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A nested modeling scheme to integrate regional groundwater flow and local groundwater flow/land subsidence: a case study from Tokyo and its surroundings

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The land subsidence due to groundwater extraction was a significant problem in Tokyo. The regulation of groundwater extraction has worked out quite effectively to recover the hydraulic potential and has ceased the land subsidence. On the other hand, the recovered hydraulic potential has been affecting the stability of underground infrastructures. Based on these temporal changes of groundwater related problems, the possibility to control hydraulic potential should be discussed and implemented. For this purpose, it is desirable to be able to estimate the amount of possible ground re-subsidence by groundwater extraction quantitatively. Because the past maximum effective stress controls the re-start of permanent land subsidence, high-resolution modeling to simulate the spatio-temporal change of the effective stress in the clayey layers is necessary. On the other hand, groundwater flow system is much larger in space, and hence, it is difficult to set appropriate boundary conditions close to the area of interest. Thus, combined simulation of both regional flow and high resolution groundwater flow/land deformation processes is desirable. We developed a new scheme to integrate regional groundwater flow and local groundwater flow/land subsidence coupled models by transferring the boundary conditions each other at the interface of two models and applied it to Tokyo. This modeling scheme could represent temporal changes of the stress profile in clayey layers, land subsidence in the drawdown period and land expansion in the groundwater recovery period in the Tokyo lowland quite well. It implies that this scheme works out for predicting future groundwater potentials and land

deformation in urban areas.