Comparison of DSM2 Water Temperature Calculations for the PA and NAA BDCP Scenarios

For: Dr. Chandra Chilmakuri
Water Resources Engineer
CH2MHill
916-335-0409 (Main Office)
916-286-3017 (Direct)

Contact: Dr. Marianne Guerin
Senior Water Resources Specialist
Associate
Resource Management Associates
707-864-2950 (Main Office)
925-283-3729 (Direct)

August 03, 2015

Contents

Figures

Tables

1. Executive Summary

The work discussed in this report covers the application of a calibrated QUAL water temperature model, V8.1.2, to selected Bay-Delta Conservation Plan (BDCP) scenario simulations and additional data and explanatory background to assist in the interpretation of the model results. Additional documentation on the calibration and residual analysis of the water temperature model is found in the Appendix.

DSM2 is a suite of one-dimensional numerical models developed at the Department of Water Resources (DWR) of the State of California. DSM2-HYDRO calculates the hydrodynamics of the Sacramento-San Joaquin Delta region, while the dynamics of water temperature are conceptualized in the DSM2-QUAL mass transport model. The models are run consecutively, with QUAL using previously calculated HYDRO model output in its calculations for the transport of water temperature.

All of the DSM2 simulations represent hypothetical modeled water years 1922 – 2003, October 1921 – September 2003, with BDCP scenarios representing proposed or predicted changes to: Delta operations such as exports and the volume and timing of reservoir releases; meteorological conditions due to climate change; and, stage height at Martinez due to sea level rise. Changes to modeled Delta bathymetry included in previous BDCP model scenarios are NOT included in the scenarios discussed herein.

Differences in model output reflect differences between the BDCP Proposed Action (PA) scenario and the base[1] No Action Alternative scenario (NAA) in the Early Long Term (ELT) time frame under assumed climate changes and sea level rise conditions as well as changes in export volumes, location and timing. Changes in water temperature at the inflow boundaries due to upstream effects from climate change, changes in runoff, changes in reservoir usage, changes in effluent volume or water temperature due to population changes, or other potentially influential parameters are not considered. A set of representative model output locations was selected and monthly averaged to represent an average result for each month at each location. In addition, regional averages of daily water temperature are plotted along with the difference between the two scenarios, calculated as (PA – NAA).

Input files for DSM2 HYDRO simulations were supplied to RMA, and then modified to represent hypothetical conditions for the calculation of water temperature. Changes to the HYDRO model input for this purpose consist of the addition of effluent inflow at twelve locations within the DSM2 model domain. Boundary conditions for water temperature calculations were synthesized from historical data for the QUAL water temperature model.

A single set of boundary conditions for effluent inflow and water temperature, river inflow water temperature and model domain meteorology were synthesized from existing data and applied to

[1] The BDCP Proposed Action alternative is a simulation that reflects changes to the conditions in the No Action alternative in this ELT time frame which is considered the base case herein.

both of the scenarios. In the HYDRO model runs, effluent inflow representing current-day (2000 – 2005) conditions of wastewater treatment plants discharges into the Delta were included in both scenarios, but otherwise the hydrodynamic conditions and all other inputs to HYDRO used in the BDCP simulations were implemented without alteration.

Boundary conditions for effluent inflow and water temperature were synthesized on an annual year basis (January – December) using existing data for each modeled year (1921 – 2003), creating a correspondence between one model year and one historical year. Using the aforementioned year-correspondence, Sacramento Regional Wastewater Treatment Plant (SRWTP) effluent flows were scaled to maintain the percentage of effluent flow in Sacramento R. inflow at or below the historical 2000 - 2005 daily maximum (approximately 4.5%). All other effluent flows were applied without scaling using the same annual year selection.

Meteorological and water temperature boundary conditions were synthesized based on time series of projected daily average temperatures supplied to RMA that represent a future climate change condition for the Early Long Term (ELT) time frame. These time series were then used as a basis for formulating the hourly meteorological boundary conditions used in the QUAL nutrient model. The synthetic hourly meteorological time series were developed by first matching average air temperature under this climate change condition with historical air temperature used in DSM2 at approximately the same annual date (+/- 2 days), creating a correspondence between these historical dates and the model dates. Existing hourly meteorological data used in the calibration of the QUAL nutrient model from the historical dates was then used to build the model time series for meteorological and water temperature boundary conditions. The set of matched daily air temperature dates was also used to develop time series of daily water temperature at three model boundaries – Sacramento, Vernalis and Martinez – that were then used to as water temperature boundary conditions at the model inflow boundaries.

The DSM2/QUAL temperature model was calibrated for the time span 1990 - 2008 (Guerin, 2010). Model calibration was followed by a validation step. Data availability and the spatial and temporal resolution of calibration data dictated the quality of the calibration. Details on the temperature model calibration are documented in (Guerin, 2010), and discussed briefly in the Appendix of this document.

Figures representing the model bias in the historical simulation of water temperature are included in the Appendix as a guide to the interpretation of model results for analysis regions specified in previous BDCP analyses in the DSM2 model domain. For example, modeled water temperature in the South Delta and the upstream section of the San Joaquin R. was biased by several Celsius degrees cooler than indicated by data in the summer. This bias in model calculations is mainly due to the limitation in QUAL to a single meteorological region – previous results indicated that a minimum of two meteorological regions are required for modeling water temperature over the entire Delta (Guerin, 2010). However, since the boundary condition data, including meteorology, applied in the BDCP scenarios is based on historical data used in the calibrated model, the average

monthly bias in the historical model can be applied to the BDCP model as a regional correction to model output on a monthly-average basis.

Model results of monthly averaged output comparing the BDCP PP scenario with NAA scenario are illustrated qualitatively in time series plots of water temperature. Quantitative comparisons are made by comparing monthly results for the PP alternative in a tabular format. To compute a monthly average the standard daily model output is averaged to monthly time series, and then a single average is then computed for each month. For example, a single value is calculated for January water temperature, which represents the value in a given region over the entire modeled time span, 1921 – 2003.

Although some model output is represented as a daily average, for statistical purposes, monthly averages were calculated (from the daily average model output) and are suggested as the standard for comparison of scenario results. Although some of the boundary conditions for the scenarios are daily time series, others - notably south Delta exports - are monthly time series. The south Delta export strongly influence the movement of water through the Delta, particularly during periods of lower inflow. In addition, there is a strong regional bias in water temperature created in the model domain due to the limitation of DSM2 to a single meteorological region. In order to understand the effect of the water temperature bias on the scenarios, this bias is best interpreted on monthly averages as the day-to-day and season to season variations in ELT scenario inflow and export do not fully represent the historical conditions on which the bias is based.

1. Background

Objectives

The main objectives of the work discussed in this document are to: (1) document model parameterization, boundary conditions and results of BDCP DSM2 water temperature simulations; and, (2) provide information on regional model bias as an aid to the appropriate interpretation of the DSM2 BDCP scenario water temperature results.

DSM2 Simulations for BDCP

The Delta Simulation Model-2,[2] or DSM2, is a suite of one-dimensional models that were used in this project to model the hydrodynamics and water temperature dynamics in the Delta under a range of changes to Delta bathymetry due to the restoration of tidal marsh area, as well as changes due to Delta operations, sea level rise and climate change as conceptualized in BDCP scenarios.

The DSM2 suite of models was developed by California's Department of Water Resources (DWR). The hydrodynamic and water quality modules, HYDRO and QUAL, respectively, have been

[2] http://baydeltaoffice.water.ca.gov/modeling/deltamodeling/models/dsm2/dsm2.cfm

developed by DWR to simulate historical conditions in the Delta – this implementation is called the "Historical Model" herein. DSM2 is also frequently used to model hypothetical scenarios, as it was in this project for the BDCP. The BDCP scenario simulations were run using sets of hypothetical conditions over the water years[3] 1921 – 2003. The conditions modeled in this time frame do not represent conditions that actually occurred during these years – however, inflow boundary conditions are based loosely on the natural flow conditions occurring in California watersheds during this time frame.

[3] A water year runs from the first of October the previous year through the end of September in the given year.

2. DSM2 Model Description

DSM2 – General information

DSM2 is a suite of one-dimensional hydrodynamic and water quality simulation models used to represent conditions in the Sacramento-San Joaquin Delta. DSM2 was developed by the Department of Water Resources (DWR) and is frequently used to model impacts associated with projects in the Delta, such as changes in exports, diversions, or channel geometries associated with dredging in Delta channels. It is considered the official Delta model for many purposes.

The simplification of the Delta to a one-dimensional model domain means that DSM2 can simulate the entire Delta region rapidly in comparison with higher dimensional models. Although many channels in the Delta are modeled well in one dimension, the loss of spatial detail in areas that are naturally multi-dimensional, such as Suisun Bay, limit DSM2's accuracy in those areas. In addition, the DSM2 grid conceptualizes several open water areas, for example Franks Tract and Mildred Island, as zero-dimensional "reservoir" volumes. For the transport of QUAL constituents, a reservoir is assumed to be a fully-mixed volume.

DSM2 contains three separate modules, a hydrodynamic model (HYDRO), a water quality module (QUAL), and a particle tracking module (PTM). HYDRO was developed from the USGS FOURPT model (USGS, 1997). DWR adapted the FOURPT model to the Delta, accounting for such features as operable gates, open water areas, and export pumps. The water quality model, QUAL, is based on the Branched Lagrangian Transport Model (Jobson, 1997), also developed by the USGS. QUAL uses the hydrodynamics simulated in HYDRO as the basis for its transport calculations. The capability to simulate water temperature (and nutrient dynamics) in QUAL was developed by Rajbhandari (1995a, 1995b). The third module in the DSM2 suite is PTM, which simulates the fate and transport of neutrally buoyant particles. PTM also uses hydrodynamic results from HYDRO to track the fate of particles released at user-defined points in space and in time.

Detailed descriptions of the mathematical formulation implemented in HYDRO and for constituents in QUAL, required data, and past applications of the DSM2 Historical Model are documented in a series of reports available at:

http://baydeltaoffice.water.ca.gov/modeling/deltamodeling/annualreports.cfm.

Documentation on the calibration and validation of the HYDRO model and the QUAL model for salinity used in the current and prior versions of DSM2 is available at that website. The calibration of DSM2 has generally focused on hydrodynamics and the transport of salinity, modeled as electrical conductivity (EC), and of dissolved organic carbon (DOC). The calibration of HYDRO in DSM2 Version 8 for hydrodynamics used in this project is assumed to be sufficient for our purposes.

Recently (Guerin, 2010), the water temperature and nutrient models in QUAL Version 6 were calibrated in the Delta for the years 1990 through 2008 to model the transport of nutrients and water temperature as an extension of the base Historical Model implementation. In QUAL, water

temperature can be modeled independently of the nutrients. The Version 6 calibration (Guerin, 2010) required the collection and synthesis of a large quantity of data needed to set the model boundary conditions over the modeled time span (1990 – 2008) and to calibrate and validate the model calculations. The description of the data used for the initial calibration, in particular the results of the water temperature calibration, is covered in detail in (Guerin, 2010). Subsequently, the temperature and nutrient models were recalibrated as improved versions of QUAL were made available (Guerin, 2011).

With the introduction of a new bathymetry in the DSM2 model grid of the Delta to incorporate the flooding of Liberty Island in the Cache Slough area due to levee breaks in the late 1990's, a recalibration of the hydrodynamics in HYDRO was undertaken for this bathymetry change by Chilmakuri (2009), and a new version for the DSM2 suite of models, Version 8[4], was introduced. The hydrodynamic simulations discussed in this report were run using the executable HYDRO Verison-8.0.6 (the version used in other BDCP DSM2 modeling), while the water temperature models were run using QUAL Version-8.1.2 (the most recent version in 2014). QUAL Version-8.1.2 corrects and improves QUAL's computational accuracy. The computational results from the HYDRO version (8.0.6) used are somewhat different from those calculated in the most recent version (8.1.2), so the former version (8.0.6) of HYDRO was used as the hydrodynamic basis for the water temperature simulations for consistency with previous hydrodynamic results.

BDCP Model Bathymetry

Figure 2-1 shows the changes to the network of the DSM2 model (Chilmakuri, 2009) used for the scenario simulations used in this study. The major changes are the inclusion of the Liberty Island open water area - this is modeled as a zero-dimensional "reservoir" in DSM2 terminology - and an extension and refinement in the grid at the northern boundary of the model. Figure 2-2 shows the earlier DSM2 Version 6 grid with channels, nodes and general location of open water areas other than Liberty Island.

[4] http://baydeltaoffice.water.ca.gov/modeling/deltamodeling/models/dsm2/dsm2.cfm

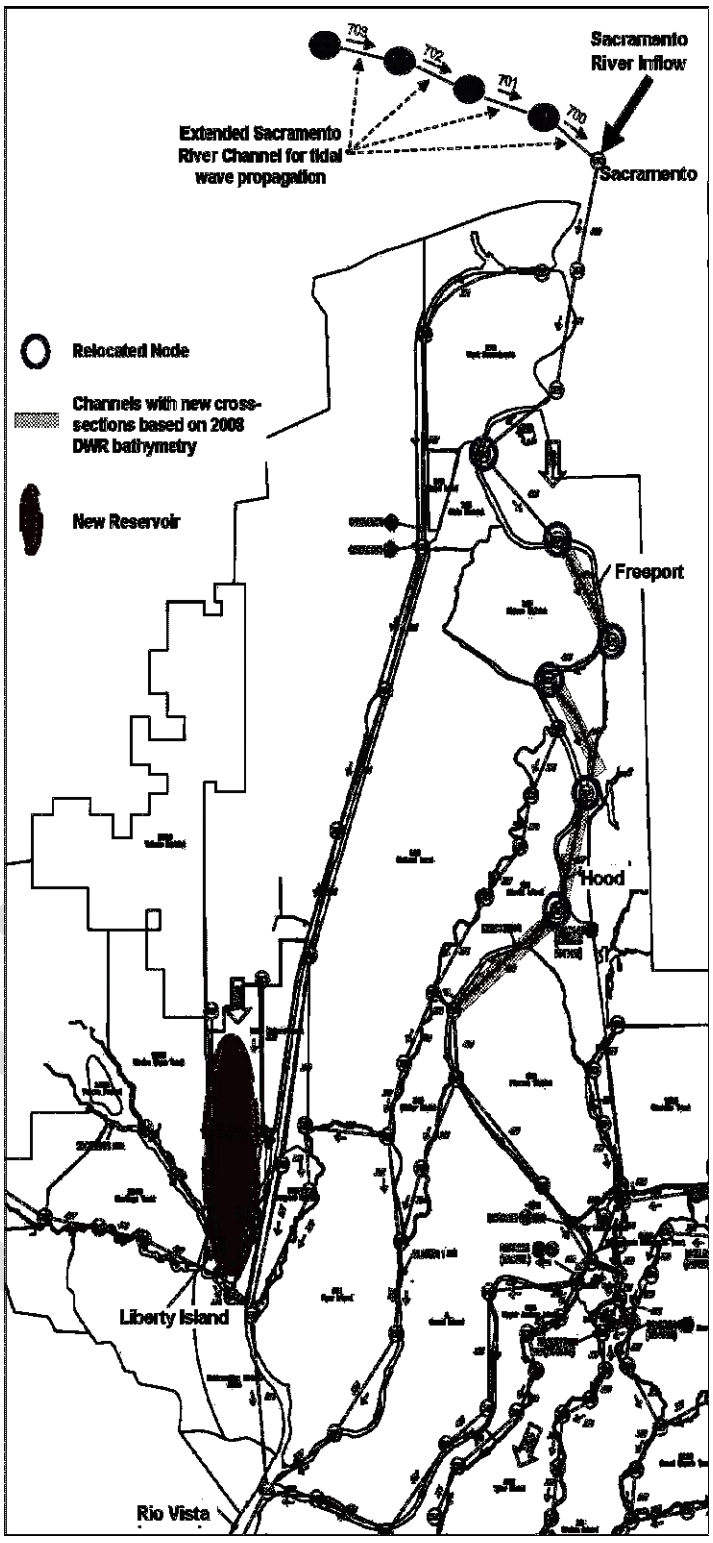


Figure 2-1 Changes implemented in the DSM2 V.8 model grid showing the new Liberty Island "reservoir" location, and changes to the grid and modes along the upstream portion of the Sacramento River.

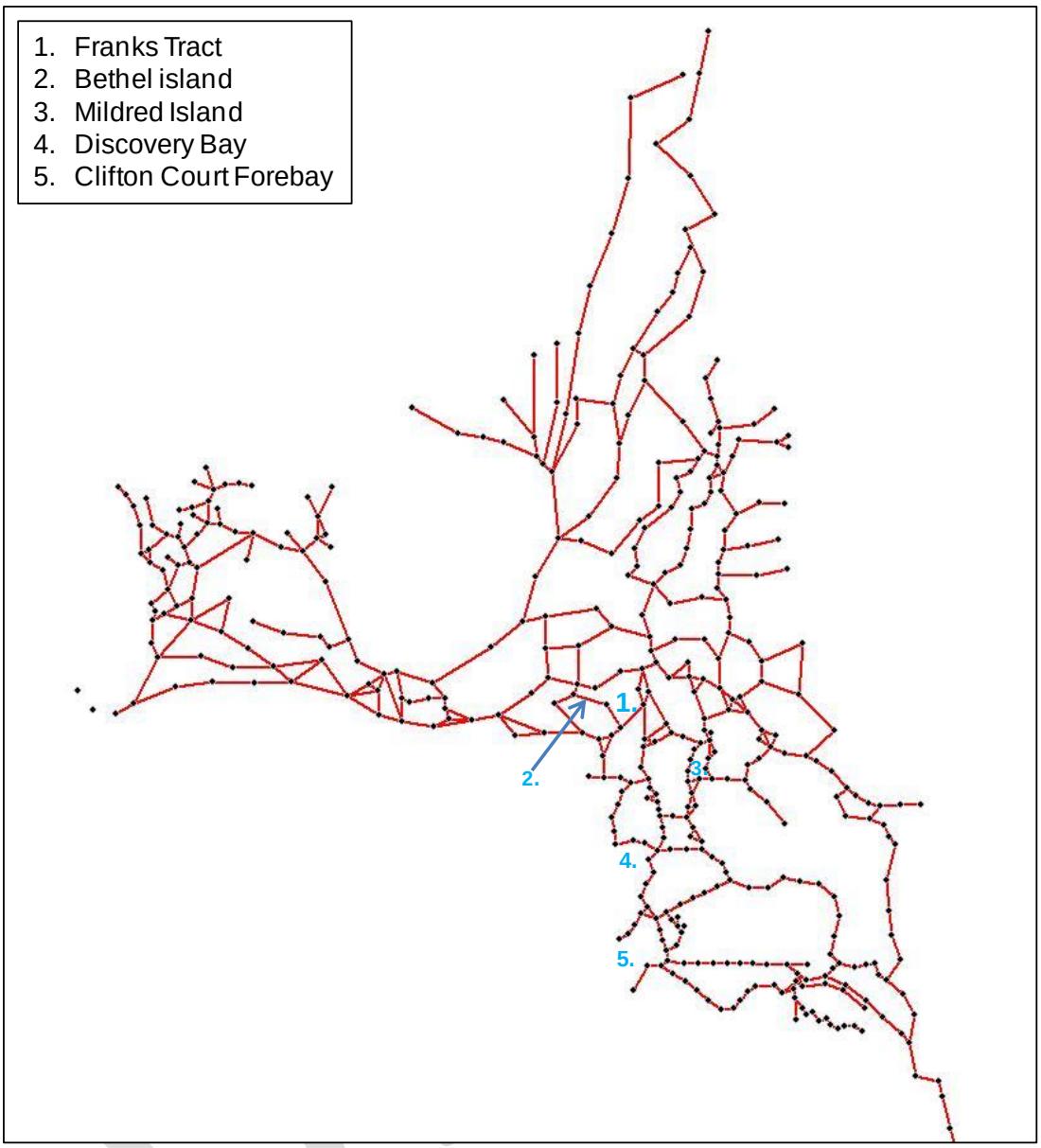


Figure 2-2 DSM2 Version 6 model grid showing channels (red), the approximate location of reservoirs (blue numbers), and nodes (black) between channels or at model boundaries.

3. Description of the DSM2 HYDRO and QUAL models

The implementation of the DSM2 modules HYDRO and QUAL discussed in this report extends the standard configuration of the DSM2 "Historical Model" by including effluent inflow from the main wastewater treatment plants (WWTPs) with outfalls within DSM2's model domain in the Delta.

HYDRO flow and stage boundaries

Boundaries that define the movement of water into and out of the Delta consist of inflow boundaries, outflow boundaries and a stage boundary set at Martinez. In Figure 3-1, the main inflow boundaries are denoted by blue stars. These boundaries are found at the each of the major rivers (Sacramento, San Joaquin, Calaveras, Mokelumne and Cosumnes), and at the Yolo Bypass and the Lisbon Toe Drain (in the Yolo region). The Yolo boundary only has inflow during periods of high Sacramento River inflow which generally occurs late fall through early spring. Flows at the Lisbon Toe Drain near Liberty Island on the north western edge of the Delta, used in the Version 6 implementation of the nutrient model and the Version 8 calibration discussed herein, are incorporated in the Yolo flow boundary for each of the BDCP scenarios discussed in this document.

Figure 3-2 shows the approximate location of effluent inflow boundaries used in BDCP scenarios discussed in this report – two effluent locations supplying inflow to the Delta at Woodland and Davis are not included at boundary conditions. The combined volume of effluent water is generally small in comparison with other inflow contributions except in periods of very low inflow. The effects of evaporation, precipitation, and channel depletions and additions ascribed to agricultural influences are modeled using the Delta Island Consumptive Use (DICU) model[5]. This model is used to set boundary conditions at 258 locations throughout the Delta – these locations are subdivided into 142 regions. DICU flow boundary conditions vary monthly by region and are set by Water Year Type.

QUAL's Conceptual Model for Water Temperature

The conceptual model for portraying the transport of water temperature in DSM2-QUAL is based on equations adopted from QUAL-2E (Brown and Barnwell, 1987). DSM2 is limited to a single set of meteorological boundary conditions for the entire model domain. This constitutes a major simplification for the Delta as the conditions can vary substantially regionally – for example, wind speed can vary by a factor of two at different meteorological observation stations within the Delta. DICU inflow water temperature is specified as a single monthly time series that is repeated annually. Effluent inflow water temperature was developed from wastewater treatment plant data. Details on the development of scenario boundary conditions for QUAL are discussed in Section 4.

[5] http://www.iep.ca.gov/dsm2pwt/reports/DSM2FinalReport_v07-19-02.pdf, http://baydeltaoffice.water.ca.gov/modeling/deltamodeling/models/dicu/DICU_Dec2000.pdf

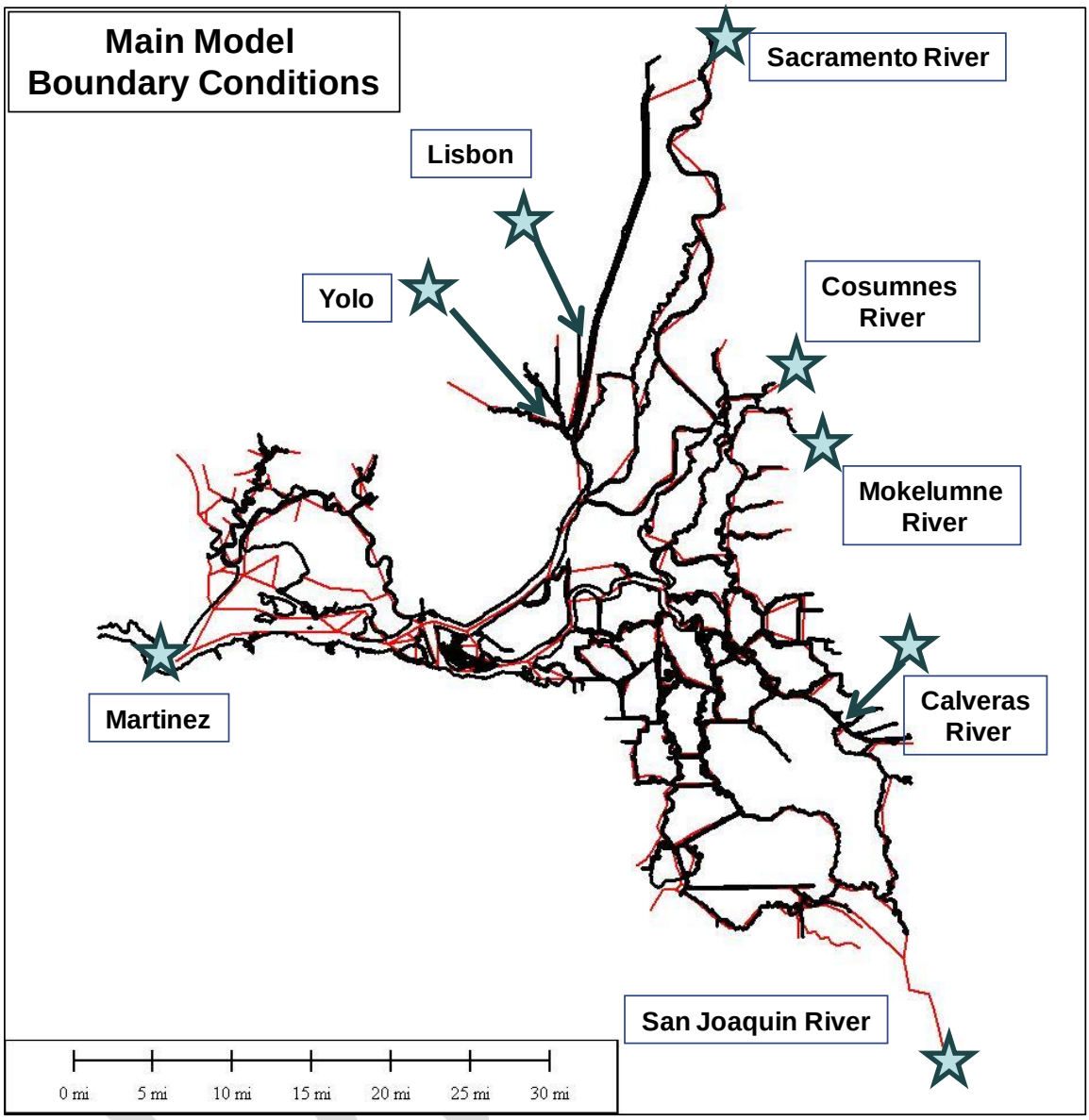


Figure 3-1 Approximate location of the model inflow (or outflow) boundaries (blue stars). The stage boundary is at Martinez.

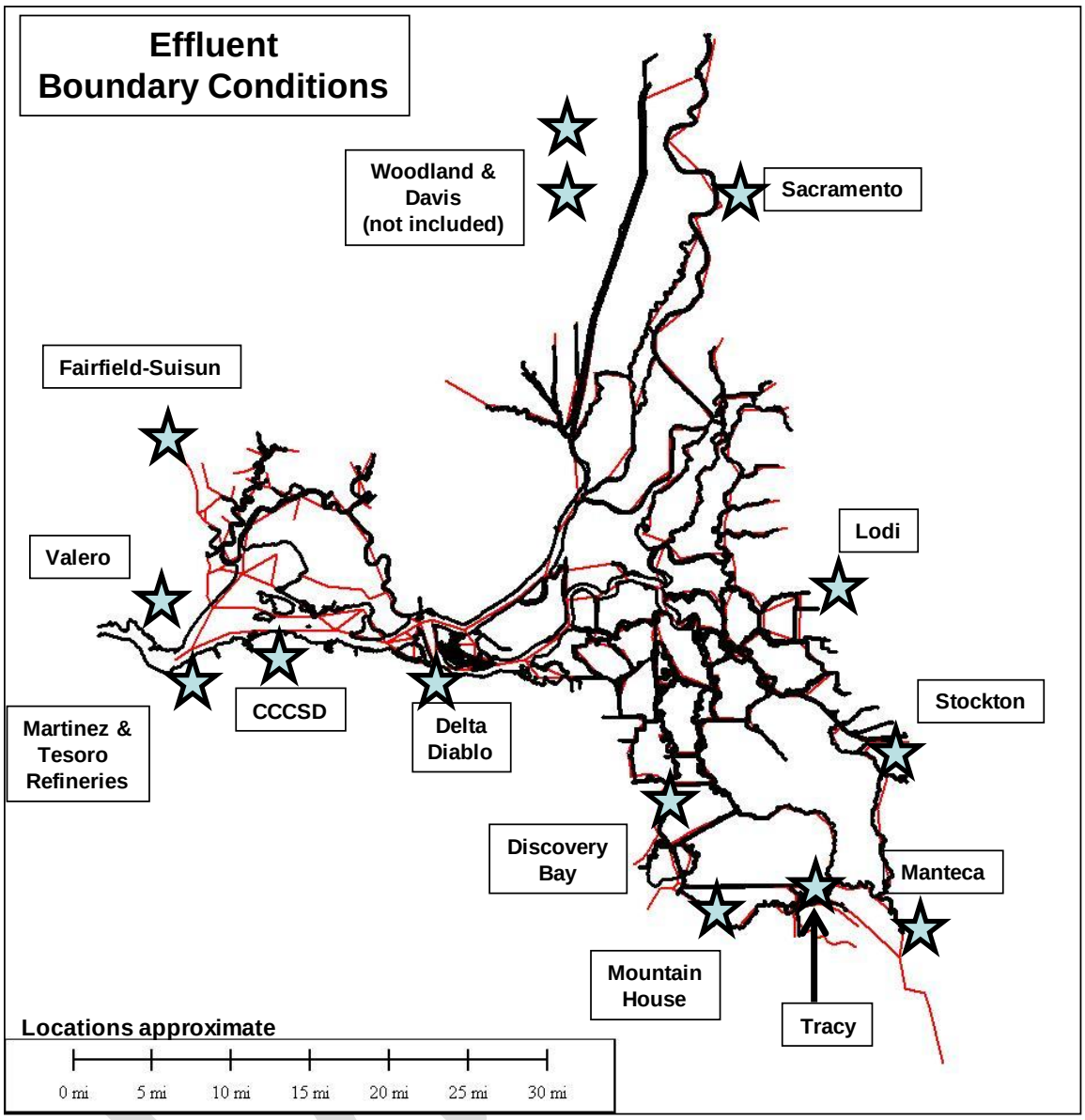


Figure 3-2 Approximate location of effluent boundary conditions for waste water treatment plants considered in this report.

4. BDCP Water Temperature Simulation Comparisons

DSM2 hydrodynamic and water temperature models were run and subject to QA/QC for the following BDCP scenarios:

- NAA_ ELT
- PA_ ELT

The hydrodynamic models were run using the executable for HYDRO Verison-8.0.6, the version used in other BDCP DSM2 modeling, while the water temperature models were run using the QUAL executable Version-8.1.2 (the most recent version as of 2014). The two versions are fully compatible.

Analysis Period

The analysis period was October 1921– September 2003. The months February - September 1921 were modeled as a spin-up period (mainly for the water temperature simulations).

Boundary Conditions for the Scenarios

Hydrodynamic boundary conditions

The standard hydrodynamic boundary conditions for both scenarios were provided to RMA by CH2MHill for DSM2 model input. Effluent inflow boundaries were added to the HYDRO for the water temperature modeling – this aspect is covered below in the section on setting effluent boundary conditions. With the exception of effluent inflow, the hydrodynamic boundary conditions for each of the BDCP model scenarios were used without alteration from the original. Identical effluent inflow conditions were used for all scenarios.

Water temperature boundary conditions

Boundary conditions must be specified for water temperature at inflow boundaries and at the tidal boundary at Martinez, as specified in Figure 3-1, and for effluent locations as specified in Figure 3-2. Water temperature must also be specified at each DICU inflow location. For the BDCP scenarios documented in this report, DICU inflow water temperature is given as a monthly average that repeats annually – the values are shown in Figure 4-1. For comparison, the DICU temperature used in the BDCP scenarios (purple line, adapted from (DWR, 1995)) is shown in comparison to a Delta-wide average of agricultural drain data (blue line) from DWR's Municipal Water Quality Investigations (MWQI) branch database, 1997 through 2004. Note that although DICU inflows and outflows are also specified as monthly averages, the flows vary by year type so do not repeat annually.

The boundary conditions for meteorological parameters required for QUAL water temperature simulations were developed for the ELT time frame - the details are covered in later in this section.

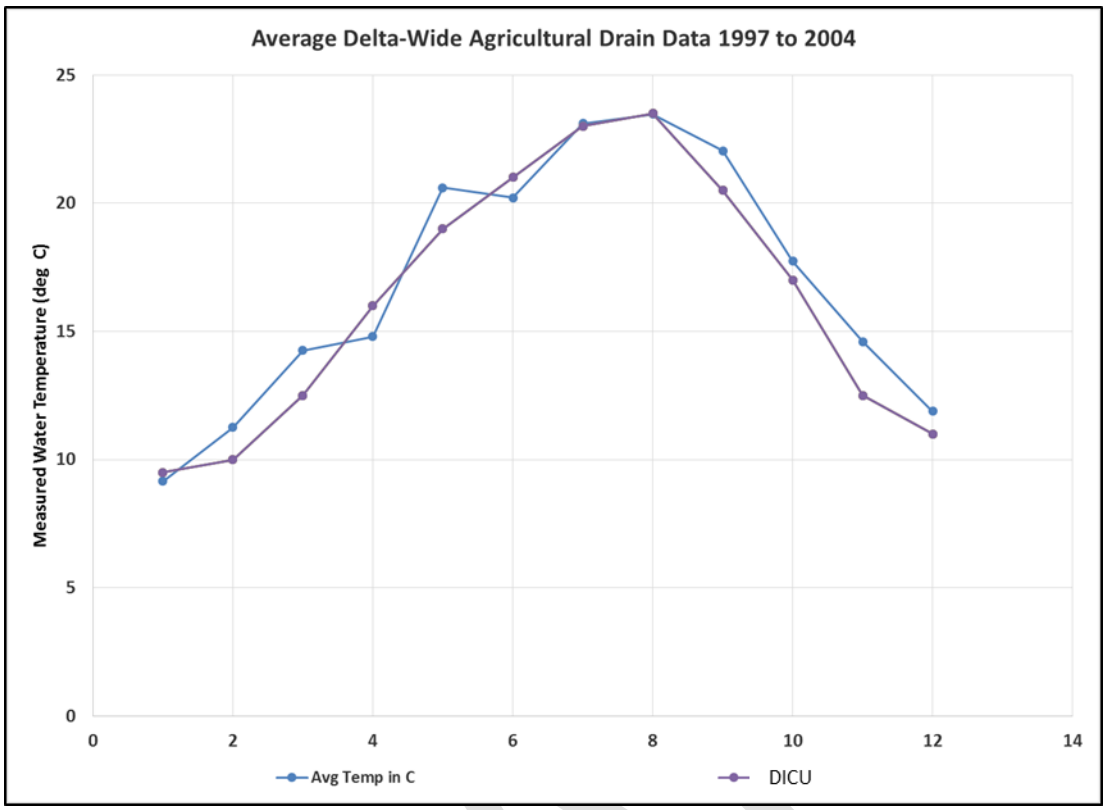


Figure 4-1 Comparison of DICU inflow water temperature (purple line) and a Delta-wide average of agricultural drain data (blue line) from the MWQI database.

Synthesis of meteorological and water temperature boundary conditions

Computations for the meteorological and water temperature boundary condition development were performed using Matlab scripts. Compilation of the output was performed in either Matlab or EXCEL. The assembly and calculation of effluent boundary conditions was done in EXCEL.

Effluent boundary conditions

Effluent boundary conditions were set in two ways, as discussed below. These boundary conditions are identical for the NAA and PA scenarios. For the period 1975 – 1992, time series developed for the previous BDCP model simulations were used. In these years, effluent was set using historical data from the years 2000 through 2005 - boundary conditions from a historical year were selected to represent each modeled year. The historical year to use for boundary condition during a given model year, 1975 – 1991, was selected using a similar water year type on the Sacramento River as a general guide.

Table 4-1 shows the annual correspondence established between the historical year (Column 3) and the modeled year (Column 1). Sacramento Regional Wastewater Treatment Plant (SRWTP) effluent flows were scaled, using this year-correspondence, to ensure the daily percentage of

effluent flow in Sacramento R. inflow remained below the historical 2000 -2005 maximum (approximately 4.5%, see Figure 4-2). All other effluent flows were applied without scaling using the annual year selection shown in Table 4-1. Effluent water temperature boundary conditions were set using the annual correspondence in Table 4-1. Unlike flow values, values for effluent inflow water temperature were not scaled from the values recorded in the historical time series for any of the effluent locations.

For the remainder of the modeled years for these two scenarios, historical years 2000 – 2004 were used. For leap years, either 2000 or 2004 was used, and for the other model years, historical years 2001, 2002 and 2003 were used the correspondence and the scaling for SRWTP inflows are shown in Table 4-2 for the years 1921 – 1974 and Table 4-3 for the years 1992 -2003. Effluent water temperature boundary conditions were set using the annual correspondence in Table 4-2 and Table 4-3. Effluent water temperature boundary conditions were set using the annual correspondence in Table 4-1. Unlike flow values, values for effluent inflow water temperature were not scaled from the values recorded in the historical time series for any of the effluent locations.

Effluent inflow and water temperature boundary conditions are included for completeness – however, their influence on Delta-wide water temperature is small.

Synthesis of meteorological and water temperature boundary conditions

Meteorological and water temperature boundary conditions were developed separately from the effluent boundary conditions. A single set of synthetic meteorology was generated for both scenarios using historical data, for the ELT future climate change condition. Meteorological boundary conditions for QUAL include air temperature (dry bulb), wet bulb temperature, atmospheric pressure, wind speed and cloud cover.

Projected daily average temperatures for the ELT climate change condition were used as a basis for meteorological boundary condition development by closely matching the average air temperature specified for a given day in the ELT time frame with historical air temperature at approximately the same annual date (+/- 2 days) using the meteorological data[6] from the calibrated QUAL water temperature model. For a given model day for the ELT climactic condition, the projected average daily temperature is compared with daily average temperatures within +/- two days for all available historical years from the calibrated model (i.e., 1990 – 2008). The absolute value of the closest temperature is chosen from the list, the selected day and year is recorded, and the set of hourly meteorological conditions from the chosen historical day and year is then used for that model day. There are 3 minor exceptions to this algorithm - the final day in February in leap years was developed separately using a similar protocol (February 29 +/- two days), and the first two and last two days in each calendar year (*i.e.*, in January and December) were set using only days in the same month in each historical calendar year. For example, for

[6] This methodology was adapted from a method developed by Don Smith (President, RMA) for creating meteorological boundary conditions from historical data.

December 31st of the ELT scenario year, the algorithm scanned through the final two days in December in each year of the historical data base to select the date with the closet match (in absolute value). The final meteorological boundary conditions were set as hourly time series.

As a rough comparison, Figure 4-3 and Figure 4-4 document the monthly averages of the meteorological parameters used as BDCP boundary conditions in the ELT time frame.

A single set of boundary conditions for daily water temperature were also generated using historical data by using the same dates used in matching the projected ELT and historical air temperatures. The historical water temperatures used in the calibrated QUAL model at the Sacramento R., Martinez and the San Joaquin R. boundaries from that day were then mapped into the BDCP scenario boundary conditions for water temperature. These were the only three time series used in setting all inflow boundary water temperatures. Figure 4-5 illustrates the monthly averaged time series for water temperature and the boundaries at which these time series were used.

Table 4-1 Correspondence between the former BDCP scenario model years (Column 1) and the Historical Model year (Column 3) used to apply all effluent BC, and the factor used to scale SRWTP effluent inflow (Column 4).

Model year	Sac WY Type	Historical BC Year	Factor*SRWTP Flow
1975	*W*	2000	1.0
1976	*C*	2004	1/1.4
1977	*C*	2002	1/1.6
1978	*AN*	2000	1.15
1979	*BN*	2004	1.0
1980	*AN*	2000	1.0
1981	*D*	2001	1.0
1982	*W*	2000	1.7
1983	*W*	2001	1.5
1984	*W*	2002	1.2
1985	*D*	2001	1.0
1986	*W*	2000	1.0
1987	*D*	2001	1/1.1
1988	*C*	2002	1/1.5
1989	*D*	2004	1/1.25
1990	***C***	2001	1/2.1
1991	***C***	2000	1/2

Table 4-2 Correspondence between the BDCP scenario years 1921 - 1974 and Historical years used to apply effluent BC, and the factor used to scale SRWTP effluent inflow).

Scenario Year	Sac WY Type	Historical BC Year	Factor*SRWTP Flow
1921	AN	2003	1
1922	AN	2003	1
1923	BN	2001	1/1.1
1924	C	2004	1/1.2
1925	D	2001	1
1926	D	2001	1
1927	W	2003	1
1928	AN	2000	1/1.4
1929	C	2001	1/1.1
1930	D	2001	1/1.3
1931	C	2001	1/1.3
1932	D	2004	1/1.2
1933	C	2001	1/1.1
1934	C	2001	1/2.5
1935	BN	2001	1/2.2
1936	BN	2004	1/1.1
1937	BN	2001	1
1938	W	2001	1
1939	D	2002	1/2.0
1940	AN	2000	1
1941	W	2003	1
1942	W	2003	1/1.4
1943	W	2003	1
1944	D	2000	1
1945	BN	2001	1
1946	BN	2001	1
1947	D	2001	1
1948	BN	2004	1/1.8
1949	D	2002	1/1.2
1950	BN	2002	1
1951	AN	2003	1
1952	W	2004	1
1953	W	2003	1
1954	AN	2003	1
1955	D	2001	1/1.3
1956	W	2000	1
1957	AN	2003	1
1958	W	2003	1
1959	BN	2001	1/1.3
1960	D	2004	1/1.1
1961	D	2001	1/1.2
1962	BN	2001	1
1963	W	2003	1
1964	D	2004	1/1.1
1965	W	2003	1
1966	BN	2001	1
1967	W	2003	1
1968	BN	2004	1
1969	W	2003	1
1970	W	2003	1
1971	W	2003	1
1972	BN	2004	1
1973	AN	2003	1
1974	W	2003	1

Table 4-3 Correspondence between the BDCP scenario years 1992 - 2003 and Historical years used to apply effluent BC, and the factor used to scale SRWTP effluent inflow).

Scenario Year	Sac WY Type	Historical BC Year	Factor*SRWTP Flow
1992	C	2004	1/1.5
1993	AN	2003	1
1994	C	2001	1/1.1
1995	W	2003	1
1996	W	2000	1
1997	W	2003	1
1998	W	2003	1
1999	W	2003	1
2000	AN	2000	1
2001	D	2001	1
2002	D	2002	1
2003	AN	2003	1

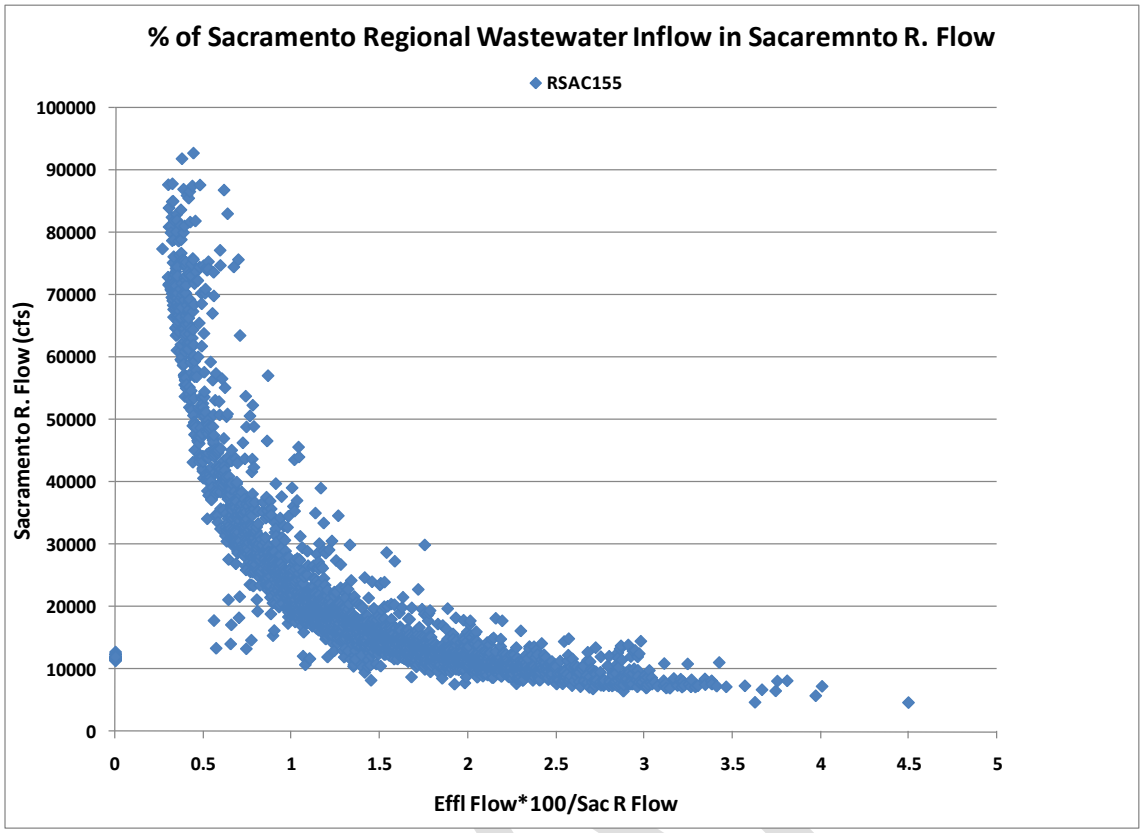


Figure 4-2 Maximum percentage of Sacramento Regional Wastewater inflow in Sacramento R. inflow was generally less than 4 %.

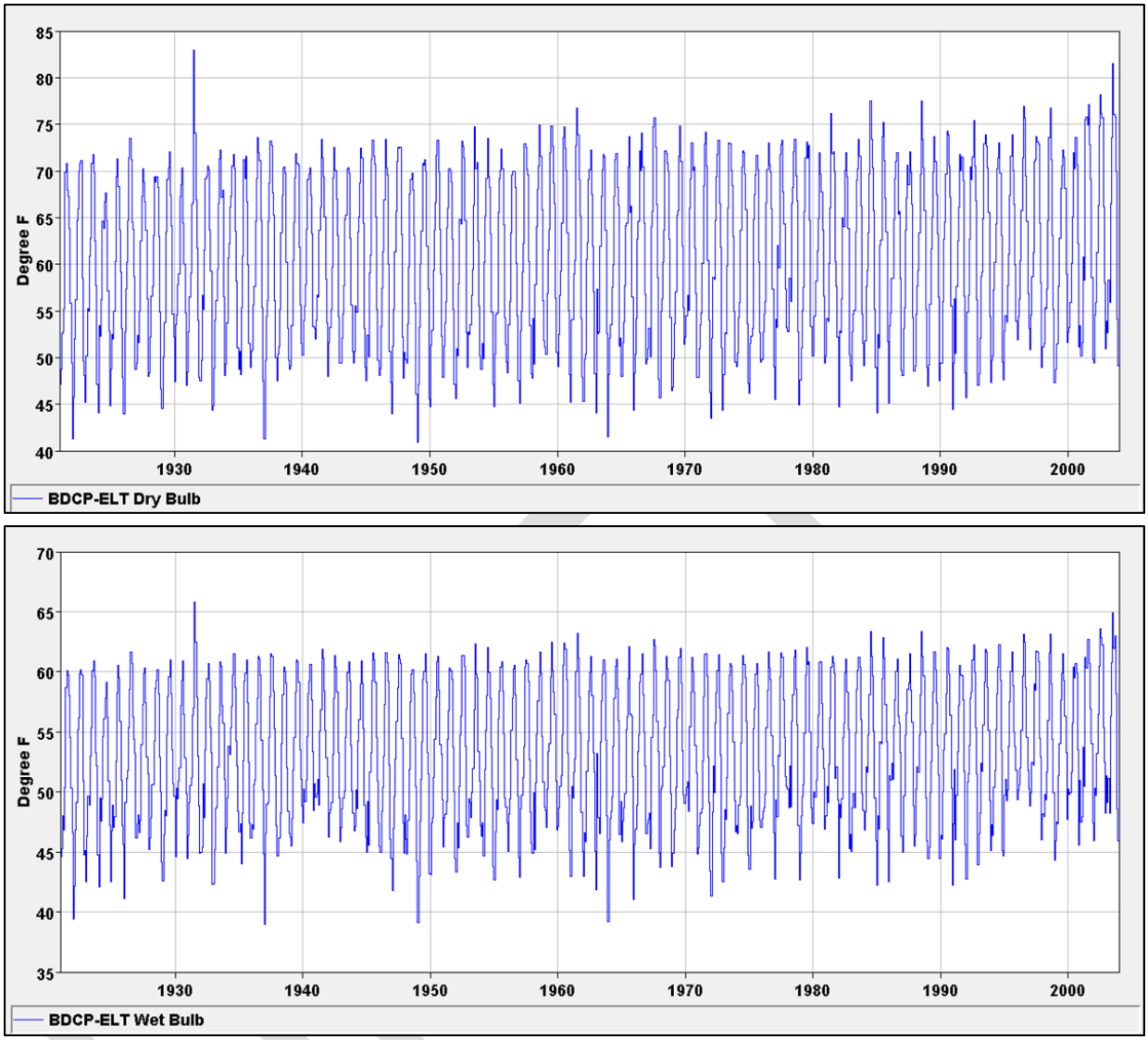


Figure 4-3 Monthly average air temperature (upper) and wet bulb temperature (lower) for the ELT scenario time frame.

Figure 4-4 Monthly average wind speed (upper), fraction cloud cover and atmospheric pressure (lower) for the ELT scenario time frame.

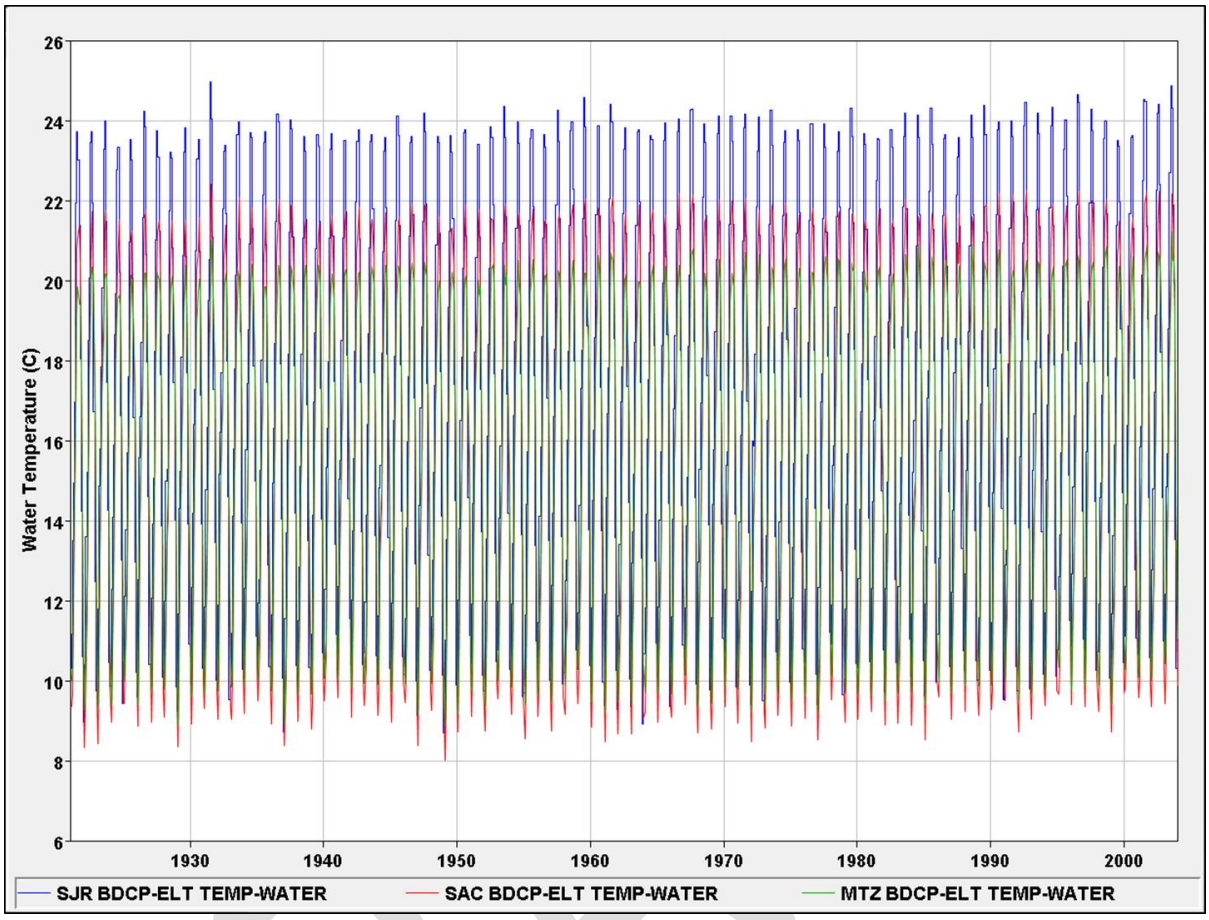


Figure 4-5 Inflow water temperature for the Sacramento and San Joaquin Rivers and the Martinez stage boundary for the ELT scenario time frame. The San Joaquin River boundary is also applied to the Calaveras River. The Sacramento River boundary is applied to all remaining inflow boundaries. The Martinez time series is only used at that location.

5. Results

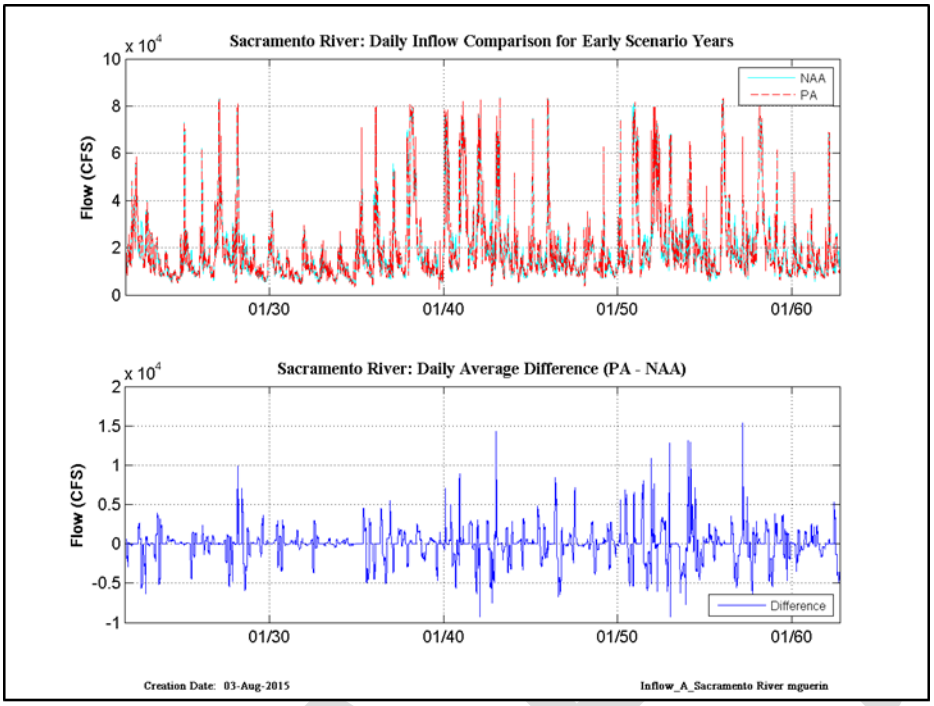
Comparison of Scenario Hydrodynamics

The difference between the hydrodynamics of the PA and NAA scenarios is illustrated graphically in plots of the daily time series of the main inflow and export locations. In this section, the plots illustrate the flows and the differences (PA – NAA) split into two time frames (early years and later years) for ease of viewing. Additional plots are available in the Appendix which plot the corresponding percent differences.

Comparing Figure 5-1, Figure 5-2 and Figure 5-3, the main inflow difference between the PA and NAA scenarios occurs at the Sacramento River, with flow differences ranging from -5000 to over 10,000 CFS and only sporadic flow differences at the Yolo and San Joaquin River inflow locations.

Export differences are substantial at all three of the main export locations. NAA exports at the SWP (Figure 5-4) and CVP (Figure 5-5) south Delta locations are greater than PA exports by more than 7,000 CFS and 4,000 CFS, respectively. The PA scenario instead has increased exports at the NDD location (Figure 5-6) on the Sacramento River, while the NAA scenario exports no water here.

In summary, water temperature differences between the NAA and PA scenarios will be driven by a combination of inflow and export on the Sacramento River, as well as differences in exports levels at the SWP and CVP locations in the south Delta.



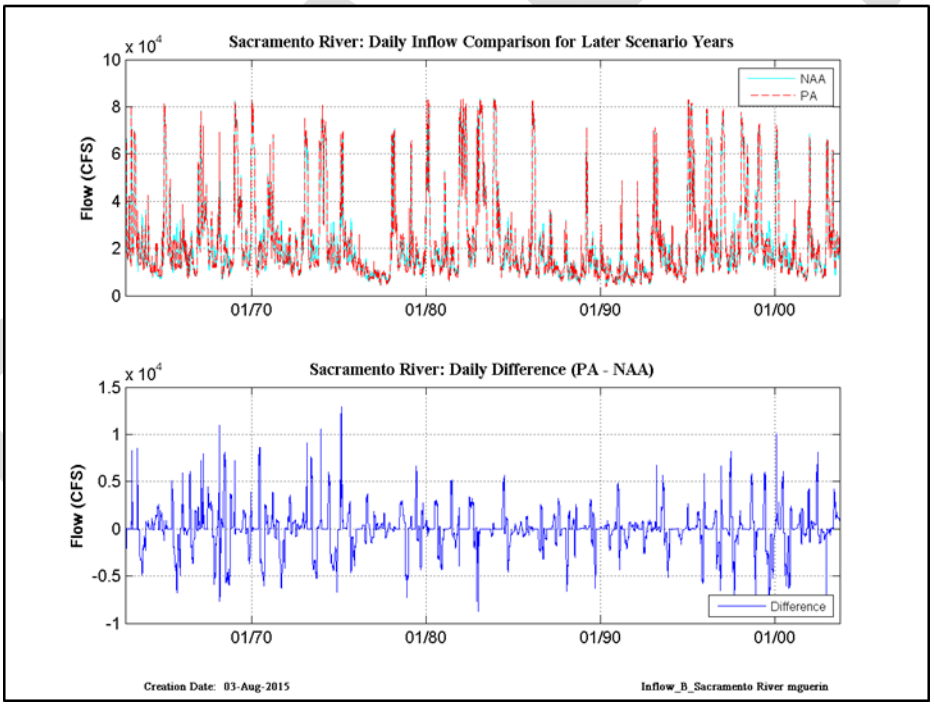


Figure 5-1 Daily inflow (CFS) on the Sacramento River for the PA and NAA scenarios and the flow difference (PA – NAA). The simulation time frame is split in two for clarity.

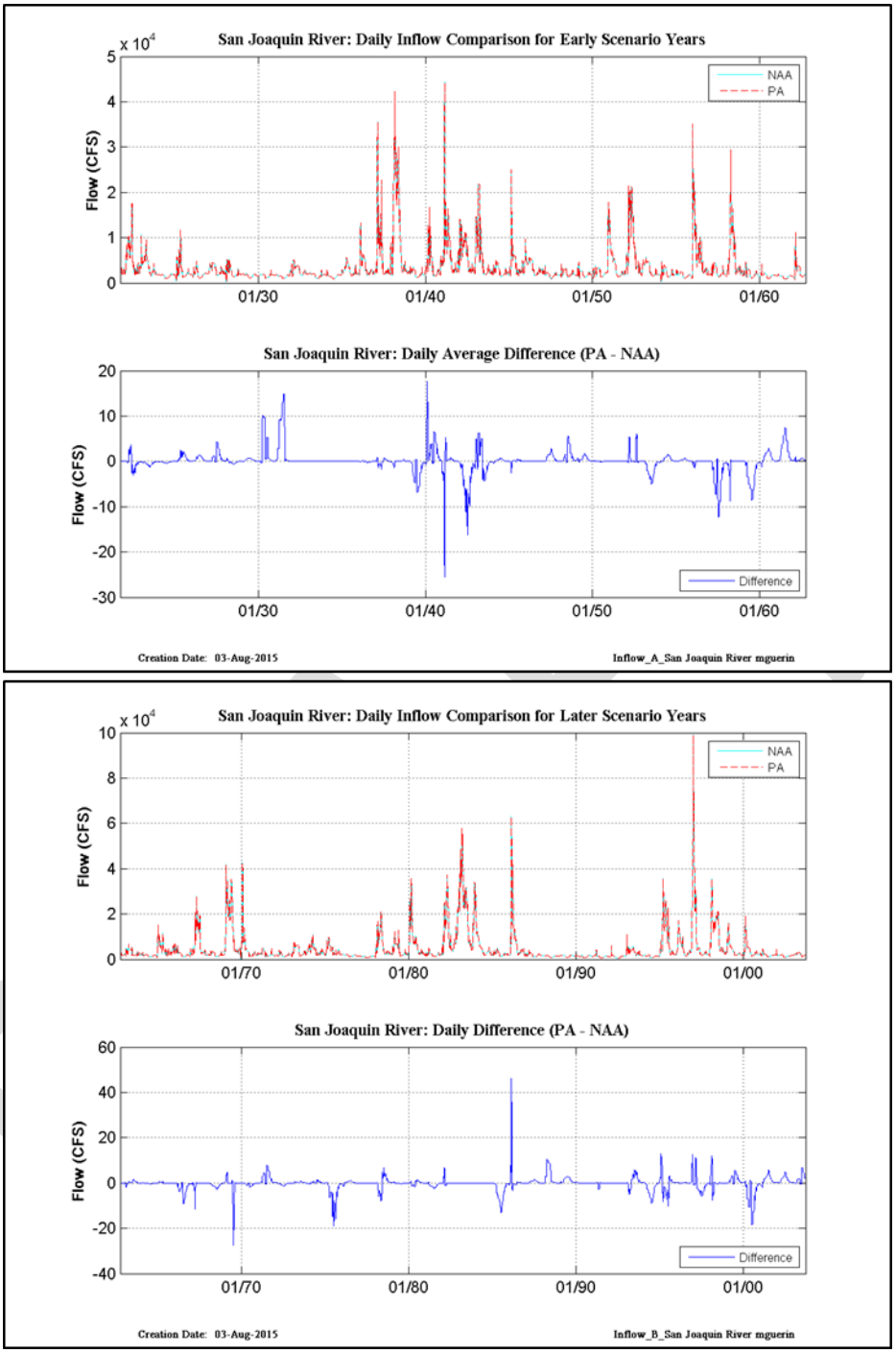
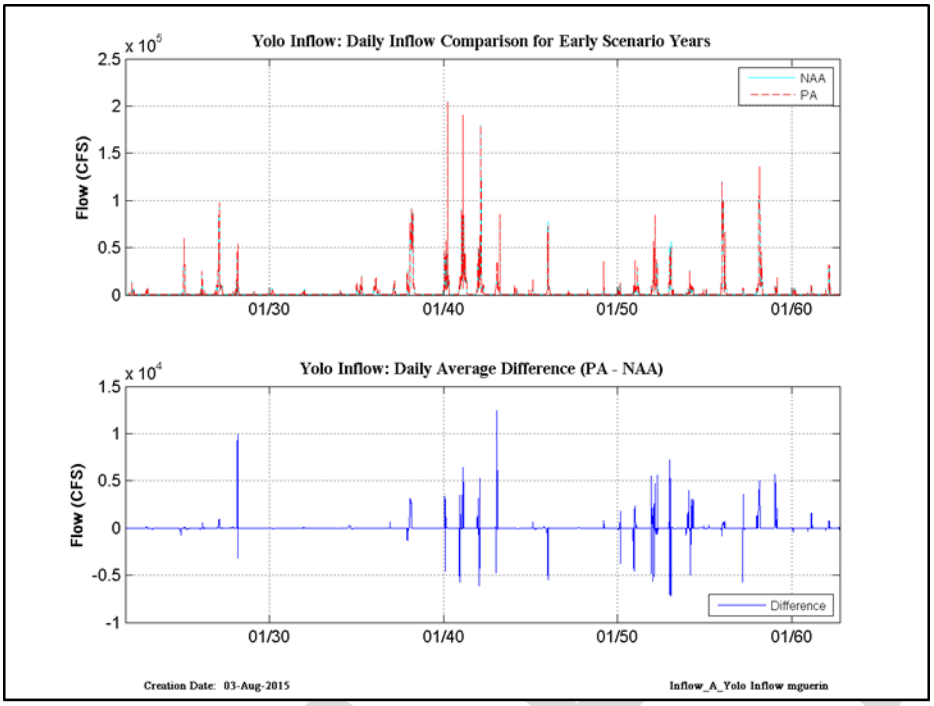


Figure 5-2 Daily inflow (CFS) on the San Joaquin River for the PA and NAA scenarios and the flow difference (PA – NAA). The simulation time frame is split in two for clarity.



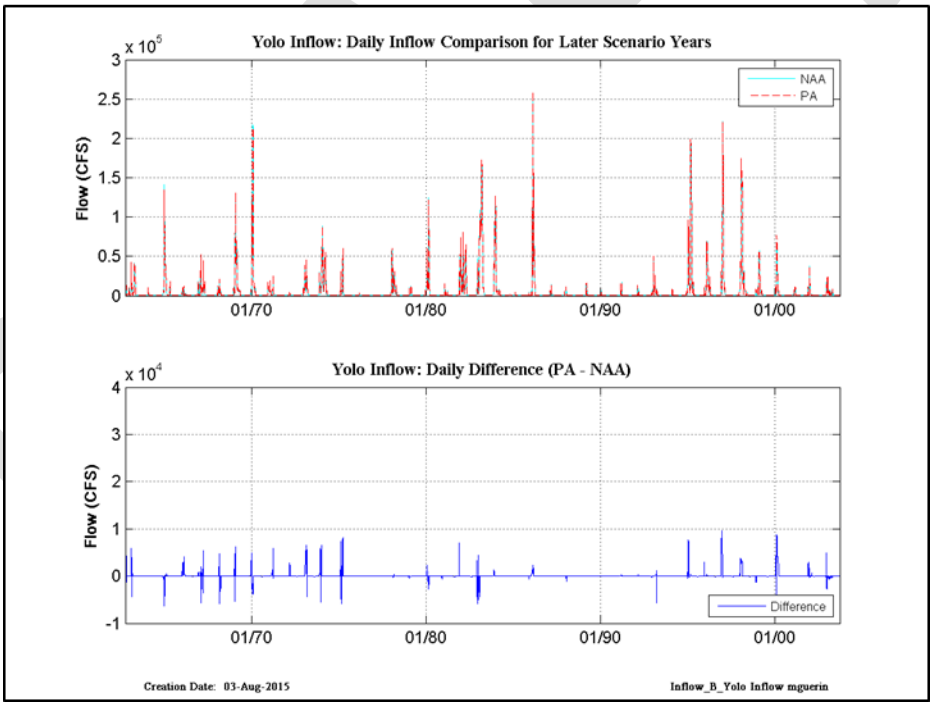
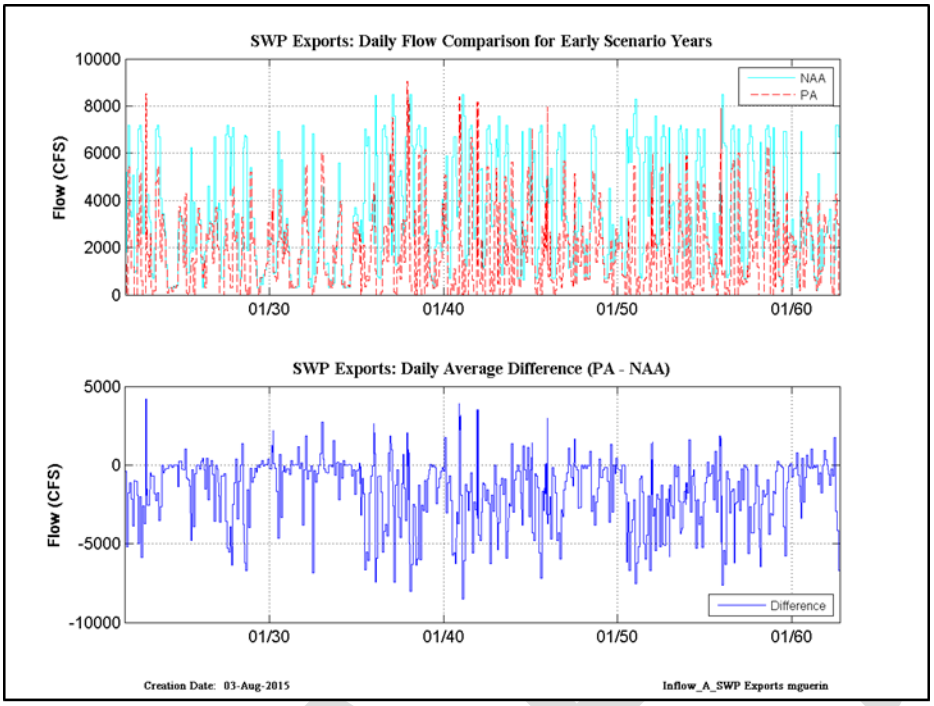


Figure 5-3 Daily inflow (CFS) from the Yolo Bypass for the PA and NAA scenarios and the flow difference (PA – NAA). The simulation time frame is split in two for clarity.



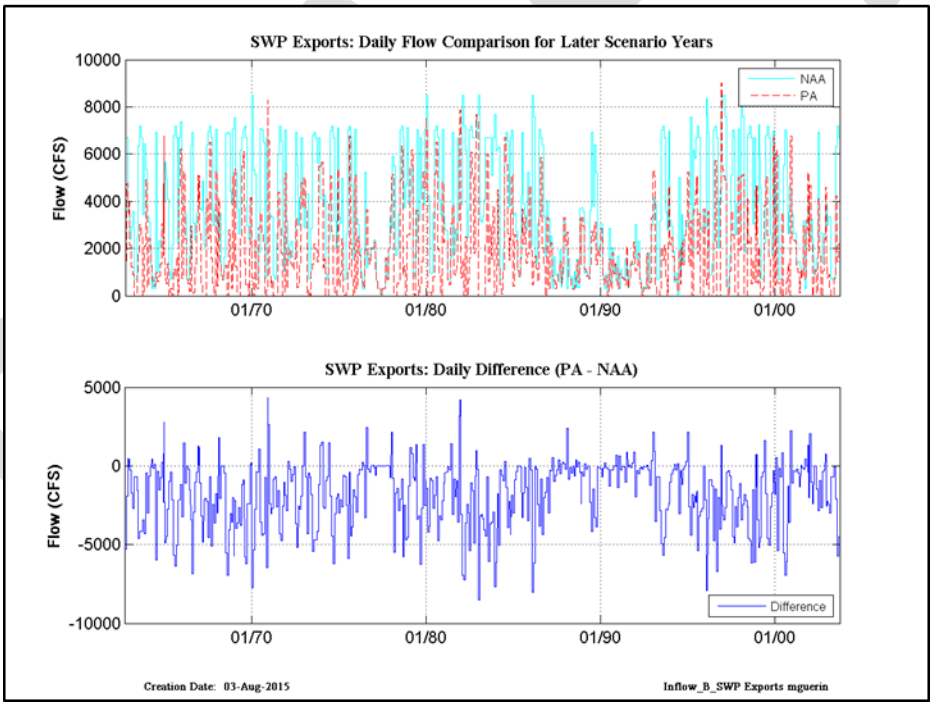
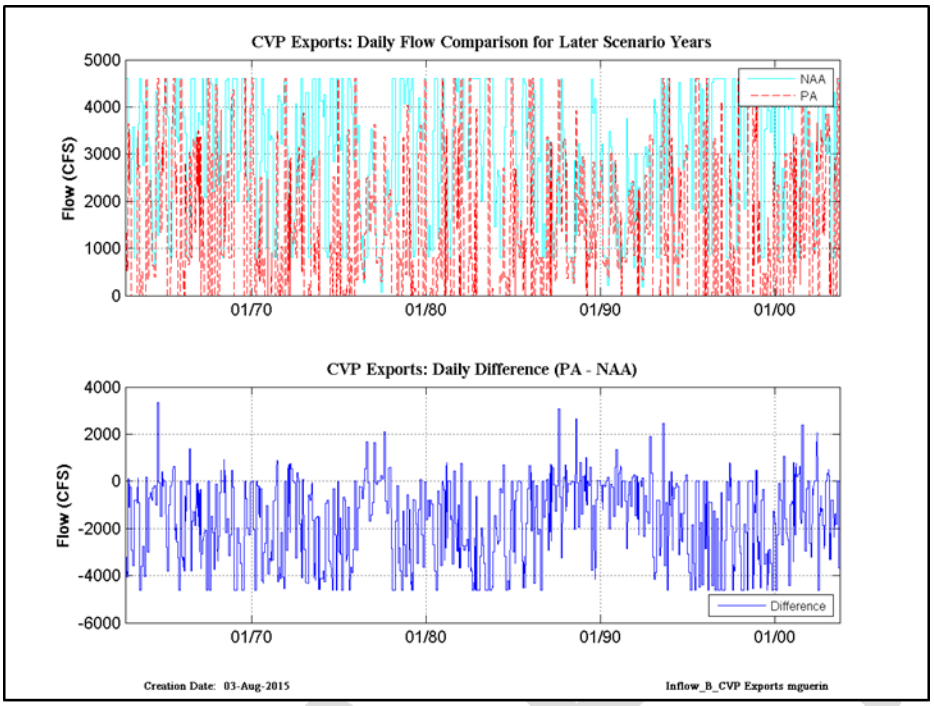


Figure 5-4 Daily export flow (CFS) from the SWP south Delta export location for the PA and NAA scenarios and the flow difference (PA – NAA). The simulation time frame is split in two for clarity.



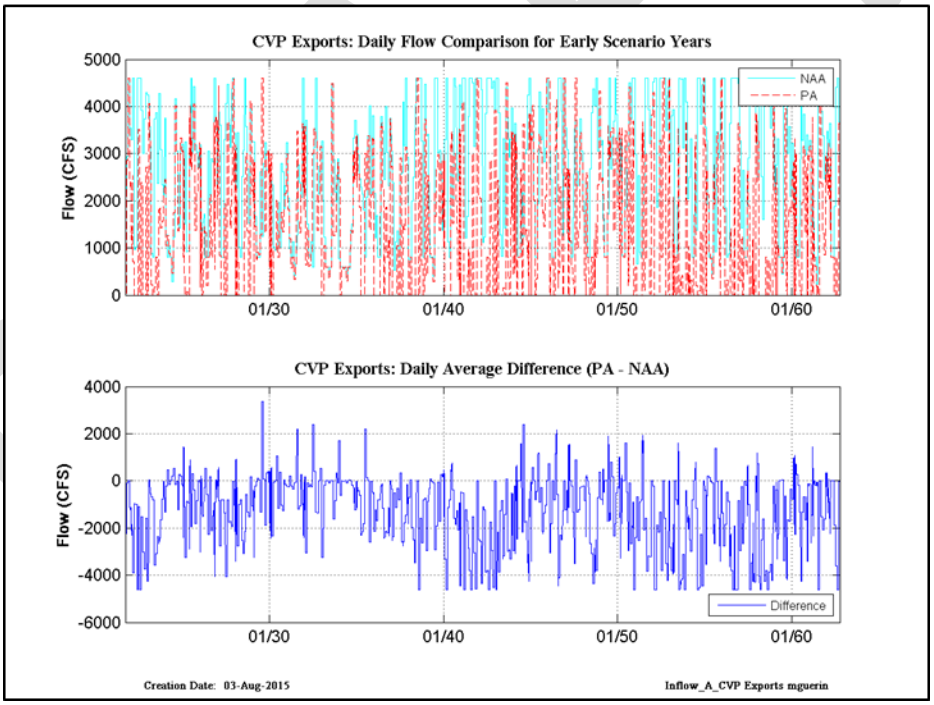


Figure 5-5 Daily export flow (CFS) from the CVP south Delta export location for the PA and NAA scenarios and the flow difference (PA – NAA). The simulation time frame is split in two for clarity.

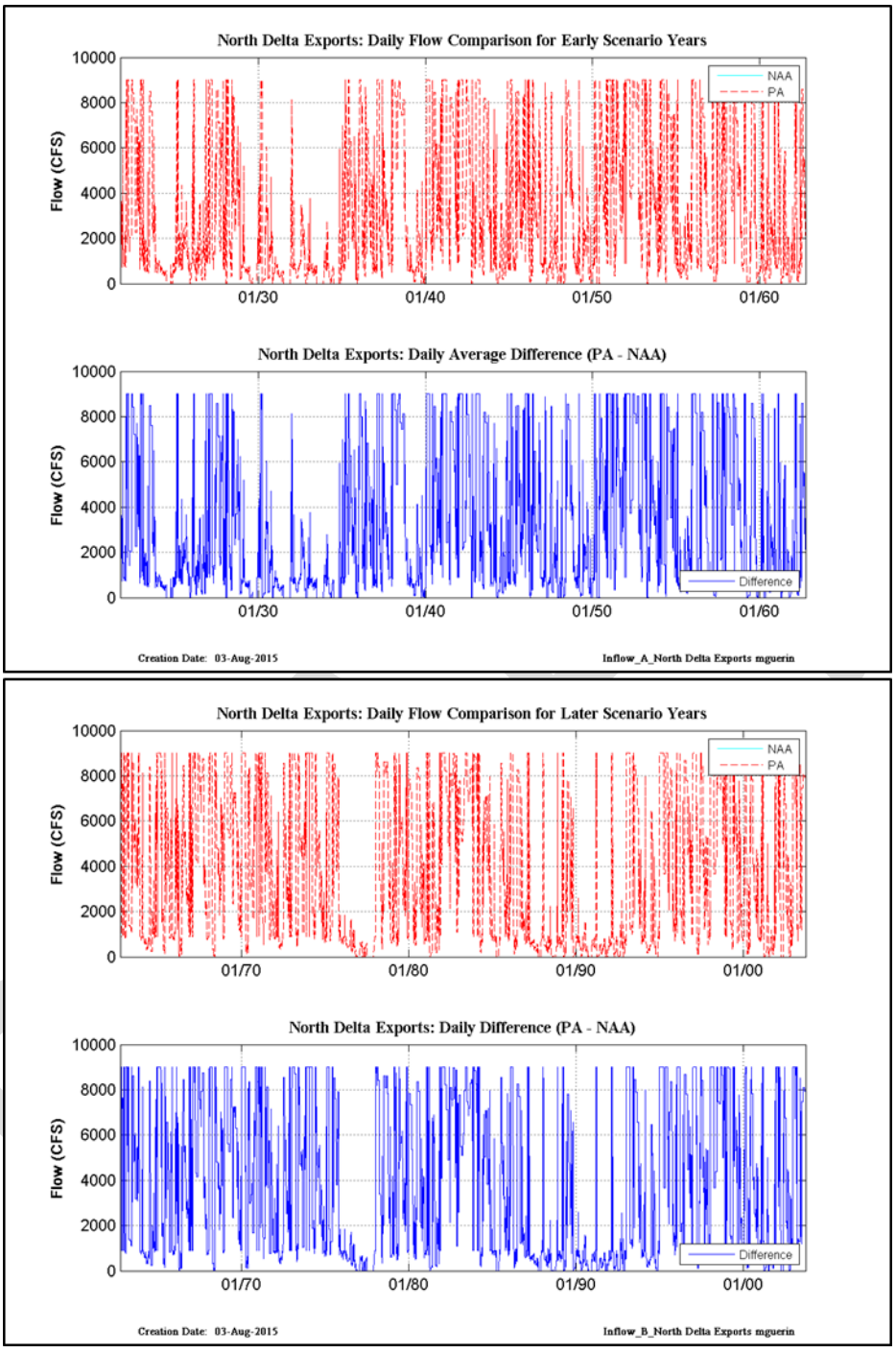


Figure 5-6 Daily export flow (CFS) from the North Delta Diversion (NDD) location for the PA and NAA scenarios and the flow difference (PA – NAA). The simulation time frame is split in two for clarity. Note that there are no NDD exports in the NAA scenario.

Comparison of Scenario Water Temperature Results

The comparison of BDCP scenario results is based primarily on the regional averages of scenario model output. Eight regions are considered – as depicted in brown font in Figure 5-7. – the South Delta region was refined by considered the San Joaquin River as a subregion due to its importance for fisheries concerns.

Graphical comparisons are shown as two sets of plots for each region – in each set the simulation time span is split in two for visual clarity. In one set, daily regional averages are compared for the two scenarios as well as the difference (PA – NAA). In the other set, monthly average results are considered. In addition, tabular data is presented showing the monthly average percent difference between the two scenarios for each modeled water year. The tables are also split into two time frames. At the bottom of the second table for each region, the maximum and minimum percent difference for each month is shown, as well as average monthly percent difference split by water year type.

For example, for the Cache Slough region, Figure 5-8 and Figure 5-9, show time series graphs of the PA and NAA monthly average and daily average model output, respectively, as well as the difference (PA – NAA) time series for each. In the Cache Slough region, the daily average difference in water temperature for the monthly averages ranges in +/- 0.1 degrees C, while for the daily averages it ranges in +/- 0.5 degrees C. For percent differences between the scenarios (Table 5-1and Table 5-2), the summary statistics at the bottom of Table 5-2 indicate that the maximum percent difference over all months and years occurred in March (of 2002), and that averaged by water year type, there are no notable trends in the percent difference of model output.

For the North Delta region, (Figure 5-10, Figure 5-11 Table 5-3 Table 5-4), the monthly and daily average percent differences are generally in the ranges +/- 0.1 degrees C and +/- 1.0 degrees C, respectively. In the tabular data, there are no notable trends in the percent difference of model output either in maximum and minimum or as split by water year type.

For the East Delta region, (Figure 5-12,Figure 5-13,Table 5-5, Table 5-6), the monthly and daily average percent differences are generally in the ranges +/- 0.2 degrees C and +/- 1.0 degrees C, respectively. In the tabular data, there are no notable trends in the percent difference of model output either in maximum and minimum or as split by water year type.

For the South Delta region, (Figure 5-14, Figure 5-15, Table 5-7, Table 5-8), the monthly and daily average percent differences are generally in the ranges +/- 0.2 degrees C and +/- 1.0 degrees C, respectively. In the tabular data, for the statistic listing the maximum percent differences (*i.e.*, increases in percent difference of the PA scenario in comparison to the NAA), the greatest percent differences were in the winter (January – March). However, there are no notable trends in the averages by water year type.

For the West Delta region, (Figure 5-16, Figure 5-17, Table 5-9, Table 5-10), the monthly and daily average percent differences are generally in the ranges +/- 0.2 degrees C and +/- 0.5 degrees C, respectively. In the tabular data, for the statistic listing the maximum percent differences (*i.e*., increases in percent difference of the PA scenario in comparison to the NAA), the greatest percent differences were in the fall and winter (November – March). There is a minor trend for increases in percent difference of water temperature in the PA scenario to occur February – March of the Wet, Above Average and Below Normal water year types.

For the SJR (San Joaquin River) region, (Figure 5-18,
Figure 5-19, Table 5-11, Table 5-12), the monthly and daily average percent differences are generally in the ranges +/- 0.2 degrees C and +/- 0.5 degrees C, respectively. In the tabular data, for the statistic listing the maximum percent differences (*i.e*., increases in percent difference of the PA scenario in comparison to the NAA), the greatest percent differences were in the winter (January – March). There is a minor trend for increases in percent difference of water temperature in the PA scenario to occur January – March in all of the water year types.

For the Suisun Marsh region, (Figure 5-20, Figure 5-21, Table 5-13, Table 5-14), the monthly and daily average percent differences are generally in the ranges 0.0 to 0.1 degrees C and -0.1 to 0.2 degrees C, respectively. In the tabular data, there are no notable trends in the percent difference of model output either in maximum and minimum or as split by water year type.

For the Suisun Bay region, (Figure 5-22, Figure 5-23, Table 5-15, Table 5-16), the monthly and daily average percent differences are generally in the ranges 0.0 to 0.2 degrees C and -0.2 to 0.4 degrees C, respectively. . In the tabular data, for the statistic listing the maximum percent differences, the greatest percent differences were in the fall and winter (November – March). There is a minor trend for increases in percent difference of water temperature in the PA scenario to occur February – March of the Wet, Above Average and Below Normal water year types.

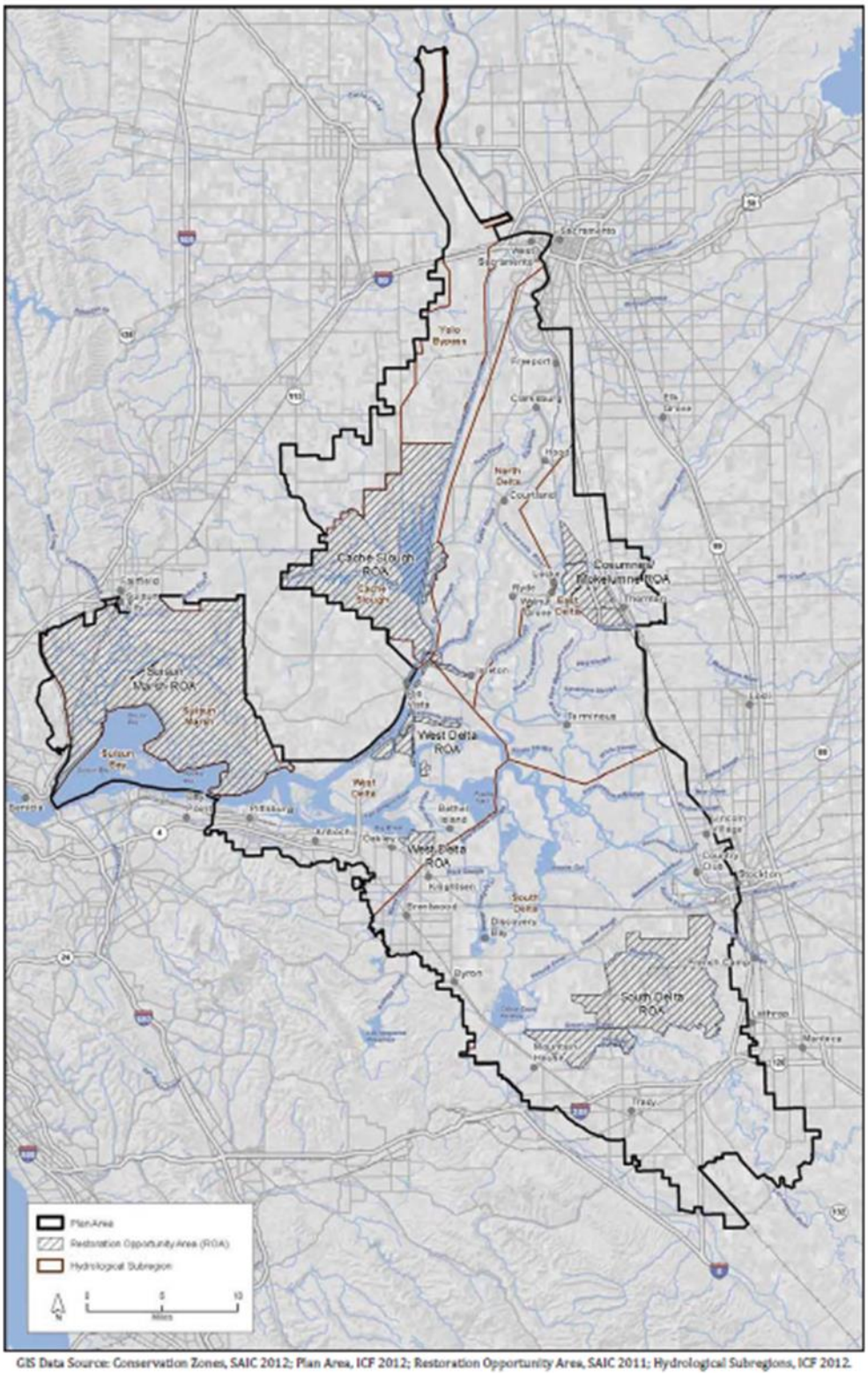


Figure 5-7 This figure shows the boundaries of seven analysis regions within DSM2's model domain. The Yolo Bypass Region is outside of the model domain. For our purposes, the South Delta region is split into two, with the San Joaquin River (SJR) forming an important subregion for fisheries purposes.

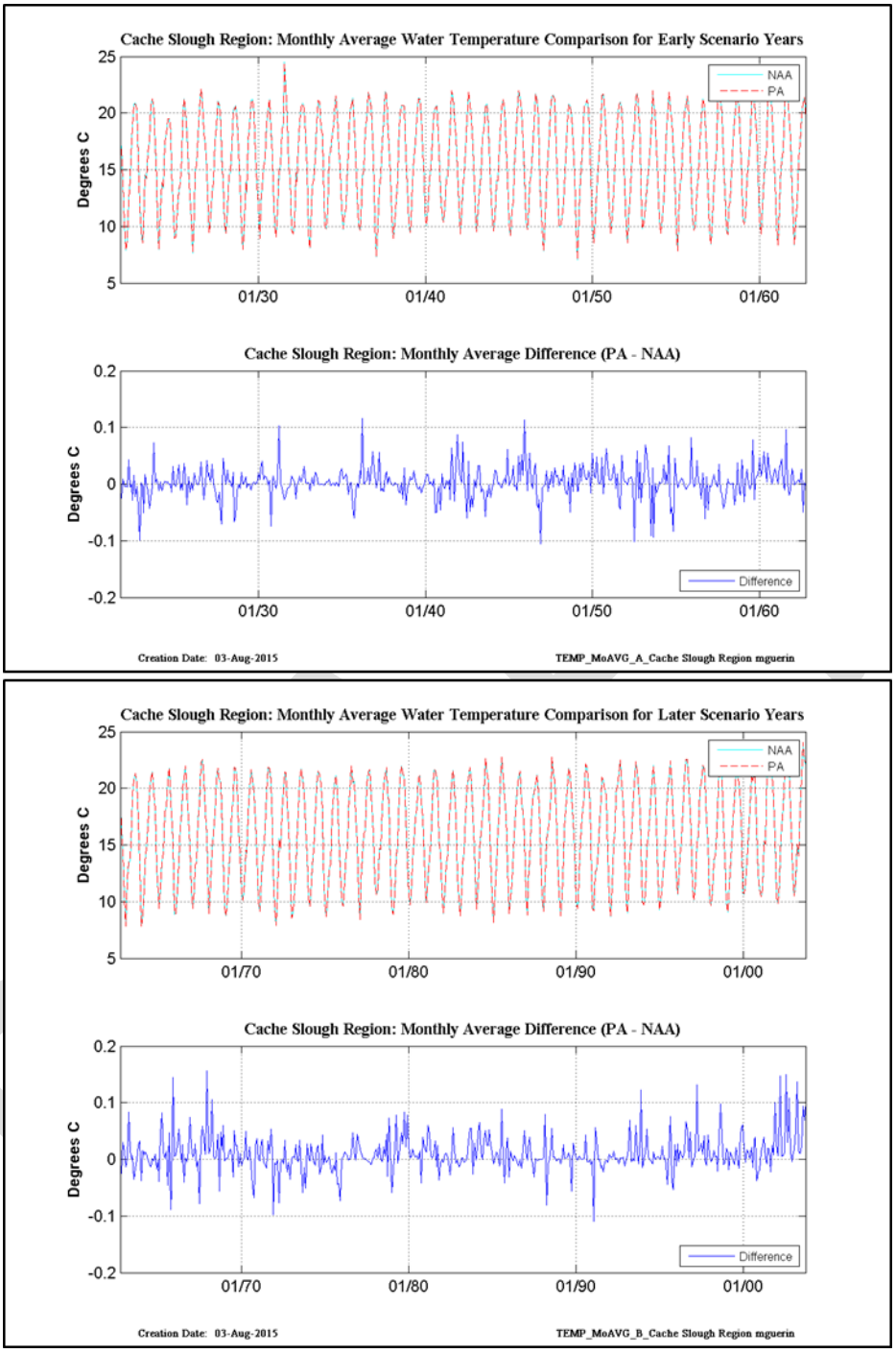


Figure 5-8 Cache Slough region monthly average water temperature and temperature difference (PA – NAA).

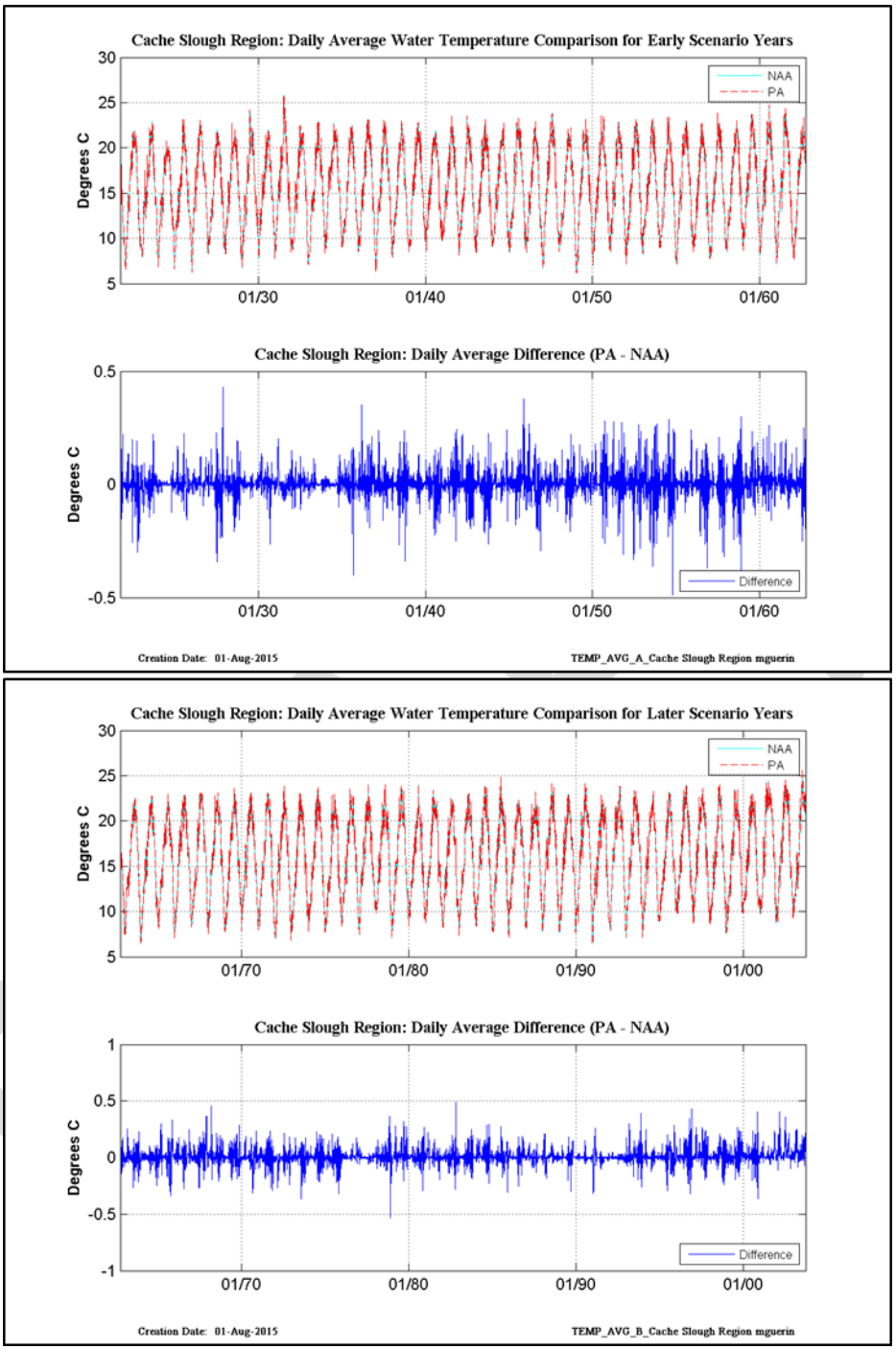


Figure 5-9 Cache Slough region daily average water temperature and temperature difference (PA – NAA)

Table 5-1 Cache Slough region monthly average percent difference table.

WY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1922	-0.14	0.06	-0.04	-0.05	-0.06	0.34	-0.04	0.00	-0.16	0.07	-0.11	-0.02
1923	-0.24	-0.84	0.02	-0.07	-0.51	0.12	-0.02	-0.06	-0.25	-0.12	-0.01	0.36
1924	0.02	0.06	0.03	-0.14	0.04	-0.08	-0.01	0.03	0.02	0.02	-0.01	0.00
1925	-0.10	0.26	-0.01	-0.04	0.11	0.25	-0.08	0.01	-0.05	0.17	0.06	-0.20
1926	0.09	-0.11	0.03	-0.13	0.18	0.07	0.01	0.00	0.03	0.17	0.02	-0.15
1927	0.01	0.28	0.12	0.21	0.03	0.28	0.00	-0.05	-0.15	-0.16	-0.07	-0.30
1928	-0.43	0.33	0.21	0.00	0.22	0.02	0.04	-0.03	0.10	-0.33	-0.28	-0.06
1929	0.00	-0.06	0.22	-0.01	0.05	0.09	-0.06	0.00	0.00	-0.05	0.00	0.02
1930	0.00	0.01	0.16	0.09	0.23	0.31	0.05	0.09	0.06	-0.01	0.03	-0.40
1931	0.05	0.11	0.03	-0.09	0.11	0.69	0.01	-0.03	-0.11	-0.11	-0.09	-0.04
1932	-0.04	-0.02	0.14	0.10	0.02	-0.18	-0.01	0.02	0.07	0.02	0.07	0.15
1933	0.02	0.01	0.02	-0.14	-0.01	0.09	-0.01	0.13	0.09	0.01	-0.01	0.00
1934	0.00	-0.01	-0.02	0.03	0.04	0.05	-0.01	0.00	0.00	-0.01	0.01	0.01
1935	-0.02	0.14	0.23	0.10	0.10	0.16	0.09	-0.11	0.00	0.02	-0.18	-0.32
1936	-0.07	0.01	-0.07	0.24	0.10	0.80	0.00	0.02	0.03	0.13	0.00	0.12
1937	0.32	0.20	0.15	-0.09	0.10	0.41	-0.08	-0.04	-0.07	0.06	0.10	0.00
1938	0.08	0.02	0.00	-0.02	0.02	0.00	-0.01	-0.06	-0.08	0.01	-0.13	0.14
1939	-0.23	-0.07	0.03	0.13	0.07	0.07	0.14	0.03	-0.02	-0.04	-0.02	-0.08
1940	-0.03	-0.01	0.05	0.17	0.15	0.00	0.02	-0.01	0.04	-0.25	-0.24	-0.08
1941	-0.02	-0.35	0.17	-0.02	-0.06	0.05	-0.01	0.05	-0.15	0.29	0.11	-0.15
1942	0.20	0.58	0.25	0.12	0.02	0.55	0.03	-0.08	-0.30	0.19	-0.23	-0.11
1943	-0.23	0.05	-0.07	0.01	0.28	0.24	-0.10	-0.04	-0.09	-0.28	-0.06	-0.11
1944	-0.01	-0.17	-0.06	0.03	0.23	0.15	0.00	0.01	-0.01	-0.03	0.02	0.05
1945	0.01	0.43	-0.03	0.04	0.09	0.26	-0.02	-0.01	-0.06	0.23	0.02	0.26
1946	0.09	0.78	0.33	-0.12	0.17	0.39	0.04	-0.05	0.13	0.17	-0.18	-0.21
1947	-0.17	-0.87	-0.06	-0.05	0.00	0.17	-0.08	0.05	0.00	0.10	-0.03	0.14
1948	0.07	0.12	-0.03	0.09	0.05	0.27	0.01	-0.09	-0.09	0.05	-0.24	0.10
1949	-0.07	0.27	0.20	-0.18	-0.12	0.27	0.03	0.22	0.10	0.04	0.04	0.12
1950	0.06	-0.11	0.55	0.20	0.09	0.37	0.03	0.00	0.05	0.22	-0.08	0.13
1951	0.36	0.23	0.07	0.07	0.11	0.27	0.19	-0.04	0.10	-0.18	-0.21	0.25
1952	0.07	0.03	0.03	-0.01	0.09	0.08	0.09	0.00	-0.55	-0.01	0.27	-0.12
1953	0.21	-0.25	0.02	0.03	0.59	0.38	0.11	-0.01	-0.49	0.13	-0.45	0.01
1954	-0.09	-0.06	0.04	0.02	0.03	0.27	0.00	0.12	0.01	0.31	-0.25	-0.21
1955	-0.50	0.32	0.10	-0.08	-0.01	0.04	0.07	0.04	-0.01	-0.04	-0.02	-0.01
1956	0.02	0.59	0.12	-0.05	0.02	0.32	0.03	-0.01	-0.14	0.09	-0.07	-0.31
1957	0.08	-0.34	-0.03	-0.06	0.05	0.12	0.02	-0.01	-0.02	0.16	-0.05	-0.08
1958	-0.27	-0.24	-0.14	0.10	0.01	0.00	0.00	0.01	-0.18	-0.07	0.17	-0.05
1959	-0.11	0.30	0.21	-0.30	0.06	0.18	0.01	-0.05	0.01	0.34	-0.13	0.04
1960	0.07	0.10	0.44	0.16	0.24	0.40	0.16	0.02	0.26	0.13	0.06	0.00
1961	0.11	0.20	0.15	0.01	0.27	0.22	0.28	0.03	-0.05	0.42	0.00	-0.10
1962	-0.06	0.21	0.13	-0.01	0.01	0.05	0.05	0.02	0.13	-0.24	0.01	-0.02
1963	-0.15	0.20	0.13	-0.17	0.02	0.62	0.10	0.00	0.03	-0.17	-0.07	0.00
1964	0.15	0.25	-0.48	0.17	0.08	0.10	0.06	0.00	-0.04	-0.06	0.01	-0.01

Table 5-2 Cache Slough region monthly average percent difference table (continued).

WY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1965	0.05	-0.13	-0.01	-0.41	0.41	0.60	0.09	0.02	0.08	-0.22	0.22	-0.47
1966	-0.29	0.95	0.06	0.08	0.23	0.40	0.10	-0.03	0.13	-0.19	0.01	-0.02
1967	0.08	0.50	0.22	0.04	0.10	0.21	-0.10	-0.01	-0.42	0.17	0.26	0.16
1968	0.05	0.99	0.28	0.11	0.21	0.72	0.04	0.01	0.03	0.20	-0.27	0.24
1969	0.10	0.42	-0.03	0.01	0.01	0.09	0.12	0.03	-0.16	0.23	0.11	0.12
1970	-0.08	0.07	-0.09	-0.01	0.03	0.34	0.04	0.00	0.11	-0.04	-0.23	-0.34
1971	0.15	0.26	0.00	-0.02	0.19	0.26	-0.04	-0.06	-0.08	0.15	0.05	0.26
1972	0.08	-0.75	-0.08	-0.11	-0.01	-0.49	-0.04	0.00	-0.04	0.16	0.00	-0.12
1973	-0.03	-0.28	0.02	0.05	0.02	0.20	0.00	-0.02	0.16	-0.07	-0.28	-0.07
1974	-0.30	0.20	0.01	-0.02	0.26	0.07	-0.03	-0.06	0.09	0.12	-0.12	-0.07
1975	0.24	-0.07	0.07	-0.05	-0.02	0.04	-0.11	-0.14	-0.05	-0.10	0.05	-0.22
1976	-0.27	-0.57	0.01	0.05	0.11	0.06	0.04	-0.01	0.00	0.04	0.23	0.06
1977	-0.01	0.29	0.29	0.22	0.11	0.04	0.00	0.01	0.00	-0.02	-0.02	-0.05
1978	0.01	0.02	0.12	0.17	0.03	0.19	0.00	-0.02	0.11	0.02	0.20	-0.15
1979	0.39	0.12	-0.62	-0.19	0.16	0.56	-0.04	0.02	0.09	0.22	0.13	0.40
1980	0.13	0.58	0.22	0.02	0.07	0.13	0.06	0.02	0.04	0.00	0.07	-0.22
1981	0.23	0.17	0.14	0.14	0.50	0.33	0.03	0.01	0.05	0.15	-0.06	0.12
1982	-0.24	-0.05	0.00	-0.06	0.09	0.08	0.02	-0.09	-0.15	0.00	0.26	0.08
1983	-0.03	-0.01	-0.13	-0.09	0.02	0.02	-0.03	-0.02	0.01	0.15	0.25	0.27
1984	-0.15	0.20	-0.01	0.06	0.41	0.44	0.08	0.00	0.17	0.23	0.12	0.12
1985	0.29	0.19	0.12	-0.10	0.02	0.10	0.04	-0.07	-0.02	0.39	0.00	-0.22
1986	0.08	0.29	-0.35	0.14	0.02	-0.02	0.04	0.02	-0.02	-0.05	0.00	-0.09
1987	0.11	0.32	0.13	-0.01	0.17	0.28	0.03	-0.04	-0.16	0.00	0.00	0.00
1988	0.00	0.00	0.00	0.03	0.66	-0.51	-0.05	0.00	0.11	0.24	0.02	0.02
1989	-0.02	-0.01	0.02	-0.09	0.01	0.19	0.01	0.01	0.02	0.05	0.00	-0.29
1990	0.16	0.10	0.02	-0.01	0.04	0.04	0.00	0.00	0.01	0.19	-0.02	-0.02
1991	-0.01	-0.06	-0.02	-1.18	0.44	0.27	0.00	0.00	-0.08	-0.05	-0.11	-0.02
1992	0.00	-0.04	0.09	0.03	0.03	0.10	0.00	0.01	0.00	-0.03	0.01	0.01
1993	0.02	-0.08	0.00	0.08	0.18	0.49	-0.03	0.01	-0.02	0.27	0.06	-0.04
1994	0.24	0.83	-0.14	0.01	0.10	0.36	0.03	0.00	-0.02	-0.03	0.06	0.00
1995	0.02	0.04	0.02	0.01	0.20	0.01	0.01	-0.06	-0.23	0.08	0.34	-0.19
1996	-0.32	0.18	-0.09	0.25	-0.03	0.11	0.04	0.01	0.07	0.30	0.24	0.01
1997	0.27	-0.09	-0.05	-0.02	0.14	0.86	0.09	0.09	0.14	0.04	0.19	-0.01
1998	-0.06	0.28	0.07	-0.04	-0.01	0.11	0.02	0.03	-0.12	0.18	0.43	0.19
1999	-0.05	-0.05	0.20	0.13	-0.18	0.10	0.06	-0.02	-0.05	0.10	0.01	-0.08
2000	0.24	0.39	0.57	0.18	-0.04	0.12	0.08	0.00	0.10	-0.07	0.16	0.19
2001	-0.23	-0.17	-0.18	0.12	0.23	0.25	0.01	-0.04	0.09	0.08	-0.10	0.12
2002	0.04	0.64	0.25	0.07	0.63	1.04	0.03	0.04	0.06	0.64	0.13	0.49
2003	0.07	-0.03	0.13	0.17	0.45	0.91	0.10	0.06	0.11	0.39	0.31	0.46
Max	0.39	0.99	0.57	0.25	0.66	1.04	0.28	0.22	0.26	0.64	0.43	0.49
Min	-0.50	-0.87	-0.62	-1.18	-0.51	-0.51	-0.11	-0.14	-0.55	-0.33	-0.45	-0.47

WY Type	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
Wet	-0.01	0.11	0.02	0.00	0.10	0.23	0.02	-0.02	-0.10	0.05	0.06	-0.05
AN	0.01	0.06	0.10	0.06	0.09	0.24	0.03	0.00	0.04	0.03	-0.05	0.00
BN	0.02	0.18	0.08	0.00	0.06	0.30	0.01	-0.03	0.01	0.09	-0.06	0.07
Dry	-0.01	0.07	0.06	0.02	0.16	0.23	0.04	0.02	0.02	0.12	0.01	-0.02
Critical	0.02	0.06	0.05	-0.11	0.15	0.10	0.00	0.01	0.00	0.02	0.01	0.00

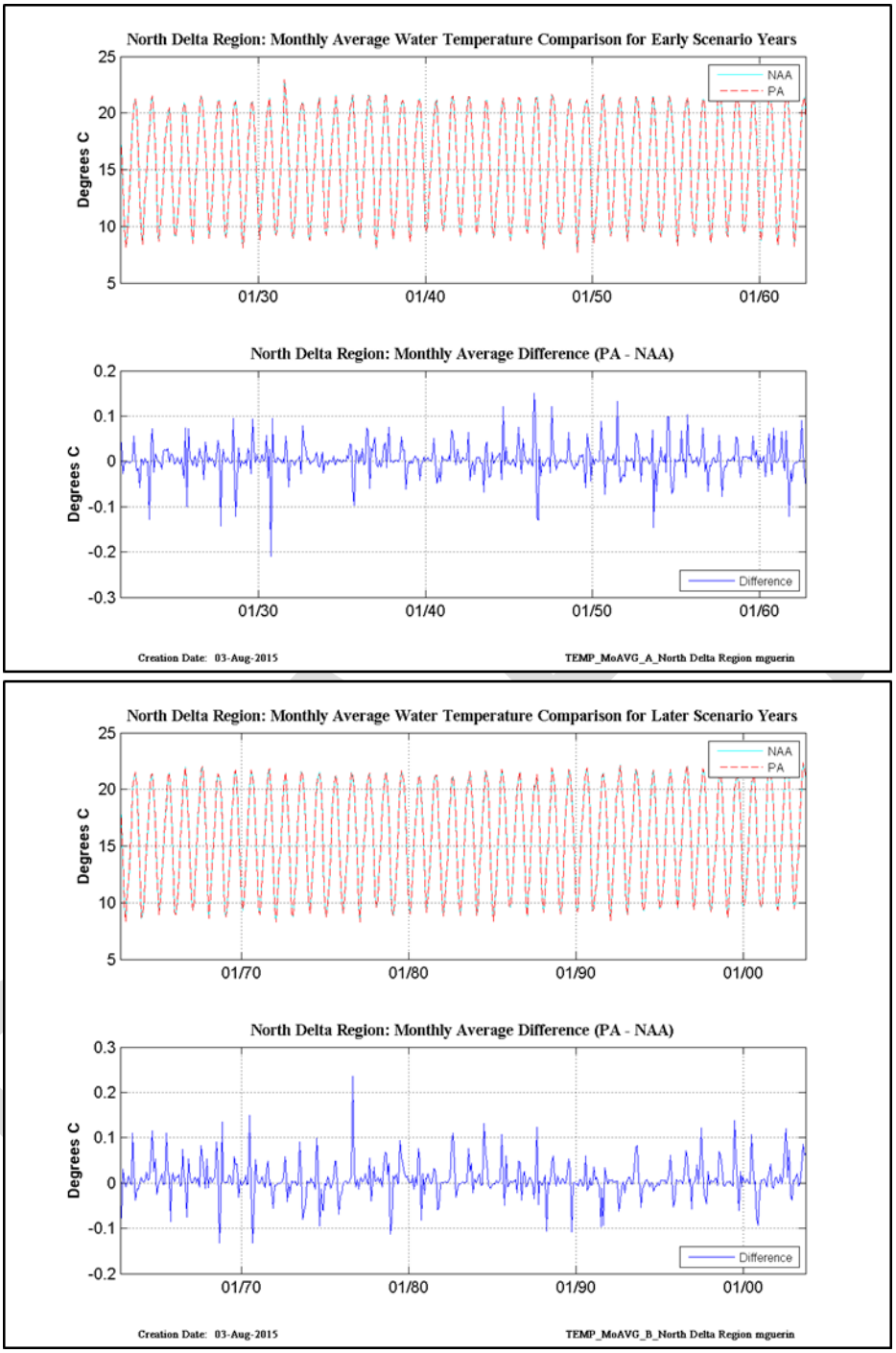


Figure 5-10 North Delta region monthly average water temperature and temperature difference (PA – NAA).

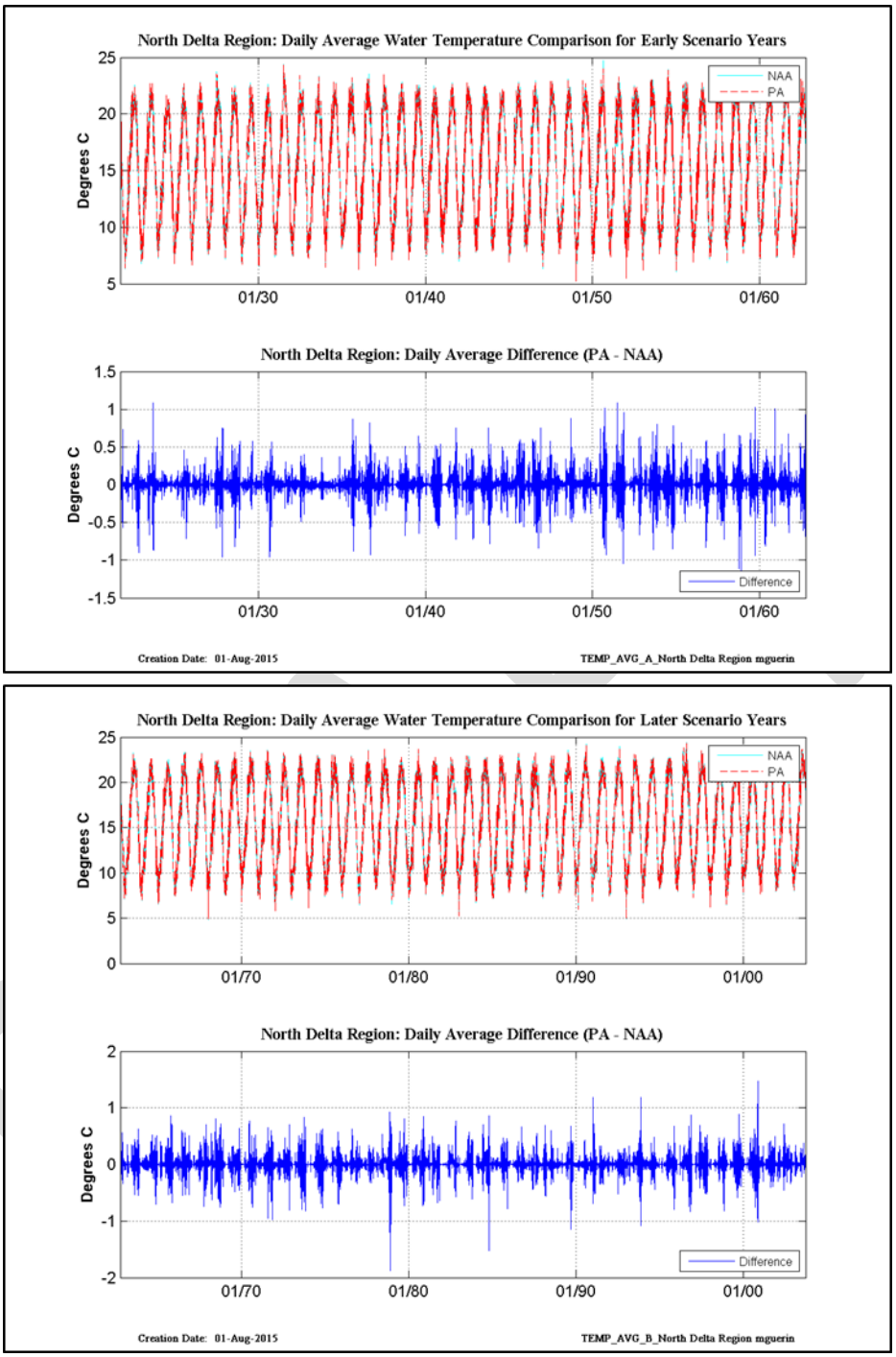


Figure 5-11 North Delta region daily average water temperature and temperature difference (PA – NAA).

Table 5-3 North Delta region monthly average percent difference table.

WY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1922	0.24	-0.20	-0.03	-0.03	0.01	-0.02	-0.02	0.01	0.01	0.27	0.02	-0.11
1923	-0.09	-0.47	0.05	0.00	-0.07	0.05	-0.02	-0.01	-0.70	0.15	0.34	-0.12
1924	0.10	0.08	0.01	-0.04	-0.03	-0.15	0.17	0.14	0.13	0.14	-0.01	0.08
1925	0.11	0.10	-0.06	-0.02	0.09	0.01	-0.04	0.05	-0.06	-0.17	0.36	-0.53
1926	0.45	0.05	0.03	-0.10	0.07	0.08	-0.08	0.00	0.14	0.03	0.03	-0.21
1927	0.25	0.09	-0.03	0.11	0.01	0.06	0.00	-0.07	0.05	0.22	0.10	-0.72
1928	-0.11	0.19	0.03	-0.01	0.09	0.01	-0.03	-0.01	0.47	0.07	-0.57	-0.21
1929	0.17	-0.10	0.03	-0.05	-0.04	0.02	-0.06	0.16	0.07	-0.13	0.44	0.13
1930	-0.02	0.11	0.01	-0.02	0.03	0.12	0.00	0.04	0.29	-0.18	0.12	-1.09
1931	0.57	0.19	-0.01	-0.02	0.09	0.02	0.02	-0.02	0.03	-0.02	0.26	0.09
1932	-0.35	0.01	0.02	0.00	-0.10	0.01	0.01	0.03	0.06	-0.13	0.37	0.17
1933	0.18	0.03	0.07	-0.06	-0.02	-0.01	0.00	0.05	0.11	-0.05	-0.06	0.01
1934	0.11	-0.18	-0.03	0.00	-0.07	0.01	0.00	0.00	0.06	-0.04	-0.02	0.02
1935	0.00	0.03	-0.03	0.04	0.00	0.01	0.10	0.03	0.18	0.17	-0.28	-0.50
1936	0.14	0.16	-0.04	0.16	0.03	0.22	-0.05	-0.02	0.37	0.30	-0.28	0.14
1937	0.12	0.33	0.55	-0.05	-0.13	0.01	-0.08	-0.01	0.17	0.19	-0.07	0.10
1938	0.44	-0.01	0.01	-0.03	0.01	0.02	0.01	0.00	0.04	0.26	0.12	0.12
1939	-0.37	-0.13	-0.01	-0.05	0.03	-0.03	0.04	0.07	0.02	0.03	-0.19	-0.03
1940	0.00	0.08	0.00	0.05	0.08	0.02	0.00	0.05	0.26	0.01	-0.23	-0.22
1941	-0.10	-0.32	0.12	0.04	0.03	0.03	0.01	0.07	0.00	0.33	0.27	0.07
1942	-0.05	0.19	0.07	-0.04	0.02	0.07	0.04	0.01	0.02	0.30	-0.20	-0.05
1943	-0.01	-0.21	0.01	0.09	0.09	0.07	-0.03	-0.03	-0.36	0.15	0.20	-0.02
1944	-0.21	-0.24	0.19	-0.05	0.03	0.07	0.07	0.10	0.09	-0.19	0.57	-0.04
1945	0.18	-0.04	-0.03	-0.09	0.00	0.05	-0.01	-0.07	0.12	0.35	0.05	-0.14
1946	0.29	0.10	0.02	-0.01	-0.06	0.06	-0.01	-0.06	0.77	0.45	-0.58	-0.64
1947	0.16	-0.25	-0.03	-0.14	-0.04	0.03	0.06	0.03	-0.12	0.56	0.10	0.06
1948	-0.11	-0.04	-0.03	0.06	-0.01	0.01	0.01	-0.03	0.06	0.31	0.03	-0.02
1949	-0.06	-0.12	-0.03	-0.11	0.00	0.11	0.07	0.09	-0.07	-0.27	0.28	0.16
1950	0.12	-0.30	0.12	-0.09	0.06	0.02	-0.01	0.01	0.47	0.29	0.07	-0.37
1951	-0.05	0.08	0.02	0.05	0.02	0.13	-0.06	-0.04	0.69	0.00	-0.22	-0.17
1952	-0.17	-0.25	0.14	0.01	0.03	0.01	0.05	0.02	-0.11	0.29	0.26	0.11
1953	-0.04	-0.34	0.10	0.03	0.07	0.08	0.00	-0.04	0.01	0.32	-0.68	-0.02
1954	-0.39	-0.09	0.01	0.35	0.03	0.00	0.11	-0.13	0.50	0.46	-0.10	-0.36
1955	-0.36	0.04	-0.02	0.00	0.04	0.01	0.47	0.00	0.02	-0.17	0.48	0.07
1956	0.09	0.06	-0.05	0.01	0.01	0.08	-0.08	0.02	0.06	0.35	0.08	-0.11
1957	-0.01	-0.49	-0.10	-0.12	0.04	0.07	-0.02	-0.01	0.01	0.27	0.04	-0.38
1958	-0.14	-0.08	-0.11	0.05	0.02	0.01	0.01	0.06	0.01	0.26	0.23	0.00
1959	-0.20	-0.03	0.11	0.08	0.10	0.08	0.03	0.06	0.00	0.26	0.08	0.04
1960	0.14	-0.12	0.11	-0.03	0.04	0.09	-0.22	0.02	0.14	0.28	0.01	-0.14
1961	0.44	0.03	-0.03	0.01	0.08	0.10	0.43	0.01	-0.10	0.31	-0.05	-0.61
1962	-0.12	-0.33	-0.07	-0.05	-0.03	-0.03	0.00	0.04	0.45	0.10	-0.13	-0.29
1963	-0.46	0.22	0.03	-0.10	0.04	0.13	-0.01	-0.03	0.55	0.13	-0.18	-0.06
1964	-0.08	0.01	0.15	0.03	0.02	0.04	0.16	0.04	0.05	0.28	0.54	0.13

Table 5-4 North Delta region monthly average percent difference table (continued).

WY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1965	0.30	-0.20	-0.05	0.01	0.06	0.17	-0.02	-0.01	0.60	0.13	0.06	-0.43
1966	0.03	0.16	0.02	0.13	0.12	0.16	-0.05	0.00	0.37	0.08	-0.01	-0.38
1967	0.30	0.10	0.00	0.01	0.10	0.11	0.01	0.06	-0.04	0.38	0.25	0.11
1968	-0.07	0.38	-0.11	0.09	0.12	0.01	0.06	0.07	0.44	0.18	-0.63	-0.22
1969	0.80	0.03	0.01	0.01	0.02	0.14	0.10	-0.02	0.01	0.27	0.19	0.20
1970	-0.19	0.06	-0.04	0.02	0.03	0.13	-0.03	-0.01	0.75	-0.01	-0.63	-0.24
1971	0.31	0.05	0.00	0.00	0.04	0.12	0.00	-0.06	0.16	0.23	-0.03	0.00
1972	-0.23	-0.41	-0.05	-0.06	-0.01	-0.01	0.00	0.02	0.06	0.28	0.21	-0.21
1973	-0.01	-0.17	0.05	0.01	0.03	0.03	-0.04	0.01	0.45	0.08	-0.38	-0.31
1974	-0.27	0.03	0.00	0.00	0.10	0.01	0.00	-0.07	0.48	0.17	-0.44	-0.06
1975	-0.33	-0.45	0.00	-0.05	0.14	0.04	-0.08	-0.01	0.05	0.23	0.22	-0.01
1976	-0.42	-0.21	-0.23	0.00	0.03	0.04	0.00	0.00	0.03	0.07	1.12	0.13
1977	-0.05	0.05	-0.15	0.12	0.12	0.02	0.03	0.12	0.03	-0.02	0.26	-0.20
1978	0.02	0.25	0.05	0.04	0.12	0.01	0.07	-0.04	0.19	0.32	0.30	0.10
1979	0.24	-0.87	-0.89	0.18	0.09	0.15	-0.01	-0.01	0.47	0.26	0.20	0.11
1980	0.07	0.12	0.03	0.02	0.02	0.15	-0.09	0.07	-0.02	0.36	0.24	-0.42
1981	0.12	-0.18	0.10	0.11	0.20	0.05	-0.02	0.03	0.16	0.13	-0.03	-0.29
1982	-0.34	0.00	0.01	0.00	0.02	0.01	0.01	0.05	0.06	0.43	0.52	0.20
1983	-0.18	-0.09	-0.01	-0.03	0.02	0.02	0.00	0.01	0.02	0.37	0.12	0.22
1984	-0.12	0.06	0.00	0.03	0.13	0.16	-0.04	-0.02	0.67	0.31	0.21	-0.03
1985	-0.04	-0.09	-0.04	-0.03	-0.03	0.05	0.00	0.03	0.04	0.49	0.06	-0.25
1986	0.35	-0.07	-0.03	0.05	0.02	0.03	0.01	0.04	-0.11	0.23	0.21	-0.20
1987	0.08	0.17	-0.09	-0.06	0.04	0.11	0.04	0.01	-0.17	0.06	0.58	-0.24
1988	0.02	0.01	-0.05	0.02	0.16	-0.77	0.02	-0.02	0.10	0.22	0.28	0.04
1989	-0.04	0.11	0.03	-0.02	0.10	0.05	-0.01	0.00	0.11	0.25	0.14	-0.54
1990	0.00	0.01	-0.04	-0.02	-0.07	0.06	0.04	-0.04	0.00	0.28	-0.08	-0.04
1991	0.06	-0.04	-0.05	0.37	0.07	0.11	-0.01	-0.06	-0.49	-0.06	-0.43	0.17
1992	0.08	-0.01	0.08	0.05	0.07	0.01	0.02	0.01	0.02	-0.29	-0.17	-0.04
1993	0.01	-0.16	0.03	0.06	0.12	0.10	-0.01	-0.01	0.16	0.37	0.39	0.01
1994	-0.04	-0.38	-0.12	-0.06	0.04	0.05	0.00	-0.05	0.00	-0.01	-0.08	-0.04
1995	-0.04	0.01	-0.06	0.07	0.05	0.03	0.04	-0.01	0.03	0.08	0.28	0.06
1996	-0.30	-0.26	0.07	0.05	0.02	0.05	0.03	-0.01	0.11	0.33	0.25	0.00
1997	0.06	-0.41	-0.03	0.02	0.06	0.30	-0.01	0.21	0.61	0.12	-0.13	-0.15
1998	-0.27	0.18	-0.04	0.07	0.02	0.03	0.08	0.04	-0.03	0.33	0.28	0.17
1999	-0.03	-0.05	0.01	0.03	0.01	0.04	-0.02	-0.04	0.69	0.26	0.01	-0.30
2000	0.14	-0.06	0.15	0.04	0.01	0.07	0.00	-0.01	0.52	0.17	-0.01	0.01
2001	-0.46	-0.74	-0.20	0.07	0.06	0.06	0.03	-0.04	0.06	0.10	0.19	-0.04
2002	-0.06	0.08	0.12	0.00	0.05	0.15	-0.01	0.09	0.40	0.55	0.05	0.35
2003	-0.15	-0.27	0.07	0.05	0.12	0.16	-0.05	0.01	0.18	0.38	0.28	0.32
Max	0.80	0.38	0.55	0.37	0.20	0.30	0.47	0.21	0.77	0.56	1.12	0.35
Min	-0.46	-0.87	-0.89	-0.14	-0.13	-0.77	-0.22	-0.13	-0.70	-0.29	-0.68	-1.09

WY Type	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
Wet	0.00	-0.06	0.00	0.02	0.04	0.08	0.00	0.01	0.17	0.25	0.06	-0.04
AN	-0.02	-0.06	0.02	0.04	0.05	0.06	-0.01	-0.01	0.26	0.21	-0.02	-0.14
BN	0.02	-0.09	-0.03	0.03	0.02	0.06	0.00	0.00	0.23	0.24	-0.07	-0.18
Dry	-0.03	-0.06	0.01	-0.02	0.04	0.06	0.06	0.03	0.06	0.11	0.20	-0.17
Critical	0.06	-0.03	-0.04	0.03	0.04	-0.05	0.02	0.03	0.00	0.01	0.14	0.03

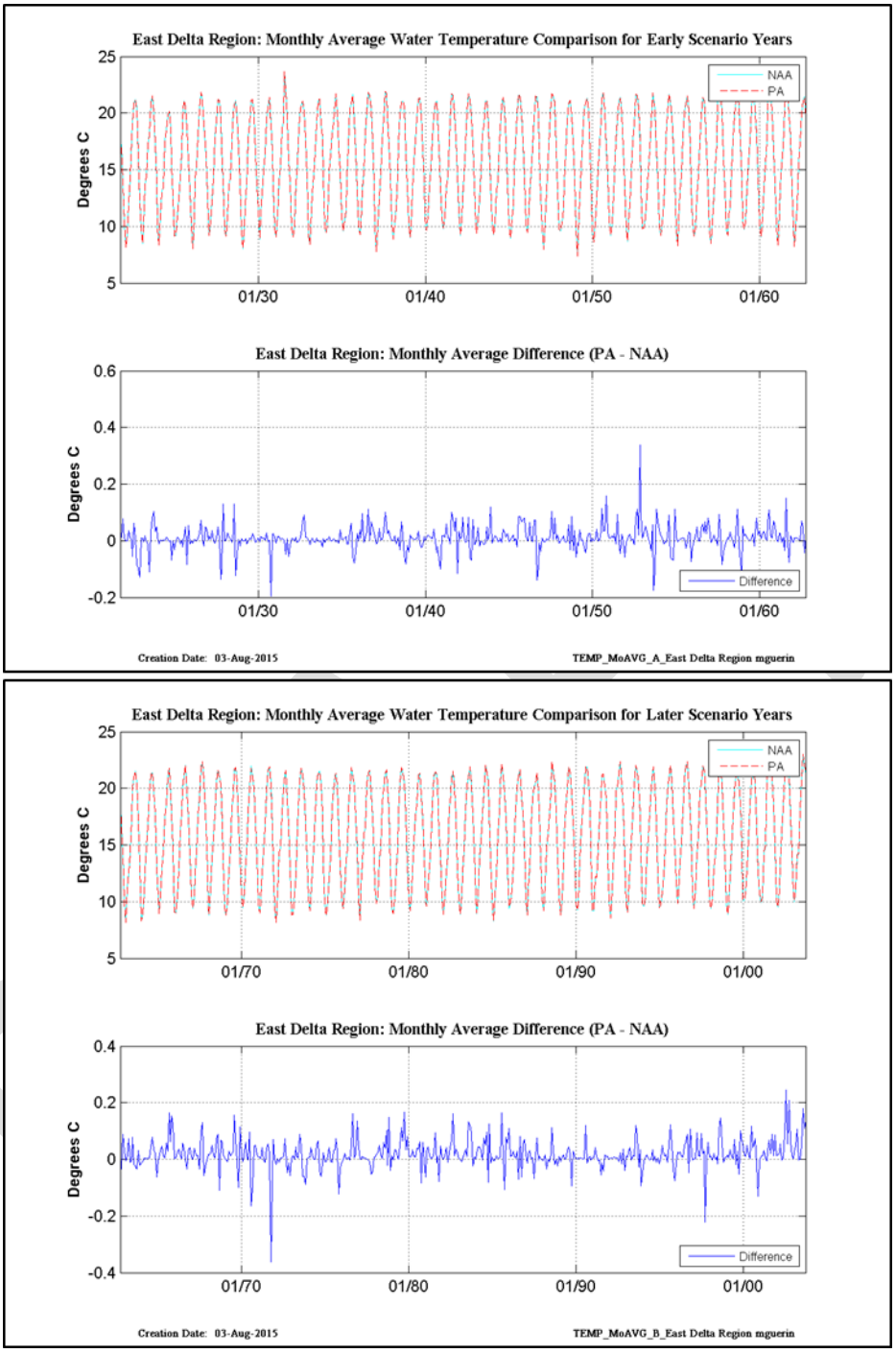


Figure 5-12 East Delta region monthly average water temperature and temperature difference (PA – NAA).

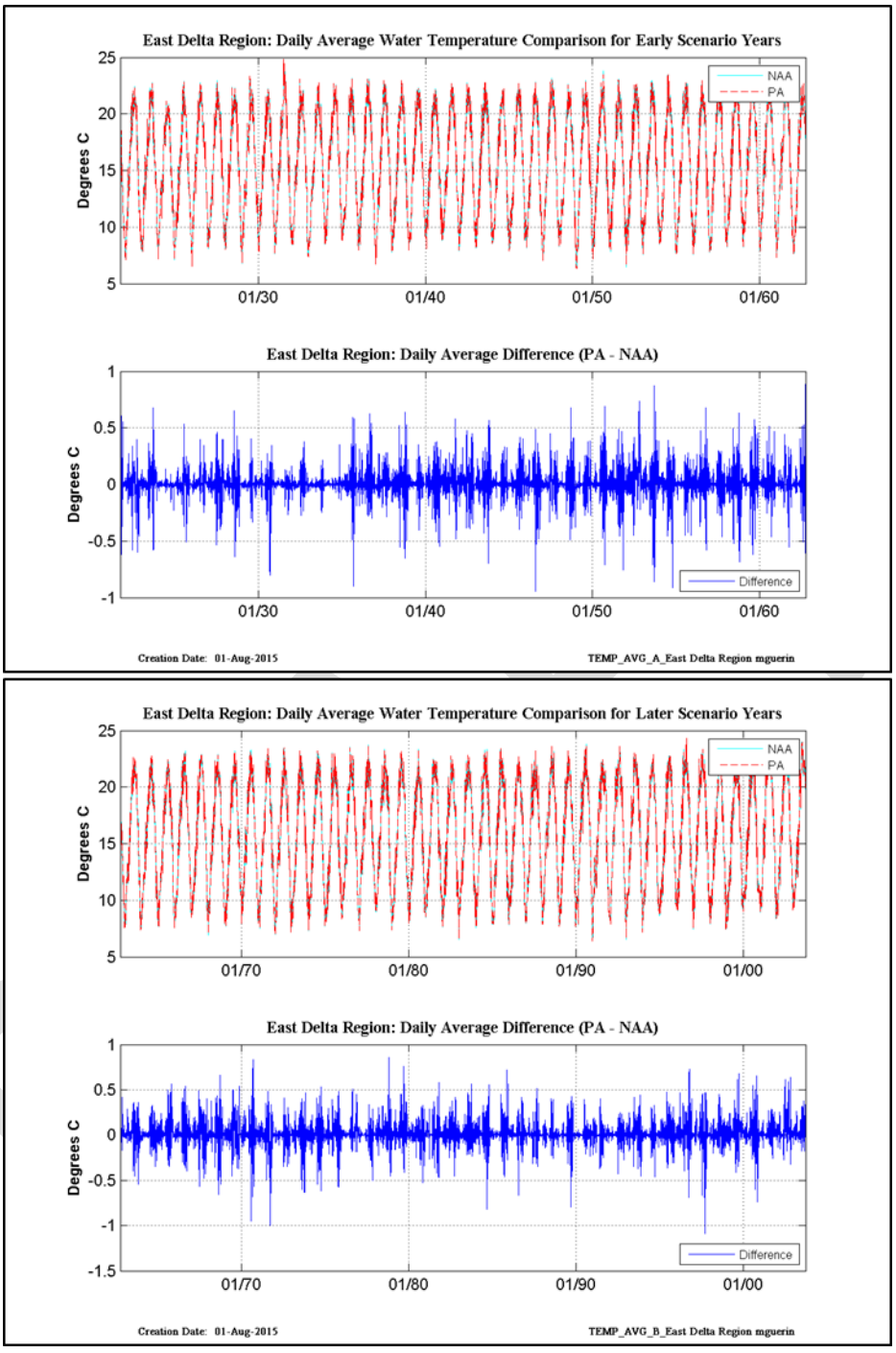


Figure 5-13 East Delta region daily average water temperature and temperature difference (PA – NAA).

Table 5-5 East Delta region monthly average percent difference table.

WY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1922	-0.14	0.06	-0.04	-0.05	-0.06	0.34	-0.04	0.00	-0.16	0.07	-0.11	-0.02
1923	-0.24	-0.84	0.02	-0.07	-0.51	0.12	-0.02	-0.06	-0.25	-0.12	-0.01	0.36
1924	0.02	0.06	0.03	-0.14	0.04	-0.08	-0.01	0.03	0.02	0.02	-0.01	0.00
1925	-0.10	0.26	-0.01	-0.04	0.11	0.25	-0.08	0.01	-0.05	0.17	0.06	-0.20
1926	0.09	-0.11	0.03	-0.13	0.18	0.07	0.01	0.00	0.03	0.17	0.02	-0.15
1927	0.01	0.28	0.12	0.21	0.03	0.28	0.00	-0.05	-0.15	-0.16	-0.07	-0.30
1928	-0.43	0.33	0.21	0.00	0.22	0.02	0.04	-0.03	0.10	-0.33	-0.28	-0.06
1929	0.00	-0.06	0.22	-0.01	0.05	0.09	-0.06	0.00	0.00	-0.05	0.00	0.02
1930	0.00	0.01	0.16	0.09	0.23	0.31	0.05	0.09	0.06	-0.01	0.03	-0.40
1931	0.05	0.11	0.03	-0.09	0.11	0.69	0.01	-0.03	-0.11	-0.11	-0.09	-0.04
1932	-0.04	-0.02	0.14	0.10	0.02	-0.18	-0.01	0.02	0.07	0.02	0.07	0.15
1933	0.02	0.01	0.02	-0.14	-0.01	0.09	-0.01	0.13	0.09	0.01	-0.01	0.00
1934	0.00	-0.01	-0.02	0.03	0.04	0.05	-0.01	0.00	0.00	-0.01	0.01	0.01
1935	-0.02	0.14	0.23	0.10	0.10	0.16	0.09	-0.11	0.00	0.02	-0.18	-0.32
1936	-0.07	0.01	-0.07	0.24	0.10	0.80	0.00	0.02	0.03	0.13	0.00	0.12
1937	0.32	0.20	0.15	-0.09	0.10	0.41	-0.08	-0.04	-0.07	0.06	0.10	0.00
1938	0.08	0.02	0.00	-0.02	0.02	0.00	-0.01	-0.06	-0.08	0.01	-0.13	0.14
1939	-0.23	-0.07	0.03	0.13	0.07	0.07	0.14	0.03	-0.02	-0.04	-0.02	-0.08
1940	-0.03	-0.01	0.05	0.17	0.15	0.00	0.02	-0.01	0.04	-0.25	-0.24	-0.08
1941	-0.02	-0.35	0.17	-0.02	-0.06	0.05	-0.01	0.05	-0.15	0.29	0.11	-0.15
1942	0.20	0.58	0.25	0.12	0.02	0.55	0.03	-0.08	-0.30	0.19	-0.23	-0.11
1943	-0.23	0.05	-0.07	0.01	0.28	0.24	-0.10	-0.04	-0.09	-0.28	-0.06	-0.11
1944	-0.01	-0.17	-0.06	0.03	0.23	0.15	0.00	0.01	-0.01	-0.03	0.02	0.05
1945	0.01	0.43	-0.03	0.04	0.09	0.26	-0.02	-0.01	-0.06	0.23	0.02	0.26
1946	0.09	0.78	0.33	-0.12	0.17	0.39	0.04	-0.05	0.13	0.17	-0.18	-0.21
1947	-0.17	-0.87	-0.06	-0.05	0.00	0.17	-0.08	0.05	0.00	0.10	-0.03	0.14
1948	0.07	0.12	-0.03	0.09	0.05	0.27	0.01	-0.09	-0.09	0.05	-0.24	0.10
1949	-0.07	0.27	0.20	-0.18	-0.12	0.27	0.03	0.22	0.10	0.04	0.04	0.12
1950	0.06	-0.11	0.55	0.20	0.09	0.37	0.03	0.00	0.05	0.22	-0.08	0.13
1951	0.36	0.23	0.07	0.07	0.11	0.27	0.19	-0.04	0.10	-0.18	-0.21	0.25
1952	0.07	0.03	0.03	-0.01	0.09	0.08	0.09	0.00	-0.55	-0.01	0.27	-0.12
1953	0.21	-0.25	0.02	0.03	0.59	0.38	0.11	-0.01	-0.49	0.13	-0.45	0.01
1954	-0.09	-0.06	0.04	0.02	0.03	0.27	0.00	0.12	0.01	0.31	-0.25	-0.21
1955	-0.50	0.32	0.10	-0.08	-0.01	0.04	0.07	0.04	-0.01	-0.04	-0.02	-0.01
1956	0.02	0.59	0.12	-0.05	0.02	0.32	0.03	-0.01	-0.14	0.09	-0.07	-0.31
1957	0.08	-0.34	-0.03	-0.06	0.05	0.12	0.02	-0.01	-0.02	0.16	-0.05	-0.08
1958	-0.27	-0.24	-0.14	0.10	0.01	0.00	0.00	0.01	-0.18	-0.07	0.17	-0.05
1959	-0.11	0.30	0.21	-0.30	0.06	0.18	0.01	-0.05	0.01	0.34	-0.13	0.04
1960	0.07	0.10	0.44	0.16	0.24	0.40	0.16	0.02	0.26	0.13	0.06	0.00
1961	0.11	0.20	0.15	0.01	0.27	0.22	0.28	0.03	-0.05	0.42	0.00	-0.10
1962	-0.06	0.21	0.13	-0.01	0.01	0.05	0.05	0.02	0.13	-0.24	0.01	-0.02
1963	-0.15	0.20	0.13	-0.17	0.02	0.62	0.10	0.00	0.03	-0.17	-0.07	0.00
1964	0.15	0.25	-0.48	0.17	0.08	0.10	0.06	0.00	-0.04	-0.06	0.01	-0.01

Table 5-6 East Delta region monthly average percent difference table (continued).

WY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1965	0.05	-0.13	-0.01	-0.41	0.41	0.60	0.09	0.02	0.08	-0.22	0.22	-0.47
1966	-0.29	0.95	0.06	0.08	0.23	0.40	0.10	-0.03	0.13	-0.19	0.01	-0.02
1967	0.08	0.50	0.22	0.04	0.10	0.21	-0.10	-0.01	-0.42	0.17	0.26	0.16
1968	0.05	0.99	0.28	0.11	0.21	0.72	0.04	0.01	0.03	0.20	-0.27	0.24
1969	0.10	0.42	-0.03	0.01	0.01	0.09	0.12	0.03	-0.16	0.23	0.11	0.12
1970	-0.08	0.07	-0.09	-0.01	0.03	0.34	0.04	0.00	0.11	-0.04	-0.23	-0.34
1971	0.15	0.26	0.00	-0.02	0.19	0.26	-0.04	-0.06	-0.08	0.15	0.05	0.26
1972	0.08	-0.75	-0.08	-0.11	-0.01	-0.49	-0.04	0.00	-0.04	0.16	0.00	-0.12
1973	-0.03	-0.28	0.02	0.05	0.02	0.20	0.00	-0.02	0.16	-0.07	-0.28	-0.07
1974	-0.30	0.20	0.01	-0.02	0.26	0.07	-0.03	-0.06	0.09	0.12	-0.12	-0.07
1975	0.24	-0.07	0.07	-0.05	-0.02	0.04	-0.11	-0.14	-0.05	-0.10	0.05	-0.22
1976	-0.27	-0.57	0.01	0.05	0.11	0.06	0.04	-0.01	0.00	0.04	0.23	0.06
1977	-0.01	0.29	0.29	0.22	0.11	0.04	0.00	0.01	0.00	-0.02	-0.02	-0.05
1978	0.01	0.02	0.12	0.17	0.03	0.19	0.00	-0.02	0.11	0.02	0.20	-0.15
1979	0.39	0.12	-0.62	-0.19	0.16	0.56	-0.04	0.02	0.09	0.22	0.13	0.40
1980	0.13	0.58	0.22	0.02	0.07	0.13	0.06	0.02	0.04	0.00	0.07	-0.22
1981	0.23	0.17	0.14	0.14	0.50	0.33	0.03	0.01	0.05	0.15	-0.06	0.12
1982	-0.24	-0.05	0.00	-0.06	0.09	0.08	0.02	-0.09	-0.15	0.00	0.26	0.08
1983	-0.03	-0.01	-0.13	-0.09	0.02	0.02	-0.03	-0.02	0.01	0.15	0.25	0.27
1984	-0.15	0.20	-0.01	0.06	0.41	0.44	0.08	0.00	0.17	0.23	0.12	0.12
1985	0.29	0.19	0.12	-0.10	0.02	0.10	0.04	-0.07	-0.02	0.39	0.00	-0.22
1986	0.08	0.29	-0.35	0.14	0.02	-0.02	0.04	0.02	-0.02	-0.05	0.00	-0.09
1987	0.11	0.32	0.13	-0.01	0.17	0.28	0.03	-0.04	-0.16	0.00	0.00	0.00
1988	0.00	0.00	0.00	0.03	0.66	-0.51	-0.05	0.00	0.11	0.24	0.02	0.02
1989	-0.02	-0.01	0.02	-0.09	0.01	0.19	0.01	0.01	0.02	0.05	0.00	-0.29
1990	0.16	0.10	0.02	-0.01	0.04	0.04	0.00	0.00	0.01	0.19	-0.02	-0.02
1991	-0.01	-0.06	-0.02	-1.18	0.44	0.27	0.00	0.00	-0.08	-0.05	-0.11	-0.02
1992	0.00	-0.04	0.09	0.03	0.03	0.10	0.00	0.01	0.00	-0.03	0.01	0.01
1993	0.02	-0.08	0.00	0.08	0.18	0.49	-0.03	0.01	-0.02	0.27	0.06	-0.04
1994	0.24	0.83	-0.14	0.01	0.10	0.36	0.03	0.00	-0.02	-0.03	0.06	0.00
1995	0.02	0.04	0.02	0.01	0.20	0.01	0.01	-0.06	-0.23	0.08	0.34	-0.19
1996	-0.32	0.18	-0.09	0.25	-0.03	0.11	0.04	0.01	0.07	0.30	0.24	0.01
1997	0.27	-0.09	-0.05	-0.02	0.14	0.86	0.09	0.09	0.14	0.04	0.19	-0.01
1998	-0.06	0.28	0.07	-0.04	-0.01	0.11	0.02	0.03	-0.12	0.18	0.43	0.19
1999	-0.05	-0.05	0.20	0.13	-0.18	0.10	0.06	-0.02	-0.05	0.10	0.01	-0.08
2000	0.24	0.39	0.57	0.18	-0.04	0.12	0.08	0.00	0.10	-0.07	0.16	0.19
2001	-0.23	-0.17	-0.18	0.12	0.23	0.25	0.01	-0.04	0.09	0.08	-0.10	0.12
2002	0.04	0.64	0.25	0.07	0.63	1.04	0.03	0.04	0.06	0.64	0.13	0.49
2003	0.07	-0.03	0.13	0.17	0.45	0.91	0.10	0.06	0.11	0.39	0.31	0.46
Max	0.39	0.99	0.57	0.25	0.66	1.04	0.28	0.22	0.26	0.64	0.43	0.49
Min	-0.50	-0.87	-0.62	-1.18	-0.51	-0.51	-0.11	-0.14	-0.55	-0.33	-0.45	-0.47
WY Type	**OCT**	**NOV**	**DEC**	**JAN**	**FEB**	**MAR**	**APR**	**MAY**	**JUN**	**JUL**	**AUG**	**SEP**
Wet	-0.01	0.11	0.02	0.00	0.10	0.23	0.02	-0.02	-0.10	0.05	0.06	-0.05
AN	0.01	0.06	0.10	0.06	0.09	0.24	0.03	0.00	0.04	0.03	-0.05	0.00
BN	0.02	0.18	0.08	0.00	0.06	0.30	0.01	-0.03	0.01	0.09	-0.06	0.07
Dry	-0.01	0.07	0.06	0.02	0.16	0.23	0.04	0.02	0.02	0.12	0.01	-0.02
Critical	0.02	0.06	0.05	-0.11	0.15	0.10	0.00	0.01	0.00	0.02	0.01	0.00

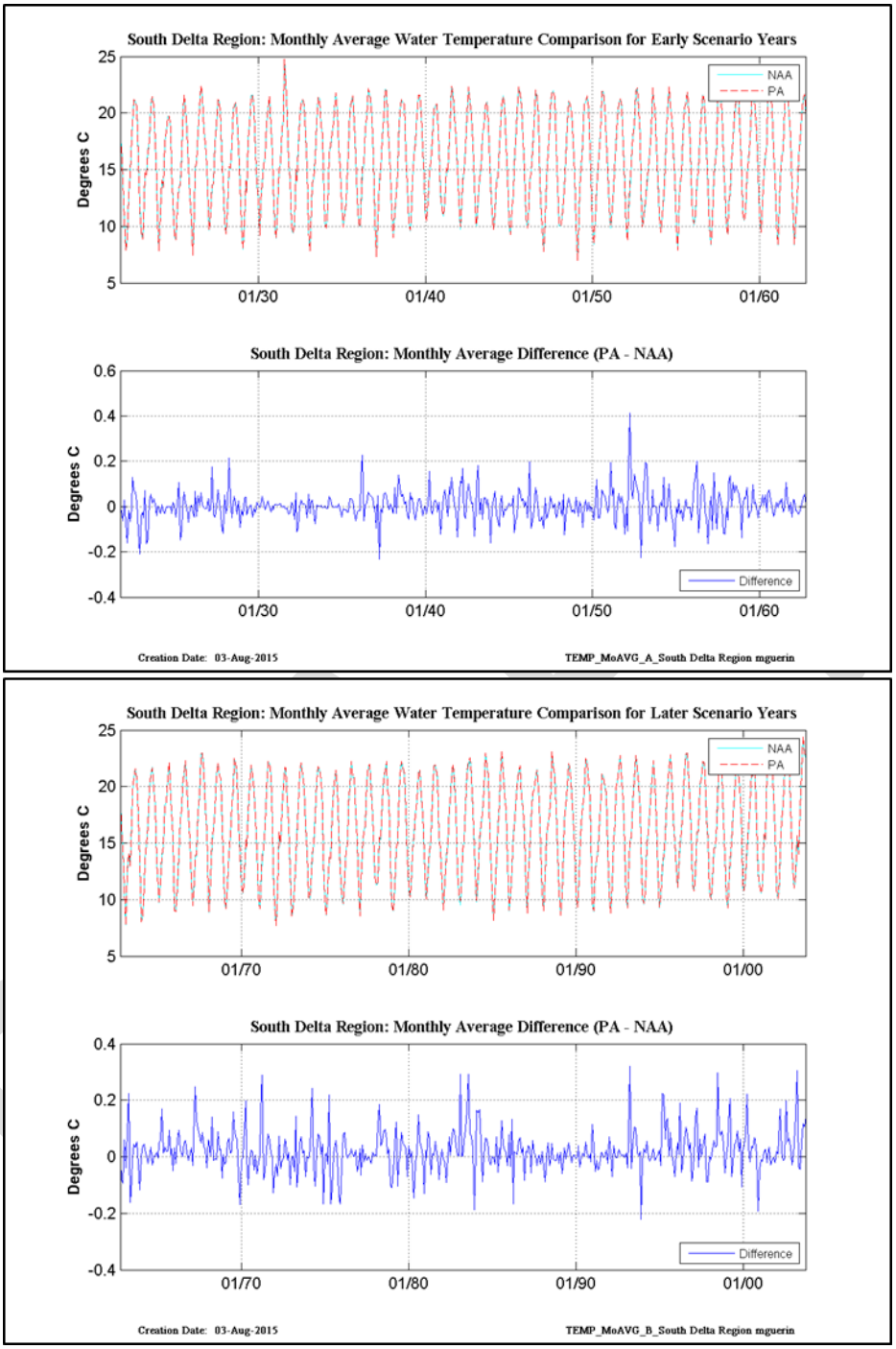
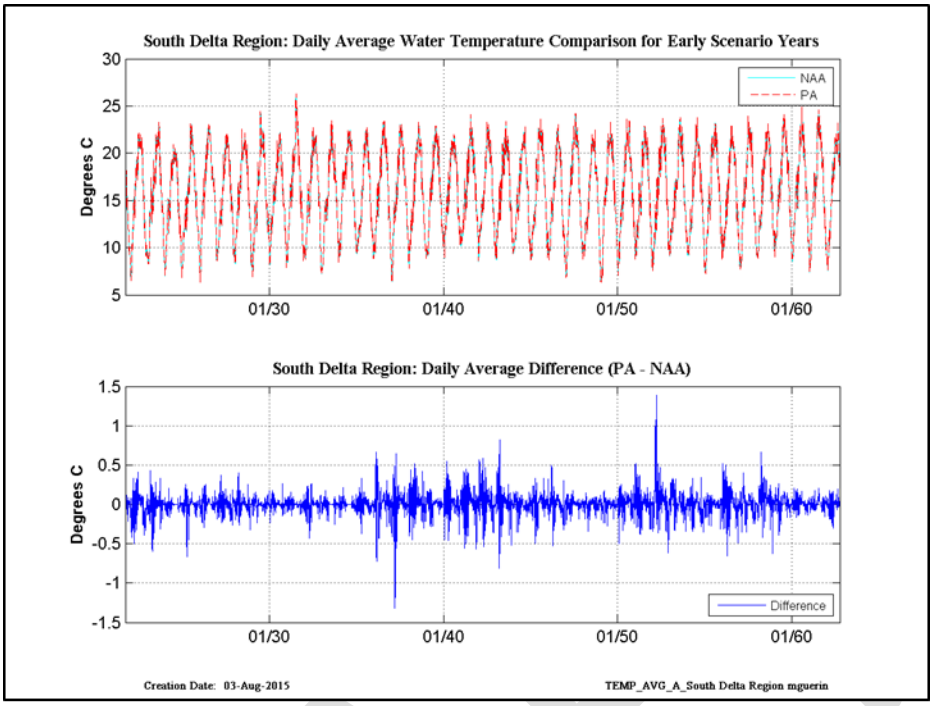


Figure 5-14 South Delta region monthly average water temperature and temperature difference (PA – NAA).



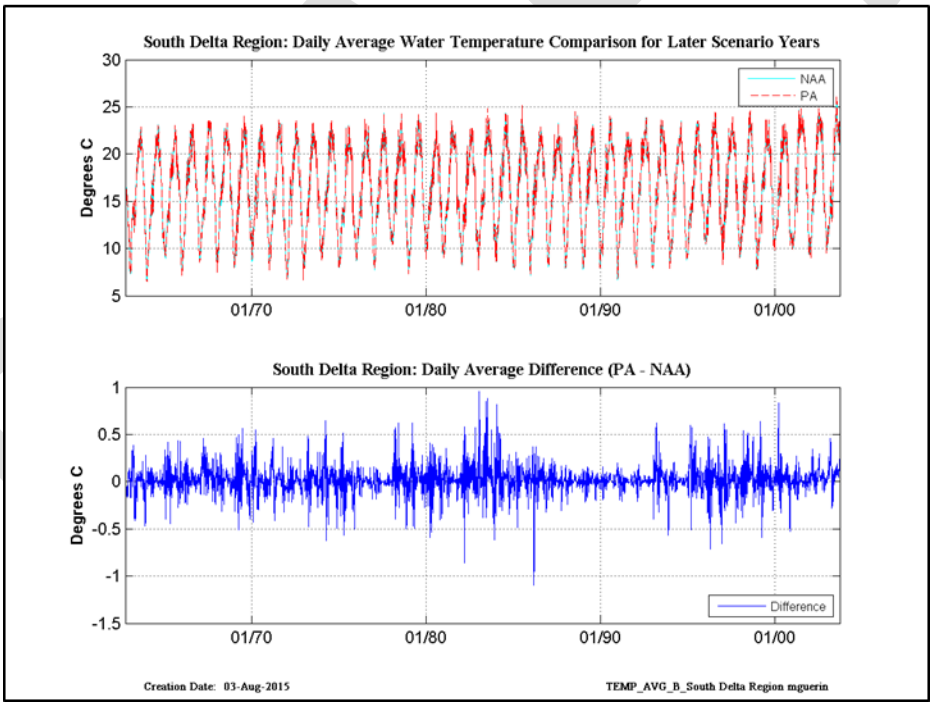


Figure 5-15 South Delta region daily average water temperature and temperature difference (PA – NAA).

Table 5-7 South Delta region monthly average percent difference table.

WY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1922	-0.10	-0.44	0.27	-0.88	-1.78	-0.14	-0.44	-0.04	0.67	0.34	0.30	0.09
1923	-0.69	-1.76	-0.39	-0.29	-0.49	0.48	-1.12	-0.86	0.16	0.27	0.06	0.16
1924	0.08	-0.28	0.01	-0.04	-0.27	0.06	-0.13	-0.18	0.00	-0.01	0.00	0.00
1925	-0.21	0.15	0.05	-0.52	0.06	0.79	-1.06	-0.63	-0.06	0.30	0.07	-0.04
1926	-0.44	-0.03	0.04	-0.36	-0.40	0.45	-0.27	0.26	0.02	0.27	0.05	-0.03
1927	-0.07	-0.04	0.30	-0.23	-0.11	1.29	-0.25	-0.27	0.00	0.34	0.08	-0.16
1928	-0.50	-0.84	0.49	-0.33	0.14	1.42	0.23	-0.29	0.09	0.22	0.08	-0.17
1929	0.15	-0.66	-0.13	-0.48	0.36	0.30	-0.29	-0.08	0.02	0.03	-0.21	-0.04
1930	-0.17	0.13	0.05	-0.03	0.06	0.32	0.09	-0.10	0.04	0.12	-0.01	-0.13
1931	0.01	-0.11	0.07	0.09	0.05	0.06	0.08	-0.01	-0.01	0.01	-0.04	-0.04
1932	-0.22	-0.20	0.19	0.04	-0.56	0.40	-0.79	-0.55	0.01	0.13	0.04	0.05
1933	0.03	-0.32	0.57	-0.38	0.18	0.20	-0.17	-0.48	0.02	0.01	-0.01	0.03
1934	-0.02	-0.04	0.03	-0.06	-0.08	0.26	0.16	0.01	-0.02	0.00	0.00	-0.02
1935	0.07	-0.09	-0.39	-0.12	-0.12	-0.11	-0.17	-0.13	0.17	0.16	0.11	-0.13
1936	-0.38	-0.20	-0.17	-0.19	1.15	1.51	-0.40	0.04	0.07	0.29	0.24	0.21
1937	0.20	-0.05	0.00	-1.30	0.45	-1.65	-0.06	-0.15	0.28	0.28	0.22	0.08
1938	-0.08	0.09	-0.08	-0.32	0.75	-0.24	0.45	0.79	0.42	0.21	0.27	0.06
1939	0.14	-0.28	-0.53	0.64	0.31	0.27	-0.17	-0.34	-0.06	0.15	0.17	0.02
1940	-0.24	-0.06	0.03	-0.30	0.05	1.04	-0.10	-0.18	0.09	0.14	0.07	-0.12
1941	0.10	-0.93	-0.28	0.37	0.61	0.14	-0.30	0.49	0.29	0.58	0.28	0.04
1942	-0.13	-0.88	0.15	1.18	0.85	1.23	-0.25	-0.31	0.31	0.45	0.28	0.06
1943	0.09	-0.94	-0.12	0.96	1.47	-0.23	0.23	-0.30	0.20	0.18	0.03	0.16
1944	-0.14	-1.17	-0.04	0.34	0.59	-0.27	-0.44	-0.52	0.04	0.24	-0.22	-0.06
1945	-0.09	0.03	0.16	0.04	0.04	0.39	-0.74	-0.37	-0.22	0.37	0.31	0.12
1946	0.20	-0.01	0.22	-0.50	-0.05	1.41	-0.64	-0.38	-0.05	0.38	0.19	-0.14
1947	-0.39	-0.52	-0.45	-1.20	0.35	-0.38	-0.16	-0.01	0.22	0.07	-0.03	0.05
1948	-0.29	-0.16	0.21	0.00	-0.36	0.45	-0.93	-0.28	0.06	0.18	0.02	-0.12
1949	-0.07	-0.20	0.42	-0.22	-0.50	0.17	-0.04	-0.53	0.02	0.13	-0.09	0.09
1950	-0.12	-0.01	-0.12	-0.70	0.12	0.90	-0.33	-0.29	0.05	0.34	0.24	0.23
1951	0.08	-0.17	0.01	1.96	0.41	0.60	-0.50	-0.57	0.07	0.28	0.08	0.22
1952	0.02	-0.89	-0.05	-1.22	1.45	3.16	0.54	0.20	0.75	0.49	0.36	0.27
1953	-0.35	-1.68	-0.15	0.82	1.63	1.39	-0.17	-0.46	-0.17	0.34	-0.01	0.00
1954	-0.03	-0.75	0.00	0.19	-0.01	1.02	-0.31	-0.37	0.11	0.45	0.00	-0.25
1955	-0.48	-1.22	-0.03	-0.40	0.30	-0.25	-0.09	-0.35	-0.01	0.14	-0.04	-0.02
1956	-0.03	-0.41	-0.10	0.98	1.21	1.44	-0.77	-0.24	0.46	0.47	0.32	-0.12
1957	-0.30	-1.21	-0.22	0.52	-0.95	1.03	-0.03	-0.57	-0.02	0.29	0.15	-0.02
1958	-0.73	-0.93	-0.07	-0.64	0.88	1.06	-0.01	0.59	0.30	0.45	0.31	0.26
1959	0.01	-0.96	0.00	0.35	0.31	0.58	-0.31	-0.16	-0.07	0.42	0.06	0.09
1960	-0.01	-0.35	-0.04	0.01	0.43	0.04	0.31	-0.14	0.28	0.33	0.12	-0.01
1961	-0.26	-0.13	0.18	-0.04	0.21	0.09	0.22	-0.13	0.00	0.46	0.10	-0.11
1962	0.10	-0.36	0.31	0.33	-0.15	-0.16	-0.21	-0.10	0.06	0.18	0.25	0.05
1963	-0.49	-0.64	0.56	-0.51	0.67	1.60	-1.23	-0.46	-0.02	0.21	0.16	0.25
1964	-0.15	-0.86	0.04	0.44	0.41	0.19	0.02	-0.14	0.02	0.16	-0.13	0.02

Table 5-8 South Delta region monthly average percent difference table (continued).

WY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1965	0.01	0.12	-0.05	0.51	0.51	1.23	0.09	0.19	0.10	0.10	0.42	0.03
1966	0.16	-0.31	0.35	-0.26	0.57	0.67	0.14	0.08	0.01	0.23	0.26	0.07
1967	-0.07	0.07	0.28	-0.33	1.35	1.81	0.92	0.55	0.39	0.22	0.37	0.16
1968	0.15	-0.25	0.57	0.63	0.02	0.94	-0.08	-0.05	-0.05	0.40	0.11	0.12
1969	-0.46	0.05	-0.26	-0.18	0.43	0.46	0.08	0.11	0.80	0.46	0.32	0.29
1970	-0.42	-1.19	-0.09	-0.01	0.80	1.30	-0.01	-0.56	-0.04	0.11	0.09	-0.24
1971	0.03	-0.42	-0.20	0.04	1.47	2.13	-0.55	-0.31	0.13	0.36	0.26	0.06
1972	-0.03	-1.00	-0.61	-0.32	-0.61	0.46	-0.28	-0.07	-0.02	0.29	0.24	-0.06
1973	0.09	-0.78	-0.06	0.03	-0.46	1.05	-0.69	-0.27	0.22	0.31	0.07	0.10
1974	-0.43	0.00	-0.05	0.25	0.99	1.76	-0.22	-0.60	0.09	0.37	0.31	0.03
1975	0.24	-1.23	-0.03	0.16	-0.22	1.62	-1.23	-0.63	0.07	0.20	0.27	0.00
1976	-0.84	-1.30	-0.31	0.80	0.71	0.07	-0.04	0.03	0.04	0.13	0.04	0.00
1977	0.13	-0.35	-0.25	0.33	-0.56	0.30	-0.11	0.06	-0.07	0.00	-0.04	-0.12
1978	0.09	0.00	0.06	0.03	0.98	1.21	0.26	0.30	0.44	0.45	0.27	0.06
1979	0.14	-0.76	-1.15	-0.55	0.39	0.85	-0.68	-0.11	-0.01	0.38	0.21	0.20
1980	0.18	-0.50	0.36	-0.03	0.14	-0.44	-0.93	-0.10	0.06	0.71	0.25	0.18
1981	0.03	-0.91	0.23	-0.01	0.72	0.46	-0.40	0.06	0.02	0.25	0.05	0.03
1982	-0.52	-0.09	0.22	-0.11	-0.15	-0.65	-0.01	0.38	0.02	0.26	0.45	0.45
1983	0.23	0.04	0.02	3.05	0.02	0.02	0.36	0.55	0.78	1.33	0.37	0.34
1984	0.17	-1.29	0.18	1.68	1.32	1.10	0.30	-0.51	0.02	0.29	0.29	0.14
1985	-0.08	-0.20	0.01	-0.03	-0.24	0.52	-0.33	0.17	-0.04	0.55	0.19	0.12
1986	0.09	-0.23	0.87	-0.33	1.05	-1.03	0.11	0.07	0.04	0.26	0.31	0.07
1987	0.19	-0.52	0.17	0.17	0.34	0.22	-0.34	0.30	0.08	0.03	-0.14	0.02
1988	0.03	-0.17	0.18	-0.36	-0.74	0.02	0.30	-0.17	0.00	0.20	-0.03	-0.07
1989	-0.07	0.10	-0.23	0.19	-0.57	-0.05	0.18	-0.04	0.10	0.23	0.05	-0.11
1990	0.02	0.04	-0.04	0.01	0.38	-0.26	0.00	0.06	0.00	0.23	0.06	-0.02
1991	0.05	-0.11	1.17	0.38	-0.41	-0.09	-0.32	-0.15	0.07	0.08	-0.01	0.01
1992	0.11	-0.17	0.68	0.15	-0.61	0.25	0.02	-0.02	-0.01	0.12	0.04	0.01
1993	0.04	-0.02	0.14	-0.42	0.57	2.11	-0.27	0.27	0.51	0.45	0.07	0.02
1994	0.10	-1.48	-0.16	0.29	0.12	0.37	-0.01	-0.09	-0.01	0.10	0.13	-0.07
1995	0.00	0.03	0.25	-0.30	1.78	1.58	0.41	0.71	0.69	0.02	0.38	0.05
1996	-0.13	-0.47	0.12	0.43	0.06	1.30	-0.33	-0.10	0.29	0.45	0.34	0.12
1997	0.27	-0.61	-0.57	0.01	1.14	1.08	-0.23	0.32	0.01	0.17	0.32	0.38
1998	-0.51	-0.57	0.02	-0.11	0.22	0.40	0.23	0.24	1.56	0.41	0.33	0.43
1999	0.26	-0.42	0.08	0.49	1.13	1.55	-0.46	-0.12	0.23	0.24	0.42	0.09
2000	0.33	-0.68	0.17	0.39	0.63	1.54	0.19	-0.10	0.16	0.15	0.31	0.29
2001	0.04	-1.54	-0.40	-0.09	-0.13	0.11	0.16	-0.10	0.03	0.15	-0.13	-0.05
2002	-0.01	-0.13	0.18	0.11	1.03	1.17	0.11	-0.07	-0.03	0.83	0.23	0.29
2003	0.21	-0.19	0.07	0.45	1.22	1.99	-0.24	-0.24	0.23	0.48	0.47	0.64
Max	0.33	0.15	1.17	3.05	1.78	3.16	0.92	0.79	1.56	1.33	0.45	0.64
Min	-0.84	-1.76	-1.15	-1.30	-1.78	-1.65	-1.23	-0.86	-0.22	-0.01	-0.22	-0.25

WY Type	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
Wet	-0.11	-0.52	0.04	0.25	0.82	1.02	-0.09	0.01	0.30	0.35	0.28	0.12
AN	-0.01	-0.43	0.10	0.13	0.07	0.96	-0.22	-0.17	0.20	0.33	0.16	0.09
BN	-0.04	-0.42	-0.07	-0.21	0.09	0.48	-0.42	-0.20	0.03	0.30	0.18	0.06
Dry	-0.13	-0.44	-0.01	-0.05	0.13	0.24	-0.17	-0.16	0.04	0.25	0.02	0.01
Critical	-0.01	-0.45	0.16	0.07	-0.07	0.12	-0.06	-0.09	0.01	0.08	-0.01	-0.03

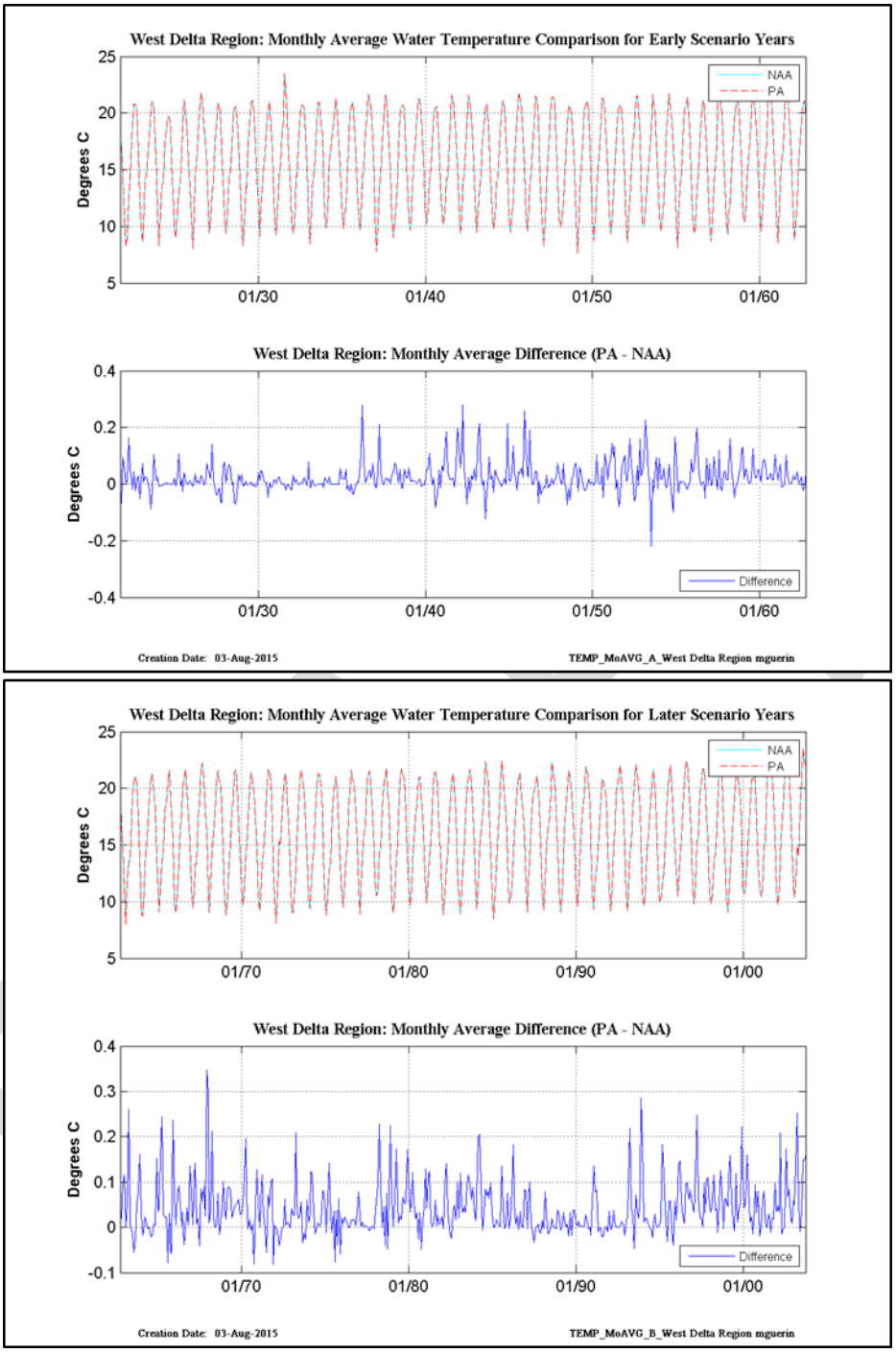


Figure 5-16 West Delta region monthly average water temperature and temperature difference (PA – NAA).

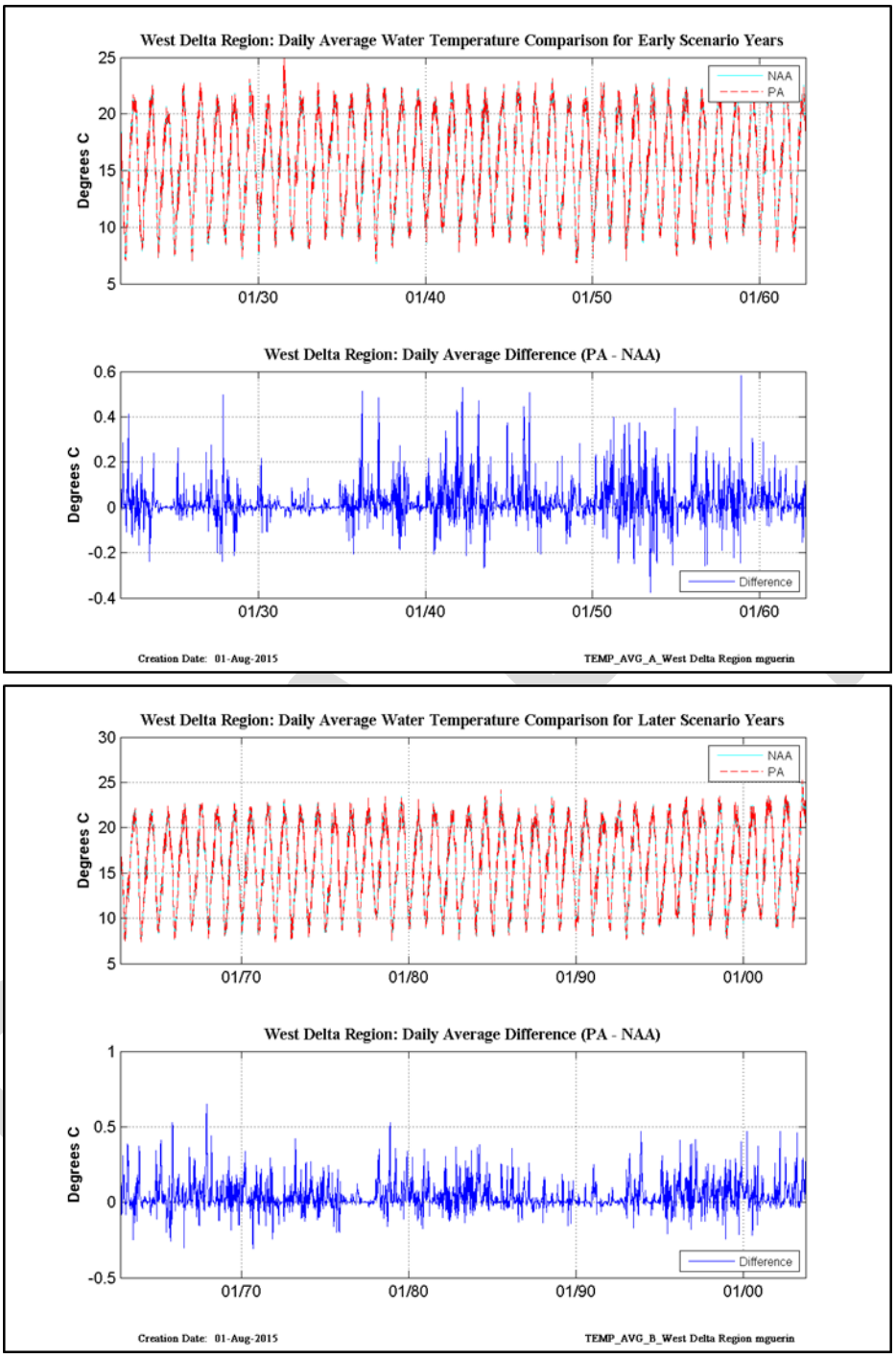


Figure 5-17 West Delta region daily average water temperature and temperature difference (PA – NAA).

Table 5-9 West Delta region monthly average percent difference table.

WY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1922	-0.38	0.65	0.53	0.08	0.10	1.36	0.36	0.06	-0.09	0.21	-0.12	0.09
1923	0.18	-0.41	0.20	0.87	0.07	0.19	0.16	0.05	-0.12	-0.43	-0.10	0.50
1924	0.23	0.08	0.23	-0.10	-0.05	-0.04	-0.02	0.01	0.01	0.01	0.00	0.00
1925	-0.01	0.01	0.23	-0.09	0.23	0.85	-0.04	0.10	-0.15	0.19	0.06	0.00
1926	0.02	0.10	0.02	-0.11	0.09	0.26	0.03	0.07	0.01	0.15	0.09	-0.02
1927	0.02	0.47	0.39	0.45	0.17	1.12	0.10	-0.07	-0.21	-0.13	-0.06	-0.33
1928	-0.39	0.43	0.75	0.06	0.40	0.50	0.40	0.00	0.02	-0.32	-0.34	-0.18
1929	0.20	0.05	0.32	-0.07	-0.06	0.08	0.01	-0.01	0.01	0.04	-0.03	0.00
1930	-0.06	-0.03	0.33	0.14	0.40	0.35	0.11	0.03	0.02	-0.23	0.02	-0.07
1931	-0.04	0.06	0.15	0.03	0.17	0.19	0.06	0.00	0.01	0.01	-0.10	-0.02
1932	-0.02	-0.08	-0.20	0.35	0.05	0.13	0.08	-0.02	0.01	0.02	0.03	0.11
1933	0.05	-0.03	0.77	-0.11	-0.14	0.12	0.01	-0.05	-0.02	0.00	0.00	0.00
1934	0.01	-0.08	0.22	0.11	0.04	0.17	0.00	-0.01	0.01	0.01	0.00	0.00
1935	0.00	0.36	0.18	0.20	0.16	0.47	-0.13	-0.03	-0.12	0.00	-0.18	-0.13
1936	-0.01	0.05	0.07	0.72	1.07	2.02	0.54	0.03	0.10	0.15	0.23	0.10
1937	0.40	0.18	-0.03	-0.17	0.38	1.62	0.30	0.05	-0.01	0.08	0.09	0.06
1938	0.10	0.01	0.29	0.51	0.73	0.49	0.16	0.02	0.27	-0.07	-0.06	0.25
1939	0.15	0.14	0.54	0.21	0.08	0.11	0.06	0.04	0.01	0.06	0.08	-0.04
1940	-0.01	-0.01	0.02	0.49	0.47	0.80	0.24	0.00	0.10	-0.41	-0.20	-0.18
1941	0.29	-0.09	0.58	0.47	0.97	1.34	0.29	0.14	0.08	0.09	0.10	-0.05
1942	0.34	1.33	1.13	0.63	1.07	2.18	0.38	0.04	-0.36	0.11	-0.14	0.16
1943	0.09	0.40	0.12	0.43	1.54	1.65	0.22	-0.03	0.07	-0.59	-0.11	-0.05
1944	0.55	0.13	0.25	-0.29	0.47	0.24	0.16	0.05	0.01	-0.03	0.02	0.10
1945	0.00	1.46	0.13	0.13	0.43	1.14	0.30	0.11	-0.10	0.21	0.18	0.27
1946	0.13	1.72	1.22	0.41	0.24	1.44	0.27	-0.01	0.06	0.22	0.18	-0.34
1947	0.06	-0.30	-0.22	-0.13	-0.12	0.24	-0.09	-0.02	-0.03	0.10	-0.01	0.08
1948	0.13	0.53	0.41	0.11	0.00	0.61	0.05	-0.05	-0.39	-0.07	-0.26	0.11
1949	0.16	0.48	0.70	0.06	-0.31	0.48	0.22	0.03	-0.10	-0.10	-0.04	0.09
1950	0.00	0.04	0.08	-0.03	0.07	0.82	0.07	0.00	0.02	0.26	-0.22	0.52
1951	0.42	0.10	0.61	0.97	1.36	0.77	0.92	-0.11	0.07	-0.39	-0.18	0.29
1952	0.45	0.72	0.11	0.19	0.73	1.34	0.44	0.13	-0.32	-0.19	0.30	-0.01
1953	0.87	0.21	0.41	0.89	2.03	1.16	0.25	0.00	-1.19	0.08	-0.12	0.16
1954	0.55	-0.11	0.83	0.19	0.17	0.47	0.04	-0.07	-0.01	0.33	0.06	-0.26
1955	-0.59	1.15	0.90	-0.21	-0.29	0.08	0.04	0.06	0.02	-0.04	-0.08	0.00
1956	0.08	0.59	0.38	0.60	1.30	1.56	0.45	0.08	-0.02	0.04	0.00	-0.25
1957	0.53	-0.04	0.73	-0.06	-0.01	0.74	0.28	0.01	-0.08	0.54	-0.05	-0.11
1958	0.23	0.35	0.15	0.18	0.59	1.36	0.33	0.03	-0.24	-0.02	0.02	0.18
1959	0.34	0.86	1.16	0.19	0.51	0.26	0.04	0.01	0.11	0.55	0.20	0.12
1960	0.13	0.35	0.32	0.07	0.65	0.65	0.44	0.09	0.09	0.09	0.18	0.07
1961	0.09	0.73	0.45	0.17	0.49	0.51	-0.07	-0.05	0.01	0.44	0.13	0.03
1962	0.00	0.05	0.31	0.21	0.18	0.38	0.04	0.04	0.13	-0.11	-0.05	0.23
1963	0.12	0.65	1.10	0.00	0.48	2.01	0.05	-0.04	-0.08	-0.27	-0.12	0.25
1964	0.45	1.19	0.35	-0.20	0.08	0.17	0.07	-0.02	0.00	-0.10	-0.08	0.04

Table 5-10 West Delta region monthly average percent difference table (continued).

WY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1965	0.02	1.11	0.33	0.49	1.39	1.86	0.21	0.13	0.12	-0.38	0.14	-0.31
1966	-0.28	1.51	0.70	0.07	0.69	0.70	0.31	0.02	0.16	-0.18	0.00	0.21
1967	0.03	0.89	0.69	0.06	1.07	1.10	0.07	0.12	-0.22	0.38	0.25	0.42
1968	0.13	2.17	2.85	0.11	0.32	1.50	0.14	0.00	0.03	0.34	-0.07	0.07
1969	0.27	0.69	0.43	0.20	0.83	0.70	0.56	0.12	0.17	0.21	0.23	0.26
1970	0.37	0.20	0.25	0.55	1.03	1.39	0.46	-0.02	0.09	-0.03	0.03	-0.41
1971	0.30	0.89	0.52	-0.01	0.58	0.91	0.19	-0.02	-0.29	0.33	0.22	0.49
1972	0.64	-0.62	0.04	-0.03	-0.10	-0.27	-0.17	-0.01	0.01	0.29	0.02	0.06
1973	0.05	-0.01	0.46	0.30	0.25	1.65	0.35	0.11	0.11	0.26	-0.16	-0.06
1974	-0.16	0.43	0.12	0.33	1.20	0.89	0.23	-0.08	0.00	0.05	0.01	0.05
1975	0.42	0.59	0.55	-0.13	0.63	1.15	0.16	-0.06	0.18	-0.37	0.17	-0.20
1976	0.39	-0.45	0.21	0.08	0.19	0.09	0.06	0.00	0.00	0.08	0.07	0.09
1977	0.02	0.22	0.70	0.27	0.02	0.08	0.00	0.02	0.01	0.00	-0.03	0.01
1978	0.00	-0.02	0.17	0.55	0.88	1.63	0.59	0.00	0.22	-0.18	0.34	-0.24
1979	0.35	1.63	0.68	0.02	0.61	1.28	0.37	0.06	0.12	0.09	0.31	0.25
1980	0.31	1.22	0.95	0.37	0.65	0.90	0.37	0.11	0.18	-0.13	0.15	-0.26
1981	0.11	0.31	1.22	0.44	0.92	0.93	0.07	0.01	0.06	0.28	0.01	0.13
1982	0.04	0.07	0.24	-0.03	0.90	1.09	0.26	-0.02	-0.08	-0.12	0.16	0.25
1983	0.09	0.79	0.21	1.34	0.47	0.25	0.31	0.19	0.48	0.55	0.44	0.30
1984	0.50	0.26	0.14	0.69	1.82	1.46	0.60	-0.04	0.17	0.38	0.32	0.38
1985	0.35	0.69	0.31	-0.01	0.02	0.12	0.06	0.02	0.01	0.60	0.21	-0.02
1986	0.04	0.55	-0.04	0.17	0.75	1.30	0.36	0.04	0.14	-0.03	0.16	0.01
1987	0.00	0.52	0.71	-0.04	0.38	0.75	0.06	-0.06	-0.17	-0.02	0.01	0.04
1988	-0.05	-0.08	0.14	-0.04	0.67	0.16	-0.09	-0.05	0.01	0.09	0.01	-0.01
1989	-0.01	0.27	0.24	-0.07	0.03	0.24	0.11	0.01	0.04	-0.09	0.16	-0.09
1990	0.22	0.25	0.08	0.03	0.14	0.02	0.02	0.00	0.01	0.13	0.07	-0.02
1991	0.00	-0.11	0.54	1.52	0.64	0.65	-0.07	-0.01	-0.02	-0.10	-0.09	-0.01
1992	0.01	-0.06	0.32	-0.05	0.01	0.26	0.03	0.01	0.00	0.00	0.01	0.06
1993	0.03	-0.12	0.14	0.25	0.92	1.61	0.29	0.13	-0.23	0.32	0.16	0.10
1994	0.43	1.88	1.80	0.13	0.19	0.14	0.04	0.00	-0.02	-0.11	0.04	0.15
1995	0.00	0.00	0.05	0.17	1.64	0.94	0.26	0.06	-0.16	0.27	0.26	-0.04
1996	-0.23	0.38	0.13	0.80	1.22	1.08	0.36	0.13	0.04	0.43	0.43	0.30
1997	0.45	0.40	0.46	0.33	1.03	1.67	0.44	0.11	0.09	0.01	0.45	0.16
1998	0.61	0.72	0.45	0.34	0.59	0.87	0.27	0.25	-0.06	0.23	0.55	0.37
1999	-0.02	0.46	0.58	0.52	1.07	1.28	0.43	0.08	-0.05	0.56	0.06	0.20
2000	0.29	1.44	1.14	0.40	0.51	1.21	0.55	0.07	0.11	-0.07	0.18	0.47
2001	0.19	0.62	-0.17	0.02	0.57	0.55	0.08	0.00	0.07	0.13	-0.05	0.09
2002	0.09	0.61	0.33	0.50	0.30	1.53	-0.09	-0.02	0.02	0.74	0.29	0.38
2003	0.15	0.06	0.52	0.51	1.19	1.77	0.33	-0.06	0.17	0.62	0.66	0.72
Max	0.87	2.17	2.85	1.52	2.03	2.18	0.92	0.25	0.48	0.74	0.55	0.72
Min	-0.59	-0.62	-0.22	-0.29	-0.31	-0.27	-0.17	-0.11	-1.19	-0.59	-0.34	-0.41
WY Type	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
Wet	0.20	0.50	0.38	0.39	0.99	1.24	0.30	0.05	-0.05	0.06	0.14	0.10
AN	0.12	0.28	0.53	0.32	0.53	1.03	0.36	0.02	0.04	0.06	0.04	0.03
BN	0.14	0.68	0.57	0.20	0.33	0.87	0.16	0.02	0.00	0.10	0.02	0.15
Dry	0.09	0.38	0.35	0.04	0.23	0.45	0.07	0.02	0.00	0.12	0.06	0.05
Critical	0.13	0.16	0.48	0.15	0.16	0.16	0.00	-0.01	0.00	0.01	0.00	0.02

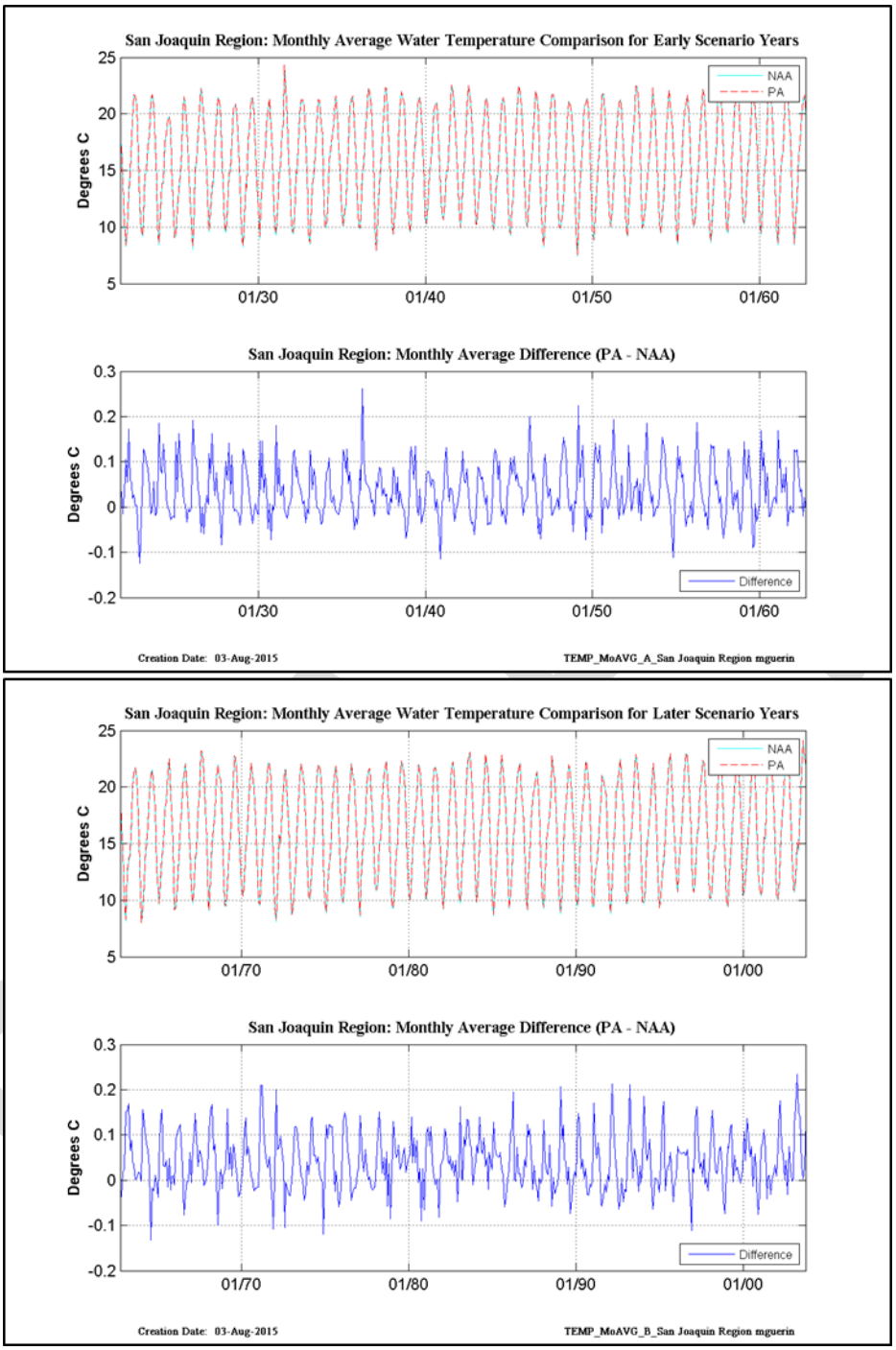
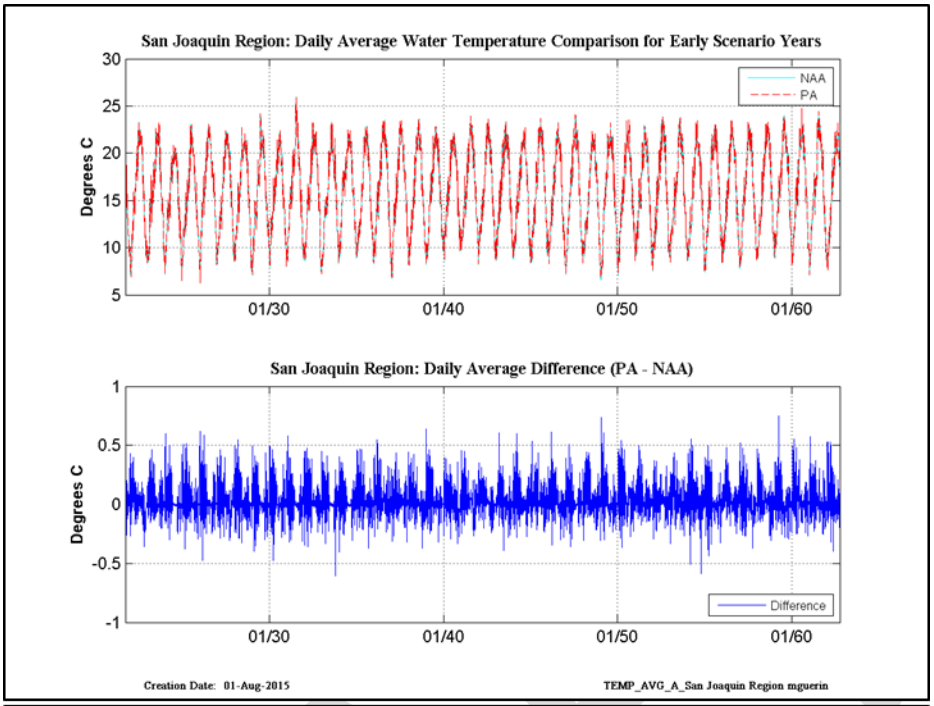


Figure 5-18 SJR (San Joaquin River) region monthly average water temperature and temperature difference (PA – NAA).



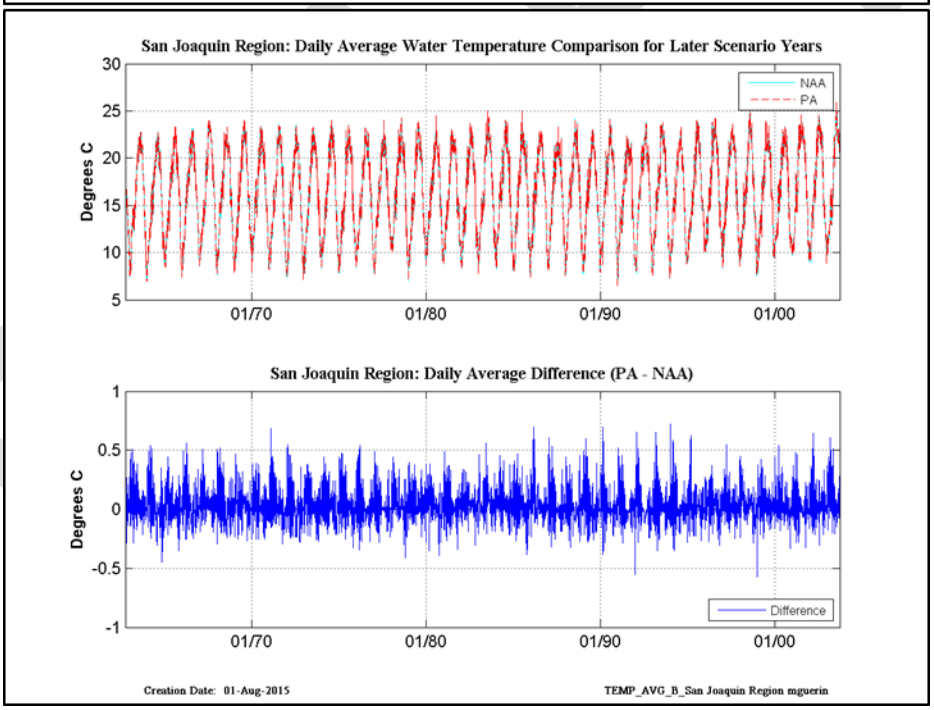


Figure 5-19 SJR (San Joaquin River) region daily average water temperature and temperature difference (PA – NAA).

Table 5-11 SJR (San Joaquin) region monthly average percent difference table.

WY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1922	0.20	-0.11	0.31	1.27	0.57	1.32	0.39	0.30	0.10	0.13	0.01	0.01
1923	-0.43	-1.02	-0.23	0.75	1.20	0.81	0.66	0.51	0.26	-0.07	-0.03	0.27
1924	-0.11	-0.08	0.15	2.20	0.74	0.54	1.02	0.54	0.11	-0.01	-0.04	-0.15
1925	-0.15	-0.16	-0.25	1.57	0.29	1.23	0.72	0.43	0.29	0.04	0.03	-0.18
1926	-0.02	-0.08	0.01	2.39	1.03	0.71	0.67	0.23	0.11	-0.25	-0.01	-0.31
1927	0.02	0.17	0.05	1.24	0.65	1.21	0.47	0.14	0.39	0.09	0.03	-0.26
1928	-0.50	0.03	0.51	1.06	0.51	0.97	0.19	0.65	0.04	-0.04	-0.03	-0.05
1929	-0.08	-0.29	-0.07	1.55	1.03	0.63	0.59	0.31	0.10	-0.04	-0.17	-0.05
1930	0.05	-0.07	-0.14	1.62	0.32	1.08	0.21	0.44	0.21	-0.24	0.03	-0.38
1931	0.02	-0.05	0.05	1.94	0.29	0.72	0.17	0.17	0.26	-0.01	-0.06	-0.13
1932	0.01	0.06	0.24	1.26	1.17	0.46	0.61	0.33	0.24	0.15	0.04	0.07
1933	-0.19	-0.03	-0.17	1.47	1.04	0.28	0.59	0.40	0.00	-0.01	-0.04	-0.20
1934	-0.17	-0.03	0.01	0.76	0.71	0.69	0.10	0.05	0.13	-0.03	-0.03	-0.07
1935	-0.10	0.04	0.18	1.27	0.97	0.65	0.90	0.30	0.38	0.05	0.05	-0.25
1936	-0.13	-0.30	0.07	0.84	0.33	1.79	0.70	0.32	0.25	0.21	0.19	0.05
1937	0.09	-0.14	-0.10	0.72	0.39	0.64	0.55	0.14	0.21	0.11	0.13	-0.05
1938	-0.10	0.14	0.08	0.93	0.57	0.14	0.44	0.01	0.17	0.06	-0.01	-0.03
1939	-0.42	-0.38	-0.10	1.22	1.26	0.76	0.37	0.77	0.04	-0.08	0.19	-0.18
1940	-0.11	-0.04	0.06	0.72	0.67	0.50	0.29	0.35	0.28	-0.04	0.09	-0.01
1941	-0.28	-0.85	0.09	0.18	0.79	0.89	0.33	0.07	0.21	0.18	0.10	-0.16
1942	-0.03	0.03	0.23	0.60	0.72	0.91	0.39	0.31	0.41	0.14	-0.07	-0.18
1943	-0.19	-0.44	-0.15	0.09	0.75	0.60	0.40	0.36	0.14	0.03	0.12	-0.19
1944	-0.20	-0.28	-0.06	1.02	1.16	0.81	0.42	0.59	0.11	-0.10	-0.02	-0.10
1945	-0.22	0.34	0.49	1.17	0.62	0.76	0.71	0.33	0.36	0.21	0.20	0.21
1946	-0.11	0.05	0.15	0.23	0.88	1.46	0.84	0.34	0.38	0.22	-0.03	-0.30
1947	-0.15	-0.56	-0.11	1.09	1.07	0.40	0.13	0.22	0.20	-0.09	-0.05	-0.01
1948	0.03	0.15	-0.05	0.94	1.00	1.27	1.03	0.78	0.28	0.03	-0.04	0.03
1949	-0.31	0.10	0.07	1.61	2.38	0.41	0.62	0.77	0.20	-0.34	-0.01	-0.13
1950	-0.08	-0.18	-0.07	0.98	1.30	0.82	0.63	0.79	0.30	-0.26	0.07	0.10
1951	0.09	-0.03	0.04	0.54	0.91	1.42	0.87	0.34	0.18	-0.13	0.02	0.34
1952	-0.10	-0.01	0.13	0.46	1.20	0.58	-0.06	0.06	0.24	0.19	0.28	-0.06
1953	0.29	-0.22	0.29	0.46	0.91	1.36	0.42	0.25	0.05	0.12	-0.10	-0.07
1954	0.01	-0.01	0.23	0.95	1.39	1.07	0.73	0.36	0.23	0.11	-0.01	-0.27
1955	-0.66	0.11	0.39	1.60	0.76	0.82	0.45	0.40	0.01	-0.21	-0.09	-0.11
1956	-0.02	0.09	-0.32	0.38	0.99	1.37	0.71	0.35	0.18	0.05	0.02	-0.10
1957	-0.07	-0.36	0.49	1.60	1.17	0.97	0.30	0.35	0.22	0.04	0.11	-0.19
1958	-0.42	-0.27	-0.11	1.28	1.06	0.84	0.27	-0.03	0.16	0.06	0.17	-0.14
1959	-0.31	-0.22	0.13	1.40	0.68	0.43	0.78	0.43	0.13	-0.39	-0.38	0.04
1960	-0.17	-0.09	0.07	1.81	0.70	0.84	0.05	0.43	0.28	-0.10	-0.07	0.03
1961	0.11	0.17	0.08	2.01	0.72	0.74	0.21	0.44	0.16	0.38	-0.19	-0.03
1962	0.02	-0.07	-0.12	1.51	1.13	1.01	0.45	0.19	0.19	-0.10	0.09	-0.05
1963	-0.22	0.12	0.26	1.87	1.22	1.25	0.47	0.51	0.21	0.16	0.00	0.02

Table 5-12 SJR (San Joaquin) region monthly average percent difference table (continued).

WY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1965	0.06	-0.07	-0.35	0.42	1.11	1.13	0.22	0.17	0.24	-0.07	0.21	-0.11
1966	0.05	0.06	-0.11	0.97	0.94	0.84	0.74	0.31	0.16	-0.36	-0.14	-0.01
1967	-0.02	0.42	-0.05	0.77	0.92	1.09	0.67	0.17	0.34	0.24	0.16	-0.05
1968	-0.02	0.09	0.58	1.22	1.28	1.12	0.41	0.45	0.00	-0.45	0.01	0.11
1969	-0.11	0.08	0.16	0.39	1.40	0.17	0.46	0.05	0.40	0.30	0.16	0.04
1970	-0.22	-0.20	-0.01	0.34	0.92	0.92	0.37	0.42	0.25	0.04	0.01	-0.11
1971	-0.09	-0.12	-0.15	1.23	1.89	1.57	0.76	0.38	0.20	0.13	0.23	-0.04
1972	-0.32	-0.83	0.02	2.46	0.60	0.47	0.65	0.36	0.17	-0.49	-0.02	-0.09
1973	-0.19	-0.28	0.00	0.46	1.01	0.88	0.73	0.43	0.20	0.04	0.02	-0.22
1974	-0.17	0.29	0.12	0.41	1.16	1.02	0.37	0.30	0.18	0.24	0.06	0.01
1975	-0.02	-0.89	0.14	1.37	0.82	0.93	0.84	0.65	0.19	-0.12	0.09	-0.05
1976	-0.36	-0.30	0.14	1.35	1.27	0.95	0.45	0.30	0.14	-0.20	-0.11	-0.08
1977	-0.09	0.11	0.29	1.67	0.97	0.35	0.12	0.41	0.15	0.00	0.04	-0.08
1978	-0.13	-0.10	-0.13	0.34	0.91	1.00	0.57	0.08	0.24	-0.01	0.28	-0.28
1979	0.20	-0.66	0.21	1.41	0.73	0.36	0.38	0.43	0.11	0.14	0.25	0.34
1980	0.09	0.28	0.49	0.57	1.15	0.27	0.59	0.22	0.45	-0.03	0.12	-0.46
1981	0.14	-0.47	0.46	1.02	0.96	0.54	0.76	0.22	0.04	-0.05	0.01	0.00
1982	-0.51	0.23	0.38	0.55	0.97	0.66	0.31	0.19	0.28	0.11	0.19	0.05
1983	0.24	-0.38	0.21	1.67	0.03	0.00	0.63	0.42	0.63	0.58	0.35	0.35
1984	-0.06	0.16	0.40	0.78	0.52	0.93	0.43	0.32	0.48	0.13	0.23	-0.10
1985	0.34	0.29	0.23	1.49	0.64	0.42	0.31	0.29	0.29	0.11	0.05	-0.30
1986	-0.22	0.03	0.22	0.97	0.93	1.26	0.01	-0.01	0.35	0.07	0.06	-0.08
1987	-0.04	0.30	0.29	1.35	0.81	0.82	0.39	-0.10	0.16	-0.03	-0.08	-0.23
1988	0.02	-0.05	0.07	1.44	0.34	0.12	0.08	0.44	0.05	-0.25	0.03	-0.15
1989	-0.10	-0.07	0.24	2.33	0.87	0.85	0.28	0.23	-0.04	0.13	-0.35	-0.20
1990	0.00	0.13	0.08	1.26	1.42	0.85	0.16	0.25	0.02	0.12	-0.14	-0.17
1991	-0.05	-0.10	-0.03	1.81	0.63	0.37	0.56	0.24	-0.27	-0.27	-0.18	-0.05
1992	-0.14	0.09	-0.02	1.41	1.83	0.78	0.33	0.19	-0.02	-0.30	-0.19	0.02
1993	-0.26	-0.14	-0.26	0.80	0.81	1.43	0.51	0.02	0.33	0.23	0.11	-0.12
1994	0.18	-0.04	0.33	1.91	0.89	0.29	0.38	0.52	0.01	-0.30	-0.22	0.02
1995	0.02	0.00	-0.28	0.37	1.11	1.30	-0.15	-0.01	0.15	0.15	0.27	0.03
1996	-0.27	-0.01	0.05	0.70	0.53	0.43	0.36	0.32	0.29	0.24	0.30	0.04
1997	-0.22	-0.79	0.25	0.15	1.11	1.05	0.48	0.13	0.19	0.03	0.27	-0.04
1998	0.02	-0.15	0.32	1.02	1.33	0.61	0.17	0.08	0.13	0.28	0.32	0.16
1999	-0.27	-0.53	0.16	0.78	0.64	0.86	0.80	-0.02	0.28	0.09	0.14	0.04
2000	-0.04	0.08	0.22	1.00	0.36	0.96	0.59	0.28	0.35	-0.06	0.21	0.28
2001	-0.06	-0.60	-0.27	0.68	0.74	0.72	0.43	-0.20	0.03	0.04	-0.14	0.02
2002	0.08	0.22	0.09	0.72	1.34	1.23	0.42	0.32	0.01	0.18	-0.14	0.34
2003	0.15	-0.01	0.02	1.15	1.38	1.58	1.03	0.78	0.15	0.01	0.12	0.61
Max	0.34	0.42	0.58	2.46	2.38	1.79	1.03	0.79	0.63	0.58	0.35	0.61
Min	-0.66	-1.02	-0.35	0.09	0.03	0.00	-0.15	-0.20	-0.27	-0.63	-0.38	-0.46
WY Type	**OCT**	**NOV**	**DEC**	**JAN**	**FEB**	**MAR**	**APR**	**MAY**	**JUN**	**JUL**	**AUG**	**SEP**
Wet	-0.11	-0.12	0.08	0.75	0.93	0.89	0.41	0.22	0.26	0.14	0.14	-0.04
AN	-0.06	-0.05	0.15	0.80	0.83	0.95	0.52	0.32	0.21	0.02	0.08	-0.03
BN	-0.10	-0.19	0.08	1.13	0.86	0.89	0.67	0.41	0.23	-0.08	0.02	0.03
Dry	-0.08	-0.08	0.07	1.47	0.96	0.76	0.42	0.35	0.14	-0.06	-0.05	-0.10
Critical	-0.07	-0.06	0.07	1.64	0.95	0.54	0.40	0.34	0.05	-0.12	-0.10	-0.09

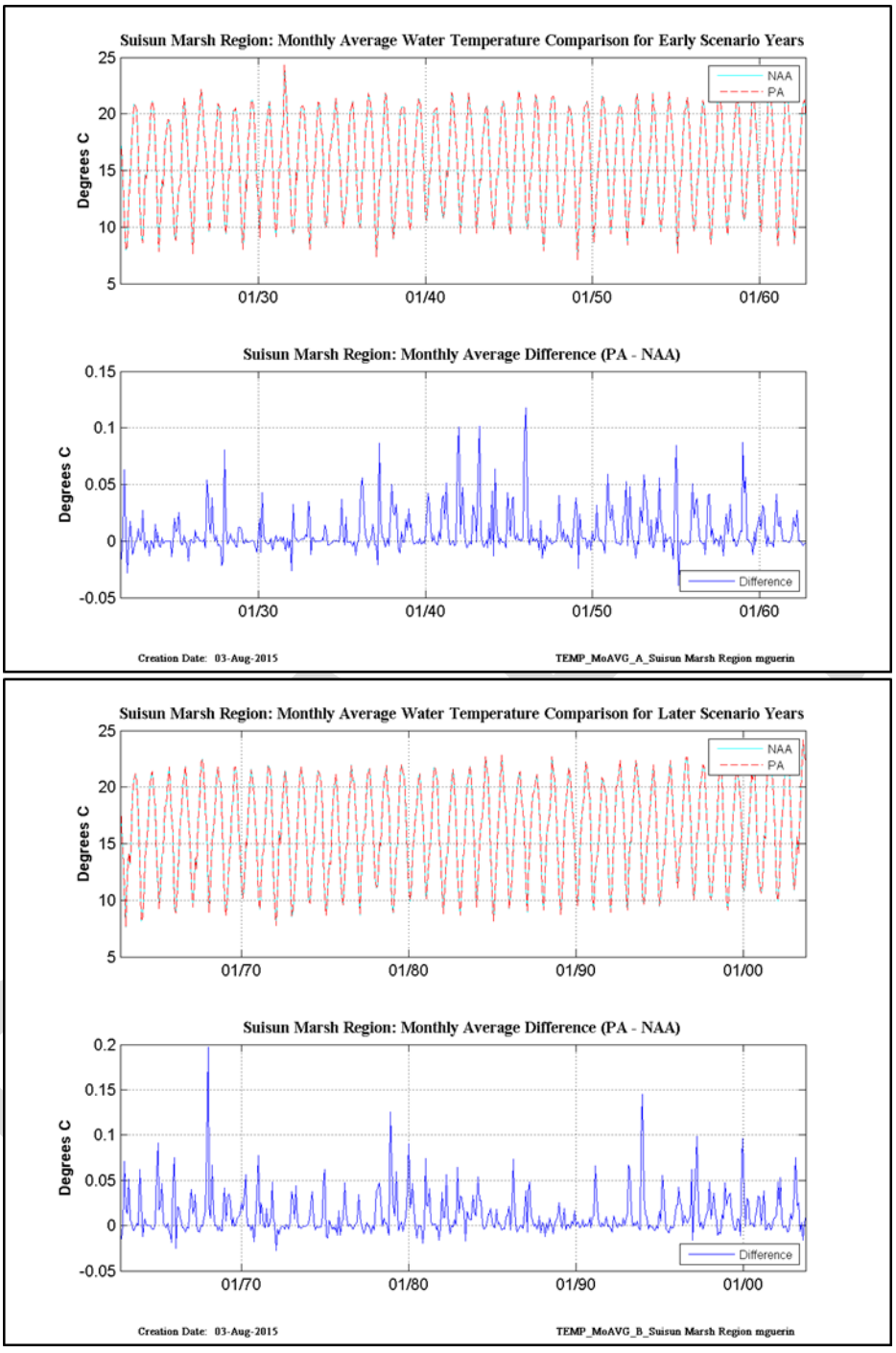


Figure 5-20 Suisun Marsh region monthly average water temperature and temperature difference (PA – NAA).

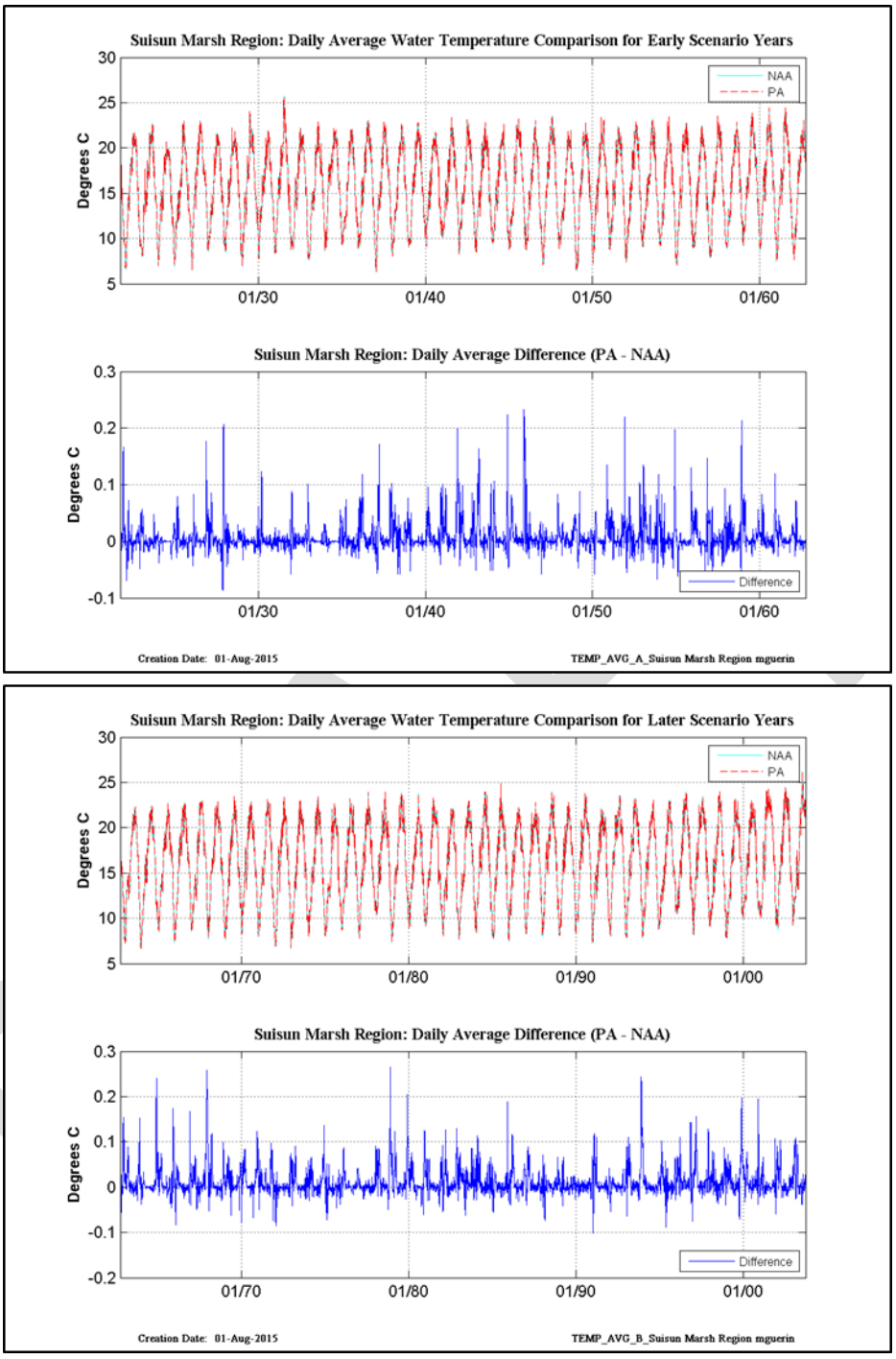


Figure 5-21 Suisun Marsh region daily average water temperature and temperature difference (PA – NAA).

Table 5-13 Suisun Marsh region monthly average percent difference table.

WY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1922	-0.09	0.06	0.60	0.10	-0.34	-0.01	0.12	0.00	-0.06	-0.03	0.00	0.00
1923	0.07	0.01	0.01	0.32	0.14	-0.05	0.00	-0.01	-0.07	0.00	-0.01	-0.03
1924	0.09	-0.01	0.07	-0.05	-0.05	0.02	-0.02	0.00	0.00	0.00	0.00	0.00
1925	-0.09	-0.02	0.21	0.09	0.09	0.19	0.00	-0.02	-0.01	0.02	-0.01	-0.01
1926	-0.11	0.00	0.01	-0.02	-0.01	0.06	0.02	0.02	0.00	0.00	0.00	0.01
1927	-0.03	0.35	0.34	0.20	0.06	0.29	0.06	0.00	0.03	-0.02	-0.02	-0.03
1928	-0.13	-0.13	0.77	0.14	-0.02	0.01	0.04	0.00	0.00	0.01	-0.02	-0.03
1929	0.07	0.09	0.10	-0.02	-0.02	0.01	-0.01	0.00	-0.01	0.00	0.00	-0.01
1930	-0.03	-0.07	0.05	0.22	-0.08	0.31	0.04	0.00	-0.01	-0.01	-0.01	0.01
1931	-0.05	-0.04	0.00	0.05	0.00	0.00	0.02	0.00	0.02	-0.01	-0.04	0.01
1932	-0.04	0.01	-0.26	0.34	0.03	0.01	0.01	0.00	0.00	0.01	0.01	0.01
1933	0.03	0.03	0.34	0.22	-0.12	0.02	0.02	-0.01	0.00	0.00	0.00	0.00
1934	0.01	0.00	0.13	0.10	-0.03	-0.02	-0.01	-0.01	0.00	0.00	0.00	0.00
1935	0.00	0.04	0.31	0.06	-0.03	0.18	0.00	0.00	-0.01	-0.01	-0.02	0.00
1936	-0.08	-0.01	0.00	0.28	0.43	0.37	0.19	0.03	0.01	-0.03	0.00	0.00
1937	0.08	0.03	-0.03	-0.06	-0.22	0.62	0.13	0.02	0.01	-0.03	0.00	0.01
1938	-0.02	0.16	0.45	0.29	0.21	0.25	0.02	-0.04	-0.05	0.04	-0.01	0.00
1939	0.12	0.07	0.27	0.12	0.14	0.01	-0.02	-0.01	0.00	-0.01	0.01	-0.01
1940	0.00	-0.02	-0.01	0.18	0.35	0.22	0.07	0.00	0.02	-0.01	-0.01	-0.02
1941	0.05	0.02	0.33	0.37	0.16	0.35	0.10	-0.01	-0.02	-0.01	0.00	-0.02
1942	-0.01	0.46	0.81	0.07	0.34	0.34	0.10	0.00	-0.03	-0.01	0.00	-0.02
1943	0.18	0.18	0.18	-0.01	0.48	0.72	0.05	-0.01	-0.03	-0.01	0.00	-0.03
1944	0.09	-0.02	0.39	-0.13	0.57	0.11	0.03	-0.02	0.02	0.00	0.00	-0.01
1945	-0.03	0.29	0.22	0.05	0.32	0.31	0.04	0.01	0.04	0.00	0.01	0.00
1946	0.02	0.62	1.09	0.38	0.04	-0.02	0.10	0.00	0.01	0.00	0.01	-0.02
1947	-0.05	0.15	-0.15	-0.03	-0.08	0.04	0.00	-0.01	0.01	-0.01	-0.01	0.00
1948	0.00	0.05	0.39	0.11	0.01	0.08	0.02	-0.01	0.03	0.01	-0.02	-0.03
1949	0.04	0.17	0.37	0.24	-0.29	0.18	0.03	0.01	0.01	0.01	-0.03	0.00
1950	0.00	-0.05	0.08	0.01	0.02	0.23	0.03	0.00	0.00	0.00	-0.01	-0.05
1951	0.12	0.39	0.24	0.19	0.29	0.11	0.09	-0.01	-0.01	-0.01	-0.02	0.00
1952	0.13	0.17	0.54	-0.05	0.10	0.38	0.09	0.02	-0.02	-0.07	0.00	-0.01
1953	0.17	0.18	0.16	0.55	0.34	0.26	0.05	-0.02	0.10	-0.02	-0.03	0.01
1954	0.12	0.05	0.51	0.19	0.11	-0.08	0.04	-0.01	0.01	0.01	0.02	-0.02
1955	-0.10	0.28	0.84	0.04	-0.37	-0.02	0.01	-0.02	-0.01	-0.01	-0.02	-0.01
1956	-0.01	0.14	0.45	0.21	0.32	0.28	0.10	0.00	0.00	-0.01	-0.01	-0.06
1957	0.03	0.29	0.41	0.05	0.10	-0.02	0.01	0.00	0.01	-0.02	0.02	0.00
1958	-0.08	0.08	0.24	0.07	0.09	0.27	0.11	0.00	0.01	-0.02	-0.01	0.01
1959	0.05	0.06	0.76	0.41	0.50	0.01	0.01	-0.01	-0.01	-0.05	0.04	-0.02
1960	0.06	0.11	0.20	0.11	0.26	0.20	0.03	-0.03	0.02	-0.01	-0.01	-0.01
1961	-0.03	0.15	0.40	0.17	0.11	0.15	0.05	0.00	0.00	0.00	0.00	-0.01
1962	0.00	0.04	0.20	0.18	0.12	0.22	0.00	0.00	-0.01	-0.02	-0.01	-0.01
1963	-0.09	0.00	0.65	0.25	0.11	0.36	0.05	0.01	-0.02	-0.03	0.00	0.01
1964	0.00	0.46	0.30	-0.14	0.05	0.05	0.00	0.00	0.00	0.00	-0.02	-0.02

Table 5-14 Suisun Marsh region monthly average percent difference table (continued).

WY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1965	0.02	0.43	0.83	0.19	0.19	0.34	0.02	0.00	-0.01	0.01	-0.03	-0.06
1966	-0.11	0.30	0.80	-0.28	0.18	0.14	0.05	0.02	-0.01	-0.01	-0.03	-0.01
1967	-0.02	0.17	0.35	0.14	0.19	0.25	0.00	-0.04	-0.04	0.00	0.00	0.04
1968	0.09	0.53	1.85	0.23	0.07	0.44	0.10	0.00	0.00	-0.03	-0.01	-0.03
1969	-0.04	0.14	0.42	0.06	0.29	0.26	0.17	0.00	0.05	0.00	0.00	0.04
1970	0.06	0.09	0.22	0.17	0.31	0.37	0.08	0.00	0.00	-0.03	0.00	-0.09
1971	0.03	0.24	0.76	0.02	0.24	0.13	0.00	-0.01	0.10	-0.01	0.00	0.05
1972	0.29	0.06	0.03	-0.35	-0.04	-0.06	-0.02	0.00	-0.01	-0.02	0.00	0.00
1973	-0.02	0.03	0.44	0.30	0.07	0.32	0.12	-0.01	0.00	-0.02	-0.01	0.00
1974	-0.01	0.00	0.04	0.13	0.22	0.28	0.04	-0.03	0.00	-0.01	-0.01	-0.01
1975	0.06	0.34	0.60	-0.14	-0.13	0.04	0.00	-0.02	-0.01	-0.02	0.00	-0.05
1976	0.10	-0.08	0.03	0.08	0.39	0.09	0.02	0.00	0.01	0.00	-0.02	0.00
1977	0.01	0.03	0.31	0.14	0.03	-0.02	-0.06	-0.03	0.02	0.00	-0.01	-0.05
1978	0.00	-0.03	0.06	0.34	0.37	0.32	0.20	-0.01	0.04	0.01	0.01	0.00
1979	-0.06	0.92	0.67	0.25	0.10	0.41	0.11	-0.03	0.00	0.02	-0.03	0.01
1980	0.06	0.28	0.82	0.20	0.29	0.33	0.11	-0.01	-0.07	0.00	0.00	-0.01
1981	-0.11	-0.01	0.70	0.23	0.17	0.28	0.03	0.00	0.00	0.01	-0.02	0.00
1982	-0.11	-0.02	0.33	0.10	0.08	0.41	0.08	-0.02	-0.05	0.00	-0.01	0.03
1983	0.01	0.52	0.14	0.38	0.27	0.16	0.11	-0.10	0.08	0.05	0.03	0.03
1984	0.19	0.10	0.10	0.29	0.45	0.18	0.17	0.01	-0.02	-0.01	0.02	0.06
1985	0.07	0.13	0.05	-0.02	-0.02	0.13	0.01	0.01	0.00	-0.02	-0.01	-0.02
1986	0.06	0.08	0.23	-0.04	0.21	0.49	0.20	0.01	-0.04	-0.02	0.00	0.00
1987	-0.02	0.09	0.34	-0.08	0.32	0.33	0.06	0.03	0.00	0.01	-0.02	0.01
1988	0.06	-0.05	0.03	0.02	-0.10	0.02	-0.03	0.05	0.00	0.01	-0.04	0.01
1989	0.04	0.07	0.23	0.08	-0.03	0.07	0.11	-0.03	0.01	0.00	-0.02	0.03
1990	0.00	0.11	0.00	0.05	0.03	-0.01	0.00	0.03	-0.01	0.01	0.00	0.01
1991	0.05	-0.01	0.09	0.11	0.53	0.24	0.06	0.00	-0.01	0.02	-0.01	0.01
1992	0.05	0.00	-0.01	-0.04	-0.06	0.07	0.03	0.01	-0.01	0.01	0.00	-0.01
1993	0.04	0.00	0.08	0.16	0.57	0.41	0.10	0.00	0.02	0.00	0.02	-0.02
1994	-0.03	0.60	1.40	0.34	0.12	0.07	-0.02	0.01	-0.01	-0.01	-0.02	-0.03
1995	0.00	-0.03	0.16	0.05	0.45	0.27	0.06	-0.02	-0.03	-0.04	0.00	-0.02
1996	-0.01	0.06	0.17	0.21	0.35	0.18	0.14	0.00	0.06	0.03	0.01	0.04
1997	0.06	0.44	-0.14	0.19	0.43	0.62	0.11	-0.01	0.02	-0.02	0.01	0.03
1998	0.07	0.11	0.45	0.08	0.20	0.26	0.10	0.03	-0.06	-0.03	-0.04	0.06
1999	0.04	0.34	0.22	0.35	0.31	0.28	0.09	0.02	-0.02	-0.02	0.04	0.03
2000	-0.06	0.47	0.87	0.30	-0.01	0.21	0.16	0.00	0.01	0.01	-0.01	0.04
2001	0.10	0.26	0.27	0.01	0.16	0.24	-0.03	-0.02	0.00	0.01	-0.02	-0.01
2002	0.04	0.05	0.12	0.48	0.20	0.36	0.05	-0.01	-0.01	0.00	-0.03	-0.02
2003	0.07	0.04	0.15	0.38	0.61	0.14	0.18	-0.04	0.02	-0.07	0.02	0.05
Max	0.29	0.92	1.85	0.55	0.57	0.72	0.20	0.05	0.10	0.05	0.04	0.06
Min	-0.13	-0.13	-0.26	-0.35	-0.37	-0.08	-0.06	-0.10	-0.07	-0.07	-0.04	-0.09

WY Type	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
Wet	0.03	0.18	0.35	0.16	0.24	0.31	0.08	-0.01	0.00	-0.01	0.00	0.00
AN	0.01	0.11	0.38	0.19	0.18	0.15	0.10	-0.01	0.00	-0.01	0.00	0.00
BN	0.02	0.21	0.46	0.11	0.12	0.21	0.05	0.00	0.00	-0.01	-0.01	-0.01
Dry	0.00	0.10	0.24	0.09	0.07	0.15	0.02	0.00	0.00	0.00	-0.01	0.00
Critical	0.04	0.06	0.22	0.08	0.07	0.05	0.00	0.00	0.00	0.00	-0.01	0.00

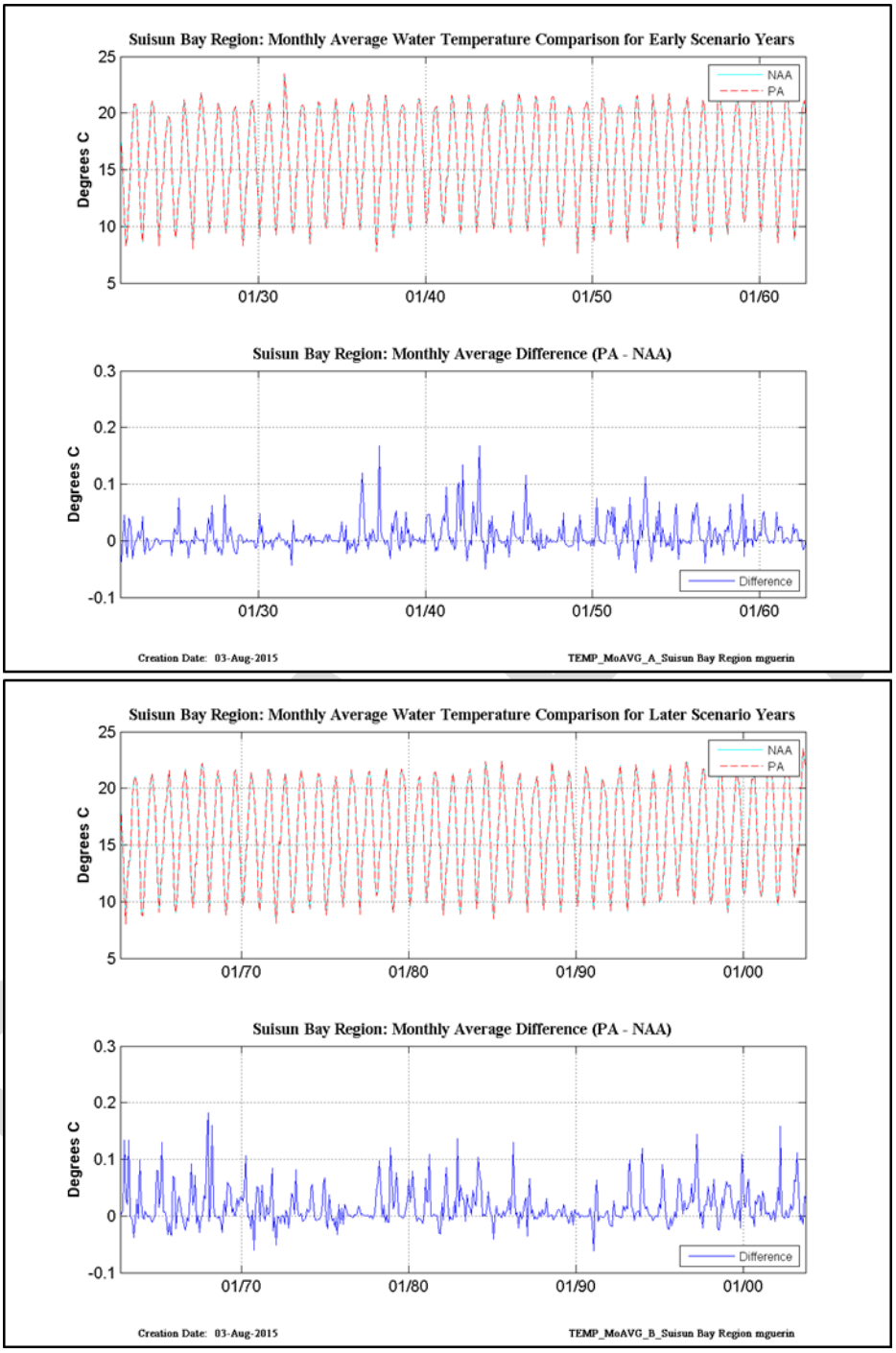


Figure 5-22 Suisun Bay region monthly average water temperature and temperature difference (PA – NAA).

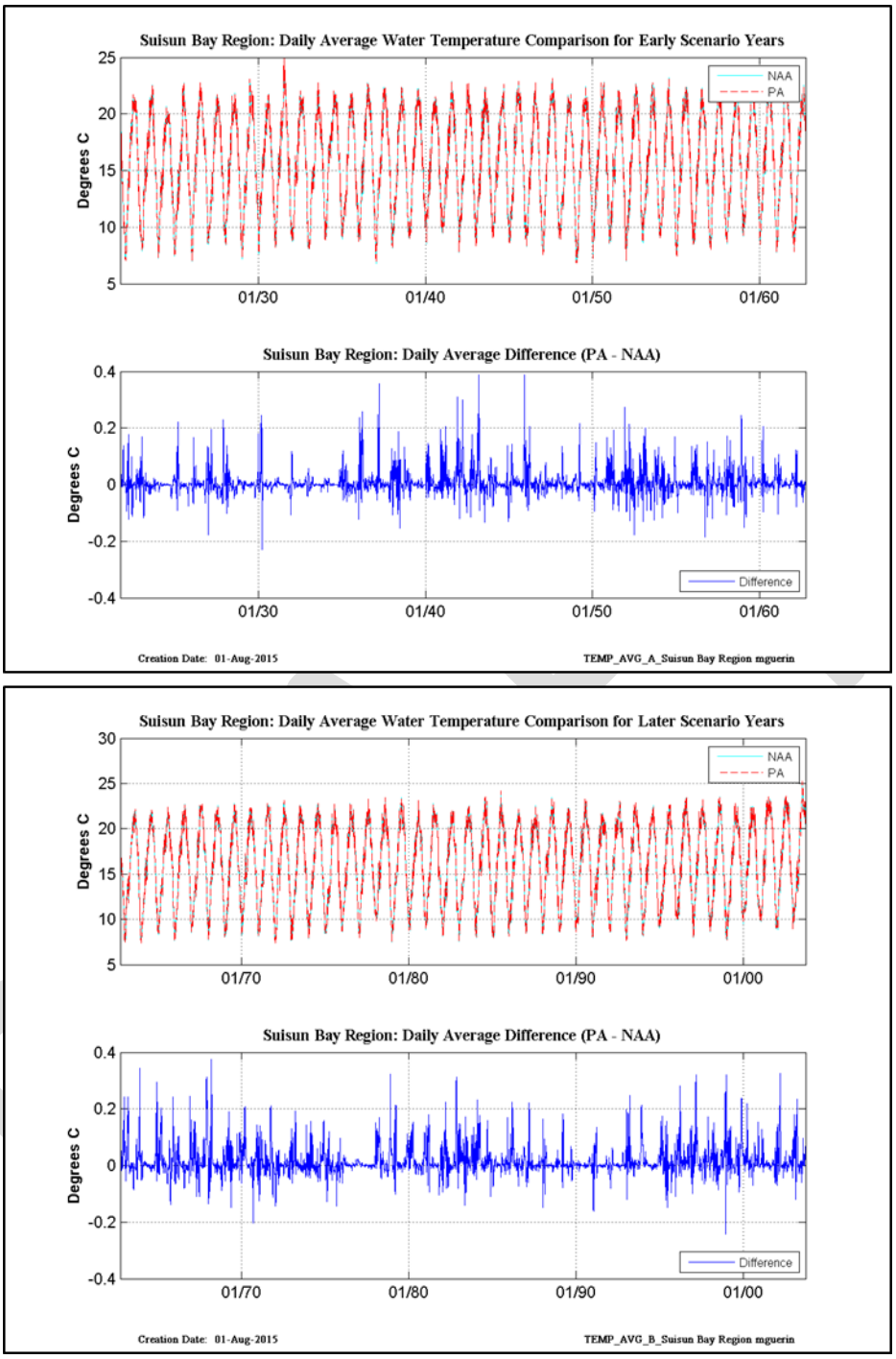


Figure 5-23 Suisun Bay region daily average water temperature and temperature difference (PA – NAA).

Table 5-15 Suisun Bay region monthly average percent difference table.

WY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1922	-0.21	0.05	0.42	-0.05	-0.33	0.32	0.24	0.01	-0.17	-0.06	0.00	0.01
1923	0.10	0.01	0.11	0.49	-0.02	-0.17	0.03	0.01	-0.10	-0.07	-0.06	-0.03
1924	0.02	0.02	0.04	-0.05	-0.06	0.01	-0.01	0.00	0.00	0.00	0.00	0.00
1925	-0.17	-0.03	0.23	0.14	0.11	0.57	-0.04	0.01	-0.02	0.01	-0.01	-0.01
1926	-0.19	-0.05	0.01	-0.01	-0.06	0.16	0.03	0.02	0.00	0.00	0.01	0.01
1927	-0.14	0.03	0.35	0.36	0.14	0.48	0.03	-0.05	0.02	-0.10	-0.05	-0.09
1928	-0.15	-0.07	0.75	0.16	-0.03	0.10	0.17	0.02	-0.04	-0.08	-0.11	-0.11
1929	0.05	0.07	0.09	-0.05	-0.02	-0.01	0.02	-0.01	-0.01	0.00	-0.01	0.00
1930	-0.08	-0.07	0.10	0.53	0.10	0.19	-0.10	0.00	0.00	-0.03	-0.02	0.02
1931	-0.09	-0.04	0.01	0.07	0.02	0.10	0.02	0.00	0.01	0.00	-0.04	0.00
1932	-0.08	-0.04	-0.42	0.38	0.05	-0.01	0.02	-0.01	0.00	0.00	-0.02	0.00
1933	0.05	0.06	0.01	0.16	-0.10	0.03	0.05	-0.01	0.00	0.00	0.00	0.00
1934	-0.02	0.00	0.06	0.11	-0.02	0.08	0.02	0.00	0.00	0.00	0.00	0.00
1935	-0.02	0.07	0.28	0.08	-0.01	0.23	-0.16	0.01	-0.08	-0.02	-0.05	0.02
1936	-0.13	-0.05	-0.07	0.59	0.70	0.84	0.33	0.00	0.02	-0.07	0.07	0.00
1937	0.11	0.07	0.00	-0.02	0.02	1.25	0.12	0.03	0.01	-0.03	0.00	0.00
1938	-0.07	-0.21	0.29	0.14	0.40	0.44	0.05	-0.03	-0.09	0.12	-0.02	-0.01
1939	0.31	0.09	0.19	-0.12	-0.06	0.09	0.01	0.01	0.00	-0.01	0.03	-0.02
1940	0.01	-0.04	-0.01	0.42	0.41	0.34	0.12	0.01	0.07	-0.09	-0.05	-0.09
1941	0.01	0.01	0.28	0.44	0.30	0.67	0.17	0.02	0.03	-0.03	0.02	-0.08
1942	-0.04	0.60	0.86	0.18	0.52	1.00	0.19	-0.01	-0.19	-0.05	0.00	-0.04
1943	0.40	0.29	0.17	0.09	0.79	1.27	0.07	-0.02	-0.01	-0.24	-0.03	-0.11
1944	0.21	0.04	0.39	-0.22	0.15	0.15	0.06	0.00	0.00	-0.02	-0.01	-0.01
1945	-0.07	0.06	-0.27	-0.01	0.28	0.43	0.10	0.04	0.03	0.01	0.03	-0.02
1946	-0.02	0.35	1.09	0.21	0.21	0.36	0.26	-0.03	0.00	-0.04	0.07	-0.09
1947	-0.10	0.16	-0.13	-0.13	-0.12	0.08	-0.02	-0.01	0.02	-0.01	0.00	-0.01
1948	-0.01	0.00	0.23	0.09	0.01	0.40	0.03	-0.04	-0.04	-0.05	-0.05	-0.05
1949	-0.04	0.10	0.22	0.15	-0.20	0.35	0.09	0.00	0.00	-0.01	-0.03	-0.01
1950	-0.01	-0.07	0.05	-0.10	0.11	0.58	0.07	0.00	-0.01	-0.01	-0.02	-0.03
1951	0.11	0.37	0.44	0.30	0.56	0.09	0.39	-0.03	-0.04	-0.16	-0.02	-0.02
1952	0.14	0.09	0.35	-0.04	0.26	0.62	0.15	0.05	-0.15	-0.27	0.00	-0.04
1953	0.20	0.17	0.05	0.62	0.98	0.47	0.07	-0.01	-0.20	-0.08	0.07	-0.01
1954	0.25	0.08	0.63	-0.11	0.22	0.08	0.01	-0.06	-0.01	-0.04	0.07	-0.09
1955	-0.07	0.28	0.62	-0.11	-0.31	0.03	-0.04	0.01	0.00	-0.01	-0.02	0.00
1956	-0.03	-0.01	0.46	0.33	0.57	0.51	0.24	0.02	0.00	0.01	-0.01	-0.20
1957	0.03	0.07	0.41	-0.13	-0.02	0.12	0.15	0.00	-0.03	0.06	0.05	-0.01
1958	-0.15	0.14	0.16	0.28	0.14	0.54	0.19	-0.03	-0.09	-0.01	-0.03	0.05
1959	0.13	0.34	0.71	-0.26	0.35	-0.03	0.02	0.00	0.02	-0.05	0.18	0.01
1960	0.00	0.06	0.12	0.09	0.41	0.37	0.09	0.05	0.02	-0.02	0.00	0.00
1961	-0.02	0.05	0.48	0.20	0.22	0.17	0.15	-0.03	0.00	0.02	0.02	-0.01
1962	-0.02	0.04	0.28	0.15	0.20	0.16	0.01	0.00	0.01	-0.08	-0.05	0.01
1963	0.03	0.07	1.24	0.41	0.17	1.00	0.00	-0.03	-0.04	-0.18	-0.03	0.14
1964	-0.03	0.72	0.28	-0.03	-0.05	0.06	0.03	-0.01	0.00	-0.02	-0.05	-0.02

Table 5-16 Suisun Bay region monthly average percent difference table (continued).

WY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1965	0.01	0.58	0.73	0.17	0.34	0.97	0.05	0.04	-0.01	-0.16	-0.06	-0.18
1966	-0.19	0.45	0.68	-0.25	0.15	0.26	0.13	0.01	0.00	-0.08	-0.11	-0.01
1967	-0.05	0.23	0.82	0.20	0.35	0.54	-0.10	0.01	-0.16	-0.01	0.00	0.17
1968	0.17	0.82	1.68	-0.10	0.17	1.10	0.11	0.00	-0.01	-0.02	0.00	-0.05
1969	-0.17	0.03	0.27	0.01	0.58	0.42	0.34	0.03	0.07	0.00	0.00	0.15
1970	0.10	0.22	0.30	0.26	0.45	0.74	0.21	-0.01	-0.01	-0.10	0.05	-0.31
1971	0.07	0.35	0.49	-0.10	0.13	0.41	0.03	-0.05	0.10	0.01	0.04	0.21
1972	0.50	-0.20	-0.02	-0.63	-0.01	-0.01	-0.09	0.01	0.00	-0.07	0.05	0.02
1973	-0.13	0.07	0.44	0.36	0.04	0.62	0.21	0.01	0.00	0.03	-0.04	-0.03
1974	-0.02	0.09	0.06	0.14	0.46	0.43	0.09	-0.04	-0.04	-0.03	-0.03	0.01
1975	0.13	0.40	0.64	-0.12	-0.21	0.29	0.04	-0.05	-0.02	-0.09	-0.01	-0.17
1976	0.12	-0.10	0.13	-0.15	0.18	0.09	0.03	0.01	0.00	0.00	-0.01	0.01
1977	0.00	0.04	0.16	0.11	0.02	0.03	0.00	-0.01	0.00	0.00	-0.01	0.00
1978	-0.03	0.01	0.06	0.42	0.56	0.68	0.34	-0.01	0.09	-0.05	0.01	-0.05
1979	-0.06	0.87	0.66	0.14	0.26	0.55	0.30	0.02	0.00	-0.01	-0.02	0.00
1980	0.07	0.19	0.58	0.26	0.46	0.59	0.27	0.02	-0.05	-0.02	-0.02	-0.04
1981	-0.07	0.05	0.61	0.27	0.21	0.79	0.00	0.00	0.02	0.00	0.00	-0.01
1982	-0.19	-0.22	0.22	-0.07	0.40	0.66	0.16	-0.04	-0.01	-0.03	-0.02	0.13
1983	-0.01	1.08	0.15	0.61	0.36	0.23	0.19	-0.06	0.19	0.08	0.07	0.01
1984	0.25	0.20	0.17	0.39	0.93	0.50	0.39	0.00	0.02	0.00	0.07	0.21
1985	0.11	0.03	0.01	-0.47	-0.01	0.13	0.01	0.02	0.01	-0.02	0.04	0.00
1986	0.04	0.09	0.31	0.03	0.41	0.93	0.30	0.01	0.03	-0.10	0.03	-0.03
1987	0.01	0.16	0.29	-0.39	0.20	0.49	0.02	0.06	-0.03	-0.01	-0.02	0.00
1988	0.04	-0.01	0.11	0.02	0.06	0.21	-0.01	0.00	0.00	0.01	-0.03	-0.01
1989	0.02	0.07	0.10	0.09	-0.01	0.15	0.11	0.00	-0.01	-0.06	-0.01	0.05
1990	-0.09	0.08	0.03	0.02	0.05	-0.02	0.01	0.00	-0.01	0.00	-0.01	0.00
1991	0.08	0.03	-0.12	-0.66	0.27	0.49	-0.06	0.00	0.00	-0.01	-0.01	0.00
1992	0.04	0.06	-0.12	-0.19	-0.17	0.18	0.02	0.00	0.00	0.00	-0.02	-0.01
1993	0.10	0.06	0.17	0.14	0.67	0.70	0.12	0.06	-0.04	0.02	0.03	0.05
1994	-0.01	0.54	1.12	0.25	0.11	0.12	0.04	0.00	0.00	-0.04	-0.03	0.00
1995	0.00	-0.01	0.22	0.13	0.79	0.47	0.10	-0.01	-0.10	-0.12	-0.01	-0.08
1996	-0.03	0.05	-0.03	0.42	0.58	0.47	0.22	0.02	0.13	0.05	0.06	0.11
1997	0.15	0.40	0.20	0.32	0.67	0.96	0.26	-0.02	0.04	-0.10	0.08	0.09
1998	0.11	0.34	0.30	0.10	0.32	0.48	0.13	0.09	-0.10	-0.12	-0.03	0.15
1999	0.08	0.32	0.60	0.58	0.51	0.43	0.17	0.06	-0.03	0.04	0.12	0.13
2000	-0.11	0.70	0.84	0.19	0.14	0.35	0.41	0.01	-0.01	0.00	-0.08	0.13
2001	0.12	0.28	0.31	0.01	0.40	0.22	0.02	0.03	0.01	0.03	-0.03	-0.01
2002	0.05	-0.06	0.16	0.52	0.18	1.13	0.04	-0.01	-0.02	0.05	-0.01	-0.01
2003	0.11	0.07	0.17	0.61	0.52	0.75	0.31	-0.04	-0.01	-0.06	0.15	0.14
Max	0.50	1.08	1.68	0.62	0.98	1.27	0.41	0.09	0.19	0.12	0.18	0.21
Min	-0.21	-0.22	-0.42	-0.66	-0.33	-0.17	-0.16	-0.06	-0.20	-0.27	-0.11	-0.31

WY Type	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
Wet	0.03	0.20	0.37	0.23	0.44	0.61	0.14	0.00	-0.02	-0.06	0.01	0.01
AN	0.00	0.12	0.38	0.20	0.25	0.36	0.21	0.00	-0.02	-0.04	0.00	-0.01
BN	0.03	0.20	0.39	0.03	0.17	0.43	0.09	0.00	-0.01	-0.04	0.00	-0.02
Dry	0.00	0.10	0.20	0.05	0.07	0.28	0.03	0.01	0.00	-0.01	-0.01	0.00
Critical	0.02	0.07	0.13	-0.04	0.03	0.11	0.01	0.00	0.00	0.00	-0.02	0.00

Discussion

Water temperature differences between the NAA and PA scenarios are driven by a combination of inflow and export on the Sacramento River, as well as differences in export levels at the SWP and CVP locations in the south Delta, as all other factors are constant between the two scenarios are of lesser magnitude and influence.

In the graphical and tabular results comparing modeled water temperature for the PA and NAA scenarios presented in the Results section (), it was found that the differences in an absolute sense and in a percent difference sense are small, even when examined on a daily average instead of a monthly average basis. The greatest daily average differences were found in the South Delta region, ranging between +/- 1.0 degree C. When examined as monthly percent differences and by water year type, the increases in temperature appear to occur mainly in the Wet water year type, and mainly in the winter months.

The regular bias in the historical QUAL modeled water temperature calculations quantified in the Appendix can be used to improve the accuracy in interpreting the BDCP scenario model results in the BDCP subregions. Because the meteorology and water temperature boundary conditions for the BDCP scenarios was developed based on those of the calibrated Historical Model, the calculated average bias also applies to the regions identified in the BDCP scenarios. Note that since the meteorology and inflow water temperatures for the ELT time frame scenarios were developed using meteorology and inflow water temperatures from the present day Historical Model, the maximum and minimum values for boundary condition temperatures for the ELT scenarios are bounded by present-day maximums.

Due to the simplifications used in the conceptualizations of BDCP scenarios for DSM2 HYDRO and QUAL-water temperature, it is preferable to use the model results from QUAL as monthly averages along with application of the calculated average regional bias in water temperature from the historical simulation results.

7. References

Brown, Linfield C., Thomas O. Barnwell, 1987. The Enhanced Stream Water Quality Models QUAL2E and QUAL2E_UNCAS: Documentation and User Manual, USEPA Environmental Prot3ction Laboratory, May, 1987.

DWR (Department of Water Resources), 1995. Modeling Support Branch, Representative Delta Island Return Flow Quality for Use in DSM2: Memorandum Report May 1995, Division of Planning, Department of Water Resources. 1995.

Jobson,1997 (USGS).
http://baydeltaoffice.water.ca.gov/modeling/deltamodeling/models/misc/BLTMenhancementsUSGSWRI97_4050.pdf

Guerin, M., Modeling the Fate and Transport of Ammonia Using DSM2-QUAL: Calibration/Validation Report, Prepared for: Metropolitan Water District, 2010.

Guerin, M., Modeling the Fate and Transport of Nutrients Using DSM2: Calibration/Validation Report, Prepared for: Metropolitan Water District, November, 2011.

Rajbhandari, H. Dynamic simulation of water quality in surface water sytems utilizing a Langrangian reference frame. Ph.D. Dissertation. University of California, Davis. 1995a.

Rajbhandari, H., DWR 1995 Annual Progress Report, Chap 3: Water Quality. 1995b.

USGS,1997.
http://baydeltaoffice.water.ca.gov/modeling/deltamodeling/models/misc/FourPointUSGSWRI97_4016.pdf

8. Appendix

Water Temperature Model Calibration/validation

Data acquisition locations used to support the water temperature model calibration are shown in Figure 8-1. Discussion on the sources and quality of this data is covered in great detail in (Guerin, 2010) and in (Guerin, 2011). Both graphical and statistical model evaluation techniques were used in the analysis of calibration and validation results. Water temperature calibration and validation statistics were calculated on an annual basis by Wet or Dry Water Year Type at each available location. Residuals for water temperature were calculated as the difference (data – model) between the measured data and the modeled result on the same time scale, hourly or daily averages.

Selected plots documenting the quality of the water temperature model calibration are shown in Figure 8-2 through Figure 8-6. As discussed in (Guerin, 2010), the temperature model calibration results are generally Very Good. The main draw-back in the DSM2/QUAL temperature model is that meteorological boundary conditions are applied globally over the model domain, but model results indicate that a minimum of two temperature regions are required to improve results. The current model results are very good along the Sacramento River corridor where the calibration was focused. In the Central and South Delta, modeled water temperatures in the summer months can be several degrees Celsius cooler than indicated by the data, as illustrated at ROLD024 (Figure 8-6). However, the model temperature trends and diurnal variations are reasonable.

A more extensive analysis of the modeling of water temperature was undertaken to help define potential pitfalls with the conceptualization of Liberty Island as a fully mixed reservoir in DSM2. This analysis is documented in (RMA, 2015).

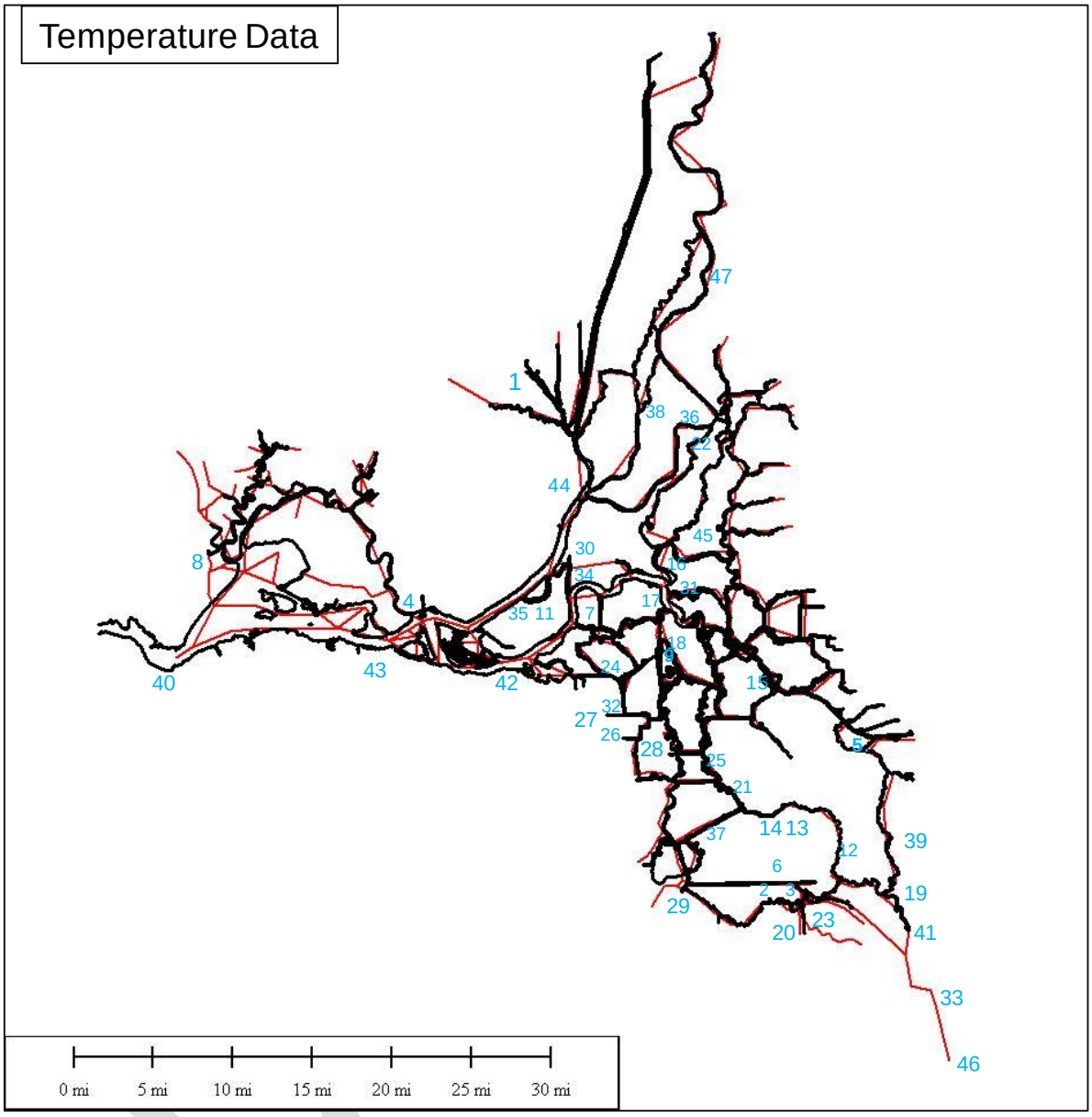


Figure 8-1 Locations of temperature data regular time series. Data quality and length of record was variable.

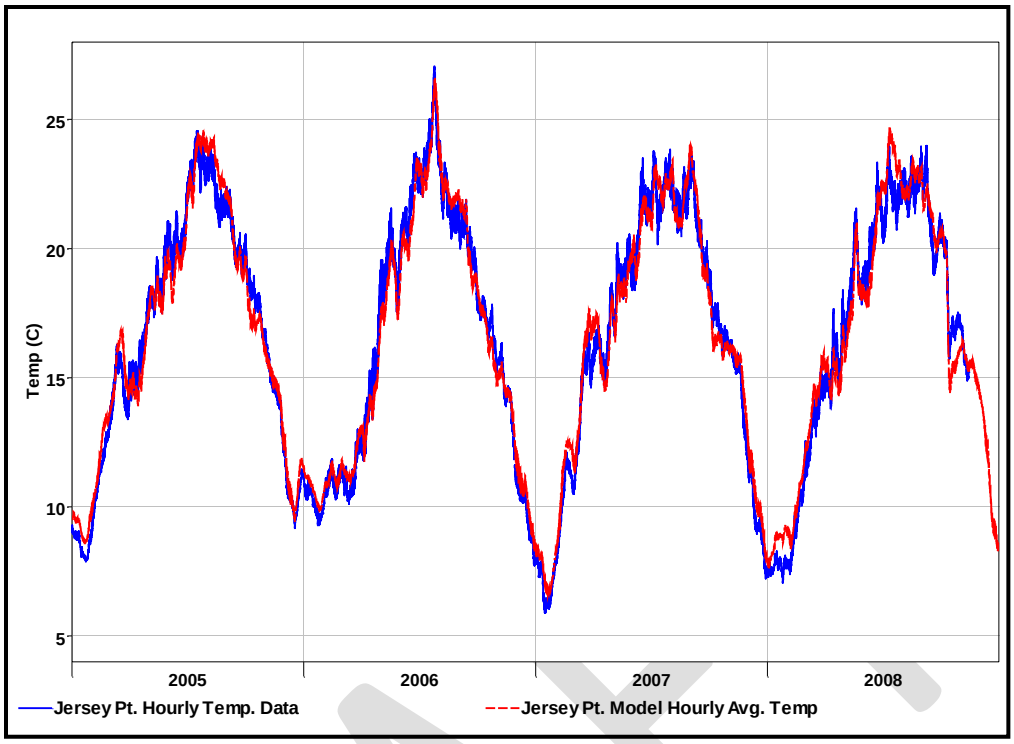


Figure 8-2 Hourly calibration results for water temperature at Jersey Point. Blue line is hourly data, red line is the modeled hourly result averaged from 15-minute model output.

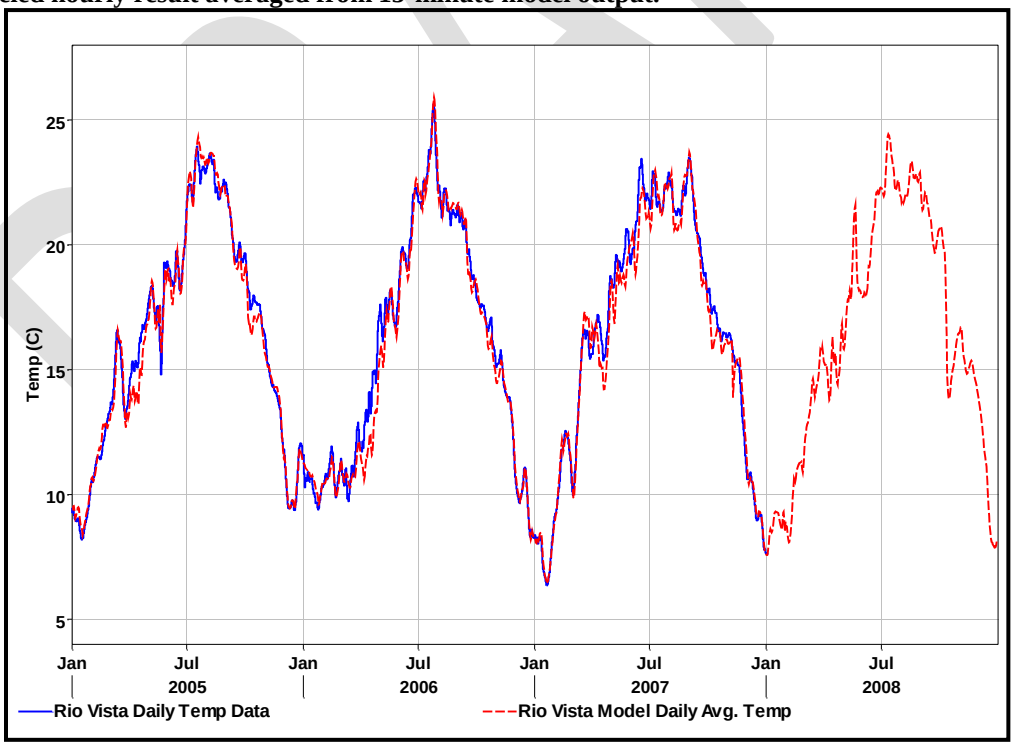


Figure 8-3 Daily calibration results for water temperature at Rio Vista. Blue line is daily data, red line is the modeled daily result averaged from 15-minute model output.

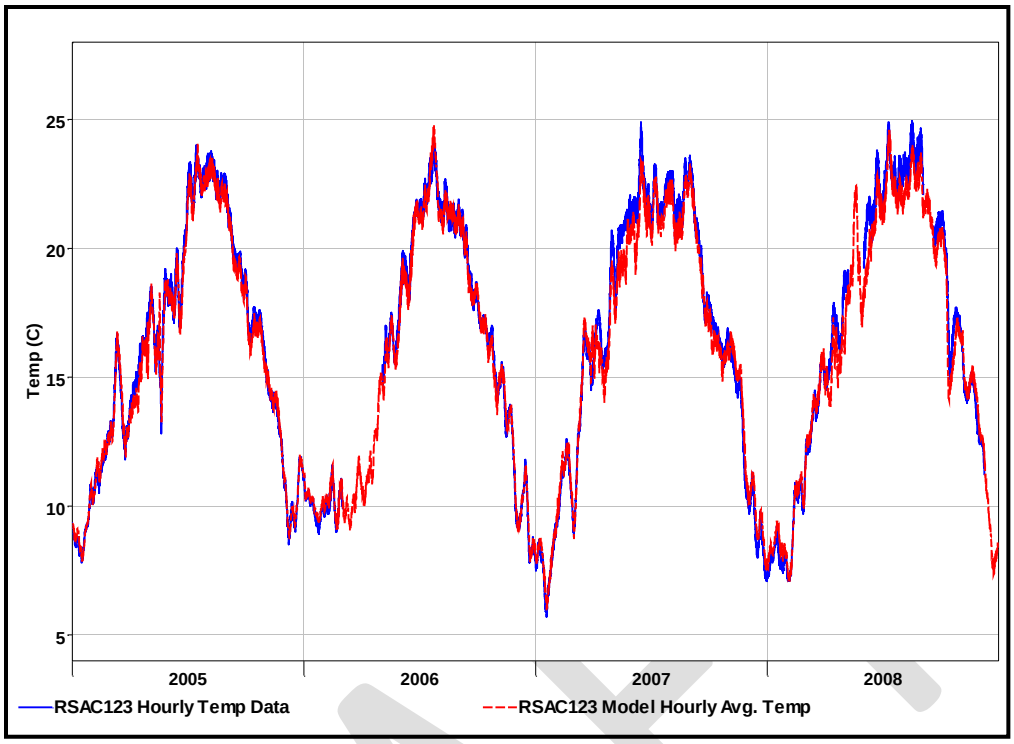


Figure 8-4 Hourly calibration results for water temperature at RSAC123. Blue line is hourly data, red line is the modeled hourly result averaged from 15-minute model output.

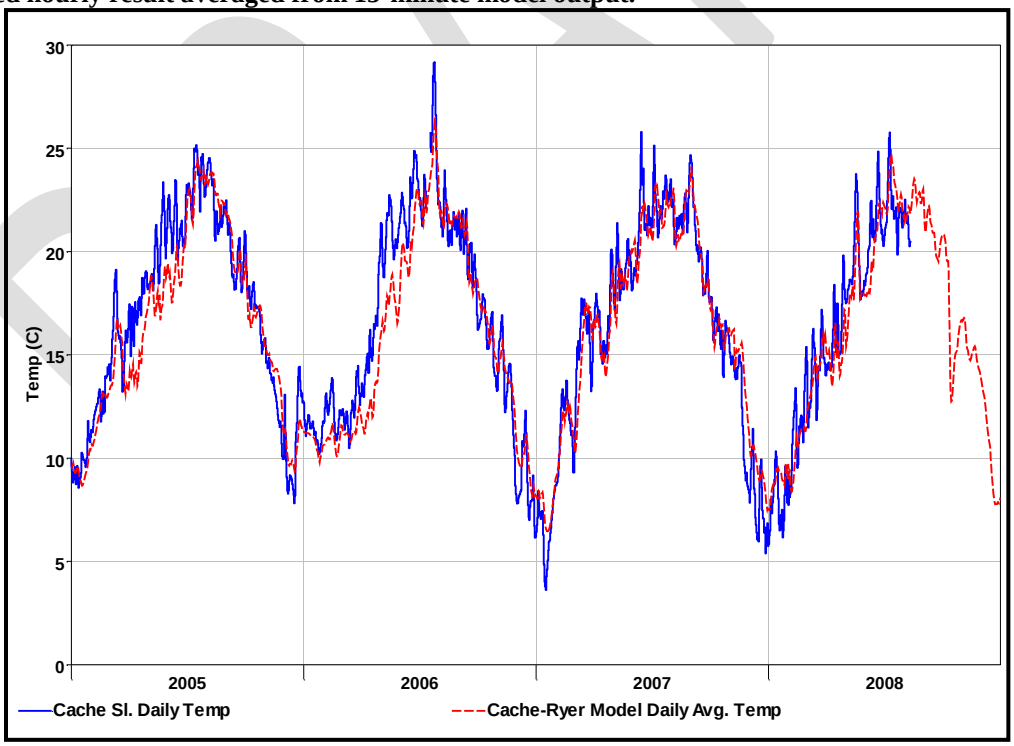


Figure 8-5 Hourly calibration results for water temperature at locations in the Cache Slough area. Blue line is daily data, red line is the modeled daily result averaged from 15-minute model output.

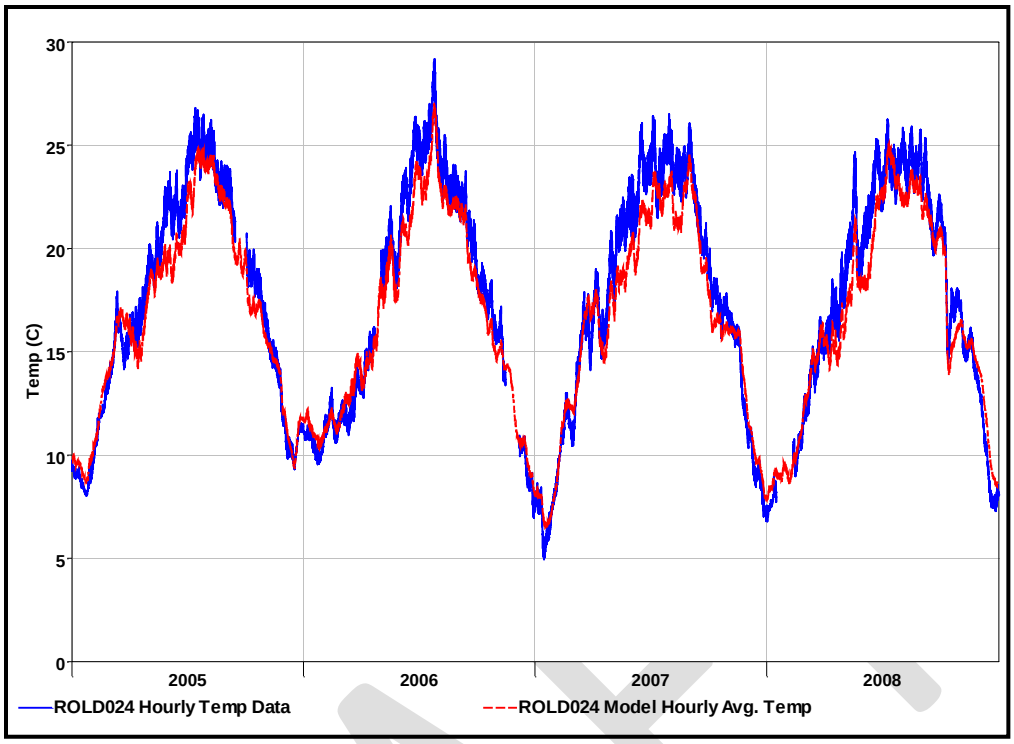


Figure 8-6 Hourly calibration results for water temperature at ROLD024. Blue line is hourly data, red line is the modeled hourly result averaged from 15-minute model output.

Residual analysis using recent data

The DSM2 Historical model was used to calculate estimates of bias in water temperature modeling at a monthly time step using model residuals (*i.e.*, model – data). The Historical water temperature model was run with boundary conditions relevant to the type of conditions used in the BDCP analyses. The following process was used to create estimates of QUAL model bias in water temperature using the seven regions identified in the BDCP scenarios (Figure 5-7):

- Process Step 1: CDEC data was downloaded at each location where there was water temperature data in the Delta, with a focus on data from 12/2007 to 03/2012
    - The data was examined and spurious data points were deleted – for most locations the gaps were then filled with a linear approximation.
    - The data was then daily-averaged
- Process Step 2: The DSM2 Historical model output (15-min output) at each available CDEC data location was daily averaged.
    - The difference (model-data) was calculated, sorted by month, and an overall average was calculated for each month at every data location.
    - The individual location results were categorized by the BDCP region as individual bar charts, and then collated as a BDCP-regional bar chart and also in a tabular format.

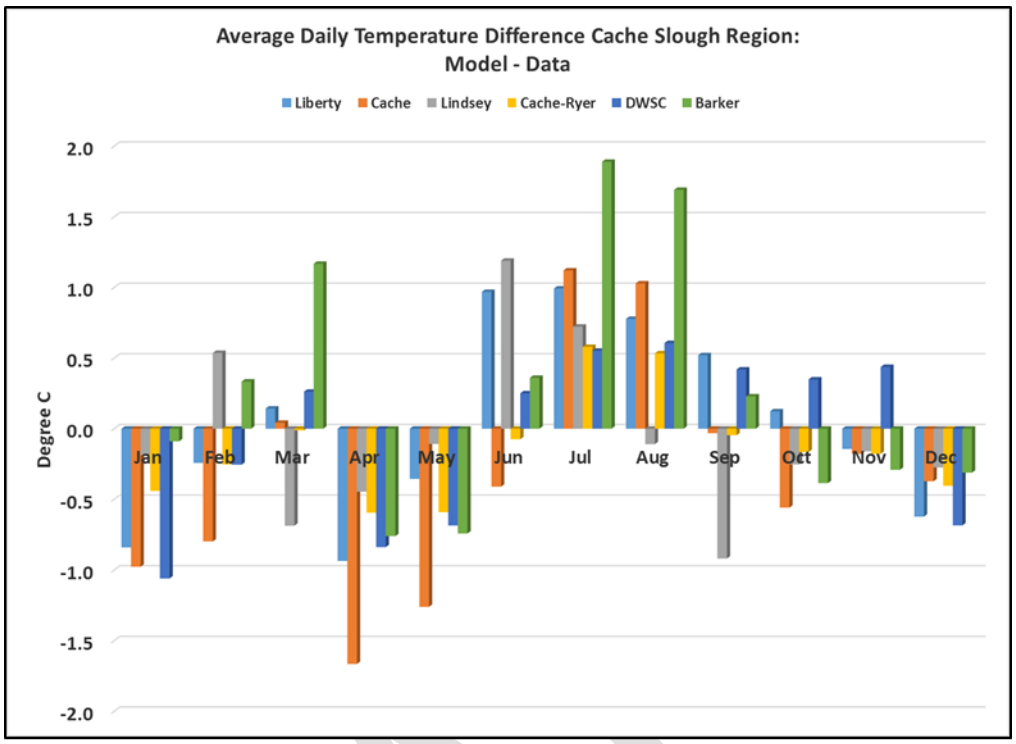
The results in the individual and regional bar charts and tables give an estimate of the bias in the BDCP water temperature results, and the bias is generally regular, i.e., it the direction of the bias is consistent over the locations in a given region. For example, in the South Delta Region, the regional bar chart (Figure 8-13) shows that regional water temperature calculated by Historical DSM2 is too cold by 1- 2 °C from April to October annually. The estimates of bias found in the Tables as regional averages can be used in the interpretation of BDCP regional water temperature results.

Special notes:

- Some locations had data that was harder to identify as spurious – those locations are noted in text near the individual bar chart
- At some locations, e.g. Dutch Slough in the West Delta Region, the results are quite different from the other locations, indicating that the influences on that location are complicated – possibly more of a mixture of the hydrodynamic influences on nearby regions and/or that DSM2 model results do not accurately reflect the data.

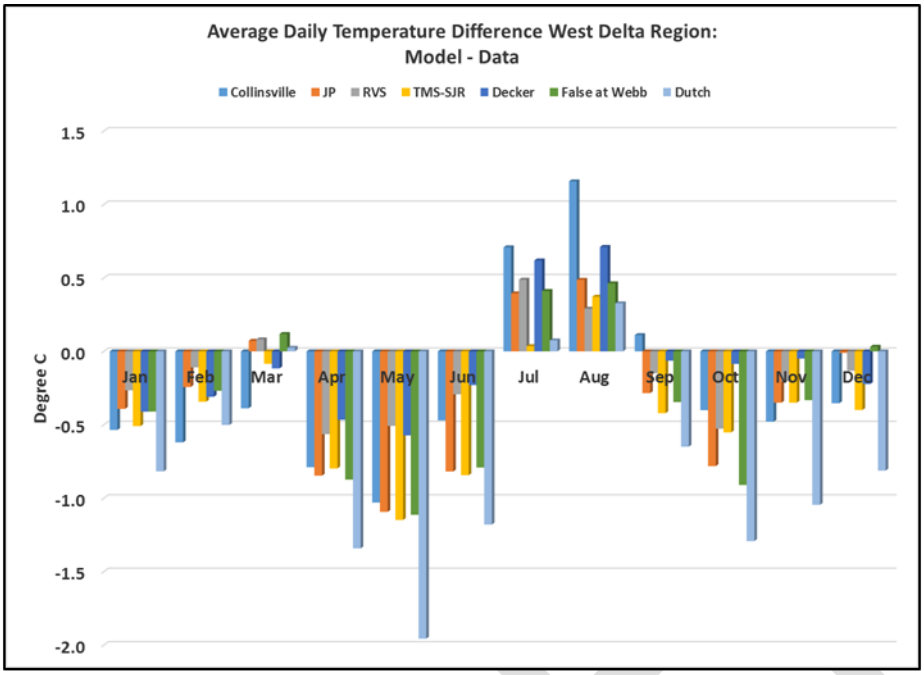
The water temperature and meteorological boundary conditions used in DSM2-BDCP models were developed based on historical data, so it is expected that the magnitude of the regional (model – data) bias calculations documented herein are applicable to BDCP models as a regional monthly bias in water temperature. The reason that the bias occurs in the DSM2 water temperature model is that DSM2 only allows a single meteorological region as a boundary condition when in fact the meteorological conditions influencing the Delta would more realistically require a minimum of two regions. When the

bias is regular as it is in the South Delta, for example, this legitimately allows for correction in the interpretation of the BDCP model results.



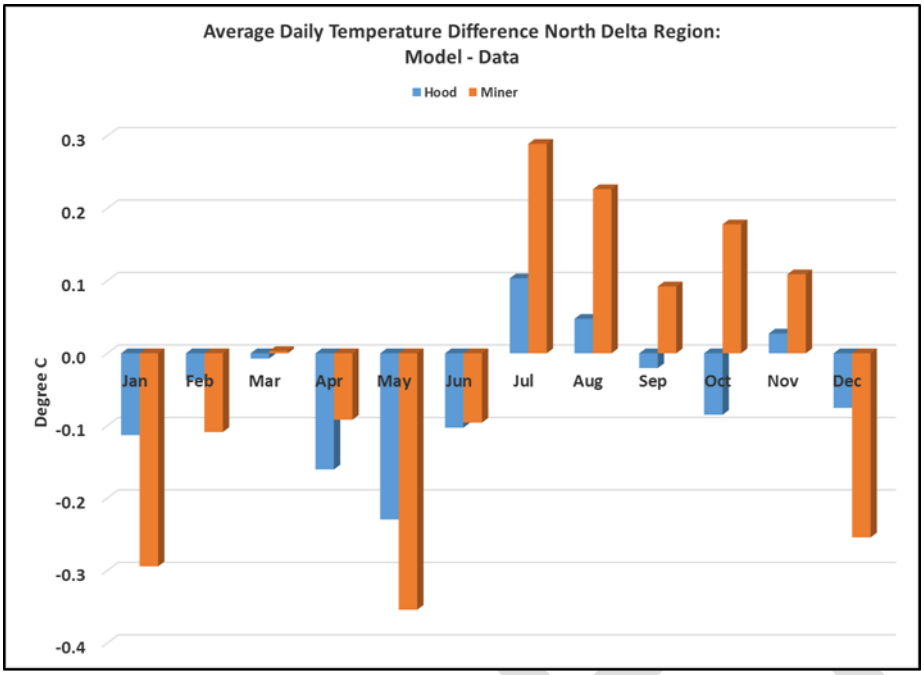
Cache Region: Average Monthly Temperature Difference From Daily Average Data (Deg C)							
	Liberty	Cache	Lindsey	Cache-Ryer	DWSC	Barker	Average
Jan	-0.8	-1.0	-0.2	-0.4	-1.1	-0.1	-0.6
Feb	-0.2	-0.8	0.5	-0.3	-0.3	0.3	-0.1
Mar	0.1	0.0	-0.7	0.0	0.3	1.2	0.2
Apr	-0.9	-1.7	-0.4	-0.6	-0.8	-0.8	-0.9
May	-0.4	-1.3	-0.1	-0.6	-0.7	-0.7	-0.6
Jun	1.0	-0.4	1.2	-0.1	0.3	0.4	0.4
Jul	1.0	1.1	0.7	0.6	0.6	1.9	1.0
Aug	0.8	1.0	-0.1	0.5	0.6	1.7	0.8
Sep	0.5	0.0	-0.9	0.0	0.4	0.2	0.0
Oct	0.1	-0.6	-0.3	-0.2	0.3	-0.4	-0.1
Nov	-0.1	-0.2	-0.2	-0.2	0.4	-0.3	-0.1
Dec	-0.6	-0.4	-0.3	-0.4	-0.7	-0.3	-0.4

Figure 8-7 QUAL water temperature bias calculation for the Cache Slough region.



West Delta: Average Monthly Temperature Difference From Daily Average Data (Deg C)								
	Collinsville	JP	RVS	TMS-SJR	Decker	False at Webb	Dutch	Average
Jan	-0.5	-0.4	-0.3	-0.5	-0.4	-0.4	-0.8	-0.5
Feb	-0.6	-0.2	-0.1	-0.3	-0.3	-0.3	-0.5	-0.3
Mar	-0.4	0.1	0.1	-0.1	-0.1	0.1	0.0	0.0
Apr	-0.8	-0.8	-0.6	-0.8	-0.5	-0.9	-1.3	-0.8
May	-1.0	-1.1	-0.5	-1.1	-0.6	-1.1	-2.0	-1.1
Jun	-0.5	-0.8	-0.3	-0.8	-0.2	-0.8	-1.2	-0.7
Jul	0.7	0.4	0.5	0.0	0.6	0.4	0.1	0.4
Aug	1.2	0.5	0.3	0.4	0.7	0.5	0.3	0.5
Sep	0.1	-0.3	-0.1	-0.4	-0.1	-0.3	-0.6	-0.3
Oct	-0.4	-0.8	-0.5	-0.6	-0.1	-0.9	-1.3	-0.6
Nov	-0.5	-0.3	-0.2	-0.3	0.0	-0.3	-1.0	-0.4
Dec	-0.4	0.0	-0.1	-0.4	-0.2	0.0	-0.8	-0.3

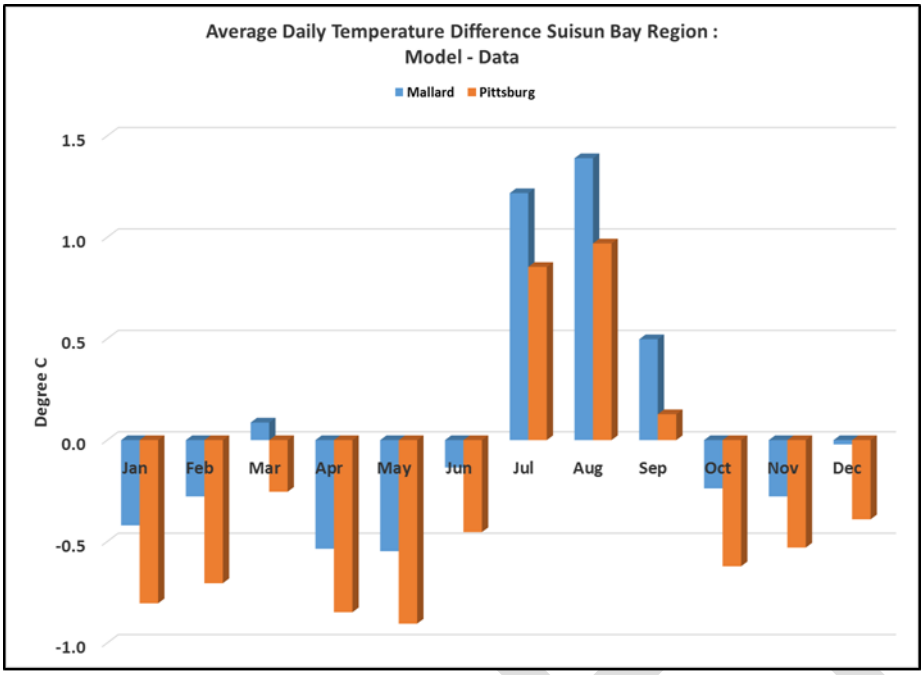
Figure 8-8 QUAL water temperature bias calculation for the West Delta region.



North Delta: Average Monthly Temperature Difference From Daily Average Data (Deg C)

	Hood	Miner	Average
Jan	-0.1	-0.3	-0.2
Feb	0.0	-0.1	-0.1
Mar	0.0	0.0	0.0
Apr	-0.2	-0.1	-0.1
May	-0.2	-0.4	-0.3
Jun	-0.1	-0.1	-0.1
Jul	0.1	0.3	0.2
Aug	0.0	0.2	0.1
Sep	0.0	0.1	0.0
Oct	-0.1	0.2	0.0
Nov	0.0	0.1	0.1
Dec	-0.1	-0.3	-0.2

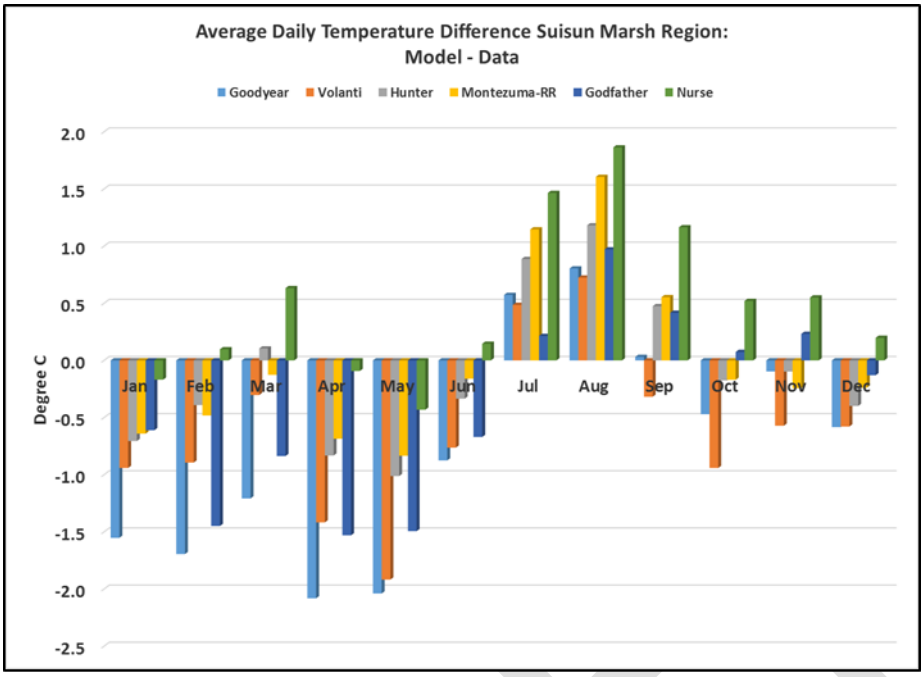
Figure 8-9 QUAL water temperature bias calculation for the North Delta region.



Suisun Bay: Average Monthly Temperature Difference From Daily Average Data (Deg C)

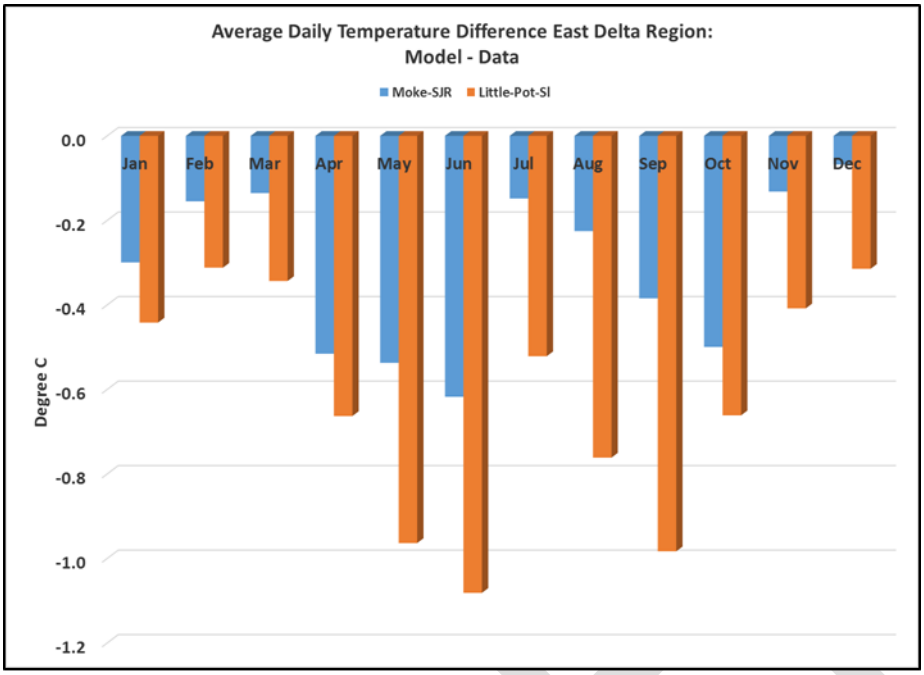
	Mallard	Pittsburg	Average
Jan	-0.4	-0.8	-0.6
Feb	-0.3	-0.7	-0.5
Mar	0.1	-0.3	-0.1
Apr	-0.5	-0.8	-0.7
May	-0.5	-0.9	-0.7
Jun	-0.1	-0.5	-0.3
Jul	1.2	0.9	1.0
Aug	1.4	1.0	1.2
Sep	0.5	0.1	0.3
Oct	-0.2	-0.6	-0.4
Nov	-0.3	-0.5	-0.4
Dec	0.0	-0.4	-0.2

Figure 8-10 QUAL water temperature bias calculation for the Suisun Bay region.



Suisun Marsh: Average Monthly Temperature Difference From Daily Average Data (Deg C)							
	Goodyear	Volanti	Hunter	Montezuma-RR	Godfather	Nurse	Average
Jan	-1.6	-0.9	-0.7	-0.6	-0.6	-0.2	-0.8
Feb	-1.7	-0.9	-0.4	-0.5	-1.4	0.1	-0.8
Mar	-1.2	-0.3	0.1	-0.1	-0.8	0.6	-0.3
Apr	-2.1	-1.4	-0.8	-0.7	-1.5	-0.1	-1.1
May	-2.0	-1.9	-1.0	-0.8	-1.5	-0.4	-1.3
Jun	-0.9	-0.8	-0.3	-0.2	-0.7	0.1	-0.4
Jul	0.6	0.5	0.9	1.1	0.2	1.5	0.8
Aug	0.8	0.7	1.2	1.6	1.0	1.9	1.2
Sep	0.0	-0.3	0.5	0.6	0.4	1.2	0.4
Oct	-0.5	-0.9	-0.2	-0.2	0.1	0.5	-0.2
Nov	-0.1	-0.6	-0.1	-0.2	0.2	0.6	0.0
Dec	-0.6	-0.6	-0.4	-0.2	-0.1	0.2	-0.3

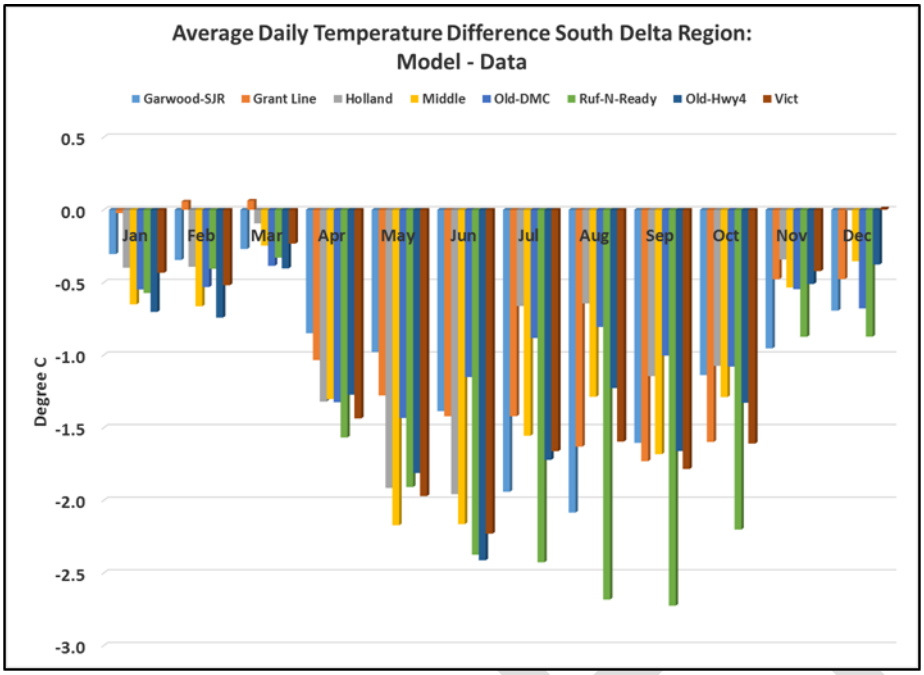
Figure 8-11 QUAL water temperature bias calculation for the Suisun Marsh region.



East Delta: Average Monthly Temperature Difference From Daily Average Data (Deg C)

	Moke-SJR	Little-Pot-Sl	Average
Jan	-0.3	-0.4	-0.4
Feb	-0.2	-0.3	-0.2
Mar	-0.1	-0.3	-0.2
Apr	-0.5	-0.7	-0.6
May	-0.5	-1.0	-0.8
Jun	-0.6	-1.1	-0.8
Jul	-0.1	-0.5	-0.3
Aug	-0.2	-0.8	-0.5
Sep	-0.4	-1.0	-0.7
Oct	-0.5	-0.7	-0.6
Nov	-0.1	-0.4	-0.3
Dec	-0.1	-0.3	-0.2

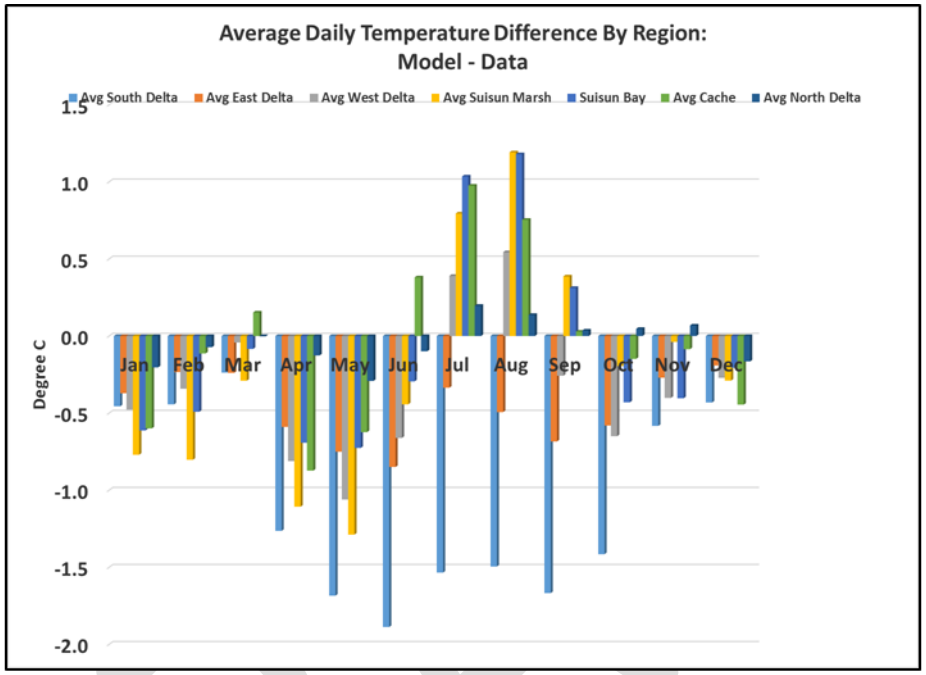
Figure 8-12 QUAL water temperature bias calculation for the East Delta region.



South Delta: Average Monthly Temperature Difference From Daily Average Data (Deg C)

	Garwood-SJR	Grant Line	Holland	Middle	Old-DMC	Ruf-N-Ready	Old-Hwy4	Vict	Middle-Holt	Average
Jan	-0.3	0.0	-0.4	-0.7	-0.5	-0.6	-0.7	-0.4	-0.5	-0.5
Feb	-0.3	0.1	-0.4	-0.7	-0.5	-0.4	-0.7	-0.5	-0.4	-0.4
Mar	-0.3	0.1	-0.1	-0.2	-0.4	-0.3	-0.4	-0.2	0.0	-0.2
Apr	-0.9	-1.0	-1.3	-1.3	-1.3	-1.6	-1.3	-1.4	-1.3	-1.3
May	-1.0	-1.3	-1.9	-2.2	-1.4	-1.9	-1.8	-2.0	-1.9	-1.7
Jun	-1.4	-1.4	-2.0	-2.2	-1.2	-2.4	-2.4	-2.2	-1.8	-1.9
Jul	-1.9	-1.4	-0.7	-1.6	-0.9	-2.4	-1.7	-1.7	-0.8	-1.5
Aug	-2.1	-1.6	-0.6	-1.3	-0.8	-2.7	-1.2	-1.6	-0.8	-1.5
Sep	-1.6	-1.7	-1.1	-1.7	-1.0	-2.7	-1.7	-1.8	-1.2	-1.7
Oct	-1.1	-1.6	-1.1	-1.3	-1.1	-2.2	-1.3	-1.6	-1.2	-1.4
Nov	-1.0	-0.5	-0.3	-0.5	-0.5	-0.9	-0.5	-0.4	-0.4	-0.6
Dec	-0.7	-0.5	0.0	-0.4	-0.7	-0.9	-0.4	0.0	-0.1	-0.4

Figure 8-13 QUAL water temperature bias calculation for the South Delta region.



Regional Averages Compiled: Average Monthly Temperature Difference From Daily Average Data (Deg C)							
	Avg South Delta	Avg East Delta	Avg West Delta	Avg Suisun Marsh	Suisun Bay	Avg Cache	Avg North Delta
Jan	-0.5	-0.4	-0.5	-0.8	-0.6	-0.6	-0.2
Feb	-0.4	-0.2	-0.3	-0.8	-0.5	-0.1	-0.1
Mar	-0.2	-0.2	0.0	-0.3	-0.1	0.2	0.0
Apr	-1.3	-0.6	-0.8	-1.1	-0.7	-0.9	-0.1
May	-1.7	-0.8	-1.1	-1.3	-0.7	-0.6	-0.3
Jun	-1.9	-0.8	-0.7	-0.4	-0.3	0.4	-0.1
Jul	-1.5	-0.3	0.4	0.8	1.0	1.0	0.2
Aug	-1.5	-0.5	0.5	1.2	1.2	0.8	0.1
Sep	-1.7	-0.7	-0.3	0.4	0.3	0.0	0.0
Oct	-1.4	-0.6	-0.6	-0.2	-0.4	-0.1	0.0
Nov	-0.6	-0.3	-0.4	0.0	-0.4	-0.1	0.1
Dec	-0.4	-0.2	-0.3	-0.3	-0.2	-0.4	-0.2

Figure 8-14 Compilation of the QUAL water temperature bias calculation for seven regions used in previous BDCP simulations.