EMERGING TECHNIQUES AND TECHNOLOGIES FOR A HARMFUL ALGAL BLOOM (HAB) OBSERVING SYSTEM

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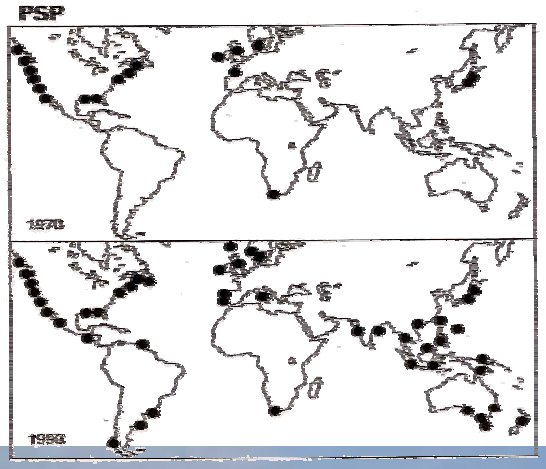
The occurrence of harmful algal blooms (HABs) is increasing in frequency and severity in many coastal environments worldwide. HABs can also cause a variety of illnesses in humans, ranging from mild reactions to death. In addition to risks to human health and environmental impact, significant economic losses occur in aquaculture, fisheries, and tourism. A critical problem that faces coastal managers and scientists is the *limited spatial and temporal sampling* of HABs to allow for *accurate* and *near real-time detection*. This is a critical gap in our knowledge of HABs in order to solve real-world solutions to a potentially damaging situation. Unfortunately, HABs are increasing worldwide at alarming rates of proliferation. The HAB problem is now widespread and serious. HABs contaminate and destroy coastal resources, the livelihoods of local residents are threatened and the sustenance of the human population is copromised. The objective of this proposal is to develop a harmful algal bloom system that addresses the **immediate** needs of coastal communities. In this proposal, we seek to develop aircraft for the monitoring of harmful algal blooms. Our aircraft instrumentation will serve to increase the temporal and spatial distribution of HAB detection. At NASA, we have developed a unique aircraft platform through Director Discretionary Funds. The aircraft platform addresses a unique temporal and spatial scale which present Ocean Color satellites cannot address. Our approach is both unique and novel because it bridges the gap between shipboard sampling which is labor intensive and wide spatial sampling of ocean color satellite remote sensing. We have recently developed the capability of monitoring harmful algal blooms with a compact hyperspectral uplooking and downlooking spectroradiometer mounted on a Twin Otter aircraft. In addition, we have coupled a CCD array digital camera and Heimann infrared radiometer to measure sea surface temperature. Flying at an altitude of 500 meters will allow for rapid surveys of coastal waters. The ability to fly over the bloom with high temporal and spatial coverage will allow for an accurate assesment of the cause and distribution of these highly episodic events. The ability to acquire hyperspectral ocean color data, sea surface temperature data, and real color imaging is an innovative technique to monitoring HABs.



Aircraft are a unique platform to monitor and understand the dynamics of harmful algal blooms. Because we fly at a relatively low altitude, HABs can be monitored continuously and the concentrations of blooms do not have an atmospheric correction. We are able to capture much finer resolution than conventional satellites. We are able to acquire data at a rate of 100-200 m resolution in addition to capturing important temporal events such as tidal forcing, diel migration, and daily advection by currents. Because satellites have only one overpass per day, they are not able to capture these critical areas in harmful algal bloom research which are necessary in understanding the ecology and oceanography of harmful algal blooms. The feasibility and utility of this platform is ideal for application to harmful algal bloom detection due to its 1) low cost; 2) ability to telemeter data in real time; and 3) its ability to sense out phytoplankton patches using a suite of bio-optical sensors. The demonstration of aircraft has broad applications to the Japanese economy because our instrumentation is easily accessible and has applications for fisheries to become aware of these HAB scenarios in real time.