FLOOD DISASTER MONITORING WITH ALOS/PALSAR OBSERVATION

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1. INTRODUCTION

Phased array type L-band Synthetic Aperture Radar(PALSAR) boarded on Advanced Land Observing Satellite(ALOS) provides high resolution (6.25 m pixel spacing) data even in the night and severe weather conditions, which is useful to monitor flood disasters even in heavy rain conditions. Active convection systems passed over Gifu prefecture in middle Japan and provided much precipitation during 02–03 September 2008, which caused flood-inundated area to Seino, Gifu prefecture. PALSAR observation was conducted at 2230(local time) on 02 September and 1031(local time) on 03 September 2008. This research will present these observation results and discuss effective algorithm to identify flood-inundated area.

2. DATA PROCESSING

PALSAR raw data was processed by using the JAXA/SIGMA-SAR[1]. PALSAR observations employed off-nadir angle of 45.2 degrees at 2230(LT) on 02 September, which allows to identify flood-inundated area with smaller back scattering from water surface by comparing with PALSAR images in same area without flood-inundated. In this research, we compare with PALSAR observation on 25 January 2007 with off-nadir of 41.5 degrees, and estimate normalized radar cross section P_a and P_b corresponding to each pixel of results on 02 September and 25 January 2007 by

$$P_a = 10\log_{10} < DN^2 > - 83.0 \ \ (dB),$$

where DN means brightness of each pixel, $<>$ corresponds to spatial averaging. Then we evaluate to identify the flood-inundated with simple differences by

$$P_b - P_a > T_d,$$

where T_d is a threshold value, or normalization correlation by

$$NR_{ab} = \frac{R_{ab}}{\sqrt{R_{aa}R_{bb}}} < T_r,$$

where R_{ab} means cross correlation of P_a and P_b, R_{aa} and R_{bb} are auto correlation of P_a and P_b, respectively, and T_r is a threshold.

3. OBSERVATION RESULTS

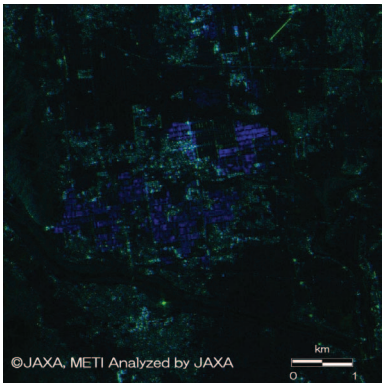
Figure 1 (a) shows an image around Seinou area in Gifu prefecture, green and blue colors are assigned to each pixel on 02 September 2008 and 25 January 2007, respectively. There are some area with the blue pixel in Figure (a), which are considered to area that has smaller brightness due to water surface on 02 September 2008. Figure 1 (b) shows an image of GIS data provided by Gifu prefecture[2], red lines mean flood-inundated area identified with real field investigations by Gifu prefecture on 03 September, blue lines mean flood-inundated area estimated with PALSAR images at 1031(LT) on 03 September[3]. In Figure 1 (b), flood-inundated area was defined with radar cross section of -13 (dB) because this observation employed off-nadir angle of 21.5 degrees which provided larger radar cross section, which is difficult to compare the results with off-nadir of 41.5 degrees on 25 January[3]. These blue area is well associated with flood-inundated area identified with real field investigations(red area) because these field investigations were conducted during daytime on 03 September. Figure 1 (a), on the

Thanks to Gifu prefecture for providing GIS data

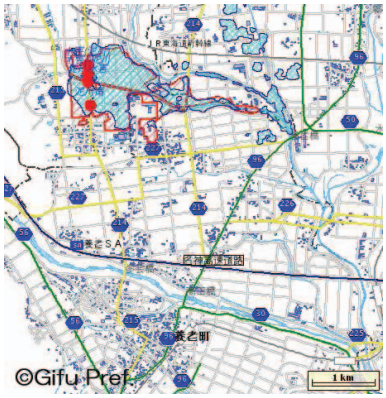
other hand, some area are estimated to be water surface area at 2230(LT) 02 September, which are different area from Figure 1(b) at 1031(LT) 03 September due to time-lags of 12 hours. Figure 2 (a) shows differences radar cross section P_b on 25 January from P_a at 2230 on 02 September ($P_b - P_a$), and it is found that there are some large differences area corresponding to water surface area shown in Figure 1 (a), however, there are also many large differences due to different surface conditions because these images were obtained on summer (02 September 2008) and winter (25 January 2007), it is difficult to decide a threshold T_d. Figure 2 (b) shows variances of differences($P_b - P_a$) with 3×3 pixels(18.75×18.75 m), and it is clear to identify water surface area. Figure 2 (c) shows normalization correlations(NR_{ab}) with 3×3 pixels, however, it is not clear to identify water suface area owing to less correlation of pixels with different ground conditions between summer and winter.

4. SUMMARY

We described PALSAR images to identify water surface area in Gifu prefecture on 02 September 2008 by comparing with the image on 25 January 2007, and found that the simple differences and the normalization correlations were not available for images with different surface conditions, variances of differences were useful to identify flood-inundated area.

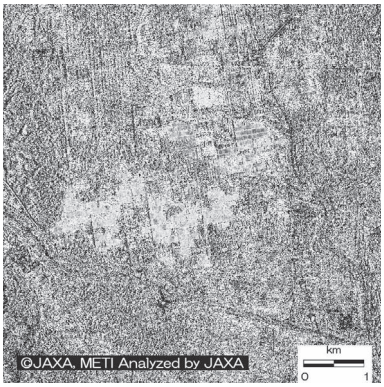


(a) PALSAR image.

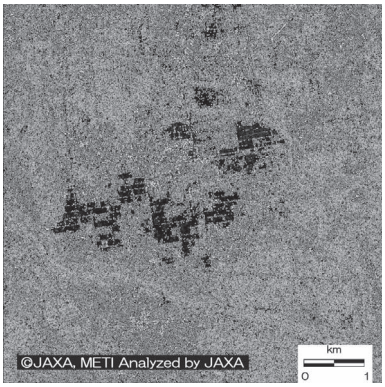


(b) GIS image by Gifu Prefecture[2].

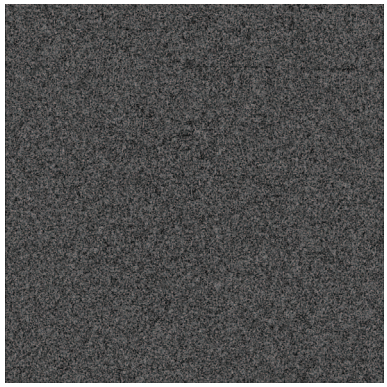
Fig. 1. Example of images in Seino area, Gifu prefecture, (a) PALSAR image (Green : 02 September 2008, Blue : 25 January 2007), (b) GIS image by Gifu prefecture[2].



(a) Radar cross section differences.



(b) Variances of differences.



(b) Normalization correlation.

Fig. 2. PALSAR images based on Fig. 1 (a) : (a) radar cross section differences($P_b - P_a$), (b) variances of differences with 3×3 pixels, (c) normalization correlations with 3×3 pixels($(1 - NR_{ab}) \times 10^5$).

5. REFERENCES

[1] M. Shimada, "Verification processor for sar calibration and interferometry," *adv. Space Res.*, vol. 23, pp. 1477–1486, No.8 1999.

[2] http://www.gis2.pref.gifu.jp/MyMap20/GifuAdvanceMap/GifuAdvanceMap.jsp

[3] M.Ohki M.Shimada O.Isoguchi and N.Kawano, "Alos/palsar observation of flood disasters in 2008: early results and evaluation," *Remote Sensing Society of Japan*, Autumn annual meeting, pp. 215–216, Dec 2008.