Assessing land use/cover dynamics for the Yellow River Basin in China

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Introduction

The Yellow River Basin, the second largest river basin in China, has played an important role in China´s social, political, and economic development. Recently, this region is exposed to intense and rapid socio-economic changes and belongs to one of the most dynamic regions in China, due to the high abundance of natural resources (oil and gas) and fertile land. Owing to these tremendous changes and the increased demand for natural resources, the characteristics and landscape features have evolved dramatically, degrading and destroying the prevailing environment and harming society.

The lack of precise and consistent information about the current land use/cover characteristics and dynamics hamper an effective and sustainable regional and local resource planning and management. In this context, we present a unique analysis for the Yellow River Basin by delineating the respective land use/cover for two time steps (2003 and 2013) at a spatial resolution of 250 m to catch the dynamics during the last decade.

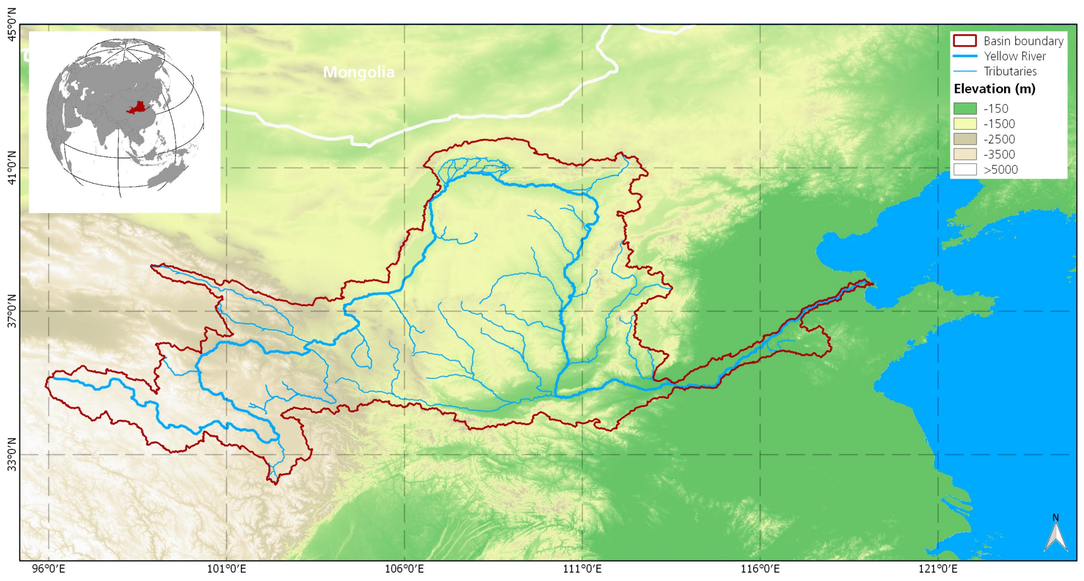

Figure 1. Physiographic overview of the Yellow River Basin (China).

Data processing and classification

8-day 250 m composites (MOD09Q1) acquired by the Terra satellite served as basis data for this analysis. The TIMESAT tool [1] was used first to smooth (Savitzky-Golay filter) the derived NDVI time series, reducing the influence of noise found inherently in original MODIS data and then to compute various phenological metrics (e.g. start of season, end of season, peak value, rate of increase) [2]. Additionally, annual NDVI statistics (e.g. median, minimum) as well as auxiliary data (elevation, slope) were computed. A total number of 18 variables served as input for the classification model.

The collection of reference data for model training and testing was done with very high resolution data via Google Earth plus high resolution Landsat imagery for the respective year. We chose the often applied Random Forest classifier to derive the final YRB LC classification for each year. The entire work flow is depicted in Fig. 2.

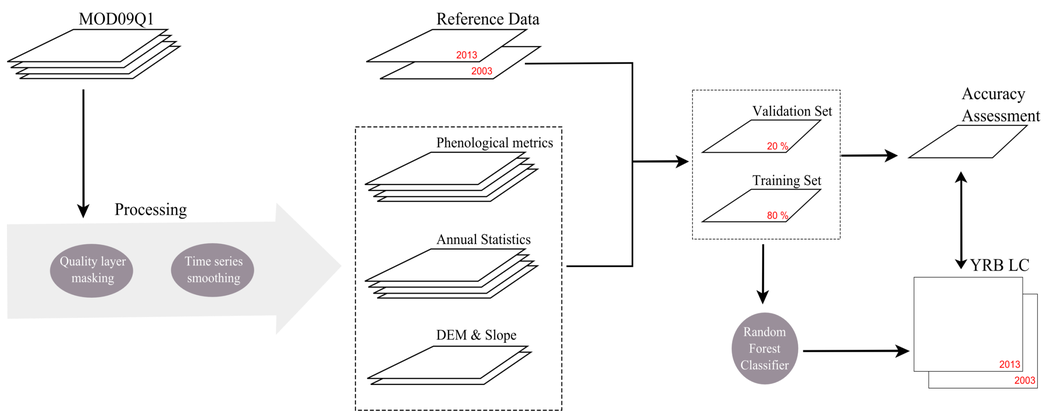

Figure 2. Flowchart illustrating the data processing and land cover classification procedure.

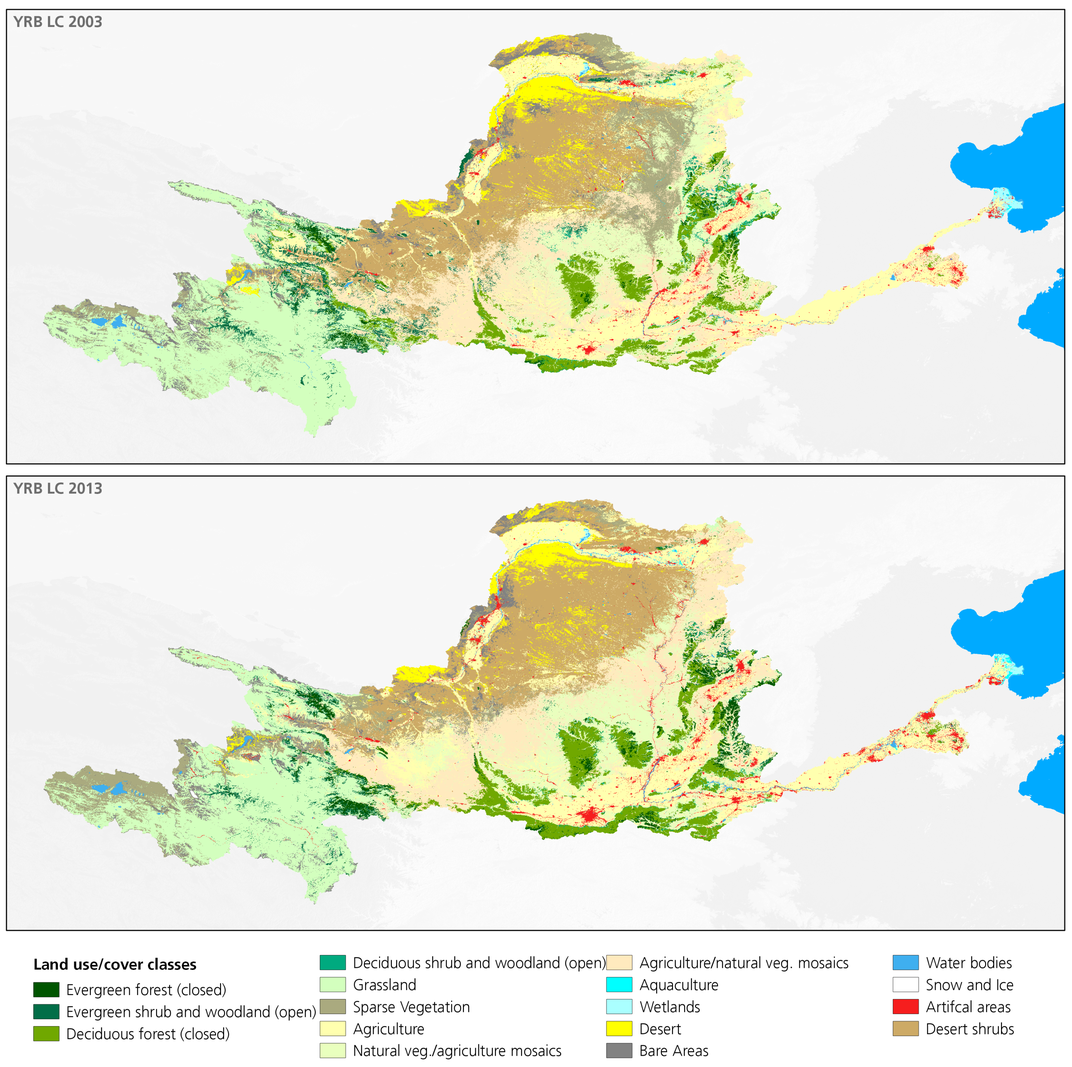

Figure 3. Delineated land use/cover of the Yellow River Basin (YRB LC) for 2003 and 2013.

Assessing the land use/cover dynamics

The dominant landscape feature in the basin are agricultural areas, covering around 25%, which are mainly distributed across the central Loess Plateau and the alluvial areas of the North China Plain, as well as in large irrigation districts in the arid north (Fig. 3). We can examine a slight agricultural expansion. The most dynamic region is the Loess Plateau. Major land use policies, enacted and implemented in the late 1990s, have led to a strong reduction of sparse vegetation in the Loess Plateau. Terracing and planting activities aim to stop the massive erosion to reduce the large quantities of sediment attaining the Yellow River and its tributaries. Obvious is also the transformation and degradation of grassland systems in the source area, mainly induced by overgrazing by livestock of local communities. Further, urban and artificial structures almost doubled.

The YRB LC products enhance the perspective characterizing regional land use/cover dynamics and are better suited for delineating higher spatial detail compared to global LC products (Fig. 4). The overall accuracies of 89% (2003) and 85% (2013) are as good as various other regional studies across the globe.

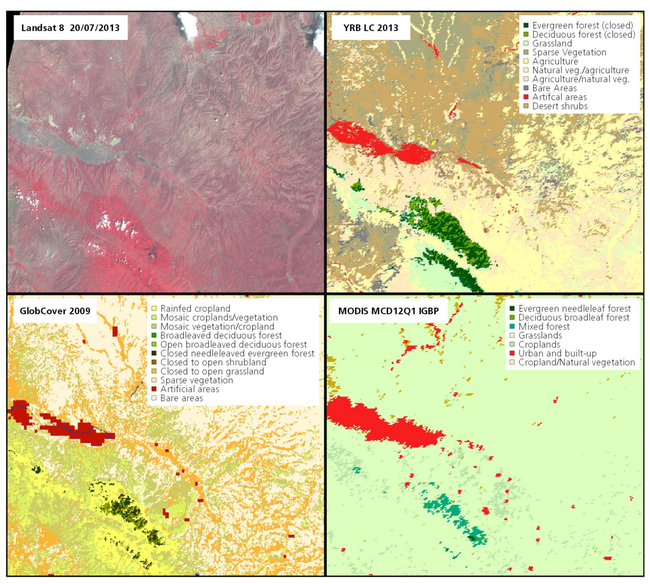

Figure 4. Comparison between YRB LC 2013 and existing land cover products (GlobCover and MODIS IGBP 2012). Landsat 8 imagery depicted in false color composite (band combination: 4-3-2).

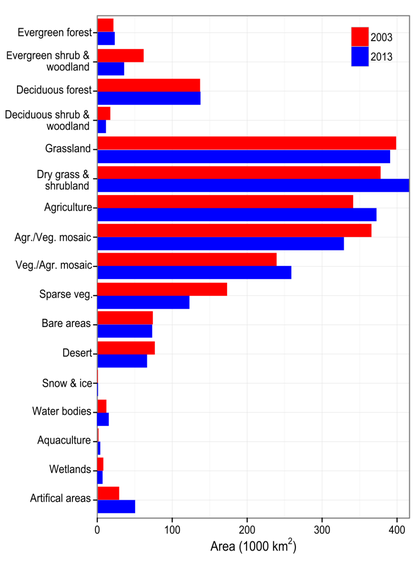

Figure 5. Land cover proportion (100 km²) for each year.

[1] Jönsson, P. & Eklundh, L. 2004. TIMESAT – a program for analyzing time-series of satellite sensor data. *Computers & Geoscience* 40:833-845.

[2] Jönsson, P. & Eklundh, L. 2002. Seasonality extraction by function fitting to time-series of satellite sensor data. *IEEE Transactions on Geoscience and Remote Sensing* 40:1824-1832.

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