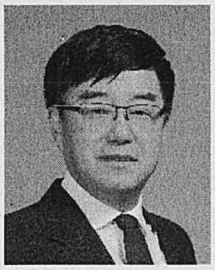
Does groundwater pumping affect ground surface temperature?

It is observed that the air temperature in the North China Plain (NCP) has been increasing since 1970s when a regional cone of depression was formed due to groundwater over-pumping. Does groundwater pumping affect ground surface temperature? We answer this question by building a coupled ParFlow.CLM model representing subsurface and land-surface processes and their interactions in the North China Plain (NCP) at high spatio-temporal resolutions. The model was validated using the water and energy fluxes reported in previous studies and from the JRA-55 reanalysis and then applied to examine the impacts of groundwater pumping and irrigation on the ground surface temperature (GST). Results show that groundwater pumping significantly affects GST in the NCP and that changes of water table depth (WTD) can significantly affect land surface heat fluxes when WTD ranges roughly between 0.01–10 m. The subsurface acts as a buffer to temporal variations in heat fluxes at the land-surface, and long-term pumping can gradually weaken this buffer, leading to increases in the spatio-temporal variability of GST of hotter summers and colder winters. The variations of GST are expected to increase faster initially and gradually slow down due to the nonlinear behaviors of GST with WTD. The findings from this study in the NCP may have implications for other regions with groundwater depletion. A briefly introduction to the Southern University of Science & Technology and its School of Environmental Science & Engineering may also be presented in the seminar if time allows.

A Brief Bio of You-Kuan Zhang



Dr. You-Kuan Zhang is a chair professor in School of Environmental Science & Technology (ESE) of Southern University of Science & Engineering (SUSTech), China. He was associate and Executive Dean of ESE. Before joining SUSTech, Dr. Zhang was the Director of the Center for Hydrosciences Research at Nanjing University, and a tenured full professor and research engineer of IIHR at the University of Iowa. He received his PhD in Hydrology from the University of Arizona. His research interests are in the areas of groundwater hydrology, fluid flow and contaminant transport modeling, and temporal variations of hydrological variables. He has published more than 200 papers and made significant impact in scale-dependent dispersion theory in geologic media, effects of land use land cover changes on stream flow variations, and temporal scaling of hydrogeological variables. He was elected as a fellow of the Gelogical Society of America in 2005 and the president of International Professional for Advance in China Earth Sciences (IPACES) in 2003 and served as AE for several journals in his research areas.