

Interannual mass variation over Chao Phraya river basin observed by GRACE

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A project to assess the effects of human activities on the subsurface environment in Asian developing cities has been in progress (Research Institute for Humanity and Nature, Japan, 2009). Bangkok, Thailand is one of the study cities in this project. Using GRACE satellite gravity data of 2002 to 2009, we recovered landwater mass variation over the Chao Phraya river basin, where Bangkok is located on the downstream. The result shows that a negative interannual mass trend was observed over the Chao Phraya river basin from 2002 to the beginning of 2005, and after that, no significant trend was observed up to 2009.

Over Bangkok and the surrounding area, serious groundwater decrease has been reported because of the previous excessive pumping accompanying development of the city. One of our concerns is whether the GRACE-derived negative trend from 2002 to 2005 has some relationship with the previous groundwater pumping. Thus, we firstly compared the GRACE-derived mass variation with a groundwater storage variation calculated by a regional numerical groundwater model (Yamanaka, personal communication, 2009). The result shows that the model-estimated confined groundwater storage shows positive interannual trend over the GRACE mission time period, which is in contrast to GRACE-derived negative mass change. Further, the magnitude of the confined groundwater storage change is much smaller than that of the GRACE-derived mass change. Thus, it is expected that the negative mass trend was not caused by regional confined groundwater decrease.

On the other hand, the terrestrial water storage variation derived from global scale hydrological model shows similar change with the GRACE-derived mass variation. Further, similar mass trend changes at the beginning of 2005 are observed not only over Chao Phraya basin, but over several other areas in the world, e.g. Africa, Antarctica etc. Thus, we supposed that the negative mass change over Chao Phraya basin does not mainly come from impacts of local human activities, but from large-scale meteorological or climatological factors. To discuss why the trend change was caused at the beginning of 2005, we compared GRACE-derived mass variation with global scale ocean model and atmospheric objective reanalysis data, and investigated the correlations.

Besides of the trend change in time series, the spatial location of the significant trend area over Bangkok and the surrounding area changed at the beginning of 2005. We will also discuss the spatial shift of the trend over the area by comparing local hydrological observation data sets.