海洋環境影響評価のための漏出CO_2海中拡散モデル
A numerical model for calculating the behavior of leaked CO_2 in the sea for assessing the potential impacts on the marine environment

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To mitigate global warming, the reduction of carbon dioxide (CO_2) in the atmosphere is indispensable. We should make every endeavor to do it. Among options for it, CO_2 capture and storage (CCS) is thought to be one of the most important ones. Captured CO_2 in major CO_2 emission sources, such as power plants, is transported into deep geological formations and stored there. In Japan, mainly off shore areas will be selected as the storage sites. There is still concern that stored CO_2 may leak out into the sea and that leaked CO_2 may impact the marine organisms. To diminish the risk of CO_2 leakage, it goes without saying that it is necessary to select the storage sites and the formations where CO_2 will be stored stably and safely. In addition, we should enhance scientific knowledge and develop methods to assess the potential marine environmental impacts in case the stored CO_2 should leak out. How much the marine environment or organisms will be impacted depends on the rise in the CO_2 concentration in seawater consequent on the leakage.
Aiming at calculating dispersion of leaked CO_2 in the sea, we are developing a numerical model. In JpGU 2015 meeting, we presented a model where the leaked CO_2 dissolved into seawater (ΔDIC) is represented as a passive tracer. In the model, CO_2 bubbles were not calculated. However, it is considered that CO_2 would leak out from the seafloor mainly as bubbles. CO_2 bubbles from the seabed rise in the water column, dissolving into seawater. These processes may affect the distribution of ΔDIC because the dissolution rate and the movement of CO_2 bubbles depend on the size of the bubbles, and temperature and salinity of ambient water. Therefore, we have incorporated CO_2 bubbles into the model. The model is based on a non-hydrostatic ocean model, named kinaco, which has a Lagrangian particle tracking scheme. To represent CO_2 bubbles in the model, we apply properties of CO_2 bubbles, such as the mass and volume, to the particles. Based on the size of bubbles, and temperature and salinity of the cells that the bubbles exist in, the buoyancy and the dissolution rates are calculated. According to them, the movements and the sizes of CO_2 bubbles are computed. CO_2 dissolved into seawater is dispersed as ΔDIC, which is calculated as a passive tracer in the model. In our presentation, details of the model and examples of the calculation with the model will be presented.

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