

Evaluating the Natural Background CO₂ fluxes at CO₂ Release Site with Numerical Simulation

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Abstract

As the CO₂ concentration in the air is increasing, the international community have adopted the Geological Carbon Storage is one of the ways to reduce CO₂. However, the stored CO₂ in targeted storage site can be released through the unexpected faults or abandoned wells. If the abundant CO₂ is released to the surface, elevated CO₂ concentration at the surface will significantly damage the surface water and the ecological system. Therefore, incipient detecting the released CO₂ flux is important. However, when monitoring CO₂ flux, there also exist the natural background CO₂ produced by the respiration of plant roots and microorganisms. Hence, the prediction of the natural CO₂ flux at storage site can be used for making a distinction between the natural background CO₂ fluctuation and anthropogenic CO₂ release.

In Eumseong, Republic of Korea, controlled CO₂ release site was developed by the Korea CO₂ Storage Environmental Management (K-COSEM) Research Center. CO₂ was released from the 50 m length PVC pipe buried at 2.5 m-depth, and CO₂ fluxes were monitored. Extra parameters such as meteorological data, soil moisture and temperature were monitored at the same time. The simulator was used to simulate the natural background CO₂ flux at the unsaturated zone: HYDRUS with SOILCO₂ package. Furthermore, simulated surface CO₂ fluxes were compared with field-observed data to validate the CO₂ transport model and evaluate CO₂ release process with more precision. Finally, after calibrating the simulated natural background CO₂ flux to the monitored data, the CO₂ flux interval between the simulated and monitored values was calculated to predict the mass of release CO₂ during the CO₂ release test.

Our research concluded that, Hydrus-SOILCO₂ simulator provided precise prediction of the background soil-surface CO₂ flux except the artificial CO₂ release period. In addition, both measured and simulated data identified atmospheric temperature and precipitation to be major environmental factors controlling the CO₂ fluxes. Finally, it is expected that this validated natural CO₂ flux prediction model could be used to detect the abnormal CO₂ release.