BBG21-05 会場:304 時間:5 月 27 日 10:05-10:20

サンゴの環境変化に対する応答を評価・予測するためのリーフスケールモデリングシステム
Reef-scale modeling system for evaluating and predicting coral responses to future environmental changes

中村 隆志 [1*] ; 灘岡 和夫 [1] ; 渡邉 敦 [1] ; 山本 高大 [1]
NAKAMURA, Takashi[1*] ; NADAOKA, Kazuo[1] ; WATANABE, Atsushi[1] ; YAMAMOTO, Takahiro[1]

[1] 東京工業大学大学院情報理工
[1]Tokyo Institute of Technology

Coral reefs exhibit significant spatiotemporal variations in temperature, CO_2 system parameters (dissolved inorganic carbon, total alkalinity, pH, $CaCO_3$ saturation state, etc.), flow field, etc. Therefore it is difficult to regard any coral incubation experiments as those simulating actual environmental conditions, because many experiments are conducted under steady or gradually changing environmental conditions. Reconstruction of reef environments by numerical hydrodynamic simulations is getting close to practical use level with the developments in computer simulation technology (e.g., Watanabe et al. 2013). Development of a sophisticated coral-response model coupled with a reef-scale hydrodynamic model is an effective approach for evaluating and predicting reef responses to the changes in various environmental conditions. For this purpose, we recently developed a coral polyp model (Nakamura et al. 2013), which can well reconstruct the coral responses to ocean acidification, flow conditions and others. We then incorporated it into a reef-scale model based on a 3D hydrodynamic model (ROMS) following the Carbonate System Dynamics (CSD) model (Watanabe et al. 2013). The developed model system was applied to the Shiraho fringing reef, Ishigaki Island, Japan, and it was confirmed that the model system well reconstructed the spatiotemporal variations of the reef environmental parameters. According to IPCC (2013), pCO_2 will reach at ca. 935 μatm and sea-level will rise to ca. 0.45-0.82 cm for late 21st century if we select the RCP8.5 scenario. Therefore we analyzed four different scenarios: (1) present condition, (2) high pCO_2 (~935 μatm) condition, (3) high sea-level condition (63 cm higher than present), and (4) high pCO_2 and high sea-level condition. The simulation result of high-pCO_2 condition indicated that the coral calcification rate will decrease to ca. 75% from the present condition. When the sea-level will be 63 cm higher than the present condition, the calcification will increase to ca. 107% because both the mass exchange between the corals and their ambient sea water and that between inside and outside of the reef will be enhanced due to higher flow condition. When both pCO_2 increase and sea-level rise will occur, the calcification rate will decrease to ca. 77%. This rate is lower than the present condition but it keeps higher than the case only with high-pCO_2 effect. The results imply that comprehensive evaluation of concurrent multiple environmental effects is important for future predictions.

キーワード: サンゴポリプモデル, サンゴ礁スケール, 数値シミュレーション, 海洋酸性化, 海水準上昇
Keywords: coral polyp model, reef scale, numerical simulation, ocean acidification, sea-level rise