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InSAR for monitoring cavern integrity: 2D surface movement over Bryan Mound

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Abstract

Surface deformation is important to monitor above solution-mined caverns in order to help ensure the ongoing safety, and to track the long-term geomechanical stability, of these underground assets. InSAR is becoming an increasingly utilized technology within the solution mining industry to fulfill subsidence monitoring needs as this approach provides highly accurate and regular measurements of movement above storage facilities, salt domes and the surrounding area.

The Bryan Mound storage site in Texas is part of the Department of Energy's Strategic Petroleum Reserve (SPR), which contains the world's largest supply of emergency crude. As such, monitoring the health of the caverns located at this facility is of national interest.

Two stacks of radar imagery collected by the Cosmo-SkyMed constellation of X-band satellites are currently being used to monitor subsidence over the Bryan Mound site. The use of two separate stacks (acquired from ascending and descending polar orbits) is particularly advantageous as this allows signals from two viewing geometries to be identified and combined in order to isolate and decompose results into true vertical and east-west horizontal movement vectors.

In the case of Bryan Mound, vertical subsidence observed at this site is coupled with the presence of predominantly west-ward horizontal motion over much of the dome. An updated processing has been carried out in spring 2018, which more completely captures recent movement patterns occurring over the past 1.5 years.

This paper will describe the InSAR work that has been carried out over the Bryan Mound salt dome to date, with particular emphasis placed on the utility of 2D deformation results in helping to characterize the integrity of underground storage caverns. Future work on the integration of detailed ground movement results with other types of monitoring data (for instance with cavern pressure information) to provide a more complete picture of cavern and dome health will also be explored.

Key words: InSAR, Strategic Petroleum Reserves, Subsidence, Caverns, Instrumentation and Monitoring, Rock Mechanics, DOE (US Department of Energy), Bryan Mound