

Flow Science Incorporated
723 E. Green Street
Pasadena CA 91101
(626) 304-1134 • Fax (626) 304-9427



LAKE MEAD 2006 MODEL CALIBRATION

JANUARY 2009 QUARTERLY REPORT

Prepared for
National Park Service

Reviewed by
E. John List, Ph.D., P.E.

Reviewed by
Imad A. Hannoun, Ph.D., P.E.

Prepared by
Al Preston, Ph.D.

FSI 064081
January 2, 2009



JANUARY 2009 QUARTERLY REPORT

This document summarizes the progress through December 2008 on the calibration of the Lake Mead ELCOM/CAEDYM model for the year 2006. An outline of the work that is expected to be completed during the next three months is also included. Since the model calibration for year 2007 is being done in conjunction with 2006, this document also includes details of the 2007 calibration. However, it is noted that the year 2007 calibration is being done under a separate contract between Flow Science Incorporated and the Clean Water Coalition.

WORK PERFORMED TO DATE

Data Gathering and Analysis

As summarized below, some additional data gathering and analysis were performed.

CCWRD WWTP Effluent Data

The flow rate and water quality data for the CCWRD WWTP effluent were obtained and analyzed together with the already gathered COH and COLV WWTP data. Particular emphasis was given to the phosphorus loads from the WWTP's and in the Las Vegas Wash. Figure 1 shows plots of the mass load of TP computed from the WWTP data and the LVW data. The two data-sets show good agreement with each other. The annual and growing season averaged TP loads for years 1999 through 2007 are plotted in Figure 2. The TP loads in 2006 and 2007 were comparable to the loads in 2004 and higher than the loads in 2005.

USGS Platform Data

Six-hourly profile data for temperature, conductivity, pH, dissolved oxygen and fluorescence were gathered from the USGS platforms on Lake Mead at Las Vegas Bay, Sentinel Island, Virgin Basin, and Overton Arm (see Figure 3). These data are plotted as color contours as a function of time and depth in Figures 4 through 8 for years 2006 and 2007. The plots indicate that the data-sets are of good quality with fewer gaps than in previous years. These data will be useful for model comparison.

Initial comparisons between the fluorescence data and the USBR and SNWA chlorophyll *a* data have been made and plotted in Figures 9 through 14. There is some correlation between the fluorescence and chlorophyll *a* data, which is most evident in the Las Vegas Bay where the chlorophyll *a* concentrations are higher. In particular the comparison of the Las Vegas Bay fluorescence data with the SNWA data at LVB3.5 (Figure 13) indicates reasonable correlation. Future work will focus on trying to quantify and formalizing this correlation.

In-Reservoir Water Quality Data

Water quality data (temperature, conductivity, dissolved oxygen, pH, bromide, total organic carbon, chlorophyll *a*, phosphorus and nitrogen) have been gathered from the numerous sampling stations in Lake Mead (see Figure 3 for the locations of some selected stations). Data were gathered from the USBR, COLV and SNWA. The physical data have all been processed and formatted to enable plotting in Tecplot and comparison with model results.

The COLV nutrient data have also been processed and formatted. However, there were some issues with the format of the SNWA and USBR nutrient data that were initially obtained from the SNWA database. These data have since been re-obtained in appropriate format and are in the process of being formatted for Tecplot.

Construction of Model Input

Preliminary model input files have all been constructed as detailed below:

1. Meteorology. These include daily rainfall data and hourly data for air temperature, relative humidity, solar radiation, wind speed and wind direction at Sentinel Island. Wind speed and direction data from the Virgin Basin and Overton Arm (see Figure 3) have also been developed for application to the upper basins.
2. Inflow/outflow rates. These include inflow rates for the Las Vegas Wash, Colorado, Virgin and Muddy Rivers and outflow rates for the Hoover Dam and SNWA intakes.
3. Inflow water quality parameters required for the physical model (ELCOM). These data include temperature, conductivity (and salinity), perchlorate and bromide for the Las Vegas Wash, Colorado, Virgin and Muddy Rivers.
4. Inflow water quality parameters required for the water quality model (CAEDYM). These data include dissolved oxygen, pH, total organic carbon, chlorophyll *a*, phosphorus and nitrogen for the Las Vegas Wash, Colorado, Virgin and Muddy Rivers.

Initial plots of the model input data have been made directly from the model input files as part of the quality checking process.

Preliminary Model Runs

ELCOM

Preliminary model runs with ELCOM only (temperature, salinity/conductivity, perchlorate and bromide) have been performed on both 300-m and 600-m grids. These simulation results have been plotted against in-reservoir field data and indicate reasonable agreement. However additional adjustments and simulations will be necessary to improve the results. These adjustments include reducing summer inflows in the Virgin River to account for diversions downstream from where the flow gauging station is located, as well re-examining other model input and possibly using alternative data sets. (i.e. data from different sampling agencies and/or different station locations).

CAEDYM

Preliminary model runs including CAEDYM (nutrients, pH, DO, chlorophyll *a*) are underway on the 600-m grid. These model runs are computed continuously from the beginning of 2005 through 2007 (i.e., three continuous years of simulation). Once completed, the results of these simulations will be plotted against the in-reservoir field data.

WORK TO BE COMPLETED IN NEXT QUARTER

The following briefly summarizes the modeling work that is expected to be completed within the next three months.

Data Analysis

Additional analysis will be made to formalize and quantify the correlation between fluorescence and chlorophyll *a*.

Data Formatting

The recently re-obtained USBR and SNWA in-reservoir data will be formatted to enable plotting in Tecplot and comparison with simulation results. This includes computing chlorophyll *a* and phosphorus growing season averages at all station locations in the lake.

Additional Model Calibration Runs

Additional model calibration runs will be conducted. These will involve potential debugging of the model or model input files, and extensive plotting of model results to

enable calibration of the model. Where appropriate, the model input data may be re-examined based upon the model results, and possible changes to the model input (such as using alternative data sets, isolating inflow water quality around storm dates, and/or adding additional water quality data points to represent dilution during storms) may be made.

Spatially Variable Sediment Oxygen Demand

The CAEDYM code will be modified to enable the implementation of spatially variable sediment oxygen demand (SOD). The three model years (2005 through 2007) will be re-run once this is complete to enable the appropriate values and distribution of SOD to be determined.

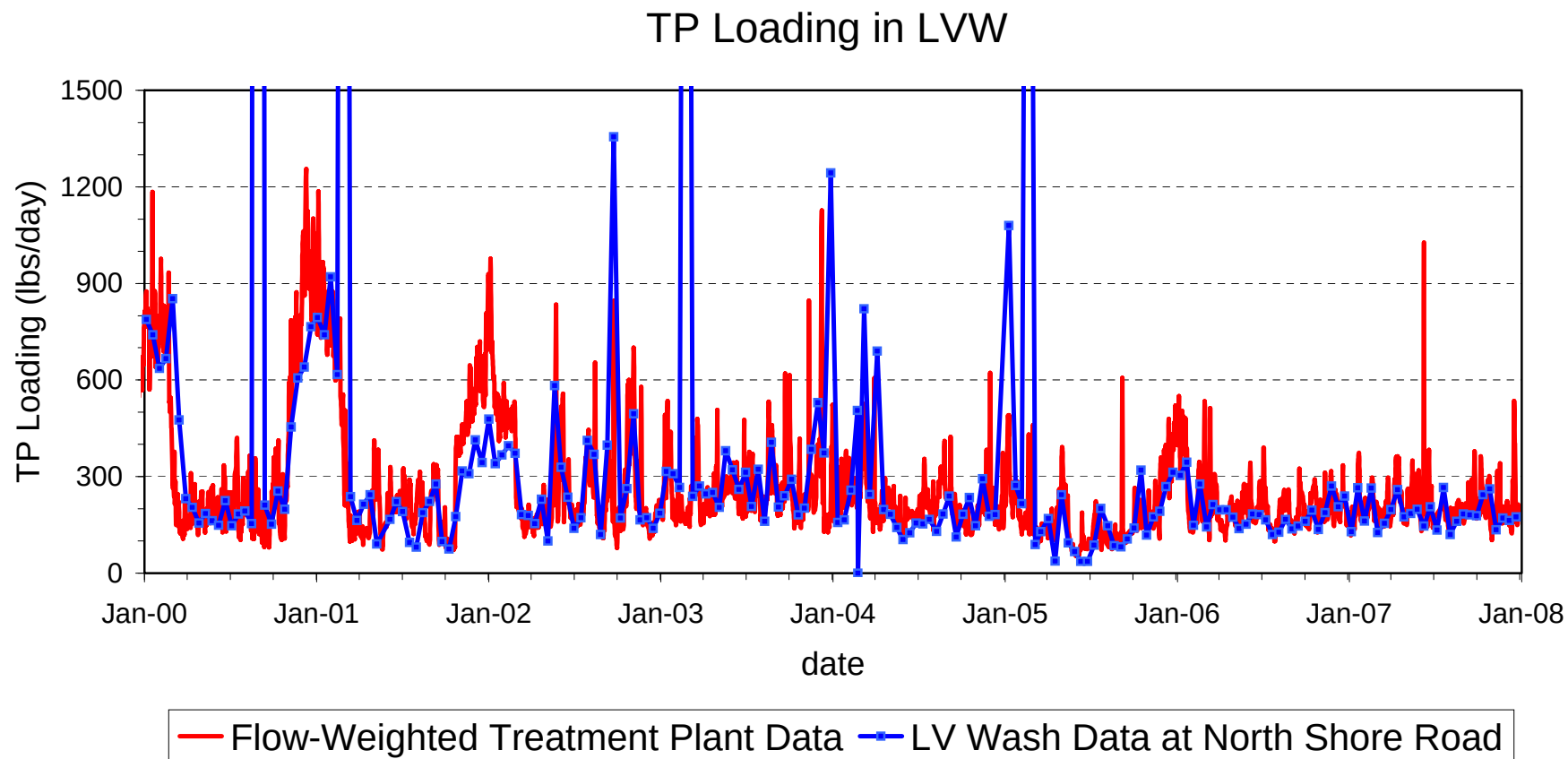
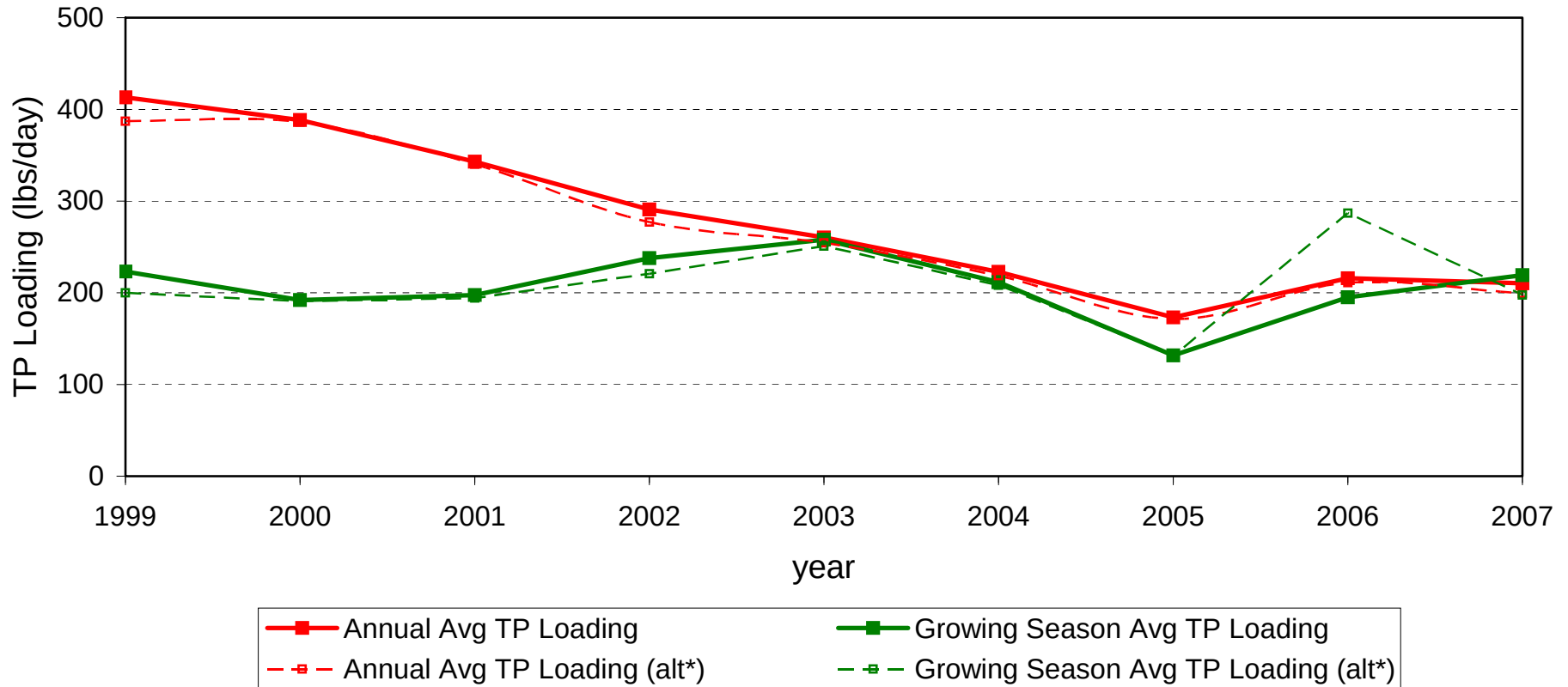


Figure 1

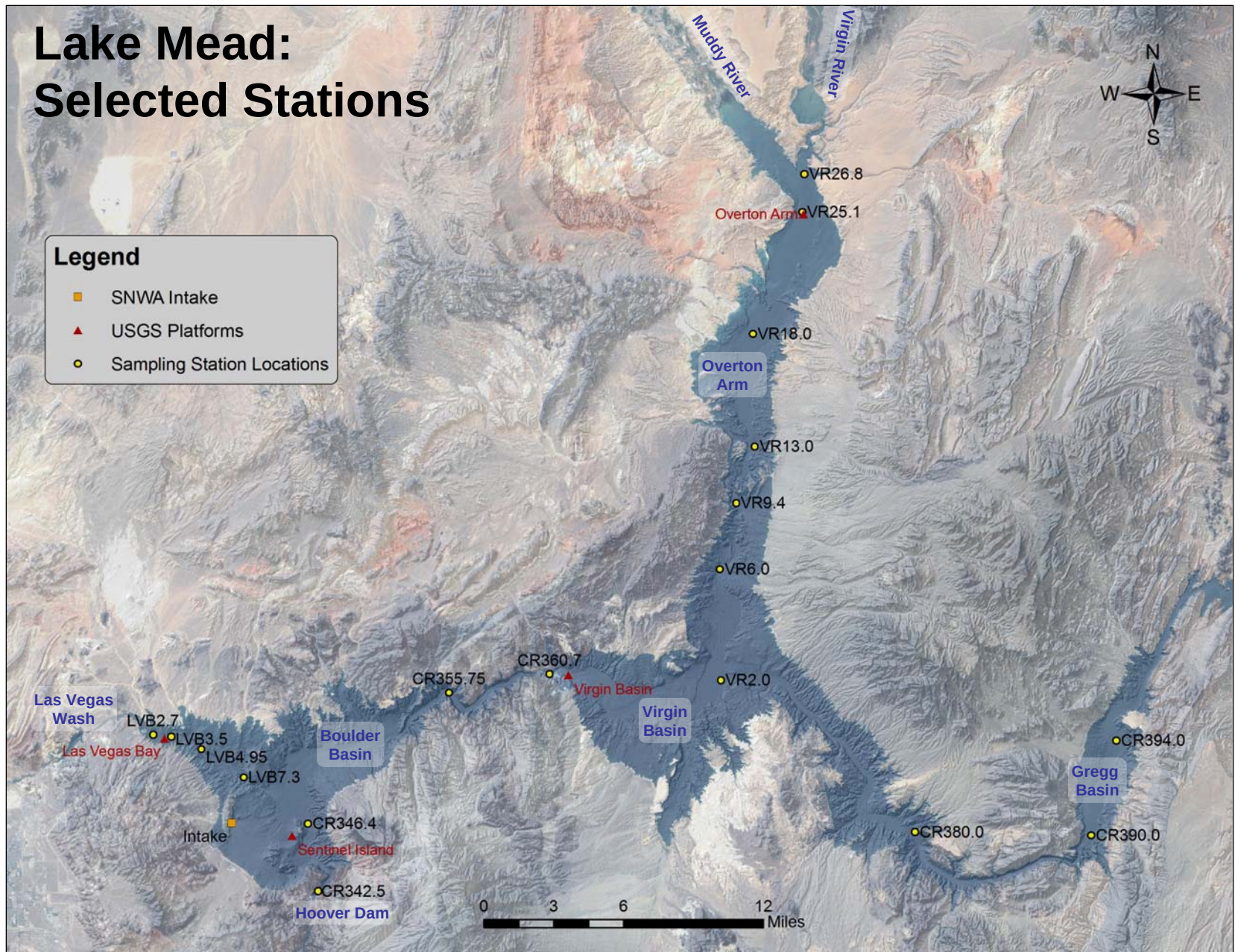
Average WWTP TP Loadings (Annual and Growing Season)



* Alternate computation of averages excludes dates where there are no data and/or no flow.

Figure 2

Lake Mead: Selected Stations



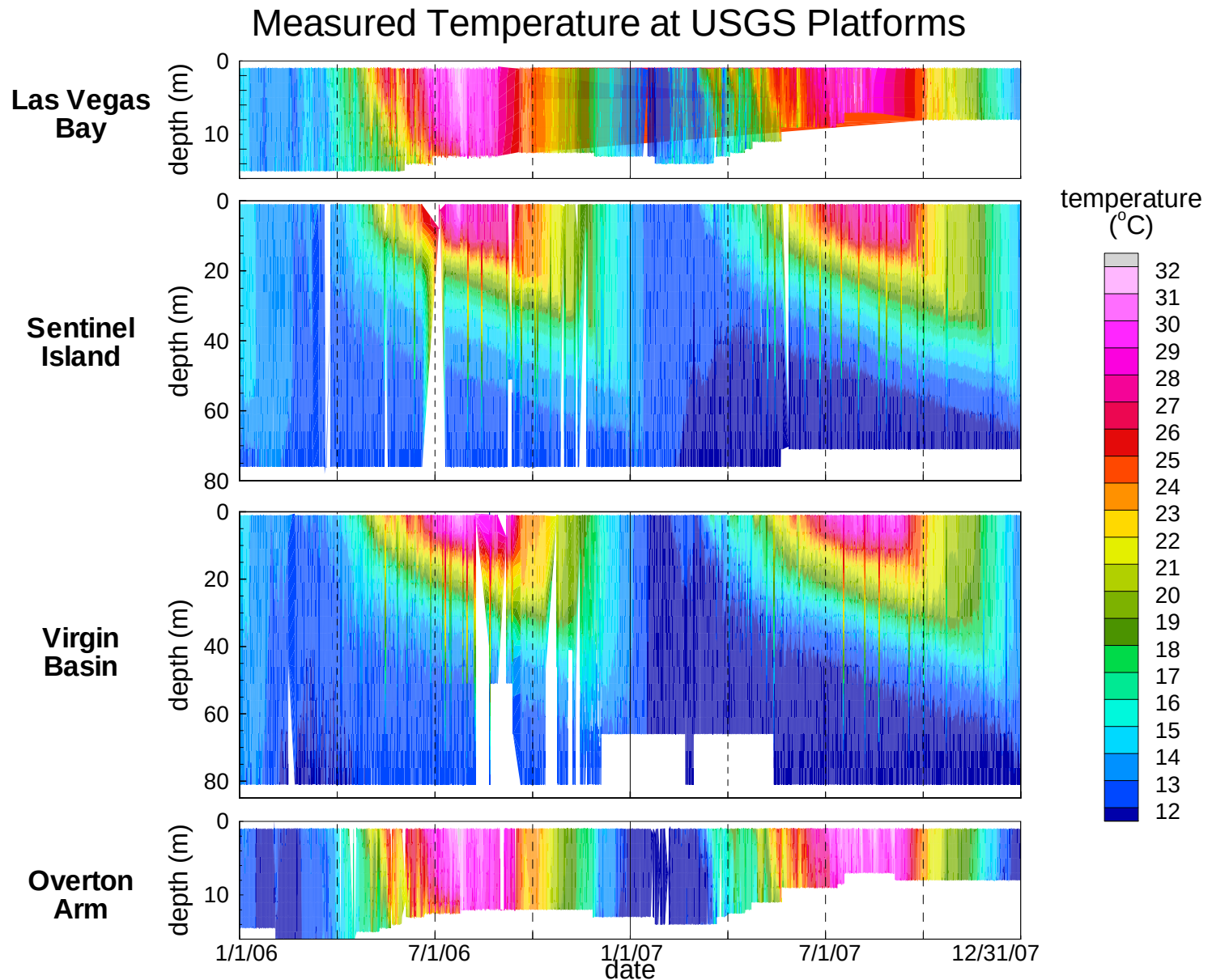
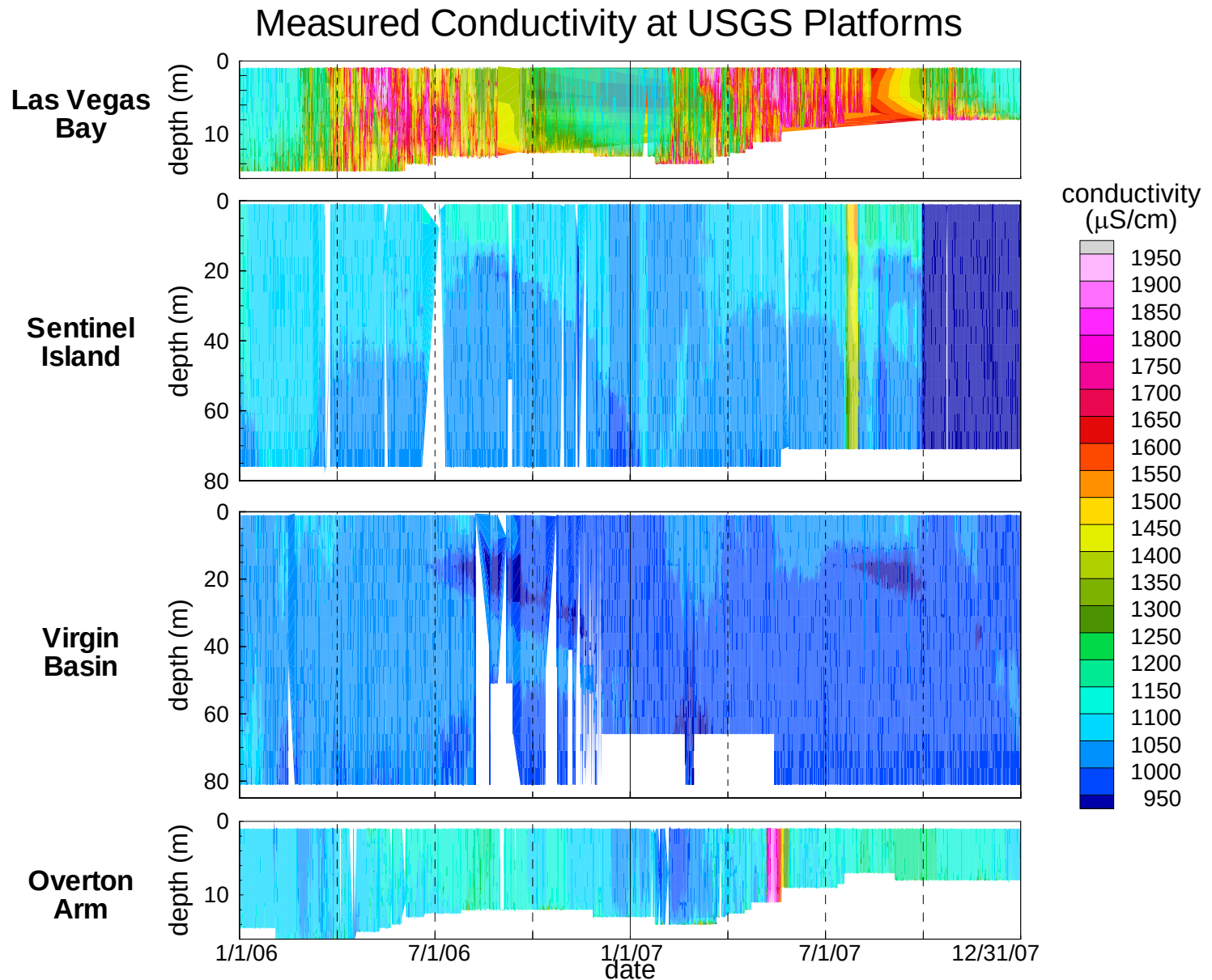


Figure 4



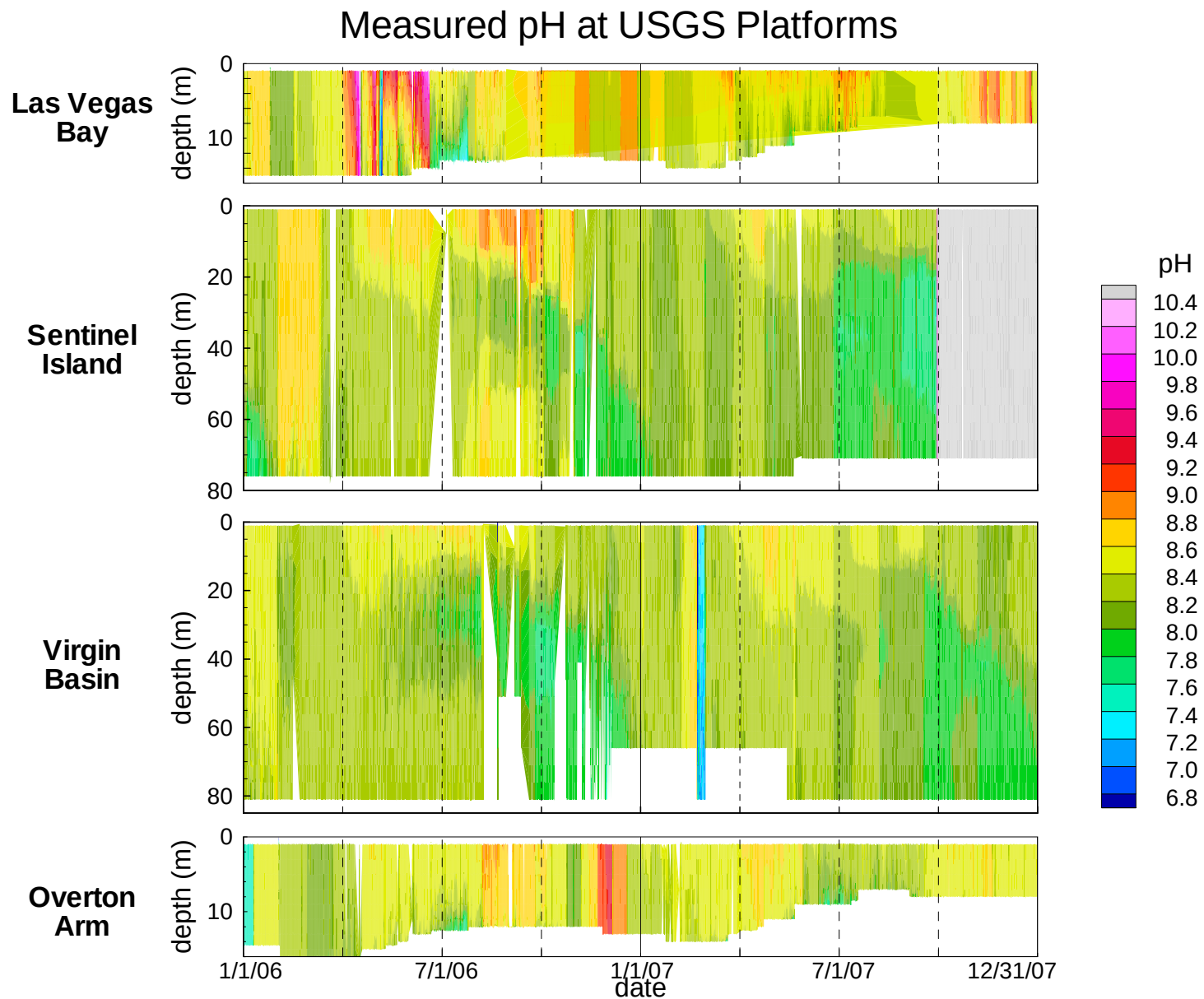


Figure 6

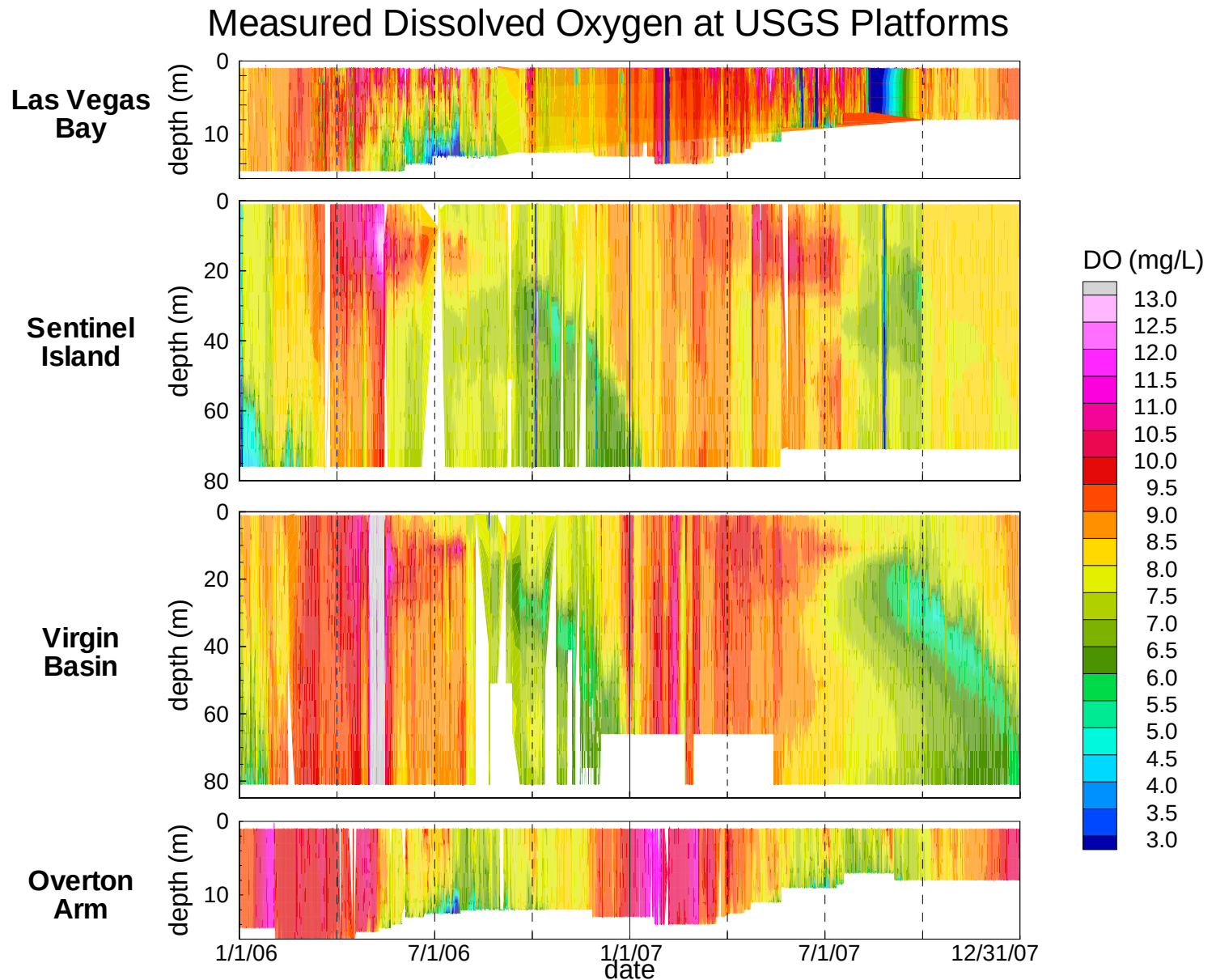


Figure 7

Measured Fluorescence at USGS Platforms

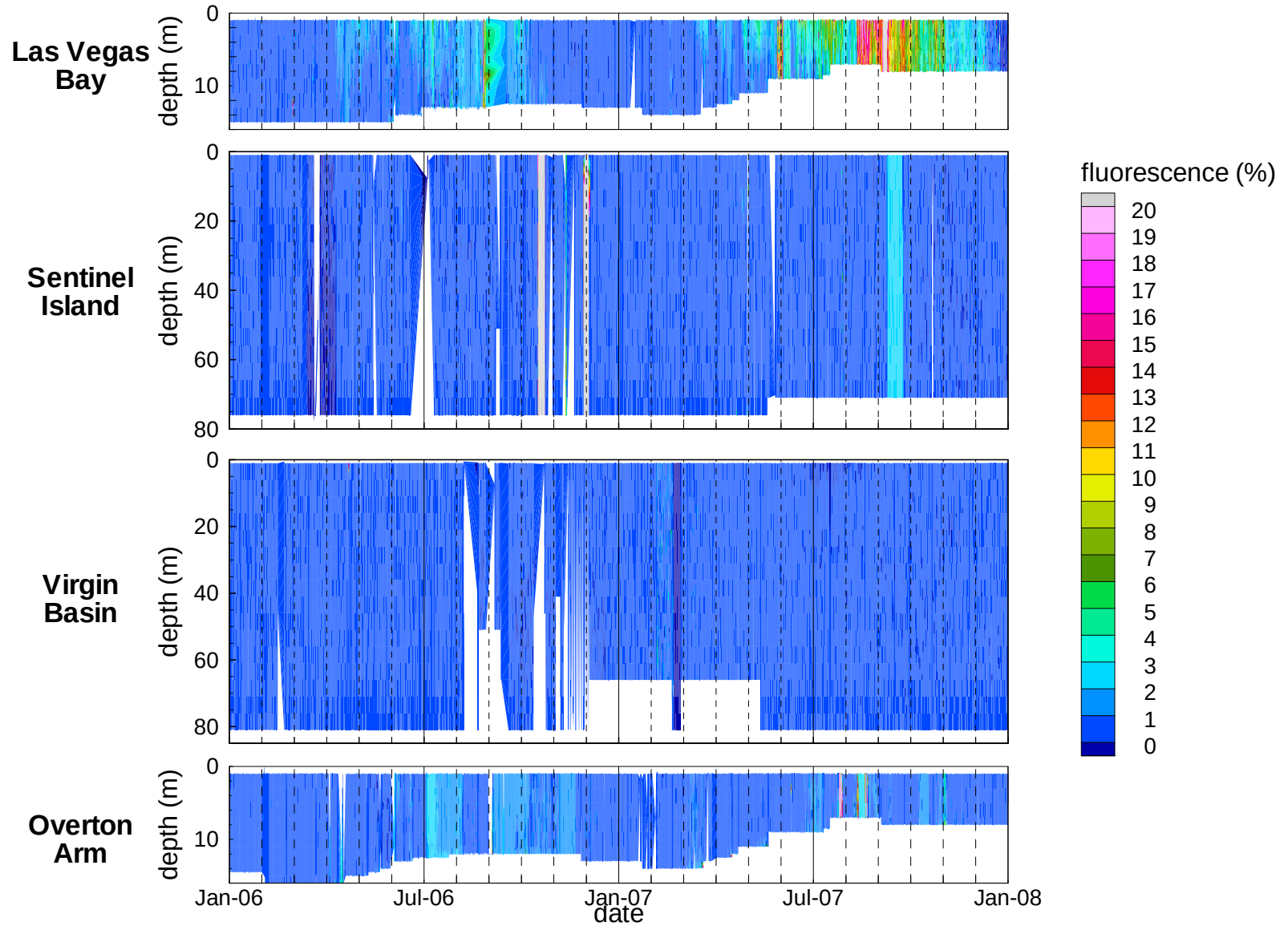


Figure 8

Measured Chlorophyll a and Fluorescence

USBR Station LVB3.5 and USGS Platform Las Vegas Bay Site 3

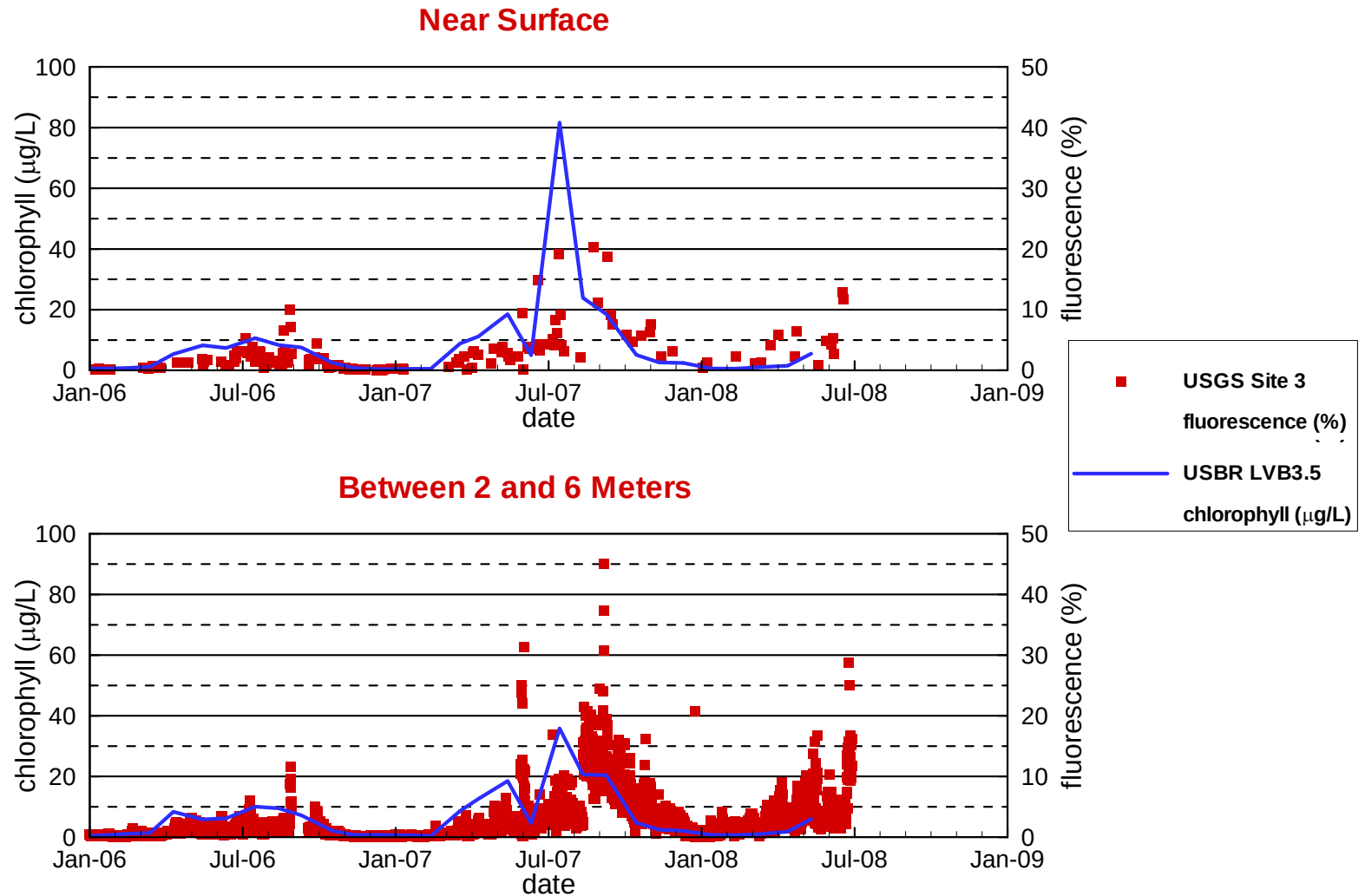
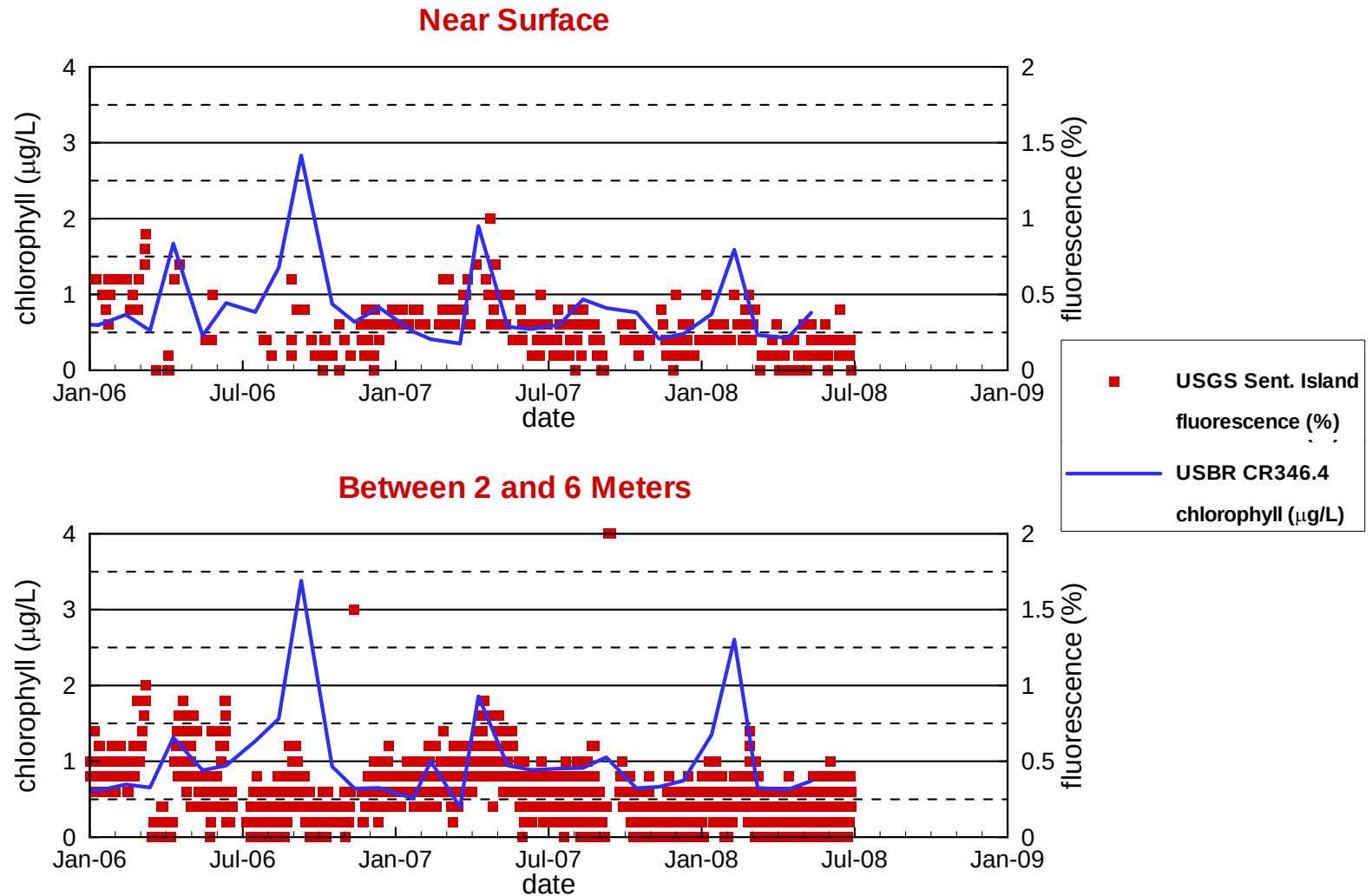


Figure 9

Measured Chlorophyll a and Fluorescence

USBR Station CR346.4 and USGS Platform Sentinel Island



Measured Chlorophyll a and Fluorescence

USBR Station CR360.7 and USGS Platform Virgin Basin

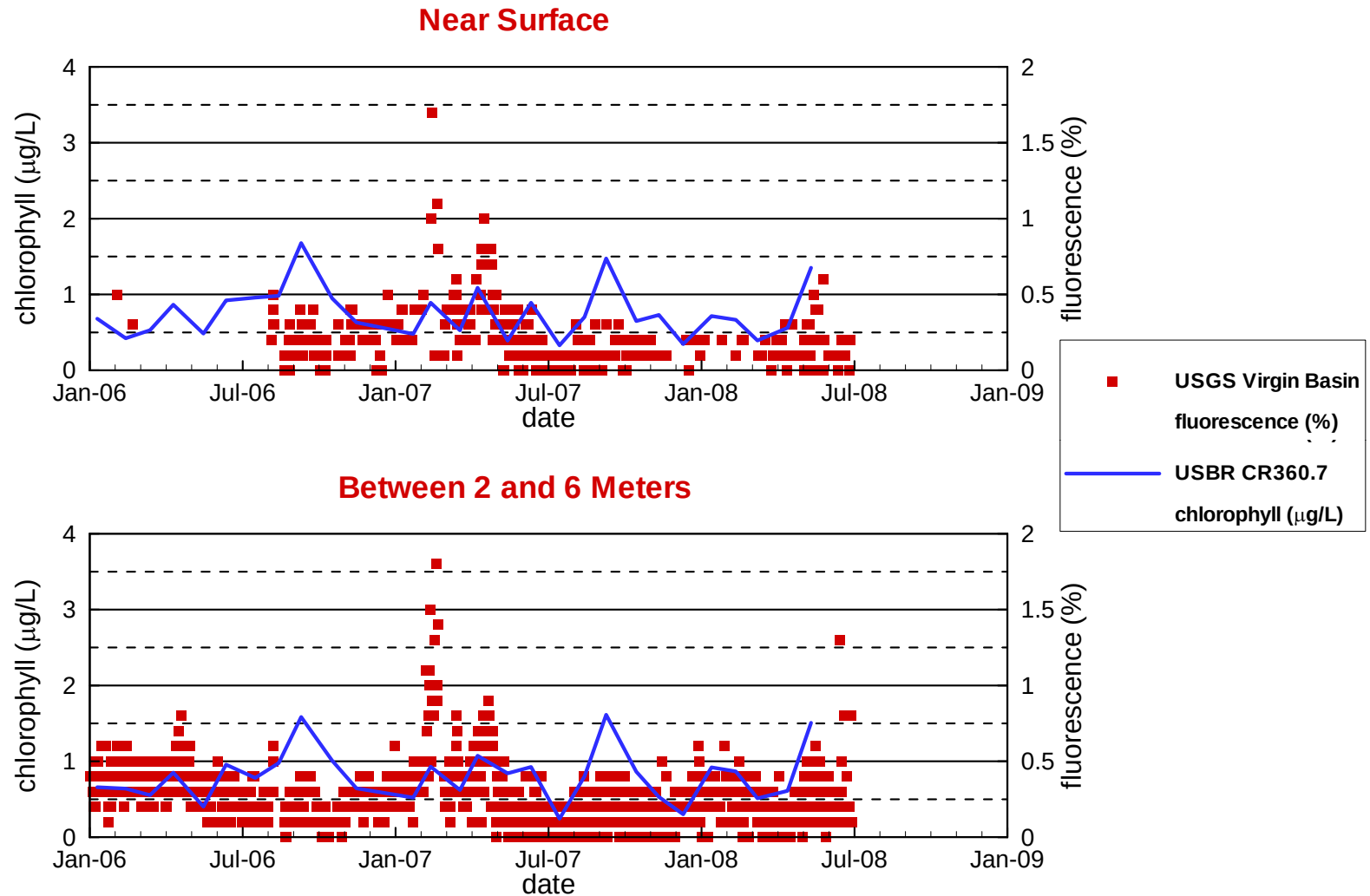


Figure 11

Measured Chlorophyll a and Fluorescence

USBR Station VR25.1 and USGS Platform Overton Arm

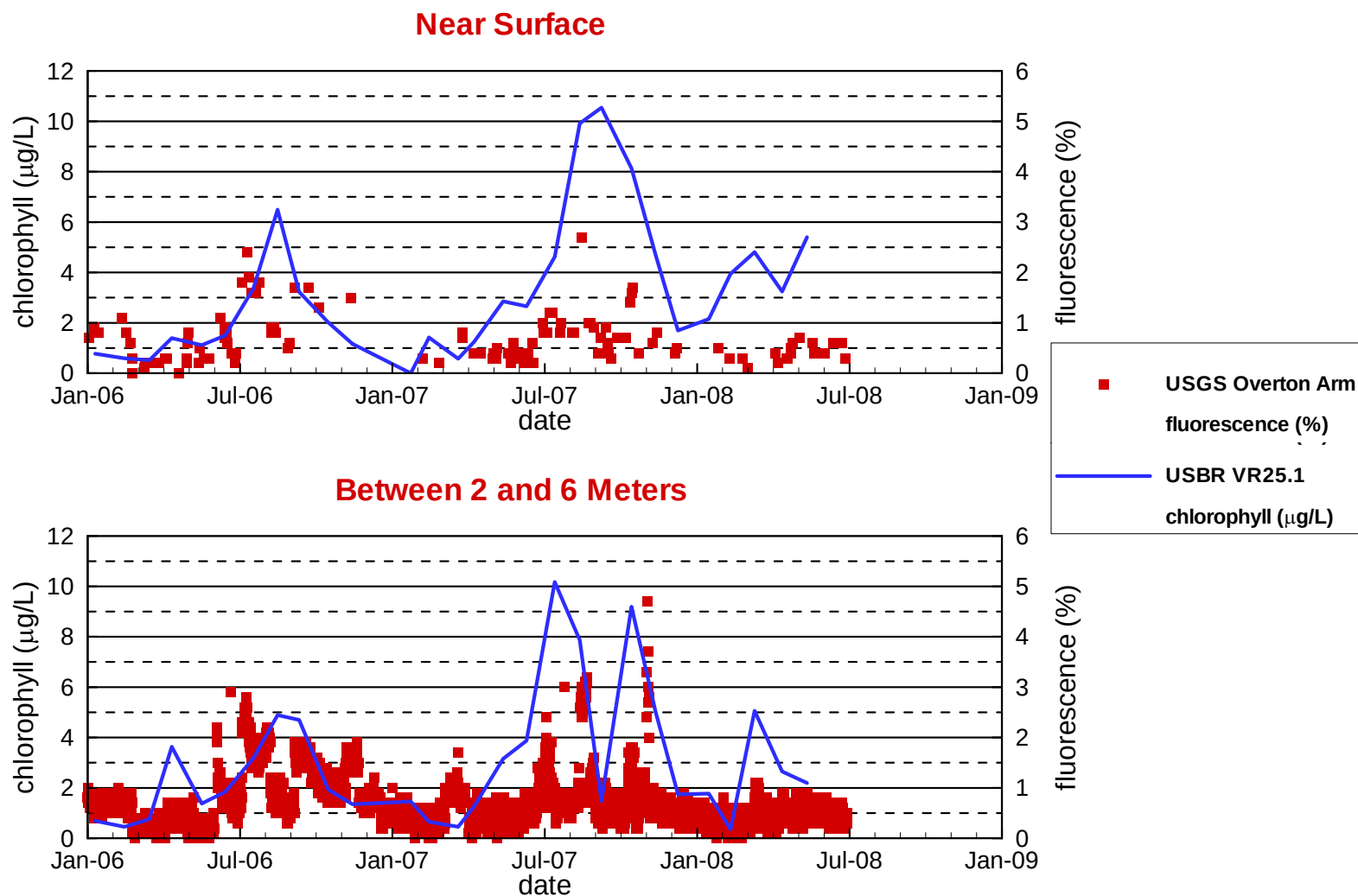
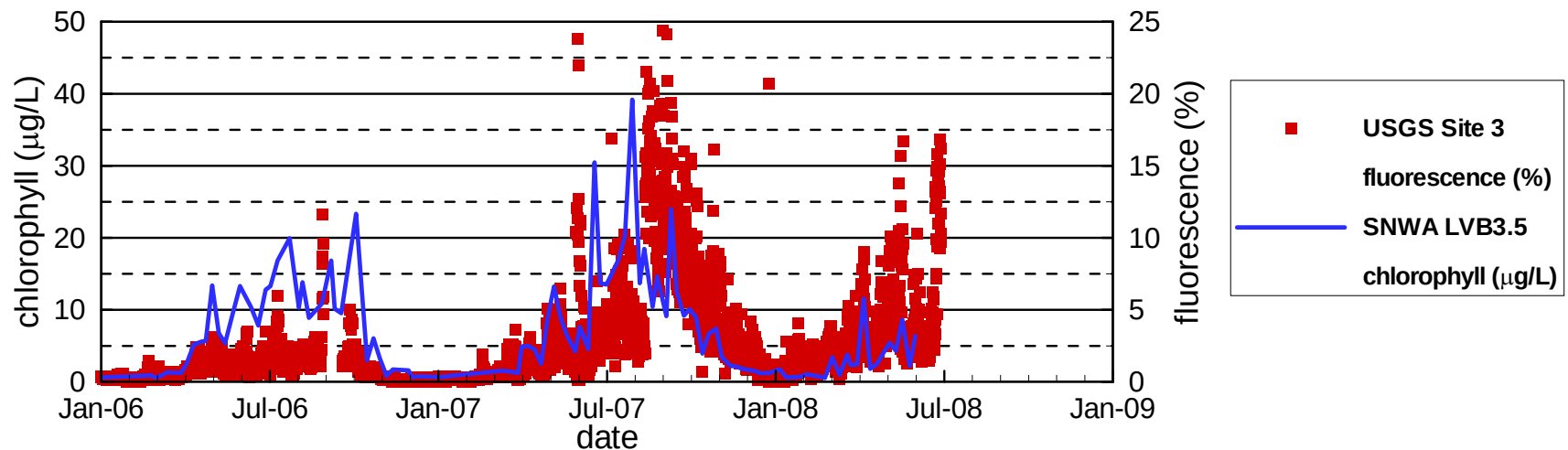


Figure 12

Measured Chlorophyll a and Fluorescence

SNWA Station LVB3.5 and USGS Platform Las Vegas Bay Site 3

Between 2 and 6 Meters



Measured Chlorophyll a and Fluorescence

SNWA Station CR346.4 and USGS Platform Sentinel Island

Between 2 and 6 Meters

