Preliminary study on the application of satelite-based monitoring for land surface displacement to inverse analyses of groundater flow/land subsidence modeling

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Incerasing land subsidence monitoring data with InSAR and GNSS techniques are expected to improve a calibration process of groundwater flow/land subsidence model. However, the observed data possibly includes the displacement caused not only by known groundwater abstraction but also natural displacements such as seismic/post-seismic crustal motion. Then, it is not straight forward to use the observed data for inverse analysis. It is important to separate known and unknown components from monitoring data with a simultaneous
calibration of land subsidence model.
This study presents a new method based on the prior assumption that the crustal deformation is smooth in space relative to land subsidence cone caused by groundwater abstraction. It consists of the iteration of the following three steps. In the first step, the map of difference between the observed data and the calculated result of the land subsidence model with assumed parameters. In the next step, the spatial roughness of difference map is evaluated from the rotational energy. In the final step, the model parameters are modified to minimize the spatial roughness of unknown components.
This method was tested by a synthetic data composed of land subsidence from the assumed groundwater abstraction, the assumed sudden and long-term displacement like earthquake and post seismic motion. The proposed method successfully separated the land subsidence caused by groundwater abstraction and other components, and exactly found the model parameters. The results suggest that the porposed method has the possibility to enhance the application of satellite-based land subsidence monitoring data to the calibration of land subsidence models.

Keywords: groundwater, land subsidence modeling, inverse analysis, satellite-based monitoring

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