Geophysical Research Abstracts
Vol. 12, EGU2010-2293, 2010
EGU General Assembly 2010

Linkages beyond boundaries between surface/subsurface and land /ocean for better management of groundwater under the changing climate and society in Asia

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Change in reliable water resources between groundwater and surface water occurred in many Asian cities depending on the development stage of urbanization and climate change. Although the subsurface water is connected with surface water in hydrological cycle, both waters were treated separately. Intensive field observations and data collections had been made in the basins including Tokyo, Osaka, Bangkok, Jakarta, Manila, Seoul, and Taipei, to evaluate the relationship between development stage of the city and various subsurface environments in Asia beyond the boundary between surface and subsurface environment under the condition of climate change. As a factor of separating water, energy and material at the earth surface into above and below the surface, land use/cover changes at three ages (1940's, 1970's and 2000's) in Asian 7 cities have been analyzed based on GIS with 0.5 km grid at seven targeted cities. Urbanization causes the decease in groundwater recharge rate and increase thermal energy transport into the subsurface. Global warming and heat island effects are also evaluated with in the cities and compared.

Another boundary for water and material transports exists between land and ocean. Regarding material (contaminant) transports to the coast, direct groundwater discharge is recently recognized as a significant water and material pathway from land to ocean. Many Asian major cities are located in the coastal zone so material and contaminant transports by groundwater is a key to understanding the coastal water pollution and the effects on associated ecosystems. The exchanges of sea water and fresh water between the boundary were analyzed during the last 100 years in Asian coasts.

In this paper, the importance of integrated treatments between surface/subsurface and land/ocean will be shown for better understanding and management of subsurface environment including groundwater under the condition of climate variation.