Florida Keys National Marine Sanctuary

SEACAR Water Quality Analysis

Last compiled on 30 September, 2025

Contents

Indicators **2**

Nutrients . . . 2

Total Nitrogen - Discrete . . . 2

Total Phosphorus - Discrete . . . 4

Water Quality . . . 6

Dissolved Oxygen - Discrete . . . 6

Dissolved Oxygen - Continuous . . . 8

Dissolved Oxygen Saturation - Discrete . . . 10

Dissolved Oxygen Saturation - Continuous . . . 12

Salinity - Discrete . . . 14

Salinity - Continuous . . . 16

Water Temperature - Discrete . . . 18

Water Temperature - Continuous . . . 19

pH - Discrete . . . 39

pH - Continuous . . . 41

Water Clarity . . . 43

Turbidity - Discrete . . . 43

Turbidity - Continuous . . . 45

Total Suspended Solids - Discrete . . . 47

Chlorophyll a, Uncorrected for Pheophytin - Discrete . . . 49

Chlorophyll a, Corrected for Pheophytin - Discrete . . . 51

Secchi Depth - Discrete . . . 53

Colored Dissolved Organic Matter - Discrete . . . 55

Indicators

Nutrients

Total Nitrogen - Discrete

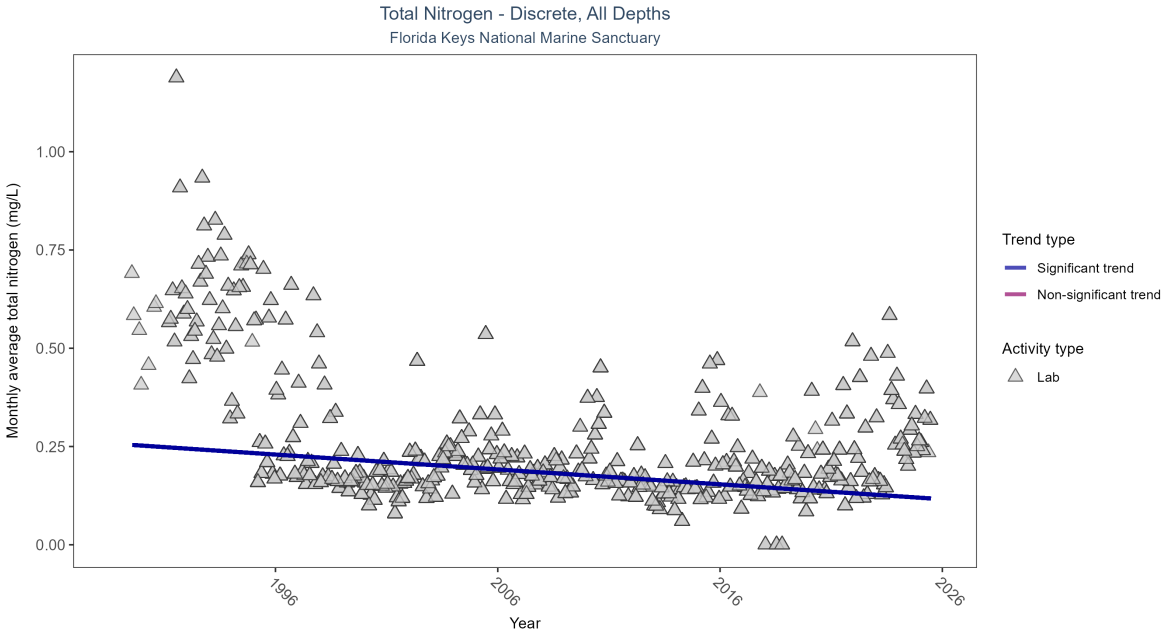

Figure 1: Scatter plot of monthly average total nitrogen over time. If the time series included ten or more years of discrete observations, a significant (blue) or non-significant (magenta) trend line is also shown. Only nitrogen values obtained from laboratory analyses (triangles) are included in the plot.

Table 1: Seasonal Kendall-Tau Results for - Total Nitrogen

Activity Type	Statistical Trend	Sample Count	Years with Data	Period of Record	Median Result Value	Tau	Sen Intercept	Sen Slope	P
Lab	Significantly decreasing trend	34692	37	1989 - 2025	0.14636	-0.24149	0.25605	-0.00379	0

Monthly average total nitrogen decreased by less than 0.01 mg/L per year.

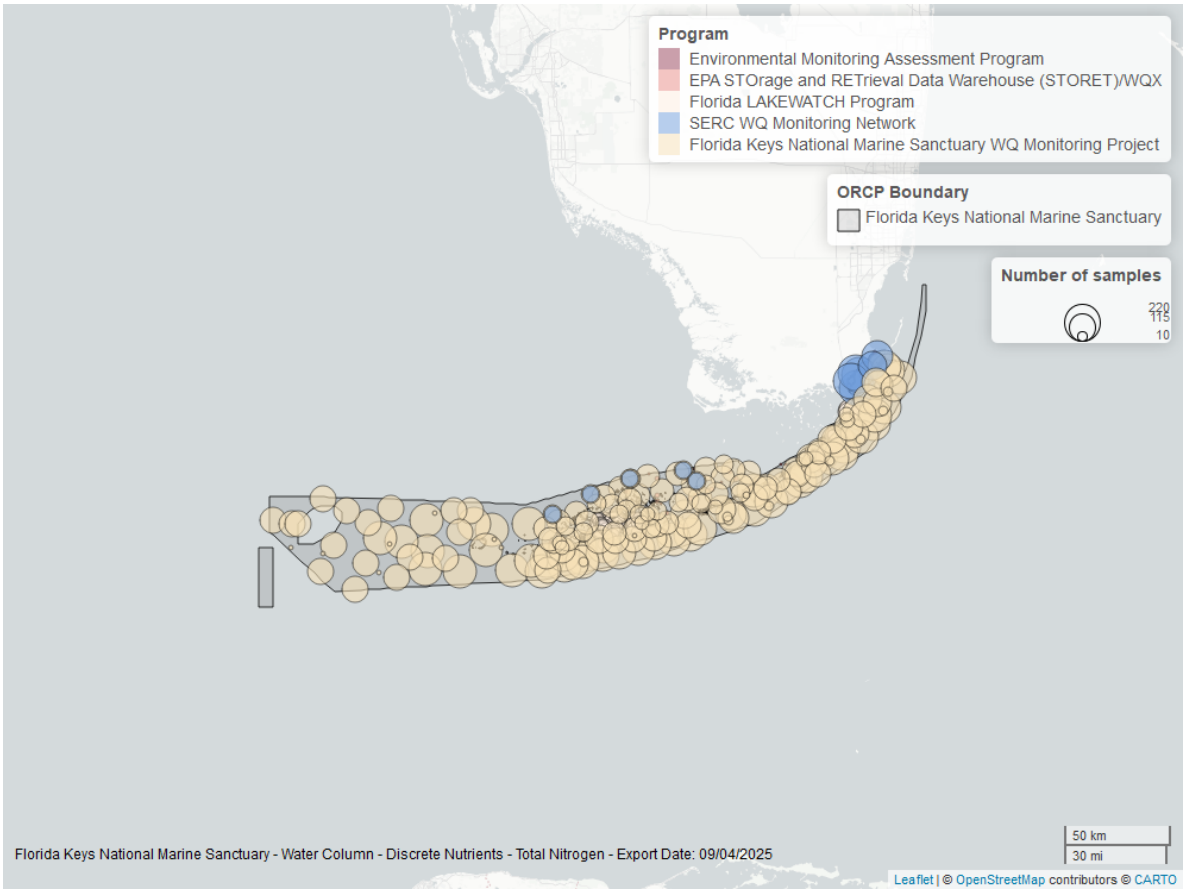

Figure 2: Map showing location of discrete water quality sampling locations within the boundaries of *Florida Keys National Marine Sanctuary*. The bubble size on the maps above reflect the amount of data available at each sampling site.

Total Phosphorus - Discrete

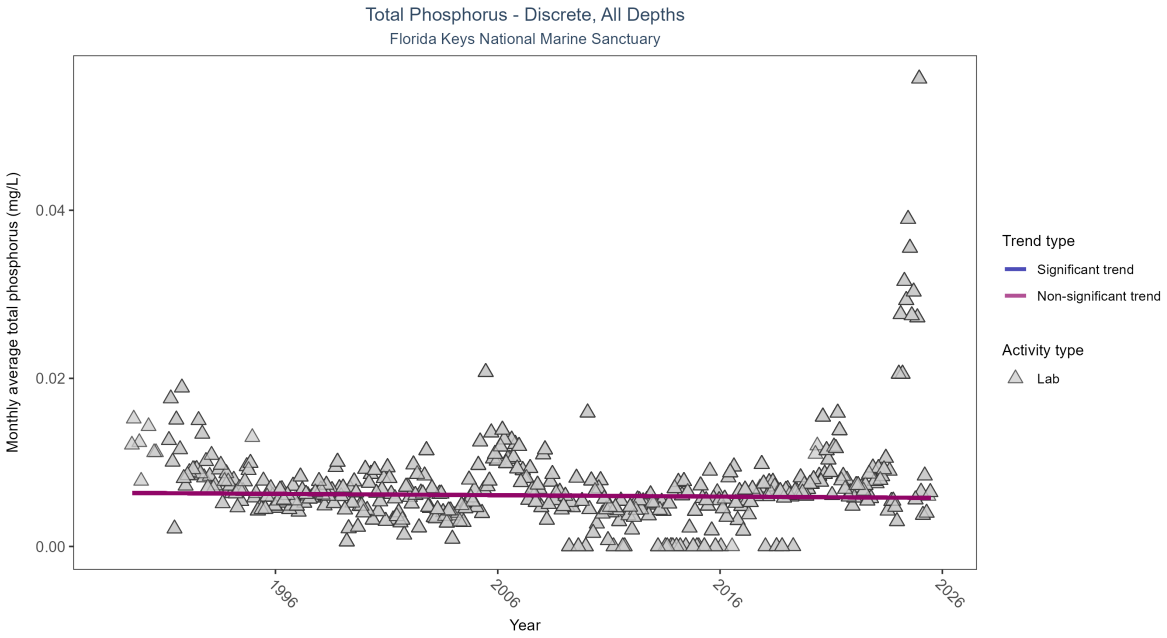

Figure 3: Scatter plot of monthly average total phosphorus over time. If the time series included ten or more years of discrete observations, a significant (blue) or non-significant (magenta) trend line is also shown. Only phosphorus values obtained from laboratory analyses (triangles) are included in the plot.

Table 2: Seasonal Kendall-Tau Results for - Total Phosphorus

Activity Type	Statistical Trend	Sample Count	Years with Data	Period of Record	Median Result Value	Tau	Sen Intercept	Sen Slope	P
Lab	No significant trend	32400	37	1989 - 2025	0.00589	-0.04048	0.00637	-0.00002	0.2519

Total phosphorus showed no detectable trend between 1989 and 2025.

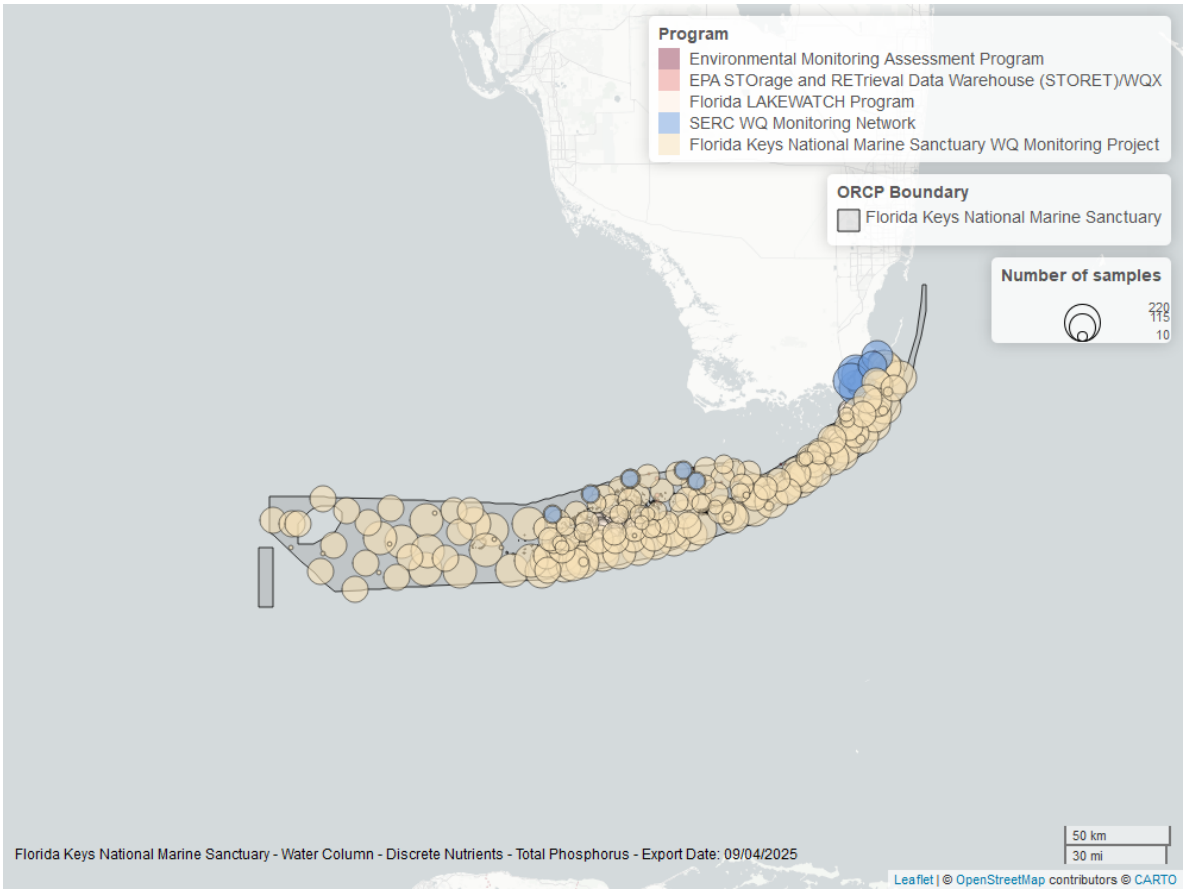

Figure 4: Map showing location of discrete water quality sampling locations within the boundaries of *Florida Keys National Marine Sanctuary*. The bubble size on the maps above reflect the amount of data available at each sampling site.

Water Quality

Dissolved Oxygen - Discrete

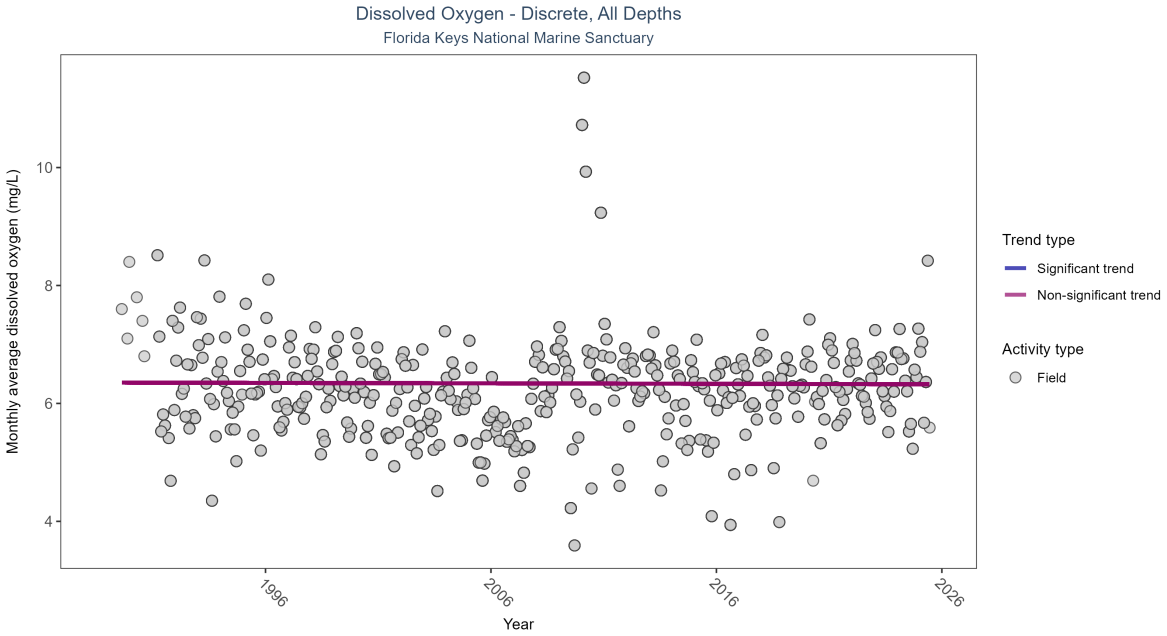

Figure 5: Scatter plot of monthly average dissolved oxygen over time. If the time series included ten or more years of discrete observations, a significant (blue) or non-significant (magenta) trend line is also shown. Only dissolved oxygen values measured in the field (circles) are included in the plot.

Table 3: Seasonal Kendall-Tau Results for - Dissolved Oxygen

Activity Type	Statistical Trend	Sample Count	Years with Data	Period of Record	Median Result Value	Tau	Sen Intercept	Sen Slope	P
Field	No significant trend	52269	37	1989 - 2025	6.30336	-0.00903	6.35318	-0.00076	0.7864

Dissolved oxygen showed no detectable trend between 1989 and 2025.

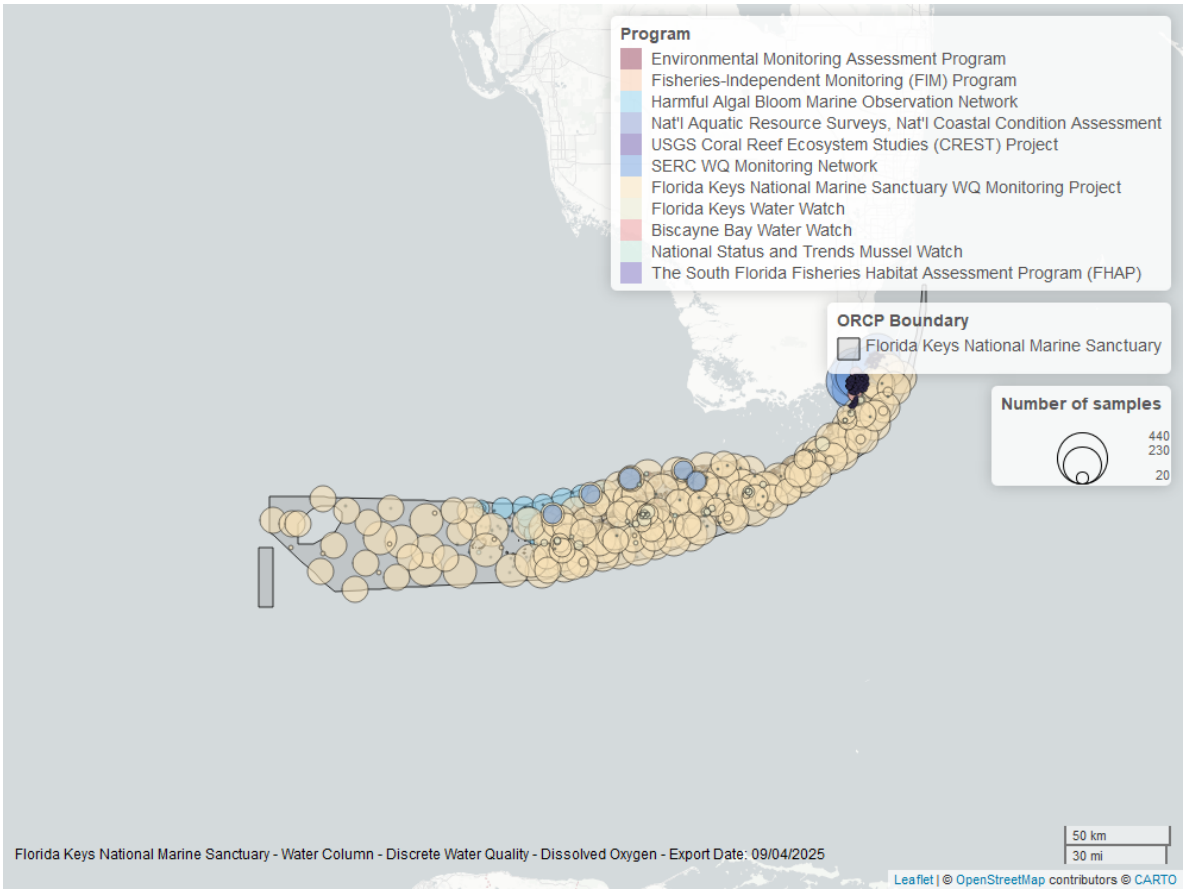

Figure 6: Map showing location of discrete water quality sampling locations within the boundaries of *Florida Keys National Marine Sanctuary*. The bubble size on the maps above reflect the amount of data available at each sampling site.

Dissolved Oxygen - Continuous

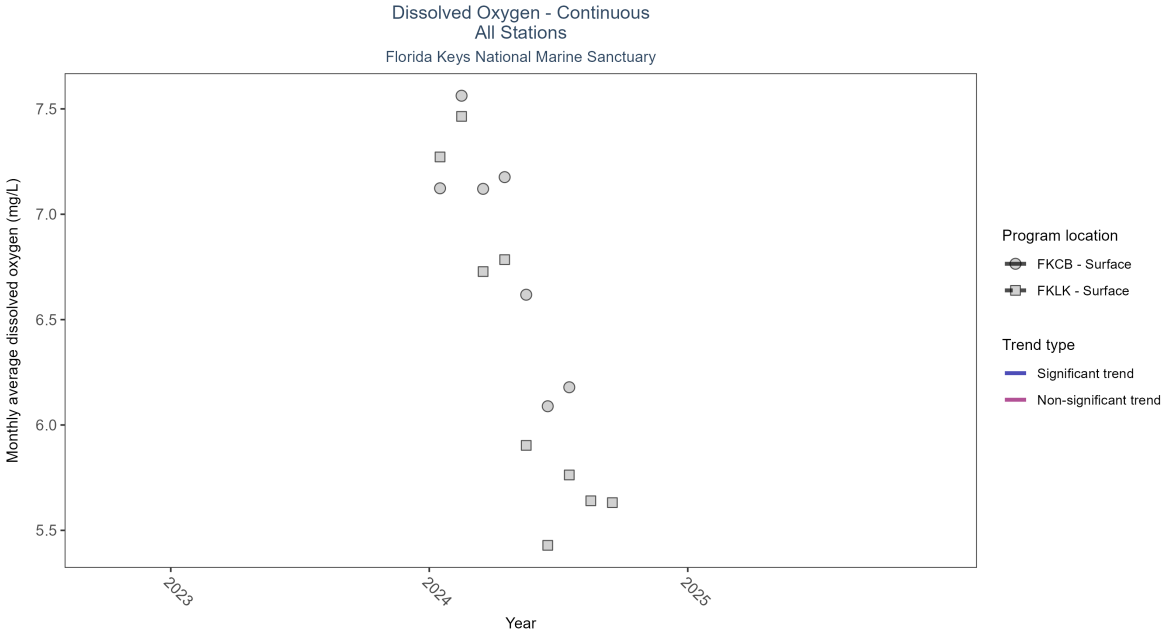

Figure 7: Scatter plot of monthly average dissolved oxygen over time at continuously monitored program locations. Each location is analyzed separately, with significant (blue) or non-significant (magenta) trend lines shown for time series that included five or more years of observations.

Table 4: Seasonal Kendall-Tau Results - Dissolved Oxygen

Program Location	Statistical Trend	Sample Count	Years with Data	Period of Record	Median Result Value	Tau	Sen Intercept	Sen Slope	P
FKLK	Insufficient data to calculate trend	21525	1	2024 - 2024	6.2	-	-	-	-
FKCB	Insufficient data to calculate trend	16262	1	2024 - 2024	6.8	-	-	-	-

There was insufficient data to fit a model for two locations.

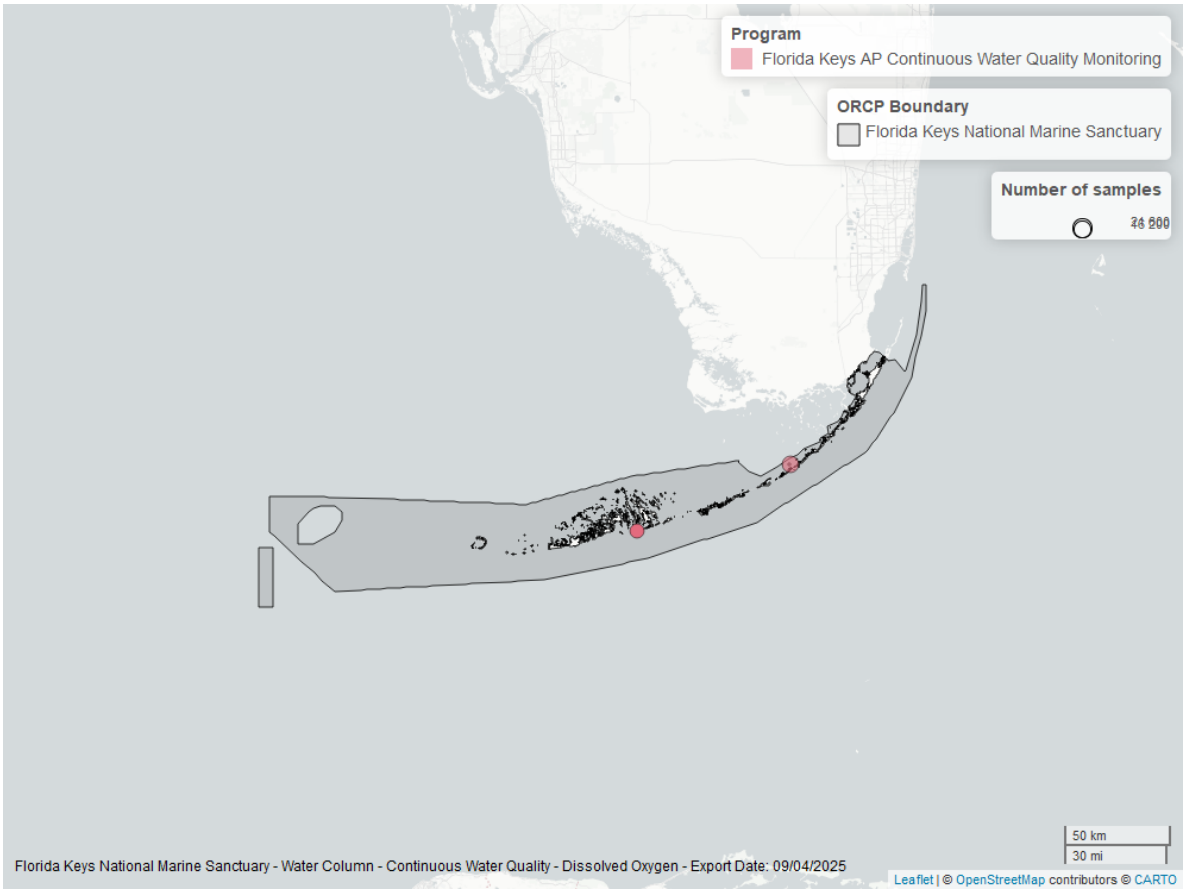

Figure 8: Map showing location of dissolved oxygen continuous water quality sampling locations within the boundaries of *Florida Keys National Marine Sanctuary*. The bubble size on the maps above reflect the amount of data available at each sampling site.

Dissolved Oxygen Saturation - Discrete

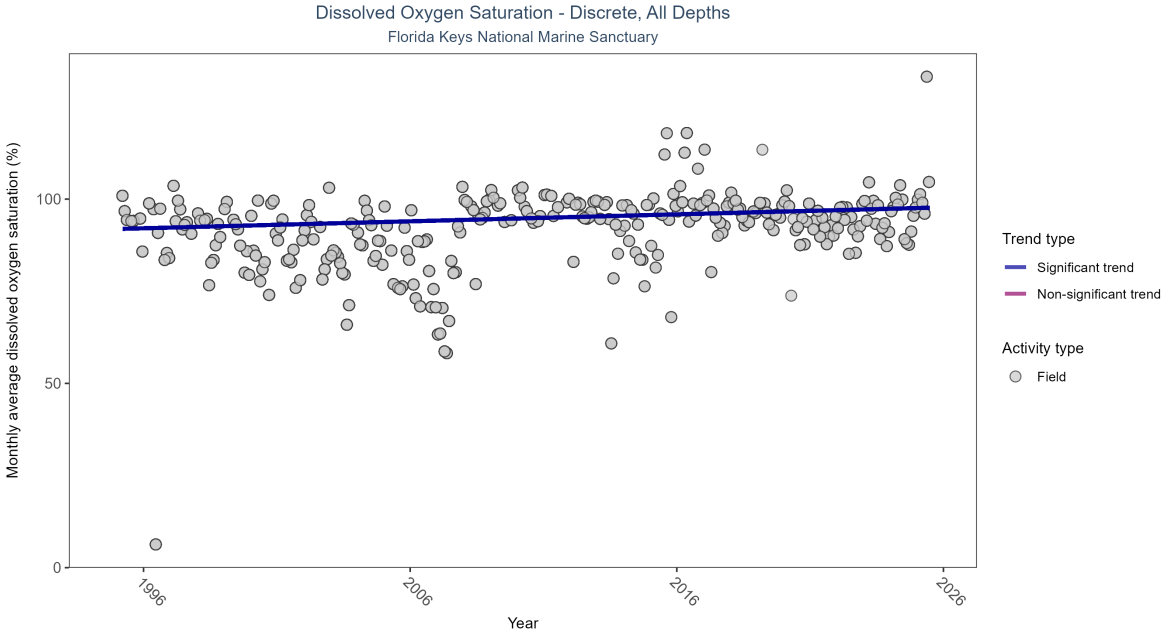

Figure 9: Scatter plot of monthly average dissolved oxygen saturation over time. If the time series included ten or more years of discrete observations, a significant (blue) or non-significant (magenta) trend line is also shown. Only dissolved oxygen saturation values measured in the field (circles) are included in the plot.

Table 5: Seasonal Kendall-Tau Results for - Dissolved Oxygen Saturation

Activity Type	Statistical Trend	Sample Count	Years with Data	Period of Record	Median Result Value	Tau	Sen Intercept	Sen Slope	P
Field	Significantly increasing trend	29573	31	1995 - 2025	94.78069	0.19145	91.89696	0.18908	0

Monthly average dissolved oxygen saturation increased by 0.19% per year.

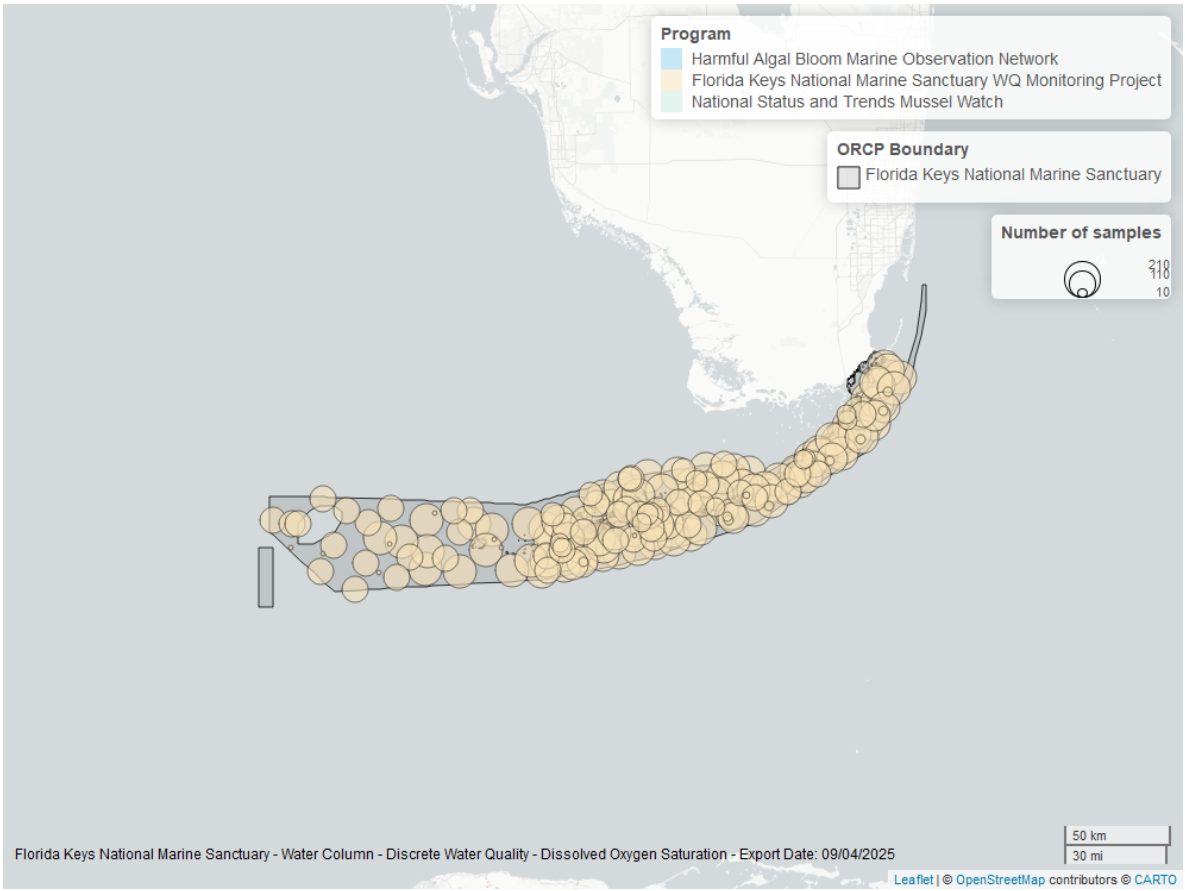

Figure 10: Map showing location of discrete water quality sampling locations within the boundaries of *Florida Keys National Marine Sanctuary*. The bubble size on the maps above reflect the amount of data available at each sampling site.

Dissolved Oxygen Saturation - Continuous

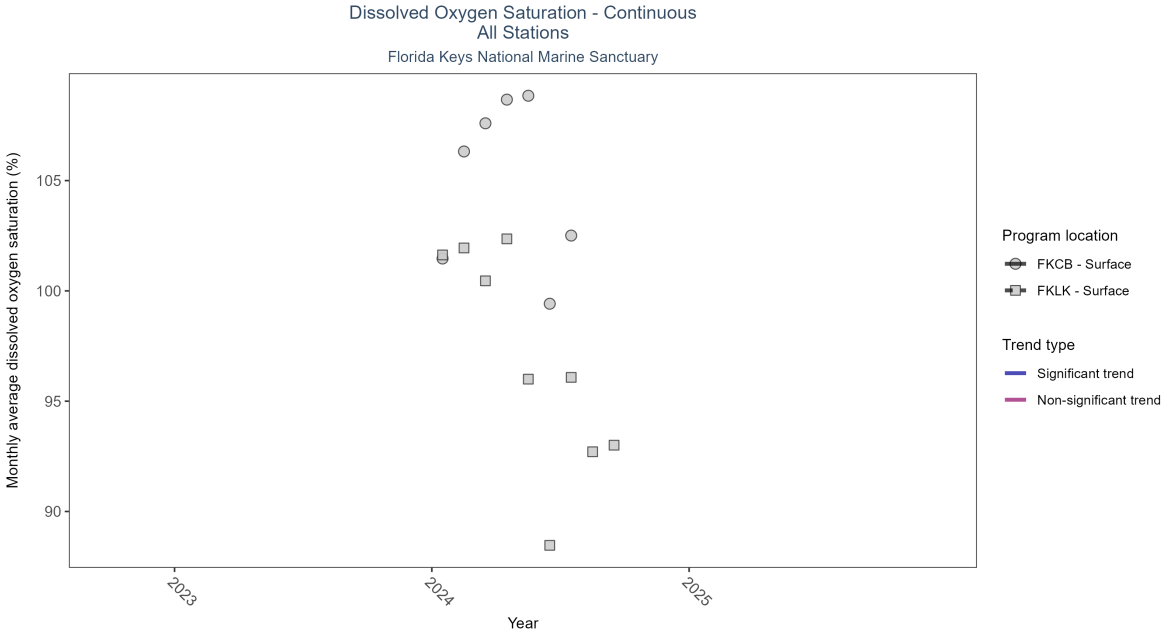

Figure 11: Scatter plot of monthly average dissolved oxygen saturation over time at continuously monitored program locations. Each location is analyzed separately, with significant (blue) or non-significant (magenta) trend lines shown for time series that included five or more years of observations.

Table 6: Seasonal Kendall-Tau Results - Dissolved Oxygen Saturation

Program Location	Statistical Trend	Sample Count	Years with Data	Period of Record	Median Result Value	Tau	Sen Intercept	Sen Slope	P
FKLK	Insufficient data to calculate trend	21525	1	2024 - 2024	91.9	-	-	-	-
FKCB	Insufficient data to calculate trend	16263	1	2024 - 2024	103.3	-	-	-	-

There was insufficient data to fit a model for two locations.

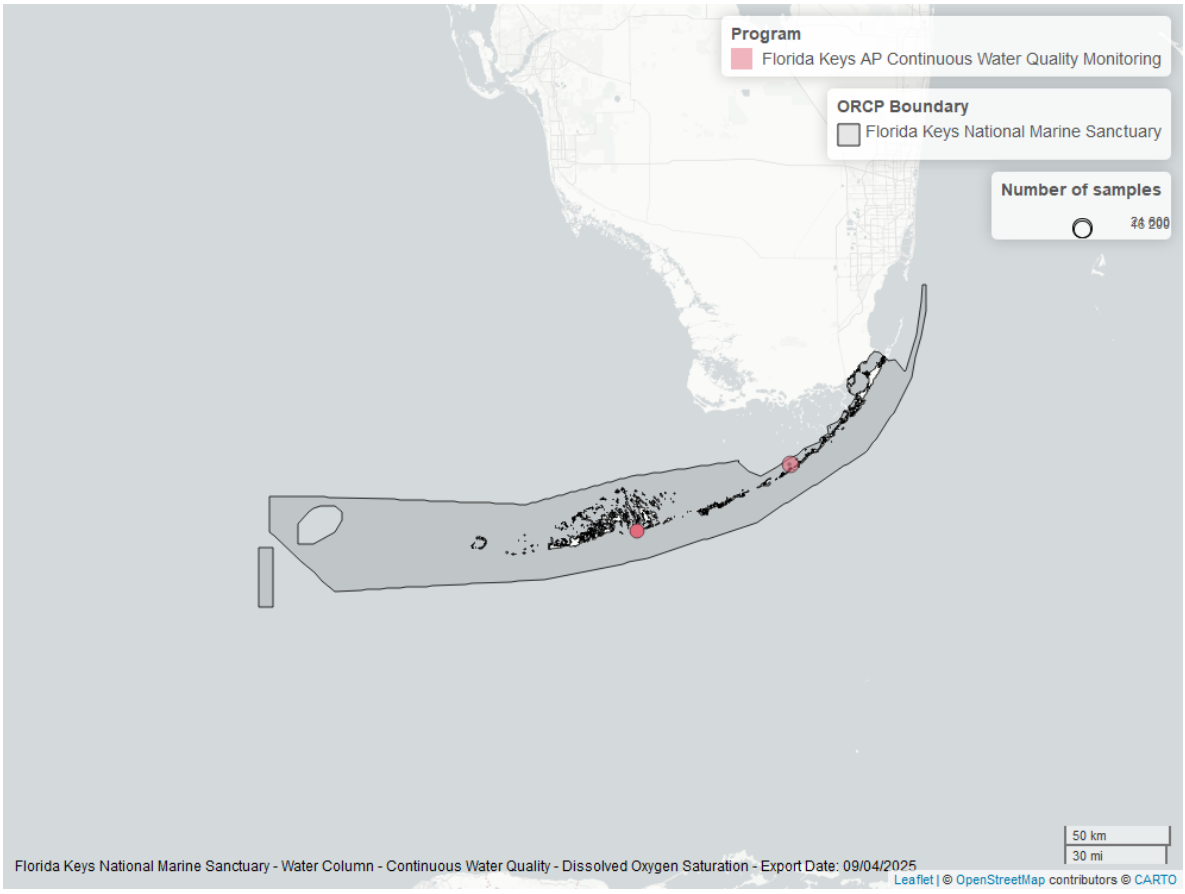

Figure 12: Map showing location of dissolved oxygen saturation continuous water quality sampling locations within the boundaries of *Florida Keys National Marine Sanctuary*. The bubble size on the maps above reflect the amount of data available at each sampling site.

Salinity - Discrete

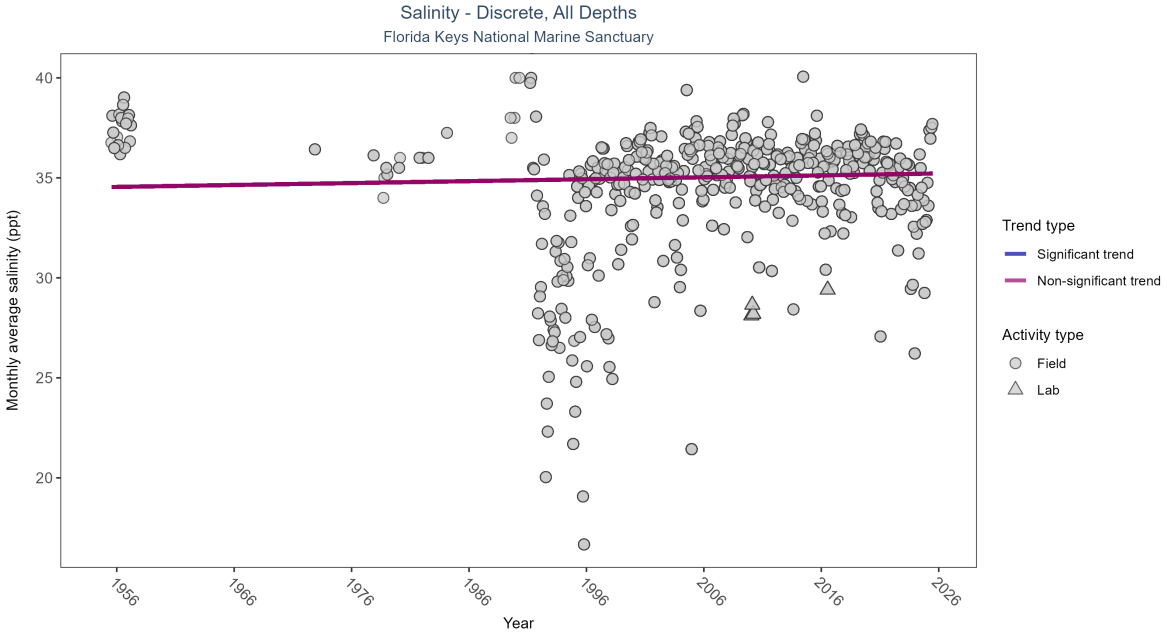

Figure 13: Scatter plot of monthly average salinity over time. If the time series included ten or more years of discrete observations, significant (blue) or non-significant (magenta) trend lines are also shown. Discrete salinity values derived from grab samples analyzed in the field (circles) or the laboratory (triangles) are both included in the plot.

Table 7: Seasonal Kendall-Tau Results for - Salinity

Activity Type	Statistical Trend	Sample Count	Years with Data	Period of Record	Median Result Value	Tau	Sen Intercept	Sen Slope	P
All	No significant trend	56024	48	1955 - 2025	36.18475	0.0374	34.53791	0.00961	0.279

Salinity showed no detectable trend between 1955 and 2025.

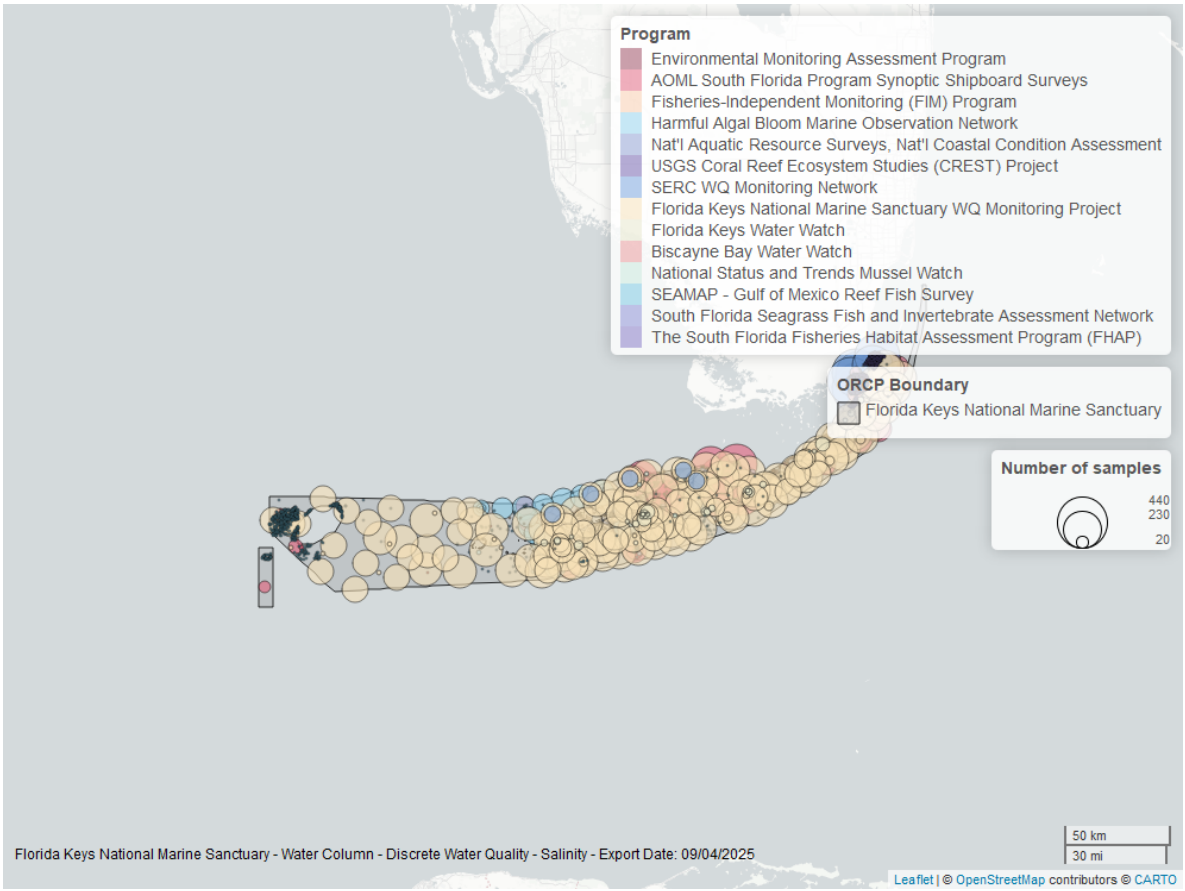

Figure 14: Map showing location of discrete water quality sampling locations within the boundaries of *Florida Keys National Marine Sanctuary*. The bubble size on the maps above reflect the amount of data available at each sampling site.

Salinity - Continuous

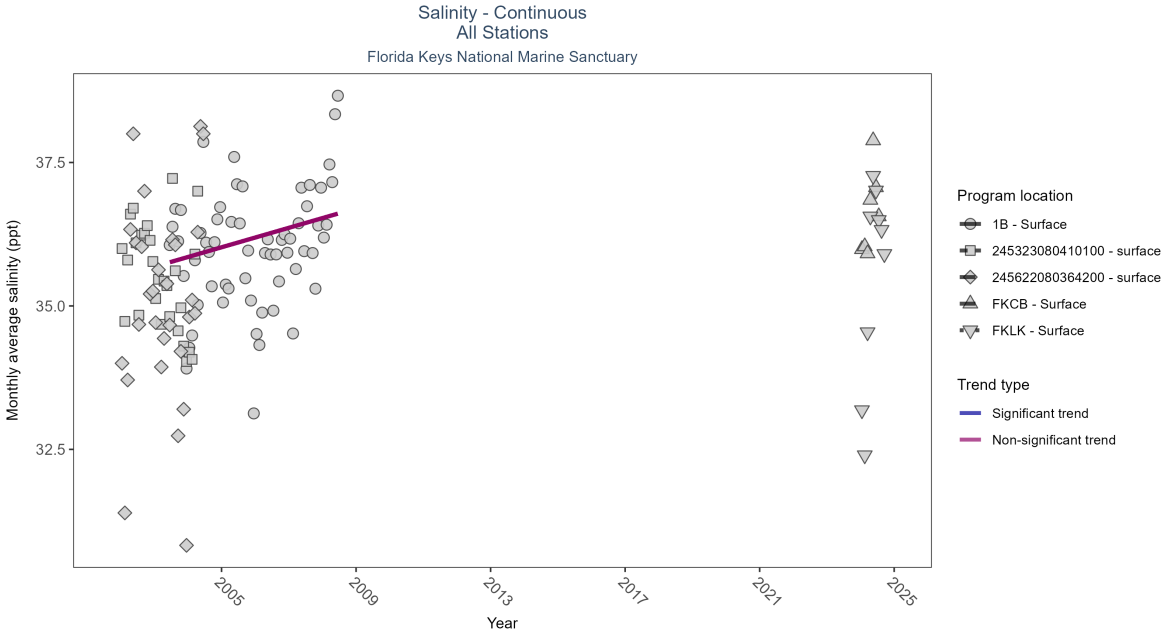

Figure 15: Scatter plot of monthly average salinity over time at continuously monitored program locations. Each location is analyzed separately, with significant (blue) or non-significant (magenta) trend lines shown for time series that included five or more years of observations.

Table 8: Seasonal Kendall-Tau Results - Salinity

Program Location	Statistical Trend	Sample Count	Years with Data	Period of Record	Median Result Value	Tau	Sen Intercept	Sen Slope	P
1B	No significant trend	86204	6	2003 - 2008	36.07	0.24	35.68	0.17	0.0543
245622080364200	Insufficient data to calculate trend	764	3	2002 - 2004	35.00	-	-	-	-
245323080410100	Insufficient data to calculate trend	746	3	2002 - 2004	35.00	-	-	-	-
FKLK	Insufficient data to calculate trend	21517	1	2024 - 2024	36.10	-	-	-	-
FKCB	Insufficient data to calculate trend	16258	1	2024 - 2024	36.50	-	-	-	-

No detectable change in monthly average salinity was observed at one location. There was insufficient data to fit a model for four locations.

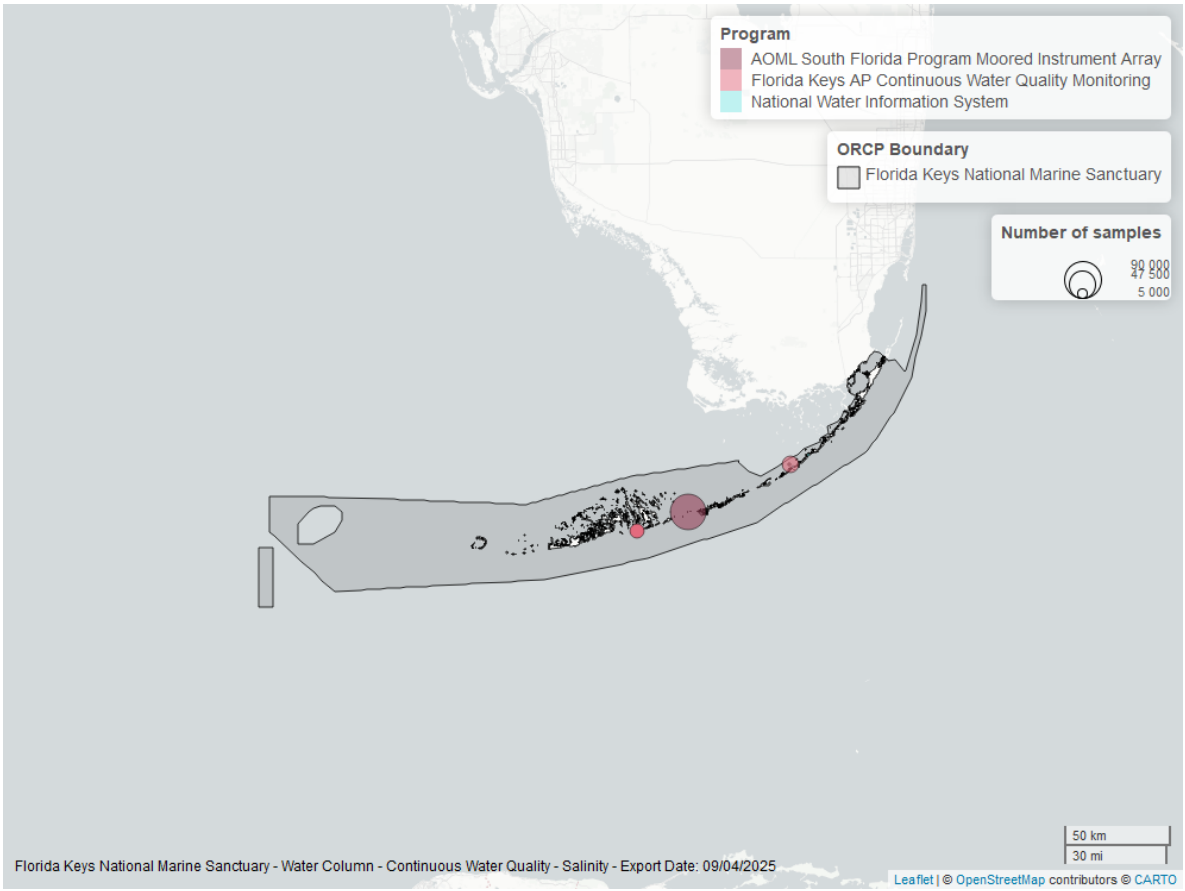

Figure 16: Map showing location of salinity continuous water quality sampling locations within the boundaries of *Florida Keys National Marine Sanctuary*. The bubble size on the maps above reflect the amount of data available at each sampling site.

Water Temperature - Discrete

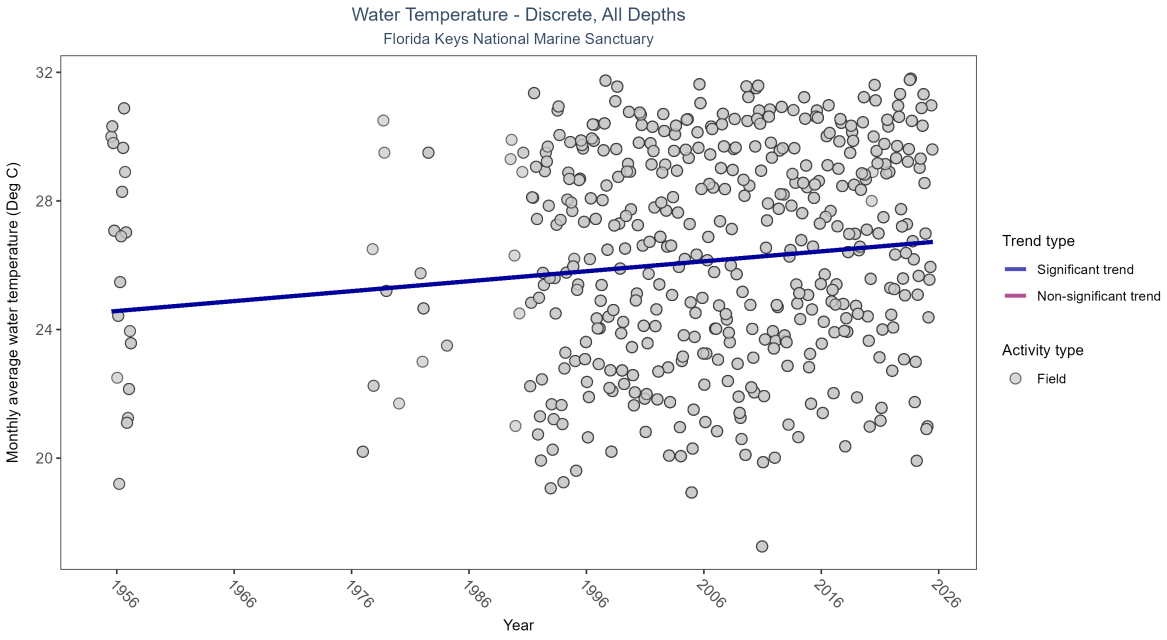

Figure 17: Scatter plot of monthly average water temperature over time. If the time series included ten or more years of discrete observations, a significant (blue) or non-significant (magenta) trend line is also shown. Only water temperature measurements taken in the field (circles) are included in the plot.

Table 9: Seasonal Kendall-Tau Results for - Water Temperature

Activity Type	Statistical Trend	Sample Count	Years with Data	Period of Record	Median Result Value	Tau	Sen Intercept	Sen Slope	P
Field	Significantly increasing trend	61726	47	1955 - 2025	27.3	0.23992	24.54436	0.03093	0

Monthly average water temperature increased by 0.03°C per year.

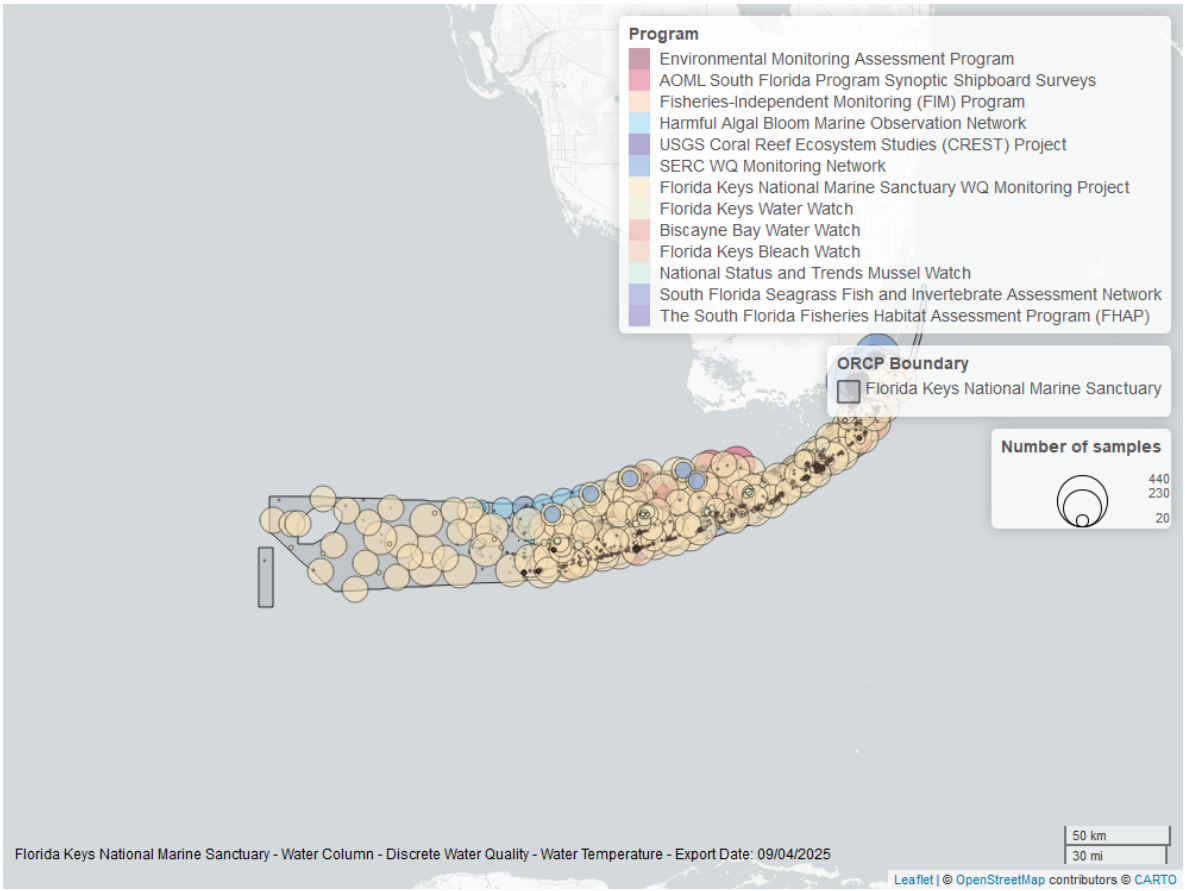

Figure 18: Map showing location of discrete water quality sampling locations within the boundaries of *Florida Keys National Marine Sanctuary*. The bubble size on the maps above reflect the amount of data available at each sampling site.

Water Temperature - Continuous

Atlantic Oceanographic and Meteorological Laboratory (AOML) South Florida Program Moored Instrument Array - *2*

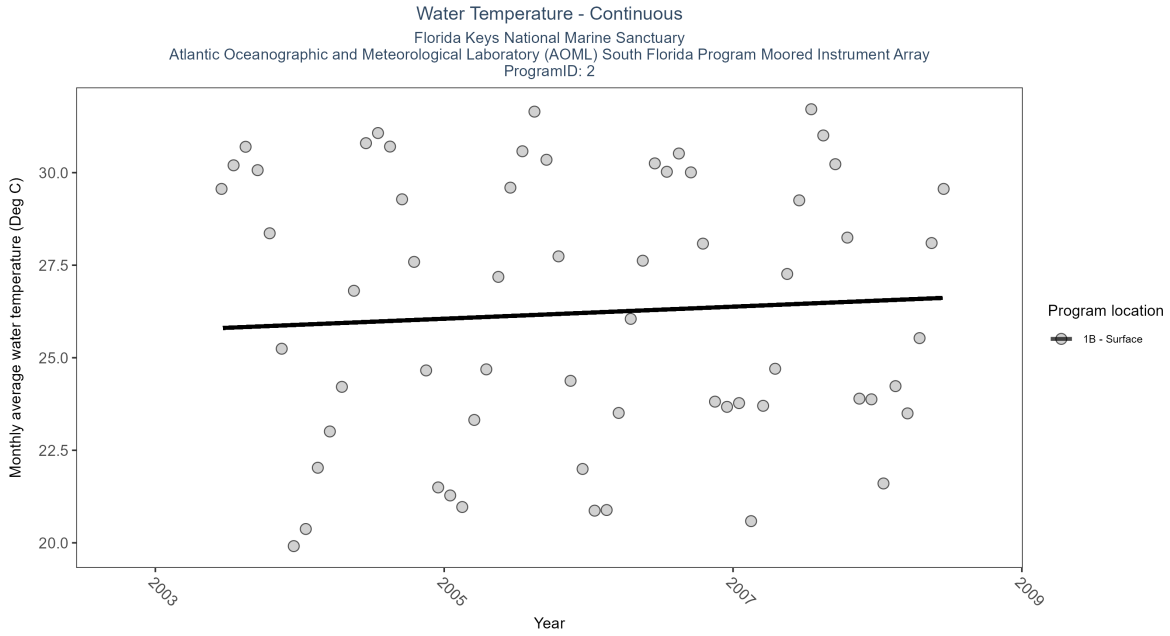

Figure 19: Scatter plot of monthly average water temperature over time at continuously monitored program locations. Each location is analyzed separately, with significant (blue) or non-significant (magenta) trend lines shown for time series that included five or more years of observations.

Table 10: Seasonal Kendall-Tau Results for All Stations - Water Temperature

Program Location	Statistical Trend	Sample Count	Years with Data	Period of Record	Median Result Value	Tau	Sen Intercept	Sen Slope	P
1B	Significantly increasing trend	86204	6	2003 - 2008	26.38	0.26	25.73	0.16	0.0392

At eighty-two program locations, monthly average water temperature increased between 0.01 and 0.16°C per year. No detectable change in monthly average water temperature was observed at forty-one locations. There was insufficient data to fit a model for nine locations.

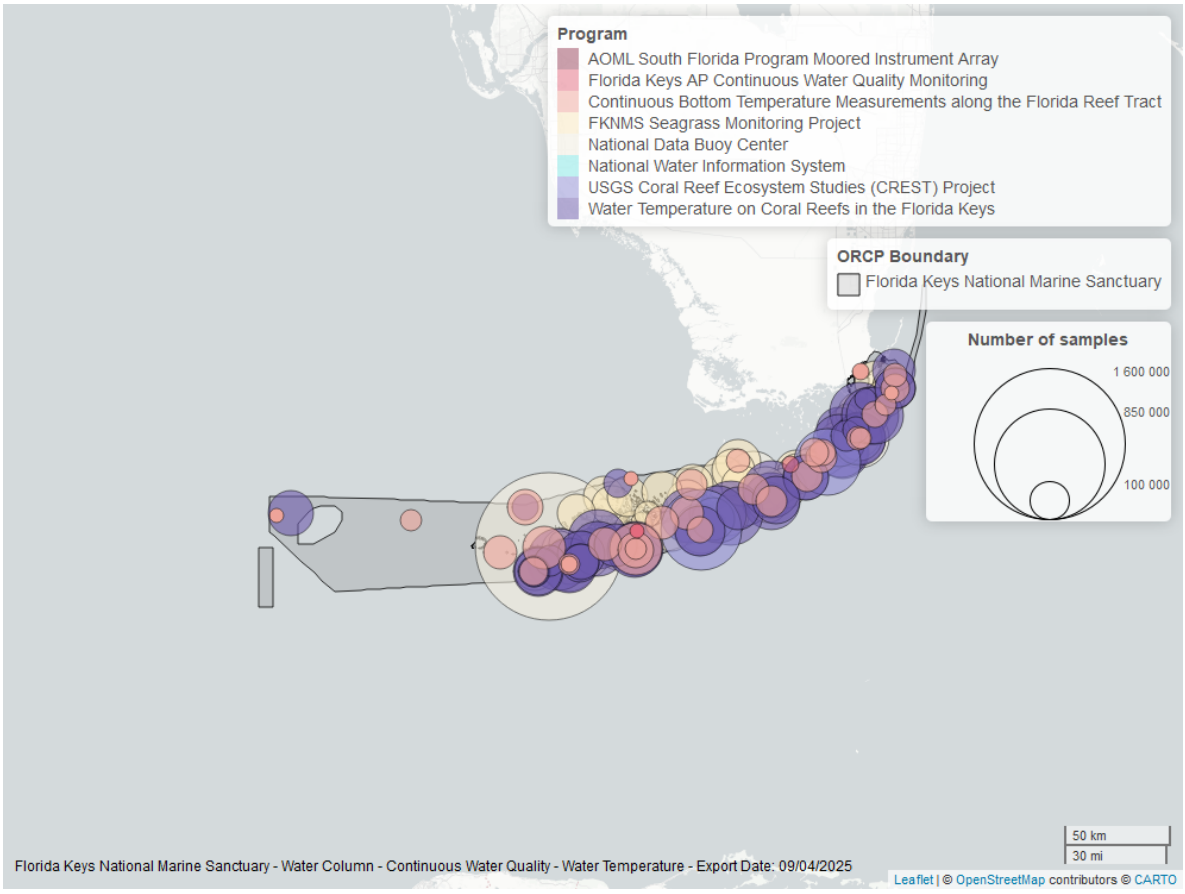

Figure 20: Map showing location of water temperature continuous water quality sampling locations within the boundaries of *Florida Keys National Marine Sanctuary*. The bubble size on the maps above reflect the amount of data available at each sampling site.

National Data Buoy Center - *5*

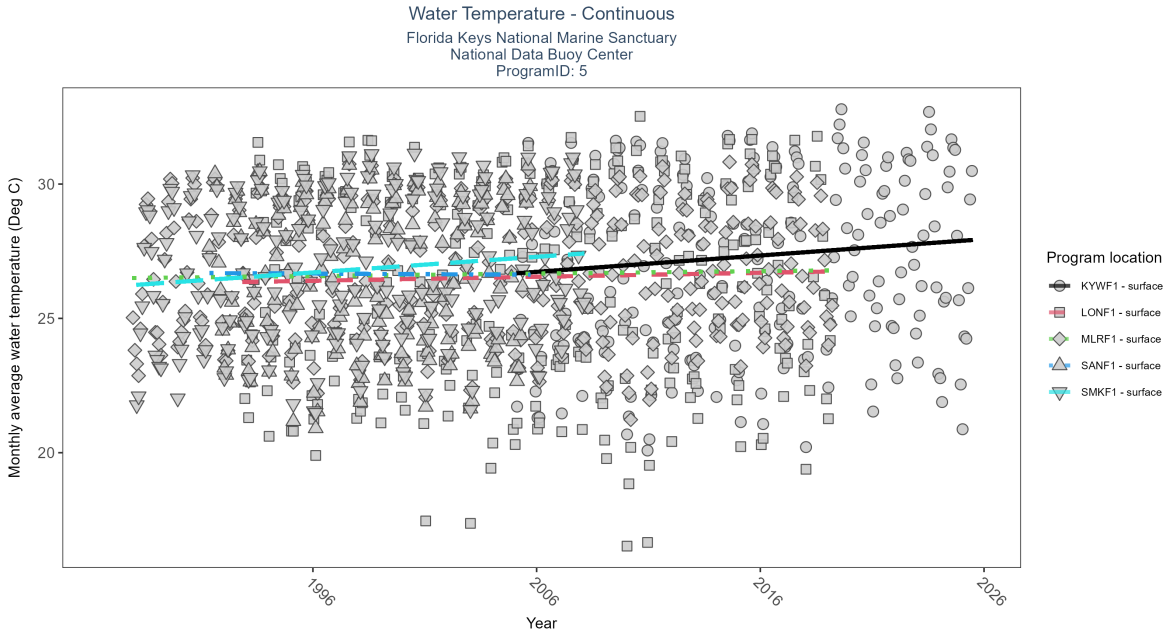

Figure 21: Scatter plot of monthly average water temperature over time at continuously monitored program locations. Each location is analyzed separately, with significant (blue) or non-significant (magenta) trend lines shown for time series that included five or more years of observations.

Table 11: Seasonal Kendall-Tau Results for All Stations - Water Temperature

Program Location	Statistical Trend	Sample Count	Years with Data	Period of Record	Median Result Value	Tau	Sen Intercept	Sen Slope	P
KYWF1	Significantly increasing trend	1522889	21	2005 - 2025	27.5	0.29	26.67	0.06	0
LONF1	No significant trend	205971	28	1992 - 2019	26.6	0.07	26.34	0.01	0.0825
MLRF1	Significantly increasing trend	256798	33	1987 - 2019	26.5	0.10	26.49	0.01	0.0043
SMKF1	Significantly increasing trend	154326	21	1988 - 2008	26.8	0.34	26.24	0.06	0
SANF1	No significant trend	117833	15	1991 - 2005	26.7	-0.03	26.69	0.00	0.6199

At eighty-two program locations, monthly average water temperature increased between 0.01 and 0.16°C per year. No detectable change in monthly average water temperature was observed at forty-one locations. There was insufficient data to fit a model for nine locations.

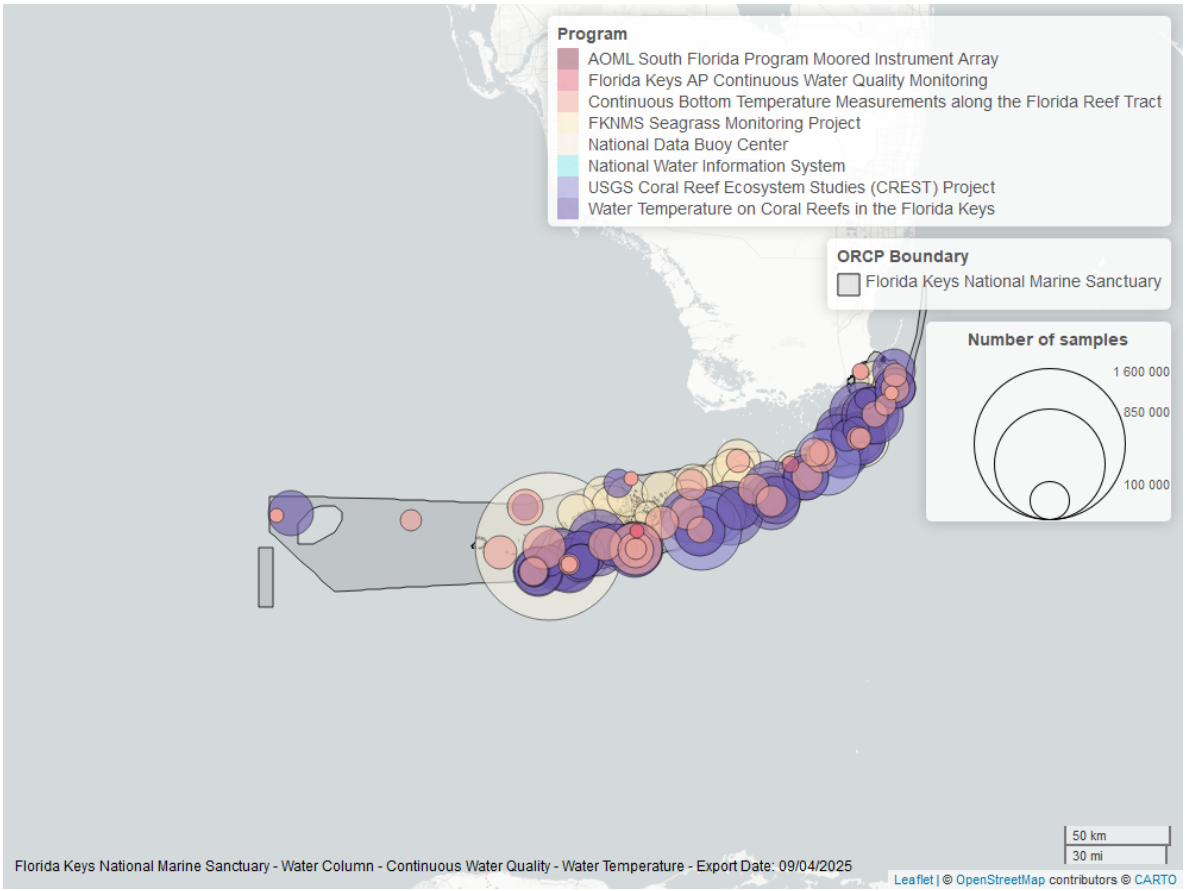

Figure 22: Map showing location of water temperature continuous water quality sampling locations within the boundaries of *Florida Keys National Marine Sanctuary*. The bubble size on the maps above reflect the amount of data available at each sampling site.

National Water Information System - *7*

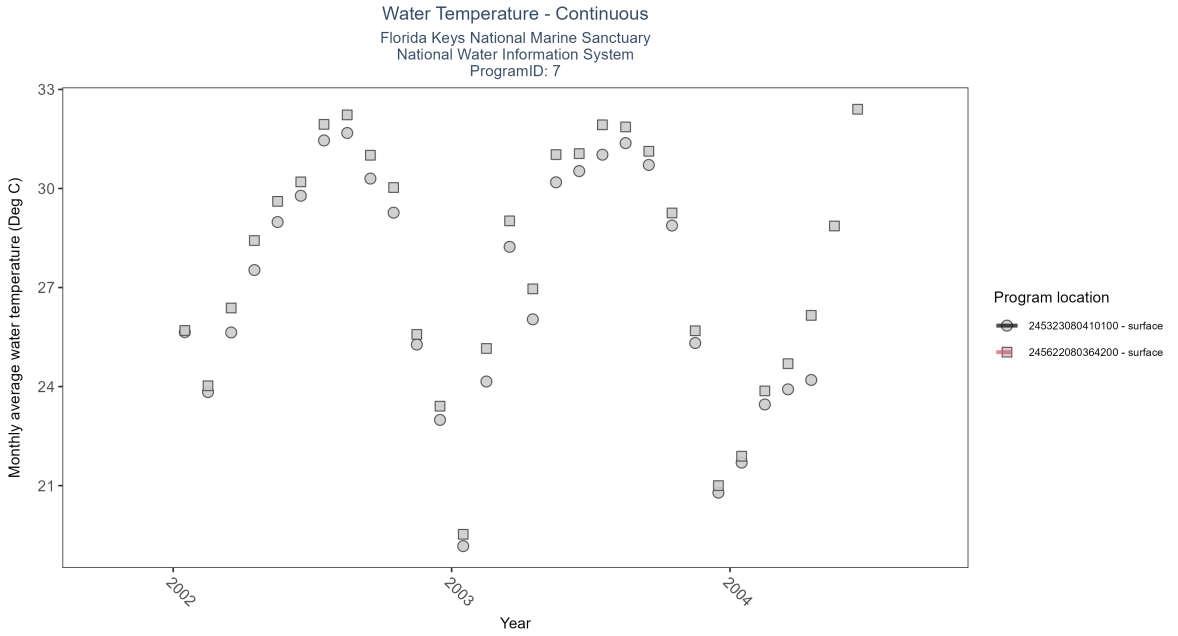

Figure 23: Scatter plot of monthly average water temperature over time at continuously monitored program locations. Each location is analyzed separately, with significant (blue) or non-significant (magenta) trend lines shown for time series that included five or more years of observations.

Table 12: Seasonal Kendall-Tau Results for All Stations - Water Temperature

Program Location	Statistical Trend	Sample Count	Years with Data	Period of Record	Median Result Value	Tau	Sen Intercept	Sen Slope	P
245622080364200	Insufficient data to calculate trend	853	3	2002 - 2004	28.3	-	-	-	-
245323080410100	Insufficient data to calculate trend	791	3	2002 - 2004	27.9	-	-	-	-

At eighty-two program locations, monthly average water temperature increased between 0.01 and 0.16°C per year. No detectable change in monthly average water temperature was observed at forty-one locations. There was insufficient data to fit a model for nine locations.

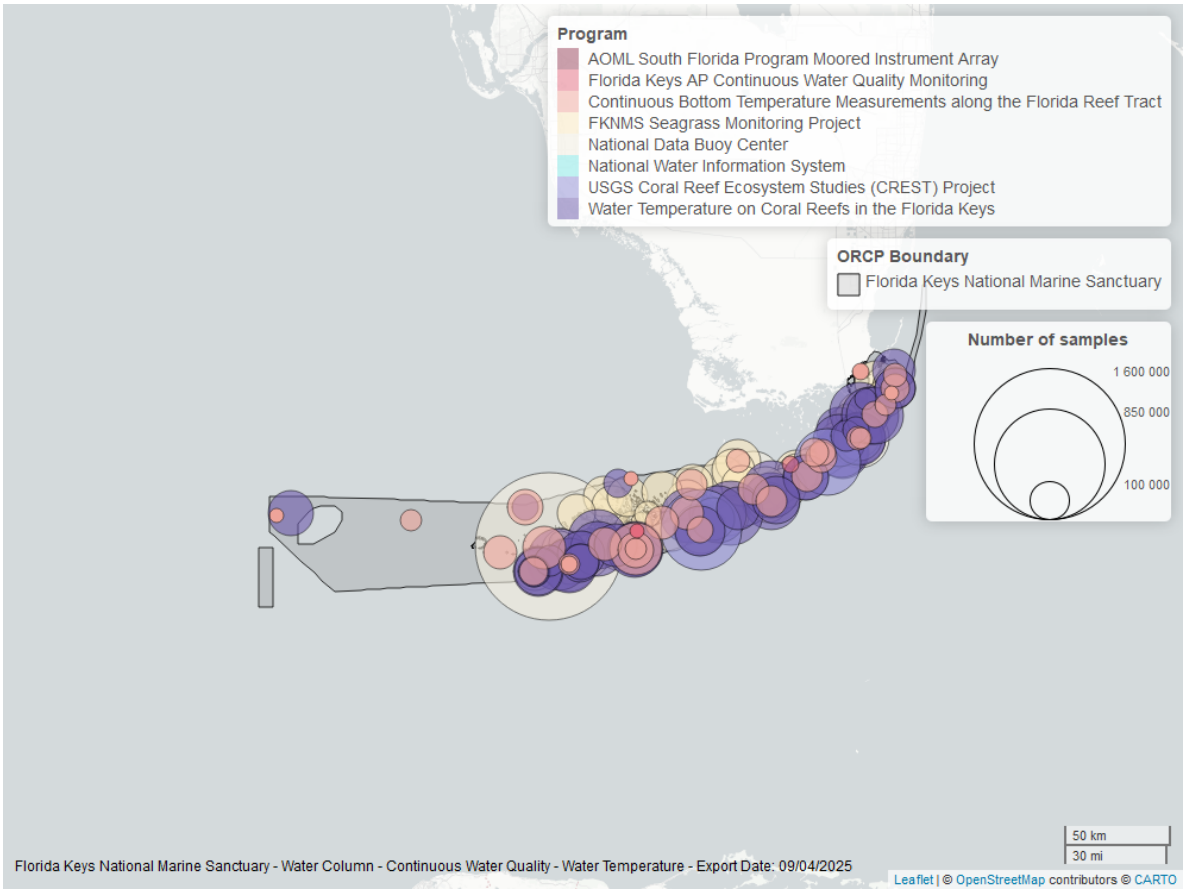

Figure 24: Map showing location of water temperature continuous water quality sampling locations within the boundaries of *Florida Keys National Marine Sanctuary*. The bubble size on the maps above reflect the amount of data available at each sampling site.

Florida Keys National Marine Sanctuary Seagrass Monitoring Project - *296*

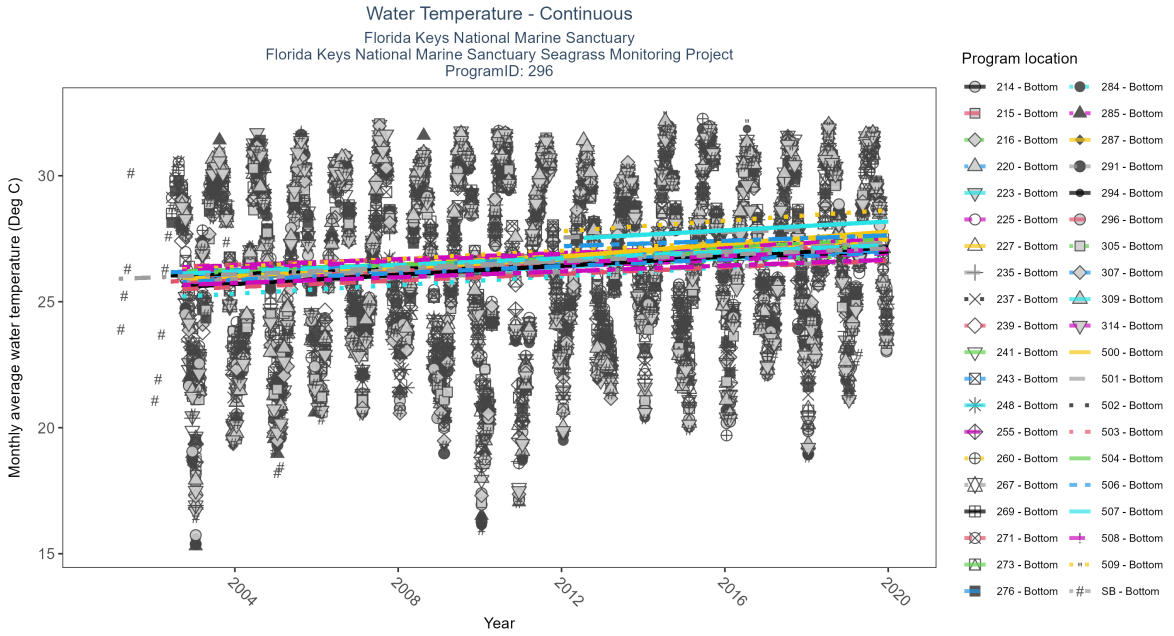

Figure 25: Scatter plot of monthly average water temperature over time at continuously monitored program locations. Each location is analyzed separately, with significant (blue) or non-significant (magenta) trend lines shown for time series that included five or more years of observations.

Table 13: Seasonal Kendall-Tau Results for All Stations - Water Temperature

Program Location	Statistical Trend	Sample Count	Years with Data	Period of Record	Median Result Value	Tau	Sen Intercept	Sen Slope	P
276	Significantly increasing trend	123833	18	2002 - 2019	26.87	0.21	26.15	0.05	2e-04
287	Significantly increasing trend	133008	18	2002 - 2019	26.87	0.29	25.84	0.08	0
291	Significantly increasing trend	116240	18	2002 - 2019	26.38	0.26	25.72	0.09	0
305	Significantly increasing trend	122296	18	2002 - 2019	26.43	0.22	26.07	0.06	1e-04
307	Significantly increasing trend	110802	17	2002 - 2019	26.74	0.22	25.73	0.07	3e-04
SB	Significantly increasing trend	145514	19	2001 - 2019	26.34	0.23	25.9	0.06	0
214	Significantly increasing trend	136333	18	2002 - 2019	26.52	0.27	25.84	0.07	0
225	Significantly increasing trend	117692	17	2002 - 2019	26.82	0.32	26.32	0.06	0
235	Significantly increasing trend	128499	18	2002 - 2019	27.14	0.28	25.77	0.08	0
237	Significantly increasing trend	122250	18	2002 - 2019	26.38	0.31	25.74	0.09	0
239	Significantly increasing trend	111523	17	2002 - 2018	26.92	0.24	25.96	0.07	1e-04
241	Significantly increasing trend	127914	18	2002 - 2019	27.26	0.27	25.91	0.09	0
243	Significantly increasing trend	121593	18	2002 - 2019	26.62	0.3	26	0.07	0
248	Significantly increasing trend	111702	18	2002 - 2019	26.79	0.31	25.54	0.08	0
255	Significantly increasing trend	119939	18	2002 - 2019	26.35	0.24	25.73	0.07	0
260	Significantly increasing trend	97832	16	2002 - 2019	27.07	0.28	26.22	0.08	0
267	Significantly increasing trend	99735	18	2002 - 2019	26.57	0.24	25.64	0.05	2e-04
269	Significantly increasing trend	106458	17	2002 - 2019	26.74	0.21	26.02	0.05	0.001
271	Significantly increasing trend	133627	18	2002 - 2019	26.92	0.26	25.77	0.07	0
273	Significantly increasing trend	129817	18	2002 - 2019	27.16	0.24	26.16	0.05	0
223	Significantly increasing trend	133082	18	2002 - 2019	26.89	0.3	25.84	0.08	0
227	Significantly increasing trend	105351	17	2003 - 2019	26.67	0.29	26.06	0.08	0
220	Significantly increasing trend	126033	17	2003 - 2019	26.52	0.25	25.94	0.06	0
215	Significantly increasing trend	133286	16	2003 - 2018	26.74	0.26	26.42	0.05	0
284	Significantly increasing trend	123977	17	2002 - 2019	26.86	0.28	25.14	0.09	0
285	Significantly increasing trend	121423	18	2002 - 2019	26.86	0.25	26.17	0.07	0
309	Significantly increasing trend	107410	18	2002 - 2019	27.85	0.27	26.07	0.06	0
216	Significantly increasing trend	98535	17	2002 - 2018	26.26	0.31	25.86	0.06	0
314	Significantly increasing trend	110686	18	2002 - 2019	27.41	0.23	25.63	0.06	2e-04
294	Significantly increasing trend	112348	18	2002 - 2019	26.92	0.27	25.52	0.09	0
296	Significantly increasing trend	114497	17	2002 - 2019	27.36	0.21	25.45	0.07	2e-04
500	Significantly increasing trend	69048	8	2012 - 2019	27.33	0.23	26.79	0.12	0.0074
506	No significant trend	35198	7	2012 - 2019	27.41	0.04	27.2	0.05	0.735
507	No significant trend	47517	8	2012 - 2019	27.36	0.18	27.48	0.09	0.1213
508	No significant trend	24021	6	2012 - 2019	26.67	0.33	26.54	0.07	0.2949
509	No significant trend	38607	8	2012 - 2019	27.70	0.05	27.79	0.11	0.4739
502	Insufficient data to calculate trend	22765	4	2016 - 2019	26.70	-	-	-	-
501	No significant trend	34805	5	2012 - 2018	27.48	0.11	27.55	0.05	0.6481
503	Insufficient data to calculate trend	7490	1	2016 - 2016	28.74	-	-	-	-
504	Insufficient data to calculate trend	4339	1	2018 - 2018	29.84	-	-	-	-

At eighty-two program locations, monthly average water temperature increased between 0.01 and 0.16°C per year. No detectable change in monthly average water temperature was observed at forty-one locations. There was insufficient data to fit a model for nine locations.

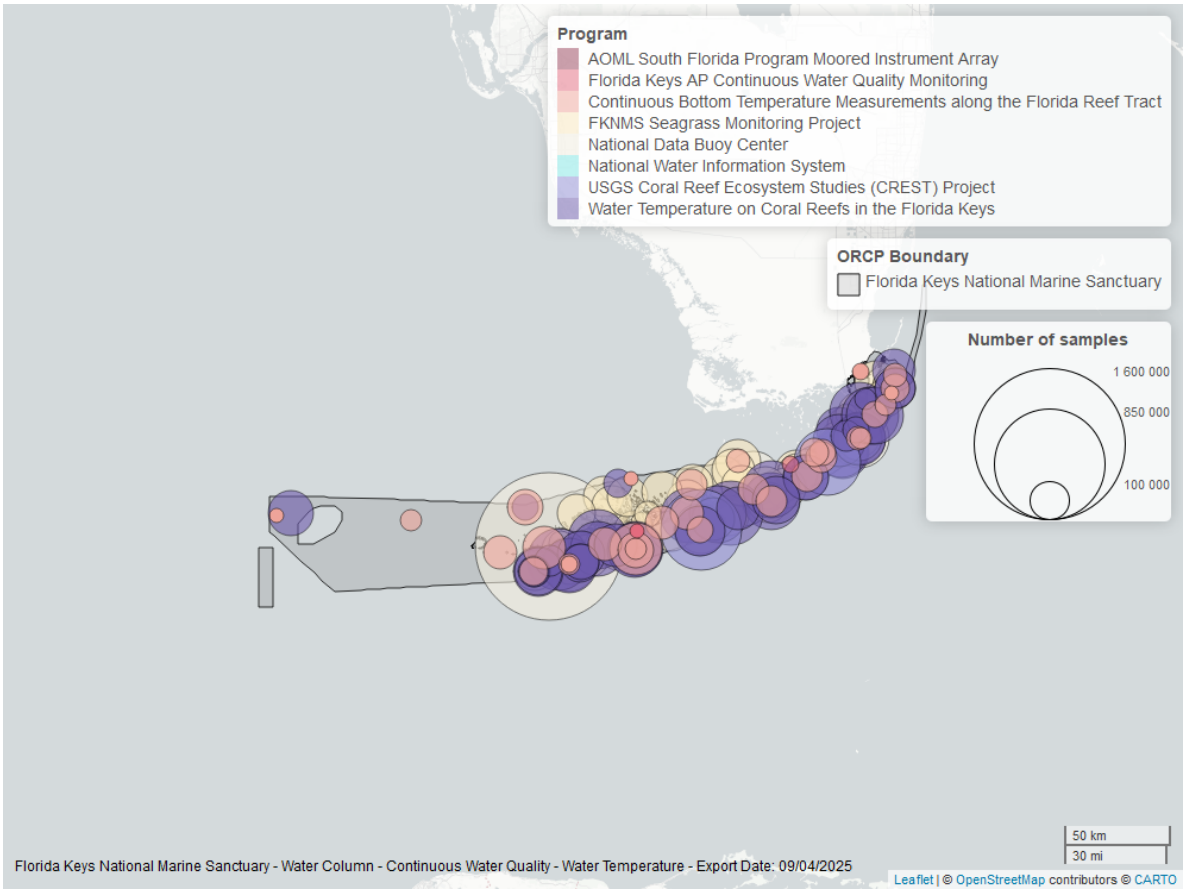

Figure 26: Map showing location of water temperature continuous water quality sampling locations within the boundaries of *Florida Keys National Marine Sanctuary*. The bubble size on the maps above reflect the amount of data available at each sampling site.

USGS Coral Reef Ecosystem Studies (CREST) Project - *899*

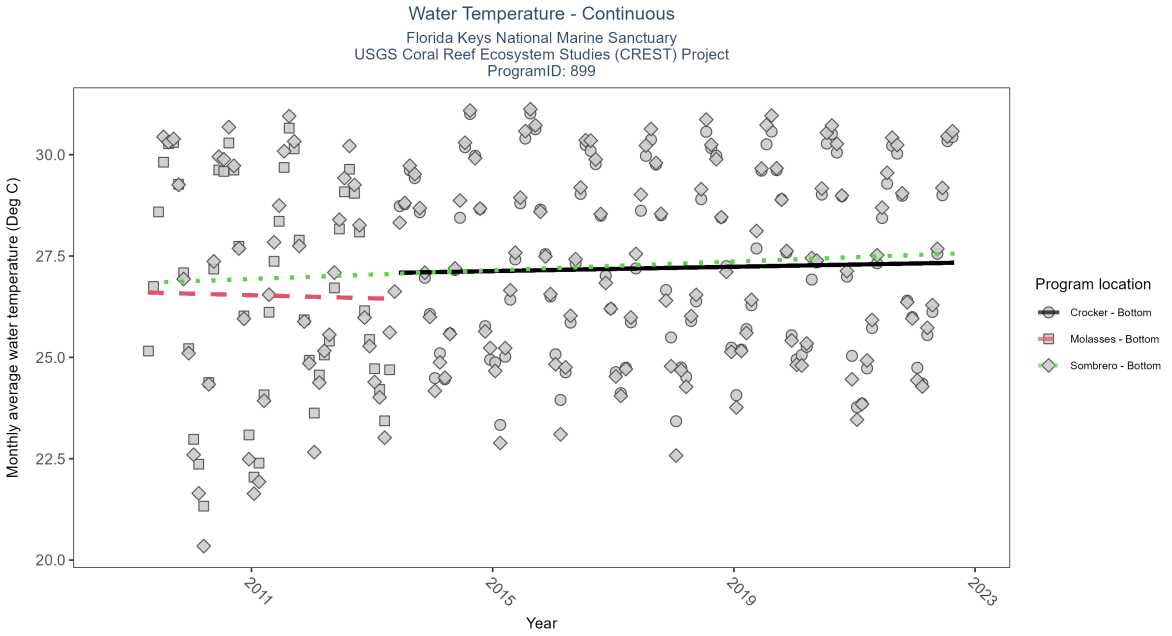

Figure 27: Scatter plot of monthly average water temperature over time at continuously monitored program locations. Each location is analyzed separately, with significant (blue) or non-significant (magenta) trend lines shown for time series that included five or more years of observations.

Table 14: Seasonal Kendall-Tau Results for All Stations - Water Temperature

Program Location	Statistical Trend	Sample Count	Years with Data	Period of Record	Median Result Value	Tau	Sen Intercept	Sen Slope	P
Sombrero	Significantly increasing trend	459354	14	2009 - 2022	27.16	0.26	26.83	0.05	0
Molasses	No significant trend	140713	5	2009 - 2013	26.72	-0.03	26.61	-0.04	0.9247
Crocker	Significantly increasing trend	322670	10	2013 - 2022	27.32	0.15	27.07	0.03	0.0436

At eighty-two program locations, monthly average water temperature increased between 0.01 and 0.16°C per year. No detectable change in monthly average water temperature was observed at forty-one locations. There was insufficient data to fit a model for nine locations.

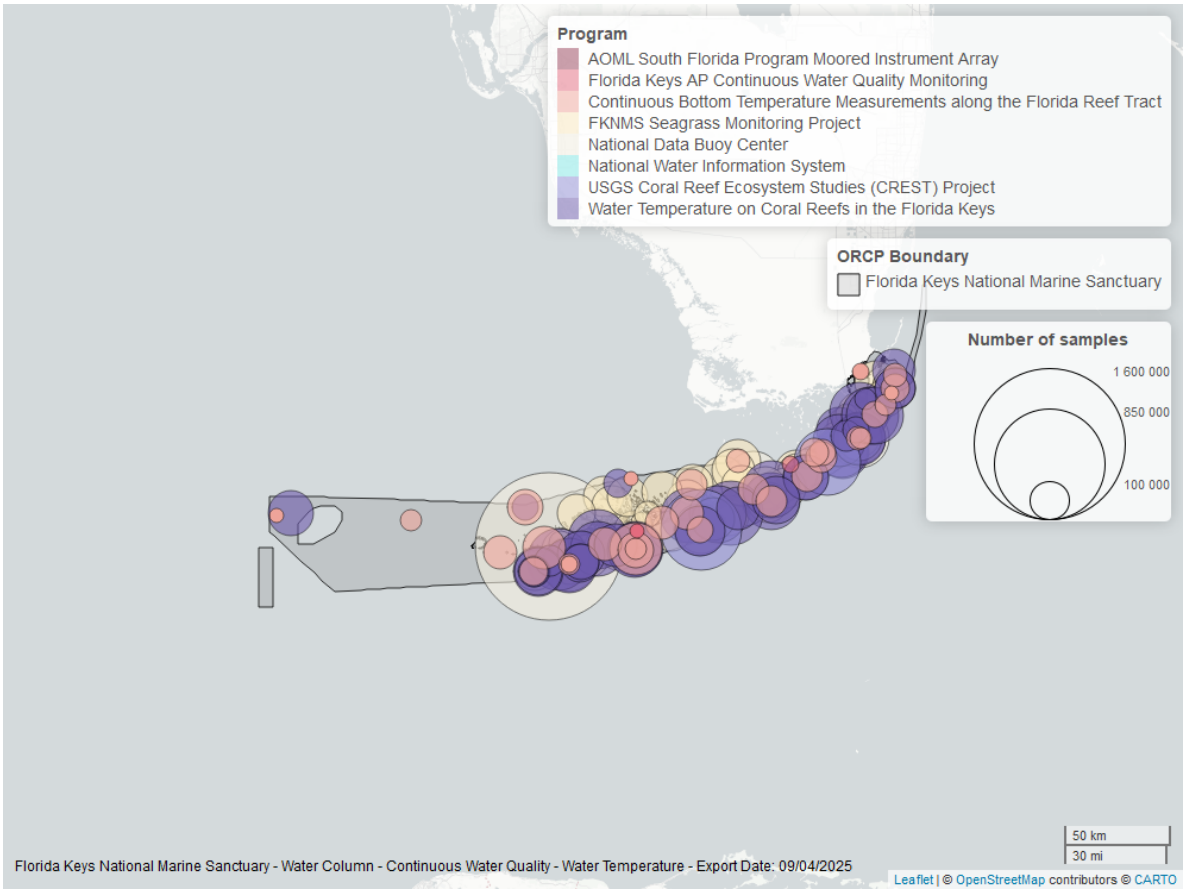

Figure 28: Map showing location of water temperature continuous water quality sampling locations within the boundaries of *Florida Keys National Marine Sanctuary*. The bubble size on the maps above reflect the amount of data available at each sampling site.

Water Temperature on Coral Reefs in the Florida Keys - *986*

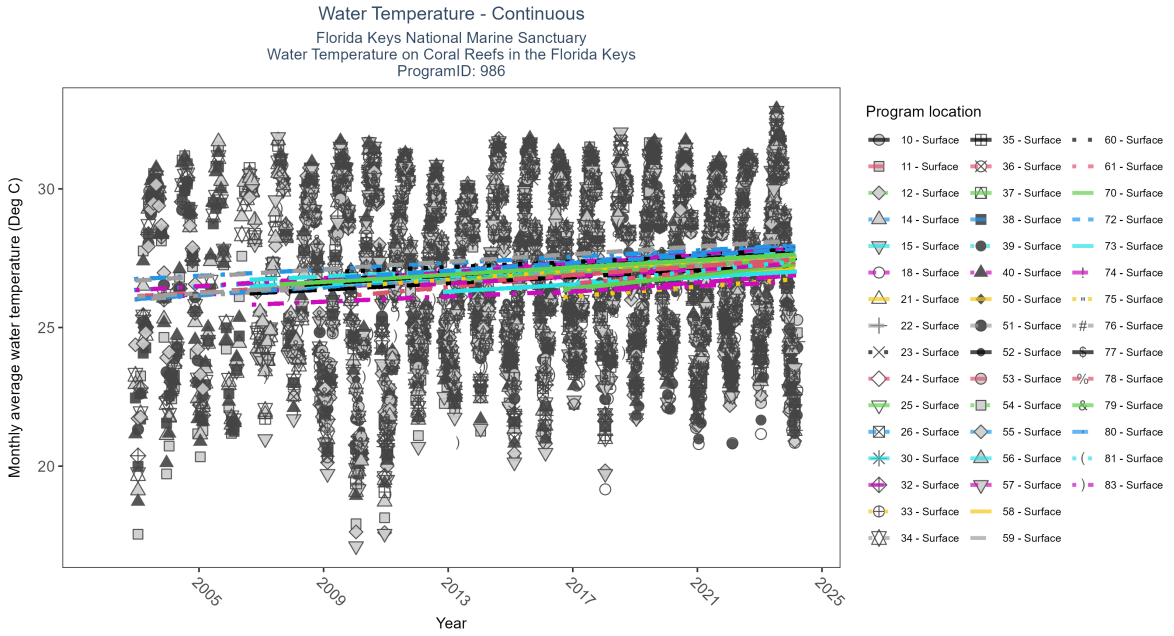

Figure 29: Scatter plot of monthly average water temperature over time at continuously monitored program locations. Each location is analyzed separately, with significant (blue) or non-significant (magenta) trend lines shown for time series that included five or more years of observations.

Table 15: Seasonal Kendall-Tau Results for All Stations - Water Temperature

Program Location	Statistical Trend	Sample Count	Years with Data	Period of Record	Median Result Value	Tau	Sen Intercept	Sen Slope	P
55	Significantly increasing trend	231874	23	2002 - 2024	26.94	0.33	26.69	0.06	0
15	Significantly increasing trend	218855	19	2006 - 2024	27.04	0.23	26.45	0.06	0
79	Significantly increasing trend	190275	18	2007 - 2024	26.94	0.33	26.51	0.07	0
40	Significantly increasing trend	259048	23	2002 - 2024	26.89	0.33	26.28	0.07	0
38	Significantly increasing trend	271179	23	2002 - 2024	26.59	0.35	25.96	0.07	0
73	Significantly increasing trend	193376	17	2008 - 2024	26.81	0.40	26.47	0.08	0
34	Significantly increasing trend	289051	23	2002 - 2024	26.84	0.36	25.94	0.07	0
56	Significantly increasing trend	190431	19	2006 - 2024	26.81	0.28	26.69	0.05	0
59	Significantly increasing trend	206603	20	2002 - 2024	26.96	0.37	26.63	0.07	0
36	Significantly increasing trend	207795	18	2007 - 2024	27.01	0.32	26.43	0.07	0
53	Significantly increasing trend	193391	17	2008 - 2024	27.06	0.42	26.53	0.08	0
57	Significantly increasing trend	202888	17	2008 - 2024	27.08	0.38	26.61	0.08	0
12	Significantly increasing trend	152036	15	2008 - 2024	27.18	0.26	26.41	0.07	0
35	Significantly increasing trend	232782	19	2006 - 2024	26.98	0.28	26.19	0.06	0
11	Significantly increasing trend	243135	20	2003 - 2024	26.84	0.34	26.13	0.07	0
14	Significantly increasing trend	238807	21	2002 - 2024	26.96	0.31	26.29	0.06	0
26	Significantly increasing trend	156891	16	2009 - 2024	27.08	0.31	26.74	0.08	0
52	Significantly increasing trend	202154	17	2008 - 2024	27.01	0.40	26.61	0.08	0
24	Significantly increasing trend	126389	13	2010 - 2024	27.08	0.40	26.16	0.10	0
77	Significantly increasing trend	203309	17	2008 - 2024	27.01	0.36	26.51	0.07	0
54	Significantly increasing trend	142926	13	2012 - 2024	27.09	0.31	26.64	0.06	0
78	Significantly increasing trend	102736	11	2014 - 2024	27.16	0.27	26.66	0.08	2e-04
22	Significantly increasing trend	185473	16	2009 - 2024	26.96	0.28	26.35	0.07	0
50	Significantly increasing trend	118231	12	2013 - 2024	27.11	0.33	26.82	0.07	0
72	Significantly increasing trend	198393	16	2008 - 2023	26.86	0.47	26.39	0.08	0
32	Significantly increasing trend	237317	20	2003 - 2024	26.74	0.36	26.04	0.07	0
80	Significantly increasing trend	182341	16	2009 - 2024	27.03	0.33	26.77	0.07	0
30	Significantly increasing trend	131074	13	2012 - 2024	26.67	0.26	26.23	0.06	1e-04
60	Significantly increasing trend	156278	16	2009 - 2024	27.01	0.23	26.99	0.05	3e-04
83	Significantly increasing trend	139311	17	2006 - 2023	25.86	0.19	25.79	0.05	4e-04
74	Significantly increasing trend	142860	13	2012 - 2024	26.94	0.31	26.52	0.06	0
76	Significantly increasing trend	183695	16	2009 - 2024	26.98	0.35	26.63	0.07	0
25	Significantly increasing trend	132181	14	2010 - 2024	27.28	0.21	26.73	0.07	0.0012
18	Significantly increasing trend	59983	9	2016 - 2024	27.18	0.20	26.21	0.08	0.031
51	Significantly increasing trend	237296	20	2003 - 2024	26.74	0.37	26.11	0.06	0
70	Significantly increasing trend	119048	12	2013 - 2024	27.01	0.33	26.73	0.06	0
61	Significantly increasing trend	68996	9	2016 - 2024	27.35	0.39	26.46	0.11	0
23	Significantly increasing trend	128184	13	2012 - 2024	27.43	0.27	26.73	0.08	0
75	Significantly increasing trend	159540	15	2010 - 2024	27.23	0.39	26.49	0.08	0
37	Significantly increasing trend	67333	9	2016 - 2024	27.03	0.30	26.27	0.12	0.0012
58	Significantly increasing trend	87137	11	2014 - 2024	27.35	0.25	26.94	0.07	0.0029
81	Significantly increasing trend	68931	9	2016 - 2024	27.35	0.39	26.48	0.11	0
39	No significant trend	48939	7	2018 - 2024	27.06	0.09	27.06	0.08	0.4478
21	Significantly increasing trend	69835	9	2016 - 2024	27.23	0.20	26.46	0.08	0.0257
33	No significant trend	50595	8	2016 - 2024	27.06	0.17	26.04	0.09	0.1793
10	No significant trend	32760	5	2020 - 2024	27.48	0.23	26.68	0.20	0.18

At eighty-two program locations, monthly average water temperature increased between 0.01 and 0.16°C per year. No detectable change in monthly average water temperature was observed at forty-one locations. There was insufficient data to fit a model for nine locations.

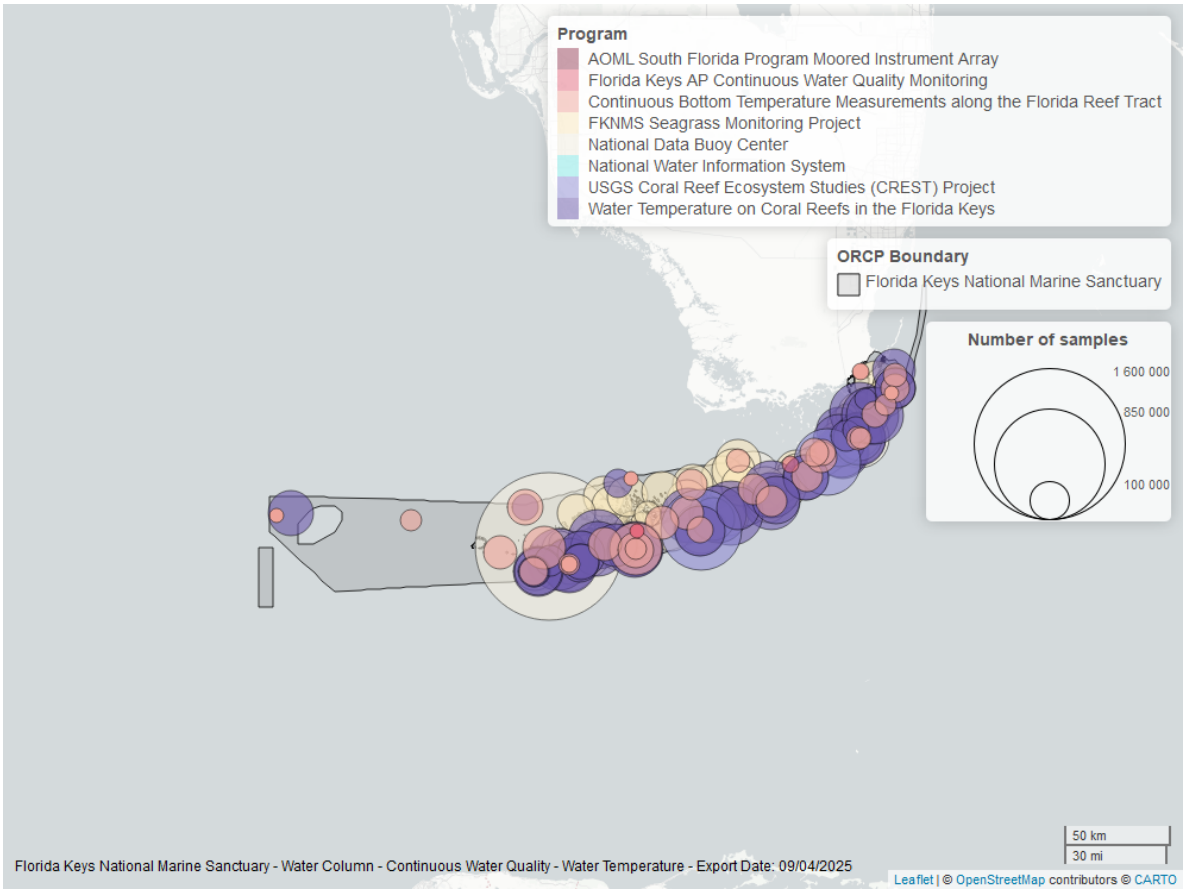

Figure 30: Map showing location of water temperature continuous water quality sampling locations within the boundaries of *Florida Keys National Marine Sanctuary*. The bubble size on the maps above reflect the amount of data available at each sampling site.

Continuous Bottom Temperature Measurements along the Florida Reef Tract - *989*

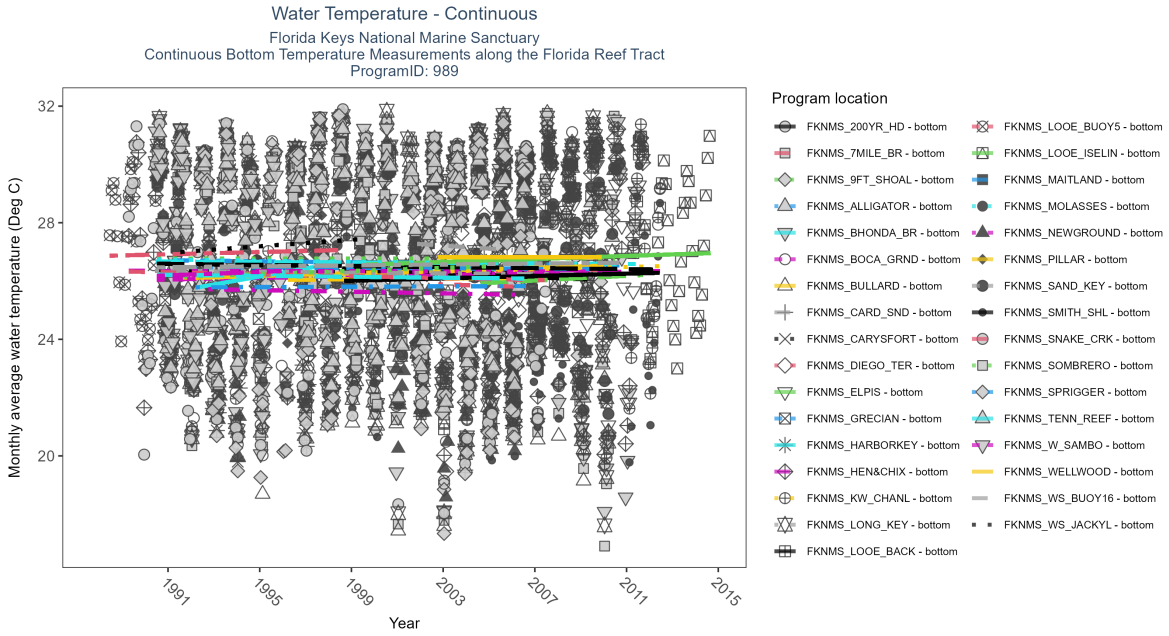

Figure 31: Scatter plot of monthly average water temperature over time at continuously monitored program locations. Each location is analyzed separately, with significant (blue) or non-significant (magenta) trend lines shown for time series that included five or more years of observations.

Table 16: Seasonal Kendall-Tau Results for All Stations - Water Temperature

Program Location	Statistical Trend	Sample Count	Years with Data	Period of Record	Median Result Value	Tau	Sen Intercept	Sen Slope	P
FKNMS-GRECIAN	No significant trend	51723	18	1990 - 2010	26.65	-0.03	26.48	0	0.6634
FKNMS-KW-CHANL	No significant trend	123578	18	1991 - 2012	26.27	0.1	26.11	0.02	0.0805
FKNMS-LONG-KEY	No significant trend	69656	19	1990 - 2010	26.64	-0.03	26.35	-0.01	0.5769
FKNMS-7MILE-BR	No significant trend	73055	19	1991 - 2010	26.66	0.05	26.22	0.01	0.3549
FKNMS-BULLARD	Significantly increasing trend	66230	18	1992 - 2009	26.31	0.12	26.11	0.02	0.0313
FKNMS-SAND-KEY	No significant trend	59287	18	1990 - 2010	26.70	0.05	26.46	0.01	0.323
FKNMS-BHONDA-BR	No significant trend	77111	22	1990 - 2011	26.60	-0.02	26.67	0	0.6571
FKNMS-LOOE-ISELIN	No significant trend	194367	13	1999 - 2014	26.88	0.13	26.55	0.03	0.0801
FKNMS-ALLIGATOR	No significant trend	65144	19	1990 - 2010	26.55	-0.06	26.72	-0.01	0.2339
FKNMS-HEN-and-CHIX	No significant trend	72285	21	1989 - 2011	26.50	-0.01	26.35	0	0.8763
FKNMS-9FT-SHOAL	No significant trend	80299	21	1990 - 2010	26.50	0	26.76	0	0.9917
FKNMS-SMITH-SHL	No significant trend	94527	10	1998 - 2012	25.45	0.13	25.99	0.02	0.1933
FKNMS-LOOE-BACK	No significant trend	84984	18	1990 - 2012	26.80	-0.06	26.6	-0.01	0.4216
FKNMS-BOCA-GRND	No significant trend	73434	17	1990 - 2012	26.14	0.08	26.04	0.01	0.1662
FKNMS-200YR-HD	No significant trend	44601	12	1998 - 2009	26.10	-0.1	26.45	-0.04	0.172
FKNMS-CARYSFORT	No significant trend	55001	16	1990 - 2006	26.40	-0.03	26.38	0	0.6354
FKNMS-SPRIGGER	No significant trend	41834	13	1992 - 2006	26.10	0.02	25.78	0	0.8553
FKNMS-TENN-REEF	No significant trend	63260	16	1990 - 2006	26.70	-0.06	26.22	-0.01	0.2738
FKNMS-SOMBRERO	No significant trend	48974	13	1991 - 2005	26.50	0.13	26.14	0.03	0.0508
FKNMS-ELPIS	No significant trend	31035	8	2004 - 2011	26.35	0.06	25.9	0.04	0.5313
FKNMS-LOOE-BUOY5	No significant trend	35252	10	1988 - 1998	26.90	0.05	26.86	0.02	0.3627
FKNMS-PILLAR	No significant trend	40805	11	1996 - 2006	26.24	0.02	26.04	0.01	0.9363
FKNMS-WS-JACKYL	No significant trend	29557	9	1991 - 1999	26.40	0.17	26.96	0.06	0.086
FKNMS-MOLASSES	No significant trend	36146	13	1990 - 2002	26.70	-0.05	26.74	-0.01	0.4806
FKNMS-SNAKE-CRK	No significant trend	56777	19	1989 - 2007	26.16	-0.06	26.33	-0.02	0.2771
FKNMS-CARD-SND	No significant trend	18249	6	2001 - 2006	26.52	-0.05	27.32	-0.05	0.7909
FKNMS-NEWGROUND	No significant trend	35329	12	1992 - 2006	25.49	-0.05	25.73	-0.01	0.5207
FKNMS-WELLWOOD	No significant trend	30427	8	2002 - 2009	26.43	0	26.82	0	1
FKNMS-DIEGO-TER	No significant trend	16693	5	2002 - 2006	25.58	-0.05	25.91	-0.03	0.8407
FKNMS-WS-BUOY16	Insufficient data to calculate trend	8123	3	2003 - 2005	25.99	-	-	-	-
FKNMS-MAITLAND	Insufficient data to calculate trend	12421	4	2004 - 2007	26.07	-	-	-	-
FKNMS-W-SAMBO	No significant trend	18786	6	1990 - 1995	26.90	0.09	26.16	0.03	0.5597
FKNMS-HARBORKEY	No significant trend	15407	5	1992 - 1997	26.50	0.14	25.74	0.14	0.3261

At eighty-two program locations, monthly average water temperature increased between 0.01 and 0.16°C per year. No detectable change in monthly average water temperature was observed at forty-one locations. There was insufficient data to fit a model for nine locations.

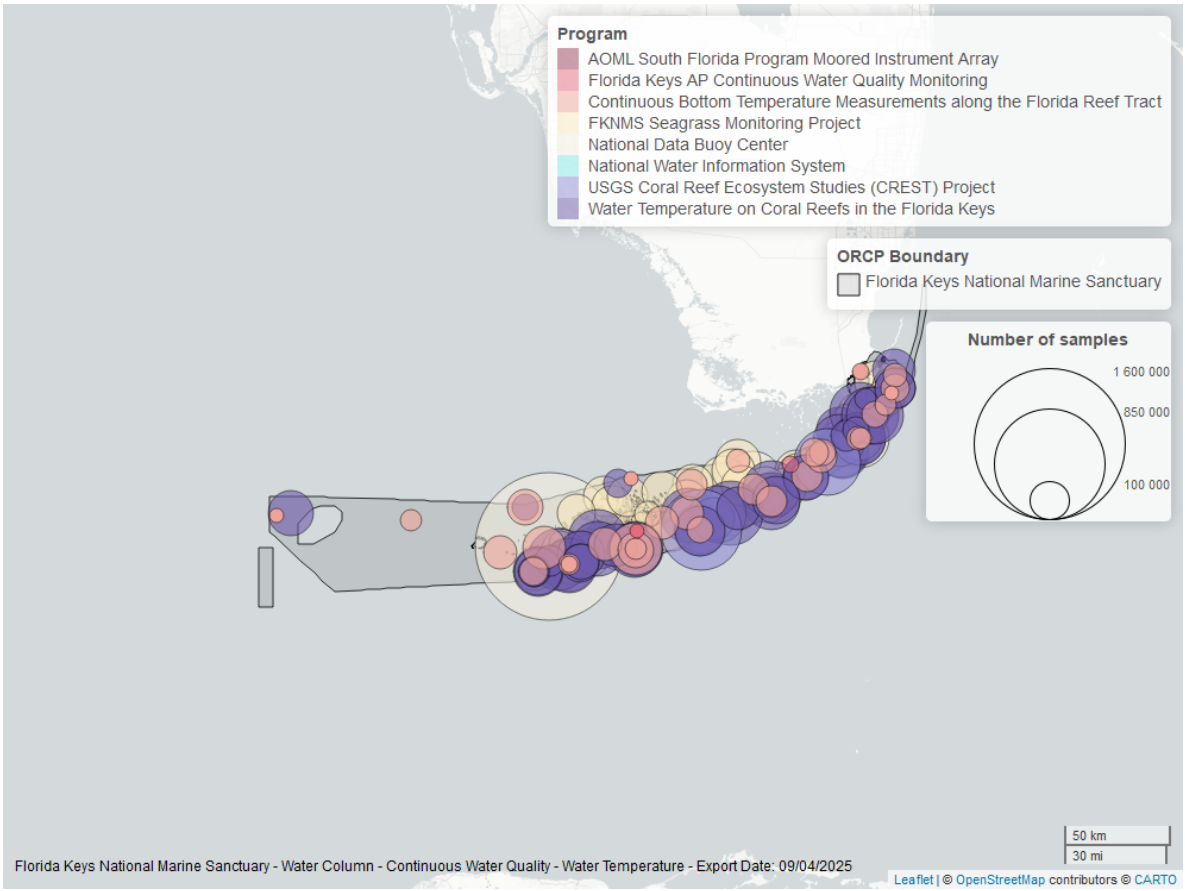

Figure 32: Map showing location of water temperature continuous water quality sampling locations within the boundaries of *Florida Keys National Marine Sanctuary*. The bubble size on the maps above reflect the amount of data available at each sampling site.

Florida Keys Aquatic Preserves Continuous Water Quality Monitoring - *10004*

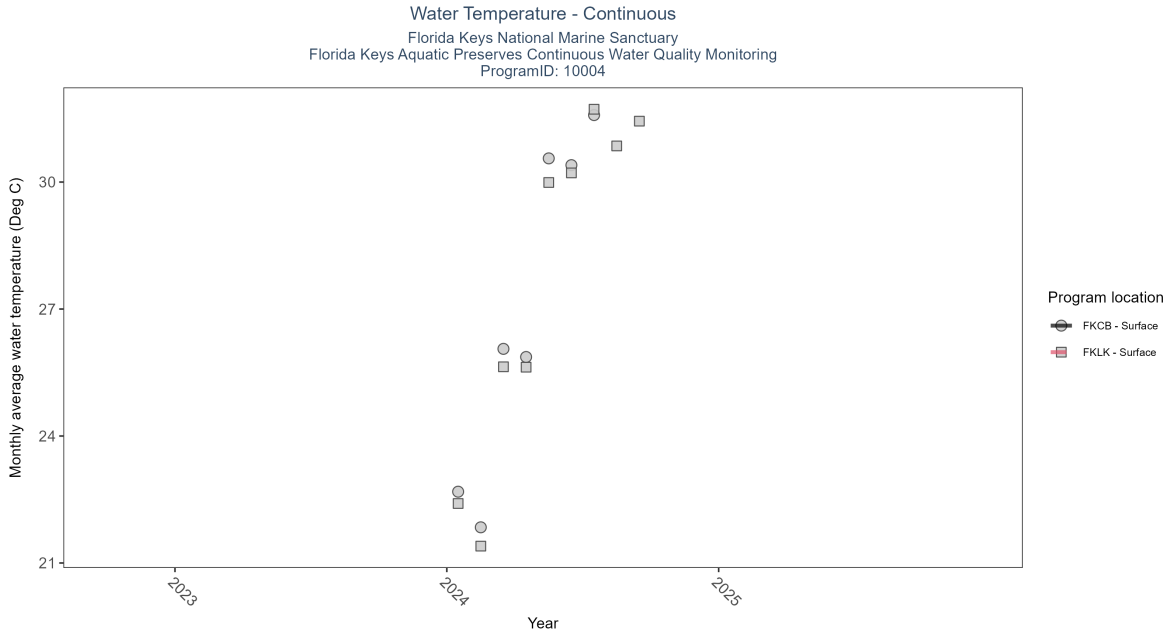

Figure 33: Scatter plot of monthly average water temperature over time at continuously monitored program locations. Each location is analyzed separately, with significant (blue) or non-significant (magenta) trend lines shown for time series that included five or more years of observations.

Table 17: Seasonal Kendall-Tau Results for All Stations - Water Temperature

Program Location	Statistical Trend	Sample Count	Years with Data	Period of Record	Median Result Value	Tau	Sen Intercept	Sen Slope	P
FKCB	Insufficient data to calculate trend	16263	1	2024 - 2024	26.8	-	-	-	-
FKLK	Insufficient data to calculate trend	21517	1	2024 - 2024	29.0	-	-	-	-

At eighty-two program locations, monthly average water temperature increased between 0.01 and 0.16°C per year. No detectable change in monthly average water temperature was observed at forty-one locations. There was insufficient data to fit a model for nine locations.

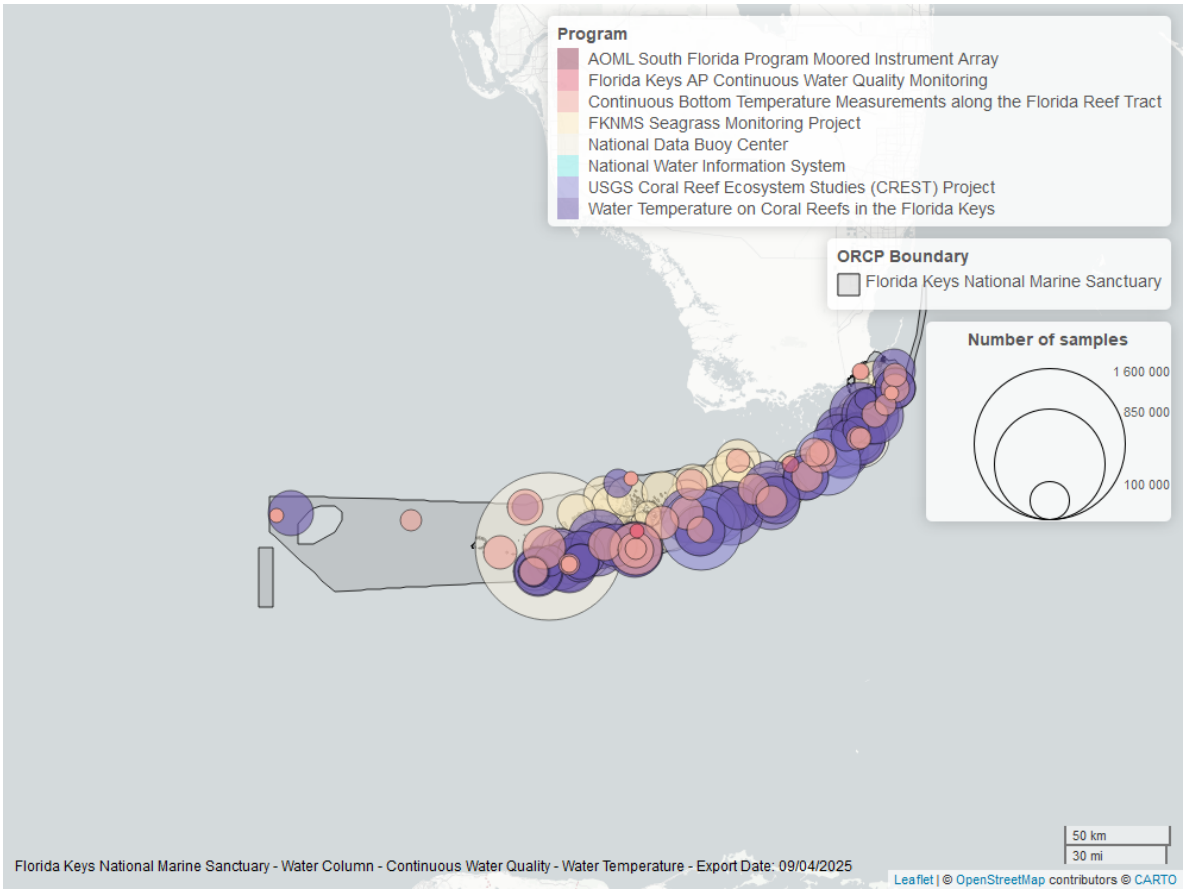

Figure 34: Map showing location of water temperature continuous water quality sampling locations within the boundaries of *Florida Keys National Marine Sanctuary*. The bubble size on the maps above reflect the amount of data available at each sampling site.

pH - Discrete

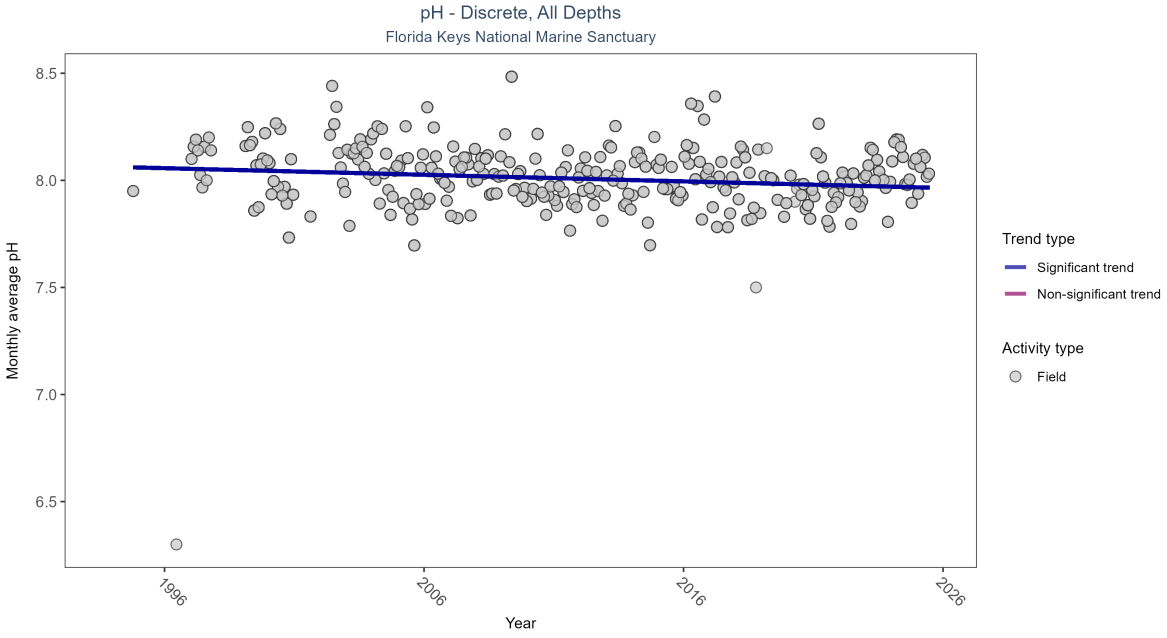

Figure 35: Scatter plot of monthly average pH over time. If the time series included ten or more years of discrete observations, a significant (blue) or non-significant (magenta) trend line is also shown. Only pH values measured in the field (circles) are included in the plot.

Table 18: Seasonal Kendall-Tau Results for - pH

Activity Type	Statistical Trend	Sample Count	Years with Data	Period of Record	Median Result Value	Tau	Sen Intercept	Sen Slope	P
Field	Significantly decreasing trend	10078	30	1994 - 2025	8.04	-0.14463	8.06294	-0.00308	4e-04

Monthly average pH decreased by less than 0.01 pH units per year.

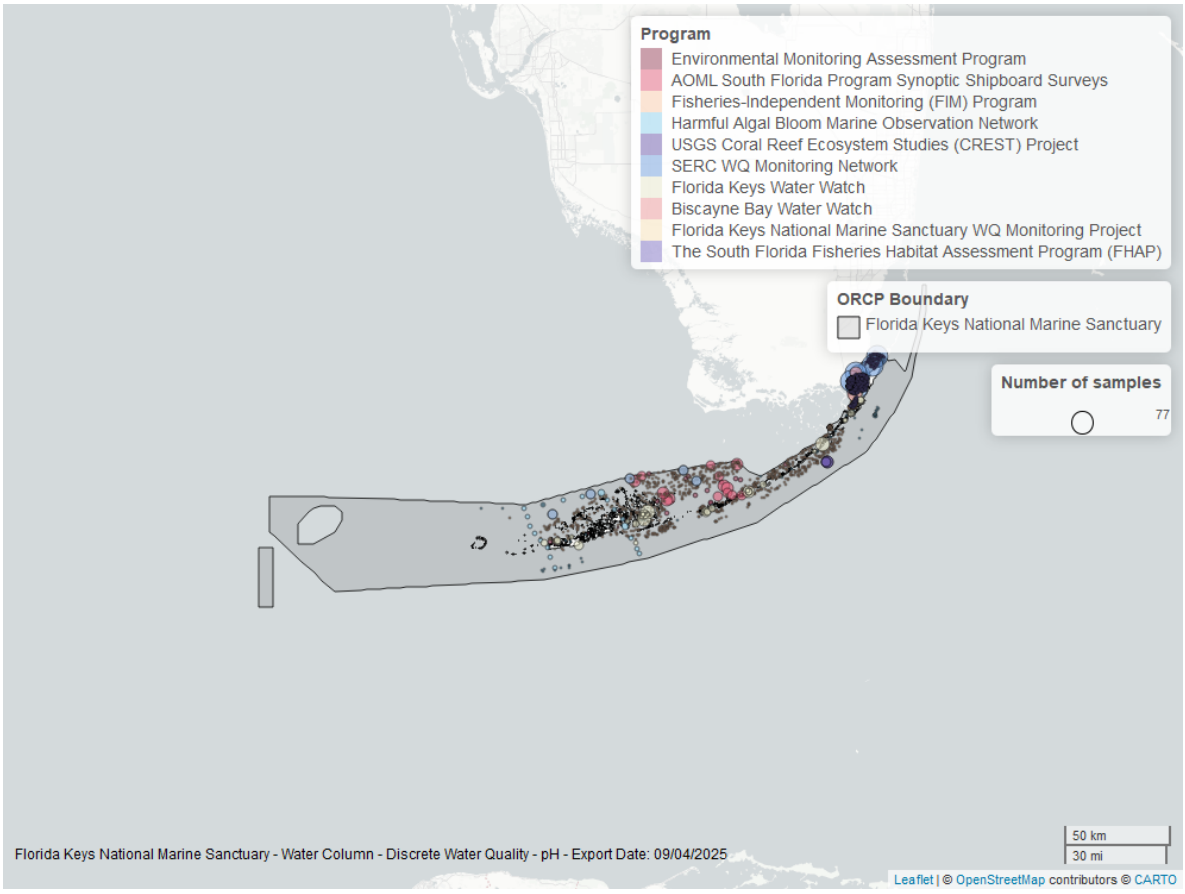

Figure 36: Map showing location of discrete water quality sampling locations within the boundaries of *Florida Keys National Marine Sanctuary*. The bubble size on the maps above reflect the amount of data available at each sampling site.

pH - Continuous

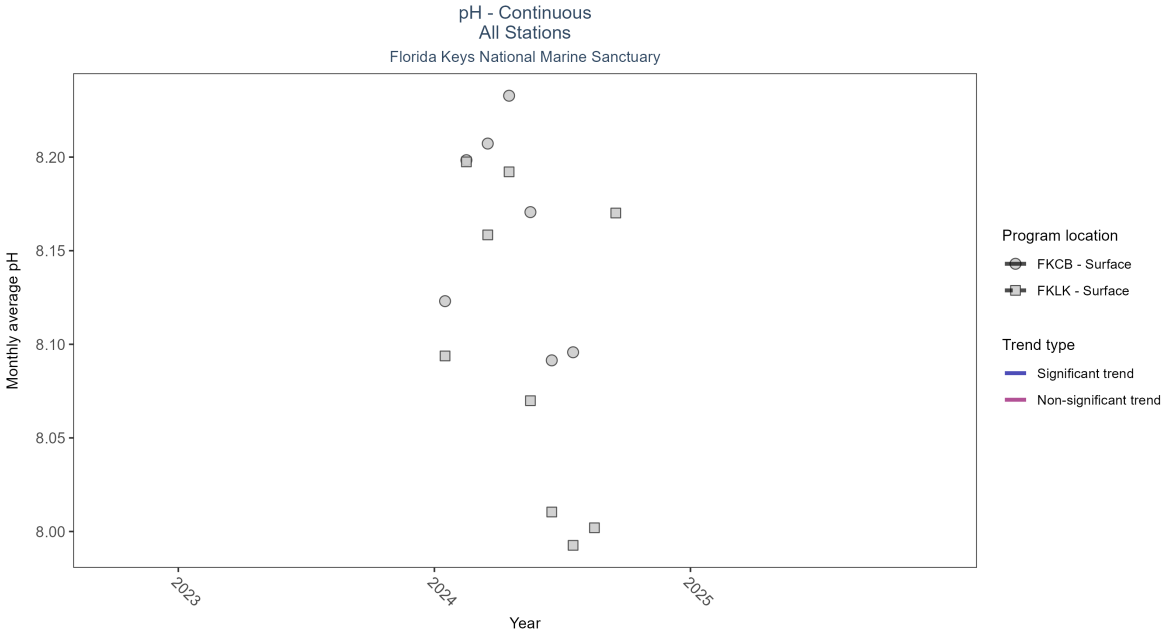

Figure 37: Scatter plot of monthly average pH over time at continuously monitored program locations. Each location is analyzed separately, with significant (blue) or non-significant (magenta) trend lines shown for time series that included five or more years of observations.

Table 19: Seasonal Kendall-Tau Results - pH

Program Location	Statistical Trend	Sample Count	Years with Data	Period of Record	Median Result Value	Tau	Sen Intercept	Sen Slope	P
FKLK	Insufficient data to calculate trend	21517	1	2024 - 2024	8.1	-	-	-	-
FKCB	Insufficient data to calculate trend	16263	1	2024 - 2024	8.2	-	-	-	-

There was insufficient data to fit a model for two locations.

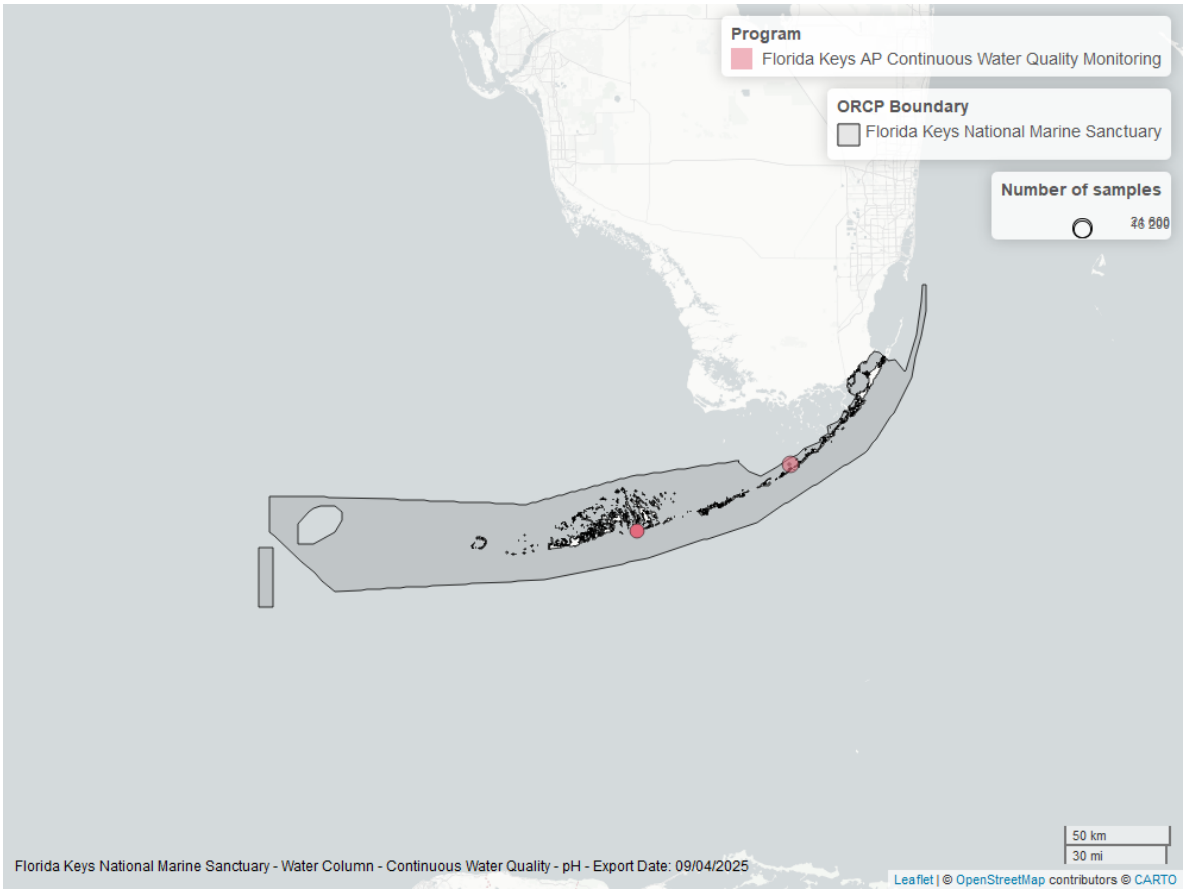

Figure 38: Map showing location of ph continuous water quality sampling locations within the boundaries of *Florida Keys National Marine Sanctuary*. The bubble size on the maps above reflect the amount of data available at each sampling site.

Water Clarity

Turbidity - Discrete

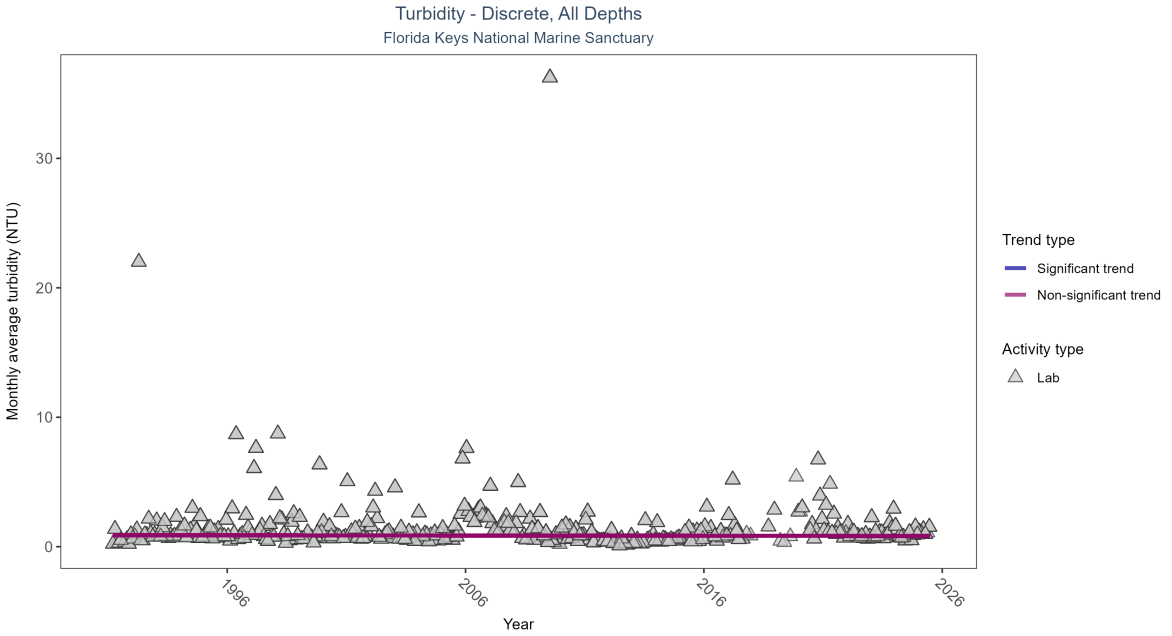

Figure 39: Scatter plot of monthly average turbidity over time. If the time series included ten or more years of discrete observations, a significant (blue) or non-significant (magenta) trend line is also shown. Only turbidity values measured in the laboratory (triangles) are included in the plot.

Table 20: Seasonal Kendall-Tau Results for - Turbidity

Activity Type	Statistical Trend	Sample Count	Years with Data	Period of Record	Median Result Value	Tau	Sen Intercept	Sen Slope	P
Lab	No significant trend	8296	35	1991 - 2025	0.66	-0.02291	0.88731	-0.00172	0.531

Turbidity showed no detectable trend between 1991 and 2025.

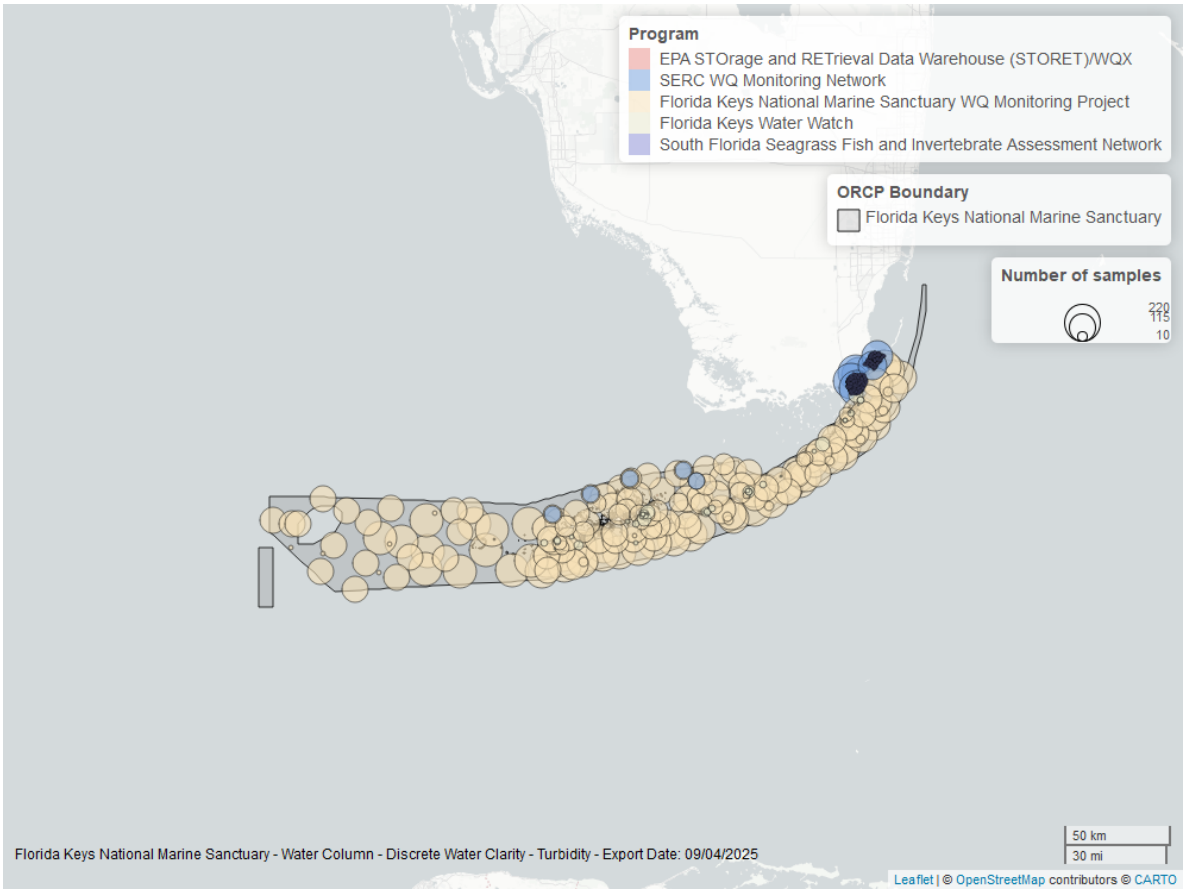

Figure 40: Map showing location of discrete water quality sampling locations within the boundaries of *Florida Keys National Marine Sanctuary*. The bubble size on the maps above reflect the amount of data available at each sampling site.

Turbidity - Continuous

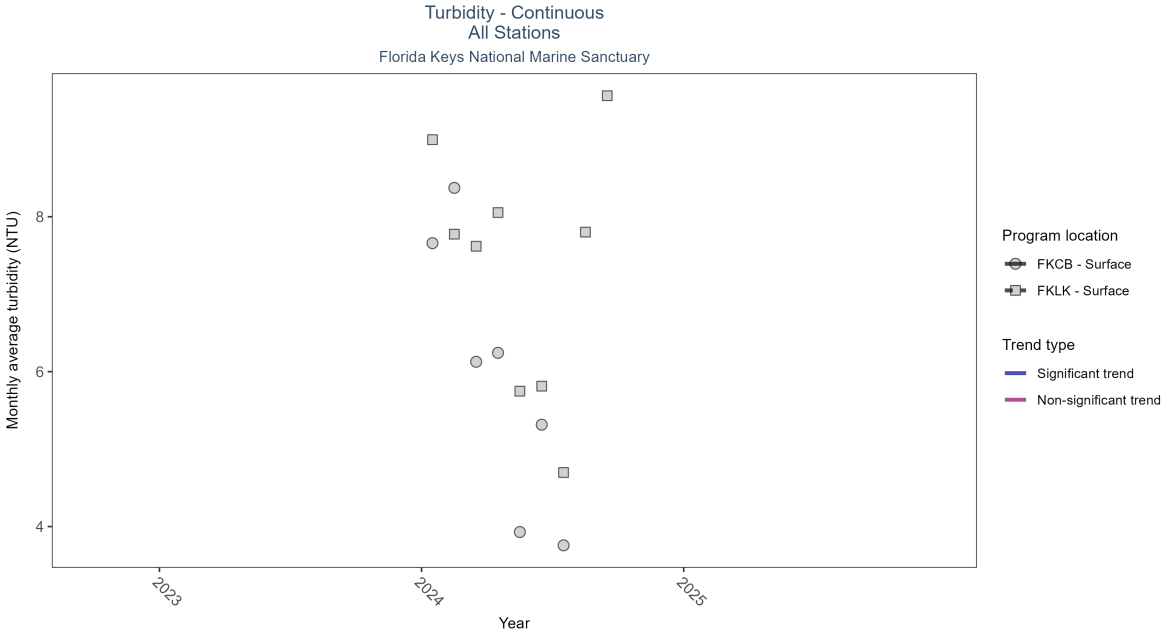

Figure 41: Scatter plot of monthly average turbidity over time at continuously monitored program locations. Each location is analyzed separately, with significant (blue) or non-significant (magenta) trend lines shown for time series that included five or more years of observations.

Table 21: Seasonal Kendall-Tau Results - Turbidity

Program Location	Statistical Trend	Sample Count	Years with Data	Period of Record	Median Result Value	Tau	Sen Intercept	Sen Slope	P
FKLK	Insufficient data to calculate trend	21399	1	2024 - 2024	6	-	-	-	-
FKCB	Insufficient data to calculate trend	16240	1	2024 - 2024	4	-	-	-	-

There was insufficient data to fit a model for two locations.

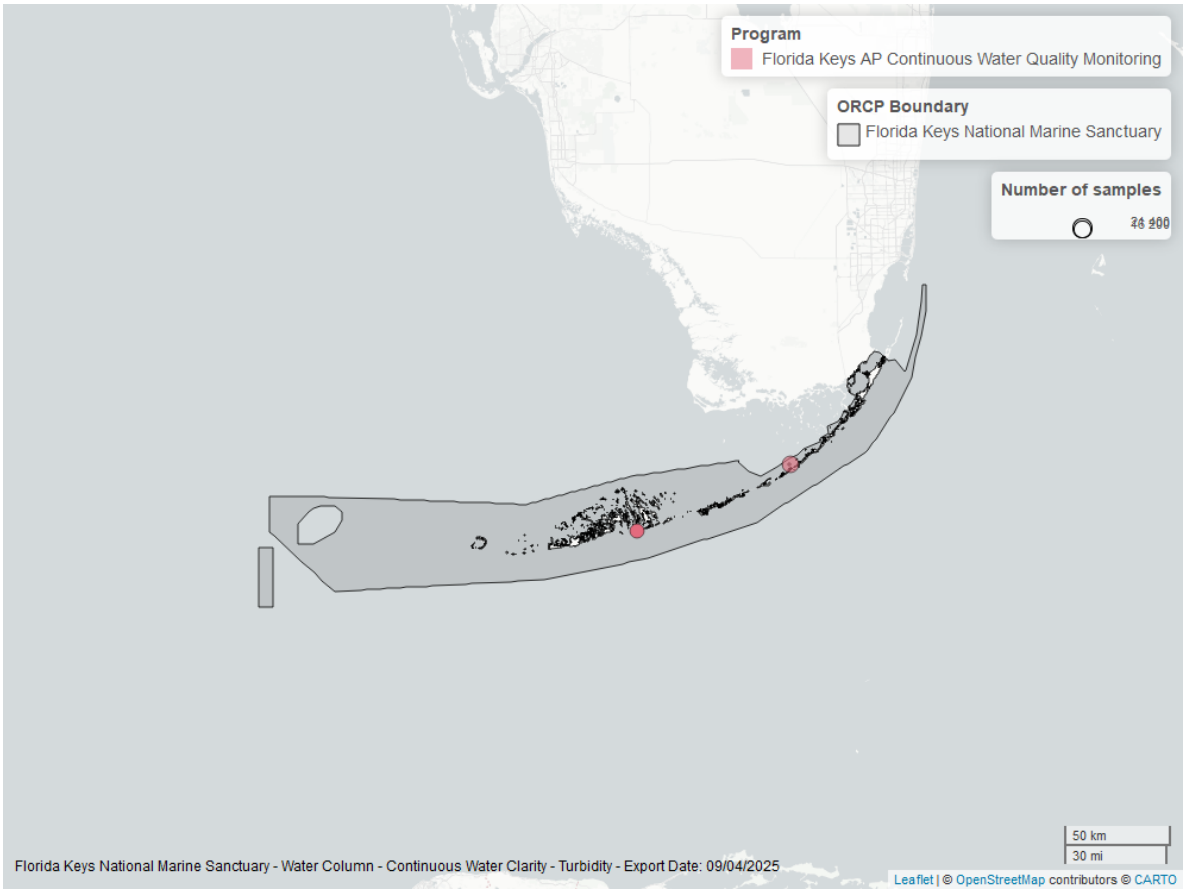

Figure 42: Map showing location of turbidity continuous water quality sampling locations within the boundaries of *Florida Keys National Marine Sanctuary*. The bubble size on the maps above reflect the amount of data available at each sampling site.

Total Suspended Solids - Discrete

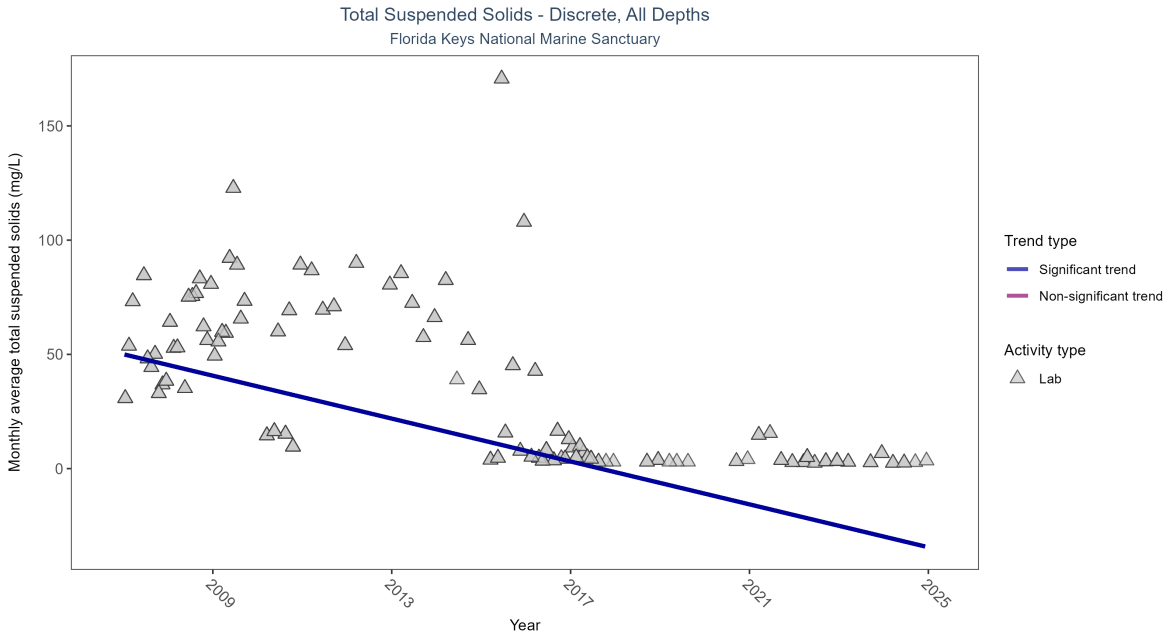

Figure 43: Scatter plot of monthly average total suspended solids (TSS) over time. If the time series included ten or more years of discrete observations, a significant (blue) or non-significant (magenta) trend line is also shown. Only TSS values obtained from laboratory analyses (triangles) are included in the plot.

Table 22: Seasonal Kendall-Tau Results for - Total Suspended Solids

Activity Type	Statistical Trend	Sample Count	Years with Data	Period of Record	Median Result Value	Tau	Sen Intercept	Sen Slope	P
Lab	Significantly decreasing trend	537	18	2007 - 2024	12	-0.59838	50.05297	-4.69333	0

Monthly average total suspended solids decreased by 4.69 mg/L per year, indicating an increase in water clarity.

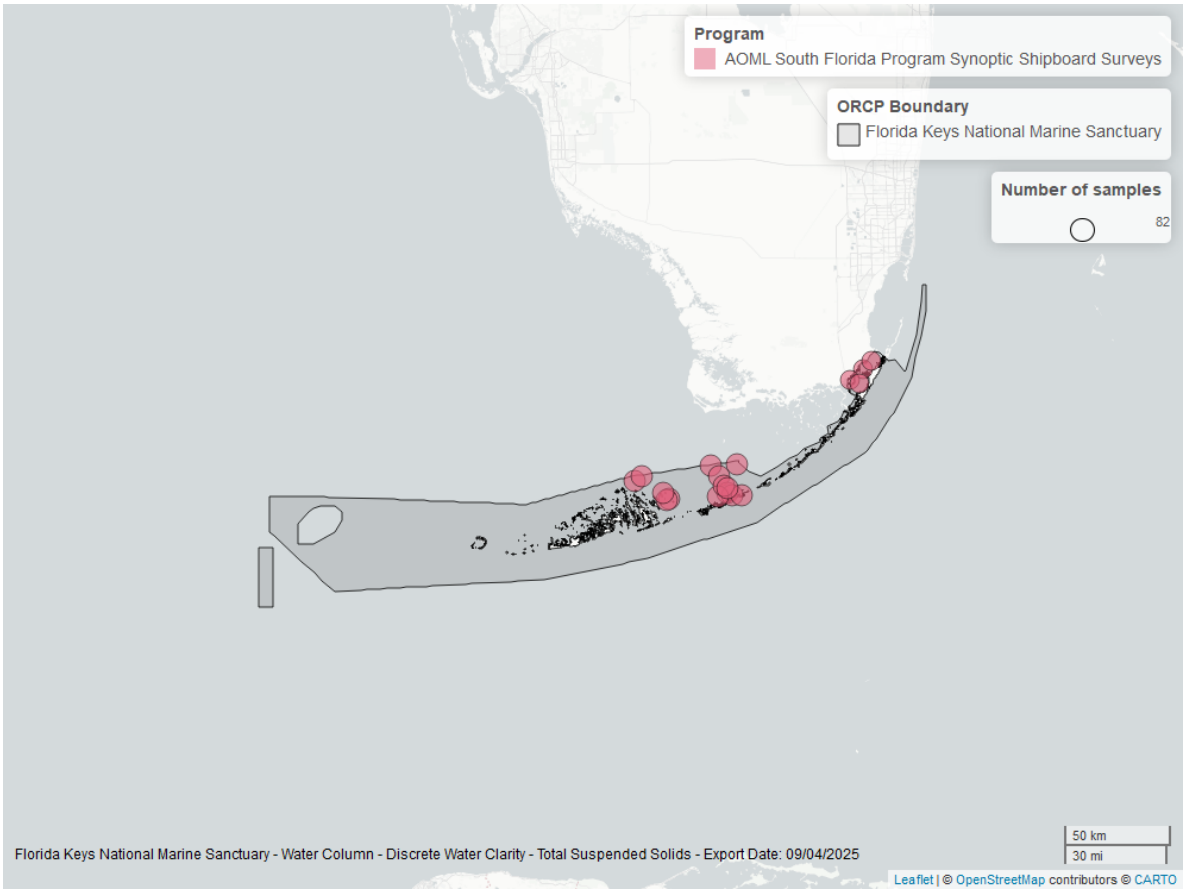

Figure 44: Map showing location of discrete water quality sampling locations within the boundaries of *Florida Keys National Marine Sanctuary*. The bubble size on the maps above reflect the amount of data available at each sampling site.

Chlorophyll a, Uncorrected for Pheophytin - Discrete

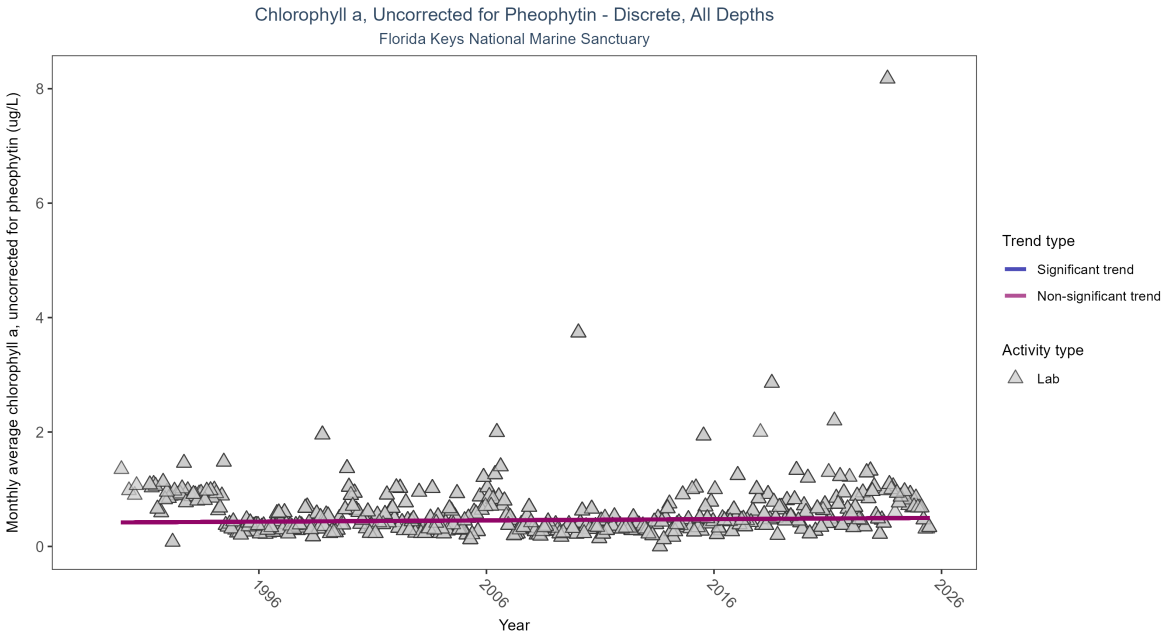

Figure 45: Scatter plot of monthly average levels of chlorophyll a, uncorrected for pheophytin, over time. If the time series included ten or more years of discrete observations, a significant (blue) or non-significant (magenta) trend line is also shown. Only laboratory-analyzed chlorophyll a (triangles) is included in the plot.

Table 23: Seasonal Kendall-Tau Results for - Chlorophyll a, Uncorrected for Pheophytin

Activity Type	Statistical Trend	Sample Count	Years with Data	Period of Record	Median Result Value	Tau	Sen Intercept	Sen Slope	P
Lab	No significant trend	21214	37	1989 - 2025	0.29775	0.0606	0.4178	0.00221	0.0904

Chlorophyll a, uncorrected for pheophytin, showed no detectable trend between 1989 and 2025.

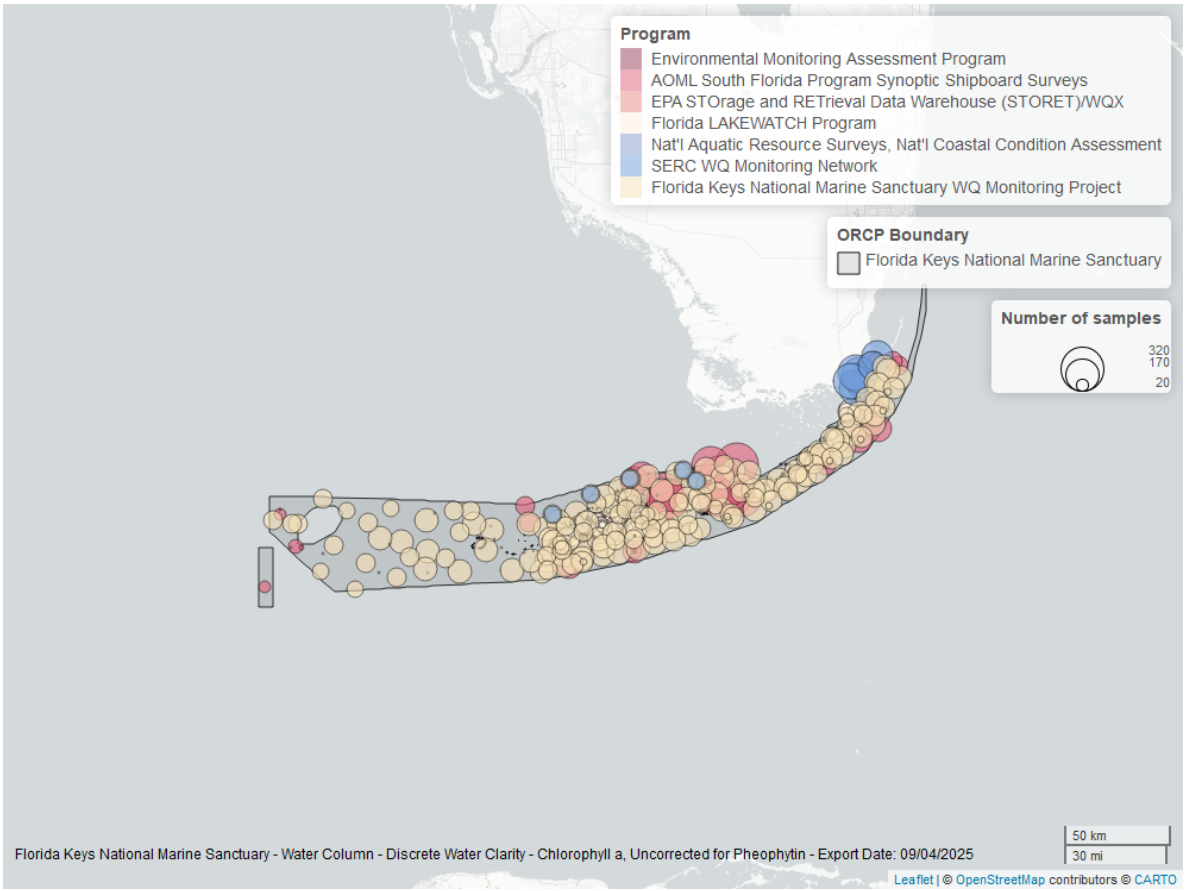

Figure 46: Map showing location of discrete water quality sampling locations within the boundaries of *Florida Keys National Marine Sanctuary*. The bubble size on the maps above reflect the amount of data available at each sampling site.

Chlorophyll a, Corrected for Pheophytin - Discrete

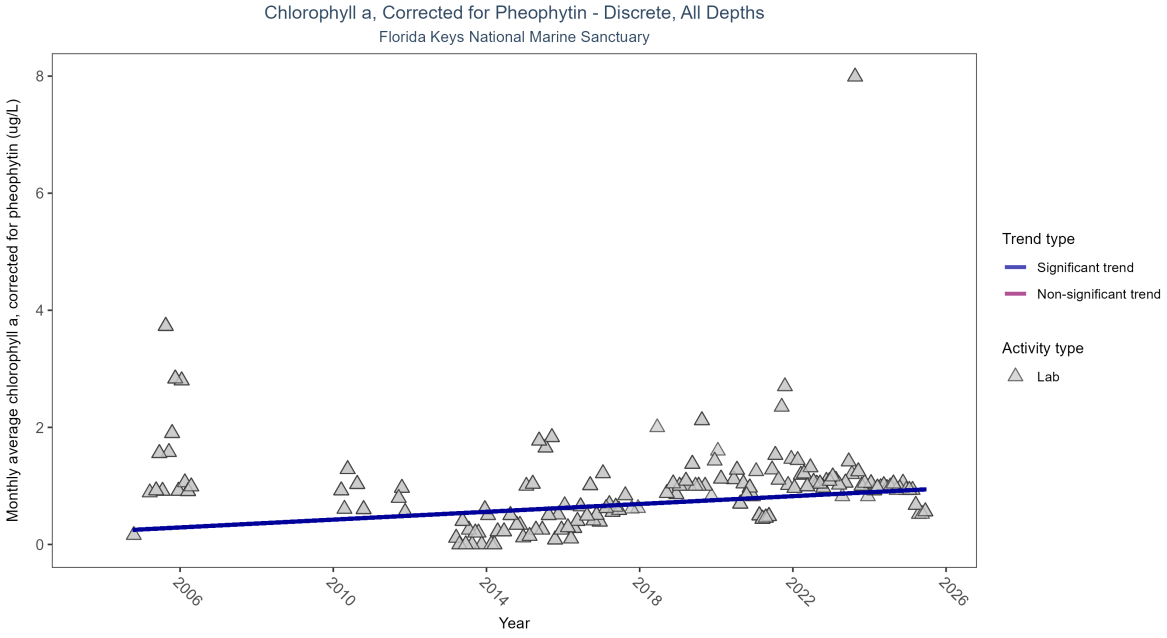

Figure 47: Scatter plot of monthly average levels of chlorophyll a, corrected for pheophytin, over time. If the time series included ten or more years of discrete observations, a significant (blue) or non-significant (magenta) trend line is also shown. Only laboratory-analyzed chlorophyll a (triangles) is included in the plot.

Table 24: Seasonal Kendall-Tau Results for - Chlorophyll a, Corrected for Pheophytin

Activity Type	Statistical Trend	Sample Count	Years with Data	Period of Record	Median Result Value	Tau	Sen Intercept	Sen Slope	P
Lab	Significantly increasing trend	2130	18	2004 - 2025	0.6495	0.24111	0.22352	0.03339	1e-04

Monthly average chlorophyll a, corrected for pheophytin, increased by 0.03 µg/L per year, indicating a decrease in water clarity.

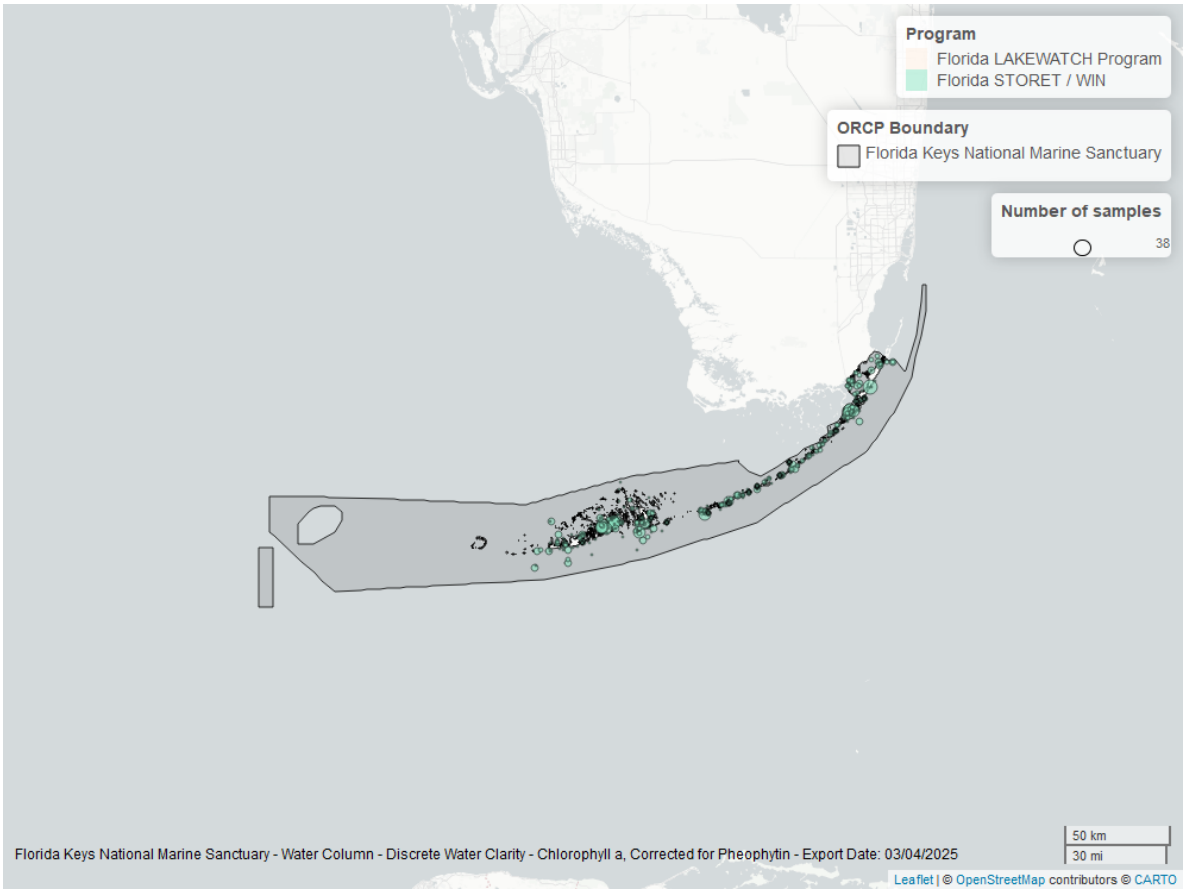

Figure 48: Map showing location of discrete water quality sampling locations within the boundaries of *Florida Keys National Marine Sanctuary*. The bubble size on the maps above reflect the amount of data available at each sampling site.

Secchi Depth - Discrete

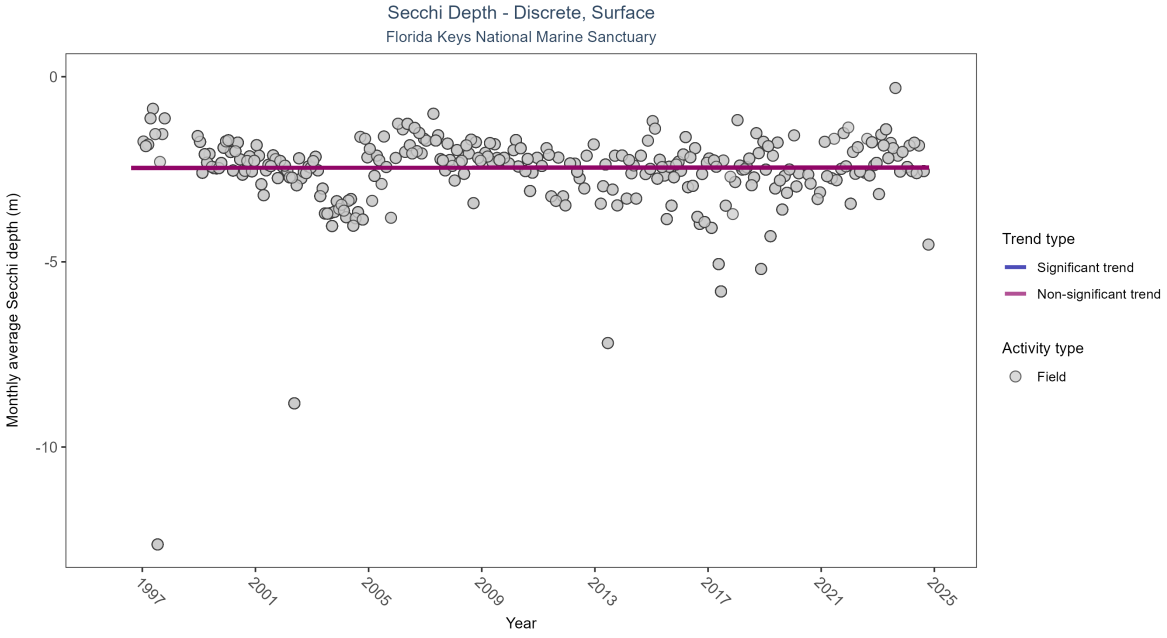

Figure 49: Scatter plot of monthly average Secchi depth over time. If the time series included ten or more years of discrete observations, a significant (blue) or non-significant (magenta) trend line is also shown. Secchi depth is only measured in the field (circles).

Table 25: Seasonal Kendall-Tau Results for - Secchi Depth

Activity Type	Statistical Trend	Sample Count	Years with Data	Period of Record	Median Result Value	Tau	Sen Intercept	Sen Slope	P
Field	No significant trend	5102	29	1996 - 2024	-2.13363	0.00171	-2.46264	0.00038	0.924

Secchi depth showed no detectable trend between 1996 and 2024.

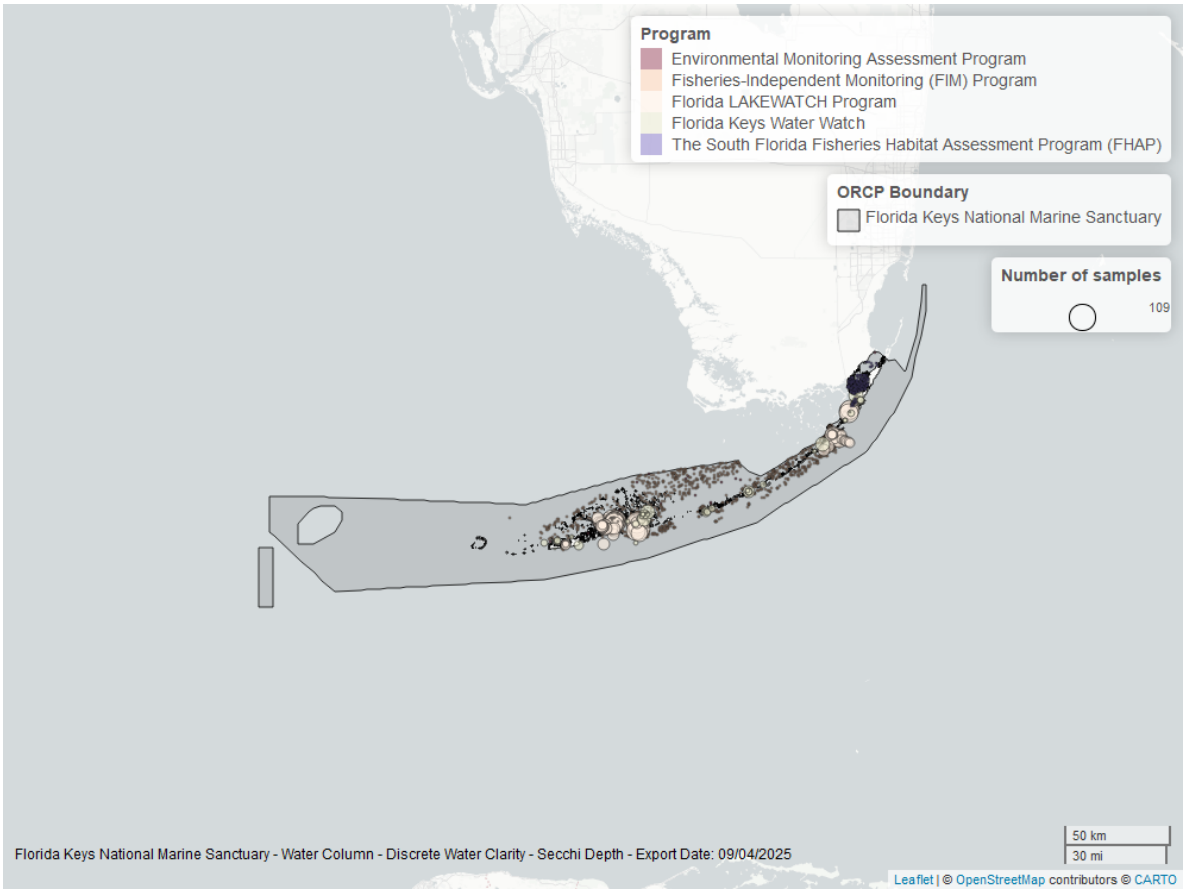

Figure 50: Map showing location of discrete water quality sampling locations within the boundaries of *Florida Keys National Marine Sanctuary*. The bubble size on the maps above reflect the amount of data available at each sampling site.

Colored Dissolved Organic Matter - Discrete

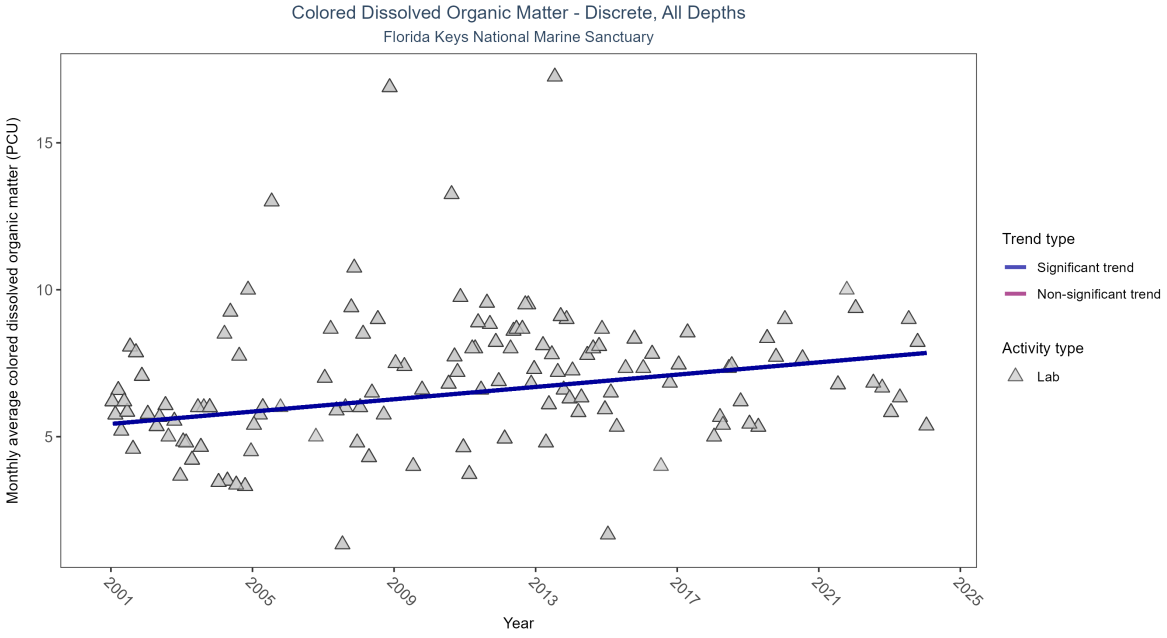

Figure 51: Scatter plot of monthly average colored dissolved organic matter (CDOM) over time. If the time series included ten or more years of discrete observations, a significant (blue) or non-significant (magenta) trend line is also shown. Only laboratory-analyzed CDOM (triangles) is included in the plot.

Table 26: Seasonal Kendall-Tau Results for - Colored Dissolved Organic Matter

Activity Type	Statistical Trend	Sample Count	Years with Data	Period of Record	Median Result Value	Tau	Sen Intercept	Sen Slope	P
Lab	Significantly increasing trend	1025	24	2001 - 2024	6	0.2457	5.43536	0.10476	3e-04

Monthly average colored dissolved organic matter increased by 0.1 PCU per year, indicating a decrease in water clarity.

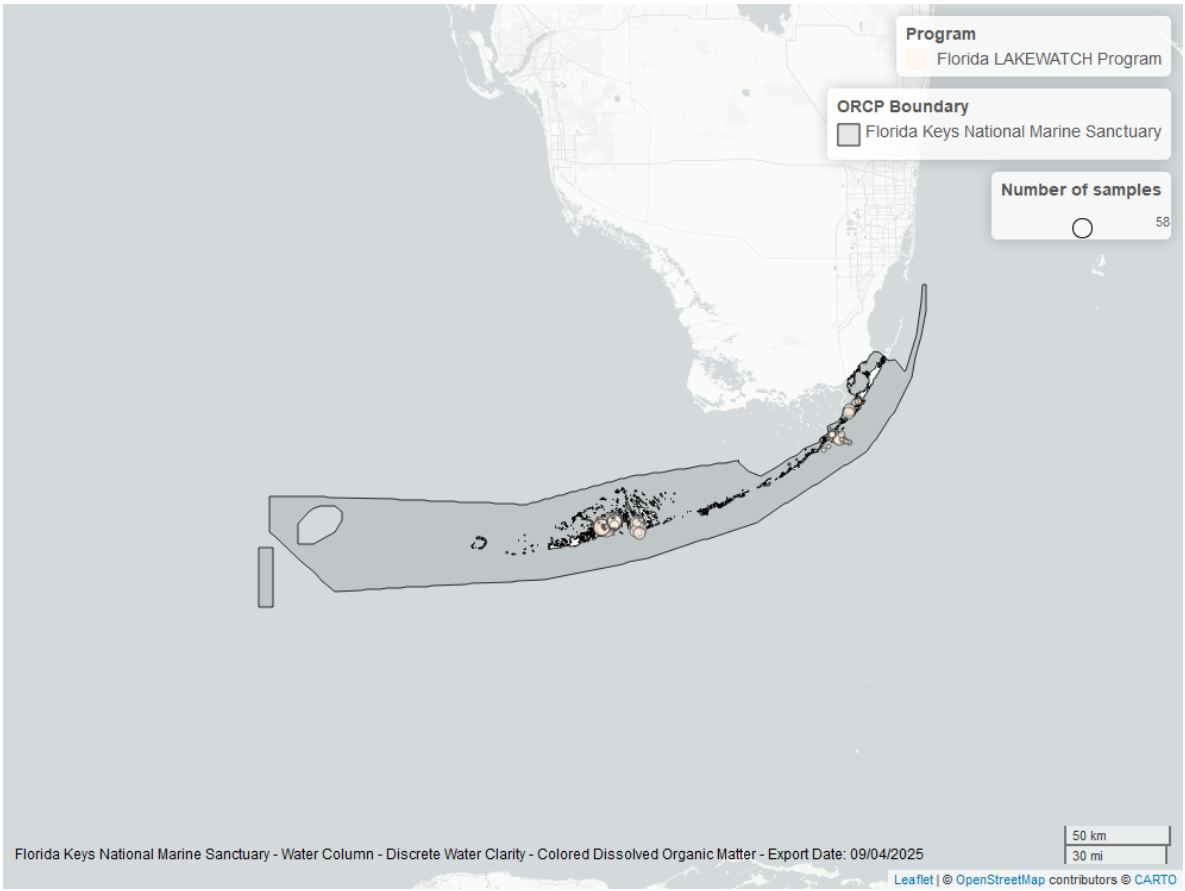

Figure 52: Map showing location of discrete water quality sampling locations within the boundaries of *Florida Keys National Marine Sanctuary*. The bubble size on the maps above reflect the amount of data available at each sampling site.