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Mapping the irrigation area for estimation of agricultural water demand in North China Plain using MODIS remote sensing data

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ABSTRACT

North China Plain is one of the most important agricultural regions in China with severe challenges of water shortage. Agriculture in the plain is very intensive. Farming in the region is a typical irrigation-supported system of winter wheat, followed by summer maize. In this paper, we present our systematic investigation of mapping the irrigated winter wheat farmlands in the Plain using MODIS remote sensing data. Since water demand for irrigation is generally related to the cropping systems during the winter wheat growing season when rainfall is few, we use NDVI with a threshold to identify the cropping structure of the region. Our study indicates that irrigation area in the plain can be properly mapped using the MODIS data.

Keywords: irrigation mapping, North China Plain, agriculture, winter wheat system, water shortage, MODIS data

METHODOLOGY

Winter wheat has been identified as the main cropping system requiring intensive irrigation during the growing season from March to early June in North China Plain. This provides the possibility to use MODIS remote sensing data with 36 bands within 0.4-14.4 μ m for irrigation mapping. The data have a spatial resolution of 250m for bands 1 and 2 , which is used to compute the normalized difference of vegetation index (NDVI) showing spatial distribution of green vegetation.

$$NDVI = \frac{B_2 - B_1}{B_2 + B_1}$$

Where B_1 and B_2 are bands 1 and 2 of MODIS data. Using a threshold of 0.1, we are able to map irrigated farmland from NDVI image. Integrating with green vegetation cover rate, irrigation area can be computed from the irrigated area for agricultural water demands.

Figure 1. Geographical location of North China Plain

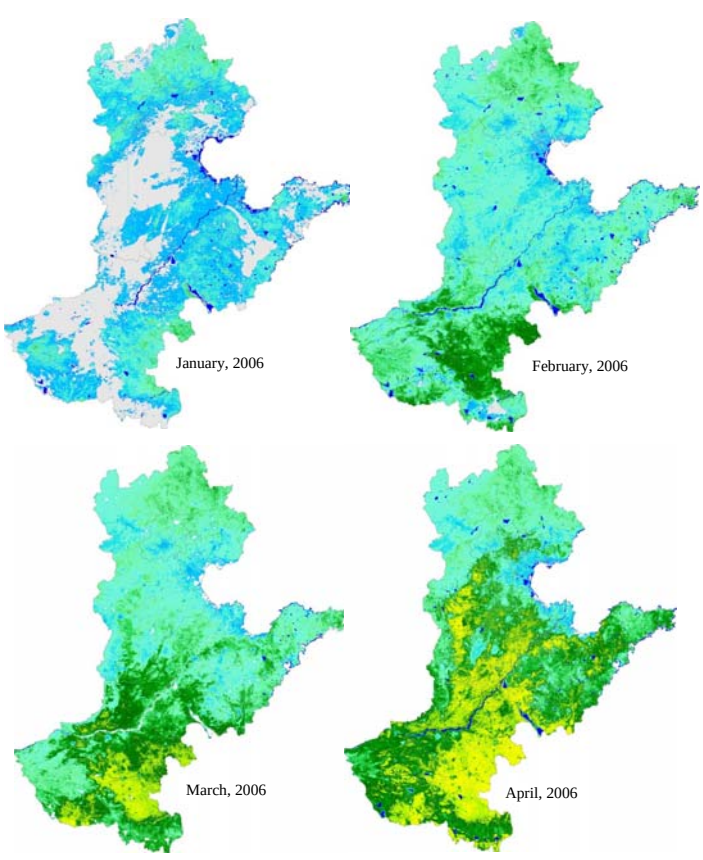

Figure 2. Compositions of maximal NDVI showing changes of winter wheat cropping in the Plain.

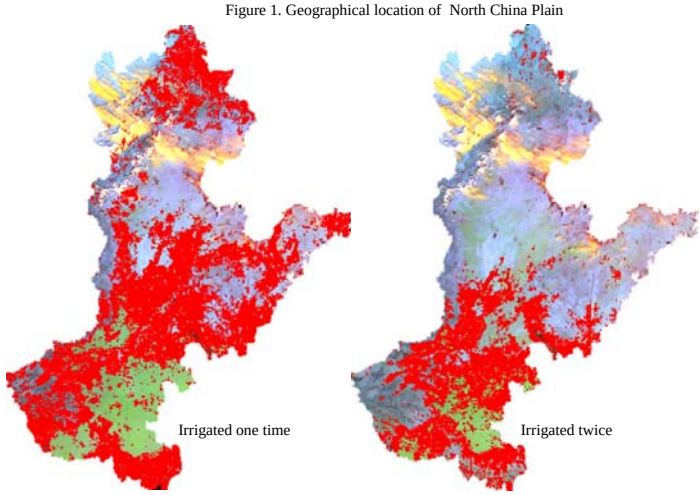

Figure 3. Spatial distribution of irrigation area (red color) in the plain. The background is a color composition of the Plain, with yellow indicating clouds.

CONCLUSION

An approach has been proposed in the study to map the irrigated area in North China Plain using the MODIS data. Our results indicate that the mapping accuracy is able to meet the requirements of administrating water resources for efficient utilization. Total irrigation area of the region is about 1.2 million hectares in 2006. Agricultural water demands for various areas have been estimated on the basis of the irrigation mapping.

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