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Assuring Integrity of CO2 storage sites through ground surface monitoring (SENSE)

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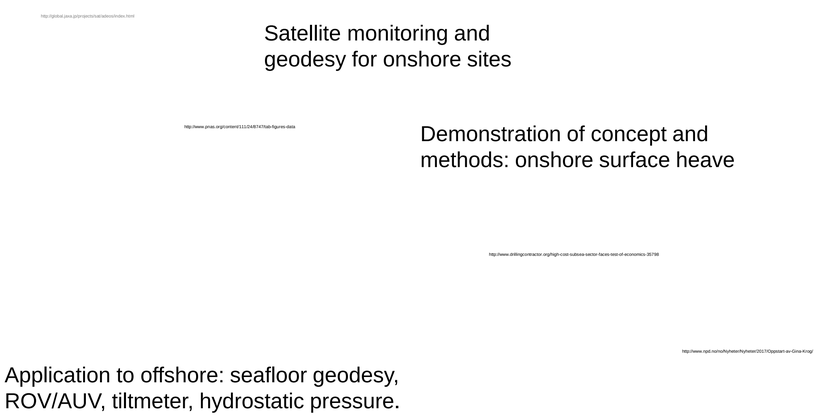
Introduction and objective

Monitoring of geological CO_2 storage is crucial for large-scale injection to gain acceptance as a reliable method for globally reducing CO_2 emissions. Monitoring plans for large-scale operations need to include both the injection and post-injection phases to assure CO_2 is stored over geological time-scales. SENSE Project has ambitions to develop reliable, continuous and cost-efficient monitoring based on ground movement detection combined with geomechanical modeling and inversion, utilizing new technology developments, data processing optimization, and interpretation algorithms. The proposed research activities include:

1. demonstration of continuous monitoring of surface deformation and subsurface pressure distribution using satellite data, water pressure sensors, fiber optics and seafloor geodesy
2. quantitative characterization of critical geomechanical and hydraulic parameters and automatization routine for data processing and interpretation;
3. optimization of sampling arrays and offering storage site operators a cost-effective monitoring option, forming part of an effective site assurance program and feeding into existing workflows for an early alert system.



SENSE project concept

WP1: Quantification of ground movement

- Improvement of accuracy of acquired ground movement data;
- Automation of InSAR data processing to accelerate availability of ground movement to site operators;
- Demonstration of a new ocean bottom lander for cost-effective seafloor data acquisition;
- Demonstration of fiber optic strain cable for measuring ground uplift offshore.

WP2: Geomechanics modelling and rock strain

Big-data-driven theoretical and conceptual SMART models based on the newly acquired and available data in SENSE;

- Advanced coupled flow-geomechanics simulations of the candidate sites including non-linearity and inelasticity;
- Coupling of geomechanical behavior of the candidate sites with changes in pressure and saturation in the subsurface.

WP3: History matching inversion; coupled flow -mechanics

- History matching (inversion) of surface deformation with subsurface pressure distribution, based on conceptual models;
- Development of inversion algorithms;
- Application of inversion technique to onshore and offshore data acquired in SENSE.

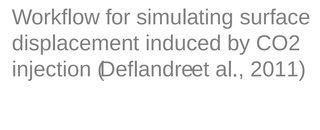
Proposed study sites

Site #1: Hatfield Moors, UK onshore gas storage site

Site #2: Hontomin, Spain, pilot CO_2 injection site

Site #3: Mecklenburg Bay, Germany. Ideal geological conditions for injection

Site #4: Gulf of Mexico: evaluating ground deformation in GoM geologic setting



SENSE project structure and workflow

- First campaign completed Oct. 2019
- Coring was performed; samples to be tested
- New injection experiment (air in sand) applied for Nov 2020

WP4: Integration of results for cost effective monitoring

- Assessment of the effectiveness of SENSE ground deformation monitoring techniques;
- Evaluation of the ground-monitoring approach for real-time monitoring and early warning;
- Recommendation to integrate continuously acquired ground data with monitored information such as bottom hole pressure, seismic and micro-seismic.

History matching inversion concept

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