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Terrestrial Water Storage in Northeastern Asia with GRACE satellite

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Monthly measurements of time-variable gravity from the GRACE (Gravity Recovery and Climate Experiment) satellite mission was used to investigate the temporal change of Terrestrial Water Storage (TWS) in the arid regions of Northeastern Asia, during the period of April, 2004 to December, 2010. The study area was a square between 40 degree N and 50 degree N, and between 90 degree E and 115 degree E, which includes most of Mongolia and a part of northern China.

The results show that decreasing trend of TWS was observed in mountainous areas and in Inner Mongolia, while TWS is fairly constant in the central area of Mongolia. These findings are consistent with the reported decrease of glaciers [Kadota et al., 2011] and the depletion of groundwater level in Inner Mongolia during the last several decades [Kitawaki, et al., 2010]. TWS observed in the central Mongolia does not contradict with hydrological characteristics of the region with dry climate, where precipitation almost equals evaporation [Kaihotsu et al., 2004], and groundwater level hardly shows noticeable change without excessive human influence.

Autocorrelation between TWS from GRACE and the surface soil moisture from the microwave remote sensing of AMSR-E (Advanced Microwave Scanning Radiometer for Earth Observation System) [Fujii, et al., 2009] was investigated, where the latter was processed with the same filters used with GRACE. It was found that there is a higher correlation in the dry regions, which indicates that there is a possibility that TWS variations in dry regions depend mainly on that of the surface soil moisture. On the other hand, the soil moisture is well-correlated with TWS at 3 month earlier in the mountainous regions. This suggest linkage between snow and soil moisture in the region.

These results indicate the potential of GRACE to provide information on hydrological change, such as soil moisture, groundwater storage, glacier, etc, in the arid and semi-arid regions, even though variations of TWS are relativity smaller in the regions.

Keywords: arid region, Mongolia, Hydrological change, climate change, AMSR-E