DETECTION ACCURACY OF WATERLOGGED PADDY FIELDS USING WIDE FINE MODE OF RADARSAT-2

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ABSTRACT: RADARSAT-2 starts Wide Fine mode observation in 2011. Wide Fine mode of RADARSAT-2 can observe 150km by 170km with highly spatial resolution (spatial resolution 15.2-8.2m by 7.7m). Moreover this mode has high cost performance; cost per area is about one fifth of Fine mode. I tried to detect waterlogged paddy fields using the Wide Fine observation mode, and evaluate accuracy. As a result lowest detection overall accuracy was 68.2% in Fukushima prefecture. Against highest detection accuracy was 80.4% in Ibaraki prefecture. Detection accuracy of Wide Fine mode is somewhat lower than Fine mode. It is a natural result. However, in 2011, transplanting activity was unusual because influence of huge earthquake, tsunami and Fukushima Daiichi nuclear disaster. Therefore this lower accuracy influenced not only spatial resolution but also these disasters. It is consider that Wide Fine mode of RADARSAT-2 is useful for detection of waterlogged paddy fields.

1. INTRODUCTION

RADARSAT-2 starts new observation mode, Wide Ultra-Fine, Wide Multi-Look Fine, Wide Standard Quad-Pol, Wide Fine Quad-Pol and Wide Fine in 2011. These wide modes are reduced spatial resolution than normal mode. For example spatial resolution of Fine mode (normal/previous mode) is 10.4-6.8m (Range) by 7.7m (Azimuth). On the other hand one of Wide Fine mode is 15.2-7.2m by 7.7m. However Wide Fine mode can observe 150km by 170km against Fine mode can observe 50km by 50km. Therefor Wide Fine mode has high cost performance; cost per area is about one fifth of Fine mode. I tried to detect waterlogged paddy fields using the new Wide Fine observation mode, and evaluate usability to comparing with my previous study.

2. MATERIALS AND METHOD

2.1 Study area and data used

The study carried out Ibaraki, Tochigi, Gunma, Miyagi and Fukushima prefecture, Japan (Figure 1). 4 scenes RADARSAT-2 Wide Fine mode data used and these data observed 7, 9, 19, 26 June 2011 (Table 1).
Almost study area, transplanting of paddy rice carry out early May. Therefore these images are past about one month from transplanting.
In addition I use several GIS data. Ibaraki, Tochigi, Gunma and Fukushima prefecture are used each agricultural field polygon GIS data. These data are digitizing from aerial photo. 10m resolution DEM data are published by Geospatial Information Authority of Japan (GSI). Moreover land use map used.

Table 1: Satellite data used

Date	Main area	Mode	Spatial resolution	Polarization	Incident angle	Orbit	Range direction
07-Jun-11	Miyagi	WideFine	10.2-8.2m×7.7m	HH	31.27	Ascending	Left
09-Jun-11	Ibaraki, Tochigi					Descending	Right
19-Jun-11	Fukushima					Ascending	Right
26-Jun-11	Gunma, Tochigi					Descending	Right

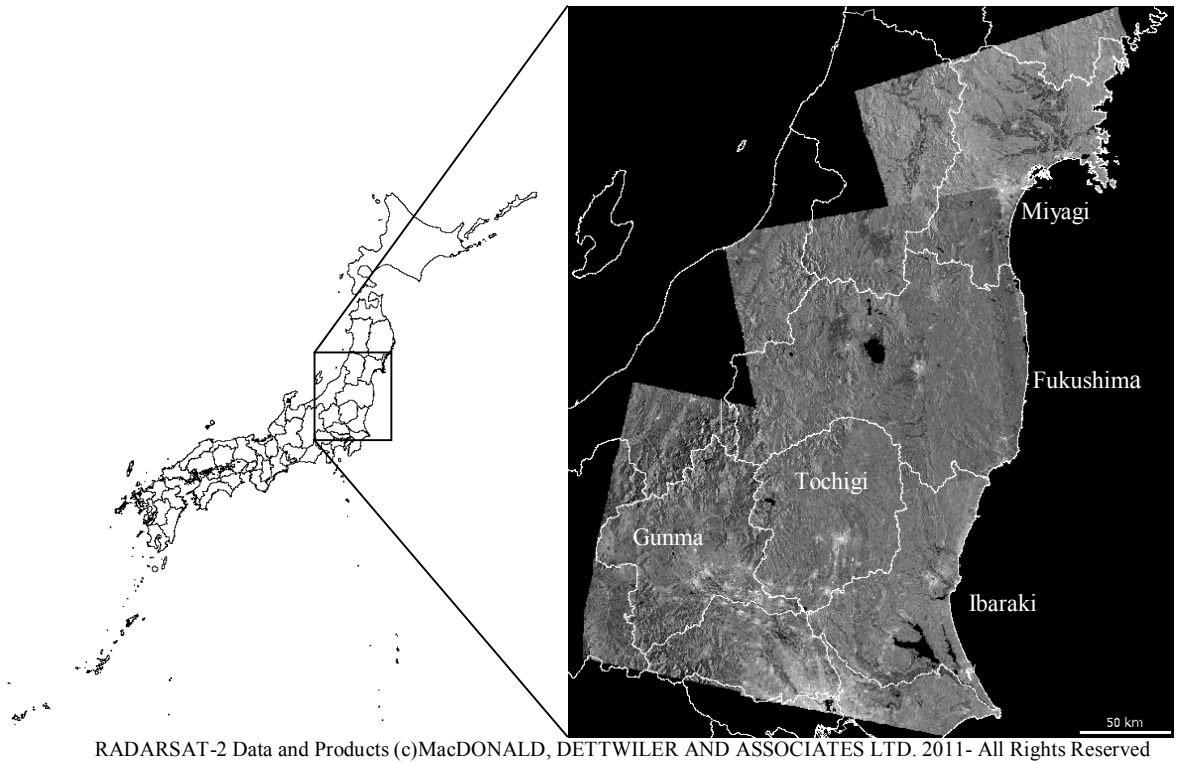

Figure 1: Study area and satellite data used

2.2 Method

Preprocess of RADARSAT-2 are carried out using NEST, ESA. After that analysis carried out using area mensuration system of paddy rice, which developed by Ministry of Agriculture, Forestry and Fisheries.

At first I extract agricultural area using GIS data. Next each agricultural fields compute mean of backscatter coefficient. After that histogram of backscatter coefficient decide threshold of flooded and non-waterlogged fields. Finally agricultural fields under threshold assumed as waterlogged paddy fields. Ground survey carried out several hundred points with GPS camera (Figure 2). Total numbers of ground truth are 2597 fields. Validation carried out that results compare with ground truth data. Miyagi prefecture was not carry out validation because of no GIS data.

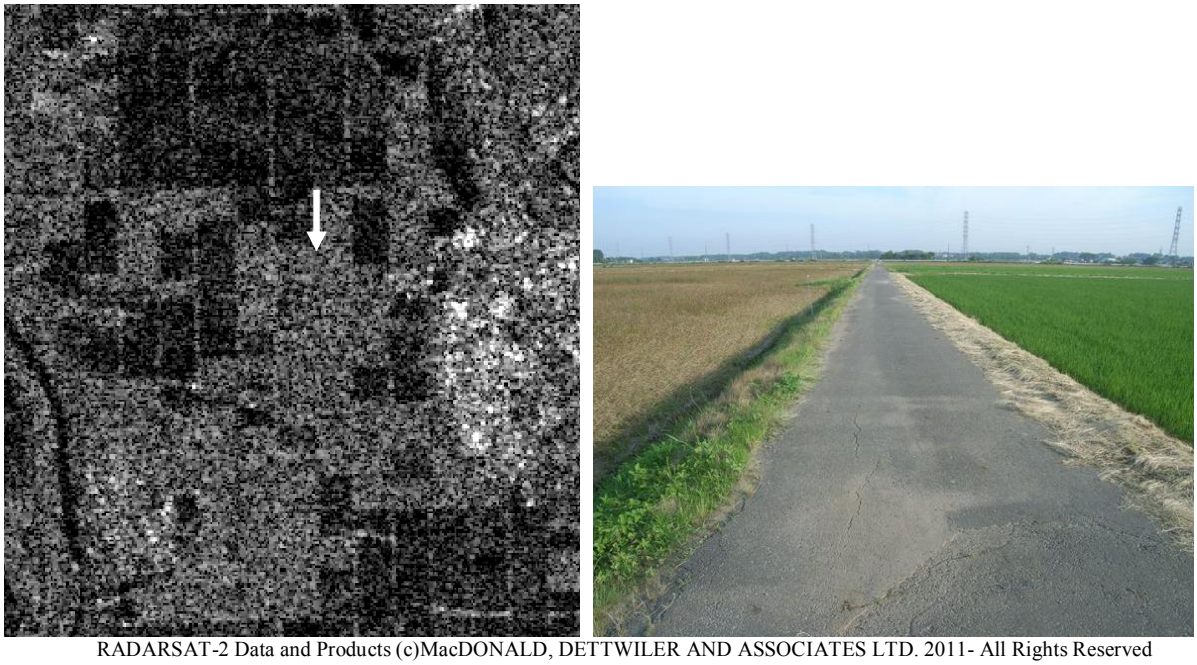

Figure 2: Sample of ground truth
Photo taken with arrow place and direction

3. Results and discussion

3.1 Results of detection

Figure 2 shows sample of satellite data, agricultural polygon, mean of backscatter coefficient (Gamma nought) and results. In satellite image, waterlogged paddy fields look dark because specular reflection. Japanese paddy fields are small (in this area, typical paddy field size is 30m by 100m). However RADARSAT-2 image of Wide Fine mode can identify waterlogged paddy fields. On the other hand smaller paddy fields than typical size are sometime occur miss classification. However when compare with satellite image and result map, distribution pattern is similar, it indicates good result.

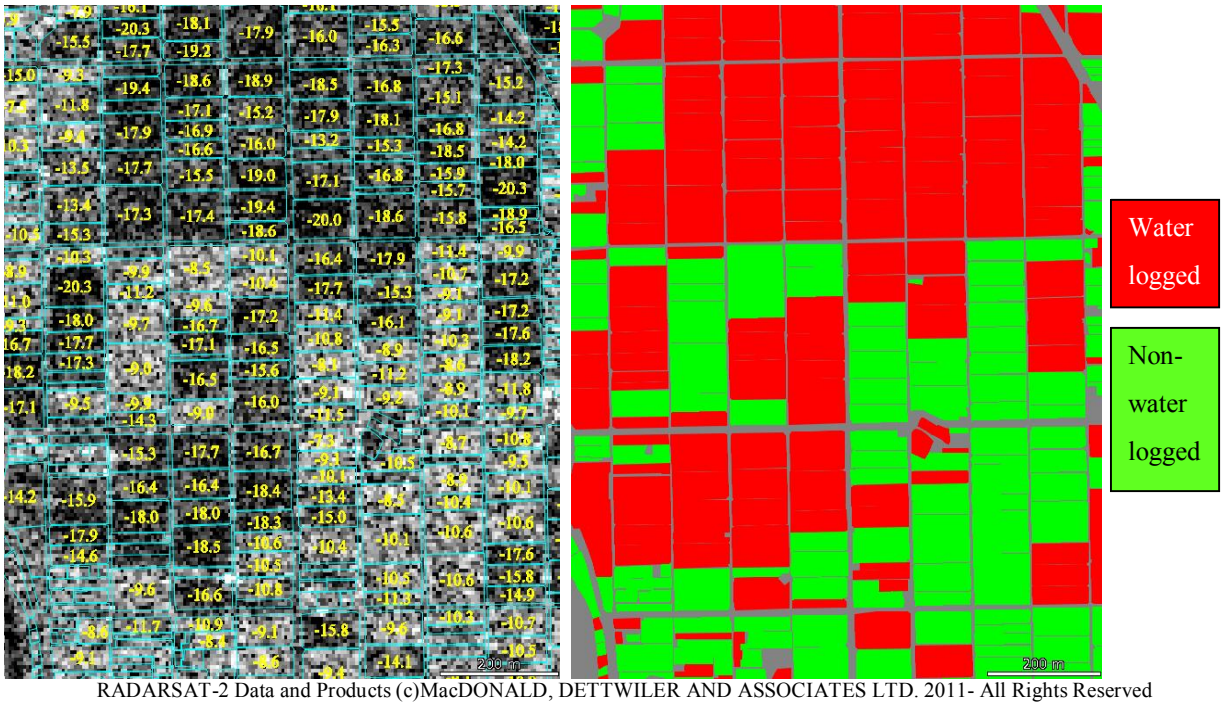

Figure 2: Sample of satellite data, agricultural polygon, mean of backscatter, and results.

3.2 Validation of detection accuracy

Table 2 shows results of validation. Total ground truth points are 2597 fields. Lowest detection overall accuracy was 68.2% in Fukushima prefecture. Against highest detection overall accuracy was 80.4% in Ibaraki prefecture. It is consider that Fukushima prefecture affect Fukushima Daiichi nuclear disaster.
Figure 3 shows accuracy changes when under 10a (100m2, 10m by 10m) paddy fields exclude (total sample n=1914). Detection accuracy of waterlogged paddy fields increase every prefecture. Especially Gunma prefecture is increase overall accuracy 7.2 point. These results indicate that detection accuracy of small fields is low, and distribution (ratio) of small field is ununiformed.
Accuracy of detection using Wide Fine mode is somewhat lower than my previous study using Fine mode data. It is a natural result. However, in this year, transplanting activity was unusual because influence of huge earthquake, tsunami and Fukushima Daiichi nuclear disaster. Therefore it is consider that the lower accuracy affect not only spatial resolution but also these.

Table 2: Results of validation

Ibaraki prefecture

	Waterlogged(number)	Non-waterlogged(number)	Producer's Accuracy(%)
Paddy fields(number)	866	177	83.0
Non-paddy fields(number)	78	177	69.4
User's Accuracy(%)	91.7	50.0	Overall Accuracy (%) 80.4

Tochigi prefecture

	Waterlogged(number)	Non-waterlogged(number)	Producer's Accuracy(%)
Paddy fields(number)	315	76	80.6
Non-paddy fields(number)	14	27	65.9
User's Accuracy(%)	95.7	26.2	Overall Accuracy (%) 79.2

Fukushima prefecture

	Waterlogged(number)	Non-waterlogged(number)	Producer's Accuracy(%)
Paddy fields(number)	48	27	64.0
Non-paddy fields(number)	29	72	71.3
User's Accuracy(%)	62.3	72.7	Overall Accuracy (%) 68.2

Gunma prefecture

	Waterlogged(number)	Non-waterlogged(number)	Producer's Accuracy(%)
Paddy fields(number)	463	120	79.4
Non-paddy fields(number)	75	33	30.6
User's Accuracy(%)	86.1	21.6	Overall Accuracy (%) 71.8

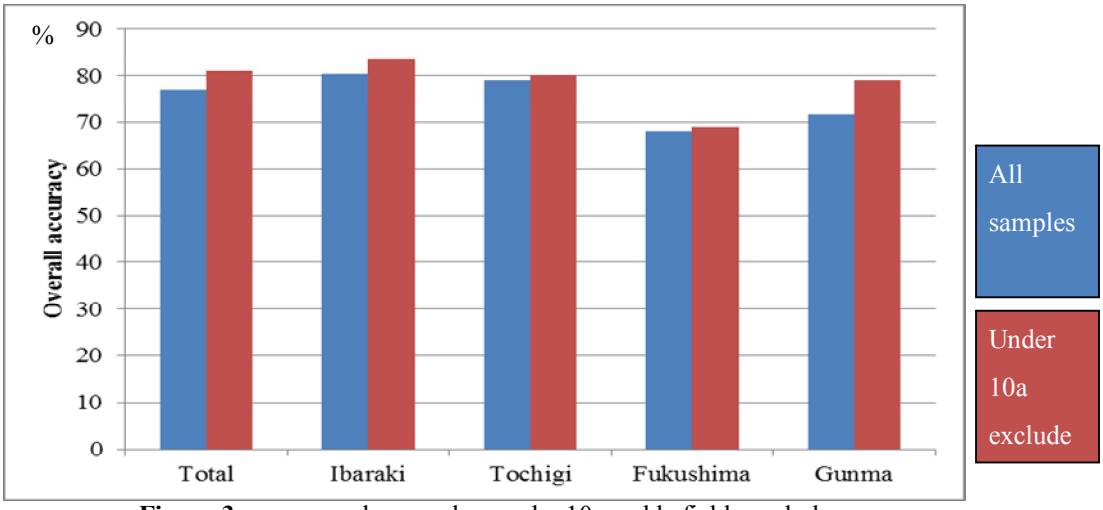

Figure 3: accuracy change when under 10a paddy fields exclude

4. Conclusion

Detection accuracy of Wide Fine mode is somewhat lower than Fine mode. It is a natural result. However, in 2011, transplanting activity was unusual because influence of huge earthquake, tsunami and Fukushima Daiichi nuclear disaster. Therefore this lower accuracy influenced not only spatial resolution but also these disasters. It is consider that Wide Fine mode of RADARSAT-2 is useful for detection of waterlogged paddy fields.

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