Community metabolism in coral reef ecosystem at Sesoko Island by using the water flow box model

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Owing to the global warming and environmental change, coral reefs have been under a serious threat of degradation in the world. In order to understand the present state of coral reefs and predict the future change, it is important to study the relationship between the global environmental change and the community metabolism in coral reefs. Coral reef ecosystems are characterized by the high carbon productivity of photosynthesis-respiration and calcification. These parameters represent the conditions of reef environment and are needed to monitor continuously to the future.

In this study, we introduced a model to estimate the daily organic and inorganic carbon production rate of coral reef under the natural water flow system.

The study area for model calculation was a fringing reef in front of Sesoko Station, Tropical Biosphere Research Center, Okinawa, Japan. About 20 boxes were applied to this area to construct the variations of oxygen and alkalinity concentrations at the end point of the water flow where we are continuously monitoring the water quality using the multi- parameter sensors (YSI-6600 or YSI-6920). Dissolved oxygen (DO), pH, temperature, salinity and water current were monitored every 15 minutes. Total alkalinity was measured by the Gran titration. These concentrations are oscillating by benthic community metabolism. The degree and pattern of the oscillation depends on the irradiance, depth, residence time of reef water and concentration level of in-flow oceanic water. Photosynthesis-irradiance and calcification-irradiance curves of the community metabolism were determined to fit the reconstructed oscillations of the model with monitored real variations of oxygen and alkalinity.

Community metabolism calculated by the water flow model was within the range of the other coral reefs. Net primary production was lower than zero during summer because of high respiration rate of benthic metabolism. This suggests that the Sesoko coral reef ecosystem has a significant seasonal variation that is autotrophic during winter while heterotrophic in summer. The results indicate that the water flow box model can be used for the estimation of community metabolisms in natural reef environment and applied for the long-term monitoring of the reef ecosystem.