Geophysical Research Abstracts
Vol. 19, EGU2017-13006-2, 2017
EGU General Assembly 2017

Combination of poroelasticity theory and constant strain rate test in modelling land subsidence due to groundwater extraction

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Extensive groundwater extraction leads to a drawdown of the ground water table. Consequently, soil effective stress increases and can cause land subsidence. Analysis of land subsidence generally requires a numerical model based on poroelasticity theory, which was first proposed by Biot (1941). In the review of regional land subsidence accompanying groundwater extraction, Galloway and Burbey (2011) stated that more research and application is needed in coupling of stress-dependent land subsidence process. In geotechnical field, the constant rate of strain tests (CRS) was first introduced in 1969 (Smith and Wahls 1969) and was standardized in 1982 through the designation D4186-82 by American Society for Testing and Materials. From the reading values of CRS tests, the stress-dependent parameters of poroelasticity model can be calculated. So far, there is no research to link poroelasticity theory with CRS tests in modelling land subsidence due to groundwater extraction.
One dimensional CRS tests using conventional compression cell and three dimension CRS tests using Rowe cell were performed. The tests were also modelled by using finite element method with mixed elements. Back analysis technique is used to find the suitable values of hydraulic conductivity and bulk modulus that depend on the stress or void ratio. Finally, the obtained results are used in land subsidence models.

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