Multi-interferogram InSAR Techniques for Monitoring Surface Deformation in CO2 Sequestration

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The geological sequestration of CO2 is rapidly becoming recognized as an effective tool for reducing GHG emissions. Although the scientific community will play a central role in demonstrating the feasibility of carbon capture and sequestration (CCS), it is perhaps even more important to convince public opinion that CCS does not pose a hazard to health and to the environment.

The role of pilot projects aimed at identifying reliable, accurate monitoring techniques is therefore fundamental. One of the most important initiatives to date is the In Salah Gas CO2 Storage Assurance Joint Industry Project (JIP) which involves industry, governments and academia. Born from a Joint Venture between BP, Sonatrach and StatoilHydro, the JIP has been injecting CO2 in Algeria since 2004 at a rate of almost 1 million tons of CO2 per year with the stated goal of demonstrating best practices for CO2 storage monitoring, integrity and verification technologies.

During the first stage of the project (2004-07) PSInSAR™, a multi-interferogram radar satellite technique for measuring ground movement, provided some of the most exciting and promising monitoring results. Injection of CO2 into the saline aquifer caused changes in the fluid pressure field. This in turn produced an uplift of the ground surface, centered on the injection wells, of approximately 5 mm/yr that was precisely detected and measured by PSInSAR™. It is worth noting that these results were obtained using satellite data from one of the relatively older satellites.

Today, data from a new generation of satellites with significantly improved characteristics is being used in the second stage of the JIP to provide even more detailed monitoring information. The new sensors have a higher spatial resolution, lower revisiting times, and use a different wavelength. In preliminary findings the PSInSAR™ processing of data from the new sensors produces a density of points (Permanent Scatterers - PS) for measuring surface deformation that is up to an order of magnitude higher than with the older data. In addition, an evolution of the PSInSAR™ algorithm which is set for release is also producing significant increases in the density of PS.

In this paper we will present some of the surface deformation results from the JIP and also show an example of an application of the updated PSInSAR™ algorithm to the Weyburn (Saskatchewan) area, in which the increase in the density of PS is well over an order of magnitude compared to the previous version.