Integration of detailed ship-based sampling should be employed when HABs are detected in a region. High spatial resolution data collection methods should be utilized just inside and outside of the bloom region (Figure X.11). A detailed sampling grid within the HAB can be designed according to the along- and cross-shore extent of the HAB; the extent of the HAB may be determined using satellite images if it has a surface expression, is large enough for observation, and has a discernable color signature. If the HAB is determined to be highly extensive or patchy, measurements can be made along several detailed sampling grids in different locations. Our suggested measurement approach within the detailed sampling grid is to utilize an AUV or glider together with a vertical profiling instrument package, and whole water sample collection from Niskin bottles deployed from small research boats. Instruments on the AUV or glider could include: (1) (spectral) fluorometer, (2) spectral backscatter and other inherent optical property sensors, (3) rapid chemical analyzer, (4) MBBP, (5) pressure sensor, (6) temperature sensor, (7) conductivity meter, (8) acoustic-based current meter, and (9) GPS. The AUV or glider can operate at pre-programmed speeds and patterns, e.g., in a zigzag or sawtooth pattern along the detailed sampling grid from the surface to the mixed layer or another depth or at a specified fixed depth (e.g., using artificial intelligence; Schofield et al., 2003). The instruments can sample up to 10 times per second for high spatial and temporal resolution.

The vertical profiling package should be relatively small, lightweight, and deployable from small research boats. Vertical profiles should be obtained at pre-specified locations along the detailed sampling grid. Battery-powered instruments on the profiling package can include: (1) hyperspectral IOP and AOP instruments, (2) (spectral) fluorometer, (3) optical-based chemical analyzer, (4) MBBP, (5) pressure sensor, (6) temperature sensor, and (7) conductivity meter. These instruments can profile at < 10 cm s^{-1} and should sample several times per second for high vertical resolution (the ac-9 and ac-s have an inherent time scale associated with flushing, and it is longer than this). Niskin bottle samples and plankton samples can be obtained along pre-specified sections of the detailed sampling grid, e.g., at the four corners and at the center. These water samples should be immediately taken to the laboratory for phytoplankton species identification, nutrient analyses, and toxin analysis. Opening and closing nets with 25 μ m mesh size can also be attached to the vertical profiling package to collect plankton samples at specific depths (Herren, 2002). The outflow of the MBBP can provide pumped seawater to the net at a rate of 350-400 mL s^{-1} (Herren, 2002). A GPS unit on the small boat can obtain the exact locations of vertical profiles, bottle samples, and net tows.

The suggested instrumentation is by no means inexpensive and it is expected that most HAB monitoring and/or research programs will be unable to put together such an extensive observation system. At a minimum, a HAB program should have access to large-scale, synoptic observations such as ocean color satellite images and their derived product, chlorophyll-a concentration. Chlorophyll-a concentration information will at least alert researchers to the formation of blooms in the region of interest and assist in coordination of shipboard sampling efforts with respect to sampling in time and space. Inshore, where ocean color satellite data are contaminated by land, a HAB program should deploy at least one lightweight mooring, within 5 km of shore, for monitoring and characterization purposes. The close proximity to the coastline will facilitate mooring