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

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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 require 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.

Key Findings
Many variables needed by resource managers cannot currently be retrieved from satellite measurements (e.g., toxins, fecal coliform, pH, O₂). 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.

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