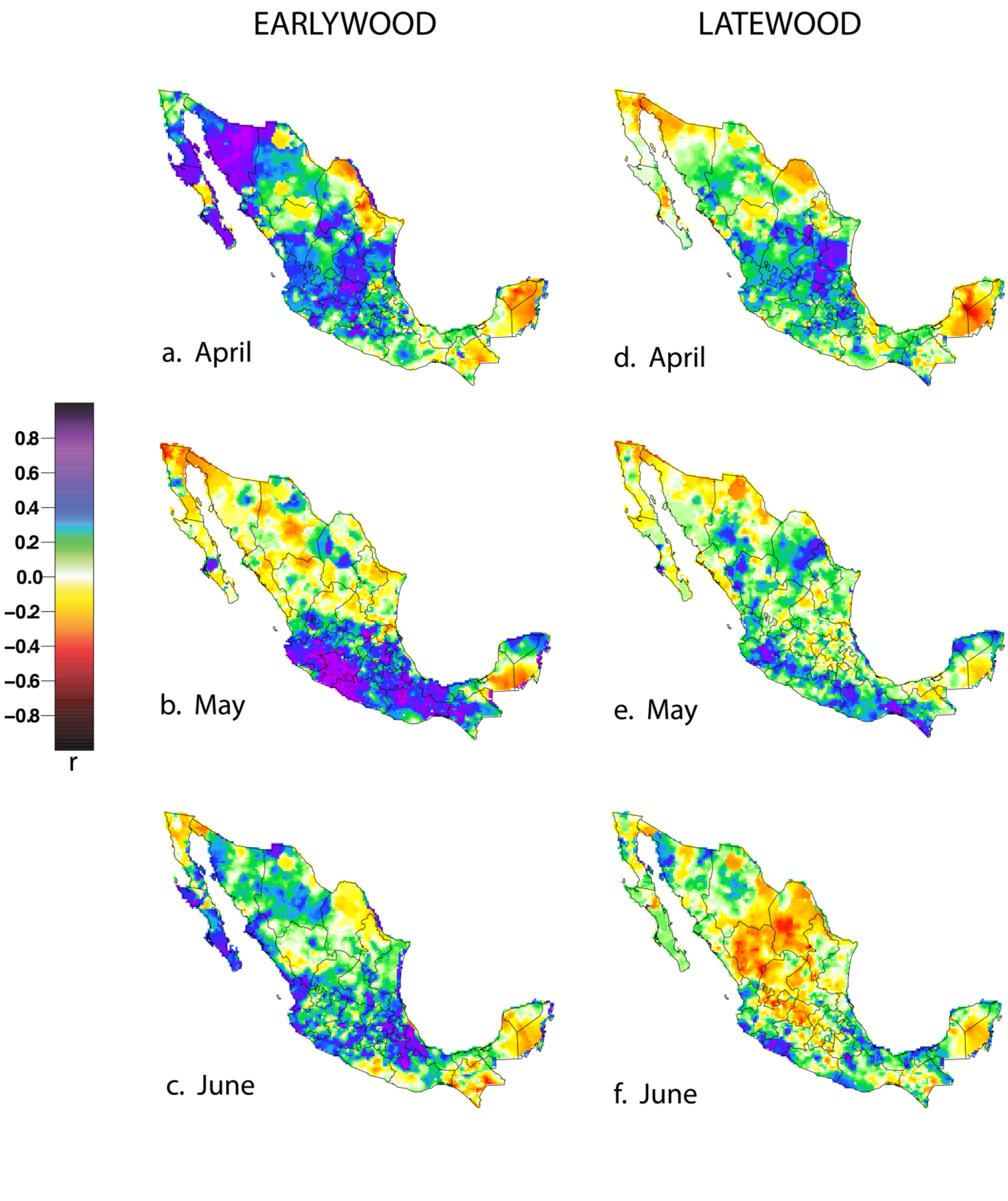
Appendix A

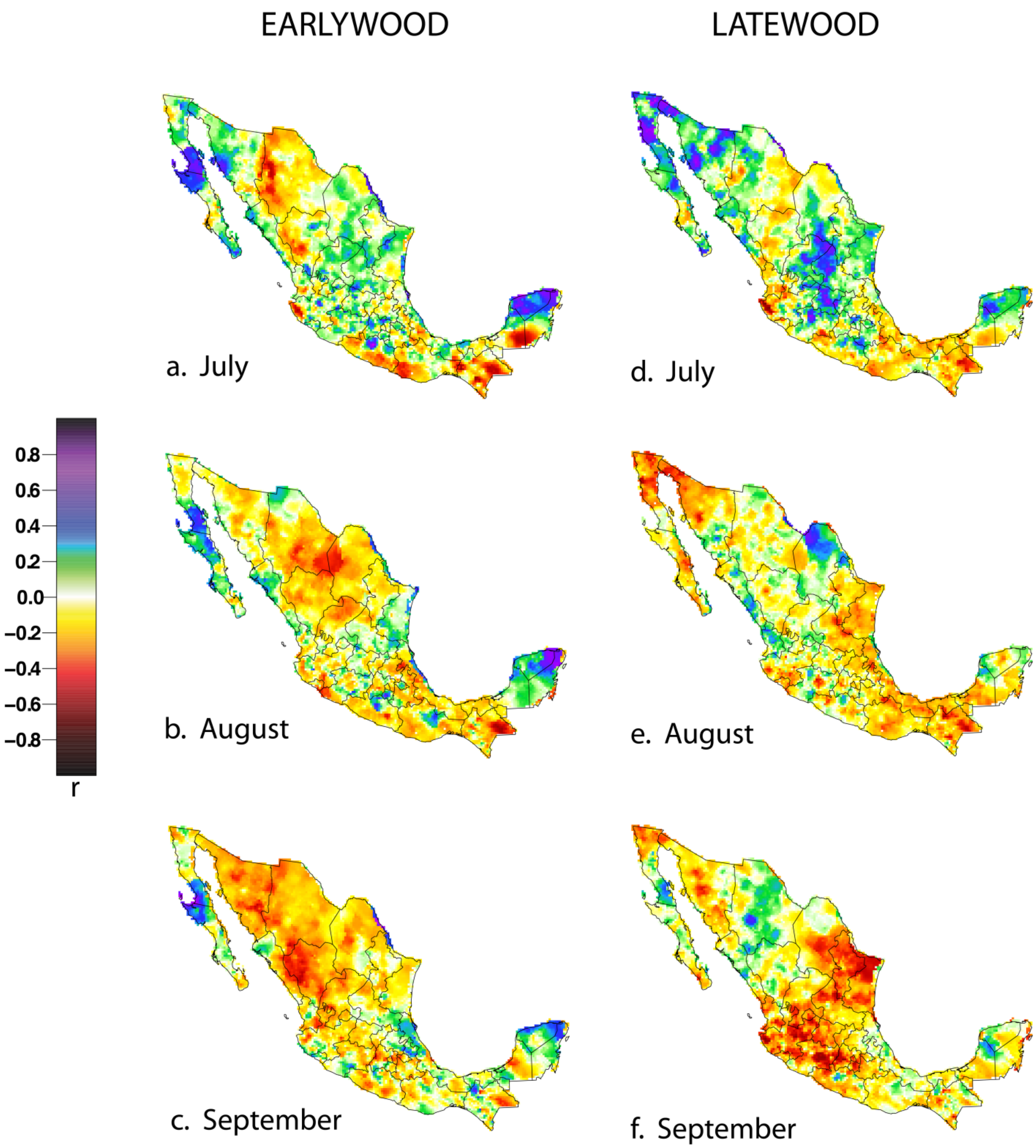
This is a catalogue of correlation maps created during analysis that were not included in the body of this paper. The maps show correlations between EW and LW tree-ring chronologies from Douglas fir in central Mexico and the gridded historical precipitation dataset created by Zhu and Lettenmaier (2007). Tree-ring sites in this appendix include El Malpaso (20.404° N, 98.467° W), Pinal de Amole (21.172° N, 99.702° W), Villareal (19.538° N, 97.881° W), and Cerro la Peña(17.163° N, 96.632° W). Only maps not included in the body of the paper are depicted in Appendix A.

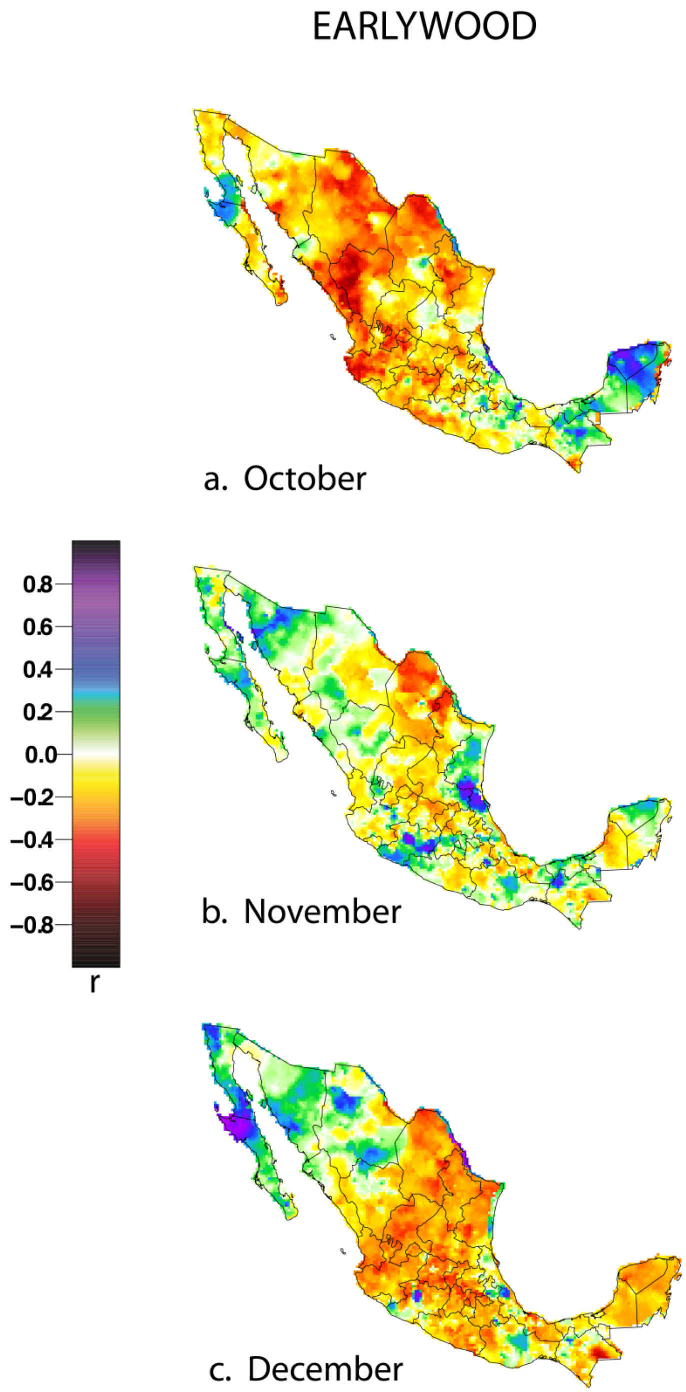
All sites in Appendix A show similar strong regional correlation between EW and spring precipitation (April, May, and June). Cerro la Peña and El Malpaso, though, demonstrate extremely weak regional correlation between LW and summer precipitation (June-September), with only a few small, localized pockets of positive correlation through those months. Pinal de Amole exhibits some strong regional LW signal with precipitation in August, but July and September are especially weak and even negatively correlated. The monthly correlations depicted here for Villareal are suggestive of its utility in creating a regional average tree-ring chronology capable of modeling separate seasonal climate signals. Though there is significant common signal between EW and LW at Villareal, there is very strong regional correlation between EW and spring precipitation and meaningful regional correlation between LW and June, July, and September precipitation.

El Malpaso:

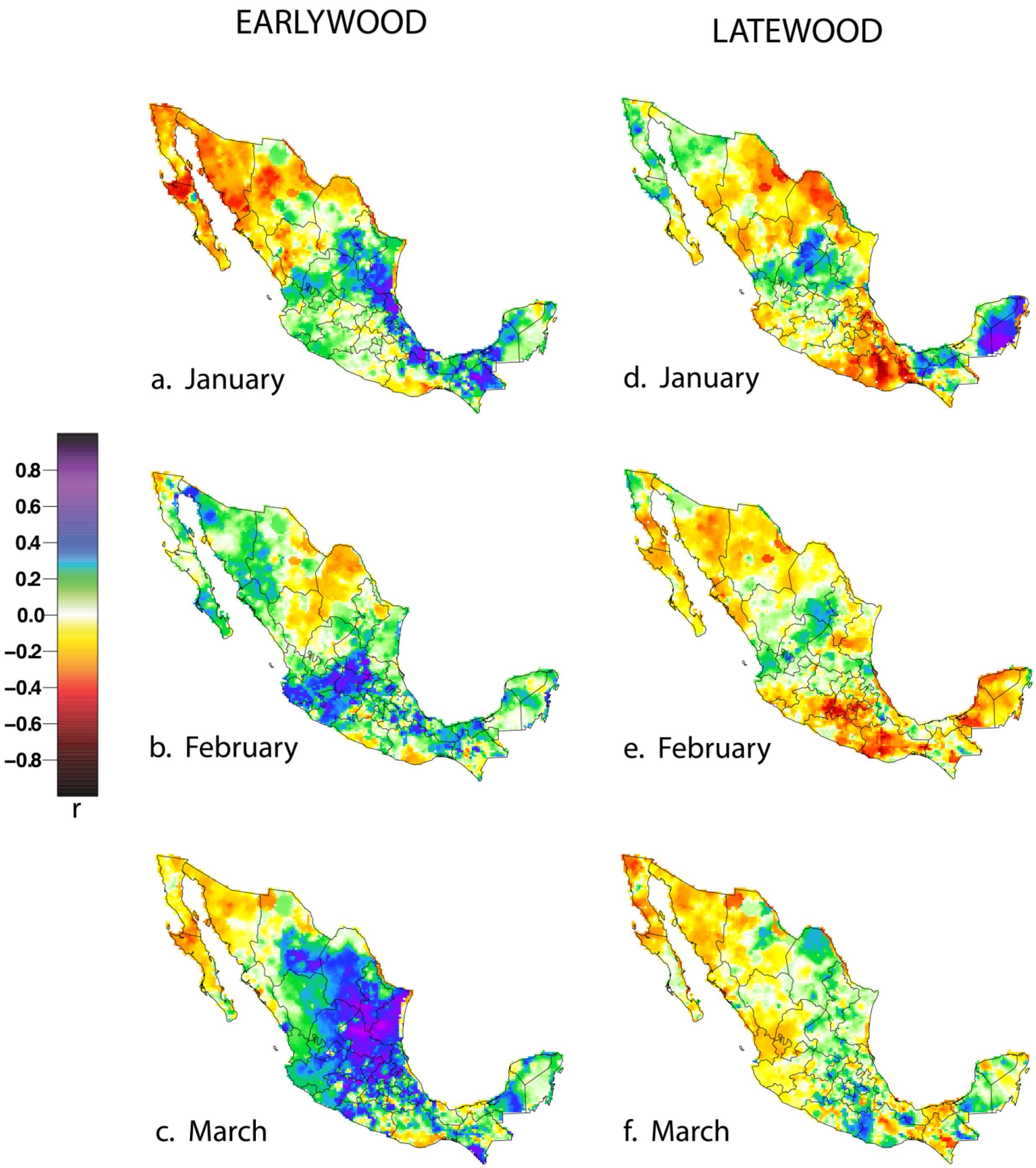

EARLYWOOD
LATEWOOD
a. January
b. February
c. March
d. January
e. February
f. March
0.8
0.6
0.4
0.2
0.0
−0.2
−0.4
−0.6
−0.8
r

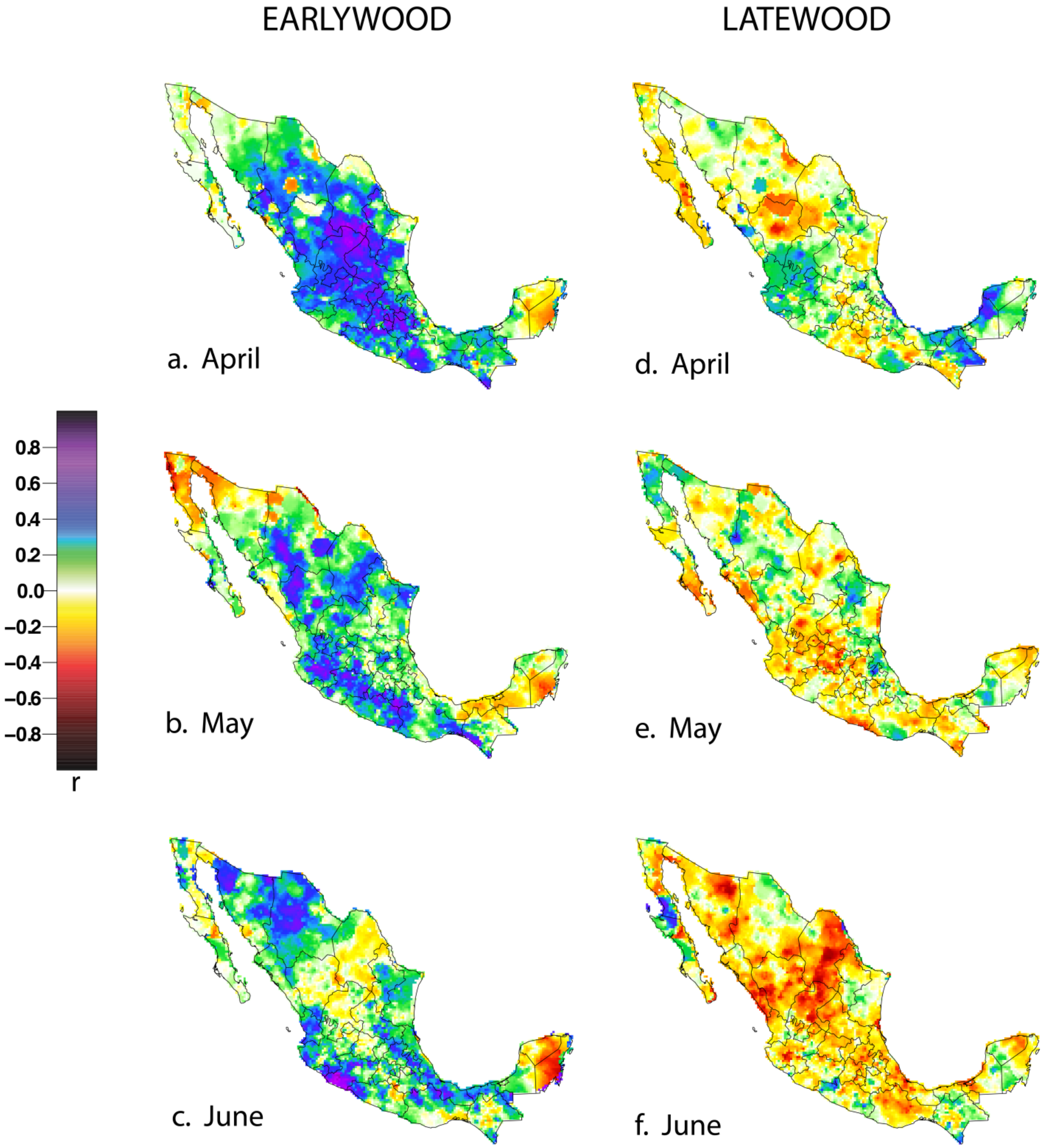

EARLYWOOD
LATEWOOD
a. April
d. April
b. May
e. May
c. June
f. June
0.8
0.6
0.4
0.2
0.0
–0.2
–0.4
–0.6
–0.8
r

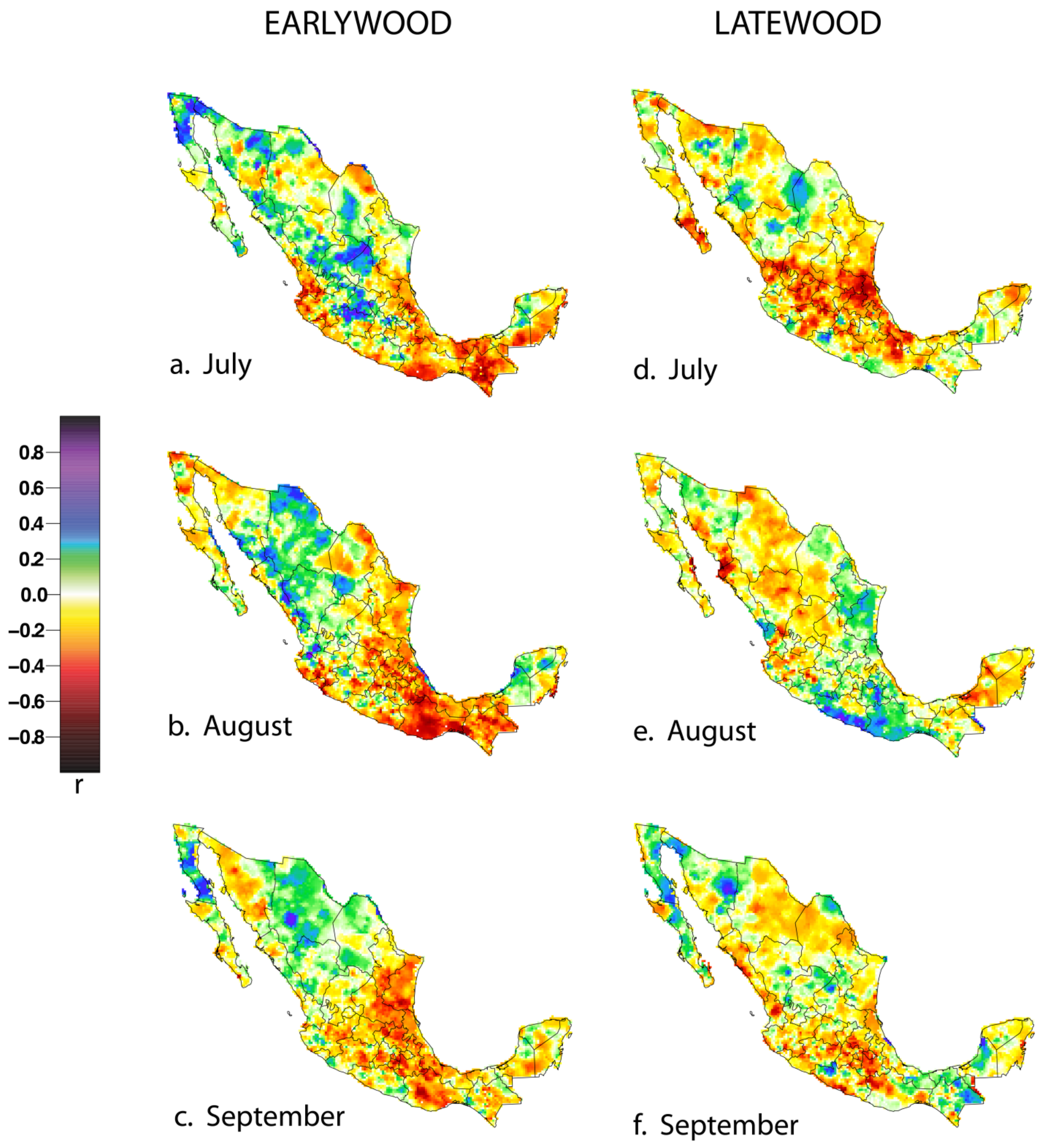

EARLYWOOD
LATEWOOD
a. July
d. July
b. August
e. August
c. September
f. September
0.8
0.6
0.4
0.2
0.0
−0.2
−0.4
−0.6
−0.8
r

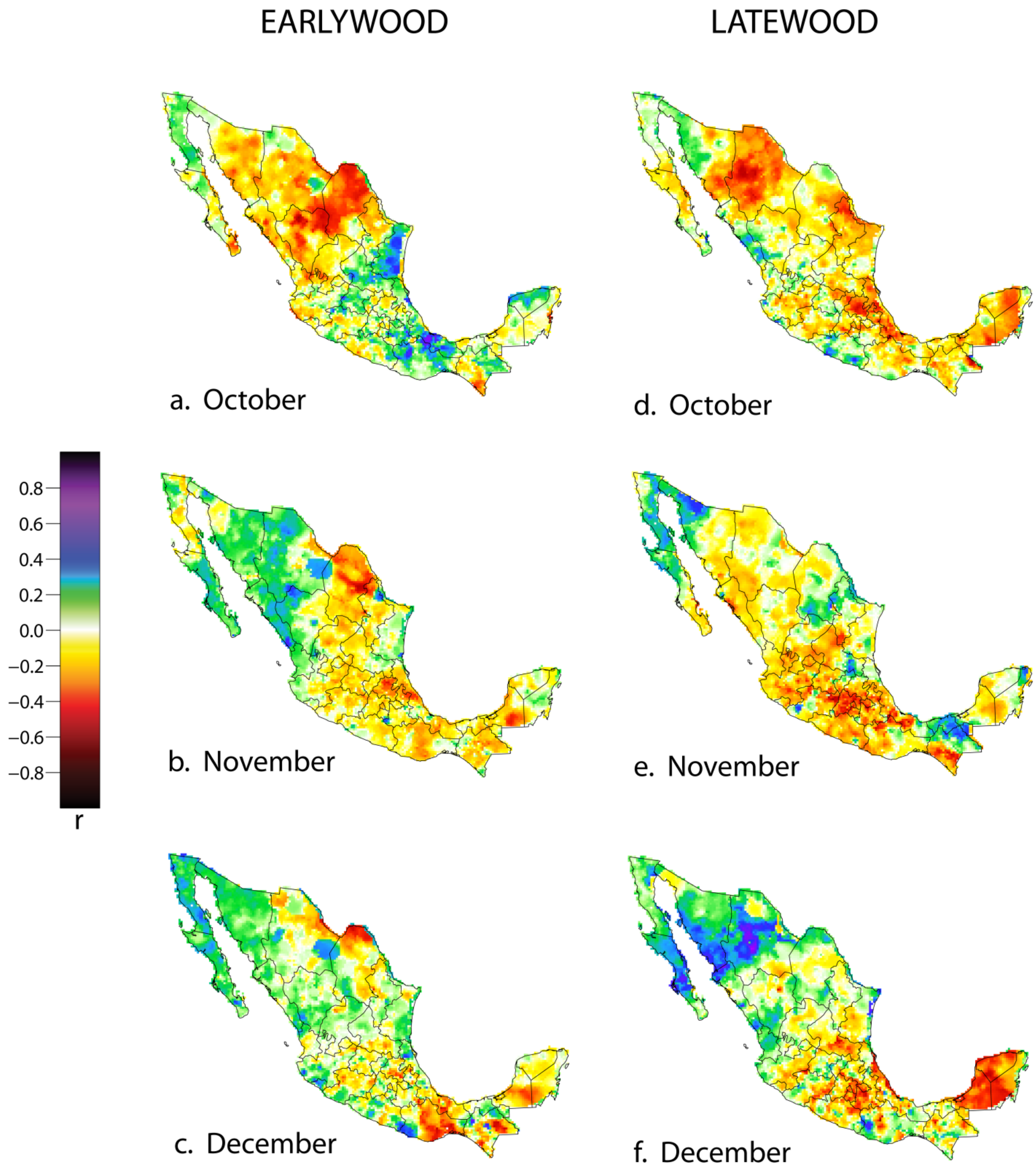

EARLYWOOD
LATEWOOD
a. October
d. October
b. November
e. November
c. December
f. December
0.8
0.6
0.4
0.2
0.0
−0.2
−0.4
−0.6
−0.8
r

Pinal de Amole:

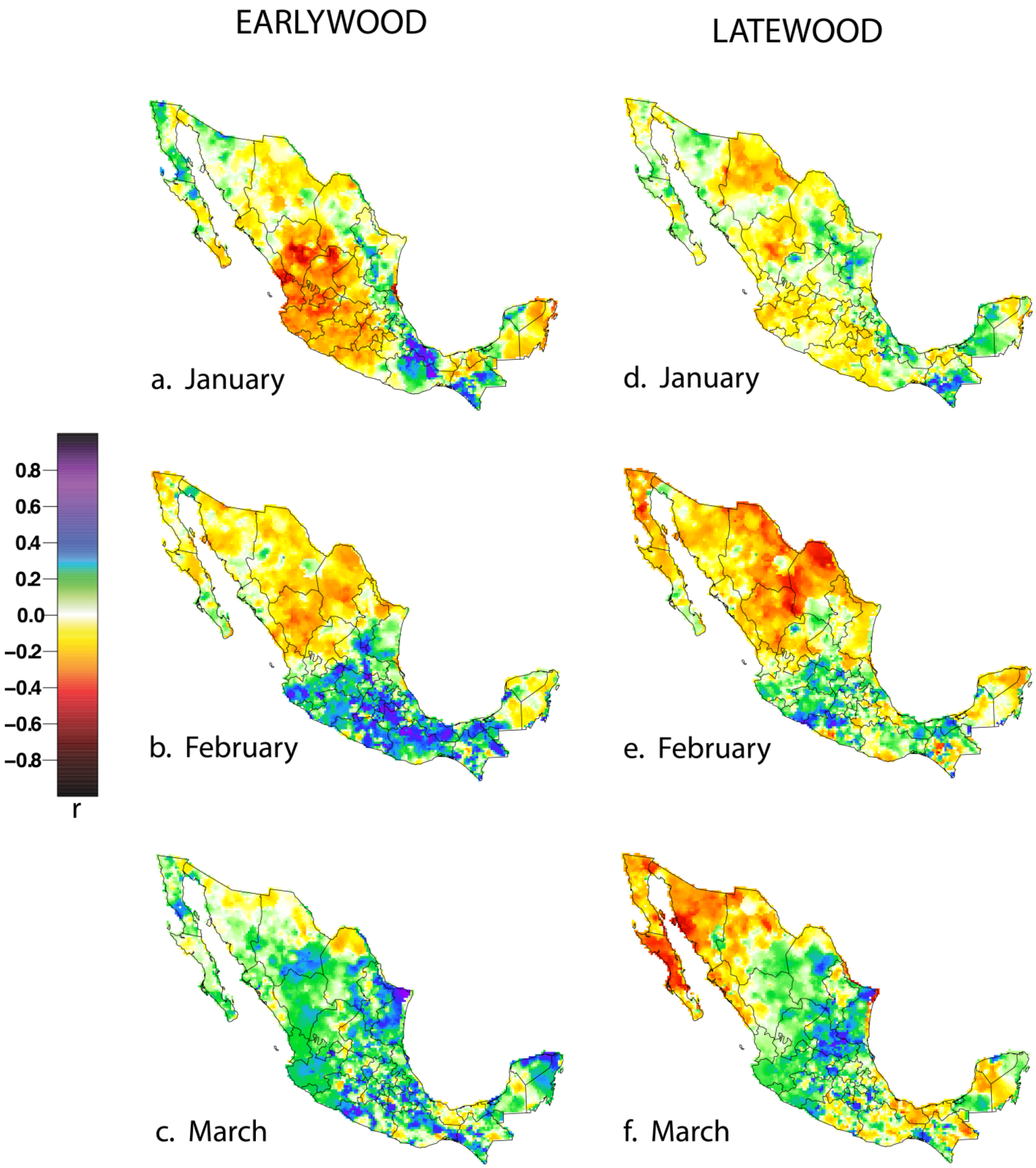



EARLYWOOD
LATEWOOD
0.8
0.6
0.4
0.2
0.0
−0.2
−0.4
−0.6
−0.8
r
a. April
b. May
c. June
d. April
e. May
f. June


EARLYWOOD
LATEWOOD
a. July
d. July
b. August
e. August
c. September
f. September
0.8
0.6
0.4
0.2
0.0
−0.2
−0.4
−0.6
−0.8
r


EARLYWOOD
LATEWOOD
a. October
d. October
b. November
e. November
c. December
f. December
0.8
0.6
0.4
0.2
0.0
−0.2
−0.4
−0.6
−0.8
r

Villareal: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LATEWOOD
a. January
d. January
b. February
e. February
c. March
f. March
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0.6
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0.2
0.0
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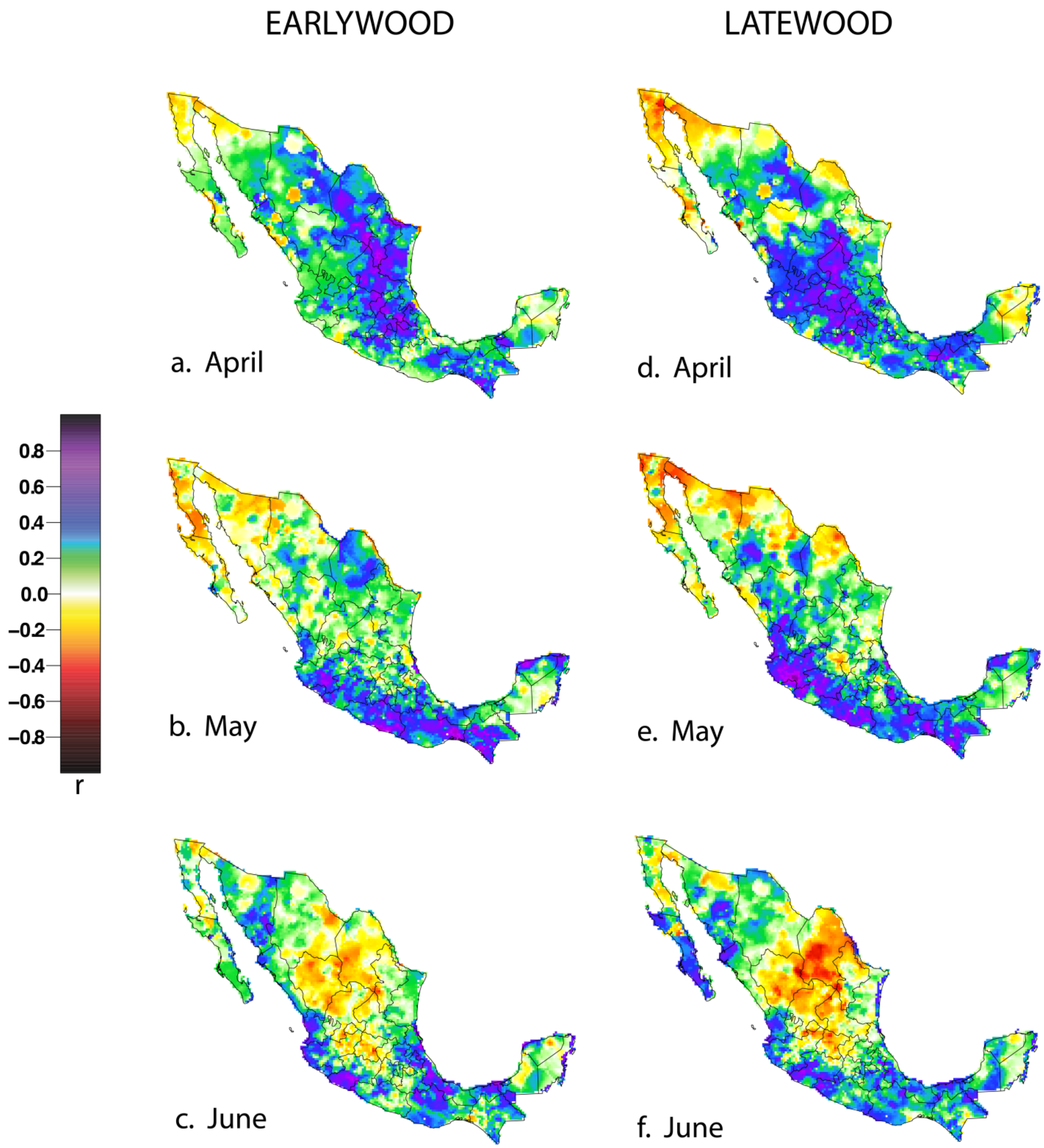
−0.4
−0.6
−0.8
r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LATEWOOD
a. April
b. May
c. June
d. April
e. May
f. June
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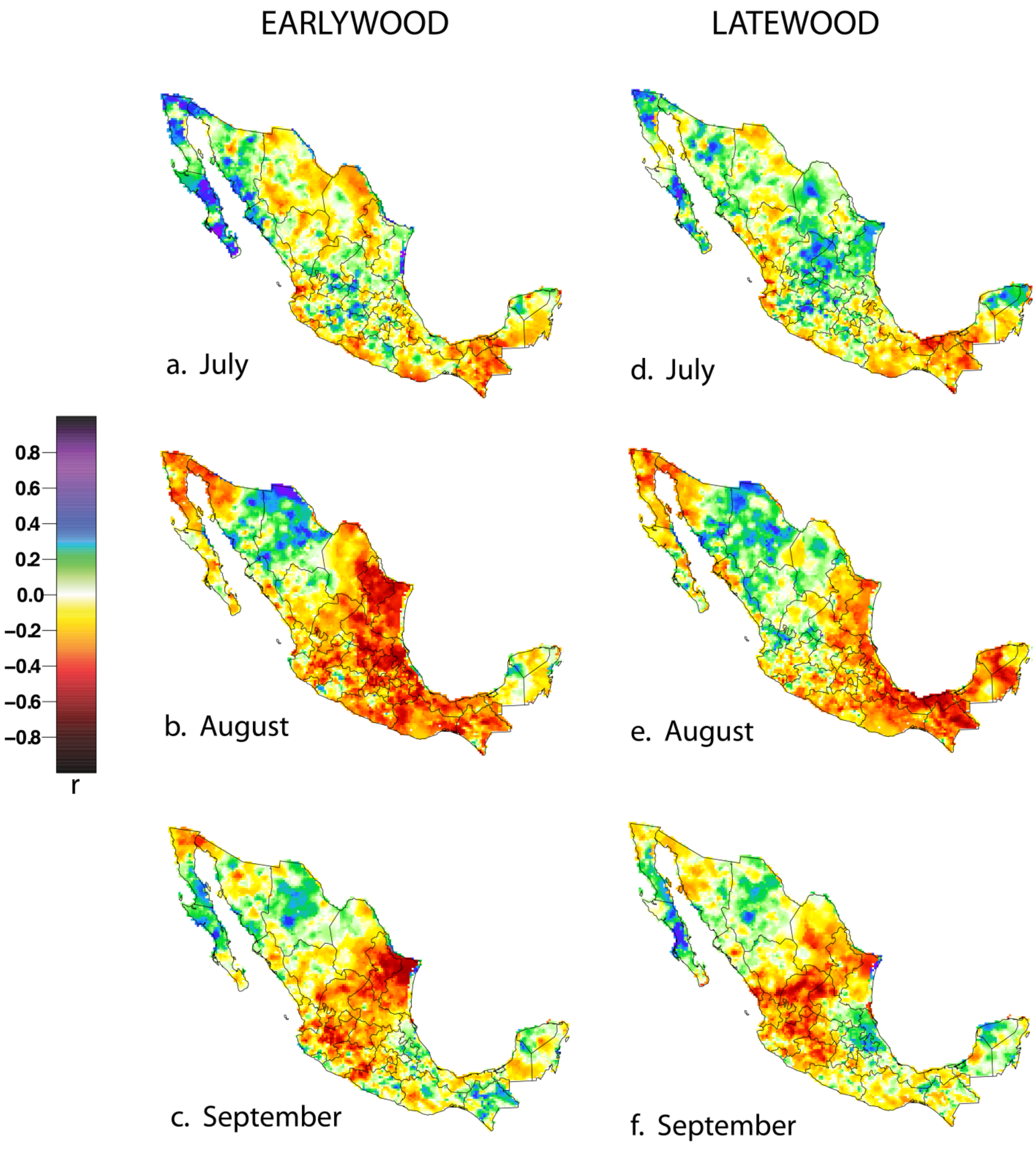
0.6
0.4
0.2
0.0
–0.2
–0.4
–0.6
–0.8
r


EARLYWOOD
LATEWOOD
a. July
d. July
b. August
e. August
c. September
f. September
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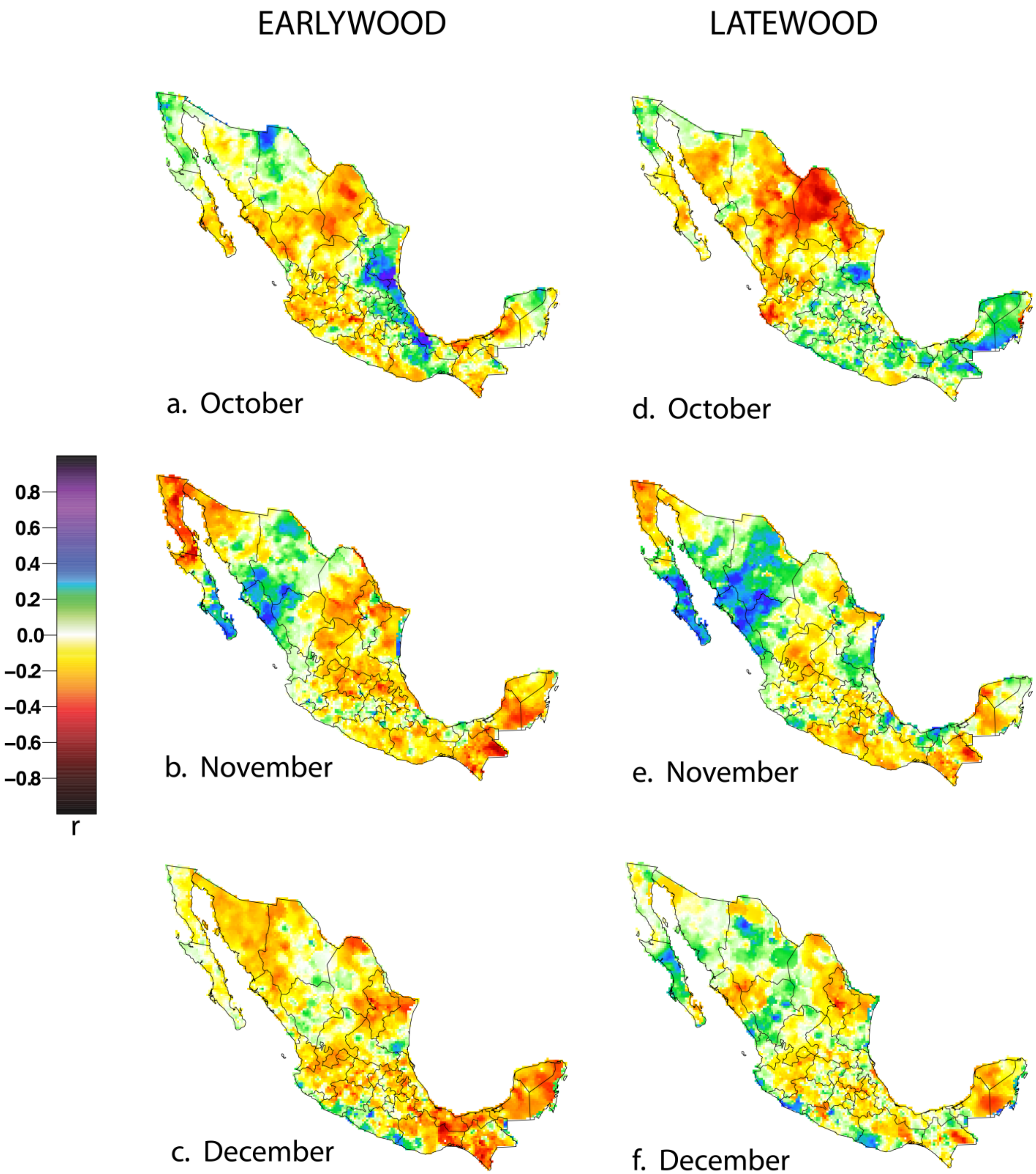
0.6
0.4
0.2
0.0
–0.2
–0.4
–0.6
–0.8
r


EARLYWOOD
LATEWOOD
a. October
d. October
b. November
e. November
c. December
f. December
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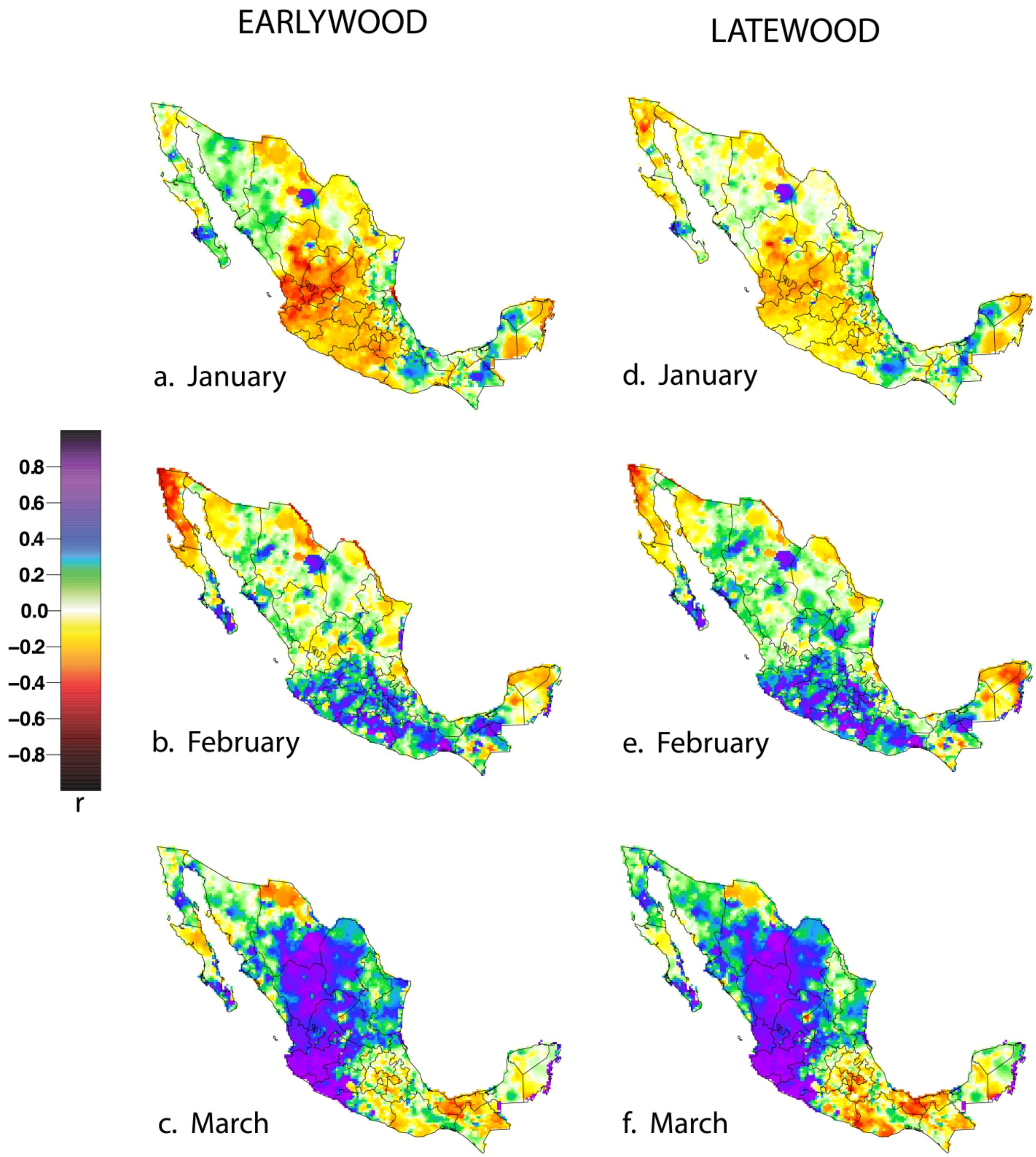
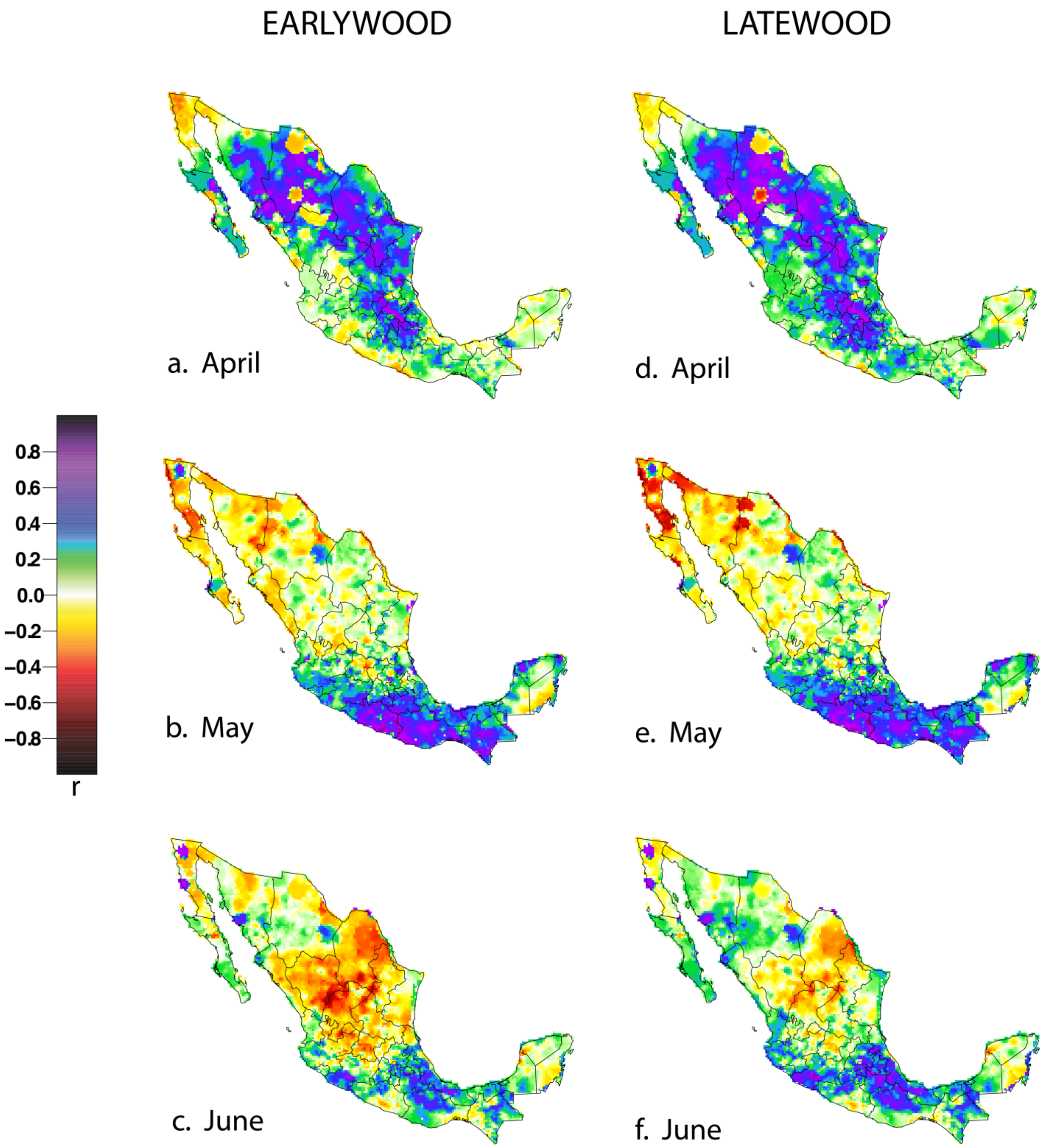
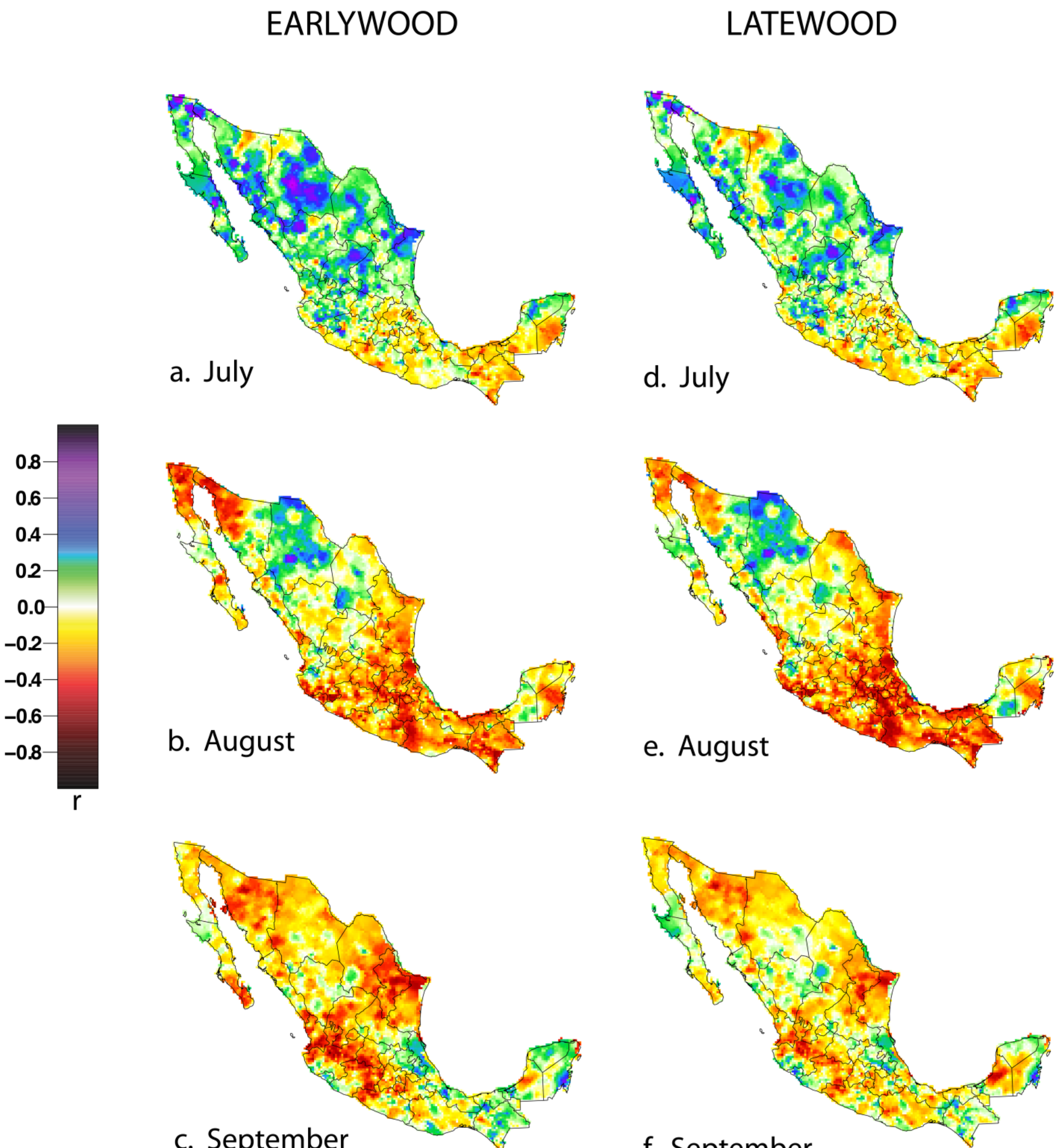
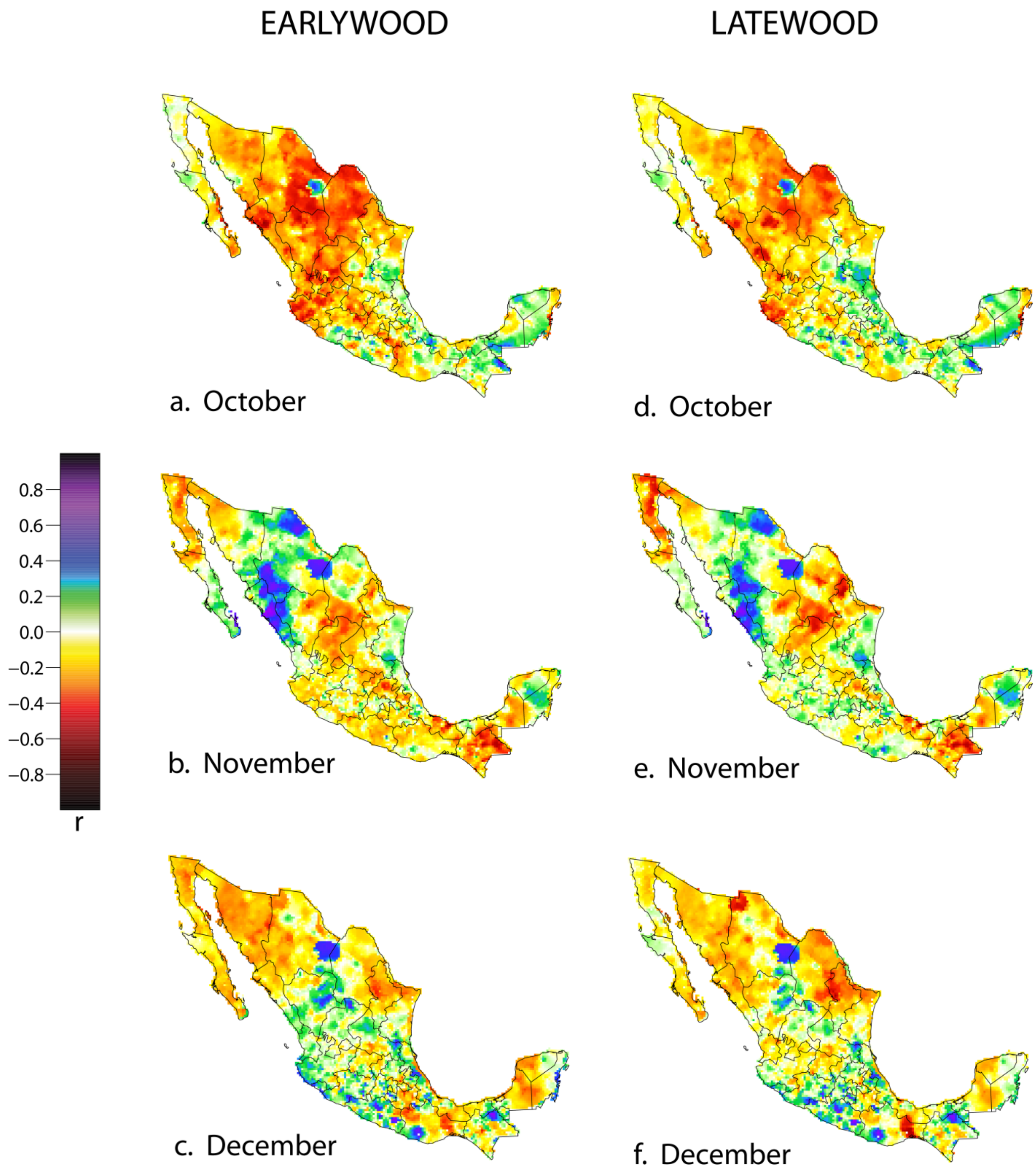
0.6
0.4
0.2
0.0
−0.2
−0.4
−0.6
−0.8
r

Cerro la Peña:



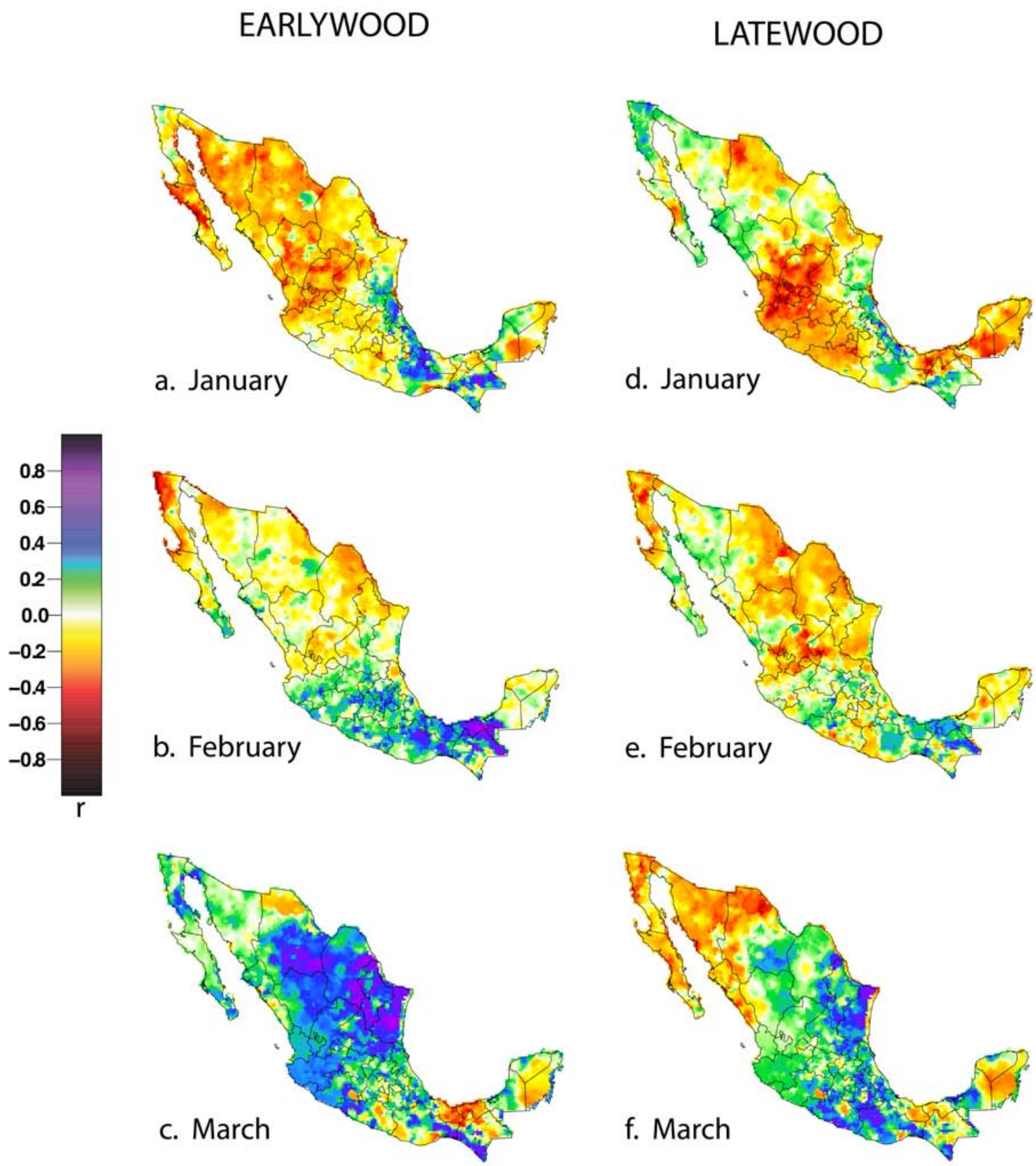

EARLYWOOD
LATEWOOD
a. April
b. May
c. June
d. April
e. May
f. June
0.8
0.6
0.4
0.2
0.0
−0.2
−0.4
−0.6
−0.8
r

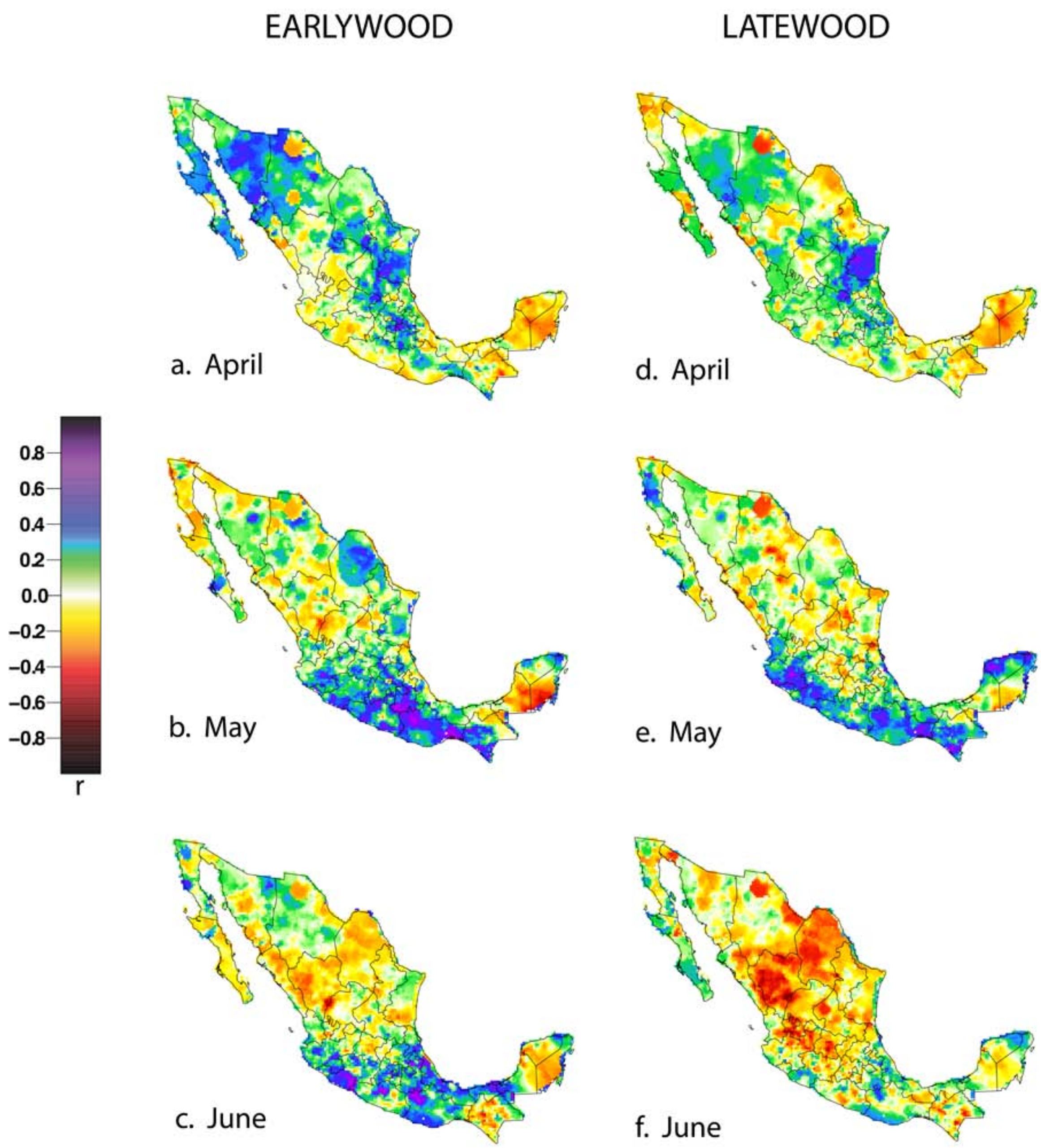

EARLYWOOD
LATEWOOD
a. July
b. August
c. September
d. July
e. August
f. September
0.8
0.6
0.4
0.2
0.0
–0.2
–0.4
–0.6
–0.8
r

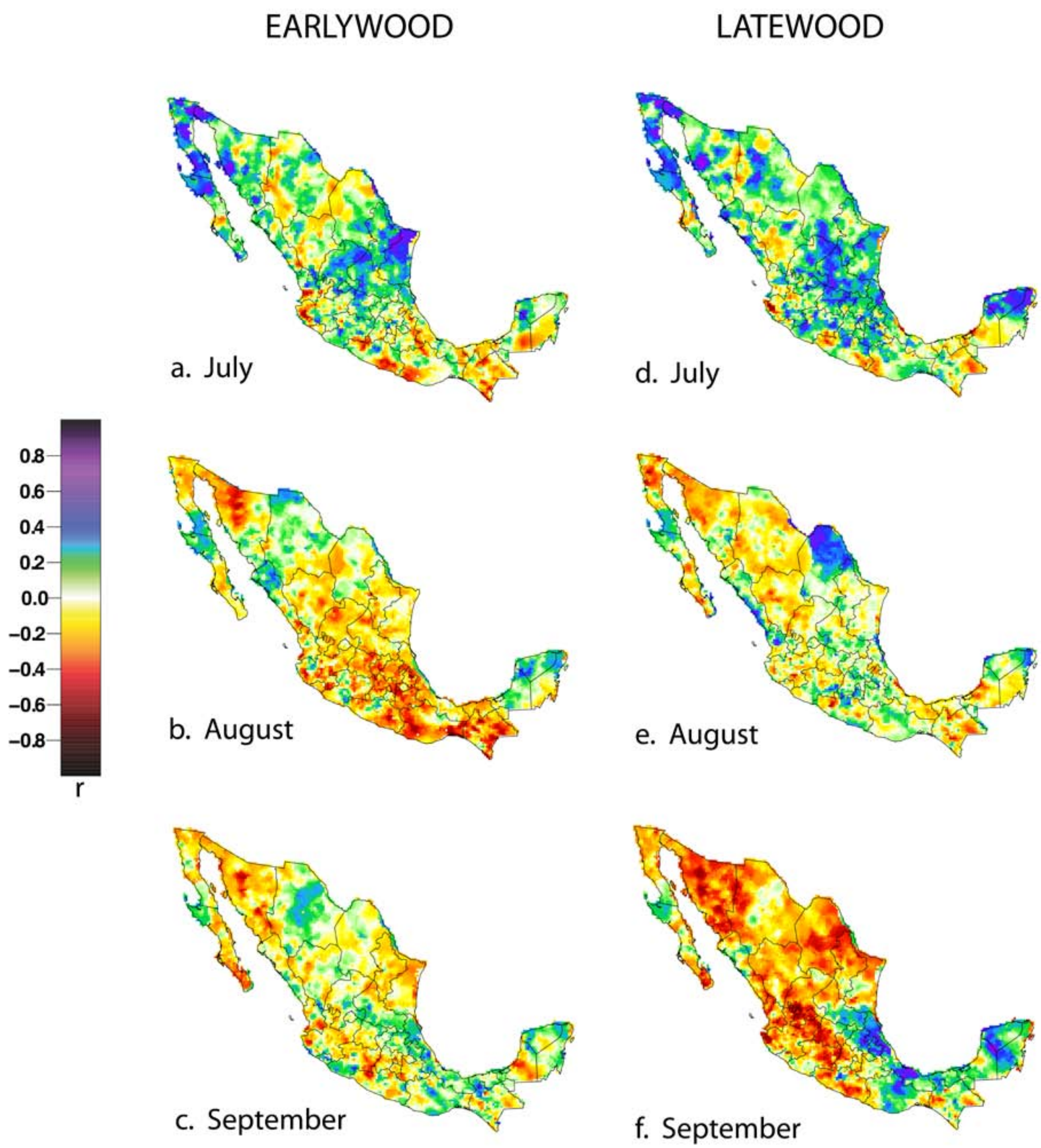


EARLYWOOD
LATEWOOD
a. October
d. October
b. November
e. November
c. December
f. December
0.8
0.6
0.4
0.2
0.0
−0.2
−0.4
−0.6
−0.8
r

Cuauhtémoc la Fragua:




EARLYWOOD
LATEWOOD
a. April
b. May
c. June
d. April
e. May
f. June
0.8
0.6
0.4
0.2
0.0
−0.2
−0.4
−0.6
−0.8
r


EARLYWOOD
LATEWOOD
a. July
b. August
c. September
d. July
e. August
f. September
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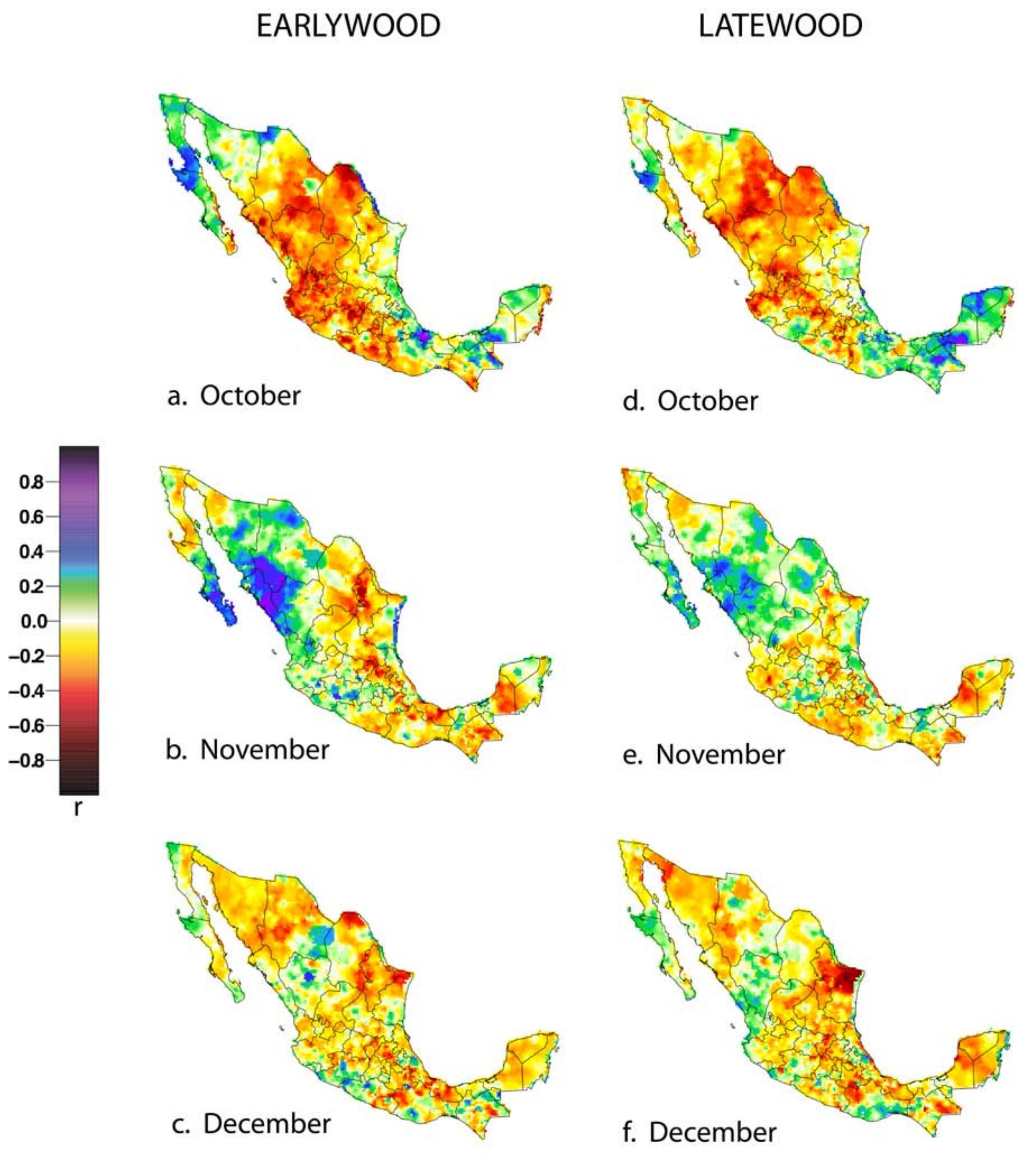
0.6
0.4
0.2
0.0
−0.2
−0.4
−0.6
−0.8
r


EARLYWOOD
LATEWOOD
a. October
d. October
b. November
e. November
c. December
f. December
0.8
0.6
0.4
0.2
0.0
−0.2
−0.4
−0.6
−0.8
r

Appendix B

This is a list of the grid points extracted from the Zhu and Lettenmaier (2007) gridded precipitation dataset for the calculation of spring (April-May) and summer (June-September) regional precipitation series for central Mexico (see Figures 7, 8, 10, and 11). Grid points listed in the log fall within the respective extraction zones, and their correlation coefficient values surpassed the designated threshold value of r = 0.40. Time series from each of the qualifying grid points were averaged together into a single time series representing precipitation for the extraction region. The list catalogs the geographic coordinates of each qualifying grid point and includes the correlation between each grid point's precipitation time series and the respective tree-ring chronologies.

Appendix Table B1. Qualifying Extraction Region Grid Points from Correlation of EW and Spring Precipitation at Cuauhtémoc la Fragua

Point	Latitude	Longitude	r-value
68	15.68750	-96.18750	0.4060000
72	15.68750	-96.68750	0.4310000
88	15.81250	-96.06250	0.4060000
89	15.81250	-96.18750	0.4030000
93	15.81250	-96.68750	0.4210000
94	15.81250	-96.81250	0.4710000
95	15.81250	-96.93750	0.4380000
96	15.81250	-97.06250	0.4410000
117	15.93750	-95.93750	0.4370000
118	15.93750	-96.06250	0.4270000
119	15.93750	-96.18750	0.4030000
123	15.93750	-96.68750	0.4200000
124	15.93750	-96.81250	0.4540000
125	15.93750	-96.93750	0.4800000
126	15.93750	-97.06250	0.4530000
127	15.93750	-97.18750	0.4430000
128	15.93750	-97.31250	0.4250000
129	15.93750	-97.43750	0.4150000

Cont.

130	15.93750	-97.56250	0.4690000
131	15.93750	-97.68750	0.4690000
132	15.93750	-97.81250	0.4820000
156	16.06250	-95.81250	0.4190000
157	16.06250	-95.93750	0.4380000
158	16.06250	-96.06250	0.4230000
163	16.06250	-96.68750	0.4080000
164	16.06250	-96.81250	0.4480000
165	16.06250	-96.93750	0.4650000
166	16.06250	-97.06250	0.4210000
167	16.06250	-97.18750	0.4300000
168	16.06250	-97.31250	0.4390000
169	16.06250	-97.43750	0.4300000
170	16.06250	-97.56250	0.4510000
171	16.06250	-97.68750	0.4650000
172	16.06250	-97.81250	0.4500000
206	16.18750	-94.43750	0.4530000
207	16.18750	-94.56250	0.4640000
208	16.18750	-94.68750	0.5330000
209	16.18750	-94.81250	0.4910000
210	16.18750	-94.93750	0.4580000
224	16.18750	-96.68750	0.4050000
225	16.18750	-96.81250	0.4230000
226	16.18750	-96.93750	0.4030000
228	16.18750	-97.18750	0.4240000
229	16.18750	-97.31250	0.4250000
230	16.18750	-97.43750	0.4190000
231	16.18750	-97.56250	0.4280000
232	16.18750	-97.68750	0.4360000
233	16.18750	-97.81250	0.4320000
234	16.18750	-97.93750	0.4100000
235	16.18750	-98.06250	0.4050000
236	16.18750	-98.18750	0.4220000
269	16.31250	-94.43750	0.4240000
270	16.31250	-94.56250	0.4730000
271	16.31250	-94.68750	0.5120000
272	16.31250	-94.81250	0.5220000
273	16.31250	-94.93750	0.4820000
274	16.31250	-95.06250	0.5030000
275	16.31250	-95.18750	0.4120000
288	16.31250	-96.81250	0.4150000
291	16.31250	-97.18750	0.4080000
292	16.31250	-97.31250	0.4130000
293	16.31250	-97.43750	0.4780000
294	16.31250	-97.56250	0.4210000
295	16.31250	-97.68750	0.4460000
296	16.31250	-97.81250	0.4030000
297	16.31250	-97.93750	0.4050000
298	16.31250	-98.06250	0.4290000
299	16.31250	-98.18750	0.4560000
300	16.31250	-98.31250	0.4260000
335	16.43750	-94.43750	0.4030000
337	16.43750	-94.68750	0.4580000
338	16.43750	-94.81250	0.5140000
339	16.43750	-94.93750	0.5260000
340	16.43750	-95.06250	0.5720000
342	16.43750	-95.31250	0.4590000
343	16.43750	-95.43750	0.4470000
344	16.43750	-95.56250	0.4250000
358	16.43750	-97.31250	0.4060000
359	16.43750	-97.43750	0.4190000
361	16.43750	-97.68750	0.4140000

Cont.

362	16.43750	-97.81250	0.4570000
363	16.43750	-97.93750	0.4140000
364	16.43750	-98.06250	0.4450000
365	16.43750	-98.18750	0.4980000
366	16.43750	-98.31250	0.4900000
367	16.43750	-98.43750	0.4610000
404	16.56250	-94.81250	0.4520000
405	16.56250	-94.93750	0.5150000
406	16.56250	-95.06250	0.5100000
407	16.56250	-95.18750	0.6310000
408	16.56250	-95.31250	0.5790000
409	16.56250	-95.43750	0.4660000
410	16.56250	-95.56250	0.4120000
423	16.56250	-97.18750	0.4120000
424	16.56250	-97.31250	0.4040000
425	16.56250	-97.43750	0.4050000
426	16.56250	-97.56250	0.4400000
427	16.56250	-97.68750	0.4390000
429	16.56250	-97.93750	0.4290000
430	16.56250	-98.06250	0.4510000
431	16.56250	-98.18750	0.5100000
432	16.56250	-98.31250	0.5300000
433	16.56250	-98.43750	0.5160000
434	16.56250	-98.56250	0.4110000
470	16.68750	-94.56250	0.4100000
471	16.68750	-94.68750	0.4500000
472	16.68750	-94.81250	0.5030000
473	16.68750	-94.93750	0.5870000
474	16.68750	-95.06250	0.6040000
475	16.68750	-95.18750	0.6120000
476	16.68750	-95.31250	0.5900000
477	16.68750	-95.43750	0.5800000
478	16.68750	-95.56250	0.4700000
479	16.68750	-95.68750	0.4090000
490	16.68750	-97.06250	0.4060000
491	16.68750	-97.18750	0.4370000
492	16.68750	-97.31250	0.4270000
493	16.68750	-97.43750	0.4460000
494	16.68750	-97.56250	0.4090000
495	16.68750	-97.68750	0.4190000
498	16.68750	-98.06250	0.4150000
499	16.68750	-98.18750	0.4820000
500	16.68750	-98.31250	0.5210000
501	16.68750	-98.43750	0.4610000
542	16.81250	-94.56250	0.4150000
543	16.81250	-94.68750	0.5490000
544	16.81250	-94.81250	0.6180000
545	16.81250	-94.93750	0.5710000
546	16.81250	-95.06250	0.6240000
547	16.81250	-95.18750	0.5630000
548	16.81250	-95.31250	0.4900000
549	16.81250	-95.43750	0.5640000
550	16.81250	-95.56250	0.5150000
558	16.81250	-96.56250	0.4270000
562	16.81250	-97.06250	0.4450000
563	16.81250	-97.18750	0.4910000
564	16.81250	-97.31250	0.4830000
565	16.81250	-97.43750	0.4690000
571	16.81250	-98.18750	0.4230000
572	16.81250	-98.31250	0.4740000
616	16.93750	-94.56250	0.5180000
617	16.93750	-94.68750	0.6020000

Cont.

618	16.93750	-94.81250	0.6630000
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620	16.93750	-95.06250	0.5670000
621	16.93750	-95.18750	0.4760000
623	16.93750	-95.43750	0.4720000
624	16.93750	-95.56250	0.4130000
631	16.93750	-96.43750	0.4100000
632	16.93750	-96.56250	0.4560000
633	16.93750	-96.68750	0.4600000
634	16.93750	-96.81250	0.4500000
635	16.93750	-96.93750	0.4670000
636	16.93750	-97.06250	0.5050000
637	16.93750	-97.18750	0.5470000
638	16.93750	-97.31250	0.5930000
639	16.93750	-97.43750	0.4980000
640	16.93750	-97.56250	0.4100000
694	17.06250	-94.68750	0.4180000
695	17.06250	-94.81250	0.5560000
696	17.06250	-94.93750	0.4880000
697	17.06250	-95.06250	0.4630000
698	17.06250	-95.18750	0.4400000
699	17.06250	-95.31250	0.4100000
701	17.06250	-95.56250	0.4110000
708	17.06250	-96.43750	0.4100000
709	17.06250	-96.56250	0.4700000
710	17.06250	-96.68750	0.4650000
711	17.06250	-96.81250	0.4820000
712	17.06250	-96.93750	0.5050000
713	17.06250	-97.06250	0.4960000
714	17.06250	-97.18750	0.5260000
715	17.06250	-97.31250	0.6310000
716	17.06250	-97.43750	0.6060000
717	17.06250	-97.56250	0.4850000
718	17.06250	-97.68750	0.4620000
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797	17.18750	-97.81250	0.4980000
798	17.18750	-97.93750	0.4250000
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870	17.31250	-96.68750	0.4140000
871	17.31250	-96.81250	0.4690000
872	17.31250	-96.93750	0.5030000
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874	17.31250	-97.18750	0.6940000
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876	17.31250	-97.43750	0.7200000
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878	17.31250	-97.68750	0.7170000
879	17.31250	-97.81250	0.6130000
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Cont.

945	17.43750	-95.56250	0.4290000
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956	17.43750	-96.93750	0.4850000
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958	17.43750	-97.18750	0.7260000
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960	17.43750	-97.43750	0.7540000
961	17.43750	-97.56250	0.7920000
962	17.43750	-97.68750	0.7320000
963	17.43750	-97.81250	0.6950000
964	17.43750	-97.93750	0.6670000
965	17.43750	-98.06250	0.5370000
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1041	17.56250	-96.93750	0.5100000
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1043	17.56250	-97.18750	0.6800000
1044	17.56250	-97.31250	0.6590000
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1129	17.68750	-97.18750	0.6110000
1130	17.68750	-97.31250	0.5770000
1131	17.68750	-97.43750	0.6460000
1132	17.68750	-97.56250	0.7200000
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1137	17.68750	-98.18750	0.6750000
1138	17.68750	-98.31250	0.5420000
1139	17.68750	-98.43750	0.5460000
1140	17.68750	-98.56250	0.4230000
1151	17.68750	-99.93750	0.4960000
1152	17.81250	-100.0625	0.5640000
1153	17.81250	-100.1875	0.5170000
1154	17.81250	-100.3125	0.5220000
1155	17.81250	-100.4375	0.5800000
1156	17.81250	-100.5625	0.4380000
1193	17.81250	-94.31250	0.4020000
1196	17.81250	-94.68750	0.4070000
1204	17.81250	-95.68750	0.4750000
1205	17.81250	-95.81250	0.4160000
1214	17.81250	-96.93750	0.4610000
1215	17.81250	-97.06250	0.4690000
1216	17.81250	-97.18750	0.4690000
1217	17.81250	-97.31250	0.5350000
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1220	17.81250	-97.68750	0.6630000
1221	17.81250	-97.81250	0.6860000
1222	17.81250	-97.93750	0.7060000
1223	17.81250	-98.06250	0.6680000
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Cont.

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1226	17.81250	-98.43750	0.6290000
1227	17.81250	-98.56250	0.5110000
1228	17.81250	-98.68750	0.4060000
1236	17.81250	-99.68750	0.4620000
1237	17.81250	-99.81250	0.5770000
1238	17.81250	-99.93750	0.6180000
1239	17.93750	-100.0625	0.6160000
1240	17.93750	-100.1875	0.5130000
1241	17.93750	-100.3125	0.5400000
1242	17.93750	-100.4375	0.5520000
1301	17.93750	-94.43750	0.4010000
1302	17.93750	-94.56250	0.4190000
1303	17.93750	-94.68750	0.4460000
1304	17.93750	-94.81250	0.4580000
1312	17.93750	-95.81250	0.4450000
1324	17.93750	-97.31250	0.5470000
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1327	17.93750	-97.68750	0.6610000
1328	17.93750	-97.81250	0.7130000
1329	17.93750	-97.93750	0.6620000
1330	17.93750	-98.06250	0.7330000
1331	17.93750	-98.18750	0.7560000
1332	17.93750	-98.31250	0.6760000
1333	17.93750	-98.43750	0.7280000
1334	17.93750	-98.56250	0.6350000
1335	17.93750	-98.68750	0.4880000
1342	17.93750	-99.56250	0.4250000
1343	17.93750	-99.68750	0.5650000
1344	17.93750	-99.81250	0.6810000
1345	17.93750	-99.93750	0.7270000
1346	18.06250	-100.0625	0.6770000
1347	18.06250	-100.1875	0.5790000
1348	18.06250	-100.3125	0.4190000
1349	18.06250	-100.4375	0.4200000
1413	18.06250	-94.31250	0.4230000
1414	18.06250	-94.43750	0.4260000
1415	18.06250	-94.56250	0.4050000
1416	18.06250	-94.68750	0.4080000
1417	18.06250	-94.81250	0.4520000
1423	18.06250	-95.56250	0.4290000
1425	18.06250	-95.81250	0.4080000
1426	18.06250	-95.93750	0.4600000
1427	18.06250	-96.06250	0.4850000
1437	18.06250	-97.31250	0.5620000
1438	18.06250	-97.43750	0.6330000
1439	18.06250	-97.56250	0.6570000
1440	18.06250	-97.68750	0.6090000
1441	18.06250	-97.81250	0.7300000
1442	18.06250	-97.93750	0.7340000
1443	18.06250	-98.06250	0.7810000
1444	18.06250	-98.18750	0.6960000
1445	18.06250	-98.31250	0.6590000
1446	18.06250	-98.43750	0.7480000
1447	18.06250	-98.56250	0.7220000
1448	18.06250	-98.68750	0.5870000
1449	18.06250	-98.81250	0.4910000
1455	18.06250	-99.56250	0.4670000
1456	18.06250	-99.68750	0.7190000
1457	18.06250	-99.81250	0.7170000
1458	18.06250	-99.93750	0.7120000

Cont.

1459	18.18750	-100.0625	0.6180000
1460	18.18750	-100.1875	0.4840000
1462	18.18750	-100.4375	0.4260000
1530	18.18750	-94.31250	0.4300000
1531	18.18750	-94.43750	0.4420000
1539	18.18750	-95.43750	0.4710000
1543	18.18750	-95.93750	0.5070000
1544	18.18750	-96.06250	0.4930000
1554	18.18750	-97.31250	0.4150000
1555	18.18750	-97.43750	0.5120000
1556	18.18750	-97.56250	0.5510000
1557	18.18750	-97.68750	0.4460000
1558	18.18750	-97.81250	0.6790000
1559	18.18750	-97.93750	0.6670000
1560	18.18750	-98.06250	0.7340000
1561	18.18750	-98.18750	0.6040000
1562	18.18750	-98.31250	0.5430000
1563	18.18750	-98.43750	0.7570000
1564	18.18750	-98.56250	0.7040000
1565	18.18750	-98.68750	0.6020000
1566	18.18750	-98.81250	0.5590000
1567	18.18750	-98.93750	0.4610000
1568	18.18750	-99.06250	0.4850000
1573	18.18750	-99.68750	0.4920000
1574	18.18750	-99.81250	0.5270000
1575	18.18750	-99.93750	0.6100000
1576	18.31250	-100.0625	0.4730000
1577	18.31250	-100.1875	0.4880000
1578	18.31250	-100.3125	0.4610000
1653	18.31250	-94.81250	0.4060000
1658	18.31250	-95.43750	0.4430000
1659	18.31250	-95.56250	0.4370000
1660	18.31250	-95.68750	0.4460000
1674	18.31250	-97.43750	0.4970000
1675	18.31250	-97.56250	0.4790000
1676	18.31250	-97.68750	0.5660000
1677	18.31250	-97.81250	0.5440000
1678	18.31250	-97.93750	0.5780000
1679	18.31250	-98.06250	0.6360000
1680	18.31250	-98.18750	0.6300000
1681	18.31250	-98.31250	0.6350000
1682	18.31250	-98.43750	0.7470000
1683	18.31250	-98.56250	0.6760000
1684	18.31250	-98.68750	0.5630000
1686	18.31250	-98.93750	0.4120000
1687	18.31250	-99.06250	0.4280000
1691	18.31250	-99.56250	0.4690000
1692	18.31250	-99.68750	0.4900000
1693	18.31250	-99.81250	0.5360000
1694	18.31250	-99.93750	0.6400000
1695	18.43750	-100.0625	0.5770000
1696	18.43750	-100.1875	0.5920000
1774	18.43750	-95.56250	0.4300000
1777	18.43750	-95.93750	0.4560000
1780	18.43750	-96.31250	0.4100000
1789	18.43750	-97.43750	0.4040000
1790	18.43750	-97.56250	0.4840000
1791	18.43750	-97.68750	0.4790000
1792	18.43750	-97.81250	0.5250000
1793	18.43750	-97.93750	0.5880000
1794	18.43750	-98.06250	0.5260000
1795	18.43750	-98.18750	0.5500000

Cont.

1796	18.43750	-98.31250	0.5590000
1797	18.43750	-98.43750	0.6220000
1798	18.43750	-98.56250	0.5430000
1799	18.43750	-98.68750	0.4060000
1806	18.43750	-99.56250	0.4650000
1808	18.43750	-99.81250	0.6280000
1809	18.43750	-99.93750	0.5190000
1810	18.56250	-100.0625	0.5340000
1811	18.56250	-100.1875	0.5440000
1887	18.56250	-95.93750	0.5800000
1888	18.56250	-96.06250	0.6230000
1890	18.56250	-96.31250	0.4030000
1891	18.56250	-96.43750	0.4210000
1897	18.56250	-97.18750	0.4680000
1898	18.56250	-97.31250	0.5100000
1899	18.56250	-97.43750	0.4510000
1900	18.56250	-97.56250	0.4860000
1901	18.56250	-97.68750	0.4670000
1902	18.56250	-97.81250	0.5740000
1903	18.56250	-97.93750	0.5680000
1904	18.56250	-98.06250	0.5470000
1905	18.56250	-98.18750	0.4030000
1915	18.56250	-99.43750	0.4020000
1918	18.56250	-99.81250	0.5880000
1919	18.56250	-99.93750	0.5220000
1920	18.68750	-100.0625	0.6160000
1921	18.68750	-100.1875	0.5960000
1995	18.68750	-96.06250	0.4230000
2004	18.68750	-97.18750	0.4460000
2005	18.68750	-97.31250	0.4790000
2006	18.68750	-97.43750	0.5350000
2009	18.68750	-97.81250	0.5390000
2010	18.68750	-97.93750	0.4490000
2011	18.68750	-98.06250	0.4450000
2012	18.68750	-98.18750	0.4390000
2021	18.68750	-99.31250	0.4890000
2025	18.68750	-99.81250	0.4140000
2026	18.68750	-99.93750	0.5360000
2027	18.81250	-100.0625	0.5210000
2104	18.81250	-97.31250	0.4420000
2108	18.81250	-97.81250	0.5220000
2109	18.81250	-97.93750	0.5610000
2110	18.81250	-98.06250	0.5660000
2111	18.81250	-98.18750	0.5830000
2112	18.81250	-98.31250	0.4010000
2119	18.81250	-99.18750	0.4790000
2120	18.81250	-99.31250	0.6180000
2121	18.81250	-99.43750	0.4090000
2202	18.93750	-97.56250	0.4200000
2203	18.93750	-97.68750	0.5320000
2204	18.93750	-97.81250	0.5100000
2205	18.93750	-97.93750	0.5760000
2206	18.93750	-98.06250	0.6160000
2207	18.93750	-98.18750	0.6240000
2208	18.93750	-98.31250	0.4580000
2209	18.93750	-98.43750	0.4170000
2215	18.93750	-99.18750	0.4110000
2216	18.93750	-99.31250	0.6490000
2291	19.06250	-96.56250	0.4460000
2293	19.06250	-96.81250	0.4600000
2297	19.06250	-97.31250	0.4560000
2300	19.06250	-97.68750	0.4510000

Cont.

2301	19.06250	-97.81250	0.4190000
2302	19.06250	-97.93750	0.5400000
2303	19.06250	-98.06250	0.6160000
2304	19.06250	-98.18750	0.5150000
2305	19.06250	-98.31250	0.4520000
2309	19.06250	-98.81250	0.4670000
2310	19.06250	-98.93750	0.5050000
2311	19.06250	-99.06250	0.4790000
2312	19.06250	-99.18750	0.5190000
2313	19.06250	-99.31250	0.5570000
2389	19.18750	-96.56250	0.4140000
2390	19.18750	-96.68750	0.4070000
2391	19.18750	-96.81250	0.5210000
2398	19.18750	-97.68750	0.5620000
2399	19.18750	-97.81250	0.5510000
2400	19.18750	-97.93750	0.6120000
2401	19.18750	-98.06250	0.5630000
2402	19.18750	-98.18750	0.4950000
2403	19.18750	-98.31250	0.4270000
2404	19.18750	-98.43750	0.4860000
2405	19.18750	-98.56250	0.4660000
2406	19.18750	-98.68750	0.4600000
2407	19.18750	-98.81250	0.5470000
2408	19.18750	-98.93750	0.5440000
2410	19.18750	-99.18750	0.4140000
2412	19.18750	-99.43750	0.5060000
2413	19.18750	-99.56250	0.4510000
2487	19.31250	-96.56250	0.4130000
2489	19.31250	-96.81250	0.4110000
2490	19.31250	-96.93750	0.5270000
2493	19.31250	-97.31250	0.4500000
2496	19.31250	-97.68750	0.5860000
2497	19.31250	-97.81250	0.5850000
2498	19.31250	-97.93750	0.6100000
2499	19.31250	-98.06250	0.5730000
2500	19.31250	-98.18750	0.4530000
2501	19.31250	-98.31250	0.5180000
2502	19.31250	-98.43750	0.5680000
2503	19.31250	-98.56250	0.5540000
2504	19.31250	-98.68750	0.4370000
2507	19.31250	-99.06250	0.4660000
2509	19.31250	-99.31250	0.4520000
2510	19.31250	-99.43750	0.4810000
2511	19.31250	-99.56250	0.4010000
2512	19.31250	-99.68750	0.4910000
2586	19.43750	-96.93750	0.4440000
2589	19.43750	-97.31250	0.4780000
2590	19.43750	-97.43750	0.4780000
2592	19.43750	-97.68750	0.5710000
2593	19.43750	-97.81250	0.4880000
2594	19.43750	-97.93750	0.5000000
2595	19.43750	-98.06250	0.5200000
2596	19.43750	-98.18750	0.4770000
2597	19.43750	-98.31250	0.5160000
2598	19.43750	-98.43750	0.5730000
2599	19.43750	-98.56250	0.4190000
2601	19.43750	-98.81250	0.4620000
2602	19.43750	-98.93750	0.4060000
2605	19.43750	-99.31250	0.4920000
2607	19.43750	-99.56250	0.4590000
2615	19.56250	-100.5625	0.4340000
2682	19.56250	-96.68750	0.4510000

Cont.

2683	19.56250	-96.81250	0.4600000
2684	19.56250	-96.93750	0.4380000
2687	19.56250	-97.31250	0.5870000
2688	19.56250	-97.43750	0.5570000
2689	19.56250	-97.56250	0.4200000
2691	19.56250	-97.81250	0.4660000
2692	19.56250	-97.93750	0.5150000
2694	19.56250	-98.18750	0.4800000
2695	19.56250	-98.31250	0.4780000
2696	19.56250	-98.43750	0.5310000
2697	19.56250	-98.56250	0.4370000
2699	19.56250	-98.81250	0.4370000
2700	19.56250	-98.93750	0.5080000
2702	19.56250	-99.18750	0.4080000
2703	19.56250	-99.31250	0.4540000
2706	19.56250	-99.68750	0.5060000
2713	19.68750	-100.5625	0.4930000
2780	19.68750	-96.68750	0.4970000
2781	19.68750	-96.81250	0.4750000
2782	19.68750	-96.93750	0.4190000
2785	19.68750	-97.31250	0.5630000
2786	19.68750	-97.43750	0.5440000
2789	19.68750	-97.81250	0.4160000
2790	19.68750	-97.93750	0.5970000
2791	19.68750	-98.06250	0.5710000
2792	19.68750	-98.18750	0.5340000
2793	19.68750	-98.31250	0.4380000
2794	19.68750	-98.43750	0.5030000
2795	19.68750	-98.56250	0.4910000
2797	19.68750	-98.81250	0.4340000
2798	19.68750	-98.93750	0.4490000
2800	19.68750	-99.18750	0.5070000
2801	19.68750	-99.31250	0.5300000
2803	19.68750	-99.56250	0.4920000
2810	19.81250	-100.4375	0.4880000
2879	19.81250	-96.68750	0.4730000
2880	19.81250	-96.81250	0.4320000
2881	19.81250	-96.93750	0.4270000
2884	19.81250	-97.31250	0.4660000
2885	19.81250	-97.43750	0.4090000
2886	19.81250	-97.56250	0.4140000
2887	19.81250	-97.68750	0.4570000
2888	19.81250	-97.81250	0.5170000
2889	19.81250	-97.93750	0.6520000
2890	19.81250	-98.06250	0.6140000
2891	19.81250	-98.18750	0.5780000
2892	19.81250	-98.31250	0.5290000
2895	19.81250	-98.68750	0.4080000
2896	19.81250	-98.81250	0.4570000
2978	19.93750	-96.81250	0.4380000
2979	19.93750	-96.93750	0.4300000
2981	19.93750	-97.18750	0.4360000
2982	19.93750	-97.31250	0.4280000
2986	19.93750	-97.81250	0.5830000
2987	19.93750	-97.93750	0.5370000
2988	19.93750	-98.06250	0.5380000
2989	19.93750	-98.18750	0.5330000
2990	19.93750	-98.31250	0.5070000
2991	19.93750	-98.43750	0.4580000
2993	19.93750	-98.68750	0.4160000
3075	20.06250	-96.93750	0.4560000
3076	20.06250	-97.06250	0.4710000

Cont.

3077	20.06250	-97.18750	0.5290000
3078	20.06250	-97.31250	0.4540000
3086	20.06250	-98.31250	0.5190000
3087	20.06250	-98.43750	0.4520000
3090	20.06250	-98.81250	0.4060000
3172	20.18750	-97.06250	0.5120000
3173	20.18750	-97.18750	0.4850000
3174	20.18750	-97.31250	0.4230000
3186	20.18750	-98.81250	0.4950000
3187	20.18750	-98.93750	0.4330000
3188	20.18750	-99.06250	0.4260000
3270	20.31250	-97.18750	0.4100000
3283	20.31250	-98.81250	0.4410000
3284	20.31250	-98.93750	0.4310000
3285	20.31250	-99.06250	0.4070000
3286	20.31250	-99.18750	0.4550000
3562	20.68750	-97.56250	0.5040000
3564	20.68750	-97.81250	0.4120000
3565	20.68750	-97.93750	0.4420000
3566	20.68750	-98.06250	0.4070000
3567	20.68750	-98.18750	0.4030000
3568	20.68750	-98.31250	0.4080000
3658	20.81250	-97.56250	0.5580000
3659	20.81250	-97.68750	0.5560000
3660	20.81250	-97.81250	0.4950000
3661	20.81250	-97.93750	0.4840000
3753	20.93750	-97.56250	0.5730000
3754	20.93750	-97.68750	0.5740000
3755	20.93750	-97.81250	0.5020000
3756	20.93750	-97.93750	0.4170000
3762	20.93750	-98.68750	0.4060000
3763	20.93750	-98.81250	0.4650000
3764	20.93750	-98.93750	0.4130000
3846	21.06250	-97.68750	0.5340000
3847	21.06250	-97.81250	0.4090000
3937	21.18750	-97.68750	0.4650000

Appendix Table B2. Qualifying Extraction Region Grid Points from Correlation of LW and Summer Precipitation at Cuauhtémoc la Fragua

Point	Latitude	Longitude	r-value
875	17.31250	-97.31250	0.4080000
960	17.43750	-97.43750	0.4290000
1045	17.56250	-97.43750	0.4790000
1046	17.56250	-97.56250	0.4520000
1131	17.68750	-97.43750	0.4330000
1132	17.68750	-97.56250	0.4370000
1133	17.68750	-97.68750	0.4760000
1218	17.81250	-97.43750	0.4130000
1219	17.81250	-97.56250	0.4350000
1238	17.81250	-99.93750	0.4400000
1239	17.93750	-100.0625	0.4380000
1325	17.93750	-97.43750	0.4010000

Cont.

1343	17.93750	-99.68750	0.4480000
1344	17.93750	-99.81250	0.4680000
1345	17.93750	-99.93750	0.4680000
1346	18.06250	-100.0625	0.4360000
1423	18.06250	-95.56250	0.4120000
1424	18.06250	-95.68750	0.4760000
1425	18.06250	-95.81250	0.5080000
1456	18.06250	-99.68750	0.5880000
1457	18.06250	-99.81250	0.5300000
1458	18.06250	-99.93750	0.5140000
1459	18.18750	-100.0625	0.4570000
1541	18.18750	-95.68750	0.4950000
1542	18.18750	-95.81250	0.5500000
1573	18.18750	-99.68750	0.5050000
1574	18.18750	-99.81250	0.4040000
1658	18.31250	-95.43750	0.4280000
1659	18.31250	-95.56250	0.4050000
1660	18.31250	-95.68750	0.4590000
1661	18.31250	-95.81250	0.4910000
1692	18.31250	-99.68750	0.4770000
1695	18.43750	-100.0625	0.4170000
1696	18.43750	-100.1875	0.4110000
1774	18.43750	-95.56250	0.5560000
1775	18.43750	-95.68750	0.4550000
1811	18.56250	-100.1875	0.4100000
1883	18.56250	-95.43750	0.4440000
1921	18.68750	-100.1875	0.4400000
1990	18.68750	-95.43750	0.4500000
1991	18.68750	-95.56250	0.4020000
2490	19.31250	-96.93750	0.4190000
2491	19.31250	-97.06250	0.4550000
2496	19.31250	-97.68750	0.4280000
2592	19.43750	-97.68750	0.4240000
2685	19.56250	-97.06250	0.4370000
2687	19.56250	-97.31250	0.4660000
2688	19.56250	-97.43750	0.5410000
2781	19.68750	-96.81250	0.4800000
2782	19.68750	-96.93750	0.4840000
2785	19.68750	-97.31250	0.5290000
2786	19.68750	-97.43750	0.5570000
2787	19.68750	-97.56250	0.4490000
2790	19.68750	-97.93750	0.4720000
2791	19.68750	-98.06250	0.4510000
2792	19.68750	-98.18750	0.4570000
2798	19.68750	-98.93750	0.4330000
2799	19.68750	-99.06250	0.4320000
2879	19.81250	-96.68750	0.4450000
2880	19.81250	-96.81250	0.4550000
2881	19.81250	-96.93750	0.5340000
2882	19.81250	-97.06250	0.5020000
2883	19.81250	-97.18750	0.4780000
2884	19.81250	-97.31250	0.4960000
2885	19.81250	-97.43750	0.5150000
2886	19.81250	-97.56250	0.4630000
2887	19.81250	-97.68750	0.5000000
2888	19.81250	-97.81250	0.4420000
2889	19.81250	-97.93750	0.5250000
2890	19.81250	-98.06250	0.5230000
2891	19.81250	-98.18750	0.4860000
2895	19.81250	-98.68750	0.4290000
2896	19.81250	-98.81250	0.4730000
2978	19.93750	-96.81250	0.4740000

Cont.

2979	19.93750	-96.93750	0.5010000
2981	19.93750	-97.18750	0.4360000
2986	19.93750	-97.81250	0.5310000
2987	19.93750	-97.93750	0.4810000
2988	19.93750	-98.06250	0.4050000
2989	19.93750	-98.18750	0.4520000
2993	19.93750	-98.68750	0.4390000
3075	20.06250	-96.93750	0.4480000
3076	20.06250	-97.06250	0.5010000
3077	20.06250	-97.18750	0.4820000
3078	20.06250	-97.31250	0.4460000
3086	20.06250	-98.31250	0.4420000
3172	20.18750	-97.06250	0.5190000
3173	20.18750	-97.18750	0.5210000
3174	20.18750	-97.31250	0.4180000
3182	20.18750	-98.31250	0.4030000
3270	20.31250	-97.18750	0.4210000
3371	20.43750	-97.56250	0.4150000
3379	20.43750	-98.56250	0.4250000
3468	20.56250	-97.56250	0.4390000
3476	20.56250	-98.56250	0.4200000
3561	20.68750	-97.43750	0.4180000
3562	20.68750	-97.56250	0.5120000
3564	20.68750	-97.81250	0.4210000
3658	20.81250	-97.56250	0.5450000
3659	20.81250	-97.68750	0.5130000
3660	20.81250	-97.81250	0.4910000
3661	20.81250	-97.93750	0.4720000
3751	20.93750	-97.31250	0.4080000
3753	20.93750	-97.56250	0.5170000
3754	20.93750	-97.68750	0.5170000
3755	20.93750	-97.81250	0.5090000
3756	20.93750	-97.93750	0.4810000
3844	21.06250	-97.43750	0.6450000
3845	21.06250	-97.56250	0.5280000
3846	21.06250	-97.68750	0.5050000
3847	21.06250	-97.81250	0.4900000
3848	21.06250	-97.93750	0.4600000
3935	21.18750	-97.43750	0.7050000
3936	21.18750	-97.56250	0.7030000
3937	21.18750	-97.68750	0.4830000
3938	21.18750	-97.81250	0.4600000
3939	21.18750	-97.93750	0.4060000
4023	21.31250	-97.43750	0.5880000
4024	21.31250	-97.56250	0.6720000
4025	21.31250	-97.68750	0.4290000
4105	21.43750	-97.43750	0.5590000
4106	21.43750	-97.56250	0.5500000
4183	21.56250	-97.43750	0.4810000
4184	21.56250	-97.56250	0.5320000
4267	21.68750	-99.68750	0.4220000
4268	21.68750	-99.81250	0.4210000
4269	21.68750	-99.93750	0.4310000
4270	21.81250	-100.0625	0.4240000
4332	21.81250	-99.81250	0.4160000
4333	21.81250	-99.93750	0.4800000
4334	21.93750	-100.0625	0.4580000
4397	21.93750	-99.93750	0.4640000
4398	22.06250	-100.0625	0.4540000
4461	22.06250	-99.93750	0.4520000
4462	22.18750	-100.0625	0.4780000
4463	22.18750	-100.1875	0.4510000

Cont.

4464	22.18750	-100.3125	0.4010000
4471	22.18750	-101.1875	0.4530000
4523	22.18750	-99.68750	0.4120000
4524	22.18750	-99.81250	0.4120000
4526	22.31250	-100.0625	0.4550000
4527	22.31250	-100.1875	0.4170000

Appendix Table B3. Qualifying Extraction Region Grid Points from Correlation of EW and Spring Precipitation Averaged from Cuauhtémoc la Fragua and Villareal

Point	Latitude	Longitude	r-value
1	14.56250	-92.31250	0.4470000
2	14.68750	-92.18750	0.4470000
3	14.68750	-92.31250	0.4740000
5	14.81250	-92.18750	0.4770000
6	14.81250	-92.31250	0.6080000
8	14.81250	-92.56250	0.4520000
9	14.93750	-92.18750	0.4750000
10	14.93750	-92.31250	0.5840000
11	14.93750	-92.43750	0.6180000
12	14.93750	-92.56250	0.6170000
13	14.93750	-92.68750	0.5210000
16	15.06250	-92.31250	0.5180000
17	15.06250	-92.43750	0.5140000
18	15.06250	-92.56250	0.5460000
19	15.06250	-92.68750	0.4870000
20	15.06250	-92.81250	0.6250000
21	15.18750	-92.18750	0.5400000
23	15.18750	-92.43750	0.6030000
24	15.18750	-92.56250	0.5830000
25	15.18750	-92.68750	0.5380000
26	15.18750	-92.81250	0.5490000
27	15.18750	-92.93750	0.5060000
28	15.31250	-92.18750	0.4450000
30	15.31250	-92.43750	0.4730000
31	15.31250	-92.56250	0.5830000
33	15.31250	-92.81250	0.5760000
34	15.31250	-92.93750	0.5520000
35	15.31250	-93.06250	0.5490000
38	15.43750	-92.43750	0.6500000
39	15.43750	-92.56250	0.6190000
40	15.43750	-92.68750	0.5600000
41	15.43750	-92.81250	0.5160000
42	15.43750	-92.93750	0.5440000
43	15.43750	-93.06250	0.5860000
44	15.43750	-93.18750	0.6320000
45	15.56250	-92.06250	0.4310000
48	15.56250	-92.43750	0.5390000
49	15.56250	-92.56250	0.4380000
51	15.56250	-92.81250	0.5090000
52	15.56250	-92.93750	0.5490000

Cont.

53	15.56250	-93.06250	0.5700000
54	15.56250	-93.18750	0.5390000
55	15.56250	-93.31250	0.5500000
62	15.68750	-92.81250	0.4070000
63	15.68750	-92.93750	0.5300000
64	15.68750	-93.06250	0.5200000
65	15.68750	-93.18750	0.4860000
66	15.68750	-93.31250	0.4070000
67	15.68750	-93.43750	0.4260000
72	15.68750	-96.68750	0.4070000
93	15.81250	-96.68750	0.4020000
94	15.81250	-96.81250	0.4820000
95	15.81250	-96.93750	0.4740000
96	15.81250	-97.06250	0.4860000
112	15.93750	-93.68750	0.4190000
113	15.93750	-93.81250	0.4130000
115	15.93750	-95.68750	0.4310000
116	15.93750	-95.81250	0.4050000
117	15.93750	-95.93750	0.4540000
118	15.93750	-96.06250	0.4440000
119	15.93750	-96.18750	0.4270000
123	15.93750	-96.68750	0.4230000
124	15.93750	-96.81250	0.4910000
125	15.93750	-96.93750	0.5530000
126	15.93750	-97.06250	0.5060000
127	15.93750	-97.18750	0.4890000
128	15.93750	-97.31250	0.4600000
129	15.93750	-97.43750	0.4630000
130	15.93750	-97.56250	0.5360000
131	15.93750	-97.68750	0.5380000
132	15.93750	-97.81250	0.5510000
155	16.06250	-95.68750	0.4340000
156	16.06250	-95.81250	0.4970000
157	16.06250	-95.93750	0.4710000
158	16.06250	-96.06250	0.4440000
161	16.06250	-96.43750	0.4260000
162	16.06250	-96.56250	0.4260000
163	16.06250	-96.68750	0.4460000
164	16.06250	-96.81250	0.5230000
165	16.06250	-96.93750	0.5440000
166	16.06250	-97.06250	0.4900000
167	16.06250	-97.18750	0.5060000
168	16.06250	-97.31250	0.4850000
169	16.06250	-97.43750	0.4690000
170	16.06250	-97.56250	0.5210000
171	16.06250	-97.68750	0.5350000
172	16.06250	-97.81250	0.5200000
173	16.06250	-97.93750	0.4760000
188	16.18750	-92.18750	0.4120000
189	16.18750	-92.31250	0.4310000
204	16.18750	-94.18750	0.4230000
205	16.18750	-94.31250	0.4880000
206	16.18750	-94.43750	0.5240000
207	16.18750	-94.56250	0.5210000
208	16.18750	-94.68750	0.5370000
209	16.18750	-94.81250	0.4620000
210	16.18750	-94.93750	0.4450000
211	16.18750	-95.06250	0.4110000
213	16.18750	-95.31250	0.4120000
214	16.18750	-95.43750	0.4190000
217	16.18750	-95.81250	0.4680000
218	16.18750	-95.93750	0.4670000

Cont.

219	16.18750	-96.06250	0.4180000
222	16.18750	-96.43750	0.4070000
223	16.18750	-96.56250	0.4170000
224	16.18750	-96.68750	0.4700000
225	16.18750	-96.81250	0.5150000
226	16.18750	-96.93750	0.4990000
228	16.18750	-97.18750	0.5090000
229	16.18750	-97.31250	0.5020000
230	16.18750	-97.43750	0.4680000
231	16.18750	-97.56250	0.4770000
232	16.18750	-97.68750	0.5080000
233	16.18750	-97.81250	0.5100000
234	16.18750	-97.93750	0.5100000
235	16.18750	-98.06250	0.4850000
236	16.18750	-98.18750	0.4850000
251	16.31250	-92.18750	0.4170000
268	16.31250	-94.31250	0.4760000
269	16.31250	-94.43750	0.5460000
270	16.31250	-94.56250	0.5920000
271	16.31250	-94.68750	0.5870000
272	16.31250	-94.81250	0.5160000
273	16.31250	-94.93750	0.4140000
274	16.31250	-95.06250	0.4680000
275	16.31250	-95.18750	0.4620000
276	16.31250	-95.31250	0.4220000
277	16.31250	-95.43750	0.4740000
278	16.31250	-95.56250	0.4910000
279	16.31250	-95.68750	0.4080000
282	16.31250	-96.06250	0.4200000
283	16.31250	-96.18750	0.4080000
284	16.31250	-96.31250	0.4120000
287	16.31250	-96.68750	0.4370000
288	16.31250	-96.81250	0.4890000
289	16.31250	-96.93750	0.4850000
290	16.31250	-97.06250	0.4730000
291	16.31250	-97.18750	0.4940000
292	16.31250	-97.31250	0.4990000
293	16.31250	-97.43750	0.5270000
294	16.31250	-97.56250	0.4650000
295	16.31250	-97.68750	0.5070000
296	16.31250	-97.81250	0.4880000
297	16.31250	-97.93750	0.5080000
298	16.31250	-98.06250	0.4950000
299	16.31250	-98.18750	0.4910000
300	16.31250	-98.31250	0.4640000
301	16.31250	-98.43750	0.4170000
317	16.43750	-92.18750	0.4620000
331	16.43750	-93.93750	0.4020000
332	16.43750	-94.06250	0.4400000
333	16.43750	-94.18750	0.4660000
334	16.43750	-94.31250	0.5240000
335	16.43750	-94.43750	0.5540000
336	16.43750	-94.56250	0.5440000
337	16.43750	-94.68750	0.5810000
338	16.43750	-94.81250	0.5630000
339	16.43750	-94.93750	0.5310000
340	16.43750	-95.06250	0.5830000
342	16.43750	-95.31250	0.5200000
343	16.43750	-95.43750	0.5500000
344	16.43750	-95.56250	0.5340000
345	16.43750	-95.68750	0.5140000
346	16.43750	-95.81250	0.4720000

Cont.

354	16.43750	-96.81250	0.4300000
355	16.43750	-96.93750	0.4530000
356	16.43750	-97.06250	0.4640000
357	16.43750	-97.18750	0.4600000
358	16.43750	-97.31250	0.4880000
359	16.43750	-97.43750	0.5140000
360	16.43750	-97.56250	0.4780000
361	16.43750	-97.68750	0.4520000
362	16.43750	-97.81250	0.5020000
363	16.43750	-97.93750	0.4760000
364	16.43750	-98.06250	0.5230000
365	16.43750	-98.18750	0.5310000
366	16.43750	-98.31250	0.4860000
367	16.43750	-98.43750	0.4700000
386	16.56250	-92.56250	0.4070000
387	16.56250	-92.68750	0.4400000
399	16.56250	-94.18750	0.4990000
400	16.56250	-94.31250	0.4740000
401	16.56250	-94.43750	0.5250000
402	16.56250	-94.56250	0.5510000
403	16.56250	-94.68750	0.5450000
404	16.56250	-94.81250	0.5880000
405	16.56250	-94.93750	0.6040000
406	16.56250	-95.06250	0.5900000
407	16.56250	-95.18750	0.7100000
408	16.56250	-95.31250	0.6720000
409	16.56250	-95.43750	0.5620000
410	16.56250	-95.56250	0.5130000
411	16.56250	-95.68750	0.5070000
412	16.56250	-95.81250	0.4890000
413	16.56250	-95.93750	0.4090000
419	16.56250	-96.68750	0.4230000
421	16.56250	-96.93750	0.4240000
422	16.56250	-97.06250	0.4470000
423	16.56250	-97.18750	0.4810000
424	16.56250	-97.31250	0.4880000
425	16.56250	-97.43750	0.5020000
426	16.56250	-97.56250	0.5250000
427	16.56250	-97.68750	0.4840000
428	16.56250	-97.81250	0.4170000
429	16.56250	-97.93750	0.4580000
430	16.56250	-98.06250	0.5020000
431	16.56250	-98.18750	0.5200000
432	16.56250	-98.31250	0.5060000
433	16.56250	-98.43750	0.5100000
434	16.56250	-98.56250	0.4630000
454	16.68750	-92.56250	0.4130000
455	16.68750	-92.68750	0.4110000
458	16.68750	-93.06250	0.4300000
459	16.68750	-93.18750	0.5070000
460	16.68750	-93.31250	0.4600000
468	16.68750	-94.31250	0.4210000
469	16.68750	-94.43750	0.5190000
470	16.68750	-94.56250	0.5670000
471	16.68750	-94.68750	0.6040000
472	16.68750	-94.81250	0.6410000
473	16.68750	-94.93750	0.7080000
474	16.68750	-95.06250	0.6970000
475	16.68750	-95.18750	0.7200000
476	16.68750	-95.31250	0.6990000
477	16.68750	-95.43750	0.6920000
478	16.68750	-95.56250	0.5850000

Cont.

479	16.68750	-95.68750	0.5230000
480	16.68750	-95.81250	0.4600000
481	16.68750	-95.93750	0.4190000
485	16.68750	-96.43750	0.4240000
486	16.68750	-96.56250	0.4510000
487	16.68750	-96.68750	0.4350000
489	16.68750	-96.93750	0.4290000
490	16.68750	-97.06250	0.4670000
491	16.68750	-97.18750	0.5070000
492	16.68750	-97.31250	0.5150000
493	16.68750	-97.43750	0.5380000
494	16.68750	-97.56250	0.4830000
495	16.68750	-97.68750	0.4760000
497	16.68750	-97.93750	0.4120000
498	16.68750	-98.06250	0.4820000
499	16.68750	-98.18750	0.5180000
500	16.68750	-98.31250	0.5230000
501	16.68750	-98.43750	0.4830000
502	16.68750	-98.56250	0.4490000
503	16.68750	-98.68750	0.4340000
526	16.81250	-92.56250	0.4740000
530	16.81250	-93.06250	0.4990000
531	16.81250	-93.18750	0.4610000
532	16.81250	-93.31250	0.5320000
533	16.81250	-93.43750	0.4450000
541	16.81250	-94.43750	0.5040000
542	16.81250	-94.56250	0.6120000
543	16.81250	-94.68750	0.7030000
544	16.81250	-94.81250	0.7520000
545	16.81250	-94.93750	0.6970000
546	16.81250	-95.06250	0.7440000
547	16.81250	-95.18750	0.6840000
548	16.81250	-95.31250	0.6110000
549	16.81250	-95.43750	0.6700000
550	16.81250	-95.56250	0.6430000
551	16.81250	-95.68750	0.5180000
556	16.81250	-96.31250	0.4350000
557	16.81250	-96.43750	0.4990000
558	16.81250	-96.56250	0.5460000
559	16.81250	-96.68750	0.4720000
560	16.81250	-96.81250	0.4220000
561	16.81250	-96.93750	0.4690000
562	16.81250	-97.06250	0.5350000
563	16.81250	-97.18750	0.5700000
564	16.81250	-97.31250	0.5610000
565	16.81250	-97.43750	0.5200000
566	16.81250	-97.56250	0.4240000
570	16.81250	-98.06250	0.4460000
571	16.81250	-98.18750	0.4770000
572	16.81250	-98.31250	0.5330000
573	16.81250	-98.43750	0.4750000
574	16.81250	-98.56250	0.4530000
600	16.93750	-92.56250	0.4720000
604	16.93750	-93.06250	0.4730000
607	16.93750	-93.43750	0.4170000
615	16.93750	-94.43750	0.4420000
616	16.93750	-94.56250	0.6160000
617	16.93750	-94.68750	0.6510000
618	16.93750	-94.81250	0.6600000
619	16.93750	-94.93750	0.6850000
620	16.93750	-95.06250	0.6560000
621	16.93750	-95.18750	0.5860000

Cont.

622	16.93750	-95.31250	0.5080000
623	16.93750	-95.43750	0.5890000
624	16.93750	-95.56250	0.5710000
625	16.93750	-95.68750	0.4620000
626	16.93750	-95.81250	0.5080000
627	16.93750	-95.93750	0.5240000
628	16.93750	-96.06250	0.5030000
629	16.93750	-96.18750	0.5160000
630	16.93750	-96.31250	0.5280000
631	16.93750	-96.43750	0.5860000
632	16.93750	-96.56250	0.6240000
633	16.93750	-96.68750	0.6180000
634	16.93750	-96.81250	0.5840000
635	16.93750	-96.93750	0.5790000
636	16.93750	-97.06250	0.5880000
637	16.93750	-97.18750	0.6230000
638	16.93750	-97.31250	0.6590000
639	16.93750	-97.43750	0.5470000
640	16.93750	-97.56250	0.4770000
647	16.93750	-98.43750	0.4490000
694	17.06250	-94.68750	0.4500000
695	17.06250	-94.81250	0.5280000
696	17.06250	-94.93750	0.5250000
697	17.06250	-95.06250	0.5220000
698	17.06250	-95.18750	0.5380000
699	17.06250	-95.31250	0.5170000
700	17.06250	-95.43750	0.5670000
701	17.06250	-95.56250	0.6280000
702	17.06250	-95.68750	0.5760000
703	17.06250	-95.81250	0.5730000
704	17.06250	-95.93750	0.5410000
705	17.06250	-96.06250	0.5200000
706	17.06250	-96.18750	0.5240000
707	17.06250	-96.31250	0.5420000
708	17.06250	-96.43750	0.5840000
709	17.06250	-96.56250	0.6300000
710	17.06250	-96.68750	0.6560000
711	17.06250	-96.81250	0.6600000
712	17.06250	-96.93750	0.6450000
713	17.06250	-97.06250	0.5760000
714	17.06250	-97.18750	0.5610000
715	17.06250	-97.31250	0.6750000
716	17.06250	-97.43750	0.6390000
717	17.06250	-97.56250	0.5140000
718	17.06250	-97.68750	0.4560000
719	17.06250	-97.81250	0.4110000
720	17.06250	-97.93750	0.4280000
744	17.18750	-100.9375	0.4340000
745	17.18750	-91.31250	0.4310000
774	17.18750	-94.93750	0.4030000
777	17.18750	-95.31250	0.4340000
778	17.18750	-95.43750	0.5000000
779	17.18750	-95.56250	0.5680000
780	17.18750	-95.68750	0.5380000
781	17.18750	-95.81250	0.5330000
782	17.18750	-95.93750	0.5050000
783	17.18750	-96.06250	0.5130000
784	17.18750	-96.18750	0.5510000
785	17.18750	-96.31250	0.5790000
786	17.18750	-96.43750	0.5940000
787	17.18750	-96.56250	0.6120000
788	17.18750	-96.68750	0.6290000

Cont.

789	17.18750	-96.81250	0.6460000
790	17.18750	-96.93750	0.6490000
791	17.18750	-97.06250	0.6660000
792	17.18750	-97.18750	0.6790000
793	17.18750	-97.31250	0.7100000
794	17.18750	-97.43750	0.6860000
795	17.18750	-97.56250	0.6670000
796	17.18750	-97.68750	0.5560000
797	17.18750	-97.81250	0.4930000
798	17.18750	-97.93750	0.4110000
821	17.31250	-100.8125	0.4580000
822	17.31250	-100.9375	0.4680000
825	17.31250	-91.06250	0.4100000
826	17.31250	-91.18750	0.4340000
860	17.31250	-95.43750	0.4580000
861	17.31250	-95.56250	0.6000000
862	17.31250	-95.68750	0.5850000
863	17.31250	-95.81250	0.5250000
864	17.31250	-95.93750	0.4450000
865	17.31250	-96.06250	0.5140000
866	17.31250	-96.18750	0.5330000
867	17.31250	-96.31250	0.5600000
868	17.31250	-96.43750	0.5840000
869	17.31250	-96.56250	0.5260000
870	17.31250	-96.68750	0.5310000
871	17.31250	-96.81250	0.5880000
872	17.31250	-96.93750	0.5910000
873	17.31250	-97.06250	0.6700000
874	17.31250	-97.18750	0.6780000
875	17.31250	-97.31250	0.6860000
876	17.31250	-97.43750	0.7270000
877	17.31250	-97.56250	0.7850000
878	17.31250	-97.68750	0.7310000
879	17.31250	-97.81250	0.6370000
880	17.31250	-97.93750	0.4900000
881	17.31250	-98.06250	0.4010000
901	17.43750	-100.5625	0.4130000
902	17.43750	-100.6875	0.4620000
903	17.43750	-100.8125	0.4780000
904	17.43750	-100.9375	0.4710000
905	17.43750	-101.0625	0.4270000
906	17.43750	-101.1875	0.4070000
907	17.43750	-101.3125	0.4100000
908	17.43750	-101.4375	0.4570000
909	17.43750	-91.06250	0.5040000
910	17.43750	-91.18750	0.5440000
944	17.43750	-95.43750	0.4660000
945	17.43750	-95.56250	0.6190000
946	17.43750	-95.68750	0.6240000
947	17.43750	-95.81250	0.5590000
948	17.43750	-95.93750	0.4920000
949	17.43750	-96.06250	0.5460000
950	17.43750	-96.18750	0.5600000
951	17.43750	-96.31250	0.5460000
952	17.43750	-96.43750	0.4910000
953	17.43750	-96.56250	0.4480000
954	17.43750	-96.68750	0.4680000
955	17.43750	-96.81250	0.4880000
956	17.43750	-96.93750	0.5790000
957	17.43750	-97.06250	0.6120000
958	17.43750	-97.18750	0.7070000
959	17.43750	-97.31250	0.6960000

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960	17.43750	-97.43750	0.7490000
961	17.43750	-97.56250	0.7850000
962	17.43750	-97.68750	0.7810000
963	17.43750	-97.81250	0.7540000
964	17.43750	-97.93750	0.7160000
965	17.43750	-98.06250	0.5330000
979	17.43750	-99.81250	0.4240000
983	17.56250	-100.3125	0.4200000
984	17.56250	-100.4375	0.4460000
985	17.56250	-100.5625	0.5450000
986	17.56250	-100.6875	0.4940000
987	17.56250	-100.8125	0.4690000
992	17.56250	-101.4375	0.4210000
993	17.56250	-101.5625	0.5140000
994	17.56250	-91.06250	0.5690000
995	17.56250	-91.18750	0.6330000
1019	17.56250	-94.18750	0.4020000
1030	17.56250	-95.56250	0.4780000
1031	17.56250	-95.68750	0.5580000
1032	17.56250	-95.81250	0.5540000
1033	17.56250	-95.93750	0.4910000
1034	17.56250	-96.06250	0.5220000
1035	17.56250	-96.18750	0.5640000
1036	17.56250	-96.31250	0.4960000
1039	17.56250	-96.68750	0.4390000
1040	17.56250	-96.81250	0.4870000
1041	17.56250	-96.93750	0.5460000
1042	17.56250	-97.06250	0.6280000
1043	17.56250	-97.18750	0.6060000
1044	17.56250	-97.31250	0.6240000
1045	17.56250	-97.43750	0.6930000
1046	17.56250	-97.56250	0.7470000
1047	17.56250	-97.68750	0.7890000
1048	17.56250	-97.81250	0.7990000
1049	17.56250	-97.93750	0.7690000
1050	17.56250	-98.06250	0.6940000
1051	17.56250	-98.18750	0.4320000
1053	17.56250	-98.43750	0.4560000
1054	17.56250	-98.56250	0.4610000
1055	17.56250	-98.68750	0.4070000
1056	17.56250	-98.81250	0.4520000
1064	17.56250	-99.81250	0.5110000
1067	17.68750	-100.1875	0.4910000
1068	17.68750	-100.3125	0.5710000
1069	17.68750	-100.4375	0.5940000
1070	17.68750	-100.5625	0.5720000
1071	17.68750	-100.6875	0.4670000
1079	17.68750	-101.6875	0.5590000
1080	17.68750	-91.06250	0.6610000
1081	17.68750	-91.18750	0.6960000
1104	17.68750	-94.06250	0.4280000
1105	17.68750	-94.18750	0.4470000
1106	17.68750	-94.31250	0.4020000
1112	17.68750	-95.06250	0.4400000
1113	17.68750	-95.18750	0.4430000
1117	17.68750	-95.68750	0.4580000
1118	17.68750	-95.81250	0.5510000
1119	17.68750	-95.93750	0.5180000
1120	17.68750	-96.06250	0.5040000
1121	17.68750	-96.18750	0.4920000
1122	17.68750	-96.31250	0.4020000
1126	17.68750	-96.81250	0.4020000

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1127	17.68750	-96.93750	0.5320000
1128	17.68750	-97.06250	0.5740000
1129	17.68750	-97.18750	0.5520000
1130	17.68750	-97.31250	0.5680000
1131	17.68750	-97.43750	0.6370000
1132	17.68750	-97.56250	0.6540000
1133	17.68750	-97.68750	0.7390000
1134	17.68750	-97.81250	0.6730000
1135	17.68750	-97.93750	0.6980000
1136	17.68750	-98.06250	0.6410000
1137	17.68750	-98.18750	0.6260000
1138	17.68750	-98.31250	0.4760000
1139	17.68750	-98.43750	0.5050000
1140	17.68750	-98.56250	0.5020000
1141	17.68750	-98.68750	0.4820000
1142	17.68750	-98.81250	0.4670000
1150	17.68750	-99.81250	0.5340000
1151	17.68750	-99.93750	0.6230000
1152	17.81250	-100.0625	0.6180000
1153	17.81250	-100.1875	0.5930000
1154	17.81250	-100.3125	0.6080000
1155	17.81250	-100.4375	0.6840000
1156	17.81250	-100.5625	0.5920000
1165	17.81250	-101.6875	0.4470000
1166	17.81250	-101.8125	0.6880000
1167	17.81250	-91.06250	0.7130000
1168	17.81250	-91.18750	0.7210000
1191	17.81250	-94.06250	0.4630000
1192	17.81250	-94.18750	0.4560000
1193	17.81250	-94.31250	0.4320000
1194	17.81250	-94.43750	0.4260000
1196	17.81250	-94.68750	0.4360000
1199	17.81250	-95.06250	0.4460000
1200	17.81250	-95.18750	0.4880000
1201	17.81250	-95.31250	0.4600000
1202	17.81250	-95.43750	0.4980000
1203	17.81250	-95.56250	0.5800000
1204	17.81250	-95.68750	0.6750000
1205	17.81250	-95.81250	0.4920000
1206	17.81250	-95.93750	0.4430000
1208	17.81250	-96.18750	0.4930000
1209	17.81250	-96.31250	0.4480000
1213	17.81250	-96.81250	0.4060000
1214	17.81250	-96.93750	0.4990000
1215	17.81250	-97.06250	0.5310000
1216	17.81250	-97.18750	0.4500000
1217	17.81250	-97.31250	0.5280000
1218	17.81250	-97.43750	0.6660000
1219	17.81250	-97.56250	0.6270000
1220	17.81250	-97.68750	0.6670000
1221	17.81250	-97.81250	0.6750000
1222	17.81250	-97.93750	0.6050000
1223	17.81250	-98.06250	0.5770000
1224	17.81250	-98.18750	0.6280000
1225	17.81250	-98.31250	0.5680000
1226	17.81250	-98.43750	0.6180000
1227	17.81250	-98.56250	0.5620000
1228	17.81250	-98.68750	0.5250000
1229	17.81250	-98.81250	0.4590000
1236	17.81250	-99.68750	0.6340000
1237	17.81250	-99.81250	0.7680000
1238	17.81250	-99.93750	0.7640000

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1239	17.93750	-100.0625	0.6900000
1240	17.93750	-100.1875	0.5960000
1241	17.93750	-100.3125	0.6480000
1242	17.93750	-100.4375	0.6830000
1243	17.93750	-100.5625	0.5090000
1252	17.93750	-101.6875	0.4250000
1253	17.93750	-101.8125	0.6710000
1254	17.93750	-101.9375	0.7230000
1255	17.93750	-102.0625	0.7140000
1256	17.93750	-102.1875	0.7150000
1257	17.93750	-102.3125	0.6140000
1277	17.93750	-91.43750	0.4040000
1285	17.93750	-92.43750	0.4140000
1298	17.93750	-94.06250	0.4480000
1299	17.93750	-94.18750	0.4500000
1300	17.93750	-94.31250	0.4090000
1301	17.93750	-94.43750	0.4240000
1302	17.93750	-94.56250	0.4290000
1303	17.93750	-94.68750	0.4400000
1304	17.93750	-94.81250	0.4740000
1307	17.93750	-95.18750	0.4360000
1308	17.93750	-95.31250	0.4710000
1309	17.93750	-95.43750	0.5780000
1310	17.93750	-95.56250	0.6210000
1311	17.93750	-95.68750	0.6720000
1312	17.93750	-95.81250	0.6270000
1313	17.93750	-95.93750	0.5680000
1314	17.93750	-96.06250	0.5270000
1315	17.93750	-96.18750	0.5520000
1316	17.93750	-96.31250	0.5190000
1321	17.93750	-96.93750	0.4020000
1322	17.93750	-97.06250	0.4590000
1323	17.93750	-97.18750	0.4840000
1324	17.93750	-97.31250	0.6090000
1325	17.93750	-97.43750	0.6620000
1326	17.93750	-97.56250	0.6730000
1327	17.93750	-97.68750	0.7040000
1328	17.93750	-97.81250	0.7070000
1329	17.93750	-97.93750	0.5390000
1330	17.93750	-98.06250	0.6010000
1331	17.93750	-98.18750	0.6430000
1332	17.93750	-98.31250	0.6000000
1333	17.93750	-98.43750	0.6700000
1334	17.93750	-98.56250	0.6550000
1335	17.93750	-98.68750	0.5690000
1336	17.93750	-98.81250	0.4740000
1342	17.93750	-99.56250	0.4900000
1343	17.93750	-99.68750	0.6990000
1344	17.93750	-99.81250	0.7660000
1345	17.93750	-99.93750	0.7700000
1346	18.06250	-100.0625	0.7540000
1347	18.06250	-100.1875	0.6610000
1348	18.06250	-100.3125	0.5420000
1349	18.06250	-100.4375	0.5390000
1350	18.06250	-100.5625	0.5170000
1359	18.06250	-101.6875	0.4650000
1360	18.06250	-101.8125	0.5760000
1361	18.06250	-101.9375	0.7100000
1362	18.06250	-102.0625	0.7560000
1363	18.06250	-102.1875	0.6940000
1364	18.06250	-102.3125	0.6700000
1365	18.06250	-102.4375	0.5810000

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1366	18.06250	-102.5625	0.5630000
1367	18.06250	-102.6875	0.5930000
1368	18.06250	-102.8125	0.6180000
1388	18.06250	-91.18750	0.4060000
1389	18.06250	-91.31250	0.4230000
1390	18.06250	-91.43750	0.4850000
1391	18.06250	-91.56250	0.4660000
1392	18.06250	-91.68750	0.4170000
1393	18.06250	-91.81250	0.4270000
1394	18.06250	-91.93750	0.4360000
1395	18.06250	-92.06250	0.4570000
1396	18.06250	-92.18750	0.4860000
1397	18.06250	-92.31250	0.4910000
1398	18.06250	-92.43750	0.4810000
1399	18.06250	-92.56250	0.4770000
1400	18.06250	-92.68750	0.4130000
1411	18.06250	-94.06250	0.4200000
1412	18.06250	-94.18750	0.4580000
1413	18.06250	-94.31250	0.4760000
1414	18.06250	-94.43750	0.4500000
1417	18.06250	-94.81250	0.4460000
1418	18.06250	-94.93750	0.4060000
1419	18.06250	-95.06250	0.4320000
1420	18.06250	-95.18750	0.4610000
1423	18.06250	-95.56250	0.6880000
1424	18.06250	-95.68750	0.6810000
1425	18.06250	-95.81250	0.6200000
1426	18.06250	-95.93750	0.6390000
1427	18.06250	-96.06250	0.6320000
1428	18.06250	-96.18750	0.5910000
1429	18.06250	-96.31250	0.5500000
1430	18.06250	-96.43750	0.4890000
1437	18.06250	-97.31250	0.6120000
1438	18.06250	-97.43750	0.5920000
1439	18.06250	-97.56250	0.6810000
1440	18.06250	-97.68750	0.6860000
1441	18.06250	-97.81250	0.7580000
1442	18.06250	-97.93750	0.6900000
1443	18.06250	-98.06250	0.6530000
1444	18.06250	-98.18750	0.6080000
1445	18.06250	-98.31250	0.5900000
1446	18.06250	-98.43750	0.7010000
1447	18.06250	-98.56250	0.6990000
1448	18.06250	-98.68750	0.6150000
1449	18.06250	-98.81250	0.5280000
1450	18.06250	-98.93750	0.4460000
1451	18.06250	-99.06250	0.4630000
1454	18.06250	-99.43750	0.4910000
1455	18.06250	-99.56250	0.5400000
1456	18.06250	-99.68750	0.7280000
1457	18.06250	-99.81250	0.6830000
1458	18.06250	-99.93750	0.7410000
1459	18.18750	-100.0625	0.7000000
1460	18.18750	-100.1875	0.5900000
1461	18.18750	-100.3125	0.5280000
1462	18.18750	-100.4375	0.5260000
1463	18.18750	-100.5625	0.4380000
1472	18.18750	-101.6875	0.4620000
1473	18.18750	-101.8125	0.5560000
1474	18.18750	-101.9375	0.6230000
1475	18.18750	-102.0625	0.7280000
1476	18.18750	-102.1875	0.7330000

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1477	18.18750	-102.3125	0.6810000
1478	18.18750	-102.4375	0.6070000
1479	18.18750	-102.5625	0.5830000
1480	18.18750	-102.6875	0.5950000
1481	18.18750	-102.8125	0.6190000
1482	18.18750	-102.9375	0.6390000
1483	18.18750	-103.0625	0.6840000
1484	18.18750	-103.1875	0.7220000
1505	18.18750	-91.18750	0.4150000
1506	18.18750	-91.31250	0.4530000
1507	18.18750	-91.43750	0.4670000
1508	18.18750	-91.56250	0.4920000
1509	18.18750	-91.68750	0.4590000
1510	18.18750	-91.81250	0.4680000
1511	18.18750	-91.93750	0.4640000
1512	18.18750	-92.06250	0.4960000
1513	18.18750	-92.18750	0.4970000
1514	18.18750	-92.31250	0.4490000
1515	18.18750	-92.43750	0.4460000
1516	18.18750	-92.56250	0.4370000
1517	18.18750	-92.68750	0.4440000
1518	18.18750	-92.81250	0.4560000
1521	18.18750	-93.18750	0.4090000
1522	18.18750	-93.31250	0.4300000
1523	18.18750	-93.43750	0.4080000
1528	18.18750	-94.06250	0.4320000
1529	18.18750	-94.18750	0.4800000
1530	18.18750	-94.31250	0.4970000
1531	18.18750	-94.43750	0.4700000
1538	18.18750	-95.31250	0.6180000
1539	18.18750	-95.43750	0.7440000
1540	18.18750	-95.56250	0.6860000
1541	18.18750	-95.68750	0.5470000
1542	18.18750	-95.81250	0.5400000
1543	18.18750	-95.93750	0.6720000
1544	18.18750	-96.06250	0.6410000
1545	18.18750	-96.18750	0.5090000
1546	18.18750	-96.31250	0.4520000
1547	18.18750	-96.43750	0.5040000
1554	18.18750	-97.31250	0.4880000
1555	18.18750	-97.43750	0.4970000
1556	18.18750	-97.56250	0.5370000
1557	18.18750	-97.68750	0.5460000
1558	18.18750	-97.81250	0.6610000
1559	18.18750	-97.93750	0.6450000
1560	18.18750	-98.06250	0.6510000
1561	18.18750	-98.18750	0.5260000
1562	18.18750	-98.31250	0.4740000
1563	18.18750	-98.43750	0.7180000
1564	18.18750	-98.56250	0.6840000
1565	18.18750	-98.68750	0.6010000
1566	18.18750	-98.81250	0.5140000
1567	18.18750	-98.93750	0.4480000
1568	18.18750	-99.06250	0.5800000
1569	18.18750	-99.18750	0.4080000
1572	18.18750	-99.56250	0.4990000
1573	18.18750	-99.68750	0.5570000
1574	18.18750	-99.81250	0.5010000
1575	18.18750	-99.93750	0.6250000
1576	18.31250	-100.0625	0.5520000
1577	18.31250	-100.1875	0.5970000
1578	18.31250	-100.3125	0.5660000

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1579	18.31250	-100.4375	0.4480000
1589	18.31250	-101.6875	0.4990000
1590	18.31250	-101.8125	0.6340000
1591	18.31250	-101.9375	0.5530000
1592	18.31250	-102.0625	0.6860000
1593	18.31250	-102.1875	0.7440000
1594	18.31250	-102.3125	0.6830000
1595	18.31250	-102.4375	0.5910000
1596	18.31250	-102.5625	0.5750000
1597	18.31250	-102.6875	0.5900000
1598	18.31250	-102.8125	0.6320000
1599	18.31250	-102.9375	0.6570000
1600	18.31250	-103.0625	0.6800000
1601	18.31250	-103.1875	0.6540000
1602	18.31250	-103.3125	0.6660000
1603	18.31250	-103.4375	0.6420000
1604	18.31250	-103.5625	0.6150000
1629	18.31250	-91.31250	0.4360000
1630	18.31250	-91.43750	0.4640000
1632	18.31250	-91.68750	0.4380000
1633	18.31250	-91.81250	0.4590000
1634	18.31250	-91.93750	0.4580000
1635	18.31250	-92.06250	0.4800000
1636	18.31250	-92.18750	0.5050000
1637	18.31250	-92.31250	0.4610000
1638	18.31250	-92.43750	0.4380000
1639	18.31250	-92.56250	0.4330000
1640	18.31250	-92.68750	0.4420000
1643	18.31250	-93.06250	0.4540000
1644	18.31250	-93.18750	0.4430000
1645	18.31250	-93.31250	0.4220000
1646	18.31250	-93.43750	0.4260000
1647	18.31250	-93.56250	0.4300000
1652	18.31250	-94.68750	0.4670000
1653	18.31250	-94.81250	0.4710000
1658	18.31250	-95.43750	0.6430000
1659	18.31250	-95.56250	0.6480000
1660	18.31250	-95.68750	0.5740000
1661	18.31250	-95.81250	0.5640000
1662	18.31250	-95.93750	0.5470000
1663	18.31250	-96.06250	0.4310000
1664	18.31250	-96.18750	0.4230000
1665	18.31250	-96.31250	0.4810000
1666	18.31250	-96.43750	0.5350000
1667	18.31250	-96.56250	0.4690000
1674	18.31250	-97.43750	0.4070000
1676	18.31250	-97.68750	0.6200000
1677	18.31250	-97.81250	0.5030000
1678	18.31250	-97.93750	0.5260000
1679	18.31250	-98.06250	0.5220000
1680	18.31250	-98.18750	0.5430000
1681	18.31250	-98.31250	0.5600000
1682	18.31250	-98.43750	0.6980000
1683	18.31250	-98.56250	0.6610000
1684	18.31250	-98.68750	0.4990000
1687	18.31250	-99.06250	0.5080000
1688	18.31250	-99.18750	0.4120000
1691	18.31250	-99.56250	0.6010000
1692	18.31250	-99.68750	0.5970000
1693	18.31250	-99.81250	0.6460000
1694	18.31250	-99.93750	0.7540000
1695	18.43750	-100.0625	0.7260000

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1696	18.43750	-100.1875	0.6980000
1697	18.43750	-100.3125	0.5110000
1708	18.43750	-101.6875	0.5070000
1709	18.43750	-101.8125	0.7260000
1710	18.43750	-101.9375	0.7610000
1711	18.43750	-102.0625	0.7840000
1712	18.43750	-102.1875	0.7670000
1713	18.43750	-102.3125	0.6630000
1714	18.43750	-102.4375	0.6010000
1715	18.43750	-102.5625	0.5860000
1716	18.43750	-102.6875	0.6120000
1717	18.43750	-102.8125	0.6580000
1718	18.43750	-102.9375	0.6810000
1719	18.43750	-103.0625	0.6370000
1720	18.43750	-103.1875	0.6420000
1721	18.43750	-103.3125	0.6760000
1722	18.43750	-103.4375	0.6370000
1723	18.43750	-103.5625	0.6340000
1749	18.43750	-91.43750	0.4080000
1750	18.43750	-91.56250	0.4630000
1751	18.43750	-91.68750	0.4630000
1752	18.43750	-91.81250	0.4940000
1753	18.43750	-91.93750	0.4600000
1754	18.43750	-92.06250	0.4850000
1755	18.43750	-92.18750	0.4950000
1756	18.43750	-92.31250	0.4930000
1757	18.43750	-92.43750	0.4790000
1758	18.43750	-92.56250	0.4450000
1759	18.43750	-92.68750	0.4080000
1762	18.43750	-93.06250	0.4410000
1763	18.43750	-93.18750	0.4910000
1764	18.43750	-93.31250	0.4340000
1767	18.43750	-93.68750	0.4240000
1774	18.43750	-95.56250	0.5920000
1775	18.43750	-95.68750	0.5090000
1776	18.43750	-95.81250	0.4280000
1777	18.43750	-95.93750	0.5880000
1778	18.43750	-96.06250	0.5490000
1779	18.43750	-96.18750	0.4740000
1780	18.43750	-96.31250	0.5320000
1781	18.43750	-96.43750	0.5290000
1783	18.43750	-96.68750	0.4610000
1790	18.43750	-97.56250	0.4850000
1791	18.43750	-97.68750	0.5150000
1792	18.43750	-97.81250	0.5660000
1793	18.43750	-97.93750	0.4760000
1795	18.43750	-98.18750	0.4150000
1796	18.43750	-98.31250	0.4750000
1797	18.43750	-98.43750	0.5820000
1798	18.43750	-98.56250	0.5000000
1805	18.43750	-99.43750	0.4740000
1806	18.43750	-99.56250	0.6340000
1807	18.43750	-99.68750	0.5430000
1808	18.43750	-99.81250	0.7060000
1809	18.43750	-99.93750	0.6180000
1810	18.56250	-100.0625	0.6850000
1811	18.56250	-100.1875	0.6980000
1812	18.56250	-100.3125	0.4010000
1823	18.56250	-101.6875	0.4700000
1824	18.56250	-101.8125	0.7230000
1825	18.56250	-101.9375	0.7160000
1826	18.56250	-102.0625	0.7850000

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1827	18.56250	-102.1875	0.8110000
1828	18.56250	-102.3125	0.6880000
1829	18.56250	-102.4375	0.6400000
1830	18.56250	-102.5625	0.6150000
1831	18.56250	-102.6875	0.6450000
1832	18.56250	-102.8125	0.6720000
1833	18.56250	-102.9375	0.6690000
1834	18.56250	-103.0625	0.6110000
1835	18.56250	-103.1875	0.6300000
1836	18.56250	-103.3125	0.6120000
1837	18.56250	-103.4375	0.6070000
1838	18.56250	-103.5625	0.6050000
1839	18.56250	-103.6875	0.5670000
1870	18.56250	-91.81250	0.4400000
1871	18.56250	-91.93750	0.4870000
1872	18.56250	-92.06250	0.4480000
1873	18.56250	-92.18750	0.4610000
1874	18.56250	-92.31250	0.4900000
1875	18.56250	-92.43750	0.4770000
1876	18.56250	-92.56250	0.4550000
1877	18.56250	-92.68750	0.4040000
1880	18.56250	-94.93750	0.4170000
1887	18.56250	-95.93750	0.5130000
1888	18.56250	-96.06250	0.6530000
1889	18.56250	-96.18750	0.5440000
1890	18.56250	-96.31250	0.5100000
1891	18.56250	-96.43750	0.5340000
1892	18.56250	-96.56250	0.5440000
1893	18.56250	-96.68750	0.5370000
1894	18.56250	-96.81250	0.5220000
1897	18.56250	-97.18750	0.4870000
1898	18.56250	-97.31250	0.4610000
1899	18.56250	-97.43750	0.4210000
1900	18.56250	-97.56250	0.4900000
1901	18.56250	-97.68750	0.4960000
1902	18.56250	-97.81250	0.5270000
1903	18.56250	-97.93750	0.4530000
1914	18.56250	-99.31250	0.4410000
1915	18.56250	-99.43750	0.5090000
1918	18.56250	-99.81250	0.6100000
1919	18.56250	-99.93750	0.5490000
1920	18.68750	-100.0625	0.6560000
1921	18.68750	-100.1875	0.6620000
1932	18.68750	-101.5625	0.5320000
1933	18.68750	-101.6875	0.5880000
1934	18.68750	-101.8125	0.7000000
1935	18.68750	-101.9375	0.7150000
1936	18.68750	-102.0625	0.7270000
1937	18.68750	-102.1875	0.7040000
1938	18.68750	-102.3125	0.7090000
1939	18.68750	-102.4375	0.6730000
1940	18.68750	-102.5625	0.6560000
1941	18.68750	-102.6875	0.7120000
1942	18.68750	-102.8125	0.6690000
1943	18.68750	-102.9375	0.6090000
1944	18.68750	-103.0625	0.6090000
1945	18.68750	-103.1875	0.5980000
1946	18.68750	-103.3125	0.5440000
1947	18.68750	-103.4375	0.5290000
1948	18.68750	-103.5625	0.5360000
1949	18.68750	-103.6875	0.5010000
1950	18.68750	-103.8125	0.4480000

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1981	18.68750	-91.81250	0.4100000
1982	18.68750	-91.93750	0.4440000
1983	18.68750	-92.06250	0.4240000
1984	18.68750	-92.18750	0.4580000
1985	18.68750	-92.31250	0.5040000
1986	18.68750	-92.43750	0.5090000
1987	18.68750	-92.56250	0.4630000
1988	18.68750	-95.18750	0.4230000
1994	18.68750	-95.93750	0.4780000
1995	18.68750	-96.06250	0.5970000
1996	18.68750	-96.18750	0.4760000
1997	18.68750	-96.31250	0.4230000
1999	18.68750	-96.56250	0.4860000
2000	18.68750	-96.68750	0.4880000
2001	18.68750	-96.81250	0.4680000
2002	18.68750	-96.93750	0.5140000
2003	18.68750	-97.06250	0.4960000
2004	18.68750	-97.18750	0.5620000
2005	18.68750	-97.31250	0.5110000
2006	18.68750	-97.43750	0.6090000
2007	18.68750	-97.56250	0.4990000
2008	18.68750	-97.68750	0.4760000
2009	18.68750	-97.81250	0.4970000
2010	18.68750	-97.93750	0.4130000
2021	18.68750	-99.31250	0.5980000
2022	18.68750	-99.43750	0.4950000
2025	18.68750	-99.81250	0.4770000
2026	18.68750	-99.93750	0.5320000
2027	18.81250	-100.0625	0.5350000
2028	18.81250	-100.1875	0.4280000
2037	18.81250	-101.3125	0.4590000
2038	18.81250	-101.4375	0.5320000
2039	18.81250	-101.5625	0.4480000
2040	18.81250	-101.6875	0.5220000
2041	18.81250	-101.8125	0.6050000
2042	18.81250	-101.9375	0.5470000
2043	18.81250	-102.0625	0.6370000
2044	18.81250	-102.1875	0.6880000
2045	18.81250	-102.3125	0.6550000
2046	18.81250	-102.4375	0.6770000
2047	18.81250	-102.5625	0.6450000
2048	18.81250	-102.6875	0.6830000
2049	18.81250	-102.8125	0.6530000
2050	18.81250	-102.9375	0.6480000
2051	18.81250	-103.0625	0.6380000
2052	18.81250	-103.1875	0.5980000
2053	18.81250	-103.3125	0.5350000
2054	18.81250	-103.4375	0.5180000
2055	18.81250	-103.5625	0.5200000
2056	18.81250	-103.6875	0.4120000
2091	18.81250	-91.68750	0.4610000
2092	18.81250	-95.81250	0.4700000
2093	18.81250	-95.93750	0.4520000
2094	18.81250	-96.06250	0.4810000
2095	18.81250	-96.18750	0.5140000
2096	18.81250	-96.31250	0.4600000
2098	18.81250	-96.56250	0.4040000
2099	18.81250	-96.68750	0.4860000
2100	18.81250	-96.81250	0.4760000
2101	18.81250	-96.93750	0.4590000
2102	18.81250	-97.06250	0.5060000
2103	18.81250	-97.18750	0.4190000

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2104	18.81250	-97.31250	0.5700000
2105	18.81250	-97.43750	0.5530000
2106	18.81250	-97.56250	0.4680000
2107	18.81250	-97.68750	0.5000000
2108	18.81250	-97.81250	0.5370000
2109	18.81250	-97.93750	0.5190000
2110	18.81250	-98.06250	0.4440000
2111	18.81250	-98.18750	0.6260000
2112	18.81250	-98.31250	0.4060000
2119	18.81250	-99.18750	0.4730000
2120	18.81250	-99.31250	0.7250000
2121	18.81250	-99.43750	0.5880000
2125	18.81250	-99.93750	0.4140000
2126	18.93750	-100.0625	0.4330000
2132	18.93750	-100.8125	0.4040000
2133	18.93750	-100.9375	0.4470000
2134	18.93750	-101.0625	0.4460000
2135	18.93750	-101.1875	0.4350000
2139	18.93750	-101.6875	0.4280000
2143	18.93750	-102.1875	0.6040000
2144	18.93750	-102.3125	0.5780000
2145	18.93750	-102.4375	0.6170000
2146	18.93750	-102.5625	0.5770000
2147	18.93750	-102.6875	0.5990000
2148	18.93750	-102.8125	0.6120000
2149	18.93750	-102.9375	0.6200000
2150	18.93750	-103.0625	0.6110000
2151	18.93750	-103.1875	0.5310000
2152	18.93750	-103.3125	0.5370000
2153	18.93750	-103.4375	0.5440000
2154	18.93750	-103.5625	0.5250000
2155	18.93750	-103.6875	0.4230000
2157	18.93750	-103.9375	0.5200000
2158	18.93750	-104.0625	0.5440000
2191	18.93750	-96.18750	0.4030000
2192	18.93750	-96.31250	0.4430000
2193	18.93750	-96.43750	0.4710000
2194	18.93750	-96.56250	0.5360000
2195	18.93750	-96.68750	0.5330000
2196	18.93750	-96.81250	0.5630000
2197	18.93750	-96.93750	0.5460000
2198	18.93750	-97.06250	0.5200000
2199	18.93750	-97.18750	0.4850000
2200	18.93750	-97.31250	0.5070000
2202	18.93750	-97.56250	0.5200000
2203	18.93750	-97.68750	0.6420000
2204	18.93750	-97.81250	0.5790000
2205	18.93750	-97.93750	0.6260000
2206	18.93750	-98.06250	0.5270000
2207	18.93750	-98.18750	0.6660000
2208	18.93750	-98.31250	0.5080000
2209	18.93750	-98.43750	0.5040000
2213	18.93750	-98.93750	0.4140000
2216	18.93750	-99.31250	0.7350000
2217	18.93750	-99.43750	0.4150000
2220	18.93750	-99.81250	0.4070000
2229	19.06250	-100.9375	0.4060000
2238	19.06250	-102.0625	0.4050000
2239	19.06250	-102.1875	0.5620000
2240	19.06250	-102.3125	0.5620000
2241	19.06250	-102.4375	0.5240000
2242	19.06250	-102.5625	0.5400000

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2243	19.06250	-102.6875	0.6050000
2244	19.06250	-102.8125	0.5590000
2245	19.06250	-102.9375	0.5170000
2246	19.06250	-103.0625	0.4730000
2248	19.06250	-103.3125	0.4440000
2249	19.06250	-103.4375	0.5180000
2250	19.06250	-103.5625	0.6230000
2251	19.06250	-103.6875	0.5370000
2252	19.06250	-103.8125	0.5070000
2253	19.06250	-103.9375	0.5130000
2254	19.06250	-104.0625	0.4950000
2255	19.06250	-104.1875	0.5190000
2256	19.06250	-104.3125	0.5950000
2257	19.06250	-104.4375	0.5190000
2289	19.06250	-96.31250	0.4390000
2290	19.06250	-96.43750	0.4420000
2291	19.06250	-96.56250	0.6310000
2292	19.06250	-96.68750	0.4460000
2293	19.06250	-96.81250	0.6470000
2294	19.06250	-96.93750	0.5520000
2295	19.06250	-97.06250	0.4730000
2296	19.06250	-97.18750	0.4030000
2297	19.06250	-97.31250	0.5470000
2300	19.06250	-97.68750	0.5840000
2301	19.06250	-97.81250	0.4930000
2302	19.06250	-97.93750	0.4690000
2303	19.06250	-98.06250	0.5320000
2304	19.06250	-98.18750	0.6020000
2305	19.06250	-98.31250	0.5950000
2306	19.06250	-98.43750	0.5070000
2307	19.06250	-98.56250	0.4130000
2308	19.06250	-98.68750	0.4020000
2309	19.06250	-98.81250	0.4350000
2310	19.06250	-98.93750	0.5290000
2311	19.06250	-99.06250	0.5120000
2312	19.06250	-99.18750	0.4970000
2313	19.06250	-99.31250	0.6590000
2316	19.06250	-99.68750	0.4290000
2338	19.18750	-102.4375	0.4330000
2339	19.18750	-102.5625	0.5260000
2340	19.18750	-102.6875	0.5860000
2341	19.18750	-102.8125	0.5260000
2342	19.18750	-102.9375	0.4760000
2343	19.18750	-103.0625	0.4390000
2344	19.18750	-103.1875	0.4610000
2345	19.18750	-103.3125	0.4900000
2346	19.18750	-103.4375	0.5480000
2347	19.18750	-103.5625	0.5920000
2348	19.18750	-103.6875	0.6320000
2349	19.18750	-103.8125	0.6250000
2350	19.18750	-103.9375	0.6040000
2351	19.18750	-104.0625	0.4170000
2352	19.18750	-104.1875	0.4530000
2353	19.18750	-104.3125	0.5740000
2354	19.18750	-104.4375	0.4540000
2356	19.18750	-104.6875	0.4540000
2357	19.18750	-104.8125	0.4670000
2388	19.18750	-96.43750	0.4750000
2389	19.18750	-96.56250	0.5800000
2390	19.18750	-96.68750	0.5970000
2391	19.18750	-96.81250	0.6400000
2392	19.18750	-96.93750	0.6230000

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2395	19.18750	-97.31250	0.4190000
2398	19.18750	-97.68750	0.5790000
2399	19.18750	-97.81250	0.5020000
2400	19.18750	-97.93750	0.5010000
2401	19.18750	-98.06250	0.5400000
2402	19.18750	-98.18750	0.5170000
2403	19.18750	-98.31250	0.5040000
2404	19.18750	-98.43750	0.5940000
2405	19.18750	-98.56250	0.5090000
2406	19.18750	-98.68750	0.4800000
2407	19.18750	-98.81250	0.4720000
2408	19.18750	-98.93750	0.5060000
2409	19.18750	-99.06250	0.4220000
2412	19.18750	-99.43750	0.5560000
2413	19.18750	-99.56250	0.4940000
2414	19.18750	-99.68750	0.4340000
2415	19.18750	-99.81250	0.4010000
2438	19.31250	-102.6875	0.5010000
2439	19.31250	-102.8125	0.4570000
2440	19.31250	-102.9375	0.4410000
2441	19.31250	-103.0625	0.4370000
2442	19.31250	-103.1875	0.4440000
2443	19.31250	-103.3125	0.4910000
2444	19.31250	-103.4375	0.6090000
2445	19.31250	-103.5625	0.6000000
2446	19.31250	-103.6875	0.6190000
2447	19.31250	-103.8125	0.6560000
2448	19.31250	-103.9375	0.5370000
2450	19.31250	-104.1875	0.5130000
2451	19.31250	-104.3125	0.4490000
2452	19.31250	-104.4375	0.4610000
2454	19.31250	-104.6875	0.4720000
2455	19.31250	-104.8125	0.4550000
2456	19.31250	-104.9375	0.5020000
2457	19.31250	-105.0625	0.5080000
2487	19.31250	-96.56250	0.5820000
2488	19.31250	-96.68750	0.5680000
2489	19.31250	-96.81250	0.4210000
2490	19.31250	-96.93750	0.6870000
2491	19.31250	-97.06250	0.4290000
2493	19.31250	-97.31250	0.4590000
2494	19.31250	-97.43750	0.4080000
2496	19.31250	-97.68750	0.6550000
2497	19.31250	-97.81250	0.5450000
2498	19.31250	-97.93750	0.5760000
2499	19.31250	-98.06250	0.5340000
2501	19.31250	-98.31250	0.4640000
2502	19.31250	-98.43750	0.5200000
2503	19.31250	-98.56250	0.5610000
2504	19.31250	-98.68750	0.4640000
2507	19.31250	-99.06250	0.4110000
2508	19.31250	-99.18750	0.4240000
2509	19.31250	-99.31250	0.4750000
2510	19.31250	-99.43750	0.5780000
2512	19.31250	-99.68750	0.5200000
2536	19.43750	-102.6875	0.4020000
2541	19.43750	-103.3125	0.4400000
2542	19.43750	-103.4375	0.6040000
2543	19.43750	-103.5625	0.6620000
2544	19.43750	-103.6875	0.6490000
2545	19.43750	-103.8125	0.6150000
2546	19.43750	-103.9375	0.5800000

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2548	19.43750	-104.1875	0.4320000
2549	19.43750	-104.3125	0.4010000
2550	19.43750	-104.4375	0.4990000
2551	19.43750	-104.5625	0.5380000
2552	19.43750	-104.6875	0.4950000
2553	19.43750	-104.8125	0.5010000
2554	19.43750	-104.9375	0.5930000
2555	19.43750	-105.0625	0.5340000
2584	19.43750	-96.68750	0.5970000
2585	19.43750	-96.81250	0.5310000
2586	19.43750	-96.93750	0.5710000
2587	19.43750	-97.06250	0.4360000
2589	19.43750	-97.31250	0.4510000
2590	19.43750	-97.43750	0.5250000
2591	19.43750	-97.56250	0.5190000
2592	19.43750	-97.68750	0.6710000
2593	19.43750	-97.81250	0.5510000
2594	19.43750	-97.93750	0.5430000
2595	19.43750	-98.06250	0.5230000
2597	19.43750	-98.31250	0.4230000
2598	19.43750	-98.43750	0.4920000
2599	19.43750	-98.56250	0.4080000
2600	19.43750	-98.68750	0.4440000
2601	19.43750	-98.81250	0.5990000
2602	19.43750	-98.93750	0.4400000
2603	19.43750	-99.06250	0.4150000
2604	19.43750	-99.18750	0.4530000
2605	19.43750	-99.31250	0.5440000
2606	19.43750	-99.43750	0.4450000
2607	19.43750	-99.56250	0.4670000
2608	19.43750	-99.68750	0.4010000
2615	19.56250	-100.5625	0.4260000
2616	19.56250	-100.6875	0.4060000
2622	19.56250	-101.4375	0.4310000
2623	19.56250	-101.5625	0.4820000
2624	19.56250	-101.6875	0.4330000
2632	19.56250	-102.6875	0.4200000
2637	19.56250	-103.3125	0.5050000
2638	19.56250	-103.4375	0.6100000
2639	19.56250	-103.5625	0.6670000
2640	19.56250	-103.6875	0.6330000
2641	19.56250	-103.8125	0.6870000
2642	19.56250	-103.9375	0.5240000
2643	19.56250	-104.0625	0.4530000
2645	19.56250	-104.3125	0.4400000
2647	19.56250	-104.5625	0.4670000
2648	19.56250	-104.6875	0.4260000
2649	19.56250	-104.8125	0.4050000
2650	19.56250	-104.9375	0.4700000
2651	19.56250	-105.0625	0.5220000
2652	19.56250	-105.1875	0.5880000
2682	19.56250	-96.68750	0.6690000
2683	19.56250	-96.81250	0.6300000
2684	19.56250	-96.93750	0.5700000
2685	19.56250	-97.06250	0.4580000
2686	19.56250	-97.18750	0.4110000
2687	19.56250	-97.31250	0.6130000
2688	19.56250	-97.43750	0.6050000
2689	19.56250	-97.56250	0.5160000
2690	19.56250	-97.68750	0.4500000
2691	19.56250	-97.81250	0.5030000
2692	19.56250	-97.93750	0.6260000

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2693	19.56250	-98.06250	0.4480000
2694	19.56250	-98.18750	0.5150000
2695	19.56250	-98.31250	0.5010000
2696	19.56250	-98.43750	0.5660000
2697	19.56250	-98.56250	0.4770000
2699	19.56250	-98.81250	0.5720000
2700	19.56250	-98.93750	0.5890000
2701	19.56250	-99.06250	0.5060000
2702	19.56250	-99.18750	0.5400000
2703	19.56250	-99.31250	0.4880000
2706	19.56250	-99.68750	0.4490000
2713	19.68750	-100.5625	0.5090000
2714	19.68750	-100.6875	0.4660000
2721	19.68750	-101.5625	0.4750000
2722	19.68750	-101.6875	0.4360000
2735	19.68750	-103.3125	0.5600000
2736	19.68750	-103.4375	0.5480000
2737	19.68750	-103.5625	0.6520000
2738	19.68750	-103.6875	0.6200000
2739	19.68750	-103.8125	0.6310000
2740	19.68750	-103.9375	0.4200000
2741	19.68750	-104.0625	0.4510000
2742	19.68750	-104.1875	0.4110000
2743	19.68750	-104.3125	0.4390000
2744	19.68750	-104.4375	0.4250000
2745	19.68750	-104.5625	0.4780000
2746	19.68750	-104.6875	0.4040000
2747	19.68750	-104.8125	0.4040000
2749	19.68750	-105.0625	0.4330000
2750	19.68750	-105.1875	0.5180000
2751	19.68750	-105.3125	0.6020000
2780	19.68750	-96.68750	0.6880000
2781	19.68750	-96.81250	0.6160000
2782	19.68750	-96.93750	0.5340000
2783	19.68750	-97.06250	0.4530000
2784	19.68750	-97.18750	0.4350000
2785	19.68750	-97.31250	0.6360000
2786	19.68750	-97.43750	0.6140000
2787	19.68750	-97.56250	0.5060000
2788	19.68750	-97.68750	0.4520000
2789	19.68750	-97.81250	0.4650000
2790	19.68750	-97.93750	0.6180000
2791	19.68750	-98.06250	0.6550000
2792	19.68750	-98.18750	0.6330000
2793	19.68750	-98.31250	0.5350000
2794	19.68750	-98.43750	0.6530000
2795	19.68750	-98.56250	0.5930000
2796	19.68750	-98.68750	0.4800000
2797	19.68750	-98.81250	0.5510000
2798	19.68750	-98.93750	0.5700000
2799	19.68750	-99.06250	0.5160000
2800	19.68750	-99.18750	0.6140000
2801	19.68750	-99.31250	0.5770000
2802	19.68750	-99.43750	0.4540000
2803	19.68750	-99.56250	0.5780000
2809	19.81250	-100.3125	0.4140000
2810	19.81250	-100.4375	0.5150000
2811	19.81250	-100.5625	0.4320000
2812	19.81250	-100.6875	0.4870000
2813	19.81250	-100.8125	0.4510000
2820	19.81250	-101.6875	0.4080000
2829	19.81250	-102.8125	0.4200000

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2831	19.81250	-103.0625	0.4700000
2832	19.81250	-103.1875	0.5320000
2833	19.81250	-103.3125	0.6730000
2834	19.81250	-103.4375	0.6940000
2835	19.81250	-103.5625	0.6790000
2836	19.81250	-103.6875	0.6850000
2837	19.81250	-103.8125	0.5140000
2838	19.81250	-103.9375	0.4340000
2839	19.81250	-104.0625	0.4340000
2840	19.81250	-104.1875	0.4400000
2841	19.81250	-104.3125	0.4640000
2842	19.81250	-104.4375	0.4400000
2843	19.81250	-104.5625	0.4370000
2844	19.81250	-104.6875	0.4330000
2848	19.81250	-105.1875	0.4670000
2849	19.81250	-105.3125	0.5660000
2850	19.81250	-105.4375	0.6070000
2879	19.81250	-96.68750	0.6090000
2880	19.81250	-96.81250	0.5360000
2881	19.81250	-96.93750	0.5140000
2882	19.81250	-97.06250	0.4970000
2883	19.81250	-97.18750	0.5280000
2884	19.81250	-97.31250	0.5340000
2885	19.81250	-97.43750	0.4820000
2886	19.81250	-97.56250	0.5360000
2887	19.81250	-97.68750	0.5820000
2888	19.81250	-97.81250	0.6050000
2889	19.81250	-97.93750	0.7060000
2890	19.81250	-98.06250	0.6600000
2891	19.81250	-98.18750	0.6400000
2892	19.81250	-98.31250	0.6180000
2893	19.81250	-98.43750	0.5150000
2894	19.81250	-98.56250	0.4970000
2895	19.81250	-98.68750	0.5230000
2896	19.81250	-98.81250	0.5840000
2902	19.81250	-99.56250	0.4510000
2903	19.81250	-99.68750	0.4120000
2911	19.93750	-100.6875	0.4940000
2912	19.93750	-100.8125	0.4180000
2919	19.93750	-101.6875	0.4140000
2920	19.93750	-101.8125	0.4920000
2921	19.93750	-101.9375	0.4300000
2930	19.93750	-103.0625	0.5310000
2931	19.93750	-103.1875	0.5980000
2932	19.93750	-103.3125	0.7370000
2933	19.93750	-103.4375	0.6890000
2934	19.93750	-103.5625	0.6790000
2935	19.93750	-103.6875	0.6550000
2936	19.93750	-103.8125	0.5900000
2937	19.93750	-103.9375	0.4590000
2938	19.93750	-104.0625	0.4270000
2939	19.93750	-104.1875	0.5060000
2940	19.93750	-104.3125	0.5520000
2948	19.93750	-105.3125	0.5240000
2949	19.93750	-105.4375	0.5140000
2978	19.93750	-96.81250	0.5190000
2979	19.93750	-96.93750	0.5160000
2981	19.93750	-97.18750	0.5020000
2982	19.93750	-97.31250	0.4790000
2986	19.93750	-97.81250	0.6820000
2987	19.93750	-97.93750	0.5890000
2988	19.93750	-98.06250	0.5310000

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2989	19.93750	-98.18750	0.5720000
2990	19.93750	-98.31250	0.5540000
2991	19.93750	-98.43750	0.5330000
2992	19.93750	-98.56250	0.5170000
2993	19.93750	-98.68750	0.5790000
3018	20.06250	-101.8125	0.4400000
3019	20.06250	-101.9375	0.4250000
3027	20.06250	-102.9375	0.5040000
3028	20.06250	-103.0625	0.5970000
3029	20.06250	-103.1875	0.5810000
3030	20.06250	-103.3125	0.6890000
3031	20.06250	-103.4375	0.7100000
3032	20.06250	-103.5625	0.6230000
3033	20.06250	-103.6875	0.6160000
3034	20.06250	-103.8125	0.6210000
3035	20.06250	-103.9375	0.6020000
3036	20.06250	-104.0625	0.5360000
3037	20.06250	-104.1875	0.6570000
3038	20.06250	-104.3125	0.6610000
3039	20.06250	-104.4375	0.5260000
3046	20.06250	-105.3125	0.5230000
3047	20.06250	-105.4375	0.5390000
3048	20.06250	-105.5625	0.5420000
3075	20.06250	-96.93750	0.4930000
3076	20.06250	-97.06250	0.5250000
3077	20.06250	-97.18750	0.5200000
3078	20.06250	-97.31250	0.4570000
3086	20.06250	-98.31250	0.6140000
3087	20.06250	-98.43750	0.5540000
3088	20.06250	-98.56250	0.4950000
3089	20.06250	-98.68750	0.5080000
3090	20.06250	-98.81250	0.5530000
3091	20.06250	-98.93750	0.5430000
3092	20.06250	-99.06250	0.5200000
3093	20.06250	-99.18750	0.4980000
3094	20.06250	-99.31250	0.4110000
3124	20.18750	-103.0625	0.4150000
3125	20.18750	-103.1875	0.5760000
3126	20.18750	-103.3125	0.6450000
3127	20.18750	-103.4375	0.6090000
3128	20.18750	-103.5625	0.5770000
3129	20.18750	-103.6875	0.6240000
3130	20.18750	-103.8125	0.5070000
3131	20.18750	-103.9375	0.5930000
3132	20.18750	-104.0625	0.6210000
3133	20.18750	-104.1875	0.6120000
3134	20.18750	-104.3125	0.5440000
3135	20.18750	-104.4375	0.6210000
3136	20.18750	-104.5625	0.4220000
3140	20.18750	-105.0625	0.4330000
3141	20.18750	-105.1875	0.4480000
3142	20.18750	-105.3125	0.4110000
3143	20.18750	-105.4375	0.4580000
3144	20.18750	-105.5625	0.5240000
3172	20.18750	-97.06250	0.5420000
3173	20.18750	-97.18750	0.5080000
3174	20.18750	-97.31250	0.4840000
3175	20.18750	-97.43750	0.4730000
3176	20.18750	-97.56250	0.4060000
3177	20.18750	-97.68750	0.4260000
3178	20.18750	-97.81250	0.4230000
3183	20.18750	-98.43750	0.4520000

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3185	20.18750	-98.68750	0.5320000
3186	20.18750	-98.81250	0.6230000
3187	20.18750	-98.93750	0.4960000
3188	20.18750	-99.06250	0.5450000
3189	20.18750	-99.18750	0.5180000
3190	20.18750	-99.31250	0.4560000
3191	20.18750	-99.43750	0.4790000
3206	20.31250	-101.3125	0.4020000
3221	20.31250	-103.1875	0.5430000
3222	20.31250	-103.3125	0.6200000
3223	20.31250	-103.4375	0.5120000
3224	20.31250	-103.5625	0.5210000
3225	20.31250	-103.6875	0.5840000
3226	20.31250	-103.8125	0.5150000
3227	20.31250	-103.9375	0.5170000
3228	20.31250	-104.0625	0.5030000
3229	20.31250	-104.1875	0.5080000
3230	20.31250	-104.3125	0.5510000
3231	20.31250	-104.4375	0.5420000
3232	20.31250	-104.5625	0.5130000
3233	20.31250	-104.6875	0.4630000
3234	20.31250	-104.8125	0.5040000
3235	20.31250	-104.9375	0.5040000
3236	20.31250	-105.0625	0.5110000
3237	20.31250	-105.1875	0.4950000
3238	20.31250	-105.3125	0.4530000
3239	20.31250	-105.4375	0.4280000
3240	20.31250	-105.5625	0.4750000
3241	20.31250	-105.6875	0.4810000
3270	20.31250	-97.18750	0.5200000
3271	20.31250	-97.31250	0.4110000
3272	20.31250	-97.43750	0.5400000
3273	20.31250	-97.56250	0.4720000
3274	20.31250	-97.68750	0.4480000
3275	20.31250	-97.81250	0.4100000
3277	20.31250	-98.06250	0.4030000
3283	20.31250	-98.81250	0.5760000
3284	20.31250	-98.93750	0.5490000
3285	20.31250	-99.06250	0.5240000
3286	20.31250	-99.18750	0.5690000
3287	20.31250	-99.31250	0.5090000
3318	20.43750	-103.1875	0.4570000
3319	20.43750	-103.3125	0.4860000
3320	20.43750	-103.4375	0.4740000
3322	20.43750	-103.6875	0.5410000
3323	20.43750	-103.8125	0.5060000
3327	20.43750	-104.3125	0.5210000
3328	20.43750	-104.4375	0.5410000
3329	20.43750	-104.5625	0.5240000
3330	20.43750	-104.6875	0.4710000
3331	20.43750	-104.8125	0.4760000
3332	20.43750	-104.9375	0.5000000
3333	20.43750	-105.0625	0.4790000
3334	20.43750	-105.1875	0.4250000
3335	20.43750	-105.3125	0.4150000
3337	20.43750	-105.5625	0.4360000
3338	20.43750	-105.6875	0.4510000
3370	20.43750	-97.43750	0.4360000
3372	20.43750	-97.68750	0.4160000
3373	20.43750	-97.81250	0.4030000
3374	20.43750	-97.93750	0.5180000
3375	20.43750	-98.06250	0.4530000

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3376	20.43750	-98.18750	0.4210000
3379	20.43750	-98.56250	0.4320000
3380	20.43750	-98.68750	0.4460000
3384	20.43750	-99.18750	0.4880000
3385	20.43750	-99.31250	0.4540000
3386	20.43750	-99.43750	0.4160000
3418	20.56250	-103.4375	0.5230000
3419	20.56250	-103.5625	0.5300000
3420	20.56250	-103.6875	0.5230000
3421	20.56250	-103.8125	0.4470000
3425	20.56250	-104.3125	0.5330000
3426	20.56250	-104.4375	0.4800000
3427	20.56250	-104.5625	0.4760000
3428	20.56250	-104.6875	0.4910000
3429	20.56250	-104.8125	0.4520000
3430	20.56250	-104.9375	0.4590000
3467	20.56250	-97.43750	0.4020000
3468	20.56250	-97.56250	0.4910000
3469	20.56250	-97.68750	0.4420000
3470	20.56250	-97.81250	0.5470000
3471	20.56250	-97.93750	0.5120000
3472	20.56250	-98.06250	0.5140000
3473	20.56250	-98.18750	0.5260000
3474	20.56250	-98.31250	0.5210000
3475	20.56250	-98.43750	0.5210000
3476	20.56250	-98.56250	0.4760000
3477	20.56250	-98.68750	0.4880000
3482	20.56250	-99.31250	0.4370000
3516	20.68750	-103.5625	0.4320000
3517	20.68750	-103.6875	0.4680000
3526	20.68750	-104.8125	0.4090000
3527	20.68750	-104.9375	0.4360000
3528	20.68750	-105.0625	0.4360000
3529	20.68750	-105.1875	0.4060000
3559	20.68750	-97.18750	0.4080000
3560	20.68750	-97.31250	0.4510000
3561	20.68750	-97.43750	0.5100000
3562	20.68750	-97.56250	0.6330000
3563	20.68750	-97.68750	0.5090000
3564	20.68750	-97.81250	0.5940000
3565	20.68750	-97.93750	0.5950000
3566	20.68750	-98.06250	0.5660000
3567	20.68750	-98.18750	0.5000000
3568	20.68750	-98.31250	0.5240000
3569	20.68750	-98.43750	0.5310000
3570	20.68750	-98.56250	0.5670000
3571	20.68750	-98.68750	0.5120000
3572	20.68750	-98.81250	0.4100000
3573	20.68750	-98.93750	0.4200000
3611	20.81250	-103.6875	0.4320000
3614	20.81250	-104.0625	0.4710000
3620	20.81250	-104.8125	0.4250000
3621	20.81250	-104.9375	0.4330000
3622	20.81250	-105.0625	0.4520000
3623	20.81250	-105.1875	0.4540000
3656	20.81250	-97.31250	0.5210000
3657	20.81250	-97.43750	0.5340000
3658	20.81250	-97.56250	0.5960000
3659	20.81250	-97.68750	0.6100000
3660	20.81250	-97.81250	0.6050000
3661	20.81250	-97.93750	0.6180000
3662	20.81250	-98.06250	0.5470000

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3663	20.81250	-98.18750	0.5370000
3664	20.81250	-98.31250	0.5240000
3665	20.81250	-98.43750	0.4860000
3666	20.81250	-98.56250	0.5200000
3667	20.81250	-98.68750	0.4970000
3668	20.81250	-98.81250	0.4680000
3710	20.93750	-104.0625	0.4140000
3711	20.93750	-104.1875	0.4070000
3716	20.93750	-104.8125	0.4630000
3717	20.93750	-104.9375	0.5000000
3718	20.93750	-105.0625	0.4740000
3719	20.93750	-105.1875	0.4830000
3720	20.93750	-105.3125	0.4700000
3721	20.93750	-105.4375	0.4350000
3751	20.93750	-97.31250	0.5380000
3752	20.93750	-97.43750	0.5410000
3753	20.93750	-97.56250	0.5620000
3754	20.93750	-97.68750	0.5520000
3755	20.93750	-97.81250	0.5690000
3756	20.93750	-97.93750	0.5290000
3757	20.93750	-98.06250	0.5030000
3758	20.93750	-98.18750	0.5180000
3759	20.93750	-98.31250	0.4820000
3760	20.93750	-98.43750	0.4780000
3761	20.93750	-98.56250	0.4990000
3762	20.93750	-98.68750	0.5440000
3763	20.93750	-98.81250	0.5310000
3764	20.93750	-98.93750	0.4840000
3765	20.93750	-99.06250	0.4370000
3766	20.93750	-99.18750	0.4040000
3810	21.06250	-104.6875	0.4690000
3811	21.06250	-104.8125	0.4610000
3812	21.06250	-104.9375	0.4830000
3813	21.06250	-105.0625	0.5000000
3814	21.06250	-105.1875	0.5300000
3815	21.06250	-105.3125	0.5120000
3844	21.06250	-97.43750	0.5550000
3845	21.06250	-97.56250	0.5480000
3846	21.06250	-97.68750	0.5420000
3847	21.06250	-97.81250	0.4970000
3848	21.06250	-97.93750	0.4440000
3849	21.06250	-98.06250	0.4030000
3850	21.06250	-98.18750	0.4490000
3851	21.06250	-98.31250	0.5020000
3852	21.06250	-98.43750	0.5120000
3853	21.06250	-98.56250	0.5190000
3854	21.06250	-98.68750	0.5030000
3874	21.18750	-101.1875	0.4250000
3885	21.18750	-102.5625	0.4650000
3890	21.18750	-103.1875	0.4130000
3905	21.18750	-105.0625	0.4640000
3906	21.18750	-105.1875	0.5380000
3935	21.18750	-97.43750	0.6260000
3936	21.18750	-97.56250	0.5940000
3937	21.18750	-97.68750	0.5090000
3938	21.18750	-97.81250	0.4460000
3942	21.18750	-98.31250	0.5090000
3943	21.18750	-98.43750	0.5050000
3944	21.18750	-98.56250	0.4830000
3945	21.18750	-98.68750	0.4390000
3976	21.31250	-102.5625	0.4310000
3977	21.31250	-102.6875	0.4170000

Cont.

3996	21.31250	-105.0625	0.4380000
3997	21.31250	-105.1875	0.5030000
4023	21.31250	-97.43750	0.4030000
4024	21.31250	-97.56250	0.5350000
4025	21.31250	-97.68750	0.4470000
4030	21.31250	-98.31250	0.4580000
4031	21.31250	-98.43750	0.5060000
4032	21.31250	-98.56250	0.4880000
4033	21.31250	-98.68750	0.4650000
4085	21.43750	-105.1875	0.4040000
4105	21.43750	-97.43750	0.5310000
4106	21.43750	-97.56250	0.5340000
4112	21.43750	-98.31250	0.4200000
4113	21.43750	-98.43750	0.5050000
4114	21.43750	-98.56250	0.4980000
4115	21.43750	-98.68750	0.4810000
4116	21.43750	-98.81250	0.4450000
4125	21.43750	-99.93750	0.4260000
4132	21.56250	-100.8125	0.4510000
4167	21.56250	-105.1875	0.4190000
4184	21.56250	-97.56250	0.4090000
4191	21.56250	-98.43750	0.4500000
4192	21.56250	-98.56250	0.4300000
4195	21.56250	-98.93750	0.4600000
4201	21.56250	-99.68750	0.4900000
4202	21.56250	-99.81250	0.4610000
4203	21.56250	-99.93750	0.4370000
4244	21.68750	-105.0625	0.4050000
4266	21.68750	-99.56250	0.5080000
4267	21.68750	-99.68750	0.5650000
4268	21.68750	-99.81250	0.5250000
4269	21.68750	-99.93750	0.4440000
4302	21.81250	-104.0625	0.4170000
4305	21.81250	-104.4375	0.4120000
4306	21.81250	-104.5625	0.4010000
4308	21.81250	-104.8125	0.4200000
4309	21.81250	-104.9375	0.4510000
4310	21.81250	-105.0625	0.5050000
4311	21.81250	-105.1875	0.4170000
4312	21.81250	-105.3125	0.4810000
4313	21.81250	-105.4375	0.5230000
4314	21.81250	-105.5625	0.4710000
4315	21.81250	-97.68750	0.4630000
4316	21.81250	-97.81250	0.4740000
4331	21.81250	-99.68750	0.4710000
4332	21.81250	-99.81250	0.4480000
4333	21.81250	-99.93750	0.4860000
4334	21.93750	-100.0625	0.4690000
4369	21.93750	-104.4375	0.4340000
4370	21.93750	-104.5625	0.4160000
4371	21.93750	-104.6875	0.4380000
4372	21.93750	-104.8125	0.4280000
4373	21.93750	-104.9375	0.4450000
4374	21.93750	-105.0625	0.4130000
4376	21.93750	-105.3125	0.4340000
4377	21.93750	-105.4375	0.4840000
4378	21.93750	-105.5625	0.5390000
4379	21.93750	-97.68750	0.5160000
4380	21.93750	-97.81250	0.4870000
4397	21.93750	-99.93750	0.4780000
4398	22.06250	-100.0625	0.4850000
4433	22.06250	-104.4375	0.4060000

Cont.

4436	22.06250	-104.8125	0.4240000
4437	22.06250	-104.9375	0.4220000
4440	22.06250	-105.3125	0.4270000
4441	22.06250	-105.4375	0.4140000
4442	22.06250	-105.5625	0.4780000
4443	22.06250	-105.6875	0.4870000
4444	22.06250	-97.81250	0.4470000
4445	22.06250	-97.93750	0.4140000
4461	22.06250	-99.93750	0.4030000
4462	22.18750	-100.0625	0.5110000
4463	22.18750	-100.1875	0.4930000
4501	22.18750	-104.9375	0.4050000
4526	22.31250	-100.0625	0.4310000
4527	22.31250	-100.1875	0.4550000
4582	22.31250	-99.06250	0.4060000
4598	22.43750	-101.0625	0.4330000
4599	22.43750	-101.1875	0.5240000
4660	22.56250	-100.9375	0.4230000
4661	22.56250	-101.0625	0.4870000
4662	22.56250	-101.1875	0.5060000
4724	22.68750	-100.9375	0.4350000
4725	22.68750	-101.0625	0.4760000
4726	22.68750	-101.1875	0.5280000
4727	22.68750	-101.3125	0.4770000
4789	22.81250	-100.9375	0.4230000
4790	22.81250	-101.0625	0.5010000
4791	22.81250	-101.1875	0.5170000
4792	22.81250	-101.3125	0.4580000
4902	22.93750	-97.81250	0.4020000

Appendix Table B4. Qualifying Extraction Region Grid Points from Correlation of LW and Summer Precipitation Averaged from Cuauhtémoc la Fragua and Villareal

Point	Latitude	Longitude	r-value
1456	18.06250	-99.68750	0.4670000
1573	18.18750	-99.68750	0.4700000
1692	18.31250	-99.68750	0.4220000
2688	19.56250	-97.43750	0.4150000
2786	19.68750	-97.43750	0.4700000
2791	19.68750	-98.06250	0.4110000
2792	19.68750	-98.18750	0.4060000
2885	19.81250	-97.43750	0.4080000
2888	19.81250	-97.81250	0.4090000
2889	19.81250	-97.93750	0.4280000
2891	19.81250	-98.18750	0.4070000
3086	20.06250	-98.31250	0.4500000
3658	20.81250	-97.56250	0.4050000
3659	20.81250	-97.68750	0.4320000
3660	20.81250	-97.81250	0.4330000
3661	20.81250	-97.93750	0.4330000
3753	20.93750	-97.56250	0.4010000
3754	20.93750	-97.68750	0.4210000
3755	20.93750	-97.81250	0.4390000
3756	20.93750	-97.93750	0.4190000

Cont.

3846	21.06250	-97.68750	0.4080000
3847	21.06250	-97.81250	0.4190000
3848	21.06250	-97.93750	0.4030000
3935	21.18750	-97.43750	0.4620000
3936	21.18750	-97.56250	0.4210000
4024	21.31250	-97.56250	0.4100000
4471	22.18750	-101.1875	0.4810000
4725	22.68750	-101.0625	0.4150000
4726	22.68750	-101.1875	0.4080000

References

Anderson, B.T., Roads, J.O., Chen, S.C., Juang, H.M. 2000."Regional simulation of the low-level winds over the gulf of California and southwestern United States."*Journal of Geophysical Research*, 105 (D14), 17955-17969.

Berbery, E.H. 2001."Mesoscale moisture analysis of the North American Monsoon."*Journal of Climate* 14, 121-137.

Biondi, F., 2001.A 400-year tree-ring chronology from the tropical treeline of North America.*Ambio*, 30,162-166.

Cavazos T., Hastenrath, S. 1990. Convection and rainfall over Mexico and their modulation by the Southern Oscillation. *International Journal of Climatology* 10: 377-386.

Cleavland, M.K. 1983. X-ray densitometric measurement of climatic influence on the intra-annual characteristics of southwestern semiarid conifer tree-rings. Ph.D. dissertation, University of Arizona, 171 pp.

Cleaveland, M.K., E.R. Cook, and D.W. Stahle, 1992: Secular variability of the ENSO signal detected in tree– ring data from Mexico and the southern United States. In**:** *El Nino: Historical and Paleoclimatic Aspects of the Southern Oscillation* , edited by H. Diaz and V. Markgraf, Cambridge University Press, pp. 271–291.

Cleaveland M.K., D.W. Stahle, M.D. Therrell, J. Villanueva-Diaz, and B.T. Burns. 2003. "Tree-ring reconstructed winter precipitation and tropical teleconnections in Durango, Mexico." *Climatic Change,* 59: 369-388.

Cook, E.R. and Kairiukstis, L.A. (editors) 1990. Methods of Dendrochronology: Applications in the Env. Sciences. Kluwer Academic Publishers, Doredrecht.Pp. xii, 394.

Cook, E. R., D. M. Meko, D. W. Stahle, and M. K. Cleaveland, 1996: Tree-ring reconstructions of past drought across the coterminous United States: tests of a regression method and calibration/verification results. Pages 155-169 in J. S. Dean, D. M. Meko, and T. W. Swetnam, editors.*Tree Rings, Environment, and Humanity*. Radiocarbon, Tucson, AZ.

Cook, E.R., D.M. Meko, D.W. Stahle, M.K. Cleaveland. 1999. "Drought reconstructions for the continental United States." *Journal of Climate.*

Cook, E.R., C.A. Woodhouse, C.M. Eakin, D.M. Meko, and D.W. Stahle, 2004: Long-term aridity changes in the western United States. *Science,* 306, 5698: 1015-1018.

Daly, C., R.P. Neilson, and D.L. Phillips, 1994: A Statistical-Topographic Model for Mapping Climatological Precipitation over Mountainous Terrain. *J. Appl. Meteor.*, **33**, 140-158.

D'Arrigo, R.D., and G.C. Jacoby, 1991: A 1000-year record of winter precipitation from northwestern New Mexico, USA: A reconstruction from tree rings and its relation to El Nino and the Southern Oscillation. *Holocene*, 1, 95-101.

Davies, S. J., Metcalfe, S. E., Bernal-Brooks, F., Chacon-Torres, A., Farmer, J. G., Mackenzie, A. B. and Newton, A. J. 2005. "Lake Sediments Record Sensitivity of Two Hydrologically Closed Upland Lakes in Mexico to Human Impact." *Ambio*, 34(6), 470-475.

Debreczy, Z. and I. Rácz. 1995. New species and varieties of conifers from Mexico. *Phytologia* 78: 217-243.

Diaz, S.C., R. Touchan, T.W. Swetnam, 2001: A tree-ring reconstruction of past precipitation for Baja California Sur, Mexico. *International Journal* of *Climatology* **21**: 1007–1019

Douglas, M., Maddox, R.A., Howard, K., Reyes, S. 1993. "The Mexican Monsoon." *Journal of Climate* 6, 1665-1677.

Fernández, W. and J. A. Barrantes. 1996. "The Central American temporal: A long-lived tropical rain-producing system." *Top. Meteorology and Oceanography,* **3** (2) 73–88.

Flores, Marco A.S. 2008. "Assessing the variability of long-term Mexican instrumental records and the ENSO modulating force." Ph.D. dissertation, University of East Anglia, Climatic Research Unit.

Fowells, H. A. 1965. Silvics of forest trees of the United States. Washington, D. C. 762 p. (U. S. Department of Agriculture. Agriculture handbook no. 271)

Fye, F.K., D.W. Stahle, and E.R. Cook, 2003: Paleoclimatic analogs to twentieth-century moisture regimes across the United States. *Bulletin of the American Meteorological Society.*

Fye, F.K., D.W. Stahle, and E.R. Cook, 2004: Twentieth-century sea surface temperature patterns in the Pacific during decadal moisture regimes over the United States. *Earth Interactions* 8:22:1-22.

Fye, F.K., D.W. Stahle, E.R. Cook, and M.K. Cleaveland, 2006: NAO influence on sub-decadal moisture variability over central North America. *Geophysical Research Letters* 33, L15707.

Galindo, I., and Mosino, P. 1992. "Precipitation patterns in Mexico associated with ENSO." *Extended Abstracts, Paleo-ENSO Records Int. Symp.*, Lima, Peru, United Nations Development Programme, 111-115.

Galo, E. R., W. Fernández, and E. Zarate. 1996. “Aspectossinópticos y dinámicos del temporal del 29 de Octubre al 3 de Noviembre de 1985 sobre Costa Rica.” *Top.Meteor.Oceanogr.*,**3** (2) 107–123.

Gochis, D.J., Castillo, Louis Brito and Shuttleworth, James. 2005. “Hydroclimatology of the North American Monsoon region in northwest Mexico.” *Journal of Hydrology* 316 (1-4), pp. 53-70.

Hastenrath, S. 2002. “The Intertropical Convergence Zone of the Eastern Pacific Revisited.” *Int. J. Climatol*. 22: 347–356

Higgins, R.W., Chen, Y., Douglas, A.V. 1999. “Interannual variability of the North American warm season precipitation regime.”*Journal of Climate* 12, 653-680.

Hodell, D.A., M. Brenner, J.H. Curtis, T.P. Guilderson. 2001. “Solar Forcing of Drought Frequency in the Maya Lowlands.” *Science,* Vol. 292.

Hodell D.A., M. Brenner, J.H. Curtis. 2005. “Terminal classic drought in the northern Maya lowlands inferred from multiple sediment cores in Lake Chichancanab (Mexico).” *Quaternary Science Reviews*, Vol. 24, 12-13: 1413-1427.

Hodell D.A., M. Brenner, J.H. Curtis, Medina-Gonzalez,E.I. Can, A. Albornaz-Pat, and T.P. Guilderson. 2005. “Climate change on the Yucatan Peninsula during the little ice age.” *Quaternary Research* 63 (2): 109-121.

Hulme, M. 1994. “Validation of large-scale precipitation fields in general circulation models.” *Blobal Precipitation and Climate Change, NATO ASI Ser.* Vol. 126, pp. 387-406, Springer-Verlag, New York.

Hulme, M. T.J. Osborn, and T.C. Johns. 1998. “Precipitation sensitivity to global warming: comparison of observations with HadCM2 simulations.” *Geophysical Research Letters,* 25: 3379-3382.

Kottek, M., J. Grieser, C. Beck, B. Rudolf, and F. Rubel, 2006. “World Map of Koppen-Geiger Climate Classification updated.” *Meteorol. Z.*, **15**, 259-263.

Magaña V.O., 1998. Climatologia de Mexico. En: *Los impactos de El Nino en Mexico* (V. Magaña, Ed.). Centro de Ciencias de la Atmosfera, UNAM. Mexico, 228 pp.

Magaña V.O., J.A. Amador and S. Medina. 1999. “The midsummer drought over Mexico and Central America.” *J. Climate* **2**, 1577-1588.

Magaña V.O., J.L. Vazquez, J.L. Perez and J.B. Perez. 2003. “Impact of El Nino on precipitation in Mexico.” *Geofis. Int*. 42, 313-330.

Martínez, M. 1963. Las Pináceas Mexicanas, 3rd edition. Universidad Nacional Autónoma de México, Mexico City.

Maurer, E.P., A.W. Wood, J.C. Adam, D.P. Lettenmaier, and B. Nijssen. 2002. "A long-term hydrologically based dataset of land surface fluxes and states for the coterminous United States. *Journal of Climate, 15:* 3237-3251.

Meko, D.M. and C.H. Baisan. 2001. "Summer rainfall from latewood width." *International Journal of Climate,* 21: 697-708.

Metcalfe, S.E. 1987. "Historical Data and Climatic Change in Mexico- A Review." *The Geographical Journal,* Vol. 153, No.2, pp. 211-222.

Metcalfe, S. E. 2006. "Late Quaternary Environments of the Northern Deserts and Central Transvolcanic Belt of Mexico." *Annals- Missouri Botanical Garden*, 93(2), 258-273.

Mexico, in Europa World online. London, Routledge. University of Arkansas at Fayetteville. Retrieved 14 October 2010 from http://www.europaworld.com/entry

Mosino, A.P. and E. Garcia, 1966."Evaluacion de la sequiaintraestrival en la Republica Mexicana." Conferencia Regional Latinoamericana, Union Geografica Internacional, **3**, 500-516. Ciudad de Mexico, 9-15 de agosto.

Pavia, E.G., Graef, F., Reyes, J. 2006. "PDO-ENSO effects in the climate of Mexico." *American Meteorological Society* 19, pp. 6433-6438.

Peña, Malaquias and Michael W. Douglas. 2002. "Characteristics of Wet and Dry Spells over the Pacific Side of Central America during the Rainy Season." *Monthly Weather Review*, 130, 3054-3073

Peralta-Hernandez A.R., L.R. Barba-Martinez, V.O. Magaña, A.D. Matthias and J.J Luna-Ruiz. 2008. "Temporal and spatial behavior of temperature and precipitation during the Canicula (midsummer drought) under El Nino conditions in central Mexico." *Atmosfera,* **21** (3), 265-280.

Pohl, Kelly, Therrell MD, Blaly JS, Ayotte N, Cabrera-Hernandez JG, Diaz-Castro C, Cornejo-Oviedo EH, Elvir JA, Gonzalez-Elizondo,M., Opland D, Park J, Pederson G, Bernal-Salazar S, Vasquez-Selem L, Villanueva-Diaz J, Stahle DW. 2003. "A cool season precipitation reconstruction for Saltillo, Mexico." *Tree-Ring Research* 59(1):11–19

Portig, W. 1958. "Der Temporal von endeoktober 1957." *Meteor.Rundsch.,* **11**:150–156.

Quintas, I. 2000. “ERIC II: Documentation of the climatologic database and data extraction program.” *InstitutoMexicanodelTecnologia del Agua* (IMTA), pp. 54.

Sayles, E.B. 1936. “An Archaeological Survey of Chihuahua, Mexico.” *Medallion Papers*, No. 22. Gila Pueblo, Globe.

Schulman, E. 1944. “Dendrochronology in Mexico.” *Tree-Ring Bulletin,* 10, 18-24.

Scott, S.D. 1966. “Dendrochronology in Mexico.” University of Arizona Press, Tuscon.

Shepard, D.S. 1984. “Computer mapping: The SYMAP interpolation algorithm.” *Spatial Statistics and Models*, G.L. Gaile and C.J. Willmott, Eds., D. Reidel, 133-145.

Stahle, D.W., and Cleaveland, M.K. 1993. “Southern Oscillation extremes reconstructed from tree-rings of the Sierra Madre Occidental and southern Great Plains.” *Journal of Climate* 6, 129-140.

Stahle, D.W., D’Arrigo, R.D., Krusic, P.J., Cleaveland, M.K., Cook, E.R., Allan, R.J., Cole, J.E., Dunbar, R.B., Therrell, M.D., Gay, D.A., Moore, M.D., Stokes, M.A., Burns, B.T., Villanueva-Diaz, J., Thompson, L.G. 1998. “Experimental dendroclimatic reconstruction of the Southern Oscillation.” *Bulletin of the American Meteorological Society* 79(10), pp. 2137-2152.

Stahle D.W., Cleaveland M.K., Therrell M.D., Villanueva-Diaz J., 1999: Tree-Ring reconstruction of winter and summer precipitation in Durango, Mexico, for the past 600 years. In 10*th Symposium on Global Change Studies*, 10 –15 *January* 1999, *Dallas, TX*, Karl TR (Program Chairman). American Meteorological Society: Boston, MA; 317–318.

Stahle, D.W., M.D. Therrell, J. Villanueva-Diaz, E.C. Olviedo, 2003: The ancient Douglas fir (*Pseudotsugamenziesii)* Forest near Cuauhtemoc la Fragua, Puebla, Mexico. *Research Proposal*

Stahle, D.W., M.K. Cleaveland, H.D. Grissino-Mayer, R.D. Griffin, F.K. Fye, M.D. Therrell, D.J. Burnette, D.M. Meko, and J. Villanueva-Diaz. 2009. “Cool- and warm-season precipitation reconstruction over western New Mexico.” *American Meteorological Society.*

Therrell, M.D., J. Villanueva-Diaz, D.W. Stahle, and M.K. Cleaveland. 2002: Warm-season tree growth and precipitation over Mexico. *Journal of Geophysical Research,* 107, 4205.

Therrell, M.D., D.W. Stahle, M.K. Cleaveland, J. Villanueva-Diaz, E. Cornejo Oviedo, 2006: Tree-ring reconstructed maize yield in Central Mexico: 1474-2001. *Climatic Change* 74: 493-504.

Villanueva-Diaz, J., and G.R. McPherson. 1996. "Reconstruction of precipitation and PDSI from tree-ring chronologies developed in the mountains of New Mexico, USA and Sonora, Mexico." In Proceedings Meeting Hydrological Sect. J. Ariz. Nev. Academy of Sciences, 26: 45-54.

Visser, H. and Molenaar, J. 1988."Kalman filter analysis in dendroclimatology."*Biometrics*, 44, 929–940.

Whitmore T.J., M. Brenner, J.H. Curtis, B.H. Dahlin, and B.W. Leyden. 1996. "Climatic and human influences on lakes of theYucatan Peninsula, Mexico: an interdisciplinary, paleolimnological approach." *Holocene*, vil. 6, no. 3: 273-287.

Zhu C. and D.P. Lettenmaier. 2007. "Long-term climate and derived surface hydrology and energy flux data for Mexico." *Journal of Climate* 20, pp. 1936-1946.