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漏出 CO2 の海洋環境影響評価手法
A method for assessing the impacts of leaked CO2 on the marine environment

内本 圭亮 [1*] ; 松村 義正 [2] ; 喜田 潤 [1] ; 渡辺 雄二 [1]
UCHIMOTO, Keisuke[1*] ; MATSUMURA, Yoshimasa[2] ; KITA, Jun[1] ; WATANABE, Yuji[1]

[1] 公益財団法人地球環境産業技術研究機構, [2] 北海道大学低温科学研究所
[1]Research Institute of Innovative Technology for the Earth, [2]Institute of Low Temperature Science Hokkaido University

Carbon dioxide (CO_2) capture and storage (CCS) is promising technology that mitigates the global warming. Captured CO_2 from industrial processes is transported to a reservoir in the deep geological formations. Storage sites are selected so deliberately that CO_2 is believed to be stably stored in the reservoir. However, in case of a worst-case scenario, we should assess the impacts of leakage. In Japan, CO_2 will be stored under the seabed, so that CO_2 would leak out into the sea if unexpected leakage should occur. Therefore, we should assess the potential impacts on the marine environment. In this talk, we will introduce a method of the assessment that we have been developing. The method consists of two tools; a numerical model and a database of marine biological impacts. A numerical model predicts dispersion, i.e. distribution and concentration, of leaked CO_2 in the sea. Since leaked CO_2 is advected and diffused by ocean flow, the model should properly represent flow, temperature, and salinity fields in the sea. In addition, seasonal variation in the sea could be important for the simulation. Stratification in the sea strengthens in summer and weakens in winter, so that leaked CO_2 would be more likely to be mixed vertically in winter than in summer. We have been developing an ocean model for simulating leaked CO_2, taking consideration of those factors above. The model is based on a non-hydrostatic ocean model, called *kinaco*, developed by Matsumura and Hasumi (2008). In general, numerical cost of a non-hydrostatic model is very expensive. In *kinaco*, numerical cost is improved greatly, which enables a simulation in a relatively large area and of a relatively long period, as a simulation with a non-hydrostatic model. With this model, we conducted a numerical simulation in a gulf-like topography. A passive tracer, which is regarded as TCO_2 (total dissolved inorganic carbon) originating from leaked CO_2, is injected near the bottom. In order to represent seasonal variation, sea surface temperature (SST) is restored to temporally variable temperature from observational data, and temperature and salinity on a lateral boundary are also restored to observational data. Wind velocity data given at the sea surface, which are converted to wind stress in the model and drive the model ocean, are daily mean observational data. In order to access the potential impacts of leaked CO_2 on the marine organisms, we make use of a database of marine biological impacts of CO_2 concentration that RITE has been compiling. The biological impacts of CO_2 in the ocean are referred to not TCO_2 but partial pressure of CO_2 (pCO_2), and so the calculated TCO_2 in the simulation should be converted to pCO_2. With the resulting pCO_2 values and the database, we can estimate the potential area where marine organisms might be impacted.

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