ALOS/RPC FILE AND ITS APPLICATION TO DISASTER MONITORING

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ABSTRACT

In the case of huge natural disaster occurred, it is effective to use satellite image data for understanding the disaster exactly, because satellite can observe wide area quickly in the short time. Wide range images of satellite are frequently used for providing the basic information of disaster and its area for prevention of secondary disaster and for making a plan to disaster recovery. When satellite images had been used for disaster recovery, it has been required the coordinate information with high accuracy coordinate information for comparing before and after disaster or for using as the background image on GIS system. To give the coordinate information to the satellite image, mainly two methods are common, one is to use GCP (Ground Control Point) and the other is use RPC（Rational Polynomial Coefficients）file. The former, it is often difficult to get the GCP information which has sufficient quantity and quality to give sufficient coordinate information to satellite image. The latter, on the other hand, it can be obtained in a short time not only to the region. In this paper, it is reported about accuracy validation results of PRISM(ALOS) RPC files which has developed this time. Next, it is shown two examples of the case studies on disaster monitoring.

1. INTRODUCTION

In the case of huge natural disaster were occurred, it is effective to use satellite images for disaster monitoring. By estimating a disaster and its exactly damage from immediately after, it can be provided the basic information for prevention of secondary disaster and for making a plan to disaster recovery. In the case of using Satellite images for disaster recovery, it has been required the coordinate information with high accuracy for comparing before and after disaster or for using as the background image on GIS system. There are some methods which has given the coordinate information to satellite images. First, it is to use GCP Ground Control Point (Bignone and Umakawa, 2008). This method needs to get GCP information, or not, survey in the regions is required. It costs long time and inappropriate to disaster monitoring that is required urgency. Furthermore, according to the number of GCP points or its distribution, it could not be provided sufficient accuracy. Second, it is to do their own geometric correction of the satellite data from the giving information such as CEOS(Committee on Earth Observation Satellites). In this method, it is unnecessary to get any GCP information and relatively high accuracy can be expected. However, it must be created individually in each of the researchers and is generally not popular. Third, the method is to use RPC (Rational Polynomial Coefficients) files. In this method, so RPC file is provided with satellite data provided by satellite data distributer that it can be processed quickly and are available not only to the region. Therefore, for disaster monitoring which often required agility, it is effective to use RPC file. RPC file is a set of 80 parameters which is translated image coordinate (pixel and line) to coordinate information (latitude and longitude). This RPC file can be generally used by commercial remote sensing tools such as ERDAS IMAGINE, ENVI.
In this paper, first, features of PRISM(ALOS) which was developed now are explained. Second, accuracy verification by using GCP are conducted. Finally, it was reported as an example applied to an actual disaster monitoring by using the ALOS images which were processed using the ALOS/PRC: 1) 2010 Haiti Earthquake; 2) Landslide in Hunza, Pakistsan.

2. ALOS/PRC

2.1 Features

RPC（Rational Polynomial Coefficients） file is a set of 80 conversion parameters which transformed image coordinate (pixels and lines) to map coordinate (latitude and longitude) and is a set of approximation coefficients of strict projection model (Tao and Yong, 2001). Figure 1 shows the use of image grid to solve the RPC. This image grid is same as CP file(see below). In the case of ALOS/RPC, it was created based on the information of CEOS. Its specification has been depend on the type of satellites, sensors and the product (JAXA,2006 and JAXA,2007). RPC file corresponding to each satellite sensor products, is imported with the remote sensing data (CEOS in ALOS) using mainly remote sensing tool such as ERDAS IMAGINE, ENVI and so on and satellite image could has coordinate information. It is well known some methods to create RPC files. One method which is created directly from the information to CEOS (Schneider et.al,2008). Another method is add external evaluation element to the RPC model, called "RPC model bias correction". Method in this paper is a common way to create RPC file making CP(Control Point) file as an intermediate product without using GCP information. Using CP file, RPC file is created from “RPC tool” which developed previously.

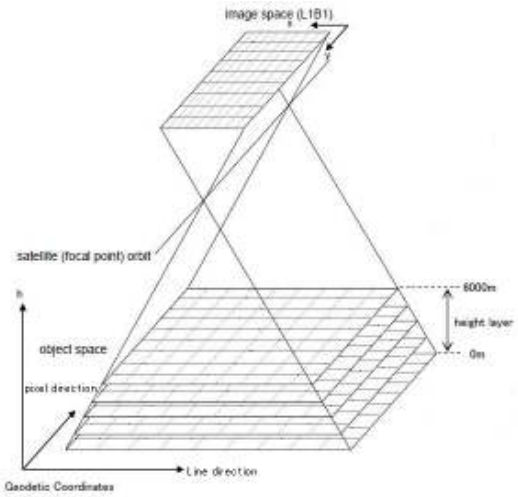

Figure 1 Use of image grid to solve the RPC

2.2 CP file

CP (Control Point) file is a data set which contains lines and pixels on the image, and the corresponding pair of latitude, longitude and ellipsoidal height which is composed of a grid (see in Fig.1). RPC file is composed of 80 pairs parameters of approximate factor, considered as a reference point for the CP file. A set of configuration of the grid (pixel direction, lines direction and geodetic height direction), which affect the accuracy of the RPC files, is 10 × 10 × 5 (= 500 points) as this configuration of the grid (pixel direction grid, line direction grid and elevation, respectively). CP file is calculated by using CEOS(transformation parameters from the LED file, the imaging time parameters from IMG data and orbital information from the SUP file).

2.3 Accuracy assessment

Table 1 results of accuracy verification

Scene			⊿X			⊿Y		
Date	Site	GCP	Bias[m]	SD[m]	RMS[m]	Bias[m]	SD[m]	RMS[m]
2007/3/1	Tsukuba	6	2.006	1.541	1.688	9.163	0.464	0.509
2007/6/6	Niigata	3	−7.925	0.805	0.986	2.549	2.339	2.865
2009/12/4	Paris	12	0.878	2.358	2.463	3.043	3.566	3.725
2010/1/30	Yamaguchi	4	−4.686	3.997	4.616	0.799	2.905	3.355
2010/2/2	Seoul	11	−0.674	1.339	1.404	7.217	2.292	2.404
2010/8/29	Brisbane	4	−2.089	3.916	4.521	1.978	1.046	1.208
2010/12/23	Fukuoka	7	−0.892	1.439	1.554	−3.487	2.011	2.172
RMS			3.406	1.285	1.506	4.162	1.056	1.147

RPC files created from the CEOS of the PRISM L1B1, importing the image data to the ERDAS Imagine 2010 and it has be measured the coordinate accuracy using GCP information. Table 1 shows the results of accuracy verification on observed area. In Table 1, Date, Site and GCP are observation date, observation area and the number of GCP, respectively. ΔX is shown the error of bias parallel to pixel direction and ΔY is to line direction. Bias, SD and RMS are the bias between GCP and measuring point, standard deviation and root mean square, respectively. The unit of ΔX and ΔY are m (meter) converted from "degrees" which is the unit of measuring.

The result of accuracy verification, it were obtained the results the coordinate accuracy as approximately 2 pixels in both the pixel line direction.

3. CASE STUDIES ON DISASTER MONITORING

In this chapter, it is represented two application examples of the RPC files from ALOS data. One is the example used to create DEM, and other is used as a background image in GIS.

3.1 2010 Haiti Earthquake

At 21:00 53 minutes 12 January 2010 (UTC), earthquake had occurred on approximately 25km west-southwest as the epicenter of Haiti's capital Port-au-France(magnitude 7.0, epicentral earthquake focal depth of 13km). Cause of this earthquake, extensive damage occurred around the capital Port-au-France, many buildings collapsed and more than 200,000 people dead. In this study, it was used to investigate the current state in the region affected by the disaster to obtain a pre-disaster of ALOS data to create a orthorectified image.

3.2 Landslide in Hunza, Pakistsan

January 04, 2010, a large landslide occurred in Hunza, Pakistan and its landslide stopped the flow of Hunza River. Dammed lake water level has continued to rise until early June and it has been threatened collapse of the dam. According to the observations, local-level rise and emissions is estimated hat the transition to a stable state to peak in around April 6. It was performed monitoring the water level on dammed lake change by creating the DEM which has derived from pre-disaster ALOS data, and using as a background image on GIS.

4. CONCLUSIONS

Coordinate accuracy of the RPC created in this study was estimated about 2 pixel direction to pixel and line direction (about 5m). RPC file created in this study was used to create the DEM (Pakistan), and was used as a background image (Haiti) as example. By using the RPC file with PRISM(ALOS) data, both examples of the disaster were effective for disaster monitoring. In the above two regions, comparative information was available as a background image although it could not be confirmed the coordinate accuracy although it could not be confirmed the coordinate accuracy due to the lack of GCP information.
Based on the results of accuracy verification, it has derived the position accuracy “about 2 pixel with pixel line direction (about 5m).These results present that position information derived by RPC file is sufficient for creating the DEM or for using a background image on GIS. Thus, the RPC file by using the PRISM(ALOS) image, is expected to disaster monitoring.

5. ACKNOWLEGEMENT

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