Short Listing Saline Reservoirs for Potential Carbon Storage

A Look at the Viability of Candidate Reservoirs in the United States through
Fuzzy c-Means Clustering

Abstract

1 Introduction

1.1 Carbon Storage

Scope to US bc available data
    Motivation and whats what

1.2 Potential Storage Site: Saline Formations

Of possible candidates for long term carbon sequestration, saline formations have emerged as a promising candidate. Such formations are prevalent throughout North America. These brine coated layers of permeable rock are able to store carbon my way of "solubility trapping, mineral trapping, structural trapping and residual trapping."
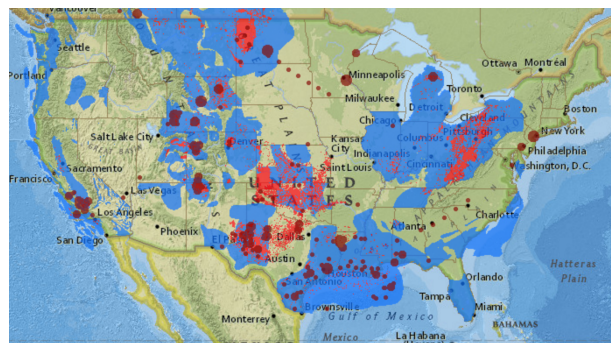

Figure 1: A map of the United States overlaid with geological saline resources for potential carbon storage (blue), stationary sources of petroleum and natural gas (brown) and other oil and gas resources (red) [6]

The more than 180,000 potential injection sites in the United States have been estimated by the U.S. Department of Energy to have capacity of over 12 trillion tons of CO_2. Saline formations are promising also because of their proximity to CO_2 point sources, allowing easy transition of U.S. energy assets to "near-zero carbon emissions via low-cost carbon storage retrofits." [5] Furthermore, there is much existing technology and regulatory acceptance with respect to injections into saline reservoirs as brines are frequently injected into

saline reservoirs in EOR and the U.S. EPA has designated some deep saline formations for hazardous waste disposal.

There are currently at least 3 saline aquifer injection projects that have been undertaken in the continental United States, which have together injected over a million tons of CO_2 to date. Each of these projects operates on a time scale of at least twenty years, allocating at least 10 years to "characterizing geologic and terrestrial opportunities for carbon storage and identifying CO_2 stationary sources within the territories of the individual RCSPs and evaluating promising CO_2 storage opportunities through a series of small-scale field projects" [2], [3], [4].

Important Charecterists

1.2.1 Associated Risk

2 Methodology

2.1 Overview

As described in the previous section, saline aquifers are luckily a far vast enough resource for us to currently store the desired amount of carbon. However, selecting the best aquifers for storage is a tremendous task considering the quantity of potential aquifers ($\approx 180,000$) and the factors that characterize each one. For this reason we seek to develop a tool to immediately help identify some of the best candidate deep saline aquifers in the United States. The fundamental workings of this tool will be in the characterization of potential aquifers based on a series of characteristics as per section 2.2. Having fully characterized each candidate aquifer, we fully employ a Fuzzy c-Means clustering analysis to each of the $\approx 180,000$, 9 dimensional vectors representing the system to create a model that will determine how strongly each aquifer is characterized by each of the 9 features, to be discusses further in section 2.3. Once this model is created, it will allow researchers to essentially filter potential storage sites by different characteristics. For example, we will be able to observe all aquifers that have at least a given storage capacity and/or are at least a given distance from a major fault line.

2.2 Saline Aquifer Characterization

Each of the 9 characterization features falls into one of two categories. The first category of features describes the geological aspects of the aquifer, strictly its ability to store carbon. The second describes some of the factors that effect the potential risks and barriers to societal acceptance regarding potential storage sights.

2.2.1 Geological Characterization

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2.2.2 non-Geological Characterization

Other sources, check the notes.txt The list below is a list of dimensions used to characterize saline formations with respect to environmental features not directly related to the ability of the formation to store carbon. They are listed with reasonings for their inclusion in this early stage work in no particular order.

1. *Potential Impact on Drinking Water Sources*

2. *Proximity to and Size of Population Centers*

3. *Proximity to and Magnitude of Fault Lines*

4. *Proximity to National Parks*

Cover where you got your data and why you chose the features. dimensions you chose

2.3 Fuzzy c-Means Clustering

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2.4 Analysis of Site Already in Use

Talk about the few points that represent wells that are already in use and how they fit in your model.

3 Results

These are some of the results

4 Discussion and Analysis

5 Future Work

5.1 Better Characterization of Saline Formations

The 9 features isolated for characterization are a minimal set for reasonable characterization of saline formations. Better and more detailed (higher dimensional) characterizations of these formations would necessarily allow for more data for Fuzzy c-Means clustering to base its similarity measures on, thereby increasing the accuracy and effectiveness of this tool. Further dimensions include the existence of a caprock over the layer of porous rock. The existence of such a caprock is extremely important to the viability of a potential site as it plays an important part in keeping the injected carbon below the surface and in place.

6 Conclusion

References

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