Imperial College London

Global CO_2 storage capacity: Modeling limitations of geography and injectivity
Eligible for Departmental and University Scholarships
Supervisor: Dr Sam Krevor

Description
The importance of carbon capture and storage in the mitigation of climate changes arises from the potential capacity for the injection of large volumes of CO_2 into suitable subsurface geologic formations (Figure 1). The assessment reports of the Intergovernmental Panel on Climate Change (Bruckner et al., 2014) estimate that in the average of scenarios where CO_2 concentration is stabilised at 450 ppm by 2100, storage demand approaches 15 Gt CO_2 per year by 2050, and persists at around 20 Gt per year from 2060-2100. This represents approximately 1200 Gt CO_2 stored underground by 2100. However, these modeled estimates disregard potential limitations to achieving these rates and volumes of storage from either the geographic availability of subsurface storage reservoirs, or the pressure limitations to allowable rates of injection (Koelbl et al., 2014). In this project the PhD candidate will work with experts in subsurface CO_2 storage at Imperial College London and the British Geological Survey, as well as the leading industry partners in developing and deploying industrial scale CO_2 storage - Equinor, BP, and Shell. The PhD project will evaluate the potential for geographic and reservoir injectivity constraints to lead to bottlenecks in the development of large scale CO_2 storage globally.

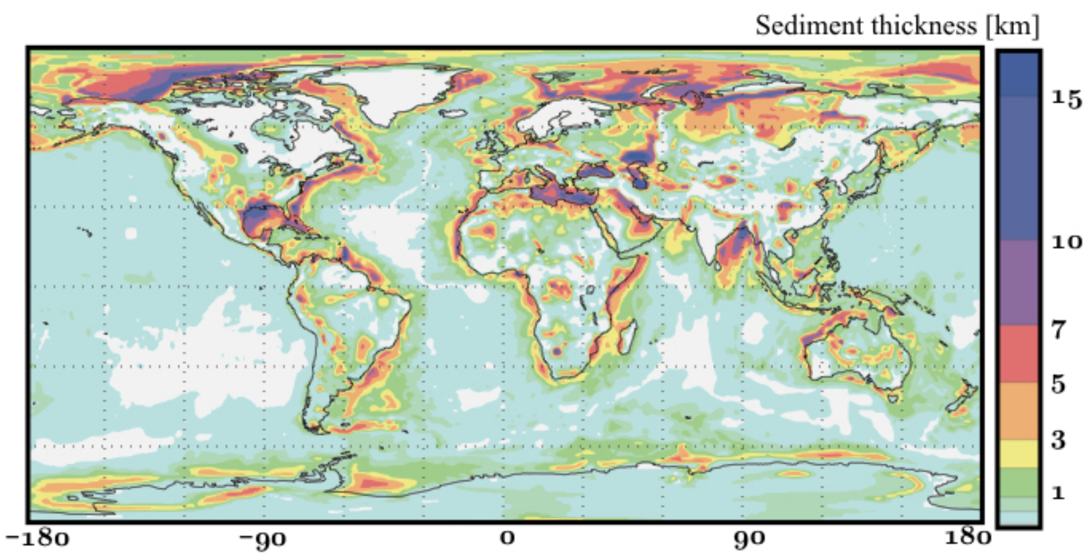

Figure 1. Global sediment thickness (Laske & Masters, 1997); CO_2 storage resources are located in sedimentary basins

The pressure induced geomechanical failure of the reservoir-caprock system is the primary limit on allowable rates of injection in a given location. It can lead to the

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leakage of CO_2 back to the atmosphere or induce dangerous seismicity (Zoback & Gorelick, 2012). The presence of sedimentary basins provide the geographic constraint on the presence of potential subsurface storage sites. Advanced numerical modeling techniques have been developed to evaluate pressurization and seismic hazard in response to CO_2 injection in reservoirs. Similarly, extensive datasets have been developed identifying the geographic distribution of potential subsurface reservoirs worldwide (Consoli & Wildgust, 2017).

Project aims

In this project, the student will compile these datasets and apply a range of numerical and mathematical modeling techniques to analyse scenarios of regional and global CO_2 storage deployment, constrained by location and pressure-limited injection rates. Ultimately this will result in an evaluation of the potential for CO_2 storage to play the role that the IPCC suggests is needed to avoid dangerous climate change.

Student profile and Imperial Research Environment

This project will combine numerical and mathematical modelling of subsurface fluid flow with geographic analysis and techno-economic modelling of CO_2 storage demand to evaluate the potential geographic and geological limitations to subsurface CO_2 storage projected by energy systems models. Applicants should have a strong background in a quantitative science or engineering field, with background in geoscience also a benefit.

This studentship is offered as eligible for one of the departmental or university scholarships, including the EPSRC, Janet Watson, and Imperial College Scholarships. For further details about eligibility criteria, please see information at the following: http://www.imperial.ac.uk/earth-science/prosp-students/phd-opportunities/

Please do not hesitate to contact me for further information and informal enquiries:
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References:

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