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Editorial

Retrieval of key eco-hydrological parameters for cold and arid regions

1. Introduction

Retrieval of eco-hydrological variables/parameters from the world's cold and arid regions using remote sensing is more challenging compared to other regions, and less research work on quantitative remote sensing has been carried out in these specific regions. This is because: (1) Cold and arid regions are most likely to be located in the world's remote and relatively under-developed areas, where conventional in situ observations are more scarce and more difficult to be carried out so that the validation of remote sensing is more difficult. (2) Terrain in cold and arid regions is usually more complex and landscape is more fragmented and heterogeneous. The special issue aims to address these challenges.

The papers appeared in this special issue use two regions as the case study areas. Both of them are located in west China, where one of most diverse and fragile environments exists in the world, with the Qinghai-Tibetan plateau elevated in the south and high mountains, plateaus, deserts, and oases interspersed in the north. The first case study area is the Qinghai-Tibetan plateau (QTP), the so-called world's third pole. QTP is a cold area, where the cryosphere dominates the natural environment and changes rapidly in recent years. Another case study area is the Heihe river basin, the second largest and a very typical inland river basin (endorheic basin) in northwest China, where mountain cryosphere and the world's driest area coexist. Environmental change in China's inland river basins is controlled by water resource availability, which is further influenced by both climate change and human activities such as farming and grazing.

2. Summary of the special issue papers

The presented papers in this special issue can be grouped into three themes: (1) retrieval and analysis of cryospheric variables; (2) retrieval and validation of soil moisture on QTP; (3) retrieval of eco-hydrological parameters in arid region.

On cryospheric variables, four papers are to address the retrieval and change analysis of the lake level, the snow water equivalent, and the near-surface soil freeze-thaw cycle.

Kropacek et al. (2012) investigated the lake level change of the Nam Co, the largest endorheic lake on the QTP by the satellite altimetry measurements. Lake elevations were extracted from records of radar and laser altimeters for the period 2000–2009. It was detected that there was a steady rise of the water level of the Nam Co with an annual rate of 0.31 m/year for the period 2000–2009. Phan et al. (2012) inventoried the water level changes of 154 lakes on the QTP using the ICESat GLAS laser altimetry. An area averaged increase in lake level of 0.20 m/year over the QTP was observed between 2003 and 2009. However, a significant drop of water level in the southern QTP and along the Himalayan mountains was also found.

Airborne microwave radiometry observations at K- and Ka-bands were obtained in a mountainous watershed in the upper reaches of the Heihe river basin. A simplified retrieval model of snow depth was developed (Che et al., 2012) by comparing the observed and simulated brightness temperatures of snow using a physically based radiative transfer model. It can successfully estimate snow depth and snow water equivalent in complex terrains with good accuracy.

Near-surface soil freeze-thaw cycle on the QTP was detected using special sensor microwave/imager data. It was found that the frozen days have decreased about 33.7 days, the onset date of soil thaw has advanced by approximately 14 days, and the onset date of soil freeze has lagged by approximately 10 days over the period 1988–2007 on the QTP (Li et al., 2012a).

Surface soil moisture is important in hydrological and ecological processes at all spatial scales. Two papers are published to discuss this topic.

Lu et al. (2012) developed a land data assimilation system to generate a soil moisture climatology on the QTP. Validation using in situ observation showed that both the soil moisture and the land surface energy fluxes produced by the system are more realistic than the reanalysis and model simulations. Dente et al. (2012) introduced a soil moisture and temperature observation network, which consists of 20 stations set up in the water source region of the Yellow River, for validating remote sensing data products. Good agreement has been found between in situ time series and the AMSR-E soil moisture products.

There are five papers on the retrieval of eco-hydrological parameters in arid region, i.e., land surface temperature, evapotranspiration, and biomass.

Liu et al. (2012) developed a new algorithm to separate vegetation and soil temperatures, using airborne multi-angular thermal infrared remote sensing data. This algorithm is based on the localized correlation between multi-angle observations in VNIR bands and TIR band. Validation results indicated that the retrieved results can reflect the spatial and temporal distribution of component temperatures. It was found that in arid region the difference between vegetation and soil temperature can be as large as twenty degrees.

Song et al. (2012) developed a new remote sensing based evapotranspiration model. A biophysics-based surface resistance model was revised to account for water stress and temperature constraints. Validation result indicated that this new method can estimate the crop evapotranspiration in arid region with good accuracy. Li et al. (2012b) employed the evapotranspiration fraction

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method to estimate evapotranspiration for different land types in the Heihe river basin. The analysis on the spatial and temporal distribution of evapotranspiration in the oasis area suggested that rational utilization of water resources in the oasis is essential to manage the water resources in the inland river basins.

Wang et al. (2012) used the eddy covariance observations obtained in the WATER project to calibrate and validate a light use efficiency model for estimating the gross primary production (GPP). The yearly GPP and the net primary production for the Heihe river basin were calculated and the maximum light use efficiencies of maize and alpine meadow were obtained. Tian et al. (2012) explored the performances of various non-parametric and parametric methods in retrieving the forest above-ground biomass. The best result was achieved from airborne LiDAR data using the regression method but the non-parametric method with SPOT data was also able to map forest biomass over complex terrain as an alternative to the more expensive airborne LiDAR data.

We wish the special issue could contribute to the improvement of the remote sensing observation on the hydrological and ecological processes in cold and arid regions with very fragile and sensitive environment under the observed and projected climate changes and human-induced environmental disturbances.

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