GC13F-1092

# Prioritizing aquatic science and applications needs in the Chesapeake Bay for a space-borne hyperspectral mission

Stephanie Schollaert Uz[1], Kevin R. Turpie[2], Shelly Tomlinson[3], Christopher W. Brown[4]

[1]NASA Goddard Space Flight Center, Greenbelt, MD [2]University of Maryland Baltimore County, Baltimore, MD [3]National Center for Coastal Ocean Science, NOAA, Silver Spring, MD [4]Center for Satellite Applications and Research, NOAA, College Park, MD

**Corresponding author: <stephanie.uz@nasa.gov>**

## Introduction

The Chesapeake Bay is the largest estuary in North America, benefiting a growing population through its ecosystem services, fishing, recreation, and transportation routes. Studies indicate the health of the Bay has seen some improvement in recent years, yet threats to its health persist (e.g. warming, pollution nutrient run-off). Increasing human activities in coastal regions requires constant vigilance by agencies managing water quality, to ensure the safety of the population. Since April, 2018 an interagency working group has been meeting monthly and a day-long workshop was convened with science and applications stakeholders around the overall theme of monitoring water quality from space. Current ocean color images indicate bloom locations used to guide *in situ* sampling efforts, despite limited spatial, spectral and temporal resolution. High resolution hyperspectral remote sensing provides a potential opportunity to measure additional indicators of ecological health and water quality. Assessing the needs of the aquatic user community around the Chesapeake Bay will inform science and applications recommendations during the current architecture study for a Surface Biology and Geology (SBG) Mission, as well as future scoping studies of other coastal and inland water bodies.

## Method

An interagency working group meets monthly at NASA Goddard and held a one-day workshop in August, 2018, bringing together remote sensing scientists with resource managers from around the Chesapeake Bay. Discussions focus on environmental variables needed by managers and whether and how remote sensing could address those needs through current or future capabilities. The main themes being explored include:

- Impacts to human health, such as harmful algal blooms, shellfish poisoning, and *Vibrio cholerae*.
- Quantifying ecology and the economic value of information needed to support decision making.
- Land-water interactions such as wetlands, turbidity, and bottom depth.


Credit: NASA/Michael Taylor & Ginger Butcher

*The Chesapeake Bay with its tributaries and estuaries and their sediment plumes visible in this Landsat 8 image (30m resolution). Measurements from space can assist water quality managers and guide sampling, especially around oyster beds within a growing aquaculture industry.*

| Satellite | Spatial | Temporal | Spectral Bands |
|---|---|---|---|
| MERIS 2002-12<br>OLCI Sentinel-3<br>2016-present | 300 m | 2 day | 10 (5 on red edge) |
| MODIS high res<br>Terra 1999; Aqua 2002 | 250/500 m | 1-2 day | 4 (1 red, 1 NIR) |
| MODIS low res | 1 km | 1-2 day | 7-8 (2 in red edge) |
| Landsat | 30 m | 8 or 16 day | 4 (1 red, 1 NIR) |
| Sentinel-2a (2015)<br>2b (2017) MSI | 20 m | 10 day each<br>5 day with 2 satellites | 5 (1 red; 2 NIR, 1 in red edge) |

*NOAA NCCOS satellite comparison for harmful algal bloom applications. Existing sensors are limited in spatial, temporal, or spectral coverage. Green indicates a good fit for operational products; orange, marginal; yellow, OK; red, poor. No single sensor can meet operational needs.*

## Key Findings

Many variables needed by resource managers cannot currently be retrieved from satellite measurements (e.g. toxins, fecal coliform, pH, $O_2$). We need a multi-faceted monitoring system that exploits ecological associations with satellite-derived products. Sustained satellite measurements provide a long-term average from which anomalies may be detected. Aquatic features move and change faster than polar-orbiting satellites can observe. Clouds and the intervening atmosphere obstruct a satellite view of the water at visible and infrared wavelengths. Despite challenges, a synoptic view of key variables (e.g. SST, Chl-a, salinity) improves the efficiency of *in situ* sampling around aquaculture sites.

## Next steps

- Work with Maryland Department of the Environment (MDE) and others to sample the optical, biological, physical, and chemical properties of water flowing into the Bay from land with a goal of finding a unique spectral signature associated with sewage.
- Plan a follow-up interagency workshop to integrate observations with modeling efforts. No single observing system can solve all problems, but assimilation could tap the strengths of each asset.
- Assist a regional field campaign with interagency assets for SBG Study architecture recommendations.

## Acknowledgements

Participants of the interagency Chesapeake Bay working group and workshop are gratefully recognized. Motivation to form the group began with Mark Trice, Maryland DNR and has sustained through collaboration with Rusty McKay, MDE, Rossana Del Vecchio of UMD, and many others. NASA Goddard Applied Sciences team members Brendan McAndrew and Jamie Dulaney assist with the monthly meetings and workshops. Support from Jim Irons, Earth Sciences Division Director at NASA Goddard, is greatly appreciated. Additionally, we appreciate suggestions and support from the Applied Science Program at NASA HQ, specifically: Ecological Forecasting (Woody Turner), Water Resources (Brad Doorn), and Disasters (David Green).