Figure 3.11: Conceptual drawing of the "Ocean Color" GoMOOS moorings that have bio-optical instrumentation for use in ocean color remote sensing validation/calibration. The right panel shows the above water irradiance sensor mounted on the buoy, the ocean color bio-optical instrumentation package mounted at 3m, and the small optics package mounted on the mooring at 18 m (from top to bottom).

Buoys are usually moored using either a taut, or slack, wire design, although the recent introduction of wires with more spring offers advantages of both designs. Wire types include:

- ***Taut-Wire Surface Moorings***: For the ATLAS systems used in the TAO, TRITON and PIRATA mooring networks, the upper 500 m of the mooring utilizes a jacketed 1.27 cm non-rotating (nilspin). This segment is followed by an eight-strand plaited nylon line (1.9 cm) extending to just above the ocean bottom, where an acoustic release couples it to a ~2000 kg railroad wheel anchor. Taut-line moorings, with a nominal scope of 0.985 (ratio of mooring line length to water depth) are used in water depths greater than 1800 m to ensure that the upper section of the mooring is nearly vertical. More detailed information on the ATLAS taut-wire mooring design is available on-line at (http://www.pmel.noaa.gov/tao).
- ***Slack-Wire Moorings:*** The TAO slack-line moorings have a scope of 1.35, due to either shallow bathymetry, or severe current regimes. GoMOOS moorings are slack-wire moorings, with a scope of ~ 1.32, using 80 m of wire and 100 m of chain, anchored by 3 railroad wheels (Fig. 3.11). In these cases, the upper portion of the mooring is kept close to vertical (but less so than with taut-line moorings) by using a reverse catenary design. The reverse catenary design allows the capabilities of being stretched under tension while utilizing traditional catenary concepts through a semi-slack method. Although taut-line moorings maintain subsurface sensor locations at or near desired depths, surface instruments may be subjected to stronger forces from waves and currents. The slack-line moorings provide greater flexibility in the upper water column, which may help reduce these forces.
- ***Semi-slack/taut Wire Mooring:*** MOOS moorings are on 'semi-slack' S shaped tethers with a 1.20% scope. The BTM and HALE ALOHA 3 m diameter buoy platforms have been previously configured as semi-slack moorings. However, the new configurartions will be an inverse catenary design to reduce stress on all mooring components..

Subsurface Moorings

Subsurface moorings tested off Hawaii and used in the Southern Ocean during JGOFS (Fig. 3.7) are designed to minimize the vertical motion of radiometers derived from wave action and to remove the shading effect of a surface buoy and wiring. The mooring hardware includes two glass spheres and one large steel sphere. The 17" glass sphere beneath the sensor head was used to limit the range of tilt of the sensors. Note, however, that the mooring design allows vertical and horizontal movement of the sensors with variations in currents.

Profiling Moorings

Profiling optical moorings generally consist of a buoyant instrumented vehicle and a bottom-mounted enclosure housing a winch, controller and batteries if used autonomously. Profiles are achieved by paying out a tether which can also allow communications between the controller and instruments on the vehicle. Communications with a shore-based server, for example with a cell phone modem, allows data transmission and periodic updating of mission parameters such as profiling frequencies and minimum profile depth. Surface detachment of the profiling vehicle from the tether can facilitate instrument maintenance without recovery of the whole system.

Drifting Buoy Configurations

Drifting buoys have been deployed with AOP sensors in various configurations, most notably the ship-launched or air-launched CMOD type (McLean and Lewis, 1991), and the more common WOCE/OCM type, both manufactured by MetOcean Data Systems Limited. Both systems have surface tracking in-water multichannel radiance radiometers, and a single channel above water irradiance sensor (490 nm) and telemeter data back to the user via the ARGOS system. Due to bandwidth restrictions, the systems report an hourly average of radiometric measurements sampled every 90 seconds. Typically (latitude dependent) 12 data collections are reported to the user per day.