There are good correlations between DOC and TOC and between DOC and UVA254 (Figure 3-9 and 3-10) over the entire range of concentrations. However, over the range of concentrations of most interest in surface waters, i.e., less than 20 mg/l, the correlations appear weaker, particularly between DOC and UVA254. UVA254 has been has been related to aromaticity of organic carbon and THMFP (see Chapter 2). These data call for measurements of all three parameters wherever possible, and are consistent with past reports that suggest organic carbon from multiple sources is less likely to have a clear DOC-UVA254 relationship.

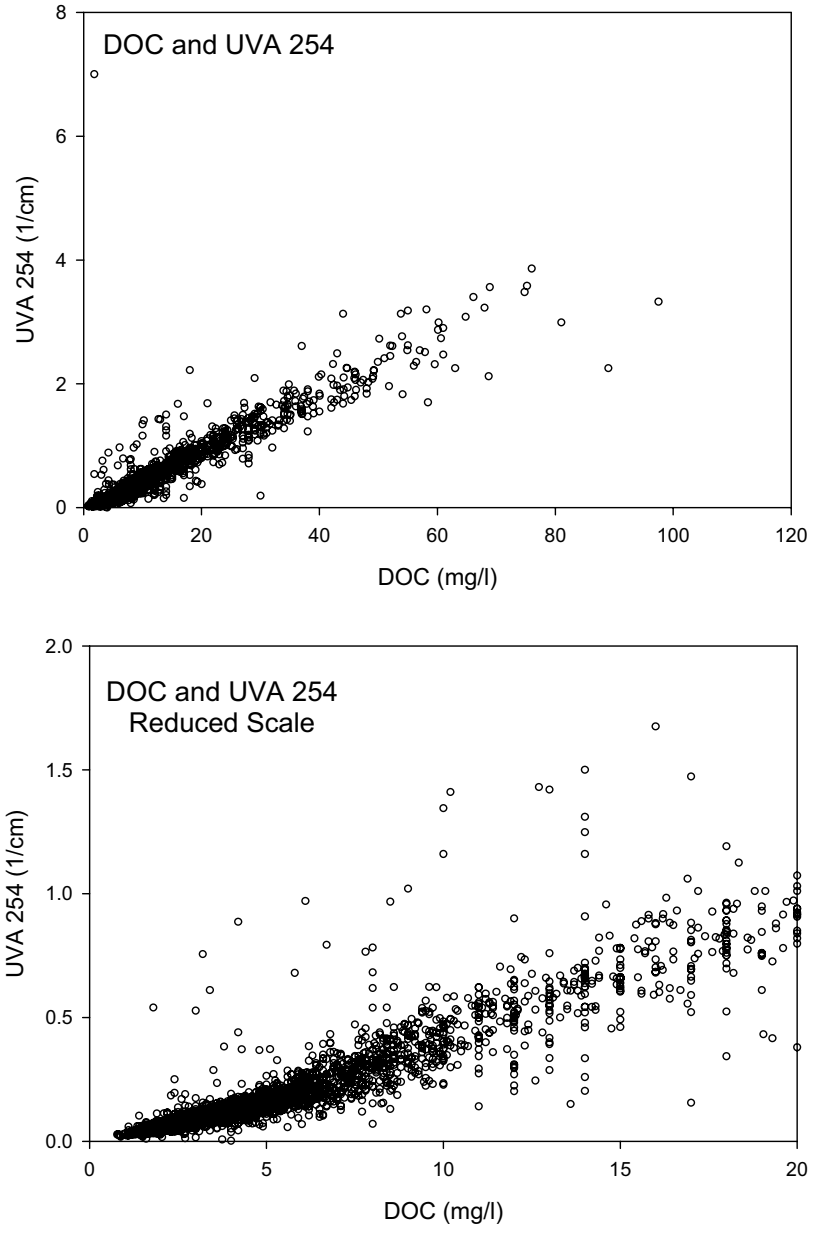

Figure 3-9. DOC and UVA254 at all stations in the database where contemporaneous measurements were available.

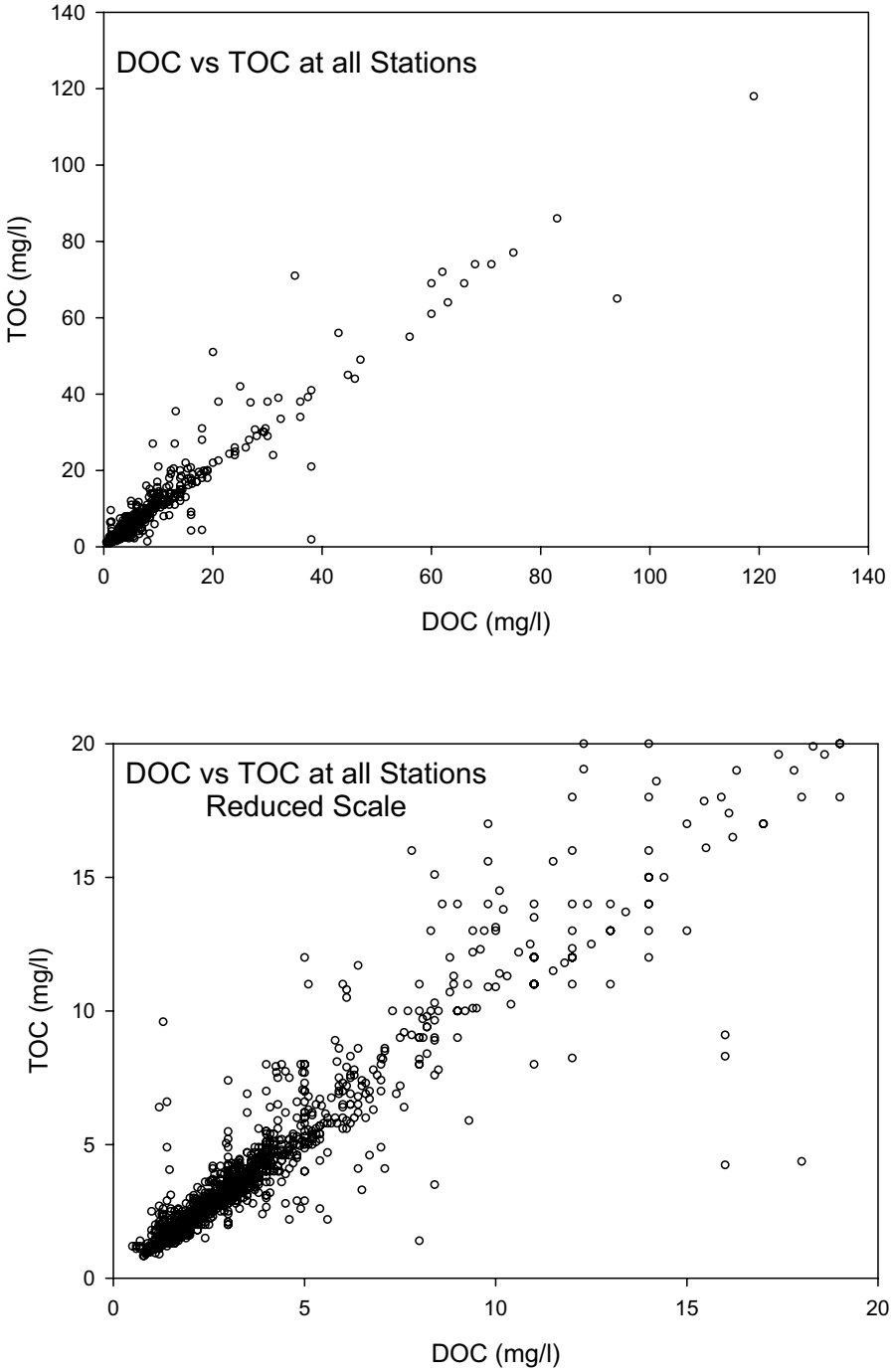

Figure 3-10. DOC and TOC at all stations in the database where contemporaneous measurements were available.

Trends along the main stem of the two major rivers were examined through box plots. Figure 3-11 and 3-12 show the TOC concentrations by station moving from upstream to downstream for the Sacramento and San Joaquin Rivers. An interesting and contrasting trend emerges. The Sacramento River concentrations increase from upstream to downstream, possibly due to the addition of organic carbon from anthropogenic (human) sources. In the San Joaquin River (downstream of Sack Dam), concentrations first increase then decrease as the river flows downstream. Immediately downstream of Sack Dam, the river is dominated by agricultural drainage which is diluted as the river flows downstream by flows from other sources with lower concentrations, principally the tributaries on the east side of the valley.

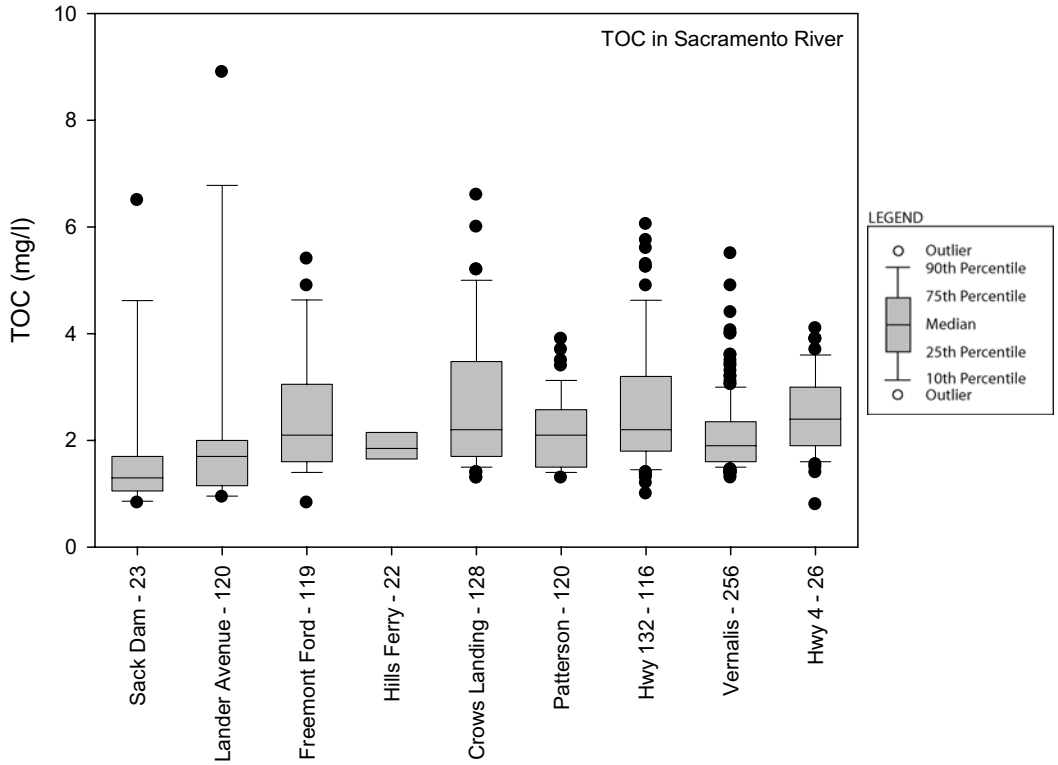

Figure 3-11. TOC at various locations in Sacramento River. The number of data points is shown after each station name.

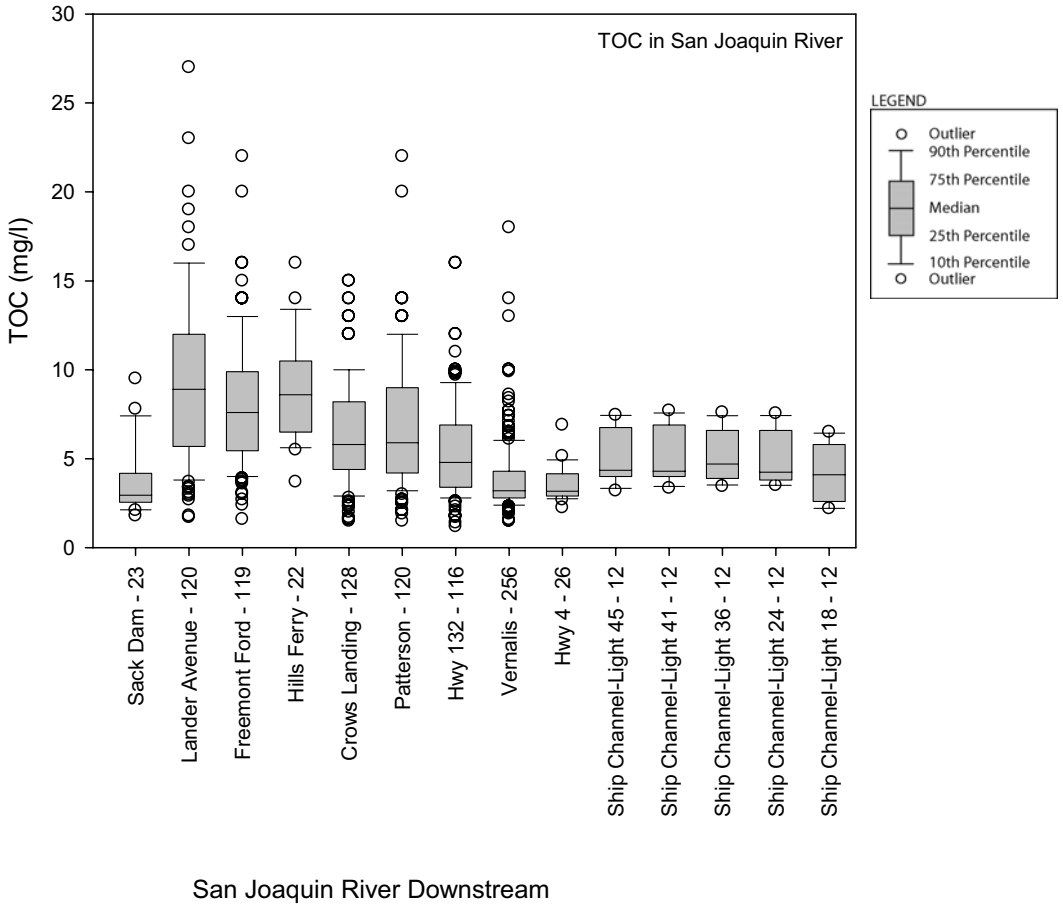

Figure 3-12. TOC at various locations in San Joaquin River. The number of data points is shown after each station name.

Seasonal patterns in concentration can also be explored through box plots as shown in Figures 3-13 and 3-14. In each of the figures, three plots display concentrations at locations moving downstream. As with the previous set of figures, there are important differences between the Sacramento and San Joaquin Basins. In the Sacramento River, the highest concentrations are associated with the wet months, with relatively lower concentrations in the dry months. Moving downstream, the seasonal variation of data decreases, as evidenced by greater uniformity of concentrations at Mallard Island than at Freeport. In the San Joaquin River, the highest concentrations are observed in the dry months when the flows are dominated by agricultural drainage. Organic carbon concentrations in the San Joaquin River are substantially higher than in the Sacramento River.

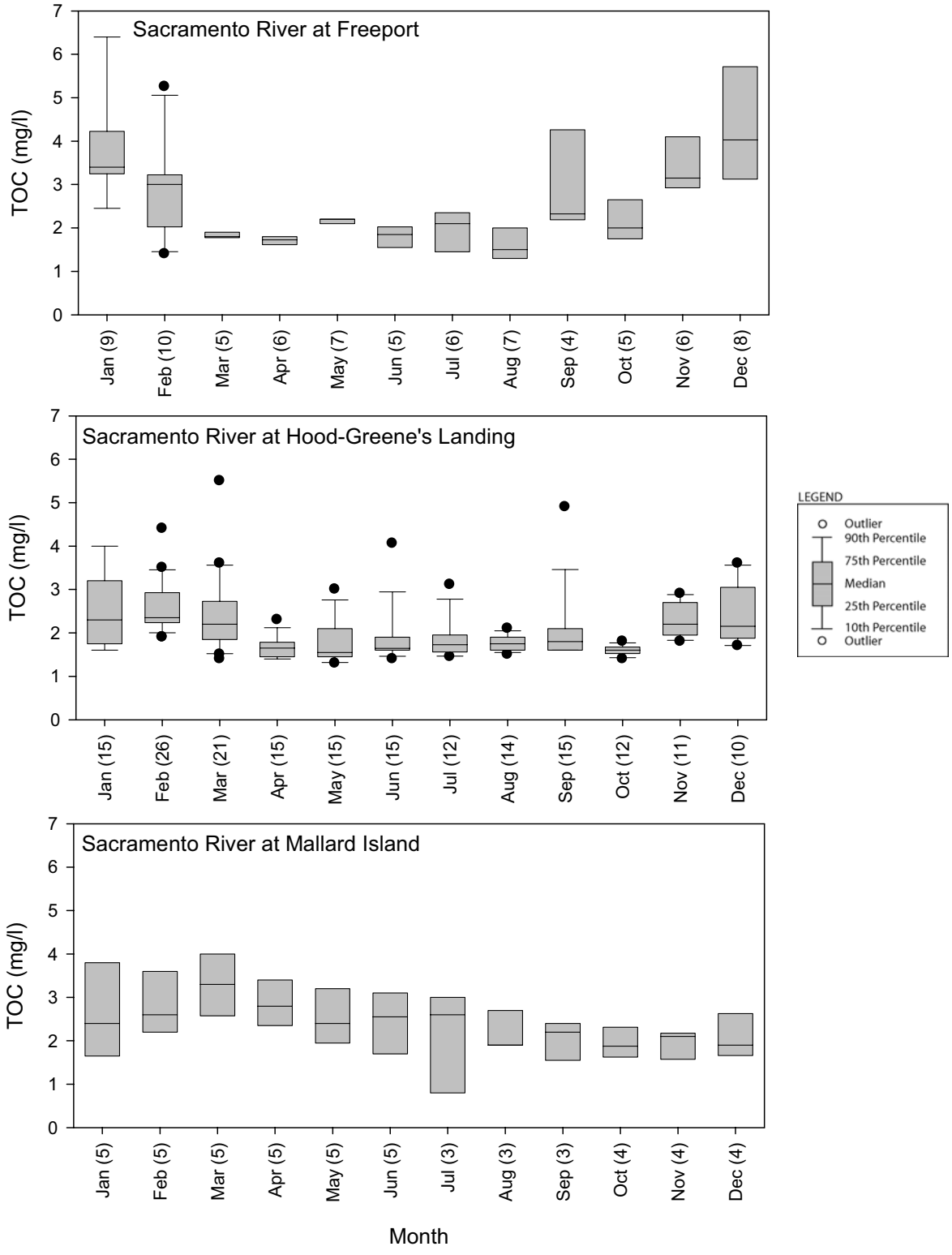

Figure 3-13. Temporal variation in concentrations at key locations in the Sacramento River. The number of data points is shown after each month.

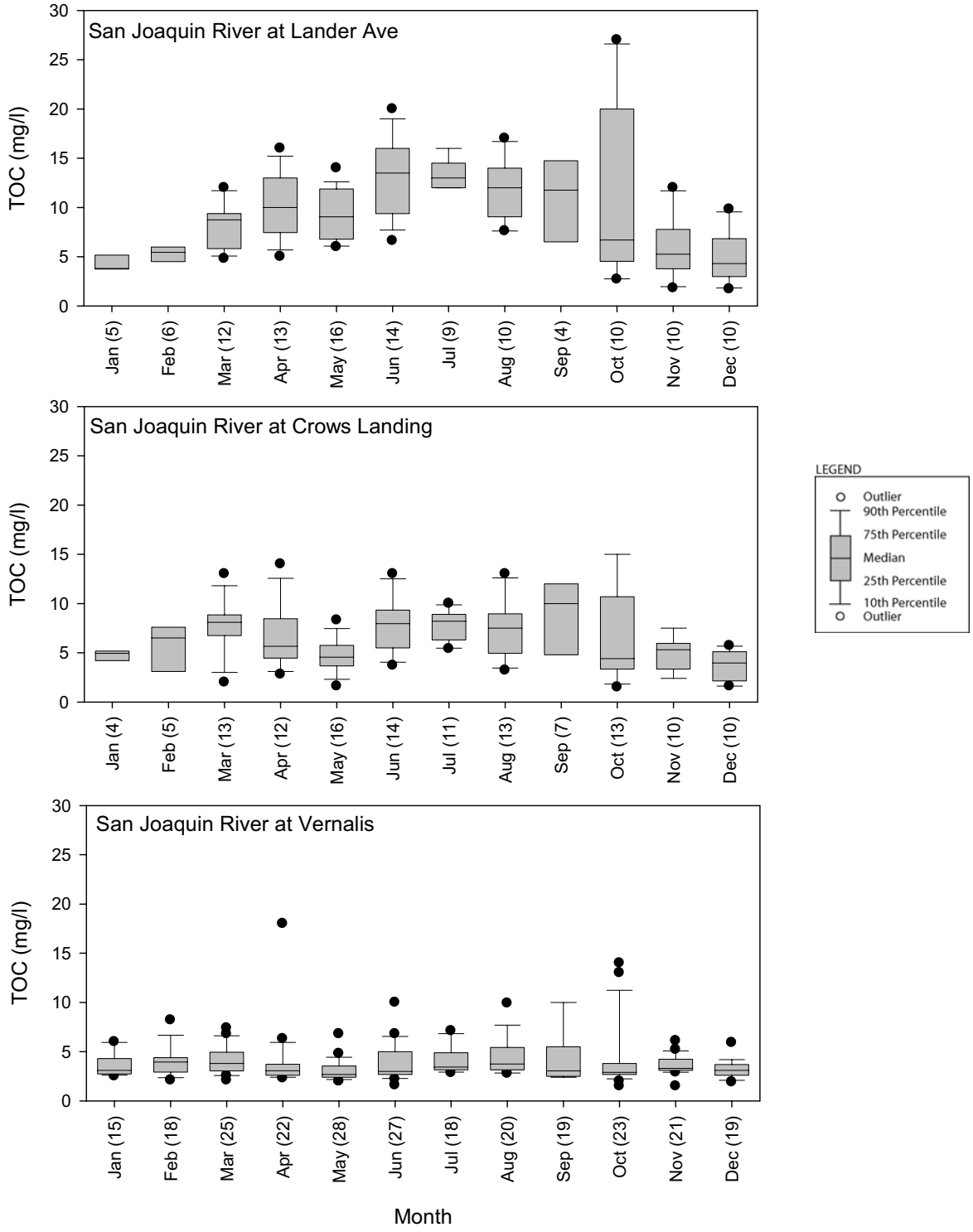

Figure 3-14. Temporal variation in TOC concentrations at key locations in San Joaquin River. The number of data points is shown after each month.

3.2 ADDITIONAL DATA USED

In addition to the values in the database discussed above, some additional sources of information were also gathered for this analysis. This includes flow data, which are used in combination with concentration data to estimate loads, and some additional chemistry data. The data described below refer specifically to data that were manipulated and/or analyzed for the purpose of this work. Analyses presented by other authors in published papers and reports are cited throughout this report.

3.2.1 FLOW DATA

The USGS has an extensive network of flow monitoring stations throughout California (Figure 3-15). Daily stream discharge data were obtained from the United States Geological Survey (USGS) from http://nwis.waterdata.usgs.gov/usa/nwis/discharge at selected locations for which loads were estimated. These locations primarily corresponded to the outflow locations of the major tributaries of the Sacramento and San Joaquin Rivers. A detailed evaluation of the flow data is presented in Appendix B. Additional flow data for the Delta region (including outflows in municipal/industrial intakes) were obtained from a computer model called DAYFLOW (supported by California Department of Water Resources, and available electronically from http://www.iep.ca.gov/dayflow/index.html). DAYFLOW uses historical pumping records where available, and this data is in the most convenient form for use and manipulation. Load estimates using the USGS and DAYFLOW values are presented in Chapters 4 and 5.

3.2.2 CHEMISTRY DATA

A major additional source of chemistry data was the Municipal Water Quality Investigations (MWQI) Program, from which data was obtained electronically for this task from http://wdl10.water.ca.gov/wq/mwqi/mwqimap.cfm. MWQI data through 2000 were included in the Drinking Water Policy Database; however, data from 2000 to the present were entered into DWR's Water Data Library. The MWQI Program obtains grab sample data on TOC, DOC, and UVA254 at 10 locations around the Delta. Limited data were also obtained from the MWQI real time monitoring program at selected locations around the Delta (http://wq.water.ca.gov/mwq/toc/tocpage.htm). Other chemistry data sources included a database of USGS and EPA data compiled for the purpose of evaluating organic carbon loads in the Central Valley (Saleh, et al., 2003). Additional data from MWQI and Saleh et al. (2003) are included in the data summary provided in Appendix A.

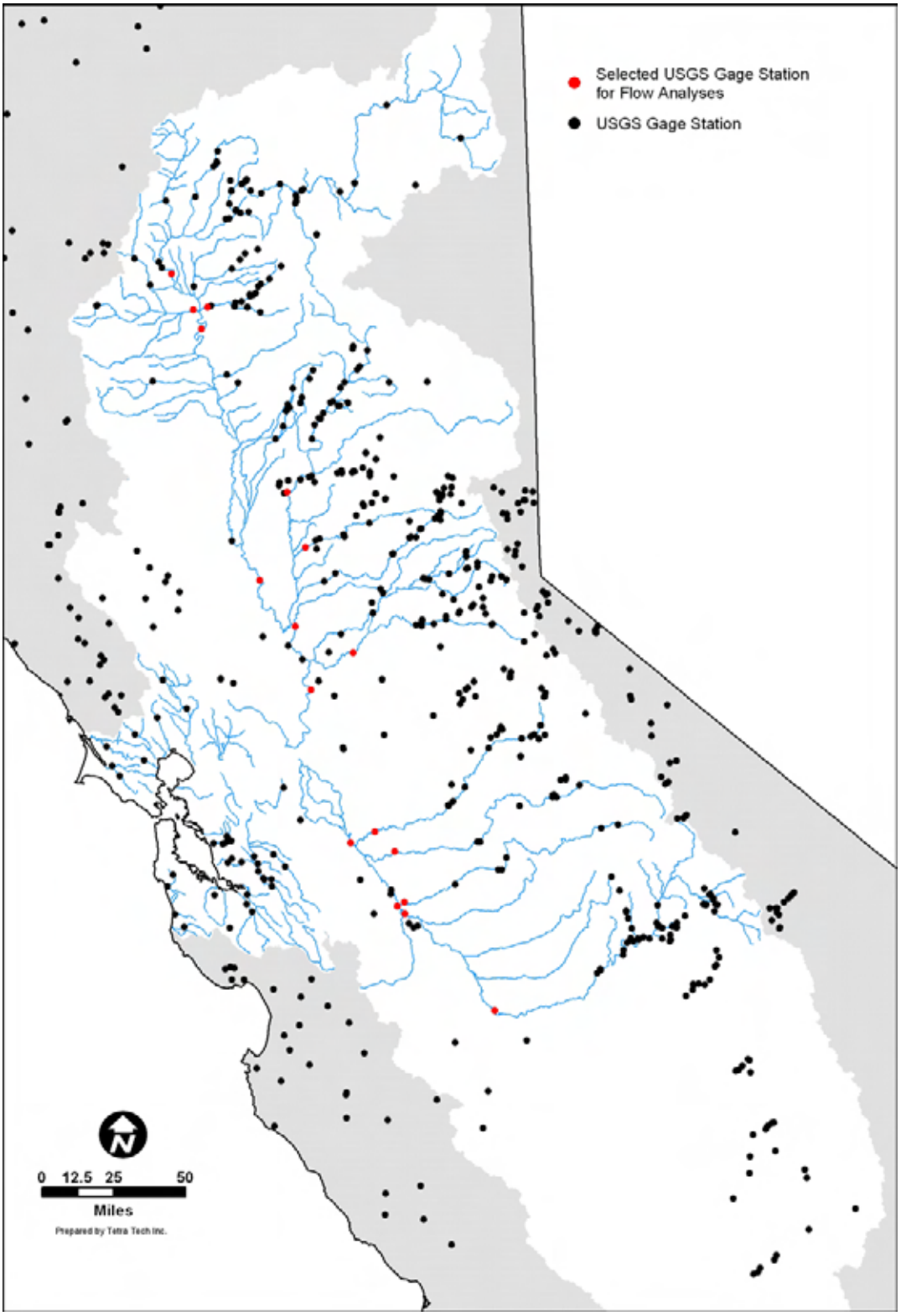

Figure 3-15. Stations with continuous flow records available through the USGS (on the internet at http://nwis.waterdata.usgs.gov/usa/nwis/discharge). Flow records for different stations exist over different time periods.

3.3 MAJOR FINDINGS

The vast majority of the organic carbon data in the database, compiled by the Central Valley Drinking Water Policy Workgroup, consisted of measurements of TOC, DOC, and UVA at 254 nm. Most stations reported one or two of these parameters, with very few reporting all three. Data on other parameters, such as THMFP, were not present in this database. Point source data on organic carbon were limited to three wastewater treatment plants. Flow data were not part of the database and were obtained from other publicly available sources.

Most of the data are collected in and near the Delta, with relatively limited sampling in the upper portions of the watershed. There was very little information on the organic carbon concentrations in reservoir releases, although reservoirs and their upstream watersheds together comprise a large portion of the overall watershed area.

Box plots provided a quick summary of the available data, and showed clearly the elevated DOC/TOC concentrations in the San Joaquin Basin and in the Delta agricultural drains. At most locations, much of the TOC is present as DOC, although the percentage varies by location and by season. The Sacramento and San Joaquin Rivers show interesting trends, with the former exhibiting the highest concentrations in wet months, and the latter the highest concentrations in dry months.