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High Resolution Climate-Hydrology Scenarios for San Francisco's Bay Area

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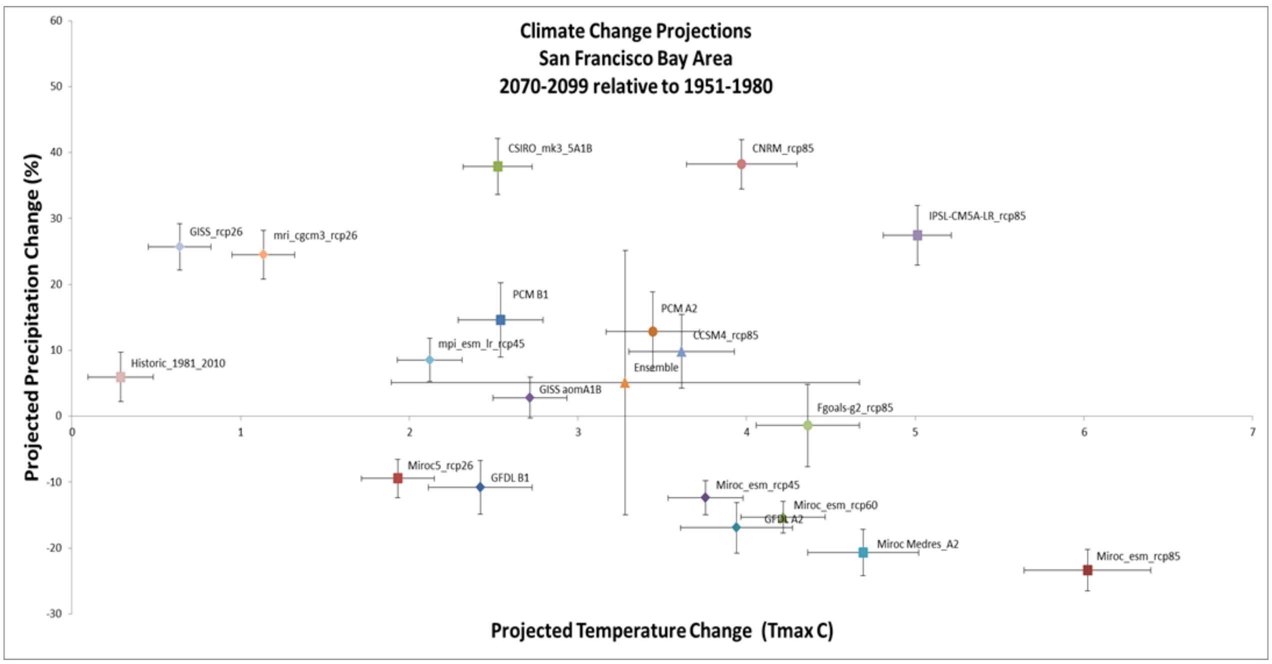

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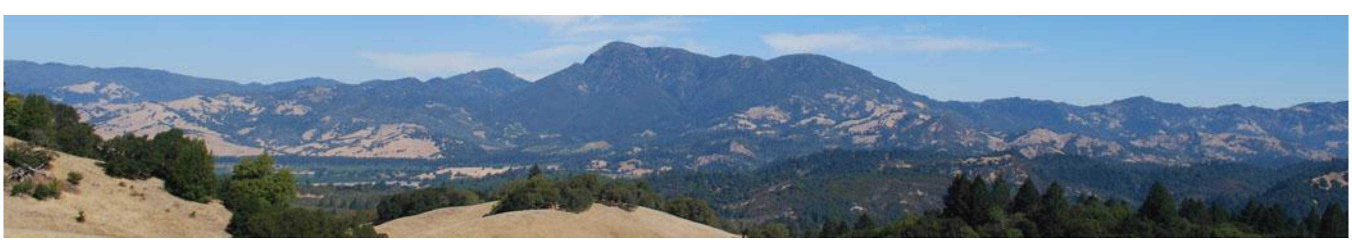

A Dwight Center for Conservation Science **Technical Report**

PROJECT SUMMARY

High Resolution Climate-Hydrology Scenarios for San Francisco's Bay Area

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Project goal: The goal of this study is to deliver climate and hydrology projections for applied use with the geographic extent of the ten Bay Area counties and to provide managers an interpretive analysis of the range of projected changes in the context of historic climate patterns. To fulfill this goal this project generated a fine-scaled set of climate and hydrology projections for the 10 San Francisco Bay Area counties through the next century that are consistent with the International Panel on Climate Change (IPCC) Global Circulation Models (GCMs) and that are firmly grounded in higher resolution historical empirical data capturing the region's weather patterns and watershed dynamics.

Why this is important: To prepare for the inevitable effects of global change, scientists, managers, and conservation practitioners require fine spatial scale projections of future conditions for ecologically relevant climate and hydrologic variables. Given the inherent uncertainty in projecting the future, data are required that reflect the range of plausible scenarios for a given focal area. In the biologically diverse San Francisco Bay Area, many regional weather phenomena are driven by regional climate patterns not yet fully captured by global circulation modeling efforts.

Project overview: We created a series of 18 future climate scenarios for a suite of seasonal and annual climate and hydrology variables, downscaled to 270 meter grid cell resolution covering all 10 Bay Area counties. The 18 futures were chosen by cluster analysis to characterize the range of future conditions represented by 100 global circulation model projections run under alternative future greenhouse gas emissions scenarios for both the 4th and 5th assessment reports of the IPCC. A two-step downscaling process used the 800m PRISM spatial climate dataset (Daly et al. 2002) for baseline observations of temperature and precipitation, and the Basin Characterization Model (Flint and Flint 2012) to produce four seasonal and annual temperature variables and six annual hydrologic variables calculated across water years: annual precipitation, actual and potential evapotranspiration, soil recharge and runoff, and climatic water deficit. Taken together, these data offer multiple future scenarios for ecologically relevant variables at fine spatial scales, providing an invaluable and unprecedented resource for climate change adaptation planning efforts.

Project impact: This project has generated perhaps the highest resolution coupled climate-hydrology data set available worldwide. While our project started with a 10-Bay Area county focus, because of the high applicability of the products to climate adaptation planning needs, this approach has now been extended via partner projects to the full extent of California and its contributing basins, the Great Basin, and Upper and Lower Colorado River Basins, Latin America, and Brazil. For the first time, land and water managers in analyzed regions have access to localized assessments of potential climate change that make the critical link to soil, stream, and aquifer conditions. These data sets have potential applications to a broad range of adaptive management challenges, including managing water supply, flood control, agriculture, endangered species conservation, fire management, extreme events, and urban and rural planning.

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PROJECT TEAM

The Dwight Center for Conservation Science at Pepperwood is an ecology institute dedicated to applying science to the protection of Northern California's wild lands through habitat conservation, leading-edge research, and interdisciplinary educational programs. The mission of Pepperwood is to advance science-based conservation of ecosystems throughout our region and beyond. Dedicated to conservation of the biodiversity represented within our 3,120-acre preserve, Pepperwood provides a unique platform for hosting guest research teams such as the interdisciplinary team who created this groundbreaking set of *High Resolution Climate-Hydrology Scenarios for San Francisco's Bay Area*.

Pepperwood hosts the Terrestrial Biodiversity and Climate Change Collaborative (TBC3), a group of university, NGO and governmental researchers conducting research, monitoring and outreach to enhance the stewardship of the San Francisco Bay Area's Conservation Lands Network in the face of climate change. TBC3 is co-chaired by David Ackerly (UC Berkeley) and Lisa Micheli (Pepperwood) and works in partnership with the Bay Area Open Space Council (BAOSC) and the Bay Area Ecosystems and Climate Change Consortium (BAECCC) to integrate ecosystem services into regional strategies for climate adaptation. A full list of project participants is provided below.

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INTRODUCTION

Projections of future climate scenarios are essential for assessing the potential biological, physical and socioeconomic impacts of a changing climate. Global circulation models are the source of information about future climate on the basis of assumed emissions scenarios, yet in their effort to capture the energy balance of the entire global climate system; their outputs are spatially coarse – on the order of 2.0-2.5 degree grids. In addition, the archived outputs of global climate model simulations available to the consumers of climate model data focus on simplistic variables such as average temperature and precipitation (daily, monthly or annual). These very basic climate variables produced at such coarse spatial resolution do not offer the information required by scientists, natural resource managers, conservation practitioners, and others that are working on climate change impacts assessments and adaptation planning at local to regional scales.

Additional challenges for ecological forecasting occur when ecologically important regional climate patterns are not captured in global model simulations. In the San Francisco Bay Area, regional oceanic upwelling produces a coastal fog pattern that drives steep climatic gradients from the coast to inland regions, creating diverse microclimates that in turn support a rich and highly endemic local flora. Adaptation strategies for conservation of the SF Bay Area's globally recognized biodiversity require projections of future climates for ecologically relevant variables at spatial resolutions that characterize the complex topography and climatic gradients influencing regional biodiversity patterns.

To support the climate change information needs of SF Bay Area conservation and natural resource management communities, we formed an interdisciplinary group of scientists to produce a series of fine spatial scale climate and hydrology variables representing the range of possible future climates based on both 4^{th} and 5^{th} assessment IPCC climate modeling efforts. Using PRISM 800m spatial climate data as a baseline, we downscaled 18 global climate model simulations selected by a statistical cluster analysis to be representative of the full range of future possible climate scenarios based on 100 IPCC model results. We used the 270-m downscaled futures as input into the Basin Characterization Model to generate a suite of hydrologic and climate variables that are known drivers of SF Bay Area vegetation distributions.

SCREENING GCM OUTPUTS FOR USE IN THE BAY AREA

The main purpose of the screening is to reduce the number of "climate futures" that need to be processed through the BCM, while covering the full range of responses. A climate future is defined as a combination of a General Circulation Model (GCM) and an emissions scenario (CMIP3) or representative concentration pathway (RCP; CMIP5), to be referred to collectively in this paper as "scenario". A total of 100 downscaled futures were provided from CMIP3 and CMIP5. Only those CMIP3 futures that included both T_{max} and T_{min} (N= 19) were considered, and all CMIP5 futures (N=81) were included because they reported T_{max} and T_{min}. When multiple runs of a GCM-scenario combination were available, only Run 1 was selected, leaving a total of 92 futures for screening from which 18 future scenarios were selected for further analysis.

Monthly GCM outputs were downscaled to 800 m by Bridget Thrasher using the BCSD method (Thrasher et al. 2013), with PRISM providing the historical climate (1981-2010, called "current") for bias correction. Spatial averages over the 10 Bay Area Counties were extracted for 30-year averages (2010-2039, 2040-2069, and 2070-2099, referred to as *near-century*, *mid-century*, and *end-century*) for the climate factors T_{max}, T_{min}, and PPT (Table 1).

TIME PERIODS

The following discussion highlights issues regarding the 30-year time periods chosen for these analyses. The use of non-overlapping 30-year periods builds on existing statistically robust standard 30-year climatologies. The progression of temperature by 30-year periods is a robust measure of warming rates, and 30 years allow for the characterization of variability and climatic extremes.

Baseline (1951-1980): This historical baseline is recognized as the last 30-year period of relatively stable climate. It includes the most severe historical 2-year drought (1976-1977).

Recent (1981-2010): This 30-year period already has shown some climate changes. Mean annual temperature (averaged across the Bay Area) increased by 0.5°C above the 1951-1980 baseline. Precipitation increased by 4%, and it was a period of high inter-annual variability reflecting several wet El Nino and flood years, a 6-year drought from 1987 to 1992, and a 3-year drought from 2007-2009.

Near Century (2010-2039): The near-term future projections should be used with some caution because the model runs that are generally initiated in about 1950 do not consistently develop the long term climate cycles, such as El Nino-La Nina cycles and the related Pacific Decadal Oscillation (PDO), within the early part of the simulations. For example, in 2010-2012, the Bay Area experienced relatively cool conditions driven by La Nina embedded into a recent flip to the cool PDO, which produced a cool Pacific Ocean along the West Coast, and this cannot be accurately represented by the near-term model simulations. There is relatively little divergence in temperature increases among futures over this short period because emissions scenarios do not diverge until mid-century. Precipitation differences are driven by models, and there is no consensus.

Mid Century (2040-2069): This time period is when substantial warming becomes apparent, and emission scenarios and models begin to more strongly diverge. As a planning horizon, it provides a combination of larger temperature changes with a time scale that allows for some vegetation and hydrologic responses and is within the scope of long-term management planning. Some present infrastructure will require replacement/repair/retrofit during this time period. Precipitation differences again are driven by models, and there is no consensus.

End Century (2070-2099): This time period is when the futures diverge strongly according to model and emissions scenario. While beyond typical planning horizons, this time scale is when substantial vegetation shifts are possible and substantial replacement/repair/retrofit of current infrastructure will be necessary. Precipitation differences again are driven by models, and there is no consensus.

The results of these spatial extractions for all 92 futures and time periods are in Appendix 1.

Descriptive Statistics

The progression of all 92 futures by 30-year period is relatively smooth for annual T_{max}. All futures diverge smoothly from the 1981-2010 average from PRISM (22.1°C) to a spread from 22.5°C to 28°C at end-century (Figure 1a). A number of futures show a leveling of temperature from mid- to end-century – these are futures with emissions scenarios that have substantial mitigation by mid-century. Precipitation (PPT) is more variable among the futures (Figure 1b), ranging from 1.3 to 2.4 mm/day, compared with 1.8 mm/day in the current period (76% and 137% of current); there is no consensus among the futures on precipitation. The relatively large leaps in PPT from current to near-century are mostly within the range of historical variability – the largest successive change in PPT from one 30-year period to another was around 10%, and the largest difference among the 30-year periods in the last century was 17%. Therefore, large changes in PPT cannot be ruled out, especially since the climate has become destabilized over the last 30 years due to anthropomorphic climate change beginning in approximately 1980.

In an effort to better understand the roles of GCM versus emissions scenario, a two-way ANOVA was done on 2070-2099 annual T_{max} (Table 2) for CMIP5, chosen so as not to duplicate models used in both CMIP3 and 5. The difference between the Least Square Mean and the Mean in some models reflects some missing scenarios for those models in the CMIP5 data set.

Model sensitivity to greenhouse forcings ranged over 2.8°C (from 23.5°C for GISS-e2-r to 26.3°C for Miroc-esm-chem). Mean scenario forcings varied over 2.7°C (from 23.6°C for RCP26 to 26.3°C for RCP85). Temperature forcings are an additive function of model and scenario, and the end-century T_{max} increases range from 1.2°C in GISS-e2-r RCP26 to 6.0°C in Miroc-esm RCP85.

Precipitation variability is completely a function of model, with no consistent emissions scenario effects (Table 3). The range of end-century precipitation is 1.4 mm/day (-24%, Miroc-esm and Miroc-esm-chem) to 2.3 mm/day (+37%, Cnrm-cm5).

Effects of Scenario through Time

The “spaghetti diagram” of temperature trajectories in Figure 1 can be further decomposed into the time-varying effects of scenarios, highlighting the divergence among models and time periods according to assumptions regarding emissions (Figure 2). The scenarios from AR4 and AR5 are summarized as CO_2 concentration at the end of each 30-year period, and the response variable is JJA (summer) maximum temperature (JJA T_{max}). In the near-century (2010-2039) there is little divergence among the scenarios in CO_2 concentrations (450-500 ppm), and the differing JJA T_{max} responses (range 30.1 to 32.3°C) are a result of differing model sensitivities to greenhouse gas forcings. By mid-century (2040-2069), CO_2 concentrations diverge among scenarios (range 450 to 675 ppm) with a clear trend of higher temperature with higher emissions (~1°C between the lowest and highest average response). By end-century (2070-2099) there is strong divergence of CO_2 concentrations (425 to 975 ppm) and temperatures (32 to 34.5°C). Model effects remain strong in all time periods, with greater divergence through time (2°C spread in near-century, 3.5-4°C at end-century).

By framing the temperature response in this manner, choosing a specific future for analysis becomes less important than realizing that reaching certain temperature thresholds (and concomitant hydrological and ecological responses) is more a matter of “when” rather “if,” and “how high” with the exception of the lowest emission scenario (RCP26) where CO_2 concentrations stabilize at 425 ppm. It also highlights (along with Table 2) that emission mitigation has a key role to play in ameliorating the largest potential warming. Note that all temperature factors (annual and seasonal T_{min} and T_{max}) are highly inter-correlated and follow this general pattern.

Multivariate Cluster Analysis

The purpose of the cluster analysis was to group similar futures so that a subset could be chosen that represents a full range of responses. After consideration of the Bay Area Mediterranean climate and some exploratory data analysis, four factors were chosen for the cluster analysis. Annual T_{max} was chosen as the temperature variable for simplicity, since all temperature variables were highly inter-correlated ($r>0.9$) and therefore the use of two or more temperature factors was redundant. Precipitation was broken down by season - SON (fall), DJF (winter), MAM (spring) – because changes in seasonality can have profound effects on water balance. For example, the intensity of the dry season is greatly affected by spring rainfall. All futures maintain a precipitation peak in winter, but vary more widely in fall and spring. JJA (summer) precipitation was low among all futures, suggesting that the summer monsoon will not extend north to the Bay Area; summer precipitation was not included in the cluster analysis. Keeping the number of factors to a minimum allows for easier interpretation of the futures.

The hierarchical clustering was implemented in JMP 10.0 (SAS Institute 2010) using Ward's minimum variance agglomerative method. Each cluster is color-coded in the dendrogram (Figure 3). The graphic also includes a color-coded legend that shows the relative values of each input variable ordered from left to right (SON PPT, DJF PPT, MAM PPT, and Ann T_{max}). Note general similarities within each cluster, but detailed examination of the factors is beyond the scope of this discussion.

One future from each cluster was randomly chosen to represent that cluster. Those futures are highlighted in the left hand column. The ID of each future, the cluster ID number, the number of futures in the cluster, and seasonal rainfall/annual T_{max} are included in Table 4, along with the current 1980-2009 baseline.

In addition, the four futures previously chosen from CMIP3 for California climate change assessments are included in the ensemble, because they represent a combination of warmer-drier and warmer-wetter that were selected for assessing climate impacts, and according to expert judgment captured key aspects of the historical California climate (Cayan et al. 2006). Furthermore, they were downscaled using a constructed analogs (CA) technique (Hidalgo et al. 2008) that creates a richer spatial pattern than the Bias-Corrected Statistical Downscaling (BCSD) method, because CA uses historical weather patterns to match broad scale GCM outputs rather than imposing a historical spatial pattern via PRISM.

The overall ensemble results are presented as a scatterplot of absolute annual T_{min} change versus % precipitation change (Figure 4) for end-century, averaged over the 10 Bay Area counties. The broad scatter of the results (from <1°C to 6°C, and from -24% to +37% PPT) indicates that the cluster technique worked well in capturing the full range of climate responses. While the ensemble mean is presented, note that it is not a true central tendency for climate response as if each output were an independent, equally likely realization – the likelihood of different emissions scenarios for example, is unknown, and precipitation differences are largely a function of the GCM.

The more detailed seasonal changes in PPT can be examined in Table 4 by season. SON PPT ranges from 0.67 – 1.76 mm/day; DJF PPT ranges from 2.73 - 6.36 mm/day, and MAM from 1.20 – 2.27 mm/day. The mean PPT date (a weighted average of fall, winter, and spring) ranged from Jan 1 to Jan 27. Most futures cluster close to the 1980-2009 average (Jan 19).

HYDROLOGIC RESPONSE: BASIN CHARACTERIZATION MODEL

Temperature and precipitation need to be converted into hydrologically and ecologically relevant variables for impact assessment. The Basin Characterization Model (BCM, Flint and Flint 2012b; Flint et al. 2013) is used to calculate hydrologic balance at fine spatial scales (270 m). Brief descriptions of the BCM are provided, but for details consult the abovementioned references.

The 800-m monthly temperature and precipitation grids for the 18 futures were downscaled further to 270 m for use as inputs to the BCM. Five climate factors are calculated directly from these downscaled grids: 1) DJF (winter) T_{min}; 2) JJA (summer) T_{max}; 3) annual total PPT; 4) mean T_{max}; and 5) mean T_{min}.

The flow chart of the BCM (Figure 5) shows how monthly inputs of precipitation, temperature, and solar radiation are processed to produce hydrologic outputs. Soils and underlying geology are mapped on the same 270-m scale. Solar radiation is calculated as a function of topographic shading and diurnal temperature range and cloudiness, and combined with air temperature to calculate *Potential Evapotranspiration* (PET) according to the Priestly-Taylor PET formulation. Watershed available water enters the soil profile; soils are characterized by water holding capacity, a function of porosity and depth (from SSURGO), and plant-available water is defined by the difference between water contents at field capacity and wilting point. Some water returns to the atmosphere as *Actual Evapotranspiration* (AET), at a rate determined by PET if soil moisture is available. If soil moisture is not sufficient to meet PET demand, *Climatic Water Deficit* (CWD) starts to accumulate – CWD is calculated as PET minus AET.

Once the soil profile is filled and AET satisfied, water infiltrates below the rooting zone as *recharge* to groundwater as a function of bedrock permeability. Recharge goes into shallow and deep groundwater and provides recession flow after storm events and baseflow for streams during the dry season. Excess water beyond recharge rates becomes *runoff* (surface water). Some recharge into shallow groundwater becomes surface flow later in the season – total stream discharge is therefore a combination of runoff and a portion of recharge.

Recharge and runoff are keys to water supply. Recharge, in particular, is a precious resource in a Mediterranean climate.

Both AET and CWD are important ecological variables for vegetation, because they are integrated measures over the water year from the beginning of the rainy season (October) to the end of the dry season (September). AET correlates strongly with vegetation productivity, and CWD is seasonal water stress accumulated over the dry season. The combination of AET and CWD is a primary determinant of vegetation physiognomy (biomass and structure).

A summary of BCM outputs is provided in Table 5 and Appendix 2, 3 and 4. Table 5 includes descriptions of their significance.

The hydrologic response for the 18 futures (Figure 6) shows an end-century spread of -68 mm to +41 mm in AET, and a spread of +10 mm to +235 mm. AET and CWD are functions of temperature increases and changes in PPT. Wetter futures fall out in the lower right of the plot, while drier futures are in the upper left.

Snapshots of maps of key outputs are presented in Figure 7. Full sized maps are available at http://www.bayarealands.org/gis/maps.php. The strong coastal-inland gradients and orographic effects are apparent in the raw climatic variables. The hydrologic variables (AET, CWD, Recharge, and Runoff) show integrated effects of soils and bedrock geology, embedded within the climatic gradients. Full discussions of the detailed spatial patterns are beyond the scope of this report.

Water Balance in the Bay Area Mediterranean Climate

The Bay Area has a Mediterranean climate with a cool rainy season from October through April, and a warm dry season from May-September. Pine Gulch Creek is a planning watershed (PWS) on the Marin Coast, and will be used as a primary example but all watersheds in the region follow the general pattern with varying magnitudes of different components. Monthly 30-year climatology for 1980-2009 is shown in Figure 1.1.8. Precipitation starts in October (44 mm), and increases to ~170 mm in December, January, and February, decreases to 125 mm in March, and virtually stops by May (25 mm) for a total of 888 mm, with almost no precipitation June through September. Mild temperatures (6° C Dec-Jan T_{min}, 22° C Jul-Aug T_{max}, and diurnal ranges of 8-10°C) are typical of the immediate Pacific Coast.

This meteorological pattern produces a hydrologic response illustrated in the water balance diagram (Figure 1.1.9) showing a 30-year hydroclimatology (1980-2009) of Pine Gulch Creek (top panel). 888 mm/year of PPT are partitioned into 494 mm/year of AET, 220 mm/year of runoff, and 174 mm/year of recharge (inset table on diagram). With the exception of precipitation, these numbers correspond to the integrated area of each distinct color in the graph. The annual climatic water deficit (CWD) is 656 mm, and is the amount of water that could have been evaporated if it had been available. It is calculated as CWD = PET - AET, so the total PET is 1150 mm.

The monthly dynamics over the water year (October 1 through September 30) illustrate the seasonality of the Mediterranean climate (Figure 9). The first PPT (40 mm in October) all becomes AET, with a slight CWD of 44 mm. PPT increases to 114 mm in November, and soil storage increases, with minimal runoff and recharge. From December through February, PPT (170-175 mm/month) fills soil storage (125-160 mm), and generates recharge peaks (40-50 mm/month) and runoff peaks (50-70 mm/month). AET is 30-40 mm/month. PPT drops in March (120 mm), runoff and recharge both decrease (25-30 mm/month), and AET increases to 75 mm/month as temperatures rise and drive increased PET. In April and May, recharge and runoff cease, AET peaks at 90-110 mm/month, drawing on spring PPT (80 mm total in April and May) and soil storage. Available soil moisture is depleted by June. CWD starts to accumulate in May (51 mm/month), peaks in July (166 mm/month), and decreases in September (110 mm/month). The cumulative water year CWD is 656 mm/year.

The absolute and relative magnitude of each water balance component in a place is dependent on spatial inputs of soil depth, bedrock permeability, PPT, and temperature. Therefore, adjacent watersheds with different underlying geology and soils may have different hydrologic responses (Figure 9). The BCM is specifically designed to account for these varied spatial inputs. Fern Creek (bottom graph, a coastal planning watershed to the south of Pine Gulch Creek) receives higher rainfall

(1072 mm versus 888 mm). The most striking difference between Fern Creek and Pine Gulch Creek is 8-fold lower recharge in Fern Creek (22 mm versus 174 mm) and concomitant increase in runoff (577 versus 220 mm), caused by impermeable bedrock in Fern Creek. Maximum soil storage in Fern Creek is lower than in Pine Gulch Creek (120 versus 160 mm), caused by thinner soils. CWD is higher in Fern Creek (716 versus 656 mm) despite higher precipitation, because of lower soil water storage capacity.

The smoothness of the curves is a statistical artifact of averaging over 30 years. Any given year will deviate substantially from the 30-year average. A set of varied years for Fern Creek is provided below (Figure 10), including the driest years in the past century (1976 and 1977), a recognized drought year (1987), and two wet years (1995 and 1998). Note that there was virtually no runoff in 1976 and 1977 (the most severe 2-year drought in the weather record), and that the soil water was never completely filled in 1976 even in the wet coastal watershed – drier inland watersheds had even less available water. While 1987 was a drought year, from January through March the soils were fully charged with water, and a runoff peak occurred in February. The extreme monthly runoff peaks in 1995 and 1998 were floods in many Bay Area streams. But note the extreme month to month variation possible in our climate – a rainless February in 1995 was sandwiched between two flood peaks in January and March.

Limitations on BCM Output

There are several limitations on BCM output that must be considered. The model is one-dimensional for each grid cell, and hydrologic routing is only done by accumulating at the catchment scale (i.e. a Planning Watershed). The water balance for vegetation in upland, non-riparian areas is the most reliable component because horizontal transfer of water subsurface is minimal during the dry season when soils are below field capacity. Recharge, runoff, and total stream discharge are for unmodified catchments, and the effects of water infrastructure on downstream hydrology are not included. Hydrologic modifications in valley bottoms (drain tiles, flood basins, canals, etc.) are not considered as well, but those areas are so heavily converted to urban and cultivated agriculture that conservation actions are quite different than in the foothills and mountains.

The spatial scale (270 m, 18 acres/grid cell) does not capture narrow riparian zones. Riparian zones can be represented by the stream network as linear features that intersect BCM cells.

Fine-scale topography at 30 m or less is the scale at which topoclimatic differences are most accurately mapped. Nesting a fine-scale solar radiation model within the BCM grid can capture this sub-grid diversity. Similarly, nesting topographic position and slope (which determine cold air pooling) can capture sub-grid diversity in minimum temperatures. Several other topographic factors such as topographic index (a measure of convergent and divergent flow across hillslopes) can also be nested. Diversity statistics at the 270 scale can then be incorporated into measures of climate space. This is an area of ongoing research (Ackerly et al. 2010).

APPLICATIONS TO MANAGEMENT

How does one apply these data sets to management? All the futures are "wrong" in some sense; projecting annual weather in detail is impossible, but trends averaged over 30-years and associated variability statistics are internally consistent. Picking the "most likely" future is a futile exercise; precipitation in particular is highly variable among models. But the following trends are robust:

1) Temperatures will warm and the question is how fast and how much (see Figures 2 and 4).
2) CWD increases across all futures, because increased PET in the dry season is acting on limited soil moisture storage, and any excesses in PPT will result in recharge or runoff in the wet season. Therefore, from the viewpoint of vegetation the landscape will become more effectively arid in all futures (see Figure 6).
3) Recharge and runoff are direct functions of PPT – high monthly PPT, especially in mid-winter, goes directly to runoff once maximal recharge rates are satisfied.
4) Interannual variability and stressful multi-year events (i.e. droughts) will still pose the fundamental challenge to managers, and are an intrinsic feature of climate futures. Extreme events are what drive ecosystem changes and stress infrastructure.

In the absence of a most likely future, the suggested approach given uncertainties is to be "scenario-neutral" (Brown and Wilby 2013, Prudhomme et al. 2010). This approach uses different climate futures to examine the limits of acceptable system performance, e.g. the ability of a water supply system to meet demand, or the ability of a conservation network to support some minimum amount of a key vegetation type or species. In this approach, the first step is to define a threshold of failure in system performance. In short, ask the question "What does it take to break the system?" Then multiple futures and time periods are applied to the system, and the thresholds of failure over various time periods are determined probabilistically. In this ensemble, 54 options exist (18 futures x 3 time periods). Then, management options can be examined to see if the threat of system failure can be ameliorated or tolerated.

This approach puts the onus on managers to define the particulars of their systems of interest. Because each watershed/preserve/landscape or area of interest is unique, there is really no set answer *a priori*. Probabilities of vegetation transition are particularly relevant for land managers, but short of that, changes in productivity (AET) or increased drought stress (CWD), provide some metrics of landscape stress. Changes in recharge and runoff, of course, are directly relevant to water supply and aquatic ecosystems.

Choice of Futures

Any combination of future and time period can be used for assessing the likelihood of exceeding key thresholds; think of the 18 futures and 3 time periods as a menu for exploration of system resiliency in the face of varying degrees of climate change. Given the wide variety of futures to choose from, where should an assessment start? Several recommendations have come out of investigations.

1) There is no evidence to date that the highest emissions scenarios (RCP85 and SRES-A2) will be avoided, so consideration of these extreme scenarios is necessary.
2) An easily understandable climate future is one where the Pacific storm track moves northward, leading to drier conditions overall with a compression of the rainy season. Such a future provides spatial analogs from more southern regions in California; i.e. the Central Coast and Southern California.
3) Examining a worse-case future provides a benchmark for system performance.
4) There is much experience in California with the GFDL/PCM A2/B1 futures which span a range of Warmer-Hotter and Drier-Wetter. These futures are in the Explorer (Task 4.3).
5) Of those 4 futures, it is recommended that the GFDL-A2 be the starting point for assessment.
6) Once GFDL-A2 is assessed, then the other three futures should be considered.
7) A mid-century time period (see below) provides enough time for substantial climate change, but is still within a reasonable planning horizon.

Uses of BCM Output for Conservation Planning

The advantage of using BCM output over raw climate inputs is that the resultant outputs are integrated water balance variables that are more directly relevant to ecosystems and water supply.

Several approaches for using BCM output for climate change assessment for conservation are discussed below. They generally fall into three categories; direct targeting of important hydrologic and climatic areas; *post hoc* evaluation of climatic resilience of areas chosen for current conservation values; and management considerations.

Direct Targeting Opportunities

1) *Direct targeting of key hydrologic resources*: Areas of high recharge that are the result of high precipitation, shallow soils, and high bedrock permeability are a good example. These locations are stable on the landscape under climate change, even if the absolute magnitude of recharge changes. Recharge is precious in our Mediterranean climate because it provides baseflow for streams during the dry season, and many rural communities depend on local groundwater. Key recharge areas can be prioritized by Planning Watersheds with high value aquatic resources (i.e. foothill yellow-legged frog, steelhead, and native fishes). Protecting locally high recharge areas from development, even low density rural development, prevents or reduces recharge from occurring due to disruptions in surface hydrology by roads, houses, and other infrastructure.

Similar reasoning applies to high runoff areas above water supply reservoirs, with the emphasis on maintaining water quality (primarily sediment in upper watersheds). The current period (1981-2010) recharge and runoff maps are good first order spatial representations of these important resources.

2) *Direct targeting of local climatic refugia:* The coolest, moistest locations within a given area provide potential local refugia for species. Intact alluvial flats with deep soils, riparian corridors, and north-facing slopes are particularly important. Narrow riparian areas and many north-facing slopes are below the 270-m scale of the BCM outputs. Riparian areas are by themselves critical conservation targets under numerous criteria. For climate change resiliency, riparian zones can be considered as linear features that intersect BCM grid cells, and a distance to riparian function can be generated. Sub-grid solar radiation (at 30 m) can be nested within the BCM grid, and diversity measures (range and minimum solar radiation calculated for each 270-m cell (or any arbitrary area). This further downscaling is an area of active research.
3) *Direct targeting of high diversity areas:* Local climatic diversity at scales from ~500 meters to several kilometers allows species to redistribute on local scales well-within the dispersal range of many species. Neighborhood range of BCM output at varying scales, or within defined areas (i.e. contiguous protected lands), is a powerful measure of local resilience. Comparisons between the magnitude of spatial variability and projected changes in climate are the crux of a risk analysis at a landscape scale, and some examples are presented below.
4) *Direct targeting of resistant areas where climate changes less*: Climate change is not necessarily uniform across the landscape. There is spatial variability in historic climate changes; mountains have behaved differently than valley bottoms and lower foothills across much of the Bay Area. Deeper soils behave very differently than do shallow soils in response to reductions in precipitation, and somewhat paradoxically show larger absolute increases in CWD and reductions in AET with lower precipitation. The Standardized Euclidean distance between historic and projected climates integrates multiple factors into the magnitude of climate change in each BCM cell, and is presented below. Some caution is recommended here, because downscaling methods may create spatial artifacts, or greatly mute spatial variability in rates of change.

Post Hoc Evaluation of Climatic Resilience

Rather than use the BCM outputs as direct targets, a second approach is to evaluate existing conservation lands, conservation priorities identified by other criteria, and conservation opportunities in terms of contributions to climate change resiliency. The key concept here is that an expansion of spatially contiguous climate space increases resilience. The basic procedure is:

1) *Define the area of interest:* The best example is contiguous existing conservation lands and any potential additions.

2) *Evaluate resiliency metrics within the existing lands:* Many of the analyses described above can be incorporated; perhaps the simplest is the range and proportional distribution of key factors (i.e. CWD) within the area.
3) *Add in proposed new lands and re-evaluate resiliency metrics:* Recalculate the range and proportional distribution of key factors with the additional lands and evaluate expansion of climate space within the contiguous area.
4) *Connectivity effects:* If the new lands make a connection between existing complexes of conservation lands, then evaluate the entire newly contiguous area.

A potential initial application of this procedure is to identify the highest conservation priorities based on the numerous other criteria (i.e. multiple benefit areas) and add them to the existing network, then evaluates the climatic range within the new conservation network pieces.

This analysis is also applicable to water resources. Additions to protected recharge areas within Planning Watersheds can be quantified by calculating the volume of recharge provided by those lands; similarly runoff into reservoir catchments can also be assessed.

Implications for Land Management

Changing hydrologic balance will manifest itself in the following ways that will pose management challenges.

1) Higher CWD can lead to direct mortality of existing vegetation through drought stress. Vegetation composition and structure will change – woodlands will thin, even to the point of loss of trees in open oak savannas that lead to conversion to grasslands. Drought stressed vegetation is also more susceptible to insect outbreaks and pathogens. Dead standing trees pose safety hazards especially in heavily used recreational areas.
2) Higher CWD increases fire risk and intensity. Fire seasons will lengthen, and drier vegetation is more flammable. Fire protection and management become ever more important. Post-fire weed management is critical if native vegetation is to occupy burnt areas. Post-fire erosion control is also critical for protection of water quality.
3) Decreased AET leads to reduced net primary productivity, with cascading effects up the food chain. Wildlife may suffer food shortages if key plant resources are less productive, and rangeland productivity greatly affects grazing management.
4) Increased AET leads to increased net primary productivity which may appear to be a good thing. However, combined with increased CWD increased productivity can lead to increased fuel loads and higher fire intensities. Fuels management, especially at the urban-wildland interface may become a higher priority where AET increases locally.
5) Decreased runoff will lead to lower chances of filling ponds, reservoirs, and intermittent streams during drier than average periods. Water for wildlife, both aquatic and terrestrial, may

become highly restricted in low runoff areas. Lack of sufficient runoff pulses can hinder the movement of anadramous fish upstream, especially if streams have partial fish barriers.

6) Increased runoff from extreme storms poses flood risks and can increase erosion and landslides. Even under drier climate futures, extreme rainfall events will occur and may even be more intense than historical events. Flooding is a natural part of fluvial systems, but poses risks to human infrastructure in floodplains. Flood control projects, especially hard infrastructure like levees, channelization, and bank protection structures can have negative effects on habitat. More natural methods of flood management may provide opportunities for maintenance and enhancement of habitat. Over time, stream geomorphology will readjust to changing flow frequencies and intensities but the readjustments can be shocking to the systems (large sediment pulses and redistribution in particular). Where flood protection is important, conservation lands can play an important role in flood attenuation in concert with conservation goals.
7) Decreased recharge will lead to lower base-flow in streams during the dry season, and may turn permanent streams intermittent over much of their length. Protection and management of permanent reaches of streams, such as deep pools, becomes more important.
8) Inter-annual variability in all these factors will remain high or even increase with climate change. Many strategies and tactics to deal with inter-annual (and intra-annual) variability will take on more importance in a “flashier” climate.

All of these changes amplify current management challenges. The triggers for changes have been and will be multi-year droughts or extreme flood events, and fires (the vast majority of ignitions are human caused, but occasional dry lightning storms can cause multiple ignitions in a short period). Identifying landscape-level changes that are a direct result of climate change is a challenge, given the number of natural processes (i.e. succession) and human perturbations (i.e. nitrogen deposition, fire suppression, and invasive weeds) that affect ecosystems. Systematic monitoring of vegetation and aquatic conditions is essential to tease out the contributions and interactions among these drivers of ecosystem change.

All of the principles of effective land, watershed, and riparian management are still applicable, and increase in importance under a changing climate. For watershed management issues and key stewardship and management issues, see Chapters 5 and 9 of the Conservation Lands Network Report (Bay Area Open Space Council 2011).

NEXT STEPS: TIME SERIES ANALYSIS: RUNNING AVERAGES AND EXCEEDENCE PROBABILITIES

Climate change analysis is necessarily probabilistic – no climate model can project exact yearly events, but after a long enough period (30-years) probability distributions of annual weather and runs of extremes (i.e. droughts) can be assessed. These distributions are characterized by "exceedance probabilities," which can be stated as "What is the level of a factor (say runoff) that is exceeded 10%, 50%, or 90% over the 30-years? A 10% exceedance probability means that runoff exceeded that value 27/30 years (or conversely, was less than that value 3/30 years). 10% and 90% levels are very likely to be encountered in a 30-year period and are a useful benchmark. For runoff, recharge, and AET, low values are stressful so the 10% value is a good benchmark, for CWD high values are stressful and the 90% level is a good benchmark.

Climatic extremes are what stress systems and drive system change. Single years can be extreme, but multi-year droughts are the key extreme events. Historically, 1976-77, 1987-92, and 2007-09 are the benchmark multi-year droughts. But an analysis of temporal autocorrelation in PPT shows that there basically is no autocorrelation and years are independent: a dry year is as likely to be followed by another dry year as by an average or wet year.

In order to capture the frequency and intensity of multi-year events, 2- and 3-year running averages of all outputs were calculated for each cell over the entire study area. Then, the exceedance probabilities (min, 10%, 50%, 90%, and max) of 2- and 3-year events were calculated.

Small changes in the mean value have disproportionate effects on the tails of distributions, because of the non-linear behavior of probability distributions. What was once a 1 in 100 year event (probability in any given year of 1%) can become a 1 in 20 year event (5% in any given year). Given the use of historical exceedance probabilities in infrastructure planning (i.e. water supply, flood control, culverts, drainage basins, etc.) these changes have broad implications.

2- and 3-year running averages of runoff and recharge are of great interest for water managers. For example, reservoirs can be classified by the number of years storage they provide so a large 3-year reservoir (such as Lake Sonoma) will have some resiliency in the face of 2-year drought. But even large reservoirs will be drained by extended periods of low runoff.

2- and 3-year running averages of CWD for vegetation are of great interest for vegetation managers. Multi-run years of high CWD greatly stress vegetation, and are associated with mortality events in some California forests (cites). Fire danger increases cumulatively with extended high CWD. Low AET is correlated with high CWD (remember that CWD + AET = PET, and vegetation productivity decreases. It may take several normal to wet years for vegetation water balance to recover from multi-year droughts.

These analyses have been archived, but have not yet been explicitly incorporated into analyses. They are most useful at the scale of planning watersheds and reservoir catchments, and will be a key component of TBC3's proposed Watershed Managers Toolbox.

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TABLES

Table 1: Screening Criteria for Developing Subset of Climate Projections for Future Analysis

Spatial averages over the 10 Bay Area Counties for three time series: near-century (2010-2039), mid-century (2040-2069), and end-century (2070-2099). SON = September, October, November; DJF = December, January, February; MAM = March, April, May; JJA = June, July, August.

	Annual	**SON (Fall)**	**DJF (Winter)**	**MAM (Spring)**	**JJA (Summer)**
Mean	Tmax	Tmax	Tmax	Tmax	Tmax
Mean	Tmin	Tmin	Tmin	Tmin	Tmin
Mean	PPT	PPT	PPT	PPT	PPT
SD	Tmax	Tmax	Tmax	Tmax	Tmax
SD	Tmin	Tmin	Tmin	Tmin	Tmin
SD	PPT	PPT	PPT	PPT	PPT

Table 2: Tmax ANOVA Analysis

Tmax ANOVA analysis of CMIP5 projections for 2070-2099 for effects of models and effects of scenarios

Model Effects Ann_Tmax 2070-2099

Level	Least Sq Mean	Std Error	Mean
giss-e2-r	23.5	0.1	23.5
mri-cgcm3	23.8	0.1	23.8
inmcm4	23.4	0.2	24.0
ccsm4	24.2	0.1	24.2
gfdl-esm2m	24.3	0.1	24.3
mpi-esm-lr	24.4	0.1	24.4
noresm1-m	24.5	0.1	24.5
gfdl-esm2g	24.6	0.1	24.7
fgoals-g2	24.7	0.1	24.7
miroc5	24.7	0.1	24.7
ipsl-cm5a-mr	24.7	0.1	24.8
bcc-csm1-1	24.8	0.1	24.8
hadgem2-cc	25.2	0.3	24.9
csiro-mk3-6-0	25.1	0.1	25.1
cnrm-cm5	24.5	0.2	25.1
canesm2	25.4	0.1	25.4
hadgem2-es	25.5	0.1	25.5
gfdl-cm3	25.5	0.1	25.5
access1-0	25.0	0.2	25.6
ipsl-cm5a-lr	25.2	0.1	25.6
miroc-esm-chem	25.9	0.1	25.9
miroc-esm	26.3	0.1	26.3

Scenario Effects Ann_Tmax 2070-2099

Level	Least Sq Mean	Std Error	Mean
rcp26	23.6	0.1	23.6
rcp45	24.5	0.1	24.5
rcp60	24.8	0.1	24.9
rcp85	26.3	0.1	26.2

Table 3: PPT ANOVA Analysis

PPT ANOVA analysis of CMIP5 projections for 2070-2099 for effects of models and effects of scenarios.

Model Effects Annual PPT (mm/day) 2070-2099

Level	Least Sq Mean	Std Error	Mean
miroc-esm	1.4	0.1	1.4
miroc-esm-chem	1.4	0.1	1.4
miroc5	1.6	0.1	1.6
gfdl-esm2m	1.7	0.1	1.7
bcc-csm1-1	1.7	0.1	1.7
access1-0	1.7	0.1	1.7
fgoals-g2	1.7	0.1	1.7
gfdl-cm3	1.7	0.1	1.7
mpi-esm-lr	1.8	0.1	1.8
noresm1-m	1.8	0.1	1.8
hadgem2-cc	1.8	0.1	1.8
gfdl-esm2g	1.8	0.1	1.8
csiro-mk3-6-0	1.8	0.1	1.8
hadgem2-es	1.9	0.1	1.9
ccsm4	1.9	0.1	1.9
ipsl-cm5a-mr	1.9	0.1	1.9
giss-e2-r	1.9	0.1	1.9
ipsl-cm5a-lr	2.0	0.1	2.0
inmcm4	2.0	0.1	2.0
mri-cgcm3	2.0	0.1	2.0
canesm2	2.1	0.1	2.1
cnrm-cm5	2.3	0.1	2.3

Scenario Effects Annual PPT (mm/day) 2070-2099

Level	Least Sq Mean	Std Error	Mean
rcp26	1.8	0.03	1.8
rcp45	1.8	0.03	1.8
rcp60	1.8	0.04	1.8
rcp85	1.8	0.03	1.8

Table 4: Descriptive Statistics of the Final Chosen Futures

Each future has model, scenario, cluster ID number (an identifier from JMP), number of futures in the cluster, fall, winter and spring PPT (mm/day), the weighted average date of PPT, and annual Tmax.

Source	Model	Emission Scenario	Cluster ID Number	Number of Futures	SON PPT	DJF PPT	MAM PPT	Mean PPT Day	Ann T_{max}
Historical	PRISM	--	--	1	1.27	3.82	1.72	Jan 19	22.06
CMIP3	csiro_mk3_5	A1B	4	11	1.13	6.03	2.09	Jan 23	24.34
CMIP3	giss_aom	A1B	1	10	1.26	4.15	1.50	Jan 15	24.62
CMIP3	miroc3_2_mr	A2	5	4	1.76	2.34	1.20	Jan 1	26.73
CMIP5	ccsm4	rcp85	3	11	1.11	4.58	1.63	Jan 19	25.51
CMIP5	cnrm-cm5	rcp85	8	2	1.59	6.35	1.43	Jan 11	25.86
CMIP5	fgoals-g2	rcp85	6	5	0.67	4.58	1.33	Jan 23	26.27
CMIP5	giss-e2-r	rcp26	13	5	1.57	4.62	2.27	Jan 20	22.38
CMIP5	ipsl-cm5a-lr	rcp85	12	2	1.00	5.88	1.85	Jan 22	26.86
CMIP5	miroc-esm	rcp45	9	5	0.89	3.16	1.79	Jan 27	25.68
CMIP5	miroc-esm	rcp60	11	4	1.30	3.01	1.36	Jan 13	26.21
CMIP5	miroc-esm	rcp85	10	2	1.03	2.73	1.34	Jan 17	28.08
CMIP5	miroc5	rcp26	14	9	1.14	3.51	1.58	Jan 19	23.74
CMIP5	mpi-esm-lr	rcp45	7	11	1.23	4.03	1.92	Jan 21	23.94
CMIP5	mri-cgcm3	rcp26	2	11	1.54	4.95	1.88	Jan 16	22.94
CMIP3	gfdl	A2	---	---	1.38	3.90	1.36	Jan 12	24.93
CMIP3	gfdl	B1	---	---	1.55	3.98	1.55	Jan 12	23.42
CMIP3	pcm	A2	---	---	1.37	5.36	2.07	Jan 20	24.40
CMIP3	pcm	B1	---	---	1.60	5.20	2.21	Jan 18	23.49

Table 5: Descriptions of Key BCM Climatic and Hydrologic Outputs

DJF T_{min}: Average Winter (December through February) daily minimum temperature °C
The average minimum temperature over the coldest months (December-February) is a prime determinant of frost and freeze frequency, and chilling hours for winter dormant plants. DJF T_{min} is critical for frost and freeze probabilities. The main gradient of DJF T_{min} is from the coast (warmer) to inland (colder), but it strongly affected by local topography. Cold air pools at lower elevations, so valley bottoms are colder than surrounding slopes and ridges where cold air drains away. Local gradients of DJF T_{min} can exceed 3° C or more. DJF T_{min} exceeds 10° in much of the Bay Area under a 3°C rise in temperature, producing novel climates with no local analogs.
JJA T_{max} : Average Summer (June-August) daily maximum temperature °C
The average summer maximum temperature in the three warmest months (June-August) is a prime determinant of heat wave extremes, and is an important contributor to PET. JJA T_{max} is critical for growing degree days, heat stress, and aridity. The main gradient of JJA T_{max} is from the coast (16°C at Pt. Reyes) to inland (34°C at the fringes of the Central Valley) and is shaped by the marine layer and fog penetrating gaps in the mountains. JJA T_{max} also decreases at higher elevations (i.e. Mt. Hamilton and North Bay mountains).
Precipitation (mm H_2O per month or per year)
PPT varies widely across the Bay Area, from >2000 mm in the Sonoma Coast Range to <300 mm in the rain shadow of the Inner Coast Ranges. PPT is highly variable from year to year, and the region regularly experiences extremes of droughts and deluge. As the prime determinant of water availability, the amount and seasonal timing of PPT controls all hydrologic variables (Runoff, Recharge, AET and CWD). PPT projections are the most uncertain outputs of climate models.
PET: Potential Evapotranspiration (mm H_2O per month or per year)
PET is a measure of the evaporative power of the atmosphere and is the amount of water that could be evaporated if it were freely available. In the Basin Characterization Model (BCM) it is calculated as a function of air temperature and solar radiation according to the Priestly-Taylor formulation. PET increases with increased air temperature because warmer air can hold more moisture.
AET: Actual Evapotranspiration (mm H_2O per month or per year)
AET is the amount of water transferred from the soil to the atmosphere through vegetation and direct surface evaporation. AET is constrained by the amount of soil available water and is a good first order measure of vegetation productivity. Deeper soils produce greater AET than shallow soils, all else being equal, because deeper soils store more soil moisture at the end of the rainy season. AET peaks in the spring when soil moisture is available and PET is high. In our Mediterranean climate, nearly all precipitation in April and May is likely to be partitioned to AET. Differences of 25-50 mm over 30-year averages are ecologically significant.
CWD: Climatic Water Deficit (mm H_2O per year)
CWD is an integrated measure of seasonal water stress and aridity, and is calculated as a cumulative sum of the difference between PET and AET over the dry season. It is the additional amount of water that could have been evaporated had it been freely available. CWD generally starts accumulating in the spring as soil water is drawn down by increasing PET. Variations in CWD over short distances reflect soil moisture capacity. The interaction of CWD and AET is a primary determinant of vegetation structure in California. Potential vegetation trends from low to high CWD proceed from coniferous forests - montane hardwoods - oak forests/woodlands – chaparral - grassland. The interaction of CWD and AET is a primary determinant of vegetation structure in California. Differences of 25-100+ mm over 30-year averages are ecologically significant.

Table 5 continued

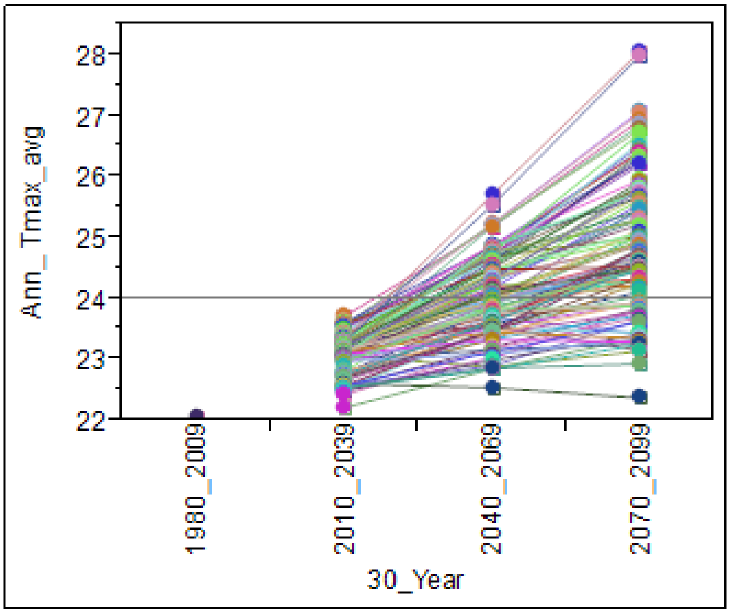
Recharge (mm H_2O per month or per year)
Recharge is water that drains below the rooting zone and becomes groundwater. Recharge is affected greatly by bedrock permeability and soil depth, and is strongly correlated (r > 0.9) with PPT. Water drains below the rooting zone when soils are fully charged at a rate determined by bedrock permeability (fractures). There is a maximum recharge rate at each location. Recharge is sensitive to the timing of moderate and heavy precipitation, and can be very episodic in the more arid reaches of the Bay Area. Recharge ends up in both shallow and deeper groundwater, and provides stream baseflow during the dry season (primarily shallow), and extractable groundwater (primarily deep) for water supply. Some areas are recharge dominated and others are runoff dominated, depending on bedrock permeability. Because recharge provides natural subsurface storage that provides the sole source of stream baseflow in the dry season, and many Bay Area communities depend on well water, it is a precious resource. Conservation of high recharge areas is a high priority.
Runoff (mm H_2O per month or per year)
Runoff is water that feeds surface stream flow, and generally occurs during storms when the soil is fully charged with water. Annual runoff is strongly correlated (r > 0.9) with PPT. Runoff occurs on shallower soils more rapidly than on deeper soils. When soils are fully charged and maximum recharge rates satisfied, excess water becomes immediate streamflow that month. Runoff is sensitive to the timing of moderate and heavy precipitation, and can be very episodic in the more arid reaches of the Bay Area. Large pulses of runoff fill local water supply reservoirs. Large monthly runoff events sometimes result in floods, but not necessarily because flood peaks are driven by much shorter term precipitation than the monthly time scale used in the BCM. Some areas are runoff dominated and others are recharge dominated, depending on bedrock permeability.

FIGURES

Figure 1: Analyzed Global Circulative Model (GCM) Outputs

Progressions of all futures by 30-year periods for (a) annual maximum air temperature, and (b) annual precipitation.

(a)



(b)

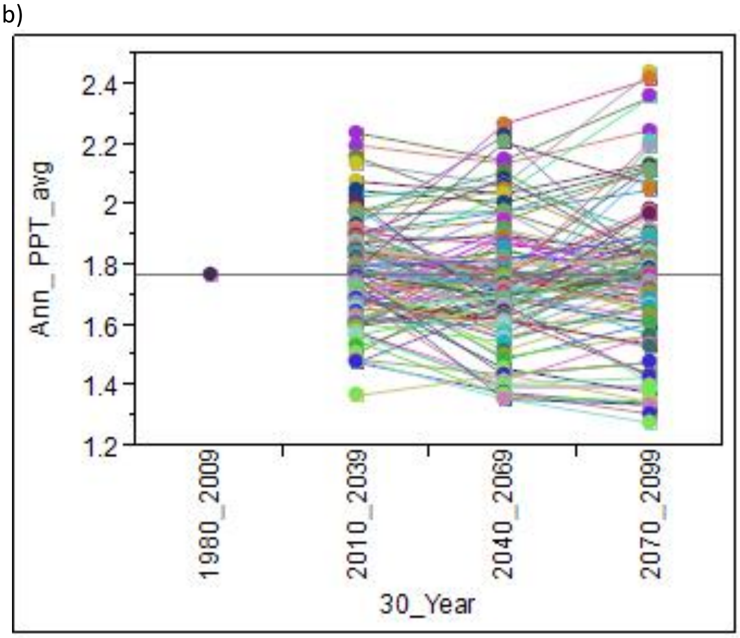


Figure 2: Progression of Summer (JJA) Temperatures

Progression of Summer (JJA) temperatures across all models as a function of CO_2 concentrations by 30-year periods.

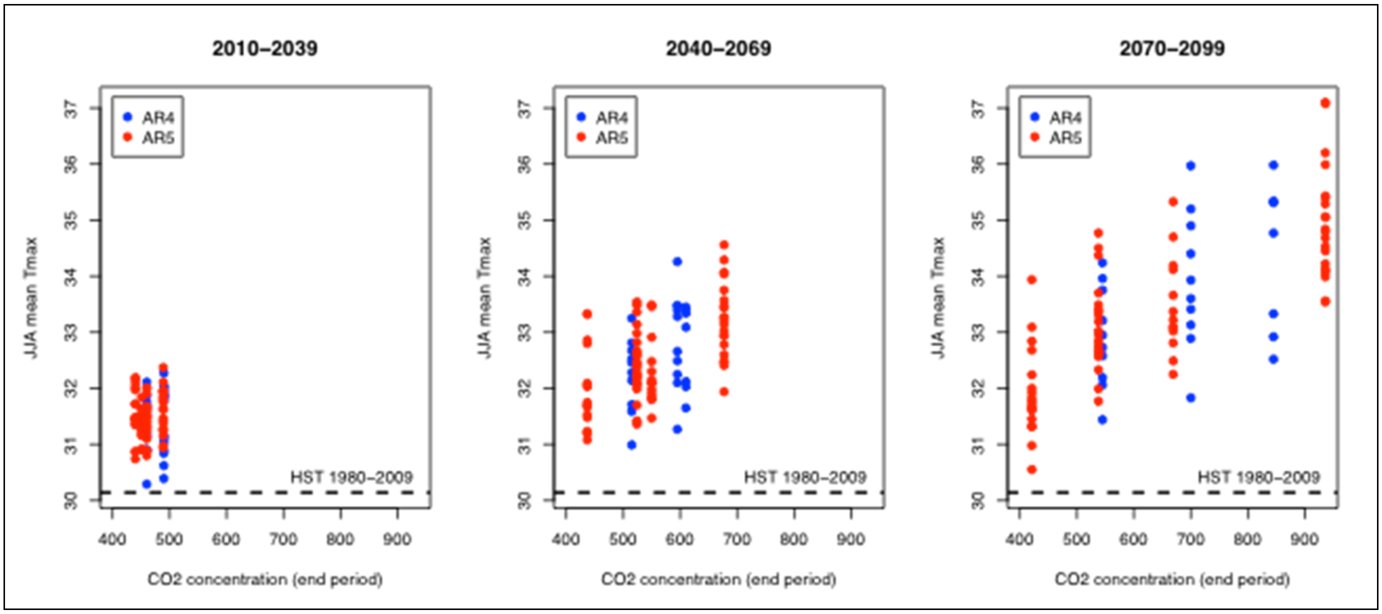
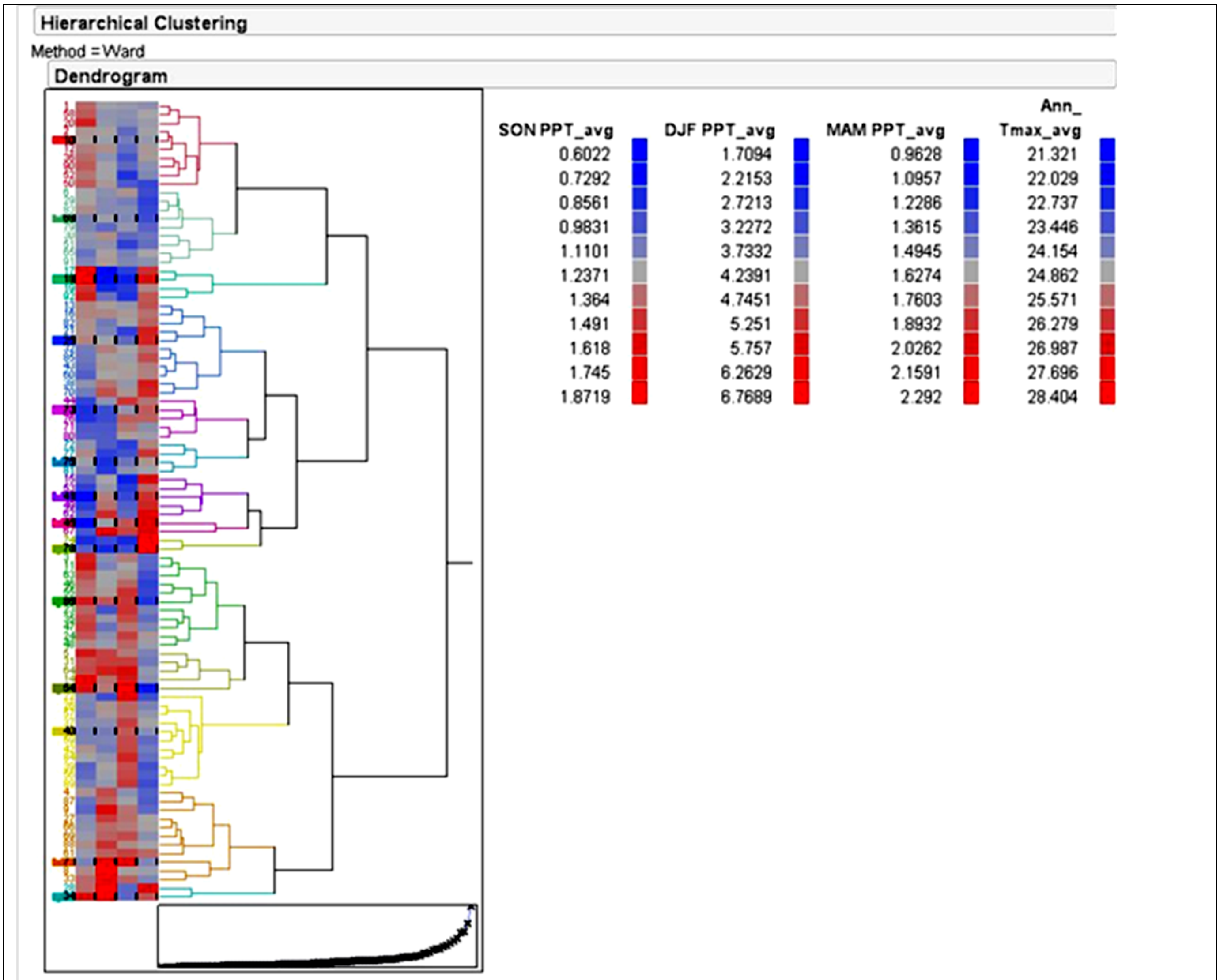


Figure 3: Cluster Analysis Output

The cluster analysis output includes the dendrogram, in which each of the 14 clusters is color coded arbitrarily. The color ramps to the right correspond in order to the colored boxes on the left of the dendrogram. The highlighted numbers at the far left are the one future chosen from each cluster.



PRISM 1980-2009 SON PPT = 1.27, DJF PPT = 4.0, MAM PPT = 1.78, Ann Tmax = 22.06

Figure 4: Graphic Representation of Climate Changes among Futures

Graphic representation of climate changes among futures, by change in mean Tmax and percent change in PPT. The error bars are the spatial standard deviation of changes. The ensemble mean is the average of all futures, the error bars on the ensemble mean are the standard deviation among all 18 futures.

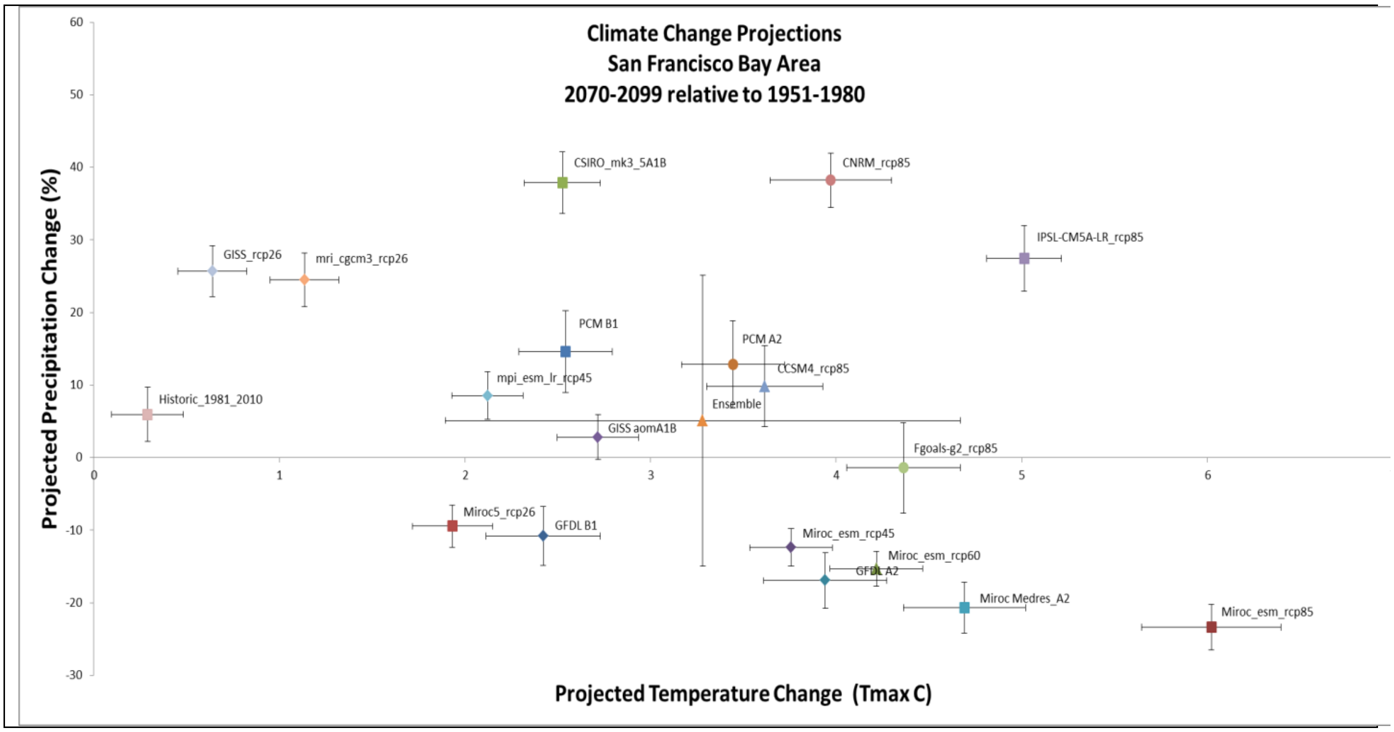


Figure 5: Basin Characterization Model Flowchart

The Basin Characterization Model flowchart shows how climate inputs are processed to calculate hydrologic outputs.

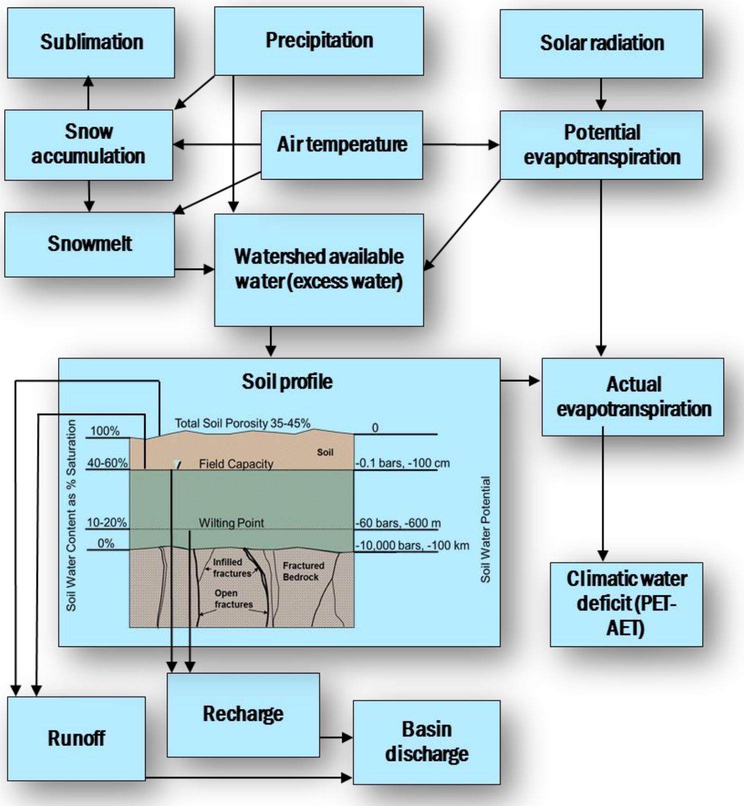


Figure 6: Scatterplot of Changes in AET and CWD

Changes in AET and CWD for the 18 models as a scatterplot. The error bars are spatial standard deviations.

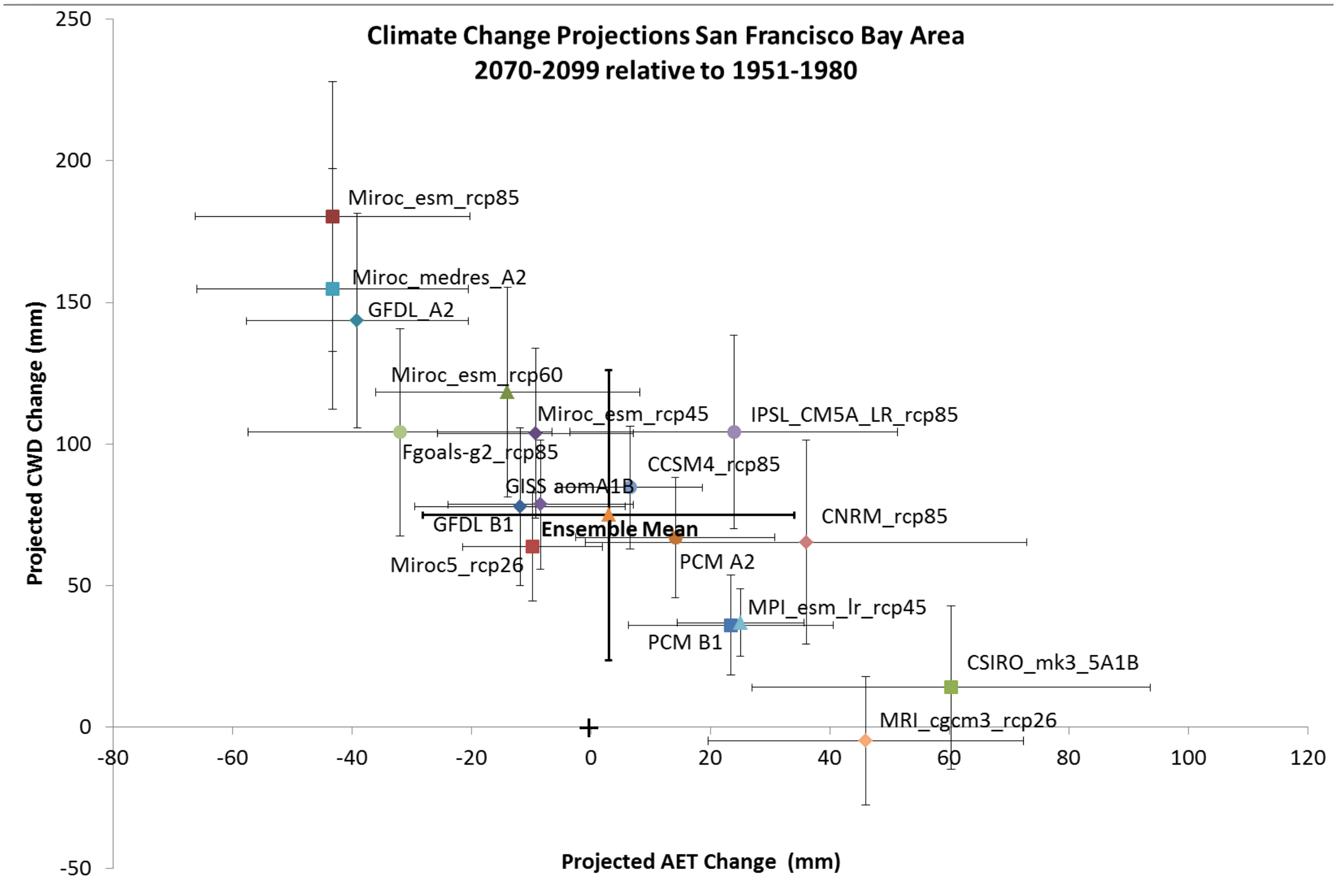


Figure 7: Snapshot Maps of Key Climate and Hydrologic Variables for 1981-2010

The generation of these maps is described in the report for Output 4.3 (Branciforte et al. 2013).

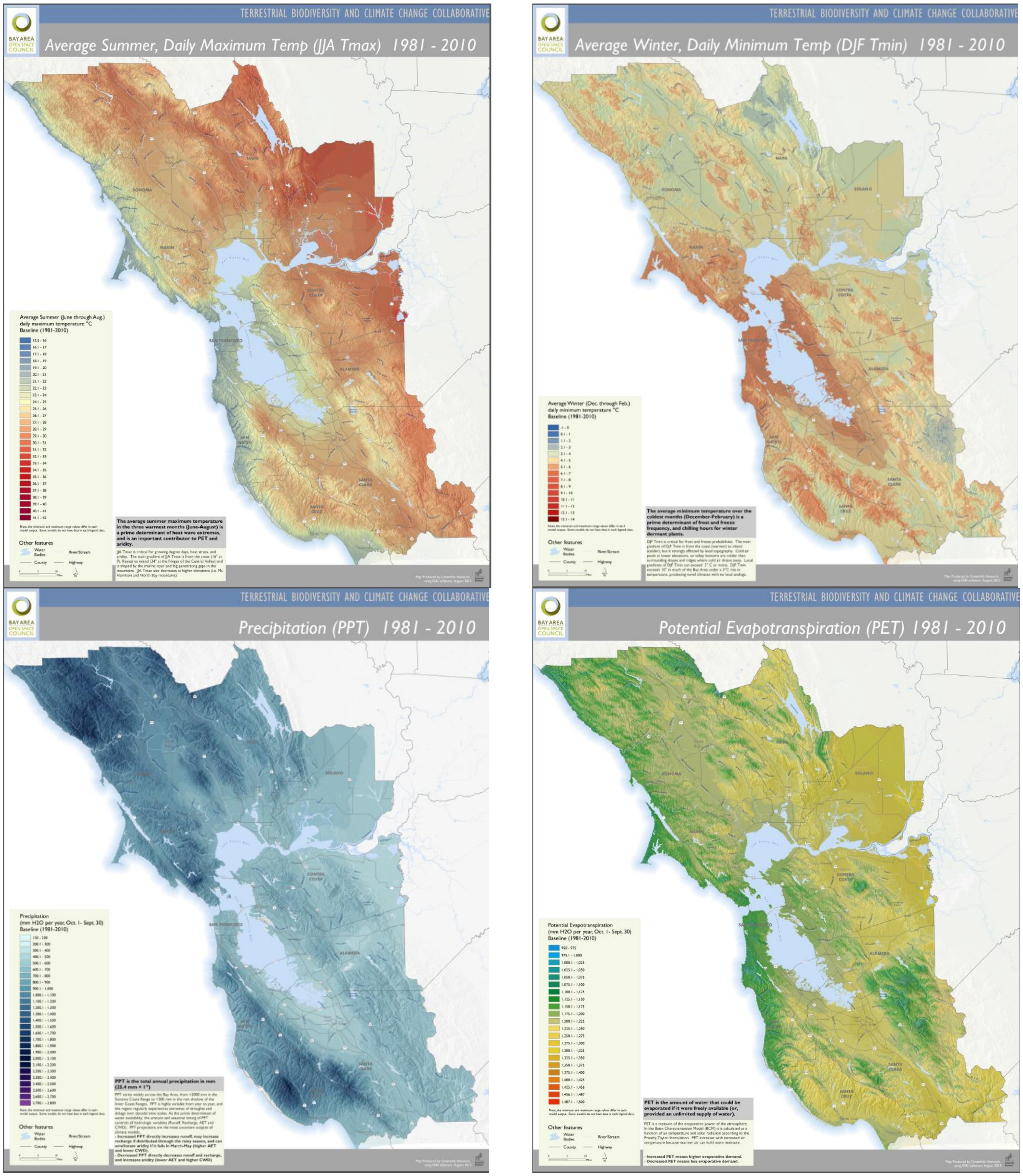


Figure 7 (continued)

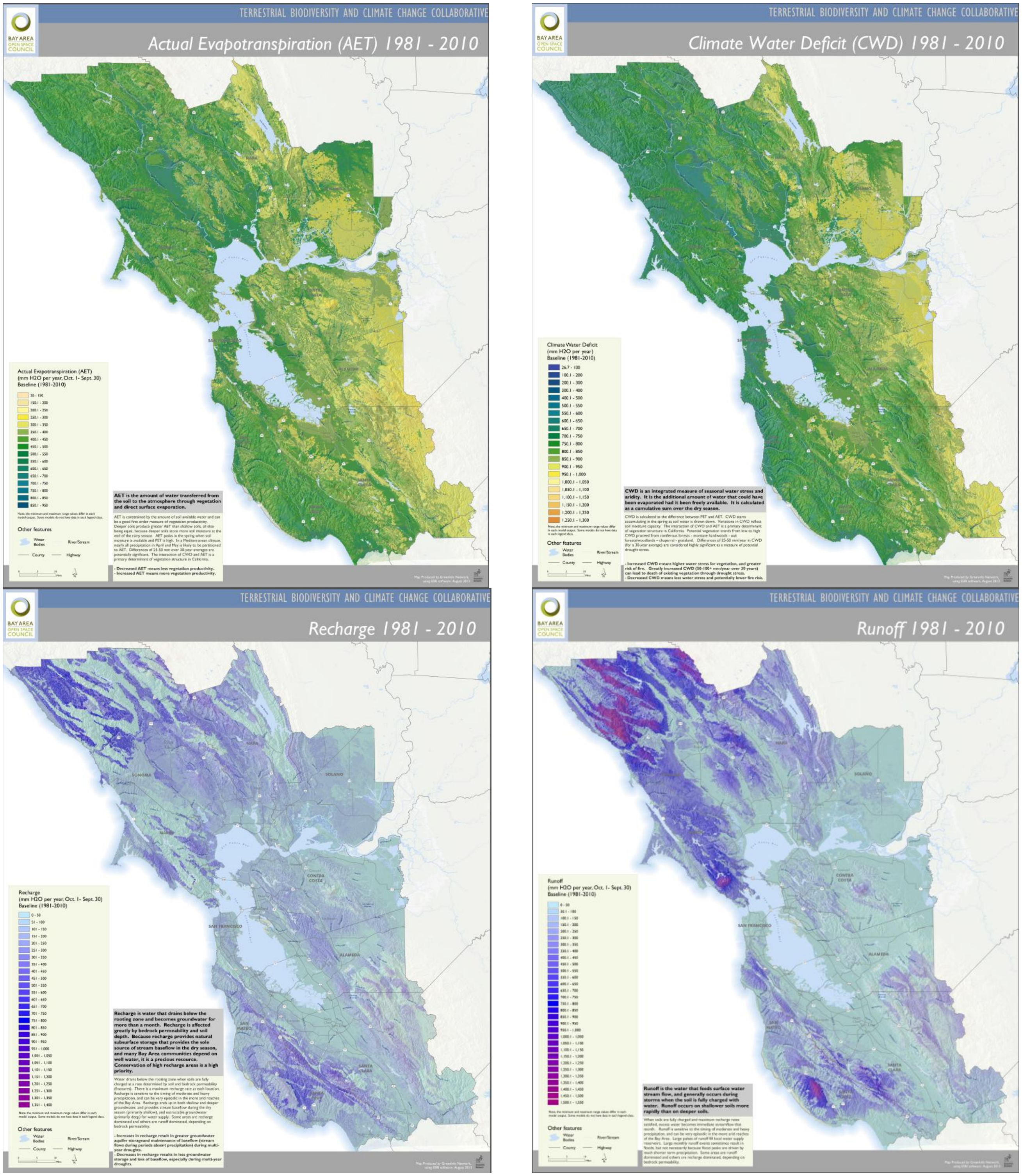


Figure 8: Monthly Temperature and Precipitation for Pine Gulch Creek

PPT = precipitation, Tmax = maximum temperature, Tmin = minimum temperature.

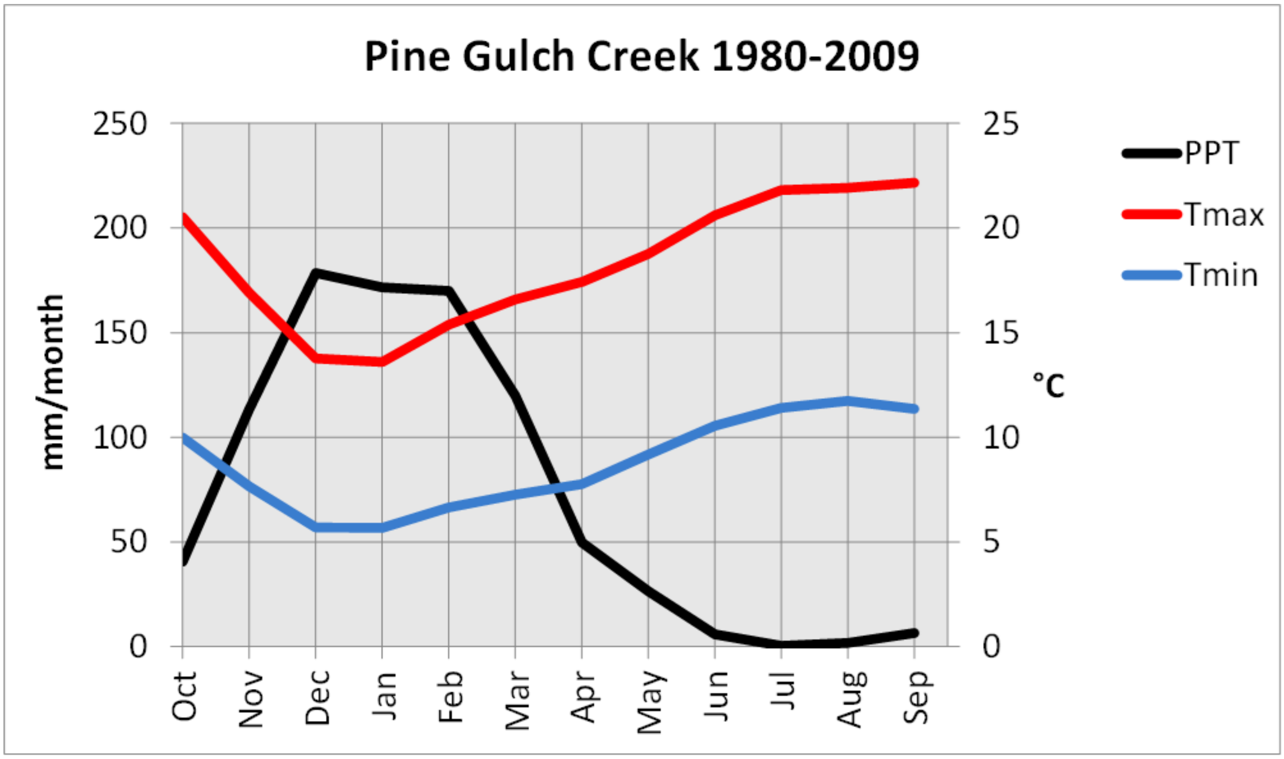


Figure 9: Water Balance Diagrams for Pine Gulch Creek and Fern Creek

This water balance diagram graphically shows the monthly progression of hydrologic variables through the water year. The stacked variables are non-overlapping, so the monthly values can be read directly from the graph. Annual totals are in the table embedded in the graph. See text for further explanation. CWD = climatic water deficit, AET = actual evapotranspiration, Soil is the total storage in the soil, PPT = precipitation, Tmax = annual maximum temperature, Tmin = annual minimum temperature.

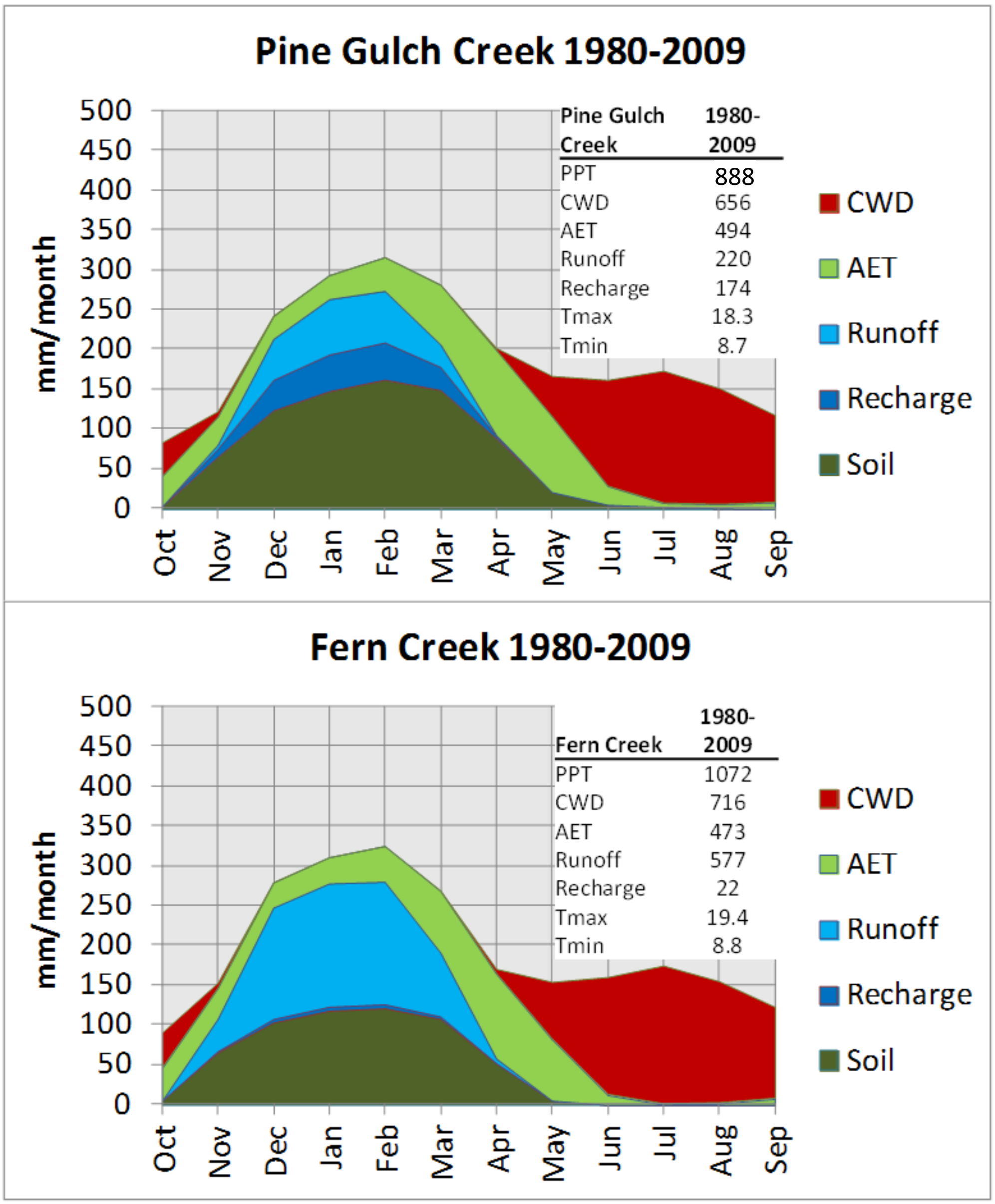
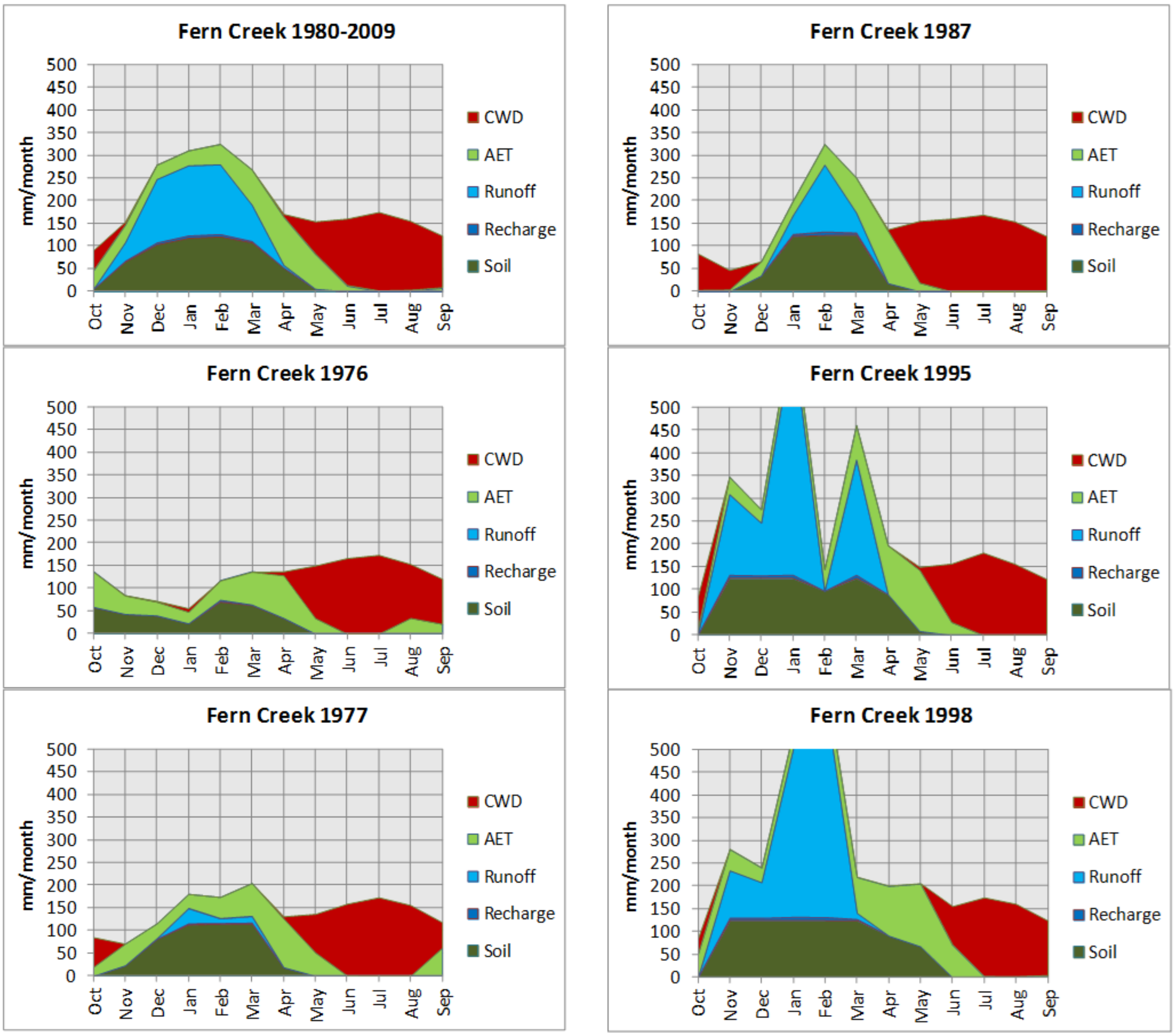


Figure 10: Fern Creek Water Balance Diagrams for Extreme Years

Fern Creek water balance diagrams show hydrologic responses to extreme years. 1976 and 1977 were the two driest years in the weather record, 1987 was a high CWD year at the beginning of a six-year drought, 1995 and 1998 produced floods in many Bay Area streams.



APPENDICES

Appendix 1: Table of Downscaled Climate Outputs Averaged Across 10 Bay Area Counties

Index	CMIP	Model	Scenario	Run	30_Year	Ann_ PPT_avg	Ann_ PPT_sd	SON PPT_avg	SON PPT_sd	DJF PPT_avg	DJF PPT_sd	MAM PPT_avg	MAM PPT_sd
1	PRISM	PRISM	Hist1	run1	1950_1999	1.75	1.41	1.37	1.26	3.82	2.87	1.72	1.41
2	PRISM	PRISM	Hist1	run1	1970_1999	1.77	1.43	1.43	1.25	3.8	3.12	1.78	1.46
3	PRISM	PRISM	Hist	run1	1980_2009	1.77	1.42	1.27	1.17	4	2.96	1.78	1.54
4	CMIP3	bccr_bcm2_0	A1B	run1	2010_2039	1.83	1.51	1.24	1.06	4.43	3.68	1.61	1.61
5	CMIP3	bccr_bcm2_0	A1B	run1	2040_2069	1.92	1.55	1.38	1.1	4.58	3.87	1.65	1.5
6	CMIP3	bccr_bcm2_0	A1B	run1	2070_2099	1.82	1.47	1.37	1.24	4.19	3.28	1.59	1.28
7	CMIP3	bccr_bcm2_0	A2	run1	2010_2039	1.79	1.42	1.3	1.03	4.06	3.21	1.68	1.45
8	CMIP3	bccr_bcm2_0	A2	run1	2040_2069	1.68	1.36	1.16	1.04	4.14	3.35	1.42	1.13
9	CMIP3	bccr_bcm2_0	A2	run1	2070_2099	1.8	1.53	1.27	1.23	4.3	3.91	1.44	1.24
10	CMIP3	bccr_bcm2_0	B1	run1	2010_2039	1.91	1.33	1.18	0.98	4.75	3.23	1.71	1.38
11	CMIP3	bccr_bcm2_0	B1	run1	2040_2069	1.87	1.33	1.53	1.29	4.3	2.97	1.61	1.23
12	CMIP3	bccr_bcm2_0	B1	run1	2070_2099	1.83	1.53	1.53	1.44	3.96	3.16	1.73	1.62
13	CMIP3	csiro_mk3_5	A1B	run1	2010_2039	1.8	1.32	1.29	1.03	4.35	3.08	1.48	1.14
14	CMIP3	csiro_mk3_5	A1B	run1	2040_2069	2.04	1.46	1.28	1.09	5.13	3.42	1.63	1.26
15	CMIP3	csiro_mk3_5	A1B	run1	2070_2099	2.36	1.57	1.13	0.99	6.03	3.74	2.09	1.35
16	CMIP3	csiro_mk3_5	A2	run1	2010_2039	2.14	1.45	1.07	0.97	5.54	3.28	1.89	1.33
17	CMIP3	csiro_mk3_5	A2	run1	2040_2069	2.07	1.53	1.17	1.18	5.36	3.64	1.68	1.42
18	CMIP3	csiro_mk3_5	A2	run1	2070_2099	2.44	1.48	1.3	1.2	6.61	3.22	1.65	1.18
19	CMIP3	csiro_mk3_5	B1	run1	2010_2039	2.08	1.48	1.4	1.21	4.94	3.28	1.91	1.37
20	CMIP3	csiro_mk3_5	B1	run1	2040_2069	2.04	1.4	1.16	1.1	4.84	2.73	2.02	1.58
21	CMIP3	csiro_mk3_5	B1	run1	2070_2099	2.14	1.39	1.05	0.91	5.68	3.23	1.74	1.13
22	CMIP3	csrio_mk3_0	A1B	run1	2010_2039	1.83	1.25	1.66	1.32	3.86	2.86	1.67	1.06
23	CMIP3	csrio_mk3_0	A1B	run1	2040_2069	1.77	1.34	1.42	1.37	4.1	2.98	1.47	1.11
24	CMIP3	csrio_mk3_0	A1B	run1	2070_2099	1.99	1.27	1.28	1.11	5.01	2.98	1.56	1.07
25	CMIP3	csrio_mk3_0	A2	run1	2010_2039	1.91	1.47	1.49	1.37	4.26	3.21	1.69	1.27
26	CMIP3	csrio_mk3_0	A2	run1	2040_2069	1.95	1.41	1.65	1.33	4.35	3.04	1.78	1.24
27	CMIP3	csrio_mk3_0	A2	run1	2070_2099	2.12	1.51	1.55	1.55	5.11	3.2	1.73	1.25
28	CMIP3	csrio_mk3_0	B1	run1	2010_2039	1.86	1.35	1.7	1.33	4.11	2.83	1.53	1.12
29	CMIP3	csrio_mk3_0	B1	run1	2040_2069	1.78	1.24	1.49	1.16	4.07	2.65	1.53	1.18
30	CMIP3	csrio_mk3_0	B1	run1	2070_2099	1.76	1.27	1.24	1.04	3.97	2.66	1.67	1.22
31	CMIP3	giss_aom	A1B	run1	2010_2039	1.86	1.47	1.3	1.28	4.49	3.48	1.59	1.33
32	CMIP3	giss_aom	A1B	run1	2040_2069	1.58	1.28	1.47	1.35	3.16	2.46	1.66	1.41
33	CMIP3	giss_aom	A1B	run1	2070_2099	1.75	1.43	1.26	1.13	4.15	3.61	1.5	1.38
34	CMIP3	giss_aom	A1B	run2	2010_2039	1.61	1.26	1.45	1.06	3.47	2.75	1.46	1.19
35	CMIP3	giss_aom	A1B	run2	2040_2069	1.69	1.29	1.3	1.01	3.9	3.06	1.42	1.08
36	CMIP3	giss_aom	A1B	run2	2070_2099	1.61	1.3	1.12	0.94	3.93	2.9	1.39	1.25
37	CMIP3	giss_aom	B1	run1	2010_2039	1.94	1.5	1.5	1.41	4.41	3.26	1.75	1.44
38	CMIP3	giss_aom	B1	run1	2040_2069	1.75	1.44	1.34	1.27	3.93	3.13	1.73	1.53
39	CMIP3	giss_aom	B1	run1	2070_2099	1.75	1.59	1.56	1.59	3.82	3.47	1.62	1.51
40	CMIP3	giss_aom	B1	run2	2010_2039	1.74	1.11	1.33	1.02	4.05	2.32	1.47	0.96
41	CMIP3	giss_aom	B1	run2	2040_2069	1.56	1.2	1.28	1.11	3.51	2.41	1.36	1.26
42	CMIP3	giss_aom	B1	run2	2070_2099	1.72	1.24	1.31	0.99	4.07	2.67	1.49	1.34
43	CMIP3	inmcm3_0	A1B	run1	2010_2039	2.16	1.43	1.65	1.29	5.12	2.75	1.59	1.12
44	CMIP3	inmcm3_0	A1B	run1	2040_2069	1.98	1.41	1.61	1.35	4.51	2.61	1.76	1.42
45	CMIP3	inmcm3_0	A1B	run1	2070_2099	1.83	1.37	1.32	1	4.44	3.36	1.45	1.08
46	CMIP3	inmcm3_0	A2	run1	2010_2039	1.98	1.51	1.68	1.55	4.53	3.1	1.64	1.13
47	CMIP3	inmcm3_0	A2	run1	2040_2069	2.11	1.64	1.65	1.48	5.02	3.75	1.67	1.5
48	CMIP3	inmcm3_0	A2	run1	2070_2099	1.85	1.35	1.31	1.09	4.33	2.86	1.58	1.13
49	CMIP3	inmcm3_0	B1	run1	2010_2039	1.99	1.43	1.57	1.47	4.47	2.74	1.82	1.37
50	CMIP3	inmcm3_0	B1	run1	2040_2069	1.68	1.39	1.4	1.26	3.66	3.48	1.59	1.14
51	CMIP3	inmcm3_0	B1	run1	2070_2099	2.12	1.49	1.74	1.45	4.71	2.96	1.95	1.43
52	CMIP3	miroc3_2_hr	A1B	run1	2010_2039	1.91	1.44	1.24	1.15	4.44	3.11	1.81	1.36
53	CMIP3	miroc3_2_hr	A1B	run1	2040_2069	1.74	1.3	1.35	1.19	4.21	2.81	1.34	1.23

Index	JJA PPT_avg	JJA PPT_sd	Ann_ Tmax_avg	Ann_ Tmax_sd	SON Tmax_avg	SON Tmax_sd	DJF Tmax_avg	DJF Tmax_sd	MAM Tmax_avg	MAM Tmax_sd	JJA Tmax_avg
1	0.11	0.19	21.92	1.73	23.56	1.74	13.6	1.58	20.41	2.03	30.08
2	0.11	0.2	21.94	1.72	23.44	1.82	13.73	1.53	20.55	2.07	30.05
3	0.09	0.14	22.06	2.69	23.5	1.82	13.8	1.51	20.81	2.07	30.14
4	0.09	0.11	22.48	1.75	24.31	1.63	13.81	1.74	20.97	2.26	30.84
5	0.08	0.14	23.7	1.84	25.2	1.88	14.98	1.54	22.5	2.35	32.1
6	0.09	0.14	24.53	1.78	26.26	1.88	15.51	1.88	23.22	2	33.13
7	0.09	0.15	22.75	1.64	24.38	1.52	14.29	1.69	21.28	2.12	31.02
8	0.05	0.08	23.35	1.68	24.93	1.77	14.54	1.69	21.89	2.03	32.03
9	0.09	0.17	24.77	1.74	26.58	1.68	15.64	1.97	23.55	2	33.33
10	0.1	0.15	22.5	1.65	24.08	1.76	14.11	1.38	20.89	2.09	30.9
11	0.05	0.07	23.04	1.68	24.59	1.55	14.18	1.87	21.65	1.79	31.71
12	0.06	0.09	23.83	1.7	25.36	1.83	15.3	1.51	22.52	2.2	32.19
13	0.13	0.17	23	1.55	24.71	1.58	14.62	1.44	21.54	1.67	31.15
14	0.12	0.2	23.88	1.48	26.02	1.41	15.38	1.24	21.9	1.74	32.25
15	0.12	0.15	24.34	1.43	26.27	1.54	15.8	1.01	22.4	1.73	32.89
16	0.12	0.17	22.74	1.48	24.7	1.47	14.36	1	20.79	2.02	31.08
17	0.09	0.11	23.74	1.55	25.79	1.62	15.12	1.16	21.88	1.8	32.12
18	0.16	0.19	24.71	1.57	26.9	1.48	16.04	0.95	23.02	2.2	32.92
19	0.11	0.16	22.56	1.52	24.68	1.63	14.13	1.29	20.56	1.7	30.9
20	0.12	0.14	23.21	1.37	25.06	1.46	14.78	0.94	21.43	1.57	31.59
21	0.14	0.2	23.85	1.53	26.03	1.72	15.31	1.08	21.98	1.63	32.06
22	0.1	0.12	22.43	1.42	24.32	1.39	14.33	1.5	20.67	1.48	30.39
23	0.12	0.18	23.19	1.59	25.22	1.84	14.49	1.52	21.76	1.67	31.27
24	0.1	0.13	23.71	1.59	25.79	1.56	15.2	1.17	22.04	2.06	31.83
25	0.16	0.22	22.72	1.52	24.87	1.57	14.31	1.43	21.06	1.61	30.62
26	0.1	0.14	23.34	1.65	25.27	1.65	14.89	1.54	21.58	1.88	31.65
27	0.12	0.18	24.28	1.54	26.44	1.52	15.73	1.43	22.44	1.72	32.52
28	0.12	0.15	22.22	1.41	23.82	1.26	13.96	1.25	20.85	1.71	30.29
29	0.11	0.14	22.86	1.52	24.89	1.5	14.37	1.29	21.18	1.76	30.99
30	0.1	0.14	23.37	1.55	25.28	1.64	15.12	1.82	21.72	1.6	31.44
31	0.08	0.08	22.63	1.63	24.39	1.85	14.3	1.33	20.98	1.9	30.89
32	0.04	0.05	23.92	1.62	25.32	1.82	15.77	1.66	22.11	1.92	32.49
33	0.05	0.08	24.62	1.66	26.26	1.9	16.31	1.49	22.5	1.88	33.41
34	0.1	0.14	22.79	1.65	24.38	1.52	14.44	1.69	21.22	2.11	31.13
35	0.06	0.1	23.84	1.57	25.45	1.63	15.31	1.31	21.96	2.03	32.66
36	0.05	0.07	24.64	1.67	26.11	1.62	16.14	1.6	22.75	2.04	33.6
37	0.08	0.13	22.67	1.63	24.41	1.81	14.18	1.67	20.98	1.59	31.14
38	0.06	0.1	23.44	1.81	24.91	2.05	15.21	1.55	21.51	2.19	32.14
39	0.04	0.04	23.79	1.74	25.21	1.83	15.31	1.71	21.9	2.13	32.73
40	0.07	0.1	22.82	1.54	24.37	1.61	14.61	1.34	21.13	1.93	31.21
41	0.06	0.09	23.44	1.57	24.82	1.63	14.89	1.42	21.73	2	32.28
42	0.06	0.08	23.95	1.59	25.42	1.58	15.56	1.32	22.2	2.05	32.58
43	0.15	0.19	23.58	1.63	25.34	1.5	15.19	1.48	21.8	1.93	31.99
44	0.09	0.12	24.7	1.6	26.65	1.67	15.87	1.41	22.87	2	33.39
45	0.11	0.16	25.03	1.65	26.68	1.74	16.3	1.51	23.23	1.89	33.93
46	0.09	0.14	23.23	1.66	24.97	1.6	14.63	1.74	21.5	2.01	31.85
47	0.14	0.22	24.56	1.66	26.35	1.45	16.01	1.5	22.76	2.14	33.09
48	0.11	0.14	25.87	1.72	27.94	1.74	17.04	1.25	23.73	1.99	34.77
49	0.12	0.17	23.31	1.65	24.95	1.59	14.79	1.47	21.62	2.12	31.87
50	0.12	0.16	24	1.71	25.75	1.54	15.68	1.35	22.12	2.31	32.46
51	0.12	0.15	24.48	1.54	26.39	1.45	15.89	1.2	22.67	2	32.95
52	0.11	0.15	23.58	1.7	25.2	1.82	14.9	1.44	21.95	1.93	32.27
53	0.12	0.15	25.23	1.8	26.78	2.01	16.38	1.67	23.48	1.93	34.26

Index	JJA Tmax_sd	Ann_ Tmin_avg	Ann_ Tmin_sd	SON Tmin_avg	SON Tmin_sd	DJF Tmin_avg	DJF Tmin_sd	MAM Tmin_avg	MAM Tmin_sd	JJA Tmin_avg	JJA Tmin_sd
1	1.49	7.86	1.35	8.81	1.25	3.05	1.73	6.57	1.32	12.99	1.1
2	1.37	8.08	1.32	8.95	1.24	3.23	1.66	6.91	1.34	13.24	1
3	1.4	8.38	1.26	9.18	1.19	3.52	1.61	7.27	1.2	13.56	1.03
4	1.35	8.44	1.29	9.52	1.01	3.55	1.91	6.87	1.21	13.82	1.06
5	1.4	9.65	1.48	10.64	1.41	4.76	1.7	8.09	1.55	15.09	1.14
6	1.32	10.47	1.45	11.75	1.32	5.28	2.09	8.65	1.38	16.17	0.98
7	1.13	8.65	1.22	9.71	1.03	3.81	1.55	7.09	1.36	13.97	0.9
8	1.22	9.21	1.32	10.3	1.28	4.08	1.85	7.53	1.34	14.93	0.96
9	1.33	10.74	1.42	12.02	1.19	5.45	2.07	9.02	1.44	16.49	1.06
10	1.36	8.55	1.27	9.4	1.19	3.98	1.66	6.94	1.33	13.9	1.02
11	1.33	9.03	1.32	10.04	1.16	4.1	2.07	7.46	1.13	14.51	0.99
12	1.26	9.77	1.32	10.84	1.2	4.94	1.85	8.2	1.4	15.09	0.94
13	1.48	9.01	1.22	10.14	1.28	4.09	1.24	7.53	1.23	14.29	1.07
14	1.44	10.04	1.3	11.39	1.24	5.19	1.5	8.19	1.4	15.43	1.06
15	1.2	10.78	1.23	11.97	1.08	5.76	1.46	9.02	1.33	16.33	0.95
16	1.33	8.92	1.22	10.04	1.17	4.23	1.26	7.24	1.28	14.18	1.03
17	1.39	9.86	1.31	11.23	1.25	4.83	1.64	8.03	1.28	15.32	1
18	1.41	11.11	1.3	12.56	1.07	6.11	1.4	9.26	1.51	16.52	1.01
19	1.31	8.79	1.28	10.04	1.27	4.02	1.76	7.1	1.15	14.03	0.92
20	1.29	9.46	1.2	10.5	1.14	4.6	1.31	7.86	1.28	14.87	1.01
21	1.52	10.06	1.27	11.42	1.22	5.18	1.3	8.2	1.26	15.4	1.08
22	1.35	8.41	1.11	9.67	1.16	3.57	1.44	6.85	1.09	13.54	0.89
23	1.42	9.03	1.2	10.37	1.14	3.94	1.59	7.48	1.1	14.3	1.04
24	1.52	9.73	1.15	10.93	1.13	4.9	1.37	7.92	1.14	15.17	1.01
25	1.41	8.68	1.22	9.92	1.29	3.73	1.81	7.16	1.02	13.89	0.84
26	1.44	9.31	1.4	10.61	1.31	4.31	1.73	7.64	1.41	14.72	1.11
27	1.45	10.35	1.37	11.66	1.26	5.46	1.74	8.49	1.29	15.81	1.12
28	1.37	8.23	1.1	9.36	1.01	3.33	1.38	6.81	1.1	13.41	0.85
29	1.38	8.78	1.18	10.14	1.15	3.76	1.67	7.12	1.13	14.11	0.91
30	1.31	9.26	1.21	10.44	1.25	4.42	1.58	7.61	1.25	14.56	0.86
31	1.3	8.59	1.22	9.69	1.13	3.79	1.69	7.16	1.12	13.75	0.91
32	1.12	9.6	1.19	10.7	1.16	4.8	1.57	7.99	1.11	14.92	0.83
33	1.27	10.34	1.31	11.57	1.26	5.58	1.81	8.35	1.29	15.86	0.83
34	1.33	8.6	1.21	9.73	1.12	3.53	1.67	7.22	1.14	13.91	0.95
35	1.12	9.59	1.29	10.72	1.27	4.55	1.48	7.97	1.35	15.1	0.85
36	1.32	10.23	1.31	11.21	1.21	5.28	1.59	8.52	1.31	15.98	0.95
37	1.35	8.69	1.28	9.94	1.11	3.81	1.89	7.08	1.21	13.98	0.82
38	1.5	9.2	1.3	10.16	1.37	4.46	1.63	7.56	1.27	14.66	0.96
39	1.27	9.54	1.27	10.6	1.28	4.53	1.77	7.84	1.13	15.18	0.92
40	1.19	8.68	1.15	9.56	1.21	3.96	1.12	7.3	1.22	13.95	0.87
41	1.28	9.1	1.32	10.08	1.27	3.91	1.39	7.63	1.5	14.73	1.06
42	1.3	9.66	1.35	10.64	1.44	4.82	1.48	8.09	1.36	15.04	1.02
43	1.53	9.76	1.31	10.76	1.33	5.42	1.63	7.77	1.2	15.07	1.05
44	1.37	10.65	1.12	11.95	1.27	6.01	1.42	8.62	0.9	16.05	0.9
45	1.44	11.01	1.16	12.09	1.12	6.43	1.57	8.98	1.08	16.57	0.73
46	1.33	9.22	1.35	10.37	1.31	4.69	1.75	7.4	1.34	14.49	1.03
47	1.48	10.71	1.25	11.8	1.3	6.37	1.67	8.57	1.14	16.08	0.89
48	1.58	11.67	1.2	13.11	1.28	6.86	1.49	9.37	0.91	17.3	1.01
49	1.48	9.25	1.32	10.17	1.23	4.7	1.78	7.55	1.19	14.58	1.16
50	1.57	9.85	1.21	10.92	1.25	5.1	1.7	7.96	1.2	15.39	0.75
51	1.45	10.64	1.18	11.83	1.17	6.06	1.41	8.74	1.31	15.92	0.84
52	1.5	9.28	1.33	10.37	1.24	4.13	1.44	7.88	1.34	14.71	1.1
53	1.51	10.73	1.34	11.88	1.16	5.63	1.62	8.96	1.42	16.44	1.08

Index	CMIP	Model	Scenario	Run	30_Year	Ann_ PPT_avg	Ann_ PPT_sd	SON PPT_avg	SON PPT_sd	DJF PPT_avg	DJF PPT_sd	MAM PPT_avg	MAM PPT_sd
54	CMIP3	miroc3_2_hr	A1B	run1	2070_2099	1.67	1.31	1.03	0.91	4.26	2.91	1.2	1.26
55	CMIP3	miroc3_2_hr	B1	run1	2010_2039	1.86	1.34	1.28	1.19	4.31	2.85	1.76	1.37
56	CMIP3	miroc3_2_hr	B1	run1	2040_2069	1.65	1.32	1.51	1.38	3.61	2.75	1.28	1.17
57	CMIP3	miroc3_2_hr	B1	run1	2070_2099	1.9	1.28	1.31	1.04	4.5	2.67	1.66	1.13
58	CMIP3	miroc3_2_mr	A1B	run1	2010_2039	1.48	1.17	1.45	1.53	3.11	2.27	1.29	0.95
59	CMIP3	miroc3_2_mr	A1B	run1	2040_2069	1.38	1.11	1.23	1.02	2.85	2.59	1.35	0.89
60	CMIP3	miroc3_2_mr	A1B	run1	2070_2099	1.34	1.01	1.7	1.2	2.28	1.74	1.3	0.89
61	CMIP3	miroc3_2_mr	A1B	run2	2010_2039	1.58	1.22	1.28	1.1	3.62	2.51	1.33	1.04
62	CMIP3	miroc3_2_mr	A1B	run2	2040_2069	1.42	1.26	1.34	1.15	2.95	2.4	1.22	1.11
63	CMIP3	miroc3_2_mr	A1B	run2	2070_2099	1.57	1.28	1.55	1.41	3.26	1.77	1.32	1.17
64	CMIP3	miroc3_2_mr	A1B	run3	2010_2039	1.51	1.15	1.25	1.15	3.23	2.27	1.42	1.13
65	CMIP3	miroc3_2_mr	A1B	run3	2040_2069	1.77	1.44	1.39	1.34	3.89	2.65	1.66	1.56
66	CMIP3	miroc3_2_mr	A1B	run3	2070_2099	1.72	1.42	1.55	1.48	3.78	2.58	1.45	1.38
67	CMIP3	miroc3_2_mr	A2	run1	2010_2039	1.55	1.25	1.51	1.22	3.12	3.2	1.44	0.89
68	CMIP3	miroc3_2_mr	A2	run1	2040_2069	1.37	1.21	1.25	1.17	2.76	2.97	1.4	0.94
69	CMIP3	miroc3_2_mr	A2	run1	2070_2099	1.35	1.21	1.76	1.52	2.34	1.87	1.2	0.97
70	CMIP3	miroc3_2_mr	A2	run2	2010_2039	1.49	1.22	1.12	1	3.29	2.83	1.46	1.24
71	CMIP3	miroc3_2_mr	A2	run2	2040_2069	1.36	1.08	1.12	0.92	2.97	2.22	1.29	1.1
72	CMIP3	miroc3_2_mr	A2	run2	2070_2099	1.28	1.03	1.12	0.99	2.69	1.86	1.25	1.05
73	CMIP3	miroc3_2_mr	A2	run3	2010_2039	1.71	1.31	1.34	1.06	3.99	3.18	1.46	0.98
74	CMIP3	miroc3_2_mr	A2	run3	2040_2069	1.46	1.19	1.28	1.04	3.05	2.38	1.45	1.25
75	CMIP3	miroc3_2_mr	A2	run3	2070_2099	1.38	1.09	1.2	1.06	3.07	2.05	1.17	1.12
76	CMIP3	miroc3_2_mr	B1	run1	2010_2039	1.58	1.09	1.61	0.99	3.28	2.98	1.38	0.86
77	CMIP3	miroc3_2_mr	B1	run1	2040_2069	1.4	1.15	1.43	1.21	2.46	2.39	1.6	1.07
78	CMIP3	miroc3_2_mr	B1	run1	2070_2099	1.4	1.09	1.48	1.17	2.72	2.27	1.29	0.96
79	CMIP3	miroc3_2_mr	B1	run2	2010_2039	1.37	1.06	1.15	1.07	3.16	2.29	1.11	0.85
80	CMIP3	miroc3_2_mr	B1	run2	2040_2069	1.44	1.21	1.02	0.76	3.24	2.61	1.45	1.22
81	CMIP3	miroc3_2_mr	B1	run2	2070_2099	1.35	1.01	0.97	0.96	2.87	1.91	1.44	1.02
82	CMIP3	miroc3_2_mr	B1	run3	2010_2039	1.69	1.4	1.35	1.27	3.79	2.94	1.48	1.36
83	CMIP3	miroc3_2_mr	B1	run3	2040_2069	1.63	1.32	1.16	0.94	3.73	3	1.6	1.39
84	CMIP3	miroc3_2_mr	B1	run3	2070_2099	1.82	1.29	1.59	1.2	3.86	2.82	1.74	1.15
85	CMIP5	access1-0	historical	run1	1970_1999	1.76	1.35	1.17	1.08	3.89	2.72	1.75	1.35
86	CMIP5	access1-0	rcp45	run1	2010_2039	1.6	1.19	1.42	1.08	3.55	2.63	1.34	0.95
87	CMIP5	access1-0	rcp45	run1	2040_2069	1.88	1.34	1.35	1.03	4.47	3.19	1.53	1.13
88	CMIP5	access1-0	rcp45	run1	2070_2099	1.8	1.3	1.53	1.14	4.05	3.01	1.54	1.25
89	CMIP5	access1-0	rcp85	run1	2010_2039	1.89	1.3	1.49	1.04	4.47	2.88	1.51	1.18
90	CMIP5	access1-0	rcp85	run1	2040_2069	1.61	1.2	1.02	1.07	4.17	2.77	1.15	0.98
91	CMIP5	access1-0	rcp85	run1	2070_2099	1.62	1.23	1.28	0.99	3.83	2.67	1.31	1.02
92	CMIP5	bcc-csm1-1	historical	run1	1970_1999	1.87	1.35	1.41	1.09	4.2	2.88	1.8	1.29
93	CMIP5	bcc-csm1-1	rcp26	run1	2010_2039	1.78	1.41	1.37	1.09	3.83	3.47	1.84	1.3
94	CMIP5	bcc-csm1-1	rcp26	run1	2040_2069	1.49	1.31	1.22	1.06	3.1	3.12	1.6	1.27
95	CMIP5	bcc-csm1-1	rcp26	run1	2070_2099	1.61	1.34	1.15	0.9	3.19	3.25	2.01	1.5
96	CMIP5	bcc-csm1-1	rcp45	run1	2010_2039	1.62	1.41	1.31	1.17	3.36	3.27	1.71	1.3
97	CMIP5	bcc-csm1-1	rcp45	run1	2040_2069	1.77	1.45	1.22	0.92	3.93	3.2	1.89	1.6
98	CMIP5	bcc-csm1-1	rcp45	run1	2070_2099	1.65	1.37	1.38	1.14	3.25	3.15	1.89	1.49
99	CMIP5	bcc-csm1-1	rcp60	run1	2010_2039	1.53	1.33	1.33	1.24	2.99	2.63	1.76	1.34
100	CMIP5	bcc-csm1-1	rcp60	run1	2040_2069	1.7	1.39	1.25	1.07	3.67	3.18	1.83	1.35
101	CMIP5	bcc-csm1-1	rcp60	run1	2070_2099	1.83	1.44	1.41	1.35	4	2.95	1.86	1.28
102	CMIP5	bcc-csm1-1	rcp85	run1	2010_2039	1.73	1.45	1.28	1.12	3.85	3.29	1.76	1.53
103	CMIP5	bcc-csm1-1	rcp85	run1	2040_2069	1.92	1.52	1.02	1.02	4.27	3.59	2.22	1.73
104	CMIP5	bcc-csm1-1	rcp85	run1	2070_2099	1.74	1.49	1.31	1.02	4.18	4.01	1.44	1.31
105	CMIP5	canesm2	historical	run1	1970_1999	1.74	1.25	1.26	1.01	4.16	2.9	1.41	1.06

Index	JJA PPT_avg	JJA PPT_sd	Ann_ Tmax_avg	Ann_ Tmax_sd	SON Tmax_avg	SON Tmax_sd	DJF Tmax_avg	DJF Tmax_sd	MAM Tmax_avg	MAM Tmax_sd	JJA Tmax_avg
54	0.11	0.14	26.79	1.59	28.5	1.64	17.69	1.56	25.01	2.03	35.97
55	0.13	0.18	23.6	1.58	25.02	1.57	15.16	1.4	22.12	1.88	32.11
56	0.13	0.14	24.7	1.65	26.2	1.83	16	1.5	23.34	1.95	33.25
57	0.11	0.14	25.46	1.46	27.23	1.59	16.58	1	23.81	1.82	34.24
58	0.12	0.18	23.62	1.71	24.98	1.64	14.94	1.56	22.5	2.11	32.04
59	0.09	0.14	24.87	1.64	26.83	1.73	16.24	1.67	23.16	1.68	33.28
60	0.08	0.13	26.26	1.83	27.75	1.67	17.57	1.92	24.47	2.36	35.2
61	0.12	0.18	23.45	1.66	25.22	1.67	14.58	1.39	21.97	1.98	32.03
62	0.12	0.19	24.9	1.78	26.72	1.81	15.93	1.8	23.49	2.45	33.48
63	0.12	0.21	25.96	1.68	27.97	1.65	17.14	1.47	24.35	2.2	34.4
64	0.08	0.15	23.4	1.82	24.86	1.6	14.93	1.96	21.98	2.15	31.84
65	0.1	0.15	24.69	1.8	26.12	1.64	16.06	1.87	23.11	2.1	33.47
66	0.07	0.1	25.83	1.79	27.62	1.62	16.86	1.96	23.9	2.08	34.9
67	0.1	0.13	23.35	1.52	24.77	1.62	15.03	1.56	21.71	1.65	31.91
68	0.09	0.14	24.77	1.69	26.49	1.61	16.22	1.76	22.89	1.95	33.45
69	0.08	0.13	26.73	1.74	28.19	1.76	17.75	1.59	24.98	2.02	35.98
70	0.11	0.14	23.48	1.6	25.21	1.58	14.53	1.51	22.31	2.03	31.88
71	0.08	0.13	24.64	1.68	26.56	1.65	15.66	1.66	22.96	2.04	33.39
72	0.08	0.15	26.59	1.84	28.7	1.79	17.49	1.71	24.81	2.45	35.34
73	0.07	0.1	23.11	1.61	24.37	1.49	14.76	1.69	21.57	1.85	31.77
74	0.06	0.08	24.63	1.74	26.08	1.49	16	1.76	23.11	2.12	33.34
75	0.05	0.09	26.34	1.92	27.76	1.84	17.48	1.84	24.82	2.32	35.31
76	0.09	0.15	23.25	1.62	24.75	1.35	14.87	1.63	21.65	2.02	31.75
77	0.11	0.13	24.43	1.64	26	1.5	16.3	1.83	22.6	1.98	32.81
78	0.08	0.1	25.23	1.71	26.64	1.71	16.81	1.58	23.49	2.19	33.96
79	0.08	0.1	23.33	1.61	24.88	1.62	14.75	1.5	22.12	1.94	31.59
80	0.09	0.16	23.95	1.57	26	1.45	15.27	1.5	22.02	2.06	32.52
81	0.13	0.16	25.16	1.51	26.99	1.66	16.24	1.37	23.65	1.79	33.75
82	0.1	0.19	23.22	1.64	24.77	1.53	14.62	1.69	21.81	1.85	31.68
83	0.07	0.11	24.08	1.67	25.79	1.49	15.5	1.63	22.37	2.05	32.67
84	0.12	0.15	24.53	1.61	26.24	1.59	16.13	1.98	22.56	1.73	33.21
85	0.11	0.14	21.9	1.54	23.51	1.59	13.62	1.48	20.32	1.9	30.17
86	0.09	0.11	23.27	1.57	24.77	1.59	14.54	1.47	22.16	1.85	31.63
87	0.1	0.16	24.06	1.46	25.66	1.53	15.22	1.17	22.7	1.72	32.62
88	0.08	0.1	24.68	1.52	26.18	1.69	15.85	1.24	23.35	1.87	33.31
89	0.1	0.12	23.36	1.54	24.86	1.56	14.91	1.38	21.85	1.88	31.83
90	0.07	0.1	24.8	1.59	26.61	1.78	15.84	1.35	23.28	1.84	33.44
91	0.07	0.07	26.45	1.54	28.25	1.84	17.61	1.1	24.85	1.79	35.05
92	0.09	0.14	22.02	1.58	23.53	1.65	13.59	1.3	20.6	1.96	30.36
93	0.11	0.18	23.34	1.68	25.26	1.57	14.71	1.76	21.67	2.06	31.72
94	0.09	0.13	23.7	1.62	25.5	1.63	15.26	1.75	22.03	1.88	32.06
95	0.08	0.08	23.43	1.75	25.42	1.63	14.82	1.81	21.73	2.06	31.76
96	0.07	0.07	23.06	1.61	25.15	1.6	14.36	1.75	21.22	1.92	31.49
97	0.09	0.16	24.14	1.68	25.91	1.63	15.92	1.58	22.16	2.14	32.57
98	0.09	0.14	24.22	1.71	26.1	1.68	15.67	1.75	22.31	2.05	32.85
99	0.09	0.14	23.33	1.64	25.08	1.57	15.04	1.46	21.72	2.03	31.52
100	0.09	0.09	23.91	1.78	25.79	1.83	15.52	1.88	22.04	1.99	32.3
101	0.1	0.16	25.05	1.68	27.22	1.59	16.37	1.61	22.96	2.07	33.66
102	0.07	0.11	23.51	1.79	24.98	1.7	15.08	1.46	22.02	2.4	31.95
103	0.11	0.18	24.88	1.82	27.08	1.76	16.35	1.6	22.61	2.09	33.46
104	0.09	0.15	26.43	1.78	27.92	1.79	17.83	1.43	24.55	2.14	35.43
105	0.12	0.14	21.97	1.62	23.68	1.78	13.5	1.54	20.63	1.93	30.03

Index	JJA Tmax_sd	Ann_ Tmin_avg	Ann_ Tmin_sd	SON Tmin_avg	SON Tmin_sd	DJF Tmin_avg	DJF Tmin_sd	MAM Tmin_avg	MAM Tmin_sd	JJA Tmin_avg	JJA Tmin_sd
54	1.2	11.93	1.19	13.21	0.97	6.7	1.58	10.03	1.24	17.77	0.92
55	1.4	9.33	1.16	10.19	1.08	4.43	1.4	7.98	1.18	14.75	1.02
56	1.28	10.21	1.13	11.35	1.15	5.04	1.4	8.77	1.04	15.64	0.93
57	1.29	11.06	1.14	12.26	1.05	5.88	1.05	9.45	1.19	16.68	1.08
58	1.47	9.22	1.34	10.06	1.17	4.13	1.58	7.99	1.41	14.68	1.21
59	1.34	10.32	1.27	11.7	1.13	5.22	1.66	8.61	1.12	15.78	1.01
60	1.34	11.63	1.42	12.86	1.24	6.31	1.87	9.8	1.65	17.49	0.98
61	1.49	9.08	1.27	10.3	1.18	3.97	1.51	7.49	1.25	14.58	1
62	1.23	10.27	1.33	11.74	1.32	4.79	1.5	8.6	1.45	15.93	0.99
63	1.34	11.45	1.28	13.08	1.18	6.01	1.49	9.68	1.32	17.03	1.04
64	1.62	8.99	1.43	9.92	1.25	4.01	2.06	7.63	1.43	14.41	1.23
65	1.49	10.32	1.4	11.36	1.15	5.18	1.89	8.66	1.37	16.04	1.19
66	1.35	11.46	1.29	12.88	1.06	6.06	1.77	9.48	1.37	17.4	0.95
67	1.27	9.08	1.17	10	1.18	4.16	1.6	7.56	1.03	14.59	0.94
68	1.47	10.25	1.3	11.51	1.23	5.23	1.64	8.41	1.34	15.88	1.03
69	1.34	12.02	1.29	13.41	1.26	6.36	1.45	10.08	1.3	18.17	1.04
70	1.38	9.04	1.23	10.17	1.13	3.67	1.61	7.75	1.29	14.57	1
71	1.51	9.94	1.25	11.36	1.13	4.5	1.38	8.25	1.25	15.67	1.15
72	1.47	11.8	1.36	13.53	1.32	6.17	1.37	9.88	1.42	17.57	1.2
73	1.33	8.81	1.25	9.67	1.1	3.98	1.65	7.27	1.27	14.31	1.04
74	1.48	10.1	1.22	11.23	1.09	4.9	1.65	8.53	1.29	15.75	1.06
75	1.69	11.58	1.47	12.74	1.36	6.36	1.91	9.8	1.54	17.43	1.27
76	1.4	8.98	1.3	9.97	1.03	4.1	1.85	7.47	1.31	14.4	1
77	1.24	9.94	1.19	11.04	0.99	4.99	1.57	8.36	1.29	15.38	0.93
78	1.26	10.72	1.29	11.82	1.13	5.66	1.65	9	1.32	16.35	0.97
79	1.36	8.85	1.21	9.88	1.13	3.8	1.65	7.55	1.12	14.19	0.95
80	1.26	9.47	1.21	10.87	1.07	4.21	1.34	7.8	1.36	15.02	0.92
81	1.25	10.55	1.14	11.83	1.13	5.06	1.44	8.98	1.08	16.33	0.92
82	1.5	8.9	1.18	9.96	1.06	3.86	1.7	7.46	1.13	14.29	1.06
83	1.41	9.75	1.22	10.97	1.15	4.64	1.46	8.13	1.25	15.26	1
84	1.28	10.33	1.21	11.61	1.12	5.38	1.74	8.44	1.16	15.92	1.01
85	1.2	7.87	1.17	8.71	1.04	3.07	1.63	6.55	1.21	13.12	0.85
86	1.42	8.99	1.26	10.01	1.01	3.92	1.71	7.77	1.23	14.25	1.11
87	1.31	9.81	1.25	10.85	1.02	4.77	1.55	8.33	1.29	15.26	1.11
88	1.22	10.42	1.22	11.66	1.02	5.19	1.43	8.89	1.36	15.92	0.92
89	1.3	9.17	1.15	10.13	1.01	4.43	1.33	7.69	1.12	14.45	0.96
90	1.4	10.35	1.3	11.59	1.17	5.4	1.54	8.54	1.22	15.84	1.22
91	1.35	12.07	1.36	13.73	1.26	6.87	1.54	9.91	1.21	17.76	1.38
92	1.36	8.03	1.2	8.92	1.13	3.19	1.57	6.77	1.2	13.24	1
93	1.4	9.16	1.29	10.36	1.15	4.06	1.77	7.74	1.27	14.48	0.99
94	1.16	9.41	1.22	10.51	1.11	4.5	1.78	7.9	1.19	14.77	0.83
95	1.36	9.16	1.25	10.37	1.03	4.01	1.71	7.78	1.25	14.45	0.99
96	1.28	8.85	1.25	10.12	1.07	3.72	1.89	7.29	1.22	14.25	0.96
97	1.42	9.85	1.22	10.96	1.11	5.25	1.42	8.14	1.3	15.08	1.02
98	1.18	9.95	1.31	11.15	1.23	4.96	1.91	8.29	1.2	15.44	0.83
99	1.32	9.03	1.17	10.06	1.12	4.19	1.41	7.58	1.13	14.31	0.94
100	1.34	9.66	1.27	10.81	1.17	4.78	1.71	8.04	1.21	14.98	1
101	1.28	10.6	1.23	12.04	1	5.52	1.49	8.79	1.34	16.05	0.97
102	1.41	9.31	1.32	10.19	1.19	4.44	1.51	7.94	1.39	14.65	1.04
103	1.66	10.6	1.32	11.96	1.14	5.77	1.55	8.65	1.3	15.98	1.17
104	1.49	11.94	1.33	13.03	1.21	7.05	1.54	9.94	1.34	17.74	1.11
105	1.25	8	1.2	8.94	1.13	3.14	1.54	6.67	1.22	13.2	0.84

Index	CMIP	Model	Scenario	Run	30_Year	Ann_ PPT_avg	Ann_ PPT_sd	SON PPT_avg	SON PPT_sd	DJF PPT_avg	DJF PPT_sd	MAM PPT_avg	MAM PPT_sd
106	CMIP5	canesm2	rcp26	run1	2010_2039	1.98	1.61	1.74	1.48	4.46	4.35	1.55	1.1
107	CMIP5	canesm2	rcp26	run1	2040_2069	2.05	1.77	1.28	1.15	4.72	4.24	2.06	1.52
108	CMIP5	canesm2	rcp26	run1	2070_2099	1.84	1.44	1.14	0.95	4.4	3.78	1.77	1.41
109	CMIP5	canesm2	rcp45	run1	2010_2039	1.91	1.46	1.46	1.26	4.46	3.51	1.58	1.42
110	CMIP5	canesm2	rcp45	run1	2040_2069	1.98	1.53	1.43	1.18	4.66	3.38	1.66	1.41
111	CMIP5	canesm2	rcp45	run1	2070_2099	2.05	1.51	1.16	1.11	5.18	3.47	1.75	1.49
112	CMIP5	canesm2	rcp85	run1	2010_2039	1.85	1.52	1.4	1.35	4.33	3.21	1.63	1.6
113	CMIP5	canesm2	rcp85	run1	2040_2069	2.27	1.8	1.56	1.29	5.57	4.73	1.78	1.3
114	CMIP5	canesm2	rcp85	run1	2070_2099	2.42	1.86	1.37	1.18	6.47	5.24	1.43	1.38
115	CMIP5	ccsm4	historical	run1	1970_1999	1.73	1.27	1.34	1.1	3.79	2.65	1.72	1.15
116	CMIP5	ccsm4	rcp26	run1	2010_2039	1.66	1.3	1.19	1	3.94	3.1	1.42	1.17
117	CMIP5	ccsm4	rcp26	run1	2040_2069	1.86	1.33	1.18	0.98	4.37	2.94	1.8	1.48
118	CMIP5	ccsm4	rcp26	run1	2070_2099	1.68	1.32	1.24	1.17	3.92	2.98	1.5	1.27
119	CMIP5	ccsm4	rcp45	run1	2010_2039	1.7	1.38	1.24	1.32	4.12	2.9	1.38	1.32
120	CMIP5	ccsm4	rcp45	run1	2040_2069	1.81	1.39	1.21	1.02	4.45	3.44	1.59	1.32
121	CMIP5	ccsm4	rcp45	run1	2070_2099	1.81	1.33	1.19	1.21	4.46	2.96	1.44	1.22
122	CMIP5	ccsm4	rcp60	run1	2010_2039	1.69	1.23	1.15	0.99	4.24	2.75	1.3	1.17
123	CMIP5	ccsm4	rcp60	run1	2040_2069	1.78	1.36	1.37	1.29	4.2	2.7	1.44	1.24
124	CMIP5	ccsm4	rcp60	run1	2070_2099	2.13	1.52	1.42	1.28	5.12	3.13	1.86	1.48
125	CMIP5	ccsm4	rcp85	run1	2010_2039	1.84	1.44	1.17	1.23	4.33	3.09	1.76	1.46
126	CMIP5	ccsm4	rcp85	run1	2040_2069	1.71	1.28	1.1	0.98	4.03	2.67	1.54	1.31
127	CMIP5	ccsm4	rcp85	run1	2070_2099	1.86	1.51	1.11	0.94	4.58	3.39	1.63	1.58
128	CMIP5	cnrm-cm5	historical	run1	1970_1999	1.77	1.31	1.41	1.15	4.04	2.64	1.54	1.26
129	CMIP5	cnrm-cm5	rcp45	run1	2010_2039	2.2	1.59	1.42	1.32	5.56	4.21	1.71	1.17
130	CMIP5	cnrm-cm5	rcp45	run1	2040_2069	2.14	1.57	1.45	1.32	5.45	3.44	1.53	1.1
131	CMIP5	cnrm-cm5	rcp45	run1	2070_2099	2.25	1.76	1.37	1.35	5.88	4.56	1.78	1.28
132	CMIP5	cnrm-cm5	rcp85	run1	2010_2039	2.24	1.6	1.47	1.55	5.81	3.31	1.6	1.22
133	CMIP5	cnrm-cm5	rcp85	run1	2040_2069	2.15	1.71	1.6	1.33	5.16	3.95	1.75	1.34
134	CMIP5	cnrm-cm5	rcp85	run1	2070_2099	2.36	1.7	1.59	1.37	6.35	4.06	1.43	0.98
135	CMIP5	csiro-mk3-6-0	historical	run1	1970_1999	1.65	1.29	1.34	1.1	3.52	2.62	1.67	1.29
136	CMIP5	csiro-mk3-6-0	rcp26	run1	2010_2039	1.79	1.44	1.22	1.27	4.35	2.98	1.46	1.14
137	CMIP5	csiro-mk3-6-0	rcp26	run1	2040_2069	1.57	1.24	1.01	0.86	3.64	2.34	1.54	1.22
138	CMIP5	csiro-mk3-6-0	rcp26	run1	2070_2099	1.88	1.59	1.44	1.26	4.08	3.46	1.84	1.55
139	CMIP5	csiro-mk3-6-0	rcp45	run1	2010_2039	1.61	1.22	1.05	0.97	3.74	2.36	1.52	1.11
140	CMIP5	csiro-mk3-6-0	rcp45	run1	2040_2069	1.55	1.19	0.9	1	3.67	2.57	1.42	1.04
141	CMIP5	csiro-mk3-6-0	rcp45	run1	2070_2099	1.69	1.36	1.36	1.45	3.99	2.88	1.37	1.06
142	CMIP5	csiro-mk3-6-0	rcp60	run1	2010_2039	1.78	1.29	1.04	0.97	4.37	2.55	1.62	1.05
143	CMIP5	csiro-mk3-6-0	rcp60	run1	2040_2069	1.78	1.37	1.14	1.11	4.52	2.98	1.35	0.95
144	CMIP5	csiro-mk3-6-0	rcp60	run1	2070_2099	1.78	1.3	1.16	1.15	3.96	2.61	1.86	1.32
145	CMIP5	csiro-mk3-6-0	rcp85	run1	2010_2039	1.63	1.42	1.18	1.15	3.54	2.57	1.71	1.44
146	CMIP5	csiro-mk3-6-0	rcp85	run1	2040_2069	1.73	1.47	1.1	1.27	4.23	2.35	1.51	1.32
147	CMIP5	csiro-mk3-6-0	rcp85	run1	2070_2099	1.89	1.52	1.18	1.29	4.67	3.11	1.58	1.23
148	CMIP5	fgoals-g2	historical	run1	1970_1999	1.88	1.33	1.29	1.12	4.34	2.65	1.74	1.29
149	CMIP5	fgoals-g2	rcp26	run1	2010_2039	1.94	1.26	1.38	1.21	4.34	2.44	1.89	1.25
150	CMIP5	fgoals-g2	rcp26	run1	2040_2069	1.63	1.17	0.96	0.84	3.87	2.62	1.6	1.15
151	CMIP5	fgoals-g2	rcp26	run1	2070_2099	1.8	1.3	1.04	0.98	4.27	2.42	1.82	1.42
152	CMIP5	fgoals-g2	rcp45	run1	2010_2039	1.81	1.28	1.16	1.07	3.94	2.66	2.07	1.45
153	CMIP5	fgoals-g2	rcp45	run1	2040_2069	1.79	1.36	1.09	1.02	4.19	2.85	1.75	1.4
154	CMIP5	fgoals-g2	rcp45	run1	2070_2099	1.67	1.19	1.12	0.91	3.73	2.06	1.8	1.36
155	CMIP5	fgoals-g2	rcp85	run1	2010_2039	1.71	1.19	0.93	0.81	4.03	2.46	1.8	1.32

Index	JJA PPT_avg	JJA PPT_sd	Ann_ Tmax_avg	Ann_ Tmax_sd	SON Tmax_avg	SON Tmax_sd	DJF Tmax_avg	DJF Tmax_sd	MAM Tmax_avg	MAM Tmax_sd	JJA Tmax_avg
106	0.13	0.16	23.58	1.53	25.29	1.53	14.9	1.16	22.01	1.85	32.17
107	0.17	0.2	24.23	1.51	25.8	1.61	15.61	1.22	22.62	1.93	32.86
108	0.13	0.18	24.28	1.41	25.6	1.57	15.8	1.17	22.82	1.54	32.84
109	0.13	0.17	23.58	1.61	25.11	1.59	14.87	1.27	22.33	1.96	32
110	0.17	0.21	24.36	1.44	25.95	1.53	15.5	1.09	22.87	1.75	33.14
111	0.17	0.18	24.89	1.54	26.67	1.61	16	1.03	23.38	2.14	33.49
112	0.11	0.17	23.72	1.66	25.12	1.63	15	1.36	22.36	2.12	32.37
113	0.19	0.21	25.19	1.59	26.75	1.65	16.37	1.27	23.59	1.98	34.04
114	0.32	0.25	26.95	1.65	28.67	1.57	17.64	1.1	25.53	2.08	35.99
115	0.11	0.13	21.9	1.56	23.53	1.56	13.55	1.65	20.29	1.79	30.22
116	0.09	0.08	23.07	1.5	24.56	1.63	14.48	1.4	21.87	1.85	31.37
117	0.13	0.19	22.89	1.54	24.53	1.43	14.59	1.24	21.34	1.9	31.08
118	0.08	0.1	23.15	1.51	24.97	1.6	14.81	1.45	21.48	1.73	31.32
119	0.09	0.13	23.31	1.74	24.87	1.84	14.81	1.59	21.95	2.13	31.62
120	0.1	0.13	23.54	1.6	25.07	1.55	14.94	1.6	22.07	1.85	32.08
121	0.1	0.11	24.06	1.58	25.84	1.64	15.33	1.53	22.52	1.66	32.57
122	0.1	0.12	22.8	1.53	24.85	1.41	13.88	1.37	21.58	1.78	30.91
123	0.1	0.13	23.59	1.52	25.25	1.54	15.09	1.45	22.22	1.76	31.8
124	0.13	0.16	24.12	1.56	25.83	1.65	16	1.27	22.14	1.87	32.49
125	0.11	0.13	22.98	1.68	24.59	1.55	14.52	1.58	21.52	2.02	31.26
126	0.11	0.13	23.93	1.75	25.91	1.64	15.11	1.9	22.29	1.81	32.47
127	0.16	0.22	25.51	1.63	27.52	1.45	16.78	1.57	23.76	1.92	33.99
128	0.11	0.16	21.98	1.6	23.44	1.66	13.58	1.21	20.82	2.03	30.12
129	0.11	0.15	23	1.51	24.71	1.66	14.62	1.19	21.58	1.8	31.14
130	0.1	0.16	23.75	1.57	25.26	1.77	15.34	1.32	22.41	1.84	31.99
131	0.08	0.12	24.35	1.6	26.29	1.53	15.81	1.44	22.49	1.79	32.79
132	0.11	0.16	23.05	1.68	24.85	1.89	14.6	1.31	21.47	2.02	31.25
133	0.1	0.16	24.32	1.77	26.51	1.78	15.62	1.73	22.5	1.95	32.6
134	0.12	0.19	25.86	1.61	27.85	1.6	17.12	1.19	24.24	1.83	34.22
135	0.1	0.12	21.76	1.59	23.31	1.61	13.48	1.33	20.24	2.03	30.03
136	0.11	0.17	23.2	1.59	25.04	1.68	14.67	1.6	21.67	1.72	31.47
137	0.13	0.18	23.73	1.59	25.38	1.56	15.31	1.61	22.19	1.87	32.03
138	0.18	0.21	23.9	1.65	26.08	1.76	15.53	1.72	22.09	1.76	31.92
139	0.09	0.13	22.81	1.61	24.56	1.57	14.1	1.52	21.47	1.94	31.1
140	0.13	0.18	24.45	1.6	26.43	1.81	15.8	1.65	22.87	1.75	32.67
141	0.13	0.21	25.01	1.66	27.21	1.62	16.58	1.34	23.29	2.07	32.96
142	0.12	0.17	22.54	1.55	24.39	1.83	14.07	1.29	20.8	1.68	30.91
143	0.1	0.15	23.67	1.58	25.56	1.61	15.2	1.45	22.07	1.98	31.83
144	0.11	0.15	24.83	1.59	26.85	1.66	16.53	1.25	23.14	2.07	32.81
145	0.09	0.12	22.91	1.79	24.61	1.87	14.59	1.7	21.26	2.1	31.15
146	0.15	0.24	24.73	1.69	27.12	1.74	15.99	1.53	22.85	2.04	32.94
147	0.14	0.17	26.53	1.77	28.92	1.73	17.78	1.39	24.6	2.28	34.79
148	0.1	0.12	21.88	1.63	23.53	1.61	13.7	1.37	20.26	2.06	30.01
149	0.11	0.14	22.52	1.64	24.3	1.72	13.89	1.49	21.15	1.94	30.74
150	0.1	0.13	23.54	1.56	25.54	1.65	15.1	1.26	21.87	2.12	31.67
151	0.11	0.14	23.45	1.62	25.4	1.67	14.64	1.38	21.92	2.08	31.82
152	0.09	0.1	23.17	1.62	25.19	1.61	14.62	1.27	21.46	2.19	31.41
153	0.11	0.16	23.98	1.66	25.77	1.63	15.18	1.27	22.6	2.2	32.37
154	0.06	0.1	24.46	1.62	26.15	1.58	15.52	1.21	23.18	2.4	33.02
155	0.1	0.13	23.3	1.69	25.4	1.93	14.55	1.16	21.78	2.22	31.46

Index	JJA Tmax_sd	Ann_ Tmin_avg	Ann_ Tmin_sd	SON Tmin_avg	SON Tmin_sd	DJF Tmin_avg	DJF Tmin_sd	MAM Tmin_avg	MAM Tmin_sd	JJA Tmin_avg	JJA Tmin_sd
106	1.49	9.45	1.18	10.44	1.03	4.4	1.52	7.93	1.25	15.02	0.98
107	1.28	9.95	1.14	10.68	1.05	4.95	1.39	8.6	1.1	15.53	0.96
108	1.16	9.93	1.07	10.41	1	5.24	1.29	8.66	0.95	15.42	0.92
109	1.42	9.48	1.17	10.42	1.13	4.48	1.4	8.08	1.11	14.93	0.97
110	1.27	10.35	1.18	11.4	1.12	5.23	1.34	8.65	1.12	16.14	1.02
111	1.17	10.77	1.12	11.75	1.05	5.61	1.15	9.21	1.27	16.5	0.88
112	1.34	9.55	1.2	10.41	0.99	4.5	1.41	8.07	1.3	15.23	1.01
113	1.39	11.19	1.28	12.18	1.12	5.99	1.45	9.46	1.29	17.13	1.17
114	1.68	13.05	1.32	14.34	1.21	7.39	1.45	10.98	1.24	19.46	1.32
115	1.25	7.89	1.2	8.83	1.09	3.07	1.66	6.54	1.18	13.11	0.86
116	1.13	8.95	1.28	9.77	1.21	4.05	1.59	7.73	1.36	14.25	0.98
117	1.34	9.19	1.16	9.92	1.02	4.49	1.35	7.85	1.24	14.52	0.91
118	1.28	9.29	1.13	10.3	1.08	4.57	1.66	7.71	1.04	14.6	0.89
119	1.3	9.17	1.39	10.08	1.26	4.45	1.97	7.7	1.38	14.46	1.01
120	1.26	9.36	1.29	10.22	1.02	4.6	1.63	7.88	1.33	14.75	0.98
121	1.37	9.9	1.23	10.91	1.15	5.02	1.65	8.37	1.04	15.31	1.03
122	1.4	8.88	1.22	10.11	0.94	3.69	1.59	7.63	1.19	14.09	1.05
123	1.28	9.67	1.18	10.59	1.03	4.74	1.46	8.34	1.1	14.99	1
124	1.34	10.31	1.11	11.17	1.05	5.85	1.32	8.47	1.09	15.75	0.96
125	1.33	8.97	1.35	9.82	1.16	4.14	1.58	7.64	1.39	14.25	1.05
126	1.4	9.86	1.44	10.98	1.24	4.77	2.07	8.34	1.25	15.4	1.08
127	1.37	11.4	1.31	12.56	1.12	6.36	1.86	9.56	1.22	17.14	0.98
128	1.37	8.01	1.23	8.83	1.05	3.26	1.56	6.84	1.28	13.17	0.98
129	1.22	9.12	1.21	9.92	1.08	4.63	1.68	7.8	1.18	14.15	0.93
130	1.31	9.8	1.24	10.6	1.19	5.27	1.37	8.4	1.2	14.88	1.01
131	1.48	10.45	1.2	11.48	1.11	5.86	1.5	8.81	1.05	15.66	0.99
132	1.37	9.28	1.24	10.27	1.12	4.73	1.33	7.75	1.25	14.35	1.1
133	1.53	10.42	1.39	11.81	1.18	5.56	1.84	8.65	1.21	15.62	1.18
134	1.51	12.11	1.36	13.45	1.29	7.38	1.59	10.13	1.18	17.47	1.19
135	1.29	7.77	1.22	8.66	1.12	2.87	1.56	6.52	1.25	13.07	0.96
136	1.27	9.06	1.23	10.17	1.09	4.14	1.53	7.49	1.23	14.46	0.99
137	1.28	9.51	1.24	10.55	1.02	4.28	1.93	8.1	1.08	15.1	0.94
138	1.41	9.85	1.29	11.31	1.27	4.69	1.72	8.27	1.22	15.12	0.98
139	1.4	8.66	1.26	9.64	1.21	3.53	1.66	7.34	1.2	14.08	1
140	1.26	10.21	1.3	11.46	1.36	4.8	1.54	8.74	1.35	15.78	0.92
141	1.43	10.86	1.22	12.51	1.08	5.6	1.6	9.13	1.21	16.24	0.96
142	1.28	8.61	1.22	9.59	1.1	3.83	1.43	7.05	1.26	13.99	0.96
143	1.25	9.53	1.16	10.74	1.08	4.51	1.34	7.92	1.31	14.93	0.95
144	1.26	10.74	1.29	12.02	1.2	5.64	1.47	9.14	1.43	16.15	0.97
145	1.5	8.78	1.28	9.85	1.3	3.75	1.4	7.26	1.22	14.22	1.12
146	1.31	10.64	1.35	12.34	1.4	5.21	1.31	8.78	1.44	16.24	1.06
147	1.65	12.6	1.46	14.37	1.29	6.97	1.75	10.6	1.47	18.39	1.31
148	1.4	7.97	1.2	8.83	1.02	3.39	1.57	6.65	1.27	12.99	0.95
149	1.48	8.62	1.17	9.67	1.06	3.61	1.6	7.41	1.18	13.79	0.93
150	1.14	9.34	1.07	10.5	1.04	4.51	1.19	7.85	1.2	14.54	0.84
151	1.3	9.24	1.17	10.28	1.07	4.22	1.43	7.83	1.3	14.64	0.91
152	1.35	9.04	1.2	10.28	1.1	4.06	1.53	7.6	1.2	14.25	0.97
153	1.5	9.79	1.12	10.84	1.02	4.66	1.32	8.42	1.3	15.22	1
154	1.19	10.18	1.16	11.24	1.07	4.91	1.34	8.96	1.29	15.64	0.94
155	1.38	9.22	1.18	10.42	1.32	4.12	1.18	7.9	1.18	14.43	1.01

Index	CMIP	Model	Scenario	Run	30_Year	Ann_ PPT_avg	Ann_ PPT_sd	SON PPT_avg	SON PPT_sd	DJF PPT_avg	DJF PPT_sd	MAM PPT_avg	MAM PPT_sd
156	CMIP5	fgoals-g2	rcp85	run1	2040_2069	1.76	1.27	1.07	1.02	4.39	2.73	1.44	1.18
157	CMIP5	fgoals-g2	rcp85	run1	2070_2099	1.67	1.25	0.67	0.59	4.58	2.77	1.33	1.21
158	CMIP5	gfdl-cm3	historical	run1	1970_1999	1.67	1.21	1.26	0.96	3.63	2.55	1.69	1.3
159	CMIP5	gfdl-cm3	rcp26	run1	2010_2039	1.85	1.28	1.2	1.1	4.24	2.63	1.95	1.35
160	CMIP5	gfdl-cm3	rcp26	run1	2040_2069	1.82	1.32	1.12	1	4.19	2.61	1.89	1.72
161	CMIP5	gfdl-cm3	rcp26	run1	2070_2099	1.74	1.16	1.28	0.93	3.74	2.13	1.84	1.38
162	CMIP5	gfdl-cm3	rcp45	run1	2010_2039	1.78	1.26	1.23	1.01	4.08	2.74	1.77	1.41
163	CMIP5	gfdl-cm3	rcp45	run1	2040_2069	1.85	1.31	1.36	1.28	4.11	2.47	1.87	1.41
164	CMIP5	gfdl-cm3	rcp45	run1	2070_2099	1.77	1.23	1.07	1.07	4.37	2.64	1.64	1.19
165	CMIP5	gfdl-cm3	rcp60	run1	2010_2039	1.61	1.23	1.24	1.07	3.37	2.4	1.81	1.35
166	CMIP5	gfdl-cm3	rcp60	run1	2040_2069	1.79	1.29	1.19	0.98	4.13	2.4	1.82	1.5
167	CMIP5	gfdl-cm3	rcp60	run1	2070_2099	1.69	1.19	0.94	0.9	3.99	2.43	1.88	1.4
168	CMIP5	gfdl-cm3	rcp85	run1	2010_2039	1.67	1.19	1.15	0.89	3.98	2.63	1.48	1.25
169	CMIP5	gfdl-cm3	rcp85	run1	2040_2069	1.91	1.23	1.2	1.07	4.44	2.69	1.89	1.33
170	CMIP5	gfdl-cm3	rcp85	run1	2070_2099	1.66	1.29	0.7	0.8	4.15	3	1.81	1.44
171	CMIP5	gfdl-esm2g	historical	run1	1970_1999	1.75	1.27	1.23	1.06	3.9	2.48	1.81	1.3
172	CMIP5	gfdl-esm2g	rcp26	run1	2010_2039	1.85	1.26	1.34	1.01	4.25	3.47	1.76	1.24
173	CMIP5	gfdl-esm2g	rcp26	run1	2040_2069	1.74	1.22	1.28	1.06	3.9	2.64	1.65	1.16
174	CMIP5	gfdl-esm2g	rcp26	run1	2070_2099	1.86	1.49	1.36	1.32	4.21	3.53	1.77	1.16
175	CMIP5	gfdl-esm2g	rcp45	run1	2010_2039	1.78	1.37	1.03	0.88	4.56	3.96	1.39	1.02
176	CMIP5	gfdl-esm2g	rcp45	run1	2040_2069	1.75	1.49	1.33	1.25	4.14	3.52	1.5	1.2
177	CMIP5	gfdl-esm2g	rcp45	run1	2070_2099	1.73	1.37	1.47	1.3	3.63	3.06	1.74	1.37
178	CMIP5	gfdl-esm2g	rcp60	run1	2010_2039	1.81	1.52	1.47	1.47	4.14	3.54	1.54	1.18
179	CMIP5	gfdl-esm2g	rcp60	run1	2040_2069	1.81	1.47	1.41	1.37	3.96	3.03	1.76	1.23
180	CMIP5	gfdl-esm2g	rcp60	run1	2070_2099	1.82	1.47	1.3	1.12	4.12	3.34	1.77	1.4
181	CMIP5	gfdl-esm2g	rcp85	run1	2010_2039	1.92	1.48	1.41	1.19	4.67	3.88	1.52	1.14
182	CMIP5	gfdl-esm2g	rcp85	run1	2040_2069	1.71	1.39	1.19	1.25	3.96	3.2	1.64	1.27
183	CMIP5	gfdl-esm2g	rcp85	run1	2070_2099	1.76	1.38	0.92	0.98	4.7	4.32	1.41	1.05
184	CMIP5	gfdl-esm2m	historical	run1	1970_1999	1.74	1.25	1.26	1.04	3.86	2.69	1.79	1.3
185	CMIP5	gfdl-esm2m	rcp26	run1	2010_2039	1.6	1.27	1.36	1.19	3.46	2.42	1.43	1.04
186	CMIP5	gfdl-esm2m	rcp26	run1	2040_2069	1.83	1.51	1.63	1.5	4.14	3.3	1.43	1.2
187	CMIP5	gfdl-esm2m	rcp26	run1	2070_2099	1.81	1.45	1.4	1.38	4.37	3.15	1.39	1.07
188	CMIP5	gfdl-esm2m	rcp45	run1	2010_2039	1.69	1.42	1.42	1.59	3.72	2.96	1.54	1.18
189	CMIP5	gfdl-esm2m	rcp45	run1	2040_2069	1.7	1.31	1.32	1.32	4.05	2.48	1.3	1
190	CMIP5	gfdl-esm2m	rcp45	run1	2070_2099	1.63	1.38	1.16	1.18	4	2.91	1.31	1.05
191	CMIP5	gfdl-esm2m	rcp60	run1	2010_2039	1.6	1.23	1.3	1.13	3.48	2.49	1.53	1.16
192	CMIP5	gfdl-esm2m	rcp60	run1	2040_2069	1.68	1.36	1.37	1.5	3.87	3.24	1.39	0.88
193	CMIP5	gfdl-esm2m	rcp60	run1	2070_2099	1.71	1.38	1.34	1.45	4.21	3.05	1.27	1.04
194	CMIP5	gfdl-esm2m	rcp85	run1	2010_2039	1.75	1.41	1.47	1.43	3.96	2.5	1.37	1.06
195	CMIP5	gfdl-esm2m	rcp85	run1	2040_2069	1.5	1.28	1.2	1.37	3.3	2.83	1.47	1.09
196	CMIP5	gfdl-esm2m	rcp85	run1	2070_2099	1.57	1.18	0.93	1.06	4.05	2.56	1.29	0.97
197	CMIP5	giss-e2-r	historical	run1	1970_1999	1.84	1.31	1.51	1.2	4.16	2.68	1.63	1.3
198	CMIP5	giss-e2-r	rcp26	run1	2010_2039	2.05	1.45	1.34	1.13	4.62	3.33	2.2	1.32
199	CMIP5	giss-e2-r	rcp26	run1	2040_2069	2.01	1.51	1.54	1.26	4.72	3.07	1.7	1.41
200	CMIP5	giss-e2-r	rcp26	run1	2070_2099	2.13	1.39	1.57	1.2	4.62	2.88	2.27	1.46
201	CMIP5	giss-e2-r	rcp45	run1	2010_2039	2.03	1.43	1.31	1.25	4.56	3.12	2.12	1.29
202	CMIP5	giss-e2-r	rcp45	run1	2040_2069	2.07	1.63	1.43	1.2	4.49	3.55	2.33	1.56
203	CMIP5	giss-e2-r	rcp45	run1	2070_2099	1.91	1.38	1.34	1.2	4.35	2.66	1.89	1.17
204	CMIP5	giss-e2-r	rcp60	run1	2010_2039	1.94	1.42	1.26	1.05	4.21	3	2.12	1.42
205	CMIP5	giss-e2-r	rcp60	run1	2040_2069	2.23	1.59	1.46	1.32	5.2	3.15	2.16	1.4
206	CMIP5	giss-e2-r	rcp60	run1	2070_2099	1.79	1.44	1.06	0.99	4.17	3.03	1.84	1.47
207	CMIP5	giss-e2-r	rcp85	run1	2010_2039	1.9	1.38	1.38	1.07	4.21	2.81	1.9	1.49

Index	JJA PPT_avg	JJA PPT_sd	Ann_ Tmax_avg	Ann_ Tmax_sd	SON Tmax_avg	SON Tmax_sd	DJF Tmax_avg	DJF Tmax_sd	MAM Tmax_avg	MAM Tmax_sd	JJA Tmax_avg
156	0.08	0.13	24.74	1.7	26.86	1.82	15.59	1.33	23.33	2.34	33.14
157	0.05	0.07	26.27	1.71	29	1.72	16.74	1.28	24.51	2.55	34.84
158	0.1	0.15	21.88	1.53	23.52	1.5	13.47	1.68	20.43	1.83	30.06
159	0.06	0.1	23.43	1.7	25.37	2.01	14.68	1.65	21.53	1.93	32.19
160	0.07	0.09	24.06	1.56	25.89	1.5	15.32	1.45	22.3	1.98	32.8
161	0.08	0.14	24.17	1.54	26.43	1.64	15.4	1.41	22.19	1.85	32.68
162	0.06	0.08	23.41	1.57	25.22	1.39	14.82	1.65	21.57	1.9	32.01
163	0.07	0.13	24.67	1.48	26.94	1.65	15.7	1.38	22.62	1.73	33.48
164	0.04	0.06	25.32	1.52	27.93	1.86	16.01	1.08	22.87	1.77	34.5
165	0.07	0.1	23.12	1.79	24.93	1.89	14.31	1.75	21.58	2.1	31.64
166	0.06	0.09	24.27	1.48	26.18	1.44	15.53	1.37	22.47	1.78	32.91
167	0.04	0.06	25.45	1.56	28.08	1.66	16.36	1.7	23.19	1.67	34.19
168	0.05	0.06	23.56	1.72	25.58	1.57	14.63	1.66	21.86	2.23	32.11
169	0.05	0.06	25.23	1.56	27.75	1.58	16.18	1.49	22.92	1.87	34.07
170	0.04	0.05	27.1	1.8	30	1.74	17.39	1.94	24.82	2.33	36.2
171	0.09	0.12	21.87	1.59	23.49	1.7	13.52	1.46	20.4	1.94	30.05
172	0.06	0.09	23.38	1.57	25.03	1.46	14.82	1.51	21.93	1.87	31.72
173	0.11	0.17	23.57	1.72	25.22	1.61	15.41	1.59	21.93	2.08	31.75
174	0.11	0.15	23.16	1.63	24.91	1.43	14.91	1.7	21.79	1.88	30.98
175	0.08	0.12	23.27	1.69	25.12	1.66	14.91	1.59	21.55	2.18	31.49
176	0.1	0.13	24.19	1.51	25.3	1.49	15.81	1.4	22.81	1.78	32.82
177	0.13	0.17	24.33	1.63	26.06	1.44	15.94	1.56	22.78	1.96	32.58
178	0.11	0.16	23.28	1.47	24.93	1.48	14.84	1.42	21.74	1.66	31.63
179	0.13	0.2	23.79	1.61	25.67	1.71	15.55	1.54	21.82	1.74	32.15
180	0.1	0.13	24.71	1.64	26.68	1.64	16.16	1.21	22.92	2.16	33.1
181	0.09	0.11	23.3	1.57	24.68	1.5	15.13	1.36	21.77	1.91	31.62
182	0.08	0.12	24.55	1.64	25.96	1.66	15.84	1.46	23.14	1.87	33.27
183	0.07	0.11	26.4	1.65	28.44	1.66	17.47	1.61	24.63	1.89	35.06
184	0.1	0.1	21.91	1.59	23.65	1.64	13.58	1.35	20.37	2	30.05
185	0.1	0.15	23.03	1.56	24.82	1.67	14.16	1.62	21.69	1.68	31.44
186	0.1	0.11	23.17	1.61	24.88	1.57	14.46	1.61	21.71	1.99	31.7
187	0.1	0.14	23.27	1.6	24.8	1.61	14.55	1.32	22.04	2.08	31.69
188	0.09	0.1	22.97	1.51	24.62	1.47	14.47	1.32	21.41	1.91	31.41
189	0.09	0.13	23.54	1.62	25.05	1.33	14.75	1.58	22.2	2.26	32.22
190	0.09	0.11	23.93	1.65	25.67	1.58	14.95	1.78	22.44	1.92	32.66
191	0.1	0.13	22.76	1.64	24.43	1.59	13.97	1.61	21.46	2.14	31.18
192	0.08	0.12	23.47	1.63	25.12	1.73	14.68	1.66	21.99	1.97	32.09
193	0.05	0.07	24.36	1.55	25.9	1.55	15.05	1.59	23.14	1.85	33.37
194	0.09	0.12	23.14	1.68	24.69	1.82	14.08	1.87	21.82	1.85	31.95
195	0.06	0.08	24.29	1.64	26.2	1.63	15.11	1.59	22.62	2.16	33.2
196	0.06	0.08	25.64	1.66	28.05	1.79	16.26	1.12	23.73	2.2	34.53
197	0.1	0.12	21.7	1.57	23.1	1.59	13.39	1.41	20.19	1.91	30.12
198	0.09	0.12	22.62	1.63	24.83	1.85	14	1.26	20.77	1.93	30.87
199	0.1	0.11	22.55	1.46	24	1.32	13.98	1.27	21.03	1.89	31.19
200	0.08	0.12	22.38	1.46	24.19	1.55	14.13	1.29	20.63	1.74	30.55
201	0.09	0.1	22.55	1.5	24.43	1.63	14.13	1.33	20.79	1.8	30.86
202	0.09	0.11	22.85	1.57	24.39	1.51	14.63	1.49	20.94	2.07	31.42
203	0.09	0.13	23.26	1.45	24.89	1.65	14.67	1.25	21.7	1.58	31.77
204	0.08	0.13	22.59	1.66	24.43	1.68	14	1.29	20.74	2.09	31.16
205	0.09	0.12	22.91	1.54	24.71	1.67	14.41	1.36	21.02	1.72	31.47
206	0.07	0.11	23.67	1.52	25.6	1.46	14.91	1.32	21.94	1.99	32.25
207	0.1	0.12	22.59	1.62	24.45	1.68	13.87	1.74	21.07	1.83	30.94

Index	JJA Tmax_sd	Ann_ Tmin_avg	Ann_ Tmin_sd	SON Tmin_avg	SON Tmin_sd	DJF Tmin_avg	DJF Tmin_sd	MAM Tmin_avg	MAM Tmin_sd	JJA Tmin_avg	JJA Tmin_sd
156	1.33	10.48	1.24	11.87	1.23	5.05	1.39	8.93	1.31	16.02	1.04
157	1.23	11.83	1.23	13.52	1.28	6.31	1.27	10.07	1.36	17.42	1.02
158	1.21	7.88	1.22	8.83	1.06	3.02	1.73	6.63	1.3	13.05	0.9
159	1.17	8.96	1.35	10.15	1.36	3.96	1.8	7.55	1.28	14.22	1.05
160	1.27	9.6	1.19	10.65	1.04	4.65	1.41	8.15	1.3	15	0.93
161	1.09	9.61	1.07	11.07	1.11	4.51	1.03	8.04	1.14	14.81	0.85
162	1.39	8.86	1.25	9.93	1.14	3.99	1.64	7.4	1.33	14.11	1.05
163	1.1	9.91	1.16	11.26	1.06	4.97	1.58	8.17	1.07	15.29	0.93
164	1.09	10.21	1.09	11.85	1	5.18	1.5	8.25	1.06	15.57	0.81
165	1.42	8.76	1.32	9.88	1.26	3.48	1.78	7.49	1.3	14.17	1.06
166	1.26	9.64	1.16	10.78	1.05	4.63	1.73	8.17	1.14	14.99	0.91
167	1.12	10.53	1.26	12.03	1.18	5.31	1.67	8.83	1.16	15.98	1.05
168	1.3	8.96	1.21	10.22	1	3.91	1.76	7.36	1.26	14.31	0.93
169	1.19	10.38	1.27	11.83	1.29	5.43	1.64	8.41	1.25	15.83	0.89
170	1.32	11.6	1.23	13.23	1.11	6.14	1.63	9.74	1.27	17.31	0.91
171	1.27	7.88	1.19	8.76	1.08	3.08	1.61	6.62	1.26	13.04	0.91
172	1.28	8.88	1.24	9.84	0.99	4.16	1.72	7.73	1.25	13.78	0.97
173	1.45	9.11	1.37	9.9	1.06	4.75	1.84	7.83	1.35	13.97	1.2
174	1.44	8.83	1.29	9.76	1.03	4.38	1.9	7.77	1.28	13.35	1.02
175	1.2	8.87	1.32	9.91	1.18	4.3	1.71	7.34	1.41	13.92	0.94
176	1.35	9.48	1.28	10.12	1.17	4.99	1.63	8.23	1.21	14.6	1.16
177	1.42	9.44	1.21	10.37	0.98	5.05	1.73	8.33	1.13	14.05	1.02
178	1.23	8.9	1.17	9.88	1.08	4.18	1.54	7.64	1.18	13.91	0.92
179	1.27	9.21	1.26	10.34	1.05	4.73	1.69	7.75	1.29	14.05	0.95
180	1.47	9.88	1.25	10.9	1.16	5.36	1.33	8.55	1.33	14.71	1.1
181	1.43	8.85	1.22	9.62	1.06	4.45	1.52	7.47	1.28	13.84	1.04
182	1.53	9.66	1.27	10.16	1.18	5.17	1.66	8.65	1.21	14.67	1.09
183	1.31	11.06	1.3	12.11	1.14	6.62	1.77	9.71	1.24	15.82	0.98
184	1.27	7.89	1.21	8.9	1.08	3.09	1.59	6.57	1.26	13.02	0.9
185	1.26	8.63	1.22	9.69	0.99	3.51	1.73	7.48	1.16	13.81	0.87
186	1.21	8.76	1.3	9.77	1.02	3.94	1.77	7.53	1.29	13.86	0.91
187	1.22	8.91	1.27	9.65	1.04	4.11	1.56	7.86	1.47	14.01	0.87
188	1.25	8.64	1.2	9.6	0.97	3.73	1.47	7.35	1.26	13.89	0.93
189	1.37	8.91	1.23	9.68	0.92	4.11	1.63	7.72	1.35	14.19	1.01
190	1.27	9.07	1.19	9.85	0.95	4.29	1.78	7.82	1.16	14.32	0.84
191	1.27	8.51	1.24	9.46	1.02	3.32	1.69	7.5	1.33	13.76	0.9
192	1.17	8.98	1.25	9.86	1.06	4.13	1.73	7.78	1.29	14.16	0.83
193	1.08	9.59	1.21	10.47	1.07	4.49	1.77	8.51	1.01	14.89	0.82
194	1.19	8.76	1.39	9.78	1.27	3.49	1.97	7.43	1.37	14.28	0.91
195	1.12	9.49	1.31	10.55	1.06	4.37	1.81	8.24	1.49	14.75	0.81
196	1.31	10.49	1.31	11.83	1.23	5.49	1.48	8.95	1.4	15.67	0.97
197	1.36	7.74	1.21	8.56	1.08	2.98	1.55	6.34	1.21	13.08	1
198	1.24	8.55	1.25	9.93	1.26	3.56	1.37	7.01	1.26	13.67	0.96
199	1.23	8.36	1.13	9.17	0.8	3.38	1.48	6.92	1.16	13.95	0.95
200	1.18	8.34	1.13	9.48	1.12	3.67	1.43	6.88	1.07	13.34	0.93
201	1.21	8.56	1.19	9.62	1.02	3.77	1.53	7.03	1.3	13.8	0.94
202	1.18	8.89	1.27	9.8	1.03	4.2	1.72	7.28	1.34	14.26	0.92
203	1.18	9.23	1.15	10.2	1.03	4.23	1.63	7.85	1.06	14.66	0.86
204	1.4	8.59	1.31	9.71	1.05	3.63	1.83	7.01	1.31	13.93	1.03
205	1.23	8.98	1.19	10.07	1.02	4.18	1.45	7.26	1.2	14.37	0.88
206	1.23	9.44	1.2	10.62	0.97	4.27	1.43	7.96	1.33	14.91	0.93
207	1.26	8.55	1.3	9.62	1.23	3.59	1.8	7.15	1.17	13.86	0.98

Index	CMIP	Model	Scenario	Run	30_Year	Ann_ PPT_avg	Ann_ PPT_sd	SON PPT_avg	SON PPT_sd	DJF PPT_avg	DJF PPT_sd	MAM PPT_avg	MAM PPT_sd
208	CMIP5	giss-e2-r	rcp85	run1	2040_2069	2.09	1.56	1.24	1.04	4.96	3.48	2.09	1.78
209	CMIP5	giss-e2-r	rcp85	run1	2070_2099	1.82	1.42	1.11	0.99	4.37	3.47	1.76	1.24
210	CMIP5	hadgem2-cc	historical	run1	1970_1999	1.7	1.32	1.35	1.07	3.71	2.76	1.6	1.31
211	CMIP5	hadgem2-cc	rcp45	run1	2010_2039	1.61	1.18	1.27	0.99	3.37	2.14	1.68	1.52
212	CMIP5	hadgem2-cc	rcp45	run1	2040_2069	1.9	1.4	1.19	1.11	4.58	2.57	1.57	1.19
213	CMIP5	hadgem2-cc	rcp45	run1	2070_2099	1.78	1.5	1.4	1.43	4.02	3.32	1.56	1.3
214	CMIP5	hadgem2-es	historical	run1	1970_1999	1.8	1.31	1.54	1.17	3.89	2.66	1.7	1.2
215	CMIP5	hadgem2-es	rcp26	run1	2010_2039	1.63	1.4	0.97	0.98	3.71	3.21	1.74	1.52
216	CMIP5	hadgem2-es	rcp26	run1	2040_2069	1.72	1.38	1.23	1.17	3.74	2.96	1.87	1.45
217	CMIP5	hadgem2-es	rcp26	run1	2070_2099	1.74	1.26	1.13	0.98	3.85	2.69	1.83	1.42
218	CMIP5	hadgem2-es	rcp45	run1	2010_2039	1.88	1.34	1.15	0.98	4.38	3.01	1.95	1.38
219	CMIP5	hadgem2-es	rcp45	run1	2040_2069	1.78	1.49	1.22	1.13	4.14	3.4	1.64	1.32
220	CMIP5	hadgem2-es	rcp45	run1	2070_2099	1.74	1.33	1.03	0.81	4.23	3.16	1.65	1.29
221	CMIP5	hadgem2-es	rcp60	run1	2010_2039	1.78	1.4	1.23	0.92	3.81	3.11	2	1.44
222	CMIP5	hadgem2-es	rcp60	run1	2040_2069	1.73	1.45	1.25	1.01	4.04	3.68	1.59	1.09
223	CMIP5	hadgem2-es	rcp60	run1	2070_2099	1.98	1.5	1.2	1.01	4.82	3.39	1.85	1.57
224	CMIP5	hadgem2-es	rcp85	run1	2010_2039	1.92	1.47	1.36	1.08	4.26	3.01	2	1.63
225	CMIP5	hadgem2-es	rcp85	run1	2040_2069	1.63	1.28	1.18	1.08	3.41	2.68	1.81	1.34
226	CMIP5	hadgem2-es	rcp85	run1	2070_2099	1.97	1.56	1.01	1.27	5.29	4.04	1.44	1.01
227	CMIP5	inmcm4	historical	run1	1970_1999	1.66	1.29	1.13	1.05	3.65	2.78	1.74	1.25
228	CMIP5	inmcm4	rcp45	run1	2010_2039	1.88	1.48	1.47	1.14	4.24	3.34	1.7	1.35
229	CMIP5	inmcm4	rcp45	run1	2040_2069	1.9	1.4	1.51	1.23	4.49	3.4	1.51	1.12
230	CMIP5	inmcm4	rcp45	run1	2070_2099	1.84	1.37	1.44	1	4.22	3.65	1.67	1.35
231	CMIP5	inmcm4	rcp85	run1	2010_2039	1.73	1.25	1.48	1.13	3.99	3.18	1.4	0.89
232	CMIP5	inmcm4	rcp85	run1	2040_2069	1.75	1.35	1.34	0.94	4.05	3.3	1.53	1.3
233	CMIP5	inmcm4	rcp85	run1	2070_2099	2.21	1.64	1.44	1.01	5.41	4.6	1.98	1.41
234	CMIP5	ipsl-cm5a-lr	historical	run1	1970_1999	1.67	1.28	1.39	1.12	3.58	2.63	1.53	1.09
235	CMIP5	ipsl-cm5a-lr	rcp45	run1	2010_2039	1.75	1.45	1.57	1.27	3.9	3.08	1.45	1.32
236	CMIP5	ipsl-cm5a-lr	rcp45	run1	2040_2069	1.67	1.43	1.3	1.05	3.81	3.53	1.54	1.15
237	CMIP5	ipsl-cm5a-lr	rcp45	run1	2070_2099	1.74	1.47	1.08	0.96	4.3	4.03	1.51	1.21
238	CMIP5	ipsl-cm5a-lr	rcp60	run1	2010_2039	1.74	1.48	1.32	1.11	3.89	3.66	1.68	1.25
239	CMIP5	ipsl-cm5a-lr	rcp60	run1	2040_2069	1.74	1.4	1.07	0.96	3.96	3.46	1.79	1.39
240	CMIP5	ipsl-cm5a-lr	rcp60	run1	2070_2099	1.92	1.67	1.17	1.04	4.74	4.43	1.72	1.52
241	CMIP5	ipsl-cm5a-lr	rcp85	run1	2010_2039	1.87	1.42	1.02	0.85	4.62	3.89	1.72	1.33
242	CMIP5	ipsl-cm5a-lr	rcp85	run1	2040_2069	1.66	1.34	1.03	1.01	3.98	3.37	1.56	1.2
243	CMIP5	ipsl-cm5a-lr	rcp85	run1	2070_2099	2.2	1.73	1	0.88	5.88	4.51	1.85	1.72
244	CMIP5	ipsl-cm5a-mr	historical	run1	1970_1999	1.82	1.3	1.28	1.05	4.13	2.64	1.78	1.44
245	CMIP5	ipsl-cm5a-mr	rcp26	run1	2010_2039	1.78	1.36	1.04	1.05	4.23	3.25	1.73	1.25
246	CMIP5	ipsl-cm5a-mr	rcp26	run1	2040_2069	1.98	1.45	1.19	1.07	4.67	3.58	1.88	1.1
247	CMIP5	ipsl-cm5a-mr	rcp26	run1	2070_2099	1.72	1.27	1.13	0.97	4.14	2.79	1.53	1.08
248	CMIP5	ipsl-cm5a-mr	rcp45	run1	2010_2039	2.01	1.35	1.2	1.1	4.85	2.99	1.83	1.12
249	CMIP5	ipsl-cm5a-mr	rcp45	run1	2040_2069	1.65	1.36	1.13	1.22	3.98	3.19	1.43	1.06
250	CMIP5	ipsl-cm5a-mr	rcp45	run1	2070_2099	1.99	1.54	1.2	1.04	4.82	3.69	1.83	1.36
251	CMIP5	ipsl-cm5a-mr	rcp85	run1	2010_2039	1.85	1.48	1.29	1.13	4.34	3.82	1.55	1.05
252	CMIP5	ipsl-cm5a-mr	rcp85	run1	2040_2069	1.78	1.43	1.22	1.17	4.29	3.34	1.56	1.3
253	CMIP5	ipsl-cm5a-mr	rcp85	run1	2070_2099	1.97	1.56	1.11	1.05	4.97	3.94	1.67	1.24
254	CMIP5	miroc-esm-chem	historical	run1	1970_1999	1.7	1.3	1.34	1.17	3.67	2.91	1.68	1.16
255	CMIP5	miroc-esm-chem	rcp26	run1	2010_2039	1.68	1.37	0.99	0.87	3.66	3.08	1.93	1.42
256	CMIP5	miroc-esm-chem	rcp26	run1	2040_2069	1.62	1.35	1.33	1.12	3.43	3.15	1.58	1.25
257	CMIP5	miroc-esm-chem	rcp26	run1	2070_2099	1.54	1.33	1.01	0.91	3.3	2.76	1.73	1.53
258	CMIP5	miroc-esm-chem	rcp45	run1	2010_2039	1.49	1.21	1.06	1.05	3.27	2.37	1.57	1.15

Index	JJA PPT_avg	JJA PPT_sd	Ann_ Tmax_avg	Ann_ Tmax_sd	SON Tmax_avg	SON Tmax_sd	DJF Tmax_avg	DJF Tmax_sd	MAM Tmax_avg	MAM Tmax_sd	JJA Tmax_avg
208	0.06	0.09	23.5	1.63	25.18	1.54	14.72	1.58	21.63	2.06	32.47
209	0.06	0.07	24.59	1.5	26.32	1.48	15.53	1.28	22.93	1.91	33.56
210	0.1	0.11	22.03	1.56	23.55	1.6	13.75	1.52	20.81	1.88	30.09
211	0.09	0.12	23.03	1.68	24.93	1.51	14.52	1.9	21.46	2.05	31.24
212	0.09	0.11	24.08	1.58	25.86	1.62	15.51	1.59	22.53	1.7	32.42
213	0.11	0.13	24.9	1.49	27.09	1.61	16.2	1.55	23.14	1.51	33.19
214	0.11	0.16	21.93	1.58	23.5	1.6	13.66	1.53	20.53	1.85	30.03
215	0.07	0.07	23.67	1.8	25.67	1.69	15.12	1.78	21.88	2.24	32.02
216	0.09	0.11	23.83	1.6	26.09	1.44	15.32	1.6	21.83	2.17	32.09
217	0.1	0.12	23.89	1.68	25.96	1.55	15.19	1.44	22.2	2.3	32.24
218	0.09	0.09	23.16	1.59	24.89	1.51	14.56	1.6	21.46	1.96	31.68
219	0.1	0.12	24.41	1.6	26.4	1.64	15.65	1.37	22.65	2.06	32.98
220	0.09	0.11	25.31	1.51	27.63	1.41	16.5	1.4	23.4	2.02	33.7
221	0.11	0.16	23.17	1.58	24.89	1.26	14.63	1.47	21.61	2.21	31.55
222	0.09	0.13	24.18	1.7	26.1	1.59	15.66	1.35	22.46	2.26	32.48
223	0.08	0.09	25.57	1.73	27.61	1.72	16.76	1.68	23.75	2.06	34.12
224	0.07	0.06	23.43	1.57	25.37	1.39	14.81	1.57	21.59	2.13	31.94
225	0.07	0.08	25.24	1.75	27.36	1.85	16.61	1.72	23.25	2.15	33.75
226	0.1	0.1	27.06	1.56	29.61	1.64	17.99	1.27	25.24	2.02	35.4
227	0.11	0.14	22.1	1.58	23.83	1.56	13.99	1.43	20.54	1.85	30.04
228	0.09	0.09	22.5	1.65	23.96	1.57	14.09	1.65	21.06	2.21	30.9
229	0.09	0.11	23	1.58	24.65	1.64	14.17	1.67	21.46	1.69	31.7
230	0.08	0.11	23.43	1.5	25.01	1.34	14.61	1.41	21.51	2.03	32.62
231	0.09	0.13	22.74	1.54	24.31	1.75	14.1	1.42	21.15	1.62	31.38
232	0.09	0.12	23.68	1.66	25.24	1.47	14.76	1.56	22.29	2.09	32.41
233	0.06	0.09	24.61	1.72	26.43	1.73	15.59	1.69	22.31	2.21	34.07
234	0.09	0.13	21.98	1.59	23.43	1.64	13.81	1.41	20.46	1.93	30.21
235	0.06	0.08	23.08	1.69	24.59	1.6	14.72	1.66	21.71	1.87	31.31
236	0.09	0.13	24.36	1.68	25.78	1.68	16.05	2.02	23.15	1.94	32.47
237	0.09	0.15	24.9	1.64	26.19	1.59	16.45	2.02	23.59	1.89	33.39
238	0.12	0.19	23.29	1.66	24.71	1.54	15	2	22.1	1.91	31.4
239	0.11	0.16	24.11	1.72	26.1	1.66	15.75	1.81	22.49	2.14	32.09
240	0.09	0.16	24.96	1.6	26.7	1.6	16.5	1.7	23.52	1.86	33.08
241	0.07	0.12	23.18	1.69	24.73	1.63	14.58	1.57	21.75	2.05	31.64
242	0.09	0.13	25.2	1.9	26.97	1.66	16.42	2.2	23.8	2.22	33.57
243	0.08	0.14	26.86	1.61	29.01	1.77	18.13	1.68	24.99	1.79	35.29
244	0.1	0.13	21.86	1.55	23.52	1.51	13.42	1.26	20.46	1.93	30.04
245	0.12	0.17	22.99	1.57	24.8	1.47	14.53	1.37	21.16	2.03	31.48
246	0.13	0.15	23.1	1.65	25.09	1.61	14.8	1.58	21.28	2.01	31.22
247	0.1	0.13	23.35	1.74	25.23	1.65	15.06	1.68	21.49	2.15	31.61
248	0.15	0.19	23.05	1.71	24.97	1.74	14.46	1.43	21.23	1.93	31.55
249	0.09	0.14	24.15	1.57	26.24	1.51	15.78	1.38	22.29	2.09	32.28
250	0.14	0.21	24.48	1.69	26.4	1.63	15.95	1.86	22.91	2.05	32.66
251	0.14	0.18	23.23	1.74	24.7	1.94	14.95	1.49	21.82	2.03	31.43
252	0.11	0.17	24.83	1.64	26.74	1.85	16.26	1.53	23.06	1.7	33.26
253	0.08	0.12	26.42	1.72	29.09	1.75	17.49	1.73	24.41	1.94	34.68
254	0.11	0.15	21.87	1.67	23.54	1.72	13.6	1.61	20.27	1.92	30.02
255	0.12	0.15	23.6	1.64	25.38	1.93	15.19	1.36	21.76	1.88	32.1
256	0.11	0.15	24.49	1.63	25.99	1.76	15.88	1.56	22.78	1.95	33.32
257	0.11	0.15	24.53	1.5	26.3	1.38	15.99	1.37	22.73	1.99	33.09
258	0.1	0.13	23.28	1.6	25.1	1.57	14.79	1.53	21.56	1.71	31.67

Index	JJA Tmax_sd	Ann_ Tmin_avg	Ann_ Tmin_sd	SON Tmin_avg	SON Tmin_sd	DJF Tmin_avg	DJF Tmin_sd	MAM Tmin_avg	MAM Tmin_sd	JJA Tmin_avg	JJA Tmin_sd
208	1.22	9.45	1.26	10.45	1	4.4	1.69	7.75	1.22	15.16	1
209	1.22	10.38	1.13	11.5	1.05	4.94	1.3	8.66	1.06	16.36	0.92
210	1.24	7.97	1.2	8.89	1.07	3.22	1.72	6.75	1.24	13.06	0.91
211	1.39	8.83	1.28	10.02	1.13	3.91	1.89	7.31	1.18	14.1	1.03
212	1.36	9.75	1.26	10.97	1.26	4.87	1.45	8.08	1.23	15.06	1.11
213	1.33	10.55	1.17	12.21	1.1	5.25	1.4	8.67	1.02	16.08	1.02
214	1.33	8.01	1.22	8.96	1.01	3.32	1.63	6.72	1.25	13.07	0.98
215	1.54	9.31	1.41	10.51	1.26	4.29	1.94	7.7	1.45	14.74	1.17
216	1.22	9.69	1.16	11.28	1.02	4.62	1.81	7.84	1.15	15.04	0.78
217	1.49	9.79	1.24	11.03	1.14	4.75	1.75	8.3	1.28	15.08	0.93
218	1.21	9.02	1.16	10.07	1.05	4.1	1.73	7.44	1	14.45	0.92
219	1.25	10.16	1.26	11.67	1.16	4.87	1.54	8.31	1.3	15.8	1.08
220	1.18	11.02	1.19	12.71	1.07	5.59	1.87	9.16	1.13	16.63	0.88
221	1.34	9.03	1.24	10.12	1.06	3.89	1.91	7.69	1.2	14.44	0.93
222	1.41	10.03	1.31	11.49	1.35	4.9	1.67	8.4	1.27	15.34	1.01
223	1.44	11.3	1.45	12.74	1.4	6.17	2.14	9.39	1.31	16.86	1.08
224	1.19	9.39	1.29	10.64	1.19	4.45	1.95	7.8	1.27	14.67	0.88
225	1.28	10.89	1.5	12.5	1.58	5.59	2.06	8.9	1.33	16.55	1.15
226	1.27	12.92	1.3	14.89	1.31	7.37	1.63	10.68	1.32	18.71	1.05
227	1.36	7.95	1.21	8.76	1.09	3.05	1.66	6.72	1.21	13.25	0.9
228	1.23	8.57	1.3	9.6	1.16	4.09	1.62	6.94	1.37	13.65	0.97
229	1.31	8.96	1.31	9.64	1.07	4.8	1.76	7.16	1.38	14.28	1.06
230	1.2	9.38	1.19	10.3	1.06	4.57	1.84	7.89	1.18	14.79	0.89
231	1.34	8.65	1.33	9.65	1.33	4.09	1.58	7	1.23	13.87	1.12
232	1.54	9.33	1.38	10.19	1.14	4.47	1.84	7.96	1.18	14.69	1.18
233	1.35	11.15	1.13	12.05	1.01	6.92	1.46	9.24	1	16.41	1.05
234	1.28	7.99	1.25	8.85	1.17	3.28	1.68	6.7	1.22	13.12	0.94
235	1.55	9.39	1.37	10.21	1.24	4.6	1.75	7.91	1.47	14.85	1.06
236	1.15	10.42	1.38	11.52	1.37	5.12	2.04	8.85	1.29	16.21	0.92
237	1.31	11.1	1.36	12.42	1.06	6.1	2.11	9.16	1.41	16.75	0.96
238	1.38	9.22	1.19	10.34	1.24	4.11	1.58	7.72	1.06	14.73	0.84
239	1.45	10.4	1.24	11.69	1.15	5.35	1.88	8.74	1.22	15.8	0.91
240	1.34	11.52	1.36	12.79	1.19	6.62	1.98	9.75	1.41	16.93	0.97
241	1.59	9.41	1.38	10.22	1.19	4.18	2.08	8.03	1.38	15.22	0.98
242	1.73	11.22	1.49	12.81	1.34	5.69	2.19	9.39	1.49	16.9	1.04
243	1.27	13.79	1.33	15.23	1.44	9.05	1.41	11.67	1.4	19.19	0.94
244	1.33	7.97	1.17	8.79	1.09	3.17	1.61	6.69	1.16	13.21	0.85
245	1.36	9.14	1.27	10.34	1.34	4.28	1.77	7.65	1.15	14.3	1.02
246	1.28	9.73	1.34	11.21	1.21	4.78	2.23	8.14	1.38	14.75	0.88
247	1.47	9.88	1.17	10.6	1.31	5.63	1.4	8.62	1.24	14.7	0.91
248	1.64	9.36	1.39	10.44	1.35	4.37	2.12	7.86	1.17	14.76	1.08
249	1.28	10.39	1.39	11.76	1.4	5.2	2.23	8.77	1.18	15.74	0.94
250	1.25	10.87	1.31	12.17	1.08	6.12	2.15	9.05	1.37	16.16	0.83
251	1.38	9.6	1.42	10.64	1.29	5.25	1.9	8.08	1.42	14.37	1.13
252	1.47	11.41	1.39	13.11	1.32	6.31	2.1	9.63	1.32	16.59	1.07
253	1.47	13.28	1.14	15.58	1.28	8.31	1.22	10.98	1.15	18.23	0.99
254	1.35	7.87	1.26	8.82	1.1	3.01	1.73	6.57	1.22	13.04	0.96
255	1.42	9.49	1.24	10.53	1.34	4.43	1.46	7.96	1.13	15.05	1.1
256	1.19	10.29	1.17	11.28	1.19	5.06	1.47	8.73	1.17	16.08	0.93
257	1.34	10.29	1.14	11.28	1.03	5.2	1.41	8.79	1.14	15.87	1
258	1.5	9.11	1.22	10.12	1.11	4.09	1.57	7.68	1.13	14.56	1.18

Index	CMIP	Model	Scenario	Run	30_Year	Ann_ PPT_avg	Ann_ PPT_sd	SON PPT_avg	SON PPT_sd	DJF PPT_avg	DJF PPT_sd	MAM PPT_avg	MAM PPT_sd
259	CMIP5	miroc-esm-chem	rcp45	run1	2040_2069	1.44	1.3	0.96	0.95	3.25	3.18	1.42	1.19
260	CMIP5	miroc-esm-chem	rcp45	run1	2070_2099	1.48	1.27	1.18	1.04	3.37	3.22	1.3	1.03
261	CMIP5	miroc-esm-chem	rcp60	run1	2010_2039	1.57	1.32	1.06	1.14	3.61	2.94	1.5	1.21
262	CMIP5	miroc-esm-chem	rcp60	run1	2040_2069	1.41	1.37	1.07	0.85	3	3.38	1.5	1.34
263	CMIP5	miroc-esm-chem	rcp60	run1	2070_2099	1.43	1.3	0.88	0.77	3.16	2.7	1.57	1.35
264	CMIP5	miroc-esm-chem	rcp85	run1	2010_2039	1.74	1.45	1.27	1.09	4.12	3.68	1.53	1.26
265	CMIP5	miroc-esm-chem	rcp85	run1	2040_2069	1.36	1.28	0.8	0.77	3.21	3.41	1.42	1.17
266	CMIP5	miroc-esm-chem	rcp85	run1	2070_2099	1.34	1.28	0.87	0.91	3.14	3.15	1.24	1.1
267	CMIP5	miroc-esm	historical	run1	1970_1999	1.84	1.42	1.44	1.22	4.22	2.97	1.67	1.38
268	CMIP5	miroc-esm	rcp26	run1	2010_2039	1.65	1.31	1.11	1.04	3.48	2.52	1.93	1.62
269	CMIP5	miroc-esm	rcp26	run1	2040_2069	1.7	1.32	1.37	1.37	3.44	2.36	1.92	1.56
270	CMIP5	miroc-esm	rcp26	run1	2070_2099	1.41	1.12	1.22	1.08	2.8	2.23	1.47	1.27
271	CMIP5	miroc-esm	rcp45	run1	2010_2039	1.76	1.25	1.53	1.36	3.39	2.23	1.97	1.41
272	CMIP5	miroc-esm	rcp45	run1	2040_2069	1.44	1.21	0.92	1.07	3.11	2.32	1.59	1.35
273	CMIP5	miroc-esm	rcp45	run1	2070_2099	1.48	1.14	0.89	0.92	3.16	1.91	1.79	1.55
274	CMIP5	miroc-esm	rcp60	run1	2010_2039	1.48	1.22	1.13	1.12	3.15	2.24	1.53	1.35
275	CMIP5	miroc-esm	rcp60	run1	2040_2069	1.67	1.38	1.42	1.54	3.38	2.66	1.82	1.52
276	CMIP5	miroc-esm	rcp60	run1	2070_2099	1.43	1.21	1.3	1.15	3.01	2.32	1.36	1.14
277	CMIP5	miroc-esm	rcp85	run1	2010_2039	1.69	1.29	1.25	1.01	3.51	2.63	1.95	1.49
278	CMIP5	miroc-esm	rcp85	run1	2040_2069	1.38	1.17	0.91	0.81	2.95	2.48	1.5	1.37
279	CMIP5	miroc-esm	rcp85	run1	2070_2099	1.31	1.11	1.03	0.99	2.73	2.17	1.34	1.33
280	CMIP5	miroc5	historical	run1	1970_1999	1.84	1.33	1.5	1.1	4	2.7	1.81	1.41
281	CMIP5	miroc5	rcp26	run1	2010_2039	1.78	1.19	1.29	1.07	4.2	2.47	1.55	1.11
282	CMIP5	miroc5	rcp26	run1	2040_2069	1.74	1.32	1.24	1.07	4.02	2.49	1.64	1.23
283	CMIP5	miroc5	rcp26	run1	2070_2099	1.57	1.08	1.14	0.72	3.51	2.28	1.58	1.25
284	CMIP5	miroc5	rcp45	run1	2010_2039	1.83	1.35	1.35	1.14	4.03	2.74	1.9	1.29
285	CMIP5	miroc5	rcp45	run1	2040_2069	1.63	1.24	1.15	1.08	3.84	2.45	1.43	1.05
286	CMIP5	miroc5	rcp45	run1	2070_2099	1.53	1.16	1.03	0.94	3.36	2.35	1.65	1.29
287	CMIP5	miroc5	rcp60	run1	2010_2039	1.62	1.27	1.02	0.9	3.71	2.81	1.66	1.24
288	CMIP5	miroc5	rcp60	run1	2040_2069	1.63	1.1	1.18	1	3.73	2.32	1.53	1.13
289	CMIP5	miroc5	rcp60	run1	2070_2099	1.44	1.22	1.16	1.03	2.93	2.72	1.56	1.31
290	CMIP5	miroc5	rcp85	run1	2010_2039	1.75	1.19	1.26	1.14	3.73	2.22	1.9	1.15
291	CMIP5	miroc5	rcp85	run1	2040_2069	1.52	1.06	1.11	0.84	3.45	2.3	1.41	0.89
292	CMIP5	miroc5	rcp85	run1	2070_2099	1.67	1.25	1.28	1.16	3.71	2.57	1.61	1.19
293	CMIP5	mpi-esm-lr	historical	run1	1970_1999	1.78	1.3	1.44	1.21	3.84	2.6	1.75	1.22
294	CMIP5	mpi-esm-lr	rcp26	run1	2010_2039	1.7	1.42	1.18	1.27	3.73	2.79	1.78	1.4
295	CMIP5	mpi-esm-lr	rcp26	run1	2040_2069	1.9	1.54	1.44	1.46	4.3	3.11	1.74	1.33
296	CMIP5	mpi-esm-lr	rcp26	run1	2070_2099	1.7	1.34	1.29	1.39	3.91	2.45	1.55	1.36
297	CMIP5	mpi-esm-lr	rcp45	run1	2010_2039	1.86	1.52	1.34	1.38	4.19	3.02	1.76	1.53
298	CMIP5	mpi-esm-lr	rcp45	run1	2040_2069	1.8	1.45	1.38	1.27	4.08	3.12	1.55	1.37
299	CMIP5	mpi-esm-lr	rcp45	run1	2070_2099	1.82	1.43	1.23	1.19	4.03	2.27	1.92	1.68
300	CMIP5	mpi-esm-lr	rcp85	run1	2010_2039	1.77	1.41	1.3	1.19	4.12	2.89	1.57	1.42
301	CMIP5	mpi-esm-lr	rcp85	run1	2040_2069	1.7	1.35	1.1	1.1	4.1	2.69	1.41	1.24
302	CMIP5	mpi-esm-lr	rcp85	run1	2070_2099	1.77	1.52	1.1	1.31	4.32	3.26	1.6	1.28
303	CMIP5	mri-cgcm3	historical	run1	1970_1999	1.78	1.33	1.29	1.16	3.91	2.69	1.81	1.34
304	CMIP5	mri-cgcm3	rcp26	run1	2010_2039	1.97	1.37	1.65	1.37	4.34	2.69	1.81	1.44
305	CMIP5	mri-cgcm3	rcp26	run1	2040_2069	1.98	1.4	1.61	1.32	4.35	2.84	1.91	1.58
306	CMIP5	mri-cgcm3	rcp26	run1	2070_2099	2.12	1.4	1.54	1.34	4.95	2.8	1.88	1.46
307	CMIP5	mri-cgcm3	rcp45	run1	2010_2039	1.8	1.29	1.18	1.28	4.27	2.47	1.67	1.34
308	CMIP5	mri-cgcm3	rcp45	run1	2040_2069	1.82	1.33	1.49	1.09	4.16	2.73	1.49	1.37

Index	JJA PPT_avg	JJA PPT_sd	Ann_ Tmax_avg	Ann_ Tmax_sd	SON Tmax_avg	SON Tmax_sd	DJF Tmax_avg	DJF Tmax_sd	MAM Tmax_avg	MAM Tmax_sd	JJA Tmax_avg
259	0.11	0.12	24.77	1.7	26.56	1.79	15.98	1.42	23.22	2.03	33.36
260	0.1	0.13	25.29	1.52	27.09	1.5	16.46	1.17	23.26	1.99	34.37
261	0.12	0.15	23.08	1.66	24.86	1.92	14.79	1.45	21.42	1.78	31.26
262	0.08	0.09	24.87	1.69	26.65	1.79	16.3	1.49	23.09	2.11	33.46
263	0.1	0.11	25.76	1.88	27.57	1.98	17.15	1.43	23.62	2.39	34.7
264	0.09	0.12	23.31	1.47	24.95	1.54	14.74	1.17	21.54	1.89	31.96
265	0.08	0.11	25.55	1.66	27.65	1.76	16.66	1.22	23.59	1.94	34.29
266	0.09	0.13	28.01	2	30.41	1.94	18.82	1.83	25.7	2.43	37.1
267	0.11	0.14	21.92	1.62	23.31	1.74	13.77	1.38	20.6	1.86	29.99
268	0.1	0.14	23.36	1.62	25.08	1.58	14.95	1.59	21.46	1.91	31.97
269	0.1	0.12	24.48	1.69	26.26	1.82	15.84	1.35	22.47	2.02	33.33
270	0.1	0.13	25.09	1.69	26.63	1.77	16.43	1.6	23.41	1.96	33.94
271	0.1	0.13	23.26	1.59	24.82	1.75	14.85	1.34	21.46	1.79	31.9
272	0.12	0.16	24.88	1.9	26.83	1.92	16.13	1.51	23	2.31	33.54
273	0.11	0.15	25.68	1.68	27.53	1.87	16.85	1.43	23.55	1.96	34.77
274	0.11	0.15	23.54	1.65	24.99	1.61	15.22	1.54	22.16	1.99	31.84
275	0.09	0.14	24.72	1.73	26.43	2.03	16.18	1.49	22.83	2.01	33.49
276	0.11	0.16	26.21	1.62	27.96	1.69	17.15	1.55	24.39	1.84	35.33
277	0.09	0.15	23.34	1.89	25.01	1.91	14.86	1.72	21.6	2.2	31.86
278	0.11	0.14	25.72	1.82	27.65	1.94	16.93	1.67	23.73	2.03	34.56
279	0.08	0.12	28.08	1.76	30.28	1.81	18.87	1.71	26.1	2.15	37.08
280	0.09	0.11	21.64	1.59	23.27	1.73	13.34	1.5	19.94	1.93	29.98
281	0.11	0.13	23.07	1.52	24.85	1.59	14.46	1.24	21.55	1.78	31.45
282	0.09	0.12	23.35	1.55	25.2	1.5	14.97	1.44	21.75	2.05	31.48
283	0.11	0.13	23.74	1.52	25.59	1.45	15.08	1.35	22.27	1.71	32
284	0.1	0.13	23.01	1.58	24.77	1.65	14.49	1.57	21.29	1.79	31.5
285	0.1	0.15	23.95	1.59	25.94	1.68	15.09	1.57	22.54	1.76	32.22
286	0.07	0.1	24.71	1.57	26.8	1.52	15.7	1.48	23.01	1.94	33.38
287	0.11	0.15	23.1	1.55	25.1	1.67	14.48	1.43	21.43	1.59	31.41
288	0.09	0.13	23.62	1.57	25.57	1.87	14.82	1.37	22.08	1.73	31.98
289	0.09	0.13	24.82	1.7	26.88	1.9	16.16	1.43	22.98	1.65	33.22
290	0.08	0.12	23.13	1.62	24.91	1.75	14.7	1.52	21.17	1.75	31.76
291	0.09	0.14	24.45	1.56	26.65	1.63	15.63	1.34	22.75	1.68	32.78
292	0.12	0.18	25.7	1.68	28.19	1.78	16.68	1.58	23.81	1.97	34.1
293	0.11	0.13	22.01	1.56	23.7	1.66	13.58	1.42	20.5	1.91	30.27
294	0.13	0.21	23.1	1.66	25.03	1.53	14.6	1.77	21.31	1.92	31.46
295	0.12	0.19	23.34	1.69	25.28	1.71	14.85	1.52	21.7	2.08	31.53
296	0.11	0.14	23.3	1.56	25.16	1.53	14.86	1.18	21.75	1.94	31.45
297	0.12	0.16	23.17	1.66	25.48	1.7	14.52	1.46	21.32	2.09	31.35
298	0.16	0.25	23.76	1.67	25.35	1.61	15.2	1.58	22.47	2.06	32.07
299	0.13	0.23	23.94	1.8	26.07	1.79	15.12	1.5	22.23	2.54	32.33
300	0.12	0.19	23.24	1.67	25.06	1.57	14.33	1.67	21.77	1.94	31.79
301	0.15	0.24	24.51	1.62	26.64	1.71	15.72	1.51	22.64	1.92	33.02
302	0.1	0.19	25.93	1.58	28.51	1.45	16.77	1.29	24	2.01	34.45
303	0.09	0.11	22.1	1.59	23.73	1.62	13.91	1.48	20.52	2.06	30.26
304	0.09	0.13	22.55	1.58	24.13	1.69	14.17	1.11	21.03	2.11	30.87
305	0.11	0.14	22.87	1.65	24.59	1.62	14.38	1.75	21.3	2.06	31.23
306	0.11	0.14	22.94	1.57	24.41	1.68	14.55	1.38	21.48	1.8	31.32
307	0.1	0.15	22.58	1.63	24.36	1.7	14.09	1.45	21.11	2.23	30.8
308	0.09	0.12	23.14	1.71	24.87	1.85	14.47	1.4	21.88	2.23	31.36

Index	JJA Tmax_sd	Ann_ Tmin_avg	Ann_ Tmin_sd	SON Tmin_avg	SON Tmin_sd	DJF Tmin_avg	DJF Tmin_sd	MAM Tmin_avg	MAM Tmin_sd	JJA Tmin_avg	JJA Tmin_sd
259	1.32	10.47	1.28	11.55	1.28	5.16	1.56	8.98	1.16	16.2	1.01
260	1.24	11.07	1.17	12.19	1.06	5.76	1.4	9.26	1.18	17.09	1
261	1.43	8.94	1.15	9.99	1.25	4	1.26	7.48	1.13	14.27	1
262	1.26	10.48	1.18	11.62	1.19	5.22	1.26	8.92	1.2	16.18	1.03
263	1.44	11.52	1.28	12.75	1.36	6.15	1.16	9.67	1.29	17.51	1.15
264	1.26	9.23	1.17	10.1	1.13	4.21	1.39	7.68	1.21	14.88	0.94
265	1.6	11.23	1.26	12.54	1.32	5.85	1.29	9.44	1.21	17.1	1.26
266	1.71	13.48	1.4	15.19	1.42	7.82	1.31	11.22	1.33	19.7	1.42
267	1.34	7.97	1.21	8.82	1.18	3.29	1.47	6.76	1.18	13.05	0.97
268	1.45	9.28	1.25	10.29	1.08	4.39	1.72	7.68	1.15	14.76	1.06
269	1.5	10.2	1.21	11.32	1.1	5.03	1.5	8.44	1.17	16	1.03
270	1.4	10.52	1.19	11.58	1.12	5.2	1.69	8.96	1.21	16.36	0.9
271	1.54	9.28	1.22	10.23	1.09	4.35	1.7	7.73	1.18	14.75	1.18
272	1.79	10.53	1.44	11.73	1.35	5.34	1.78	8.74	1.5	16.27	1.3
273	1.33	11.36	1.16	12.47	1.07	6.05	1.35	9.48	1.18	17.42	0.93
274	1.41	8.96	1.25	9.75	1.1	4.03	1.72	7.66	1.25	14.46	1.03
275	1.28	10.38	1.24	11.53	1.12	5.36	1.66	8.65	1.26	16.02	0.93
276	1.35	11.76	1.17	13.03	1.08	6.33	1.54	9.84	1.19	17.87	0.98
277	1.7	9.33	1.52	10.34	1.45	4.31	1.83	7.88	1.43	14.8	1.34
278	1.54	11.15	1.34	12.38	1.25	5.84	1.71	9.25	1.29	17.12	1.15
279	1.38	13.3	1.31	14.94	1.22	7.56	1.78	11.11	1.33	19.56	1.05
280	1.2	7.72	1.2	8.71	1.14	2.92	1.68	6.3	1.13	12.91	0.94
281	1.36	8.94	1.29	9.95	1.15	4.11	1.84	7.56	1.21	14.16	1.03
282	1.25	9.24	1.21	10.38	1.01	4.38	1.56	7.73	1.33	14.51	0.94
283	1.46	9.42	1.17	10.48	0.93	4.3	1.68	8.05	1.09	14.84	1.03
284	1.43	8.93	1.17	9.89	1	4.04	1.61	7.49	1.1	14.31	1.06
285	1.35	9.49	1.23	10.62	1.09	4.43	1.92	8.08	1.09	14.8	0.96
286	1.22	10.05	1.24	11.23	0.96	4.87	1.9	8.56	1.27	15.57	0.99
287	1.46	8.79	1.24	9.85	0.94	3.86	1.94	7.39	1.14	14.05	1.11
288	1.26	9.21	1.16	10.32	1.07	4.1	1.58	7.78	1.07	14.6	0.93
289	1.64	10.13	1.2	11.49	1.05	4.92	1.61	8.56	1.08	15.56	1.12
290	1.36	8.99	1.26	10.03	1.11	4.06	1.84	7.35	1.23	14.47	0.98
291	1.45	9.96	1.22	11.29	1.06	4.79	1.67	8.36	1.13	15.37	1.11
292	1.4	11.28	1.29	12.84	1.13	5.94	1.72	9.43	1.34	16.87	1.13
293	1.22	8.02	1.18	8.99	1.13	3.17	1.54	6.71	1.15	13.21	0.93
294	1.25	9.07	1.29	10.19	1.11	4.06	1.95	7.58	1.21	14.47	0.83
295	1.37	9.38	1.26	10.53	1.25	4.41	1.69	7.93	1.25	14.66	0.94
296	1.35	9.22	1.18	10.36	1.09	4.26	1.45	7.86	1.2	14.43	0.94
297	1.33	9.21	1.29	10.63	1.21	4.18	1.71	7.64	1.23	14.37	0.95
298	1.32	9.86	1.27	10.8	1.2	4.83	1.71	8.64	1.3	15.17	0.89
299	1.37	10.04	1.36	11.29	1.33	4.93	1.71	8.51	1.46	15.44	0.93
300	1.39	9.26	1.34	10.43	1.21	3.98	1.87	7.89	1.2	14.74	0.95
301	1.27	10.53	1.32	11.84	1.28	5.34	1.7	8.83	1.32	16.06	0.9
302	1.32	12.1	1.28	13.84	1.16	6.67	1.46	10.17	1.27	17.73	0.97
303	1.24	8.09	1.21	9.04	1.04	3.38	1.61	6.73	1.33	13.22	0.93
304	1.27	8.6	1.22	9.58	1.2	3.71	1.29	7.24	1.26	13.88	0.96
305	1.25	8.89	1.23	10	1.04	3.89	1.87	7.5	1.19	14.21	0.92
306	1.52	9.03	1.15	9.9	1.15	4.15	1.34	7.69	1.23	14.38	1.03
307	1.18	8.58	1.26	9.62	1.23	3.63	1.4	7.23	1.52	13.83	0.93
308	1.32	9.04	1.18	10.09	1.12	3.96	1.32	7.74	1.17	14.37	0.93

Index	CMIP	Model	Scenario	Run	30_Year	Ann_ PPT_avg	Ann_ PPT_sd	SON PPT_avg	SON PPT_sd	DJF PPT_avg	DJF PPT_sd	MAM PPT_avg	MAM PPT_sd
309	CMIP5	mri-cgcm3	rcp45	run1	2070_2099	1.9	1.25	1.08	0.93	4.83	2.67	1.61	1.23
310	CMIP5	mri-cgcm3	rcp85	run1	2010_2039	1.79	1.35	1.17	1.25	4.07	2.6	1.74	1.38
311	CMIP5	mri-cgcm3	rcp85	run1	2040_2069	2.21	1.36	1.42	1.27	5.66	2.63	1.69	1.28
312	CMIP5	mri-cgcm3	rcp85	run1	2070_2099	2.07	1.19	1.29	1.16	5.25	2.32	1.69	1.18
313	CMIP5	noresm1-m	historical	run1	1970_1999	1.75	1.34	1.28	1.07	4.15	3.1	1.56	1.34
314	CMIP5	noresm1-m	rcp26	run1	2010_2039	1.66	1.35	1.17	1.08	3.83	2.72	1.55	1.46
315	CMIP5	noresm1-m	rcp26	run1	2040_2069	1.61	1.32	1.03	0.83	3.91	3.02	1.39	1.32
316	CMIP5	noresm1-m	rcp26	run1	2070_2099	1.8	1.4	1.12	1.26	4.07	2.71	1.88	1.38
317	CMIP5	noresm1-m	rcp45	run1	2010_2039	1.57	1.27	1.34	1.28	3.43	2.31	1.36	1.31
318	CMIP5	noresm1-m	rcp45	run1	2040_2069	1.67	1.36	1.35	1.15	3.58	2.7	1.68	1.42
319	CMIP5	noresm1-m	rcp45	run1	2070_2099	1.84	1.62	1.4	1.39	4.21	3.48	1.44	1.11
320	CMIP5	noresm1-m	rcp60	run1	2010_2039	1.62	1.3	1.37	1.16	3.4	2.62	1.53	1.19
321	CMIP5	noresm1-m	rcp60	run1	2040_2069	1.6	1.3	1.11	1.04	3.59	2.73	1.55	1.28
322	CMIP5	noresm1-m	rcp60	run1	2070_2099	1.8	1.4	1.14	1.1	4.35	3.06	1.53	1.21
323	CMIP5	noresm1-m	rcp85	run1	2010_2039	1.7	1.37	1.31	1.31	3.98	2.95	1.47	1.04
324	CMIP5	noresm1-m	rcp85	run1	2040_2069	1.56	1.27	1.32	1.19	3.3	2.37	1.42	1.27
325	CMIP5	noresm1-m	rcp85	run1	2070_2099	1.67	1.33	1.53	1.28	3.61	2.48	1.26	1.1

Index	JJA PPT_avg	JJA PPT_sd	Ann_ Tmax_avg	Ann_ Tmax_sd	SON Tmax_avg	SON Tmax_sd	DJF Tmax_avg	DJF Tmax_sd	MAM Tmax_avg	MAM Tmax_sd	JJA Tmax_avg
309	0.1	0.14	23.63	1.63	25.66	1.62	14.75	1.31	22.08	2	31.99
310	0.11	0.16	22.71	1.59	24.52	1.83	14.36	1.32	21.02	1.91	30.97
311	0.09	0.14	23.47	1.58	25.44	1.73	14.67	1.36	21.79	1.81	31.94
312	0.09	0.16	24.82	1.58	27.11	1.79	15.67	1.22	22.93	1.82	33.54
313	0.1	0.14	21.95	1.58	23.54	1.58	13.64	1.45	20.67	2.05	29.98
314	0.11	0.14	23.15	1.72	24.64	1.8	14.78	1.83	21.82	2.05	31.35
315	0.15	0.19	23.46	1.63	25.25	1.62	15.01	1.41	21.89	1.88	31.7
316	0.15	0.16	23.36	1.55	25.16	1.58	15.08	1.14	21.56	1.81	31.64
317	0.13	0.12	22.98	1.75	24.62	1.83	14.28	1.62	21.77	1.97	31.29
318	0.16	0.18	23.85	1.69	25.47	1.63	15.57	1.54	22.21	2.06	32.15
319	0.21	0.24	24.49	1.67	26.36	1.63	16	1.47	22.89	1.96	32.72
320	0.11	0.18	22.76	1.71	24.41	1.78	14.45	1.41	20.98	1.97	31.25
321	0.14	0.2	23.65	1.7	25.27	1.57	15.2	1.48	22.21	2.09	31.9
322	0.16	0.22	24.5	1.7	26.52	1.69	15.59	1.52	22.9	2.19	33.02
323	0.1	0.11	23.24	1.75	25.16	1.53	14.71	1.45	21.79	2.23	31.27
324	0.18	0.22	24.33	1.75	26.27	1.97	15.49	1.5	22.68	2.02	32.94
325	0.3	0.28	25.8	1.79	27.78	1.67	17.2	1.56	24.08	2.26	34.13

Index	JJA Tmax_sd	Ann_ Tmin_avg	Ann_ Tmin_sd	SON Tmin_avg	SON Tmin_sd	DJF Tmin_avg	DJF Tmin_sd	MAM Tmin_avg	MAM Tmin_sd	JJA Tmin_avg	JJA Tmin_sd
309	1.53	9.58	1.23	10.69	1.1	4.44	1.28	8.19	1.39	14.98	0.99
310	1.24	8.67	1.16	9.59	1.19	3.89	1.33	7.2	1.23	13.97	0.88
311	1.38	9.54	1.26	10.68	1.25	4.53	1.4	7.92	1.26	14.98	1.06
312	1.47	10.79	1.26	12.11	1.21	5.46	1.22	9	1.34	16.55	1.16
313	1.27	7.9	1.19	8.75	1.05	3.22	1.58	6.71	1.24	12.96	0.9
314	1.2	9.07	1.31	9.85	1.36	4.19	1.68	7.86	1.23	14.36	0.94
315	1.47	9.45	1.22	10.49	1.25	4.48	1.42	7.92	1	14.9	1.04
316	1.32	9.45	1.23	10.39	1.19	4.6	1.3	7.94	1.19	14.87	0.96
317	1.44	8.78	1.4	9.93	1.36	3.49	1.72	7.47	1.27	14.23	0.97
318	1.36	9.63	1.31	10.66	1.15	4.9	1.84	8.01	1.23	14.99	0.96
319	1.5	10.29	1.28	11.53	1.11	5.41	1.55	8.6	1.18	15.57	1.05
320	1.4	8.76	1.37	9.71	1.19	3.78	1.72	7.2	1.22	14.35	1.05
321	1.53	9.6	1.34	10.46	1.3	4.65	1.61	8.18	1.24	15.08	1.08
322	1.32	10.44	1.27	11.55	1.12	5.22	1.58	8.93	1.34	16.04	0.96
323	1.6	9.15	1.31	10.31	1.14	4.14	1.65	7.86	1.31	14.26	1.1
324	1.37	10.17	1.36	11.5	1.37	4.79	1.47	8.43	1.27	15.98	1.11
325	1.58	11.63	1.31	13.02	1.28	6.44	1.38	9.73	1.33	17.32	1.09

Appendix 2: Basin Characterization Model Output Summary – Average Annual Tmax and Tmin

Midcentury Models 2040-2069

Model	Emissions Scenario	CMIP Vintage	Time Period	Ann_Tmax_avg degC	Delta_HST_Tmax_avg degC	Ann_Tmin_avg degC	Delta_HST_Tmin_avg degC
historic (hst)	N/A	N/A	1951-1980	21.1		7.9	
current	N/A	N/A	1981-2010	21.4	0.3	8.7	0.8
Assumption: Business as Usual							
ccsm4	rcp85	CMIP5	2040-2069	23.9	2.8	10.3	2.4
GFDL	A2	CMIP3	2040-2069	24.1	3.0	10.6	2.7
PCM	A2	CMIP3	2040-2069	24.2	3.1	9.9	2.0
cnrm-cm5	rcp85	CMIP5	2040-2069	24.3	3.2	10.8	2.9
miroc3_2_mr	A2	CMIP3	2040-2069	24.6	3.5	10.7	2.8
fgoals-g2	rcp85	CMIP5	2040-2069	24.7	3.6	10.9	3.0
ipsl-cm5a-lr	rcp85	CMIP5	2040-2069	25.2	4.1	11.7	3.8
miroc-esm	rcp85	CMIP5	2040-2069	25.5	4.4	11.5	3.6
		Business as Usual Average		**24.6**	**3.5**	**10.8**	**2.9**
Assumption: Mitigated							
giss_aom	A1B	CMIP3	2040-2069	23.9	2.8	10	2.1
csiro_mk3_5	A1B	CMIP3	2040-2069	23.9	2.8	10.5	2.6
miroc-esm	rcp60	CMIP5	2040-2069	24.6	3.5	10.8	2.9
		Mitigated Average		**24.1**	**3.0**	**10.4**	**2.5**
Assumption: Highly Mitigated							
PCM	B1	CMIP3	2040-2069	23.7	2.6	9.4	1.5
GFDL	B1	CMIP3	2040-2069	23.8	2.7	10.2	2.3
mpi-esm-lr	rcp45	CMIP5	2040-2069	23.9	2.8	10.4	2.5
miroc-esm	rcp45	CMIP5	2040-2069	24.8	3.7	11	3.1
		Highly Mitigated Average		**24.1**	**3.0**	**10.3**	**2.4**
Assumption: Super Mitigated							
giss-e2-r	rcp26	CMIP5	2040-2069	22.6	1.5	8.8	0.9
mri-cgcm3	rcp26	CMIP5	2040-2069	22.9	1.8	9.4	1.5
miroc5	rcp26	CMIP5	2040-2069	23.4	2.3	9.7	1.8
		Super Mitigated Average		**23.0**	**1.9**	**9.3**	**1.4**
		ALL Scenarios Average		**24.1**	**3.0**	**10.4**	**2.5**

Appendix 3: Basin Characterization Model Output Summary – Summer Tmax and Winter Tmin

Midcentury Models 2040-2069

Model	Emissions Scenario	CMIP Vintage	Time Period	JJA Tmax_avg degC	Delta_HST_JJA_Tmax degC	DJF Tmin_avg degC	Delta_HST_DJF_Tmin degC
historic (hst)	N/A	N/A	1951-1980	27.9		4.1	
current	N/A	N/A	1981-2010	28.1	0.2	4.7	0.6
Assumption: Business as Usual							
ccsm4	rcp85	CMIP5	2040-2069	32.0	4.1	5.6	1.5
GFDL	A2	CMIP3	2040-2069	32.0	4.1	6.4	2.3
PCM	A2	CMIP3	2040-2069	31.3	3.4	5.2	1.1
cnrm-cm5	rcp85	CMIP5	2040-2069	32.2	4.3	6.4	2.3
miroc3_2_mr	A2	CMIP3	2040-2069	32.8	4.9	6.1	2.0
fgoals-g2	rcp85	CMIP5	2040-2069	32.7	4.8	6.0	1.9
ipsl-cm5a-lr	rcp85	CMIP5	2040-2069	33.2	5.3	6.6	2.5
miroc-esm	rcp85	CMIP5	2040-2069	34.0	6.1	6.7	2.6
		Business as Usual Average		**32.5**	**4.6**	**6.1**	**2.0**
Assumption: Mitigated							
giss_aom	A1B	CMIP3	2040-2069	32.0	4.1	5.7	1.6
csiro_mk3_5	A1B	CMIP3	2040-2069	31.8	3.9	6.0	1.9
miroc-esm	rcp60	CMIP5	2040-2069	32.9	5.0	6.2	2.1
		Mitigated Average		**32.2**	**4.3**	**6.0**	**1.9**
Assumption: Highly Mitigated							
PCM	B1	CMIP3	2040-2069	30.9	3.0	4.5	0.4
GFDL	B1	CMIP3	2040-2069	31.3	3.4	6.0	1.9
mpi-esm-lr	rcp45	CMIP5	2040-2069	31.7	3.8	5.8	1.7
miroc-esm	rcp45	CMIP5	2040-2069	33.1	5.2	6.2	2.1
		Highly Mitigated Average		**31.8**	**3.9**	**5.6**	**1.5**
Assumption: Super Mitigated							
giss-e2-r	rcp26	CMIP5	2040-2069	30.8	2.9	4.3	0.2
mri-cgcm3	rcp26	CMIP5	2040-2069	30.9	3.0	4.8	0.7
miroc5	rcp26	CMIP5	2040-2069	31.1	3.2	5.3	1.2
		Super Mitigated Average		**30.9**	**3.0**	**4.8**	**0.7**
		ALL Scenarios Average		**32.0**	**4.1**	**5.8**	**1.7**

Appendix 4: Basin Characterization Model Output Summary – PPT and CWD

Midcentury Models 2040-2069

Model	Emissions Scenario	CMIP Vintage	Time Period	Ann_ PPT_avg mm	Delta_Ann_HST _PPT_avg mm	% HST PPT	Model CWD	Delta_HST_CW D	% HST CWD
historic (hst)	N/A	N/A	1951-1980	762			788		
current	N/A	N/A	1981-2010	791	29	104%	798	10	101%
Assumption: Business as Usual									
ccsm4	rcp85	CMIP5	2040-2069	649	-113	85%	894	106	113%
GFDL	A2	CMIP3	2040-2069	647	-115	85%	911	123	116%
PCM	A2	CMIP3	2040-2069	699	-63	92%	877	89	111%
cnrm-cm5	rcp85	CMIP5	2040-2069	828	66	109%	872	84	111%
miroc3_2_mr	A2	CMIP3	2040-2069	536	-226	70%	934	146	119%
fgoals-g2	rcp85	CMIP5	2040-2069	662	-100	87%	918	130	116%
ipsl-cm5a-lr	rcp85	CMIP5	2040-2069	635	-127	83%	926	138	118%
miroc-esm	rcp85	CMIP5	2040-2069	529	-233	69%	961	173	122%
			Business as Usual Average	**648**	**-114**	**85%**	**912**	**124**	**116%**
Assumption: Mitigated									
giss_aom	A1B	CMIP3	2040-2069	601	-161	79%	895	107	114%
csiro_mk3_5	A1B	CMIP3	2040-2069	779	17	102%	870	82	110%
miroc-esm	rcp60	CMIP5	2040-2069	640	-122	84%	898	110	114%
			Mitigated Average	**673**	**-89**	**88%**	**888**	**100**	**113%**
Assumption: Highly Mitigated									
PCM	B1	CMIP3	2040-2069	679	-83	89%	863	75	110%
GFDL	B1	CMIP3	2040-2069	686	-76	90%	874	86	111%
mpi-esm-lr	rcp45	CMIP5	2040-2069	677	-85	89%	875	87	111%
miroc-esm	rcp45	CMIP5	2040-2069	556	-206	73%	938	150	119%
			Highly Mitigated Average	**650**	**-113**	**85%**	**888**	**100**	**113%**
Assumption: Super Mitigated									
giss-e2-r	rcp26	CMIP5	2040-2069	774	12	102%	835	47	106%
mri-cgcm3	rcp26	CMIP5	2040-2069	760	-2	100%	836	48	106%
miroc5	rcp26	CMIP5	2040-2069	670	-92	88%	874	86	111%
			Super Mitigated Average	**735**	**-27**	**96%**	**848**	**60**	**108%**
			ALL Scenarios Average	**667**	**-95**	**88%**	**892**	**104**	**113%**