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The influence of river discharge on marine ecosystem in the South East Asia and West Pacific (SEA-WP) region

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The SEA-WP region is one of the richest marine biodiversity in the world ocean. In recent years, the coastal ecosystem in this region is in critical condition with the increase in the influence of human-induced loads (e.g., population pressure, coastal overfishing, and water pollution) and the stress of climate change (e.g., global warming and rainfall fluctuation). Purpose of our study is to get a clear coastal ecosystem condition and make a prediction of the change of coastal ecosystem with the climate change in this region. In the present study, to investigate the influence of river discharge on the marine ecosystem, we have used a coupled physical-biological model. We developed an ocean general circulation model that covers the Pacific and Indian Oceans with horizontal resolution of 1/3 degree (IP1 model), and conducted a simulation of ocean current variations driven by realistic atmospheric forcing. In addition, to resolve more detailed features of ocean current variations and relevant mesoscale eddies in the SEA-WP region, we conducted a simulation of a model with horizontal resolution of 1/9 degree (IP2 model) nested within the IP1 model. We incorporated the ecosystem model into the IP2 model. The ecosystem model is a seven-compartment ecosystem model based on the nitrogen cycle. The model has a boundary condition of river discharge data (37 rivers in this region) and makes an impact on physical and biological processes. The simulated ocean circulation in the Indonesian archipelago region has a good performance compared with the observed data. The model also reproduced the energetic eddy activity in the complex topography of Indonesian archipelago. The simulated surface chlorophyll reproduced the distribution of satellite ocean color. The model shows high concentration in the coastal and Indonesian archipelago regions and low concentration in the subtropical region. The model also shows the large impact of river discharge on the marine ecosystem in the estuary, especially in Chang Jiang River, and Mekong River. The outflow of nutrients from the river mouth spreads to open ocean by the ocean circulation and the high surface chlorophyll concentration is distributed. In Java Sea and Makasar Strait, the effect for marine ecosystem is limited in the estuary because of the river discharge is small.

Keywords: marine ecosystem, river discharge, ocean model, Indonesian archipelago