Columbia/Snake River Temperature Modeling Preliminary Results

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Contents

Summary

- The water temperature component of MASS1 was recalibrated for the 1977 season using available data.
- The simulation error for the 1977 season was generally between 0.5 and 1.5°C.
- The 1994 weather scenario is in progress.

1 1977 Conditions Scenario

The simulation period was limited to April 1, 1977 to October 31, 1977. The heat exchange component of MASS1 was recalibrated for this period and the conditions listed below. Simulated temperatures were compared to observed at several locations. Table 1 summarizes the comparison for the period. Several figures follow showing graphical comparisons.

This simulation was performed using the following conditions:

- Observed 1977 flows for model boundaries:
  - Columbia River at Grand Coulee (hourly),

  - Snake River at Anatone (daily),
  - North Fork Clearwater River at Dworshak (hourly), and
  - Clearwater River at Orofino (daily)
- Observed 1977 flows at all gaged tributaries;
- Constant project forebay stages (normal pool elevation);
- Observed 1977 daily water temperatures at Grand Coulee;
- Observed 1977 daily water temperatures at Anatone;
- Dworshak and Orofino temperatures set to that observed at Spalding;
- Water temperatures at tributaries were set to observed 1977 daily values when available, long term monthly averages when observed data not available; and
- Meteorology data at
  - Pranghorn Airport, Wenatchee,
  - Hanford Meteorological Station, and
  - Portland International Airport.

Table 1: Statistical comparison of simulated and observed temperatures from April through September (RMS and AME units are degrees Celsius)

	N	R^2	Bias	RMS	AME
LMN Scroll Case	128	0.89	-0.36	1.52	1.17
LGS Scroll Case	124	0.89	-0.30	1.49	1.18
IHR Scroll Case	200	0.94	-0.17	1.31	1.02
RIS Scroll Case	212	0.98	-0.30	0.59	0.49
MCN Scroll Case	151	0.97	-0.94	1.26	1.06
BON Scroll Case	85	0.97	-1.25	1.56	1.35
Snake R. @ Burbank	210	0.95	-0.33	1.27	0.95
Columbia R. @ Vernita Bridge	214	0.98	-0.29	0.62	0.51
Columbia R. @ Richland	214	0.98	-0.57	0.82	0.68
Columbia R. @ Umatilla	201	0.98	-0.47	0.77	0.62
Columbia R. @ Warrendale	214	0.98	-0.37	1.26	0.95
Columbia R. @ Vancouver	191	0.97	-0.69	1.46	1.10
Columbia R. @ Kalama	214	0.98	-0.75	1.28	1.01

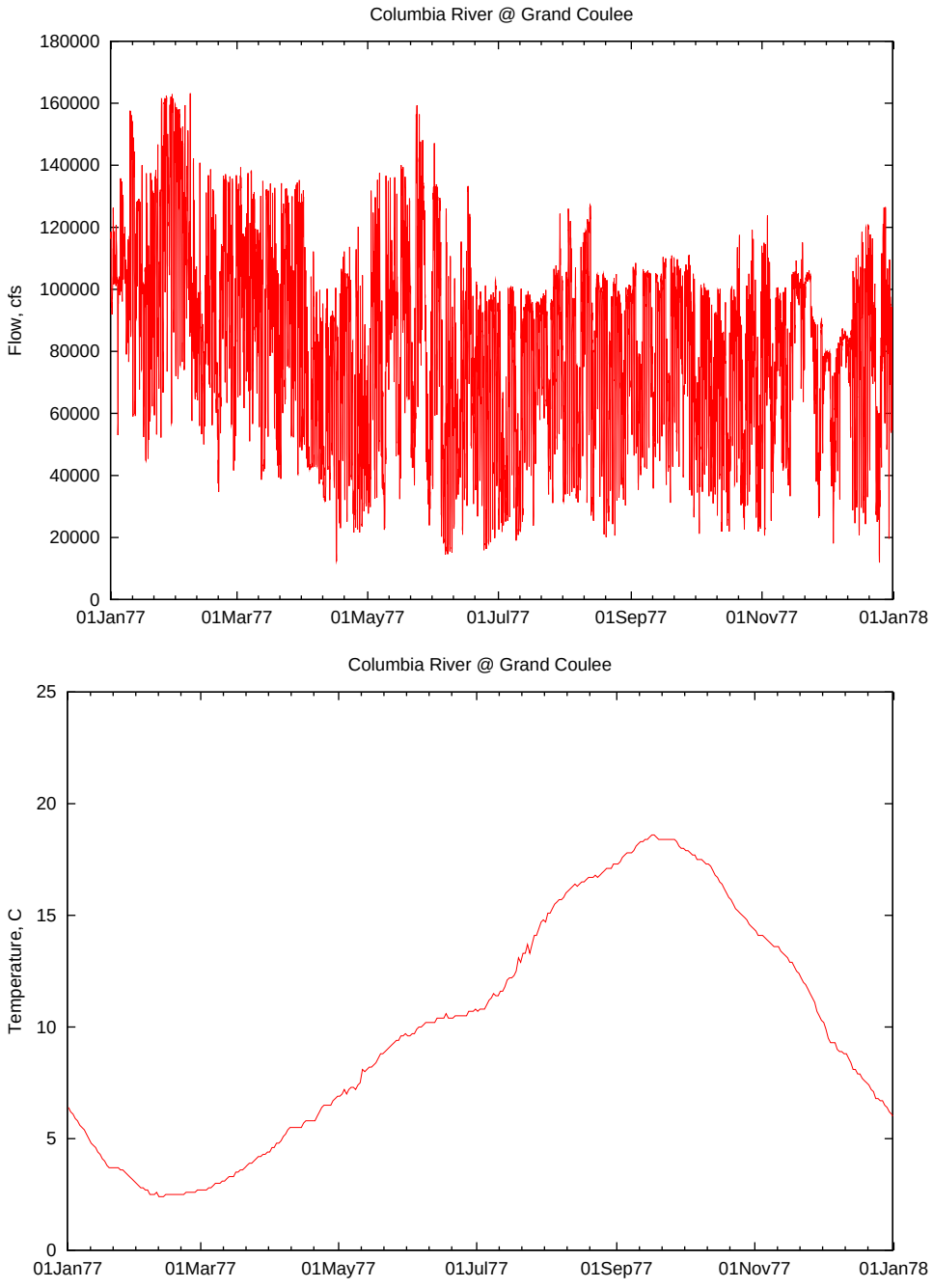

Figure 1: Flow and temperature boundary conditions at Grand Coulee dam.

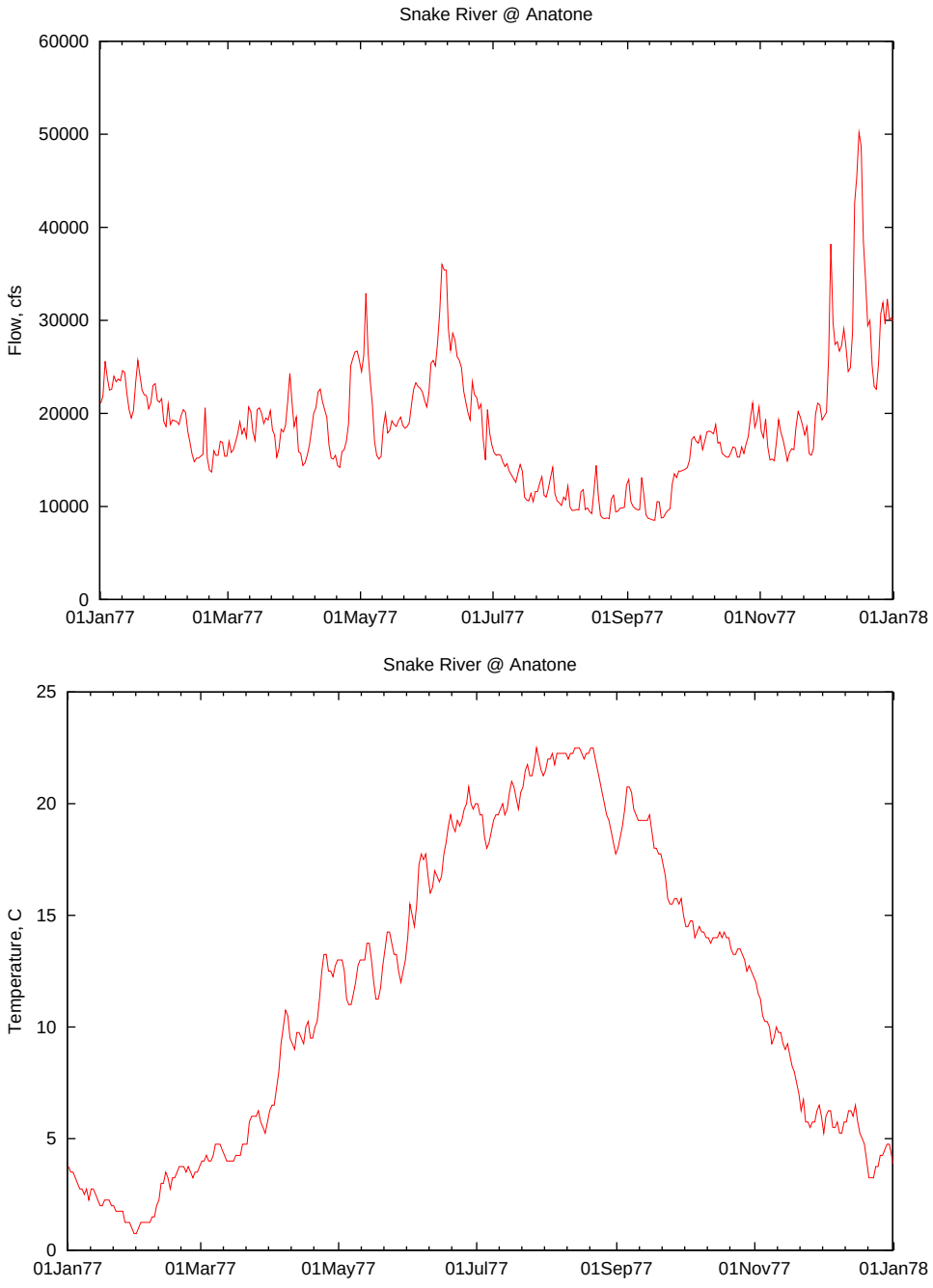

Figure 2: 1977 Snake River flow and temperature boundary conditions at Anatone.

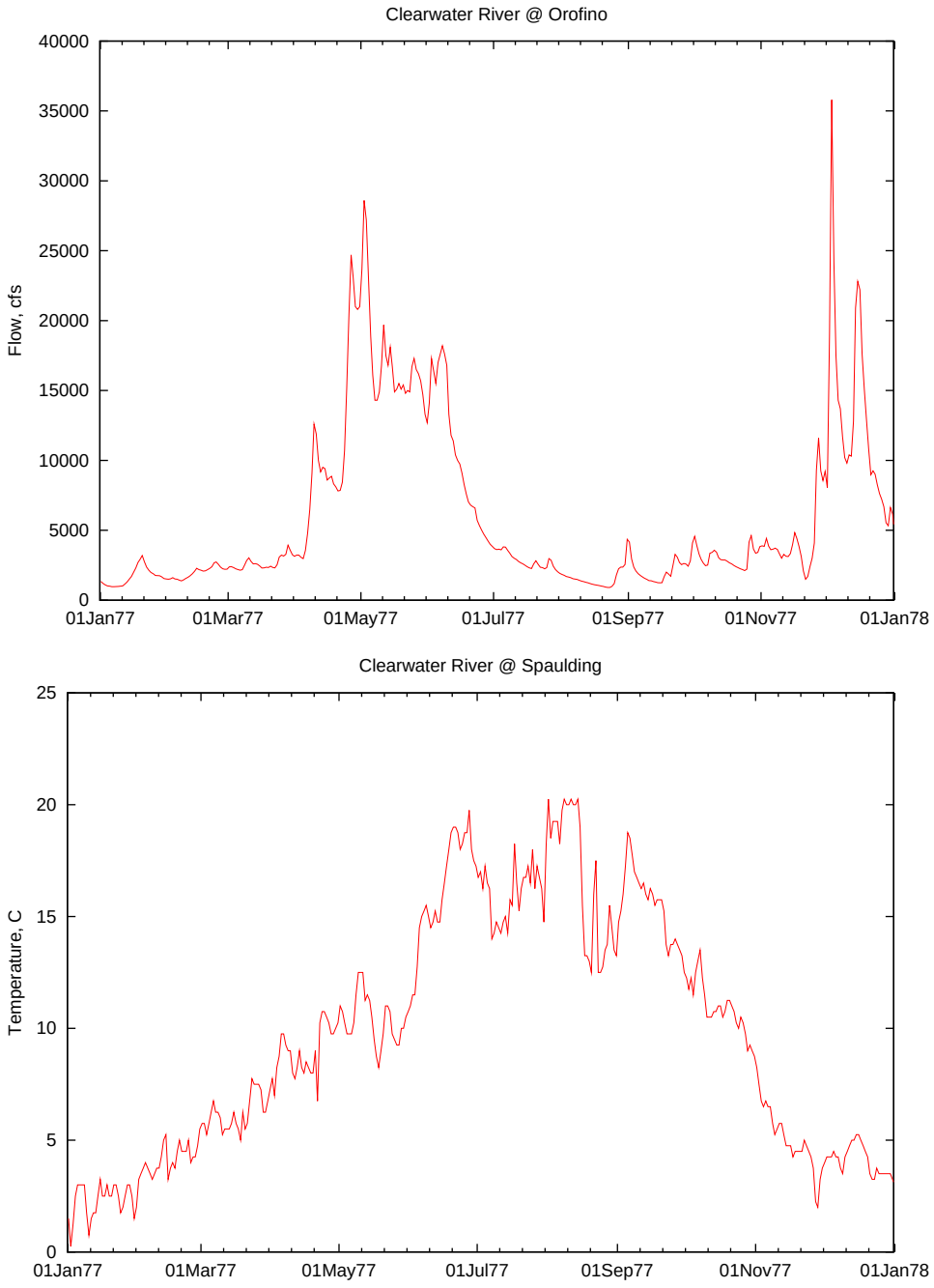

Figure 3: 1977 Clearwater River flow and temperature boundary conditions at Orofino. Temperature is taken from the Spaulding gage downstream.

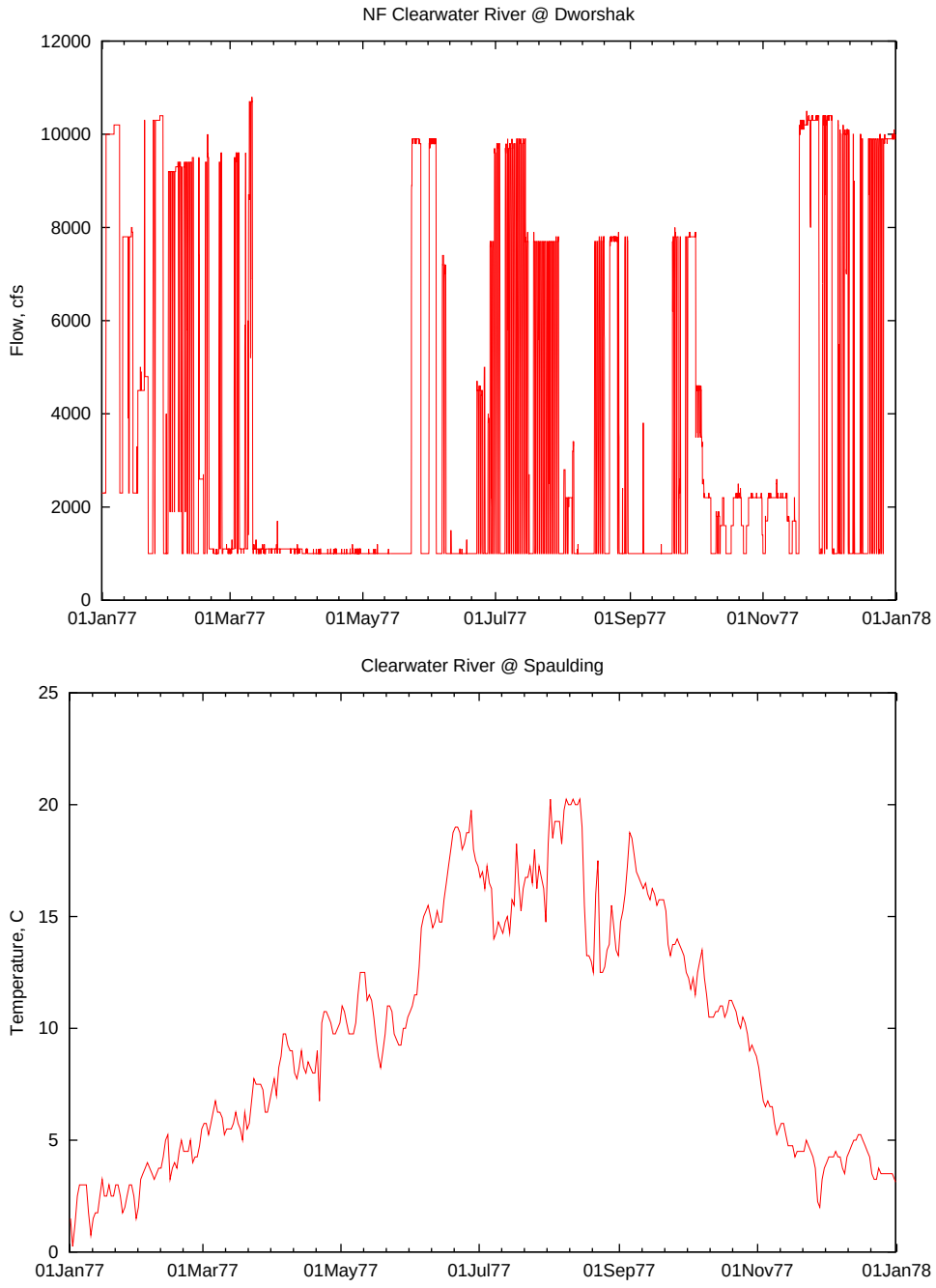

Figure 4: 1977 North Fork Clearwater River flow and temperature boundary conditions at Dworshak dam. Temperature is taken from the Spaulding gage downstream.

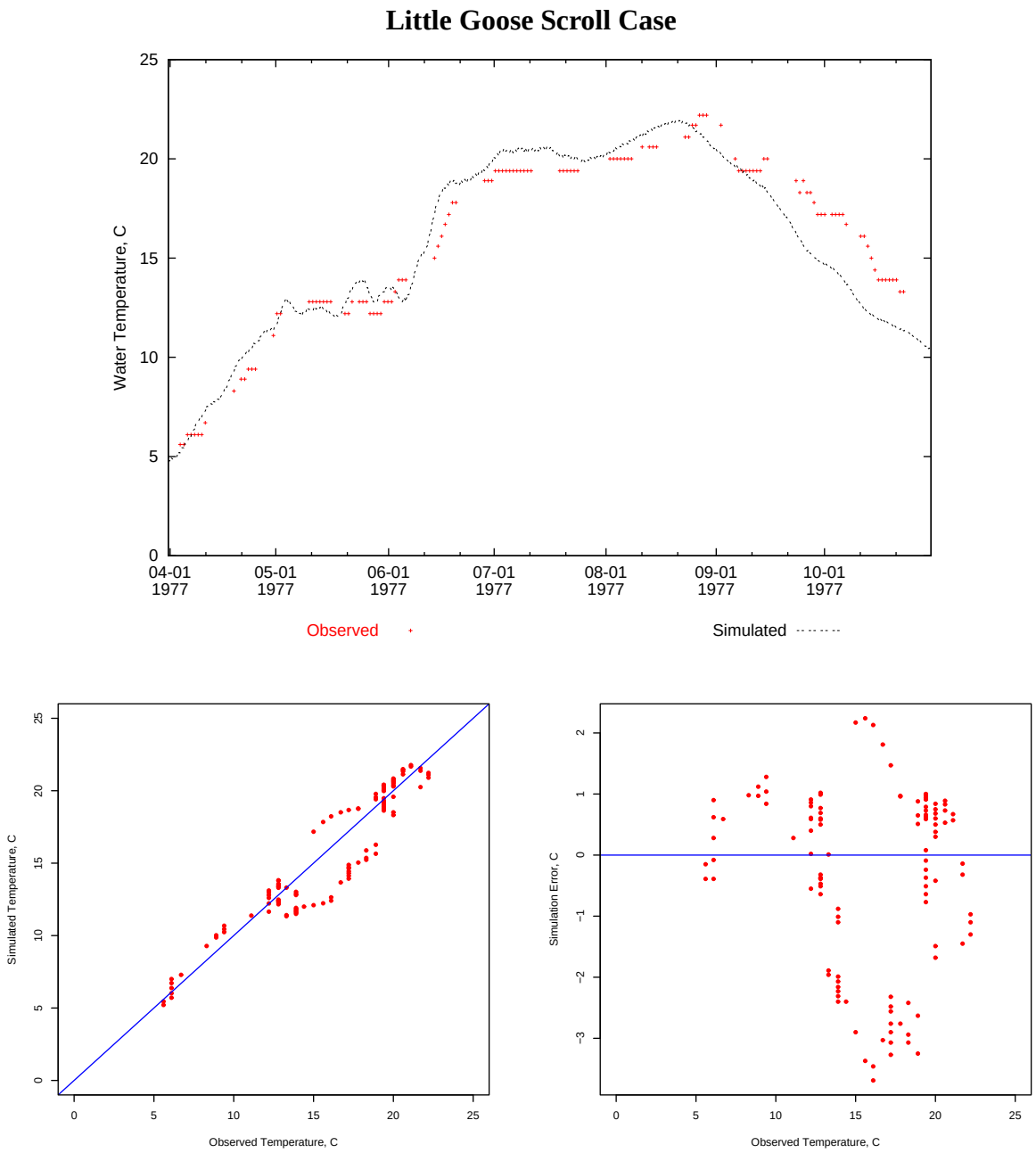

Figure 5: Comparison of simulated temperature and observed scroll case temperature (instantaneous) at Little Goose dam.

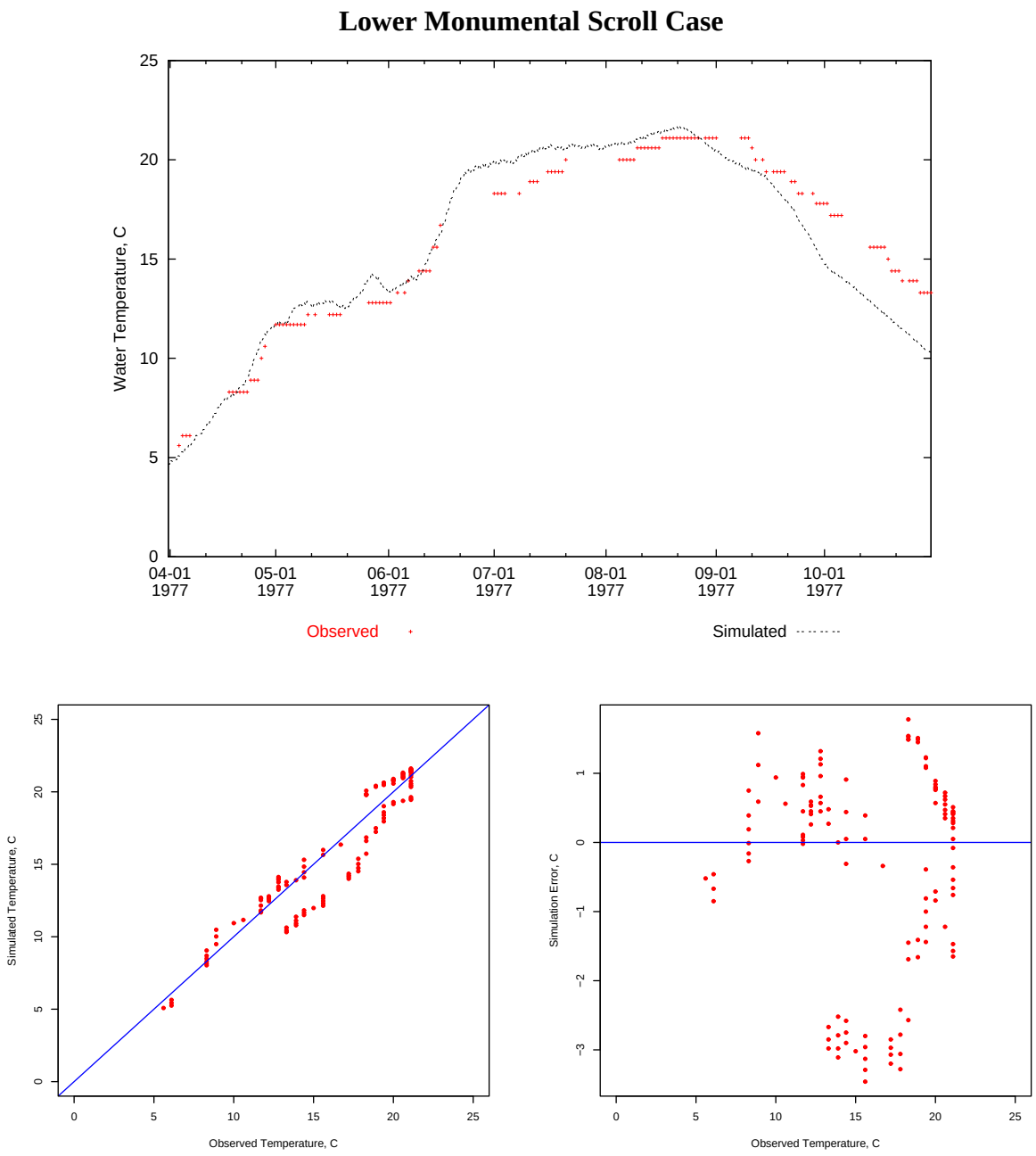

Figure 6: Comparison of simulated temperature and observed scroll case temperature (instantaneous) at Lower Monumental dam.

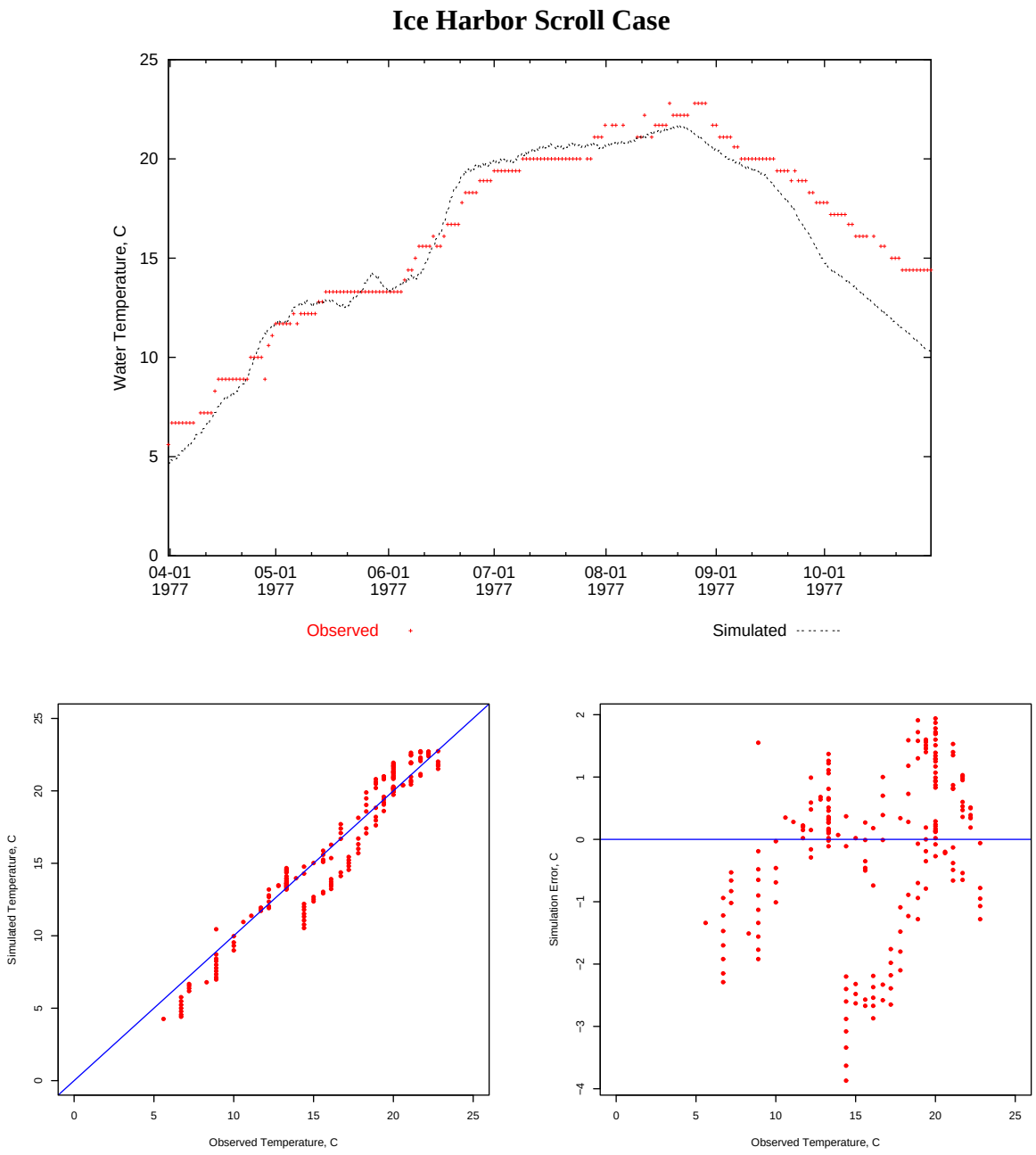

Figure 7: Comparison of simulated temperature and observed scroll case temperature (instantaneous) at Ice Harbor dam.

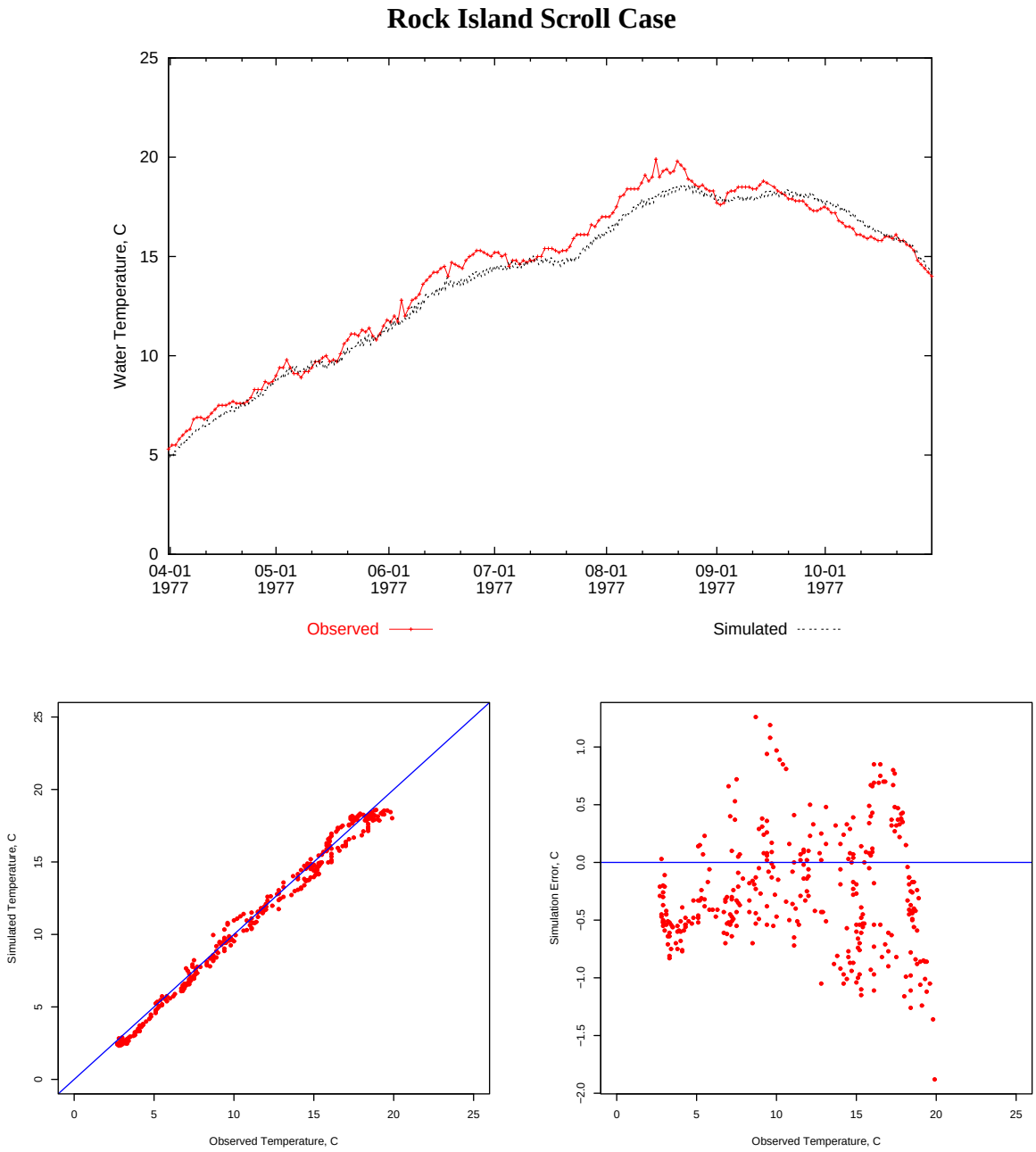

Figure 8: Comparison of simulated temperature and observed scroll case temperature (instantaneous) at Rock Island dam.

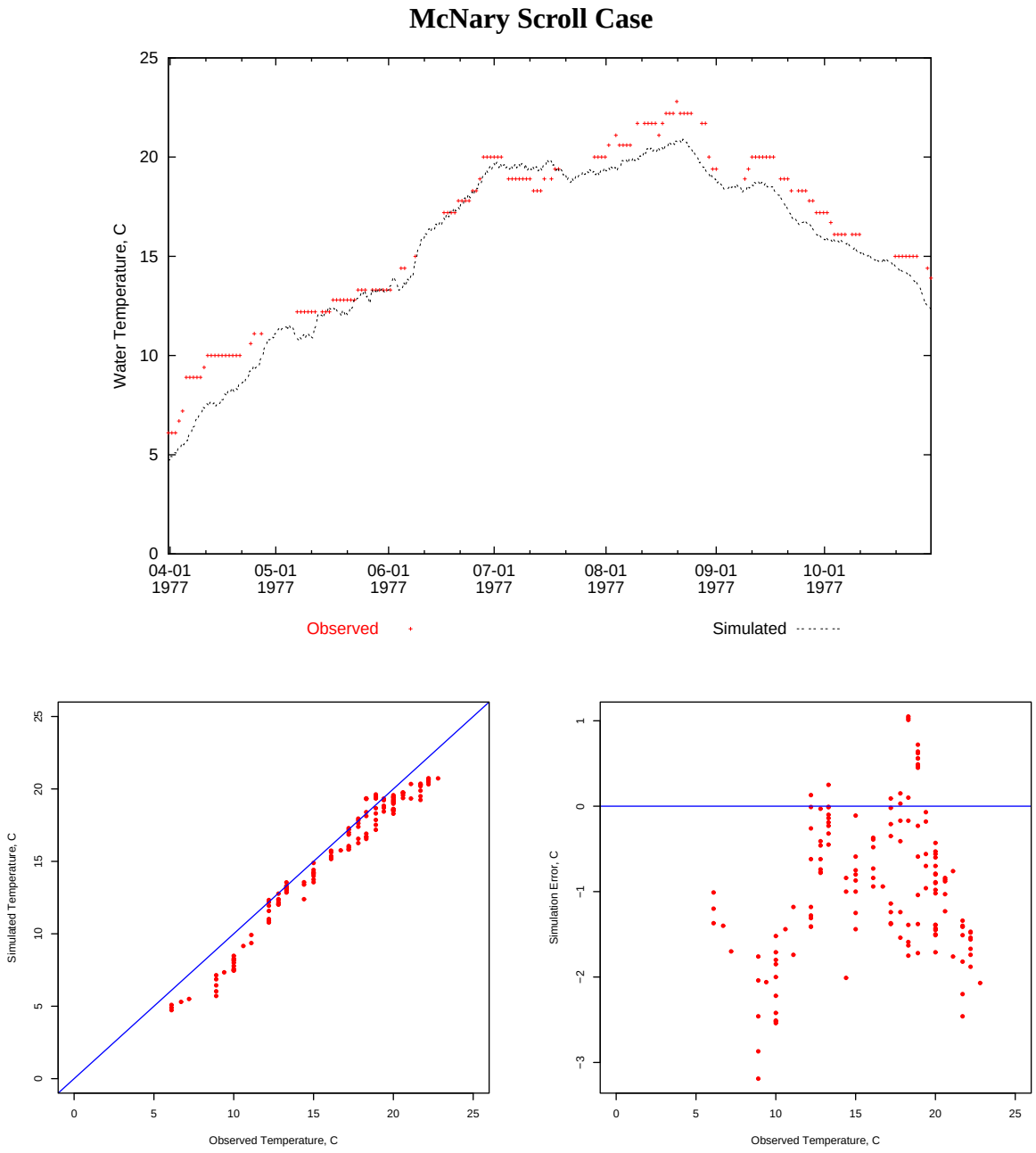

Figure 9: Comparison of simulated temperature and observed scroll case temperature (instantaneous) at McNary dam.

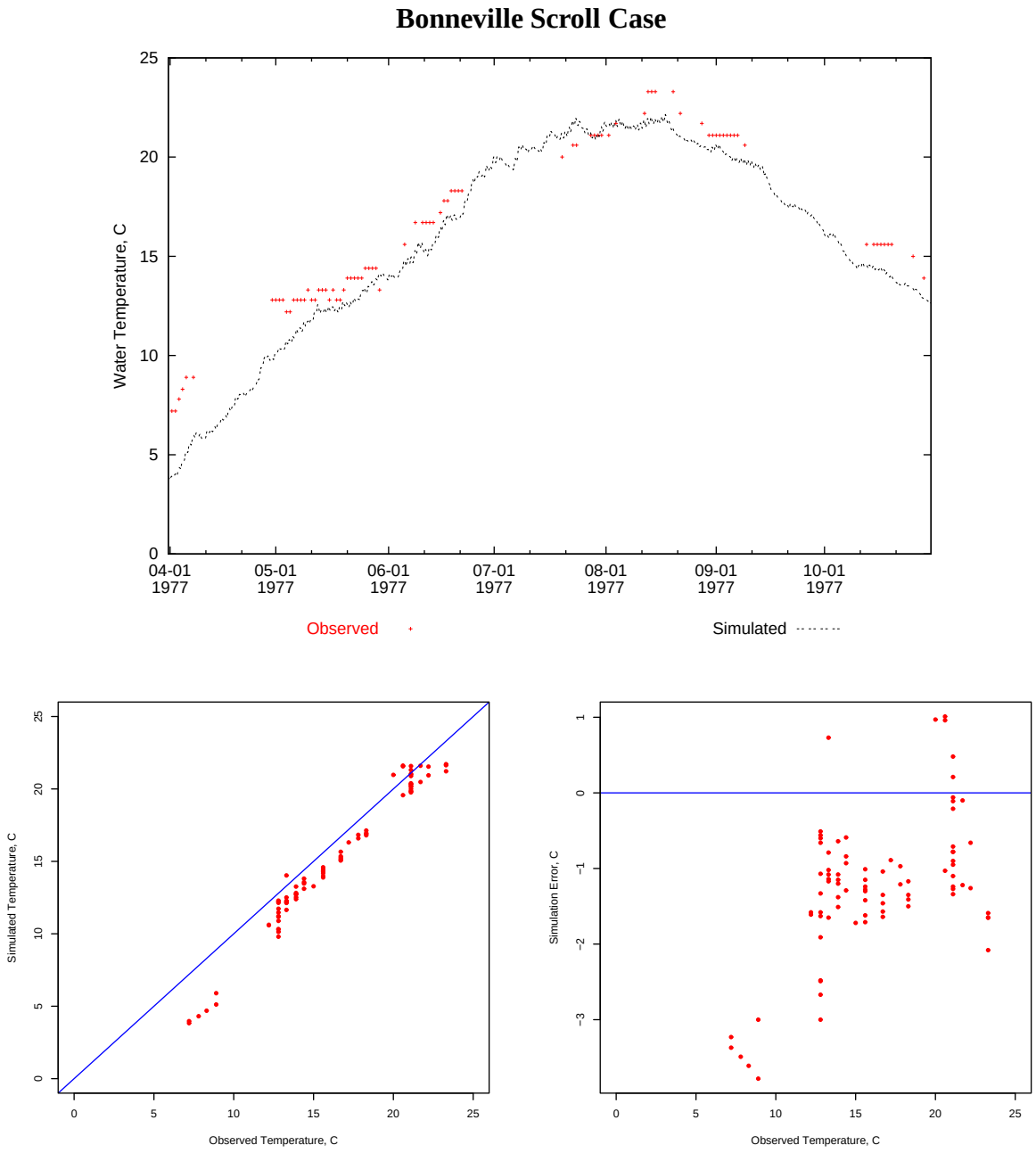

Figure 10: Comparison of simulated temperature observed scroll case temperature (instantaneous) at Bonneville dam.

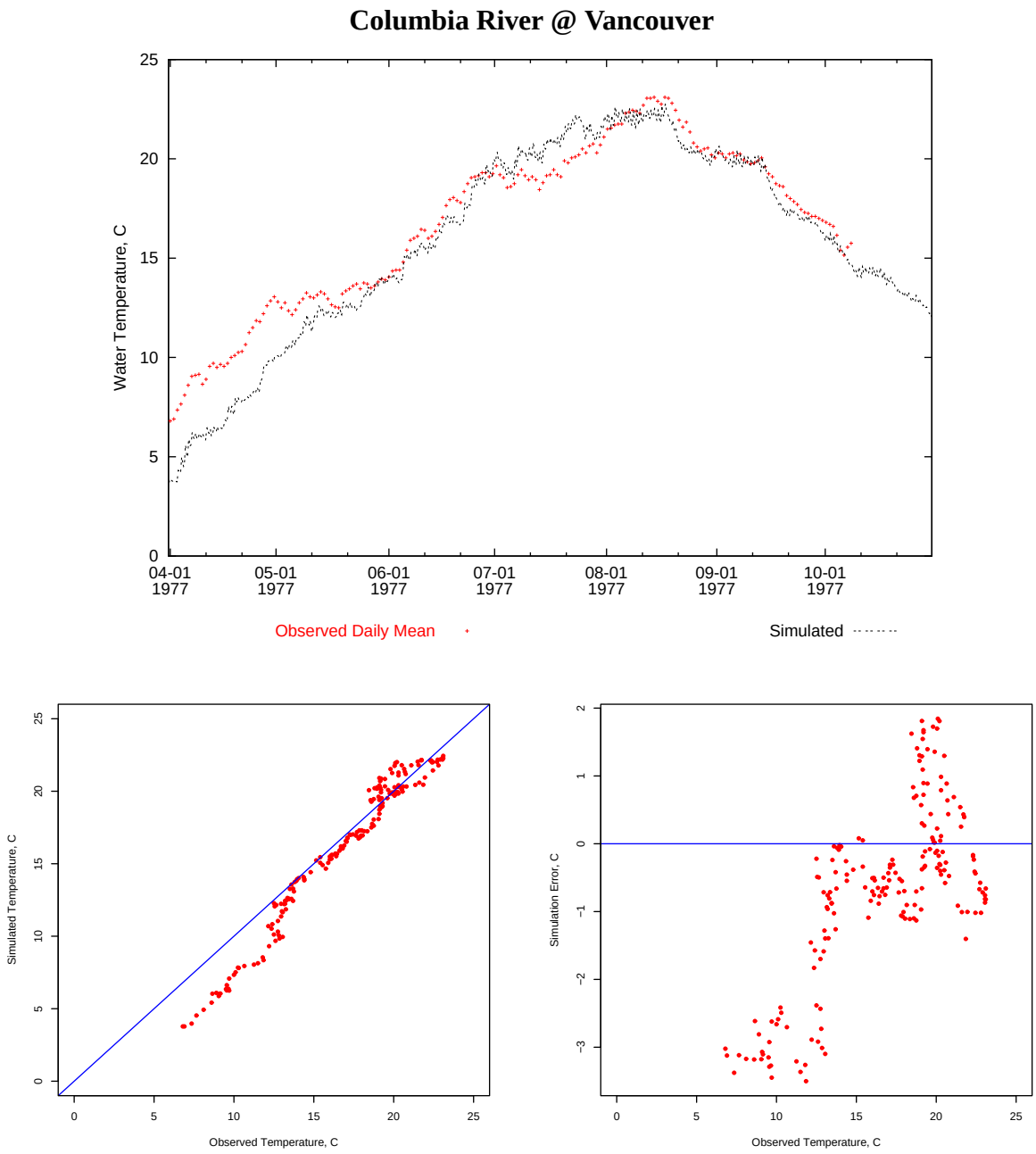

Figure 11: Comparison of simulated and observed daily mean Columbia River temperature at the USGS gage near Vancouver, Washington.

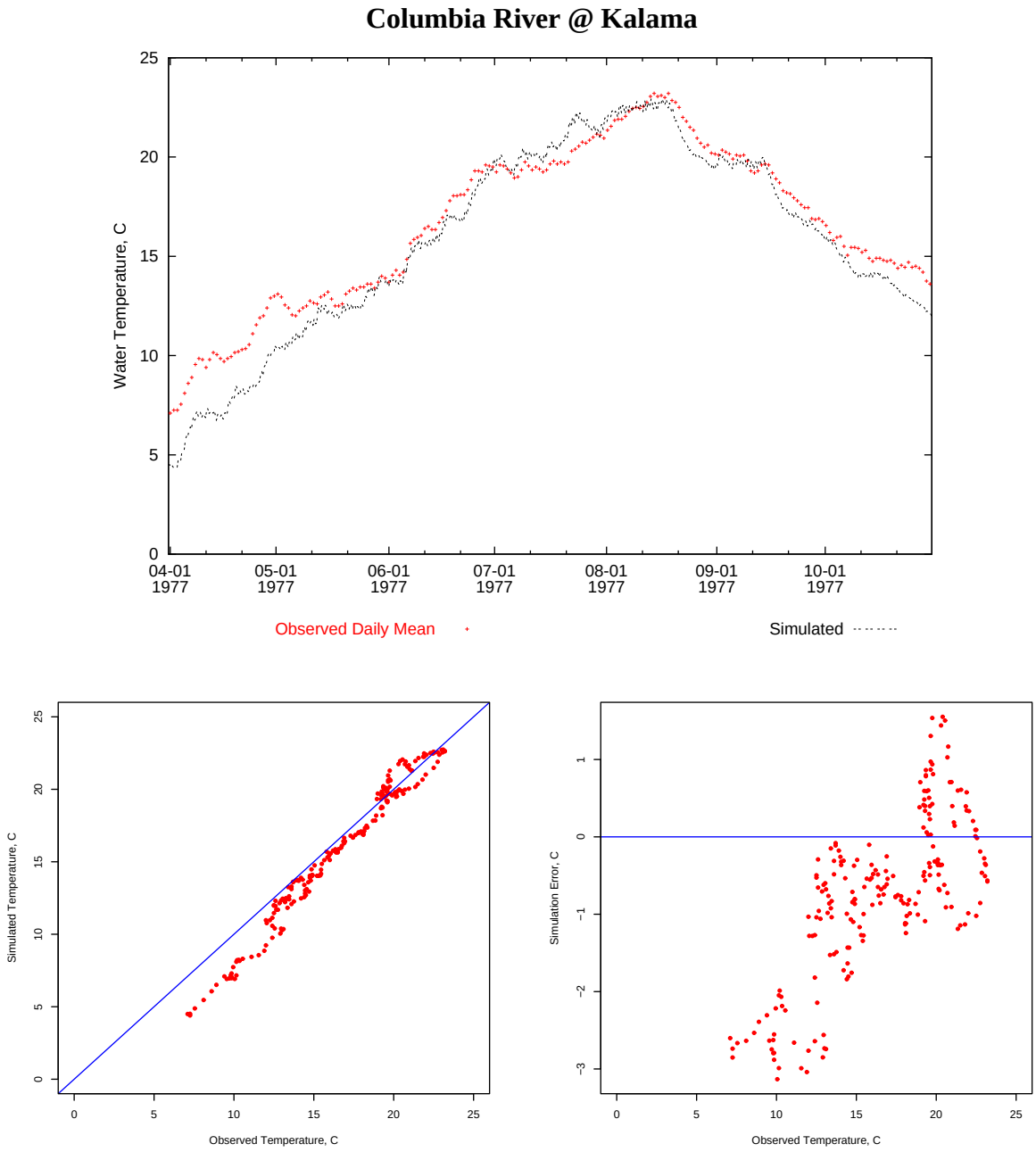

Figure 12: Comparison of simulated and observed daily mean Columbia River temperature at the USGS gage near Kalama, Washington.

2 1994 Weather Scenario

This scenario is the same as the 1977 conditions scenario, except that 1994 weather was used (at the same stations). This means that the same water temperatures were used at the boundaries (Grand Coulee and Clearwater and Snake Rivers).

Graphical comparisons to the 1977 conditions scenario at several locations follow. Note that the change in weather conditions only apply within the MASS1 domain, so water temperature differences near model boundaries (Chief Joseph forebay, Figure 13, for example) are very small. Those differences grow as the water travels through the system.

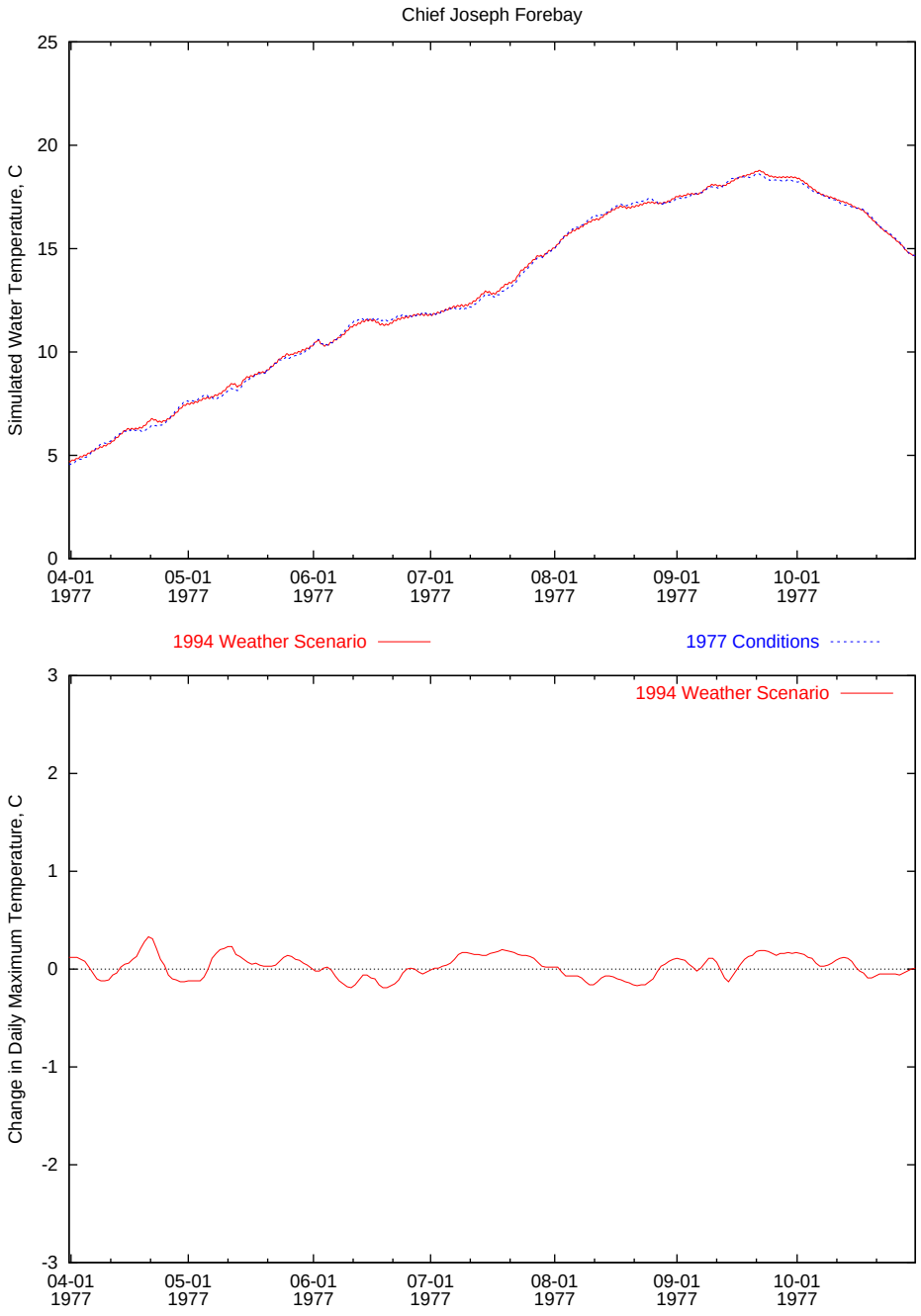

Figure 13: Time series comparison at Chief Joseph forebay of the 1994 weather and 1977 conditions scenario.

Chief Joseph Forebay

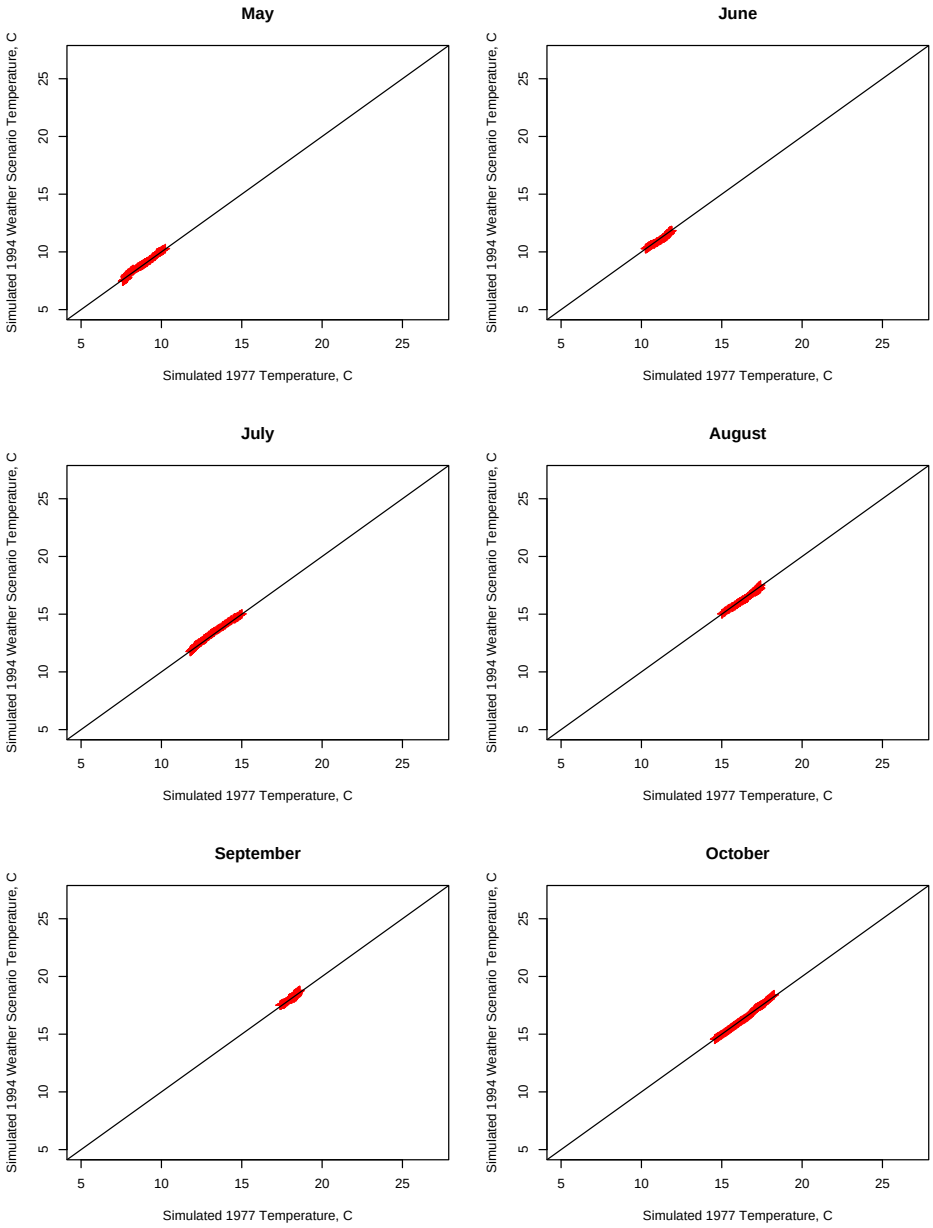

Figure 14: Scatter plot comparison, by month, at Chief Joseph forebay of the 1994 weather and 1977 conditions scenario.

Chief Joseph Forebay

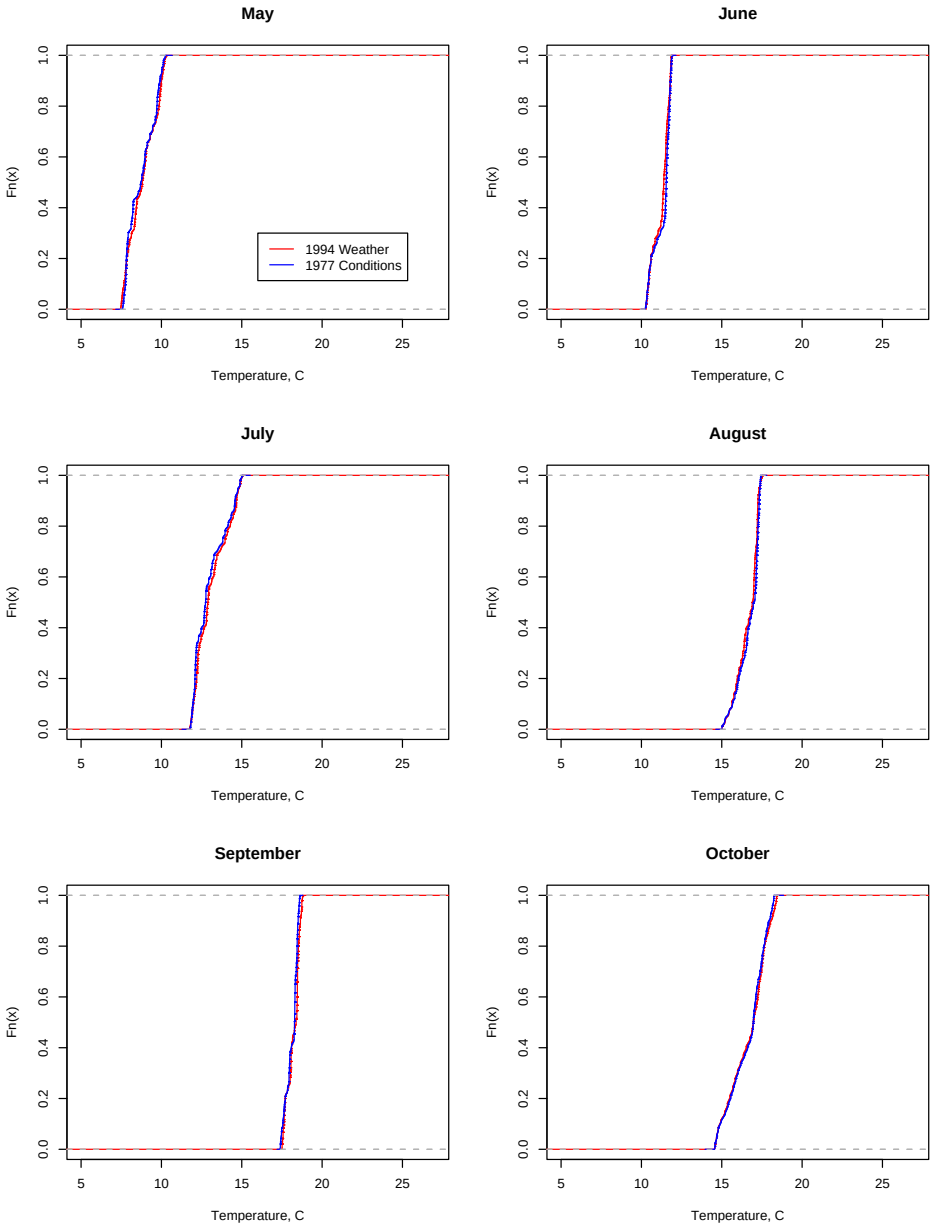

Figure 15: Cumulative frequency distribution (CFD) plot comparison, by month, at Chief Joseph forebay of the 1994 weather and 1977 conditions scenario.

Rock Island Forebay

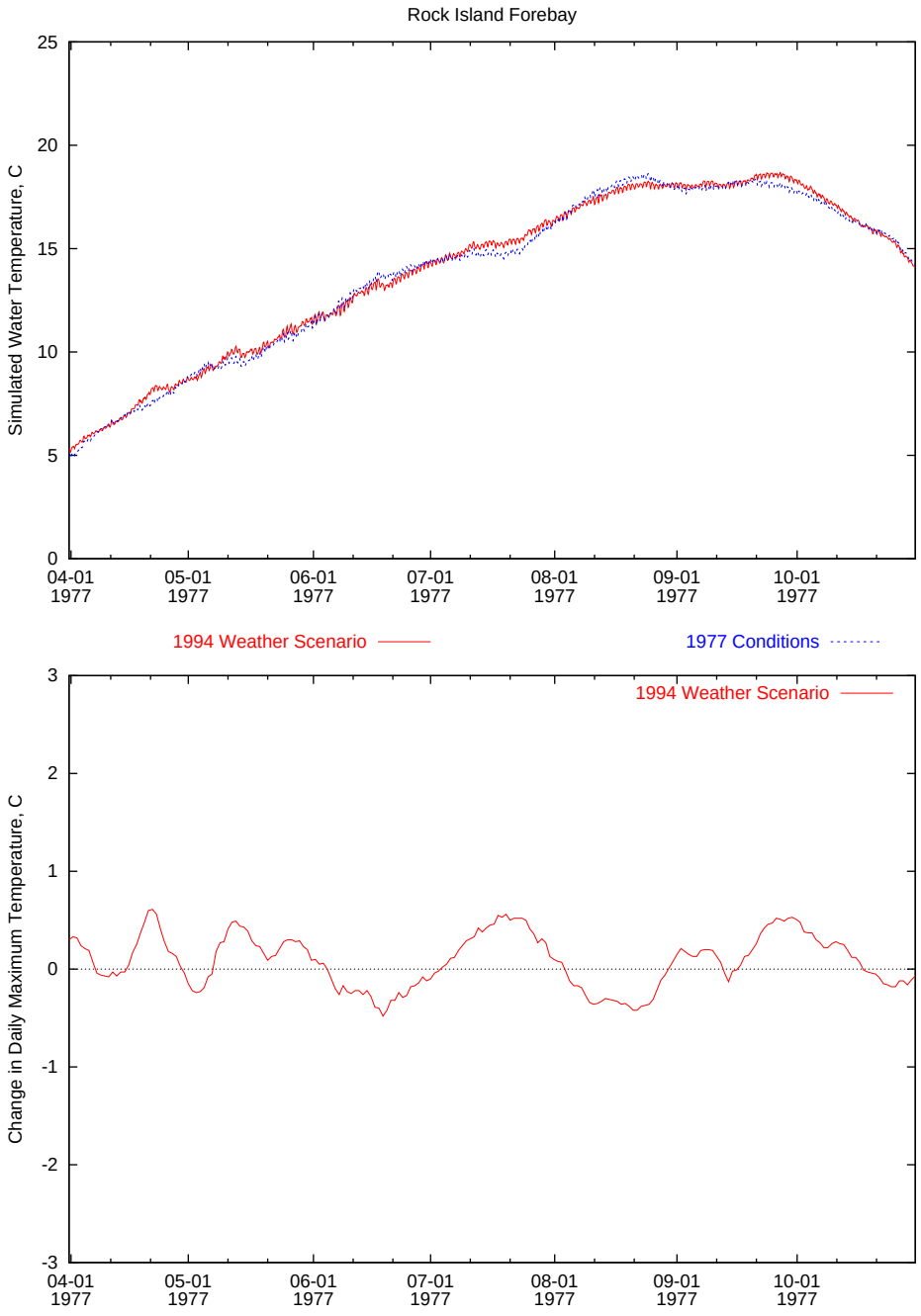

Figure 16: Time series comparison at Rock Island forebay of the 1994 weather and 1977 conditions scenario.

Rock Island Forebay

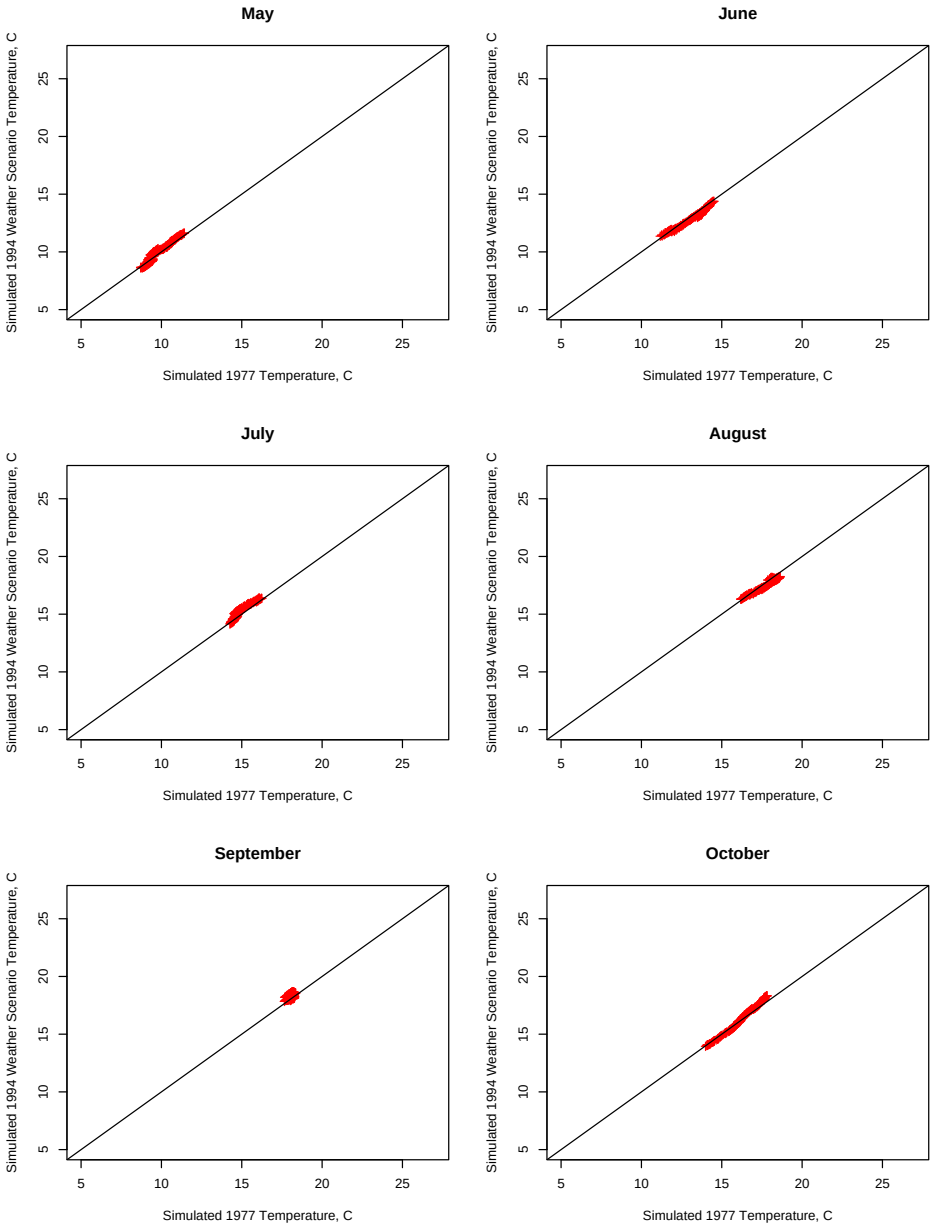

Figure 17: Scatter plot comparison, by month, at Rock Island fore-bay of the 1994 weather and 1977 conditions scenario.

Rock Island Forebay

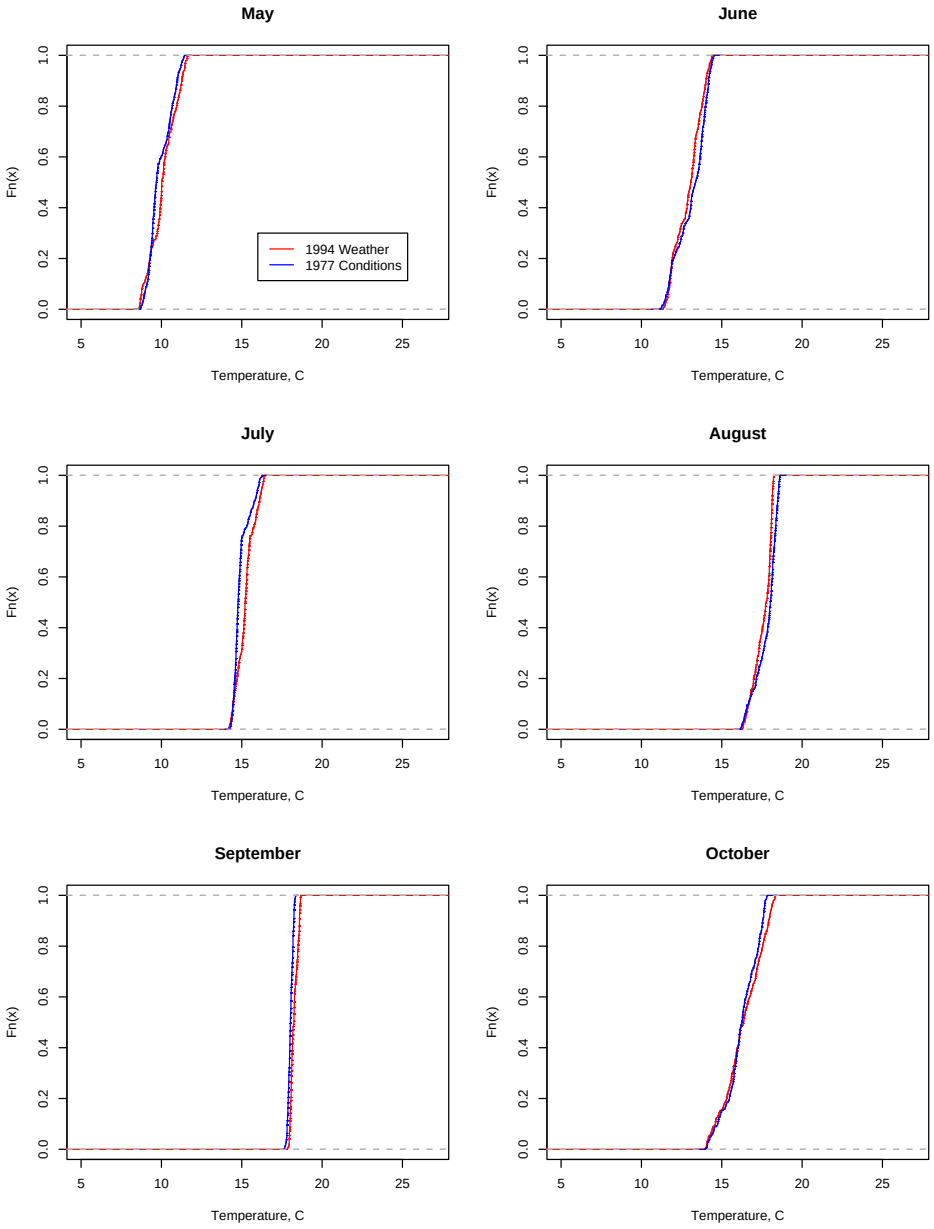

Figure 18: Cumulative frequency distribution (CFD) plot comparison, by month, at Rock Island forebay of the 1994 weather and 1977 conditions scenario.

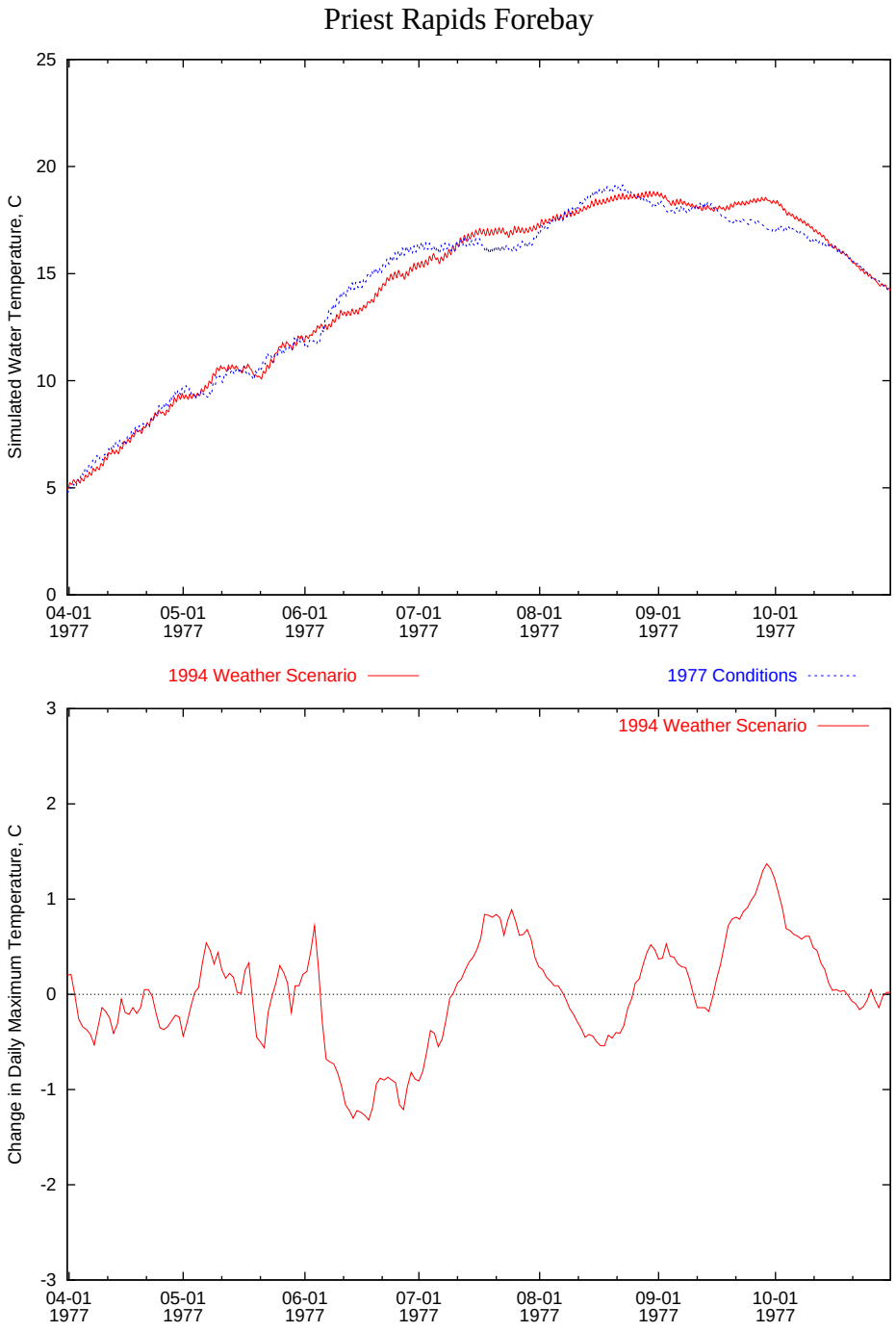

Figure 19: Time series comparison at Priest Rapids forebay of the 1994 weather and 1977 conditions scenario.

Priest Rapids Forebay

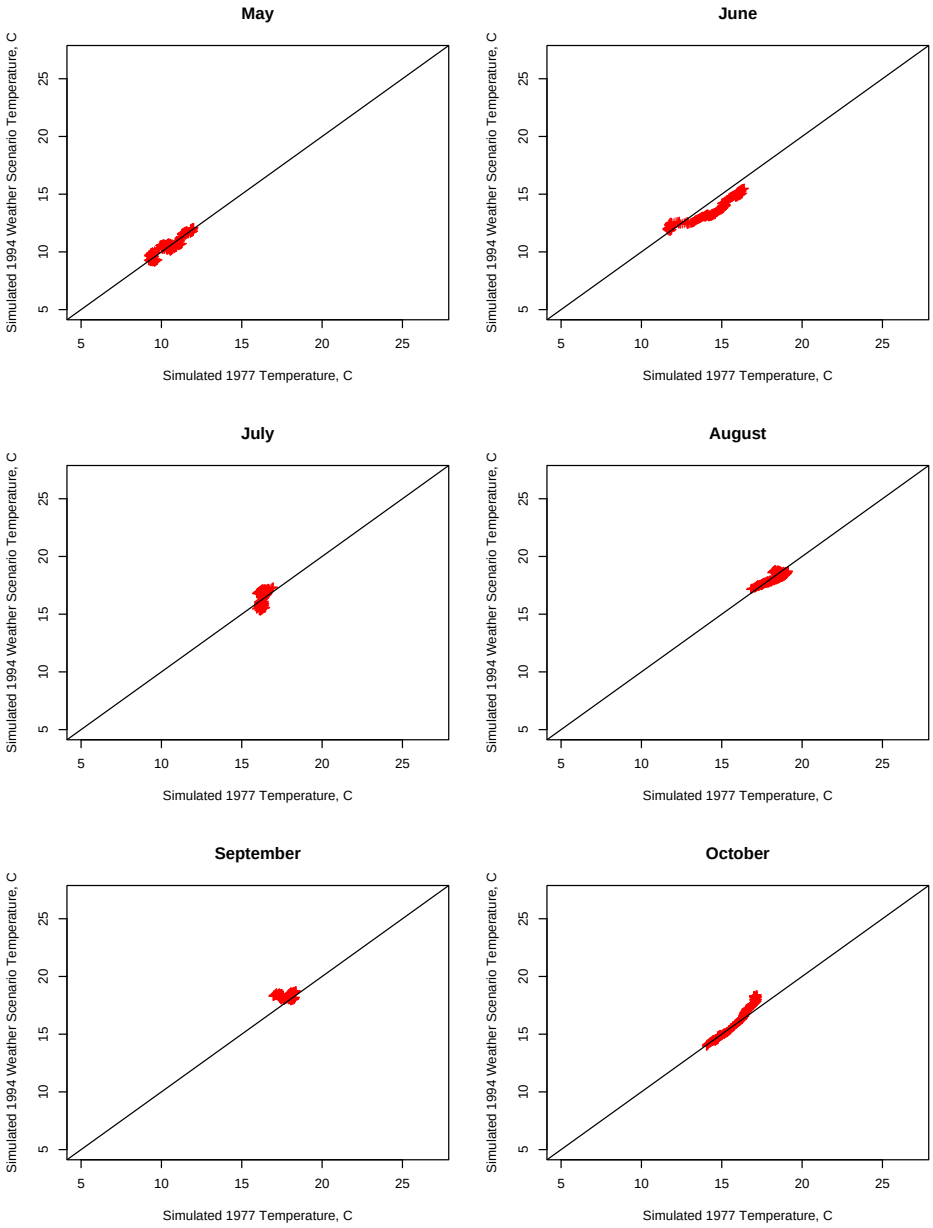

Figure 20: Scatter plot comparison, by month, at Priest Rapids forebay of the 1994 weather and 1977 conditions scenario.

Priest Rapids Forebay

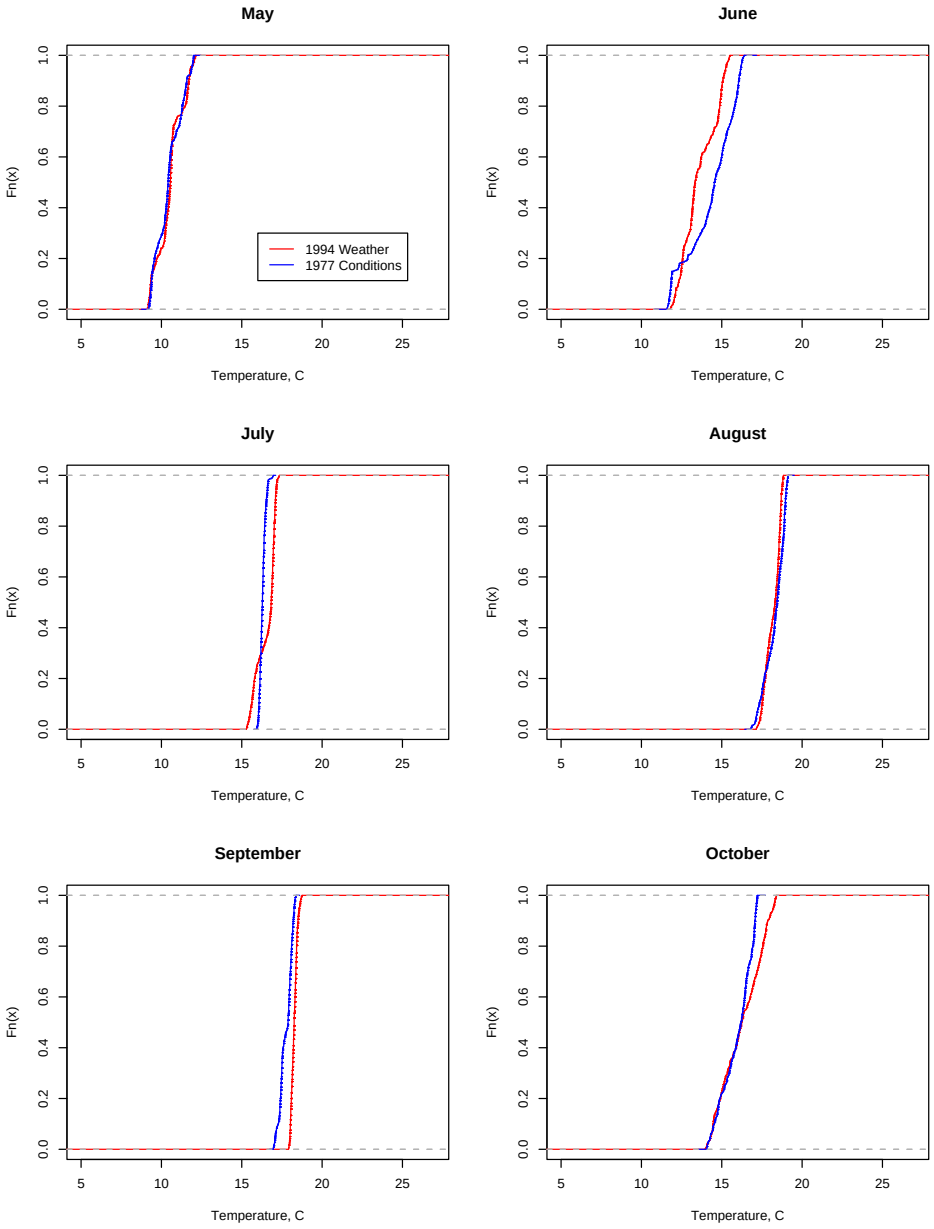

Figure 21: Cumulative frequency distribution (CFD) plot comparison, by month, at Priest Rapids forebay of the 1994 weather and 1977 conditions scenario.

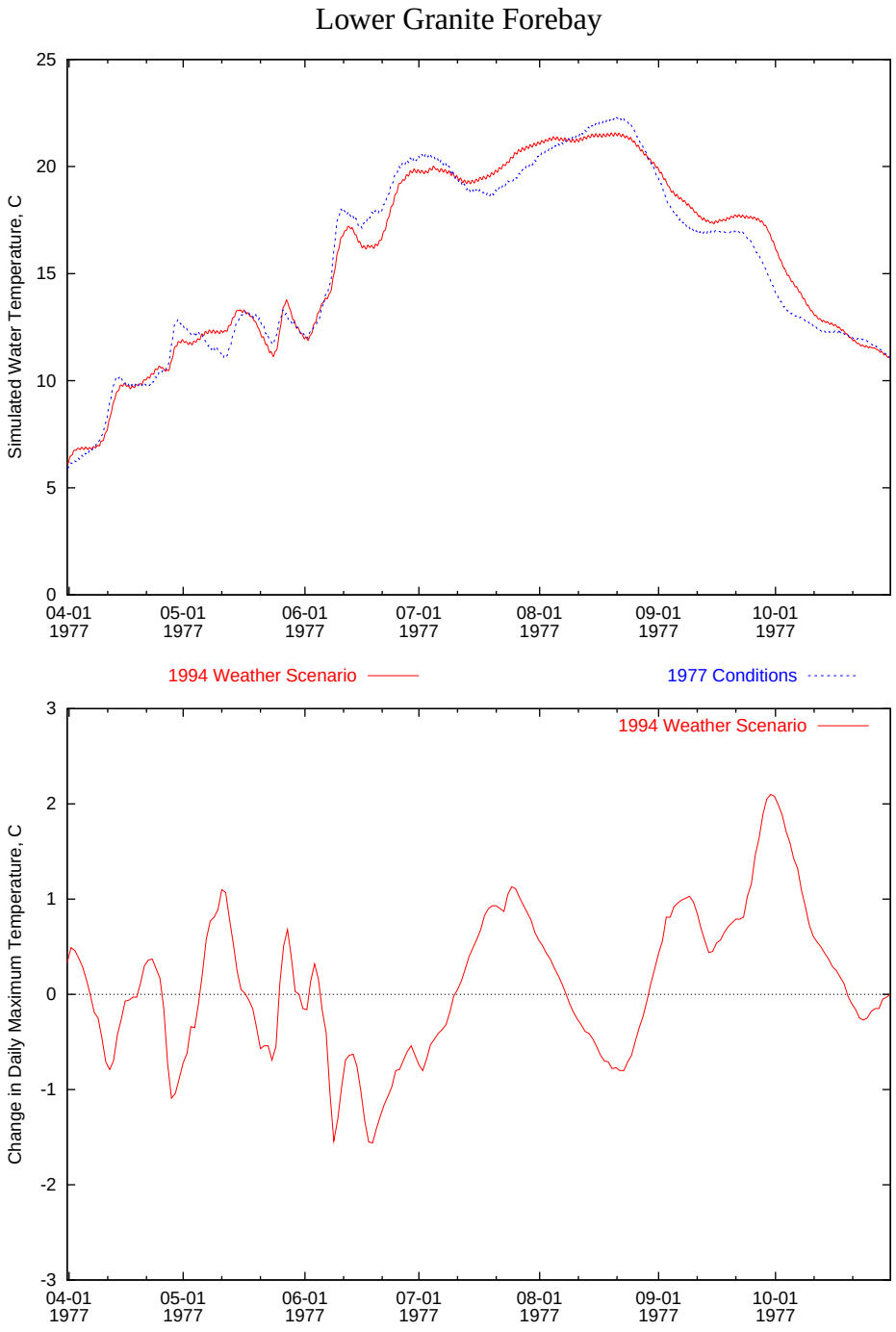

Figure 22: Time series comparison at Lower Granite forebay of the 1994 weather and 1977 conditions scenario.

Lower Granite Forebay

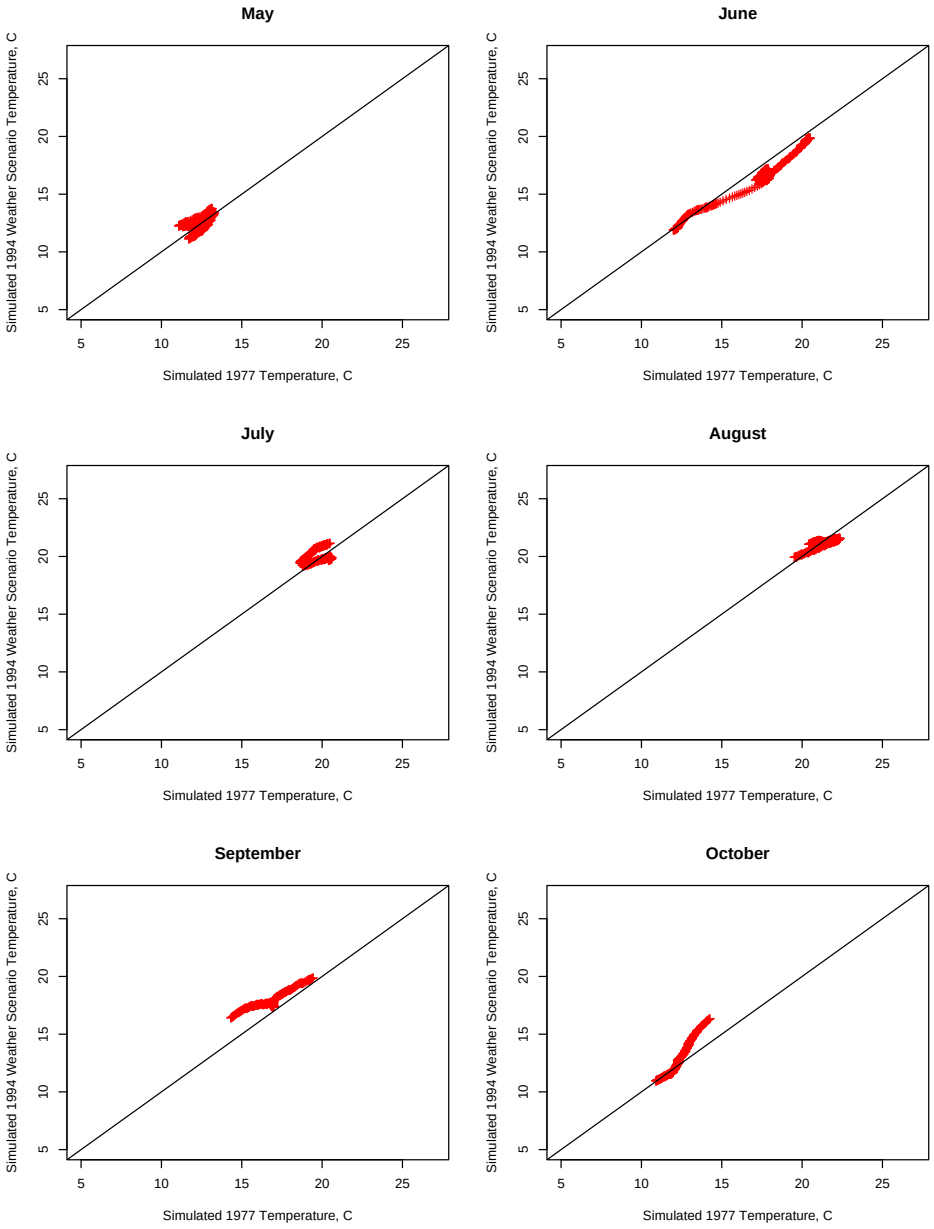

Figure 23: Scatter plot comparison, by month, at Lower Granite forebay of the 1994 weather and 1977 conditions scenario.

Lower Granite Forebay

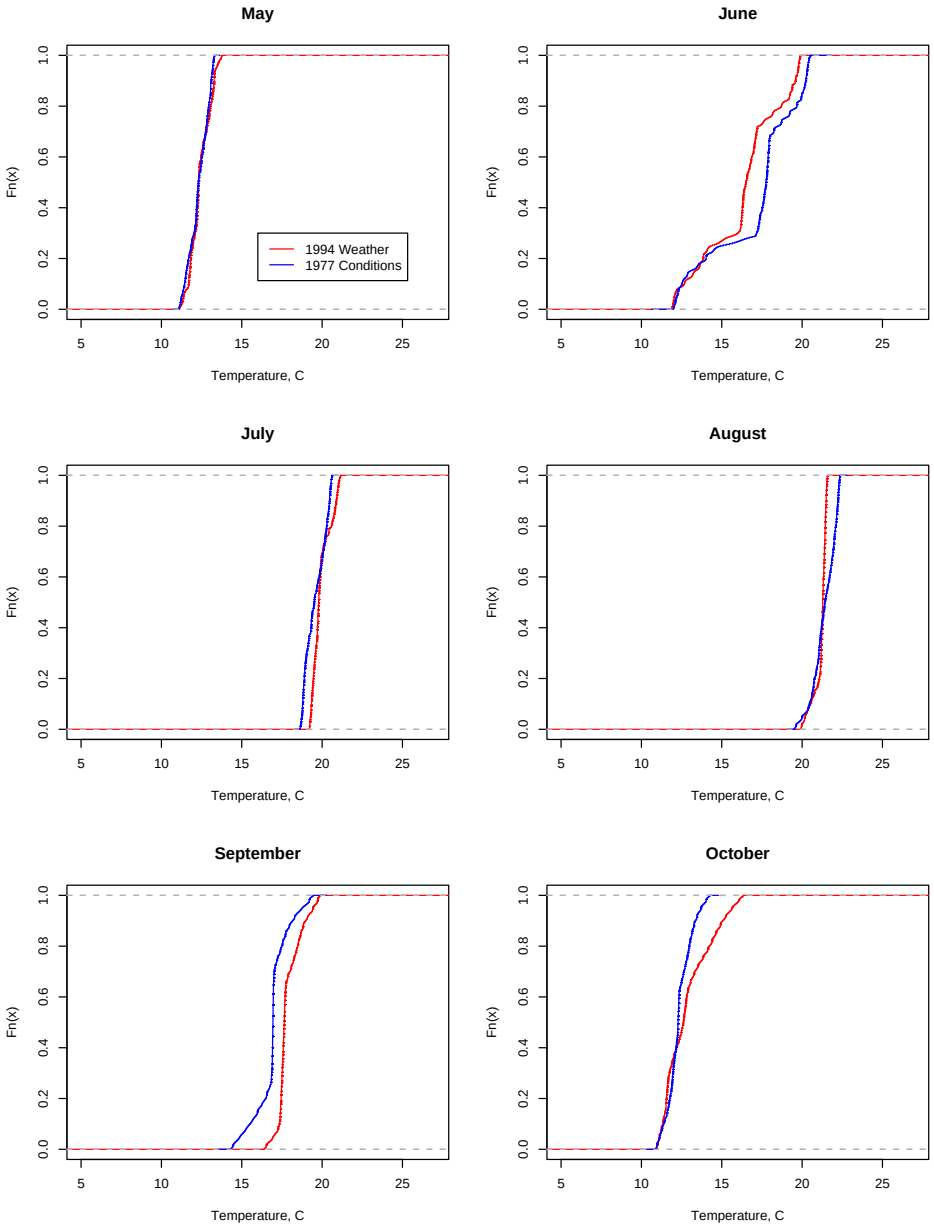

Figure 24: Cumulative frequency distribution (CFD) plot comparison, by month, at Lower Granite forebay of the 1994 weather and 1977 conditions scenario.

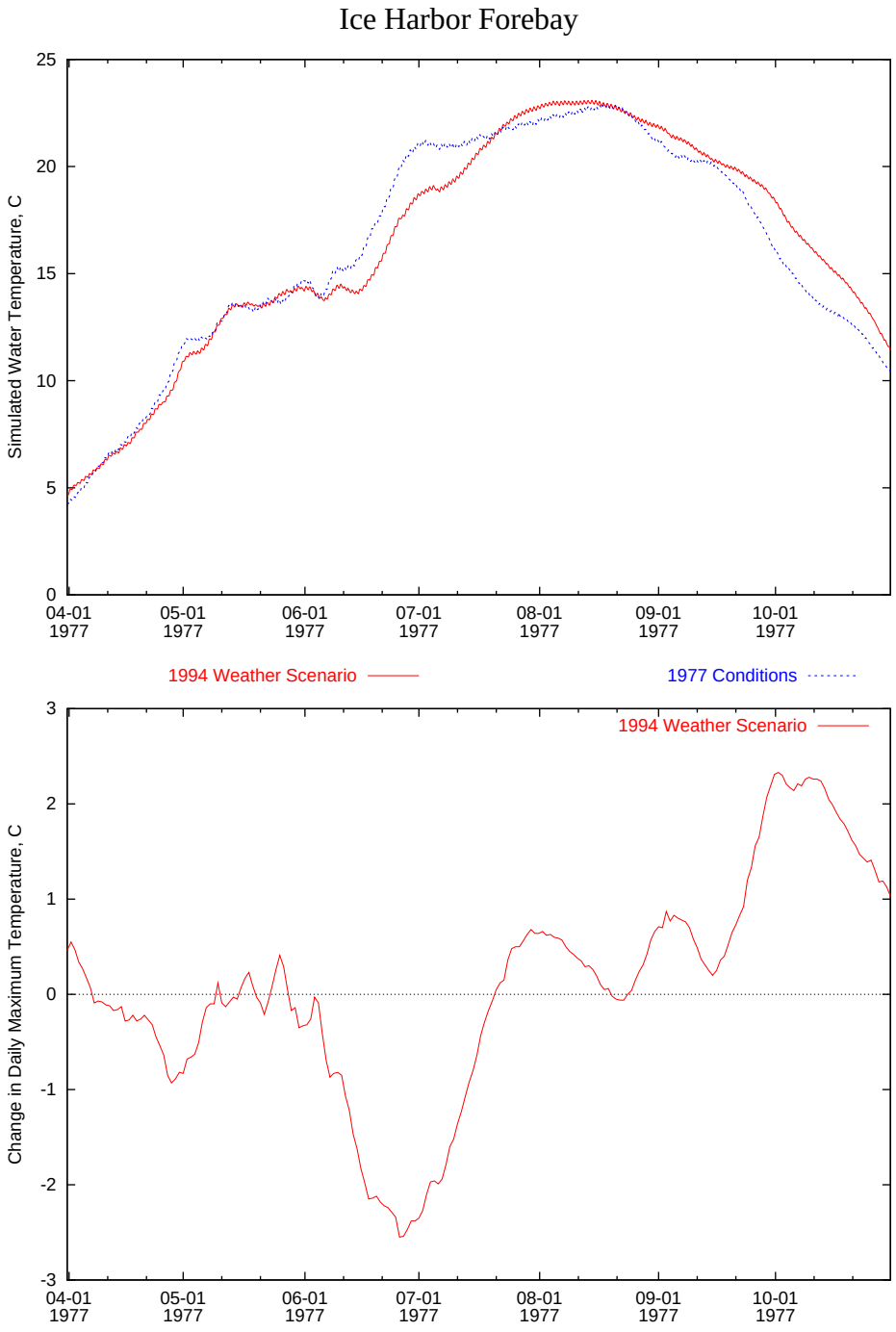

Figure 25: Time series comparison at Ice Harbor forebay of the 1994 weather and 1977 conditions scenario.

Ice Harbor Forebay

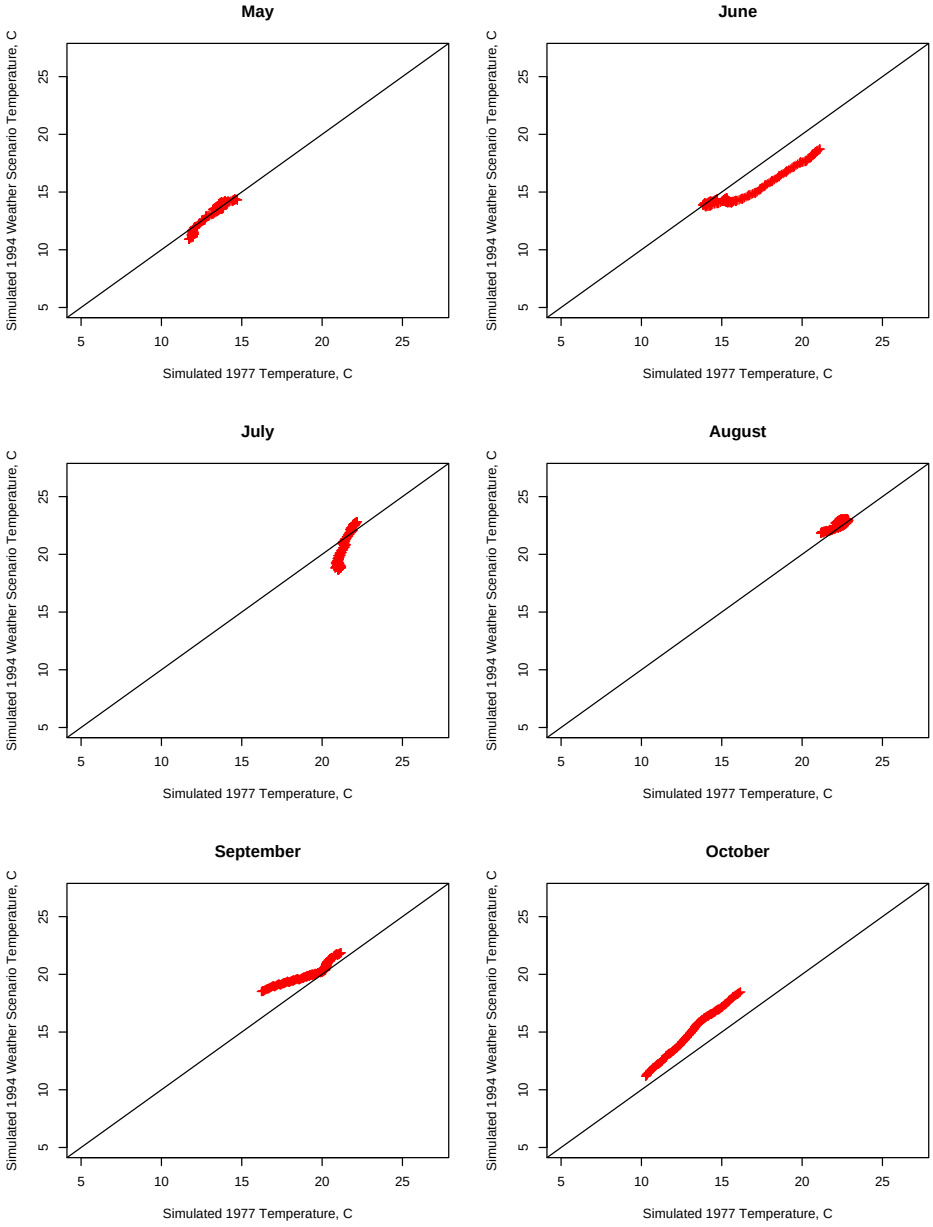

Figure 26: Scatter plot comparison, by month, at Ice Harbor forebay of the 1994 weather and 1977 conditions scenario.

Ice Harbor Forebay

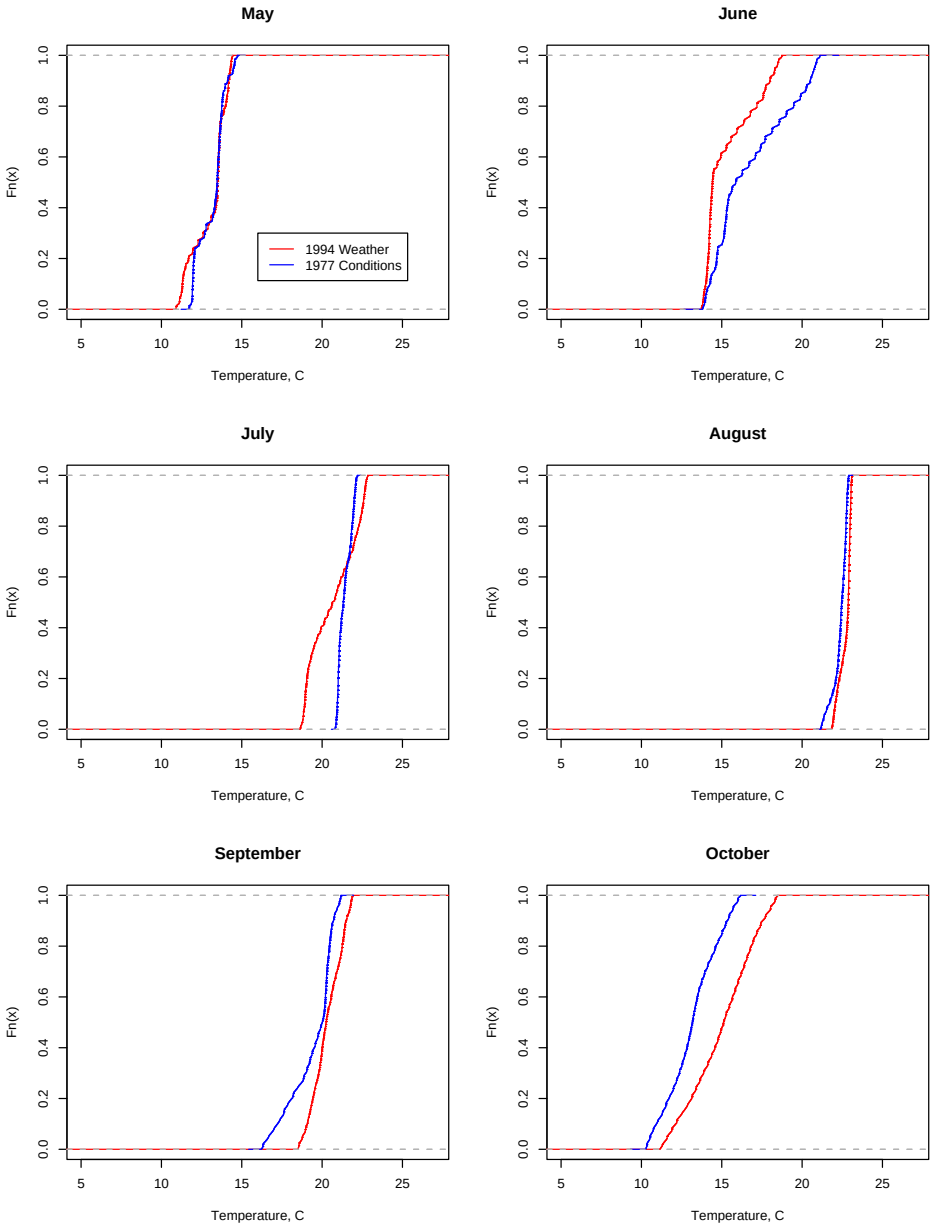

Figure 27: Cumulative frequency distribution (CFD) plot comparison, by month, at Ice Harbor forebay of the 1994 weather and 1977 conditions scenario.

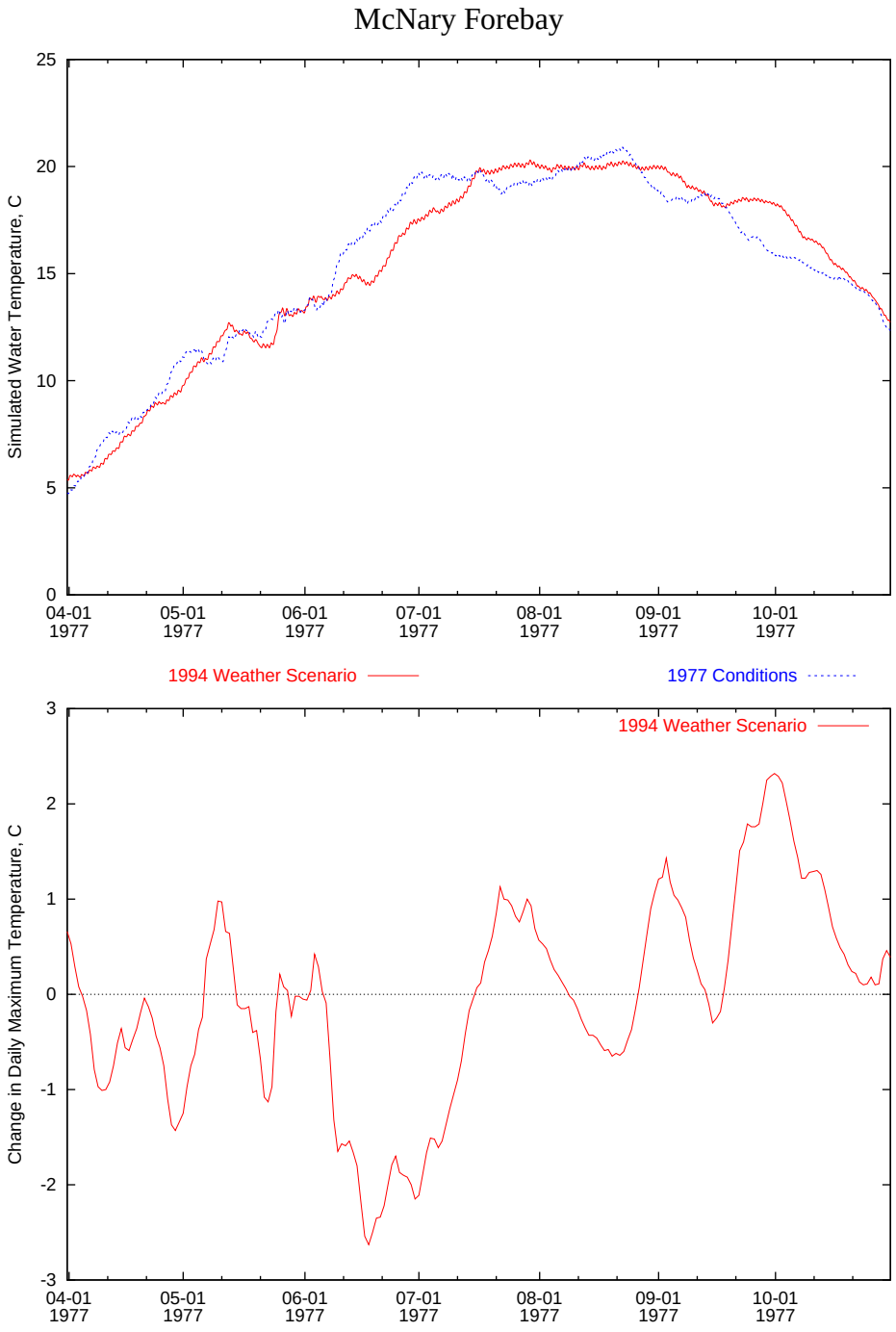

Figure 28: Time series comparison at McNary forebay of the 1994 weather and 1977 conditions scenario.

McNary Forebay

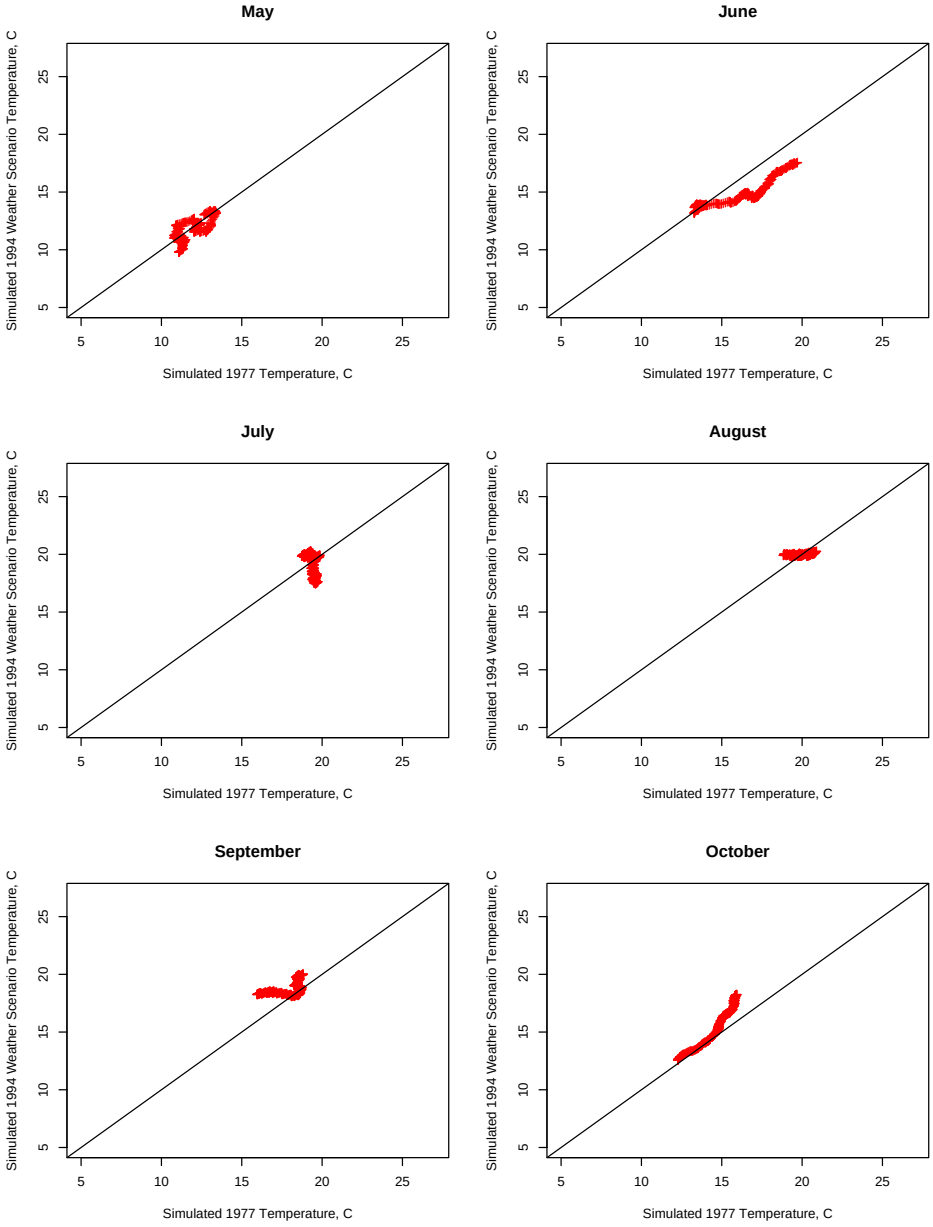

Figure 29: Scatter plot comparison, by month, at McNary forebay of the 1994 weather and 1977 conditions scenario.

McNary Forebay

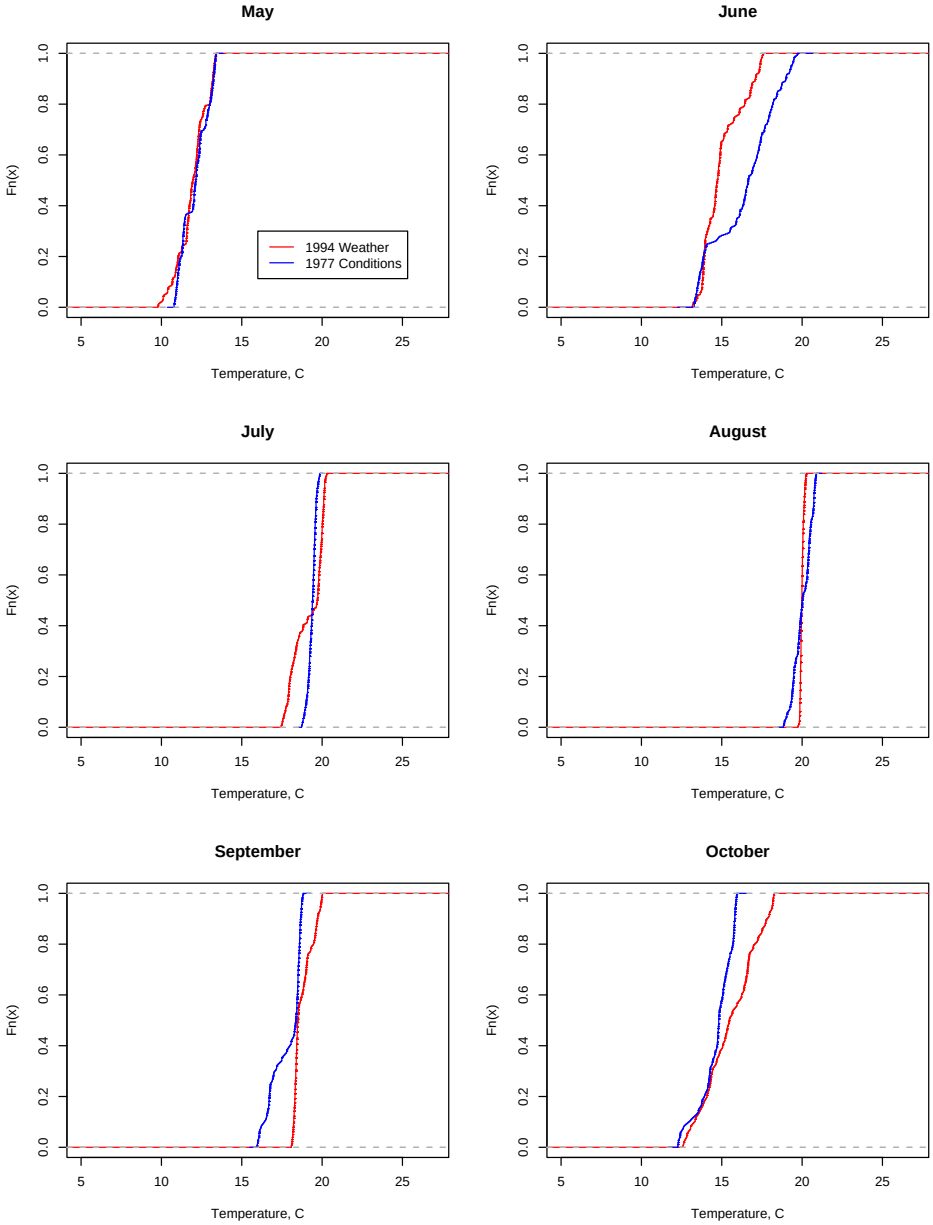

Figure 30: Cumulative frequency distribution (CFD) plot comparison, by month, at McNary forebay of the 1994 weather and 1977 conditions scenario.

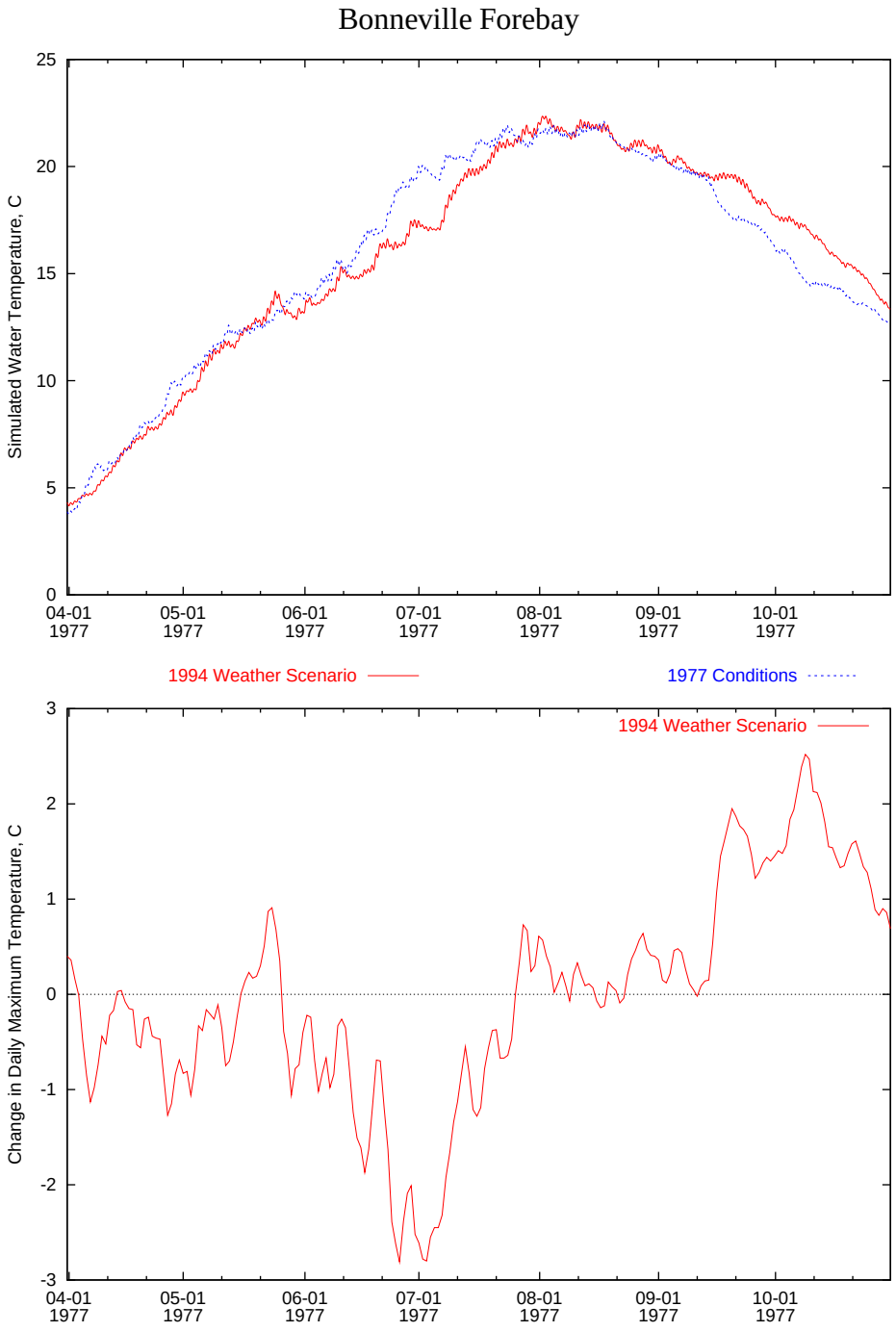

Figure 31: Time series comparison at Bonneville forebay of the 1994 weather and 1977 conditions scenario.

Bonneville Forebay

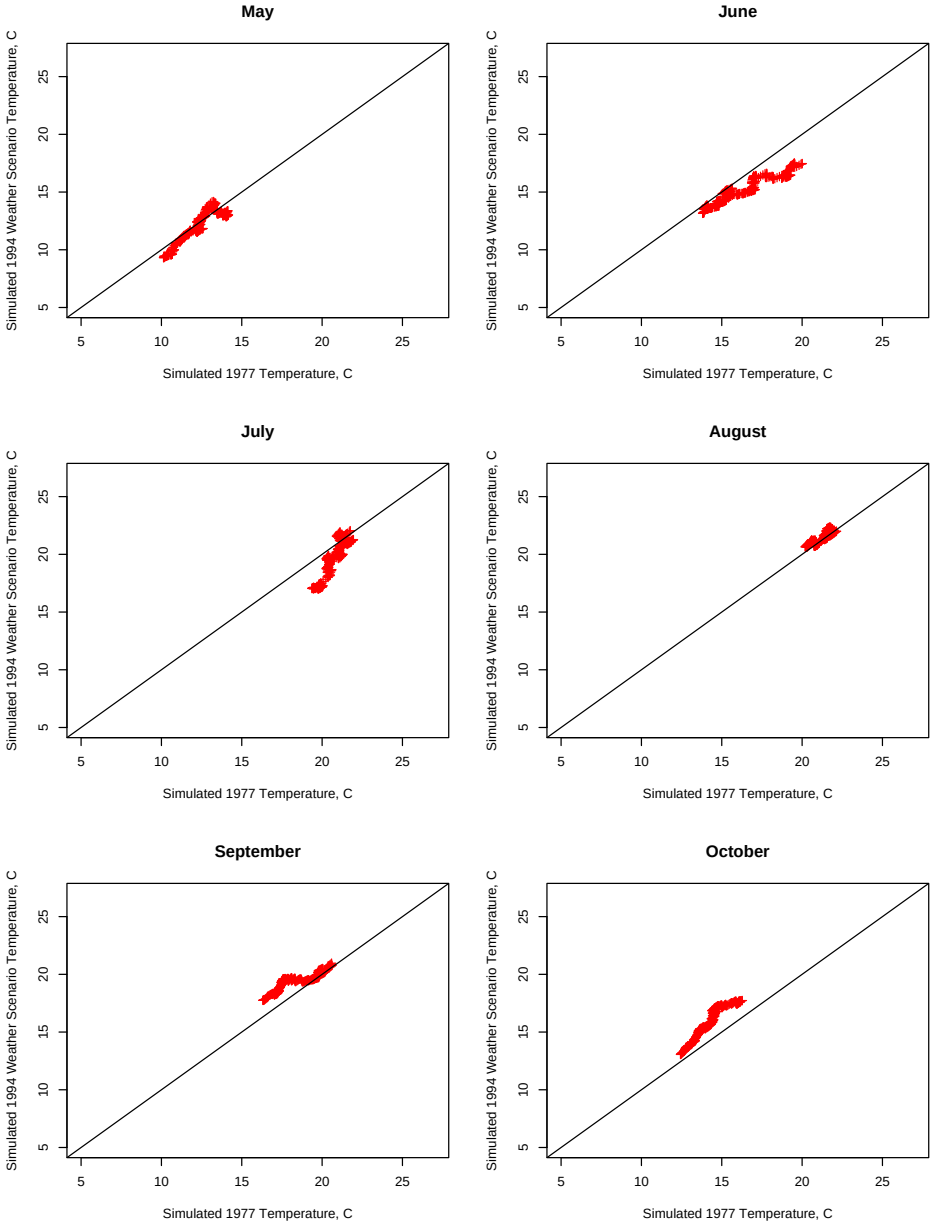

Figure 32: Scatter plot comparison, by month, at Bonneville forebay of the 1994 weather and 1977 conditions scenario.

Bonneville Forebay

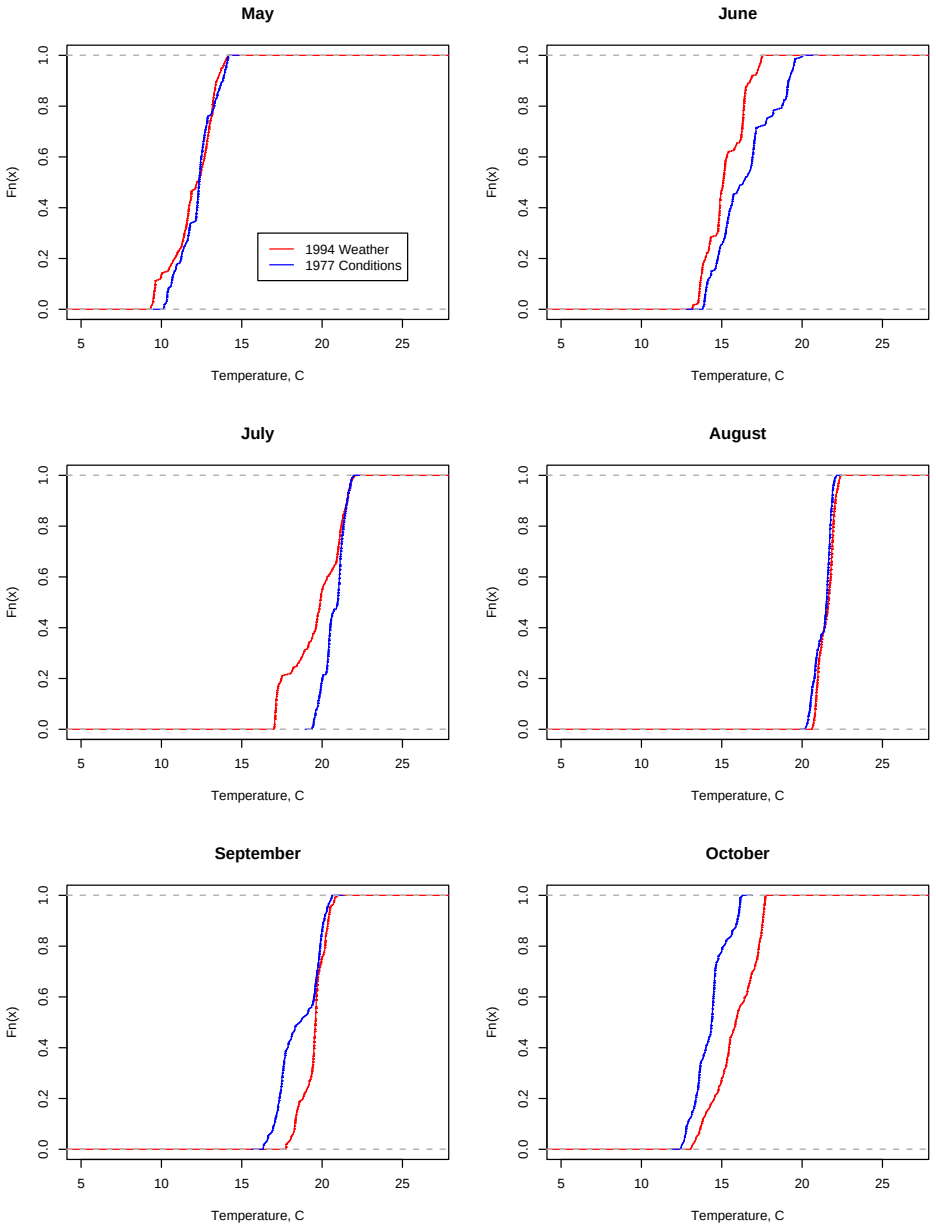

Figure 33: Cumulative frequency distribution (CFD) plot comparison, by month, at Bonneville forebay of the 1994 weather and 1977 conditions scenario.

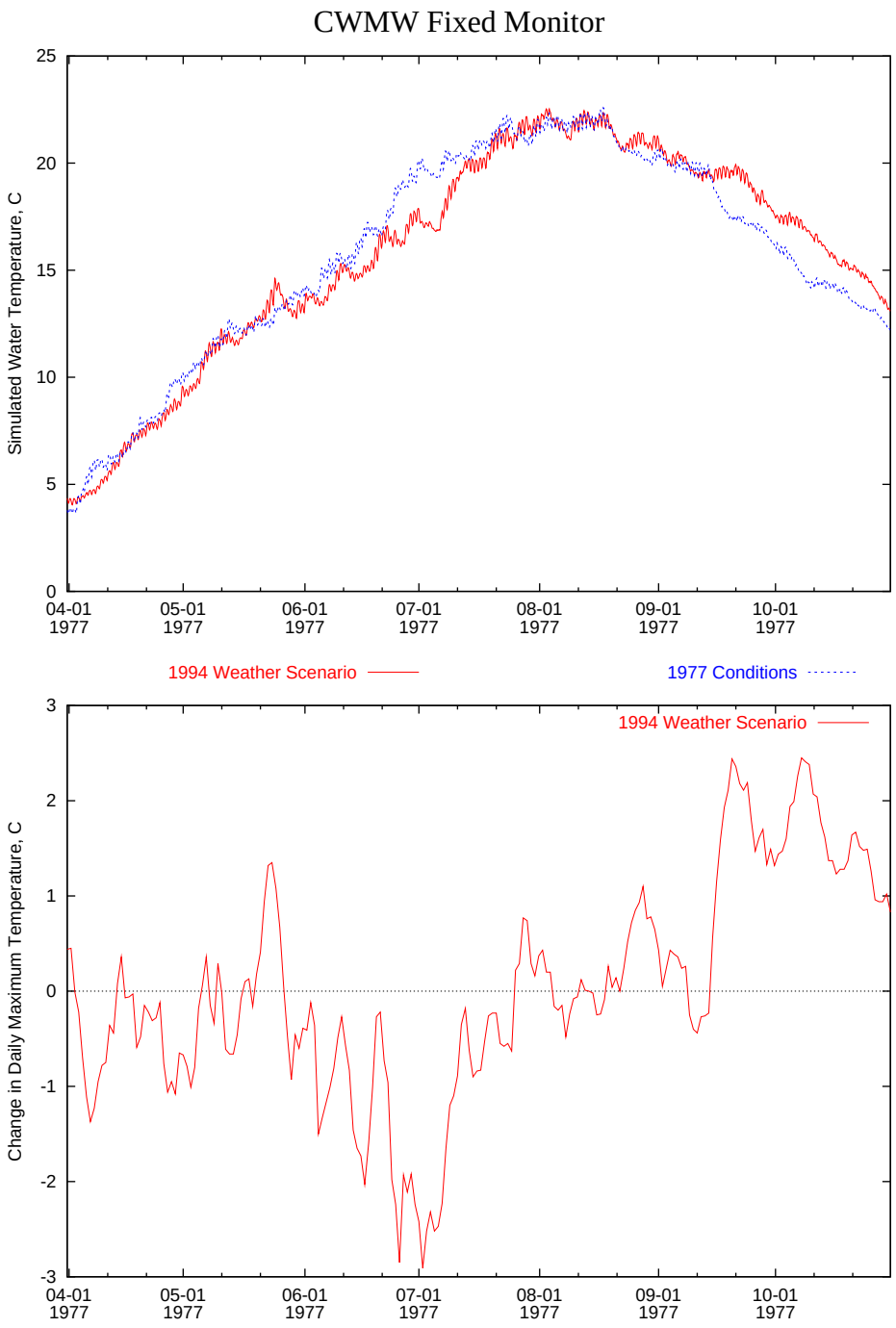

Figure 34: Time series comparison at Camas/Washougal fixed monitor of the 1994 weather and 1977 conditions scenario.

CWMW Fixed Monitor

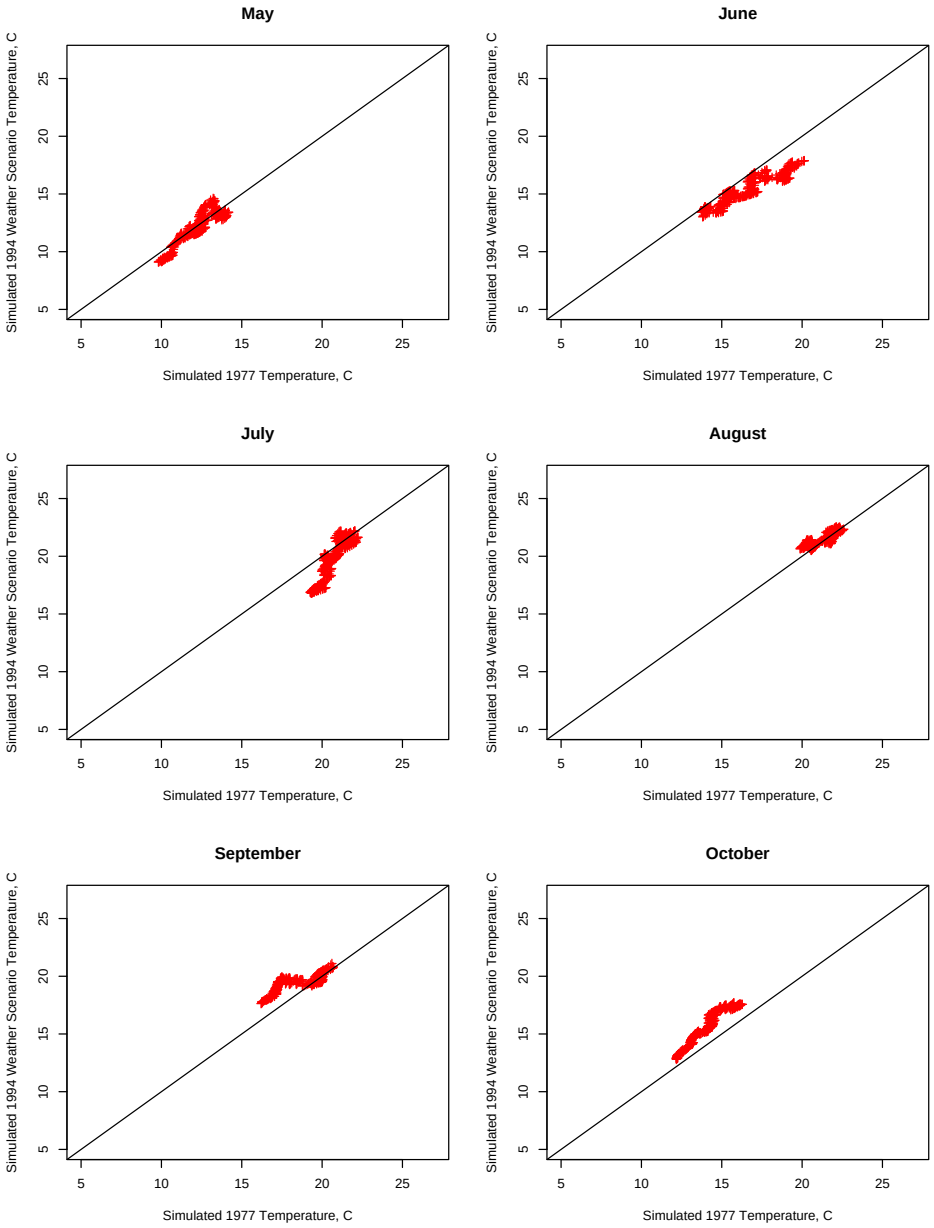

Figure 35: Scatter plot comparison, by month, at Camas/Washougal fixed monitor of the 1994 weather and 1977 conditions scenario.

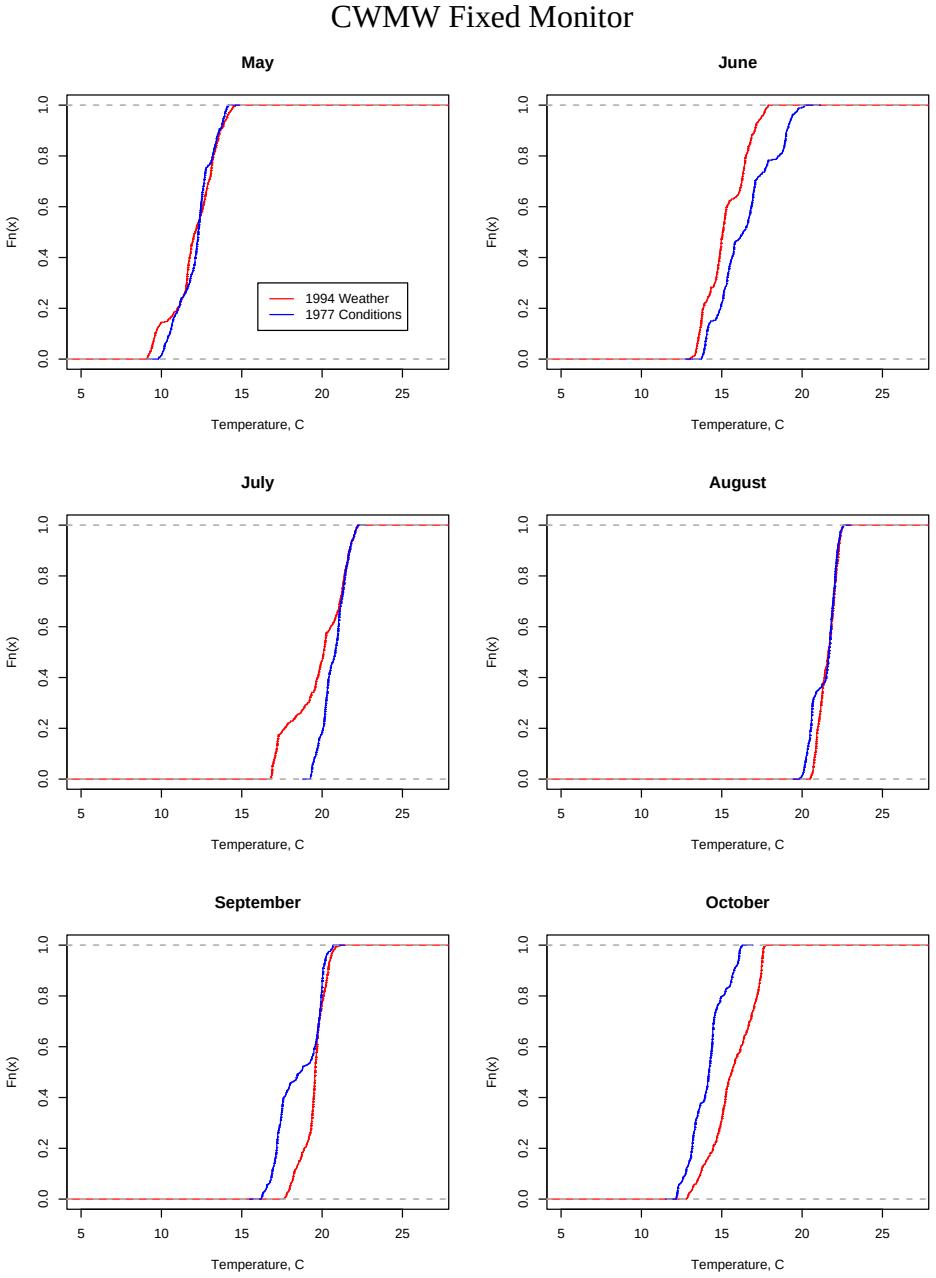

Figure 36: Cumulative frequency distribution (CFD) plot comparison, by month, at Camas/Washougal fixed monitor of the 1994 weather and 1977 conditions scenario.

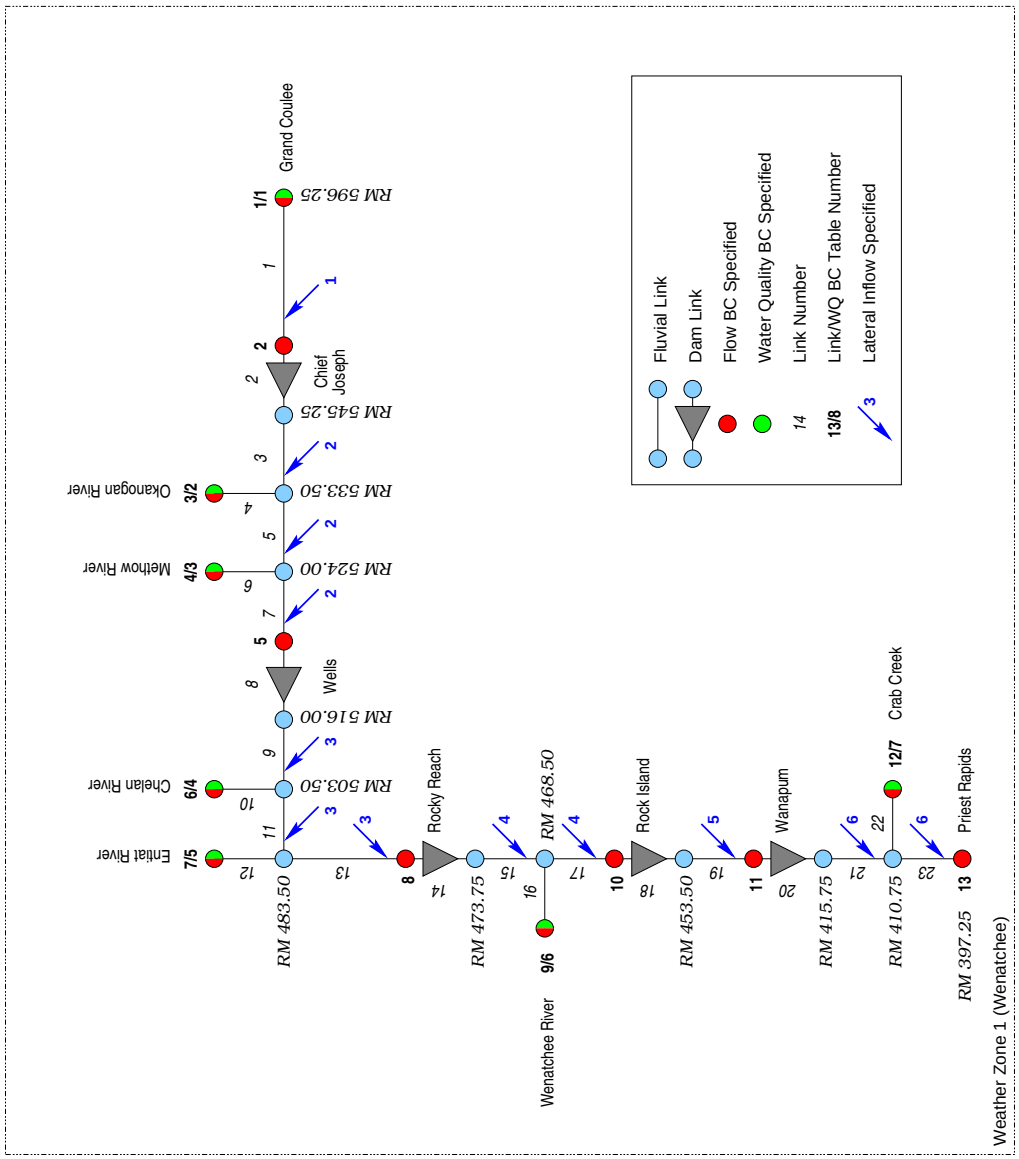

Figure 37: Schematic of MASS1 application to the mid-Columbia.

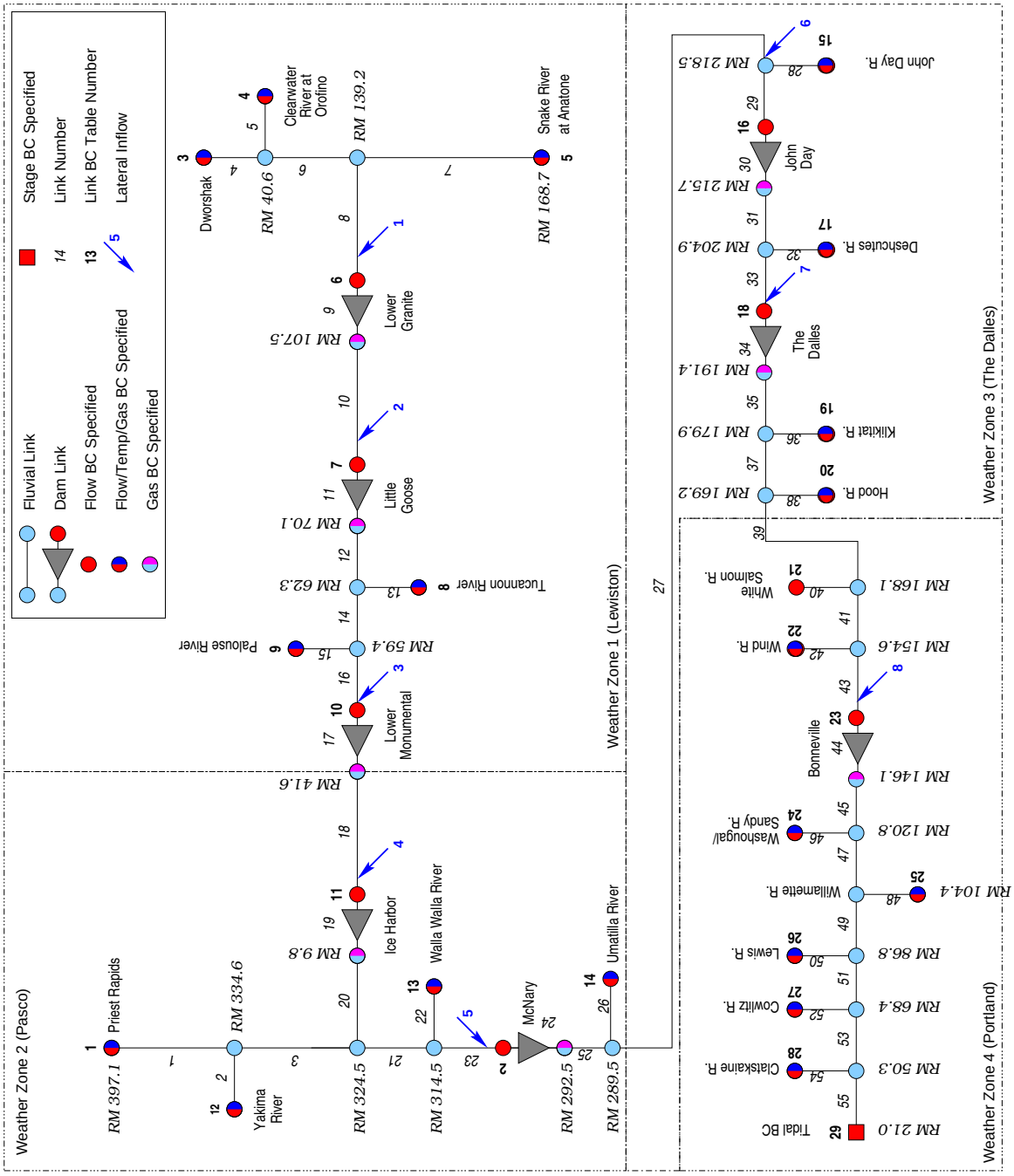

Figure 38: Schematic of MASS1 application to the lower Snake and Columbia Rivers.