A study on efficient method for renewal of a national DEM using various surveying results

01 Summary

Digital Elevation Model (hereinafter DEM) is one of the most important spatial data in order to manage the national territory efficiently. In recent years, as both hardware and software technology develop rapidly, establishment methods of DEM as well as its application fields have been diversifying in advanced countries. Under the circumstance, as the demand of DEM increases, related studies on update frequency, lattice spacing, establishment and updating methods of DEM have been implementing steadily. However there is no strategic national plan for developing DEM nationwide to reduce time and cost. Therefore, an appropriate plan and method by the government should be set up for the procedure throughout establishment, update and management of national DEM. In this study, an efficient process of establishing DEM was derived by using and analyzing various fundamental surveying results such as LiDAR data, digital topographic maps produced by the national geographic information institute of the Republic of Korea. Through these process, we standardize the procedure of merging various data based on the accuracy in each data. We expect that the fixed quantity analysis would strengthen the support of national development plan, environmental change detection, disaster management, etc.
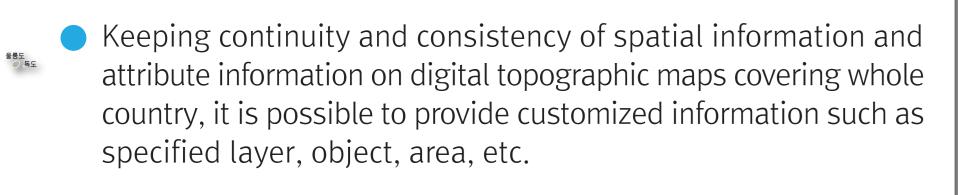
02 Collection of the source data

Seamless digital topographic map

- Keeping continuity and consistency of spatial information and attribute information on digital topographic maps covering whole country, it is possible to provide customized information such as specified layer, object, area, etc.
- Collected layer : contour line, elevation point, ground control point
- Production year : 2013

Aerial photographing 3-dimensional geospatial information

- On the basis of aerial triangulation outcomes, the procedure from collecting data to making topographic maps expresses the real world to 3-dimension with point, line and polygon.
- Collected layer : building, tributary, road, embankment, elevation point
- Production year : 2011 ~ 2013
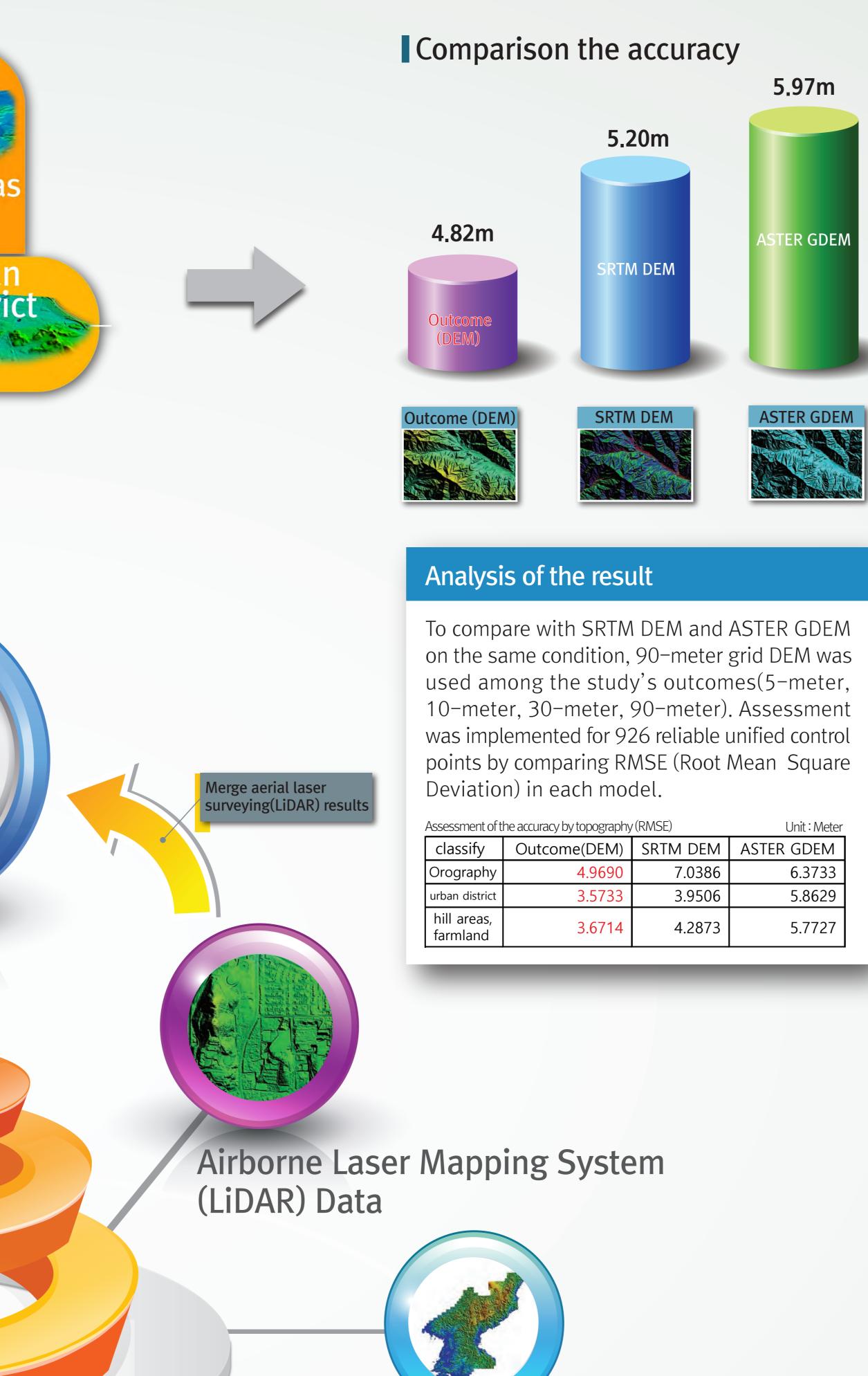
Airborne Laser Mapping System (LiDAR) Data

- This technology calculates the land elevation value by the procedure of emitting laser pulse (70KHz) from the aircraft to the land surface and collecting reflected laser pulse.
- Collected data : 3-dimensional geospatial information (V-world) and public surveying results
- Production year : 2010 ~ 2013

Other collected data : unified control points, photo control points, 10-meter DEM of North Korea

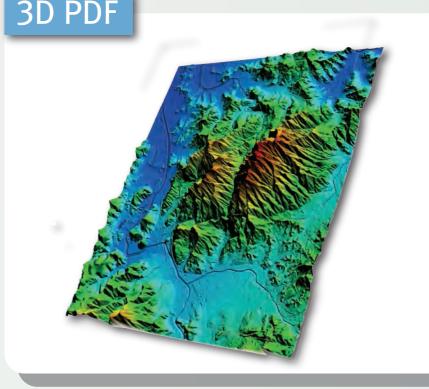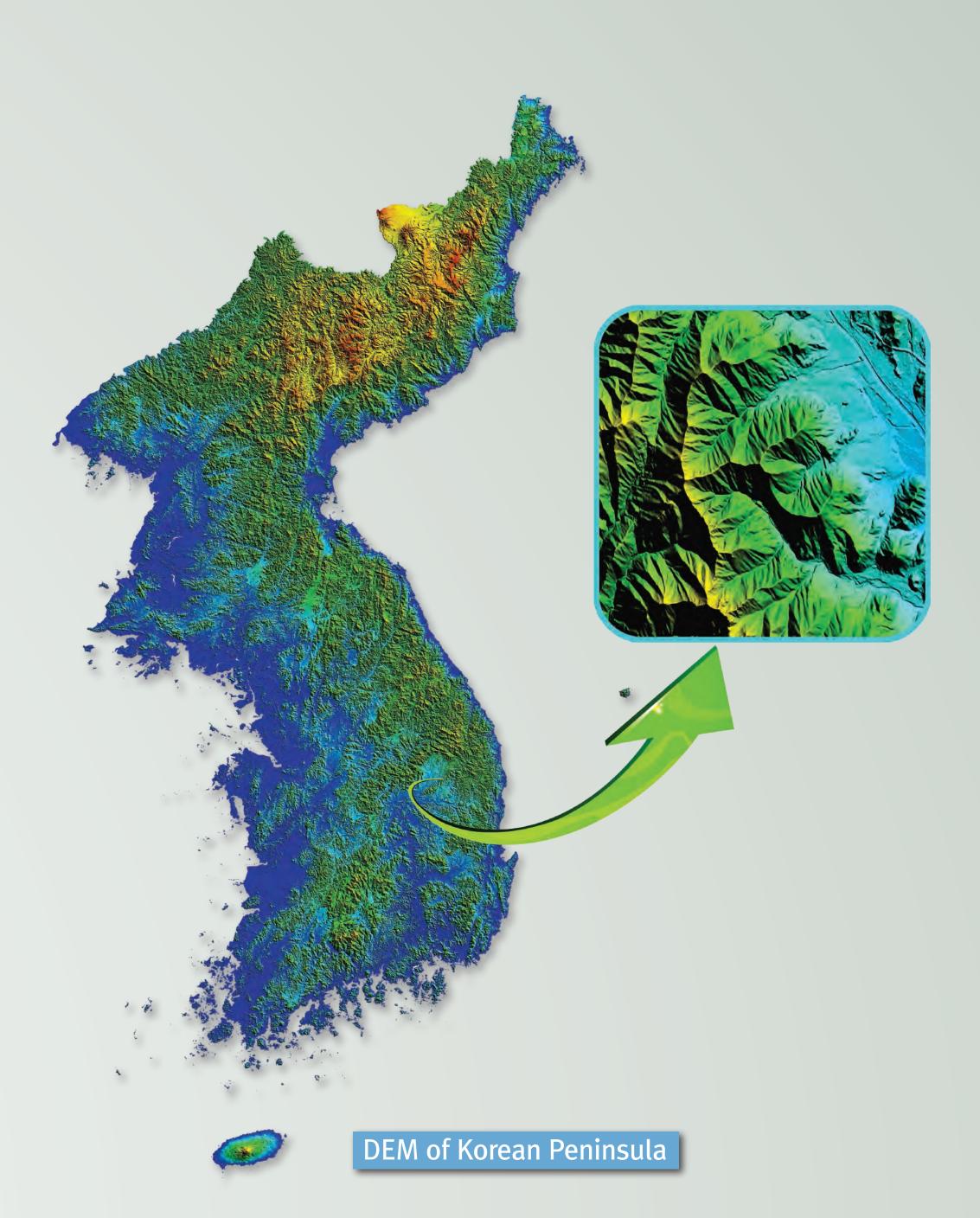## 03 Digital Elevation Model Development Procedure

Edit breakline using drawing results

contour data road

Before editing breakline / after editing breakline

- Among the drawing results, roads, streams, stoneworks, embankment are extracted to be used as breakline and overlapped parts between roads and contour lines are deleted to edit breakline of overlapped part to make elevation value more accurate and reliable.

Topography cross section (roads)

Before editing breakline / after editing breakline

Before editing breakline

after editing breakline

On-site surveying results

Assessment of the accuracy by topography

Orography — hill areas
farmland — urban district

Merge aerial laser surveying(LiDAR) results

Produce IMG
Produce TIN
Edit Breakline

Unified control points, photo control point

Seamless digital topographic map

Aerial photographing 3-dimensional geospatial information

Airborne Laser Mapping System (LiDAR) Data

10-meter DEM of North Korea

Comparison the accuracy

4,82m Outcome (DEM)
5.20m SRTM DEM
5.97m ASTER GDEM

Outcome (DEM) / SRTM DEM / ASTER GDEM

Analysis of the result

To compare with SRTM DEM and ASTER GDEM on the same condition, 90-meter grid DEM was used among the study's outcomes(5-meter, 10-meter, 30-meter, 90-meter). Assessment was implemented for 926 reliable unified control points by comparing RMSE (Root Mean Square Deviation) in each model.

Assessment of the accuracy by topography (RMSE) Unit : Meter

classify	Outcome(DEM)	SRTM DEM	ASTER GDEM
Orography	4.9690	7.0386	6.3733
urban district	3.5733	3.9506	5.8629
hill area, farmland	3.6714	4.2873	5.7727

04 Product by grid size

DEM 5m → DEM 10m → DEM 30m → DEM 90m

05 Developed Digital Elevation Model

DEM by grid size

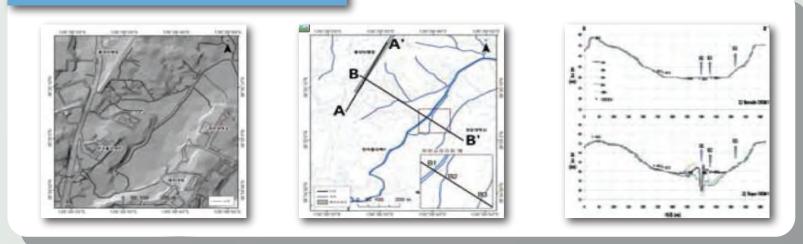Shaded Relief Map

3D PDF

DEM of Korean Peninsula

06 Expected Effect of Digital Elevation Model

Expectation

- Departing from depending foreign DEM, by providing DEM covering whole Korean Peninsula, we hope to promote broad application in academic field and private sector.
- Through analyzing various basic surveying results and merging efficient developing methods, we expect the cost reduction in developing DEM and the improvement of DEM quality.
- By using precise DEM in the process of developing orthophoto, the accuracy of aerial photograph, satellite imagery, SAR could be increased by reducing topographic distortion in roads and streams.

Urban Planning

Basic information for road and urban planning because of the features expressing the surface of the earth and terrain in digital

National Defense Field

Primary information for the analysis of navigation missile development or terrain obstacles disturbing communication, shooting, movement of troops

Disaster Management Field

Possible to apply in various ways such as analyzing flooded area and planning for recovery.

National Geographic Information Institute
Ministry of Land, Infrastructure and Transport