Dylan R. Harp, Curtis M. Oldenburg and Rajesh Pawar, 2019, A Metric for Evaluating Conformance Robustness During Geologic CO2 Sequestration Operations, *International Journal of Greenhouse Gas Control,* to appear.

Abstract A metric for quantifying the robustness of a designation of conformance of a geologic CO2 sequestration (GCS) project during its operational phase is developed and demonstrated. Conformance in this context is a measure of the degree to which the sequestration system is understood and can be accurately modeled along with the degree to which the storage system is performing as designed. The robustness of conformance quantiles the degree to which parameter values can deviate from their current nominal estimates and still produce model forecasts that meet the performance criteria for the GCS operation. We develop and demonstrate the approach on a simplified scenario to illustrate the concept using a single uncertain parameter (homogeneous reservoir permeability) and a single performance criterion (critical pressure at a monitoring well in the reservoir; i.e., one that may displace brine from the reservoir to an overlying drinking water aquifer for example). Increased confidence in conformance assessment as more monitoring data are obtained is incorporated through the standard error of the coefficient (reservoir permeability in the case presented here), which we designate as the concordance metric. As more monitoring data become available during the course of the GCS operation, the standard error of the coefficient decreases (in general), thereby leading to increased conformance robustness as a larger deviation from nominal is required to fail to meet performance criteria. Increasing conformance robustness over time builds confidence that a GCS project will continue to meet performance criteria during the life-span of the project, thereby supporting designations of conformance. A lack of conformance robustness provides a critical warning that the performance criteria of the GCS operation are not robust against probabilistic and non-probabilistic uncertainty in model conceptualization and/or model parameters.

Keywords geologic carbon sequestration, CO2 storage, conformance, concordance, performance