Evaluation of ALOS PALSAR Interferometry in the West Coast of Korea: Preliminary Results

Jung-Hyun Choi, Chang-Wook Lee and Joong-Sun Won

Department of Earth System Sciences, Yonsei University, 134 Shinchon-dong, Seodaemun-gu, Seoul 120-749, Korea
e-mail: jh0046@yonsei.ac.kr
Tel.: +82-2-2123-2673 Fax: +82-2-392-6527

ABSTRACT

Precise digital elevation model (DEM) is an important issue in coastal area where DEMs in a time series are especially required. Although LIDAR system is useful in coastal regions, it is not yet popular in Korea mainly because of its high surveying cost and national security reasons. Recently, precise coastal DEM have been made using radar interferometry, waterline method. One of these methods, Spaceborne imaging radar interferometry has been widely used to measure the topography and deformation of the Earth. We acquired ALOS PALSAR FBD mode (Fine Beam Dual) data for evaluating the quality of interferograms and their coherency. The purpose of this study is construction of DEM using the ALOS PALSAR data using radar interferometry and analysis of surface characteristics by coherence and magnitude map over the Ganghwado and Siwha tidal flats and near coastal lands.

KEY WORDS: Coastal DEM, ALOS PALSAR, SAR Interferometry

1. INTRODUCTION

Coastal areas are invaluable in geologic, environmental and ecological aspects associated with flood control, pollution specie, fish, and etc. although, coastal areas show dynamic morphologic changes that arise from high tidal energy and sediments transportation. Coastal changes results from sediment budget processes, tectonic process, relative sea-revel movements and human impacts. So, continuous monitoring of coastal area is very important to interpret an ecosystem and topography, coastal development planning. In order to continued attention of coastal areas, it is necessary to construct digital elevation model (DEM). The DEM of Coastal areas in a time series can be utilized to monitor changes annually or seasonally. Nevertheless, there are very difficult and expensive for detail research to investigate of coastal area. In the mean time, remote sensing technique is an effective tool for monitoring coastal environment. Recently, coastal DEMs have been made using airborne radar interferometry (Wimmer, 2000), waterline method (Greidanus, 1999; Won, 2003). These methods are a useful approach in the practical application of satellite remote sensing to coastal area environments. One of these methods, spaceborne imaging radar interferometry (InSAR) has been widely used to measure the topography and deformation of the Earth. Generally, in repeat pass SAR interferometry in coastal regions have obstacle which is variations of coastal surface conditions. For construction of DEM coastal area, it is necessary to highly coherent interferograms. To do this, it must be reduced by precise co-registration between master and slave images.

In this study, ALOS PALSAR data were used to evaluate the quality of DEM over the coastal lands of Ganghwado, Siwha- and Hwaong-lake area, respectively.

2. DATA PROCESSING

2.1 Study area

The west coast of the Korea peninsula is famous for its large tidal range and vast tidal flats. As shown in Fig. 1, Ganghwado tidal flats, Siwha- and Hwaong-lakes which are located near the coastal area were selected for this study. Ganghwa tidal flat (A), which is an open type and one of the biggest flats on the west coast of Korea peninsula, is located in the mid-western part of Korea peninsula. A large amount of sediment inflows from the Han River has been recoded in this area. The distributions of sediments in Kanghwa tidal flat can be classified into mud flat, mixed flat and sand flat. Shiwha-lake (B) adjacent to the cities of Ansan, Siheung and Whasung is located on the west coast of Korea peninsula. This lake is bounded by the dike of its length is 12.6 km. As a consequence, the tidal flat of its size is 173 km^2 were formed. Shiwha-lake consists of mud flat, sand and mixed flat. Hwaong-lake (C) consist of mud tidal flat and a large reclaimed land, constructed by the tidal reclamation project for the development of the coastal region of the Nanyang Estuary in Korea peninsula.

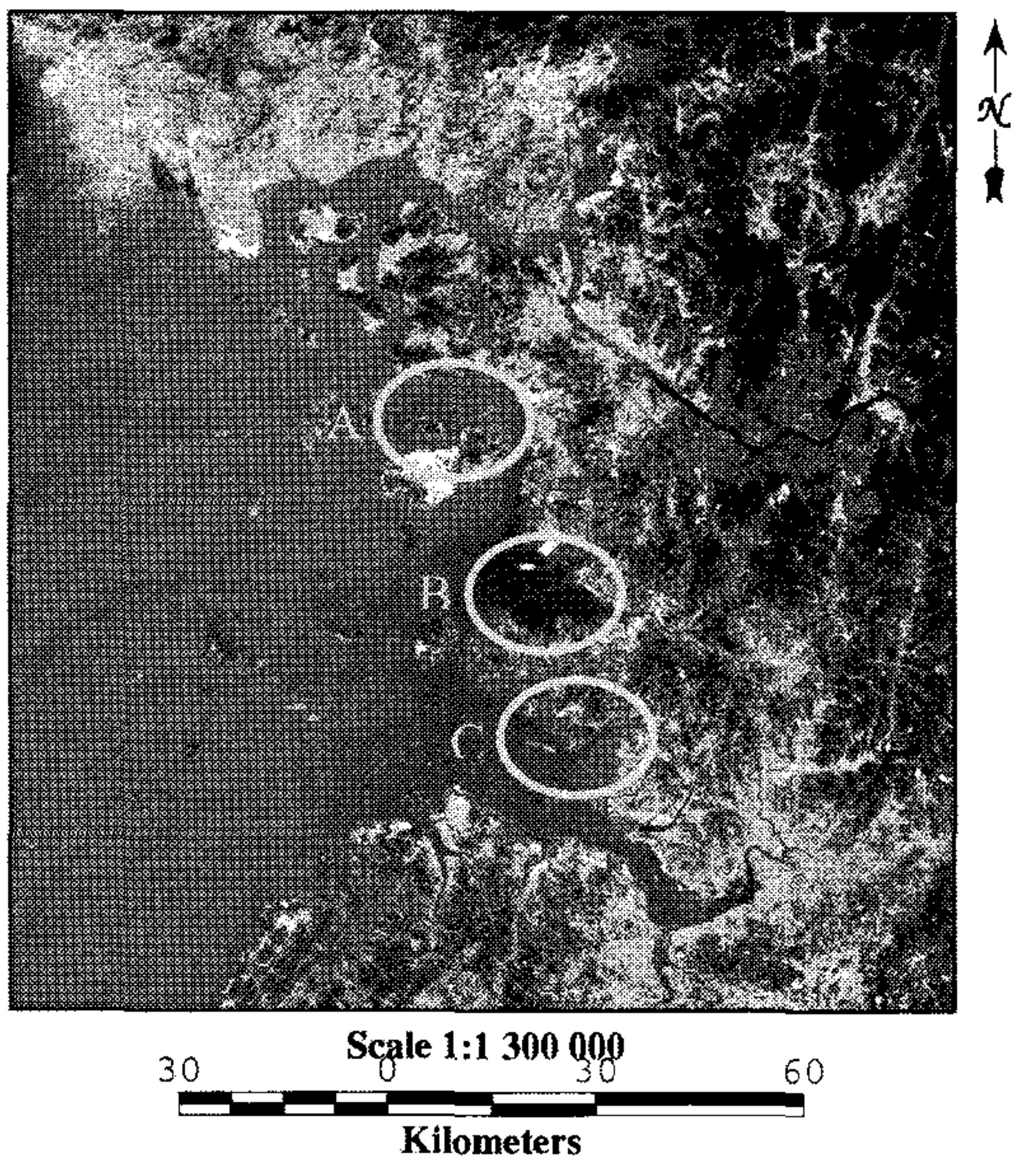

Figure 1. The LANDSAT-ETM image acquired on 14-02-2002 over the study area. The 'A' area shows the Kanghwa tidal flat, 'B' area presents Shiwha-lake and 'C' area is Hwaong-lake.

2.2 SAR data and processing

In this study, L-band SAR dataset were acquired on west coast of Korea peninsula during the three months using the ALOS satellite (Table 1). Dataset were obtained in FBD modes (Fine Beam Dual) with ascending tracks and 34.4° incidence angle. Also, the data are archived and delivered by 80 km × 80 km, we restored the original continuity of the data by concatenating the scenes, forming 23 km × 84 km continuous SAR coverage of study area. This interferogram has 820 m perpendicular baseline and 75 m the height ambiguity.

SATELLITE	TYPE	ACQUISITION DATE
ALOS/ PALSAR	Ascending/ L-band/ FBD mode	2007. 05. 22.
		2007. 08. 22.

Table 1. Summary of ALOS PALSAR data

We used GAMMA software for raw data processing to make SLC (single look complex) data and generated interfrograms. The trajectory of the satellite was tuned to the help of Ground Control Points (GCPs) derived from the SRTM-3 DEM for more accurate baseline information. Interferograms phases are converted to terrain heights after unwrapping stage.

3. RESULT AND DISCUSSIONS

We applied the InSAR techniques with ALOS PALSAR data over the study area. Figure.2 shows coherent phase to allow for DEM construction. The coherence map of figure 2 (left) shows coastal area which represents high coherence and low coherence region according to characteristic of a reflector. Figure 2 (right) shows interferogram on the west coast of Korea peninsula. Ganghwa tidal flat has low coherence between 0.3 and 0.5. Therefore, it makes low quality of interferograms, because of the interferogram's quality depends on the coherence. However, Siwha-lake and Hwaong-lake areas have a higher coherence value (From 0.7 and 0.9) than Ganghwa tidal area. The reason of difference coherence value is tidal condition between tidal flat area (Ganghwa) and reclaimed zone (Siwha-lake and Hwaong-lake).

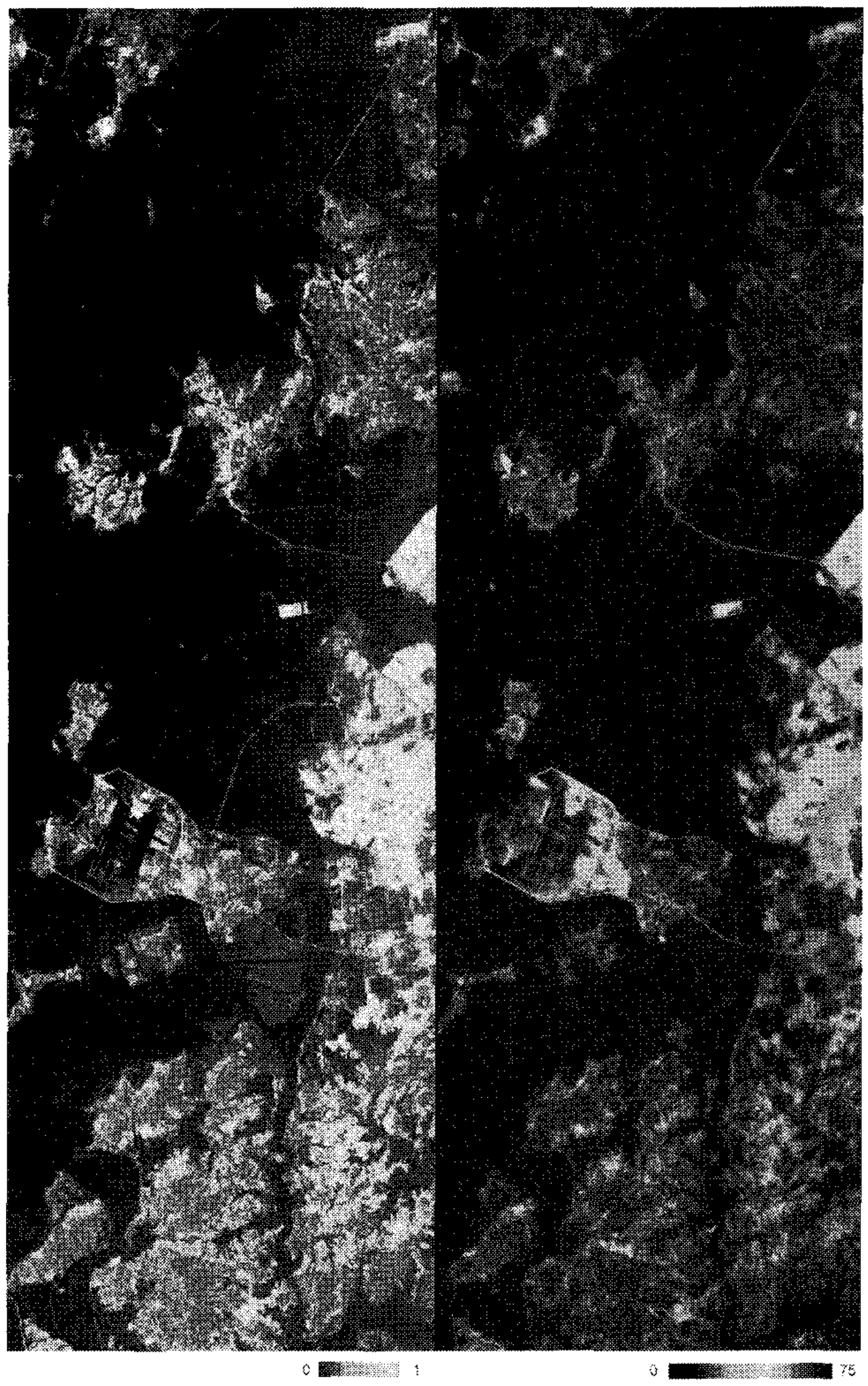

Figure 2. Coherence map (left) and Interferogram (right) using ALOS PALSAR data over Ganghwado and Siwha tidal flats on the west coast of Korea peninsula .

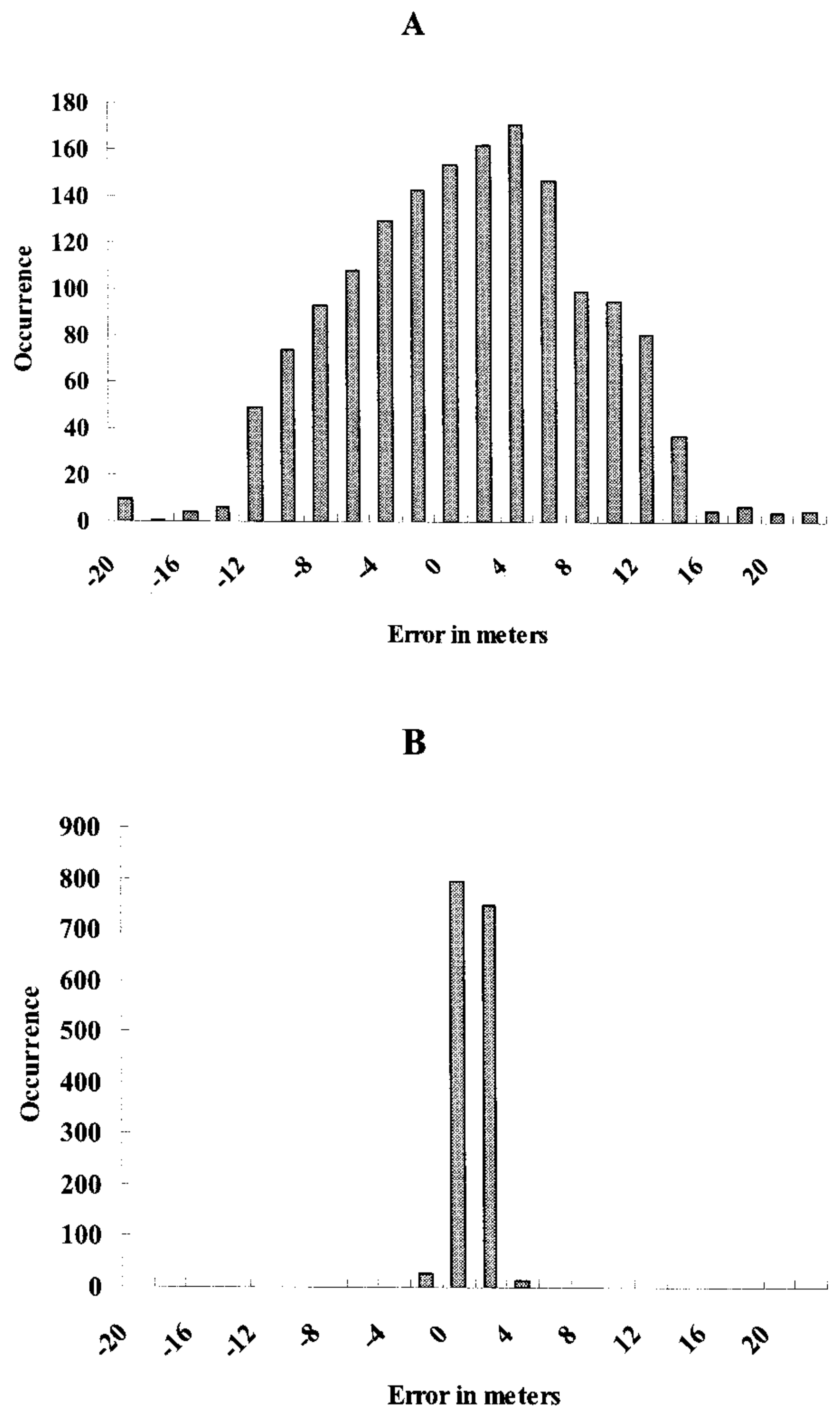

Figure 3. Histogram of the elevation accuracy derived from (A) ALOS PALSAR pair, (B) SRTM-3 DEM over Hwaong-lake. Standard deviation = 7.4m. The reference datum is SRTM-3 DEM.

We calculated terrain height from ALOS PALSAR dataset using InSAR method over Hwanog-lake area. In order to compare the elevation accuracy of terrain height from ALOS PALSAR dataset with that from SRTM-3 DEM, we estimated standard deviation value within interferograms (Figure 3). Figure 3 (A) shows elevation accuracy derived from ALOS PALSAR pair. The standard deviation was about 7.4m. Figure 3 (B) shows elevation accuracy derived from SRTM-3 DEM. The standard deviation was about 0.87m. The reason of difference standard deviation value is height sensitivity of ALOS PALSAR pair. Figure 4 shows constructed DEM using ALOS PALSAR pair.

Figure 4. Generated DEM from ALOS PALSAR dataset.

4. CONCLUSION

SAR Interferometry (InSAR) is a powerful technique for the generation of Digital Elevation Model (DEM). The quantity of these fringes can be measured terrain height. We applied this technique to monitor change in coastal areas and tidal flats. For application of SAR interferometry in coastal areas, the temporal baseline, height sensitivity and tide condition have to be considered.

we attempted to construct DEM using ALOS PALSAR pair with a perpendicular baseline of 820 m and a height sensitivity of 75 m at southern of Ganghwa tidal flat, Siwha- and Hwaong-lake over west coastal of Korea peninsula,. The DEM was successfully constructed by ALOS PALSAR pair over Siwha-lake and Hwaong-lake. If the temporal baseline is enough short to maintain the coherent phases and height sensitivity is enough small, we will be able to successfully construct a precise DEM over coastal area. From now on, more ALOS PALSAR data will be needed to construct precise DEM of West Coast of Korea peninsular.

5. REFERENCES

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