Urban growth monitoring and prediction with remote sensing and GIS in Wuhan region, China

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Introduction

- Land Use/Cover Changes (LUCC) play an important role to the transformation of the earth's climate system (Mahmood *et al.* 2014) and it has largely affected the global warming (Muñoz-Rojas *et al.* 2015). It is necessary to monitor actual LUCC for sustainable urban development.
- Urban growth is the most important social and economic phenomenon that influences urban planning in the 21st century (United Nations 2015).

Data and Methods

- In order to examine the urban growth in Wuhan region, we used a 100 km × 100 km study area covering the capital city of Hubei Province, China. (Fig. 1)
- Multi-layer Perceptron Neural Network (MLP NN) is a module of TerrSet software that can accurately simulate LUCC in urban areas (Shooshtari and Gholamalifard 2015). The advantage of using MLP NN is that it can deal with nonlinear relationships among variables. It is the most robust method for the transition potential modeling (Eastman 2009).
- MLP NN was used for transition potential mapping and Markov module in TerrSet - Land Change Modeler was used for simulation and prediction.
- The actual change simulation is done by Land Change Modeler, which uses an internal module to allocate the quantity of change (predicted using 2000 and 2009 maps) based on the transition potential maps (modeled using 2000 and 2009 maps, the driving factors, and MLP NN).
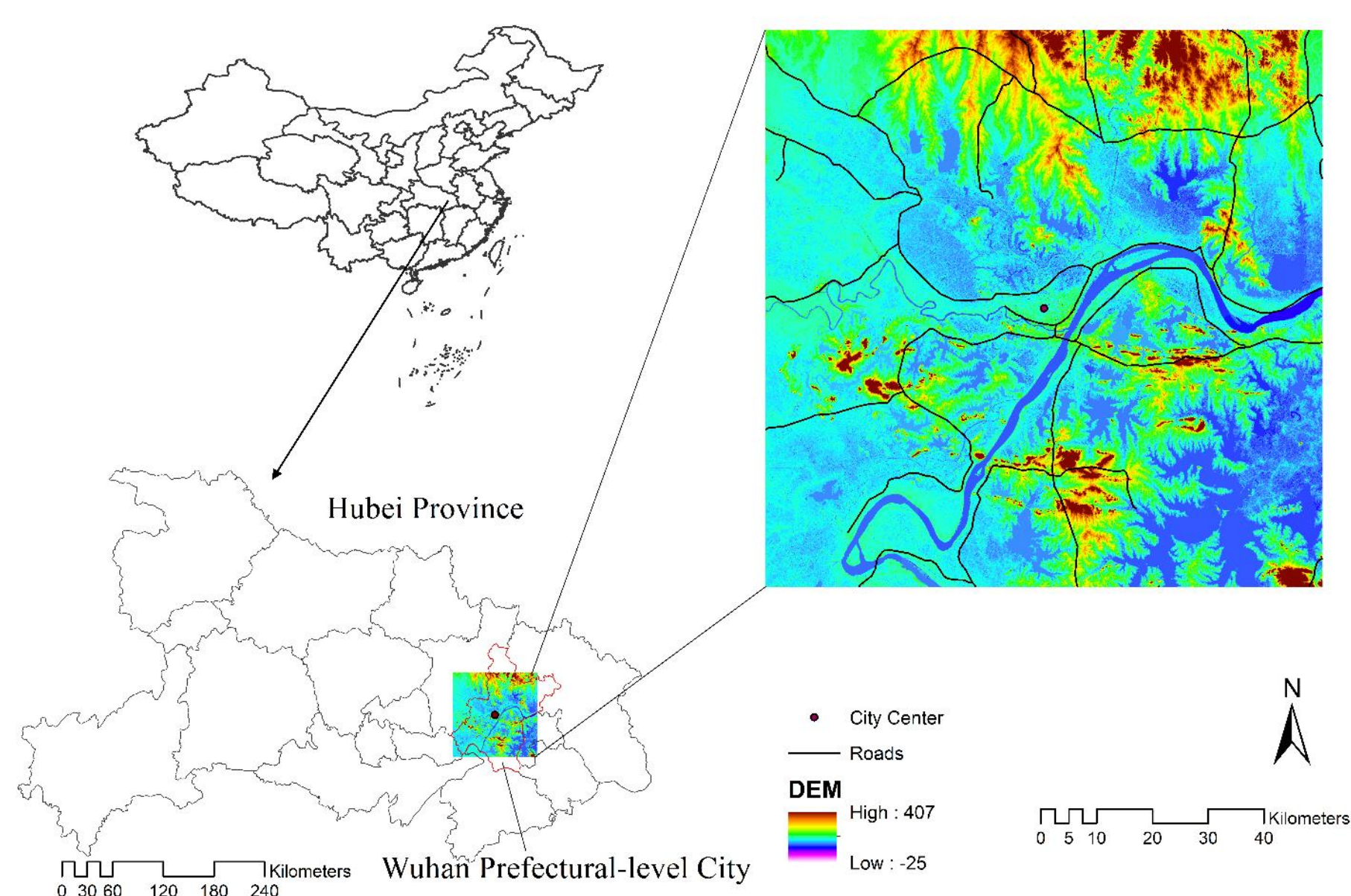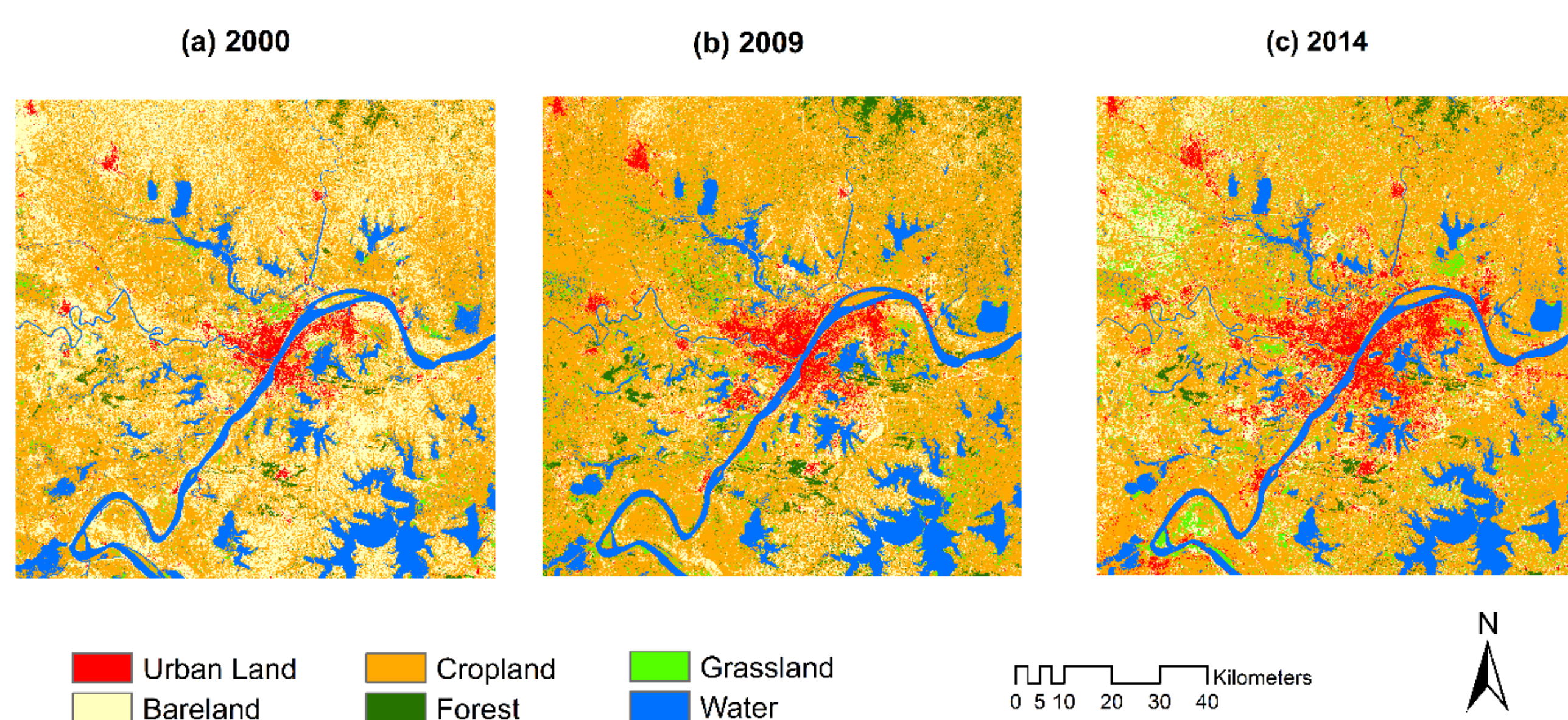

Fig. 1. Location of Wuhan region, China

Fig. 2. LUCC maps in Wuhan region in 2000, 2009 and 2014.

Results

- The classified land use/cover maps (Fig. 2) shows the detected LUCC in Wuhan region. Spatially, it can be observed that over the years urban land had expanded outward of the city core and along two sides of Yangtze River.
- In the past 14 years (2000-2014), the total area of urban land increased from 27.30 thousand ha to 71.06 thousand ha, resulting in a net increase of 160.29%. It can be observed that majority of the landscape was covered with cropland, bareland and water. Grasslands were limitedly distributed in the study area. The cropland and other lands near the urban land in 2000 had been replaced by urban land in 2014.
- Fig. 3 shows the (a) actual map and (b) simulated map of urban and non-urban land in 2014. Fig. 4 presents the predicted urban land of Wuhan region in 2030. It can be found that the new growth area would extend in the northwestern and southwestern directions.
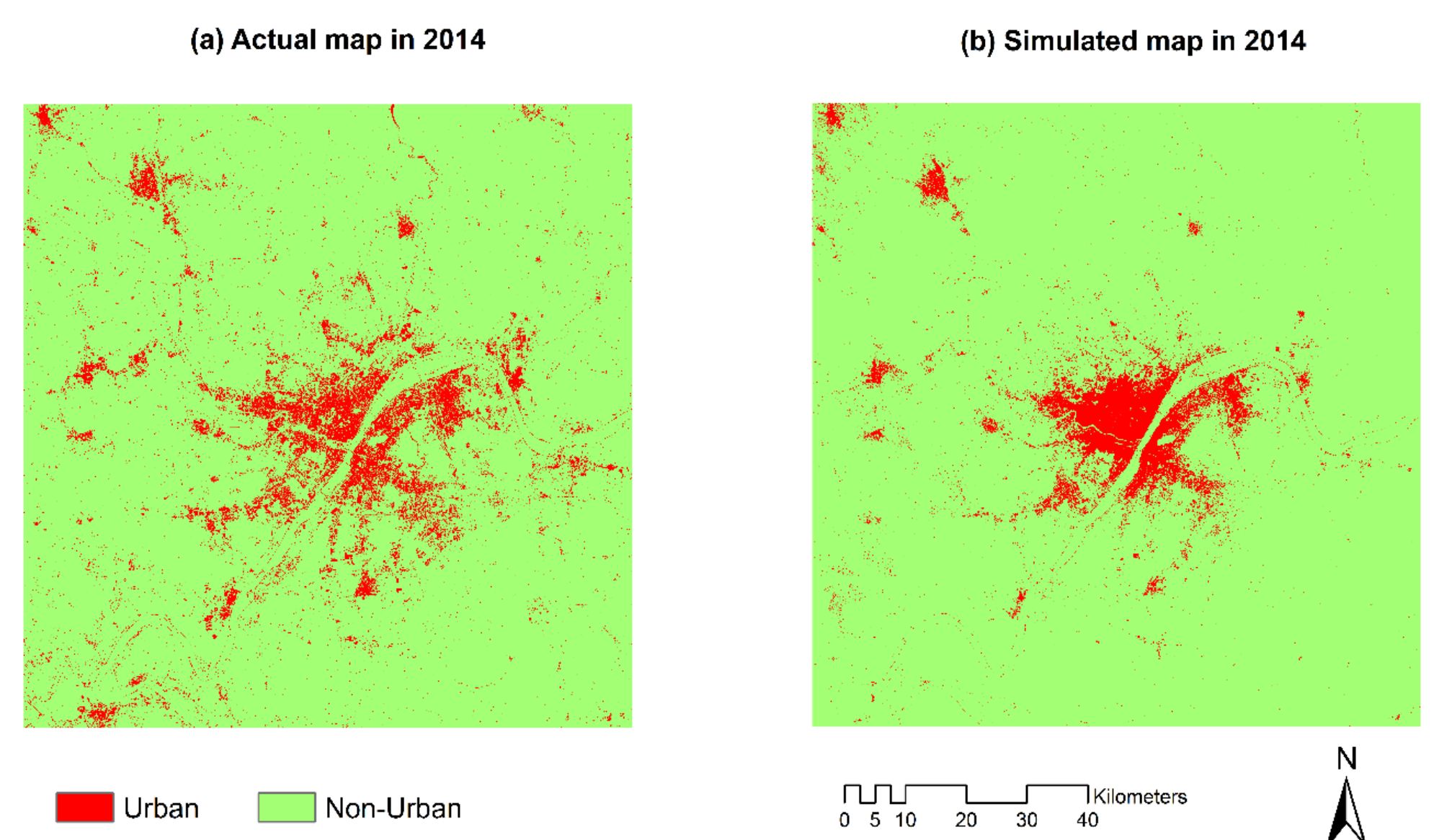

Fig. 3. The urban/non-urban land map in Wuhan region in 2014

Conclusions

- In Wuhan region the urban land expanded from 27.30 thousand ha in 2000 to 71.06 thousand ha in 2014. The urbanization developed along the two sides of Yangtze River.
- The new growth area would be 41.27% larger than that in 2014. The simulation result shows that the newly urbanized areas will be extended in the northwestern and southwestern parts in Wuhan region in 2030.
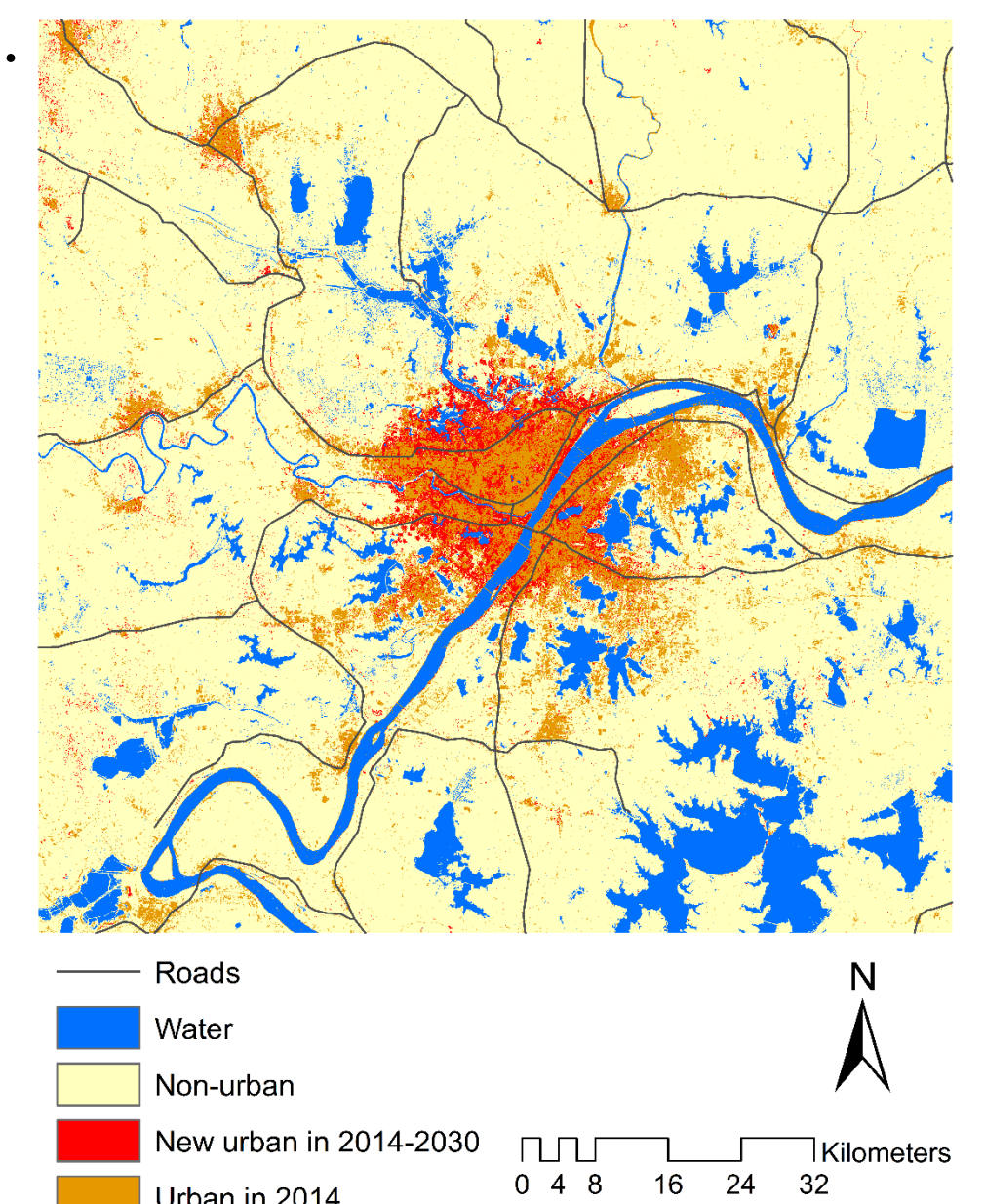

Fig. 4. Predicted urban land in 2030 with the actual urban land in 2014