Chester River Hydrodynamic and Water Quality Modeling using SCHISM/HEM3D

by

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Outline:

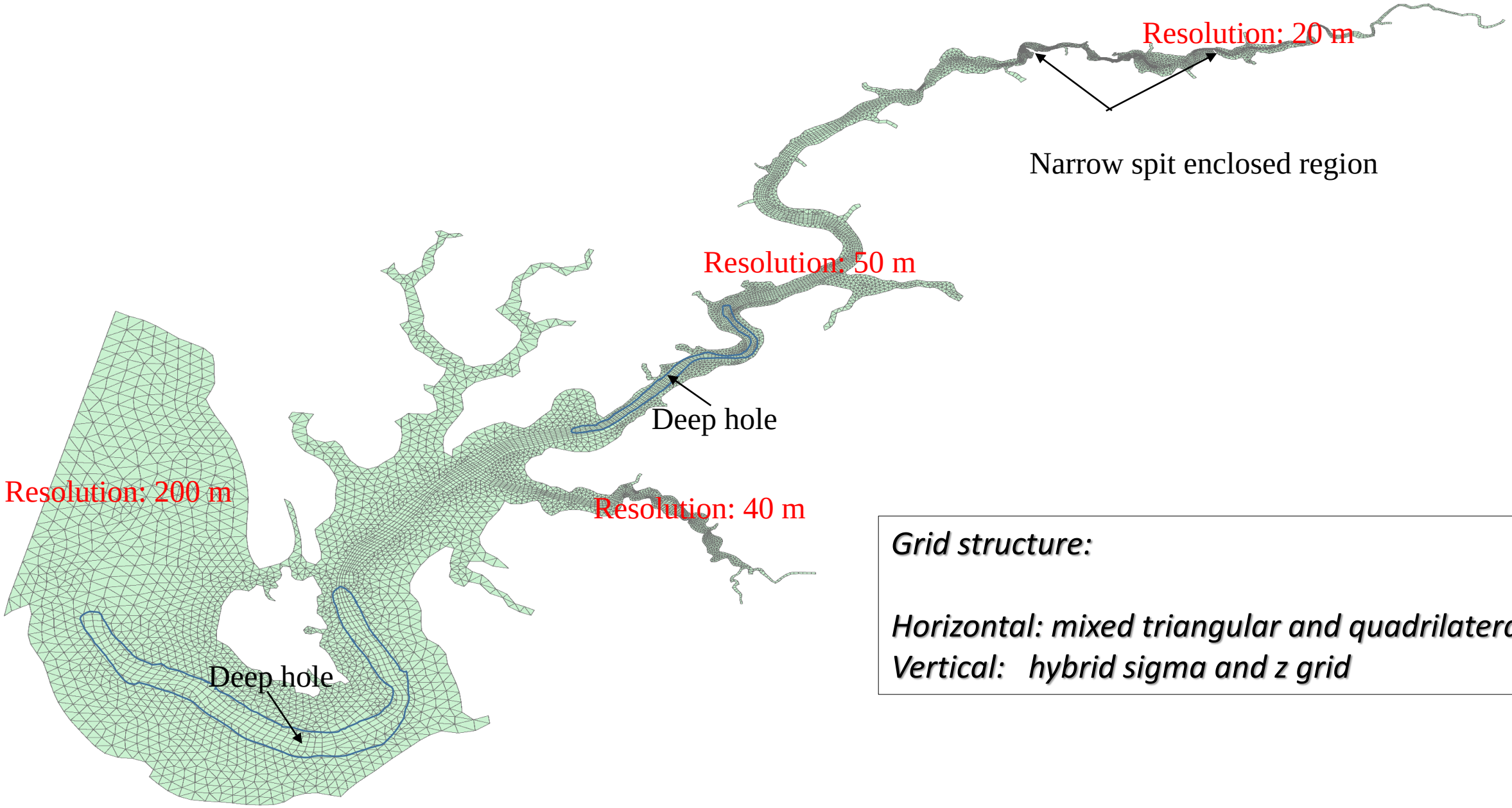
I. Modeling domain, grid, and watershed loading in the Chester River

II. Modeling setup - field stations and parameters specification

III. Water quality modeling results

IV. Comments

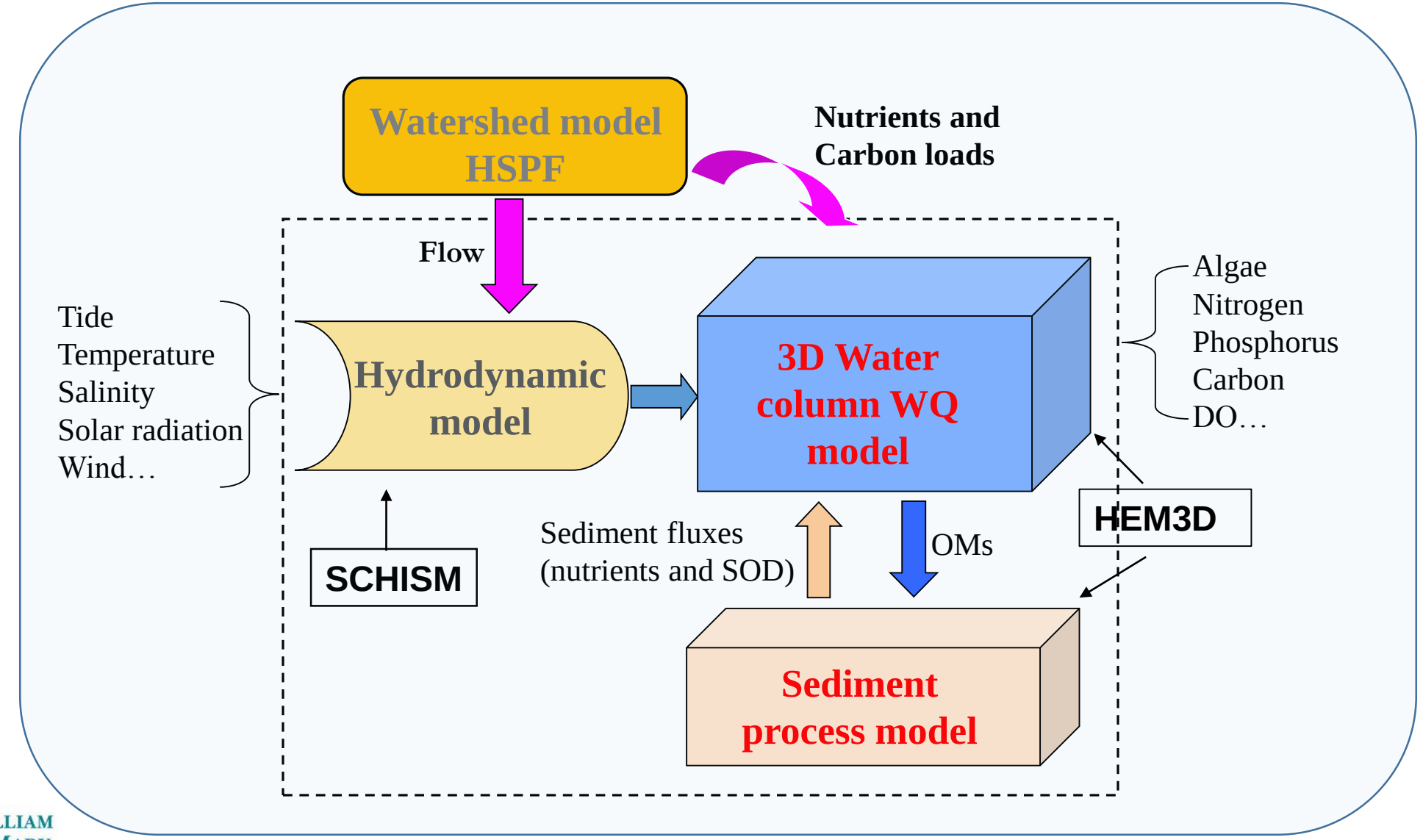
I.1 Modeling Grid



Grid structure:

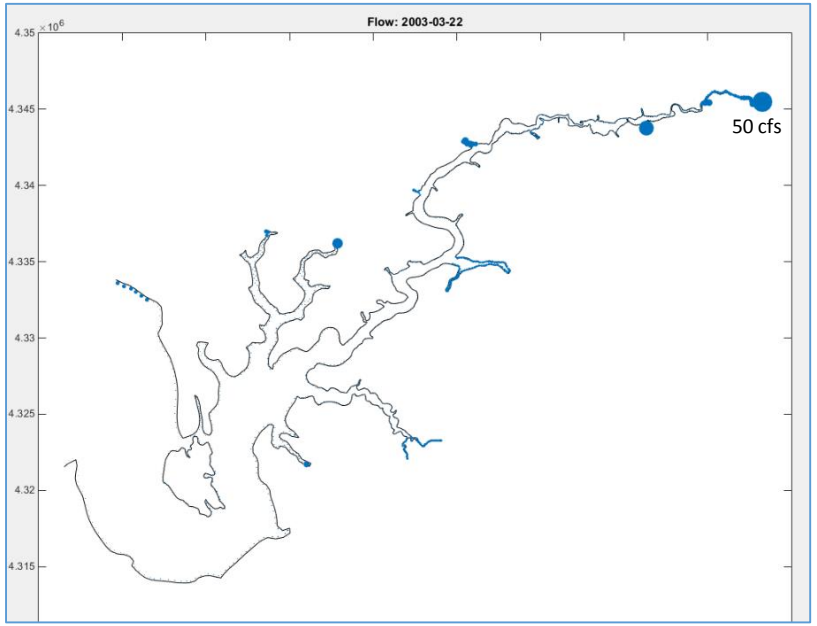
Horizontal: mixed triangular and quadrilateral
Vertical: hybrid sigma and z grid

Modeling framework



I.2 Watershed delineation

Example of watershed daily flow distribution



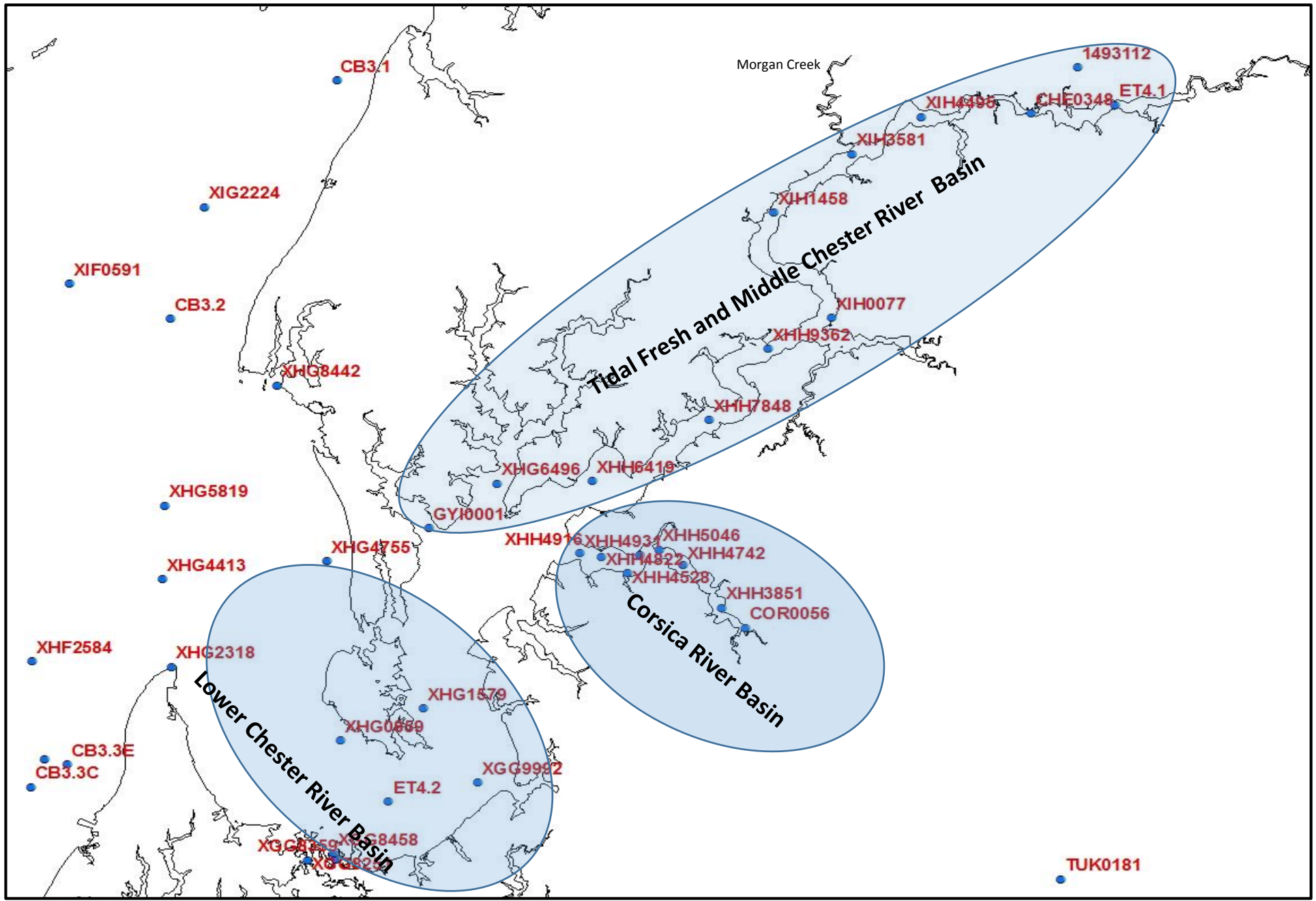
II.1 Monitoring setup

Field Station Map

Divided into three major basins

1. Tidal fresh and middle Chester River basin
2. Corsica River basin
3. Lower Chester River basin

(used later for presenting modeling results)



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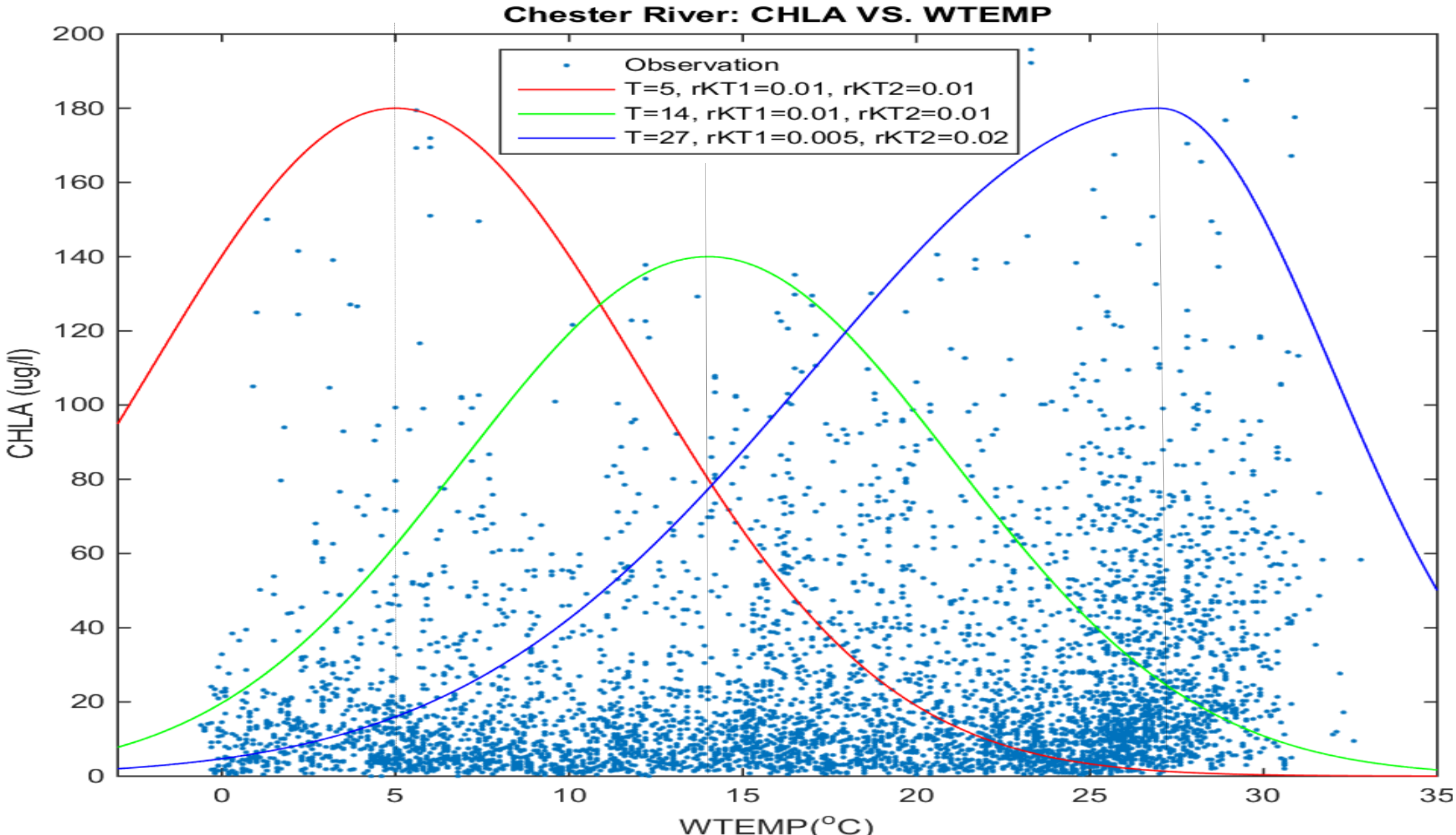
II.2 Parameter specification

a. Optimal temperature for algal bloom



b. Incident Light

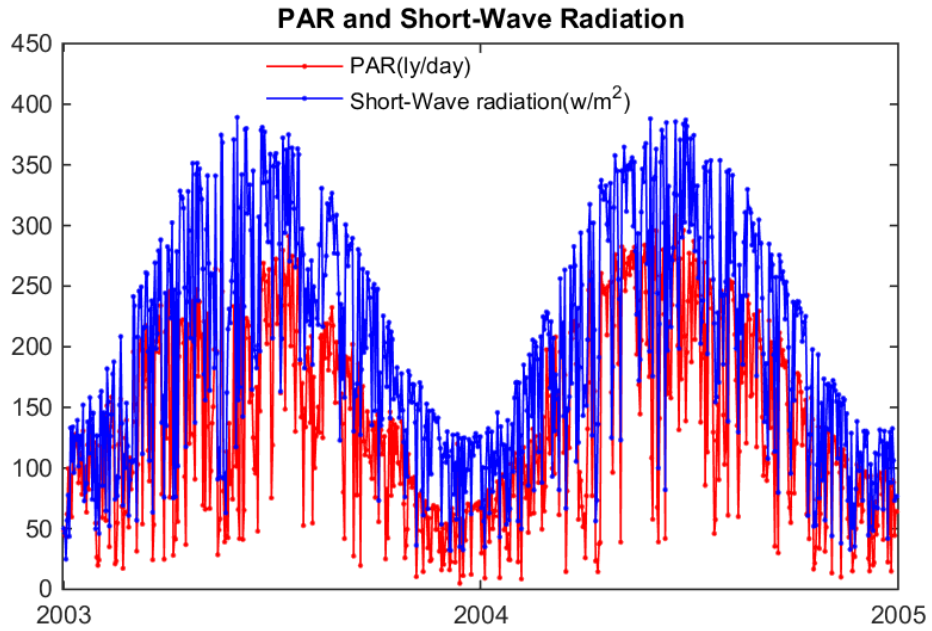
The surface light forcing function was obtained by a transfer function transferring short-wave radiation to PAR

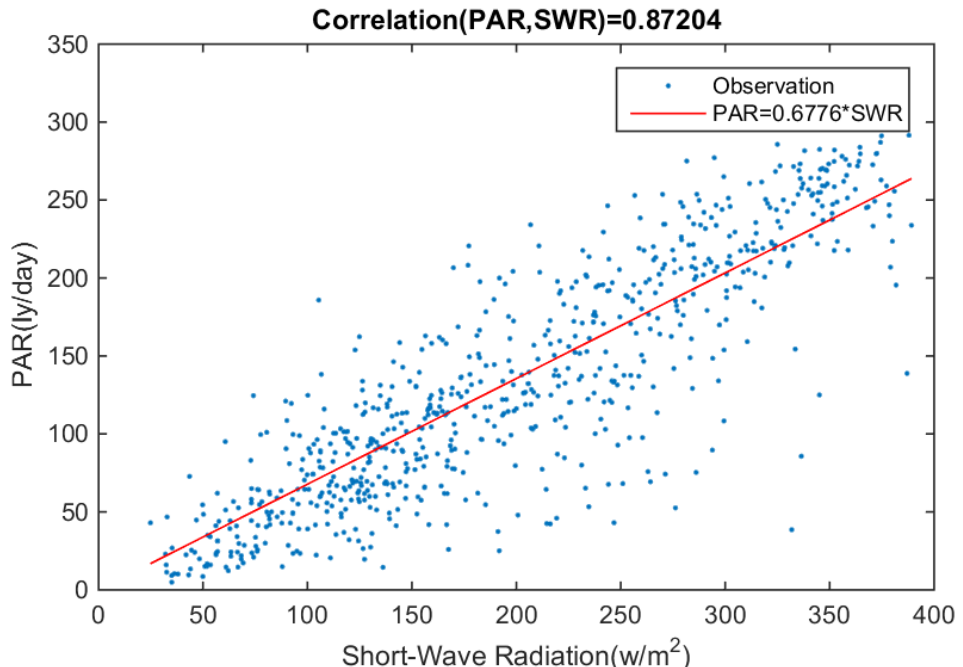
1). The upper plot shows the time series for daily PAR versus daily short-wave radiation from NARR.

2). The lower plot shows the correlation between PAR and short-wave radiation.

3). The formulation for the conversion from short-wave radiation to PAR is PAR=0.6776*SWR. Here SWR stands for short-wave radiation.

NARR are available from: http://rda.ucar.edu/download/chifan





c. Light attenuation in the water column

The formulation for light attenuation in the water column is the empirical formula as follows:

$$Ke = a_0 + a_1 * \mathrm{CHLA} + a_2 * \mathrm{TSS}$$

Ke: light attenuation (m^{-1})

a_0: background attenuation (m^{-1})

a_1 : attenuation coefficient for CHLA ($\frac{m^2}{mg}$)

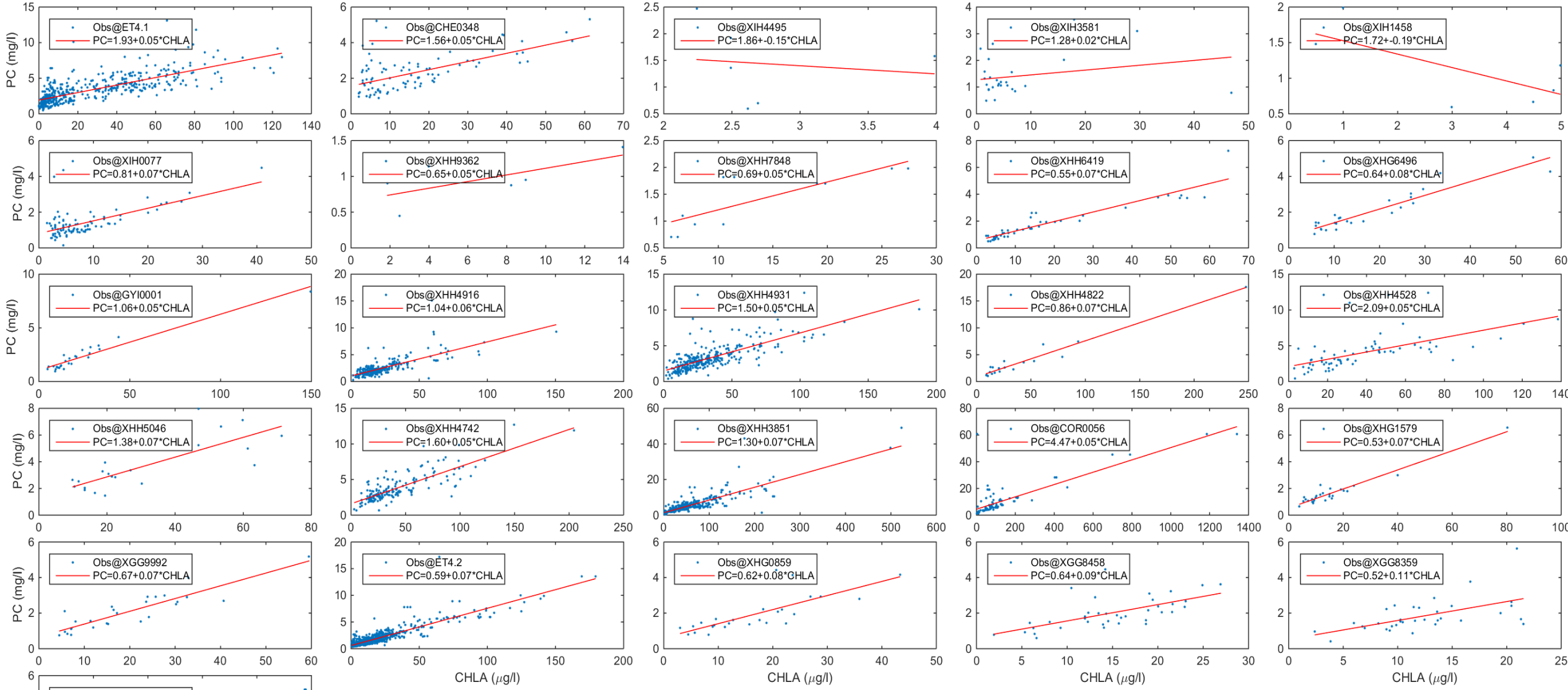
a_2 : attenuation coefficient for TSS ($\frac{m^2}{g}$)

where a0=0.26 ; a1=0.017; a2=0.07;

1) CHLA is calculated from the model.
2) TVSS is estimated based by PC (particulate carbon)

d. Chla to Carbon Ratio

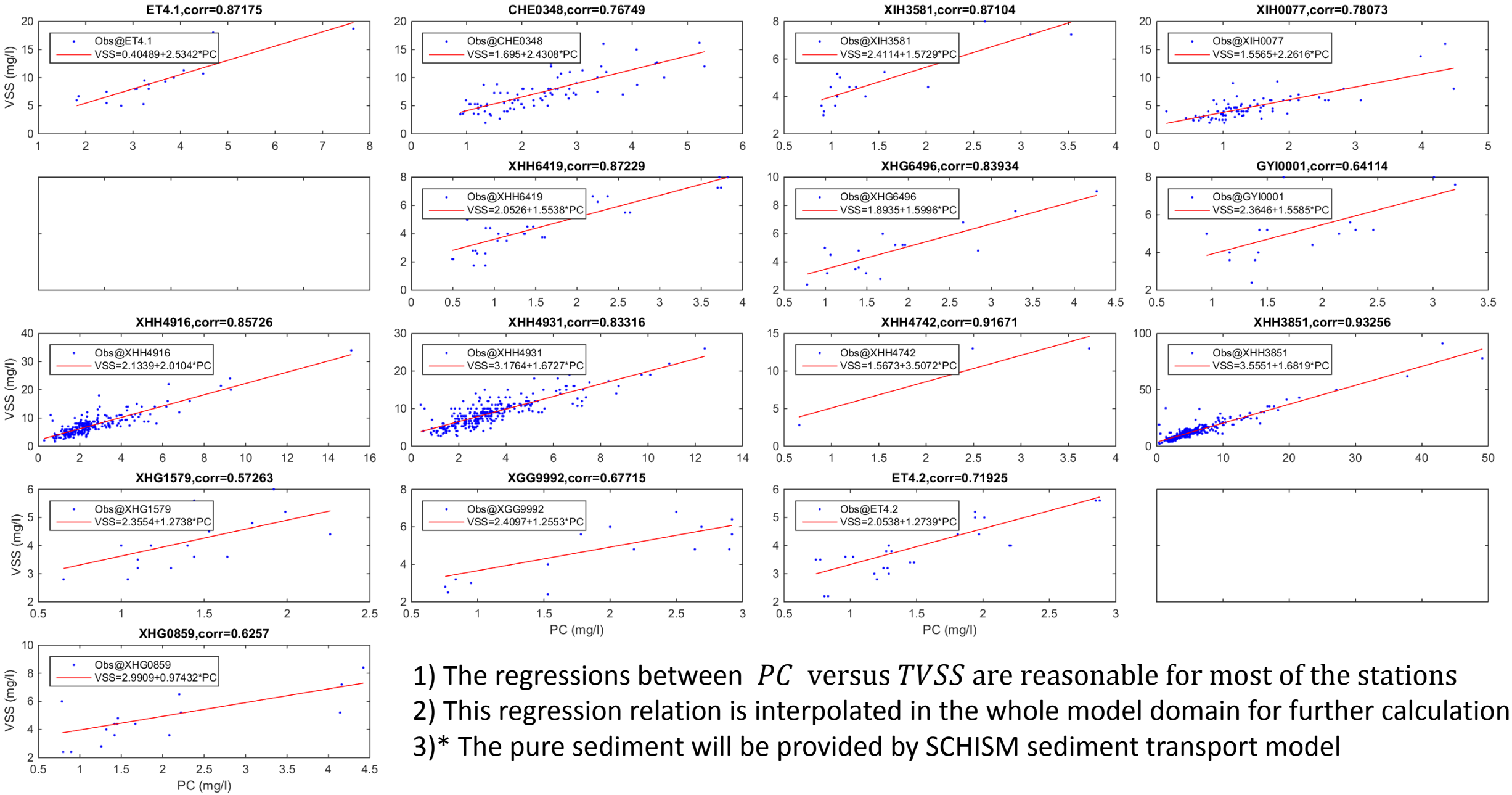
small slope due to low Chlorophyll



1). The analysis shows that the slope of C:Chla is about (0.05-0.07) for most Chester River Stations

2). A constant value Carbon: Chla=0.059 (C: Chla ratio=16.9), is used

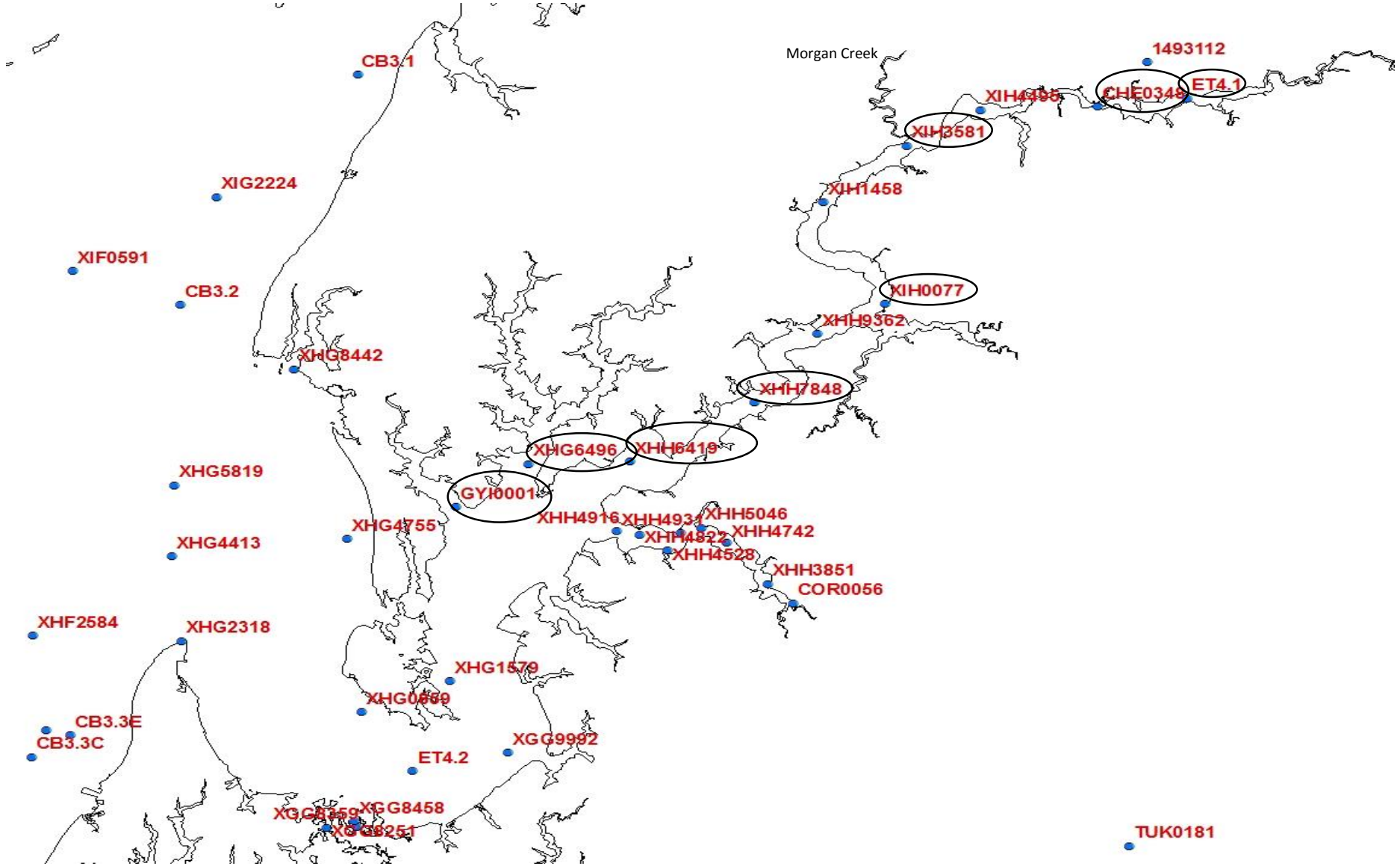
e. TVSS versus PC



1) The regressions between PC versus $TVSS$ are reasonable for most of the stations
2) This regression relation is interpolated in the whole model domain for further calculation
3)* The pure sediment will be provided by SCHISM sediment transport model

III. Water quality modeling results

Stations selected in Tidal fresh and middle Chester River stations



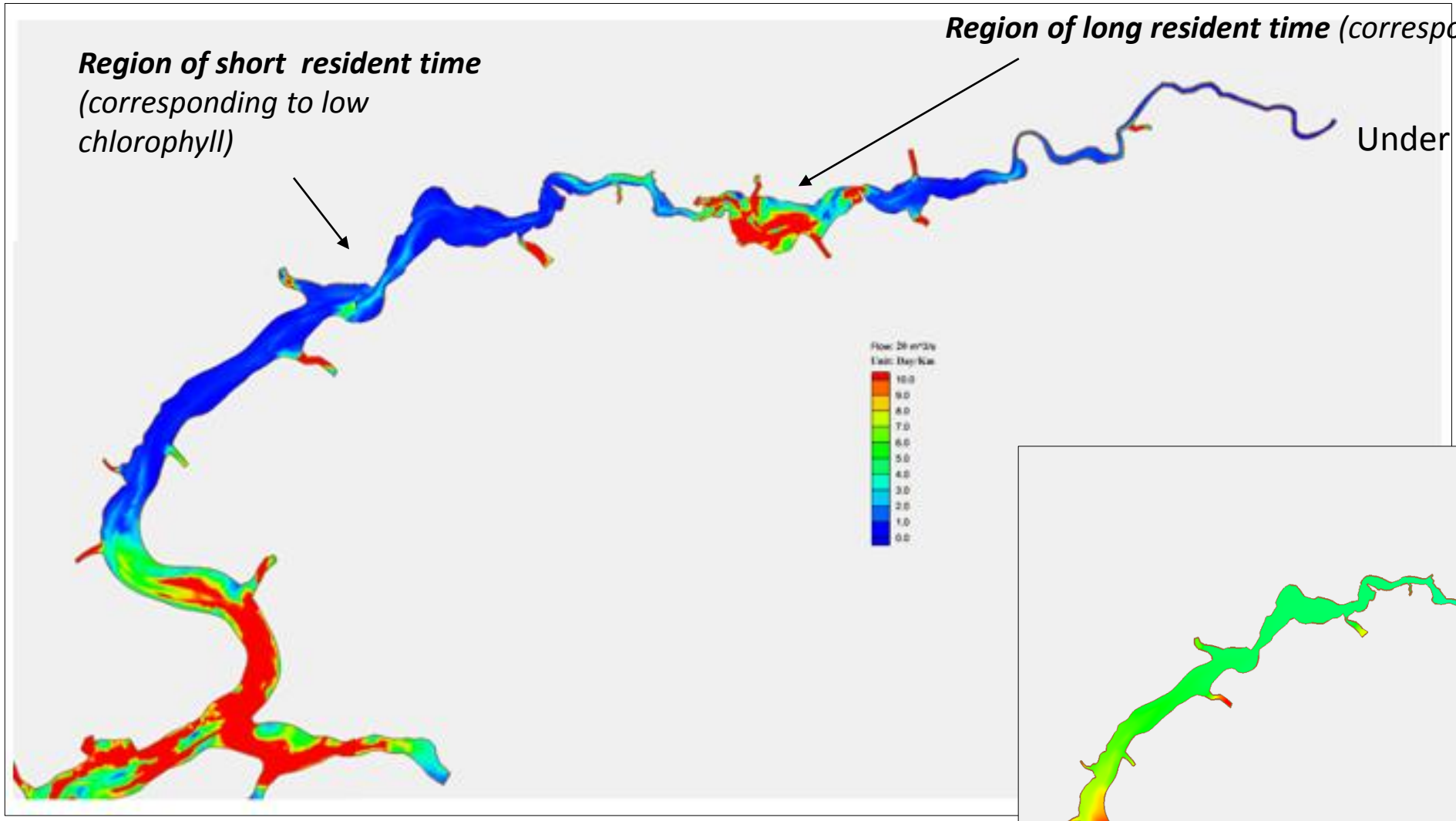
A Region Semi-enclosed by the Spits

Local resident time (day/km)

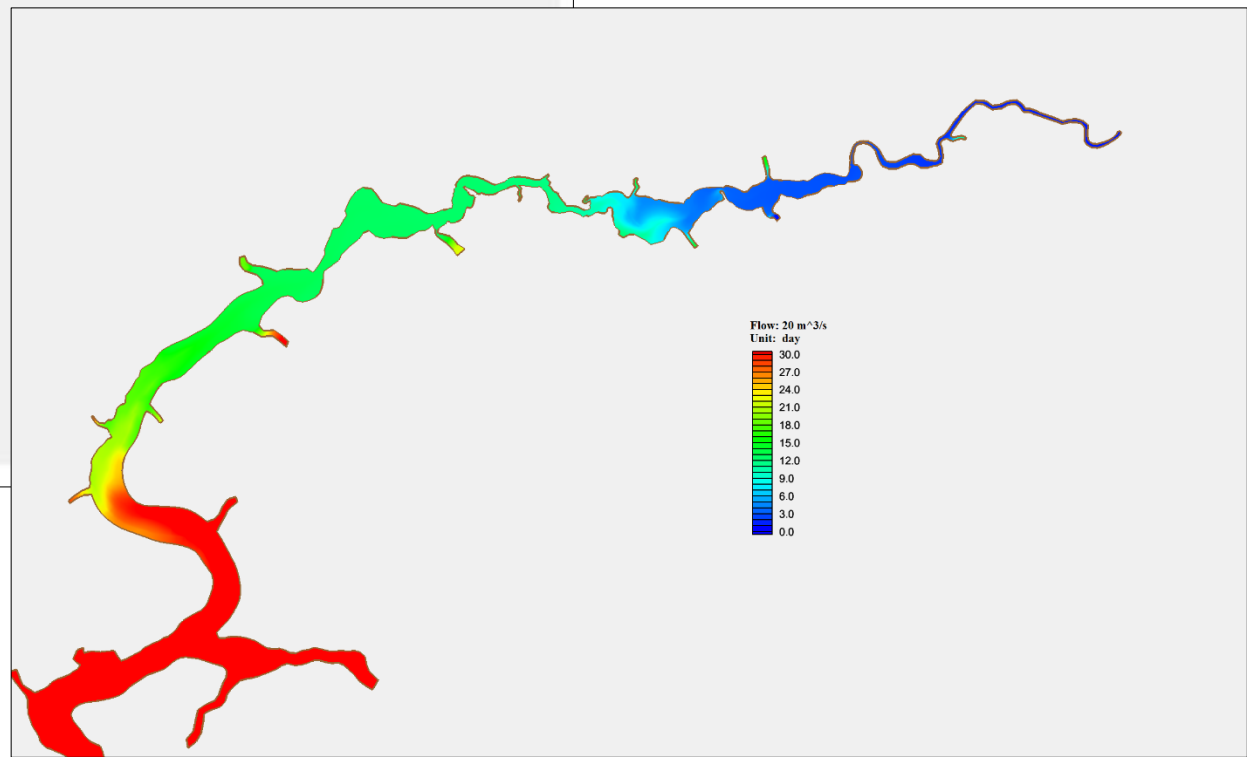
Region of short resident time *(corresponding to low chlorophyll)*

Region of long resident time *(corresponding to higher chlorophyll)*

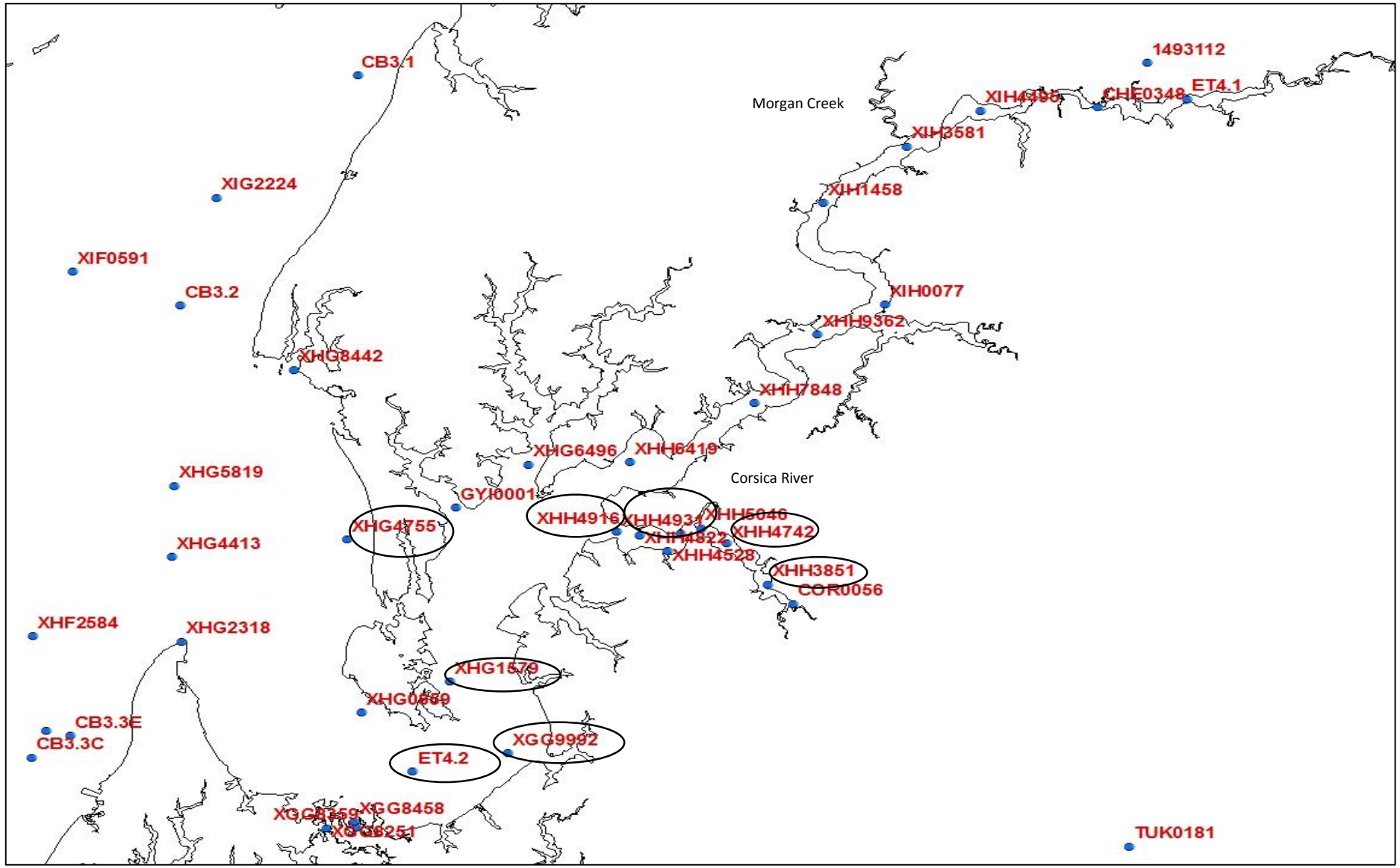
Under 20 m**3/sec



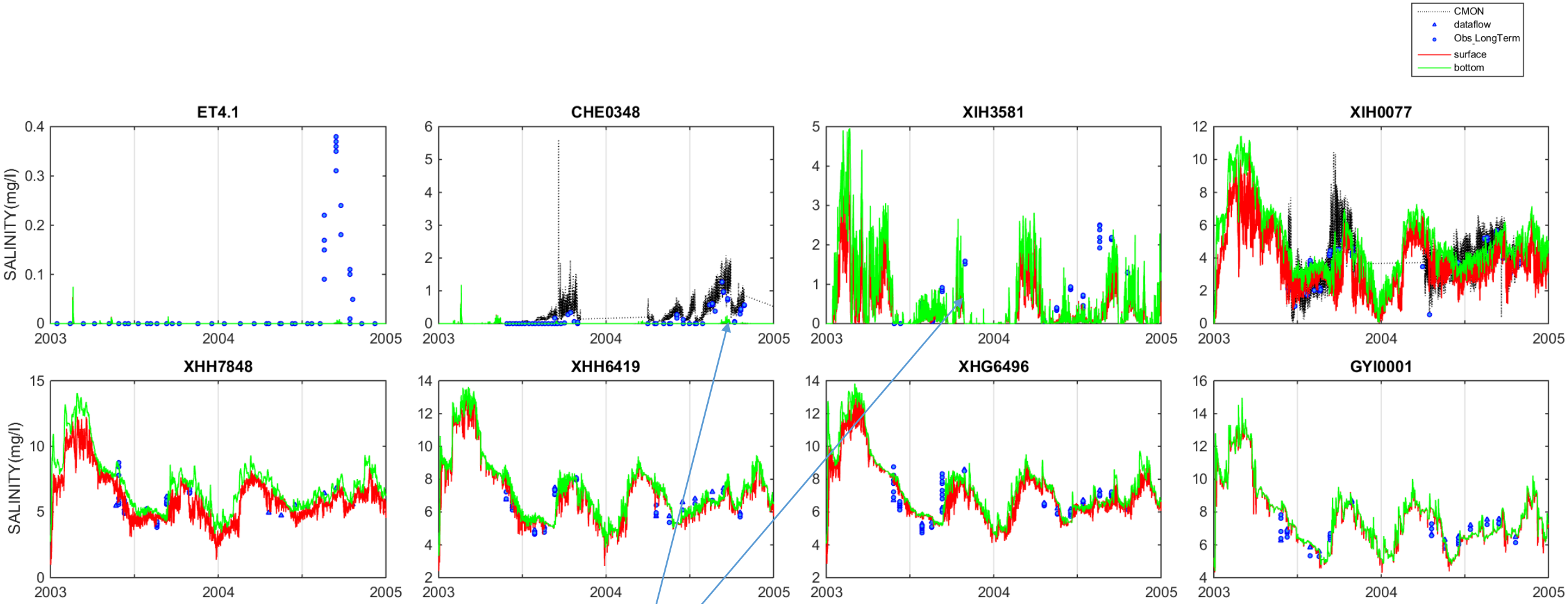
Age



Stations selected in Corsica River and lower Chester River

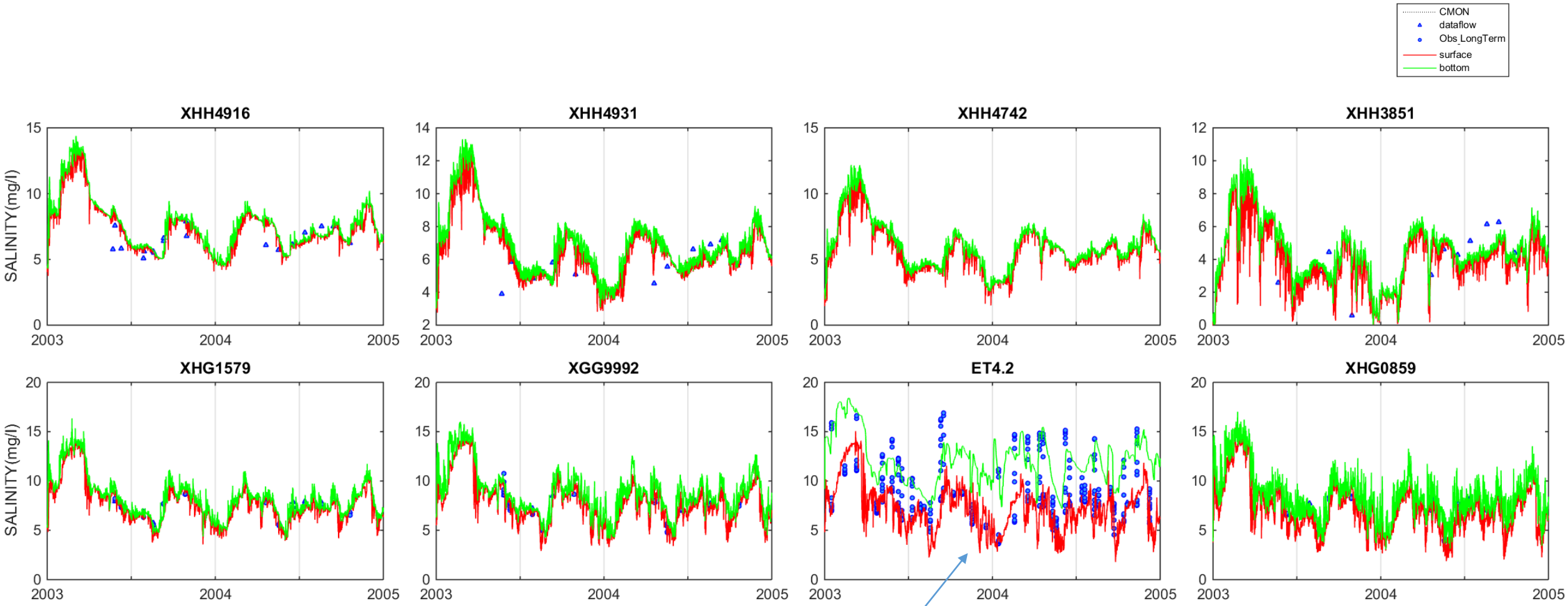


Salinity in the tidal fresh and middle Chester River

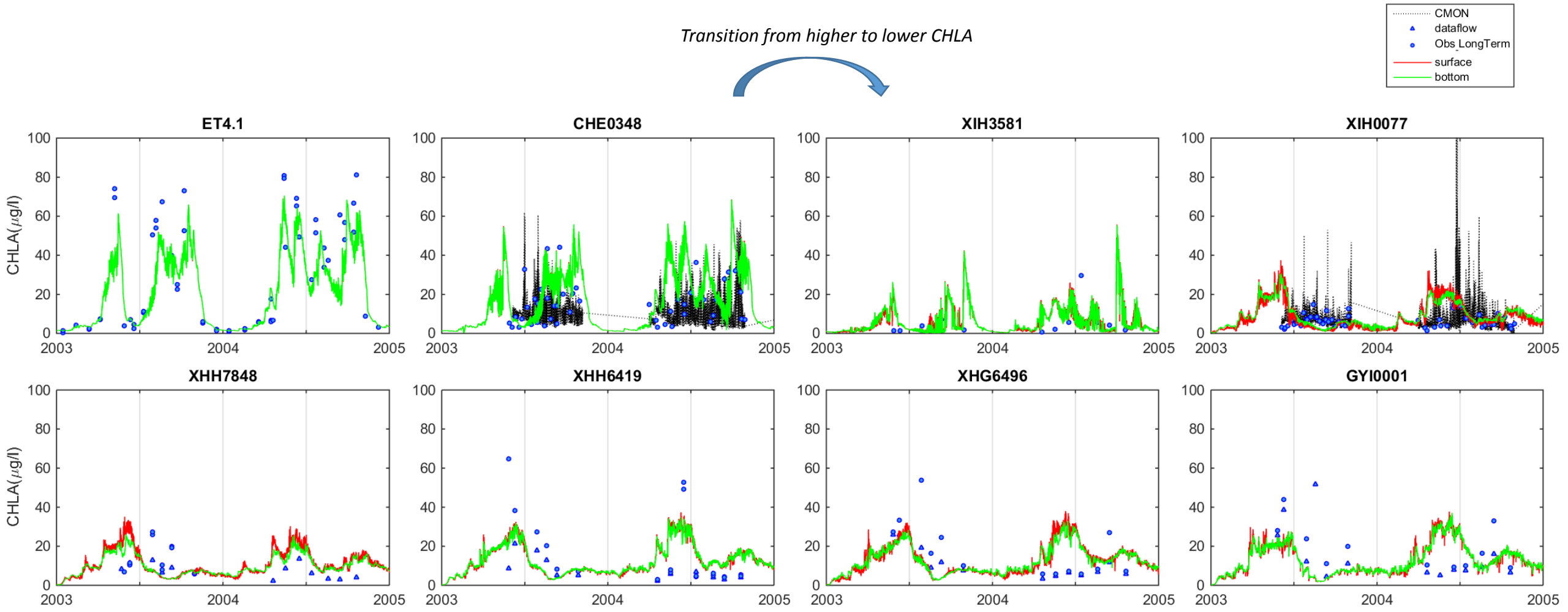


Salt intrusion prediction

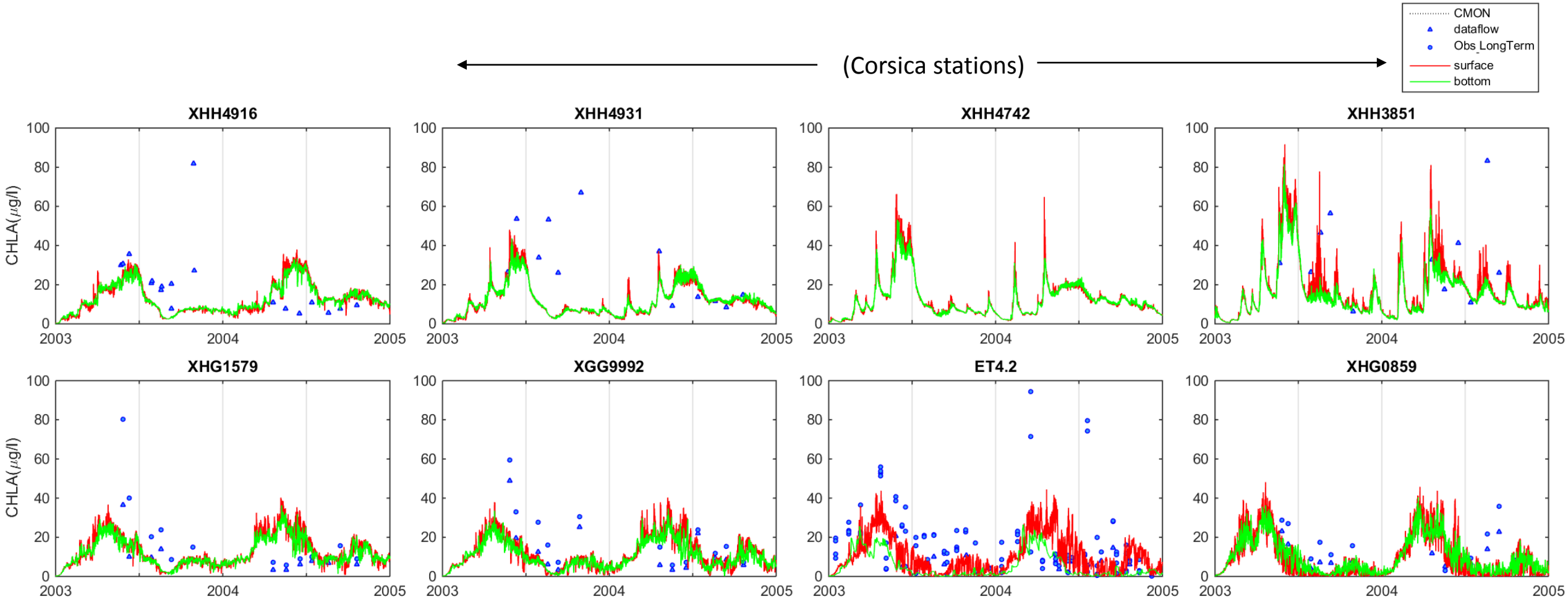
Salinity in the Corsica River and lower Chester River



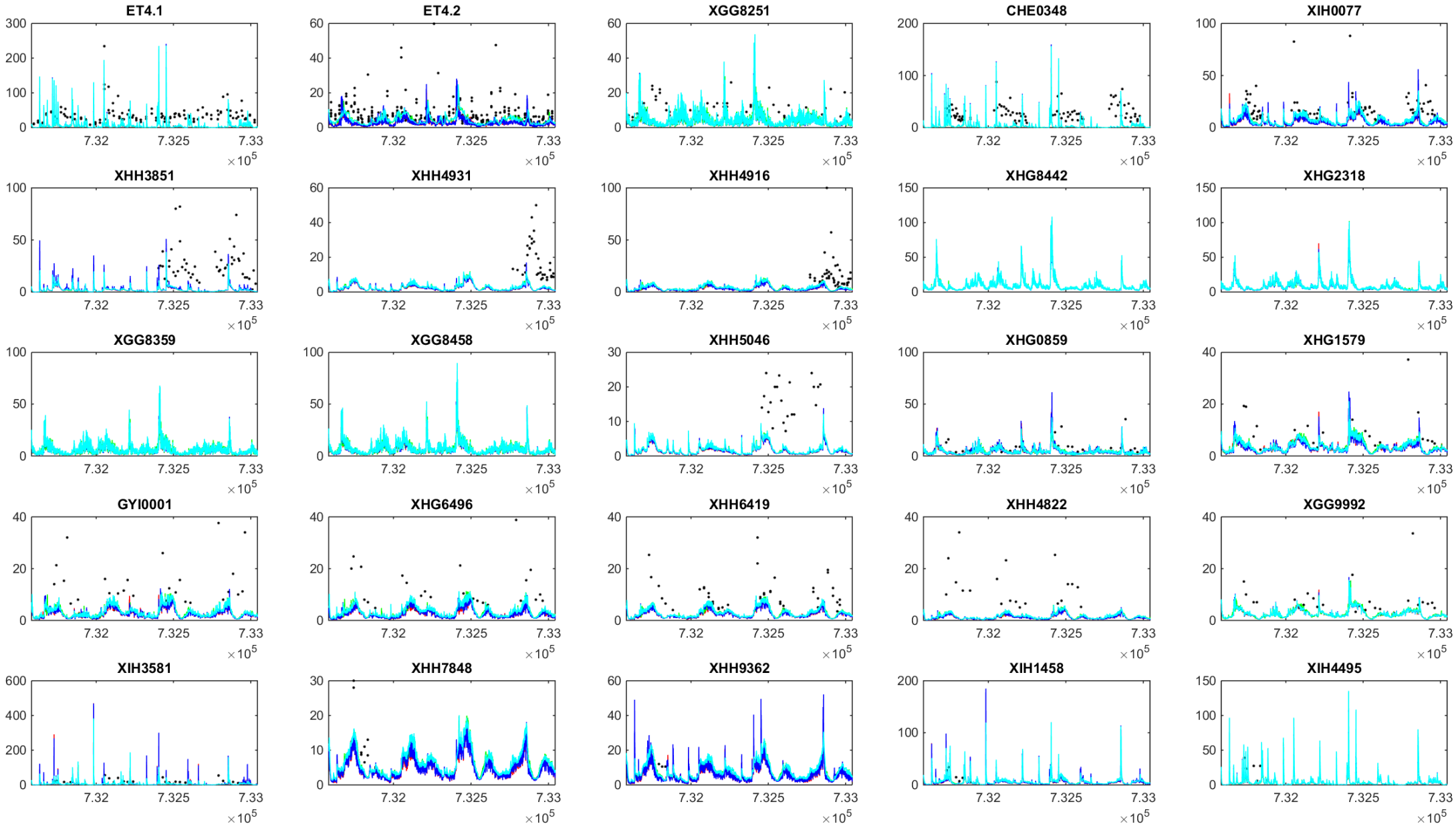
Chlorophyll in the tidal fresh and middle Chester River



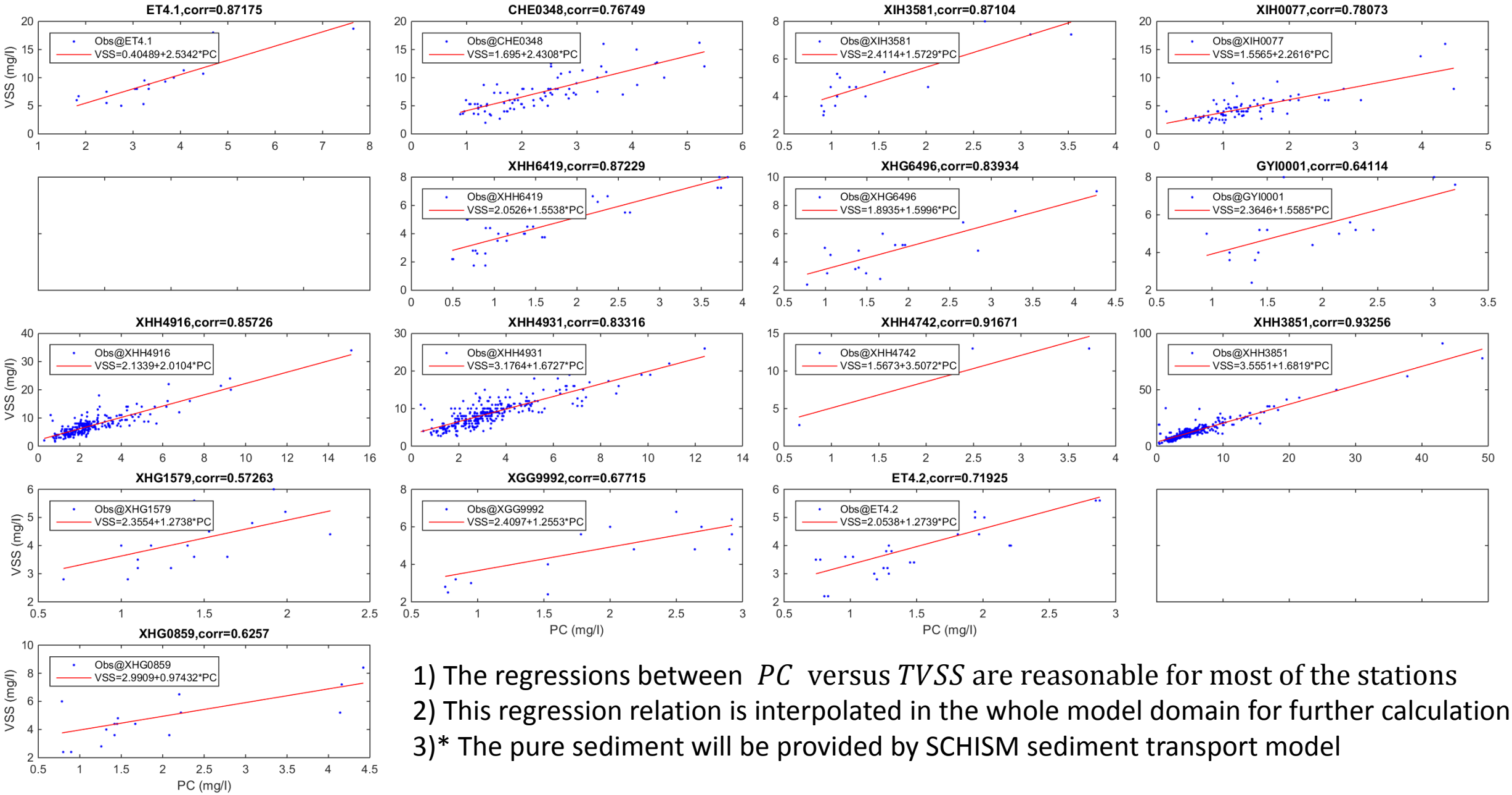
Chlorophyll in the Corsica River and lower Chester River



Chlorophyll does not sensitive to the reduction of freshwater and T,S of open boundary condition

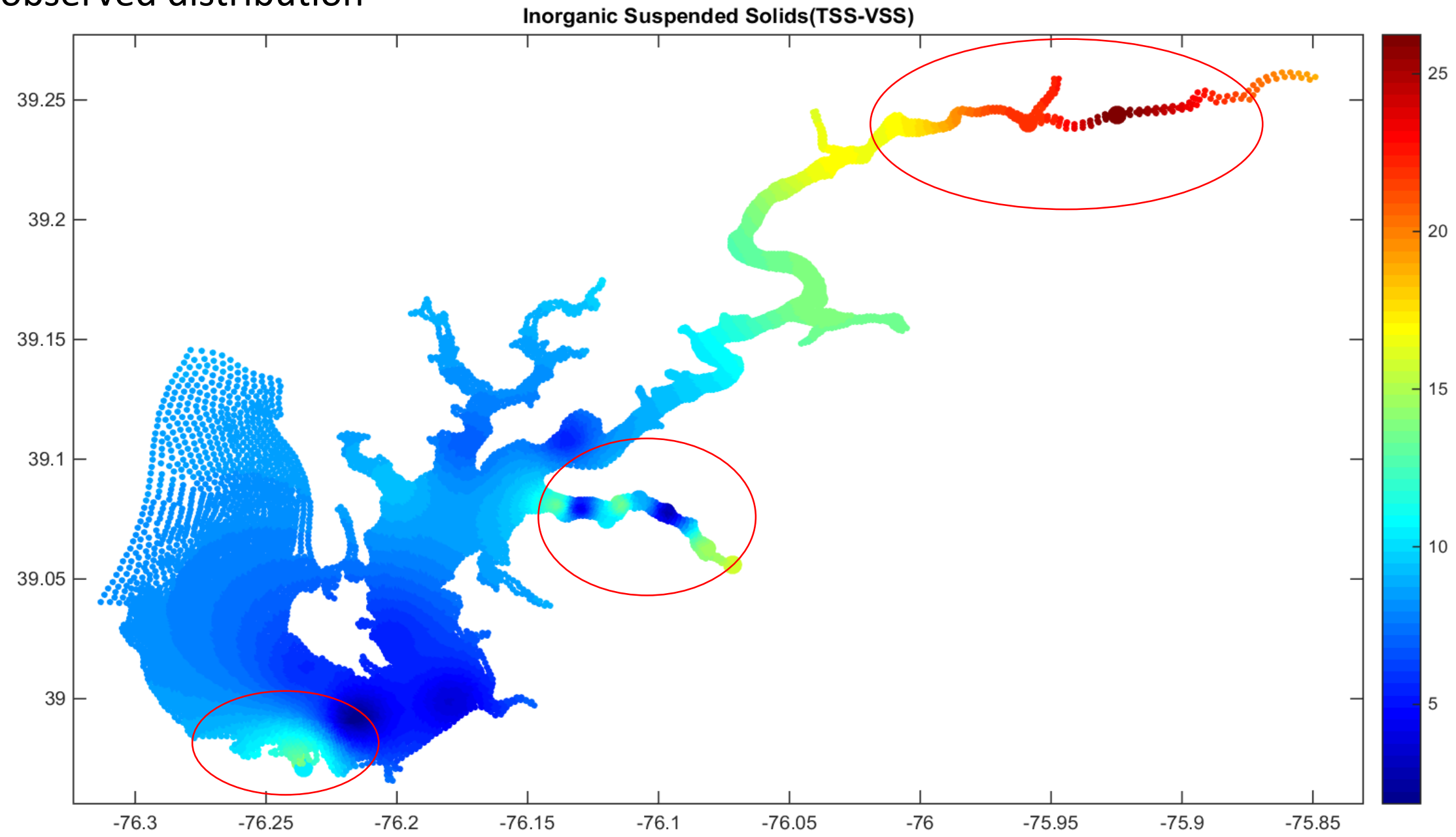


e. TVSS versus PC



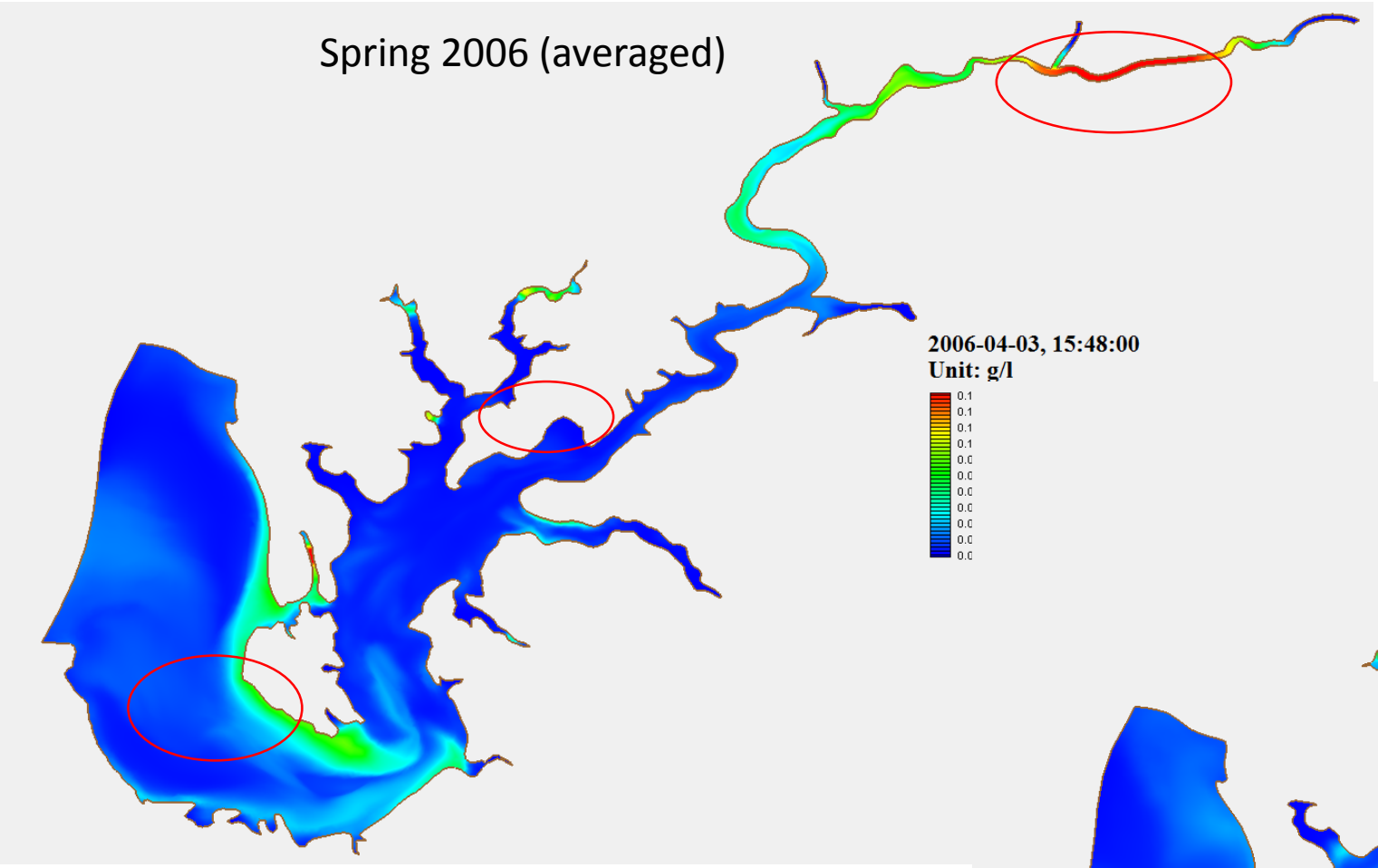
1) The regressions between PC versus $TVSS$ are reasonable for most of the stations
2) This regression relation is interpolated in the whole model domain for further calculation
3)* The pure sediment will be provided by SCHISM sediment transport model

TSS – VSS observed distribution

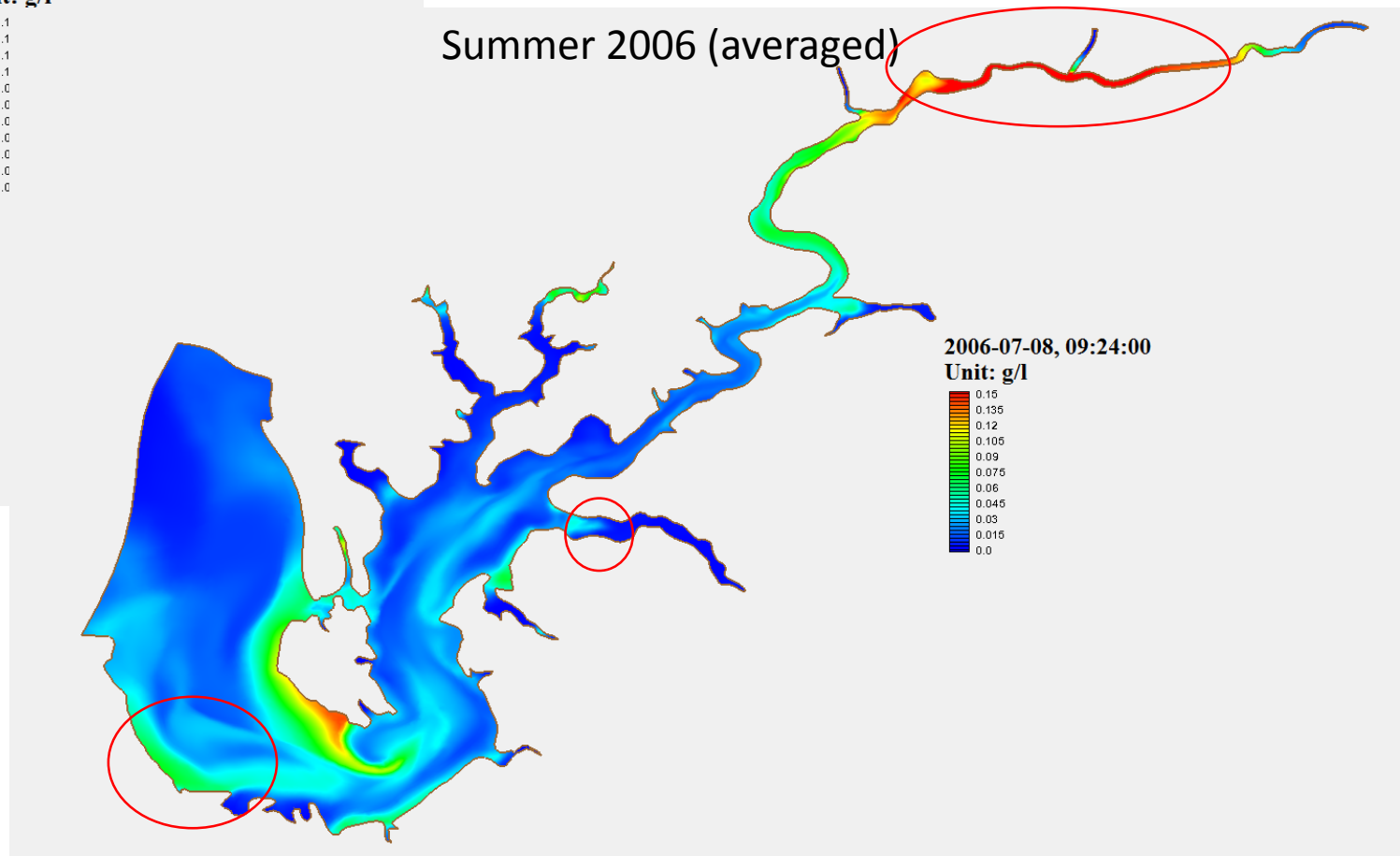


Model Simulated Inorganic Sediment distribution

Spring 2006 (averaged)



Summer 2006 (averaged)



IV. Comments

- Special Features in the Upper Chester River which was confined by narrow spit has a long residence time and could be important for salt intrusion and for phytoplankton bloom

- Results from sediment transport model are reasonable compared with the observed spatial distribution of TSS-VSS. Waves are found to be important for resuspension process