Combining Efforts to Conduct Shallow Water Quality Monitoring in Maryland Using: High Speed Spatial Mapping and Continuous Monitoring

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Introduction

The St. Mary's River Project (SMRP) is a state funded program that investigates matters related to water quality and ecological health and uses this information to protect, restore and manage the historic and ecologically important St. Mary's River and nearby tributaries. The SMRP program is made up of one full time research coordinator, two principal investigators, and students from St. Mary's College of Maryland. The students along with the research coordinator conduct the field work and collect data from March through October.

SMRP works closely with the Chesapeake Biological Laboratory (UMCES-CBL) in conducting its shallow water quality monitoring for Maryland Department of Natural Resources (MD-DNR) throughout the St. Mary's River, Patuxent River, and numerous other water bodies in the Chesapeake Bay watershed. CBL is contracted by SMRP to analyze the water quality data which is sent to MD-DNR where it is published on their website "Eyes on the Bay" http://mddnr.chesapeakebay.net/eyesonthebay/index.cfm.

The ecology research group at CBL has been conducting their own shallow water monitoring throughout the Patuxent River and nearby water bodies for many years using high speed mapping techniques and continuous monitoring. They monitored the water quality in the Patuxent River after one particular storm event in June of 2006 at the request of the Chesapeake Research Consortium. Around the same time SMRP was collecting within the St. Mary's River using Dataflow® and Continuous Monitoring data sondes (ConMon).

The mid-Atlantic coast is an area that is subject to occasional severe storms. Over the period of June 24-28, 2006 the Chesapeake Bay region experienced a rainfall event comparable to 1972's devastating tropical storm Agnes. The region received an average of over 8 inches of rain during a 4 day period. Daily flows were measured at about 1/3 of those during Agnes.

Materials and methods

The two types of shallow water monitoring techniques used by SMRP are Dataflow® (Maddent and Day 1992) and Continuous Monitoring (ConMon). Dataflow® provides instantaneous readings of water quality data in addition to recording spatial data. The dataflow unit is composed of a computer, monitor, keyboard, GPS unit and water quality meter and can be moved between research vessels.

There are different models of Dataflow® units that are being used in the field by SMRP and CBL. CBL uses a model that has the monitor, keyboard, GPS, and hard drive all contained in one case (Figure 1). SMRP uses a version that houses the monitor and keyboard in the cabin of the vessel, and the computer including GPS unit is contained in a separate case located on the back deck of the vessel (Figure 2).

Con Mon (Figure 3) is the second type of shallow water monitoring that SMRP conducts in and around the St. Mary's River watershed. ConMon involves the placement of water meters (YSI 6600 extended deployment sondes) in the field for two week intervals.

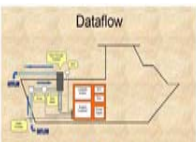

Figure 1. Diagram of CBL's dataflow set-up on research vessel.

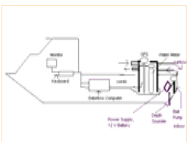

Figure 2. Diagram of SMRP dataflow set-up on research vessel.

Figure 3. Photo of continuous monitoring station in a St. Mary's River tributary.

Figure 4a

Figure 4b

Figure 4c

Figure 4d

Figure 4e

Figure 4f

Figures 4a-4f. Figure 4a shows CBL's dataflow computer, monitor, and keyboard in a self contained pelican case. Figure 4b shows the manifold which is made out of a pvc frame that stands alone on the deck and contains the sonde, GPS, and flow meter. Figures 4c depicts SMRP's dataflow computer, Figure 4d shows the manifold, which is made of plastic board and stands alone on the back deck fitted with a sonde, GPS, and flow meter. Figure 4e shows the SMRP dataflow computer hooked up on the boat, and Figure 4f shows the model sonde (YSI 6600) used for dataflow by both CBL and SMRP. The 6600 YSI sonde records water temperature, specific conductivity, salinity, dissolved oxygen % saturation and mg/L, turbidity, chlorophyll, and fluorescence.

Figure 5

Figure 6

Figure 5 represents the Patuxent River and shows the dataflow track map that CBL performed in June 2006 after a significant rain event. This rain event produced between 12 and 16 inches of rain in the Chesapeake Bay region over five days.

Figure 6 shows the ConMon station in St. George's Creek as well as its proximity to the St. Mary's River.

Results

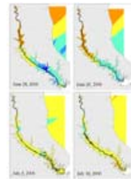

Figure 7a

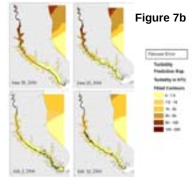

Figure 7b

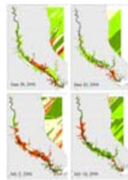

Figure 7c

Figure 7a through 7c represent CBL's water quality results for 4 days (June 8th, 30th, July 5th, and 10th) after the significant rain event in June 2006 (June 24th-26th). **Figure 7a** shows dissolved oxygen is depleted upriver closest to the rain event and as time progresses levels start to increase **Figure 7b** shows turbidity levels are elevated closest to the storm event and start to decrease as time progresses. Lastly, **Figure 7c** depicts chlorophyll densities. Overall chlorophyll levels are more diluted throughout the river and start to increase as time progresses.

Figure 8

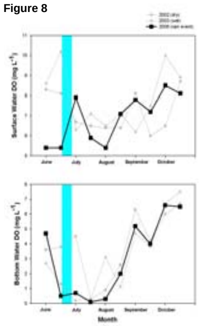

Figure 8 depicts surface and bottom water dissolved oxygen at station LE1.2 (near St. Leonard) on the Patuxent River. Blue shaded area indicates the June 2006 rain event and grey data shows data from a dry (2002) and wet (2003) year for comparison. MD-DNR data from http://www.chesapeakebay.net.

Dissolved oxygen (DO), an important indicator of ecosystem condition, responded to the rain event in both surface and bottom concentrations Surface water DO rose immediately following the June 2006 rain event. This contrasts with the pattern of decreasing DO as temperatures increase at the beginning of summer seen in both a dry (2002) and wet (2003) year. In bottom waters a strong depression of DO was seen following the rain event. This depression lasted for up to three months and was longer than would be expected for a year that, other than the rain event, had average flows.

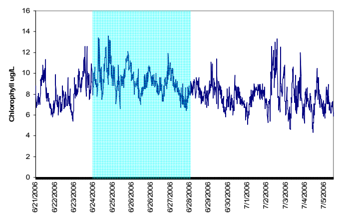

Figure 9a

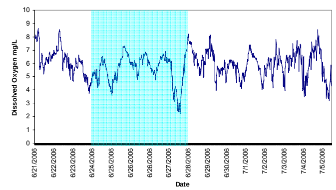

Figure 9b

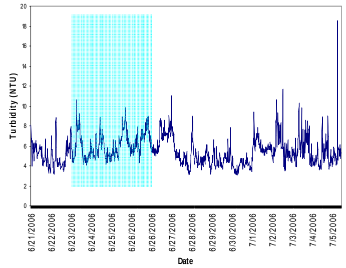

Figure 9c

Figures 9a thru 9c represent the St. Mary's River Continuous Monitoring Station data for chlorophyll a (ug/L^{-1}), dissolved oxygen (mg/L^{-1}), and turbidity (NTU) at St. George's Creek for the dates between June 21 thru July 5, 2006. Shaded aqua areas represent dates of the June 2006 storm event. **Figure 9a**, Chlorophyll spiked around July 2nd from 8 to 10 μg/L whereas dissolved oxygen (**Figure 9b**) dropped from about 6 mg/L^{-1} to ~2.5 mg/L^{-1} and then increased to ~7mg/L^{-1} the next day. Turbidity (**Figure 9c**) decreased closer to the rain event on June 27th from ~9 NTU's down to ~3.5 NTU's and stayed low until ~July 1st.

Conclusions

Patuxent River:

Surface mapping data indicated increased turbidity following the rain event and persisting until July 5, 2006. Dissolved oxygen was very low immediately following the rain event and remained low (< 5 mg L^{-1}) for several weeks. A clear response in chlorophyll-*a* concentrations was seen immediately following the rain event with levels reaching over 20 μg L^{-1} throughout most of the mesohaline portion of the Patuxent River Estuary.

Fixed station monitoring data indicated a strong depression in bottom water dissolved oxygen lasting for about three months. This is a longer period that would be expected given that this was, aside from the storm, an average flow year.

St. George's Creek:

ConMon data indicated for the 2 week period during and after the storm event in June 2006, that chlorophyll increased from ~10 to ~14μg/L^{-1}. Dissolved oxygen remained between 4 and 7 mg/L^{-1} throughout the rain event and on June 27th dropped down to 2mg/L^{-1}. Turbidity mostly remained consistent between 4 and 9 NTU's throughout the rain event and after.

Combining the results from high speed mapping and continuous monitoring helps show the responsive nature of these systems and is consistent with the idea that these estuaries will also rapidly respond to load reductions due to management actions.

Literature cited

Boynton, W.R., S.M. Moesel, E.M. Bailey and J. Anderson. 2006. Pages 3.1-3.19 in Department of Natural resources/ Environmental Protection Center Level 1 No. 24. Annappolis, Maryland.

EEG (Ecosystem Ecology Group). 2007. Water quality. Accessed 26 October 2007. http://www.gonzo.cbl.umces.edu.

Acknowledgments

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For further information

Please contact afdrohan@smcm.edu *and/or bailey@cbl.umces.edu*. More information on this and related projects can be obtained at www.smrpweb.smcm.edu *and http://www.gonzo.cbl.umces.edu*. This poster can be found online at http://smrpweb.smcm.edu.