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Monitoring of a gas reservoir in Western Siberia through SqueeSAR

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The success of surface movement monitoring using InSAR is critically dependent on the coherence of the radar signal though time and over space. As a result, rural areas are more difficult to monitor with this technology than are areas with a lot of infrastructure. The development of advanced algorithms exploiting distributed scatterers, such as SqueeSAR, has improved these possibilities considerably. However, in rural areas covered with varying quantities of snow and ice, it had not yet been possible to demonstrate the applicability of the technology.
We performed a study to assess the applicability of InSAR for assessing land movement is Western Siberia, where we chose the area of the Yuznho Russkoye field for a detailed analysis, after a screening using data that involved a number of fields in the vicinity of the Yuznho Russkoye Field. A first evaluation with C-band data ranging from 2004 – 2010 was unsuccessful due to the small number of images. Therefore we investigated the applicability of X-band data. 75 images were available spanning a period spanning May 2012 until July 2013.
Within the summer periods when there was no snow coverage, the X-band data showed good coherence. The subsidence during a summer season, however, was not sufficient to make a quantitative comparison between geomechanical predictions and geodetic observations. Including the winter season in the analysis, however, destroyed the coherence and no subsidence signal could be derived. Quite unexpectedly, however, by cutting out the winter season and using the two disconnected summer seasons simultaneously, the coherence re-appeared and a subsidence estimate was established covering the full period. This way, the temporal surface movement could be established as a function of the position in the field.
The spatial subsidence distribution was subsequently compared with the expected pattern expected from the location of producing wells and was found to be show a good correlation. Subsidence was clearly concentrated in the areas with the most producing wells and therefore where the gas production was assumed to be the largest. The potential of the technology is to use the distribution of the subsidence pattern in combination with the gas production characteristics to better assess the flow properties of the reservoir. These characteristics include the sealing behavior of faults causing reservoir compartments and possible activity of connected aquifers.