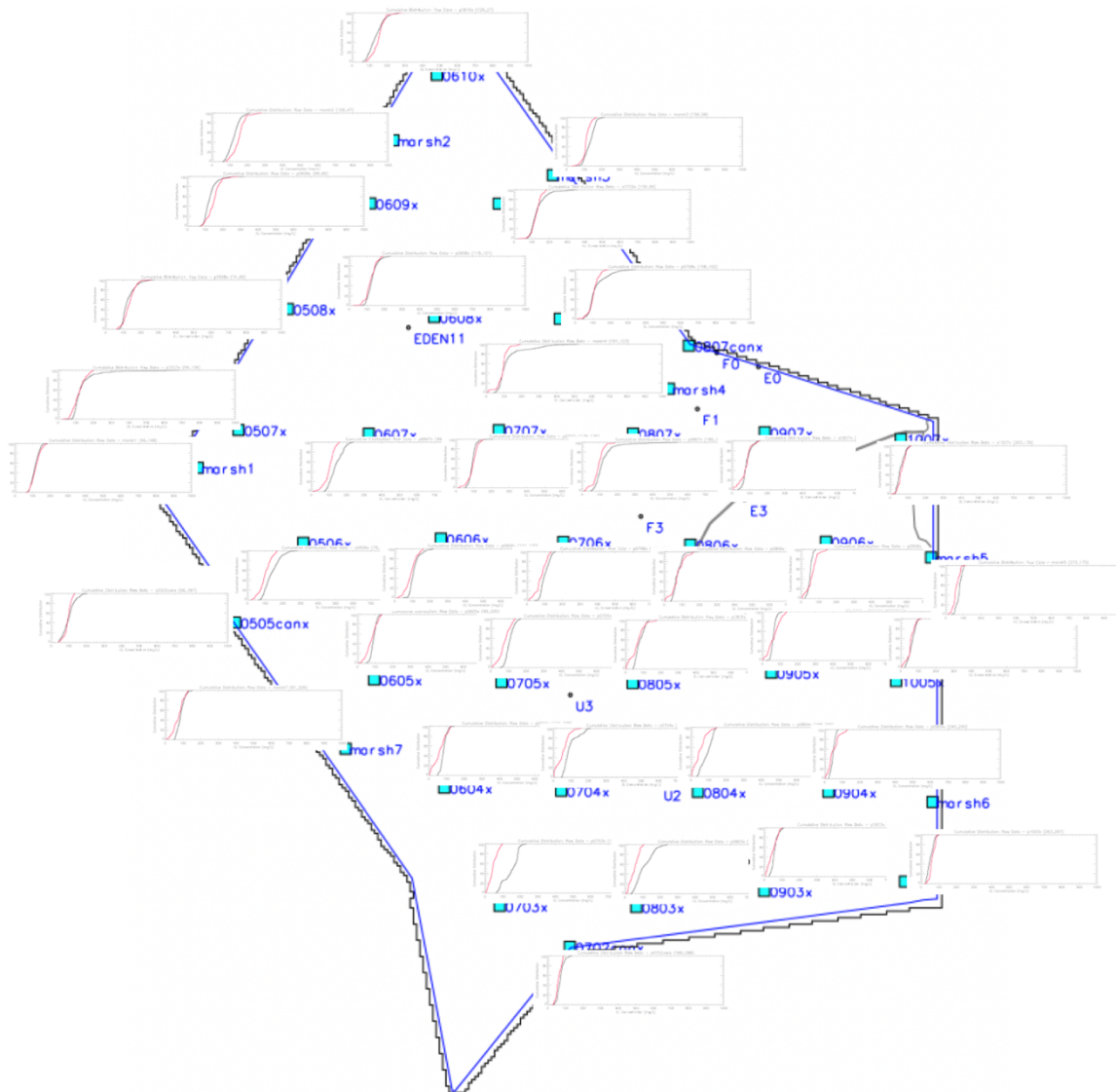


Everglades Landscape Model (ELM) Modeling in Support of Water Conservation Area 2A Flow Restoration: *Task3 -- Revised -- Model Performance*



Submitted to the Marsh Ecology Research Group
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Summary

The EcoLandMod (<http://www.ecolandmod.com>) system was used to develop/refine two hydro-ecological simulation models in Water Conservation Area 2A (WCA-2A). These applications of the Everglades Landscape Model (ELM) encompass the entire hydrologic basin at two different grid scales: one at a 500 m grid resolution (updating an existing application), and the other at a 100 m grid resolution (newly developed). The 500 m application was useful in initial model refinements, but the grid resolution is not fine enough to meet all of the goals of this Project overall.

After a lengthy period of model refinements - including discovery of data-errors by the developer - the 100 m application now has performance characteristics that meet the needs of our Project. The model is now ready to be used in model application to Project future scenario evaluations.

The current Project aims to evaluate the flow characteristics in the northeastern sector of WCA-2A, thus influencing much of the basin. Of primary interest is the influence of the elevated berm that was created along the southern side-boundary of the borrow canal that receives managed inflows from the S-10A, -C, and -D structures (the Hillsboro Canal levee is along the northern side-boundary of the borrow canal). If continuous, the berm (hereafter referred to as the NEberm) tends to block or reduce canal-overbank flows towards the south into the receiving marsh. Extensive efforts were made in our Project's Task 2 to integrate-synthesize new elevation survey data, and to characterize model-scale elevation of the berm (and of the entire basin).

Early development of the new 100 m scale application made it obvious that boundary condition elevations (and aquifer hydraulic conductivity) were critical drivers of the hydrologic behavior of the system. Coupled with ELM canal vectors that are superimposed on the raster grid (mostly along the domain boundary), the transient interactions under high-to-low flow conditions led to extensive model permutations and sensitivity evaluations. The ELM canal vectors may be segmented as deemed necessary to characterize the complex boundary flows, with canal vectors and marsh grid cells interacting via integrated surface and groundwater flows.

As indicated above, of particular interest is the narrow section along the domain boundary that extends from near S10D, around the NE corner, along part of the eastern levee, and intersecting with airboat trails. Those airboat trails can be significant hydrologic features (at least near the airboat launching areas and extending some kilometers to the SW and to the S). A fascinating, and challenging, suite of flows to simulate and assess.

With results documented below, it appears that the NE airboat trail (referenced below as ELM R43 and derivative segments R43-R44-R45) that extends into the marsh to the southwest is primarily a vegetation attribute, and not a mini-canal that fluxes water and constituents into the marsh - at least within the limitations of the observed data and the model. Thus, we conclude that, in this model framework, that airboat trail is not an appropriate vector of water and constituent flow into the depths of the marsh.

Fully describing the above is beyond the scope of this Task 3 Performance Assessment report (with the Statement of Work specifically calling for "limited text" description). What is included

here are a) bullet-point text summary of input and output data, b) map output summaries, and c) comparisons of observed and modeled data via both statistical tables and time series graphs.

Since the September 19, 2025 (version 1b) of this Model Performance Assessment, a number of input data refinements/corrections have been made, but no modifications were made to the model source code. We have removed all references to the 500 m grid application data and results, and below present only input and output data associated with the 100 m application.

*While a variety of edits (including deletions of reference to the 500 m app) were made to the original document, the text in this grey-italics is intended to highlight significant new changes to the model system, primarily with respect to **Input Data** changes. The majority of model results and evaluations are new, and not highlighted in this fashion.*

Simulation input for ELM3wca2_100 (ELM v3.2.6)

SEE EXTENSIVE ELM V2.5 AND V3.2.4 DOCUMENTATION FOR SPECIFIC DEFINITIONS OF MODEL INPUT DATA, MODEL STRUCTURE, AND MODEL OUTPUT DATA

Input data

Fixed parameters

- **GlobalParms:** All (*but one, grid-scale specific*) global parameters are the same since ELM v2.5 (here, we reverted four periphyton parameters back from those updated in ELM3reg500 v3.2.4, which worked excellently for southern Everglades; but those updated parms led to some model underestimation bias of TP in surface water in WCA-2A regions, particularly in non-calcareous high-TP areas)
 - *The grid-specific "GP_dispLenRef" parameter was erroneously kept at a value of 500 m; instead, it was required to be changed to match the model grid scale of 100 m. Old (2006) misleading parameter documentation led developer to forget the need to change for the 100 m grid.*
- **HabParms:** Habitat-specific parameters are almost all the same as ELM v2.5, with the exceptions being that we applied the updated ELM3reg500 v3.2.4 parameters for Macrophyte Ksp (half-saturation concentration of available phosphorus for uptake kinetics)
- **CanalData.chan:** Canal vectors (in UTM geographic coordinates) were modified in a variety of ways (from those used in ELM3reg500), via altered segmentations and depths-widths (see infrastructure **Figure 1**).
 - As discussed later, the ~large airboat trail near the eastern boundary to the north (ELM R42, shown in other Figures) was maintained in final simulations. The airboat trail (ELM R43,R44,R45, shown in other Figures) that extends to the southwest, from the northeast corner, was tested extensively (see below **Appendix E** Sensitivity section), but determined to not provide an accurate depiction of flows into the marsh interior.
- **CanalData.struct:** Water control structure locations are specific to the 100 m grid scale rows-columns, as are the use of "virtual" structures which depend on the segmentation of any specific canal reach (e.g., connecting segments of the borrow canal receiving S10A,B,C flows)
 - *new 5-cell inflows of STA2 in NW region*
 - *new canal inflow of STA2 in W region*
 - *(see infrastructure **Figure 1**)*

Boundary condition flows

- **CanalData.struct_wat:** Historical 1984-2010 daily water control structure water-flows in each of the inflow and outflow structures were previously obtained from DBHYDRO, and were used in earlier simulations
 - *For these 1984-2010 historical flows, we found that the S11 (A,B,C) and S38 DBHYDRO flow demands were excessive, and so instead used the SFWMM v7.0 simulated (not observed) flows (as did the RSM-GL (Senarath et al. 2014). Moreover, both the SFWMM and RSM-GL used SFWMM simulated (not the higher observed) flows for the S10 total flows, which we also now use. See RSM-SFWMM structures **Figure 2**). In addition, the SFWMM v7.0 used*

*simulated (not observed) flows for the single G335 STA2 inflow into WCA2A (through Dec 2010). [The Senarath et al. (2014) RSM-GL report involved calibration through Dec 2000, so no STA2 flows existed at that time]. We also used the SFWMM simulated flows for the STA2 flows. **Figure 3** shows the summed differences between SFWMM simulated vs DBHYDRO observed flows.*

- *As noted above (**Figure 1**), the ELM3wca2_100 partitioned the following SFWMM single-structures' total flows into separate ELM structures: S10= S10A, S10C, S10D; S11= S11A, S11B, S11C; G335= G336_S, G336A, G336B, G336C, G336D, G336E, G336F.*
- **CanalData.struct_TP, and .struct_TS:** For all inflow structures, daily 1984-2010 and 2020-2022 interpolations of (less-frequent) observed TP and chloride from SFWMD staff resulted in daily TP and daily TS (Total Salt, in terms of chloride-only) concentrations in each of the inflow structures
- **BoundCond_stage:** Daily simulated-historical 1984-2010 stage from the SFWMM v7 historical-calibration output, used only to calculate head-tail difference along ELM peripheral boundary cells for fluxing (ground)water in-out of the domain boundary cells; (SFWMM historical calibration encompasses 1984-2010, thus does not apply to the special-case 2020-2022 ELM simulations below, as those SFWMM data do not exist)
- **rain.bin and pET.bin:** Observed daily grid_io binary spatial time series provided by SFWMD for rainfall (daily, 1914 - 2016) and potential ET (daily, 1948 - 2016)
- **meteor.pts:** only used in the special-case of 2020-2022 simulations; these are text-data assemblages of daily observed rain and pET, for 7 sites distributed in/around WCA-2A, obtained from USGS-EDEN; used in daily spatial interpolations on-the-fly via ELM code during ELM simulations

Initial condition maps

- **elevation** - initial (dynamic simulated) condition: 1993 survey, 2004 HAED survey, or 2018 GannModified (revised, now GannCombo); applied an additional overlay of observed-calculated NEberm-specific elevation data (within a NEberm "mask")
 - *see next section **Elevation data refinement** for new details & figures*
- **icMacBio** - initial (dynamic simulated) macrophyte biomass is constant in space
- **icHabitat** - initial (and constant in these simulations) habitat type is either the 1982 (Rutchey) ELM habitats (1984-2010, and test in 2020-2022, simulations), or the 2018 (Gann classes crosswalked to) ELM habitats (2020-2022 simulation).
 - *added the ELM habitat class (=29) of "Human Influence" to the cells outside of the bounding levee (within the model domain), and to the cells within the 1-cell-wide NEberm mask (see below derivation of the mask)*
 - ***Figure 4** shows the 1982 and 2018 initial (and constant) habitat types*
- **Hydraulic Conductivity** - fixed parameter map was resampled-rescaled from ELMreg500 v3.2.4 (which was resampled from SFWMM v5.4)
 - *added cell-width values = 1 m/d along the peripheral NE berm mask and eastern boundary (hydraulic conductivity **Figure 5**)*
- **other** map data (including initial soil attributes, initial surface and unsaturated water depths, other) were resampled-rescaled from ELM3reg500 v3.2.4

- *icSfWt, icUnsat 2020* - initial surface and unsaturated water depths were obtained from EDEN model estimates and resampled-rescaled, only for the special-case of 2020-2022 simulations

Input data - Elevation data refinement

Task 2 Report

- forms the basis of subsequent revisions outlined here (dtm == Gann digital terrain model)

Berm

- *We revisited the Task 2 method of determining the berm elevation, which used interpolations of the berm point survey data (which were isolated to particular sub-areas along the berm)*
- *It is understood that the north-south discontinuities in the marsh dtm are due to interference from ponded water (and vegetation). While those marsh spatial values are certainly erroneous, it is apparent that we can derive the (high elevation) berm elevation exclusively from the original (10m) fine-scale Gann dtm.*
- **Figure 6:** *The Gann dtm (@10m) was filtered via 9-neighbor median values within a small region along the berm. The result was resampled, within a 1-cell-width berm mask, @100m using median values. The mask was removed, the result was filtered via 5-neighbor median values, then that result was resampled within the 1-cell-width berm mask, to result in the final berm elevation product derived solely from the Gann dtm, referred to below as "**bermOverlay**"*

1993 (Rutchey) elevation map (Figure 7a)

- *Initial condition for 1984-2010 calibration run (developed by K. Rutchey, pers. comm. 1997). Filled values external to levee bounds using the Regularized Spline with Tension (RST) interpolation method from values inside of the levee*
- *The "**bermOverlay**" was superimposed on (replacing the) cells in the above 1993 map, resulting in the final map used in simulations*

2004 (USGS HAED) elevation map (Figure 7b)

- *Initial condition for 1984-2010 TEST calibration run, and (an option used in the) 2020-2022 calibration run. Revised the original RST basin-wide interpolation, to use ONLY HAED survey points that definitively fell inside the levee boundary (i.e., marsh points). Filled values external to levee bounds using the RST method from values inside of the levee*
- *The "**bermOverlay**" was superimposed on (replacing the) cells in the above 2004 (HAED) map, resulting in the final map used in simulations*

2018 (Gann) elevation map (Figure 7c)

- *The southern section of the (Task 2 Report) GannModified elevation result had substantial linear artifacts that we never addressed; now, we filtered those out in that southern section, then separately filtered the boundary between the northern and southern sections. Both operations done using the same moving window neighborhood tool described in Task 2 Report.*
- *For the sake of a different version/name, we took to a new convention and referred to this as the GannCombo (**Sept 2025**).*
- *Initial condition (option) for 2020-2022 calibration run. Filled (GannCombo) values external to levee bounds using the RST method from values inside of the levee*

- The "**bermOverlay**" was superimposed on (replacing the) cells in the above 2018 (Gann) map, resulting in the final map used in simulations

Special-case 2020-2022

Boundary condition flows

- **CanalData.struct_wat**: Historical 2020-2022 daily water control structure water-flows in each of the inflow and outflow structures were previously obtained from DBHYDRO, and used in these simulations
 - *As noted above for the 1984-2010 historical simulations, it appears very likely that the DBHYDRO observed flows for most structures are erroneous, unless the SFWMD has corrected database data at some unknown point.*
- **BoundCond_stage**: As demonstrated in the **Interim Status of Task 3 Report** (July 12, 2025), groundwater exchanges into and out-of the WCA-2A basin are essential to accurately simulating the hydro-ecology of the basin, particularly in wet-wet years
 - For other runs, we used output from the SFWMM to provide stages adjacent to the ELM periphery - for historical (calibration) runs and for future scenario runs. The SFWMM historical calibration encompasses 1984-2010, and we have no other source for modeling the historical (post-2010) stage boundary conditions for groundwater flows
 - For this 2020-2022 historical simulation, the stage-based groundwater flow calculations used assigned external stages that equaled the land-elevation of the adjacent peripheral ELM grid cell inside the model domain
- ***Because of these major boundary condition (structure and stage) flow limitations, the 2020-2022 simulation is only run for assessing the relative spatial and temporal patterns of chloride, as a flow tracer. It is understood that peripheral groundwater inflows-outflows (into and out of the basin) influence even surface water dynamics. Moreover, it is likely that observed inflow and outflow structure flow data may be erroneous for 2020-2022, as they are for 1984-2010 - and if so lead to erroneous dynamics in the basin. (See Appendix E Sensitivity for some supporting information).***

Meteorological inputs

- We obtained 2020-2022 daily rainfall and potential ET (pET) from EDEN: <http://sofia.usgs.gov/eden> , on 5/11/2025
- Sites are: S11B, EDEN11, G339, S10A, F1, U3, and S7
- During ELM runtime, an ELM algorithm for spatio-temporal interpolations uses the above site daily data and produces "on-the-fly" spatially distributed daily rain and pET across whatever ELM domain is being used.

Observed marsh conductivity (logger) conversion to chloride concentrations

- *The logger DataSondes sample surface water conductivity in the marsh. The ELM simulates chloride, for all input and output data. The conversion from conductivity to chloride is complex, with the relationship varying (significantly) spatially within WCA-2A, apparently dependent on source water characteristics and localized rainfall.*
- *S. Newman and D.Y. Lee provided (10/13/25) a statistical fit of all observed conductivity vs. chloride sample concentrations in the basin, assessed across different sets of years. Their best fit for a generalized WCA-2A relationship pertinent to the 2020-2022 ELM-simulated-years was:*

$Cl = a \times \text{Exp}(b \times \text{cond})$, where $a=41.556344$, $b=0.0011631$

- Preliminary runs indicated a simulated vs. observed bias using that relationship:
 - ELM 1984-2010 historical Cl bias in Threshold transects was median=12 mg/l underpredict (calib16 run);
 - ELM 2020-2022 historical Cl bias in logger sites when using the Newman & Lee equation was median= 45 mg/l underpredict (logCalib16_uncorr run);
- Based on those results, we used the following bias-adjusted equation for observed Cl concentration, in the model simulated vs. observed assessments (logCalib16 run):
 $Cl = a \times \text{Exp}(b \times \text{cond}) - \text{biasAdj}$, where $a=41.556344$, $b=0.0011631$, $\text{biasAdj}=0.033$

Figure 1. ELM3wca2 infrastructure, showing the operating canal/levee vectors, water control structures, and long-term monitoring sites. R13 is a receiving canal of STA2 flows, via L6 levee degradation; the location of its associated inflow structure, elm G336_S, is not relevant, as its flow merely shows up in the R13 to flow into WCA-2A. The NE airboat trails are not shown here.

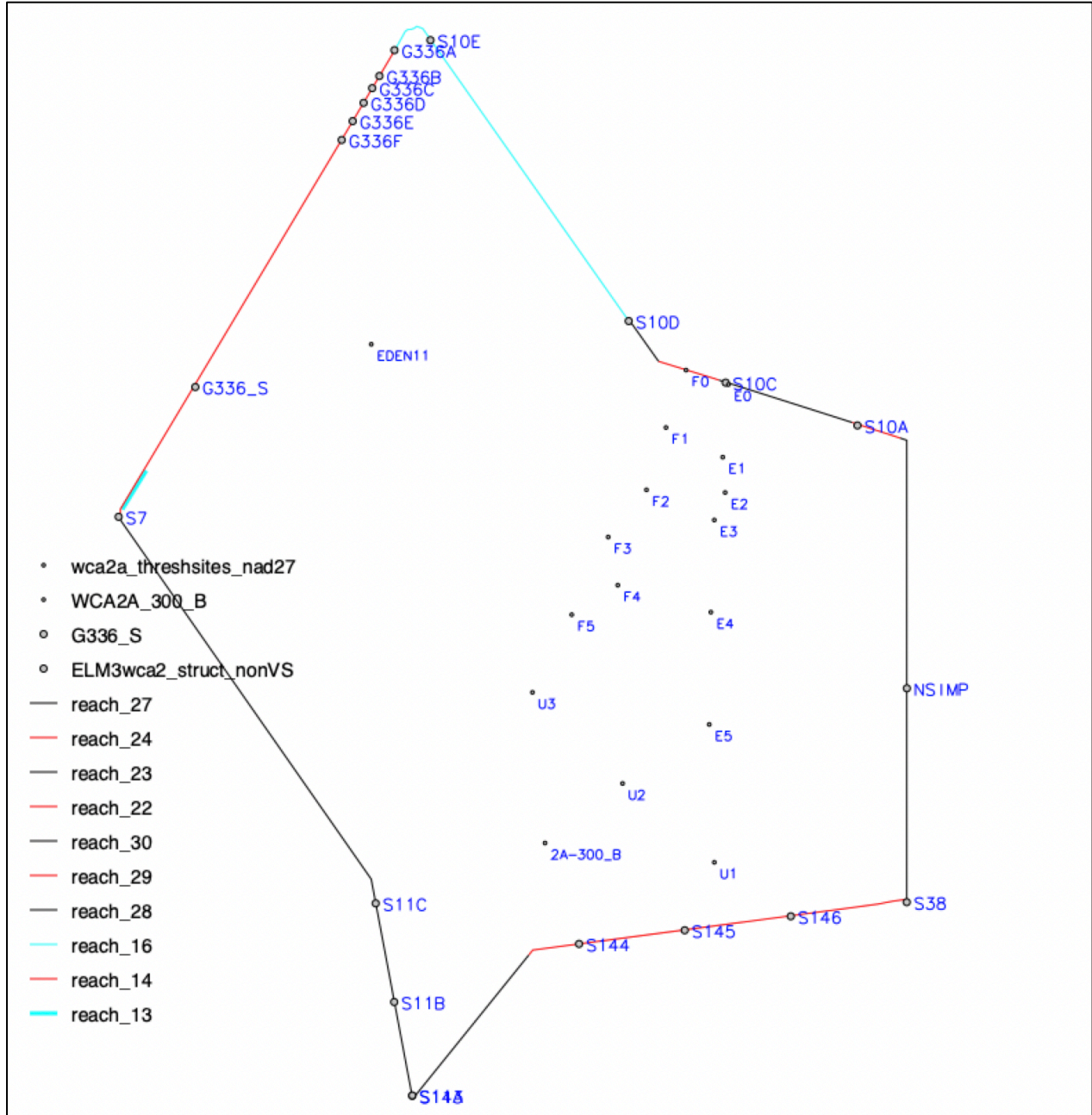


Figure 2. RSM-GL water control structures used in their calibration run (1984-2000, thus not including STA-2). Structures with imposed flows used observed historical DBHYDRO values. Structures with simulated flows (in WCA-2A) used simulated historical values from the SFWMM. (The SFWMM v7.0 calibration run that included STA-2 used simulated historical, not observed, flows for the single G335 flow from STA-2 into WCA-2A).

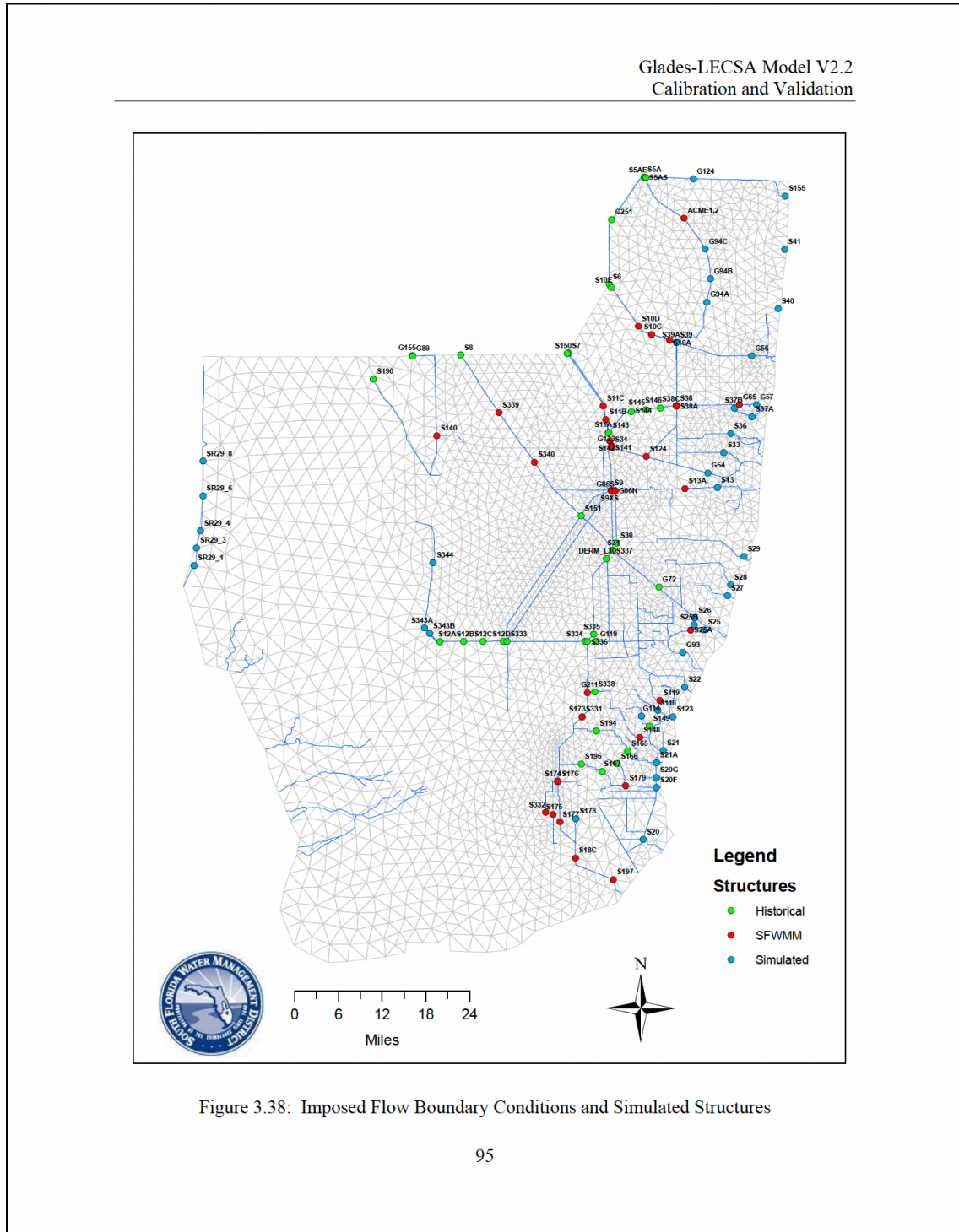


Figure 3.38: Imposed Flow Boundary Conditions and Simulated Structures

Figure 3. Differences between 1984-2010 SFWMM-simulated-historical vs. observed-historical daily flows in WCA-2A structures. For all structures for which the SFWMM v7.0 used its management algorithms rather than DBHYDRO data to drive the model, the calculation is: Diff=DBHYDRO - SFWMM. All data in daily cfs. This is a split-sheet view of a spreadsheet that has 9,862 records. DiffSum is the Period Of Record (POR) sum of the differences. The last row (SFWMM_SimSum) is the POR sum of each structure's SFWMM flows, for reference. Note that POR sums do not reflect the pulses of significant differences between sources.

Date	year	mon	da	G335	S10	S10E	S11	S143	S144	S145	S146	S38	S7
1/1/84	1984	1	1	0	0		0	0				0	0
1/2/84	1984	1	2	0	0		0	0				0	0
1/3/84	1984	1	3	0	0		0	0				0	0
1/4/84	1984	1	4	0	0		564.15	0				0	0
1/5/84	1984	1	5	0	0		671.72	0				0	0
12/26/10	2010	12	26	0	0		0	0				0	0
12/27/10	2010	12	27	0	0		0	0				0	0
12/28/10	2010	12	28	0	0		0	0				0	0
12/29/10	2010	12	29	0	0		0	0				0	0
12/30/10	2010	12	30	0	0		0	0				0	0
12/31/10	2010	12	31	0	0		0	0				0	0
	DiffSum:			113,864	827,613		825,664	33,676				28,597	-51,016
	DiffMin:			0	0		-2,564	0				0	-1,071
	DiffMax:			2,875	4,957		2,733	484				562	0
	SFWMM_SimSum:			1,271,079	3,406,932		6,420,276	256,766				1,074,343	3,231,009

Figure 4. Habitat types used in ELM3wca2_100 simulations: the 1984-2010 calibration run (using 1982 habitat map), and the 2020-2022 calibration run (using the 2018 habitat map, and test with the 1982 habitat map).

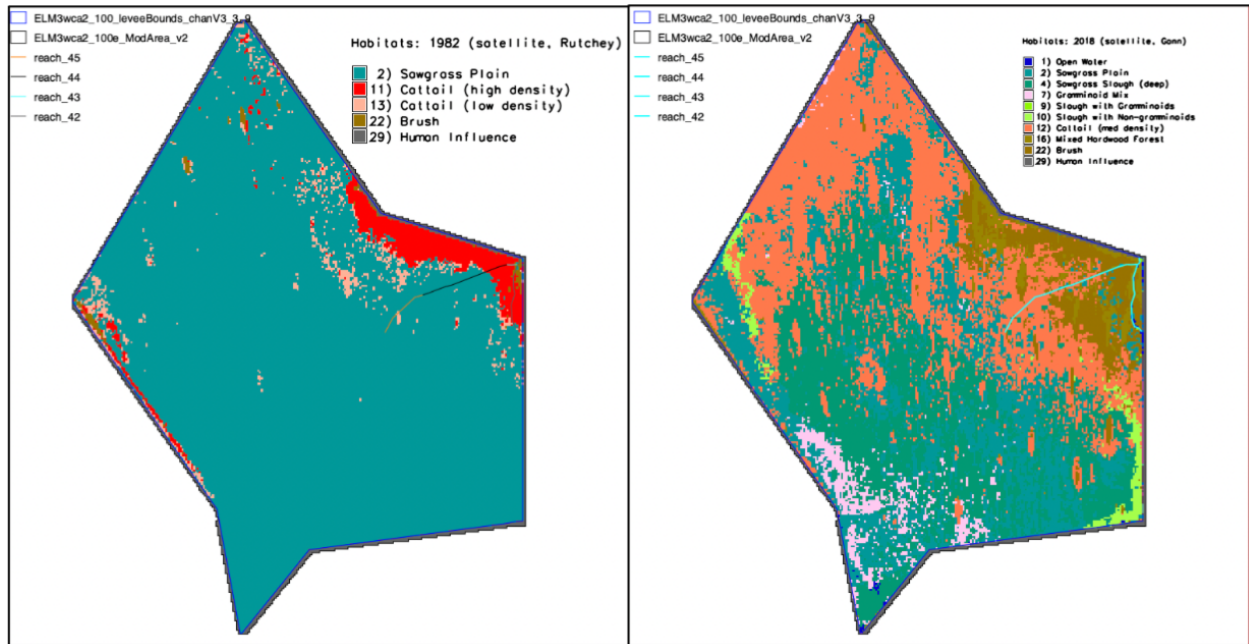


Figure 5. Hydraulic conductivity map parameters used in ELM3wca2_100 simulations. The only changes from those of the SFWMM are the rescaling-smoothing of the 2x2 mile grid data, and the addition of a low value along the eastern-peripheral cells outside of the levee bounds, and along the berm itself.

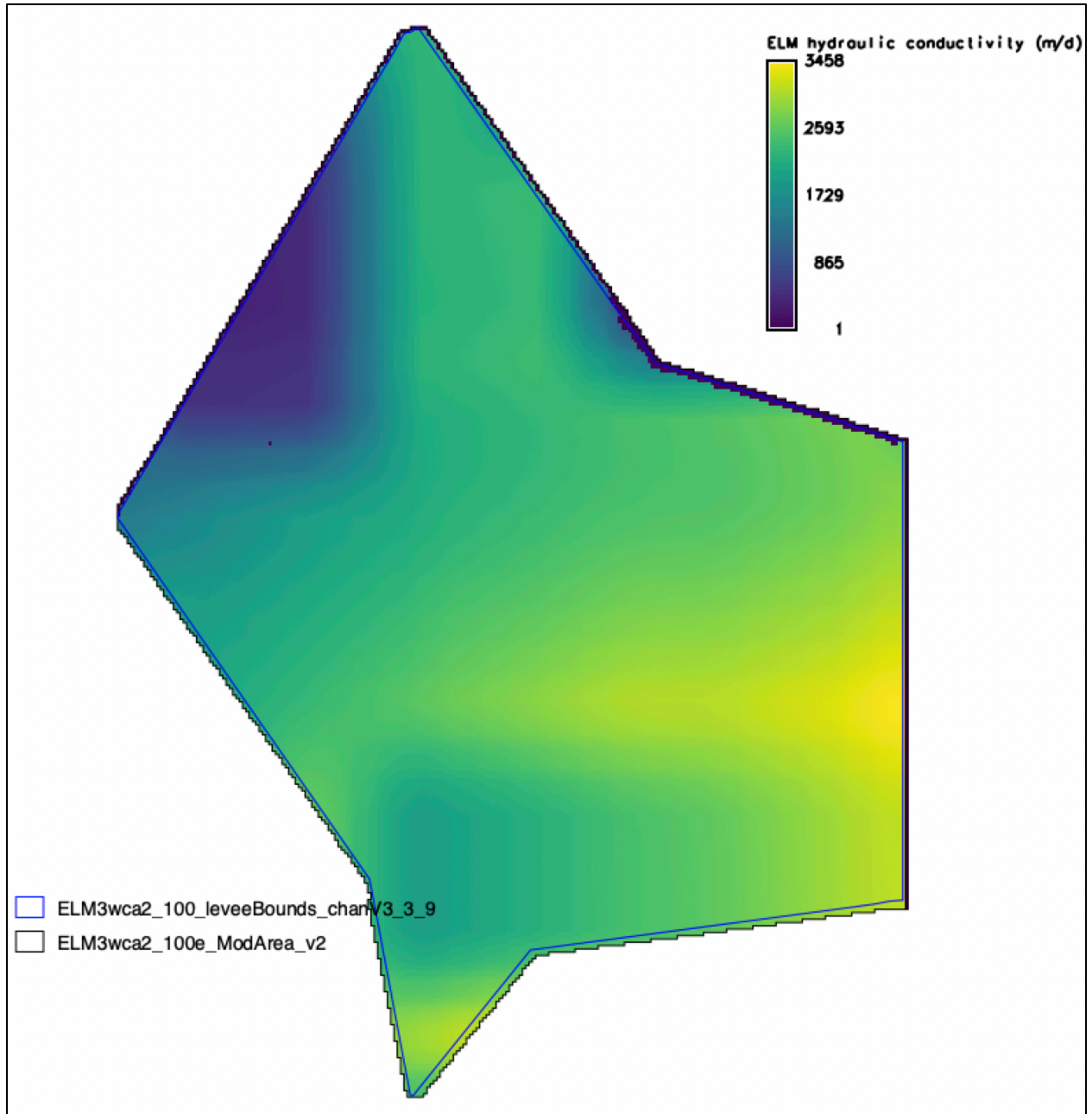


Figure 6. Derivation of NEberm elevation, from the Gann dtm. The Gann dtm (@10m) was filtered via 9-neighbor median values within a small region along the berm (left figure). The result was resampled, within a 1-cell-width berm mask, @100m using median values. The mask was removed, the result was filtered via 5-neighbor median values, then that result was resampled within the 1-cell-width berm mask, to result in the final berm elevation product (right figure) derived solely from the Gann dtm, referred to as "bermOverlay".

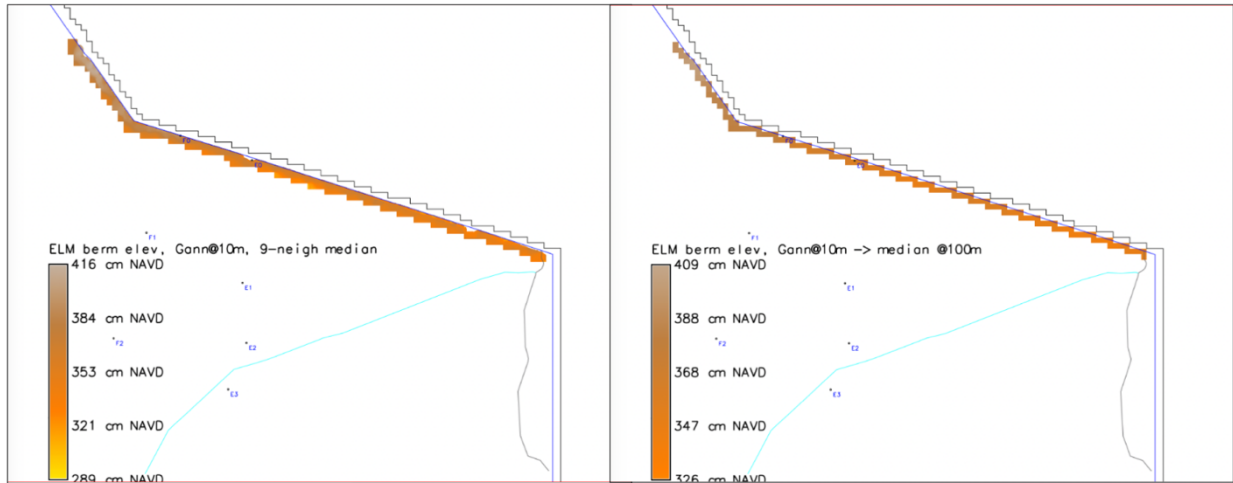


Figure 7a. ELM initial (dynamic variable) elevation, 1993 (Rutchey). Used in 1984-2010 calibration run. Includes the "bermOverlay".

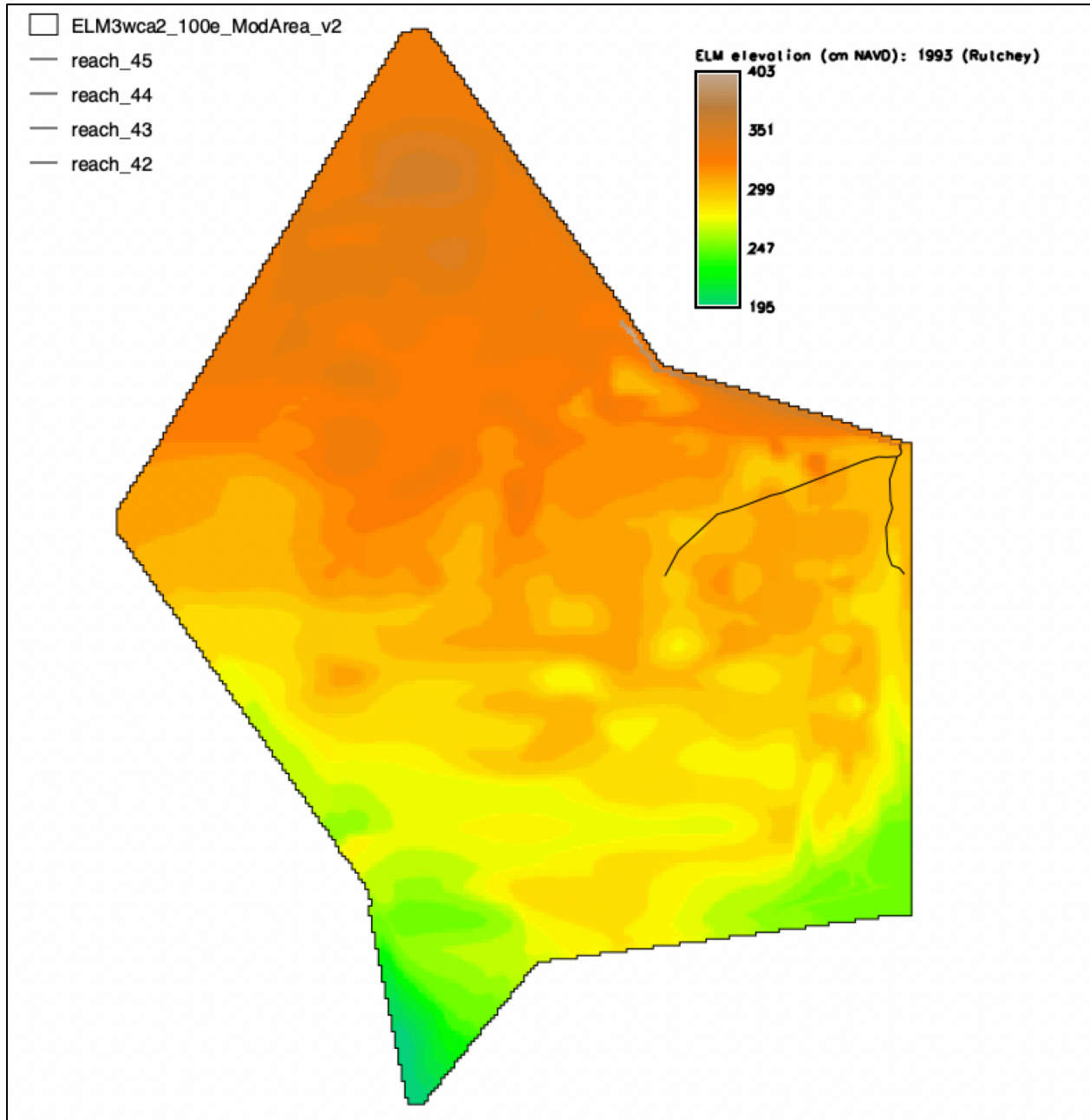


Figure 7b. ELM initial (dynamic variable) elevation, 2004 (HAED). Used in 1984-2010 TEST calibration run, and (an option used in the) 2020-2022 calibration run. Includes the "bermOverlay".

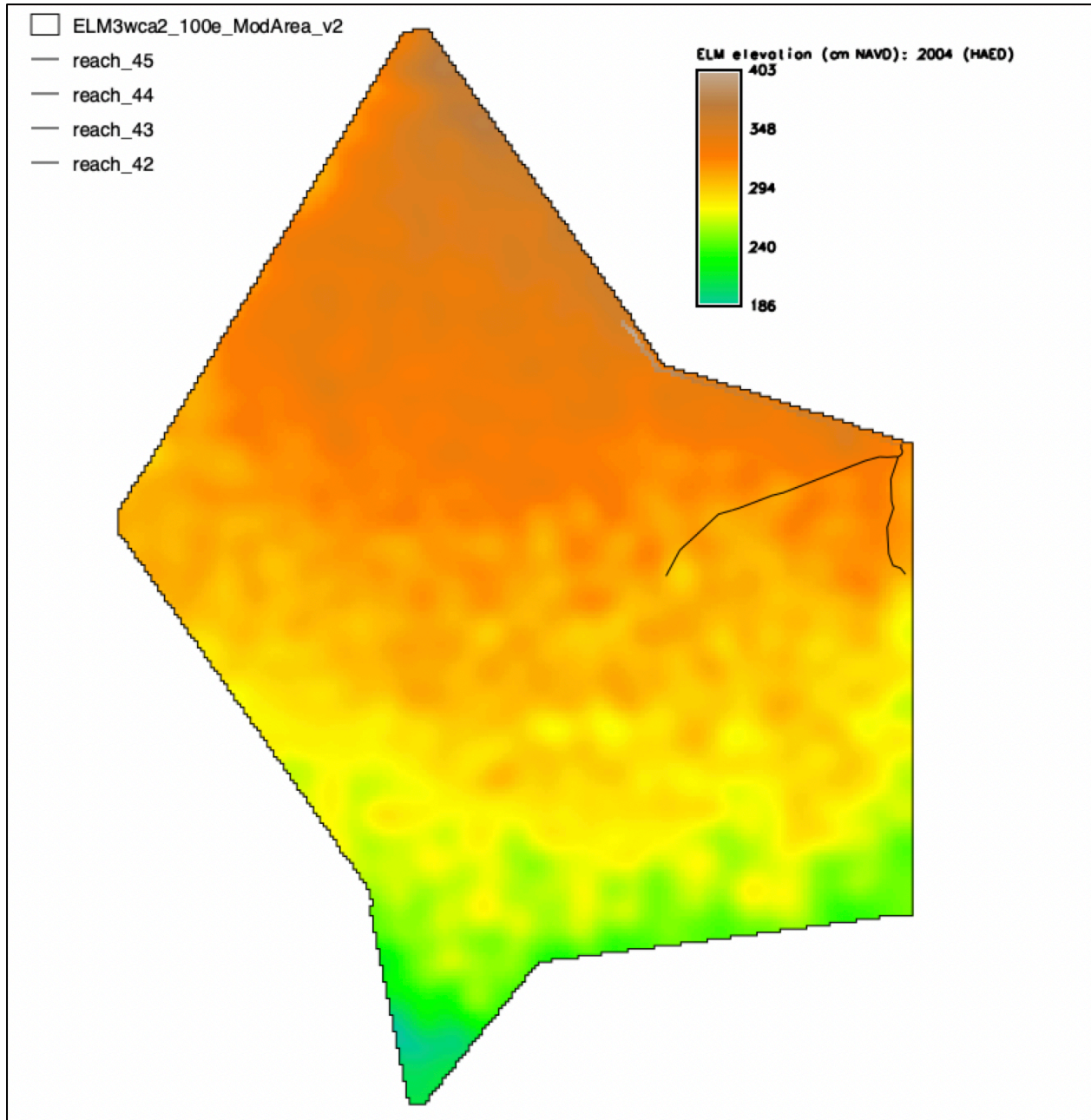
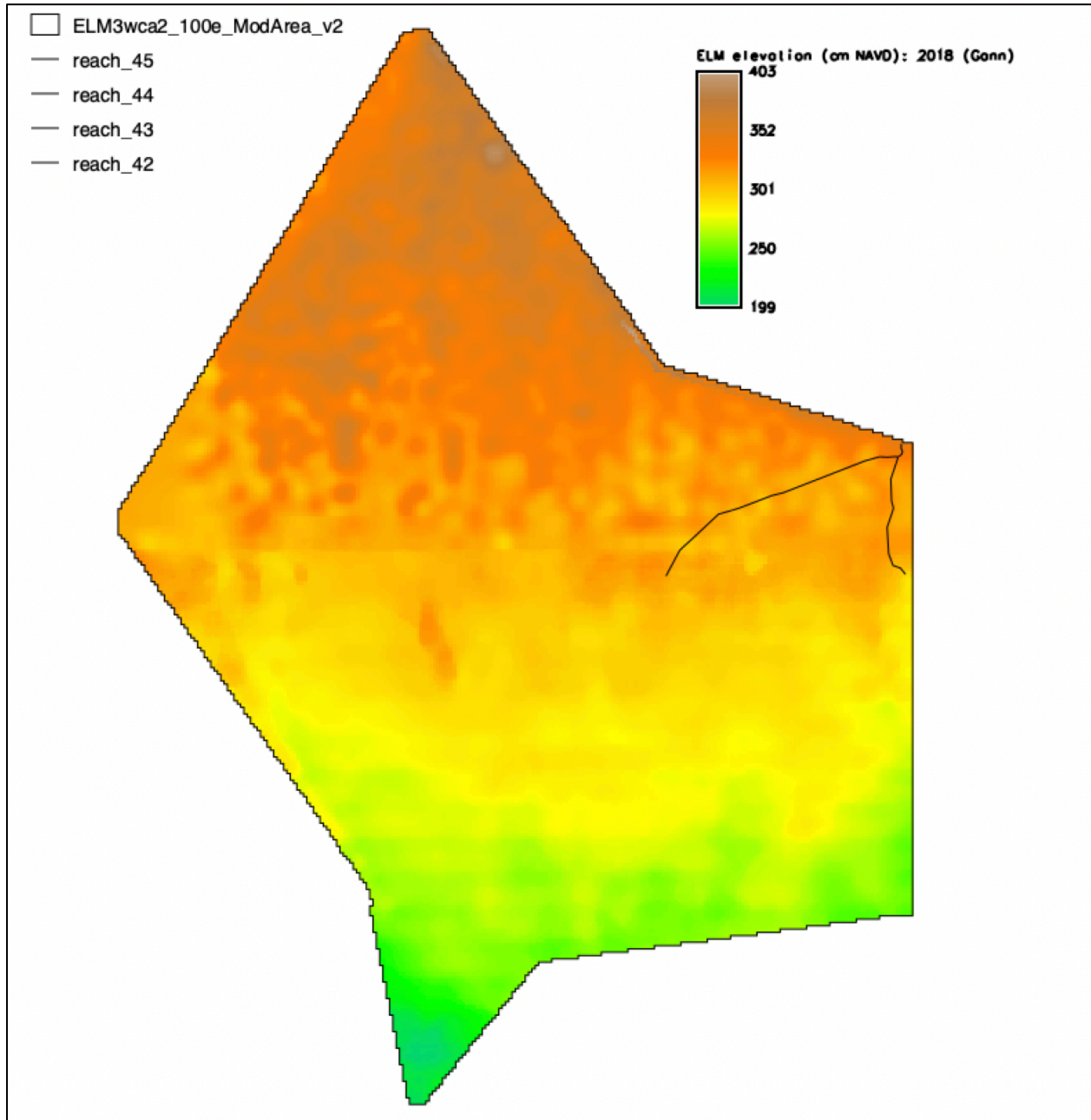


Figure 7c. ELM initial (dynamic variable) elevation, 2018 (Gann). Used in (option) for 2020-2022 calibration run. Includes the "bermOverlay".



Simulation output outline for ELM3wca2_100 (ELM v3.2.6)

SEE EXTENSIVE ELM V2.5 AND V3.2.4 DOCUMENTATION FOR SPECIFIC DEFINITIONS OF MODEL INPUT DATA, MODEL STRUCTURE, AND MODEL OUTPUT DATA

Performance outline: Temporal extent - 27yr 1984-2010 history-matching

- Initial elevation= 1993
- Initial habitat= 1982
- Simulation named "calib16"
- Output site-specific performance assessments: excellent stage, Cl, and (ok) TP performance (meeting/exceeding that of ELM3reg500 v3.2.4)
 - Sites: statistics **Tables 1,2,3**: 7 stage, 15 surfwat Cl, 15 surfwat TP
 - Sites: time series graphs **Appendices.A,B,C**: 7 stage, 15 surfwat Cl, 15 surfwat TP
- Output map patterns
 - Surface water depth mean **Figure 8**
 - Soil P Accumulation Rate **Figure 9**
 - Peat Accretion (elevation change) Rate **Figure 10**
 - Soil P concentration **Figure 11**
- Observed map patterns
 - Soil P concentration **Figure 11**
 - Elevation change **Figure 12**
- Raw netCDF spatial time series of multiple output variables at 30-d output frequencies, found (temporarily) at: <https://www.ecolandmod.com/tmp/download.html>
- FitzSystem model input/output archive: ./arc_out/ELM3wca2_100/calib16/

Performance outline: Temporal extent - 2+ yr 2020-2022 history-matching

- Initial elevation= 2004 (& see 2018 Sensitivity test, Appendix E)
- Initial habitat= 1982 (& see 2018 Sensitivity test, Appendix E)
- Output site-specific performance assessments: excellent Cl performance
 - Logger sites: statistics **Table 4**: 38 surfwat Cl
 - Logger sites: time series graphs **Appendix D**: 38 surfwat Cl
- Output map patterns
 - Logger site map **Figure 13**
 - Map of 38 logger sites' simulated and observed Cumulative Frequency Distributions (CFDs) for surface water Cl concentrations, **Figure 14** - see **Appendix D** for each site's time series and CFDs
- Raw netCDF spatial time series of Cl concentrations at 30-d and 2-d output frequencies, found (temporarily) at: <https://www.ecolandmod.com/tmp/download.html>
- FitzSystem model input/output archive: ./arc_out/ELM3wca2_100B/logCalib16/

Performance outline: Sensitivity tests, 1984-2010 & 2020-2022 history-matching

- **Appendix E Sensitivity** shows results using variations of NE airboat trail configurations, and Gann elevation and habitat maps

Simulation output: 1984-2010

Table 1. Stage performance (*calib16*). Statistical evaluation of (ELM v3.2.6) simulated vs. observed daily stage, 1984 – 2010. Units of Bias (observed minus simulated) and RMSE are meters.

ELM3wca2_100 <i>calib16</i>				
STATION	N	NS_Eff	Bias	RMSE
WCA2F1	5870	0.14	0.01	0.23
WCA2F4	5121	0.45	-0.01	0.17
WCA2E4	5197	0.43	0.00	0.18
2A-17_B	9852	0.63	0.02	0.17
2A-300_B	9730	0.59	0.07	0.20
WCA2U1	5278	0.46	0.01	0.21
EDEN11	1606	-0.31	-0.14	0.20
Median:	5278	0.45	0.01	0.20

Table 2. Chloride performance (*calib16*). Statistical evaluation of (ELM v3.2.6) paired simulated vs. observed surface water chloride concentration, 1984 – 2010, aggregated by (wet vs. dry) seasons. Units of Bias (observed minus simulated) and RMSE are mg l⁻¹ (ppm). Relative Bias (RelBias) is the proportion of Bias divided by the Observed Mean (ObsMean).

ELM3wca2_100 <i>calib16</i>					
STATION	ObsMean	N	Bias	RelBias	RMSE
E1	136	24	16	0.12	28
E2	125	28	10	0.08	26
E3	127	31	11	0.09	31
E4	118	31	6	0.05	27
E5	112	31	11	0.10	29
F1	147	23	18	0.12	30
F2	147	28	19	0.13	35
F3	142	27	10	0.07	27
F4	130	28	7	0.05	26
F5	140	31	14	0.10	36
U1	101	31	12	0.12	21
U2	123	31	32	0.26	46
U3	127	29	12	0.10	33
F0	126	32	8	0.06	25
E0	123	32	17	0.14	26
MedianAll	127	31	12	0.10	28
MedianCanal	125	32	13	0.10	26
MedianMarsh	127	29	12	0.10	29

Table 3. TP performance (calib16). Statistical evaluation of (ELM v3.2.6) paired simulated vs. observed surface water phosphorus concentration, 1984 – 2010, aggregated by (wet vs. dry) seasons. Units of Bias (observed minus simulated) and RMSE are $\mu\text{g l}^{-1}$ (ppb). Relative Bias (RelBias) is the proportion of Bias divided by the Observed Mean (ObsMean).

ELM3wca2_100 <i>calib16</i>					
STATION	ObsMean	N	Bias	RelBias	RMSE
E1	48	23	24	0.50	33
E2	44	25	22	0.50	27
E3	31	28	15	0.49	19
E4	14	29	4	0.26	5
E5	8	30	1	0.07	4
F1	78	21	50	0.64	76
F2	45	27	28	0.63	40
F3	24	27	12	0.48	15
F4	17	28	6	0.36	8
F5	11	30	2	0.21	4
U1	10	30	-1	-0.06	6
U2	11	30	6	0.51	21
U3	9	29	2	0.18	5
F0	70	30	12	0.17	45
E0	62	31	17	0.27	40
MedianAll	24	29	12	0.36	19
MedianCanal	66	31	14	0.22	42
MedianMarsh	17	28	6	0.48	15

Figure 8. Simulated ponded surface water depth, mean across 1984-2010 (calib16). Sites are SFWMD "Threshold" monitoring, along with EDEN11 and 2A-300B hydrologic monitoring sites. The hydrologic site "2-17" is effectively the same as "U3" shown here.

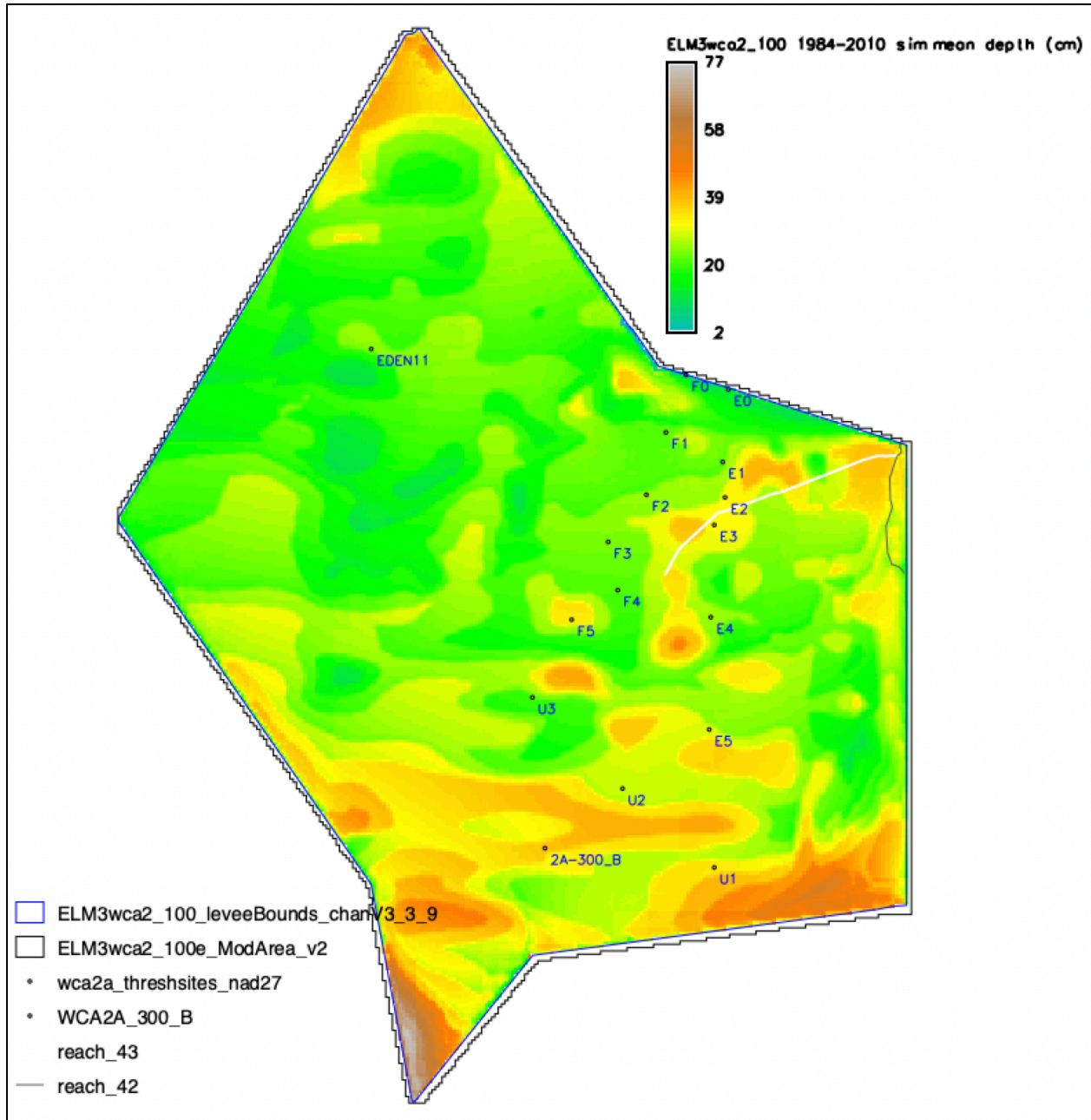


Figure 9. Simulated soil P accumulation rate, 1984-2010 (calib16). Left figure is entire Period of Simulation rate; middle figure is rate during pre-STA years; right figure is rate during years with STA-2 operating. In this "calib16" run, the airboat trail R42 is active; the airboat trail R43 is inactive, shown only for reference.

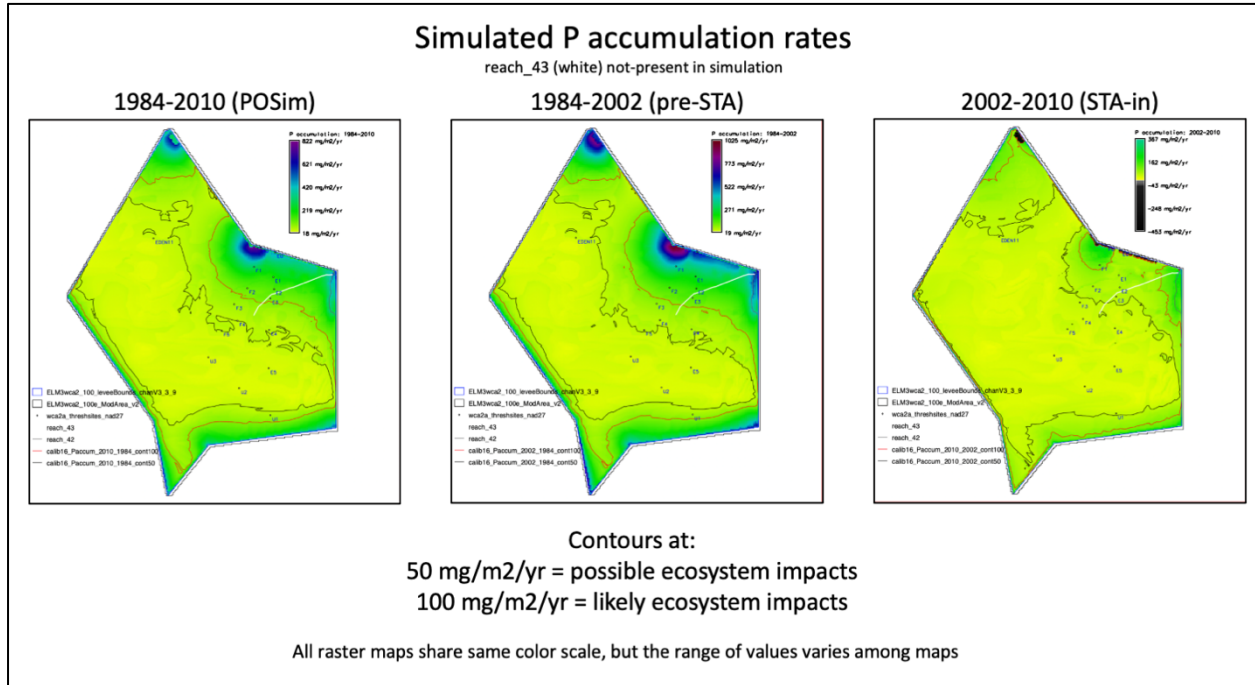


Figure 10. Simulated peat accretion (elevation change) rate, 1984-2010 (calib16). Left figure is entire Period of Simulation rate; middle figure is rate during pre-STA years; right figure is rate during years with STA-2 operating. In this "calib16" run, the airboat trail R42 is active; the airboat trail R43 is inactive, shown only for reference.

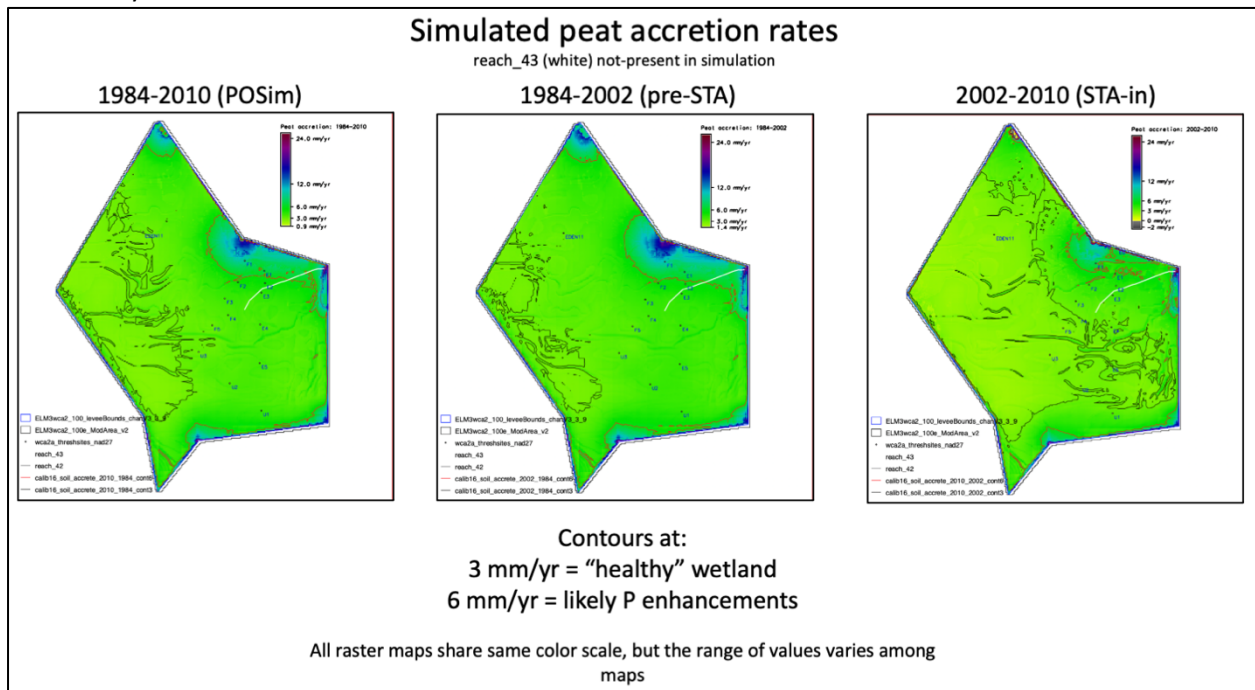


Figure 11. Simulated and observed soil TP concentration (0-10 cm depth), 1984-2010 (calib16). Upper row of figures are simulated values; lower row of figures are the (1990 and 2003) observed data, with the sampling points shown interpolated using the RST method.

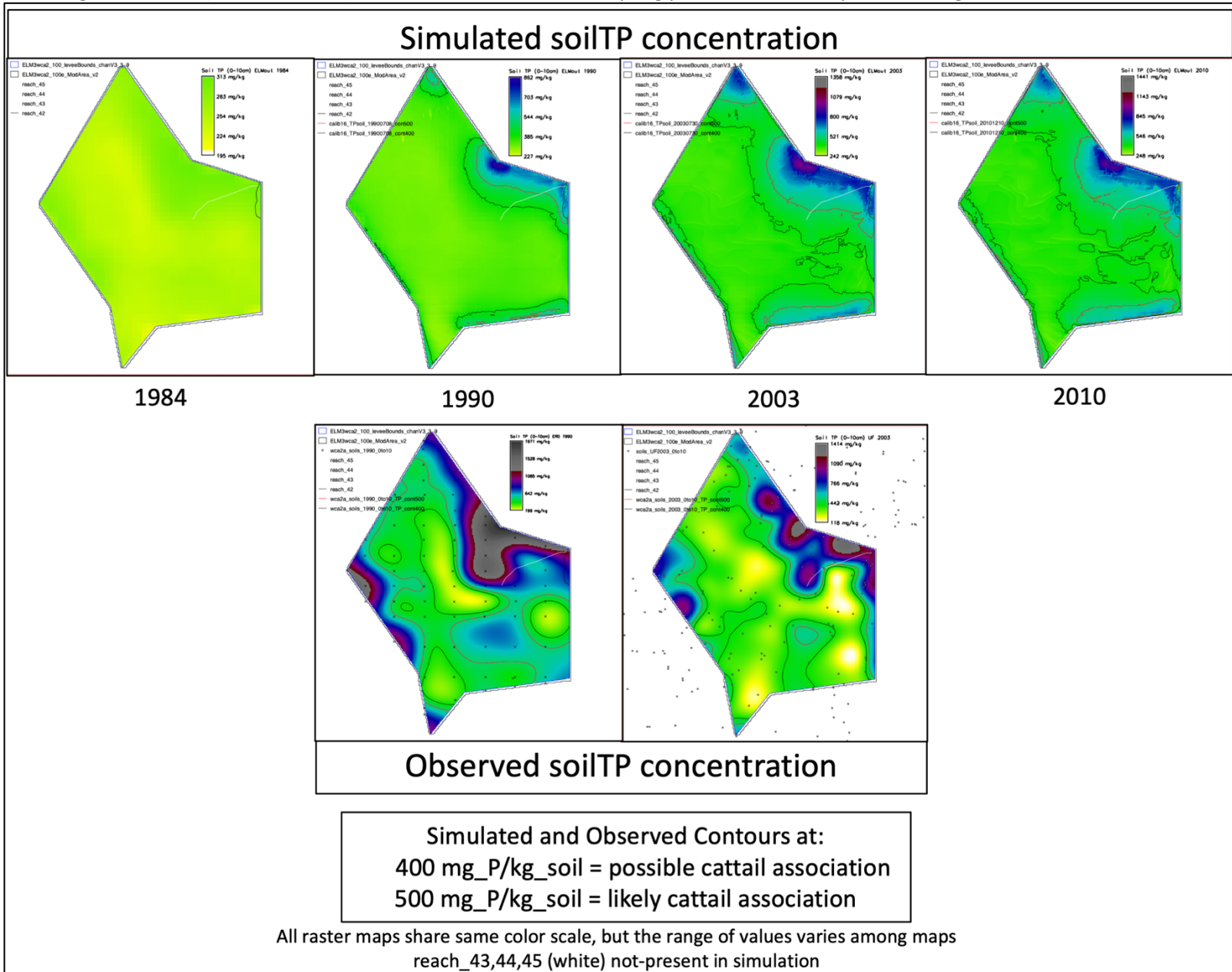
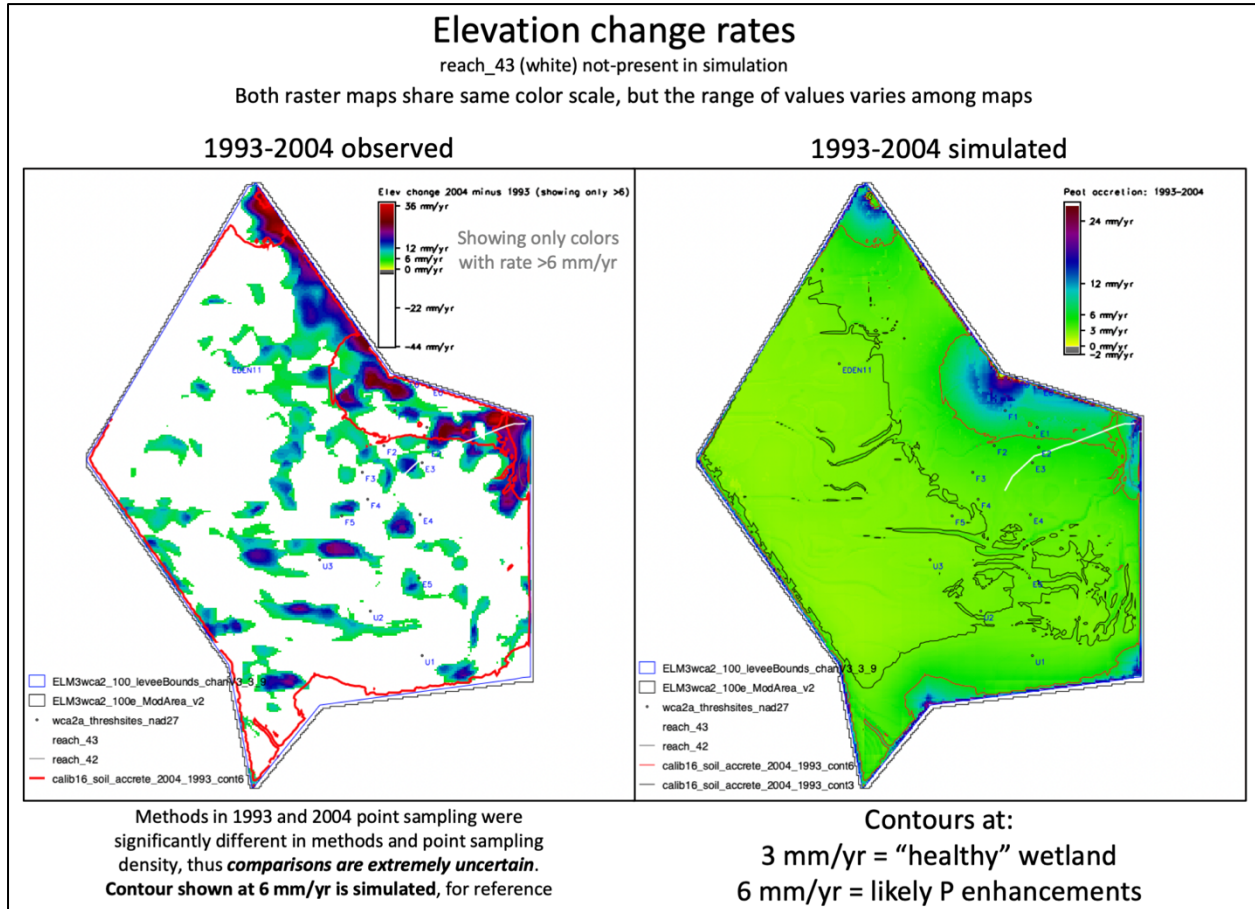


Figure 12. Simulated and observed land elevation change, between 1993 and 2004. The observed rates used the difference between the 1993 (Rutchey) and 2004 (USGS HAED) maps; the simulated peat accretion (elevation change) rate was from the 1984-2010 run (calib16).



Simulation output: 2020-2022

Table 4a (next page). Chloride performance (logCalib16). Statistical evaluation of (ELM v3.2.6) paired simulated vs. (biasAdjusted) observed surface water chloride concentration, 2020 – 2022, for both all unaggregated data, and for data aggregated by (wet vs. dry) seasons. Units of Bias (observed minus simulated) and RMSE are mg l^{-1} (ppm). Relative Bias (RelBias) is the proportion of Bias divided by the Observed Mean (ObsMean).

The biasAdjusted data were deemed to be most suitable for use in these comparative simulations of the pattern of ELM performance.

ALL, and SEAsonal, surface water Cl: ELM3wca2_100 logCalib16 (bias-corrected-observed-data)									
STATION	OBS_MEAN	ALL_N	SEA_N	ALL_BIAS	ALL_RelBias	SEA_BIAS	SEA_RelBias	ALL_RMSE	SEA_RMSE
marsh1	114	645	4	-5	-0.04	-5	-0.04	29	16
marsh2	123	808	5	-28	-0.23	-25	-0.20	49	32
marsh3	132	474	5	21	0.16	19	0.14	43	33
marsh4	129	490	5	35	0.27	35	0.27	101	64
marsh5	77	591	5	17	0.22	21	0.27	30	30
marsh7	88	490	5	13	0.15	12	0.14	44	21
p0505canx	102	286	5	6	0.06	10	0.10	39	24
p0506x	138	672	5	39	0.28	37	0.27	76	58
p0507x	135	735	5	19	0.14	17	0.13	79	46
p0508x	129	726	5	-6	-0.05	-4	-0.03	51	33
p0604x	84	546	5	22	0.26	23	0.27	45	31
p0605x	92	530	5	12	0.13	11	0.12	32	17
p0606x	111	598	5	19	0.17	17	0.15	49	30
p0607x	141	441	5	39	0.28	37	0.26	64	46
p0608x	131	579	5	9	0.07	9	0.07	39	26
p0609x	127	807	5	-21	-0.17	-18	-0.14	44	28
p0610x	137	807	5	-14	-0.10	-5	-0.04	59	35
p0702canx	71	753	5	10	0.14	10	0.14	22	15
p0703x	148	365	4	102	0.69	113	0.77	114	118
p0704x	95	474	5	42	0.44	38	0.40	64	50
p0705x	106	498	5	30	0.28	30	0.28	50	35
p0706x	102	471	5	22	0.22	23	0.22	43	27
p0707x	93	438	5	-3	-0.03	-4	-0.04	30	21
p0708x	118	572	5	15	0.13	14	0.12	64	38
p0709x	134	595	5	9	0.07	2	0.01	51	24
p0803x	109	661	5	56	0.52	68	0.63	79	79
p0804x	92	507	5	40	0.44	44	0.48	61	48
p0805x	78	515	5	15	0.19	13	0.17	45	28
p0806x	76	389	4	0	0.00	-1	-0.01	42	22
p0807x	121	509	5	31	0.26	28	0.23	75	52
p0903x	59	706	5	12	0.20	15	0.25	35	27
p0904x	47	470	5	-1	-0.02	1	0.02	31	9
p0905x	64	466	5	-4	-0.06	-2	-0.03	34	18
p0906x	51	551	5	-13	-0.26	-11	-0.22	32	26
p0907x	84	511	5	6	0.07	7	0.08	35	27
p1003x	53	674	5	-10	-0.19	-10	-0.19	21	12
p1005x	63	555	5	7	0.11	10	0.16	35	29
p1007x	59	554	5	-6	-0.10	-3	-0.05	28	18
Median:	102	551	5	12	0.14	12	0.14	44	29

Table 4b (next page). Chloride performance (logCalib16). Statistical evaluation of (ELM v3.2.6) paired simulated vs. (NOT-biasAdjusted) observed surface water chloride concentration, 2020 – 2022, for both all unaggregated data, and for data aggregated by (wet vs. dry) seasons. Units of Bias (observed minus simulated) and RMSE are mg l^{-1} (ppm). Relative Bias (RelBias) is the proportion of Bias divided by the Observed Mean (ObsMean).

The NOT-biasAdjusted data were deemed to be, well, biased, and not the most suitable data to use in these comparative simulations of the pattern of ELM performance.

ALL, and SEAsOnal, surface water Cl: ELM3wca2_100 logCalib16 (NOT-bias-corrected-observed-data)									
STATION	OBS_MEAN	ALL_N	SEA_N	ALL_BIAS	ALL_RelBias	SEA_BIAS	SEAS_RelBias	ALL_RMSE	SEA_RMSE
marsh1	147	645	4	28	0.19	28	0.19	40	32
marsh2	156	808	5	5	0.03	8	0.05	40	22
marsh3	165	474	5	54	0.33	52	0.32	66	58
marsh4	162	490	5	68	0.42	68	0.42	116	86
marsh5	110	591	5	50	0.46	54	0.49	56	58
marsh7	121	490	5	46	0.38	45	0.37	62	48
p0505canx	135	286	5	39	0.29	43	0.32	55	48
p0506x	171	672	5	72	0.42	70	0.41	97	83
p0507x	168	735	5	52	0.31	50	0.30	92	66
p0508x	162	726	5	27	0.17	29	0.18	57	43
p0604x	117	546	5	55	0.47	56	0.48	67	60
p0605x	125	530	5	45	0.36	44	0.35	54	46
p0606x	144	598	5	52	0.36	50	0.35	69	56
p0607x	174	441	5	72	0.41	70	0.40	88	75
p0608x	164	579	5	42	0.26	42	0.26	57	49
p0609x	160	807	5	12	0.08	15	0.09	41	26
p0610x	170	807	5	19	0.11	28	0.16	61	44
p0702canx	104	753	5	43	0.41	43	0.41	47	44
p0703x	181	365	4	135	0.75	146	0.81	144	150
p0704x	128	474	5	75	0.59	71	0.55	89	78
p0705x	139	498	5	63	0.45	63	0.45	75	65
p0706x	135	471	5	55	0.41	56	0.41	67	58
p0707x	126	438	5	30	0.24	29	0.23	43	35
p0708x	151	572	5	48	0.32	47	0.31	78	59
p0709x	167	595	5	42	0.25	35	0.21	66	42
p0803x	142	661	5	89	0.63	101	0.71	105	109
p0804x	125	507	5	73	0.59	77	0.62	86	79
p0805x	111	515	5	48	0.43	46	0.41	64	53
p0806x	109	389	4	33	0.30	32	0.29	53	39
p0807x	154	509	5	64	0.42	61	0.40	94	75
p0903x	92	706	5	45	0.49	48	0.52	56	53
p0904x	80	470	5	32	0.40	34	0.43	44	35
p0905x	97	466	5	29	0.30	31	0.32	44	36
p0906x	84	551	5	20	0.24	22	0.26	36	32
p0907x	117	511	5	39	0.33	40	0.34	53	48
p1003x	86	674	5	23	0.27	23	0.27	29	24
p1005x	96	555	5	40	0.42	43	0.45	53	51
p1007x	92	554	5	27	0.29	30	0.33	38	34
Median:	135	551	5	45	0.36	45	0.35	61	51

Figure 13. Sites of the SFWMD "logger" daily (hourly) sampling. Note that the 807canx (canal) site is located in an ELM3wca2_100 marsh grid cell that is on the high-elevation NEberm, and thus is not used in simulated-observed comparisons. The marsh6 site did not have any observed CI data, and thus also not used. The "logCalib16" run does not simulate the NE airboat trail denoted here by reach_43, and is shown only for reference in this context.

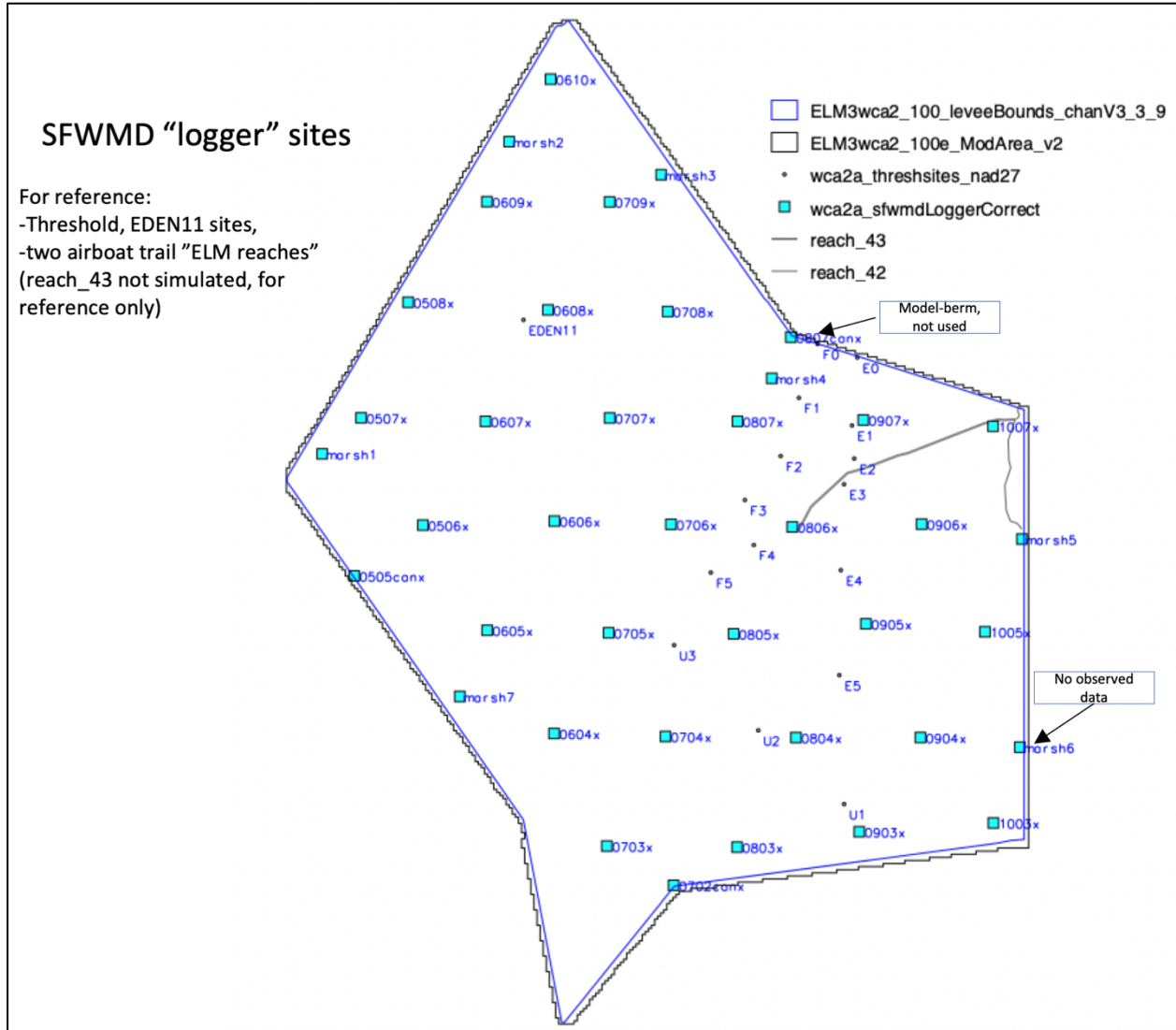
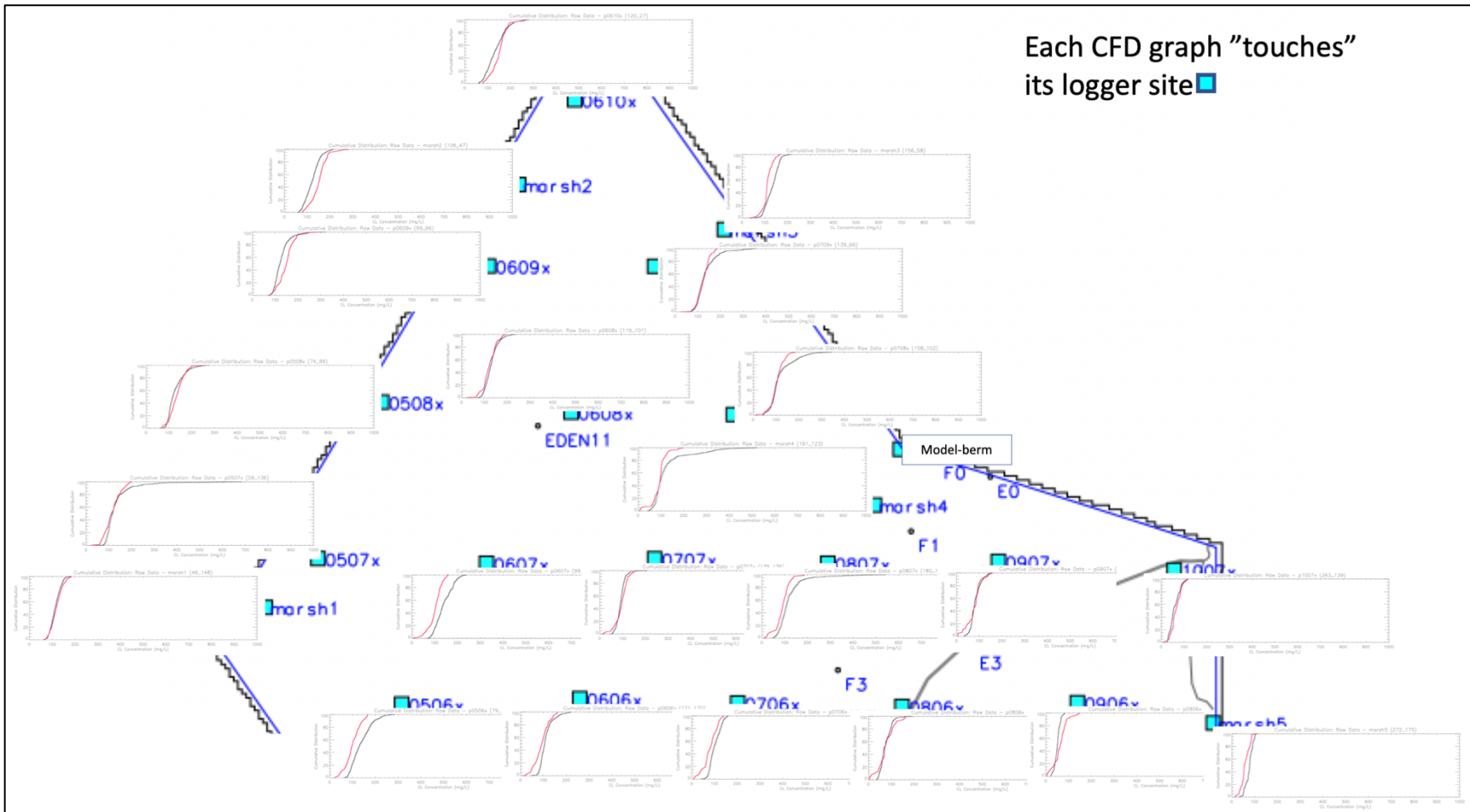
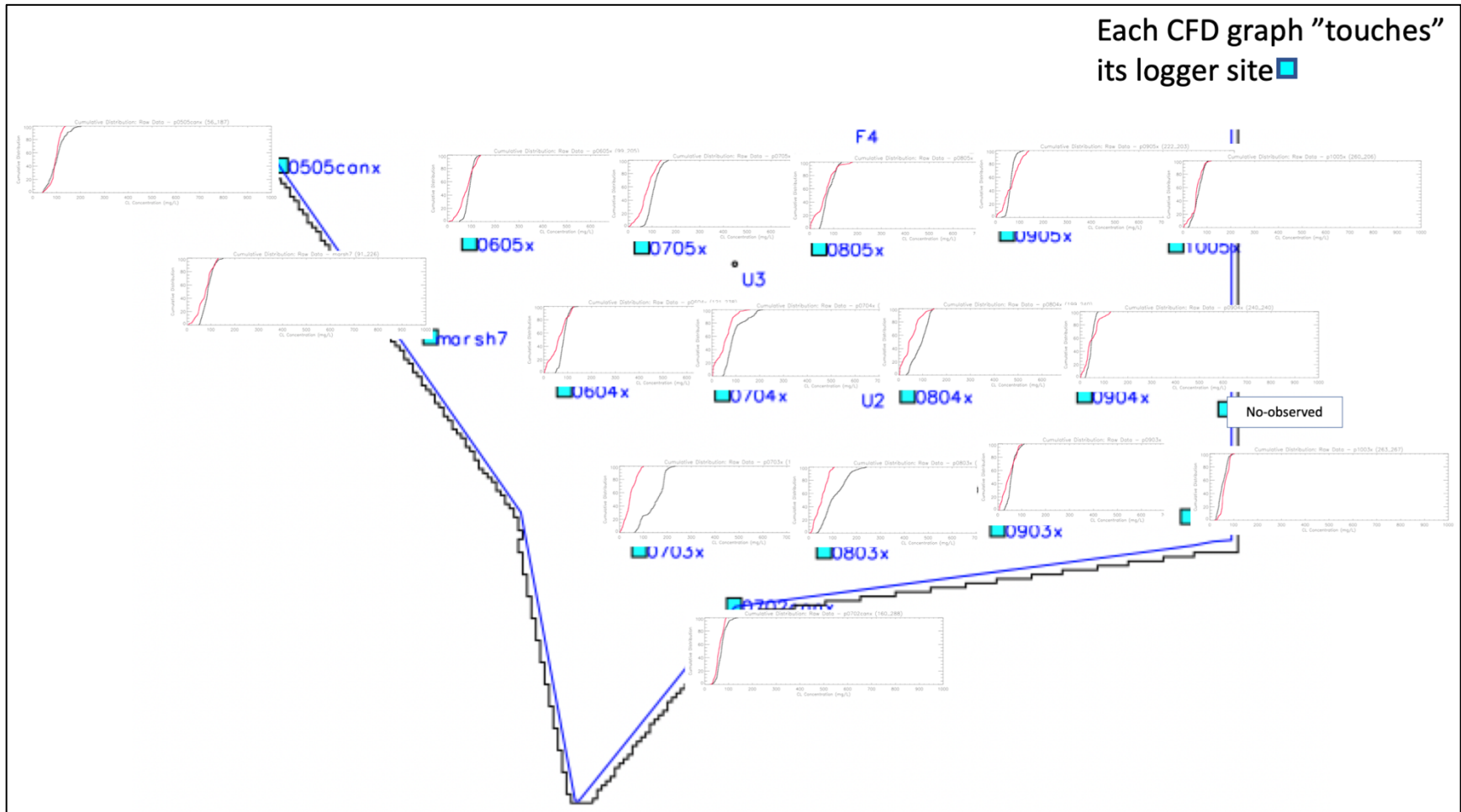


Figure 14. (A. North, B. South). Spatial patterns of the (logCalib16) Cumulative Frequency Distributions (CFDs) of simulated (red) and observed (black) surface water Cl concentration at 38 SFWMD logger sites (daily-paired-data, Aug 2020 – Dec 2022). See **Appendix D** for each site's time series and CFD, and their full definitions.

14A.



14B.



Appendix A. Stage model vs. observed time series (7 sites-pages). Plots of stage hydrographs and their associated Cumulative Frequency Distributions (CFD) for the period of record 1984-2010 at each monitoring location.

The red dashed line in the stage hydrographs is the model grid cell's land surface elevation, which is a time-varying output variable of the model. The model grid cell column and row locations are shown in parentheses (col_row) of each plot's title.

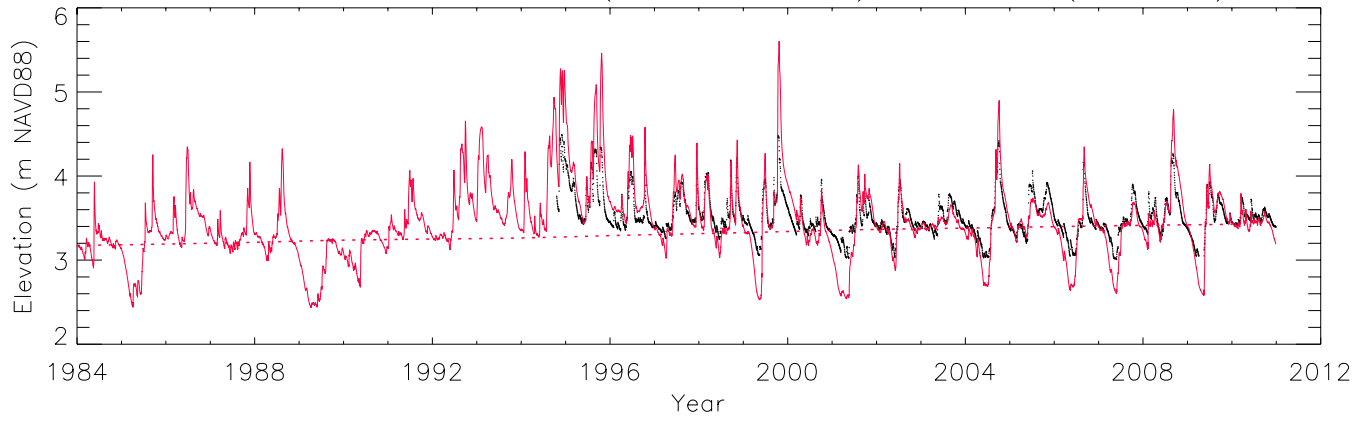
a) All data, with no temporal aggregation, of daily observations (black dots) and model results (red line).

b) All data were aggregated into arithmetic mean values by wet and dry seasons within water years; the continuous lines pass through mean of all daily data points for each season; the mean of paired simulated & observed values are shown in red boxes and black diamonds, respectively; the 95% Confidence Interval (CI) of the paired means are shown by the "___" symbols in the red for the model and black for the observed data.

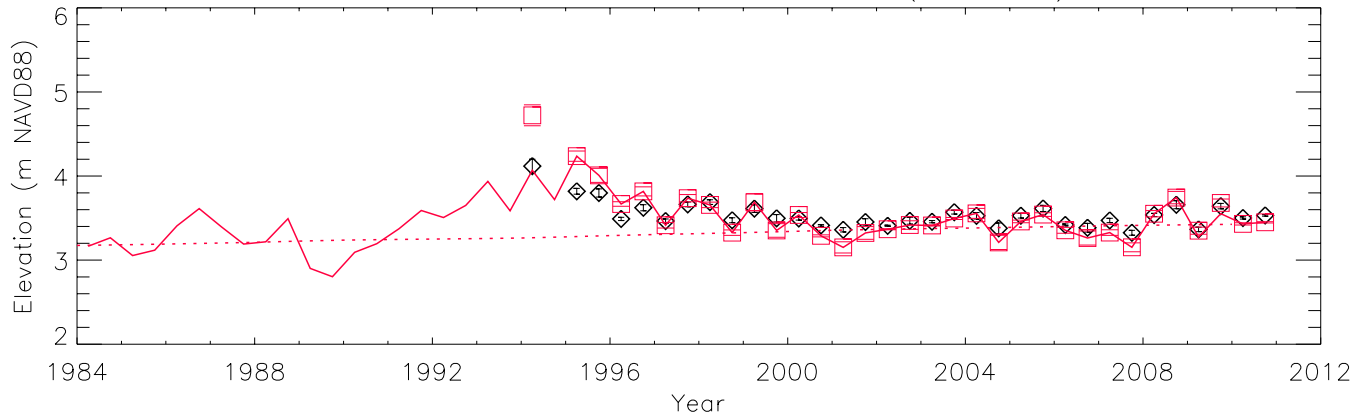
c) All data aggregated into arithmetic mean values by water year, with the same treatment as in plot b).

d) The cumulative frequency distributions of the simulated and observed (raw, un-aggregated) data; the 95% confidence interval for observed data is shown in the dashed black lines. Note that only paired simulated and observed data points are used.

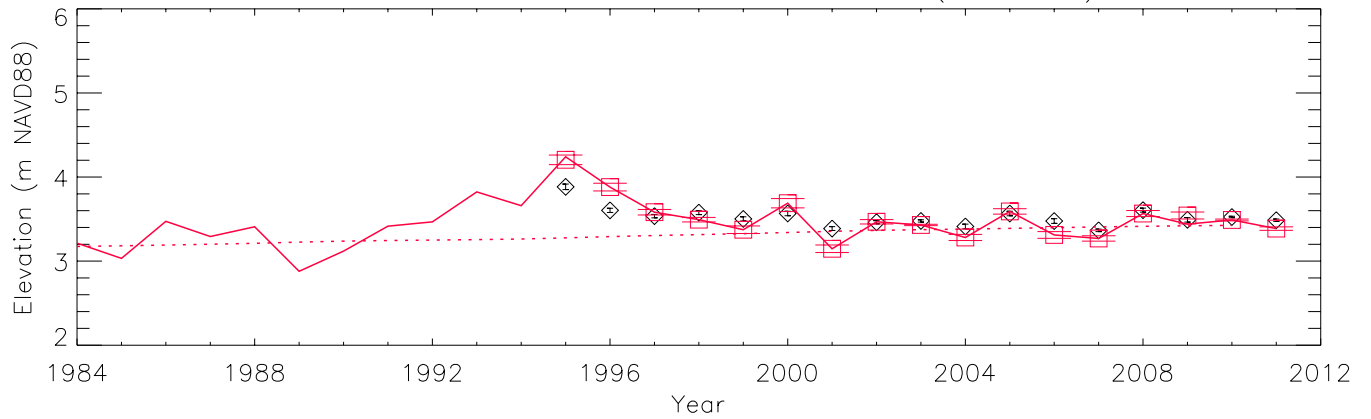
ELM3wca2_100 Raw Data (Obs. N = 5870) – WCA2F1 (200_130)



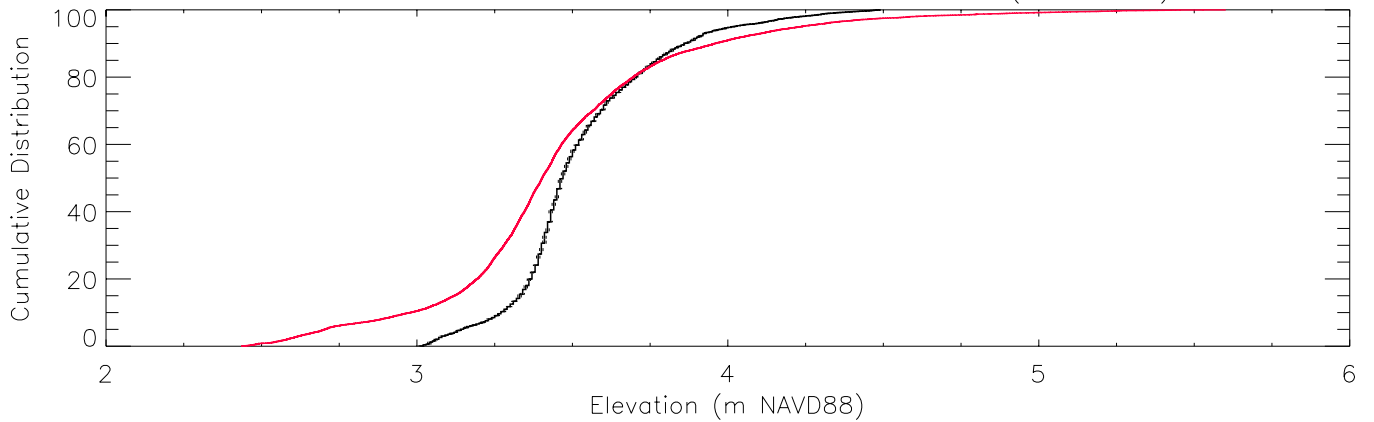
Mean: Season – 95% CI – WCA2F1 (200_130)



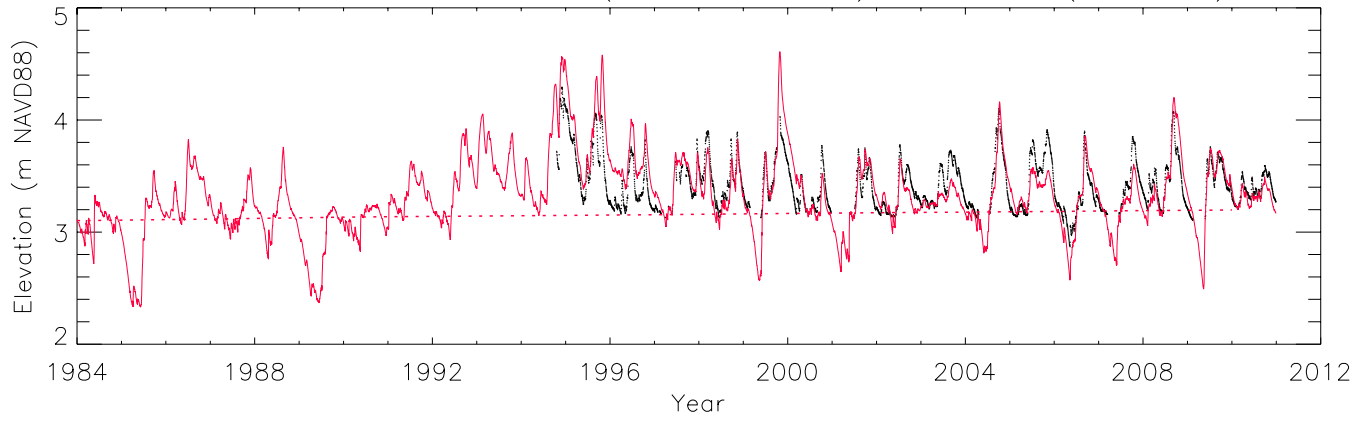
Mean: Water Year – 95% CI – WCA2F1 (200_130)



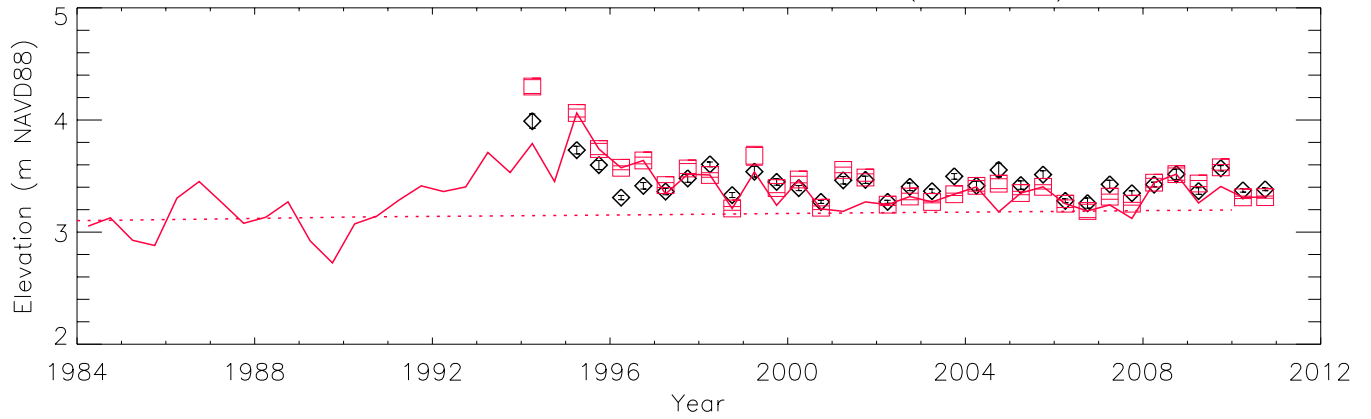
Cumulative Distribution: Raw Data – WCA2F1 (200_130)



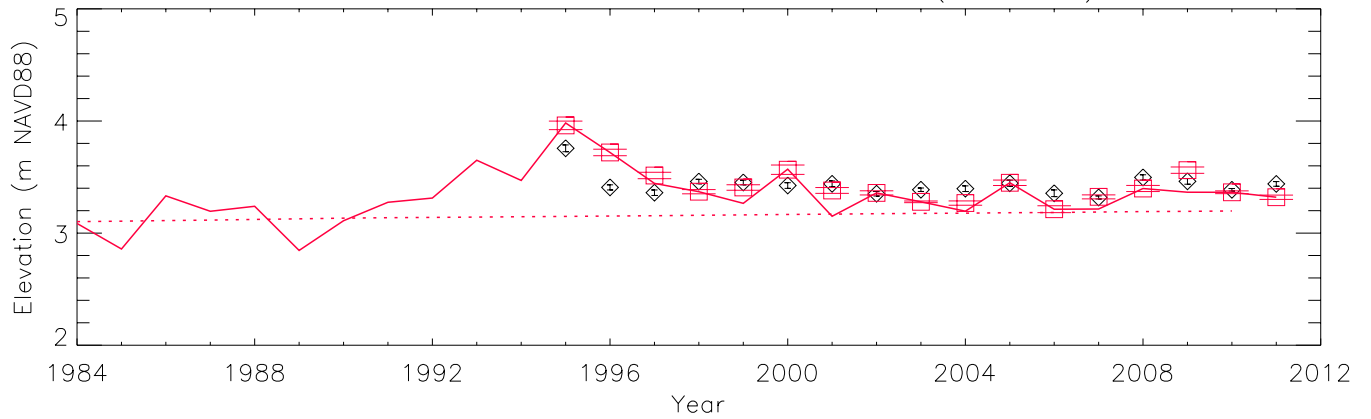
ELM3wca2_100 Raw Data (Obs. N = 5121) – WCA2F4 (186_177)



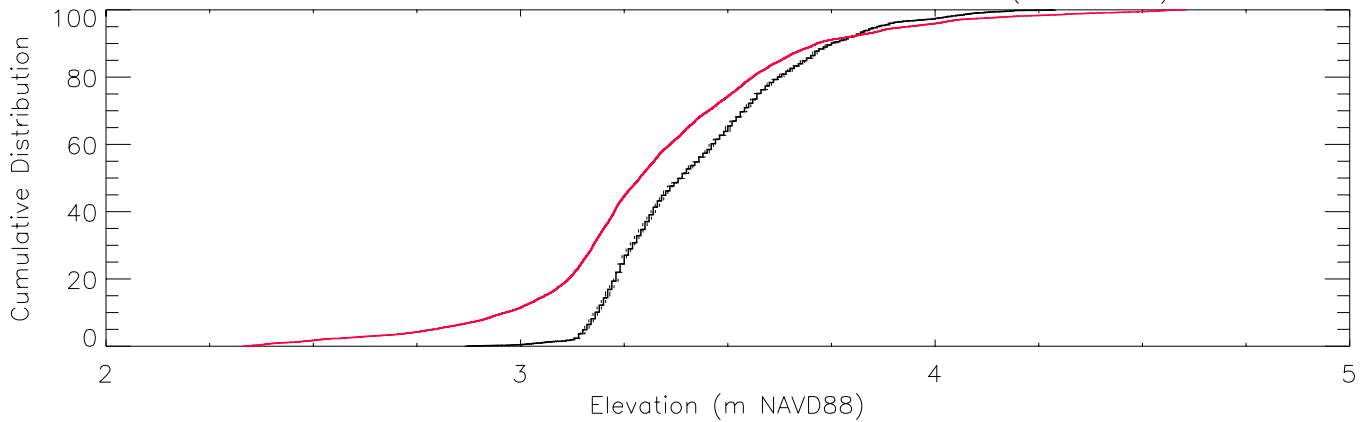
Mean: Season – 95% CI – WCA2F4 (186_177)



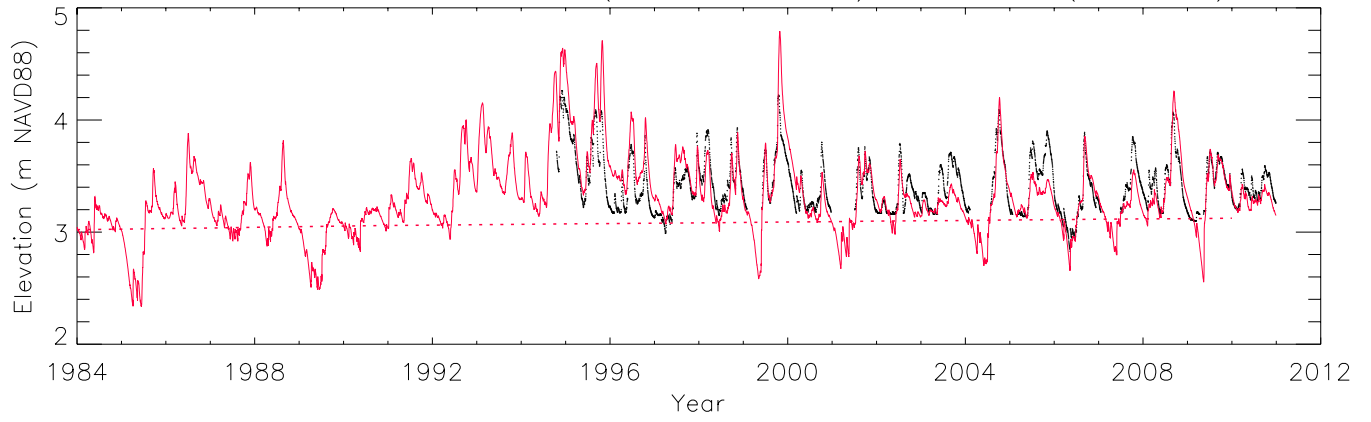
Mean: Water Year – 95% CI – WCA2F4 (186_177)



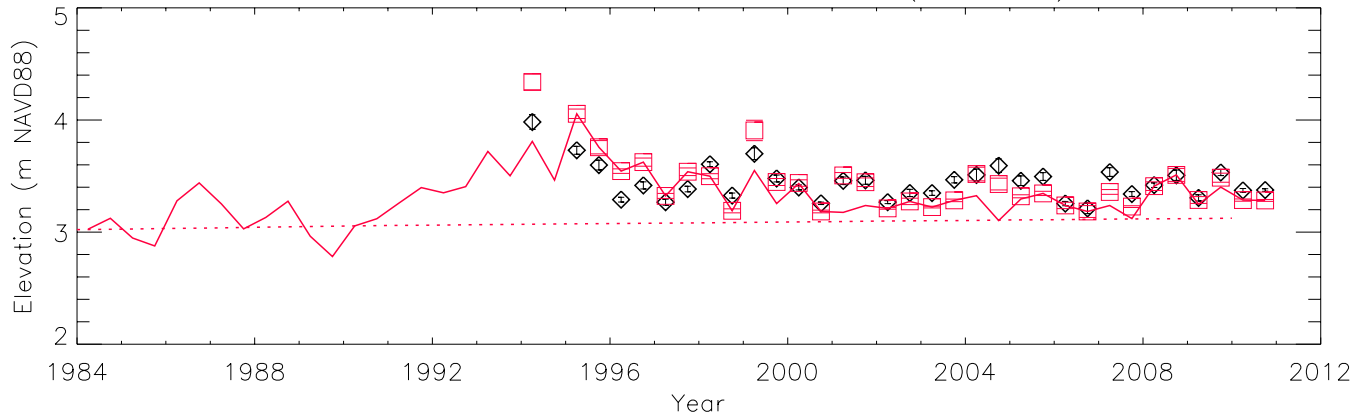
Cumulative Distribution: Raw Data – WCA2F4 (186_177)



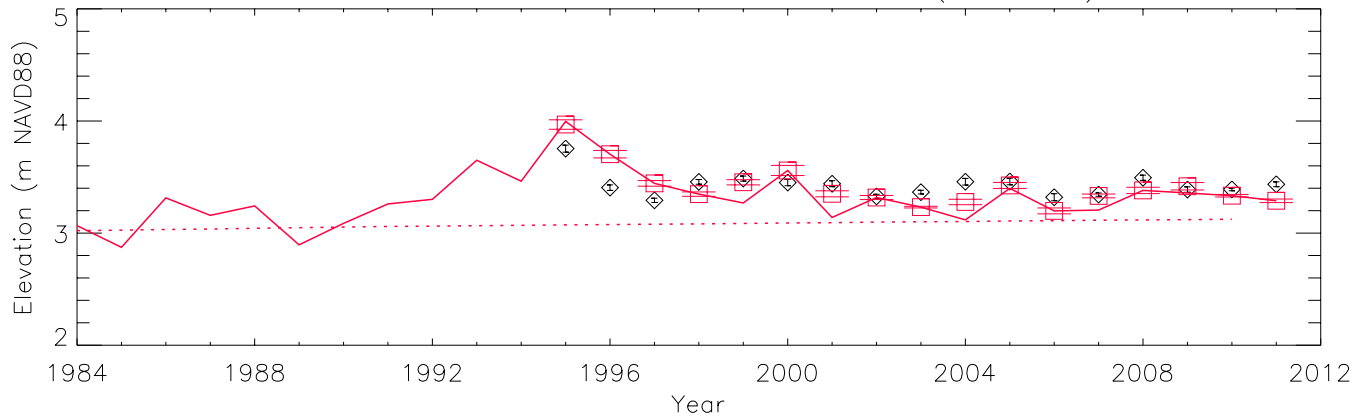
ELM3wca2_100 Raw Data (Obs. N = 5197) – WCA2E4 (214_186)



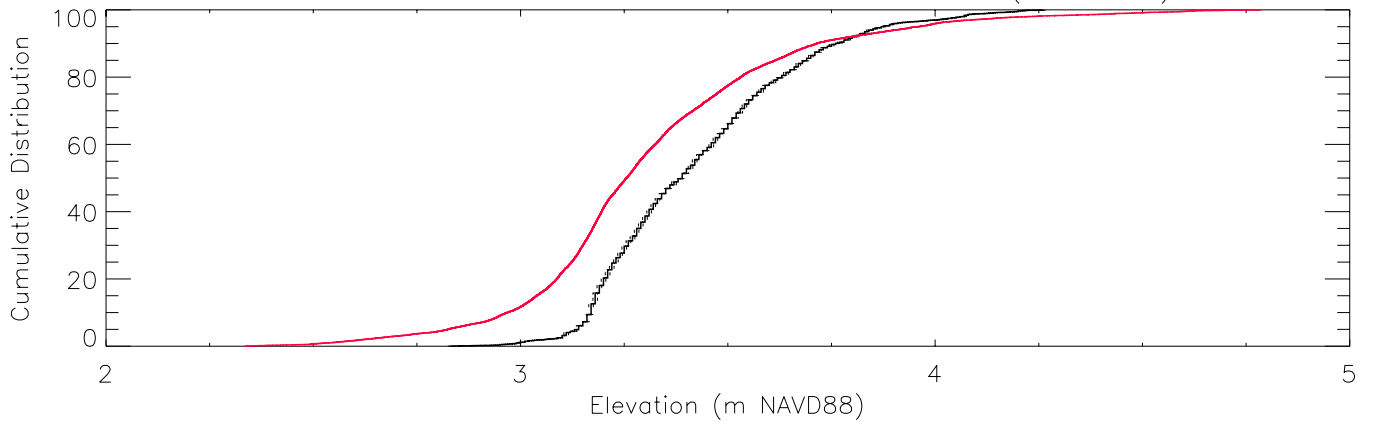
Mean: Season – 95% CI – WCA2E4 (214_186)



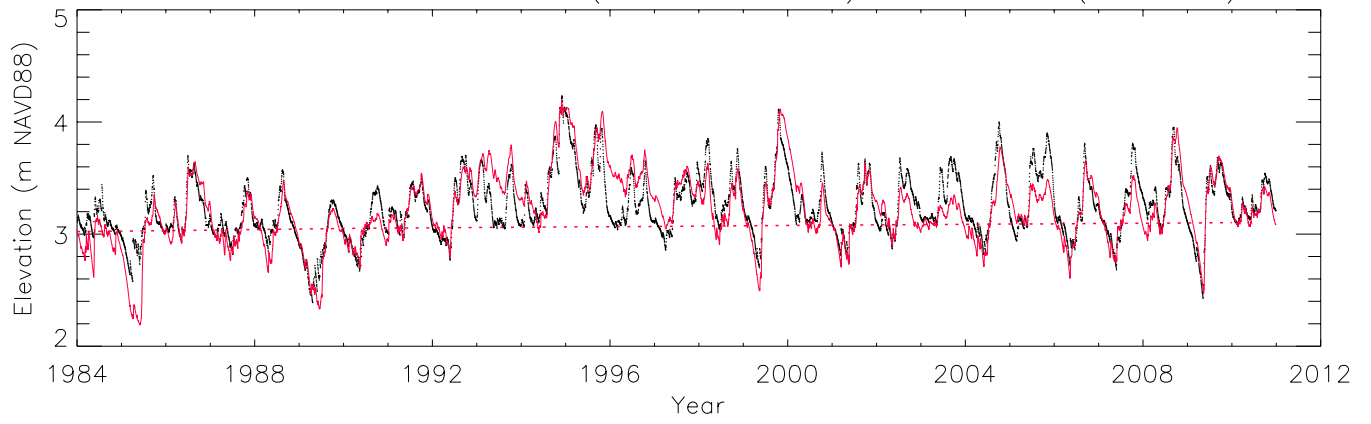
Mean: Water Year – 95% CI – WCA2E4 (214_186)



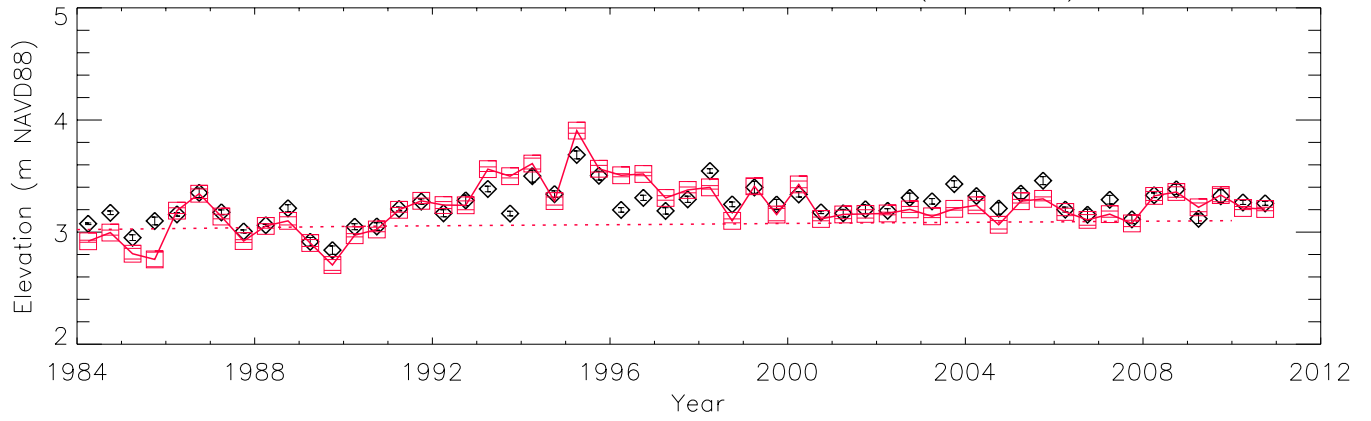
Cumulative Distribution: Raw Data – WCA2E4 (214_186)



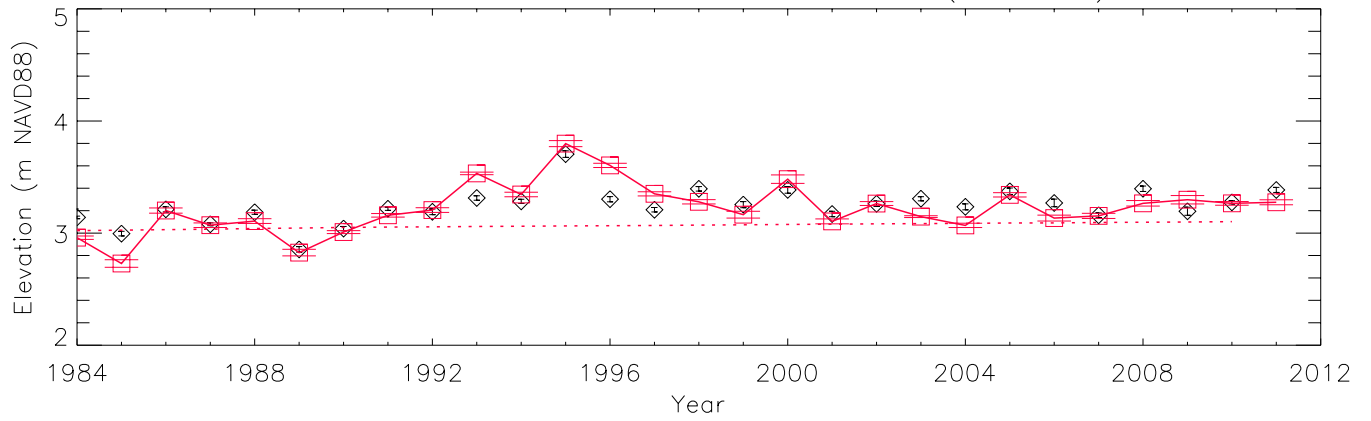
ELM3wca2_100 Raw Data (Obs. N = 9852) - 2A-17_B (160_211)



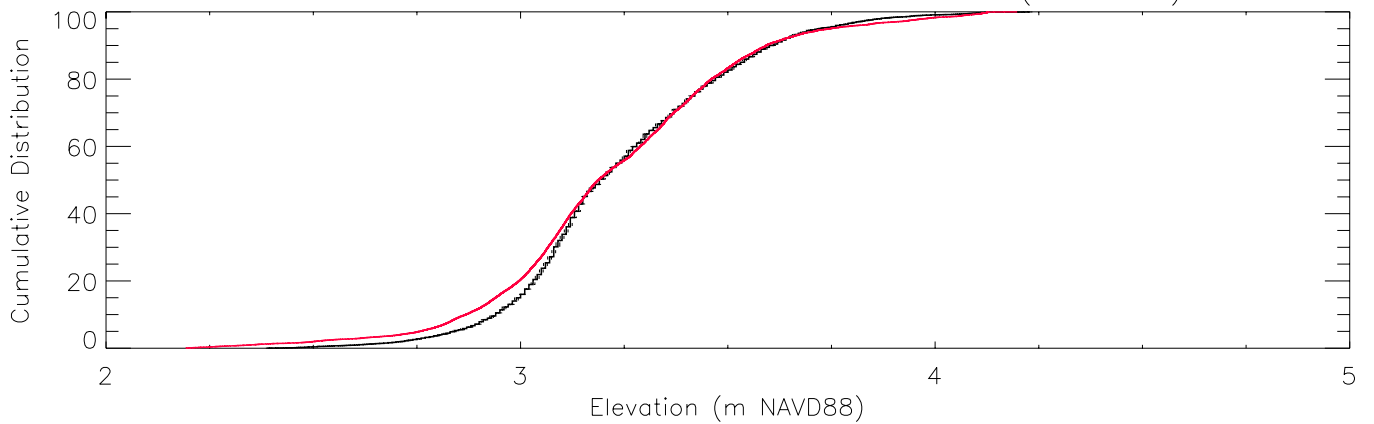
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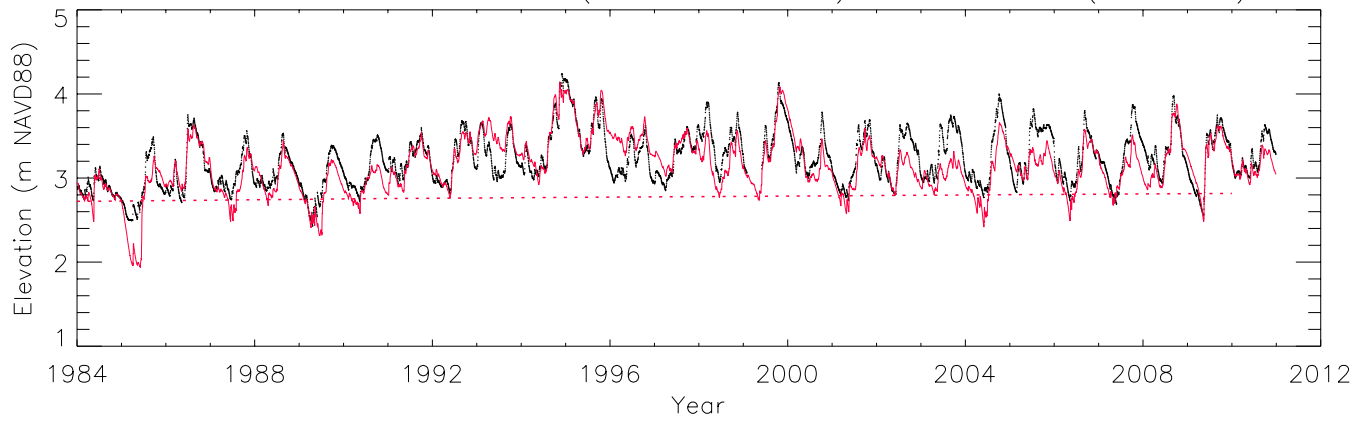
Mean: Water Year - 95% CI - 2A-17_B (160_211)



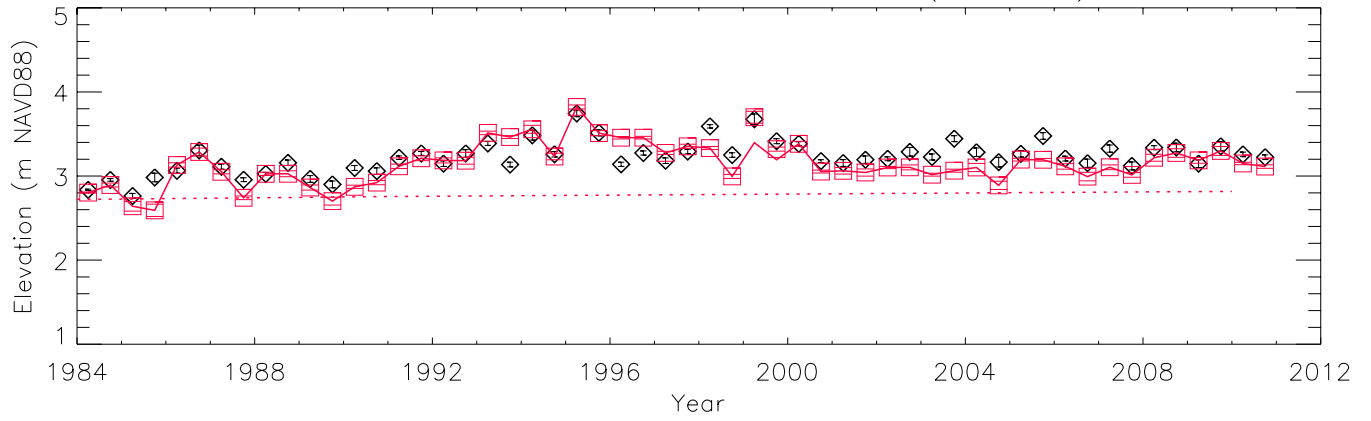
Cumulative Distribution: Raw Data - 2A-17_B (160_211)



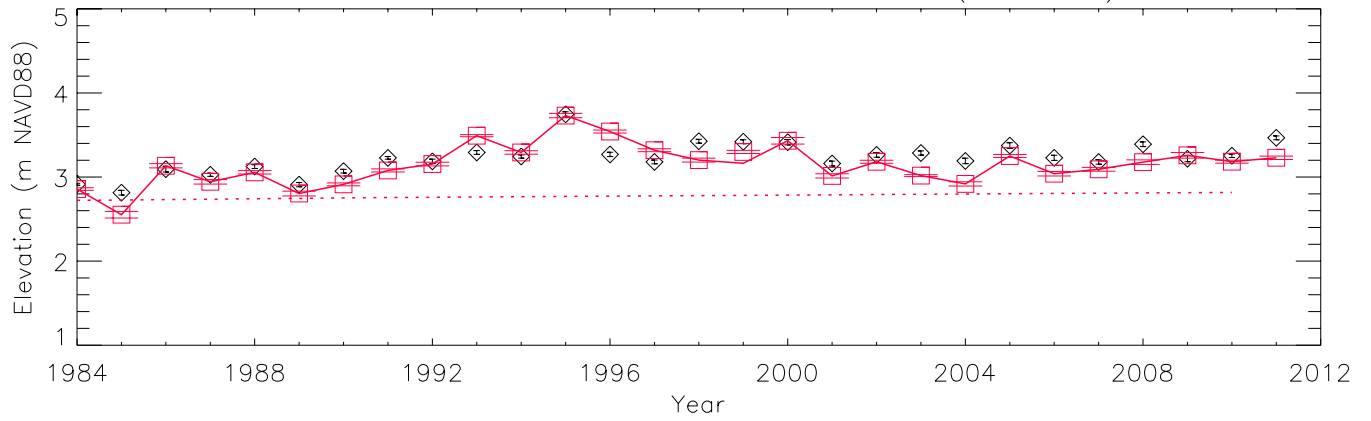
ELM3wca2_100 Raw Data (Obs. N = 9730) - 2A-300_B (163_256)



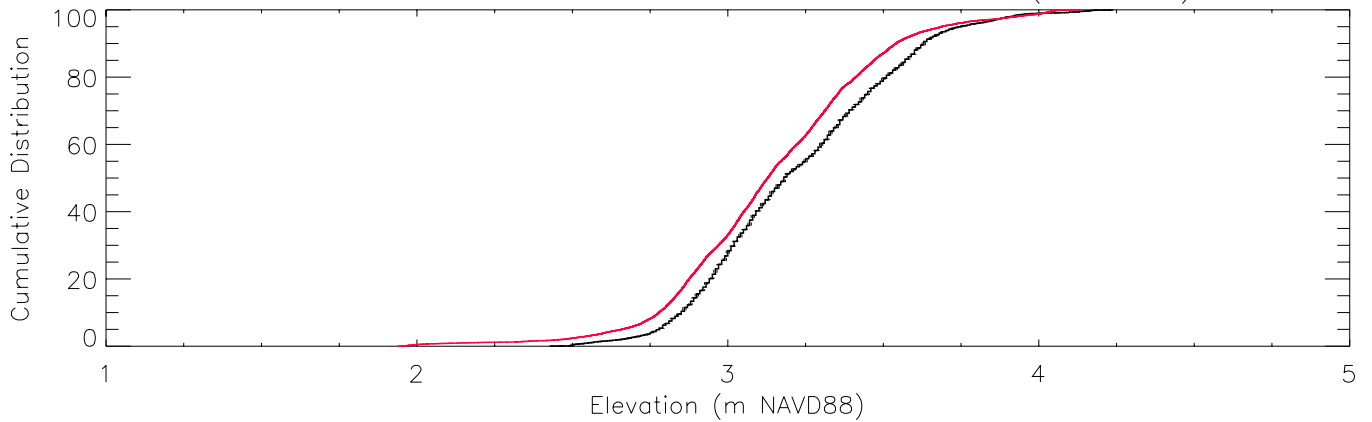
Mean: Season - 95% CI - 2A-300_B (163_256)



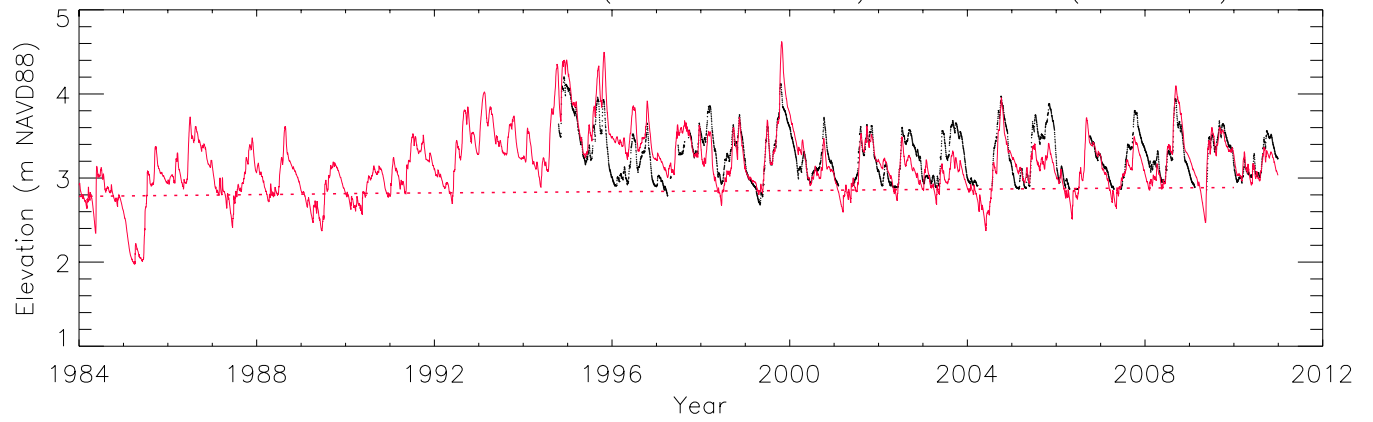
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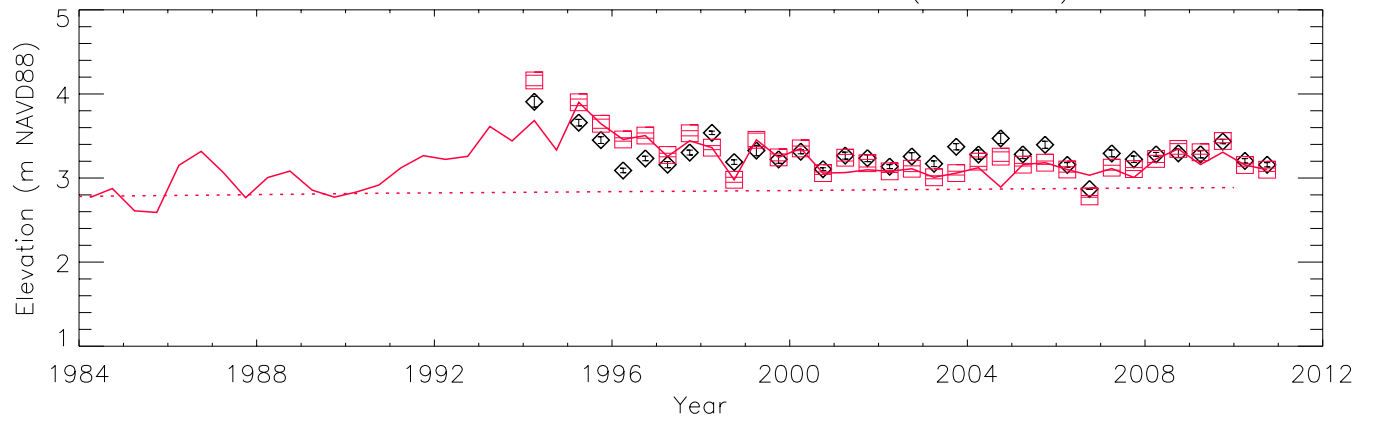
Cumulative Distribution: Raw Data - 2A-300_B (163_256)



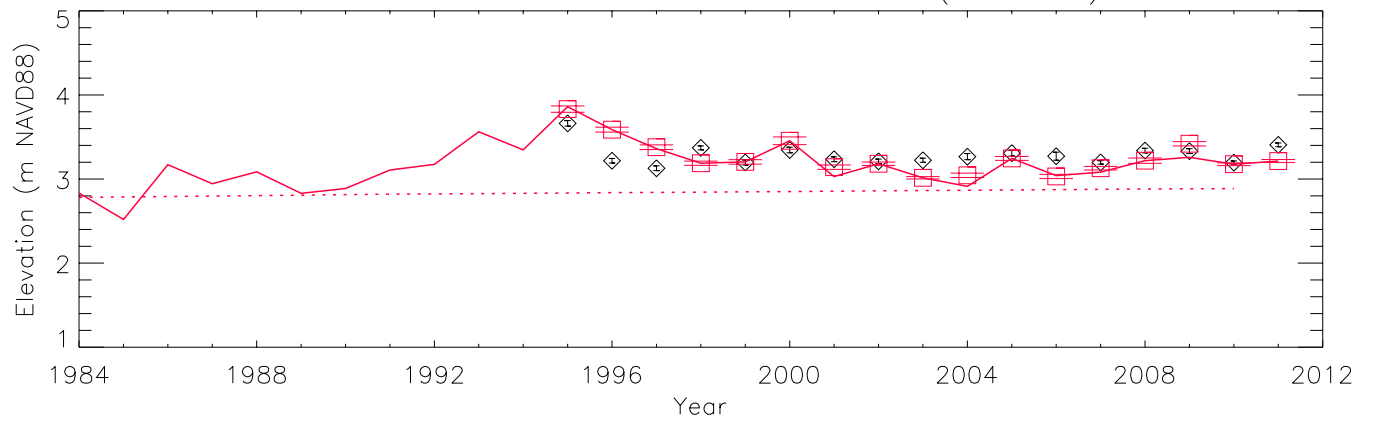
ELM3wca2_100 Raw Data (Obs. N = 5278) – WCA2U1 (215_261)



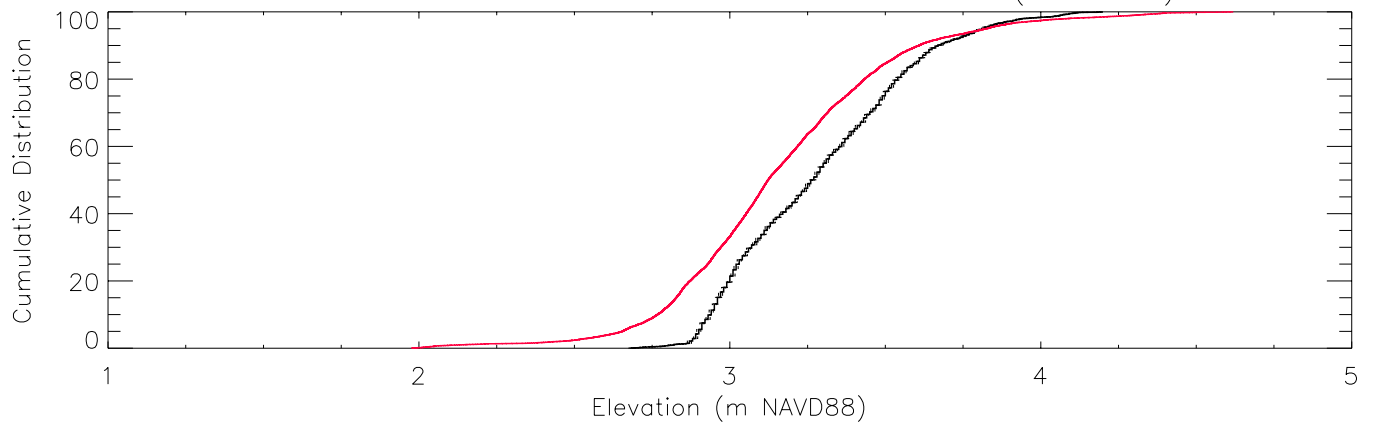
Mean: Season – 95% CI – WCA2U1 (215_261)



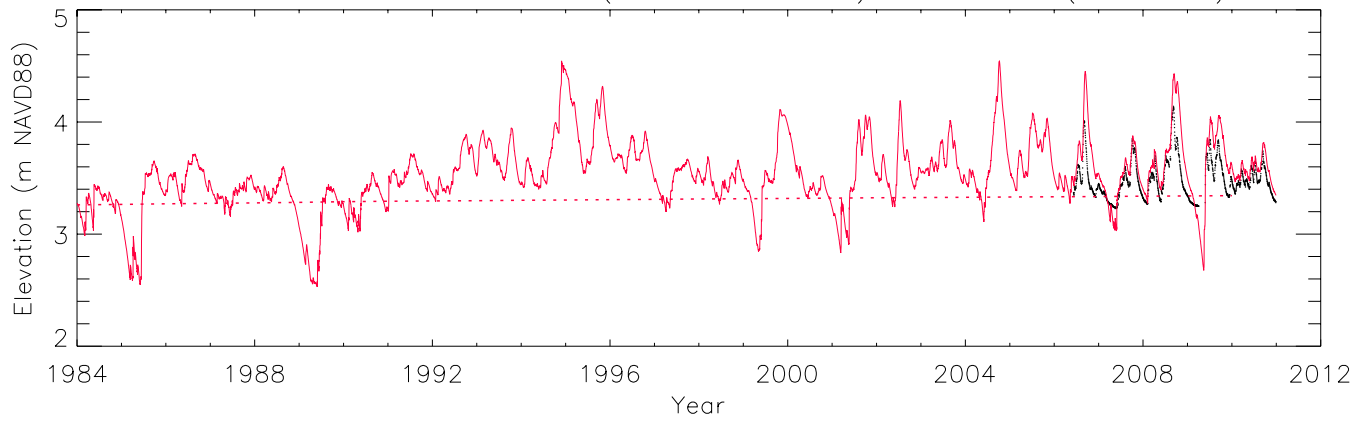
Mean: Water Year – 95% CI – WCA2U1 (215_261)



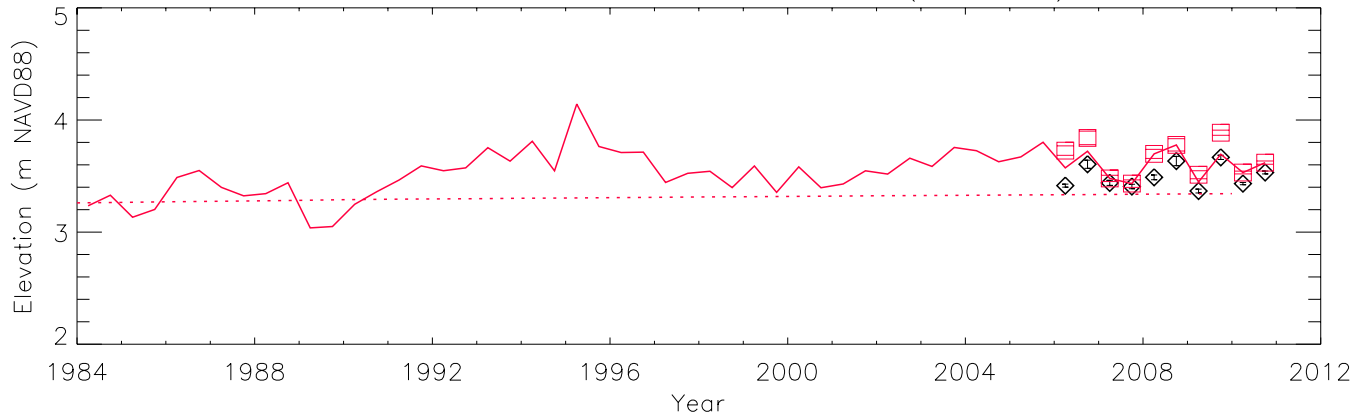
Cumulative Distribution: Raw Data – WCA2U1 (215_261)



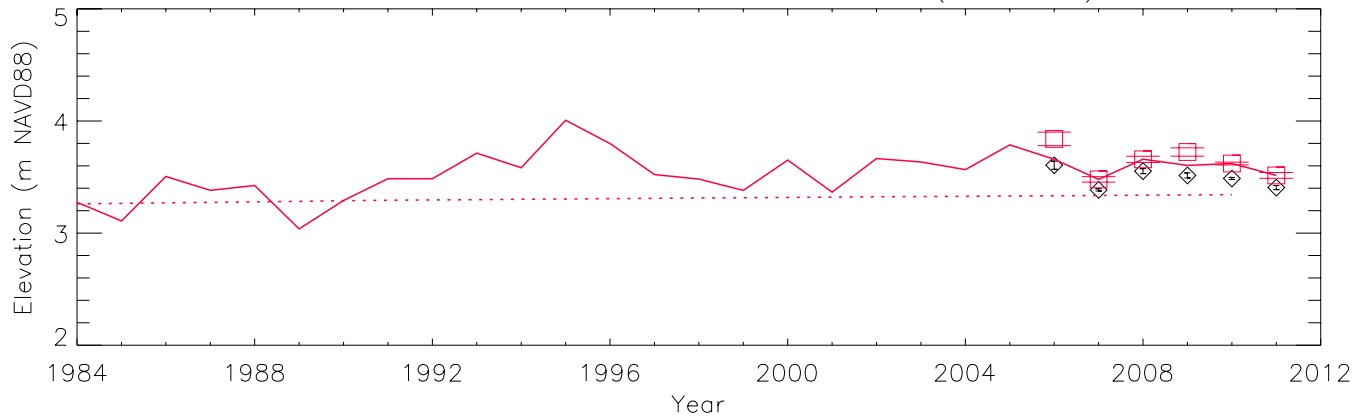
ELM3wca2_100 Raw Data (Obs. N = 1606) – EDEN11 (111_105)



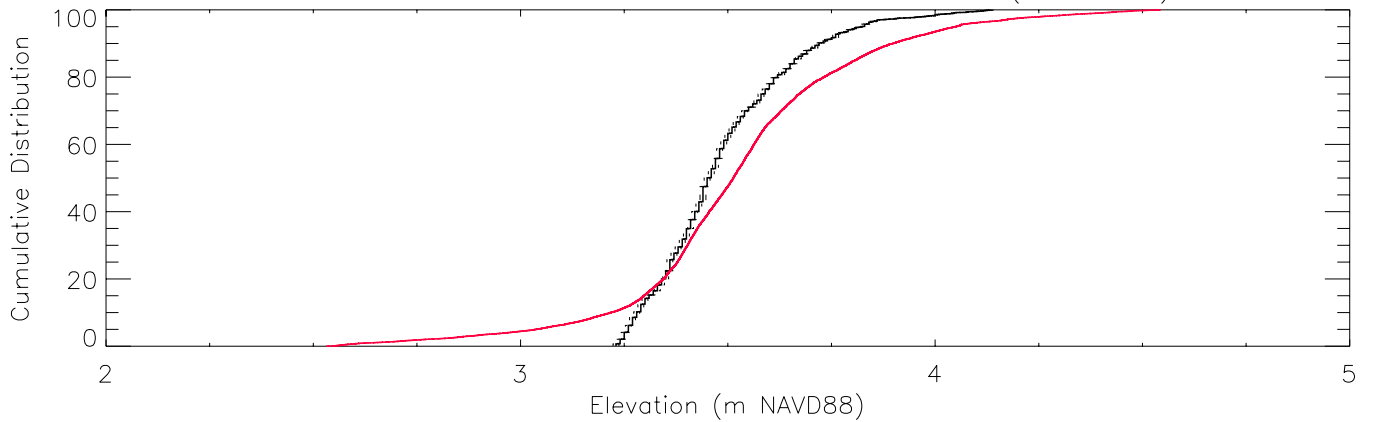
Mean: Season – 95% CI – EDEN11 (111_105)



Mean: Water Year – 95% CI – EDEN11 (111_105)



Cumulative Distribution: Raw Data – EDEN11 (111_105)

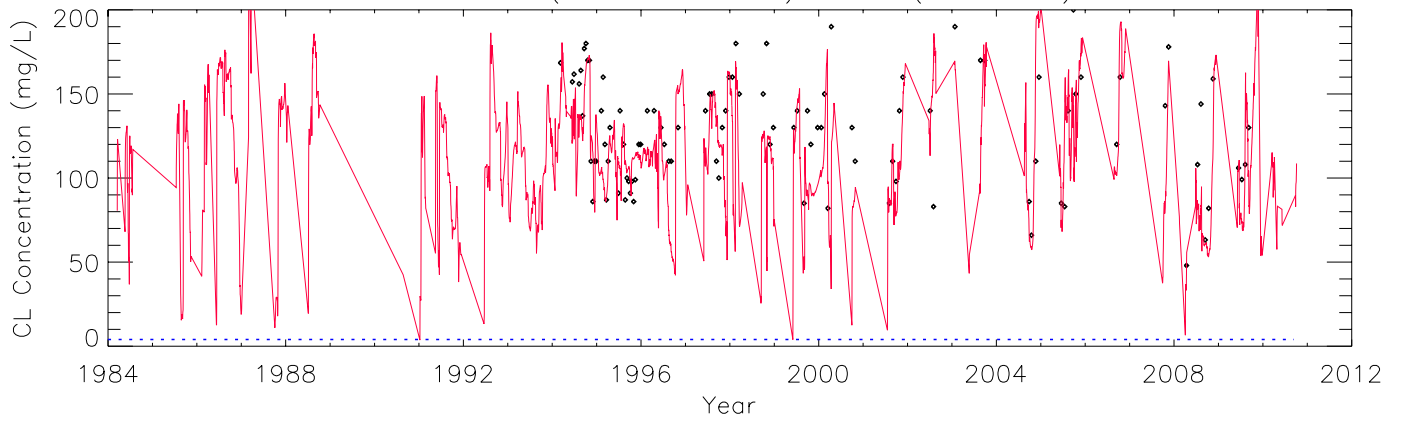


Appendix B. Chloride model vs. observed time series (15 sites-pages). Plots of surface water chloride (Cl) concentration and their associated Cumulative Frequency Distributions (CFD) for the period of record 1984-2010 at each monitoring location.

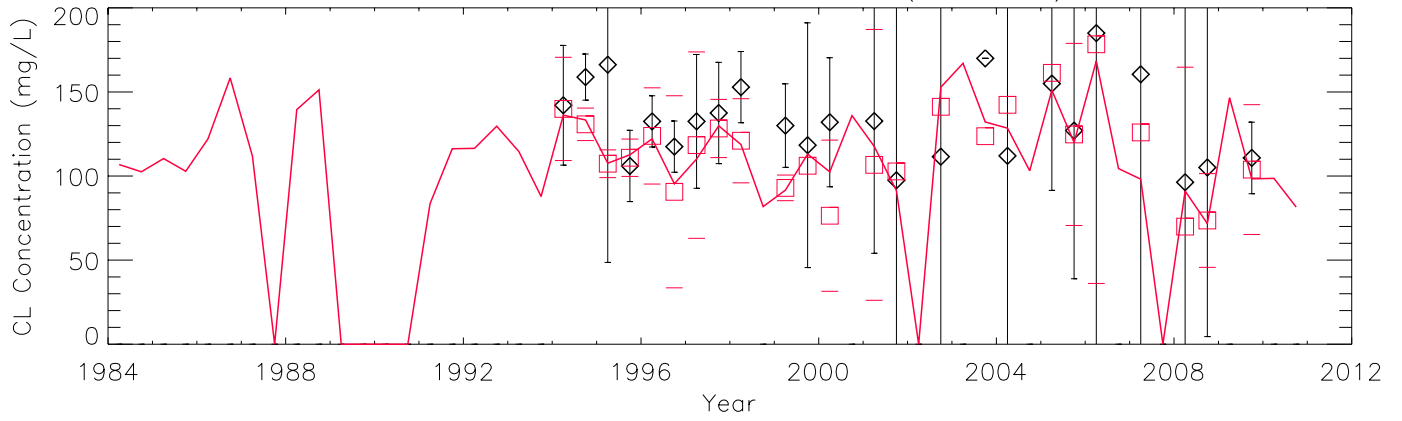
The model grid cell column and row locations (col_row) or canal reach identifier (single integer) are shown in parentheses of each plot's title.

- a) All data, with no temporal aggregation, of daily observations (black dots) and model results (red line).
- b) All data were aggregated into arithmetic mean values by wet and dry seasons within water years; the continuous lines pass through mean of all daily data points for each season; the mean of paired simulated & observed values are shown in red boxes and black diamonds, respectively; the 95% Confidence Interval (CI) of the paired means are shown by the "___" symbols in the red for the model and black for the observed data.
- c) All data aggregated into arithmetic mean values by water year, with the same treatment as in plot b).
- d) The cumulative frequency distributions of the simulated and observed (raw, un-aggregated) data; the 95% confidence interval for observed data is shown in the dashed black lines. Note that only paired simulated and observed data points are used.

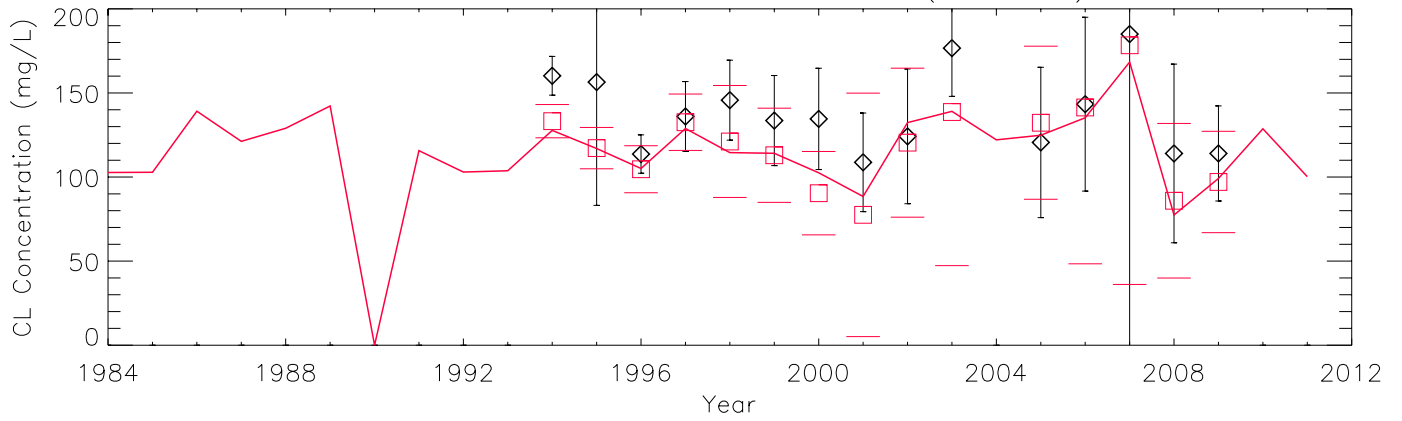
Raw Data (Obs. N = 102) – E1 (217_139)



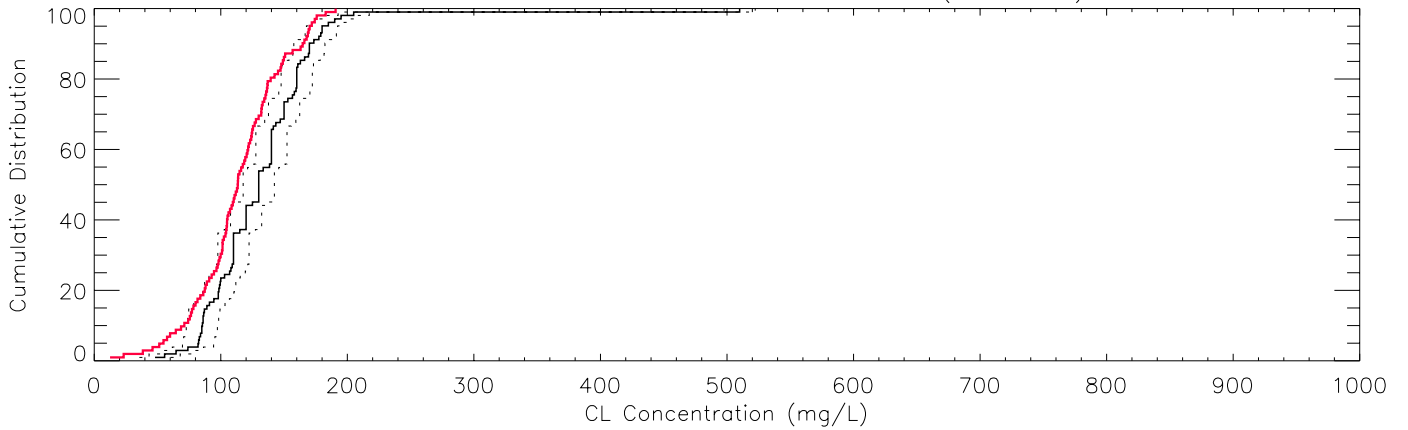
Mean: Season – 95% CI – E1 (217_139)



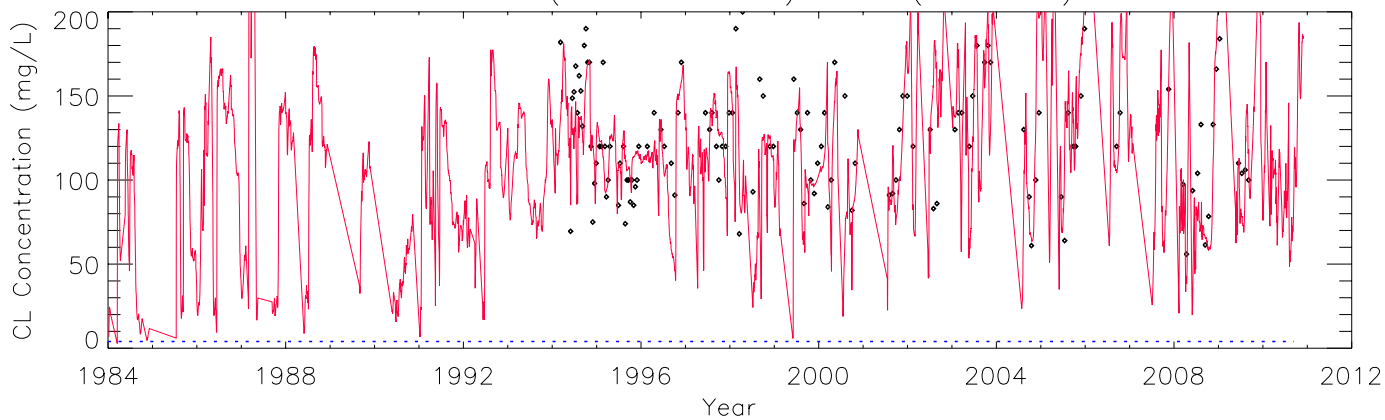
Mean: Water Year – 95% CI – E1 (217_139)



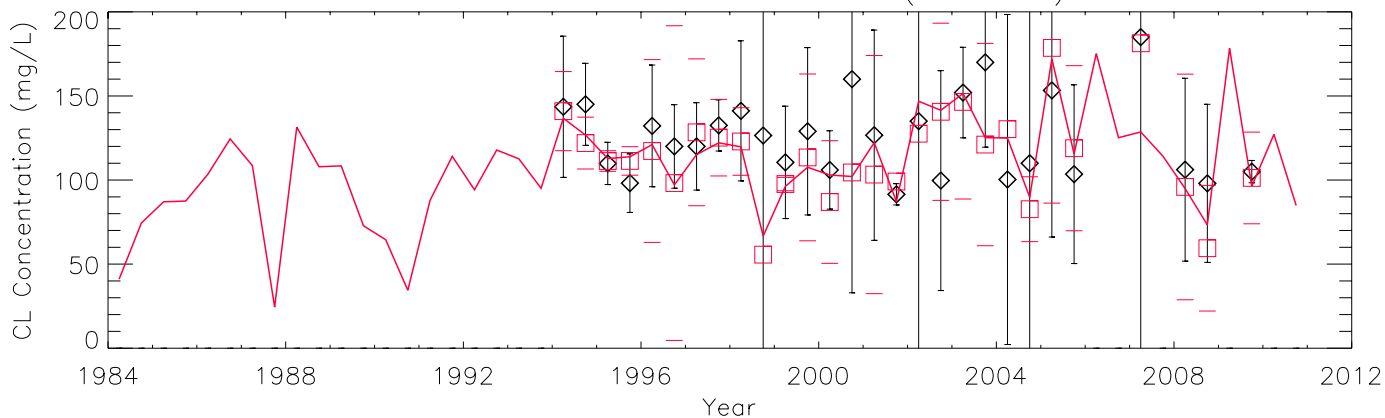
Cumulative Distribution: Raw Data – E1 (217_139)



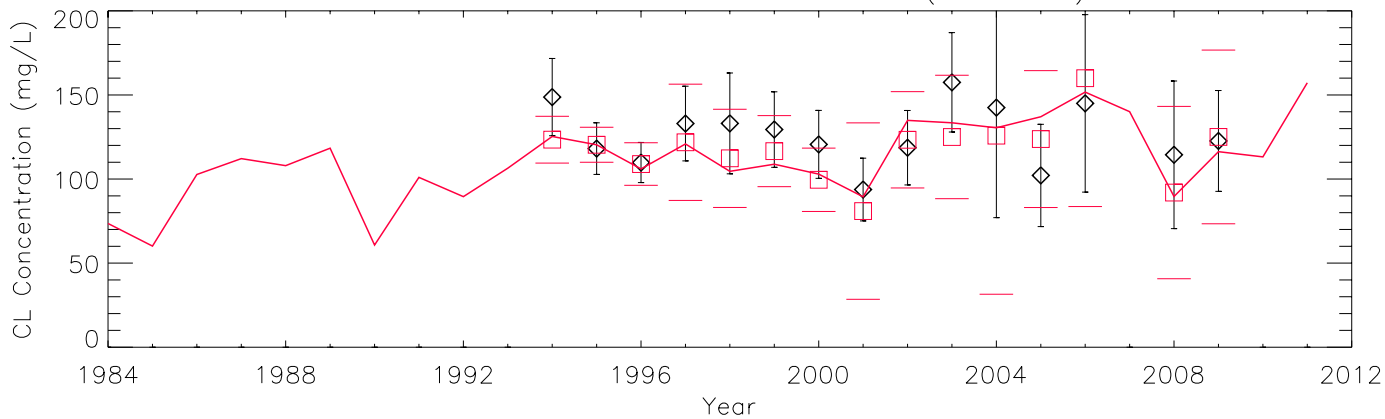
Raw Data (Obs. N = 127) – E2 (218_149)



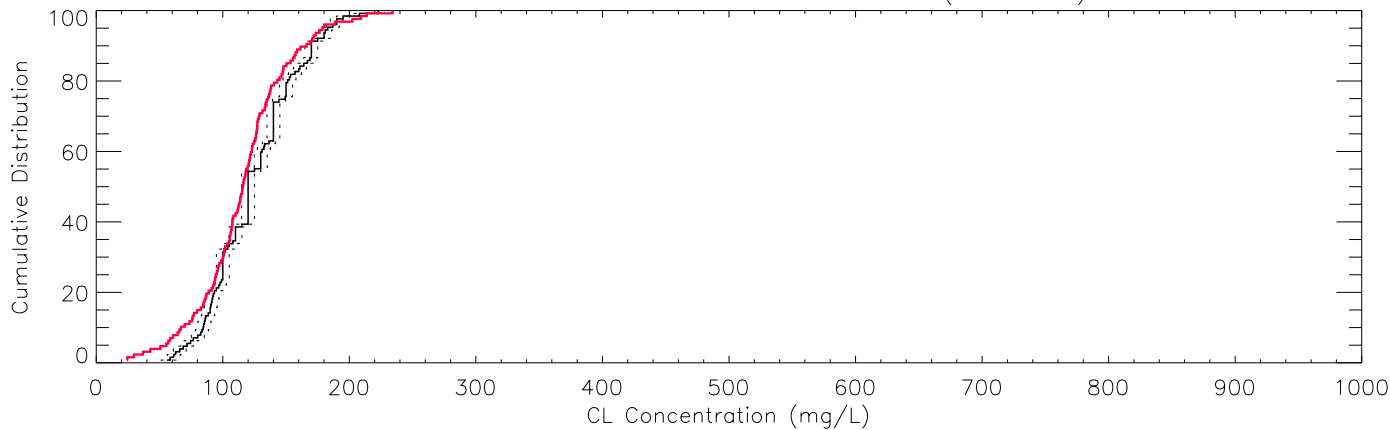
Mean: Season – 95% CI – E2 (218_149)



Mean: Water Year – 95% CI – E2 (218_149)



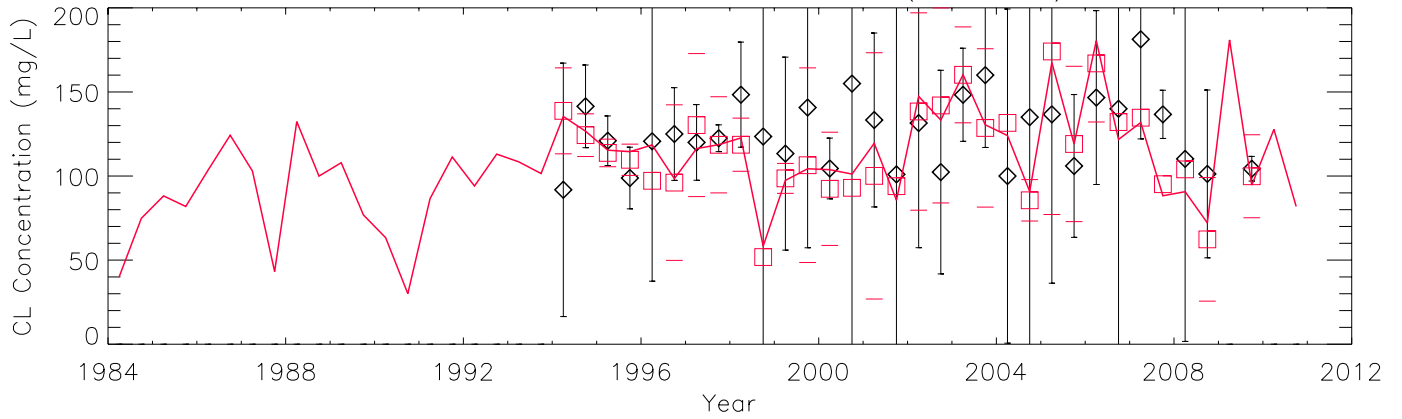
Cumulative Distribution: Raw Data – E2 (218_149)



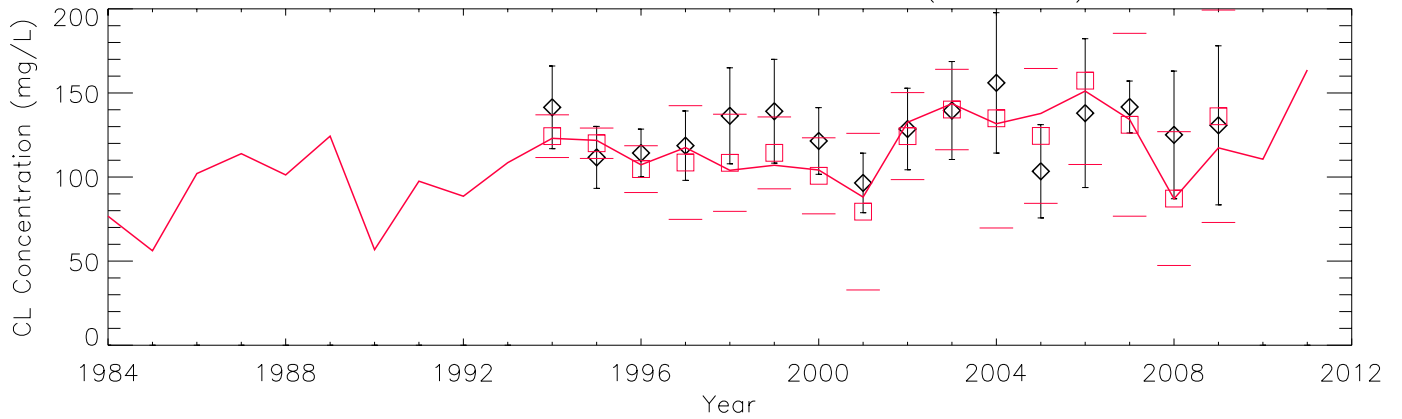
Raw Data (Obs. N = 132) – E3 (215_158)



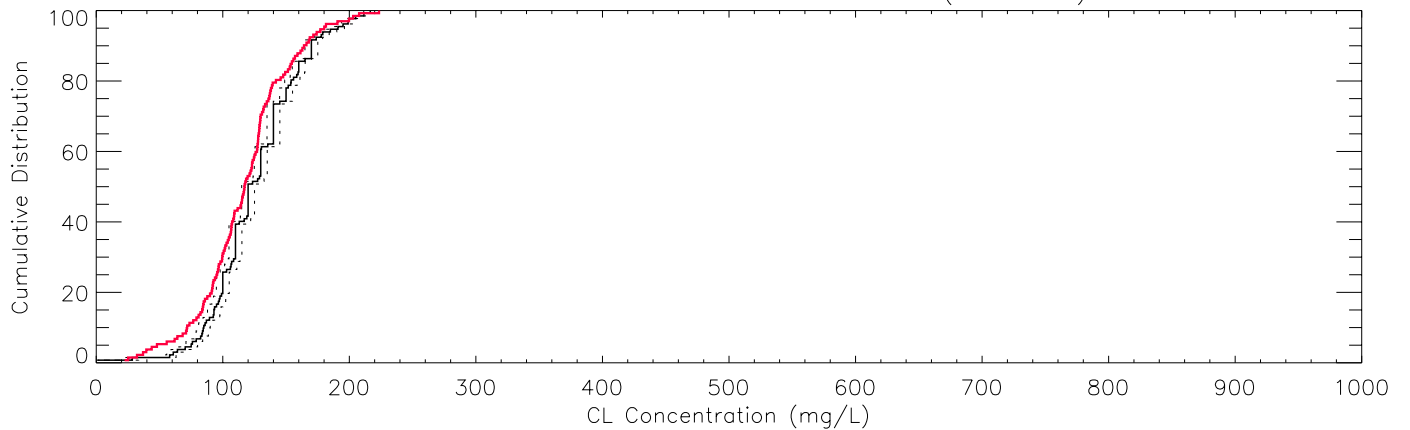
Mean: Season – 95% CI – E3 (215_158)



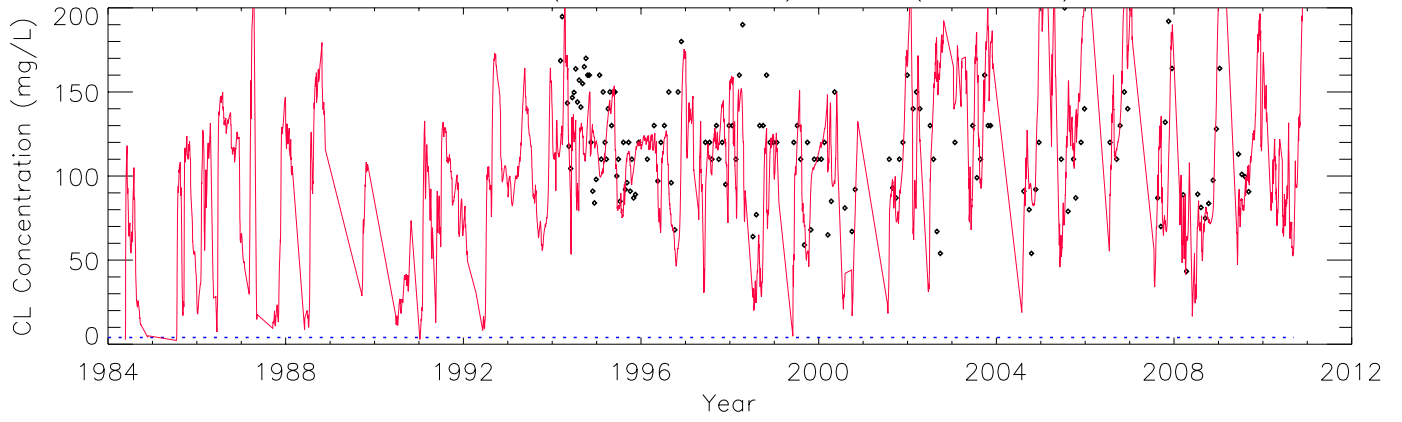
Mean: Water Year – 95% CI – E3 (215_158)



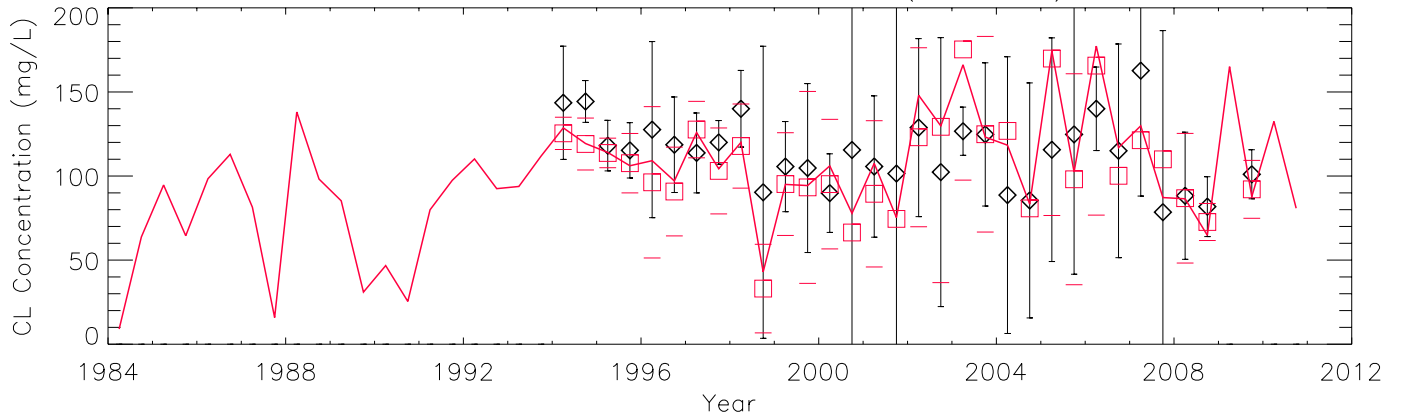
Cumulative Distribution: Raw Data – E3 (215_158)



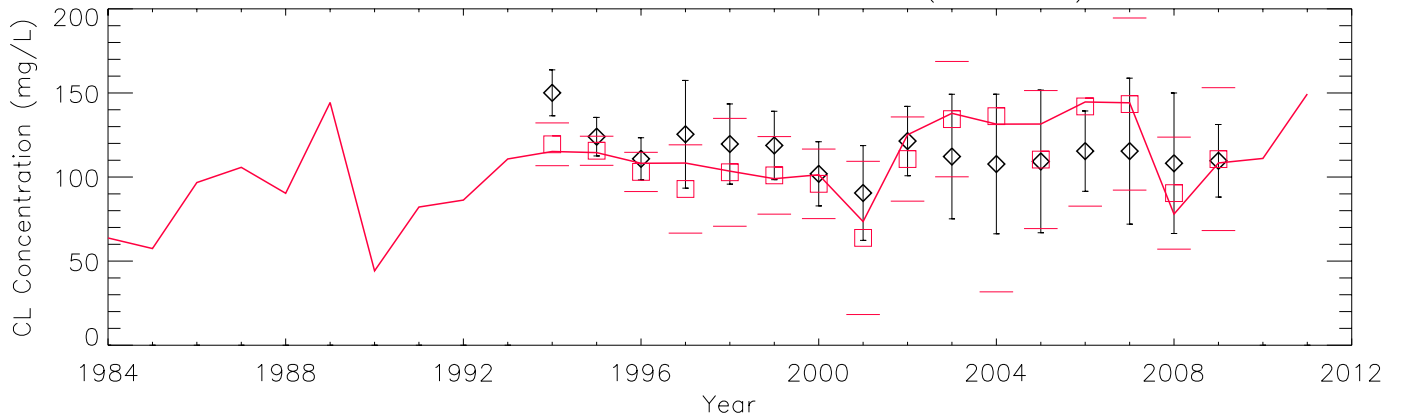
Raw Data (Obs. N = 143) – E4 (214_186)



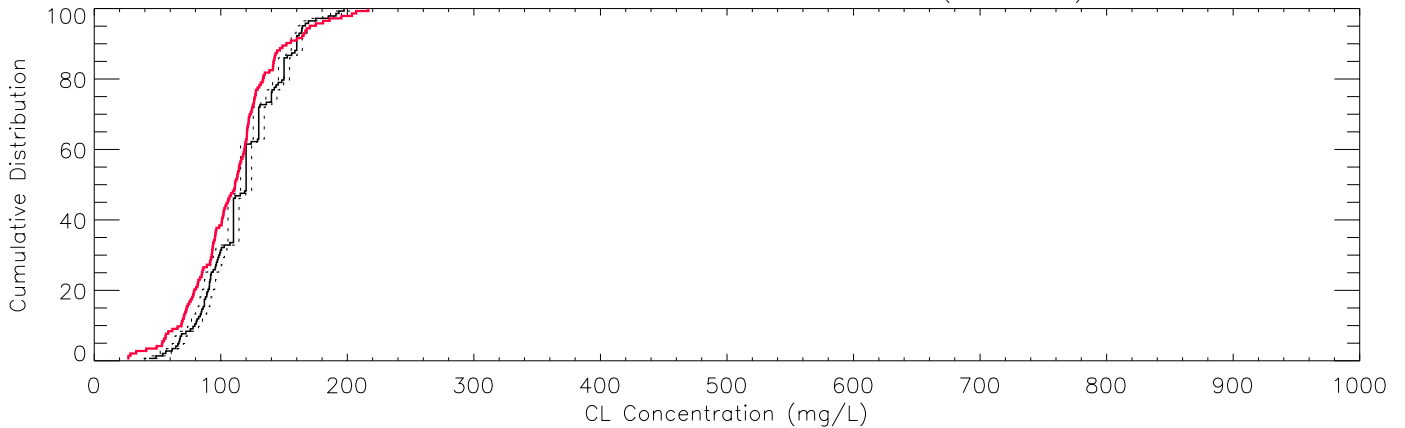
Mean: Season – 95% CI – E4 (214_186)



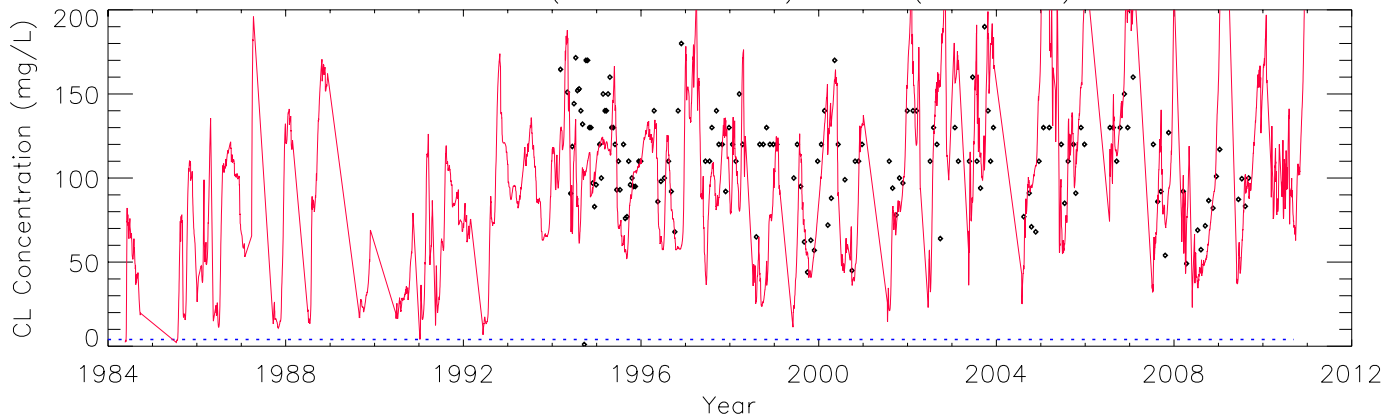
Mean: Water Year – 95% CI – E4 (214_186)



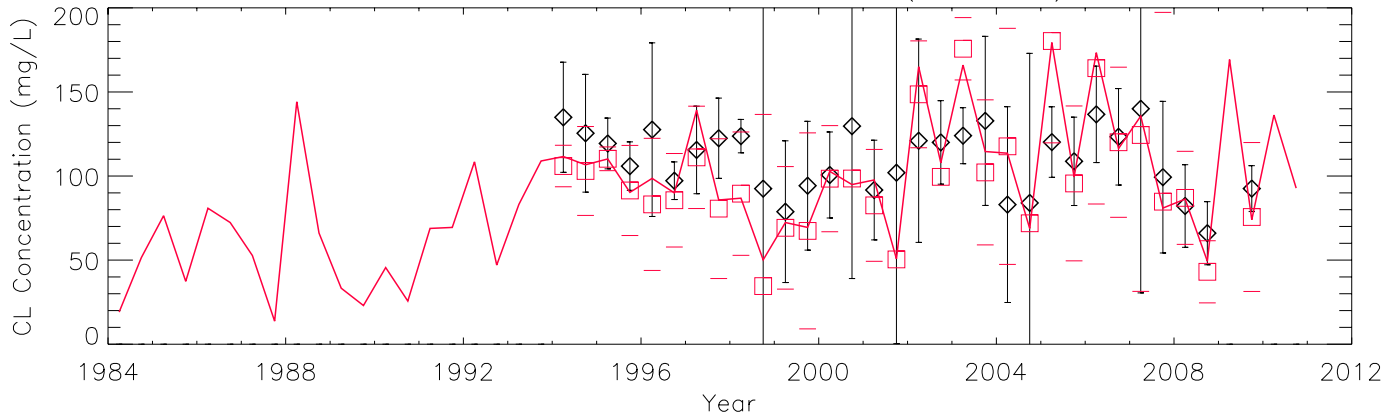
Cumulative Distribution: Raw Data – E4 (214_186)



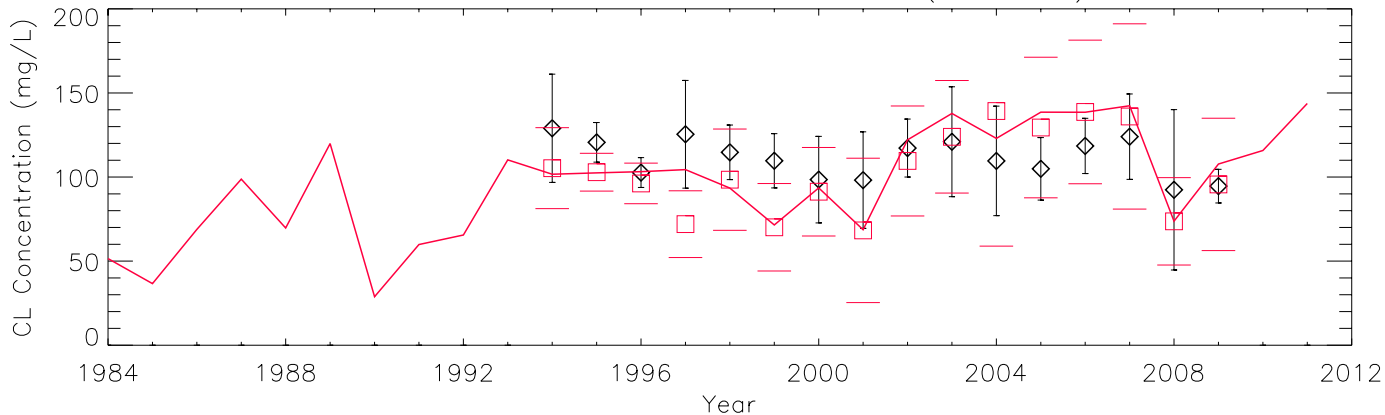
Raw Data (Obs. N = 150) – E5 (213_220)



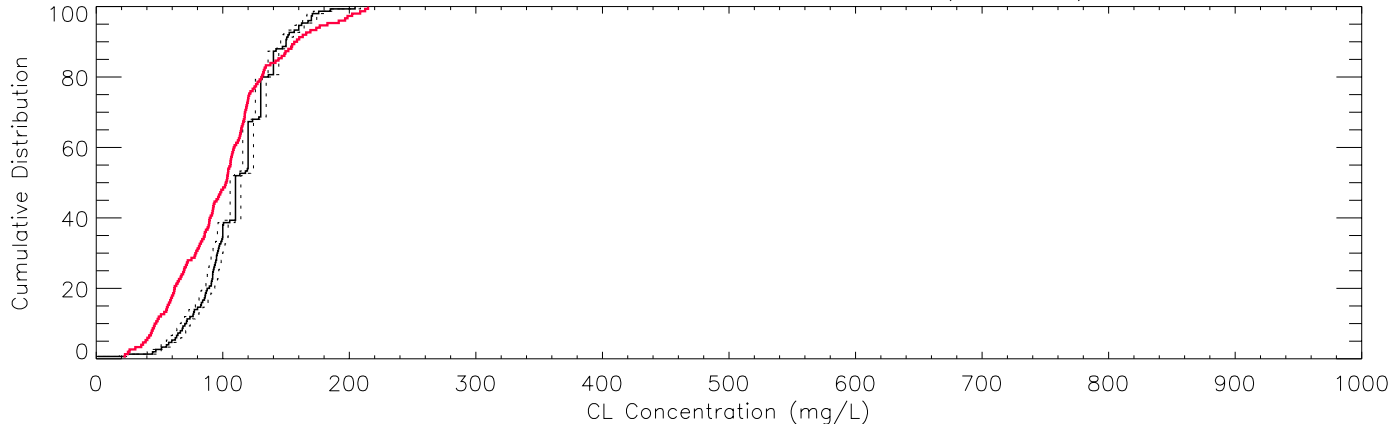
Mean: Season – 95% CI – E5 (213_220)



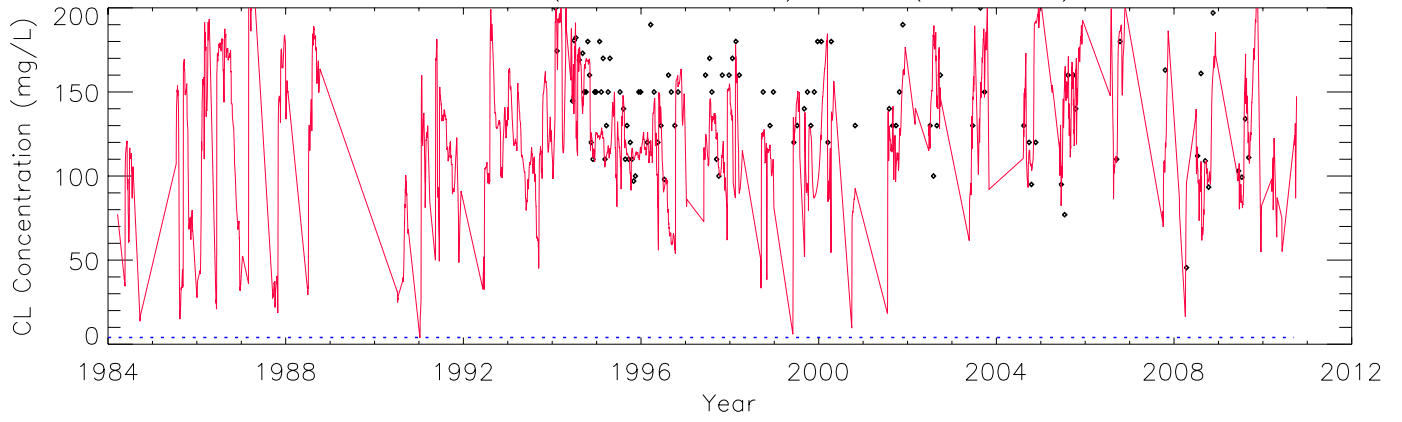
Mean: Water Year – 95% CI – E5 (213_220)



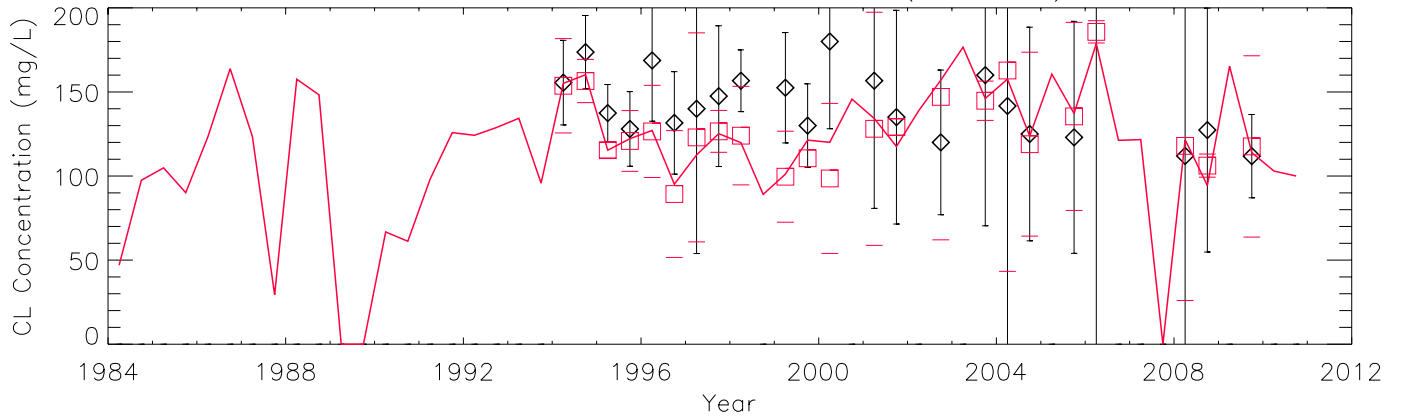
Cumulative Distribution: Raw Data – E5 (213_220)



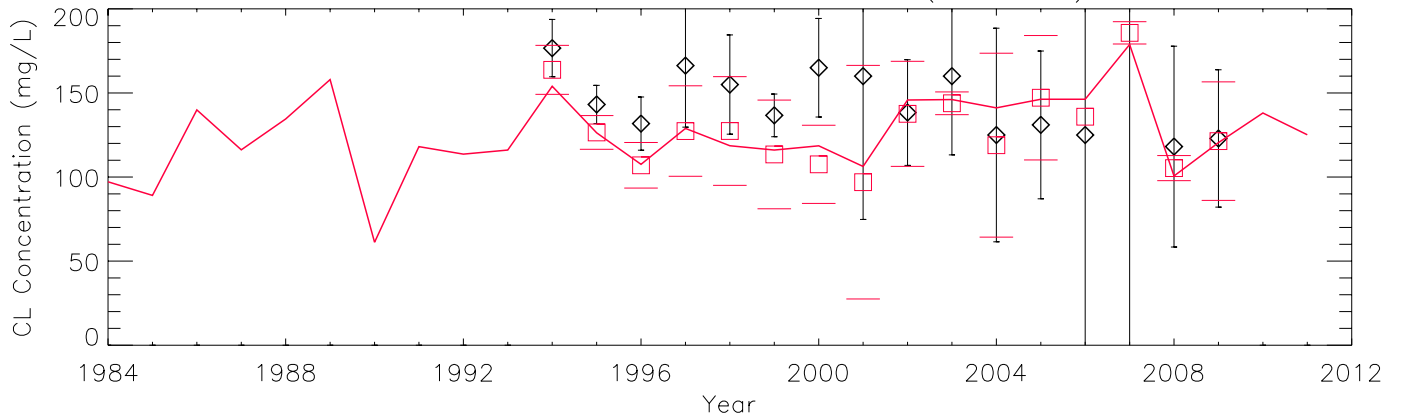
Raw Data (Obs. N = 108) – F1 (200_130)



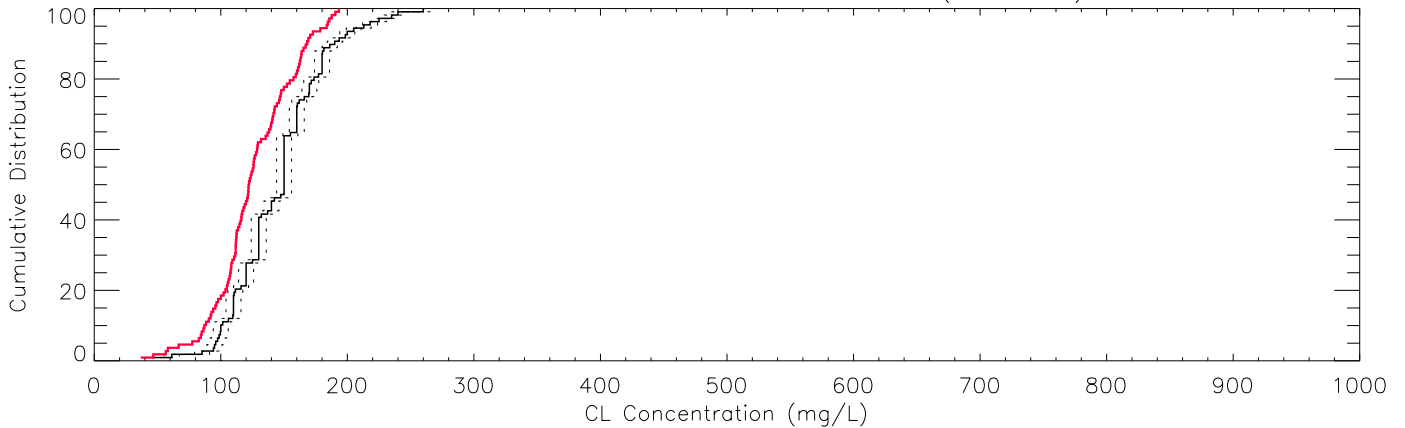
Mean: Season – 95% CI – F1 (200_130)



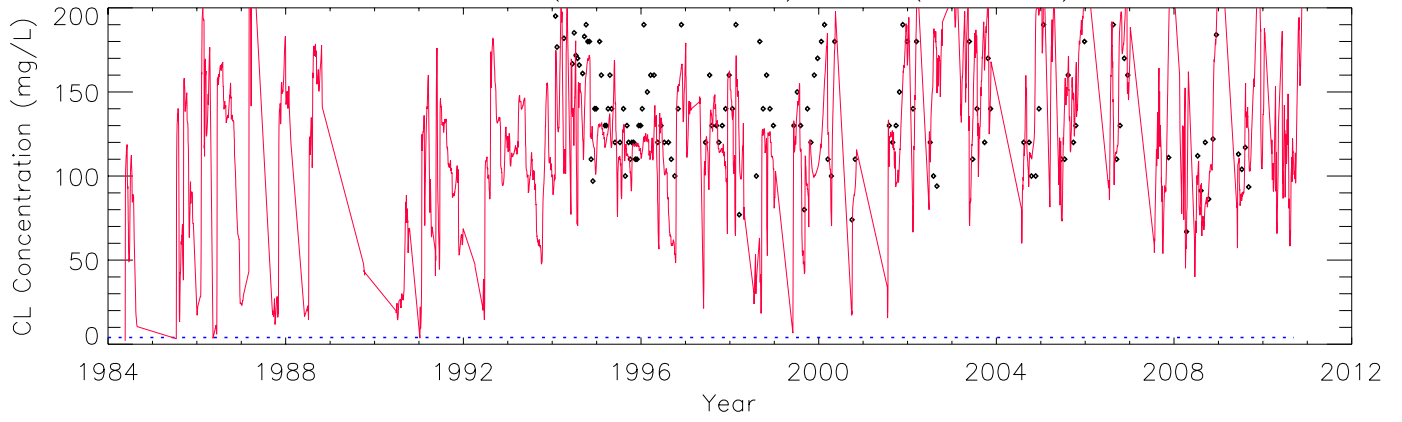
Mean: Water Year – 95% CI – F1 (200_130)



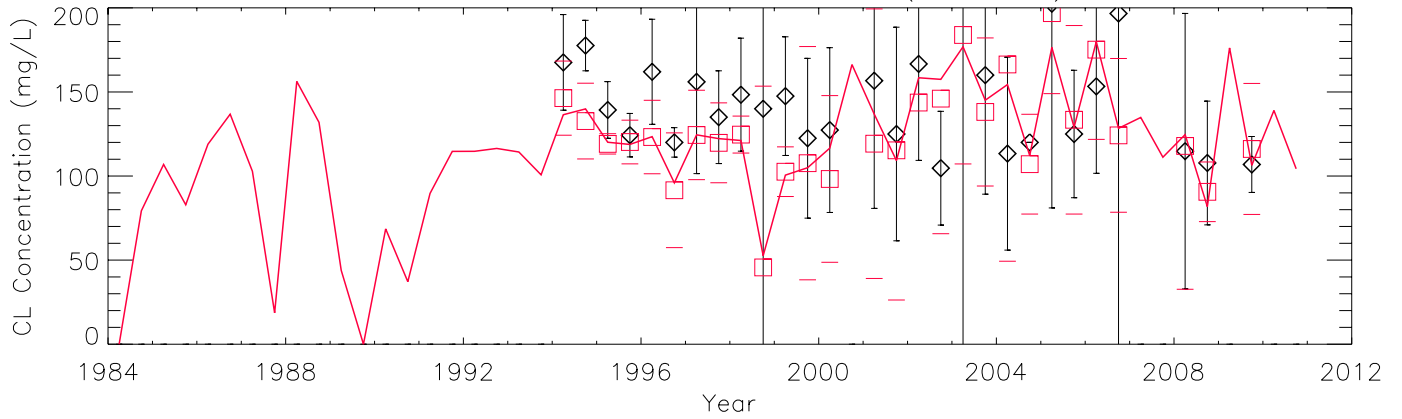
Cumulative Distribution: Raw Data – F1 (200_130)



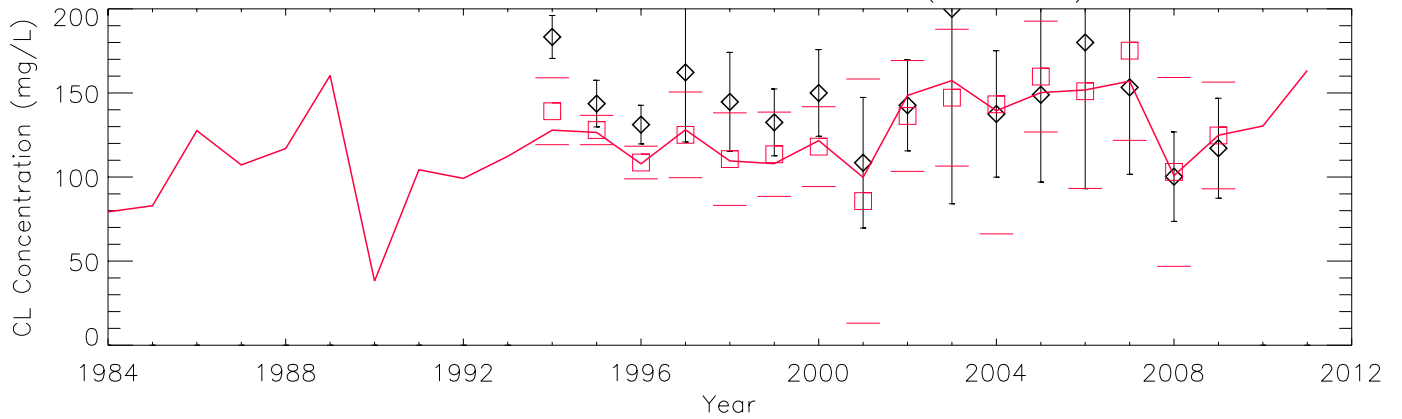
Raw Data (Obs. N = 138) – F2 (194_149)



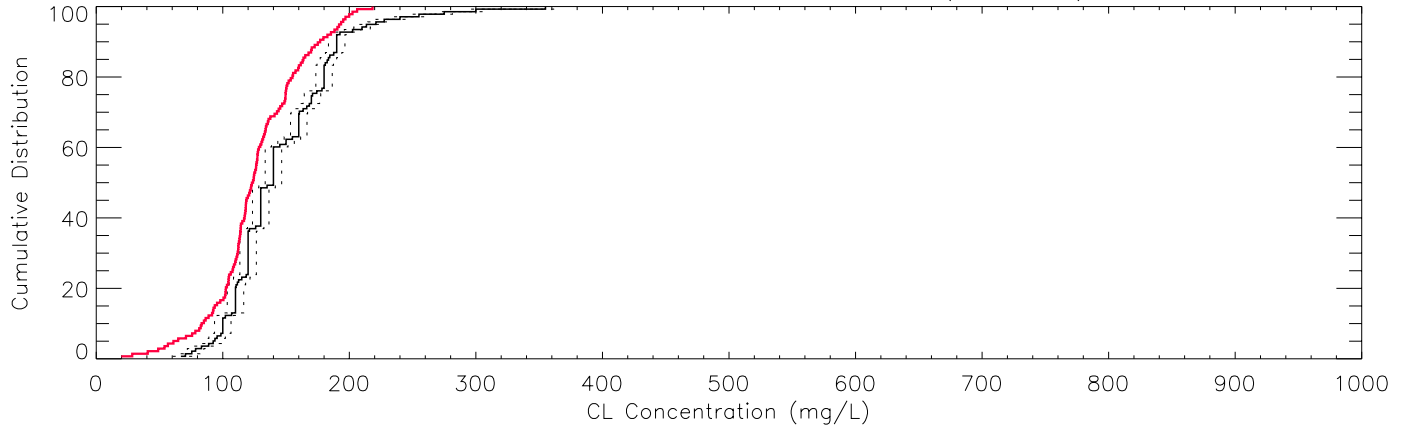
Mean: Season – 95% CI – F2 (194_149)



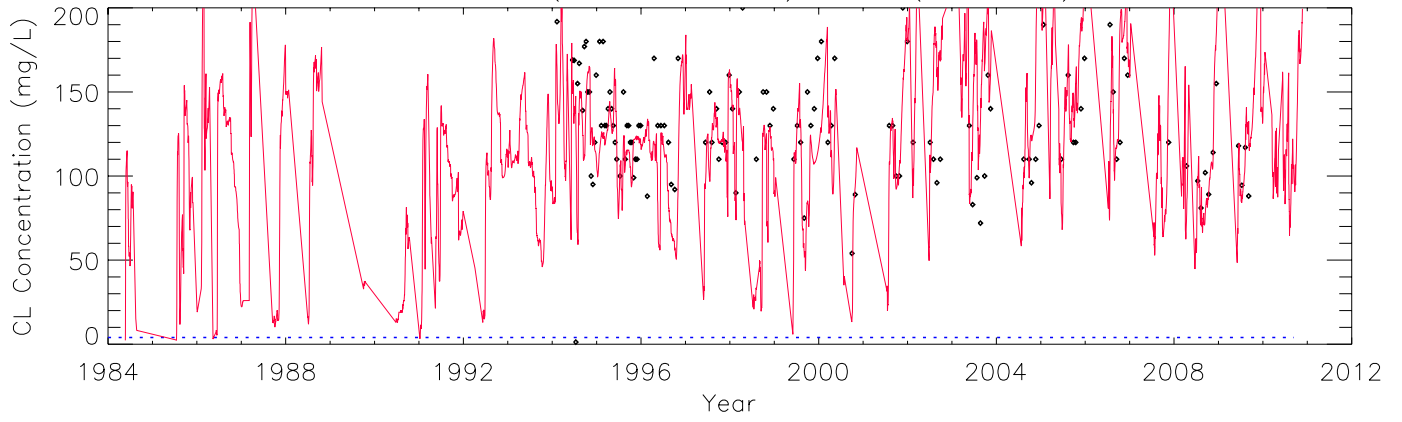
Mean: Water Year – 95% CI – F2 (194_149)



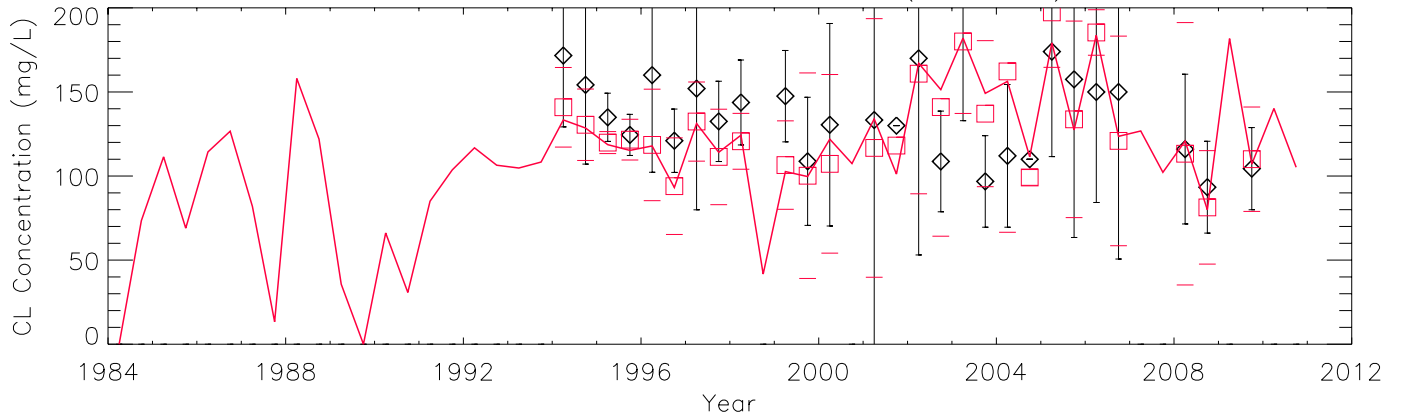
Cumulative Distribution: Raw Data – F2 (194_149)



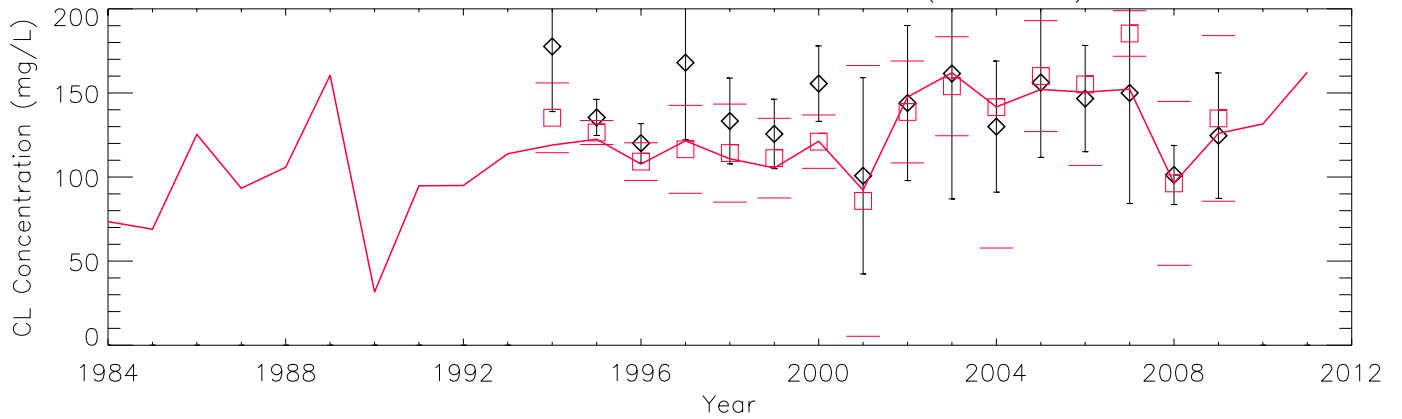
Raw Data (Obs. N = 142) – F3 (183_163)



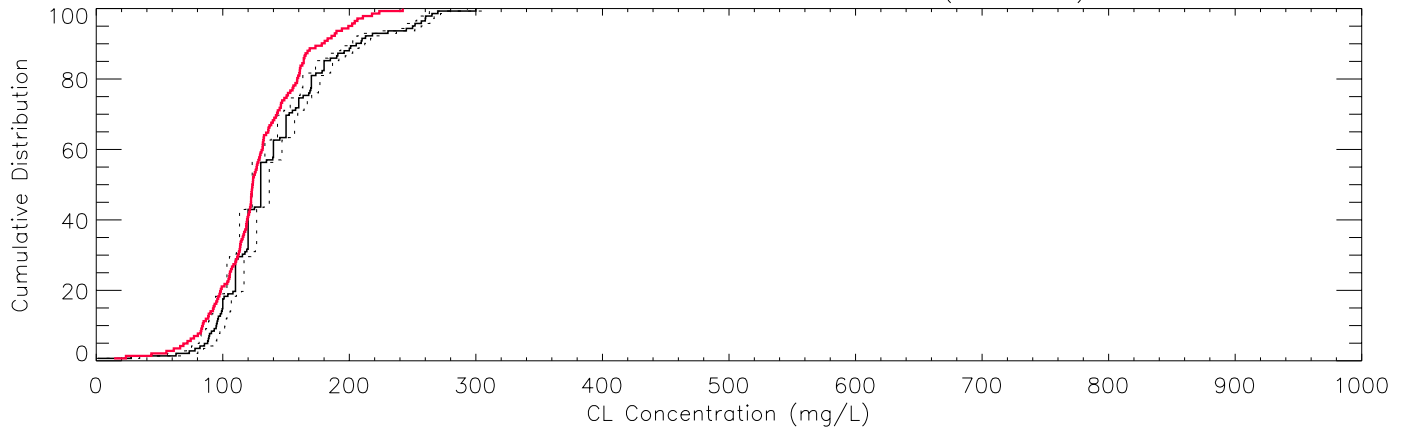
Mean: Season – 95% CI – F3 (183_163)



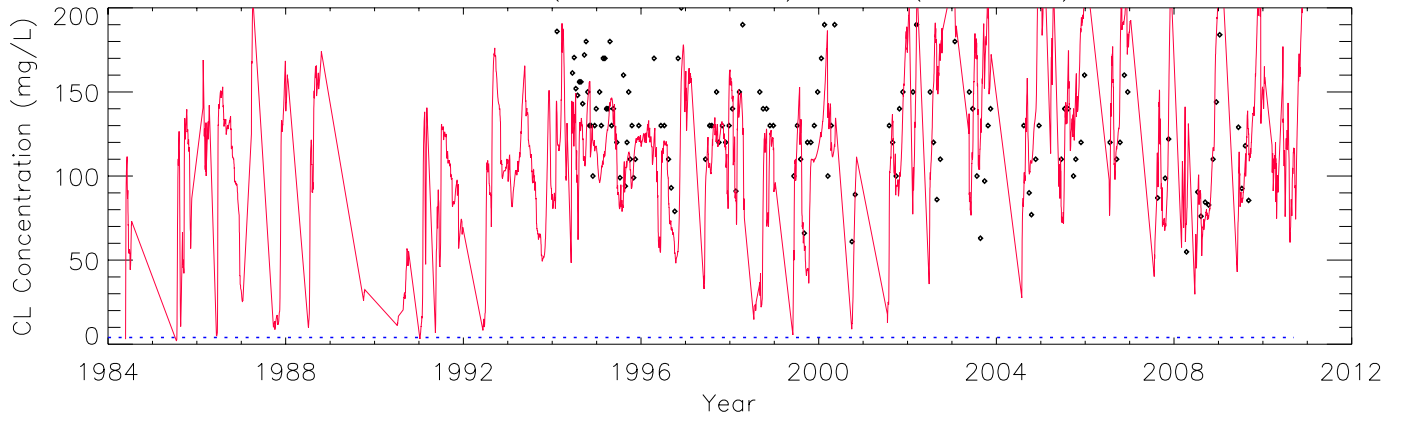
Mean: Water Year – 95% CI – F3 (183_163)



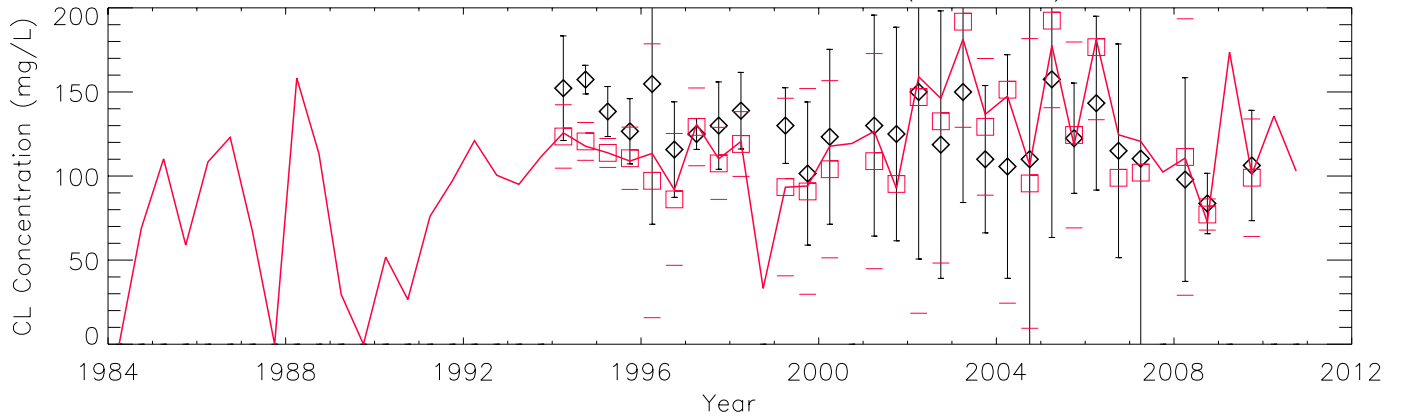
Cumulative Distribution: Raw Data – F3 (183_163)



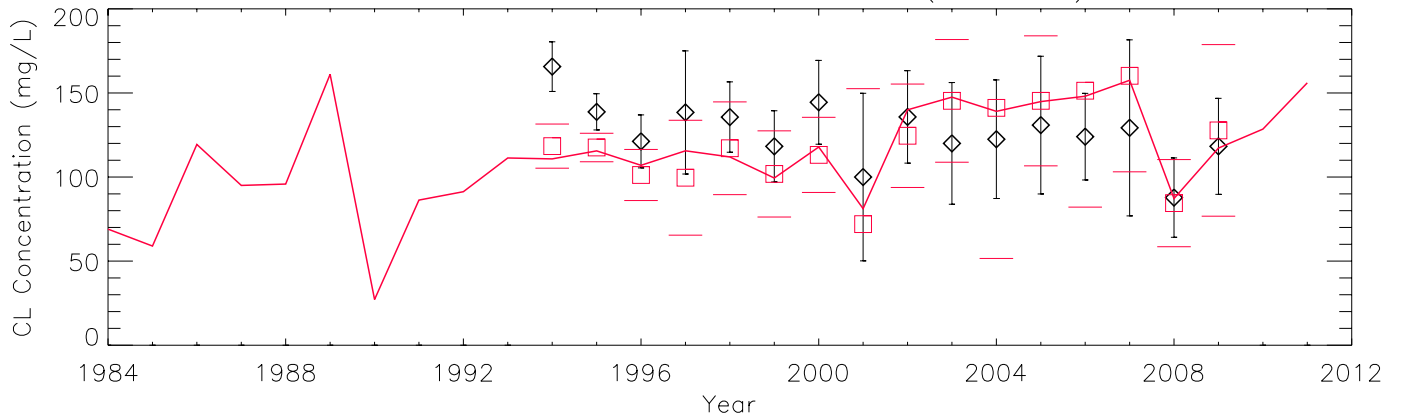
Raw Data (Obs. N = 129) – F4 (186_177)



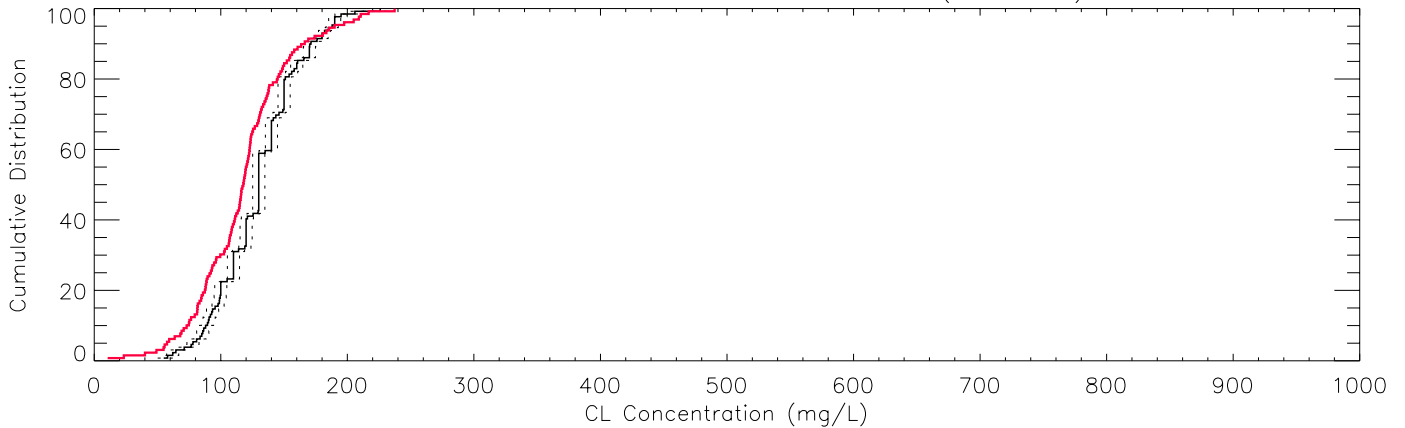
Mean: Season – 95% CI – F4 (186_177)



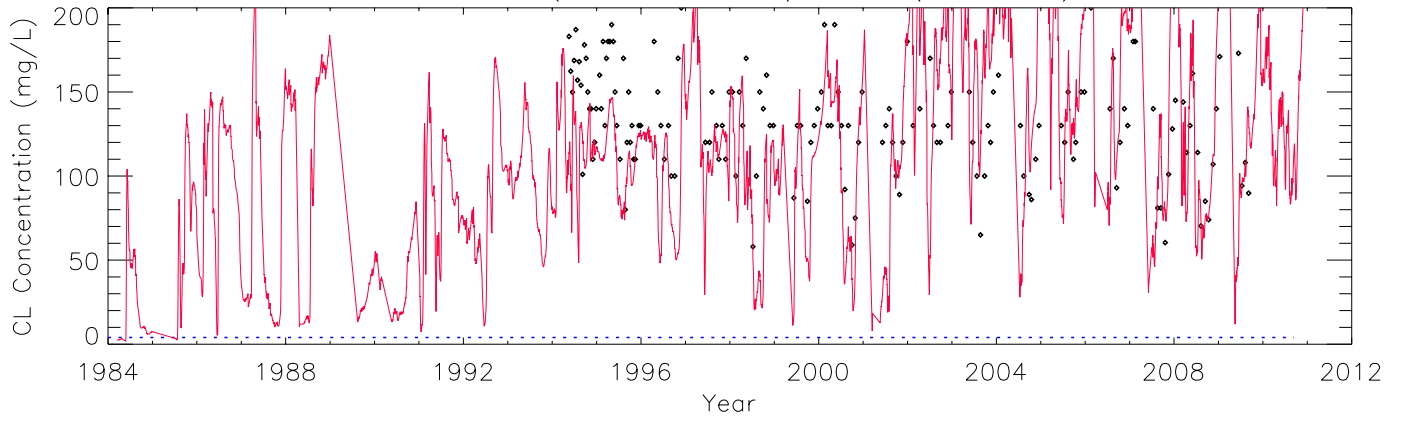
Mean: Water Year – 95% CI – F4 (186_177)



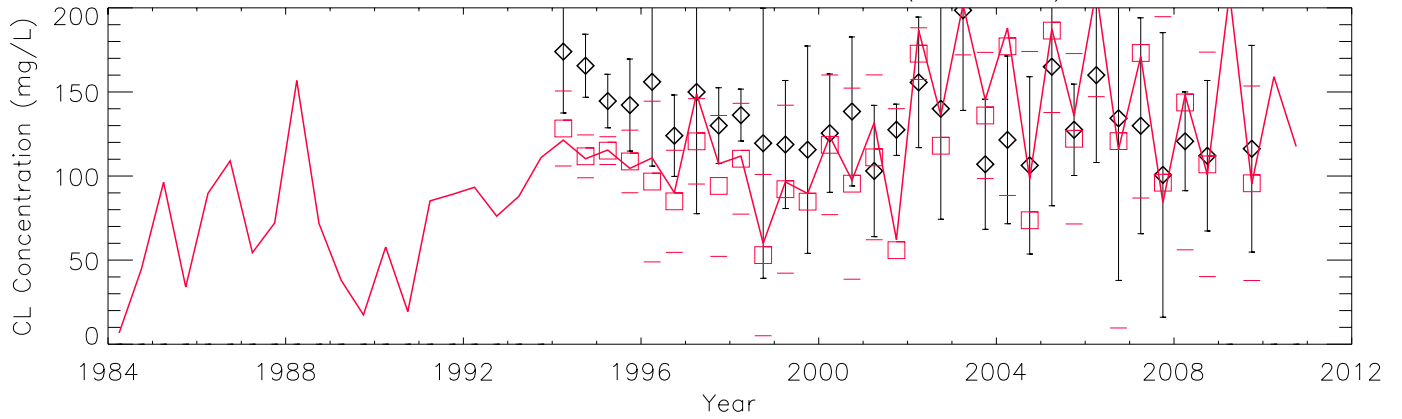
Cumulative Distribution: Raw Data – F4 (186_177)



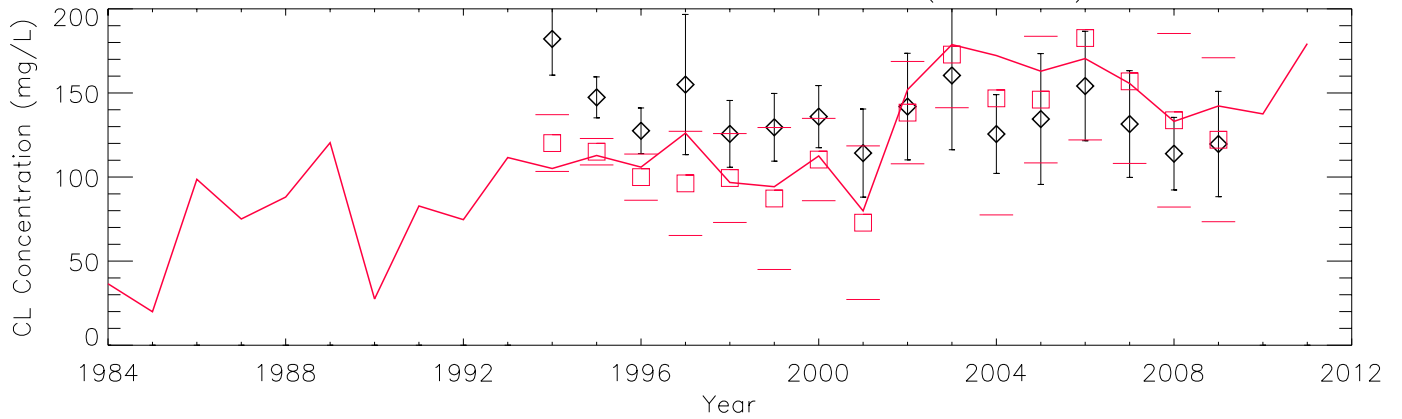
Raw Data (Obs. N = 170) – F5 (172_186)



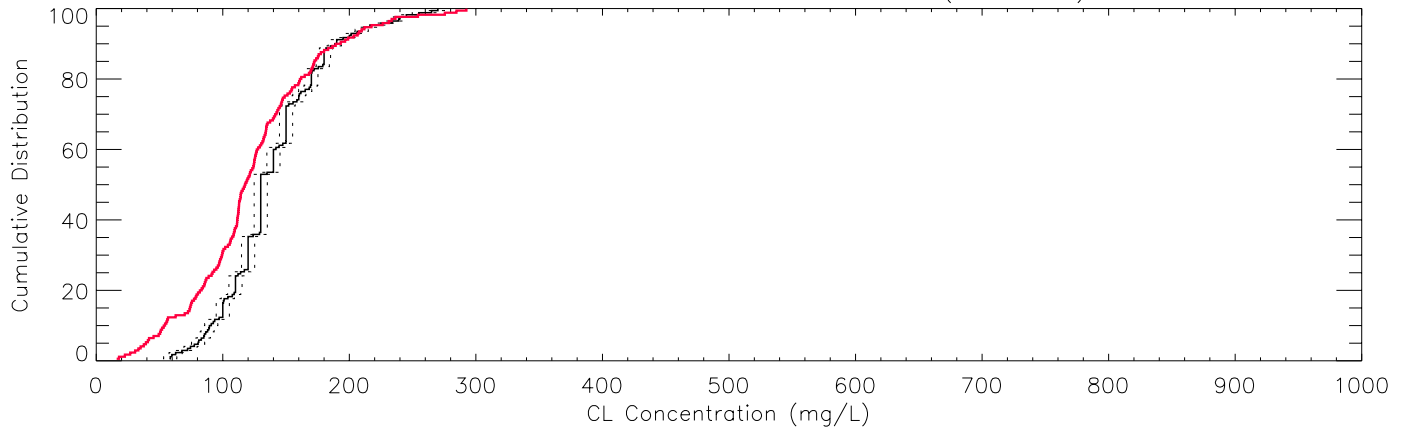
Mean: Season – 95% CI – F5 (172_186)



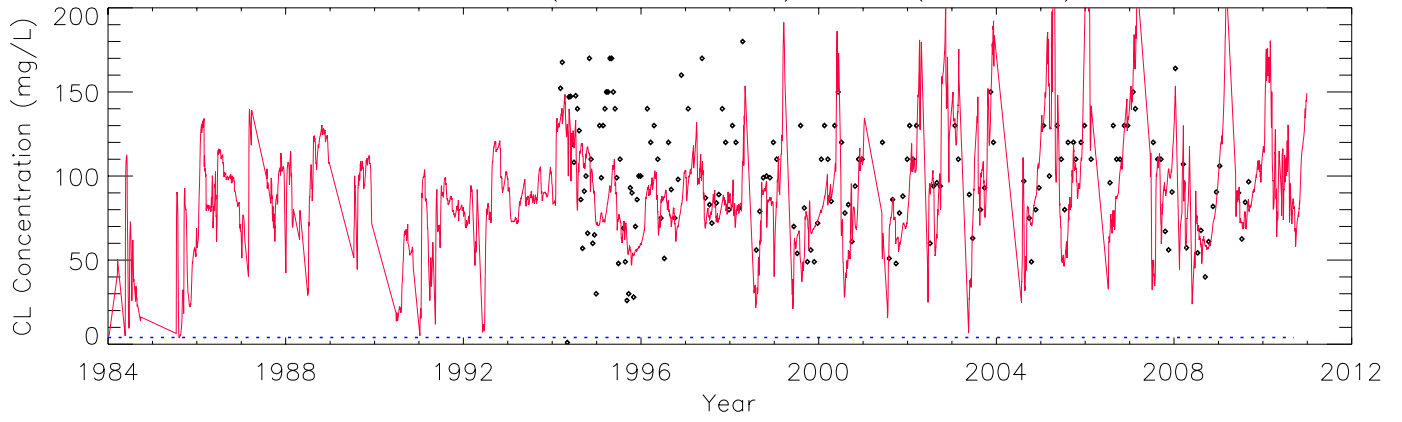
Mean: Water Year – 95% CI – F5 (172_186)



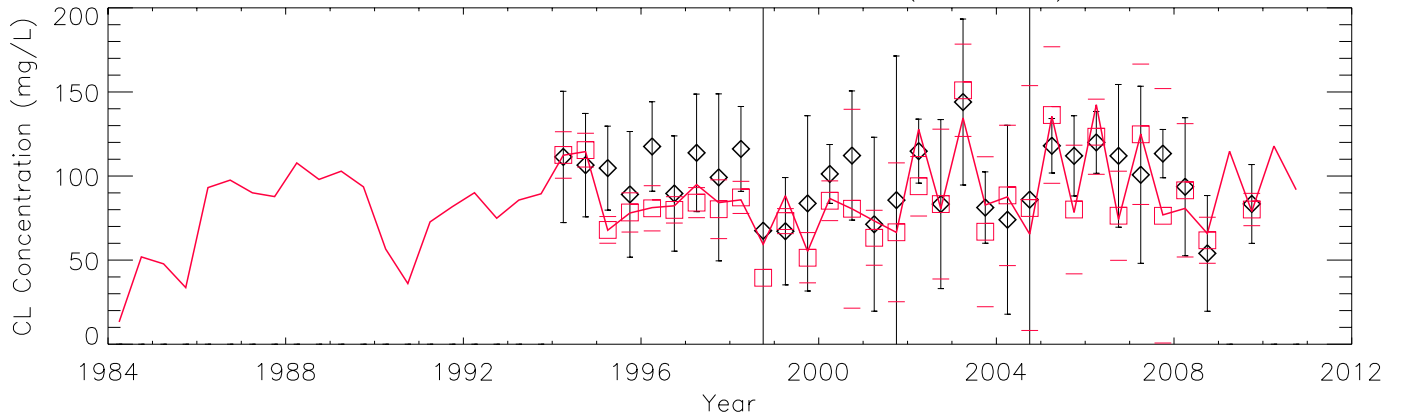
Cumulative Distribution: Raw Data – F5 (172_186)



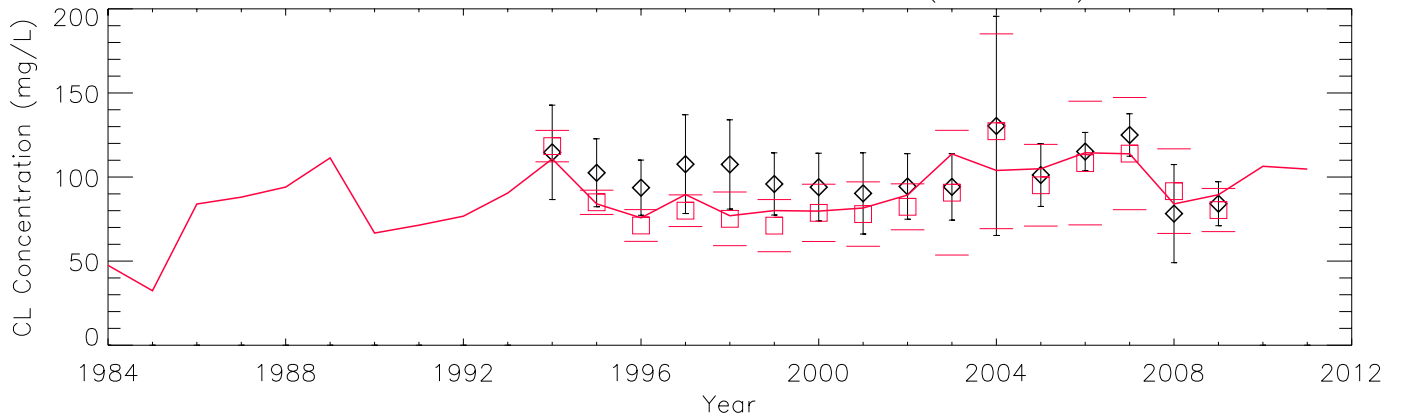
Raw Data (Obs. N = 164) – U1 (215_261)



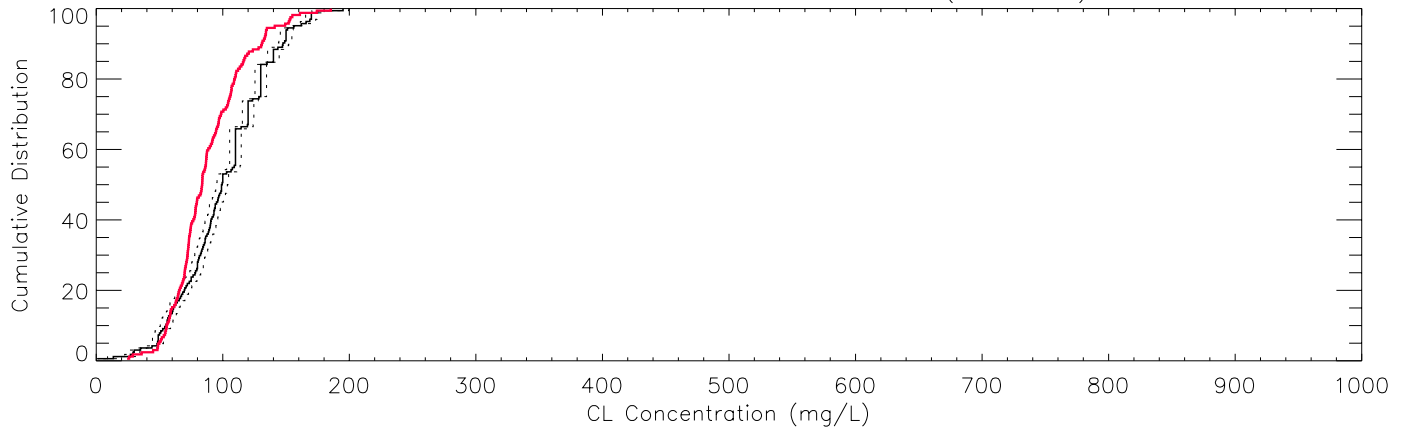
Mean: Season – 95% CI – U1 (215_261)



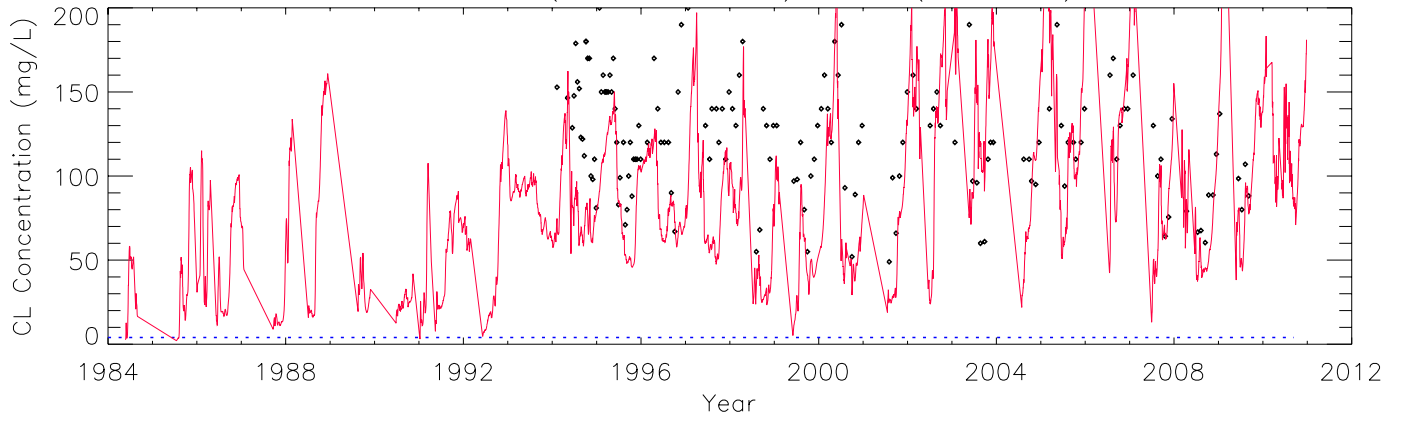
Mean: Water Year – 95% CI – U1 (215_261)



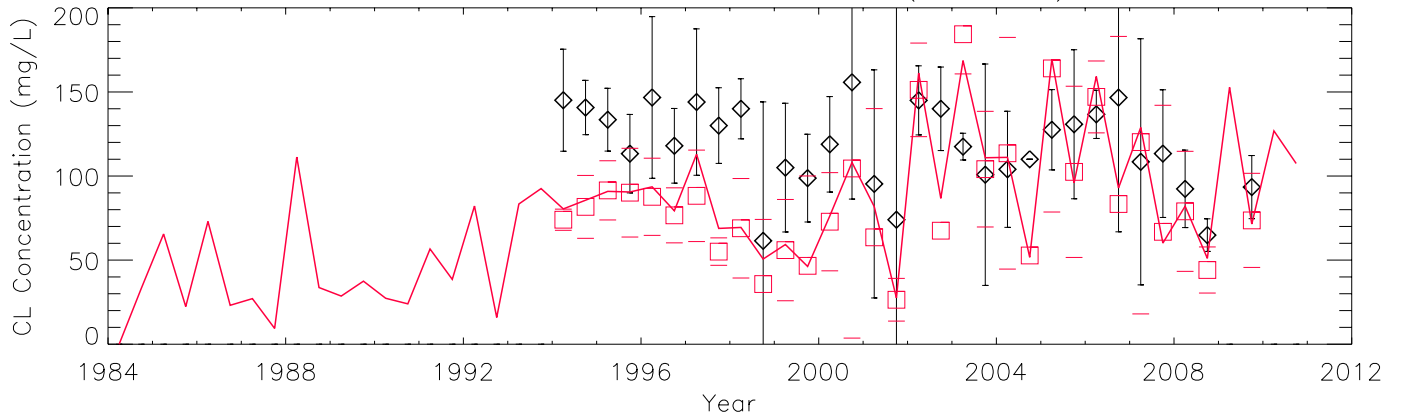
Cumulative Distribution: Raw Data – U1 (215_261)



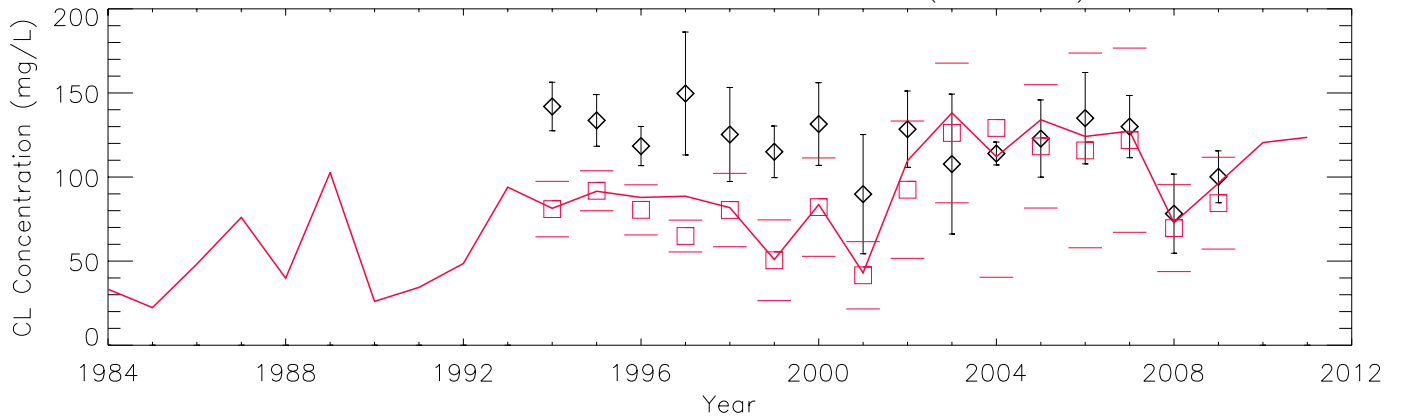
Raw Data (Obs. N = 153) – U2 (187_237)



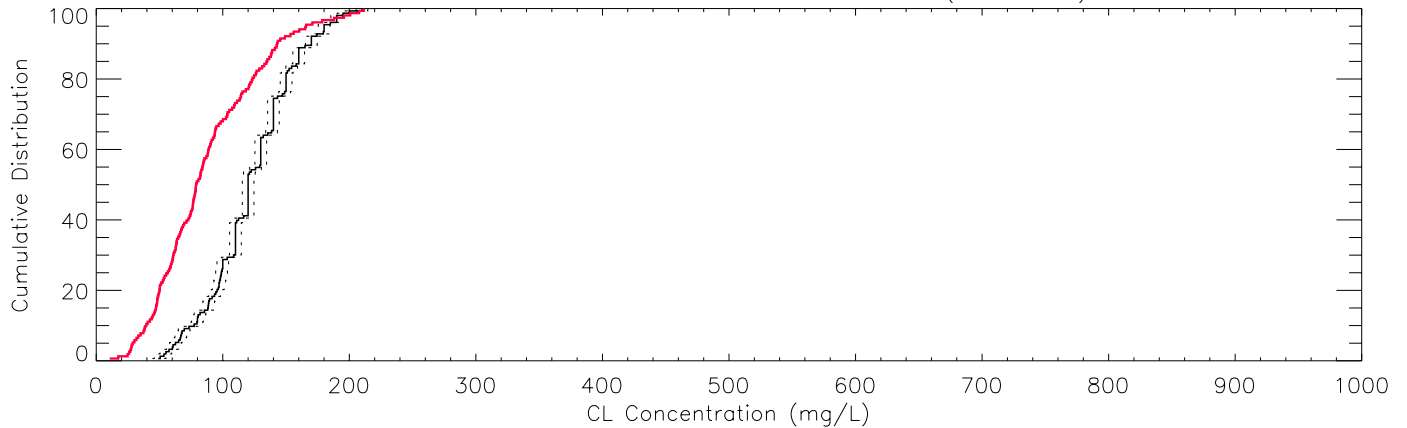
Mean: Season – 95% CI – U2 (187_237)



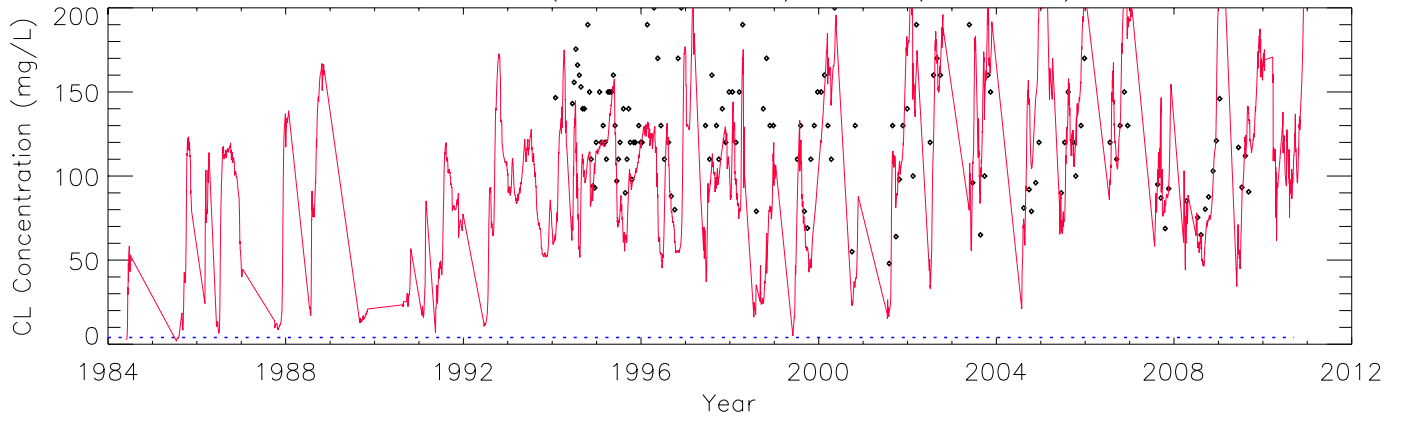
Mean: Water Year – 95% CI – U2 (187_237)



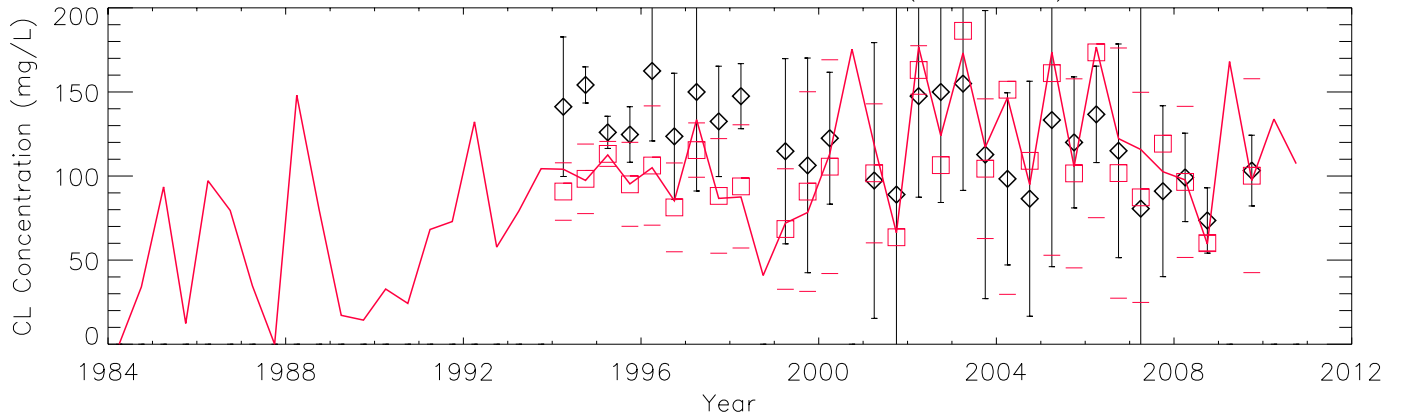
Cumulative Distribution: Raw Data – U2 (187_237)



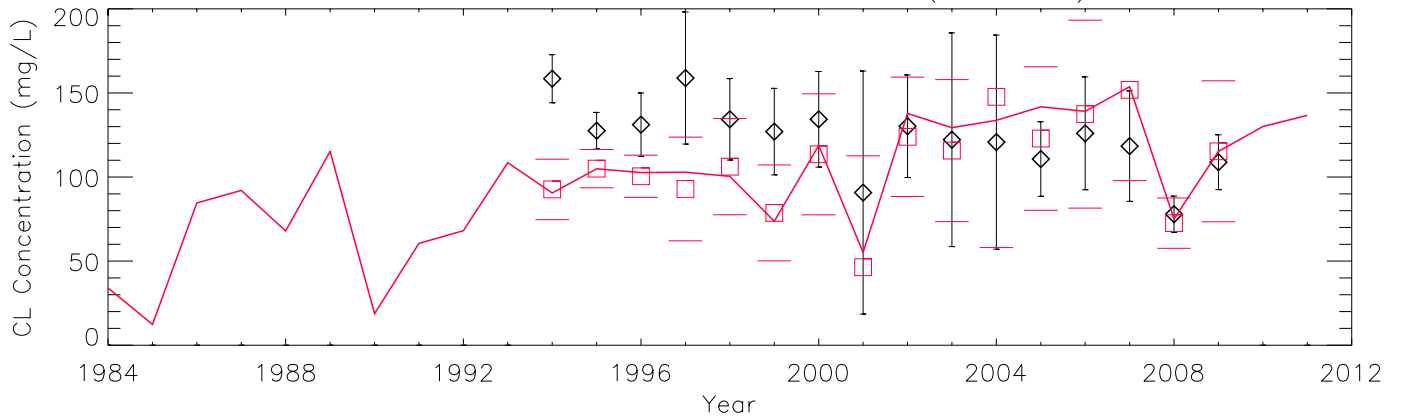
Raw Data (Obs. N = 134) – U3 (160_210)



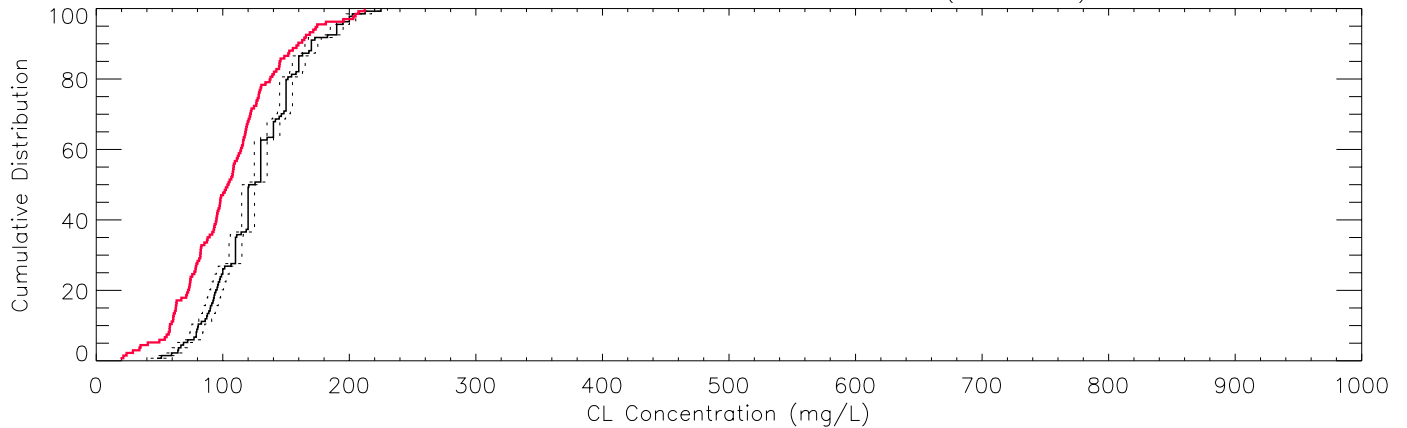
Mean: Season – 95% CI – U3 (160_210)

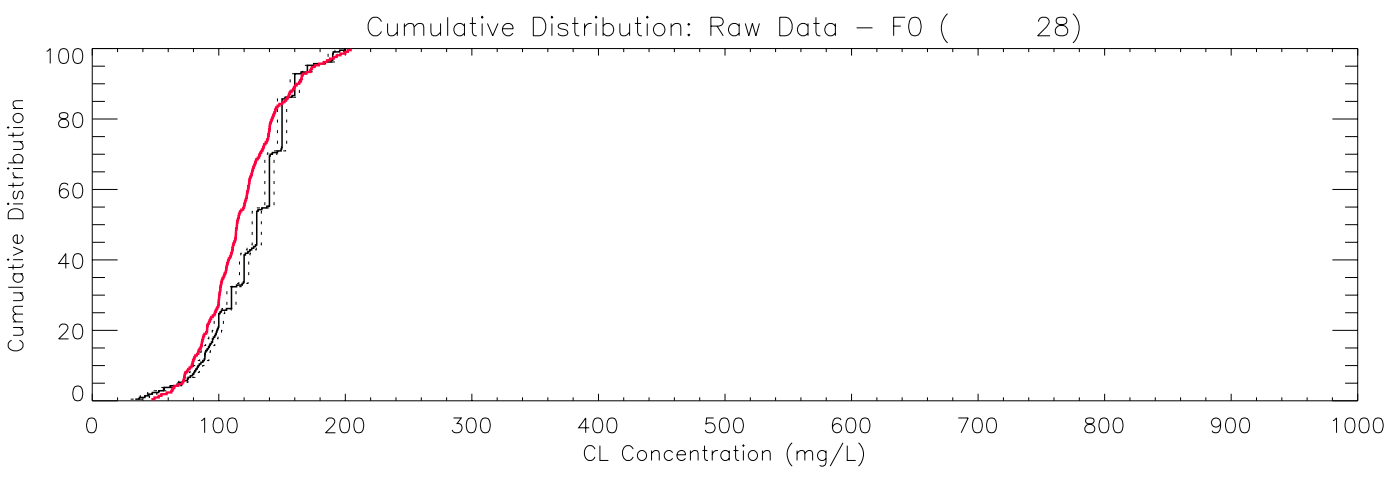
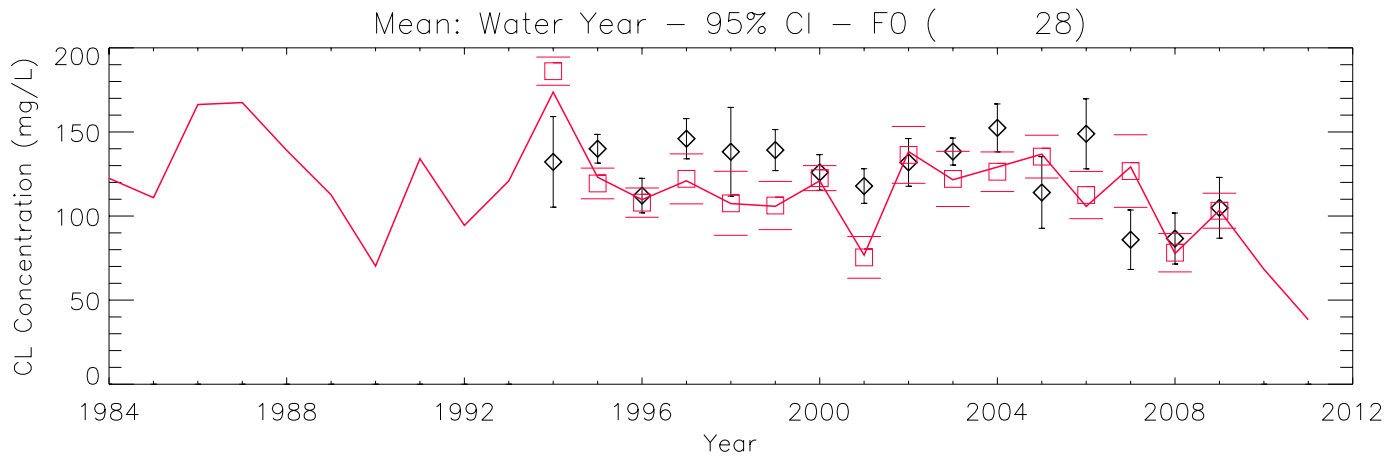
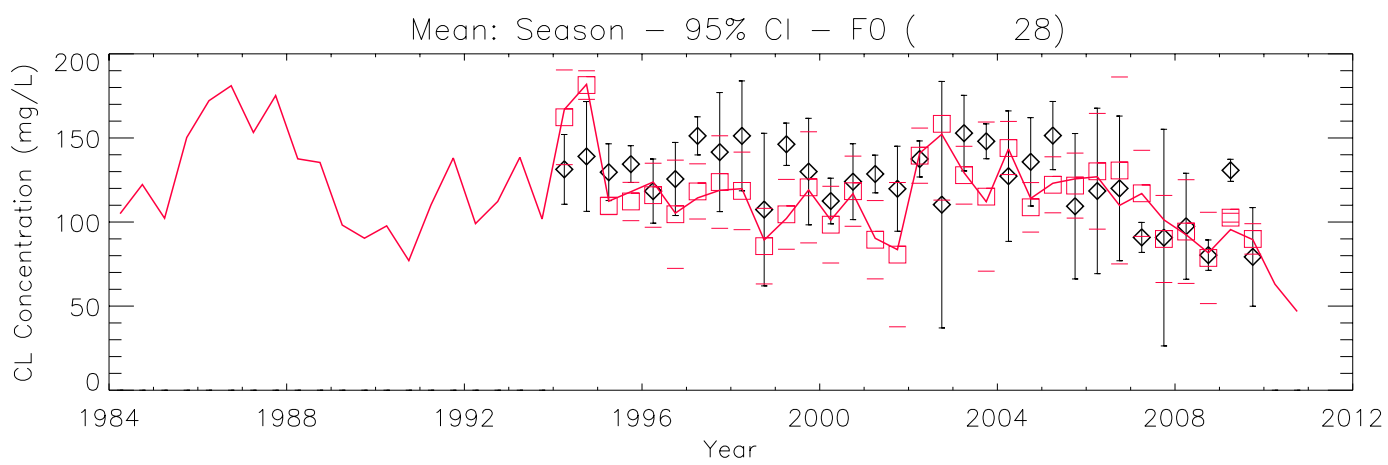
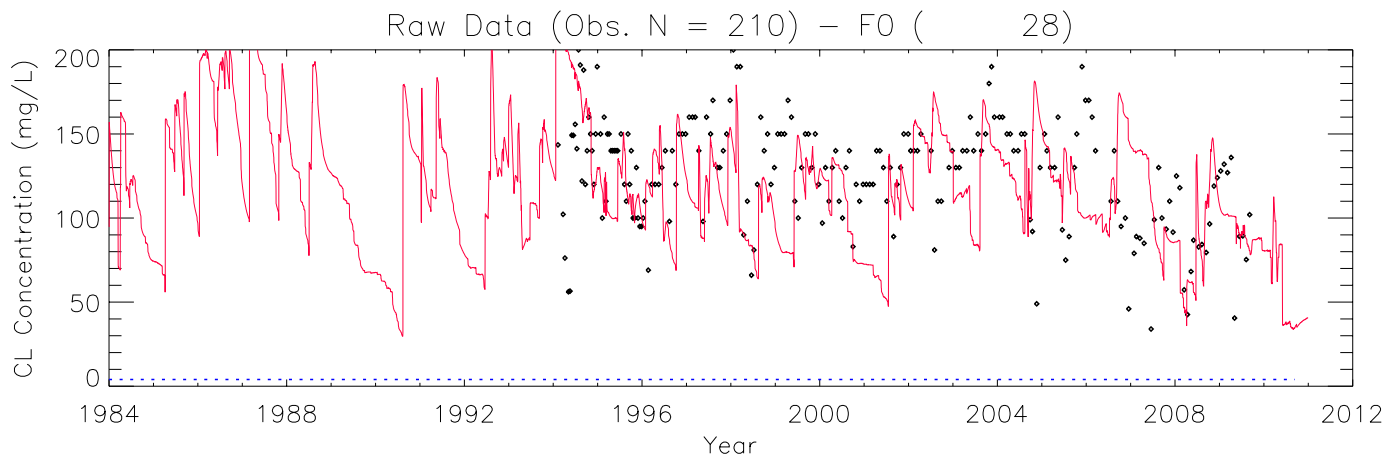


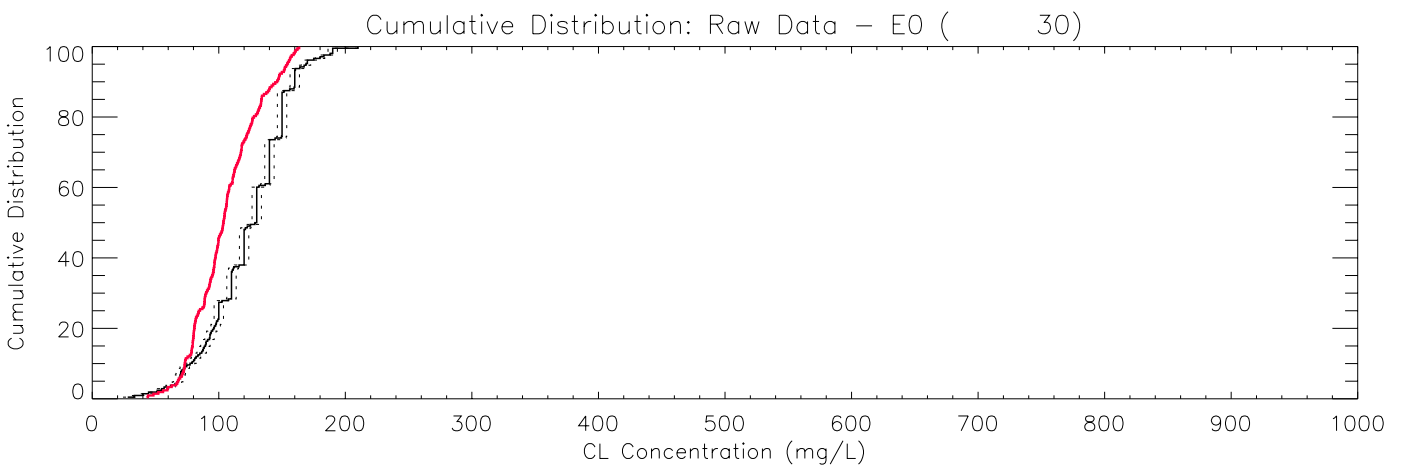
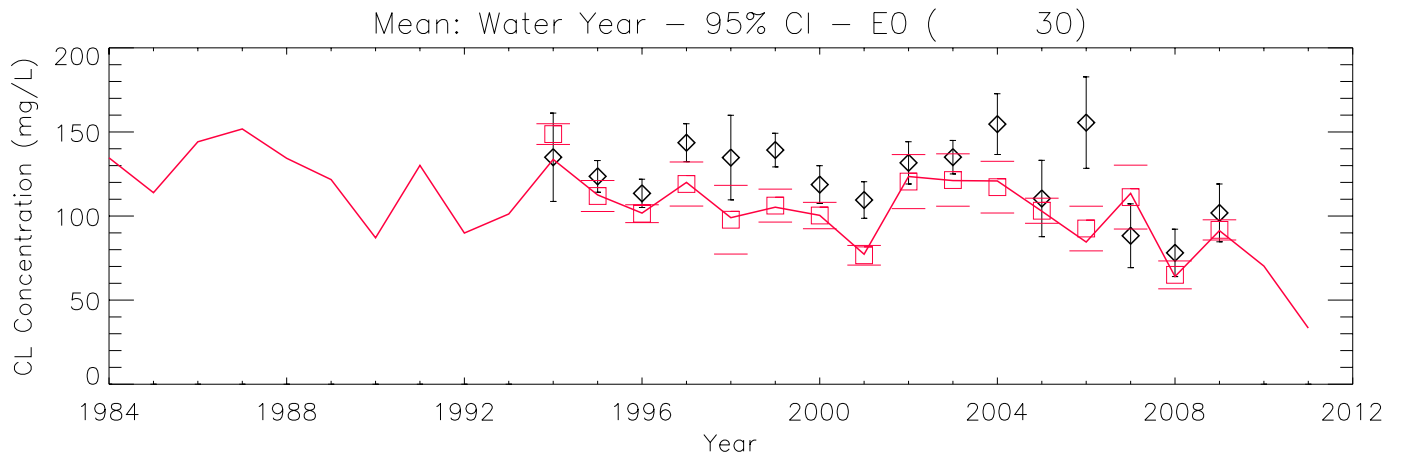
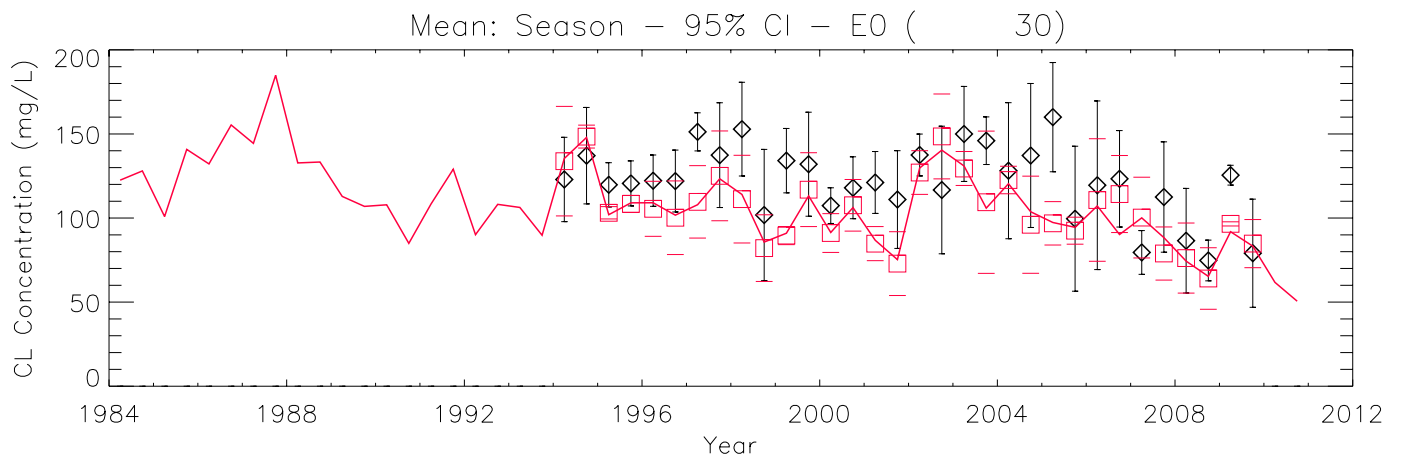
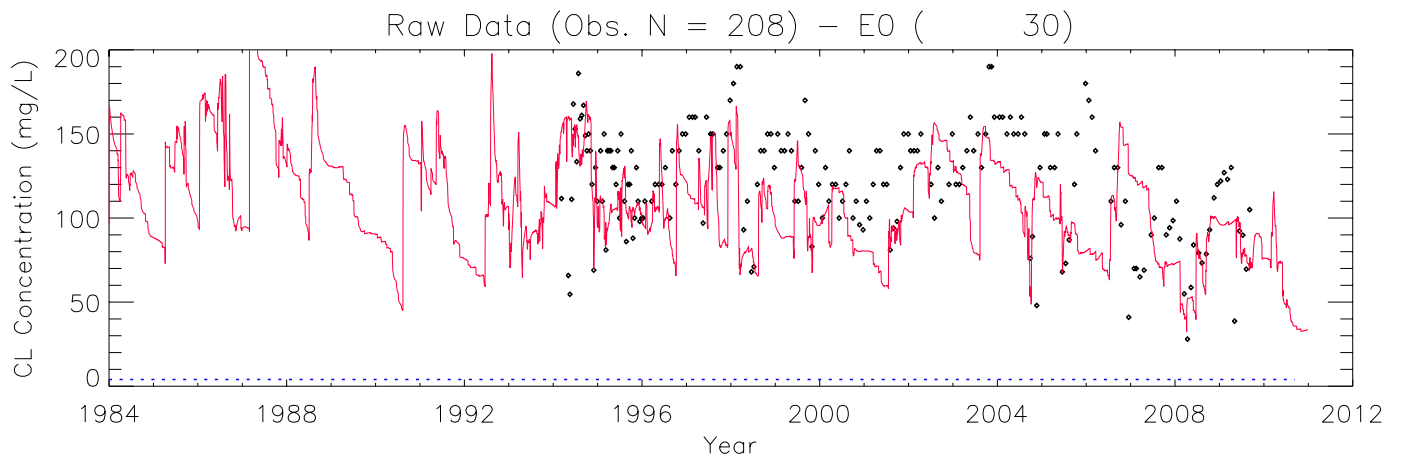
Mean: Water Year – 95% CI – U3 (160_210)



Cumulative Distribution: Raw Data – U3 (160_210)





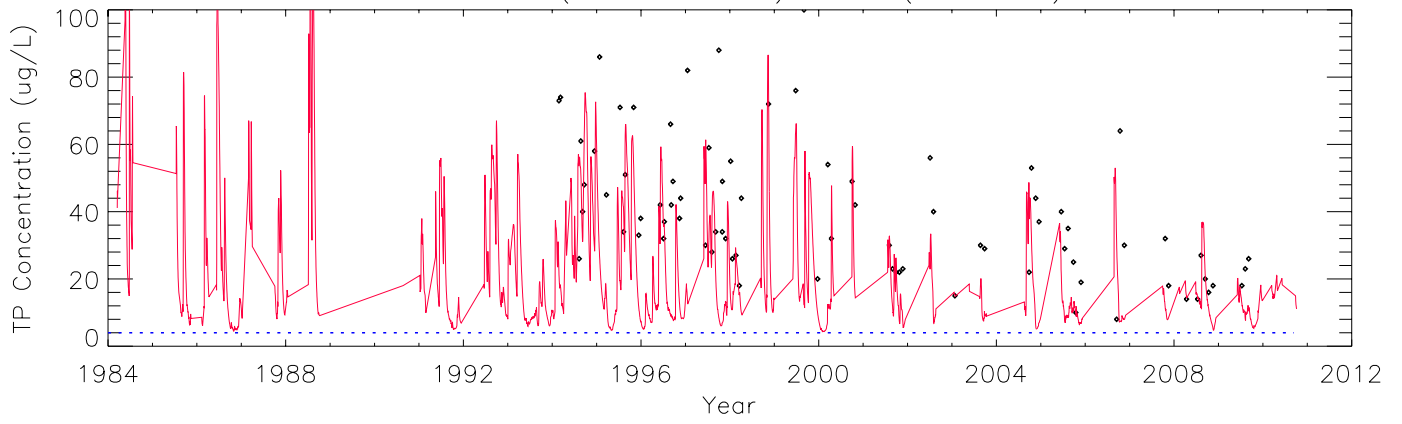


Appendix C. TP model vs. observed time series (15 sites-pages). Plots of surface water total phosphors (TP) concentration and their associated Cumulative Frequency Distributions (CFD) for the period of record 1984-2010 at each monitoring location.

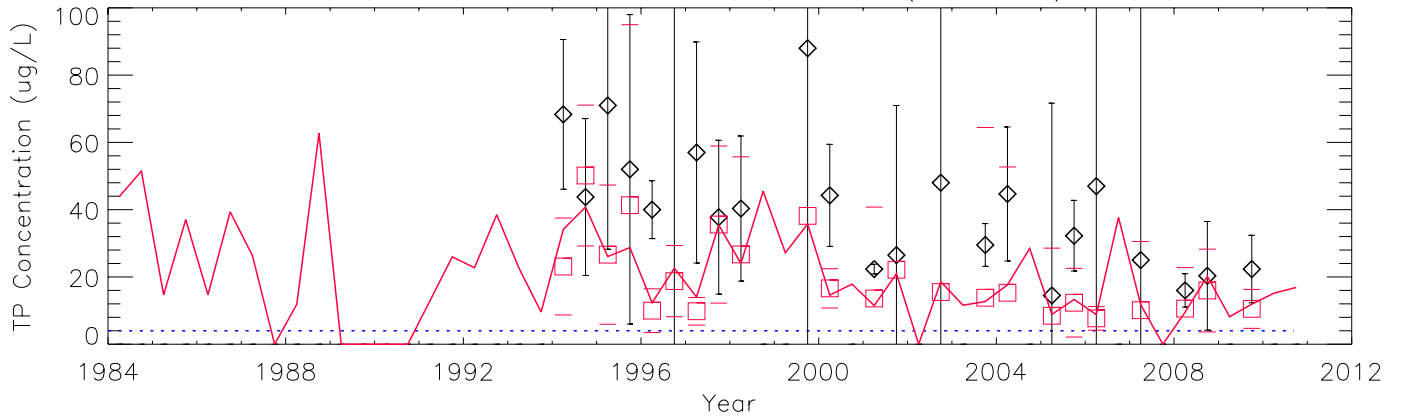
The constant dashed line indicates the TP field sampling Detection Limit (DL = 4 ug l-1 for the model period of record), which was the minimum value used for observed data in plots and statistics. To enable equivalent comparisons, any simulated value which was below the DL was set equal to the DL. The model grid cell column and row locations (col_row) or canal reach identifier (single integer) are shown in parentheses of each plot's title.

- a) All data, with no temporal aggregation, of daily observations (black dots) and model results (red line).
- b) All data were aggregated into arithmetic mean values by wet and dry seasons within water years; the continuous lines pass through mean of all daily data points for each season; the mean of paired simulated & observed values are shown in red boxes and black diamonds, respectively; the 95% Confidence Interval (CI) of the paired means are shown by the "___" symbols in the red for the model and black for the observed data.
- c) All data aggregated into arithmetic mean values by water year, with the same treatment as in plot b).
- d) The cumulative frequency distributions of the simulated and observed (raw, un-aggregated) data; the 95% confidence interval for observed data is shown in the dashed black lines. Note that only paired simulated and observed data points are used.

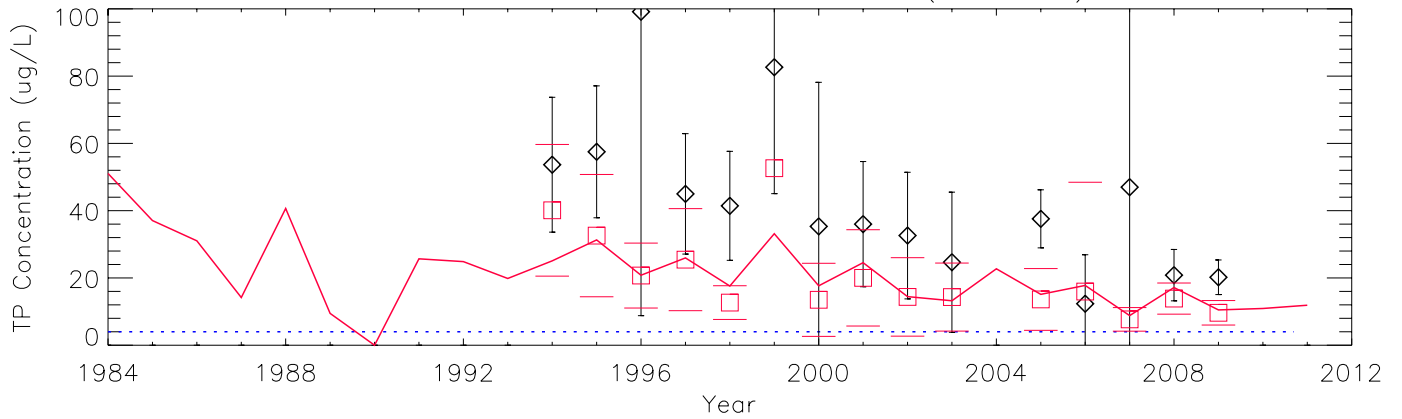
Raw Data (Obs. N = 82) – E1 (217_139)



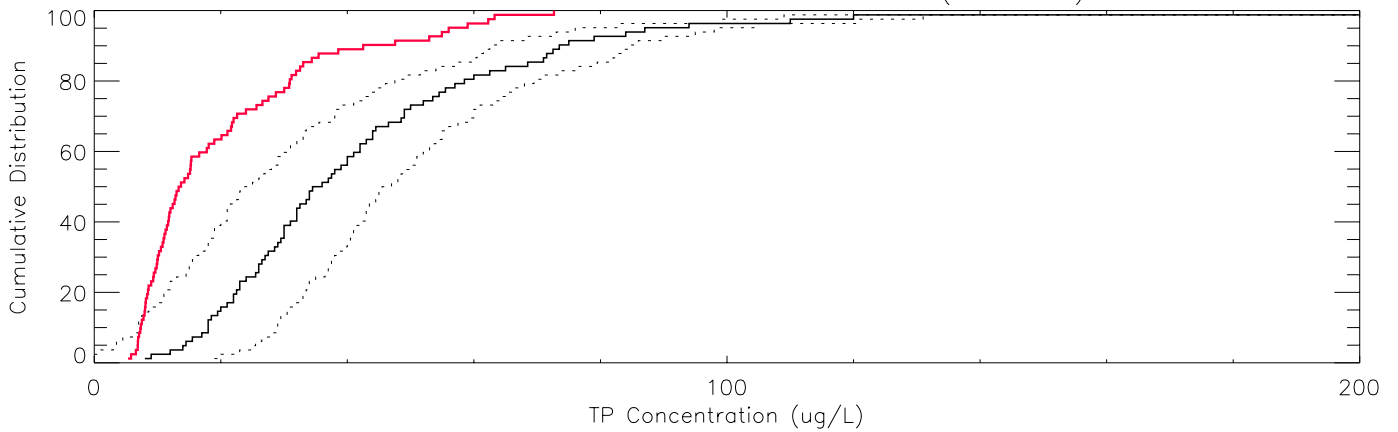
Mean: Season – 95% CI – E1 (217_139)



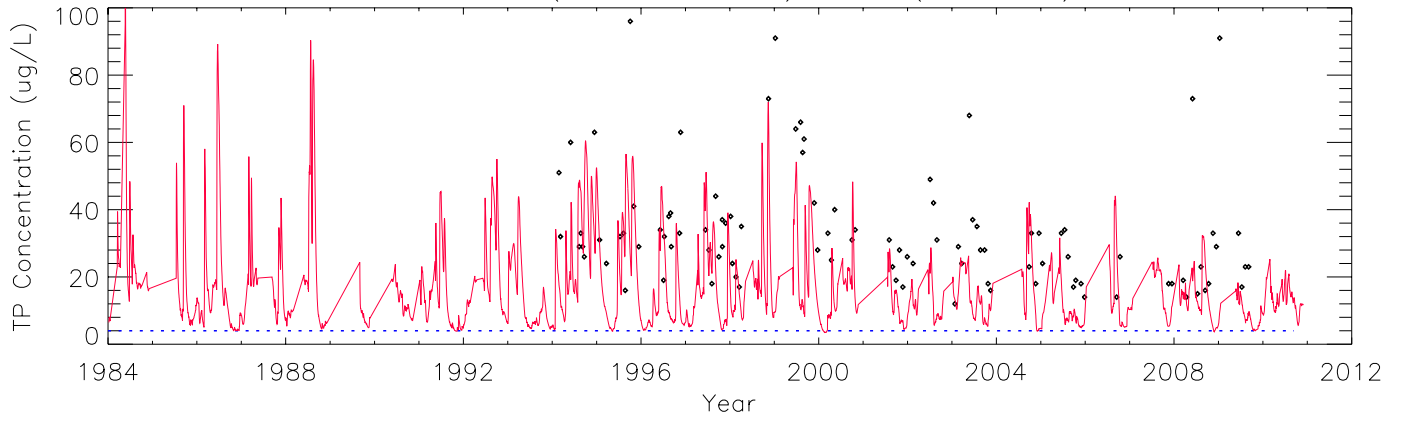
Mean: Water Year – 95% CI – E1 (217_139)



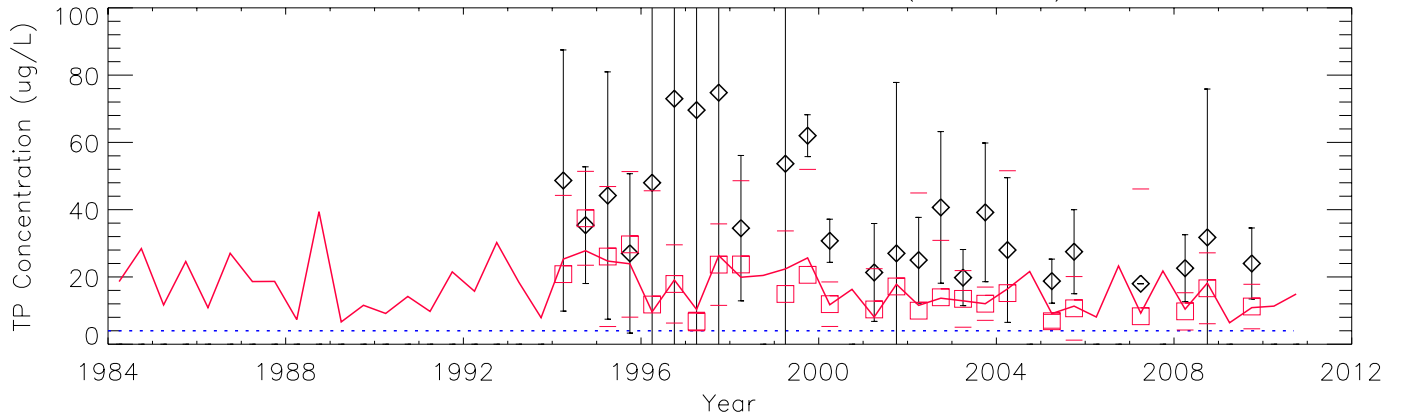
Cumulative Distribution: Raw Data – E1 (217_139)



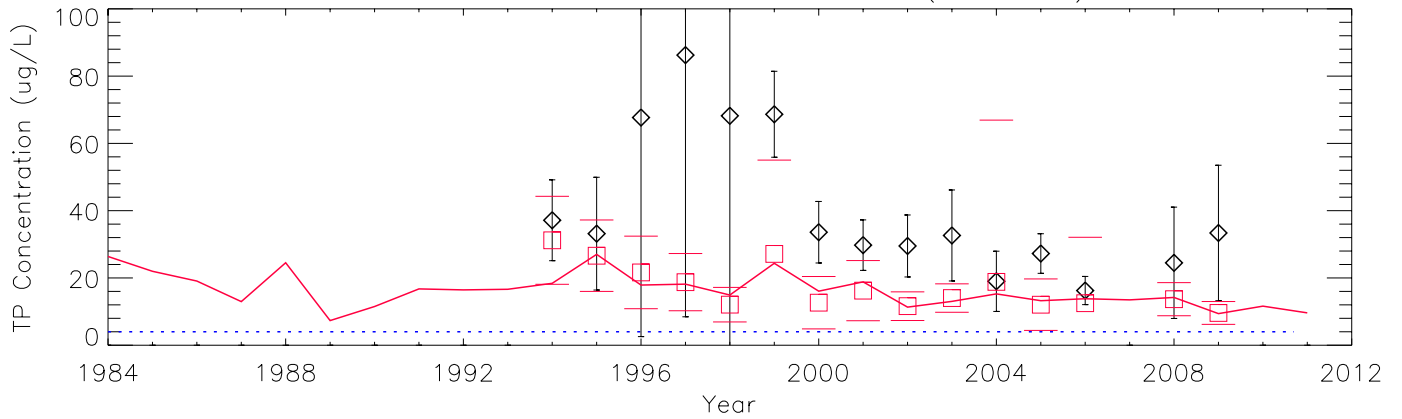
Raw Data (Obs. N = 104) – E2 (218_149)



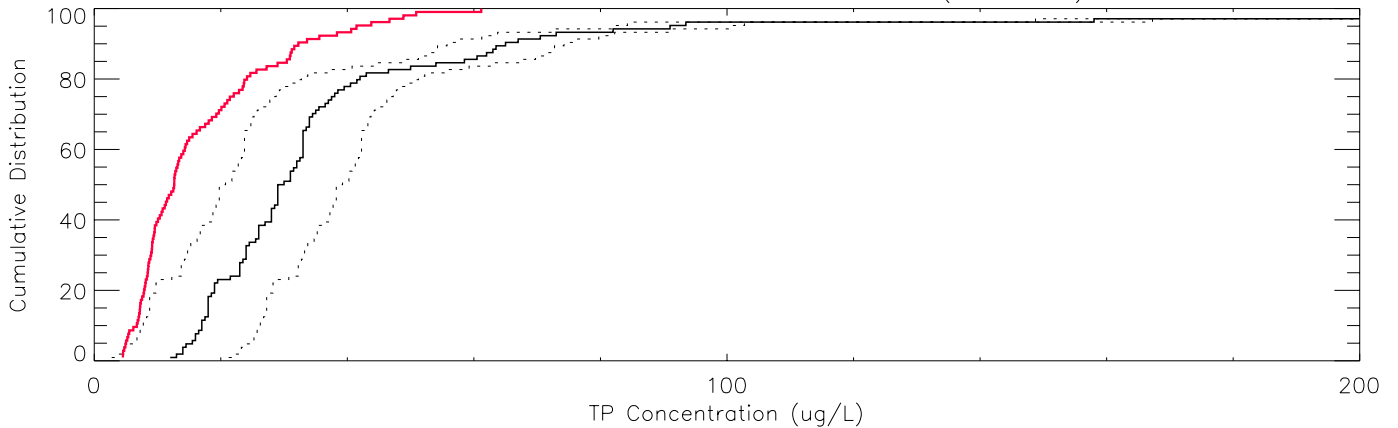
Mean: Season – 95% CI – E2 (218_149)



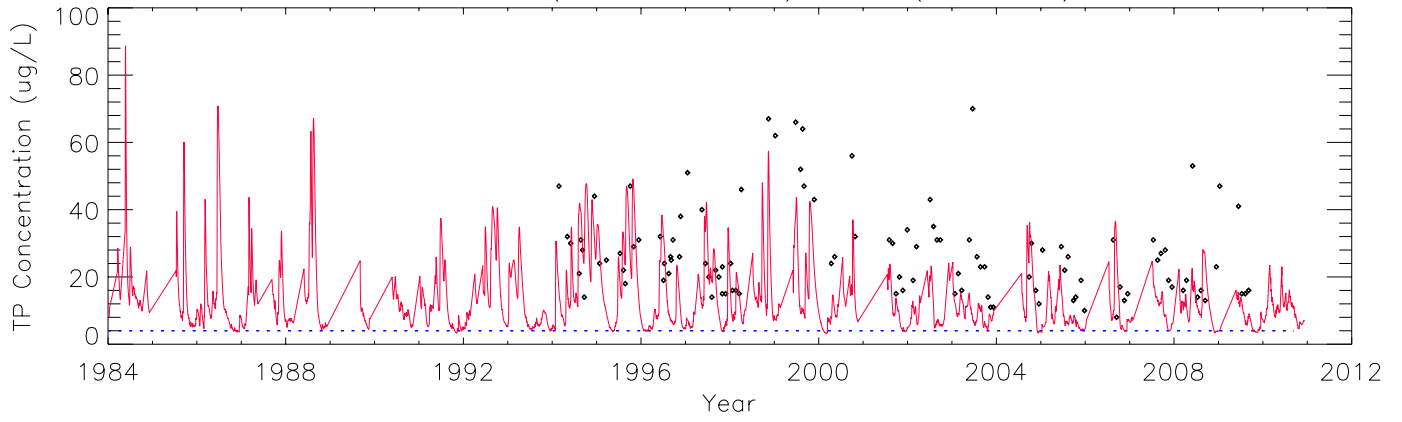
Mean: Water Year – 95% CI – E2 (218_149)



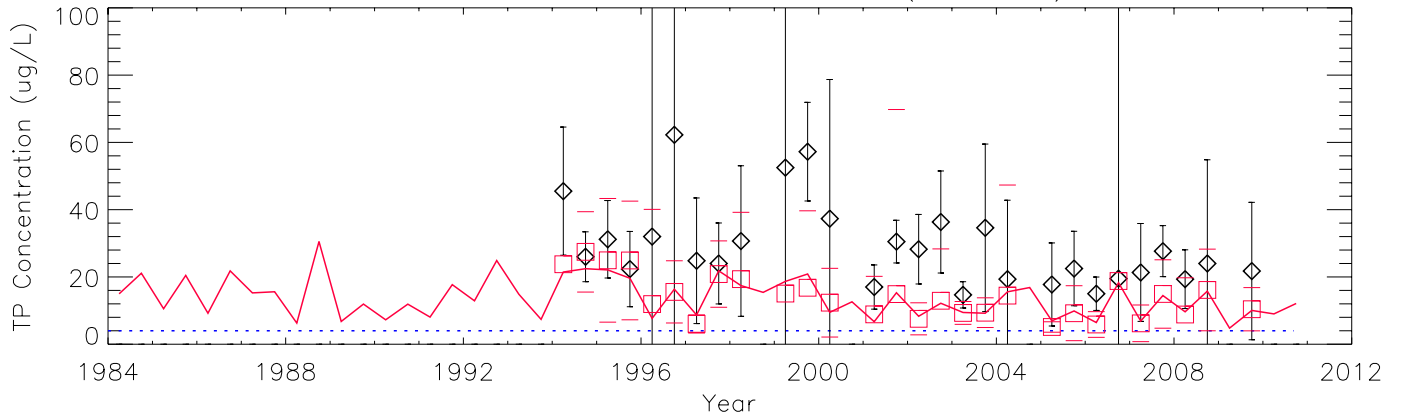
Cumulative Distribution: Raw Data – E2 (218_149)



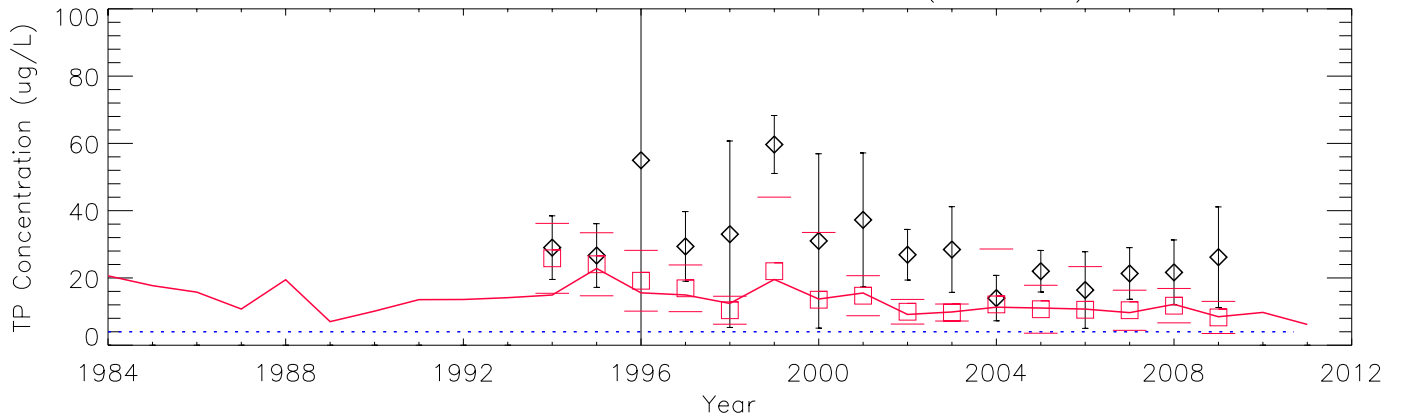
Raw Data (Obs. N = 111) – E3 (215_158)



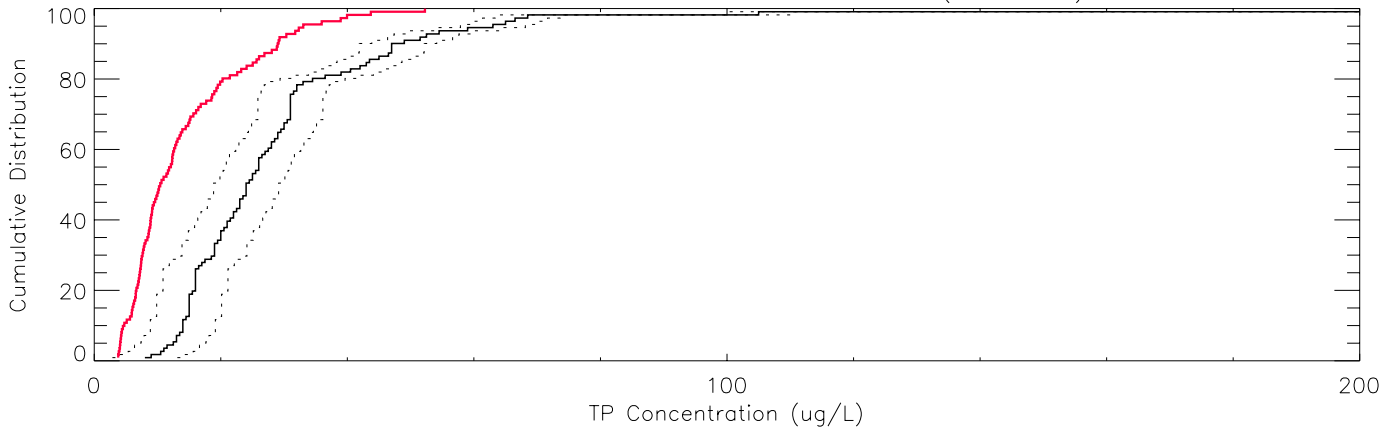
Mean: Season – 95% CI – E3 (215_158)



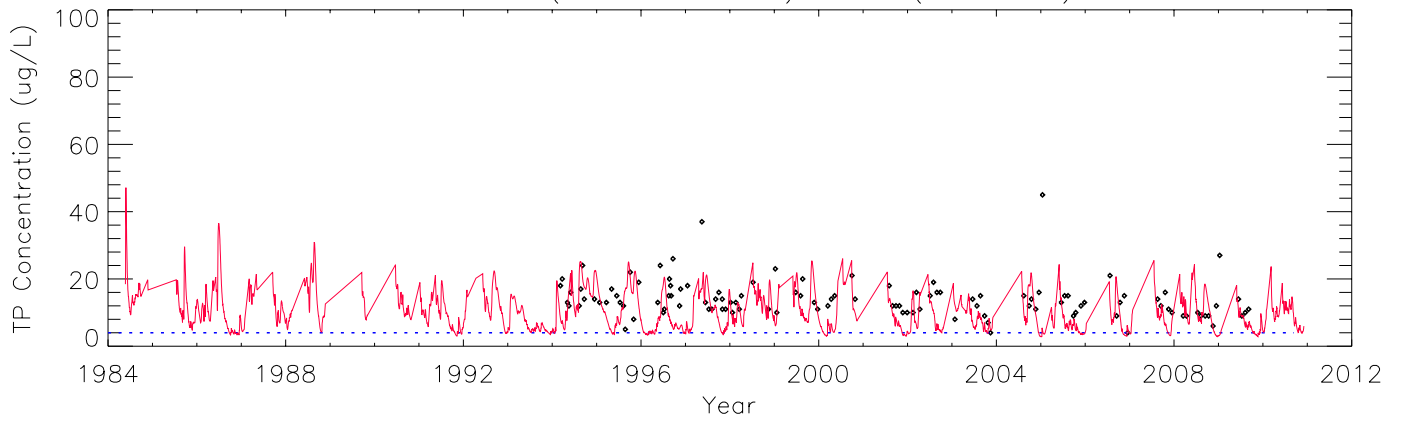
Mean: Water Year – 95% CI – E3 (215_158)



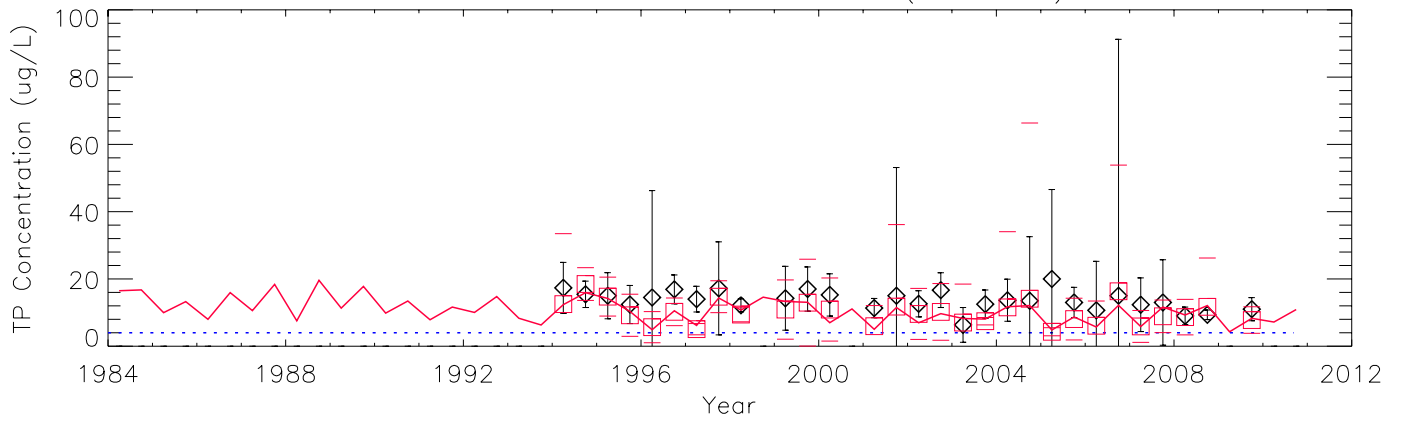
Cumulative Distribution: Raw Data – E3 (215_158)



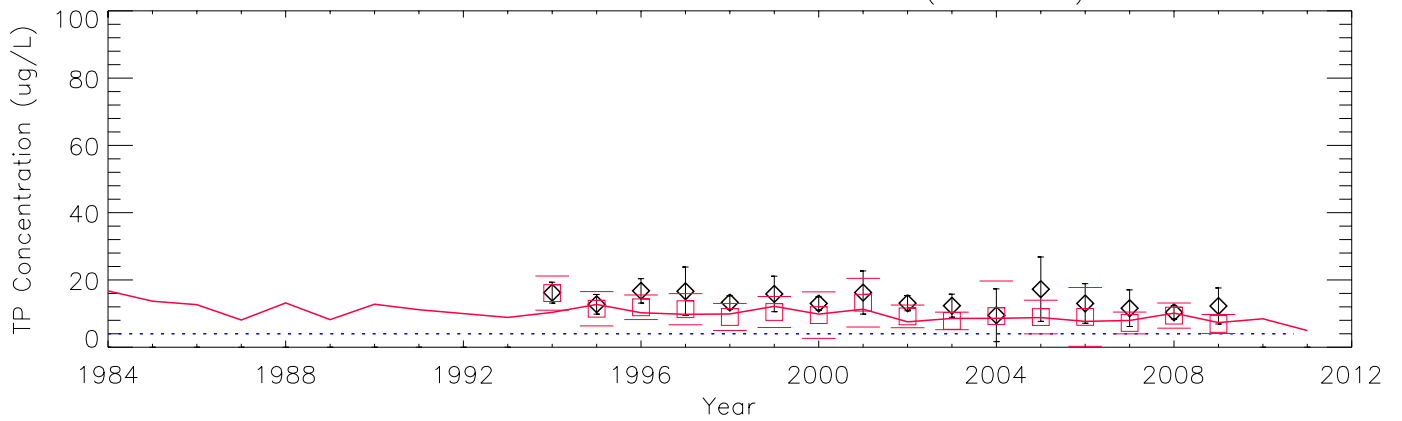
Raw Data (Obs. N = 116) – E4 (214_186)



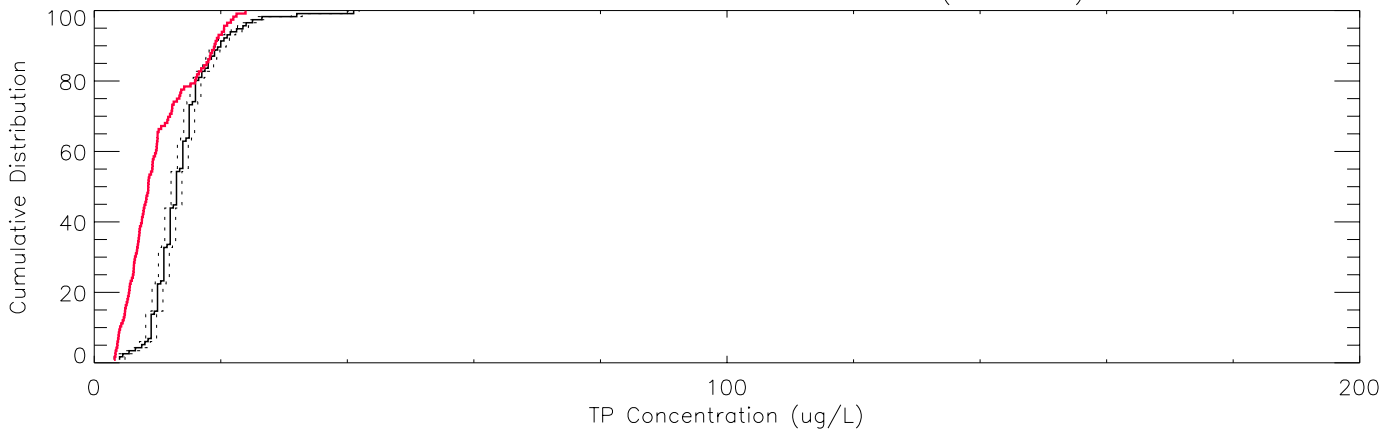
Mean: Season – 95% CI – E4 (214_186)



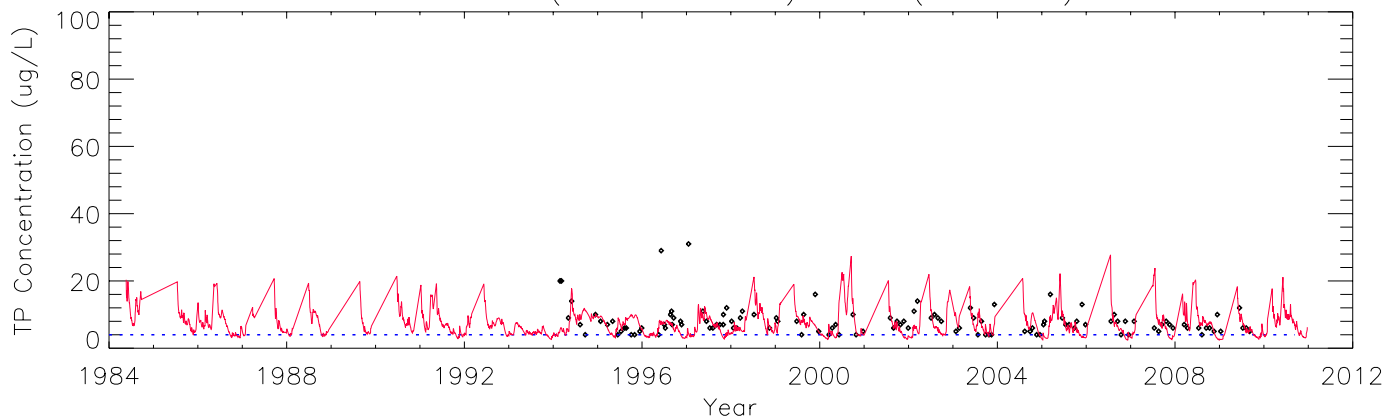
Mean: Water Year – 95% CI – E4 (214_186)



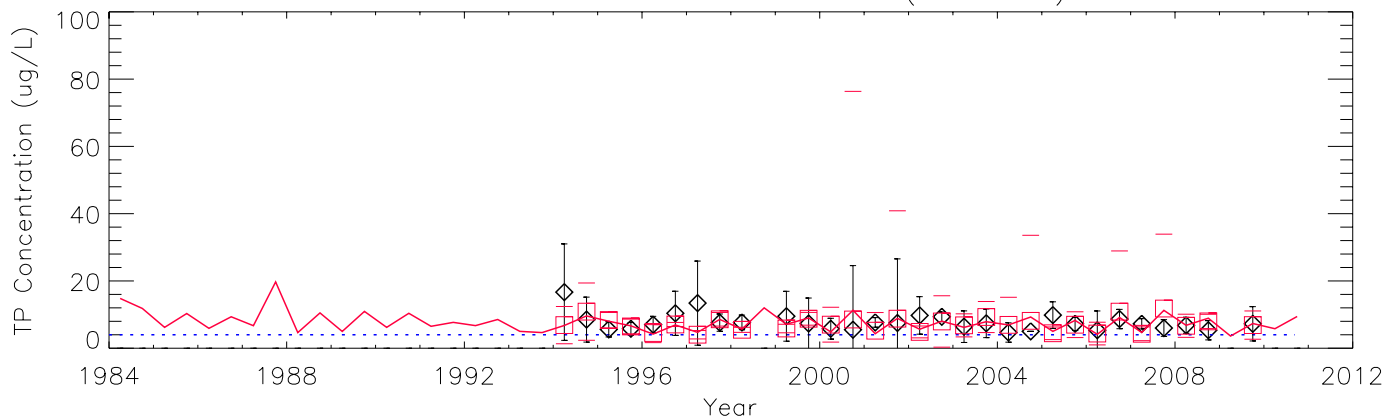
Cumulative Distribution: Raw Data – E4 (214_186)



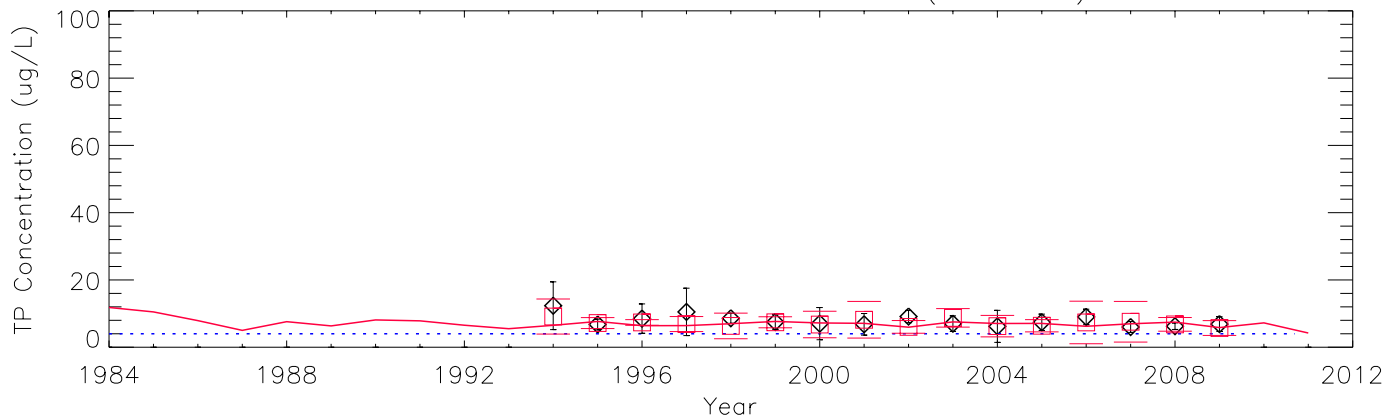
Raw Data (Obs. N = 122) – E5 (213_220)



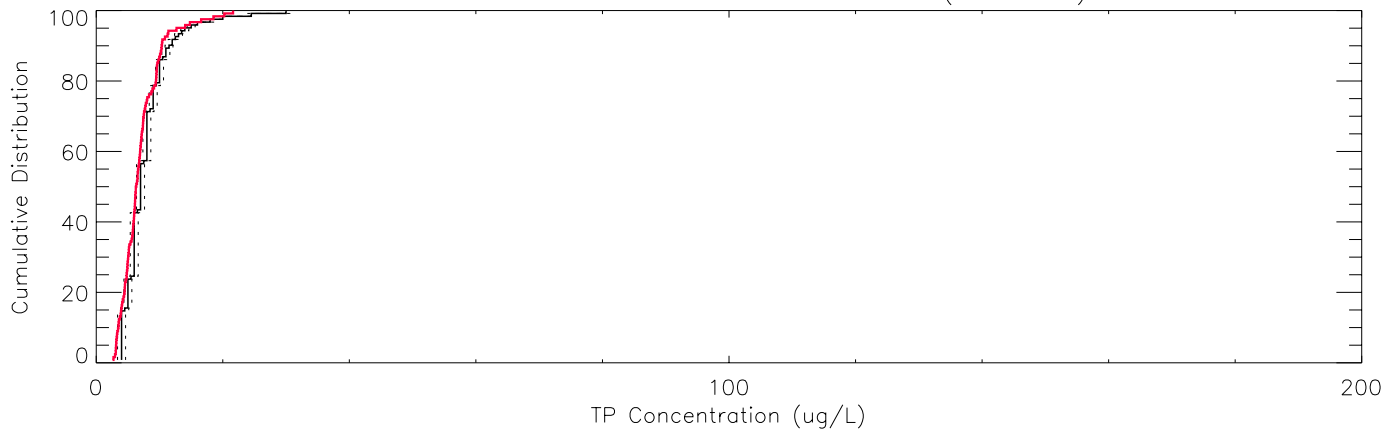
Mean: Season – 95% CI – E5 (213_220)



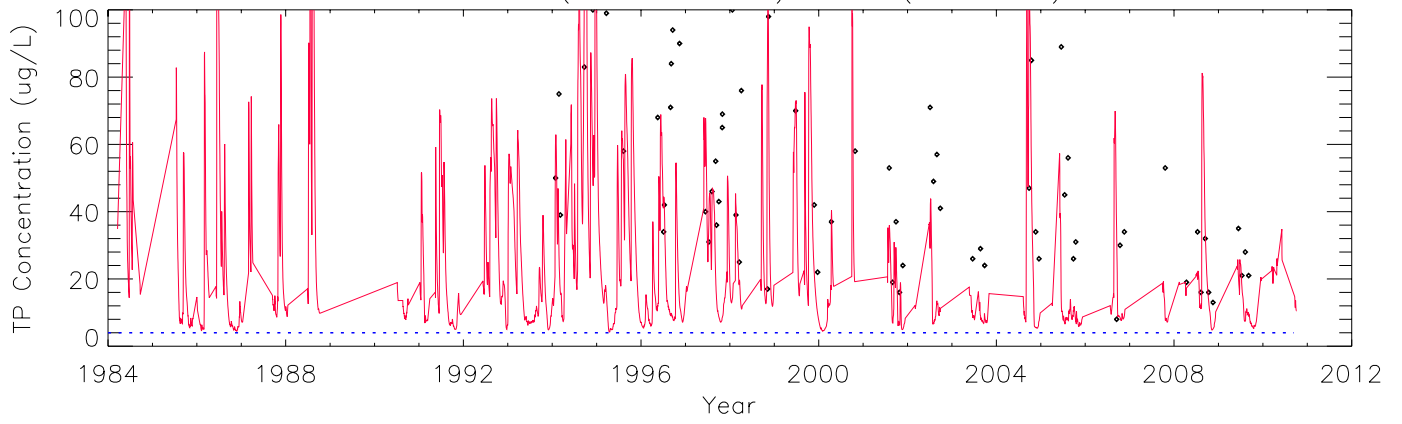
Mean: Water Year – 95% CI – E5 (213_220)



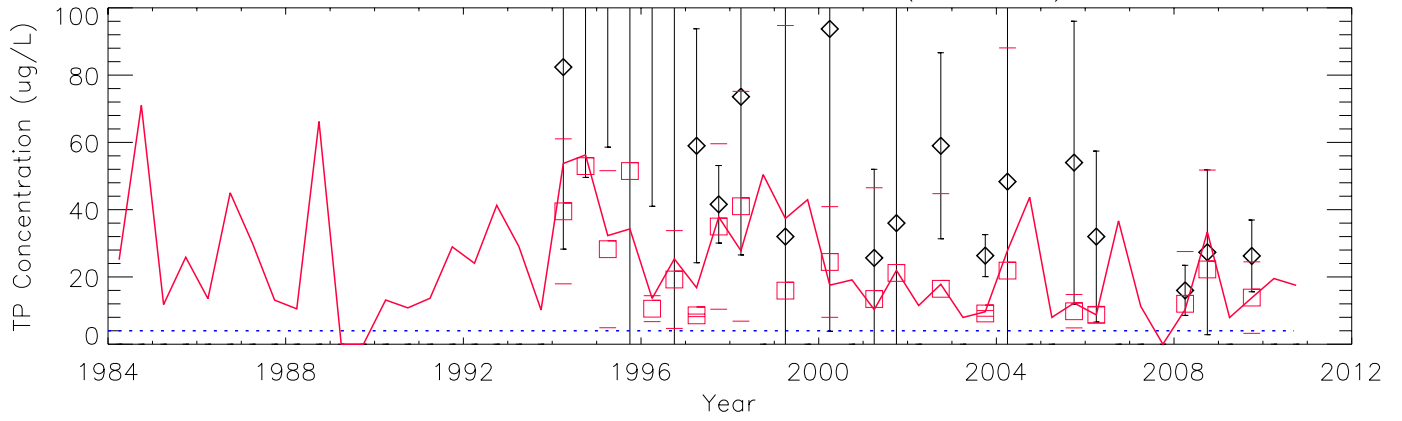
Cumulative Distribution: Raw Data – E5 (213_220)



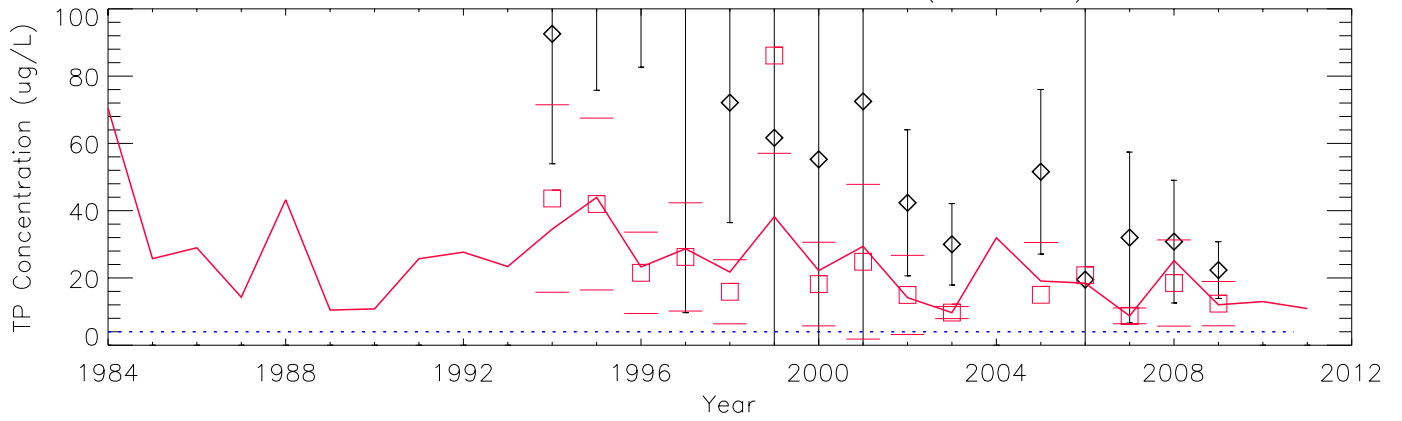
Raw Data (Obs. N = 84) – F1 (200_130)



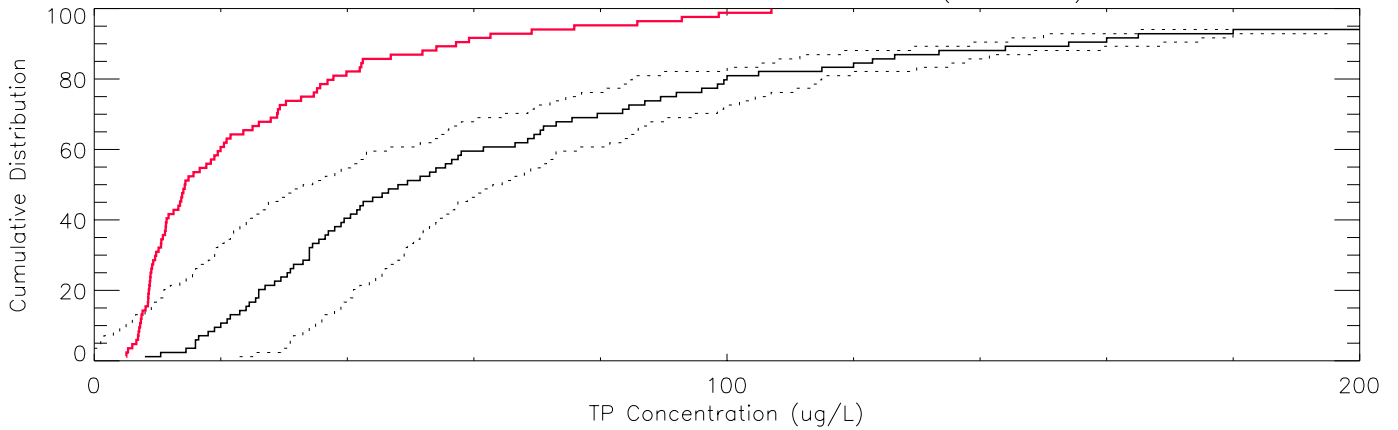
Mean: Season – 95% CI – F1 (200_130)



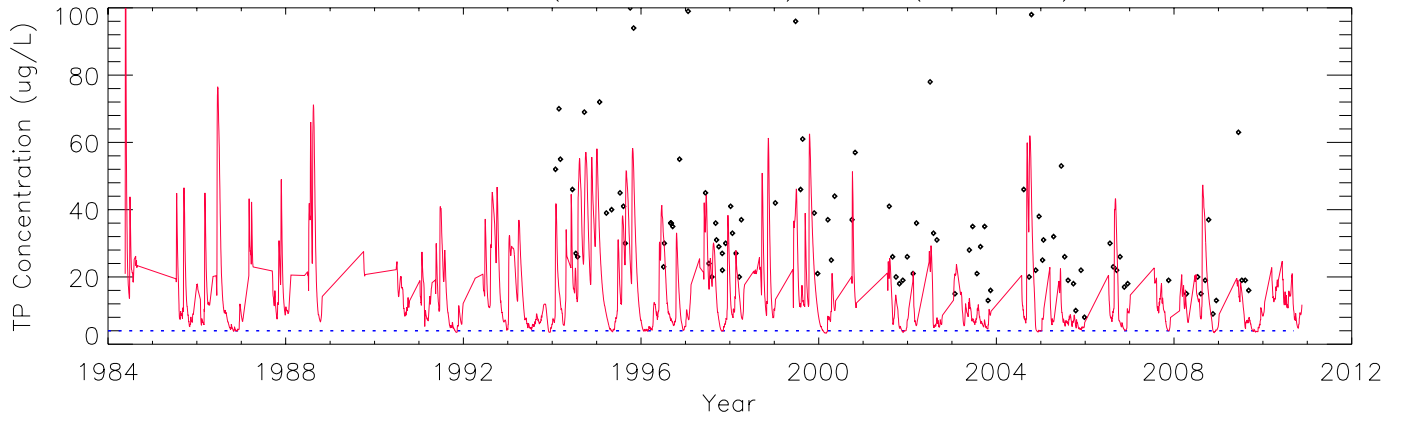
Mean: Water Year – 95% CI – F1 (200_130)



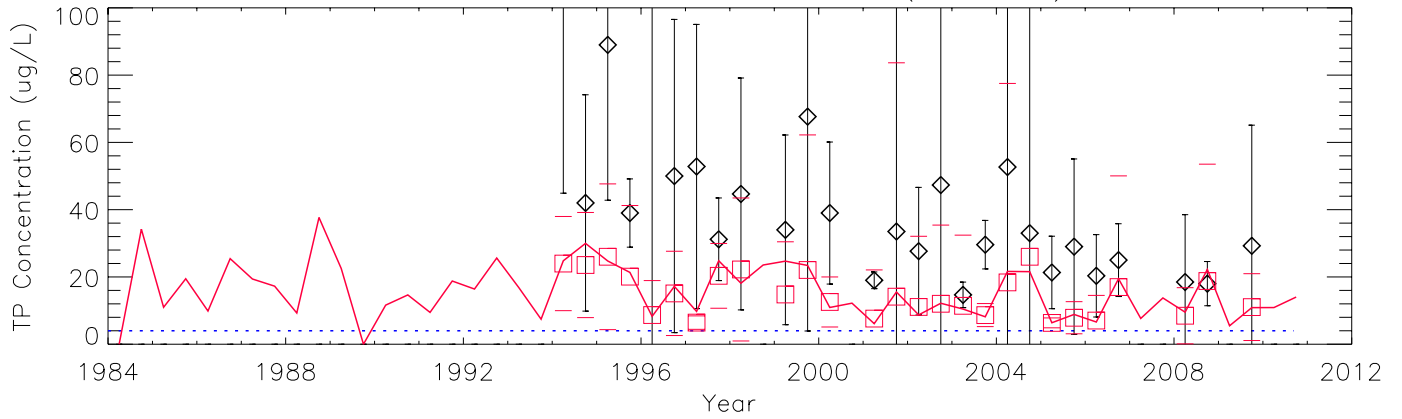
Cumulative Distribution: Raw Data – F1 (200_130)



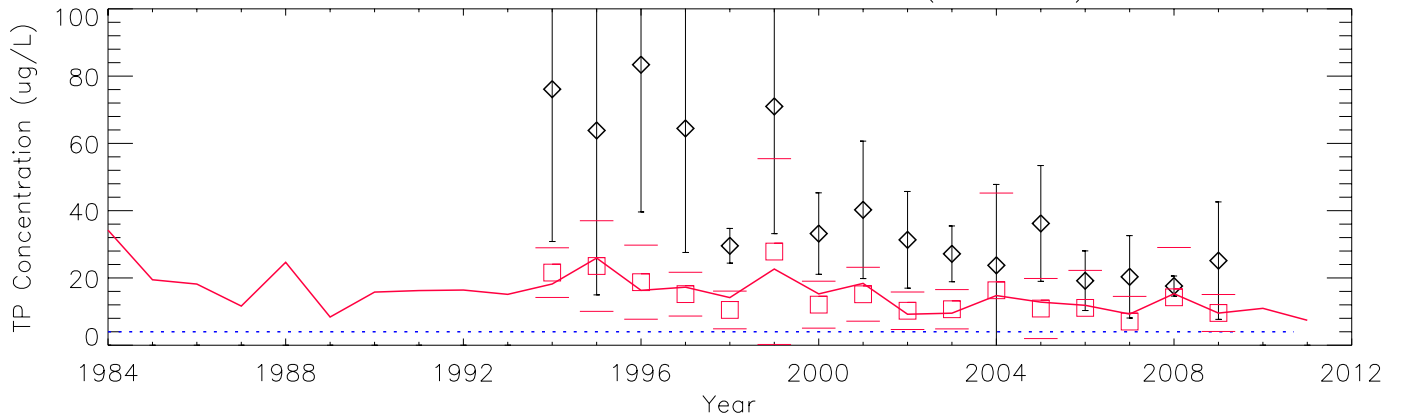
Raw Data (Obs. N = 108) – F2 (194_149)



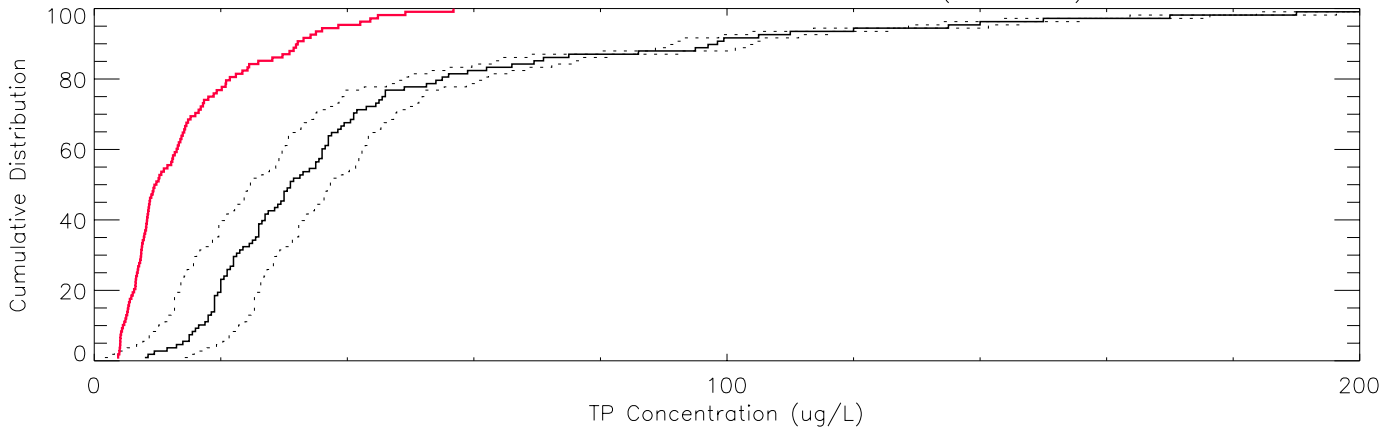
Mean: Season – 95% CI – F2 (194_149)



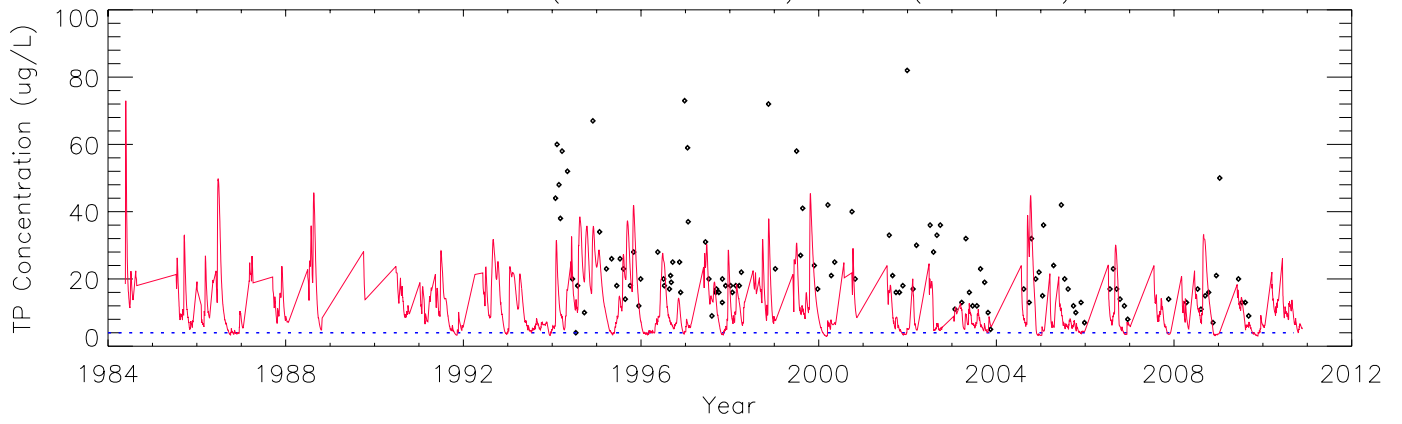
Mean: Water Year – 95% CI – F2 (194_149)



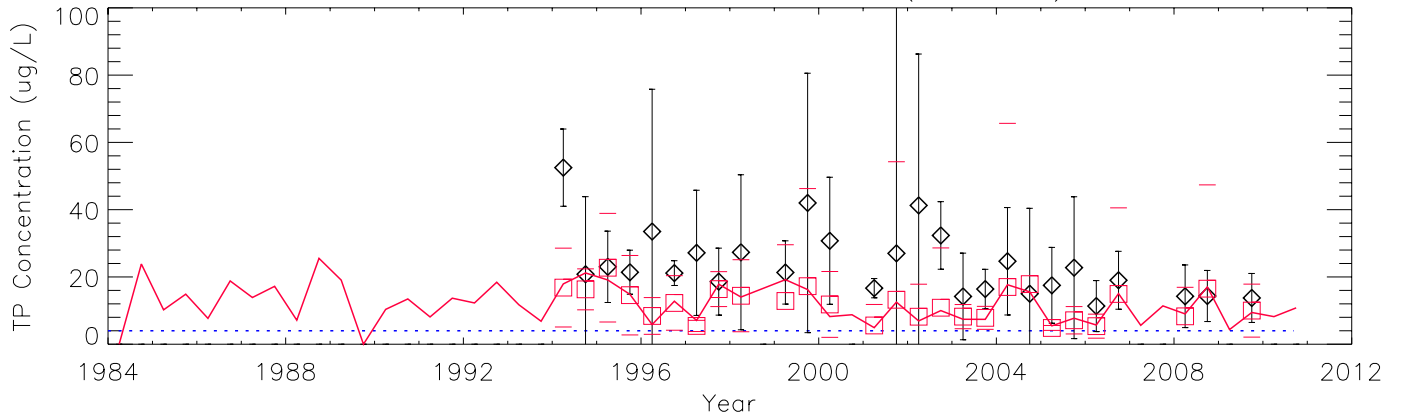
Cumulative Distribution: Raw Data – F2 (194_149)



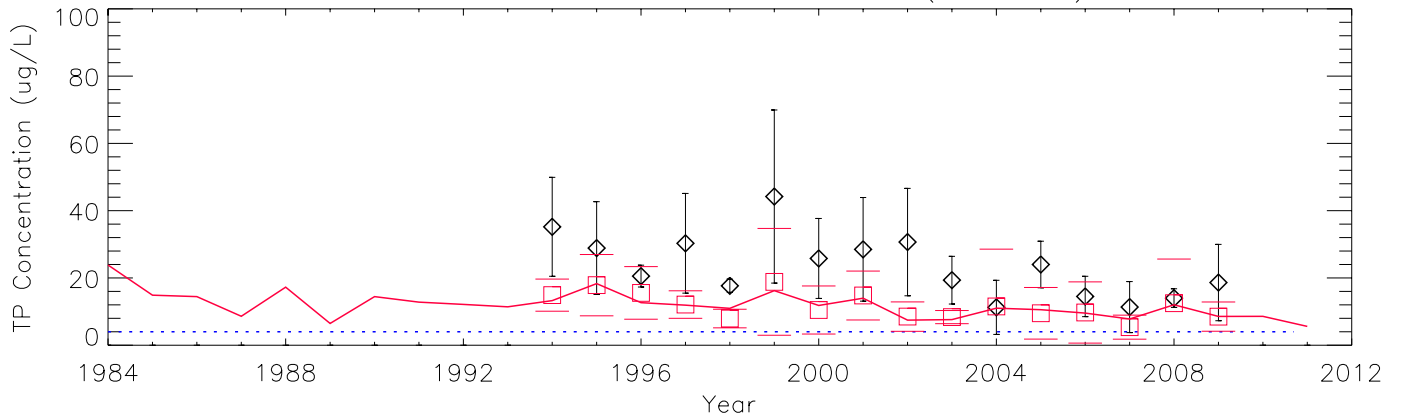
Raw Data (Obs. N = 116) – F3 (183_163)



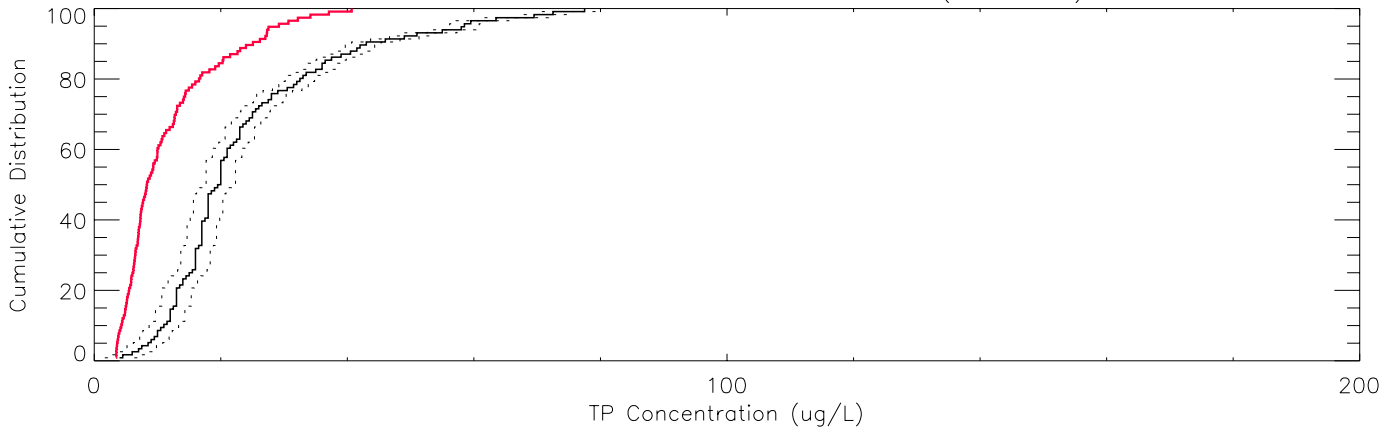
Mean: Season – 95% CI – F3 (183_163)



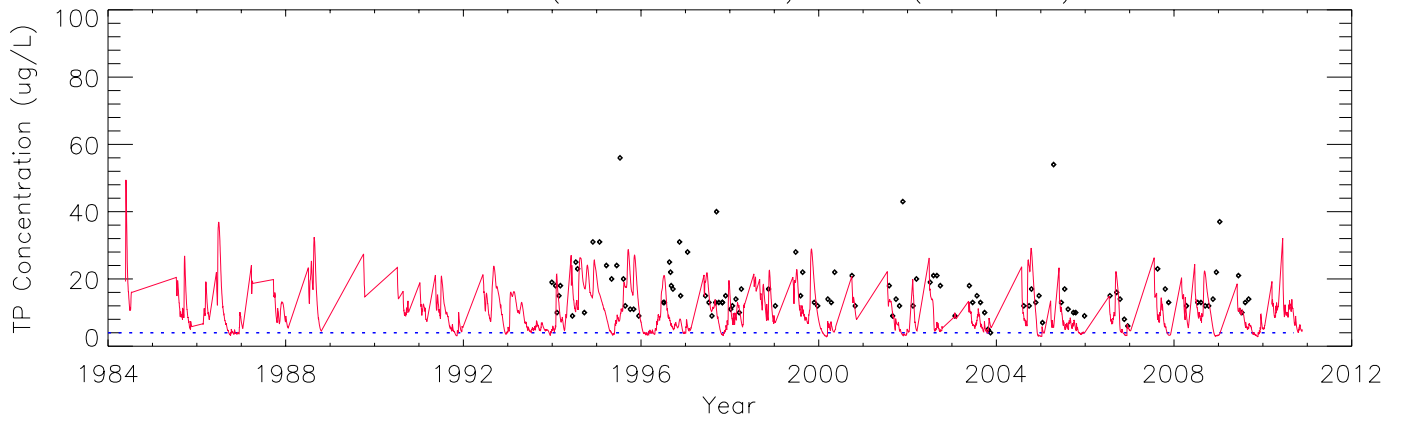
Mean: Water Year – 95% CI – F3 (183_163)



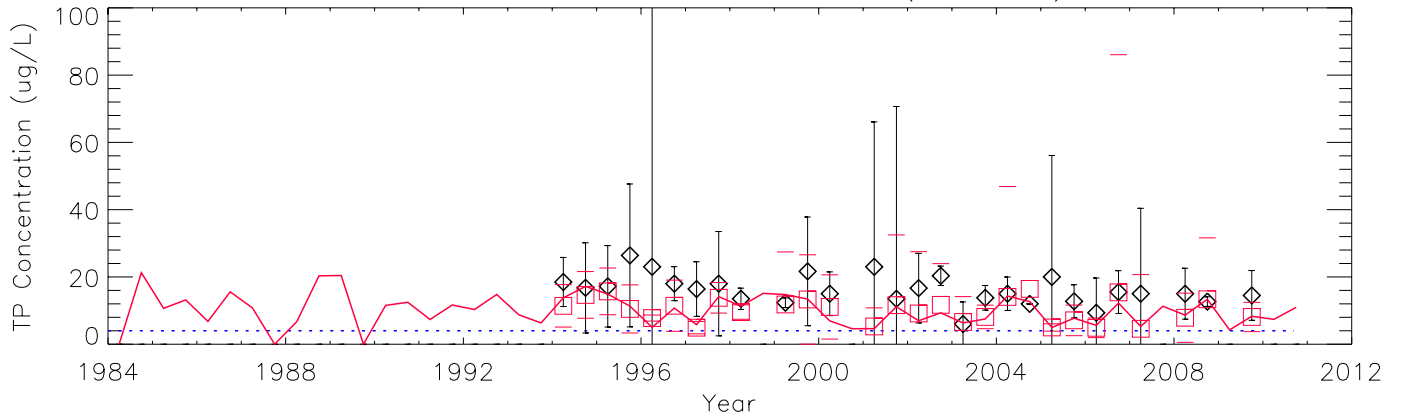
Cumulative Distribution: Raw Data – F3 (183_163)



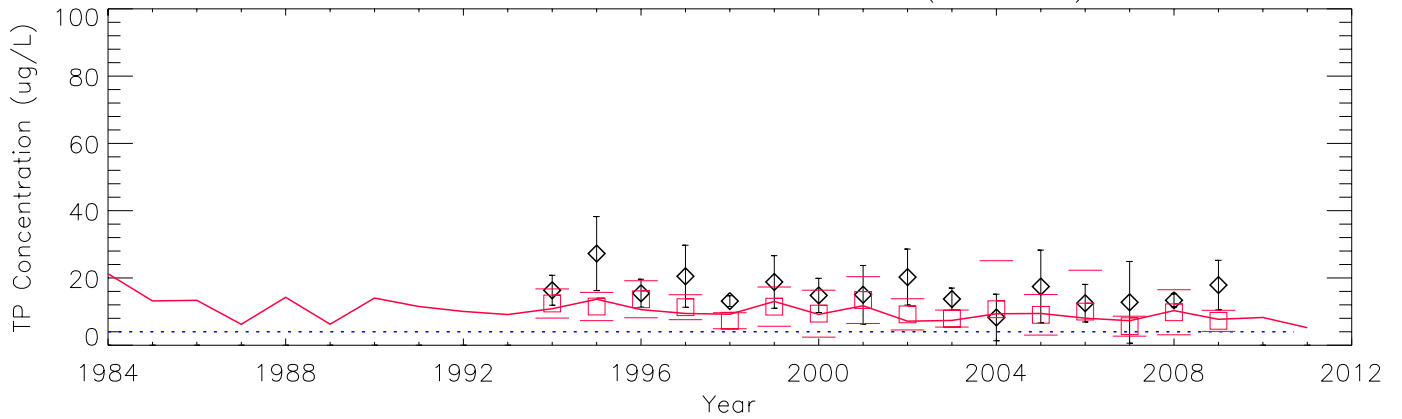
Raw Data (Obs. N = 107) – F4 (186_177)



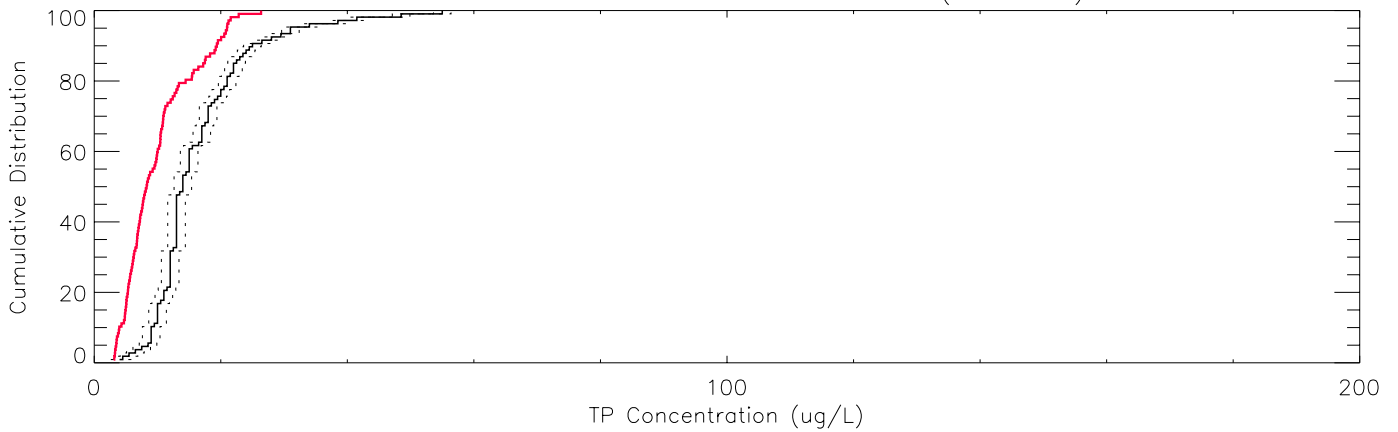
Mean: Season – 95% CI – F4 (186_177)



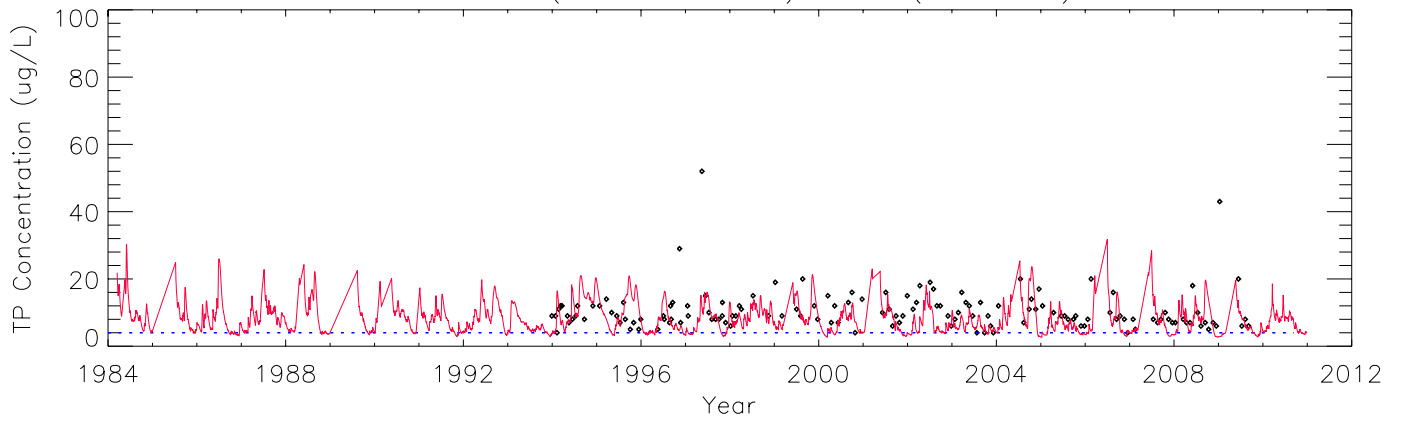
Mean: Water Year – 95% CI – F4 (186_177)



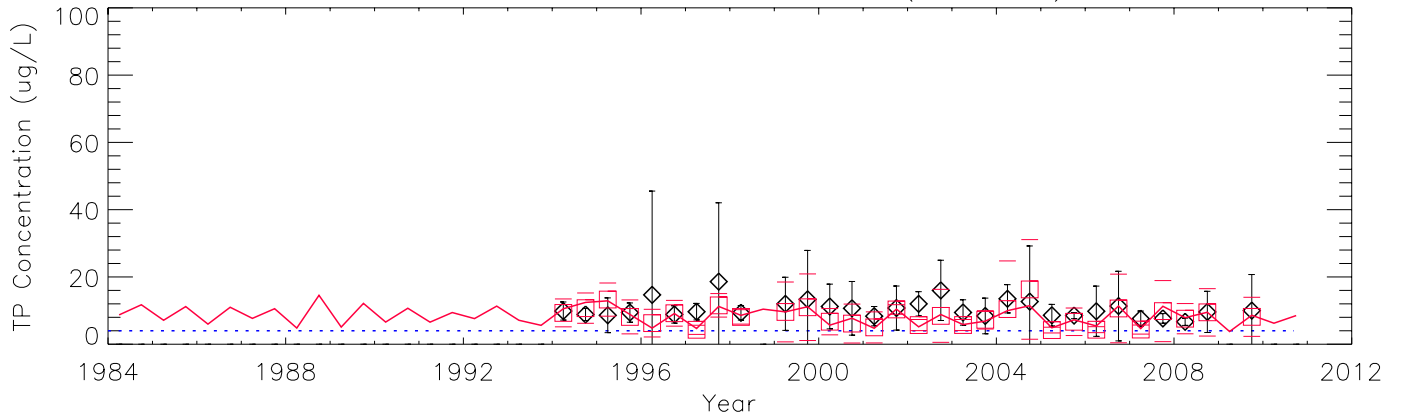
Cumulative Distribution: Raw Data – F4 (186_177)



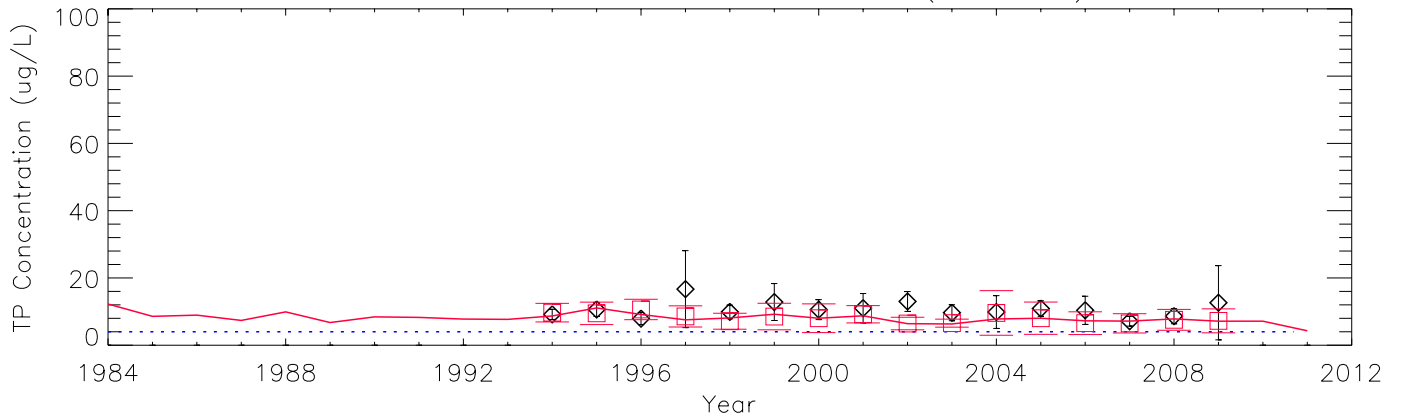
Raw Data (Obs. N = 143) – F5 (172_186)



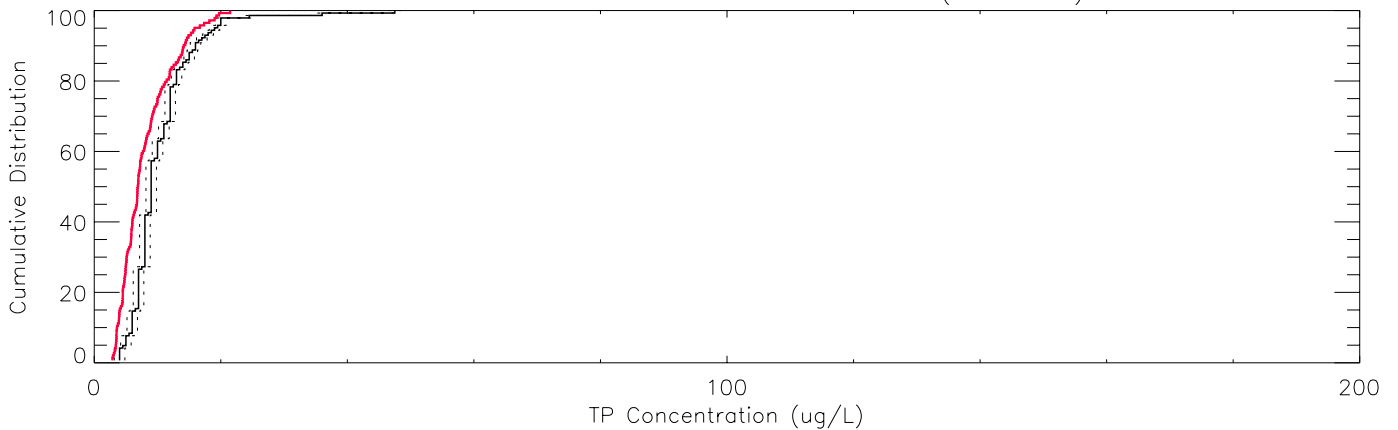
Mean: Season – 95% CI – F5 (172_186)



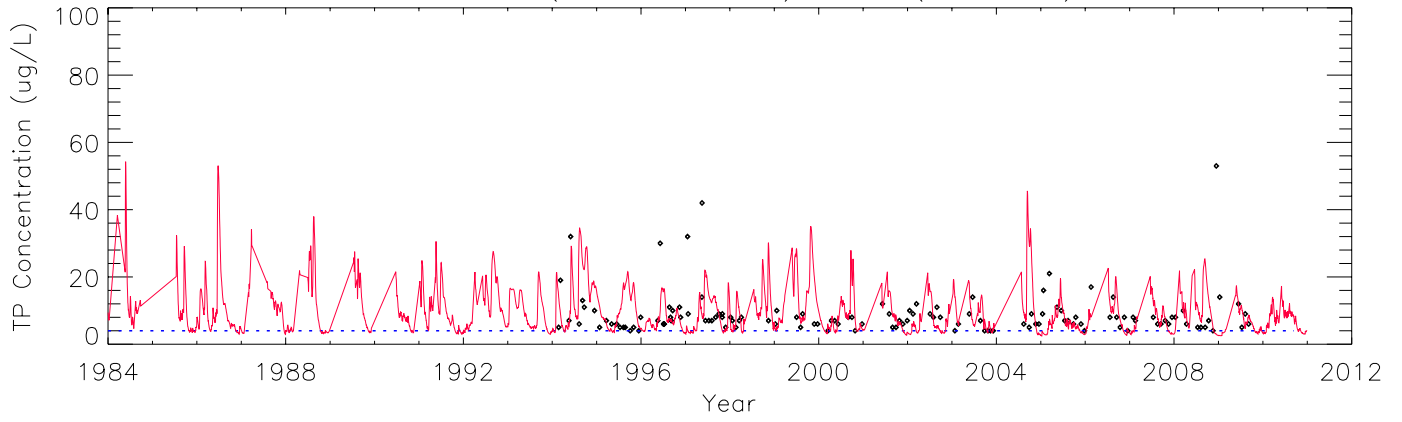
Mean: Water Year – 95% CI – F5 (172_186)



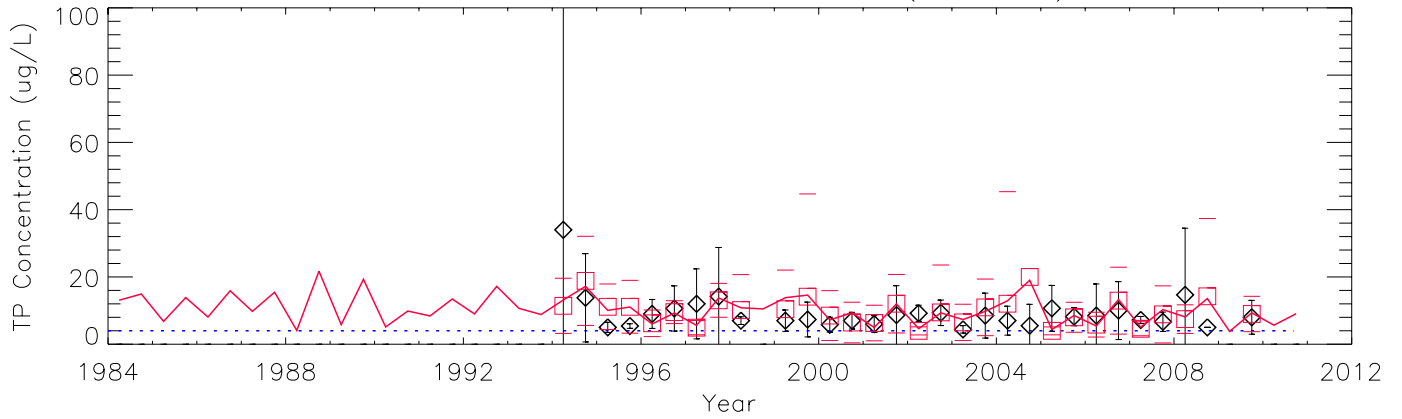
Cumulative Distribution: Raw Data – F5 (172_186)



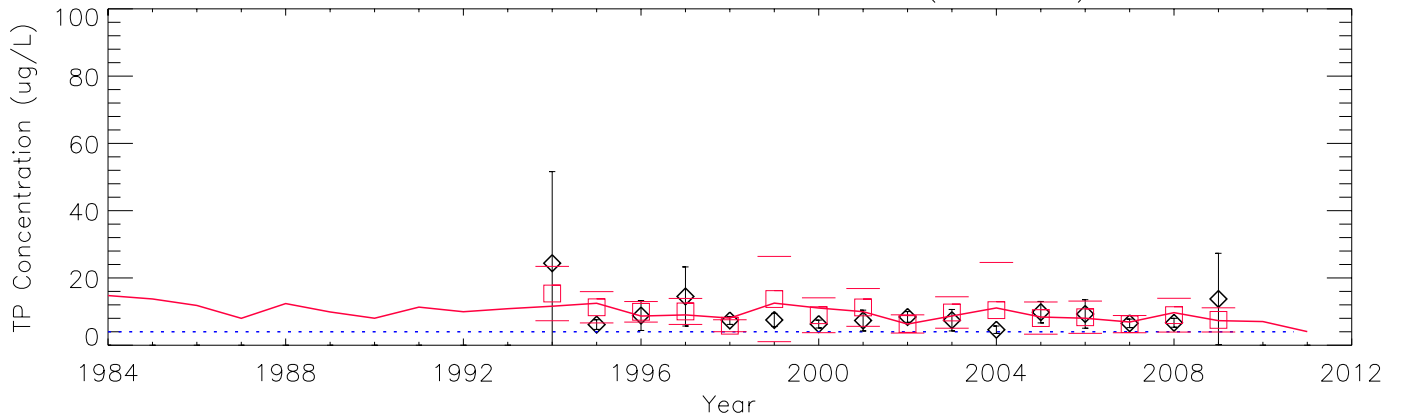
Raw Data (Obs. N = 131) – U1 (215_261)



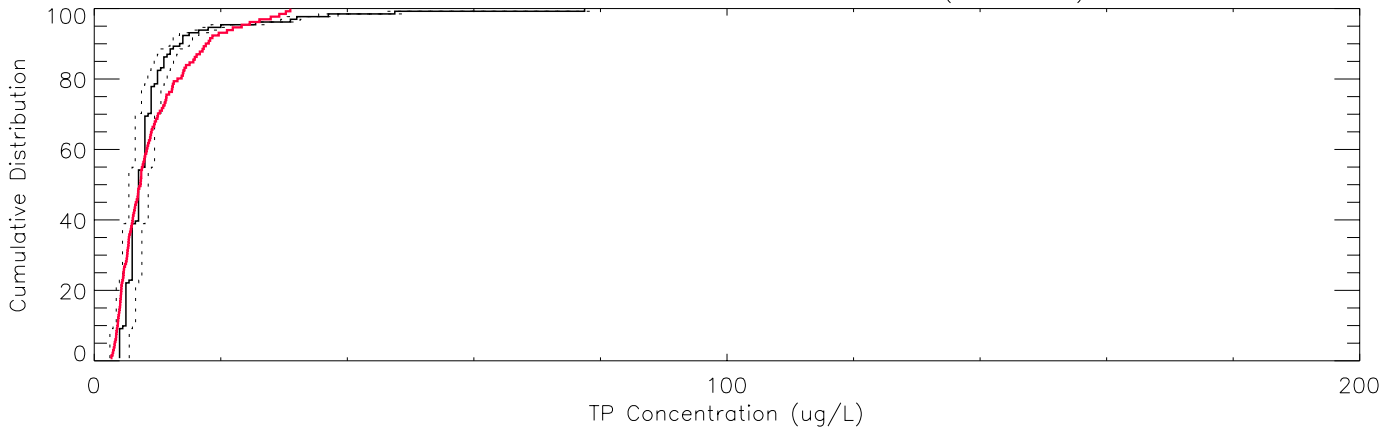
Mean: Season – 95% CI – U1 (215_261)



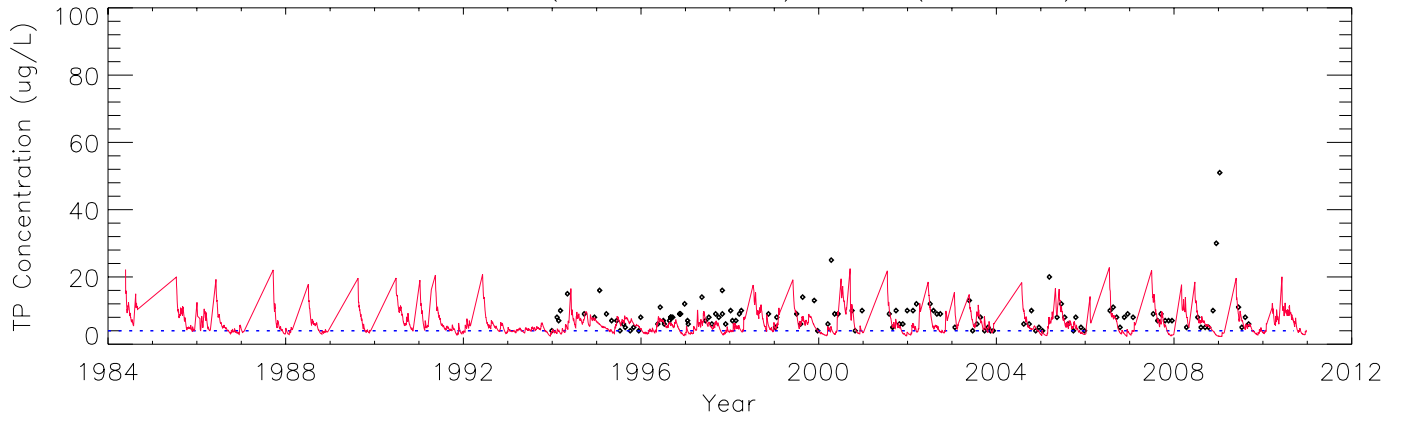
Mean: Water Year – 95% CI – U1 (215_261)



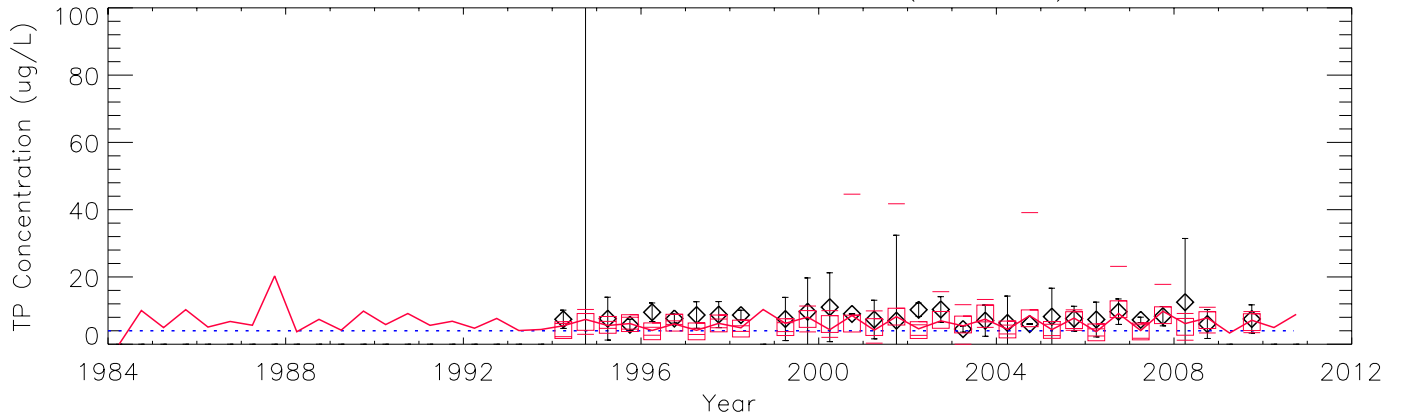
Cumulative Distribution: Raw Data – U1 (215_261)



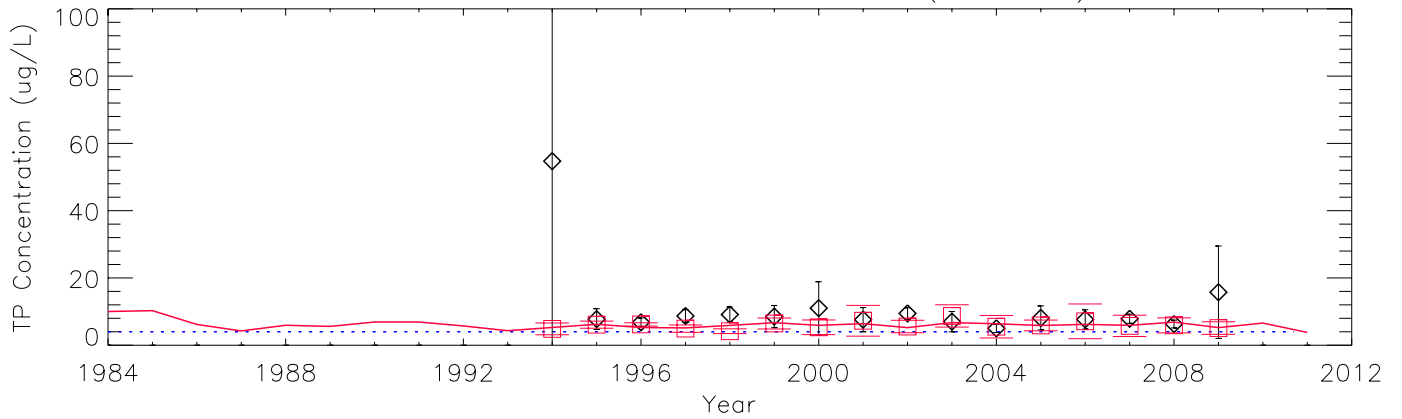
Raw Data (Obs. N = 122) – U2 (187_237)



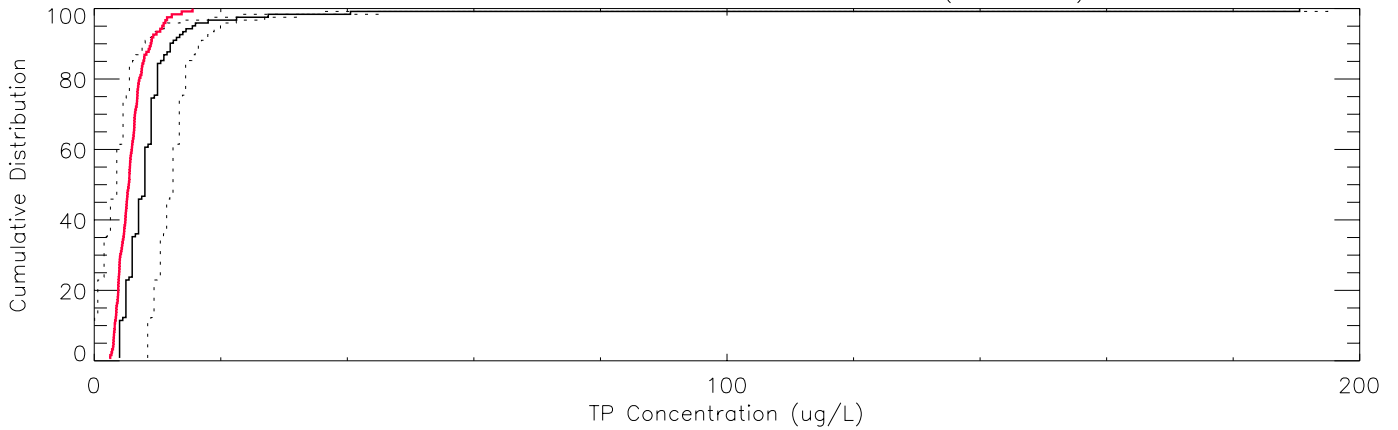
Mean: Season – 95% CI – U2 (187_237)



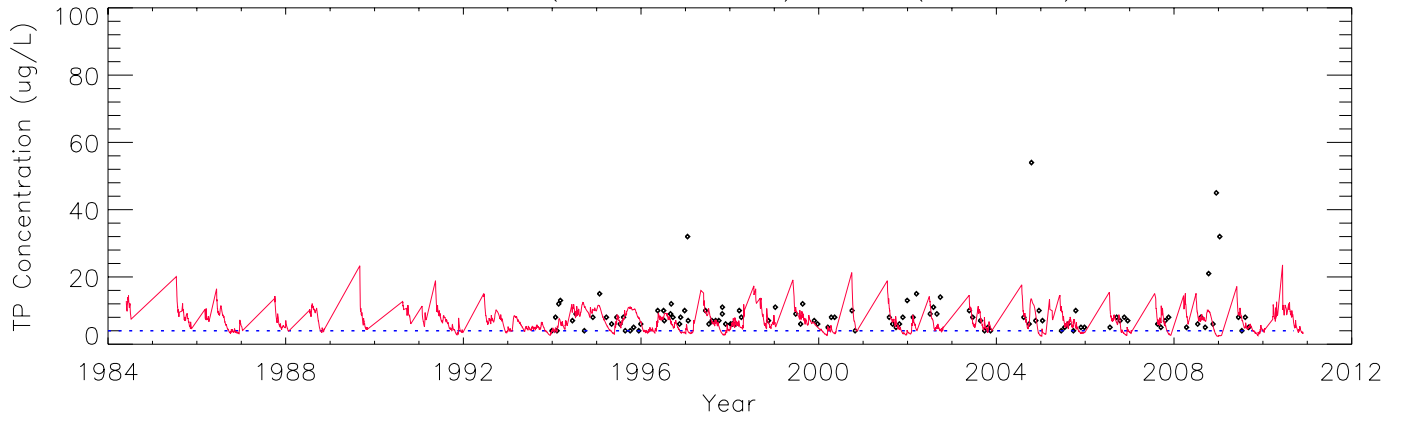
Mean: Water Year – 95% CI – U2 (187_237)



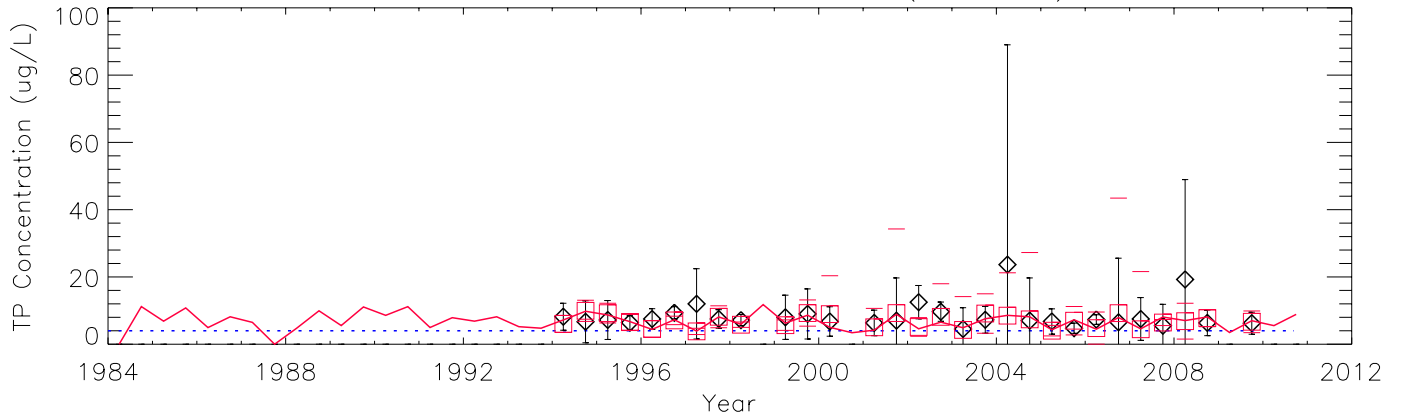
Cumulative Distribution: Raw Data – U2 (187_237)



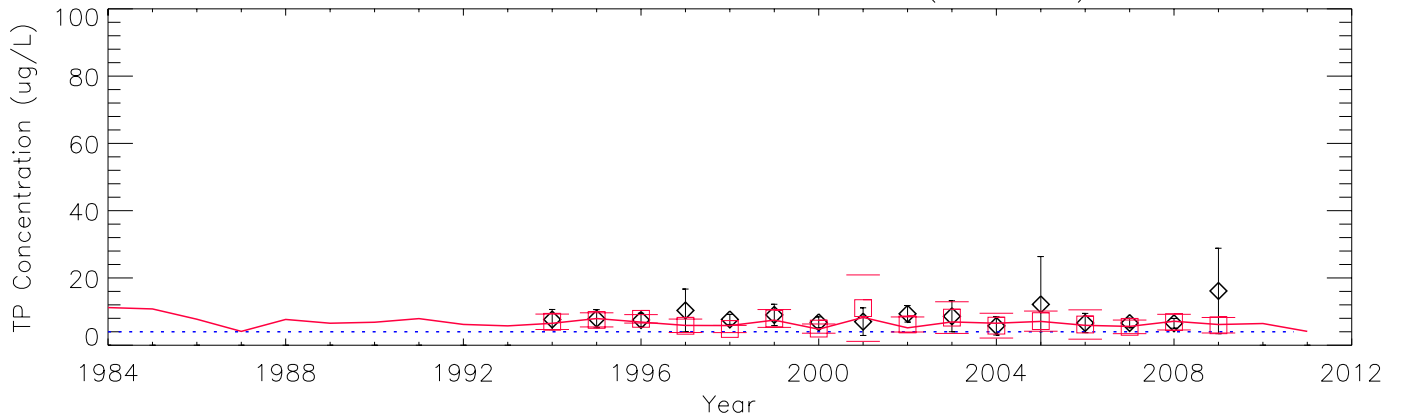
Raw Data (Obs. N = 108) – U3 (160_210)



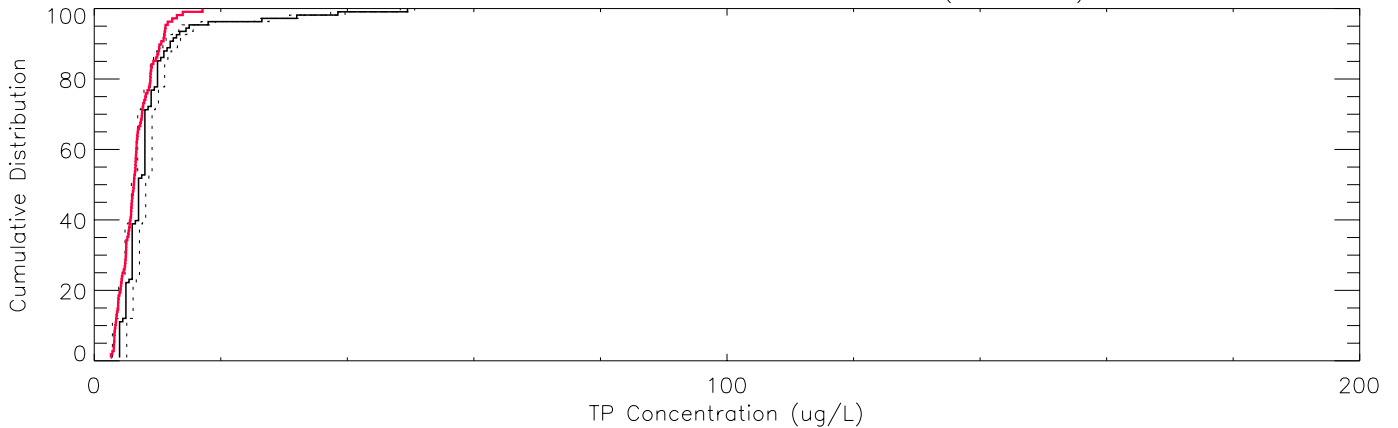
Mean: Season – 95% CI – U3 (160_210)

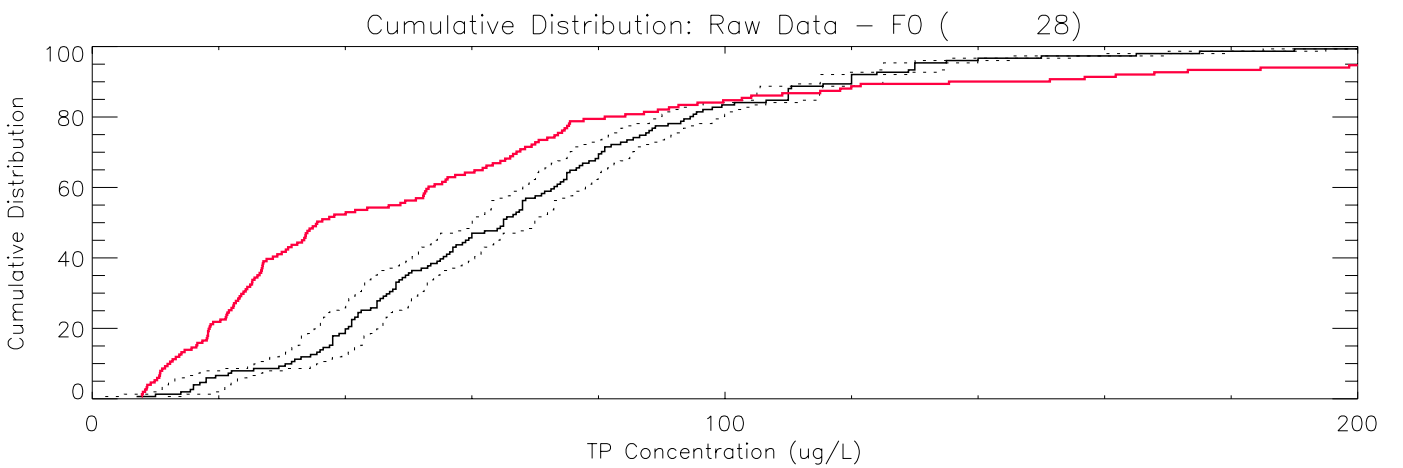
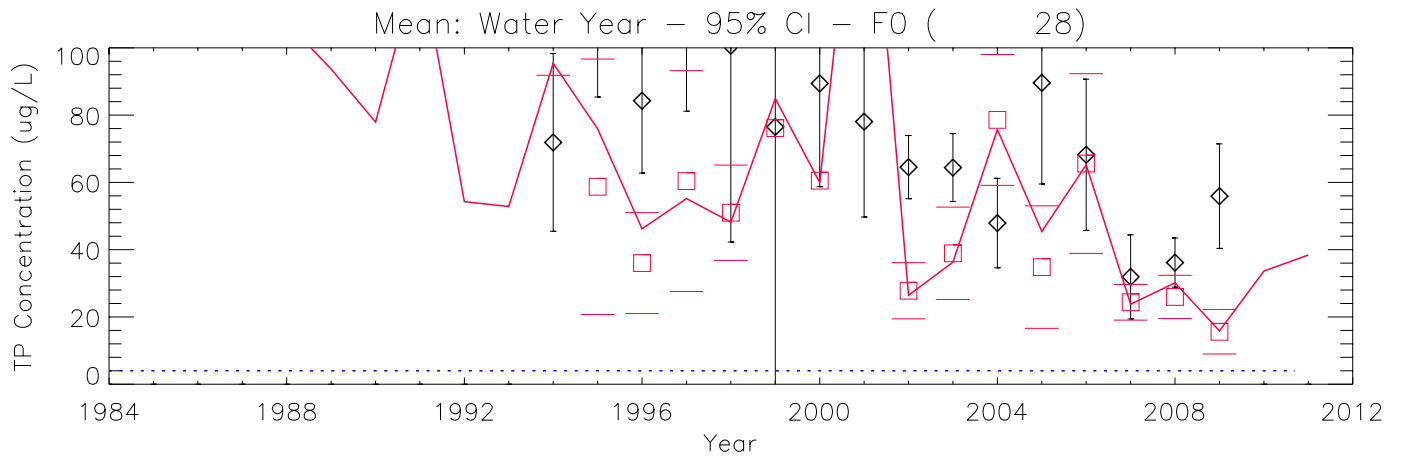
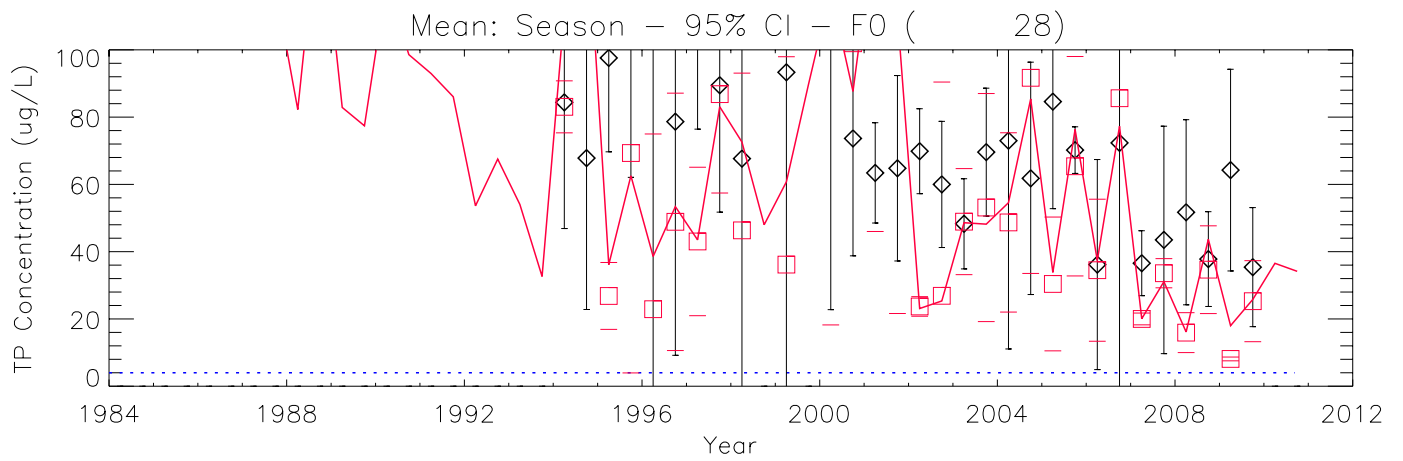
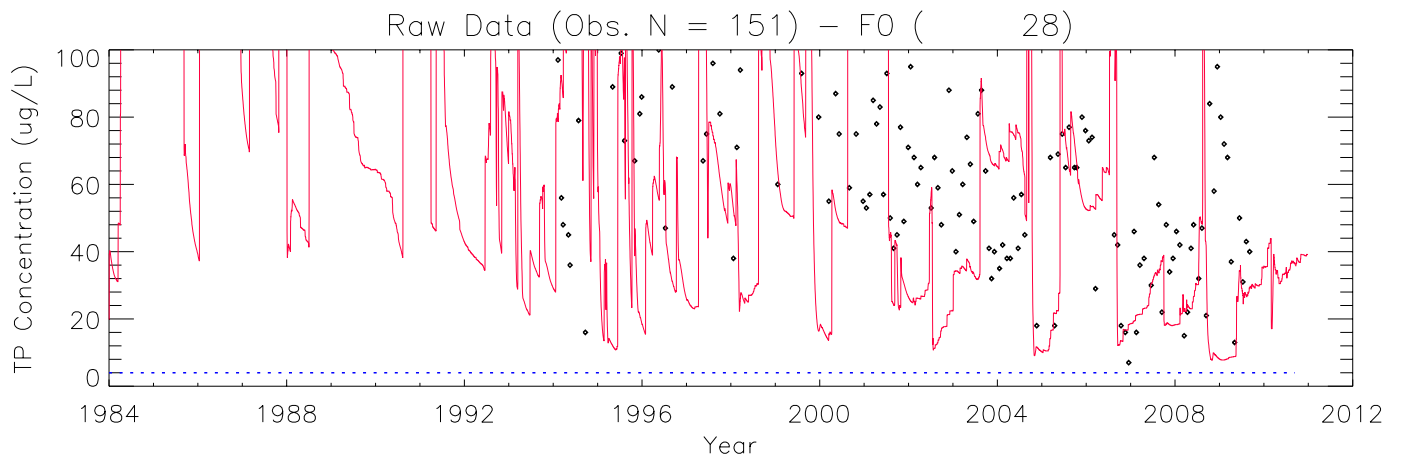


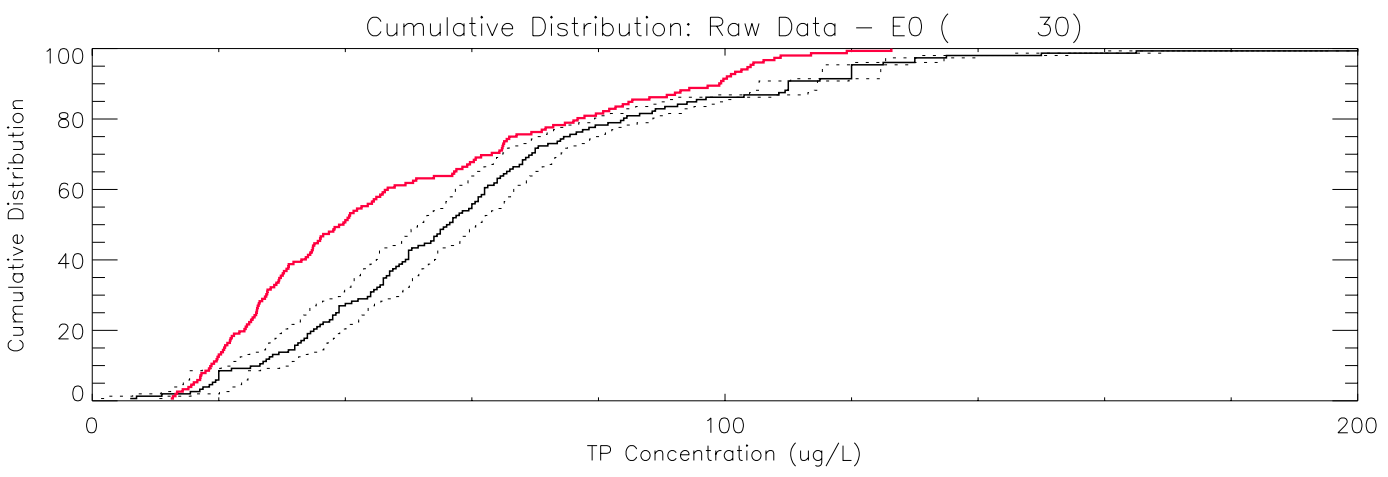
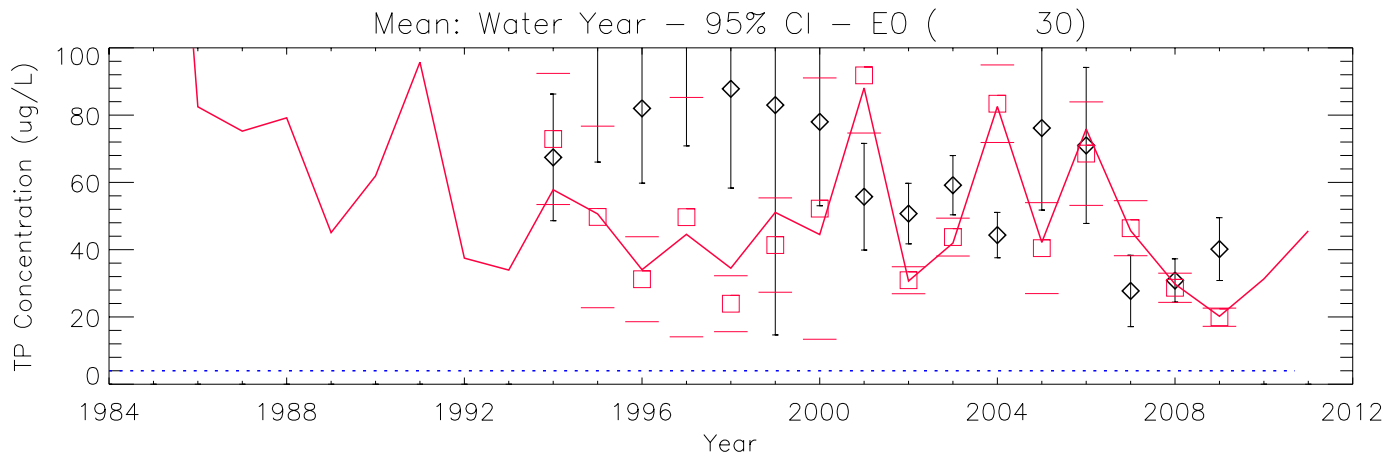
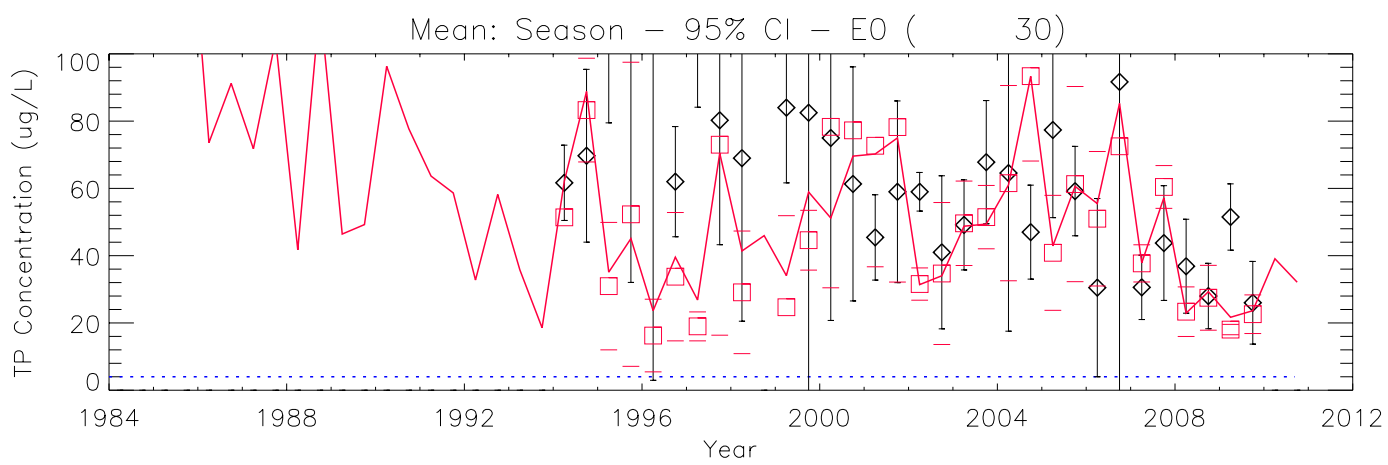
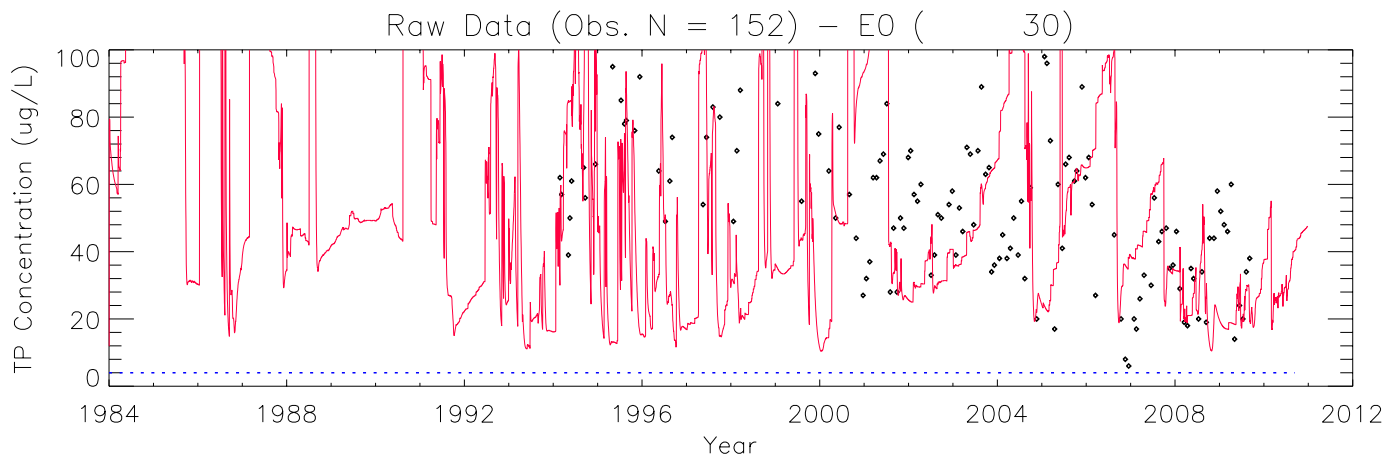
Mean: Water Year – 95% CI – U3 (160_210)



Cumulative Distribution: Raw Data – U3 (160_210)







Appendix D. Logger chloride model vs. observed time series (38 sites-pages). Plots of surface water chloride (Cl) concentration and their associated Cumulative Frequency Distributions (CFD) for the period of record 8/1/2020-12/31/2022 at each monitoring location.

The model grid cell column and row locations (col_row) or canal reach identifier (single integer) are shown in parentheses of each plot's title.

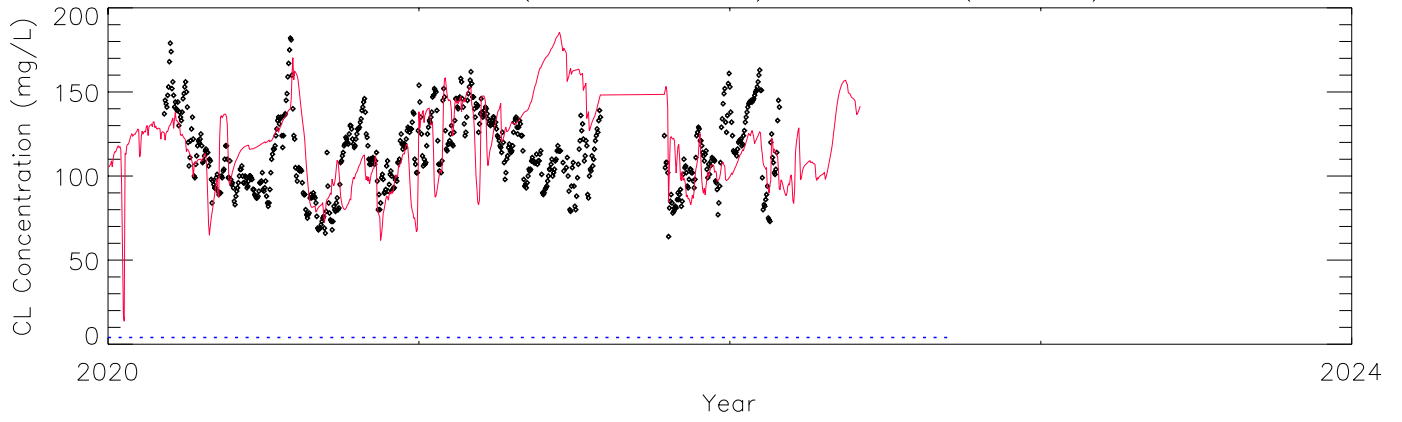
- a) All data, with no temporal aggregation, of daily observations (black dots) and model results (red line).

- b) All data were aggregated into arithmetic mean values by wet and dry seasons within water years; the continuous lines pass through mean of all daily data points for each season; the mean of paired simulated & observed values are shown in red boxes and black diamonds, respectively; the 95% Confidence Interval (CI) of the paired means are shown by the "___" symbols in the red for the model and black for the observed data.

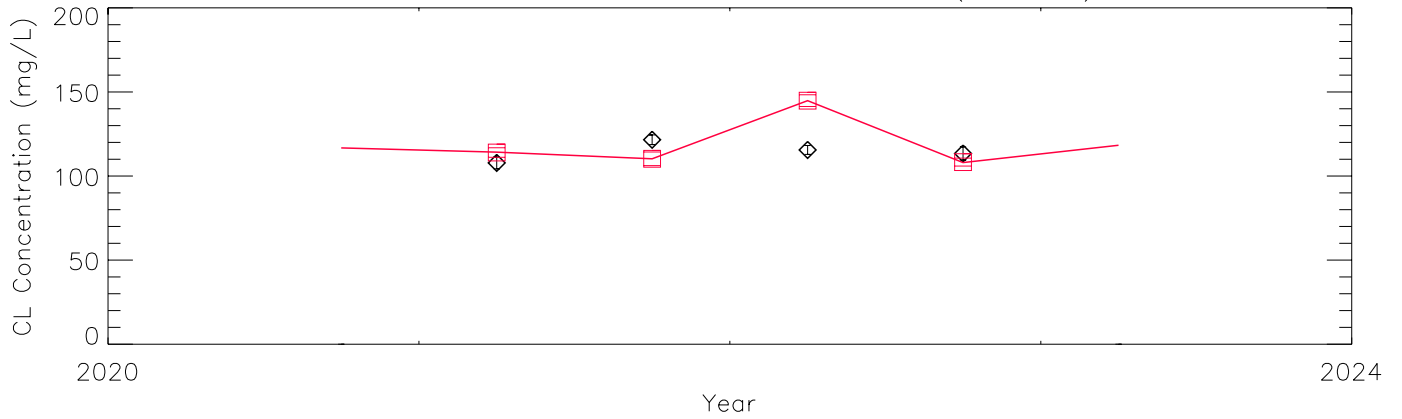
- c) All data aggregated into arithmetic mean values by water year, with the same treatment as in plot b).

- d) The cumulative frequency distributions of the simulated and observed (raw, un-aggregated) data; the 95% confidence interval for observed data is shown in the dashed black lines. Note that only paired simulated and observed data points are used.

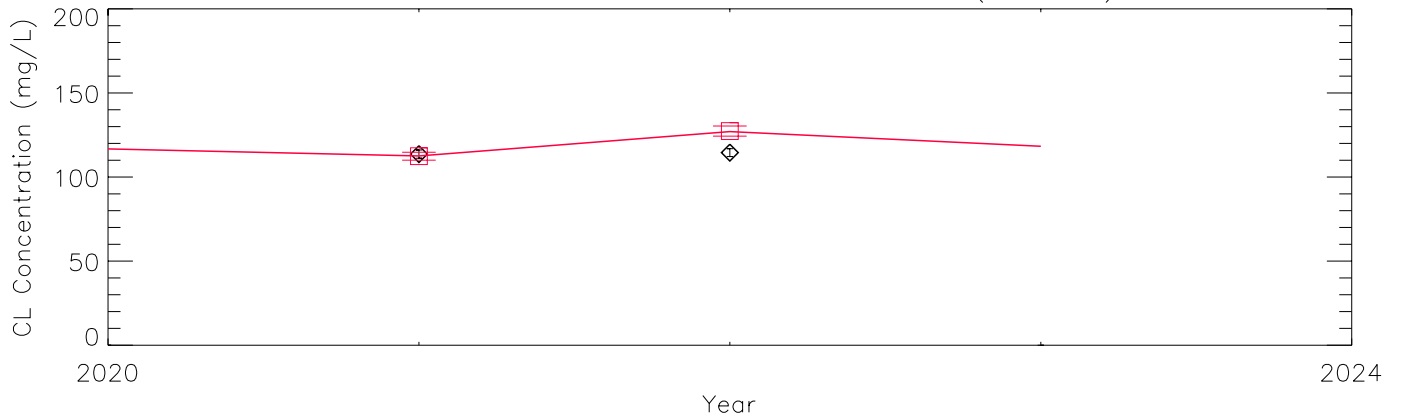
Raw Data (Obs. N = 645) – marsh1 (46_148)



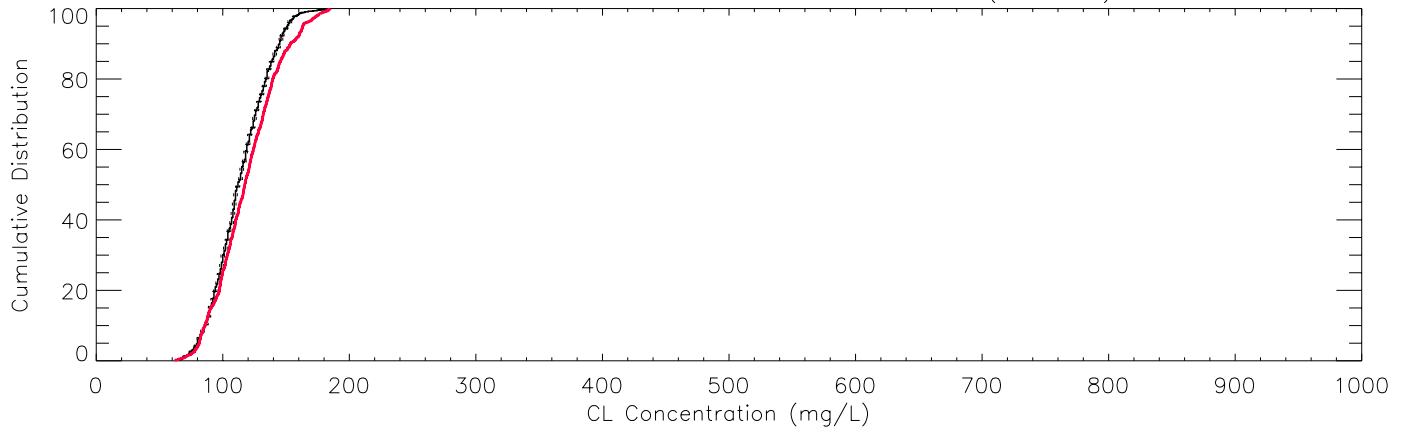
Mean: Season – 95% CI – marsh1 (46_148)

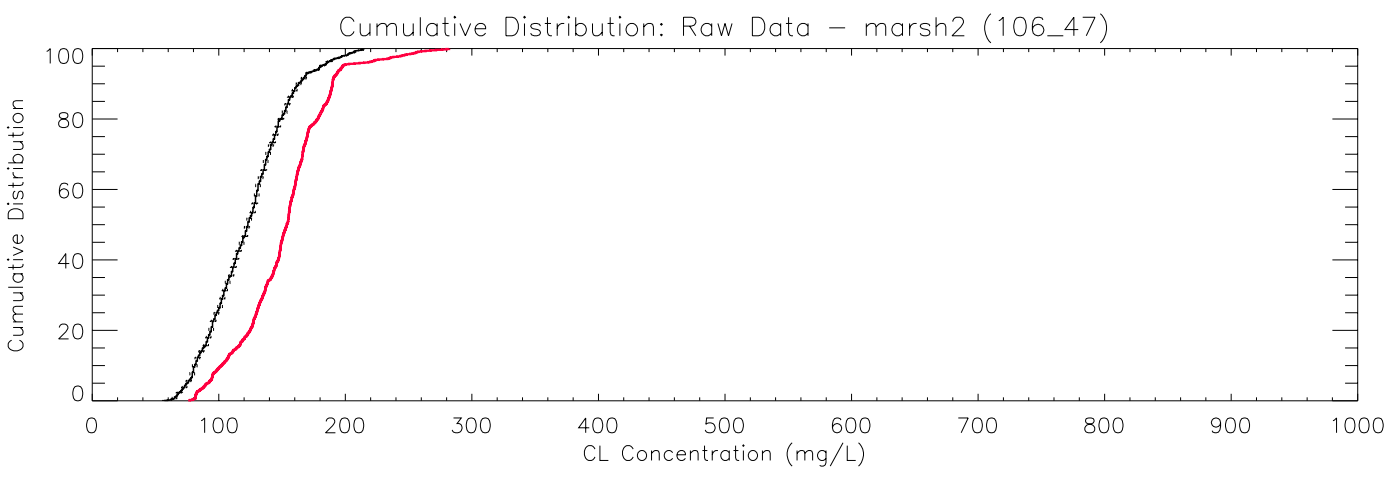
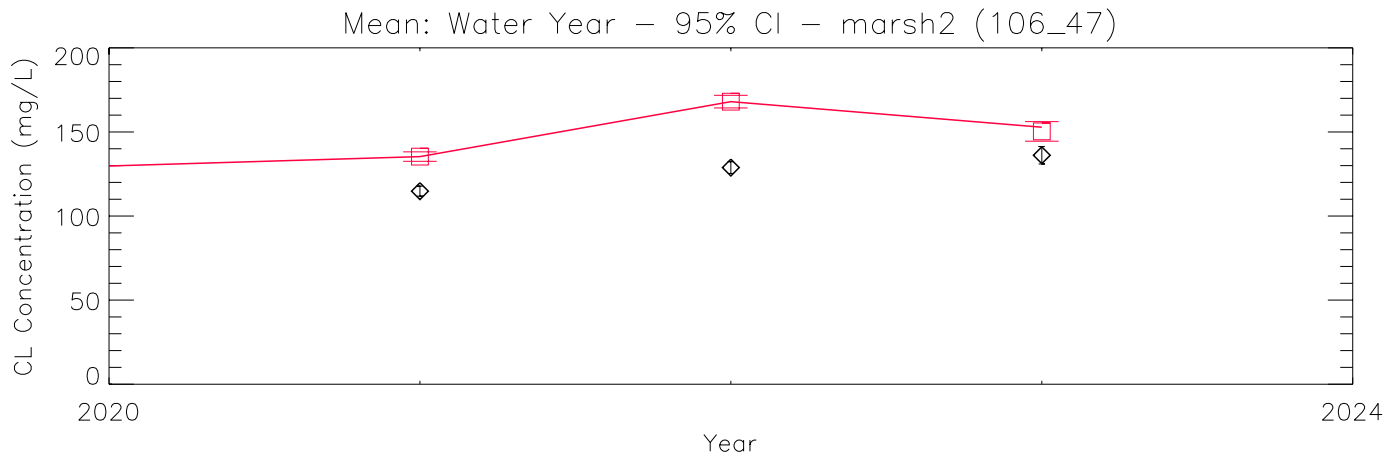
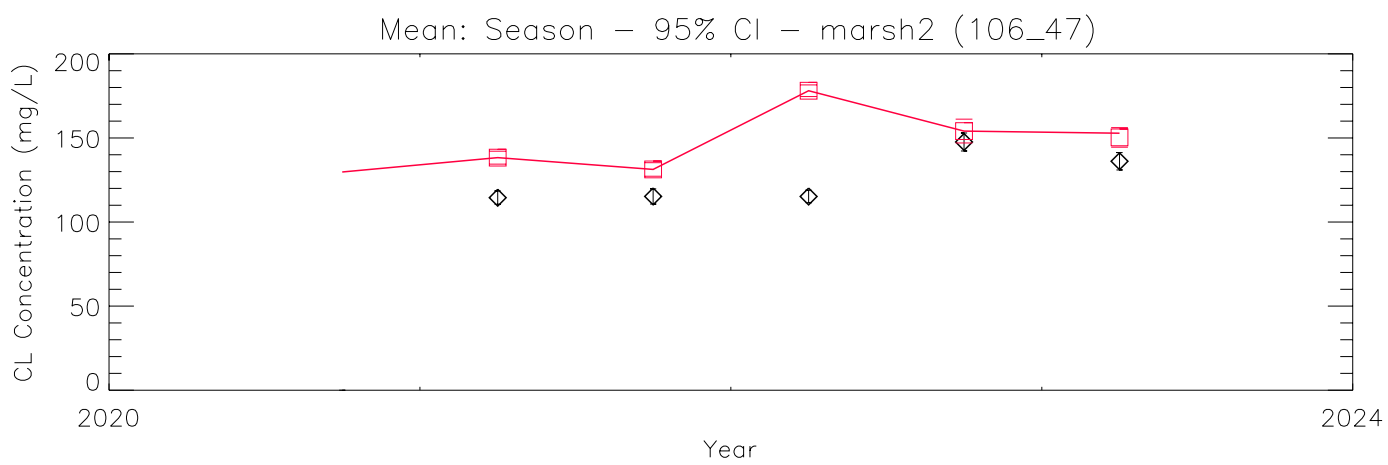
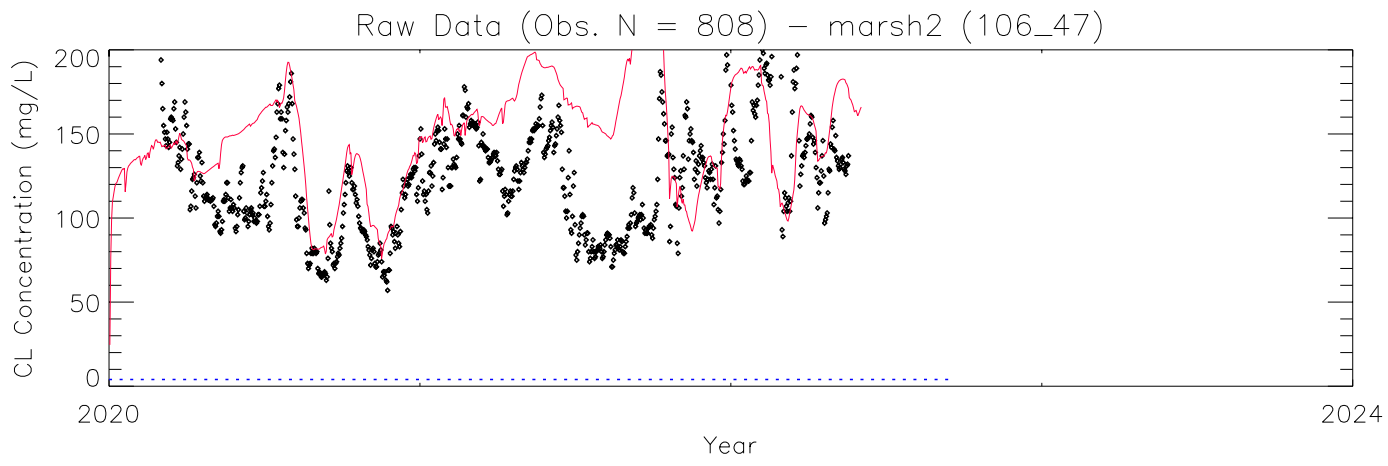


Mean: Water Year – 95% CI – marsh1 (46_148)

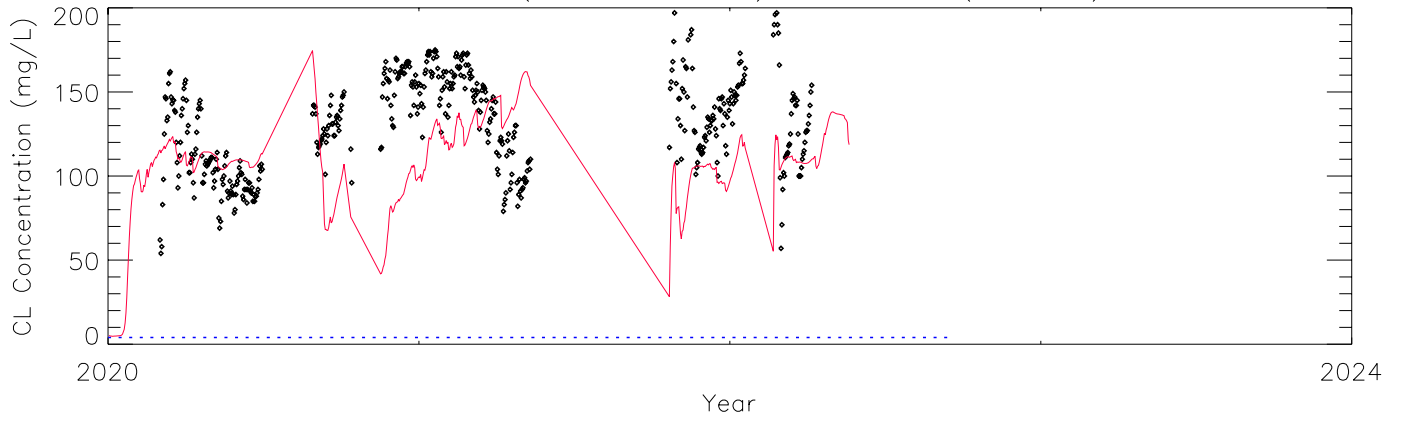


Cumulative Distribution: Raw Data – marsh1 (46_148)

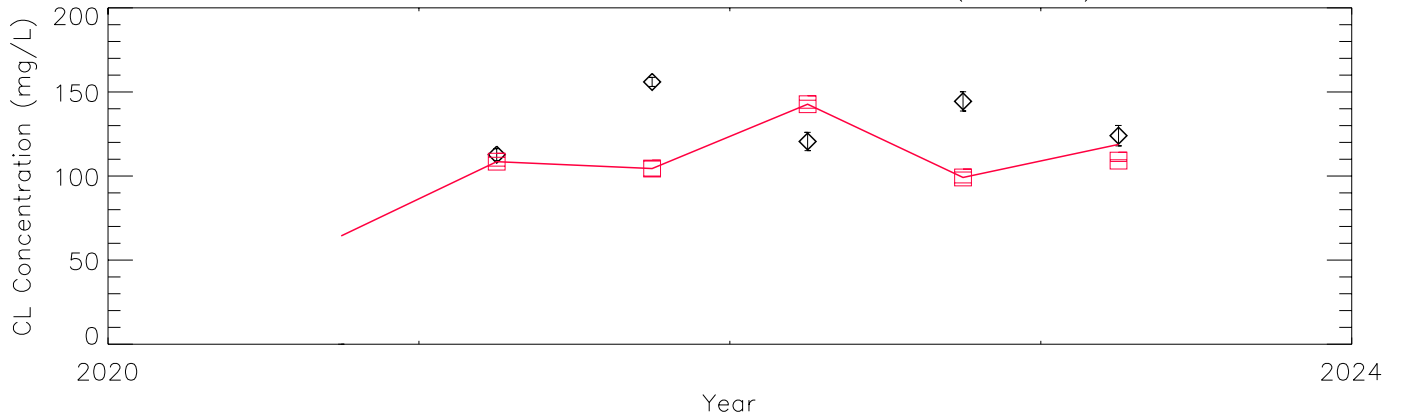




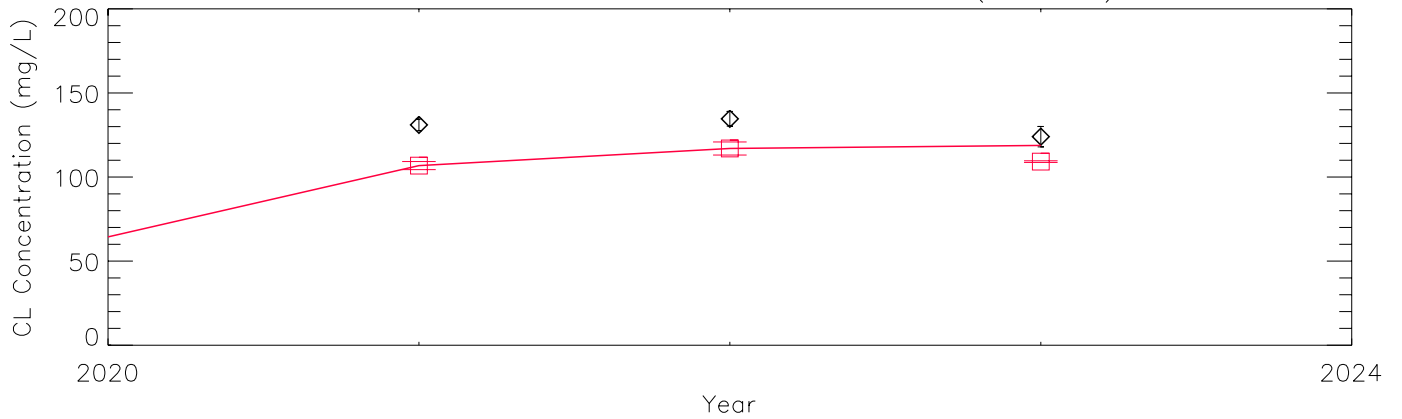
Raw Data (Obs. N = 474) – marsh3 (156_58)



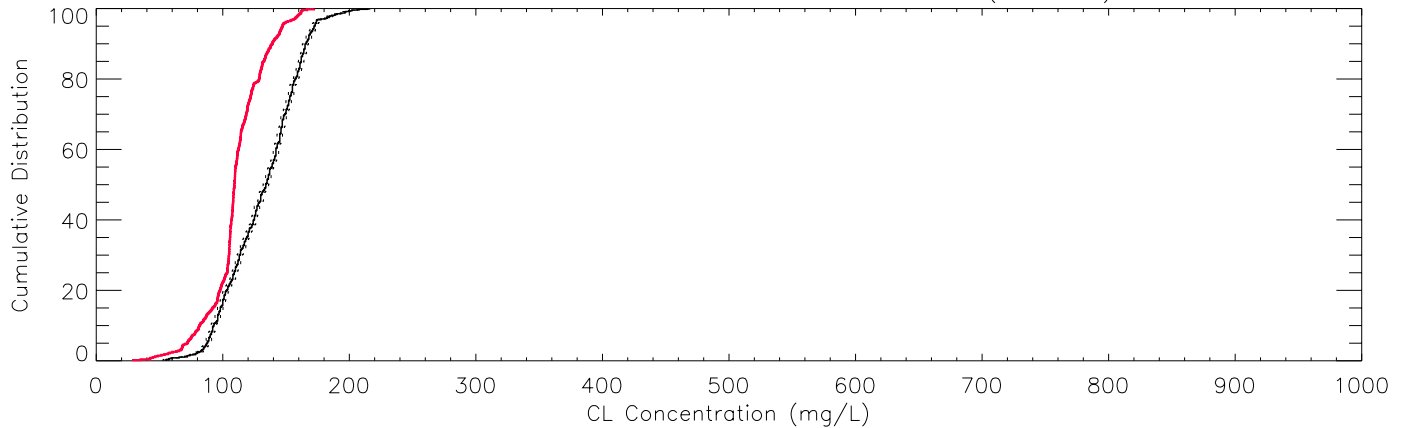
Mean: Season – 95% CI – marsh3 (156_58)



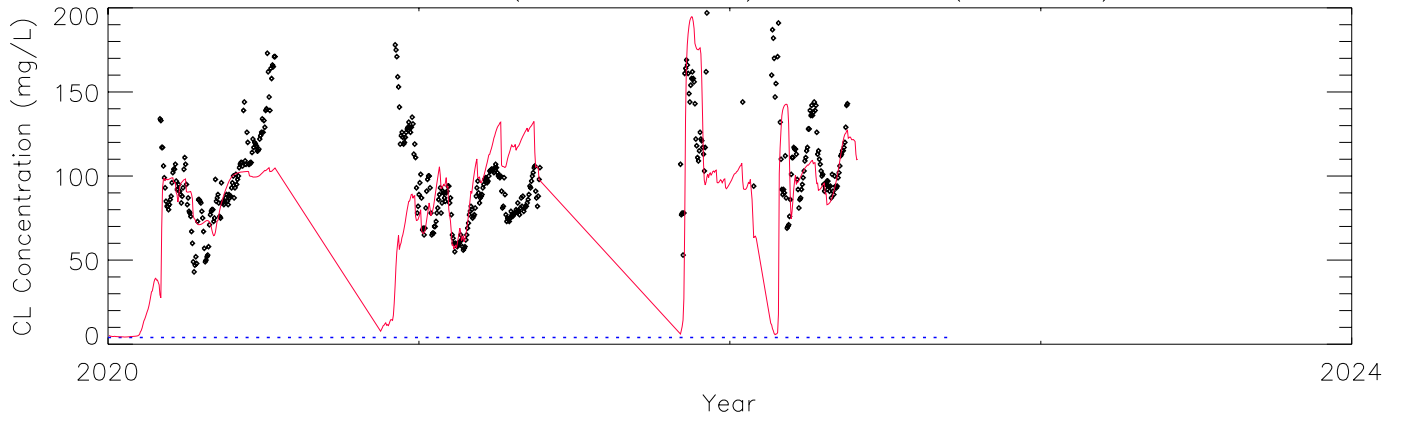
Mean: Water Year – 95% CI – marsh3 (156_58)



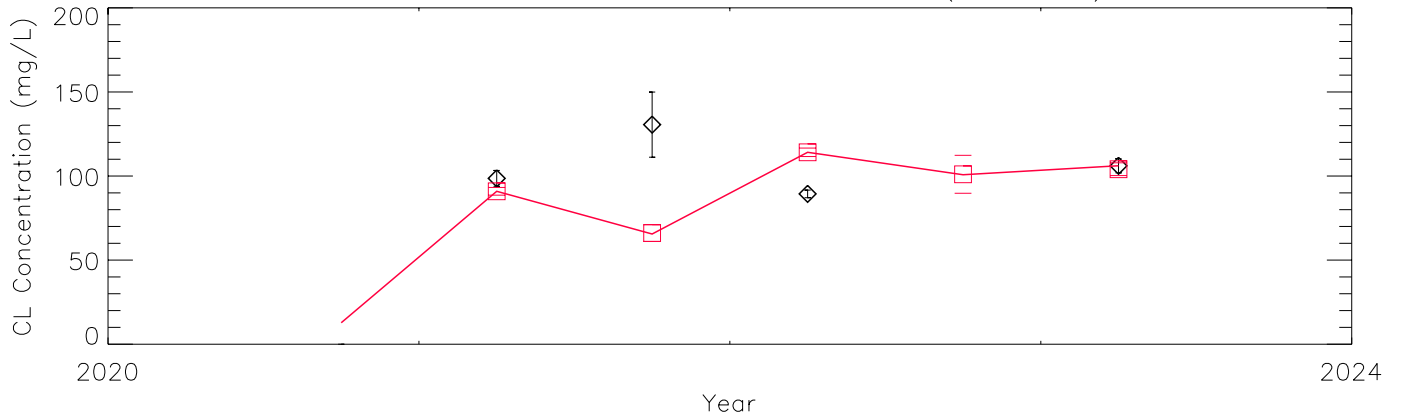
Cumulative Distribution: Raw Data – marsh3 (156_58)



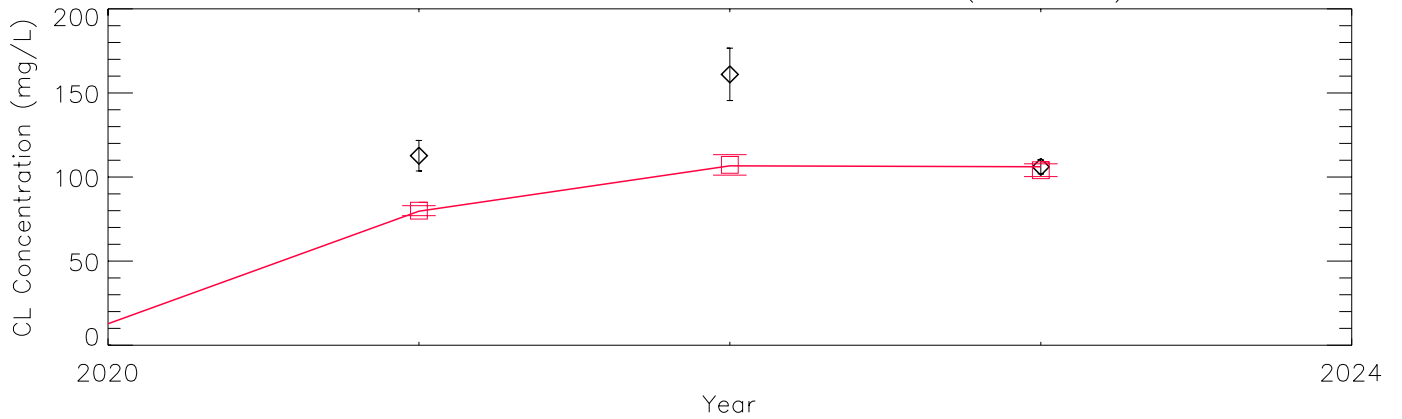
Raw Data (Obs. N = 490) – marsh4 (191_123)



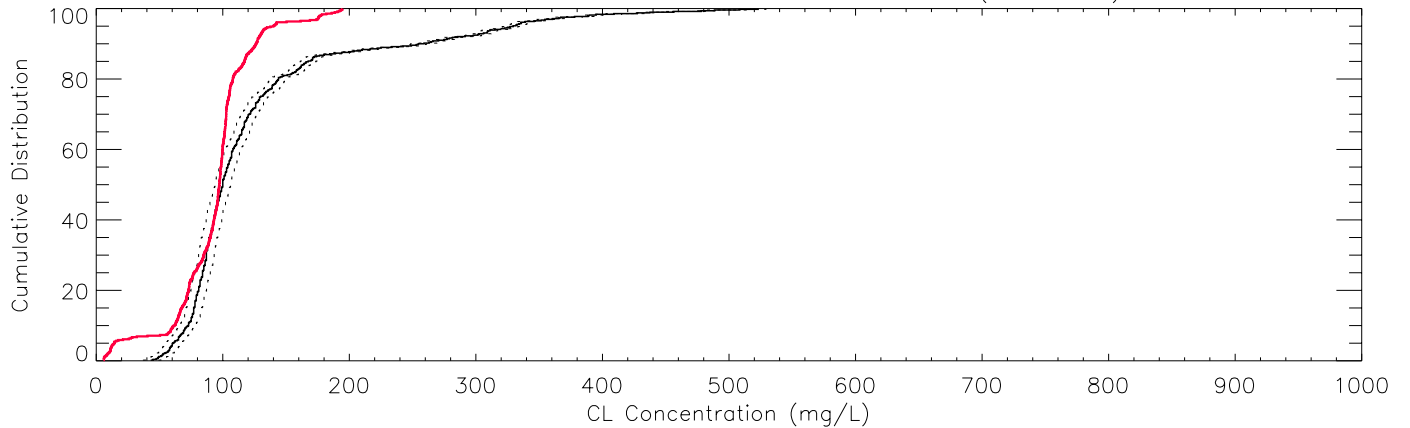
Mean: Season – 95% CI – marsh4 (191_123)



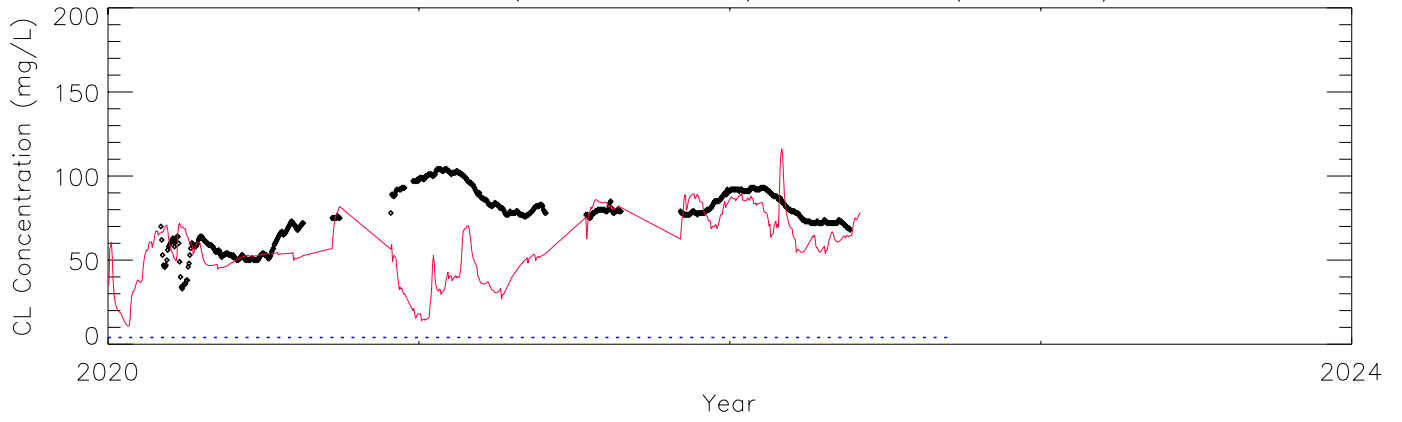
Mean: Water Year – 95% CI – marsh4 (191_123)



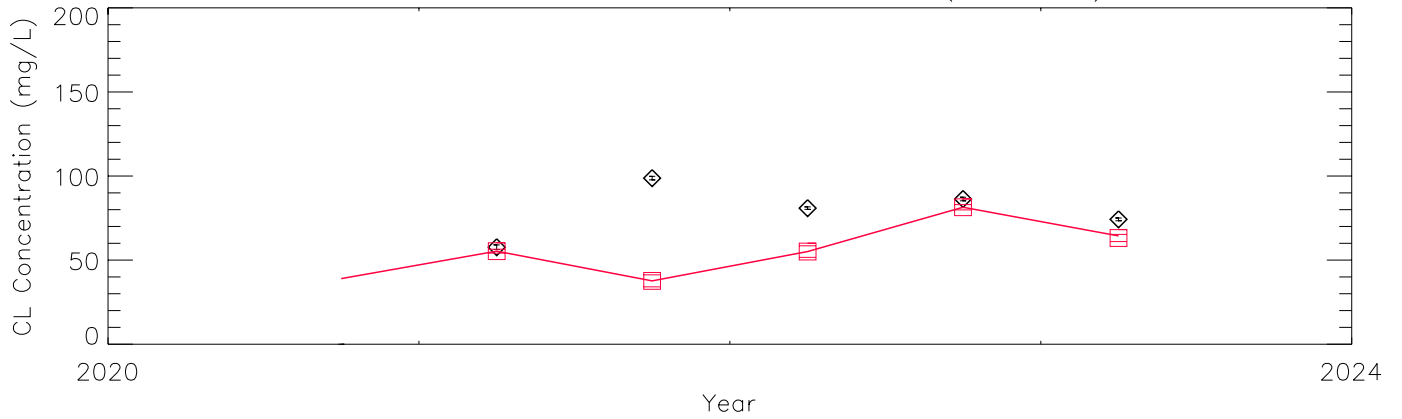
Cumulative Distribution: Raw Data – marsh4 (191_123)



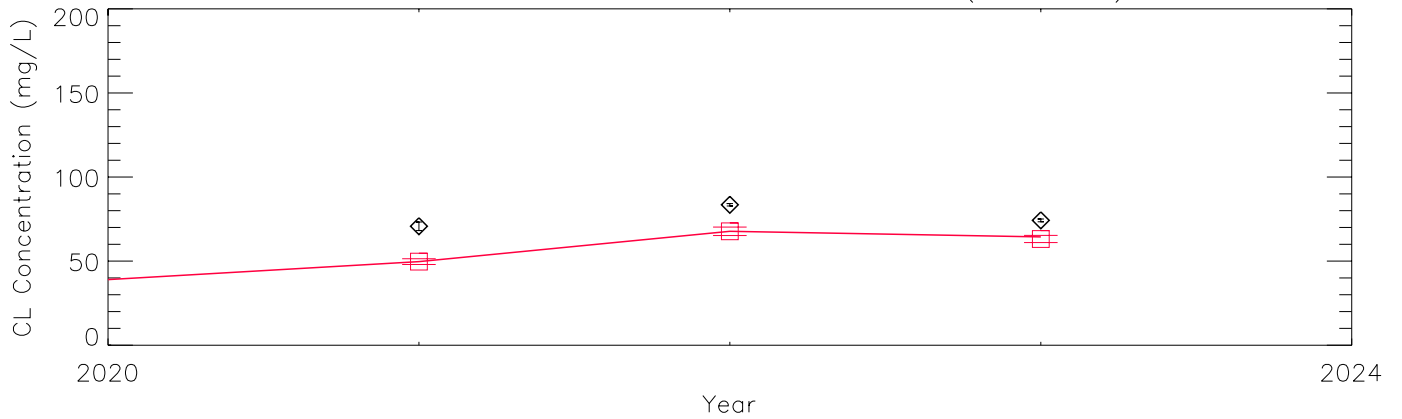
Raw Data (Obs. N = 591) – marsh5 (272_175)



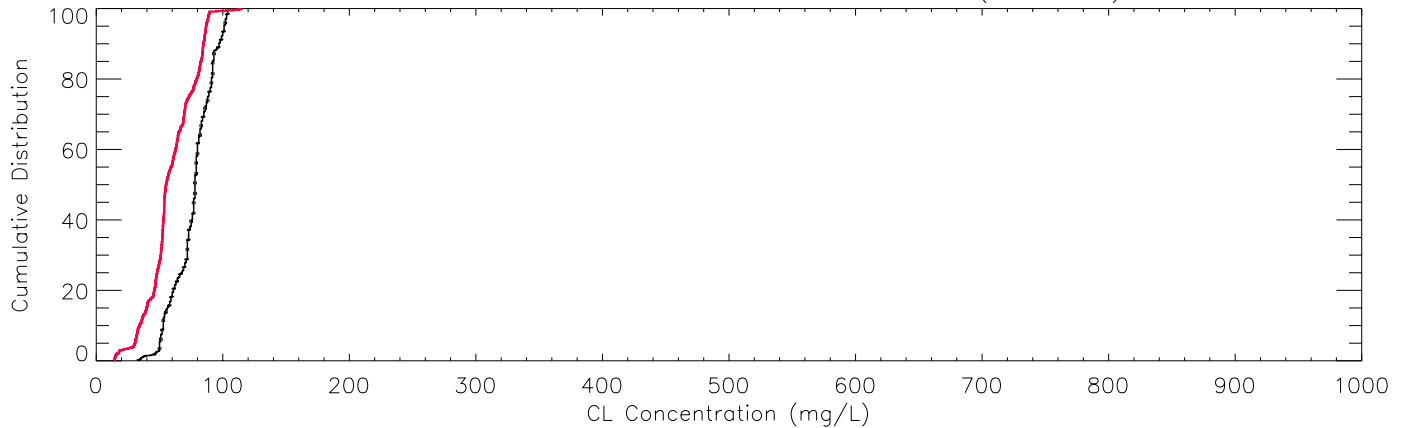
Mean: Season – 95% CI – marsh5 (272_175)



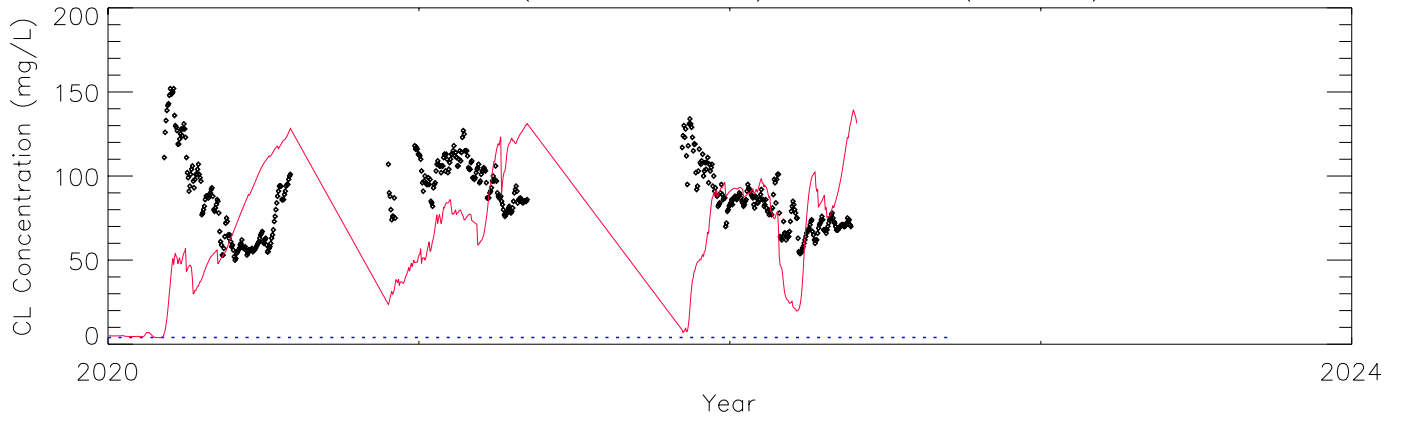
Mean: Water Year – 95% CI – marsh5 (272_175)



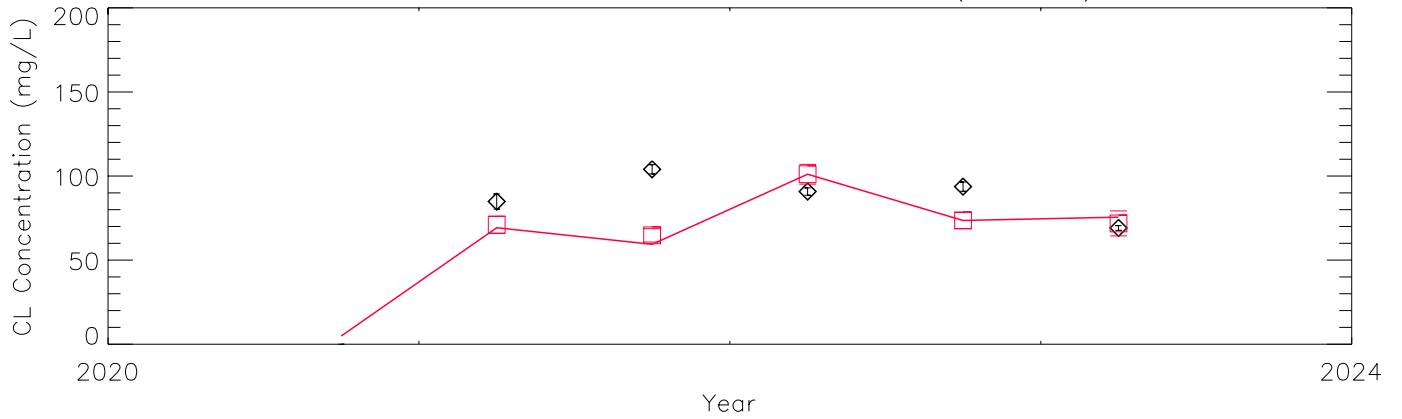
Cumulative Distribution: Raw Data – marsh5 (272_175)



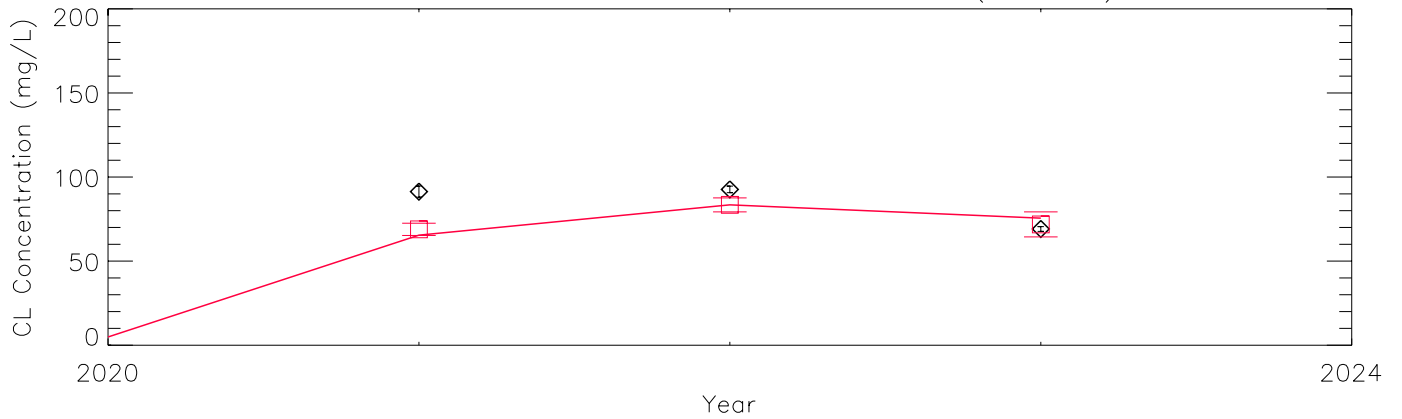
Raw Data (Obs. N = 490) – marsh7 (91_226)



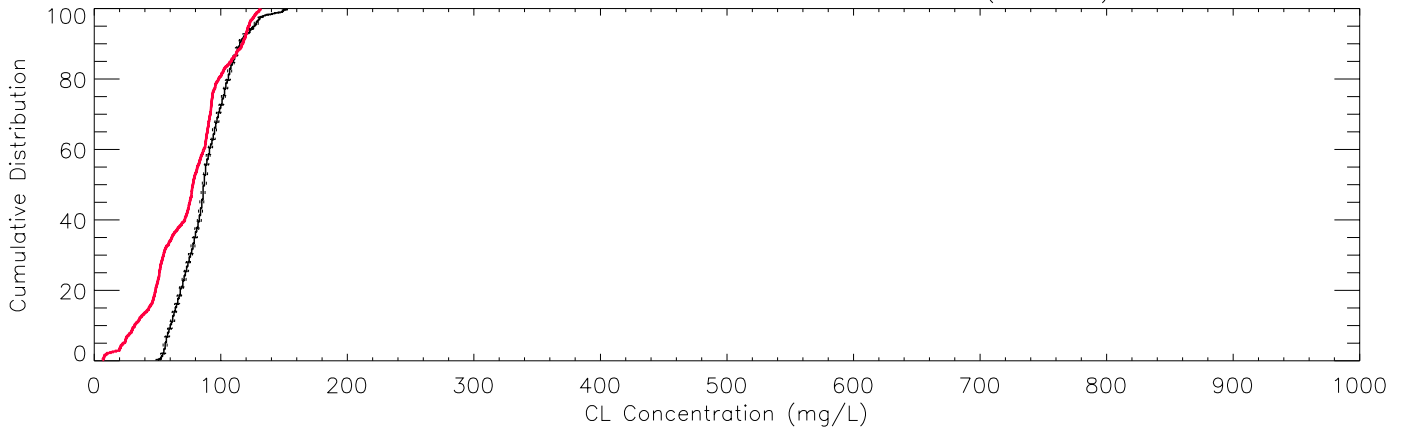
Mean: Season – 95% CI – marsh7 (91_226)



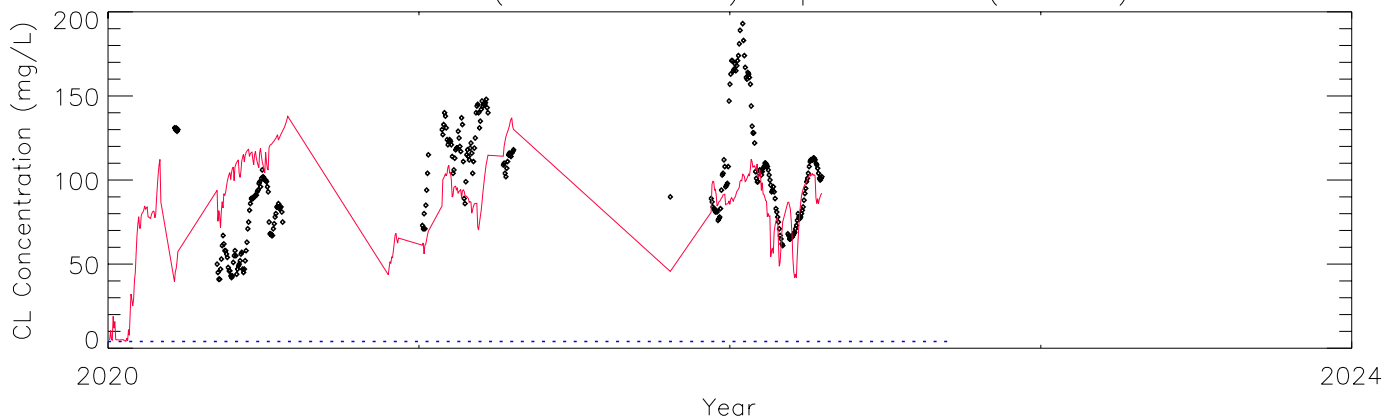
Mean: Water Year – 95% CI – marsh7 (91_226)



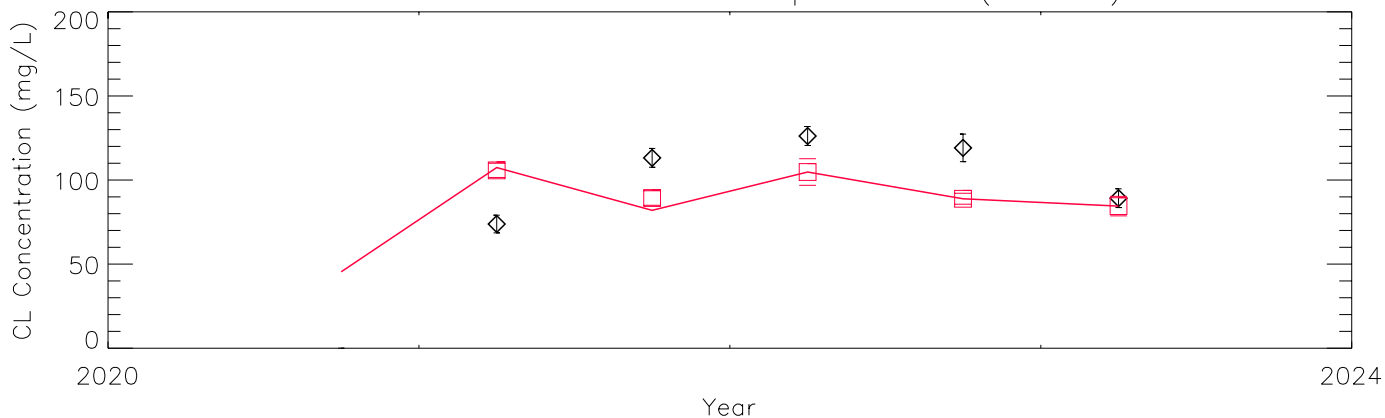
Cumulative Distribution: Raw Data – marsh7 (91_226)



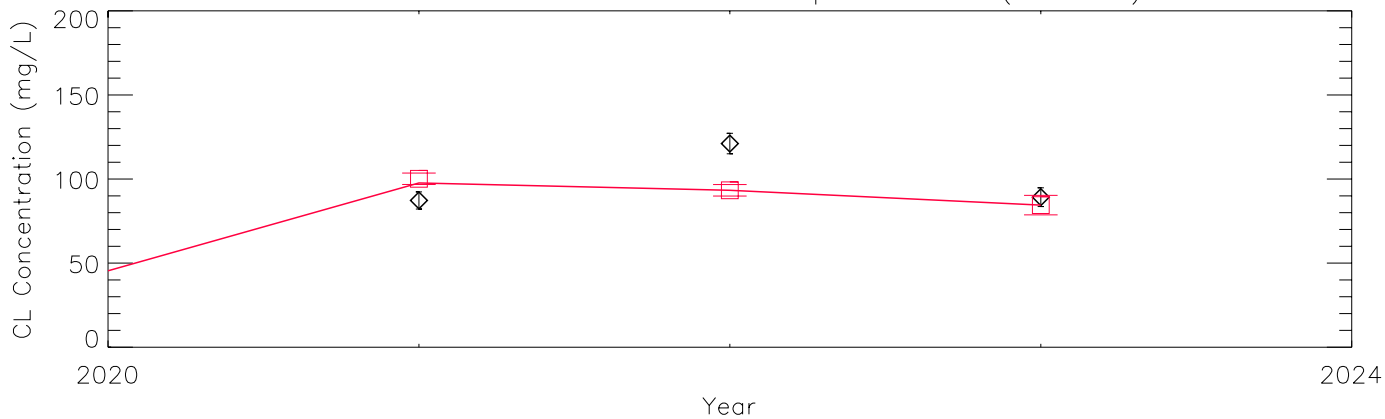
Raw Data (Obs. N = 286) – p0505canx (56_187)



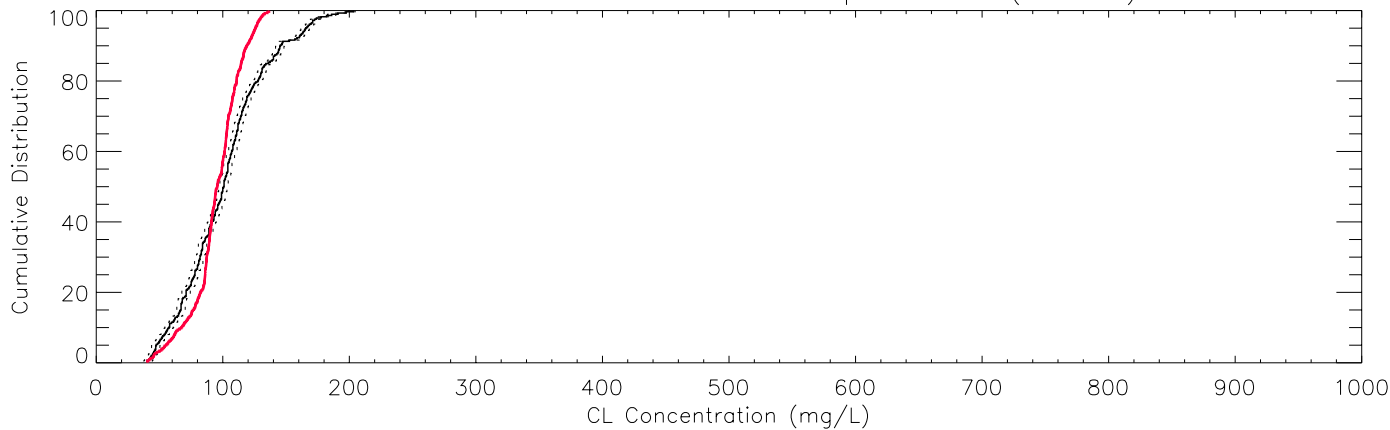
Mean: Season – 95% CI – p0505canx (56_187)

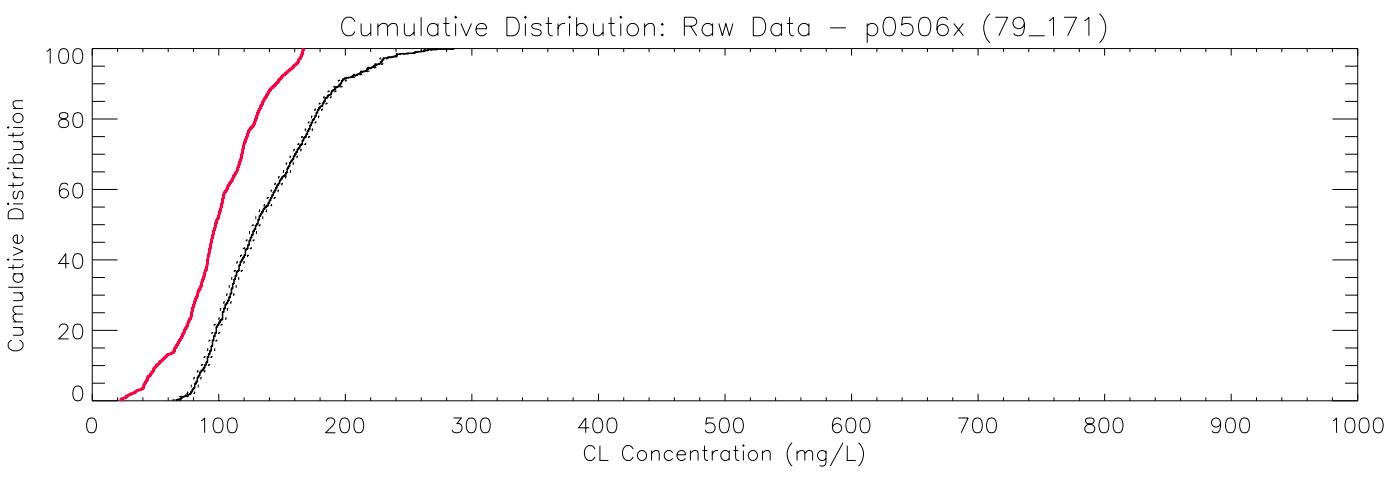
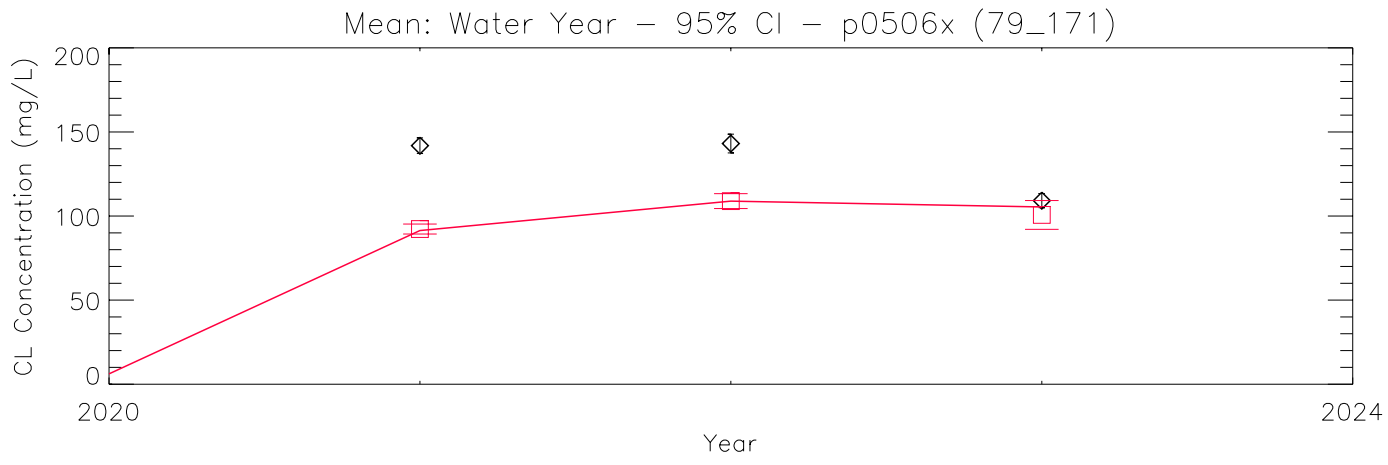
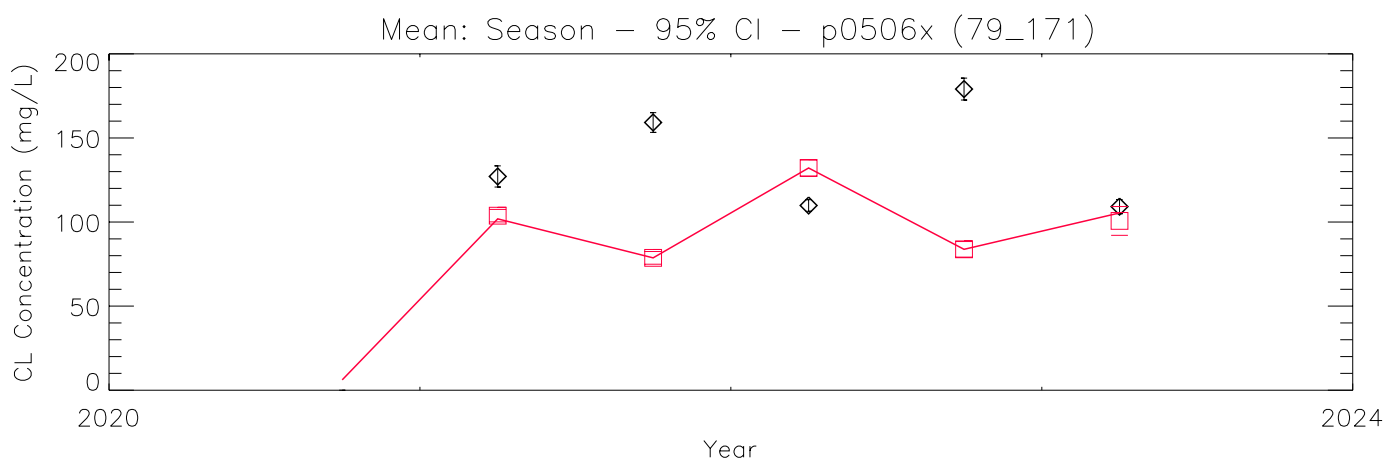
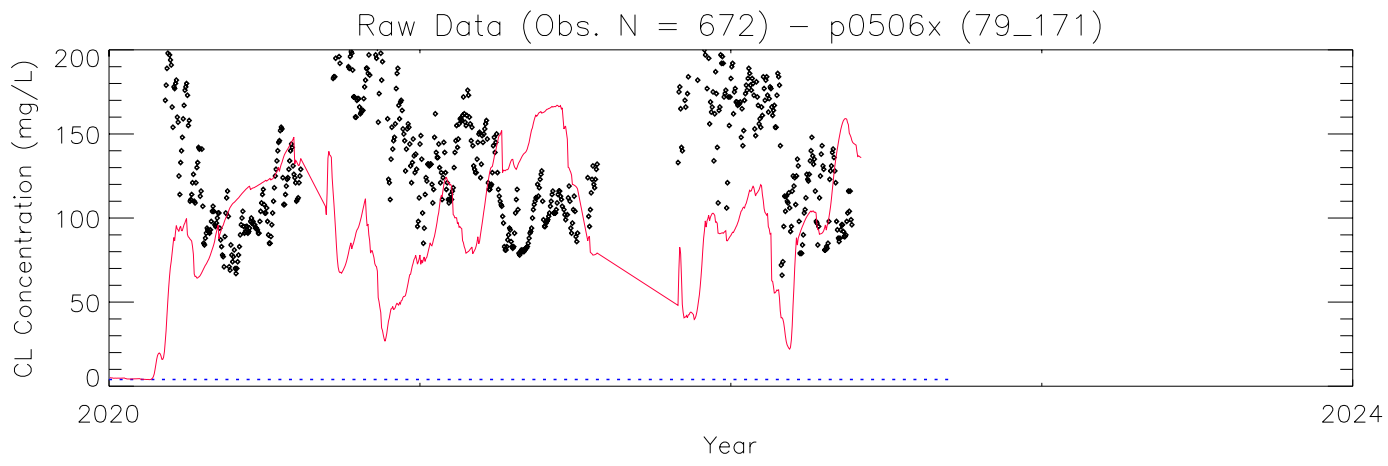


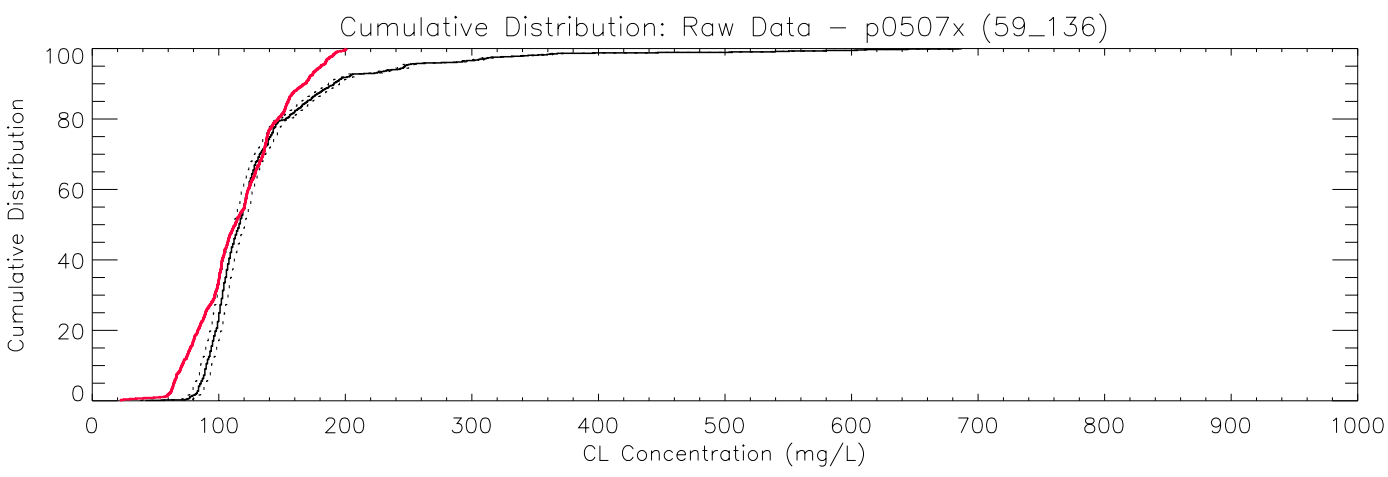
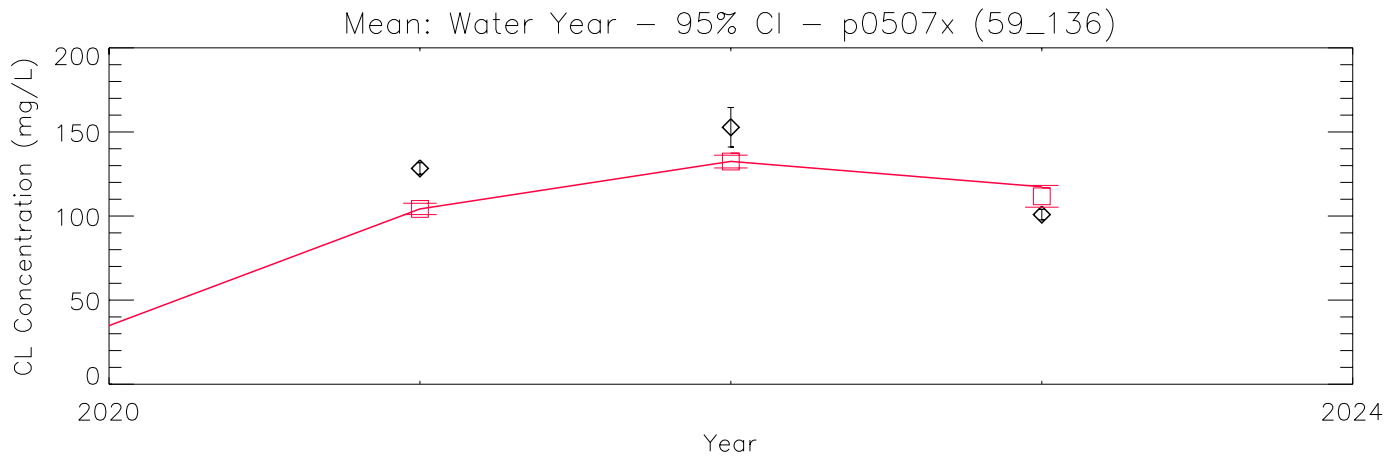
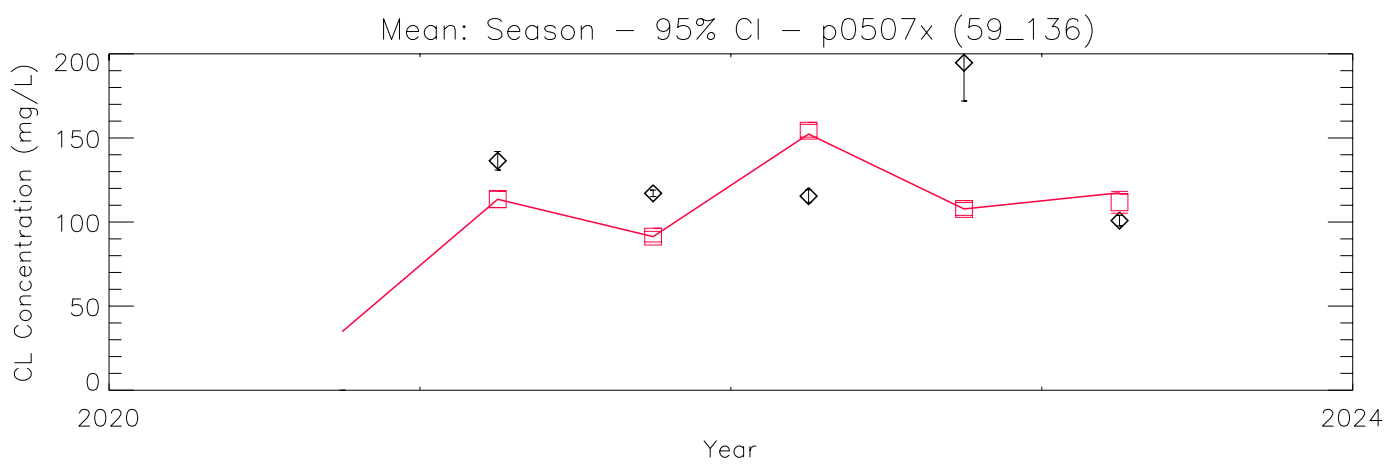
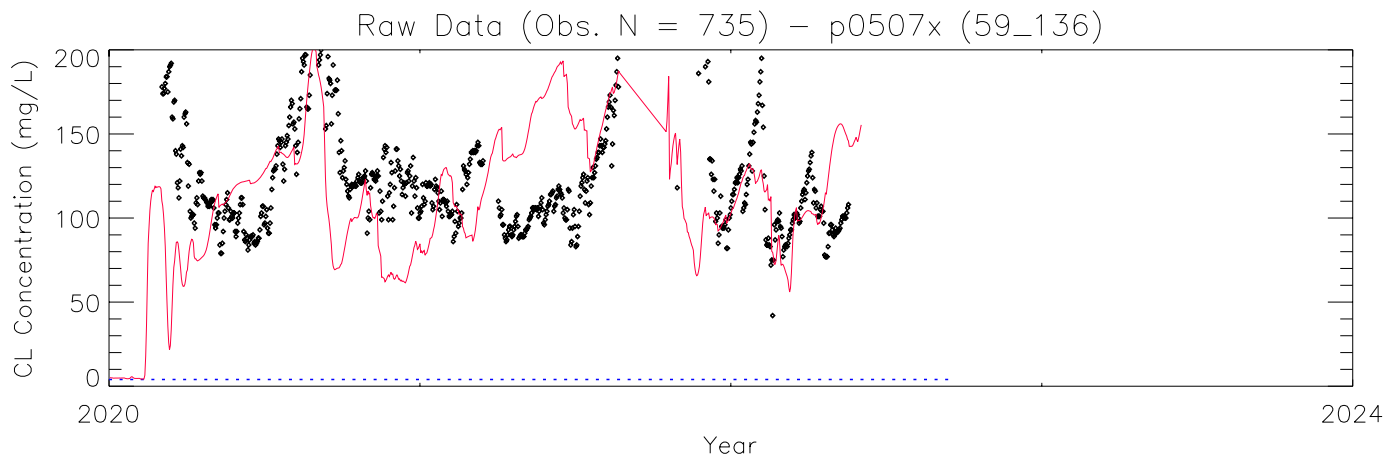
Mean: Water Year – 95% CI – p0505canx (56_187)

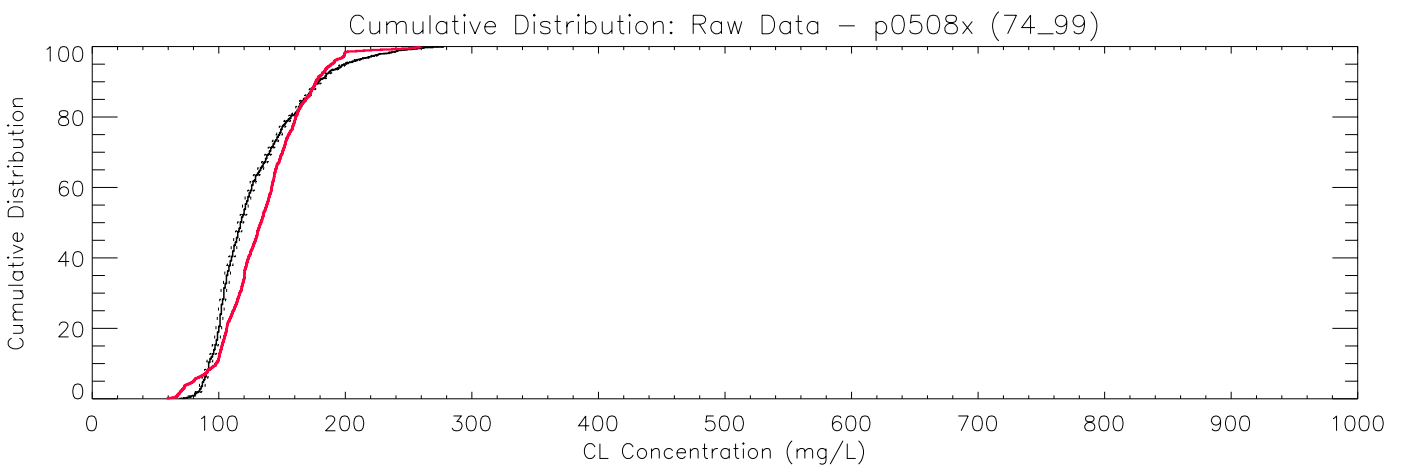
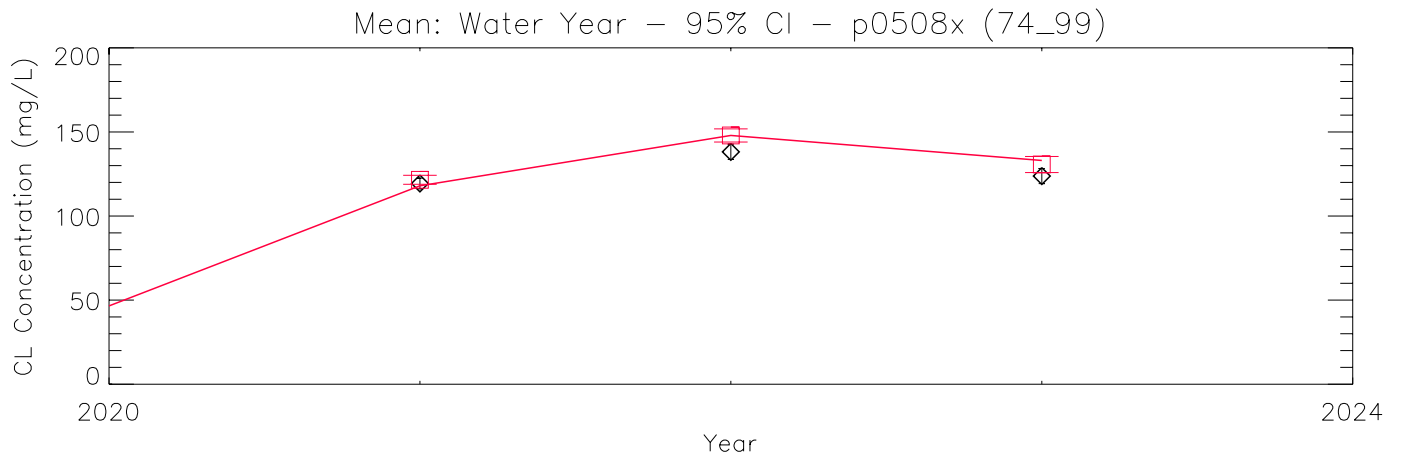
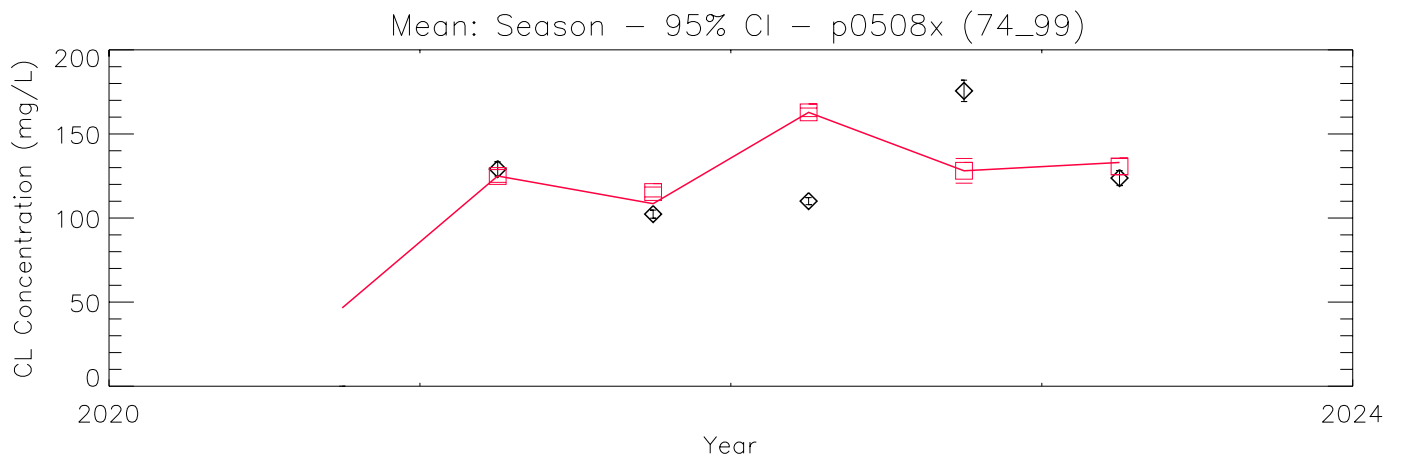
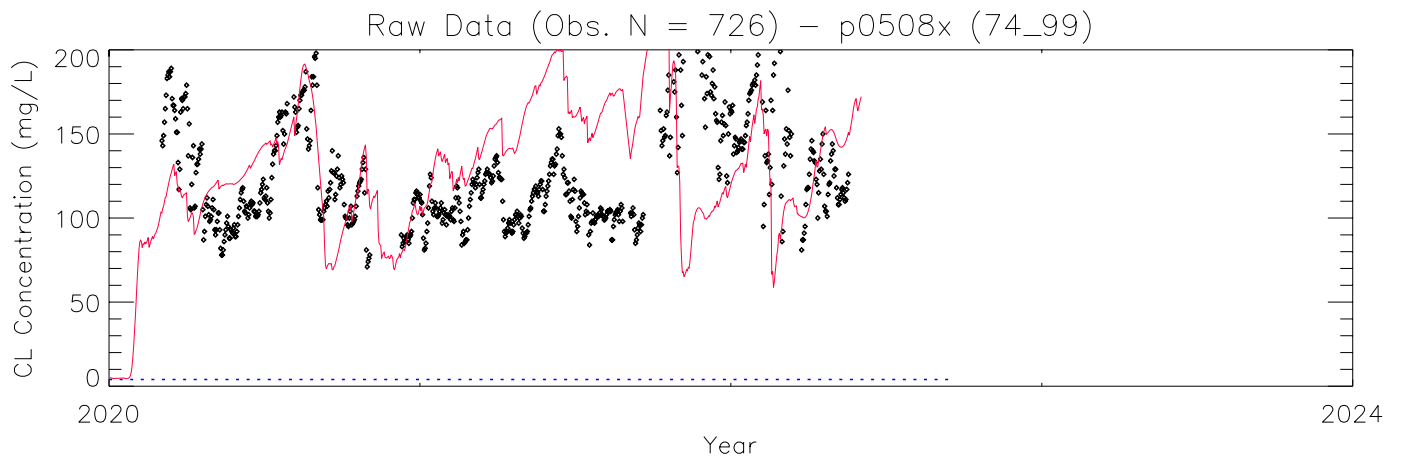


Cumulative Distribution: Raw Data – p0505canx (56_187)

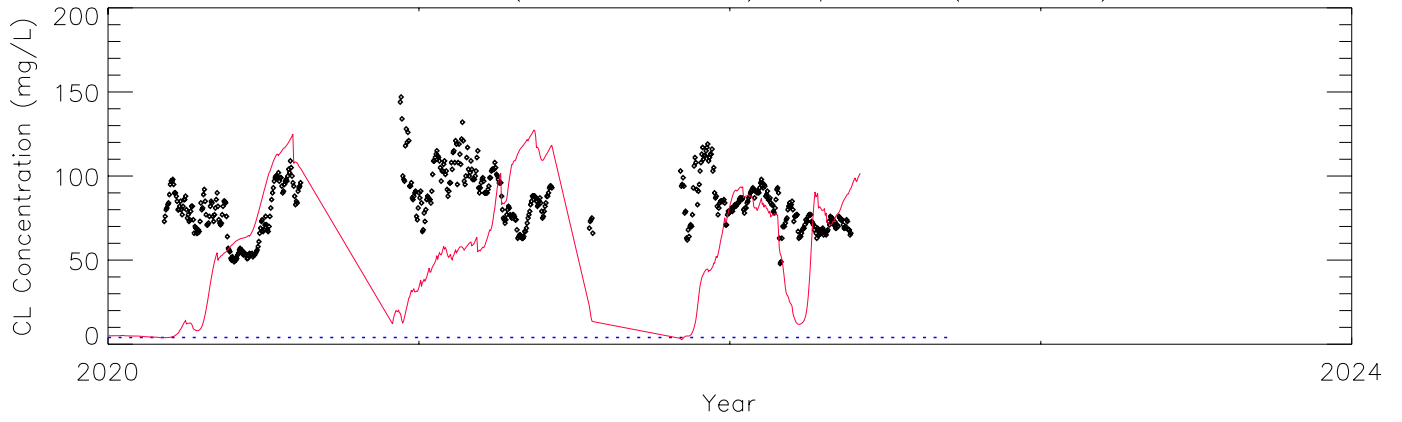




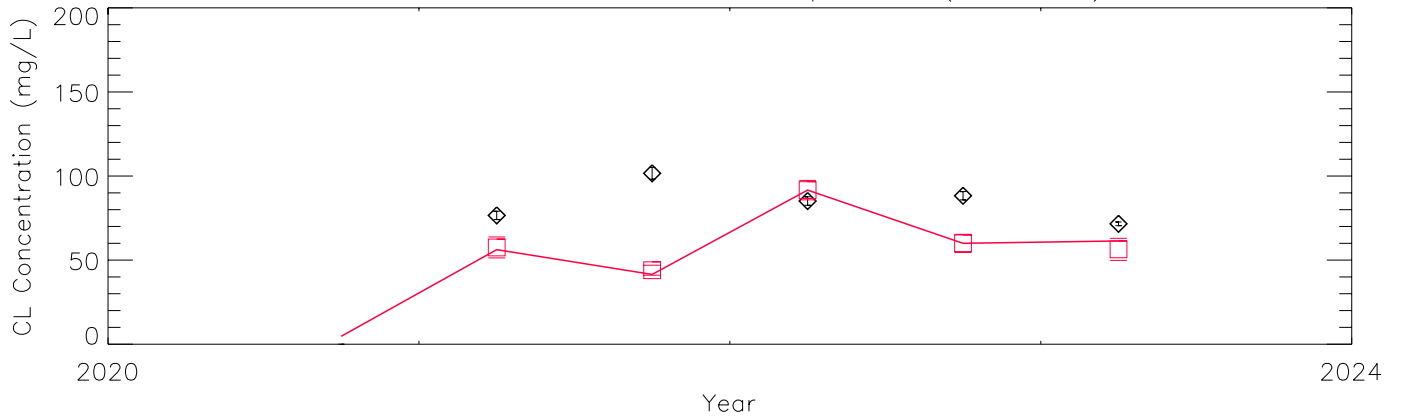




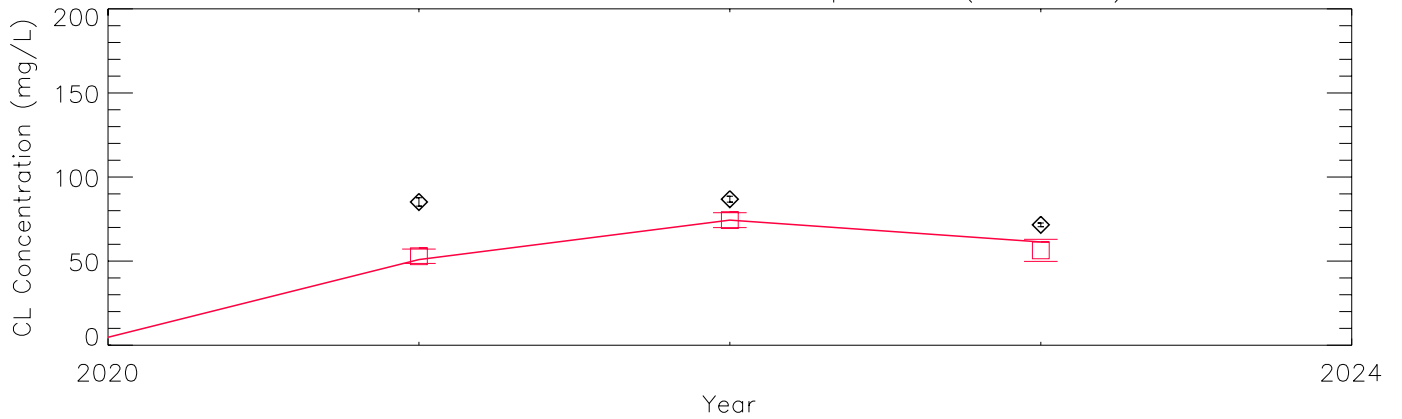
Raw Data (Obs. N = 546) - p0604x (121_238)



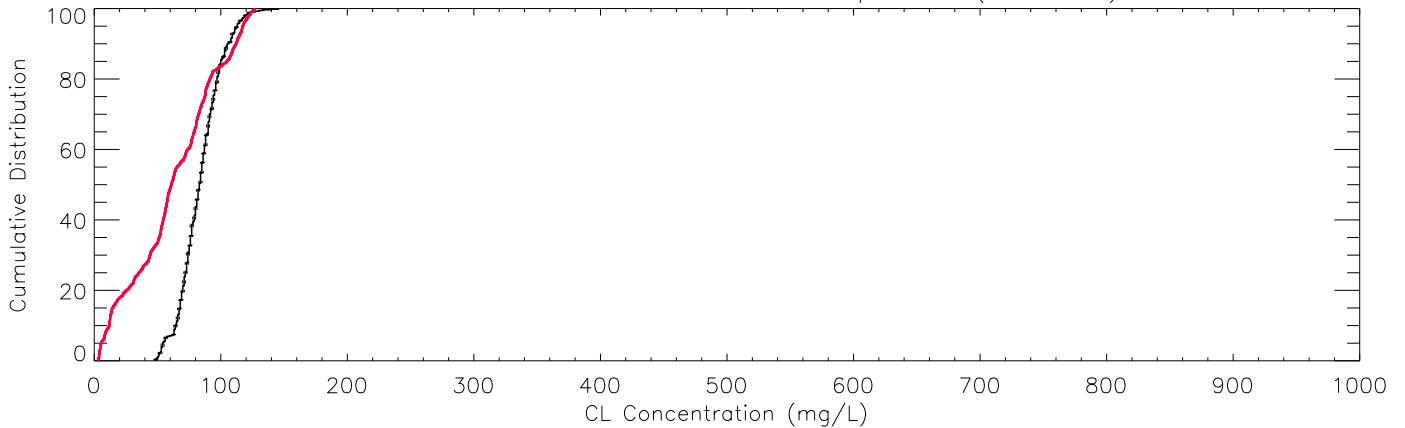
Mean: Season - 95% CI - p0604x (121_238)



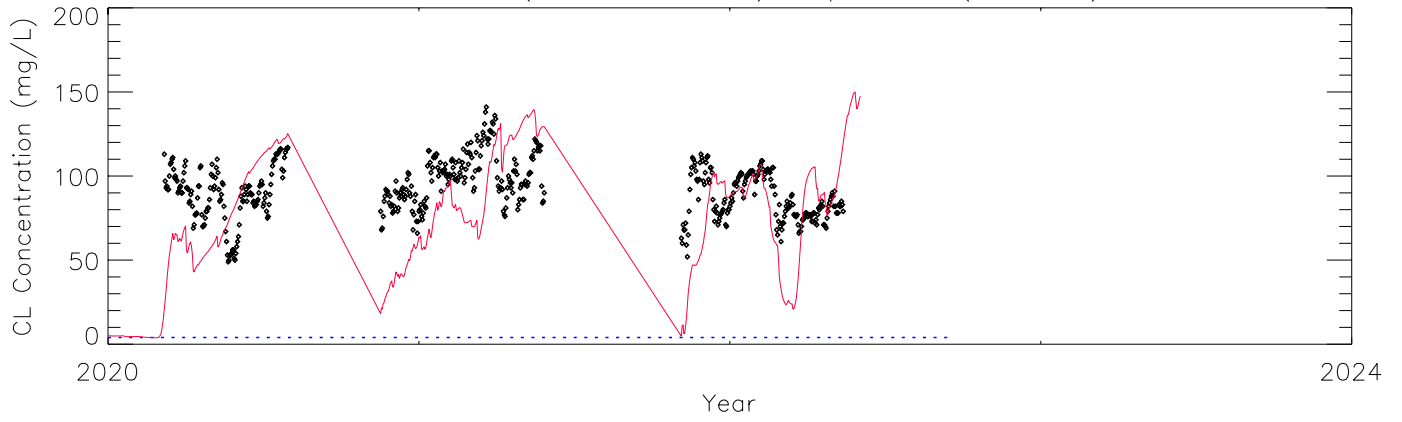
Mean: Water Year - 95% CI - p0604x (121_238)



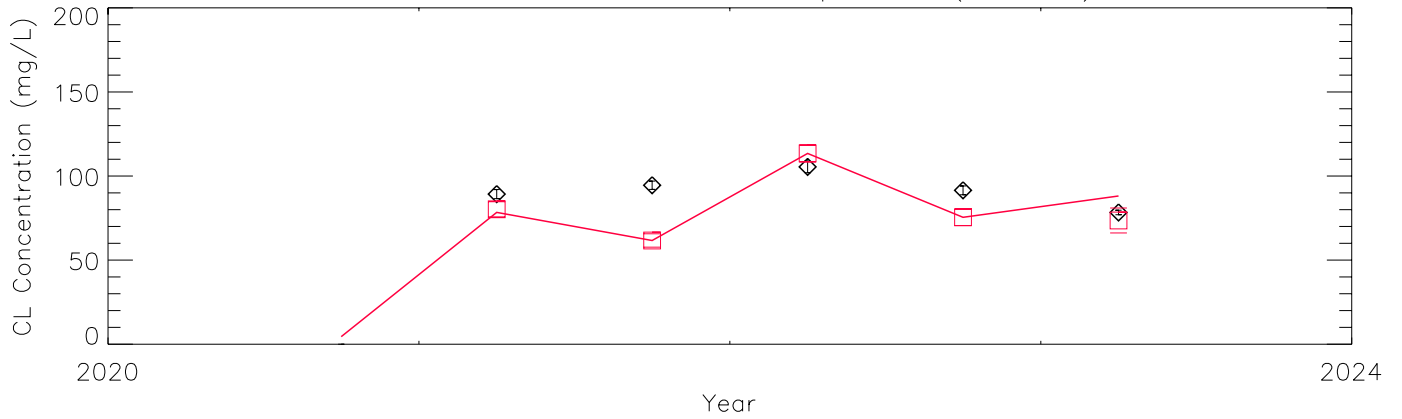
Cumulative Distribution: Raw Data - p0604x (121_238)



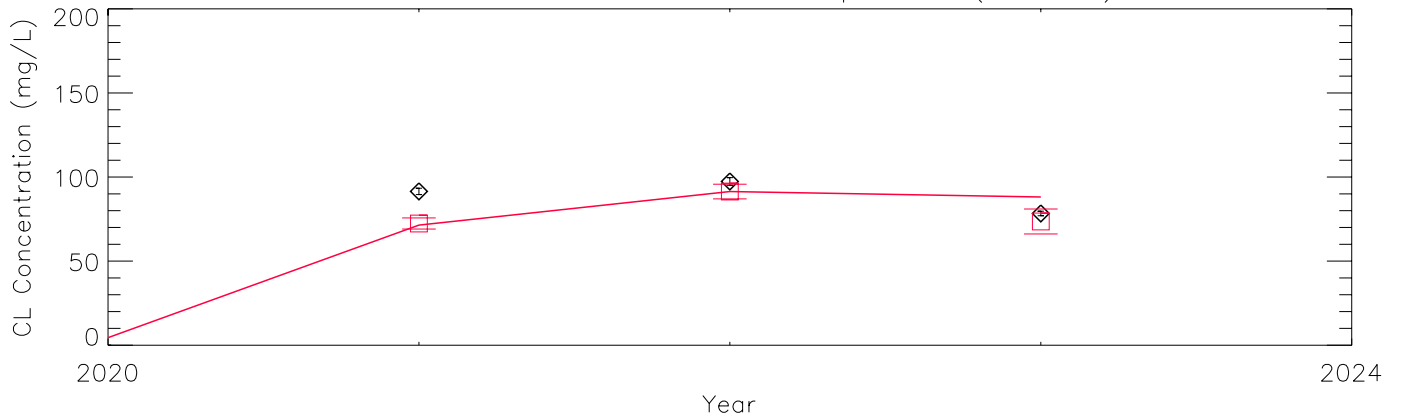
Raw Data (Obs. N = 530) – p0605x (99_205)



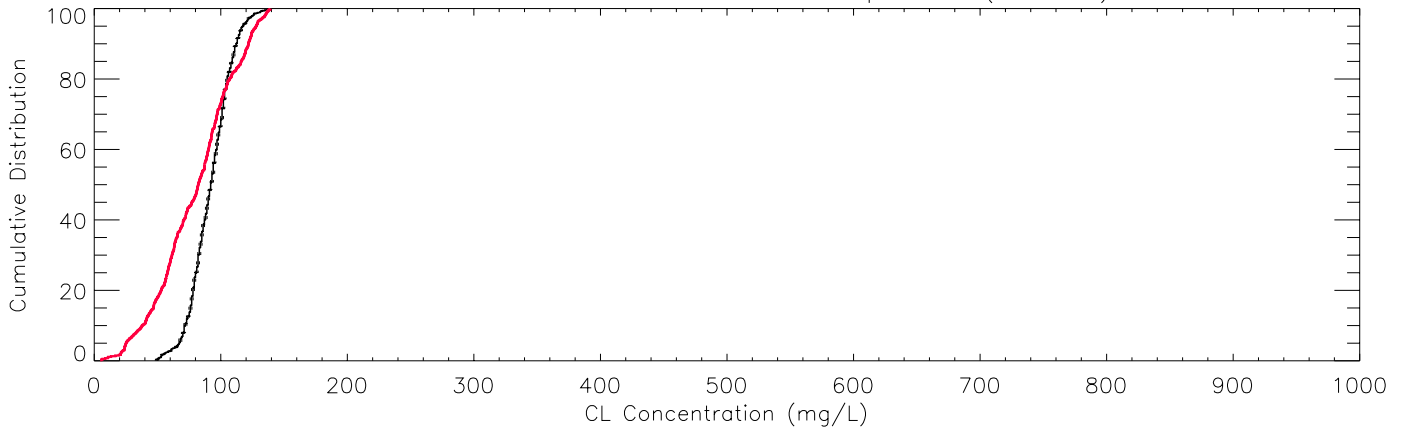
Mean: Season – 95% CI – p0605x (99_205)



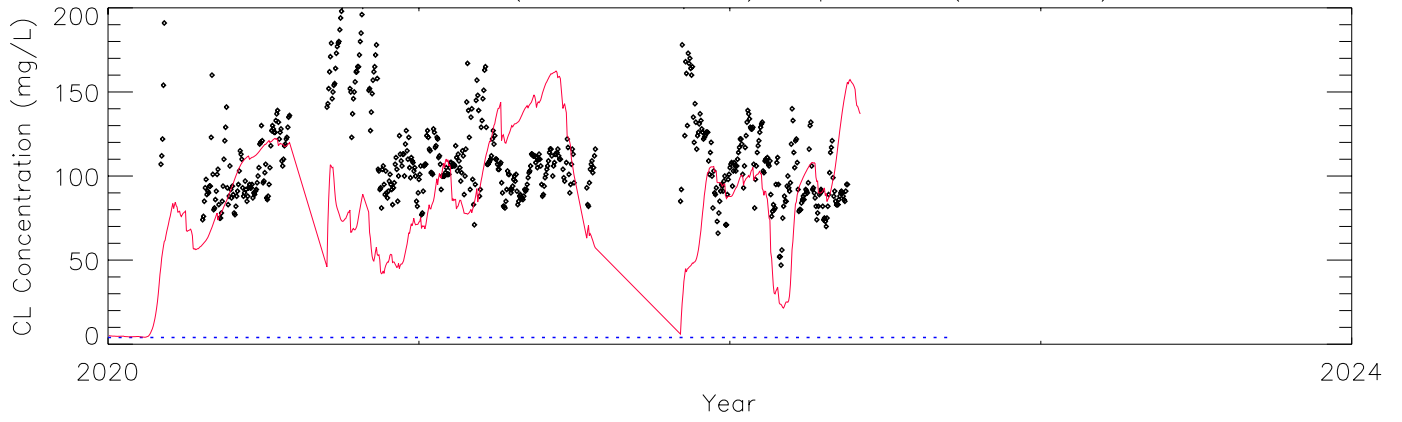
Mean: Water Year – 95% CI – p0605x (99_205)



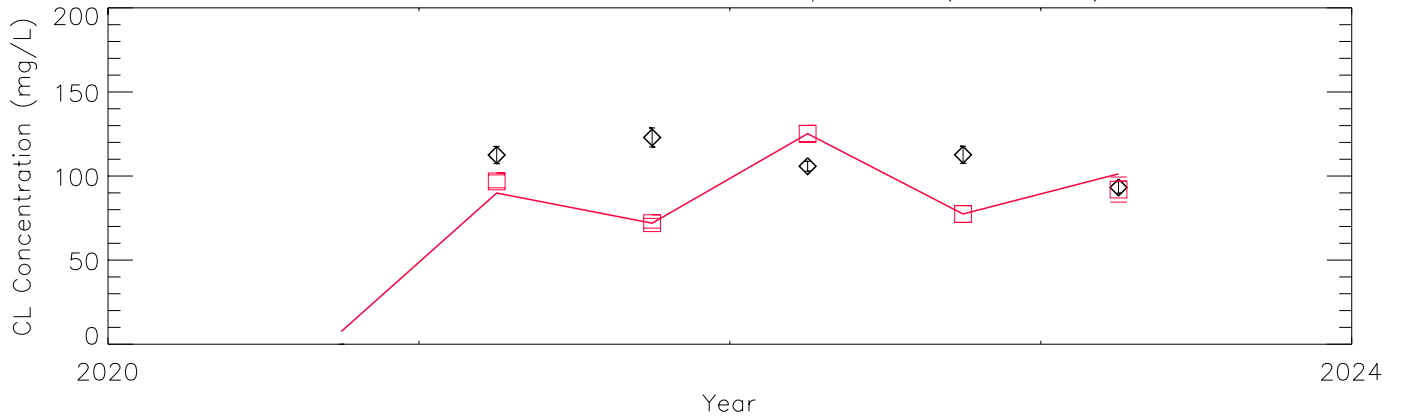
Cumulative Distribution: Raw Data – p0605x (99_205)



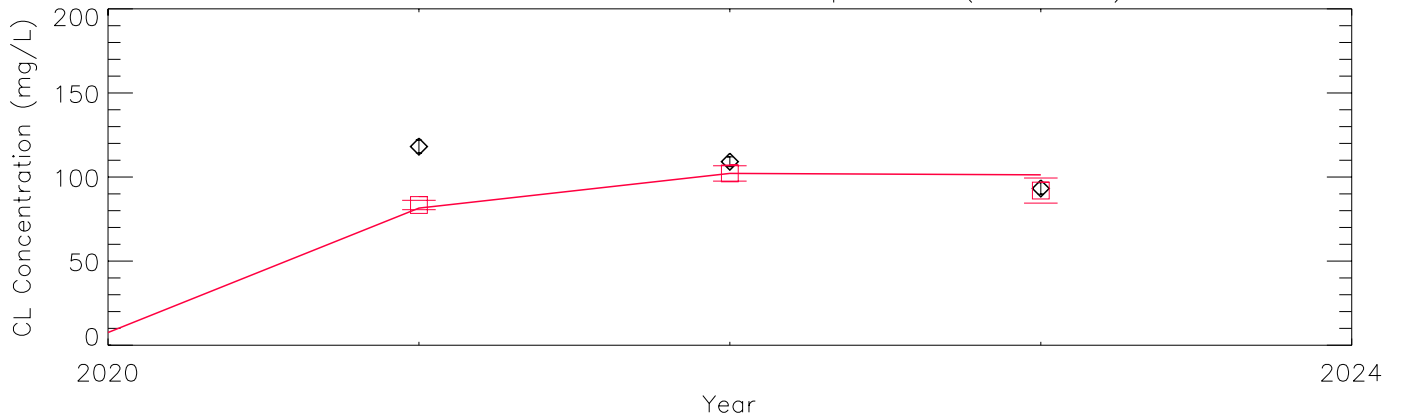
Raw Data (Obs. N = 598) - p0606x (121_170)



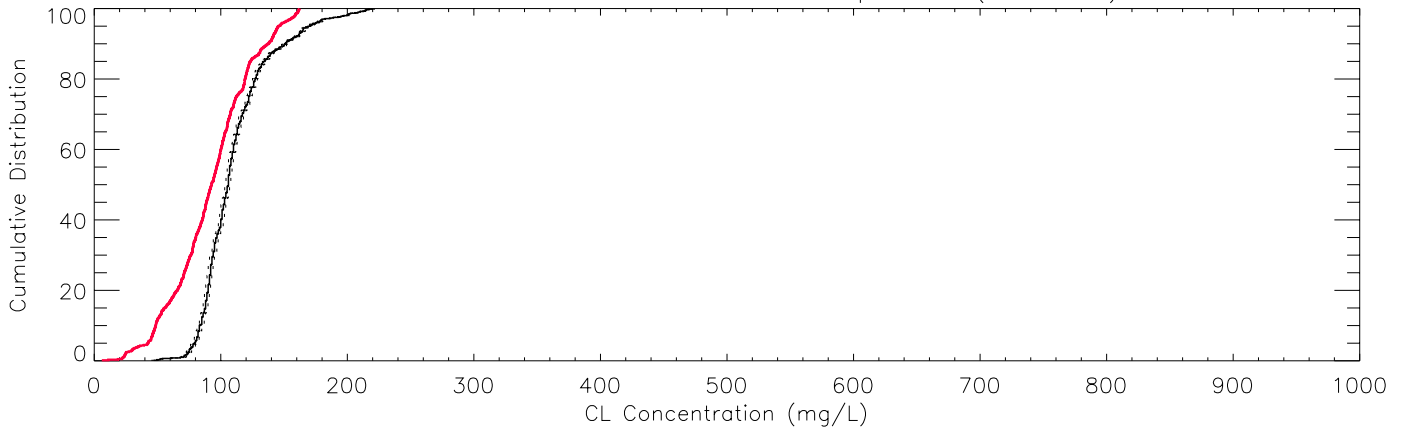
Mean: Season - 95% CI - p0606x (121_170)

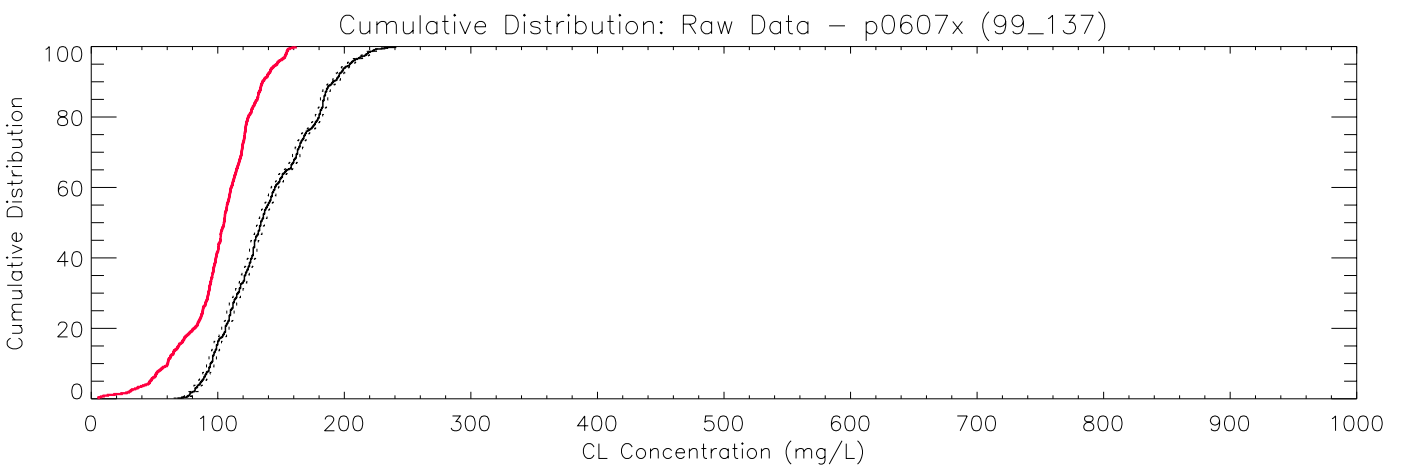
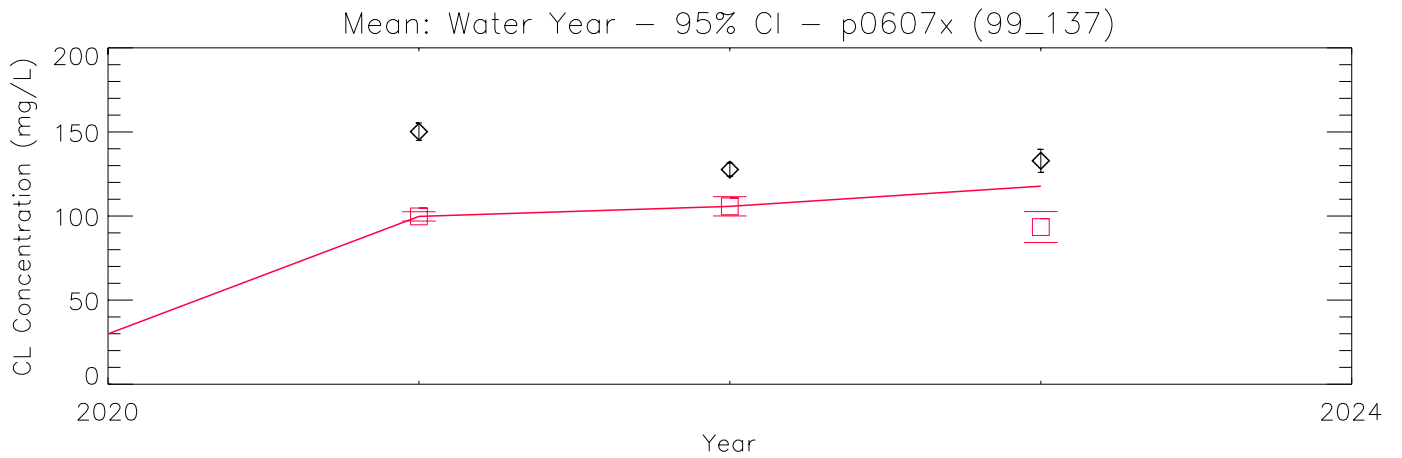
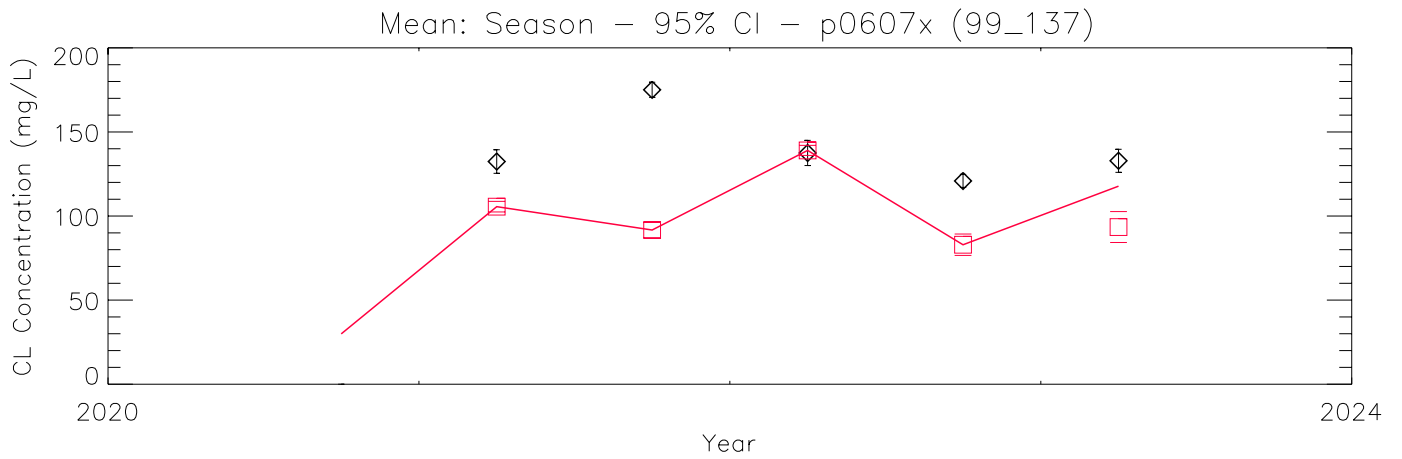
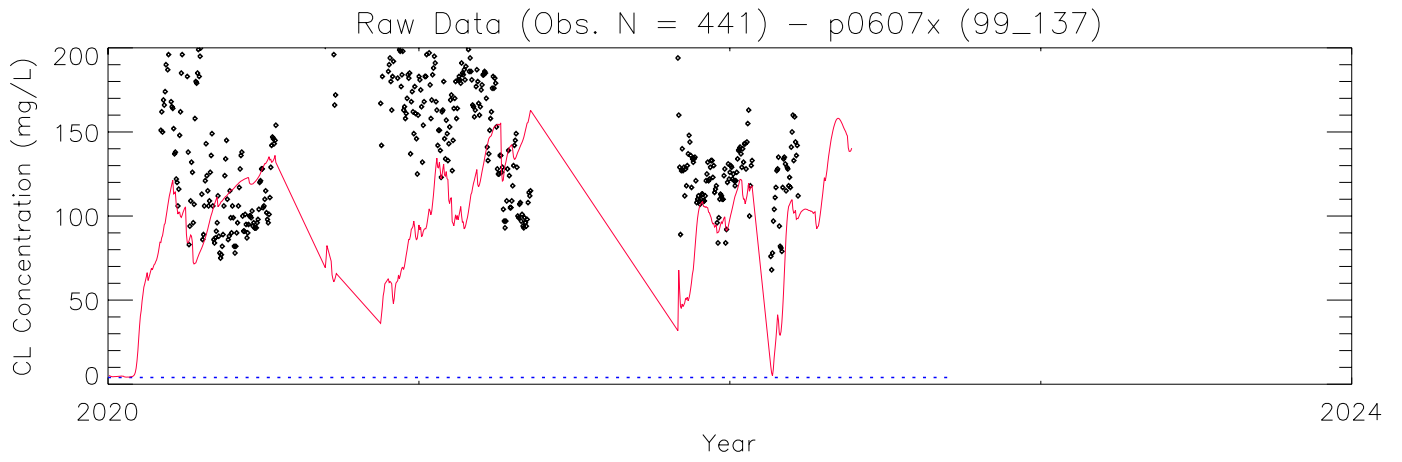


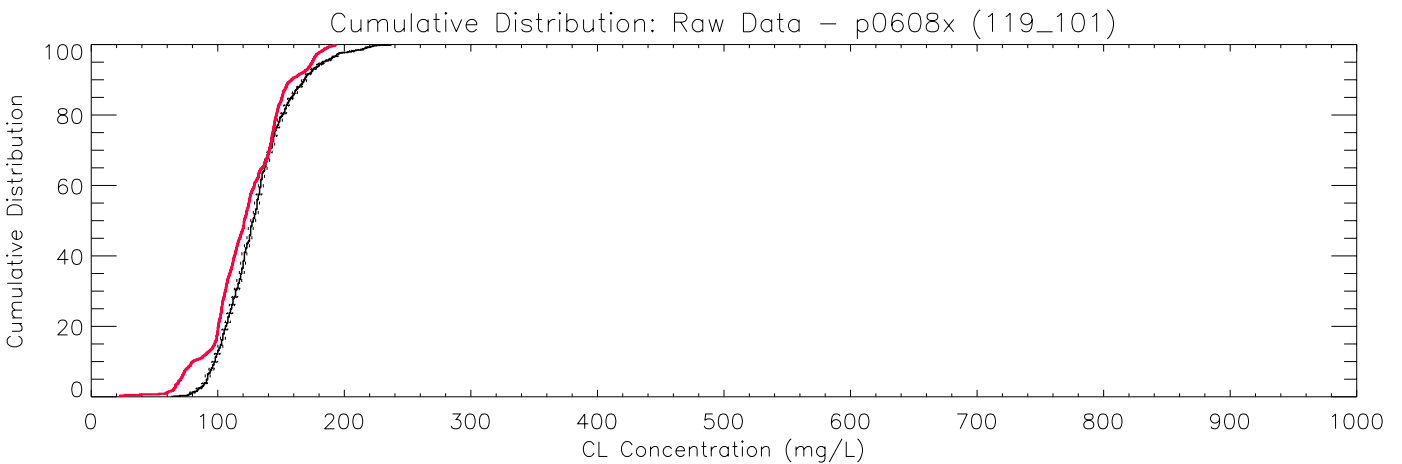
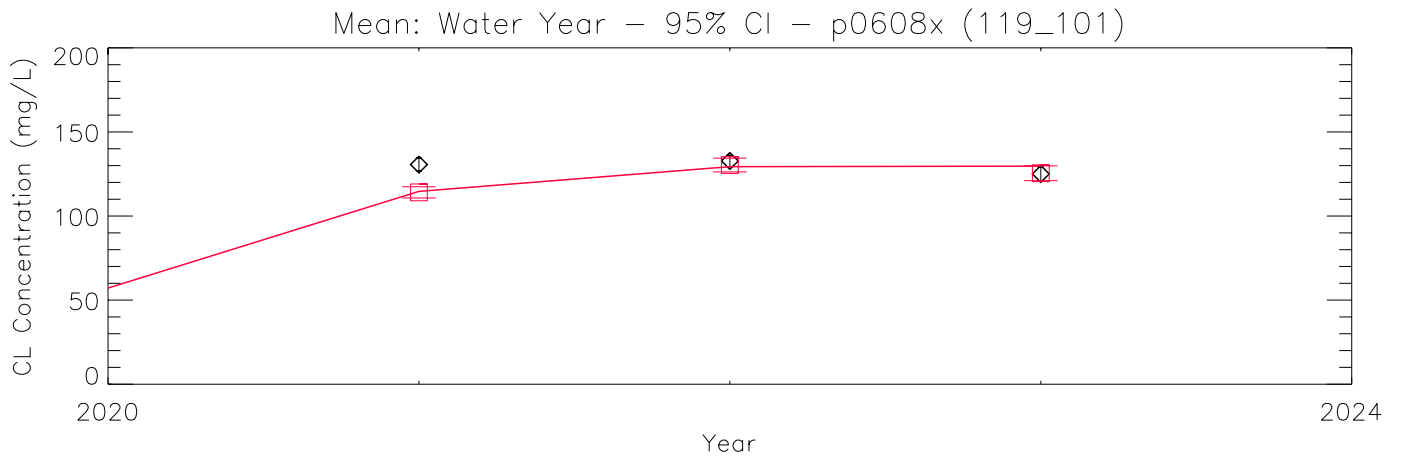
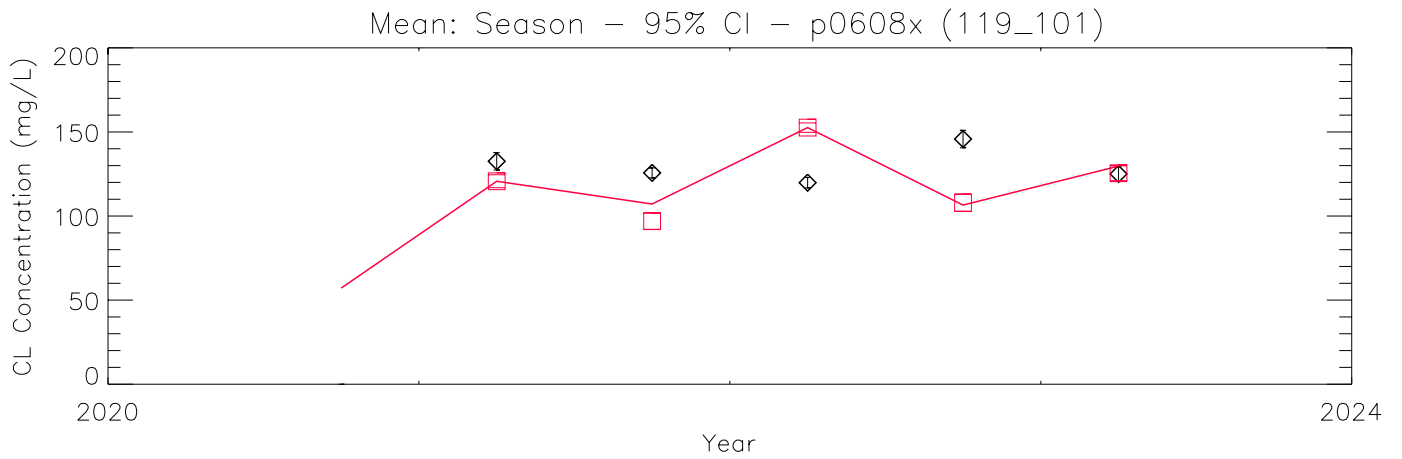
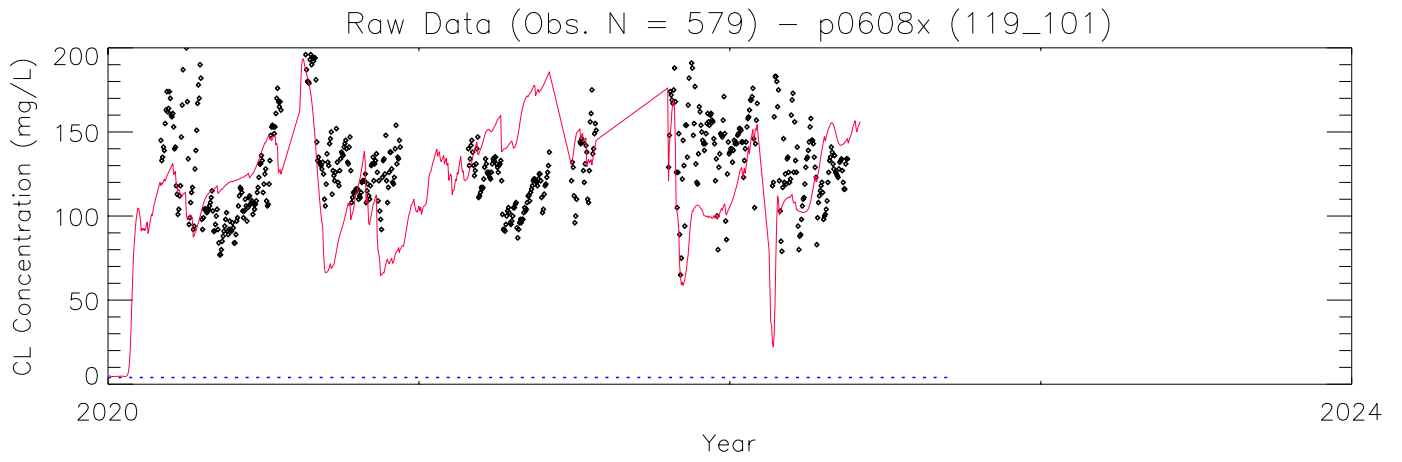
Mean: Water Year - 95% CI - p0606x (121_170)

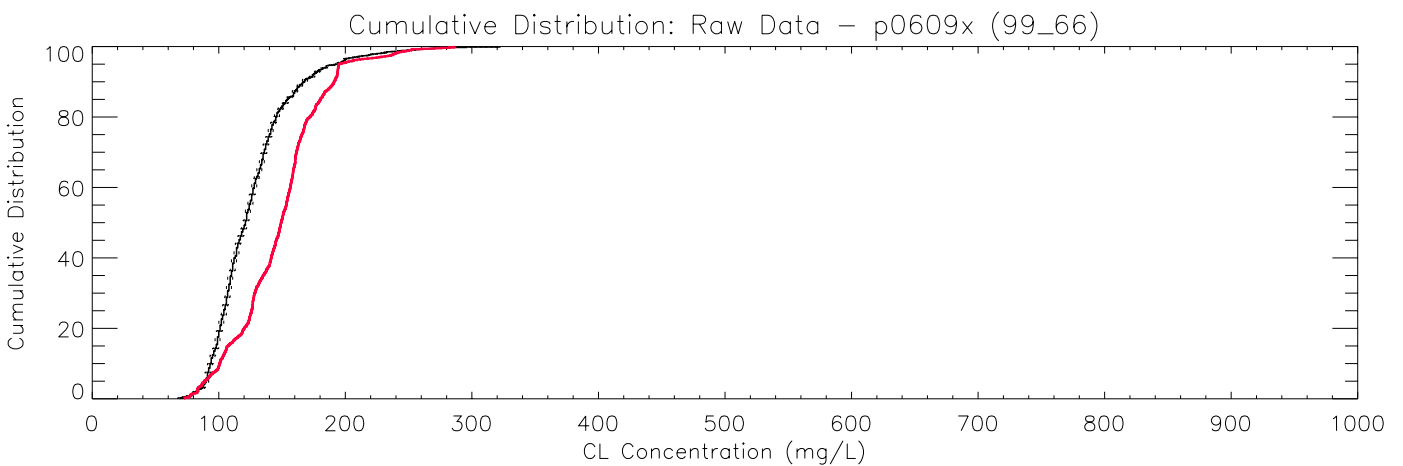
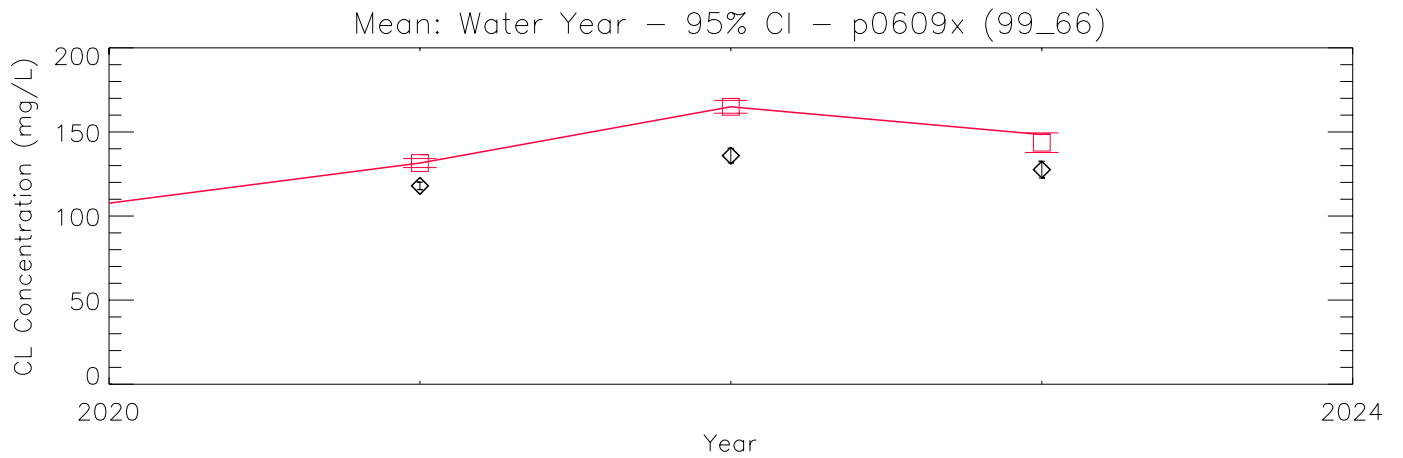
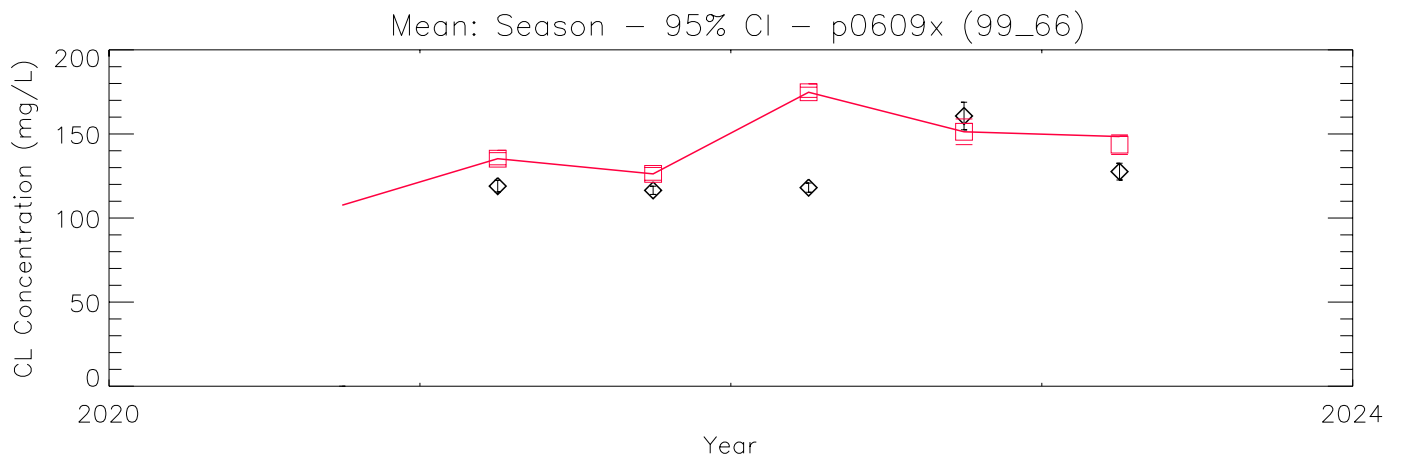
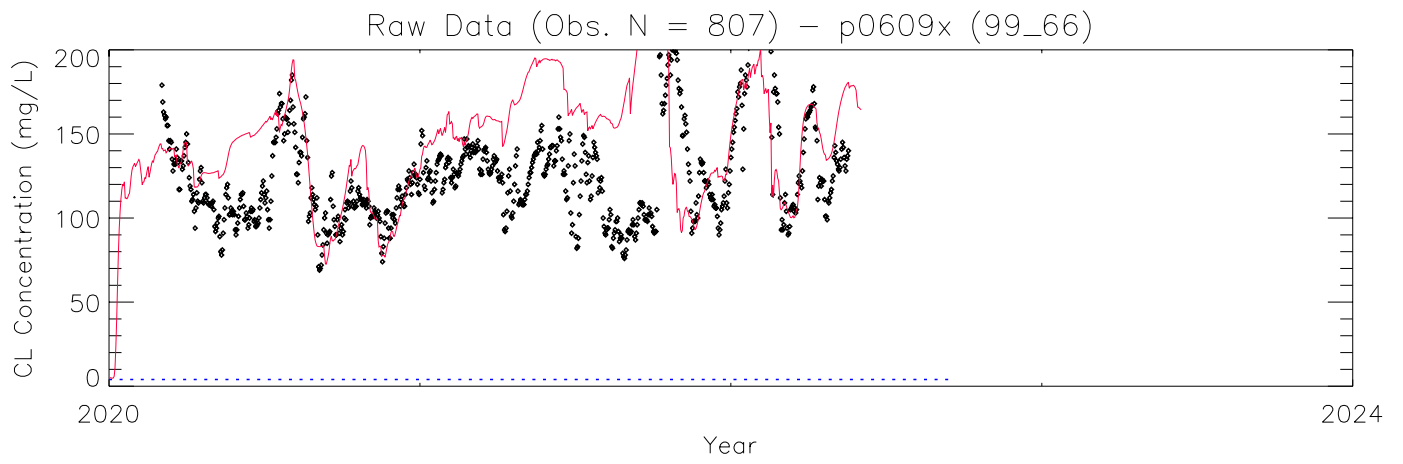


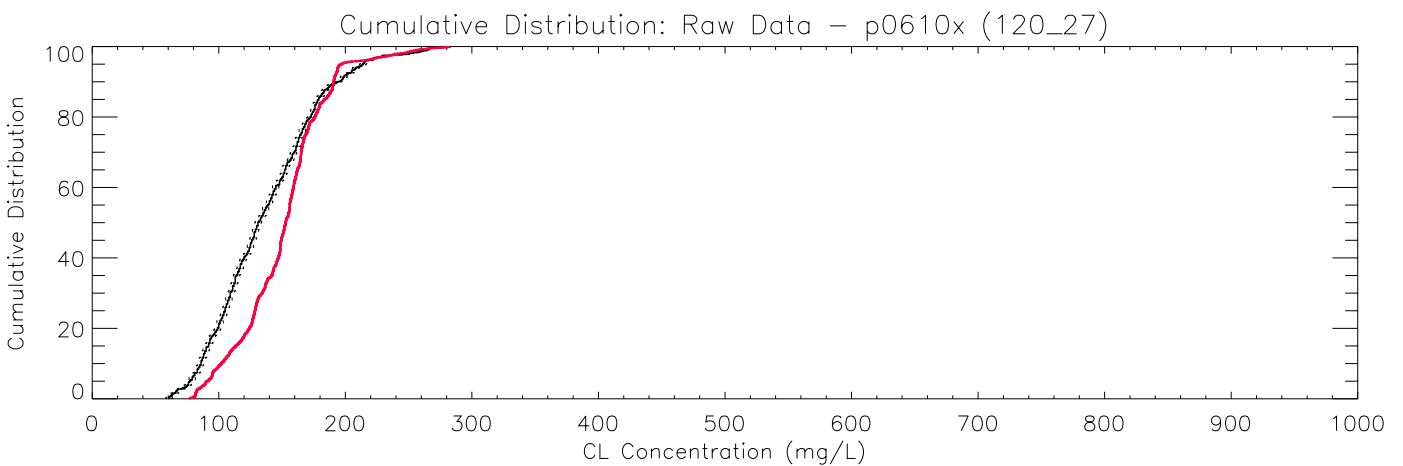
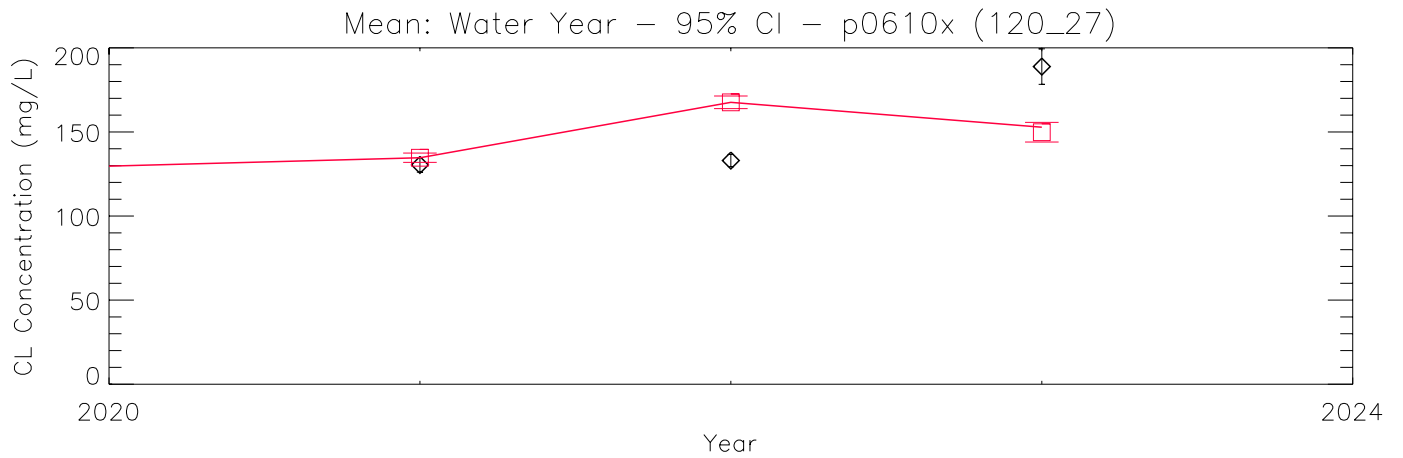
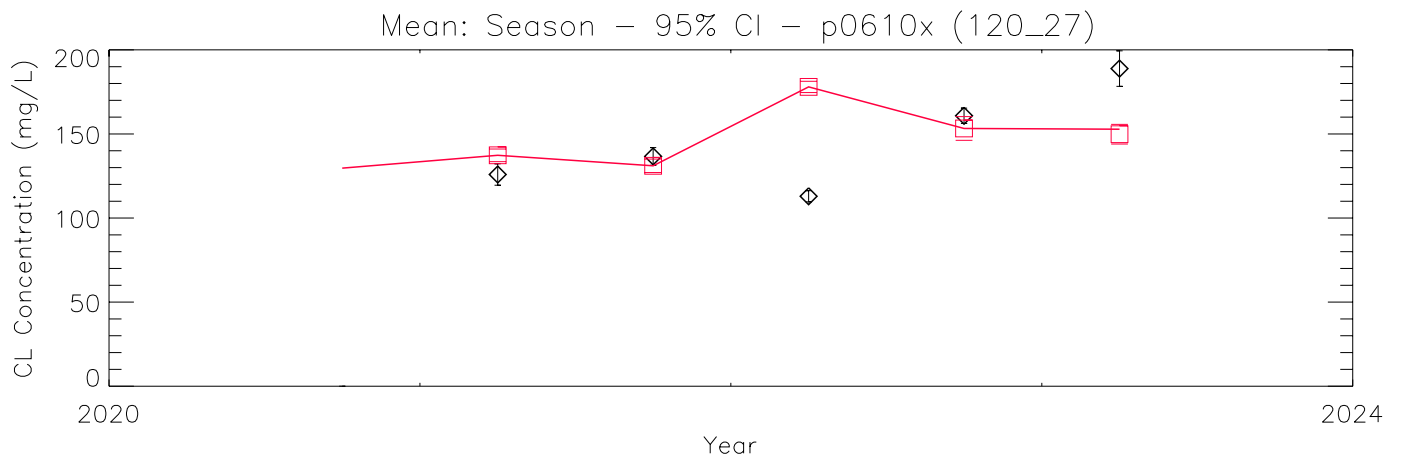
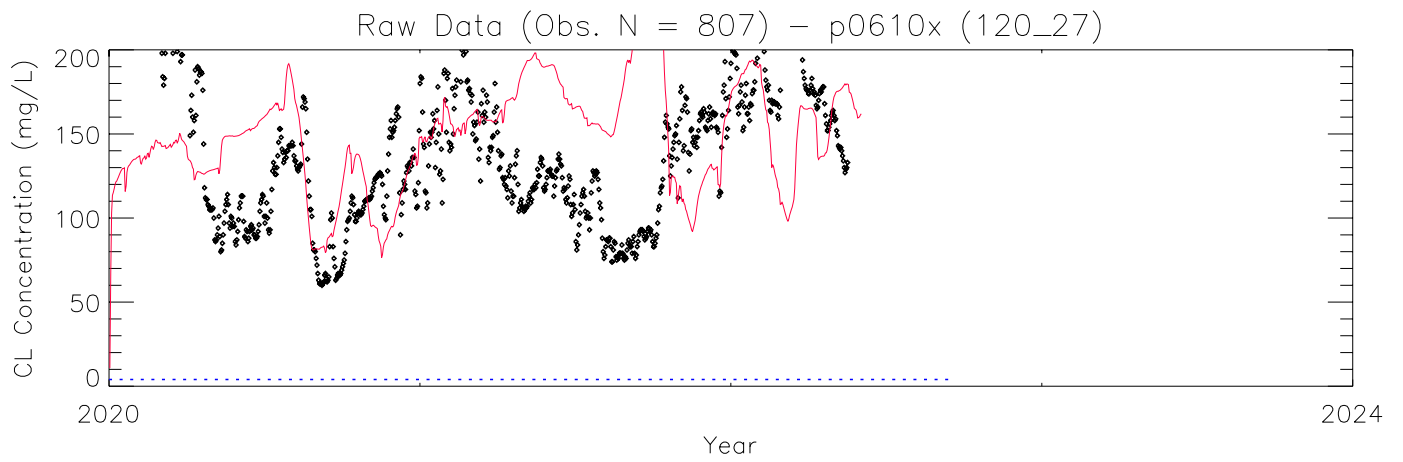
Cumulative Distribution: Raw Data - p0606x (121_170)



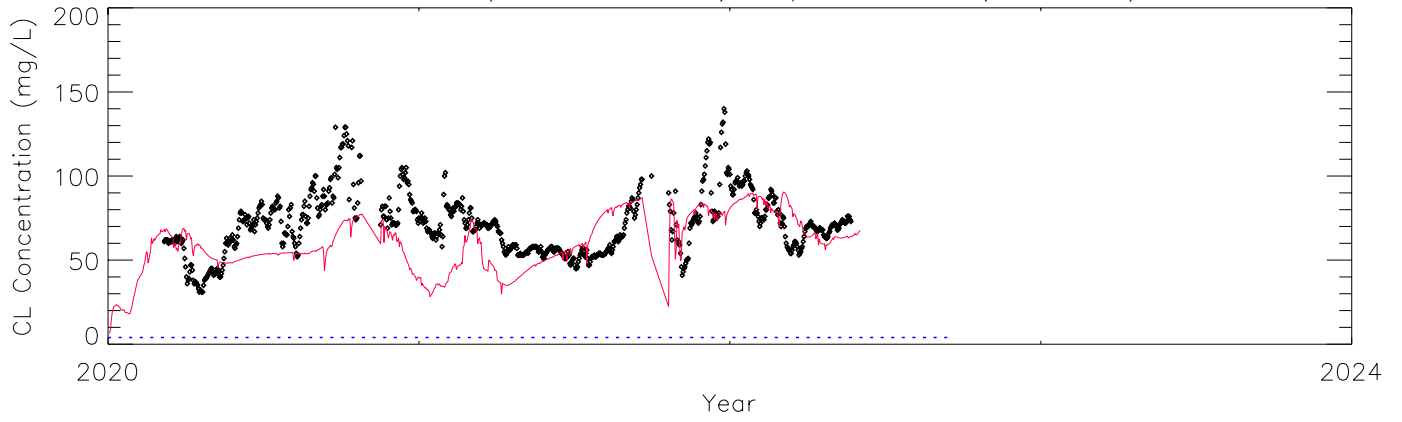




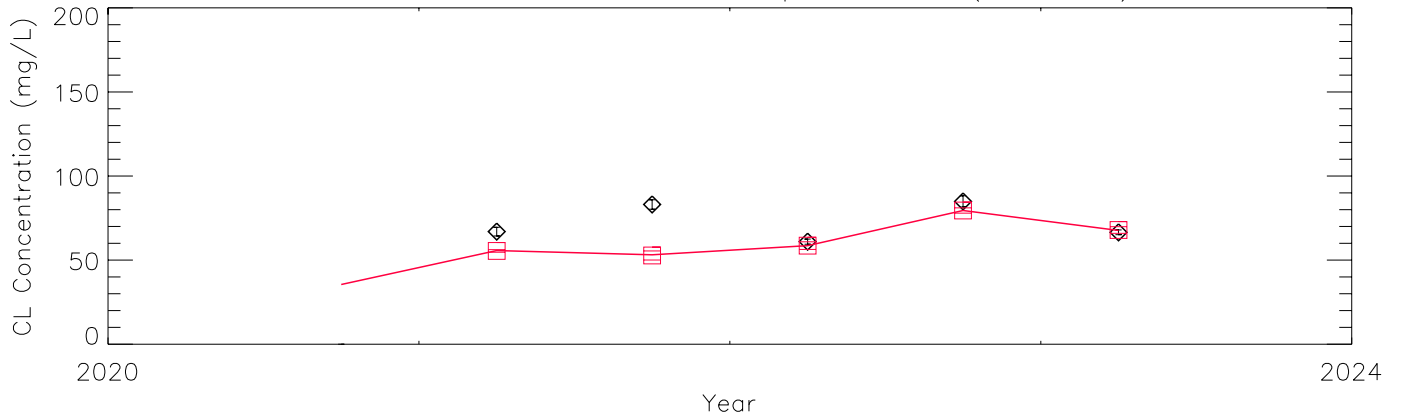




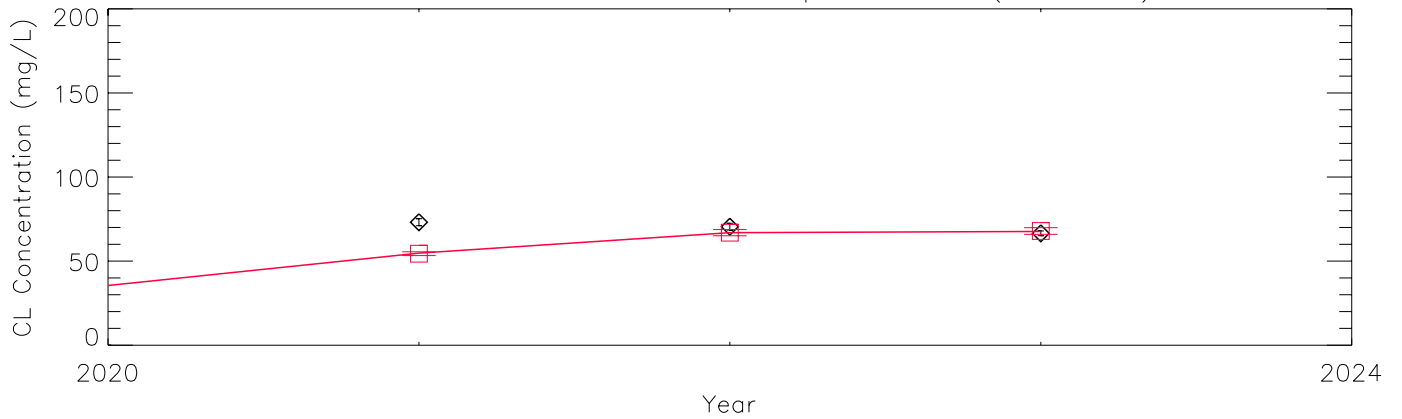
Raw Data (Obs. N = 753) – p0702canx (160_288)



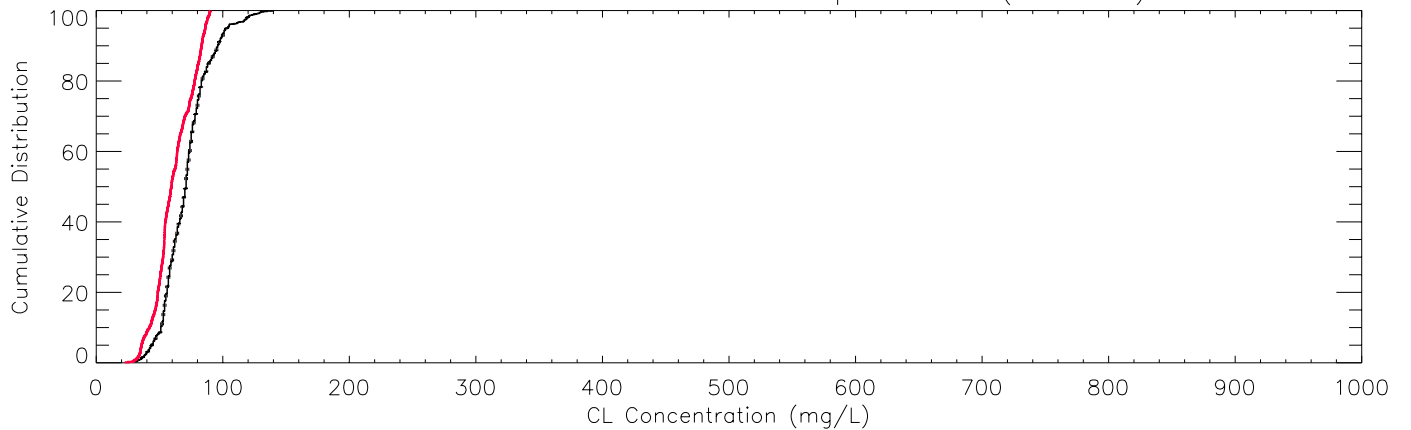
Mean: Season – 95% CI – p0702canx (160_288)



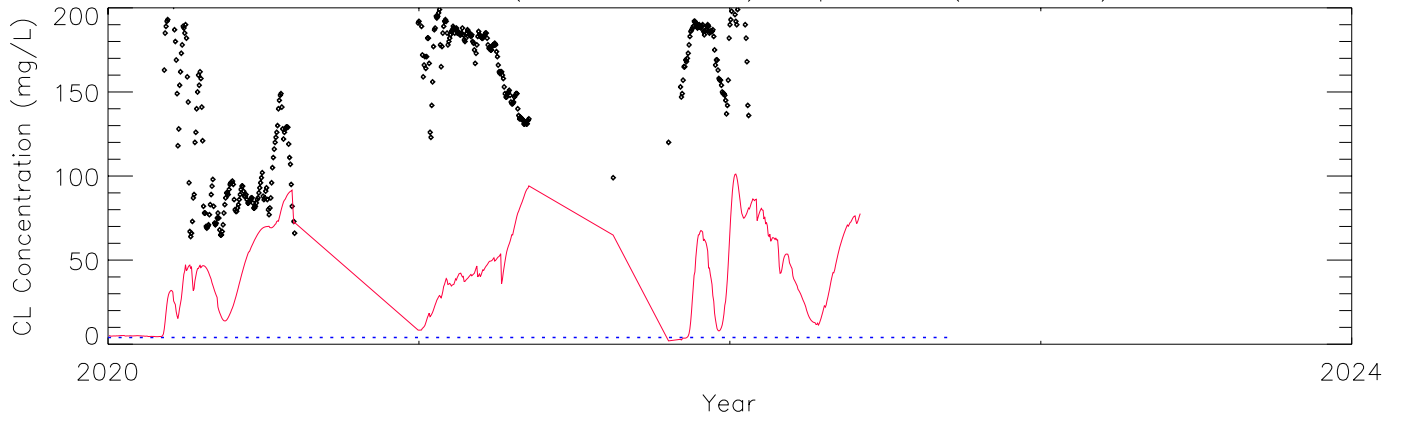
Mean: Water Year – 95% CI – p0702canx (160_288)



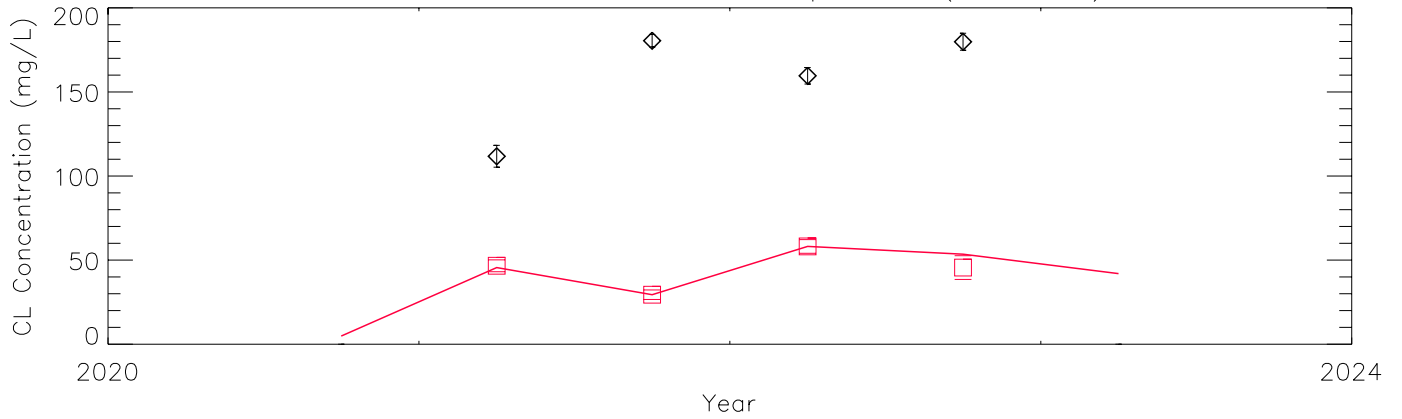
Cumulative Distribution: Raw Data – p0702canx (160_288)



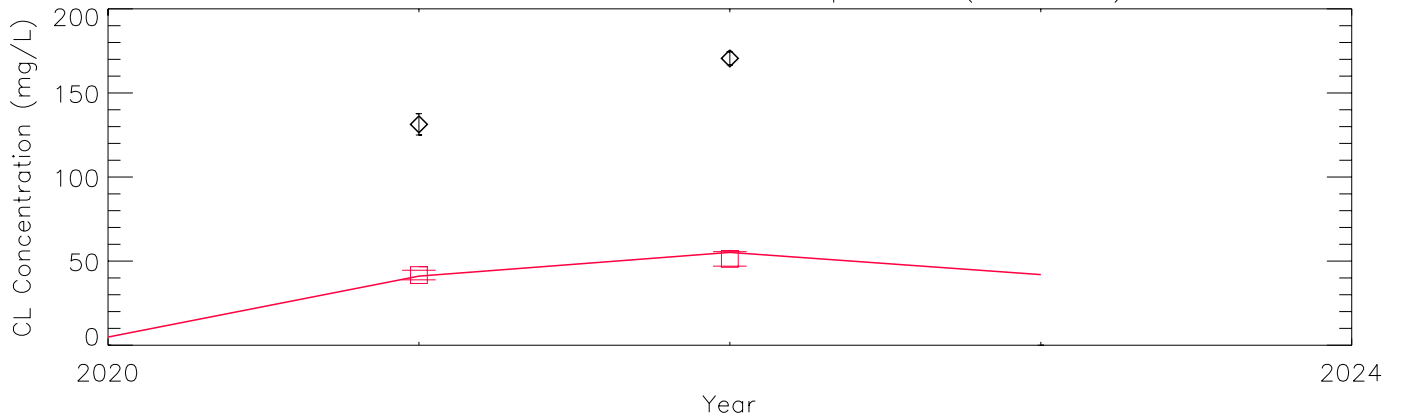
Raw Data (Obs. N = 365) - p0703x (138_275)



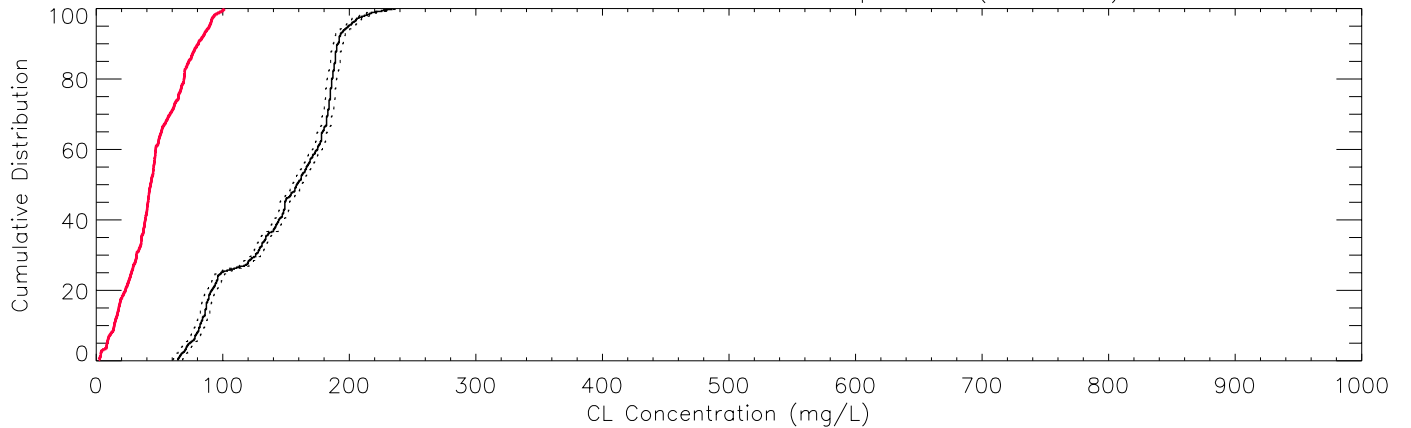
Mean: Season - 95% CI - p0703x (138_275)



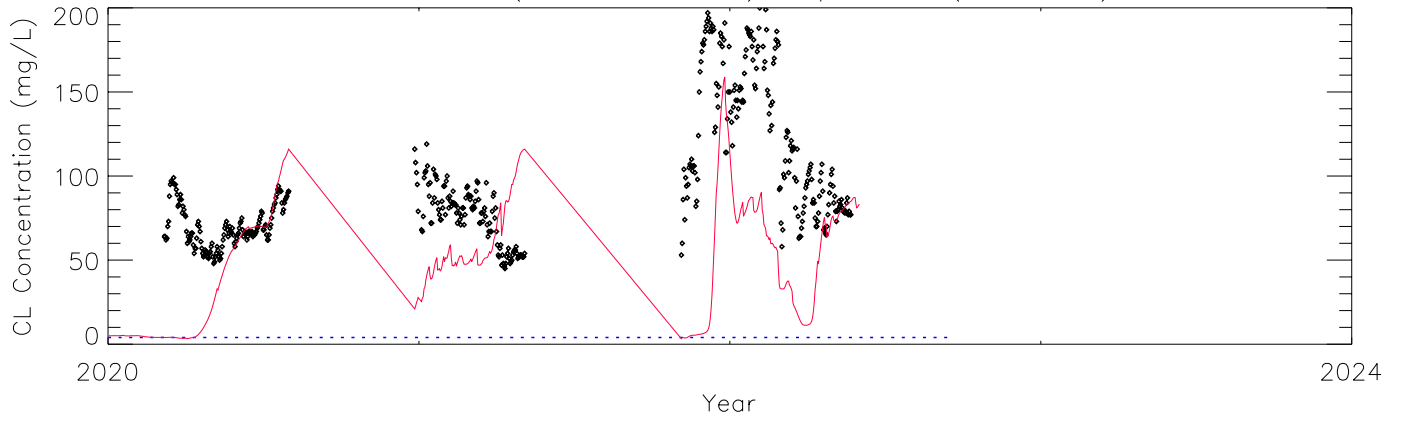
Mean: Water Year - 95% CI - p0703x (138_275)



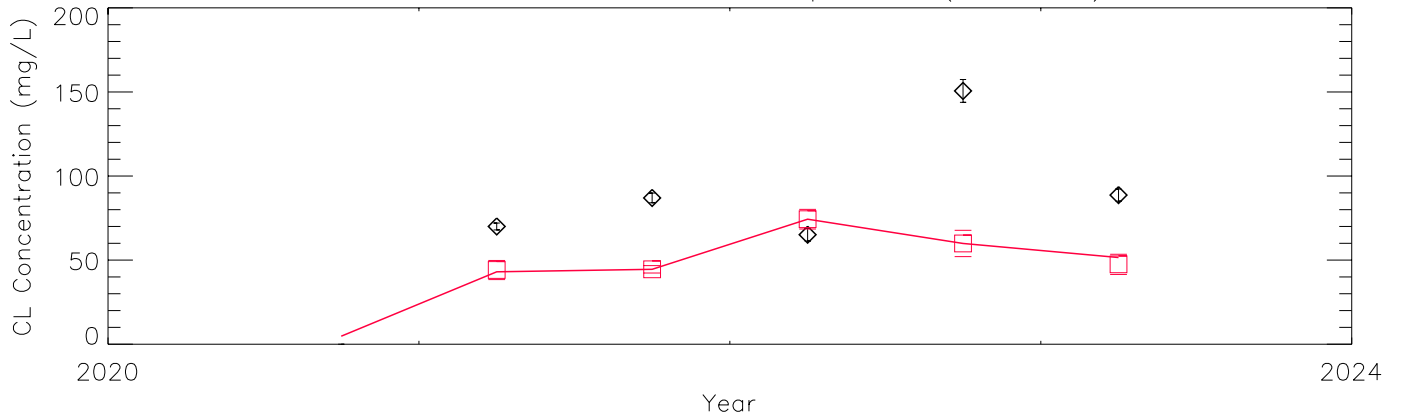
Cumulative Distribution: Raw Data - p0703x (138_275)



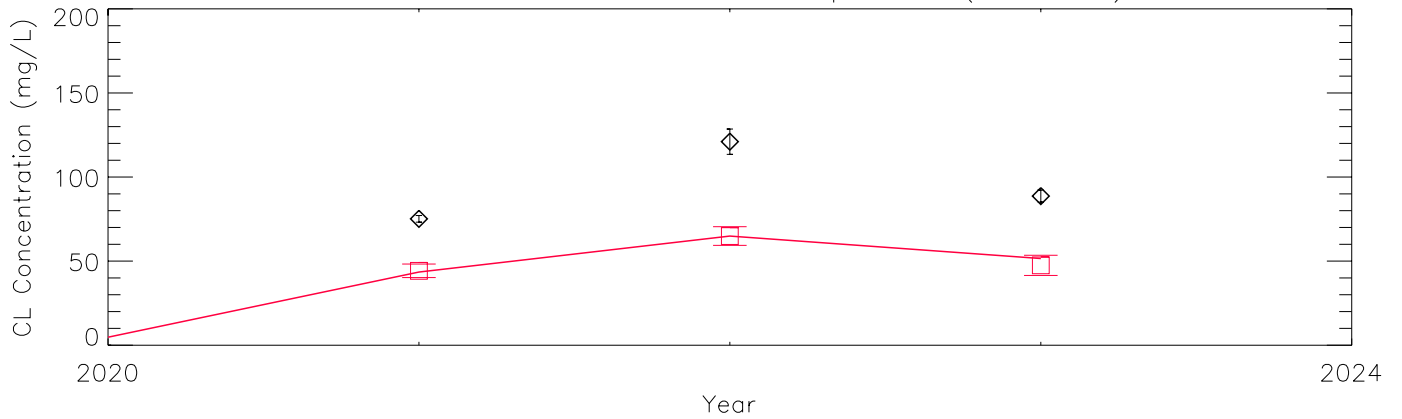
Raw Data (Obs. N = 474) - p0704x (157_239)



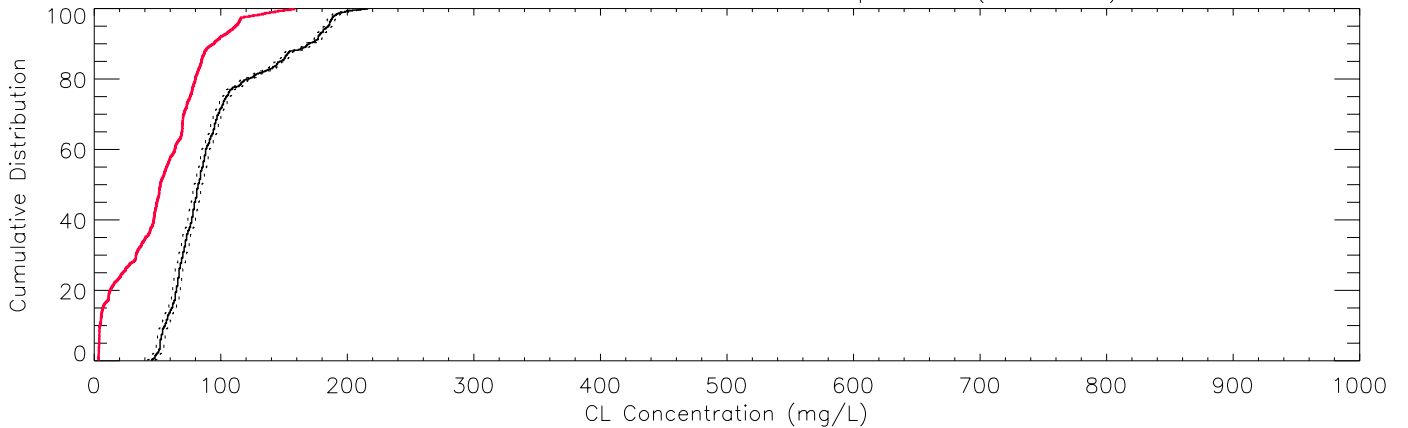
Mean: Season - 95% CI - p0704x (157_239)



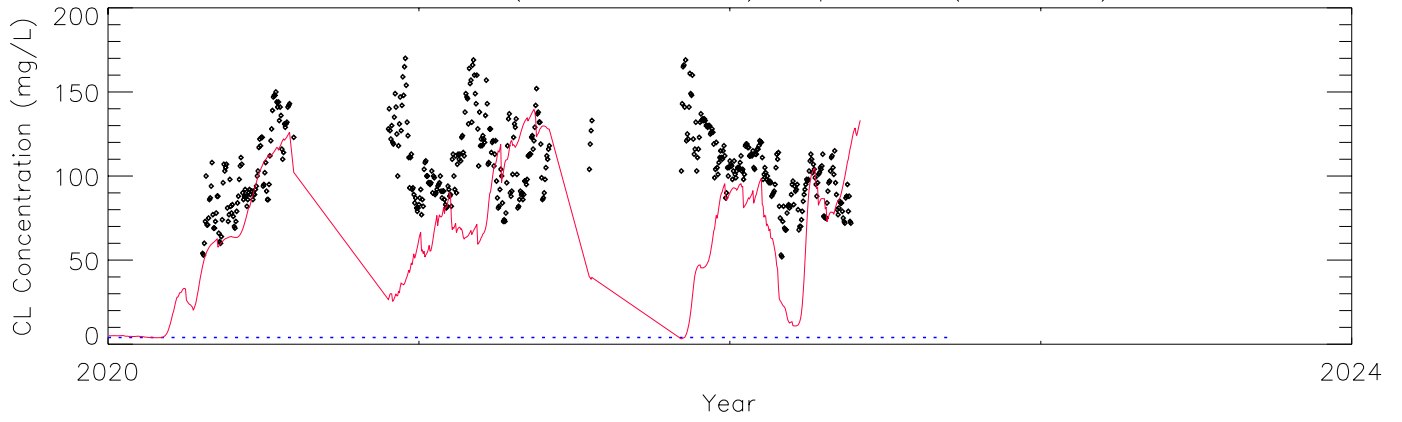
Mean: Water Year - 95% CI - p0704x (157_239)



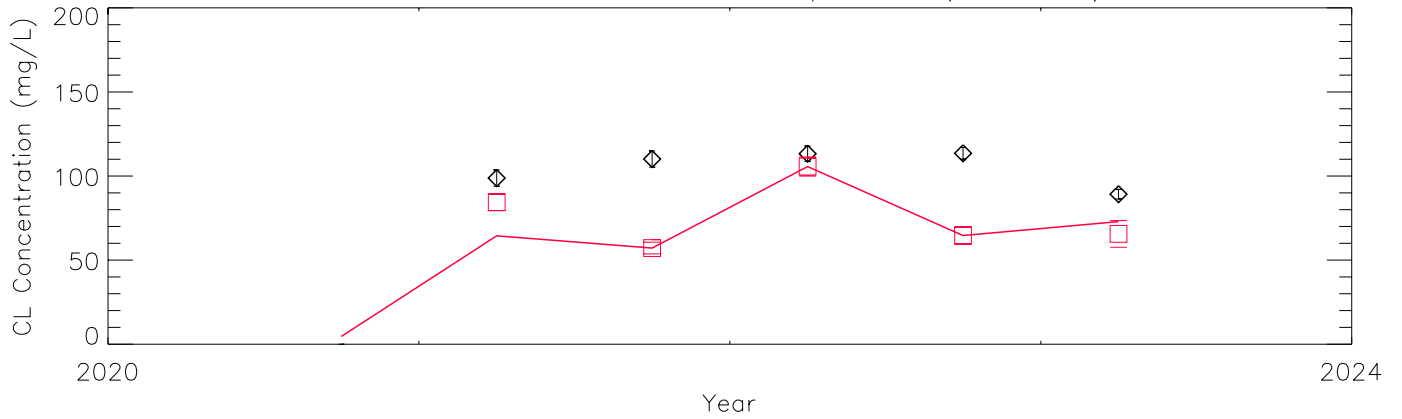
Cumulative Distribution: Raw Data - p0704x (157_239)



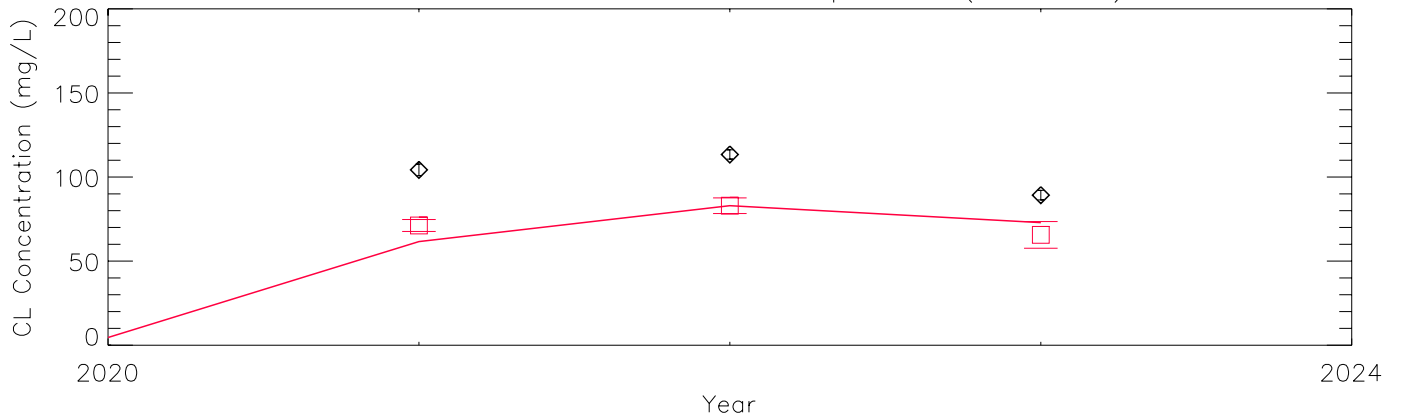
Raw Data (Obs. N = 498) - p0705x (139_206)



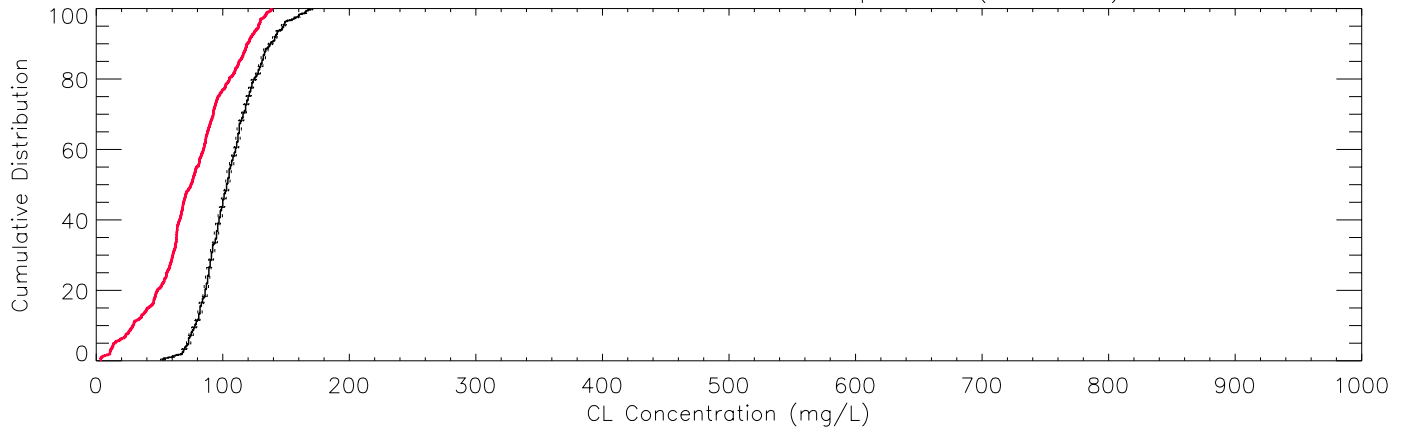
Mean: Season - 95% CI - p0705x (139_206)



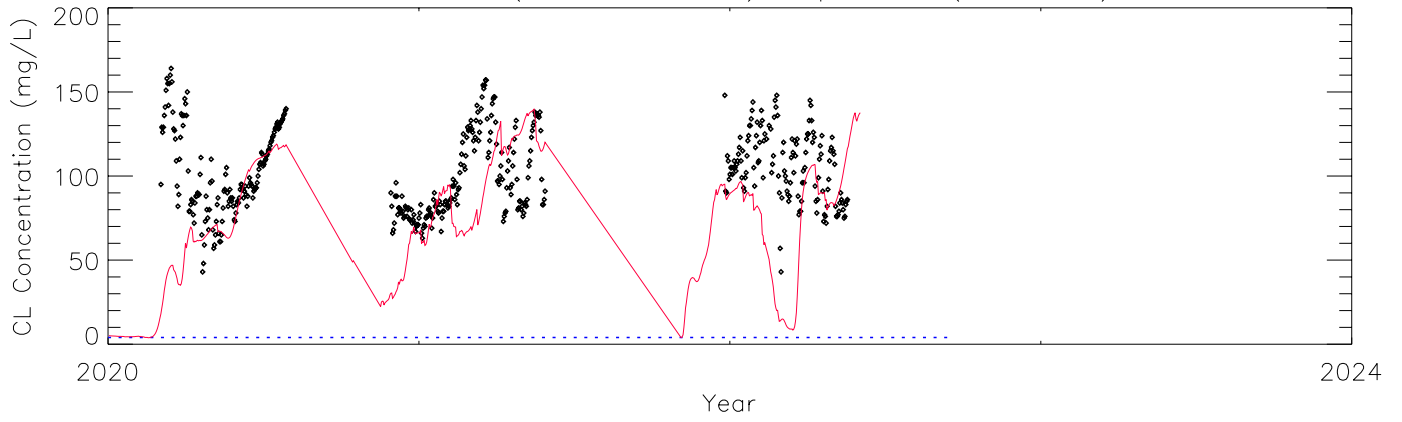
Mean: Water Year - 95% CI - p0705x (139_206)



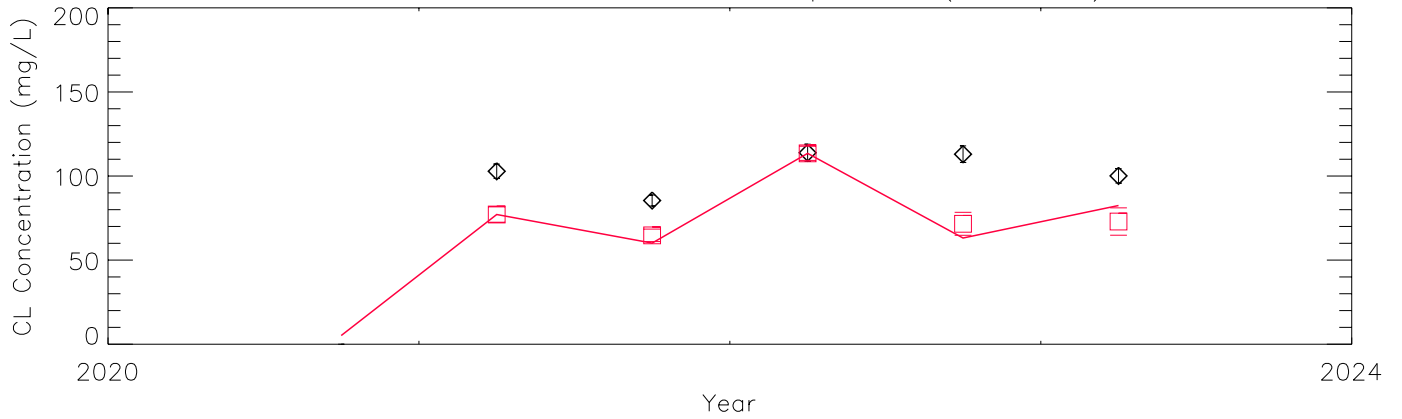
Cumulative Distribution: Raw Data - p0705x (139_206)



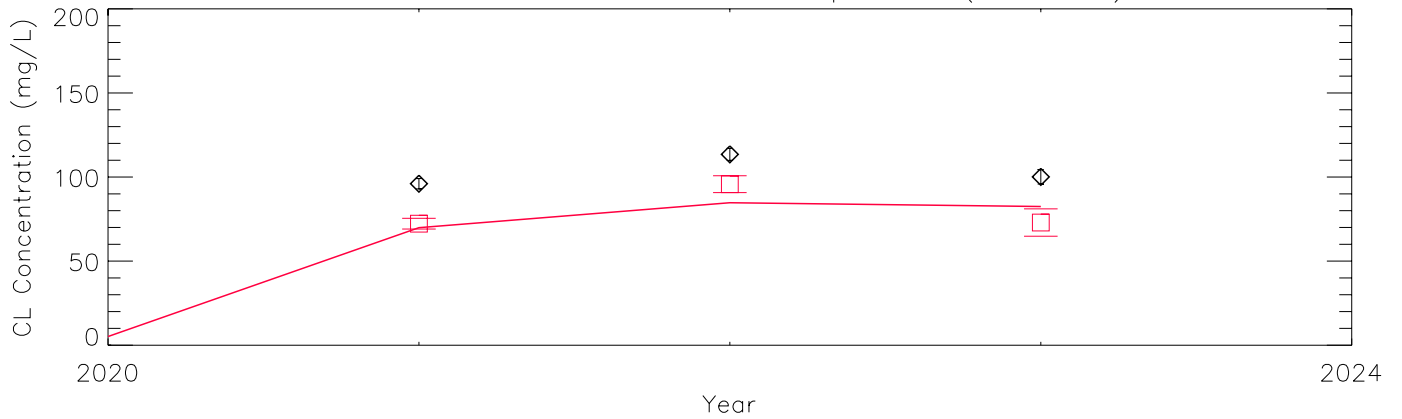
Raw Data (Obs. N = 471) - p0706x (159_171)



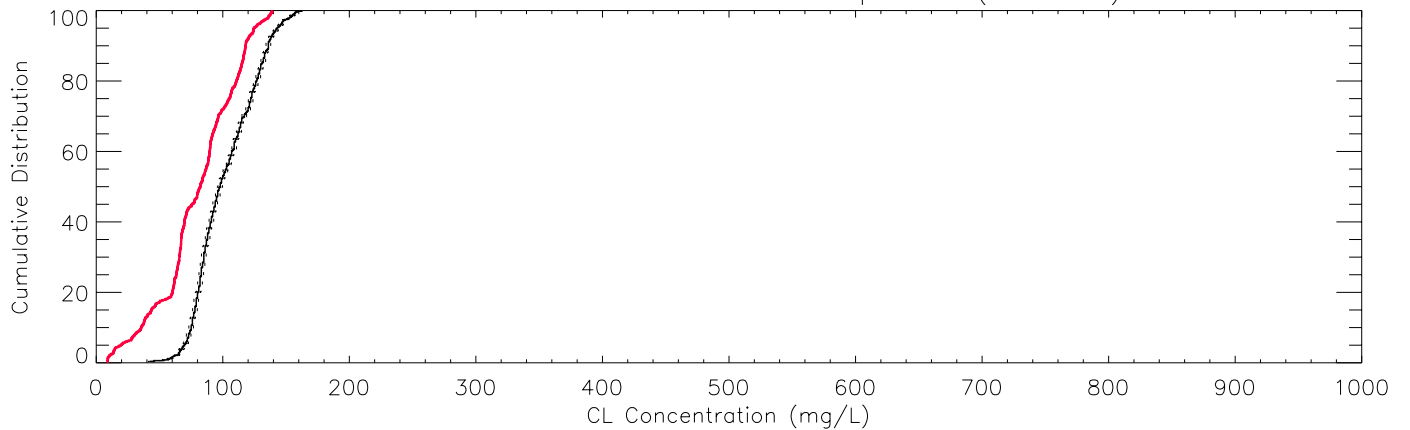
Mean: Season - 95% CI - p0706x (159_171)



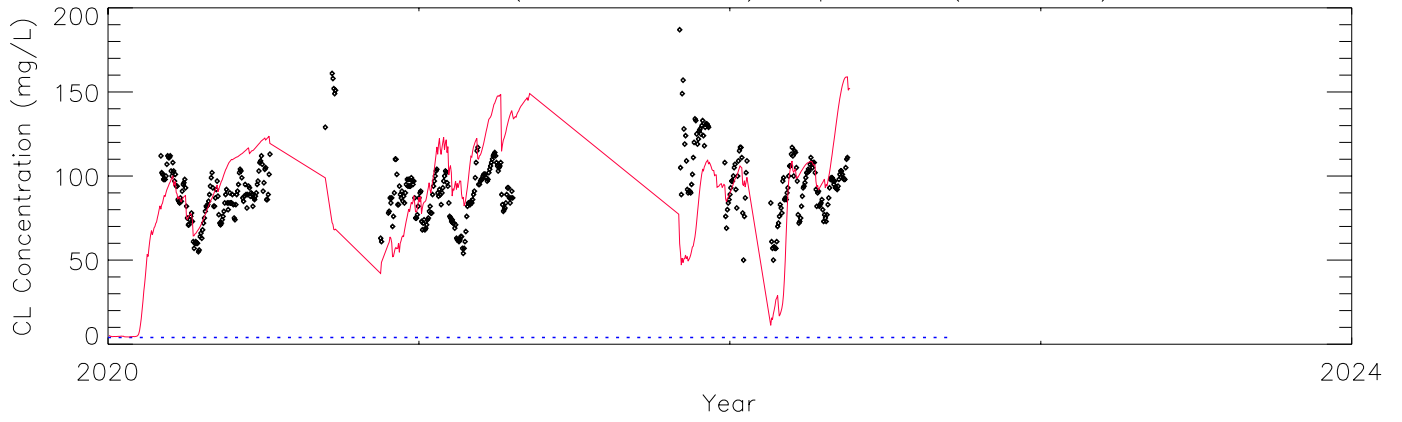
Mean: Water Year - 95% CI - p0706x (159_171)



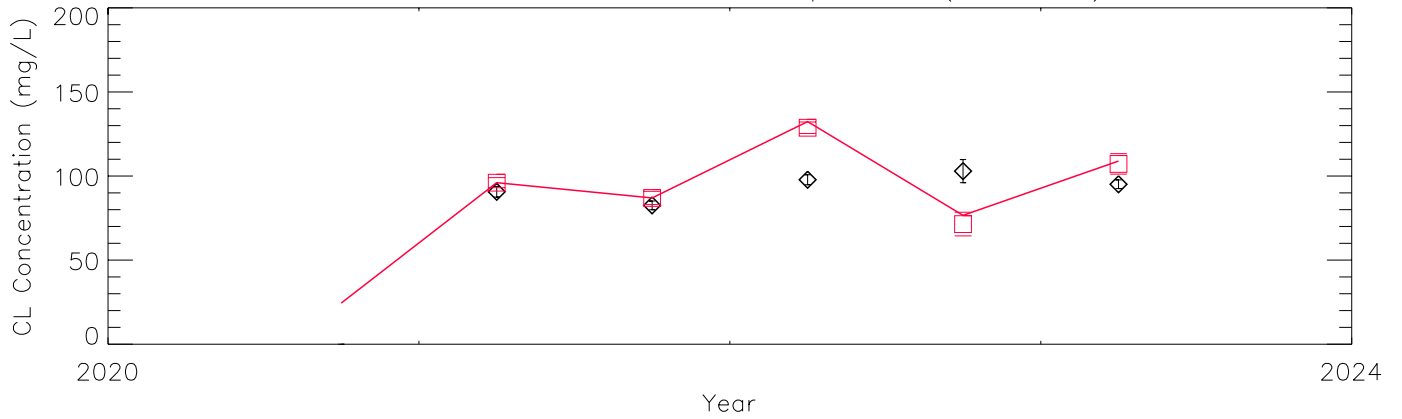
Cumulative Distribution: Raw Data - p0706x (159_171)



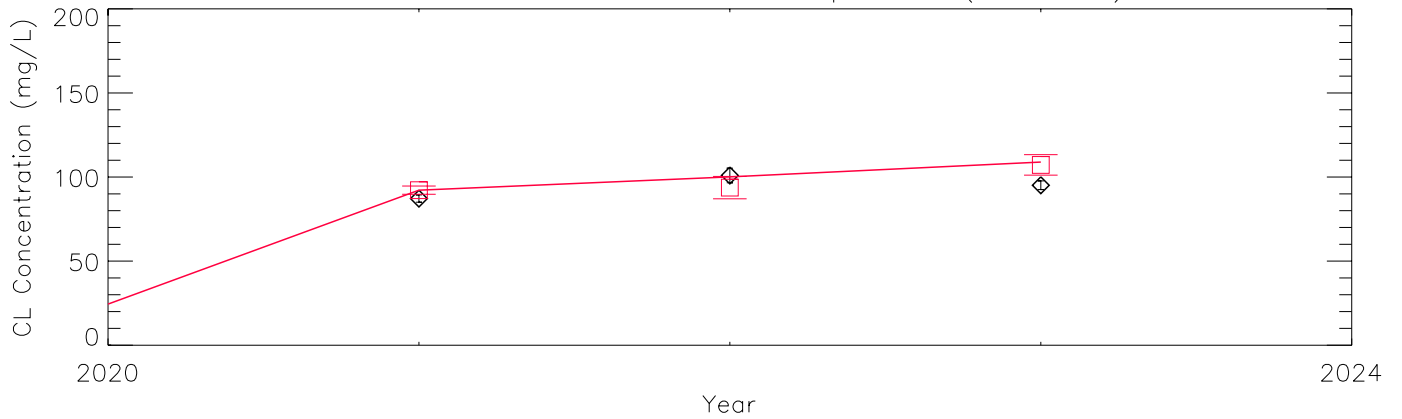
Raw Data (Obs. N = 438) - p0707x (139_136)



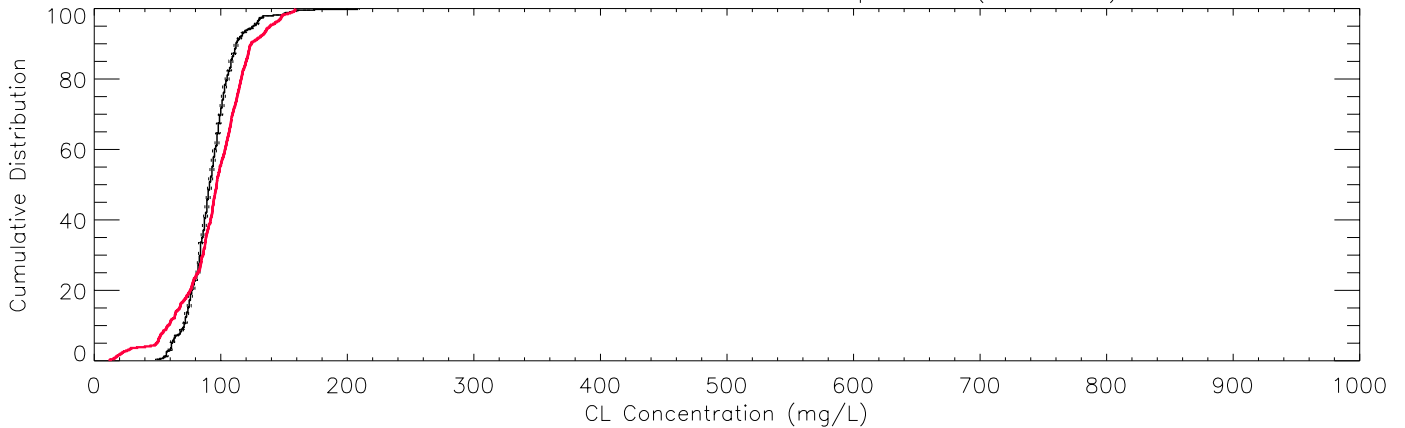
Mean: Season - 95% CI - p0707x (139_136)



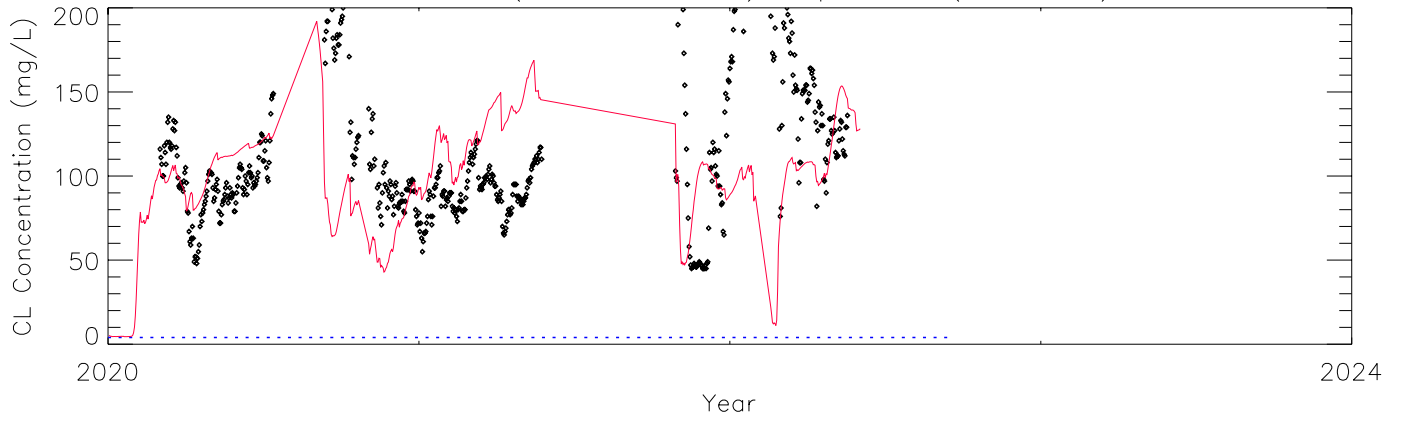
Mean: Water Year - 95% CI - p0707x (139_136)



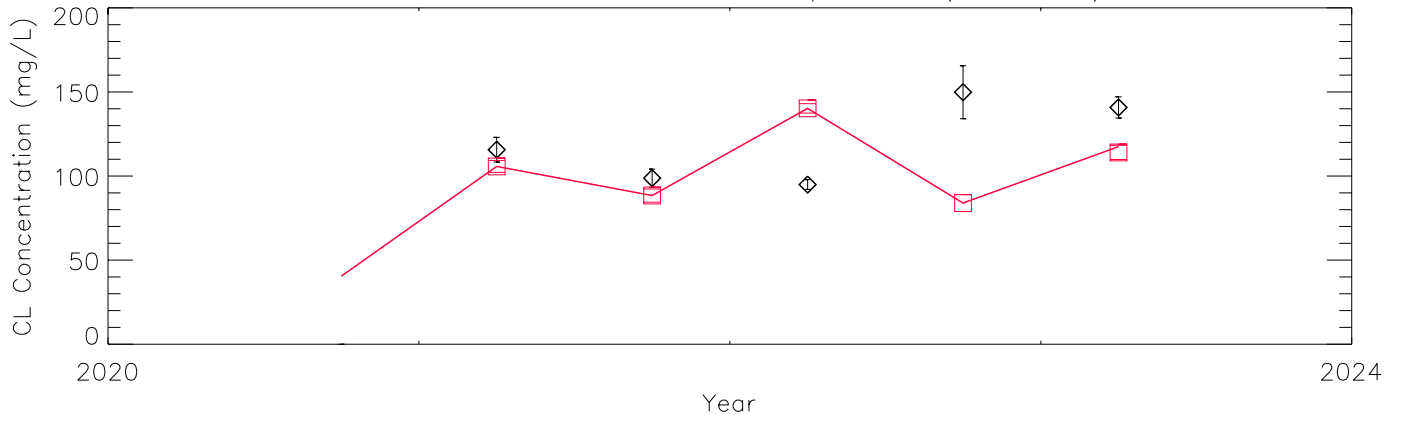
Cumulative Distribution: Raw Data - p0707x (139_136)



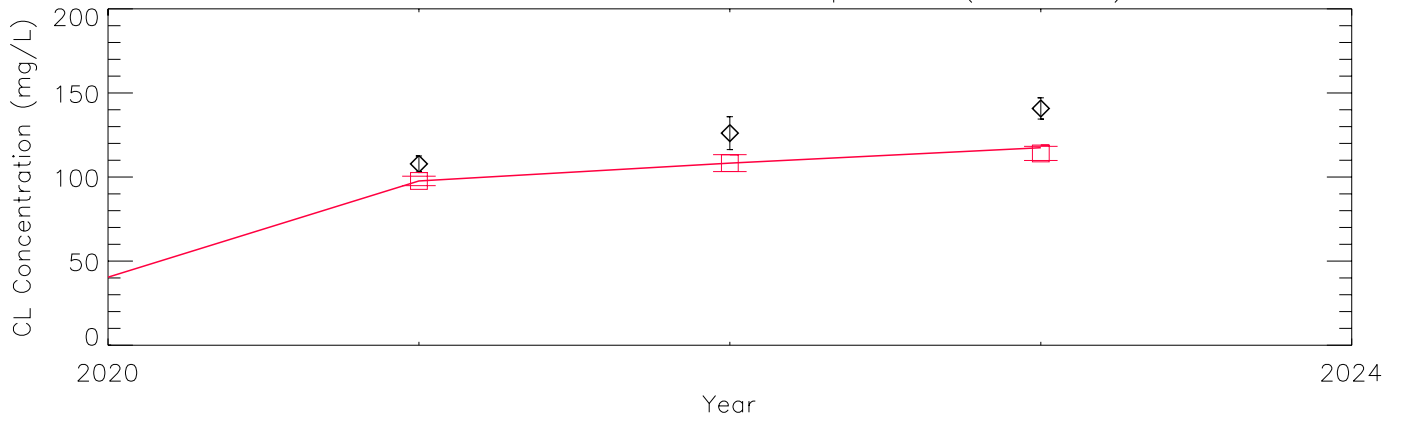
Raw Data (Obs. N = 572) - p0708x (158_102)



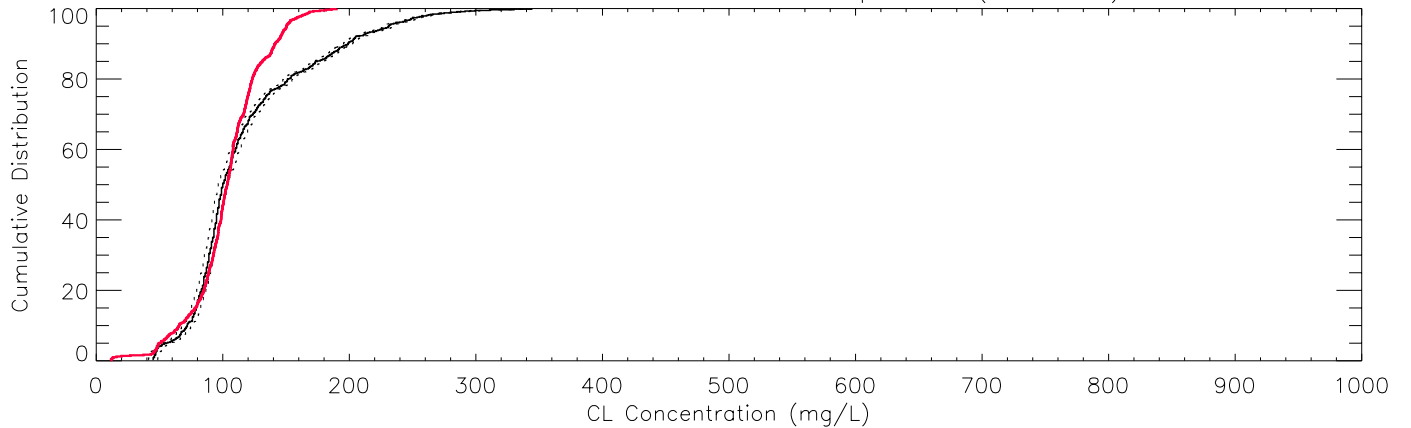
Mean: Season - 95% CI - p0708x (158_102)

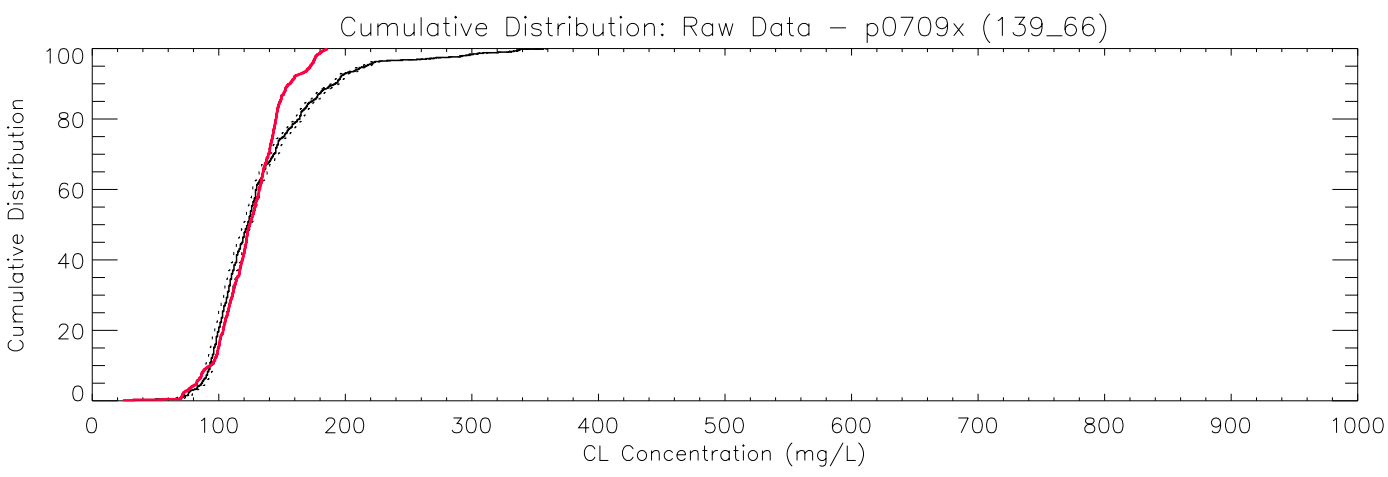
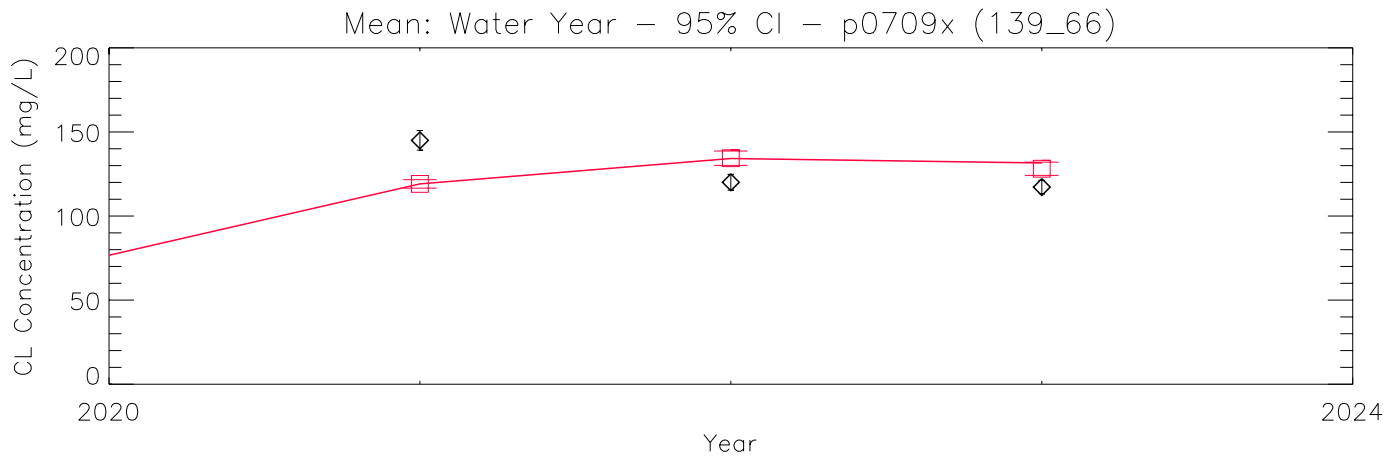
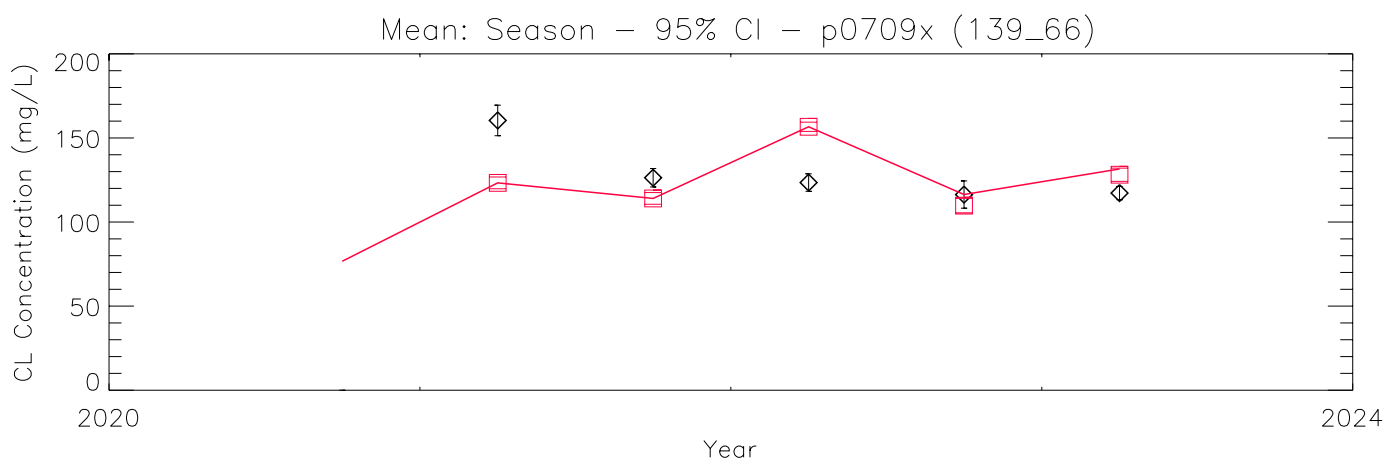
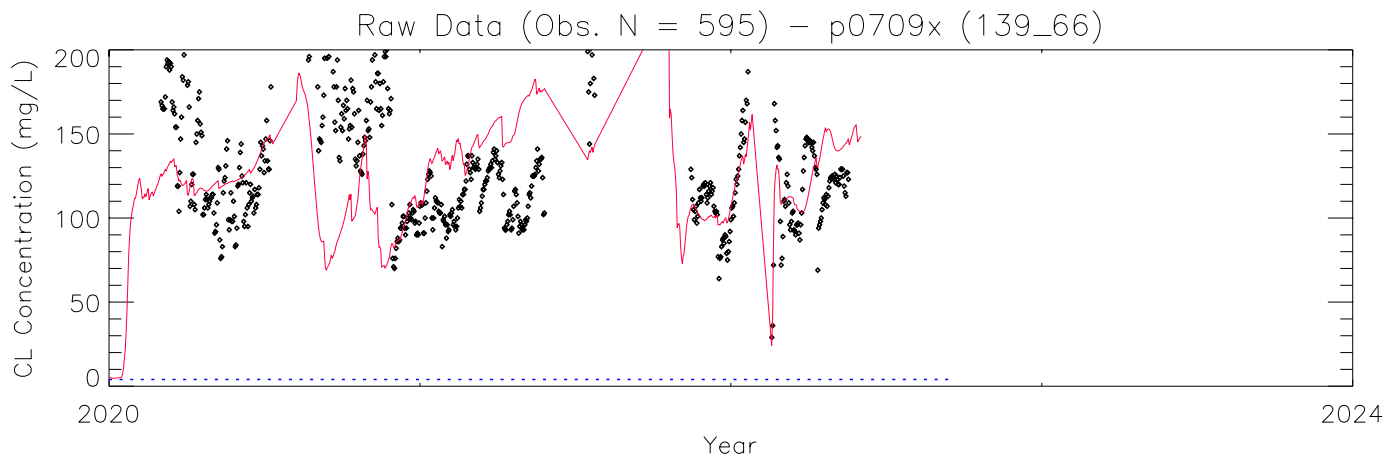


Mean: Water Year - 95% CI - p0708x (158_102)

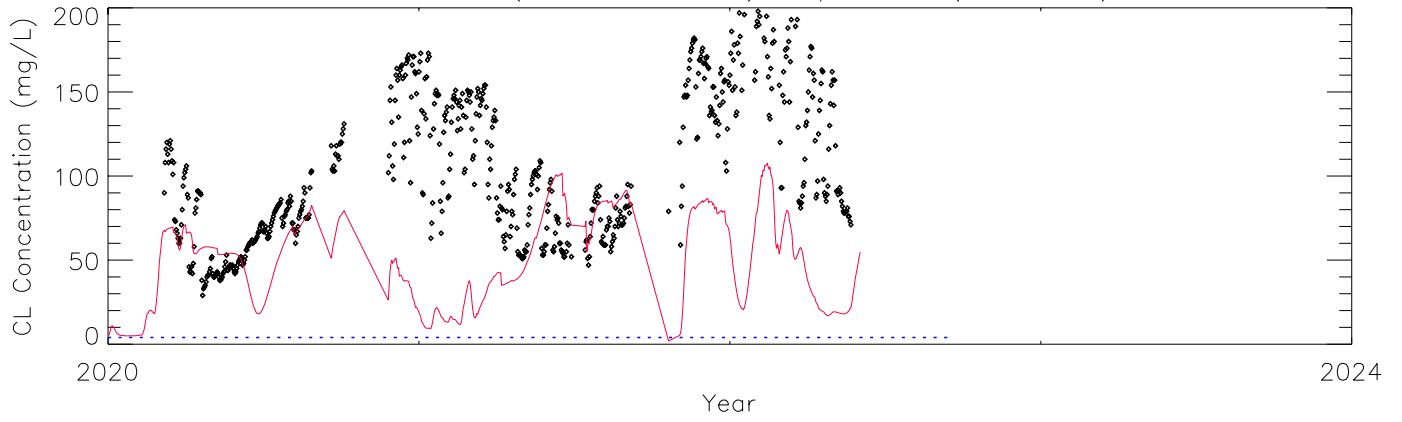


Cumulative Distribution: Raw Data - p0708x (158_102)

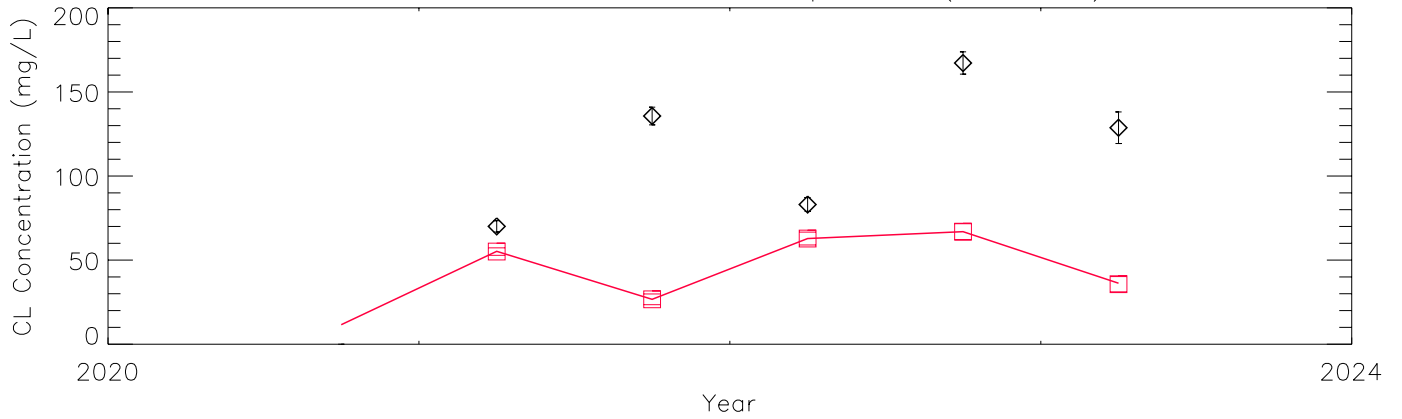




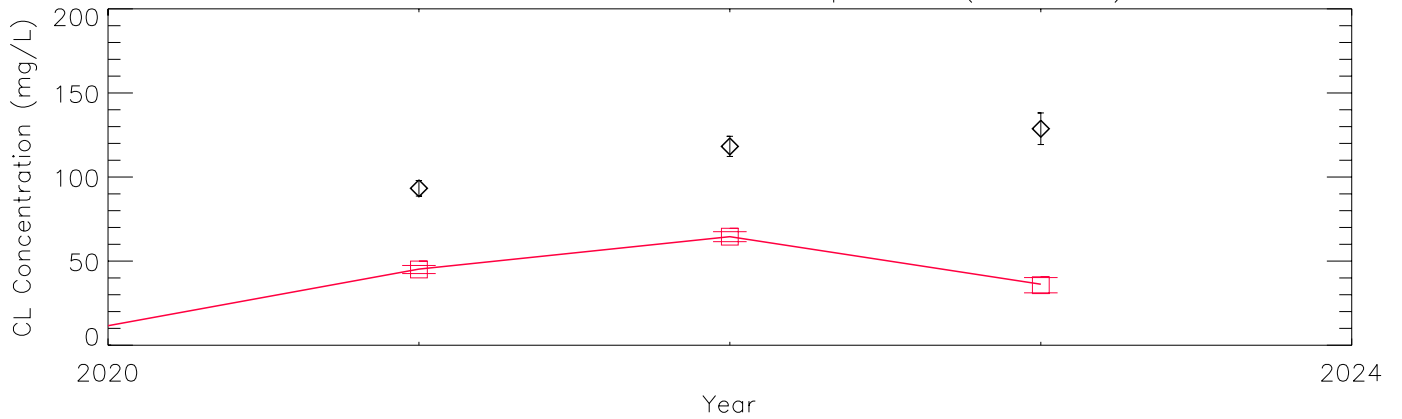
Raw Data (Obs. N = 661) - p0803x (180_275)



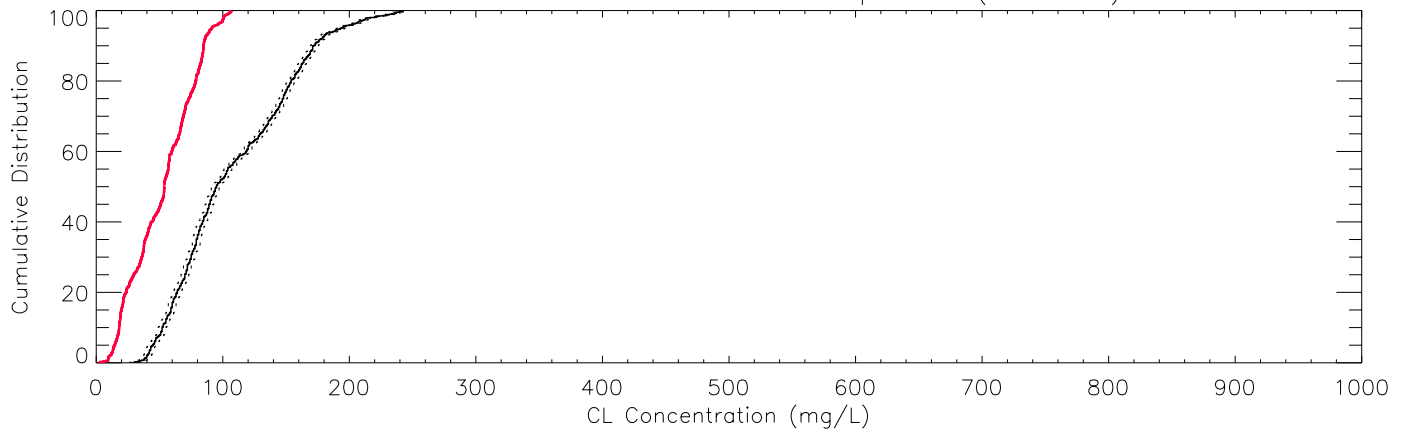
Mean: Season - 95% CI - p0803x (180_275)



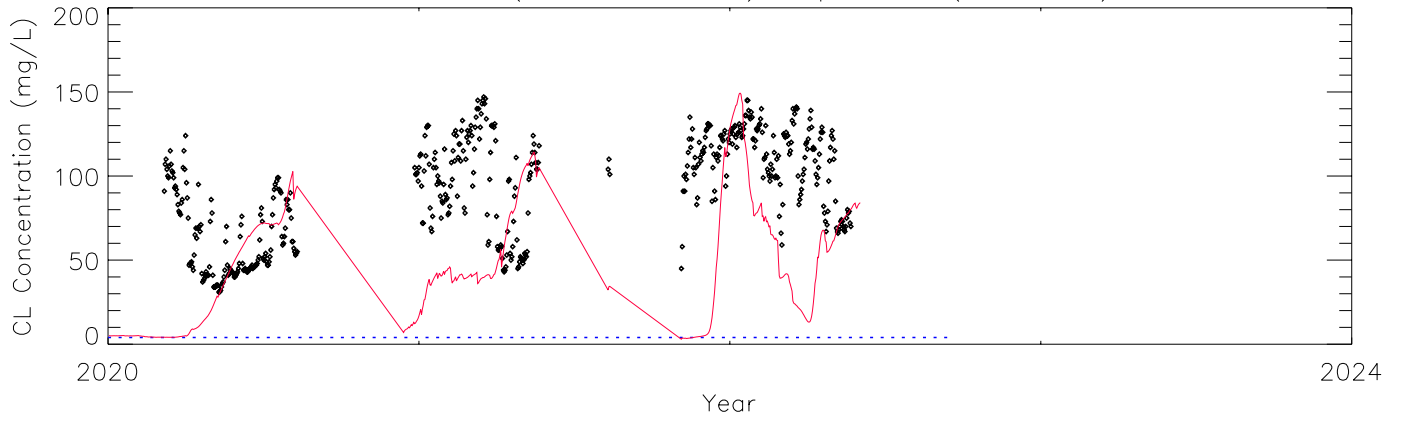
Mean: Water Year - 95% CI - p0803x (180_275)



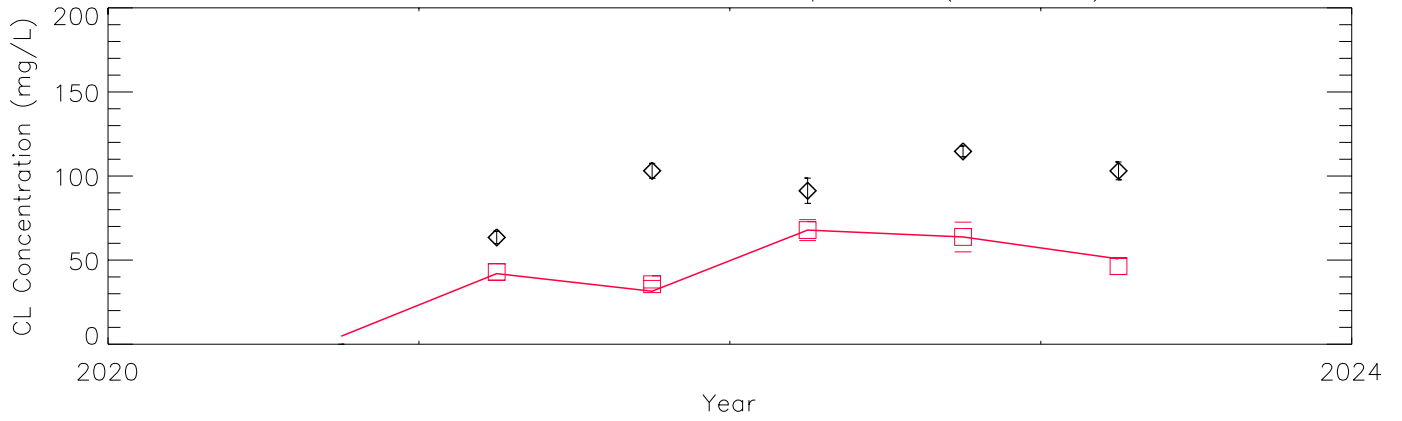
Cumulative Distribution: Raw Data - p0803x (180_275)



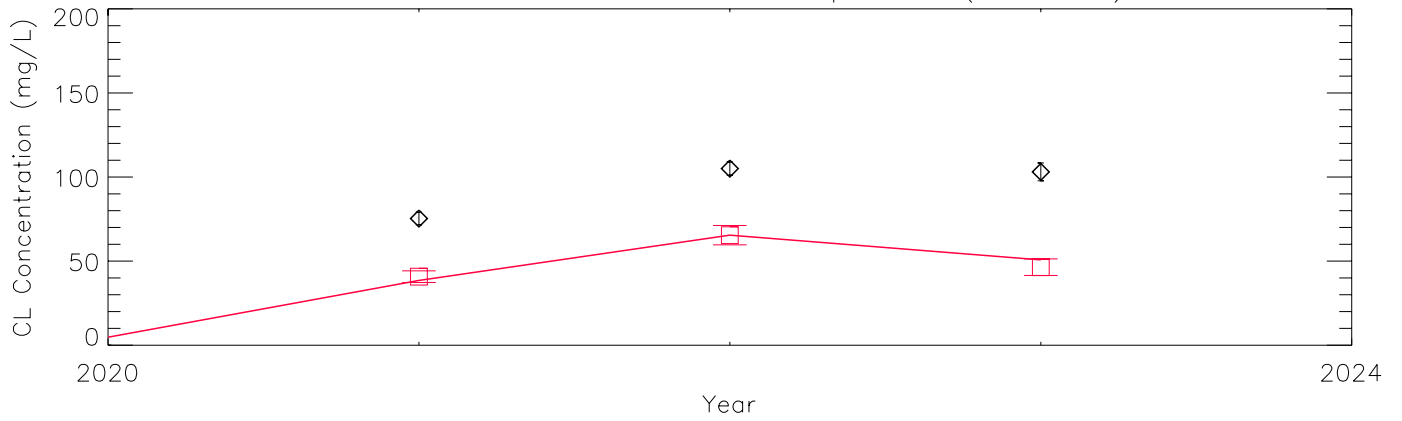
Raw Data (Obs. N = 507) - p0804x (199_240)



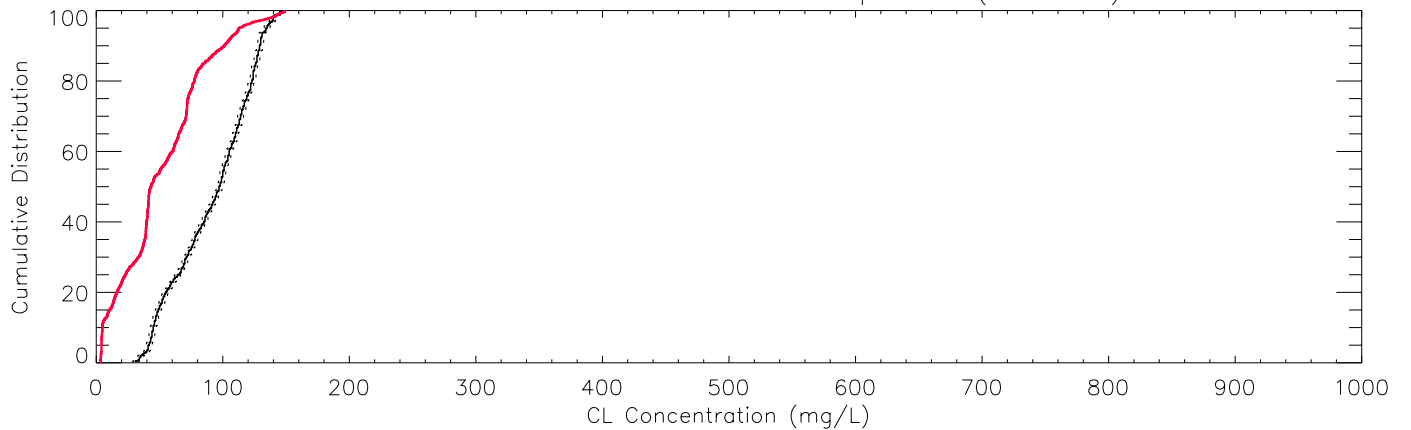
Mean: Season - 95% CI - p0804x (199_240)



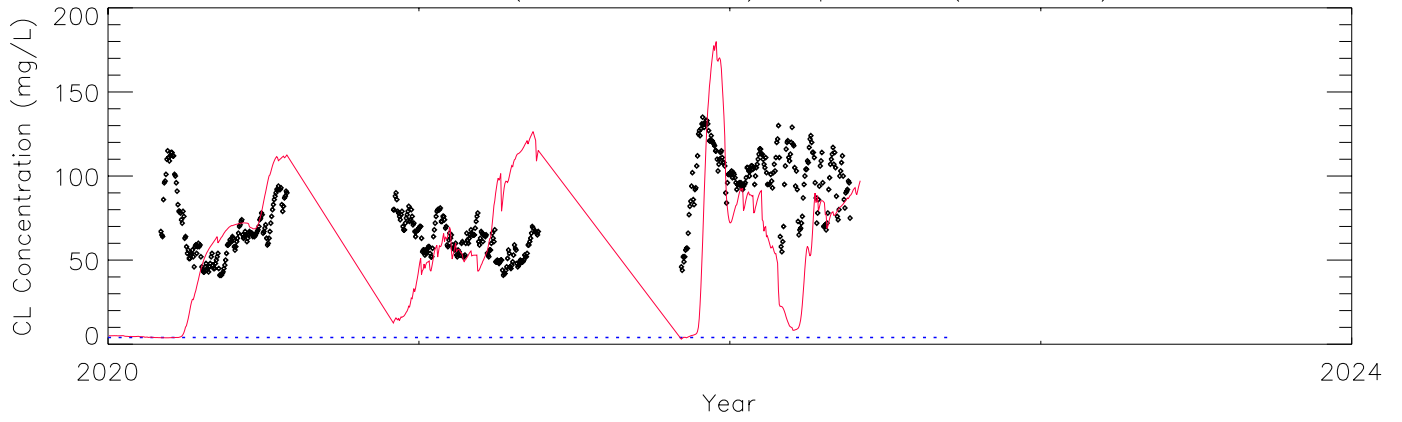
Mean: Water Year - 95% CI - p0804x (199_240)



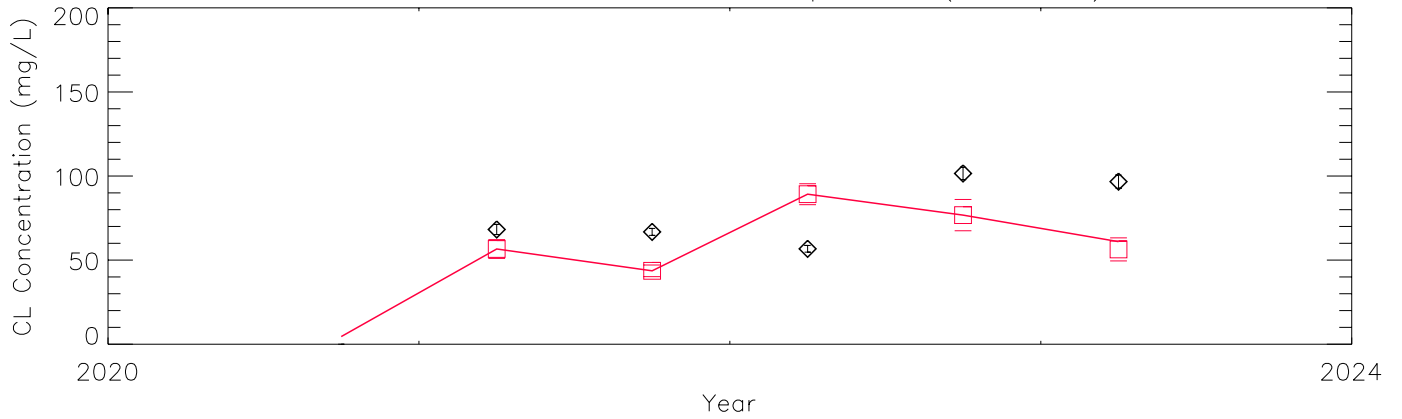
Cumulative Distribution: Raw Data - p0804x (199_240)



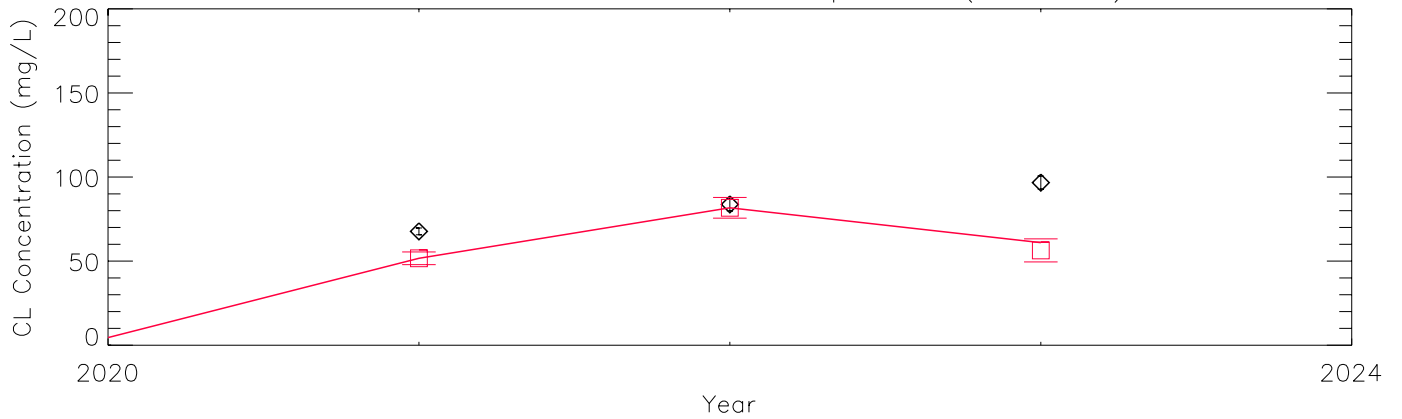
Raw Data (Obs. N = 515) - p0805x (179_206)



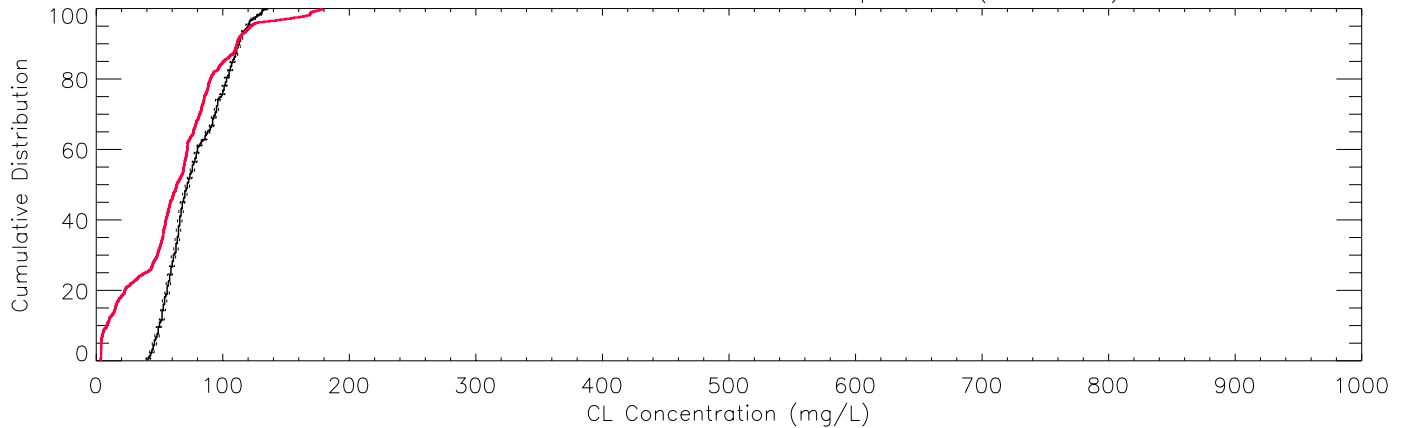
Mean: Season - 95% CI - p0805x (179_206)



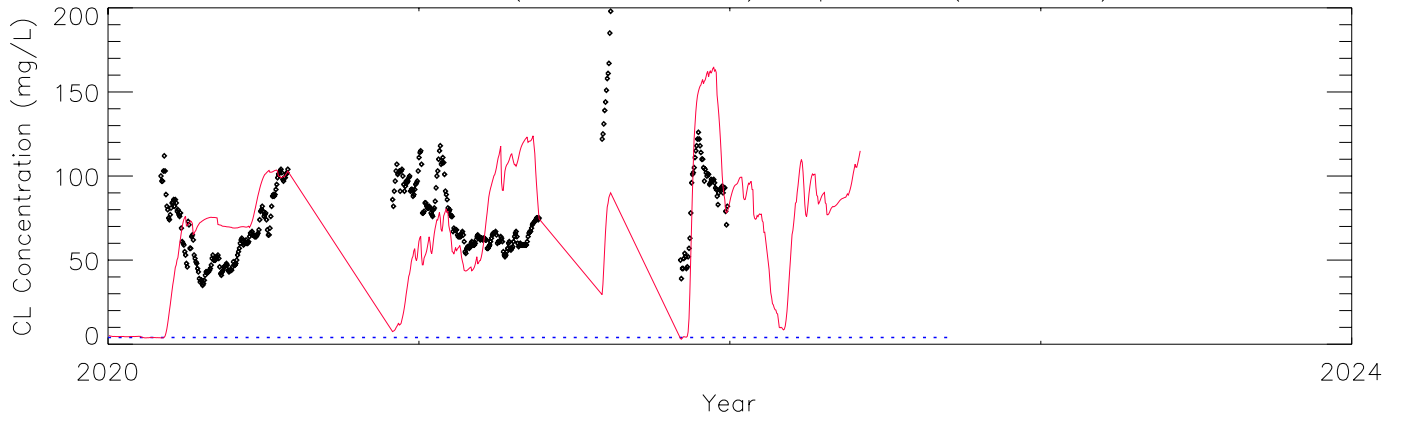
Mean: Water Year - 95% CI - p0805x (179_206)



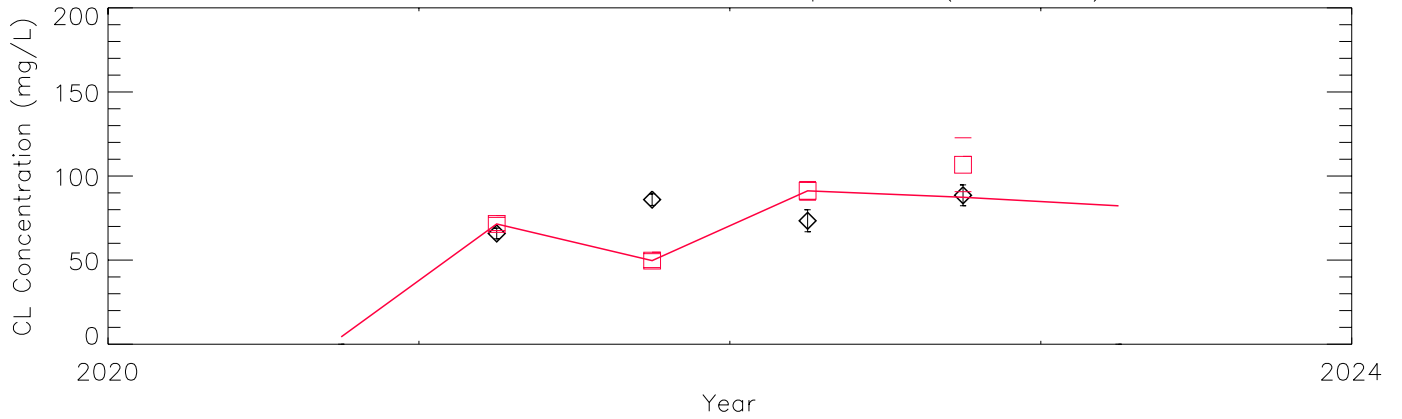
Cumulative Distribution: Raw Data - p0805x (179_206)



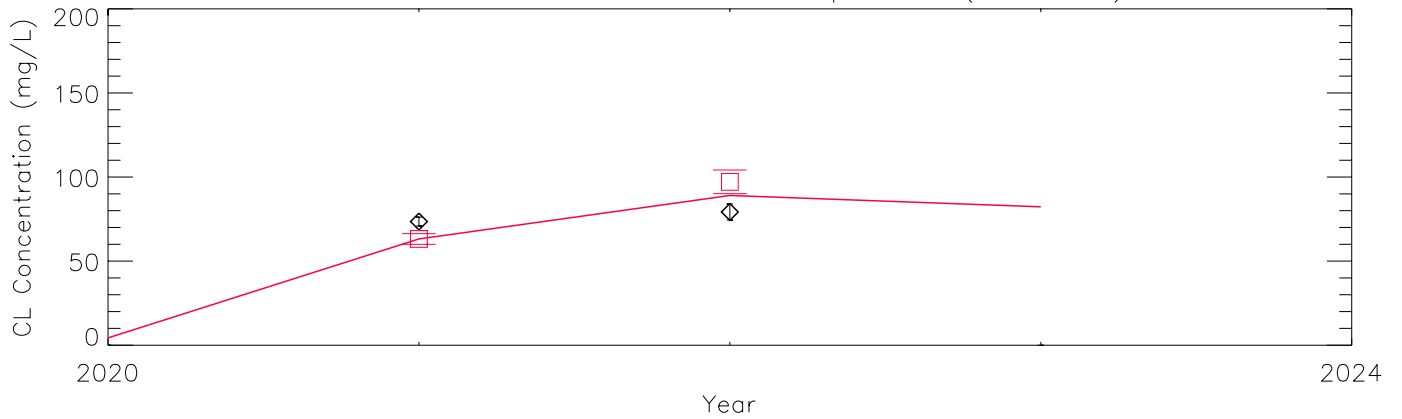
Raw Data (Obs. N = 389) - p0806x (198_172)



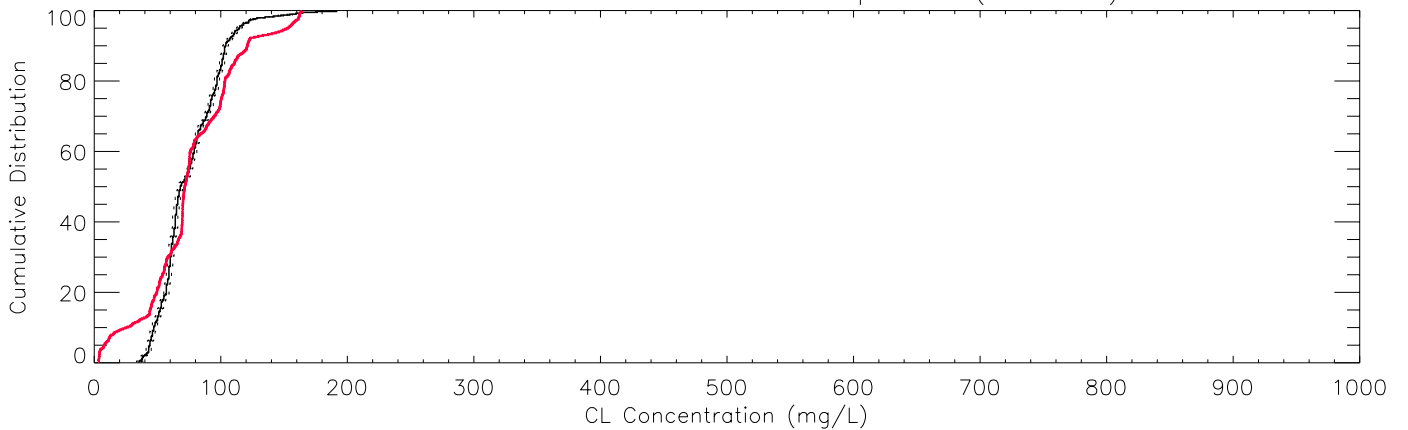
Mean: Season - 95% CI - p0806x (198_172)

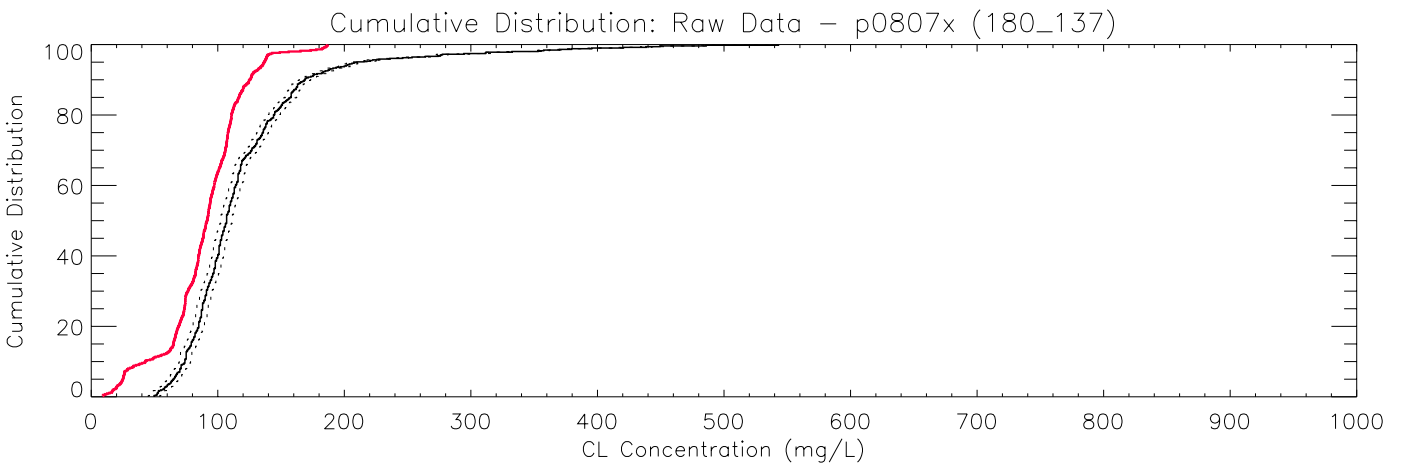
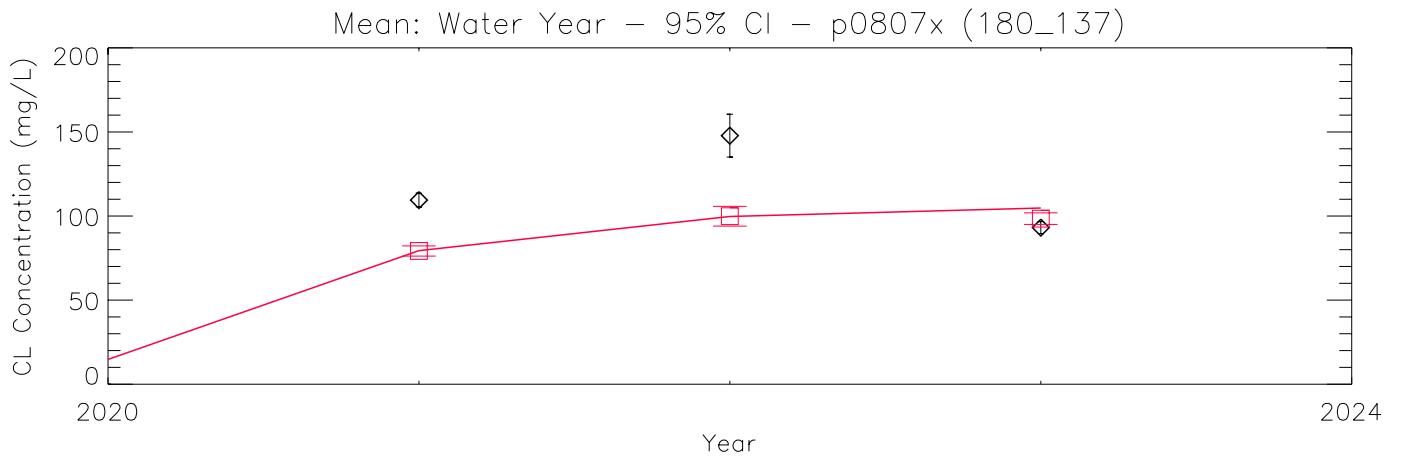
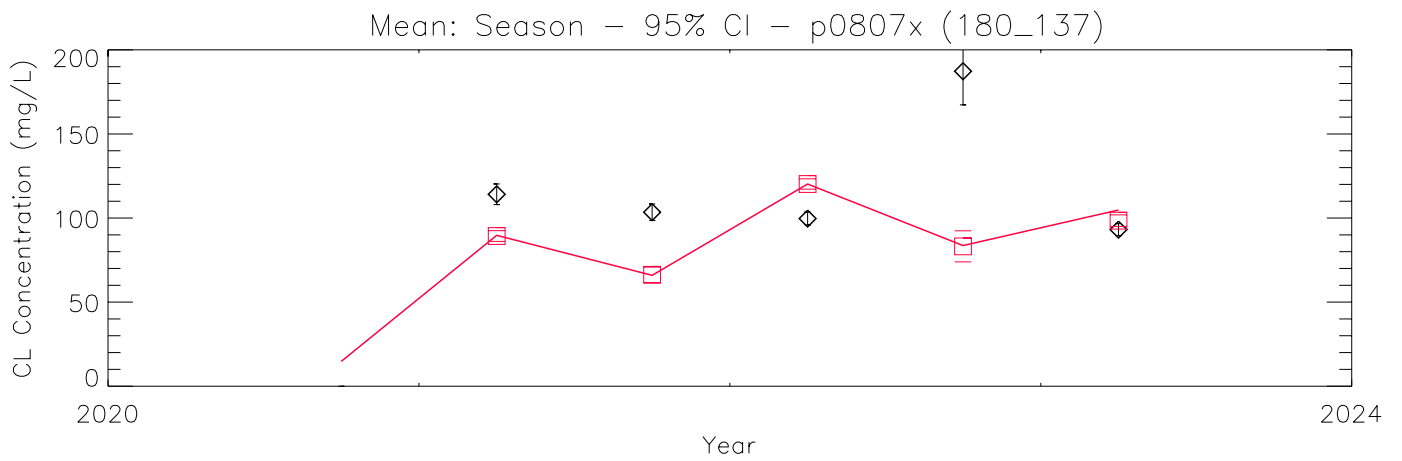
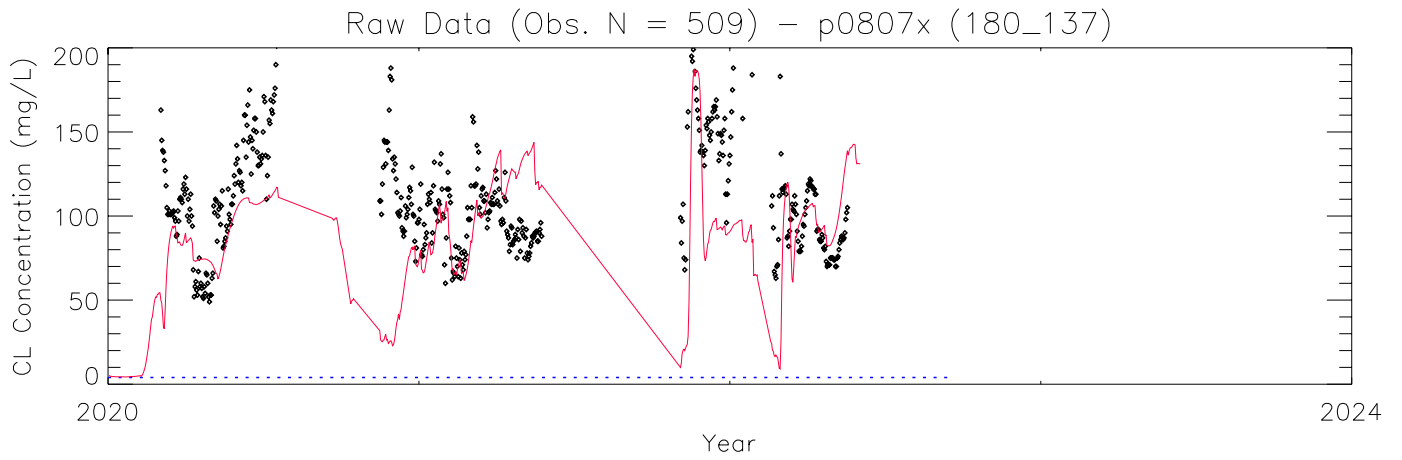


Mean: Water Year - 95% CI - p0806x (198_172)

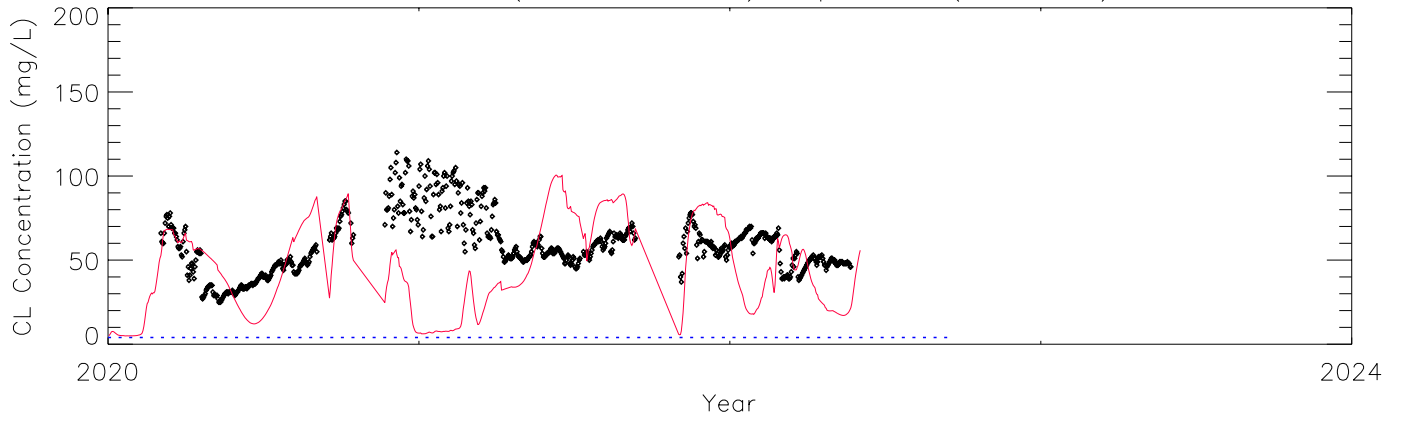


Cumulative Distribution: Raw Data - p0806x (198_172)

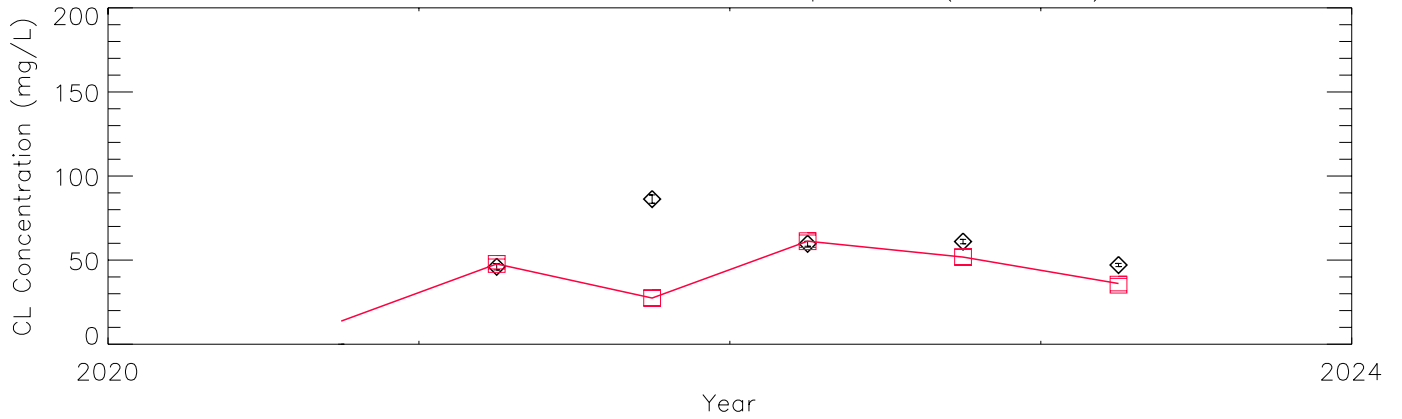




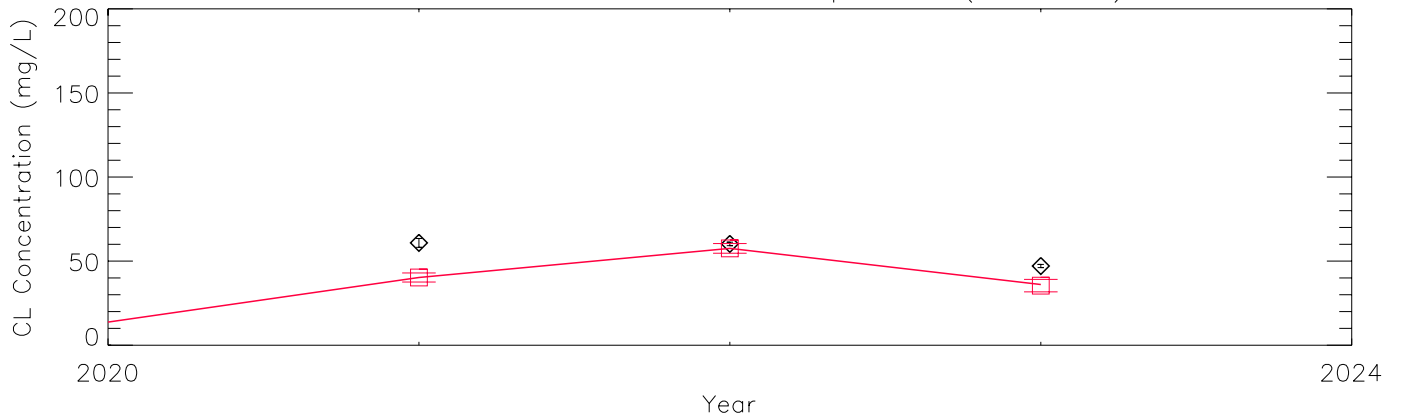
Raw Data (Obs. N = 706) - p0903x (220_270)



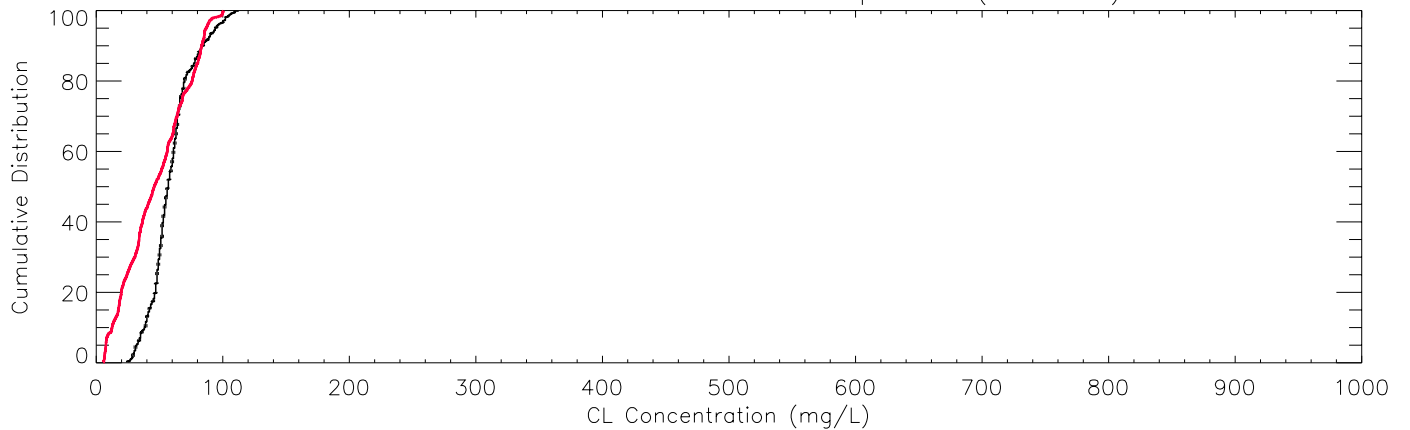
Mean: Season - 95% CI - p0903x (220_270)



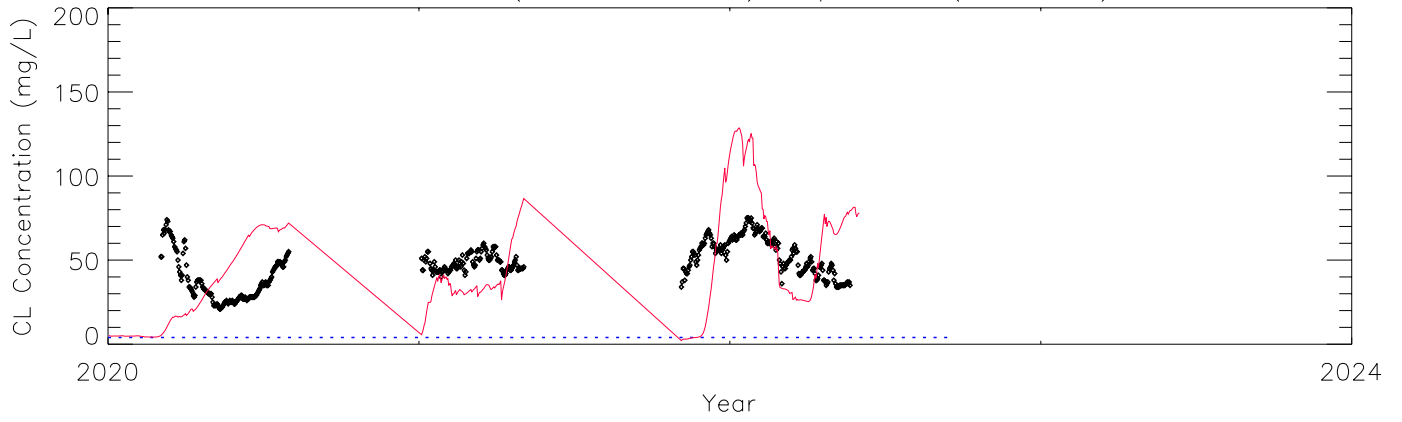
Mean: Water Year - 95% CI - p0903x (220_270)



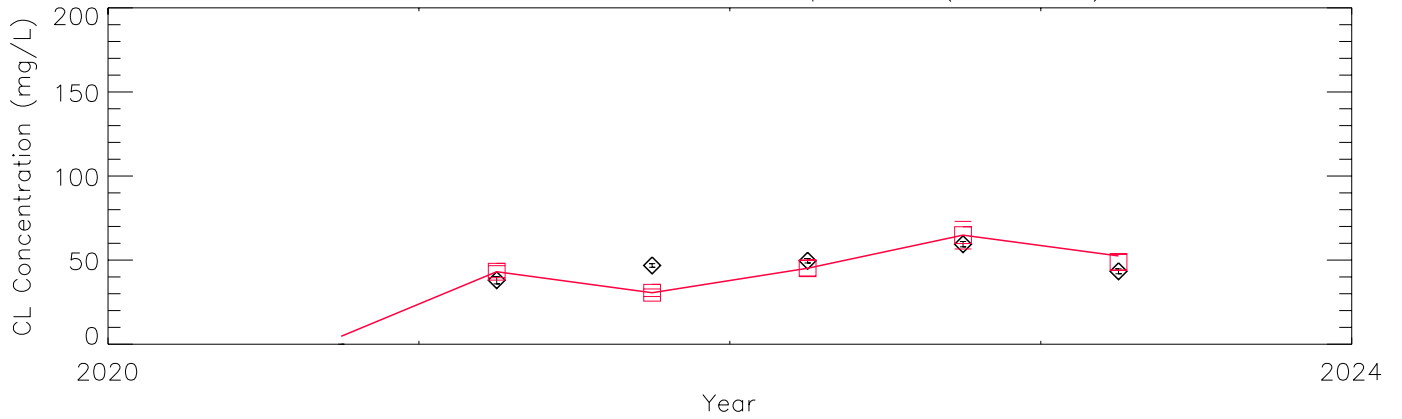
Cumulative Distribution: Raw Data - p0903x (220_270)



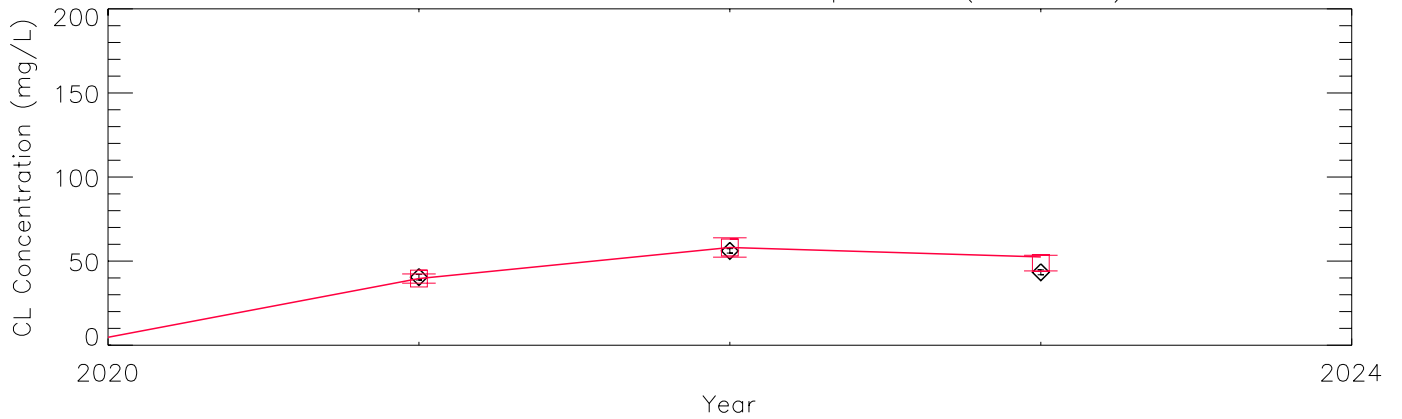
Raw Data (Obs. N = 470) - p0904x (240_240)



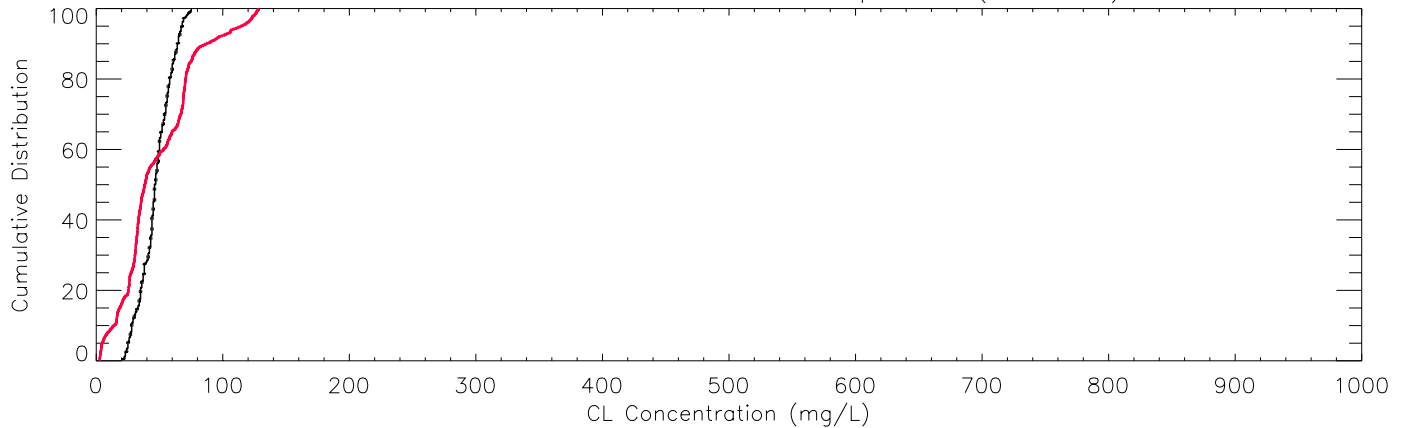
Mean: Season - 95% CI - p0904x (240_240)



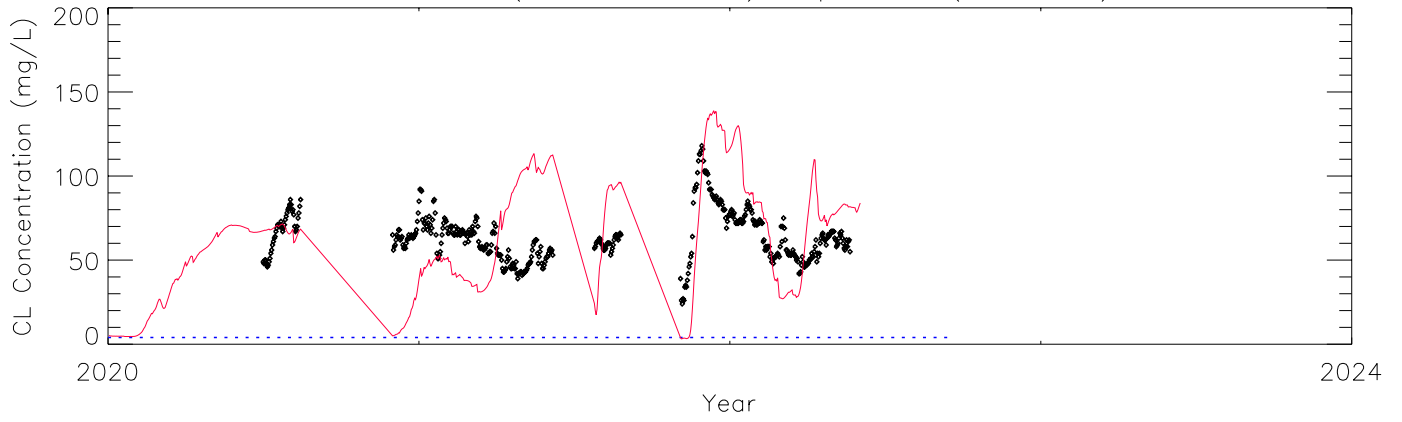
Mean: Water Year - 95% CI - p0904x (240_240)



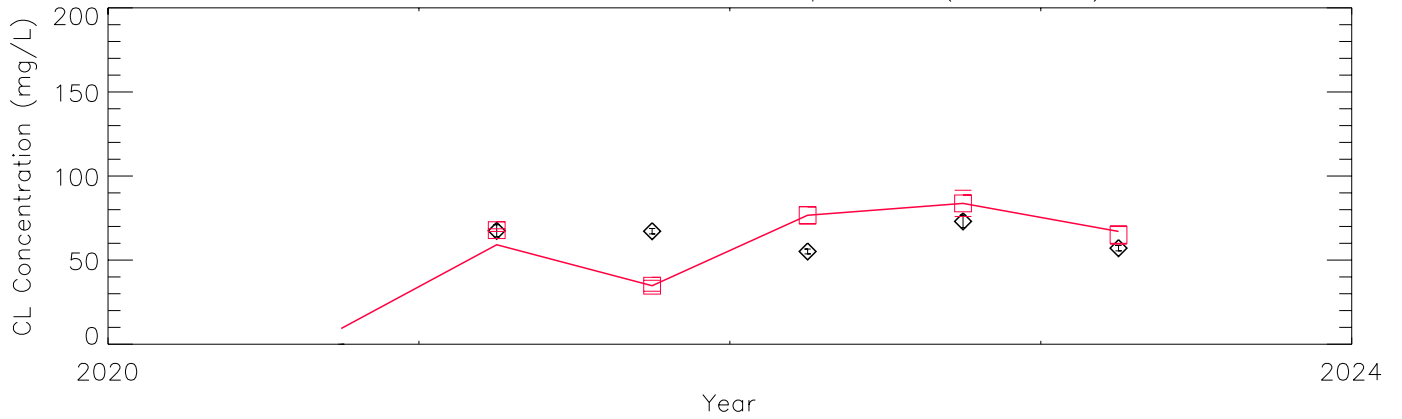
Cumulative Distribution: Raw Data - p0904x (240_240)



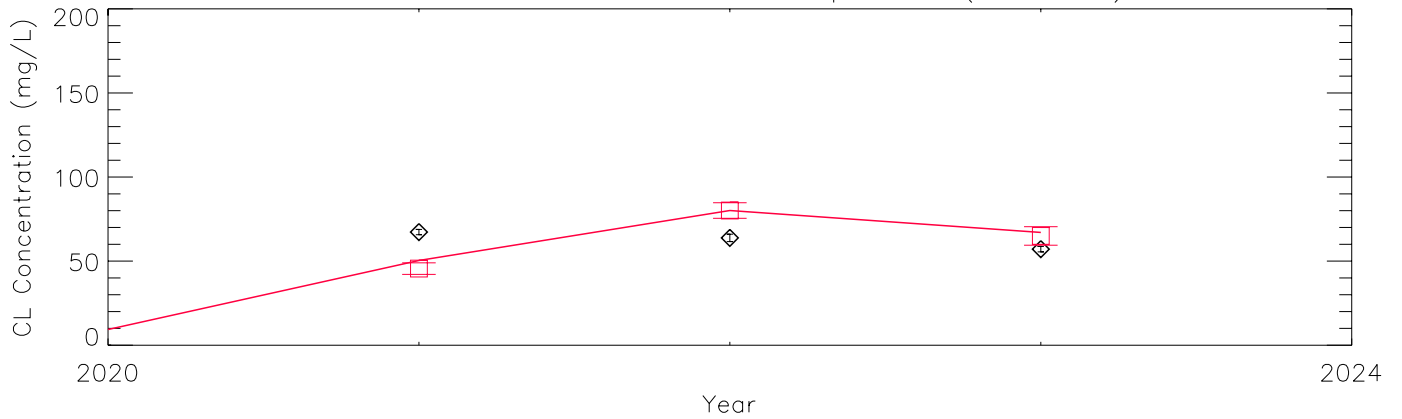
Raw Data (Obs. N = 466) - p0905x (222_203)



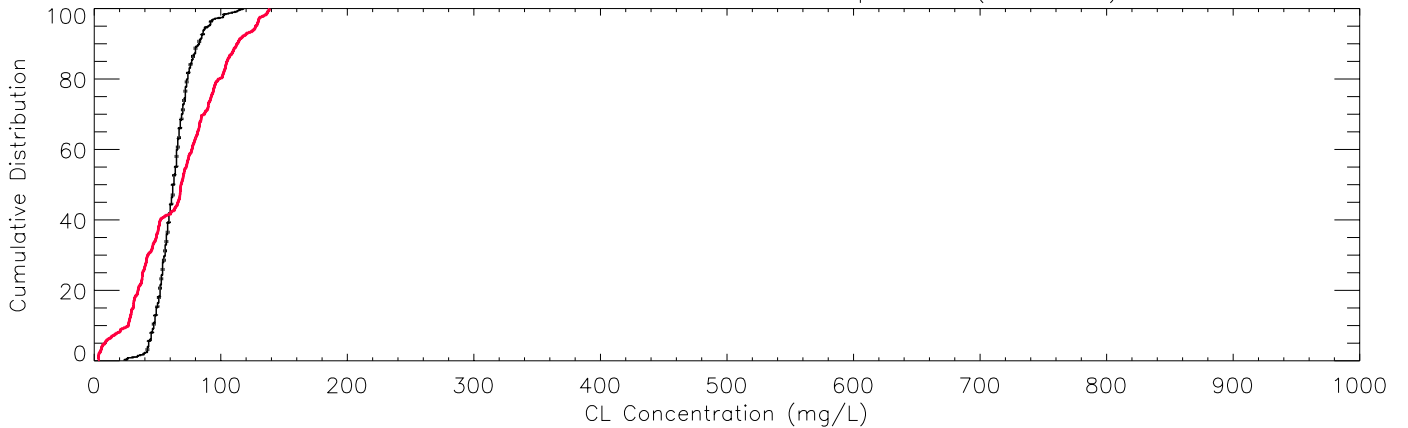
Mean: Season - 95% CI - p0905x (222_203)



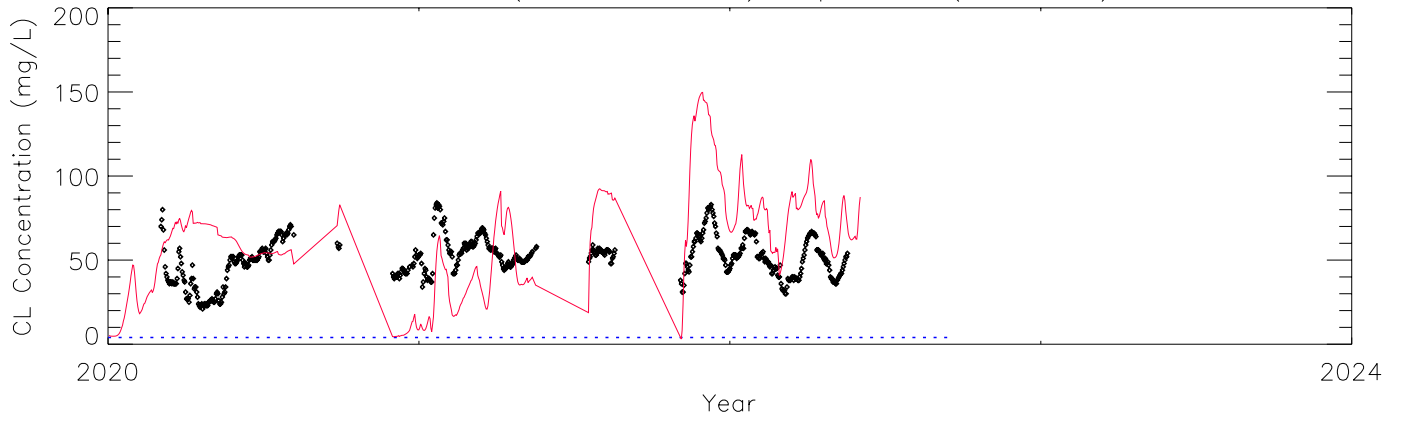
Mean: Water Year - 95% CI - p0905x (222_203)



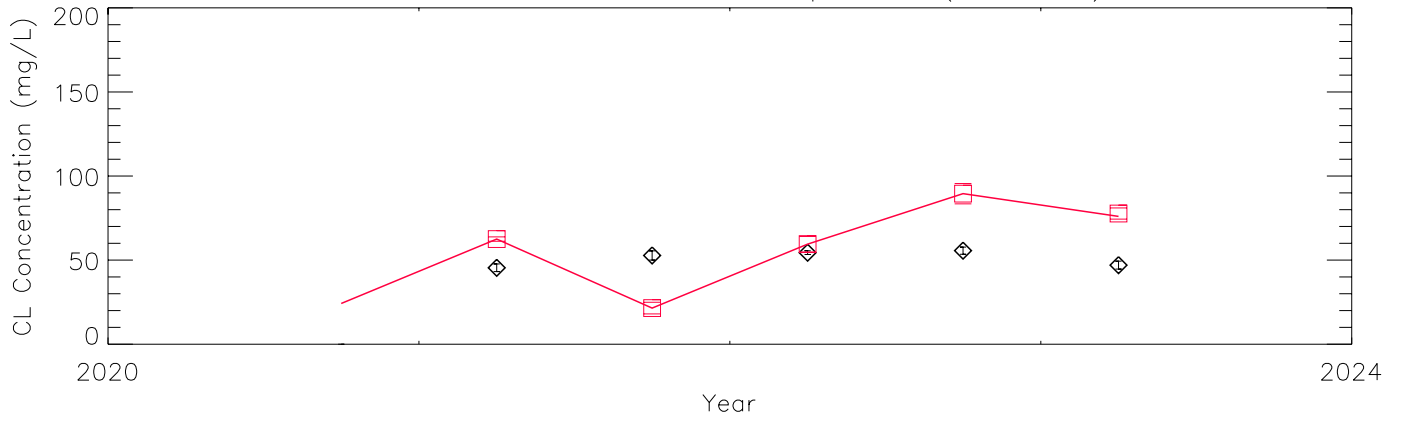
Cumulative Distribution: Raw Data - p0905x (222_203)



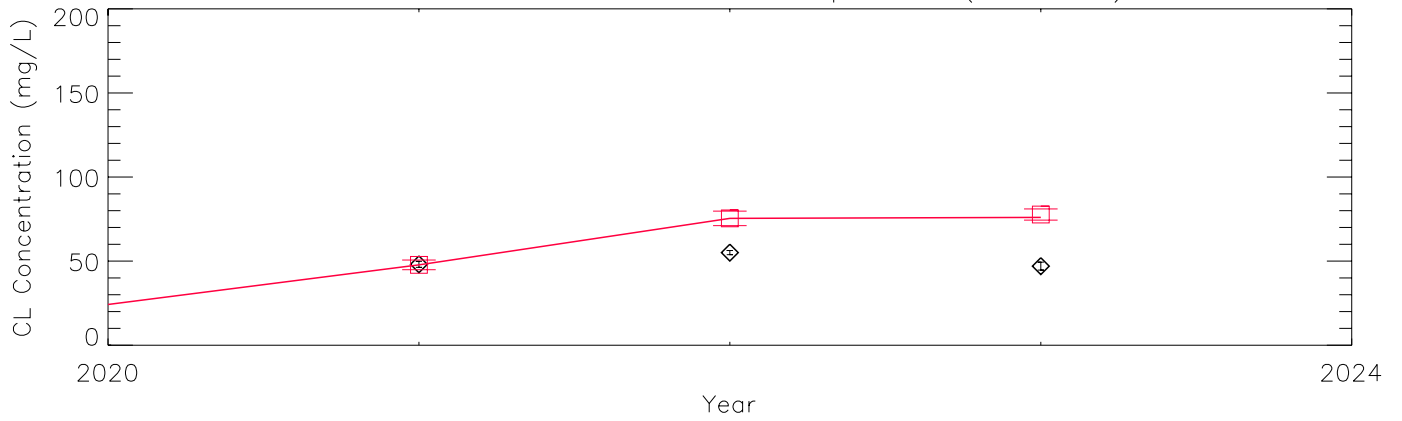
Raw Data (Obs. N = 551) - p0906x (240_171)



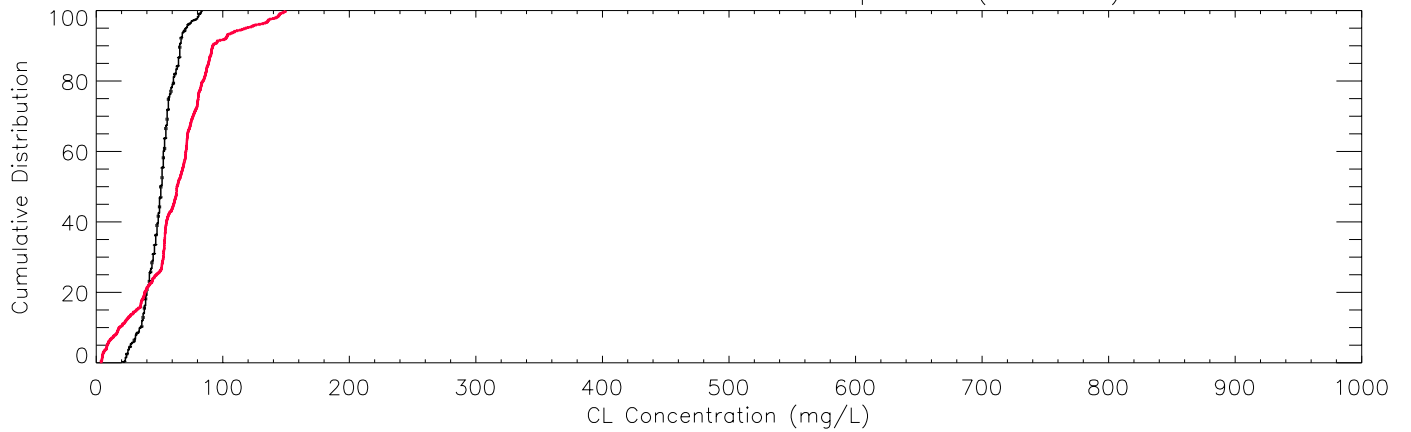
Mean: Season - 95% CI - p0906x (240_171)



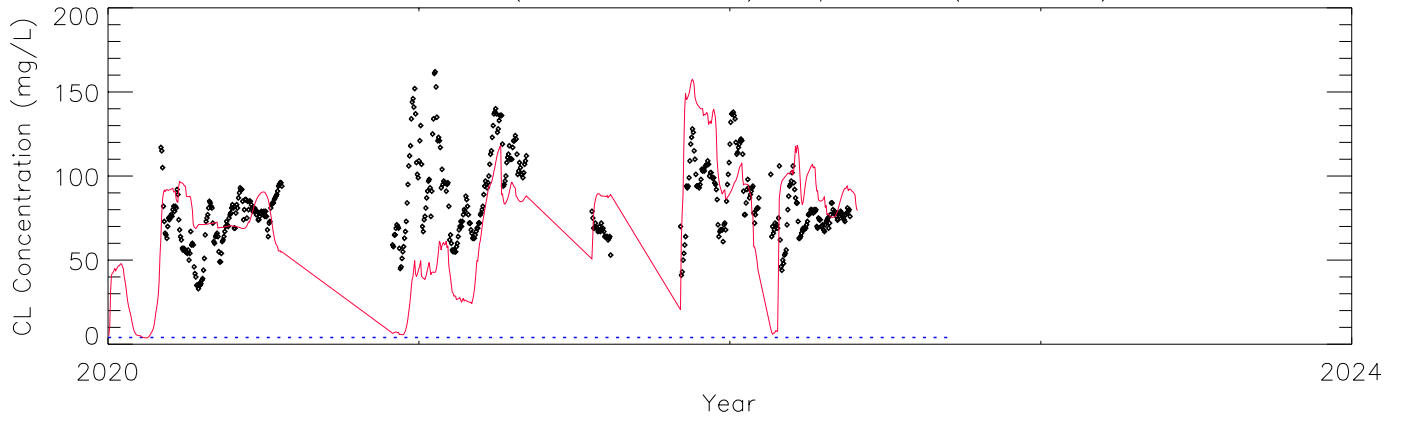
Mean: Water Year - 95% CI - p0906x (240_171)



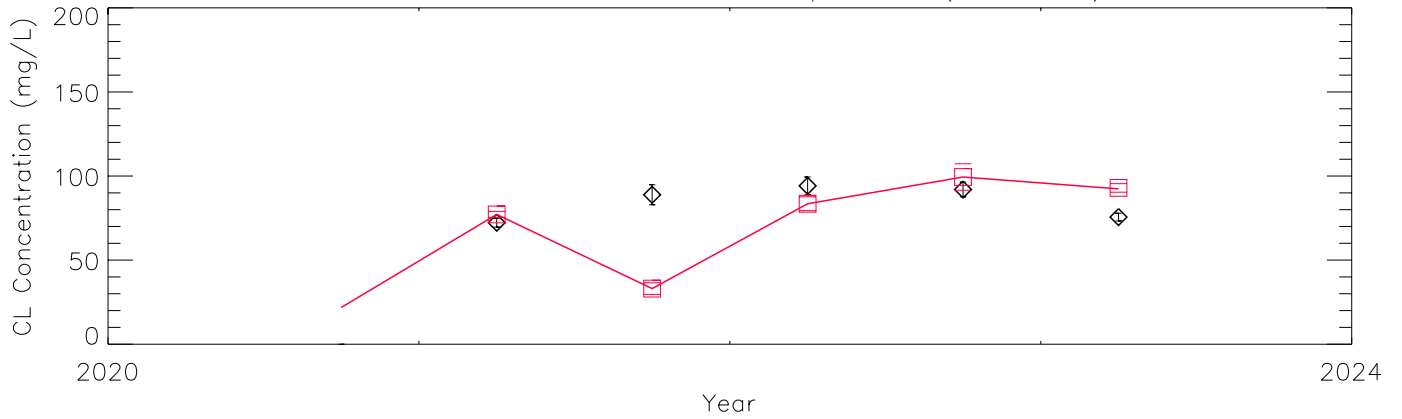
Cumulative Distribution: Raw Data - p0906x (240_171)



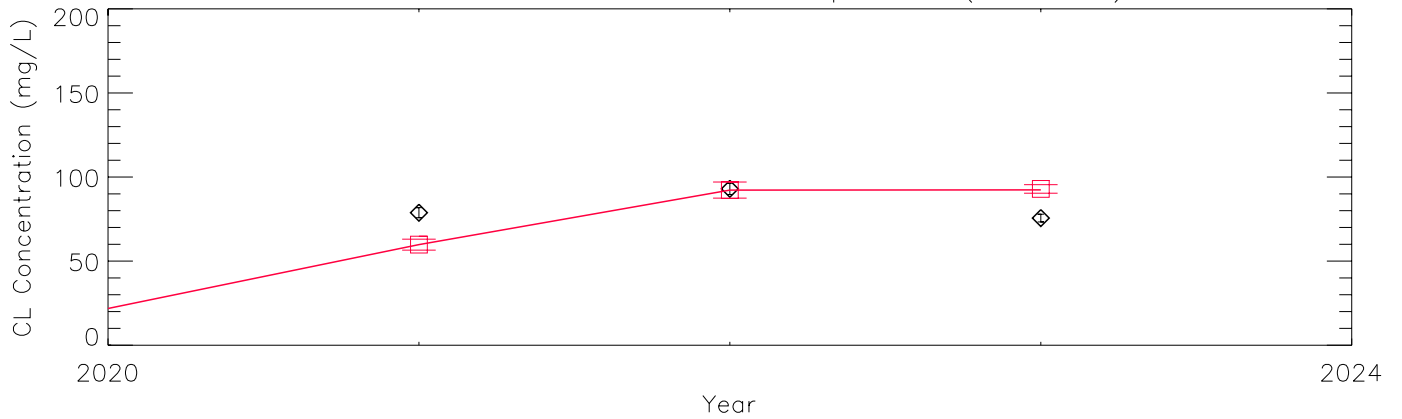
Raw Data (Obs. N = 511) - p0907x (221_137)



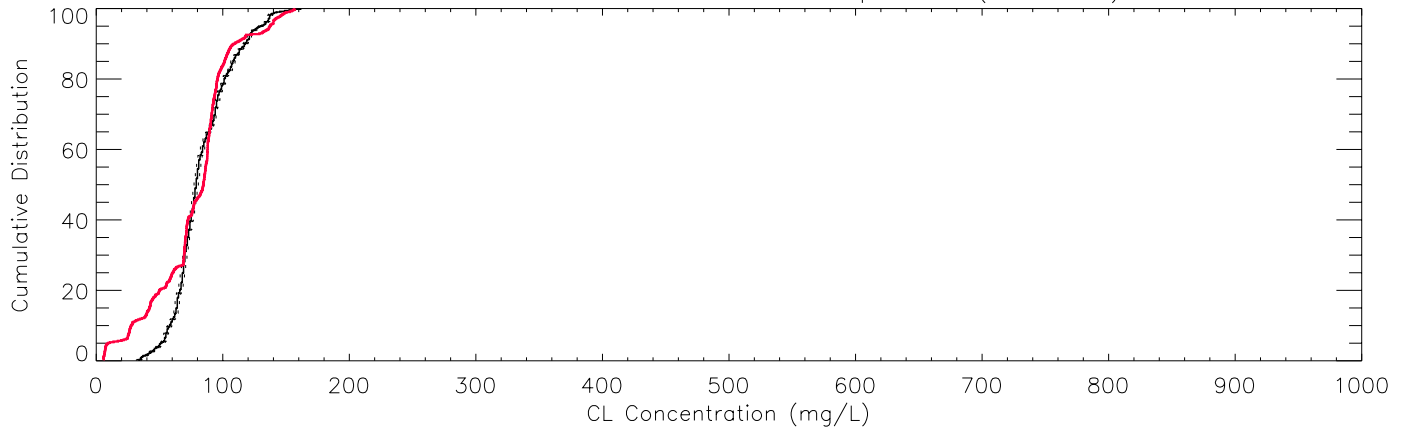
Mean: Season - 95% CI - p0907x (221_137)



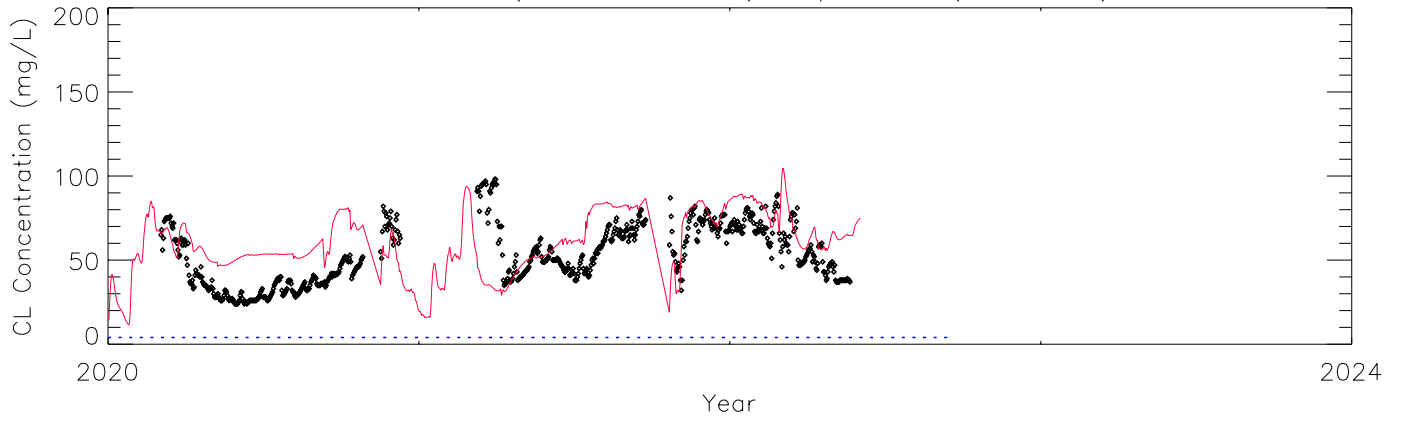
Mean: Water Year - 95% CI - p0907x (221_137)



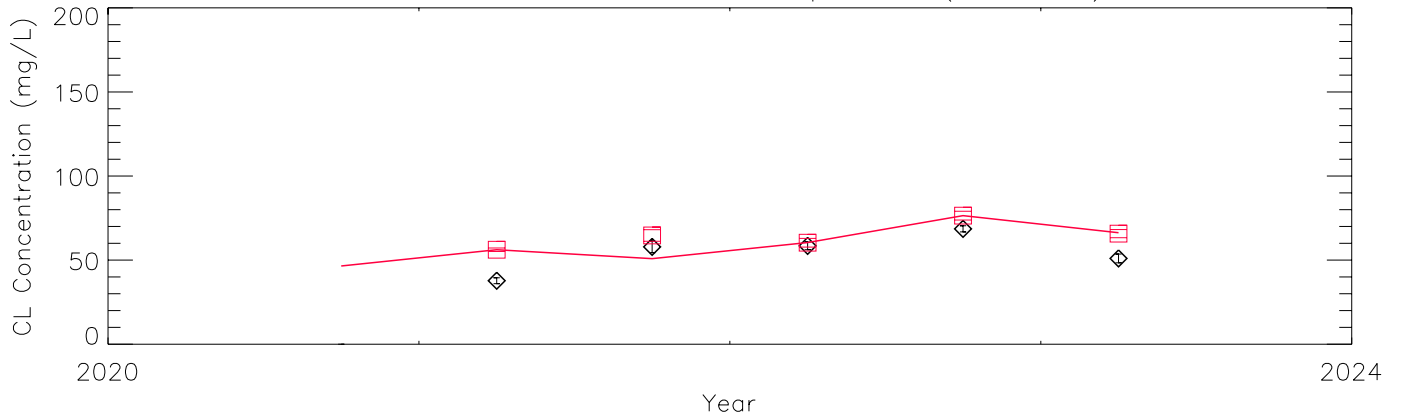
Cumulative Distribution: Raw Data - p0907x (221_137)



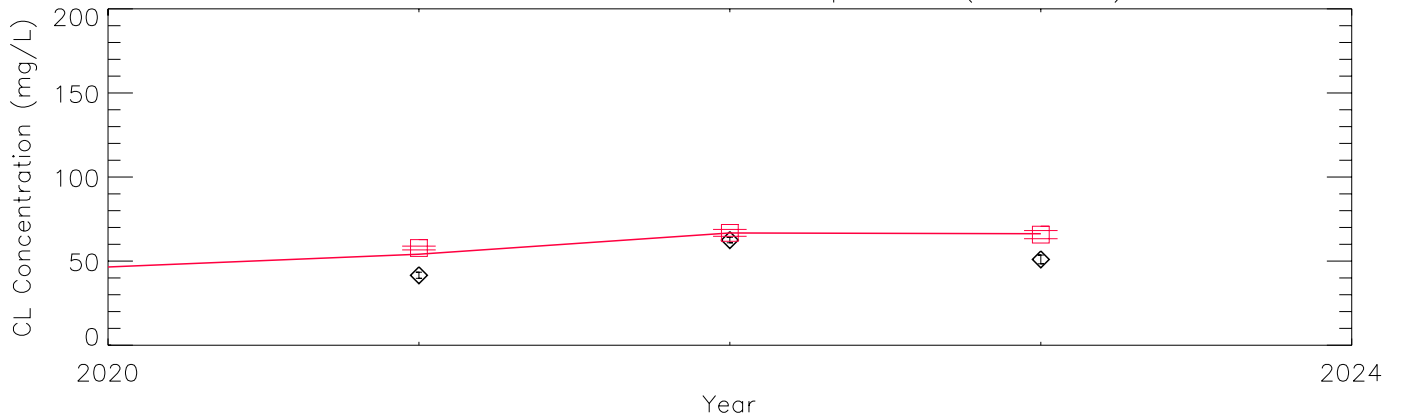
Raw Data (Obs. N = 674) - p1003x (263_267)



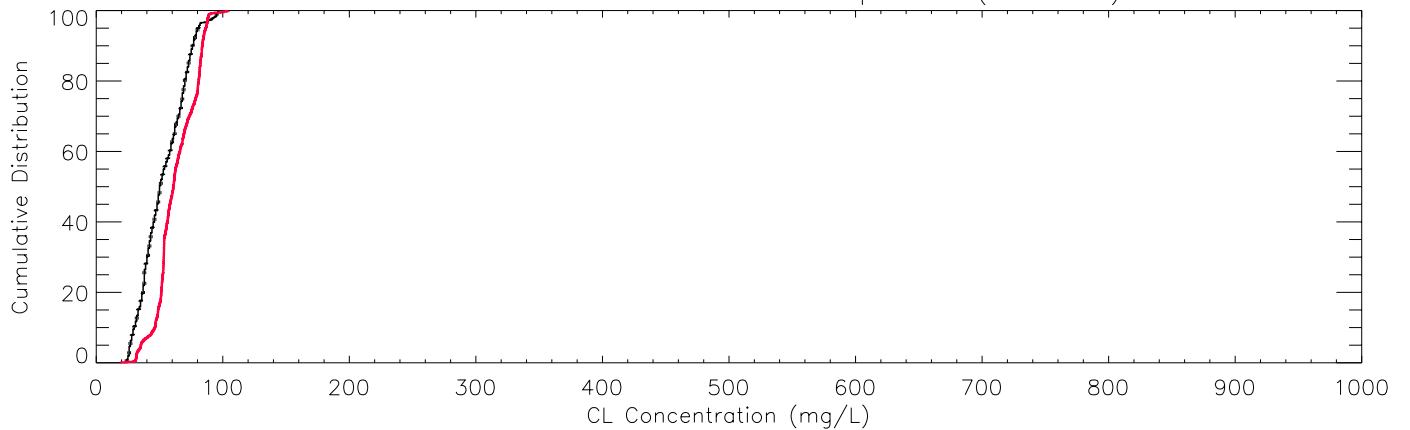
Mean: Season - 95% CI - p1003x (263_267)



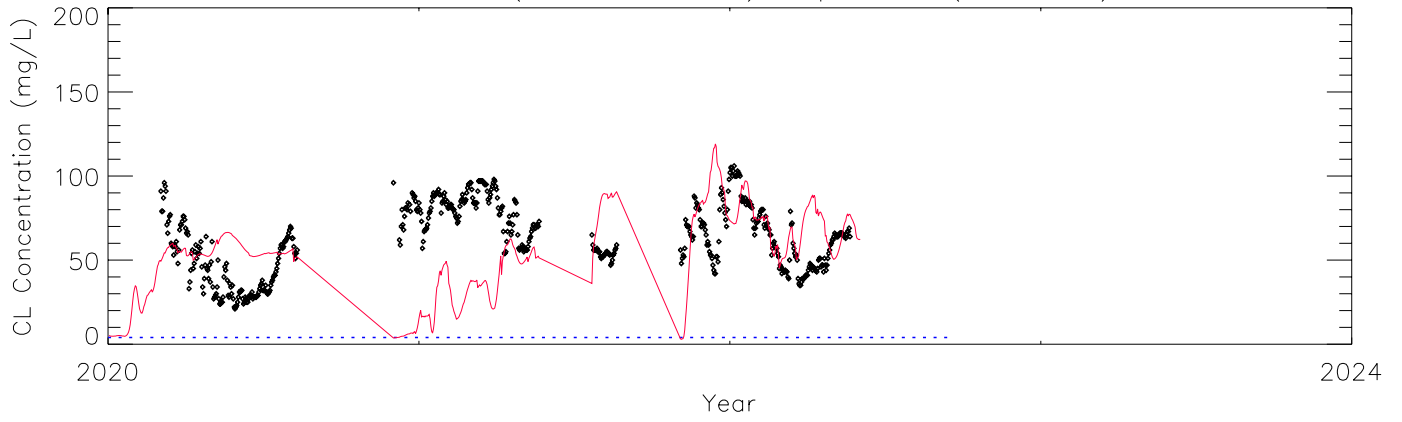
Mean: Water Year - 95% CI - p1003x (263_267)



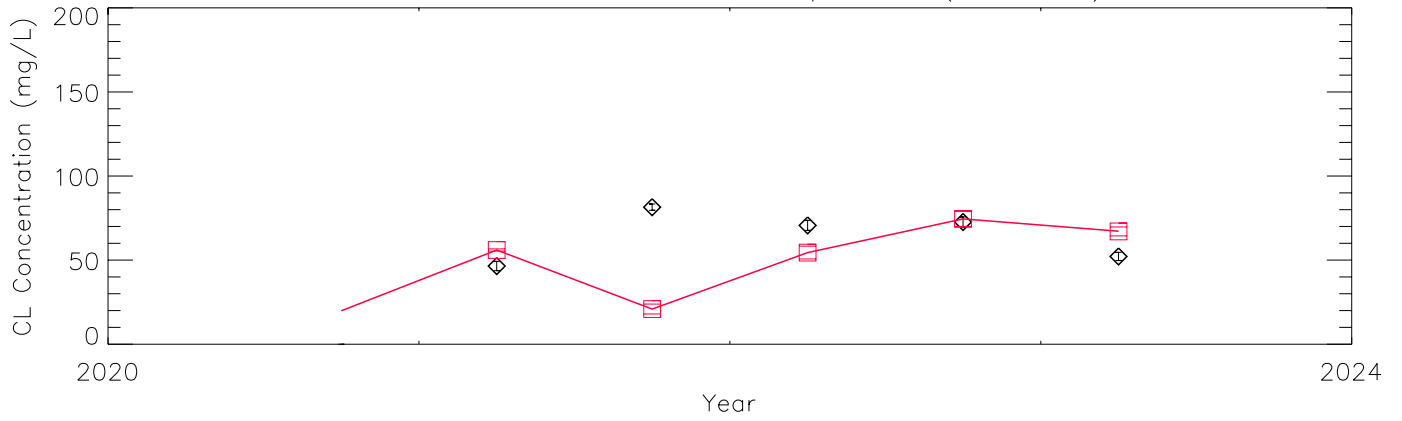
Cumulative Distribution: Raw Data - p1003x (263_267)



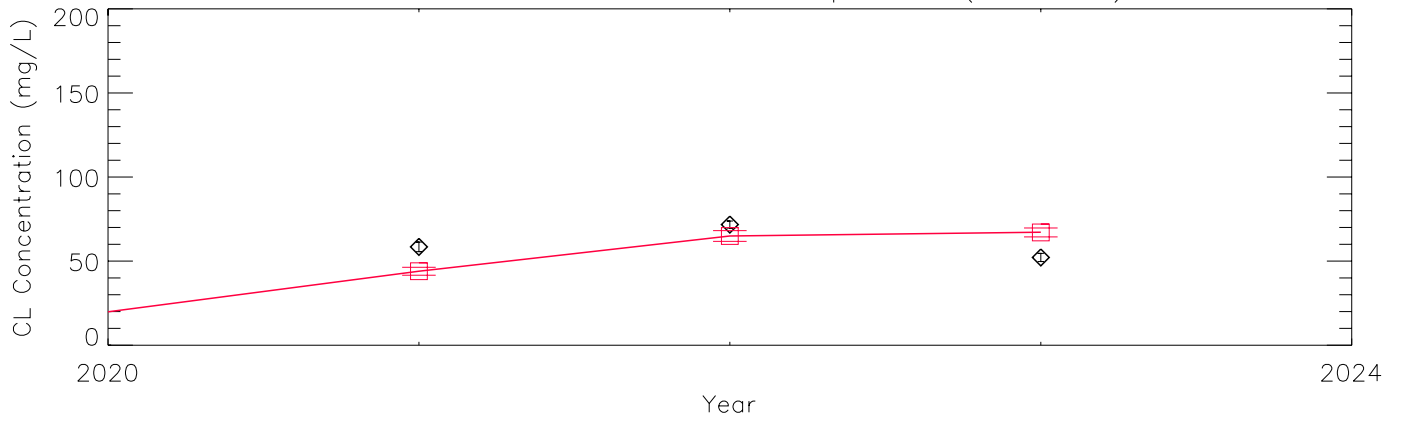
Raw Data (Obs. N = 555) - p1005x (260_206)



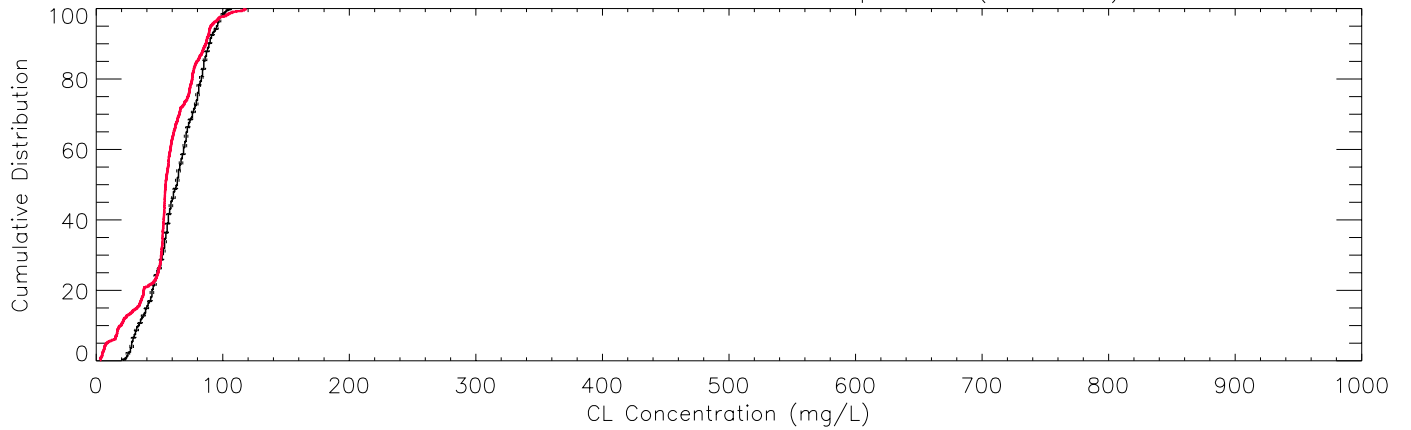
Mean: Season - 95% CI - p1005x (260_206)



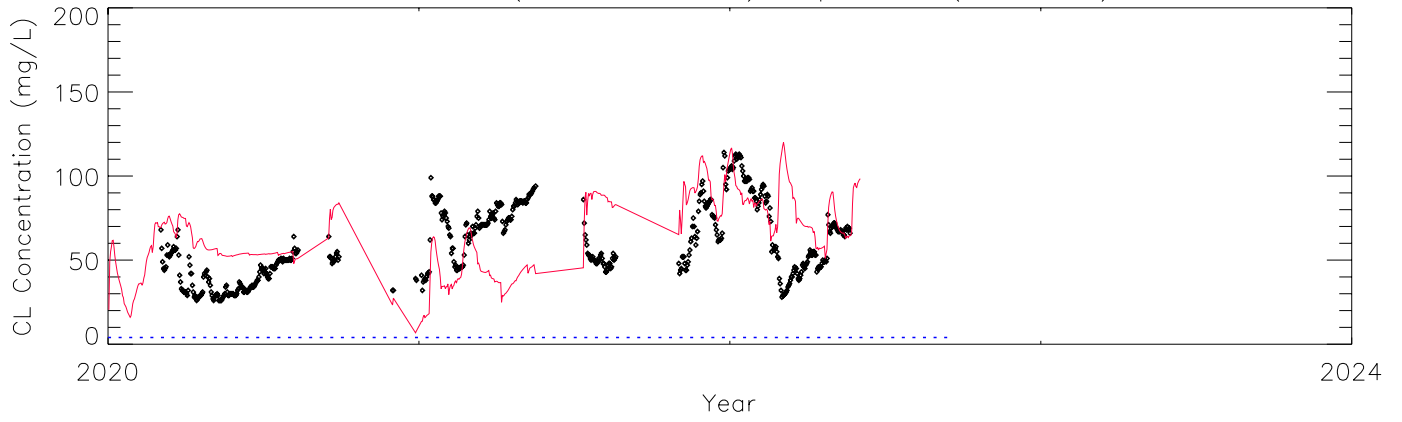
Mean: Water Year - 95% CI - p1005x (260_206)



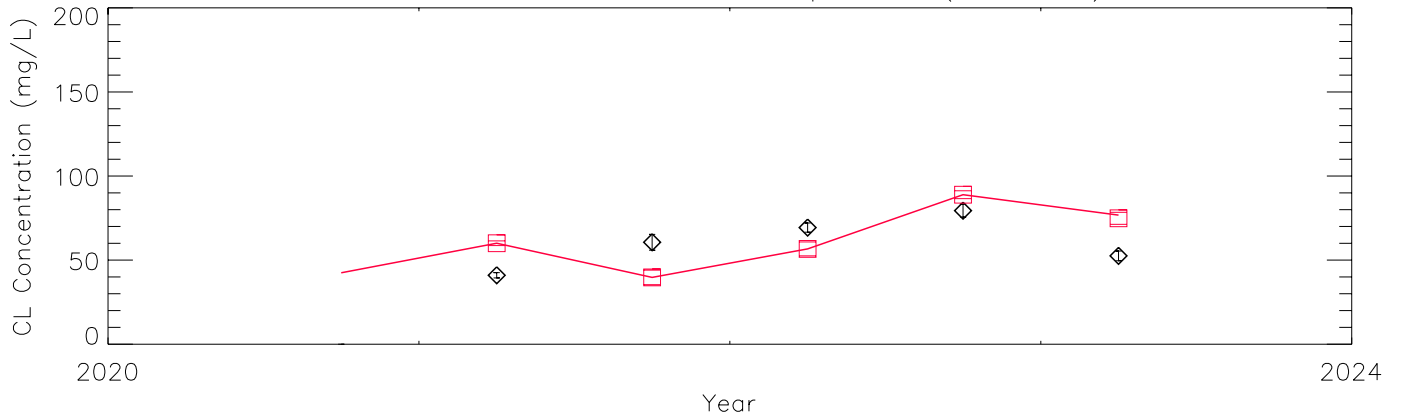
Cumulative Distribution: Raw Data - p1005x (260_206)



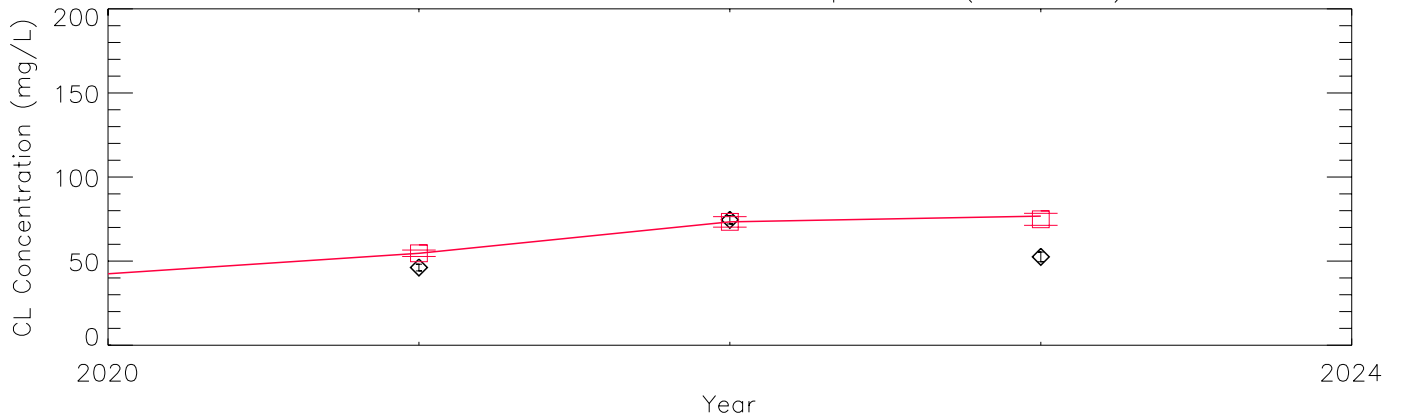
Raw Data (Obs. N = 554) - p1007x (263_139)



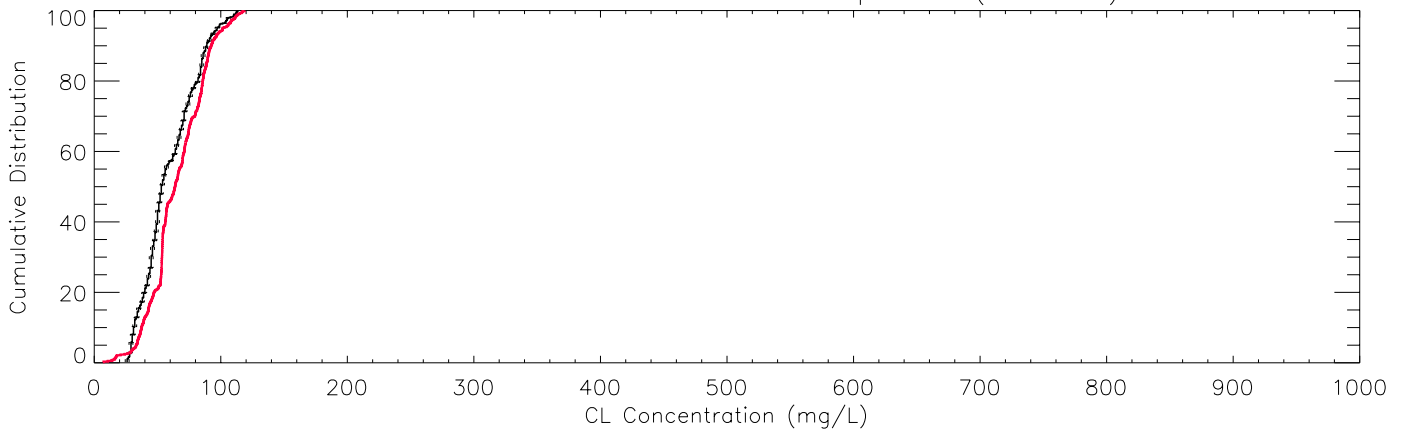
Mean: Season - 95% CI - p1007x (263_139)



Mean: Water Year - 95% CI - p1007x (263_139)



Cumulative Distribution: Raw Data - p1007x (263_139)



Appendix E. Sensitivity of simulation output variables to variations on: 1) 1984-2010 runs of different NE airboat trail segmentations and depths-widths; and 2) 2020-2022 logger runs of combinations of adding segmented NE airboat trail, Gann vegetation, and Gann elevation.

We used the model variable FlocP_OM is the P:OM concentration of the floc layer, because it is a useful "fast-intermediate" response time variable. Fast is chloride and water. (Slow variables are soil P concentration, soil elevation change).

Summary conclusions from the below results: The results from evaluating the efficacy of the NE airboat trail as a hydrologic attribute were mixed. Statistically, the best NE airboat trail configuration was that of "calibC23" (same as "logCalibC23") (segmented R43-R44-R45), with statistics of CI performance being similar to those of not including that airboat trail ("calib16", "logCalib16"): in the northeast region, some sites were similar in performance, some were slightly worse. But the sites are sparse relative to this assessment need, and the below map visualizations, relative to other known ecological patterns, leads us to conclude that

The model and observed data do not support the use of the "R43" (segmented or otherwise) in our future scenario evaluations in the next phase of this project.

Moreover, as indicated in the Task 2 Report, there are substantial uncertainties/issues with the 2018 Gann elevation data, and with the crosswalk of Gann vegetation canopy classes to ELM hydro-ecological classes.

The use of the Gann elevation and vegetation data is uncertain for our future scenario evaluations in the next phase of this project.

Figure E1. Patterns of simulated FlocP_OM concentration (mg_P/kg_OM) in the 1984-2010 runs, with varying combinations of segmentations and depths-widths of the "R43-R44-R45" airboat trail. All output maps are 30-d mean FlocP_OM concentration snapshots, at the same color-scale. All simulations use the same maps, driving data,, etc., but differ by airboat trail configuration. Each sub-figure (AA-C) is on a separate page.

AA. Map of the NE airboat trail segmentations (top), and (bottom) the SFWMM historical S10_total daily structure inflows used to drive the 1984-2010 runs

A. "Calib19" (R43) vs. "Calib16" (no R43) runs,

showing an example time series of 30-d mean snapshot comparisons (July, Aug, Sept 1988, and Oct 1989). Trail dimensions shown.

B. "Calib19" (R43) vs. "Calib17" (larger R43);

"Calib19" (R43) vs. "Calib20" (smaller R43); and

"Calib19" (R43) vs. "Calib21" (R43-R44, decreasing dimensions) runs,

showing the 30-d mean snapshot comparisons for Sept 1988. Trail dimensions shown.

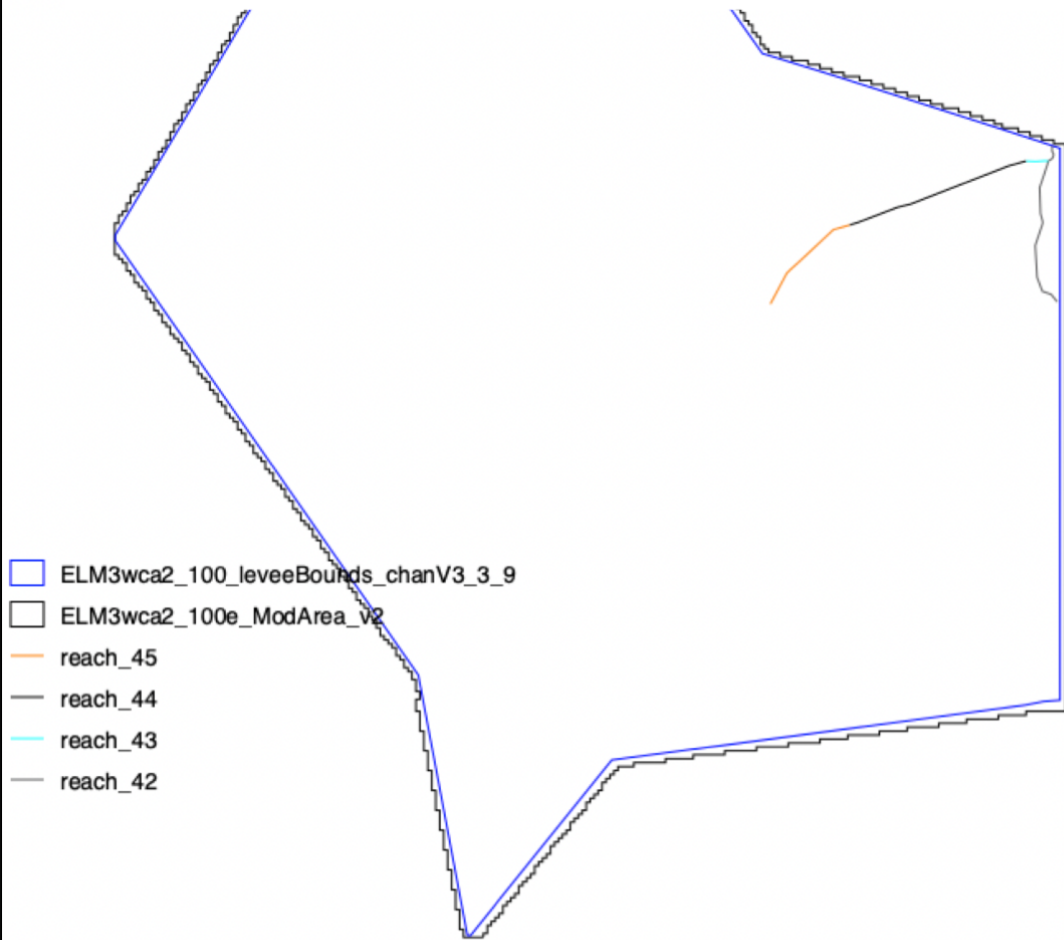
C. "Calib19" (R43) vs. "CalibC22" (R43-R44-R45, varying ~large widths);

"Calib19" (R43) vs. "CalibC23" (R43-R44-R45, varying small widths) runs,

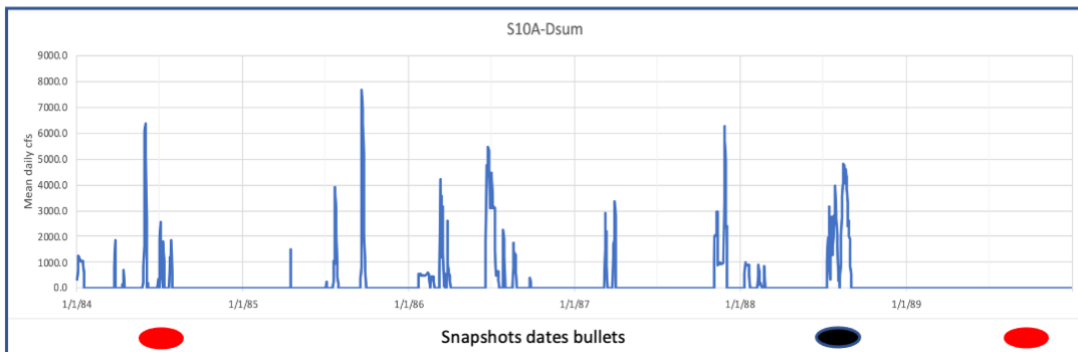
showing the 30-d mean snapshot comparisons for Sept 1988, and (for calib19 vs calibC23 only), a **new date of Aug 1984** (see above AA inflow time series). Trail dimensions shown.

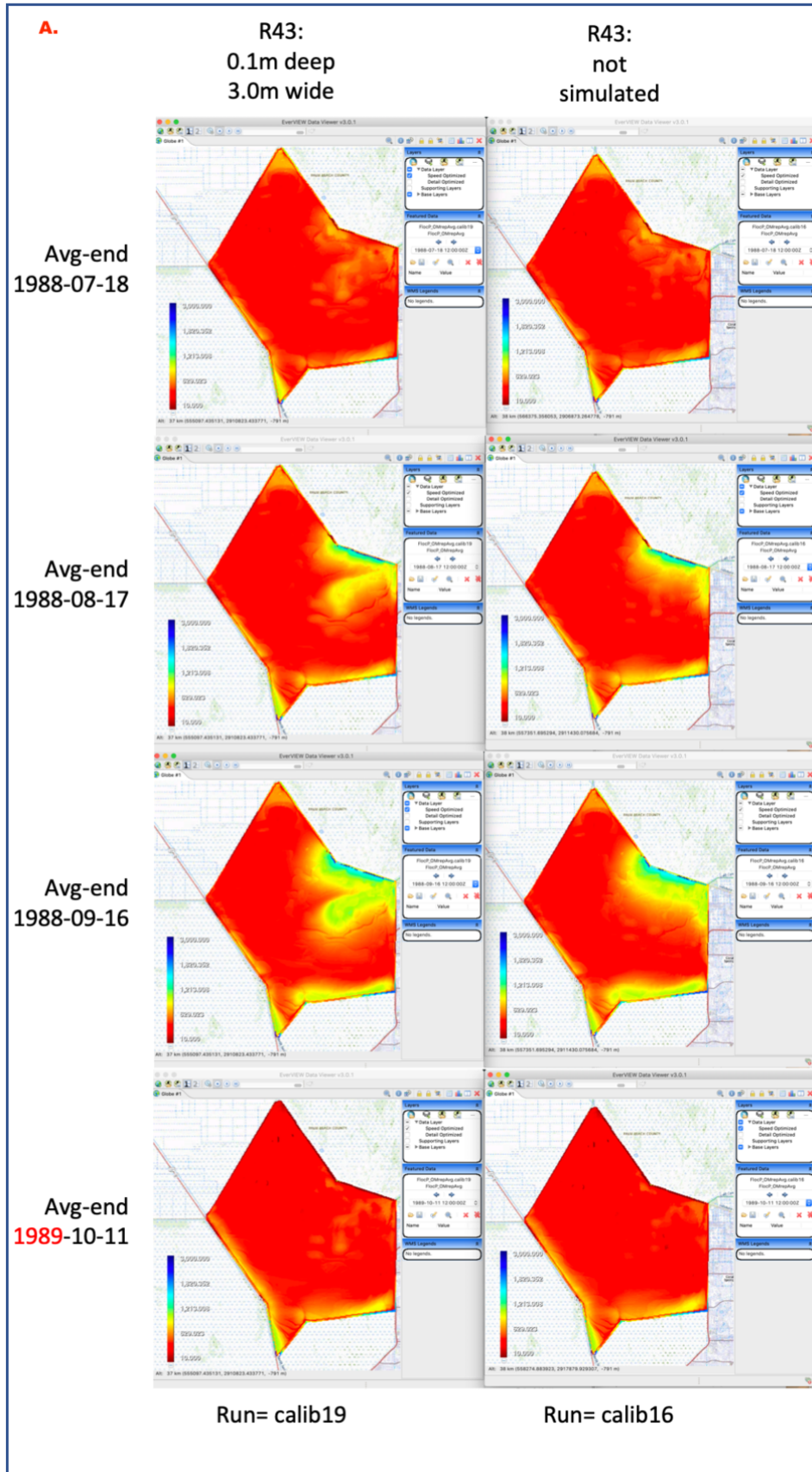
AA.

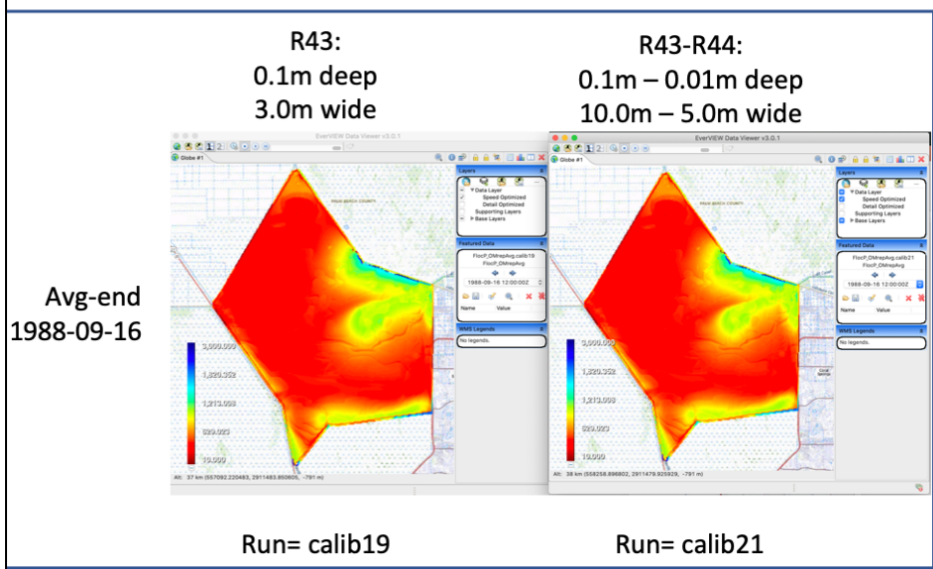
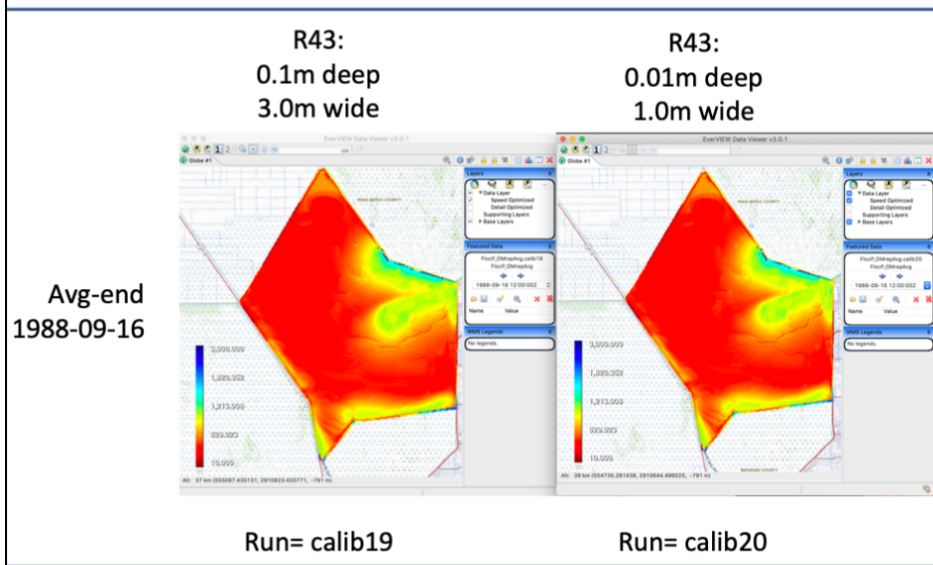
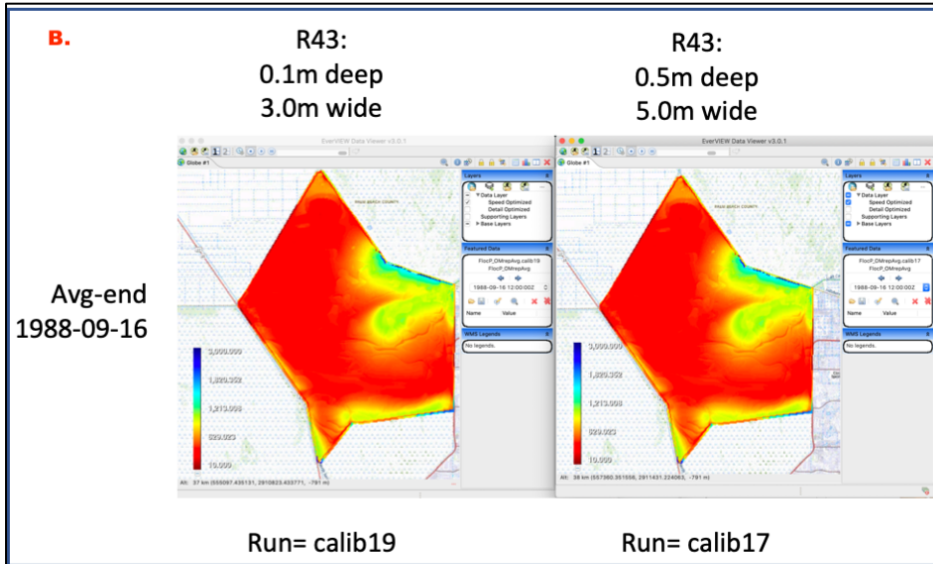
- airboat trail “reach_42” simulated in all runs
- airboat trail R43-only is single-trail, encompassing pictured R43-R44-R45
- airboat trail R43-R44 is pictured R43, with R44 encompassing pictured R44-R45
- airboat trail R43-R44-R45 as pictured below



- ELM3wca2_100_leveeBounds_chanV3_3_9
- ELM3wca2_100e_ModArea_v2
- reach_45
- reach_44
- reach_43
- reach_42







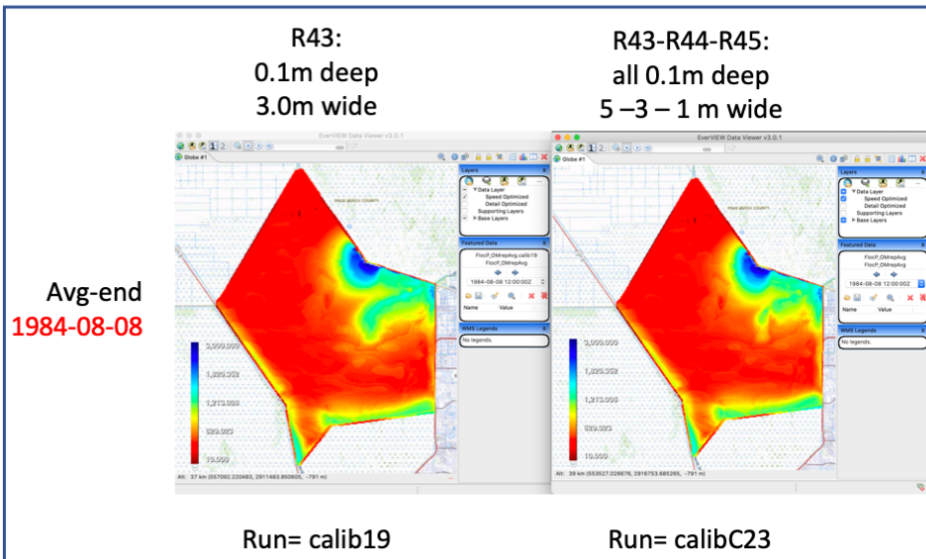
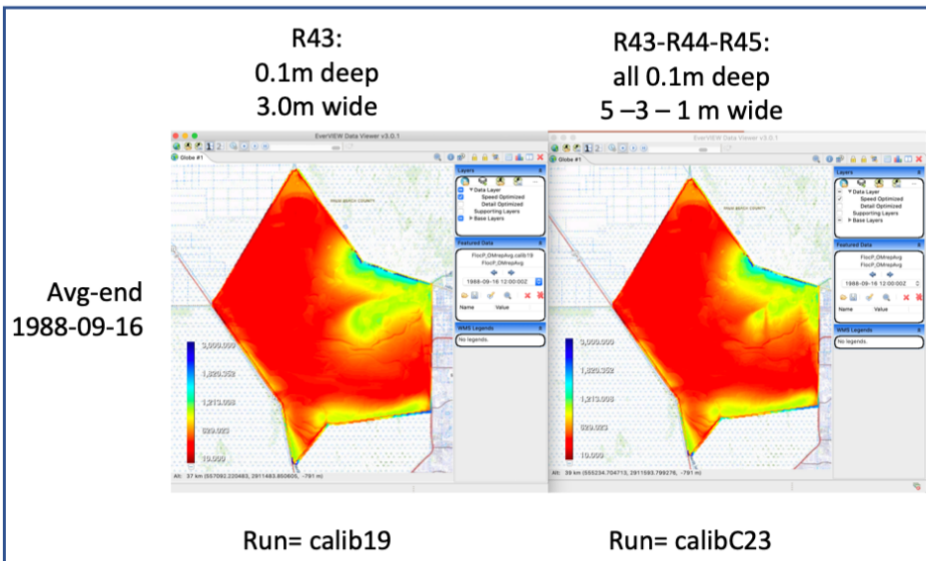
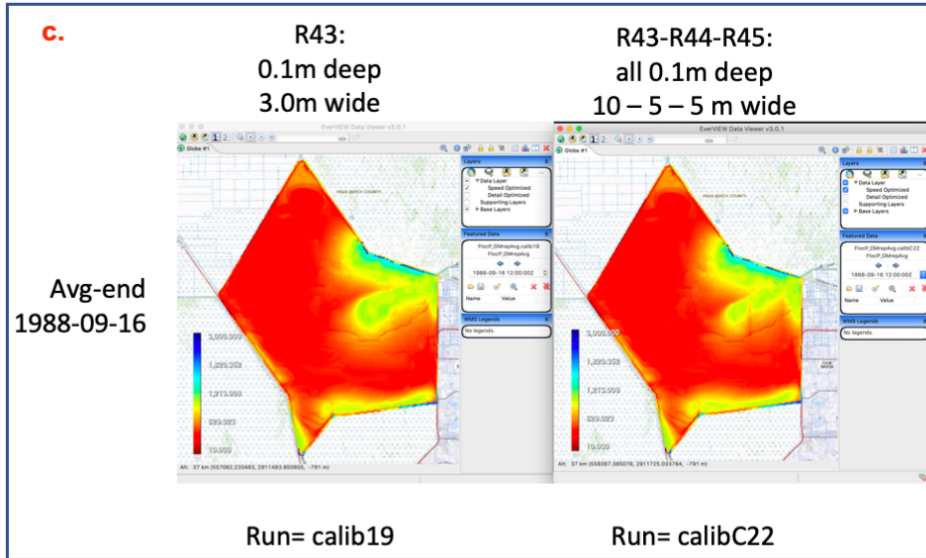
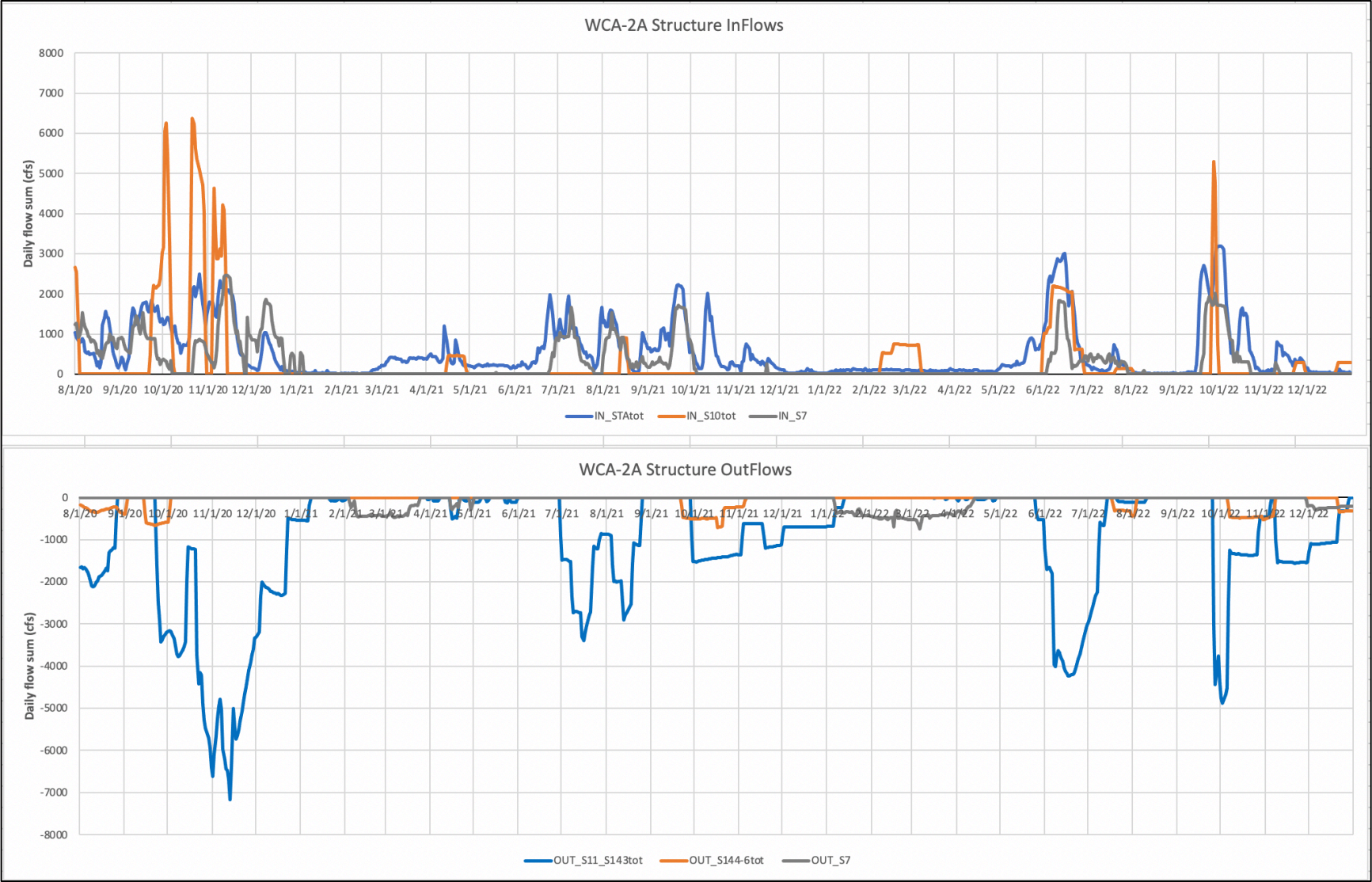


Figure E2. Patterns of simulated variables in the 2020-2022 "logger" runs, with varying combinations of using the segmented "R43-R44-R45" airboat trail, the Gann 2018 Habitats, and the Gann 2018 Elevation. Each sub-figure (AA-D) is on a separate page.

- AA.** The DBHYDRO historical WCA-2A daily structure inflows and outflows, used to drive the Aug 2020 - Dec 2022 "logger" runs
- A.** The "logCalib16" run, using same (relevant) data as "calib16" run (1984-2010)
- B.** The "logCalibC23" run, using same data as "logcalib16" run, EXCEPT using:
 - NE airboat trail (R43-R44-R45, attributes per 1984-2010 "calib_C23" run)
- C.** The "logCalib_gann" run, using same data as "logcalib16" run, EXCEPT using:
 - NE airboat trail (R43-R44-R45, attributes per 1984-2010 "calib_C23" run)
 - Gann 2018 Habitat map
- D.** The "logCalib_gannH_E" run, using same data as "logcalib16" run, EXCEPT using:
 - NE airboat trail (R43-R44-R45, attributes per 1984-2010 "calib_C23" run)
 - Gann 2018 Habitat map
 - Gann 2018 Elevation map

AA.



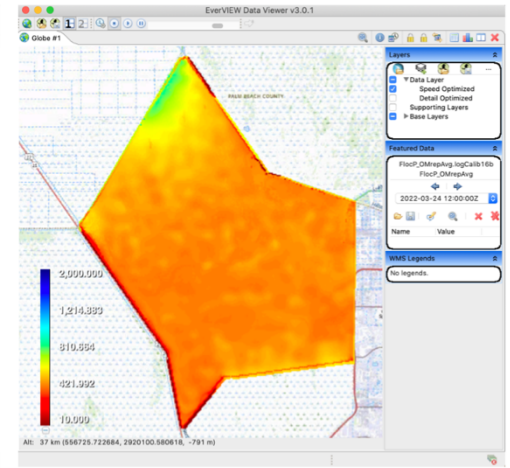
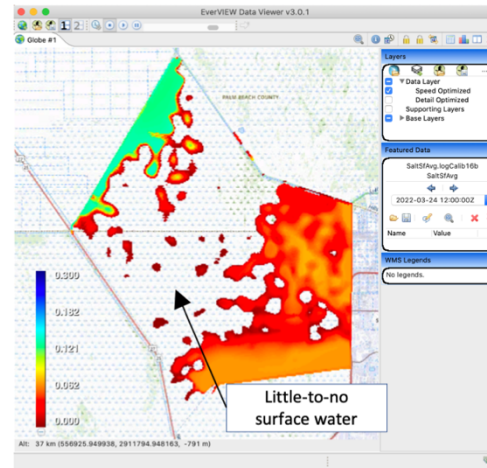
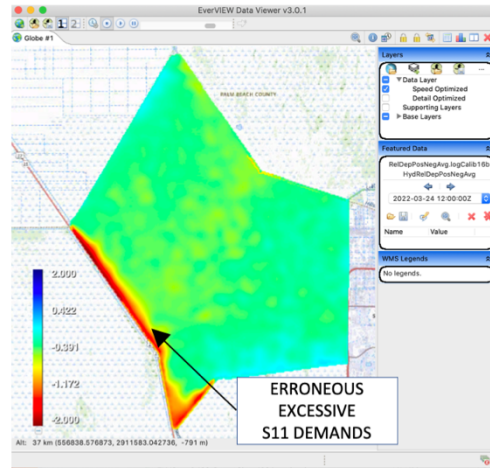
A.

Water Depth Relative to Land Elevation (m)

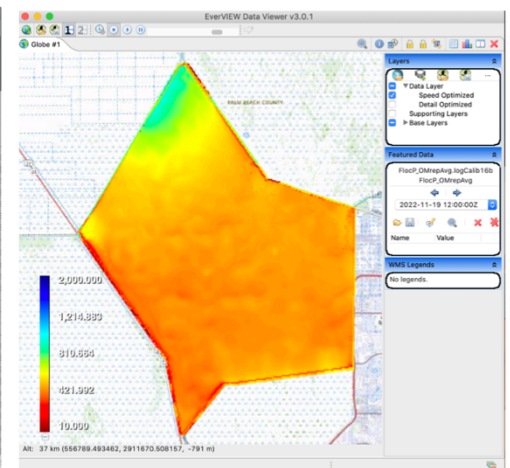
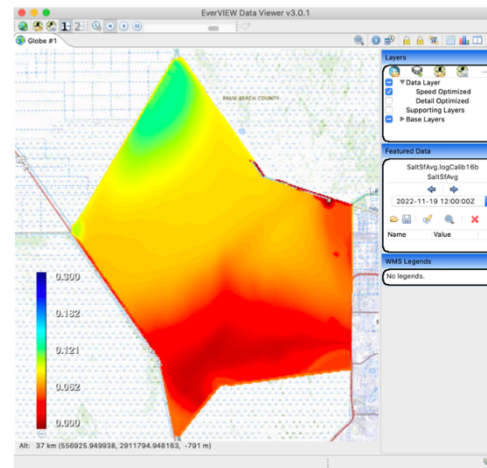
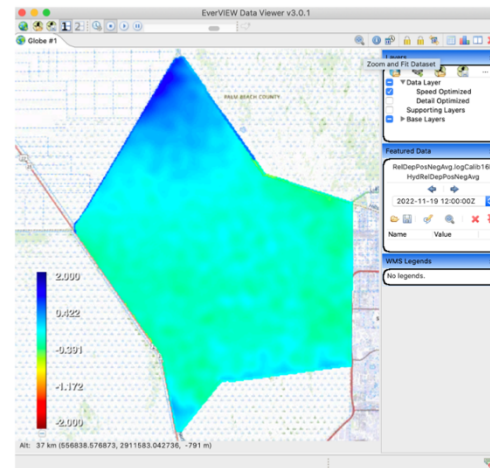
Surface Water Chloride Concentration (g/l)

Floc P:OM TP Concentration (mg_P/kg_OM)

30-d mean ending 2022-03-24



30-d mean ending 2022-11-19



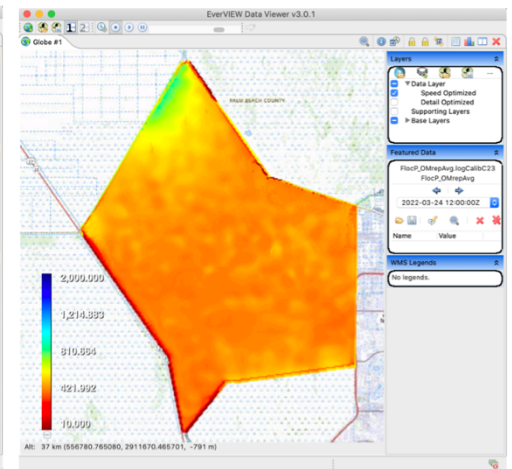
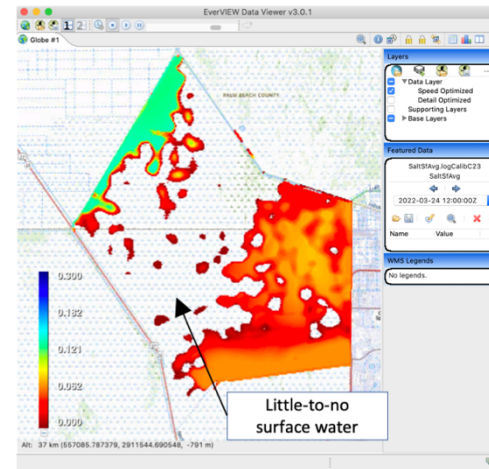
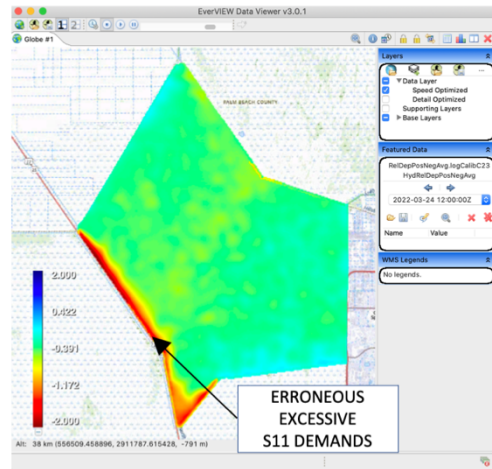
B.

Water Depth Relative to Land Elevation (m)

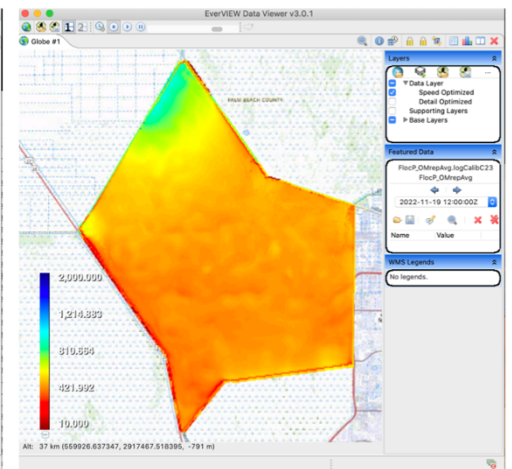
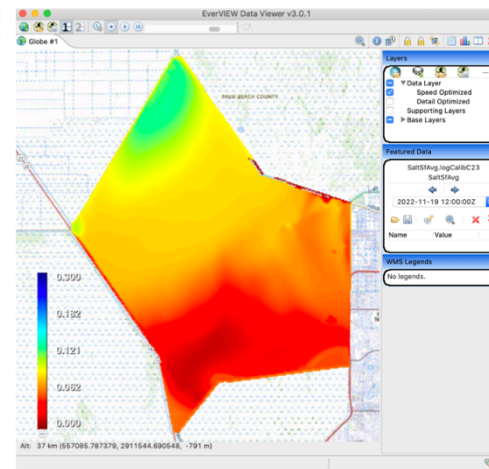
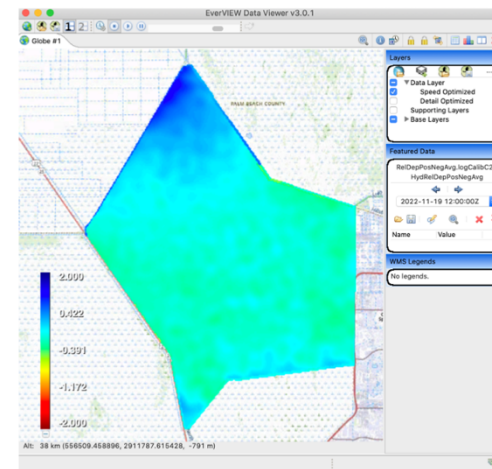
Surface Water Chloride Concentration (g/l)

Floc P:OM TP Concentration (mg_P/kg_OM)

30-d mean ending 2022-03-24



30-d mean ending 2022-11-19



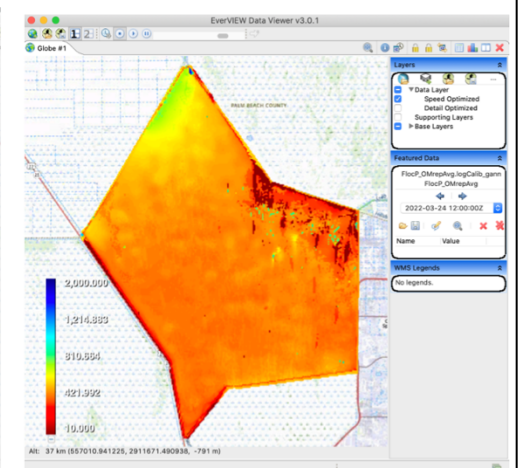
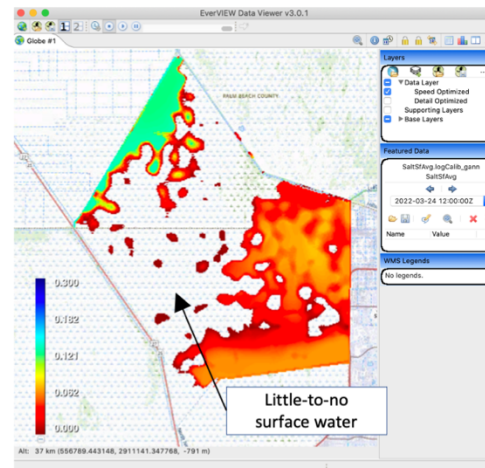
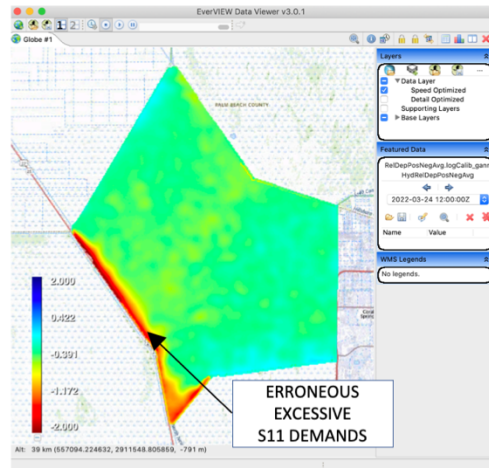
C.

Water Depth Relative to Land Elevation (m)

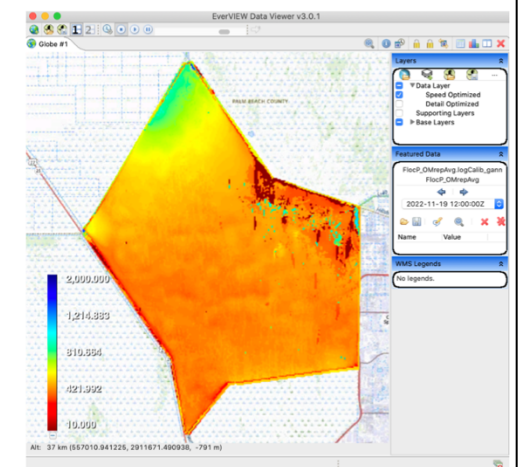
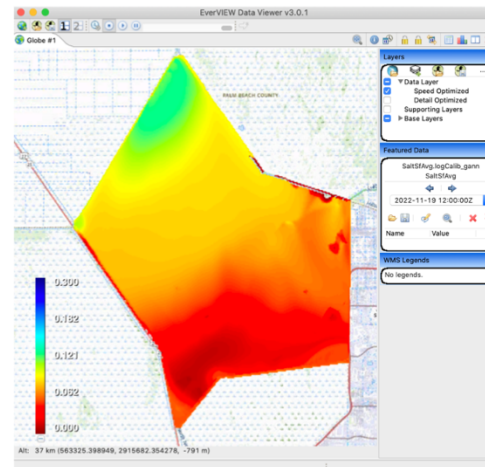
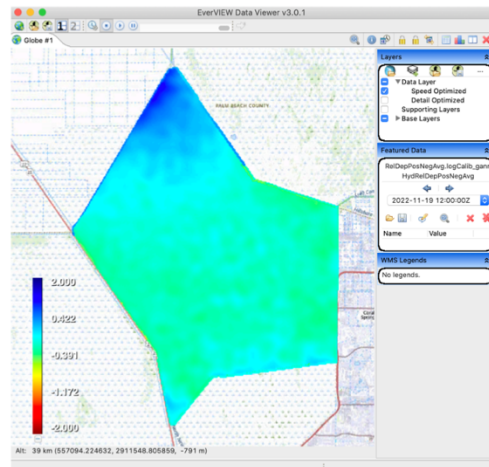
Surface Water Chloride Concentration (g/l)

Floc P:OM TP Concentration (mg_P/kg_OM)

30-d mean ending 2022-03-24



30-d mean ending 2022-11-19



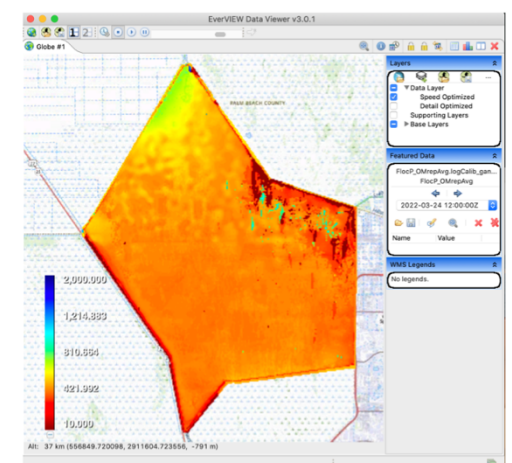
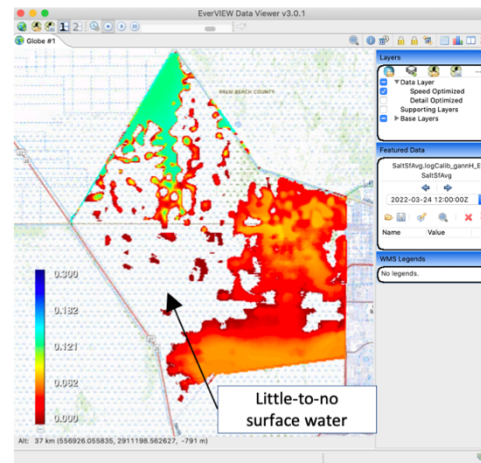
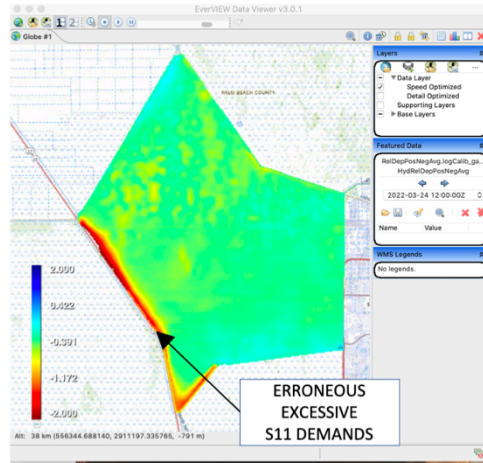
D.

Water Depth Relative to Land Elevation (m)

Surface Water Chloride Concentration (g/l)

Floc P:OM TP Concentration (mg_P/kg_OM)

30-d mean ending 2022-03-24



30-d mean ending 2022-11-19

