
Multi-temporal-InSAR (Envisat & Sentinel), Permanent GNSS and levelling study of subsidence in Vauvert, South of France.

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Résumé

The town of Vauvert, France, hosts since 1973 a mining activity of the Oligocene salt deposit located mainly between 2500 m to 3000 m deep (Valette, 1995). The salt is extracted by injection of water into a well. The pressure pushes the product of the salt dissolution (i.e. brine) to the surface through another well.

Since the beginning of the production, millions of tons of salt have been extracted from the ground (about 1 million tons per year at current annual production). The compaction of the salt cavities induces a surface subsidence of about 8 km in diameter with a maximum vertical deformation of about 2 cm/yr (Raucoules et al., 2003).

Levelling has been historically used to estimate and quantify the effect of the mining activity on the long-term subsidence. Levelling benchmarks, including national levelling benchmarks and local network are measured once a year by IGN (Institut Géographique National).

We use several measurement techniques to improve knowledge on the effect of the mining activity on the surface deformation. To do so we have, in addition to levelling:

- Multi-temporal InSAR: PS-InSAR, SBAS-InSAR and combination (StaMPS software (Hooper et al., 2004) on Envisat and Sentinel-1 SAR images,

- GNSS (4 permanent stations), daily solutions, time series analysis over up to 1.5 year,

Separately, each technique has its own limitation. Atmospheric artefact for InSAR and GNSS and single reference station for levelling are some well-known biases that can lead to high level of uncertainty. The final objective is thereby to mix the techniques mentioned above to:

- Densify the displacement fields and reduce their uncertainties,

- Improve knowledge of the long-term subsidence,

- Detect transient signals possibly due to spatial and temporal displacement of salt extraction.

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The use of both Envisat and Sentinel-1 SAR images allows us to study the subsidence induced by the mining activity from 2003 to nowadays, with data gaps. Envisat dataset spans about 10 years thus allowing for a reliable long-term analysis. On the other hand, the high temporal resolution of Sentinel dataset gives the possibility to precisely compare GNSS and InSAR time series.

Utilization of InSAR, GNSS and levelling datasets allows discussing their global consistency and the advantages of each of these different datasets for reservoir monitoring. Levelling analysis is compared to Envisat results for an improved long-term analysis and results are compared with the time evolution of the salt production. Otherwise GNSS and Sentinel time series are compared for a more detailed temporal and spatial analysis.