

**PLUME TRACKING MONITORING PLAN FOR THE POINT  
LOMA AND SOUTH BAY OCEAN OUTFALL REGIONS, SAN  
DIEGO, CALIFORNIA**

**Progress Report  
March 2021**

**Report Period: January – December 2020**

City of San Diego Point Loma Wastewater Treatment Plant  
(NPDES CA0107409; Order No. R9-2017-0007)

City of San Diego South Bay Water Reclamation Plant  
(NPDES CA0109045; Order No. R9-2013-0006  
as amended by Order Nos. R9-2014-0071 and R9-2017-0023)

U.S. IBWC South Bay International Wastewater Treatment Plant  
(NPDES CA0108928; Order No. R9-2014-0009  
as amended by Order Nos. R9-2014-0094, R9-2017-0024, and R9-2019-0012)

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## Background

The Plume Tracking Monitoring Plan (PTMP) was designed to develop new and effective procedures for enhanced water quality monitoring and adaptive plume tracking in the San Diego region. These procedures included: (a) the deployment of a real-time oceanographic mooring systems (RTOMS) located near the terminal diffuser wye structures of the Point Loma Ocean Outfall (PLOO) and the South Bay Ocean Outfall (SBOO); (b) deployment of static ADCP and thermistor moorings; and (c) deployment and testing of a remotely operated towed vehicle (ROTV; i.e., ScanFish III). Although the requirement to develop the PTMP did not go into effect until October 1, 2017 for the PLOO region, and December 13, 2017 for the SBOO region, work began about two years earlier with the Scripps Institution of Oceanography (SIO), to design, build, and initiate field testing of the PLOO and SBOO real-time mooring systems.

Detailed here are significant activities that have been completed to date to achieve the objectives outlined in the PTMP (see Table 1 for updated PTMP timeline). As shown in this report, the deployment of both the SBOO and PLOO moorings is progressing well and closely following the original schedule, as stated in the PTMP. However, challenges along the way, as highlighted in this report and prior progress reports, have delayed deployments and impacted our ability to stick exactly to the original schedule. Table 1 shows the current timeline of activities updated to reflect current and expected deployment and retrieval dates. Through the end of 2020, the PLOO RTOMS has completed two deployments and the SBOO RTOMS has completed three deployments. However, due to the COVID-19 pandemic, restrictions put in place in 2020 are now starting to impact our progress and will almost certainly result in future delays in equipment turnaround from both SIO and instrument manufacturers (such as Sea-Bird). Therefore, at this stage, it is likely that upcoming deployments will be delayed to the later half of spring 2021.

### Timeline of Activities Completed (2015-2020)

#### 2015

*November*

- Initial acquisition, training, and testing of the ROTV (ScanFish III).

#### 2016

*May*

- ScanFish software/hardware training and field testing.

*December*

- First Deployment of SBOO RTOMS.

#### 2017

*May*

- ScanFish software/hardware training and field testing.

*November*

- ScanFish software/hardware training and field testing.

*December*

- First Retrieval of SBOO RTOMS.

**2018***March*

- First Deployment of PLOO RTOMS.

*June*

- ScanFish software/hardware training and field testing.

*August*

- Second Deployment of SBOO RTOMS.

**2019***March*

- First Retrieval of PLOO RTOMS.

*May*

- ScanFish software/hardware training and field testing.
- Consultation with Scripps staff to strategize locations of the City's static moorings.

*June*

- 2018 PTMP Progress Report submitted.

*September*

- Second Retrieval of SBOO RTOMS.

*October*

- Further consultation with SIO to develop a plan to transfer data storage and processing responsibilities of RTOMS data to the City of San Diego by the end of the current SIO contract in 2022.
- Second Deployment of PLOO RTOMS (see Figure 1).

*December*

- Work plan for ROTV/CTD quarterly surveys completed (see Plume Tracking Pilot Study, submitted to Regional Board on March 3, 2020).
- Third Deployment of SBOO RTOMS (see Figure 2).

**2020***February*

- PTMP Pilot Study - first quarter testing implemented in PLOO region. ScanFish towed at 60m, 80m, and 100m contours at PLOO water quality stations (see Figure 3).

*March*

- 2019 PTMP Progress Report submitted.

*May*

- Implemented ocean acidification (total alkalinity and dissolved inorganic carbon) and nitrate + nitrite water sample collection to supplement mooring data validation.
- Completed QA/QC review and assigned qualifiers for RTOMS data through 2019.

- Plume Tracking Pilot Study - second quarter testing implemented in PLOO region. ScanFish towed at 60m, 80m, and 100m contours at PLOO water quality stations (ScanFish controller issues prevented the implementation of testing in SBOO region this quarter) (see Figure 3).

#### *June*

- 2018-2019 Biennial Receiving Waters Monitoring & Assessment Report submitted, including initial results from both RTOMs.
- Consultation with SIO staff on ways to improve RTOMS data quality and instrument placement to better target plumes.

#### *August*

- PTMP Pilot Study - third quarter testing implemented in PLOO region. ScanFish towed at 60m, 80m, and 100m contours at PLOO stations (see Figure 3).
- PTMP Pilot Study - first quarter testing implemented in SBOO region. ScanFish towed at 10m, 20m, and 30m contours at SBOO stations (ScanFish became fouled on fishing gear and broke deflector wire, in addition to other technical issues which reduced the testing period).

#### *September*

- Second Retrieval of PLOO RTOM – This retrieval was somewhat premature due to RTOMS breaking free from anchor cable on Sept 29<sup>th</sup>.

#### *October*

- Re-terminate ScanFish wire and connections to restore operational capabilities.

#### *November*

- PTMP Pilot Study – fourth quarter testing implemented in PLOO region. ScanFish towed at 60m, 80m, and 100m contours at PLOO stations (see Figure 3).
- PTMP Pilot Study - second quarter testing implemented in SBOO region. ScanFish became fouled on fishing gear and hit an obstacle/seabed, which resulted in the prevention of any further testing in SBOO this quarter.
- ScanFish was repaired and made ready for next quarter testing.

#### *December*

- Third Retrieval of SBOO RTOMS.

### **Changes to Project Plan**

The 2019 PTMP Progress Report detailed significant issues we experienced with Sea-Bird Scientific, the supplier of many of the RTOMS sensors, which resulted in the delayed servicing of a number of essential oceanographic sensors. Specifically, the second deployment of the PLOO RTOM was delayed by approximately seven months due to several sensor related issues with Sea-Bird. As a result, we secured additional funding from the City to purchase new sensors, and we aimed to service back-up sensors while the RTOMS were deployed to ensure a speedy and efficient redeployment time. However, in 2020, the COVID pandemic forced the shutdown of Sea-Bird, and other essential equipment suppliers. The City also immediately cut all additional non-essential spending, which, unfortunately, included our request for additional sensors. Since this time, operations have restarted at Sea-Bird, and the City has reissued the funds for new sensors. However, Sea-Bird and the City have now entered into a lengthy contract

negotiation due to new, and unexpected, terms and conditions imposed by Sea-Bird, which is further delaying operations. Additionally, due to COVID restrictions put in place in 2020, SIO staff are, still to this day, unable to work on site to prepare the RTOMS for redeployment. We are currently working with both Sea-Bird and SIO to find a speedy resolution.

Fortunately, both the PLOO and SBOO RTOMS were deployed and in operation throughout much of the COVID-19 pandemic. However, now that they have been retrieved, there are a number of barriers preventing their redeployment in a timely manner (as described above). We are working to resolve the issues described here and hope to redeploy both RTOMS by the later half of Spring 2021. Furthermore, in consideration of the numerous equipment issues described in this report, including the PLOO mooring breaking free from its anchor, we are considering trialing shorter deployment periods (less than a year) to maximize data quality and structural integrity of the moorings themselves. We also maintain our goal previously stated in the 2019 Progress Report to secure back up sensors for both moorings to facilitate a speedy and efficient redeployment time in the future.

In 2020, City staff successfully initiated the Plume Tracking Pilot Study, which aimed to address the third component of the PTMP to evaluate the use of the City's ScanFish III ROTV for plume tracking. The initial goal of the project was to compare towed CTD measurements from the ScanFish to traditional fixed grid vertical-profile CTD measurements during each quarterly water quality sampling period in 2020 (i.e., February, May, August, November). This aspect of the pilot study was completed successfully for PLOO region, and full results will be reported in the 2020-2021 Biennial Receiving Waters Monitoring and Assessment Report. Preliminary data are presented in Figure 3. Unfortunately, a number of issues were identified in the SBOO monitoring region, which may hinder the future usefulness of this technique for plume tracking purposes in this area. Specifically, the shallow depth and the greater occurrence of obstacles and fishing gear in this region, caused significant damage to the ScanFish, which resulted in many repairs at great cost to the City. On numerous occasions, the ScanFish was almost completely lost due to entanglement and obstructions in the water column. As a result, the next stage of the pilot study, which will evaluate the use of the ScanFish for adaptive plume tracking, throughout 2021, will initially be carried out in the Point Loma region. Adaptive plume tracking will aim to evaluate the use of the ScanFish to identify, follow, and map the course of wastewater plume dispersion from the PLOO to provide a rapid assessment of plume location and heading at any given time. By focusing this stage of the study in the PLOO region, this will ensure that we can fully evaluate the ability of the ScanFish to perform adaptive plume tracking, while not risking the safety of staff, or the potential loss of this very expensive equipment. We anticipate reporting these results in the 2020-2021 Biennial Report.

**Historical Equipment Issues**

*(Previously reported, but updated and included here for reference)*

**RTOMS****PLOO-01**

- Sea-Bird SeapHOx pH sensor @ 94 m (bottom): batteries died a few days into deployment, due to incorrect configuration during pool calibration testing.
- Turner Cyclops C7 Chlorophyll *a* and CDOM sensor @ 94 m (bottom): failed entire deployment.
- Chelsea UviLux BOD sensor @ 94 m (bottom): reset to factory default then failed one week after deployment.
- Sea-Bird SUNA nitrate sensor @ 94 m (bottom): fouled or otherwise failed ~five months after deployment, recorded large negative values.
- Sea-Bird SUNA nitrate sensor @ 1 m (surface): recorded negative values, possibly due to incorrect zero calibration and may be corrected post-processing.
- RDI ADCP batteries died shortly after 11 months deployed: was only predicted to last eight to nine months based on RDI software.
- AIS stopped working after deployment. New unit purchased.

**SBOO-02**

- Sea-Bird SeapHOx pH sensor @ 24 m (bottom): Failed after five months deployed.
- RDI ADCP batteries died shortly after 12 months deployed: was only predicted to last eight to nine months based on RDI software.
- Bottom controller @ 24 m: batteries died, as expected, after 12 months deployed, thus no bottom Satlantic SUNA nitrate, Wetlabs Eco-Triplet (CDOM, Chl-a, Backscatter), Chelsea UviLux (BOD), or Sea-Bird SeapHOx (pH) data after batteries died (Aug-Sept 2019).

**Equipment Issues from Current Reporting Period****RTOMS****PLOO-02**

- Pro-Oceanus pCO<sub>2</sub> sensor @ 1 m (surface): reading low values prior to deployment. Internal pump was replaced, which remedied the problem and worked for duration of deployment.
- Sea-Bird SUNA nitrate sensor @ 1 m (surface): recorded negative values at beginning of deployment and then continued to drift high throughout deployment. Initial values possibly due to incorrect zero calibration and may be possible to correct for drift during post-processing.
- Sea-Bird SUNA nitrate sensor @ 89 m (bottom): recorded very noisy suspect data after seven months deployed, then stabilized followed by step change and drift in data.

- Sea-Bird SeapHOx pH sensor @ 89 m (bottom): batteries for the SBE37-ODO part of the package ran out after three months deployed, and the problem fixed remotely by sending a command to switch power source to controller batteries.
- Sea-Bird SeapHOx pH sensor @ 30 m (middle): Failed after four months deployed.
- Sea-Bird ECO triplet chlorophyll, CDOM, and turbidity sensor and Chelsea UviLux BOD sensor @ 30 m (middle): Failed after nine months deployed, possibly related to problem with mid-water controller.
- Sea-Bird ECO triplet chlorophyll, CDOM, and turbidity sensor @ 1 m (surface): frequently reported noisy and negative values for much of the deployment and the sensor maxed out of programmed range for chlorophyll and turbidity.
- Cell phone communication lost on PLOO RTOM on February 14, 2020. Remote attempts to swap cell service were attempted without success. Cell phone modem on mooring was replaced on March 4, 2020 and communication resumed.
- Beacon that provides mooring position stopped working in March due to hardware problem and then communicated intermittently. New beacon installed on April 21, 2020 during favorable weather.
- On September 29, 2020, the mooring broke free from the anchor just below the 30 m instrument package and began drifting south towards Mexico. Staff were able to recover the top of the mooring and most of the remaining bottom portion later that evening.

**SBOO-03**

- Sea-Bird MicroCAT-ODO salinity, temperature, oxygen sensor @ 18 m (middle): Stopped reporting data after six months deployed. Upon recovery, it was noted that the connector on the mid water controller of the instrument had been sheared off.
- All sensors connected to bottom water controller (26 m) failed to report data consistently after eight months deployed. Impacted sensors include: Sea-Bird SeapHOx pH sensor, Sea-Bird ECO triplet chlorophyll, CDOM, and turbidity sensor, Sea-Bird SUNA nitrate sensor, and Chelsea UviLux BOD sensor.
- Sea-Bird SeapHOx pH sensor @ 1 m (surface): Failed to report data after nine months deployed.
- Sea-Bird SUNA nitrate sensor @ 26 m (bottom): recorded negative values throughout deployment. Suspect values possibly due to incorrect zero calibration and may be possible to correct for drift during post-processing.
- Sea-Bird ECO triplet chlorophyll, CDOM, and turbidity sensor @ 1 m (surface): intermittently reported noisy values and negative values for CDOM in particular during deployment and the sensor maxed out of programmed range for chlorophyll and turbidity on occasion.
- Sea-Bird SUNA nitrate sensor @ 1 m (surface): After nine months deployed, sensor showed significant step change in data and began reporting negative values.

**ScanFish**

- ScanFish flap motors (both sides) were found to be leaking oil and in need of replacement. Received both new motor flaps from EIVA with a significant discount in pricing (40%). Repairs done before February survey. Cost of repairs \$8000.
- ScanFish controller and altimeter returned to Denmark in May after displaying false altimeter readings that caused the ScanFish to be non-operable. Controller would not pass the pre-flight check with erroneous altimeter readings. EIVA recommended a firmware upgrade to the controller, which resulted in further firmware issues. Cost of repairs, backup cables, altimeter, and pressure sensor \$16,000.
- ScanFish continued to display intermittent errors with altimeter even with a new unit. Although much less frequently. We found a work around by not bringing the ScanFish shallower than 10-15 meters.
- ScanFish hit an obstruction in the SBOO region, possibly derelict fishing gear. One deflector cable pulled through fitting. Both deflector cables were seriously damaged. Deflector cable attachment point slid along tow cable toward ScanFish. Found rope fibers on all 3 cables.
- While towing along the 30m depth contour in the SBOO region, as we transitioned to the 20m contour the Flight software displayed: “System Error”, no communication between Scanfish and deck box. Recovered ScanFish main data cable bulkhead failed causing a short (connection smoking). Operations cancelled for remaining two days. Cost of repairs \$2500.
- ScanFish crashed in November and a large portion of the underside shell cracked off while surveying in SBOO region. Port cable clip found to be missing. Port cable had blue and orange fibers embedded in it. Appeared to have caught a trap on upcast and then crashed into bottom. Electronics still functioned, but operated poorly afterwards. Cost of repairs \$3500.

**Planned Activities (2021-2022)****2021***February*

- Redeployment of static ADCP and thermistor moorings in PLOO and SBOO regions.
- Adaptive Plume Tracking Study - first quarter ScanFish testing to be implemented in PLOO region.

*March*

- Submit 2020 PTMP Progress Report.
- Recovery and redeployment of static ADCP and thermistor moorings in PLOO and SBOO regions.
- Complete QA/QC review and assign qualifiers for RTOM data through 2020.

*May*

- Forth Deployment of SBOO RTOMS.
- Adaptive Plume Tracking Study - second quarter ScanFish testing to be implemented in PLOO region.



*June*

- Submit 2020 Interim Report, including preliminary results from RTOMS.
- Third Deployment of PLOO RTOMS.

*August*

- Adaptive Plume Tracking Study - third quarter ScanFish testing to be implemented in PLOO region.

*September*

- Retrieval and redeployment of static ADCP and thermistor moorings in PLOO and SBOO regions.

*November*

- Adaptive Plume Tracking Study - fourth quarter ScanFish testing to be implemented in PLOO region.

**2022***January*

- Forth Recovery of SBOO RTOMS.
- Complete QA/QC review and assign qualifiers for RTOM data through 2021.
- Assess future of Adaptive Plume Tracking for PLOO and SBOO – consult with SIO and Regional Board for direction.

*February*

- Complete analysis of data from PLOO and SBOO RTOMS and ScanFish adaptive sampling for inclusion in the City's 2020-2021 Biennial Receiving Waters Monitoring and Assessment Report.

*March*

- Submit 2021 PTMP Progress Report.
- Retrieval and redeployment of static ADCP and thermistor moorings in PLOO and SBOO regions.
- Third Recovery of PLOO RTOMS.

*June*

- Submit 2020-2021 Biennial Receiving Waters Monitoring and Assessment Report, including results from RTOMs and ScanFish.

**Tables and Figures**  
**Plume Tracking Monitoring Plan**  
**Progress Report**  
**March 2021**

**TABLE 1.** Updated Plume Tracking Monitoring Plan timeline/progress. Current reporting year highlighted.

		Real-time Ocean Mooring Systems					Static ADCP / Thermistor Moorings*	Adaptive Plume Tracking				Progress
Year	Quarter	PLOO		SBOO		Data Management		ROTV Training & Testing	Develop Pilot Study	Conduct Pilot Study	Implement Adaptive Plume Tracking	
		Deploy (D) / Recover (R)	Acquire Data	Deploy (D) / Recover (R)	Acquire Data							
2016	Qtr 1						PL, SB					•
	Qtr 2						PL, SB	X				•
	Qtr 3						PL, SB					•
	Qtr 4			D1	X	X	PL, SB					•
2017	Qtr 1				X	X	PL, SB					•
	Qtr 2				X	X	PL, SB	X				•
	Qtr 3				X	X	PL, SB					•
	Qtr 4			R1	X	X	PL, SB	X				•
2018	Qtr 1	D1	X			X	PL, SB					•
	Qtr 2		X			X	PL, SB	X				•
	Qtr 3		X	D2	X	X	PL, SB		X			•
	Qtr 4		X		X	X	PL, SB		X			•
2019	Qtr 1	R1	X		X	X	PL, SB		X			•
	Qtr 2				X	X	PL, SB	X	X			•
	Qtr 3	D2	X	R2	X	X	PL, SB		X			•
	Qtr 4		X	D3	X	X	SB		X			•
2020	Qtr 1		X		X	X	PL, SB			X		•
	Qtr 2		X		X	X	PL, SB			X		•
	Qtr 3	R2	X		X	X	PL, SB			X		•
	Qtr 4			R3	X	X	PL, SB			X		•
2021	Qtr 1					X	A/N				X	
	Qtr 2			D4	X	X	A/N				X	
	Qtr 3	D3	X		X	X	A/N				X	
	Qtr 4		X	R4	X	X	A/N				X	
2022	Qtr 1		X	D5	X	X	A/N				X	
	Qtr 2	R3	X		X	X	A/N				X	
	Qtr 3		X		X	X	A/N				X	
	Qtr 4		X	R5	X	X	A/N				X	

**FIGURE 1.** Preliminary data from the second deployment of the PLOO real-time oceanographic mooring system from 10/07/2019 – 09/29/2020, shown as daily averages. These raw real-time data have not been reviewed for quality and may include errors. Parameters include, **A:** Temperature; **B:** Salinity; **C:** Carbon Dioxide; **D:** pH; **E:** Oxygen; **F:** Nitrate; **G:** Chlorophyll; **H:** CDOM; **I:** Turbidity; and **J:** BOD. For real time preliminary data from the PLOO mooring, see <http://mooring.ucsd.edu/dev/ploo/>

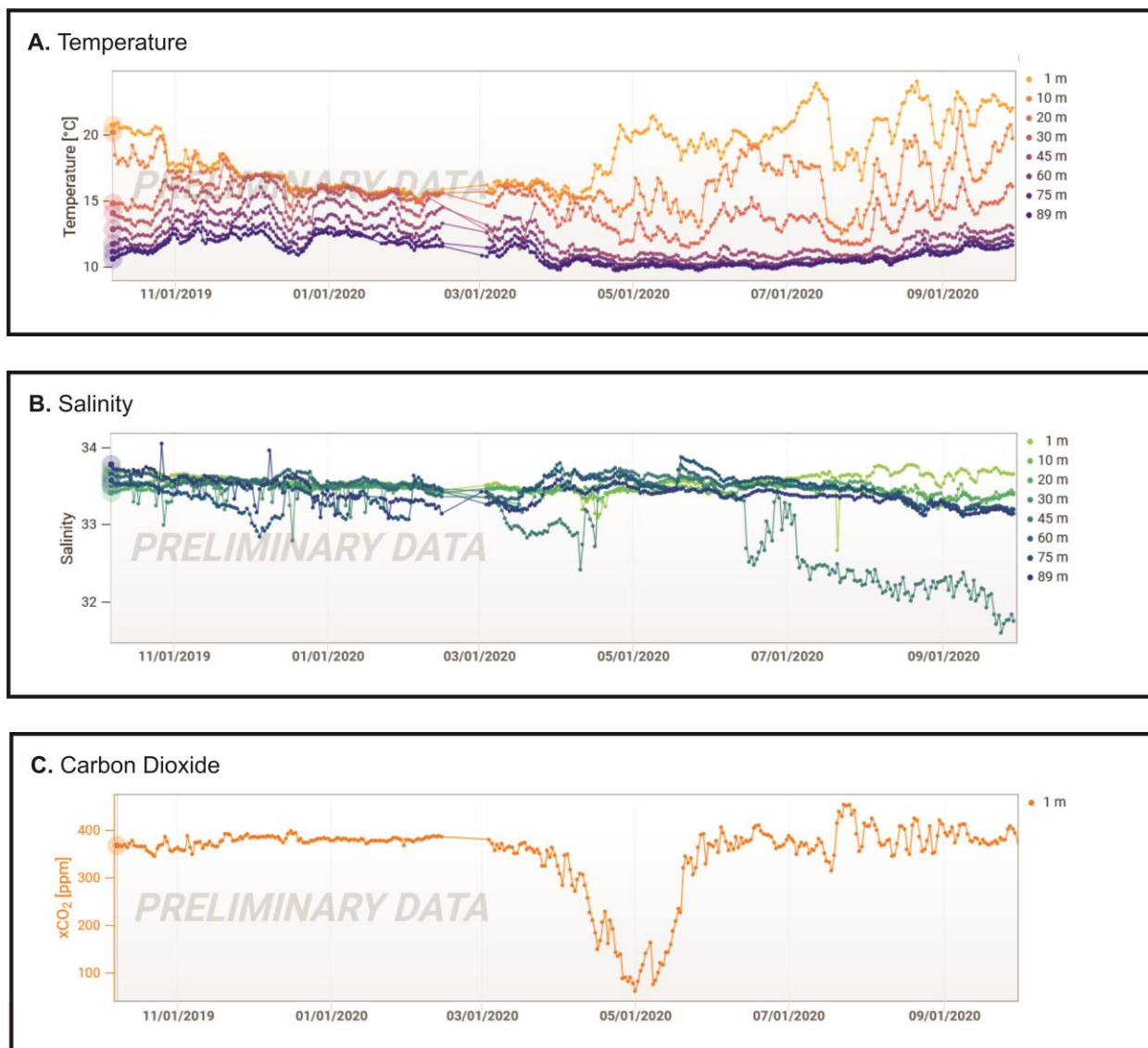


FIGURE 1. Continued...

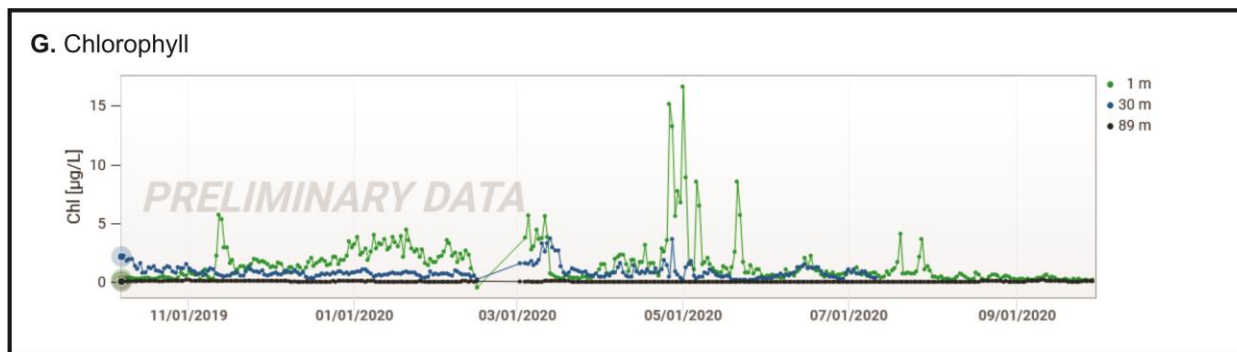
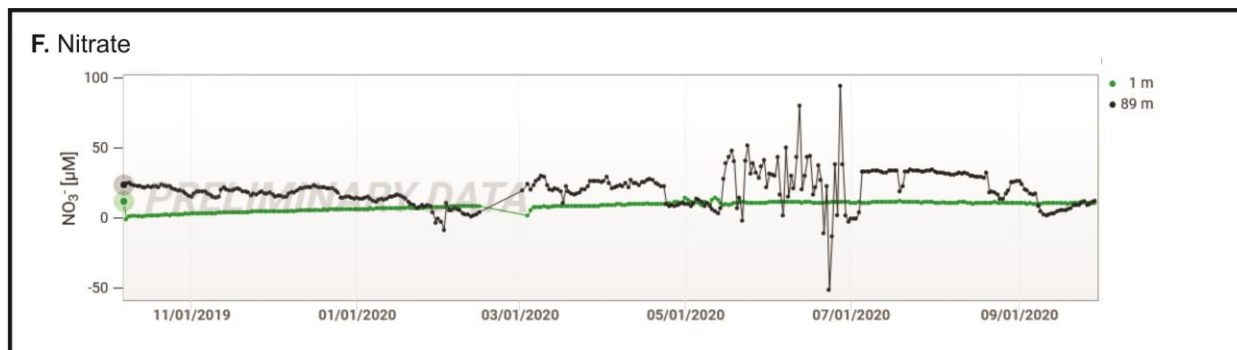
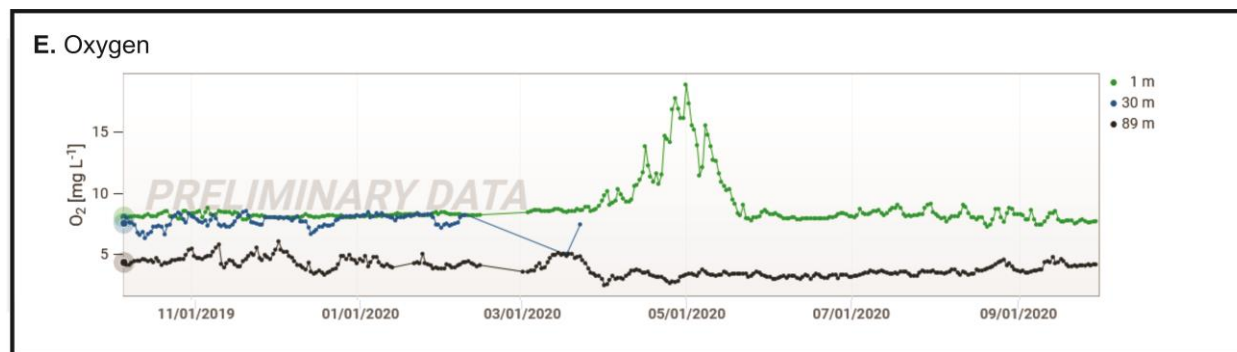
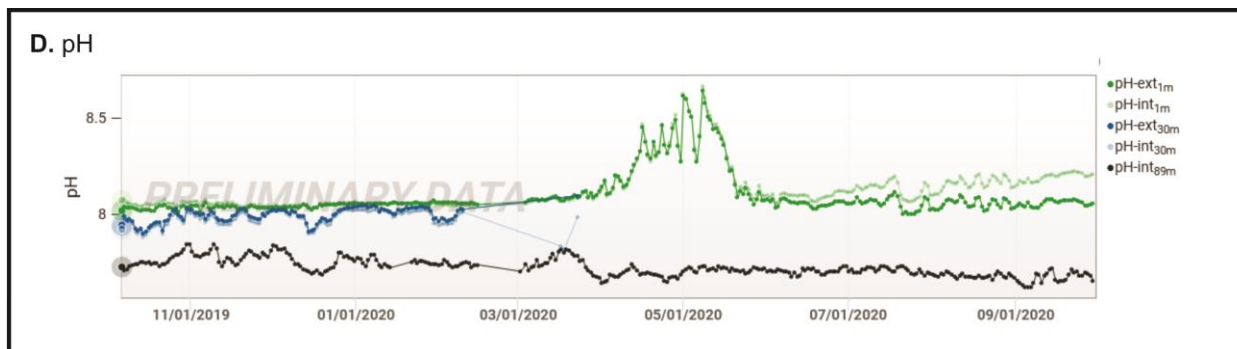
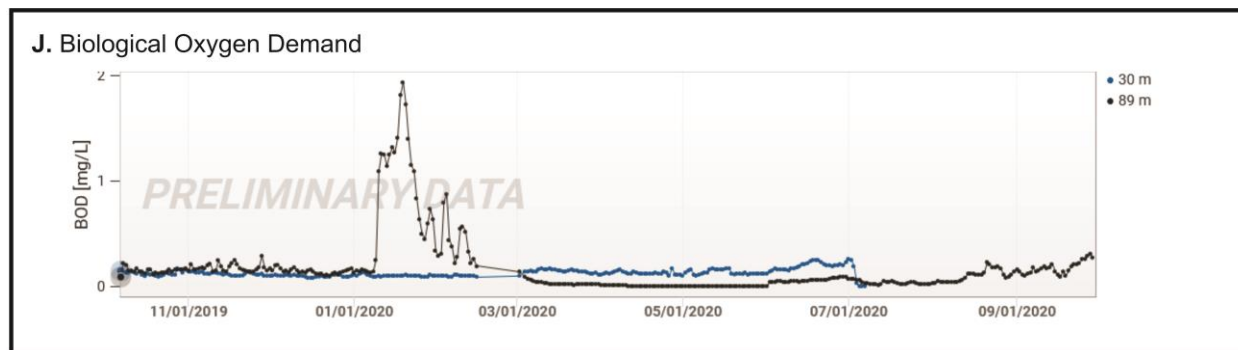
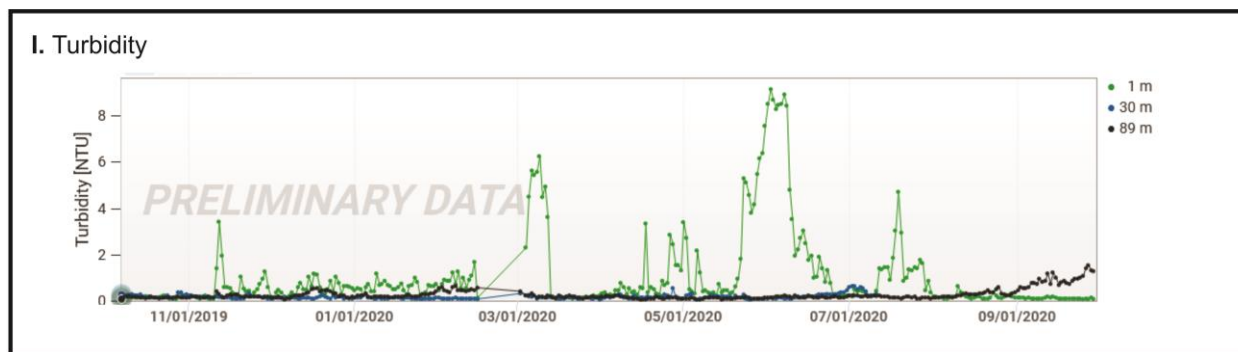
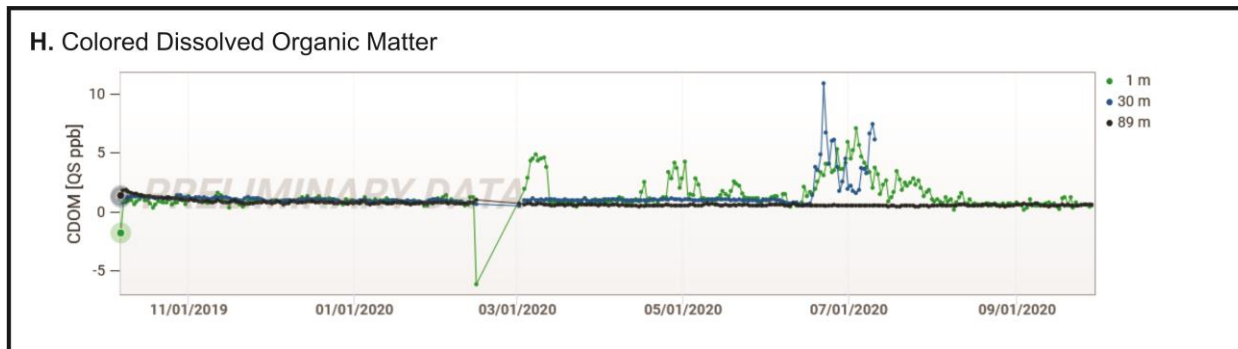


FIGURE 1. Continued...



**FIGURE 2.** Preliminary data from the third deployment of the SBOO real-time oceanographic mooring system from 12/18/2019 – 12/17/2020, shown as daily averages. These raw real-time data have not been reviewed for quality and may include errors. Parameters include, **A:** Temperature; **B:** Salinity; **C:** Carbon Dioxide; **D:** pH; **E:** Oxygen; **F:** Nitrate; **G:** Chlorophyll; **H:** CDOM; **I:** Turbidity; and **J:** BOD. For real time preliminary data from the SBOO mooring, see <http://mooring.ucsd.edu/dev/sboo/>

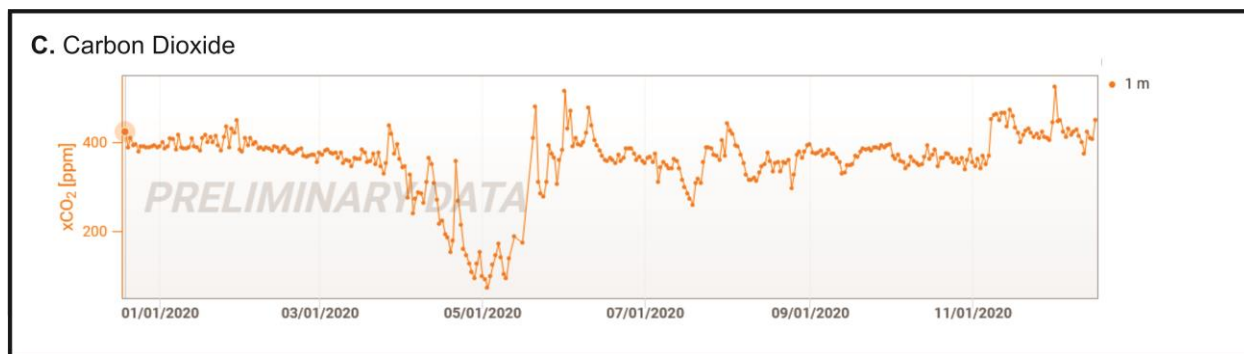
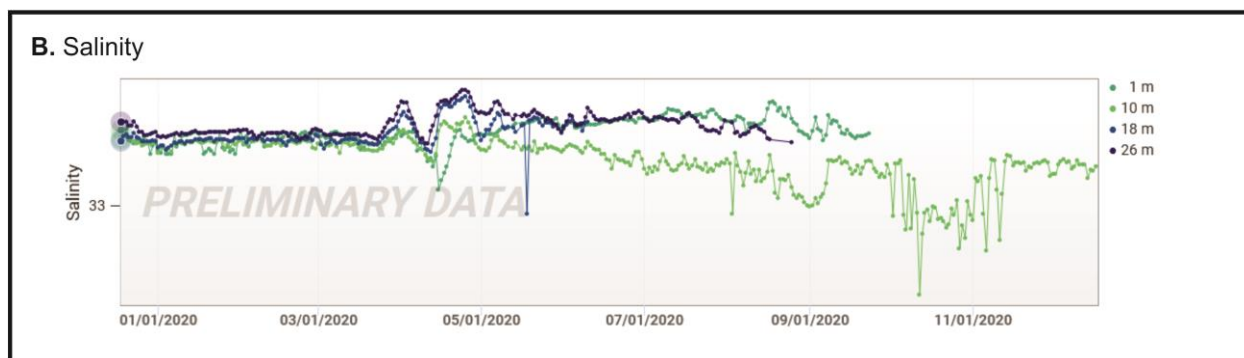
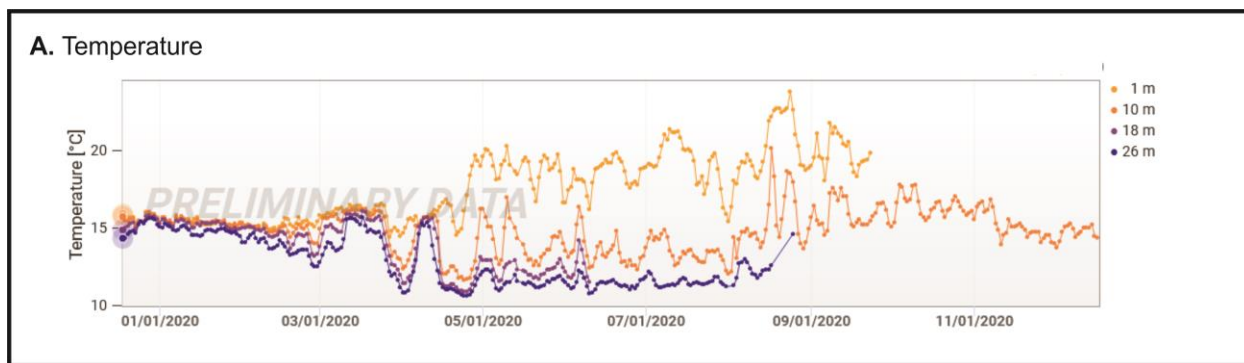


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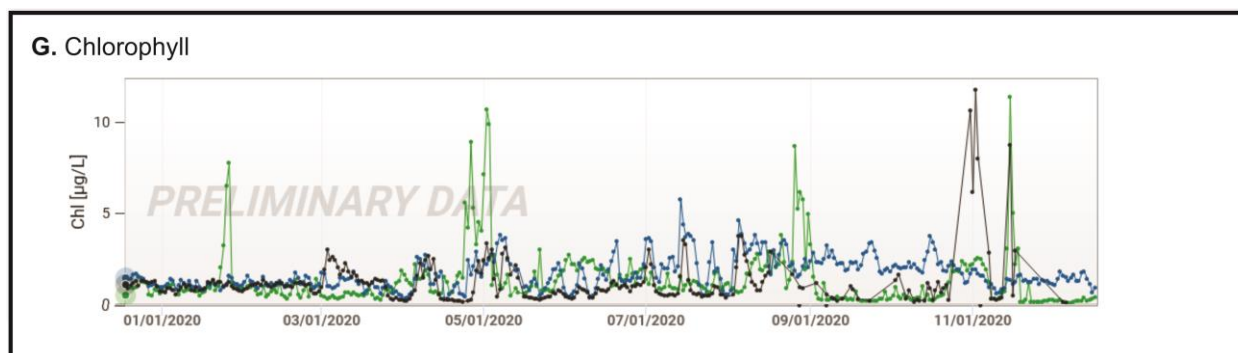
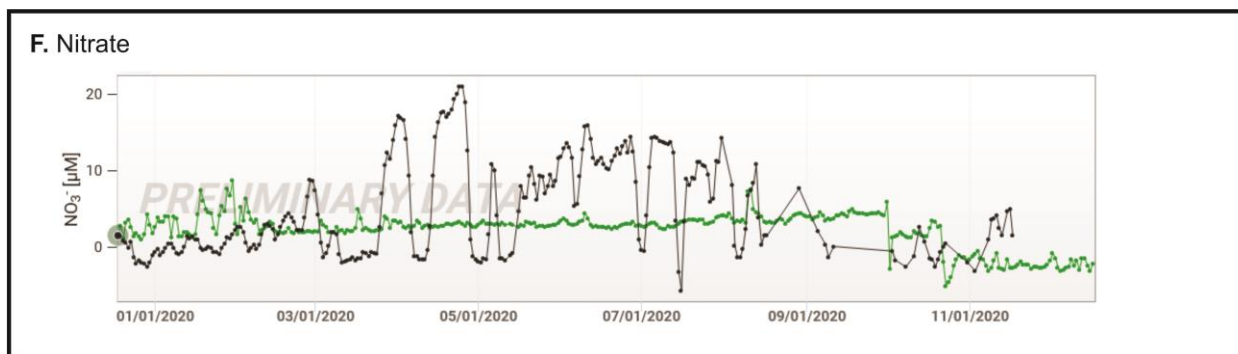
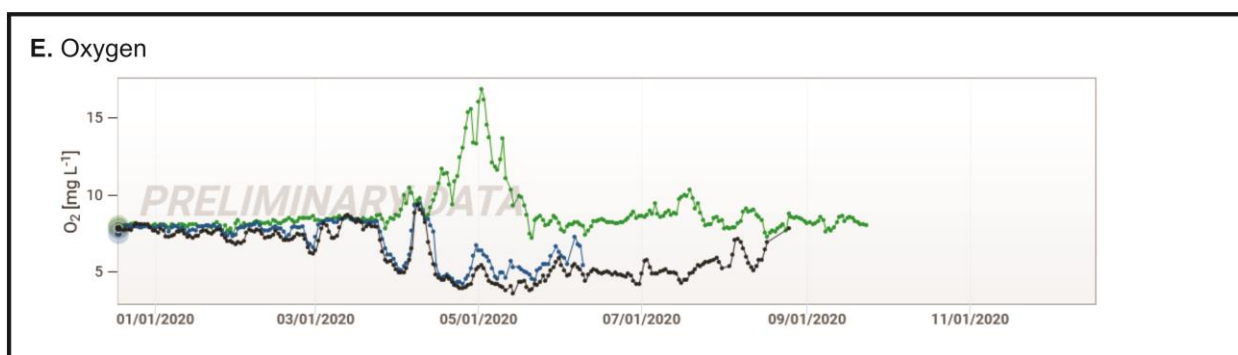
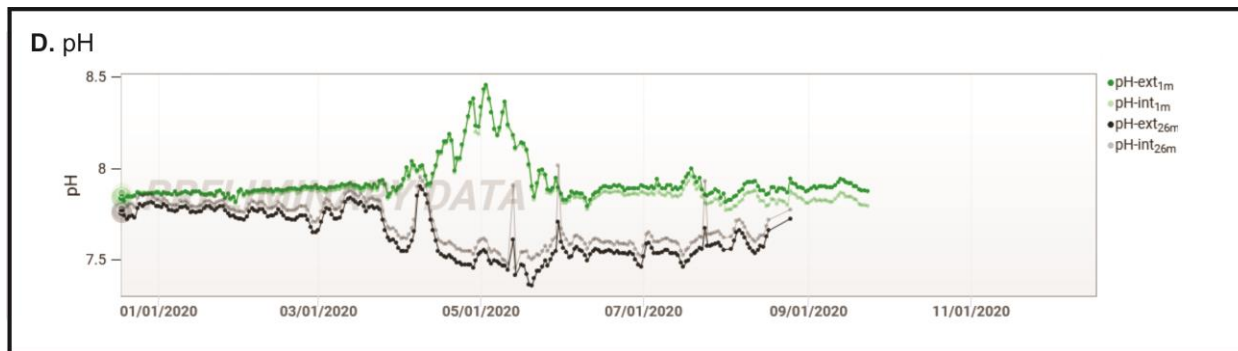
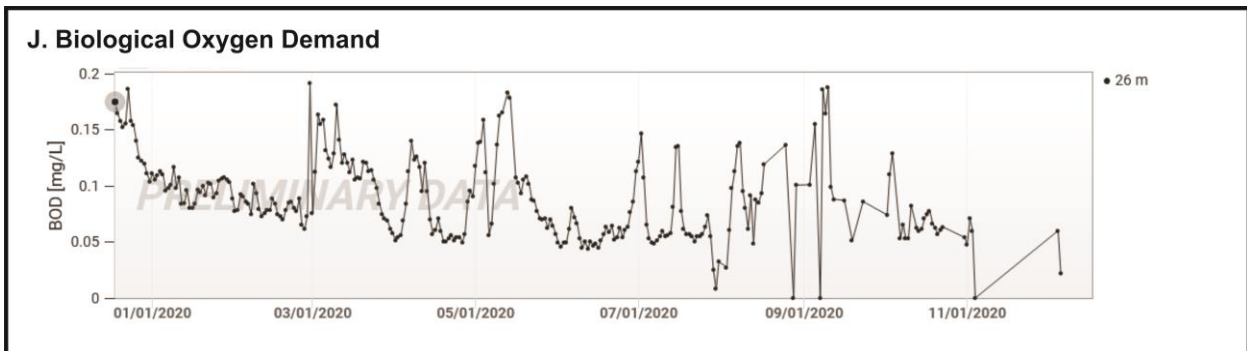
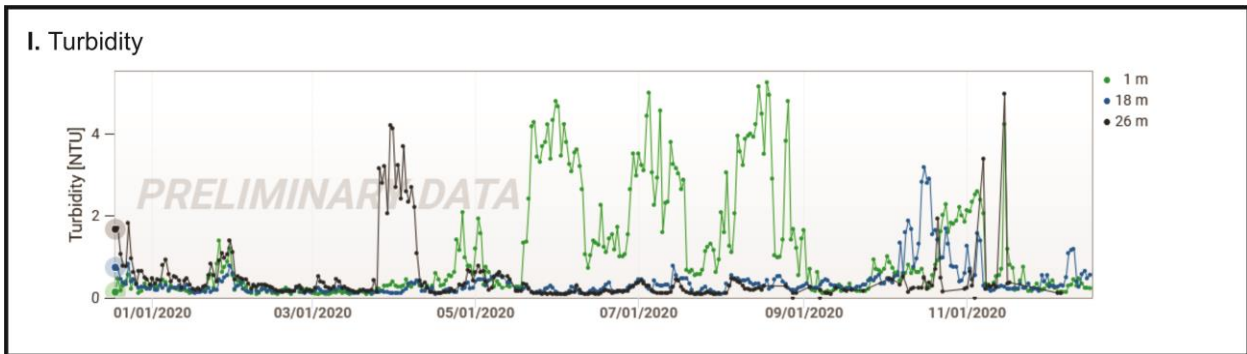
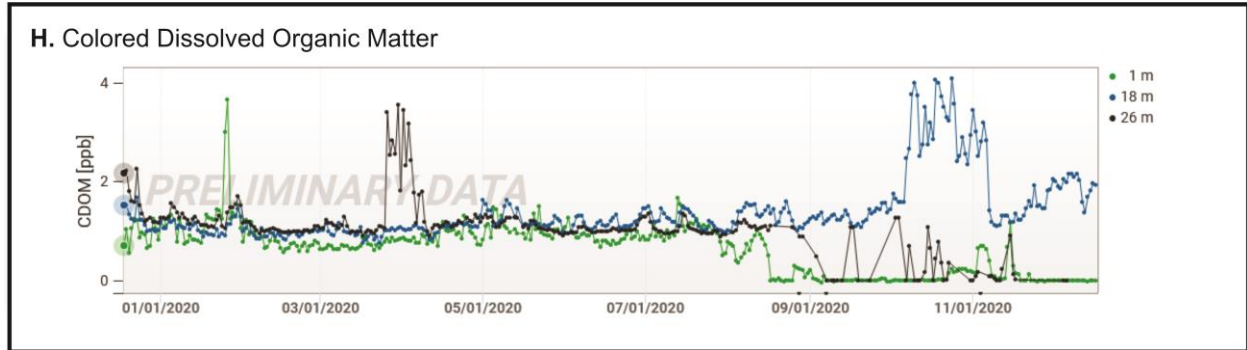




FIGURE 2. Continued...



**FIGURE 3.** Preliminary maps from the PTMP Pilot Study produced from quarterly ScanFish tows in the PLOO region. Maps for the SBOO region are not currently available. Parameters presented include: Colored Dissolved Organic Matter (CDOM); and Optical Brightness (OB). These raw data have not been reviewed for quality and so may include errors.

