Japan Geoscience Union Meeting 2010
(May 23-28 2010 at Makuhari, Chiba, Japan)

HTT032-04 Room: 202 Time: May 24 11:30-11:45

Results of the evaluation of the horizontal positional accuracy of large-scale geospatial information

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We report the results of the quality evaluation of the horizontal positional accuracy of large-scale geospatial information that were obtained from both public surveys and private enterprise surveys.

The Geospatial Information Authority of Japan (GSI of Japan) started in FY 2007 the development and provision of the Fundamental Geospatial Data (FGD). In the development works, the data on the scale of 1:2500 or larger are being compiled in city planning areas from existing public survey data, and their quality of the horizontal positional accuracy is evaluated by comparing them with the data from land surveys conducted in the FGD development works. Digital maps made by private enterprises will be used if they meet some criteria on data quality, terms of use and others, and their quality is also evaluated. In this report, we evaluate public survey data in 255 districts from the areas of FGD development and private enterprise survey data in 9 districts obtained for the usability test.

We adopt as the definition of positional accuracy what is defined as absolute accuracy in the Japanese Standards for Geographic Information: the closeness of the reported coordinate value to the true or accepted value as true. Suppose that the coordinates accepted as true are those, say Q 1, obtained by land survey at a ground point, and that the reported coordinates are those, say Q2, obtained by aerial survey and map compilation at the same point. Positional accuracy is represented by the closeness of Q2 to Q1, that is, the statistical behavior of differences (Q2-Q1). The differences (Q2-Q1) are expected to follow a normal distribution, whose mean value and standard deviation represent the accuracy.

We call points used for the quality evaluation "verification points," which are distributed with the density of 3 to 5 points per $1km^2$ in districts sampled by 5% from FGD development area. For the evaluation, tested are the statistical hypotheses: 1) the distribution of Q2-Q1 has no bias, 2) the distribution has no anisotropy in XY coordinate plane, 3) the distribution conforms to a normal distribution, and 4) the standard deviation does not exceed a criterion (2.5m in case of the scale 1: 2500).

The results of the evaluation of public survey data in the 255 districts are as follows:
1) 61% of the districts are admitted at the significance level of 0.05 to have no bias. Generally, mean values of the distributions in the 255 districts are small. 97% range within +/-0.5m.
2) 76% are admitted at the significance level of 0.05 to have no anisotropy. Numbers of the data with abnormal values are limited in the rest of the districts which are not admitted to have no anisotropy.
3) Many are admitted to conform to normal distributions.
4) The standard deviations in all the districts are within the criterion of 2.5m, generally range

from 0.1m to 1.0m, and do not exceed 1.5m.

The results of the evaluation of private enterprise survey data in the 9 districts are as follows:
1) Two of the nine districts are admitted at the significance level of 0.05 to have no bias. Two of the rest show bias larger than 1m.
2) Three districts are admitted at the significance level of 0.05 to have no anisotropy. Some data show abnormal values in the rest of the districts which are not admitted to have no anisotropy.
3) Two districts are admitted at the significance level of 0.05 to conform to normal distributions.
4) The standard deviations range from 0.9m to 3.1m. They are admitted at the significance level of 0.05 not to exceed 2.5m in eight districts and 1.75m in six districts.

We conclude that the public survey data have high quality of positional accuracy with the viewpoint that the standard deviations of positions never exceed the criterion of 2.5m and that they are even more accurate than those prescribed by the general standard of rules on public survey works for digital topography (1.75m in the case of the scale 1:2500).

Keywords: positional accuracy, quality evaluation, public survey data, private enterprise survey data, 1:2500 scale