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Historical Hydroclimatic Change At Theodore Roosevelt National Park: 1895 - 2011

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HISTORICAL HYDROCLIMATIC CHANGE AT THEODORE ROOSEVELT NATIONAL PARK: 1895 – 2011

by

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This thesis submitted by Rhonda Fietzek-DeVries in partial fulfillment of the requirements for the Degree of Master of Science from the University of North Dakota, has been read by the Faculty Advisory Committee under whom the work has been done, and is hereby approved.

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May 2, 2013

Date

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Rhonda Fietzek-DeVries
May 2013

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To my mom (Jan) and grandson (Gavin)

ABSTRACT

Although numerous studies have examined hydroclimatic and climatic changes in our national parks, no previous studies have examined historical temperature, precipitation and hydroclimatic changes at Theodore Roosevelt National Park (South Unit). Documenting historical trends in temperature, precipitation and hydroclimatic variables is important for understanding present and future changes in vegetation and wildlife.

I used 117 (1895 – 2011) years of temperature and precipitation data obtained from the PRISM data network to construct the historical climatic water budget time series based upon the Thornthwaite water-budget model. Trend lines and descriptive statistics are used to analyze the monthly, seasonal and annual climatic variables.

The results reveal positive trends in the mean annual (T_{mean}) and mean minimum (T_{min}) air temperatures at the 95% significance level. The mean annual air temperature increased at a rate of 1.6°C per century, while the mean annual maximum (T_{max}) and minimum air temperatures increased at rates of 0.9°C and 2.1°C per century, respectively, over the period of record (P-O-R). On a seasonal basis, a statistically significant positive trend was observed in all seasons for T_{min} and three seasons (winter, fall, spring) for T_{mean} air temperatures. T_{max} showed a significant positive trend for the summer and winter seasons. On a monthly basis, all months except June experienced a significant warming trend in the mean minimum air temperature. The various time series

reveal a tendency toward climate warming with significantly warmer winter and summer periods. The warming is greater in the mean minimum temperature than in the mean maximum temperature in the time series, resulting in a statistically significant decrease of the diurnal temperature range (DTR). Annual precipitation has decreased at a rate of 13.8 mm per century over the same period, although the trend is not statistically significant. Negative precipitation trends were observed in the summer and winter seasons. The winter season trend was statistically significant with a rate of -11.2 mm per century.

The Thornthwaite water balance model output variables indicated a significant increase in the mean annual potential evapotranspiration, and annual moisture deficit, and a statistically significant decrease in annual actual evapotranspiration, annual snow storage and the annual ratio of actual to potential evapotranspiration. The study site's increasing temperature and decreasing precipitation are consistent with global warming projections, which are driving a higher moisture deficit.

CHAPTER I

INTRODUCTION

Climate change is typically discussed in global terms, yet its effects are always felt at the local scale. Our national parks are one example of local scale climatic change that can serve as an early indicator of climate change (Burns et al., 2003). Their unique ecosystems are constrained within political boundaries that were set up mainly for the purpose of conservation and species protection (Burns et al., 2003), making them excellent areas to observe and monitor how native species are responding to changes created by climate and environmental change.

Located in west-central North Dakota, Theodore Roosevelt National Park (TRNP) is a semi-arid grassland ecosystem and is the state's only national park. The park is separated into two large tracts of land: the North and South Units and a third smaller Elkhorn Ranch site, all of which are located along the Little Missouri River. The South Unit of the park will be the focus of this study.

The National Park Service (NPS) initiated their Climate Change Response Strategy (http://www.nps.gov/climatechange/docs/NPS_CCRS.pdf) to address the consequences of climate change, however, only some individual parks have been equipped to monitor climate-sensitive indicators. TRNP was not chosen to be one of the parks monitored for the examination of climate change within its boundaries.

Although numerous studies (DiLeo, et al. 2003; Wise, 2012; Balling, et al. 1992; McCabe and Gray, 2010; Scott and Jones, 2005; Caffrey and Beavers, 2008) have examined hydroclimatic and/or climatic change in our national parks, there have been no previous empirical studies that examined historical temperature, precipitation and hydroclimatic changes at TRNP.

The National Park Service has stated that the mission of Theodore Roosevelt National Park is to preserve and protect the natural and cultural resources of the park for the benefit and enjoyment of this and future generations, and to honor Theodore Roosevelt's conservation legacy. Yet the park's own Statement for Management acknowledges that they have no existing budget or resources to monitor ambient conditions (National Parks System (NPS), 1989; NPS, 2011).

The purpose of this study is to examine historical climate and hydroclimatic changes at the TRNP South Unit, focusing upon monthly, seasonal, and annual air temperature, precipitation and climatic water budget variables. These changes can cause disturbance within these fragile ecosystems by changing vegetation cover, impacting wildlife, affecting wildfires and prescribed burning practices, and threatening local and regional tourism. This analysis of TRNP historical climatic and hydroclimatic data will document past climatic trends as well as provide a benchmark against which climatic change can be evaluated.

CHAPTER II

STUDY AREA

Location

Located in west-central North Dakota, TRNP is comprised of three geographically separated areas: a North and a South Unit and the Elkhorn Ranch site. The North Unit is located near Watford City, ND and the South Unit is near Medora, ND. The Elkhorn Ranch site, which is also under National Park Service jurisdiction, is located between the two units along the Little Missouri River (Fig.1). Much of the park's land lies within the deeply dissected valley walls of the Little Missouri River and minor ephemeral tributaries that feed into the river.

The total area for all three units is 285.0 km^2, with the South Unit encompassing 186.7 km^2 of the total area (NPS, 2012k). A break-down from the NPS of the total area is as follows:

- Total Federal: 285.0 km^2
- Total Nonfederal: 3.0 km^2
- Total Wilderness: 121.1 km^2
- South Unit / Wilderness: 186.7km^2 / 42.5 km^2
- North Unit / Wilderness: 97.5 km^2/ 78.5 km^2
- Elkhorn Ranch: 0.9 km^2

In 1978, 121.1 km^2 was designated wilderness and placed in the National Wilderness Preservation System for preservation in its natural condition (NPS, 2012l).

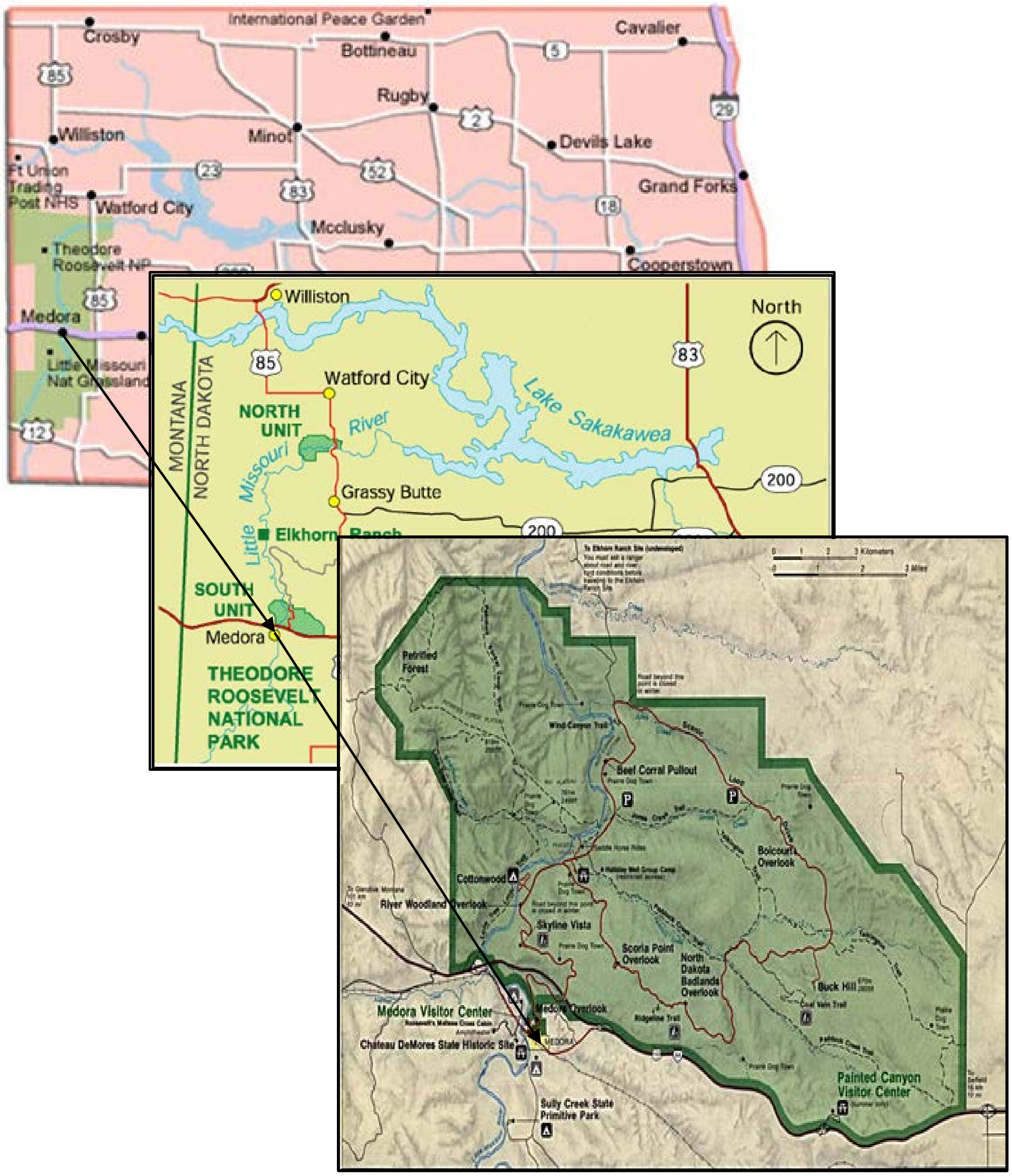

Figure 1. Location of study area. The South Unit of Theodore Roosevelt National Park is situated immediately north of Medora, ND, bordering Interstate Highway 94. Source: www.theodore.roosevelt.national-park.com/map.htm.

History

Following the death of Theodore Roosevelt in 1919, proposals were initiated to establish a memorial in his honor because of his contributions to the safekeeping and protection of our nation's resources. In 1934, the federal government signed into agreement the Roosevelt Regional Park Project. By 1941, construction of roads, trails, picnic areas, and campgrounds had been completed in the North and South Roosevelt Regional Parks (Uhler, 2007c).

An approval was acquired in 1942 to retain the Roosevelt Recreation Demonstration Area (RDA) for the purpose of possible inclusion into the National Park System, at which time the North Dakota state government announced that it did not want the land as a state park. State legislation failed to establish a park; it was vetoed because some felt the area did not possess the qualities that merit national park status. In November 1946, the RDA was officially transferred to the United States Fish and Wildlife Service as Theodore Roosevelt National Wildlife Refuge. After considerable negotiations and compromise, President Truman, in 1947, signed the bill (PL-38) that created Theodore Roosevelt National Memorial Park. This included lands that roughly make up today's South Unit and the Elkhorn Ranch site. The North Unit was added to the Memorial Park in 1948, with additional boundary revisions made in later years (Uhler, 2007c).

As a memorial park, it was the only one of its kind in the National Park System; the land was recognized for its diverse cultural and natural resources. On 10 November 1978, the area was given national park status when President Carter signed Public Law 95-625 that changed its name and designation to Theodore Roosevelt National Park (Uhler, 2007c).

Geology

TRNP is part of a physiographic region known as the Little Missouri Badlands (Bluemle, 1991). Part of the unglaciated Missouri Plateau lies within southwest North

Dakota; it is an eastward sloping plateau with terraced uplands and local badlands. Deposited during the Paleocene Epoch, the exposed sedimentary layers in most of the Little Missouri Badlands are between 55 and 65 million years old (Godfread, 1994). The rocks were elevated after deposition and buried by streams that transported large amounts of eroded material from the Rocky Mountains. The rocks have not been significantly deformed tectonically. The strata are horizontal with the exception of local areas of mass wasting (Bluemle, 1975; Godfread, 1994).

During the Pleistocene Epoch, continental ice sheets advanced southward from present-day Canada and reached as far as the park's North Unit boundary. The ice blocked the flow of the north-flowing rivers, forcing them to create new stream courses eastward and southward, causing them to empty into the Mississippi River instead of Hudson Bay. By the time the ice retreated, the northern portions of both the Little Missouri and Missouri rivers were entrenched in their new channels. The Little Missouri's new path in the north followed a steeper course, causing the whole river to flow faster and cut deeply into the land; the valley is surrounded by the upland surface of the Missouri Plateau. The primary factors in the badlands development were formed by the cutting action of rivulets and rills flowing down over steeply sloping faces of soft, fine-grained sediments composed mainly of clay and silt (Harris et al., 2004; Uhler, 2007b; Bluemle, 1991).

Lignite coal continues to shape the badlands. Lightning or spontaneous combustion can ignite coal beds which can then burn for many years. The underground burning bakes the overlying sediments into a hard, natural red brick called scoria. The mineral hematite, an iron oxide, gives the scoria its red color. The scoria not only lends color to the badlands but also helps to shape them. The rocks that have been heated are hardened to various degrees: clays and silts are fired as hard as brick and sands are melted and fused into glass. The fire-hardened rocks are more resistant to erosion than the unbaked rocks. Over time, erosion has worn down the less resistant rocks, leaving behind spectacular knobs, ridges and buttes (Harris et al., 2004; Uhler, 2007b).

Petrified wood is found throughout the region, particularly in the badlands, where stumps and intact trunks have weathered from the surrounding sediments. Many stumps are exposed on the Petrified Forest Plateau of the South Unit; these stumps are thought to be primarily species of the genus *Metasequoia*. Mollusks, fresh-water clams, turtles, and ancient alligator fossils have also been found within the geologic formations (NPS, 2012c; Von Loh et al., 2007).

The major hydrologic feature in TRNP is the Little Missouri River. The river flows north from its origins in Wyoming near the Black Hills and the Bighorn Mountains, through all three units of Theodore Roosevelt National Park, and finally to the Missouri River in central North Dakota. The depth of the river fluctuates widely throughout the year, usually reaching its peak depth in May and June with the runoff from the spring snow melt, and then is reduced to a shallow, meandering stream during the heat of summer. Sudden severe summer thunderstorms also cause occasional rises due to flash flooding. The tributary creeks flowing into the river typically trend southeast and northwest in the South Unit and west and south in the North Unit. There are numerous smaller drainages that are typically dry, flowing only during or following precipitation events. Many small ponds and reservoirs are present in the environs surrounding the park, in addition to wetland depressions, channels and a few active springs found at scattered locations throughout the park. Dugouts, check dams, larger earth fill dams, pumped ground water, and natural surface water supplies are used to support the grazing animals (Von Loh et al., 2007; NPS, 2012j).

Ecosystems

The topography of the Badlands provides for a vast diversity of plant life. Trees are not the dominant habitat type in the park, but they do provide an important element of the park's habitat diversity. There are primarily two types of forests: juniper woodlands and hardwood forests. Rocky Mountain juniper (*Juniperus scopulorum*) is the most common forest type in the park because the junipers benefit from the less intense solar irradiance and lower rates of evaporation of the microclimates on the north faces of the buttes. The dry climate limits the amount of hardwood forests; green ash (*Fraxinus pennsylvanica*), eastern cottonwood (*Populus deltoides*), quaking aspen (*Populus tremuloides*) American elm (*Ulmus americana*), and box elder (*Acer negundo*) occupy the heads of some draws on the Petrified Forest Plateau and near the river bottoms where water is more often available. The riparian woodlands are typically dense, and can occur as both evergreen and deciduous. The trees are typically taller within the river floodplain than in other areas because of increased water availability. Their ability to tap into ground water makes them more drought tolerant. These larger trees permit shrubby vegetation to grow beneath them, and the habitat favors some animals such as white-tailed deer, porcupines, and forest-dwelling birds (Harrington and Harman, 1991; NPS, 2012i).

River and stream ecosystems play a vital role within the park. The Little Missouri River and the numerous small creeks that feed into it support a wide variety of plants and animals. Small mammals, fish, ducks and geese, bald eagles and white pelicans utilize the river. The Little Missouri River is the only aquatic environment in the park that can support fish. Many of the park's large animals, such as bison, wild horses, and deer, find water in the river or temporary sources of drinking water when snow melts or heavy rains cause the creeks to flow (NPS, 2012g).

The flood plains adjacent to the Little Missouri River are a unique habitat type that contributes to the diversity of habitat, plants, and animals in the park. The periodic flooding of the Little Missouri River has allowed trees such as cottonwoods and green ash to become established on the flood plain. The cottonwoods provide valuable habitat for other plants and animals. White-tailed deer prefer the heavily wooded cottonwood forests. Numerous species of birds are attracted to the trees in the Little Missouri floodplain because of the diverse and abundant food sources and easy access to water. The flat, grassy areas on the floodplains provide grazing opportunities for the park's numerous grazing mammals, including bison, deer, horses, and elk. Prairie dog towns can be found at various locations on the floodplain as well. Although the forests, floodplain and river and streams are important ecosystems, prairie grassland is the most important and abundant ecosystem type found in TRNP (NPS, 2012f; Godfread, 1994).

Native Vegetation

The prairies have been maintained in their natural state by climate, grazing and fire. The mixed prairie grasses are able to cope with the low annual precipitation, going dormant as the relatively wet spring gives way to a dry, hot summer (NPS, 2012m). The grasslands encompass a rich and constantly changing diversity of plants and animals. Native grasses, forb species and shrubs encompass a diverse array of plants.

Approximately 500 species of vascular plants have been identified. While the majority of plants are typical of the Missouri Plateau, some species from the southwestern desert and Great Basin regions as well as from the boreal forests can be found in the park (NPS, 2010e; Root et al., 2001). The place to place variation in plant species is attributed to the individual species' ability to vie for scarce resources such as water (Harrington and Harman, 1991).

In the late 1990s, as part of the USGS-NPS Vegetation Mapping Program, approximately 31 vegetation types and six land use / land cover types were classified within the South Unit (Von Loh et al., 2007). Vegetation was described for the following eight major park habitat types:

- Mixed grass prairie
- Badland sparse vegetation
- Sandbars
- Shrublands
- Wetland
- Woodlands
- Prairie dog town sites
- Exotic herbaceous

Grasslands are distributed across deeper soils, including plains, valleys, buttes, and sand hills and ridges, but they can also occupy thin soils on gravelly slopes and hills that quickly release moisture. A mixture of low-growing shrubs, forbs, and grasses is also associated with the sparse vegetation on the badlands ridges, slopes, hills, and drainages (Von Loh et al., 2007).

Salt grass, western wheatgrass, needle-and-thread, and little bluestem are the most abundant grasses and provide valuable forage for grazing animals. Historic pastures are still populated by introduced species such as crested wheatgrass (*Agropyron cristatum*), Kentucky bluegrass (*Poa pratensis*), and smooth brome (*Bromus inermis*). Kentucky bluegrass covers extensive areas within the park, but is most abundant on the east side of the South Unit. Smooth brome and alfalfa (*Medicago sativa*) have been planted in disturbed road rights-of-way throughout the area. Preferring relatively moist conditions, yellow sweetclover (*Melilotus officianalis*) and white sweetclover (*Melilotus alba*) have invaded smaller areas in the South Unit (Root et al., 2001).

Although they may be abundant in a particular habitat, most grassland forbs are not constrained to a particular grassland type. The commencement of flowering of the earliest species is dependent on temperature (Godfread, 1994). Among the earliest of flowers, the pasque flower (*Anemone patens*), buttercup (*Ranunculus glaberrimus*) and pussytoes (*Antennaria parvifolia*) usually appear in April. Later flowering forbs such as the Prairie phlox (*Phlox hoodii*), wild parsley (*Musineon divaricatum*), yellow wild parsley (*Lomatium foeniculaceum*), prairie smoke (*Geum triflorum*), locoweed (*Oxytropis lambertii*) and golden pea (*Thermopsis rhombifo lia*) generally begin to appear in May (Godfread, 1994).

The Badland habitats are characterized by a sparse (typically 5% to 10% cover) mixture of low-growing shrubs, forbs (broad-leaved herbs other than grass), and grasses (Von Loh et al., 2007). They are found on exposed cliffs, ridges, slopes, narrow gorges, buttes, mounds, fans, and drainages. The most abundant shrubs in the badlands sparse vegetation complex at the park include broom snakeweed (*Gutierrezia sarothrae*), Wyoming big sagebrush (*Artemisia tridentata*), spiny saltbush (*Atriplex confertifolia*), and winterfat (*Krascheninnikovia lanata*). American sea-blite (*Sueda depressa*) and inland saltgrass (*Distichlis spicata*) are the most common grasses found in this habitat, while Barr's milkvetch (*Astragalus barrii*), Dakota wild buckwheat (*Eriogonum visheri*), and tufted evening-primrose (*Oenothera caespitosa*) are typical forbs. Sparse vegetation communities dominated by three-leaved sumac or sparse Rocky Mountain juniper stands are located on landscapes with exposures of scoria (Von Loh et al., 2007).

Sandbar habitats created by the changes of water levels in the Little Missouri River are very sparsely vegetated, with weedy communities found on newly exposed and deposited sandbars. Because of the dynamic environment in which this community is located, the number of species in an area is relatively low and consists primarily of the exotic spiny cocklebur (*Xanthium spinosum*) or lesser burdock (*Arctium minus*) (Von Loh et al., 2007).

Shrublands are widespread, inhabiting all major drainages, heads of draws, hillslopes, and flats. Riparian shrublands include stands of sandbar willow (*Salix interior*) in the moderately moist habitats, and broad expanses of silver sagebrush (*Artemisia cana*) and buckbrush (*Symphoricarpos occidentalis*) across floodplains. These typical floodplain species and the silver buffaloberry (*Shepherdia argentea*) can also be found occupying intermittent drainages, mesic swales and upland depressions outside the floodplain. Preferring extreme dry conditions, black sagebrush (*Artemisia tridentata*), rabbitbrush (*Chrysothamnus nauseosus*), and saltbush (*Atriplex confertifolia and A. canescens*) communities occupy narrow terraces and benches above the valley floor in the badlands as well (Von Loh et al., 2007; Godfread, 1994).

Other widely distributed vegetation types in and around TRNP include wetland and prairie dog towns. Wetlands, though relatively rare due to extensive erosion, are found in depressions, meandering drainages, seeps, springs, and old oxbows. Wetland vegetation such as cattail (*Typha angustifolia*) and prairie cordgrass (*Spartina pectinata*) can also be found in the shallower water of ponds developed for livestock and seepage zones below dam structures (Von Loh et al., 2007).

Prairie dog town sites are often dominated by early successional forbs, many of them exotic, including fetid marigold (*Dyssodia papposa*), bigbract verbena (*Verbena bracteata*), field bindweed (*Convolvulus arvensis*), and mullein (*Verbascum thapsus*) (Godfread, 1994; Von Loh et al., 2007).

The absence of fire has allowed woodier plants such as sagebrush, wild rose and junipers to become established, displacing many of the grasses and forbs. Periodic fire, whether natural or prescribed by the park, is necessary to improve habitat and forage diversity. Fire reduces the woody vegetation and removes litter, which allows early successional grasses and forbs to re-establish themselves. Prairie plants have adapted to fires by growing underground storage structures, and having their growth points slightly below ground surface. The soil under a prairie is a dense mat of tangled roots, rhizomes, bulbs, and rootstock. The plants die back every winter, but are kept alive from year to year by their underground root systems. As some of these roots die and decompose each year they add organic matter to the soil (Benders-Hyde, 2010; NPS, 2010b).

Numerous studies have been made describing grassland communities in North Dakota. Hanson and Whitman (1938) were the first to identify major grassland types in western North Dakota. Other important studies of western North Dakota grasslands include those by Hansen et al. (1984), Hirch (1985), Butler et al. (1986) and Von Loh et al. (2007). While many grassland communities have common species, the difference in the abundance of a particular species in a community depends upon moisture, soil and salinity (Godfread, 1994). Soils in the park are formed from bedrock eroded and washed into old alluvial deposits on high terraces, recent alluvial deposits on floodplains, and sand and loess deposited by wind on uplands. The typical soils of the park are described as regosols belonging to the Baineville Series (Von Loh et al., 2007). Entisols and Mollisols are the most predominant soil orders present in the South Unit. Entisols develop from the deposits of steep slope erosion, alluvial floodplain deposition, and eolian deposition. Mollisols are prairie soils characterized by a darkening of the soil due to the addition of organic matter (Von Loh et al., 2007).

Non-Native Invasive Species

More than 60 species of exotic plants can be found within the park's boundaries, and many were introduced prior to its designation as a national park. Leafy spurge (*Euphorbia esula*), spotted knapweed (*Centaurea maculosa*), Russian knapweed (*Centarurea* repens), Canada thistle (*Cirsium arvense*), black henbane (*Hyoscyamus niger*), absinth wormwood (*Artemisia absinthium*) and salt cedar or tamarisk (*Tamarix ramosissima*) have become serious invaders and have caused substantial habitat damage. They have few enemies and are not eaten by the native grazing species. They also have the ability to produce a toxin that suppresses the growth of neighboring plants (NPS, 2010d). Non-native invasive plant species are considered a threat because they can replace native species and decrease plant species diversity, which may further reduce or jeopardize populations of rare plant species. They also reduce the land's carrying capacity for livestock and grazing wildlife, may be poisonous to livestock or wildlife, carry detrimental insects, diseases, or parasites, alter the intensity and patterns of fires, increase soil nitrogen levels to the detriment of native species, cause increased soil erosion and runoff, and generally degrade or destroy wildlife habitat (Trammell, 1994). The most aggressive of the exotic plant species at TRNP is leafy spurge (*Euphorbia esula*), first observed in the park in the late 1960's (Trammell, 1994). It is now found throughout the park in all habitat types, although it prefers streambeds, drainages, and wooded draws. The control of leafy spurge infestations has become a primary resource management issue at TRNP (Root et al., 2001).

Changes in precipitation and temperature will have the most profound impact on the geographic ranges of many species. Changes in precipitation could cause water-loving or water-resistant species to outcompete one another (Dukes and Mooney, 1999). Rising temperatures would allow the spread northward of some species currently restricted in their northern ranges due to, for example, the probability of an early freeze. Increasing temperatures can enhance winter survival of some invasive organisms that would not survive otherwise (Simberloff, 2000).

Wildlife

TRNP supports numerous wildlife species including many animal species native to the northern Great Plains. A total of 252 species of vertebrate wildlife have been recorded in the park (NPS, 1989). Park personnel actively manage some of the larger mammals to ensure the overall health of the park's vegetation resource. These include bison (*Bison bison*), pronghorn antelope (*Antilocapra americana*), mule and white-tailed deer (*Odocoileus hemionus and O. virginianus*), Rocky Mountain elk (*Cervus elaphus*), Rocky Mountain bighorn sheep (*Ovis canadensis*), horse (*Equus caballus*), and the black-tailed prairie dog (*Cynomys ludovicianus*) (NPS, 2010c). These grazing animals rely on the abundance of prairie grasses and forbs to provide valuable forage, nutrients and habitat for their survival. Domesticated cattle and sheep do not currently graze within the park, although adjacent grasslands under private ownership or managed by U.S. Forest Service are grazed annually (Von Loh et al., 2007).

Both bison and feral horse populations are actively managed. Park resource managers maintain herd size that is compliant with the carrying capacity of the park's ranges. The carrying capacity reflects forage productivity and range size. It is the range's ability to produce forage to meet the requirements of grazing animals. Climatic changes such as increased atmospheric concentration of CO2, changes in temperature, and changes in precipitation amounts and patterns have the potential to affect rangeland ecosystems by affecting the quality and quantity of forage produced (Baker and Viglizzo, 1998).

In 1956, 29 bison were reintroduced into the South Unit (NPS, 2012d). The park has conducted regular bison roundups (about every 3-5 years) since 1962, and since 1993, resource managers have used a forage allocation model as a guide when establishing population objectives (200-300) for bison in the South Unit (Westfall et al., 2002). Current park policy allows the culled bison to be transferred to other agencies including zoos, national parks, and to Native American tribes. A total of 2,992 bison have been shipped out of the park between the years 1962-2008 (NPS, 2012d; NPS, 2012e).

The horse population in the South Unit has historically varied between 70-110 animals (NPS, 2012h). As with bison, park resource managers use the forage allocation model as a guide for setting a population objective of 50 to 90 horses in the South Unit (Westfall et al., 2002). Feral horse roundups have been used to actively manage these herds to satisfy park and herd objectives; as necessary, additional reduction strategies are implemented to reduce the number of horses to approximately 60 (NPS, 2012h).

There are also several varieties of snakes, lizards and turtles as well as a few amphibians that make the park their home, and over 186 types of birds can be found living in or passing through the park (NPS, 2009a,b; NPS, 2010a).

Climate

TRNP lies within the Northern Great Plains and has a designated Köppen-Geiger climate classification of BSk (steppe climate denoting that at least one month averages below 32°F). It is typified by a semi-arid, continental climate that includes short, hot, dry summers; long, cold, dry winters; warm, sunny days; cool nights; low rainfall and low humidity (NWS Internet Service Team, 2011; Godfread, 1994). The average wind speed is greatest in late winter and early spring and least in summer with a mean annual wind speed of 11 mph (USGS/Northern Prairie Wildlife Research Center, 2013).

This area of the Great Plains has a distinctive continental climate (Rosenberg, 1986). The area experiences a wide range in its diurnal (night to day) and annual (winter to summer) air temperatures as dictated by continentality. Temperatures in the spring and fall seasons can vary dramatically and change abruptly within short time periods. Daytime temperatures over 38º C are fairly common in July and August. Winter daily lows sometimes reach below -40º C. Average temperatures recorded for the Medora

Weather Station range from -11.9 °C in January to 21.2 °C in July with a mean annual air temperature (T_{mean}) of 14.5 °C (WRCC, 2012). Figure 2 presents a climograph of mean maximum and minimum monthly air temperatures and mean monthly precipitation for Medora, North Dakota.

Precipitation is irregularly distributed, and amounts vary from year to year in the prairies; there is usually a long dry period during the summer months (Rosenberg, 1986). Annual precipitation is 375.2 mm, with 79.5 cm of annual snowfall (79.5 mm water equivalent) (WRCC, 2012). Precipitation for this region is usually heaviest in late spring and early summer (75% falls between April and September), which coincides with the growing season that extends roughly from mid-May to mid-September (NPS, 2010f).

Winter precipitation is light and occurs as snow, although some rain can be experienced well into October (Jensen, 1972). During most winters the snow cover is less than 12 inches. However, the strong winds usually redistribute the snow cover so that large drifts accumulate in sheltered areas to the obvious benefit of some plant communities (NWS Internet Service Team, 2011).

The combined effect of high air temperatures, low humidity, strong winds and clear skies usually indicates a very rapid consumption of water by plants. The annual evaporation demand exceeds annual rainfall in most years, which leads to a regional water supply deficit. Recurrent drought is also a part of the regional climate, which will usually increase the mean air temperature (Rosenberg, 1986).

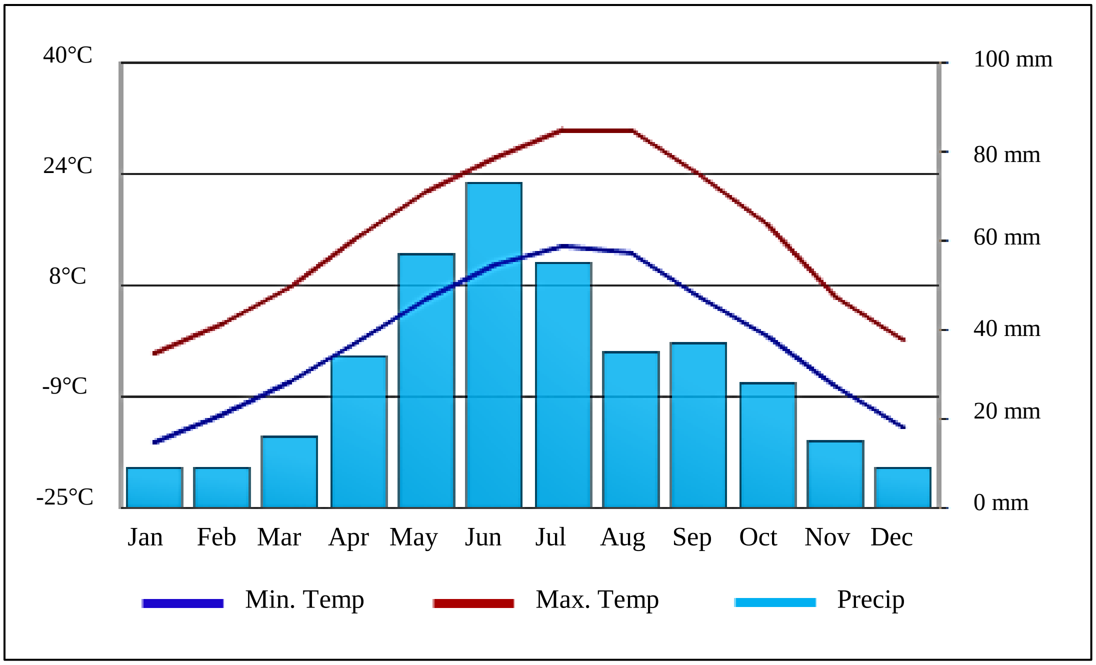

Figure 2. Climograph for Medora, North Dakota. Source: U.S. Climate Data, 2012.

Tourism

Theodore Roosevelt National Park is the most popular visitor attraction in North Dakota and provides significant economic and employment benefits for the state and region (Stynes, 2011). The colorful Little Missouri Badlands provide a picturesque backdrop to Theodore Roosevelt National Park. Visitors to TRNP have the opportunity to experience the badlands environment and to understand and enjoy it as Roosevelt once did. While visitor activities are generally available at all times of the year, the park superintendent may restrict use of any area or trail in order to protect visitors and the park's resources. Weather conditions may also warrant closing an area, and extreme fire conditions may restrict the use of fires and grills within the park (NPS, 2012b).

The park offers scenic drives, wildlife viewing, approximately 100 miles of foot and horse trails and opportunities for back country hiking and camping. There are two developed campgrounds in the South Unit: Cottonwood Campground and the Roundup Group Horse Campground.

A major feature of the South Unit is a paved, 36-mile, scenic loop road with interpretive signs that explain some of the park's historical and natural features. A museum at the South Unit Visitor Center provides background on Theodore Roosevelt and his ranching days; self-guided tours of Roosevelt's Maltese Cross Cabin are open for public viewing year-round (NPS, 2012b).

An important park experience is created by the interplay of natural forces including weather, vegetation, wildlife, vistas, smells, color and shape of landform, air quality, varied light, and seasons. Geological forces continue to create spectacular examples of badlands and provide opportunities for visual interpretation of the erosion processes (NPS, 2007).

Painted Canyon, located approximately 7 miles east of Medora, provides another opportunity for visitors to get oriented to the South Unit of the park. When traveling west on I-94, this is the first introduction to the South Unit and includes the Painted Canyon Overlook that provides views of the badlands from the canyon rim (Uhler, 2007d).

Winter activities within the South Unit are limited, but include cross-country skiing, snowshoeing, and occasional snowmobiling on the river corridor. The park does not groom any trails for cross-country skiing. Skiers blaze their own trails through the snow, and the best places to cross-country ski are usually on the frozen Little Missouri River or on closed park roads. Skiing on park trails can be somewhat treacherous because the trails are narrow and many cross creek bottoms. These creek bottoms may be too steep for safe skiing and may also fill up with blowing snow hiding their true depth. Snowmobiling is restricted to the Little Missouri River (Uhler, 2007a; NPS, 2012b).

With an initial visitor count of 26,773 in 1948, visitor numbers to the park peaked at 998,849 in 1972 (Table 1). There was an abrupt decline in the number of visitors during the 1980's but the count has been rebounding since 1990, with 623,748 visits recorded for 2010 (NPS, 2012l). Visitation is highest in June, July and August, although visitation has been increasing during the shoulder seasons of May and September. Lowest visitation is November to February (Uhler, 2007e).

From 1 October 2010 to 30 September 2011, the park contributed approximately $29.5 million to the local economy (within 50 miles of the park), and supported 503 jobs (a combination of park employees and full/part-time jobs created by visitors and park employees spending money or wages in the local area) (Stynes, 2011).

Table 1. Number of TRNP Annual Visitors. Source: nps.gov, 2012a.

Year	Recreation Visitors	Year	Recreation Visitors
1948	26,773	1980	595,734
1949	82,810	1981	702,873
1950	71,447	1982	677,014
1951	81,590	1983	415,118
1952	131,773	1984	361,139
1953	120,804	1985	377,152
1954	133,600	1986	390,553
1955	125,100	1987	424,846
1956	154,700	1988	413,527
1957	129,100	1989	459,171
1958	163,500	1990	460,718
1959	182,300	1991	468,926
1960	223,200	1992	475,937
1961	235,600	1993	475,160
1962	245,700	1994	505,349
1963	237,500	1995	460,699
1964	261,500	1996	436,081
1965	233,600	1997	393,265
1966	500,300	1998	448,286
1967	555,800	1999	431,311
1968	562,400	2000	431,813
1969	658,700	2001	446,609
1970	680,000	2002	471,551
1971	707,200	2003	490,295
1972	998,849	2004	474,589
1973	849,700	2005	493,198
1974	698,600	2006	435,359
1975	800,900	2007	456,588
1976	937,600	2008	516,804
1977	828,400	2009	586,928
1978	825,985	2010	623,748
1979	591,646	2011	563,407
		Total	**28,400,425**

CHAPTER III

LITERATURE REVIEW

Climate Change Studies in U.S. National Parks

The IPCC 4th Assessment Report (2007) states that warming of the climate system is unequivocal, and is now evident from observations of increased global average air and ocean temperatures, widespread melting of snow and ice, and rising global sea levels. Eleven of the last twelve years (1995-2006) rank among the twelve warmest years in the instrumental record of global air temperature since 1850.

The IPCC predicts that climate change will have both positive and negative effects, but the adverse effects will predominate with greater rates of climate change. General findings include:

- It is very likely that cold days, cold nights and frost will become less frequent over most land areas, while hot days and hot nights will become more frequent;
- It is likely that heat waves will become more frequent over most land areas;
- It is likely that the frequency of heavy precipitation events (or proportion of total rainfall from heavy rainfalls) will increase over most areas.

Based upon additional evidence from a wide range of species, recent warming is strongly affecting terrestrial biological systems, including such changes as earlier timing shifts in the ranges of plant and animal species. Satellite observations since the early

1980's also suggest a trend in many regions towards earlier greening of vegetation in the spring linked to longer thermal growing seasons due to recent warming (IPCC, 2007). The IPCC lists prairie wetlands and remnant native grasslands, two Midwestern ecoregions, as natural systems that will likely experience irreversible damage with increasing global temperatures.

An extensive literature search was conducted on climate change studies involving U.S. national parks, and climate change in semi-arid grasslands. This search yielded considerable literature, but no single study addressing climate change at TRNP. The available literature fell into three categories:

- Changes associated with increased temperature and precipitation;
- Changes associated with increased atmospheric CO_2 levels;
- Changes associated with increases in both atmospheric CO_2 levels and precipitation.

Current discussions concerning climate change, and global warming specifically, have raised concerns with climate zones shifting in a northerly direction (Seneviratne et al., 2006; Lough et al., 2008; Hughes, 2000). To understand how TRNP ecosystem might respond to climate change, one can look to other studies in semi-arid grasslands**.** A study of a northern California grassland by Suttle et al. (2007) stated the predicted ecological response to climate change is based largely on direct climatic effects on species. However, in their study they found that species interactions strongly influence the responses to changing climate by overturning direct climatic effects within five years. They manipulated the seasonality and the intensity of rainfall over large replicate plots and examined the responses across several trophic levels. In general, communities in winter-addition and ambient rainfall plots responded similarly across years to annual variation in rainfall. Dramatic changes were seen in the spring addition, with the strongest initial response by the nitrogen-fixing forbs. The exotic annual grasses showed a weaker response to the first year of spring water addition, but after the proliferation of nitrogen-fixing forbs, annual grass production rose dramatically. Being the first to germinate, winter grasses are among the earliest to complete their life cycle and generally do not respond to extensions of the rainy season. These plants benefited from the nitrogen-fixing debris, and after successive years, the accumulation of annual grass litter suppressed the germination and re-growth of leafy forbs, which then steeply declined. As forbs were eliminated by annual grasses, the plant species diversity collapsed to nearly half, with early-senescing annual grasses increasingly dominating the resource base, food availability and habitat quality for higher trophic levels diminished. This is especially true during the summer, when later-blooming forbs provide a critical food resource for invertebrate herbivores. As altered environmental conditions persisted across years, individualistic responses by species to climate were overshadowed by the lagged effects of altered community-level interactions (Suttle et al., 2007).

Knapp and Soule (1996) analyzed vegetation change and atmospheric CO_2 enrichment on the Island Research Natural Area in central Oregon. The area is a semi-arid continental climate receiving approximately 249 mm of precipitation in the form of snow during the winter months. Although plant community changes can come from numerous factors, they found their results to be consistent with laboratory and controlled field outcomes. Between the years 1960-1994, the area showed an increase in big sagebrush and western juniper, and a slight decrease in perennial grass cover. Overall, most woody species experienced major increases while the dominant herbaceous species experienced reductions. As regional natural ecosystems continue to shift towards an increased woody-species cover and density, sagebrush-steppe and juniper woodlands could produce broad implications by range productivity and watershed dynamics (Knapp and Soule, 1996).

By studying global climate change brought on by increased CO_2 levels and its effects on mammalian species diversity in U.S. National Parks researchers found that if atmospheric CO_2 levels doubled over baseline levels, U.S. National Parks would lose up to 20 percent of their current mammalian species diversity in any one park, with an average loss of 8.3%. The variation of species loss in individual parks is a reflection in the climate modeling forecasting of southern ecosystem types. The models project a substantial northward shift, with the more northerly ecosystem types remaining but becoming compressed toward the northern boundary of the continental U.S. Their assessment indicates that national parks are not expected to meet their mandate of protecting the current mammalian species within park boundaries for several reasons; all parks will experience a wave of species influxes, while other parks are projected to face significant losses in current species diversity as a direct consequence of vegetation shifts due to climate change. Further warming will likely result in changes in spring breeding dates, flowering, and budburst which can further disrupt current species associations. Their results suggest that the effects of global climate change on wildlife communities may be most noticeable not as a drastic loss of species from their current ranges but instead as a fundamental change in community structure as species associations shift due to influxes of new species (Burns et al., 2003).

In their study in the Rocky Mountain National Park, Wang et al. (2002) used the Hadley and Canadian Climate Center global climate models to project the impact of future climate on elk population. They found that a large population of herbivores can exert strong effects on plant communities and that these effects can amplify or attenuate a variety of ecosytem processes. The models revealed that wetter summers and warmer winters increased the elk population drastically. The increased precipitation in summer stimulated the abundance of vegetation for the elk, which helped to sustain them throughout the winter months when there is less vegetation upon which to feed. Warmer winters put less stress on the elk thus lessening the winter kill numbers (Wang et al., 2002).

Effects of Climatic Changes on Semi-arid Grasslands

The Canadian Rockies have experienced a mean annual air temperature increase of 1.5° C over the past 100 years. Luckman and Kavanagh (2000) observed treeline and vegetation advancement upslope, but also found variable responses in vegetation to climate changes that reflected species differences as well as local differences in microclimate and site conditions (Luckman and Kavanagh, 2000).

Zhou et al. (2009) studied how underground processes respond to climate warming. Infrared heaters were used to heat the soil of tallgrass prairie sites in the Great Plains. They found warming the soil significantly stimulated soil respiration and deep-collar soil organic matter (SOM) decompostition resulting from increases in the above ground and below ground biomass (Zhou et al., 2009).

It should be noted that while researchers have observed increased vegetation with climatic warming, additional studies have indicated it is the timing of the precipitation rather than the amount that enhances additional plant growth (Bates et al., 2005; Svejcar et al., 1999). The above studies also indicated that enhanced vegetation growth was dependent on individual plant species and the interaction among plant species within the plant community.

Changes in Atmospheric CO_2 and Precipitation

Other studies by Morgan et al. (2010) and Bachman et al. (2009) show similar results regarding the effects of increased CO_2 and soil moisture. Elevated CO_2 directly increased plant productivity of semi-arid grasslands and mixed prairie grasses through nitrogen use efficiency (NUE), water use efficiency (WUE) and a CO_2 induced increase in soil moisture, while warming reduced soil moisture, and increased CO_2 enhanced soil moisture. The rising CO_2 concentration stimulated photosynthesis, induced stomatal closure, and reduced canopy transpiration in almost all herbaceous species. The Prairie Heating and CO_2 Enrichment (PHACE) experiment conducted by Morgan et al. (2010) found grassland response was also contingent upon individual species and competition among the different species (Bachman et al., 2009).

CHAPTER IV

METHODOLOGY

An initial attempt was made to obtain historical air temperature and precipitation datasets from the Western Regional Climate Center (WRCC) (http://www.wrcc.dri.edu/cgi-bin/cliMAIN.pl?nd5813). A review of the WRCC monthly mean air temperature and precipitation datasets for the Medora Weather Station (#325813) found that the period of record (P-O-R) only went back to 1948. Of the 64 reported years for monthly mean air temperature, 70% were missing at least one day per month. The precipitation dataset was somewhat more complete, with 35% of the P-O-R reporting at least one day missing per month. Table 2 shows a 10-year sample of missing data at the Medora Weather Station for the mean monthly air temperature time series (°F) obtained from WRCC. WRCC criteria for data standards state that the maximum allowable number of missing days is five. In addition, individual months are not used for annual or monthly statistics if more than five days are missing. Individual years are not used for annual statistics if any month in that year has more than five days missing. Missing data presents a problem when analyzing historical climate data as incomplete datasets can lead to misleading conclusions; therefore another source of data was required.

Table 2. Monthly Mean Air Temperature (°F), Medora Weather Station, 2000 - 2010.

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual Precipitation (mm)
2000	20.45 a	27.20 a	38.65 a	42.62	56.56	61.50 b	74.16 f	74.50 i	59.24 k	50.45 j	20.42 r	16.09 t	41.16
2001	24.67 j	13.27 q	34.44 o	47.28 j	57.50 c	62.00 f	72.88 j	74.52 h	63.53 k	----- z	----- z	19.75 q	57.50
2002	24.21	31.08 j	20.47 l	41.12 j	53.79 j	67.83	76.74	71.53 m	62.22	35.98	34.12	23.82	46.42
2003	14.31	12.09	28.55	47.80	53.55	----- z	75.00	76.03	58.95	52.32	25.40	25.42	42.67
2004	13.32	22.59	----- z	48.08	53.13	----- z	----- z	66.08	63.20	----- z	34.88	27.11 l	43.04
2005	15.17 b	29.80	36.89	49.00	----- z	65.30	73.02	68.81	61.92	47.08	37.13	22.29	46.04
2006	32.90	----- z	----- z	----- z	56.84	66.97	75.86 t	71.27 a	55.57	40.66	31.15	22.78 a	47.27
2007	20.34	15.18	38.37	41.22	56.37	65.60	75.98	69.18	58.73	46.58	31.83	17.15	44.71
2008	13.42	16.47	32.77	41.35	53.90	62.15	72.73	70.84	56.10	43.81	32.92	9.16	42.13
2009	12.02	18.13 a	25.98	40.50	53.50	60.93	66.66	65.69	63.23	37.92	36.48	8.00	40.75
2010	12.32	11.32	32.56	45.60	50.71	63.03	68.92	69.92	55.48	48.23	27.87	11.81	41.48

Missing data criteria: a = 1 day missing, b = 2 days missing, c = 3 days,..etc.,z = 26 or more days missing.

PRISM Climate Data

Originally developed in 1991 for precipitation estimation, PRISM (Parameter-elevation Regressions on Independent Slopes Model) is a climate analysis and mapping system that uses point measurements of precipitation, temperature, and a digital elevation model (DEM), along with spatial datasets, to generate gridded estimates of annual, monthly and event-based climatic parameters. PRISM has been generalized and applied successfully to temperature, snowfall, growing degree-days, and weather generator parameters (Daly et al., 1997).

The system's analytical tool continuously incorporates point data, a digital elevation model, and expert knowledge of complex climatic extremes, including rain shadows, coastal effects and temperature inversions. PRISM predicts precipitation for each specified grid cell's DEM elevations using a weight precipitation/elevation (P/E) regression function from nearby stations. Stations with location, elevation, and topographic positioning similar to that of the grid cell are given greater weight in the regression. A prediction interval for the estimate is calculated whenever possible, which is an approximation of the uncertainty involved (PRISM Climate Group, 2011).

There are many methods used for interpolating precipitation from irregularly spaced monitoring stations onto a regular grid of points. PRISM has been compared to such methods as kriging, detrended kriging, and cokriging. In a study of the Willamette River Basin, Oregon using a jackknife cross-validation exercise, PRISM exhibited lower overall bias and mean absolute error when compared to kriging, detrended kriging, and cokriging (Daly et al., 1994). PRISM has since been applied to the entire United States with excellent results, even in regions where orographic processes do not dominate precipitation patterns (Daly et al., 1994). Relying on many localized, facet-specific P/E relationships instead of a single domain-wide relationship, PRISM will continually adjust its frame of reference to accommodate local and regional changes in orographic regime with minimal loss of predictive capability (Daly et al., 1994; Phillips et al., 1992).

The PRISM methodology has been used in numerous hydroclimatic studies (Kumar and Duffy, 2009; Ellis et al., 2009; Sankarasubramanian and Vogel, 2003; Small et al., 2006), and output products have been extensively evaluated since its conception. A panel of state climatologists from several western states and other experts, critically reviewed PRISM methods and the resulting precipitation maps, and concluded that PRISM produced precipitation maps equaled or exceeded the quality of the best manually-prepared maps available (Daly, 1996).

The most commonly used interpolated datasets are probably PRISM and Daymet. Both use similar inputs but apply different interpolation methods. Daymet is daily climatological data developed by Dr. Peter E. Thornton for plant growth model inputs.

Using a Gaussian weighting filter for its interpolation method, Daymet generates daily gridded surfaces of temperature, precipitation, humidity, and radiation over large regions while incorporating areas of complex terrain. The relationships of temperature and precipitation to elevation are determined directly from a network of observations. Daymet also requires digital elevation data input for the region of interest (Thornton et al., 1997; Goddard Space Flight Center, 2012).

A comparison study of the two datasets found that unless a daily resolution is required, PRISM is a more robust predictor of continuous temperature data over the conterminous United States (Scully, 2010). Daly et al. (2008) compared the PRISM data sets with Daymet and WorldClim climate data sets. WorldClim is a set of data grids generated through interpolation of average monthly climate data from weather stations. Variables included are monthly total precipitation, monthly mean, minimum and maximum temperature, and 19 derived bioclimatic variables such as annual trends in mean annual temperature and annual precipitation, seasonality and extreme or limiting environmental factors (Hijmans et al., 2005). Daly et al. (2008) used a relatively dense station data set, and demonstrated that the physiographically sensitive PRISM interpolation process resulted in significantly improved climate grids over those of WorldClim and Daymet.

The PRISM Data Explorer (http://prismmap.nacse.org/nn/) uses latitude and longitude coordinates to extract point data from a specified grid. The Medora Weather Station (#325813, 46°55’0” N / -103°31’00”W) was used because of its location within the park's South Unit, which was the study area of interest. The specified grid cell extracted from the PRISM database has a grid resolution of 2.5 minutes and a grid elevation of 752 meters. It is assumed that the Medora Weather Station grid cell is climatically representative of the entire South Unit (Rosenberg, 1986; Jensen, 1972). Serially complete time series of mean monthly maximum (T_{max}) and minimum (T_{min}) air temperature (°C), and monthly precipitation total (millimeters) for the time series 1895–2011 were obtained. Secondary time series of mean monthly air temperature (T_{mean}) and mean monthly diurnal air temperature range (DTR) were derived from the primary T_{max} and T_{min} air temperature time series.

Diurnal Temperature Range (T_{range})

The diurnal temperature range (DTR) is an important index of climate change since DTR is susceptible to a variety of environmental effects including water vapor, cloud cover, urban influences, and surface evaporative cooling from precipitation (Sun et al., 2006). The DTR is the difference between the daily maximum and minimum air temperature thus is calculated by: maximum daily temperature minus the minimum daily temperature. Globally, T_{min} air temperatures have generally increased at a larger rate than the T_{max} temperatures, resulting in a decrease in the mean diurnal temperature range overtime (Easterling et al., 1997).

Recent studies have demonstrated a strong relation between trends of the DTR and decreases in pan evaporation, suggesting that the DTR decrease in these areas is influenced by increases of cloud amount soil moisture, evaporation, vegetation distribution and reduced insolation (Global Warming Science, 2010; Sun et al., 2006).

Thornthwaite Water Budget Analysis

Model Input Parameters

Software for reconstructing the historical climatic water budget time series using the Thornthwaite water-budget approach (TWBB) for the TRNP South Unit was obtained from the USGS (McCabe and Markstrom, 2007). The public domain software was downloaded from the NASA Global Change Master Directory (http://gcmd.nasa.gov/records/USGS_OFR_2007_1088.html). The software utilizes a graphical user interface (GUI) to allow the user to specify a series of selected hydrological and climatic parameters for any specified location. These selected model parameters control how the water balance calculations are modeled for the period of record. The model uses the Thornthwaite water-balance methodology and functions incorporated in the software to allocate water across different components of a localized hydrologic cycle (Fig. 3).

The software requires two sets of climatic input time series: mean monthly air temperature (°C) and monthly precipitation (mm). The monthly precipitation total and mean monthly air temperature time series for the period of January, 1895 to December, 2011, were used to drive the model calculations. Figure 4 shows a screen shot of the GUI used for the input model parameters.

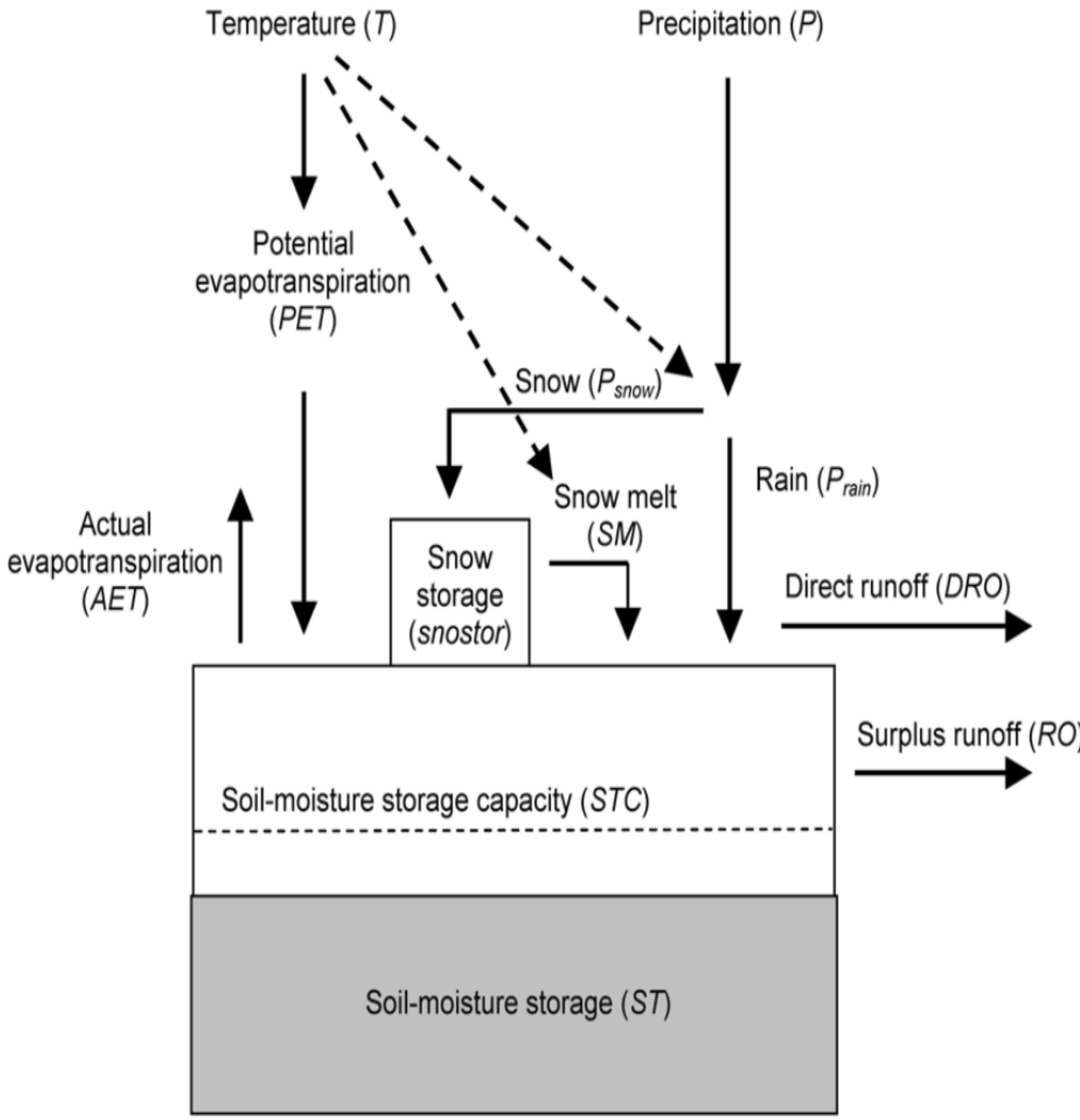

Figure 3. Conceptual diagram of the Thornthwaite water-balance program. Source: USGS (2012a).

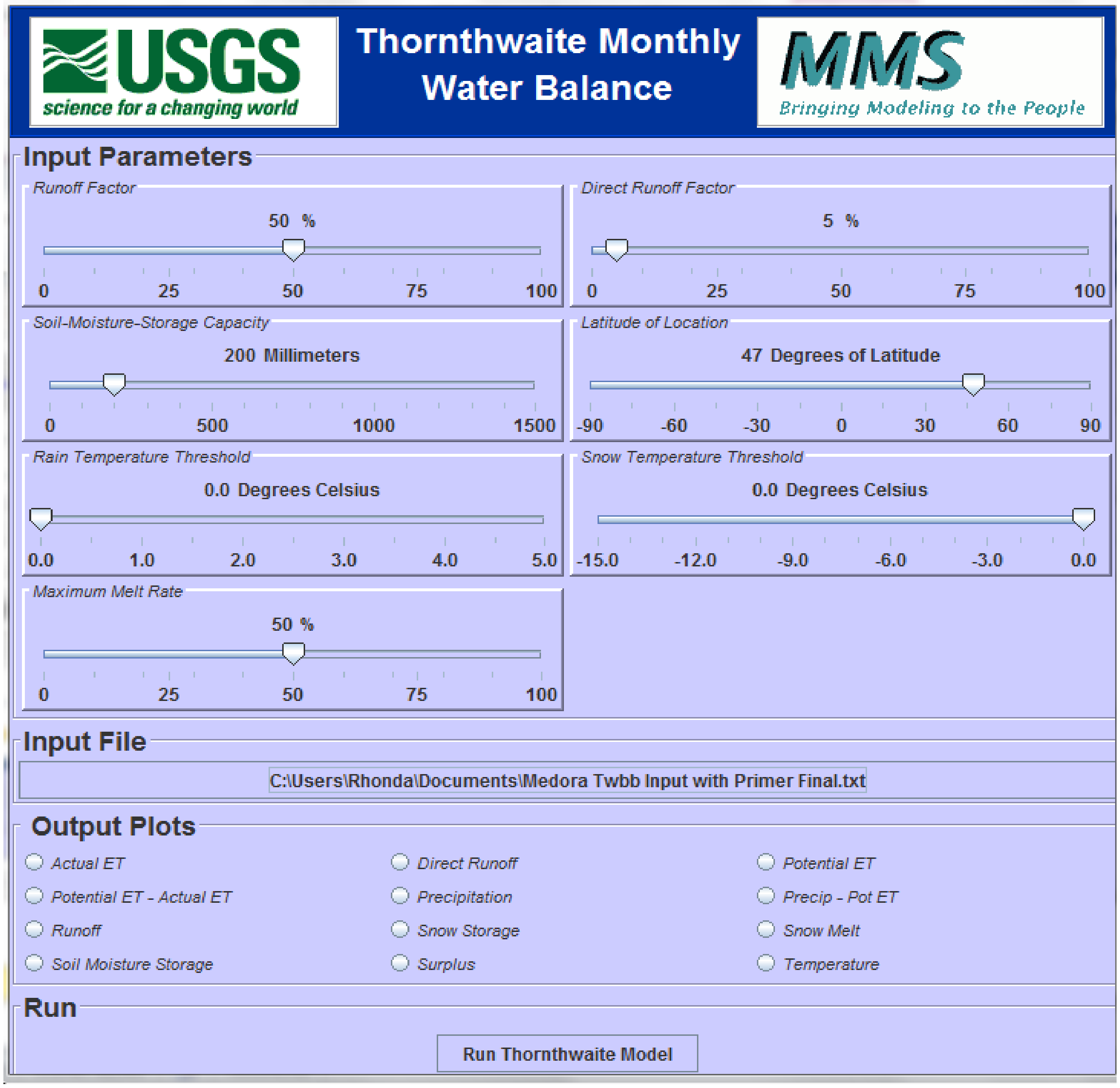

Figure 4. Thornthwaite Monthly Water Balance model GUI with adjustable input parameters and model output options.

Table 3 lists the model parameters, their value range and the value used for each parameter in the study. Default values for runoff factor, direct runoff factor, soil-moisture storage capacity, rain and snow temperature thresholds, and maximum melt rate were used (Fig. 4). The latitude was set at 47 degrees for the Medora Weather Station and the default values were set by the model. These values can be adjusted to a location's

Table 3. Input Parameters for the Thornthwaite Monthly Water Balance Model.

Model Parameter	Range	Value Used	Reference
Runoff factor (%)	0 - 100	50	Default
Direct runoff factor (%)	0 - 100	50	Default
Soil-moisture storage capacity (mm)	0 - 1500	200	Default
Maximum melt rate (%)	0 - 100	50	Default
Latitude of study area (°)	-90 - 90	47°	Actual location
Rain temperature threshold (°C)	0.0 - 5.0	0.0	Default
Snow temperature threshold (°C)	-15.0 - 0.0	0.0	Default

recommended value. The system will not allow invalid or extreme values to be entered (McCabe and Markstrom, 2007).

Since the Thornthwaite model tracks soil moisture storage, which can carry over from year to year, Dr. Greg McCabe (personal communication, June 20, 2011) recommended that for optimal model output values, additional years be added to the beginning of the input file to prime the software, so that the model simulations would have more realistic initial conditions. Therefore, the years 1895-1904 (ten years) were added to the beginning of the input data file to prime the program.

Model Output Parameters

Following the execution of the water-budget analysis computations, the program provides output for each month/year, and nine hydrologic variables: potential ET, precipitation, precipitation minus potential ET, soil moisture storage, actual ET, potential ET minus actual ET, snow storage, surplus water, and runoff. Table 4 further defines these nine output variables. For a full description of how these parameters are used, the Thornthwaite model documentation should be consulted (McCabe and Markstrom, 2007).

Table 4. Output Variables of the Thornthwaite Monthly Water Balance Model.

Model Output Variable	**Abbreviation**	**Definition**
Potential ET (mm)	PET	The amount of evapotranspiration that would occur if a surface water supply were not limiting (water demand).
Precipitation (mm)	P	Moisture input in the form of rain or snow (water supply).
Precipitation minus potential ET (mm)	P-PET	Water supply minus water demand value; positive values represent a potential of surplus water; negative values represent a potential for water deficit (aridity index).
Soil moisture storage (mm)	Soil Moisture Storage	The amount of water held in the soil at any particular time; the maximum value is dependent upon soil characteristics.
Actual ET (mm)	ET	Actual amount of water consumed by evapotranspiration.
Potential ET minus actual ET (mm)	PET-AET	Climatic moisture deficit (plant water stress index).
Snow storage (mm)	Snow Storage	Snow accumulation on surface.
Surplus water (mm)	Surplus	Occurs when P exceeds PE and the soil is at field capacity (saturated).
Runoff (mm)	ROtotal	Occurs when the rainfall intensity exceeds the rate of infiltration, or if the soil is at its water holding capacity (excess surplus).

More sophisticated models for agricultural and drainage-basin monitoring and research have been developed and utilized in recent decades, but they continue to be grounded in Thornthwaite's original concepts of PE and the calculation of the monthly water-budget. Thornthwaite's analysis of the computed monthly water budget has proven to be an effective tool in understanding the distribution and extent of the water resources at a local scale (Mather, 1991; Todhunter, 1995; Muller et al., 1999).

Monthly model input and output values were averaged or summed to arrive at seasonal and annual values of each parameter. Seasons were defined using the standard climatological definition: winter (December-January-February (DJF)), spring (March-April-May (MAM)), summer (June-July-August (JJA)), and fall (September-October-November (SON)).

Derived Model Output Parameters

Ratio of Actual to Potential Evapotranspiration (RAT_A)

Another way to characterize the hydroclimatic environment is to compare the mean annual evapotranspiration (ET_A) with the mean annual potential evapotranspiration (PET_A) and to express that relationship as a ratio ($RAT_A = ET_A/PET_A$). The TWBB potential and actual evapotranspiration monthly and annual values are used for the calculation of RAT_A. The RAT_A ratio is an index of plant moisture stress, essentially a ratio of supply to demand. A high value of this index (approaching 1.0), indicates that the moisture supply nearly meets the potential water demand, while a low value (approaching 0.0) indicates that moisture supply falls well below the potential water demand (Peterson and Johnson, 1995).

Climate Moisture Index (CMI)

Data obtained from the TWBB output data was used to compute the Willmott and Feddema Climate Moisture Index (CMI) (Feddema, 2005). The CMI is an annual index based upon the ratio of annual precipitation (P) to annual potential evapotranspiration, (PET). Specifically,

$$CMI = (P / PET) - 1 \text{ when } P < PET; \quad (1)$$

$$CMI = 1 - (PET / P) \text{ when } P \geq PET. \quad (2)$$

The CMI ranges from +1.0 to -1.0, with wet climates showing positive CMI and dry climates a negative CMI. The CMI illustrates the relationship between plant water demand and available precipitation (Feddema, 2005).

Model Validation

In order to further evaluate the performance of the TWBB output values in the study area, two validation tests were made to compare TWBB output data to independent datasets. The first test compares the monthly Modified Palmer Drought Index (PMDI) values to the TWBB monthly soil moisture storage values (Fig. 5). The PMDI is a meteorological drought index that is used to assess the severity of dry or wet periods of weather (NOAA/National Climatic Data Center, 2012a). The monthly value indicates the severity of a wet or dry spell. This index is also based upon a monthly water balance between monthly moisture supply and water demand. The PMDI incorporates a weighted average of the wet and dry index terms, using probability as the weighting factor. Although similar, the PMDI and PDSI (Palmer Drought Severity Index) will have the same values during an established drought or wet spell, but will have different values during a transition period. While widely used throughout the United States, a disadvantage of the PMDI is that it lags when emerging from a drought period (Alley, 1984; Hayes, 2012). The index ranges from +4.0 to -4.0, with negative values denoting dry periods and positive values indicating wet periods; values outside of the index range, however, can occur. Table 5 lists the standard PMDI classification indices (NOAA National Climatic Data Center, 2012c).

Table 5. PMDI Classification Index.

PMDI Index Value	
> 4.00	Extremely wet
3.00 to 3.99	Severely wet
2.00 to 2.99	Moderately wet
1.00 to 1.99	Mildly wet
0.50 to 0.99	Incipient wet spell
0.49 to -0.49	Near normal
-0.50 to -0.99	Incipient dry spell
-1.00 to -1.99	Mild droughts
-2.00 to -2.99	Moderate droughts
-3.00 to -3.99	Severe droughts
< -4.00	Extreme drought

Modified Palmer Drought Severity Index (PMDI) and Soil Moisture Storage Analysis

In the first comparison test, mean monthly PMDI index data for the North Dakota Climate Division 7 was obtained from the National Climatic Data Center (NOAA/NCDC, 2012b).   Figure 5 shows the mean annual soil moisture storage (mm) plotted on the Y axis and the mean annual PMDI index value plotted on the X axis. A linear trend line of the fitted data is included. The coefficient of determination (R^2 value) of the linear regression was 0.674, which had a P-value <0.001, indicating a statistically significant relationship between the soil moisture storage values and the PMDI. The second comparison graph in this test shows the monthly PMDI and monthly soil moisture storage values plotted for the P-O-R (Fig. 6). The values do show close agreement in the years

1909, 1935, 1942, 1972, 1978, 1980, 1993 and 2011, however, the overall comparison was less matched.

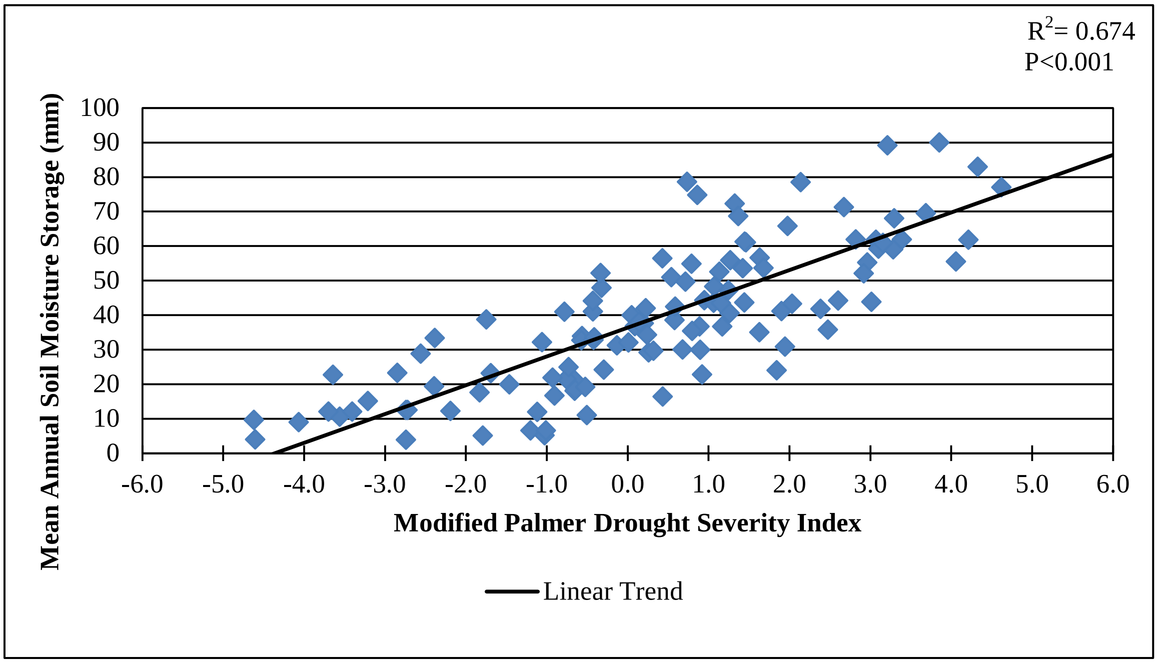

Figure 5. Mean annual PMDI and mean annual soil moisture storage comparison, 1895-2011. N=117.

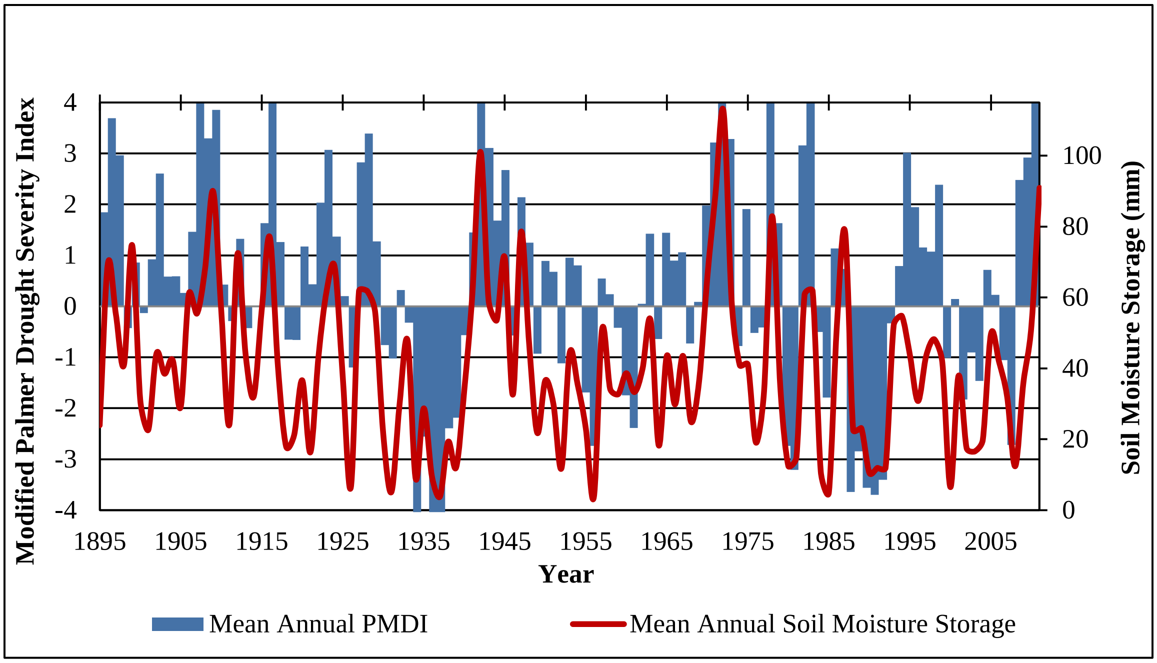

Figure 6. Mean annual PMDI and mean annual soil moisture storage time series, 1895-2011. N=117.

Stream Discharge and TWBB Runoff Analysis

The second test compares mean monthly stream discharge to the TWBB monthly runoff variable (Appendix E). Stream gage discharge for the Little Missouri River at Medora (USGS gage #06336000) was obtained from the USGS Surface-Water Monthly Statistics site (http://waterdata.usgs.gov/nwis). Figure 7 shows the location of the stream gage.

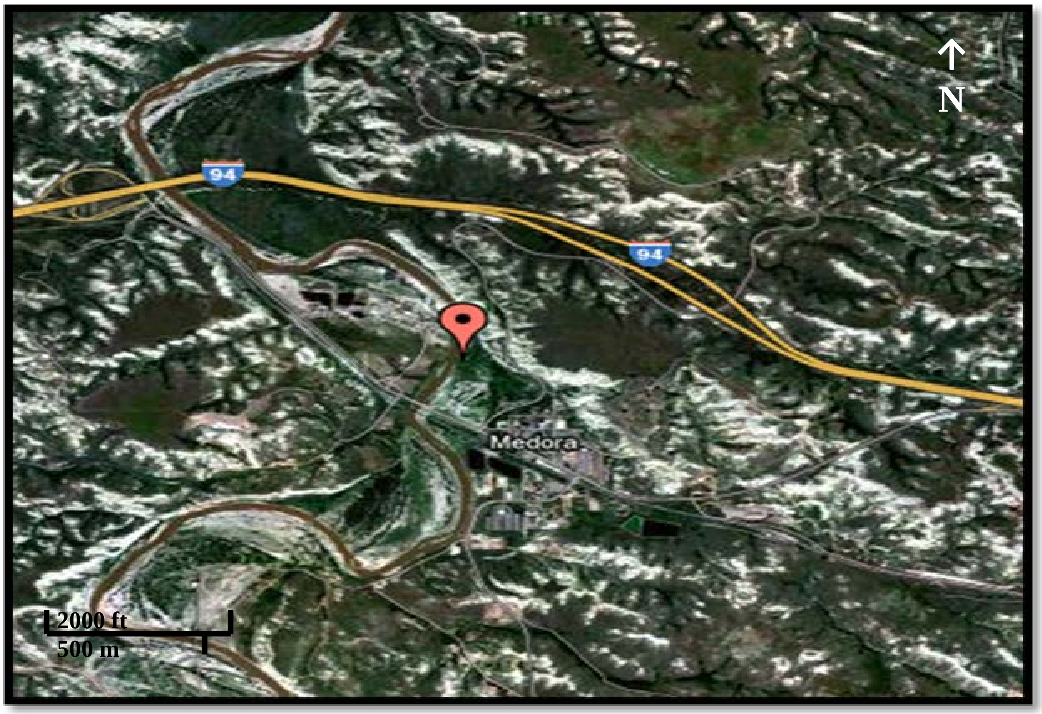

Figure 7. Location of Little Missouri River USGS Medora stream gage (#06336000). The elevation is 684.8 m. Source: NOAA/NWS, (2012).

Caution should be exercised when using the model's runoff values. McCabe and Hay (2002) found the TWBB model performed poorly in the central U.S. in a study of 44 river basins. The model was unable to simulate on a monthly time step runoff that results from short-term precipitation events; it also had insufficient representation of important location-specific hydrological processes such as shallow ground or surface water storage. This inability of the model to accurately simulate runoff explains the poor fit between model simulated and observed monthly runoff totals.

Converting the measured mean monthly discharge (cfs) value to an equivalent runoff depth (mm) allows the data to be compared to the TWBB monthly runoff variable in comparable units. To convert the mean discharge values in cubic feet per second to runoff depth in millimeters per month involves a conversion. This conversion factor is then multiplied by the cfs monthly values supplied by the USGS. The drainage area (6,190 miles^2) of the Little Missouri River Medora stream gage (USGS, 2012b) is needed to complete the conversion.

A complete time series of the mean monthly stream discharge (mm) for the comparison test would have probably yielded more thorough results, however, it was difficult finding complete USGS Medora stream discharge data. For example, the years 1975 to 2000 were completely missing from the dataset. 52 complete years of the 117 year P-O-R was used for the the mean monthly stream discharge depth (mm)/TWBB runoff depth (mm) comparison (Fig.8). The increase in stream discharge with the increase in runoff is statistically signficant with a P-value <0.001.

Figure 9 presents a comparison of mean monthly runoff (mm) from the TWBB model and observed mean monthly stream discharge (mm). Comparable results are seen in the timing between the peak and minimum stream discharge and runoff values.

The runoff totals in the Thornthwaite model tend to move from peak spring runoff to minimum summer/fall flows much more slowly than do the recorded stream gage discharge values. A changing soil moisture storage capacity that is due to the freezing and thawing of the ground could potentially account for the less than comparable match.

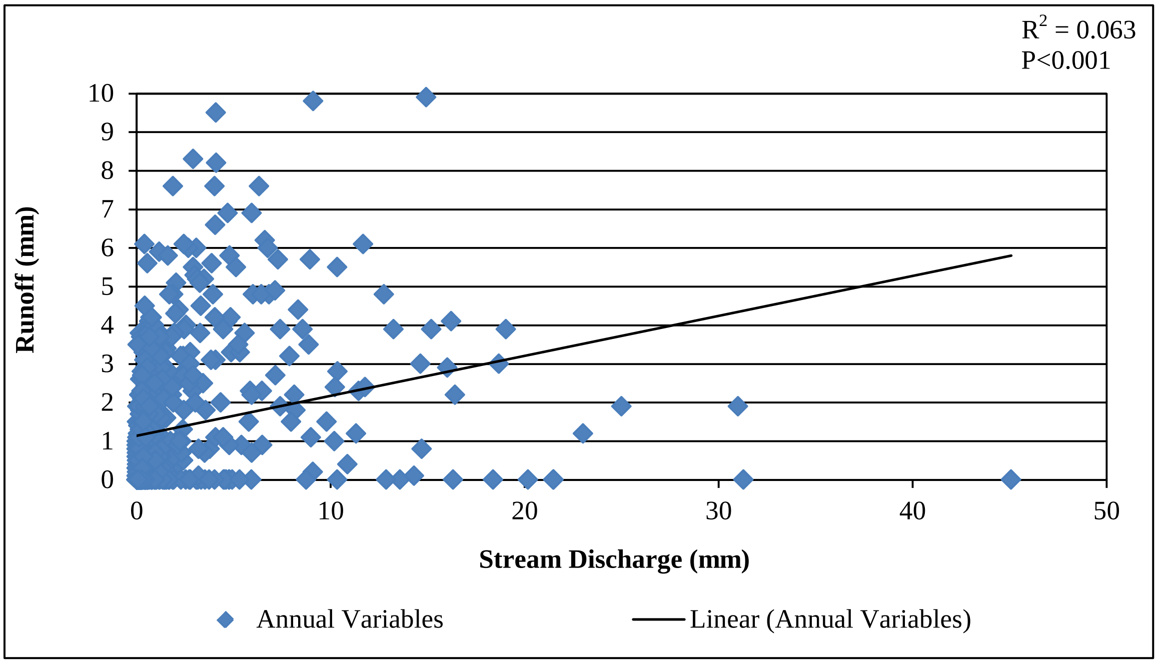

Figure 8. Mean monthly comparison of TWBB runoff values (mm) to Medora stream gage discharge values (mm). N=624 points.

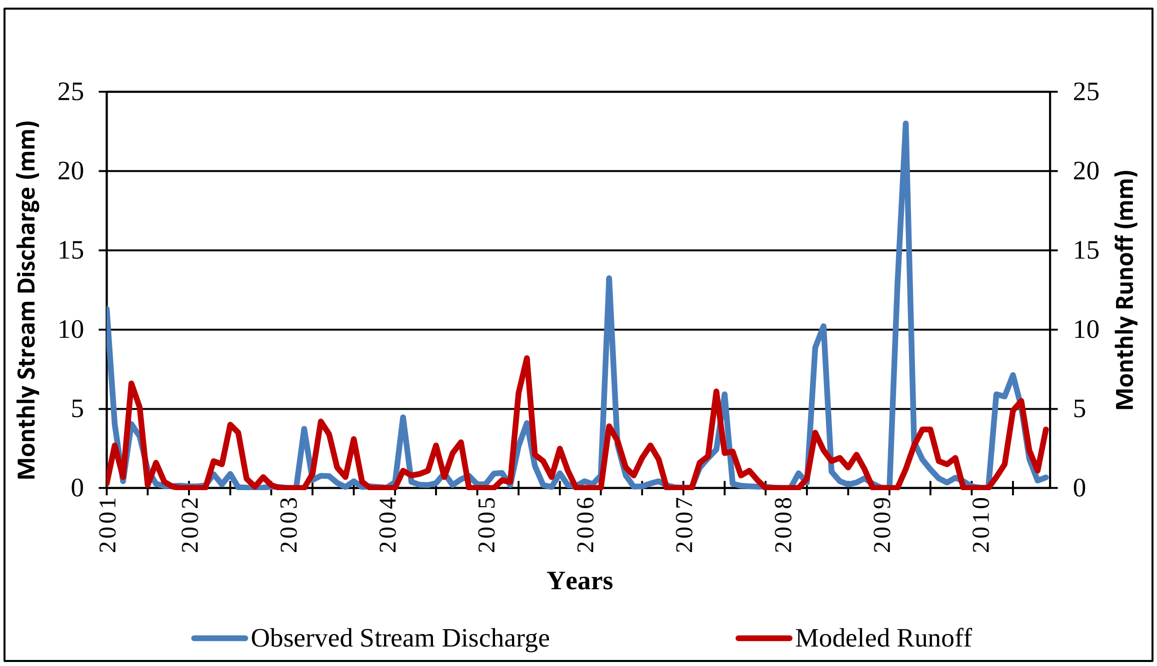

Figure 9. 2001 – 2010 water year (October – September) Little Missouri River USGS Gage #06336000 mean monthly stream discharge (mm) and TWBB runoff data (mm). N=121.

CHAPTER V

RESULTS AND DISCUSSION

PRISM Data Analysis 1895 - 2011

A listing of the complete PRISM climatic time series for T_{mean}, T_{max}, T_{min}, and PCP can be found in Appendices A, B, C, and D, respectively.

Mean Annual Temperature (T_{mean})

The mean annual air temperature time series from 1895 – 2011 is shown in Figure 10, along with a linear trend line for the P-O-R. The long-term mean annual air temperature is shown by a horizontal line. The graph shows an increasing warming trend over the P-O-R and a long-term mean of 5.3°C. The coefficient of determination (R^2 value) of the linear regression was 0.222, which had a P-value <0.001. The mean annual air temperature has increased at a rate of 1.6°C per century over the past 117 years. This warming trend is consistent with the IPCC's 2007 Synthesis Report, as well as studies by Hansen et al. (2006) and NASA/GISS (2012) that show a a warming trend in global air temperature over the past century. Figure 11 presents the same time series and linear trend line but includes a moving average obtained using a nine-term binomial filter to more clearly show decadal scale temperature variations.

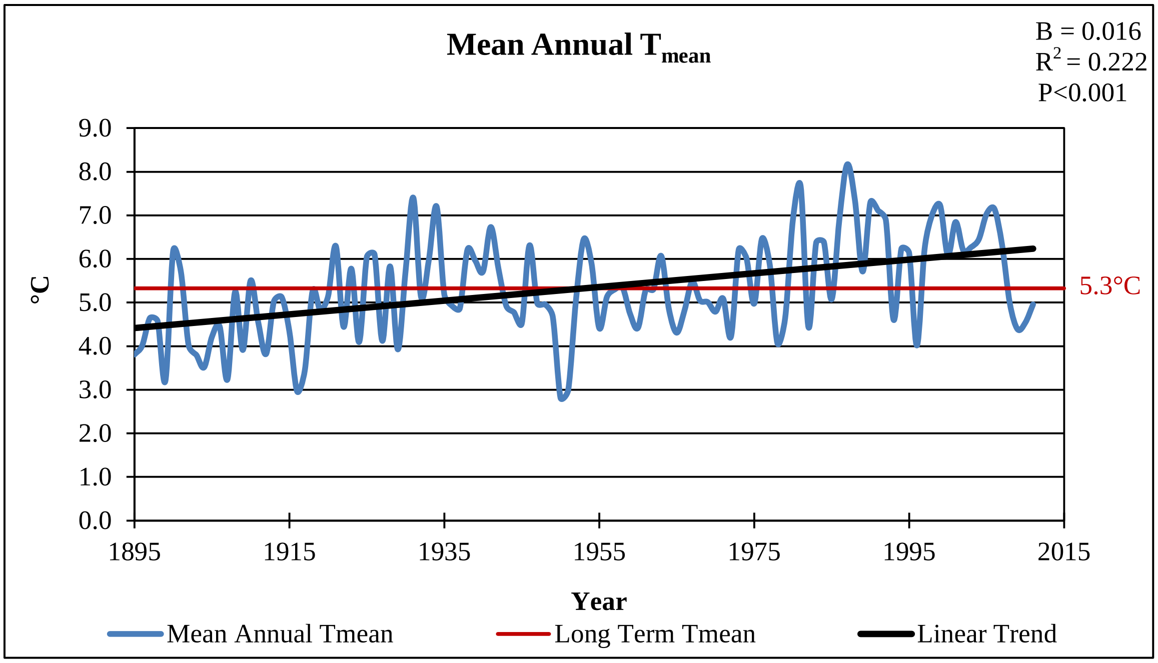

Figure 10. Time series of mean annual air temperature (°C) (T_{mean}) with linear trend line, 1895-2011. Long-term T_{mean} is 5.3 °C. N=117.

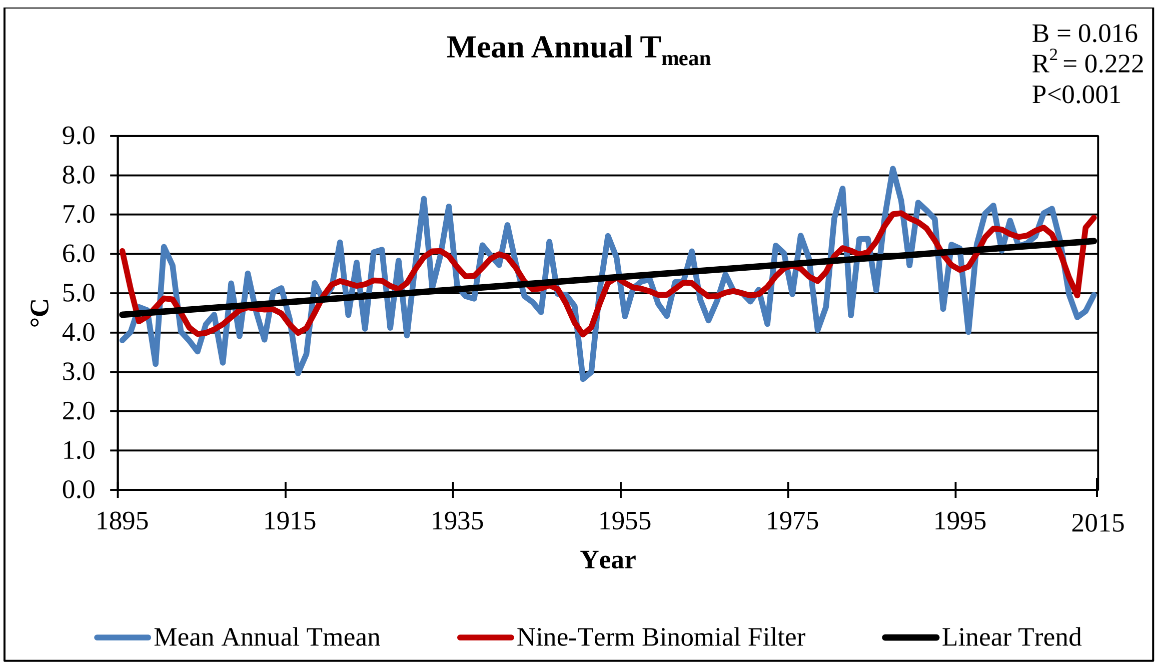

Figure 11. Time series of mean annual air temperature (°C) and linear trend line with a nine-term binomial filter. N=117.

Time series of the four seasonal T_{mean} datasets are shown in Figure 12. All four seasons show an increasing warming trend, however only the spring, fall and winter seasons were statistically significant. Winter experienced the largest warming trend with a rate increase of 2.6 °C per century over the P-O-R. Lesser warming trends were seen in spring and summer. Fall and summer seasons show the least amount of increase over the time series with a rate of 1.1 °C per century. Winter, spring and fall seasonal trends were statistically significant with P-values < 0.05. This type of seasonal warming increase is consistent with seasonal T_{mean} air temperature changes observed in other regions. Alaska's seasonal mean annual air temperature increased throughout the state from 1949 to 1998. Seasonal increases were highest in winter and spring and lowest in summer; fall was the only season in which slight decreases were observed (U.S. Fish and Wildlife Service, 2009; Stafford et al., 2000). Stations in the southeast U.S. show similar findings; the greatest seasonal increase in mean annual air temperature occurs during the winter months, which produces a reduction in the number of freezing days (United States Global Change Research Program, 2009). The Great Lakes region has also experienced milder winter air temperatures, which has led to reduced ice cover on the Great Lakes, with seasonal spring warm-up occurring earlier than in the past (Andersen, 2012).

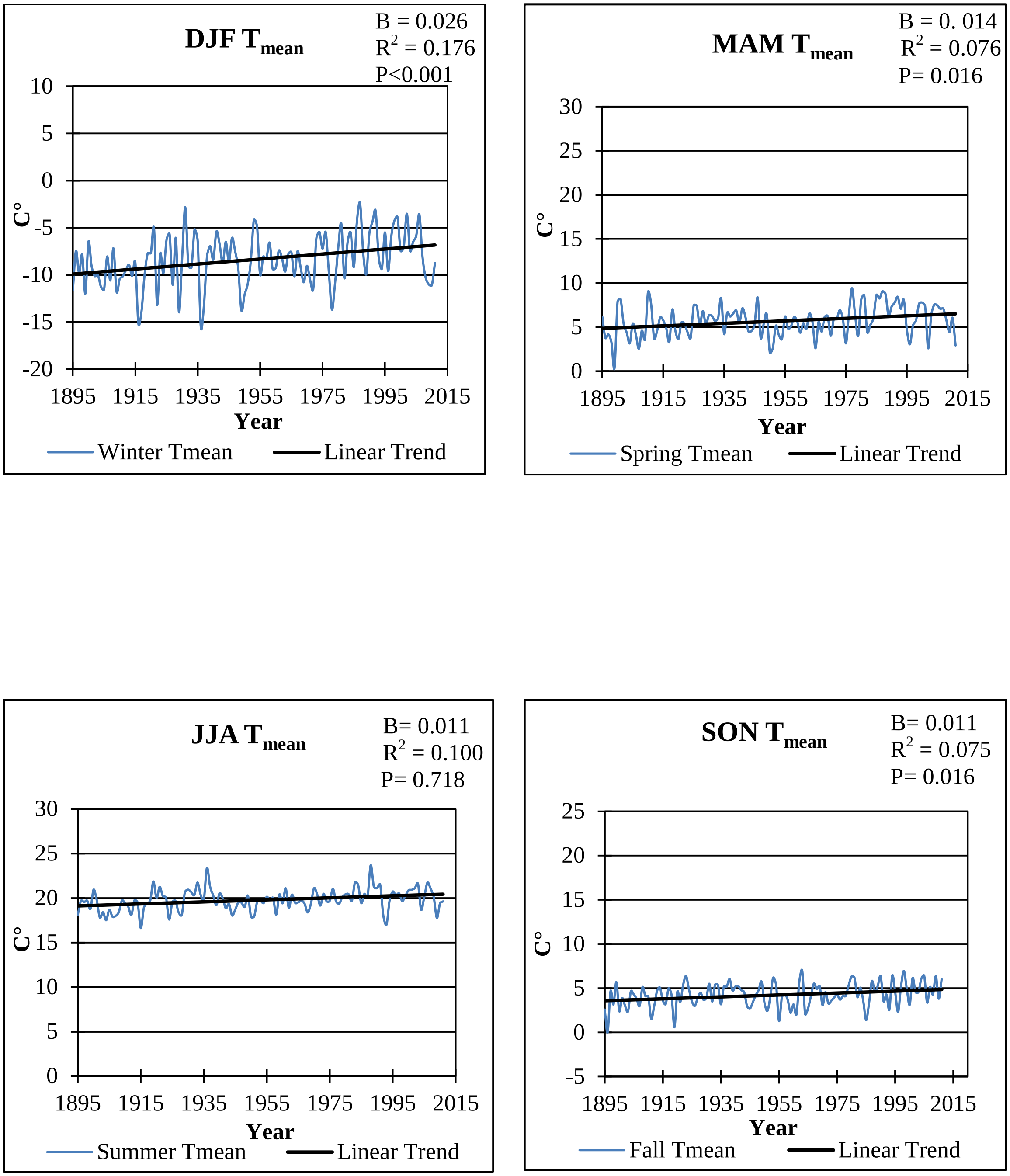

Figure 12. Time series of mean seasonal air temperature (°C) (T_{mean}) for the P-O-R with linear trend line. N=117.

Mean Annual Maximum/Minimum Temperature (T_{max}/T_{min})

The mean annual maximum (T_{max}) and the mean annual minimum (T_{min}) time series plots can be found on Figures 13 and 14, respectively. The T_{min} time series shows a statistically significant warming trend with of 2.1°C/100 years over the P-O-R, while

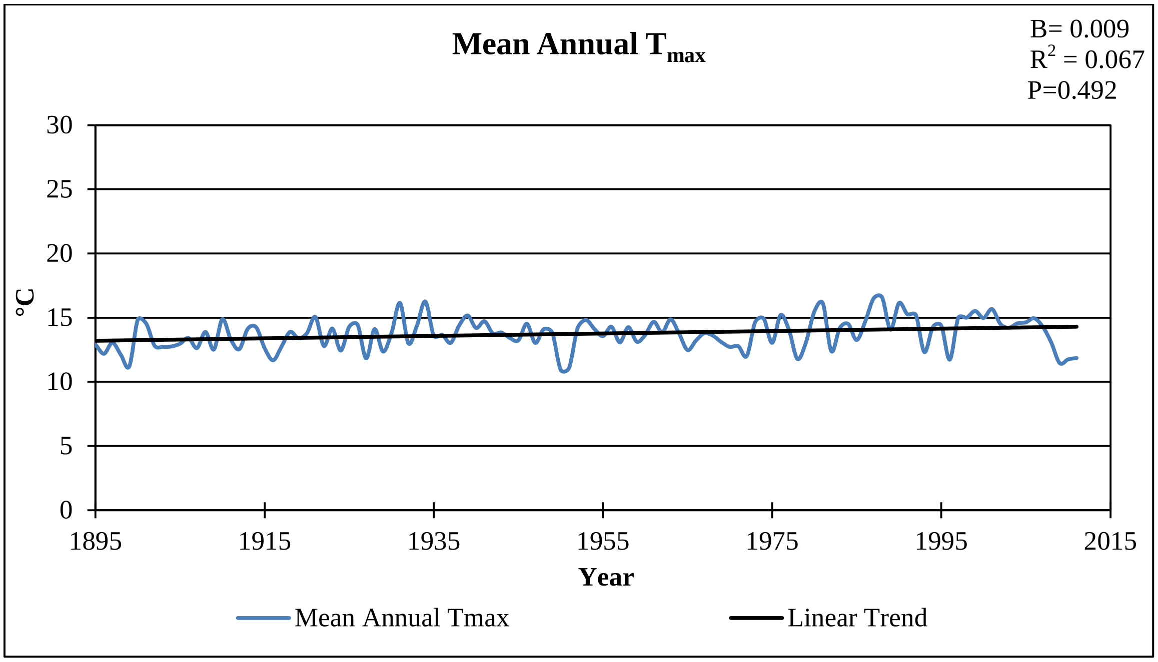

Figure 13. Mean annual maximum air temperature (°C) (T_{max}) time series for the P-O-R with linear trend line. The long term mean is 13.7°C. N=117.

the warming trend for the mean annual maximum air temperature time series rate is not statistically significant. This suggests that the mean annual minimum air temperature is the major driver of the T_{mean} air temperature warming trend (Fig. 10).

The greater rate of warming in T_{min} as compared to T_{max} is consistent with other studies that found mean minimum air temperatures are increasing at a faster rate than mean maximum air temperatures (Karaburun et al., 2011; Zhang et al., 2000; IPCC, 1997).

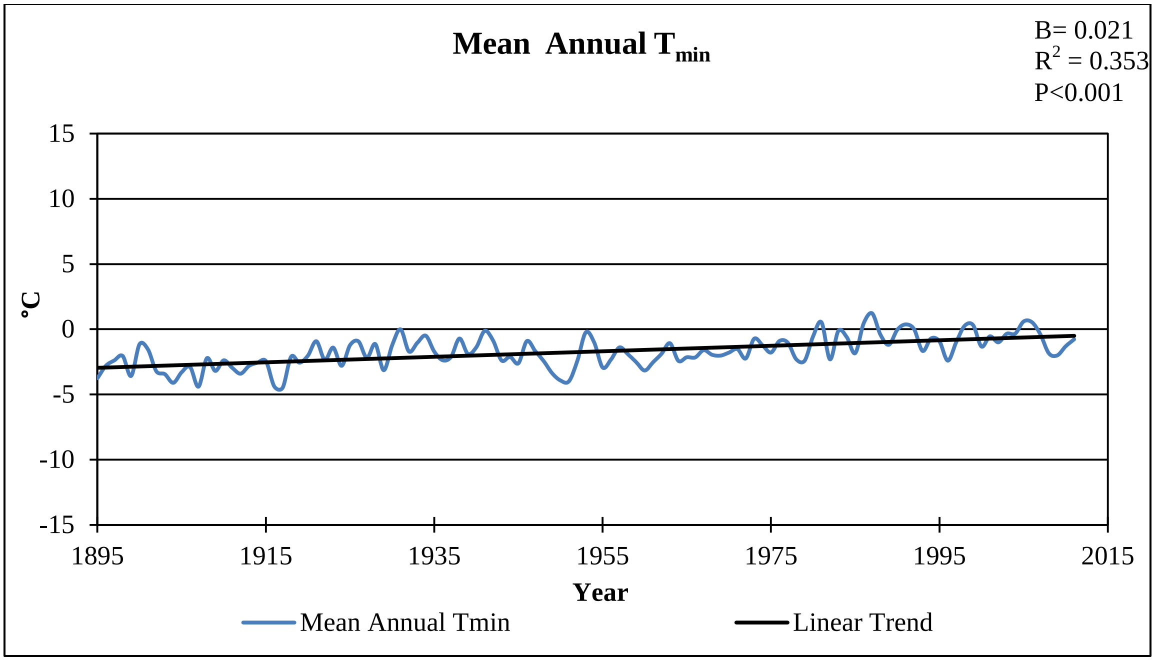

Figure 14. Mean annual minimum air temperature (°C) (T_{min}) time series for the P-O-R with linear trend line. The long term mean is -1.7°C. N=117.

Figures 15 and 16 show the seasonal changes in the mean annual maximum and mean minimum air temperatures for the P-O-R. The winter and summer season T_{max} time series showed a significant warming trend ($P < 0.05$), whereas the mean seasonal T_{min} for all four seasons featured statistically significant warming trends ($P<0.05$).

Linear trend analysis of the individual mean monthly maximum air temperature (Figs. 17 and 18) and mean monthly minimum air temperature (Figs. 19 and 20) series show a greater range of results. T_{max} had nine months (Jan, Feb, Mar, Jun, Jul, Aug, Sept, Nov, Dec) with a warming trend, and three months (Apr, May, Oct) with a cooling trend, however only the warming trend for February, March and July had a P-value of <0.05. All individual T_{min} months had a warming trend with a P-value of <0.05 with the exception of June (Figs. 19 and 20).

Previous studies show that for most locations worldwide, the average increase in the mean monthly, seasonal, and annual minimum air temperature is larger than associated changes in the mean monthly, seasonal, and annual maximum air temperature. The study results obtained for Medora, ND also show that the rate of warming for the mean minimum air temperature time series is greater than that of the mean maximum air temperature time series.

An elevated T_{min} air temperature may have direct but counterbalancing effects on above ground net primary productivity and the abundance of plants through mechanisms such as increased rates of carbon assimilation due to warmer mornings and accelerated carbon loss through increased rates of respiration due to warmer nights (Cordero et al., 2011; Alward et al., 1999).

Despite strong year-to-year variations, the Midwest has observed a noticeable increase in average temperatures. The largest increase has occurred in winter, which has produced earlier dates for the last spring frost, and extended the length of the frost-free or growing season by more than one week (United States Global Change Research Program, 2009).

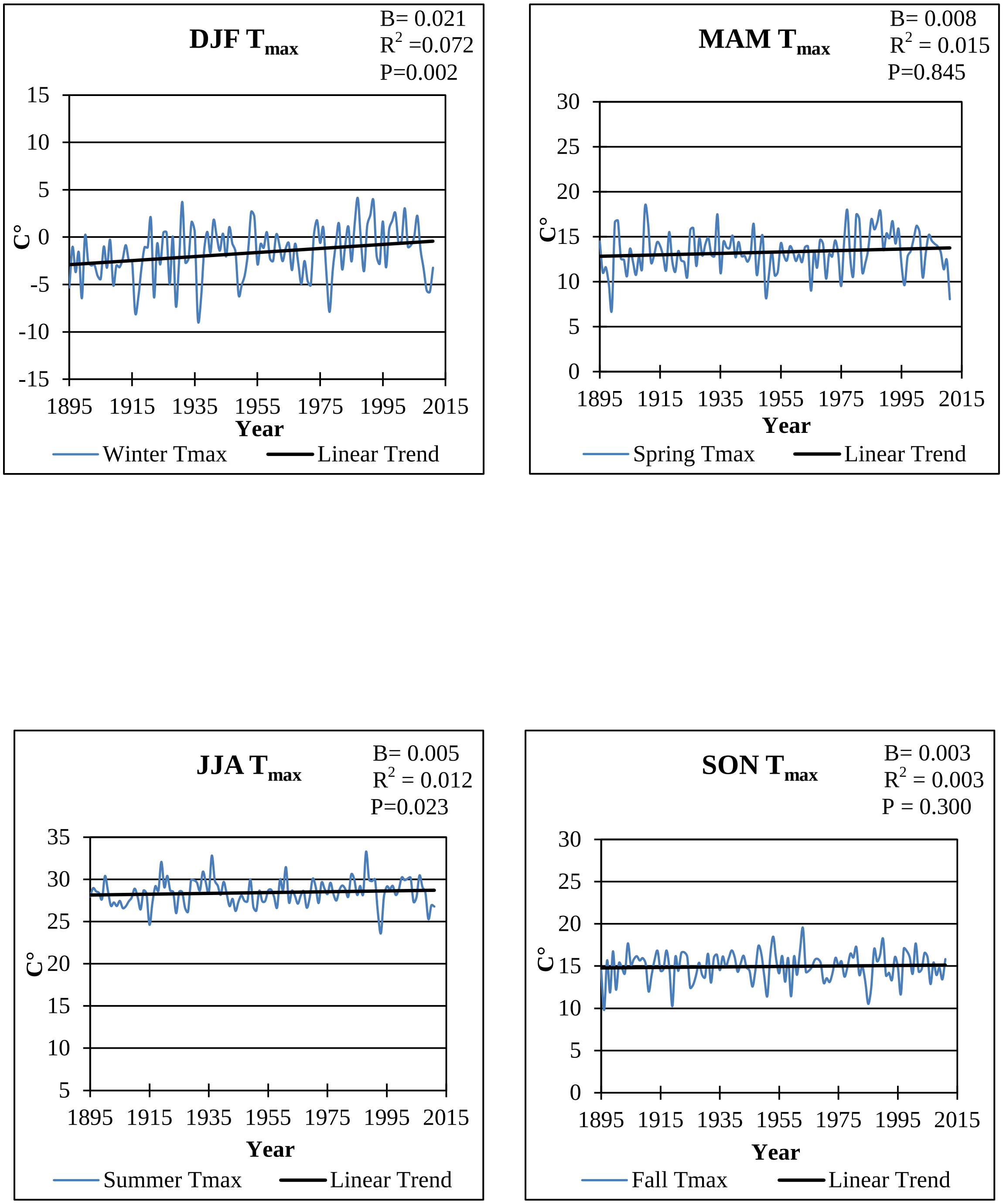

Figure 15. Mean seasonal maximum air temperature (°C) (T_{max}) time series for the P-O-R with linear trend line. N=117.

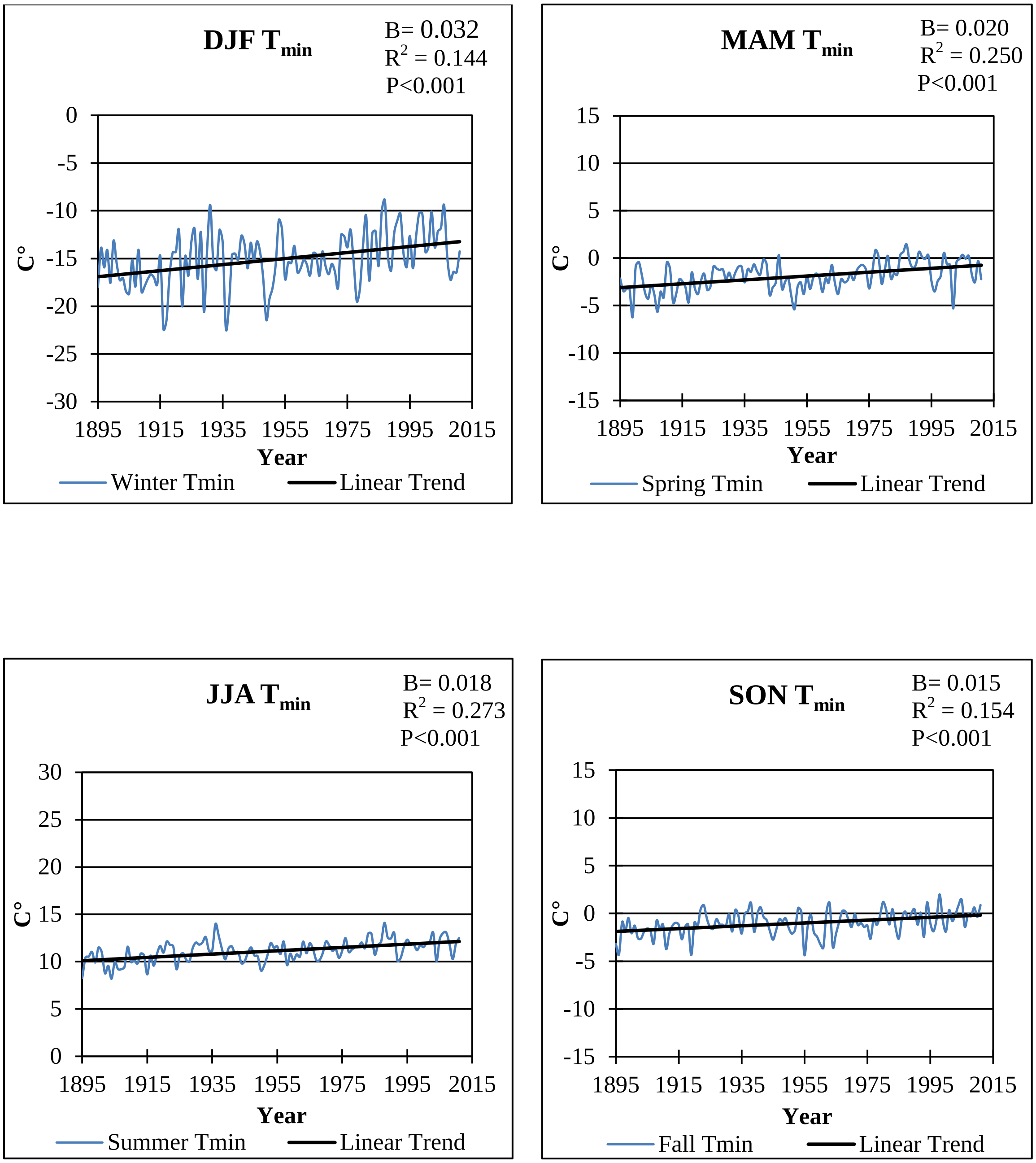

Figure 16. Mean seasonal minimum air temperature (°C) (T_{min}) time series for the P-O-R with linear trend line. N=117.

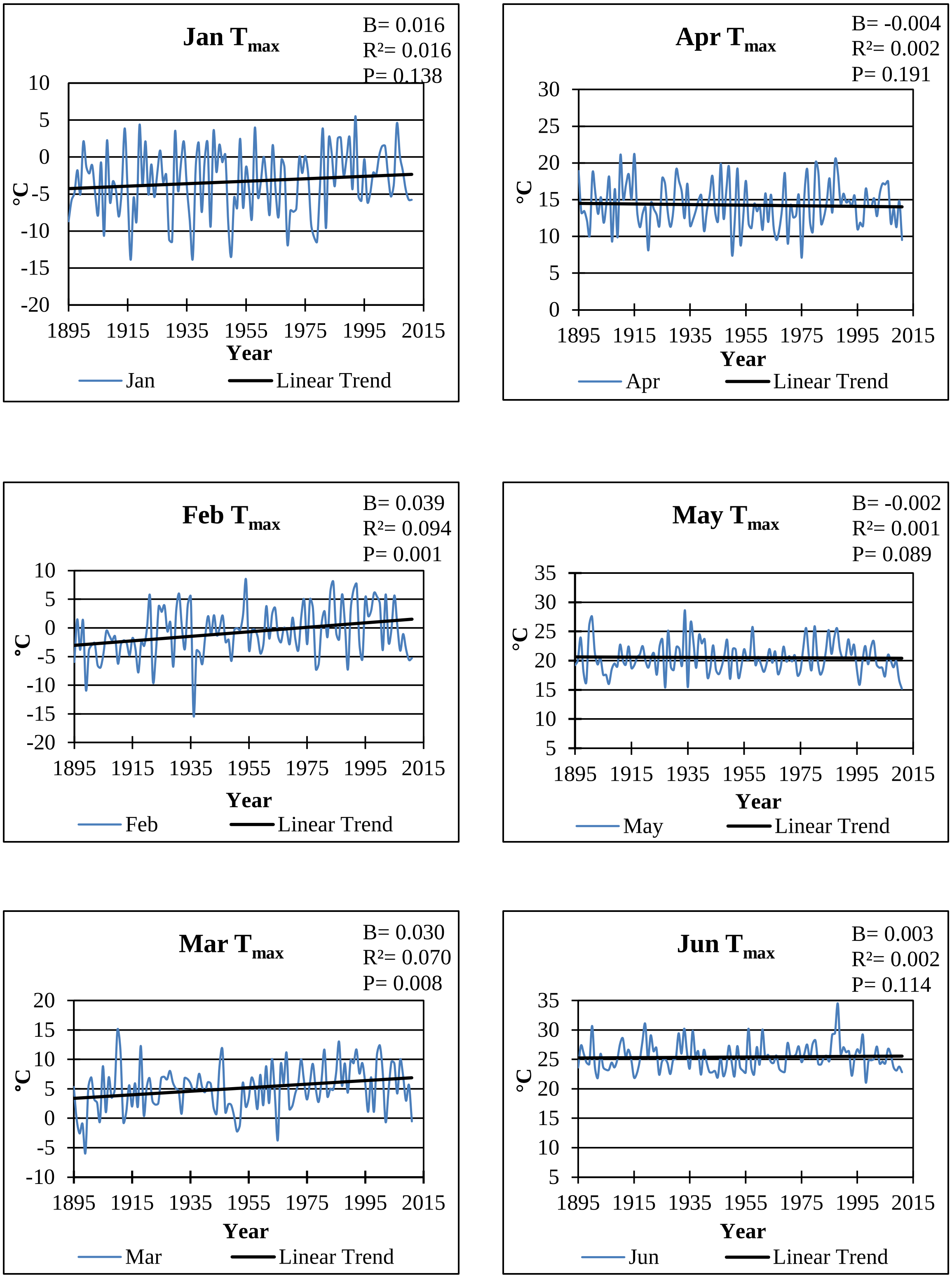

Figure 17. Individual mean monthly maximum air temperature (°C) (T_{max}) time series for the P-O-R with linear trend line. N=117.

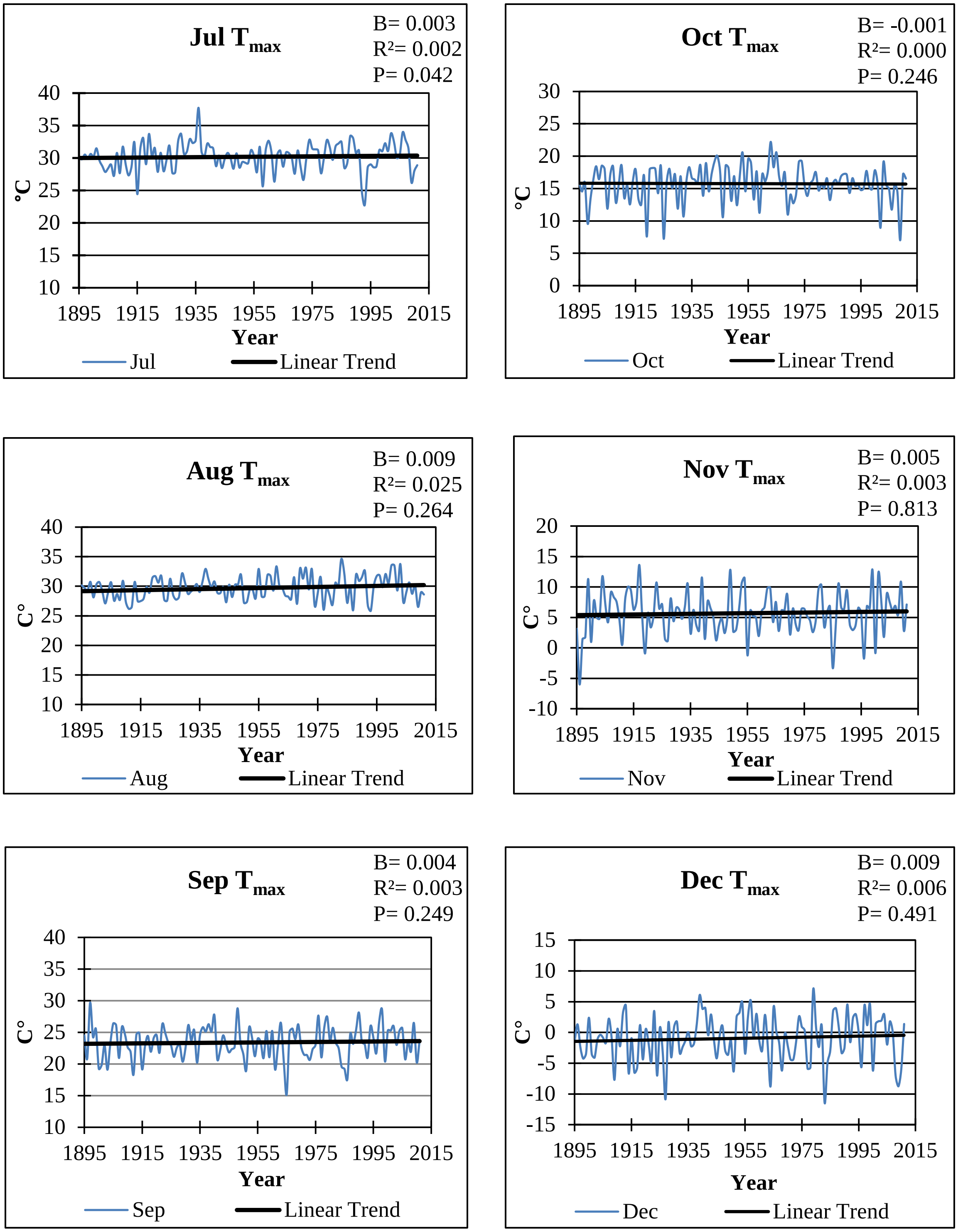

Figure 18. Individual mean monthly maximum air temperature (°C) (T_{max}) time series for the P-O-R with linear trend line. N=117.

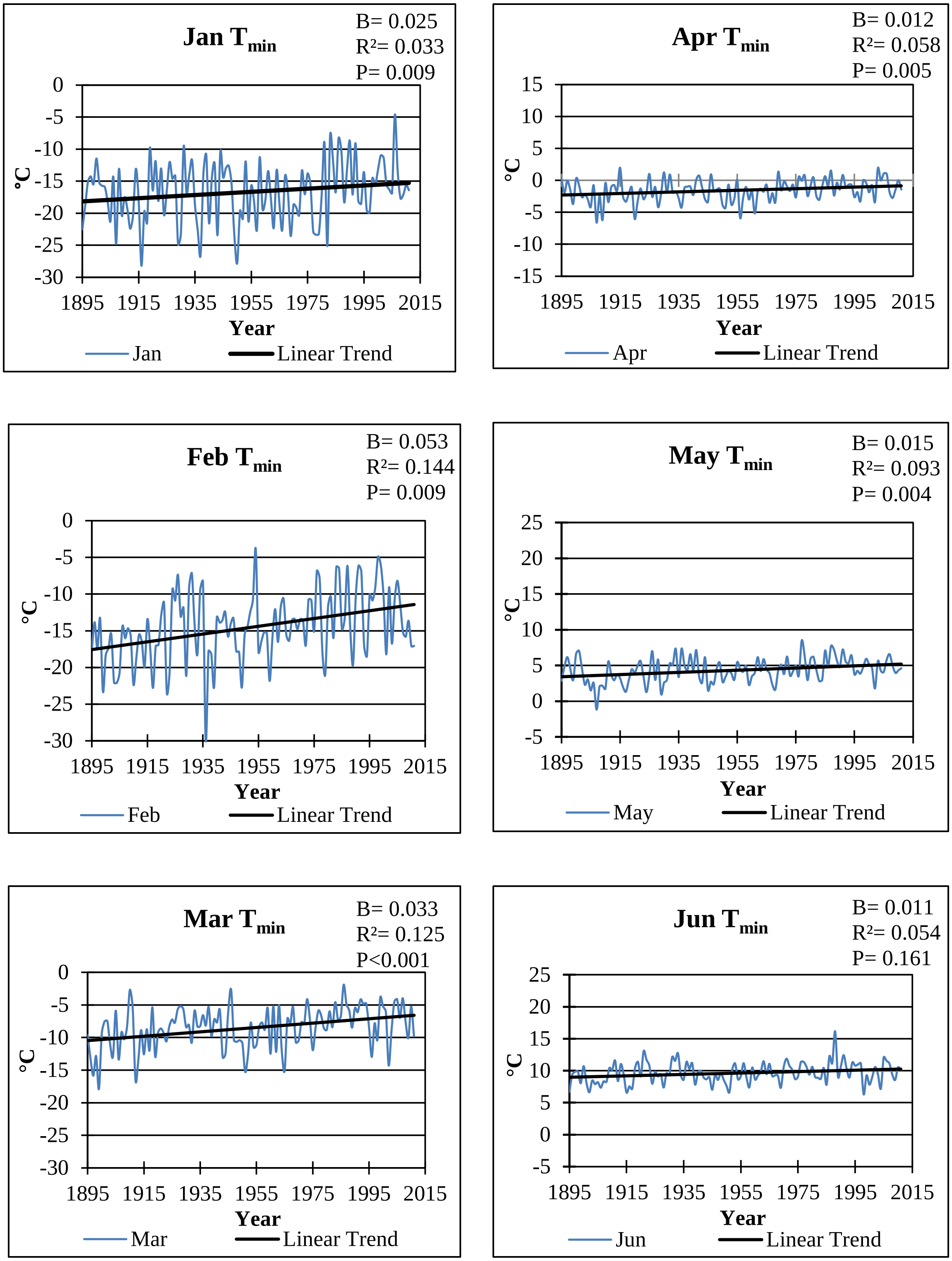

Figure 19. Individual mean monthly minimum air temperature (°C) (T_{min}) time series for the P-O-R with linear trend line. N=117.

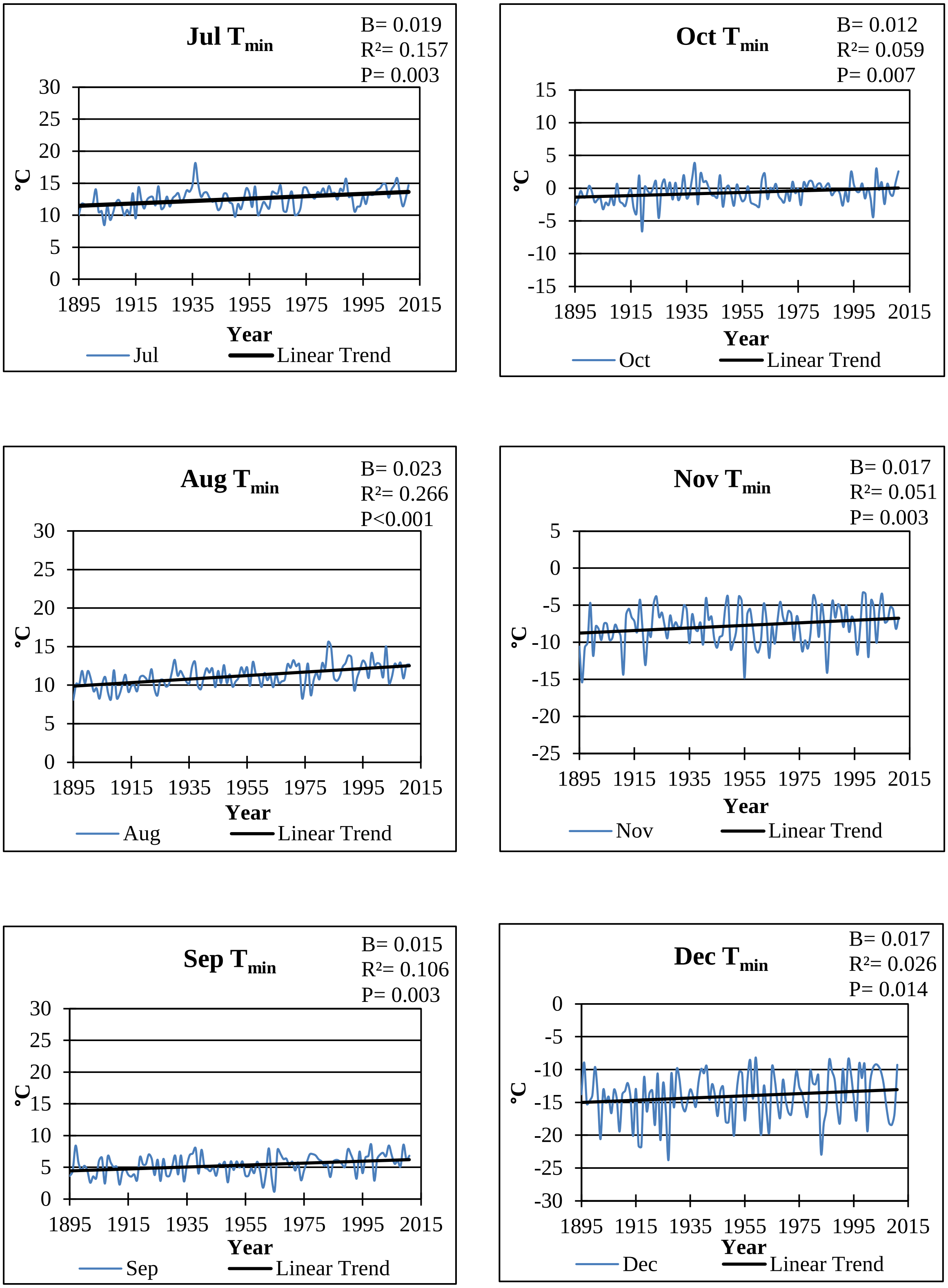

Figure 20. Individual mean monthly minimum air temperature (°C) (T_{min}) time series for the P-O-R with linear trend line. N=117.

Diurnal Temperature Range (T_{range})

The diurnal temperature range (DTR) is a significant index of climate change because DTR is susceptible to a variety of environmental effects including water vapor, cloudiness, and urban influences (Sun et al., 2006). T_{min} air temperatures have generally increased at a larger rate than T_{max} temperatures, resulting in a decrease in the diurnal temperature range over time. This decrease ranged between 0.58°C/100 years to 3.58°C/100 years, depending on the location (Price et al., 1999).

Figure 21 shows the mean annual diurnal temperature range for the P-O-R. The figure shows a statistically significant (P-value <0.001) decrease in the diurnal temperature range over the study period, which is consistent with research results and observations made by Karl et al. (1984), Lauritsen and Rogers (2012), and Sun et al. (2006) for many other global locations over the last century.

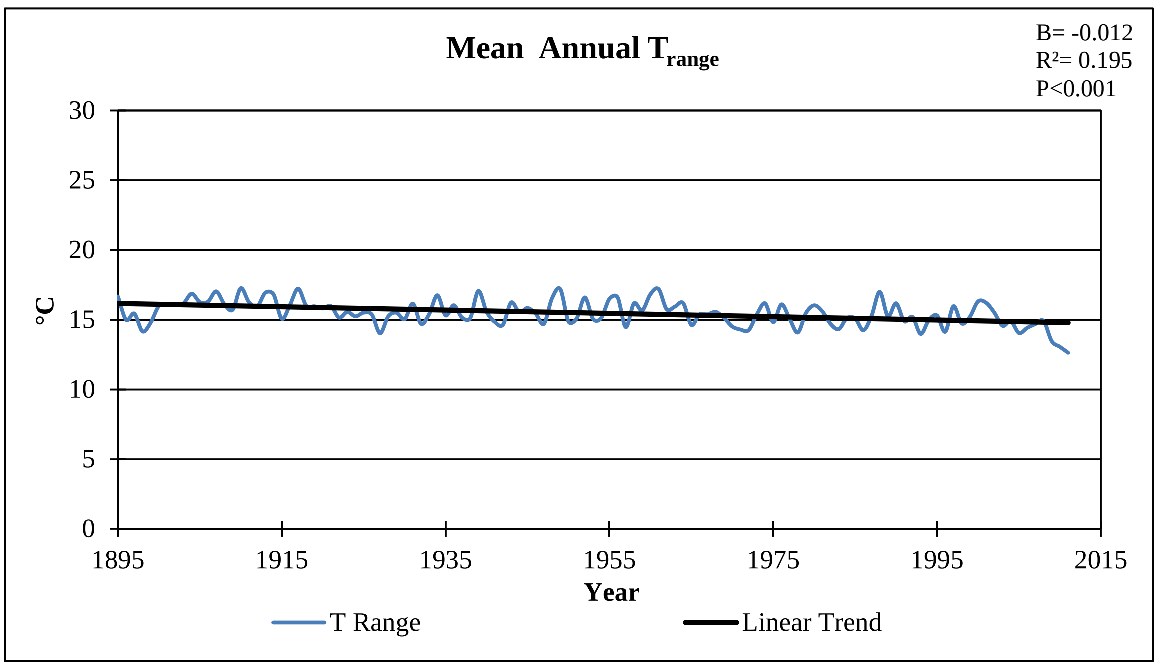

Figure 21. Mean annual diurnal temperature range (°C) (T_{range}) time series for the P-O-R with linear trend. N=117.

Precipitation (PCP)

The time series for annual precipitation amount for calendar years 1895 - 2011 is shown in Figure 22. Although there is a strong interannual variation in the annual precipitation, the trend line is not statistically significant. Figure 22 shows the interannual variation in annual precipitation (mm); there is a small decreasing linear trend in precipitation indicated by the negative slope of -13.8 mm per century. The extreme drought event in the 1930's can easily be seen in Figures 22 and 23, as well as the droughts in the 1950s and 1980s. The IPCC Synthesis Report (2007) states that more extreme weather events (both heavy precipitation events and droughts) can be expected as a result of global warming.

While the long term trend in annual precipitation has not changed, there were seasonal decreases in precipitation. Negative seasonal trends were observed in the summer and winter seasons. The winter season had a statistically significant negative trend, with a rate of -11.2 mm/100 years (Fig. 24); although they were not statistically significant, positive trends were observed in the spring and fall seasons (6.6 mm/100 years and 8.5 mm/100 years), respectively (Fig. 24).

Precipitation is a key driver in defining grassland types, productivity and decomposition rates. On a regional scale, an increase in the mean annual precipitation would increase the mixed prairie grass plant production and decomposition rates (Chimmer and Welker, 2005). However, it is likely that any small amount of increased PCP (spring and fall season) would not be significant enough to offset increased evapotranspiration related to higher temperatures and the atmosphere's increased ability to absorb moisture through evaporation (IPCC, 2007; Thibeault, 2010).

Mixed grass prairie ecosystems are also strongly influenced by changes in precipitation, especially winter precipitation. Winter snowpacks have a very strong influence on plant respiration during the entire growing season. The increased winter snow is able to infiltrate to deep soil depths and is then available for plant growth by deep rooted perennials during the entire growing season, whereas increased summer rain only saturates the top of the soil and is quickly absorbed by plants or evaporated, limiting the influence of summer rain (Chimmer and Welker, 2005).

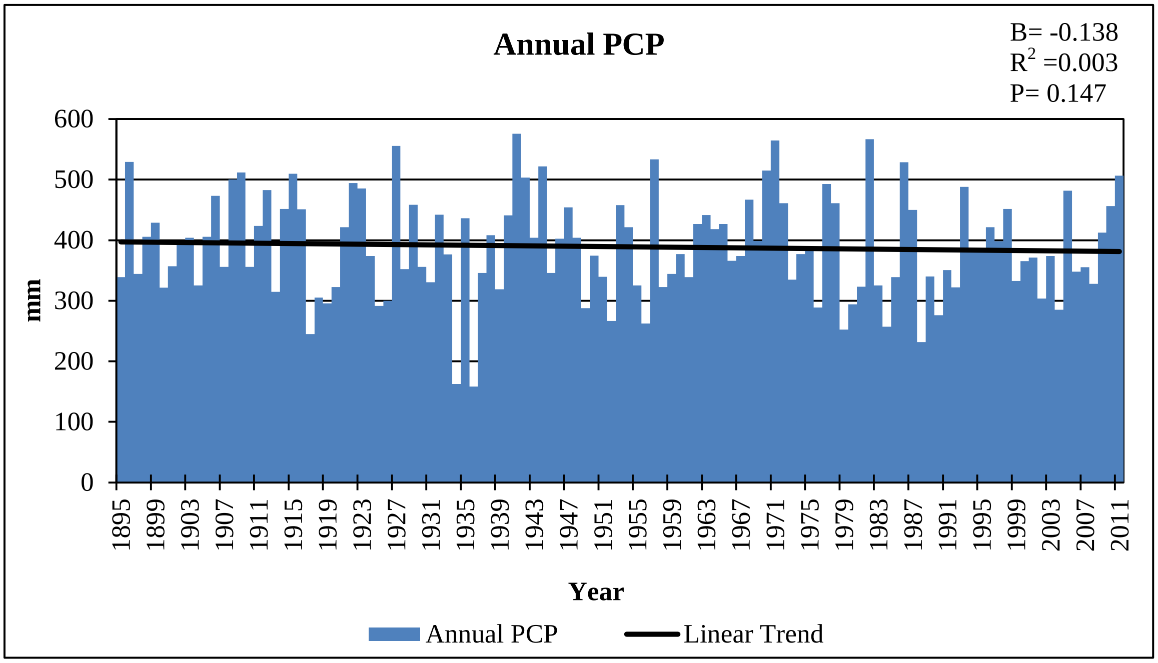

Figure 22. P-O-R of annual precipitation (mm) with linear trend line. The long term mean is 389.1 mm. N=117.

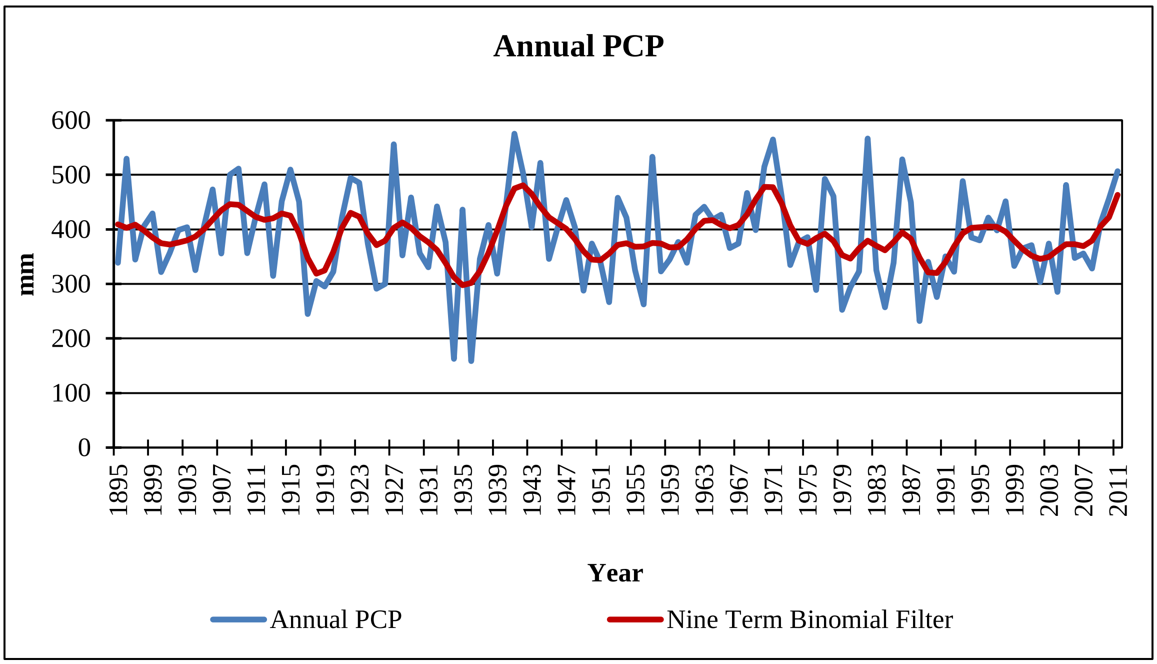

Figure 23. Nine-term binomial filter for P-O-R annual precipitation (mm). N=117.

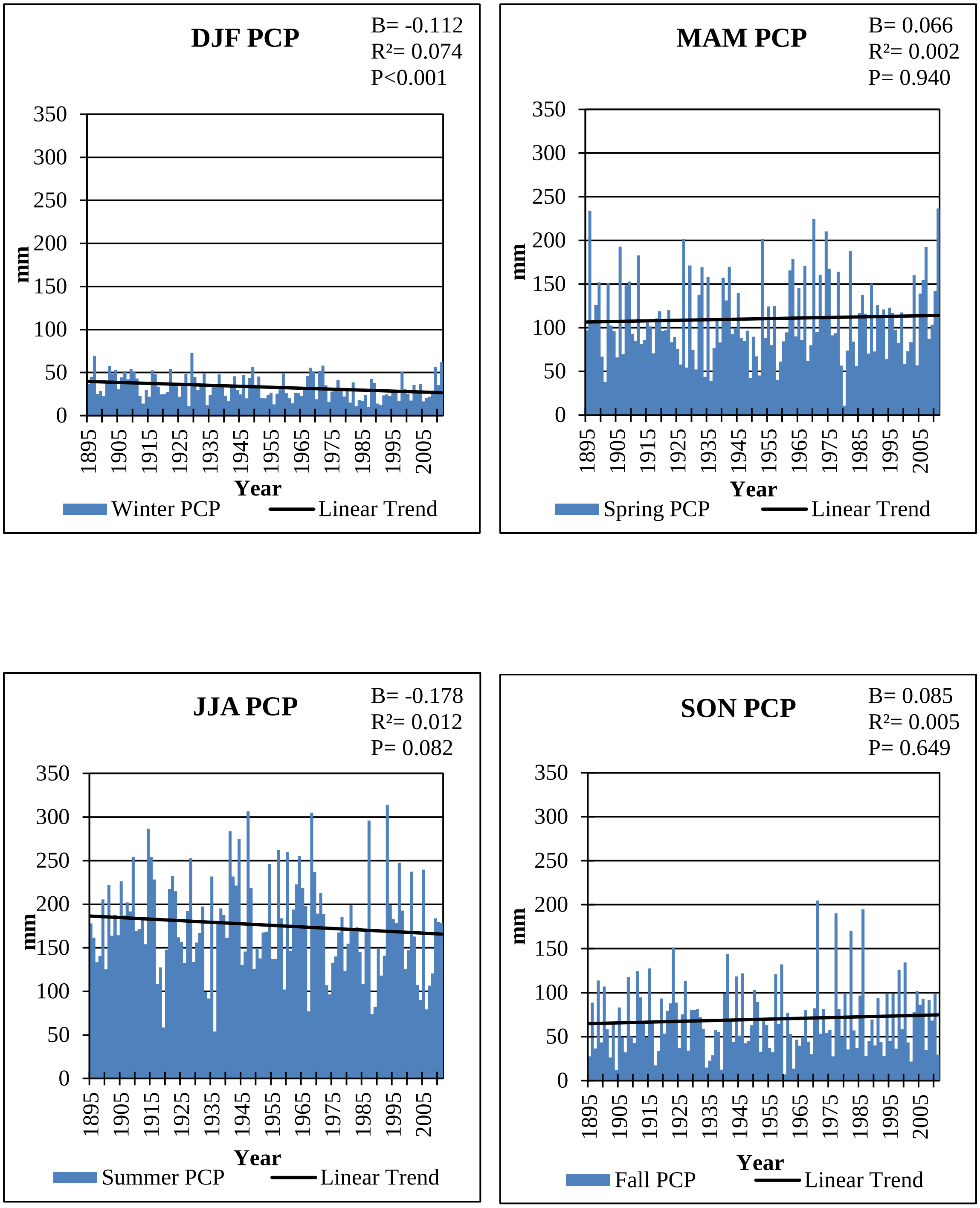

Figure 24. Seasonal precipitation amount (mm) time series for the P-O-R with trend lines. N=117.

Thornthwaite Water Budget Analysis, 1895 - 2011

The climatic water budget values obtained from the Thornthwaite Water Balance Model for the Medora Weather Station based upon 30-year normals 1981–2010 is shown in Figure 25. The results follow a typical seasonal water balance for a mid-latitude semi-arid site. Annual PET totals 600 mm, and monthly values peak in July due to the long summer days and high air temperatures. Annual AET totals 356 mm; monthly AET totals are always less than PET, and peak by June, about a month earlier than does PET. Mean annual PCP totals 374 mm, with a distinct warm season precipitation maximum typical of continental climates. Monthly PCP decreases until September when it then exceeds AET. PCP continues to exceed AET through the fall and winter months, allowing for soil moisture recharge (R) to begin in mid-September. PCP continues to exceed AET until mid-March due to the seasonally reduced evapotranspiration. An initial small soil moisture deficit (D) begins in mid-March and increases to a severe deficit by mid-summer. The mean annual cumulative deficit is 244 mm; the mean annual RAT_A ratio of 0.60 and the mean annual CMI index of -0.40 are indicative a semi-arid climate that experiences a significant water deficit.

For a more complete historical hydroclimatological representation of TRNP, it is necessary to analyze the statistical properties (Table 6) and frequency distribution (Figs. 26-34) of the individual water balance variable for the complete 117 years.

Figure 26 shows the mean annual air temperature time series (T_{mean}). The trend line shows a warming trend of 1.6°C per century. The graph shows a high degree of interannual variability, distinct warm and cold spells, and a statistically significant trend toward warmer air temperatures over time. Figure 27 shows the annual precipitation

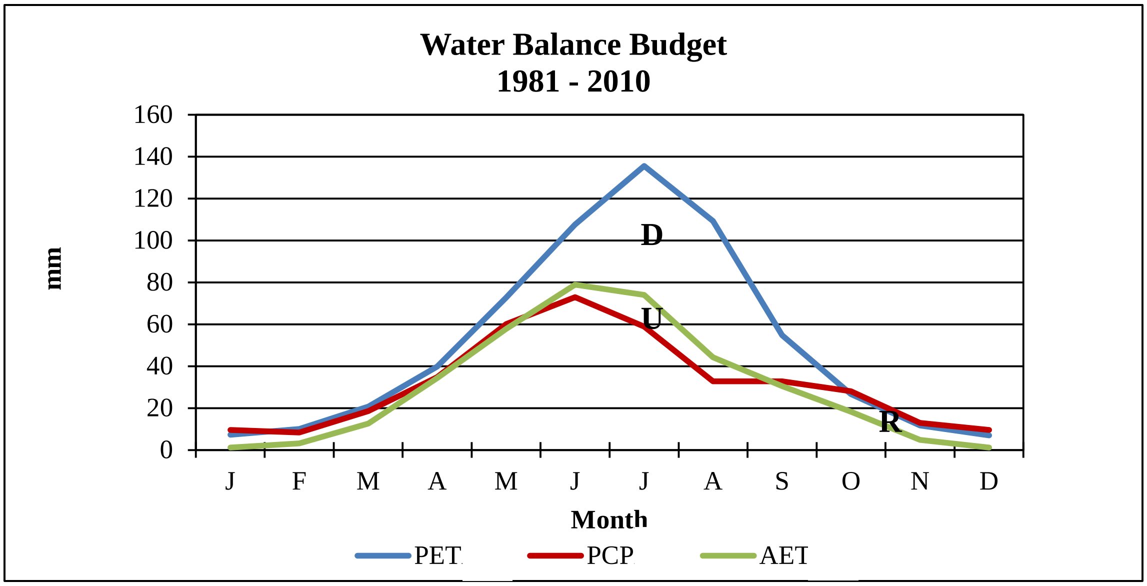

Figure 25. Climatic water balance for the Medora Weather Station based upon monthly temperature and precipitation normals for 1981 - 2010. PET=potential evapotranspiration: PCP=precipitation; AET=actual evapotranspiration; D=soil moisture deficit; U=soil moisture utilization; R=soil moisture recharge.

(PCP) time series. A positive trend toward increasing water demand (PET_A) is shown in Figure 28; however it is not statistically significant. The long-term relationship for AET_A is statistically significant (<0.05), and shows a negative trend toward decreasing actual evapotranspiration over time (Fig. 29). Another important measure of potential ecosystem change relevant to vegetation patterns is moisture deficit (PET_A –AET_A) (Peterson and Johnson, 1995). The PET_A - AET_A (Fig. 30) linear trend line shows a statistically significant ($P<0.05$) positive slope, indicating an increasing moisture deficit over time. The larger the contrast between the climatic demand for water and the availability of precipitation, the more an area will experience drought (Ellis et al., 2009). The study site's increasing temperature and decreasing PCP are consistent with global warming projections (IPCC, 2007), which are driving the trend toward higher moisture deficits. A negative trend for decreasing snow storage is shown in Figure 31, which is statistically significant ($P<0.05$). The decreasing amount of precipitation and warming air temperature over time lead to a decreasing amount of snowfall and snow storage over time. The reduced accumulation and earlier melt of seasonal snowpacks are the expected hydrologic consequences to warming. This can lead to earlier soil recharge, but also may lead to summer drought stress, as changes in the timing and magnitude of soil-water recharge is an important implication for vegetation structure and function (Tague et al., 2009).

The mean annual runoff total (ROtotal) (Fig. 32) shows a slight increasing trend. The spatial and temporal variability of precipitation can have a significant effect upon the amount of runoff (Kumar and Duffy, 2009). However, what is noticeable on the graph is the large ROtotal for 2011. The WRCC reported 155.5 mm for the Medora Weather Station in May 2011, which caused the unusual ROtotal value for May 2011.

Soil moisture storage has a strong influence on the distribution of plant and animal species, and on the productivity of ecosystems (Tague et al., 2009). It is imperative for maintaining the abundance and diversity of the mixed prairie grasses in the park to provide forage for the grazing animals and valuable habitat for the animal species. The interannual variability of soil moisture storage is seen in Figure 33; a slightly decreasing trend line is also evident, though the trend is not statistically significant. Figures 34 and 35 show the results for RAT_A and CMI, respectively. Since they are both moisture indices their temporal patterns are similar. A decreasing linear trend line is noted for both indices, indicating an increasing moisture deficit over time, although the CMI negative trend is not statistically significant. The frequency distribution of the CMI index value is more evenly distributed. The mean CMI is -0.33, which is a semi-arid climate classification.

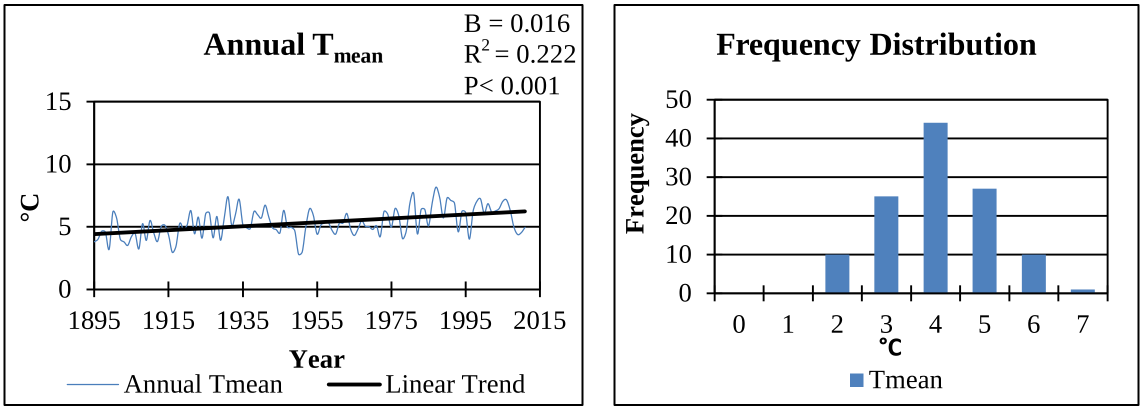

Figure 26. TWBB P-O-R mean annual air temperature (°C) with linear trend line and frequency distribution. N=117.

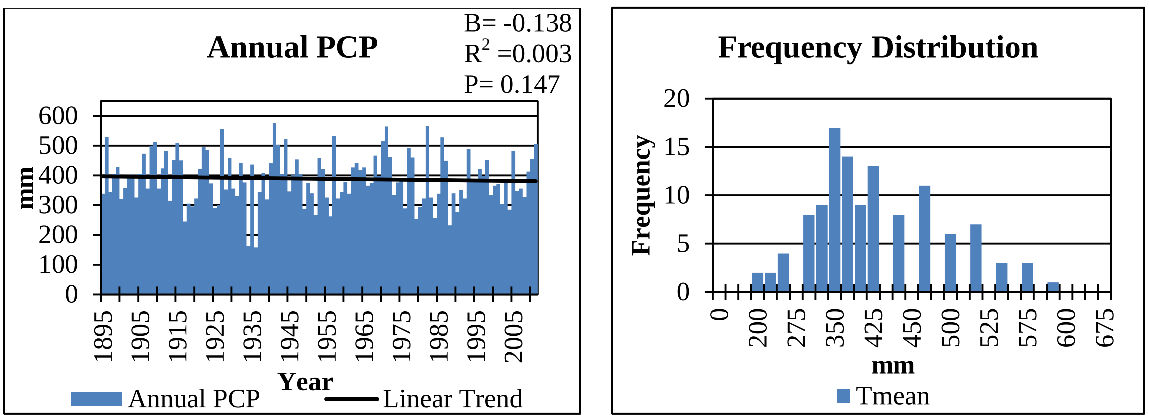

Figure 27. TWBB P-O-R annual precipitation (mm) with linear trend line and frequency distribution. N=117.

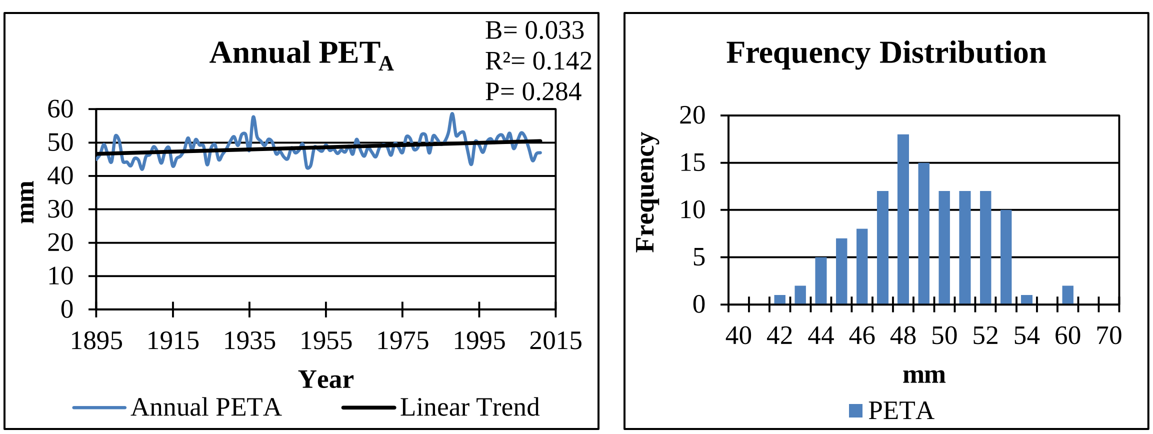

Figure 28. TWBB P-O-R mean annual potential evaportranspiration (mm) with linear trend line and frequency distribution. N=117.

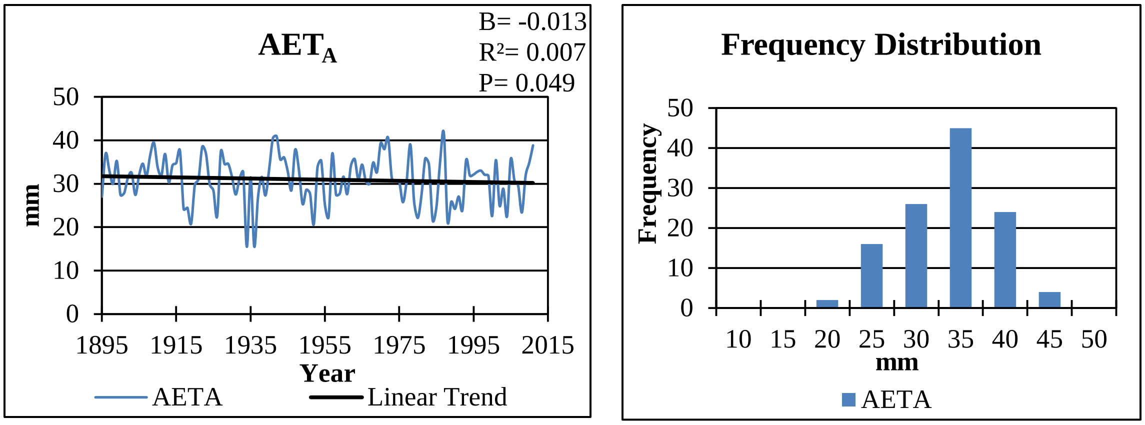

Figure 29. TWBB P-O-R mean annual actual evapotranspiration (mm) with linear trend line and frequency distribution. N=117.

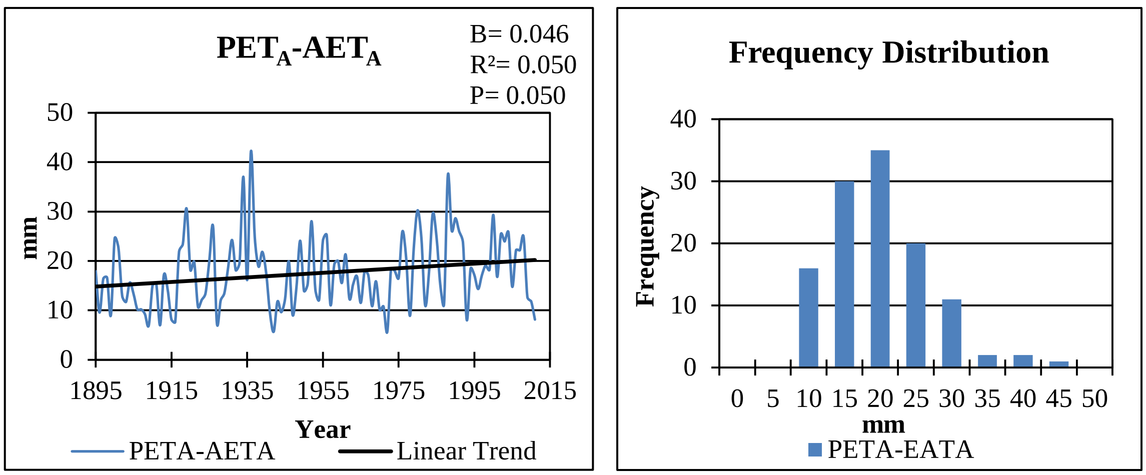

Figure 30. TWBB P-O-R mean annual potential evapotranspiration minus mean annual actual evapotranspiration (mm) with linear trend line and frequency distribution. N=117.

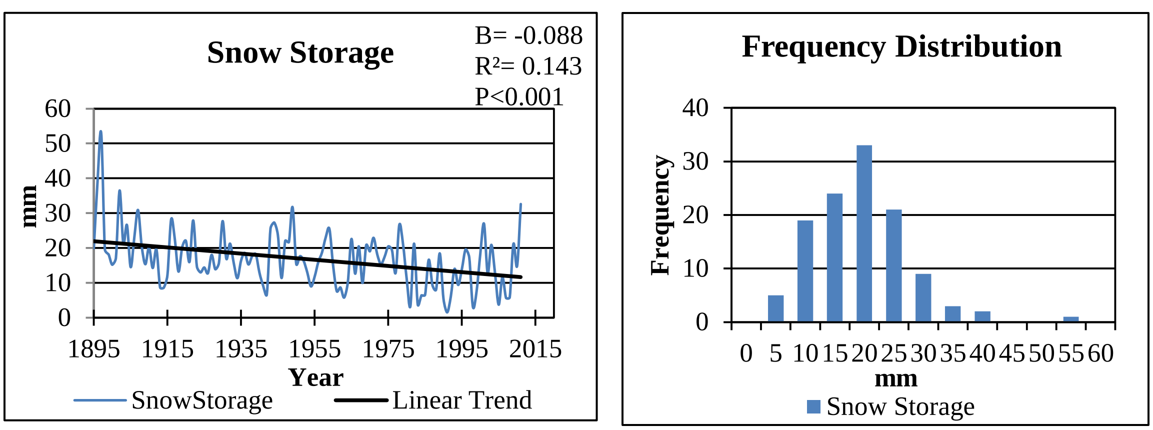

Figure 31. TWBB P-O-R mean annual snow storage (mm) with linear trend line and frequency distribution. N=117.

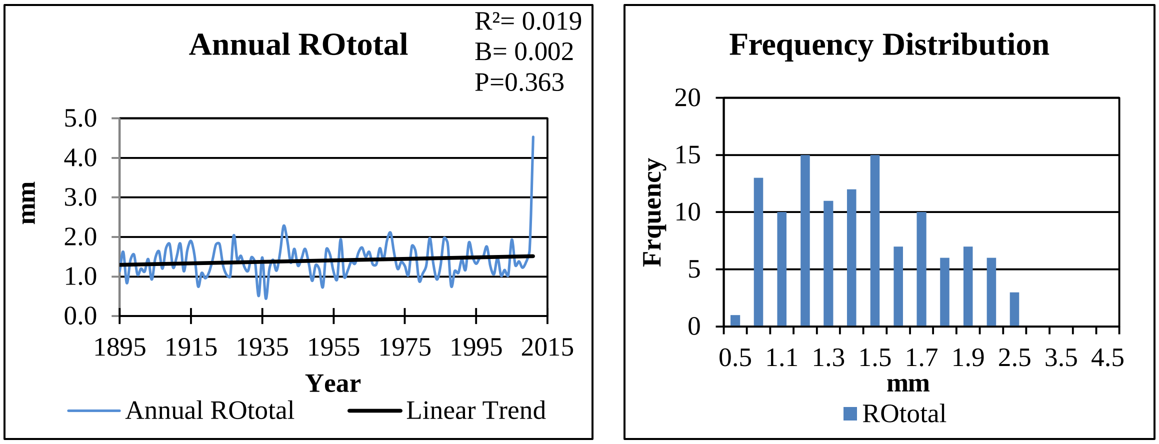

Figure 32. TWBB P-O-R mean annual runoff total (mm) with linear trend line and frequency distribution. N=117.

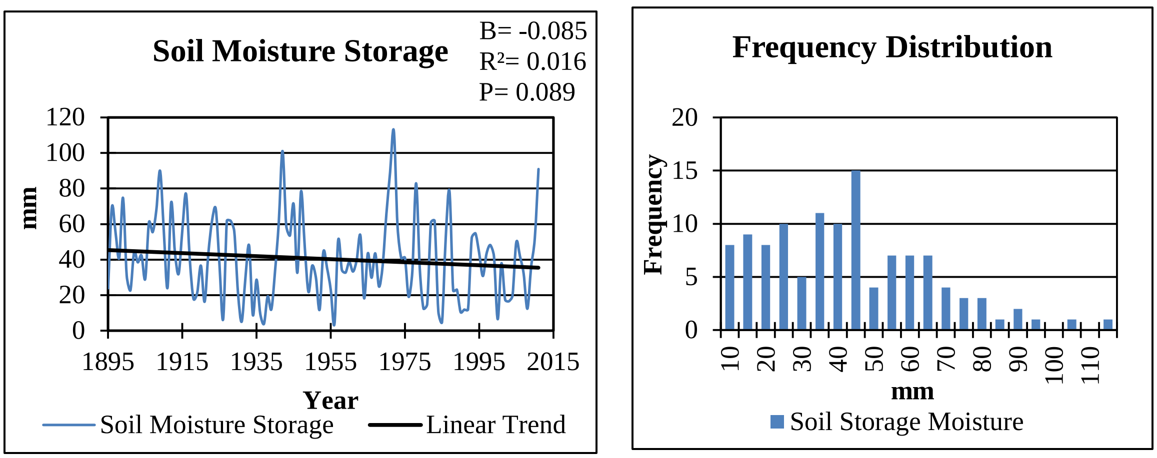

Figure 33. TWBB P-O-R soil moisture storage (mm) with linear trend line and frequency distribution. N=117.

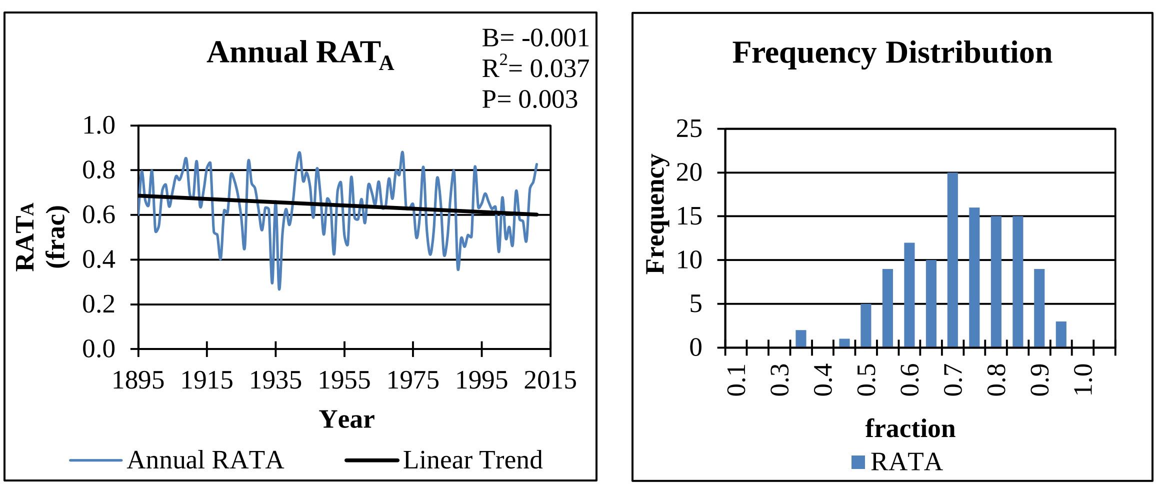

Figure 34. TWBB P-O-R RATA Ratio (actual evapotranspiration/potential evapotranspiration) (fraction) with linear trend line and frequency distribution. N=117.

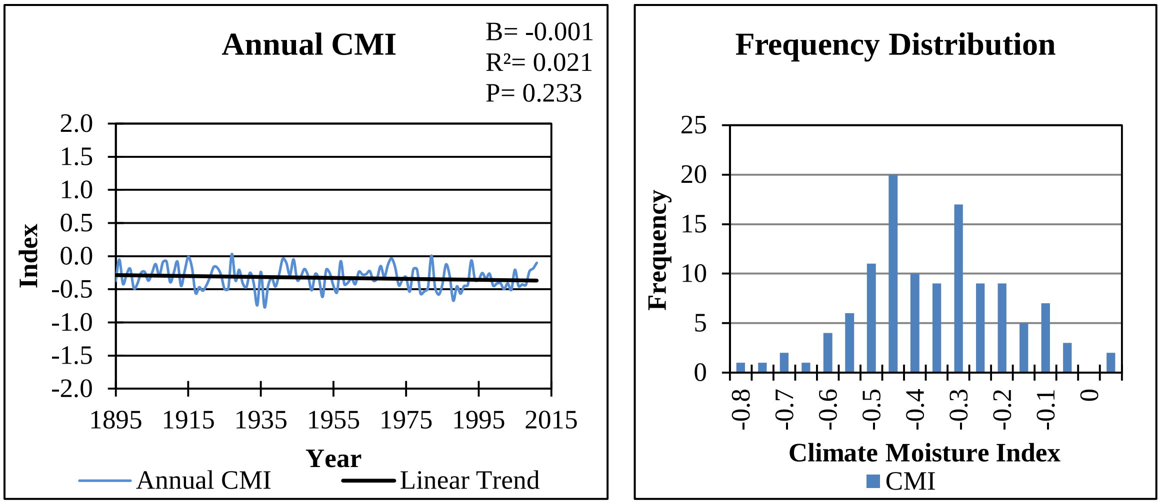

Figure 35. TWBB P-O-R annual Climate Moisture Index with linear trend line and frequency distribution. N=117.

Table 6. Descriptive Statistics for Water Balance Budget Output Variables, 1895 – 2011.

Annual Variables	**TAA** (°C)	**PCPA** (mm)	**PETA** (mm)	**ETA** (mm)	**DEF** (mm)	**RATA** (fraction)	**CMI** (index)
Mean	5.3	389.2	48.5	31.0	17.5	0.643	-0.33
Standard Error	0.1	7.8	0.27	0.6	0.6	0.012	0.01
Median	5.1	377.2	48.4	31.5	16.8	0.648	-0.33
Standard Deviation	1.1	84.4	2.9	5.4	7.0	0.128	0.16
Coefficient of Variation (%)	21.3	21.7	6.1	17.4	40.3	19.8	NA
Skewness	0.1	-0.0	0.3	-0.4	0.7	-0.4	-0.0
Range	5.3	417.2	16.7	26.2	36.5	0.610	0.80
Minimum	2.8	158.4	42.0	15.4	5.5	0.269	-0.79
Maximum	8.1	575.6	58.7	41.7	42.2	0.879	0.03
Confidence Level (95.0%)	0.2	15.4	0.54	0.98	1.29	0.02	0.02

CHAPTER VI

CONCLUSION

This study has provided historical climate and hydroclimatic changes at the TRNP South Unit, focusing upon monthly, seasonal, and annual air temperature, precipitation and climatic water budget variables. The results revealed statistically significant positive trends in mean annual air temperature (T_{mean}) and mean annual minimum air temperature (T_{min}). Mean annual air temperature increased at a rate of 1.6°C/100 years, while mean annual maximum and minimum air temperatures increased at rates of 0.9°C/100 years and 2.1°C/100 years, respectively, over the P-O-R. On a seasonal basis, a statistically significant positive trend was observed in all seasons for the T_{min} and three seasons (winter, fall, spring) for the T_{mean} air temperature. T_{max} air temperature showed a significant positive trend for the summer and winter seasons only. On a monthly basis, all months experienced a significant warming trend in mean minimum air temperature. The analysis of the time series reveals a tendency towards warmer years, with significantly warmer winter and summer periods. The minimum temperature warming is greater than the maximum temperature warming, resulting in a decrease in the DTR. Annual precipitation has decreased at a rate of 13.8 mm/100 years, although the trend is not statistically significant. Negative trends were observed seasonally in the summer and winter seasons, although only the winter season negative trend of -11.2 mm/100 years was statistically significant.

The Thornthwaite water balance model output variables indicate an increase in the climatic demand for water with a decrease in the precipitation. The study site's increasing temperature and decreasing PCP are consistent with global warming projections, which are driving a higher moisture deficit.

The predominate TRNP ecosystem is prairie grassland with a semi-arid climate that is sensitive to climatic change. The risks arising from projected human induced climate change increase significantly and systematically with increasing mean air temperature (T_{mean}). Risk levels are generally low for a change of 1°C T_{mean} or lower increase, but for some cases, particularly for highly vulnerable ecosystems and/or species, the risk levels are not insignificant. Above 1°C T_{mean}, risks increase substantially and often rapidly for the highly vulnerable ecosystems and species on a regional level (Hare, 2005).

Climatic warming with increased precipitation could put TRNP prairie grasses at risk. The studies have shown dramatic increases in the nitrogen-fixing forbs initially, but the interaction with annual grasses changes this result as seen by a later reduction in the forbs and an increase in annual grasses. Plant species diversity is also greatly reduced in these areas. These in turn will reduce food resources for invertebrate herbivores and habitat availability. Increased precipitation can increase soil salinity and decrease soil oxygen, especially in soils that are poorly drained. This can predispose TRNP vegetation to plant diseases and insect attacks. Increased invasion of non-native species is also possible.

Warming with decreasing precipitation can also have detrimental effects on prairie grasses as noted by the earlier studies. Less precipitation limits forest or tree expansion in the ecosystem due to the lack of available water. Increases in fuel loads from drought stricken annual grasses will increase fire risks. Wildfires will kill tree saplings and encourage woody shrubs to grow. The prairie grass ecosystem could eventually shift towards an increased woody-species cover and density in sagebrush and juniper woodlands leading to a decrease in range productivity and watershed dynamics.

The National Park Service preserves more than 84 million acres within the National Park System. Global climate change threatens the integrity of all national parks, and challenges the NPS's mission to leave park resources unimpaired for future generations. The effects of climate change will also impact the ability of the NPS to meet its mission and comply with legal mandates. Most resource protection laws that the NPS must comply with were not written with consideration of a changing climate. The National Park Service has responded to climate change by examining its policy, planning and decision-making. A Climate Change Response Steering Committee representing parks, regions, managers, and subject–matter experts has been established to provide guidance to the NPS (Steuer, 2010).

Changes in temperature and precipitation as well as increased CO_2 levels have shown they will enhance plant production, but the studies addressing the climatic changes were site specific; for example, some of the locations were California, Oregon, Nevada, Wyoming and Kansas; but because national parks are unique ecosystems, each will have its own individual responses. The analysis of TRNP historical hydroclimatic data has examined the past climatic trends and provides a benchmark for future climate change studies. While the previous scenarios could be future predictions for TRNP, future statistical analysis and research is needed to gather site specific data within TRNP, such as precipitation timing, vegetation cover percentages, grazing and prescribed burn practices. The additional information and study results would enable park officials to adapt to and mitigate the effects of climatic change.

APPENDICES

Appendix A
Medora Weather Station #325813
Monthly and Annual T_{mean} (°C)

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual T_{mean}
1895	-15.6	-11.8	-2.2	9.6	11.0	15.2	20.1	19.1	14.1	-2.6	-3.7	-7.5	3.8
1896	-12.4	-6.2	-6.7	5.6	12.4	18.4	20.8	19.9	12.6	-1.9	-10.7	-3.8	4.0
1897	-10.0	-10.6	-9.2	6.7	15.1	17.9	21.1	19.7	19.1	-0.4	-4.6	-8.8	4.6
1898	-8.0	-6.0	-6.9	5.4	11.3	17.2	20.7	21.3	15.0	-1.4	-4.1	-9.5	4.6
1899	-10.2	-17.1	-11.9	3.3	9.6	16.1	21.1	19.2	15.0	-1.3	3.3	-8.7	3.2
1900	-4.7	-11.1	-2.1	9.5	16.3	20.7	21.1	21.1	12.3	0.4	-5.4	-3.6	6.2
1901	-8.2	-10.2	-0.3	7.6	17.3	15.9	22.8	20.8	12.2	-0.5	0.0	-8.7	5.7
1902	-9.0	-9.1	-2.1	5.2	13.0	14.2	20.1	19.2	12.8	-2.1	-1.6	-12.4	4.0
1903	-8.5	-14.3	-4.2	6.6	10.8	17.2	19.7	18.4	11.3	-1.8	-2.4	-7.2	3.8
1904	-11.6	-14.5	-6.7	4.4	11.7	15.8	18.2	18.6	13.3	-1.4	2.1	-7.7	3.5
1905	-14.5	-12.6	1.5	5.2	9.5	15.7	19.9	20.4	16.2	-3.2	-0.1	-7.5	4.2
1906	-7.5	-7.5	-6.2	8.6	10.1	15.3	19.1	19.3	16.3	-2.2	-2.7	-9.2	4.5
1907	-17.7	-8.7	-1.1	1.3	7.4	16.4	18.8	18.8	11.7	-2.6	-0.1	-5.4	3.2
1908	-5.4	-8.4	-3.4	7.0	10.3	16.0	21.3	18.0	16.3	-1.3	0.4	-7.7	5.2
1909	-13.2	-8.6	-1.8	1.8	10.8	17.7	20.0	21.4	15.3	-2.6	-0.4	-13.6	3.9
1910	-10.4	-14.3	6.2	10.3	10.4	18.9	21.6	17.8	13.8	0.7	-2.3	-6.7	5.5
1911	-11.9	-10.8	3.1	5.8	14.2	20.1	19.5	17.5	13.5	-2.0	-6.9	-7.8	4.5
1912	-15.2	-8.8	-8.6	8.0	11.9	16.9	19.1	18.3	10.3	-2.3	0.8	-4.4	3.8
1913	-12.3	-9.6	-6.2	8.9	11.1	18.8	19.4	21.0	14.5	-2.7	2.3	-4.9	5.0
1914	-4.6	-12.4	-1.6	6.8	13.1	17.2	22.9	18.3	14.8	-1.0	1.4	-13.4	5.1
1915	-11.4	-7.6	-5.3	11.6	11.0	14.3	17.0	18.7	11.5	-0.2	-0.5	-6.9	4.3
1916	-21.1	-10.5	-1.4	5.4	10.6	15.1	22.8	19.0	13.2	-3.0	-0.5	-14.1	3.0
1917	-12.6	-15.3	-5.0	4.0	10.9	15.9	22.7	19.5	14.2	-3.9	4.7	-13.7	3.4
1918	-15.0	-9.8	3.5	5.5	12.0	19.2	20.0	20.0	12.4	1.9	-1.6	-5.0	5.3
1919	-2.7	-10.0	-6.2	6.4	13.5	21.2	23.1	21.3	15.4	-6.6	-7.0	-10.4	4.8
1920	-10.1	-6.4	-2.1	1.0	12.0	17.2	21.5	21.3	15.0	0.2	-1.4	-6.5	5.1
1921	-4.9	-2.8	-0.9	5.6	11.9	21.1	22.2	20.5	13.6	-0.4	-2.9	-7.5	6.3
1922	-11.6	-16.4	-3.2	6.2	13.0	19.0	19.7	21.9	16.7	-0.8	0.2	-11.6	4.4
1923	-7.0	-12.6	-4.1	5.0	12.4	18.9	22.7	18.6	15.6	0.0	3.5	-3.6	5.8
1924	-12.8	-2.8	-2.9	4.7	9.4	15.2	19.5	18.1	13.6	1.0	-0.1	-13.9	4.1
1925	-9.3	-4.0	-0.2	9.5	13.1	17.2	20.5	20.9	14.6	-4.6	0.6	-5.6	6.0
1926	-5.6	-1.8	-0.3	7.3	15.3	17.1	22.4	19.6	12.0	0.2	-3.1	-9.8	6.1
1927	-9.0	-6.9	0.5	6.1	9.2	16.9	19.5	18.8	14.5	1.3	-4.1	-17.3	4.1
1928	-8.3	-5.5	1.4	3.6	15.5	14.9	20.2	19.2	13.4	-0.8	0.9	-4.5	5.8
1929	-18.0	-14.0	0.2	5.8	10.0	17.3	22.8	21.9	12.0	0.9	-1.8	-9.9	3.9
1930	-17.3	-3.1	-1.7	10.2	10.5	17.3	23.6	22.0	13.8	-1.7	-0.3	-4.5	5.7
1931	-3.0	-0.6	-1.7	7.8	12.6	20.8	21.3	20.0	16.5	0.8	-0.8	-4.9	7.4

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual T_{mean}
1932	-10.7	-7.1	-5.0	8.5	13.7	18.8	21.8	20.5	13.8	-1.8	-1.5	-9.3	5.1
1933	-7.4	-10.9	0.5	5.3	12.2	21.5	23.4	20.4	16.1	-0.8	0.9	-9.4	6.0
1934	-4.9	-2.7	-0.8	7.7	18.0	17.7	23.0	20.4	11.5	2.0	2.5	-8.1	7.2
1935	-11.4	-1.4	-1.1	4.4	9.4	16.0	23.7	19.6	14.9	-1.5	-3.9	-6.5	5.2
1936	-15.7	-22.7	-1.0	4.0	16.9	20.6	28.0	21.6	16.4	-0.9	0.0	-8.2	4.9
1937	-20.1	-10.9	-1.7	6.1	14.1	18.0	23.0	23.0	16.1	1.6	-2.1	-8.7	4.9
1938	-7.5	-11.2	1.1	7.0	11.6	18.8	21.6	20.6	17.2	3.8	-2.8	-5.3	6.2
1939	-4.5	-14.5	-2.2	7.3	15.5	15.1	22.9	19.6	14.6	-2.5	2.1	-1.9	6.0
1940	-14.5	-7.3	-1.4	4.2	13.6	18.1	22.6	20.9	17.7	2.2	-4.4	-3.4	5.7
1941	-7.5	-5.9	-0.8	6.8	15.4	17.3	22.1	20.5	12.9	1.0	1.8	-2.8	6.7
1942	-5.2	-7.4	0.0	8.1	10.3	15.9	20.4	20.2	13.5	1.1	-0.2	-7.5	5.8
1943	-16.4	-5.1	-5.7	8.6	10.6	15.7	21.3	21.0	14.5	0.0	-0.7	-4.6	4.9
1944	-3.5	-8.5	-5.9	5.1	14.4	16.0	19.6	18.5	14.1	-1.0	-4.1	-7.5	4.8
1945	-8.2	-7.0	1.5	4.4	10.0	14.5	20.6	21.1	12.8	-1.2	-3.5	-10.7	4.5
1946	-5.6	-5.6	4.5	10.4	10.2	17.3	22.0	19.2	13.9	-1.4	-2.2	-7.0	6.3
1947	-6.7	-10.1	-4.7	5.4	10.6	15.4	21.6	21.4	13.9	2.0	-3.3	-5.8	5.0
1948	-7.6	-10.0	-4.1	7.5	12.8	16.6	20.2	20.3	17.3	-2.8	-0.1	-10.4	5.0
1949	-16.3	-14.2	-4.1	9.0	14.5	18.0	21.2	21.7	13.0	-0.2	4.5	-10.8	4.7
1950	-20.6	-8.0	-5.2	1.9	9.8	16.1	19.1	18.5	13.8	0.4	-4.1	-7.8	2.8
1951	-12.5	-7.3	-8.8	3.9	12.7	14.4	20.6	18.9	11.8	-1.0	-3.5	-13.2	3.0
1952	-13.8	-6.4	-6.9	9.3	13.1	18.7	20.1	20.2	15.8	-2.7	-1.1	-5.5	5.1
1953	-4.7	-4.2	-0.8	2.6	10.5	17.4	20.8	20.8	14.6	0.5	3.4	-3.6	6.5
1954	-14.1	2.3	-4.8	4.8	11.0	15.9	22.7	19.7	13.6	-0.9	3.5	-2.8	5.9
1955	-8.5	-10.8	-3.9	8.8	13.7	16.0	21.9	22.6	13.9	-2.0	-8.0	-10.6	4.4
1956	-11.3	-8.5	-0.7	2.9	12.3	20.7	19.5	19.1	13.6	-1.6	-0.1	-4.5	5.1
1957	-15.4	-7.8	-1.1	4.2	12.3	16.3	23.1	20.7	12.9	0.3	-0.1	-1.7	5.3
1958	-3.6	-8.4	-3.6	6.7	15.4	14.9	17.8	21.7	14.7	-2.1	-1.5	-7.7	5.3
1959	-12.4	-13.2	1.0	5.2	10.8	18.8	21.0	21.5	13.5	-2.4	-4.4	-2.6	4.7
1960	-10.7	-9.4	-5.1	6.2	12.1	16.4	22.4	19.5	14.8	-2.6	-2.7	-7.8	4.4
1961	-6.7	-4.1	1.8	2.9	11.7	19.7	21.2	22.5	10.5	-2.9	-1.5	-11.5	5.3
1962	-10.7	-9.2	-4.8	7.1	12.1	17.6	18.7	20.4	13.5	1.3	2.5	-4.8	5.3
1963	-15.0	-4.6	2.5	5.3	11.9	18.6	22.1	20.5	17.2	2.3	1.4	-9.3	6.1
1964	-5.8	-3.6	-4.0	7.0	13.9	17.0	22.3	19.1	11.8	-1.6	-3.9	-14.1	4.8
1965	-11.6	-8.5	-9.4	5.2	12.0	17.8	21.0	19.8	8.2	0.0	-0.1	-2.8	4.3
1966	-15.4	-9.4	1.0	3.0	12.7	17.4	22.7	19.0	16.4	-0.4	-3.7	-5.7	4.8
1967	-7.3	-6.8	-1.0	4.5	10.0	16.4	20.8	21.0	16.4	0.7	-0.5	-8.4	5.5
1968	-9.1	-6.9	2.9	5.2	10.3	16.1	20.2	18.9	15.1	-1.2	0.8	-11.8	5.0
1969	-17.7	-8.8	-4.6	10.0	13.4	15.1	20.1	22.9	16.3	-1.7	1.1	-5.9	5.0
1970	-13.0	-5.8	-4.2	3.7	12.5	19.2	22.4	21.8	14.0	-2.2	-2.6	-8.4	4.8
1971	-13.3	-7.8	-1.7	7.0	12.3	18.7	19.4	23.2	13.7	-0.4	0.4	-10.4	5.1
1972	-13.6	-10.4	-1.0	5.8	13.1	18.1	18.4	21.0	13.0	-1.9	-1.2	-10.6	4.2

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual T_{mean}
1973	-6.7	-4.4	2.9	5.6	12.2	18.0	20.6	22.8	13.2	1.0	-3.4	-7.4	6.2
1974	-9.6	-3.0	-0.5	7.4	10.8	17.9	23.5	17.5	12.7	-0.8	-0.1	-3.8	6.0
1975	-6.8	-9.0	-4.4	2.2	11.6	16.8	22.9	19.4	13.8	-0.1	-0.9	-5.9	5.0
1976	-8.8	-0.9	-1.3	8.1	12.9	18.6	22.4	22.2	16.7	-2.6	-3.0	-6.7	6.5
1977	-16.0	-2.2	1.7	9.5	17.0	19.5	22.1	17.4	14.1	0.9	-2.6	-10.7	5.9
1978	-17.1	-12.6	-0.7	6.4	13.6	17.9	20.1	20.1	16.4	0.2	-4.1	-11.4	4.1
1979	-17.3	-13.6	-2.9	4.1	10.7	18.5	21.8	20.1	17.2	1.1	-2.2	-1.6	4.7
1980	-10.5	-5.5	-1.2	9.6	15.9	19.4	23.1	18.8	15.0	1.0	3.0	-5.6	6.9
1981	-2.6	-3.7	2.8	9.6	13.4	16.6	22.9	21.7	15.8	-0.1	2.8	-7.3	7.7
1982	-17.4	-8.8	-2.3	4.6	11.0	16.5	21.4	21.1	14.3	0.6	-2.9	-4.9	4.4
1983	-2.7	0.0	0.2	4.8	10.7	17.0	23.2	25.1	14.0	0.7	0.5	-17.1	6.4
1984	-5.6	0.8	-1.2	6.9	12.3	18.0	22.8	23.6	11.5	-0.3	-0.4	-11.6	6.4
1985	-10.3	-7.8	0.5	9.3	16.2	16.3	23.0	19.1	12.5	0.4	-8.7	-9.4	5.1
1986	-2.9	-7.7	5.6	6.2	13.0	20.7	20.5	20.3	11.9	0.7	-2.7	-2.5	6.9
1987	-3.9	-0.2	0.3	11.0	15.9	20.3	21.7	18.5	15.4	-1.0	3.1	-3.2	8.2
1988	-10.4	-7.0	1.7	8.1	16.4	25.3	23.6	22.2	14.3	-0.6	0.0	-5.4	7.4
1989	-6.7	-13.5	-2.1	7.0	13.8	17.5	24.4	21.9	15.2	-0.2	0.8	-9.7	5.7
1990	-3.0	-3.5	2.2	7.2	12.6	18.9	21.8	22.7	18.0	-0.9	1.9	-10.2	7.3
1991	-10.7	0.3	1.6	7.7	13.9	19.3	22.1	23.1	15.3	-2.7	-2.1	-2.7	7.1
1992	-1.8	0.4	3.8	6.9	14.6	18.4	17.7	18.0	14.5	-0.5	-1.1	-8.3	6.9
1993	-11.7	-10.0	1.4	6.7	13.1	15.6	17.0	18.4	12.1	-2.0	-2.5	-3.0	4.6
1994	-12.2	-11.9	2.3	7.4	14.6	18.2	20.0	21.0	16.7	2.5	0.0	-3.9	6.2
1995	-6.9	-2.4	-1.2	4.2	11.2	18.8	21.0	22.5	14.1	0.6	-0.9	-7.2	6.1
1996	-12.8	-4.4	-5.9	5.0	10.1	18.6	20.2	22.2	14.1	-0.5	-6.7	-11.6	4.0
1997	-12.4	-3.1	-0.4	4.1	11.9	20.1	21.1	20.4	16.7	-0.5	-0.7	-2.4	6.2
1998	-8.3	0.6	-4.6	8.2	13.6	13.7	22.2	23.1	18.6	0.7	1.6	-5.1	7.0
1999	-9.0	-0.3	3.4	6.9	12.7	17.0	22.2	21.6	11.7	-1.6	4.6	-2.4	7.2
2000	-6.5	-3.0	3.6	6.1	13.7	16.3	23.1	23.2	15.8	0.0	-6.4	-12.8	6.1
2001	-4.8	-11.0	0.9	7.2	14.0	17.1	22.7	23.1	16.1	-1.6	3.9	-5.4	6.8
2002	-4.9	-1.6	-7.5	4.7	10.6	18.9	24.3	20.2	16.6	-4.3	1.4	-4.0	6.2
2003	-9.0	-9.7	-2.1	8.9	12.2	16.8	23.7	24.4	14.9	3.0	-4.1	-3.6	6.3
2004	-10.8	-5.4	2.5	8.6	11.5	15.9	21.4	18.8	16.8	-0.2	1.6	-3.3	6.5
2005	-10.2	-1.3	2.6	9.1	10.7	18.2	22.2	20.0	16.3	0.9	2.1	-6.1	7.0
2006	0.0	-5.5	-1.4	9.2	13.4	19.2	24.3	21.7	13.1	-2.4	-0.6	-5.2	7.2
2007	-6.7	-9.6	3.0	4.9	13.3	18.5	24.3	20.5	14.8	0.7	-0.1	-7.8	6.3
2008	-9.8	-8.4	-0.2	5.5	11.9	16.5	22.4	21.5	13.6	-0.8	0.1	-12.6	5.0
2009	-10.8	-8.7	-3.6	4.9	11.9	15.8	18.8	18.7	17.5	-1.1	2.7	-13.6	4.4
2010	-10.7	-11.3	0.2	7.4	10.5	17.1	20.3	20.8	13.2	0.9	-2.7	-11.3	4.5
2011	-11.1	-11.2	-5.2	4.0	9.9	16.5	21.8	20.6	15.3	2.6	0.2	-4.0	5.0

Appendix B
Medora Weather Station #325813
Monthly and Annual T_{max} (°C)

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1895	-8.7	-5.9	5.3	18.9	19.2	23.6	30.1	30.2	24.5	15.9	3.1	-1.3
1896	-5.9	1.5	-0.2	13.2	20.1	27.4	29.8	29.7	20.9	14.5	-6.0	1.3
1897	-4.8	-3.8	-2.6	13.5	24.0	26.0	30.5	29.2	29.7	15.9	1.4	-2.4
1898	-1.8	1.3	-1.0	12.2	18.0	24.5	30.0	30.7	24.3	9.6	1.8	-4.3
1899	-5.0	-10.9	-5.9	10.2	16.3	24.2	30.6	28.1	25.5	13.4	11.3	-3.4
1900	2.1	-4.0	5.2	18.7	25.9	30.7	30.2	30.3	19.3	16.4	1.0	2.4
1901	-1.3	-3.0	6.9	15.9	27.6	23.7	31.5	30.7	19.9	18.4	7.8	-3.5
1902	-2.2	-2.7	3.3	13.1	21.4	21.8	29.6	29.2	22.9	16.4	5.0	-4.1
1903	-1.1	-6.5	2.6	15.3	19.4	25.9	28.8	27.1	19.1	18.5	4.8	-1.2
1904	-4.9	-6.9	-0.5	11.9	20.4	23.7	27.9	29.0	23.3	18.0	11.8	-0.4
1905	-7.8	-4.5	8.9	14.6	17.6	23.3	28.4	30.7	26.4	11.9	7.3	-0.9
1906	-0.7	-0.5	1.0	18.0	17.6	23.2	29.0	27.6	26.1	17.1	4.2	-1.7
1907	-10.6	-1.3	7.0	9.3	16.0	24.5	27.3	28.7	20.9	18.4	9.1	2.3
1908	2.2	-2.2	3.5	16.5	18.5	23.6	30.8	27.7	25.8	12.8	8.3	-0.9
1909	-6.1	-1.5	4.8	9.9	19.5	24.9	27.7	30.9	24.8	15.5	7.5	-7.7
1910	-3.3	-6.3	15.1	21.1	19.0	27.6	31.8	27.3	22.6	18.6	4.6	0.5
1911	-4.4	-2.9	11.6	15.1	22.8	28.6	29.1	26.2	21.9	13.5	0.5	-2.2
1912	-8.1	-2.2	-0.6	17.0	20.0	25.5	27.3	26.5	18.3	15.5	8.0	3.2
1913	-4.3	-2.7	1.0	18.5	19.3	26.7	28.6	30.7	24.6	12.5	10.1	4.4
1914	3.9	-4.8	5.6	15.1	22.4	25.0	32.4	27.5	24.9	16.0	9.5	-6.6
1915	-4.9	-1.8	2.0	21.2	18.7	21.9	24.4	27.5	19.2	18.0	6.3	-0.9
1916	-13.9	-3.6	6.0	13.4	19.2	22.6	31.3	27.9	22.8	13.5	7.6	-6.5
1917	-5.5	-7.8	2.0	11.3	20.6	24.6	33.1	29.9	24.4	12.5	13.6	-5.7
1918	-8.6	-2.4	12.3	13.2	21.1	28.0	29.0	28.9	21.9	17.0	5.1	1.2
1919	4.4	-3.1	0.6	14.0	22.5	31.1	33.7	31.4	24.1	7.6	-0.9	-4.4
1920	-3.8	0.1	5.2	8.1	20.0	25.2	30.3	31.7	24.6	17.9	5.7	0.5
1921	2.1	5.6	6.8	14.6	18.8	29.1	31.5	30.6	21.8	18.2	3.4	-1.7
1922	-5.1	-9.3	2.9	13.7	20.5	26.4	27.9	31.8	26.3	18.0	5.3	-4.8
1923	-1.0	-4.6	2.3	12.9	21.2	27.0	30.8	27.7	24.9	14.3	10.8	3.5
1924	-5.4	3.8	2.6	11.5	17.6	22.4	28.0	27.6	23.5	18.5	6.4	-7.0
1925	-2.2	2.8	6.8	17.9	22.5	24.6	29.7	31.3	22.9	7.3	7.2	0.8
1926	0.9	3.9	7.1	17.2	23.6	25.1	31.9	28.5	21.1	15.7	1.5	-3.3
1927	-3.4	-0.6	6.6	13.2	15.4	24.4	27.7	27.7	22.6	18.1	1.2	-10.8
1928	-2.4	1.0	8.1	11.3	25.1	22.5	27.8	28.2	23.0	15.1	8.1	1.6
1929	-11.2	-6.8	6.1	13.6	18.9	24.9	32.6	32.1	20.4	17.2	4.4	-4.1
1930	-11.4	3.0	5.1	19.1	18.4	25.2	33.7	30.7	22.5	11.9	6.6	0.9
1931	3.5	6.0	4.6	17.5	22.3	29.4	30.6	28.7	26.2	16.9	6.3	1.7

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1932	-4.6	-0.1	0.8	16.1	22.0	26.0	31.0	29.1	23.7	10.7	4.8	-3.4
1933	-0.8	-3.7	6.8	12.5	19.3	30.2	32.9	29.6	25.4	15.9	6.8	-2.4
1934	2.1	4.1	6.7	17.2	28.6	26.2	32.3	30.4	20.2	18.3	10.5	-1.3
1935	-4.1	5.5	6.0	11.5	15.5	23.5	32.7	29.0	24.5	16.6	2.4	0.1
1936	-8.7	-15.3	4.7	12.3	26.4	29.8	37.7	30.8	25.8	16.4	6.2	-2.2
1937	-13.7	-4.0	4.8	13.5	23.2	25.7	31.0	32.9	25.1	15.9	3.8	-1.8
1938	-1.3	-4.3	7.6	14.9	18.8	26.4	30.2	31.2	26.3	18.7	2.9	1.4
1939	1.9	-6.3	5.4	15.6	24.4	22.4	32.2	29.8	25.1	13.9	11.6	6.1
1940	-7.4	-1.4	4.4	10.7	22.9	26.6	31.7	30.8	27.7	18.9	1.5	3.8
1941	-0.6	2.1	6.1	13.5	23.6	24.6	31.5	28.9	20.7	14.6	7.7	4.0
1942	1.9	-1.2	5.8	15.6	17.2	22.9	28.7	28.8	22.2	17.2	6.6	-0.5
1943	-9.4	2.2	1.7	18.2	18.6	22.8	30.4	29.9	24.5	19.1	5.1	2.9
1944	3.5	-1.3	0.8	13.3	22.6	23.0	28.5	27.3	23.2	20.1	1.2	-1.1
1945	-2.0	0.1	8.8	12.1	18.5	21.9	29.9	30.3	21.9	17.8	3.7	-4.2
1946	1.7	2.1	11.7	19.9	17.7	25.3	30.8	28.2	22.3	10.6	4.8	-0.7
1947	-0.7	-2.5	1.1	12.4	18.9	22.2	29.9	30.3	22.7	18.5	2.4	1.1
1948	0.3	-2.1	2.4	16.3	21.0	23.5	28.4	30.3	28.8	18.2	5.2	-2.9
1949	-9.0	-5.8	2.3	19.2	23.5	27.3	30.7	32.0	23.4	13.1	12.8	-3.6
1950	-13.5	-0.3	0.4	7.6	16.9	24.5	28.5	27.2	21.6	16.9	2.7	-1.3
1951	-5.5	-0.1	-2.3	12.1	22.0	22.1	29.4	27.3	19.0	12.4	3.0	-6.3
1952	-6.8	-0.3	-1.1	19.2	21.9	27.3	29.3	29.4	25.7	16.9	6.2	2.5
1953	2.5	2.4	6.1	9.0	17.1	23.7	29.2	29.3	24.2	20.6	10.7	3.2
1954	-6.9	8.4	2.0	12.4	19.0	23.1	31.2	28.0	21.2	14.6	11.5	4.9
1955	-1.3	-3.8	3.3	17.6	22.0	22.8	30.3	32.9	24.0	19.6	-1.2	-3.4
1956	-4.3	-0.4	6.9	11.7	20.2	30.2	27.8	28.3	23.5	19.0	6.1	2.5
1957	-8.3	-0.3	5.5	11.1	20.4	23.7	31.7	28.3	20.9	13.3	5.2	5.2
1958	4.0	-1.5	1.6	14.4	25.8	22.4	25.6	31.9	25.2	17.7	5.0	-0.9
1959	-5.3	-4.5	7.4	13.4	19.3	27.1	31.1	31.8	21.1	11.2	2.0	3.0
1960	-3.4	-2.8	2.2	14.1	20.6	24.1	32.7	29.3	25.2	17.2	6.0	-1.4
1961	0.0	3.8	8.9	10.9	19.3	30.1	30.9	33.4	19.1	16.1	6.7	-3.0
1962	-3.5	-1.9	2.6	15.9	18.1	25.3	26.4	30.1	23.0	17.7	9.8	2.9
1963	-7.8	2.5	10.1	12.0	19.5	25.8	30.5	29.7	26.5	22.2	9.9	-2.3
1964	1.6	3.5	4.1	15.7	22.0	24.6	31.2	28.4	20.4	18.3	4.3	-8.7
1965	-4.6	-1.4	-3.7	11.1	19.6	24.4	28.7	28.3	15.2	20.6	7.6	4.0
1966	-8.1	-2.5	9.1	9.5	21.6	25.7	30.9	27.8	25.1	16.8	2.8	0.2
1967	-0.4	0.0	6.0	11.0	17.7	23.5	30.8	31.5	25.6	15.4	6.2	-1.7
1968	-1.5	-0.5	11.2	13.9	18.9	23.0	29.9	27.0	23.9	17.5	6.1	-6.2
1969	-11.8	-2.8	1.6	18.6	22.4	22.9	27.6	33.0	26.3	11.0	8.8	-0.2
1970	-7.2	1.8	2.1	9.1	19.9	27.8	31.2	31.3	22.8	14.1	2.2	-2.1
1971	-7.4	-2.1	4.2	14.2	20.8	25.6	28.6	33.1	21.5	12.7	6.5	-4.4
1972	-7.0	-3.9	5.9	12.6	19.9	25.5	26.6	29.5	21.4	14.1	3.8	-4.4

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1973	0.0	2.1	10.0	12.9	20.9	25.9	30.1	32.9	20.6	19.1	2.9	-1.4
1974	-2.2	4.9	6.3	15.6	17.4	27.2	32.8	26.7	22.4	19.2	6.4	2.6
1975	0.1	-2.9	3.2	7.1	18.3	24.6	31.5	28.8	23.0	15.6	6.4	0.9
1976	-2.2	5.0	5.9	15.7	22.2	25.9	31.3	31.6	27.6	13.9	5.2	0.3
1977	-9.1	3.4	9.3	19.1	25.6	27.5	31.2	26.0	21.1	15.7	4.5	-5.9
1978	-10.8	-7.2	5.2	12.0	20.8	25.2	27.6	29.6	25.7	16.3	2.6	-5.7
1979	-11.5	-6.2	2.8	10.7	18.5	27.7	30.0	28.5	27.5	17.5	4.4	7.1
1980	-3.9	0.9	6.4	20.0	25.9	28.2	32.8	26.8	23.6	14.7	9.7	0.8
1981	3.8	2.9	11.7	18.7	20.5	24.3	31.7	30.6	25.7	15.7	10.3	-2.4
1982	-9.6	-1.6	3.8	11.7	17.7	24.2	29.7	30.0	23.4	15.1	3.5	1.1
1983	2.5	6.4	5.0	12.7	18.6	25.3	31.8	34.6	22.5	16.6	5.9	-11.4
1984	0.4	8.0	4.9	14.7	21.6	25.6	32.2	32.2	19.6	13.2	6.8	-5.0
1985	-3.9	-0.9	7.7	17.9	25.2	24.7	32.5	27.2	19.2	15.7	-3.3	-2.9
1986	2.5	-2.0	13.0	13.3	21.2	29.2	28.5	30.0	17.6	16.4	3.2	3.5
1987	2.6	5.8	5.5	20.4	24.0	29.5	29.2	25.9	24.8	15.7	10.6	3.9
1988	-2.5	0.6	9.3	18.7	25.5	34.5	33.4	32.0	23.2	16.9	6.6	0.8
1989	-0.1	-7.3	4.3	14.4	21.9	26.0	33.1	30.9	25.3	17.3	6.4	-3.4
1990	2.7	3.4	9.9	15.8	20.4	27.1	30.7	31.5	28.1	17.2	9.5	-2.5
1991	-4.3	6.7	9.4	14.6	20.6	26.2	31.2	32.6	23.5	14.3	3.8	4.6
1992	5.5	7.6	11.7	14.9	23.7	26.4	24.8	26.7	23.1	16.6	2.9	-1.6
1993	-5.3	-2.9	7.6	14.1	21.0	22.2	22.8	25.9	21.0	15.4	3.6	2.4
1994	-5.9	-5.4	9.4	15.5	22.7	25.2	28.6	30.0	26.0	15.6	6.6	3.0
1995	-0.3	5.3	6.0	11.0	18.6	26.7	29.0	31.7	24.2	14.8	5.7	0.0
1996	-6.0	2.1	1.1	11.9	15.9	26.1	28.6	31.8	21.7	15.0	-1.8	-5.6
1997	-4.9	3.0	7.0	11.4	20.0	29.1	28.7	29.8	26.7	17.7	6.9	4.4
1998	-2.1	6.1	1.1	16.5	22.5	21.1	31.2	32.1	28.6	15.3	6.5	1.2
1999	-2.4	5.5	10.7	14.2	19.4	24.8	31.0	30.5	20.4	14.9	12.8	4.5
2000	0.2	4.2	12.4	14.1	22.2	24.9	32.3	33.5	25.3	17.8	-0.9	-6.2
2001	1.5	-3.9	7.8	15.2	23.3	25.2	31.1	33.5	25.3	15.6	12.2	1.4
2002	1.5	5.8	-0.7	12.8	19.4	27.2	33.8	29.3	26.0	9.0	8.2	1.8
2003	-2.4	-2.6	4.8	15.8	18.8	24.3	32.5	33.8	23.0	19.0	1.8	1.9
2004	-5.3	-0.1	9.6	17.2	18.8	24.7	30.0	27.3	25.2	15.6	8.9	2.9
2005	-3.5	5.7	9.3	17.1	17.3	24.3	30.5	28.9	25.7	15.0	7.6	-2.0
2006	4.6	0.4	4.2	17.5	20.9	26.8	34.0	30.6	20.7	11.7	6.1	1.8
2007	0.2	-4.0	10.0	11.8	20.0	25.8	32.8	28.7	23.6	15.7	6.9	0.0
2008	-1.9	-1.1	7.2	13.8	18.9	23.6	31.4	30.1	22.0	14.4	5.5	-7.0
2009	-4.4	-3.7	3.0	11.3	19.9	23.1	26.2	26.5	26.5	7.0	10.9	-8.8
2010	-5.8	-5.6	5.7	14.8	16.7	23.8	28.0	29.0	20.2	17.2	2.8	-6.0
2011	-5.8	-5.3	-0.5	9.5	15.2	22.8	28.9	28.6	23.8	16.6	7.1	1.4

Appendix C
Medora Weather Station #325813
Monthly and Annual T_{min} (°C)

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1895	-22.5	-17.6	-9.6	0.3	2.8	6.7	10.0	8.1	3.6	-2.6	-10.6	-13.8
1896	-18.9	-13.8	-13.2	-2.0	4.8	9.4	11.8	10.2	4.4	-1.9	-15.4	-8.9
1897	-15.1	-17.5	-15.9	-0.1	6.2	9.8	11.7	10.1	8.4	-0.4	-10.7	-15.3
1898	-14.3	-13.3	-12.8	-1.5	4.6	9.9	11.4	11.9	5.7	-1.4	-10.0	-14.8
1899	-15.5	-23.3	-17.9	-3.7	3.0	8.0	11.5	10.2	4.6	-1.3	-4.7	-13.9
1900	-11.5	-18.3	-9.5	0.3	6.6	10.7	11.9	11.8	5.2	0.4	-11.8	-9.6
1901	-15.2	-17.4	-7.6	-0.8	7.1	8.1	14.0	10.9	4.5	-0.5	-7.8	-13.9
1902	-15.7	-15.5	-7.5	-2.6	4.6	6.6	10.5	9.2	2.6	-2.1	-8.2	-20.6
1903	-15.9	-22.1	-11.1	-2.2	2.3	8.5	10.7	9.6	3.6	-1.8	-9.7	-13.2
1904	-18.2	-22.1	-12.9	-3.0	3.1	7.9	8.5	8.3	3.2	-1.4	-7.5	-15.1
1905	-21.3	-20.7	-5.9	-4.2	1.5	8.2	11.4	10.2	6.0	-3.2	-7.5	-14.1
1906	-14.3	-14.4	-13.4	-0.8	2.5	7.3	9.3	11.1	6.5	-2.2	-9.7	-16.7
1907	-24.8	-16.0	-9.2	-6.6	-1.2	8.3	10.3	9.0	2.4	-2.6	-9.4	-13.0
1908	-13.1	-14.7	-10.3	-2.4	2.0	8.3	11.9	8.2	6.7	-1.3	-7.6	-14.5
1909	-20.4	-15.7	-8.4	-6.2	2.2	10.4	12.4	11.9	5.8	-2.6	-8.4	-19.5
1910	-17.5	-22.4	-2.7	-0.4	1.7	10.1	11.5	8.3	5.0	0.7	-9.2	-13.8
1911	-19.3	-18.8	-5.4	-3.4	5.6	11.6	10.0	8.9	5.1	-2.0	-14.3	-13.3
1912	-22.4	-15.5	-16.6	-1.1	3.7	8.4	10.8	10.2	2.3	-2.3	-6.3	-12.1
1913	-20.4	-16.5	-13.5	-0.7	2.9	11.0	10.2	11.3	4.3	-2.7	-5.5	-14.1
1914	-13.1	-20.0	-8.9	-1.6	3.8	9.4	13.4	9.1	4.7	-1.0	-6.6	-20.1
1915	-17.9	-13.4	-12.6	2.0	3.2	6.6	9.5	9.9	3.8	-0.2	-7.2	-13.0
1916	-28.2	-17.3	-8.7	-2.6	2.0	7.6	14.3	10.0	3.5	-3.0	-8.6	-21.6
1917	-19.7	-22.8	-12.0	-3.3	1.3	7.2	12.4	9.2	3.9	-3.9	-4.2	-21.8
1918	-21.5	-17.1	-5.4	-2.1	2.9	10.5	11.0	11.0	3.0	1.9	-8.4	-11.2
1919	-9.8	-16.9	-12.9	-1.1	4.5	11.4	12.4	11.2	6.6	-6.6	-13.1	-16.4
1920	-16.5	-12.8	-9.3	-6.1	4.0	9.1	12.8	10.9	5.5	0.2	-8.6	-13.6
1921	-11.9	-11.2	-8.6	-3.3	4.9	13.1	12.8	10.5	5.5	-0.4	-9.2	-13.2
1922	-18.1	-23.5	-9.3	-1.3	5.6	11.7	11.6	12.1	7.0	-0.8	-4.8	-18.4
1923	-13.0	-20.6	-10.6	-3.0	3.5	10.8	14.5	9.6	6.4	0.0	-3.8	-10.6
1924	-20.3	-9.4	-8.3	-2.0	1.3	8.0	11.0	8.7	3.8	1.0	-6.6	-20.8
1925	-16.5	-10.9	-7.2	1.0	3.6	9.8	11.3	10.6	6.2	-4.6	-6.0	-12.1
1926	-12.0	-7.4	-7.7	-2.6	7.0	9.1	12.9	10.7	2.9	0.2	-7.8	-16.4
1927	-14.6	-13.1	-5.7	-1.0	3.0	9.5	11.4	9.8	6.3	1.3	-9.5	-23.7
1928	-14.2	-11.9	-5.2	-4.2	5.8	7.4	12.6	10.1	3.8	-0.8	-6.4	-10.7
1929	-24.9	-21.2	-5.6	-2.1	1.0	9.6	13.1	11.7	3.6	0.9	-8.0	-15.8
1930	-23.3	-9.2	-8.4	1.3	2.6	9.3	13.4	13.3	5.1	-1.7	-7.3	-9.9
1931	-9.5	-7.2	-8.1	-1.9	3.0	12.2	12.0	11.3	6.9	0.8	-8.0	-11.5

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1932	-16.8	-14.2	-10.8	0.9	5.3	11.5	12.7	11.9	3.9	-1.8	-7.7	-15.3
1933	-14.0	-18.2	-5.9	-1.9	5.1	12.7	13.9	11.2	6.9	-0.8	-5.0	-16.4
1934	-11.8	-9.4	-8.3	-1.7	7.4	9.3	13.7	10.5	2.8	2.0	-5.6	-14.8
1935	-18.7	-8.3	-8.3	-2.8	3.4	8.6	14.7	10.2	5.3	-1.5	-10.1	-13.0
1936	-22.8	-30.0	-6.6	-4.3	7.4	11.4	18.2	12.4	6.9	-0.9	-6.2	-14.1
1937	-26.5	-17.8	-8.2	-1.2	5.0	10.3	14.9	13.0	7.2	1.6	-8.1	-15.7
1938	-13.8	-18.1	-5.3	-1.0	4.3	11.2	12.9	9.9	8.0	3.8	-8.5	-11.9
1939	-10.8	-22.7	-9.8	-1.0	6.6	7.8	13.5	9.5	4.0	-2.5	-7.3	-9.9
1940	-21.6	-13.1	-7.2	-2.3	4.3	9.7	13.6	11.0	7.8	2.2	-10.3	-10.6
1941	-14.5	-13.9	-7.7	0.1	7.2	10.0	12.7	12.2	5.1	1.0	-4.1	-9.5
1942	-12.3	-13.6	-5.8	0.7	3.4	8.9	12.1	11.6	4.8	1.1	-7.0	-14.6
1943	-23.5	-12.4	-13.0	-1.1	2.6	8.7	12.2	12.2	4.4	0.0	-6.5	-12.2
1944	-10.4	-15.8	-12.5	-3.0	6.2	9.0	10.8	9.8	5.0	-1.0	-9.5	-13.9
1945	-14.4	-14.1	-5.9	-3.4	1.6	7.0	11.3	11.9	3.7	-1.2	-10.7	-17.1
1946	-13.0	-13.3	-2.7	0.9	2.7	9.4	13.3	10.3	5.5	-1.4	-9.3	-13.3
1947	-12.6	-17.8	-10.4	-1.7	2.4	8.6	13.3	12.6	5.2	2.0	-9.0	-12.6
1948	-15.5	-17.9	-10.7	-1.4	4.6	9.6	12.0	10.3	5.8	-2.8	-5.4	-17.9
1949	-23.6	-22.7	-10.4	-1.3	5.4	8.6	11.7	11.4	2.6	-0.2	-3.9	-18.0
1950	-27.8	-15.6	-10.9	-3.9	2.7	7.6	9.8	9.8	5.9	0.4	-10.9	-14.3
1951	-19.6	-14.5	-15.3	-4.3	3.4	6.6	11.8	10.5	4.6	-1.0	-10.0	-20.1
1952	-20.8	-12.5	-12.7	-0.7	4.2	10.2	10.9	10.9	5.9	-2.7	-8.4	-13.5
1953	-11.9	-10.7	-7.7	-3.8	3.9	11.1	12.5	12.3	5.0	0.5	-3.8	-10.3
1954	-21.3	-3.9	-11.5	-2.9	3.0	8.7	14.2	11.5	5.9	-0.9	-4.5	-10.6
1955	-15.7	-17.9	-11.1	0.0	5.5	9.1	13.4	12.3	3.7	-2.0	-14.8	-17.8
1956	-18.3	-16.5	-8.3	-5.9	4.5	11.2	11.3	9.9	3.7	-1.6	-6.3	-11.5
1957	-22.6	-15.2	-7.7	-2.8	4.1	8.9	14.5	13.0	4.8	0.3	-5.5	-8.6
1958	-11.3	-15.4	-8.8	-1.0	4.9	7.4	10.1	11.5	4.1	-2.1	-7.9	-14.4
1959	-19.4	-21.8	-5.5	-3.0	2.3	10.5	10.9	11.2	5.9	-2.4	-10.7	-8.2
1960	-18.0	-16.0	-12.5	-1.7	3.5	8.6	12.1	9.8	4.4	-2.6	-11.4	-14.2
1961	-13.4	-12.1	-5.2	-5.2	4.0	9.2	11.5	11.6	1.8	-2.9	-9.7	-20.0
1962	-17.9	-16.5	-12.2	-1.7	6.2	9.9	11.1	10.7	4.0	1.3	-4.8	-12.5
1963	-22.3	-11.8	-5.0	-1.3	4.2	11.5	13.6	11.3	8.0	2.3	-7.0	-16.3
1964	-13.3	-10.6	-12.0	-1.8	5.9	9.5	13.5	9.7	3.3	-1.6	-12.1	-19.5
1965	-18.6	-15.6	-15.2	-0.7	4.4	11.1	13.4	11.4	1.3	0.0	-7.8	-9.6
1966	-22.7	-16.4	-7.1	-3.5	3.9	9.2	14.6	10.3	7.8	-0.4	-10.2	-11.5
1967	-14.2	-13.6	-8.0	-2.0	2.3	9.3	10.8	10.5	7.1	0.7	-7.1	-15.0
1968	-16.7	-13.4	-5.3	-3.5	1.6	9.2	10.6	10.7	6.3	-1.2	-4.5	-17.4
1969	-23.6	-14.8	-10.7	1.4	4.3	7.3	12.6	12.7	6.4	-1.7	-6.6	-11.6
1970	-18.7	-13.4	-10.5	-1.6	5.1	10.5	13.6	12.3	5.3	-2.2	-7.4	-14.6
1971	-19.1	-13.6	-7.6	-0.1	3.8	11.9	10.1	13.2	5.9	-0.4	-5.8	-16.5
1972	-20.3	-17.0	-7.8	-0.9	6.2	10.8	10.2	12.5	4.5	-1.9	-6.2	-16.9

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1973	-13.3	-10.8	-4.1	-1.7	3.6	10.1	11.1	12.8	5.8	1.0	-9.7	-13.4
1974	-17.1	-10.8	-7.2	-0.7	4.2	8.7	14.2	8.3	3.0	-0.8	-6.5	-10.2
1975	-13.8	-15.1	-11.9	-2.7	5.0	9.1	14.3	10.1	4.5	-0.1	-8.2	-12.6
1976	-15.4	-6.9	-8.5	0.6	3.6	11.3	13.4	12.8	5.8	-2.6	-11.2	-13.6
1977	-22.9	-7.9	-5.9	-0.1	8.5	11.4	13.0	8.7	7.1	0.9	-9.7	-15.5
1978	-23.4	-18.0	-6.6	0.8	6.4	10.6	12.6	10.7	7.1	0.2	-10.8	-17.1
1979	-23.2	-21.0	-8.6	-2.5	2.9	9.4	13.6	11.6	6.9	1.1	-8.8	-10.3
1980	-17.2	-11.8	-8.8	-0.9	5.9	10.6	13.4	10.8	6.3	1.0	-3.7	-12.1
1981	-9.0	-10.3	-6.0	0.5	6.2	9.0	14.2	12.9	6.0	-0.1	-4.8	-12.2
1982	-25.2	-16.0	-8.4	-2.5	4.4	8.9	13.1	12.2	5.2	0.6	-9.3	-10.9
1983	-7.9	-6.3	-4.6	-3.0	2.8	8.7	14.6	15.6	5.5	0.7	-4.9	-22.8
1984	-11.6	-6.5	-7.3	-0.9	3.0	10.4	13.4	15.0	3.5	-0.3	-7.6	-18.2
1985	-16.7	-14.7	-6.8	0.7	7.1	7.8	13.5	11.0	5.9	0.4	-14.1	-15.9
1986	-8.3	-13.4	-1.9	-0.9	4.8	12.3	12.4	10.6	6.2	0.7	-8.5	-8.6
1987	-10.3	-6.2	-4.9	1.5	7.7	11.2	14.1	11.1	6.0	-1.0	-4.4	-10.2
1988	-18.3	-14.7	-5.9	-2.4	7.2	16.2	13.8	12.4	5.5	-0.6	-6.7	-11.6
1989	-13.2	-19.7	-8.5	-0.4	5.7	9.1	15.7	12.9	5.1	-0.2	-4.9	-16.0
1990	-8.7	-10.3	-5.5	-1.4	4.8	10.6	12.9	13.9	7.8	-0.9	-5.7	-18.0
1991	-17.1	-6.1	-6.1	0.9	7.2	12.4	13.1	13.6	7.1	-2.7	-7.9	-9.9
1992	-9.1	-6.9	-4.2	-1.0	5.6	10.4	10.6	9.4	5.8	-0.5	-5.0	-14.9
1993	-18.1	-17.0	-4.9	-0.7	5.3	8.9	11.3	11.0	3.2	-2.0	-8.6	-8.5
1994	-18.6	-18.5	-4.8	-0.7	6.4	11.3	11.5	12.1	7.5	2.5	-6.5	-10.7
1995	-13.6	-10.1	-8.3	-2.6	3.8	10.8	13.0	13.2	4.1	0.6	-7.5	-14.3
1996	-19.5	-10.9	-13.0	-1.9	4.3	11.0	11.8	12.7	6.5	-0.5	-11.7	-17.7
1997	-19.9	-9.2	-7.8	-3.3	3.9	11.2	13.4	11.0	6.8	-0.5	-8.2	-9.2
1998	-14.6	-4.9	-10.4	0.0	4.8	6.3	13.2	14.2	8.6	0.7	-3.3	-11.3
1999	-15.6	-6.0	-3.9	-0.4	5.9	9.3	13.3	12.6	2.9	-1.6	-3.5	-9.2
2000	-13.2	-10.3	-5.3	-1.9	5.2	7.8	13.9	12.9	6.3	0.0	-12.0	-19.4
2001	-11.0	-18.2	-6.1	-0.8	4.7	9.0	14.2	12.6	7.0	-1.6	-4.4	-12.1
2002	-11.3	-9.1	-14.3	-3.4	1.8	10.6	14.9	11.1	7.3	-4.3	-5.3	-9.9
2003	-15.5	-16.8	-9.0	1.9	5.6	9.4	14.8	15.0	6.7	3.0	-10.1	-9.2
2004	-16.3	-10.8	-4.5	0.0	4.3	7.2	12.8	10.3	8.4	-0.2	-5.7	-9.4
2005	-16.9	-8.2	-4.1	1.1	4.1	12.1	14.0	11.1	6.9	0.9	-3.5	-10.3
2006	-4.6	-11.4	-7.0	1.0	5.8	11.5	14.7	12.8	5.6	-2.4	-7.3	-12.2
2007	-13.5	-15.2	-4.0	-1.9	6.6	11.1	15.8	12.3	6.0	0.7	-7.1	-15.7
2008	-17.7	-15.8	-7.5	-2.8	5.0	9.4	13.3	12.9	5.2	-0.8	-5.3	-18.2
2009	-17.1	-13.6	-10.1	-1.5	4.0	8.6	11.4	10.9	8.6	-1.1	-5.6	-18.4
2010	-15.6	-17.1	-5.3	0.0	4.3	10.5	12.6	12.6	6.2	0.9	-8.2	-16.7
2011	-16.4	-17.1	-9.8	-1.4	4.6	10.1	14.7	12.7	6.8	2.6	-6.8	-9.3

Appendix D
Medora Weather Station #325813
Monthly/Annual Precipitation Totals (mm)

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual PCP
1895	9.9	13.7	12.7	30.5	53.1	105.2	64.8	7.6	5.1	2.0	20.3	12.7	337.6
1896	26.9	14.0	33.3	45.7	154.2	99.1	50.3	11.9	16.8	11.7	59.7	4.1	527.6
1897	32.5	30.5	57.4	27.7	19.3	41.1	57.2	34.5	7.6	9.7	19.1	5.6	342.1
1898	3.0	11.7	28.4	43.9	53.1	79.5	43.9	16.8	33.0	65.8	14.7	9.9	403.9
1899	8.6	10.9	25.7	42.9	82.3	78.5	79.8	45.7	4.3	35.6	3.3	8.9	426.5
1900	1.3	16.8	28.4	15.5	22.9	11.2	34.3	79.5	69.9	18.8	17.8	4.1	320.3
1901	0.0	10.9	18.8	13.7	5.1	136.1	71.9	14.0	42.2	4.1	12.2	27.4	356.4
1902	4.8	33.5	61.5	6.1	83.1	67.6	52.3	43.4	5.3	9.1	11.7	19.1	397.5
1903	19.8	8.9	4.1	12.2	85.3	37.6	54.9	94.7	57.7	2.8	3.3	19.6	400.8
1904	15.7	15.7	50.0	15.7	30.0	113.0	12.2	37.6	8.4	3.0	0.3	21.1	322.8
1905	12.4	13.2	7.9	1.3	56.4	122.2	81.0	22.4	43.7	15.2	23.4	4.8	403.9
1906	13.0	8.6	14.0	40.1	137.2	109.5	15.7	61.5	21.1	8.1	20.1	22.4	471.2
1907	34.3	9.9	14.5	9.9	45.5	79.0	87.4	34.5	25.1	5.8	1.3	7.4	354.6
1908	12.7	21.8	47.8	39.1	61.5	120.4	42.7	29.2	42.4	56.9	17.8	7.9	500.1
1909	10.7	15.7	9.7	14.0	129.5	114.8	60.7	77.7	33.3	6.4	10.2	27.2	509.8
1910	15.7	29.2	24.9	31.8	36.1	89.4	40.9	38.4	20.6	11.2	10.9	6.1	355.1
1911	15.5	15.5	5.1	22.9	57.4	81.0	34.3	56.1	67.8	38.1	17.8	11.7	423.2
1912	17.5	4.3	20.6	58.9	103.6	38.6	83.3	59.7	44.5	48.3	2.0	1.0	482.3
1913	9.7	4.1	26.9	9.1	44.5	63.0	40.6	50.5	33.3	25.4	6.6	0.0	313.7
1914	5.6	14.5	18.0	17.5	49.5	174.5	53.1	55.6	26.2	16.5	6.1	9.4	446.5
1915	4.8	6.9	4.3	17.3	84.1	127.8	107.7	18.0	62.5	37.1	27.7	9.9	508.0
1916	22.1	5.6	21.6	30.5	48.3	118.9	67.6	41.4	36.1	22.9	9.1	24.6	448.6
1917	17.0	6.4	14.5	39.4	16.5	59.9	21.6	26.4	8.1	8.9	0.3	23.9	242.8
1918	11.7	8.1	6.1	63.0	40.6	31.8	51.1	44.2	11.2	9.1	13.5	13.7	304.0
1919	3.0	11.2	24.4	38.9	55.1	22.9	24.9	10.9	14.2	58.9	19.1	10.4	293.9
1920	13.2	8.9	32.0	27.9	36.8	69.6	35.6	41.4	21.6	28.4	3.3	3.0	321.8
1921	5.8	6.9	25.7	34.0	36.3	112.8	62.0	40.1	45.0	3.0	30.5	14.7	416.8
1922	9.9	31.2	5.1	18.3	96.3	123.2	90.7	16.0	31.0	24.1	31.5	12.4	489.7
1923	14.7	13.7	12.7	36.3	33.5	102.4	93.0	17.3	119.6	19.6	11.4	6.9	481.1
1924	4.1	11.9	27.9	37.3	22.4	109.2	35.8	16.8	15.2	69.9	3.0	17.5	371.1
1925	11.7	1.0	17.8	30.2	26.9	110.0	31.8	14.2	16.5	18.5	2.3	8.9	289.8
1926	9.1	7.9	3.0	6.1	48.3	66.3	38.6	26.4	24.4	30.0	20.6	16.8	297.4
1927	10.2	5.1	11.7	45.5	143.5	68.1	73.2	51.1	72.9	21.1	17.5	32.5	552.2
1928	3.8	2.8	7.1	24.1	22.4	120.1	62.2	69.1	17.0	16.3	1.0	4.1	350.0
1929	31.0	10.9	45.0	11.2	115.3	104.6	25.1	5.8	37.8	24.4	17.3	29.2	457.7
1930	12.7	20.8	2.0	37.1	35.6	95.3	10.2	51.6	44.5	25.9	9.1	10.7	355.3
1931	5.1	15.5	20.3	1.0	30.2	74.4	73.2	17.5	55.6	18.5	6.1	8.6	326.1

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	TTL PCP
1932	16.0	9.1	32.8	56.4	48.0	123.4	41.1	33.8	1.3	53.6	17.3	9.1	442.0
1933	31.0	4.1	22.4	50.3	96.5	46.7	38.1	14.0	16.0	20.1	22.6	13.5	375.2
1934	4.8	1.0	29.2	8.1	6.1	67.1	18.5	5.3	11.4	0.0	3.3	5.8	160.8
1935	10.9	3.0	39.6	42.7	73.7	75.9	115.3	40.1	3.3	2.0	17.0	9.7	433.3
1936	12.7	8.6	15.5	9.4	14.2	18.0	11.4	24.6	10.2	10.2	8.4	14.7	158.0
1937	11.9	5.8	18.0	24.1	33.8	104.6	44.5	26.4	32.3	20.1	5.1	16.5	343.2
1938	23.6	17.8	17.3	20.6	71.1	118.1	52.6	21.6	21.3	15.0	19.3	6.1	404.4
1939	16.8	10.9	6.9	23.1	52.8	93.5	48.8	44.2	6.1	6.1	0.0	7.6	316.7
1940	2.0	16.8	24.9	96.0	34.3	66.0	79.0	17.0	52.8	37.3	8.1	4.1	438.4
1941	6.9	5.1	10.7	44.2	75.4	157.7	70.1	52.8	101.9	33.3	8.4	4.8	571.2
1942	3.0	17.5	27.7	65.5	75.2	122.4	61.5	45.2	43.4	17.0	7.4	12.7	498.6
1943	31.8	10.7	23.4	35.6	34.0	98.6	47.5	77.0	7.9	24.4	11.2	3.0	404.9
1944	20.6	7.1	18.5	15.2	65.3	197.9	15.7	58.7	49.8	1.0	66.3	2.0	518.2
1945	11.9	4.8	49.5	43.4	45.5	72.6	30.5	27.4	32.5	5.1	13.2	7.9	344.4
1946	5.1	8.1	20.1	14.2	53.3	54.6	65.8	25.4	38.1	74.4	8.1	33.0	400.3
1947	8.9	4.1	14.7	47.8	21.3	194.3	47.2	64.5	17.3	14.5	10.4	6.9	451.9
1948	17.3	14.5	6.9	39.1	49.0	81.3	105.7	31.5	5.1	10.4	29.2	11.7	401.6
1949	33.3	15.7	16.0	3.6	22.9	29.2	75.2	19.6	7.1	54.4	1.0	6.9	284.7
1950	13.5	10.4	22.9	37.1	29.5	79.5	21.3	49.3	69.6	22.4	11.7	7.6	374.7
1951	11.7	19.3	3.8	25.7	36.8	46.5	53.8	36.8	55.4	26.7	6.6	14.2	337.3
1952	6.6	13.0	17.3	0.0	28.2	42.2	83.1	40.1	19.3	2.8	10.4	1.0	263.9
1953	7.1	4.6	32.3	63.8	104.9	77.7	30.7	58.7	19.3	42.7	5.1	8.4	455.2
1954	5.6	15.5	38.1	14.2	35.6	121.4	29.2	95.8	44.7	16.5	2.3	3.0	421.9
1955	9.7	12.7	3.8	65.8	53.8	84.8	42.9	9.1	6.1	6.9	23.6	4.3	323.6
1956	5.6	2.3	13.5	4.3	61.0	19.8	84.8	29.2	12.7	7.9	11.4	5.1	257.6
1957	15.2	6.4	18.5	65.8	40.1	187.5	32.0	39.9	61.2	36.1	21.8	3.0	527.6
1958	3.3	20.6	6.4	18.0	15.7	91.2	75.4	12.2	3.3	18.8	41.1	9.9	316.0
1959	17.8	28.7	6.9	11.9	41.4	69.1	15.0	17.3	88.6	21.6	21.1	1.8	341.1
1960	7.9	3.6	13.2	5.1	65.0	138.4	41.9	64.5	0.5	1.0	5.8	14.5	361.4
1961	0.5	17.8	13.7	51.1	29.0	72.6	56.9	16.0	73.2	3.0	0.8	2.3	336.8
1962	8.1	2.0	26.7	24.4	112.5	44.7	111.3	37.8	21.1	26.7	5.3	4.1	424.7
1963	13.0	10.4	37.6	76.7	62.0	152.4	36.8	32.3	12.4	1.3	0.0	3.0	437.9
1964	7.6	3.0	3.0	21.6	64.5	124.0	48.0	83.1	14.7	4.1	27.4	15.0	416.1
1965	11.7	7.4	6.9	42.9	95.5	82.6	79.0	56.9	29.5	0.0	10.2	3.8	426.2
1966	19.8	9.1	18.3	22.4	45.0	78.2	65.8	52.3	21.8	10.9	15.7	3.6	363.0
1967	23.4	16.0	8.9	101.9	57.9	56.1	16.8	4.6	58.2	17.8	3.8	6.1	371.3
1968	18.0	6.1	2.8	24.6	33.8	117.9	77.0	111.0	20.3	21.1	3.0	30.5	466.1
1969	16.8	9.9	6.4	29.7	44.5	151.4	65.8	17.5	6.6	23.1	0.8	24.6	397.0
1970	15.0	1.0	9.4	75.9	137.7	115.3	70.1	3.3	44.2	13.7	24.9	3.0	513.6
1971	26.4	10.9	8.9	58.9	26.7	196.3	14.5	1.5	114.8	78.2	11.9	14.2	563.4
1972	13.7	12.4	20.3	20.6	118.1	62.0	51.1	74.2	23.6	28.2	1.3	31.2	456.7

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	TTL PCP
1973	4.6	18.3	15.5	62.7	33.0	70.9	21.1	15.0	64.5	2.5	14.5	12.2	334.8
1974	2.5	9.1	12.7	31.2	164.8	17.5	50.8	29.0	9.9	23.9	19.8	4.1	375.4
1975	2.0	5.8	43.4	64.3	59.2	103.1	20.3	9.9	21.3	24.4	12.2	19.8	385.8
1976	19.1	2.8	5.3	45.5	40.4	84.1	47.2	9.7	9.4	14.0	4.1	7.6	289.1
1977	15.2	5.8	20.8	2.5	69.3	88.1	26.4	51.6	133.6	30.2	24.4	19.8	487.9
1978	3.8	16.8	6.1	31.2	126.7	73.4	73.2	37.3	44.7	6.4	30.5	9.4	459.5
1979	3.3	17.3	6.4	26.7	23.4	30.7	65.5	25.9	26.9	11.2	11.4	1.5	250.2
1980	14.0	7.1	3.6	0.3	6.9	56.1	22.9	75.2	26.4	62.0	10.9	8.1	293.4
1981	2.3	0.3	1.0	29.0	43.7	94.2	35.6	68.1	13.2	6.6	14.7	12.7	321.3
1982	16.5	6.1	51.3	33.8	101.9	87.6	37.1	44.7	48.5	117.3	2.8	15.7	563.4
1983	3.6	1.0	24.6	6.1	52.6	72.6	54.1	45.0	33.3	7.6	15.7	6.1	322.3
1984	8.6	1.3	15.0	37.3	3.3	69.3	11.9	60.2	19.1	14.5	3.3	8.1	252.0
1985	1.3	0.3	18.0	34.0	64.3	14.5	65.8	27.7	40.6	40.4	15.7	15.0	337.6
1986	7.9	14.2	4.3	65.0	67.6	101.9	63.8	4.1	146.8	17.3	29.0	2.0	523.7
1987	3.6	6.1	46.2	1.5	68.1	25.4	156.7	98.6	16.0	7.4	4.8	0.3	434.6
1988	16.3	14.5	14.0	0.0	55.4	38.1	30.0	5.3	25.9	11.7	6.9	11.7	229.6
1989	16.3	7.1	27.2	76.7	46.7	46.2	12.2	24.9	9.7	45.2	14.5	14.2	340.9
1990	5.6	2.3	8.1	26.7	37.6	92.5	49.8	5.6	9.7	26.7	3.6	6.1	274.1
1991	3.3	8.4	6.1	66.0	54.9	94.0	14.0	11.7	70.9	19.6	4.1	0.8	353.6
1992	9.4	1.3	19.6	61.0	33.0	34.5	47.8	58.2	20.3	3.6	19.6	12.4	320.5
1993	7.1	9.9	7.1	58.9	54.1	115.8	163.6	34.8	6.1	7.9	14.2	7.9	487.4
1994	10.4	8.4	13.0	26.2	24.6	166.6	26.2	4.3	16.5	75.4	6.9	4.1	382.5
1995	16.5	5.3	24.4	18.5	79.8	56.4	82.3	41.9	2.3	33.3	10.2	7.1	378.0
1996	12.7	8.1	22.4	25.4	68.8	90.4	43.7	42.9	57.9	17.5	23.4	6.6	419.9
1997	6.9	9.7	18.5	66.5	13.7	49.8	164.3	33.3	20.6	14.0	1.8	1.0	400.1
1998	4.6	36.8	14.2	14.2	55.1	102.9	37.3	53.8	18.8	85.9	22.4	9.9	455.9
1999	13.7	13.2	4.1	29.0	86.1	39.4	23.1	64.8	39.4	13.7	5.6	4.6	336.6
2000	2.0	11.7	5.6	13.2	43.4	37.8	95.5	11.7	25.1	21.6	87.4	12.7	367.8
2001	7.1	2.5	6.1	53.1	14.2	132.1	103.4	3.6	33.0	8.1	2.5	7.9	373.6
2002	12.2	8.4	20.1	34.8	30.7	79.2	69.3	11.7	2.5	15.0	4.1	14.7	302.8
2003	11.7	1.3	60.5	18.3	84.3	68.8	25.4	14.2	61.2	8.4	9.1	16.8	380.0
2004	19.8	8.1	21.1	15.5	20.1	21.3	53.8	13.2	43.9	58.2	0.0	8.4	283.5
2005	5.6	0.5	10.7	8.1	119.6	162.6	41.7	35.1	14.0	51.6	22.6	11.2	483.1
2006	8.6	4.8	17.0	78.5	61.7	30.0	15.0	39.4	54.1	36.6	3.0	5.6	354.3
2007	2.0	17.8	31.0	38.6	121.9	42.9	47.5	20.6	22.6	10.2	2.8	2.0	359.9
2008	3.3	5.3	6.1	11.7	71.6	52.8	33.3	38.9	25.1	41.9	24.1	20.6	334.8
2009	10.9	18.0	26.7	23.9	52.8	74.9	73.2	34.5	29.5	38.1	0.3	26.4	409.2
2010	9.7	9.4	13.5	30.5	101.3	112.0	46.5	19.8	73.2	7.1	20.6	16.0	459.5
2011	37.8	17.8	21.3	76.5	157.7	41.1	70.1	45.2	13.5	9.1	5.6	8.9	504.7

Appendix E
Thornthwaite Water Balance Budget Output Values

Date	PET (mm)	P (mm)	P-PET (mm)	Soil Moisture (mm)	AET (mm)	PET-AET (mm)	Snow Storage (mm)	Surplus (mm)	ROtotal (mm)
Jan-1895	4.4	9.8	-4.4	22.9	0.5	3.8	31.2	0	0
Feb-1895	6.6	13.8	-6.6	22.2	0.8	5.8	45.1	0	0
Mar-1895	17.7	12.9	-17.7	20.2	2	15.7	58	0	0
Apr-1895	47	30.7	11.2	31.4	47	0	29	0	1.5
May-1895	65.2	53.4	0	31.5	65.2	0	14.5	0	2.7
Jun-1895	90.2	105.1	16.9	48.3	90.2	0	7.2	0	5.3
Jul-1895	120.4	65.2	-51.3	36	81.5	38.9	0	0	3.3
Aug-1895	95	7.6	-87.8	20.2	23	72	0	0	0.4
Sep-1895	51.8	5.2	-46.9	15.4	9.6	42.2	0	0	0.3
Oct-1895	25.1	1.9	-23.3	13.6	3.6	21.5	0	0	0.1
Nov-1895	9.4	20.4	-9.4	13	0.6	8.8	20.4	0	0
Dec-1895	6.5	12.7	-6.5	12.6	0.4	6.1	33.2	0	0
Jan-1896	5.3	26.9	-5.3	12.2	0.3	5	60.1	0	0
Feb-1896	9.3	13.9	-9.3	11.7	0.6	8.7	74	0	0
Mar-1896	13.3	33.4	-13.3	10.9	0.8	12.6	107.4	0	0
Apr-1896	36.7	46.1	60.8	71.7	36.7	0	53.7	0	2.3
May-1896	71	154.5	102.6	174.2	71	0	26.8	0	7.7
Jun-1896	110	99.3	-2.2	172.3	109.7	0.3	13.4	0	5
Jul-1896	126	50.4	-71.3	110.8	116.1	9.9	6.7	0	2.5
Aug-1896	99.9	11.9	-81.9	65.4	63.4	36.5	0	0	0.6
Sep-1896	47.4	16.6	-31.6	55.1	26.1	21.3	0	0	0.8
Oct-1896	24.6	11.8	-13.4	51.4	14.9	9.7	0	0	0.6
Nov-1896	6.1	60.3	-6.1	49.8	1.6	4.5	60.3	0	0
Dec-1896	8.2	4.2	-8.2	47.8	2	6.2	64.5	0	0
Jan-1897	6.2	32.8	-6.2	46.3	1.5	4.7	97.3	0	0
Feb-1897	7	30.8	-7	44.7	1.6	5.4	128.1	0	0
Mar-1897	11.4	57.8	-11.4	42.1	2.6	8.9	185.9	0	0
Apr-1897	39.2	28.2	80.6	122.7	39.2	0	93	0	1.4
May-1897	83.7	19.2	-19	111	76.3	7.3	46.5	0	1
Jun-1897	106.9	41.1	-44.6	86.3	87.1	19.9	23.2	0	2.1
Jul-1897	128.6	57.7	-62.1	59.4	93.2	35.3	11.6	0	2.9
Aug-1897	98.1	34.7	-59.4	41.8	56.4	41.7	5.8	0	1.7
Sep-1897	70.5	7.6	-57.5	29.8	25.1	45.4	0	0	0.4
Oct-1897	26.9	9.6	-17.8	27.1	11.7	15.1	0	0	0.5
Nov-1897	8.9	19.3	-8.9	25.9	1.2	7.7	19.3	0	0
Dec-1897	6	5.7	-6	25.2	0.8	5.2	24.9	0	0
Jan-1898	7	3	-7	24.3	0.9	6.1	27.9	0	0
Feb-1898	9.4	11.9	-9.4	23.1	1.1	8.2	39.8	0	0
Mar-1898	13.2	28.4	-13.2	21.6	1.5	11.7	68.2	0	0
Apr-1898	36.1	44.3	40.1	61.7	36.1	0	34.1	0	2.2
May-1898	66.4	53.3	1.3	63.1	66.4	0	17	0	2.7
Jun-1898	102.1	79.2	-18.3	57.3	89.5	12.5	8.5	0	4
Jul-1898	125.1	44.5	-74.4	36	72.1	53.1	0	0	2.2
Aug-1898	108.6	17	-92.5	19.3	32.8	75.9	0	0	0.8
Sep-1898	54.8	33	-23.4	17.1	33.6	21.2	0	0	1.7
Oct-1898	21.4	66.2	41.5	58.6	21.4	0	0	0	3.3
Nov-1898	9.2	14.7	-9.2	55.9	2.7	6.5	14.7	0	0
Dec-1898	5.8	10.2	-5.8	54.3	1.6	4.2	24.9	0	0
Jan-1899	6.1	8.7	-6.1	52.6	1.6	4.4	33.6	0	0
Feb-1899	4.7	10.8	-4.7	51.4	1.2	3.5	44.4	0	0
Mar-1899	9.7	25.6	-9.7	48.9	2.5	7.2	70	0	0
Apr-1899	31.7	43.2	44.4	93.3	31.7	0	35	0	2.2
May-1899	59.8	83	36.5	129.8	59.8	0	17.5	0	4.1
Jun-1899	95.7	78.6	-12.3	121.8	91.4	4.3	8.8	0	3.9
Jul-1899	128	80.3	-43	95.6	111.2	16.8	0	0	4
Aug-1899	95.3	46.5	-51.1	71.2	68.6	26.7	0	0	2.3
Sep-1899	55	4.2	-51	53	22.2	32.8	0	0	0.2
Oct-1899	24.2	35.8	9.8	62.8	24.2	0	0	0	1.8
Nov-1899	14.6	3.4	-11.3	59.3	6.8	7.8	0	0	0.2
Dec-1899	6.1	8.9	-6.1	57.5	1.8	4.3	8.9	0	0

Jan-00	8.6	1.4	-8.6	55	2.5	6.1	10.3	0	0
Feb-00	6.8	16.8	-6.8	53.1	1.9	4.9	27.1	0	0
Mar-00	17.7	28.6	-17.7	48.4	4.7	13	55.8	0	0
Apr-00	46.6	15.6	-3.9	47.5	43.6	2.9	27.9	0	0.8
May-00	90.1	22.8	-54.5	34.5	48.6	41.5	13.9	0	1.1
Jun-00	127.2	11.3	-109.5	15.6	36.6	90.6	7	0	0.6
Jul-00	128.2	34.4	-88.5	8.7	46.6	81.6	0	0	1.7
Aug-00	107.1	79.6	-31.5	7.3	77	30.1	0	0	4
Sep-00	46.3	70.3	20.5	27.9	46.3	0	0	0	3.5
Oct-00	27.9	18.8	-10.1	26.5	19.2	8.7	0	0	0.9
Nov-00	8.5	18	-8.5	25.3	1.1	7.4	18	0	0
Dec-00	8.3	4.2	-8.3	24.3	1.1	7.3	22.2	0	0
Jan-01	6.9	0	-6.9	23.4	0.8	6	22.2	0	0
Feb-01	7.2	11	-7.2	22.6	0.8	6.4	33.3	0	0
Mar-01	19.9	19	-19.9	20.4	2.2	17.6	52.2	0	0
Apr-01	41.4	13.8	-2.2	20.1	39.4	2	26.1	0	0.7
May-01	96.2	5.1	-78.3	12.2	25.8	70.4	13.1	0	0.3
Jun-01	94.4	136	41.4	53.6	94.4	0	6.5	0	6.8
Jul-01	142.4	72.2	-67.3	35.6	93.2	49.2	0	0	3.6
Aug-01	105.2	14	-92	19.2	29.6	75.6	0	0	0.7
Sep-01	46.1	41.9	-6.3	18.6	40.4	5.7	0	0	2.1
Oct-01	29	4.2	-25	16.3	6.3	22.7	0	0	0.2
Nov-01	11.8	12.3	-11.8	15.3	1	10.9	12.3	0	0
Dec-01	6.1	27.6	-6.1	14.8	0.5	5.6	39.9	0	0
Jan-02	6.6	5	-6.6	14.4	0.5	6.1	44.8	0	0
Feb-02	7.8	33.6	-7.8	13.8	0.6	7.2	78.5	0	0
Mar-02	17.8	61.8	-17.8	12.6	1.2	16.5	140.3	0	0
Apr-02	35.8	6	40.1	52.7	35.8	0	70.1	0	0.3
May-02	73.7	83.2	40.3	93	73.7	0	35.1	0	4.2
Jun-02	85.1	67.7	-3.3	91.5	83.4	1.7	17.5	0	3.4
Jul-02	120.4	52.5	-61.7	63.2	86.9	33.5	8.8	0	2.6
Aug-02	95.3	43.6	-45.1	49	64.4	30.9	0	0	2.2
Sep-02	47.7	5.3	-42.7	38.5	15.5	32.3	0	0	0.3
Oct-02	25.9	9.1	-17.3	35.2	12	13.9	0	0	0.5
Nov-02	10.7	11.8	-10.7	33.3	1.9	8.9	11.8	0	0
Dec-02	4.8	19	-4.8	32.5	0.8	4	30.9	0	0
Jan-03	6.8	19.9	-6.8	31.4	1.1	5.7	50.8	0	0
Feb-03	5.6	8.9	-5.6	30.5	0.9	4.7	59.7	0	0
Mar-03	15.6	4.1	-15.6	28.1	2.4	13.2	63.7	0	0
Apr-03	38.9	12.2	4.6	32.7	38.9	0	31.9	0	0.6
May-03	64.4	86.2	33.4	66.1	64.4	0	15.9	0	4.3
Jun-03	102.3	37.8	-58.5	46.8	63.2	39.2	8	0	1.9
Jul-03	117.8	54.5	-58.1	33.2	73.3	44.5	0	0	2.7
Aug-03	90.5	95.8	0.5	33.7	90.5	0	0	0	4.8
Sep-03	43.7	58.4	11.8	45.5	43.7	0	0	0	2.9
Oct-03	27.9	2.9	-25.2	39.7	8.4	19.5	0	0	0.1
Nov-03	10.2	3.4	-10.2	37.7	2	8.2	3.4	0	0
Dec-03	6.7	19.9	-6.7	36.4	1.3	5.4	23.3	0	0
Jan-04	5.6	15.7	-5.6	35.4	1	4.6	39	0	0
Feb-04	5.5	15.9	-5.5	34.4	1	4.6	54.9	0	0
Mar-04	13.3	50.2	-13.3	32.1	2.3	11	105	0	0
Apr-04	34.1	15.9	33.5	65.7	34.1	0	52.5	0	0.8
May-04	68.1	30	-13.3	61.3	59.2	9	26.3	0	1.5
Jun-04	93.7	114.2	27.9	89.2	93.7	0	13.1	0	5.7
Jul-04	107	12.1	-88.9	49.6	57.7	49.2	6.6	0	0.6
Aug-04	92.1	38.2	-49.3	37.3	55.1	37.1	0	0	1.9
Sep-04	49.2	8.4	-41.2	29.7	15.7	33.5	0	0	0.4
Oct-04	27.8	3	-24.9	26	6.6	21.2	0	0	0.2
Nov-04	13.5	0.2	-13.4	24.2	1.9	11.6	0	0	0
Dec-04	6.4	21.4	-6.4	23.4	0.8	5.7	21.4	0	0
Jan-05	4.7	12.4	-4.7	22.9	0.5	4.1	33.8	0	0
Feb-05	6.2	13.3	-6.2	22.2	0.7	5.5	47.1	0	0
Mar-05	22.2	8	9	31.2	22.2	0	23.6	0	0.4
Apr-05	35.7	1.2	-22.8	27.6	16.4	19.3	11.8	0	0.1
May-05	59.4	56.6	0.3	27.9	59.4	0	5.9	0	2.8
Jun-05	93.4	122.1	28.5	56.4	93.4	0	0	0	6.1
Jul-05	119.4	81.8	-41.7	44.6	89.5	30	0	0	4.1
Aug-05	103	22.6	-81.5	26.4	39.7	63.3	0	0	1.1

Sep-05	59.1	44	-17.3	24.2	44.1	15	0	0	2.2
Oct-05	21.7	15.3	-7.2	23.3	15.4	6.3	0	0	0.8
Nov-05	11.8	23.7	-11.8	21.9	1.4	10.4	23.7	0	0
Dec-05	6.5	4.8	-6.5	21.2	0.7	5.8	28.4	0	0
Jan-06	7.2	13.2	-7.2	20.4	0.8	6.4	41.6	0	0
Feb-06	8.6	8.8	-8.6	19.6	0.9	7.7	50.5	0	0
Mar-06	13.8	14.2	-13.8	18.2	1.4	12.5	64.6	0	0
Apr-06	44.2	40.2	26.2	44.5	44.2	0	32.3	0	2
May-06	61.4	138.4	86.3	130.8	61.4	0	16.2	0	6.9
Jun-06	90.9	110.1	21.7	152.5	90.9	0	8.1	0	5.5
Jul-06	113.7	15.5	-90.9	83.2	92.1	21.6	0	0	0.8
Aug-06	96	61.6	-37.5	67.6	74.1	21.9	0	0	3.1
Sep-06	59.5	20.7	-39.9	54.1	33.1	26.4	0	0	1
Oct-06	26.4	8	-18.8	49	12.7	13.7	0	0	0.4
Nov-06	10	20.2	-10	46.6	2.5	7.6	20.2	0	0
Dec-06	5.9	22.4	-5.9	45.2	1.4	4.5	42.6	0	0
Jan-07	3.8	34.6	-3.8	44.3	0.9	3	77.2	0	0
Feb-07	8	9.9	-8	42.6	1.8	6.2	87	0	0
Mar-07	18.9	14.6	-18.9	38.6	4	14.9	101.6	0	0
Apr-07	28.1	9.9	32.1	70.6	28.1	0	50.8	0	0.5
May-07	52.1	45.2	16.3	86.9	52.1	0	25.4	0	2.3
Jun-07	97.4	79	-9.7	82.7	91.9	5.5	12.7	0	3.9
Jul-07	111.2	88.5	-20.7	74.1	99	12.2	6.4	0	4.4
Aug-07	93.3	34.6	-54.1	54.1	59.2	34	0	0	1.7
Sep-07	44.7	25.3	-20.6	48.5	29.6	15	0	0	1.3
Oct-07	27.2	5.8	-21.6	43.2	10.8	16.4	0	0	0.3
Nov-07	11.8	1.2	-11.8	40.7	2.5	9.2	1.2	0	0
Dec-07	7.4	7.2	-7.4	39.2	1.5	5.9	8.5	0	0
Jan-08	8.2	12.6	-8.2	37.6	1.6	6.6	21	0	0
Feb-08	8.1	21.8	-8.1	36.1	1.5	6.6	42.8	0	0
Mar-08	16.4	47.8	-16.4	33.1	3	13.4	90.7	0	0
Apr-08	40.1	39.1	42.4	75.5	40.1	0	45.3	0	2
May-08	62.2	61.6	19.1	94.6	62.2	0	22.7	0	3.1
Jun-08	94.7	120.1	30.7	125.3	94.7	0	11.3	0	6
Jul-08	130.4	42.3	-84.5	72.4	98.8	31.5	5.7	0	2.1
Aug-08	88.3	29.3	-54.8	52.5	53.3	35	0	0	1.5
Sep-08	59.4	42.7	-18.9	47.6	45.5	13.9	0	0	2.1
Oct-08	23.8	57.2	30.5	78.1	23.8	0	0	0	2.9
Nov-08	12.1	17.8	4.8	82.9	12.1	0	0	0	0.9
Dec-08	6.5	7.9	-6.5	80.2	2.7	3.8	7.9	0	0
Jan-09	5.1	10.7	-5.1	78.2	2	3	18.6	0	0
Feb-09	8	15.8	-8	75.1	3.1	4.9	34.4	0	0
Mar-09	18.1	9.8	-18.1	68.3	6.8	11.3	44.2	0	0
Apr-09	29	14	6.4	74.6	29	0	22.1	0	0.7
May-09	64.4	129.2	69.4	144.1	64.4	0	11.1	0	6.5
Jun-09	105.5	114.4	8.7	152.8	105.5	0	5.5	0	5.7
Jul-09	120.2	60.9	-56.8	109.3	106.8	13.4	0	0	3
Aug-09	109.6	79.2	-34.4	90.5	94	15.6	0	0	4
Sep-09	55.8	33.3	-24.2	79.6	42.6	13.2	0	0	1.7
Oct-09	24.8	6.6	-18.6	72.2	13.7	11.2	0	0	0.3
Nov-09	11.6	10.4	-11.6	68	4.2	7.4	10.4	0	0
Dec-09	4.5	27.4	-4.5	66.5	1.5	3	37.8	0	0
Jan-10	6	15.8	-6	64.5	2	4	53.6	0	0
Feb-10	5.6	29.4	-5.6	62.7	1.8	3.8	83	0	0
Mar-10	29.7	24.8	35.4	98.1	29.7	0	41.5	0	1.2
Apr-10	49.1	31.9	1.9	100	49.1	0	20.8	0	1.6
May-10	62.6	36.1	-17.9	91.1	53.6	8.9	10.4	0	1.8
Jun-10	113.5	89.4	-23.3	80.5	100.8	12.7	5.2	0	4.5
Jul-10	132.8	41.1	-88.5	44.8	79.9	52.9	0	0	2.1
Aug-10	87.5	38.6	-50.8	33.5	48.1	39.4	0	0	1.9
Sep-10	51	20.7	-31.4	28.2	24.9	26.1	0	0	1
Oct-10	30.2	11.2	-19.6	25.4	13.4	16.8	0	0	0.6
Nov-10	10.3	11	-10.3	24.1	1.3	9	11	0	0
Dec-10	6.9	6	-6.9	23.3	0.8	6	17	0	0
Jan-11	5.5	15.7	-5.5	22.7	0.6	4.8	32.7	0	0
Feb-11	7	15.6	-7	21.9	0.8	6.2	48.4	0	0
Mar-11	24.5	5.2	4.6	26.5	24.5	0	24.2	0	0.3
Apr-11	37.2	22.6	-3.6	26	34.1	3.1	12.1	0	1.1

May-11	79.1	56.9	-19	23.6	62.6	16.5	6	0	2.8
Jun-11	122.5	80.8	-39.7	18.9	87.5	35	0	0	4
Jul-11	116.4	34.4	-83.8	11	40.6	75.9	0	0	1.7
Aug-11	86	56.3	-32.5	9.2	55.3	30.7	0	0	2.8
Sep-11	50	68.1	14.7	23.9	50	0	0	0	3.4
Oct-11	23.8	38.3	12.6	36.5	23.8	0	0	0	1.9
Nov-11	7.7	18	-7.7	35	1.4	6.3	18	0	0
Dec-11	6.4	11.7	-6.4	33.9	1.1	5.3	29.7	0	0
Jan-12	4.5	17.6	-4.5	33.2	0.8	3.7	47.3	0	0
Feb-12	7.9	4.3	-7.9	31.9	1.3	6.6	51.6	0	0
Mar-12	11.9	20.7	-11.9	30	1.9	10	72.3	0	0
Apr-12	42.5	58.9	49.6	79.6	42.5	0	36.1	0	2.9
May-12	68.6	103.3	47.6	127.2	68.6	0	18.1	0	5.2
Jun-12	100.6	39	-54.5	92.5	80.7	19.8	9	0	2
Jul-12	113.3	83.8	-24.6	81.1	100.1	13.2	0	0	4.2
Aug-12	90.5	59.7	-33.8	67.4	70.4	20.1	0	0	3
Sep-12	40.9	44.6	1.5	68.9	40.9	0	0	0	2.2
Oct-12	25	47.8	20.4	89.3	25	0	0	0	2.4
Nov-12	12.5	2.1	-10.5	84.6	6.7	5.8	0	0	0.1
Dec-12	7.9	1	-7.9	81.2	3.3	4.6	1	0	0
Jan-13	5.3	9.7	-5.3	79.1	2.2	3.2	10.8	0	0
Feb-13	7.5	4.1	-7.5	76.1	3	4.5	14.8	0	0
Mar-13	13.7	27.1	-13.7	70.9	5.2	8.5	42	0	0
Apr-13	44.9	9.3	-15	65.6	35.2	9.7	21	0	0.5
May-13	65.6	44.7	-12.6	61.4	57.1	8.5	10.5	0	2.2
Jun-13	113.4	62.7	-48.6	46.5	79.7	33.7	5.2	0	3.1
Jul-13	115.7	40.9	-71.5	29.9	60.8	54.9	0	0	2
Aug-13	107	50.5	-59	21.1	56.8	50.2	0	0	2.5
Sep-13	53	33.1	-21.6	18.8	33.7	19.3	0	0	1.7
Oct-13	22.5	25.6	1.8	20.6	22.5	0	0	0	1.3
Nov-13	13.7	6.7	-7.3	19.9	7.1	6.5	0	0	0.3
Dec-13	7.7	0	-7.7	19.1	0.8	6.9	0	0	0
Jan-14	8.6	5.6	-8.6	18.3	0.8	7.8	5.7	0	0
Feb-14	6.3	14.5	-6.3	17.7	0.6	5.8	20.2	0	0
Mar-14	18.3	18.4	-18.3	16.1	1.6	16.7	38.6	0	0
Apr-14	39.4	17.7	-3.2	15.8	36.4	3	19.3	0	0.9
May-14	74.1	49.9	-17	14.5	58.4	15.7	9.7	0	2.5
Jun-14	102.5	176.2	74.5	89	102.5	0	0	0	8.8
Jul-14	143.8	54.8	-91.7	48.2	92.9	50.9	0	0	2.7
Aug-14	90.3	55.4	-37.7	39.1	61.7	28.6	0	0	2.8
Sep-14	54.2	26.4	-29.1	33.4	30.8	23.4	0	0	1.3
Oct-14	26.5	16.7	-10.6	31.6	17.6	8.8	0	0	0.8
Nov-14	13	6	-7.3	30.5	6.9	6.1	0	0	0.3
Dec-14	4.5	9.6	-4.5	29.8	0.7	3.8	9.6	0	0
Jan-15	5.6	4.8	-5.6	29	0.8	4.8	14.5	0	0
Feb-15	8.5	7.1	-8.5	27.7	1.2	7.3	21.6	0	0
Mar-15	14.6	4.3	-14.6	25.7	2	12.5	25.9	0	0
Apr-15	53.2	17.4	-23.7	22.7	32.5	20.6	12.9	0	0.9
May-15	65	84.4	21.7	44.3	65	0	6.5	0	4.2
Jun-15	85.3	128.2	43	87.3	85.3	0	0	0	6.4
Jul-15	99.4	108.3	3.4	90.7	99.4	0	0	0	5.4
Aug-15	92.4	17.8	-75.5	56.5	51.2	41.2	0	0	0.9
Sep-15	44.1	62.5	15.2	71.7	44.1	0	0	0	3.1
Oct-15	28.9	37.1	6.4	78.1	28.9	0	0	0	1.9
Nov-15	11.5	27.8	-11.5	73.6	4.5	7	27.8	0	0
Dec-15	6.8	9.9	-6.8	71.1	2.5	4.3	37.7	0	0
Jan-16	3.1	21.9	-3.1	70	1.1	2	59.7	0	0
Feb-16	7.1	5.7	-7.1	67.5	2.5	4.6	65.4	0	0
Mar-16	18.6	21.9	-18.6	61.3	6.3	12.3	87.3	0	0
Apr-16	36.3	31.1	37	98.2	36.3	0	43.6	0	1.6
May-16	63.4	48.7	4.7	102.9	63.4	0	21.8	0	2.4
Jun-16	89.7	118.9	34.2	137.1	89.7	0	10.9	0	5.9
Jul-16	143	68	-72.9	87.1	120	23	5.5	0	3.4
Aug-16	94	41.4	-49.2	65.7	66.2	27.8	0	0	2.1
Sep-16	49	35.6	-15.2	60.7	38.8	10.2	0	0	1.8
Oct-16	23	23.1	-1	60.4	22.3	0.7	0	0	1.2
Nov-16	11.5	9.4	-11.5	56.9	3.5	8	9.4	0	0
Dec-16	4.3	25.1	-4.3	55.7	1.2	3.1	34.4	0	0

Jan-17	5.2	17.3	-5.2	54.2	1.5	3.8	51.7	0	0
Feb-17	5.3	6.5	-5.3	52.8	1.4	3.8	58.2	0	0
Mar-17	14.9	14.8	-14.9	48.8	3.9	10.9	73	0	0
Apr-17	33.1	39.5	40.9	89.8	33.1	0	36.5	0	2
May-17	64.8	16.5	-30.9	75.9	47.8	17	18.2	0	0.8
Jun-17	94.4	60.2	-28	65.3	77	17.4	9.1	0	3
Jul-17	142.1	22	-112	28.7	66.6	75.5	0	0	1.1
Aug-17	97.5	26.5	-72.3	18.3	35.5	61.9	0	0	1.3
Sep-17	52.1	8.2	-44.3	14.3	11.8	40.2	0	0	0.4
Oct-17	21.7	8.9	-13.3	13.3	9.4	12.3	0	0	0.4
Nov-17	15.9	0.2	-15.6	12.3	1.3	14.6	0	0	0
Dec-17	4.4	24.1	-4.4	12	0.3	4.2	24.1	0	0
Jan-18	4.5	11.7	-4.5	11.7	0.3	4.2	35.9	0	0
Feb-18	7.4	8.1	-7.4	11.3	0.4	7	44	0	0
Mar-18	25.1	6.1	2.7	14	25.1	0	22	0	0.3
Apr-18	36.5	63.4	34.7	48.7	36.5	0	11	0	3.2
May-18	69.3	41.2	-24.7	42.7	50.6	18.7	5.5	0	2.1
Jun-18	115.9	32	-80	25.6	53	62.9	0	0	1.6
Jul-18	120.3	51.5	-71.3	16.5	58.1	62.2	0	0	2.6
Aug-18	100	43.8	-58.3	11.7	46.5	53.5	0	0	2.2
Sep-18	46.8	11.2	-36.2	9.6	12.8	34.1	0	0	0.6
Oct-18	29.9	9.2	-21.2	8.6	9.7	20.2	0	0	0.5
Nov-18	10.7	13.3	-10.7	8.1	0.5	10.3	13.3	0	0
Dec-18	7.6	13.7	-7.6	7.8	0.3	7.3	27	0	0
Jan-19	9.7	3	-9.7	7.4	0.4	9.3	30	0	0
Feb-19	7.3	11.3	-7.3	7.1	0.3	7	41.3	0	0
Mar-19	13.8	24.4	-13.8	6.6	0.5	13.3	65.7	0	0
Apr-19	38.5	39.2	31.5	38.2	38.5	0	32.9	0	2
May-19	75.8	55.2	-7	36.9	70.2	5.6	16.4	0	2.8
Jun-19	131.4	22.7	-101.6	18.1	48.5	82.9	8.2	0	1.1
Jul-19	144.9	25	-113	7.9	42.2	102.7	0	0	1.3
Aug-19	108.9	11	-98.4	4	14.4	94.5	0	0	0.6
Sep-19	56.1	14.4	-42.5	3.2	14.5	41.6	0	0	0.7
Oct-19	17.1	60.1	40	43.1	17.1	0	0	0	3
Nov-19	7.7	18.8	-7.7	41.5	1.7	6	18.8	0	0
Dec-19	5.5	10.4	-5.5	40.3	1.1	4.3	29.2	0	0
Jan-20	6.1	13.2	-6.1	39.1	1.2	4.9	42.5	0	0
Feb-20	9.2	9	-9.2	37.3	1.8	7.4	51.5	0	0
Mar-20	17.8	31.8	-17.8	34	3.3	14.5	83.4	0	0
Apr-20	27.6	27.6	40.3	74.3	27.6	0	41.7	0	1.4
May-20	69.2	36.8	-13.4	69.3	60.7	8.4	20.8	0	1.8
Jun-20	102.1	69.9	-25.3	60.5	85.6	16.5	10.4	0	3.5
Jul-20	132	35.9	-92.7	32.5	67.4	64.6	5.2	0	1.8
Aug-20	108.7	42.1	-63.5	22.2	55.5	53.2	0	0	2.1
Sep-20	54.9	21.7	-34.3	18.4	24.4	30.5	0	0	1.1
Oct-20	29.2	28.4	-2.2	18.2	27.2	2	0	0	1.4
Nov-20	10.9	3.2	-10.9	17.2	1	9.9	3.2	0	0
Dec-20	6.9	2.9	-6.9	16.6	0.6	6.3	6.2	0	0
Jan-21	8.5	5.9	-8.5	15.9	0.7	7.8	12.1	0	0
Feb-21	11.4	7	-11.4	15	0.9	10.5	19.1	0	0
Mar-21	19.1	26.1	-19.1	13.5	1.4	17.7	45.2	0	0
Apr-21	36.7	34.1	18.3	31.8	36.7	0	22.6	0	1.7
May-21	68.6	36.9	-22.3	28.3	49.9	18.7	11.3	0	1.8
Jun-21	130.2	112.2	-18	25.8	114.8	15.4	5.6	0	5.6
Jul-21	137.4	61.8	-73.1	16.3	73.7	63.6	0	0	3.1
Aug-21	103.7	43.3	-62.6	11.2	46.3	57.4	0	0	2.2
Sep-21	50.4	45.5	-7.2	10.8	43.6	6.8	0	0	2.3
Oct-21	28.8	3	-26	9.4	4.2	24.6	0	0	0.1
Nov-21	9.9	30.8	-9.9	9	0.5	9.4	30.8	0	0
Dec-21	6.6	14.8	-6.6	8.7	0.3	6.3	45.6	0	0
Jan-22	5.6	10	-5.6	8.4	0.2	5.4	55.6	0	0
Feb-22	4.9	31.8	-4.9	8.2	0.2	4.7	87.4	0	0
Mar-22	16.6	5.1	-16.6	7.5	0.7	15.9	92.6	0	0
Apr-22	38.1	18.6	25.9	33.4	38.1	0	46.3	0	0.9
May-22	73.8	96.5	41	74.4	73.8	0	23.1	0	4.8
Jun-22	114.8	124.9	15.4	89.9	114.8	0	11.6	0	6.2
Jul-22	117.8	91.5	-25.2	78.6	104	13.9	5.8	0	4.6
Aug-22	112.9	15.7	-92.1	42.4	56.9	56	0	0	0.8

Sep-22	60.9	31	-31.4	35.7	36.1	24.8	0	0	1.6
Oct-22	28.4	24.2	-5.4	34.7	23.9	4.4	0	0	1.2
Nov-22	12	32.4	18.8	53.5	12	0	0	0	1.6
Dec-22	5.1	12.4	-5.1	52.2	1.4	3.7	12.4	0	0
Jan-23	7.4	14.6	-7.4	50.2	1.9	5.5	27.1	0	0
Feb-23	6.2	14	-6.2	48.7	1.6	4.7	41	0	0
Mar-23	15.7	13	-15.7	44.9	3.8	11.8	54	0	0
Apr-23	35.3	36.6	26.5	71.3	35.3	0	27	0	1.8
May-23	70.8	33.8	-25.2	62.3	54.6	16.2	13.5	0	1.7
Jun-23	113.6	102.7	-9.3	59.4	107.2	6.4	6.8	0	5.1
Jul-23	141.5	95.3	-44.2	46.3	110.4	31.1	0	0	4.8
Aug-23	92.2	17	-76	28.7	33.8	58.4	0	0	0.9
Sep-23	57	120.7	57.6	86.3	57	0	0	0	6
Oct-23	25.9	19.7	-7.2	83.2	21.8	4.1	0	0	1
Nov-23	14.7	11.1	-4.1	81.5	12.3	2.4	0	0	0.6
Dec-23	8.3	7	-8.3	78.1	3.4	4.9	7	0	0
Jan-24	5.2	4.1	-5.2	76.1	2	3.2	11.2	0	0
Feb-24	11.4	12.2	-11.4	71.7	4.4	7.1	23.3	0	0
Mar-24	16.9	28.6	-16.9	65.7	6.1	10.8	51.9	0	0
Apr-24	34.7	38	27.3	92.9	34.7	0	26	0	1.9
May-24	59	22.5	-24.7	81.5	45.8	13.2	13	0	1.1
Jun-24	90.4	109.6	20.2	101.7	90.4	0	6.5	0	5.5
Jul-24	116.2	35.6	-75.9	63.1	78.9	37.3	0	0	1.8
Aug-24	89.2	16.8	-73.2	40	39.1	50.2	0	0	0.8
Sep-24	50.4	15.2	-36	32.8	21.6	28.8	0	0	0.8
Oct-24	30.4	70.5	36.6	69.3	30.4	0	0	0	3.5
Nov-24	11.8	3.1	-11.8	65.2	4.1	7.7	3.1	0	0
Dec-24	4.4	17.7	-4.4	63.8	1.4	3	20.8	0	0
Jan-25	6.4	12	-6.4	61.8	2.1	4.4	32.8	0	0
Feb-25	10.6	1	-10.6	58.5	3.3	7.3	33.8	0	0
Mar-25	20	18	-20	52.6	5.8	14.1	51.9	0	0
Apr-25	46.6	30.6	8.5	61.1	46.6	0	25.9	0	1.5
May-25	73.9	27.1	-35.2	50.3	49.5	24.4	13	0	1.4
Jun-25	102.4	110	8.6	58.9	102.4	0	6.5	0	5.5
Jul-25	123.6	32	-86.7	33.4	62.4	61.2	0	0	1.6
Aug-25	106.3	14.6	-92.4	17.9	29.3	77	0	0	0.7
Sep-25	53.4	16.2	-38	14.5	18.8	34.6	0	0	0.8
Oct-25	18.1	18.6	-0.4	14.5	17.7	0.4	0	0	0.9
Nov-25	12.3	2.3	-10.1	13.8	2.9	9.4	0	0	0.1
Dec-25	7.3	8.9	-7.3	13.3	0.5	6.8	8.9	0	0
Jan-26	8.1	9.3	-8.1	12.7	0.5	7.6	18.2	0	0
Feb-26	12.2	7.8	-12.2	12	0.8	11.4	26	0	0
Mar-26	19.8	2.9	-19.8	10.8	1.2	18.6	29	0	0
Apr-26	40.8	6.3	-20.3	9.7	21.5	19.2	14.5	0	0.3
May-26	84.9	48.8	-31.3	8.2	55.1	29.8	7.2	0	2.4
Jun-26	101.6	67.2	-30.6	6.9	72.3	29.3	0	0	3.4
Jul-26	139.3	38.9	-102.4	3.4	40.5	98.8	0	0	1.9
Aug-26	97.9	26.4	-72.8	2.1	26.3	71.6	0	0	1.3
Sep-26	45.5	24.7	-22.1	1.9	23.7	21.8	0	0	1.2
Oct-26	27.2	30.2	1.4	3.4	27.2	0	0	0	1.5
Nov-26	9.8	20.6	-9.8	3.2	0.2	9.6	20.6	0	0
Dec-26	5.7	17	-5.7	3.1	0.1	5.6	37.6	0	0
Jan-27	6.5	10.4	-6.5	3	0.1	6.4	48	0	0
Feb-27	8.9	5.2	-8.9	2.9	0.1	8.8	53.1	0	0
Mar-27	20.8	12	17.2	20.1	20.8	0	26.6	0	0.6
Apr-27	37.8	45.9	19.1	39.1	37.8	0	13.3	0	2.3
May-27	58.1	143.8	85.1	124.2	58.1	0	6.6	0	7.2
Jun-27	100.6	67.7	-29.6	105.8	89.4	11.2	0	0	3.4
Jul-27	116.5	73.3	-46.9	81	94.5	22.1	0	0	3.7
Aug-27	92.9	50.9	-44.6	63	66.4	26.5	0	0	2.5
Sep-27	53	74.6	17.9	80.8	53	0	0	0	3.7
Oct-27	30.3	21.2	-10.2	76.7	24.3	6.1	0	0	1.1
Nov-27	9.2	17.8	-9.2	73.2	3.5	5.7	17.8	0	0
Dec-27	3.6	33	-3.6	71.9	1.3	2.3	50.8	0	0
Jan-28	6.9	4	-6.9	69.4	2.5	4.4	54.7	0	0
Feb-28	9.7	3	-9.7	66.1	3.4	6.3	57.7	0	0
Mar-28	22.1	7	13.4	79.4	22.1	0	28.8	0	0.4
Apr-28	32.3	24.7	5.6	85	32.3	0	14.4	0	1.2

May-28	85.8	22.8	-57	60.8	53	32.8	7.2	0	1.1
Jun-28	89	120.2	32.3	93.1	89	0	0	0	6
Jul-28	121.5	62.6	-62	64.3	88.4	33.1	0	0	3.1
Aug-28	95.2	69.9	-28.8	55	75.6	19.6	0	0	3.5
Sep-28	49.6	17	-33.5	45.8	25.4	24.3	0	0	0.9
Oct-28	25.9	16.2	-10.5	43.4	17.8	8.1	0	0	0.8
Nov-28	12.5	1.1	-11.5	40.9	3.5	9	0	0	0.1
Dec-28	7.8	4	-7.8	39.3	1.6	6.2	4	0	0
Jan-29	3.8	31.8	-3.8	38.5	0.7	3	35.8	0	0
Feb-29	5.7	11.3	-5.7	37.4	1.1	4.6	47.2	0	0
Mar-29	20.5	45.7	46.5	83.9	20.5	0	23.6	0	2.3
Apr-29	37	11	-14.8	77.7	28.4	8.6	11.8	0	0.5
May-29	61	114.8	53.9	131.7	61	0	5.9	0	5.7
Jun-29	102.7	103.4	1.4	133	102.7	0	0	0	5.2
Jul-29	143.1	25	-119.4	53.6	103.1	40	0	0	1.2
Aug-29	112.7	5.4	-107.6	24.8	34	78.8	0	0	0.3
Sep-29	45.5	37.9	-9.5	23.6	37.2	8.3	0	0	1.9
Oct-29	29.1	24.9	-5.4	22.9	24.3	4.8	0	0	1.2
Nov-29	10.6	17.5	-10.6	21.7	1.2	9.4	17.5	0	0
Dec-29	5.6	29.7	-5.6	21.1	0.6	5	47.2	0	0
Jan-30	3.9	12.9	-3.9	20.7	0.4	3.5	60.1	0	0
Feb-30	11.2	21.3	-11.2	19.5	1.2	10.1	81.4	0	0
Mar-30	18.2	2	-18.2	17.8	1.8	16.5	83.4	0	0
Apr-30	48.6	36.7	27.9	45.7	48.6	0	41.7	0	1.8
May-30	63	36	-7.9	43.9	56.9	6.1	20.8	0	1.8
Jun-30	102.9	95.2	-2.1	43.4	101.3	1.6	10.4	0	4.8
Jul-30	149.8	10	-135.1	14.1	44	105.8	5.2	0	0.5
Aug-30	113.4	50.7	-60.1	9.9	57.6	55.8	0	0	2.5
Sep-30	51	45	-8.3	9.4	43.1	7.9	0	0	2.2
Oct-30	22.8	26	2	11.4	22.8	0	0	0	1.3
Nov-30	11.6	9.3	-11.6	10.8	0.7	11	9.3	0	0
Dec-30	7.9	11	-7.9	10.3	0.4	7.4	20.3	0	0
Jan-31	9.5	5.2	-9.5	9.8	0.5	9	25.4	0	0
Feb-31	13.1	15.6	-13.1	9.2	0.6	12.5	41	0	0
Mar-31	18.2	20.4	-18.2	8.4	0.8	17.4	61.4	0	0
Apr-31	42	1.1	-10.3	7.9	32.2	9.9	30.7	0	0.1
May-31	72	30.6	-27.6	6.8	45.5	26.5	15.4	0	1.5
Jun-31	127.9	75.3	-48.7	5.2	80.9	47	7.7	0	3.8
Jul-31	130.2	74.1	-52.1	3.8	79.4	50.8	0	0	3.7
Aug-31	100.2	17.7	-83.4	2.2	18.4	81.8	0	0	0.9
Sep-31	60.3	56.6	-6.5	2.2	53.9	6.4	0	0	2.8
Oct-31	28.8	18.8	-10.9	2	18	10.8	0	0	0.9
Nov-31	11.3	6.3	-11.3	1.9	0.1	11.2	6.3	0	0
Dec-31	7.7	8.7	-7.7	1.9	0.1	7.6	15	0	0
Jan-32	5.9	16.4	-5.9	1.8	0.1	5.8	31.5	0	0
Feb-32	8.7	9.2	-8.7	1.7	0.1	8.7	40.6	0	0
Mar-32	14.8	33	-14.8	1.6	0.1	14.7	73.7	0	0
Apr-32	43.8	56.6	46.8	48.4	43.8	0	36.8	0	2.8
May-32	76.7	47.8	-12.9	45.2	67	9.8	18.4	0	2.4
Jun-32	112.7	122.3	12.7	57.9	112.7	0	9.2	0	6.1
Jul-32	34.5	41.4	-86	33	73.4	61.1	0	0	2.1
Aug-32	103.2	33.6	-71.3	21.3	43.7	59.5	0	0	1.7
Sep-32	50.8	1.2	-49.7	16	6.4	44.5	0	0	0.1
Oct-32	21.9	53.3	28.8	44.8	21.9	0	0	0	2.7
Nov-32	10.8	17.7	-10.8	42.3	2.4	8.4	17.7	0	0
Dec-32	5.8	9.4	-5.8	41.1	1.2	4.6	27.1	0	0
Jan-33	7.2	31.4	-7.2	39.6	1.5	5.8	58.5	0	0
Feb-33	6.9	3.9	-6.9	38.2	1.4	5.5	62.4	0	0
Mar-33	20.8	22.4	31.7	69.9	20.8	0	31.2	0	1.1
Apr-33	35.9	50.9	28.1	98	35.9	0	15.6	0	2.5
May-33	69.9	96.2	29.3	127.2	69.9	0	7.8	0	4.8
Jun-33	133.5	46.9	-81.1	75.7	104	29.5	0	0	2.3
Jul-33	148.2	38.8	-111.3	33.5	78.9	69.2	0	0	1.9
Aug-33	102.7	13.6	-89.8	18.5	28	74.7	0	0	0.7
Sep-33	58.8	15.9	-43.7	14.4	19.2	39.6	0	0	0.8
Oct-33	26.6	20	-7.5	13.9	19.6	7	0	0	1
Nov-33	12.5	23	9.3	23.2	12.5	0	0	0	1.1
Dec-33	5.8	13.5	-5.8	22.5	0.7	5.1	13.5	0	0

Jan-34	8.5	5	-8.5	21.6	1	7.5	18.5	0	0
Feb-34	11.6	1	-11.6	20.3	1.2	10.3	19.5	0	0
Mar-34	19.2	29.5	-19.2	18.4	2	17.3	49.1	0	0
Apr-34	41.8	8.3	-9.4	17.5	33.3	8.6	24.5	0	0.4
May-34	100.3	6.1	-82.2	10.3	25.2	75	12.3	0	0.3
Jun-34	105.8	68	-35.1	8.5	72.5	33.3	6.1	0	3.4
Jul-34	144.4	18.6	-120.6	3.4	28.9	115.5	0	0	0.9
Aug-34	102.9	5.3	-97.9	1.7	6.7	96.2	0	0	0.3
Sep-34	44.2	11.5	-33.2	1.4	11.2	33	0	0	0.6
Oct-34	31.2	0.1	-31.1	1.2	0.3	30.9	0	0	0
Nov-34	13.9	3.5	-10.6	1.1	3.4	10.5	0	0	0.2
Dec-34	6.3	6	-6.3	1.1	0	6.3	6	0	0
Jan-35	5.7	11.1	-5.7	1.1	0	5.6	17	0	0
Feb-35	12.5	3.3	-12.5	1	0.1	12.4	20.3	0	0
Mar-35	18.9	40.8	-18.9	0.9	0.1	18.8	61.1	0	0
Apr-35	33.9	43.3	37.7	38.7	33.9	0	30.5	0	2.2
May-35	59	74.2	26.8	65.4	59	0	15.3	0	3.7
Jun-35	95.3	75.8	-15.6	60.3	84.8	10.5	7.6	0	3.8
Jul-35	151	115.3	-33.9	50.1	127.3	23.6	0	0	5.8
Aug-35	97.9	40.5	-59.4	35.2	53.4	44.5	0	0	2
Sep-35	54.6	3.2	-51.5	26.2	12.1	42.4	0	0	0.2
Oct-35	26.6	1.9	-24.7	22.9	5.1	21.5	0	0	0.1
Nov-35	9.3	17.4	-9.3	21.9	1.1	8.3	17.4	0	0
Dec-35	7	9.7	-7	21.1	0.8	6.2	27	0	0
Jan-36	4.3	12.6	-4.3	20.6	0.5	3.9	39.6	0	0
Feb-36	3.3	8.8	-3.3	20.3	0.3	3	48.4	0	0
Mar-36	19.1	15.6	-19.1	18.4	1.9	17.1	63.9	0	0
Apr-36	33.2	9.4	7.7	26.1	33.2	0	32	0	0.5
May-36	93.7	14.2	-64.2	17.7	37.9	55.9	16	0	0.7
Jun-36	126.5	17.9	-101.5	8.7	34	92.5	8	0	0.9
Jul-36	196.4	11.3	-177.7	1	26.5	169.9	0	0	0.6
Aug-36	110.8	24.8	-87.3	0.5	23.9	86.9	0	0	1.2
Sep-36	59.7	10.2	-50	0.4	9.9	49.9	0	0	0.5
Oct-36	26.9	10.2	-17.2	0.4	9.8	17.1	0	0	0.5
Nov-36	11.9	8.4	-3.9	0.4	8	3.9	0	0	0.4
Dec-36	6.3	15.1	-6.3	0.4	0	6.3	15.1	0	0
Jan-37	3.3	12	-3.3	0.4	0	3.3	27.1	0	0
Feb-37	6.9	6	-6.9	0.3	0	6.9	33.1	0	0
Mar-37	18.2	18.2	-18.2	0.3	0	18.2	51.3	0	0
Apr-37	37.9	24.4	10.9	11.2	37.9	0	25.6	0	1.2
May-37	79	33.9	-33.9	9.3	46.9	32	12.8	0	1.7
Jun-37	107.5	105.6	-0.7	9.3	106.8	0.7	6.4	0	5.3
Jul-37	144.1	44.4	-95.5	4.8	53	91.1	0	0	2.2
Aug-37	120.6	26.9	-95	2.5	27.9	92.7	0	0	1.3
Sep-37	58.9	32.3	-28.2	2.2	31	27.9	0	0	1.6
Oct-37	28.6	20.1	-9.5	2.1	19.2	9.4	0	0	1
Nov-37	10.4	5.1	-10.4	2	0.1	10.3	5.1	0	0
Dec-37	6	16.8	-6	1.9	0.1	6	21.9	0	0
Jan-38	7.2	24	-7.2	1.8	0.1	7.1	45.9	0	0
Feb-38	6.8	17.8	-6.8	1.8	0.1	6.7	63.8	0	0
Mar-38	21.7	17.5	26.8	28.5	21.7	0	31.9	0	0.9
Apr-38	39.9	20.4	-4.6	27.9	35.9	3.9	15.9	0	1
May-38	67.3	71.8	8.8	36.7	67.3	0	8	0	3.6
Jun-38	112.9	120.4	9.5	46.2	112.9	0	0	0	6
Jul-38	132.1	53.5	-81.3	27.4	69.6	62.5	0	0	2.7
Aug-38	103.8	21.3	-83.6	16	31.7	72.1	0	0	1.1
Sep-38	62.7	20.7	-43	12.5	23.1	39.6	0	0	1
Oct-38	33.3	15	-19	11.3	15.5	17.8	0	0	0.8
Nov-38	10	19.8	-10	10.8	0.6	9.4	19.8	0	0
Dec-38	7.5	6.1	-7.5	10.4	0.4	7.1	25.9	0	0
Jan-39	8.7	17.1	-8.7	9.9	0.5	8.2	42.9	0	0
Feb-39	5.5	10.9	-5.5	9.7	0.3	5.3	53.9	0	0
Mar-39	17.7	7	-17.7	8.8	0.9	16.8	60.8	0	0
Apr-39	40.7	23.2	11.8	20.6	40.7	0	30.4	0	1.2
May-39	85.9	53.1	-20.2	18.5	67.7	18.1	15.2	0	2.7
Jun-39	90	94.1	7.1	25.5	90	0	7.6	0	4.7
Jul-39	143.2	49	-89	14.2	65.5	77.7	0	0	2.4
Aug-39	98.1	44.7	-55.6	10.2	46.4	51.7	0	0	2.2

Sep-39	53.4	6.1	-47.6	7.8	8.2	45.2	0	0	0.3
Oct-39	23.7	6.2	-17.8	7.1	6.6	17.1	0	0	0.3
Nov-39	13.5	0	-13.5	6.6	0.5	13	0	0	0
Dec-39	9.2	7.7	-9.2	6.3	0.3	8.9	7.7	0	0
Jan-40	4.7	2	-4.7	6.2	0.1	4.5	9.7	0	0
Feb-40	8.7	17	-8.7	5.9	0.3	8.4	26.8	0	0
Mar-40	18.6	25.3	-18.6	5.4	0.5	18	52	0	0
Apr-40	33.6	97.3	84.8	90.1	33.6	0	26	0	4.9
May-40	76.6	34.8	-30.5	76.4	59.8	16.8	13	0	1.7
Jun-40	108.5	65.2	-40	61.1	83.8	24.7	6.5	0	3.3
Jul-40	141.1	79.3	-59.3	43	100	41.2	0	0	4
Aug-40	105.9	16.8	-89.9	23.7	35.3	70.6	0	0	0.8
Sep-40	65	53.5	-14.2	22	52.5	12.5	0	0	2.7
Oct-40	32	37.1	3.2	25.2	32	0	0	0	1.9
Nov-40	9	8.3	-9	24	1.1	7.9	8.3	0	0
Dec-40	8.4	4.2	-8.4	23	1	7.4	12.5	0	0
Jan-41	7.2	6.8	-7.2	22.2	0.8	6.4	19.2	0	0
Feb-41	9.4	5.2	-9.4	21.1	1	8.4	24.4	0	0
Mar-41	19.3	10.8	-19.3	19.1	2	17.2	35.1	0	0
Apr-41	39.4	44.8	20.7	39.8	39.4	0	17.6	0	2.2
May-41	85.5	75.6	-4.9	38.9	81.6	3.9	8.8	0	3.8
Jun-41	102.9	160	57.9	96.7	102.9	0	0	0	8
Jul-41	136.7	71.2	-69	63.4	101	35.6	0	0	3.6
Aug-41	103.7	52.5	-53.9	46.3	66.9	36.8	0	0	2.6
Sep-41	48.2	102.2	48.9	95.3	48.2	0	0	0	5.1
Oct-41	26.9	33.6	5	100.3	26.9	0	0	0	1.7
Nov-41	13.3	8.2	-5.5	97.5	10.5	2.7	0	0	0.4
Dec-41	8.8	4.8	-8.8	93.2	4.3	4.5	4.8	0	0
Jan-42	8.3	3	-8.3	89.4	3.9	4.4	7.8	0	0
Feb-42	8.6	17.6	-8.6	85.5	3.9	4.8	25.5	0	0
Mar-42	20.3	28	19	104.6	20.3	0	12.7	0	1.4
Apr-42	42.9	66.1	26.3	130.8	42.9	0	6.4	0	3.3
May-42	62.3	75.7	16	146.9	62.3	0	0	0	3.8
Jun-42	94.5	124	23.3	170.1	94.5	0	0	0	6.2
Jul-42	123.1	62.4	-63.8	115.8	113.6	9.5	0	0	3.1
Aug-42	101.8	45.5	-58.5	81.9	77.1	24.6	0	0	2.3
Sep-42	49.9	43.8	-8.2	78.6	45	4.9	0	0	2.2
Oct-42	29.3	17	-13.2	73.4	21.3	8	0	0	0.8
Nov-42	11.7	7.4	-11.7	69.1	4.3	7.4	7.4	0	0
Dec-42	6.5	12.8	-6.5	66.8	2.3	4.3	20.2	0	0
Jan-43	4.1	31.5	-4.1	65.5	1.4	2.8	51.7	0	0
Feb-43	9.9	11	-9.9	62.2	3.2	6.7	62.7	0	0
Mar-43	14.2	23.3	-14.2	57.8	4.4	9.8	86	0	0
Apr-43	44	35.8	32.9	90.7	44	0	43	0	1.8
May-43	63.5	33.8	-9.8	86.3	58.1	5.4	21.5	0	1.7
Jun-43	93.5	97.5	9.9	96.2	93.5	0	10.8	0	4.9
Jul-43	130	46.9	-80	57.7	88.5	41.5	5.4	0	2.3
Aug-43	106.8	77.1	-28.2	49.6	86.8	20.1	0	0	3.9
Sep-43	53	8	-45.4	38.3	18.9	34.2	0	0	0.4
Oct-43	30	24.8	-6.5	37.1	24.8	5.3	0	0	1.2
Nov-43	11.3	11.1	-11.3	35	2.1	9.2	11.1	0	0
Dec-43	7.8	3	-7.8	33.6	1.4	6.4	14.2	0	0
Jan-44	9.2	20.6	-9.2	32	1.6	7.7	34.8	0	0
Feb-44	8	7	-8	30.8	1.3	6.7	41.8	0	0
Mar-44	14.1	18.5	-14.1	28.6	2.2	11.9	60.4	0	0
Apr-44	35.6	15.1	8.9	37.5	35.6	0	30.2	0	0.8
May-44	80.3	65.4	-3	36.9	77.8	2.5	15.1	0	3.3
Jun-44	95	200	102.5	139.4	95	0	7.5	0	10
Jul-44	117.2	15.6	-94.9	73.3	88.5	28.7	0	0	0.8
Aug-44	91.5	58.9	-35.5	60.3	69	22.5	0	0	2.9
Sep-44	51.9	49.7	-4.6	58.9	48.6	3.2	0	0	2.5
Oct-44	30	1	-29	50.3	9.5	20.5	0	0	0.1
Nov-44	9.2	67.9	-9.2	48	2.3	6.9	67.9	0	0
Dec-44	6.5	2.2	-6.5	46.5	1.6	5	70.1	0	0
Jan-45	6.9	12	-6.9	44.9	1.6	5.3	82.1	0	0
Feb-45	8.8	4.9	-8.8	42.9	2	6.9	87	0	0
Mar-45	22.2	50.4	69.2	112	22.2	0	43.5	0	2.5
Apr-45	33.9	43.9	29.5	141.6	33.9	0	21.8	0	2.2

May-45	61.2	45.5	-7	136.6	59.1	2.1	10.9	0	2.3
Jun-45	86.5	72.6	-12.1	128.3	82.6	3.8	5.4	0	3.6
Jul-45	124.7	30.5	-90.2	70.4	92.3	32.3	0	0	1.5
Aug-45	107.1	27.3	-81.1	41.9	54.5	52.5	0	0	1.4
Sep-45	47.7	33	-16.4	38.4	34.8	13	0	0	1.6
Oct-45	27.8	4.9	-23.2	34	9.1	18.7	0	0	0.2
Nov-45	9.5	13.2	-9.5	32.4	1.6	7.9	13.2	0	0
Dec-45	5.4	7.8	-5.4	31.5	0.9	4.5	21.1	0	0
Jan-46	8.1	5.2	-8.1	30.2	1.3	6.8	26.2	0	0
Feb-46	9.6	8.2	-9.6	28.8	1.5	8.2	34.5	0	0
Mar-46	26.8	20.4	9.9	38.6	26.8	0	17.2	0	1
Apr-46	49.4	14.2	-27.3	33.4	27.4	22	8.6	0	0.7
May-46	61.9	53.5	-2.5	33	59.8	2	0	0	2.7
Jun-46	103.3	54.6	-51.3	24.5	60.4	42.9	0	0	2.7
Jul-46	136.2	65.3	-74.2	15.4	71.1	65.1	0	0	3.3
Aug-46	95.5	25.8	-71	9.9	30	65.6	0	0	1.3
Sep-46	51.3	38.2	-15	9.2	37	14.3	0	0	1.9
Oct-46	22	75.3	49.5	58.7	22	0	0	0	3.8
Nov-46	10.3	8.3	-10.3	55.7	3	7.3	8.3	0	0
Dec-46	6.7	33.5	-6.7	53.8	1.9	4.9	41.8	0	0
Jan-47	7.6	9	-7.6	51.8	2	5.5	50.8	0	0
Feb-47	7.3	4	-7.3	49.9	1.9	5.4	54.8	0	0
Mar-47	15.1	15.1	-15.1	46.1	3.8	11.4	69.8	0	0
Apr-47	36.1	48.4	44.7	90.8	36.1	0	34.9	0	2.4
May-47	63.6	21.4	-25.8	79.1	49.5	14.1	17.5	0	1.1
Jun-47	91.3	196	103.6	182.7	91.3	0	8.7	0	9.8
Jul-47	132.7	46.2	-80.1	109.6	125.8	6.9	0	0	2.3
Aug-47	109.6	64.4	-48.4	83.1	87.7	21.9	0	0	3.2
Sep-47	51.4	17.6	-34.7	68.7	31.1	20.3	0	0	0.9
Oct-47	31.4	14.5	-17.6	62.6	19.8	11.6	0	0	0.7
Nov-47	9.7	10.5	-9.7	59.6	3	6.6	10.5	0	0
Dec-47	7.3	7	-7.3	57.4	2.2	5.1	17.4	0	0
Jan-48	7.2	17.4	-7.2	55.4	2.1	5.1	34.9	0	0
Feb-48	7.3	14.4	-7.3	53.3	2	5.3	49.2	0	0
Mar-48	15.6	7.1	-15.6	49.2	4.2	11.5	56.3	0	0
Apr-48	41.1	40	25	74.2	41.1	0	28.2	0	2
May-48	72.7	49.5	-11.6	69.9	65.4	7.3	14.1	0	2.5
Jun-48	98.4	81.6	-13.9	65	89.4	9	7	0	4.1
Jul-48	121.4	105.3	-14.3	60.4	111.8	9.7	0	0	5.3
Aug-48	102.1	31.7	-71.9	38.7	51.9	50.2	0	0	1.6
Sep-48	63.3	5	-58.5	27.4	16.1	47.2	0	0	0.3
Oct-48	26.8	10.7	-16.6	25.1	12.4	14.3	0	0	0.5
Nov-48	11.8	29.5	-11.8	23.6	1.5	10.3	29.5	0	0
Dec-48	5.4	11.9	-5.4	23	0.6	4.8	41.3	0	0
Jan-49	4.2	33.5	-4.2	22.5	0.5	3.7	74.8	0	0
Feb-49	5.6	16.1	-5.6	21.8	0.6	5	91	0	0
Mar-49	15.7	16.2	-15.7	20.1	1.7	14	107.1	0	0
Apr-49	45.1	3.4	11.7	31.8	45.1	0	53.6	0	0.2
May-49	80.6	22.6	-32.3	26.7	53.4	27.2	26.8	0	1.1
Jun-49	107.3	29.7	-65.7	17.9	50.4	56.9	13.4	0	1.5
Jul-49	129.4	76.2	-50.3	13.4	83.6	45.8	6.7	0	3.8
Aug-49	111.3	20.2	-85.4	7.7	31.6	79.7	0	0	1
Sep-49	48.5	7	-41.8	6.1	8.2	40.2	0	0	0.3
Oct-49	24.8	54.7	27.2	33.2	24.8	0	0	0	2.7
Nov-49	15.6	1.2	-14.5	30.8	3.5	12.1	0	0	0.1
Dec-49	5.3	7.1	-5.3	30	0.8	4.5	7.1	0	0
Jan-50	3.2	13.7	-3.2	29.5	0.5	2.7	20.8	0	0
Feb-50	8.3	10.5	-8.3	28.3	1.2	7.1	31.3	0	0
Mar-50	14.6	22.9	-14.6	26.2	2.1	12.6	54.2	0	0
Apr-50	29	37.2	33.4	59.6	29	0	27.1	0	1.9
May-50	60.4	29.8	-18.6	54.1	47.3	13	13.6	0	1.5
Jun-50	95.4	79.4	-13.3	50.5	85.7	9.7	6.8	0	4
Jul-50	113.7	21.2	-86.8	28.6	48.8	64.9	0	0	1.1
Aug-50	91.5	48.8	-45.1	22.1	52.8	38.7	0	0	2.4
Sep-50	50.8	69.3	15	37.2	50.8	0	0	0	3.5
Oct-50	28.4	22.2	-7.3	35.8	22.5	6	0	0	1.1
Nov-50	9.2	11.8	-9.2	34.1	1.6	7.5	11.8	0	0
Dec-50	6.4	7.7	-6.4	33.1	1.1	5.3	19.4	0	0

Jan-51	5.3	11.9	-5.3	32.2	0.9	4.4	31.3	0	0
Feb-51	8.7	19.5	-8.7	30.8	1.4	7.3	50.9	0	0
Mar-51	11.7	3.8	-11.7	29	1.8	9.9	54.6	0	0
Apr-51	33	26.3	19.3	48.2	33	0	27.3	0	1.3
May-51	72.2	37	-23.4	42.6	54.5	17.8	13.7	0	1.9
Jun-51	86	46.8	-34.7	35.2	58.7	27.3	6.8	0	2.3
Jul-51	124.2	54.2	-65.9	23.6	70	54.3	0	0	2.7
Aug-51	93.6	36.7	-58.8	16.7	41.8	51.8	0	0	1.8
Sep-51	44.9	55.5	7.9	24.5	44.9	0	0	0	2.8
Oct-51	23.7	27.1	2	26.6	23.7	0	0	0	1.4
Nov-51	9.5	6.6	-9.5	25.3	1.3	8.3	6.6	0	0
Dec-51	4.6	14	-4.6	24.7	0.6	4	20.6	0	0
Jan-52	4.9	6.5	-4.9	24.1	0.6	4.3	27.1	0	0
Feb-52	9.2	12.7	-9.2	23	1.1	8.1	39.8	0	0
Mar-52	13.2	17.4	-13.2	21.5	1.5	11.7	57.2	0	0
Apr-52	46	0	-17.4	19.6	30.5	15.6	28.6	0	0
May-52	73.9	28.1	-32.9	16.4	44.2	29.7	14.3	0	1.4
Jun-52	112.4	42.5	-64.9	11.1	52.8	59.5	7.1	0	2.1
Jul-52	120.8	84.3	-33.6	9.2	89.1	31.7	0	0	4.2
Aug-52	101.4	0	-101.4	4.5	4.7	96.8	0	0	0
Sep-52	57.8	19.7	-39.1	3.7	19.6	38.2	0	0	1
Oct-52	25.8	2.9	-23.1	3.2	3.2	22.7	0	0	0.1
Nov-52	11.1	10.3	-11.1	3.1	0.2	10.9	10.3	0	0
Dec-52	7.4	1.1	-7.4	2.9	0.1	7.3	11.4	0	0
Jan-53	8.6	7.2	-8.6	2.8	0.1	8.4	18.6	0	0
Feb-53	10.5	4.6	-10.5	2.7	0.1	10.4	23.2	0	0
Mar-53	19.2	33.1	-19.2	2.4	0.3	19	56.3	0	0
Apr-53	30.4	64.1	58.6	61	30.4	0	28.2	0	3.2
May-53	63	104.5	50.4	111.4	63	0	14.1	0	5.2
Jun-53	103.8	77.6	-23	98.6	93.6	10.2	7	0	3.9
Jul-53	126.3	31.2	-89.7	54.4	80.9	45.5	0	0	1.6
Aug-53	105.5	59.7	-48.8	41.1	70	35.5	0	0	3
Sep-53	53.5	19.6	-34.9	33.9	25.8	27.8	0	0	1
Oct-53	32	43.1	9	42.9	32	0	0	0	2.2
Nov-53	14.7	5	-10	40.8	6.9	7.8	0	0	0.2
Dec-53	8.3	8.1	-8.3	39.1	1.7	6.6	8.1	0	0
Jan-54	4.8	5.4	-4.8	38.1	0.9	3.9	13.6	0	0
Feb-54	15.7	15.7	6	44.1	15.7	0	6.8	0	0.8
Mar-54	15.1	38.2	-15.1	40.8	3.3	11.7	45	0	0
Apr-54	34.8	14.1	1.1	41.9	34.8	0	22.5	0	0.7
May-54	65	35.9	-19.7	37.8	49.4	15.5	11.2	0	1.8
Jun-54	94.3	121.5	26.7	64.5	94.3	0	5.6	0	6.1
Jul-54	142.1	28.2	-109.7	29.1	67.8	74.3	0	0	1.4
Aug-54	98.6	96.2	-7.2	28.1	92.5	6.2	0	0	4.8
Sep-54	50.2	44.6	-7.8	27	43.5	6.7	0	0	2.2
Oct-54	25.4	16.3	-9.9	25.7	16.8	8.6	0	0	0.8
Nov-54	14.7	2.4	-12.5	24.1	3.9	10.9	0	0	0.1
Dec-54	8.7	3	-8.7	23	1	7.7	3	0	0
Jan-55	6.8	9.7	-6.8	22.2	0.8	6	12.7	0	0
Feb-55	7	12.6	-7	21.5	0.8	6.2	25.3	0	0
Mar-55	15.9	3.9	-15.9	19.8	1.7	14.2	29.2	0	0
Apr-55	44.7	66.2	32.8	52.5	44.7	0	14.6	0	3.3
May-55	77	54.4	-18	47.8	63.7	13.3	7.3	0	2.7
Jun-55	94.8	84.9	-6.8	46.2	89.6	5.2	0	0	4.2
Jul-55	134.7	43.1	-93.8	24.5	62.6	72.1	0	0	2.2
Aug-55	118	9.1	-109.3	11.1	22.1	95.9	0	0	0.5
Sep-55	51.1	6.4	-45.1	8.6	8.6	42.6	0	0	0.3
Oct-55	28.7	6.7	-22.3	7.7	7.3	21.3	0	0	0.3
Nov-55	7.2	24.1	-7.2	7.4	0.3	7	24.1	0	0
Dec-55	5.4	4.2	-5.4	7.2	0.2	5.2	28.3	0	0
Jan-56	5.7	5.6	-5.7	7	0.2	5.5	33.8	0	0
Feb-56	8.1	2.3	-8.1	6.7	0.3	7.8	36.2	0	0
Mar-56	19.4	14	-19.4	6	0.6	18.7	50.2	0	0
Apr-56	31	4.4	-1.7	6	29.3	1.7	25.1	0	0.2
May-56	70.6	61.6	0.5	6.5	70.6	0	12.5	0	3.1
Jun-56	127.2	19.9	-102	3.2	28.5	98.7	6.3	0	1
Jul-56	116.6	85.5	-29.1	2.7	88	28.6	0	0	4.3
Aug-56	94.9	31.8	-64.7	1.9	31.1	63.8	0	0	1.6

Sep-56	50.2	12.8	-38.1	1.5	12.5	37.7	0	0	0.6
Oct-56	28.5	8	-20.9	1.3	7.8	20.7	0	0	0.4
Nov-56	11.8	11.4	-11.8	1.3	0.1	11.7	11.4	0	0
Dec-56	7.9	5.2	-7.9	1.2	0	7.8	16.5	0	0
Jan-57	4.4	15.6	-4.4	1.2	0	4.4	32.1	0	0
Feb-57	8.4	6.5	-8.4	1.1	0	8.4	38.6	0	0
Mar-57	18.9	18.4	-18.9	1	0.1	18.8	57	0	0
Apr-57	33.6	66.1	57.7	58.8	33.6	0	28.5	0	3.3
May-57	70.4	40.3	-17.9	53.5	57.8	12.6	14.2	0	2
Jun-57	96.8	189.6	90.5	144	96.8	0	7.1	0	9.5
Jul-57	145.4	32.4	-107.5	66.6	115.3	30.1	0	0	1.6
Aug-57	104.5	40.2	-66.4	44.5	60.2	44.3	0	0	2
Sep-57	48.1	62.3	11.1	55.6	48.1	0	0	0	3.1
Oct-57	25.3	36.6	9.5	65	25.3	0	0	0	1.8
Nov-57	11.8	22	-11.8	61.2	3.8	7.9	22	0	0
Dec-57	9.4	3.2	-9.4	58.3	2.9	6.5	25.2	0	0
Jan-58	9.1	3.2	-9.1	55.7	2.7	6.5	28.4	0	0
Feb-58	8.1	21	-8.1	53.4	2.2	5.8	49.5	0	0
Mar-58	16.2	6.4	-16.2	49.1	4.3	11.9	55.9	0	0
Apr-58	39.2	17.9	5.7	54.8	39.2	0	27.9	0	0.9
May-58	85.2	16.1	-56	39.5	44.6	40.6	14	0	0.8
Jun-58	88.8	91	4.6	44.1	88.8	0	7	0	4.5
Jul-58	105	80.9	-21.1	39.4	88.5	16.5	0	0	4
Aug-58	111.4	12.1	-99.9	19.7	31.2	80.2	0	0	0.6
Sep-58	53.7	3.4	-50.4	14.8	8.2	45.5	0	0	0.2
Oct-58	26.9	19	-8.9	14.1	18.7	8.2	0	0	0.9
Nov-58	10.8	41.8	-10.8	13.3	0.8	10.1	41.8	0	0
Dec-58	6.5	10	-6.5	12.9	0.4	6	51.8	0	0
Jan-59	5.3	18	-5.3	12.6	0.3	5	69.8	0	0
Feb-59	6	29.1	-6	12.2	0.4	5.6	98.9	0	0
Mar-59	21.5	7.1	34.7	46.9	21.5	0	49.4	0	0.4
Apr-59	35.8	12	0.4	47.3	35.8	0	24.7	0	0.6
May-59	64.2	42.1	-11.9	44.5	55.1	9.1	12.4	0	2.1
Jun-59	113	69.6	-40.7	35.4	81.4	31.7	6.2	0	3.5
Jul-59	127.7	15.1	-107.1	16.4	39.5	88.2	0	0	0.8
Aug-59	109.7	17.3	-93.2	8.8	24.1	85.6	0	0	0.9
Sep-59	49.9	89.3	34.9	43.7	49.9	0	0	0	4.5
Oct-59	21.8	21.8	-1.1	43.5	21	0.9	0	0	1.1
Nov-59	9	21.2	-9	41.5	2	7.1	21.2	0	0
Dec-59	8.9	1.9	-8.9	39.7	1.8	7	23.1	0	0
Jan-60	5.9	8	-5.9	38.5	1.2	4.7	31	0	0
Feb-60	7.6	3.6	-7.6	37	1.5	6.1	34.6	0	0
Mar-60	14.7	13.3	-14.7	34.3	2.7	12	47.9	0	0
Apr-60	38	4.9	-9.4	32.7	30.2	7.8	23.9	0	0.2
May-60	69.5	66.1	5.3	38	69.5	0	12	0	3.3
Jun-60	97.2	151.9	53.1	91.1	97.2	0	6	0	7.6
Jul-60	138.9	41.8	-93.2	48.7	88.2	50.7	0	0	2.1
Aug-60	97.4	65.9	-34.7	40.2	71.1	26.3	0	0	3.3
Sep-60	54.2	0.5	-53.8	29.4	11.3	43	0	0	0
Oct-60	26.1	1.1	-25.1	25.7	4.7	21.4	0	0	0.1
Nov-60	10.1	5.7	-10.1	24.4	1.3	8.8	5.7	0	0
Dec-60	6.4	14.4	-6.4	23.6	0.8	5.6	20.1	0	0
Jan-61	7.6	0.4	-7.6	22.7	0.9	6.7	20.5	0	0
Feb-61	10.5	18	-10.5	21.5	1.2	9.3	38.5	0	0
Mar-61	22.7	13.8	9.7	31.3	22.7	0	19.2	0	0.7
Apr-61	30.9	51.9	28.1	59.3	30.9	0	9.6	0	2.6
May-61	67.8	28.9	-30.7	50.2	46.2	21.6	0	0	1.4
Jun-61	119.2	73.6	-49.3	37.8	82.3	36.9	0	0	3.7
Jul-61	129.2	56.9	-75.2	23.6	68.3	60.9	0	0	2.8
Aug-61	116.9	16.2	-101.5	11.6	27.3	89.5	0	0	0.8
Sep-61	41.4	73.3	28.3	39.9	41.4	0	0	0	3.7
Oct-61	25.1	3.1	-22.1	35.5	7.3	17.7	0	0	0.2
Nov-61	10.8	0.6	-10.8	33.6	1.9	8.9	0.6	0	0
Dec-61	5.1	2.3	-5.1	32.7	0.9	4.3	2.9	0	0
Jan-62	5.9	8.3	-5.9	31.7	1	4.9	11.2	0	0
Feb-62	7.7	1.9	-7.7	30.5	1.2	6.5	13.1	0	0
Mar-62	15	27.2	-15	28.2	2.3	12.7	40.3	0	0
Apr-62	40.1	25	3.7	32	40.1	0	20.1	0	1.2

May-62	69.7	113.5	48.1	80.1	69.7	0	10.1	0	5.7
Jun-62	105	44.1	-58	56.9	70.2	34.8	5	0	2.2
Jul-62	110.7	111.6	0.3	57.2	110.7	0	0	0	5.6
Aug-62	102.7	38.2	-66.4	38.2	55.3	47.4	0	0	1.9
Sep-62	49.9	21	-29.9	32.5	25.7	24.2	0	0	1.1
Oct-62	29.9	26.7	-4.5	31.7	26.1	3.8	0	0	1.3
Nov-62	13.9	5.3	-8.8	30.3	6.4	7.4	0	0	0.3
Dec-62	7.7	4.2	-7.7	29.2	1.2	6.5	4.2	0	0
Jan-63	4.5	13.2	-4.5	28.5	0.7	3.9	17.3	0	0
Feb-63	10.2	10.5	-10.2	27	1.5	8.8	27.9	0	0
Mar-63	23.6	37.8	26.2	53.3	23.6	0	13.9	0	1.9
Apr-63	36	77.4	44.5	97.8	36	0	7	0	3.9
May-63	68.6	63.3	-1.5	97	67.9	0.8	0	0	3.2
Jun-63	111.9	153	33.5	130.5	111.9	0	0	0	7.6
Jul-63	136.4	37	-101.3	64.4	101.2	35.2	0	0	1.9
Aug-63	103.2	32.7	-72.2	41.2	54.3	49	0	0	1.6
Sep-63	63	12.4	-51.3	30.6	22.3	40.7	0	0	0.6
Oct-63	35.5	1.2	-34.3	25.4	6.4	29.1	0	0	0.1
Nov-63	13	0	-13	23.7	1.7	11.3	0	0	0
Dec-63	5.8	3	-5.8	23	0.7	5.1	3	0	0
Jan-64	8	7.7	-8	22.1	0.9	7.1	10.7	0	0
Feb-64	10.9	3.2	-10.9	20.9	1.2	9.7	13.9	0	0
Mar-64	15.8	3	-15.8	19.2	1.7	14.1	16.9	0	0
Apr-64	39.9	22.1	-10.5	18.2	30.4	9.4	8.4	0	1.1
May-64	78.1	65	-7.9	17.5	70.9	7.2	0	0	3.2
Jun-64	101.3	124.5	17	34.5	101.3	0	0	0	6.2
Jul-64	138.4	49.1	-91.8	18.7	62.5	76	0	0	2.5
Aug-64	94.7	81.9	-16.9	17.1	79.4	15.4	0	0	4.1
Sep-64	45.1	14.6	-31.2	14.4	16.6	28.5	0	0	0.7
Oct-64	27.9	4.1	-23.9	12.7	5.7	22.2	0	0	0.2
Nov-64	9.3	27.8	-9.3	12.1	0.6	8.7	27.8	0	0
Dec-64	4.3	15.2	-4.3	11.8	0.3	4.1	43.1	0	0
Jan-65	5.6	11.7	-5.6	11.5	0.3	5.3	54.8	0	0
Feb-65	8.1	7.4	-8.1	11	0.5	7.6	62.2	0	0
Mar-65	11.3	7	-11.3	10.4	0.6	10.6	69.1	0	0
Apr-65	35.7	43.1	39.8	50.2	35.7	0	34.6	0	2.2
May-65	69.4	95.8	38.9	89	69.4	0	17.3	0	4.8
Jun-65	105.9	83.1	-18.3	80.9	95.7	10.2	8.6	0	4.2
Jul-65	127.9	78	-45.2	62.6	101	26.9	0	0	3.9
Aug-65	99.1	57.6	-44.4	48.7	68.6	30.5	0	0	2.9
Sep-65	36.1	29.3	-8.3	46.7	29.8	6.3	0	0	1.5
Oct-65	31.5	0	-31.5	39.3	7.4	24.1	0	0	0
Nov-65	11.8	10.3	-11.8	37	2.3	9.5	10.3	0	0
Dec-65	8.8	3.8	-8.8	35.4	1.6	7.1	14.1	0	0
Jan-66	4.4	20.1	-4.4	34.6	0.8	3.6	34.3	0	0
Feb-66	7.6	9.5	-7.6	33.3	1.3	6.3	43.7	0	0
Mar-66	21.5	18.9	18.3	51.6	21.5	0	21.9	0	0.9
Apr-66	31.2	22.1	0.7	52.3	31.2	0	10.9	0	1.1
May-66	72.5	44.9	-24.3	46	54.5	18	5.5	0	2.2
Jun-66	103.7	79	-23.2	40.6	85.8	17.8	0	0	4
Jul-66	142.2	66.3	-79.2	24.5	79.1	63.1	0	0	3.3
Aug-66	94.4	52.8	-44.2	19.1	55.6	38.8	0	0	2.6
Sep-66	60	22	-39	15.4	24.7	35.3	0	0	1.1
Oct-66	27.6	10.9	-17.3	14.1	11.7	15.9	0	0	0.5
Nov-66	9.4	15.7	-9.4	13.4	0.7	8.8	15.7	0	0
Dec-66	7.3	3.8	-7.3	12.9	0.5	6.8	19.5	0	0
Jan-67	7.3	23.8	-7.3	12.4	0.5	6.8	43.2	0	0
Feb-67	8.9	16.3	-8.9	11.9	0.6	8.4	59.5	0	0
Mar-67	19	9.1	-19	10.7	1.1	17.9	68.6	0	0
Apr-67	34.2	103.2	98.1	108.9	34.2	0	34.3	0	5.2
May-67	61.2	58.5	11.5	120.4	61.2	0	17.2	0	2.9
Jun-67	97.2	55.4	-36	98.7	82.9	14.3	8.6	0	2.8
Jul-67	125.7	16.9	-101.1	48.8	74.5	51.2	0	0	0.8
Aug-67	106.8	4.8	-102.2	23.9	29.5	77.3	0	0	0.2
Sep-67	59.6	57.9	-4.6	23.3	55.6	4.1	0	0	2.9
Oct-67	27.4	18.2	-10.1	22.1	18.4	9	0	0	0.9
Nov-67	11.5	4	-11.5	20.9	1.3	10.3	4	0	0
Dec-67	6.2	6	-6.2	20.2	0.6	5.5	10	0	0

Jan-68	6.5	18.3	-6.5	19.6	0.7	5.9	28.3	0	0
Feb-68	8.9	6.1	-8.9	18.7	0.9	8	34.4	0	0
Mar-68	24.2	2.7	-4.5	18.3	20.2	4.1	17.2	0	0.1
Apr-68	35.8	25.1	-3.4	18	32.7	3	8.6	0	1.3
May-68	62.2	34.2	-21.1	16.1	42.9	19.2	0	0	1.7
Jun-68	95.5	117.9	16.5	32.5	95.5	0	0	0	5.9
Jul-68	121.8	75.8	-49.7	24.5	80.2	41.7	0	0	3.8
Aug-68	93.5	111.4	12.3	36.8	93.5	0	0	0	5.6
Sep-68	55.3	20.3	-36	30.2	25.9	29.4	0	0	1
Oct-68	27.6	21.3	-7.3	29.1	21.3	6.2	0	0	1.1
Nov-68	12.5	2.9	-9.7	27.6	4.2	8.3	0	0	0.1
Dec-68	5	31.1	-5	27	0.7	4.3	31.1	0	0
Jan-69	3.8	16.5	-3.8	26.4	0.5	3.3	47.6	0	0
Feb-69	7.9	10.1	-7.9	25.4	1	6.8	57.7	0	0
Mar-69	15.2	5.8	-15.2	23.5	1.9	13.3	63.6	0	0
Apr-69	48	29.2	11.5	35	48	0	31.8	0	1.5
May-69	75.4	45	-16.7	32.1	61.6	13.8	15.9	0	2.3
Jun-69	90	152.4	62.8	94.8	90	0	7.9	0	7.6
Jul-69	120.8	66.3	-49.8	71.2	94.6	26.2	0	0	3.3
Aug-69	119.7	18.2	-102.4	34.7	53.8	65.9	0	0	0.9
Sep-69	59.5	6.6	-53.3	25.5	15.5	44	0	0	0.3
Oct-69	22.2	23	-0.3	25.5	21.9	0.3	0	0	1.2
Nov-69	12.7	0.6	-12.2	23.9	2.1	10.6	0	0	0
Dec-69	7.2	24.8	-7.2	23	0.9	6.4	24.8	0	0
Jan-70	5.1	14.9	-5.1	22.5	0.6	4.5	39.7	0	0
Feb-70	9.5	1.1	-9.5	21.4	1.1	8.4	40.8	0	0
Mar-70	15.6	9.6	-15.6	19.7	1.7	13.9	50.4	0	0
Apr-70	32.6	76.3	65	84.8	32.6	0	25.2	0	3.8
May-70	71.4	138.6	72.9	157.6	71.4	0	12.6	0	6.9
Jun-70	115.6	116.1	1	158.6	115.6	0	6.3	0	5.8
Jul-70	139.1	70.3	-66	106.3	125.4	13.7	0	0	3.5
Aug-70	111.9	2.8	-109.3	48.2	60.7	51.2	0	0	0.1
Sep-70	51.6	43.6	-10.2	45.7	43.9	7.8	0	0	2.2
Oct-70	24	13.4	-11.3	43.1	15.3	8.7	0	0	0.7
Nov-70	10.1	25.2	-10.1	41	2.2	7.9	25.2	0	0
Dec-70	6.2	3.1	-6.2	39.7	1.3	4.9	28.3	0	0
Jan-71	5	26.4	-5	38.7	1	4	54.8	0	0
Feb-71	8.4	11	-8.4	37.1	1.6	6.8	65.7	0	0
Mar-71	18.2	9	-18.2	33.7	3.4	14.8	74.7	0	0
Apr-71	40.1	59.9	54.2	87.9	40.1	0	37.3	0	3
May-71	70.5	26.6	-26.5	76.3	55.6	14.8	18.7	0	1.3
Jun-71	112.7	197.9	84.7	161	112.7	0	9.3	0	9.9
Jul-71	115.2	13.4	-93.2	86	97.1	18.2	0	0	0.7
Aug-71	122.2	1.5	-120.8	34.1	53.3	68.9	0	0	0.1
Sep-71	50.6	115	58.7	92.7	50.6	0	0	0	5.8
Oct-71	24.4	77.8	49.5	142.3	24.4	0	0	0	3.9
Nov-71	12.1	11.8	-0.9	141.6	11.9	0.3	0	0	0.6
Dec-71	5.4	14.5	-5.4	137.8	3.9	1.6	14.5	0	0
Jan-72	4.9	13.7	-4.9	134.4	3.4	1.5	28.2	0	0
Feb-72	7.1	12.5	-7.1	129.6	4.8	2.3	40.7	0	0
Mar-72	19.1	20.5	-19.1	117.2	12.4	6.7	61.2	0	0
Apr-72	37.2	20.8	13.2	130.4	37.2	0	30.6	0	1
May-72	73.9	119.4	54.8	185.2	73.9	0	15.3	0	6
Jun-72	108.4	61.8	-42	146.3	105.3	3.1	7.6	0	3.1
Jul-72	108.7	51.6	-52	108.3	94.7	14	0	0	2.6
Aug-72	106.4	75.3	-34.9	89.4	90.4	16	0	0	3.8
Sep-72	48.3	23.6	-25.9	77.8	34	14.3	0	0	1.2
Oct-72	24.2	28.5	2.9	80.7	24.2	0	0	0	1.4
Nov-72	11	1.3	-11	76.3	4.5	6.6	1.3	0	0
Dec-72	5.4	31.8	-5.4	74.2	2.1	3.3	33.1	0	0
Jan-73	7.6	4.6	-7.6	71.4	2.8	4.8	37.7	0	0
Feb-73	10.4	18.2	-10.4	67.7	3.7	6.7	56	0	0
Mar-73	24.3	15.5	18.4	86.1	24.3	0	28	0	0.8
Apr-73	36.6	63	37.2	123.3	36.6	0	14	0	3.2
May-73	70.3	32.8	-32.1	103.5	57.9	12.3	7	0	1.6
Jun-73	107.6	70.6	-33.5	86.2	91.4	16.1	0	0	3.5
Jul-73	124.6	21.5	-104.2	41.3	65.3	59.3	0	0	1.1
Aug-73	119.6	15.1	-105.2	19.6	36.1	83.5	0	0	0.8

Sep-73	49	63.9	11.7	31.2	49	0	0	0	3.2
Oct-73	31	2.5	-28.6	26.8	6.9	24.1	0	0	0.1
Nov-73	9.6	14.8	-9.6	25.5	1.3	8.3	14.8	0	0
Dec-73	6.6	12.2	-6.6	24.6	0.8	5.7	27	0	0
Jan-74	6.3	2.6	-6.3	23.9	0.8	5.5	29.6	0	0
Feb-74	11.3	9.3	-11.3	22.5	1.4	10	38.9	0	0
Mar-74	19.7	12.8	-19.7	20.3	2.2	17.4	51.7	0	0
Apr-74	41.1	31.5	14.7	35	41.1	0	25.8	0	1.6
May-74	64.3	166	106.4	141.4	64.3	0	12.9	0	8.3
Jun-74	107.2	17.3	-84.3	81.8	82.5	24.7	6.5	0	0.9
Jul-74	149.3	50.7	-94.6	43.1	93.4	55.9	0	0	2.5
Aug-74	85.8	28.4	-58.8	30.4	39.7	46.1	0	0	1.4
Sep-74	47.5	10	-37.9	24.7	15.3	32.2	0	0	0.5
Oct-74	29.5	23.9	-6.8	23.8	23.5	5.9	0	0	1.2
Nov-74	11.8	20	-11.8	22.4	1.4	10.4	20	0	0
Dec-74	8.2	4.1	-8.2	21.5	0.9	7.3	24.2	0	0
Jan-75	7.5	2.1	-7.5	20.7	0.8	6.7	26.2	0	0
Feb-75	7.8	5.9	-7.8	19.9	0.8	7	32.2	0	0
Mar-75	15.4	44.1	-15.4	18.4	1.5	13.9	76.2	0	0
Apr-75	29.7	64.3	69.5	87.8	29.7	0	38.1	0	3.2
May-75	67.7	59.2	7.6	95.4	67.7	0	19.1	0	3
Jun-75	99.9	103.2	7.7	103.1	99.9	0	9.5	0	5.2
Jul-75	143.5	19.9	-115.1	43.8	87.7	55.7	0	0	1
Aug-75	96.8	9.6	-87.7	24.6	28.3	68.5	0	0	0.5
Sep-75	50.8	21.1	-30.7	20.8	23.8	27	0	0	1.1
Oct-75	26.8	24.4	-3.7	20.4	23.6	3.3	0	0	1.2
Nov-75	11.2	12.2	-11.2	19.3	1.1	10.1	12.2	0	0
Dec-75	7.2	19.8	-7.2	18.6	0.7	6.5	32	0	0
Jan-76	6.6	19.2	-6.6	18	0.6	6	51.3	0	0
Feb-76	12.9	2.8	-12.9	16.8	1.2	11.7	54.1	0	0
Mar-76	18.6	5.4	-18.6	15.2	1.6	17.1	59.4	0	0
Apr-76	42.8	45.7	30.3	45.5	42.8	0	29.7	0	2.3
May-76	73.1	40.3	-19.9	41	57.7	15.4	14.9	0	2
Jun-76	111.8	84.2	-24.4	36	92.4	19.4	7.4	0	4.2
Jul-76	138.8	47.3	-86.4	20.5	67.9	70.9	0	0	2.4
Aug-76	114.8	8.6	-106.6	9.5	19	95.7	0	0	0.4
Sep-76	61.1	9.5	-52.1	7.1	11.5	49.6	0	0	0.5
Oct-76	23.6	14.1	-10.2	6.7	13.8	9.8	0	0	0.7
Nov-76	9.8	4	-9.8	6.4	0.3	9.5	4	0	0
Dec-76	6.9	7.7	-6.9	6.2	0.2	6.7	11.8	0	0
Jan-77	4.3	15.2	-4.3	6	0.1	4.1	26.9	0	0
Feb-77	11.9	5.9	-11.9	5.7	0.4	11.5	32.8	0	0
Mar-77	22.5	21.5	14.4	20.1	22.5	0	16.4	0	1.1
Apr-77	46.8	2.5	-36.2	16.4	14.2	32.6	8.2	0	0.1
May-77	94.6	69.9	-19.9	14.8	76.3	18.3	0	0	3.5
Jun-77	117.7	89.3	-32.8	12.4	87.3	30.4	0	0	4.5
Jul-77	136.7	26.7	-111.3	5.5	32.2	104.4	0	0	1.3
Aug-77	85.2	51.6	-36.2	4.5	50	35.2	0	0	2.6
Sep-77	51.7	134.6	76.2	80.7	51.7	0	0	0	6.7
Oct-77	27.8	30.7	1.3	82	27.8	0	0	0	1.5
Nov-77	10.1	24.8	-10.1	77.9	4.1	6	24.8	0	0
Dec-77	5.4	20	-5.4	75.8	2.1	3.3	44.9	0	0
Jan-78	4	3.9	-4	74.3	1.5	2.5	48.7	0	0
Feb-78	6.2	17	-6.2	72	2.3	3.9	65.7	0	0
Mar-78	19.3	6.2	-19.3	65	7	12.4	71.9	0	0
Apr-78	38.5	31.6	27.5	92.5	38.5	0	35.9	0	1.6
May-78	76.3	126.2	61.6	154.1	76.3	0	18	0	6.3
Jun-78	107	73.2	-28.5	132.1	100.5	6.5	9	0	3.7
Jul-78	120.9	73.7	-41.8	104.5	106.7	14.2	0	0	3.7
Aug-78	101.1	38.1	-65	70.6	70.1	31	0	0	1.9
Sep-78	59.8	44.7	-17.3	64.4	48.6	11.2	0	0	2.2
Oct-78	27.7	6.2	-21.8	57.4	13	14.8	0	0	0.3
Nov-78	9.2	30.6	-9.2	54.8	2.6	6.5	30.6	0	0
Dec-78	5.1	9.3	-5.1	53.4	1.4	3.7	39.9	0	0
Jan-79	3.9	3.3	-3.9	52.3	1	2.9	43.2	0	0
Feb-79	5.9	17.5	-5.9	50.8	1.5	4.3	60.7	0	0
Mar-79	16.9	6.4	-16.9	46.5	4.3	12.6	67.1	0	0
Apr-79	33.4	26.8	25.6	72.1	33.4	0	33.5	0	1.3

May-79	64	23.4	-24.9	63.1	48	15.9	16.8	0	1.2
Jun-79	111.1	31.1	-73.2	40	61	50.1	8.4	0	1.6
Jul-79	134.3	65.7	-63.5	27.3	83.5	50.8	0	0	3.3
Aug-79	100.6	26.9	-75.1	17.1	35.8	64.8	0	0	1.3
Sep-79	62.8	27.2	-36.9	13.9	29	33.8	0	0	1.4
Oct-79	29.6	11.4	-18.8	12.6	12.1	17.5	0	0	0.6
Nov-79	10.4	11.4	-10.4	11.9	0.7	9.7	11.4	0	0
Dec-79	9.4	1.4	-9.4	11.4	0.6	8.9	12.8	0	0
Jan-80	6	13.9	-6	11	0.3	5.6	26.7	0	0
Feb-80	9.7	7.1	-9.7	10.5	0.5	9.2	33.8	0	0
Mar-80	18.8	3.6	-18.8	9.5	1	17.8	37.4	0	0
Apr-80	46.9	0.2	-28	8.2	20.2	26.7	18.7	0	0
May-80	88.1	6.9	-72.2	5.2	18.8	69.3	9.4	0	0.3
Jun-80	117.4	56.6	-54.2	3.8	64.6	52.8	0	0	2.8
Jul-80	145.2	23.1	-123.2	1.5	24.3	120.9	0	0	1.2
Aug-80	93.1	74.9	-21.9	1.3	71.3	21.8	0	0	3.7
Sep-80	54.7	26.4	-29.6	1.1	25.3	29.4	0	0	1.3
Oct-80	27.1	62.2	32	33.2	27.1	0	0	0	3.1
Nov-80	14.3	10.9	-3.9	32.5	11	3.3	0	0	0.5
Dec-80	7.3	8.1	-7.3	31.3	1.2	6.1	8.1	0	0
Jan-81	9.7	2.3	-9.7	29.8	1.5	8.2	10.4	0	0
Feb-81	10.8	0.1	-10.8	28.2	1.6	9.2	10.5	0	0
Mar-81	24.1	1	-17.9	25.7	8.7	15.4	5.3	0	0.1
Apr-81	46.9	29	-14.1	23.8	34.6	12.3	0	0	1.4
May-81	75.3	43.7	-33.8	19.8	45.5	29.8	0	0	2.2
Jun-81	98.8	95	-8.6	19	91.1	7.8	0	0	4.7
Jul-81	143.9	35.3	-110.4	8.5	44	99.9	0	0	1.8
Aug-81	111.7	68.6	-46.5	6.5	67.2	44.5	0	0	3.4
Sep-81	57.8	13.9	-44.6	5.1	14.6	43.1	0	0	0.7
Oct-81	27	6.5	-20.8	4.5	6.7	20.3	0	0	0.3
Nov-81	14.1	14.8	0	4.5	14.1	0	0	0	0.7
Dec-81	6.6	12.8	-6.6	4.4	0.2	6.5	12.8	0	0
Jan-82	3.9	16.6	-3.9	4.3	0.1	3.8	29.4	0	0
Feb-82	7.9	6.1	-7.9	4.1	0.2	7.7	35.5	0	0
Mar-82	17.5	51.3	-17.5	3.8	0.4	17.1	86.8	0	0
Apr-82	34.5	34	41.2	45	34.5	0	43.4	0	1.7
May-82	65.1	102.7	54.1	99.1	65.1	0	21.7	0	5.1
Jun-82	98.2	87.6	-4.1	97.1	96.1	2.1	10.8	0	4.4
Jul-82	131	37.2	-90.2	53.3	84.6	46.4	5.4	0	1.9
Aug-82	107.2	45.2	-58.8	37.6	64.1	43.2	0	0	2.3
Sep-82	52.5	48.8	-6.2	36.4	47.5	5	0	0	2.4
Oct-82	27	118.2	85.3	121.8	27	0	0	0	5.9
Nov-82	9.9	3	-9.9	115.7	6	3.9	3	0	0
Dec-82	7.7	16	-7.7	111.3	4.4	3.2	19	0	0
Jan-83	9.7	3.6	-9.7	105.9	5.4	4.3	22.5	0	0
Feb-83	13.7	1	-1.4	105.1	13	0.7	11.3	0	0.1
Mar-83	20.5	24.8	8.7	113.9	20.5	0	5.6	0	1.2
Apr-83	34.9	6.2	-23.4	100.6	24.8	10.1	0	0	0.3
May-83	63.8	53	-13.5	93.8	57.1	6.7	0	0	2.6
Jun-83	101.3	73.9	-31.1	79.2	84.8	16.5	0	0	3.7
Jul-83	146.3	54.6	-94.4	41.8	89.2	57	0	0	2.7
Aug-83	137.6	45.1	-94.7	22	62.7	74.9	0	0	2.3
Sep-83	51.6	33.4	-19.8	19.8	33.9	17.7	0	0	1.7
Oct-83	28.4	7.6	-21.2	17.7	9.3	19.1	0	0	0.4
Nov-83	12.2	16.1	3	20.8	12.2	0	0	0	0.8
Dec-83	3.6	6.2	-3.6	20.4	0.4	3.2	6.2	0	0
Jan-84	8.1	8.7	-8.1	19.6	0.8	7.3	14.9	0	0
Feb-84	14.3	1.3	-5.6	19	9.2	5.1	7.5	0	0.1
Mar-84	18.8	15.2	-18.8	17.2	1.8	17	22.7	0	0
Apr-84	39.6	37.9	7.7	24.9	39.6	0	11.3	0	1.9
May-84	70.5	3.3	-61.7	17.2	16.5	54	5.7	0	0.2
Jun-84	107.7	72.6	-33.1	14.4	77.5	30.3	0	0	3.6
Jul-84	142.9	11.8	-131.8	4.9	20.7	122.3	0	0	0.6
Aug-84	125.3	61.1	-67.2	3.3	59.7	65.6	0	0	3.1
Sep-84	44.2	18.9	-26.2	2.8	18.4	25.8	0	0	0.9
Oct-84	24.8	14.9	-10.6	2.7	14.3	10.5	0	0	0.7
Nov-84	11.6	3.2	-11.6	2.5	0.2	11.4	3.2	0	0
Dec-84	5.1	8.2	-5.1	2.5	0.1	5	11.4	0	0

Jan-85	6	1.3	-6	2.4	0.1	6	12.7	0	0
Feb-85	8.4	0.1	-8.4	2.3	0.1	8.3	12.8	0	0
Mar-85	20.8	18.2	2.9	5.2	20.8	0	6.4	0	0.9
Apr-85	46	34	-7.3	5	38.9	7.1	0	0	1.7
May-85	89.6	64.6	-28.2	4.3	62.1	27.5	0	0	3.2
Jun-85	96.6	14.4	-83	2.5	15.4	81.2	0	0	0.7
Jul-85	144.4	66.8	-81	1.5	64.4	80	0	0	3.3
Aug-85	94.7	27.4	-68.7	1	26.6	68.2	0	0	1.4
Sep-85	47.1	40.8	-8.3	0.9	38.8	8.3	0	0	2
Oct-85	27.3	40.3	11	11.9	27.3	0	0	0	2
Nov-85	6.9	15.7	-6.9	11.5	0.4	6.5	15.7	0	0
Dec-85	5.8	15.4	-5.8	11.1	0.3	5.5	31.1	0	0
Jan-86	9.6	7.8	-9.6	10.6	0.5	9	38.9	0	0
Feb-86	8.5	14.4	-8.5	10.2	0.4	8	53.3	0	0
Mar-86	28.6	4.3	2.2	12.3	28.6	0	26.6	0	0.2
Apr-86	38	65.5	37.6	50	38	0	13.3	0	3.3
May-86	73.6	67.8	-2.5	49.3	71.7	1.9	6.7	0	3.4
Jun-86	127.5	102.9	-23	43.6	110.1	17.4	0	0	5.1
Jul-86	123.4	65	-61.7	30.2	75.2	48.2	0	0	3.2
Aug-86	101.9	4	-98.1	15.4	18.6	83.3	0	0	0.2
Sep-86	45.2	148	95.4	110.7	45.2	0	0	0	7.4
Oct-86	28.2	17.4	-11.7	104.3	23	5.2	0	0	0.9
Nov-86	10.1	29.3	-10.1	99	5.2	4.8	29.3	0	0
Dec-86	8.9	2	-8.9	94.6	4.4	4.5	31.4	0	0
Jan-87	9	3.4	-9	90.4	4.3	4.8	34.8	0	0
Feb-87	13.5	6.1	-13.5	84.3	6.1	7.4	41	0	0
Mar-87	20.6	46.8	44.2	128.5	20.6	0	20.5	0	2.3
Apr-87	51.1	1.5	-39.5	103.2	37	14.1	10.2	0	0.1
May-87	87.9	67.6	-18.6	93.6	78.9	9	5.1	0	3.4
Jun-87	124.3	25.5	-94.9	49.2	73.8	50.5	0	0	1.3
Jul-87	133.1	171.4	29.7	78.9	133.1	0	0	0	8.6
Aug-87	91.5	99.2	2.7	81.5	91.5	0	0	0	5
Sep-87	56.2	15.7	-41.3	64.7	31.8	24.4	0	0	0.8
Oct-87	26.2	7.5	-19	58.6	13.3	12.9	0	0	0.4
Nov-87	14.4	5	-9.7	55.7	7.6	6.8	0	0	0.2
Dec-87	8.6	0.2	-8.6	53.3	2.4	6.2	0.2	0	0
Jan-88	6	16.6	-6	51.7	1.6	4.4	16.7	0	0
Feb-88	8.8	14.5	-8.8	49.5	2.3	6.5	31.2	0	0
Mar-88	22.5	14.3	6.7	56.2	22.5	0	15.6	0	0.7
Apr-88	42.9	0.1	-35	46.3	17.7	25.2	7.8	0	0
May-88	90.8	56	-29.8	39.4	67.9	22.9	0	0	2.8
Jun-88	169.4	38.5	-132.8	13.2	62.8	106.6	0	0	1.9
Jul-88	149.8	30.2	-121.1	5.2	36.7	113	0	0	1.5
Aug-88	114.7	5.1	-109.8	2.4	7.7	107	0	0	0.3
Sep-88	52.6	25.9	-28.1	2	24.9	27.7	0	0	1.3
Oct-88	27.5	12	-16.2	1.9	11.5	16	0	0	0.6
Nov-88	11.8	7	-11.8	1.8	0.1	11.7	7	0	0
Dec-88	7.4	11.5	-7.4	1.7	0.1	7.4	18.6	0	0
Jan-89	7.6	16.3	-7.6	1.6	0.1	7.5	34.9	0	0
Feb-89	5.9	7.2	-5.9	1.6	0	5.9	42.1	0	0
Mar-89	17.8	27.1	-17.8	1.4	0.1	17.6	69.2	0	0
Apr-89	40	76.9	67.7	69.1	40	0	34.6	0	3.8
May-89	77.4	46.4	-16.1	63.6	66.9	10.5	17.3	0	2.3
Jun-89	104.5	46	-52.1	47	68.9	35.5	8.7	0	2.3
Jul-89	157.5	11.7	-137.8	14.6	52.1	105.4	0	0	0.6
Aug-89	112.7	24.8	-89.2	8.1	30	82.6	0	0	1.2
Sep-89	55.6	9.8	-46.3	6.2	11.1	44.4	0	0	0.5
Oct-89	28.2	45.2	14.7	20.9	28.2	0	0	0	2.3
Nov-89	12.4	14.5	1.3	22.2	12.4	0	0	0	0.7
Dec-89	5.7	14.5	-5.7	21.6	0.6	5.1	14.5	0	0
Jan-90	9.5	5.5	-9.5	20.6	1	8.5	20	0	0
Feb-90	11	2.2	-11	19.4	1.1	9.8	22.2	0	0
Mar-90	23.2	8.1	-4.4	19	19.2	4	11.1	0	0.4
Apr-90	40.4	26.9	-9.3	18.1	32	8.4	5.5	0	1.3
May-90	71.8	38	-30.1	15.4	44.3	27.4	0	0	1.9
Jun-90	113.5	93.3	-24.8	13.5	90.6	22.9	0	0	4.7
Jul-90	134.1	50.3	-86.3	7.7	53.6	80.5	0	0	2.5
Aug-90	118.5	5.3	-113.4	3.3	9.4	109.1	0	0	0.3

Sep-90	66	9.7	-56.8	2.4	10.2	55.8	0	0	0.5
Oct-90	27.5	26.8	-2.1	2.4	25.5	2.1	0	0	1.3
Nov-90	13.4	3.6	-9.9	2.2	3.6	9.8	0	0	0.2
Dec-90	5.5	6.2	-5.5	2.2	0.1	5.4	6.2	0	0
Jan-91	5.9	3.4	-5.9	2.1	0.1	5.8	9.5	0	0
Feb-91	13.9	8.2	3.5	5.6	13.9	0	0	0	0.4
Mar-91	22.4	6.1	-16.6	5.1	6.2	16.2	0	0	0.3
Apr-91	41.8	65.9	20.8	25.9	41.8	0	0	0	3.3
May-91	77.9	54	-26.6	22.5	54.8	23.2	0	0	2.7
Jun-91	116.8	93.8	-27.7	19.3	92.2	24.6	0	0	4.7
Jul-91	136.9	13.2	-124.3	7.3	24.6	112.3	0	0	0.7
Aug-91	121.5	11.3	-110.8	3.3	14.8	106.7	0	0	0.6
Sep-91	55.8	69.8	10.5	13.8	55.8	0	0	0	3.5
Oct-91	23.8	20	-4.9	13.4	19.3	4.6	0	0	1
Nov-91	10.5	3.9	-10.5	12.7	0.7	9.7	3.9	0	0
Dec-91	8.8	0.8	-8.8	12.2	0.6	8.2	4.8	0	0
Jan-92	10.3	9.6	-10.3	11.5	0.6	9.6	14.4	0	0
Feb-92	13.9	1.3	-5.5	11.2	8.7	5.2	7.2	0	0.1
Mar-92	25.5	19.9	0.5	11.8	25.5	0	0	0	1
Apr-92	39.8	61.4	18.5	30.3	39.8	0	0	0	3.1
May-92	81.4	32.7	-50.3	22.7	38.7	42.7	0	0	1.6
Jun-92	110	34.6	-77.1	13.9	41.6	68.4	0	0	1.7
Jul-92	104.1	48.1	-58.4	9.9	49.8	54.3	0	0	2.4
Aug-92	88.8	58.4	-33.4	8.2	57.1	31.7	0	0	2.9
Sep-92	53	20.6	-33.4	6.8	21	32.1	0	0	1
Oct-92	27.4	3.4	-24.2	6	4	23.3	0	0	0.2
Nov-92	11.1	19.6	-11.1	5.7	0.3	10.8	19.6	0	0
Dec-92	6.2	12.7	-6.2	5.5	0.2	6.1	32.3	0	0
Jan-93	5.6	7.2	-5.6	5.3	0.2	5.4	39.5	0	0
Feb-93	7.3	9.9	-7.3	5.2	0.2	7.1	49.4	0	0
Mar-93	22	7	9.3	14.5	22	0	24.7	0	0.3
Apr-93	39.3	59.8	29.9	44.4	39.3	0	12.3	0	3
May-93	74.3	54.3	-16.5	40.7	61.5	12.9	6.2	0	2.7
Jun-93	92.6	116.2	24	64.7	92.6	0	0	0	5.8
Jul-93	99.9	163.2	55.2	119.9	99.9	0	0	0	8.2
Aug-93	90.8	34.7	-57.9	85.2	67.6	23.2	0	0	1.7
Sep-93	45.8	6.2	-39.9	68.2	22.9	22.9	0	0	0.3
Oct-93	25.2	7.8	-17.8	62.1	13.5	11.7	0	0	0.4
Nov-93	10.2	14.1	-10.2	59	3.2	7	14.1	0	0
Dec-93	8.6	7.8	-8.6	56.4	2.5	6.1	21.9	0	0
Jan-94	5.4	10.4	-5.4	54.9	1.5	3.9	32.3	0	0
Feb-94	6.5	8.5	-6.5	53.1	1.8	4.7	40.7	0	0
Mar-94	23.3	13.1	9.5	62.6	23.3	0	20.4	0	0.7
Apr-94	41	26.3	-5.8	60.8	37	4	10.2	0	1.3
May-94	81.2	24.7	-52.6	44.8	44.6	36.6	5.1	0	1.2
Jun-94	109.1	168.5	56	100.8	109.1	0	0	0	8.4
Jul-94	120	26.4	-94.9	53	72.9	47.1	0	0	1.3
Aug-94	106.9	4.1	-103	25.7	31.2	75.7	0	0	0.2
Sep-94	61.1	16.5	-45.4	19.9	21.5	39.6	0	0	0.8
Oct-94	29.1	75.7	42.8	62.6	29.1	0	0	0	3.8
Nov-94	11.9	6.9	-5.3	61	8.2	3.7	0	0	0.3
Dec-94	8.2	4	-8.2	58.5	2.5	5.7	4	0	0
Jan-95	7.5	16.5	-7.5	56.3	2.2	5.3	20.5	0	0
Feb-95	11.7	5.3	-11.7	53	3.3	8.4	25.8	0	0
Mar-95	18.8	24.2	-18.8	48	5	13.8	49.9	0	0
Apr-95	33.6	18.4	8.8	56.8	33.6	0	25	0	0.9
May-95	65.7	80.5	23.3	80.1	65.7	0	12.5	0	4
Jun-95	112.7	57	-52.3	59.1	81.4	31.4	6.2	0	2.9
Jul-95	127.8	83.4	-42.3	46.6	98	29.8	0	0	4.2
Aug-95	116.7	42.4	-76.5	28.8	58.1	58.7	0	0	2.1
Sep-95	51.9	2.1	-49.9	21.6	9.2	42.8	0	0	0.1
Oct-95	26.7	33.1	4.7	26.3	26.7	0	0	0	1.7
Nov-95	11.2	10.2	-11.2	24.9	1.5	9.7	10.2	0	0
Dec-95	6.7	7.1	-6.7	24	0.8	5.8	17.2	0	0
Jan-96	5.2	12.8	-5.2	23.4	0.6	4.6	30	0	0
Feb-96	10.4	8.1	-10.4	22.2	1.2	9.2	38.1	0	0
Mar-96	14	22.2	-14	20.6	1.6	12.4	60.4	0	0
Apr-96	35.3	25.4	19	39.6	35.3	0	30.2	0	1.3

May-96	61.4	69.3	19.5	59.1	61.4	0	15.1	0	3.5
Jun-96	111.3	91.4	-16.9	54.1	99.4	11.9	7.5	0	4.6
Jul-96	121.2	43.3	-72.5	34.5	68.3	52.8	0	0	2.2
Aug-96	115.3	43.7	-73.8	21.8	54.2	61	0	0	2.2
Sep-96	51.9	58.1	3.3	25	51.9	0	0	0	2.9
Oct-96	26.1	17.2	-9.8	23.8	17.6	8.5	0	0	0.9
Nov-96	7.8	23.6	-7.8	22.9	0.9	6.9	23.6	0	0
Dec-96	5.1	6.4	-5.1	22.3	0.6	4.5	30	0	0
Jan-97	5.3	6	-5.3	21.7	0.6	4.7	36.1	0	0
Feb-97	11.3	9.7	-11.3	20.5	1.2	10	45.8	0	0
Mar-97	19.7	18.5	-19.7	18.5	2	17.7	64.3	0	0
Apr-97	33.3	66.1	61.6	80.1	33.3	0	32.1	0	3.3
May-97	68.8	13	-40.4	64	44.6	24.2	16.1	0	0.7
Jun-97	122.8	49.9	-67.4	42.4	77	45.8	8	0	2.5
Jul-97	128.2	164.2	35.9	78.3	128.2	0	0	0	8.2
Aug-97	102.8	33.3	-71.1	50.5	59.5	43.3	0	0	1.7
Sep-97	61	20.8	-41.2	40.1	30.2	30.8	0	0	1
Oct-97	28.3	13.4	-15.6	36.9	15.9	12.5	0	0	0.7
Nov-97	11.4	1.9	-11.4	34.8	2.1	9.3	1.9	0	0
Dec-97	9	1.1	-9	33.3	1.6	7.4	3	0	0
Jan-98	6.8	4.1	-6.8	32.1	1.1	5.7	7.1	0	0
Feb-98	14.1	36.8	27.9	60.1	14.1	0	0	0	1.8
Mar-98	15.2	13.1	-15.2	55.5	4.6	10.6	13.1	0	0
Apr-98	43.2	14.2	-23.1	49.1	26.5	16.7	6.6	0	0.7
May-98	76.7	55.2	-17.7	44.8	63.3	13.3	0	0	2.8
Jun-98	82.4	102.7	15.1	59.9	82.4	0	0	0	5.1
Jul-98	137.5	37.3	-102.1	29.3	66	71.5	0	0	1.9
Aug-98	121.7	52.7	-71.7	18.8	60.6	61.2	0	0	2.6
Sep-98	68.4	18.8	-50.5	14.1	22.6	45.8	0	0	0.9
Oct-98	27.3	84.6	53.1	67.2	27.3	0	0	0	4.2
Nov-98	13.1	22.4	8.1	75.3	13.1	0	0	0	1.1
Dec-98	7.6	9.8	-7.6	72.5	2.9	4.7	9.8	0	0
Jan-99	6.6	13.5	-6.6	70.1	2.4	4.2	23.3	0	0
Feb-99	13.4	13.1	-13.4	65.4	4.7	8.7	36.4	0	0
Mar-99	25	4	-3	64.4	23	2	18.2	0	0.2
Apr-99	39.7	28.7	-3.2	63.4	37.5	2.2	9.1	0	1.4
May-99	72.1	84.7	17.5	80.8	72.1	0	0	0	4.2
Jun-99	101.2	39.9	-63.4	55.2	63.5	37.8	0	0	2
Jul-99	137.2	21.4	-116.9	22.9	52.6	84.6	0	0	1.1
Aug-99	110.4	64.4	-49.2	17.3	66.8	43.6	0	0	3.2
Sep-99	44.6	39.3	-7.2	16.7	38	6.6	0	0	2
Oct-99	25.1	13.7	-12.2	15.7	14	11.1	0	0	0.7
Nov-99	15.8	5.7	-10.4	14.8	6.2	9.6	0	0	0.3
Dec-99	9	4.5	-9	14.2	0.7	8.3	4.5	0	0
Jan-00	7.6	2.1	-7.6	13.6	0.5	7.1	6.6	0	0
Feb-00	11.3	11.3	-11.3	12.9	0.8	10.5	17.9	0	0
Mar-00	25.2	5.6	-10.9	12.2	15	10.2	9	0	0.3
Apr-00	37.8	10.4	-18.9	11	20	17.8	0	0	0.5
May-00	76.8	42.8	-36.1	9	42.7	34.2	0	0	2.1
Jun-00	97	37.5	-61.4	6.3	38.4	58.6	0	0	1.9
Jul-00	145.5	97.6	-52.8	4.6	94.3	51.2	0	0	4.9
Aug-00	122.3	12.1	-110.8	2.1	14	108.2	0	0	0.6
Sep-00	57.6	25.3	-33.6	1.7	24.3	33.3	0	0	1.3
Oct-00	28.9	21.7	-8.3	1.6	20.7	8.2	0	0	1.1
Nov-00	8	87.3	-8	1.6	0.1	7.9	87.3	0	0
Dec-00	4.7	11.6	-4.7	1.5	0	4.7	98.9	0	0
Jan-01	8.5	7	-8.5	1.5	0.1	8.5	106	0	0
Feb-01	6.9	2.3	-6.9	1.4	0.1	6.8	108.2	0	0
Mar-01	21.4	6	38.5	39.9	21.4	0	54.1	0	0.3
Apr-01	40.5	53.8	37.7	77.6	40.5	0	27.1	0	2.7
May-01	78.3	13.3	-52.1	57.3	46.4	31.9	13.5	0	0.7
Jun-01	101.6	131.1	29.7	87	101.6	0	6.8	0	6.6
Jul-01	141.4	102.8	-37	70.9	120.5	20.9	0	0	5.1
Aug-01	121.3	3.5	-118	29.1	45.1	76.1	0	0	0.2
Sep-01	58.9	32.8	-27.7	25.1	35.2	23.6	0	0	1.6
Oct-01	25.7	7.9	-18.2	22.8	9.8	15.9	0	0	0.4
Nov-01	15.1	2.6	-12.6	21.4	3.9	11.2	0	0	0.1
Dec-01	7.5	8.1	-7.5	20.6	0.8	6.7	8.1	0	0

Jan-02	8.4	12.2	-8.4	19.7	0.9	7.6	20.3	0	0
Feb-02	12.3	8.6	-12.3	18.5	1.2	11.1	28.9	0	0
Mar-02	12.7	18.7	-12.7	17.3	1.2	11.6	47.6	0	0
Apr-02	34.6	34.4	21.8	39.1	34.6	0	23.8	0	1.7
May-02	63.4	30.5	-22.5	34.7	45.3	18.1	11.9	0	1.5
Jun-02	113.6	80.5	-31.2	29.3	87.9	25.7	5.9	0	4
Jul-02	157	70.4	-84.2	17	85.1	71.8	0	0	3.5
Aug-02	101.3	11.9	-90	9.3	19	82.3	0	0	0.6
Sep-02	60.7	2.9	-57.9	6.6	5.5	55.2	0	0	0.1
Oct-02	19.2	14.8	-5.1	6.5	14.3	4.9	0	0	0.7
Nov-02	13	4	-9.2	6.2	4.1	8.9	0	0	0.2
Dec-02	8.1	14.7	-8.1	5.9	0.3	7.9	14.7	0	0
Jan-03	6.6	11.8	-6.6	5.7	0.2	6.4	26.6	0	0
Feb-03	7.5	0.3	-7.5	5.5	0.2	7.3	26.8	0	0
Mar-03	17.7	57.7	-17.7	5	0.5	17.2	84.5	0	0
Apr-03	44.8	18.3	14.8	19.8	44.8	0	42.3	0	0.9
May-03	70.1	84.5	31.3	51.1	70.1	0	21.1	0	4.2
Jun-03	100.1	67.7	-25.3	44.6	81.3	18.8	10.6	0	3.4
Jul-03	150.4	25.3	-121.1	17.6	56.3	94.1	5.3	0	1.3
Aug-03	131.7	14.4	-112.7	7.7	28.9	102.8	0	0	0.7
Sep-03	54.4	61.8	4.2	11.9	54.4	0	0	0	3.1
Oct-03	32.8	7.4	-25.8	10.4	8.6	24.2	0	0	0.4
Nov-03	9.2	8.7	-9.2	9.9	0.5	8.7	8.7	0	0
Dec-03	8.3	16.2	-8.3	9.5	0.4	7.9	24.9	0	0
Jan-04	5.9	20.1	-5.9	9.2	0.3	5.6	45.1	0	0
Feb-04	9.7	8.5	-9.7	8.8	0.4	9.3	53.5	0	0
Mar-04	23.7	22.8	24.8	33.5	23.7	0	26.8	0	1.1
Apr-04	44.1	15.6	-15.9	30.9	30.8	13.3	13.4	0	0.8
May-04	67.2	18.6	-42.8	24.3	31	36.2	6.7	0	0.9
Jun-04	94.6	21.8	-67.1	16.1	35.6	59	0	0	1.1
Jul-04	130.6	54	-79.4	9.7	57.7	73	0	0	2.7
Aug-04	93.1	14.2	-79.6	5.8	17.4	75.8	0	0	0.7
Sep-04	61.4	43.9	-19.7	5.3	42.3	19.2	0	0	2.2
Oct-04	26.8	57.8	28.2	33.4	26.8	0	0	0	2.9
Nov-04	13.1	0	-13.1	31.2	2.2	10.9	0	0	0
Dec-04	8.5	8	-8.5	29.9	1.3	7.2	8	0	0
Jan-05	6.1	5.2	-6.1	29	0.9	5.2	13.2	0	0
Feb-05	12.6	0.7	-12.6	27.2	1.8	10.8	13.9	0	0
Mar-05	23.8	10.9	-6.5	26.3	18.1	5.6	6.9	0	0.5
Apr-05	45.4	8.4	-30.5	22.3	18.9	26.5	0	0	0.4
May-05	63.9	119.7	49.8	72.1	63.9	0	0	0	6
Jun-05	109	164.4	47.2	119.3	109	0	0	0	8.2
Jul-05	137.8	41.7	-98.1	60.8	98.2	39.6	0	0	2.1
Aug-05	100.2	33.7	-68.2	40	52.7	47.5	0	0	1.7
Sep-05	59.3	13.4	-46.6	30.7	22.1	37.2	0	0	0.7
Oct-05	27.2	50.2	20.5	51.2	27.2	0	0	0	2.5
Nov-05	13.5	22.7	8.1	59.3	13.5	0	0	0	1.1
Dec-05	7.1	10.7	-7.1	57.2	2.1	5	10.7	0	0
Jan-06	11.4	9.8	-11.4	53.9	3.3	8.2	20.6	0	0
Feb-06	9.7	5	-9.7	51.3	2.6	7.1	25.6	0	0
Mar-06	18.6	17.7	-18.6	46.5	4.8	13.8	43.3	0	0
Apr-06	45.9	77.7	49.5	96	45.9	0	21.6	0	3.9
May-06	75.4	59.5	-8	92.2	71.2	4.2	10.8	0	3
Jun-06	115.6	25.4	-86.1	52.5	69.2	46.4	5.4	0	1.3
Jul-06	156.9	15.2	-137.1	16.5	55.8	101.1	0	0	0.8
Aug-06	111.5	38.8	-74.6	10.4	43	68.5	0	0	1.9
Sep-06	48.9	53.4	1.9	12.2	48.9	0	0	0	2.7
Oct-06	22.2	36.8	12.7	25	22.2	0	0	0	1.8
Nov-06	11.4	2.9	-11.4	23.5	1.4	10	2.9	0	0
Dec-06	7.5	5.6	-7.5	22.7	0.9	6.6	8.5	0	0
Jan-07	7.6	2.1	-7.6	21.8	0.9	6.7	10.6	0	0
Feb-07	7.5	17.7	-7.5	21	0.8	6.7	28.3	0	0
Mar-07	24.4	31.3	19.5	40.5	24.4	0	14.1	0	1.6
Apr-07	35.1	39.3	9.3	49.7	35.1	0	7.1	0	2
May-07	75.1	121.9	47.8	97.5	75.1	0	0	0	6.1
Jun-07	110.6	44	-68.9	63.9	75.3	35.3	0	0	2.2
Jul-07	156.4	45.7	-113	27.8	79.5	76.9	0	0	2.3
Aug-07	103.6	16.9	-87.5	15.6	28.2	75.4	0	0	0.8

Sep-07	54.3	22.6	-32.8	13.1	24.1	30.2	0	0	1.1
Oct-07	27.6	9.3	-18.8	11.8	10.1	17.6	0	0	0.5
Nov-07	11.8	2.8	-11.8	11.1	0.7	11.1	2.8	0	0
Dec-07	6.4	2	-6.4	10.8	0.4	6	4.9	0	0
Jan-08	6.3	3.1	-6.3	10.5	0.3	5.9	8	0	0
Feb-08	8.1	5	-8.1	10	0.4	7.7	13	0	0
Mar-08	20	6.1	-20	9	1	19	19.1	0	0
Apr-08	36.4	11.6	-15.9	8.3	21.3	15.1	9.5	0	0.6
May-08	68.9	69.4	6.6	14.9	68.9	0	0	0	3.5
Jun-08	98.2	48.3	-52.3	11	49.8	48.4	0	0	2.4
Jul-08	139	33.8	-106.9	5.1	38	101	0	0	1.7
Aug-08	110.1	38.6	-73.4	3.2	38.6	71.5	0	0	1.9
Sep-08	50.2	25.2	-26.3	2.8	24.3	25.9	0	0	1.3
Oct-08	25.4	42	14.5	17.4	25.4	0	0	0	2.1
Nov-08	11.9	24.4	11.3	28.6	11.9	0	0	0	1.2
Dec-08	4.8	20.6	-4.8	27.9	0.7	4.1	20.6	0	0
Jan-09	5.9	11.1	-5.9	27.1	0.8	5.1	31.7	0	0
Feb-09	8	19	-8	26	1.1	6.9	50.7	0	0
Mar-09	16.2	26.6	-16.2	23.9	2.1	14.1	77.3	0	0
Apr-09	35.1	23.7	26.1	50	35.1	0	38.6	0	1.2
May-09	68.9	53.3	1	51.1	68.9	0	19.3	0	2.7
Jun-0994	74.8	-13.4	47.7	84.1	9.9	9.7	0	3.7	
Jul-09	111.5	74.2	-31.3	40.2	87.6	23.9	0	0	3.7
Aug-09	92.5	34.9	-59.3	28.3	45	47.4	0	0	1.7
Sep-09	64.2	30.3	-35.4	23.3	33.8	30.4	0	0	1.5
Oct-09	20	37.7	15.9	39.1	20	0	0	0	1.9
Nov-09	14	0.3	-13.7	36.5	3	11	0	0	0
Dec-09	4.5	26.6	-4.5	35.6	0.8	3.7	26.6	0	0
Jan-10	5.9	9.7	-5.9	34.6	1.1	4.9	36.4	0	0
Feb-10	6.7	9.5	-6.7	33.4	1.2	5.6	45.9	0	0
Mar-10	20.5	13.5	15.3	48.7	20.5	0	22.9	0	0.7
Apr-10	41	29.4	-1.7	48.3	39.8	1.3	11.5	0	1.5
May-10	63.2	99	36.6	84.9	63.2	0	5.7	0	4.9
Jun-10	102	110.8	9	93.9	102	0	0	0	5.5
Jul-10	122.4	47.1	-77.6	57.5	81.2	41.2	0	0	2.4
Aug-10	105.1	21.5	-84.6	33.2	44.8	60.3	0	0	1.1
Sep-10	49.1	73	20.3	53.4	49.1	0	0	0	3.7
Oct-10	29.1	6.4	-23	47.3	12.3	16.9	0	0	0.3
Nov-10	10.1	19.7	-10.1	44.9	2.4	7.7	19.7	0	0
Dec-10	5.2	16.2	-5.2	43.7	1.2	4	35.9	0	0
Jan-11	5.8	37.9	-5.8	42.5	1.3	4.5	73.8	0	0
Feb-11	6.8	17.9	-6.8	41	1.4	5.4	91.8	0	0
Mar-11	14.7	21.4	-14.7	38	3	11.7	113.2	0	0
Apr-11	33.3	76.5	96	134.1	33.3	0	56.6	0	3.8
May-11	60.7	138.8	99.4	200	60.7	0	28.3	33.4	23.7
Jun-11	97.8	51	-35.3	164.7	97.8	0	14.1	0	10.9
Jul-11	134	81.7	-49.4	124	125.3	8.7	7.1	0	8.3
Aug-11	104.4	45.6	-53.9	90.6	83.9	20.5	0	0	4.4
Sep-11	55.9	13.6	-43	71.1	32.4	23.5	0	0	1.7
Oct-11	30.1	10.2	-20.4	63.9	16.9	13.2	0	0	1
Nov-11	12	5.8	-6.5	61.8	7.6	4.5	0	0	0.5
Dec-11	8.1	6.4	-8.1	59.3	2.5	5.6	6.4	0	0.1

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