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Monitoring gas reservoirs by seismic interferometry

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Ambient seismic noise can be used to image spatial anomalies in the subsurface, without the need of recordings from seismic sources, such as earthquakes or explosions. Furthermore, the temporal variation of ambient seismic noise's can be used to infer temporal changes of the seismic velocities in the investigated medium. Such temporal variations can reflect changes of several physical properties/conditions in the medium. For example, they may be consequence of stress changes, variation of hydrogeological parameters, pore pressure and saturation changes due to fluid injection or extraction. Passive image interferometry allows to continuously monitor small temporal changes of seismic velocities in the subsurface, making it a suitable tool to monitor time-variant systems such as oil and gas reservoirs or volcanic environments. The technique does not require recordings from seismic sources in the classical sense, but is based on the processing of noise records. Moreover, it requires only data from one or two seismic stations, their locations constraining the sampled target area. Here we apply passive image interferometry to monitor a gas storage reservoir in northern Italy. The Collalto field (Northern Italy) is a depleted gas reservoir located at 1500 m depth, now used as a gas storage facility. The reservoir experience a significant temporal variation in the amount of stored gas: the injection phases mainly occur in the summer, while the extraction take place mostly in winter. In order to monitor induced seismicity related to gas storage operations, a seismic network (the Collalto Seismic Network) has been deployed in 2011. The Collalto Seismic Network is composed by 10 broadband stations, deployed within an area of about 20 km x 20 km, and provides high-quality continuous data since January 1st, 2012. In this work we present preliminary results from ambient noise interferometry using a two-months sample of continuous seismic data, i.e. from October 1st, 2012, to the November 30th, 2012, a time frame when gas extraction operations took place. This work has been funded by the German BMBF "Geothecnologien" project MINE (BMBF03G0737A).