SBC LTER: Comparison of spherical and planar light sensors

Overview

Seafloor irradiance in permanent plots at three subtidal reefs off Santa Barbara, California was compared using data collected from paired planar and spherical PAR sensors. The three reefs (Isla Vista 34° 23.275'N, 119° 32.792'W; Mohawk 34° 23.649'N, 119° 43.762'W; and Naples 34° 25.342'N, 119° 57.102'W) ranged in depth from 5.8 m to 8.9 m (MLLW) and were chosen to represent a range of physical and biological characteristics. The purpose of the comparison was to develop a method for calibrating irradiance data collected from the two types of sensors.

Irradiance was recorded twice per minute using submersible spherical PAR sensors (MKV-L, Alec Electronics, Japan) and submersible planar PAR sensors (DEFI-L, Alec Electronics, Japan) in the spring of 2016. Sensors were programmed to collect data on the same cycle to facilitate comparisons. Measurements were averaged every 15 minutes and data are presented as average instantaneous irradiance per quarter hour in units of μmol m^{-2} sec^{-1}. Data were subset to represent daylight hours from 07:00 – 17:00 local time.

Paired Measurements of seafloor irradiance

Paired PAR sensors were mounted ~ 30 cm off the bottom on weighted mounts or steel stakes using stainless steel hose clamps. Sensors were retrieved for data download ~6 weeks after deployment. Sensors were wrapped in black electrical tape during transport from the laboratory to the field to ensure that all light readings prior to deployment were zero. Once deployed underwater the tape was removed and the time of deployment was noted in an event log.

Biological fouling (primarily by benthic diatoms) on the sensors occurred to varying degrees during deployment. To account for attenuation of light due to biofouling we cleaned the sensors in situ 20 minutes before retrieval and calculated attenuation (*a*) by biofouling as:

$$(a) = -\ln\left(\frac{dirty}{clean}\right)$$

where *dirty* represents the mean irradiance sampled once per minute for 20 minutes prior to the sensor being cleaned on retrieval day, and *clean* represents the mean irradiance sampled once per minute for 20 minutes immediately after cleaning. The effects of biofouling on irradiance were assessed by comparing mean dirty and mean clean irradiance using a student's t-test with

α = 0.05. Irradiance values from significantly fouled sensors were corrected on each day of the deployment using the equation:

$$Corrected\ irradiance = Measured\ irradiance * \exp\left(\frac{a}{\sum d}\right) * t$$

where *a* represents attenuation due to fouling as described above, *d* represents the total number of days since deployment (over which we assume the fouling accumulated), and *t* represents the number of days that passed since deployment (Harrer et al. 2013).

References

Harrer, S. L., D. C. Reed, R. J. Miller and S. J. Holbrook. 2013. Patterns and controls of the dynamics of net primary production by understory macroalgal assemblages in giant kelp forests. Journal of Phycology, 49: 248-257