Monitoring of land deformation due to oil production by InSAR time series analysis using PALSAR data in Bolivarian Republic of Venezuela
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The target area of this study is the Maracaibo sedimentary basin located in the western part of Bolivarian Republic of Venezuela. The full-scale exploration and development for oil resources in Venezuela which was the greatest oil-producing country in South America had begun at the Maracaibo sedimentary basin in the 1910s, and it was a center of the oil product in Venezuela until the 1980s. But, in most of oil fields in the Maracaibo sedimentary basin, there is concern over the drain on recoverable reserves due to deterioration, and the production amount of petroleum in Venezuela has been diminishing these days. Leveling and GPS surveying were carried out in the past, and they revealed that the large-scale subsidence phenomenon of which cumulative subsidence amount was approximately 5 meter had occurred.

The authors applied the vertical displacement measurement by InSAR time series analysis using PALSAR data obtained in the Fine-beam and ScanSAR observation mode. As a result, it could be confirmed clear ground deformation in the surrounding of three oil fields (Tia Juana, Lagunillas and Bachaquero) and easily recognized that the areas of phase anomalies detected by this analysis had expanded and the number of interference fringes had increased over time. The annual velocity of vertical ground surface displacement measured by InSAR time series analysis was -51 mm per year, -103 mm per year and -58 mm per year in Tia Juana, Lagunillas and Bachaquero oil field respectively. The tendency that an earth surface shifted towards the center of phase anomalies was detected from the result of the horizontal ground change measurement.

It was interpreted from Google Earth and Landsat images that oil-related facilities (mainly bowling stations) were built intensively over the areas where phase anomalies were detected. Therefore, it was inferred that there was a high association between the operation activity of the oil field and ground deformation. In addition, the deterioration is remarkable in the oil fields of the Maracaibo basin and oil production volume has been declining, on the other hand the spatial volume of the ground surface deformation also showed a clear decreasing trend.