Integrating GIS with MERI's Environmental Monitoring

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Abstract

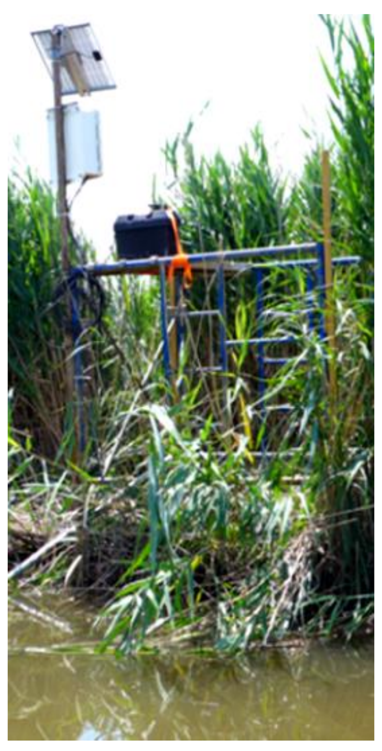
Field sensors were deployed to determine tidal creek flow measurements and their associated turbidity changes during flood and ebb cycles. These measurements can aid in our understanding of sediment transport and possible accretion patterns occurring in Meadowlands wetlands. The study detected a clear tidal discharge asymmetry of the marsh drainage system. It has been suggested that these tidal discharge asymmetries occur as a consequence of drainage basin morphology and storage characteristics in conjunction with prevailing tidal range and stage (Boon 1975).

In this study we use GIS to determine general basin morphology and storage characteristics of five tidal creek basins and compare these with the corresponding stage velocity curves. If there is a strong correlation between landscape metrics, properties, sediment transport, and accretion; then we could use landscape metrics to monitor and predict accretion rates without having to actually measure sediment transport.

Methodology

Right: Standard construction scaffolding made monitoring station. Setup is versatile and simple and routinely lasted less than an hour.

Far right: GPS and elevation data being collected for the sites

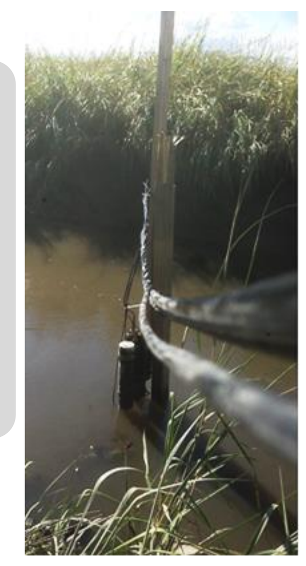


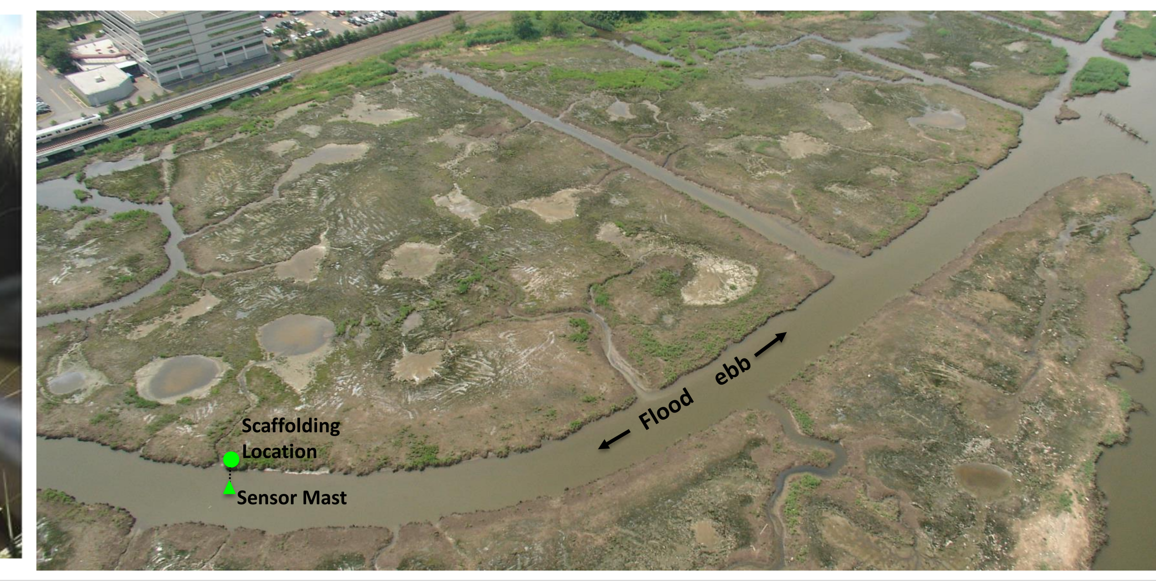
Sensing Equipment

- All data was collected and processed by MERI staff using Campbell Scientific, SonTek, and YSI data acquisition systems, and sensors.
- Campbell Scientific pressure transducer
- SonTek Argonaut ADV 3D flow sensor
- YSI Multiparameter sonde

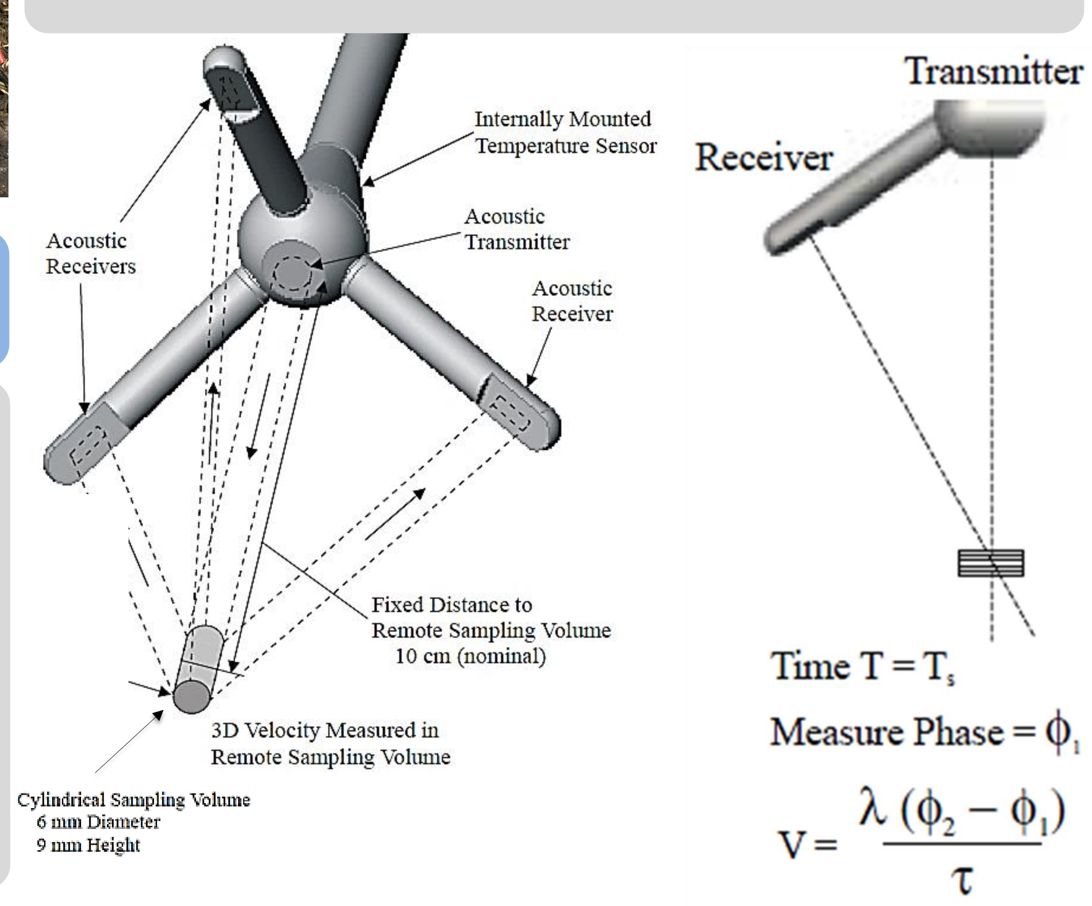
GPS Data was obtained using a survey grade Trimble RTK GPS accurate to 10cm.
Data collected May-September 2014

Left: A view of the sensor cluster measuring velocity, turbidity, and depth is ready to be deployed.
Right: The installed sensor mast, its head was positioned 30 cm from the creek bed.





Below: Detail of the 3d acoustic Doppler velocimeter sensor head. The sensor pulses a 10mhz wave and uses the reflected energy to report 3D velocity measurements.

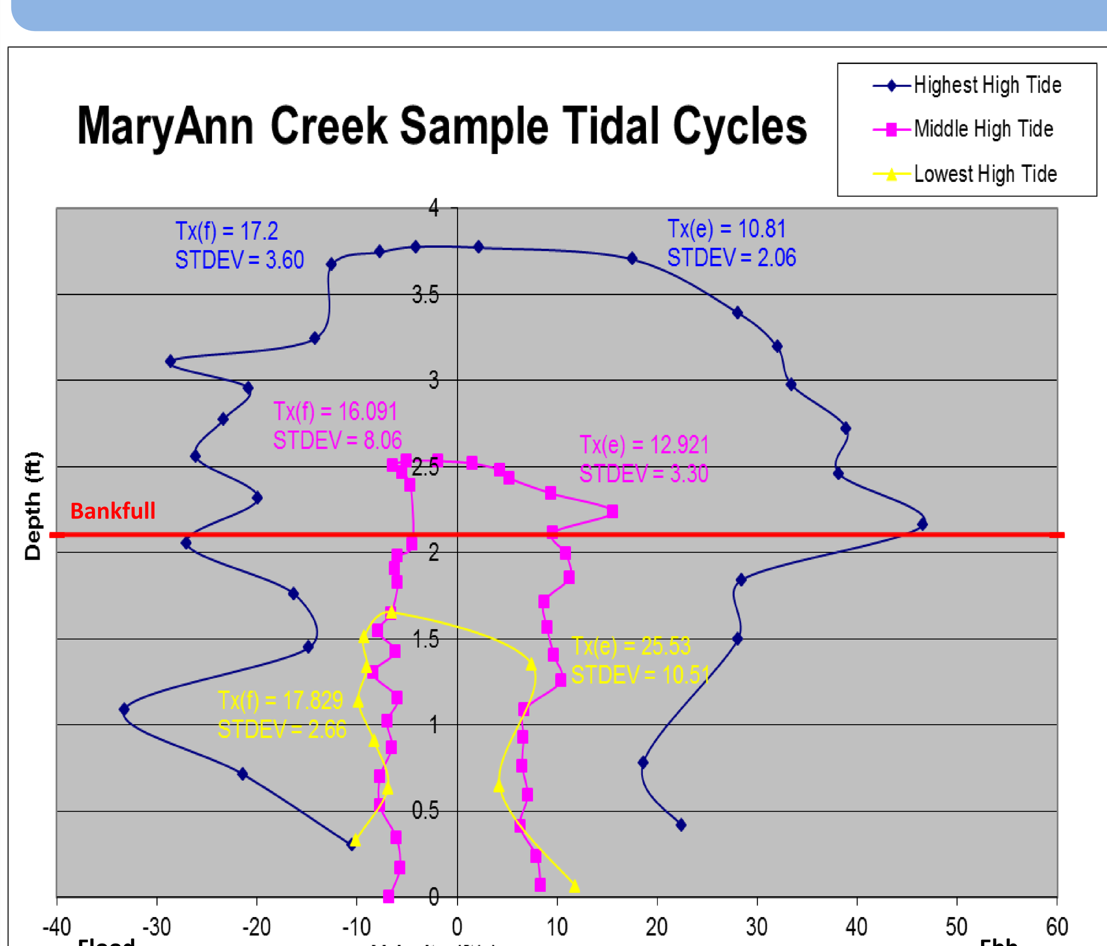


Above: Aerial image of Anderson Creek Site. Note the natural retention areas surrounding the creek that constitute the accommodation space. Hydro-flattened aerial LiDAR was used to survey the study area to determine proper placement of the sensors after each creek was selected.
Below: Orthophototography of Anderson and MaryAnn Creeks.

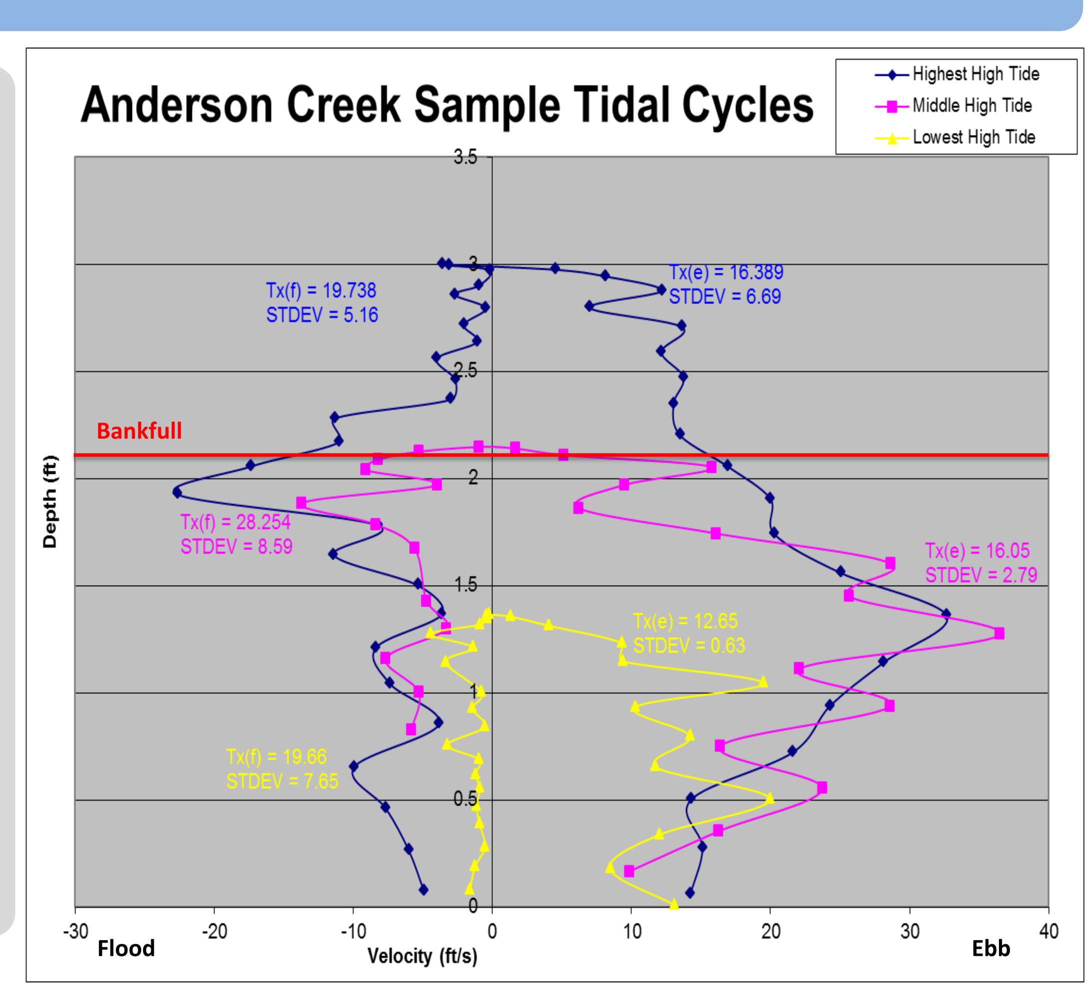
MaryAnn Creek and Anderson Creek

MaryAnn and Anderson creeks are located within 1000 feet of one another, but exhibit different ecological characteristics. Anderson creek has experienced major invasive species, (*Phragmites australis*) remediation, and is now substantially less vegetated than MaryAnn creek, which has not undergone remediation.

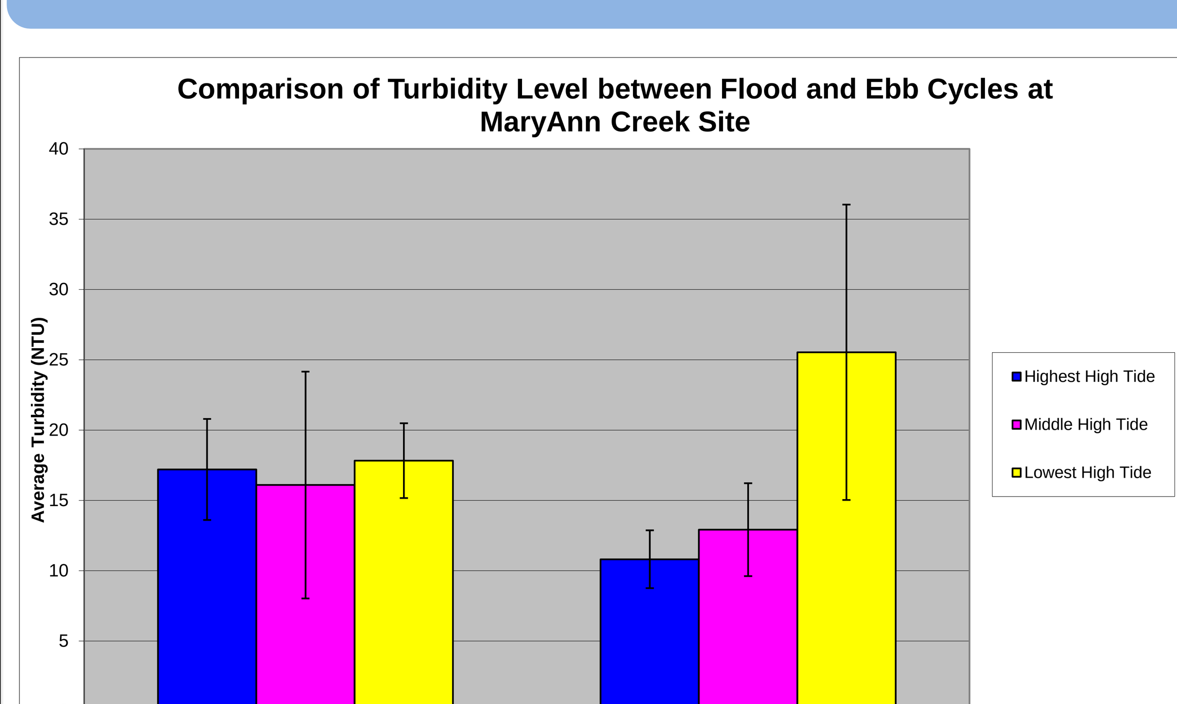
Stage Velocity Curves



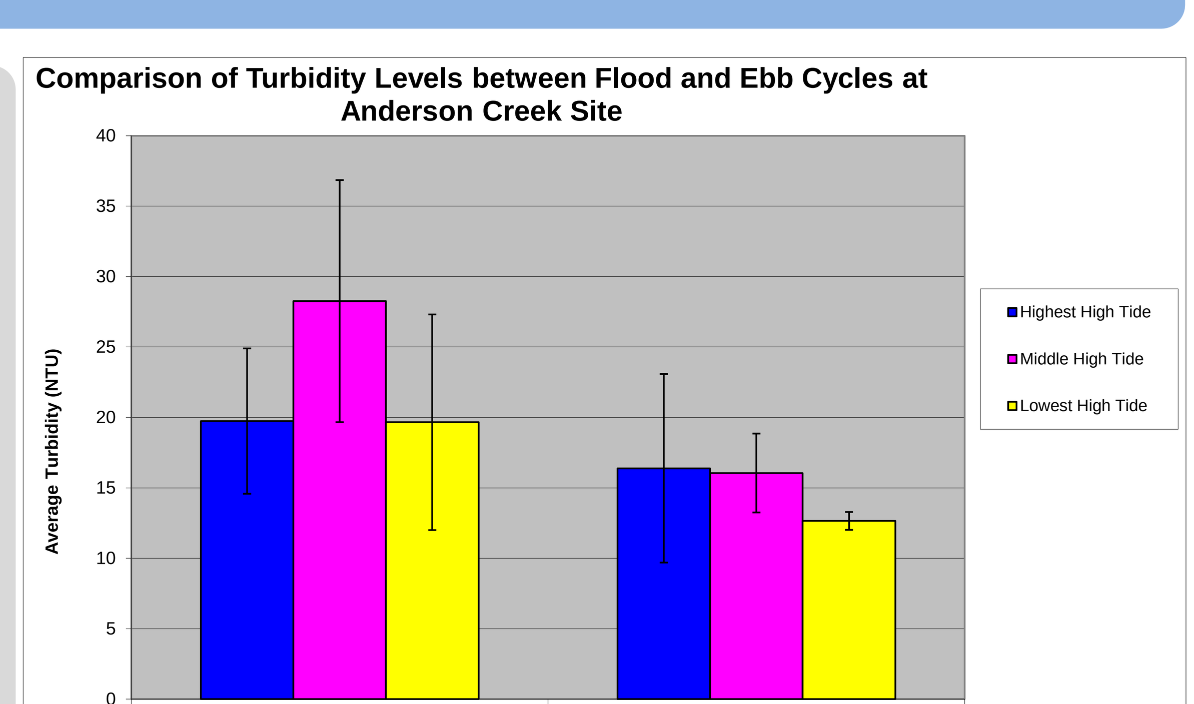
Sample tidal cycle data shown. Velocity during the ebb phase of the tidal cycle is greater than the velocity of the flood phase. The red line in each graph represents the "bankfull" elevation. Below this elevation water is channeled mainly through creeks, instead of freely flowing on to and across the marsh. Once flowing across the marsh the velocity drops dramatically due to vegetation, and much of the suspended load settles out.



Velocity Vs. Turbidity



Average turbidity is generally greater in the flood phase than in the ebb phase, indicating that sediment is being brought into the creek. Sediment allows the marsh to accrete and keep up with sea level rise, and replenish vital nutrients



Conclusion

- Although ecologically different, MaryAnn and Anderson creeks have similar patterns of velocity and turbidity.
- The lower energy flood phase carries with it more sediment than the flood phase. This implies that the marsh is not sediment starved, and will accrete naturally.
- The high velocity ebb phase carries little sediment with it showing that both the marsh surface, and creek beds are not being eroded quickly, allowing accretion to occur.
- Invasive species remediation seems to have little to no effect on the ability of the marsh to accrete normally.
- Future studies of this area may focus on determining the accretion rates in the area, the impact of sea level rise on the marsh, and incorporate sites with tide gates and other anthropomorphic impairments.

Acknowledgments and References

Boon, J. (1975). Tidal discharge asymmetry in a salt marsh drainage system. Limnology and Oceanography, 20(1), 71-80.