Soybean Extraction of Brazil Typical Regions Based on Landsat8 Images

Kejian Shen, Xue Han, Haijun Wang, Weijie Jiao

Soybean Extraction of Brazil Typical Regions Based on Landsat8 Images

Kejian Shen [1,a,*], Xue Han [1,b], Haijun Wang [1, c], Weijie Jiao [1, d]

[1] Chinese Academy of Agricultural Engineering, Innovation Team of Crop Monitoring by Remote Sensing, Beijing Chaoyang District Maizidian Street No. 41, Beijing 100125,China;
[a]ashenkejian@126.com, [b] hanxue37119@163.com, [c]haijun076481@163.com, [d]jiaoweijie0502@163.com

Abstract. Considering the spatial distribution and harvest times of Brazil soybean, using Landsat8 data, this paper chose 3 study area, determine the optimum classification images by visually comparison of multi-period images, extract soybean by ISODATA unsupervised classification method and visual correction. The conclusion is that Landsat8 path/row of 225/75 (between Study area3 and Study area2) are soybean transition area of harvest 1 time in a year and harvest 2 times in a year; Classification result can be used for sampling survey of national scale and the full coverage survey of county scale. Soybean classification method can be used to improve the method of low resolution image and to guide other medium resolution image.

Keywords: soybean transition area; harvest 2times in a year; sampling survey

1 Introduction

In recent years, Chinese soybean planting area is gradually reducing, the domestic soybean self-sufficiency ability has been reduced to about 20%, China mainly imports soybean from United States, Brazil, Argentina [1]. Timely acquisition of the world soybean crop area and its spatial distribution can be used to forecast crop yields, formulate agricultural policies, ensure national food security [2, 3]. Remote sensing has characteristics of wide coverage and low cost, can provided a technical means for fast, accurate and dynamic monitoring of crop area [4].

United States, European Union, China, and other countries have designed crop area survey systems which take advantage of remote sensing and sampling method [5-7], sampling method could solves the contradiction between the accuracy, timeliness and cost. Spot, Rapideye and Landsat images are frequently used as sample image. Considering the free download of landsat8 data, bigger width of Landsat8, this research chooses landsat8 image as data source.

Crop extraction should consider electromagnetic spectrum characteristics, spatial characteristics, time characteristics and auxiliary data [8]. Supervised classification, unsupervised classification, object-oriented method and decision tree classification are frequently used methods. In crop growth cycle, the change of physiological, shape and structure of crop will resulted in seasonal changes of spectral characteristics. Considering to the characteristics of soybean in Brazil, this paper, tried to give transition area of soybean harvest in 1 or 2 times in a year and try to give classify method of image for sampling method.

2 Study area and data source

2.1 Study area

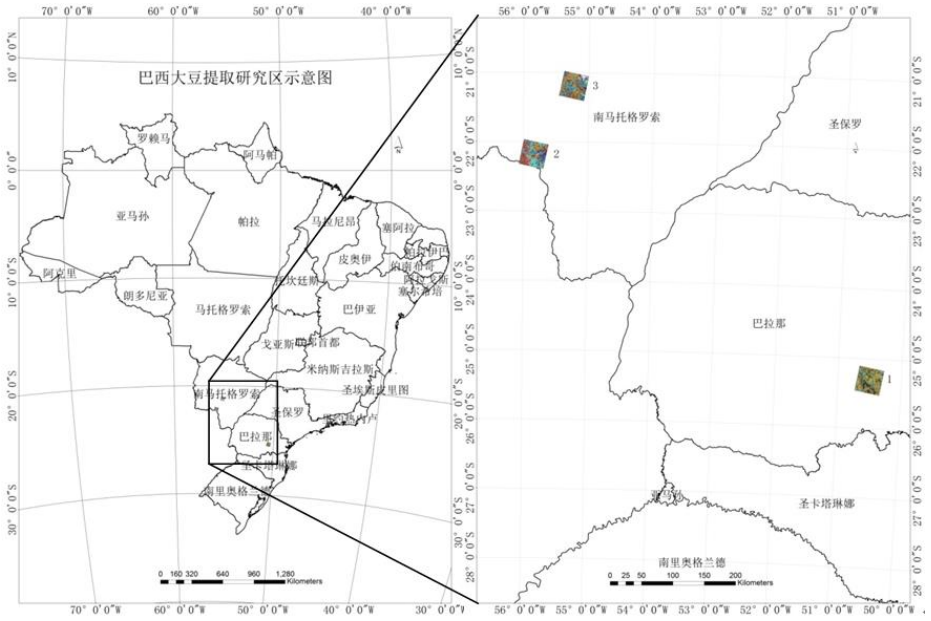

Fig.1. The sketch map of study area

Most of Brazil belongs to tropical climate, southern parts belongs to subtropical climate. Due to the tropical climate and long growing season, crop cycles are complicated. Below is a month-by-month (Table1) account of what to expect during growing season. Brazil soybean mainly distribute in central and southern, exists harvest 1 time in a year and 2 times in a year, according to the number of remote sensing images for soybean extraction, three research areas are selected (Figure 1), the size of each is 40km x 40km. Extraction of soybean in study area 1 located in Paraná need 1 time image ,which was acquired 2014-01-21; Extraction of soybean in study area 2 located in south Mato Grosso need 2 times images, which were acquired 2013-11-30 and 2014-02-02; Extraction of soybean in study area 3 located in middle Mato Grosso need 3 time images, which were acquired on 2013-11-30/ 2014-02-02/2014-04-07(Table 2).

Table 1. Brazil Soybean Month-By-Month Crop Cycle*

September	● Early soybean begins in Mato Grosso and central Brazil.
October	● Soybean planting in full swing in southern Brazil.
November	● Early November is main planting period.
December	● Finish planting, early-planted soybeans flowering and setting pods.

* From: http://www.soybeansandcorn.com/Brazil-Crop-Cycles

	• Begin spraying to control soybean rust.
January	• Soybeans flowering and setting pods. • Some very early soybeans in central Brazil may be harvested this month. • Continue spraying to control soybean rust.
February	• Main pod filling month. • Early soybeans being harvested. • Soybean rust control now focused on later maturing soybeans.
March	• Main soybean harvesting month. • Critical time for soybean rust to affect late maturing soybeans.
April	• Finish soybean harvest.
May	• Rains have ended in central Brazil and dry season has started. • Scattered rains continue to fall in southern Brazil.
June-July-August	• This is the dry season in central Brazil. • Occasional rains can occur in southern Brazil.

2.2 Data

landsat8 Multi-spectral image listed as Table 2 are used.

Table 2. Landsat8 Multi-spectral image

Path/row	Data	Acquired time	Path/row
study area 1	Landsat8	2014-01-21	221/78
study area 2	Landsat8	2013-11-30 2014-02-02	225/75
study area 3	Landsat8	2013-11-30 2014-02-02 2014-04-07	225/75

3 Methodology

First classification step is determine the optimum classification images by visually comparison of multi-period images, which need to retrieval same path/row landsat8 images during 2013.09-2014.06. Second classification step is unsupervised classification method and visual correction.

Study area3 harvest 2 times in a year, the extraction of soybean requires three images of different acquired time. The first reason is that same plot harvest 2 times in a year, the second reason is that soybean sowing time of adjacent land vary about 1-2month. Therefore, classification result of soybean study area3 = time1+ time2+ time3.

Study area2 harvest 1 times in a year, the extraction of soybean requires two images of different acquired time. The reason is that soybean sowing time of adjacent land vary about 1-2month. Therefore, classification result of soybean study area2 = time1+ time2.

Study area1 harvest 1 times in a year, the extraction of soybean requires one images of acquired time. Classification result of soybean study area1 = time1.

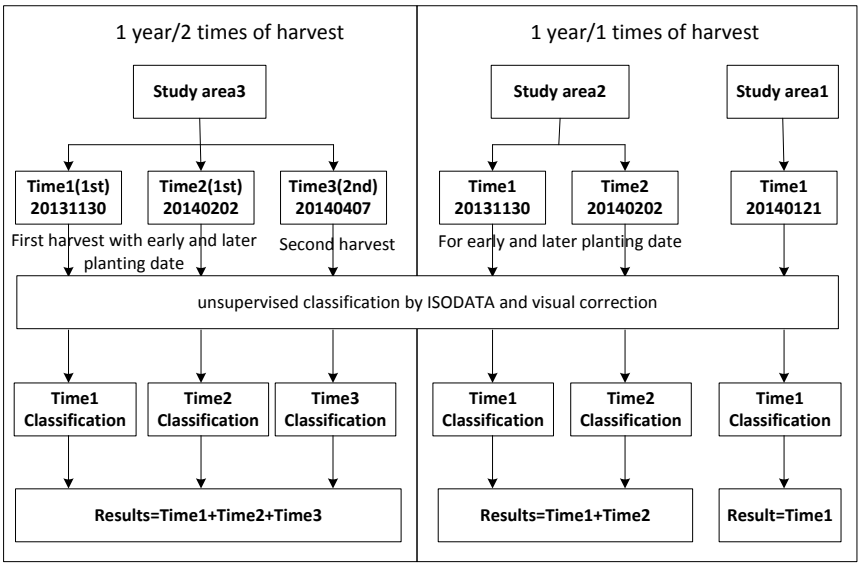

Fig.2. Flow chart of experiment

4 Results and Discussion

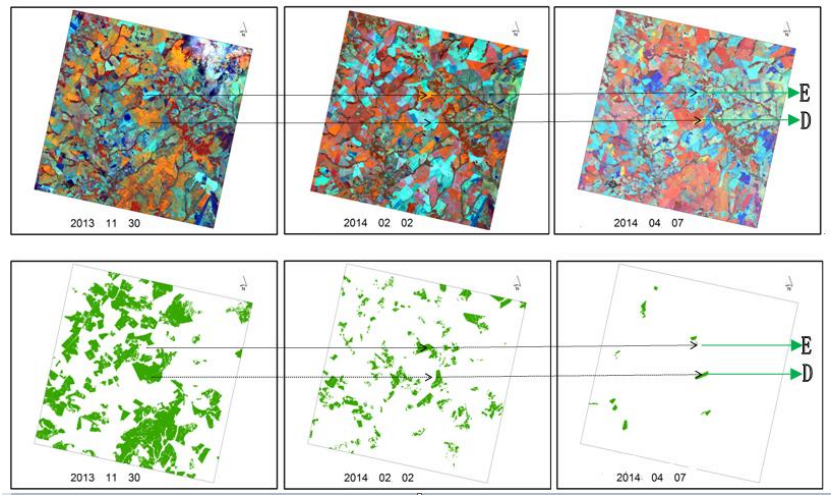

Fig.3. Study area 3 (3 images)

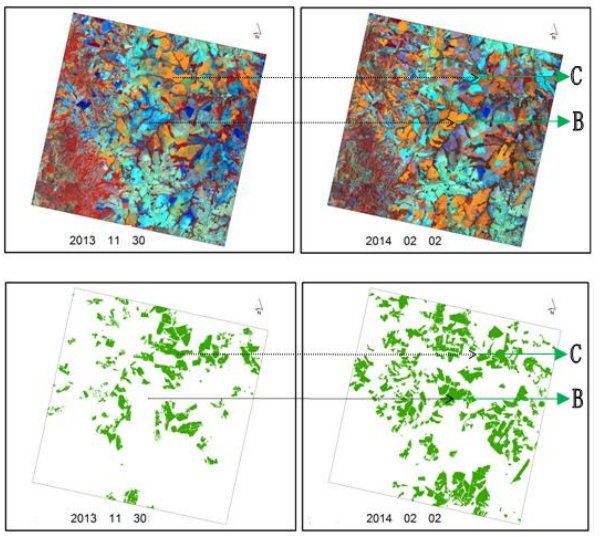

Fig. 4. Study area 2 (2 images)

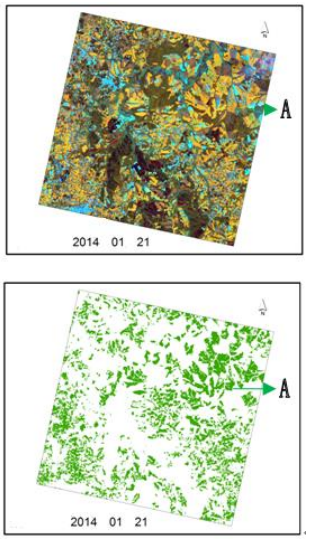

Fig.5. Study area 1 (1 image)

Table 3. Image feature

	Plot	Time1	Time 2	Time 3
Study area3	E(1)	Bare land （20131130 blue）	Soybean （20140202 yellow）	Bare land （20140407 blue）
	D(2)	Soybean （20131130 yellow）	Bare land （20140202 blue）	Soybean （20140407 yellow）
Study area2	C(1)	Soybean （20131130 yellow）	Bare land （20140202 blue）	
	B(1)	Bare land （20131130 blue）	Soybean （20140202 yellow）	
Study area1	A(1)	Soybean （20140121 yellow）		

Remote sensing images and classification results of the study area 3 are shown in Figure 3. Remote sensing images and classification results of the study area 2 are shown in Figure 4. Remote sensing images and classification results of the study area 1 are shown in Figure 5. Image features are in Table 3 summarized from Figure 3, Figure 4 and Figure 5.

From Figure 3 and Table 3, we can see that plot-E which harvest soybean 1 time is bare land on 20131130, soybean on 20140202, bare land on 20140407; plot-D which harvest soybean 2 times is soybean on 20131130, bare land on 20140202, soybean on 20140407. The extraction of soybean is: 639.99km^2 Result =483.49 km^2 (Time1) + 145.00 km^2 (Time2) +11.50 km^2 (Time3)。

From Figure 4 and Table 3, we can see that plot-C which harvest soybean 1 time is soybean on 20131130, bare land on 20140202; plot-B which harvest soybean 1 time is bare land on 20131130, soybean on 20140202. The extraction of soybean is: 495.64km^2 Result =Time1 Union Time2 (in ArcGIS).

From Figure 5 and Table 3, we can see that plot-A which harvest soybean 1 time is soybean on 20140121. The extraction of soybean is: 398.04km^2 Result =Time1.

In this paper, we do not have accuracy assessment, because the lack of high resolution remote sensing data and field data.

5 Conclusions

Considering the spatial distribution and harvest times of Brazil soybean, using Landsat8 data, using Landsat8 data, this paper chose 3 study area, determine the optimum classification images by visually comparison of multi-period images, extract soybean by ISODATA unsupervised classification method and visual correction. The conclusion is that Landsat8 path/row of 225/75 (between Study area3 and Study area2) are soybean transition area of harvest 1 time in a year and harvest 2 times in a year; Classification result can be used for sampling survey of national scale and the full coverage survey of county scale. Soybean classification method can be used to improve the method of low resolution image and to guide other medium resolution image.

Acknowledgment

Funds for this research was provided by National Natural Science Foundation of China (No. 41301506) and Civil Space Project in the 12th Five-Year Plan of China （2011-2015）.

References

1. Liu Zhongtang.Some thoughts concerning development strategy for soybean industry in China. [J]. Soybean Science, 2013, 32 (3):283-285.
2. Han Lijian, Pan Yaozhong, Jia Bin, et al.Acquisition of paddy rice coverage based on multi-temporal IRS-P6 satellite AWiFS RS-data [J]. Transactions of the CSAE,2007,23 (05): 137-143.
3. Tsiligirides T A.Remote sensing as a tool for agricultural statistics: a case study of area frame sampling methodology in Hellas[J].Computers and electronics in agriculture, 1998, 20(1): 45-77.
4. Liu Jiyuan.Study on national resources environment survey and dynamic monitoring using remote sensing[J]. Journal of Remote Sensing, 1997, 1(03): 225-230.
5. Wu Bingfang, and Li Qiangzi.Crop acreage estimation using two individual sampling frameworks with stratification[J].Journal of Remote Sensing, 2004, 8 (6):551-569.
6. Shen Kejian, He Hao, Meng Hongwei, et al. Review on spatial sampling survey on crop area estimation[J].Chinese Journal of Agricultural Resources and Regional Planning,2012, 33(04): 11-16.
7. Gallego F J.Remote sensing and land cover area estimation[J]. International Journal of Remote Sensing, 2004, 25(15): 3019-3047.
8. Jia Kun, Li Qiangzi. Review of Features Selection in Crop Classification Using Remote Sensing Data[J]. Resources Science, 2013, 35(12): 2507-2516.