Determining performance indicators for linking monitoring results and risk assessment – application to the CO2 storage pilot of Hontomin, Spain

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Abstract (591 words)

Risk management is an essential part of any CO_2 injection and storage operation, not only to ensure there will be no detrimental impacts towards health or the environment, but also as a mean to build trust with stakeholders. Operational risk management can be divided in three parts: 1/ risk assessment, where risk is studied and commonly involves numerical modelling; 2/ monitoring during operations is needed in order to check that the evolution of the site is in line with the assessment; and 3/ risk mitigation or risk treatment which includes any measure that can lower the risk either before or during operations.

Currently, there are few papers looking at the links between these three parts, which are nonetheless essential for an optimal management of the risks: monitoring systems and mitigation measures should be put in place according to the results of risk assessment; monitoring should have set thresholds for activating corrective measures; risk assessment should be updated with results from monitoring, etc.

The focus of this work is on the feedback from monitoring towards risk assessment and risk mitigation. Many papers already studied the field of "history-matching", but this is generally restricted to the update of the geological and dynamical models of the operation, and it deals less frequently with the risk assessment update. However, as some field experience demonstrated (most famously at Sleipner), there is a high probability that the CO_2 plume behaves differently than initially foreseen. This can have a large effect on the assessment of risks: some risks might not be relevant anymore while new risks might be discovered. It is thus important to get a current understanding of the risks during operations, otherwise some decisions (for instance deploying contingency monitoring or activating mitigation measures) could be based on outdated information. In addition, it is important that predetermined thresholds are in place for activating the appropriate mitigation measures.

By comparing the initial assessment with the site evolution, it is expected that some deviation will occur. We should then distinguish between:

- "acceptable" deviations that would not necessitate an update of the risk assessment
- "large" deviations that would lead to an update of the risk assessment
- "unacceptable" deviations that would lead to an update of risk assessment and the activation of appropriate mitigation measures.

The purpose of this work is to propose indicators that enable to quantify the deviations between the observations from the monitoring system and the predictions from the risk assessment (including numerical modelling). Criteria are then created for distinguishing acceptable, large and

unacceptable deviations. This is applied on a real operation: the CO_2 storage pilot site of Hontomin, in Spain, operated by CIUDEN. Setting the indicators consists in finding one or several metrics related to each of the monitoring technique currently deployed at the site. The metric should allow to link the observations to the risk assessment. For instance the pressure measurement at or near the injection well can be linked to the risk of wellbore leakage. The completeness of the indicators is ensured by checking that each identified risk is represented by at least one indicator. The main difficulty of this work is to propose indicators that are both operational (i.e. can be computed quickly and easily) and in coherency with the stated objective. For instance, for monitoring techniques that are imaging the plume, the issue is to create meaningful quantitative indicators (e.g. approximate area of the plume, maximum distance from the injection well, or probability of leakage in the caprock).

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